[1.0 Introduction and Description 1](#_Toc85403404)

[1.1 Purpose of this Characteristic 1](#_Toc85403405)

[1.1.1 Relationship to Other Documents 1](#_Toc85403406)

[1.2 System Description 2](#_Toc85403407)

[1.2.1 General 2](#_Toc85403408)

[1.2.2 ATC Support with Active Surveillance 2](#_Toc85403409)

[1.2.3 ATC Support with Passive Surveillance 2](#_Toc85403410)

[1.2.4 Traffic Alert and Collision Avoidance System (TCAS) Support 3](#_Toc85403411)

[1.2.5 Support to Digital Communication 3](#_Toc85403412)

[1.3 Mark 4 Transponder Functions 3](#_Toc85403413)

[1.3.1 Transponder Functions (TXF) 4](#_Toc85403414)

[1.3.2 Extended Interface Functions (EIF) 4](#_Toc85403415)

[1.4 System Description 5](#_Toc85403416)

[1.4.1 Mark 4 Transponder Unit 5](#_Toc85403417)

[1.4.2 Mark 4 Transponder Control Panel 5](#_Toc85403418)

[1.4.3 Antenna 5](#_Toc85403419)

[1.5 Interchangeability 5](#_Toc85403420)

[1.5.1 General 5](#_Toc85403421)

[1.5.2 Interchangeability Desired For the Mark 4 (ARINC 718A) Transponder System 5](#_Toc85403422)

[1.5.3 Interchangeability Considerations 6](#_Toc85403423)

[1.6 Regulatory Approval 6](#_Toc85403424)

[2.0 Interchangeability Standards 8](#_Toc85403425)

[2.1 Introduction 8](#_Toc85403426)

[2.2 Form Factor, Connector, and Index Pin Coding 8](#_Toc85403427)

[2.2.1 Transponder Unit 8](#_Toc85403428)

[2.2.2 Standard Control Panel 8](#_Toc85403429)

[2.2.3 Antenna 9](#_Toc85403430)

[2.3 Interwiring 9](#_Toc85403431)

[2.4 Power Circuitry 9](#_Toc85403432)

[2.4.1 Primary Power Input 9](#_Toc85403433)

[2.4.2 Power Control Circuitry 10](#_Toc85403434)

[2.4.3 The Common Ground 10](#_Toc85403435)

[2.4.4 The AC Common Cold 10](#_Toc85403436)

[2.4.5 Internal Circuit Protection 10](#_Toc85403437)

[2.5 Standard Interfaces 10](#_Toc85403438)

[2.6 Environmental Conditions 11](#_Toc85403439)

[2.7 Cooling 11](#_Toc85403440)

[2.8 Grounding and Bonding 11](#_Toc85403441)

[2.9 Standardized Signaling 12](#_Toc85403442)

[2.9.1 ARINC 429 Digital Information Transfer System Data Bus 12](#_Toc85403443)

[2.9.2 Standard “Open” 12](#_Toc85403444)

[2.9.3 Standard “Ground” 12](#_Toc85403445)

[2.9.4 Standard “Applied Voltage” Output 12](#_Toc85403446)

[2.9.5 Standard Discrete Input 12](#_Toc85403447)

[2.9.6 Standard Discrete Output 14](#_Toc85403448)

[2.9.7 Standard Program Pin Input 14](#_Toc85403449)

[3.0 System Characteristics 15](#_Toc85403450)

[3.1 Purpose 15](#_Toc85403451)

[3.2 Description of the SSR Mode A/C 16](#_Toc85403452)

[3.3 SSR Mode S System Description 16](#_Toc85403453)

[3.4 SSR/Mode S Compatibility 17](#_Toc85403454)

[3.5 Mode S Functional Description 17](#_Toc85403455)

[3.5.1 Interrogator-Transponder lnteraction 17](#_Toc85403456)

[3.5.2 Address/Parity 18](#_Toc85403457)

[3.5.3 Surveillance 19](#_Toc85403458)

[3.5.4 Data Link Communications 19](#_Toc85403459)

[3.6 Communication Data 20](#_Toc85403460)

[3.6.1 Mode A and Mode C Reply Data 20](#_Toc85403461)

[3.6.2 Mode S GICB Register Data 20](#_Toc85403462)

[3.6.3 Mode S Specific Services Protocol (MSP) Data 21](#_Toc85403463)

[3.6.4 Broadcast Data 21](#_Toc85403464)

[3.6.5 Mode S Subnetwork Data 21](#_Toc85403465)

[3.7 ATC System and Pilots’ Use of Mode S 21](#_Toc85403466)

[4.0 Transponder Unit Description 23](#_Toc85403467)

[4.1 General 23](#_Toc85403468)

[4.2 Transponder Part 23](#_Toc85403469)

[4.2.1 SSR Mode A/C Functions 24](#_Toc85403470)

[4.2.2 Mode S Functions 24](#_Toc85403471)

[4.2.3 Transponder Receiver Characteristics 24](#_Toc85403472)

[4.2.3.1 Receiver Center Frequency and Bandwidth 24](#_Toc85403473)

[4.2.3.2 Image Response 25](#_Toc85403474)

[4.2.3.3 Other Spurious Responses 25](#_Toc85403475)

[4.2.3.4 IF Pickup Rejection 25](#_Toc85403476)

[4.2.3.5 RF Rejection 25](#_Toc85403477)

[4.2.3.6 CW Discrimination 25](#_Toc85403478)

[4.2.4 Receiver Sensitivity and Minimum Triggering Level (MTL) 25](#_Toc85403479)

[4.2.4.1 SSR Mode A/C and Intermode Interrogation Modes 26](#_Toc85403480)

[4.2.4.2 Mode S Interrogation Modes 26](#_Toc85403481)

[4.2.4.3 Mode S Dynamic Range 27](#_Toc85403482)

[4.2.5 Sidelobe Suppression 27](#_Toc85403483)

[4.2.5.1 SSR Mode A/C Interrogations 27](#_Toc85403484)

[4.2.5.2 Intermode Interrogations 27](#_Toc85403485)

[4.2.5.3 SSR Mode A/C and Intermode Suppression 28](#_Toc85403486)

[4.2.5.4 SSR Mode A/C and Intermode Suppression Duration 28](#_Toc85403487)

[4.2.5.5 Mode S Sidelobe Suppression 28](#_Toc85403488)

[4.2.6 Receiver Desensitization and Recovery Times 28](#_Toc85403489)

[4.2.6.1 Echo Suppression and Recovery 28](#_Toc85403490)

[4.2.6.2 Desensitization 28](#_Toc85403491)

[4.2.6.3 Recovery 29](#_Toc85403492)

[4.2.6.3.1 Recovery from a Mode S Interrogation 29](#_Toc85403493)

[4.2.6.3.2 Recovery from a Mode S Comm C Interrogation 29](#_Toc85403494)

[4.2.6.3.3 Recovery from a Suppression Pair 29](#_Toc85403495)

[4.2.7 Transponder Dead Time 29](#_Toc85403496)

[4.2.8 Decoding Facilities 29](#_Toc85403497)

[4.2.8.1 SSR Mode A/C Interrogation Modes 29](#_Toc85403498)

[4.2.8.2 Simultaneous Reception of Two SSR Mode A/C Pulse Patterns 30](#_Toc85403499)

[4.2.8.3 Intermode Interrogation Modes 30](#_Toc85403500)

[4.2.8.4 Mode S Interrogation Modes 31](#_Toc85403501)

[4.2.8.5 Decoding of Interrogations 31](#_Toc85403502)

[4.2.8.6 Pulse Decoder Tolerances 31](#_Toc85403503)

[4.2.8.6.1 SSR Mode A/C Interrogations 31](#_Toc85403504)

[4.2.8.6.2 Intermode Interrogations 31](#_Toc85403505)

[4.2.8.6.3 Mode S Interrogation Preambles 32](#_Toc85403506)

[4.2.8.7 Pulse Duration Discrimination 32](#_Toc85403507)

[4.2.8.8 Random Triggering Rate 32](#_Toc85403508)

[4.2.8.9 Mode S No-Reply 32](#_Toc85403509)

[4.2.9 Mutual Suppression Pulses 33](#_Toc85403510)

[4.2.10 Mode S Transponder Lockout Control 33](#_Toc85403511)

[4.2.11 Transponder Transmitter Characteristics 34](#_Toc85403512)

[4.2.11.1 Reply Transmission Frequency 34](#_Toc85403513)

[4.2.11.2 Transmitter Unit Power Output 34](#_Toc85403514)

[4.2.11.3 Transponder Emission Spectrum 34](#_Toc85403515)

[4.2.11.4 Reply Pulse Shape 34](#_Toc85403516)

[4.2.11.5 Transmitter Duty Cycle 35](#_Toc85403517)

[4.2.11.5.1 SSR Mode A/C Reply Rate Capability 35](#_Toc85403518)

[4.2.11.5.2 Mode S Reply Rate Capability 35](#_Toc85403519)

[4.2.12 Reply Delay and Jitter 36](#_Toc85403520)

[4.2.12.1 SSR Mode A/C Reply Delay and Jitter 36](#_Toc85403521)

[4.2.12.2 Mode S Reply Delay and Jitter 36](#_Toc85403522)

[4.2.12.3 SSR Mode S All-Call Reply Delay and Jitter (not applicable to DO-181F or later) 36](#_Toc85403523)

[4.2.13 Mark 4 Transponder Reply Capability and Control 36](#_Toc85403524)

[4.2.13.1 SSR Mode A/C Reply Rate Capability and Reply Rate Control 36](#_Toc85403525)

[4.2.13.2 Mode S Reply Rate Capability and Reply Rate Control 36](#_Toc85403526)

[4.2.14 SSR Mode A Reply Codes 36](#_Toc85403527)

[4.2.15 Special Position Identification (“Ident”) Pulse 36](#_Toc85403528)

[4.2.16 Reply Pulse Interval Tolerances 37](#_Toc85403529)

[4.2.16.1 SSR Mode A/C Reply Pulse Interval Tolerances 37](#_Toc85403530)

[4.2.16.2 Mode S Reply Pulse Interval Tolerances 37](#_Toc85403531)

[4.2.17 SSR Mode C Pressure Altitude Transmission 37](#_Toc85403532)

[4.2.18 Air Data Input 37](#_Toc85403533)

[4.2.18.1 ARINC 706 Air Data Computer Input 38](#_Toc85403534)

[4.2.18.2 ARINC 575 Air Data Computer Input 38](#_Toc85403535)

[4.2.18.3 ARINC 565 Synchro Data Input 38](#_Toc85403536)

[4.2.19 Mode S Replies 39](#_Toc85403537)

[4.2.19.1 Mode S Reply Altitude/Identity Report 39](#_Toc85403538)

[4.2.19.2 Mode S Transponder Squitter 39](#_Toc85403539)

[4.2.19.2.1 General 39](#_Toc85403540)

[4.2.19.2.2 Acquisition Squitter Transmissions 40](#_Toc85403541)

[4.2.19.2.3 Airborne Position Extended Squitter 40](#_Toc85403542)

[4.2.19.2.4 Airborne Velocity Extended Squitter 40](#_Toc85403543)

[4.2.19.2.5 Surface Position Extended Squitter 40](#_Toc85403544)

[4.2.19.2.6 Aircraft Identification Extended Squitter 41](#_Toc85403545)

[4.2.19.2.7 ADS-B Periodic Status and Event-Driven Squitters 41](#_Toc85403546)

[4.2.19.2.7.1 ADS-B Periodic Status Extended Squitter Messages 41](#_Toc85403547)

[4.2.19.2.7.1.1 Target State and Status Extended Squitter Message 41](#_Toc85403548)

[4.2.19.2.7.1.2 Aircraft Operational Status Extended Squitter Message 42](#_Toc85403549)

[4.2.19.2.7.2 Event-Driven Squitter Extended Squitter Messages (not applicable to DO-260C and later) ……………………………………………………………………………………42](#_Toc85403550)

[4.2.19.2.7.2.1 TCAS Resolution Advisory Report Extended Squitter Message 43](#_Toc85403551)

[4.2.19.2.7.2.2 Emergency Status Extended Squitter Message 43](#_Toc85403552)

[4.2.19.2.7.2.3 Event-Driven Message Priority 43](#_Toc85403553)

[4.2.19.2.7.2.4 ADS-B Weather AIREP Message 43](#_Toc85403554)

[4.2.19.2.7.2.5 ADS-B Weather PIREP Message 44](#_Toc85403555)

[4.2.19.2.8 Surface/Airborne Determination 44](#_Toc85403556)

[4.2.19.3 Unavailable Data 47](#_Toc85403557)

[4.2.20 Extended Length Message (ELM) Protocol 47](#_Toc85403558)

[4.2.20.1 Uplink ELM Protocol 47](#_Toc85403559)

[4.2.20.2 Downlink ELM Protocol 48](#_Toc85403560)

[4.2.21 Antenna Diversity Operation 49](#_Toc85403561)

[4.2.21.1 Antenna Selection 49](#_Toc85403562)

[4.2.21.2 Received Signal Delay Tolerance 49](#_Toc85403563)

[4.2.21.3 Differential Reply Delay 49](#_Toc85403564)

[4.2.21.4 Antenna Selection for Squitter Transmissions 49](#_Toc85403565)

[4.2.21.5 RF Port Transmitter Isolation 50](#_Toc85403566)

[4.3 Extended Interface Functions 50](#_Toc85403567)

[4.3.1 General 50](#_Toc85403568)

[4.3.2 Broadcast 50](#_Toc85403569)

[4.3.2.1 Uplink 50](#_Toc85403570)

[4.3.2.2 Downlink 50](#_Toc85403571)

[4.3.3 Ground Initiated Comm-B (GICB) Support 51](#_Toc85403572)

[4.3.4 Mode S Specific Services Protocol Support 53](#_Toc85403573)

[4.3.5 Dataflash Support 53](#_Toc85403574)

[4.3.6 ISO 8208 Subnetwork Support 54](#_Toc85403575)

[4.3.7 ADS-B Support 54](#_Toc85403576)

[4.3.7.1 ADS-B Configuration 54](#_Toc85403577)

[4.3.7.1.1 Aircraft Category 54](#_Toc85403578)

[4.3.7.1.2 Aircraft/Vehicle Length/Width 55](#_Toc85403579)

[4.3.7.1.3 ADS-B Receiver Capability 55](#_Toc85403580)

[4.3.7.1.4 GPS Antenna Longitudinal Offset 55](#_Toc85403581)

[4.3.7.1.5 Source Integrity Level (SIL) 55](#_Toc85403582)

[4.3.7.1.6 System Design Assurance (SDA) 55](#_Toc85403583)

[4.3.7.1.7 Velocity Accuracy, NACv 55](#_Toc85403584)

[4.3.7.1.8 Aircraft Type Character (AIREP) 56](#_Toc85403585)

[4.3.7.1.9 Transponder Antenna Longitudinal Offset 56](#_Toc85403587)

[4.3.7.1.10 Gross Weight 56](#_Toc85403588)

[4.3.7.1.11 Wingspan 56](#_Toc85403589)

[4.3.7.1.12 ADS-B Configuration Parity 56](#_Toc85403590)

[4.3.7.2 ADS-B Data Interfaces 56](#_Toc85403591)

[4.3.7.3 ADS-B OUT Function Fail 56](#_Toc85403592)

[4.3.7.3.1 Legacy ADS-B OUT Function Fail (e.g., dependent) 56](#_Toc85403593)

[4.3.7.3.2 ADS-B OUT Function Fail (e.g., independent) 57](#_Toc85403594)

[4.4 Mark 4 Transponder Configuration 57](#_Toc85403595)

[4.4.1 Installation Configuration 57](#_Toc85403596)

[4.4.1.1 Static Airframe Information 57](#_Toc85403597)

[4.4.1.2 Airframe Parameter Data 58](#_Toc85403598)

[4.4.1.3 Default Configuration 58](#_Toc85403599)

[4.4.1.3.1 Broadcast 58](#_Toc85403600)

[4.4.1.3.2 Ground Initiated Comm-B Protocol 58](#_Toc85403601)

[4.4.1.3.3 Minimum Subset of Data Input Capability 60](#_Toc85403602)

[4.4.2 Installation Specific Configuration 60](#_Toc85403603)

[4.4.2.1 Broadcast 61](#_Toc85403604)

[4.4.2.2 Ground Initiated Comm-B (GICB) Protocol 61](#_Toc85403605)

[4.4.2.3 Mode S Specific Services Protocol (MSP) 62](#_Toc85403606)

[4.4.2.4 ISO 8208 Services 63](#_Toc85403607)

[4.4.2.5 Ground Speed Determination Parameters 63](#_Toc85403608)

[4.4.2.6 Airspeed Determination Parameters 64](#_Toc85403609)

[4.4.2.7 Radar Altitude Determination Parameters 64](#_Toc85403610)

[4.5 Control Panel 65](#_Toc85403611)

[4.5.1 Mark 4 Transponder Control 65](#_Toc85403612)

[4.5.2 Dual Installations 66](#_Toc85403613)

[4.6 Mark 4 Transponder Functional Test and Monitoring 66](#_Toc85403614)

[4.6.1 Functional Test 66](#_Toc85403615)

[4.6.1.1 General 66](#_Toc85403616)

[4.6.1.2 Transponder Functional Test 67](#_Toc85403617)

[4.6.1.3 Extended Interface Functional Test 67](#_Toc85403618)

[4.6.2 Monitoring 67](#_Toc85403619)

[4.7 Data Interfaces 68](#_Toc85403620)

[4.7.1 General 68](#_Toc85403621)

[4.7.2 Avionics Data Interface 68](#_Toc85403622)

[4.7.3 Mode S Specific Services Protocol Interface (Optional) 68](#_Toc85403623)

[4.7.3.1 MSP Channel Availability Report 68](#_Toc85403624)

[4.7.3.2 MSP Data Exchange 69](#_Toc85403625)

[4.7.3.3 MSP Delivery Status Reporting 71](#_Toc85403626)

[4.7.3.4 Broadcast Data Exchange 72](#_Toc85403627)

[4.7.4 ISO 8208 DTE/DCE Interface (Optional) 72](#_Toc85403628)

[4.7.4.1 ISO 8208 Packet Transfer 72](#_Toc85403629)

[4.7.4.2 Ground DTE Connectivity Report 73](#_Toc85403630)

[4.7.4.3 Airborne DTE Connectivity Report 74](#_Toc85403631)

[4.8 Operational Modes of the Mark 4 Transponder 74](#_Toc85403632)

[5.0 Built-In Test and Maintenance Provisions 76](#_Toc85403633)

[5.1 Fault Detection and Reporting 76](#_Toc85403634)

[5.1.1 General 76](#_Toc85403635)

[5.1.2 Self-Monitoring 76](#_Toc85403636)

[5.1.3 Failure Rate Monitor 76](#_Toc85403637)

[5.1.4 Fault Messaging 77](#_Toc85403638)

[5.2 Ramp Maintenance 77](#_Toc85403639)

[5.2.1 Return to Service Testing 77](#_Toc85403640)

[5.2.2 Data Loading 79](#_Toc85403641)

[5.2.3 Data Loading Fault Recovery 79](#_Toc85403642)

[5.3 Provisions for Automatic Test Equipment 79](#_Toc85403643)

[5.3.1 General 79](#_Toc85403644)

[5.3.2 ATE Testing 79](#_Toc85403645)

[6.0 Control Panel Design 80](#_Toc85403646)

[6.1 Introduction 80](#_Toc85403647)

[6.2 Form Factor and Connector 80](#_Toc85403648)

[6.3 Control Information Transfer 80](#_Toc85403649)

[6.4 Control Functions 80](#_Toc85403650)

[6.4.1 Standby/On Switching 80](#_Toc85403651)

[6.4.2 Code Selectors 81](#_Toc85403652)

[6.4.3 “Ident” Pulse (SPI) On/Off 81](#_Toc85403653)

[6.4.4 Altitude Reporting On/Off 81](#_Toc85403654)

[6.4.5 Altitude Data Source Select 81](#_Toc85403655)

[6.4.6 Self-Test On/Off 82](#_Toc85403656)

[6.4.7 TCAS Sensitivity Control (TCAS II only) 82](#_Toc85403657)

[6.4.8 TCAS Display Control 82](#_Toc85403658)

[6.5 Control Panel Power and Initialization 82](#_Toc85403659)

[6.5.1 Dual Transponder Control Panel Considerations 82](#_Toc85403660)

[6.6 Human Centered Design 83](#_Toc85403661)

[6.7 Flight Ident Implementation 83](#_Toc85403662)

[6.7.1 Control Panel Labeling for Flight ID 83](#_Toc85403663)

[6.7.2 Code Selectors and Display 83](#_Toc85403664)

[6.7.3 Flight Ident Control Information Transfer 83](#_Toc85403665)

[7.0 Antenna 84](#_Toc85403666)

[7.1 Introduction 84](#_Toc85403667)

[7.2 Impedance and VSWR 84](#_Toc85403668)

[7.3 Gain and Polarization 84](#_Toc85403669)

[7.4 Power Rating 84](#_Toc85403670)

[7.5 Radiation Pattern 84](#_Toc85403671)

[7.6 Connector 84](#_Toc85403672)

[7.7 L-Band Systems Physical Isolation 85](#_Toc85403673)

[7.8 Antenna Installation 85](#_Toc85403674)

[7.8.1 Total Interconnection Losses 85](#_Toc85403675)

[ATTACHMENT 1 A TRANSPONDER UNIT CONNECTOR POSITIONING 86](#_Toc85403676)

[ATTACHMENT 1 B CONTROL UNIT CONNECTOR POSITIONING 87](#_Toc85403677)

[ATTACHMENT 1 C INDEX PIN CODING 88](#_Toc85403678)

[ATTACHMENT 1 D NOTES TO CONNECTOR KEYING 91](#_Toc85403679)

[1.1 MINIMUM SUBSET – SINGLE-SIDED CONFIGURATION RECOMMENDED KEYING 91](#_Toc85403680)

[1.2 MINIMUM TIF – DOUBLE-SIDED CONFIGURATION RECOMMENDED KEYING 91](#_Toc85403681)

[ATTACHMENT 2 A-1 TIF AND MINIMUM SUBSET CONFIGURATIONS PIN ALLOCATION – MINIMUM SUBSET 92](#_Toc85403682)

[ATTACHMENT 2 A-2 TIF AND MINIMUM SUBSET CONFIGURATIONS STANDARD INTERWIRING 95](#_Toc85403683)

[ATTACHMENT 2 A-3 TIF AND MINIMUM SUBSET CONFIGURATIONS NOTES APPLICABLE TO STANDARD INTERWIRING 99](#_Toc85403684)

[ATTACHMENT 2 B-1 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION PIN ALLOCATION 110](#_Toc85403685)

[ATTACHMENT 2 B-2 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION STANDARD INTERWIRING 112](#_Toc85403686)

[ATTACHMENT 2 B-3 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING 117](#_Toc85403687)

[ATTACHMENT 2 C-1 MINIMUM TIF, DOUBLE SIDED CONFIGURATION PIN ALLOCATION 136](#_Toc85403688)

[ATTACHMENT 2 C-2 MINIMUM TIF, DOUBLE-SIDED CONFIGURATION STANDARD INTERWIRING 138](#_Toc85403689)

[ATTACHMENT 2 C-3 MINIMUM TIF, DOUBLE-SIDED CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING 143](#_Toc85403690)

[ATTACHMENT 2 D-1 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION PIN ALLOCATION 163](#_Toc85403691)

[ATTACHMENT 2 D-2 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION STANDARD INTERWIRING 165](#_Toc85403692)

[ATTACHMENT 2 D-3 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING 171](#_Toc85403693)

[ATTACHMENT 2 E-1 MINIMUM TIF, DOUBLE SIDED FOR DO-260C AND ED-102B CONFIGURATION PIN ALLOCATION 199](#_Toc85403694)

[ATTACHMENT 2 E-2 MINIMUM TIF, DOUBLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION STANDARD INTERWIRING 201](#_Toc85403695)

[ATTACHMENT 2 E-3 MINIMUM TIF, DOUBLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING 206](#_Toc85403696)

[ATTACHMENT 2 F TRANSPONDER/CONTROL PANEL WIRING 233](#_Toc85403697)

[ATTACHMENT 2 G TRANSPONDER DATA SOURCE SELECTION SWITCHING 236](#_Toc85403698)

[ATTACHMENT 3 SOURCES FOR GICB REGISTER LOADING AND SAMPLE INTERFACES 238](#_Toc85403699)

[ATTACHMENT 3 A-1 NOTES TO THE PRIMARY SOURCES OF ARINC 429 INPUT DATA 259](#_Toc85403700)

[ATTACHMENT 3 B ARINC 429 OUTPUT DATA 279](#_Toc85403701)

[ATTACHMENT 3 C ADDITIONAL ARINC 429 INPUT AND OUTPUT 283](#_Toc85403702)

[ATTACHMENT 3 D SAMPLE INTERFACE CONFIGURATIONS 284](#_Toc85403703)

[ATTACHMENT 4 ARINC 429 DATA WORDS 289](#_Toc85403704)

[ATTACHMENT 5 DLP INTERFACE 344](#_Toc85403705)

[5.1 Mode S/Data Link Processor Interface Bus 344](#_Toc85403706)

[5.1.1 Basic Data Exchange Protocols 344](#_Toc85403707)

[5.1.1.1 Detailed Example and Discussion of the Data Exchange Protocols 344](#_Toc85403708)

[5.1.2 Data Exchange Protocols for Uplink Message 345](#_Toc85403709)

[5.1.2.1 Surveillance and Comm-A Interrogations 345](#_Toc85403710)

[5.1.2.1.1 Transaction Rates 345](#_Toc85403711)

[5.1.2.1.2 Data Storage 346](#_Toc85403712)

[5.1.2.1.3 Data Transfer 346](#_Toc85403713)

[5.1.2.1.3.1 Surveillance Interrogation 346](#_Toc85403714)

[5.1.2.1.3.2 Comm-A Interrogation 346](#_Toc85403715)

[5.1.2.1.3.3 Comm-A Broadcast 347](#_Toc85403716)

[5.1.2.2 Uplink Extended Length Message 347](#_Toc85403717)

[5.1.2.2.1 Uplink (ELM) Comm Data 347](#_Toc85403718)

[5.1.2.2.2 Transaction Rates 347](#_Toc85403719)

[5.1.2.2.3 Data Storage 347](#_Toc85403720)

[5.1.2.2.4 Data Transfer 347](#_Toc85403721)

[5.1.3 Data Exchange for Downlink Messages 348](#_Toc85403722)

[5.1.3.1 Data for Comm-B Messages 348](#_Toc85403723)

[5.1.3.1.1 Transaction Rates 348](#_Toc85403724)

[5.1.3.1.2 Data Storage 348](#_Toc85403725)

[5.1.3.1.3 Data Transfer 349](#_Toc85403726)

[5.1.3.1.3.1 Ground-Initiated Comm-B Data 349](#_Toc85403727)

[5.1.3.1.3.2 Air-Initiated Comm-B Data 349](#_Toc85403728)

[5.1.3.1.3.3 Air-Initiated Comm-B Broadcast Data 350](#_Toc85403729)

[5.1.3.1.3.4 Comm-B Message Closeout 351](#_Toc85403730)

[5.1.3.1.3.5 Cancellation of Air-Initiated Comm-B Message 351](#_Toc85403731)

[5.1.3.1.3.6 Comm-B Broadcast Timeout 351](#_Toc85403732)

[5.1.3.2 Downlink ELM Comm Data 351](#_Toc85403733)

[5.1.3.2.1 Transaction Rates 352](#_Toc85403734)

[5.1.3.2.2 Data Storage 352](#_Toc85403735)

[5.1.3.2.3 Data Transfer 352](#_Toc85403736)

[5.1.3.2.4 Cancellation of a Downlink ELM 353](#_Toc85403737)

[5.1.3.2.5 Downlink ELM Closeout 353](#_Toc85403738)

[5.2 Extended Length Message (ELM) Transfer 353](#_Toc85403739)

[5.2.1 Comm-C/Comm-D ELM Protocol 353](#_Toc85403740)

[5.2.1.1 Ground-to-Air ELM Transfer 353](#_Toc85403741)

[5.2.1.1.1 Initializing Segment Transfer 354](#_Toc85403742)

[5.2.1.1.2 Intermediate Segment Transfers 354](#_Toc85403743)

[5.2.1.1.3 Final Segment Transfer 354](#_Toc85403744)

[5.2.1.1.4 Segments Not Received by Transponder 355](#_Toc85403745)

[5.2.2 ELM Data Transfer Interface Standards 355](#_Toc85403746)

[5.2.2.1 General Description 355](#_Toc85403747)

[5.2.2.2 Data Transfer System Standards 356](#_Toc85403748)

[5.2.3 ELM Uplink Transactions 356](#_Toc85403749)

[5.2.3.1 ELM Uplink Data Storage 356](#_Toc85403750)

[5.2.3.2 ELM Output Data Word Format 356](#_Toc85403751)

[5.2.3.3 ELM Output Data Priority 356](#_Toc85403752)

[ATTACHMENT 6 SUPPRESSION PULSE SYSTEM CHARACTERISTICS 366](#_Toc85403753)

[6.1 General 366](#_Toc85403754)

[6.2 Suppression System Parameters 367](#_Toc85403755)

[6.2.1 Number of Suppression Pulse Recipients (Suppressees) 367](#_Toc85403756)

[6.2.2 Number of Suppression Pulse Donors (Suppressors) 367](#_Toc85403757)

[6.2.3 System Impedance 367](#_Toc85403758)

[6.2.4 System Cabling Capacitance 367](#_Toc85403759)

[6.3 Suppression Pulse Output From Suppressor Equipment 368](#_Toc85403760)

[6.3.1 Amplitude…………………………………………………………………………………368](#_Toc85403761)

[6.3.2 Polarity…...………………………………………………………………………………368](#_Toc85403762)

[6.3.3 Generator Impedance 368](#_Toc85403763)

[6.3.4 Synchronization 368](#_Toc85403764)

[6.3.5 Duration (TACAN/DME) 368](#_Toc85403765)

[6.3.6 Duration (Transponder) 368](#_Toc85403766)

[6.3.7 Rise Time…..………………………………………………………………………………369](#_Toc85403767)

[6.3.8 Decay Time……………………………..…………………………………………………369](#_Toc85403768)

[6.3.9 Spurious Output from Suppressor 369](#_Toc85403769)

[6.4 Suppression Pulse Input At Suppressee Equipment 369](#_Toc85403770)

[6.4.1 Impedance ………………………………………………………………………………369](#_Toc85403771)

[6.4.2 Spurious Output 369](#_Toc85403772)

[ATTACHMENT 7 DIVERSITY ANTENNA SELECTION 370](#_Toc85403773)

[7.1 General…………………………………………………………………………………...370](#_Toc85403774)

[7.2 Approach A………………………………………………………………………………370](#_Toc85403775)

[7.3 Approach B………………………………………………………………………………370](#_Toc85403776)

[7.4 Approach C………………………………………………………………………………370](#_Toc85403777)

[ATTACHMENT 8 TYPICAL BLADE ANTENNA 372](#_Toc85403778)

[ATTACHMENT 9 AIRPLANE PERSONALITY MODULE (APM) IMPLEMENTATION GUIDELINES FOR THE TRANSPONDER 374](#_Toc85403779)

[9.1 Purpose…………………………………………………………………………………...374](#_Toc85403780)

[9.2 APM Compatibility 374](#_Toc85403781)

[9.3 Data Blocks 374](#_Toc85403782)

[9.3.1 Header Block 374](#_Toc85403783)

[9.3.2 Identity Block 376](#_Toc85403784)

[9.3.3 Generic Block 376](#_Toc85403785)

[9.3.4 User Blocks (Optional) 382](#_Toc85403786)

[9.3.5 Integrity Block 382](#_Toc85403787)

[9.4 Data Loader Considerations 382](#_Toc85403788)

[9.5 APM Programming Considerations 382](#_Toc85403789)

[9.5.1 Host LRU Programming 382](#_Toc85403790)

[9.5.2 Shop Programming 382](#_Toc85403791)

[9.5.3 Data Loader Considerations 382](#_Toc85403792)

[ATTACHMENT 10 EXAMPLE GICB REGISTER LOADING ARCHITECTURE 383](#_Toc85403793)

[10.1 Purpose 383](#_Toc85403794)

[10.2 Description of the GICB Loading Function 383](#_Toc85403795)

[10.2.1 The GICB Register Loader 384](#_Toc85403796)

[10.2.2 The Formatting Algorithms 384](#_Toc85403797)

[ATTACHMENT 11 MODE A REPLY CODE COMBINATIONS 385](#_Toc85403798)

[APPENDIX A ACRONYM LIST 387](#_Toc85403799)

[APPENDIX B OPTIONAL CONTROL PANEL CONFIGURATION 393](#_Toc85403800)

# Introduction and Description

## Purpose of this Characteristic

This Characteristic describes a standard Mark 4 Air Traffic Control Transponder (ATCRBS/Mode S) with Extended Interface Functions (EIF). The document defines equipment capable of supporting Traffic Alert and Collision Avoidance System (TCAS) functions, and advanced surveillance capabilities defined by the International Civil Aviation Organization (ICAO) as Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM), Automatic Dependent Surveillance-Broadcast (ADS‑B), Extended (112-bit) Squitter, and the enhanced Surveillance capabilities provided by the ICAO definitions in the Manual on Mode S Specific Services are supported. This unit is specifically designed for installation in commercial transport type aircraft.

This Characteristic also provides design guidance for the development and installation of a Mark 4 transponder with Extended Interface Functions (EIF) intended primarily for airline use. It describes the desired operational capabilities and defines standards which are necessary to achieve interchangeability.

This Characteristic provides standards for:

* Form factor
* Control features
* Connector pin allocation
* Interwiring
* Interfaces

These provisions will promote interchangeability of equipment from different manufacturers. The minimum operational and performance capabilities of this unit are further described in the related RTCA and EUROCAE Minimum Operational Performance Standards (MOPS) documents for the Mode S transponder and the Airborne Data Link Processor (refer to Section 3.1 for additional document references).

.

### Relationship to Other Documents

The original definition of a transponder having Mode Select (Mode S) capability appeared in **ARINC Characteristic 718:** *Mark 3 Air Traffic Control Transponder (ATCRBS)*. The transponder defined by ARINC Characteristic 718 is considered to provide as a minimum “Level 2” functionality.

The capability to avoid mid-air collisions was introduced by ARINC Characteristic 735: Traffic Alert and Collision Avoidance System (TCAS). The TCAS Receiver/Processor utilizes the transponder for communications; thus, the transponder is considered to be a part of the TCAS system.  Enhancements/updates have been introduced in ARINC Characteristic 735A/B/C.

Collision Avoidance Systems have evolved from TCAS II to ACAS Xa.  ACAS Xu has also been developed for Detect and Avoid (DAA) systems.  References to TCAS/ACAS are intended to encompass TCAS II, ACAS Xa, and ACAS Xu.  When necessary to differentiate between specific technologies, the specific terms are used.

The transponder functionality described in this Characteristic is based on ARINC Characteristic 718 making the Mark 4 (ARINC 718A) transponder functionally compatible with a Mark 3 (ARINC 718) transponder.

COMMENTARY

The combined Mode S transponder/extended interface function will be referred to as a Mark 4 (ARINC 718A) transponder. The nomenclature Mark 4 will be used when it is necessary to distinguish it from the Mark 3 (ARINC 718) transponder defined in ARINC Characteristic 718. In cases when it is clear that the Mark 4 transponder is indicated, the word transponder may be used alone for readability.

## System Description

### General

The Mark 4 transponder provides essential elements in the evolution towards free flight by its ability to support:

1. ATC systems operating with active surveillance.
2. ATC systems operating with passive surveillance.
3. Airborne systems operating with active surveillance (e.g., TCAS/ACASX).

.

1. Digital communication.

The central element in the above scenario is represented by the Mode S system which is further described in Section 3 of this document.

### ATC Support with Active Surveillance

ATC systems with active surveillance are supported by the Mark 4 transponder in the classical interrogator - transponder scenario.

The Mark 4 transponder provides the surveillance functions of a classical Secondary Surveillance Radar (SSR) Mode A/C transponder plus those of a SSR Mode S transponder.

COMMENTARY

For the purpose of this document the term “SSR Mode A/C” is used for the conventional SSR Mode 3/A and Mode C (also known as ATCRBS).

The Mode S communication capability allows the exchange of tactical messages with Air Traffic Control and other users. It is furthermore used to derive aircraft parameters for improved Air Traffic Control.

For these purposes, the transponder interoperates with the interrogators by means of the SSR Mode A/C and Mode S protocols. It receives altitude and other aircraft parameters from the avionics and interacts with communication functions onboard.

### ATC Support with Passive Surveillance

The extended squitter function, which may be offered by the transponder, allows use of the transponder in support of passive surveillance. For this purpose, the transponder receives information from local navigation systems like GNSS and transmits them periodically.

Passive ground or airborne systems will receive these reports and establish tracking of the aircraft.

For the support of this function, the transponder autonomously transmits the reports on the Mode S downlink frequency and requires an interface to the local navigation systems by means of avionics buses.

### Traffic Alert and Collision Avoidance System (TCAS) Support

The transponder represents an essential element in the TCAS installation since the transponder portion of it serves as the 1030 MHz receiver for the local TCAS. Its transmitter supports remote TCAS installations by providing them with replies to their interrogations and by means of the extended squitter. For this purpose, the transponder is closely coupled with the TCAS of an aircraft.

### Support to Digital Communication

The extended interface functions enable the transponder to offer digital communication functions which allow tactical communication with the ground (e.g., to exchange flight path data, to access weather data bases, ATIS). The transponder is interfaced with communication functions onboard and communicates with ground systems via the Mode S data link.

## Mark 4 Transponder Functions

The Mark 4 transponder consists of two logically distinct elements. These are:

1. Transponder Function (TXF) comprising functions related to the Mode S and ATCRBS systems.
2. Extended Interface Function (EIF) comprising functions related to the Mode S data link and the Mode S specific services.

The above terms will be used to distinguish the two functions within the Mark 4 transponder where appropriate. This logical distinction is only used for descriptive purposes and does not preclude any implementation solution.

### Transponder Functions (TXF)

The Transponder Function (TXF) receives SSR Mode A/C coded interrogations from SSR interrogators and responds to these interrogations as if it were an SSR transponder.

The transponder function also responds to interrogations sent by Mode S interrogators. These interrogations are discretely addressed to individual aircraft. The addressed airborne Mode S transponder responds with Mode S replies which contain either the 4096 Mode A identity or Mode C automatic aircraft altitude codes.

The TXF also supports a ground-air-ground link capability between Mode S ground based applications and the transponder equipped aircraft, thus making use of the additional information coding capacity available with the discretely addressed interrogations and replies of the Mode S system.

### Extended Interface Functions (EIF)

The Extended Interface Function (EIF) of the transponder includes:

1. Mode S Enhanced Surveillance functions by delivering particular aircraft parameters to the ground.
2. Mode S specific communications for dedicated stand-alone applications for ATC use.
3. Growth capability to support of Mode S specific protocol and broadcast services.

COMMENTARY

The transponder interoperates with elements residing in the Mode S ground interrogator, and a logically separated unit called Ground Data Link Processor (GDLP).

Since the communication services listed above may become available, manufacturers could decide only to implement function “a” now and design their equipment so that it can be upgraded to include the other functions later. However the burden of later upgrades for the airlines will have to be taken into account.

Mark 4 transponders should be clearly labeled stating their data link capability. The Label would indicate the transponder communication capability level 2, 3, 4, or 5 plus a suffix formed from the letters defined below:

1. Capability of Enhanced Surveillance (i.e., the default GICB support specified in 4.4.1.3.2) (suffix ‑d1).
2. Capability of -d1 plus Mode S Specific Protocol and Broadcast Protocols (suffix -d2).
3. Capability of -d2 plus ISO-8208 support (suffix -d3).

COMMENTARY

For example, a Level 5 transponder with extended squitter (e), Surveillance Identifier SI codes (s), and full data link capability (-d3) would be designated “Level 5es-d3.” This marking is expected to be identified in the transponder TSO.

## System Description

The system consists of primarily three separated units described further below:

1. Mark 4 Transponder Unit.
2. Mark 4 Transponder Control Panel.
3. Antenna.

### Mark 4 Transponder Unit

The Mark 4 transponder unit houses all elements which provide the power supply, the RF processing, and the communication processing. These can be further distinguished as Transponder Functions (TXF) and the Extended Interface Functions (EIF).

### Mark 4 Transponder Control Panel

The pilot control of the Mark 4 transponder and possibly an associated TCAS system is accomplished by a transponder control panel or an equivalent data input from a centralized avionics management system. For the purpose of communicating with these systems the transponder should utilize the two wire serial digital frequency/function selection system defined in **ARINC Specification 720**: *Digital Frequency/Function Selection for Airborne Electronic Equipment.* Section 6 of this document provides more information on the control panel functions.

### Antenna

The Mode S functions of the transponder should either be supported by one or two antennas for the operational unit. Two antennas are required if the Mark 4 is coupled with an on-board TCAS, or if the aircraft’s weight or maximum airspeed is such that diversity is specified in ICAO Annex 10. The diversity installation should be made as such that one antenna is mounted on top of the fuselage and the other on the bottom. The antennas should be capable of receiving and transmitting the SSR/Mode S frequencies of 1030 and 1090 MHz (L‑Band) respectively.

## Interchangeability

### General

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

### Interchangeability Desired For the Mark 4 (ARINC 718A) Transponder System

Unit interchangeability is desired for the transponder, the control panel, and the antenna regardless of manufacturing source of the individual items.

### Interchangeability Considerations

The Mark 4 transponder is intended to replace Mark 3 transponders with minimum impact on the airframe installation. Maintenance considerations have also suggested allowing replacement of a Mark 3 (ARINC 718) transponder by a Mark 4 (ARINC 718A) transponder when necessary (even without having the full benefit of all Mark 4 transponder functions in that case).

Based on the above considerations as much compatibility as possible with the Mark 3 transponder interwiring has been attempted. Essential goals in this are:

1. Standard Form Factor
2. Standard Aircraft Interwiring
3. Standard Control Panel

Transponder designers should note that to meet these objectives, especially in regard to the pin allocation at the service connector, the Mark 4 transponder requires determination of the wiring characteristic of its mating plug (i.e., Mark 3 or Mark 4). Upon such determination the Mark 4 transponder will be required to apply interpretation of the associated plug wiring consistent with the respective characteristic (see Attachment 2 for more information).

COMMENTARY

Full implementations of Mark 4 transponders are not backward compatible with Mark 3 transponder installations that use Gillham altitude data inputs. Although partial Mark 4 implementations that do not reuse the Gillham inputs as digital data inputs are able to support Gillham data, installers are recommended to, wherever possible, update the altitude data source to reflect the requirements of TCAS safety and 25-foot altitude reporting requirements.

The number of new interfaces necessary for the full functioning of the Mark 4 transponder required use of almost all available spare pins of the currently used service connector..

The forward-looking interchangeability may be achieved by implementation of table-loaded information to provide this (static configuration) information (e.g., by an Airplane Personality Module (APM) or via an ARINC 429 data bus).

Another aspect of forward-looking definition is introduced by the configuration means of the transponder which is used to customize certain properties of the transponder to adapt it to particular avionics architecture. This configuration means also allows for introducing future requirements.

New interfaces for the Mark 4 transponder have been arranged on the service connector to provide the maximum forward and backward compatibility with Mark 3 transponders. New interfaces, especially those that will provide data necessary for computing and filling the Ground-Initiated Comm-B registers, use pins and pin pairs that correspond to similar or undefined inputs on the Mark 3 transponder.

## Regulatory Approval

The Transponder Interface equipment should meet all applicable ICAO, EASA, and FAA regulatory requirements. This document does not and cannot set forth the specific requirements that the equipment must meet to be assured approval. This information must be obtained from the appropriate regulatory authority.

# Interchangeability Standards

## Introduction

This Section sets forth the specific form factor, mounting provisions, interwiring, input and output interfaces and power supply characteristics desired for the Mark 4 transponder system. These standards are necessary to ensure the continued independent design and development of both the equipment and the airframe installations.

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

## Form Factor, Connector, and Index Pin Coding

### Transponder Unit

The transponder should comply with the dimensional standards in **ARINC Specification 600**: *Air Transport Avionics Equipment Interfaces* for the 4 MCU form factor. The transponder should also comply with ARINC 600 standards in respect of weight, racking attachments, front and rear projections, and cooling.

The transponder should be provided with a low insertion force, size 2 shell ARINC 600 service connector. It should be located on the center grid of the transponder unit’s rear panel. Special index pin coding is used to differentiate the Mark 4 (ARINC 718A) transponder from the Mark 3 (ARINC 718) transponder, and yet maintain compatibility with the aircraft wiring. See Attachment 1C of this document for details.

The Top Plug (TP) and Middle Plug (MP) inserts of this connector should each provide 70 socket type contacts and one large diameter coaxial contact. The Bottom Plug (BP) insert should provide 11 pin type contacts and two small diameter coaxial contacts. Attachment 1A to this document shows the connector arrangement and Attachment 2 the pin assignments.

Functions not assigned pins on the service connector in Attachment 2 to this document, but need to be brought to the “outside world” to facilitate testing the transponder with automatic test equipment (ATE), should be assigned pins on an auxiliary connector of a type selected by the equipment manufacturer. The manufacturer should observe the standards of ARINC Specification 600 when choosing the location for this connector. It should be noted that, other than to accommodate the needs for equipment identification by the ATE described in this document, the manufacturer is free to make the pin assignments. The airlines do not want the unassigned (“future spare”) pins of the service connector used for functions associated solely with ATE use.

### Standard Control Panel

Control of the transponder is affected by means of facilities provided on a dedicated control panel or on the data entry panel of a centralized radio management system. The approach used in a given airframe should be the choice of the airline and/or the airframe manufacturer. Guidance on the design of a transponder control panel suitable to use with the transponder may be found in Section 6 of this document.

COMMENTARY

The term “Standard Control Panel” applies to a control panel that conforms to the functional specification described in Section 6 of this document.

### Antenna

The physical characteristics, mounting dimensions and connector type shown in Attachment 8 to this Characteristic should be considered “typical” for the transponder system antenna.

COMMENTARY

While the airframe designer may have some perfectly valid reasons for using another style or type of antenna, it is recommended that the final design reflect airline desires. The airlines wish to avoid the spare parts problem introduced by the use of an antenna which does not conform to this standard.

Section 7 of this document provides further information on the antenna system.

## Interwiring

The standard interwiring to be installed for the transponder is set forth in Attachment 2 to this Characteristic. This interwiring is designed to provide the degree of interchangeability specified in Section 1.5 of this document. Manufacturers are cautioned not to rely upon special wires, cabling or shielding for use with particular units, because they will not exist in the standard installation.

COMMENTARY

Why Standardize Interwiring?

The standardized interwiring is perhaps the heart of all ARINC Characteristics. It is this feature which allows the airline customer to complete negotiations with the airframe manufacturer so that the latter can proceed with engineering and initial fabrication prior to airline commitment on a specific source of equipment. This provides the equipment manufacturer with many valuable months in which to put the final “polish” on his equipment in development.

The reader is also cautioned to give due consideration to the specific Notes in Attachment 2 as they apply to the standard interwiring.

## Power Circuitry

### Primary Power Input

The equipment should be designed to use 115 Vac 400 Hz single phase power. This primary power should be protected by a single circuit breaker, situated in the aircraft power distribution center, of the size shown in Attachment 2 to this document. The aircraft power supply characteristics, utilization, equipment design limitations and general guidance material are set forth in **ARINC Report 609:** *Design Guidance for Aircraft Electrical Power Systems.*

### Power Control Circuitry

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

COMMENTARY

Although only one transponder of a dual installation will be operating at a time, users may desire the inoperative unit to be held in a powered up “standby” condition so that its BITE may detect and annunciate any failures that would render it incapable of providing service when called upon. See Sections 4.5.2, 4.8, and 6.4.1 for additional information about dual installations and standby-on switching.

### The Common Ground

The wire connected to the Transponder connector pin labeled “Chassis Ground” should be employed as the DC ground return to aircraft structure. It is not intended as a common return for circuits carrying heavy ac currents. Equipment manufacturers should design their equipment accordingly.

### The AC Common Cold

The wire connected to the Transponder connector pin labeled “115 Vac Cold” should be grounded to the same structure that provides the DC chassis ground but at a separate ground stud. Airframe manufacturers are advised to keep all ground wires as short as practicable to minimize noise pick up and radiation.

### Internal Circuit Protection

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

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

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

## Standard Interfaces

The transponder receives and sends data on several interfaces. Interchangeability between units of different manufacturers requires that the communication interfaces are compatible with each other from the electrical and protocol point of view. Interfaces in this respect are interfaces to the avionics buses as well as the interfaces to the onboard applications requiring communication services.

The definition of these interfaces is a necessary part of the interchangeability standards set forth by this Characteristic. Detailed are contained in Section 4.7 of this document.

## Environmental Conditions

The transponder should be specified environmentally in terms of the requirements of RTCA DO 160, “Environment Conditions and Test Procedures for Airborne Equipment.”

## Cooling

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

COMMENTARY

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

Equipment failures in aircraft due to inadequate thermal management have plagued the airlines for many years. Section 3.5 of ARINC Specification 600 contains information needed by airframe and equipment suppliers to prevent such problems in the future. The airlines regard this material as “required reading” for all potential suppliers of transponder and aircraft installation.

## Grounding and Bonding

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

COMMENTARY

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

## Standardized Signaling

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

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

### ARINC 429 Digital Information Transfer SystemData Bus

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

### Standard “Open”

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

COMMENTARY

In many installations, a single switch is used to supply a logic input to several LRUs. One or more of these LRUs may utilize a pull up resistor in its input circuitry. The result is that an “open” may be accompanied by the presence of +27.5 Vdc nominal. The signal could range from 18.5 to 36 Vdc.

### Standard “Ground”

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

### Standard “Applied Voltage” Output

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

### Standard Discrete Input

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

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

COMMENTARY

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

The voltage levels and resistances used are, in general, acceptable to hardware manufacturers and airlines. This definition of Discrete is also being used in the other ARINC 700-series Characteristics; however, there are few exceptions for special conditions.The logic sources for the Discrete Inputs to the transponder are expected to take the form of switches mounted on the airframe component (e.g., flap, landing gear) from which the input is desired. These switches will either connect the Discrete Input pins on the connector to airframe DC ground or leave them open circuit as necessary to reflect the physical condition of the related components. The transponder will, in each case, be expected to provide the dc signal to be switched. Typically, this is done through a pull up resistor. The transponder input should sense the voltage on each input to determine the state (open or closed) of each associated switch.

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

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

### Standard Discrete Output

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

COMMENTARY

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

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

COMMENTARY

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

### Standard Program Pin Input

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

COMMENTARY

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

The encoding logic of the program pin relies upon two possible states of the designated input pin. One state is an “open” as defined in Section 2.9.2 of this Characteristic. The other state is a connection (short circuit i.e., 10 ohms or less) to the pin designated as the “Program Common” pin (TP-5D and MP-6H, respectively).

COMMENTARY

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

# System Characteristics

## Purpose

This Section provides detailed characteristics of the Mode S transponder system. In addition, the following industry standards are provided as reference documents. The latest version of the following documents applies.

1. ICAO Annex 10 Volume IV “Surveillance Radar and Collision Avoidance Systems” and Chapter 5 of Volume III Part 1 “SSR Mode S Air-Ground Data Link”.

This material contains the standards for the Mode S system and the Mode S subnetwork. The Mode S system description is in the ICAO Manual of the Secondary Surveillance Radar (SSR) Systems and the Subnetwork description is in the ICAO Mode S Subnetwork Guidance material approved by ICAO in 1997.

1. ICAO Doc. 9871, “Technical Provisions for Mode S Specific Services and Extended Squitter”.

This document provides information on the use of GICB registers in the transponder. It outlines how the data in the GICB registers is structured and which update rates apply.

1. RTCA DO-181E and EUROCAE ED-73E “Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders”.

These documents describe the minimum operational and performance standards for the transponder part of the Mark 4 transponder.

1. RTCA DO-260B and EUROCAE ED-102A “Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)”.
2. RTCA DO-181F and EUROCAE ED-73F “Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment.
3. RTCA DO-260C and EUROCAE ED-102B “Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)”.

These documents describe the minimum operational and performance standards for the extended interface part of the Mark 4 transponder.

It is important to design the Mark 4 transponder in compliance with the above documents so that it becomes fully compatible with the Mode S system and related operational requirements (such as extended squitter, TCAS cross-link, and Level 5).

Throughout this document the performance standards of transponders can be reference by the RTCA and EUROCAE identifiers or by the Version Number broadcasted in the Aircraft Operational Status Message extended squitter. Version 1 transponders are designed to DO-260A, Version 2 transponders are designed to DO-260B, and Version 3 transponders are designed to DO-260C.

## Description of the SSR Mode A/C

The SSR Mode A/C system consists of airborne transponders and ground-based interrogators. Interrogators send interrogation pulse-groups which trigger each airborne transponder located in the coverage of the antenna main beam. Upon reception of such a pulse group a reply pulse-group is transmitted by a transponder. These replies are received by the interrogator and decoded. The decoded data contained in the messages is forwarded and displayed to the ATC controller.

The measurement of the round-trip transit time determines the range (rho) to the replying aircraft. The mean direction of the series of replies from an aircraft in the main beam of the interrogator antenna, or the pointing direction of the antenna main beam combined with off-boresight information of a single reply from an aircraft, determines the azimuth (theta). The pattern of pulses in the multiple-pulse reply provides individual pressure altitude and Mode A identity information pertaining to the responding aircraft.

## SSR Mode S System Description

SSR Mode S is based on the same principles as SSR Mode A/C but has the following additional features:

1. All Mode S transponders can be individually addressed by a unique address.
2. The amount and variety of Mode S data is much larger than Mode A/C data.
3. The communication channel is protected by a protocol which avoids loss of information and protects the data bits by an error detecting/correcting code.
4. The Mark 4 transponder can autonomously send reports carrying aircraft information and thus supports Automatic Dependent Surveillance systems without the involvement of active interrogators.

With the above features, ground-air-ground data link communications can be accommodated integrally with the surveillance functions of the system. Mode S is an evolutionary upgrade to Mode A/C intended to provide the enhanced surveillance and communication capability required for new air traffic control applications. This will be enabled with only a very limited amount of additional functions necessary for communication purposes.

COMMENTARY

For the purpose of this document the term “SSR Mode S” implies a combined SSR Mode A/C/Mode S capability.

The data link capability of Mode S allows it to serve as an essential element of the Traffic Alert and Collision Avoidance System (TCAS). For Mode S and TCAS equipped aircraft, all TCAS avoidance maneuvers are coordinated through the Mode S transponder. In addition, a sole Mode S transponder (i.e., not accompanied by a TCAS) is responsible for reporting Mode C altitude data to a TCAS on another aircraft.

The principal feature of Mode S that differs from SSR is that each aircraft is assigned a unique 24-bit address code. Using this unique code, interrogations can be directed to a particular aircraft, and replies unambiguously identified. Channel interference is minimized because an interrogator can limit its interrogations to targets of interest. In addition, by proper timing of interrogations, replies from closely-spaced aircraft can be received without mutual interference. The unique address in each interrogation and reply also permits the inclusion of data link messages to or from a particular aircraft.

Phase Overlay is an optional feature applicable only to DO-181F/DO-260C or later transponders.  This feature provides a means of increasing the throughput on the 1090 MHz frequency by overlaying 8PSK phase modulated information onto the PPM messages.  Such messages contain additional information without changing the time occupancy of the frequency and remaining within the defined spectrum characteristics.  Refer to DO-181F and DO-260C for details.

## SSR/Mode S Compatibility

In order to facilitate the evolutionary transition from the Mode A/C system to the Mode S system, the same radio frequencies are used for interrogations (1030 MHz) and replies (1090 MHz) as for SSR Mode A/C. The Mode S waveforms (modulation techniques) have been chosen to reduce the interference between SSR Mode A/C and Mode S.

The information content of both uplink and downlink Mode S transmissions are further protected by parity check bits generated by a cyclic coding algorithm.

COMMENTARY

Because the interference resistance of the Mode S system relies on the DPSK modulation on the uplink and the PPM format on the downlink, the DPSK demodulation processor within the transponder should be designed carefully. Particular attention should also be given to the precise timing required in the downlink pulses.

To support the evolutionary transition from SSR Mode A/C to Mode S over an extended period, Mode S installations, both ground and airborne, include full SSR Mode A/C capability. Mode S interrogators provide surveillance of SSR Mode A/C-equipped aircraft and Mode S transponders that are capable of replying to SSR Mode A/C interrogators. To accomplish this dual mode of operation (SSR Mode A/C and Mode S) with minimum equipment complexity:

1. Mode S uses the same interrogation and reply frequencies, as does SSR Mode A/C.
2. Mode S interrogators interrogate both SSR Mode A/C and Mode S transponders and process replies from both SSR Mode A/C and Mode S transponders.
3. Mode S transponders receive both SSR Mode A/C and Mode S interrogations and transmit both SSR Mode A/C and Mode S replies.

## Mode S Functional Description

### Interrogator-Transponder lnteraction

Mode S interrogators send their interrogations in a certain schedule, which consists of periods foreseen for SSR Mode S All-Call interrogations as well as for discretely addressed Mode S interrogations. The SSR Mode S All-Call interrogations can be decoded by SSR Mode A/C transponders as well as by Mode S transponders. A Mode A/C transponder cannot distinguish this Mode S All-Call from other Mode A/C interrogations and replies normally as if it was interrogated by a Mode A/C interrogator. Mode S equipped aircraft, however, detect the slightly different interrogation waveform and respond with a Mode S reply containing their 24-bit address. This allows the interrogator to acquire Mode S equipped aircraft entering the coverage of the interrogator.

Upon the reception of the Mode S reply the interrogator knows that this aircraft is Mode S equipped and puts it on a roll-call list which holds the aircraft’s range and azimuth. From this moment on the transponder is interrogated discretely with Mode S interrogations. The roll-call list allows interrogating the transponder at a pre-computed moment so that its reply does not overlap with other replies.

Further replies to SSR Mode S only All-Calls can be prevented by commanding the All-Call lockout of the Mode S transponder. This lockout does not affect the reply capability to standard SSR Mode A/C interrogations. Mode S transponders reply to Mode A/C interrogations under all circumstances.

The acquisition of aircraft entering an airspace served by an interrogator requires a certain amount of communication overhead. To avoid this, in case the aircraft flies into the airspace covered by an adjacent interrogator, the Mode S address as well as the aircraft’s position can be passed from one interrogator to the other by means of ground communication lines.

In regions where Mode S interrogators are not connected by ground lines, a protocol exists which provides for the Mode S transponder to be in a lockout state for only those interrogators which have the aircraft on roll-call. Therefore, as the aircraft flies into airspace served by an adjacent Mode S interrogator, the new interrogator can acquire the aircraft via its reply to a Mode S only All-Call interrogation.

Aircraft are tracked by the interrogator throughout its assigned airspace. A Mode S equipped aircraft will report either its Mode C altitude, or its 4096 Mode A identity code, in the Mode S reply, depending on the type of discrete interrogation received. During each scan, interrogations of Mode A/C aircraft are made in both Mode A and Mode C. If, on scanning through a Mode S equipped aircraft’s location, the interrogator does not receive a valid reply, it can re-interrogate a limited number of times. Interrogators may interrogate at a power “tailored” to the range of the aircraft, and re-interrogate at high power if the “tailored” lower power attempt fails.

The monopulse techniques used in Mode S surveillance allow improved position determination of targets while reducing the number of required interrogations. This reduction in the number of interrogations and replies improves the radio frequency interference environment.

### Address/Parity

All discrete Mode S interrogations (56-bit or 112-bit) and replies (except All-Call and Broadcast transactions) contain the 24-bit discrete address allocated to the aircraft. The 24-bit discrete address allows a very large number of aircraft to operate in the air traffic control environment without occurrence of a duplicated address.

Blocks of address codes have been allocated to state aircraft registration authorities by ICAO. Users requiring an ICAO address will have to apply to these organizations for an address code assignment. Since this address is not only used for Mode S but as well for other air/ground/air communication systems it is referred to as the ICAO 24-bit address.

The critical nature of many of the messages carried by Mode S will require a high degree of message integrity. The information content of both uplink and downlink transmissions is therefore protected by parity check bits generated by a 24-bit cyclic coding algorithm. These parity check bits are overlaid on the discrete address to save coding space and thus assure that a message will be accepted only if it is not corrupted and contains the correct address. This technique ensures that the probability of an erroneous message being accepted is extremely small. The error-detecting codes in both interrogations and replies are designed to produce an undetected error rate of better than one in 107 112-bit transmissions. A high degree of message reliability is therefore assured through the knowledge that the message is correct, plus the capability of the sensor to re-interrogate if no correct message was received.

### Surveillance

The primary function of Mode S is improved surveillance. For the Mode S transponder this function can be accomplished by use of “short” (56-bit) transmissions in both directions. In these transmissions, the aircraft reports its Mode C altitude or Mode A 4096 identity code as well as its flight status (airborne, on the ground, alert, Special Position Identification (SPI)). With very little effect on the RF environment the surveillance messages can carry additional 56 message bits making them 112-bits long.

In addition, to elicited replies, a Mode S transponder transmits “squitters.” A squitter transmission is an unsolicited reply which is transmitted at a rate specified in ICAO Annex 10. The squitter transmission can be received by airborne or ground systems designed for passive surveillance. Long squitters support Automatic Dependent Surveillance-Broadcast (ADS-B) by reporting the aircraft’s position and other data.

Interrogations for the purposes of air-to-air surveillance and collision avoidance maneuver coordination messages from airborne collision avoidance systems are addressed to Mode S equipped aircraft based upon the address extracted from squitter signals. These interrogations are used for Mode S target tracking and collision threat assessment by TCAS on other aircraft.

COMMENTARY

Air-to-Air data is exchanged with TCAS to achieve collision avoidance. The formats of data words exchanged between the Mode S transponder and the TCAS computer unit are defined in ARINC Characteristics 735()

### Data Link Communications

The discrete addressing and digital encoding of Mode S transmissions permit their use as a digital link. Certain interrogation and reply formats of the Mode S system contain coding space for the transmission of data. Such data transmissions may be used for air-to-air data interchange for collision avoidance, or may be used to exchange messages that are considered to be in the categories of safety and regulation of flight.

Mode S transmissions may be handled as one 56-bit message included as part of “long” 112-bit interrogations or replies. These transmissions include the message in addition to surveillance data, and thus will generally be used in place of, rather than in addition to, a surveillance interrogation and/or reply.

An efficient transmission of longer messages can be accomplished by the extended length message (ELM) capability. Using this capability, a sequence of up to sixteen 80-bit message segments (each within a 112-bit transmission) can be exchanged, either ground-to-air or air-to-ground, and can be acknowledged with a single reply/interrogation.

The Ground Initiated Comm-B (GICB) protocol allows the ground to extract data from any of the 255 56-bit registers in the transponder. This protocol operates with minimum communication overhead and can be performed by short (56-bit) surveillance interrogations, requesting long (112-bit) replies. The GICB protocol is essential for the enhanced surveillance function. It is important that the register locations hold up-to-date information since some of the data is used by real-time applications on the ground (e.g., improved tracking). For this reason they need to be updated by the extended interface function (EIF) in the Mark 4 transponder on regular intervals.

The data stored in the GICB registers originates from particular data words received on different avionics buses connected to the Mark 4 transponder. The data formats and update rates are specified in the ICAO Doc 9871.

The Mode S Specific Services Protocol (MSP) provides efficient communication for time critical ATC applications. This communication function only needs to route the data to the appropriate onboard location and to accept the responses or requests to be transferred to the ground.

The Mark 4 transponder may provide a Switched Virtual Circuit (SVC) service, which offers a protected SVC communication service between the ground and onboard applications.

The SVC service offers an ISO 8208 Data Circuit-Terminating Equipment (DCE) interface to onboard systems. Other subnetworks are designed to support the ISO 8208 interface as well and can thus all be used in the same way.

## Communication Data

### Mode A and Mode C Reply Data

The identification code content as required for Mode A replies and certain Mode S replies is under the control of the equipped aircraft. The crew can input, the Mode A code upon controller advice. The Mode C data is derived from an onboard pressure altitude source.

Mode A code designations selected must be displayed to the pilot in the form of four digits, each of which lies between 0 and 7 inclusive. This data is then converted to the appropriate format to be included in Mode A and certain Mode S replies. Attachment 11 to this document gives a complete tabulation of this coding system, together with specific examples of its application.

The altitude information required for Mode C and certain Mode S replies will be derived from an altitude computing device such as an Air Data System, Altitude Computer System, or other part of the aircraft altimeter system. The coding technique to be employed for altitude transmissions is defined in ICAO Annex 10 and the reference pressure is to be 29.92 Hg (1013.2 hPa).

### Mode S GICB Register Data

In support of the expanded surveillance functions the Mark 4 transponder transmits aircraft data supplied from various avionics sources.

The Mode S GICB data are delivered via special transponder registers (GICB registers). The Extended Interface Function (EIF) within the Mark 4 transponder is in charge of reading the data from avionics buses, pre-processing them and storing them in the appropriate formats in the transponders GICB registers. From here they can be read by the ground systems without further involvement of the EIF. It should be noted that it is essential that the data is maintained and kept up-to-date by the EIF.

### Mode S Specific Services Protocol (MSP) Data

As an option, the Mark 4 transponder may support the Mode S Specific Services protocol by which bi-directional communication between ground applications and onboard applications can be achieved in an efficient way. In support of this the transponder delivers uplink messages and receives downlink messages which are exchanged with onboard applications via the EIF in the Mark 4 transponder.

### Broadcast Data

The extended interface function can accept downlink broadcast data which it forwards to the transponder for delivery to any interrogator. In the opposite direction the transponder delivers uplink broadcasts via the EIF to the onboard avionics.

### Mode S Subnetwork Data

As an option, the Mark 4 transponder may contain a dedicated processing chain in the EIF, which supports switched virtual circuits on the Mode S subnetwork. This allows the use of the Mode S subnetwork in parallel with other subnetworks in a transparent way. The Mark 4 transponder may support ISO 8208 packets at its interface to the avionics.

## ATC System and Pilots’ Use of Mode S

Mode S transponders serve the ATC system by supplying accurate aircraft position data. To achieve this, rho and theta values are derived from the interrogation reply activity.

In addition to its fundamental surveillance function, the Mark 4 transponder specified in this document may include additional functions, to support the ATC in several additional aspects:

1. Aircraft state vector data can be obtained for better position estimation leading to more airspace capacity.
2. Digital exchange of frequency change information, clearances, ATIS, and so forth allows reduced pilot and controller workload and reduces the risk of errors.
3. Exchange of flight path data between ATC flow management units and the flight management systems of the aircraft facilitates optimization of the flight path leading to more fuel economy and finally free flight.
4. Aircraft derived weather data could be transmitted to and from the ground in support of a more accurate and up-to-date weather data base.

Transponder SSR replies, Mode S replies, and squitter transmissions are used by Wide Area Multilateration (WAM).  WAM is a distributed surveillance technology that works by deploying multiple sensors throughout an area to provide coverage of a desired airspace, particularly in areas of challenging terrain which limits the use of secondary radar.

# Transponder Unit Description

## General

This Section provides a description of the functions, characteristics, and interfaces of the Mark 4 transponder. It establishes the necessary requirements to ensure the interchangeability of equipment from different manufacturers. It is essential to consult the related parts of the documents listed in Section 3.1 of this document. In case of inconsistencies between provisions defined in this Characteristic and those introduced by the documents listed in Section 3.1, the requirements specified by the referenced documents should have precedence. The main requirement basis is, of course, ICAO Annex 10.

The Mark 4 transponder system can be subdivided into the following elements:

1. Transponder Function (TXF) – The transponder portion comprises all functions needed to receive, transmit and process uplink and downlink messages including receiver, demodulator, modulator, transmitter, and receive/transmit processing logic.
2. Extended Interface Function (EIF) – The EIF comprises all functions that are needed to obtain data from and deliver data to the avionics. This includes all processing needed to load the transponder GICB registers, decode and prepare SLMs or ELMs, in support of the Mode S specific services and provide the ISO 8208 Switched Virtual Circuit (SVC) functions.
3. Antennas – The antennas are the devices used to transmit and receive the RF signals employed in the SSR Mode A/C, and Mode S systems.
4. Control Panel – The control panel enables the pilots to control the Mark 4 transponder.

This organization of system elements is used solely for the structuring of this document. Manufacturers are free to combine elements in any form. However, it should be noted that a clear separation of transponder function and EIF has certain benefits. The description of these elements is provided in the following sections.

## Transponder Part

The transponder portion of the Mark 4 transponder may be provided in four different levels:

1. Level 2, with only Comm-A and Comm-B support.
2. Level 3, with additional uplink ELM capability.
3. Level 4, with additional downlink ELM capability.
4. Level 5, with efficient multi-site support and substantial data throughput.

The most capable transponder levels for modern transport aircraft are levels 4 and 5. With its higher throughput capacity the level 5 transponder is the most advanced transponder.

The following Sections provide some brief descriptions of the TXF part of the Mark 4 transponder to assist understanding.

COMMENTARY

The ICAO SARPs and RTCA MOPS for this function are contained in the documents listed in Section 3.1 of this document. In case of a conflict with ARINC Characteristic 718A, the SARPs and MOPS should be taken as the correct standards.

### SSR Mode A/C Functions

The Mark 4 transponder should provide all the features required by ICAO for SSR Mode A identity reporting, SSR Mode C automatic altitude reporting, and special identification reporting (“Ident”) in airspace regions served by SSR Mode A/C.

### Mode S Functions

The Mark 4 transponder TXF should, as a minimum, provide the following Mode S interrogation/reply capabilities according to the transponder level:

1. SSR Mode S All-Call (not applicable to DO-181F or later).
2. Mode S-Only All-Call.
3. Surveillance interrogations and replies.
4. Air-to-air surveillance replies.
5. Acquisition Squitter transmissions.
6. Comm-A interrogations and Comm-B replies.

The TXF should be capable of delivering the content of all properly decoded, uniquely addressed, or broadcast Mode S format, interrogations listed in “c” through “f” to the EIF. It should be capable of accepting from the EIF the data prepared for transmission in Mode S replies as listed above.

The Mark 4 transponder, connected to a source of altitude data, flight-identity data, and pilot control unit, as described in this Characteristic, is sufficient to support the basic provisions of the ATC surveillance function in SSR Mode A/C, Mode S, or mixed interrogator environments.

The Mark 4 transponder may also provide a ground-air-ground data link capability for the support of additional ATC services. Whereas upgrading of the ATC system may be implemented to provide additional services via Mode S, the Mode S Specific Services using the Comm-A/Comm-B capability is the air/ground communication link that will make expanded surveillance services available for the equipped aircraft. The Comm-C/Comm-D interrogation/reply capability and the Extended Length Message (ELM) protocol provide for a more efficient method for the ground-air-ground transfer of longer messages.

### Transponder Receiver Characteristics

#### Receiver Center Frequency and Bandwidth

The receiver design center frequency is 1030 MHz.

The nose bandwidth of the receiver should be such that interrogation signals having the standard pulse parameters may be received, demodulated, and processed with a fidelity consistent with the performance goals of this Characteristic.

The skirt bandwidth should be such that the sensitivity is at least 60 dB down at ±25 MHz and beyond, so as to provide for minimum interference from signals outside the transponder interrogation frequency band.

#### Image Response

The image response, measured under normal triggering level conditions, should be such that the maximum response to signals at image frequencies is at least 60 dB down from the minimum triggering level of the receiver.

#### Other Spurious Responses

All other spurious responses (outside the ±25 MHz skirt bandwidth) measured under normal triggering conditions should be such that the maximum response to such signals is at least 60 dB down from the minimum triggering level of the receiver.

#### IF Pickup Rejection

The intermediate frequency amplifier should be shielded from extraneous radiated energy pick-up at any frequency in the IF band.

#### RF Rejection

RF Rejection should be provided which will enable the transponder to operate in the presence of out-of-band energy as well as that in other portions of the 1030-1090 MHz band. Installation designers should exercise particular care to avoid possible interference from radar equipment operating in the aircraft.

COMMENTARY

Installation designers should be aware of the need for suitable 1030-1090 MHz band antenna separation on aircraft equipped with an Airborne Collision Avoidance System and one or more Mode S transponders. TCAS transmits on the Mode S transponders’ receiver frequency. Equipment designers have indicated that 20 dB of antenna separation should be sufficient to ensure proper operation of 1030-1090 MHz band equipment on the same aircraft. See Section 7, Antenna.

#### CW Discrimination

The equipment should provide maximum protection from interference due to modulated and unmodulated CW signals in the proper frequency range. (See Section 4.2.8.7 for specific requirements on short and long pulse rejection.)

### Receiver Sensitivity and Minimum Triggering Level (MTL)

The Minimum Triggering Level (MTL) of the transponder is the input signal level at which 90 percent reply efficiency (ratio of number of prescribed replies to number of interrogations in percent) is obtained.

COMMENTARY

Precaution should be taken in the aircraft installation design and the equipment design itself to minimize receiver performance degradation due to blocking by signals transmitted from TCAS equipment on board the aircraft. Maximizing the path lengths between TCAS and transponder antennas will help in this respect as will the use of local oscillators that do not develop by-products on the other system’s receive frequency.

#### SSR Mode A/C and Intermode Interrogation Modes

Mode S transponders may be inhibited from replying to an intermode interrogation by a lockout condition. Also received signals may not be decoded during specified recovery time following a prior reply. Otherwise, the receiver sensitivity should be such that replies are generated to 90 percent of SSR Mode A, Mode C, and intermode interrogations with a long P4 when:

1. The pulses P1, P3, and long P4 (when used) constituting an interrogation are of equal amplitude and pulse P2 is not detected, and
2. The amplitude of these signals received at the transponder end of the antenna transmission line is -77 dBm ± 3 dBm.
3. The widths of pulses P1 and P3 are within the limits 0.8 ± 0.1 µsec and the width of P4 is within the limit 1.6 ± 0.1 µsec.

COMMENTARY

The long P4 Intermode Interrogations are not supported by Mark 4 Transponders designed to DO-181F or ED-73F.

The difference in interrogation signal level that produces 90 percent replies for Mode A and Mode C should not exceed 1 dB.

COMMENTARY

This sensitivity assumes a transmission line loss of 3 dB and the use of simple quarter-wave antenna, such that the minimum triggering level at the antenna end of the transmission line is between -71 dBm and -77 dBm.

The above sensitivity applies to Mode S transponders operating in both Mode S and SSR Mode A/C interrogation environments. The ICAO standard for the SSR Mode A/C, however, permit transponder MTL limits of -69 dBm and -77 dBm at the antenna end of the transmission line (-72 dBm and -80 dBm at the transponder antenna terminal).

#### Mode S Interrogation Modes

Mode S transponders may be inhibited from replying to an All-Call interrogation (e.g., when on the ground or due to a lockout condition) and received signals may not be decoded during specified recovery time. Otherwise, with the Mode S transponder adjusted to comply with Section 4.2.4.1, replies to 90 percent of Mode S interrogations requiring replies should be generated when:

1. The two pulses P1 and P2 of the preamble, and the data block pulse are of equal amplitude and pulse P5 is not present, and
2. The amplitude of these signals at the transponder end of the transmission line is 77 ± 3 dBm, and
3. The decoded DPSK data indicates an interrogation, which is accepted by the transponder and the transponder is equipped to handle the received format.

COMMENTARY

This sensitivity assumes a transmission line loss of 3 dB and the use of a simple quarter-wave antenna, such that the triggering level at the antenna end of the transmission line is between -77 dBm and -71 dBm.

#### Mode S Dynamic Range

The Mode S transponder should reply with at least 90 percent efficiency under the conditions listed in Section 4.2.4.2 for input signal levels between MTL and MTL+3 dB, and with at least 99 percent efficiency for any input signal level from MTL+3 dB to 24 dBm. The Mode S reply efficiency should not exceed 10 percent for any input signal level less than -84 dBm.

### Sidelobe Suppression

#### SSR Mode A/C Interrogations

At all times a reply is required by ICAO Annex 10, the transponder should reply (with not less than 90 percent efficiency) when P1 and P3 pulses are received and all of the following conditions are met:

1. Either the received amplitude of P1 is greater than 9 dB above the received amplitude of P2, or no pulse is received at the position 2 ± 0.7 µsec following P1.
2. No pulse is received in the P4 pulse position.
3. The received amplitude of a proper interrogation is greater than 10 dB above the received amplitude of random pulses (where these pulses are not recognized by the transponder as P1, P2, or P3).

COMMENTARY

It is possible for the random pulse to fall in such a time position that it would pair up with one of the pulses in a proper interrogation and generate an unwanted suppression or a reply. When this occurs, the suppression and/or dead time should be in accordance with Sections 4.2.5.4 and 4.2.7.

1. The received signal amplitude is between MTL and 24 dBm.

#### Intermode Interrogations

At all times that reply is required by Annex 10, the transponder should reply (not less than 90 percent efficiency) when all the following conditions are met:

1. The received amplitude of both P3 and long P4 is greater than 1 dB below but no greater than 3 dB above the received amplitude of P1.

COMMENTARY

The long P4 Intermode Interrogations are not supported by Mark 4 Transponders designed to DO-181F or ED-73F.

1. Either the received amplitude of P1 is greater than 9 dB above the received amplitude of P2, or no pulse is received at the position 2 ± 0.7 µsec following P1.
2. The received amplitude of a proper interrogation is more than 10 dB above the received amplitude of random pulses (where the latter are not recognized by the transponder as P1, P2, P3, or P4).

COMMENTARY

It is possible for the random pulse to fall in such a time position that it could pair up with one of the pulses in a proper interrogation and generate an unwanted suppression or a reply. When this occurs, the suppression and/or dead time should be in accordance with Sections 4.2.5.4 and 4.2.7.

1. The received signal amplitude is between MTL and -24 dBm.

#### SSR Mode A/C and Intermode Suppression

Upon receipt of a correctly coded SSR Mode A/C or Intermode interrogation with a long P4, transponder Mode A/C and Intermode replies should be suppressed with not less than 99 percent efficiency when the received amplitude of P2 is equal to or above the received amplitude of P1 and is spaced 2 ± 0.15 µsec after P1.

COMMENTARY

It is not the intention of this Section to require the detection of P3 and P4 as a prerequisite for the initiation of suppression action.

This suppression characteristic should apply over the received signal amplitude range between 3 dB above MTL and -24 dBm.

#### SSR Mode A/C and Intermode Suppression Duration

Transponder suppression for Mode A/C and Intermode interrogations, through disabling of decoder recognition capabilities, should occur for an initial period of 35   
±5 µsec measured from the end of P2. This suppression should be implemented in the Mode S transponder. The suppression should be capable of being reinitiated for full suppression duration within 2 µsec of the end of a prior suppression period.

#### Mode S Sidelobe Suppression

Sidelobe suppression for all Mode S formats is characterized by the reception of Pulse P5 overlapping the sync phase reversal in the data block (P6). If the amplitude of P5 exceeds that of P6 by 3 dB or more, the transponder reply ratio should be less than 10 percent. If, however, P5 is at least 12 dB below the amplitude of P6, the transponder should respond with a reply ratio of at least 99 percent for all signal levels between 3 dB above MTL and -24 dBm.

### Receiver Desensitization and Recovery Times

#### Echo Suppression and Recovery

The transponder should contain an echo suppression facility designed to permit normal operation in the presence of echoes of signal in space. The provision of this facility should be compatible with that for the suppression of Sidelobe interrogations described in Section 4.2.5 of this document.

#### Desensitization

Upon receipt of any pulse more than 0.7 µsec in duration (desensitization pulse), the transponder should be desensitized by raising the receiver threshold. Immediately after the desensitization pulse, the receiver threshold should be between the level of the desensitization pulse and 9 dB below that, with the exception of possible overshoot during the first µsec following the desensitizing pulse.

COMMENTARY

A Mode S interrogation which has not been accepted by the transponder has the same effect as a desensitizing pulse.

Single pulses of duration less than 0.7 µsec need not cause the specified desensitization; however, any desensitization produced should be limited to the amplitude stated above.

#### Recovery

The receiver should recover sensitivity within 3 dB of MTL within 15 µsec after reception of a pulse having a signal strength up to 50 dB above MTL. Recovery should be at an average rate not exceeding 4.0 dB per µsec.

##### Recovery from a Mode S Interrogation

After receiving a Mode S interrogation for which no reply is needed the transponder should recover sensitivity to within reasons “a,” “c,” or “d” listed in Section 4.2.8.9. The Mode S transponder should recover sensitivity to within 3 dB of MTL no later than 45 µsec after receipt of the sync phase reversal (see ICAO Annex 10).

##### Recovery from a Mode S Comm C Interrogation

Upon receiving and recognizing a Mode S Comm-C interrogation for which no reply is required, the Mode S transponder should recover sensitivity to within 3 dB of MTL no later than 45 µsec after receiving the sync phase reversal.

##### Recovery from a Suppression Pair

In the Mode S transponder, Mode A/C and Mode S All-Call suppression should take place following reception of a P1-P2 pair, as described in Section 4.2.5. If a Mode S data block is not detected following a P1-P2 pair, the Mode S transponder should recover sensitivity to Mode S interrogations at the rate prescribed in Section 4.2.6.3. Mode A/C suppression pairs should not otherwise interfere with the reception of Mode S interrogations regardless of the lockout state of the Mode S transponder.

### Transponder Dead Time

The time interval, beginning at the end of a reply transmission and ending when the receiver has regained its sensitivity to within 3 dB of MTL, should not exceed 125 µsec.

COMMENTARY

Dead time should be minimized to maximize system reliability.

### Decoding Facilities

#### SSR Mode A/C Interrogation Modes

The transponder should offer decoding facilities on two Mode A/C modes, each mode having a ±0.2 µsec tolerance on the time interval between P1 and P3.

These are:

1. Mode A - 8.0 µsec.
2. Mode C - 21.0 µsec.

COMMENTARY

See Section 4.2.8.2 of this document concerning the omission of decoding capability for other modes.

#### Simultaneous Reception of Two SSR Mode A/C Pulse Patterns

If a transponder receives two valid Mode A/C pulse patterns simultaneously, it should:

1. Enter the SSR Mode A/C suppression state if one of the received pulse patterns is a P1-P2 suppression pair.
2. Generate a valid Mode C reply if the two received pulse patterns are Mode A and Mode C interrogations.

COMMENTARY

Simultaneous receipt of two interrogation pulse patterns can occur whenever there are two or more interrogators transmitting in the same airspace.

For example, a single pulse from an interfering interrogator received 8 or 21 µsec before the second pulse of a P1-P2 pair can cause the transponder to simultaneously recognize Mode A/C interrogation and Mode A/C suppression. When this occurs, the Mode S transponder should enter the Mode A/C suppression state. It will thereby be enabled to receive the remainder as a possible interrogation waveform following the P1-P2 pair.

A single interference pulse received 8 µsec before the second pulse of a Mode C interrogation (or 21 µsec before the second pulse of a Mode A interrogation) can cause the transponder to simultaneously recognize both interrogation patterns. When this occurs, a Mode C reply is preferred because a missing Mode A reply usually causes less degradation of beacon tracking.

#### Intermode Interrogation Modes

The Mode S transponder should offer decoding facilities on two intermode interrogation modes, each mode having a ± 0.2 µsec tolerance on the time interval between P1 and P3 and a ± 0.05 µsec tolerance, on the time interval between P3 and P4.

These are:

1. Mode A - Mode S All-Call.
2. Mode C - Mode S All-Call.

COMMENTARY

A short (0.8 ± 0.1 µsec) P4 pulse indicates an SSR Mode A/C-only All-Call interrogation to which Mode S transponders do not reply (see ICAO Annex 10). The long P4 Intermode Interrogations are not supported by Mark 4 Transponders designed to DO-181F or ED-73F.

#### Mode S Interrogation Modes

The Mode S transponder should offer facilities for decoding the Mode S preamble and data block. The preamble and data block have a ± 0.05 µsec tolerance on the time interval between P1 and P2, a ± 0.05 µsec tolerance on the interval between P2 and the sync phase reversal and a ± 0.02 µsec tolerance on position of data bit modulation phase reversals. Mode S data block message formats and message bit functions are given in ICAO Annex 10. Surveillance Identifier (SI) code processing should be implemented in the Mark 4 transponder.

#### Decoding of Interrogations

Decoding of interrogations should be done in such a manner that any one pulse arriving at the receiver does not disable or desensitize the receiver other than in the manner permitted under Section 4.2.6.1, Echo Suppression and Recovery.

COMMENTARY

Receiver gain setting gates should not be generated after the receipt of any single pulse. Gain setting gates should be formed only after reception and proper decoding of at least two pulses (if gain setting gates are formed at all) to protect against transponder capture.

#### Pulse Decoder Tolerances

##### SSR Mode A/C Interrogations

The transponder should respond to at least 90 percent of qualified Mode A and Mode C P1 - P3 pulse pairs. These qualified pulse pairs are those with spacing within ±0.2 µsec of the specified interrogation Mode Spacing. This condition should be met over the signal range from MTL to -24 dBm when no P2 pulse is present. There should be no response during permitted recovery time.

The transponder should reply to no more than 10 percent of the interrogations when:

1. The interval between P1 and P3 differs from that specified by more than ± 1 µsec.
2. A single pulse is received.

These conditions should be met at all input signal levels up to -24 dBm.

##### Intermode Interrogations

Mode S transponders should not reply during permitted recovery time or when inhibited by a lockout condition. Otherwise, the Mode S transponder should respond with Mode S All-Call replies to at least 90 percent of Mode A and Mode C P1 - P3 - P4 triads with P1 - P3 spacing within ± 0.2 µsec of the specified interrogation Mode Spacing, P3 - P4 spacing within ± 0.1 µsec of the specified spacing, and P4 duration 1.6 ± 0.1 µsec. This condition should be met over the signal range from MTL to -24 dBm when no P2 pulse is present.

The Mode S transponder should reply to no more than 10 percent of the interrogations when the interval between P1 and P3 differs from that specified by more than ± 1 µsec.

The Mode S transponder should reply with 90 percent efficiency with SSR Mode A/C replies and not Mode S All-Call replies when either of the following conditions is satisfied:

1. A leading edge for P4 is not detected in the interval from 1.7 to 2.3 µsec following the leading edge of P3.
2. The amplitude of P4 is more than 6 dB below the amplitude of P3.

The Mode S transponder should reply to no more than 10 percent of the interrogations when all other conditions for a reply are satisfied but the duration of P4 is less than 1.2 µsec or greater than 2.5 µsec.

These conditions should be met over the signal range from MTL to -24 dBm.

COMMENTARY

The long P4 Intermode Interrogations are not supported by Mark 4 Transponders designed to DO-181F or ED-73F.

##### Mode S Interrogation Preambles

The Mode S transponder pulse decoder should accept at least 90 percent of P1 - P2 Mode S interrogation preamble pairs with spacing within ± 0.05 µsec of the specified spacing with Mode S interrogation signal levels over the range from MTL to - 24 dBm. This condition should be considered met if the transponder replies to 90 percent of properly addressed Mode S interrogation formats which the transponder can handle, over the specified range of levels.

#### Pulse Duration Discrimination

Pulses of received amplitude that are between the minimum triggering level and 6 dB above this level and of a duration less than 0.3 µsec should not cause the transponder to initiate more than 10 percent reply or suppression action. With the exception of single pulses with amplitude variations approximating an interrogation, any single pulse of a duration more than 1.5 µsec should not cause the transponder to initiate reply or suppression action over the signal amplitude range from MTL to 50 dB above MTL.

#### Random Triggering Rate

With the transponder adjusted to Section 4.2.4.1 and the altitude reporting function active, the random triggering rate should be not greater than one Mode A/C reply or one Mode A/C suppression per second averaged over a period not less than 30 seconds, under laboratory environment conditions.

COMMENTARY

The ICAO Annex 10 SSR System SARPS specify the random triggering rate in terms of equipment performance on the aircraft. However, the airlines have chosen, to specify it in terms of equipment performance on the bench, where the measurement may be made much more easily. They believe that the value they have stated for the parameter on the bench is more than adequate to show that equipment meets the SARPs when installed on the aircraft.

#### Mode S No-Reply

The Mode S transponder should not reply to a Mode S interrogation when one, or a combination of, the following conditions occur (see also ICAO Annex 10):

1. The decoded bits of the Address/Parity field or Parity field contain an address other than one which requires a reply.
2. The decoded interrogation is a Mode S Broadcast.
3. The interrogation requests a reply, for which the transponder is not equipped.
4. The Mode S data sync phase reversal is not detected.
5. The decoded interrogation is a Mode S only All-Call to which:
   1. the transponder is locked out or:
   2. the stochastic algorithm determines that no reply should be transmitted or:
   3. the aircraft is on the ground condition with Inhibit Replies configuration wired.

### Mutual Suppression Pulses

For the purposes of inhibiting other pulse equipment in the aircraft, the transponder should generate a suppression pulse each time a reply group or squitter is transmitted. These pulses should conform to the standards of Attachment 6 of this document.

The transponder should itself be suppressed when similar pulses are applied to it from generators in other equipment. It should recover full receiver sensitivity within 15 µsec of the end of a pulse causing such suppression.

The transponder should not be damaged if the suppression output is accidentally short-circuited or open-circuited, and it, and other equipment connected to the suppression system should continue to operate satisfactorily, although without the benefit of a suppression service.

### Mode S Transponder Lockout Control

The Mode S transponder can be prevented from accepting certain interrogations by command from the interrogator. If the interrogation contains code 1 in the PC field a lockout timer (TD) is started. The transponder should not respond to SSR Mode S or Mode S-only All-Call interrogations with II=0 while the timer is active. The timer should run for 18 ±1 seconds following the last lockout start command received.

To prevent transponder acquisition from being denied to an interrogator by lockout commands from another source, a multisite lockout protocol is used. If an interrogation is received with the Designator Identifier (DI) field set for 1 or 7 the transponder should examine the Lockout State (LOS) sub-field in the Special Designator (SD) field. If this bit is set to 1, the contents of the Interrogator Identification Subfield Designator (IIS) sub-field should be examined for a non-zero identifier representing the site issuing the multisite lockout command. When the multisite lockout command is received, the lockout timer is initiated for the II code specified in the IIS sub-field of the interrogation, and continues to run for 18 ±1 seconds past the last multisite lockout command.

COMMENTARY

Multisite lockout does not affect the transponder’s response to Mode S All-Call interrogations with the II field set to zero or to SSR Mode S All-Call interrogations.

### Transponder Transmitter Characteristics

#### Reply Transmission Frequency

The reply transmission center frequency should be 1090 MHz. Frequency variation due to any cause, including changes in duty cycle from zero to the maximum for which the transmitter is designed and the effects of a possible 3.5 dB (1.5:1 VSWR) mismatch of any phase angle at the antenna should not exceed ±1 MHz.

The transmitter frequency should stabilize within the ±1 MHz tolerance within two seconds of being switched “On.”

COMMENTARY

Manufacturers are encouraged to regard obtaining the best possible degree of isolation between the transmitter and the antenna system as a fundamental design aim, as the problems associated with poor isolation are a serious problem for the airlines.

#### Transmitter Unit Power Output

The peak pulse power output available at the antenna terminal of the transponder unit (i.e., at the service connector of the LRU) should be 26 dBW ± 2 dB for all pulses of required replies over the range of reply rate and transmitter duty cycle required. For both SSR Mode A/C and Mode S transponders, reply pulse amplitude variation should be less than 1 dB between any constituent pulses of any single SSR Mode A/C reply and jitter should be less than 1 dB. In a Mode S transponder, the pulse amplitude variation of one pulse with respect to any other pulse in a 56-bit or 112-bit Mode S reply should not exceed 2 dB.

The transponder peak pulse power output at the LRU is defined as 26 dBW ± 2dB based on the anticipated insertion loss of 2 ± 1 dB.

These figures should apply with the transmitter correctly terminated. Power pulling due to a 3.5 dB (1.5:1 VSWR) antenna mismatch of any phase angle should not exceed 1.5 dB. The transmitter should not be damaged if the antenna terminal is accidentally short-circuited or open-circuited.

Full transmitter power should be available within two seconds of the transponder being switched “On.”

#### Transponder Emission Spectrum

The emission spectrum for the transponder should be within the limits specified in ICAO Annex 10.

#### Reply Pulse Shape

The transponder’s RF reply pulses should have the characteristics shown in Table 4.2-1 when measured using a linear detector.

Table 4.2-1 – Reply Pulse Shape

|  |  |  |
| --- | --- | --- |
|  | SSR Mode A/C Reply Pulses (μsec) | Mode S Reply Pulses  (μsec) |
| Rise Time  (10% to 90% Amplitude) | 0.05 to 0.1 | 0.1 Max. |
| Decay Time  (90% to 10% Amplitude) | 0.05 to 0.2 | 0.2 Max |
| Duration  (50% to 50% Amplitude) | 0.45 ± 0.1 | 0.5 ± 0.05  or  1.0 ± 0.05 |

Note: The intent of the lower limit on rise and decay time for Mode A/C reply pulses (0.05 µsec) is to reduce sideband radiation of Mode A/C transponders. The rise and decay time may be less provided that sideband radiation is no greater than that which would be produced theoretically by a trapezoidal wave having the stated rise or decay time.

#### Transmitter Duty Cycle

The transponder should be capable of generating replies to a combination of SSR Mode A/C and Mode S interrogations as specified below. The total reply rate over each time interval specified is defined as the sum of the individual Mode A/C and Mode S reply rates over this interval.

##### SSR Mode A/C Reply Rate Capability

The transponder should be capable of replying with 15 pulse replies to 120 interrogations within a 100 msec period and continuously at a rate of 500 per second.

##### Mode S Reply Rate Capability

A level 2 and above transponder should, in addition to any required squitter and TCAS transmissions, have a minimum Mode S reply rate capability as follows:

1. 50 replies, 16 of which are long reply format messages, in any one second interval.
2. 18 replies, 6 of which are long reply format messages, in a 100 msec period.
3. 8 replies, 4 of which are long reply format messages, in a 25 msec period.
4. 4 replies, 2 of which are long reply format messages, in a 1.6 msec period.

A level 4 Transponder should, in addition to the capabilities listed above, have a minimum downlink ELM capability per unit design, and per ICAO Annex 10 requirements.

A level 5 transponder should, in addition to any required squitter and TCAS transmissions, have a minimum Mode S reply rate capability as follows:

1. 50 replies, 24 of which are long reply format messages, in any one second interval.
2. 18 replies, 9 of which are long reply format messages, in a 100 msec period.
3. 8 replies, 6 of which are long reply format messages, in a 25 msec period.
4. 4 replies, 2 of which are long reply format messages, in a 1.6 msec period.

A level 5 Transponder should, in addition to the capabilities listed above, have a minimum downlink ELM capability per ICAO Annex 10 requirements.

### Reply Delay and Jitter

#### SSR Mode A/C Reply Delay and Jitter

The time delay between the arrival at the transponder of the leading edge of P3 and the transmission of the leading edge of the first pulse of the reply should be 3.0 ± 0.5 µsec. The total jitter of the reply group with respect to P3 should not exceed ± 0.1 µsec for receiver input signal levels between 3 dB above MTL and -24 dBm. Delay variation between Modes A and C should not exceed 0.2 µsec.

#### Mode S Reply Delay and Jitter

The time delay between the arrival at the Mode S transponder of the sync phase reversal of the Mode S interrogation data block and the transmission of the leading edge of the first preamble pulse of the reply should be 128.0 ± 0.25 µsec. The jitter of the reply delay should not exceed 0.05 µsec rms.

#### SSR Mode S All-Call Reply Delay and Jitter (not applicable to DO-181F or later)

The time delay between the arrival at the Mode S transponder of the leading edge of pulse P4 of the interrogation and the transmission of the leading edge of the first preamble pulse of the reply should be 128.0 ± 0.25 µsec. The jitter of the reply delay should not exceed 0.06 µsec rms. for receiver input signal levels between 3 dB above MTL and -24 dBm.

### Mark 4 Transponder Reply Capability and Control

#### SSR Mode A/C Reply Rate Capability and Reply Rate Control

The transponder should be capable of generating 15-pulse SSR Mode A/C replies per DO-181().

A sensitivity-reduction reply rate limit should be incorporated into the transponder for Mode A/C replies. The limit should be capable of being adjusted between 500 continuous Mode A and Mode C replies per second and the maximum continuous rate of which the transponder is capable, or 2000 replies per second, whichever is the lesser, without regard to the number of pulses in each reply. Sensitivity reduction should apply only to the receipt of SSR Mode A/C, SSR Mode S All-Call, and SSR-Only All-Call interrogations.

#### Mode S Reply Rate Capability and Reply Rate Control

If a reply rate limiting device is provided for Mode S replies, it should enable at least the reply rates specified in Section 4.2.11.5.2. A limiting device may be used to protect the Mark 4 transponder from accidental over-interrogation.

### SSR Mode A Reply Codes

The 4096 reply codes formed from the framing pulses and the information pulses should be manually selectable by the pilot for replies to interrogations on Mode A.

### Special Position Identification (“Ident”) Pulse

In addition to the Mode A reply code formed from the framing pulses and a selected combination of information pulses, the transponder should be capable of transmitting the Special Position Identification (“Ident”) pulse. Each time the “Ident” function is activated by the pilot, this pulse should be added to the reply pulse train 4.35 µsec after the second Mode A framing pulse. Transmission of the pulse should begin upon receipt by the transponder of the control word in which bit 2 is changed from the binary “zero” state to the binary “one” state. It should conclude 18 ± 1 seconds after receipt by the transponder of the control word in which this bit reverts to the binary “zero” state. It should be possible to re-initiate such a period of “Ident” pulse transmission at any time, including those times during which it is already being transmitted.

### Reply Pulse Interval Tolerances

#### SSR Mode A/C Reply Pulse Interval Tolerances

The pulse interval tolerance for each pulse (including the last framing pulse) with respect to the first framing pulse of the reply group should be ± 0.1 µsec. The pulse interval tolerance of the Special Position Identifier (SPI) pulse with respect to the last framing pulse of the reply group should be ± 0.1 µsec. The pulse interval tolerance of any pulse in the reply group with respect to any other pulse (except the first framing pulse) should not exceed ± 0.15 µsec.

COMMENTARY

All pulse interval tolerance measurements should be taken between the 50 percent amplitude points on the leading edge of the pulses being measured, and should be made using a linear detector.

#### Mode S Reply Pulse Interval Tolerances

The pulse interval tolerance for each pulse with respect to the first pulse of the Mode S reply preamble should be ± 0.05 µsec.

### SSR Mode C Pressure Altitude Transmission

Independently of other modes and codes selected, the transponder should reply automatically to Mode C interrogations with aircraft pressure altitude information, using the code structure referenced in Section 3.6.1.

### Air Data Input

Three alternative sources for altitude data should be supported by the Mark 4 transponder to report the barometric altitude required for SSR Mode C and Mode S altitude replies. These are:

* **ARINC Characteristic 706:** *Air Data Computer*
* **ARINC Characteristic 575:** *Air Data Computer*
* **ARINC Characteristic 565:** *Synchro Data*

If used, the digital air data computers may provide data other than altitude data on their buses which might be used for the GICB register loading performed by the extended interface function of the Mark 4 transponder. To allow the access to the data of the air data computer inputs, both the transponder altitude reporting and the extended interface function described in Section 4.3, should have access to the related input bus data.

The Mark 4 transponder should provide two data input ports to select the altitude type supported. “Altitude Type Select” should identify which type is active and should be accessed for data. Furthermore, the transponder should use for Mode C and Mode S altitude reporting, and delivery to TCAS, the altitude data (after conversion) from whichever source is selected by the pilot. If so selected by the pilot (Altitude Reporting Off), the transponder should reply to Mode C interrogations with framing pulses only, insert all zeros in the “AC” field to Mode S replies, and insert all zeros (including Sign Status Matrix (SSM)) in the altitude data delivered to TCAS.

The Mark 4 transponder should continue to reply to Mode C interrogations, but with framing pulses only, set the Mode S “AC” field to zeros, and set the altitude data delivered to TCAS with an SSM of No Computed Data (NCD) for any of the following conditions.

1. If altitude data source monitoring circuitry automatically inhibits delivery of altitude data or provides a failure “flag” as a consequence of detecting a failure in the altitude data source.
2. If the sign/status matrix of the digital altitude data word received from the selected source at the transponder is coded “failure warning” or “no computed data”.
3. If the digital altitude data parity check fails.

If the sign/status matrix of the received word indicates “functional test” and the aircraft is on the ground, the Mark 4 transponder should regard the data as valid and transmit it.

COMMENTARY

Mark 4 transponder altitude data provided to the TCAS (via the XT bus) is to be encoded in increments of 25 feet or less. Altitude reported via interrogation-replies is to be encoded in accordance with ICAO Annex 10.

The Mark 4 transponder has also made provisions for altitude data extraction directly from other aircraft systems. See Attachment 2C, Note 30 Altitude Type Select, for more information.

#### ARINC 706 Air Data Computer Input

The primary source of digital altitude information will be an altitude computing device such as one conforming to **ARINC Characteristic 706:** *Subsonic Air Data System*. This will deliver a variety of air data parameters to the Mark 4 transponder on an ARINC 429 low-speed data bus. The transponder should pick out the relevant altitude words from this data stream by recognizing their Label codes.

#### ARINC 575 Air Data Computer Input

To permit the Mark 4 transponder to be used on aircraft equipped with air data computers conforming to **ARINC Characteristic 575:** *Mark 3 Subsonic Air Data Systems (Digital) DADS*, it should be capable of accepting altitude data from two such computers at the connector pins reserved for this purpose (see Attachment 2). The digital data standards for these inputs are defined in Section 9 of ARINC Characteristic 575.

#### ARINC 565 Synchro Data Input

To permit the Mark 4 transponder to be used on aircraft not capable of providing digital altitude information, it should be able to utilize analog inputs provided in coarse/fine synchro form at the connector pins set for this purpose in Attachment 2. These inputs should conform to the standards set forth in Section 5.7.5 of ARINC Characteristic 575 or the material referenced in Section 5.4.1 of **ARINC Characteristic 565:** *Mark 2 Subsonic Air Data System.*

### Mode S Replies

Data block formats and bit functions for the Mode S reply data block are to be found in ICAO Annex 10.

#### Mode S Reply Altitude/Identity Report

This 13-bit ID or AC field in Mode S surveillance reply data blocks should contain respectively the SSR Mode A code (Section 4.2.13.2) including the X bit or pressure altitude code (Section 4.2.17). In the event that the conditions described in Section 4.2.17 require the transmission of Mode C framing pulses only, the Mode S pressure altitude report should consist of an all-zero code.

#### Mode S Transponder Squitter

##### General

In addition to the normal replies, the Mark 4 transponder should provide unsolicited replies which are known as squitter transmissions. These transmissions are emitted at prescribed rates autonomously by the transponder. In order to ensure that no synchronous garbling of transmissions from different transponders can occur, the squitters should have certain random properties. Squitter transmissions should be uniformly distributed over a specific range of time relative to the previous emission of the squitter of the same type, as defined in RTCA DO-260B, RTCA DO-260C, RTCA DO-181E, RTCA DO-181F, and ICAO Annex 10.

A digital system may have a certain time quantization when a squittter transmission is generated. Manufacturers should ensure that this quantization is as small as possible.

COMMENTARY

Investigation has shown that a quantization not to exceed 10 ms is sufficient (leading to at least 40 discrete squitter positions within a ±200 msec squitter interval).

Eight different squitter types may be emitted in support of passive ground and airborne implementations:

1. Acquisition squitter.
2. Airborne position extended squitter.
3. Airborne velocity extended squitter.
4. Surface position extended squitter.
5. Aircraft identification extended squitter.
6. ADS-B Periodic Status

(e.g., Target State and Status and Aircraft Operational Status).

1. Event-driven squitter. (not applicable to DO-260C or later)
2. ADS-B Weather AIREP  
   (e.g., Aircraft State, Weather State messages).
3. ADS-B Weather PIREP.

Squitters (b) and (c) are only transmitted when the aircraft is airborne. Alternatively, the surface position (d) is emitted when the aircraft is on the ground.

Squitters (b) through (d), (f) and (i) carry real-time information which needs to be up-to-date when emitted. The data is stored in particular GICB registers, which are updated by the EIF at regular intervals as specified in ICAO Annex 10. If a field of a register is not updated for any reason for more than a period of time specified in DO-260(), its data are cleared.

Squitter transmissions should be delayed (but not omitted during the decoding of interrogations) until completion of prescribed replies or during suppression intervals controlled by other avionics equipment in the aircraft (see Attachment 6).

Extended squitters are normally enabled. Squitter transmissions should not be suppressed during SSR Mode A/C sidelobe suppression intervals.

##### Acquisition Squitter Transmissions

Acquisition squitter transmissions should be emitted once per second at random intervals that are uniformly distributed over the range from 0.8 to 1.2 seconds relative to the previous acquisition squitter emission. The acquisition squitter consists of the Mode S All-call reply (Downlink Format 11).

##### Airborne Position Extended Squitter

When enabled, the airborne position squitter is emitted when the aircraft is airborne. The determination of the airborne/ground status is described in Section 4.2.19.2.8 of this document.

The airborne position squitter contains position information derived from aircraft navigation aids. The data content is described in the ICAO Annex 10, RTCA DO-260B and RTCA DO-260C. The extended squitter for airborne position is transmitted as Downlink Format 17. The airborne position squitter is emitted twice per second at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds relative to the previous airborne position squitter emission.

##### Airborne Velocity Extended Squitter

When enabled, the airborne velocity squitter is generated when the aircraft is airborne. The determination of the airborne/ground status is described in Section 4.2.19.2.8 of this document.

The airborne velocity squitter data content is described in the ICAO Annex 10, RTCA DO-260B, and RTCA DO-260C for GICB register 0,9. The extended squitter for airborne position is transmitted as Downlink Format 17. The airborne velocity squitter is emitted twice per second at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds relative to the previous airborne velocity squitter emission.

##### Surface Position Extended Squitter

When enabled, the surface position squitter is emitted when the aircraft is on the ground. The determination of the airborne/ground status is described in Section 4.2.19.2.8 of this document.

The surface position squitter contains position information derived from aircraft navigation aids. The data content is described in the ICAO Annex 10, RTCA DO-260B, and RTCA DO-260C register 0,6. The extended squitter for airborne position is transmitted as Downlink Format 17.

Once started, the surface position squitter is emitted when in the on-ground state at “high” or “low” repetition rates.

If the “high” rate is selected, then the surface position squitter should be transmitted at random intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds relative to the previous surface position squitter.

If the “low” rate is selected, then the surface position squitter should be transmitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds relative to the previous surface position squitter.

In the event that transmission rate cannot be determined, then the “high” rate should be used as the default transmission rate for surface position squitters.

Rate switching is accomplished as described in RTCA DO-260().

##### Aircraft Identification Extended Squitter

When enabled, the aircraft identification squitter reports the aircraft identification. The data content is defined in the ICAO Annex 10, RTCA DO-260B, and RTCA DO-260C register 0,8. The extended squitter for airborne position is transmitted as Downlink Format 17.

The aircraft identification squitter is emitted at different repetition rates dependent on whether the aircraft is airborne or on the ground and if on the ground whether it is moving or effectively stationary:

1. For aircraft that are airborne or the “high” rate has been determined for surface position squitters as described in Section 4.2.19.2.5 of this document, the repetition rate is once per 5 seconds at random intervals that are uniformly distributed over the range from 4.8 to 5.2 seconds relative to the previous Aircraft Identification squitter emission.
2. For aircraft that are effectively stationary as determined by the “low” rate being determined for surface position squitters as described in Section 4.2.19.2.5 of this document, the repetition rate is once per 10 seconds at random intervals that are uniformly distributed over the range from 9.8 to 10.2 seconds relative to the previous Aircraft Identification squitter emission.

##### ADS-B Periodic Status and Event-Driven Squitters

###### ADS-B Periodic Status Extended Squitter Messages

Target State and Status Extended Squitter Message

When enabled, the “Target State and Status” squitter message is used to provide the current state of an airborne aircraft in navigating to its intended trajectory and the status of the aircraft’s navigation source and TCAS/ACAS systems. The data content is defined in ICAO Document No. 9871, RTCA DO-260B, and RTCA DO-260C for register 6,2. The messages is broadcast using Downlink Format 17 with “TYPE” code “29” and “Subtype” code = “1”.

The Target State and Status Message is broadcast only when the aircraft is airborne and when target state information (see Attachment 3A for Register 62HEX) is available and valid as a minimum.

Broadcast rate of the “Target State and Status” message is uniformly distributed over the range of 1.2 to 1.3 seconds.

Aircraft Operational Status Extended Squitter Message

When enabled, the “Aircraft Operational Status” squitter message is used to provide current aircraft status information. The data content is defined in ICAO Document No. 9871, RTCA DO-260B, and RTCA-260C for register 6,5. The message is broadcast using Downlink Format 17 with “TYPE” code “31” and “Subtype” code = “0” when in the airborne state and “1” when in the on-ground state.

Broadcast rate of the “Airborne Aircraft Operational Status” message depends on whether the “Target State and Status” message is being broadcast and whether there has been a change in TCAS, Navigation Accuracy Category, SIL, and NIC Supplement data. If the “Target State and Status” message is being broadcast, then the “Airborne Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 2.4 to 2.6 seconds. If the “Target State and Status” message is not being broadcast and there has been no change in TCAS/NAC/SIL/NIC Supplement information, then the “Airborne Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 2.4 to 2.6 seconds. If the “Target State and Status” message is not being broadcast and there has been a change in TCAS/NAC/SIL/NIC Supplement information, then the “Airborne Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds.

Broadcast rate of the “Surface Aircraft Operational Status” message depends on whether the aircraft is moving and whether there has been a change in NIC Supplement, Navigation Accuracy Category, or SIL information. If the aircraft is not moving, then the “Surface Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds. If the aircraft is moving and there has been no change in NIC Supplement/NAC/SIL information, then the “Surface Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 2.4 to 2.6 seconds. If the aircraft is moving and there has been a change in NIC Supplement/NAC/SIL information, then the “Surface Aircraft Operational Status” message is broadcast at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds.

Per DO-260C, Aircraft Operational Status Extended Squitter Messages are only broadcast if Airborne or Surface Position Extended Squitter Messages are being broadcast.

###### Event-Driven Squitter Extended Squitter Messages (not applicable to DO-260C and later)

When enabled, the Event-Driven Squitter is emitted once, each time the GICB register 0,A is loaded with data. The extended squitter for airborne position is transmitted as Downlink Format 17, with the type code set to values between 29 and 31, dependent on the encoding used. The event driven squitter rate is limited to twice a second. In case the event-driven squitter rate has reached the limit, event driven squitters are not emitted. The GICB register 0,A may still be updated with new data but only the data stored most recently in GICB register 0,A will be sent when the squitter rate limit is no longer exceeded.

TCAS Resolution Advisory Report Extended Squitter Message

When enabled, the “TCAS Resolution Advisory” event-driven squitter message is used to provide current TCAS Resolution Advisory information. The data content is defined in ICAO Document No. 9871, RTCA DO-260B, and DO-260C for register 6,1. The message is broadcast using Downlink Format 17 with “TYPE” code “28” and “Subtype” code = “2”.

When TCAS Resolution Advisory data is actively available, the TCAS Resolution Advisory information is broadcast via Register 0,A at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds.

Emergency Status Extended Squitter Message

When enabled, the “Emergency Status” event-driven squitter message is used to provide emergency and Mode A Code Change information. The data content is defined in ICAO Document No. 9871, RTCA DO-260B, and DO-260C for register 6,1. The message is broadcast using Downlink Format 17 with “TYPE” code “28” and “Subtype” code = “1.”

When there has been no change in the Mode A code, the Emergency Status information is broadcast via Register 0,A at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds.

When there has been a change in the Mode A code, the Emergency Status information is broadcast via Register 0,A at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds.

Event-Driven Message Priority

Priority of the event-driven message protocol is established such that the “TCAS Resolution Advisory” (e.g., TYPE=28, Subtype=2) message always takes priority over the “Emergency Status” (e.g., TYPE=28, Subtype=1) message.

ADS-B Weather AIREP Message

When enabled, the "Aircraft State” message is used to provide aircraft configuration, type characters, gross weight, and wingspan. The data content is defined in ICAO Document No. 9871 and DO-260C for Register 6,8. The message is broadcast using Downlink Format 17 with “TYPE” code “26” and “Subtype” code = ”0”.

The Aircraft State squitter is emitted at different repetition rates dependent on whether the aircraft is airborne or on the ground and if on the ground whether it is moving or effectively stationary:

1. For aircraft that are airborne or the “high” rate has been determined for surface position squitters as described in Section 4.2.19.2.5 of this document, the repetition rate is once per 5 seconds at random intervals that are uniformly distributed over the range from 4.8 to 5.2 seconds relative to the previous Aircraft State squitter emission.
2. For aircraft that are effectively stationary as determined by the “low” rate being determined for surface position squitters as described in Section 4.2.19.2.5 of this document, the repetition rate is once per 10 seconds at random intervals that are uniformly distributed over the range from 9.8 to 10.2 seconds relative to the previous Aircraft State squitter emission.

When enabled, the ADS-B Weather AIREP messages “Weather State” message or “Alternate Weather State” message is used to provide meteorological information. The data content is defined in ICAO Document No. 9871 and DO-260C for Register 6,9 and Register 6,A. The messages are broadcast using Downlink Format 17 with “TYPE” code “26” and “Subtype” code = “1” or “2” respectively.

The “Weather State” message “Subtype” code = “1” or “Alternate Weather State” message “Subtype” code = “2” is broadcast for aircraft that are airborne at the rate of once per 2 seconds at random intervals that are uniformly distributed over the range from 2.1 to 2.3 seconds relative to the previous “Weather State” or “Alternate Weather State” squitter emission.  The “Weather State” and “Alternate Weather State” messages are not transmitted concurrently, refer to DO-260C for details.ADS-B Weather PIREP Message

When enabled, the “PIREP” message is used to provide pilot observed meteorological information. The data content is defined in ICAO Document No. 9871 and DO-260C for Register 6,B , Register 6,C and Register 6,D. The message is broadcast using Downlink Format 17 with “TYPE” code “27” and “Subtype” code = “0”, “1”, or “2”.

The “PIREP” message is broadcast at the rate of once per 3 seconds at random intervals that are uniformly distributed over the range from 3.1 to 3.5 seconds relative to the previous “PIREP” squitter emission. If more than one “Subtype” message is valid, the different messages are interleaved by broadcasting the “PIREP” message subtypes in ascending order.

##### Surface/Airborne Determination

The determination of whether the aircraft is airborne or on the ground is historically determined by logic inputs on the Mark 4 transponder rear connector (refer to Attachment 2 for details). A more reliable means of determining Air/Ground status has been provided in ICAO Annex 10 and RTCA DO-260B as provided in the following:

1. If there is a means to automatically determine the vertical status (e.g. Air/Ground Switch) of the given Aircraft Category (see “c” below), then such information should be used to determine whether to report the airborne state or the On-ground state.
2. If there is no means to automatically determine the vertical status of the given Aircraft Category, then the airborne state should be reported except under the condition provided in Table 4.2-2. If the conditions given in Table 4.2-2 are met for the given Aircraft Category, then the surface state should be reported for the installation.
3. If the automatically determined Air/Ground status is not available or indicates the airborne state, then the Airborne state should be reported in accordance with “b” above.

If one of the conditions in Table 4.2-3 is satisfied, then the Airborne state should be reported irrespective of the automatically determined Air/Ground status.

1. The transponder will normally configure the variable squitter rates dependent on the Airborne or On-ground state determination.
2. (DO-181E/DO-260B and earlier) The transponder may also be commanded by interrogation to report the surface or airborne squitter formats independent of the self-determined Air/Ground status. This command has no effect on the vertical status reported in the CA, FS, or VS fields.

Table 4.2-2 – Determination of On-Ground State

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Aircraft Category Set “A”** | | | | | | | | | | |
| Coding | Meaning | Ground Speed | | | | Airspeed | Radio Altitude | | | |
| 0 | No Aircraft Category Information | Always report Airborne state | | | | | | | | |
| 1 | Light (<15,500 lbs.) | Always report Airborne state | | | | | | | | |
| 2 | Small (15,500 to 75,000 lbs.) | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| 3 | Large (75,000 to 300,000 lbs.) | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| 4 | High-Vortex Large  (aircraft such as B-757) | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| 5 | Heavy (> 300,000 lbs.) | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| 6 | High Performance  (> 5g acceleration and >400 knots) | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| 7 | Rotorcraft | Always report Airborne state (See Note 1) | | | | | | | | |
| **Aircraft Category Set “B”** | | | | | | | | | | |
| Coding | Meaning | Ground Speed | | | | Airspeed | Radio Altitude | | | |
| 0 | No Aircraft Category Information | Always report Airborne state | | | | | | | | |
| 1 | Glider/Sailplane | Always report Airborne state | | | | | | | | |
| 2 | Lighter - than- Air | Always report Airborne state (See Note 2) | | | | | | | | |
| 3 | Parachutist/Skydiver | Always report Airborne state | | | | | | | | |
| 4 | Ultralight/hang-glider/paraglider | Always report Airborne state | | | | | | | | |
| 5 | Reserved | Reserved | | | | | | | | |
| 6 | Unmanned Aerial Vehicle | Always report Airborne state | | | | | | | | |
| 7 | Space/Trans - Atmospheric vehicle | < 100 knots | or | | | < 100 knots | or | | | < 50 feet |
| **Aircraft Category Set “C”** | | | | | | | | | | |
| Coding | Meaning | Ground Speed | | | Airspeed | | | | Radio Altitude | |
| 0 | No Aircraft Category Information | Always report Airborne state | | | | | | | | |
| 1 | Surface Vehicle - Emergency Vehicle | Always report On-ground state | | | | | | | | |
| 2 | Surface Vehicle - Service Vehicle | Always report On-ground state | | | | | | | | |
| 3 | Fixed Ground or Tethered Obstruction | Always report Airborne state (See Note 3) | | | | | | | | |
| 4 - 7 | Reserved | Reserved | | | | | | | | |
| **Aircraft Category Set “D”** | | | | | | | | | | |
| Coding | Meaning | Ground Speed | | Airspeed | | | | Radio Altitude | | |
| 0 | No Aircraft Category Information | Always report Airborne state | | | | | | | | |
| 1 - 7 | Reserved | Reserved | | | | | | | | |

Notes:

1. Because of the unique operating capabilities of rotorcraft, (i.e., hover), an operational rotorcraft should always report the “Airborne” state unless the “On-ground” state is specifically declared in compliance with Section 4.2.19.2.8.a above.
2. Because of the unique operating capabilities of “Lighter-than-Air” vehicles, i.e., balloons, and operational “Lighter-than-Air” vehicle should always report the “Airborne” State unless the “On-ground” state is specifically declared in compliance with Section 4.2.19.2.8.a above.
3. Because of the fact that it is important for fixed ground or tethered obstructions to report altitude, such objects should always report the “Airborne” State.

Table 4.2-3 – Validation of On-Ground State

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Airborne Position Message Broadcast** | | | | | | | |
| **Aircraft Category Set “A”** | | | | | | | |
| Coding | Meaning | Ground Speed | | Airspeed | Radio Altitude | | |
| 0 | No Aircraft Category Information | No Change to “On-the-Ground” status | | | | | |
| 1 | Light (<15,500 lbs.) | No Change to “On-the-Ground” status | | | | | |
| 2 | Small (15,500 to 75,000 lbs.) | > 100 knots | or | > 100 knots | | or | > 50 feet |
| 3 | Large (75,000 to 300,000 lbs.) | > 100 knots | or | > 100 knots | | or | > 50 feet |
| 4 | High-Vortex Large  (aircraft such as B-757) | > 100 knots | or | > 100 knots | | or | > 50 feet |
| 5 | Heavy (> 300,000 lbs.) | > 100 knots | or | > 100 knots | | or | > 50 feet |
| 6 | High Performance  (> 5g acceleration and >400 knots) | > 100 knots | or | > 100 knots | | or | > 50 feet |
| 7 | Rotorcraft | No Change to “On-the-Ground” status | | | | | |

#### Unavailable Data

If a reply is transmitted containing one or more data fields (including spare (SP) bits) for which there is no available data input device, or for which there is an input device with no data to transmit, those transmitted data fields should consist of all zeros.

### Extended Length Message (ELM) Protocol

The extended-length message (ELM) protocol provides for more efficient transmission of long data link messages to aircraft by permitting the grouping of up to 16 message segments into a single entity which can be acknowledged by a single reply or interrogation.

The Mark 4 transponder of sufficient capability (level 3, 4, and 5) should support ELM transfers as described in ICAO Annex 10.

#### Uplink ELM Protocol

For level 3, 4, or 5 Mark 4 transponders the uplink ELM protocol operates in 5 steps (a, b, c, d, and f) for an uplink ELM that is successful at the first attempt (see ICAO Annex 10 for details):

1. The interrogator requests a reservation for an uplink ELM.
2. The transponder grants the reservation.
3. The interrogator transfers between 2 and 16 Comm-C segments.
4. The interrogator determines the status of the reception of all the segments by examining a transponder reply.
5. The interrogator repeats any segments indicated as not received by the transponder.
6. When all segments are indicated as successfully received by the transponder, the interrogator closes out the uplink ELM and its reservation.

Each ELM segment is included in a single Comm-C transmission. (The limit of 16 segments refers solely to the manner in which the message is transferred over the link.)

The minimum length of a ground-to-air ELM is two segments. The transfer of up to 16 segments may take place without an intervening air-to-ground reply. In this way, channel loading is minimized. Message segments (one per Comm-C interrogation) may be transmitted with a minimum time of 50 µsec between the beginning of successive interrogations. This minimum spacing is necessary to permit the resuppression of Mode A/C transponders. Delivery of the message may take place during a single scan or over a few scans depending on the momentary load of the link and the sensor loading.

The segment of an ELM with the largest segment number is delivered first and is called the initializing segment. This “last segment first” protocol is used to inform the transponder of the total number of segments to be transferred. If the transponder ELM processor fails to receive an initializing segment, it will ignore the data content of all further segments of the same message since the reception of a new initializing segment automatically clears all data stored in any of the other segment buffers.

After the initializing segment has been delivered, the intermediate segments are transferred. Intermediate segments may be delivered in any order once the transponder ELM processor has been initialized with segment N 1. If the entire message consists of only two segments, there will be no intermediate transfers.

The last segment delivered by the interrogator will be marked as the final segment to which the transponder is requested to reply.

If one or more segments of the ELM are not received by the transponder, this fact is indicated by zeros in the corresponding bit positions in a Transmission Acknowledgment Subfield (TAS) in the reply. If the TAS indicates that the initializing segment was not received, the interrogator re-transmits the entire message. If segments other than the initializing segment are missing, they are re-transmitted.

The enhanced uplink protocol allows the transponder to process several uplink ELMs from several different interrogators rather than being limited to processing one Uplink ELM at a time. This increases the overall capacity on the uplink.

#### Downlink ELM Protocol

For level 4 or 5 Mark 4 transponders the downlink ELM protocol operates in six steps (a., b., c., d., e., f., and g.) for a downlink ELM that is successful at the first attempt (see ICAO Annex 10 for details):

1. The transponder announces the presence of a downlink ELM.
2. The interrogator requests a reservation to extract the downlink ELM after recognizing the downlink ELM request in one of the surveillance replies.
3. The transponder grants the reservation.
4. The interrogator requests delivery of downlink ELM segments.
5. The transponder autonomously sends all the available segments of the ELM without waiting for further interrogations.
6. The interrogator requests any segments not successfully received to be repeated.
7. When the interrogator has successfully received all segments, it closes out the downlink ELM and its reservation.

The interrogator extracts a downlink ELM by transmitting a Comm-C interrogation. On receipt of this request, the transponder transfers the requested segments by means of Comm-D replies. The requested segments may be transmitted in any order.

Segments lost in downlink transmissions will be requested again by the interrogator on a subsequent interrogation. This process is repeated until all segments have been transferred.

When all segments have been successfully transferred to the ground, the interrogator will send a closeout for that message.

The enhanced multisite downlink protocol allows for the transponder to process several downlink ELMs to several interrogators without the necessity to clear one transaction before starting the next one. This increases the capacity of the downlink.

### Antenna Diversity Operation

The Mark 4 transponder should provide two RF ports to accommodate the use of two separately located antennas that are arranged in an antenna diversity configuration.

The Mark 4 transponder performance characteristics set forth in this document should apply when either RF port is active or the other RF port is terminated in its characteristic impedance.

#### Antenna Selection

Selection of the antenna to be used for reply should be accomplished automatically within the Mark 4 transponder in accordance with the standards in ICAO Annex 10.

COMMENTARY

The technique to be employed for this purpose is the manufacturer’s option. The airlines do not, however, consider the use of repetitive switching between the antennas to be appropriate. Guidance on possible acceptable techniques is presented in Attachment 7 to this document.

#### Received Signal Delay Tolerance

If an interrogation is received at either RF port 0.125 µsec or less in advance of reception at the other port, the interrogations should be considered simultaneous and the reply antenna selection criteria applied. If an interrogation is received at either port 0.375 µsec or more in advance of reception at the other port, the antenna selected for the reply should be that through which the earlier interrogation was received. If the relative time of receipt is between 0.125 and 0.375 µsec, the transponder may select the antenna for reply either on the basis of the simultaneous interrogation criteria or on the basis of the earlier time of arrival.

#### Differential Reply Delay

At any fixed signal level, the average reply delay when RF port 2 is selected and the average value when RF port 1 is selected should differ by no more than 0.1 µsec, as measured at the RF ports.

#### Antenna Selection for Squitter Transmissions

When operated in installations not requiring antenna diversity, all Mark 4 transponder squitter transmissions should occur out the bottom antenna. When operated in installations requiring antenna diversity, for each squitter type, squitter transmissions should occur alternately out the top/bottom antennas when the aircraft is airborne, and out the top antenna only, when the aircraft is on-the-ground. See ICAO Annex 10 for further information regarding “airborne” and “on-the-ground” states.

#### RF Port Transmitter Isolation

The isolation between the two RF ports should be such that the reply signal power transmitted from the selected RF port exceeds that transmitted from the port not selected by 20 dB or more.

## Extended Interface Functions

### General

The extended interface functions of the Mark 4 transponder may be logically split into the following blocks:

1. Mode S Specific Services consisting of:
   1. Broadcast
   2. Ground initiated Comm-B
   3. Mode S specific services protocol
2. Mode S subnetwork support.
3. ADS-B support.

These functions need to operate independently of each other. Great care should be taken that malfunctions (e.g., overload, deadlocks) in one of these cannot have adverse effects on other functions.

The following Sections outline the functions and required interfaces in detail.

COMMENTARY

The SARPs and MOPS for these functions are contained in the documents listed in Section 3.1 of this document and in case of conflict those documents should be taken as the standards.

### Broadcast

The broadcast function needs to be supported in ground-to-air as well as in air-to-ground direction and is described separately below.

#### Uplink

The extended interface function in the Mark 4 transponder receives broadcast messages flagged as broadcasts from the transponder function. When receiving a broadcast, the EIF should deliver the data on either the “General Purpose #1 and #2 Out” or on the “MSP/ATSU/CMU #1 and #2 Out,” depending upon its configuration. The broadcast data should be delivered by the related protocol as described in Section 4.7.3.

#### Downlink

Downlink broadcasts are generated by a Mode S specific services application and are received by the EIF of the Mark 4 transponder on the “MSP/ATSU/CMU #1 and #2 In,” dependent on its configuration.

The data is received by a protocol as described in Section 4.7.3. The transponder should extract the data from the received information and format the related broadcast in accordance with the ICAO Annex 10.

### Ground Initiated Comm-B (GICB) Support

The EIF of the Mark 4 transponder is in charge of loading and updating the ground initiated Comm-B registers in the TXF part of it, which are not filled automatically by the transponder protocols. The GICB support in the EIF needs to read data from various avionics buses possibly reformat the data and load it into the appropriate GICB registers of the transponder at the appropriate time intervals. Also note the EIF supports the squitter (see Section 4.2.19.2 of this document).

Data may be supplied to the transponder in different configurations (or a combination of these configurations).

1. The necessary avionics buses are all directly routed to the Mark 4 transponder.
2. The data from the avionics buses is collected in an external data concentrator and sent on one or more dedicated buses to the Mark 4 transponder.

In configuration (a) all buses are connected to the Mark 4 transponder on the dedicated ports. This configuration enables existing aircraft installations to provide the data without the addition of an external data concentrator. See Attachment 2 to this document for details on the input pin allocation.

In configuration (b) the data is received from the external concentrator via a few dedicated input buses. This approach minimizes the number of inputs to be supported by the Mark 4 transponder.

COMMENTARY

In certain cases data is transmitted with the same Label on different buses. In those cases the meaning of the related data words can only be determined by knowing the bus which transported the word. In case of an external concentrator this information could be lost (unless a new Label is allocated). If necessary, words with the same Label but different meaning should be sent from the concentrator to the transponder on separate buses to enable the distinction.

The update function needs to be configured adequately to respect the particular avionics configuration of the airframe in which the Mark 4 transponder is intended to be operated (refer to Section 4.4 for details on configuration issues).

The GICB loading function needs to be capable of the following generic functions:

1. Read specified data word from a specified avionics bus.
2. Extract the data from the data word.
3. Check validity (by means of the SSM), if the data is invalid or out of date, use an alternative source (in case automatic selection is enabled) or load the GICB register field related to the particular Label with all zeros. Under no circumstances should the entire GICB register be cleared simply because one data parameter is not valid. Only the data field that uses the data parameter should be cleared if no valid data is available.
4. Possibly reformat the data.
5. Load the data into the related GICB register in the TXF of the Mark 4 transponder.
6. Repeatedly update the GICB capability report registers 1,8 - 1,C in accordance with the ICAO Doc. 9871. The EIF needs to check periodically the availability of the related data words for this purpose.

Attachment 10 to this document offers example architecture of the GICB register loading function.

Under certain conditions the data received on the primary input source (designated as “source 1”) that provides data for register loading may not be available, or not accurately reflect the parameters used to fly the aircraft. The transponder should therefore be capable of collecting the data from an alternative source (designated as “source 2”). The transponder is provided with several discrete inputs to accept and interpret discrete selection signals offered by some avionics architectures (see Attachment 2 for details).

In addition to the selection controlled by discrete inputs, the Mark 4 transponder may optionally provide an automatic selection of alternative sources. If the transponder is operated in the default configuration, the selection is made automatically as outlined in Section 4.4.1. If the transponder is operated in the installation specific configuration mode an automatic selection can be enabled or disabled in the configuration data base as described in Section 4.4.2.

The input sources in Table 4.3-1 should be selected if the automatic configuration is enabled.

Table 4.3-1 – Input Sources

|  |  |  |
| --- | --- | --- |
| **Discrete Selected Source** | **Available** | **Available** |
| Source 1 | 1 | 2 |
| Source 2 | 2 | 2 |

The automatic selection should revert to the discrete commanded source when the data for that source has become available again.

COMMENTARY

In certain airframes no discrete source selection signals are available. On these airframes the above automatic selection will be the only selection mechanism available.

When the Mark 4 transponder is configured as installation specific, according to Section 4.4.2,

* The input controlling the source selection.
* The enabling of automatic selection.
* The labels and ports for source 1 and source 2 are defined in the configuration data base for the GICB register loading function.

The detailed requirements, especially the data structures of the GICB registers of the transponder, are described in the ICAO Doc. 9871.

COMMENTARY

Manufacturers are urged to ensure the GICB register loading function can be adapted and made compatible with the ICAO Doc. 9871 to incorporate possible upgrades and possible changes at a later stage.

Great care must be taken that the overall performance of the extended interface function ensures that the loading of the transponder registers is (under all load conditions) not performed slower than dictated by the minimum update rates prescribed in the ICAO Doc. 9871.

The Mark 4 transponder may be connected to air data computers to obtain altitude data to support altitude reporting. The related input buses also provide relevant data for the GICB register loading function of the EIF. Means should be foreseen to make the information carried on these buses also available to the Comm B register loading function of the EIF.

The sources for data to be loaded into the GICB registers may differ from one aircraft installation to another. In order to develop a generic unit which accommodates a variety of architectures, the Mark 4 transponder should be configurable. This especially applies to the sources of avionics data (refer to Attachment 2F to this document for data configuration details, and to Attachment 3A to this document for details on the primary sources of the GICB register data).

### Mode S Specific Services Protocol Support

As an option, the Mark 4 transponder may support the Mode S Specific Services protocol as described in the ICAO Annex 10.

On the uplink, this function should read the MSP packets delivered from the transponder portion of the Mark 4 transponder and send them out on the “General Purpose #1 and #2” outputs or the “MSP/ATSU/CMU #1 and #2” outputs (refer to Attachment 2) dependent on the transponder configuration. The protocol to be used is described in Section 4.7.3.

On the downlink, the Mode S Specific Services function of the Mark 4 transponder should accept the Mode S specific protocol data on the “MSP/ATSU/CMU #1 and #2” interfaces from the Mode S specific services application. The protocol to be used is described in Section 4.7.3.

Where two output buses of the Mark 4 transponder are connected to redundant equipment, the transponder should attempt to send the data on both buses   
(#1 and #2) simultaneously. The communication protocol handshaking is performed on both buses independently. Only the active one of the redundant systems would properly respond and further process the data.

The availability of Mode S Specific Services needs to be indicated by a bit in the related GICB registers 1,D to 1,F as described in the ICAO Annex 10. The related bits need to be set or reset depending upon the availability of the Mode S Specific Services. A Mode S Specific Services function located somewhere in the avionics will need to periodically report its availability by means of a dedicated report at least every 2 seconds. If this report is not received for more than 4 seconds the related MSP will be considered to be not supported and the related capability bit should be reset by the Mark 4 transponder.

### Dataflash Support

As an option, the Mark 4 transponder may support the “Dataflash” service as specified in the ICAO Annex 10. This requires support of the Downlink MSP 3 for the air to ground transmissions and Uplink MSP 6 with a Service Request (SR) value of one, i.e., SR=1.

COMMENTARY

The Dataflash MSP function requires constant monitoring of changes of individual fields within the GICB registers and must therefore, unlike other Mode S Specific Services applications, be implemented in the Mark 4 transponder itself. Transponders designed to DO-181F have an option to support “Basic Dataflash” that replaces the previously defined “Dataflash” service.

### ISO 8208 Subnetwork Support

If ISO 8208 subnetwork support is included, the EIF of the Mark 4 transponder needs to implement the SVC elements according to ICAO Doc 9871. This requires two state machines (one for the Mode S side and one for the ISO 8208 side), both interconnected via a reformatting process which interfaces the Mode S data link with the ISO 8208 DCE offered to the onboard avionics. The implementation of the SVC function is defined in ICAO Doc. 9871.

The SVC function of the Mark 4 transponder transmits on the “MSP/ATSU/CMU #1 and #2” outputs according to Attachment 2 to this document. For the opposite direction, the “MSP/ATSU/CMU #1 and #2” inputs are used. The protocol is described in Section 4.7.4 of this document.

Where two output buses of the Mark 4 transponder are connected to redundant equipment, the transponder should attempt to send the data on both buses (#1 and #2) simultaneously. The communication protocol handshaking is performed on both buses independently. Only the active one of these redundant systems would respond and further process the data.

The availability of onboard DTEs needs to be dynamically identified by the Mark 4 transponder. The availability needs to be reported by a related bit in the data link capability report in GICB register 1,0.

Since a link failure on the path to the DTE can only be discovered by the Mark 4 transponder, if a periodic report ceases to arrive, each DTE connected to the transponder will need to report its DTE number to the transponder at least every 2 seconds. If this report is not received for more than 4 seconds then the related DTE will be considered unavailable and the related bit in the data link capability report in GICB register 1,0 should be reset.

### ADS-B Support

The ADS-B function requires additional configuration and data interfaces over that required for Basic and Enhanced Transponder functions. The following Sections discuss the interfaces needed to support the ADS-B function.

#### ADS-B Configuration

The ADS-B function requires additional configuration data over that required for Basic and Enhanced Transponder functions. The following Sections detail the individual configuration parameters needed to support the ADS-B Transmit function.

##### Aircraft Category

The Aircraft Category field is encoded using Discrete Inputs as defined in Attachment 2A, 2B, and 2C.

##### Aircraft/Vehicle Length/Width

The Aircraft/Vehicle Length/Width field is encoded using Discrete Inputs as defined in Attachment 2B and 2C.

##### ADS-B Receiver Capability

The ADS-B Receiver Capability field is encoded using Discrete Inputs as defined in Attachment 2B and 2C.

##### GPS Antenna Longitudinal Offset

The GPS Antenna Longitudinal Offset field provides information regarding the distance of the GPS Antenna from the Nose of the Aircraft. The field is encoded using discrete inputs as defined in Attachment 2B and 2C.

##### Source Integrity Level (SIL)

ADS-B position sources must provide Integrity on their reported position to be used for aircraft separation applications. The Integrity of a position source must be established in conjunction with FAA guidance. Currently the only position sources with an established Source Integrity Level (SIL) are GPS sensors that meet TSO-C129, TSO-C145, or TSO-C146. Future revisions of this document may address additional position sources (e.g., Hybrid GNSS/IRS, Dual DME).

The SIL of a position source for this ARINC 718A-3 version is established in accordance with Note 25 provided in Attachment 3A-1.

Reference ARINC 743A for definition of a complete GPS navigation solution. The Fine Latitude and Fine Longitude labels can be used to distinguish a GPS solution from other position sources.

##### System Design Assurance (SDA)

ADS-B Transmit systems include at least a position source (e.g. GPS), an ADS-B transmitter (e.g., Transponder), and antenna. The ADS-B System Design Assurance field is set to the least stringent Design Assurance for all of the ADS-B Transmit System components. For this ARINC 718A-3 version, all components of the ADS-B Transmit System must meet or exceed a Design Assurance level of 10-5, to be validated by the aircraft manufacturer. Transponders compliant with this document should report System Design Assurance of 10-5.

The System Design Assurance field is encoded using discrete inputs as defined in Attachment 2B and 2C.

##### Velocity Accuracy, NACv

Velocity Accuracy is a dynamic quantity that may be computed by the position source. For this version of ARINC 718A, only GNSS sources may provide non-zero Navigation Accuracy Category\_Velocity (NACv). The aircraft manufacturer must validate that the GNSS sources installed are capable of supporting Velocity Accuracy of 10 m/s or better. Guidance for establishing this performance can be found in RTCA DO-260B/DO-260C, Appendix J. Results of such validation are then provided to the transponder via discrete input as provided in Note 54 of Attachments 2B-3 and 2C-3. Final encoding of NACV information into ADS-B messages is established as provided in Note 22 of Attachment 3A-1.

##### Aircraft Type Character (AIREP)

The Aircraft Type Character (AIREP) field is encoded using Discrete Inputs as defined in Attachment 2D and 2E.

##### Transponder Antenna Longitudinal Offset

The Transponder Antenna Longitudinal Offset field is encoded using Discrete Inputs as defined in Attachment 2D and 2E.

##### Gross Weight

The Gross Weight field is encoded using Discrete Inputs as defined in Attachment 2D and 2E.

##### Wingspan

The Wingspan field is encoded using Discrete Inputs as defined in Attachment 2D and 2E.

##### ADS-B Configuration Parity

This version of ARINC 718A also establishes the use of one discrete input to encode the parity of the configuration selections discussed in Sections 4.3.7.1.1 through 4.3.7.1.12. Encoding of the parity is defined in Attachment 2B and 2C.

#### ADS-B Data Interfaces

In order to support the ADS-B function, the transponder needs to accept GNSS digital data in the ARINC 743A format on at least one port. At this time, no other position sources should be used to populate ADS-B position fields until guidance has been established for how to appropriately set NIC, SIL, and the Per Hour fields in conjunction with FAA. If other position data source are used to populate the ADS-B position fields, then the NIC, SIL, and the Per Hour fields should be set to ZERO (0) or “Unknown”.

#### ADS-B OUT Function Fail

##### Legacy ADS-B OUT Function Fail (e.g., dependent)

The ADS-B Transmitting and Receiving Subsystems depend on a position source to provide the data to populate the ADS-B Messages and Reports. These sources or interconnects between them and the ADS-B device may fail and prevent the system from transmitting ADS-B Messages or Reports. In this case, the ADS-B transmit subsystem cannot function, but there is not a failure of the ADS-B device (e.g., the transponder) itself. It is desirable to indicate that the ADS-B function is failed independently of the ADS-B Device Failure Annunciation. The intent is to properly declare and ADS-B Failure when the ADS-B OUT Function cannot be performed but all other Transponder functions are still normal.

1. In the event that all navigation sources that can be used for the Airborne or Surface Position Message are either missing or invalid, then the ADS-B Function Fail Annunciation shall be asserted. The status of the ADS-B Function shall be available for annunciation to the flight crew. Methods of annunciation are as follows:
   1. Transponder Fail Discrete #1 Out (MP-3K)
   2. Transponder Fail Discrete #2 Out (TP-3B)
   3. “ADS-B OUT Status” in Label 352 (See Table 4-18)

Note: Although it is desirable to have an independent ADS-B Function Fail annunciation, some legacy airplanes may have to share the ADS-B Device Failure annunciation to also indicate when an ADS-B Function Fail has occurred. This is the case addressed in 1 and 2 directly above.

1. In the case where the ADS-B Transmitting Subsystem is also integrated with a Mode S Transponder, caution should be taken to ensure that the ADS-B Function Fail is not interpreted as a Mode S Transponder Device Failure that could generate a subsequent TCAS Fail annunciation. For this Characteristic, it is important to ensure that a transponder failure is not declared to the TCAS function via the Transponder/TCAS interface (see ARINC 735B) when the failure is an ADS-B Function Failure but there has been no failure of the transponder functions.

##### ADS-B OUT Function Fail (e.g., independent)

An independent ADS-B OUT Fail Discrete Output is provided at TP-3A, as shown in Attachments 2B-1 and 2C-1.

This discrete output should be an “open” when the ADS-B OUT Function has failed. The output should be a “ground” when the ADS-B OUT Function is operating normally.

## Mark 4 Transponder Configuration

Configuration information generally is necessary to adapt the Mark 4 transponder to a particular airframe. A subset of the functions of the transponder can, however, be implemented in a generic fashion supporting any airframe installation without the need for airframe specific configuration information. This is referred to as the “Default Configuration” (refer to Section 4.4.1.3). In addition to this a data base controlled configuration mechanism has been foreseen to support the full set of functions of the transponder in a specific airframe installation. This configuration mechanism is referred to as the “Installation Specific Configuration”   
(refer to Section 4.4.2).

### Installation Configuration

Aircraft Information, as defined in this section, consists of two separate sets of data: “Static Airframe Configuration” information (e.g., “Maximum Cruising Airspeed,” “Altitude Type”) as defined in Section 4.4.1.1, and Airframe Parameter Data (e.g., “Position Information,” “Ground Speed”) as defined in Section 4.4.1.2.

#### Static Airframe Information

The Mark 4 transponder may provide airframe configuration to the transponder via rear-interconnect Program Pin wiring on the aircraft. By coding these pins, specific information pertinent to the airframe in which the transponder is installed is made known to the unit. This information is then used either to configure the unit regarding other input ports (e.g., Altitude Type Select identify which rear-interconnect pins supply altitude data), or to provide the transponder information which it uses (e.g., Maximum Cruising Airspeed as applied in DF=0 replies).

The Mark 4 transponder may provide for the Airframe Configuration via rear-interconnect programming pins (see Attachment 2).

To provide for Mark 4 transponder expansion capability, this airframe configuration information may also be able to be loaded and stored within the unit.

Such configuration information would then be accepted in-lieu of rear interconnect program pin inputs, and may be loaded via an ARINC 615 data loader, or through the (reserved inputs) Airplane Personality Module (APM) defined in ARINC Report 607.

#### Airframe Parameter Data

Transponder implementation of Airframe Parameter Data defines the source of the aircraft data and how such data is routed and processed before being loaded into the GICB registers to fulfill the transponder Minimum Operational Performance requirements as defined in those governing specifications. However, as an Equipment Characteristic, this document must provide a level of unit interchangeability (see Section 1.5). To promote this interchangeability, a “default” level of Airframe Parameter Data commonality must exist. In lieu of any superseding configuration information, the default interwiring and interoperability standards are to be applied for all installations and equipment suppliers.

#### Default Configuration

##### Broadcast

In the absence of any specific configuration data, as described in Section 4.4.2, the transponder should default to providing a minimum subset of BDS registers for GICB, using data available from the minimum input ports as specified in Section 4.4.1.3.3. Table 4.4-1 lists the BDS registers that a transponder should support and the data that the transponder should default to in filling those BDS registers.

##### Ground Initiated Comm-B Protocol

In a transponder that supports Extended squitters, in the absence of any specific configuration data, as described in Section 4.4.2, the transponder should default to providing a minimum subset of BDS registers for Extended squitter, using data available from the minimum input ports as specified in Section 4.4.1.3.3. Table 4.4-1 lists the BDS Extended squitter registers that the transponder should support and the data that the transponder should default to in filling those Extended squitter registers.

Table 4.4-1 – Default Data Sources

|  |  |  |
| --- | --- | --- |
| **GICB Register** | | |
| **BDS** | **Parameter** | **Typical Label** |
| 0,5/0,6 | Autonomous Horiz. Integrity Limit | 130 |
| 0,5/0,9 | Altitude (1013.25 hPa) (Barometric) | 203 |
| 0,5/0,6 | Latitude – Present Position | 110, 120, 310 |
| 0,5/0,6 | Longitude – Present Position | 111, 121, 311 |
| 0,6/0,9/5,0 | Ground Speed | 112, 312, 012 {see Note 2} |
| 0,6/5,0 | Ground Track | 103, 313, 013 {see Note 2} |
| 0,8/2,0 | Aircraft Identification (Flight Ident.) | 233, 234, 235, 236, 237, 360, 301, 302, 303 {see Note 3} |
| 0,9 | East/West Velocity | 174, 367 |
| 0,9 | North/South Velocity | 166, 367 |
| 0,9/6,0 | Vertical Rate | 165, 365, 212, 232 |
| 0,9 | GNSS Height (HAE) | 370 |
| 0,9/5,0 | True Airspeed | 210, 230 |
| 0,9/6,0 | Computed Airspeed | 206 |
| 4,0/6,2 | Selected Altitude | 102, 025 {see Note 2} |
| 4,0/6,2 | FMS Selected Altitude | 102 |
| 4,0/6,2 | Barometric Pressure Setting | 234 |
| 5,0 | Roll Angle | 325 |
| 5,0 | Track Angle Rate | 335 |
| 6,0 | Magnetic Heading | 320, 014 {see Note 2} |
| 6,0 | Mach | 205 |
| 6,2 | Selected Heading | 101 |
| Surveillance | 4096 Ident Code (Mode A) | 016, 031 |
| Surveillance | Barometric Altitude (Mode C) | 203 |

Notes:

1. Information regarding probable data sources and applicable source priorities for each parameter is provided in Attachment 3A.
2. Labels “0XX” represent data words which present the actual data in BCD format. Unless otherwise specified, labels “1XX,” “2XX,” or “3XX” represent data words which present the actual data in BINARY format. BINARY format data is always preferred when both BINARY and BCD data are available.
3. Per Annex 10, Volume IV Section 3.1.2.9, if flight identification (ARINC 429 Labels 233-237 or 360) is unavailable (i.e., no labels received or set as NCD) then the registration of the aircraft, if available, must be inserted into the character subfields of registers 08HEX and 20HEX. On certain airframe configurations this information may be provided within ARINC 429 Labels 301-303. In all cases, encoding of these register subfields should conform to Annex 10, Volume IV Section 3.1.2.9.
4. .

Manufacturers are encouraged to extend the capability of the system beyond the defined default.

##### Minimum Subset of Data Input Capability

The following ports should be considered the minimum default beyond the basic inputs (Altitude, Mode-A Code). This default provides the basis for part interchangeability while still providing the basic set of envisioned data (known as downlink aircraft parameters) and potential for ADS-B capability as well.

FMC/GNSS #1 In #1 (TP-2A/TP-2B)

IRS/FMS/Data Conc In #1 (TP-2C/TP-2D)

FMC #1, Gen In #2 (TP-6A/TP-6B)

Cntrl Data A or FCC/MCP #1/VHF #3 In (TP-7A/TP-7B) or FCC/MCP #1/VHF #3 In MP-3F/MP-3G)

Note: There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to both TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it would be the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G is needed for VHF #3 In.

### Installation Specific Configuration

When the Mark 4 transponder is “table” loaded with configuration information, this data will be used in-lieu of the default (see Section 4.4.1).

This configuration information may be:

1. Stored in an Airplane Personality Module (APM). See ARINC Report 607.
2. Stored in an internal non-volatile memory of the transponder and loaded by a data loader. See ARINC Report 615.
3. Directly implemented in the Mark 4 transponder software.

COMMENTARY

When configured in an installation providing data loaded table configuration information, the transponder should, upon application of power and before any RF processing is made available, access its table entry point. As a minimum, if the table is found to be invalid, the system reverts to the default configuration (see Section 4.4.1).

It is not the intent to have manufacturers design their units to provide installation - specific configuration interchangeability.

#### Broadcast

Uplink broadcast messages are delivered to the on-board avionics. Output ports “MSP/ATSU/CMU #1 and #2” or “General Purpose Out #1 and #2” are suggested for this purpose (refer to Attachment 2).

COMMENTARY

TCAS information, including Broadcast number, is provided to the on board TCAS unit via the XTCOORD output bus (refer to Attachment 2).

Parameters to be specified for the uplink broadcast are given in Tables 4.4-2 and 4.4-3.

Table 4.4-2 – Uplink Broadcast Configuration List

|  |  |  |  |
| --- | --- | --- | --- |
| **Broadcast Number** | **Output Port** | **SAL** | **Dest. Code** |
| ID1 | p1 | SAL1 | D1 |
| ••• | | | |
| IDn | pn | SALn | Dn |

Table 4.4-3 – Uplink Broadcast Parameter List

|  |  |
| --- | --- |
| **Variable** | **Description** |
| Broadcast number | Broadcast ID for which this entry exists |
| Output Port | The physical port on which the broadcast is delivered to the avionics.  The coding of which is a local issue for a particular unit. |
| SAL | System address Label for the destination |
| Destination Code | A possible destination code to be entered in the related protocol word in the Williamsburg protocol |

The Mark 4 transponder supports only those broadcasts, which are contained in Tables 4.4-2 and Table 4.4-3. Broadcasts with other IDs than those given should be ignored.

For the downlink direction, the broadcast may be received on the “MSP/ATSU/CMU” input ports. The broadcast ID is contained in the received broadcast message.

#### Ground Initiated Comm-B (GICB) Protocol

The configuration for the Ground Initiated Comm-B protocol should provide entries on GICB register level to define:

1. The GICB register to be supported.
2. The update interval for that register.
3. An identification of the formatting algorithm to be used for the particular GICB register entry.

A GICB register entry is generally organized in fields. For these fields, the following entries should be provided:

1. An identifier defining the control of source #1/2 selection (i.e., related Mark 4 transponder discrete input).
2. The ports and labels relating to the individual GICB register fields of primary source (source 1) and secondary source (source 2), respectively.

The configuration list for the GICB protocol should contain the parameters: in Tables 4.4-4 and 4.4-5.

The Mark 4 transponder should only support those GICB registers for which entries exist in Tables 4.4-4 and 4.4-5.

The list can be subdivided into the n entries which are each related to an entire GICB register and k entries which further define the configuration details relating to individual fields of that particular GICB register entry.

#### Mode S Specific Services Protocol (MSP)

Mode S Specific Services protocol data is delivered to and received from the on-board avionics via the “MSP/ATSU/CMU” input and output ports (refer to Attachment 2).

For MSP configuration, the parameters to be defined are in Tables 4.4-6 and 4.4-7.

The Mark 4 transponder should support only those entries, which are listed.

Table 4.4-4 – GICB Register Update Configuration List

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **GICB Register Related** | | | **GICB Register Field Related** | | | | | | |
|  | update | formatting | source | source 1 | | | source 2 | | |
| BDS | interval | algorithm | selection | port | label | switch | port | label | switch |
|  |  |  | s1 | p11,1 | l11,1 | sw11,1 | p21,1 | l21,1 | sw21,1 |
| BDS1 | t1 | F1 | ••• | ••• | | | ••• | | |
|  |  |  | sk | p11,k | l11,k | sw11,k | p21,k | l21,k | sw21,k |
| **…** | | | | | | | | | |
|  |  |  | s1 | p1n,1 | l1n,1 | sw1n,1 | p2n,1 | l2n,1 | sw2n,1 |
| BDSn | tn | Fn | ••• | ••• | | | ••• | | |
|  |  |  | sk | p1n,k | l1n,k | sw1n,k | p2n,k | l2n,k | sw2n,k |

Table 4.4-5 – GICB Register Update Variables

| **Variable** | **Description** |
| --- | --- |
| BDS | The GICB register number to be loaded with the data. |
| Update Interval | The update interval in 10 ms increments. |
| Formatting Algorithm | An identifier which informs the GICB register loader which formatting algorithm to use. |
| Source Selection | An identifier which informs the GICB register loader which discrete select input is to be respected in the source selection between sources 1 and 2.  If set to ZERO the auto selection is activated.  The coding of the reference to the discrete inputs is a local issue for a particular unit. |
| Port | The physical port on which the ARINC 429 words are received.  The coding of which is a local issue for a particular unit. |
| Label | The Label of the ARINC 429 word |
| Switch | An integer variable which can be used to configure the formatting algorithm dependent on the source selection and installation. This field may not be required in all cases, but for consistency and to allow potential upgrades it should be accepted by each formatting algorithm even if it has no function. |

Table 4.4-6 – MSP Channel Configuration List

|  |  |  |  |
| --- | --- | --- | --- |
| **MSP/CH** | **Port** | **SAL** | **Dest. Code** |
| MSP1 | p1 | SAL1 | D1 |
| ••• | | | |
| MSPn | pn | SALn | Dn |

Table 4.4-7 – MSP Channel Parameters

|  |  |
| --- | --- |
| **Variable** | **Description** |
| MSP | The MSP channel supported by the installation. |
| Port | The physical port on which the Mode S Specific Services application can be reached.  The coding of which is a local issue for a particular unit. |
| SAL | System Address Label |
| Dest. Code | A possible destination code to be entered in the related protocol word in the Williamsburg protocol. |

Note: Attachment 10 to this document offers a description of a possible architecture to implement the GICB register loading function and also indicates the use of the configuration parameters and source select discretes.

#### ISO 8208 Services

When implemented ISO 8208 messages may be delivered to and received from on-board avionics. Ports “MSP/ATSU/CMU In #1 and #2” and “MSP/ATSU/CMU Out #1 and #2” are suggested for this purpose (refer to Attachment 2).

In addition to the used ports the ISO 8208 services need to be configured by defining which DTEs can be reached. The Mark 4 transponder should only support those DTEs, which are contained in the list.

For ISO 8208 services, the parameters to be defined are defined in Tables 4.4-8 and 4.4-9.

Table 4.4-8 – ISO 8208 Configuration List

|  |  |  |  |
| --- | --- | --- | --- |
| **DTE** | **Port** | **SAL** | **Dest. Code** |
| DTE1 | p1 | SAL1 | D1 |
| ••• | | | |
| DTEn | pn | SALn | Dn |

Table 4.4-9 – ISO 8208 Configuration List

|  |  |
| --- | --- |
| **Variable** | **Description** |
| DTE | The DTE number available in the installation. |
| Port | The physical port to which the ISO 8208 services are connected.  The coding of which is a local issue for a particular unit. |
| SAL | System Address Label |
| Dest. Code | A possible destination code to be entered in the related protocol word in the Williamsburg protocol. |

#### Ground Speed Determination Parameters

In support of determining the Air/Ground status for squitter functions, the EIF may need to determine the ground speed. Particular ARINC 429 labels that provide ground speed data in different aircraft installations. In order to configure the Mark 4 transponder to use the appropriate ground speed data source and apply the appropriate threshold values, the entries and variables are defined in Tables 4.4-10 and 4.4-11.

Table 4.4-10 – Ground Speed Source

|  |  |  |  |
| --- | --- | --- | --- |
| **Port** | **Label** | **Airborne** | **Ground** |
| P1 | L1 | agspeed | ggspeed |

Table 4.4-11 – Ground Speed Source Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| Port | The physical port on which the ground speed ARINC 429 words are received. The coding of which is a local issue for a particular unit. |
| Label | The Label of the ARINC word |
| agspeed | The ground speed threshold for determining the airborne state. When the ground speed reaches the established threshold (see Table 4.2-2), the airborne state is determined. |
| ggspeed | The ground speed threshold for determining the on-ground state. When the ground speed is less than the given threshold (see Table 4.2-2), the on-ground state is determined. |

#### Airspeed Determination Parameters

In support of determining the Air/Ground status for squitter functions, the EIF may need to determine the airspeed. Particular ARINC 429 labels provide airspeed data in different aircraft installations. In order to configure the Mark 4 transponder to use the appropriate airspeed data source and apply the appropriate threshold values, the entries and variables are defined in Tables 4.4-10 and 4.4-11.

Table 4.4-12 – Airspeed Source

|  |  |  |  |
| --- | --- | --- | --- |
| **Port** | **Label** | **Airborne** | **Ground** |
| P1 | L1 | aaspeed | gaspeed |

Table 4.4-13 – Airspeed Source Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| Port | The physical port on which the airspeed ARINC 429 words are received. The coding of which is a local issue for a particular unit. |
| Label | The Label of the ARINC word |
| aaspeed | The airspeed threshold for determining the airborne state. When the airspeed reaches the established threshold (see Table 4.2-2), the airborne state is determined. |
| gaspeed | The airspeed threshold for determining the on-ground state. When the airspeed is less than the given threshold (see Table 4.2-2), the on-ground state is determined. |

#### Radar Altitude Determination Parameters

In support of determining the Air/Ground status for squitter functions, the EIF may need to determine the Radar Altitude. Different ARINC 429 labels may provide Radar Altitude data depending on the aircraft installation. In order to configure the Mark 4 transponder to use the appropriate Radar Altitude data source and apply the appropriate threshold values, the entries and variables are defined in Tables 4.4-14 and 4.4-15.

Table 4.4-14 – Radar Altitude Source

|  |  |  |  |
| --- | --- | --- | --- |
| **Port** | **Label** | **Airborne** | **Ground** |
| P1 | L1 | aralt | gralt |

Table 4.4-15 – Radar Altitude Source Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| Port | The physical port on which the Radar Altitude ARINC 429 words are received. The coding of which is a local issue for a particular unit. |
| Label | The Label of the ARINC word |
| aralt | The Radar Altitude threshold for determining the airborne state. When the Radar altitude reaches the established threshold (see Table 4.2-2),the airborne state is determined. |
| gralt | The Radar Altitude threshold for determining the on-ground state. When the Radar Altitude is less than the given threshold (see Table 4.2-2), the on-ground state is determined. |

## Control Panel

The control panel should allow the pilot to control the Mark 4 transponder and to identify its status. This may include:

1. The entry of the 4096 Mode A reply code including the Ident function.
2. The activation and deactivation of the transponder.
3. The selection of the active unit in case of redundant installation.
4. The display of the transponder status.
5. The selection of the altitude source (1, 2, and off).
6. The control of the TCAS computer.
7. Selection and display of Flight Identification code.

### Mark 4 Transponder Control

The SSR Mode A reply code selected by the pilot and the settings of other transponder controls will be conveyed from the control unit to the Mark 4 transponder by means of the serial digital data transfer technique described in ARINC Specification 429. Two serial digital data input ports should be provided on the Mark 4 transponder, one labeled “A” and the other “B” as shown in the Standard Interwiring of Attachment 2. The transponder should determine which of these ports should be “open” by reference to the binary state of the control source selection discrete input. It should respond to control data delivered to the “A” port and ignore data delivered to the “B” port when the source selection discrete is in the “ground” state. It should respond to data delivered to the “B” port, and ignore data delivered to the “A” port, when the discrete is in the “open circuit” state. The ground state of the discrete is defined in Section 2.9.3 of this document. The maximum current flow through the discrete wire should not exceed 20 mA. The “open circuit” state is defined in Section 2.9.2 of this document (+30 Vdc max).

When the Mark 4 transponder is installed in an aircraft in which a dedicated control panel supplies the control information, the data bus from the control panel should be connected to the “B” port on the transponder. The “A” port and the source selection discrete input are unused. When the transponder is installed in an aircraft in which a centralized radio management system is employed, its normal control data source should be connected to the “A” port, its back-up data source to the “B” port and the source selection discrete input wired in the manner defined by the radio management system.

Transponder replies should be inhibited when the data is questionable. ARINC Specification 429 defines the format of the serial digital control word delivered to the transponder and the word repetition rate (5 per second minimum). Transponder replies should not be sent when:

1. This rate falls below 5 per second (word removal from the bus signifies control information source failure).
2. The word sign/status matrix indicates an invalid condition.
3. The word parity is incorrect.

Section 6 of this document describes the transponder control functions in detail and how they relate to the settings of the bits of the control word.

ARINC Specification 429 is the controlling document for the characteristics of the transponder control interface. Descriptive material in this document, including the word format definition in Attachment 4, is included for reference purposes only. In the event of a conflict between this document and ARINC Specification 429, the latter should be assumed to be correct.

### Dual Installations

Dual installations of the Mark 4 transponder should be configured such that only one transponder is active at a time, the other remaining in the “standby” condition until pilot action at the control panel calls for a changeover. Section 6 of this document describes the recommended means of achieving this changeover.

## Mark 4 Transponder Functional Test and Monitoring

### Functional Test

#### General

The Mark 4 transponder should enter the functional test mode when (i) it recognizes the sign/status matrix changing to “functional test” code in the serial digital words delivered to it from the pilot’s control panel (see ARINC Specification 429), or (ii) the normally open-circuit “functional test discrete” input pin on the transponder service connector changes from “open” to ground (0 to 3 Vdc) potential by means of a remote push-button switch. In addition, a push-button switch should be provided on the front panel of the transponder for local activation of the test feature. The transponder should revert to normal operation after the functional test sequence has been performed.

COMMENTARY

Situations have been observed in which a self-test push button was accidentally activated for a long period causing a continuous self-test to be performed. It therefore has been recommended in this Characteristic that the self-test should only be activated when the self-test command shows a “non-test” to “test” transition.

Manufacturers providing the functional test feature should note that it should be designed such that its effects on the overall equipment reliability are negligibly small. It should also be recognized that if the self-test function causes the radiation of test interrogation signals or prevents the transponder from replying to proper interrogations during the test period, its use should be limited to the minimum required to determine the transponder’s status. The test interrogation rate should not exceed 450 per second and the test interrogation signal level at the antenna end of the transmission line should not exceed a level of -40 dBm.

Functional test features that are capable of evaluating the performance of the circuitry of the transponder without the need for ground accessory equipment or ground station signals have been recognized to be helpful for airlines.

#### Transponder Functional Test

The Mark 4 transponder should provide an internal “functional test” feature. The monitors described in Section 4.6.2 would then be used to determine the transponder’s status.

COMMENTARY

Such a feature could involve the injection into the receiver front-end of the transponder portion of low-level simulated interrogations generated internally when a button is pressed.

#### Extended Interface Functional Test

In an installation with the 24-bit hardwired address and when the transponder is loaded with installation-specific configuration data, the test of the extended interface function should at least include:

1. A hardware test of the processor (if possible), the memories, all peripherals, and interfaces.
2. A software checksum.

The functional test of the extended interface function should be designed in such a way that it does not change the states in any of the extended interface functions software.

An additional functional test mode should be available that checks whether or not all communication data and related avionics systems can be reached. This would allow testing of all connected interfaces after a unit has been replaced during maintenance. This test would require operation of the related avionics systems as well. Such a feature could make extra ground equipment unnecessary.

### Monitoring

Provisions should be made for an integrity monitor that enunciates malfunctions of equipment functions it has been designed to monitor.

Equipment malfunction monitors should accommodate data comparison functions that validate information received from multiple sources. If “duplicate input” information comparison identifies a discrepancy, the equipment manufacturer should ensure clear indication of the failure so that the crew may determine any corrective actions needed.

Two pins on from the transponder rear connector are provided for the monitor enunciation function in the Standard Interwiring of Attachment 2.

Manufacturers building Mark 4 transponder equipment should offer an efficient antenna performance monitoring system.

COMMENTARY

It was noted in the past that the antenna performance monitoring and fault enunciation did not work satisfactorily. In a diversity antenna installation it is even more important that the antennas performances are carefully monitored.

## Data Interfaces

### General

The Mark 4 transponder has particular interfaces for avionics data for GICB register loading and optionally for input/output of Mode S specific services protocol data.

### Avionics Data Interface

The avionics data is received in two different ways dependent on the avionics installation:

1. On a number of ARINC 429 buses from various aircraft systems.
2. Via ARINC 429 buses from a data concentrator.

The data words will be received on high-speed or low-speed data ARINC 429 data buses. The interface should be capable of adjusting to the received data rates as specified by ARINC Specification 429.

### Mode S Specific Services Protocol Interface (Optional)

When data is transferred using the Mode S specific services protocol interface, it should be transferred with the protocol specified in ARINC Specification 429, Part 3, File Transfer Techniques which defines the ARINC 429 Williamsburg protocol version 3. The protocol variables should be set to their standard values as listed in Part 3 of ARINC Specification 429. GFI = 1 is used, indicating that Mode S data is contained in the Logical Data Unit (LDU). The bus should be a high-speed ARINC 429 bus.

The general LDU structure starts with a Type ID which allows the distinction between MSP data, broadcast data, connectivity reporting, ISO 8208 data and other data. Following the Type ID, two reserved bytes are foreseen to allow future expansion.

The following packets are used in conjunction with the MSP data exchange:

1. MSP channel availability report from external devices (Type-ID = 1).
2. MSP data exchange record (Type-ID = 2).
3. MSP delivery notice record (Type-ID = 3).
4. Broadcast data exchange record (Type-ID = 4).

#### MSP Channel Availability Report

Type-ID = 1 signifies the MSP channel availability report from an external device.

The MSP channel availability report needs to be sent to the Mark 4 transponder periodically at least every 2 seconds. In order to inform the transponder about the path on which the MSP function can be reached, an optional System Address Label (SAL) and a destination code may be added. The MSP availability report can accommodate availability indications for one or more MSP channels at the same time. A number field indicates how many MSP channels are reported in the particular record. The LDU format and variables are depicted in Figure 4.7-1 and Table 4.7-1.

Table 4.7-1 – MSP Channel Availability Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| num | The number of MSP function reports contained in this record. |
| M/CH | This field serves two purposes; it carries the 6 bit MSP channel number plus a two bit direction indicator.  The 6 least significant bits represent the MSP channel number.  The two most significant bits indicate the direction in which the MSP is supported.  The coding of these two bits, when interpreted as a binary number is:  0 = not defined  1 = uplink  2 = downlink  3 = bidirectional |
| SAL | System Address Label of the system hosting the particular MSP function.  If not provided, then these fields should be set to zero. |
| Destination Code | A possible destination code to be entered in the related protocol word in the Williamsburg protocol.  If not provided, then this field should be set to zero. |

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 1 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | num | |
| Byte 5 | M/CH1 | |
| Byte 6 | SAL1 | |
| Byte 7 | Dest Code1 | |
| Byte 8 | M/CH2 | |
| Byte 9 | SAL2 | |
| Byte 10 | Dest Code2 | |
|  |  |  |
|  | •••• | |
|  |  |  |
|  | MCHk | |
|  | SALk | |
|  | Dest Codek | |

Figure 4.7-1 – MSP Channel Availability

#### MSP Data Exchange

Type-ID = 2 signifies the data following is MSP protocol data. Two slightly different packet formats are used for the delivery of data from external devices to the Mark 4 transponder and from the transponder to external devices. The reason for this is that a message reference (MREF) is required for data sent to the transponder but not in the opposite direction (i.e., MREF is always set to 0).

The LDU format used to transfer MSP data from external devices to the Mark 4 transponder is shown in Figure 4.7-2.

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 2 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | MREF | |
| Byte 5 | M/CH | |
| Byte 6 | II | |
| Byte 7 | MSP Data Byte 1 | |
|  |  |  |
|  | •••• | |
|  |  |  |
| Byte n+6 | MSP Data Byte n | |
|  |  | |

1 ≤ n ≤ 159

Figure 4.7-2 – MSP Data Transfer Format – External to Transponder

The LDU format used to transfer MSP data from the Mark 4 transponder to external devices is shown in Figure 4.7-3.

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 2 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | 0 | |
| Byte 5 | M/CH | |
| Byte 6 | II | |
| Byte 7 | MSP Data Byte 1 | |
|  |  |  |
|  | •••• | |
|  |  |  |
| Byte n+6 | MSP Data Byte n | |

1 ≤ n ≤151

Figure 4.7-3 – MSP Data Transfer Format Transponder to External

The meaning of the variables is given in Table 4.7-3.

Table 4.7-3 – MSP Data Transfer Format Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| MREF | When received from an MSP application: A message reference number incremented from one MSP message on that channel to the other modulo 255.  When sent by the Mark 4 transponder: set to 0 (message numbering is not supported by the Mark 4 transponder). |
| M/CH | The MSP channel number as described in ICAO Annex 10. |
| II | The II code of the interrogator to which the message is destined or from which the message originates. |
| MSP Data | The message data originating from the Mode S specific services application on the ground or on board. The message may consist of between 1 and 159 bytes in the direction to the Mark 4 transponder and between 1 and 151 bytes on the direction from the transponder to the MSP function. |

#### MSP Delivery Status Reporting

Type-ID = 3 signifies MSP delivery status reporting. The LDU format which is used to indicate successful MSP data delivery to the ground is shown below. The packet is only used in the direction from the Mark 4 transponder to the external devices and the format and variables are given in Figure 4.7-4 and Table 4.7-4.

Table 4.7-4 – MSP Delivery Status Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| M/CH | The MSP channel number as described in ICAO Annex 10 Volume III. |
| MREF | The reference number included in the related downlink MSP record received from the MSP application before.. |
| II | The II code of the interrogator to which the message was destined |
| DELST | The delivery status of the downlink MSP message:  DELST = 0; the message timed out (TZ timer) without closeout  DELST = 1; message was closed out (successful delivery) |

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 3 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | M/CH | |
| Byte 5 | MREF | |
| Byte 6 | II | |
| Byte 7 | DELST | |

Figure 4.7-4 – MSP Delivery Status Format

#### Broadcast Data Exchange

Type-ID = 4 signifies broadcast data. The LDU format to transfer broadcast data is shown in Figure 4.7-5 and Table 4.7-5.

Table 4.7-5 – Broadcast Data Exchange Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| BI | The Broadcast Identifier as described in the ICAO Annex 10 |
| Broadcast Data | The broadcast data originating from the Mode S specific services application on the ground or on board. This block is always 6 bytes long. |

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 4 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | BI | |
| Byte 5 | Broadcast data Byte 1 | |
|  |  |  |
|  | •••• | |
|  |  |  |
| Byte 10 | Broadcast data Byte 6 | |

Figure 4.7-5 – Broadcast Data Exchange Format

### ISO 8208 DTE/DCE Interface (Optional)

The ISO 8208 interface serves three purposes:

1. The message transfer of ISO 8208 packets (Type-ID = 10).
2. The connectivity report for Ground DTEs according to Annex 10   
   (Type-ID = 11).
3. The connectivity report for available airborne DTEs according to Annex 10 (Type-ID = 12).

The physical layer and the data link layer used to transport the ISO 8208 packets between the Mark 4 transponder DCE and an aircraft system requiring the Mode S Specific Services should be implemented with version 3 of ARINC 429 Williamsburg protocol, on a high-speed bus. The protocol variables should be set to their standard values as listed in ARINC Specification 429. GFI = 1 is used indicating that Mode S data is contained in the LDUs. Full duplex mode should be supported.

COMMENTARY

The designer is cautioned to verify the interface protocol implemented in the complementary DTE/DCE interface before developing ARINC 429 Williamsburg as the final solution.

#### ISO 8208 Packet Transfer

Type-ID = 10 is used to indicate that standard ISO 8208 packets are contained in the LDU. The ISO 8208 packets should be coded as defined in ISO 8208. The ISO 8208 interface should have the following properties:

1. The basic packet formats should be used.
2. The window size should be 2.
3. The sequence numbering should be modulo 8.
4. The following facilities should be supported:
   1. Fast select (ISO 8208 Section 13.16)
   2. CCITT priority of data in a connection (ISO 8208 Section 15.3.2.5)

The reception of other facility requests than those mentioned above should cause the DCE of the Mark 4 transponder to react as described in ISO 8208.

The packet format for the ISO 8208 packets as transferred by the Williamsburg LDUs is shown in Figure 4.7-6.

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 10 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | GFI | logical |
| Byte 5 | Channel Identifier | |
| Byte 6 | Packet Type Identifier | |
| Byte 7 | Fields depending on ISO packet type | |
|  | •••• | |
| Byte n |  | |

Figure 4.7-6 – Packet Transfer Format

All fields behind the two reserved fields are coded as specified in ISO 8208 as string of octets.

#### Ground DTE Connectivity Report

Type-ID = 11 indicates that the data contained in the LDU is a ground DTE connectivity report. The format and variables are shown in Figure 4.7-7 and Table 4.7-7.

Table 4.7-7 – Ground DTE Connectivity Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| DTEREF | The DTE address number of the accessible ground DTE (0...255) |

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 11 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | DTEREF 1 | |
|  | •••• | |
| Byte n+3 | DTEREF n | |

Figure 4.7-7 – Ground DTE Connectivity Format

A connectivity report consists of between 1 and 255 bytes dependent on the number of simultaneously available DTEs. It is expected that the report will on average be no longer than 16 bytes dependent on the number of currently available ground DTEs. This connectivity report is sent whenever new ground DTEs become available or become unavailable. The connected DTEs need to overwrite their list of active DTEs by the updated list of DTEs. The report needs to be sent to all DTEs known by the Mark 4 transponder.

#### Airborne DTE Connectivity Report

Type-ID = 12 indicates that the data contained in the LDU is an airborne DTE connectivity report. The airborne DTE connectivity report informs the Mark 4 transponder about the availability of airborne DTEs. Each DTE periodically sends a connectivity report at least every 2 seconds. The format and variables are shown in Figure 4.7-8 and Table 4.7-8.

Table 4.7-8 – Airborne DTE Connectivity Variables

|  |  |
| --- | --- |
| **Variable** | **Description** |
| DTE | The airborne DTE sub-address supported by the installation. |
| SAL | System Address Label of the system hosting the particular DTE.  If not provided, then this field should be set to zero. |
| Dest. Code | A possible destination code to be entered in the related protocol word in the Williamsburg protocol.  If not provided, then this field should be set to zero. |

|  |  |  |
| --- | --- | --- |
|  | **MSB** | **LSB** |
| Byte 1 | Type ID = 12 | |
| Byte 2 | reserved | |
| Byte 3 | reserved | |
| Byte 4 | DTE1 | |
| Byte 7 | SAL1 | |
| Byte 8 | Destination Code1 | |

Figure 4.7-8 – Airborne DTE Connectivity Format

## Operational Modes of the Mark 4 Transponder

The Mark 4 transponder will have three operational modes:

1. “Power off” Mode

In this mode the transponder does not receive any primary power. This mode is the normal mode when the avionics is switched off or the circuit breaker to the transponder is pulled (the transponder is presented with an open circuit power input).

The transponder should be capable to maintain specific internal states during a “Power-off” mode condition for a minimum of 500 msec, and all program or configuration non-volatile settings during a “power off” mode condition for up to 3 years.

1. “Standby” Mode

In this mode the transponder receives primary power but conducts no RF transmission, in any event. The “Standby” condition may be commanded by the Standby/On discrete input at its service connector or by loss of valid transponder control data.

In the “standby” condition the Mark 4 transponder should be operational but with limited capabilities. In this mode the Mark 4 transponder should not respond to received interrogations. It should continue to transmit periodic data on defined ARINC 429 output ports. Mark 4 transponder BITE functions should be operational in the “standby” mode, but may be reduced in scope due to the inability to transmit. When in standby mode the Mark 4 transponder should respond to bus test commands.

1. “On” Mode

In this mode the transponder receives primary power and has been commanded to the “On” condition by the standby/on discrete.

In the “On” condition the transponder should be capable of replying to interrogations and should establish logical connections to the connected applications which require the communication functions.

All functions should be activated in the “On” condition of the Mark 4 transponder.

# Built-In Test and Maintenance Provisions

## Fault Detection and Reporting

### General

The transponder should support at least one of the following Built-In Test Equipment (BITE) capabilities:

**ARINC Report 624:** *Onboard Maintenance System*

**ARINC Report 604:** *Guidance for Design and Use of Built-In Test Equipment*

Multi-Purpose Control and Display Unit (MCDU) maintenance pages contain a fault log formatted in accordance with either ARINC Report 624 or 604. The aircrew should be able to print this maintenance log on the cockpit printer via selection on the MCDU.

COMMENTARY

The option used should be compatible with the aircraft in which the transponder will be installed.

BITE in the transponder should be capable of detecting at least 95% of the faults or failures which can occur within the transponder, and as many faults as possible associated with other interfaces.

Where possible, optional functions present in the transponder that is not activated by the operator should be excluded from all on-board testing. The intent is to eliminate unnecessary removals.

BITE should closely relate to bench testing. Error modes encountered on the aircraft should be reproducible in the shop. Error messages recorded by BITE should assist bench testing.

No failure occurring in the BITE subsystem should interfere with the normal operation of the transponder.

### Self-Monitoring

The self-contained fault detection should incorporate nonvolatile memory and logic to identify true hardware faults based on the historical trends. This includes a flight hour monitor as well as air-ground logic to monitor installed time on the aircraft.BITE should be functioning in transponders selected to “Standby” by the flight crew and detected failures annunciated.

Performance monitoring of the transponder should cause a failure to be annunciated when the unit is wired with all zeros or all ones in the address code.

### Failure Rate Monitor

Reasonable failure rate thresholds for some significant faults should be incorporated such that the transponder would optionally set a flag when these thresholds are exceeded.

COMMENTARY

Some hardware faults that would be reset during a ground check or power interruption may not be repeated immediately. This condition may allow the unit to remain on board the aircraft. A threshold exceedance monitor would detect and set the flag when one of these transient faults exceeds an acceptable rate of occurrence. Some airlines may choose to deactivate such a monitor.

### Fault Messaging

The transponder will have a “go/no-go” light or indicator indicating overall unit performance ability. BITE fault messages (MCDU display, code lights or otherwise) will be as descriptive as possible (English language fault descriptions). When an external or internal fault occurs, the transponder will alert maintenance personnel to the status of the specific system components, either as a displayed list, or on request.

System faults should be classified based on their effect on the system as debilitating or non-debilitating. Fault displays should also indicate the most probable correction of the problem.

A system debilitating failure is any non-recoverable failure which prohibits the transponder from performing any basic required function. Cockpit and/or LRU failure annunciation is provided for a system debilitating failure. A system debilitating failure will be logged in BITE memory. If recoverable, crew action may be necessary.

A non-system-debilitating failure is any BITE-detected failure which is auto-recoverable within specified/acceptable operational limitations (of short duration and requiring no crew action for recovery) and which has no adverse impact on the required functions of the transponder. A non-system-debilitating failure will be logged in BITE memory, but need not be cockpit and/or LRU annunciated.

## Ramp Maintenance

### Return to Service Testing

When a transponder is installed on an air transport aircraft, some form of end-to-end testing should be available for two primary reasons:

* to provide an operational verification of the system function prior to return to service
* to reduce unnecessary removals of the transponder when the fault was actually in another part of the system.

As an end-to-end test, the procedure should verify integrity of the LRU as well as interfaces with other systems. This maintenance test will provide test values on the digital outputs with the appropriate status matrix code for the test condition as defined in ARINC Specification 429. This test can also exercise internal monitoring and diagnostic routines and provide test formats on the MCDU and on a multifunction display.

COMMENTARY

The airlines prefer test results to indicate the probable cause of failure. Emphasis on end to end system testing will lead to a desirable increase in the Mean Time Between Unscheduled Removal (MTBUR), especially for removals that were not related to LRU faults.

Means should be provided for initiating this maintenance test either through an externally supplied discrete input or an MCDU prompt. The transponder may also have the capability, via a switch on the front of the transponder, for initiating the maintenance test. If this switch is provided, an indicator should also be mounted on the transponder front panel to show the result of the test.

The transponder should also go into the functional test mode whenever bit numbers 30 and 31 of the frequency/function selection digital words supplied to the transponder from the control panel, or other source, take on the binary states representing the “functional test” code defined in ARINC Specification 429.

The maintenance test initiated by a functional test command provides an indication of the current installation capabilities with regard to the unit. The Mark 4 transponder may optionally provide for an extended test which combines the current installation capability with information provided in the unit non-volatile memory. Such an “extended test” allow maintenance personnel to isolate intermittent failures.

The functional test is commanded by means described. The extended test is commanded by externally supplied discrete input or front panel switch, only, and is initiated by providing the test command for a period in excess of four seconds. If the extended test is provided, the unit should provide a clear indication of its operation.

When the Mark 4 transponder receives a functional test command, it should perform the sequence of operations described below:

Perform an indicator test in which all indicator elements are activated simultaneously.

Provide the results of the functional test by extinguishing indicator elements not found to cause failure. Conversely, any components defined on the indicator elements which are found failed will have corresponding indicator elements activated. In the case when No Fault is found, the unit should provide clear indication of this condition.

If the extended test is supported and commanded, the functional test result should be deactivated and indication of extended test should be made.

During extended test, the unit should correlate its non-volatile memory fault report for up to the last four flight legs. The results of this report should be combined with the result of the functional test and provided on the front panel. Front panel indicator element operation should be the same as that for the functional test, including clear indication of No Fault Found.

Indicator operation, whether No Fault or indication of fault, should remain for at least 10 seconds, after which time all indicators should be deactivated.

COMMENTARY

The selected number of four flight legs to be examined in the extended test should be made easily alterable in the BITE implementation to allow adjustments when enough field history with the particular implementation is gained.

Also note that the selected number of flight legs may also be limited by the number of legs available in the Mark 4 transponder memory buffer.

While the functional test is active the transponder outputs should set the sign/status matrices of the output word to the “functional test” code as described in ARINC Specification 429. Should the data on the output buses become unreliable during the time where the functional test is executed, the content of the sign/status matrix of the affected word(s) should change to the “failure warning” code, in accordance with ARINC Specification 429. In accordance with ARINC Specification 429, an inconsistency discovered by the functional test between received frequency/function selection data and forwarded frequency/function selection data should cause the data to be removed from the output buses.

### Data Loading

It is expected that operational software and data bases (e.g., configuration data) will be on-board loadable. If data loadable the transponder should accept this data from a data loader in accordance with ARINC Report 615.

COMMENTARY

It is recognized that some minimal level of “boot” software must be non-loadable to provide the basic loading interface.

The transponder should provide compatibility testing to ensure that loadable software and data are compatible with the transponder hardware configuration.

Mechanisms should be provided to ensure the integrity of the loaded data.

### Data Loading Fault Recovery

In all cases, when loading software or data, the procedure will provide a method for recovering from faults. The transponder system will be able to abort a software or data base loading process without a major disruption of the system (disruption requiring removal of the transponder from the aircraft).

## Provisions for Automatic Test Equipment

### General

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

### ATE Testing

The transponder should be ATE testable and should have a test program written for example using the ATLAS language elements of ARINC Specification 626, Standard ATLAS Subset for Modular Test. Development of the test program set should consider and apply the quality characteristics set forth in ARINC Specification 626.

# Control Panel Design

## Introduction

Where a central avionics management computer is not available, a control panel for the transponder will be used. This Section sets forth the characteristics of a “Standard Control Panel” for use by those airlines having “standard” transponder controller needs. Manufacturers should recognize that not all users’ needs will be “standard,” and that some customers may thus request alternative features in their panels.

## Form Factor and Connector

The “Standard Control Panel” should be packaged as a 5.75” wide by 2.25” high Dzus-mounted control panel. The depth of the box behind the panel should not exceed 5.00”, excluding the connectors. A control panel intended for use in a single transponder installation should employ a connector type M83723 72R16247, (mates with M83723 75R16247) mounted in the Left Plug (LP) position shown in the diagram of Attachment 1B. A control panel designed for use in a dual transponder installation should employ both this connector in this position, and a connector type M83723 72R16248, (mates with M83723 75R16248) mounted in the Right Plug (RP) position shown in Attachment 1B.

COMMENTARY

Attachment 2 to this document shows an example of pin assignments, which should be identical on both connectors except for the panel light (5 Vac) power input. Panel light power should be wired in the LP connector only.

## Control Information Transfer

The transfer of control information from the control panel to the transponder unit(s) should be achieved by means of an ARINC 429 data bus conforming to the standards for low-speed (12.5 to 14 kbps) operation. The format of the control panel digital data output word is defined in ARINC Specification 429. This information is reproduced for reference purposes only in Attachment 4 to this document. The word repetition rate should be five times per second, minimum.

Note that ARINC Specification 429 is the controlling document for the characteristics of the transponder control interface. In the event of a conflict between this document and ARINC Specification 429 in this area, the latter should be assumed to be correct.

## Control Functions

### Standby/On Switching

Means allowing the crew to select whether the connected transponder(s) should be in the “Standby” condition or switched “On” should be provided. Means must be foreseen which ensure that only one unit of a dual installation can be switched on at a time. The related operation modes are described in Section 4.8 of this document.

The transponder should enter the “Standby” condition when a control panel switch grounds pin TP7G on the service connector.

The transponder should enter the “on” condition when the control panel switch is opened causing the dc ground on transponder connector pin TP7G to be removed. The standby/on discrete output of the control panel is connected to pin 7 of the Control panel connector.

### Code Selectors

Means should be provided for the crew to select the desired reply code for ATCRBS Mode A interrogations. The selected code should be displayed to the crew as a four digit number, the relationship of this number to the pulse content of the code being that described in Attachment 3A to this document. Bits 18 through 29 of the control panel digital data output word should contain octal-encoded representations of each digit of the reply code, as shown in Attachment 4.

### “Ident” Pulse (SPI) On/Off

Means should be provided for the crew to add the Special Position Identification (“Ident”) pulse to ATCRBS Mode A reply codes, as described in Section 4.3.7.1 of this document. A push button, spring loaded to the “Off” position is suitable for this purpose. In the “Off” position of this facility, bit 12 of the control panel digital data output word (Label 016) should take on the binary “zero” state. In the “On” (“Ident” SPI pulse to be transmitted) condition, this bit should take on the binary “one” state. This bit should remain in the binary “one” state for the period of manual operation of the switch function (depression of the push button) and revert to the binary “zero” state on its release.

### Altitude Reporting On/Off

Means should be provided for the crew to inhibit/not inhibit the transmission of the information pulse content of replies to ATCRBS Mode C interrogations and Mode S pressure altitude reports. (Refer to Sections 4.3.8 and 4.3.9.1 of this document.) In the “not inhibit” (Altitude Reporting “On”) condition of this facility, bit 11 of the control panel digital data output word should take on the binary “zero” state. In the “inhibit” (Altitude Reporting “Off”) condition, this bit should take on the binary “one” state.

When the transponder is in the “inhibit-altitude reporting” condition, altitude data delivered to TCAS should be all zeros including the Sign Status Matrix (SSM). This should cause TCAS to go into Standby (Sensitivity Level 1).

### Altitude Data Source Select

Means should be provided for the crew to select which of the two available sources of altitude data supplies the information for ATCRBS Mode C replies and Mode S pressure altitude reports. Attachment 2G shows how a switch on the control panel should be wired to affect this selection. Alternatively, a remote altitude source selector switch may be provided in a convenient cockpit location instead of (but not as well as) the control panel switch. Such a switch should be wired as shown by the 6.4.5 dotted lines on the diagram of Attachment 2G. See also Attachment 2A.

This altitude data source select function will operate on the serial digital data inputs to the transponder only. If the transponder is configured to accept Gillham derived altitude inputs (see Section 1.5 and Attachment 2), an additional hard-wired source select function may be needed.

### Self-Test On/Off

Means should be provided for the crew to initiate the transponder functional test described in Section 4.6.1 of this document. A push-button, spring-loaded to the “Off” position is suitable for this purpose.

In the “Off” position of this facility, bits 30 and 31 of the control panel digital data output words (Label 016) should contain other than the bit pattern defined for “functional test” in ARINC Specification 429.

In the “On” condition of this facility, these bits should take on this “functional test” code. Bits 30 and 31 should retain the “functional test” bit pattern for the period of manual operation of the switch function (depression of the push-button) and revert to a different bit pattern on its release.

### TCAS Sensitivity Control (TCAS II only)

Means should be provided for the crew to select one of seven TCAS sensitivity levels. The selected level should be encoded in bits. 15, 16 and 17 of the control panel digital data output word (Label 016) for delivery by the transponder to the TCAS computer. See Attachment 4.

### TCAS Display Control

Means should be provided for the crew to select certain TCAS data display options. The selected option should be encoded in bits 13 and 14 of the control panel digital data output word (Label 016) for delivery by the transponder to the TCAS computer. See Attachment 4.

## Control Panel Power and Initialization

The control panel should be powered from the aircraft 115 Vac primary supply as shown in Attachment 2B. Power supply transients of the amplitudes and duration defined in ARINC Report 413A and RTCA DO-160 should not result in the control panel output containing false information concerning the settings of the control functions. Settings should also survive the transfer of transponder operations from one unit to the other of a dual installation. This is to obviate the need for the crew to make otherwise unnecessary entries after having effected the changeover.

On first applying power to a transponder system after a lengthy power-off period, the information bits of the control panel digital output word associated with entry facilities that do not retain entered data in some manner (such as a key-pad) should take on the binary “zero” state. The control panel output word information bits associated with entry facilities which do retain entered data through the power-off condition (e.g., toggle switches), should take on the binary states reflecting the actual settings of these facilities. Mode A reply code “0000” should be displayed on the controller in these circumstances indicating to the crew the need to enter the desired code.

### Dual Transponder Control Panel Considerations

The crew interface for a dual system should be the same as that provided for a single system with the exception of the presence on the dual system panel of the number 1/number 2 selection facilities. Displays and data entry facilities should be common for the two systems.

COMMENTARY

The degree of redundancy provided in the electronics “behind the panel” is the manufacturer’s option. Conceivably, approaches extending to almost completely separate electronics packages for each transponder could be followed.

## Human Centered Design

The control panel selection should be of a type that minimizes inadvertent operation.

## Flight Ident Implementation

Where flight ident is not available from another source, means should be provided in the control panel for the crew to enter the Flight Identification Code. The Flight Identification function can be integrated with the ATC/TCAS control panel, or it can be available by using a dedicated Flight Identification control panel connected to a Flight Identification capable ARINC 429 input port in the transponder referenced in Attachment 4.

COMMENTARY

Flight ident is the call sign used in flight.

### Control Panel Labeling for Flight ID

There should be clear labeling on the control panel for selection of the Flight Ident function. Flight Identification can be labeled by using acronyms such as, “FLT ID,” “FLIGHT ID,” “FLIGHT IDENT” or “FLIGHT NO.”

### Code Selectors and Display

Means should be provided for the crew to enter the Flight Identification code, by using a keypad or rotary knobs. The control panel should allow the crew to enter any alphanumeric combination of characters, to allow the entry of any call sign or aircraft registration where flight plan has been filed in accordance with ICAO Annex 10.

Selection and entry of the Flight Identification code should not interfere with any other ATC/TCAS functions selected.

Means should be provided in the control panel to display the Flight Identification code. Unused Flight Ident characters in the display should be blanked.

### Flight Ident Control Information Transfer

Flight Identification code should be transmitted to both transponders from the control panel using Flight ID ARINC 429 data words 1-5 (labels 233, 234, 235, 236, and 237). Integrated ATC/TCAS/FLT ID control panels will transmit both control words and Flight ID words to the transponder per Section 6.3. A dedicated Flight Ident control panel should transmit only Flight identification on ARINC 429 data words 1-5 (labels 233, 234, 235, 236, and 237) to the transponder per Section 6.3. The dedicated Flight ID panel should connect to the General Purpose FMS input bus in the transponder.

Flight ID ARINC 429 data word 5 (Label 237) is needed only if the control panel supports more than 8 characters.

# Antenna

## Introduction

The antenna should be designed to receive and transmit vertically polarized signals in the frequency range 960 to 1215 MHz so that it may be used interchangeably for the ATCRBS/Mode S, DME, and the optional non-directional TCAS antenna for the bottom antenna installation. The following paragraphs and Attachment 8 set forth details of a L-band antenna having both this capability and the omni directional coverage desired for the ATCRBS/Mode S/TCAS systems.

## Impedance and VSWR

The VSWR produced by the antenna terminating a 50 ohm transmission line should not exceed 1.42:1 (1.0 to 1.1 GHz) or 1.8:1 (0.96 to 1.22 GHz) when installed on a four foot diameter (or larger) ground plane (see Figure 1, Attachment 8). The antenna should provide a direct path to airframe ground.

## Gain and Polarization

The antenna polarization should be predominately vertical. The gain should not be more than 1.5 dB below a matched vertically polarized quarter-wave stub.

## Power Rating

The antenna should be capable of continuous operation at a peak pulse power input of 4 kW, and at an average power input of 250 watts.

## Radiation Pattern

The radiation pattern should be omni directional when measured on the center of the ground plane (see Figure 1, Attachment 8) at conic angles from 5 to 30 degrees above the ground plane.

COMMENTARY

For combined DME, ATCRBS/Mode S, and TCAS applications, the ideal azimuth radiation pattern of the antenna when installed on the aircraft is omni directional. If the pattern is not omni directional forward coverage should be slightly favored over aft or lateral coverage.

## Connector

The connector should be a Type C.

COMMENTARY

The choice of antenna connector type gave rise to much Subcommittee debate. The relative merits of several different types were reviewed, including “C,” “HN” and “SC.” None of these, or indeed, any other, received the unanimous support of the Subcommittee. When the tumult ceased, a process of opinion sampling produced a conclusion to call out the type “C” in this Characteristic. This connector has been used for many years on L-band antennas. The feeling was that any remaining problems with it could be solved in a cooperative effort of the airlines, the antenna manufacturers and airframe manufacturers.

## L-Band Systems Physical Isolation

The installation designer should also be aware of the need for physical isolation between antennas. This is necessary to protect receiver input circuitry from high energy RF pulses and to minimize the mutual radiation effects on each antenna. 20 dB of isolation will provide sufficient protection. This corresponds to 2.5 wave lengths or 30 inches.

COMMENTARY

Recent interest has grown in the possibility of not needing to connect the Mutual Suppression input/output of the Transponder to the aircraft on-board DME equipment in the interest of reducing installation wiring. Appendix 6 of this document and ARINC 709-8 address the requirements of the Suppression network. Both appendices in the documents imply the need to implement the suppression connections with all L-Band equipment if there is any doubt that appropriate antenna isolation cannot be maintained. Next, ARINC 709-8 Section 6.2.3 indicates that at least 20 dB of isolation must be established between ATC Transponder, other DMEs, TACAN, and IFF antennas. The paragraph above reinforces this requirement and provides the recommended distance between antennas to establish such isolation. The prudent sure way to ensure appropriate isolation and reduce interference between L-Band systems is to implement the suppression network. In no case should the suppression network not be used between the Mode-S Transponder and the TCAS Computer. However, it may be acceptable to not connect the suppression network to the DME units provided that the minimum isolation of 20 dB is maintained. Installers should ensure that the minimum isolation will be maintained under all conditions if the decision is made not to implement the suppression network with the DME units.

## Antenna Installation

In ATCRBS transponder aircraft installations, one antenna should be provided on a lower surface of the aircraft for each ATCRBS transponder installed.

In Mode S transponder aircraft, two antennas should be provided on the aircraft for each Mode S transponder installed. These antennas should be installed on the top and bottom of the fuselage as close to the longitudinal center line as practical. The two antennas should be located as close to the same fuselage station as practical and the horizontal displacement should not exceed 25 feet. The electrical length and attenuation of the cables connecting the antennas to the transponder should be matched within the limits specified by the equipment manufacturer.

### Total Interconnection Losses

In Mode S installations, losses in the coaxial cable connecting the transponder to either antenna will impact the receiver sensitivity as well as the transmitter power output. For this reason, antenna cable losses for each coaxial cable, including cable connectors, should be equal to 2.0 ± 1.0 dB at 1030 MHz.

1. A TRANSPONDER UNIT CONNECTOR POSITIONING



1. B CONTROL UNIT CONNECTOR POSITIONING



1. C INDEX PIN CODING

Avionics designers should design the ARINC 718A-compliant Mark 4 transponder to be a “backward compatible unit with future looking capabilities”. As a backward compatible unit, the Mark 4 transponder is expected to be designed to be fully interchangeable with an ARINC 718 Mark 3 transponder. This means aircraft originally fitted with a Mark 3 transponder can be simply updated by removal of the Mark 3 unit and replacement with a Mark 4 unit. All previous ARINC 718 functionality is maintained.

As a “future looking” unit, the Mark 4 transponder may employ aircraft parameter data in methods described in this Characteristic. In order to provide these additional services, aircraft parameter data sources must be connected to the Mark 4 transponder service connector. The Mark 4 transponder will automatically detect such interfaces and use them.

A degree of safety must be designed which prevents a service connector configured with “Mark 4 intended” aircraft parameter data sources from being accessed by a Mark 3 transponder. This is necessary because a Mark 3 transponder may adversely affect such aircraft parameter data sources due to the nature of the new connections in comparison with the ARINC 718 electrical connections. Mark 3 (ARINC 718) application of the transponder and its mating (Aircraft) plug provides 3 female (receptacle) keys in the transponder unit, and 3 male (pin) keys at the aircraft plug, as shown in the following diagram:



Figure 1C-1 – ARINC 718 Transponder Keying

To provide backward compatibility, and yet provide assurance that a Mark 3 (ARINC 718) transponder is not installed to a Mark 4 (ARINC 718A) configured aircraft plug, the ARINC 600 keying is altered at both the Mark 4 transponder and the aircraft plug. Alteration is as shown in the following diagram:



Figure 1C-2 – ARINC 718A Transponder Keying

Figure 1C-2 shows the ARINC 718A transponder has eliminated the upper-most key restraint, while the aircraft-tray has installed a center index post in a slightly rotated position, thus preventing an ARINC 718 transponder from being inserted. The ARINC 718A transponder can be inserted in either ARINC 718 installations (key code 05) or into ARINC 718A installations (key code 41). The center index post of an ARINC 718A transponder must remain as per Figure 1C-1 on any transponder that supports Gillham unless such a transponder auto detects ARINC 429 activity on Gillham inputs.

Note: Equipment installers are alerted that installation of the Mark 4 transponder (rotated half hexagon) keying is essential for system integrity when any aircraft digital data sources are routed to the pins defined for Gillham use in ARINC 718 (Pins TP-1A to TP-1K, TP-2K, TP-3K, MP-4A to MP-4K, MP-5K, and MP-6K). Also consideration must be given to changing the keying when the installation uses pins for a different purpose than that defined in ARINC 718.

Those pins identified as most likely to cause a conflict are (TP-3A, TP-3J, TP-6H, TP-6J and MP-3J, MP-5C, MP-5D, MP-5H, MP-6J, MP-7K, and MP-5G). Conflicts will depend upon the use of the pins on the aircraft and the transponders certified for installation in that location, but it is up to the installer to ensure that the keying is changed where damage to the aircraft might occur from installing a Mark 3 unmodified transponder.

Associated with the change of keying of the transponder is the activation of the “Backward Incompatibility Discrete” pin (Bottom plug pin 2). The use of this pin is to identify to the installed transponder that the installation has connections that are not compatible with ARINC 718 and should always be grounded when a conflict of pin functions is determined.

1. D NOTES TO CONNECTOR KEYING
   1. MINIMUM SUBSET – SINGLE-SIDED CONFIGURATION RECOMMENDED KEYING

The keying specified for the Minimum Subset, Single-Sided Configuration (Attachment 2B) is the same keying as that specified in Attachment 1C, Figure 1C-1 for ARINC 718 transponders.

* 1. MINIMUM TIF – DOUBLE-SIDED CONFIGURATION RECOMMENDED KEYING

The keying specified for the Minimum TIF, Double-Sided Configuration (Attachment 2C) is the same keying as that specified in Attachment 1C, Figure 1C-2 for ARINC 718A transponders.

1. A-1 TIF AND MINIMUM SUBSET CONFIGURATIONS PIN ALLOCATION – MINIMUM SUBSET

Bottom Plug (BP)



Suppression pulse daisy chaining without external “T” connectors

Note: The layout of these contacts within this connector will minimize common mode failures between duplicate systems. The equipment manufacturer and installer should bear this segregation in mind in the design of equipment and installations.



1. A-2 TIF AND MINIMUM SUBSET CONFIGURATIONS STANDARD INTERWIRING

**TOP PLUG**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| MSP/ATSU/CMU/In #2 A | TP-1A | ARINC 429 Input | MSP/ATSU/CMU #2 | 2,43 |
| MSP/ATSU/CMU/In #2 B | TP-1B | ARINC 429 Input | MSP/ATSU/CMU #2 | 2,43 |
| Data Loader In A | TP-1C | ARINC 429 Input | 615 Data Loader | 1,2 |
| Data Loader In B | TP-1D | ARINC 429 Input | 615 Data Loader | 1,2 |
| Reserved, Weather In #1 A | TP-1E | ARINC 429 Input | 707 Radar Altimeter #1 | 1,2 |
| Reserved, Weather In #1 B | TP-1F | ARINC 429 Input | 707 Radar Altimeter #1 | 1,2 |
| DFS/VHF #1 A | TP-1G | ARINC 429 Input | 720 DFS #1, or | 1,2 |
| DFS/VHF #1 B | TP-1H | ARINC 429 Input | 716 VHF #1 | 1,2 |
| GPS Time Mark #2 A | TP-1J | Differential Input | 743A GNSS #2 | 16 |
| GPS Time Mark #2 B | TP-1K | Differential Input | 743A GNSS #2 | 16 |
| FMC/GNSS #1 In #1 A | TP-2A | ARINC 429 Input | 743A GNSS #1 or | 2,3,44,47,49 |
| FMC/GNSS #1 In #1 B | TP-2B | ARINC 429 Input | 702A FMC #1 | 2,3,44,47,49 |
| IRS/FMS/Data Concentrator In #1 A | TP-2C | ARINC 429 Input | 702A FMC #1, 704 IRS | 2,3,44, 47 |
| IRS/FMS/Data Concentrator In #1 B | TP-2D | ARINC 429 Input | #1, Data Conc. #1 | 2,3,44, 47 |
| General Output #1 A | TP-2E | ARINC 429 HS Output | 615 Data Loader, or | 15,44,47 |
| General Output #1 B | TP-2F | ARINC 429 HS Output | As Needed | 15,44,47 |
| MSP/ATSU/CMU In #1 A | TP-2G | ARINC 429 Input | MSP/ATSU/CMU #1 | 2,43 |
| MSP/ATSU/CMU In #1 B | TP-2H | ARINC 429 Input | MSP/ATSU/CMU #1 | 2,43 |
| Reserved, Weather In #2 A | TP-2J | ARINC 429 Input | 707 Radar Altimeter #1 | 1,2 |
| Reserved, Weather In #2 B | TP-2K | ARINC 429 Input | 707 Radar Altimeter #1 | 1,2 |
| FMC 1/2 Select Discrete Input | TP-3A | Discrete Output |  | 5 |
| XPDR Fail Discrete #2 Output | TP-3B | Discrete Output |  | 6,44 |
| Cable Delay Program – Top/Bottom | TP-3C | Program Pin Input |  | 7,44 |
| Cable Delay Program – Value | TP-3D | Program Pin Input |  | 7,44 |
| Cable Delay Program – Value | TP-3E | Program Pin Input |  | 7,44 |
| Vendor Discrete Input | TP-3F | Discrete Input |  | 8 |
| SDI Input Discrete | TP-3G | Discrete Input |  | 9,44 |
| SDI Input Discrete | TP-3H | Discrete Input |  | 9,44 |
| FMC/GNSS 1/2 Select Discrete Input (Reserved) | TP-3J | Discrete Input |  | 10 |
| General Output #2 A | TP-3K | ARINC 429 HS Output |  | 15 |
| Synchro Altitude #1 Coarse Input X | TP-4A | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Coarse Input Y | TP-4B | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Coarse Input Z | TP-4C | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Reference Input H | TP-4D | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Reference Input C | TP-4E | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Fine Input X | TP-4F | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Fine Input Y | TP-4G | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Fine Input Z | TP-4H | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #1 Flag | TP-4J | Discrete Fault Input | 565 ADC | 11,44 |
| General Output #2 B | TP-4K | ARINC 429 HS Output |  | 15 |
| Maximum Cruising True Airspeed – 17 | TP-5A | Program Pin Input |  | 12,44 |
| Maximum Cruising True Airspeed – 16 | TP-5B | Program Pin Input |  | 12,44 |
| Maximum Cruising True Airspeed – 15 | TP-5C | Program Pin Input |  | 12,44 |
| Top Plug Common | TP-5D | Ground Reference |  | 44 |
| TX Coordination A | TP-5E | ARINC 429 HS Input | 735A/B TCAS | 13,44 |
| TX Coordination B | TP-5F | ARINC 429 HS Input | 735A/B TCAS | 13,44 |
| XT Coordination A | TP-5G | ARINC 429 HS Output | 735A/B TCAS | 13,44 |
| XT Coordination B | TP-5H | ARINC 429 HS Output | 735A/B TCAS | 13,44 |
| Air/Ground Discrete Input #2 | TP-5J | Discrete Input |  | 14.44 |
| Air/Ground Discrete Input #1 | TP-5K | Discrete Input |  | 14.44 |
| FMC #1, General Input #2 A | TP-6A | ARINC 429 Input | 702A FMC #1 | 2,3,44 |
| FMC #1, General Input #2 B | TP-6B | ARINC 429 Input | 702A FMC #1 | 2,3,44 |
| Reserved DGPS ARINC 429 Output Data Bus A | TP-6C | ARINC 429 Output | 743A GNSS #1 and #2 | 15 |
| GPS Time Mark #1 A | TP-6D | Differential Input | 743A GNSS #2 | 16 |
| GPS Time Mark #1 B | TP-6E | Differential Input | 743A GNSS #2 | 16 |
| Spare | TP-6F |  |  | 48 |
| Spare | TP-6G |  |  | 48 |
| GPS/GNSS In #1 A | TP-6H | ARINC 429 Input | 743A GNSS #1 | 1,2,49 |
| GPS/GNSS In #1 B | TP-6J | ARINC 429 Input | 743A GNSS #1 | 1,2,49 |
| Antenna Program | TP-6K | Program Pin Input |  | 17,44 |
| Control Data “A” or  FCC #1/MCP #1/VHF #3 Input Port A | TP-7A | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2,18,20,44,45 |
| Control Data “A” or  FCC #1/MCP #1/VHF #3 Input Port B | TP-7B | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2,18,20,44,45 |
| Reserved DGPS ARINC 429 Output Data Bus B | TP-7C | ARINC 429 Output | 743A GNSS #1 and #2 | 15 |
| Control Data Port Select Discrete Input | TP-7D | Discrete Input |  | 18,20,44 |
| Control Data “B” Input Port A | TP-7E | ARINC 429 Input | 718 Control | 2,18,44 |
| Control Data “B” Input Port B | TP-7F | ARINC 429 Input | 718 Control | 2,18,44 |
| Standby/On Discrete Input | TP-7G | Discrete Input |  | 19,44 |
| Digital Air Data #1 Input A | TP-7H | ARINC 429 Input | 706 ADS #1 or | 2,44 |
| Digital Air Data #1 Input B | TP-7J | ARINC 429 Input | 575 ADS #1 | 2,44 |
| FCC/MCP ½ Select Discrete In | TP-7K | Discrete Input |  | 18,20 |
| Top Antenna RF | TP-Coax | Coaxial Input | Top Antenna | 44 |
| MIDDLE PLUG | | | | |
| SIGNAL NAME | PIN | SIGNAL TYPE | SOURCE/SINK | NOTES |
| Mode S Address Bit A1 MSB  or (Resv Output) APM Power (Red) | MP-1A | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A2  or (Resv Output) APM Power Ret/Com (Black) | MP-1B | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A3  or (Resv Output) APM Clock (Green) | MP-1C | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A4  or (Resv Output) APM Ser Data Input (Blue) | MP-1D | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A5  or (Resv Output) APM Serial Data Input (Gray) | MP-1E | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A6  or (Resv Out) APM Write Enable #1 Output (White) | MP-1F | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A7  or (Resv Out) APM Write Enable #2 Output (Violet) | MP-1G | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A8  or (Resv Output) APM Enable #1 Output (Yellow) | MP-1H | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A9  or (Resv Output) APM Enable #2 Output (Orange) | MP-1J | Program Pin Input | 607 APM | 21,22,44 |
| Mode S Address Bit A10 MSB | MP-1K | Program Pin Input |  | 21,44 |
| Mode S Address Bit A11 | MP-2A | Program Pin Input |  | 21,44 |
| Mode S Address Bit A12 | MP-2B | Program Pin Input |  | 21,44 |
| Mode S Address Bit A13 | MP-2C | Program Pin Input |  | 21,44 |
| Mode S Address Bit A14 | MP-2D | Program Pin Input |  | 21,44 |
| Mode S Address Bit A15 | MP-2E | Program Pin Input |  | 21,44 |
| Mode S Address Bit A16 | MP-2F | Program Pin Input |  | 21,44 |
| Mode S Address Bit A17 | MP-2G | Program Pin Input |  | 21,44 |
| Mode S Address Bit A18 | MP-2H | Program Pin Input |  | 21,44 |
| Mode S Address Bit A19 | MP-2J | Program Pin Input |  | 21,44 |
| Mode S Address Bit A20 | MP-2K | Program Pin Input |  | 21,44 |
| Mode S Address Bit A21 | MP-3A | Program Pin Input |  | 21,44 |
| Mode S Address Bit A22 | MP-3B | Program Pin Input |  | 21,44 |
| Mode S Address Bit A23 | MP-3C | Program Pin Input |  | 21,44 |
| Mode S Address Bit A24 LSB | MP-3D | Program Pin Input |  | 21,44 |
| 24-bit/APM Address Select Discrete Input | MP-3E | Discrete Input |  | 8,23 |
| FCC/MCP #1/VHF #3 Input A | MP-3F | ARINC 429 Input | MCP, 701 FCC #1 | 2,20,44,45 |
| FCC/MCP #1/VHF #3 Input B | MP-3G | ARINC 429 Input | MCP, 701 FCC #1 | 2,20,44,45 |
| Functional Test Discrete Input | MP-3H | Discrete Input |  | 44 |
| Data Loader Activate Discrete Input | MP-3J | Discrete Output |  | 24 |
| Transponder Fail #1 Discrete Output | MP-3K | Discrete Output | 718 Control | 25,44 |
| FMC #2, General Input #2 A | MP-4A | ARINC 429 Input | 702A FMC #2 | 1,2,3 |
| FMC #2, General Input #2 B | MP-4B | ARINC 429 Input | 702A FMC #2 | 1,2,3 |
| FMC/GNSS #2 In #1 A | MP-4C | ARINC 429 Input | 743A GNSS #2 or | 1,2,3,49 |
| FMC/GNSS #2 In #1 B | MP-4D | ARINC 429 Input | 702A FMC #2 | 1,2,3,49 |
| GPS/GNSS #2 In A | MP-4E | ARINC 429 Input | 743A GNSS #2 | 1,2,49 |
| GPS/GNSS #2 In B | MP-4F | ARINC 429 Input | 743A GNSS #2 | 1,2,49 |
| DFS/VHF #2 In A | MP-4G | ARINC 429 Input | 720 DFS #2, or | 1,2 |
| DFS/VHF #2 In B | MP-4H | ARINC 429 Input | 716 VHF #2 | 1,2 |
| FCC/MCP In #2 A | MP-4J | ARINC 429 Input | 701 FCC #2, MCP #2 | 1,2,20 |
| FCC/MCP In #2 B | MP-4K | ARINC 429 Input | 701 FCC #2, MCP #2 | 1,2,20 |
| Digital Air Data #2 Input A | MP-5A | ARINC 429 Input | 706 ADS #2 or | 2 |
| Digital Air Data #2 Input B | MP-5B | ARINC 429 Input | 575 ADS #2 | 2 |
| IRS/FMS/Data Concentrator In #2 A | MP-5C | ARINC 429 Input | 702A FMC #2, 704 | 2,3 |
| IRS/FMS/Data Concentrator In #2 B | MP-5D | ARINC 429 Input | IRS #2, Data Conc #2 | 2,3 |
| MSP/ATSU/CMU Out #1 A | MP-5E | ARINC 429 HS Output | MSP/ATSU/CMU #1 | 4,43,44,47 |
| MSP/ATSU/CMU Out #1 B | MP-5F | ARINC 429 HS Output | MSP/ATSU/CMU #1 | 4,43,44,47 |
| Extended Squitter Disable | MP-5G | Discrete Input |  | 34,44 |
| Mode S DL/DLP | MP-5H | Program Pin Input |  | 44,47 |
| Antenna Bite Program Discrete Input | MP-5J | Program Pin Input |  | 28 |
| IRS 1/2 Select Discrete Input | MP-5K | Program Pin Input |  | 26 |
| Maintenance Data Input A | MP-6A | ARINC 429 Input | As Required | 2,44 |
| Maintenance Data Input B | MP-6B | ARINC 429 Input | As Required | 2,44 |
| Maintenance Data Output A | MP-6C | ARINC 429 Input | As Required | 4,44 |
| Maintenance Data Output B | MP-6D | ARINC 429 Input | As Required | 4,44 |
| Alternate Source Select Discrete Input | MP-6E | Discrete Input | 718 Control Pin #16 | 29,44 |
| Altitude Type Select \_B Discrete Input | MP-6F | Program Pin Input |  | 30,44 |
| Altitude Type Select \_A Discrete Input | MP-6G | Program Pin Input |  | 30,44 |
| Middle Plug Common | MP-6H | Ground Reference |  |  |
| MSP/ATSU/CMU Out #2 A | MP-6J | ARINC 429 HS Output | MSP/ATSU/CMU #2 | 4,43 |
| MSP/ATSU/CMU 1/2 Select | MP-6K | Program Pin Input |  | 36 |
| Synchro Altitude #2 Coarse Input X | MP-7A | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Coarse Input Y | MP-7B | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Coarse Input Z | MP-7C | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Reference Input H | MP-7D | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Reference Input C | MP-7E | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Fine Input X | MP-7F | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Fine Input Y | MP-7G | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Fine Input Z | MP-7H | 26 Vac Input | 565 ADC | 11,44 |
| Synchro Altitude #2 Flag | MP-7J | Discrete Fault Input | 565 ADC | 11,44 |
| MSP/ATSU/CMU Out #2 B | MP-7K | ARINC 429 HS Output | MSP/ATSU/CMU #2 | 4,43 |
| Bottom Antenna RF | MP-Coax | Coaxial Input | Bottom Antenna |  |

**BOTTOM PLUG**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| 115 Vac Primary Power Hot | BP-1 | 115 Vac |  | 31,32,44 |
| Backward Incompatibility Discrete | BP-2 | Program Pin Input |  | 33 |
| Reserved 28 Vdc Return | BP-3 |  |  | 44 |
| Aircraft Category Discrete Input #1 | BP-4 | Program Pin Input |  | 27 |
| Aircraft Category Discrete Input #2 | BP-5 | Program Pin Input |  | 27 |
| Aircraft Category Discrete Input #3 | BP-6 | Program Pin Input |  | 27 |
| 115 Vac Primary Power Cold | BP-7 | 115 Vac |  | 31,32,44 |
| Signal Ground | BP-8 |  |  | 32,44 |
| Reserved Weather In 1/2 Select | BP-9 |  |  | 35 |
| Reserved 28 Vdc | BP-10 |  |  | 44 |
| Chassis Ground | BP-11 | Ground Reference |  | 44 |
| Suppression | BP-12 Coax | Coax | Other Suppression | 44 |
| Suppression (for Daisy Chaining) | BP-13 Coax | Coax |  | 44 |

**CONTROL PANEL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| Panel Lighting Supply A | J1-CP-1 | 0 to 5 Vac Lighting |  | 37 |
| Panel Lighting Supply B | J1-CP-2 | 0 to 5 Vac Lighting |  | 37 |
| 115 Vac Power HI | J1-CP-3 | Aircraft Power |  |  |
| 115 Vac Power LO | J1-CP-4 | Aircraft Power Return |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 38 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/On | J1-CP-7 | Discrete Input | Control Panel | 19 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 37,39 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 40 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 14 |
| Transponder Fail Logic #2 Input | J1-CP-12 | Discrete Input |  | 46 |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  |  |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 14 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 29 |
| Flight ID Capability | J1-CP-17 | Discrete Input |  | 51 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light Power Source | 41 |
| Altitude Comparison Fail Discrete | J1-CP-19 | Discrete Output |  |  |
| Transponder Fail Logic #1 Input | J1-CP-20 | Analog Input |  | 46 |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 42 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 14 |
|  |  |  |  |  |
| Reserved ARINC 429 Input A | J2-CP-1 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-2 | Digital |  | 50 |
| Reserved ARINC 429 Input A | J2-CP-13 | Digital |  | 52 |
| Reserved ARINC 429 Input B | J2-CP-14 | Digital |  | 52 |

1. A-3 TIF AND MINIMUM SUBSET CONFIGURATIONS NOTES APPLICABLE TO STANDARD INTERWIRING
2. Re-definition of Gillham Input Pins

It is not the intention of this specification to encourage, or define the means for, the continued use of Gillham altitude encoding in transponders; there are well-documented concerns of its failure modes and their interaction with safe TCAS operation. However, some operators may desire uniform carriage of transponders for Gillham and non-Gillham aircraft. Manufacturers may wish to accommodate these users by producing transponders that perform both some Enhanced Surveillance functionality and allow Gillham altitude inputs. It is not expected that an aircraft using Gillham will be also providing Enhanced Surveillance; such installations are likely to be discouraged by regulators.

Transponder manufacturers should note that when providing a transponder that still provides Gillham functionality, although also implementing some Mark 4 functions, the keying of the transponder must be left as a Mark 3 configuration (see Note 33) to ensure it cannot be fitted into an aircraft completely wired for Mark 4 functionality.

This allows an operator to use a single part number unit to support minimum Enhanced Surveillance functionality on some aircraft and Gillham on others, provided the keying instructions in Attachment 1C are adhered to.

Mark 4 transponder keying should only be provided on a transponder that does not support Gillham or has been certified to ensure that the Gillham function will not be mistakenly activated and cause damage to the aircraft.

It is likely that airframe manufacturers will require different part numbers for Gillham and non-Gillham transponders, and that the deactivation of any included Gillham function be performed internally to the transponder.

1. General ARINC 429 Input Data Buses

These ARINC 429 input data buses may be either high-speed (100 kbps) or low-speed (12.5 kbps).

The Mark 4 transponder must be able to process either without additional command direction.

1. ARINC 702A FMC/FMS Data Inputs

Two FMS input ports are provided for each FMC: FMC/GNSS IN #1 and FMC GEN IN #2. Two ports have been assigned to support common existing FMC configurations where the Flight ID is available on the FMC General Purpose output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the ARINC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

1. General ARINC 429 Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 low-speed (12.5 kbps) bus requirements, unless otherwise noted.

1. FMC 1/2 Select Discrete Input

This pin is used to select the active ports for FMC General Input Data on TP-6A/TP-6B for FMC #1, or MP-4A/MP-4B for FMC #2. When the pin is open, the FMC #1 port is active. When the pin is grounded, the FMC #2 port is active.

1. Transponder Fail Discrete #2 Output

This discrete output should be an “open” when the Mark 4 transponder has failed. The output should be a “ground” when the transponder is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

1. Cable Delay Program

These pins provide the capability to identify the installation’s relative cable delay. When programming, “1” is designated by connecting the desired pin to Top Plug Common (TP-5D).

|  |  |
| --- | --- |
| **Pin** | **Coding** |
| TP-3C | 0 = Add time delay to top  1 = Add time delay to bottom |

|  |  |  |  |
| --- | --- | --- | --- |
| **TP-3D** | **TP-3E** | **Differential Delay (nsec)** | **Add (nsec) in XPDR** |
| 0 | 0 | 0 - 50 | 0 |
| 0 | 1 | 51 - 150 | 100 |
| 1 | 0 | 151 - 250 | 200 |
| 1 | 1 | 251 - 350 | 300 |

TP-5D Top Plug Common Pin

The Round Trip cable delay is twice the length (in feet) multiplied by the delay (in nsec/ft). A typical delay is 1.54 nsec/ft.

Example Calculation:

Given:

* Top cable length = 75 ft.
* Bottom cable length = 25 ft.

Procedure:

1. Select Top/Bottom code “1,” to add time compensation to the bottom antenna.
2. Install coding in the interwiring: Connect TP-3C to TP-5D
3. Calculate time compensation:
   1. Calculate the difference in cable lengths: 75 - 25 = 50 ft.
   2. Determine the cable delay: 50 ft. x 2 x 1.54 = 154 nsec
   3. Select coding: (151 - 250 nsec)
4. Install coding in the interwiring: Connect TP-3D to TP-5D  
    Leave TP-3E “Open”
5. Program Pins

As a means to provide compatibility between Mark 3 transponders and Mark 4 transponders, it is important that these inputs are interpreted as program common inputs. Designers are alerted that interconnected wiring provides unit configuration information which needs to be properly interpreted.

1. Source/Destination Identifier (SDI) Encoding

These pins are for encoding the location of the Mark 4 transponder in the aircraft, (i.e., “system number”) per Section 2.1.4. of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected to Chassis or Aircraft ground or to TP-5D. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the transponder to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins TP-3G and TP-3H should be left open circuit with the result that bit numbers 9 and 10 are always binary “zero.”

|  |  |  |
| --- | --- | --- |
| **Transponder/No.** | **Connector Pin** | |
| **TP-3G** | **TP-3H** |
| Not Applicable | Open | Open |
| 1 | Open | Ground |
| 2 | Ground | Open |
| 3 | Ground | Ground |

1. FMC/GNSS 1/2 Select Discrete Input (Reserved)

This pin is used to select the active port for FMC/GNSS data. When the pin is open the number 1 FMC/GNSS port is active and when it is grounded the number 2 FMC/GNSS port is active.

1. Optional Synchro Input

Synchro altitude signals, when used, should conform to the standards set forth in ARINC Characteristic 565, Mark 2 Sub-Sonic Air Data System. (See Section 4.2.18.3 of this Standard.)

1. Maximum Cruising Airspeed Capability

The RI field contains information pertaining to the designed maximum cruising airspeed capability of the aircraft in which the Mark 4 transponder is installed. To insert the code for the bit to be designated “1,” connect the appropriate pin (TP-5A, TP-5B, or TP-5C) to Top Plug Common, TP-5D. Max airspeed coding is shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **TP-5C** | **TP-5B** | **TP-5A** | **Description** |
| **BIT 15** | **BIT 16** | **BIT 17** |
| 0 | 0 | 0 | No maximum airspeed available |
| 0 | 0 | 1 | Airspeed up to 75 kts |
| 0 | 1 | 0 | Airspeed between 75 and 150 kts |
| 0 | 1 | 1 | Airspeed between 150 and 300 kts |
| 1 | 0 | 0 | Airspeed between 300 and 600 kts |
| 1 | 0 | 1 | Airspeed between 600 and 1200 kts |
| 1 | 1 | 0 | Airspeed more than 1200 kts |
| 1 | 1 | 1 | Not Assigned |

1. ACAS/Mark 4 Transponder Interface

The ACAS/Mark 4 transponder interface consists of two ARINC 429 high-speed buses. Refer to ARINC Characteristic 735() for the full definition of this interface.

1. Air/Ground Logic Input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. Air/Ground Discrete Input #2 is to be used when it is desired that the transponder automatically inhibit replies per ICAO Annex 10 when the aircraft is on the ground. Air/Ground Discrete Input #1 is to be used when replies are not to be inhibited when the aircraft is on the ground. Airframe and equipment manufacturers are cautioned to provide “sneak circuit” protection for these inputs so that malfunctions of other equipment connected to the same logic source do not affect operation. The system should be designed such that the normal failure mode should be to the “airborne” condition.

COMMENTARY

It is recommended that aircraft installations implement the use of Air/Ground Discrete Input #2 in order to minimize the amount of unnecessary ATCRBS Mode A and Mode C replies when in the ON-Ground state. As such, the use of Air/Ground Discrete Input #1 is discouraged.

1. ARINC 429 High-Speed Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 high-speed (100 kbps) bus operation, unless otherwise noted.

1. GPS Time Mark Inputs

The Differential Time Mark input is an interface to an ARINC 743A GNSS receiver to provide synchronization to other aircraft systems. Signal characteristics for the Time Mark (i.e., tag) are provided in Attachment 8 of ARINC Characteristic 743A.

1. Antenna Program

This program pin input is assigned to identify an installation in which only one antenna is used (i.e., the bottom antenna). A “ground” at this input should be used to indicate a single antenna installation, while an “open” should be interpreted as a dual antenna installation. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Control Panel Interface

The Mark 4 transponder is equipped with two control data input ports and a port selection function to accommodate the different control philosophies described in ARINC Specification 720. The interwiring diagram reflects the philosophy in which a dedicated Control Panel is used. The data output port of this panel is normally wired to Control Data Input Port “B” on the transponder unit. Control Data Input Port “A” and the port selection discrete function are not normally wired.

When implemented, the Control Data Port Select Discrete Input is used to select the active control port as follows:

When the Control Data Port Select Discrete Input, TP-7D, is open then Control Data Input Port B is the active control port.

In this configuration, Control Data “A” Input Port, TP-7A/TP-7B, is configured to accept input data from the FCC #1, the MCP #1, or the VHF #3.

In this configuration, selection of the FCC #1/MCP #1 or FCC #2/MCP #2 active input port is further determined by the setting of the FCC/MCP 1/2 Select Discrete Input as provided in Note 20, below.

When the Control Data Port Select Discrete Input, TP-7D, is grounded then Control Data Input Port A is the active control port.

In this configuration, Control Data “A” Input Port, TP-7A/TP-7B, is configured as the active control input and therefore is not expected to be processing FCC#1, MCP#1, or VHF#3 data.

1. Standby/On Control

The Standby/On Control discrete provide a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. To obtain “Standby” operation, connect pin TP-7G to Chassis or Airframe ground. For “On” operation, leave pin TP-7G “open.” (See Section 6.4.1 of this Characteristic for further detail.)

1. FCC/MCP 1/2 Select Discrete Input

The use of several pins (TP-7A/TP-7B, MP-3F/MP-3G, MP-4J/MP-4K) is affected by whether the FCC/MCP 1/2 Select Discrete input (TP-7K) is grounded or not. This pin (TP-7K) is used to select the active port for FCC/MCP data as follows:

When the pin is open the FCC/MCP #1/VHF #3 port is active:

If the Control Data Port Select Discrete Input, TP-7D, is open, then FCC/MCP #1, and VHF #3 data is accepted via TP-7A/TP-7B or MP-3F/MP-3G.

If the Control Data Port Select Discrete Input, TP-7D, is grounded, then TP-7A/TP-7B are configured to accept Control Data. In this configuration, the Mark 4 transponder may be capable of processing FCC/MCP data on MP-3F/MP-3G. See Note 45.

When the pin is grounded the FCC/MCP #2 port is active on MP-4J/MP-4K.

1. Mode S Aircraft Address

The aircraft Mode S Address (also known as the ICAO 24-bit aircraft address) consists of a 24-bit sequence uniquely assigned to each aircraft. To provide aircraft installation insertion of the aircraft address, for each address bit designated “1” connect the corresponding connector pin to Middle Plug Common, MP-6H, or other Common. For “0” address bits, leave the corresponding connector pin open.

The aircraft Mode S address should be transmitted (RF) by the Mode S transmitter with the most significant bit (MSB) first. The MSB is designated A1.

1. (Reserved) Avionics Personality Module Interface

These pins are reserved for future interface to an ARINC 607 Avionics Personality Module (APM). It is expected that when interfaced to the APM, the APM will provide the appropriate Mode S Address (also referred to as the ICAO 24-Bit Address) as well as other installation relevant data that may be required. (See Attachment 9 of this document for additional information regarding the APM).

1. 24Bit/APM Address Select Discrete Input

This pin is used to identify the source of the Mode S Address (i.e., ICAO 24-Bit Address). The source can be the address program pins (MP-A10 through A-24 or an Avionics Personality Module (APM) method. When connection between this input and any of the Mode S Address inputs or connection to aircraft ground is detected then, the Mode S Address (i.e., ICAO 24-Bit Address) will be accepted from the program pin inputs. Otherwise address and configuration data should be accepted via the APM interface.

1. Data Loader Activate Discrete Input

This pin is used to indicate that the Data Load function is active. When connected to ground, this pin indicates that Data Load information is active on TP-1C/TP-1D and that protocol exchange should be initiated via TP-2E/TP-2F. When the pin is in the “open” circuit state, the Data Load function is not active and no action is required by the Mark 4 transponder.

1. Transponder Fail #1 Discrete Output

When the Mark 4 transponder unit has failed, this discrete output should supply +5 Vdc to operate Fail lamps (maximum current capability of 25 mA per lamp) and provide diode protection against sneak circuits. When the transponder unit has not failed, the output should be an “open” (100,000 ohms or more resistance from this pin to airframe ground).

Note: This is not a standard discrete output.

1. IRS 1/2 Select Discrete Input

This pin is used to select the active port for Inertial Reference System (IRS)/Flight Management System (FMS)/Data Concentrator input data. When the pin is open the number 1 IRS/FMS/Data Concentrator port is active and when it is grounded the number 2 IRS/FMS/Data Concentrator port is active.

1. Aircraft Category Program Pins #1, #2, #3

These pins are used to program the aircraft category. An “open” pin represents a logical “0,” while a connection of the pin to Middle Pin Common (MP-6H) represents a logical “1.”

The coding of the aircraft category is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **BP-4** | **BP-5** | **BP-6** | **Description** |
| **Cat #1** | **Cat #2** | **Cat #3** |
| 0 | 0 | 0 | No Aircraft Category Information |
| 0 | 0 | 1 | Small (12,500 lbs.) |
| 0 | 1 | 0 | Medium (12,500 to 75,000 lbs.) |
| 0 | 1 | 1 | Large (75,000 to 190,000 lbs.) |
| 1 | 0 | 0 | Extra Large (190,000 to 300,000 lbs.) |
| 1 | 0 | 1 | Heavy (>300,000 lbs.) |
| 1 | 1 | 0 | High Performance (> 5G acceleration capability) |
| 1 | 1 | 1 | Rotorcraft |

1. Antenna Bite Program Discrete Input

This program input should be connected to the Middle Plug Common (MP-6H) to indicate to the Mark 4 transponder unit that the antenna has the facility to provide BITE information. An antenna having a dc path to ground may be used, thus providing the ability to sense the presence of the antenna, and confirming cable continuity for BITE purposes.

This discrete input should only be checked when in the on-ground state.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active port for ARINC 429, ARINC 575, Synchro, and Gillham data sources. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. Altitude Air Data Type Select

The Mark 4 transponder is capable of receiving three types of altitude information. Two programming pins are assigned to select which type of altitude is to be processed as follows:

|  |  |  |
| --- | --- | --- |
| **Pin** | | **Selection** |
| **MP-6F** | **MP-6G** |
| 0 | 0 | ARINC 429 Data via ARINC 429 ADS Input Ports |
| 0 | 1 | Synchro Data via Synchro Input Ports |
| 1 | 0 | ARINC 575 Data via ARINC 429 ADS Input Ports |
| 1 | 1 | Not Used (formerly Gillham Altitude) |
| Logic “1” is designated by connecting the appropriate pin to Middle Plug Common (MP-6H). | | |
| Logic “0” is designated by leaving the respective pin in the open-circuit state. | | |

The following rules apply to altitude type selection and use:

a. Synchro (Course and Fine) Altitude and Validity Flag on two ports.

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Flag is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the synchro data.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Flag is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

b. ARINC 429 words on two ports:

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Selected Source is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the selected source.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Selected Source is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

c. ARINC 575 (DADS) words on two ports:

Same as for ARINC 429 data.

1. Primary Power Wiring

The “primary power cold” function has been assigned to be a long pin in the BP insert of the Mark 4 transponder unit to ensure that it breaks after the “primary power hot” connection when the transponder unit is removed from the rack. This is intended to prevent the infamous “hot pull” problems, which can occur when the ground circuit is interrupted during removal of the equipment with the power applied.

Because all of the pins in the control panel connector(s) are of equal length, this same precaution cannot be taken. The system circuit breaker should be opened before the control panel interconnect(s) is (are) broken.

1. Wire Sizes

It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakage occurs.

1. Backward Incompatibility Discrete Input

The Backward Incompatibility Discrete Input is used to identify to the installed transponder that the aircraft in which it has been installed has connections that are not compatible with an ARINC 718 (Mark 3 transponder). It is essential for system integrity that this pin is grounded when any aircraft digital data sources are routed to the pins defined for Gillham use in ARINC 718 (Pins TP-1A to TP-1K, TP-2K, TP-3K, MP-4A to MP-4K, MP-5K, and MP-6K).

Also consideration must be given to grounding the pin when the installation uses pins for a different purpose than that defined in ARINC 718 that may cause a conflict. Those pins identified as most likely to cause a conflict are (TP-3A, TP-3J, TP-6H, TP-6J and MP-3J, MP-5C, MP-5D, MP-5H, MP-6J, MP-7K, and MP-5G). Conflicts will depend upon the use of the pins on the aircraft and the transponders certified for installation in that location, but it is up to the installer to ensure that the pin is grounded where conflicts might occur.

1. Extended Squitter Disable Discrete Input

The Extended Squitter Disable Discrete is used to disable all Extended Squitter functions. When the pin is grounded Extended Squitter functions are disabled and when it is “open” the Extended Squitter functions are enabled.

1. Reserved Weather In #1/2 Select Discrete Input

This pin is used to select the active port for Weather In (includes Radar Altitude) data. When the pin is “open” Reserved Weather In #1 port is active and when it is grounded the Reserved Weather In #2 port is active.

1. MSP/ATSU/CMU #1/2 Select Discrete Input

This pin is used to select the active port for MSP/ATSU/CMU data. When the pin is “open” the number 1 MSP/ATSU/CMU port is active and when it is grounded the number 2 MSP/ATSU/CMU port is active.

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “Standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a dc ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. High-Speed and/or Special Purpose Buses

The MSP/ATSU/CMU buses should be configurable to be used as high-speed ARINC 429 buses as well as for special purposes or protocols.

1. Minimum Subset

These interfaces are identified as the Minimum Subset necessary to satisfy ARINC 718A compatibility requirements. Refer to Attachment 2A: Minimum Subset Pin Allocation.

1. FCC/MCP #1 Inputs

There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to both sets TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it would be the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G are needed for VHF #3 In.

1. Transponder Fail Logic

Transponder Fail Logic #1 Input

When the transponder has failed, this input discrete to the control panel should be +5 Vdc, and it should cause the transponder fail indicator to be illuminated. When transponder has not failed the input to this discrete should be “open.”

Transponder Fail logic #2 Input

When the transponder has failed, this input discrete to the control panel should be “open” and it should cause the transponder fail indicator to be illuminated. When the transponder has not failed, this input discrete should be grounded.

1. Mode S DL/DLP Discrete Input

The Mode S DL/DLP Discrete may be used to indicate that TP-2A/TP-2B and MP-5E/MP-5F utilize the Comm A/B protocol interface as specified in Attachment 5 of this document, and for a level 3 and above transponder that TP-2C/TP-2D and TP-2E/TP-2F utilize the Comm C/D protocol as specified in Attachment 5. When the pin (MP-5H) is grounded then TP-2A/TP-2B and MP-5E/MP-5F will operate as defined in Attachment 5 and, depending upon the level and functionality of the transponder, TP-2C/TP-2D and TP-2E/TP-2F may operate as defined in Attachment 5. When MP-5H is open TP- 2A/TP-2B, MP-5E/MP-5F, TP-2C/TP-2D, and TP-2E/TP-2F will operate as defined in Attachment 2.

1. Spare Pin Usage

The connector pins marked “Spare” in Standard Interwiring list are available for assignment, as the airline industry desires. However, if the interchangeability for the system specified in Section 1.5 of this Characteristic is to be retained, any such assignment thought necessary must be coordinated with the AEEC staff and approved by the industry prior to being made.

1. GPS/GNSS

See ARINC Characteristic 743A for complete definitions for input and output between the Mark 4 transponder and the GPS/GNSS.

1. Reserved ARINC 429 Input

This function is implemented in the right plug (J2) only of dual system control panels. This input may be used to provide data to the control panel form ARINC 429 buses such as the TCAS Maintenance Output bus.

1. Flight ID Disable Input (J1)

|  |  |
| --- | --- |
| **Flight ID Disable** | |
| **State** | **Description** |
| Open | Flight ID capability is enabled in control panel |
| Ground | Flight ID capability is disabled in control panel |

This function is only applicable to Control Panels that have the ability to transmit Flight ID information to the transponder.

1. B-1 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION PIN ALLOCATION

BOTTOM PLUG (BP)



Note: Bottom Plug shown above is the same as that previously defined in ARINC 718-4, Attachment 1C.

1. B-2 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION STANDARD INTERWIRING

TOP PLUG

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Aircraft/Vehicle Length/Width A MSB | TP-1A | Program Pin Input |  | 1, 44, 52 |
| Aircraft/Vehicle Length/Width B | TP-1B | Program Pin Input\_Strobed |  | 1, 44, 52, 63 |
| Aircraft/Vehicle Length/Width C LSB | TP-1C | Program Pin Input\_Strobed |  | 1, 44, 52, 63 |
| GPS Antenna Longitudinal Offset A MSB | TP-1D | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset B | TP-1E | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset C LSB | TP-1F | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| Navigation Accuracy Category\_Velocity (NACV) | TP-1G | Program Pin Input\_Strobed |  | 1, 44, 54, 63 |
| System Design Assurance (SDA) | TP-1H | Program Pin Input\_Strobed |  | 1, 44, 55, 63 |
| GPS Time Mark (Differential) A | TP-1J | Differential Input | 743A GNSS | 1, 16, 67 |
| GPS Time Mark (Differential) B | TP-1K | Differential Input | 743A GNSS | 1, 16, 67 |
| FMC/GNSS #1 In #1 A | TP-2A | ARINC 429 Input | 743A GNSS #1 or | 2, 3, 44, 47, 49 |
| FMC/GNSS #1 In #1 B | TP-2B | ARINC 429 Input | 702A FMC #1 |  |
| IRS/FMS/Data Concentrator In #1 A | TP-2C | ARINC 429 Input | 702A FMC #1, 704 IRS | 2, 3, 44, 47 |
| IRS/FMS/Data Concentrator In #1 B | TP-2D | ARINC 429 Input | #1, Data Conc. #1 |  |
| General Output #1 A | TP-2E | ARINC 429 HS Output | 615 Data Loader, or | 15, 44, 47 |
| General Output #1 B | TP-2F | ARINC 429 HS Output | As Needed | 15, 44, 47 |
| Not Assigned | TP-2G |  |  |  |
| Not Assigned | TP-2H |  |  |  |
| Spare | TP-2J |  |  | 1, 48 |
| ADS-B FAIL Disable | TP-2K | Program Pin Input |  | 1, 44, 64 |
| ABS-B OUT Fail Discrete Out | TP-3A | Discrete Output |  | 5 |
| XPDR Fail Discrete #2 Out | TP-3B | Discrete Output |  | 6, 44 |
| Cable Delay Program – Top/Bottom | TP-3C | Program Pin Input |  | 7, 44 |
| Cable Delay Program – Value | TP-3D | Program Pin Input |  | 7, 44 |
| Cable Delay Program – Value | TP-3E | Program Pin Input |  | 7, 44 |
| Common | TP-3F |  |  | 8 |
| SDI Input Discrete | TP-3G | Discrete Input |  | 9, 44 |
| SDI Input Discrete | TP-3H | Discrete Input |  | 9, 44 |
| Common | TP-3J |  |  | 10 |
| Common | TP-3K |  |  | 56 |
| Synchro Altitude #1 Coarse Input X | TP-4A | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Coarse Input Y | TP-4B | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Coarse Input Z | TP-4C | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Reference Input H | TP-4D | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Reference Input C | TP-4E | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Fine Input X | TP-4F | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Fine Input Y | TP-4G | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Fine Input Z | TP-4H | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #1 Flag | TP-4J | Discrete Fault Input | 565 ADC | 11, 44 |
| Not Assigned | TP-4K |  |  |  |
| Maximum Cruising Airspeed – 17 | TP-5A | Program Pin Input |  | 12, 44 |
| Maximum Cruising Airspeed – 16 | TP-5B | Program Pin Input |  | 12, 44 |
| Maximum Cruising Airspeed – 15 | TP-5C | Program Pin Input |  | 12, 44 |
| Top Plug Common | TP-5D | Ground Reference |  | 44 |
| TX Coordination A | TP-5E | ARINC 429 HS Input | 735A/B TCAS | 13, 44 |
| TX Coordination B | TP-5F | ARINC 429 HS Input | 735A/B TCAS | 13, 44 |
| XT Coordination A | TP-5G | ARINC 429 HS Output | 735A/B TCAS | 13, 15, 44 |
| XT Coordination B | TP-5H | ARINC 429 HS Output | 735A/B TCAS | 13, 15, 44 |
| Air/Ground Discrete Input #2 | TP-5J | Discrete Input |  | 14, 44 |
| Air/Ground Discrete Input #1 | TP-5K | Discrete Input |  | 14, 44 |
| FMC #1, General Input #2 A | TP-6A | ARINC 429 Input | 702A FMC #1 | 2, 3, 44 |
| FMC #1, General Input #2 B | TP-6B | ARINC 429 Input | 702A FMC #1 | 2, 3, 44 |
| Not Assigned | TP-6C |  |  |  |
| Not Assigned | TP-6D |  |  |  |
| Not Assigned | TP-6E |  |  |  |
| Not Assigned | TP-6F |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| Not Assigned | TP-6G |  |  |  |
| Not Assigned | TP-6H |  |  | 57 |
| Not Assigned | TP-6J |  |  | 57 |
| Antenna Program | TP-6K | Program Pin Input |  | 17, 44 |
| Control Data “A” or FCC #1/MCP #1/VHF #3 Input Port A | TP-7A | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2, 18, 20, 44,  45 |
| Control Data “A” or FCC #1/MCP #1/VHF #3 Input Port B | TP-7B | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2, 18, 20, 44,  45 |
| Not Assigned | TP-7C |  |  |  |
| Control Port Select Discrete Input | TP-7D | Discrete Input |  | 18, 20, 44 |
| Control Data “B” Input Port A | TP-7E | ARINC 429 Input | 718 Control | 2, 18, 44 |
| Control Data “B” Input Port B | TP-7F | ARINC 429 Input | 718 Control | 2, 18, 44 |
| Standby/On Discrete Input | TP-7G | Discrete Input |  | 19, 44 |
| Digital Air Data #1 Input A | TP-7H | ARINC 429 Input | 706 ADS #1 or | 2, 44 |
| Digital Air Data #1 Input B | TP-7J | ARINC 429 Input | 575 ADS #1 | 2, 44 |
| Not Assigned | TP-7K |  |  | 20 |
| Top Antenna RF | TP-Coax | Coaxial Input | Top Antenna | 44 |

| **MIDDLE PLUG**  **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Mode S Address Bit A1 MSB | MP-1A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A2 | | MP-1B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A3 | | MP-1C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A4 | | MP-1D | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A5 | | MP-1E | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A6 | | MP-1F | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A7 | | MP-1G | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A8 | | MP-1H | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A9 | | MP-1J | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A10 | | MP-1K | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A11 | | MP-2A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A12 | | MP-2B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A13 | | MP-2C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A14 | | MP-2D | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A15 | | MP-2E | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A16 | | MP-2F | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A17 | | MP-2G | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A18 | | MP-2H | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A19 | | MP-2J | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A20 | | MP-2K | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A21 | | MP-3A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A22 | | MP-3B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A23 | | MP-3C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A24 LSB | MP-3D | Program Pin Input |  | 21, 22, 44 |
| Common | MP-3E |  |  | 23 |
| Not Assigned | MP-3F |  |  |  |
| Not Assigned | MP-3G |  |  |  |
| Functional Test Discrete Input | MP-3H | Discrete Input |  | 44 |
| Reserved Discrete Out | MP-3J | Discrete Output |  | 24 |
| Transponder Fail #1 Discrete Output | MP-3K | Discrete Output | 718 Control | 25, 44 |
| Spare | MP-4A |  |  | 1, 26, 48 |
| Spare | MP-4B |  |  | 1, 26, 48 |
| FMC/GNSS #2 In #1 (Optional) A | MP-4C | ARINC 429 Input | 743A GNSS #2 or | 2, 3, 49 |
| FMC/GNSS #2 In #1 (Optional) B | MP-4D | ARINC 429 Input | 702A FMC #2 | 2, 3, 49 |
| Aircraft Category A MSB | MP-4E | Program Pin Input\_Strobed |  | 1, 44, 27, 63 |
| Aircraft Category B LSB | MP-4F | Program Pin Input\_Strobed |  | 1, 44, 27, 63 |
| ADS-B Configuration Parity | MP-4G | Program Pin Input |  | 1, 44, 66 |
| ADS-B Receive Capability | MP-4H | Program Pin Input\_Strobed |  | 1, 44, 63, 65 |
| Spare | MP-4J |  |  | 1, 48 |
| Spare | MP-4K |  |  | 1, 48 |
| Digital Air Data #2 Input A | MP-5A | ARINC 429 Input | 706 ADS #2 or | 2, 44 |
| Digital Air Data #2 Input B | MP-5B | ARINC 429 Input | 575 ADS #2 | 2, 44 |
| Not Assigned | MP-5C |  |  |  |
| Not Assigned | MP-5D |  |  |  |
| MSP/ATSU/CMU Out #1 A | MP-5E | ARINC 429 HS Output | MSP/ATSU/ | 4, 43, 44, 47 |
| MSP/ATSU/CMU Out #1 B | MP-5F | ARINC 429 HS Output | CMU #1 | 4, 43, 44, 47 |
| Extended Squitter Disable | MP-5G | Discrete Input |  | 34, 44 |
| Not Assigned | MP-5H |  |  | 47 |
| Antenna Bite Program Discrete Input | MP-5J | Program Pin Input |  | 28 |
| Spare | MP-5K |  |  | 1, 48 |
| Maintenance Data Input A | MP-6A | ARINC 429 Input | As Required | 2, 44 |
| Maintenance Data Input B | MP-6B | ARINC 429 Input | As Required | 2, 44 |
| Maintenance Data Output A | MP-6C | ARINC 429 Input | As Required | 4, 44 |
| Maintenance Data Output B | MP-6D | ARINC 429 Input | As Required | 4, 44 |
| Alternate Source Select Discrete Input | MP-6E | Discrete Input | 718 Control Pin #16 | 29, 44 |
| Altitude Type Select\_A Discrete Input | MP-6F | Program Pin Input |  | 30, 44 |
| Altitude Type Select\_B Discrete Input | MP-6G | Program Pin Input |  | 30, 44 |
| Middle Plug Common | MP-6H | Ground Reference |  | 21, 28 |
| Not Assigned | MP-6J |  |  | 59 |
| Common | MP-6K |  |  | 60 |
| Synchro Altitude #2 Coarse Input X | MP-7A | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Coarse Input Y | MP-7B | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Coarse Input Z | MP-7C | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Reference Input H | MP-7D | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Reference Input C | MP-7E | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Fine Input X | MP-7F | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Fine Input Y | MP-7G | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Fine Input Z | MP-7H | 26 Vac Input | 565 ADC | 11, 44 |
| Synchro Altitude #2 Flag | MP-7J | Discrete Fault Input | 565 ADC | 11, 44 |
| Not Assigned | MP-7K |  |  | 61 |
| Bottom Antenna RF | MP-Coax | Coaxial Input | Bottom Antenna | 44 |

**BOTTOM PLUG**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| 115 Vac Primary Power Hot | BP-1 | 115 Vac |  | 31, 32, 44 |
| Not Assigned | BP-2 |  |  | 33 |
| Reserved 28 Vdc Return | BP-3 |  |  | 44 |
| Not Assigned | BP-4 |  |  |  |
| Not Assigned | BP-5 |  |  |  |
| Not Assigned | BP-6 |  |  |  |
| 115 Vac Primary Power Cold | BP-7 | 115 Vac |  | 31, 32, 44 |
| Signal Ground | BP-8 |  |  | 32, 44 |
| Not Assigned | BP-9 |  |  |  |
| Reserved 28 Vdc | BP-10 |  |  | 44 |
| Chassis Ground | BP-11 | Ground Reference |  | 44 |
| Suppression | BP-12 Coax | Coax | Other Suppression | 44 |
| Suppression (for Daisy Chaining) | BP-13 Coax | Coax |  | 44 |

**CONTROL PANEL**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Panel Lighting Supply A | J1-CP-1 | 0 – 5 Vac Lighting |  | 37 |
| Panel Lighting Supply B | J1-CP-2 | 0 – 5 Vac Lighting |  | 37 |
| 115 Vac Power HI | J1-CP-3 | Aircraft Power |  |  |
| 115 Vac Power LO | J1-CP-4 | Aircraft Power Return |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 38 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/ON | J1-CP-7 | Discrete Input | Control Panel | 19 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 37, 39 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 40 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 14 |
| Transponder Fail Logic #2 Input | J1-CP-12 | Discrete Input |  | 46 |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  | 15, 44, 47 |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 14 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 29 |
| ADS-B OUT Fail #1 | J1-CP-17 | Discrete Input |  | 51 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light  Power Source | 41 |
| Altitude Comparison Fail Discrete | J1-CP-19 | Discrete Output |  |  |
| Transponder Fail Logic #1 Input | J1-CP-20 | Analog Input |  | 46 |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 42 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 14 |
| Reserved ARINC 429 Input A | J2-CP-1 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-2 | Digital |  | 50 |
| Reserved ARINC 429 Input A | J2-CP-13 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-14 | Digital |  | 50 |
| ADS-B OUT Fail #2 | J2-CP-17 | Discrete Input |  | 51 |

1. B-3 MINIMUM SUBSET, SINGLE-SIDED CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING
2. Re-definition of Gillham Input Pins

Gillham Altitude inputs are used only with ARINC 718A-1 and ARINC 718-4 transponder configurations. In Supplement 2 and later, these pins have been reassigned to provide for the input of various ADS-B parameters and configuration information. As such, these pins are not used for Gillham Altitude Input with the Minimum Subset, Single-Sided Configuration, specified in Attachment 2B-1.

1. General ARINC 429 Input Data Buses

These ARINC 429 input data buses may be either high-speed (100 kbps) or low-speed   
(12.5 kbps).

The Mark 4 transponder must be able to process either without additional command direction.

1. ARINC 702A FMC/FMS Data Inputs

Two FMS input ports are provided for the FMC: FMC/GNSS #1 IN #1 and FMC #1, GEN IN #2

These ports are assigned to support common existing FMC configurations where the Flight ID is available on the FMC General Purpose output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the ARINC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

1. General ARINC 429 Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 low-speed (12.5 kbps) bus requirements, unless otherwise noted.

1. ADS-B OUT Fail Discrete Output

This discrete output should be an “open” when the ADS-B OUT Function has failed. The output should be a “ground” when the ADS-B OUT Function is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

1. Transponder Fail Discrete #2 Output

This discrete output should be an “open” when the Mark 4 transponder has failed. The output should be a “ground” when the transponder is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Cable Delay Program

These pins provide the capability to identify the installation’s relative cable delay. When programming, “1” is designated by connecting the designated pin to Top Plug Common (TP-5D).

|  |  |  |  |
| --- | --- | --- | --- |
| TP-3D | TP-3E | Differential Delay (nsec) | Add (nsec) in XPDR |
| 0 | 0 | 0 - 50 | 0 |
| 0 | 1 | 51 - 150 | 100 |
| 1 | 0 | 151 - 250 | 200 |
| 1 | 1 | 251 - 350 | 300 |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

|  |  |
| --- | --- |
| **PIN** | **Coding/Meaning** |
| **TP-3C** |
| 0 | Add time delay to top |
| 1 | Add time delay to bottom |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | |

TP-5D Top Plug Common Pin

The Round Trip cable delay is twice the length (in feet) multiplied by the delay (in nsec/ft). A typical delay is 1.54 nsec/ft.

Example calculation:

Given:

* Top cable length = 75 ft.
* Bottom cable length = 25 ft.

Procedure:

1. Select Top/Bottom code “1”, to add time compensation to the bottom antenna.
2. Install coding in the interwiring: Connect TP-3C to TP-3F
3. Calculate time compensation:
   1. Calculate the difference in cable lengths: 75 - 25 = 50 ft.
   2. Determine the cable delay: 50 ft. X 2 X 1.54 = 154 nsec
   3. Select coding: (151 – 250 nsec)
4. Install coding in the interwiring: Connect TP-3D to TP-3F
5. Program Pins

As a means to provide compatibility between Mark 3 transponders and Mark 4 transponders, it is important that these inputs are interpreted as program common inputs. Designers are alerted that interconnected wiring provides unit configuration information which needs to be properly interpreted.

For example, ARINC 718-4 defines TP-3F as “Common”. ARINC 718A-1 assigns TP-3F as either “Vendor Discrete Input” or “Common”. ARINC 718A-2, Attachment 2B-1 assigns the pin as “Common”. Likewise, ARINC 718A-3, Attachment 2B-1 assigns the pin as “Common”.

1. Source/Destination Identifier (SDI) Encoding

These pins are for encoding the location of the Mark 4 transponder in the aircraft, (i.e., “system number”) per Section 2.1.4 of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected to Chassis or Aircraft ground or to TP-5D. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the transponder to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins TP-3G and TP-3H should be left open circuit with the result that bit numbers 9 and 10 are always binary “0”.

|  |  |  |
| --- | --- | --- |
| Source/Destination Identifier (SDI) Encoding | | |
| **Transponder/No.** | **Connector Pin** | |
| **TP-3G** | **TP-3H** |
| Not Applicable | Open | Open |
| 1 | Open | Ground |
| 2 | Ground | Open |
| 3 | Ground | Ground |

1. Common

The Minimum Subset, Single-Sided Configuration retains TP-3J as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders.

Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Optional Synchro Input

Synchro altitude signals, when used, should conform to the standards set forth in ARINC Characteristic 565, Mark 2 Sub-Sonic Air Data System. (See Section 4.2.18.3 of this standard.)

1. Maximum Cruising Airspeed Capability

The RI field contains information pertaining to the designed maximum cruising airspeed capability of the aircraft in which the Mark 4 transponder is installed. To insert the code for the bit to be designated “1”, connect the appropriate pin (TP-5A, TP-5B, or TP-5C) to Top Plug Common, TP-5D. Max airspeed coding is shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum Cruising Airspeed Encoding** | | | |
| **PIN** | | | **Selection or Description** |
| **TP-5C**  **BIT 15** | **TP-5B**  **BIT 16** | **TP-5A**  **BIT 17** |
| 0 | 0 | 0 | No maximum airspeed available |
| 0 | 0 | 1 | Airspeed up to 75 kts |
| 0 | 1 | 0 | Airspeed between 75 and 150 kts |
| 0 | 1 | 1 | Airspeed between 150 and 300 kts |
| 1 | 0 | 0 | Airspeed between 300 and 600 kts |
| 1 | 0 | 1 | Airspeed between 600 and 1200 kts |
| 1 | 1 | 0 | Airspeed more than 1200 kts |
| 1 | 1 | 1 | Not Assigned |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

1. ACAS/Mark 4 Transponder Interface

The ACAS/Mark 4 transponder interface consists of two ARINC 429 high-speed buses. Refer to ARINC Characteristic 735A or 735B for the full definition of this interface.

The XT – TX interface between the Transponder and TCAS is used to coordinate information between the two functions. As such, ARINC Characteristics 735A and 735B define exact protocols that must be maintained by the interface to preserve its integrity. Unnecessary exposure of the interface to noise sources can result in reduced integrity of the interface which can lead to intermittent TCAS System failures. Therefore, routing of the XT bus to aircraft systems other than TCAS is strongly discouraged. Likewise, routing of the TX bus to aircraft systems other than the Transponder is strongly discouraged.

1. Air/Ground Logic Input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. Air/Ground Discrete Input #2 is to be used when it is desired that the transponder automatically inhibit replies per ICAO Annex 10 when the aircraft is on the ground. At the time of writing of ARINC 718A-2, the recommended practice was to use Air/Ground Discrete Input #2 to inhibit ATCRBS and “all-call” replies on ground and thereby reduce the amount of RF traffic on the Mode S link. This recommended practice applies equally to the ARINC 718A-3 since ICAO Annex 10 Volume IV Amendment 82 Section 3.1.2.10.3.10 confirms the requirements to inhibit replies while the aircraft is on the ground.

Air/Ground Discrete Input #1 is to be used when replies are not to be inhibited when the aircraft is on the ground. Airframe and equipment manufacturers are cautioned to provide “sneak circuit” protection for these inputs so that malfunctions of other equipment connected to the same logic source do not affect operation. The system should be designed such that the normal failure mode should be to the airborne condition.

1. ARINC 429 High-Speed Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 high-speed (100 kbps) bus operation, unless otherwise noted.

1. GPS Time Mark Inputs

The Differential Time Mark input is an interface to an ARINC 743A GNSS receiver to provide synchronization to other aircraft systems. Signal characteristics for the Time Mark (i.e., tag) are provided in Attachment 8 of ARINC Characteristic 743A.

Because there are two possible GNSS inputs, but only one Time Mark input, the aircraft installation should ensure that the Time Mark provided is from the GNSS source that provides the best data integrity as determined by the Horizontal Integrity Limit information typically provided by Label 130. Alternatively, the aircraft installation reserves the option to switch the Time Mark input to the selected GNSS source.

1. Antenna Program

This program pin input is assigned to identify an installation in which only one antenna is used (i.e., the bottom antenna). A “ground” at this input should be used to indicate a single antenna installation, while an “open” should be interpreted as a dual antenna installation. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Control Panel Interface

The Mark 4 transponder is equipped with two control data input ports and a port selection function to accommodate the different control philosophies described in ARINC Specification 720. The interwiring diagram reflects the philosophy in which a dedicated Control Panel is used. The data output port of this panel is normally wired to Control Data Input Port B on the 4 transponder unit. Control Data Input Port A and the port selection discrete functions are not normally wired.

When implemented, the Control Data Port Select Discrete Input is used to select the active control port as follows:

1. When the Control Data Port Select Discrete Input, TP-7D, is open then Control Data Input Port B is the active control port.
   1. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured to accept input data from the FCC #1, the MCP #1, or the VHF #3.
   2. In this configuration, selection of the FCC #1/MCP #1 or FCC #2/MCP #2 active input port is further determined by the setting of the FCC/MCP 1/2 Select Discrete Input as provided in Note 20, below.
2. When the Control Data Port Select Discrete Input, TP-7D, is grounded then Control Data Input Port A is the active control port.
   1. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured as the active control input and therefore is not expected to be processing FCC#1, MCP#1, or VHF#3 data.
3. Standby/On Control

The Standby/On Control discrete provide a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. To obtain Standby operation, connect pin TP-7G to Chassis or Airframe ground. For “On” operation, leave pin TP-7G open. (See Section 6.4.1 of this Characteristic for further detail.)

1. FCC/MCP 1/2 Select Discrete Input

Attachment 2B-1, Minimum Subset, Single-Sided Configuration does not provide for dual inputs of FCC/MCP data. Likewise, TP-7K is not assigned in this configuration. Therefore, the state of TP-7K has no impact on the operation of the Minimum Subset, Single-Sided Configuration.

Implementers should be aware that dual FCC/MCP capability is provided with ARINC 718A-1 configurations and with the Minimum TIF, Double-Sided Configuration defined in Attachment 2C-1.

1. Mode S Aircraft Address

The aircraft Mode S Address (also known as the ICAO 24-bit aircraft address) consists of a 24-bit sequence uniquely assigned to each aircraft. To provide aircraft installation insertion of the aircraft address, for each address bit designated “1” connect the corresponding connector pin to Middle Plug Common, MP-6H, or other Common. For “0” address bits, leave the corresponding connector pin open.

The aircraft Mode S address should be transmitted (RF) by the Mode S transmitter with the most significant bit (MSB) first. The MSB is designated A1.

1. (Reserved) Avionics Personality Module Interface

The Minimum Subset, Single-Sided Configuration does not require an APM Interface. However, implementers should be aware that the APM interface may be used with TIF and Minimum Subset configurations previously defined by ARINC 718A-1.

1. Common or 24Bit/APM Address Select Discrete Input

The Minimum Subset, Single-Sided Configuration retains MP-3E as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the ARINC 718A-1 configurations which may implement an APM interface.

1. Reserved Discrete Out or Data Loader Activate Discrete Input

The Minimum Subset, Single-Sided Configuration retains MP-3J as a reserved discrete output. The Altitude Comparison Failure function is not used with Minimum Subset, Single-Sided Configuration, as the configuration does not implement Gillham altitude.

Implementers should be aware:

* ARINC-718-4-compliant transponders use this pin as a discrete output used to indicate an Altitude Comparison Failure.
* ARINC 718A-1-compliant transponders use this pin for data loader activation.
* The Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1 may use this pin for GPS/IRS in-use discrete.

1. Transponder Fail #1 Discrete Output

When the Mark 4 transponder unit has failed, this discrete output should supply +5 Vdc to operate Fail lamps (maximum current capability of 25 mA per lamp) and provide diode protection against sneak circuits.

When the Mark 4 transponder unit has not failed, the output should be an “open” (100,000 ohms or more resistance from this pin to airframe ground).

Note: This is not a standard discrete output.

1. Spare

The Minimum Subset, Single-Sided Configuration specifies MP-4A and MP-4B as spare.

Implementers should be aware that this pin is used for other purposes by both TIF and Minimum Subset configurations previously specified by ARINC 718A-1 as well as the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Aircraft Category Program Pins

The Minimum Subset, Single-Sided Configuration implements two input discrete pins to program the transponder with Aircraft Category information in accordance with the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT CATEGORY ENCODING | | | | | | |
| **(MP-4E and MP-4F are *Strobed*)** | | | **Register 08HEX** | | | **AIRCRAFT CATEGORY SELECTION** |
| **State**  **#** | **PIN** | | **“ME” Field** | | |
| **MP-4E**  **(A)** | **MP-4F**  **(B)** | **Bit 6** | **Bit 7** | **Bit 8** |
| 0 | 0 | 0 | 0 | 0 | 0 | No ADS-B Emitter Category Information |
| 1 | 0 | 1 | 0 | 0 | 1 | Light (<15,500 lbs.) |
| 2 | 0 | 2 | 0 | 1 | 0 | Small (15,500 to 75,000 lbs.) |
| 3 | 1 | 0 | 0 | 1 | 1 | Large (75,000 to 300,000 lbs.) |
| 4 | 1 | 1 | 1 | 0 | 0 | High-Vortex Large (aircraft such as B-757) |
| 5 | 1 | 2 | 1 | 0 | 1 | Heavy (>300,000 lbs.) |
| 6 | 2 | 0 | 1 | 1 | 0 | High Performance (> 5G acceleration and >400 knots) |
| 7 | 2 | 1 | 1 | 1 | 1 | Rotorcraft |
| 8 | 2 | 2 | NOT USED | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B). | | | | | | |

Implementers should be aware that the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1 uses the same pins identified above for the same Aircraft Category programming function. However, the TIF Configuration previously specified by ARINC 718A-1 uses BP-4, BP-5, and BP-6 for programming the Aircraft Category function.

1. Antenna Bite Program Discrete Input

This program input should be connected to the Middle Plug Common (MP-6H) to indicate to the Mark 4 transponder unit that the antenna has the facility to provide BITE information. An antenna having a DC path to ground may be used, thus providing the ability to sense the presence of the antenna, and confirming cable continuity for BITE purposes.

This discrete input should only be checked when in the on-ground state.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active port for ARINC 429, ARINC 575, and synchro data sources. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. Altitude Air Data Type Select

The Mark 4 transponder is capable of receiving three types of altitude information. Two programming pins are assigned to select which type of altitude is to be processed as follows:

|  |  |  |
| --- | --- | --- |
| ALTITUDE AIR DATA TYPE SELECTION ENCODING | | |
| **PIN** | | **SELECTION** |
| **MP-6F** | **MP-6G** |
| 0 | 0 | ARINC 429 Data via ARINC 429 ADS Input Ports |
| 0 | 1 | Synchro Data via Synchro Input Ports |
| 1 | 0 | ARINC 575 Data via ARINC 429 ADS Input Ports |
| 1 | 1 | not USED (formerly Gillham Altitude) |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Middle Plug Common (MP-6H).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | |

The following rules apply to altitude type selection and use:

a. Synchro (Course and Fine) Altitude and Validity Flag on two ports.

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Flag is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the synchro data.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Flag is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

b. ARINC 429 words on two ports:

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Selected Source is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the selected source.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Selected Source is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

c. ARINC 575 (DADS) words on two ports:

Same as for ARINC 429 data.

1. Primary Power Wiring

The primary power cold function has been assigned to be a long pin in the BP insert of the Mark 4 transponder unit to ensure that it breaks after the primary power hot connection when the transponder is removed from the rack. This is intended to prevent the infamous hot pull problems, which can occur when the ground circuit is interrupted during removal of the equipment with the power applied.

Because all of the pins in the control panel connector(s) are of equal length, this same precaution cannot be taken. The system circuit breaker should be opened before the control panel interconnect(s) is (are) broken.

1. Wire Sizes

It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakage occurs.

1. Backward Incompatibility Discrete Input

The Backward Incompatibility Discrete Input function is not used with the Minimum Subset, Single-Sided Configuration. Therefore, this Note does not apply.

Implementers should be aware:

* The Backward Incompatibility Discrete Input function is used with TIF and Minimum Subset configurations previously specified by ARINC 718A-1 and Attachment 2A-1.
* The Backward Incompatibility Discrete Input function is used with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Extended Squitter Disable Discrete Input

The Extended Squitter Disable Discrete is used to disable all Extended Squitter functions. When the pin is grounded Extended Squitter functions are disabled and when it is “open” the Extended Squitter functions are enabled.

Note 1: The Extended Squitter Disable function can be applied at any time. Specifically, it is not intended to be an on-ground function only. As it may be applicable in the airborne state, Note 2 must be observed.

Note 2: Disabling of the Extended Squitter function is not recommended during normal flight operations unless the Extended Squitter operational status is clearly indicated to the flight crew.

1. Not Used (formerly Reserved Weather In #1/2 Select Discrete Input)

The function is not used with the Minimum Subset, Single-Sided Configuration. However, implementers should be aware that pin BP-9 is used by the ARINC 718A-1 TIF Configuration to select the active port for Weather In (includes Radar Altitude) data.

1. Not Used (formerly MSP/ATSU/CMU #1/2 Select Discrete Input)

The function is not used with the Minimum Subset, Single-Sided Configuration. However, implementers should be aware that pin MP-6K is used by the ARINC 718A-1 TIF Configuration to select the active port for MSP/ATSU/CMU data.

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a DC ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. High-speed and/or Special Purpose Buses

The MSP/ATSU/CMU buses should be configurable to be used as high-speed ARINC 429 buses as well as for special purposes or protocols.

1. Minimum Subset

These interfaces are identified as the Minimum Subset necessary to satisfy ARINC 718A-3 compatibility requirements when using the Minimum Subset, Single-Sided Configuration specified in Attachment 2B-1.

1. FCC/MCP #1 Inputs

Note that the Minimum Subset, Single-Sided configuration only provides for one input of FCC/MCP #1 information at TP-7A, 7B.

There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to both TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it would be the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G are needed for VHF #3 In.

1. Transponder Fail Logic

Transponder Fail Logic #1 Input:

When the transponder has failed, this input discrete to the control panel should be +5 Vdc, and it should cause the transponder fail indicator to be illuminated. When transponder has not failed the input to this discrete should be “open”.

Transponder Fail logic #2 Input:

When the transponder has failed, this input discrete to the control panel should be “open” and it should cause the transponder fail indicator to be illuminated. When the transponder has not failed, this input discrete should be grounded.

1. Not Used - (formerly Mode S DL/DLP Discrete Input)

This function is not used with the Minimum Subset, Single-Sided Configuration. Therefore, Note 47 does not apply. Implementers should be aware that pin MP-5H may be used by the ARINC 718-4 as the Mode S DL/DLP Discrete input.

1. Spare Pin Usage

The connector pins marked “Spare” in Standard Interwiring list are available for assignment, as the airline industry desires. However, if the interchangeability for the system specified in Section 1.5 of this Characteristic is to be retained, any such assignment thought necessary must be coordinated with the AEEC staff and approved by the industry prior to being made.

1. GPS/GNSS

See ARINC Characteristic 743A for complete definitions for input and output between the Mark 4 transponder and the GPS/GNSS.

1. Reserved ARINC 429 Input

This function is implemented in the right plug (J2) only of dual system control panels. This input may be used to provide data to the control panel from ARINC 429 buses such as the TCAS Maintenance Output bus.

1. ADS-B OUT Fail Discrete Inputs

ADS-B OUT Fail #1 Discrete Input (J1-CP-17)

When the ADS-B OUT function of the #1 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #1 transponder ADS-B OUT fail indicator to be illuminated. When the #1 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #1 transponder ADS-B OUT fail indicator should not be illuminated.

ADS-B OUT Fail #2 Discrete Input (J2-CP-17)

When the ADS-B OUT function of the #2 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #2 transponder ADS-B OUT fail indicator to be illuminated. When the #2 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #2 transponder ADS-B OUT fail indicator should not be illuminated.

1. Aircraft/Vehicle Length/Width

These pins provide the capability to identify the Aircraft/Vehicle Length/Width of the installation to the transponder in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT/VEHICLE LENGTH/WIDTH ENCODING | | | | | | | | | |
| **(TP-1A is not *Strobed*. TP-1B and TP-1C are *Strobed*)** | | | | **Length**  **Code** | | | **Width**  **Code** | **Upper Bound Length and Width**  **For Each Length/Width Code** | |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | **Length** | **Width** |
| **TP-1A**  **(A)** | **TP-1B**  **(B)** | **TP-1C**  **(C)** | **Bit 21** | **Bit 22** | **Bit 23** | **Bit 24** | **(meters)** | **(meters)** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | No Data or Unknown | |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | < 15 | < 23 |
| 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | < 25 | < 28.5 |
| 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | < 34 |
| 4 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | < 35 | < 33 |
| 5 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | < 38 |
| 6 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | < 45 | < 39.5 |
| 7 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | < 45 |
| 8 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | < 55 | < 45 |
| 9 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | < 52 |
| 10 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | < 65 | < 59.5 |
| 11 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | < 67 |
| 12 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | < 75 | < 72.5 |
| 13 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | < 80 |
| 14 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | < 85 | < 80 |
| 15 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | < 90 |
| 16 | 1 | 2 | 1 | NOT USED | | | | | |
| 17 | 1 | 2 | 2 | NOT USED | | | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Note that TP-1A does not connect to TP-3B at any time. Therefore, TP-1A is NOT Strobed.  5. If the Aircraft/Vehicle is longer than 85 meters or wider than 90 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #15. | | | | | | | | | |

1. GPS Antenna Longitudinal Offset

These pins provide the capability to specify the distance of the GPS Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual GPS Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GPS ANTENNA LONGITUDINAL OFFSET ENCODING | | | | | | | | | |
| **(TP-1D, TP-1E and TP-1F**  **are *Strobed*)** | | | |  | | | | | **Upper Bound of the**  **GPS Antenna Offset**  **along Longitudinal (Roll) Axis**  **Aft from Aircraft Nose**  **(meters)** |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | |
| **TP-1D**  **(A)** | **TP-1E**  **(B)** | **TP-1F**  **(C)** | **Bit 36** | **Bit 37** | **Bit 38** | **Bit 39** | **Bit 40** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 *or* NO DATA |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Position Offset Applied by Sensor |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 4 |
| 4 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 6 |
| 5 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 8 |
| 6 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 10 |
| 7 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 12 |
| 8 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 14 |
| 9 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 16 |
| 10 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 18 |
| 11 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 20 |
| 12 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 22 |
| 13 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 24 |
| 14 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 26 |
| 15 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 28 |
| 16 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 30 |
| 17 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 32 |
| 18 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 34 |
| 19 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 36 |
| 20 | 2 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 38 |
| 21 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 40 |
| 22 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 42 |
| 23 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 44 |
| 24 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 46 |
| 25 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 48 |
| 26 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 50 |
| NOT USED | | | | 1 | 1 | 0 | 1 | 1 | 52 |
| 1 | 1 | 1 | 0 | 0 | 54 |
| 1 | 1 | 1 | 0 | 1 | 56 |
| 1 | 1 | 1 | 1 | 0 | 58 |
| 1 | 1 | 1 | 1 | 1 | 60 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. If the GPS Antenna Longitudinal Offset from the nose of the aircraft is in excess of 50 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #26.  5. Note that the encoding provided by the configuration pins has a maximum of 50 meters while the encoding provided for in Register 65HEX can go up to 60 meters. The encoding provided by the configuration pins has been restricted in order to minimize the number of discrete pins required by the function. | | | | | | | | | |

1. Navigation Accuracy Category\_Velocity (NACV)

This pin provides the capability to identify the Navigation Accuracy Category\_Velocity (NACV) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever NACV information is not provided to the transponder by another appropriate means. Also note that the encoding provided in the following table is not the final encoding that is entered into transponder registers 09 Hex and 65 Hex for transmission in ADS-B messages. The final register encoding is established in Attachment 3A-1, Note 22.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NAVIGATION ACCURACY CATEGORY\_VELOCITY (NACV) ENCODING | | | | |
| **NACV Subfield**  **Encoding** | | **(TP-1G is *Strobed*)** | | **Horizontal Velocity Error** |
| **State**  **#** | **PIN** |
| **binary** | **decimal** | **TP-1G** |
| 000 | 0 | 0 | 0 | Unknown or > 10 meters/second |
| 001 | 1 | 1 | 1 | < 10 meters/second |
| 010 | 2 | 2 | 2 | < 3 meters/second |
| 011 | 3 | NOT USED | | < 1 meter/second |
| 100 | 4 | <0.3 meters/second |
| 101 | 5 | NOT ASSIGNED IN RTCA DO-260B | | |
| 110 | 6 |
| 111 | 7 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Encoding is only provided through State 2 as it will be well into the future before navigation sources will be capable of providing NACV values approaching 1 meter/second.  5. If the NACV value to be encoded is less than 1 meter/second or better, then the Pin Configuration and bit encoding shall be set to that indicated for State #2. | | | | |

1. System Design Assurance (SDA)

This pin provides the capability to identify the System Design Assurance (SDA) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever SDA information is not provided to the transponder by another appropriate means.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SYSTEM DESIGN ASSURANCE (SDA) ENCODING | | | | | | |
| **PIN Encoding** | | **SDA Value** | | **Supported**  **Failure**  **Condition**  **(Note 6)** | **Probability of Undetected Fault causing transmission of False or**  **Misleading Information**  **(Note 7, 8)** | **Software & Hardware**  **Design Assurance Level**  **(Note 5, 7)** |
| **Register 65HEX**  **Bits 31, 32** | |
| **State #** | **TP-1H** | **(decimal)** | **(binary)** |
| 0 | 0 | 0 | 0 0 | Unknown/  No Safety Effect | > 1X10-3 per flight hour  or Unknown | N/A |
| Not Used  (Note 1) | | 1 | 0 1 | Minor | < 1X10-3 per flight hour | D |
| 1 | 1 | 2 | 1 0 | Major | < 1X10-5 per flight hour | C |
| 2 | 2 | 3 | 1 1 | Hazardous | < 1X10-7 per flight hour | B |
| Table Notes:  1. It is expected that all GPS/GNSS and ADS-B Transmitting equipment to be associated with this Characteristic will support a minimum design assurance of 10-5. Therefore, the 10-3 case having an SDA = “1” is NOT Allowed and there is no encoding provision made with TP-1H.  2. “0” coding means that TP-1H is in the “open-circuit” state.  3. “1” coding means that TP-1H is connected to Middle Plug Common (MP-6H).  4. “2” coding means that TP-1H is connected to XPDR Fail #2 (TP-3B).  5. Software Design Assurance per RTCA DO-178B (EUROCAE ED-12B). Airborne Electronic Hardware Design Assurance per RTCA DO-254 (EUROCAE ED-80).  6. Supported Failure Classification defined in AC-23.1309-1C, AC-25.1309-1A, and AC 29-2C.  7. Because the broadcast position can be used by any other ADS-B equipped aircraft or by ATC, the provisions in AC 23-1309-1C that allow reduction in failure probabilities and design assurance level for aircraft under 6,000 pounds do not apply.  8. Includes probability of transmitting false or misleading latitude, longitude, velocity, or associated accuracy and integrity metrics. | | | | | | |

1. Common

The Minimum Subset, Single-Sided Configuration retains TP-3K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Not Assigned

The Minimum Subset, Single-Sided Configuration does not assign usage of TP-6H and TP-6J. Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. MP-3F/MP-3G

The ARINC 718A-2 Minimum Subset (i.e., Attachment 2A-1) Configuration assigns MP-3F,3G for FCC/MCP #1/VHF #3 input. Likewise, the ARINC 718A-2 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration assigns MP-3F,3G for FCC/MCP #1/VHF #3 input. ARINC 718A Supplement-2, Attachment 2C-1, Minimum TIF, Double-Sided Configuration also assigns MP-3F,3G for FCC/MCP #1/VHF #3 input.

The ARINC 718A-3 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration does not assign any usage of MP-3F or MP-3G. However, the ARINC 718A-3 Minimum TIF, Double Sided (i.e., Attachment 2C-1) continues to assign MP-3F,3G for FCC/MCP #1/VHF #3 input.

Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes in the different configuration discussed above.

1. Not Assigned

The Minimum Subset, Single-Sided Configuration does not assign usage of MP-6J. Implementers should be aware that these pins were previously used in ARINC 718A-1 transponders for output of ARINC 429 data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Common

The Minimum Subset, Single-Sided Configuration retains MP-6K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Not Assigned

The Minimum Subset, Single-Sided Configuration does not assign usage of MP-7K. Implementers should be aware that these pins were previously used in ARINC 718A-1 transponders for output of ARINC 429 data.

1. Note Reserved
2. Program Pin Strobe

Each of the discrete inputs (program pins) assigned to Aircraft Length/Width, Aircraft Category, ADS-B Receiver Capability, and GPS Antenna Offset has 2 states: state 0 when left “open” and state 1 when it is connected to a program pin common. An additional state, state 2 can be achieved when a discrete input is connected to a discrete output pin TP-3B Transponder Fail Discrete #2 Output. To determine state 2, the discrete inputs are read twice while the discrete output is driven active and inactive. This is done at power-on only. Each of the discrete inputs can have only one of the 3 states. At power-on and regardless of the air/ground state, the following sequence reads the strobed program pins:

1. Set the discrete output TP-3B “open” and read each of the program pins.
2. Set the discrete output TP-3B to “ground” and read each of the program pins.
3. Decode results to program pin state:
4. If a program pin is “open” for both the steps “a” and “b”, it is not connected to the discrete output pin TP-3B or program common pin, which puts the program pin in state 0.
5. If a program pin is connected to “ground” for both the steps “a” and “b”, it is connected to “ground”, which puts the program pin in state 1.
6. If a program pin is “open” on step “a” and connected to “ground” on step “b”, it is connected to the discrete output pin TP 3B, which is state 2.
7. ADS-B FAIL Disable

This pin is used to enable or disable annunciation of an ADS-B function fail via the Fail Warn Discrete outputs (TP-3B and MP-3K) in accordance with the following table:

|  |  |
| --- | --- |
| ADS-B FAIL DISABLE ENCODING | |
| **PIN STATUS** | **ADS-B FUNCTION FAIL DECLARATION SELECTION** |
| **TP-2K** |
| Open – circuit | Failures of the ADS-B Function shall be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) as well as via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |
| Connected to  TP-5D | Failures of the ADS-B Function shall NOT be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) but shall continue to be declared via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |

1. ADS-B Receive Capability

This pin is strobed and used to indicate the ADS-B IN Receive Capability of the Aircraft installation in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| ADS-B RECEIVE CAPABILITY ENCODING | | |
| **PIN Encoding**  **(*Strobed*)** | | **SELECTION/MEANING** |
| **State #** | **MP-4H** |
| 0 | 0 | Aircraft installation has no capability to receive either 1090 ES IN or UAT IN |
| 1 | 1 | Aircraft installation has capability to receive 1090 ES IN Only |
| 2 | 2 | Aircraft installation has capability to receive both 1090 ES IN and UAT IN |
| Table Notes:  *1. “0” coding means that MP-4H is in the “open-circuit” state.*  *2. “1” coding means that MP-4H is connected to Middle Plug Common (MP-6H).*  *3. “2” coding means that MP-4H is connected to XPDR Fail #2 (TP-3B).*  *4. It is expected that future implementations with TCAS or the Traffic Function will have additional capability to communicate the state of 1090ES IN and UAT IN. Presently, no such method is identified in this Characteristic.* | | |

1. ADS-B Configuration Parity

MP-4G is used to indicate the parity of the ADS-B Configuration installation to the transponder and is best illustrated in the following table. Column #1 of the table defines those ADS-B Configuration Parameters that are to be used to establish the configuration parity. Column #2 of the table defines the actual ADS-B Configuration Pins that are to be used to establish the configuration parity. Once the connection requirements are established for all of the necessary ADS-B Configuration Parameters and Pins, then establish the number of pins that are connected to Common as illustrated in Column #8 of the table. Then, establish the parity (as illustrated in Column #9 of the table) and Connect MP-4G to Common if the Parity is ODD. Otherwise, leave MP-4G in the “open-circuit” state since Parity is EVEN.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SAMPLES OF ADS-B CONFIGURATION PARITY ENCODING | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|  | | | **PIN shown in Column #2**  **is Connected to** | | | | **# of Pins**  **Connected to**  **Common** | **PARITY** | **CONNECT**  **MP-4G**  **TO** |
| **ADS-B PARAMETER** | **PIN** | **STATE** | **OPEN** | **COMMON** | | **STROBE** |
| **OPEN** | **TP-5D** | **MP-6H** | **TP-3B** |
| AIRCRAFT/VEHICLE  LENGTH/WIDTH | TP-1A | 1 (0) | (Z) | X |  |  | X = 7  (Z = 6) | ODD  (EVEN) | COMMON  AT  MP-6H  (OPEN) |
| TP-1B | 0 (1) | X | (Z) |  |  |
| TP-1C | 2 (0) | (Z) |  |  | X |
| GPS ANTENNA  LONGITUDINAL  OFFSET | TP-1D | 2 (0) | (Z) |  |  | X |
| TP-1E | 1 (1) |  | X (Z) |  |  |
| TP-1F | 0 (1) | X | (Z) |  |  |
| NACV | TP-1G | 1 (0) | (Z) | X |  |  |
| SYSTEM DESIGN  ASSURANCE | TP-1H | 1 (0) | (Z) | X |  |  |
| ADS-B FAIL DISABLE | TP-2K | 0 (1) | X | (Z) |  |  |
| AIRCRAFT CATEGORY | MP-4E | 1 (1) |  |  | X (Z) |  |
| MP-4F | 1 (0) | (Z) |  | X |  |
| ADS-B RECEIVE  CAPABILITY | MP-4H | 1 (1) |  |  | X (Z) |  |
| Table Notes:  1. The ADS-B Configuration Parameters to be used to establish the ADS-B Configuration Parity are listed in  Column #1.  2. The ADS-B Configuration Pins that are to be used to establish the ADS-B Configuration Parity are listed in  Column #2.  3. Column #3 presents the state of the ADS-B Configuration Pins for two separate samples. Sample #1 is show in Bold Font while sample #2 is shown in parenthesis.  4. Columns #4 through 7 indicate the actual connections that should be made for each ADS-B Configuration Parameter Pin for each sample. Sample #1 is indicated with an “X” while sample #2 is shown with “(Z)”.  5. Column #8 indicates the number of ADS-B Configuration Pins that are connected to Common for each of the two samples. Sample #1 is shown as “X = 7” while sample #2 is shown as “(Z = 6)”.  6. Column #9 indicates the parity of the count established in Column #8 for each of the two samples. Sample #1 is shown as “ODD” while sample #2 is shown as “(EVEN)”.  7. Column #10 indicates the connection that should be made for MP-4G for each of the two samples. Sample #1 results in MP-4G being connected to MP-6H. Sample #2 results in MP-4G being in the “open-circuit” state*.* | | | | | | | | | |

1. GPS Time Mark (Differential)

Although the GPS Time Mark inputs on TP-1J and TP-1K are not included in the Minimum Subset (see Note 44), it is highly recommended that these inputs be connected to the appropriate GPS outputs in order to be able to comply with future precision position reporting that may be required by future applications.

1. C-1 MINIMUM TIF, DOUBLE SIDED CONFIGURATION PIN ALLOCATION

****

Note: Bottom Plug shown above is the same as that previously defined in ARINC 718-4, Attachment 1C, BP.

1. C-2 MINIMUM TIF, DOUBLE-SIDED CONFIGURATION STANDARD INTERWIRING

**TOP PLUG**

| **SIGNAL NAME** | | **PIN** | | **SIGNAL TYPE** | | **SOURCE/SINK** | | **NOTES** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aircraft/Vehicle Length/Width A MSB | | TP-1A | | Program Pin Input | |  | | 1, 44, 52 |
| Aircraft/Vehicle Length/Width B | | TP-1B | | Program Pin Input\_Strobed | |  | | 1, 44, 52, 63 |
| Aircraft/Vehicle Length/Width C LSB | | TP-1C | | Program Pin Input\_Strobed | |  | | 1, 44, 52, 63 |
| GPS Antenna Longitudinal Offset A MSB | | TP-1D | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset B | | TP-1E | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset C LSB | | TP-1F | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| Navigation Accuracy Category\_Velocity (NACV) | | TP-1G | | Program Pin Input\_Strobed | |  | | 1, 44, 54, 63 |
| System Design Assurance (SDA) | | TP-1H | | Program Pin Input\_Strobed | |  | | 1, 44, 55, 63 |
| GPS Time Mark #2 (Differential) A | | TP-1J | | Differential Input | | 743A GNSS #1 | | 1, 16, 67 |
| GPS Time Mark #2 (Differential) B | | TP-1K | | Differential Input | | 743A GNSS #1 | | 1, 16, 67 |
| FMS/GNSS #1 In #1 A | | TP-2A | | ARINC 429 Input | | 743A GNSS #1 or | | 2, 3, 44, 47, 49 |
| FMS/GNSS #1 In #1 B | | TP-2B | | ARINC 429 Input | | 702A FMC #1 | |  |
| IRS/FMS/Data Concentrator In #1 A | | TP-2C | | ARINC 429 Input | | 702A FMC #1, 704 IRS | | 2, 3, 44 |
| IRS/FMS/Data Concentrator In #1 B | | TP-2D | | ARINC 429 Input | | #1, Data Conc. #1 | | 47 |
| General Output #1 A | | TP-2E | | ARINC 429 HS Output | | 615 Data loader, or | | 15, 44, 47 |
| General Output #1 B | | TP-2F | | ARINC 429 HS Output | | As Needed | | 15, 44, 47 |
| MSP/ATSU/CMU In #1 A | | TP-2G | | ARINC 429 Input | | MSP/ATSU/CMU #1 | | 2, 43 |
| MSP/ATSU/CMU In #1 B | | TP-2H | | ARINC 429 Input | | MSP/ATSU/CMU #1 | | 2, 43 |
| Spare | | TP-2J | |  | |  | | 1, 48 |
| ADS-B FAIL Disable | | TP-2K | | Program Pin Input | |  | | 1, 44, 64 |
| ADS-B OUT FAIL Discrete Output | | TP-3A | | Discrete Output | |  | | 5 |
| XPDR Fail Discrete #2 Out | | TP-3B | | Discrete Output | |  | | 6, 44 |
| Cable Delay Program – Top/Bottom | | TP-3C | | Program Pin Input | |  | | 7, 44 |
| Cable Delay Program – Value | | TP-3D | | Program Pin Input | |  | | 7, 44 |
| Cable Delay Program – Value | | TP-3E | | Program Pin Input | |  | | 7, 44 |
| Vendor Discrete Input | | TP-3F | | Discrete Input | |  | | 8 |
| SDI Input Discrete | | TP-3G | | Discrete Input | |  | | 9, 44 |
| SDI Input Discrete | | TP-3H | | Discrete Input | |  | | 9, 44 |
| FMC/GNSS ½ Select Discrete Input | | TP-3J | | Discrete Input | |  | | 8, 10 |
| Spare | | TP-3K | |  | |  | | 1, 48, 56 |
| Synchro Altitude #1 Coarse Input X | | TP-4A | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Coarse Input Y | | TP-4B | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Coarse Input Z | | TP-4C | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Reference Input H | | TP-4D | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Reference Input C | | TP-4E | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Fine Input X | | TP-4F | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Fine Input Y | | TP-4G | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Fine Input Z | | TP-4H | | 26 Vac Input | | 565 ADC | | 11, 44 |
| Synchro Altitude #1 Flag | | TP-4J | | Discrete Fault Input | | 565 ADC | | 11, 44 |
| Spare | | TP-4K | |  | |  | | 1, 48 |
| Maximum Cruising Airspeed – 17 | | TP-5A | | Program Pin Input | |  | | 12, 44 |
| Maximum Cruising Airspeed – 16 | | TP-5B | | Program Pin Input | |  | | 12, 44 |
| Maximum Cruising Airspeed – 15 | | TP-5C | | Program Pin Input | |  | | 12, 44 |
| Top Plug Common | | TP-5D | | Ground Reference | |  | | 44 |
| TX Coordination A | | TP-5E | | ARINC 429 HS Input | | 735A/B TCAS | | 2, 13, 44 |
| TX Coordination B | | TP-5F | | ARINC 429 HS Input | | 735A/B TCAS | | 2, 13, 44 |
| XT Coordination A | | TP-5G | | ARINC 429 HS Output | | 735A/B TCAS | | 13, 15, 44 |
| XT Coordination B | | TP-5H | | ARINC 429 HS Output | | 735A/B TCAS | | 13, 15, 44 |
| Air/Ground Discrete Input #2 | | TP-5J | | Discrete Input | |  | | 14, 44 |
| Air/Ground Discrete Input #1 | | TP-5K | | Discrete Input | |  | | 14, 44 |
| FMC #1, General Input #2 A | | TP-6A | | ARINC 429 Input | | 702A FMC #1 | | 2, 3, 44 |
| FMC #1, General Input #2 B | | TP-6B | | ARINC 429 Input | | 702A FMC #1 | | 2, 3, 44 |
| Not Assigned | | TP-6C | |  | |  | |  |
| GPS Time Mark #1 (Differential) A | | TP-6D | | Differential Input | | 743A GNSS #2 | | 16, 67 |
| GPS Time Mark #1 (Differential) B | | TP-6E | | Differential Input | | 743A GNSS #2 | | 16, 67 |
| Spare | | TP-6F | |  | |  | | 1, 48 |
| Spare | | TP-6G | |  | |  | | 1, 48 |
| Not Assigned | | TP-6H | |  | |  | | 21, 28, 57 |
| Not Assigned | | TP-6J | |  | |  | | 57 |
| Antenna Program | | TP-6K | | Program Pin Input | |  | | 17, 44 |
| Control Data “A” or FCC #1/MCP #1  (VHF #3 Input Port A) | | TP-7A | | ARINC 429 Input | | 718 Control FCC #1  MCP #1 or VHF #3 | | 2, 18, 20, 44, 45 |
| Control Data “A” or FCC #1/MCP #1  (VHF #3 Input Port B) | | TP-7B | | ARINC 429 Input | | 718 Control FCC #1  MCP #1 or VHF #3 | | 2, 18, 20, 44, 45 |
| Not Assigned | | TP-7C | |  | |  | |  |
| Control Port Select Discrete Input | | TP-7D | | Discrete Input | |  | | 18, 20, 44 |
| Control Data “B” Input A | | TP-7E | | ARINC 429 Input | | 718 Control | | 2, 18, 44 |
| Control Data “B” Input B | | TP-7F | | ARINC 429 Input | | 718 Control | | 2, 18, 44 |
| Standby/ON Discrete Input | | TP-7G | | Discrete Input | |  | | 19, 44 |
| Digital Air Data #1 Input A | | TP-7H | | ARINC 429 Input | | 706ADS #1 or | | 2, 44 |
| Digital Air Data #1 Input B | | TP-7J | | ARINC 429 Input | | 575 ADS #1 | | 2, 44 |
| FCC/MCP 1/2 Select Discrete Input | | TP-7K | | Discrete Input | |  | | 20 |
| Top Antenna RF | | TP-Coax | | Coaxial Input | | Top Antenna | | 44 |
| **MIDDLE PLUG**  **SIGNAL NAME** | **PIN** | | **SIGNAL TYPE** | | **SOURCE/SINK** | | **NOTES** | |
| Mode S Address Bit A1 MSB | MP-1A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A2 | | MP-1B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A3 | | MP-1C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A4 | | MP-1D | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A5 | | MP-1E | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A6 | | MP-1F | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A7 | | MP-1G | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A8 | | MP-1H | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A9 | | MP-1J | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A10 | | MP-1K | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A11 | | MP-2A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A12 | | MP-2B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A13 | | MP-2C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A14 | | MP-2D | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A15 | | MP-2E | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A16 | | MP-2F | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A17 | | MP-2G | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A18 | | MP-2H | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A19 | | MP-2J | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A20 | | MP-2K | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A21 | | MP-3A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A22 | | MP-3B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A23 | | MP-3C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A24 LSB | MP-3D | | Program Pin Input | |  | | 21,22,44 | |
| 24-bit/APM Select | MP-3E | | Discrete Input | |  | | 8,23 | |
| FCC/MCP #1/VHF #3 Input A | MP-3F | | ARINC 429 Input | | MCP, 701 FCC #1 | | 2,20,44,45,58 | |
| FCC/MCP #1/VHF #3 Input B | MP-3G | | ARINC 429 Input | | MCP, 701 FCC #1 | | 2,20,44,45,58 | |
| Functional Test Discrete Input | MP-3H | | Discrete Input | |  | | 44 | |
| GPS/IRS Use Discrete Input | MP-3J | | Discrete Input | |  | | 1,24 | |
| Transponder Fail #1 Discrete Output | MP-3K | | Discrete Output | | 718 Control | | 25,44 | |
| FMC #2 General Input #2 A | MP-4A | | ARINC 429 Input | | 702A FMC #2 | | 1,2,3,26 | |
| FMC #2 General Input #2 B | MP-4B | | ARINC 429 Input | | 702A FMC #2 | | 1,2,3,26 | |
| FMC/GNSS #2 In #1 A | MP-4C | | ARINC 429 Input | | 743A GNSS #2 or | | 2,3,44,49 | |
| FMC/GNSS #2 In #1 B | MP-4D | | ARINC 429 Input | | 702A FMC #2 | | 2,3,44,49 | |
| Aircraft Category A MSB | MP-4E | | Program Pin Input\_Strobed | |  | | 1, 44, 27, 63 | |
| Aircraft Category B LSB | MP-4F | | Program Pin Input\_Strobed | |  | | 1, 44, 27, 63 | |
| ADS-B Configuration Parity | MP-4G | | Program Pin Input | |  | | 1, 44, 66 | |
| ADS-B Receive Capability | MP-4H | | Program Pin Input\_Strobed | |  | | 1, 44, 63, 65 | |
| FCC/MCP In #2 A | MP-4J | | ARINC 429 Input | | 701 FCC #2, MCP #2 | | 1,2,20 | |
| FCC/MCP In #2 B | MP-4K | | ARINC 429 Input | | 701 FCC #2, MCP #2 | | 1,2,20 | |
| Digital Air Data #2 Input A | MP-5A | | ARINC 429 Input | | 706 ADS #2 or | | 2, 44 | |
| Digital Air Data #2 Input B | MP-5B | | ARINC 429 Input | | 575 ADS #2 | | 2, 44 | |
| IRS/FMS/Data Concentrator Input #2 A | MP-5C | | ARINC 429 Input | | 702A FMC #2, 704 | | 2,3,47 | |
| IRS/FMS/Data Concentrator Input #2 B | MP-5D | | ARINC 429 Input | | IRS #2, Data Conc. #2 | | 2,3,47 | |
| MSP/ATSU/CMU Out #1 A | MP-5E | | ARINC 429 HS Output | | MSP/ATSU/CMU #1 | | 4,43,44,47 | |
| MSP/ATSU/CMU Out #1 B | MP-5F | | ARINC 429 HS Output | | MSP/ATSU/CMU #1 | | 4,43,44,47 | |
| Extended Squitter Disable | MP-5G | | Discrete Input | |  | | 34,44 | |
| Mode S DL/DLP | MP-5H | | Program Pin Input | |  | | 44,47 | |
| Antenna Bite Program Discrete Input | MP-5J | | Program Pin Input | |  | | 28 | |
| IRS/ 1/2 Select Discrete Input | MP-5K | | Discrete Input | |  | | 62 | |
| Maintenance Data Input A | MP-6A | | ARINC 429 Input | | As Required | | 2,44 | |
| Maintenance Data Input B | MP-6B | | ARINC 429 Input | | As Required | | 2,44 | |
| Maintenance Data Output A | MP-6C | | ARINC 429 Input | | As Required | | 4,44 | |
| Maintenance Data Output B | MP-6D | | ARINC 429 Input | | As Required | | 4,44 | |
| Alternate Source Select Discrete Input | MP-6E | | Discrete Input | | 718 Control Pin #16 | | 29,44 | |
| Altitude Type Select\_A Discrete Input | MP-6F | | Program Pin Input | |  | | 30, 44 | |
| Altitude Type Select\_B Discrete Input | MP-6G | | Program Pin Input | |  | | 30, 44 | |
| Middle Plug Common | MP-6H | | Ground Reference | |  | | 21, 28 | |
| Not Assigned | MP-6J | |  | |  | | 36,59,60 | |
| Spare | MP-6K | |  | |  | | 1,48 | |
| Synchro Altitude #2 Coarse Input X | MP-7A | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Coarse Input Y | MP-7B | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Coarse Input Z | MP-7C | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Reference Input H | MP-7D | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Reference Input C | MP-7E | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Fine Input X | MP-7F | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Fine Input Y | MP-7G | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Fine Input Z | MP-7H | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Synchro Altitude #2 Flap | MP-7J | | 26 Vac Input | | 565 ADC | | 11,44 | |
| Not Assigned | MP-7K | |  | |  | | 61 | |
| Bottom Antenna RF | MP-Coax | | Coaxial Input | | Bottom Antenna | | 44 | |

**BOTTOM PLUG**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| 115 Vac Primary Power Hot | BP-1 | 115 Vac |  | 31,32,44 |
| Backward Incompatibility Discrete | BP-2 | Program Pin Input |  | 33 |
| Reserved 28 Vdc Return | BP-3 |  |  |  |
| FMC 1/2 Select Discrete Input | BP-4 | Discrete Input |  | 68 |
| Not Assigned | BP-5 |  |  |  |
| Not Assigned | BP-6 |  |  |  |
| 115 Vac Primary Power Cold | BP-7 | 115 Vac |  | 31,32,44 |
| Signal Ground | BP-8 |  |  | 32, 44 |
| Not Assigned | BP-9 |  |  | 35 |
| Reserved 28 Vdc | BP-10 |  |  |  |
| Chassis Ground | BP-11 | Ground Reference |  |  |
| Suppression | BP-12 Coax | Coax | Other Suppression |  |
| Suppression (For Daisy Chaining) | BP-13 Coax | Coax |  |  |

**CONTROL PANEL**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Panel Lighting Supply A | J1-CP-1 | 0 to 5 Vac Lighting |  | 37 |
| Panel Lighting Supply B | J1-CP-2 | 0 to 5 Vac Lighting |  | 37 |
| 115 Vac Power HI | J1-CP-3 | Aircraft Power |  |  |
| 115 Vac Power LO | J1-CP-4 | Aircraft Power Return |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 38 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/ON | J1-CP-7 | Discrete Input | Control Panel | 19 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 37,39 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 40 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 14 |
| Transponder Fail Logic #2 Input | J1-CP-12 | Discrete Input |  | 46 |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  |  |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 14 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 29 |
| ADS-B OUT Fail #1 | J1-CP-17 | Discrete Input |  | 51 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light Power Source | 41 |
| Altitude Comparison Fail Discrete | J1-CP-19 | Discrete Output |  |  |
| Transponder Fail Logic #1 Input | J1-CP-20 | Analog Input |  | 46 |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 42 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 14 |
| Reserved ARINC 429 Input A | J2-CP-1 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-2 | Digital |  | 50 |
| Reserved ARINC 429 Input A | J2-CP-13 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-14 | Digital |  | 50 |
| ADS-B OUT Fail #2 | J2-CP-17 | Discrete Input |  | 51 |

1. C-3 MINIMUM TIF, DOUBLE-SIDED CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING
2. Re-definition of Gillham Input Pins

Gillham Altitude inputs are used only with ARINC 718A-1 and ARINC 718-4 transponder configurations. In Supplement 2 and later, these pins have been reassigned to provide for the input of various ADS-B parameters and configuration information. As such, these pins are not used for Gillham Altitude Input with the Minimum Subset, Single-Sided Configuration, specified in Attachment 2C-1.

1. General ARINC 429 Input Data Buses

These ARINC 429 input data buses may be either high-speed (100 kbps) or low-speed (12.5 kbps).

The Mark 4 transponder must be able to process either without additional command direction.

1. ARINC 702A FMC/FMS Data Inputs

Two FMS input ports are provided for the FMC: FMC/GNSS #1 IN #1 and FMC #1, GEN IN #2

These ports are assigned to support common existing FMC configurations where the Flight ID is available on the FMC General Purpose output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the ARINC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

1. General ARINC 429 Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 low-speed   
(12.5 kbps) bus requirements, unless otherwise noted.

1. ADS-B OUT Fail Discrete Out

This discrete should be an “open” when the ADS-B OUT Function has failed. The output should be a “ground” when the ADS-B OUT Function is operating normally. The output should be capable of sinking at least 10 mA of current. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Transponder Fail Discrete #2 Output

This discrete output should be an “open” when the Mark 4 transponder has failed. The output should be a “ground” when the transponder is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Cable Delay Program

These pins provide the capability to identify the installation’s relative cable delay. When programming, “1” is designated by connecting the designated pin to Top Plug Common (TP-5D).

|  |  |  |  |
| --- | --- | --- | --- |
| TP-3D | TP-3E | Differential Delay (nsec) | Add (nsec) in XPDR |
| 0 | 0 | 0 - 50 | 0 |
| 0 | 1 | 51 - 150 | 100 |
| 1 | 0 | 151 - 250 | 200 |
| 1 | 1 | 251 - 350 | 300 |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

|  |  |
| --- | --- |
| **PIN** | **Coding/Meaning** |
| **TP-3C** |
| 0 | Add time delay to top |
| 1 | Add time delay to bottom |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | |

The Round Trip cable delay is twice the length (in feet) multiplied by the delay (in nsec/ft). A typical delay is 1.54 nsec/ft.

Example calculation:

Given:

* Top cable length = 75 ft.
* Bottom cable length = 25 ft.

Procedure:

1. Select Top/Bottom code “1”, to add time compensation to the bottom antenna.
2. Install coding in the interwiring: Connect TP-3C to TP-3F
3. Calculate time compensation:
4. Calculate the difference in cable lengths: 75 - 25 = 50 ft.
5. Determine the cable delay: 50 ft. X 2 X 1.54 = 154 nsec
6. Select coding: (151 – 250 nsec)
7. Install coding in the interwiring: Connect TP-3D to TP-3F
8. Program Pins

As a means to provide compatibility between Mark 3 transponders and Mark 4 transponders, it is important that these inputs are interpreted as program common inputs. Designers are alerted that interconnected wiring provides unit configuration information which needs to be properly interpreted.

For example, ARINC 718-4 defines TP-3F as “Common”. ARINC 718A-1 assigns TP-3F as either “Vendor Discrete Input” or “Common”. ARINC 718A-2, Attachment 2B-1 assigns the pin as “Common”. However, ARINC 718A-3, Attachment 2C-1 assigns the pin as “Vendor Discrete Input.”

1. Source/Destination Identifier (SDI) Encoding

These pins are for encoding the location of the Mark 4 transponder in the aircraft, (i.e., “system number”) per Section 2.1.4 of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected to Chassis or Aircraft ground or to TP-5D. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the transponder to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins TP-3G and TP-3H should be left open circuit with the result that bit numbers 9 and 10 are always binary “0”.

|  |  |  |
| --- | --- | --- |
| Source/Destination Identifier (SDI) Encoding | | |
| **Transponder/No.** | **Connector Pin** | |
| **TP-3G TP-3H** |  |
| Not Applicable | Open | Open |
| 1 | Open | Ground |
| 2 | Ground | Open |
| 3 | Ground | Ground |

1. FMC/GNSS 1/2 Select Discrete Input (Reserved)

This pin is used to select the active port for FMC/GNSS data. When the pin is open the number 1 FMC/GNSS port is active and when it is grounded the number 2 FMC/GNSS port is active.

1. Optional Synchro Input

Synchro altitude signals, when used, should conform to the standards set forth in ARINC Characteristic 565, Mark 2 Sub-Sonic Air Data System. (See Section 4.2.18.3 of this standard.)

1. Maximum Cruising Airspeed Capability

The RI field contains information pertaining to the designed maximum cruising airspeed capability of the aircraft in which the Mark 4 transponder is installed. To insert the code for the bit to be designated “1”, connect the appropriate pin (TP-5A, TP-5B, or TP-5C) to Top Plug Common, TP-5D. Max airspeed coding is shown in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| Maximum Cruising Airspeed Encoding | | | |
| **PIN** | | | **SELECTION OR DESCRIPTION** |
| **TP-5C**  **BIT 15** | **TP-5B**  **BIT 16** | **TP-5A**  **BIT 17** |
| 0 | 0 | 0 | No maximum airspeed available |
| 0 | 0 | 1 | Airspeed up to 75 kts |
| 0 | 1 | 0 | Airspeed between 75 and 150 kts |
| 0 | 1 | 1 | Airspeed between 150 and 300 kts |
| 1 | 0 | 0 | Airspeed between 300 and 600 kts |
| 1 | 0 | 1 | Airspeed between 600 and 1200 kts |
| 1 | 1 | 0 | Airspeed more than 1200 kts |
| 1 | 1 | 1 | Not Assigned |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

1. ACAS/Mark 4 Transponder Interface

The ACAS/Mark 4 transponder interface consists of two ARINC 429 high-speed buses. Refer to ARINC Characteristic 735A or 735B for the full definition of this interface.

The XT – TX interface between the Transponder and TCAS is used to coordinate information between the two functions. As such, ARINC Characteristics 735A and 735B define exact protocols that must be maintained by the interface to preserve its integrity. Unnecessary exposure of the interface to noise sources can result in reduced integrity of the interface which can lead to intermittent TCAS System failures. Therefore, routing of the XT bus to aircraft systems other than TCAS is strongly discouraged. Likewise, routing of the TX bus to aircraft systems other than the Transponder is strongly discouraged.

1. Air/Ground Logic input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. Air/Ground Discrete Input #2 is to be used when it is desired that the transponder automatically inhibit replies per ICAO Annex 10 when the aircraft is on the ground. At the writing of ARINC 718A-2, the recommended practice was to use Air/Ground Discrete Input #2 to inhibit ATCRBS and “all-call” replies on ground and thereby reduce the amount of RF traffic on the Mode S link. This recommended practice applies equally to the ARINC 718A-3 since ICAO Annex 10 Volume IV Amendment 82 Section 3.1.2.10.3.10 confirms the requirements to inhibit replies while the aircraft is on the ground.

Air/Ground Discrete Input #1 is to be used when replies are not to be inhibited when the aircraft is on the ground. Airframe and equipment manufacturers are cautioned to provide “sneak circuit” protection for these inputs so that malfunctions of other equipment connected to the same logic source do not affect operation. The system should be designed such that the normal failure mode should be to the airborne condition.

1. ARINC 429 High-Speed Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 high-speed (100 kbps) bus operation, unless otherwise noted.

1. GPS Time Mark Inputs

The Differential Time Mark input is an interface to an ARINC 743A GNSS receiver to provide synchronization to other aircraft systems. Signal characteristics for the Time Mark (i.e., tag) are provided in Attachment 8 of ARINC Characteristic 743A.

1. Antenna Program

This program pin input is assigned to identify an installation in which only one antenna is used (i.e., the bottom antenna). A “ground” at this input should be used to indicate a single antenna installation, while an “open” should be interpreted as a dual antenna installation. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Control Panel Interface

The Mark 4 transponder is equipped with two control data input ports and a port selection function to accommodate the different control philosophies described in ARINC Specification 720. The interwiring diagram reflects the philosophy in which a dedicated Control Panel is used. The data output port of this panel is normally wired to Control Data Input Port B on the transponder unit. Control Data Input Port A, and the port selection discrete functions are not normally wired.

When implemented, the Control Data Port Select Discrete Input is used to select the active control port as follows:

1. When the Control Data Port Select Discrete Input, TP-7D, is open then Control Data Input Port B is the active control port.
2. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured to accept input data from the FCC #1, the MCP #1, or the VHF #3.
3. In this configuration, selection of the FCC #1/MCP #1 or FCC #2/MCP #2 active input port is further determined by the setting of the FCC/MCP 1/2 Select Discrete Input as provided in Note 20, below.
4. When the Control Data Port Select Discrete Input, TP-7D, is grounded then Control Data Input Port A is the active control port.
5. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured as the active control input and therefore is not expected to be processing FCC#1, MCP#1, or VHF#3 data.
6. Standby/On Control

The Standby/On Control discrete provide a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive Mark 4 transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. To obtain “Standby” operation, connect pin TP-7G to Chassis or Airframe ground. For “On” operation, leave pin TP-7G “open.” (See Section 6.4.1 of this Characteristic for further detail.)

1. FCC/MCP 1/2 Select Discrete Input

The use of several pins (TP-7A/TP-7B, MP-4C/MP-4D and MP-4J/MP-4K) is affected by whether the FCC/MCP 1/2 Select Discrete input (TP-7K) is grounded or not. This pin (TP-7K) is used to select the active port for FCC/MCP data as follows:

1. When the pin is open the FCC/MCP #1/VHF #3 port is active:
   1. If the Control Data Port Select Discrete Input, TP-7D, is open, then FCC/MCP #1, and VHF #3 data is accepted via TP-7A/TP-7B or MP-4C/MP-4D.
   2. If the Control Data Port Select Discrete Input, TP-7D, is grounded, then TP-7A/TP-7B are configured to accept Control Data. In this configuration, the Mark 4 transponder may be capable of processing FCC/MCP data on MP-4C/MP-4D. See Note 45.
2. When the pin is grounded the FCC/MCP #2 port is active on MP-4J/MP-4K.
3. Mode S Aircraft Address

The aircraft Mode S Address (also known as the ICAO 24-bit aircraft address) consists of a 24-bit sequence uniquely assigned to each aircraft. To provide aircraft installation insertion of the aircraft address, for each address bit designated “1” connect the corresponding connector pin to Middle Plug Common, MP-6H, or other Common. For “0” address bits, leave the corresponding connector pin open.

The aircraft Mode S address should be transmitted (RF) by the Mode S transmitter with the most significant bit (MSB) first. The MSB is designated A1.

1. (Reserved) Avionics Personality Module Interface

The Minimum TIF, Double-Sided Configuration does not require an APM Interface. However, implementers should be aware that the APM interface may be used with TIF and Minimum Subset configurations previously defined by ARINC 718A-1.

1. 24Bit/APM Address Select Discrete Input

This pin is used to identify the source of the Mode S Address (i.e., ICAO 24-Bit Address). The source can be the address program pins (MP-A10 through A-24 or an Avionics Personality Module (APM) method. When connection between this input and any of the Mode S Address inputs or connection to aircraft ground is detected then, the Mode S Address (i.e., ICAO 24-Bit Address) will be accepted from the program pin inputs. Otherwise address and configuration data should be accepted via the APM interface.

It is expected that the Minimum TIF, Double-Sided Configuration will not need an APM interface, however, the definition of MP-3E indicates that such implementation is allowed. If the APM interface is implemented, then it should be done in accordance with Attachment 2A.

1. Reserved Discrete Out or Data Loader Activate Discrete Input

Attachment 2B-1, Minimum Subset, Single-Sided Configuration retains MP-3J as a reserved Discrete output. ARINC-718-4 implemented this pin as a discrete output used to indicate an Altitude Comparison Failure. The Altitude Comparison Failure function is not used with the ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration as the configuration does not implement Gillham altitude.

Implementers should be aware that the pin may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1. Likewise, implementers should be aware that the pin is used for data loader activation in ARINC 718A-1.

1. Transponder Fail #1 Discrete Output

When the Mark 4 transponder unit has failed, this discrete output should supply +5 Vdc to operate Fail lamps (maximum current capability of 25 mA per lamp) and provide diode protection against sneak circuits.

When the Mark 4 transponder unit has not failed, the output should be an “open” (100,000 ohms or more resistance from this pin to airframe ground).

Note: This is not a standard discrete output.

1. Spare

The Minimum TIF, Double-Sided configuration uses MP-4A and MP-4B as FMC #2 General Input Bus (ARINC 429). This is the same assignment as the TIF configuration defined in ARINC 718A-1.

Implementers should be aware that these pins are designated “Spare” in the Minimum Subset configuration defined in Attachment 2A and “Spare” in the Minimum Subset, Single-Sided configuration defined in Attachment 2B.

1. Aircraft Category Program Pins

The Minimum TIF, Double-Sided Configuration implements two input discrete pins to program the transponder with Aircraft Category information in accordance with the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT CATEGORY ENCODING | | | | | | |
| **(MP-4E and MP-4F are *Strobed*)** | | | **Register 08HEX** | | | **AIRCRAFT CATEGORY SELECTION** |
| **State**  **#** | **PIN** | | **“ME” Field** | | |
| **MP-4E**  **(A)** | **MP-4F**  **(B)** | **Bit 6** | **Bit 7** | **Bit 8** |
| 0 | 0 | 0 | 0 | 0 | 0 | No ADS-B Emitter Category Information |
| 1 | 0 | 1 | 0 | 0 | 1 | Light (<15,500 lbs.) |
| 2 | 0 | 2 | 0 | 1 | 0 | Small (15,500 to 75,000 lbs.) |
| 3 | 1 | 0 | 0 | 1 | 1 | Large (75,000 to 300,000 lbs.) |
| 4 | 1 | 1 | 1 | 0 | 0 | High-Vortex Large (aircraft such as B-757) |
| 5 | 1 | 2 | 1 | 0 | 1 | Heavy (>300,000 lbs.) |
| 6 | 2 | 0 | 1 | 1 | 0 | High Performance (> 5G acceleration and >400 knots) |
| 7 | 2 | 1 | 1 | 1 | 1 | Rotorcraft |
| 8 | 2 | 2 | NOT USED | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B). | | | | | | |

Implementers should be aware that the Minimum Subset, Single-Sided Configuration specified in Attachment 2B-1 uses the same pins identified above for the same Aircraft Category programming function. However, the TIF Configuration previously specified by ARINC 718A-1 uses BP-4, BP-5, and BP-6 for programming the Aircraft Category function.

1. Antenna Bite Program Discrete Input

This program input should be connected to the Middle Plug Common (MP-6H) to indicate to the Mark 4 transponder unit that the antenna has the facility to provide BITE information. An antenna having a DC path to ground may be used, thus providing the ability to sense the presence of the antenna, and confirming cable continuity for BITE purposes.

This discrete input should only be checked when in the on-ground state.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active port for ARINC 429, ARINC 575, and Synchro data sources. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. Altitude Air Data Type Select

The Mark 4 transponder is capable of receiving three types of altitude information. Two programming pins are assigned to select which type of altitude is to be processed as follows:

|  |  |  |
| --- | --- | --- |
| ALTITUDE AIR DATA TYPE SELECTION ENCODING | | |
| **PIN** | | **SELECTION** |
| **MP-6F** | **MP-6G** |
| 0 | 0 | ARINC 429 Data via ARINC 429 ADS Input Ports |
| 0 | 1 | Synchro Data via Synchro Input Ports |
| 1 | 0 | ARINC 575 Data via ARINC 429 ADS Input Ports |
| 1 | 1 | not USED (formerly Gillham Altitude) |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Middle Plug Common (MP-6H).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | |

The following rules apply to altitude type selection and use:

a. Synchro (Course and Fine) Altitude and Validity Flag on two ports.

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Flag is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the synchro data.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Flag is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

b. ARINC 429 words on two ports:

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Selected Source is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the selected source.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Selected Source is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

c. ARINC 575 (DADS) words on two ports:

Same as for ARINC 429 data.

1. Primary Power Wiring

The primary power cold function has been assigned to be a long pin in the BP insert of the Mark 4 transponder unit to ensure that it breaks after the primary power hot connection when the transponder unit is removed from the rack. This is intended to prevent the infamous hot pull problems, which can occur when the ground circuit is interrupted during removal of the equipment with the power applied.

Because all of the pins in the control panel connector(s) are of equal length, this same precaution cannot be taken. The system circuit breaker should be opened before the control panel interconnect(s) is (are) broken.

1. Wire Sizes

It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakage occurs.

1. Backward Incompatibility Discrete Input

The Backward Incompatibility Discrete Input is used by the installed transponder to identify those aircraft configurations that are not compatible with the Minimum Subset, Single-Sided configuration defined in Attachment 2B.

The Minimum Subset, Single-Sided configuration uses “Common” pins in the same way as existing Mark 3 transponder configurations specified by ARINC 718-4. In particular, the Minimum Subset, Single-Sided configuration assigns pins TP-3F, TP-3J, TP-3K, and TP-5D as “Common”. Likewise, pins MP-3E, MP-6H, and MP-6K are “Common”. These pins are defined in Attachment 2B.

However, the Minimum TIF, Double-Sided configuration assigns pins TP-3F, TP-3J, and TP-3K for different usage than “Common.” Likewise, pins MP-3E and MP-6K are assigned for different usage than “Common.” These pins are defined in Attachment 2C.

Because Supplement 3 introduces new interwiring configurations, pin BP-2 is used to distinguish between the two configurations as follows:

1. BP-2 is open-circuit:

“Common” pins (as discussed above in this Note) shall be recognized as legacy connections as defined in Attachment 2B for the Minimum Subset, Single-Sided configuration.

1. BP-2 is connected to aircraft ground:

“Common” pins (as discussed above in this Note) shall be recognized as defined in Attachment 2C for the Minimum TIF, Double-Sided configuration.

|  |  |  |
| --- | --- | --- |
| COMMON PIN SUMMARY | | |
| **Summary “Common” Pin** | **Minimum Subset, Single-Sided** | **Minimum TIF, Double-Sided** |
| TP-3F | Common | Vendor Discrete In |
| TP-3J | Common | FMC/GNSS 1/2 Select |
| TP-3K | Common | Spare |
| TP-5D | Common | Common |
| MP-3E | Common | 24-bit/APM Select |
| MP-6H | Common | Common |
| MP-6K | Common | Spare |

Furthermore, implementers should be aware that the Backward Incompatibility Discrete Input function continues to be used with ARINC 718A-1 configurations, per Note 33 in Attachment 2A-3.

Note: Review of Attachment 2A-3 Note 33 indicates that the Note implies that conflictmay arise when interfacing to MP-5H, MP-6J, or MP-7K. Subsequent review has established that there should not be any conflict as each of the three pins is used for the same purpose in ARINC 718-4 and all ARINC 718A, ARINC 718A-2 and ARINC 718A-3 configurations.

1. Extended Squitter Disable Discrete Input

The Extended Squitter Disable Discrete is used to disable all Extended Squitter functions. When the pin is grounded Extended Squitter functions are disabled and when it is “open” the Extended Squitter functions are enabled.

Note 1:The Extended Squitter Disable function can be applied at any time. Specifically, it is not intended to be an on-ground function only. As it may be applicable in the airborne state, Note 2 must be observed.

Note 2: Disabling of the Extended Squitter function is not recommended during normal flight operations unless the Extended Squitter operational status is clearly indicated to the flight crew.

1. Not Used (formerly Reserved Weather In #1/2 Select Discrete Input)

The function is not used with the Minimum TIF, Double-Sided configuration. However, implementers should be aware that pin BP-9 is used by the ARINC 718A-1 TIF configuration to select the active port for Weather In (includes Radar Altitude) data.

1. Not Used (formerly MSP/ATSU/CMU #1/2 Select Discrete Input)

The function is not used with the Minimum TIF, Double-Sided configuration. However, implementers should be aware that pin MP-6K is used by the ARINC 718A-1 TIF configuration to select the active port for MSP/ATSU/CMU data.

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “Standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a DC ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. High-Speed and/or Special Purpose Buses

The MSP/ATSU/CMU buses should be configurable to be used as high-speed ARINC 429 buses as well as for special purposes or protocols.

1. Minimum Subset

These interfaces are identified as the Minimum Subset necessary to satisfy ARINC 718A-2 compatibility requirements when using the Minimum TIF, Double-Sided Configuration identified in Attachment 2C-1.

1. FCC/MCP #1 Inputs

There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it is the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G is needed for VHF #3 In.

1. Transponder Fail Logic

Transponder Fail Logic #1 Input

When the transponder has failed, this input discrete to the control panel should be +5 Vdc, and it should cause the transponder fail indicator to be illuminated. When transponder has not failed the input to this discrete should be “open.”

Transponder Fail logic #2 Input

When the transponder has failed, this input discrete to the control panel should be “open” and it should cause the transponder fail indicator to be illuminated. When the transponder has not failed, this input discrete should be grounded.

1. Mode S DL/DLP Discrete Input

The Mode S DL/DLP Discrete may be used to indicate that TP-2A/TP-2B and MP-5E/MP-5F utilize the Comm A/B protocol interface as specified in Attachment 5 of this document, and for a level 3 and above transponder that TP-2C/TP-2D and TP-2E/TP-2F utilize the Comm C/D protocol as specified in Attachment 5. When pin MP-5H is grounded then TP-2A/TP-2B and MP-5E/MP-5F will operate as defined in Attachment 5 and, depending upon the level and functionality of the transponder, TP-2C/TP-2D and TP-2E/TP-2F may operate as defined in Attachment 5.

When MP-5H is open TP-2A/TP-2B, MP-5E/MP-5F, TP-2C/TP-2D, and TP-2E/TP-2F will operate as defined in Attachment 2.

1. Spare Pin Usage

The connector pins marked “Spare” in Standard Interwiring list are available for assignment, as the airline industry desires. However, if the interchangeability for the system specified in Section 1.5 of this Characteristic is to be retained, any such assignment thought necessary must be coordinated with the AEEC staff and approved by the industry prior to being made.

1. GPS/GNSS

See ARINC Characteristic 743A for complete definitions for input and output between the Mark 4 transponder and the GPS/GNSS.

1. Reserved ARINC 429 Input

This function is implemented in the right plug (J2) only of dual system control panels. This input may be used to provide data to the control panel from ARINC 429 buses such as the TCAS Maintenance Output bus.

1. ADS-B OUT Fail Discrete Inputs

ADS-B OUT Fail #1 Discrete Input (J1-CP-17)

When the ADS-B OUT function of the #1 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #1 transponder ADS-B OUT fail indicator to be illuminated. When the #1 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #1 transponder ADS-B OUT fail indicator should not be illuminated.

ADS-B OUT Fail #2 Discrete Input (J2-CP-17)

When the ADS-B OUT function of the #2 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #2 transponder ADS-B OUT fail indicator to be illuminated. When the #2 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #2 transponder ADS-B OUT fail indicator should not be illuminated.

1. Aircraft/Vehicle Length/Width

These pins provide the capability to identify the Aircraft/Vehicle Length/Width of the installation to the transponder in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT/VEHICLE LENGTH/WIDTH ENCODING | | | | | | | | | |
| **(TP-1A is not *Strobed*. TP-1B and TP-1C are *Strobed*)** | | | | **Length**  **Code** | | | **Width**  **Code** | **Upper Bound Length and Width**  **For Each Length/Width Code** | |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | **Length** | **Width** |
| **TP-1A**  **(A)** | **TP-1B**  **(B)** | **TP-1C**  **(C)** | **Bit 21** | **Bit 22** | **Bit 23** | **Bit 24** | **(meters)** | **(meters)** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | No Data or Unknown | |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | < 15 | < 23 |
| 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | < 25 | < 28.5 |
| 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | < 34 |
| 4 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | < 35 | < 33 |
| 5 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | < 38 |
| 6 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | < 45 | < 39.5 |
| 7 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | < 45 |
| 8 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | < 55 | < 45 |
| 9 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | < 52 |
| 10 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | < 65 | < 59.5 |
| 11 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | < 67 |
| 12 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | < 75 | < 72.5 |
| 13 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | < 80 |
| 14 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | < 85 | < 80 |
| 15 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | < 90 |
| 16 | 1 | 2 | 1 | NOT USED | | | | | |
| 17 | 1 | 2 | 2 | NOT USED | | | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Note that TP-1A does not connect to TP-3B at any time. Therefore, TP-1A is NOT Strobed.  5. If the Aircraft/Vehicle is longer than 85 meters, or wider than 90 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #15. | | | | | | | | | |

1. GPS Antenna Longitudinal Offset

These pins provide the capability to specify the distance of the GPS Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual GPS Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GPS ANTENNA LONGITUDINAL OFFSET ENCODING | | | | | | | | | |
| **(TP-1D, TP-1E and TP-1F**  **are *Strobed*)** | | | |  | | | | | **Upper Bound of the**  **GPS Antenna Offset**  **along Longitudinal (Roll) Axis**  **Aft from Aircraft Nose**  **(meters)** |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | |
| **TP-1D**  **(A)** | **TP-1E**  **(B)** | **TP-1F**  **(C)** | **Bit 36** | **Bit 37** | **Bit 38** | **Bit 39** | **Bit 40** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 *or* NO DATA |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Position Offset Applied by Sensor |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 4 |
| 4 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 6 |
| 5 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 8 |
| 6 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 10 |
| 7 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 12 |
| 8 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 14 |
| 9 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 16 |
| 10 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 18 |
| 11 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 20 |
| 12 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 22 |
| 13 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 24 |
| 14 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 26 |
| 15 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 28 |
| 16 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 30 |
| 17 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 32 |
| 18 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 34 |
| 19 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 36 |
| 20 | 2 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 38 |
| 21 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 40 |
| 22 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 42 |
| 23 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 44 |
| 24 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 46 |
| 25 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 48 |
| 26 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 50 |
| NOT USED | | | | 1 | 1 | 0 | 1 | 1 | 52 |
| 1 | 1 | 1 | 0 | 0 | 54 |
| 1 | 1 | 1 | 0 | 1 | 56 |
| 1 | 1 | 1 | 1 | 0 | 58 |
| 1 | 1 | 1 | 1 | 1 | 60 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. If the GPS Antenna Longitudinal Offset from the nose of the aircraft is in excess of 50 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #26.  5. Note that the encoding provided by the configuration pins has a maximum of 50 meters while the encoding provided for in Register 65HEX can go up to 60 meters. The encoding provided by the configuration pins has been restricted in order to minimize the number of discrete pins required by the function. | | | | | | | | | |

1. Navigation Accuracy Category\_Velocity (NACV)

This pin provides the capability to identify the Navigation Accuracy Category\_Velocity (NACV) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever NACV information is not provided to the transponder by another appropriate means. Also note that the encoding provided in the following table is not the final encoding that is entered into transponder registers 09 Hex and 65 Hex for transmission in ADS-B messages. The final register encoding is established in Attachment 3A-1 Note 22.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NAVIGATION ACCURACY CATEGORY\_VELOCITY (NACV) ENCODING | | | | |
| **NACV Subfield**  **Encoding** | | **(TP-1G is *Strobed*)** | | **Horizontal Velocity Error** |
| **State**  **#** | **PIN** |
| **binary** | **decimal** | **TP-1G** |
| 000 | 0 | 0 | 0 | Unknown or > 10 meters/second |
| 001 | 1 | 1 | 1 | < 10 meters/second |
| 010 | 2 | 2 | 2 | < 3 meters/second |
| 011 | 3 | NOT USED | | < 1 meter/second |
| 100 | 4 | <0.3 meters/second |
| 101 | 5 | NOT ASSIGNED IN RTCA DO-260B | | |
| 110 | 6 |
| 111 | 7 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Encoding is only provided through State 2 as it will be well into the future before navigation sources will be capable of providing NACV values approaching 1 meter/second.  5. If the NACV value to be encoded is less than 1 meter/second or better, then the Pin Configuration and bit encoding shall be set to that indicated for State #2. | | | | |

1. System Design Assurance (SDA)

This pin provides the capability to identify the System Design Assurance (SDA) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever SDA information is not provided to the transponder by another appropriate means.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SYSTEM DESIGN ASSURANCE (SDA) ENCODING | | | | | | |
| **PIN Encoding** | | **SDA Value** | | **Supported**  **Failure**  **Condition**  **(Note 6)** | **Probability of Undetected Fault causing transmission of False or**  **Misleading Information**  **(Note 7, 8)** | **Software & Hardware**  **Design Assurance Level**  **(Note 5, 7)** |
| **Register 65HEX**  **Bits 31, 32** | |
| **State #** | **TP-1H** | **(decimal)** | **(binary)** |
| 0 | 0 | 0 | 0 0 | Unknown/  No Safety Effect | > 1X10-3 per flight hour  or Unknown | N/A |
| Not Used  (Note 1) | | 1 | 0 1 | Minor | < 1X10-3 per flight hour | D |
| 1 | 1 | 2 | 1 0 | Major | < 1X10-5 per flight hour | C |
| 2 | 2 | 3 | 1 1 | Hazardous | < 1X10-7 per flight hour | B |
| Table Notes:  1. It is expected that all GPS/GNSS and ADS-B Transmitting equipment to be associated with this Characteristic will support a minimum design assurance of 10-5. Therefore, the 10-3 case having an SDA = “1” is NOT Allowed and there is no encoding provision made with TP-1H.  2. “0” coding means that TP-1H is in the “open-circuit” state.  3. “1” coding means that TP-1H is connected to Middle Plug Common (MP-6H).  4. “2” coding means that TP-1H is connected to XPDR Fail #2 (TP-3B).  5. Software Design Assurance per RTCA DO-178B (EUROCAE ED-12B). Airborne Electronic Hardware Design Assurance per RTCA DO-254 (EUROCAE ED-80).  6. Supported Failure Classification defined in AC-23.1309-1C, AC-25.1309-1A, and AC 29-2C.  7. Because the broadcast position can be used by any other ADS-B equipped aircraft or by ATC, the provisions in AC 23-1309-1C that allow reduction in failure probabilities and design assurance level for aircraft under 6,000 pounds do not apply.  8. Includes probability of transmitting false or misleading latitude, longitude, velocity, or associated accuracy and integrity metrics. | | | | | | |

1. Common

The ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration retains TP-3K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1.

1. Not Assigned

ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration does not assign usage of TP-6H and TP-6J. Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1.

1. Not Assigned

The ARINC 718A-2 Minimum Subset (i.e., Attachment 2A-1) Configuration assigns MP-3F, 3G for FCC/MCP #1/VHF #3 input. Likewise, the ARINC 718A-2 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration assigns MP-3F, 3G for FCC/MCP #1/VHF #3 input. ARINC 718A Supplement-2, Attachment 2C-1, Minimum TIF, Double-Sided Configuration also assigns MP-3F,3G for FCC/MCP #1/VHF #3 input.

The ARINC 718A-3 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration does not assign any usage of MP-3F or MP-3G. However, the ARINC 718A-3 Minimum TIF, Double Sided (i.e., Attachment 2C-1) continues to assign MP-3F, 3G for FCC/MCP #1/VHF #3 input.

Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes in the different configuration discussed above.

1. Not Assigned

ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration does not assign usage of MP-6J. Implementers should be aware that these pins were previously used in ARINC 718A-1 transponders for output of ARINC 429 data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1.

1. Spare

Attachment 2C-1, Minimum TIF, Double-Sided Configuration assigns MP-6K as “spare”. ARINC 718-4 transponders and the ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration assign MP-6K as “Common.”

1. Not Assigned

Attachment 2C-1, Minimum TIF, Double-Sided Configuration does not assign usage of MP-7K. Implementers should be aware that these pins were previously used in ARINC 718A-1 transponders for output of ARINC 429 data.

1. IRS 1/2 Select Discrete Input

This pin is used to select the active port for Inertial Reference System (IRS) /Flight Management System (FMS)/Data Concentrator input data. When the pin is open the number 1 IRS/FMS/Data Concentrator port is active and when it is grounded the number 2 IRS/FMS/Data Concentrator port is active.

1. Program Pin Strobe

Each of the discrete inputs (program pins) assigned to Aircraft Length/Width, Aircraft Category, ADS-B Receiver Capability, and GPS Antenna Offset has 2 states: state 0 when left “open” and state 1 when it is connected to a program pin common. An additional state, state 2 can be achieved when a discrete input is connected to a discrete output pin TP-3B Transponder Fail Discrete #2 Output. To determine state 2, the discrete inputs are read twice while the discrete output is driven active and inactive. This is done at power-on only. Each of the discrete inputs can have only one of the 3 states. At power-on and regardless of the air/ground state, the following sequence reads the strobed program pins:

1. Set the discrete output TP-3B “open” and read each of the program pins.
2. Set the discrete output TP-3B to “ground” and read each of the program pins.
3. Decode results to program pin state:
4. If a program pin is “open” for both the steps “a” and “b”, it is not connected to the discrete output pin TP-3B or program common pin, which puts the program pin in state 0.
5. If a program pin is connected to “ground” for both the steps “a” and “b”, it is connected to “ground”, which puts the program pin in state 1.
6. If a program pin is “open” on step “a” and connected to “ground” on step “b”, it is connected to the discrete output pin TP 3B, which is state 2.
7. ADS-B FAIL Disable

This pin is used to enable or disable annunciation of an ADS-B function fail via the Fail Warn Discrete outputs (TP-3B and MP-3K) in accordance with the following table:

|  |  |
| --- | --- |
| ADS-B FAIL DISABLE ENCODING | |
| **PIN STATUS** | **ADS-B FUNCTION FAIL DECLARATION SELECTION** |
| **TP-2K** |
| Open – circuit | Failures of the ADS-B Function shall be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) as well as via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |
| Connected to  TP-5D | Failures of the ADS-B Function shall NOT be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) but shall continue to be declared via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |

1. ADS-B Receive Capability

This pin is strobed and used to indicate the ADS-B IN Receive Capability of the Aircraft installation in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| ADS-B RECEIVE CAPABILITY ENCODING | | |
| **PIN Encoding**  **(*Strobed*)** | | **Selection/Meaning** |
| **State #** | **MP-4H** |
| 0 | 0 | Aircraft installation has no capability to receive either 1090 ES IN or UAT IN |
| 1 | 1 | Aircraft installation has capability to receive 1090 ES IN Only |
| 2 | 2 | Aircraft installation has capability to receive both 1090 ES IN and UAT IN |
| Table Notes:  1. “0” coding means that MP-4H is in the “open-circuit” state.  2. “1” coding means that MP-4H is connected to Middle Plug Common (MP-6H).  3. “2” coding means that MP-4H is connected to XPDR Fail #2 (TP-3B).  4. It is expected that future implementations with TCAS or the Traffic Function will have additional capability to communicate the state of 1090ES IN and UAT IN. Presently, no such method is identified in this Characteristic. | | |

1. ADS-B Configuration Parity

MP-4G is used to indicate the parity of the ADS-B Configuration installation to the transponder and is best illustrated in the following table. Column #1 of the table defines those ADS-B Configuration Parameters that are to be used to establish the configuration parity. Column #2 of the table defines the actual ADS-B Configuration Pins that are to be used to establish the configuration parity. Once the connection requirements are established for all of the necessary ADS-B Configuration Parameters and Pins, then establish the number of pins that are connected to Common as illustrated in Column #8 of the table. Then, establish the parity (as illustrated in Column #9 of the table) and Connect MP-4G to Common if the Parity is ODD. Otherwise, leave MP-4G in the “open-circuit” state since Parity is EVEN.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SAMPLES OF ADS-B CONFIGURATION PARITY ENCODING | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|  | | | **PIN shown in Column #2**  **is Connected to** | | | | **# of Pins**  **Connected to**  **Common** | **PARITY** | **CONNECT**  **MP-4G**  **TO** |
| **ADS-B PARAMETER** | **PIN** | **STATE** | **OPEN** | **COMMON** | | **STROBE** |
| **OPEN** | **TP-5D** | **MP-6H** | **TP-3B** |
| AIRCRAFT/VEHICLE  LENGTH/WIDTH | TP-1A | 1 (0) | (Z) | X |  |  | X = 7  (Z = 6) | ODD  (EVEN) | COMMON  AT  MP-6H  (OPEN) |
| TP-1B | 0 (1) | X | (Z) |  |  |
| TP-1C | 2 (0) | (Z) |  |  | X |
| GPS ANTENNA  LONGITUDINAL  OFFSET | TP-1D | 2 (0) | (Z) |  |  | X |
| TP-1E | 1 (1) |  | X (Z) |  |  |
| TP-1F | 0 (1) | X | (Z) |  |  |
| NACV | TP-1G | 1 (0) | (Z) | X |  |  |
| SYSTEM DESIGN  ASSURANCE | TP-1H | 1 (0) | (Z) | X |  |  |
| ADS-B FAIL DISABLE | TP-2K | 0 (1) | X | (Z) |  |  |
| AIRCRAFT CATEGORY | MP-4E | 1 (1) |  |  | X (Z) |  |
| MP-4F | 1 (0) | (Z) |  | X |  |
| ADS-B RECEIVE  CAPABILITY | MP-4H | 1 (1) |  |  | X (Z) |  |
| Table Notes:  1. The ADS-B Configuration Parameters to be used to establish the ADS-B Configuration Parity are listed in Column #1.  2. The ADS-B Configuration Pins that are to be used to establish the ADS-B Configuration Parity are listed in Column #2.  3. Column #3 presents the state of the ADS-B Configuration Pins for two separate samples. Sample #1 is show in Bold Font while sample #2 is shown in parenthesis.  4. Columns #4 through 7 indicate the actual connections that should be made for each ADS-B Configuration Parameter Pin for each sample. Sample #1 is indicated with an “X” while sample #2 is shown with “(Z)”.  5. Column #8 indicates the number of ADS-B Configuration Pins that are connected to Common for each of the two samples. Sample #1 is shown as “X = 7” while sample #2 is shown as “(Z = 6)”.  6. Column #9 indicates the parity of the count established in Column #8 for each of the two samples. Sample #1 is shown as “ODD” while sample #2 is shown as “(EVEN)”.  7. Column #10 indicates the connection that should be made for MP-4G for each of the two samples. Sample #1 results in MP-4G being connected to MP-6H. Sample #2 results in MP-4G being in the “open-circuit” state. | | | | | | | | | |

1. GPS Time Mark (Differential)

Although the GPS Time Mark inputs on TP-1J and TP-1K are not included in the Minimum Subset (see Note 44), it is highly recommended that these inputs be connected to the appropriate GPS outputs in order to be able to comply with future precision position reporting that may be required by future applications.

1. FMC 1/2 Select Discrete Input

This pin is used to select the active ports for FMC General Input Data on TP-6A/TP-6B for FMC #1, or MP-4A/MP-4B for FMC #2. When the pin is open, the FMC #1 port is active. When the pin is grounded, the FMC #2 port is active.

1. D-1 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION PIN ALLOCATION

BOTTOM PLUG (BP)



1. D-2 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION STANDARD INTERWIRING

| **TOP PLUG SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Aircraft/Vehicle Length/Width A MSB | TP-1A | Program Pin Input |  | 1, 44, 52 |
| Aircraft/Vehicle Length/Width B | TP-1B | Program Pin Input\_Strobed |  | 1, 44, 52, 63 |
| Aircraft/Vehicle Length/Width C LSB | TP-1C | Program Pin Input\_Strobed |  | 1, 44, 52, 63 |
| GPS Antenna Longitudinal Offset A MSB | TP-1D | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset B | TP-1E | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset C LSB | TP-1F | Program Pin Input\_Strobed |  | 1, 44, 53, 63 |
| Navigation Accuracy Category\_Velocity (NACV) | TP-1G | Program Pin Input\_Strobed |  | 1, 44, 54, 63 |
| System Design Assurance (SDA) | TP-1H | Program Pin Input\_Strobed |  | 1, 44, 55, 63 |
| Strobe #4 | TP-1J | Discrete Output |  | 1,16 |
| Strobe #5 | TP-1K | Discrete Output |  | 1,67 |
| FMC/GNSS #1 In #1 A | TP-2A | ARINC 429 Input | 743A GNSS #1 or | 2, 3, 44, 47, 49 |
| FMC/GNSS #1 In #1 B | TP-2B | ARINC 429 Input | 702A FMC #1 |  |
| IRS/FMS/Data Concentrator In #1 A | TP-2C | ARINC 429 Input | 702A FMC #1, 704 IRS | 2, 3, 44, 47 |
| IRS/FMS/Data Concentrator In #1 B | TP-2D | ARINC 429 Input | #1, Data Conc. #1 |  |
| General Output #1 A | TP-2E | ARINC 429 HS Output | 615 Data Loader, or | 15, 44, 47 |
| General Output #1 B | TP-2F | ARINC 429 HS Output | As Needed | 15, 44, 47 |
| Not Assigned | TP-2G |  |  |  |
| Not Assigned | TP-2H |  |  |  |
| Strobe #6 | TP-2J | Discrete Output |  | 68 |
| ADS-B FAIL Disable | TP-2K | Program Pin Input |  | 1, 44, 64 |
| ABS-B OUT Fail Discrete Out/Strobe #2 | TP-3A | Discrete Output |  | 5 |
| XPDR Fail Discrete #2 Out/Strobe #1 | TP-3B | Discrete Output |  | 6, 44 |
| Cable Delay Program – Top/Bottom | TP-3C | Program Pin Input |  | 7, 44 |
| Cable Delay Program – Value | TP-3D | Program Pin Input |  | 7, 44 |
| Cable Delay Program – Value | TP-3E | Program Pin Input |  | 7, 44 |
| Common | TP-3F |  |  | 8 |
| SDI Input Discrete | TP-3G | Discrete Input |  | 9, 44 |
| SDI Input Discrete | TP-3H | Discrete Input |  | 9, 44 |
| Common | TP-3J |  |  | 10 |
| Common | TP-3K |  |  | 56 |
| Aircraft Type Character (AIREP) #1 | TP-4A | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #2 | TP-4B | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #3 | TP-4C | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #4 | TP-4D | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #5 | TP-4E | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #6 | TP-4F | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #7 | TP-4G | Program Pin Input\_Strobed |  | 11, 44 |
| Aircraft Type Character (AIREP) #8 | TP-4H | Program Pin Input\_Strobed |  | 11, 44 |
| Spare | TP-4J |  |  | 48 |
| Spare | TP-4K |  |  | 48 |
| Maximum Cruising Airspeed – 17 | TP-5A | Program Pin Input |  | 12, 44 |
| Maximum Cruising Airspeed – 16 | TP-5B | Program Pin Input |  | 12, 44 |
| Maximum Cruising Airspeed – 15 | TP-5C | Program Pin Input |  | 12, 44 |
| Top Plug Common | TP-5D | Ground Reference |  | 44 |
| TX Coordination A | TP-5E | ARINC 429 HS Input | 735A/B TCAS | 13, 44 |
| TX Coordination B | TP-5F | ARINC 429 HS Input | 735A/B TCAS | 13, 44 |
| XT Coordination A | TP-5G | ARINC 429 HS Output | 735A/B TCAS | 13, 15, 44 |
| XT Coordination B | TP-5H | ARINC 429 HS Output | 735A/B TCAS | 13, 15, 44 |
| Air/Ground Discrete Input #2 | TP-5J | Discrete Input |  | 14, 44 |
| Air/Ground Discrete Input #1 | TP-5K | Discrete Input |  | 14, 44 |
| FMC #1, General Input #2 A | TP-6A | ARINC 429 Input | 702A FMC #1 | 2, 3, 44 |
| FMC #1, General Input #2 B | TP-6B | ARINC 429 Input | 702A FMC #1 | 2, 3, 44 |
| New 718A-5 ARINC Bus #1 A | TP-6C | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #1 B | TP-6D | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #2 A | TP-6E | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #2 B | TP-6F | ARINC 429 Input |  | 2 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| New 718A-5 ARINC Bus #3 A | TP-6G | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #3 B | TP-6H | ARINC 429 Input |  | 2 |
| Not Assigned | TP-6J |  |  | 57 |
| Antenna Program | TP-6K | Program Pin Input |  | 17, 44 |
| Control Data “A” or FCC #1/MCP #1/VHF #3 Input Port A | TP-7A | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2, 18, 20, 44,  45 |
| Control Data “A” or FCC #1/MCP #1/VHF #3 Input Port B | TP-7B | ARINC 429 Input | 718 Control, FCC #1, MCP #1, or VHF #3 | 2, 18, 20, 44,  45 |
| Gear Position (Up/Down) | TP-7C | Discrete Input |  | 73, 44 |
| Control Port Select Discrete Input | TP-7D | Discrete Input |  | 18, 20, 44 |
| Control Data “B” Input Port A | TP-7E | ARINC 429 Input | 718 Control | 2, 18, 44 |
| Control Data “B” Input Port B | TP-7F | ARINC 429 Input | 718 Control | 2, 18, 44 |
| Standby/On Discrete Input | TP-7G | Discrete Input |  | 19, 44 |
| Digital Air Data #1 Input A | TP-7H | ARINC 429 Input | 706 ADS #1 or | 2, 44 |
| Digital Air Data #1 Input B | TP-7J | ARINC 429 Input | 575 ADS #1 | 2, 44 |
| Not Assigned | TP-7K |  |  | 20 |
| Top Antenna RF | TP-Coax | Coaxial Input | Top Antenna | 44 |

| MIDDLE PLUG  **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Mode S Address Bit A1 MSB | MP-1A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A2 | | MP-1B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A3 | | MP-1C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A4 | | MP-1D | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A5 | | MP-1E | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A6 | | MP-1F | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A7 | | MP-1G | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A8 | | MP-1H | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A9 | | MP-1J | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A10 | | MP-1K | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A11 | | MP-2A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A12 | | MP-2B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A13 | | MP-2C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A14 | | MP-2D | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A15 | | MP-2E | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A16 | | MP-2F | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A17 | | MP-2G | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A18 | | MP-2H | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A19 | | MP-2J | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A20 | | MP-2K | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A21 | | MP-3A | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A22 | | MP-3B | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A23 | | MP-3C | Program Pin Input |  | 21, 22, 44 |
| Mode S Address Bit A24 LSB | MP-3D | Program Pin Input |  | 21, 22, 44 |
| Common | MP-3E |  |  | 23 |
| Not Assigned | MP-3F |  |  |  |
| Not Assigned | MP-3G |  |  |  |
| Functional Test Discrete Input | MP-3H | Discrete Input |  | 44 |
| Reserved Discrete Out | MP-3J | Discrete Output |  | 24 |
| Transponder Fail #1 Discrete Output/Strobe #3 | MP-3K | Discrete Output | 718 Control | 25, 44 |
| Spare | MP-4A |  |  | 1, 26, 48 |
| Spare | MP-4B |  |  | 1, 26, 48 |
| FMC/GNSS #2 In #1 (Optional) A | MP-4C | ARINC 429 Input | 743A GNSS #2 or | 2, 3, 49 |
| FMC/GNSS #2 In #1 (Optional) B | MP-4D | ARINC 429 Input | 702A FMC #2 | 2, 3, 49 |
| Aircraft Category A MSB | MP-4E | Program Pin Input\_Strobed |  | 1, 44, 27, 63 |
| Aircraft Category B LSB | MP-4F | Program Pin Input\_Strobed |  | 1, 44, 27, 63 |
| ADS-B Configuration Parity | MP-4G | Program Pin Input |  | 1, 44, 66 |
| ADS-B Receive Capability | MP-4H | Program Pin Input\_Strobed |  | 1, 44, 63, 65 |
| Spare | MP-4J |  |  | 1, 48 |
| Spare | MP-4K |  |  | 1, 48 |
| Digital Air Data #2 Input A | MP-5A | ARINC 429 Input | 706 ADS #2 or | 2, 44 |
| Digital Air Data #2 Input B | MP-5B | ARINC 429 Input | 575 ADS #2 | 2, 44 |
| Not Assigned | MP-5C |  |  |  |
| Not Assigned | MP-5D |  |  |  |
| MSP/ATSU/CMU Out #1 A | MP-5E | ARINC 429 HS Output | MSP/ATSU/ | 4, 43, 44, 47 |
| MSP/ATSU/CMU Out #1 B | MP-5F | ARINC 429 HS Output | CMU #1 | 4, 43, 44, 47 |
| Extended Squitter Disable | MP-5G | Discrete Input |  | 34, 44 |
| Not Assigned | MP-5H |  |  | 47 |
| Antenna Bite Program Discrete Input | MP-5J | Program Pin Input |  | 28 |
| Spare | MP-5K |  |  | 1, 48 |
| Maintenance Data Input A | MP-6A | ARINC 429 Input | As Required | 2, 44 |
| Maintenance Data Input B | MP-6B | ARINC 429 Input | As Required | 2, 44 |
| Maintenance Data Output A | MP-6C | ARINC 429 Input | As Required | 4, 44 |
| Maintenance Data Output B | MP-6D | ARINC 429 Input | As Required | 4, 44 |
| Alternate Source Select Discrete Input | MP-6E | Discrete Input | 718 Control Pin #16 | 29, 44 |
| Altitude Type Select\_A Discrete Input | MP-6F | Program Pin Input |  | 30, 44 |
| Altitude Type Select\_B Discrete Input | MP-6G | Program Pin Input |  | 30, 44 |
| Middle Plug Common | MP-6H | Ground Reference |  | 21, 28 |
| Transponder Antenna Longitudinal Offset Pin #1 | MP-6J | Program Pin Input\_Strobed |  | 70, 44 |
| Common | MP-6K |  |  | 60 |
| Gross Weight Pin #1 | MP-7A | Program Pin Input\_Strobed |  | 71, 44 |
| Gross Weight Pin #2 | MP-7B | Program Pin Input\_Strobed |  | 71, 44 |
| Gross Weight Pin #3 | MP-7C | Program Pin Input\_Strobed |  | 71, 44 |
| Gross Weight Pin #4 | MP-7D | Program Pin Input\_Strobed |  | 71, 44 |
| Spare | MP-7E |  |  | 26 |
| New 718A-5 ARINC Bus #4 A | MP-7F | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #4 B | MP-7G | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #5 A | MP-7H | ARINC 429 Input |  | 2 |
| New 718A-5 ARINC Bus #5 B | MP-7J | ARINC 429 Input |  | 2 |
| Transponder Antenna Longitudinal Offset Pin #2 | MP-7K | Program Pin Input\_Strobed |  | 70, 44 |
| Bottom Antenna RF | MP-Coax | Coaxial Input | Bottom Antenna | 44 |

**BOTTOM PLUG**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| 115 Vac Primary Power Hot | BP-1 | 115 Vac |  | 31, 32, 44 |
| Not Assigned | BP-2 |  |  | 33 |
| Reserved 28 Vdc Return | BP-3 |  |  | 44 |
| Not Assigned | BP-4 |  |  |  |
| Wingspan #1 | BP-5 | Program Pin Input\_Strobed |  | 72, 44 |
| Wingspan #2 | BP-6 | Program Pin Input\_Strobed |  | 72, 44 |
| 115 Vac Primary Power Cold | BP-7 | 115 Vac |  | 31, 32, 44 |
| Signal Ground | BP-8 |  |  | 32, 44 |
| Wingspan #3 | BP-9 | Program Pin Input\_Strobed |  | 35, 72, 44 |
| Reserved 28 Vdc | BP-10 |  |  | 44 |
| Chassis Ground | BP-11 | Ground Reference |  | 44 |
| Suppression | BP-12 Coax | Coax | Other Suppression | 44 |
| Suppression (for Daisy Chaining) | BP-13 Coax | Coax |  | 44 |

**CONTROL PANEL**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Panel Lighting Supply A | J1-CP-1 | 0 – 5 Vac Lighting |  | 37 |
| Panel Lighting Supply B | J1-CP-2 | 0 – 5 Vac Lighting |  | 37 |
| 115 Vac Power HI | J1-CP-3 | Aircraft Power |  |  |
| 115 Vac Power LO | J1-CP-4 | Aircraft Power Return |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 38 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/ON | J1-CP-7 | Discrete Input | Control Panel | 19 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 37, 39 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 40 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 14 |
| Transponder Fail Logic #2 Input | J1-CP-12 | Discrete Input |  | 46 |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  | 15, 44, 47 |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 14 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 29 |
| ADS-B OUT Fail #1 | J1-CP-17 | Discrete Input |  | 51 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light  Power Source | 41 |
| Altitude Comparison Fail Discrete | J1-CP-19 | Discrete Output |  |  |
| Transponder Fail Logic #1 Input | J1-CP-20 | Analog Input |  | 46 |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 42 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 14 |
| Reserved ARINC 429 Input A | J2-CP-1 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-2 | Digital |  | 50 |
| Reserved ARINC 429 Input A | J2-CP-13 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-14 | Digital |  | 50 |
| ADS-B OUT Fail #2 | J2-CP-17 | Discrete Input |  | 51 |

1. D-3 MINIMUM SUBSET, SINGLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING
2. Re-definition of Gillham Input Pins

Gillham Altitude inputs are used only with ARINC 718A-1 and ARINC 718-4 transponder configurations. In Supplement 2 and later, these pins have been reassigned to provide for the input of various ADS-B parameters and configuration information. As such, these pins are not used for Gillham Altitude Input with the Minimum Subset, Single-Sided Configuration, specified in Attachment 2B-1.

1. General ARINC 429 Input Data Buses

These ARINC 429 input data buses may be either high-speed (100 kbps) or low-speed   
(12.5 kbps).

The Mark 4 transponder must be able to process either without additional command direction.

1. ARINC 702A FMC/FMS Data Inputs

Two FMS input ports are provided for the FMC: FMC/GNSS #1 IN #1 and FMC #1, GEN IN #2

These ports are assigned to support common existing FMC configurations where the Flight ID is available on the FMC General Purpose output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the ARINC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

1. General ARINC 429 Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 low-speed (12.5 kbps) bus requirements, unless otherwise noted.

1. ADS-B OUT Fail Discrete Output/Strobe #2

This discrete output should be an “open” when the ADS-B OUT Function has failed. The output should be a “ground” when the ADS-B OUT Function is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Transponder Fail Discrete #2 Output/Strobe #1

This discrete output should be an “open” when the Mark 4 transponder has failed. The output should be a “ground” when the transponder is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Cable Delay Program

These pins provide the capability to identify the installation’s relative cable delay. When programming, “1” is designated by connecting the designated pin to Top Plug Common (TP-5D).

|  |  |  |  |
| --- | --- | --- | --- |
| TP-3D | TP-3E | Differential Delay (nsec) | Add (nsec) in XPDR |
| 0 | 0 | 0 - 50 | 0 |
| 0 | 1 | 51 - 150 | 100 |
| 1 | 0 | 151 - 250 | 200 |
| 1 | 1 | 251 - 350 | 300 |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

|  |  |
| --- | --- |
| **PIN** | **Coding/Meaning** |
| **TP-3C** |
| 0 | Add time delay to top |
| 1 | Add time delay to bottom |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | |

TP-5D Top Plug Common Pin

The Round Trip cable delay is twice the length (in feet) multiplied by the delay (in nsec/ft). A typical delay is 1.54 nsec/ft.

Example calculation:

Given:

* Top cable length = 75 ft.
* Bottom cable length = 25 ft.

Procedure:

Select Top/Bottom code “1”, to add time compensation to the bottom antenna.

Install coding in the interwiring: Connect TP-3C to TP-5D

c. Calculate time compensation:

1. Calculate the difference in cable lengths: 75 - 25 = 50 ft.

* 1. Determine the cable delay: 50 ft. X 2 X 1.54 = 154 nsec
  2. Select coding: (151 – 250 nsec)

1. Install coding in the interwiring: Connect TP-3D to TP-5D
2. Program Pins

As a means to provide compatibility between Mark 3 transponders and Mark 4 transponders, it is important that these inputs are interpreted as program common inputs. Designers are alerted that interconnected wiring provides unit configuration information which needs to be properly interpreted.

For example, ARINC 718-4 defines TP-3F as “Common”. ARINC 718A-1 assigns TP-3F as either “Vendor Discrete Input” or “Common”. ARINC 718A-2, Attachment 2B-1 assigns the pin as “Common”. Likewise, ARINC 718A-3, Attachment 2B-1 assigns the pin as “Common”.

1. Source/Destination Identifier (SDI) Encoding

These pins are for encoding the location of the Mark 4 transponder in the aircraft, (i.e., “system number”) per Section 2.1.4 of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected to Chassis or Aircraft ground or to TP-5D. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the transponder to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins TP-3G and TP-3H should be left open circuit with the result that bit numbers 9 and 10 are always binary “0”.

|  |  |  |
| --- | --- | --- |
| Source/Destination Identifier (SDI) Encoding | | |
| **Transponder/No.** | **Connector Pin** | |
| **TP-3G** | **TP-3H** |
| Not Applicable | Open | Open |
| 1 | Open | Ground |
| 2 | Ground | Open |
| 3 | Ground | Ground |

1. Common

The Minimum Subset, Single-Sided Configuration retains TP-3J as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders.

Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Aircraft Type Characters (AIREP)

These pins are for encoding the Aircraft Type Characters in the AIREP message. The Aircraft Type Characters #1 through #4 are made up of 8 input discretes (TP-4A through TP-4H) with each pin having 8 possible unique states (Open, Ground, Strobes 1-6). The encoding scheme for Aircraft Type Characters #1 (TP-4A, TP-4B), #2 (TP-4C, TP-4D), #3 (TP-4E, TP-4F), and #4 (TP-4G, TP-4H) are identical. The Aircraft Type Character encoding utilizes the International Alphabet No. 5 (IA-5) defined in ICAO, Annex 10, Volume IV. An example encoding for Aircraft Type Character #1 is provided in accordance with the following table:

| Aircraft Type Character Encoding | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(TP-4A and TP-4B are *Strobed*)** | | | **Register 68HEX “ME” Field** | | | | | | **Aircraft Type Character #1** |
| **Bit 12** | **Bit 13** | **Bit 14** | **Bit 15** | **Bit 16** | **Bit 17** |
| **State** | **PIN** | | **ICAO International Alphabet Number 5 (IA-5) Bit** | | | | | |
| **#** | **TP-4A** | **TP-4B** | **b6** | **b5** | **b4** | **b3** | **b2** | **b1** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N/A |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | A |
| 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | B |
| 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | C |
| 4 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | D |
| 5 | 0 | 5 | 0 | 0 | 0 | 1 | 0 | 1 | E |
| 6 | 0 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | F |
| 7 | 0 | 7 | 0 | 0 | 0 | 1 | 1 | 1 | G |
| 8 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | H |
| 9 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | I |
| 10 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | J |
| 11 | 1 | 3 | 0 | 0 | 1 | 0 | 1 | 1 | K |
| 12 | 1 | 4 | 0 | 0 | 1 | 1 | 0 | 0 | L |
| 13 | 1 | 5 | 0 | 0 | 1 | 1 | 0 | 1 | M |
| 14 | 1 | 6 | 0 | 0 | 1 | 1 | 1 | 0 | N |
| 15 | 1 | 7 | 0 | 0 | 1 | 1 | 1 | 1 | O |
| 16 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | P |
| 17 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | Q |
| 18 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | R |
| 19 | 2 | 3 | 0 | 1 | 0 | 0 | 1 | 1 | S |
| 20 | 2 | 4 | 0 | 1 | 0 | 1 | 0 | 0 | T |
| 21 | 2 | 5 | 0 | 1 | 0 | 1 | 0 | 1 | U |
| 22 | 2 | 6 | 0 | 1 | 0 | 1 | 1 | 0 | V |
| 23 | 2 | 7 | 0 | 1 | 0 | 1 | 1 | 1 | W |
| 24 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | X |
| 25 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | Y |
| 26 | 3 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | Z |
| 27 | 3 | 3 | 0 | 1 | 1 | 0 | 1 | 1 | N/A |
| 28 | 3 | 4 | 0 | 1 | 1 | 1 | 0 | 0 | N/A |
| 29 | 3 | 5 | 0 | 1 | 1 | 1 | 0 | 1 | N/A |
| 30 | 3 | 6 | 0 | 1 | 1 | 1 | 1 | 0 | N/A |
| 31 | 3 | 7 | 0 | 1 | 1 | 1 | 1 | 1 | N/A |
| 32 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | SP |
| 33 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | N/A |
| 34 | 4 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | N/A |
| 35 | 4 | 3 | 1 | 0 | 0 | 0 | 1 | 1 | N/A |
| 36 | 4 | 4 | 1 | 0 | 0 | 1 | 0 | 0 | N/A |
| 37 | 4 | 5 | 1 | 0 | 0 | 1 | 0 | 1 | N/A |
| 38 | 4 | 6 | 1 | 0 | 0 | 1 | 1 | 0 | N/A |
| 39 | 4 | 7 | 1 | 0 | 0 | 1 | 1 | 1 | N/A |
| 40 | 5 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | N/A |
| 41 | 5 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | N/A |
| 42 | 5 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | N/A |
| 43 | 5 | 3 | 1 | 0 | 1 | 0 | 1 | 1 | N/A |
| 44 | 5 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | N/A |
| 45 | 5 | 5 | 1 | 0 | 1 | 1 | 0 | 1 | N/A |
| 46 | 5 | 6 | 1 | 0 | 1 | 1 | 1 | 0 | N/A |
| 47 | 5 | 7 | 1 | 0 | 1 | 1 | 1 | 1 | N/A |
| 48 | 6 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 49 | 6 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 50 | 6 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 2 |
| 51 | 6 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 3 |
| 52 | 6 | 4 | 1 | 1 | 0 | 1 | 0 | 0 | 4 |
| 53 | 6 | 5 | 1 | 1 | 0 | 1 | 0 | 1 | 5 |
| 54 | 6 | 6 | 1 | 1 | 0 | 1 | 1 | 0 | 6 |
| 55 | 6 | 7 | 1 | 1 | 0 | 1 | 1 | 1 | 7 |
| 56 | 7 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 8 |
| 57 | 7 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 9 |
| 58 | 7 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | N/A |
| 59 | 7 | 3 | 1 | 1 | 1 | 0 | 1 | 1 | N/A |
| 60 | 7 | 4 | 1 | 1 | 1 | 1 | 0 | 0 | N/A |
| 61 | 7 | 5 | 1 | 1 | 1 | 1 | 0 | 1 | N/A |
| 62 | 7 | 6 | 1 | 1 | 1 | 1 | 1 | 0 | N/A |
| 63 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | N/A |
| **Table Notes:**  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J).  9. Aircraft Type Character Encoding of “N/A” is a bit definition not available in the ICAO IA-5 encoding scheme. | | | | | | | | | |

1. Maximum Cruising Airspeed Capability

The RI field contains information pertaining to the designed maximum cruising airspeed capability of the aircraft in which the Mark 4 transponder is installed. To insert the code for the bit to be designated “1”, connect the appropriate pin (TP-5A, TP-5B, or TP-5C) to Top Plug Common, TP-5D. Max airspeed coding is shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum Cruising Airspeed Encoding** | | | |
| **PIN** | | | **Selection or Description** |
| **TP-5C**  **BIT 15** | **TP-5B**  **BIT 16** | **TP-5A**  **BIT 17** |
| 0 | 0 | 0 | No maximum airspeed available |
| 0 | 0 | 1 | Airspeed up to 75 kts |
| 0 | 1 | 0 | Airspeed between 75 and 150 kts |
| 0 | 1 | 1 | Airspeed between 150 and 300 kts |
| 1 | 0 | 0 | Airspeed between 300 and 600 kts |
| 1 | 0 | 1 | Airspeed between 600 and 1200 kts |
| 1 | 1 | 0 | Airspeed more than 1200 kts |
| 1 | 1 | 1 | Not Assigned |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

1. ACAS/Mark 4 Transponder Interface

The ACAS/Mark 4 transponder interface consists of two ARINC 429 high-speed buses. Refer to ARINC Characteristic 735A or 735B for the full definition of this interface.

The XT – TX interface between the Transponder and TCAS is used to coordinate information between the two functions. As such, ARINC Characteristics 735A and 735B define exact protocols that must be maintained by the interface to preserve its integrity. Unnecessary exposure of the interface to noise sources can result in reduced integrity of the interface which can lead to intermittent TCAS System failures. Therefore, routing of the XT bus to aircraft systems other than TCAS is strongly discouraged. Likewise, routing of the TX bus to aircraft systems other than the Transponder is strongly discouraged.

1. Air/Ground Logic Input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

1. The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. ARINC 429 High-Speed Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 high-speed (100 kbps) bus operation, unless otherwise noted.

1. Strobe #4

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Antenna Program

This program pin input is assigned to identify an installation in which only one antenna is used (i.e., the bottom antenna). A “ground” at this input should be used to indicate a single antenna installation, while an “open” should be interpreted as a dual antenna installation. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Control Panel Interface

The Mark 4 transponder is equipped with two control data input ports and a port selection function to accommodate the different control philosophies described in ARINC Specification 720. The interwiring diagram reflects the philosophy in which a dedicated Control Panel is used. The data output port of this panel is normally wired to Control Data Input Port B on the 4 transponder unit. Control Data Input Port A and the port selection discrete functions are not normally wired.

When implemented, the Control Data Port Select Discrete Input is used to select the active control port as follows:

1. When the Control Data Port Select Discrete Input, TP-7D, is open then Control Data Input Port B is the active control port.
   1. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured to accept input data from the FCC #1, the MCP #1, or the VHF #3.
   2. In this configuration, selection of the FCC #1/MCP #1 or FCC #2/MCP #2 active input port is further determined by the setting of the FCC/MCP 1/2 Select Discrete Input as provided in Note 20, below.
2. When the Control Data Port Select Discrete Input, TP-7D, is grounded then Control Data Input Port A is the active control port.
   1. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured as the active control input and therefore is not expected to be processing FCC#1, MCP#1, or VHF#3 data.
3. Standby/On Control

The Standby/On Control discrete provides a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. When pin TP-7G is “grounded”, the standby condition is enabled and when it is “open” the standby condition is disabled. (See Section 6.4.1 of this Characteristic for further detail.)

1. FCC/MCP 1/2 Select Discrete Input

Attachment 2B-1, Minimum Subset, Single-Sided Configuration does not provide for dual inputs of FCC/MCP data. Likewise, TP-7K is not assigned in this configuration. Therefore, the state of TP-7K has no impact on the operation of the Minimum Subset, Single-Sided Configuration.

Implementers should be aware that dual FCC/MCP capability is provided with ARINC 718A-1 configurations and with the Minimum TIF, Double-Sided Configuration defined in Attachment 2C-1.

1. Mode S Aircraft Address

The aircraft Mode S Address (also known as the ICAO 24-bit aircraft address) consists of a 24-bit sequence uniquely assigned to each aircraft. To provide aircraft installation insertion of the aircraft address, for each address bit designated “1” connect the corresponding connector pin to Middle Plug Common, MP-6H, or other Common. For “0” address bits, leave the corresponding connector pin open.

The aircraft Mode S address should be transmitted (RF) by the Mode S transmitter with the most significant bit (MSB) first. The MSB is designated A1.

1. (Reserved) Avionics Personality Module Interface

The Minimum Subset, Single-Sided Configuration does not require an APM Interface. However, implementers should be aware that the APM interface may be used with TIF and Minimum Subset configurations previously defined by ARINC 718A-1.

1. Common or 24Bit/APM Address Select Discrete Input

The Minimum Subset, Single-Sided Configuration retains MP-3E as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the ARINC 718A-1 configurations which may implement an APM interface.

1. Reserved Discrete Out or Data Loader Activate Discrete Input

The Minimum Subset, Single-Sided Configuration retains MP-3J as a reserved discrete output. The Altitude Comparison Failure function is not used with Minimum Subset, Single-Sided Configuration, as the configuration does not implement Gillham altitude.

Implementers should be aware:

* ARINC-718-4-compliant transponders use this pin as a discrete output used to indicate an Altitude Comparison Failure.
* ARINC 718A-1-compliant transponders use this pin for data loader activation.
* The Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1 may use this pin for GPS/IRS in-use discrete.

1. Transponder Fail #1 Discrete Output/Strobe #3

When the Mark 4 transponder unit has failed, this discrete output should supply +5 Vdc to operate Fail lamps (maximum current capability of 25 mA per lamp) and provide diode protection against sneak circuits.

When the Mark 4 transponder unit has not failed, the output should be an “open” (100,000 ohms or more resistance from this pin to airframe ground).

Note: This is not a standard discrete output.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Spare

The Minimum Subset, Single-Sided Configuration specifies MP-4A and MP-4B as spare.

Implementers should be aware that this pin is used for other purposes by both TIF and Minimum Subset configurations previously specified by ARINC 718A-1 as well as the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Aircraft Category Program Pins

The Minimum Subset, Single-Sided Configuration implements two input discrete pins to program the transponder with Aircraft Category information in accordance with the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT CATEGORY ENCODING | | | | | | |
| **(MP-4E and MP-4F are *Strobed*)** | | | **Register 08HEX** | | | **AIRCRAFT CATEGORY SELECTION** |
| **State #** | **PIN** | | **“ME” Field** | | |
| **MP-4E**  **(A)** | **MP-4F**  **(B)** | **Bit 6** | **Bit 7** | **Bit 8** |
| 0 | 0 | 0 | 0 | 0 | 0 | No ADS-B Emitter Category Information |
| 1 | 0 | 1 | 0 | 0 | 1 | MTOW < 15500 lbs. |
| 2 | 0 | 2 | 0 | 1 | 0 | 15500 ≤ MTOW < 75000 lbs. |
| 3 | 1 | 0 | 0 | 1 | 1 | 75000 ≤ MTOW < 300000 lbs. |
| 4 | 1 | 1 | 1 | 0 | 0 | Reserved |
| 5 | 1 | 2 | 1 | 0 | 1 | MTOW ≥ 300000 lbs. |
| 6 | 2 | 0 | 1 | 1 | 0 | Reserved |
| 7 | 2 | 1 | 1 | 1 | 1 | Rotorcraft |
| 8 | 2 | 2 | NOT USED | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B). | | | | | | |

Implementers should be aware that the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1 uses the same pins identified above for the same Aircraft Category programming function. However, the TIF Configuration previously specified by ARINC 718A-1 uses BP-4, BP-5, and BP-6 for programming the Aircraft Category function.

1. Antenna Bite Program Discrete Input

This program input should be connected to the Middle Plug Common (MP-6H) to indicate to the Mark 4 transponder unit that the antenna has the facility to provide BITE information. An antenna having a DC path to ground may be used, thus providing the ability to sense the presence of the antenna, and confirming cable continuity for BITE purposes.

This discrete input should only be checked when in the on-ground state.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active air data port. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. Altitude Air Data Type Select

The Mark 4 transponder is capable of receiving three types of altitude information. Two programming pins are assigned to select which type of altitude is to be processed as follows:

|  |  |  |
| --- | --- | --- |
| ALTITUDE AIR DATA TYPE SELECTION ENCODING | | |
| **PIN** | | **Selection** |
| **MP-6F** | **MP-6G** |
| 0 | 0 | ARINC 429 Data via ARINC 429 ADS Input Ports |
| 0 | 1 | Synchro Data via Synchro Input Ports |
| 1 | 0 | ARINC 575 Data via ARINC 429 ADS Input Ports |
| 1 | 1 | not USED (formerly Gillham Altitude) |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Middle Plug Common (MP-6H).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | |

The following rules apply to altitude type selection and use:

a. ARINC 429 words on two ports:

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Selected Source is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the selected source.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Selected Source is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

b. ARINC 575 (DADS) words on two ports:

Same as for ARINC 429 data.

1. Primary Power Wiring

The primary power cold function has been assigned to be a long pin in the BP insert of the Mark 4 transponder unit to ensure that it breaks after the primary power hot connection when the transponder is removed from the rack. This is intended to prevent the infamous hot pull problems, which can occur when the ground circuit is interrupted during removal of the equipment with the power applied.

Because all of the pins in the control panel connector(s) are of equal length, this same precaution cannot be taken. The system circuit breaker should be opened before the control panel interconnect(s) is (are) broken.

1. Wire Sizes

It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakage occurs.

1. Backward Incompatibility Discrete Input

The Backward Incompatibility Discrete Input function is not used with the Minimum Subset, Single-Sided Configuration. Therefore, this Note does not apply.

Implementers should be aware:

* The Backward Incompatibility Discrete Input function is used with TIF and Minimum Subset configurations previously specified by ARINC 718A-1 and Attachment 2A-1.
* The Backward Incompatibility Discrete Input function is used with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Extended Squitter Disable Discrete Input

The Extended Squitter Disable Discrete is used to disable all Extended Squitter functions. When the pin is grounded Extended Squitter functions are disabled and when it is “open” the Extended Squitter functions are enabled.

Note 1: The Extended Squitter Disable function can be applied at any time. Specifically, it is not intended to be an on-ground function only. As it may be applicable in the airborne state, Note 2 must be observed.

Note 2: Disabling of the Extended Squitter function is not recommended during normal flight operations unless the Extended Squitter operational status is clearly indicated to the flight crew.

1. Not Used (formerly Reserved Weather In #1/2 Select Discrete Input)

The function is not used with the Minimum Subset, Single-Sided Configuration. However, implementers should be aware that pin BP-9 is used by the ARINC 718A-1 TIF Configuration to select the active port for Weather In (includes Radar Altitude) data.

1. Not Used (formerly MSP/ATSU/CMU #1/2 Select Discrete Input)

The function is not used with the Minimum Subset, Single-Sided Configuration. However, implementers should be aware that pin MP-6K is used by the ARINC 718A-1 TIF Configuration to select the active port for MSP/ATSU/CMU data.

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a DC ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. High-speed and/or Special Purpose Buses

The MSP/ATSU/CMU buses should be configurable to be used as high-speed ARINC 429 buses as well as for special purposes or protocols.

1. Minimum Subset

These interfaces are identified as the Minimum Subset necessary to satisfy ARINC 718A-3 compatibility requirements when using the Minimum Subset, Single-Sided Configuration specified in Attachment 2B-1.

1. FCC/MCP #1 Inputs

Note that the Minimum Subset, Single-Sided configuration only provides for one input of FCC/MCP #1 information at TP-7A, 7B.

There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to both TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it would be the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G are needed for VHF #3 In.

1. Transponder Fail Logic

Transponder Fail Logic #1 Input:

When the transponder has failed, this input discrete to the control panel should be +5 Vdc, and it should cause the transponder fail indicator to be illuminated. When transponder has not failed the input to this discrete should be “open”.

Transponder Fail logic #2 Input:

When the transponder has failed, this input discrete to the control panel should be “open” and it should cause the transponder fail indicator to be illuminated. When the transponder has not failed, this input discrete should be grounded.

1. Not Used - (formerly Mode S DL/DLP Discrete Input)

This function is not used with the Minimum Subset, Single-Sided Configuration. Therefore, Note 47 does not apply. Implementers should be aware that pin MP-5H may be used by the ARINC 718-4 as the Mode S DL/DLP Discrete input.

1. Spare Pin Usage

The connector pins marked “Spare” in Standard Interwiring list are available for assignment, as the airline industry desires. However, if the interchangeability for the system specified in Section 1.5 of this Characteristic is to be retained, any such assignment thought necessary must be coordinated with the AEEC staff and approved by the industry prior to being made.

1. GPS/GNSS

See ARINC Characteristic 743A for complete definitions for input and output between the Mark 4 transponder and the GPS/GNSS.

1. Reserved ARINC 429 Input

This function is implemented in the right plug (J2) only of dual system control panels. This input may be used to provide data to the control panel from ARINC 429 buses such as the TCAS Maintenance Output bus.

1. ADS-B OUT Fail Discrete Inputs

ADS-B OUT Fail #1 Discrete Input (J1-CP-17)

When the ADS-B OUT function of the #1 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #1 transponder ADS-B OUT fail indicator to be illuminated. When the #1 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #1 transponder ADS-B OUT fail indicator should not be illuminated.

ADS-B OUT Fail #2 Discrete Input (J2-CP-17)

When the ADS-B OUT function of the #2 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #2 transponder ADS-B OUT fail indicator to be illuminated. When the #2 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #2 transponder ADS-B OUT fail indicator should not be illuminated.

1. Aircraft/Vehicle Length/Width

These pins provide the capability to identify the Aircraft/Vehicle Length/Width of the installation to the transponder in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT/VEHICLE LENGTH/WIDTH ENCODING | | | | | | | | | |
| **(TP-1A is not *Strobed*. TP-1B and TP-1C are *Strobed*)** | | | | **Length**  **Code** | | | **Width**  **Code** | **Upper Bound Length and Width**  **For Each Length/Width Code** | |
| **State #** | **PIN** | | | **Register 65HEX “ME” Field** | | | | **Length** | **Width** |
| **TP-1A**  **(A)** | **TP-1B**  **(B)** | **TP-1C**  **(C)** | **Bit 21** | **Bit 22** | **Bit 23** | **Bit 24** | **(meters)** | **(meters)** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | No Data or Unknown | |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | < 15 | < 23 |
| 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | < 25 | < 28.5 |
| 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | < 34 |
| 4 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | < 35 | < 33 |
| 5 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | < 38 |
| 6 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | < 45 | < 39.5 |
| 7 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | < 45 |
| 8 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | < 55 | < 45 |
| 9 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | < 52 |
| 10 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | < 65 | < 59.5 |
| 11 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | < 67 |
| 12 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | < 75 | < 72.5 |
| 13 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | < 80 |
| 14 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | >75 | < 80 |
| 15 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | >80 |
| 16 | 1 | 2 | 1 | NOT USED | | | | | |
| 17 | 1 | 2 | 2 | NOT USED | | | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Note that TP-1A does not connect to TP-3B at any time. Therefore, TP-1A is NOT Strobed. | | | | | | | | | |

1. GPS Antenna Longitudinal Offset

These pins provide the capability to specify the distance of the GPS Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual GPS Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GPS ANTENNA LONGITUDINAL OFFSET ENCODING | | | | | | | | | |
| **(TP-1D, TP-1E and TP-1F**  **are *Strobed*)** | | | |  | | | | | **Upper Bound of the**  **GPS Antenna Offset**  **along Longitudinal (Roll) Axis**  **Aft from Aircraft Nose**  **(meters)** |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | |
| **TP-1D**  **(A)** | **TP-1E**  **(B)** | **TP-1F**  **(C)** | **Bit 36** | **Bit 37** | **Bit 38** | **Bit 39** | **Bit 40** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 *or* NO DATA |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Position Offset Applied by Sensor |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 ≤ GO ≤ 2 |
| 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 < GO ≤ 4 |
| 4 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 4 < GO ≤ 6 |
| 5 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 6 < GO ≤ 8 |
| 6 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 8 < GO ≤ 10 |
| 7 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 10 < GO ≤ 12 |
| 8 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 12 < GO ≤ 14 |
| 9 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 14 < GO ≤ 16 |
| 10 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 16 < GO ≤ 18 |
| 11 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 18 < GO ≤ 20 |
| 12 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 20 < GO ≤ 22 |
| 13 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 22 < GO ≤ 24 |
| 14 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 24 < GO ≤ 26 |
| 15 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 26 < GO ≤ 28 |
| 16 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 28 < GO ≤ 30 |
| 17 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 30 < GO ≤ 32 |
| 18 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 32 < GO ≤ 34 |
| 19 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 34 < GO ≤ 36 |
| 20 | 2 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 36 < GO ≤ 38 |
| 21 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 38 < GO ≤ 40 |
| 22 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 40 < GO ≤ 42 |
| 23 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 42 < GO ≤ 44 |
| 24 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 44 < GO ≤ 46 |
| 25 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 46 < GO ≤ 48 |
| 26 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 48 < GO ≤ 50 |
| NOT USED | | | | 1 | 1 | 0 | 1 | 1 | 50 < GO ≤ 52 |
| 1 | 1 | 1 | 0 | 0 | 52 < GO ≤ 54 |
| 1 | 1 | 1 | 0 | 1 | 54 < GO ≤ 56 |
| 1 | 1 | 1 | 1 | 0 | 56 < GO ≤ 58 |
| 1 | 1 | 1 | 1 | 1 | GO > 58 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. If the GPS Antenna Longitudinal Offset from the nose of the aircraft is in excess of 50 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #26.  5. Note that the encoding provided by the configuration pins has a maximum of 50 meters while the encoding provided for in Register 65HEX can go up to 60 meters. The encoding provided by the configuration pins has been restricted in order to minimize the number of discrete pins required by the function. | | | | | | | | | |

1. Navigation Accuracy Category\_Velocity (NACV)

This pin provides the capability to identify the Navigation Accuracy Category\_Velocity (NACV) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever NACV information is not provided to the transponder by another appropriate means. Also note that the encoding provided in the following table is not the final encoding that is entered into transponder registers 09 Hex and 65 Hex for transmission in ADS-B messages. The final register encoding is established in Attachment 3A-1, Note 22.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NAVIGATION ACCURACY CATEGORY\_VELOCITY (NACV) ENCODING | | | | |
| **NACV Subfield**  **Encoding** | | **(TP-1G is *Strobed*)** | | **Horizontal Velocity Error** |
| **State #** | **PIN** |
| **binary** | **decimal** | **TP-1G** |
| 000 | 0 | 0 | 0 | Unknown or > 10 meters/second |
| 001 | 1 | 1 | 1 | < 10 meters/second |
| 010 | 2 | 2 | 2 | < 3 meters/second |
| 011 | 3 | NOT USED | | < 1 meter/second |
| 100 | 4 | <0.3 meters/second |
| 101 | 5 | NOT ASSIGNED IN RTCA DO-260B | | |
| 110 | 6 |
| 111 | 7 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Encoding is only provided through State 2 as it will be well into the future before navigation sources will be capable of providing NACV values approaching 1 meter/second.  5. If the NACV value to be encoded is less than 1 meter/second or better, then the Pin Configuration and bit encoding shall be set to that indicated for State #2. | | | | |

1. System Design Assurance (SDA)

This pin provides the capability to identify the System Design Assurance (SDA) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever SDA information is not provided to the transponder by another appropriate means.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SYSTEM DESIGN ASSURANCE (SDA) ENCODING | | | | | | |
| **PIN Encoding** | | **SDA Value** | | **Supported**  **Failure**  **Condition**  **(Note 6)** | **Probability of Undetected Fault causing transmission of False or**  **Misleading Information**  **(Note 7, 8)** | **Software & Hardware**  **Design Assurance Level**  **(Note 5, 7)** |
| **Register 65HEX**  **Bits 31, 32** | |
| **State #** | **TP-1H** | **(decimal)** | **(binary)** |
| 0 | 0 | 0 | 0 0 | Unknown/  No Safety Effect | > 1X10-3 per flight hour  or Unknown | N/A |
| Not Used  (Note 1) | | 1 | 0 1 | Minor | < 1X10-3 per flight hour | D |
| 1 | 1 | 2 | 1 0 | Major | < 1X10-5 per flight hour | C |
| 2 | 2 | 3 | 1 1 | Hazardous | < 1X10-7 per flight hour | B |
| Table Notes:  1. It is expected that all GPS/GNSS and ADS-B Transmitting equipment to be associated with this Characteristic will support a minimum design assurance of 10-5. Therefore, the 10-3 case having an SDA = “1” is NOT Allowed and there is no encoding provision made with TP-1H.  2. “0” coding means that TP-1H is in the “open-circuit” state.  3. “1” coding means that TP-1H is connected to Middle Plug Common (MP-6H).  4. “2” coding means that TP-1H is connected to XPDR Fail #2 (TP-3B).  5. Software Design Assurance per RTCA DO-178B (EUROCAE ED-12B). Airborne Electronic Hardware Design Assurance per RTCA DO-254 (EUROCAE ED-80).  6. Supported Failure Classification defined in AC-23.1309-1C, AC-25.1309-1A, and AC 29-2C.  7. Because the broadcast position can be used by any other ADS-B equipped aircraft or by ATC, the provisions in AC 23-1309-1C that allow reduction in failure probabilities and design assurance level for aircraft under 6,000 pounds do not apply.  8. Includes probability of transmitting false or misleading latitude, longitude, velocity, or associated accuracy and integrity metrics. | | | | | | |

1. Common

The Minimum Subset, Single-Sided Configuration retains TP-3K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Not Assigned

The Minimum Subset, Single-Sided Configuration does not assign usage of TP-6J. Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. MP-3F/MP-3G

The ARINC 718A-2 Minimum Subset (i.e., Attachment 2A-1) Configuration assigns MP-3F,3G for FCC/MCP #1/VHF #3 input. Likewise, the ARINC 718A-2 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration assigns MP-3F,3G for FCC/MCP #1/VHF #3 input. ARINC 718A Supplement-2, Attachment 2C-1, Minimum TIF, Double-Sided Configuration also assigns MP-3F,3G for FCC/MCP #1/VHF #3 input.

The ARINC 718A-3 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration does not assign any usage of MP-3F or MP-3G. However, the ARINC 718A-3 Minimum TIF, Double Sided (i.e., Attachment 2C-1) continues to assign MP-3F,3G for FCC/MCP #1/VHF #3 input.

Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes in the different configuration discussed above.

1. Note Reserved
2. Common

The Minimum Subset, Single-Sided Configuration retains MP-6K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in Attachment 2C-1.

1. Note Reserved
2. Note Reserved
3. Program Pin Strobe

Each of the discrete inputs (program pins) assigned to Aircraft Length/Width, Aircraft Category, ADS-B Receiver Capability, and GPS Antenna Offset has 2 states: state 0 when left “open” and state 1 when it is connected to a program pin common. An additional state, state 2 can be achieved when a discrete input is connected to a discrete output pin TP-3B Transponder Fail Discrete #2 Output. To determine state 2, the discrete inputs are read twice while the discrete output is driven active and inactive. This is done at power-on only. Each of the discrete inputs can have only one of the 3 states. At power-on and regardless of the air/ground state, the following sequence reads the strobed program pins:

1. Set the discrete output TP-3B “open” and read each of the program pins.
2. Set the discrete output TP-3B to “ground” and read each of the program pins.
3. Decode results to program pin state:
4. If a program pin is “open” for both the steps “a” and “b”, it is not connected to the discrete output pin TP-3B or program common pin, which puts the program pin in state 0.
5. If a program pin is connected to “ground” for both the steps “a” and “b”, it is connected to “ground”, which puts the program pin in state 1.
6. If a program pin is “open” on step “a” and connected to “ground” on step “b”, it is connected to the discrete output pin TP 3B, which is state 2.
7. ADS-B FAIL Disable

This pin is used to enable or disable annunciation of an ADS-B function fail via the Fail Warn Discrete outputs (TP-3B and MP-3K) in accordance with the following table:

|  |  |
| --- | --- |
| ADS-B FAIL DISABLE ENCODING | |
| **PIN STATUS** | **ADS-B FUNCTION FAIL DECLARATION SELECTION** |
| **TP-2K** |
| Open – circuit | Failures of the ADS-B Function shall be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) as well as via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |
| Connected to  TP-5D | Failures of the ADS-B Function shall NOT be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) but shall continue to be declared via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |

1. ADS-B Receive Capability

This pin is strobed and used to indicate the ADS-B IN Receive Capability of the Aircraft installation in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| ADS-B RECEIVE CAPABILITY ENCODING | | |
| **PIN Encoding**  **(*Strobed*)** | | **Selection/Meaning** |
| **State #** | **MP-4H** |
| 0 | 0 | Aircraft installation has no capability to receive either 1090 ES IN or UAT IN |
| 1 | 1 | Aircraft installation has capability to receive 1090 ES IN Only |
| 2 | 2 | Aircraft installation has capability to receive both 1090 ES IN and UAT IN |
| Table Notes:  1. “0” coding means that MP-4H is in the “open-circuit” state.  2. “1” coding means that MP-4H is connected to Middle Plug Common (MP-6H).  3. “2” coding means that MP-4H is connected to XPDR Fail #2 (TP-3B).  4. It is expected that future implementations with TCAS or the Traffic Function will have additional capability to communicate the state of 1090ES IN and UAT IN. Presently, no such method is identified in this Characteristic. | | |

1. ADS-B Configuration Parity

MP-4G is used to indicate the parity of the ADS-B Configuration installation to the transponder and is best illustrated in the following table. Column #1 of the table defines those ADS-B Configuration Parameters that are to be used to establish the configuration parity. Column #2 of the table defines the actual ADS-B Configuration Pins that are to be used to establish the configuration parity. Once the connection requirements are established for all of the necessary ADS-B Configuration Parameters and Pins, then establish the number of pins that are connected to Common as illustrated in Column #8 of the table. Then, establish the parity (as illustrated in Column #9 of the table) and Connect MP-4G to Common if the Parity is ODD. Otherwise, leave MP-4G in the “open-circuit” state since Parity is EVEN.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SAMPLES OF ADS-B CONFIGURATION PARITY ENCODING | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|  | | | **PIN shown in Column #2**  **is Connected to** | | | | **# of Pins**  **Connected to**  **Common** | **PARITY** | **CONNECT**  **MP-4G**  **TO** |
| **ADS-B PARAMETER** | **PIN** | **STATE** | **OPEN** | **COMMON** | | **STROBE** |
| **OPEN** | **TP-5D** | **MP-6H** | **TP-3B** |
| AIRCRAFT/VEHICLE  LENGTH/WIDTH | TP-1A | 1 (0) | (Z) | X |  |  | X = 7  (Z = 6) | ODD  (EVEN) | COMMON  AT  MP-6H  (OPEN) |
| TP-1B | 0 (1) | X | (Z) |  |  |
| TP-1C | 2 (0) | (Z) |  |  | X |
| GPS ANTENNA  LONGITUDINAL  OFFSET | TP-1D | 2 (0) | (Z) |  |  | X |
| TP-1E | 1 (1) |  | X (Z) |  |  |
| TP-1F | 0 (1) | X | (Z) |  |  |
| NACV | TP-1G | 1 (0) | (Z) | X |  |  |
| SYSTEM DESIGN  ASSURANCE | TP-1H | 1 (0) | (Z) | X |  |  |
| ADS-B FAIL DISABLE | TP-2K | 0 (1) | X | (Z) |  |  |
| AIRCRAFT CATEGORY | MP-4E | 1 (1) |  |  | X (Z) |  |
| MP-4F | 1 (0) | (Z) |  | X |  |
| ADS-B RECEIVE  CAPABILITY | MP-4H | 1 (1) |  |  | X (Z) |  |
| Table Notes:  1. The ADS-B Configuration Parameters to be used to establish the ADS-B Configuration Parity are listed in  Column #1.  2. The ADS-B Configuration Pins that are to be used to establish the ADS-B Configuration Parity are listed in  Column #2.  3. Column #3 presents the state of the ADS-B Configuration Pins for two separate samples. Sample #2 is shown in parenthesis.  4. Columns #4 through 7 indicate the actual connections that should be made for each ADS-B Configuration Parameter Pin for each sample. Sample #1 is indicated with an “X” while sample #2 is shown with “(Z)”.  5. Column #8 indicates the number of ADS-B Configuration Pins that are connected to Common for each of the two samples. Sample #1 is shown as “X = 7” while sample #2 is shown as “(Z = 6)”.  6. Column #9 indicates the parity of the count established in Column #8 for each of the two samples. Sample #1 is shown as “ODD” while sample #2 is shown as “(EVEN)”.  7. Column #10 indicates the connection that should be made for MP-4G for each of the two samples. Sample #1 results in MP-4G being connected to MP-6H. Sample #2 results in MP-4G being in the “open-circuit” state*.* | | | | | | | | | |

1. Strobe #5

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Strobe #6

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Note Reserved
2. Transponder Antenna Offset

These pins provide the capability to specify the distance of the Transponder Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual Transponder Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

| Transponder Antenna Offset Encoding | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (MP-6J and MP-7K are *Strobed)* | | | Register 65HEX | | | | | Transponder Antenna Offset Along Longitudinal (Roll) Axis (TOLon) Aft From A/V Forward Extremity |
| State  # | PIN | | “ME” Field | | | | | (meters) |
| MP-6J | MP-7K | Bit 36 | Bit 37 | Bit 38 | Bit 39 | Bit 40 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO DATA |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 ≤ TOLon ≤ 1 |
| 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 < TOLon ≤ 2 |
| 3 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 2 < TOLon ≤ 4 |
| 4 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 4 < TOLon ≤ 6 |
| 5 | 0 | 5 | 0 | 0 | 1 | 0 | 1 | 6 < TOLon ≤ 8 |
| 6 | 0 | 6 | 0 | 0 | 1 | 1 | 0 | 8 < TOLon ≤ 10 |
| 7 | 0 | 7 | 0 | 0 | 1 | 1 | 1 | 10 < TOLon ≤ 12 |
| 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 12 < TOLon ≤ 14 |
| 9 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 14 < TOLon ≤ 16 |
| 10 | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 16 < TOLon ≤ 18 |
| 11 | 1 | 3 | 0 | 1 | 0 | 1 | 1 | 18 < TOLon ≤ 20 |
| 12 | 1 | 4 | 0 | 1 | 1 | 0 | 0 | 20 < TOLon ≤ 22 |
| 13 | 1 | 5 | 0 | 1 | 1 | 0 | 1 | 22 < TOLon ≤ 24 |
| 14 | 1 | 6 | 0 | 1 | 1 | 1 | 0 | 24 < TOLon ≤ 26 |
| 15 | 1 | 7 | 0 | 1 | 1 | 1 | 1 | 26 < TOLon ≤ 28 |
| 16 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 28 < TOLon ≤ 30 |
| 17 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 30 < TOLon ≤ 32 |
| 18 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 32 < TOLon ≤ 34 |
| 19 | 2 | 3 | 1 | 0 | 0 | 1 | 1 | 34 < TOLon ≤ 36 |
| 20 | 2 | 4 | 1 | 0 | 1 | 0 | 0 | 36 < TOLon ≤ 38 |
| 21 | 2 | 5 | 1 | 0 | 1 | 0 | 1 | 38 < TOLon ≤ 40 |
| 22 | 2 | 6 | 1 | 0 | 1 | 1 | 0 | 40 < TOLon ≤ 42 |
| 23 | 2 | 7 | 1 | 0 | 1 | 1 | 1 | 42 < TOLon ≤ 44 |
| 24 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 44 < TOLon ≤ 46 |
| 25 | 3 | 1 | 1 | 1 | 0 | 0 | 1 | 46 < TOLon ≤ 48 |
| 26 | 3 | 2 | 1 | 1 | 0 | 1 | 0 | 48 < TOLon ≤ 50 |
| 27 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 50 < TOLon ≤ 52 |
| 28 | 3 | 4 | 1 | 1 | 1 | 0 | 0 | 52 < TOLon ≤ 54 |
| 29 | 3 | 5 | 1 | 1 | 1 | 0 | 1 | 54 < TOLon ≤ 56 |
| 30 | 3 | 6 | 1 | 1 | 1 | 1 | 0 | 56 < TOLon ≤ 58 |
| 31 | 3 | 7 | 1 | 1 | 1 | 1 | 1 | TOLong > 58 |
| 32-63 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J). | | | | | | | | |

1. Gross Weight

Gross Weight is encoded by the table below by truncating (not rounding) the result of the formula associated with the range into which the Gross Weight falls to a natural number (N = 1, 2, 3, …4095)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Gross Weight Encoding | | | | | | | | | | | | | | | | | |
| **(MP-7A through MP-7D are *Strobed)*** | | | | | **Register 68HEX** | | | | | | | | | | | | **Gross Weight Decimal Coding Natural Number (N)** |
| **State #** | **PIN** | | | | **“ME” Field** | | | | | | | | | | | |
| **MP-7A** | **MP-7B** | **MP-7C** | **MP-7D** | **36** | **37** | **38** | **39** | **40** | **41** | **42** | **43** | **44** | **45** | **46** | **47** |  |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO Data |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1  (0 lbs. ≤ GW ˂ 55 lbs.) |
| 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| 4 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 5 |
| 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 6 |
| 7 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 7 |
| 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 8 |
| 9 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 9 |
| 10 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 10 |
| 11 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 11 |
| 12 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 12 |
| 13 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 13 |
| 14 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 14 |
| 15 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 15 |
| 16 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 16 |
| 17 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 17 |
| 18 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 18 |
| 19 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 19 |
| 20 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 20 |
| 21 | 0 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 21 |
| 22 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 22 |
| 23 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 23 |
| \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| 4095 | 7 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4095  (GW ≥ 1,514,015 lbs.) |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Greater than or Equal to | Less than | Certification/ Wake Category Boundary | Resolution | Decimal Coding (N) | Formula  (GW = Gross Weight) | | NO or INVALID Data | | | | 0 | N = 0 | | 0 lbs. | 55 lbs. | 55 lbs. | 55 lbs. | 1 | N =1 | | 55 lbs. | 15,455 lbs. | 15,432 lbs. | 40 lbs. | 2 – 386 | N=2+(GW-55)/40 | | 15,455 lbs. | 76,575 lbs. | 41,006 lbs. | 80 lbs. | 387 – 1150 | N=387+(GW-15455)/40 | | 76,500 lbs. | | 76,575 lbs. | 299,935 lbs. | 299,829 lbs. | 160 lbs. | 1151 – 2546 | N=1151+(GW-76575)/40 | | 299,935 lbs. | 775,135 lbs. | 775,000 lbs. | 480 lbs. | 2547 – 3536 | N=2547+(GW-299935)/40 | | 775,135 lbs. | 1,300,415 lbs. | None | 1120 lbs. | 3537 – 4005 | N=3537+(GW-775135)/40 | | 1,300,415 lbs. | 1,514,015 lbs. | None | 2400 lbs. | 4006 – 4094 | N=4006+(GW-1300415)/40 | | 1,514,015 lbs. | No Maximum | None | N/A | 4095 | N = 4095 | | | | | | | | | | | | | | | | | | |

1. Wingspan

Wingspan is encoded by the table below by truncating (not rounding) the result of the formula associated with the range into which the wingspan falls to a natural number (N = 1, 2, 3, …255)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Wingspan Encoding | | | | | | | | | | | | | | |
| **(BP-5, BP-6 and BP-9 are *Strobed*)** | | | | | **Register 68HEX** | | | | | | | | | **Wingspan Decimal Coding Natural Number (N)** |
| **State**  **#** | **PIN** | | | | **“ME” Field** | | | | | | | | |
| **BP-5** | **BP-6** | **BP-9** | **48** | | **49** | **50** | **51** | **52** | **53** | **54** | **55** |  | |
| 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO Data | |
| 1 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| 2 | 0 | 0 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | |
| 3 | 0 | 0 | 3 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | |
| 4 | 0 | 0 | 4 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | |
| 5 | 0 | 0 | 5 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | |
| 6 | 0 | 0 | 6 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | |
| 7 | 0 | 0 | 7 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | |
| 8 | 0 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | |
| 9 | 0 | 1 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | |
| 10 | 0 | 1 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | |
| 11 | 0 | 1 | 3 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | |
| 12 | 0 | 1 | 4 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | |
| 13 | 0 | 1 | 5 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | |
| 14 | 0 | 1 | 6 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | |
| 15 | 0 | 1 | 7 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | |
| 16 | 0 | 2 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 | |
| 17 | 0 | 2 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 | |
| 18 | 0 | 2 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 18 | |
| 19 | 0 | 2 | 3 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 19 | |
| 20 | 0 | 2 | 4 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 20 | |
| 21 | 0 | 2 | 5 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 21 | |
| 22 | 0 | 2 | 6 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 22 | |
| 23 | 0 | 2 | 7 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 23 | |
| \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | |
| 255 | 3 | 7 | 7 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J). | | | | | | | | | | | | | | |

1. Gear Position (Up/Down)

Pin TP-7C is assigned to Gear Position (Up/Down). The Mark 4 transponder should interpret a “ground” at the Gear Position (Up/Down) discrete as an indication that the aircraft gear is Down. An “open” should indicate to the transponder that gear position is Up. This information may be used to activate other functions such as identifying the flight phase for BITE.

1. E-1 MINIMUM TIF, DOUBLE SIDED FOR DO-260C AND ED-102B CONFIGURATION PIN ALLOCATION

****

Note: Bottom Plug shown above is the same as that previously defined in ARINC 718-4, Attachment 1C, BP.

1. E-2 MINIMUM TIF, DOUBLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION STANDARD INTERWIRING

| **TOP PLUG**  **SIGNAL NAME** | | **PIN** | | **SIGNAL TYPE** | | **SOURCE/SINK** | | **NOTES** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aircraft/Vehicle Length/Width A MSB | | TP-1A | | Program Pin Input | |  | | 1, 44, 52 |
| Aircraft/Vehicle Length/Width B | | TP-1B | | Program Pin Input\_Strobed | |  | | 1, 44, 52, 63 |
| Aircraft/Vehicle Length/Width C LSB | | TP-1C | | Program Pin Input\_Strobed | |  | | 1, 44, 52, 63 |
| GPS Antenna Longitudinal Offset A MSB | | TP-1D | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset B | | TP-1E | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| GPS Antenna Longitudinal Offset C LSB | | TP-1F | | Program Pin Input\_Strobed | |  | | 1, 44, 53, 63 |
| Navigation Accuracy Category\_Velocity (NACV) | | TP-1G | | Program Pin Input\_Strobed | |  | | 1, 44, 54, 63 |
| System Design Assurance (SDA) | | TP-1H | | Program Pin Input\_Strobed | |  | | 1, 44, 55, 63 |
| Strobe #4 | | TP-1J | | Discrete Output | |  | | 1,16 |
| Strobe #5 | | TP-1K | | Discrete Output | |  | | 1,67 |
| FMS/GNSS #1 In #1 A | | TP-2A | | ARINC 429 Input | | 743A GNSS #1 or | | 2, 3, 44, 47, 49 |
| FMS/GNSS #1 In #1 B | | TP-2B | | ARINC 429 Input | | 702A FMC #1 | |  |
| IRS/FMS/Data Concentrator In #1 A | | TP-2C | | ARINC 429 Input | | 702A FMC #1, 704 IRS | | 2, 3, 44 |
| IRS/FMS/Data Concentrator In #1 B | | TP-2D | | ARINC 429 Input | | #1, Data Conc. #1 | | 47 |
| General Output #1 A | | TP-2E | | ARINC 429 HS Output | | 615 Data loader, or | | 15, 44, 47 |
| General Output #1 B | | TP-2F | | ARINC 429 HS Output | | As Needed | | 15, 44, 47 |
| MSP/ATSU/CMU In #1 A | | TP-2G | | ARINC 429 Input | | MSP/ATSU/CMU #1 | | 2, 43 |
| MSP/ATSU/CMU In #1 B | | TP-2H | | ARINC 429 Input | | MSP/ATSU/CMU #1 | | 2, 43 |
| Strobe #6 | | TP-2J | | Discrete Output | |  | | 69 |
| ADS-B FAIL Disable | | TP-2K | | Program Pin Input | |  | | 1, 44, 64 |
| ABS-B OUT Fail Discrete Out/Strobe #2 | | TP-3A | | Discrete Output | |  | | 5 |
| XPDR Fail Discrete #2 Out/Strobe #1 | | TP-3B | | Discrete Output | |  | | 6, 44 |
| Cable Delay Program – Top/Bottom | | TP-3C | | Program Pin Input | |  | | 7, 44 |
| Cable Delay Program – Value | | TP-3D | | Program Pin Input | |  | | 7, 44 |
| Cable Delay Program – Value | | TP-3E | | Program Pin Input | |  | | 7, 44 |
| Vendor Discrete Input | | TP-3F | | Discrete Input | |  | | 8 |
| SDI Input Discrete | | TP-3G | | Discrete Input | |  | | 9, 44 |
| SDI Input Discrete | | TP-3H | | Discrete Input | |  | | 9, 44 |
| FMC/GNSS ½ Select Discrete Input | | TP-3J | | Discrete Input | |  | | 8, 10 |
| Spare | | TP-3K | |  | |  | | 1, 48, 56 |
| Aircraft Type Character (AIREP) #1 | | TP-4A | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #2 | | TP-4B | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #3 | | TP-4C | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #4 | | TP-4D | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #5 | | TP-4E | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #6 | | TP-4F | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #7 | | TP-4G | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Aircraft Type Character (AIREP) #8 | | TP-4H | | Program Pin Input\_Strobed | |  | | 11, 44 |
| Spare | | TP-4J | |  | |  | | 48 |
| Spare | | TP-4K | |  | |  | | 48 |
| Maximum Cruising Airspeed – 17 | | TP-5A | | Program Pin Input | |  | | 12, 44 |
| Maximum Cruising Airspeed – 16 | | TP-5B | | Program Pin Input | |  | | 12, 44 |
| Maximum Cruising Airspeed – 15 | | TP-5C | | Program Pin Input | |  | | 12, 44 |
| Top Plug Common | | TP-5D | | Ground Reference | |  | | 44 |
| TX Coordination A | | TP-5E | | ARINC 429 HS Input | | 735A/B TCAS | | 2, 13, 44 |
| TX Coordination B | | TP-5F | | ARINC 429 HS Input | | 735A/B TCAS | | 2, 13, 44 |
| XT Coordination A | | TP-5G | | ARINC 429 HS Output | | 735A/B TCAS | | 13, 15, 44 |
| XT Coordination B | | TP-5H | | ARINC 429 HS Output | | 735A/B TCAS | | 13, 15, 44 |
| Air/Ground Discrete Input #2 | | TP-5J | | Discrete Input | |  | | 14, 44 |
| Air/Ground Discrete Input #1 | | TP-5K | | Discrete Input | |  | | 14, 44 |
| FMC #1, General Input #2 A | | TP-6A | | ARINC 429 Input | | 702A FMC #1 | | 2, 3, 44 |
| FMC #1, General Input #2 B | | TP-6B | | ARINC 429 Input | | 702A FMC #1 | | 2, 3, 44 |
| New 718A-5 ARINC Bus #1 A | | TP-6C | | ARINC 429 Input | |  | | 2 |
| New 718A-5 ARINC Bus #1 B | | TP-6D | | ARINC 429 Input | |  | | 2 |
| New 718A-5 ARINC Bus #2 A | | TP-6E | | ARINC 429 Input | |  | | 2 |
| New 718A-5 ARINC Bus #2 B | | TP-6F | | ARINC 429 Input | |  | | 2 |
| New 718A-5 ARINC Bus #3 A | | TP-6G | | ARINC 429 Input | |  | | 2 |
| New 718A-5 ARINC Bus #3 B | | TP-6H | | ARINC 429 Input | |  | | 2 |
| Spare | | TP-6J | |  | |  | | 57 |
| Antenna Program | | TP-6K | | Program Pin Input | |  | | 17, 44 |
| Control Data “A” or FCC #1/MCP #1  (VHF #3 Input Port A) | | TP-7A | | ARINC 429 Input | | 718 Control FCC #1  MCP #1 or VHF #3 | | 2, 18, 20, 44, 45 |
| Control Data “A” or FCC #1/MCP #1  (VHF #3 Input Port B) | | TP-7B | | ARINC 429 Input | | 718 Control FCC #1  MCP #1 or VHF #3 | | 2, 18, 20, 44, 45 |
| Gear Position (Up/Down) | | TP-7C | | Discrete Input | |  | | 73, 44 |
| Control Port Select Discrete Input | | TP-7D | | Discrete Input | |  | | 18, 20, 44 |
| Control Data “B” Input A | | TP-7E | | ARINC 429 Input | | 718 Control | | 2, 18, 44 |
| Control Data “B” Input B | | TP-7F | | ARINC 429 Input | | 718 Control | | 2, 18, 44 |
| Standby/ON Discrete Input | | TP-7G | | Discrete Input | |  | | 19, 44 |
| Digital Air Data #1 Input A | | TP-7H | | ARINC 429 Input | | 706ADS #1 or | | 2, 44 |
| Digital Air Data #1 Input B | | TP-7J | | ARINC 429 Input | | 575 ADS #1 | | 2, 44 |
| FCC/MCP 1/2 Select Discrete Input | | TP-7K | | Discrete Input | |  | | 20 |
| Top Antenna RF | | TP-Coax | | Coaxial Input | | Top Antenna | | 44 |
| **MIDDLE PLUG**  **SIGNAL NAME** | **PIN** | | **SIGNAL TYPE** | | **SOURCE/SINK** | | **NOTES** | |
| Mode S Address Bit A1 MSB | MP-1A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A2 | | MP-1B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A3 | | MP-1C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A4 | | MP-1D | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A5 | | MP-1E | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A6 | | MP-1F | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A7 | | MP-1G | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A8 | | MP-1H | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A9 | | MP-1J | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A10 | | MP-1K | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A11 | | MP-2A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A12 | | MP-2B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A13 | | MP-2C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A14 | | MP-2D | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A15 | | MP-2E | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A16 | | MP-2F | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A17 | | MP-2G | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A18 | | MP-2H | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A19 | | MP-2J | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A20 | | MP-2K | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A21 | | MP-3A | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A22 | | MP-3B | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A23 | | MP-3C | | Program Pin Input | |  | | 21,22,44 | |
| Mode S Address Bit A24 LSB | MP-3D | | Program Pin Input | |  | | 21,22,44 | |
| 24-bit/APM Select | MP-3E | | Discrete Input | |  | | 8,23 | |
| FCC/MCP #1/VHF #3 Input A | MP-3F | | ARINC 429 Input | | MCP, 701 FCC #1 | | 2,20,44,45,58 | |
| FCC/MCP #1/VHF #3 Input B | MP-3G | | ARINC 429 Input | | MCP, 701 FCC #1 | | 2,20,44,45,58 | |
| Functional Test Discrete Input | MP-3H | | Discrete Input | |  | | 44 | |
| GPS/IRS Use Discrete Input | MP-3J | | Discrete Input | |  | | 1,24 | |
| Transponder Fail #1 Discrete Output/Strobe #3 | MP-3K | | Discrete Output | | 718 Control | | 25, 44 | |
| FMC #2 General Input #2 A | MP-4A | | ARINC 429 Input | | 702A FMC #2 | | 1,2,3,26 | |
| FMC #2 General Input #2 B | MP-4B | | ARINC 429 Input | | 702A FMC #2 | | 1,2,3,26 | |
| FMC/GNSS #2 In #1 A | MP-4C | | ARINC 429 Input | | 743A GNSS #2 or | | 2,3,44,49 | |
| FMC/GNSS #2 In #1 B | MP-4D | | ARINC 429 Input | | 702A FMC #2 | | 2,3,44,49 | |
| Aircraft Category A MSB | MP-4E | | Program Pin Input\_Strobed | |  | | 1, 44, 27, 63 | |
| Aircraft Category B LSB | MP-4F | | Program Pin Input\_Strobed | |  | | 1, 44, 27, 63 | |
| ADS-B Configuration Parity | MP-4G | | Program Pin Input | |  | | 1, 44, 66 | |
| ADS-B Receive Capability | MP-4H | | Program Pin Input\_Strobed | |  | | 1, 44, 63, 65 | |
| FCC/MCP In #2 A | MP-4J | | ARINC 429 Input | | 701 FCC #2, MCP #2 | | 1,2,20 | |
| FCC/MCP In #2 B | MP-4K | | ARINC 429 Input | | 701 FCC #2, MCP #2 | | 1,2,20 | |
| Digital Air Data #2 Input A | MP-5A | | ARINC 429 Input | | 706 ADS #2 or | | 2, 44 | |
| Digital Air Data #2 Input B | MP-5B | | ARINC 429 Input | | 575 ADS #2 | | 2, 44 | |
| IRS/FMS/Data Concentrator Input #2 A | MP-5C | | ARINC 429 Input | | 702A FMC #2, 704 | | 2,3,47 | |
| IRS/FMS/Data Concentrator Input #2 B | MP-5D | | ARINC 429 Input | | IRS #2, Data Conc. #2 | | 2,3,47 | |
| MSP/ATSU/CMU Out #1 A | MP-5E | | ARINC 429 HS Output | | MSP/ATSU/CMU #1 | | 4,43,44,47 | |
| MSP/ATSU/CMU Out #1 B | MP-5F | | ARINC 429 HS Output | | MSP/ATSU/CMU #1 | | 4,43,44,47 | |
| Extended Squitter Disable | MP-5G | | Discrete Input | |  | | 34,44 | |
| Mode S DL/DLP | MP-5H | | Program Pin Input | |  | | 44,47 | |
| Antenna Bite Program Discrete Input | MP-5J | | Program Pin Input | |  | | 28 | |
| IRS/ 1/2 Select Discrete Input | MP-5K | | Discrete Input | |  | | 62 | |
| Maintenance Data Input A | MP-6A | | ARINC 429 Input | | As Required | | 2,44 | |
| Maintenance Data Input B | MP-6B | | ARINC 429 Input | | As Required | | 2,44 | |
| Maintenance Data Output A | MP-6C | | ARINC 429 Input | | As Required | | 4,44 | |
| Maintenance Data Output B | MP-6D | | ARINC 429 Input | | As Required | | 4,44 | |
| Alternate Source Select Discrete Input | MP-6E | | Discrete Input | | 718 Control Pin #16 | | 29,44 | |
| Altitude Type Select\_A Discrete Input | MP-6F | | Program Pin Input | |  | | 30, 44 | |
| Altitude Type Select\_B Discrete Input | MP-6G | | Program Pin Input | |  | | 30, 44 | |
| Middle Plug Common | MP-6H | | Ground Reference | |  | | 21, 28 | |
| Transponder Antenna Offset Pin #1 | MP-6J | | Program PinInput\_Strobed | |  | | 70, 44 | |
| Spare | MP-6K | |  | |  | | 1,48 | |
| Gross Weight Pin #1 | MP-7A | | Program PinInput\_Strobed | |  | | 71, 44 | |
| Gross Weight Pin #2 | MP-7B | | Program PinInput\_Strobed | |  | | 71, 44 | |
| Gross Weight Pin #3 | MP-7C | | Program PinInput\_Strobed | |  | | 71, 44 | |
| Gross Weight Pin #4 | MP-7D | | Program PinInput\_Strobed | |  | | 71, 44 | |
| Spare | MP-7E | |  | |  | | 26 | |
| New 718A-5 ARINC Bus #4 A | MP-7F | | ARINC 429 Input | |  | | 2 | |
| New 718A-5 ARINC Bus #4 B | MP-7G | | ARINC 429 Input | |  | | 2 | |
| New 718A-5 ARINC Bus #5 A | MP-7H | | ARINC 429 Input | |  | | 2 | |
| New 718A-5 ARINC Bus #5 B | MP-7J | | ARINC 429 Input | |  | | 2 | |
| Transponder Antenna Offset Pin #2 | MP-7K | | Program Pin Input\_Strobed | |  | | 70, 44 | |
| Bottom Antenna RF | MP-Coax | | Coaxial Input | | Bottom Antenna | | 44 | |

**BOTTOM PLUG**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| 115 Vac Primary Power Hot | BP-1 | 115 Vac |  | 31,32,44 |
| Backward Incompatibility Discrete | BP-2 | Program Pin Input |  | 33 |
| Reserved 28 Vdc Return | BP-3 |  |  |  |
| FMC 1/2 Select Discrete Input | BP-4 | Discrete Input |  | 68 |
| Wingspan #1 | BP-5 | Program Pin Input\_Strobed |  | 72, 44 |
| Wingspan #2 | BP-6 | Program Pin Input\_Strobed |  | 72, 44 |
| 115 Vac Primary Power Cold | BP-7 | 115 Vac |  | 31,32,44 |
| Signal Ground | BP-8 |  |  | 32, 44 |
| Wingspan #3 | BP-9 | Program Pin Input\_Strobed |  | 35, 72, 44 |
| Reserved 28 Vdc | BP-10 |  |  |  |
| Chassis Ground | BP-11 | Ground Reference |  |  |
| Suppression | BP-12 Coax | Coax | Other Suppression |  |
| Suppression (For Daisy Chaining) | BP-13 Coax | Coax |  |  |

**CONTROL PANEL**

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Panel Lighting Supply A | J1-CP-1 | 0 to 5 Vac Lighting |  | 37 |
| Panel Lighting Supply B | J1-CP-2 | 0 to 5 Vac Lighting |  | 37 |
| 115 Vac Power HI | J1-CP-3 | Aircraft Power |  |  |
| 115 Vac Power LO | J1-CP-4 | Aircraft Power Return |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 38 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/ON | J1-CP-7 | Discrete Input | Control Panel | 19 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 37,39 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 40 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 14 |
| Transponder Fail Logic #2 Input | J1-CP-12 | Discrete Input |  | 46 |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  |  |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 14 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 29 |
| ADS-B OUT Fail #1 | J1-CP-17 | Discrete Input |  | 51 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light Power Source | 41 |
| Altitude Comparison Fail Discrete | J1-CP-19 | Discrete Output |  |  |
| Transponder Fail Logic #1 Input | J1-CP-20 | Analog Input |  | 46 |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 42 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 14 |
| Reserved ARINC 429 Input A | J2-CP-1 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-2 | Digital |  | 50 |
| Reserved ARINC 429 Input A | J2-CP-13 | Digital |  | 50 |
| Reserved ARINC 429 Input B | J2-CP-14 | Digital |  | 50 |
| ADS-B OUT Fail #2 | J2-CP-17 | Discrete Input |  | 51 |

1. E-3 MINIMUM TIF, DOUBLE-SIDED FOR DO-260C AND ED-102B CONFIGURATION NOTES APPLICABLE TO STANDARD INTERWIRING
2. Re-definition of Gillham Input Pins

Gillham Altitude inputs are used only with ARINC 718A-1 and ARINC 718-4 transponder configurations. In Supplement 2 and later, these pins have been reassigned to provide for the input of various ADS-B parameters and configuration information. As such, these pins are not used for Gillham Altitude Input with the Minimum Subset, Single-Sided Configuration, specified in Attachment 2C-1.

1. General ARINC 429 Input Data Buses

These ARINC 429 input data buses may be either high-speed (100 kbps) or low-speed (12.5 kbps).

The Mark 4 transponder must be able to process either without additional command direction.

1. ARINC 702A FMC/FMS Data Inputs

Two FMS input ports are provided for the FMC: FMC/GNSS #1 IN #1 and FMC #1, GEN IN #2.

These ports are assigned to support common existing FMC configurations where the Flight ID is available on the FMC General Purpose output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the ARINC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

1. General ARINC 429 Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 low-speed   
(12.5 kbps) bus requirements, unless otherwise noted.

1. ADS-B OUT Fail Discrete Out/Strobe #2

This discrete should be an “open” when the ADS-B OUT Function has failed. The output should be a “ground” when the ADS-B OUT Function is operating normally. The output should be capable of sinking at least 10 mA of current. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Transponder Fail Discrete #2 Output/Strobe #1

This discrete output should be an “open” when the Mark 4 transponder has failed. The output should be a “ground” when the transponder is operating normally. The output should be capable of sinking at least 10 mA of current. See Sections 2.9.2 and 2.9.3 for the definition of open and ground.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Cable Delay Program

These pins provide the capability to identify the installation’s relative cable delay. When programming, “1” is designated by connecting the designated pin to Top Plug Common (TP-5D).

|  |  |  |  |
| --- | --- | --- | --- |
| TP-3D | TP-3E | Differential Delay (nsec) | Add (nsec) in XPDR |
| 0 | 0 | 0 - 50 | 0 |
| 0 | 1 | 51 - 150 | 100 |
| 1 | 0 | 151 - 250 | 200 |
| 1 | 1 | 251 - 350 | 300 |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

|  |  |
| --- | --- |
| **PIN** | **Coding/Meaning** |
| **TP-3C** |
| 0 | Add time delay to top |
| 1 | Add time delay to bottom |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | |

The Round Trip cable delay is twice the length (in feet) multiplied by the delay (in nsec/ft). A typical delay is 1.54 nsec/ft.

Example calculation:

Given:

* Top cable length = 75 ft.
* Bottom cable length = 25 ft.

Procedure:

Select Top/Bottom code “1”, to add time compensation to the bottom antenna.

Install coding in the interwiring: Connect TP-3C to TP-3F

c. Calculate time compensation:

Calculate the difference in cable lengths: 75 - 25 = 50 ft.

Determine the cable delay: 50 ft. X 2 X 1.54 = 154 nsec

Select coding: (151 – 250 nsec)

1. Install coding in the interwiring: Connect TP-3D to TP-3F
2. Program Pins

As a means to provide compatibility between Mark 3 transponders and Mark 4 transponders, it is important that these inputs are interpreted as program common inputs. Designers are alerted that interconnected wiring provides unit configuration information which needs to be properly interpreted.

For example, ARINC 718-4 defines TP-3F as “Common”. ARINC 718A-1 assigns TP-3F as either “Vendor Discrete Input” or “Common”. ARINC 718A-2, Attachment 2B-1 assigns the pin as “Common”. However, ARINC 718A-3, Attachment 2C-1 assigns the pin as “Vendor Discrete Input.”

1. Source/Destination Identifier (SDI) Encoding

These pins are for encoding the location of the Mark 4 transponder in the aircraft, (i.e., “system number”) per Section 2.1.4 of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected to Chassis or Aircraft ground or to TP-5D. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the transponder to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins TP-3G and TP-3H should be left open circuit with the result that bit numbers 9 and 10 are always binary “0”.

|  |  |  |
| --- | --- | --- |
| Source/Destination Identifier (SDI) Encoding | | |
| **Transponder/No.** | **Connector Pin** | |
| **TP-3G** | **TP-3H** |
| Not Applicable | Open | Open |
| 1 | Open | Ground |
| 2 | Ground | Open |
| 3 | Ground | Ground |

1. FMC/GNSS 1/2 Select Discrete Input (Reserved)

This pin is used to select the active port for FMC/GNSS data. When the pin is open the number 1 FMC/GNSS port is active and when it is grounded the number 2 FMC/GNSS port is active.

1. Aircraft Type Characters (AIREP)

These pins are for encoding the Aircraft Type Characters in the AIREP message. The Aircraft Type Characters #1 through #4 are made up of 8 input discretes (TP-4A through TP-4H) with each pin having 8 possible unique states (Open, Ground, Strobes 1-6). The encoding scheme for Aircraft Type Characters #1 (TP-4A, TP-4B), #2 (TP-4C, TP-4D), #3 (TP-4E, TP-4F), and #4 (TP-4G, TP-4H) are identical. The Aircraft Type Character encoding utilizes the International Alphabet No. 5 (IA-5) defined in ICAO, Annex 10, Volume IV. An example encoding for Aircraft Type Character #1 is provided in accordance with the following table:

| **Aircraft Type Character Encoding** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(TP-4A and TP-4B are *Strobed*)** | | | **Register 68HEX “ME” Field** | | | | | | **Aircraft Type Character #1** |
| **Bit 12** | **Bit 13** | **Bit 14** | **Bit 15** | **Bit 16** | **Bit 17** |
| **State**  **#** | **PIN** | | **ICAO International Alphabet Number 5 (IA-5) Bit** | | | | | |
| **TP-4A** | **TP-4B** | **b6** | **b5** | **b4** | **b3** | **b2** | **b1** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N/A |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | A |
| 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | B |
| 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | C |
| 4 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | D |
| 5 | 0 | 5 | 0 | 0 | 0 | 1 | 0 | 1 | E |
| 6 | 0 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | F |
| 7 | 0 | 7 | 0 | 0 | 0 | 1 | 1 | 1 | G |
| 8 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | H |
| 9 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | I |
| 10 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | J |
| 11 | 1 | 3 | 0 | 0 | 1 | 0 | 1 | 1 | K |
| 12 | 1 | 4 | 0 | 0 | 1 | 1 | 0 | 0 | L |
| 13 | 1 | 5 | 0 | 0 | 1 | 1 | 0 | 1 | M |
| 14 | 1 | 6 | 0 | 0 | 1 | 1 | 1 | 0 | N |
| 15 | 1 | 7 | 0 | 0 | 1 | 1 | 1 | 1 | O |
| 16 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | P |
| 17 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | Q |
| 18 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | R |
| 19 | 2 | 3 | 0 | 1 | 0 | 0 | 1 | 1 | S |
| 20 | 2 | 4 | 0 | 1 | 0 | 1 | 0 | 0 | T |
| 21 | 2 | 5 | 0 | 1 | 0 | 1 | 0 | 1 | U |
| 22 | 2 | 6 | 0 | 1 | 0 | 1 | 1 | 0 | V |
| 23 | 2 | 7 | 0 | 1 | 0 | 1 | 1 | 1 | W |
| 24 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | X |
| 25 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | Y |
| 26 | 3 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | Z |
| 27 | 3 | 3 | 0 | 1 | 1 | 0 | 1 | 1 | N/A |
| 28 | 3 | 4 | 0 | 1 | 1 | 1 | 0 | 0 | N/A |
| 29 | 3 | 5 | 0 | 1 | 1 | 1 | 0 | 1 | N/A |
| 30 | 3 | 6 | 0 | 1 | 1 | 1 | 1 | 0 | N/A |
| 31 | 3 | 7 | 0 | 1 | 1 | 1 | 1 | 1 | N/A |
| 32 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | SP |
| 33 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | N/A |
| 34 | 4 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | N/A |
| 35 | 4 | 3 | 1 | 0 | 0 | 0 | 1 | 1 | N/A |
| 36 | 4 | 4 | 1 | 0 | 0 | 1 | 0 | 0 | N/A |
| 37 | 4 | 5 | 1 | 0 | 0 | 1 | 0 | 1 | N/A |
| 38 | 4 | 6 | 1 | 0 | 0 | 1 | 1 | 0 | N/A |
| 39 | 4 | 7 | 1 | 0 | 0 | 1 | 1 | 1 | N/A |
| 40 | 5 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | N/A |
| 41 | 5 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | N/A |
| 42 | 5 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | N/A |
| 43 | 5 | 3 | 1 | 0 | 1 | 0 | 1 | 1 | N/A |
| 44 | 5 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | N/A |
| 45 | 5 | 5 | 1 | 0 | 1 | 1 | 0 | 1 | N/A |
| 46 | 5 | 6 | 1 | 0 | 1 | 1 | 1 | 0 | N/A |
| 47 | 5 | 7 | 1 | 0 | 1 | 1 | 1 | 1 | N/A |
| 48 | 6 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 49 | 6 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 50 | 6 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 2 |
| 51 | 6 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 3 |
| 52 | 6 | 4 | 1 | 1 | 0 | 1 | 0 | 0 | 4 |
| 53 | 6 | 5 | 1 | 1 | 0 | 1 | 0 | 1 | 5 |
| 54 | 6 | 6 | 1 | 1 | 0 | 1 | 1 | 0 | 6 |
| 55 | 6 | 7 | 1 | 1 | 0 | 1 | 1 | 1 | 7 |
| 56 | 7 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 8 |
| 57 | 7 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 9 |
| 58 | 7 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | N/A |
| 59 | 7 | 3 | 1 | 1 | 1 | 0 | 1 | 1 | N/A |
| 60 | 7 | 4 | 1 | 1 | 1 | 1 | 0 | 0 | N/A |
| 61 | 7 | 5 | 1 | 1 | 1 | 1 | 0 | 1 | N/A |
| 62 | 7 | 6 | 1 | 1 | 1 | 1 | 1 | 0 | N/A |
| 63 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | N/A |
| **Table Notes:**  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J).  9. Aircraft Type Character Encoding of “N/A” is a bit definition not available in the ICAO IA-5 encoding scheme. | | | | | | | | | |

1. Maximum Cruising Airspeed Capability

The RI field contains information pertaining to the designed maximum cruising airspeed capability of the aircraft in which the Mark 4 transponder is installed. To insert the code for the bit to be designated “1”, connect the appropriate pin (TP-5A, TP-5B, or TP-5C) to Top Plug Common, TP-5D. Max airspeed coding is shown in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| Maximum Cruising Airspeed Encoding | | | |
| **PIN** | | | **Selection or Description** |
| **TP-5C**  **BIT 15** | **TP-5B**  **BIT 16** | **TP-5A**  **BIT 17** |
| 0 | 0 | 0 | No maximum airspeed available |
| 0 | 0 | 1 | Airspeed up to 75 kts |
| 0 | 1 | 0 | Airspeed between 75 and 150 kts |
| 0 | 1 | 1 | Airspeed between 150 and 300 kts |
| 1 | 0 | 0 | Airspeed between 300 and 600 kts |
| 1 | 0 | 1 | Airspeed between 600 and 1200 kts |
| 1 | 1 | 0 | Airspeed more than 1200 kts |
| 1 | 1 | 1 | Not Assigned |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Top Plug Common (TP-5D).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | | |

1. ACAS/Mark 4 Transponder Interface

The ACAS/Mark 4 transponder interface consists of two ARINC 429 high-speed buses. Refer to ARINC Characteristic 735A or 735B for the full definition of this interface.

The XT – TX interface between the Transponder and TCAS is used to coordinate information between the two functions. As such, ARINC Characteristics 735A and 735B define exact protocols that must be maintained by the interface to preserve its integrity. Unnecessary exposure of the interface to noise sources can result in reduced integrity of the interface which can lead to intermittent TCAS System failures. Therefore, routing of the XT bus to aircraft systems other than TCAS is strongly discouraged. Likewise, routing of the TX bus to aircraft systems other than the Transponder is strongly discouraged.

1. Air/Ground Logic input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. Air/Ground Discrete Input #2 is to be used when it is desired that the transponder automatically inhibit replies per ICAO Annex 10 when the aircraft is on the ground. At the writing of ARINC 718A-2, the recommended practice was to use Air/Ground Discrete Input #2 to inhibit ATCRBS and “all-call” replies on ground and thereby reduce the amount of RF traffic on the Mode S link. This recommended practice applies equally to the ARINC 718A-3 since ICAO Annex 10 Volume IV Amendment 82 Section 3.1.2.10.3.10 confirms the requirements to inhibit replies while the aircraft is on the ground.

Air/Ground Discrete Input #1 is to be used when replies are not to be inhibited when the aircraft is on the ground. Airframe and equipment manufacturers are cautioned to provide “sneak circuit” protection for these inputs so that malfunctions of other equipment connected to the same logic source do not affect operation. The system should be designed such that the normal failure mode should be to the airborne condition.

1. ARINC 429 High-Speed Output Data Buses

These ARINC 429 output data buses should be compatible with ARINC 429 high-speed (100 kbps) bus operation, unless otherwise noted.

1. Strobe #4

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Antenna Program

This program pin input is assigned to identify an installation in which only one antenna is used (i.e., the bottom antenna). A “ground” at this input should be used to indicate a single antenna installation, while an “open” should be interpreted as a dual antenna installation. See Section 2.9.2 and 2.9.3 for the definition of open and ground.

1. Control Panel Interface

The Mark 4 transponder is equipped with two control data input ports and a port selection function to accommodate the different control philosophies described in ARINC Specification 720. The interwiring diagram reflects the philosophy in which a dedicated Control Panel is used. The data output port of this panel is normally wired to Control Data Input Port B on the transponder unit. Control Data Input Port A, and the port selection discrete functions are not normally wired.

When implemented, the Control Data Port Select Discrete Input is used to select the active control port as follows:

a. When the Control Data Port Select Discrete Input, TP-7D, is open then Control Data Input Port B is the active control port.

1. In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured to accept input data from the FCC #1, the MCP #1, or the VHF #3.

* 1. In this configuration, selection of the FCC #1/MCP #1 or FCC #2/MCP #2 active input port is further determined by the setting of the FCC/MCP 1/2 Select Discrete Input as provided in Note 20, below.
  2. When the Control Data Port Select Discrete Input, TP-7D, is grounded then Control Data Input Port A is the active control port.

In this configuration, Control Data A Input Port, TP-7A/TP-7B, is configured as the active control input and therefore is not expected to be processing FCC#1, MCP#1, or VHF#3 data.

1. Standby/On Control

The Standby/On Control discrete provides a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive Mark 4 transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. To obtain “Standby” operation, connect pin TP-7G to Chassis or Airframe ground. For “On” operation, leave pin TP-7G “open.” (See Section 6.4.1 of this Characteristic for further detail.)

1. FCC/MCP 1/2 Select Discrete Input

The use of several pins (TP-7A/TP-7B, MP-4C/MP-4D and MP-4J/MP-4K) is affected by whether the FCC/MCP 1/2 Select Discrete input (TP-7K) is grounded or not. This pin (TP-7K) is used to select the active port for FCC/MCP data as follows:

When the pin is open the FCC/MCP #1/VHF #3 port is active:

If the Control Data Port Select Discrete Input, TP-7D, is open, then FCC/MCP #1, and VHF #3 data is accepted via TP-7A/TP-7B or MP-4C/MP-4D.

If the Control Data Port Select Discrete Input, TP-7D, is grounded, then TP-7A/TP-7B are configured to accept Control Data. In this configuration, the Mark 4 transponder may be capable of processing FCC/MCP data on MP-4C/MP-4D. See Note 45.

1. When the pin is grounded the FCC/MCP #2 port is active on MP-4J/MP-4K.
2. Mode S Aircraft Address

The aircraft Mode S Address (also known as the ICAO 24-bit aircraft address) consists of a 24-bit sequence uniquely assigned to each aircraft. To provide aircraft installation insertion of the aircraft address, for each address bit designated “1” connect the corresponding connector pin to Middle Plug Common, MP-6H, or other Common. For “0” address bits, leave the corresponding connector pin open.

The aircraft Mode S address should be transmitted (RF) by the Mode S transmitter with the most significant bit (MSB) first. The MSB is designated A1.

1. (Reserved) Avionics Personality Module Interface

The Minimum TIF, Double-Sided Configuration does not require an APM Interface. However, implementers should be aware that the APM interface may be used with TIF and Minimum Subset configurations previously defined by ARINC 718A-1.

1. 24Bit/APM Address Select Discrete Input

This pin is used to identify the source of the Mode S Address (i.e., ICAO 24-Bit Address). The source can be the address program pins (MP-A10 through A-24 or an Avionics Personality Module (APM) method. When connection between this input and any of the Mode S Address inputs or connection to aircraft ground is detected then, the Mode S Address (i.e., ICAO 24-Bit Address) will be accepted from the program pin inputs. Otherwise address and configuration data should be accepted via the APM interface.

It is expected that the Minimum TIF, Double-Sided Configuration will not need an APM interface, however, the definition of MP-3E indicates that such implementation is allowed. If the APM interface is implemented, then it should be done in accordance with Attachment 2A.

1. Reserved Discrete Out or Data Loader Activate Discrete Input

Attachment 2B-1, Minimum Subset, Single-Sided Configuration retains MP-3J as a reserved Discrete output. ARINC-718-4 implemented this pin as a discrete output used to indicate an Altitude Comparison Failure. The Altitude Comparison Failure function is not used with the ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration as the configuration does not implement Gillham altitude.

Implementers should be aware that the pin may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1. Likewise, implementers should be aware that the pin is used for data loader activation in ARINC 718A-1.

1. Transponder Fail #1 Discrete Output/Strobe #3

When the Mark 4 transponder unit has failed, this discrete output should supply +5 Vdc to operate Fail lamps (maximum current capability of 25 mA per lamp) and provide diode protection against sneak circuits.

When the Mark 4 transponder unit has not failed, the output should be an “open” (100,000 ohms or more resistance from this pin to airframe ground).

Note: This is not a standard discrete output.

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Spare

The Minimum TIF, Double-Sided configuration uses MP-4A and MP-4B as FMC #2 General Input Bus (ARINC 429). This is the same assignment as the TIF configuration defined in ARINC 718A-1.

Implementers should be aware that these pins are designated “Spare” in the Minimum Subset configuration defined in Attachment 2A and “Spare” in the Minimum Subset, Single-Sided configuration defined in Attachment 2B.

1. Aircraft Category Program Pins

The Minimum TIF, Double-Sided Configuration implements two input discrete pins to program the transponder with Aircraft Category information in accordance with the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT CATEGORY ENCODING | | | | | | |
| **(MP-4E and MP-4F are *Strobed*)** | | | **Register 08HEX** | | | **AIRCRAFT CATEGORY SELECTION** |
| **State**  **#** | **PIN** | | **“ME” Field** | | |
| **MP-4E**  **(A)** | **MP-4F**  **(B)** | **Bit 6** | **Bit 7** | **Bit 8** |
| 0 | 0 | 0 | 0 | 0 | 0 | No ADS-B Emitter Category Information |
| 1 | 0 | 1 | 0 | 0 | 1 | MTOW (<15,500 lbs.) |
| 2 | 0 | 2 | 0 | 1 | 0 | 15500 ≤ MTOW < 75000 lbs. |
| 3 | 1 | 0 | 0 | 1 | 1 | 75000 ≤ MTOW < 300000 lbs. |
| 4 | 1 | 1 | 1 | 0 | 0 | Reserved |
| 5 | 1 | 2 | 1 | 0 | 1 | MTOW ≥ 300000 lbs. |
| 6 | 2 | 0 | 1 | 1 | 0 | Reserved |
| 7 | 2 | 1 | 1 | 1 | 1 | Rotorcraft |
| 8 | 2 | 2 | NOT USED | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B). | | | | | | |

Implementers should be aware that the Minimum Subset, Single-Sided Configuration specified in Attachment 2B-1 uses the same pins identified above for the same Aircraft Category programming function. However, the TIF Configuration previously specified by ARINC 718A-1 uses BP-4, BP-5, and BP-6 for programming the Aircraft Category function.

1. Antenna Bite Program Discrete Input

This program input should be connected to the Middle Plug Common (MP-6H) to indicate to the Mark 4 transponder unit that the antenna has the facility to provide BITE information. An antenna having a DC path to ground may be used, thus providing the ability to sense the presence of the antenna, and confirming cable continuity for BITE purposes.

This discrete input should only be checked when in the on-ground state.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active port for ARINC 429, ARINC 575, and Synchro data sources. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. Altitude Air Data Type Select

The Mark 4 transponder is capable of receiving three types of altitude information. Two programming pins are assigned to select which type of altitude is to be processed as follows:

|  |  |  |
| --- | --- | --- |
| ALTITUDE AIR DATA TYPE SELECTION ENCODING | | |
| PIN | | SELECTION |
| MP-6F | MP-6G |
| 0 | 0 | ARINC 429 Data via ARINC 429 ADS Input Ports |
| 0 | 1 | Synchro Data via Synchro Input Ports |
| 1 | 0 | ARINC 575 Data via ARINC 429 ADS Input Ports |
| 1 | 1 | not USED (formerly Gillham Altitude) |
| Table Notes:  1. Logic “1” is designated by connecting the appropriate pin to Middle Plug Common (MP-6H).  2. Logic “0” is designated by leaving the respective pin in the open-circuit state. | | |

The following rules apply to altitude type selection and use:

a. Synchro (Course and Fine) Altitude and Validity Flag on two ports.

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Flag is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the synchro data.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Flag is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

b. ARINC 429 words on two ports:

The Alternate Air Data Source Select Discrete pin (MP-6E) is used to select the source.

If Selected Source is Valid:

TCAS data will be sent with indication of greater than 100 foot resolution.

ATCRBS Mode C replies will be derived from the selected source.

Mode S replies (AC field) will be sent with binary format and Q bit set to “1” (25 foot resolution).

If Selected Source is Invalid:

TCAS data will be sent with status bits set to NCD.

ATCRBS Mode C replies will consist of framing pulses only.

Mode S replies (AC field) will have the Q bit and all altitude bits set to “0” to indicate no altitude data available.

c. ARINC 575 (DADS) words on two ports:

Same as for ARINC 429 data.

1. Primary Power Wiring

The primary power cold function has been assigned to be a long pin in the BP insert of the Mark 4 transponder unit to ensure that it breaks after the primary power hot connection when the transponder unit is removed from the rack. This is intended to prevent the infamous hot pull problems, which can occur when the ground circuit is interrupted during removal of the equipment with the power applied.

Because all of the pins in the control panel connector(s) are of equal length, this same precaution cannot be taken. The system circuit breaker should be opened before the control panel interconnect(s) is (are) broken.

1. Wire Sizes

It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakage occurs.

1. Backward Incompatibility Discrete Input

The Backward Incompatibility Discrete Input is used by the installed transponder to identify those aircraft configurations that are not compatible with the Minimum Subset, Single-Sided configuration defined in Attachment 2B.

The Minimum Subset, Single-Sided configuration uses “Common” pins in the same way as existing Mark 3 transponder configurations specified by ARINC 718-4. In particular, the Minimum Subset, Single-Sided configuration assigns pins TP-3F, TP-3J, TP-3K, and TP-5D as “Common”. Likewise, pins MP-3E, MP-6H, and MP-6K are “Common”. These pins are defined in Attachment 2B.

However, the Minimum TIF, Double-Sided configuration assigns pins TP-3F, TP-3J, and TP-3K for different usage than “Common.” Likewise, pins MP-3E and MP-6K are assigned for different usage than “Common.” These pins are defined in Attachment 2C.

Because Supplement 3 introduces new interwiring configurations, pin BP-2 is used to distinguish between the two configurations as follows:

1. BP-2 is open-circuit:

“Common” pins (as discussed above in this Note) shall be recognized as legacy connections as defined in Attachment 2B for the Minimum Subset, Single-Sided configuration.

1. BP-2 is connected to aircraft ground:

“Common” pins (as discussed above in this Note) shall be recognized as defined in Attachment 2C for the Minimum TIF, Double-Sided configuration.

|  |  |  |
| --- | --- | --- |
| COMMON PIN SUMMARY | | |
| **Summary “Common” Pin** | **Minimum Subset, Single-Sided** | **Minimum TIF, Double-Sided** |
| TP-3F | Common | Vendor Discrete In |
| TP-3J | Common | FMC/GNSS 1/2 Select |
| TP-3K | Common | Spare |
| TP-5D | Common | Common |
| MP-3E | Common | 24-bit/APM Select |
| MP-6H | Common | Common |
| MP-6K | Common | Spare |

Furthermore, implementers should be aware that the Backward Incompatibility Discrete Input function continues to be used with ARINC 718A-1 configurations, per Note 33 in Attachment 2A-3.

Note: Review of Attachment 2A-3 Note 33 indicates that the Note implies that conflictmay arise when interfacing to MP-5H, MP-6J, or MP-7K. Subsequent review has established that there should not be any conflict as each of the three pins is used for the same purpose in ARINC 718-4 and all ARINC 718A, ARINC 718A-2 and ARINC 718A-3 configurations.

1. Extended Squitter Disable Discrete Input

The Extended Squitter Disable Discrete is used to disable all Extended Squitter functions. When the pin is grounded Extended Squitter functions are disabled and when it is “open” the Extended Squitter functions are enabled.

Note 1:The Extended Squitter Disable function can be applied at any time. Specifically, it is not intended to be an on-ground function only. As it may be applicable in the airborne state, Note 2 must be observed.

Note 2: Disabling of the Extended Squitter function is not recommended during normal flight operations unless the Extended Squitter operational status is clearly indicated to the flight crew.

1. Not Used (formerly Reserved Weather In #1/2 Select Discrete Input)

The function is not used with the Minimum TIF, Double-Sided configuration. However, implementers should be aware that pin BP-9 is used by the ARINC 718A-1 TIF configuration to select the active port for Weather In (includes Radar Altitude) data.

1. Not Used (formerly MSP/ATSU/CMU #1/2 Select Discrete Input)

The function is not used with the Minimum TIF, Double-Sided configuration. However, implementers should be aware that pin MP-6K is used by the ARINC 718A-1 TIF configuration to select the active port for MSP/ATSU/CMU data.

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “Standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a DC ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. High-Speed and/or Special Purpose Buses

The MSP/ATSU/CMU buses should be configurable to be used as high-speed ARINC 429 buses as well as for special purposes or protocols.

1. Minimum Subset

These interfaces are identified as the Minimum Subset necessary to satisfy ARINC 718A-2 compatibility requirements when using the Minimum TIF, Double-Sided Configuration identified in Attachment 2C-1.

1. FCC/MCP #1 Inputs

There are two assigned inputs for FCC/MCP #1, the reason for this is to allow all existing ARINC 718-4 transponder hardware to support the minimum data input capability with minimum changes. Therefore, transponders from different manufacturers will support the input at either location, or not both. Installers are alerted to the need to provision the aircraft with FCC/MCP data at both ports if the installation is possible to be used with different transponders. Therefore, an installation design that is able to accept any manufacturers ARINC 718A transponder would have the FCC/MCP #1 data source wired to TP-7A/TP-7B and MP-3F/MP-3G. Ultimately it is the intention to standardize this input at TP-7A/TP-7B, which is necessary if MP-3F/MP-3G is needed for VHF #3 In.

1. Transponder Fail Logic

Transponder Fail Logic #1 Input

When the transponder has failed, this input discrete to the control panel should be +5 Vdc, and it should cause the transponder fail indicator to be illuminated. When transponder has not failed the input to this discrete should be “open.”

Transponder Fail logic #2 Input

When the transponder has failed, this input discrete to the control panel should be “open” and it should cause the transponder fail indicator to be illuminated. When the transponder has not failed, this input discrete should be grounded.

1. Mode S DL/DLP Discrete Input

The Mode S DL/DLP Discrete may be used to indicate that TP-2A/TP-2B and MP-5E/MP-5F utilize the Comm A/B protocol interface as specified in Attachment 5 of this document, and for a level 3 and above transponder that TP-2C/TP-2D and TP-2E/TP-2F utilize the Comm C/D protocol as specified in Attachment 5. When pin MP-5H is grounded then TP-2A/TP-2B and MP-5E/MP-5F will operate as defined in Attachment 5 and, depending upon the level and functionality of the transponder, TP-2C/TP-2D and TP-2E/TP-2F may operate as defined in Attachment 5.

When MP-5H is open TP-2A/TP-2B, MP-5E/MP-5F, TP-2C/TP-2D, and TP-2E/TP-2F will operate as defined in Attachment 2.

1. Spare Pin Usage

The connector pins marked “Spare” in Standard Interwiring list are available for assignment, as the airline industry desires. However, if the interchangeability for the system specified in Section 1.5 of this Characteristic is to be retained, any such assignment thought necessary must be coordinated with the AEEC staff and approved by the industry prior to being made.

1. GPS/GNSS

See ARINC Characteristic 743A for complete definitions for input and output between the Mark 4 transponder and the GPS/GNSS.

1. Reserved ARINC 429 Input

This function is implemented in the right plug (J2) only of dual system control panels. This input may be used to provide data to the control panel from ARINC 429 buses such as the TCAS Maintenance Output bus.

1. ADS-B OUT Fail Discrete Inputs

ADS-B OUT Fail #1 Discrete Input (J1-CP-17)

When the ADS-B OUT function of the #1 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #1 transponder ADS-B OUT fail indicator to be illuminated. When the #1 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #1 transponder ADS-B OUT fail indicator should not be illuminated.

ADS-B OUT Fail #2 Discrete Input (J2-CP-17)

When the ADS-B OUT function of the #2 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #2 transponder ADS-B OUT fail indicator to be illuminated. When the #2 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #2 transponder ADS-B OUT fail indicator should not be illuminated.

1. Aircraft/Vehicle Length/Width

These pins provide the capability to identify the Aircraft/Vehicle Length/Width of the installation to the transponder in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AIRCRAFT/VEHICLE LENGTH/WIDTH ENCODING | | | | | | | | | |
| **(TP-1A is not *Strobed*. TP-1B and TP-1C are *Strobed*)** | | | | **Length Code** | | | **Width**  **Code** | **Upper Bound Length and Width**  **For Each Length/Width Code** | |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | **Length** | **Width** |
| **TP-1A**  **(A)** | **TP-1B**  **(B)** | **TP-1C**  **(C)** | **Bit 21** | **Bit 22** | **Bit 23** | **Bit 24** | **(meters)** | **(meters)** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | No Data or Unknown | |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | < 15 | < 23 |
| 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | < 25 | < 28.5 |
| 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | < 34 |
| 4 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | < 35 | < 33 |
| 5 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | < 38 |
| 6 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | < 45 | < 39.5 |
| 7 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | < 45 |
| 8 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | < 55 | < 45 |
| 9 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | < 52 |
| 10 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | < 65 | < 59.5 |
| 11 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | < 67 |
| 12 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | < 75 | < 72.5 |
| 13 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | < 80 |
| 14 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | < 85 | < 80 |
| 15 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | < 90 |
| 16 | 1 | 2 | 1 | NOT USED | | | | | |
| 17 | 1 | 2 | 2 | NOT USED | | | | | |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Note that TP-1A does not connect to TP-3B at any time. Therefore, TP-1A is NOT Strobed.  5. If the Aircraft/Vehicle is longer than 85 meters, or wider than 90 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #15. | | | | | | | | | |

1. GPS Antenna Longitudinal Offset

These pins provide the capability to specify the distance of the GPS Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual GPS Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GPS ANTENNA LONGITUDINAL OFFSET ENCODING | | | | | | | | | |
| **(TP-1D, TP-1E and TP-1F**  **are *Strobed*)** | | | |  | | | | | **Upper Bound of the**  **GPS Antenna Offset**  **along Longitudinal (Roll) Axis**  **Aft from Aircraft Nose**  **(meters)** |
| **State**  **#** | **PIN** | | | **Register 65HEX “ME” Field** | | | | |
| **TP-1D**  **(A)** | **TP-1E**  **(B)** | **TP-1F**  **(C)** | **Bit 36** | **Bit 37** | **Bit 38** | **Bit 39** | **Bit 40** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 *or* NO DATA |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Position Offset Applied by Sensor |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 ≤ GO ≤ 2 |
| 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 < GO ≤ 4 |
| 4 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 4 < GO ≤ 6 |
| 5 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 6 < GO ≤ 8 |
| 6 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 8 < GO ≤ 10 |
| 7 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 10 < GO ≤ 12 |
| 8 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 12 < GO ≤ 14 |
| 9 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 14 < GO ≤ 16 |
| 10 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 16 < GO ≤ 18 |
| 11 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 18 < GO ≤ 20 |
| 12 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 20 < GO ≤ 22 |
| 13 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 22 < GO ≤ 24 |
| 14 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 24 < GO ≤ 26 |
| 15 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 26 < GO ≤ 28 |
| 16 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 28 < GO ≤ 30 |
| 17 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 30 < GO ≤ 32 |
| 18 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 32 < GO ≤ 34 |
| 19 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 34 < GO ≤ 36 |
| 20 | 2 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 36 < GO ≤ 38 |
| 21 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 38 < GO ≤ 40 |
| 22 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 40 < GO ≤ 42 |
| 23 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 42 < GO ≤ 44 |
| 24 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 44 < GO ≤ 46 |
| 25 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 46 < GO ≤ 48 |
| 26 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 48 < GO ≤ 50 |
| NOT USED | | | | 1 | 1 | 0 | 1 | 1 | 50 < GO ≤ 52 |
| 1 | 1 | 1 | 0 | 0 | 52 < GO ≤ 54 |
| 1 | 1 | 1 | 0 | 1 | 54 < GO ≤ 56 |
| 1 | 1 | 1 | 1 | 0 | 56 < GO ≤ 58 |
| 1 | 1 | 1 | 1 | 1 | GO > 58 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. If the GPS Antenna Longitudinal Offset from the nose of the aircraft is in excess of 50 meters, then the Pin Configuration and bit encoding shall be set to that indicated for State #26.  5. Note that the encoding provided by the configuration pins has a maximum of 50 meters while the encoding provided for in Register 65HEX can go up to 60 meters. The encoding provided by the configuration pins has been restricted in order to minimize the number of discrete pins required by the function. | | | | | | | | | |

1. Navigation Accuracy Category\_Velocity (NACV)

This pin provides the capability to identify the Navigation Accuracy Category\_Velocity (NACV) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever NACV information is not provided to the transponder by another appropriate means. Also note that the encoding provided in the following table is not the final encoding that is entered into transponder registers 09 Hex and 65 Hex for transmission in ADS-B messages. The final register encoding is established in Attachment 3A-1 Note 22.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NAVIGATION ACCURACY CATEGORY\_VELOCITY (NACV) ENCODING | | | | |
| **NACV Subfield**  **Encoding** | | **(TP-1G is *Strobed*)** | | **Horizontal Velocity Error** |
| **State**  **#** | **PIN** |
| **binary** | **decimal** | **TP-1G** |
| 000 | 0 | 0 | 0 | Unknown or > 10 meters/second |
| 001 | 1 | 1 | 1 | < 10 meters/second |
| 010 | 2 | 2 | 2 | < 3 meters/second |
| 011 | 3 | NOT USED | | < 1 meter/second |
| 100 | 4 | <0.3 meters/second |
| 101 | 5 | NOT ASSIGNED IN RTCA DO-260C | | |
| 110 | 6 |
| 111 | 7 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Top Plug Common (TP-5D).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2 (TP-3B).  4. Encoding is only provided through State 2 as it will be well into the future before navigation sources will be capable of providing NACV values approaching 1 meter/second.  5. If the NACV value to be encoded is less than 1 meter/second or better, then the Pin Configuration and bit encoding shall be set to that indicated for State #2. | | | | |

1. System Design Assurance (SDA)

This pin provides the capability to identify the System Design Assurance (SDA) of the installation to the transponder in accordance with the following table. Note that the use of strobed encoding of the discrete input is implemented and should be used whenever SDA information is not provided to the transponder by another appropriate means.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SYSTEM DESIGN ASSURANCE (SDA) ENCODING | | | | | | |
| **PIN Encoding** | | **SDA Value** | | **Supported**  **Failure**  **Condition**  **(Note 6)** | **Probability of Undetected Fault causing transmission of False or**  **Misleading Information**  **(Note 7, 8)** | **Software & Hardware**  **Design Assurance Level**  **(Note 5, 7)** |
| **Register 65HEX**  **Bits 31, 32** | |
| **State #** | **TP-1H** | **(decimal)** | **(binary)** |
| 0 | 0 | 0 | 0 0 | Unknown/  No Safety Effect | > 1X10-3 per flight hour  or Unknown | N/A |
| Not Used  (Note 1) | | 1 | 0 1 | Minor | < 1X10-3 per flight hour | D |
| 1 | 1 | 2 | 1 0 | Major | < 1X10-5 per flight hour | C |
| 2 | 2 | 3 | 1 1 | Hazardous | < 1X10-7 per flight hour | B |
| Table Notes:  1. It is expected that all GPS/GNSS and ADS-B Transmitting equipment to be associated with this Characteristic will support a minimum design assurance of 10-5. Therefore, the 10-3 case having an SDA = “1” is NOT Allowed and there is no encoding provision made with TP-1H.  2. “0” coding means that TP-1H is in the “open-circuit” state.  3. “1” coding means that TP-1H is connected to Middle Plug Common (MP-6H).  4. “2” coding means that TP-1H is connected to XPDR Fail #2 (TP-3B).  5. Software Design Assurance per RTCA DO-178B (EUROCAE ED-12B). Airborne Electronic Hardware Design Assurance per RTCA DO-254 (EUROCAE ED-80).  6. Supported Failure Classification defined in AC-23.1309-1C, AC-25.1309-1A, and AC 29-2C.  7. Because the broadcast position can be used by any other ADS-B equipped aircraft or by ATC, the provisions in AC 23-1309-1C that allow reduction in failure probabilities and design assurance level for aircraft under 6,000 pounds do not apply.  8. Includes probability of transmitting false or misleading latitude, longitude, velocity, or associated accuracy and integrity metrics. | | | | | | |

1. Common

The ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration retains TP-3K as “Common” which is the same assignment or use implemented in ARINC 718-4 transponders. Implementers should be aware that the pin is used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1.

1. Not Assigned

ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration does not assign usage of TP-6H and TP-6J. Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes with the Minimum TIF, Double-Sided Configuration specified in ARINC 718A-2, Attachment 2C-1.

1. Not Assigned

The ARINC 718A-2 Minimum Subset (i.e., Attachment 2A-1) Configuration assigns MP-3F, 3G for FCC/MCP #1/VHF #3 input. Likewise, the ARINC 718A-2 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration assigns MP-3F, 3G for FCC/MCP #1/VHF #3 input. ARINC 718A Supplement-2, Attachment 2C-1, Minimum TIF, Double-Sided Configuration also assigns MP-3F,3G for FCC/MCP #1/VHF #3 input.

The ARINC 718A-3 Minimum Subset, Single Sided (i.e., Attachment 2B-1) configuration does not assign any usage of MP-3F or MP-3G. However, the ARINC 718A-3 Minimum TIF, Double Sided (i.e., Attachment 2C-1) continues to assign MP-3F, 3G for FCC/MCP #1/VHF #3 input.

Implementers should be aware that these pins were previously used in ARINC 718-4 transponders for input of ARINC 575 Air Data. Likewise, implementers should be aware that these pins may be used for other purposes in the different configuration discussed above.

1. Note Reserved
2. Spare

Attachment 2C-1, Minimum TIF, Double-Sided Configuration assigns MP-6K as “spare”. ARINC 718-4 transponders and the ARINC 718A-2, Attachment 2B-1, Minimum Subset, Single-Sided Configuration assign MP-6K as “Common.”

1. Note Reserved
2. IRS 1/2 Select Discrete Input

This pin is used to select the active port for Inertial Reference System (IRS) /Flight Management System (FMS)/Data Concentrator input data. When the pin is open the number 1 IRS/FMS/Data Concentrator port is active and when it is grounded the number 2 IRS/FMS/Data Concentrator port is active.

1. Program Pin Strobe

Each of the discrete inputs (program pins) assigned to Aircraft Length/Width, Aircraft Category, ADS-B Receiver Capability, and GPS Antenna Offset has 2 states: state 0 when left “open” and state 1 when it is connected to a program pin common. An additional state, state 2 can be achieved when a discrete input is connected to a discrete output pin TP-3B Transponder Fail Discrete #2 Output. To determine state 2, the discrete inputs are read twice while the discrete output is driven active and inactive. This is done at power-on only. Each of the discrete inputs can have only one of the 3 states. At power-on and regardless of the air/ground state, the following sequence reads the strobed program pins:

1. Set the discrete output TP-3B “open” and read each of the program pins.
2. Set the discrete output TP-3B to “ground” and read each of the program pins.
3. Decode results to program pin state:
4. If a program pin is “open” for both the steps “a” and “b”, it is not connected to the discrete output pin TP-3B or program common pin, which puts the program pin in state 0.
   * 1. If a program pin is connected to “ground” for both the steps “a” and “b”, it is connected to “ground”, which puts the program pin in state 1.
     2. If a program pin is “open” on step “a” and connected to “ground” on step “b”, it is connected to the discrete output pin TP 3B, which is state 2.
5. ADS-B FAIL Disable

This pin is used to enable or disable annunciation of an ADS-B function fail via the Fail Warn Discrete outputs (TP-3B and MP-3K) in accordance with the following table:

|  |  |
| --- | --- |
| ADS-B FAIL DISABLE ENCODING | |
| **PIN STATUS** | **ADS-B FUNCTION FAIL DECLARATION SELECTION** |
| **TP-2K** |
| Open – circuit | Failures of the ADS-B Function shall be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) as well as via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |
| Connected to  TP-5D | Failures of the ADS-B Function shall NOT be declared via the Fail Warn Discrete outputs (TP-3B and MP-3K) but shall continue to be declared via any output diagnostic words via the Maintenance Output bus (MP-6C, 6D) and any other necessary outputs. |

1. ADS-B Receive Capability

This pin is strobed and used to indicate the ADS-B IN Receive Capability of the Aircraft installation in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| ADS-B RECEIVE CAPABILITY ENCODING | | |
| **PIN Encoding**  **(*Strobed*)** | | **Selection/Meaning** |
| **State #** | **MP-4H** |
| 0 | 0 | Aircraft installation has no capability to receive either 1090 ES IN or UAT IN |
| 1 | 1 | Aircraft installation has capability to receive 1090 ES IN Only |
| 2 | 2 | Aircraft installation has capability to receive both 1090 ES IN and UAT IN |
| Table Notes:  1. “0” coding means that MP-4H is in the “open-circuit” state.  2. “1” coding means that MP-4H is connected to Middle Plug Common (MP-6H).  3. “2” coding means that MP-4H is connected to XPDR Fail #2 (TP-3B).  4. It is expected that future implementations with TCAS or the Traffic Function will have additional capability to communicate the state of 1090ES IN and UAT IN. Presently, no such method is identified in this Characteristic. | | |

1. ADS-B Configuration Parity

MP-4G is used to indicate the parity of the ADS-B Configuration installation to the transponder and is best illustrated in the following table. Column #1 of the table defines those ADS-B Configuration Parameters that are to be used to establish the configuration parity. Column #2 of the table defines the actual ADS-B Configuration Pins that are to be used to establish the configuration parity. Once the connection requirements are established for all of the necessary ADS-B Configuration Parameters and Pins, then establish the number of pins that are connected to Common as illustrated in Column #8 of the table. Then, establish the parity (as illustrated in Column #9 of the table) and Connect MP-4G to Common if the Parity is ODD. Otherwise, leave MP-4G in the “open-circuit” state since Parity is EVEN.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SAMPLES OF ADS-B CONFIGURATION PARITY ENCODING | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | | **9** | | **10** |
|  | | | **PIN shown in Column #2**  **is Connected to** | | | | | **# of Pins**  **Connected to**  **Common** | | **PARITY** | **CONNECT**  **MP-4G**  **TO** |
| **ADS-B PARAMETER** | **PIN** | **STATE** | **OPEN** | **COMMON** | | **STROBE** |  | |  | |  |
| **OPEN** | **TP-5D** | **MP-6H** | **TP-3B** |
| AIRCRAFT/VEHICLE  LENGTH/WIDTH | TP-1A | 1 (0) | (Z) | X |  |  | X = 7  (Z = 6) | | ODD  (EVEN) | | COMMON  AT  MP-6H  (OPEN) |
| TP-1B | 0 (1) | X | (Z) |  |  |
| TP-1C | 2 (0) | (Z) |  |  | X |
| GPS ANTENNA  LONGITUDINAL  OFFSET | TP-1D | 2 (0) | (Z) |  |  | X |
| TP-1E | 1 (1) |  | X (Z) |  |  |
| TP-1F | 0 (1) | X | (Z) |  |  |
| NACV | TP-1G | 1 (0) | (Z) | X |  |  |
| SYSTEM DESIGN  ASSURANCE | TP-1H | 1 (0) | (Z) | X |  |  |
| ADS-B FAIL DISABLE | TP-2K | 0 (1) | X | (Z) |  |  |
| AIRCRAFT CATEGORY | MP-4E | 1 (1) |  |  | X (Z) |  |
| MP-4F | 1 (0) | (Z) |  | X |  |
| ADS-B RECEIVE  CAPABILITY | MP-4H | 1 (1) |  |  | X (Z) |  |
| Table Notes:  1. The ADS-B Configuration Parameters to be used to establish the ADS-B Configuration Parity are listed in Column #1.  2. The ADS-B Configuration Pins that are to be used to establish the ADS-B Configuration Parity are listed in Column #2.  3. Column #3 presents the state of the ADS-B Configuration Pins for two separate samples. Sample #2 is shown in parenthesis.  4. Columns #4 through 7 indicate the actual connections that should be made for each ADS-B Configuration Parameter Pin for each sample. Sample #1 is indicated with an “X” while sample #2 is shown with “(Z)”.  5. Column #8 indicates the number of ADS-B Configuration Pins that are connected to Common for each of the two samples. Sample #1 is shown as “X = 7” while sample #2 is shown as “(Z = 6)”.  6. Column #9 indicates the parity of the count established in Column #8 for each of the two samples. Sample #1 is shown as “ODD” while sample #2 is shown as “(EVEN)”.  7. Column #10 indicates the connection that should be made for MP-4G for each of the two samples. Sample #1 results in MP-4G being connected to MP-6H. Sample #2 results in MP-4G being in the “open-circuit” state. | | | | | | | | | | | | |

1. Strobe #5

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. FMC 1/2 Select Discrete Input

This pin is used to select the active ports for FMC General Input Data on TP-6A/TP-6B for FMC #1, or MP-4A/MP-4B for FMC #2. When the pin is open, the FMC #1 port is active. When the pin is grounded, the FMC #2 port is active.

1. Strobe #6

This discrete output is used as a strobe output at power-up. The ADS-B configuration parameter strapping uses this pin as a third option in addition to the open and ground states. See the ADS-B configuration notes for additional information. During strobe conditions which are used to establish ADS-B configuration during the power-up sequence, no maintenance faults are set either via discrete outputs or diagnostic maintenance words.

1. Transponder Antenna Offset

These pins provide the capability to specify the distance of the Transponder Antenna installations from the nose of the Aircraft.

Airframe manufacturers and operators have indicated that dual Transponder Antennas are typically installed such that there is not more than 2 to 3 meters distance between the two antennas. Therefore, the midpoint distance between the two antennas along the longitudinal axis of the aircraft should be used to encode the antenna position from the nose in accordance with the following table:

| Transponder Antenna Offset Encoding | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (MP-6J and MP-7K are *Strobed)* | | | Register 65HEX | | | | | Transponder Antenna Offset Along Longitudinal (Roll) Axis (TOLon) Aft From A/V Forward Extremity |
| State  # | PIN | | “ME” Field | | | | | (meters) |
| MP-6J | MP-7K | Bit 36 | Bit 37 | Bit 38 | Bit 39 | Bit 40 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO DATA |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 ≤ TOLon ≤ 1 |
| 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 < TOLon ≤ 2 |
| 3 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 2 < TOLon ≤ 4 |
| 4 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 4 < TOLon ≤ 6 |
| 5 | 0 | 5 | 0 | 0 | 1 | 0 | 1 | 6 < TOLon ≤ 8 |
| 6 | 0 | 6 | 0 | 0 | 1 | 1 | 0 | 8 < TOLon ≤ 10 |
| 7 | 0 | 7 | 0 | 0 | 1 | 1 | 1 | 10 < TOLon ≤ 12 |
| 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 12 < TOLon ≤ 14 |
| 9 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 14 < TOLon ≤ 16 |
| 10 | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 16 < TOLon ≤ 18 |
| 11 | 1 | 3 | 0 | 1 | 0 | 1 | 1 | 18 < TOLon ≤ 20 |
| 12 | 1 | 4 | 0 | 1 | 1 | 0 | 0 | 20 < TOLon ≤ 22 |
| 13 | 1 | 5 | 0 | 1 | 1 | 0 | 1 | 22 < TOLon ≤ 24 |
| 14 | 1 | 6 | 0 | 1 | 1 | 1 | 0 | 24 < TOLon ≤ 26 |
| 15 | 1 | 7 | 0 | 1 | 1 | 1 | 1 | 26 < TOLon ≤ 28 |
| 16 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 28 < TOLon ≤ 30 |
| 17 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 30 < TOLon ≤ 32 |
| 18 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 32 < TOLon ≤ 34 |
| 19 | 2 | 3 | 1 | 0 | 0 | 1 | 1 | 34 < TOLon ≤ 36 |
| 20 | 2 | 4 | 1 | 0 | 1 | 0 | 0 | 36 < TOLon ≤ 38 |
| 21 | 2 | 5 | 1 | 0 | 1 | 0 | 1 | 38 < TOLon ≤ 40 |
| 22 | 2 | 6 | 1 | 0 | 1 | 1 | 0 | 40 < TOLon ≤ 42 |
| 23 | 2 | 7 | 1 | 0 | 1 | 1 | 1 | 42 < TOLon ≤ 44 |
| 24 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 44 < TOLon ≤ 46 |
| 25 | 3 | 1 | 1 | 1 | 0 | 0 | 1 | 46 < TOLon ≤ 48 |
| 26 | 3 | 2 | 1 | 1 | 0 | 1 | 0 | 48 < TOLon ≤ 50 |
| 27 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 50 < TOLon ≤ 52 |
| 28 | 3 | 4 | 1 | 1 | 1 | 0 | 0 | 52 < TOLon ≤ 54 |
| 29 | 3 | 5 | 1 | 1 | 1 | 0 | 1 | 54 < TOLon ≤ 56 |
| 30 | 3 | 6 | 1 | 1 | 1 | 1 | 0 | 56 < TOLon ≤ 58 |
| 31 | 3 | 7 | 1 | 1 | 1 | 1 | 1 | TOLong > 58 |
| 32-63 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J). | | | | | | | | |

1. Gross Weight

Gross Weight is encoded by the table below by truncating (not rounding) the result of the formula associated with the range into which the Gross Weight falls to a natural number (N = 1, 2, 3, …4095)

| Gross Weight Encoding | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (MP-7A through MP-7D are *Strobed*) | | | | | Register 68HEX | | | | | | | | | | | | Gross Weight Decimal Coding Natural Number (N) |
| State  # | PIN | | | | “ME” Field | | | | | | | | | | | |
| MP-7A | MP-7B | MP-7C | MP-7D | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |  |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO Data |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1  (0 lbs. ≤ GW ˂ 55 lbs.) |
| 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| 4 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 5 |
| 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 6 |
| 7 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 7 |
| 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 8 |
| 9 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 9 |
| 10 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 10 |
| 11 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 11 |
| 12 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 12 |
| 13 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 13 |
| 14 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 14 |
| 15 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 15 |
| 16 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 16 |
| 17 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 17 |
| 18 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 18 |
| 19 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 19 |
| 20 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 20 |
| 21 | 0 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 21 |
| 22 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 22 |
| 23 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 23 |
| \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| 4095 | 7 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4095  (GW ≥ 1,514,015 lbs.) |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Greater than or Equal to | Less than | Certification/ Wake Category Boundary | Resolution | Decimal Coding (N) | Formula  (GW = Gross Weight) | | NO or INVALID Data | | | | 0 | N = 0 | | 0 lbs. | 55 lbs. | 55 lbs. | 55 lbs. | 1 | N =1 | | 55 lbs. | 15,455 lbs. | 15,432 lbs. | 40 lbs. | 2 – 386 | N=2+(GW-55)/40 | | 15,455 lbs. | 76,575 lbs. | 41,006 lbs. | 80 lbs. | 387 – 1150 | N=387+(GW-15455)/40 | | 76,500 lbs. | | 76,575 lbs. | 299,935 lbs. | 299,829 lbs. | 160 lbs. | 1151 – 2546 | N=1151+(GW-76575)/40 | | 299,935 lbs. | 775,135 lbs. | 775,000 lbs. | 480 lbs. | 2547 – 3536 | N=2547+(GW-299935)/40 | | 775,135 lbs. | 1,300,415 lbs. | None | 1120 lbs. | 3537 – 4005 | N=3537+(GW-775135)/40 | | 1,300,415 lbs. | 1,514,015 lbs. | None | 2400 lbs. | 4006 – 4094 | N=4006+(GW-1300415)/40 | | 1,514,015 lbs. | No Maximum | None | N/A | 4095 | N = 4095 | | | | | | | | | | | | | | | | | | |

1. Wingspan

Wingspan is encoded by the table below by truncating (not rounding) the result of the formula associated with the range into which the wingspan falls to a natural number (N = 1, 2, 3, …255)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Wingspan Encoding | | | | | | | | | | | | |
| **(BP-5, BP-6 and BP-9 are *Strobed)*** | | | | **Register 68HEX** | | | | | | | | **Wingspan Decimal Coding Natural Number (N)** |
| **State**  **#** | **PIN** | | | **“ME” Field** | | | | | | | |
| **BP-5** | **BP-6** | **BP-9** | **48** | **49** | **50** | **51** | **52** | **53** | **54** | **55** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO Data |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 6 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 7 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 9 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 10 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 11 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 12 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 13 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 14 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 15 | 0 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 16 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 |
| 17 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 |
| 18 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 18 |
| 19 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 19 |
| 20 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 20 |
| 21 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 21 |
| 22 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 22 |
| 23 | 0 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 23 |
| \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| 255 | 3 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 |
| Table Notes:  1. Logic “0” is designated by leaving the pin in the open-circuit state.  2. Logic “1” is designated by connecting the pin to Middle Plug Common (MP-6H).  3. Logic “2” is designated by connecting the pin to XPDR Fail #2/Strobe #1 (TP-3B).  4. Logic “3” is designated by connecting the pin to ADS-B Out FAIL Discrete/Strobe #2 (TP-3A).  5. Logic “4” is designated by connecting the pin to XPDR Fail #1/Strobe 3 (MP-3K).  6. Logic “5” is designated by connecting the pin to Strobe #4 (TP-1J).  7. Logic “6” is designated by connecting the pin to Strobe #5 (TP-1K).  8. Logic “7” is designated by connecting the pin to Strobe #6 (TP-2J). | | | | | | | | | | | | |

1. Gear Position (Up/Down)

Pin TP-7C is assigned to Gear Position (Up/Down). The Mark 4 transponder should interpret a “ground” at the Gear Position (Up/Down) discrete as an indication that the aircraft gear is Down. An “open” should indicate to the transponder that gear position is Up. This information may be used to activate other functions such as identifying the flight phase for BITE.

1. F TRANSPONDER/CONTROL PANEL WIRING



Figure 2F-1 – Example Power Supply and Partial Controls

Note: Air/Ground switch input discrete (STBY-AUTO-ON control panel switch configurations) control panel output discretes J1/J2-11 and J1/J2-15 should operate as indicated on Figure 2D-3 when there is a STBY-AUTO-ON switch present in the control panel.



Figure 2F-2 – Example Antenna Transfer Select Application



Figure 2F-3 – Example Using J1/J2-11 and J1/J2-15 with AUTO-ON Switch

1. G TRANSPONDER DATA SOURCE SELECTION SWITCHING

Below is an historical diagram relating information on ADC configuration to the transponder.



Figure 2G-1 – Altitude Source Select Switching

Notes:

1. The port select input (MP-6E) should be used to control selection of the synchro and Gillham inputs as well as the ARINC 706/575 inputs shown on the diagram.
2. As indicated in Section 6.4.5, a remote altitude source selector switch may be used instead of the switch on the control panel. When this done, the remote switch should be wired as shown by the dotted lines on the diagram and the switch on the control panel omitted.

Note that the above diagram has “cross-wired” ADC outputs to transponder inputs. This provision allows transfer of ATC reported data by transponder selection without altering cockpit settings.

Airframe manufacturers and installers are to be aware that the intent of the transponder is to report the most accurate data available to the unit regardless of the transponder unit selected. While “cross-wiring” of other (GICB) parameter sources may be applied, it may not reflect this intent. Airframe manufacturers and installers are thus advised to carefully review and apply the configuration and source selection of each installation to meet the transponder intent while at the same time not increasing cockpit workload.

1. SOURCES FOR GICB REGISTER LOADING AND SAMPLE INTERFACES

The information contained in this Attachment is intended to guide the developer, the airline, and the installer, with regard to the applications for the Mark 4 transponder.

Attachment 3A: Provides a comprehensive listing of all the pertinent information that may be available on the aircraft and a listing of possible sources for this data. Note that this table identifies to the designer the potential for duplicate ARINC labels to exist, but which may contain contradictory or unrelated data. The designer is alerted to be cautious in application of that information, and that knowledge of the source of information is essential, particularly when using a data concentrator.

Attachment 3B: Provides a listing of output data available from the Transponder. This data may be used to support Transponder interfaces with other aircraft systems, such as TCAS/ACAS, ATSU or data loaders.

Attachment 3C: Provides a brief description of more historical and dedicated Mode S transponder interfaces. This Section provides guidance on research materials available for more information regarding this data.

Attachment 3D: Provides sample interface configurations applicable to future installations using data concentrators, as well as retro-fit configurations using existing equipment on the Aircraft. These examples are intended to show possible configurations for providing future needs for the downlink transmission of various aircraft parameters as well as providing data to the Ground Initiated Comm-B registers specified in the Manual of Mode S Specific Services and Automatic Dependent Surveillance-Broadcast (ADS-B).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429 Word (Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS/** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 00 | Not Valid |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 01 | Unassigned |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 02 | Linked Comm-B,  Segment 2 |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 03 | Linked Comm-B,  Segment 3 |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 04 | Linked Comm-B,  Segment 4 |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 05 | Extended Squitter  Airborne Position | Type | 130 | Autonomous Horiz. Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 2 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| Surveillance Status | 016 | Mode-S Control Panel Data | See ARINC-735B Attachment 6D | | | | | | |  |  |  |  |  | 1 |  |  |  |  | 3 |
| 031 | ATC Control Word | See ARINC-429 P1-17, Attachment 6, Table 6-46 | | | | | | |  |  |  |  |  | 1 |  |  |  |  |
| NIC Supplement-B | 130 | Autonomous Horiz. Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 4 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| Altitude | 076 | GNSS Altitude (MSL) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 370 | GNSS Height (HAE) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 203 | Altitude (1013.25 hPa) (barometric) | BNR | feet | UP | +131,072 | 17 | 1.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 261 | Hybrid Altitude (MSL) | BNR | Feet | UP | +/- 131,072 | 20 | 0.125 | 40 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| Time | 150 | UTC | BNR | hr:min:s | + | 23:59:59 | 17 | 1.0 second | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 36 |
| 140 | UTC FINE | BNR | seconds | + | 1.0 second | 20 | 0.9536743164  microseconds | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 36 |
| CPR Format | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 60 |
| Encoded  Latitude  (See Note 59) | 110 | GNSS Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 254 | Hybrid Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 010 | Latitude, Present Position | BCD | degrees | N | 180N – 180S | 6 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 310 | Latitude, Present Position | BNR | degrees | N | 0 – 180N/0 – 180S | 20 | 0.00017166 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Encoded  Longitude  (See Note 59) | 111 | GNSS Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 255 | Hybrid Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 011 | Longitude, Present Position | BCD | degrees | E | 180E – 180W | 6 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 311 | Longitude, Present Position | BNR | degrees | E | 0 – 180E/0 – 180W | 20 | 0.00017166 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Latitude/  Longitude  Estimation/  Extrapolation  Parameters  (See Note 59) | 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 5 |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | 5 |
| 112 | GNSS Ground Speed | BNR | knots | + | 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 5 |
| 312 | Ground Speed | BNR | knots | + | 4,096 | 15 | 0.125 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 012 | Ground Speed | BCD | knots | + | 0 - 7000 | 4 | 1.0 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 320 | Magnetic Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 014 | Magnetic Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 314 | True Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | 5 |
| 044 | True Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  | 5 |
| 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  | 5 |
| 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  | 5 |
| 166 | GNSS N/S Velocity | BNR | knots | N | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 6 |
| 174 | GNSS E/W Velocity | BNR | knots | E | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 6 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | | **Assignment** | | **Register Field** | **ARINC 429 Word (Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS/** | | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 05 | | Extended Squitter  Airborne Position | | Latitude/  Longitude  Estimation/  Extrapolation  Parameters | 266 | Hybrid N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 6 |
| 267 | Hybrid E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 6 |
| 366 | N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 6 |
| 367 | E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 6 |
| 06 | | Extended Squitter  Surface Position | | Type | 130 | Autonomous Horiz. Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 2 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| Movement | 112 | GNSS Ground Speed | BNR | knots | + | 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 5 |
| 312 | Ground Speed | BNR | knots | + | 4,096 | 15 | 0.125 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 012 | Ground Speed | BCD | knots | + | 0 - 7000 | 4 | 1.0 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,7 |
| Heading/Ground  Track Status | Status is established based on the data received for the Heading/Ground Track Data indicated in the following rows. | | | | | | | | | N/A | | | | | | | | | | | 5,8 |
| Heading/Ground  Track | 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 5,8 |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 5,8 |
| 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| 314 | True Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| 044 | True Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | |  |  |  |  |  |  |  | 5,8 |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| 320 | Magnetic Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| 014 | Magnetic Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5,8 |
| Time | 150 | UTC | BNR | hr:min:s | + | 23:59:59 | 17 | 1.0 second | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 36 |
| 140 | UTC FINE | BNR | seconds | + | 1.0 second | 20 | 0.9536743164  microseconds | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 36 |
| CPR Format | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |  |
|  | | Reserved | | N/A | N/A | N/A | | | | N/A | | | | | | **60** |
| Encoded  Latitude  (See Note 59) | 110 | GNSS Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  |  |
| 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  |  |
| 254 | Hybrid Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 010 | Latitude, Present Position | BCD | degrees | N | 180N – 180S | 6 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  |  |
| 310 | Latitude, Present Position | BNR | degrees | N | 0 – 180N/0 – 180S | 20 | 0.00017166 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  |  |
| Encoded  Longitude  (See Note 59) | 111 | GNSS Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  |  |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  |  |
| 255 | Hybrid Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 011 | Longitude, Present Position | BCD | degrees | E | 180E – 180W | 6 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  |  |
| 311 | Longitude, Present Position | BNR | degrees | E | 0 – 180E/0 – 180W | 20 | 0.00017166 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  |  |
| Latitude/  Longitude  Estimation/  Extrapolation  Parameters  (See Note 59) | 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 5 |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 5 |
| 112 | GNSS Ground Speed | BNR | knots | + | 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 5 |
| 312 | Ground Speed | BNR | knots | + | 4,096 | 15 | 0.125 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 012 | Ground Speed | BCD | knots | + | 0 - 7000 | 4 | 1.0 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 320 | Magnetic Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 014 | Magnetic Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 314 | True Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 5 |
| 044 | True Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 5 |
| 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 | |  | 1 |  |  |  |  |  | 5 |
| 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 | |  | 1 |  |  |  |  |  | 5 |
| 166 | GNSS N/S Velocity | BNR | knots | N | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 6 |
| 174 | GNSS E/W Velocity | BNR | knots | E | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 | |  |  |  |  |  |  |  | 6 |
| 266 | Hybrid N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 6 |
| 267 | Hybrid E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | 6 |
| 366 | N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 6 |
| 367 | E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | | 2 |  |  |  |  |  |  | 6 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | | | **Register Field** | | | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | | | | | **Signal**  **Format** | | | | **Units** | **+**  **Sense** | **Range** | | | **Sig.**  **Bits/**  **Dig.** | | | | | **Resolution** | | | **MAX**  **TX**  **INTVL** | | **GPS** | | **FMC/**  **GNSS** | **IRS/**  **FMS/** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP/** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 07 | Extended Squitter  Status | | | Transmission Rate  Subfield  (Version 1 and 2) | | | N/A | N/A | | | | | N/A | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | | 9 |
| Altitude Type  Subfield  (Version 1 and 2) | | | 370 | GNSS Height (HAE) | | | | | BNR | | | | feet | UP | +/- 131,072 | | | 20 | 0.125 | | | | | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 261 | Hybrid Altitude (MSL) | | | | | BNR | | | | Feet | UP | +/- 131,072 | | | 20 | 0.125 | | | | | | | 40 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 203 | Altitude (1013.25 hPa) (Barometric) | | | | | BNR | | | | feet | UP | +131,072 | | | 17 | 1.0 | | | | | | | 62.5 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| 08 | Extended Squitter  Aircraft Identification and Category | | | Type = 1,2,3,4 | | | N/A | N/A | | | | | N/A | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| ADS-B Emitter Category | | | N/A | N/A | | | | | N/A | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | | 20 |
| Characters  1 – 8 | | | 233 | Flight Identification Word #1 | | | | | See Attachment 4, Table 4-3 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | | 12,13 |
| 234 | Flight Identification Word #2 | | | | | See Attachment 4, Table 4-4 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | |
| 235 | Flight Identification Word #3 | | | | | See Attachment 4, Table 4-5 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | |
| 236 | Flight Identification Word #4 | | | | | See Attachment 4, Table 4-6 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | |
| Characters 9 - 10 | | | 237 | Flight Identification Word #5 | | | | | Reserved for Flight Identification Characters 9 and 10. See Attachment 4, Table 4-7 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | |
| Characters  1 - 8 | | | 301 | Aircraft Ident. Word #1 | | | | | See Attachment 4, Table 4-10 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | | 12,13, 14 |
| 302 | Aircraft Ident. Word #2 | | | | | See Attachment 4, Table 4-11 | | | | | | | | | | | | | | | | | | |
| 303 | Aircraft Ident. Word #3 | | | | | See Attachment 4, Table 4-12 | | | | | | | | | | | | | | | | | | |
| Characters 1 - 8 | | | 360 | Flight Number Character 1 - 8 | | | | | See Attachment 4, Table 4-9 | | | | | | | | | | | | | | | | | | | See Note 17 | | | | | | | | | | | 12,13 |
| 09 | Extended Squitter  Airborne Velocity  Subtype 1 and 2 | | | Type = 19 | | | N/A | N/A | | | | | N/A | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| Subtype = 1 or 2 | | | 166 | GNSS N/S Velocity | | | | | BNR | | | | knots | N | +/- 4,096 | | | 18 | | | | | 0.015625 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 174 | GNSS E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 18 | | | | | 0.015625 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 266 | Hybrid N/S Velocity | | | | | BNR | | | | knots | N | +/- 4,096 | | | 15 | | | | | 0.125 | | | 100 | |  | |  |  |  |  |  |  |  |  |  |  |
| 267 | Hybrid E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 15 | | | | | 0.125 | | | 100 | |  | |  |  |  |  |  |  |  |  |  |  |
| 366 | N/S Velocity | | | | | BNR | | | | knots | N | +/- 4,096 | | | 15 | | | | | 0.125 | | | 200 | |  | | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 367 | E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 15 | | | | | 0.125 | | | 200 | |  | | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 210 | True Airspeed | | | | | BNR | | | | knots | + | 2,048 | | | 15 | | | | | 0.0625 | | | 125 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| 206 | Computed Airspeed | | | | | BNR | | | | knots | + | 1,024 | | | 14 | | | | | 0.0625 | | | 125 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| Intent Change Flag  (Version 1 and 2) | | | Intent Chang Flag is based on a change in data in Register 40HEX | | | | | | | | | | | | | | | | | | | | | | | | | See Source Availability for Register 40HEX | | | | | | | | | | |  |
| Reserved – A  (Version 1 and 2) | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| NACVELOCITY | | | 145 | Horizontal Velocity Figure of Merit | | | | | BNR | | | | knots | + | 4096 | | | 18 | | | | | 4096\*2^-18 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  | 22 |
| See ARINC 743A-5 Attachment 4-2A | | | | | | | | | | | | | | | | | | |
| E/W Direction Bit | | | E/W Direction Bit is established via the data received for the E/W Velocity data shown in the following rows. | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| E/W Velocity | | | 174 | GNSS E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 18 | | | | | 0.015625 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 267 | Hybrid E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 15 | | | | | 0.125 | | | 100 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 367 | E/W Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 15 | | | | | 0.125 | | | 200 | |  | | 1 | 3 | 2 |  |  |  |  |  |  |  |
| N/S Direction Bit | | | N/S Direction Bit is established via the data received for the N/S Velocity data shown in the following rows. | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| N/S Velocity | | | 166 | GNSS N/S Velocity | | | | | BNR | | | | knots | N | +/- 4,096 | | | 18 | | | | | 0.015625 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 266 | Hybrid N/S Velocity | | | | | BNR | | | | knots | N | +/- 4,096 | | | 15 | | | | | 0.125 | | | 100 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 366 | N/S Velocity | | | | | BNR | | | | knots | E | +/- 4,096 | | | 15 | | | | | 0.125 | | | 200 | |  | | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Vertical Rate Source | | | Vertical Rate Source is established based on which source is used from those given for Vertical Rate data shown in the following rows. | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| Vertical Rate Sign | | | Vertical Rate Sign is established via the data received for the Vertical Rate data shown in the following rows. | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| Vertical Rate | | | 165 | GNSS Vertical Velocity | | | | | BNR | | | | Ft./min. | UP | +/- 32,768 | | | 18 | | | | | 0.125 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 345 | Hybrid Vertical Velocity | | | | | BNR | | | | Ft./min. | UP | +/- 32,768 | | | 15 | | | | | 1.0 | | | 40 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 365 | Inertial Vertical Velocity | | | | | BNR | | | | Ft./min. | + | 32,768 | | | 15 | | | | | 1.0 | | | 40 | |  | | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 212 | Altitude Rate, Barometric | | | | | BNR | | | | Ft./min. | + | 32,768 | | | 11 | | | | | 16 | | | 62.5 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| 232 | Altitude Rate | | | | | BCD | | | | Ft./min. | UP | +/- 20,000 | | | 4 | | | | | 10.0 | | | 62.5 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| Reserved -B | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
|  | NIC Supplement-D | | 247 | Horizontal Figure of Merit | | | BNR | n.m. | + | 16 | | 18 | | 6.1 E-5 | 1200 | 1 | 2 |  |  |  | |  | |  |  |  |  | 60 | |
| Difference from Barometric Alti. Sign | | | Difference from Barometric Altitude Sign is established via the data received for the  Difference from Barometric Altitude data shown in the following rows. | | | | | | | | | | | | | | | | | | | | | | | | | N/A | | | | | | | | | | |  |
| Difference from  Barometric  Altitude | | | 203 | Altitude (1013.25 hPa) (Barometric) | | | | | BNR | | | | feet | UP | +131,072 | | | 17 | | | | | 1.0 | | | 62.5 | |  | |  | 2 |  | 1 |  |  |  |  |  |  |
| 076 | GNSS Altitude (MSL) | | | | | BNR | | | | feet | UP | +/- 131,072 | | | 20 | | | | | 0.125 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
| 261 | Hybrid Altitude (MSL) | | | | | BNR | | | | Feet | UP | +/- 131,072 | | | 20 | | | | | 0.125 | | | 40 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | |  |
| 370 | GNSS Height (HAE) | | | | | BNR | | | | feet | UP | +/- 131,072 | | | 20 | | | | | 0.125 | | | 1200 | | 1 | | 2 | 3 |  |  |  |  |  |  |  |  |
|  | | | Extended Difference from  Barometric  Altitude | | | 203 | Altitude (1013.25 hPa) (Barometric) | | | BNR | feet | UP | | +131,072 | | 17 | 1.0 | | | 62.5 | |  | |  | | 2 |  | 1 | | | |  |  | |  | |  |  | | 60 | |
| 076 | GNSS Altitude (MSL) | | | BNR | feet | UP | | +/- 131,072 | | 20 | 0.125 | | | 1200 | | 1 | | 2 | | 3 |  |  | | | |  |  | |  | |  |  | | 60 | |
| 261 | Hybrid Altitude (MSL) | | | BNR | Feet | UP | | +/- 131,072 | | 20 | 0.125 | | | 40 | | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | 60 | |
| 370 | GNSS Height (HAE) | | | BNR | feet | UP | | +/- 131,072 | | 20 | 0.125 | | | 1200 | | 1 | | 2 | | 3 |  |  | | | |  |  | |  | |  |  | | 60 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS/** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP/** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 09 | Extended Squitter  Airborne Velocity  Subtype 3 and 4  (Version 1 and 2) | Type = 19 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Subtype = 3 or 4 | 166 | GNSS N/S Velocity | BNR | knots | N | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 174 | GNSS E/W Velocity | BNR | knots | E | +/- 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 266 | Hybrid N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 100 |  |  |  |  |  |  |  |  |  |  |  |
| 267 | Hybrid E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 100 |  |  |  |  |  |  |  |  |  |  |  |
| 366 | N/S Velocity | BNR | knots | N | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 367 | E/W Velocity | BNR | knots | E | +/- 4,096 | 15 | 0.125 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Intent Change Flag | Intent Chang Flag is based on a change in data in Register 40HEX | | | | | | | | | See Source Availability for Register 40HEX | | | | | | | | | |  |
| Reserved – A | N/A | | | | | | | | | N/A | | | | | | | | | |  |
| NACVELOCITY | 145 | Horizontal Velocity Figure of Merit | BNR | knots | + | 4096 | 18 | 4096\*2^-18 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 22 |
| See ARINC 743A-5 Attachment 4-2A | | | | | | |
| Heading Status | Heading Status is established via the data received for the Heading data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Heading | 320 | Magnetic Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 014 | Magnetic Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 314 | True Heading | BNR | degrees | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 044 | True Heading | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Airspeed Type | Airspeed Type is established via the data received for the Airspeed data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Airspeed | 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Vertical Rate Source | Vertical Rate Source is established based on which source is used from those given for Vertical Rate data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Vertical Rate Sign | Vertical Rate Sign is established via the data received for the Vertical Rate data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Vertical Rate | 165 | GNSS Vertical Velocity | BNR | Ft./min. | UP | +/- 32,768 | 18 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 345 | Hybrid Vertical Velocity | BNR | Ft./min. | UP | +/- 32,768 | 15 | 1.0 | 40 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 365 | Inertial Vertical Velocity | BNR | Ft./min. | + | 32,768 | 15 | 1.0 | 40 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 212 | Altitude Rate, Barometric | BNR | Ft./min. | + | 32,768 | 11 | 16 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 232 | Altitude Rate | BCD | Ft./min. | UP | +/- 20,000 | 4 | 10.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Reserved -B | N/A | | | | | | | | | N/A | | | | | | | | | |  |
| Difference from Barometric Alti. Sign | Difference from Barometric Altitude Sign is established via the data received for the  Difference from Barometric Altitude data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Difference from  Barometric  Altitude | 203 | Altitude (1013.25 hPa) (Barometric) | BNR | feet | UP | +131,072 | 17 | 1.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 076 | GNSS Altitude (MSL) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 261 | Hybrid Altitude (MSL) | BNR | Feet | UP | +/- 131,072 | 20 | 0.125 | 40 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 370 | GNSS Height (HAE) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 0A | Extended Squitter  Event Driven  Information  (Version 1 and 2) | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 0B | Air/Air State  Information 1  (Version 1 and 2) | True Airspeed Status | True Airspeed Status is established via the data received for the True Airspeed data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| True  Airspeed | 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 230 | True Airspeed | BCD | knots | + | 100 - 599 | 3 | 1.0 | 500 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Heading Switch | Heading Switch is established based on the type of data being used in the Heading Field as indicated in the following rows.  0 = Magnetic, 1 = True | | | | | | | | | N/A | | | | | | | | | |  |
| Heading Status | Heading Status is established via the data received for the Heading data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Heading Sign | Heading Sign is established via the data received for the Heading data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Heading | 320 | Magnetic Heading | BNR | Deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 014 | Magnetic Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 314 | True Heading | BNR | Deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 044 | True Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| True Track Angle Status | True Track Angle Status is established via the data received for the True Track Angle data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS/** | **FMC**  **GEN** | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP/** | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | **Notes** |
| 0B | Air/Air State  Information 1  (Version 1 and 2) | True Track Angle Sign | True Track Angle Sign is established via the data received for the True Track Angle data shown in the following rows. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| True Track  Angle | 103 | | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | | 1200 | 1 | 2 | 3 |  |  |  | |  | |  | |  | |  | |  |
| 137 | | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | |  |
| 313 | | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | | 50 |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| 013 | | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | | 500 |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| Ground  Speed | 112 | | GNSS Ground Speed | BNR | knots | + | 4,096 | 18 | 0.015625 | | 1200 | 1 | 2 | 3 |  |  |  | |  | |  | |  | |  | |  |
| 312 | | Ground Speed | BNR | knots | + | 4,096 | 15 | 0.125 | | 50 |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| 012 | | Ground Speed | BCD | knots | + | 0 - 7000 | 4 | 1.0 | | 500 |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| 0C | Air/Air State  Information 2  (Version 1 and 2) | Level Off Altitude Status | Level Off Altitude Status is established via the data received for the Level Off Altitude data shown in the following rows. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Level Off  Altitude | 025 | | Selected Altitude | BCD | feet | + | 0 – 50,000 | 5 | 1.0 | | 200 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| 102 | | Selected Altitude | BNR | feet | + | 65,536 | 16 | 1.0 | | 200 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| Next Course Status | Next Course Status is established via the data received for the Next Course data shown in the following rows. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Next Course Sign | Next Course Sign is established via the data received for the Next Course data shown in the following rows. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Next  Course | 024 | | Selected Course | BCD | degrees | + | 0 - 359 | 3 | 1.0 | | 200 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| 023 | | Selected Heading | BCD | degrees | + | 0 - 359 | 3 | 1.0 | | 200 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| 101 | | Selected Heading | BNR | Deg./180 | + | +/- 180 | 12 | 0.0439453125 | | 62.5 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| 100 | | Selected Course | BNR | Deg./180 | + | +/- 180 | 12 | 0.05 | | 333 |  |  | 2 |  |  |  | | 1 | |  | |  | |  | |  |
| Time to Next Waypoint Status | Time to Next Waypoint Status is established via the data received for the Time to Next Waypoint data shown in the following row. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Time to Next Waypoint | 002 | | Time to Go (TTG) | BCD | Min. | + | 0 – 399.9 | 4 | 0.1 | 200 | |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| Vertical Velocity Status | Vertical Velocity Status is established via the data received for the Vertical Velocity data shown in the following row. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Vertical Velocity Sign | Vertical Velocity Sign is established via the data received for the Vertical Velocity data shown in the following row. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Vertical  Velocity | 212 | | Altitude Rate, Barometric | BNR | Ft./min. | + | 32,768 | 11 | 16 | 62.5 | |  |  | 2 |  | 1 |  | |  | |  | |  | |  | |  |
| 365 | | Inertial Vertical Velocity | BNR | Ft./min. | + | 32,768 | 15 | 1.0 | 40 | |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| 165 | | GNSS Vertical Velocity | BNR | Ft./min. | UP | +/- 32,768 | 18 | 0.125 | 1200 | | 1 | 2 | 3 |  |  |  | |  | |  | |  | |  | |  |
| Roll Angle Status | Roll Angle Status is established via the data received for the Roll Angle data shown in the following row. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Roll Angle Sign | Roll Angle Sign is established via the data received for the Roll Angle data shown in the following row. | | | | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| Roll Angle | 325 | | Roll Angle | BNR | Deg./180 | Right | +/- 180 | 14 | 0.01099 | 20 | |  | 1 | 3 | 2 |  |  | |  | |  | |  | |  | |  |
| Reserved | N/A | | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | |  |
| 0D to 0E | Reserved for Air/Air  State Information | N/A | N/A | N/A | | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | |
| 0F | Reserved for ACAS | N/A | N/A | N/A | | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | |
| 10 | Data Link Capability  (DLC) Report | N/A | N/A | N/A | | N/A | | | | | | | | See Note 18 | | | | | | | | | | | | | | | |
| 11 to 16 | Reserved for Extension  To DLC Report | N/A | N/A | N/A | | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | |
| 17 | Common Usage GICB  Capability Report | N/A | N/A | N/A | | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | |
| 18 to 1F | Mode S Specific Services  Capability Report | N/A | N/A | N/A | | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 20 | Aircraft Identification | BDS Code = 20HEX | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Characters  1 – 8 | 233 | Flight Ident. Word #1 | See Attachment 4, Table 4-3 | | | | | | | See Note 17 | | | | | | | | | | 12,13 |
| 234 | Flight Ident. Word #2 | See Attachment 4, Table 4-4 | | | | | | | See Note 17 | | | | | | | | | |
| 235 | Flight Ident. Word #3 | See Attachment 4, Table 4-5 | | | | | | | See Note 17 | | | | | | | | | |
| 236 | Flight Ident. Word #4 | See Attachment 4, Table 4-6 | | | | | | | See Note 17 | | | | | | | | | |
| Characters 9 - 10 | 237 | Flight Ident. Word #5 | Reserved for Flight Identification Characters 9 and 10. See Attachment 4, Table 4-7 | | | | | | | See Note 17 | | | | | | | | | |
| Characters  1 - 8 | 301 | Aircraft Ident. Word #1 | See Attachment 4, Table 4-10 | | | | | | | See Note 17 | | | | | | | | | | 12,13, 14 |
| 302 | Aircraft Ident. Word #2 | See Attachment 4, Table 4-11 | | | | | | |
| 303 | Aircraft Ident. Word #3 | See Attachment 4, Table 4-12 | | | | | | |
| Characters 1 - 8 | 360 | Flight Number Char. 1 - 8 | See Attachment 4, Table 4-9 | | | | | | | See Note 17 | | | | | | | | | | 12,13 |
| 21 | Aircraft Registration  Number | Aircraft Registration Statue | Aircraft Registration Status is established via the data received for the Aircraft Registration data shown in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Characters  1 - 8 | 301 | Aircraft Ident. Word #1 | See Note 13 and 14 | | | | | | | See Note 13 and 14 | | | | | | | | | | 13, 14 |
| 302 | Aircraft Ident. Word #2 | See Note 13 and 14 | | | | | | | See Note 13 and 14 | | | | | | | | | |
| 303 | Aircraft Ident. Word #3 | See Note 13 and 14 | | | | | | | See Note 13 and 14 | | | | | | | | | |
| ICAO Airline  Registration  Marking | Airline Registration Status | Airline Registration Status is established via the data received for Airline Registration data shown in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Airline Registration  Characters 1-2 | N/A | Airline Registrations | N/A | | | | | | | N/A | | | | | | | | | |  |
| 22 | Antenna Position |  | N/A | Antenna 1 - 4 Position Information | TBD | | | | | | | TBD | | | | | | | | | |  |
| 25 | Aircraft Type | Model Description | N/A | Aircraft Type/Model Information | TBD | | | | | | | TBD | | | | | | | | | |  |
| 26 to 2F | Unassigned | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 30 | ACAS Active Resolution Advisory |  | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 31 to 3F | Unassigned  Version 1 and 2 | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 31 | CAS Active Resolution (Part 2) |  | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| 32 | Reserved for CAS |  | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| 33-37  (All Registers are Formatted the Same) | Extended Squitter Aircraft Status  Subtype = 3  Operational Coordination Message | Type = 28 | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Subtype =3 | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Multiple Thread Bit | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Cancel Vertical RA Complement (CVC) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Vertical RA Complement (VRC) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Cancel Horizontal RA Complement (CHC) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Horizontal RA Complement (HRC) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Horizontal Sense Bits (HSB) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Vertical Sense Bits (VSB) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |
| Threat Identity Aircraft Address (TAA) | N/A | N/A | N/A | | | | N/A | | | | | | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 40 | Selected  Vertical Intention | MCP/FCU  Selected Alt. Status | MCP/FCU Selected Altitude Status is established via the data received for  the MCP/FCU Selected Altitude data shown in the following rows. | | | | | | | | | | N/A | | | | | | | | | |  |
| MCP/FCU  Selected Altitude | 102 | MCP/FCU Selected Altitude | BNR | feet | + | 65,536 | 16 | | 1.0 | 200 |  |  | 2 |  |  |  | 1 |  |  |  | 15 |
| 025 | Selected Altitude | BCD | feet | + | 0 – 50,000 | 5 | | 1.0 | 200 |  |  | 2 |  |  |  | 1 |  |  |  | 15 |
| FMS Selected  Altitude Status | FMS Selected Altitude Status is established via the data received for  the FMS Selected Altitude data shown in the following rows. | | | | | | | | | | N/A | | | | | | | | | |  |
| FMS Selected Altitude | 102 | Selected Altitude | BNR | feet | + | 65,536 | 16 | | 1.0 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  | 19 |
| Baro Pressure Setting Status | Barometric Pressure Setting Status is established via the data received for  Barometric Pressure Setting data shown in the following rows. | | | | | | | | | | N/A | | | | | | | | | |  |
| Barometric Pressure Setting | 234 | Baro Correction (mb) #1 | BCD | Mb | + | 745 - 1050 | 5 | | 0.1 | 125 |  |  |  |  | 1 |  |  |  |  |  | 28 |
| 236 | Baro Correction (mb) #2 | BCD | Mb | + | 745-1050 | 5 | | 0.1 | 125 |  |  |  |  | 1 |  |  |  |  |  |
| Status of MCP/FCU Mode Bits | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 16 |
| VNAV Mode | 272 | From MCP of the FMC System. | DISC | N/A | | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  | 16 |
| Approach Mode | 272 | From MCP of the FMC System. | DISC | N/A | | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  | 16 |
| 273 | From MCP of the FMC System. | DISC | N/A | | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  | 16 |
| ALT Hold Mode | 272 | From MCP of the FMC System. | DISC | N/A | | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  | 16 |
| 273 | From MCP of the FMC System. | DISC | N/A | | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  | 16 |
| Status of Target Altitude  Source Bits | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | 19 |
| Target Altitude Source | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | 19 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 41 | Next Waypoint Details | Character 1 - 9 | TBD | TBD | TBD | TBD | | | | | | TBD | | | | | | | | | |  |
| 42 | Next Waypoint Details | Way-Point Latitude | TBD | TBD | TBD | TBD | | | | | | TBD | | | | | | | | | |  |
| Way-Point Longitude | TBD | TBD | TBD | TBD | | | | | | TBD | | | | | | | | | |  |
| Way-Point Crossing Altitude | TBD | TBD | TBD | TBD | | | | | | TBD | | | | | | | | | |  |
| 43 | Next Waypoint Details | Bearing to Waypoint Status | Bearing to Waypoint Status is established via the data received for Bearing to Waypoint data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Bearing to Waypoint Sign | Bearing to Waypoint Sign is established via the data received for Bearing to Waypoint data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Bearing to Way-Point | 115 | Waypoint Bearing | BNR | deg./180 | + | +/- 180 | 12 | 0.05 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Time to Go Status | Time to Go Status is established via the data received for Time to Go data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Time to Go (TTG) | 002 | Time to Go (TTG) to Waypoint | BCD | min. | + | 0 - 399.9 | 4 | 0.1 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Distance to Go Status | Distance to Go Status is established via the data received for Distance to Go data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Distance to Go (DTG) | 001 | Distance to Go (DTG) to Waypoint | BCD | n.m. | + | +/- 3999.9 | 5 | 0.1 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 44 | Meteorological  Routine Air Report  (Version 1 and 2) | FOM/Source | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Wind Speed and Direction Status | Wind Speed and Direction Status is established via the data received for Wind Speed and Direction data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Wind Speed | 315 | Wind | BNR | knots | + | 256 | 8 | 1.0 | 100 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 015 | Speed | BCD | knots | + | 0 - 399 | 3 | 1.0 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| True Wind Direction | 316 | Wind | BNR | deg./180 | CW-N | +/- 180 | 8 | 0.7 | 100 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 016 | Direction | BCD | degrees | + | 0 - 359 | 3 | 1.0 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Static Air Temperature Sign | Static Air Temperature Sign is established via the data received for Static Air Temperature data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Static Air Temperature | 213 | Static Air Temperature | BNR | deg. C | + | 512 | 11 | 0.25 | 500 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Average Static Pressure Status | Average Static Pressure Status is established via the data received for Average Static Pressure data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Average Static Pressure | 217 | Average Static Pressure | BNR | in. Hg. | + | 64 | 16 | 0.00097656 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Turbulence Status | Turbulence Status is established via the data received for Turbulence data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Turbulence | TBD | Turbulence | TBD | | | | | | | TBD | | | | | | | | | |  |
| Humidity Status | Humidity Status is established via the data received for Humidity data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Humidity | 113 | Humidity | BNR | % | + | 100 | 9 | 0.1953125 | TBD | TBD | | | | | | | | | |  |
| 45 | Meteorological  Hazard Report  (Version 1 and 2) | Turbulence Status | Turbulence Status is established via the data received for Turbulence data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Turbulence | TBD | Turbulence | TBD | | | | | | | TBD | | | | | | | | | |  |
| Wind Shear Status | Wind Shear Status is established via the data received for Wind Shear data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Wind Shear | TBD | Wind Shear | TBD | | | | | | | TBD | | | | | | | | | |  |
| Microburst Status | Microburst Status is established via the data received for Microburst data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Microburst | TBD | Microburst | TBD | | | | | | | TBD | | | | | | | | | |  |
| Icing Status | Icing Status is established via the data received for Icing data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Icing | TBD | Icing | TBD | | | | | | | TBD | | | | | | | | | |  |
| Wake Vortex Status | Wake Vortex Status is established via the data received for Wake Vortex data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Wake Vortex | TBD | Wake Vortex | TBD | | | | | | | TBD | | | | | | | | | |  |
| Static Air Temperature Status | Static Air Temperature Status is established via the data received for Static Air Temperature data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 45 | Meteorological  Hazard Report  (Version 1 and 2) | Static Air Temperature Sign | Static Air Temperature Sign is established via the data received for Static Air Temperature data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Static Air Temperature | 213 | Static Air Temperature | BNR | deg. C | + | 512 | 11 | 0.25 | 500 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Average Static Pressure Status | Average Static Pressure Status is established via the data received for Average Static Pressure data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Average Static Pressure | 217 | Average Static Pressure | BNR | in. Hg. | + | 64 | 16 | 0.0009765625 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Radio Height Status | Radio Height Status is established via the data received for Radio Height data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Radio  Height | 164 | Radio Height | BNR | feet | + | 8,192 | 16 | 0.125 | 50 |  |  | 2 |  |  |  |  |  | 1 |  | 10 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 46 | Reserved for  Flight Management System\_Mode 1 | TBD | TBD | TBD | TBD | | | | | | | TBD | | | | | | | | | |  |
| 47 | Reserved for  Flight Management System\_Mode 2 | TBD | TBD | TBD | TBD | | | | | | | TBD | | | | | | | | | |  |
| 48 | VHF Channel Report | VHF 1 – 3  Audio Status | 030 | VHF Comm Frequency | See ARINC 429 | | | | | | |  |  | 2 |  |  |  |  | 1 |  |  | 11 |
| 047 | VHF Comm Frequency | See ARINC 429 | | | | | | |  |  | 2 |  |  |  |  | 1 |  |  | 11 |
| N/A | Audio Status | N/A | | | | | | |  |  |  |  |  |  |  |  |  |  |  |
| **49 – 4F** | **Unassigned** | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 50 | Track and Turn  Report | Roll Angle Status | Roll Angle Status is established via the data received for Roll Angle data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Roll Angle Sign | Roll Angle Sign is established via the data received for Roll Angle data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Roll Angle | 325 | Roll Angle | BNR | deg./180 | Right | +/- 180 | 14 | 0.01099 | 20 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Track Angle Status | Track Angle Status is established via the data received for Track Angle data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Track Angle Sign | Track Angle Sign is established via the data received for Track Angle data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| True Track  Angle | 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| Ground Speed Status | Ground Speed Status is established via the data received for Ground Speed data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Ground  Speed | 112 | GNSS Ground Speed | BNR | knots | + | 4,096 | 18 | 0.015625 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 312 | Ground Speed | BNR | knots | + | 4,096 | 15 | 0.125 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 012 | Ground Speed | BCD | knots | + | 0 - 7000 | 4 | 1.0 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Track Angle Rate Status | Track Angle Rate Status is established via the data received for Track Angle Rate data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Track Angle Rate Sign | Track Angle Rate Sign is established via the data received for Track Angle Rate data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Track Angle Rate | 335 | Track Angle Rate | BNR | deg./sec. | CW | +/- 32 | 11 | 0.015 | 20 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| True Airspeed Status | True Airspeed Status is established via the data received for True Airspeed data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| True  Airspeed | 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 230 | True Airspeed | BCD | knots | + | 100 - 599 | 3 | 1.0 | 500 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 51 | Position Report  Coarse | Register Status | Latitude Status is established via the data received for Latitude, Longitude, and Altitude data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Latitude Sign | Latitude Sign is established via the data received for Latitude data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Latitude | 110 | GNSS Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 254 | Hybrid Latitude, Coarse | BNR | degrees | N | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 010 | Latitude, Present Position | BCD | degrees | N | 180N – 180S | 6 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 310 | Latitude, Present Position | BNR | degrees | N | 0 – 180N/0 – 180S | 20 | 0.00017166 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 51 | Position Report  Coarse | Longitude Sign | Longitude Sign is established via the data received for Longitude data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Longitude | 111 | GNSS Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 255 | Hybrid Longitude, Coarse | BNR | degrees | E | +/- 180 | 20 | 0.00017166 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 011 | Longitude, Present Position | BCD | degrees | E | 180E – 180W | 6 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 311 | Longitude, Present Position | BNR | degrees | E | 0 – 180E/0 – 180W | 20 | 0.00017166 | 200 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Pressure Altitude Sign | Pressure Altitude Sign is established via the data received for Pressure Altitude data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Pressure Altitude | 203 | Altitude (1013.25 hPa) (Barometric) | BNR | feet | UP | +131,072 | 17 | 1.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 52 | Position Report  Fine | FOM/SOURCE | 247 | Horizontal Figure of Merit | BNR | n.m. | + | 16 | 18 | 6.1 E-5 | 1200 | 1 | 2 |  |  |  |  |  |  |  |  |  |
| 167 | Estimated Position Uncertainty (ANP) | BNR | n.m. | + | 0 – 128 | 16 | 0.00195 |  |  |  | 1 |  |  |  |  |  |  |  |  |
| 171 | Required Navigation Performance (RNP) | BNR | n.m. | + | 0 – 128 | 16 | 0.00195 |  |  |  | 1 |  |  |  |  |  |  |  |  |
| 370 | GNSS Height (HAE) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 261 | Hybrid Altitude (MSL) | BNR | Feet | UP | +/- 131,072 | 20 | 0.125 | 40 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 203 | Altitude (1013.25 hPa) (Barometric) | BNR | feet | UP | +131,072 | 17 | 1.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Latitude Fine | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| Longitude Fine | 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| Pressure Altitude or GNSS Height (HAE) | 203 | Altitude (1013.25 hPa) (barometric) | BNR | feet | UP | +131,072 | 17 | 1.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 370 | GNSS Height (HAE) | BNR | feet | UP | +/- 131,072 | 20 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 53 | Air Referenced  State Vector | Magnetic Heading Status | Magnetic Heading Status is established via the data received for Magnetic Heading data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Magnetic Heading Sign | Magnetic Heading Sign is established via the data received for Magnetic Heading data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Magnetic Heading | 320 | Magnetic Heading | BNR | Deg./180 | + | +/- 180 | 15 | 0.0549316 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 014 | Magnetic Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Indicated Airspeed Status | Indicated Airspeed Status is established via the data received for Indicated Airspeed data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Indicated Airspeed (IAS) | 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Mach Number Status | Mach Number Status is established via the data received for Mach Number data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Mach | 205 | Mach | BNR | mach | + | 4.096 | 16 | 0.0000625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| True Airspeed Status | True Airspeed Status is established via the data received for True Airspeed data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| True  Airspeed | 210 | True Airspeed | BNR | knots | + | 2,048 | 15 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 230 | True Airspeed | BCD | knots | + | 100 - 599 | 3 | 1.0 | 500 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Altitude Rate Status | Altitude Rate Status is established via the data received for Altitude Rate data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Altitude Rate Sign | Altitude Rate Sign is established via the data received for Altitude Rate data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Altitude Rate | 212 | Altitude Rate, Barometric | BNR | Ft./min. | + | 32,768 | 11 | 16 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 232 | Altitude Rate | BCD | Ft./min. | UP | +/- 20,000 | 4 | 10.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| 165 | GNSS Vertical Velocity | BNR | Ft./min. | UP | +/- 32,768 | 18 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 365 | Inertial Vertical Velocity | BNR | Ft./min. | + | 32,768 | 15 | 1.0 | 40 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 345 | Hybrid Vertical Velocity | BNR | Ft./min. | UP | +/- 32,768 | 15 | 1.0 | 40 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 54 | Waypoint #1 | Parameter Status | Parameter Status is set to “0” if any of the register parameters is invalid. | | | | | | | | | N/A | | | | | | | | | |  |
| Char 1 - 5 | 130 | TCP Identification | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ETA | 056 | Estimated Time of Arrival (ETA) | BCD | hr:min | + | 0 - 23.59.9 | 5 | 0.1 | 500 |  | 1 | 2 |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 54 | Waypoint #1 | Estimated Flight Level | TBD | TBD | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Time to Go | 002 | Time to Go (TTG) | BCD | min. | + | 0 - 399.9 | 4 | 0.1 | 200 |  | 1 | 2 |  |  |  |  |  |  |  |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 55 | Waypoint #2 | Parameter Status | Parameter Status is set to “0” if any of the register parameters is invalid. | | | | | | | | | N/A | | | | | | | | | |  |
| Char 1 - 5 | 130 | TCP Identification | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ETA | 056 | Estimated Time of Arrival (ETA) | BCD | hr:min | + | 0 - 23.59.9 | 5 | 0.1 | 500 |  | 1 | 2 |  |  |  |  |  |  |  |  |
| Estimated Flight Level | TBD | TBD | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Time to Go | 002 | Time to Go (TTG) | BCD | min. | + | 0 - 399.9 | 4 | 0.1 | 200 |  | 1 | 2 |  |  |  |  |  |  |  |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 56 | Waypoint #3 | Parameter Status | Parameter Status is set to “0” if any of the register parameters is invalid. | | | | | | | | | N/A | | | | | | | | | |  |
| Char 1 - 5 | 130 | TCP Identification | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ETA | 056 | Estimated Time of Arrival (ETA) | BCD | hr:min | + | 0 - 23.59.9 | 5 | 0.1 | 500 |  | 1 | 2 |  |  |  |  |  |  |  |  |
| Estimated Flight Level | TBD | TBD | TBD | TBD |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Time to Go | 002 | Time to Go (TTG) | BCD | min. | + | 0 - 399.9 | 4 | 0.1 | 200 |  | 1 | 2 |  |  |  |  |  |  |  |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 57 to 5E | Not Assigned | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | |
| 5F | Quasi-Static  Parameter Monitoring  (Version 1 and 2) | MCP/FCU Selected  Altitude | 102 | Selected Altitude | BNR | feet | + | 65,536 | 16 | 1.0 | 200 |  |  | 2 |  |  |  | 1 |  |  |  |  |
| 025 | Selected Altitude | BCD | feet | + | 0 – 50,000 | 5 | 1.0 | 200 |  |  | 2 |  |  |  | 1 |  |  |  | 15 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Next Waypoint |  | Next Waypoint | See Register Number 41, 42, and 43 Above | | | | | | | See Register Number 41, 42, and 43 Above | | | | | | | | | |  |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| FMS Vertical Mode |  | FMS Vertical Mode | See Register Number 40 Above | | | | | | | See Register Number 40 Above | | | | | | | | | |  |
| VHF Channel Report | N/A | VHF Channel Report | See Register Number 48 Above | | | | | | | See Register Number 48 Above | | | | | | | | | | 11 |
| Met Hazards | N/A | Meteorological Report | See Register Number 45 Above | | | | | | | See Register Number 45 Above | | | | | | | | | |  |
| FMS Selected Altitude | N/A | N/A | See Register Number 40 Above | | | | | | | See Register Number 40 Above | | | | | | | | | | 54 |
| Barometric Pressure Setting minus 800 mb | N/A | N/A | See Register Number 40 Above | | | | | | | See Register Number 40 Above | | | | | | | | | | 54 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 60 | Heading and  Speed Report | Magnetic Heading Status | Magnetic Heading Status is established via the data received for Magnetic Heading data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Magnetic Heading Sign | Magnetic Heading Sign is established via the data received for Magnetic Heading data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Magnetic Heading | 320 | Magnetic Heading | BNR | Deg./180 | + | +/- 180 | 15 | 0.0549316 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 014 | Magnetic Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| Indicated Airspeed Status | Indicated Airspeed Status is established via the data received for Indicated Airspeed data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Indicated Airspeed (IAS) | 206 | Computed Airspeed | BNR | knots | + | 1,024 | 14 | 0.0625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Mach Number Status | Mach Number Status is established via the data received for Mach Number data in the following row. | | | | | | | | | N/A | | | | | | | | | |  |
| Mach | 205 | Mach | BNR | mach | + | 4.096 | 16 | 0.0000625 | 125 |  |  | 2 |  | 1 |  |  |  |  |  |  |
| Barometric Altitude Rate Status | Barometric Altitude Rate Status is established via the data received for Barometric Altitude Rate data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |
| Barometric Altitude Rate Sign | Barometric Altitude Rate Sign is established via the data received for Barometric Altitude Rate data in the following rows. | | | | | | | | | N/A | | | | | | | | | |  |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **UAS/**  **RPAS** | **AIREP Aircraft**  **Weather** | **PIREP** | **HVA** | **Notes** |
| 60 | Heading and  Speed Report | Barometric Altitude Rate | 212 | Altitude Rate, Barometric | BNR | Ft./min. | + | 32,768 | 11 | 16 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |  |  |  |  |
| 232 | Altitude Rate | BCD | Ft./min. | UP | +/- 20,000 | 4 | 10.0 | 62.5 |  |  | 2 |  | 1 |  |  |  |  |  |  |  |  |  |  |
| Inertial Vertical Velocity Status | Inertial Vertical Velocity Status is established via the data received for Inertial Vertical Velocity data in the following rows. | | | | | | | | | N/A | | | | | | | | | | | | | |  |
| Inertial Vertical Velocity Sign | Inertial Vertical Velocity Sign is established via the data received for Inertial Vertical Velocity data in the following row. | | | | | | | | | N/A | | | | | | | | | | | | | |  |
| Inertial Vertical Velocity | 365 | Inertial Vertical Velocity | BNR | Ft./min. | + | 32,768 | 15 | 1.0 | 40 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |
| 165 | GNSS Vertical Velocity | BNR | Ft/min. | + | +/- 32,768 | 18 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |
| 61 | Extended Squitter Aircraft Status  Subtype = 1  Emergency/Priority Status | Type = 28 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| Subtype =1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| Emergency/Priority Status | 016 | 4096 Ident Code | See ARINC-735B Attachment 6D | | | | | | |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  | 21 |
| 031 | 4096 Ident Code | See ARINC-429 P1-17, Attachment 6, Table 6-46 | | | | | | |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  | 21 |
| Mode A Code | 016 | 4096 Ident Code | See ARINC-735B Attachment 6D | | | | | | |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |
| 031 | 4096 Ident Code | See ARINC-429 P1-17, Attachment 6, Table 6-46 | | | | | | |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |
| Manned Unmanned Operations | 250 | N/A | N/A | | | | | | |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| Mean EDR | 251 | EDR | TBD | | | | | | |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  | 60 |
| Peak EDR | 252 | EDR | TBD | | | | | | |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  | 60 |
| Peak EDR Offset | 253 | EDR | TBD | | | | | | |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  | 60 |
| Water Vapor | 254 | N/A | TBD | | | | | | |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  | 60 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| 61 | Extended Squitter  Aircraft Status  Subtype = 2  TCAS RA  Broadcast Message | Type = 28 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| Subtype =2 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| Active Resolution Advisories (ARA) | All Resolution Advisory (RA) information is provided directly to the transponder by the TCAS Computer via the TXCoord. Bus using the TGD Protocol as specified in Attachment 19 of ARINC 735B. Exact word definitions showing the applicable RA field data are provided in ARINC 735B Attachment 19F. | | | | | | | | | Not Applicable as all RA data is provided directly by TCAS as indicated in the cell to the left. | | | | | | | | | | | | | |  |
| Resolution Advisory  Complements (RACs) |
| RA Terminated (RAT) |
| Multiple Threat Encounter (MTE) |
| Threat Type Indicator (TTI) |
| Threat Identity Data (TID) |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | | **Parameter Description** | | **Signal**  **Format** | | **Units** | **+**  **Sense** | | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | | **MAX**  **TX**  **INTVL** | | **GPS** | | **FMC/**  **GNSS** | | **IRS/**  **FMS** | | **FMC**  **GEN** | | **ADS** | | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **UAS/**  **RPAS** | **AIREP Aircraft**  **Weather** | **PIREP** | **HVA** | **Notes** |
| 62 | Target State and Status Information | Type | | N/A | | N/A | | N/A | | | | | | | | | | | N/A | | | | | | | | | | | | | | | | | |  |
| Subtype | | N/A | | N/A | | N/A | | | | | | | | | | | N/A | | | | | | | | | | | | | | | | | |  |
| SIL Supplement | | N/A | | N/A | | N/A | | | | | | | | | | | N/A | | | | | | | | | | | | | | | | | | 25 |
| Selected Altitude Type | | N/A | | N/A | | N/A | | | | | | | | | | | N/A | | | | | | | | | | | | | | | | | | 26 |
| MCP/FCU Selected Altitude *or*  FMS Selected Altitude | | 102 | | MCP/FCU Selected Altitude | | BNR | feet | | + | 65,536 | 16 | | 1.0 | | 200 | |  | |  | | 2 | |  | |  |  | 1 |  |  |  |  |  |  |  | 26, 27 |
| 025 | | Selected Altitude | | BCD | feet | | + | 0 – 50,000 | 5 | | 1.0 | | 200 | |  | |  | | 2 | |  | |  |  | 1 |  |  |  |  |  |  |  |
| 102 | | Selected Altitude | | BNR | feet | | + | 65,536 | 16 | | 1.0 | | 200 | |  | | 1 | | 3 | | 2 | |  |  |  |  |  |  |  |  |  |  |
| Barometric Pressure Setting | | 234 | | Baro Correction (mb) #1 | | BCD | Mb | | + | 745 - 1050 | 5 | | 0.1 | | 125 | |  | |  | |  | |  | | 1 |  |  |  |  |  |  |  |  |  | 28 |
| 236 | | Baro Correction (mb) #2 | | BCD | Mb | | + | 745 - 1050 | 5 | | 0.1 | | 125 | |  | |  | |  | |  | | 1 |  |  |  |  |  |  |  |  |  |
| Selected Heading Status | | Selected Heading Status is established via the data received for Selected Heading data in the following rows. | | | | | | | | | | | | | | |  | |  | |  | |  | |  |  |  |  |  |  |  |  |  |  | 29 |
| Selected Heading Sign | | Selected Heading Status is established via the data received for Selected Heading data in the following rows. | | | | | | | | | | | | | | |  | |  | |  | |  | |  |  |  |  |  |  |  |  |  |  |
| Selected Heading | | 101 | | Selected Heading | | BNR | Deg./180 | | + | +/- 180 | 12 | | 0.0439453125 | | 62.5 | |  | |  | | 1 | |  | |  |  |  |  |  |  |  |  |  |  |
| Navigation Accuracy Category\_Position  (NACP) | | 247 | | Horizontal Figure of Merit  (HFOM) | | BNR | n.m. | | + | 16 | 18 | | 6.1035E-5 | | 1200 | | 1 | | 2 | | 3 | |  | |  |  |  |  |  |  |  |  |  |  | 30 |
| Navigation Integrity Category\_Baro  (NICBARO)  (Version 1 and 2) | | N/A | | N/A | | N/A | | | | | | | | | | | N/A | | | | | | | | | | | | | | | | | | 31 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **UAS/**  **RPAS** | **AIREP Aircraft**  **Weather** | **PIREP** | **HVA** | **Notes** |
| 62 | Target State and Status Information | Source Integrity Level  (SIL) | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |  |  |  | 25,32 |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |  |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | |
| Status of MCP/FCU  Mode Bits | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 33 |
| Autopilot Engaged | 272 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| VNAV Mode Engaged | 273 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| Altitude Hold Mode | 272 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| 273 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| Reserved for  ADS-R Flag | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| Approach Mode | 272 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| 273 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| TCAS Operational | 274 | From TCAS | DISC | N/A | | | | | 100 Min | TCAS | | | | | | | | | | | | | | 34 |
| LNAV Mode Engaged | 273 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| 275 | From MCP of the FMC System. | DISC | N/A | | | | | 100 Min |  |  | 2 |  |  |  | 1 |  |  |  |  |  |  |  | 33 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | |  |
| 63 | Extended Squitter Aircraft Status  Subtype = 4  UAS/RPAS Contingency, Current TCP | Type = 28 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| Subtype = 4 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| Contingency Plan | 200 | N/A | N/A | | | | | | |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| UAS/RPAS TCP Altitude | 205 | Altitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| UAS/RPAS TCP Latitude | 210 | Latitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| UAS/RPAS TCP Longitude | 211 | Longitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| 64 | Extended Squitter Aircraft Status  Subtype = 4  UAS/RPAS Contingency, Next TCP | Type = 28 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| Subtype = 4 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| Contingency Plan | 201 | N/A | N/A | | | | | | |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  |  |
| UAS/RPAS TCP Altitude | 206 | Altitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| UAS/RPAS TCP Latitude | 212 | Latitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |
| UAS/RPAS TCP Longitude | 213 | Longitude |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | TBD |  |  |  | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | | **UAS/**  **RPAS** | | | **AIREP Aircraft**  **Weather** | **PIREP** | | **HVA** | | **Notes** |
| 65 | Aircraft  Operational  Status  Subtype = 0 | Type = 31 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| Subtype = 0 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| A\_CC Reserved  = 00 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| TCAS Operational | 274 | From TCAS | DISC | N/A | | | | | | 100 Min | TCAS | | | | | | | | | | | | | | | | | | | | | | | | | | 35 |
| A\_CC 1090 ES IN | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 36 |
| A\_CC Reserved  = 00 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| A\_CC ARV | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 56 |
| A\_CC TS | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 57 |
| A\_CC TC | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 58 |
| A\_CC UAT In | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 37 |
| A\_CC  Reserved for  ADS-R | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| A\_CC Reserved  = 0000 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| A\_OM Format  = 00 | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| Airborne\_OM (A\_OM)  TCAS RA Active | All Resolution Advisory (RA) information is provided directly to the transponder by the TCAS Computer via the TXCoord. Bus using the TGD Protocol as specified in Attachment 19 of ARINC 735B. Exact word definitions showing the applicable RA field data are provided in ARINC 735B Attachment 19F. | | | | | | | | | | Not Applicable as all RA data is provided directly by TCAS as indicated in the cell to the left. | | | | | | | | | | | | | | | | | | | | | | | | | |  |
| A\_OM  IDENT Switch Active | 016 | 4096 Ident Code | See ARINC-735B Attachment 6D | | | | | | | |  |  | |  | |  |  | 1 | |  | |  | |  | |  | |  | |  |  | | |  | |  |  |
| 031 | 4096 Ident Code | See ARINC-429 P1-17, Attachment 6, Table 6-46 | | | | | | | |  |  | |  | |  |  | 1 | |  | |  | |  | |  | |  | |  |  | | |  | |  |  |
| A\_OM Reserved for Receiving ATC Services | N/A | N/A | N/A | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 55 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| 65 | Aircraft  Operational  Status  Subtype = 0 | A\_OM  Single Antenna Flag | N/A | N/A | N/A | | | | | | | Established directly by Mode S Transponder depending on the number of active antennas. | | | | | | | | | |  |
| A\_OM  System Design Assurance | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 38 |
| A\_OM Reserved  =0000 0000 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| MOPS Version No. | N/A | N/A | N/A | | | | | | | Established by Software Load (0=DO-260, 1= DO-260A, 2=DO-260B, 3-7 = Reserved) | | | | | | | | | |  |
| NIC Supplement-A | 130 | Autonomous Horizontal Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 46 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| NACP | 247 | Horizontal Figure of Merit  (HFOM) | BNR | n.m. | + | 16 | 18 | 6.1035E-5 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 47 |
| Geometric Vertical Accuracy (GVA) | 136 | Vertical Figure of Merit (VFOM) | BNR | Feet | + | 32,768 | 18 | 0.125 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 48 |
| 135 | Hybrid Vertical Figure of Merit | BNR | Feet | + | 32,768 | 18 | 0.125 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| Source Integrity Level  (SIL) | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 25, 49 |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| Navigation Integrity Category\_Baro  (NICBARO) | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 50 |
| Heading Reference  Direction (HRD) | 320 | Magnetic Heading | BNR | Deg./  180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  | 52 |
| 014 | Magnetic Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |
| 314 | True Heading | BNR | Deg./  180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| 044 | True Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |
| 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |  |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |  |
| 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | 1 | 3 | 2 |  |  |  |  |  |  |  |
| SIL Supplement | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 53 |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |
| Reserved = 0 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| 65 | Aircraft  Operational  Status  Subtype = 1 | Type = 31 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Subtype = 1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Surface\_CC (S\_CC) Reserved  = 00 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| Surface\_CC (S\_CC)  1090 ES IN | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 39 |
| S\_CC Reserved  = 00 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| S\_CC B2 Low | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| S\_CC UAT IN | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | 40 |
| S\_CC NACV | 145 | Horizontal Velocity Figure of Merit | BNR | knots | + | 4096 | 18 | 4096\*2^-18 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 41 |
| See ARINC 743A-5 Attachment 4-2A | | | | | | |
| S\_CC  NIC Supplement-C | 130 | Autonomous Horizontal Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | 2 | 3 |  |  |  |  |  |  |  | 42 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | | **PIREP** | | **HVA** | **Notes** |
| 65 | Aircraft  Operational  Status  Subtype = 1 | Surface  Length/Width Codes | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 43 |
| Surface\_OM  (S\_OM) Reserved  = 00 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | |  |
| S\_OM  TCAS RA Active | All Resolution Advisory (RA) information is provided directly to the transponder by the TCAS Computer via the TXCoord. Bus using the TGD Protocol as specified in Attachment 19 of ARINC 735B. Exact word definitions showing the applicable RA field data are provided in ARINC 735B Attachment 19F. | | | | | | | | | Not Applicable as all RA data is provided directly by TCAS as indicated in the cell to the left. | | | | | | | | | | | | | | | | | | | | | | | | |  |
| S\_OM  IDENT Switch Active | 016 | 4096 Ident Code | See ARINC-735B Attachment 6D | | | | | | |  |  | |  |  | |  | | 1 | |  | |  | |  | |  | |  | |  | |  | |  |  |
| 031 | 4096 Ident Code | See ARINC-429 P1-17, Attachment 6, Table 6-46 | | | | | | |  |  | |  |  | |  | | 1 | |  | |  | |  | |  | |  | |  | |  | |  |  |
| S\_OM Reserved for Receiving ATC Services | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 55 |
| S\_OM  Single Antenna Flag | N/A | N/A | N/A | | | | | | | Established directly by Mode S Transponder depending on the number of active antennas. | | | | | | | | | | | | | | | | | | | | | | | | |  |
| S\_OM  System Design Assurance | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 44 |
| S\_OM  GPS Antenna Offset | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 45 |
| MOPS Version No. | N/A | N/A | N/A | | | | | | | Established by Software Load (0=DO-260, 1= DO-260A, 2=DO-260B, 3-7 = Reserved) | | | | | | | | | | | | | | | | | | | | | | | | |  |
| NIC Supplement-A | 130 | Autonomous Horizontal Integrity Limit | BNR | n.m. | + | 16 | 17 | 0.0001221 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | 46 |
| 131 | Hybrid Horizontal Integrity Limit | BNR | n.m. | + | 16 | 18 | 6.1E-5 | 1000 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| NACP | 247 | Horizontal Figure of Merit  (HFOM) | BNR | n.m. | + | 16 | 18 | 6.1035E-5 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | 47 |
| Reserved = 00 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | |  |
| Source Integrity Level  (SIL) | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | 25, 49 |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | | **PIREP** | | **HVA** | **Notes** |
|  |  | Track/Heading | 320 | Magnetic Heading | BNR | Deg./180 | + | +/- 180 | 15 | 0.0549316 | 50 |  | | 1 | 3 | | 2 | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| 014 | Magnetic Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | | 1 | 3 | | 2 | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| 132 | Hybrid True Heading | BNR | degrees | CW-N | +/- 180 | 15 | 0.0549316 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |  |
| 044 | True Heading | BCD | degrees | + | +/- 359.9 | 4 | 0.1 | 500 |  | | 1 | 3 | | 2 | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| 103 | GNSS Track Angle | BNR | degrees | CW-N | +/- 180 | 18 | 0.0006866455 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| 137 | Hybrid Track Angle | BNR | degrees | CW-N | +/- 180 | 15 | 0.005493164 | 50 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |  |
| 313 | True Track Angle | BNR | deg./180 | + | +/- 180 | 15 | 0.005493164 | 50 |  | | 1 | 3 | | 2 | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| 013 | True Track Angle | BCD | degrees | + | 0 – 359.9 | 4 | 0.1 | 500 |  | | 1 | 3 | | 2 | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |  |
| Heading Reference  Direction (HRD | See parameters listed for Track/Heading directly above. | | | | | | | | | See sources listed for Track/Heading directly above. | | | | | | | | | | | | | | | | | | | | | | | | | 52 |
| SIL Supplement | 120 | GNSS Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | 53 |
| 256 | Hybrid Latitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| 121 | GNSS Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 1200 | 1 | | 2 | 3 | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  |
| 257 | Hybrid Longitude, Fine | BNR | degrees | + | 0.000172 | 11 | 8.3819E-8 | 100 | See ARINC 738A (ADIRS) Attachment 10-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved = 0 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | |  |
| 66 to DF | Unassigned  (Version 1 and 2) | N/A | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | |  |
| 66 | IRM – Interrogation Rate Monitor Message | Type = 24 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 2 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| ATCRBS Suppression Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| ATCRBS-Only All-Call Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Short Air-Air Surveillance Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Long Air-Air Surveillance Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Identity and Altitude Surveillance Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Mode S-Only All-Call Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Other Uplink Formats Interrogation Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | | **ADS** | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | | **WX** | | **Maint**  **Comp** | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | **PIREP** | | **HVA** | **Notes** |
| 67 | IRM – Reply Rate Monitor Message | Type = 24 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 3 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| ATCRBS Reply Reporting Capability Bit | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Mode A /ATCRBS Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Mode C Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Short Air-Air Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Long Air-Air Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Identity and Altitude Surveillance Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Identity and Altitude Comm-B Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| All-Call Reply Rate | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| 68 | ADS-B Weather AIREP  Subtype 0: Aircraft State | Type = 26 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 0 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Aircraft Configuration | TBD | N/A | N/A | | | | | | |  | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60, 61 |
| Aircraft Type Character #1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 62 |
| Aircraft Type Character #2 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 62 |
| Aircraft Type Character #3 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 62 |
| Aircraft Type Character #4 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 62 |
| Gross Weight | N/A | Max Gross Takeoff Weight discrete settings | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 63 |
| 075 | Gross Weight | TBD | | | | | | |  | |  | 2 | |  |  | | |  | |  | |  |  | |  | | |  | 1 |  |  | | 60, 63 |
| Wingspan | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60, 64 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | | **ADS** | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | | **WX** | | **Maint**  **Comp** | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | **PIREP** | | **HVA** | **Notes** |
| 69 | ADS-B Weather AIREP  Subtype 1: Weather State | Type =26 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Icing Status | 233 | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Wind Quality Indicator | TBD | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Wind Speed | 315 | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Wind Direction | 316 | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Air Temperature Type | N/A | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Air Temperature | 213  211 | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Airspeed Type | TBD | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |
| Airspeed | 026 | N/A | N/A | | | | | | |  | | |  |  | |  |  | | |  | |  | |  |  | |  | | |  | TBD |  |  | | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP** | | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | | **PIREP** | | **HVA** | **Notes** |
| 6A | ADS-B Weather AIREP  Subtype 2: Alternate Weather State | Type = 26 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 2 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Icing Status | 233 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Roll Angle | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Heading Type | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Heading | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Air Temperature Type | N/A | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Air Temperature | 213  211 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Airspeed Type | N/A | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| Airspeed | 026 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | | TBD | |  |  | 60 |
| 6B | Extended Squitter ADS-B Weather PIREP  Subtype 0: Flight Weather | Type = 27 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 0 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Prep Time | 303 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Flight Visibility | 303 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Flight Weather 1 | 303 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Flight Weather 2 | 304 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Flight Weather 3 | 304 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘A’ Height | 304 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘A’ Thickness | 305 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘A’ Height Type | 305 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘A’ Coverage | 305 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | | |  | |  | |  | |  | |  | | TBD |  | 60 |
| 6C | Extended Squitter ADS-B Weather PIREP  Subtype 1: Temp, Wind and Turbulence | Type = 27 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| PIREP Air Temperature | 306 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| PIREP Air Temperature Type | 306 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| PIREP Wind Direction | 306 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| PIREP Wind Speed | 306 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Turbulence Duration | 307 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Turbulence Duration | 307 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Turbulence Intensity | 307 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Turbulence Location | 307 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘B’ Height | 308 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘B’ Thickness | 308 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘B’ Height Type | 308 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |
| Layer ‘B’ Coverage | 308 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | | |  | |  | |  | |  | |  | |  | | TBD |  | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | | **IRS/**  **FMS** | **FMC**  **GEN** | | **ADS** | | **Cont.**  **Panel** | | **FCC/**  **MCP** | | **DFS/**  **VHF** | | **WX** | | **Maint**  **Comp** | | **UAS/**  **RPAS** | | **AIREP Aircraft**  **Weather** | | **PIREP** | **HVA** | **Notes** |
| 6D | Extended Squitter ADS-B Weather PIREP  Subtype 2: Hazardous Weather | Type = 27 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 2 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| PIREP Icing | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Airspeed Change | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Wind Shear Height | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Braking Action | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Runway Number | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Runway Position | 309 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Layer ‘Height | 310 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Layer ‘C’ Thickness | 310 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Layer ‘C’ Height Type | 310 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Layer ‘C’ Coverage | 310 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Flight Weather 1 Vicinity Direction | 311 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Flight Weather 2 Vicinity Direction | 311 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| Turbulence Type | 311 | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | TBD |  | 60 |
| 6E | High Velocity and/or Altitude (HVA) Message  Subtype 0: Position | Type = 25 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 0 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| HVA Geometric Altitude (HAE) | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| HVA Latitude | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| HVA Longitude | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| 6F | High Velocity and/or Altitude (HVA) Message  Subtype 1: Velocity | Type = 25 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Subtype = 1 | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Position Integrity Category (PIC) | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| East/West Direction Bit | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| HVA East/West Velocity | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| North/South Direction Bit | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| HVA North/South Velocity | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| Sign Bit for HVA Vertical Rate | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |
| HVA Vertical Rate | TBD | N/A | N/A | | | | | | |  | |  |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |  | TBD | 60 |

| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA REQUIREMENTS** | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **UAS/**  **RPAS** | **AIREP Aircraft**  **Weather** | **PIREP** | **HVA** | **Notes** |
| 71 | Interval Management Report | Status | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| 24-bit Aircraft Address of IM Designated Traffic ID | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| IM Assigned Goal Type | 0 = Time  1 = Distance | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| IM Assigned Spacing Goal | Time or Distance | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| Reserved | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | | | | | | 60 |
| E1 to E2 | Reserved for Mode S BITE | TBD | TBD | TBD | TBD | | | | | | | TBD | | | | | | | | | | | | | |  |
| E3 | Transponder type/  part number | Format Type | N/A | Format Type | N/A | | | | | | | N/A – Provided by Software Load | | | | | | | | | | | | | |  |
| Part Number  Digits 1 - 12  or characters 1 - 8 | N/A | Transponder Type and Part Number | N/A | | | | | | | N/A – Provided by Software Load | | | | | | | | | | | | | | 23 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MODE-S GICB REGISTER DATA REQUIREMENTS AND INPUT AVAILABILITY (continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| **DATA REQUIREMENTS** | | | | | | | | | | | | | **INPUT DATA SOURCE AVAILABILITY (See Note 1)** | | | | | | | | | | |
| **Register**  **Number**  **(HEX)** | **Assignment** | **Register Field** | | **ARINC 429**  **Word**  **(Octal)** | **Parameter Description** | **Signal**  **Format** | **Units** | **+**  **Sense** | **Range** | **Sig.**  **Bits/**  **Dig.** | **Resolution** | **MAX**  **TX**  **INTVL** | **GPS** | **FMC/**  **GNSS** | **IRS/**  **FMS** | **FMC**  **GEN** | **ADS** | **Cont.**  **Panel** | **FCC/**  **MCP** | **DFS/**  **VHF** | **WX** | **Maint**  **Comp** | **Notes** |
| E4 | Transponder Software Revision Number | Status | | N/A | Status | N/A | | | | | | | N/A – Provided by Software Load | | | | | | | | | | 23 |
| Format Type | | N/A | Format Type | N/A | | | | | | | N/A – Provided by Software Load | | | | | | | | | |
| Software Revision Number  1 - 12 digits  or 1 - 8 characters | | N/A | Software Revision Number | N/A | | | | | | | N/A – Provided by Software Load | | | | | | | | | |
| E5 | TCAS (ACAS) type/part number | Format Type | | N/A | Format Type | N/A | | | | | | | TCAS | | | | | | | | | | 23 |
| Part Number  Digits 1 - 12  or characters 1 - 8 | | N/A | TCAS (ACAS) Type and Part Number | N/A | | | | | | | TCAS | | | | | | | | | |
| E6 | TCAS (ACAS) Software Revision Number | Status | | N/A | Status | N/A | | | | | | | TCAS | | | | | | | | | |  |
| Format Type | | N/A | Format Type | N/A | | | | | | | TCAS | | | | | | | | | |  |
| Software Revision Number  1 - 12 digits  or 1 - 8 characters | | N/A | Software Revision Number | N/A | | | | | | | TCAS | | | | | | | | | | 23 |
| E7 to EC | Transponder Status and Diagnostics | N/A | | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| ED to F0 | Reserved |  |  |  |  | | | | |  | | | | | |  |
| F1 | Reserved for Military Use  (Version 1 and 2) | N/A | | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| F2 | Reserved for Military Use  (Version 1 and 2) | N/A | | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| F3 to FF | Reserved  Version 1 and 2 | N/A | | N/A | N/A | N/A | | | | | | | N/A | | | | | | | | | |  |
| F1-FD | Reserved | N/A | N/A | N/A | N/A | | | | | N/A | | | | | | 60 |
| FE | Reserved for Downlink Broadcast Identifier, update request | N/A | N/A | N/A | N/A | | | | | N/A | | | | | | 60 |
| FF | Reserved for Downlink Broadcast Identifier, search request | N/A | N/A | N/A | N/A | | | | | N/A | | | | | | 60 |

1. A-1 NOTES TO THE PRIMARY SOURCES OF ARINC 429 INPUT DATA
2. This table describes potential data sources for the Mode S transponder. The designer is to note that duplicate information is not necessary (i.e., once a supply for the needed data is found, no more dedicated inputs are needed).

The preferred priority of the data source to be used for each parameter is indicated by 1, 2, 3, etc., in the appropriate data source columns when such priority is applicable. The highest priority is given by 1 with priority decreasing to 3.

The data concentrator input ports should be monitored to determine the presence of an active ATSU data concentrator as shown below. If an active ATSU is detected, the Transponder should modify the input port priorities such that the data concentrator port has the top priority of all data sources. Exceptions to this rule are the Flight ID priority should remain as stated in Note 17 and the GPS input ports should remain the top priority for the applicable labels as listed in the table.

If an active ATSU is detected, but certain data labels are not present on the ATSU data concentrator port, the transponder should default to the input data priority as listed in the table to obtain the missing data.

ATSU active determination:

Label 377 is received with a value of 167HEX, and:

Label 270 is received with bit 16=0 (ATSU in Normal operation) AND bit 20=1 (ATSU is active).

1. The Type field encoding for this register requires information specific to horizontal integrity limit data. Information given herein is intended to provide such data.

The “TYPE” field encoding must be based on horizontal integrity limit information which is typically associated with GPS/GNSS data sources. When data sources are used that do not provide horizontal integrity limit information, then the “TYPE” field must be encoded to indicate that the Horizontal Containment Radius Limit (RC), e.g., the horizontal integrity limit, is UNKNOWN.

1. Surveillance Status is a function of the Mode S transponder and Automatic Dependent Surveillance – Broadcast (ADS-B) transmitters. Appropriate definition for setting of the Surveillance Status is provided in the applicable Minimum Operational Performance Specifications (MOPS) for these systems, as well as in ICAO Doc. 9871 (formerly Annex 10, Volume III, Chapter 5 Appendix and Manual of Mode S Specific Services) in regard to definitions of BDS Register 0,5.
2. The NIC Supplement-B is a one-bit (“ME” bit 8) subfield in the Airborne Position Message and is function of the Horizontal Integrity Limit data previously identified for the Type field encoding in Note 2 of this Attachment.
3. The Compact Position Reporting (CPR) algorithm requires positional information and velocity information for Estimation or Extrapolation of future position. Information given here is in the form of polar velocity (e.g., Label 103 GNSS Track Angle and Label 112 GNSS Ground Speed can be used to derive polar velocity).
4. The Compact Position Reporting (CPR) algorithm requires positional information and velocity information for Estimation or Extrapolation of future position. Information given here is in the form of rectangular velocity (e.g./ Label 166 GNSS N/S Velocity and Label 174 GNSS E/W Velocity can be used to derive rectangular velocity).
5. Utilized for encoding Movement information.
6. Utilized for encoding Ground Track information.
7. The Transmission Rate Subfield is a function of the Mode S transponder and Automatic Dependent Surveillance – Broadcast (ADS-B) transmitters. The Transmission Rate Subfield is established by:
8. Using the Latitude/Longitude Estimation/Extrapolation Parameters previously provided in this table for the Extended Squitter Surface Position Message in Register 06 to establish the amount of movement using polar or rectangular techniques in accordance with RTCA DO-260B Section 2.2.3.3.2.3, or
9. Set due to commands received from appropriate interrogators in accordance with RTCA DO-181E Section 2.2.23.1.6.
10. Data received from a Radio Altimeter data source.
11. Data received from a VHF Communications data source.
12. Registers 08HEX and 20HEX allow for encoding only 8 characters. On certain airframe configurations this information may be provided within ARINC 429 Labels 233-237 or Label 360. In all cases, encoding of these register subfields should conform to Annex 10, Volume IV Section 3.1.2.9 where:

* All characters will be left justified prior to encoding the Character fields.
* Characters will be coded consecutively without intervening SPACE codes.
* Any unused character spaces at the end of the subfield should contain a SPACE character code.
* Any extra characters will be truncated.

The Sign Status Matrix (SSM) of labels 233 through 237 should be treated by the transponder as follows:

|  |  |  |
| --- | --- | --- |
| **SSM 233 - 237** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Normal Operation |

It is recommended that control panels and other devices supplying these labels do so by setting the SSM of labels 233 through 237 to 1, 1 for normal operation in accordance with ARINC 429 Part 1.

COMMENTARY

The following information is provided to clarify the confusion that has existed in the industry in regard to definition of the SSM for labels 233 through 237. This document now establishes the SSM to be consistent with ARINC 429 Part 1 as given below. Implementers should take note that this reflects a change from what was previously defined in ARINC 718 and EUROCAE ED-86.

ARINC 429 Part 1 Attachment 1 identifies labels 233 through 237 as ACMS data having binary (BNR) format. Word structure for labels 233 through 237 is provided in ARINC 429 Part 1, Attachment 6. ARINC 429 Part 1, Section 2.1.5.2 defines the SSM for binary words as follows:

|  |  |  |
| --- | --- | --- |
| **BNR SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Failure Warning |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Normal Operation |

Previous definitions of ARINC 429 labels 233 through 237 provided in ARINC 718 and subsequent documents identified the SSM for both BCD and discrete data. The SSM for these words include information from the following two tables:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BCD SSM (Old)** | | |  | **DISCRETE SSM** | | |
| **BIT** | | **MEANING** | **BIT** | | **MEANING** |
| **30** | **31** | **31** | **30** |
| 0 | 0 | VALID | 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data | 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test | 1 | 0 | Functional Test |
| 1 | 1 | Not Defined | 1 | 1 | Failure Warning |

1. Flight Identification or Aircraft Registration data usage should adhere to the following guidelines:
2. In accordance with the intent of ICAO Annex 10, Volume IV, Section 3.1.2.9, if Flight Identification data (Labels 233 – 237, respectively or Label 360) is available (i.e., proper labels received and SSM is not set to No Computed Data (NCD)) at any time during unit operation, then flight identification data should be inserted into the character subfields of registers 08HEX and 20HEX.
3. If flight identification data is not available (i.e., no labels received or SSM set to NCD) then Aircraft Registration should be inserted into the character subfields of registers 08HEX and 20HEX. On certain airframe configurations Aircraft Registration data may be provided within ARINC 429 Labels 301 – 303.
4. If Extended Squitter is not implemented, then if flight identification data has been entered into registers 08HEX and 20HEX and then becomes not available, then the character subfields of the registers should all be set to “0”.

If Extended Squitter is implemented, then if flight identification data has been entered into register 20HEX and then becomes not available, then the character subfields of the register should be set to “0”.

If Extended Squitter is implemented, then register 08HEX **is not** cleared or ZEROed once either Flight Identification or Aircraft Registration data has been loaded into the register during the power-on cycle. Register 08HEX **is not** cleared, since it provides information that is fundamental to track file management in the ADS-B environment.

More specifically, Extended Squitter implementation of register 08HEX should also consider the following:

* If valid Flight Identification data is available, then the data **should** be used to populate the character subfields in register 08HEX.
* After using Flight Identification data to populate the character subfields in register 08HEX in a given power-on cycle, if Flight Identification data becomes invalid or not available, then the last known valid Flight Identification data **should** be retained and used to continue population of the character subfields in register 08HEX for the duration of the power-on cycle.
* If valid Flight Identification data is not available but valid Aircraft Registration data is available in a given power-on cycle, then the valid Aircraft Registration data **should** be used to populate the character subfields in register 08HEX for the duration of the power-on cycle.
* If register 08HEX has been populated using Aircraft Registration data in a given power-on cycle and valid Flight Identification data becomes available, then the Flight Identification data **should** be used to populate the character subfields of register 08HEX for the remainder of the power-on cycle.
* Once valid Flight Identification data has been used to populate register 08HEX in a given power-on cycle, Aircraft Registration data **should not** be used to populate the character subfields of register 08HEX, even if Flight Identification data becomes invalid or not available during the power-on cycle.

Note that Aircraft Registration data must not be used to fill the character subfields of the registers once flight identification data has been used during the transponder power-on cycle.

1. In all of the above cases, encoding of the character subfields in registers 08HEX and 20HEX should conform to ICAO Annex 10, Volume IV, Section 3.1.2.9 where:

* All characters will be left justified prior to encoding the Character fields.
* Characters will be coded consecutively without intervening SPACE codes.
* Any unused character spaces at the end of the subfield will contain a SPACE character code.
* Any extra characters will be truncated.

1. Aircraft Identification labels 301-303 can be obtained from the Centralized Fault Display System via the CFDIU (Centralized Fault Display Interface Unit) on the aircraft’s maintenance bus. This is typically an ARINC 429 low-speed bus.
2. Although data is shown to be available from the MCP, it is more probable that it will be available from the FCC Control Panel (ARINC 701). In this case, the FCC Control Panel and the MCP are treated as one and the same.
3. The purpose of the MCP/FCU Mode bits in Register 40HEX is to indicate the current phase of flight. The “Status of MCP/FCU Mode Bit” is declared in Bit 48 of Register 40HEX and should be set as follows:

IF no VNAV, Altitude Hold, or Approach Mode information is being provided,

THEN, set Bit 48 to “ZERO”.

IF VNAV, Altitude Hold, or Approach Mode information is being provided,

THEN, set Bit 48 to “ONE”.

Availability and coding of Autopilot Mode Status information varies from aircraft type to aircraft type. Note that the designer should take into account the specific aircraft’s flight systems when encoding these fields. The following logic is an example of how to set BDS 4,0 Mode fields:

a. For the VNAV Mode encoding, the following logic applies:

IF Label 272 (equipment code = 001, FCC) Bit 9 = “1” and Bit 23 = “1” (indicating that Performance sub-Mode is in effect and the VNAV basic mode is in effect, e.g., engaged)

THEN set Register 40HEX VNAV Mode field (Bit 49) to “ACTIVE” (e.g., “1”, indicating that the aircraft is in the VNAV state).

OTHERWISE, set Register 40HEX VNAV Mode field (Bit 49) to “INACTIVE” (e.g., “0”, indicating that the AIRCRAFT is not in the VNAV state).

b. For the ALT HOLD Mode encoding, the following logic applies:

IF Label 273 (equipment code = 001, FCC) Bit 18 = “0” (indicating that Approach Mode is not armed) *AND* Label 272 (equipment code = 001, FCC) Bit 9 = “1” (indicating that the Performance sub-Mode of the VNAV basic Mode is in effect), *AND* Label 272 Bit 23 = “1” (indicating that the VNAV basic mode is in effect, e.g., engaged),

THEN set Register 40HEX ALT HOLD Mode field (Bit 50) to “Active” (e.g., “1”, indicating that the aircraft is in the Alt Hold state).

OTHERWISE, set Register 40HEX Altitude Hold Mode field (Bit 50) to “INACTIVE” (e.g., “0”, indicating that the aircraft C is not in the Altitude Hold state).

c. For the APPROACH Mode encoding, the following logic applies:

IF Label 272 (equipment code = 001, FCC) Bit 9 = “0” (indicating that the Performance sub-Mode of the VNAV basic Mode is not in effect) *AND* Label 273 Bit 18 = “1” (indicating that Approach Mode is Armed)

THEN set Register 40HEX APPROACH Mode field (Bit 51) to “Active” (e.g., “1”, indicating that the aircraft is in the Approach state)

OTHERWISE, set Register 40HEX Approach Mode field (Bit 51) to “INACTIVE” (e.g., “0”, indicating that the aircraft is not in the Approach Mode).

1. To achieve the most satisfactory source of Flight Ident data, the source is more important than the Label that carries the data. Therefore, Flight Ident should be captured using the following priority configuration:

|  |  |  |
| --- | --- | --- |
| **Priority** | **Label** | **Source** |
| 1 | 233-237 | Control Panel |
| 2 | 360 | Control Panel |
| 3 | 233-237 | FMC Gen |
| 4 | 360 | FMC Gen |
| 5 | 233-237 | FMC/GNSS |
| 6 | 360 | FMC/GNSS |
| 7 | 233-237 | IRS/FMS/Data Conc. |
| 8 | 360 | IRS/FMS/Data Conc. |
| 9 | 233-237 | Maintenance Data In |
| 10 | 360 | Maintenance Data In |
| 11 | 301-303 | Maintenance Data In (see Note 13) |

1. The contents and source for Register number 10 Hex are strictly defined in ICAO Doc. 9871 (formerly Annex 10, Volume III, Chapter 5 Appendix and Manual of Mode S Specific Services).
2. The first field of Register 40HEX always contains MCP/FCU Selected Altitude. Likewise, the second field of Register 40HEX always contains FMS Selected Altitude. During normal flight, one of three possible altitude sources may be in use to determine the short term target altitude. These are Aircraft Altitude, MCP/FCU Selected Altitude, or FMS Selected Altitude. Bits 54 through 56 of Register 40HEX are used to indicate which source is being used in accordance with the following:

IF there is no Altitude Source selection information being provided,

THEN Bit 54 should be set to “ZERO”.

IF Altitude Source selection information is deliberately being provided,

THEN Bit 54 should be set to “ONE”.

Next, Bits 55 and 56 are used to indicate which source is being used to establish the short term target altitude in accordance with the following table:

|  |  |
| --- | --- |
| **Bit 55,56** | **Selected Target Altitude Source** |
| 0 0 | Unknown |
| 0 1 | Aircraft Altitude |
| 1 0 | MCP/FCU Selected Altitude |
| 1 1 | FMS Selected Altitude |

1. ADS-B Emitter Category (Aircraft Category information) is provided to the transponder via three discrete input pins on the connector Middle Plug (ARINC 718A-2) or the Bottom Plug (ARINC 718A-1). Encoding of ADS-B Emitter Category information is provided in:
2. Attachment 2A-3, Note 27, for ARINC 718A-1 equipment configurations
3. Attachment 2B-3, Note 27, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
4. Attachment 2C-3, Note 27, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
5. Attachment 2D-3, Note 27, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
6. Attachment 2E-3, Note 27, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
7. The transponder uses the “4096 Ident Code” field to determine the Emergency/Priority Status Coding as shown in the following table:

|  |  |
| --- | --- |
| **4096 Ident Code** | **Emergency/Priority Status Coding** |
| All other codes  7700  7600  7500  N/A | 0 – No Emergency  1 – General Emergency  2 – No Communications  3 – Unlawful Interference  4 - Reserved |

Note that other emergency/priority status code values (e.g., lifeguard/medical emergency, minimum fuel, downed aircraft) are included in RTCA DO-260B and are expected to be encoded on an optional basis.

RTCA DO-260C transponders also use the “4096 Ident Code” with the additional defined codes in the following table:

|  |  |
| --- | --- |
| **4096 Ident Code** | **Emergency/Priority Status Coding** |
| All other codes  7700  7400  N/A  7600  7500  N/A  N/A | 0 – No Emergency  1 – General Emergency  2 – UAS/RPAS – Lost Link  3 – Minimum Fuel  4 – No Communications  5 – Unlawful Interference  6 – Aircraft in Distress – Automatic Activation  7 – Aircraft in Distress – Manual Activation |

Note that other emergency/priority status code values are included in RTCA DO-260C and are expected to be encoded on an optional basis.

1. ARINC 743A-5 Attachment 4-2A defines Label 145 to provide “Horizontal Velocity Figure of Merit” information. If available, Label 145 data can be used to directly establish the NACV encoding. Appendix J of RTCA DO-260B and DO-260C provides acceptable methods for establishing NACV by analysis and test as Horizontal Figure of Merit (HFOM) data is considered to be inappropriate for establishing NACV. The results of the RTCA DO-260B and DO-260C Appendix J test are used to establish the appropriate input strapping of TP-1G as previously provided in:
2. Attachment 2B-3, Note 54, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
3. Attachment 2C-3, Note 54, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
4. Attachment 2D-3, Note 54, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
5. Attachment 2E-3, Note 54, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations.

The final encoding of the NACV subfield in Register 09 Hex and 65 Hex is then established as follows:

|  |  |  |
| --- | --- | --- |
| IF, “Horizontal Velocity Figure of Merit” data (e.g., GNSS Label 145) is available *and* data is Valid, | | |
|  | THEN, establish the NACV subfield encoding based on the “Horizontal Velocity Figure of Merit” data in accordance with the table previously provided in Attachment 2B-3 Note 54 and Attachment 2C-3 Note 54 | |
| OTHERWISE, proceed as follows: | | |
|  | IF, Fine Latitude and Longitude data (e.g., GNSS Label 120 and 121 or Hybrid Label 256 and 257) are available and data is Valid, | |
|  |  | THEN, set the encoding of the NACV subfield in accordance with the encoding indicated by the strapping of TP-1G as per Attachment 2B-3 Note 54 and Attachment 2C-3 Note 54 |
| OTHERWISE, set the NACV subfield encoding to ZERO | | |

1. Registers E3 through E6:

These registers provided hardware and software part numbers for TCAS and the Transponder. These registers have been added as they now appear in ICAO Doc. 9871 (formerly Annex 10, Volume III, Chapter 5 Appendix and Manual of Mode S Specific Services).

1. UTC Time (Label 150) is needed to support the ability to establish the proper distribution of “even” and “odd” 200 millisecond sub-epochs over a two second period for “even” and “odd” CPR encoding.

UTC FINE Time (Label 140) is needed to support the ability to synchronize the UTC Epoch with the GNSS Time Tag as discussed in RTCA DO-260B Appendix “S”.

1. The “SIL Supplement” register field is used to indicate whether the reported SIL probability is based on a “per hour” probability or a “per sample” probability in accordance with the following table.

|  |  |
| --- | --- |
| **SIL SUPPLEMENT ENCODING** | |
| **Bit 8** | **SIL Supplement Meaning** |
| 0 | Probability of exceeding NIC radius of containment is based on “per hour” |
| 1 | Probability of exceeding NIC radius of containment is based on “per sample” |

The “SIL Supplement” is associated with the “Source Integrity Level (SIL)” which is provided in bits 51, 52 of Register 65HEX, Aircraft Operational Status Message and in bits 45, 46 of Register 62HEX, Target State and Status Message. “SIL” is encoded as shown in the following table:

|  |  |  |
| --- | --- | --- |
| **SOURCE INTEGRITY LEVEL (SIL) ENCODING** | | |
| **Register 62HEX**  **Bit 45,46** | **Register 65HEX**  **Bit 51,52** | **Source Integrity Level (SIL) Meaning** |
| 0 0 | 0 0 | Unknown or > 1 x 10-3 per flight hour or per sample |
| 0 1 | 0 1 | < 1 x 10-3 per flight hour or per sample |
| 1 0 | 1 0 | < 1 x 10-5 per flight hour or per sample |
| 1 1 | 1 1 | < 1 x 10-7 per flight hour or per sample |

In general, GPS based systems are based on “per hour”.

Likewise, GNSS/IRS systems are expected to be based on “per hour”.

Taking into consideration current GPS systems, future Hybrid GNSS/IRS systems, and FMS Systems with DME/DME Navigation capability, this Characteristic proposes that the following algorithm be implemented to establish setting of the “SIL Supplement” and “SIL”.

|  |  |
| --- | --- |
| IF Fine Latitude (Label 120) and Fine Longitude (Label 121) are available from the GPS source, | |
|  | THEN set “SIL” = “3” and “SIL Supplement” = “0”, e.g., per hour. |
| IF Hybrid Labels are available from the Hybrid source, | |
|  | THEN set “SIL” = “3” and “SIL Supplement” = “0”, e.g., per hour. |
| IF FMS is providing the Navigation information and the FMS is operating in at least a DME/DME navigation mode, | |
|  | THEN set “SIL” = “2” and “SIL Supplement” = “1”, e.g., per sample. |
| OTHERWISE, set “SIL” = “0” and “SIL Supplement” = “1” | |

In general, most existing FMS systems do not provide information regarding the current mode of navigation. It is expected that in the future FMS systems will need to provide current mode of navigation information in order to be useful sources of ADS-B data.

1. The “Selected Altitude Type” register field is used to indicate the source of Selected Altitude data that is being used to encode bits 10 through 20 of Register 62HEX. Encoding of the “Selected Altitude Type” register field is in accordance with the following table:

|  |  |
| --- | --- |
| **SELECTED ALTITUDE TYPE ENCODING** | |
| **Bit 9** | **Selected Altitude Type Meaning** |
| 0 | Data being used to encode bits 10 through 20 of Register 62HEX is derived from the Mode Control Panel/Flight Control Unit (MCP/FCU) or equivalent equipment. |
| 1 | Data being used to encode bits 10 through 20 of Register 62HEX is derived from the Flight Management System (FMS). |
| Note: Whenever there is no valid MCP/FCU or FMS Selected Altitude data available, then the “Selected Altitude Type” is set to ZERO (0*).* | |

1. The “MCP/FCU Selected Altitude *or* FMS Selected Altitude” register field is used to report or provide data from the appropriate Selected Altitude source as follows:

|  |  |
| --- | --- |
| IF Selected Altitude data is available from the Mode Control Panel/Flight Control Unit (MCP/FCU) or equivalent equipment, | |
|  | THEN such MCP/FCU Selected Altitude data shall be used to encode bits 10 through 20 of Register 62HEX. |
| IF Selected Altitude data is NOT available from the MCP/FCU or equivalent equipment, but Selected Altitude data is available from the Flight Management System (FMS), | |
|  | THEN FMS Selected Altitude data shall be used to encode bits 10 through 20 of Register 62HEX. |
| IF Selected Altitude data is NOT available from either the MCP/FCU or equivalent equipment and is NOT available from the FMS, | |
|  | THEN bits 10 through 20 of Register 62HEX shall be set to all ZERO (0). |

Note: Users of this data are cautioned that the selected altitude value transmitted by the ADS-B Transmitting Subsystem does not necessarily reflect the true intention of the airplane during certain flight modes (e.g., during certain VNAV or Approach modes), and *does* not necessarily correspond to the target altitude (the next altitude level at which the aircraft will level off).

In addition, on many airplanes, the ADS-B Transmitting Subsystem does not receive selected altitude data from the FMS and will only transmit Selected Altitude data received from a Mode Control Panel/Flight Control Unit (MCP/FCU).

1. The “Barometric Pressure Setting” register field is used to report Barometric Pressure Setting data that has been adjusted by subtracting 800 millibars from the data received from the Barometric Pressure Setting source.

Note that Barometric Pressure Setting data can be used to represent QFE or QNH/QNE, depending on local procedures. It represents the current value being used to fly the aircraft.

Some installations provide input capability for Baro Correction (mb) #1 (Label 234) and Baro Correction (mb) #2 (Label 236). In such cases, Baro Correction (mb) #1 (Label 234) is associated with Air Data System #1 and Baro Correction (mb) #2 (Label 236) is associated with Air Data System #2. When the transponder is using Air Data System #1 for altitude reporting, then Baro Correction (mb) #1 (Label 234) should be used for reporting of Baro Correction information. Likewise, when the transponder is using Air Data System #2 for altitude reporting, then Baro Correction (mb) #2 (Label 236) should be used for reporting of Baro Correction information.

1. The “Selected Heading Status” register field (bit 30) is used to indicate the status of the Selected Heading information provide in bits 32 through 39 of Register 62HEX. “Selected Heading Status” is encoded in accordance with the following table:

|  |  |
| --- | --- |
| **SELECTED HEADING STATUS ENCODING** | |
| **Bit 30** | **Selected Heading Status Meaning** |
| 0 | Data being used to encode bits 32 through 39 of Register 62HEX is either NOT Available or is INVALID. |
| 1 | Data being used to encode bits 10 through 20 of Register 62HEX is Available and is VALID. |

The “Selected Heading Sign” register field (bit 31) is used to indicate the arithmetic sign of the Selected Heading information provide in bits 32 through 39 of Register 62HEX. “Selected Heading Sign” is encoded in accordance with the following table:

|  |  |
| --- | --- |
| **SELECTED HEADING SIGN ENCODING** | |
| **Bit 31** | **Selected Heading Sign Meaning** |
| 0 | Data being used to encode bits 32 through 39 of Register 62HEX is Positive in an angular system having a range between +180 and -180 degrees. (For an Angular Weighted Binary system which ranges from 0.0 to 360 degrees, the sign bit is positive or Zero for all values that are less than 180 degrees). |
| 1 | Data being used to encode bits 32 through 39 of Register 62HEX is Negative in an angular system having a range between +180 and -180 degrees. (For an Angular Weighted Binary system which ranges from 0.0 to 360 degrees, the sign bit is ONE for all values that are equal to are greater than 180 degrees). |

The “Selected Heading Status, Sign, and Data” register fields are encoded in accordance with the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **SELECTED HEADING STATUS/SIGN/DATA ENCODING** | | | |
| **Bit 30** | **Bit 31** | **Bits 32 ------ 39** | **Selected Heading Meaning** |
| **Status** | **Sign** | **Data** |
| 0 | 0 | 0000 0000 | NO Data *or* INVALID Data |
| 1 | 0 | 0000 0000 | 0.0 degrees |
| 1 | 0 | 0000 0001 | 0.703125 degrees |
| 1 | 0 | 0000 0010 | 1.406250 degrees |
| \* | \* | \*\*\*\* \*\*\*\* | \*\*\*\* \*\*\*\* \*\*\*\* |
| 1 | 0 | 1111 1111 | 179.296875 degrees |
| 1 | 1 | 0000 0000 | 180.0 *or* -180.0 degrees |
| 1 | 1 | 0000 0001 | 180.703125 *or* -179.296875 degrees |
| 1 | 1 | 0000 0010 | 181.406250 *or* -178.593750 degrees |
| \* | \* | \*\*\*\* \*\*\*\* | \*\*\*\* \*\*\*\* \*\*\*\* |
| 1 | 1 | 1000 0000 | 270.000 *or* -90.000 degrees |
| 1 | 1 | 1000 0001 | 270.703125 *or* -89.296875 degrees |
| 1 | 1 | 1000 0010 | 271.406250 *or* -88.593750 degrees |
| \* | \* | \*\*\*\* \*\*\*\* | \*\*\*\* \*\*\*\* \*\*\*\* |
| 1 | 1 | 1111 1110 | 358.593750 *or* -1.4062500 degrees |
| 1 | 1 | 1111 1111 | 359.296875 *or* -0.7031250 degrees |

Note: On many airplanes, the ADS-B Transmitting Subsystem receives Selected Heading from a Mode Control Panel/Flight Control Unit (MCP/FCU). Users of this data are cautioned that the Selected Heading value transmitted by the ADS-B Transmission Subsystem does not necessarily reflect the true intention of the airplane during certain flight modes (e.g., during LNAV mode).

1. The “Navigation Accuracy Category\_Position (NACP)” register field indicates the 95% accuracy limits for the horizontal position that is being currently broadcast in airborne position and surface position messages. The NACP subfield is encoded based on HFOM data in accordance with the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Navigation Accuracy Category for Position (NACP) Encoding** | | | | |
| **Coding** | | **95% Horizontal Accuracy Bounds**  **(EPU)** | **Comments** | **Notes** |
| **(Binary)** | **(Decimal)** |
| 0000 | 0 | EPU > 18.52 km (10 NM) | Unknown Accuracy | 1 |
| 0001 | 1 | EPU < 18.52 km (10 NM) | RNP-10 accuracy | 1, 3 |
| 0010 | 2 | EPU < 7.408 km (4 NM) | RNP-4 accuracy | 1, 3 |
| 0011 | 3 | EPU < 3.704 km (2 NM) | RNP-2 accuracy | 1, 3 |
| 0100 | 4 | EPU < 1852 m (1 NM) | RNP-1 accuracy | 1, 3 |
| 0101 | 5 | EPU < 926 m (0.5 NM) | RNP-0.5 accuracy | 1, 3 |
| 0110 | 6 | EPU < 555.6 m (0.3 NM) | RNP-0.3 accuracy | 1, 3 |
| 0111 | 7 | EPU < 185.2 m (0.1 NM) | RNP-0.1 accuracy | 1, 3 |
| 1000 | 8 | EPU < 92.6 m (0.05 NM) | e.g., GPS (with SA on) | 1 |
| 1001 | 9 | EPU < 30 m | e.g., GPS (SA off) | 1, 2, 4 |
| 1010 | 10 | EPU < 10 m | e.g., WAAS | 1, 2, 4 |
| 1011 | 11 | EPU < 3 m | e.g., LAAS | 1, 2, 4 |
| 1100 – 1111 | 12 - 15 | Reserved |  |  |
| Table Notes:  1. The Estimated Position Uncertainty (EPU) used in the table is a 95% accuracy bound on horizontal position. EPU is defined as the radius of a circle, centered on the reported position, such that the probability of the actual position lying outside the circle is 0.05. When reported by a GPS or GNSS system, EPU is commonly called HFOM (Horizontal Figure of Merit).  2. RNP accuracy includes error sources other than sensor error, whereas horizontal error for NACP only refers to horizontal position error uncertainty.  3. A non-excluded satellite failure requires that the NACP and NACV parameters be set to ZERO along with RC being set to Unknown to indicate that the position accuracy and integrity have been determined to be invalid. Factors such as surface multi-path, which has been observed to cause intermittent setting of Label 130 Bit 11, should be taken into account by the ADS-B application and ATC. | | | | |

1. The “Navigation Integrity Category\_Baro (NICBARO)” register field indicates whether or not the barometric pressure altitude being reported in the Airborne Position Message has been cross-checked against another source of pressure altitude. NICBARO is encoded in accordance with the following table:

|  |  |
| --- | --- |
| **NICBARO Subfield Encoding** | |
| **Coding** | **Meaning** |
| 0 | The barometric altitude that is being reported in the Airborne Position Message is based on a Gillham coded input that has not been cross-checked against another source of pressure altitude. |
| 1 | The barometric altitude that is being reported in the Airborne Position message is either based on a Gillham code input that has been cross-checked against another source of pressure altitude and verified as being consistent, or is based on a non-Gillham coded source. |
| Table Notes:  1. The NIC value itself is conveyed within the ADS-B Position Message.  2. The NICBARO subfield provides a method of indicating a level of data integrity for aircraft installed with Gillham encoding barometric altitude sources. Because of the potential of an undetected error when using a Gillham encoded altitude source, a comparison will be performed with a second source and only if the two sources agree will the NICBARO subfield be set to a value of ONE (1). For other barometric altitude sources (Synchro or DADS) the integrity of the data is indicated with a validity flag or SSM (e.g., as in Label 203). No additional checks or comparisons are necessary. For these sources, the NICBARO subfield will be set to a value of ONE (1) whenever the barometric altitude is valid.  3. The use of Gillham type altimeters is strongly discouraged because of the potential for undetected altitude errors. | |

1. The “Source Integrity Level (SIL)” register field is used to define the probability of the reported horizontal position exceeding the radius of containment defined by the NIC, without alerting, assuming no avionics faults. Encoding requirements for the “SIL” register field were previously discussed in Note 25 of this Attachment.
2. The purpose of the MCP/FCU Mode bits in Register 62HEX is to indicate the current phase of flight. The “Status of MCP/FCU Mode Bit” is declared in Bit 47 or Register 62HEX and should be set as follows:

IF no Autopilot Engaged, VNAV, Altitude Hold, Approach Mode or LNAV Mode Engaged information is being provided,

THEN, set Bit 47 to “ZERO”.

IF Autopilot Engaged, VNAV, Altitude Hold, Approach Mode or LNAV Mode Engaged information is being provided,

THEN, set Bit 47 to “ONE”.

Availability and coding of Autopilot Mode Status information varies from aircraft type to aircraft type. Note that the designer should take into account the specific aircraft’s flight systems when encoding these fields. The following logic is an example of how to set BDS 6,2 Mode fields:

a. For the Autopilot Engaged encoding, the following logic applies:

IF appropriate information is available to indicate than an Autopilot System is actively engaged and controlling the aircraft flight profile,

THEN set Register 62HEX Autopilot Engaged Mode field (Bit 48) to “ACTIVE” (e.g., “1”, indicating that an Autopilot System is actively engaged and controlling the aircraft flight profile).

OTHERWISE, set Register 62HEX Autopilot Engaged Mode field (Bit 48) to “INACTIVE” (e.g., “0”, indicating that there is no current actively engaged Autopilot System.

Note: Typically, status of the autopilot being engaged or not engaged can be established based on the Label 272 (equipment code = 001, FCC) FCC Automatic Throttle Modes Discrete Word. (See ARINC-429, Part 2-16).

b. For the VNAV Mode encoding, the following logic applies:

IF Label 273 (equipment code = 001, FCC) Bit 15 = “1” (indicating that VNAV is ARMED)

THEN set Register 62HEX VNAV Mode field (Bit 49) to “ACTIVE” (e.g., “1”, indicating that the aircraft is in the VNAV state).

OTHERWISE, set Register 62HEX VNAV Mode field (Bit 49) to “INACTIVE” (e.g., “0”, indicating that the aircraft is not in the VNAV state).

c. For the ALT HOLD Mode encoding, the following logic applies:

IF Label 273 (equipment code = 001, FCC) Bit 18 = “0” (indicating that Approach Mode is not armed) *AND* Label 272 (equipment code = 001, FCC) Bit 9 = “1” (indicating that the Performance sub-Mode of the VNAV basic Mode is in effect), *AND* Label 272 Bit 23 = “1” (indicating that the VNAV basic mode is in effect, e.g., engaged),

THEN set Register 62HEX ALT HOLD Mode field (Bit 50) to “Active” (e.g., “1”, indicating that the aircraft is in the Alt Hold state).

OTHERWISE, set Register 62HEX Altitude Hold Mode field (Bit 50) to “INACTIVE” (e.g., “0”, indicating that the aircraft is not in the Altitude Hold state).

d. For the APPROACH Mode encoding, the following logic applies:

IF Label 272 (equipment code = 001, FCC) Bit 9 = “0” (indicating that the Performance sub-Mode of the VNAV basic Mode is not in effect) *AND* Label 273 Bit 18 = “1” (indicating that Approach Mode is Armed)

THEN set Register 62HEX APPROACH Mode field (Bit 52) to “Active” (e.g., “1”, indicating that the aircraft is in the Approach state)

OTHERWISE, set Register 62HEX Approach Mode field (Bit 52) to “INACTIVE” (e.g., “0”, indicating that the aircraft is not in the Approach Mode).

e. For the LNAV Engaged Mode encoding, the following logic applies:

IF Label 273 (equipment code = 001, FCC) Bit 14 = “1” (indicating that lateral navigation submode of the FMS is armed) *AND* Label 275 (equipment code = 001, FCC) Bit 11 = “1” (indicating that Lateral Navigation is selected),

THEN set Register 62HEX APPROACH Mode field (Bit 54) to “Active” (e.g., “1”, indicating that the LNAV mode is ACTIVE)

OTHERWISE, set Register 62HEX Approach Mode field (Bit 54) to “INACTIVE” (e.g., “0”, indicating that the aircraft is not in LNAV mode).

1. For the TCAS Operational Mode encoding the following logic applies:

IF Label 274 (equipment code = 035, TCAS) Bit 26 through 29 = “3 or 4” (0011 or 0100 with bit 26 being the MSB) (indicating that TCAS is operating in either the TA/RA Mode or TCAS IV),

THEN set Register 62HEX TCAS Operational field (Bit 53) to “Active” (e.g., “1”, indicating that TCAS is Operational)

OTHERWISE, set Register 62HEX TCAS Operational field (Bit 53) to “INACTIVE” (e.g., “0”. indicating that TCAS is NOT Operational).

1. For the Airborne Aircraft Operational Status Capability Class TCAS Operational Mode encoding the following logic applies:

IF Label 274 (equipment code = 035, TCAS) Bit 26 through 29 = “3 or 4” (0011 or 0100 with bit 26 being the MSB) (indicating that TCAS is operating in either the TA/RA Mode or TCAS IV),

THEN set Register 65HEX TCAS Operational field (Bit 11) to “Active” (e.g., “1”, indicating that TCAS is Operational)

OTHERWISE, set Register 65HEX TCAS Operational field (Bit 11) to “INACTIVE” (e.g., “0”. indicating that TCAS is NOT Operational).

1. The Airborne Aircraft Operational Status Capability Class 1090 ES IN field (Bit 12) of Register 65HEX encoding is established based on the state of strobed input discrete MP-4H in accordance with:
   1. Attachment 2B-3, Note 65, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 65, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 65, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 65, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
2. The Airborne Aircraft Operational Status Capability Class UAT IN field (Bit 19) of Register 65HEX encoding is established based on the state of strobed input discrete MP-4H in accordance with:
   1. Attachment 2B-3, Note 65, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 65, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 65, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 65, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
3. The Airborne Aircraft Operational Status Operational Mode System Design Assurance field (Bit 31 – 32) of Register 65HEX encoding is established based on the state of the strobed input discrete (TP-1H) in accordance with:
   1. Attachment 2B-3, Note 55, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 55, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 55, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 55, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
4. The Surface Aircraft Operational Status Capability Class 1090 ES IN field (Bit 12) of Register 65HEX encoding is established based on the state of strobed input discrete MP-4H in accordance with:
   1. Attachment 2B-3, Note 65, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 65, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 65, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 65, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
5. The Surface Aircraft Operational Status Capability Class UAT IN field (Bit 16) of Register 65HEX encoding is established based on the state of strobed input discrete MP-4H in accordance with:
   1. Attachment 2B-3, Note 65, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 65, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 65, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 65, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
6. The Surface Aircraft Operational Status Capability Class “NACV” field (Bit 17 – 19) of Register 65 encoding is equivalent to the encoding previously referenced in Note 22 of this Attachment.
7. The “NIC Supplement-C” is a one-bit (“ME” bit 20) subfield in the Surface Aircraft Operational Status Message Capability Class and is function of the Horizontal Integrity Limit data previously identified for the Type field encoding in Note 2.
8. The “Aircraft/Vehicle Length and Width Code” is a four-bit (“ME” bits 21 – 24) Capability Class Subfield in the Surface Aircraft Operational Status Message which has an encoding based on discrete inputs TP-1A, TP-1B, and TP-1C in accordance with:
   1. Attachment 2B-3, Note 52, for ARINC 718A-3, Minimum Subset, Single-Sided configurations, and
   2. Attachment 2C-3, Note 52, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 52, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 52, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
9. The Surface Aircraft Operational Status Operational Mode System Design Assurance field (Bit 31 – 32) of Register 65HEX encoding is established based on the state of the strobed input discrete (TP-2J) in accordance with:
   1. Attachment 2B-3, Note 55, for ARINC 718A-3, Minimum Subset, Single-Sided configurations
   2. Attachment 2C-3, Note 55, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
   3. Attachment 2D-3, Note 55, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
   4. Attachment 2E-3, Note 55, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
10. The “GPS Antenna Offset” is an eight-bit (“ME” bits 33 – 40) Operational Mode Subfield in the Surface Aircraft Operational Status Message. The subfield is further divided into a lateral offset subfield and a longitudinal offset subfield. The lateral offset subfield is provided in “ME” bits 33 – 35 and is set to ALL ZERO in ARINC 718A-3 implementations. The longitudinal offset subfield is provided in “ME” bits 36 – 40 and is encoded based on discrete inputs TP-1D, TP-1E, and TP-1F in accordance with:
    1. Attachment 2B-3, Note 53, for ARINC 718A-3, Minimum Subset, Single-Sided configurations, and
    2. Attachment 2C-3, Note 53, for ARINC 718A-3, Minimum TIF, Double-Sided configurations
    3. Attachment 2D-3, Note 53, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations
    4. Attachment 2E-3, Note 53, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations
11. The “NIC Supplement-A” is a one-bit (“ME” bit 44) subfield in the Aircraft Operational Status Messages and is function of the Horizontal Integrity Limit data previously identified for the Type field encoding in Note 2.
12. The “Navigation Accuracy Category for Position (NACP)” subfield is a four-bit subfield (“ME” bits 45 – 48) provided in the Aircraft Operational Status Messages and is encoded as previously discussed in Note 30 of this Attachment.
13. The “Geometric Vertical Accuracy (GVA)” subfield is a two-bit subfield (“ME” bits 49 – 50) provided in the Aircraft Operational Status Messages and is encoded in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| **Geometric Vertical Accuracy (GVA) Subfield Encoding** | | |
| **GVA Encoding** | | **Meaning (meters)** |
| **(binary)** | **(decimal)** |
| **0 0** | **0** | **Unknown or > 150 meters** |
| **0 1** | **1** | **< 150 meters** |
| **1 0** | **2** | **< 45 meters** |
| **1 1** | **3** | **Reserved** |

1. The “Source Integrity Level (SIL)” subfield is a two-bit subfield (“ME” bits 51 – 52) provided in the Aircraft Operational Status Messages and is encoded as previously discussed in Note 25 of this Attachment.
2. The “Barometric Altitude Integrity Code (NICBARO)” subfield is a one-bit subfield (“ME” bit 53) provided in the Airborne Aircraft Operational Status Messages and is encoded as previously discussed in Note 31 of this Attachment.
3. The “Track Angle/Heading” subfield is a one-bit (“ME” bit 53) provided in the Surface Aircraft Operational Status Messages and is used to indicate whether Heading or Track Angle information is being provided in the Surface Position Messages. Encoding of the “Track Angle/Heading” subfield is in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| **Track Angle/Heading Subfield Encoding** | | |
| **Encoding** | | **Meaning** |
| **(binary)** | **(decimal)** |
| **0** | **0** | **Track Angle** |
| **1** | **1** | **Heading** |

1. The “Horizontal Reference Direction (HRD)” subfield is a one-bit (“ME” bit 54) provided in the Aircraft Operational Status Messages and is used to indicate Magnetic North or True North is being used for horizontal directions such as Heading and Track Angle. Encoding of the “Horizontal Reference Direction (HRD)” is in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| **Horizontal Reference Direction (HRD) Subfield Encoding** | | |
| **Encoding** | | **Meaning** |
| **(binary)** | **(decimal)** |
| 0 | 0 | True North |
| 1 | 1 | Magnetic North |

1. The “SIL Supplement” subfield is a one-bit (“ME” bit 55) provided in the Aircraft Operational Status Messages and is used to indicate whether the reported SIL probability is based on a “per hour” or a “per sample” probability. Encoding of the “SIL Supplement” was previously discussed in Note 25 above.
2. Register 5FHEX Update:

Register 5FHEX was updated in ARINC 718A Supplement 3 to reflect the latest ICAO DOC. No. 9871 definitions. Previously, the register contained entries for Selected Heading, Selected Airspeed, Selected Mach, Selected Altitude Rate, and Selected Flight Path Angle. These entries have all been deleted from ICAO DOC. No. 9871. FMS Selected Altitude and Barometric Pressure Setting entries were added to the Register 5FHEX list since these parameters were added to ICAO DOC. No. 9871.

1. Register 65HEX, “Receiving ATC Services” Subfield:

The “Receiving ATC Services” subfield in Register 65HEX is reserved for future ADS-B versions where the ADS-B Transmit Subsystem may be receiving ATC Services as indicated by an update having been received via an appropriate interface on board the transmitting aircraft within the past 2 seconds. Otherwise, for the RTCA DO-260B and earlier versions of the MOPs, the “Receiving ATC Services” subfield is set to ZERO.

1. Register 65HEX, “ARV” Subfield:

The “ARV” subfield in Register 65HEX is set to ONE (1) if the aircraft is capable of providing data for the transmission of Airborne Velocity Message Subtype 3 and 4. Otherwise, the “ARV” subfield is set to ZERO (0).

1. Register 65HEX, “TS” Subfield:

The “TS” subfield in Register 65HEX is set to ONE (1) if the ADS-B Transmit subsystem installation has the capability to support sending messages that support Target State Reports. Otherwise, the “TS” subfield is set to ZERO (0).

RTCA DO-260B Table 2-3 establishes that this capability means the capability to send Target State and Status messages, e.g., Register 62HEX. Therefore, if the ADS-B Transmit subsystem installation has the capability to send Target State and Status messages (e.g., Register 62HEX), then the “TS” subfield should be set to (1). Otherwise, the “TS” subfield is set to ZERO (0).

1. Register 65HEX, “TC” Subfield:

The “TC” subfield in Register 65 Hex is set to ONE (1) if the ADS-B Transmit subsystem installation has the capability to support sending messages that support Trajectory Change Reports. For RTCA DO-260B compliant ADS-B Transmit subsystems, the “TC” subfield is set to ZERO (0) in accordance with RTCA DO-260B Section 2.2.3.2.7.2.3.6.

1. Register 05HEX and 06HEX, Latitude/Longitude Usage and Estimation/Extrapolation:

The Tables provided in Attachment 3A were first established in this standard. At that time, industry consensus was that any valid position data would be better than having no data. Therefore, non-GPS based position data was provided for the Encoded Latitude and Longitude subfields. Likewise, multiple non-GPS based parameters were provided as Latitude/Longitude Estimation/Extrapolation Parameters. Under special conditions, it may still be acceptable to use these parameters to establish position data: However, in those areas where the airspace requires that the position data be of established integrity, it may not be acceptable to use these parameters to establish position data. Therefore, implementers are advised that the parameters that are associated with this Note and highlighted in “yellow” may not be sufficient to satisfy Automatic Dependent Surveillance Broadcast-Out (ADS-B Out) requirements.

1. Register Changes Specific to Version 3 Transponders; DO-181F, ED-73F, DO-260C, ED-102B.
2. The “Aircraft Configuration” is a 4-bit (“ME” bits 8 – 11) Subfield in the ADS-B Weather Aircraft State Messages (AIREP). Encoding of the “Aircraft Configuration” is in accordance with the following table:

|  |  |  |
| --- | --- | --- |
| **Coding** | | **Meaning** |
| **(Binary)** | **(Decimal)** |
| 0000 | 0 | Configuration Undefined OR Invalid |
| 0001 | 1 | Slats/Flaps Retracted AND Landing Gear Retracted |
| 0010 | 2 | Low Slat/Flap Extension Range AND Landing Gear Retracted |
| 0011 | 3 | Reserved |
| 0100 | 4 | Medium Slat/Flap Extension Range AND Landing Gear Retracted |
| 0101 | 5 | Reserved |
| 0110 | 6 | High Slat/Flap Extension Range AND Landing Gear Retracted |
| 0111 | 7 | Slat/Flap Extension not Reportable AND Landing Gear Retracted |
| 1000 | 8 | Reserved |
| 1001 | 9 | Slats/Flaps Retracted AND Landing Gear Extended OR Fixed |
| 1010 | 10 | Low Slat/Flap Extension Range AND Landing Gear Extended OR Fixed |
| 1011 | 11 | Reserved |
| 1100 | 12 | Medium Slat/Flap Extension Range AND Landing Gear Extended OR Fixed |
| 1101 | 13 | Reserved |
| 1110 | 14 | High Slat/Flap Extension Range AND Landing Gear Extended OR Fixed |
| 1111 | 15 | Slat/Flap Extension Not Reportable AND Landing Gear Extended OR Fixed |

1. The “Aircraft Type” is a 24-bit (“ME” bits 12 – 35) Subfield in the ADS-B Weather Aircraft State Messages (AIREP) based on the strobed discrete inputs TP-4A, TP-4B, TP-4C, TP-4D, TP-4E, TP-4F, and TP-4J in accordance with:

Attachment 2D-3, Note 53, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations

Attachment 2E-3, Note 53, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations

1. The “Gross Weight” is a 12-bit (“ME” bits 36 – 47) Subfield in the ADS-B Weather Aircraft State Messages (AIREP) based on the strobed discrete inputs MP-7A, MP-7B, MP-7C, and MP-7D in accordance with:

Attachment 2D-3, Note 53, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations

Attachment 2E-3, Note 53, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations

1. The “Wingspan” is an 8-bit (“ME” bits 48 – 55) Subfield in the ADS-B Weather Aircraft State Messages (AIREP) based on the strobed discrete inputs BP-5, BP-6, and BP-9 in accordance with:

Attachment 2D-3, Note 53, for ARINC 718A-5, Minimum Subset, Single-Sided for DO-260C and ED-102B configurations

Attachment 2E-3, Note 53, for ARINC 718A-5, Minimum TIF, Double-Sided for DO-260C and ED-102B configurations

1. B ARINC 429 OUTPUT DATA

Data outputs are identified in Attachment 3B. The data available on the output buses listed below may be used to support Transponder interfaces with other aircraft systems, such as TCAS/ACAS, ATSU or data loaders.

Table 3B-1 – ARINC 429 HS General Output Bus

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Label** | **Parameter** | **Probable Sink** | **Signal Format** | **Data Rate**  **(Msec)** | **Notes** |
| 013 | TCAS Display Control |  | DISC | 800 – 1200 | 1 |
| 015 | Display Altitude Limits |  | DISC | 800 – 1200 | 1 |
| 016 | TCAS/ATC Control |  | DISC | 800 – 1200 | 1 |
| 031 | ATCRBS Control |  | DISC | 800 – 1200 | 1 |
| 203 | Altitude |  | BNR | 100 – 300 |  |
| 204 | Baro Corrected Altitude |  | BNR | 100 – 300 | 1 |
| 226 | Data Loader Output | Data Loader | DISC | \* | 2, 4 |
| 233 | Flight ID (Characters 1,2) |  | BNR/BCD | 800 – 5000 | 1,3 |
| 234 | Flight ID (Characters 3,4) |  | BNR/BCD | 800 – 5000 | 1,3 |
| 235 | Flight ID (Characters 5,6) |  | BNR/BCD | 800 – 5000 | 1,3 |
| 236 | Flight ID (Characters 7,8) |  | BNR/BCD | 800 – 5000 | 1,3 |
| 237 | Flight ID (Characters 9,10) |  | BNR/BCD | 800 – 5000 | 1,3 |
| 275 | Mode S Address (Part 1) |  | DISC | 100 – 1200 |  |
| 276 | Mode S Address (Part 2) |  | DISC | 100 – 1200 |  |

**Notes:**

\* Asynchronous transmission

1. This Label is transmitted only if the Transponder is receiving this Label from another source. The Transponder should echo the contents of the Label exactly as it is received.
2. The transmission of this Label is optional.
3. SSM format of the Label (BNR vs. BCD) transmitted by the Transponder should match the SSM of the Label received by the Transponder.
4. See ARINC Report 615 for complete definitions for input and output between the Mark 4 transponder and the data loader.

Table 3B-2 – MSP/ATSU/CMU ARINC 429 HS Output Bus

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Label** | **Parameter** | **Probable Sink** | **Signal Format** | **Data Rate**  **(Msec)** | **Notes** |
| 013 | TCAS Display Control |  | DISC | 800 – 1200 | 1,2 |
| 015 | Display Altitude Limits |  | DISC | 800 – 1200 | 1,2 |
| 016 | TCAS/ATC Control |  | DISC | 800 – 1200 | 1,2 |
| 031 | ATCRBS Control |  | DISC | 800 – 1200 | 1,2 |
| 172 | Subsystem Identifier | ATSU |  | 800 – 1200 |  |
| 203 | Altitude |  | BNR | 100 – 300 | 2 |
| 204 | Baro Corrected Altitude |  | BNR | 100 – 300 | 1,2 |
| 233 | Flight ID (Characters 1,2) |  | BNR/BCD | 800 – 5000 | 1,2,4 |
| 234 | Flight ID (Characters 3,4) |  | BND/BCD | 800 – 5000 | 1,2,4 |
| 235 | Flight ID (Characters 5,6) |  | BNR/BCD | 800 – 5000 | 1,2,4 |
| 236 | Flight ID (Characters 7,8) |  | BNR/BCD | 800 – 5000 | 1,2,4 |
| 237 | Flight ID (Characters 9,10) |  | BNR/BCD | 800 – 5000 | 1,2,4 |
| 270 | Transponder Status | ATSU | DISC | 800 – 1200 |  |
| 275 | Mode S Address (Part 1) | ATSU | DISC | 100 – 200 |  |
| 276 | Mode S Address (Part 2) | ATSU | DISC | 100 – 200 |  |
| 304 | ATSU Message | ATSU |  | \* | 2, 3 |
| 377 | Transponder Equip. Code | ATSU | BCD | 800 – 1200 |  |

Table 3B-3 – Mark 4 Transponder Outputs to TCAS/ACAS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER** | **LABEL** | **Interval** | | **Probable** | **Data Type** | | | **NOTE** |
| **MIN.** | **MAX.** | **SINK** | **BNR** | **BCD** | **DISC** |
| Display Control | 013 |  |  | TCAS/ACAS |  |  | X | 5,6 |
| Control | 015 |  |  | TCAS/ACAS |  |  | X | 5,6 |
| Control | 016 |  |  | TCAS/ACAS |  |  | X | 5,6 |
| Altitude | 203 | 31.25 ms | 62.5 ms | TCAS/ACAS | X |  |  | 6 |
| Altitude | 204 |  |  | TCAS/ACAS | X |  |  | 6,2 |
| Airspeed | 210 |  |  | TCAS/ACAS | X |  |  | 6,2 |
| Altitude Rate | 212 |  |  | TCAS/ACAS | X |  |  | 6,2 |
| XPDR to ACAS  Communication and  ACK/NAK | 27X | Periodic:  100 ms | Periodic:  200 ms | TCAS/ACAS |  |  | X | 6 |
| Non-periodic: See Note 6. | |  |  |  |  |
| Maintenance Word | 350 | 100 ms | 500 ms | TCAS/ACAS |  |  | X | 6 |
| Maintenance Word | 354 | 100 ms | 500 ms | TCAS/ACAS |  |  | X | 11 |

Table 3B-4 – Mark 4 Transponder Outputs to Maintenance Computer

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER** | **LABEL** | **Interval** | | **Probable** | **Data Type** | | | **NOTE** |
| **MIN.** | **MAX.** | **SINK** | **BNR** | **BCD** | **DISC** |
| Maintenance Word | 350 | 100 ms | 500 ms | Maintenance Computer |  |  | X | 10, 11 |
| ARINC Bus Status | 351 | 100 ms | 500 ms | Maintenance Computer |  |  | X | 11 |
| Discrete Pin Status | 352 | 100 ms | 500 ms | Maintenance Computer |  |  | X | 11 |
| Program Pin Status | 353 | 100 ms | 500 ms | Maintenance Computer |  |  | X | 11 |
| Flight Identification | 233 |  | 1 s | Maintenance Computer or Other Systems | X |  |  | 7, 12 |
| Flight Identification | 234 |  | 1 s | Maintenance Computer or Other Systems | X |  |  | 7, 12 |
| Flight Identification | 235 |  | 1 s | Maintenance Computer or Other Systems | X |  |  | 7, 12 |
| Flight Identification | 236 |  | 1 s | Maintenance Computer or Other Systems | X |  |  | 7, 12 |
| Flight Identification | 237 |  | 1 s | Maintenance Computer or Other Systems | X |  |  | 7, 12 |
| Aircraft Identification | 301 |  |  | Maintenance Computer or Other Systems |  |  |  | 8, 13 |
| Aircraft Identification | 302 |  |  | Maintenance Computer or Other Systems |  |  |  | 8, 13 |
| Aircraft Identification | 303 |  |  | Maintenance Computer or Other Systems |  |  |  | 8, 13 |
| Mode S Address | 275 |  | 1 s | Maintenance Computer or Other Systems |  |  | X | 9 |
| Mode S Address | 276 |  | 1 s | Maintenance Computer or Other Systems |  |  | X | 9 |

Notes for Tables 3B-2, 3B-3, and 3B-4:

\* Asynchronous transmission

1. This Label is transmitted only if the transponder is receiving this Label from another source. The Transponder should echo the contents of the Label exactly as it is received.
2. The transmission of this Label is optional.
3. This Label is reserved for ATN interface with ATSU. It is defined in Attachment 4.
4. SSM format of the Label (BNR vs. BCD) transmitted by the Transponder should match the SSM of the Label received by the Transponder.
5. These Control Words are normally echoed by the transponder exactly as received from the control device.
6. See ARINC Characteristic 735A, TCAS, for complete definitions for input and output between the Mark 4 transponder and the ACAS computer.
7. When receiving Flight Identification words having labels 233 through 237, the transponder should echo each of these words via the Maintenance Output bus exactly as the words were received.
8. When receiving Aircraft Identification words having labels 301 through 303, the transponder should echo each of these words via the Maintenance Output bus exactly as the words were received.
9. The transponder will transmit the Transponder to TCAS Word 5, Label 275, and the Transponder to TCAS Word 6, Label 276, via the Maintenance Output bus at a minimum rate of once per second to provide Mode S Address information to other systems. Full definition of Label 275 is provided in ARINC Characteristic 735A Attachment 6P. Full definition of Label 276 is provided in ARINC Characteristic 735A Attachment 6Q.
10. See ARINC 604 for complete definitions for output from the Maintenance Computer to the Mark 4 transponder.
11. Full definition of Maintenance Labels are provided in Attachment 4.
12. See Attachment 3A-1, Note 12 in regard to SSM settings for Label 233 through 237.
13. See Attachment 4, Table 4-10 for full definition of Label 301.

See Attachment 4, Table 4-11 for full definition of Label 302.

See Attachment 4, Table 4-12 for full definition of Label 303.

1. C ADDITIONAL ARINC 429 INPUT AND OUTPUT

Data inputs are identified in Attachment 3A for most “General Purpose” applications of the Mark 4 transponder. Data between the Mark 4 transponder and TCAS/ACAS, and the Mark 4 transponder and the Maintenance Computer or other aircraft systems are less General Purpose:

Table 3C-1A – Mark 4 Transponder Inputs from TCAS/ACAS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Label** | **MIN** | **MAX** | **Probable** | **Data** | | | **Note** |
| **SOURCE** | **BNR** | **BCD** | **DISC** |
| ACAS to XPDR Communication and Acknowledges | 27X | Periodic:  100 ms | Periodic:  200 ms | ACAS |  |  |  | 1 |
| Non-periodic:  See Note 1 | |  |
| Command Summary Word | 27X | 100 ms | 500 ms | Maintenance Computer |  |  |  | 1 |
| Display (Control) | 013 | 100 ms | 200 ms | ACAS Control |  |  | X | 1 |
| Control | 015 | 100 ms | 200 ms | ACAS Control |  |  | X | 1 |
| Control | 016 | 100 ms | 200 ms | ACAS Control |  |  | X | 1 |
| Navigation Source Configuration | 305 | As  Required | As  Required | ACAS |  |  | X | 3 |

Table 3C-1B – Mark 4 Transponder Inputs from Maintenance Computer

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Label** | **Interval** | | **Probable** | **Data Type** | | | **Note** |
| **MIN** | **MAX** | **SOURCE** | **BNR** | **BCD** | **DISC** |
| Command Summary Word | 27X | 100 ms | 500 ms | Maintenance Computer |  |  | X | 2 |

Notes:

1. See ARINC Characteristic 735A for complete definitions for input and output between the Mark 4 transponder and the ACAS computer.
2. See ARINC 604 for complete definitions for output from the Maintenance Computer to the Mark 4 transponder.
3. Label 305 Block Transfer Words are defined in Attachment 4, Table 4-21.
4. D SAMPLE INTERFACE CONFIGURATIONS



Figure 3D-1



Figure 3D-2



Figure 3D-3



Figure 3D-4



Figure 3D-5

1. ARINC 429 DATA WORDS

Attachment 4 contains Label definitions for ARINC 429 data words. This information is included for guidance only. In case of conflict between this and ARINC Specification 429, Part 1, ARINC Specification 429 takes precedence.

Tables 4-1 through 4-7 contain data words previously defined for the Mark 3 transponder defined by ARINC Characteristic 718. These words are reused for the Mark 4 transponder defined in this Characteristic.

Table 4-8 is the seven-bit character code (International Alphabet #5) used in ARINC 429 labels 233-237. Table 4-9 is Flight Identification supplied via ARINC 429 Label 360. Tables 4-10 through 4-13 is Aircraft Identification (Tail Number) supplied via ARINC 429 labels 301-303.

Of these new ARINC 429 word definitions, Tables 4-14 contains the data word for Achieved Navigation Performance (AANMP), Table 4-15 contains the data word for humidity, and Table 4-15 contains the ATSU Message format.

Table 4-16 through 4-19 provides definition of new Maintenance Words (Label 35X) added for consistency with Supplement 3 of this Characteristic.

Table 4-20 provides definition of a new Maintenance Word (Label 354) needed to provide configuration information to the onboard TCAS unit.

Table 4-21 provides definition of a new Label 305 block transfer format that may be used to provide aircraft and navigation source configuration data to the Transponder from TCAS via the TXCOORD bus.

Table 4-1 – DITS Control Word for Aircrew Generated Commands and Information for ACAS and Mode S Transponder – Label 01**6**

| **Bit** | **Function** | **Coding** | |
| --- | --- | --- | --- |
| 1 | Label 1st Digit | 0 | 0 |
| 2 | Label 1st Digit |  | 0 |
| 3 | Label 2nd Digit | 1 | 0 |
| 4 | Label 2nd Digit |  | 0 |
| 5 | Label 2nd Digit |  | 1 |
| 6 | Label 3rd Digit | 6 | 1 |
| 7 | Label 3rd Digit |  | 1 |
| 8 | Label 3rd Digit |  | 0 |
| 9 | SDI | (MSB) |  |
| 10 | SDI | (LSB) | [1] |
| 11 | Altitude Reporting | 0 = ON,  1 = OFF | |
| 12 | SPI | 0 = Ident OFF  1 = Ident ON | |
| 13 | Display |  |  |
| 14 | Control |  | [6] |
| 15 | Sensitivity |  |  |
| 16 | Level |  | [2] |
| 17 | Control |  |  |
| 18 | D1 |  |  |
| 19 | D2 |  |  |
| 20 | D4 |  |  |
| 21 | C1 |  |  |
| 22 | C2 | 4096 |  |
| 23 | C4 | Ident | [4] |
| 24 | B1 | Code |  |
| 25 | B2 |  |  |
| 26 | B4 |  |  |
| 27 | A1 |  |  |
| 28 | A2 |  |  |
| 29 | A4 |  |  |
| 30 | SSM |  |  |
| 31 | SSM |  | [3] |
| 32 | Parity | (Odd) |  |

1. SDI

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **10** | **9** |
| 0 | 0 | Both (TA/RA Bus #1 And #2) |
| 0 | 1 | Left (TA/RA Bus #1) |
| 1 | 0 | Right (TA/RA Bus #2) |
| 1 | 1 | Not Used |

The SDI bits are set by the Mode S control panel and indicate the intended destination. The TCAS computer should only transmit the appropriate octal Label 016 (as defined by the SDI) on the TCAS output buses.

2. Manual Sensitivity Level Control

|  |  |  |  |
| --- | --- | --- | --- |
| **Bits** | | | **Meaning** |
| **17** | **16** | **15** |
| 0 | 0 | 0 | SL = 0 (AUTOMATIC) |
| 0 | 0 | 1 | SL = 1 (STBY) |
| 0 | 1 | 0 | SL = 2 (TA ONLY) |
| 0 | 1 | 1 | SL = 3 (not used from this source) |
| 1 | 0 | 0 | SL = 4 (not used from this source) |
| 1 | 0 | 1 | SL = 5 (not used from this source) |
| 1 | 1 | 0 | SL = 6 (not used from this source) |
| 1 | 1 | 1 | SL = 7 (not used from this source) |

These bits indicate the sensitivity level that is manually selected on the Modes S Control Panel. The SL and RI fields of octal Label 274, defined in ARINC Characteristic 735A Attachment 6U, indicate the actual TCAS computer mode of operation.

**Note:** TCAS will only accept SLC codes of SLC=0, SLC=1, and SLC=2 from pilot generated sources. Other SLC codes are accepted from the Mode S ground station via the Mode S transponder. TCAS sets its SL value dependant on the input SLC values and according to rules specified in the ICAO Annex 10 SARPs.

3. Sign Status Matrix (SSM)

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **31** | **30** |
| 0 | 0 | Normal |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

4. See Attachment 11 for Mode A reply codes.

5. The transfer time should not exceed 200 msec.

COMMENTARY

The delay from the time a command is activated at the control panel to the time of the equipment response should be minimized.

6. Display Control

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **14** | **13** |
| 0 | 0 | Primary and Traffic Display |
| 0 | 1 | Primary Display Functions Only (no TCAS data) |
| 1 | 0 | TCAS Traffic Display Only |
| 1 | 1 | No Control Function Possible |

Primary display functions are those functions for which a display may have need designed when that display is also being used in a shared manner as Traffic Advisory display.

Table 4-2 – DITS Control Word for ACAS and Mode S Transponder – Label 031

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 0 | 0 | |
| 2 | Label 1st Digit |  | 0 | |
| 3 | Label 2nd Digit | 3 | 0 | |
| 4 | Label 2nd Digit |  | 1 | |
| 5 | Label 2nd Digit |  | 1 | |
| 6 | Label 3rd Digit | 1 | 0 | |
| 7 | Label 3rd Digit |  | 0 | |
| 8 | Label 3rd Digit |  | 1 | |
| 9 | SDI | (MSB) |  | |
| 10 | SDI | (LSB) | [3] | |
| 11 | Altitude Reporting | 0 = ON  1 = OFF | | |
| 12 | Reserved |  | | |
| 13 | SPI | 0 = Ident OFF  1 = Ident ON | | |
| 14 | Alt. Data Source Select | 0 = #1  1 = #2 [4] | | |
| 15 | IFR/VFR | 0 = IFR  1 = VFR | | |
| 16 | Spare |  | | |
| 17 | Reserved  (X-Pulse ON/OFF | 0 = OFF  1 = ON | | |
| 18 | D1 |  | |  |
| 19 | D2 |  | |  |
| 20 | D4 |  | |  |
| 21 | C1 |  | |  |
| 22 | C2 | 4096 | |  |
| 23 | C4 | Ident | |  |
| 24 | B1 | Code | |  |
| 25 | B2 |  | |  |
| 26 | B4 |  | |  |
| 27 | A1 |  | |  |
| 28 | A2 |  | |  |
| 29 | A4 |  | |  |
| 30 | SSM |  | |  |
| 31 | SSM |  | | [1] |
| 32 | Parity | (Odd) | |  |

1. Sign Status Matrix (SSM)

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **31** | **30** |
| 0 | 0 | Normal |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Not Defined |

2. This data word definition was retained to document its use in SSR transponders.

3. SDI Settings

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

4. The altitude reporting function should comply with the following table:

|  |  |  |
| --- | --- | --- |
| **ALT Source Selection** | **Label 031 bit 14 (from Ctrl J1)** | **Label 031 bit 14 (from Ctrl J2)** |
| 1 | 0 | 1 |
| OFF | 0 | 0 |
| 2 | 1 | 0 |

a. If Altitude Reporting 1-OFF-2 is not present in the control panel, then Label 031, bit 14, is always transmitted as “0”..”

b. If the control panel has an Altitude Reporting ON-OFF switch selection, and Altitude Source selection switch is located in a place other than the control panel, then the control panel should not transmit Label 031 when Altitude Reporting is selected in the ON position.

Table 4-3 - DITS Control Word for TCAS and Mode S Transponder – Label 233

|  |  |  |  |
| --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | |
| 1 | Label 1st Digit | 2 | 1 |
| 2 | Label 1st Digit |  | 0 |
| 3 | Label 2nd Digit | 3 | 0 |
| 4 | Label 2nd Digit |  | 1 |
| 5 | Label 2nd Digit |  | 1 |
| 6 | Label 3rd Digit | 3 | 0 |
| 7 | Label 3rd Digit |  | 1 |
| 8 | Label 3rd Digit |  | 1 |
| 9 | SDI |  |  |
| 10 | SDI |  |  |
| 11 | LSB |  | |
| 12 |  |  | |
| 13 | First Character of |  | |
| 14 |  | Encoded in  IA-5 | |
| 15 | Flight I.D. | See Table 4-8 | |
| 16 |  |  | |
| 17 | MSB |  | |
| 18 | Pad | 0 | |
| 19 | LSB |  | |
| 20 |  |  | |
| 21 | Second Character of |  | |
| 22 |  | Encoded in  IA-5 | |
| 23 | Flight I.D. | See Table 4-8 | |
| 24 |  |  | |
| 25 | MSB |  | |
| 26 | Pad | 0 | |
| 27 | Future Spare |  |  |
| 28 | Future Spare |  |  |
| 29 | Future Spare |  |  |
| 30 | SSM |  |  |
| 31 | SSM | [1] | |
| 32 | Parity | (Odd) |  |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-4 – DITS Control Word for TCAS and Mode S Transponder – Label 234

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 2 | 1 | |
| 2 | Label 1st Digit |  | 0 | |
| 3 | Label 2nd Digit | 3 | 0 | |
| 4 | Label 2nd Digit |  | 1 | |
| 5 | Label 2nd Digit |  | 1 | |
| 6 | Label 3rd Digit | 4 | 1 | |
| 7 | Label 3rd Digit |  | 0 | |
| 8 | Label 3rd Digit |  | 0 | |
| 9 | SDI |  |  | |
| 10 | SDI |  |  | |
| 11 | LSB |  | | |
| 12 |  |  | | |
| 13 | Third Character of |  | | |
| 14 |  | Encoded in IA-5 | | |
| 15 | Flight I.D. | See Table 4-8 | | |
| 16 |  |  | | |
| 17 | MSB |  | | |
| 18 | Pad | 0 | | |
| 19 | LSB |  | | |
| 20 |  |  | | |
| 21 | Fourth Character of |  | | |
| 22 |  | Encoded in  IA-5 | | |
| 23 | Flight I.D. | See Table 4-8 | | |
| 24 |  |  | | |
| 25 | MSB |  | | |
| 26 | Pad | 0 | | |
| 27 | Future Spare |  | |  |
| 28 | Future Spare |  | |  |
| 29 | Future Spare |  | |  |
| 30 | SSM |  | |  |
| 31 | SSM | [1] | | |
| 32 | Parity | (Odd) | |  |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-5 – DITS Control Word for TCAS and Mode S Transponder – Label 235

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 2 | 1 | |
| 2 | Label 1st Digit |  | 0 | |
| 3 | Label 2nd Digit | 3 | 0 | |
| 4 | Label 2nd Digit |  | 1 | |
| 5 | Label 2nd Digit |  | 1 | |
| 6 | Label 3rd Digit | 5 | 1 | |
| 7 | Label 3rd Digit |  | 0 | |
| 8 | Label 3rd Digit |  | 1 | |
| 9 | SDI |  |  | |
| 10 | SDI |  |  | |
| 11 | LSB |  | | |
| 12 |  |  | | |
| 13 | Fifth Character of |  | | |
| 14 |  | Encoded in IA-5 | | |
| 15 | Flight I.D. | See Table 4-8 | | |
| 16 |  |  | | |
| 17 | MSB |  | | |
| 18 | Pad | 0 | | |
| 19 | LSB |  | | |
| 20 |  |  | | |
| 21 | Sixth Character of |  | | |
| 22 |  | Encoded in  IA-5 | | |
| 23 | Flight I.D. | See Table 4-8 | | |
| 24 |  |  | | |
| 25 | MSB |  | | |
| 26 | Pad | 0 | | |
| 27 | Future Spare |  | |  |
| 28 | Future Spare |  | |  |
| 29 | Future Spare |  | |  |
| 30 | SSM |  | |  |
| 31 | SSM | [1] | | |
| 32 | Parity | (Odd) | |  |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-6 – DITS Control Word for TCAS and Mode S Transponder – Label 236

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 2 | | 1 |
| 2 | Label 1st Digit |  | | 0 |
| 3 | Label 2nd Digit | 3 | | 0 |
| 4 | Label 2nd Digit |  | | 1 |
| 5 | Label 2nd Digit |  | | 1 |
| 6 | Label 3rd Digit | 6 | | 1 |
| 7 | Label 3rd Digit |  | | 1 |
| 8 | Label 3rd Digit |  | | 0 |
| 9 | SDI |  | |  |
| 10 | SDI |  | |  |
| 11 | LSB |  | | |
| 12 |  |  | | |
| 13 | Seventh Character of |  | | |
| 14 |  | Encoded in IA-5 | | |
| 15 | Flight I.D. | See Table 4-8 | | |
| 16 |  |  | | |
| 17 | MSB |  | | |
| 18 | Pad | 0 | | |
| 19 | LSB |  | | |
| 20 |  |  | | |
| 21 | Eighth Character of |  | | |
| 22 |  | Encoded in IA-5 | | |
| 23 | Flight I.D. | See Table 4-8 | | |
| 24 |  |  | | |
| 25 | MSB |  | | |
| 26 | Pad | 0 | | |
| 27 | Future Spare |  |  | |
| 28 | Future Spare |  |  | |
| 29 | Future Spare |  |  | |
| 30 | SSM |  |  | |
| 31 | SSM | [1] | | |
| 32 | Parity | (Odd) |  | |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-7 – TS Control Word for TCAS and Mode S Transponder – Label 237

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 2 | | 1 |
| 2 | Label 1st Digit |  | | 0 |
| 3 | Label 2nd Digit | 3 | | 0 |
| 4 | Label 2nd Digit |  | | 1 |
| 5 | Label 2nd Digit |  | | 1 |
| 6 | Label 3rd Digit | 7 | | 1 |
| 7 | Label 3rd Digit |  | | 1 |
| 8 | Label 3rd Digit |  | | 1 |
| 9 | SDI |  | |  |
| 10 | SDI |  | |  |
| 11 | LSB |  | | |
| 12 |  |  | | |
| 13 | Ninth Character of |  | | |
| 14 |  | Encoded in IA-5 | | |
| 15 | Flight I.D. | See Table 4-8 | | |
| 16 |  |  | | |
| 17 | MSB |  | | |
| 18 | Pad | 0 | | |
| 19 | LSB |  | | |
| 20 |  |  | | |
| 21 | Tenth Character of |  | | |
| 22 |  | Encoded in IA-5 | | |
| 23 | Flight I.D. | See Table 4-8 | | |
| 24 |  |  | | |
| 25 | MSB |  | | |
| 26 | Pad | 0 | | |
| 27 | Future Spare |  |  | |
| 28 | Future Spare |  |  | |
| 29 | Future Spare |  |  | |
| 30 | SSM |  |  | |
| 31 | SSM | [1] | | |
| 32 | Parity | (Odd) |  | |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-8 – Seven-Bit Character Code Used in Labels 233-237 and XXX-XXX

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **MSBs** | | | | | | | |
|  |  | **000** | **001** | **010** | **011** | **100** | **101** | **110** | **111** |
| **LSBs** | 0000 |  |  | SPACE | 0 |  | P |  |  |
| 0001 |  |  |  | 1 | A | Q |  |  |
| 0010 |  |  |  | 2 | B | R |  |  |
| 0011 |  |  |  | 3 | C | S |  |  |
| 0100 |  |  |  | 4 | D | T |  |  |
| 0101 |  |  |  | 5 | E | U |  |  |
| 0110 |  |  |  | 6 | F | V |  |  |
| 0111 |  |  |  | 7 | G | W |  |  |
| 1000 |  |  |  | 8 | H | X |  |  |
| 1001 |  |  |  | 9 | I | Y |  |  |
| 1010 |  |  |  |  | J | Z |  |  |
| 1011 |  |  |  |  | K |  |  |  |
| 1100 |  |  |  |  | L |  |  |  |
| 1101 |  |  |  |  | M |  |  |  |
| 1110 |  |  |  |  | N |  |  |  |
| 1111 |  |  |  |  | O |  |  |  |

Seven-Bit and Six-Bit Character Code Tables

Only the seven-bit character codes for SPACE, the uppercase letters A-Z, and the decimal digits 0 to 9 should occur in the Flight Identification words, ARINC 429 labels 233 to 237. These are the character codes shown in the unshaded cells.

Table 4-9 – DITS Control Word for TCAS and Mode

Label 360 (Initial Word)

| **Bit** | **Function** | **Coding** |
| --- | --- | --- |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15  16 | Binary Word Count |  |
| 17  18  19  20  21  22 | Pad | 0  0  0  0  0  0 |
| 23  24  25  26  27  28  29 | “STX” | 0  1  0  0  0  0  0 |
| 30  31 |  | 1  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Second)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Flight Number  Char #1  MSB | Encoded in IA-5  See Table 4-8 |
| 16  17  18  19  20  21  22 | LSB  Flight Number  Char #2  MSB | Encoded in IA-5  See Table 4-8 |
| 23  24  25  26  27  28  29 | LSB  Flight Number  Char #3  MSB | Encoded in IA-5  See Table 4-8 |
| 30  31 |  | 0  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Third)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Flight Number  Char #4  MSB | Encoded in IA-5  See Table 4-8 |
| 16  17  18  19  20  21  22 | LSB  Flight Number  Char #5  MSB | Encoded in IA-5  See Table 4-8 |
| 23  24  25  26  27  28  29 | LSB  Flight Number  Char #6  MSB | Encoded in IA-5  See Table 4-8 |
| 30  31 |  | 0  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Fourth)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Flight Number  Char #7  MSB | Encoded in IA-5  See Table 4-8 |
| 16  17  18  19  20  21  22 | LSB  Flight Number  Char #8  MSB | Encoded in IA-5  See Table 4-8 |
| 23  24  25  26  27  28  29 | LSB  Origin  Char #1  MSB | Encoded in IA-5  [1] |
| 30  31 |  | 0  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Fifth)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Origin  Char #2  MSB | Encoded in IA-5 [1] |
| 16  17  18  19  20  21  22 | LSB  Origin  Char #3  MSB | Encoded in IA-5 [1] |
| 23  24  25  26  27  28  29 | LSB  Origin  Char #4  MSB | Encoded in IA-5 [1] |
| 30  31 |  | 0  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Sixth)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Destination  Char #1  MSB | Encoded in IA-5  [1] |
| 16  17  18  19  20  21  22 | LSB  Destination  Char #2  MSB | Encoded in IA-5  [1] |
| 23  24  25  26  27  28  29 | LSB  Destination  Char #3  MSB | Encoded in IA-5  [1] |
| 30  31 |  | 0  0 |
| 32 | Parity | (Odd) |

Label 360 (Intermediate Word, Seventh)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 1  1  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 0  0  0 |
| 9  10  11  12  13  14  15 | LSB  Destination  Char #4  MSB | Encoded in IA-5  [1] |
| 16  17  18  19  20  21  22 | Pad | 0  0  0  0  0  0  0 |
| 23  24  25  26  27  28  29 | Pad | 0  0  0  0  0  0  0 |
| 30  31 |  | 0  0 |
| 32 | Parity | (odd) |

1. Not needed or decoded for Flight ID

Upon receipt of Initial word in Label 360 block (STX and bits 30-31 set correctly), the following three intermediate words (2 through 4) are used to extract the Flight ID.

Table 4-10 – Aircraft Identification, Tail Number 1st Word Label 301

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 0 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 1 0  0  1 |
| 9 | SDI =00 |  |
| 10 |
| 11 | LSB |  |
| 12 | 1st Character Aircraft Tail Number | Encoded in IA-5 |
| 13 |
| 14 |
| 15 |
| 16 |
| 17 | MSB |  |
| 18 | LSB |  |
| 19 | 2nd Character Aircraft Tail Number | Encoded in IA-5 |
| 20 |
| 21 |
| 22 |
| 23 |
| 24 | MSB |  |
| 25 | LSB |  |
| 26 | 3rd Character Aircraft Tail Number | Encoded in IA-5 |
| 27 |
| 28 |
| 29 |
| 30 |
| 31 | MSB |  |
| 32 | Parity | (Odd) |

Table 4-11 – Aircraft Identification, Tail Number 2nd Word Label 302

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 0 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 2 0  1  0 |
| 9 | SDI =00 |  |
| 10 |
| 11 | LSB |  |
| 12 | 4th Character Aircraft Tail Number | Encoded in IA-5 |
| 13 |
| 14 |
| 15 |
| 16 |
| 17 | MSB |  |
| 18 | LSB |  |
| 19 | 5th Character Aircraft Tail Number | Encoded in IA-5 |
| 20 |
| 21 |
| 22 |
| 23 |
| 24 | MSB |  |
| 25 | LSB |  |
| 26 | 6th Character Aircraft Tail Number | Encoded in IA-5 |
| 27 |
| 28 |
| 29 |
| 30 |
| 31 | MSB |  |
| 32 | Parity | (Odd) |

Table 4-12 – Aircraft Identification, Tail Number 3rd Word Label 303

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 0 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 3 0  1  1 |
| 9 | SDI =00 |  |
| 10 |
| 11 | LSB |  |
| 12 | 7th Character Aircraft Tail Number | Encoded in IA-5 |
| 13 |
| 14 |
| 15 |
| 16 |
| 17 | MSB |  |
| 18 | LSB |  |
| 19 | 8th Character Aircraft Tail Number | Encoded in IA-5 |
| 20 |
| 21 |
| 22 |
| 23 |
| 24 | MSB |  |
| 25 | LSB |  |
| 26 | Spare or the 9th Character Aircraft Tail Number | Encoded in IA-5 |
| 27 |
| 28 |
| 29 |
| 30 |
| 31 | MSB |  |
| 32 | Parity | (Odd) |

Table 4-13 – Estimated Position Uncertainty (EPU)/Achieved Navigation Performance   
(ANP) – Label 167

|  |  |  |  |
| --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | |
| 1 | Label 1st Digit | 1 | 0 |
| 2 | Label 1st Digit |  | 1 |
| 3 | Label 2nd Digit | 6 | 1 |
| 4 | Label 2nd Digit |  | 1 |
| 5 | Label 2nd Digit |  | 0 |
| 6 | Label 3rd Digit | 7 | 1 |
| 7 | Label 3rd Digit |  | 1 |
| 8 | Label 3rd Digit |  | 1 |
| 9 | SDI |  | |
| 10 | SDI |  | |
| 11 | PAD |  | |
| 12 | PAD |  | |
| 13 | LSB |  | |
| 14 |  |  | |
| 15 |  |  | |
| 16 |  |  | |
| 17 |  |  | |
| 18 | Achieved Navigation | Range 128 NM | |
| 19 | Performance | Res. 0.001953 | |
| 20 |  |  | |
| 21 |  |  | |
| 22 |  |  | |
| 23 |  |  | |
| 24 |  |  | |
| 25 |  |  | |
| 26 |  |  | |
| 27 |  |  | |
| 28 | MSB |  | |
| 29 | Sign | Always pos. | |
| 30 | SSM |  | [1] |
| 31 | SSM |  |
| 32 | Parity | (Odd) |  |

1. SSM Code [BNR]

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **31** | **30** |
| 0 | 0 | Failure Warning |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Normal Operation |

Table 4-14 – Humidity – Label 113

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | 1 | 0 | |
| 2 | Label 1st Digit |  | 1 | |
| 3 | Label 2nd Digit | 1 | 0 | |
| 4 | Label 2nd Digit |  | 0 | |
| 5 | Label 2nd Digit |  | 1 | |
| 6 | Label 3rd Digit | 3 | 0 | |
| 7 | Label 3rd Digit |  | 1 | |
| 8 | Label 3rd Digit |  | 1 | |
| 9 | SDI |  | [1] | |
| 10 | SDI |  |
| 11 | PAD |  | | |
| 12 | PAD |  | | |
| 13 | PAD |  | | |
| 14 | PAD |  | | |
| 15 | PAD |  | | |
| 16 | PAD |  | | |
| 17 | PAD |  | | |
| 18 | PAD |  | | |
| 19 | PAD |  | | |
| 20 | LSB |  | | |
| 21 |  |  | | |
| 22 |  |  | | |
| 23 |  |  | | |
| 24 | Reserved for humidity |  | | |
| 25 | Data |  | | |
| 26 |  |  | | |
| 27 |  |  | | |
| 28 | MSB |  | | |
| 29 | Sign Bit |  | |  |
| 30 | SSM |  | | [2] |
| 31 | SSM |  | |
| 32 | Parity | (Odd) | |  |

1. Humidity SDI Code

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **10** | **9** |
| 0 | 0 | NOT USED |
| 0 | 1 | Side 1 (LEFT) |
| 1 | 0 | Side 2 (RIGHT) |
| 1 | 1 | Unit 3 or Not Used |

2. Humidity SSM Code

|  |  |  |
| --- | --- | --- |
| **Bits** | | **Meaning** |
| **31** | **30** |
| 0 | 0 | Failure Warning |
| 0 | 1 | No computed Data |
| 1 | 0 | Functional test |
| 1 | 1 | Normal Operation |

Table 4-15 – ATSU Message Label 304

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 0 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 4 1  0  0 |
| 9 | LSB | Encoded in IA-5 |
| 10 | 1st Character |
| 11 |
| 12 |
| 13 |
| 14 |
| 15 | MSB |
| 16 | Spare |  |
| 17 | LSB | Encoded in IA-5 |
| 18 | 2nd Character |
| 19 |
| 20 |
| 21 |
| 22 |
| 23 | MSB |
| 24 | Spare |  |
| 25 | LSB | Encoded in IA-5 |
| 26 | 3rd Character |
| 27 |
| 28 |
| 29 |
| 30 |
| 31 | MSB |
| 32 | Parity | (Odd) |

Table 4-16 – Maintenance Label 350

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LABEL 350**  **MAINTENANCE, MODE S TRANSPONDER**  **(as per ARINC 604-1, Table A7.33)** | | | | |
| **Bit No.** | **Function** | **Bit Status** | | ***Commentary*** |
| **1** | **0** |
| 1 | Label 350  (Octal) | X |  |  |
| 2 | X |  |  |
| 3 | X |  |  |
| 4 |  | X |  |
| 5 | X |  |  |
| 6 |  | X |  |
| 7 |  | X |  |
| 8 |  | X |  |
| 9 | SDI (See Note 1) |  |  |  |
| 10 |
| 11 | Unit Failure | Failure | OK |  |
| 12 | Upper Antenna Failure | Failure | OK |  |
| 13 | Lower Antenna Failure | Failure | OK |  |
| 14 | Upper Receiver Failure | Failure | OK |  |
| 15 | Lower Receiver Failure | Failure | OK |  |
| 16 | Upper Transmitter Failure | Failure | OK |  |
| 17 | Lower Transmitter Failure | Failure | OK |  |
| 18 | Upper Squitter Failure | Failure | OK |  |
| 19 | Lower Squitter Failure | Failure | OK |  |
| 20 | Control Input A Inactive | Failure | OK | *Rockwell Collins defines as:*  *“Control Source Selection”*  *“1=Side A, 0=Side B Selected”* |
| 21 | Control Input B Inactive | Failure | OK | *Rockwell Collins defines as:*  *“Control Data Inactive. 1=Inactive”* |
| 22 | TCAS Input Inactive | Failure | OK |  |
| 23 | Data Link A/B Inactive | Failure | OK |  |
| 24 | Data Link C/D Inactive | Failure | OK |  |
| 25 | Altitude Input 1 Inactive | Failure | OK |  |
| 26 | Altitude Input 2 Inactive | Failure | OK |  |
| 27 | CFDIU Input Bus | Failure | OK |  |
| 28 | Bite Test Inhibit | Inhibit | Enable |  |
| 29 | Command Word Acknowledge | ACK | NAK |  |
| 30 | SSM (See Note 2) |  |  |  |
| 31 |
| 32 | Parity (odd) |  |  |  |

[1]

|  |  |  |
| --- | --- | --- |
| **SDI ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

[2]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-17 – ARINC Bus Status Label 351

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 5 1  0  1 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 1 0  0  1 |
| 9 | SDI LSB | [1] |
| 10 | SDI MSB |
| 11 | MCP/FCU Bus | [2] |
| 12 | ATC Control | [2] |
| 13 | FMS #1 Flight ID | [2] |
| 14 | GNSS #1 Bus | [3] |
| 15 | GNSS #2 Bus | [3] |
| 16 | IRS #1 Bus | [3] |
| 17 | IRS #2 Bus | [3] |
| 18 | FMS Gen. #1 Bus | [3] |
| 19 | FMS Gen. #2 Bus | [3] |
| 20 | Spare for Full TIF |  |
| 21 | Spare for Full TIF |  |
| 22 | Spare for Full TIF |  |
| 23 | Spare for Full TIF |  |
| 24 | Spare for Full TIF |  |
| 25 | Spare for Full TIF |  |
| 26 | Spare for Full TIF |  |
| 27 | Spare for Full TIF |  |
| 28 | Spare for Full TIF |  |
| 29 | Spare for Full TIF |  |
| 30 | SSM LSB | [4] |
| 31 | SSM MSB |
| 32 | Parity | (Odd) |

[1]

|  |  |  |
| --- | --- | --- |
| **SDI ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

[2]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Active |
| 1 | Inactive |

[3]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Active |
| 1 | Inactive |

[4]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-18 – Discrete Input Status Label 352

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 5 1  0  1 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 2 0  1  0 |
| 9 | SDI LSB | [1] |
| 10 | SDI MSB |
| 11 | ATC Standby | [2] |
| 12 | Air/Ground #1 | [3] |
| 13 | Air/Ground #2 | [4] |
| 14 | Air Data Select | [5] |
| 15 | ADS-B Out Status | [6] |
| 16 | Extended Squitter Disable | [7] |
| 17 | Antenna BITE | [8] |
| 18  19 | LSB  NACV  MSB | [9] |
| 20  21 | LSB  SDA  MSB | [10] |
| 22 | ADS-B Fail Disable | [11] |
| 23 | Reserved |  |
| 24 | Reserved |  |
| 25 | Reserved |  |
| 26 | Reserved |  |
| 27 | Reserved |  |
| 28 | Reserved |  |
| 29 | Reserved |  |
| 30 | SSM LSB | [12] |
| 31 | SSM MSB |
| 32 | Parity | (Odd) |

[1]

|  |  |  |
| --- | --- | --- |
| **SDI ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

[2]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Active |
| 1 | Standby |

[3]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Airborne |
| 1 | Ground + ON |

[4]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Airborne |
| 1 | Ground + Auto |

[5]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Source #1 |
| 1 | Source #2 |

[6]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | ADS-B Active |
| 1 | ADS-B Failed *or* Inoperative |

[7]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Extended Squitter Enable |
| 1 | Extended Squitter Disabled |

[8]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Antenna BITE Disabled |
| 1 | Antenna BITE Active |

[9]

|  |  |
| --- | --- |
| **NACV ENCODING**  **(see Note 54 in Attachment 2B-3 and 2C-3)** | |
| **Value** | **Horizontal Velocity Error** |
| 0 | Unknown or > 10 meters/second |
| 1 | < 10 meters/second |
| 2 | < 3 meters/second |
| 3 | < 1 meter/second\_\_\_NOT USED |

[10]

|  |  |
| --- | --- |
| **SDA ENCODING**  **(see Note 55 in Attachment 2B-3 and 2C-3)** | |
| **Value** | **Supported Failure Condition** |
| 0 | Unknown or No Safety Effect |
| 1 | Minor (This encoding is NOT USED) |
| 2 | Major |
| 3 | Hazardous |

[11]

|  |  |
| --- | --- |
| **ADS-B FAIL DISABLE ENCODING**  **(see Note 64 in Attachment 2B-3 and 2C-3)** | |
| **Value** | **Supported Failure Condition** |
| 0 | ADS-B Function Fail Warn via the Transponder Fail Warn Discrete is NOT Enabled |
| 1 | ADS-B Function Fail Warn via the Transponder Fail Warn Discrete is Enabled |

[12]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-19 – Program Pin Status Label 353

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 5 1  0  1 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 3 0  1  1 |
| 9 | SDI LSB | [1] |
| 10 | SDI MSB |
| 11 | LSB | [2] |
| 12 | Max Cruise Airspeed |
| 13 | MSB |
| 14 | LSB | [3] |
| 15 | Length/Width Code |
| 16 |
| 17 | MSB |
| 18 | LSB 2 meters | [4] |
| 19 | GPS Antenna Position |
| 20 |
| 21 |
| 22 | MSB 32 meters |
| 23 | LSB | [5] |
| 24 | Aircraft Category |
| 25 | MSB |
| 26 | 1090 Receiver | [6] |
| 27 | UAT Receiver | [7] |
| 28 | ADS-B Config. Parity | [8] |
| 29 | Reserved |  |
| 30 | SSM LSB | [9] |
| 31 | SSM MSB |
| 32 | Parity | (Odd) |

[1]

|  |  |  |
| --- | --- | --- |
| **SDI ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

[2]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | No Max Airspeed Data |
| 1 | ≤ 75 Knots |
| 2 | ≤ 150 Knots |
| 3 | ≤ 300 Knots |
| 4 | ≤ 600 Knots |
| 5 | ≤ 1200 Knots |
| 6 | > 1200 Knots |
| 7 | Reserved |

[3]

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | |
|  | Length (m) | Width (m) |
| 0 | No Data | No Data |
| 1 | < 15 | < 23 |
| 2 | < 25 | < 28.5 |
| 3 | < 25 | < 34 |
| 4 | < 35 | < 33 |
| 5 | < 35 | < 38 |
| 6 | < 45 | < 39.5 |
| 7 | < 45 | < 45 |
| 8 | < 55 | < 45 |
| 9 | < 55 | < 52 |
| 10 | < 65 | < 59.5 |
| 11 | < 65 | < 67 |
| 12 | < 75 | < 72.5 |
| 13 | < 75 | < 80 |
| 14 | < 85 | < 80 |
| 15 | < 85 | < 90 |
| > 85 |  |
|  | > 90 |

[4]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | “0” *or* No Antenna Position Data |
| 1 | Position Offset Applied by Sensor |
| 2 | 2 m |
| 3 | 4 m |
| **…** | **…** |
| 24 | 46 m |
| 25 | 48 m |
| 26 | 50 m |
| 27 -31 | NOT USED or Optional for 52 to 60 meters |

[5]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | No Category Data |
| 1 | Light (< 15,500 lbs.) |
| 2 | Small (15,500 to 75,000 lbs.) |
| 3 | Large (75,000 to 300,000 lbs.) |
| 4 | High Vortex Large |
| 5 | Heavy ( > 300,000 lbs.) |
| 6 | High Performance |
| 7 | Rotorcraft |

[6]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | No 1090 MHz ADS-B Receiver Installed |
| 1 | 1090 MHz ADS-B Receiver Installed |

[7]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | No UAT ADS-B Receiver Installed |
| 1 | UAT ADS-B Receiver Installed |

[8]

|  |  |
| --- | --- |
| **Value** | **Meaning**  **(see Note 66 in Attachment 2B-3 and 2C-3)** |
| 0 | ADS-B Configuration Parity is ODD |
| 1 | ADS-B Configuration Parity is EVEN |

[9]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-20 – Program Pin Status Label 354, Transponder to TCAS

(Note: This Label should also be added to ARINC 735B)

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 5 1  0  1 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 4 1  0  0 |
| 9 | SDI LSB | [1] |
| 10 | SDI MSB |
| 11 | LSB | [2] |
| 12 | Length/Width Code |
| 13 |
| 14 | MSB |
| 15 | LSB |  |
| 16 | GPS Antenna Position | [3] |
| 17 |
| 18 |
| 19 | MSB |
| 20 | LSB | [4] |
| 21 | NACV |
| 22 | MSB |
| 23 | LSB | [5] |
| 24 | SDA |
| 25 | MSB |
| 26 | LSB | [6] |
| 27 | Aircraft Category |
| 28 | MSB |
| 29 | Reserved |  |
| 30 | SSM LSB | [7] |
| 31 | SSM MSB |
| 32 | Parity | (Odd) |

[1]

|  |  |  |
| --- | --- | --- |
| **SDI ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Not Used |
| 0 | 1 | Side 1 |
| 1 | 0 | Side 2 |
| 1 | 1 | Not Used |

[2]

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | |
| Length (m) | Width (m) |
| 0 | No Data | No Data |
| 1 | < 15 | < 23 |
| 2 | < 25 | < 28.5 |
| 3 | < 25 | < 34 |
| 4 | < 35 | < 33 |
| 5 | < 35 | < 38 |
| 6 | < 45 | < 39.5 |
| 7 | < 45 | < 45 |
| 8 | < 55 | < 45 |
| 9 | < 55 | < 52 |
| 10 | < 65 | < 59.5 |
| 11 | < 65 | < 67 |
| 12 | < 75 | < 72.5 |
| 13 | < 75 | < 80 |
| 14 | < 85 | < 80 |
| 15 | < 85 | < 90 |
| > 85 | > 90 |

[3]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | “0” *or* No Antenna Position Data |
| 1 | Position Offset Applied by Sensor |
| 2 | 2 m |
| 3 | 4 m |
| **…** | **…** |
| 24 | 46 m |
| 25 | 48 m |
| 26 | 50 m |
| 27 -31 | NOT USED or Optional for 52 to 60 meters |

[4]

|  |  |
| --- | --- |
| **NACV ENCODING**  **(see Note 54 in Attachment 2B-3 and 2C-3)** | |
| **Value** | **Horizontal Velocity Error** |
| 0 | Unknown or > 10 meters/second |
| 1 | < 10 meters/second |
| 2 | < 3 meters/second |
| 3 | < 1 meter/second\_\_\_NOT USED |

[5]

|  |  |
| --- | --- |
| **SDA ENCODING**  **(see Note 55 in Attachment 2B-3 and 2C-3)** | |
| **Value** | **Supported Failure Condition** |
| 0 | Unknown or No Safety Effect |
| 1 | Minor (This encoding is NOT USED) |
| 2 | Major |
| 3 | Hazardous |

[6]

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | No Category Data |
| 1 | Light (< 15,500 lbs.) |
| 2 | Small (15,500 to 75,000 lbs.) |
| 3 | Large (75,000 to 300,000 lbs.) |
| 4 | High Vortex Large |
| 5 | Heavy ( > 300,000 lbs.) |
| 6 | High Performance |
| 7 | Rotorcraft |

[7]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |
| Table Note:  The SSM of this Label 354 shall always be set to Normal (e.g., 00). | | |

Table 4-21 – Label 305 Block Transfer of Configuration Data (TCAS to Transponder)

Note: The 305 Block Transfer is used in those installations where the configuration information is only provided to the Traffic Computer (or similar function) that is physically a part of the TCAS computer. The block transfer is then used to transfer the configuration information to the Transponder which needs the information to structure ADS-B Out messages.

Table 4-21a – Label 305 Block Transfer Word 0:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bit** | **Function** | | | **Coding** | | |
| 1  2 | Label 1st Digit  Label 1st Digit | | | 3 | 1  1 | |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | | | 0 | 0  0  0 | |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | | | 5 | 1  0  1 | |
| 9 | LSB | ADS-B Emitter Category Set | | 0-3 | [1] | |
| 10 | MSB |
| 11 | LSB | Aircraft Category | | 0-7 | [2] | |
| 12 |  |
| 13 | MSB |
| 14 | LSB | Length/Width Code | | 0-15 | [3] | |
| 15 |  |
| 16 |  |
| 17 | MSB |
| 18 | 1090 ES In | | | 0/1 | [4] | |
| 19 | UAT In | | | 0/1 | [5] | |
| 20 | ADS-B Function Fail  Illuminates Control Panel Fail Lamp | | | 0/1 | [6] | |
| 21 | LSB | | Configuration  Version Number |  | [9] | 1 |
| 22 | MSB | | 0 |
| 23 | LSB | Number of Navigation Sources | | 0-7 | [7] | |
| 24 |  |
| 25 | MSB |
| 26 | LSB | Word Number | | 0 |  | |
| 27 |  | 0 |  | |
| 28 |  | 0 |  | |
| 29 | MSB | 0 |  | |
| 30 | LSB | SSM | |  | [8] | |
| 31 | MSB |
| 32 | Parity | | | (Odd) | | |

[1] Encode ADS-B Category Set as per the following table.

(Reference: RTCA DO-260B, Table 2-19).

|  |  |  |
| --- | --- | --- |
| **ADS-B EMITTER CATEGORY SET ENCODING** | | |
| **BIT** | | **MEANING** |
| **10** | **9** |
| 0 | 0 | Emitter Category Set D |
| 0 | 1 | Emitter Category Set C |
| 1 | 0 | Emitter Category Set B |
| 1 | 1 | Emitter Category Set A |
| Table Note: ARINC 718A associated aircraft typically use Category Set A. | | |

[2] Encode Aircraft Category as per the following table.

(Reference: RTCA DO-260B, Table 2-19)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ADS-B Emitter Category Set “A”** | |  | **ADS-B Emitter Category Set “B”** | |
| **Coding**  **(Bit 13,12,11)** | **Meaning** |  | **Coding**  **(Bit 13,12,11)** | **Meaning** |
| 0 | No ADS-B Emitter Category Information |  | 0 | No ADS-B Emitter Category Information |
| 1 | MTOW < 15500 lbs. |  | 1 | Glider/Sailplane |
| 2 | 15500 ≤ MTOW < 75000 lbs. |  | 2 | Lighter-than-Air |
| 3 | 75000 ≤ MTOW < 300000 lbs. |  | 3 | Reserved |
| 4 | Reserved |  | 4 | Ultralight/hang-glider/paraglider |
| 5 | MTOW ≥ 300000 lbs. |  | 5 | Reserved |
| 6 | Reserved |  | 6 | Reserved |
| 7 | Rotorcraft |  |  |  |
|  |  |  |  |  |
| **ADS-B Emitter Category Set “C”** | |  | **ADS-B Emitter Category Set “D”** | |
| **Coding**  **(Bit 13,12,11)** | **Meaning** |  | **Coding**  **(Bit 13,12,11)** | **Meaning** |
| 0 | No ADS-B Emitter Category Information |  | 0 | No ADS-B Emitter Category Information |
| 1 | Surface Vehicle - Emergency Vehicle |  | 1 - 7 | Reserved |
| 2 | Surface Vehicle - Service Vehicle |  |  |  |
| 3 | Point Obstacle (includes tethered balloons) |  |  |  |
| 4 | Cluster Obstacle |  |  |  |
| 5 | Line Obstacle |  |  |  |
| 6 - 7 | Reserved |  |  |  |
| Table Note: | | | | |
| The Emitter Category codes 1 to 5 in category set “A” are intended to advise other aircraft of the transmitting aircraft’s wake vortex characteristics, and not necessarily the transmitting aircraft’s actual maximum takeoff weight. In case of doubt, the next higher aircraft category code should be used. | | | | |

[3] Encode Length/Width Code as per the following table.

(Reference: RTCA DO-260B, Table 2-74)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **AIRCRAFT/VEHICLE LENGTH/WIDTH ENCODING** | | | | | | | | | |
| **Encoding** | | | | **Length**  **Code** | | | **Width**  **Code** | **Upper Bound Length and Width**  **For Each Length/Width Code** | |
| **BIT** | | | | **Register 65HEX “ME” Field** | | | | **Length**  **(meters)** | **Width**  **(meters)** |
| **17** | **16** | **15** | **14** | **Bit 21** | **Bit 22** | **Bit 23** | **Bit 24** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | No Data or Unknown | |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | < 15 | < 23 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | < 25 | < 28.5 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | < 34 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | < 35 | < 33 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | < 38 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | < 45 | < 39.5 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | < 45 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | < 55 | < 45 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | < 52 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | < 65 | < 59.5 |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | < 67 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | < 75 | < 72.5 |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | < 80 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | < 85 | < 80 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | < 90 |
| Table Notes:  If the Aircraft/Vehicle is longer than 85 meters, or wider than 90 meters, then the bit encoding shall be set to an encoding of 15 decimal (1111 binary). | | | | | | | | | |

[4] 0 = Aircraft does not have ADS-B 1090 Extended Squitter Receive Capability

1 = Aircraft does have ADS-B 1090 Extended Squitter Receive Capability

[5] 0 = Aircraft does not have ADS-B UAT Receive Capability

1 = Aircraft does have ADS-B UAT Receive Capability

[6] 0 = Transponder will not illuminate the ATC/TCAS Control Panel Fail Lamp when and ADS-B Function Failure is active

1 = Transponder will illuminate the ATC/TCAS Control Panel Fail Lamp when an ADS-B Function Failure is active

[7] Navigation Source Configuration Data, Label 305 Words 1 and 2, may be provided for 0 to 7 Navigation Data Sources. When data is provided for more than 1 source, Words 1 and 2 are repeated for each source.

[8]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

[9] Configuration Version Number is encoded as follows:

|  |  |  |
| --- | --- | --- |
| **CONFIGURATION VERSION NUMBER ENCODING** | | |
| **BIT** | | **MEANING** |
| **22** | **21** |
| 0 | 0 | Version 0: Used by some suppliers prior to establishment of ARINC 718A Supplement 3 |
| 0 | 1 | Version 1: Established during ARINC 718A Supplement 3 to declare the Version of the Configuration Data being transferred in the Word.  This version also applies to ARINC 718A Supplement 4. |
| 1 | 0 | Reserved |
| 1 | 1 | Reserved |

Table 4-21b – Label 305 Block Transfer Word 1:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | | **Coding** | |
| 1  2 | Label 1st Digit  Label 1st Digit | | 3 | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | | 0 | 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | | 5 | 1  0  1 |
| 9 | LSB | Source Integrity Level (SIL) | 0-3 | [1] |
| 10 | MSB |
| 11 | SIL Supplement | | 0/1 [2] | |
| 12 | LSB | Lateral GPS Antenna Offset |  | [3] |
| 13 |  |
| 14 | MSB |
| 15 | LSB | Longitudinal GPS Antenna Offset |  | [4] |
| 16 |  |
| 17 |
| 18 |
| 19 | MSB |
| 20 | Spare | | 0 |  |
| 21 | Spare | | 0 |  |
| 22 | Spare | | 0 |  |
| 23 | Spare | | 0 |  |
| 24 | Spare | | 0 |  |
| 25 | Spare | | 0 |  |
| 26 | LSB | Word Number | 1 | [5] |
| 27 |  | 0 |
| 28 |  | 0 |
| 29 | MSB | 0 |
| 30 | LSB | SSM |  | [6] |
| 31 | MSB |
| 32 | Parity | | (Odd) | |

[1] Encode Source Integrity Level (SIL) as per the following table.

(Reference: RTCA DO-260B, Table 2-72).

|  |  |  |  |
| --- | --- | --- | --- |
| **SIL Coding** | | | **Probability of Exceeding the**  **NIC Containment Radius (RC)** |
| **(Binary)**  **Bit** | | **(Decimal)** |
| **10** | **9** |
| 0 | 0 | 0 | Unknown or > 1 × 10-3  per flight hour or per sample |
| 0 | 1 | 1 | ≤ 1 × 10-3  per flight hour or per sample |
| 1 | 0 | 2 | ≤ 1 × 10-5  per flight hour or per sample |
| 1 | 1 | 3 | ≤ 1 × 10-7  per flight hour or per sample |

[2] 0 = Probability of exceeding NIC radius of containment is based on “per hour”

1 = Probability of exceeding NIC radius of containment is based on “per sample”

(Reference: RTCA DO-260B, Table 2-41).

[3] If the Navigation Source is GPS, encode the Lateral GPS Antenna Offset as per the following table:

If the Navigation Source is Not GPS, then encode ALL ZERO’s which means “NO DATA”

(Reference: RTCA DO-260B, Table 2-66).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lateral GPS Antenna Offset Encoding** | | | | |
| **“ME” Bit**  **(Message Bit)** | | | **Upper Bound of the**  **GPS Antenna Offset**  **Along Lateral (Pitch) Axis**  **Left or Right of Longitudinal (Roll) Axis** | |
| **33**  **(65)** | **34**  **(66)** | **35**  **(67)** |
| **Label 305 Encoding** | | |
| **Bit 14** | **Bit 13** | **Bit 12** | **Direction** | **(meters)** |
| 0  (left) | 0 | 0 | LEFT | NO DATA |
| 0 | 1 | 0 < GO ≤ 2 |
| 1 | 0 | 2 < GO ≤ 4 |
| 1 | 1 | GO > 4 |
| 1  (right) | 0 | 0 | RIGHT | 0 |
| 0 | 1 | 0 < GO ≤ 2 |
| 1 | 0 | 2 < GO ≤ 4 |
| 1 | 1 | GO > 4 |
| Table Notes: | | | | |
| 1. Left means toward the left wing tip moving from the longitudinal center line of the aircraft.  2. Right means toward the right wing tip moving from the longitudinal center line of the aircraft.  3. Maximum distance left or right of aircraft longitudinal (roll) axis is 6 meters or 19.685 feet. If the distance is greater than 6 meters, then the encoding should be set to 6 meters.  4. The “No Data” case is indicated by encoding of “000” as above, while the “ZERO” offset case is represented by encoding of “100” as above.  5. The accuracy requirement is assumed to be better than 2 meters, consistent with the data resolution. | | | | |

[4] If the Navigation Source is GPS, encode the Longitudinal GPS Antenna Offset as per the following table:

If the Navigation Source is Not GPS, then encode ALL ZERO’s which means “NO DATA”

(Reference: RTCA DO-260B, Table 2-67).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Longitudinal Axis GPS Antenna Offset Encoding** | | | | | |
| **“ME” Bit**  **(Message Bit)** | | | | | **Upper Bound of the**  **GPS Antenna Offset**  **Along Longitudinal (Roll) Axis**  **Aft From Aircraft Nose**  **(meters)** |
| **36**  **(68)** | **37**  **(69)** | **38**  **(70)** | **39**  **(71)** | **40**  **(72)** |
| **Label 305 Encoding** | | | | |
| **Bit 19** | **Bit 18** | **Bit 17** | **Bit 16** | **Bit**  **15** |
| 0 | 0 | 0 | 0 | 0 | NO DATA |
| 0 | 0 | 0 | 0 | 1 | Position Offset Applied by Sensor |
| 0 | 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 0 | 1 | 1 | 4 |
| 0 | 0 | 1 | 0 | 0 | 6 |
| \* | \* | \* | \* | \* | \*\*\* |
| \* | \* | \* | \* | \* | \*\*\* |
| \* | \* | \* | \* | \* | \*\*\* |
| 1 | 1 | 1 | 1 | 1 | 60 |
| Table Notes: | | | | | |
| 1. Maximum distance aft from aircraft nose is 60 meters or 196.85 feet. If the distance is greater than 60 meters, then the encoding should be set to 60 meters.  2. The accuracy requirement is assumed to be better than 2 meters, consistent with the data resolution. | | | | | |

[5] If there is Configuration Data for more than one Navigation Source, Label 305 Word 1 Word Number will increment 1,3,5…

[6]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-21c – Label 305 Block Transfer Word 2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | | **Coding** | |
| 1  2 | Label 1st Digit  Label 1st Digit | | 3 | 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | | 0 | 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | | 5 | 1  0  1 |
| 9 | LSB | Receiver Number/Navigation Source Type | [1] |  |
| 10 |  |
| 11 |  |
| 12 | MSB |
| 13 | Receiver Number or  Navigation Source Type | | 0/1 | [1] |
| 14 | LSB | System Design Assurance (SDA) | 0 - 3 | [2] |
| 15 | MSB |
| 16 | LSB | Navigation Accuracy Category\_  Velocity (NACV) | 0 - 7 | [3] |
| 17 |  |
| 18 | MSB |
| 19 | Supplier Defined 1 | | 0/1 | [4] |
| 20 | Supplier Defined 2 | | 0/1 | [4] |
| 21 | Spare | | 0 |  |
| 22 | Spare | | 0 |  |
| 23 | Spare | | 0 |  |
| 24 | Spare | | 0 |  |
| 25 | Spare | | 0 |  |
| 26 | LSB | Word Number | 0 | [5] |
| 27 |  | 1 |  |
| 28 |  | 0 |  |
| 29 | MSB | 0 |  |
| 30 | LSB | SSM |  | [6] |
| 31 | MSB |
| 32 | Parity | | (Odd) | |

[1] Receiver Number or Navigation Source Type:

If Bit 13 = “0”, then the configuration data in Words 1 and 2 applies to the Navigation Source which is connected to the 429 receiver number indicated in Bits 9 – 12.

If Bit 13 = “1”, then the configuration data in Words 1 and 2 applies to the Navigation Source Type in accordance with the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Navigation Source Type Encoding** | | | | |
| **Label 305 Encoding** | | | | **Navigation Source Type** |
| **Bit**  **12** | **Bit**  **11** | **Bit**  **10** | **Bit**  **9** |
| 0 | 0 | 0 | 0 | GPS 1 |
| 0 | 0 | 0 | 1 | GPS 2 |
| 0 | 0 | 1 | 0 | IRS |
| 0 | 0 | 1 | 1 | FMS |
| 0 | 1 | 0 | 0 | Hybrid GPS/IRS |
| 0 | 1 | 0 | 1 | Reserved |
| All Other combinations | | | | Undefined |

[2] Encode System Design Assurance (SDA) as per the following table.

(Reference: RTCA DO-260B, Table 2-65).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **System Design Assurance (SDA) Encoding** | | | | |
| **SDA Value** | | **Supported Failure Condition Note 2** | **Probability of Undetected Fault causing transmission of False or Misleading Information Note 3,4** | **Software & Hardware Design Assurance Level Note 1,3** |
| **(decimal)** | **(binary)**  **(Bit 15,14)** |
| 0 | 0 0 | Unknown/ No safety effect | > 1x10-3 per flight hour or Unknown | N/A |
| 1 | 0 1 | Minor | ≤ 1x10-3 per flight hour | D |
| 2 | 1 0 | Major | ≤ 1x10-5 per flight hour | C |
| 3 | 1 1 | Hazardous | ≤ 1x10-7 per flight hour | B |
| Table Notes: | | | | |
| 1. Software Design Assurance per RTCA DO-178B (EUROCAE ED-12B). Airborne Electronic Hardware Design Assurance per RTCA DO-254 (EUROCAE ED-80).  2. Supported Failure Classification defined in AC-23.1309-1C, AC-25.1309-1A, and AC 29-2C.  3. Because the broadcast position can be used by any other ADS-B equipped aircraft or by ATC, the provisions in AC 23-1309-1C that allow reduction in failure probabilities and design assurance level for aircraft under 6000 pounds do not apply.  4. Includes probability of transmitting false or misleading latitude, longitude, or associated accuracy and integrity metrics. | | | | |

[3] Encode Navigation Accuracy Category\_Velocity (NACV) as per the following table.

(Reference: RTCA DO-260B, Table 2-22).

|  |  |  |
| --- | --- | --- |
| **Navigation Accuracy Category for Velocity** | | |
| **Coding** | | **Horizontal Velocity Error** |
| **(Binary)**  **(Bit 20, 19, 18)** | **(Decimal)** |
| 0 0 0 | 0 | Unknown or > 10 m/s |
| 0 0 1 | 1 | < 10 m/s |
| 0 1 0 | 2 | < 3 m/s |
| 0 1 1 | 3 | < 1 m/s |
| 1 0 0 | 4 | < 0.3 m/s |
| 1 0 1 | 5 | Unknown |
| 1 1 0 | 6 | Unknown |
| 1 1 1 | 7 | Navigation Source Provides NACV Parameter Information |

[4] Provisions should be provided to set Supplier Defined bits to either state

[5] If there is Configuration Data for more than one Navigation Source, Label 350 Word 2 Word Number will increment 2, 4, 6…..

[6]

|  |  |  |
| --- | --- | --- |
| **DISCRETE SSM** | | |
| **BIT** | | **MEANING** |
| **31** | **30** |
| 0 | 0 | Normal Operation |
| 0 | 1 | No Computed Data |
| 1 | 0 | Functional Test |
| 1 | 1 | Failure Warning |

Table 4-22 - DITS Control Word for TCAS and Mode S Transponder – Label XXX

|  |  |  |  |
| --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | |
| 1 | Label 1st Digit | X | MSB |
| 2 | Label 1st Digit |  | LSB |
| 3 | Label 2nd Digit | X | MSB |
| 4 | Label 2nd Digit |  |  |
| 5 | Label 2nd Digit |  | LSB |
| 6 | Label 3rd Digit | X | MSB |
| 7 | Label 3rd Digit |  |  |
| 8 | Label 3rd Digit |  | LSB |
| 9 | SDI |  |  |
| 10 | SDI |  |  |
| 11 | LSB |  | |
| 12 |  |  | |
| 13 | First Character of |  | |
| 14 |  | Encoded in  IA-5 | |
| 15 | Aircraft Type | See Table 4-8 | |
| 16 |  |  | |
| 17 | MSB |  | |
| 18 | Pad | 0 | |
| 19 | LSB |  | |
| 20 |  |  | |
| 21 | Second Character of |  | |
| 22 |  | Encoded in  IA-5 | |
| 23 | Aircraft Type | See Table 4-8 | |
| 24 |  |  | |
| 25 | MSB |  | |
| 26 | Pad | 0 | |
| 27 | Future Spare |  |  |
| 28 | Future Spare |  |  |
| 29 | Future Spare |  |  |
| 30 | SSM |  |  |
| 31 | SSM | [1] | |
| 32 | Parity | (Odd) |  |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-23 – DITS Control Word for TCAS and Mode S Transponder – Label XXX

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bit** | **Function** | **Coding** | | |
| 1 | Label 1st Digit | X | MSB | |
| 2 | Label 1st Digit |  | LSB | |
| 3 | Label 2nd Digit | X | MSB | |
| 4 | Label 2nd Digit |  |  | |
| 5 | Label 2nd Digit |  | LSB | |
| 6 | Label 3rd Digit | X | MSB | |
| 7 | Label 3rd Digit |  |  | |
| 8 | Label 3rd Digit |  | LSB | |
| 9 | SDI |  |  | |
| 10 | SDI |  |  | |
| 11 | LSB |  | | |
| 12 |  |  | | |
| 13 | Third Character of |  | | |
| 14 |  | Encoded in IA-5 | | |
| 15 | Aircraft Type | See Table 4-8 | | |
| 16 |  |  | | |
| 17 | MSB |  | | |
| 18 | Pad | 0 | | |
| 19 | LSB |  | | |
| 20 |  |  | | |
| 21 | Fourth Character of |  | | |
| 22 |  | Encoded in  IA-5 | | |
| 23 | Aircraft Type | See Table 4-8 | | |
| 24 |  |  | | |
| 25 | MSB |  | | |
| 26 | Pad | 0 | | |
| 27 | Future Spare |  | |  |
| 28 | Future Spare |  | |  |
| 29 | Future Spare |  | |  |
| 30 | SSM |  | |  |
| 31 | SSM | [1] | | |
| 32 | Parity | (Odd) | |  |

1. Sign Status Matrix (SSM), See Note 12 on Attachment 3A of this document.

Table 4-22 – Aircraft Type 1st Word Label XXX

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | X 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | X 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | X 0  0  1 |
| 9 | SDI =00 |  |
| 10 |
| 11 | LSB |  |
| 12 | 1st Aircraft Type | Encoded in IA-5 |
| 13 |
| 14 |
| 15 |
| 16 |
| 17 | MSB |  |
| 18 | LSB |  |
| 19 | 2nd Aircraft Type | Encoded in IA-5 |
| 20 |
| 21 |
| 22 |
| 23 |
| 24 | MSB |  |
| 25 | LSB |  |
| 26 | 3rd Aircraft Type | Encoded in IA-5 |
| 27 |
| 28 |
| 29 |
| 30 |
| 31 | MSB |  |
| 32 | Parity | (Odd) |

Table 4-23 – Aircraft Type 2nd Word Label XXX

|  |  |  |
| --- | --- | --- |
| **Bit** | **Function** | **Coding** |
| 1  2 | Label 1st Digit  Label 1st Digit | 3 1  1 |
| 3  4  5 | Label 2nd Digit  Label 2nd Digit  Label 2nd Digit | 0 0  0  0 |
| 6  7  8 | Label 3rd Digit  Label 3rd Digit  Label 3rd Digit | 1 0  0  1 |
| 9 | SDI =00 |  |
| 10 |
| 11 | LSB |  |
| 12 | 4th Aircraft Type | Encoded in IA-5 |
| 13 |
| 14 |
| 15 |
| 16 |
| 17 | MSB |  |
| 18 | Pad | 0 |
| 19 | 0 |
| 20 | 0 |
| 21 | 0 |
| 22 | 0 |
| 23 | 0 |
| 24 | 0 |
| 25 | 0 |
| 26 | 0 |
| 27 | 0 |
| 28 | 0 |
| 29 | 0 |
| 30 | 0 |
| 31 | 0 |
| 32 | Parity | (Odd) |

**ACTIVE AND NEXT WAYPOINT IDENTIFICATION**

Trajectory Data

The transponder interface has been designed to allow the receipt of trajectory change point data once it is available from the FMC. Two FMS input ports are provided for each FMC: “FMC/GNSS IN #1” and “FMC IN #2.” Two ports have been assigned to support common existing FMC configurations where the Flight ID is available on the FMC/Gen In #2 output bus but the other Enhanced Surveillance and Extended Squitter data is generally only available on a Display bus output. In the future, with the introduction of the ASAS bus in the FMC 702A, it is expected that all FMC data required by the transponder, including trajectory change points, will be made available on this single bus. Transponder manufacturers should ensure that both FMC ports are capable of handling the full range of data expected. Installers should consider the provisioning of connections to the FMC ASAS bus, particularly where only one bus is required at initial installation.

Final industry agreement has not been reached on the form and extent of trajectory data and therefore detail on the data has not been included in this standard. For the definition of the data and data format likely to be available on the ASAS bus, reference should be made to ARINC Characteristic 702A.

1. DLP INTERFACE
   1. Mode S/Data Link Processor Interface Bus

The Mode S/Data Link bus utilizes a high-speed version (100 kbps) of ARINC 429, together with a special version of the ARINC 429 file data transfer protocol. The protocol utilizes the standard 32-bit ARINC 429 word and electrical characteristics; however, the meanings associated with the 32 bits have been redefined to provide for transfers of data blocks or records.

* + 1. Basic Data Exchange Protocols

Attachment 5, Figure 1 shows the various field assignments for all transmitted and received Data Link Processor bus words. The word number field is used to represent which data word has been transmitted. This number is ordered in a sequential manner for data words from 1 through 24. Preceding the data words are the “Request-to-Send” (RTS) and the “Clear-to-Send” (CTS) words. These have been assigned the word number of zero. Following the data words is the “Checksum” word which is a checksum of all of the data words, and the “Acknowledge” of which data words have been properly received. The “Checksum” and “Acknowledge” control words have been assigned a word number of all ONE'S in binary, or 31 decimal.

Attachment 5, Figure 1 also shows the T/R field which is used to indicate to the protocol whether the received word was the result of an initiator of data (transmitter of data) or a responder to an initiator (receiver of data). If the T/R field is a ONE, the word has been sent by a transmitter of data. If the T/R field is a ZERO, the word has been sent by a receiver of data. This provision in the protocol will permit the simultaneous transmission of data in both directions across the bus interface. The “CTS” bit is used to indicate when a “Clear-to-Send” has been acknowledged by a receiver. Attachment 5 Figure 2 is an example of the transmission of 3 data words with their associated word numbers.

* + - 1. Detailed Example and Discussion of the Data Exchange Protocols

Attachment 5, Figure 2 is an example of the transmission of 3 data words. The “Request-to-Send” is a transmitter word so T/R is a ONE and the No. Words field contains the number 3 in binary. The “Clear-to-Send” is sent by the receiver so its T/R field is “0” and the “CTS” field indicates that it is Clear-to-Send so its value is a “1.” Bits 8 through 26 are unused in “Request-to-Send” and “Clear-to-Send” words. The No. Words field is an echo of the “Request-to-Send” value which in this example is “3.” This sequence of control words is followed by three data words. Each data word has a word number of 1 through 3. T/R is a “1” and the data field for each word is 24 bits (8 through 31).

The Checksum word is sent by the transmitter after all data words have been sent. The Checksum is generated by the arithmetic addition of the binary values of bits 8 through 31 of all data words, the carry bit being propagated from bit 8 to 31 and the overflow discarded. In this example, it consists of the addition of 3 data fields (bits 8 through 31 of each data word).

If a word has been missed or was received with the wrong parity, the corresponding bit for that word will be reset in the Words Received Field of the “Acknowledge” word. The transmitter will then re-transmit the non-received words without a “Request-to-Send.” If the receiver does not agree with the Checksum bits 8 through 31, the response in the Words Received Field of the receiver control word will be all set to “0”. This will indicate that all words must be repeated by the transmitter.

The data words will then be followed by the “Checksum” and “Acknowledge” words to close out the transaction. If the correct data is not received after the second try, the data bus will be declared invalid by the protocol logic with the setting of a pending Data Link Bus Fail flag. An attempt will then be made to re-establish the data link bus by the transmission of 10 equally spaced “zero word” “Request-to-Send” messages within a 100 msec time period. If communications are re-established, the message that was not received is re-transmitted. If communications are not re-established, then a Data Link Bus Fail flag is set, and the non-received message is cleared out of its associated buffer.

Figures 3, 4, and 5 of Attachment 5 are high level flow diagrams of the software required to implement the protocol. Figure 3 is the flow diagram of a bus test done only by the transponder once every three seconds during normal operation and then every 10 msec during an interfering noise burst or bus failure for up to 100 msec. The three second bus test interval is used to provide a periodic test of the bus during the time when no data link messages are being transmitted, and the 10 msec interval is used to provide a recovery mode during momentary noise bursts. A bus test is accomplished by sending a “Request-to-Send” where the No. Words field is zero. If a valid “Clear-to-Send” is received with the No. Words field also equal to zero, the bus test passes. If after two tries, a valid “Clear-to-Send is not received, the bus test fails for that interval of time.

Figure 4 of Attachment 5 is the transmitter logic flow diagram and Figure 5 is the receiver logic flow diagram. Attachment 5 Figure 6 is a diagram of the reserved data word for all transponder-to-DLP data transfers and Attachment 5 Figure 7 is a diagram of the reserved data word for all DLP-to-transponder data transfers. This reserved word is either the first word transmitted in case of data transfers or is sent as a single word containing control information. The reserved word always has a word number of “1.” These words are used to interface to the ground/air protocol as described in the following sections.

* + 1. Data Exchange Protocols for Uplink Message
       1. Surveillance and Comm-A Interrogations

The transponder should be capable of presenting the content, except the 24-bit address (“AP”) field, of all properly decoded Comm-A (UF = 20 and 21) and surveillance (UF = 4 and 5) uplink transmissions, to the XPDR/DLP bus. The 24-bit Mode S address field (“AP”) should not be transferred. The content should be available within one second after reception of a normal transmission. All RF message bits are transmitted as received, i.e., the first received bit nearest to the ARINC-429 label.

* + - * 1. Transaction Rates

The transponder should be capable of handling at least 50 surveillance or Comm-A interrogations arbitrarily spaced in a one second period.

* + - * 1. Data Storage

The transponder should be capable of temporarily storing for high-speed ARINC 429 output the first 32 bits and the entire “MA” field (if a Comm-A) of at least 50 Mode S interrogations for transfer across the data bus.

* + - * 1. Data Transfer

The transfer of data to the Data Link Processor will consist of a three (for a surveillance interrogation) or a five (for a Comm-A interrogation) word data block. The first word should be the reserved word for data exchange control information, while the words following this word contain the data to be transferred. The field definition of the XPDR to DLP word 1 is shown in Attachment 5 Figure 6.

Surveillance Interrogation

For the transfer of a surveillance interrogation message, the following codes should be contained in word 1:

UDT = 0 (Data transfer of an interrogation)

UMT = 1 (Surveillance interrogation, UF = 4 or 5)

RCN = 0 (Not Defined)

UII = As specified in the “IIS” field of the Interrogation

CRN = 0 (No ELM Data)

LRI = 1 (Last Record)

The surveillance interrogation consists of 32 bits, if considered without the “AP” field which is not transferred. Word 2 will thus contain the first 24 bits and word 3 will contain the last 8 bits, which should be located in bit positions 8 through 15.

Comm-A Interrogation

For the transfer of a Comm-A interrogation, the following codes should be contained in word 1:

UDT = 0 (Data Transfer of an interrogation)

UMT = 2 (Comm-A Interrogation, UF = 20 OR 21)

RCN = 0 (Not Defined)

UII = As specified in the “IIS” field of the Interrogation

CRN = 0 (No ELM Data)

LRI = 1 (Last Record)

A Comm-A interrogation consists of 88 bits (without the “AP” field). For its transfer, the first 72 bits are contained in words 2 to 4 (3 X 24 bits) and the last 16 bits in word 5 are located in bit positions 8 through 23. It is important to note that the Comm-A RF link protocol is transparent to the transponder.

Comm-A Broadcast

For the transfer of a broadcast Comm-A interrogation, the following codes should be contained in word 1:

UDT = 0 (Data transfer of an interrogation)

UMT = 3 (Broadcast Comm-A interrogation,

UF = 20 or 21, A = 24 Ones)

RCN = 0 (Not Defined)

UII = As specified in the “IIS” field of the Interrogation

CRN = 0 (No ELM Data)

LRI = 1 (Last Record)

* + - 1. Uplink Extended Length Message

(ELM) Transfer

* + - * 1. Uplink (ELM) Comm Data

Capabilities

For uplink ELM transfers, the transponder should be capable of temporarily storing the entire contents of the uplink ELM message. This content should be available at the Data Bus interface within four seconds after reception of a complete uplink ELM.

* + - * 1. Transaction Rates

The transponder should be capable of handling at least 4 complete 16-segment Uplink ELMs in 4 seconds.

* + - * 1. Data Storage

The transponder should be capable of temporarily storing for high-speed ARINC 429 output the entire contents of at least four complete 16-segment Uplink ELMs for transfers across the data bus.

* + - * 1. Data Transfer

An Uplink ELM consists of from 2 to 16 segments. Each segment contains 88 bits (without the “AP” field).

The transfer of Uplink ELM data to the Data Link Processor consists of up to 62 data words in up to 3 records. The first record should contain up to 6 segments of uplink ELM data and the first word is the reserved word for the ELM control functions as shown in Figure 6. It should contain the following codes:

UDT = 0 (Data Transfer of an Interrogation)

UMT = 4 (Uplink ELM, UF=20)

RCN = 0 (Not Defined)

UII = As specified as Comm-C II in the transponder (“II” responsible

for the current uplink ELM)

CRN = 1 (First record for Comm-C segments with “NC” values of 0

through 5)

LRI = 1 If last record, else LRI = 0

The “CRN” field is used to identify the data of the current record. The first word of each record contains the same codes as specified above, except for the “CRN” and “LRI” codes. For records 2 and 3, “CRN” and “LRI” are coded as follows:

CRN = 2 (Second record for Comm-C segments with “NC” values 6

through 11)

LRI = 1 if last record, else LRI = 0

CRN = 3 (Third record for Comm-C segments with “NC” values 12 through

15)

LRI = 1 (Last Record)

In case of a 16-segment Uplink ELM, the last word of Comm-C data should contain the last two bytes of the last transferred segment in bit locations 8 through 23. Bits 24 through 31 of this last word should remain unused.

After each record has been transmitted, a “Checksum” should be sent followed by an “Acknowledge” and a repeat of the missed words, if required, per the protocol of Section A5.1.1. A new “Request-to-Send,” “Clear-to-Send” sequence is started for each of the second and third records. Each record should then be followed by the “Checksum/Acknowledge” sequence. Before the initiation of an Uplink ELM transfer to the DLP can begin, all segments of the message must be received and stored within the transponder.

* + 1. Data Exchange for Downlink Messages

The transponder should be capable of accepting data for every downlink field that is not generated internally by the transponder for transmission to the ground. Such acceptance should begin before the start of the reply transmission. All RF message bits are sent with the first bit to be transmitted nearest to the ARINC 429 label.

* + - 1. Data for Comm-B Messages
         1. Transaction Rates

The transponder should be capable of 16 Comm-B replies in any one second interval.

* + - * 1. Data Storage

The transponder should be capable of pre-storing 256 Comm-B message segments (“MB”: field with 56 bits) associated with ground-initiated Comm-B messages within an internal memory buffer. Each message register can be addressed by the 8-bit “BDS” code.

Air-initiated messages received from the Data Link Processor should be stored in a FIFO type of arrangement with each register capable of storing an air-initiated Comm-B message together with its message number as specified in the “RCN” field. Each register should be addressable by a message number “RCN” and should in addition provide storage for the “UII” code.

Broadcast messages should be stored in a separate, FIFO, since this message type will not consist of linked segments.

* + - * 1. Data Transfer

The transfer of one Comm-B segment from the Data Link Processor to the transponder will consist of four data words. The first word will be the reserved word followed by three words containing the 56 bits of the Comm-B message. Figures 1 through 7 show the field definition for word 1. The Comm-B segment itself is contained in words 2 to 4, word 4 containing the last 8 bits located in bit positions 8 through 15.

Ground-Initiated Comm-B Data

For the transfer of ground-initiated Comm-B message data, the following codes should be contained in the DLP to XPDR, Word 1:

DDT = 0 (Transfer of reply data)

DMT = 0 (Ground-initiated Comm-B)

RCN = 0 (Not Defined)

DII = 0 (Not Defined)

BDS = As specified for the content of the message

DRN = 0 (No ELM data)

LRI = 1 (Last Record)

Note that the “BDS” code specifies the register address of the internal transponder Comm-B data buffer. The first 8 bits in the Comm-B message may or may not contain this “BDS” code.

Air-Initiated Comm-B Data

For the transfer of a single segment air-initiated Comm-B message, the following codes should be contained in the DLP to XPDR word 1:

DDT = 0 (Transfer of reply data)

DMT = 1 (Air-initiated Comm-B)

RCN = According to current message register for air-initiated Comm-B in the DLP

DII = As specified by the DLP

BDS = 0

DRN = 0 (No ELM Data)

LRI = 1 (Last Record)

The transponder should provide storage specifically for air-initiated Comm-B messages. Each message should be stored in a FIFO type of arrangement. Each register should relate to one message and is addressed by the message number “RCN.” This technique should be applied because an air-initiated Comm-B message will be stored in the DLP as well as in the transponder. If the message is successfully delivered to the ground, the transponder receives a Comm-B closeout command from the ground, whereon the transponder transfers this information to the DLP (see Section A5.1.3.1.3.4). The DLP will then clear the message which is associated with the message number.

Up to four Comm-B segments may be linked to form a single message. The initial segment of a linked Comm-B message should be transferred to the transponder last and with the coding in word 1 a specified above (“BDS” = 0). The other segments which are transferred before the initial segment, may be transferred in any order. For the transfer of these other segments, coding in word 1 is as above except that the “BDS” code should be 2, 3, or 4 for the second, third, or fourth segments, respectively. This protocol ensures that the entire message is stored in the transponder before the transponder initiates the protocol for linked Comm-B delivery.

Note: The transponder should not process for delivery any segment of a linked Comm-B message until any previously linked Comm-B message has been properly closed-out or cancelled. The transponder will insert the second and, if appropriate, the third and fourth segments of the next linked Comm-B message for delivery into the registers reserved for ground-initiated Comm-B delivery addressed by “BDS” = 2, 3, and 4 respectively. The first segment is then delivered using the air-initiated Comm-B protocol. Coding in the “MB” field of this segment will indicate to the ground that this is part of a linked Comm-B message and the following segments(s) may be obtained by the ground-initiated Comm-B protocol using the appropriate “BDS” code(s).

Air-Initiated Comm-B Broadcast Data

For the transfer of air-initiated Comm-B broadcast data, the following codes should be contained in the DLP to XPDR word 1:

DDT = 0 (Transfer of reply data)

DMT = 2 (Air-initiated Comm-B broadcast)

RCN = According to current message register for air-initiated Comm-B broadcast in the DLP

DII = As specified by the DLP

BDS = 0 (Not Defined)

DRN = 0 (No ELM data)

LRI = 1 (Last Record)

The DLP should provide storage specifically for air-initiated broadcast Comm-B messages. These messages should be stored in a FIFO type of arrangement. Each register should relate to one message and is addressed by the message number “RCN.”

Comm-B Message Closeout

After receipt of a Comm-B closeout command, the transponder should inform the DLP about the successful delivery of the Air-initiated message. This information is transferred to the DLP by the transmission of a XPDR to DLP word 1 containing:

UDT = 1 (Air-initiated Comm-B closeout)

UMT = 0 (Not defined)

RCN = Message number of the message that has been closed out

UII = 0 (Not Defined)

DRN = 0 (Not Defined)

LRI = 1 (Last Record)

Cancellation of Air-Initiated Comm-B Message

If the DLP wants to cancel an air-initiated Comm-B message, which has already been delivered to the transponder, it should initiate a transfer of a DLP to XPDR word 1 containing:

DDT = 1 (Cancel message with message type and number as specified)

DMT = 1 (air-initiated Comm-B)

RCN = message number of the message to be cancelled.

DII = 0 (Not Defined)

BDS = 0 (Not Defined)

DRN = 0 (No ELM data)

LRI = 1 (Last Record)

Comm-B Broadcast Timeout

When a timeout of the 18 ± 1 second Comm-B broadcast timer has occurred in the Mode S transponder, a XPDR to DLP word 1 should be transferred containing:

UDT = 2 (Broadcast Comm-B timeout)

UMT = 0 (Not defined)

RCN = Message number of the message that has timed out

UII = 0 (Not Defined)

CRN = 0 (No ELM data)

LRI = 1 (Last Record)

The DLP should then clear its copy of the message that has timed out.

* + - 1. Downlink ELM Comm Data

Capabilities

Comm-D capability is not required by this document. Information on Comm-D is included herein for completeness only. If this capability is provided, the transponder should be capable of storing all Comm-D segments pertaining to the downlink ELM message prior to its transmission to the ground.

* + - * 1. Transaction Rates

If the transponder has a Comm-D capability it should be capable of transmitting at least one 4-segment ELM in any 4-second period.

* + - * 1. Data Storage

If the transponder is equipped to handle Comm-D downlink messages, it should be capable of pre-storing all Comm-D segments prior to transmission within an internal memory buffer. The minimum requirement for storage should be for 5 Comm-D segments. This includes a minimum capability of 4 segments plus a 25 percent reserve capability.

* + - * 1. Data Transfer

A downlink ELM consists of from 2 to 16 segments. Each segment contains 88 bits (without the “AP” field). The transfer of Downlink ELM data to the transponder consists of up to 62 data words in up to 3 records. The first record will contain up to 6 segments of downlink ELM data and the first word of this record is the reserved word for the ELM control functions as shown in Figure 7. It should contain the following codes:

DDT = 0 (Transfer of reply data)

DMT = 3 (Downlink ELM)

RCN = According to current message register for downlink ELM in the DLP

DII = as specified by DLP

BDS = 0 (Not Defined)

DRN = 1 (First record of Comm-D segments with ND values 0 through 5)

LRI = 1 if last record, else LRI = 0

The DRN field is used to identify the data of the current record. The first word of each record contains the same codes as specified above, except the DRN and LRI codes.

For records 2 and 3, DRN and LRI are coded as follows:

DRN = 2 (Second record of Comm-D segments with ND values 6 through 11)

LRI = 1 if last record, else LRI = 0

DRN = 3 (Third record of Comm-D segments with ND values 12 through 15)

LRI = 1 (Last Record)

In the case of a 16-segment Downlink ELM, the last word of Comm-D data will contain the last two bytes of the last transferred segment in bit locations 8 through 23. Bits 24 through 31 of this last word will remain unused.

After each record has been transmitted a “Checksum” will be sent followed by an “Acknowledge” and a repeat of the missed words, if required, per the protocol of Section A5.1.1. A new “Request-to-Send,” “Clear-to-Send” sequence is started for each of the second and third records. Each record will then be followed with the Checksum/Acknowledge sequence. Comm-D downlink may be directed or non-directed as specified by the coding in the DII field shown in Figures 1 through 7.

* + - * 1. Cancellation of a Downlink ELM

If the DLP wants to cancel a downlink ELM, which has already been delivered to the transponder, it should initiate a transfer of a DLP to XPDR word 1 containing:

DDT = 1 (Cancel message with message type and number as specified)

DMT = 3 (Downlink ELM)

RCN = Message number of the message that should be cancelled

DII = 0 (Not defined)

BDS = 0 (Not defined)

DRN = 0 (Not defined)

LRI = 1 (Last Record)

* + - * 1. Downlink ELM Closeout

After receipt of a downlink ELM close out command, the transponder should inform the DLP about the successful deliver of the air-initiated message. This information is transferred to the DLP by the transmission of an XPDR to DLP Word 1 containing:

UDT = 3 (Downlink ELM closeout)

UMT = 0 (Not Defined)

RCN = Message number of the message that has been closed out

UII = 0 (Not Defined)

DRN = 0 (Not Defined)

LRI = 1 (Last Record)

* 1. Extended Length Message (ELM) Transfer
     1. Comm-C/Comm-D ELM Protocol

Extended-length message (ELM) protocol provides for more efficient transmission of long data link messages to aircraft by permitting the grouping of up to 16 message segments into a single entity which can be acknowledged by a single reply. Each segment is included in a single Comm-C transmission. (The limit of 16 segments refers solely to the manner in which the message is transferred over the link. Longer messages can be accommodated through the use of a message continuation indicator within an ELM.)

* + - 1. Ground-to-Air ELM Transfer

Ground-to-air extended-length messages are transmitted using the Comm-C format with three different reply type codes (RC = 00, 01 and 10). The three reply type codes designate an initializing segment, intermediate segment(s), and a final segment.

Note: The minimum length of a ground-to-air ELM is two segments. The transfer of up to 16 segments may take place without intervening air-to-ground replies, as described in the next four paragraphs. In this way, channel loading is minimized. Message segments (one per Comm-C interrogation) may be transmitted at a rate of up to one per 50 µsec. This minimum spacing is required to permit the resuppression of ATCRBS transponders. Delivery of the message may take place during a single scan or over a few scans depending on the length of the message, the channel interference level, and the sensor loading. The delivery of no more than four ground-to-air ELMs during a single scan will be attempted; the nominal interval between successive scans is four seconds.

* + - * 1. Initializing Segment Transfer

The ELM transaction for an N-segment message (segment numbers 0 through N-1) is initiated by a Comm-C interrogation with RC = 00. The transponder does not reply. Receipt of this interrogation (in effect a “dial-up”) causes the transponder ELM function to prepare for a new ELM transfer. Also delivered in the initial call is the text of the final message segment in MC, and its segment number (N-1) in the NC field.

Note: This “last segment first” protocol is used to inform the transponder of the length of the message. If the transponder ELM processor fails to receive an initializing segment, it may either ignore or store the data content of all further segments of the same message since the interrogator will retransmit the entire message (see Section A5.2.1.1.4), initializing segment and all other segments, without change.

* + - * 1. Intermediate Segment Transfers

Message delivery proceeds with the transmission of intermediate segments (any sequence of N-2 segments chosen from segments N-2 through 0) via Comm-C interrogations with RC = 01, again triggering no replies. Each message segment is identified with its segment number in the NC field. The transponder ELM processor stores each segment in the appropriate storage location based upon this number. In this way, the transponder ELM processor reassembles the message, and its bookkeeping function keeps track of which segments have been received.

Note: Intermediate segments may be delivered in any order once the ELM processor has been initialized with segment N-1. If the entire message consists of only two segments, there will be no intermediate transfers.

* + - * 1. Final Segment Transfer

The interrogator transmits the final segment of a Comm-C interrogation with RC = 10. Its segment number (any number from 0 to N-2) is in NC, and the text is transmitted in MC. This RC code elicits a Comm-D reply with K = 1 and a cumulative Transponder Technical Acknowledgement in the MD field. The cumulative Transponder Technical Acknowledgement (TA) consists of a bit string (maximum length 16 bits) that indicates which segments of the ELM have been received. The first bit represents the state of the first (N-0) segment, etc., with the states defined as: 1 = segment received, and 0 = segment not received. (The remaining 64 bits of MD are spares and should be transmitted as all “0”) Thus at all times this field represents the current status of segment delivery from the time of ELM initiation. If the interrogator does not receive a reply to the Comm-C interrogation containing the final segment, this interrogation is repeated until a reply is successfully received. When all segments have been received by the transponder, the interrogator knows that its last transfer was indeed final and closes out the transaction by the transmission of a special Comm-C interrogation with RC = 11, NC = 0001 and bit 9 = 1, thereby resetting the TA field and any other bookkeeping registers in the transponder. This “Clear Comm-C” interrogation elicits a single Comm-D reply (with arbitrary message content), which serves as a technical acknowledgement to the interrogator.

To expedite the display of the message, the ELM processor in the transponder transfers the message to the appropriate output device as soon as it senses the presence of all segments (i.e., it does not await the receipt of the Clear Comm-C interrogation). However, output transfer should be enabled only once for each ground-to-air ELM message to avoid displaying the same message more than once in the event of retransmission due to TA delivery failure.

Note: The interrogator will always send a Clear Comm-C message after partial delivery of an ELM which it wishes to cancel, as well as after normal complete delivery. This procedure ensures that there will be no confusion between segments of successive ELMs, even if the initializing segment of the second ELM is subject to link failure.

* + - * 1. Segments Not Received by Transponder

If one or more segments of the ELM are not received by the transponder, this fact is indicated by “0” in the corresponding bit positions in the TA. If the TA indicates that the initializing segment was not received, the interrogator retransmits the entire message. If segments other than the initializing segment are missing, they are retransmitted with RC = 01, except for the last of the missing segments which has RC = 10 to request an updated TA. This process continues until the ground receives a cumulative TA indicating that all segments have been delivered. At that point, the transaction is closed out as described above. If standard Mode S contact is lost (i.e., if more than nominally 16 seconds has elapsed since the transponder last replied to a discrete address interrogation with IT = 1) before a ground-to-air transaction is closed out, the transponder ELM registers should be returned to their initial (power ON) state.

* + 1. ELM Data Transfer Interface Standards

This Section describes the system for transfer of ELM contents between the transponder and an on-board device that accepts ELM data. Adherence to the standards of this ELM transfer system is necessary to assure transponder unit interchangeability.

* + - 1. General Description

In Mode S transponder ELM transfer, the transponder sporadically has available, for transmission to other on-board equipment, information received from the ground. Since the Mode S ground-transponder-ground communication link is completely controlled on the ground, the airborne transfer system must be controlled by the transponder in a manner that is compatible with the Mode S ELM protocol as described above. The on-board transfer system includes a transponder output port for transfer over single twisted and shielded pair of wires to the on-board device using or distributing Mode S ELM ground-to-air information.

* + - 1. Data Transfer System Standards

The data transfer system to be used for ELM outputs from the transponder should be that described in ARINC Specification 429, Mark 33 Digital Information Transfer System (DTIS).

Each ELM uplink segment contains 9 “overhead” bits, 80 information bits and 24 Mode S address/parity bits. Six 32-bit ARINC 429 DITS words will be used in the handling of each ELM segment, in the manner described in the following paragraphs. The Mode S/address parity bits are not transferred out of the transponder.

* + 1. ELM Uplink Transactions
       1. ELM Uplink Data Storage

The transponder should receive and temporarily store uplink ELM data in accordance with ELM communication link protocol as described in Section A5.2.2.1 above. The transponder should have capacity for handling up to four complete 16-segment ELMs once every four seconds with all Mode S communication link transactions spaced within a single 25 msec interval. The transponder should be capable of output transfer of such data within four seconds after reception and validation of each complete ELM.

* + - 1. ELM Output Data Word Format

ELM data output should be ARINC 429 low-speed in the form of 32-bit words with a minimum gap of 4 bit intervals between words, and with word structure as illustrated in Figure 8. Order of output transmission of complete ELMs should be in the order received. Order of transmission of ELM segments should be in order of increasing NC number. The order of transmission of 32-bit words containing segment data should be in the order of reception of constituent data. Each complete ELM should be transferred out via the transponder output ports one time only. After transmission of a given ELM is completed, the temporary storage location for this data may be cleared and become available for succeeding uplink ELM transaction data.

* + - 1. ELM Output Data Priority

An ELM uplink communication transaction is complete when all scheduled segments have been received by the transponder, as described in Section A5.2.1. When a given ELM uplink communication transaction is complete, the stored ELM may be transferred out of the transponder. However, ELM data output transmission should be initiated only if no standard message data is stored for output transmission. When an ELM output transmission is initiated, the transfer should continue to completion of the output transfer of the ELM.

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL



WORD ONE

Received/Data LSB

(1=Received)

(0=Repeat)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| T/R | 1 | = | Transmit Control/Data Word, Checksum |
|  | 0 | = | Clear to Send, Words Ack. |
|  |  |  |  |
|  |  |  |  |
| CTS | 1 | = | Clear to Send |
|  | 0 | = | Not Clear to Send, Transmit Control, Checksum |
|  |  |  |  |
|  |  |  |  |
| Word No. | 0 | = | Transmit Control, Clear to Send |
|  | 1 - 24 | = | Word No. |
|  | (All ones) 31 | = | Checksum, Words Ack. |
|  |  |  |  |
|  |  |  |  |
| No. Words CTS | 0 | = | Bus Test (No data transmitted) |
|  | 1 - 24 | = | No. of words to be transmitted |
|  | 25 - 31 | = | Reserved |
|  |  |  |  |
|  |  |  |  |
| CHECKSUM |  |  | Whenever a checksum is sent it always represents the checksum of the 24-bit data fields for the entire message. |
|  |  |  |  |

Figure 1 – Data Link Bus Fields

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL

Figure 2 – Data Link Bus Example

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL

Figure 3 – Data Link Bus Test

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL

Notes:

**ARINC CHARACTERISTIC 718A - Page 122**

**ATTACHMENT 5**

**DLP INTERFACE**

**TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL**

1. Checksum is always the sum of the 24-bit words of the entire message. Even when repeating unreceived data, the checksum is the sum of the data within the entire message.

2 All ARINC 429 words are checked for parity. If parity is invalid, the word is rejected.

3. Only one word is allowed for each unique word number: i.e., two within a number of three cannot exist. Thus, if two words are received with the same word number, they are both declared as invalid.

Figure 4 – Transmitter ARINC 429 (H) Bus Data Link Protocol

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL



Figure 5 – Receiver Logic Diagram for Data Link ARINC Bus ProtocolTRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL

**XPDR TO DLP – WORD 1:**



Field content and coding (all fields MSB first)

**UDT** : Uplink Data Transfer

0 = Data transfer of an interrogation

(with interrogation type specified in UMT field)

1 = Comm-B close-out (with RCN for current register number)

2 = Comm-B broadcast timeout

3 = Downlink ELM Closeout (with RCN for current register number)

4-7 = Not Assigned

**UMT** : Uplink Message Type

0 = No uplink data

1 = Surveillance Interrogation

2 = Comm-A Interrogation

3 = Comm-A Broadcast Interrogation

4 = Uplink ELM

5-7 = Not Assigned

**RCN** : Register Control Number

**UII** : Uplink II, responsible for present message

**CRN** : Comm-C Record Number

0 = No ELM data

1 = 1st record : 1 – 22 24-bit words (segments 0 – 5)

2 = 2nd Record : 23 – 44 24-bit words (segments 6 – 11)

3 = 3rd record : 45 – 59 24-bit words (segments 12 – 15)

**LRI** : Last Record Indicator

0 = First or intermediate record

1 = Last Record

**P** : Parity

Figure 6 – Field Definition of First Data Word for XPDR to DLP Transfers

TRANSPONDER/DATA LINK PROCESSOR COMMUNICATIONS PROTOCOL

**DLP TO XPDR – WORD 1:**



Field content and coding (all fields MSB first)

**DDT** : Downlink Data Transfer

0 = Transfer of reply data

1 = Cancel message (associated with DMT and RCN)

2-7 = Not Assigned

**DMT** : Downlink Message Type

0 = Ground-initiated Comm-B

1 = Air-initiated Comm-B

2 = Air-initiated Comm-B Broadcast

3 = Downlink ELM

4-7 = Not Assigned

**RCN** : Register Control Number

(for Air-initiated messages, associated with DMT)

**DII**  : Downlink II

**BDS** : Register address of Comm-B buffer for present message segment

**DRN** : Comm-D Record Number

0 = No ELM data

1 = 1st record : 1 – 22 24-bit words (segments 0 – 5)

2 = 2nd record : 23 – 44 24-bit words (segments 6 – 11)

3 = 3rd record : 45 – 59 24-bit words (segments 12 – 15)

**LRI**  : Last Record Indicator

0 = First or intermediate record

1 = Last Record

**P** : Parity

Figure 7 – Field Definition of First Data Word for DLP to XPDR Transfers

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 31 | 32 |  |
| **Mode S Label** | | | | | | | | **SDI**  **(RSVD)** | **Mode S Interrogation Data Bits** | | | | | | | | | | | | | | | | | | | **Sign/**  **Status** | **P**  **Odd** |  |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 0 | 1 | 2 | 3 | 4 | 5 | NCmax | | 8 | 9 | ----------------------------- | | | | | | 16 | 0 | 0 | 0 | 0 0 |  | ELM Seg NCmaxWord 1 (initial) |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 0 | 17 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 32 | 0 | 0 | 0 | 0 1 |  | Word 2 (intermediate) |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 0 | 33 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 48 | 0 | 0 | 0 | 0 1 |  | Word 3 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 0 | 49 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 64 | 0 | 0 | 0 | 0 1 |  | Word 4 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 0 | 65 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 80 | 0 | 0 | 0 | 0 1 |  | Word 5 (intermediate) |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 0 | 81 | ------------------------------- | | | | | | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 1 |  | ELM Seg NCmaxWord 6 (final) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 0 | 1 | 2 | 3 | 4 | 5 | NC-1max | | 8 | 9 | ----------------------------- | | | | | | 16 | 0 | 0 | 0 | 0 0 |  | ELM Seg NC-1maxWord 1 (initial) |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 0 | 17 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 32 | 0 | 0 | 0 | 0 1 |  | Word 2 (intermediate) |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 0 | 33 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 48 | 0 | 0 | 0 | 0 1 |  | Word 3 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 0 | 49 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 64 | 0 | 0 | 0 | 0 1 |  | Word 4 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 0 | 65 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 80 | 0 | 0 | 0 | 0 1 |  | Word 5 (intermediate) |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 0 | 81 | ------------------------------- | | | | | | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 1 |  | ELM Seg NC-1max Word 6 (final) |
|  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  |  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  | \* | \* |  |
|  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  |  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  | \* | \* |  |
|  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  |  |  | \* | \* | \* |  |  |  |  |  |  |  |  |  | \* | \* |  |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 0 | 1 | 2 | 3 | 4 | 5 | 0 0 | | 0 | 9 | ----------------------------- | | | | | | 16 | 0 | 0 | 0 | 0 0 |  | ELM Seg 0000 Word 1 (initial) |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 0 | 17 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 32 | 0 | 0 | 0 | 0 1 |  | Word 2 (intermediate) |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 0 | 33 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 48 | 0 | 0 | 0 | 0 1 |  | Word 3 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 0 | 49 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 64 | 0 | 0 | 0 | 0 1 |  | Word 4 (intermediate) |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 0 | 65 | ------------------------------------------------------------------------- | | | | | | | | | | | | | | 80 | 0 | 0 | 0 | 0 1 |  | Word 5 (intermediate) |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 0 | 81 | ------------------------------- | | | | | | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 1 |  | ELM Seg 0000 Word 6 (final) |

Figure 8 – Word Format for Mode S Elm Data Out

1. SUPPRESSION PULSE SYSTEM CHARACTERISTICS
   1. General

On aircraft on which several pulse equipment need to operate concurrently a suppression pulse system may be required which prevents the mutual interference of the systems. The following paragraphs provide standards for such a suppression system to ensure the compatibility of individual systems utilizing the suppression pulse system.

The suppression pulse system must suppress the equipment for the minimum possible time to leave it enough time to adequately perform its intended function.

Two types of functions are incorporated in the systems contributing to the suppression pulse system. These are:

1. The suppressors which generate suppression pulses to other systems
2. The suppressees which receive suppression pulses and cease transmitting pulses for the suppression duration

Generally suppressors and suppressees are combined systems.

The suppression chain must accommodate multiple equipment (both suppressors and suppressees). Reliable functioning of this network can thus only be ensured when certain standard characteristics of input and output are adhered to. This Characteristic defines a single suppression jack on the rear of the equipment which is intended to serve as the suppression pulse output and input. The specific paragraphs on the suppression system and the individual parameters of suppressor and suppressee voltages and impedances have been coordinated among a group of interested manufacturers.

The following additional requirements and recommendations should be considered by manufacturers and equipment installers of avionics equipment utilizing the suppression pulse system.

1. Equipment connected into the suppression chain should not be damaged nor its operation impaired in any manner if the suppression system is loaded with an impedance of greater than 2000 ohms or even if it is unterminated or inadvertently shorted.
2. It is recommended that suppressee equipment suppression pulse input impedance be kept as close as possible to 2000 ohms, to help provide satisfactory operation when only a single suppressor is used on the suppression bus.
3. It is recommended that suppressor equipment be designed so that the output voltage does not rise above 70 volts if the total suppressee load is above 2000 ohms (while a maximum total resistance of 2000 ohms is specified, a single suppressee which does not follow recommendation may present a resistance greater than 2000 ohms, and should not be damaged under this condition).
4. It is recommended that suppressee equipment incorporate AC coupling to prevent continual suppression or damage to the equipment if a fault occurs in the suppressor equipment. The charging time constant of the coupling circuit should be greater than 1 msec to ensure adequate acceptance of suppression pulses up to 100 µsec in duration.

The discharge time constant should be held to a maximum of 50% of the charging time constant. The input circuit should be designed to accept a continuous DC signal at maximum amplitude of 70 volts.

* 1. Suppression System Parameters
     1. Number of Suppression Pulse Recipients (Suppressees)

A suppression pulse system should be able to drive up to six Suppression Pulse Recipients.

* + 1. Number of Suppression Pulse Donors (Suppressors)

A suppression pulse system should be able to support up to six Suppression Pulse Donors.

* + 1. System Impedance

The load impedance (for positive pulses) presented to any one suppressor output circuit by the entire inter-equipment suppression system should be not more than 2000 ohms nor less than 300 ohms resistance shunted by not more than 1850 pF capacitance.

* + 1. System Cabling Capacitance

The capacitance of the inter-equipment cabling system should not exceed 1400 pF.

COMMENTARY

The minimum resistive impedance (300 ohms) would occur in a system of six 2000 ohm suppressee loads in parallel with five 20,000 ohm suppressor loads. The maximum resistive impedance would occur with only one suppressee load. Since suppressee loads may be higher than 2000 ohms, this would imply that in some unlikely circumstances it would be necessary to add a load resistor to the system to prevent the occurrence of excessively high suppression pulse voltage levels.

The maximum capacitance of 1850 pF would occur in a system of six 50 pF suppressee loads, five 30 pF suppressor loads and maximum inter-equipment cabling capacitance of 1400 pF. It is recognized that in the unlikely circumstance where the maximum system capacitance of 1850 pF exists, a resistance loading of 2000 ohms could conceivably also exist and in this case, the decay time would be four times as long as suggested in Section 1.3 of this Attachment. In this case, it is understood that a dummy resistance load may be required in the junction box. Some limiting may be necessary in utilization equipment (suppressees) to accommodate a voltage range of 18 to 70 volts on the suppression pulse input. This voltage may vary over this range with different equipment. This limiting need be done in such a way that the time constant does not unduly stretch the suppression time applied to any suppressee, and also that the internal impedance of the suppressee be retained higher than 2000 ohms and the internal shunt capacitance 50 pF or less with any voltages under 70 volts.

* 1. Suppression Pulse Output From Suppressor Equipment
     1. Amplitude

Not less than 18 volts and not more than 70 volts as measured with loads from 300 to 2000 ohms resistance in parallel with capacitance from zero to 1850 pF.

* + 1. Polarity

The polarity of an active suppression pulse is positive.

* + 1. Generator Impedance

The impedance of the suppressor output circuit to positive pulses up to 70 volts amplitude will be not less than 20,000 ohms resistance shunted by not more than 30 pF capacitance.

* + 1. Synchronization

The suppressor pulse should reach 18 volts amplitude level within the period of 0.8 µsec to 5 µsec preceding the point at which the voltage amplitude of the transmitted RF pulse reaches the 10% level.

* + 1. Duration (TACAN/DME)

For pulse-for-pulse suppression, the suppression pulse will remain at 18 volts or greater amplitude for at least 7 µsec after the 10% level point on the leading edge of the transmitted RF pulse. For blanketing pulse suppression, the suppression pulse will remain at 18 volts or greater amplitude for at least 19 µsec for “X” channels or at least 43 µsec for “Y” channels after the 10% level point on the leading edge of the first transmitted RF pulse. In any case, the total duration at 18 volts or greater amplitude should not exceed 60 µsec.

COMMENTARY

The introduction of the DME “Y” Channels (which have an interrogation pulse spacing of 36 µsec) necessitates that the length of the blanket pulse be a minimum of 43 µsec measured from the leading edge of the first pulse. It is permissible, but not required, to use the 43 to 60 µsec pulse on both “X” and “Y” Channels. The choice of either the long blanket pulses for both “X” and “Y” or a shorter pulse for “X” channels than for “Y” channels is subject to circuit complexity considerations applicable to the individual design.

* + 1. Duration (Transponder)

The suppressor pulse will remain at 18 volts or greater amplitude until the trailing edge of the last pulse of the transmitted reply train has decayed to the 10% level point. Total duration of the suppressor pulse (at the 18 volt level) should not exceed 33 µsec for SSR replies. For 56-bit Mode S replies, duration should not exceed 75 µsec. For 112-bit Mode S replies, duration should not exceed 140 µsec. Airborne Collision Avoidance System (ACAS) operation may require the transponder to be suppressed for 200 µsec.

COMMENTARY

Installation of equipment co-located with Mode S transponders capable of Downlink Extended Length Messages (DELMs) may expect to be provided with suppression characteristics in excess of the 1 msec discharge period. Equipment need not remain in suppression for this entire period, but should not be damaged by being subjected to DELM transmissions.

* + 1. Rise Time

The pulse rise time should be equal to or greater than 20 volts per µsec.

* + 1. Decay Time

The pulse decay time should be equal to or greater than 10 volts per µsec.

* + 1. Spurious Output from Suppressor

Neither the DC steady state output potential of nor the instantaneous peak AC potential of spurious signals will exceed 1.0 volt, either polarity, measured with system loads as described above.

* 1. Suppression Pulse Input At Suppressee Equipment

Each suppressee equipment will be provided with circuitry suitable for receiving suppression pulses as specified above and employing these pulses to prevent the transmissions of the suppressor equipment from causing spurious transmissions, reduction in sensitivity or other effects interfering with the proper operation of the suppressee equipment. The circuitry of the suppressee must be designed to accommodate such factors as receiver delay time, internal pulse rise time and the like.

* + 1. Impedance

The impedance of the suppression pulse input circuit, as displayed to positive polarity pulses, should be not less than 2000 ohms resistance shunted by not more than 50 pF capacitance.

* + 1. Spurious Output

Any spurious output from the suppressee equipment appearing on the suppression pulse input connector should be not greater than 0.02 volts peak amplitude as measured with system loads as described above.

1. DIVERSITY ANTENNA SELECTION
   1. General

ICAO Annex 10 requires the use of antenna diversity to enhance the performance of the Mode S link in the air-to-air surveillance (Airborne Collision Avoidance System) environment and in ground-to-ground (on the airport surface) data delivery. Therefore, the diversity selection scheme should account for both the presence of multi-path and signal fading. Three approaches are possible for achieving diversity operation.

* 1. Approach A

Two complete receivers are provided which include the parity check functions of Mode S, each connected to one of the antennas. For the reply that antenna is used which received a valid interrogation.

In case that both antennas receive a valid interrogation, then the antenna which received the stronger signal is used. A valid interrogation will always be detected by this approach regardless of the environment. Since the interrogation and reply multi-path environments are essentially identical, it will normally select the most adequate antenna for the reply.

Under certain circumstances the transponder may receive a valid SSR Mode A/C interrogation via one antenna and a valid SSR Mode A/C all-call interrogation on the other channel where the P1 and P3 pulses of the two interrogations are time-coincident. In this case the transponder should reply with an SSR Mode A/C reply on the channel which received the SSR/Mode A/C interrogation.

* 1. Approach B

Two independent receivers including video processing and preamble detection are foreseen (one per antenna). The antenna for the decoding of the Mode S interrogation data block and transmission of the reply is chosen according to the following rules:

1. Select the top antenna if the preamble signal strength (preferably based on P1 amplitude) received via the top antenna exceeds the transponder minimum triggering level (MTL) by 10 dB or more.
2. Otherwise, select the antenna which received the stronger signal.

These rules, illustrated in Figure 1, bias the selection decision in favor of the top antenna when strong signals are received via both antennas. This bias will improve system performance in air-to-air multi-path environments.

* 1. Approach C

Approach C is based on Approach B but the decision criteria for the antenna are modified dependent on whether the aircraft is on the ground or airborne. If the aircraft is airborne the criterion a. and b. of Approach B are applied as in Approach B. If the aircraft is on the ground only criterion b. of Approach B is applied this removes the top antenna bias if the aircraft is on the ground.



Figure 1 – Decision Criterion for Top and Bottom Antenna Selection Replies

1. TYPICAL BLADE ANTENNA



Figure 1 – Antenna Ground Plane



Figure 2 – ”D” Band Blade Antenna Outline

1. AIRPLANE PERSONALITY MODULE (APM) IMPLEMENTATION GUIDELINES FOR THE TRANSPONDER
   1. Purpose

This Attachment provides appropriate implementation guidelines that should be observed when interfacing an Airplane Personality Module (APM) to the transponder.

* 1. APM Compatibility

When interfaced to the transponder, the APM installation and operation with the transponder will be compatible with the characteristics provided in **ARINC Report 607:** *Design Guidance for Avionic Equipment*.

* 1. Data Blocks

When interfaced to the transponder, the APM should provide the appropriate data blocks as specified in the following paragraphs.

Note that data referenced in the following paragraphs assumes that such data is stored with the MSB in the left most position of the memory location.

* + 1. Header Block

The Header Block will be mandatory and provide the data indicated in Table A9-1.

Table 9-1 – Transponder – APM Header Block

| **ADDRESS** | **FIELDS** | **SIZE/FORMAT** | **CONTENTS** |
| --- | --- | --- | --- |
| 00H | APM Header Length | 8 bits - binary | 13H |
| 01H | APM Header Version | 8 bits - binary | 01H |
| 02H | APM Capacity | 8 bits - binary | 00H Initialized 01H Single Segment - 512 by 8 bits 02H Dual Segments - 1024 by 8 bits  (Default Config.) 03H –FEH Reserved FFH Initialized |
| 03H | Supplier ID Code | 8 bits - binary | 00H Initialized 01H Generic 02H L-3 Comm  03H Collins 04H Honeywell 05H Thales 06H Smiths Industries 07H Teledyne Controls 08H Trimble 09HDassault Electronique 0AH UPSAT  0BH - FEH Reserved for Future  FFH Initialized |
| 04H | host LRU ID Code | 8 bits - binary | 00H Initialized 01H Reserved for ARINC 755 MMR 02H Reserved for ARINC 756 GNLU 03H Reserved for ARINC 758 CMU 04H Reserved for ARINC 760 GNU 05H Reserved for generic analog MMR 06H Reserved for ARINC 702A FMC 07H Generic transponder 08H - 2FH Reserved for future generic  equipment  30H - 7FH Reserved for Suppliers Use  FFH Initialized |
| 05 - 0FH | host LRU Label | 8 bytes - ASCII | Transponder (Generic) |
| 10 -11H | Blocks Installed | 2 bytes - binary | Bit 0 Set - Identity Block Included Bit 1 Set - Generic Block Included Bit 2 Set - User Block Included Bit 3 - 15 Reserved for future use |
| 12H | Integrity Block Style | 1 byte - binary | Identifies format of the Integrity block 00 - None (not recommended) 01 - 8-bit Checksum (not recommended) 02 - 16-bit CRC 03 - 32-bit CRC 04 - 32-bit CRS with Reed Solomon FEC 05 - FFH Reserved for future use |
| 13H | 8 bit header checksum (end of APM header block) | 8 bits - binary |  |

* + 1. Identity Block

Since the Identity Block contains the 24-bit ICAO Address, the Identity Block will be mandatory and provide the data indicated in Table A9-2.

Table 9-2 – Transponder – APM Identity Block

| **ADDRESS** | **DESCRIPTION** | **FORMAT/CONTENTS** |
| --- | --- | --- |
| 01H | Identity Block Length | 1 byte binary - 3FH |
| 02H | Identity Block Version | 1 byte binary - 01H |
| 03 - 06H | Identity Block Label | 4 bytes ASCII - “IDEN” |
| 07 - 09H | 24-bit ICAO Address | 3 bytes binary (Contains Mode S Address) |
| 0A - 10H | 56 bit official Registration Mark | 7 bytes ASCII Value is always left justified to seven characters with leading periods “.”, e.g., “.N283UA” |
| 11 - 19H | Fleet Identification Label | 8 bytes ASCII -- User Defined This field is used to store the “short name” the airline operationally associates with each airplane, typically tied to a fleet. Its value is unique to each airline. e.g., airplane “601” or “Betsy” |
| 1A - 3AH | Airplane Model Label | 16 bytes ASCII -- User Defined. e.g., “B777-200.” |
| 3B - 3CH | 2 Character Airline Agency Identifier | 2 bytes ASCI -- User Defined. e.g., United Airlines “UA.” |
| 3D - 3FH | 3 Character ICAO Airline Identifier | 3 bytes ASCII -- User Defined. e.g., United Airlines “UAL.” |
|  | Reserved -- ARINC 646 ELAN MAC Address (Not included in Version 01) |  |

* + 1. Generic Block

The Generic Block should contain information that is commonly required by all transponder units and is considered to be a mandatory block. Data to be provided by the Generic Block is identified in Table A9-3.

Table 9-3 – Transponder – APM Generic Block

| **ADDRESS** | **DESCRIPTION** | **FORMAT/CONTENTS** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 01H | Generic Block Length | 1 byte binary - 2FH | | | | | | | |
| 02H | Generic Block Version | 1 byte binary - 01H | | | | | | | |
| 03 - 06H | Generic Block Label | 4 bytes ASCII - “GENR” | | | | | | | |
| 07H | Cable Delay Program | 1 byte binary - discrete bit assignments. | | | | | | | |
| Bit 7 through 3 are Not Used | | | | | | | |
|  | | | | | | | |
| BIT 2 IS DEFINED AS FOLLOWS: | | | | | | | |
| 0 = Add Time delay to the Top Antenna Channel | | | | | | | |
| 1 = Add Time delay to the Bottom Antenna Channel | | | | | | | |
|  | | | | | | | |
| BIT 1 and 0 ARE DEFINED AS FOLLOWS: | | | | | | | |
| BIT 1 | | | BIT 0 | | DIFFERENTIAL DELAY (nsec) | | ADD (nsec) IN XPDR |
| (Transponder) | | | | |
| 0 | | 0 | | | 0-50 | | 0 |
| 0 | | 1 | | | 51-150 | | 100 |
| 1 | | 1 | | | 151-250 | | 200 |
| 1 | | 1 | | | 251-350 | | 300 |
| 08H | Antenna Information | 1 byte binary - discrete bit assignments  bit 7 through 2 are Not Used.  BIT 1 and 0 ARE DEFINED AS FOLLOWS:  BIT 1: Antenna Coupling BIT 0: Diversity Installation  0 AC coupled antenna 0 Non-Diversity Installation  1 DC coupled antenna 1 Diversity Installation | | | | | | | |
| 09H | Maximum Cruising Airspeed Capability | 1 byte binary - discrete bit assignments. | | | | | | | |
|  | | | | | | | |
| BITS 2, 1, and 0 ARE DEFINED AS FOLLOWS  (bits 7 through 3 are not used): | | | | | | | |
|  | | | | | | | |
| BIT 2 | BIT 1 | | | BIT 0 | DESCRIPTION | | |
| 0 | 0 | | | 0 | No Maximum Airspeed Data Available | | |
| 0 | 0 | | | 1 | Airspeed up to 75 knots | | |
| 0 | 1 | | | 0 | Airspeed between 75 and 150 knots | | |
| 0 | 1 | | | 1 | Airspeed between 150 and 300 knots | | |
| 1 | 0 | | | 0 | Airspeed between 300 and 600 knot | | |
| 1 | 0 | | | 1 | Airspeed between 600 and 1200 knots | | |
| 1 | 1 | | | 0 | Airspeed more than 1200 knots | | |
| 1 | 1 | | | 1 | Not Assigned | | |
| 0AH | Altitude Air Data Type Selects | 1 byte binary - discrete bit assignments. | | | | | | | |
| BITS 2, 1, and 0 ARE DEFINED AS FOLLOWS  (bits 7 through 3 are not used): | | | | | | | |
|  | | | | | | | |
| BIT 2 | BIT 1 | | | BIT 0 | | DESCRIPTION | |
| 0 | X | | | X | | Altitude Air Data Type Selects Invalid | |
| 1 | 0 | | | 0 | | ARINC-429 Data via ARINC 429 Air | |
|  |  | | |  | | Data System Input Ports | |
| 1 | 0 | | | 1 | | Synchro Data via Synchro Input Ports | |
| 1 | 1 | | | 0 | | ARINC 575 Data via ARINC 429 Air | |
|  |  | | |  | | Data System Input Ports | |
| 1 | 1 | | | 1 | | ARINC 429 Data via ARINC 429 FMS/ | |
|  |  | | |  | | IRS/ADIRS Input Ports. | |
| 0BH | BUS SPEED SELECTION DATA FLAG | 1 byte binary - discrete FLAG 00H = Use data in bytes 0CH through 0FH to determine bus  speeds.  FFH = Do not use data in bytes 0CH through 0FH to determine bus  speeds. | | | | | | | |
| 0CH | Side 1 Primary Input Bus Speed Selects | 1 byte binary - discrete bit assignments A “0” for the following bits indicates that the low-speed (12.5 kbps) is selected, while a “1” indicates that the high-speed (100 kbps) is selected for the appropriate bus defined.  BIT 7 - FMC #1, GNSS IN #1 BIT 6 - FMC #1, GENERAL INPUT #2 BIT 5 - IRS/FMS/ Data Concentrator IN #1 BIT 4 - DFS/VHF INPUT #1 BIT 3 - FCC/MCP INPUT #3 BIT 2 - (Reserved) Weather Input #1BIT 1 - MSP/ATSU/CMU IN #1 BIT 0 - GPS/GNSS IN #1 | | | | | | | |
| 0DH | Side 2 Primary Input Bus Speed Selects | 1 byte binary - discrete bit assignments A “0” for the following bits indicates that the low-speed (12.5 kbps) is selected, while a “1” indicates that the high-speed (100 kbps) is selected for the appropriate bus defined.  BIT 7 - FMC #2, GNSS #2 IN #1 BIT 6 - FMC #2, GENERAL IN #2 BIT 5 - IRS/FMS/ /Data Concentrator IN #2 BIT 4 - DFS/VHF IN #2 BIT 3 - FCC/MCP IN #2 BIT 2 - (Reserved) Weather Input #2BIT 1 - MSP/ATSU/CMU IN #2 BIT 0 - GPS/GNSS INPUT #2 | | | | | | | |
| 0EH | Auxiliary Input Bus Speed Selects | 1 byte binary - discrete bit assignments A “0” for the following bits indicates that the low-speed (12.5 kbps) is selected, while a “1” indicates that the high-speed (100 kbps) is selected for the appropriate bus defined.  BIT 7 - CONTROL DATA “A,” or FCC #1/MCP#1/ VHF #3 BIT 6 - CONTROL DATA IN *“*B*”* BIT 5 - RESERVED BIT 4 - AIR DATA IN #1 BIT 3 - AIR DATA IN #2 BIT 2 - DATA LOADER IN BIT 1 - RESERVED  BIT 0 - MAINTENANCE DATA IN | | | | | | | |

| **ADDRESS** | **DESCRIPTION** | **FORMAT/CONTENTS** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0FH | Auxiliary Input and Output Bus Speed Selects | 1 byte binary - discrete bit assignments A “0” for the following bits indicates that the low-speed (12.5 kbps) is selected, while a “1” indicates that the high-speed (100 kbps) is selected for the appropriate bus defined.  BIT 7 - DFS/VHF IN #3 BIT 6 - DGPS OUT BIT 5 - MSP/ATSU/CMU OUT #2 BIT 4 - MSP/CMU OUT #1 BIT 3 - GENERAL OUTPUT #2 BIT 2 - GENERAL OUTPUT #1 BIT 1 - RESERVED  BIT 0 - MAINTENANCE DATA OUT | | | | | | | |
| 10H | ACQUISITION SQUITTER INHIBIT FLAG | 1 byte binary - discrete FLAG 00H = NO FLAG DATA AVAILABLE FFH = FLAG DATA AVAILABLE -- INHIBIT ALL DF=11  ACQUISITION SQUITTER FUNCTIONS | | | | | | | |
| 11H | Aircraft Identification Type and Aircraft/Vehicle Type definition | If Bits 7, 6, and 5 are not set to “1,” then do not use the data provided in this byte for Aircraft Identification Type and Aircraft/Vehicle Type definition. | | | | | | | |
|  | | | | | | | |
| If Bits 7, 6, and 5 are set to “1,” then’ | | | | | | | |
|  | | | | | | | |
| BIT 4 and 3 ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 4 | BIT 3 | | | AIRCRAFT IDENT TYPE | | | |
| 0 | 0 | | | AIRCRAFT CATEGORY SET D | | | |
| 0 | 1 | | | AIRCRAFT CATEGORY SET C | | | |
| 1 | 0 | | | AIRCRAFT CATEGORY SET B | | | |
| 1 | 1 | | | AIRCRAFT CATEGORY SET A | | | |
|  | | | | | | | |
| FOR AIRCRAFT CATEGORY SET A: | | | | | | | |
|  | | | | | | | |
| BIT 2, 1, and 0 ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 2 | BIT 1 | | | BIT 0 | | DESCRIPTION | |
| 0 | 0 | | | 0 | | no aircraft category information | |
| 0 | 0 | | | 1 | | Small (12,500 lbs.) | |
| 0 | 1 | | | 0 | | Medium (12,500 to 75,000 lbs.) | |
| 0 | 1 | | | 1 | | Large (75,000 to 190,000 lbs.) | |
| 1 | 0 | | | 0 | | Extra Large  (190,000 to 300,000 lbs.) | |
| 1 | 0 | | | 1 | | Heavy (>300,000 lbs.) | |
| 1 | 1 | | | 0 | | High Performance  (>5G acceleration capability) | |
| 1 | 1 | | | 1 | | Rotorcraft | |
|  | | | | | | | |
| FOR AIRCRAFT CATEGORY SET B: | | | | | | | |
|  | | | | | | | |
| BIT 2, 1, and 0 ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 2 | BIT 1 | | | BIT 0 | | DESCRIPTION | |
| 0 | 0 | | | 0 | | no aircraft category information | |
| 0 | 0 | | | 1 | | Glider/Sailplane | |
| 0 | 1 | | | 0 | | Lighter-than-air | |
| 0 | 1 | | | 1 | | Parachutist/Skydiver | |
| 1 | 0 | | | 0 | | Surface Vehicle | |
| 1 | 0 | | | 1 | | Fixed ground or tethered obstruction | |
| 1 | 1 | | | 0 | | Unmanned Aerial Vehicle | |
| 1 | 1 | | | 1 | | Space/Transatmospheric Vehicle | |
|  | | | | | | | |
| FOR AIRCRAFT CATEGORY SET C: | | | | | | | |
|  | | | | | | | |
| BIT 2, 1, and 0 ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 2 | BIT 1 | | | BIT 0 | | DESCRIPTION | |
| 0 | 0 | | | 0 | | no aircraft category information | |
| 0 | 0 | | | 1 | | Ultralight/Hang glider/Paraglider | |
| 0 | 1 | | | 0 | |  | |
| -through- | | | | | | Unassigned | |
| 1 | 1 | | | 1 | |  | |
|  | | | | | | | |
| FOR AIRCRAFT CATEGORY SET D: | | | | | | | |
|  | | | | | | | |
| Unassigned | | | | | | | |
| 12H - 1FH | Not Assigned |  | | | | | | | |
| 20H | Antenna #1 Type/Position - Byte 1 | BIT 7, 6, and 5 ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 7 | | BIT 6 | | | BIT 5 | | DESCRIPTION |
| 0 | | 0 | | | 0 | | Invalid Byte 1 and Byte 2 Data |
| 0 | | 0 | | | 1 | | Mode S bottom antenna |
| 0 | | 1 | | | 0 | | Mode S Top Antenna |
| 0 | | 1 | | | 1 | | GNSS Antenna |
| 1 | | 0 | | | 0 | |  |
| -through- | | | | | | | Not Assigned |
| 1 | | 1 | | | 1 | |  |
|  | | | | | | | |
| BITS 4 AND 3 ARE NOT USED AND SHOULD BE “0” | | | | | | | |
|  | | | | | | | |
| BITS 2,1, AND 0 PROVIDE THE MSBs OF THE ANTENNA X POSITION AND ARE DEFINED AS FOLLOWS: | | | | | | | |
|  | | | | | | | |
| BIT 2 – 32 | | | meters X Position (MSB) | | | | |
| BIT 1 – 16 | | | meters X Position | | | | |
| BIT 0 – 8 | | | meters X Position | | | | |
|  | | | | | | | |
| The remainder of X Position is defined in Byte 2. | | | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **ADDRESS** | **DESCRIPTION** | **FORMAT/CONTENTS** | |
| 21H | Antenna #1 Type/Position - Byte 2 | BIT 7, 6, and 5 ARE DEFINED AS FOLLOWS: | |
|  | |
| BIT 7 – 4 | meters X Position |
| BIT 6 – 2 | meters X Position |
| BIT 5 – 1 | meters X Position (LSB) |
| BIT 4 – 16 | meters Z Position (MSB) |
| BIT 3 – 8 | meters Z Position |
| BIT 2 – 4 | meters Z Position |
| BIT 1 – 2 | meters Z Position |
| BIT 0 – 1 | meters Z Position (LSB) |
|  | |
| The X Position field is the distance in meters along the aircraft center line measured from the nose of the aircraft. The field will be interpreted as invalid if the value is zero. A field value of 63 indicates that the antenna position is 63 meters or more from the nose of the aircraft. | |
|  | |
| The Z Position field is the distance in meters of the antenna from the ground, measured with the aircraft unloaded and on the ground. The field will be interpreted as invalid if the value is zero. A field value of 31 means that the antenna position is 31 meters or more from the ground. | |
| 22H | Antenna #2 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 23H | Antenna #2 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 24H | Antenna #3 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 25H | Antenna #3 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 26H | Antenna #4 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 27H | Antenna #4 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 28H | Antenna #5 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 29H | Antenna #5 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 2AH | Antenna #6 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 2BH | Antenna #6 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 2CH | Antenna #7 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 2DH | Antenna #7 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |
| 2EH | Antenna #8 Type/Position - Byte 1 | See Definition Provided for Antenna #1, i.e., location 20H | |
| 2FH | Antenna #8 Type/Position - Byte 2 | See Definition Provided for Antenna #1, i.e., location 21H | |

* + 1. User Blocks (Optional)

User Blocks of memory area may be utilized and defined by suppliers as needed. No data format requirements are imposed on the data stored in this block by this specification. It may be used in addition to the Generic Blocks and Identity Blocks for supplemental information.

* + 1. Integrity Block

The Integrity Block contains the results of any host computed integrity check performed on the contents of the APM. This block contains only the resulting value of the computation based on the indicator provided in the Header Block. Its length is dependent upon the method. When Generic Block(s) are used, the specific integrity check algorithm will also be defined as part of the host LRU equipment characteristic. This integrity calculation is assumed to be calculated over all data blocks (including the Header Block), but these specifics are left to the appropriate equipment characteristic.

* 1. Data Loader Considerations

If is used to provide the transponder with the information normally provided from the APM, then the data loader should provide the appropriate data blocks structured as described in Sections 9.3.1 through 9.3.5.

* 1. APM Programming Considerations

Transponder programming of the APM is optional and is not required of the standard unit.

* + 1. Host LRU Programming

If implemented, programming of the APM by the host transponder LRU should be accomplished in accordance with ARINC Report 607.

* + 1. Shop Programming

Shop programming of the APM should be accomplished in accordance with ARINC Report 607.

* + 1. Data Loader Considerations

In installations where a data loader provides the transponder with the appropriate data as discussed in paragraph 4, it is anticipated that the transponder will be capable of programming the APM with new data received from the data loader.

1. EXAMPLE GICB REGISTER LOADING ARCHITECTURE
   1. Purpose

This Attachment provides an example of the GICBregister loading architecture which was assumed to determine the required configuration parameters. Any other architecture may also be chosen by manufacturers provided it offers similar functions. The underlying principle of this architecture is to separate the GICB related formatting from the fundamental data reading and GICB register updating function. It is felt that this split would minimize the amount of software and would at the same time simplify possible future upgrades of the transponder.

* 1. Description of the GICB Loading Function

TheGICB register loading function needs to read data from the avionics buses format them into the relatedGICB format and load them into the related GICB register. The fundamental functions for the reading of data and the GICB updating are unique for allGICB registers. The only differences are the update interval, the ARINC 429 words to be used and the formatting to be applied.

In addition to the GICB register loading function it will be required to define formatting algorithms for each supported GICB register. These formatting algorithms derive the GICBregister bit sequences from several ARINC 429 data words as required by the ICAO Manual on Mode S Specific Services. They can be non-trivial and also generally differ from one GICBregister to the other quite significantly. It was therefore assumed, that the GICB register loader and the formatting should be logically separated. One possible architecture based on this separation is shown in the figure below.



* + 1. TheGICB Register Loader

The GICB register loader forms the central element of the GICB loading function. It controls all fundamental activities of the GICB register loading. Per GICB register the GICBregister loader will determine from the supplied configuration data, together with source selection discrete inputs of the transponder which ARINC 429 labels need to be captured from the physical ports of the transponder. It will also accept the required update rate and an indication which formatting algorithm is to be used. The formatting algorithm will be supplied with the required ARINC 429 words and will return the readily formatted GICB register entry.

* + 1. The Formatting Algorithms

Formatting algorithms are dedicated to each GICBregister. They perform the function of extracting the required data from the supplied ARINC 429 words; possibly reformatting them and generating the 56 bit GICB register entry. The relative complexity of certain formatting algorithms does not allow defining the algorithm by simple table entries of a configuration table. It will therefore be more likely that these algorithms be implemented by pieces of software which can be called by the GICB register loader. These pieces of software can either be part of the fundamental transponder software or they can be added as libraries later.

1. MODE A REPLY CODE COMBINATIONS

Table 11-1 – Mode A Reply Codes

|  |  |
| --- | --- |
| **Code** | **Information Pulses Present** |
| 0000 | NONE |
| 0001 | D1 |
| 0002 | D2 |
| 0003 | D1 D2 |
| 0004 | D4 |
| 0005 | D1 D4 |
| 0006 | D2 D4 |
| 0007 | D1 D2 D4 |
| 0010 | C1 |
| 0020 | C2 |
| 0030 | C1 C2 |
| 0040 | C4 |
| 0050 | C1 C4 |
| 0060 | C2 C4 |
| 0070 | C1 C2 C4 |
| 0100 | B1 |
| 0200 | B2 |
| 0300 | B1 B2 |
| 0400 | B4 |
| 0500 | B1 B4 |
| 0600 | B2 B4 |
| 0700 | B1 B2 B4 |
| 1000 | A1 |
| 2000 | A2 |
| 3000 | A1 A2 |
| 4000 | A4 |
| 5000 | A1 A4 |
| 6000 | A2 A4 |
| 7000 | A1 A2 A4 |

Table 11-2 – Examples of Reply Code Combinations

|  |  |
| --- | --- |
| **Code** | **Contains Information Pulses** |
| 1100 | A1 B1 |
| 0011 | C1 D1 |
| 3600 | A1 A2 B2 B4 |
| 7700 | A1 A2 A4 B1 B2 B4 |
| 0314 | A1 B2 C1 D4 |
| 0536 | B1 B4 C1 C2 D2 D4 |
| 0475 | B4 C1 C2 C4 D1 D4 |
| 2004 | A2 D4 |
| 3461 | A1 A2 B4 C2 C4 D1 |
| 6060 | A2 A4 C2 C4 |
| 7777 | A1 A2 A4 B1 B2 B4 C1 C2 C4 D1 D2 D4 |

In every case, the Framing Pulses F1 - F2 bracket, information pulse content of a transmitted reply.

1. ACRONYM LIST

|  |  |
| --- | --- |
| AC | Altitude Code |
| ACAS | Airborne Collision Avoidance System |
| ADC | Air Data Computer |
| ADS | Air Data System |
| ADS-B | Automatic Dependent Surveillance - Broadcast |
| ADLP | Airborne Data Link Processor |
| AEEC | Airlines Electronic Engineering Committee |
| APM | Airplane Personality Module |
| ASAS | Aircraft Separation and Assurance System |
| ATC | Air Traffic Control |
| ATCRBS | Air Traffic Control Radar Beacon System |
| ATE | Automatic Test Equipment |
| ATIS | Automatic Traffic Information Service |
| ATM | Air Traffic Management |
| ATN | Aeronautical Telecommunication Network |
| ATSU | Air Traffic Service Unit |
| BCD | Binary Coded Decimal |
| BDS | B-Definition Subfield |
|  | B-Data Selector |
| BITE | Built-In Test Equipment |
| BNR | Binary |
| BP | Bottom Plug |
| CA | Capability |
| CAA | Civil Aviation Authority |
| CCITT | The International Telegraph and Telephone Consultative Committee |
| CDTI | Cockpit Display with Traffic Information |
| CFDIU | Centralized Fault Display Interface Unit |
| CMU | Communication Management Unit |
| CNS | Communications, Navigation and Surveillance |
| Comm-X | Comm-A : Transfer of 56 bit field, ground-to-air |
|  | Comm-B : Transfer of 56 bit field, air-to-ground |
|  | Comm-C : Transfer of 80 bit field, ground-to-air |
|  | Comm-D : Transfer of 80 bit field, air-to-ground |
| CRN | Comm-C Record Number |
| CW  DAA | Continuous Wave  Detect and Avoid systems |
| DADS | Air Data Systems (Digital) |
| DAP | Downlink of Aircraft Parameters |
| L-Band | Frequencies between 960 and 1215 MHz (includes XPDR Frequencies 1030 and 1090 MHz). |
| DCE | Data Circuit-Terminating Equipment |
| DDT | Downlink Data Transfer |
| DELM | Downlink Extended Length Message |
| DF | Downlink Format |
| DGPS | Differential Global Position System |
| DI | Designator Identification |
| DITS | Digital Information Transfer System |
| DLP | Data Link Processor |
| DME | Distance Measuring Equipment |
| DMT | Downlink Message Type |
| DPSK | Differential Phase Shift Keying |
| DRN | Comm-D Record Number |
| DTE | Data Terminal Equipment |
| EIF | Extended Interface Function |
| ELM | Extended Length Message (as in Comm-C and/or Comm-D) |
| EMI | Electro Magnetic Interference |
| ETA | Estimated Time of Arrival |
| EUROCAE | European Organization for Civil Aviation Equipment |
| FCC | Flight Control Computer |
| FIFO | First In First Out |
| FLT ID | Flight Identification |
| FMC | Flight Management Computer |
| FMS | Flight Management System |
| FS | Flight Status |
| GDLP | Ground Data Link Processor |
| GFI | General Format Indicator |
| GICB | Ground Initiated Comm-B |
| GNLU | GNSS Navigation and Landing Unit |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| HAE | Height Above Ellipsoid |
| HEX | Hexadecimal |
| HFOM | Horizontal Figure of Merit |
| Hz | Hertz |
| IAS | Indicated Airspeed |
| ICAO | International Civil Aviation Organization |
| Ident | Special Position Identification (“Ident”) pulse |
| IF | Intermediate Frequency |
| II | Interrogator Identification |
| IIS | Interrogator Identification Subfield Designator |
| IRS | Inertial Reference System |
| ISO | International Standards Organization |
| LDU | Logical Data Unit |
| Levels | Level 1 - Surveillance only |
|  | Level 2 - Comm-A and Comm-B |
|  | Level 3 - Comm-A/B and Comm-C |
|  | Level 4 - Comm-A/B/C and Comm-D |
|  | Level 5 - Level 4 operation with multiple sensors |
| LOS | Lock Out State |
| LP | Left Plug |
| LRI | Last Record Indicator |
| LRU | Line Replaceable Unit |
| LSB | Least Significant Bit |
| MA | Message, Comm-A |
| MC | Message, Comm-C |
| MCDU | Multi-Purpose Control and Display Unit |
| MD | Message, Comm-D |
| MMR | Multi-Mode Receiver |
| MODE S | Mode Select (Radar Beacon System) |
| MOPS | Minimum Operational Performance Standards |
| MP | Middle Plug |
| MREF | Message Reference |
| MSB | Most Significant Bit |
| MSL | Mean Sea Level |
| MSP | Mode S Specific Protocol |
| MTBF | Mean Time Between Failure |
| MTBUR | Mean Time Between Unscheduled Removal |
| MTL | Minimum Triggering Level |
| NACP | Navigation Accuracy Category - Position |
| NACV | Navigation Accuracy Category - Velocity |
| NCD | No Computed Data |
| NICBARO | Navigation Integrity Category - Barometric |
| NVM | Non-Volatile Memory |
| OMC | Onboard Maintenance Computer |
| OSI | Open System Interconnection |
| P | Parity |
| PC | Protocol |
| PPM | Pulse Position Modulation |
| Px | P1 = 0.8 µs pulse |
|  | P2 = 0.8 µs pulse, spaced 2.0 µs + from P1 |
|  | P3 = 0.8 µs pulse, spaced 8.0 µs (Mode A) or 21.0 µs (Mode C) from P1 |
|  | P4 = 0.8 µs pulse, spaced 2.0 µs from P3 (ATCRBS only) |
|  | P4 = 1.6 µs pulse, spaced 2.0 µs from P3 (ATCRBS/Mode S all-call)  P5 = 0.8 µs pulse, spaced 2.35 µs from P2 (overlaying synch phase reversal) |
|  | P6 = 16.25 µs pulse (short), 30.25 µs pulse (long) containing phase reversal chips designating digital signal pulses |
| RA | Resolution Advisory |
| RF | Radio Frequency |
| RMS | Root Mean Square |
| RP | Right Plug |
| SAL | System Address Label |
| SARPS | Standards and Recommended Practices |
| SD | Special Designator |
| SDA | System Design Assurance |
| SI | Surveillance Identifier(s) |
| SIL | Surveillance Integrity Level |
| SLM | Standard Length Message (contrast to ELM) |
| SP | Special Position |
| SPI | Special Position Identifier |
| SRU | Shop Replaceable Unit |
| SSM | Sign-Status Matrix |
| SSR | Secondary Surveillance Radar |
| SVC | Switched Virtual Circuit |
| TA | Traffic Advisory |
| TAS | Technical Acknowledgement Subfield |
| TCAS | Traffic Alert and Collision Avoidance System |
| TCP | Trajectory Change Point |
| TD | Transponder Designator |
| TIF | Transponder Interface Function |
| TIS | Traffic Information Service |
| TIS-B | Traffic Information Service - Broadcast |
| TP | Top Plug |
| TSO | Technical Standard Order |
| TXCOORD | TCAS-to-Transponder Coordination Bus |
| TXF | Transponder Function |
| UDT | Uplink Data Transfer |
| UMT | Uplink Message Type |
| UTC | Universal Time Coordinated |
| VS | Vertical Status |
| VSWR | Voltage Standing Wave Ratio |
| TXF | Transponder Function |
| XTCOORD | Transponder-to-TCAS Coordination Bus |
| XPDR | Transponder |

1. OPTIONAL CONTROL PANEL CONFIGURATION

The following table proposes an alternative configuration to those previously provided in Attachments 2A, 2B, and 2C in the main body of this document. The alternative configuration provides for ARINC 429 inputs on both Control Panel connectors in the interest of getting future installations to use feedback from the transponder to obtain various transponder status and configuration information. Use of the feedback inputs then allows for a reduction in the number of discrete inputs and outputs used with the previous configurations.

Table B-1 – Optional Control Panel Configuration

| **SIGNAL NAME** | **PIN** | **SIGNAL TYPE** | **SOURCE/SINK** | **NOTES** |
| --- | --- | --- | --- | --- |
| Panel Lighting Supply A | J1-CP-1 | 0 to 5 Vac Lighting |  | 3 |
| Panel Lighting Supply B | J1-CP-2 | 0 to 5 Vac Lighting |  | 3 |
| 115 Vac 400 Hz. Power Input HI | J1-CP-3 | Analog |  |  |
| 115 Vac 400 Hz. Power Input LO | J1-CP-4 | Analog |  |  |
| Antenna Transfer (1/2) Select Discrete Out | J1-CP-5 | Discrete Output |  | 4 |
| DC Ground | J1-CP-6 | Aircraft DC Ground | Aircraft DC Ground |  |
| Standby/ON | J1-CP-7 | Discrete Input | Control Panel | 2 |
| Chassis Ground | J1-CP-8 | Aircraft DC Ground | Aircraft DC Ground |  |
| Remote Functional Test | J1-CP-9 |  |  | 3,5 |
| Warning and Caution Output | J1-CP-10 |  | Warning and Caution | 6 |
| Air/Ground Switch #1 | J1-CP-11 | Discrete Output |  | 1 |
| SPARE | J1-CP-12 |  |  |  |
| Reserved 5 Vac Monitor Light Power Source Hot | J1-CP-13 | Analog Input |  |  |
| Reserved 5 Vac Monitor Light Power Source Cold | J1-CP-14 | Analog Input |  |  |
| Air/Ground Switch #2 | J1-CP-15 | Discrete Output |  | 1 |
| Altitude Source Select | J1-CP-16 | Discrete Output |  | 9 |
| ADS-B OUT Fail #1 | J1-CP-17 | Discrete Input |  | 10 |
| Monitor Light Power | J1-CP-18 | Analog | Selected Monitor Light Power Source | 7 |
| ARINC 429 Input A | J1-CP-19 | Digital |  |  |
| ARINC 429 Input B | J1-CP-20 | Digital |  |  |
| Monitor Lamp Display and Test | J1-CP-21 | Discrete Input | Lamp Test Switch | 8 |
| ARINC 429 Output A | J1-CP-22 | Digital |  |  |
| ARINC 429 Output B | J1-CP-23 | Digital |  |  |
| Air/Ground Discrete | J1-CP-24 | Discrete Input |  | 1 |
|  | J2-CP-1 |  |  |  |
|  | J2-CP-2 |  |  |  |
|  | J2-CP-13 |  |  |  |
|  | J2-CP-14 |  |  |  |
| ADS-B OUT Fail #2 | J2-CP-17 | Discrete Input |  | 10 |
| ARINC 429 Input A | J2-CP-19 | Digital |  |  |
| ARINC 429 Input B | J2-CP-20 | Digital |  |  |

Notes:

1. Air/Ground Logic input

Pin TP-5J is assigned to Air/Ground Discrete Input #2. TP-5K is assigned to Air/Ground Discrete Input #1. The Mark 4 transponder should interpret a “ground” at the Air/Ground discrete as an indication that the aircraft is on the ground. An “open” should indicate to the transponder that the aircraft is airborne. This information may be used to activate other functions such as identifying the flight phase for BITE.

The Mark 4 transponder may also be supplied other aircraft information, which may provide this determination in a more reliable manner. Air/Ground Discrete Input #2 is to be used when it is desired that the transponder automatically inhibit replies per ICAO Annex 10 when the aircraft is on the ground. At the writing of ARINC 718A-2, the recommended practice was to use Air/Ground Discrete Input #2 to inhibit ATCRBS and “all-call” replies on ground and thereby reduce the amount of RF traffic on the Mode S link. This recommended practice applies equally to the ARINC 718A-3 since ICAO Annex 10 Volume IV Amendment 82 Section 3.1.2.10.3.10 confirms the requirements to inhibit replies while the aircraft is on the ground.

Air/Ground Discrete Input #1 is to be used when replies are not to be inhibited when the aircraft is on the ground. Airframe and equipment manufacturers are cautioned to provide “sneak circuit” protection for these inputs so that malfunctions of other equipment connected to the same logic source do not affect operation. The system should be designed such that the normal failure mode should be to the airborne condition.

1. Standby/On Control

The Standby/On Control discrete provide a standby (no replies) condition for the Mark 4 transponder unit controlled from the control panel. This permits BITE to be running in the inactive Mark 4 transponder of a dual installation, thus enabling the states of both Mark 4 transponder units to be monitored continuously. To obtain “Standby” operation, connect pin TP-7G to Chassis or Airframe ground. For “On” operation, leave pin TP-7G “open.” (See Section 6.4.1 of this Characteristic for further detail.)

1. Common Control Panel Functions

These functions are implemented in the Left Plug (J1) only of dual system control panels.

1. Antenna Transfer 1/2 Select Output

This control panel discrete output should present a “ground” to indicate that the antenna transfer switch should be activated. The output should be capable of sinking at least 50 mA of current. The transfer switch is an RF relay which is used to direct the signal from the antenna to the active Mark 4 transponder unit. In the aircraft, the transfer switch should be connected as shown in Attachment 2G. The Antenna Transfer (1/2) Select Discrete output appears in two places on the control panel. On connector J1 (pin 5) a “ground” (less than 10 ohms resistance from the pin to the airframe DC ground or a voltage between 0 and +3.5 Vdc) indicates that Mark 4 transponder unit #1 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #2 or the “Standby” mode is selected. On connector J2 (pin 5) a “ground” indicates that Mark 4 transponder unit #2 is selected and its RF should be directed to the antennas. The output should present an “open” when Mark 4 transponder unit #1 or the “Standby” modes are selected. See Section 2.9.2 and 2.9.3 for definitions of “open” and “ground.”

1. Remote Functional Test (Control Panel Pin 9)

This pin provides the logic to remotely activate self-test. It may be used whether or not a self-test switch is included on the Control Panel. A ground indicates “test” and an open indicates “no test.” In the test mode the SSM of the BITS Control Word will be set to the “functional test” state.

1. To Warning and Caution (Control Panel Pin 10)

This pin supplies a DC ground potential (0 to +3.5 Vdc, 10 mA max.) to a remote master warning and caution computer when the control panel receives an Integrity Monitor Lamp fault indication. With no fault, the pin should be at 7 to 30 Vdc.

1. Integrity Monitor Lamp Power Source (Control Panel Pin 18)

This pin is used as the input power source for Integrity Monitor Indicator lamps on the control panel. The input supply voltage may range from 12 Vdc (Lo) to 28 Vdc (Hi) at 0.5 amps max.

1. Lamp Test (Control Panel Pin 21)

This pin provides the logic to test the Monitor Indicator lamps. A ground indicates monitor lamp test (0.5 amps max.) and an open indicates no test.

1. Alternate Air Data Source Select Discrete Input

This pin is used to select the active port for ARINC 429, ARINC 575, and Synchro data sources. When this pin is “open” the number 1 port is active and when it is grounded the number 2 port is active.

1. ADS-B OUT Fail Discrete Inputs

ADS-B OUT Fail #1 Discrete Input (J1-CP-17)

When the ADS-B OUT function of the #1 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #1 transponder ADS-B OUT fail indicator to be illuminated. When the #1 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #1 transponder ADS-B OUT fail indicator should not be illuminated.

ADS-B OUT Fail #2 Discrete Input (J2-CP-17)

When the ADS-B OUT function of the #2 transponder has failed, this input discrete to the control panel should be “open” and it should cause the #2 transponder ADS-B OUT fail indicator to be illuminated. When the #2 transponder ADS-B OUT function has not failed, this input discrete should be grounded and the #2 transponder ADS-B OUT fail indicator should not be illuminated.