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# introduction

## Purpose of this Document

This document provides standards for a second generation Integrated Surveillance System (2G ISS) that may be configured to suit a wide variety of aircraft installations. The 2G ISS may include components and modules to perform multiple surveillance functions:

* Airborne Collision Avoidance System (ACAS) specifically ACAS-Xa and ACAS-Xo
* Air Traffic Control Transponder (ATCRBS/Mode S)
* Terrain Awareness and Warning System (TAWS)
* Automatic Dependent Surveillance – Broadcast (ADS-B) OUT/IN
* Distance Measuring Equipment (DME)

This document uses a building block approach to define a second generation ISS with a combination of surveillance functions. This document establishes interoperability standards for the second generation ISS (2G ISS). The 2G ISS is intended for installation on commercial air transport aircraft with digital interfaces (ARINC 429 or ARINC 664) with primary applicability to future aircraft and derivatives of the current generation production aircraft. This document provides standards for equipment form factor, signal interfaces, aircraft interwiring and connector pin allocation.

The minimum operational and performance capabilities of the 2G ISS are further described in the related RTCA and EUROCAE Minimum Operational Performance Standards (MOPS) and Minimum Aviation System Performance Standards (MASPS) documents for ACAS, Mode S transponder, TAWS, ADS-B OUT/IN, and DME where ACAS in this document is meant to include ACAS-Xa and ACAS-Xo. Section 1.8 includes a list of reference documents.

The primary goal of the 2G ISS is to simplify aircraft installations and reduce life cycle costs through integration, as well as providing meaningful operational benefits. Another goal is to establish an enabling platform for future surveillance capabilities.

COMMENTARY

Manufacturers should design the ISS for current production (with aircraft installation and configuration changes), future derivative, or new aircraft architectures. The intent of this document is to maximize the functional integration of similar surveillance systems. To the extent practical, manufacturers should envisage growth provisions for integrated surveillance processing functions.

### Relationship to Other Documents

This document conforms to ARINC Report 660A recommendations for the Second Generation Integrated Surveillance System (2G ISS). Many functions included in the 2G ISS are presently defined in existing standards, for example ACAS (ARINC 735C), Transponder (ARINC 718A), TAWS (ARINC 762), ADS-B OUT (ARINC 718A-3), ADS-B IN (ARINC 735C), and DME (ARINC 709-8). Where practical, this document will define functions by referencing pertinent ARINC documents.

### Relationship to ARINC Characteristic 768

This document represents a generational step of technology for traffic and terrain surveillance compared to the original ISS defined by ARINC Characteristic 768. This document was written to retain significant structural alignment with the original ISS standard. Section headers are retained for familiarity and comparison of ISS and 2G ISS.

The term “2G ISS” refers to functions and capabilities unique to ARINC 768A.

The term “ISS” refers to function and capabilities expected to be found in all ISS-equipped aircraft.

## System Description

The 2G ISS may be implemented by the following configuration which includes the following 2G ISS functions:

* ACAS (ACAS-Xa and/or ACAS-Xo)
* ATCRBS/Mode-S
* TAWS/RWS
* ADS-B OUT
* ADS-B/TIS-B/ADS-R IN
* DME



Alternates of this configuration can be achieved through software configurations.

## Functional Descriptions

### ACAS

The function of ACAS is to determine the range, altitude and bearing of other aircraft equipped with Mode S/ATCRBS transponders with respect to the location of own aircraft. The system monitors the trajectory of these aircraft for the purpose of determining if any of them constitute a potential collision hazard. The system is responsible for estimating the separation at closest approach and determining if a potential conflict exists. If so, the system should display an advisory to the pilot. In cases defined in this document, the system should also provide guidance for the optimum vertical avoidance maneuver. The correctness of the avoidance maneuver is ensured by coordination of mutual intentions with the other ACAS or TCAS equipped aircraft through the Mode S transponder. Refer to ARINC Characteristic 735C for a detailed systems description.

### ATCRBS/Mode S Functions

The ATCRBS/Mode S transponder supports surveillance functions. These include classic Secondary Surveillance Radar (SSR) Mode A/C, Mode S, Elementary Surveillance, and Enhanced Surveillance functions. Refer to ARINC Characteristic 718A (latest revision) for a detailed system description.

### Weather Radar Functions (not applicable)

There are no weather radar functions defined for inclusion in the 2G ISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

### TAWS Functions

The TAWS function contains both the basic Ground Proximity Warning System (GPWS) functions as well as the terrain database derived forward-looking terrain alerting capability. As an optional capability, the 2G ISS may include reactive windshear detection capability. Refer to ARINC Characteristic 762 (latest revision) for a detailed system description.

#### Alert Prioritization

The 2G ISS configurations with TAWS capability should also include alert prioritization for the surveillance functions, per FAA TSO-C151d.

#### TAWS Growth Functions

The 2G ISS configurations with TAWS functionality should also consider growth capability for emerging functions.

### ADS-B OUT Function

The ADS-B OUT function supports RTCA DO-260C/EUROCAE ED-102B. Refer to ARINC 718A (latest revision) for a detailed system description.

### ADS-B IN Function

The 2G ISS may also include the capability to receive and process:

* 1090 MHz ADS-B messages from other aircraft
* 1090 MHz TIS-B messages from ADS-B ground stations
* 1090 MHz ADS-Rebroadcast (ADS-R) messages from ADS-B ground stations

The data from these messages can be used to support a number of ADS-B IN applications. Refer to Section 3.2.2 for a list of ADS-B IN applications.

### Distance Measuring Equipment (DME) Function

The 2G ISS is expected to provide the DME functions further defined in ARINC Characteristic 709-8: *Airborne Distance Measuring Equipment (DME).*

## Unit Description

The 2G ISS consists of multiple units:

* 2G ISS Processor Unit (2G ISSPU) applicable to all configurations.
* ISS Control Panel (ISS CP) applicable to all configurations. Control panels are implemented in accordance with the requirements of the airframe manufacturer.
* Omni-directional and directional antennas, applicable to all configurations.
* These units are described in Sections 1.4.1 through 1.4.4 below.

### 2G ISS Processor Unit (2G ISSPU)

The 2G ISS Processor Unit (2G ISSPU) houses all elements which provide the signal processing, power supply, ACAS/ATC/DME RF processing, TAWS processing, and the communication and I/O processing for the system.

### Weather Radar Antenna Unit (WRAU) (not applicable)

There are no weather radar functions defined for inclusion in the 2G ISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

### ISS Control Panel Description

Control of the surveillance functions may be implemented in several ways. The control functions may be integrated with the Cockpit Display System (CDS) and/or through one or more dedicated control panel(s). Control panels are implemented in accordance with the requirements of the airframe manufacturer.

COMMENTARY

It simplifies system control and display considerations at the aircraft level if an installation with multiple 2GISS units is managed entirely through a single 2GISS network entity. In this Primary/Secondary arrangement, all information for display, control, and other data is exchanged with the aircraft through the Primary 2GISS. The Secondary 2GISS then communicates with the aircraft through the Primary. To enable this desired simplification, this standard instantiates dual Optical ARINC 664 interface from each 2GISS to the aircraft systems, and a two additional Optical ARINC 664 interface dedicated between the two 2GISS units in a dual installation. A single additional port could be added, but would cause Left and Right units to require different hardware, which is unfavorable for interchangeability.



The bandwidth and latency provided by a dedicated ARINC 664 Optical interface is anticipated to be more than sufficient to accommodate control, display, and other data needed for cross-side functions of ACAS X, ADS-B IN, TAWS, and scanning DME. Furthermore, full reversionary modes are supported in the event of a failure. This implementation also presents no limitation to the aircraft from selecting either as Primary.

A traditional ARINC 429 XT - TX bus is also instantiated to accommodate systems with a single 2GISS and a traditional ARINC 718 Transponder.

[COMMITTEE QUESTIONS]

* Garmin thinks there is an advantage at the aircraft level to have all functions communicated and managed through a primary unit. Do OEMs agree?
* Do OEMS think it’s worth adding more stuff to the box to enable full operation through a primary?
  + We think that an optical interface requires two new optical ports. With one side transmitting 13xx nm and receiving 15xx nm and the other is vice-versa; we’ll need two more optical links to avoid having flavors of 2GISS.  The upside is that this could be used for redundancy.
* Do we want this to be optical, might be cheaper if it was just ethernet. Or do we like the flexibility that another pair of optical provides?
* Even if it’s optical, is it important that is ARINC 664? In the standard should we just say “fiber optic” so as not to box ourselves in?

.

### Omni-Directional and Directional Antennas

The 2G ISS should provide an ACAS/ATC/ADS-B transmit/receive directional antenna to be shared by the ACAS/ATC/ADS-B functions of each 2G ISSPU, located on the top of the fuselage. This antenna should provide the 2G ISSPU with signals for an estimation of the signal angle-of-arrival, and also have the capability to meet the omni-directional radiation pattern requirements of the ATCRBS/Mode S transponder, the ADS-B OUT (transmit) function, and the ADS-B IN (receive) function. The antenna’s footprint should be compliant with ARINC 735.

The 2G ISS is designed to operate with an ACAS/ATC/ADS-B/DME transmit/receive omni-directional antenna to be shared by the ACAS/ATC/ADS-B/DME functions of each 2G ISSPU, located on the bottom of the fuselage. The antenna’s footprint should be compliant with ARINC 718.

COMMENTARY

The installation envisioned for the 2GISS System is that each 2GISSPU unit would have its own directional top antenna and its own omnidirectional bottom antenna.

## Interchangeability

### General Requirements for Interchangeability

One of the primary functions of an ARINC Characteristic is to designate, in addition to certain performance parameters, the interchangeability in an aircraft of equipment produced by various manufacturers. The manufacturer is referred toARINC Report 607 for definitions of terms and general requirements for interchangeability. As explained in that document, the degree of interchangeability considered necessary and attainable for each particular system is specified in the pertinent ARINC Characteristic for that system.

### Interchangeability Desired for the 2G ISS

Although it is desirable to have complete interchangeability for all 2G ISS components supplied by different manufacturers, such level of interchangeability might not be achievable due to large variations between the 2G ISS configurations. However, it is necessary to maintain total system interchangeability for a given configuration supplied by different manufacturers.

Due to the complicated, and sometimes proprietary, interfaces that exist between the directional antenna and the 2G ISS processor unit, it is not practical to achieve full unit level interchangeability between the units supplied by different manufacturers for a given 2G ISS configuration. However, by maintaining form factor and interwiring standardization, system level interchangeability in installations designed in accordance with this document is a requirement for each of the 2G ISS configurations.

Interchangeability of the equipment between different aircraft types is achievable by using program pins and onboard software loading capability and loading unique software intended to be used on the aircraft that the unit is being installed.

### Interchangeability Considerations

Unchanged is the industry’s traditional desire that future evolutionary equipment improvements and the inclusion of additional functions in new equipment. These improvements should not violate the interwiring and form factor standards set forth in this document. Provisions to ensure forward looking “generation interchangeability” (as best can be predicted) are included in this document to guide manufacturers in future developments.

Forward-looking interchangeability may also be achieved by implementation of table-loaded information to provide this (static configuration) information, for example by hardware program pins, Operational Program Configuration (OPC) files, or via digital buses.

## Regulatory Approval

The 2G ISS should meet all applicable regulatory requirements (e.g. EASA and FAA). 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.

## Reliability

The airlines insist upon the utmost attention to the need for reliability in all phases in the design, production, installation and operation of the 2G ISS. It is most critical to achieve high levels of reliability to benefit from integration and to realize low life-cycle costs.

## Reference Documents

The latest versions of the following documents pertain to 2G ISS development and installation:

**ARINC Specification 404A**: *Air Transport Equipment Cases and Racking*

**ARINC Report 413A**: *Guidance for* *Aircraft Electrical Power Utilization and Transient Protection*

**ARINC Specification 429**: *Digital Information Transfer System (DITS)*

**ARINC Specification 600**: *Air Transport Avionics Equipment Interfaces*

**ARINC Report 604**: *Guidance for Design and Use of Built-In Test Equipment (BITE)*

**ARINC Report 607**: *Design Guidance for Avionic Equipment*

**ARINC Report 609**: *Design Guidance for Aircraft Electrical Power Systems*

**ARINC Report 615A**: *Software Data Loader Using Ethernet Interface*

**ARINC Report 624**: *Design Guidance for* *On-Board Maintenance System*

**ARINC Report 660A***: CNS/ATM Avionics Functional Allocation and Recommended Architectures*

**ARINC Specification 661**: *Cockpit Display System Interfaces to User Systems*

**ARINC Specification 664**: *Aircraft Data Network*

**ARINC Report 665**: *Loadable Software Standards*

**ARINC Report 667**:*Guidance for the Management of Field Loadable Software*

**ARINC Characteristic 709-8:** Airborne Distance Measuring Equipment (DME)

**ARINC Characteristic 718A***: Mark 4 Air Traffic Control Transponder   
(ATCRBS/Mode S)*

**ARINC Characteristic 735C**: *Airborne Collision Avoidance System X (ACAS X) ACAS Xa and ACAS Xo***ARINC Characteristic 762**: *Terrain Awareness and Warning System (TAWS)*

**ARINC Specification 801**: *Fiber Optic Connectors*

**ARINC Specification 813**: *Embedded Interchange Format for Terrain Databases*

**ARINC Specification 815**: *Embedded Interchange Format for Obstacle Databases*

**ARINC Specification 835**: *Guidance for Security of Loadable Software Parts Using Digital Signatures*

**FAA TSO-C66c**: *Distance Measuring Equipment (DME) Operating Within the Radio Frequency Range of 960 – 1215 Megahertz*

**FAA TSO-C112f**: *Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment*

**FAA TSO-C151d**: *Terrain Awareness and Warning System*

**FAA TSO-C166c**: *Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Service – Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)*

**FAA TSO-C195c:** *Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)*

**FAA TSO-C219:** *Airborne Collision Avoidance System (ACAS) Xa/Xo*

**ICAO Annex 10 Volume I**: Radio Navigation Aids

**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.*

**ICAO DOC 8643**: *Aircraft Type Designators*

**RTCA DO-160G/EUROCAE ED-14G**: *Environmental Conditions and Test Procedures for Airborne Equipment*

**RTCA DO-178C/EUROCAE ED-12C:** *Software Considerations in Airborne Systems and Equipment Certification*

**RTCA DO-181F/EUROCAE ED-73F**: *Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment*

**RTCA DO-189**: Minimum Operating Performance Standards for Airborne *Distance Measuring Equipment (DME) Operating Within the Radio Frequency Range of 960 – 1215 MHz*

**RTCA DO-214A**: *Audio Systems Characteristics and Minimum Operational Performance Standards for Aircraft Audio Systems and Equipment*

**RTCA DO-242A**: *Minimum Aviation System Performance Standards for Automatic Dependent Surveillance - Broadcast (ADS-B)*

**RTCA DO-254/EUROCAE ED-80**: *Design Assurance Guidance for Airborne Electronic Hardware*

**RTCA DO- 260C/EUROCAE ED-102B**: *Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)*

**RTCA DO-272D/EUROCAE ED-99D**: *User Requirements for Aerodrome Mapping Information*

**RTCA DO-276C/EUROCAE ED-98C**: *User Requirements for Terrain and Obstacle Data*

**RTCA DO-317C:** *Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications System (ASAS)*

**RTCA DO-326A/EUROCAE ED-202A:** *Airworthiness Security Process Specification*

**RTCA DO-338:** *Minimum Aviation System Performance Standards (MASPS) for ADS-B Traffic Surveillance Systems and Applications (ATSSA)*

**RTCA DO-355A/EUROCAE ED-204A:** *Information Security Guidance for Continuing Airworthiness*

**RTCA DO-356A/EUROCAE ED-203A:** *Airworthiness Security Methods and Considerations*

**RTCA DO-361A:** *Minimum Operational Performance Standards (MOPS) for Flight-deck Interval Management (FIM)*

**RTCA DO-367:***TAWS MOPS Supplement*

**RTCA DO-385:** *Minimum Operational Performance Standards for Airborne Collision Avoidance System X (ACAS X) ACAS Xa and ACAS Xo)*

# interchangebility standards

## Introduction

This section specifies the 2G ISS form factor, mounting provisions, interwiring, signal interfaces and power supply characteristics. These standards are necessary to ensure independent design and development of both 2G ISS equipment and the airframe installation.

COMMENTARY

Electrical Wiring Interconnection System (EWIS)

CFR Part 25.1701, as defined at the time of release, was assessed and it was determined that the internal wiring and connectors of the 2G ISS defined by this standard are not considered EWIS components by the regulations. However, the regulations at the time of certification should be assessed separately. 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 a customized solution could very well make the use of that custom design prohibitively expensive for the customer. Manufacturers should recognize 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

The 2G ISS equipment should conform to the guidelines of ARINC 600 and ARINC 801*.*

### 2G ISS Processor Unit (2G ISSPU)

The 2G ISS Processor Unit (2G ISSPU) should comply with the dimensional standards in ARINC 600. The unit size shall be 3 MCU. The 2G ISSPU should also comply with ARINC 600 standards in respect of weight, racking attachments, front and rear projections and cooling.



The 2G ISSPU should use a low insertion force ARINC 600 Size 2 service connector located on the center grid of the rear panel. The index code is specified as #158. The index pins on the 2G ISSPU rear connector should be set as follows per ARINC 600. The position is specified from the point of view of each unmated connector. Attachment 5B provides detailed connector drawings.

|  |  |  |  |
| --- | --- | --- | --- |
| **Position** | **Left** | **Center** | **Right** |
| 2G ISSPU | 6 | 6 | 3 |
| Aircraft | 2 | 5 | 5 |

### ISS Control Panel

Pilot control of the 2G ISSPU may be provided on a dedicated ISS control panel or multiple control panels.

2G ISS control panels should use the standard Dzus mounting. Typical control panel sizes for different configurations are shown in Attachment 2.

COMMENTARY

The Mythical “Standard Control Panel”

Control panels specific to the aircraft type sometimes vary between different airline configurations even for the same aircraft type. Therefore, it is very difficult to define a “Standard Control Panel” that is interchangeable between different manufacturers. However, form factor, connector and wiring can be standardized to allow “Standard Control Panel” provisions on the aircraft. Functional specifications for the ISS control panels are defined in Section 6 of this document.

### Omni-Directional and Directional Antennas

The physical characteristics, mounting dimensions and connector type for the directional antennas are shown in Attachment 3A. The physical characteristics, mounting dimensions and connector type for the omni-directional antennas are shown in Attachment 3B.

COMMENTARY

Airframe manufacturers are strongly encouraged to implement antenna mounting provisions that accommodate antennas with flat mounting surfaces. While airframe designers may have some perfectly valid reasons for using antennas with different curvature at the bottom to match different fuselage diameters, they should take note of the airline wishes. The airlines wish to avoid the spare parts problem introduced by the use of such antennas.

Section 4 of this document provides further information on the omni-directional and directional antennas.

### Weather Radar Antenna Unit (not apre-plicable)

[Section not applicable - ARINC may delete at publication if there is no 2.2.5]

## Weights

For the installation designer to provide proper structural design that can be used interchangeably with all manufacturers’ units, this characteristic sets forth the maximum weight expected for each unit. This is, however, not to be misconstrued as a specification on the acceptable weight limits for the equipment. Manufacturers are asked to keep ARINC informed regarding any equipment intended to conform to this Characteristic and where the equipment units do not meet the ranges set forth below. Such information should be disseminated to the airlines and airframe manufacturers.

|  |  |  |
| --- | --- | --- |
| **2G ISS Recommended Weights** | **Goal (kg)** | **Max (kg)** |
| 2G ISS Processor Unit |  |  |
|  |  |  |
| ATC/ADS-B/DME antenna | 0.12 | 0.2 |
| ACAS/ATC/ADS-B antenna | 1.3 | 1.5 |

## Standard Interwiring

The standard interwiring to be installed for the 2G ISS is set forth in Attachment 5 of this document. This interwiring is intended 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

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 airlines wish to emphasize to manufacturers that they desire a single common solution for 2G ISS, especially where it is Buyer Furnished Equipment (BFE) or selectable Supplier Furnished Equipment (SFE). The connectors and interwiring documented in this Characteristic reflect the airlines preference for this common solution.

This Characteristic also provides design guidance for highly integrated Supplier Furnished systems, but aircraft design considerations may result in deviations from this characteristic. In those cases, equipment manufacturers must consult with the airframe manufacturer or systems integrator for detailed interface requirements.

The reader should also consider the specific notes in Attachment 5 as they apply to the standard interwiring.

## Power Circuitry

### Primary Power Input

The aircraft power supply characteristics, utilization, equipment design limitations and general guidance material are set forth in ARINC 609.

### 2G ISS Processor Unit Power Input

The 2G ISS equipment should be designed to use one 28 Vdc power input.

### Power Control Circuitry

There should be no master on/off power switching within the 2G ISS. 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 DC 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 or power distribution system.

COMMENTARY

Although functions such as Transponder and ACAS operate on only one 2G ISS Processor Unit at a time in a dual installation, DME may operate on both simultaneously. When a function is in “standby” on a unit, users desire that it be held in a condition so that it’s BITE can detect and annunciate any failures that would render it incapable of providing a function when called upon.

### The Common Ground

The wires connected to the 2G ISSPU connector pins labeled “Chassis Ground” should be employed as the +28 Vdc 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 (not applicable)

[Section not applicable]

### Internal Circuit Protection

The basic master power protection means for the 2G ISSPU will be external to the unit (utilize a circuit breaker or power distribution relay). Within the equipment, no master power protection means is to be provided, although circuit protection is acceptable where the set manufacturer feels this would improve the overall reliability of the equipment.

COMMENTARY

Airlines prefer protection means other than fuses and circuit breakers. However, 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 circuit protection is provided 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 2G ISS equipment sends and receives data on several interfaces. Interoperability of equipment from different manufacturers requires that all 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.

### Equipment Spacing

With the exception of ACAS/ATC/ADS-B/DME antennas, the 2G ISS should be designed to make allowance for up to 100 foot separation distance between the components of the system to allow maximum installation flexibility for the airframe manufacturers. For the top directional ACAS/ATC/ADS-B antenna, the airframe manufacturers should design cabling and distance to maintain cable loss of 2.5 ±0.5dB from 1030 MHz to 1090 MHz, including the connector losses. For the bottom omni-directional ACAS/ATC/ADS-B/DME antenna, the airframe manufacturers should design cabling and distance to maintain cable loss of 2.5 ±0.5dB from 960 MHz to 1215 MHz, including the connector losses.

## Environmental/EMI Requirements

The 2G ISS components should be specified environmentally in terms of RTCA DO-160 latest version. Because 2G ISS components are located in different areas of the aircraft, different levels of environmental testing may be required. Tests applicable to each component are provided in Attachment 7.

## Cooling

The 2G ISSPU should be designed to accept, and airframe manufacturers should configure the installation to provide forced air cooling as defined in ARINC 600 (220 kg/hr per kW of power dissipation).

|  |  |  |
| --- | --- | --- |
| **Unit Size** | **Air Flow**  **(kg/hr at 40 deg C)** | **Max. Power Dissipation**  **(Watts)** |
| 3 MCU | 16.5 | 75 |
|  |  |  |

The coolant air pressure drop through the equipment should be per ARINC 600 level 2 cooling (25 ±5 mm) at standard conditions of 101.3 kPa. This pressure drop does not include the drop through a returning orifice when such orifice is located external to the equipment case. Air flow is calculated based 220 kg / (hr x kW) with a maximum average thermal power dissipation of 75 Watts.

A loss of in-flight cooling air will result in environmental requirements and performance specifications dependent upon the airframe. The loss of cooling scenarios expected for many installations of 2G ISSPU equipment will exceed that anticipated by ARINC 600. Some airframes may require operation without primary cooling air for as long as 20 hours with ambient air temperatures as high as 65 degrees. Some systems may require fully functional conspicuity through transponder operation for this full duration and fully functional collision avoidance in the final stages of operation. To prevent complexity in aircraft certification and crew operations, full functionality in all expected conditions is preferred by airframe manufacturers and airline operators. If convective cooling during a loss of primary cooling air is insufficient, the manufacturer may need to develop a secondary cooling solution either in the unit or on the airframe for this scenario.

Other 2G ISS components, such as control panels, should be designed for convection and conduction cooling. These units should not require forced-air cooling.

COMMENTARY

The specified cooling air flow rate is based on estimated average power dissipation. However, it should be noted that power dissipation during RF signal transmission will be higher than the estimated average. Thus, the specified air flow rate will be less than the rate recommended in ARINC 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 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 the 2G ISS equipment as well as airframe manufacturers.

## Grounding and Bonding

The 2G ISS equipment and airframe installation should conform to the guidance material in Section 3.2.4 of ARINC 600 and Appendix 2 of ARINC 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-level problem that is difficult to troubleshoot and therefore consumes an 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 material should be the first step.

## Standardized Signaling

Electrical signal inputs and outputs of the 2G ISS should be in the form of a digital format or switch contact. Standards should be established exactly to assure the desired interoperability of equipment.

Basic standards described below are applicable to all signals. Unless otherwise specified, signals should conform to the standards set forth in the sections below.

### Digital Interfaces

The 2G ISS should contain necessary digital interfaces and adequate spares to support growth functions over the foreseeable future. The recommended equipment ID for 2G ISS is 068. This ID may be used with ARINC 429 and other data transfer mediums. See ARINC Specification 429 for additional information on this topic.

#### ARINC 429 Data Bus

ARINC 429 and applicable ARINC Characteristics (e.g., ARINC 702A, 709-8, 718A, 735C, 735B, 762) define data word formats, refresh rates and resolution.

#### ARINC 664 Ethernet Bus

ARINC 664 defines the physical layer definitions for copper and fiber optic media used in aircraft installations. Exact data word formats, refresh rates and resolution are to be defined by the airframe manufacturer. The 2G ISS should be designed to accept different data formats and rates used by software data loading equipment.

The primary interface to the aircraft for the 2GISS is an optical instantiation of an ARINC 664 interface. Specifying optical interface at the top of the insert to prevents debris from copper contact wear from contaminating the fiber optic contact.

2GISSPU should implement ARINC 664 optical busses as multi-mode 1000BASE-BX at 13xx nm and 15xx nm. Each optical port should be specified to transmit on one wavelength while receiving on the other. Actual data rate will operate at 100BASE rates to avoid driving increases in size, weight, heat, power in the unit. Expected multi-mode fiber is 62 um with 125 um cladding.

#### AEEC 453 Radar Bus (not applicable)

[Section not applicable - ARINC may delete at publication if there is no 2.10.1.4]

### Discrete Interfaces

#### 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 typical signal range is 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 circuits, resistance of 10 ohms or less to signal common represents 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 is considered “applied” when the actual voltage under the specified load conditions exceeds 18.5 volts (36 Vdc maximum) and is “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 with two possible states, “open” and “ground”. The characteristics of these two states are defined in Sections 2.10.2.1 and 2.10.2.2 of this document. The maximum current flow in the steady “ground” state should not exceed 20 milliamps.

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

The maximum input capacitance to ground should be less than 1 microfarad.

COMMENTARY

The maximum input capacitance is specified because excessive input capacitance can cause current spikes of over 1 amp.

The logic sources for discrete inputs to the 2G ISS are expected to take the form of switches mounted on the airframe component (flap, including gear, etc.) from which the input is desired. These switches can 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 2G ISS is expected to provide the DC signal to be switched. Typically, this is done through a pull-up resistor. The 2G ISS input should sense the voltage on each input to determine the state (open or closed) of each associated switch.

The values of voltages (and resistance) which define the state of an input assumes that the discrete input utilizes a ground-seeking circuit. 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 is favorable among both manufacturers and users.

Because the probability is quite high that sensors (switches) will provide similar information to a number of users, unwanted signals may be impressed on the 2G ISS inputs, especially when the switches are in the open condition. For this reason, equipment manufacturers should base their logic sensing on the “ground” state of each input. Manufacturers should ensure adequate signal 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 2.10.2.1 and 2.10.2.2. 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 milliamps of steady state current. Non-standard current sinking capability may be defined.

COMMENTARY

It is recognized that 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 and will be defined in the appropriate section of this document.

The designer is cautioned that discrete input capacitance and discrete output slew rates can caused current spikes of over 1 amp.

Discrete outputs that need to source current should utilize the standard “Applied Voltage” output defined in Section 2.10.2.3. These special cases are noted in the text describing each applicable Discrete output function and in the notes to interwiring.

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

#### Standard Program Pin Inputs

Program pins may be assigned on the 2G ISS 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). Every effort should be made to minimize the number of program pins used for the 2G ISS.

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

The encoding logic of the program pin relies upon two possible states of the designated input pin. One state is an “open” as defined in Section 2.10.2.1 of this document. The other state is a connection (short circuit i.e., 10 ohms or less) to the pin designated as the “Program Common” pin.

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.

One means of reducing the program pins is to encode the programmable aspects of the system in the onboard loadable software via the Operational Program Configuration (OPC) per ARINC 665-3.

### Analog Interfaces

#### DC Panel Backlight Dimming Bus Input

[Section not applicable]

#### AC Panel Backlight Dimming Bus Input

[Section not applicable]

#### Audio Output

One audio output is provided for synthesized voice alerts, and one for DME audio identification. Audio outputs should be programmable to deliver 0.625 to 80 mW into 600 ohm load at 1000 Hz. Default audio outputs settings should provide 10 mW (nominal) into 600 ohm load per RTCA DO-214A. Audio levels should be customer selectable by Operational Program Configuration (OPC).

#### Suppression Pulse

The 2G ISS instantiates an ac coupled pulse signal to provide mutual suppression of systems transmitting on ACAS/ATC/DME frequencies. Details of the suppression pulse characteristics can be found in ARINC 735C.

### Airplane Personality Module (not applicable)

[Section not applicable - ARINC may delete at publication if there is no 2.11]

An APM will not be used in the 2G ISS installation. In lieu of an APM, the 2G ISS should be configured via hardwire program pins. Refer to Section 2.10.2.6 for program pin input definitions.

## Radome (not applicable)

[Section not applicable - ARINC may delete at publication if there is no 2.11]

## WRAU Mounting Adjustments (not applicable)

[Section not applicable - ARINC may delete at publication if there is no 2.11]

# system characteristics

## Purpose

This section describes the functional characteristics of a second generation (2G ISS) that contains the full complement of surveillance functions for traffic and terrain, i.e., configuration A. A description of ACAS, transponder, TAWS are included in subsections. The major functions of the ISS are:

Traffic Surveillance

* Airborne Collision Avoidance System (ACAS) Xa/Xo functionality per RTCA DO-385 and TSO-C219
* ATC per RTCA DO-181F and TSO-C112f
* ADS-B OUT AND IN per RTCA DO-260C and TSO C166c
* Aircraft Surveillance Applications per RTCA DO-317 and TSO C195c

Terrain Surveillance

* GPWS, TAWS (per FAA TSO-C151d)
* Alert prioritization (per FAA TSO-C151d)

Distance Measuring Equipment (DME)

* DME functionality per FAA TSO-C66c and ARINC 709-8

### 2G ISS Growth

The 2G ISS should be designed with sufficient growth capability in computer processing, memory and I/O ports necessary to support future growth applications.

#### 2G ISS Display Growth Capability

The 2G ISS should be designed to support 3D-display capability when display systems evolve to that level.

#### Runway Alerting

The runway alerting would provide advisory information to the pilots’ enhanced situational awareness of the flight crews with respect to the runways.

#### Airport Map Display Function

The 2G ISS may have an expanded terrain database to include airport surface features as defined in RTCA DO-272. This database can be used to provide airport map display function.

#### Uplinked Weather Function (not applicable)

[Section not applicable - ARINC may delete at publication if there is no 3.1.1.5]

## Traffic Surveillance Functions

### TCAS/ACAS Functions

The Airborne Collision Avoidance System function in the 2G ISS provides the basic traffic surveillance capability as defined in ARINC 735C. The basic ACAS functions included:

* Active interrogation of transponders of other aircraft and monitor of ADS-B OUT for traffic surveillance.
* Generating alerts for potential traffic conflicts.
* Coordination of avoidance maneuvers with other ACAS/TCAS equipped aircraft.

### ADS-B IN Applications

#### ADS-B IN Applications

The following is a list of ADS-B IN applications that the 2G ISS should support. Refer to the latest revision of RTCA DO-317 (ASAS MOPS) for a detailed description of each application:

* Airborne (AIRB) Situational Awareness
* Enhanced Visual Acquisition (EVAcq)
* Basic Surface Situational Awareness (SURF)
* Visual Separation on Approach (VSA)
* In-Trail Procedure (ITP)
* CDTI Assisted Visual Separation (CAVS)

#### Growth for Future ADS-B IN Applications

The following is a list of ADS-B IN applications that the 2G ISS should support in the future. Growth provisions (memory, processor throughput, and wiring pin outs) should be provided to the best extent possible:

* Surface Situational Awareness with Indications and Alerting (SURF-IA)
* Interval Management with Wake Risk Management
* Dependent (Paired) Closely Spaced Parallel Approaches
* Independent Closely Spaced Parallel Approaches (ICSPA)
* Lateral and Vertical Crossing & Passing

COMMENTARY

The list of future ADS-B IN applications was obtained from Version 2.0 of the FAA’s “Application Integrated Work Plan (AIWP)” document.

### Transponder Function

The Mode S transponder functions in the 2G ISS provide the basic traffic surveillance transponder capability as defined in ARINC 718A. The basic transponder functions include:

* Response to ATC interrogations, both ATCRBS and Mode S.
* Response to ACAS/TCAS interrogations.
* Transmission of Elementary and Enhanced data parameters.

Additionally, the ISS transponder should have capability to transmit data parameters necessary to support ADS-B traffic surveillance functions.

## Weather Surveillance Function (Not Applicable)

There are no weather radar functions defined for inclusion in the 2G ISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

## Terrain Surveillance Function

The terrain surveillance function of the 2G ISS provides the flight crew with sufficient situation information and awareness to detect that a potentially hazardous terrain condition exists.

### TAWS Functions

The TAWS function in the 2G ISS should contain terrain and obstacle databases, compliant with ARINC 813 and ARINC 815, to support enhanced terrain displays and alerts. It should be possible to indicate to the flight deck crew, through aural or visual annunciation, the current version of the terrain database. The system should contain the following functions as described in ARINC 762:

* Basic GPWS functions: Modes 1 through 6
* Extreme Attitude Alerting, such as excessive bank angle
* Terrain display based on terrain database
* Predictive terrain avoidance
* Forward looking terrain alerting based on terrain database

The system performance and functionality is defined in the latest version of FAA document TSO-C151d for Class A equipment. Vertical terrain display data may be provided as a basic function of the 2G ISS. Aircraft performance data may be used for terrain alerting.

### Terrain Surveillance Growth Functions

The terrain surveillance function in the 2G ISS should contain provisions to support growth capability related to future applications based on terrain and related databases. The following sections describe example applications. This list is not intended to be fully inclusive.

#### Flight Plan Terrain Conflict Detection

By exchanging data with the FMS, the TAWS function should have provisions to detect terrain conflict along the flight plan when the flight plan is being entered into the FMS.

#### Aeronautical Database Function

The 2G ISS should have provisions to supply data from its internal databases (e.g., terrain database and obstacle database) to other systems that would use this data for functional enhancements.

The 2G ISS should also have the capability to interface with a database server which could be localized in the 2G ISS or in a different subsystem. ARINC 813 provides an exchange format for terrain data and ARINC 815 provides an exchange format for obstacle data.

#### Enhanced Terrain Situation Awareness

The 2G ISS should include provisions for enhanced terrain situation awareness. This can be provided due to the availability of improved databases and display resolution. This may include functions such as:

* Topographic display mode.
* Obstacle icons.
* Advisory level alerting, including safe landing for final approach and alert prediction on current flight path.

#### Lateral Collision Prediction

In situations when the aircraft is facing steep terrain, a vertical pull-up maneuver may not be sufficient. The 2G ISS should have provisions to implement a lateral collision prediction algorithm that annunciates to the flight deck crew that pull-up is not sufficient and provides the safest lateral direction to avoid the terrain.

#### Obstacle Collision Prediction

An obstacle collision prediction function may be included.

## ISS Display

The 2G ISS should provide surveillance information to the cockpit display system. These may be as follows:

* Traffic surveillance and alerting information
* ADS-B IN application surveillance and alerting information
* Terrain surveillance and alerting
* DME distance information
* Status and fault indication

### Traffic Display

The ISS should provide traffic surveillance information to the display and other aircraft systems over ARINC 664. The purpose of the traffic advisory display is to assist the flight crew in visually locating an intruder. The information should be according to Display Traffic Information File (DTIF) as defined in ARINC 735C to support Cockpit Display of Traffic Information (CDTI) functions associated with the ADS-B. For the ARINC 664 bus, the DTIF file should be formatted according to the ARINC 661, CDS interface.

### Terrain Display

The terrain surveillance and alerting information for the TAWS function should be integrated in the display system. Refer to Section 3.7.1.1 for aircraft display interface definitions.

The 2G ISS should generate four display images. These images are as follows:

* Captain’s plan-view image
* Captain’s vertical profile view image (optional)
* First Officer’s plan-view image
* First Officer’s vertical profile view image (optional)

The plan view images should contain the terrain information as selected by the flight crews.

The image update rates are display specific and should be as fast as practicable.

#### Automatic Display Selection

The 2G ISS should have provision to support automatic display mode selection to change the plan view displays to display either terrain or weather information based on the alert conditions. For this function, the 2G ISS would send the specific alert condition based on the alert prioritization to the display system.

#### Ranges

This section does not set forth specific requirements for indicator display ranges. The input provisions make it possible for the equipment to select different ranges in any combination of 5-mile increments. However, ranges of 5, 10, 20, 40, 80, 160, 320, and 640 nm should be used whenever possible. The display system should be so designed that it automatically erases the displayed data when the range is changed.

COMMENTARY

The number and value of ranges used by various users have, traditionally, not been standardized. The flexibility of digital technology makes it even easier (although still costly!) to accommodate individual customer’s desires. Most of the later generation EFIS equipped aircraft use 10, 20, 40, 80, 160, 320, and 640 nm as standard ranges.

#### Automatic Range Change

The 2G ISS should have provision to support automatic range changes when alert conditions are present to allow automatic selection of a more suitable range to view the alert conditions. For this function, the 2G ISS would send the optimum range to be used for the specific alert condition to the display system.

#### Display Color

For terrain plan view displays, green, yellow and red (for terrain) and cyan (for large water surfaces) with different “dot” patterns similar to ARINC 762 TAWS equipment should be used in order to minimize re-training of the flight crews. If provided, the vertical profile displays brown should be used for terrain to avoid any confusion between the weather targets and terrain features. Solid Cyan should be used for large water surfaces.

#### Icons

The 2G ISS should use icons to the maximum extent possible to display terrain alerts on the Navigation Displays. The icon data should be transmitted in ARINC 661, CDS format.

## Alerts

The 2G ISS should provide alerting functions for the following surveillance functions: ACAS, reactive windshear, ADS-B IN (CAVS), and TAWS. The alerts should be aural and/or visual.

Note: Future aural and/or visual alerts to support ADS-B IN applications may be needed.

### Alert Prioritization

The TAWS function should perform all alert prioritization for the surveillance systems. These include ACAS, ADS-B IN (CAVS), and TAWS. The alert prioritization, as a minimum, should satisfy the current prioritization scheme as shown in Attachment 6 of this document.

The 2G ISS should also interface with the aircraft’s central alerting system to enable prioritization of the surveillance alerts at the aircraft level.

### Alert Cancel

The 2G ISS should have the capability to cancel all currently active aural alerts. The cancel command can be received over the input data buses. The advisory should remain cancelled until one of the following conditions exists:

* The currently active advisory becomes inactive and then becomes active again
* The currently active advisory is replaced by a different advisory

### Aural Alert Outputs

The 2G ISS should provide aural outputs in analog format suitable for interfacing with 600 ohm audio systems. It should also have provisions to transmit the aural alerts in digital audio format over ARINC 664 Ethernet.

#### Traffic Aural Alert Outputs

For ACAS alerts, the 2G ISS should generate synthesized voice messages as defined in ARINC 735C.

#### Weather Surveillance Alert Outputs (not applicable)

There are no weather radar functions defined for inclusion in the 2GISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

#### TAWS Aural Alert Outputs

For TAWS alerts, the 2G ISS should generate synthesized voice messages. The 2G ISS should also have provisions to generate other aural messages associated with future growth functions that might be performed by the TAWS function, such as runway alerts.

### Visual Alert Outputs

The 2G ISS should provide data for visual alerts in the cockpit.

#### Traffic Visual Alert Outputs

Traffic visual alerts are used for alerting the flight crew to currently active traffic and resolution advisories. The Resolution Advisory (RA) Display is considered to be the visual alert display for the ACAS.

COMMENTARY

RTCA DO-385 requires aural alerts to be presented by voice announcements only and prohibits the use of aural advisory signals other than voice to alert flight crews to the presence of a TA or RA. RTCA DO-385 does not specify requirements for the visual (annunciator lights) since these are considered a customer option instead of a minimum requirement.

Resolution Advisory (RA) information indicates the action the aircrew should take (or avoid taking) to minimize the risk of collision. It should provide symbolic instructions for maneuvers necessary to assure safe vertical separation between the ACAS equipped aircraft and an intruder aircraft at their point of closest approach, in accordance with RTCA DO-385. The advisory displayed may be “corrective” or “preventive” in nature depending upon the flight regime of the aircraft at the time the advisory is displayed.

The Resolution Advisory information would be contained in the DTIF generated by the 2G ISS and transmitted over the ARINC 664 bus.

#### Weather Visual Alert Outputs (not applicable)

There are no weather radar functions defined for inclusion in the 2GISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

#### TAWS Visual Alert Outputs

The ARINC 664 bus output from the 2G ISS should contain TAWS alert condition to enable the display system to generate visual alerts as defined in ARINC 762.

### Failure Annunciations

Regulatory specifications for some of the functions contained in the 2G ISS require failure annunciations for loss of specific functions. The output buses from the 2G ISS should contain functional failure data to enable the display system to generate appropriate loss-of-function annunciations.

These include but not limited to:

* Loss of Transponder function
* Transponder function in the standby mode
* Loss of ACAS function, including inability to generate resolution advisories
* Inhibit of ACAS function, either automatically or through flight crew action, including the inhibit to TA-only or standby mode
* Loss of GPWS function.
* Loss of TAWS functions that depend on aircraft position information and the database, either due to failure or through flight crew action.
* Loss of ADS-B OUT function.
* :oss of ADS-B IN application(s).

## Aircraft Interfaces

The 2G ISS aircraft interfaces may be analog, digital or discrete format. ARINC 664 bus or ARINC 429 data buses are used for the digital data. Some of the discrete signals are also transmitted and received over the digital buses. It should be noted that not all interfaces are necessary for specific configurations of the 2G ISS.   
See Attachment 5A.

### Digital Interfaces

Digital data should be supplied to the 2G ISS from a standardized digital source using ARINC 429 data buses or over an ARINC 664 bus. Proprietary buses are not recommended.

#### Display Interface

The display system interface definition is a function of the aircraft installation. It should be ARINC 664 bus with ARINC 661 cockpit display interface for both transmit and receive of data.

No dedicated display interface for HUD is provided. It is assumed that the HUD will share the data supplied to the display system over the ARINC 664 bus.

#### Radio Altimeter

Radio altimeter altitude data should be supplied to the 2G ISS from a digital source such as an ARINC 707 radio altimeter directly over the ARINC 664 bus. All Radio Altimeters on the aircraft, up to three, should be connected to the 2G ISS. The following 2G ISS functions use radio altitude data:

|  |  |
| --- | --- |
| ISS Function | Use |
| TCAS | Compute ACAS sensitivity level  To inhibit “descend” ACAS advisories when the aircraft is in close proximity to the ground  To inhibit ACAS aural annunciations when the aircraft is in close proximity to the ground |
| TAWS | Supports various TAWS alerts and altitude callouts |
| ADS-B IN | May be used to activate output of ADS-B surveillance of surface tracks when in proximity to the airport surface |

#### Barometric Altimeter

The 2G ISS should receive air data from a digital air-data source such as an ARINC 706 Air Data Computer over the ARINC 664 bus or over the ARINC 429 data bus (backup only). Two air data sources should be connected to the 2G ISS. For the transponder function, the 2G ISS should use the same barometric altitude source being used by the flight control system. The following 2G ISS functions use barometric altimeter data:

|  |  |
| --- | --- |
| ISS Function | Use |
| ACAS | Baro altitude used for collision avoidance algorithms |
| XPDR/ADS-B OUT | Report baro altitude, altitude rate, airspeed (IAS and TAS), mach number, and pressure setting to ATC ground stations |
| TAWS | TAWS Modes 1 thru 4 logic |
| ADS-B IN | Altitude rate, static air temperature, computed airspeed, and true airspeed for ADS-B IN applications where speed awareness is needed. |

#### ILS/GLS Information

The 2G ISS should interface with at least two Instrument Landing System (ILS)/GNSS Landing System (GLS) sources over the ARINC 664 bus. The source could be MMR (ARINC 755), (ARINC 756), or ILS receivers (ARINC 710). The following 2G ISS functions use ILS/GLS data:

|  |  |
| --- | --- |
| ISS Function | Use |
| TAWS | Lateral and vertical deviation data for TAWS Modes 1, 2, 5, and 6 logic |

#### GNSS Information

The 2G ISS should interface with at least two Global Navigation Satellite System (GNSS) sources over the ARINC 664 bus. The source could be MMR (ARINC 755), GNSS Navigation and Landing Unit (GNLU) (ARINC 756), GNSS Navigation Unit (GNU) (ARINC 760), or GNSS Receiver (ARINC 743B).

COMMENTARY

2G ISS functions expect GNSS position, velocity, time, and quality data to correspond to a single time of applicability. ARINC 743B defines an ARINC 429 start label that indicates all subsequent data labels are associated with a single time of applicability. The GNSS data supplied over ARINC 664 should maintain the coherency of position, velocity, time, and quality data in a similar manner.

The following 2G ISS functions use GNSS information:

|  |  |
| --- | --- |
| ISS Function | Use |
| ACAS | GNSS position for hybrid surveillance |
| XPDR/ADS-B OUT | Report GNSS position, velocity, time, altitude/height, vertical rate, and integrity (HIL/HFOM/VFOM) data to ATC ADS-B ground stations |
| TAWS | Terrain display and forward-looking terrain alerts |
| ADS-B IN | GNSS position, velocity, and associated quality indicators for use by ADS-B IN applications |

#### FMS Information

FMS data should be supplied to the 2G ISS from a digital source per ARINC 702A over the ARINC 664 bus. At least two sources should be connected to the 2G ISS.

The following 2G ISS functions use FMS state information (e.g., latitude, longitude, Actual Navigation Performance (ANP), Required Navigation Performance (RNP), Magnetic Track, etc.):

|  |  |
| --- | --- |
| ISS Function | Use |
| XPDR/ADS-B OUT | Flight ID  FMS position, velocity, and integrity data used as backup to GNSS |
| ACAS | Climb performance data  This input can be used in lieu of program pins/software option setting |
| TAWS | Lat/Long, ANP, and RNP used as backup to GNSS.  Magnetic track used for Mode 5 alert logic |
| ADS-B IN | Wind conditions, Minimum Speeds |

The following 2G ISS functions use FMS intent data information (e.g., flight plan, etc.):

|  |  |
| --- | --- |
| ISS Function | Use |
| TAWS | Flight plan data for path-based VSD terrain display. |
| ADS-B IN | FMS path data |

#### IRS Interface

Attitude information and own state vector data to support the ADS-B functions should be supplied directly from a digital IRS source over the ARINC 664 bus. At least two sources should be connected to the 2G ISS.

IRS data should be supplied to the 2G ISS from a digital source over the ARINC 664 bus. At least two sources should be connected to the 2G ISS. The following 2G ISS functions use IRS information:

|  |  |
| --- | --- |
| ISS Function | Use |
| ACAS | Inertial data for display smoothing. May optionally use heading/attitude data for intruder bearing tracking. |
| XPDR/ADS-B OUT | Inertial position (lat/long), velocity, vertical speed, and true track |
| TAWS | Several inertial parameters are used in TAWS alert logic |

#### ACAS Interface with Mode S Transponder

The interface between the ACAS and transponder subsystems within a single 2G ISSPU is internal but should be designed to maximize system robustness. In the event of ACAS failure, the ATC function should remain operational if available.

The interface from a 2G ISSPU to a cross-side transponder should be compliant with ARINC 735C, (TCAS-Transponder Interface Bus) using ARINC 429 data bus.

#### FCU/MCP Interface

The selected altitude and selected heading of the aircraft from the FCU/MCP should be provided to the 2G ISS directly from the Flight Control System or over the ARINC 664 bus or over the ARINC 429 data bus (backup only). The selected altitude information is used for Enhanced Surveillance. The selected heading information may be used for ADS-B OUT and/or ADS-B IN applications.

#### CMU/ATSU Interface

The 2G ISS should be capable of interfacing with two CMU/ATSU units over the ARINC 664 bus for data communication, either to receive uplinked data or to transmit data over the digital communication channels.

#### OMS Interface

The 2G ISS should be capable of interfacing with two on-board maintenance systems over the ARINC 664 bus for data maintenance information.

### Discrete Data

The discrete data can be supplied as a discrete signal dedicated to a function or combined with the digital data supplied by an appropriate source.

#### Landing Gear Input

The 2G ISS should accept data designating the position of the landing gear. This input can be used by the 2G ISS to support various surveillance functions.

#### Air/Ground Input

The 2G ISS should accept data indicating if the aircraft is on the ground or airborne.

#### Takeoff Power Input (Not Applicable)

There are no weather radar functions defined for inclusion in the 2G ISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

#### Time Mark Input

Reserved

#### RA/TA System Status Inputs

These inputs define the operational status of the RA/TA display systems.

#### Traffic Selector Inputs

These inputs can be used by the 2G ISS to designate a given traffic among the list of traffic. This may be necessary when DTIF is activated and ADS-B traffic is available. This may be used to enable the flight deck crew to focus on a given traffic and to acquire detailed information on that traffic.



### Programmable Data

The 2G ISS should accept (onboard and offboard) the following two files:

* Installation Configuration Option file (also known as an Option Selection Software file)
* User Selectable Options file (also known as an Airline Selection Option file)

Note:

The information contained in these two files can also come from a separate source onboard the airplane (e.g., via an ARINC 664 interface).

The following tables summarize the options both the Installation Configuration Options as well as the User Selectable Options:

Table 3-1 – ISS Installation Configuration Options

| **Function** | | **Parameter** | | **Selectable Values** | **Description** |
| --- | --- | --- | --- | --- | --- |
| ACAS | ACAS/ATC/ADS-B Antenna Coaxial Cable Loss (Upper) | | Not used  0 to 1 db  1 to 2 db  2 to 3 db | | Loss Through Upper Antenna Cable |
| ACAS | ACAS/ATC/ADS-B Antenna Coaxial Cable Loss (Lower) | | Not used  0 to 1 db  1 to 2 db  2 to 3 db | | Loss Through Lower Antenna Cable |
| ACAS | ACAS/ATC/ADS-B Antenna Coaxial Cable Delay | | 0 to 50 nsec  51 to 150 nsec  151 to 250 nsec  251 to 300 nsec | | Differential delay between upper and lower ACAS/ATC/ADS-B antenna cable runs.  The 2G ISS should provide a means to recognize and compensate for differences in the length of RF cables to the upper ACAS/ATC/ADS-B antenna and the lower ACAS/ATC/ADS-B antenna. Programmable data should provide as much as 300 nanoseconds compensation. |
| ACAS | ACAS/ATC/ADS-B Antenna Coaxial Cable Delay Sign Bit | | 1 = Add Cable Delay to Bottom Antenna  0 = Add Cable Delay to Top Antenna | | Add cable delay to either the top or bottom antenna |
| ACAS | Shared Antennas | | 1 = Enabled (share antennas)  0 = Disable (independent antennas) | | Enabled when dual 2G ISS installation share 1 set of upper/lower antennas |
| ACAS | Resolution Advisory (RA) Display Status Enable | | 1 = Disable RA Display Status Discrete Monitor  0 = Enable RA Display Status Discrete Monitor | | Enables monitoring of the two RA display status discrete inputs |
| ACAS | ACAS On-Ground Mode | | 1 = ACAS in Standby mode when on ground  0 = ACAS in TA Only mode when on ground | | Sets the ACAS to either “Standby” mode or “TA Only” mode when aircraft is On-Ground |
| ACAS | Aural Advisory Discrete Delay | | 1 = Add delay to Aural Advisory discrete output  0 = No delay | | Reference ARINC 735B section 3.6.3.  Intended for XPDR/ACAS configuration only (Config B) |
| ACAS  ADS-B IN | Traffic Display Intruder Limit | | 0 to 63 | | Limits the number of intruders displayed (from 0 to 63) |
| ACAS  ADS-B IN | Display All Traffic or Threat Traffic Only | | 1 = Display all intruders  0 = Display only TA and RA intruders | | Provides the ability to display only TA and RA intruders |
| ACAS  ATC  ADS-B | ACAS/ATC/ADS-B Antenna Monitoring Enable | | 1 = Enable Antenna Monitoring  0 = Disable Antenna Monitoring | | Enables monitoring of the ACAS/ATC/ADS-B antennas to insure they are connected to the 2G ISS Processor Unit |
| ATC | | Max Cruising Airspeed Capability | 000 = Not available  001 = 0 to 75 knots  010 = 75 to 150 knots  011 = 150 to 300 knots  100 = 300 to 600 knots  101 = 600 to 1200 knots  110 = more than 1200 knots  111 = not used | | The designed maximum airspeed capability of the aircraft in which the 2G ISS is installed |
| ATC | | Mode S Address | 24 bit Mode-S Address | | Provides the aircraft’s ICAO Mode S address |
| ADS-B OUT | | Navigation Accuracy Category – Velocity (NACv) | 000 = Unknown or ≥10m/s  001 = < 10 m/s  010 = < 3 m/s  011 = < 1m/s  100 = not used | | Indicates the velocity accuracy of the GNSS sensor when not provided dynamically. |
| ADS-B OUT | | Max Navigation Accuracy Category – Velocity (NACv) | 000 = Unknown or ≥10m/s  001 = < 10 m/s  010 = < 3 m/s  011 = < 1m/s  100 = not used | | Indicates the maximum NACv value validated for the GNSS sensor. Transmitted NACv will be limited to this value even if the sensor provides higher accuracy. |
| ADS-B OUT | | Aircraft Emitter Category | 0000 = Not available  0001 = < 15,500 lbs  0010 = 15,500 to 75,000 lbs  0011 = 75,000 to 300,000 lbs  0100 = Reserved  0101 = > 300,000 lbs  0110 = Reserved  0111 = Rotorcraft  1000 through 1111 = Reserved for Set “B” | | Indicates the type of aircraft the 2G ISS is installed on.  Ref DO-260B Table 2-19 |
| ADS-B OUT | | Maximum Takeoff Weight (MTOW) | MTOW in lbs, 12 bit field    Encode using DO‑260C  Table 2.2.3.2.7.6.3.4-2 | | Aircraft MTOW  Ref DO-260C 2.2.3.7.6.3.4 |
| ADS-B OUT | | Aircraft Length/Width | 0000 = No Data or Unknown  0001 = L ≤ 15m, W ≤ 23m  0010 = L ≤ 25m, W ≤ 28.5m  0011 = L ≤ 25m, W ≤ 34m  0100 = L ≤ 35m, W ≤ 33m  0101 = L ≤ 35m, W ≤ 38m  0110 = L ≤ 45m, W ≤ 39.5m  0111 = L ≤ 45m, W ≤ 45m  1000 = L ≤ 55m, W ≤ 45m  1001 = L ≤ 55m, W ≤ 52m  1010 = L ≤ 65m, W ≤ 59.5m  1011 = L ≤ 65m, W ≤ 67m  1100 = L ≤ 75m, W ≤ 72.5m  1101 = L ≤ 75m, W ≤ 80m  1110 = L ≤ 85m, W ≤ 80m  1111 = L > 85m, W ≤ 90m | | Indicates the type of aircraft the 2G ISS is installed on.  Ref DO-260C Table 2-74  Assign the smallest Length/Width code for which the actual aircraft length is less than or equal to the upper bound length and for which the actual aircraft width is less than or equal to the upper bound width.  If the aircraft is longer than 85 meters, or wider than 90 meters, then the Length/Width code of 1111 shall be used. |
| ADS-B OUT | | Aircraft Wingspan | Wingspan in ft, 8 bit field  Encode using DO‑260C  Table 2.2.3.2.7.6.3.5 | | Aircraft Wingspan  Ref DO-260C 2.2.3.7.6.3.5 |
| ADS-B OUT | | Position Offset Applied (POA) | 1 = Position Offset applied  0 = No offset applied | | Offset applied (=1) when the position offset between the GNSS antenna and the DO-260C defined aircraft center has been applied to the latitude/longitude position information input to the ADS-B transmit function |
| ADS-B OUT | | GNSS Antenna Longitudinal Offset #1  (GNSS #1/Left System) | GPS Antenna Offset (GO) (in meters):  00000 = No Data  00001 = Position Offset Applied by Sensor  00010 = 0 ≤ GO ≤ 2  00011 = 2 < GO ≤ 4  00100 = 4 < GO ≤ 6  00101 = 6 < GO ≤ 8  \*\*\*\*\*  11110 = 56 < GO ≤ 58  11111 = > 58 | | The GNSS Antenna Longitudinal Offset field provides information regarding the distance (in meters) of the GNSS Antenna(s) from the nose of the aircraft.  Ref DO-260C Table 2-67 |
| ADS-B OUT | | GNSS Antenna Longitudinal Offset #2  (GNSS #2/Right System) | GPS Antenna Offset (GO) (in meters):  00000 = No Data  00001 = Position Offset Applied by Sensor  00010 = 0 ≤ GO ≤ 2  00011 = 2 < GO ≤ 4  00100 = 4 < GO ≤ 6  00101 = 6 < GO ≤ 8  11110 = 56 < GO ≤ 58  11111 = > 58 | | The GNSS Antenna Longitudinal Offset field provides information regarding the distance (in meters) of the GNSS Antenna(s) from the nose of the aircraft.  Ref DO-260C Table 2-67 |
| ADS-B OUT | | GNSS Antenna Lateral Offset – Antenna #1  (GNSS #1/Left System) | GPS Antenna Offset (GO) (in meters):  000 = No Data  001 = Left 0 ≤ GO 2  010 = Left 2 < GO 4  011 = Left > 4  100 = 0 meters  101 = Right 0 ≤ GO ≤ 2  110 = Right 2 < GO ≤ 4  111 = Right > 4 | | The GNSS Antenna Lateral Offset field provides information regarding the distance (in meters) of the GNSS Antenna(s) from the longitudinal (roll) axis of the aircraft.  Ref DO-260B Table 2-66 |
| ADS-B OUT | | GNSS Antenna Lateral Offset – Antenna #2  (GNSS #2/Right System) | GPS Antenna Offset (GO) (in meters):  000 = No Data  001 = Left 0 ≤ GO 2  010 = Left 2 < GO 4  011 = Left > 4  100 = 0 meters  101 = Right 0 ≤ GO ≤ 2  110 = Right 2 < GO ≤ 4  111 = Right > 4 | | The GNSS Antenna Lateral Offset field provides information regarding the distance (in meters) of the GNSS Antenna(s) from the longitudinal (roll) axis of the aircraft.  Ref DO-260C Table 2-66 |
| ADS-B OUT | | Top ATC Antenna Longitudinal Offset #1  (2G ISS #1) | ATC Antenna Offset (AO) (in meters):  00000 = No Data  00001 = Position Offset Applied by Sensor  00010 = 0 ≤ AO ≤ 2  00011 = 2 < AO ≤ 4  00100 = 4 < AO ≤ 6  00101 = 6 < AO ≤ 8  11110 = 56 < AO ≤ 58  11111 = AO > 58 | | The Top ATC Antenna Longitudinal Offset field provides information regarding the distance (in meters) of the Top Directional ACAS/ATC/ADS-B Antenna from the nose of the aircraft.  Ref DO-260C Table 2.2.3.2.7.2.4.10-2 |
| ADS-B OUT | | Top ATC Antenna Longitudinal Offset #2  (2G ISS #2) | ATC Antenna Offset (AO) (in meters):  00000 = No Data  00001 = Position Offset Applied by Sensor  00010 = 0 ≤ AO ≤ 2  00011 = 2 < AO ≤ 4  00100 = 4 < AO ≤ 6  00101 = 6 < AO ≤ 8  11110 = 56 < AO ≤ 58  11111 = AO > 58 | | The Top ATC Antenna Longitudinal Offset field provides information regarding the distance (in meters) of the Top Directional ACAS/ATC/ADS-B Antenna from the nose of the aircraft.  Ref DO-260C Table 2.2.3.2.7.2.4.10-2 |
| ADS-B OUT | | Top ATC Antenna Lateral Offset – Antenna #1  (2G ISS #1) | ATC Antenna Offset (AO) (in meters):  000 = No Data  001 = Left 0 ≤ AO ≤ 2  010 = Left 2 < AO ≤ 4  011 = Left AO > 4  100 = 0 meters  101 = Right 0 ≤ AO ≤ 2  110 = Right 2 < AO ≤ 4  111 = Right AO > 4 | | The Top ATC Antenna Lateral Offset field provides information regarding the distance (in meters) of the Top Directional ACAS/ATC/ADS-B Antenna from the longitudinal (roll) axis of the aircraft.  Ref DO-260B Table 2.2.3.2.7.2.4.10-1 |
| ADS-B OUT | | Top ATC Antenna Lateral Offset – Antenna #2  (2G ISS #2) | ATC Antenna Offset (AO) (in meters):  000 = No Data  001 = Left 0 ≤ AO ≤ 2  010 = Left 2 < AO ≤ 4  011 = Left AO > 4  100 = 0 meters  101 = Right 0 ≤ AO ≤ 2  110 = Right 2 < AO ≤ 4  111 = Right AO > 4 | | The Top ATC Antenna Lateral Offset field provides information regarding the distance (in meters) of the Top Directional ACAS/ATC/ADS-B Antenna from the longitudinal (roll) axis of the aircraft.  Ref DO-260C Table 2.2.3.2.7.2.4.10-1 |
| ADS-B OUT | | ADS-B Transmit (Extended Squitter) Disable | 1 = Disable extended squitter  0 = Allow extended squitter | | Disables the ADS-B Transmit (Extended Squitter) function |
| ADS-B OUT | | System Design Assurance (SDA) Level | 00 > 1x10-3 or Unknown  01 ≤ 1x10-3 per flt hour  10 ≤ 1x10-5 per flt hour  11 ≤ 1x10-7 per flt hour | | System Design Assurance (SDA) of the aircraft’s ADS-B transmit system |
| ADS-B OUT | | ICAO Aircraft Type Designator | 24 bit field containing the 4 character ICAO Aircraft Type Designator  Encode each character as a 6-bit subset of the International Alphabet Number 5 (IA-5) in accordance with ICAO, Annex 10, Volume IV | | ICAO Aircraft Type Designator per ICAO Doc 8643  Ref DO-260C 2.2.3.7.6.3.3 |
| ADS-B IN | | TIS-B Function Enable | 1 = Activate the TIS-B Function  0 = Disable the TIS-B Function | | Enables the TIS-B function |
| ADS-B IN | | CDTI Function Enable | 1 = Activate the CDTI Function  0 = Disable the CDTI Function | | Enables the CDTI function |
| ADS-B IN | | ADS-B Receive Function Enable | 1 = Activate the ADS-B Receive Function  0 = Disable the ADS-B Receive Function | | Enables the ADS-B Receive function |
| ADS-B IN | | In-Trail Procedure (ITP) Function Enable | 1 = Enable ITP Function  0 = Disable ITP Function | | Enables the ITP function |
| ADS-B IN | | CDTI Assisted Visual Separation (CAVS) Function Enable | 1 = Enable CAVS Function  0 = Disable CAVS Function | | Enables the CAVS function |
| TAWS | | Terrain Display Water Color | 1 = Blue  0 = Black | | Color of sea-level water on the terrain display |
| TAWS | | Reactive Windshear Enable | 1 = Reactive Windshear Enabled  0 = Reactive Windshear Disabled | | Enables the Reactive Windshear function |
| TAWS | | Alternate Glideslope Cancel Logic | 1 = Alternate Glideslope Cancel Enabled  0 = Alternate Glideslope Cancel Disabled | | Enables the ability to cancel Mode 5 “Glideslope” alerts prior to the alert being activated |
| TAWS | | Obstacles Alert Enable | 1 = Obstacles Disabled  0 = Obstacles Enabled | | Enables the Obstacles Alert function |
| TAWS | | Reactive Windshear Caution Enable | 00 = Caution Disabled  01 = Caution Enable Without Voice  10 = Caution Enable, Voice & Visual  11 = Invalid | | Enables the Reactive Windshear Caution logic |
| TAWS | | Runway Awareness and Advisory System (RAAS) Enable | 1 = RAAS Enabled  0 = RAAS Disabled | | Enables the RAAS function |
| TAWS | | Number of Radio Altimeter Inputs | 1 = 2 LRRAs  0 = 3 LRRAs | | Identifies how many Low Range Radio Altimeter (LRRA) inputs are received by the TAWS function. Some aircraft have 2 LRRAs installed and some have 3 LRRAs installed. |
| TAWS | | Audio Menu | 4 bits (to allow for up to 64 different audio menus) | | Provides selection of an “Audio Menu” that allows specific TAWS voice callouts to be heard for a given aircraft installation |
| TAWS | | Path-Based Terrain Display Enable | 1 = Enable  0 = Disable | | Enables the TAWS Path-Based Terrain Display function |
| TAWS | | GNSS Altitude Reference WGS-84 | 1 = Use label 370 (GNSS Height above ellipsoid)  0 = Use label 076 (GNSS Altitude above MSL) | | The TAWS expects GNSS Altitude (label 076) be referenced to Mean Sea Level (MSL). However, some GNSS receivers only output GNSS height above a WGS-84 ellipsoid (label 370). If the GNSS being used supplies altitude referenced to WGS-84 instead of MSL, then the ’GNSS Altitude Reference WGS-84’ option should be set. |
| All | | Audio Level Adjustment | The number of bits assigned is a function of the number of parameters to be addressed. | | Adjusts audio output level based on different flight deck ambient noise levels and the type of aural being provided. These adjustments apply to both the 600 ohm and 8 ohm audio outputs. |
| All | | Aircraft Type | 9 bits (to allow for up to 512 aircraft types) | | Selects the aircraft type that the ISS in which the ISS is installed |

Table 3-2 – ISS User Selectable Options

| **Function** | **Parameter** | **Values** | **Description** |
| --- | --- | --- | --- |
| TAWS | 2500 foot altitude callout | 00 = No Callout  01 = 2500  10 = Radio Altimeter (Male)  11 = Radio Altimeter (Female) | Selects the aural to be heard at 2500 ft |
| TAWS | 1000 foot altitude callout | 00 = No Callout  01 = 1000  10 = 1000 (Baro)  11 = Invalid |  |
| TAWS | 500 foot altitude callout | 00 = No Callout  01 = 500  10 = 500 (Smart)  11 = 500 (Baro) |  |
| TAWS | Minimums Callout | 000 = No Callout  001 = “Decision Height” (at minimum setting)  010 = “Minimums” (at minimum setting)  011 = “Minimum” (at minimum setting)  100 = “Minimums, Minimums” (at minimum setting)  101 = “Decide” (Male) (at minimum setting)  110 = “Decide” (Female) (at minimum setting)  111 = Invalid |  |
| TAWS | Approaching Minimums Callout | 000 = No Callout  001 = “Approaching Decision Height”  010 = “Approaching Minimums”  011 = “Plus Hundred”  100 = “Fifty Above” (Male)  101 = “Fifty Above” (Female)  110 = Invalid  111 = Invalid |  |
| TAWS | Peaks Enable | 0 = Peaks Enabled  1 = Peaks Disabled |  |
| TAWS | Bank Angle Enable | 0 = Bank Angle Disabled  1 = bank Angle Enabled |  |
| TAWS | Bank Angle Selection | 00 = No Bank Angle  01 = HI Bank Angle  10 = Standard Bank Angle  11 = Variable Bank Angle | Selects the Bank Angle aural callout |
| TAWS | Low Altitude Callouts (Selection) | 0000000000000001 = 5 ft  0000000000000010 = 10 ft  0000000000000100 = 20 ft  0000000000001000 = 30 ft  0000000000010000 = 35 ft  0000000000100000 = 40 ft  0000000001000000 = 50 ft  0000000010000000 = 60 ft  0000000100000000 = 80 ft  0000001000000000 = 100 ft  0000010000000000 = 200 ft  0000100000000000 = 300 ft  0001000000000000 = 400 ft  0010000000000000 = Reserved  0100000000000000 = Reserved  1000000000000000 = Reserved | Setting of a specific bit will enable the aural callout when that altitude is reached. |

#### Aircraft Climb Performance Inputs

There are no Aircraft Climb Performance inputs defined for ACAS. Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

#### Aircraft Performance Altitude Limit

This information is captured in Table 3-1. Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768..

#### Cable Delay

This information is captured in Table 3-1. Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768..

#### TA Display Intruder Limit

This information is captured in Table 3-1. Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768..

#### Source Integrity Level (SIL)

ADS-B position sources must provide integrity on their reported position to be used for aircraft separation applications and ARINC 718A contains guidance. 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 values are set as follows:

IF Fine Latitude (label 111) and Fine Longitude (label 121) are available from the GNSS 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

Notes:

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.
2. The information in this section was derived from ARINC 718A-3, except that information for hardware program pins is replaced with software option settings.

#### Navigation Accuracy Category - Velocity (NACv)

Velocity Accuracy is a dynamic quantity and ARINC 718A contains guidance for encoding NACv information into ADS-B messages, and for validating the best accuracy of the source. Results of such validation are then provided to the transponder via the dataloadable Installation Configuration Options. For this version of ARINC 768A, only GNSS sources may provide non-zero NACv. The aircraft manufacturer must validate that the GNSS sources installed are capable of supporting a Velocity Accuracy of 10 m/s or better. Guidance for establishing this performance can be found in RTCA DO-260B, Appendix J. Results of such validation are then provided to the transponder via the dataloadable Installation Configuration Options as stated above.

The final encoding of the NACv subfield in Register 09 Hex and 65 Hex is established as follows:

IF “Horizontal Velocity Figure of Merit” data (e.g., GNSS Label 145) is available anddata is Valid,

THEN establish the NACv subfield encoding based on the “Horizontal Velocity Figure of Merit” data in accordance with the following:

000 = Unknown or ≥10m/s

001 = < 10m/s

010 = < 3 m/s

011 = < 1m/s

100 = < 0.3 m/s

OTHERWISE proceed as follows:

IF Fine Latitude and Longitude data (e.g., GNSS Label 111 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 Installation Configuration Options table above

OTHERWISE set the NACv subfield encoding to ZERO

Note: The information in this section was derived from ARINC 718A-3, except that information for hardware program pins is replaced with software option settings.

## General Maintenance

The 2G ISS should include appropriate data loading capability consistent with the philosophy and techniques used on the airplane installation.

### Data Loading

The 2G ISS operational software and databases (e.g., configuration data) will be on-board loadable in accordance with ARINC 615A. ARINC 665 loadable software standards apply for software part numbering, configuration, and media identification. The software load time for operational software and databases should not exceed 15 minutes.

COMMENTARY

It is recognized that some minimal level of “boot” software would be non-loadable to provide the basic loading interface.

The 2G ISS should be designed to allow separate software loading of individual functions. It should provide isolation between the software functions to allow modification to one function without affecting another. The 2G ISS should provide compatibility testing to ensure that loadable software and data are compatible with the 2G ISS hardware and other functional software configurations.

Mechanisms should be provided to ensure the authenticity and integrity of the loaded data. The equipment should be capable of reporting its current version to the OMS/CMS.

### On-Board Maintenance Interface

The 2G ISS should have an On-board Maintenance System (OMS) interface capability per ARINC 624 using the ARINC 664 bus.

## Distance Measuring Equipment (DME)

The 2GISS is expected to provide the DME functions further defined in ARINC Characteristic 709: *Airborne Distance Measuring Equipment (DME).*

## System Security

Airworthiness Cybersecurity requirements are applied at the aircraft level, and aircraft and system level analyses result in the assignment of security requirements to sub-systems such as 2G ISS.

At the time of publication of ARINC 768A, cybersecurity is addressed in EASA airworthiness regulations and other certification authorities are expected to follow. When no airworthiness cybersecurity regulation exists, aircraft level security requirements are levied via Special Condition or Issue Paper (FAA). Airworthiness cybersecurity regulation, when published, is expected to apply at the aircraft level and not at the appliance level (e.g. 2G ISS).

RTCA DO-326A/EUROCAE ED-202A provides an airworthiness security process that is comprehensive and intended to cover the end-to-end airplane design process from the airplane level down to the system and item levels. RTCA DO-356A/EUROCAE ED-203A provides security methods that can be applied at the aircraft, system, and item levels. Additional or different methods may be required by an individual airframe manufacturer. It is assumed that 2G ISS will be installed in an aircraft that includes security considerations as a part of its certification basis. This will result in process and security requirements for the 2G ISS.

Even with such an assumption, it is impossible for this document to foresee and specify the exact process and security requirements. Threat scenarios will be considered at the aircraft level for the 2G ISS functions integrated into the aircraft and will result in security requirements being driven down the 2G ISS developer. When developing security requirements, threat scenarios will be considered that involve intentional or inadvertent attacks affecting the 2G ISS functions themselves, or attacks on aircraft networks that exploit any new exposure provided by the equipment. Potential scenarios for which security requirements may be applied include but are not limited to:

* + Threat scenarios leveraging modifications to field-loadable software components (ARINC 667-2) can result in a requirement for digital signatures on loadable software parts (ARINC 835-1) to ensure authenticity and integrity
  + Threat scenarios involving manipulation of input data can result in requirements to validate inputs (e.g. range and size checking) to ensure only valid data is used by 2G ISS
  + Threat scenarios involving the manipulation of configuration settings during installation or maintenance operations can result in requirements to ensure authenticity and integrity of such settings

In addition, aircraft level security process may result in item level aspects required to support an operator’s security procedures for continuing airworthiness (ref. RTCA DO-355A/EUROCAE ED-204A).

Finally, it is noted that cybersecurity processes and requirements are not unidirectional between levels of integration. Therefore, 2G ISS developers will also need to provide feedback to the aircraft system level of integration requirements and activities needed to maintain the security posture of the 2G ISS in all operational regimes, including maintenance and decommissioning.

# acas/atc/ads-b antenna

## Introduction

The 2G ISS will have a top directional antenna for ACAS/ATC/ADS-B functions and a bottom omni-directional antenna for ACAS/ATC/ADS-B/DME functions. This section describes the characteristics of these antennas.

## RF Characteristics

The directional ACAS/ATC/ADS-B and omni-directional ACAS/ATC/ADS-B/DME antenna RF characteristics should conform to ARINC 735C.

## Antenna Installation

A top directional ACAS/ATC/ADS-B and a bottom omni-directional ACAS/ATC/ADS-B/DME antenna should be provided on the aircraft for each 2G ISSPU. 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 transmission line delay exhibited by the cable length to the top antenna should be equal to the transmission line delay exhibited by the cable length to the bottom antenna within + 50 ns.

COMMENTARY

The airlines are very concerned about drag induced by a non-flush antenna. Drag can be equated with aircraft operating equivalent weight, which in turn can be correlated with increased fuel burn and operating costs. The designer should note that the airline customers will look with favor upon antennas which protrude very little.

### Cable Losses

For the ACAS subsystem, 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 less than 3 dB at 1030/1090 MHz.

### Differential Cable Loss

Differences in signal level at any one input with respect to the other inputs of the directional antenna should not vary more than 0.5 dB at the computer unit. This value, which includes connectors, is expected to hold true with cable aging.

### Differential Phase Delay

The differential phase delay among the coaxial cable and connectors which connect the 2G ISS unit to the directional antenna should be limited to one wavelength (approximately eight inches) at 1090 MHz.

### Connectors

The connectors should be a Type C (TNC). They should be color coded at the antenna end to reduce probability of misconnection. Color coding is specified in Attachment 3B.

### ACAS/ATC/ADS-B/DME Systems Physical Isolation

### The installation designer should be aware of the need for physical isolation of the 2G ISS antennas from other L-band antennas. The isolation 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. The isolation between antennas is applicable in dual 2G ISS installations. Continuity Check

Each antenna element should present a specified resistance at dc voltage to perform a continuity check to verify that the antenna is installed and connected to the right terminal.

## Environmental Considerations

The antennas will be mounted in the forward part of the fuselage, collocated top and bottom, on or very near the centerline of the airframe. Attachment 7 provides standards for lightning strike protection that may apply to the installation.

The bottom mounted antenna is vulnerable to erosive and corrosive environments. It should be designed to withstand highly corrosive spray and liquids that accumulate in the bottom interior of the airplane.

COMMENTARY

The maximum height of the installed directional antenna is expected to be approximately 1.3 inches. Because of its aerodynamic shape (see Attachment 3B), it is not considered susceptible to icing effects in the general area of the proposed installation. Other factors of the installation may merit the consideration of anti-icing provisions.

# weather radar antenna unit (NOT APPLICABLE)

There are no weather radar functions defined for inclusion in the 2GISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

# control panel

## Introduction

The 2G ISS controls will be integrated within the Cockpit Display System (CDS) in new aircraft.

COMMENTARY

The 2GISS is implemented such that control, display and other data is provided by an ARINC 664 Optical interface. For this reason, traditional point-to-point specification of control and display cannot be prescribed in this standard. Network details will necessarily accommodate aircraft manufacturer specifications. Not only will the 2GISS implement bespoke network communication, but the underlying user interface, controls, and displays, will be specified by the aircraft manufacturers.

Nonetheless, the airlines strongly exhort aircraft manufacturers to implement displays and controls in a consistent manner. It is highly desirable that differences in human machine interface be minimized both between aircraft models, and between aircraft manufacturers. Though it is recognized that manufacturers are eager to provide the most efficient and effective human machine interface solution, the cost to airlines of divergent solutions is high. Part of the most efficient, effective solution needs to consider commonality of control and display across all aircraft to be considered for an airline’s fleet. Though it is beyond this scope of this standard, aircraft manufacturers are asked to coordinate common depiction of outputs and common control.

## Form Factors and Connectors

Reserved



## Control Functions

The following are typical controls that might be incorporated within the CDS:

* System selector
* Transponder standby/on switching
* Transponder code selectors
* Transponder “Ident” pulse (SPI) On/Off
* Transponder altitude reporting On/Off
* Self-test On/Off for various functions
* TAWS control for various functions
* Vertical profile direction control
* Traffic control for various functions
* TCAS Mode function
  + TA ONLY
  + TA/RA
* Flight ID
* DME control for various functions

## Interface

The control panel within the CDS should interface with each 2G ISS Processor Unit using two   
ARINC 664 network connections.

## Brightness Control

Reserved

## Control Panel Power

This specification will not define the 2G ISS control panel.

## Human-Centered Design

The control panel selection should be of a type that minimizes inadvertent operation.

# built-in test and maintenance considerations

## General

The 2G ISS should support at least one of the following Built-In Test Equipment (BITE) capabilities as defined by AEEC standards:

* ARINC Report 624
* ARINC Report 604

The 2G ISSPU should interface to the Central Maintenance System (CMS). It should report the status of all ISS units to the maintenance display device (Multi-Purpose Control and Display Unit (MCDU) or Multi-Function Display (MFD)) for the purpose of providing a fault log formatted in accordance with either ARINC 624 or ARINC 604. The fault logging method should be compatible with the Crew Management System (CMS) on the aircraft in which the ISS will be installed.

There should be no cockpit annunciation of failure unless it causes loss of function. Sufficient margin should be used to preclude nuisance failure messages. Discrepancies in 2G ISS operation caused by power bus transients, EMI, ground-handling, servicing interference, abnormal accelerations or turbulence should be recorded as events, not as faults.

### Fault Classification

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 2G ISS from performing any basic required function. Cockpit 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 2G ISS. A non-system-debilitating failure will be logged in BITE memory but need not be cockpit annunciated.

COMMENTARY

Airlines desire that as part of the 2G ISS’s design there be an ability to support 60 days (for example, 480 flight legs of data would be required for a platform operating 8 flight legs a day over 60 days) worth of fault storage. Often, airline engineering does not receive fault occurrence information from their flight departments immediately and after receiving that information they need to locate the appropriate maintenance opportunity to obtain fault data download, so a 60 day minimum capacity is desired.

### BITE Capability

BITE in the 2G ISS should be capable of detecting at least 95% of the faults or failures which can occur within the 2G ISS units, and as many faults as possible associated with other interfaces.

BITE should be initiated from the flight deck. All 2G ISS functions should be tested with BITE.

BITE should be functioning to the extent practical when the 2G ISS is in “standby” mode. Failures should be stored in non-volatile memory and reported to the on-board maintenance system.

BITE should operate continuously during flight. Monitoring of the results should be automatic, and the BITE should automatically test, detect, isolate and record intermittent and steady state failures. The BITE should display system condition and indicate any faulty Line Replaceable Unit (LRU) upon activation of the self-test routine. In addition, BITE should display faults which have been detected during in-flight monitoring.

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 2G ISS.

### Return to Service Testing

When an 2G ISS is installed on the aircraft, some form of end-to-end system testing should be available for two primary reasons:

* To provide an operational verification of the system functions prior to return to service.
* To reduce unnecessary removals of the 2G ISS when the fault was actually in another part of the system.

As an end-to-end test, the procedure should verify integrity of all LRUs as well as their interfaces with other systems.

COMMENTARY

Airlines prefer test results to indicate the probable cause of a failure. Emphasis on end-to-end system testing leads to a desirable increase in Mean Time Between Unscheduled Removal (MTBUR), especially for removals that are not related to an LRU fault.

Furthermore, in consideration of the number of functions provided by a 2GISS unit, care needs to be taken in the design of the entire Return to Service protocol. The supplier and the airlines will be expected to work together to minimize the cost, time, and risk involved in the repair and replacement of 2GISS units. First, in the event that aircraft level BITE indicates a 2GISS failure; the cost and time involved in installing a spare and verifying correct operation must be minimized while still providing unimpeachable confidence. Secondly, the time and costs associated with diagnosing and repairing the failed unit, and restoring it to operational status, must likewise be minimized. There may be several solutions to be reached logistically, but the foundation of reduced costs is accurate, reliable, unit level and system level built in test. Functions that were not the root cause of a fault should require only the operational tests for a 2GISS unit’s Return to Service, but not require a complete system’s Return to Service protocol, within the bounds of certification regulations.

## ACAS/ADS-B IN Functional Test

The 2G ISS should provide an internal “functional test” feature for ACAS as described in RTCA DO-385. Such a feature could involve the injection into the receiver front-end of low level interrogation and simulated responses, generated internally when the test is initiated.

The 2G ISS should monitor the RA display status.

The 2G ISS should begin to transmit the “test data” to the indicators when the functional test sequence is initiated. This transmission should be maintained for a period of 8 ± 0.5 seconds.

The 2G ISS should cause one cycle of the appropriate test results aural to be activated at the end of the ACAS functional test sequence. The 2G ISS should provide only aural annunciation if it has completed its functional tests and has not detected a failure. Example annunciation is “TCAS SYSTEM TEST OK”. The 2G ISS should provide only aural annunciation if any of the test criteria are not satisfied. Example annunciation is “TCAS SYSTEM TEST FAIL”. If the 2G ISS terminates the system functional test for any reason before completion of all of its tests, it should inhibit the aural annunciation.

COMMENTARY

The intended purpose of the short functional test sequence is to provide an in-flight or on-ground method of quickly verifying the functionality of the ACAS system. The above defined sequence verifies that the RA systems status discrete from the RA displays are functional, causes representative ACAS data to be displayed and causes an aural message to be annunciated at the end of the test sequence to verify the functionality of the ACAS aural warning system.

The airlines note previous unsatisfactory experience with antenna performance monitoring and fault annunciation. However, they believe that attention to this subject should be renewed because of the likely increase in maintenance problems that will follow the introduction of antenna diversity. Previous attempts at antenna monitoring have revealed difficulties. However, equipment manufacturers are urged to pay particular attention to this area.

## Transponder/ADS-B OUT Functional Test

Performance monitoring of the 2G ISS should cause a failure to be annunciated when the unit is assigned all zeros or all ones in the address code.

COMMENTARY

It is possible that some in-flight faults may reset during power interruption or during ground and not easily detected on the ground. This condition may allow the suspect unit to remain on board the aircraft. A threshold exceedance monitor is an effective method to detect and set a flag when one of these transient faults exceeds an acceptable rate of occurrence. Some airlines may choose to deactivate such a monitor.

## Radar Functional Test (not applicable)

There are no weather radar functions defined for inclusion in the 2GISS.

COMMENTARY

ARINC weather radar standards are provided in ARINC Characteristic 708A and ARINC Project Paper 748.

Section headers are provided in this document to retain organizational alignment with the original ISS definition, ARINC Characteristic 768.

## TAWS Functional Test

The 2G ISS should monitor the TAWS processing circuitry in the 2G ISSPU. The TAWS functional test should report failures in the input data and faults within the TAWS function. A test pattern may be generated during the functional test mode to test TAWS display interfaces. The self-test function should be capable of displaying the terrain database version.

## Provisions for Automatic Test Equipment

To enable Automatic Test Equipment (ATE) to be used in bench testing and maintenance, internal circuit functions not available at the unit service connector and considered by the equipment manufacturer necessary for ATE may be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer. This connector should be fitted with an adequate number of contacts needed to support ATE functions. The connector should include a protective cover suitable to protect these contacts from damage, contamination, etc., while the unit is installed in the aircraft. The manufacturer should observe ARINC 600 for unit projections, etc., when choosing the location for this auxiliary connector.

## DME Functional Test

The unit should incorporate some means of “functional test” of the DME function. The test function should provide a comprehensive approach to ensuring that the DME function is operational. The details of the test function are the responsibility of the equipment manufacturer.

Upon activation of the functional test mode, the DME function should indicate a failure for up to three seconds. Following this the DME function should send computed distance data with an SSM of “NCD” for up to three seconds. Following this the DME function should send a distance as 000.0 NM. If this distance is calculated from an internal loop back test, this distance may go up to 000.1 NM. The DME distance during the test should be sent with an SSM of “Functional Test”. The test output should continue for a minimum of three seconds but may last as long as the test indication is provided.

COMMENTARY

It is possible that some in-flight faults may reset during power interruption or during ground and not easily detected on the ground. This condition may allow the suspect unit to remain on board the aircraft. A threshold exceedance monitor is an effective method to detect and set a flag when one of these transient faults exceeds an acceptable rate of occurrence. Some airlines may choose to deactivate such a monitor.

## Storage of Fault, Health, and Maintenance Data

The 2G ISS will be installed in network centric aircraft equipped with a centralized system designed to receive fault, health, and maintenance data from LRUs and offload that data to support maintenance and repair decisions

An internal non-volatile memory is expected to be used to retain fault, health, and maintenance data as a backup in case of a failure or limitation that precludes the centralized system from collecting and offloading data for a particular LRU

Sufficient fault, health, and maintenance data should be stored to support conclusive diagnosis of any fault and support subsequent resolution or repair (such as any faults as described in Section 7.1.1 or any failed Self Test). It may be necessary to capture additional operating or monitor data before and after a fault to support diagnosis and subsequent resolution.

Sufficient health monitoring data should be stored to support identification of maintenance needs for the LRU.

Airlines prefer that non-Volatile Memory capacity should enable storage of fault and health monitoring data over 240 flight legs (based on 4 flight legs a day over 60 days)

1. 2G ISS configurations

Reserved.

ATTACHMENT 2A Example Control Panel Layout – Type I



ATTACHMENT 2B Example Control Panel Layout – Type II

ATTACHMENT 2C Example Control Panel Layout – Type III (NOT APPLICABLE)

TYPE III Control Panel (Weather Radar)

(Content of this attachment not required for 2G ISS - This attachment is here to retain organizational alignment with the original ISS definition - ARINC Characteristic 768)

ATTACHMENT 2D Control Panel Dimensions



Note: The “B” dimension can be smaller. However, control panel dimensions must comply with MS 25212 Dzus mounting provisions and allow space for the installation of a blank spacer to fill the unused space***.***

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum Dimensions in Inches (mm)** | | | |
|  | **A** | **B** | **C (excluding connectors)** |
| Type I | 5.75 (146) | 4.125 (105) | 5.00 (127) |
| Type II | 5.75 (146) | 3.50 (89) | 5.00 (127) |
| Type III | 5.75 (146) | 2.625 (67) | 6.00 (152) |



ATTACHMENT 3A ACAS/ATC/ADS-B Antenna Mounting Layout



ATTACHMENT 3B ACAS/ATC/ADS-B Antenna Outline Envelope



ACAS/ATC/ADS-B Antenna Outline Envelope

ATTACHMENT 3C ACAS/ATC/ADS-B Antenna – Aircraft Installations



ATTACHMENT 4 Weather Radar Antenna Mounting Specifications (NOT APPLICABLE)

(Content of this attachment not required for 2GISS - This attachment is here to retain for organizational alignment with the original ISS definition - ARINC Characteristic 768)

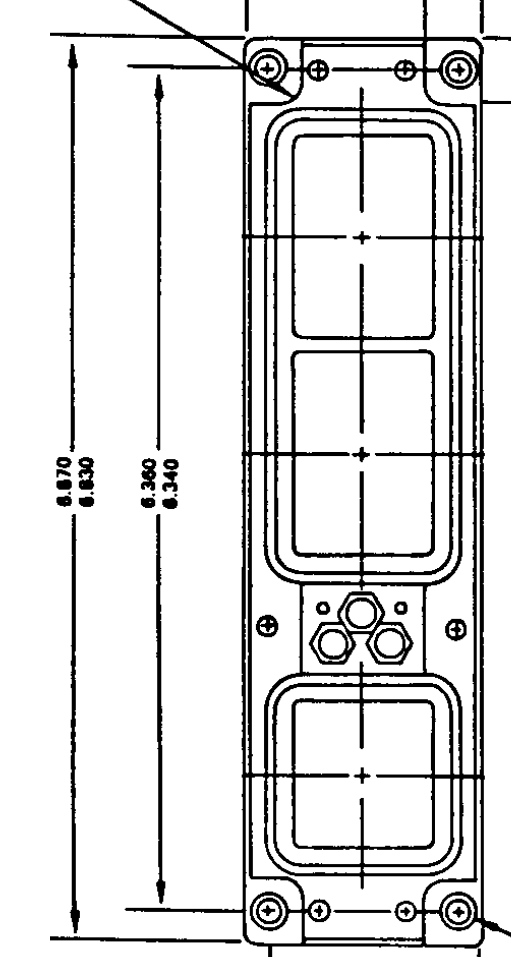
ATTACHMENT 5A Interwiring Overview

This attachment identifies 2G ISS connector pins and their use with applicable configurations

Note: “Spare” means not allocated at current time. Pin may be defined in the future.  
“Reserved” means manufacturers may use them for private or airframe-specific functions.  
“Provision” is like a spare, but more fully defined. I/O type and/or function may be partly defined.

| 2GISS - Function | Pin | Comments | Note |
| --- | --- | --- | --- |
| Audio Output #1 (hi) | MP-xx | 0-10V | Surveillance Audio |
| Audio Output #1 (lo) | MP-xx | 0-10V |  |
| Audio Output #2 (hi) | MP-xx | 0-10V | DME Audio |
| Audio Output #2 (lo) | MP-xx | 0-10V |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin | MP-xx | PP |  |
| Program Pin Common | MP-xx | PP |  |
| SDI Position | MP-xx | PP |  |
| DOUT provision | MP-xx | PP | Pin Prog Strobe or Backup Controller |
| ATC Backup Control Input(A) | MP-xx | A429 RX | Control Input, Mode A |
| ATC Backup Control Input(B) | MP-xx | A429 RX |  |
| ATC Backup Control Output (A) | MP-xx | A429 TX | Control Readback, Mode A |
| ATC Backup Control Output (B) | MP-xx | A429 TX |  |
| XT Input(A) | MP-xx | A429 RX | XT Input |
| XT Input(B) | MP-xx | A429 RX |  |
| TX Output (A) | MP-xx | A429 TX | TX Output |
| TX Output (B) | MP-xx | A429 TX |  |
| Reserved ATE | MP-xx |  |  |
| Reserved ATE | MP-xx |  |  |
| Reserved ATE | MP-xx |  |  |
| Reserved ATE | MP-xx |  |  |
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| Spare | MP-xx |  |  |
| Spare | MP-xx |  |  |
| Spare | MP-xx |  |  |
| Spare | MP-xx |  |  |
| Spare | MP-xx |  |  |
| DC Ground | MP-xx |  |  |
| DC Ground | MP-xx |  |  |
| DC Ground | MP-xx |  |  |
| DC Ground | MP-xx |  |  |
| Chassis Ground | MP-xx |  |  |
| Chassis Ground | MP-xx |  |  |
|  |  |  |  |
| Fiber Optic Network A (BiDi) | BP-8 | Fiber optic |  |
| Fiber Optic Network B (BiDi) | BP-9 | Fiber optic |  |
| Fiber Optic Crosslink A (BiDi) | BP-10 | Fiber optic |  |
| Fiber Optic Crosslink B (BiDi) | BP-11 | Fiber optic |  |
| Spare | BP-12 |  | Could be used for future fiber optic |
| 28 Vdc (Pos) | BP-4 | Power |  |
| 28 Vdc (Ret) | BP-3 | Power |  |
| Chassis Ground | BP-5 |  |  |
| Suppression Bus | BP-7 | Suppression | Size 8 Coax |
| Spare | BP-1 |  | Metal contact in this position may introduce debris on fiber contacts |
| Spare | BP-2 |  | Metal contact in this position may introduce debris on fiber contacts |
| Spare | BP-6 | Coax cavity |  |

ATTACHMENT 5B Interwiring Overview



TOP PLUG (TP)

<UPDATE>

CONTACT

ARRANGEMENT 14

SIZE 22 SIGNAL

SIZE 8 COAX

MIDDLE PLUG (MP)

<UPDATE>

CONTACT

ARRANGEMENT 14

SIZE 22 SIGNAL

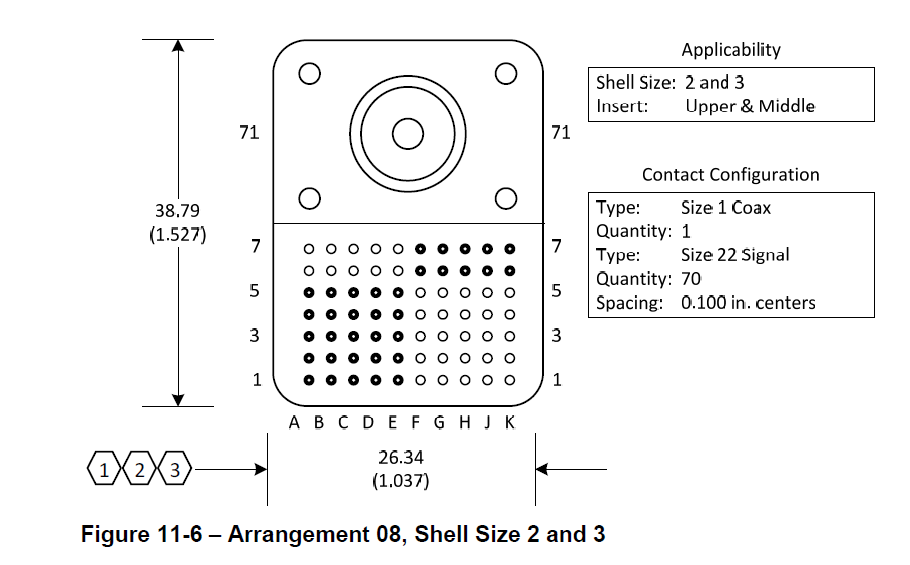
SIZE 8 COAX

INDEX PIN CODE #158

<UPDATE>

LIGHT PORTION

INDICATES KEY HOLE IN

RECEPTACLE (LRU)

BOTTOM PLUG (BP)

<UPDATE>

CONTACT

ARRANGEMENT II - IIQ2

SIZE 20 POWER

SIZE 16 POWER

SIZE 12 POWER

SIZE 8 QUADRAX

Receptacle Side  
(Rear View of 2GISS Processor Unit)

ATTACHMENT 5C ISS Pin Allocation



MP

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **J** | **K** |
| 1 | ISS/WXR CP Output (A) | ISS/WXR CP Output (B) | ISS/WXR CP Input (B) | ISS/WXR CP Input (A) | Display #1 Out (A) | Display #1 Out (B) | Display #! Input (B) | Display #1 Input (A) | Audio Output #1 (hi) | Audio Output #1 (lo) |
| 2 | Audio Inhibit Output | W/F Fail Lamp Output | W/S Caution Output | W/S Warn Output | Discrete Output | Discrete Output | Discrete Output | Discrete Input | Discrete Input | Discrete Input |
| 3 | Discrete Output | Discrete Output | Discrete Output | Discrete Output | Discrete Input | Discrete Input | Air/Gnd Discrete Input | Discrete Input | Discrete Input | Discrete Input |
| 4 | Discrete Output | Discrete Output | Discrete Output | Qual-A #1 Input | Qual-A #2 Input | Gear Down Input | W/S Inhibit Input | Discrete Input | Discrete Input | Spare |
| 5 | WRAU Output (A) | WRAU Output (B) | WRAU Input (A) | WRAU Input (A) | FCU Output (A) | FCU Output (B) | MMR #1 ILS Input (B) | MMR #1 ILS Input (A) | Air Data #1 Input (A) | Air Data #1 Input (B) |
| 6 | Reserved | Reserved | Reserved | Reserved | IRS #1 Input (A) | IRS #1 Input (B) | MMR #1 GPS Input (B) | MMR #1 GPS Input (A) | 453 Bus #1 Output (A) | 453 Bus #1 Output (B) |
| 7 | ATC/ACAS CP Output (A) | ATC/ACAS CP Output (B) | ATC/ACAS CP Input (B) | ATC/ACAS CP Input (a) | ADS-B #1 Input (A) | ADS-B #1 Input (B) | ADS-B #2 Input (B) | ADS-B #2 Input (A) | OMS #1 Input (A) | OMS #1 Input (B) |
| 8 | Spare | Spare | Spare | Spare | FCM/MCP #1 Input (A) | FCM/MCP #1 Input (B) | FMS #1 Input (B) | FMS #1 Input (A) | CMU #1 Input (A) | CMU #1 Input (B) |
| 9 | Rad Alt #1 Input (A) | Rad Alt #1 Input (B) | GPS A429 Output #1 (B) | GPS A429 Output #1 (A) | ADS-B Output #1 (A) | ADS-B Output #1 (B) | Reserved | Spare | MMR #1 TimeMark (+) | MMR #1 TimeMark (-) |
| 10 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved | Program Pin | Program Pin |
| 11 | Reserved | Program  Pin | Program Pin | Program  Pin | Program Pin | Program  Pin | Program Pin | Program  Pin | Program Pin | Program  Pin |
| 12 | Suppression Pulse (Coax) | | | | Reserved | Reserved | Reserved Clear Air Turbulence Detection (Coax) | | | |
| 13 | Display #1 NW Tx (+) | Display #1 NW Rx (+) |
| 14 | Display #1 NW Rx (-) | Display #1 NW Tx (-) |
| 15 | Reserved | Reserved |



ATTACHMENT 5D 2G ISS Control Panel – Type I Pin Assignment

|  |  |  |  |
| --- | --- | --- | --- |
| **Pin** | **Signal Name** | **Signal Type** | **In/Out** |
| A | CP POWER RETURN | ANALOG | INPUT |
| B | RESERVED |  |  |
| C | ARINC 429 RX (+) | DIGITAL | INPUT |
| D | DAY/NIGHT DIM | ANALOG | OUTPUT |
| E | DIMMING CONTROL (-) | ANALOG | OUTPUT |
| F | DIMMING CONTROL (+) | ANALOG | OUTPUT |
| G | 5 VAC DIMMING INPUT | ANALOG | INPUT |
| H | 5 VAC DIMMING RETURN | ANALOG | INPUT |
| J | CONFIRMATION CONTROL (+) | ANALOG | OUTPUT |
| K | CONFIRMATION CONTROL (-) | ANALOG | OUTPUT |
| L | SPARE |  |  |
| M | ARINC 429 TX (+) | DIGITAL | OUTPUT |
| N | RESERVED |  |  |
| P | CP POWER | ANALOG | INPUT |
| R | RESERVED |  |  |
| S | ARINC 429 RX (-) | DIGITAL | INPUT |
| T | SPARE |  |  |
| U | SPARE |  |  |
| V | TEST | DISCRETE | OUTPUT |
| W | SPARE |  |  |
| X | SPARE |  |  |
| Y | ARINC 429 TX (-) | DIGITAL | OUTPUT |
| Z | CHASSIS GND | ANALOG | INPUT |

Note: All pins are #20 AWG except pin Z (#16 AWG)

ATTACHMENT 5E 2G ISS Control Panel – Type II Pin Assignment

|  |  |  |  |
| --- | --- | --- | --- |
| **Pin** | **Signal Name** | **Signal Type** | **In/Out** |
| 1 | 5 VAC PANEL LIGHTS HI | ANALOG | INPUT |
| 2 | 5 VAC PANEL LIGHTS LO | ANALOG | INPUT |
| 3 | 115 VAC POWER HI | ANALOG | INPUT |
| 4 | 115 VAC POWER LO | ANALOG | INPUT |
| 5 | (a) ARINC 429 RX B  (b) ANTENNA TRANSFER | (a) DIGITAL  (b) DISCRETE | (a) INPUT  (b) OUTPUT |
| 6 | DC GROUND | ANALOG | INPUT |
| 7 | STANDBY/ON | DISCRETE | OUTPUT |
| 8 | CHASSIS GROUND | ANALOG | INPUT |
| 9 | FUNCTIONAL TEST/FCDE | DISCRETE | INPUT |
| 10 | WARNING AND CAUTION | DISCRETE | OUTPUT |
| 11 | AIR/GND SWITCH #1 | DISCRETE | OUTPUT |
| 12 | TRANSPONDER FAIL LOGIC #2 | DISCRETE | INPUT |
| 13 | 5 VAC INDICATOR LIGHTING HI | ANALOG | INPUT |
| 14 | 5 VAC INDICATOR LIGHTING LO | ANALOG | INPUT |
| 15 | AIR/GND SWITCH #2 | DISCRETE | OUTPUT |
| 16 | AIR/DATA SOURCE | DISCRETE | OUTPUT |
| 17 | FLIGHT ID DISABLE | DISCRETE | INPUT |
| 18 | BRIGHT/DIM CONTROL | ANALOG | INPUT |
| 19 | (a) ARINC 429 RX A  (b) ALT FAIL INPUT | (a) DIGITAL  (b) DISCRETE | (a) INPUT  (b) INPUT |
| 20 | TRANSPONDER FAIL LOGIC #1 | DISCRETE | INPUT |
| 21 | LAMP TEST | DISCRETE | INPUT |
| 22 | ARINC 429 TX A | DIGITAL | OUTPUT |
| 23 | ARINC 429 TX B | DIGITAL | OUTPUT |
| 24 | AIR/GND DISCRETE | DISCRETE | INPUT |

Note: Pins 5 and 19 are multi-function pins.

ATTACHMENT 5F 2G ISS Control Panel – Type III Pin Assignment

(Content of this attachment not required for 2GISS - This attachment is here to retain organizational alignment with the original ISS definition - ARINC Characteristic 768)

ATTACHMENT 5G-A Weather Radar Antenna Unit (WRAU) Pin Assignment – Copper Wire (NOT APPLICABLE)

(Content of this attachment not required for 2GISS - This attachment is here to retain organizational alignment with the original ISS definition - ARINC Characteristic 768)

ATTACHMENT 5G-B Radar Antenna Unit (WRAU) Pin Assignment – Fiber Optic (NOT APPLICABLE)

(Content of this attachment not required for 2GISS - This attachment is here to retain organizational alignment with the original ISS definition - ARINC Characteristic 768)

ATTACHMENT 5H Alternate Left Bottom Plug (LBP) – (A380/A350 Configuration)

(Content of this attachment not required for 2GISS - This attachment is here to retain organizational alignment with the original ISS definition - ARINC Characteristic 768)

ATTACHMENT 6 Basic Alert Prioritization

|  |  |  |  |
| --- | --- | --- | --- |
| **ALERT PRIORITIZATION SCHEME**  **per FAA TSO-C151b** | | | |
| **Priority** | **Description** | **Alert**  **Level 2** | **Comments** |
| 1 | Reactive Windshear Warning | W |  |
| 2 | Sink Rate Pull-Up Warning | W | continuous |
| 3 | Excessive Closure Pull-Up Warning | W | continuous |
| 4 | RTC Terrain Warning | W |  |
| 5 | (Reserved - V1 Callout) | I |  |
| 6 | (Reserved - Engine Fail Callout) | W |  |
| 7 | FLTA Pull-Up warning | W | continuous |
|  |  |  |  |
| 8 | RTC Terrain Caution | C | continuous |
| 9 | Minimums | I |  |
| 10 | FLTA Caution | C | 7 second period |
| 11 | Too Low Terrain | C |  |
| 12 | PDA (“Too Low Terrain”) Caution | C |  |
| 13 | Altitude Callouts | I |  |
| 14 | Too Low Gear | C |  |
| 15 | Too Low Flaps | C |  |
| 16 | Sink Rate | C |  |
| 17 | Don’t Sink | C |  |
| 18 | Glide slope | C | 3 second period |
|  |  |  |  |
| 19 | Approaching Minimums | I |  |
| 20 | Bank Angle | C |  |
| 21 | Reactive Windshear Caution | C |  |
| Mode 6 1 | ACAS RA (“Climb”, “Descend”, etc.) | W | continuous |
| Mode 6 1 | ACAS TA (“Traffic, Traffic”) | C | continuous |

Notes:

1. These alerts can occur simultaneously with TAWS voice callout alerts.
2. W= Warning, C= Caution, A= Advisory, I= Informational

ATTACHMENT 7 Summary of Environmental Test Guidlines

| **Environmental Requirement** | **ISS Line Replaceable Unit (LRU)** | | |
| --- | --- | --- | --- |
| **RTCA DO-160D Section** | **ISS**  **Processor Unit** | **ISS**  **Control Panel** | **L-Band Antenna** |
| LRU Location | Internal - Electrical Equipment Bay | Internal - Flight Deck | External - Top and Bottom Fuselage |
| Section 1.02 Equipment Classification | Essential | Essential | Essential |
| Section 1.03 4.5 Temperature Tests |  |  |  |
| 4.5.1 Ground Survival Low Temperature Test / Operating Low Temperature Test | A2 (-55 deg/ -15 deg C ) | A2 (-55 deg/-15 deg C) | D2 (-55 deg C) |
| 4.5.2 Ground Survival High Temperature Test / Short-Time Operating High Temperature Test | A2 (+85 deg/ +70 deg C) | A2 (+85 deg/+70 deg C) | D2 (+85 deg C) |
| 4.5.3 Operating High Temperature Test | A2 (+70 deg C) | A2 (+70 deg C) | D2 (+70 deg C) |
| 4.5.4 In-Flight Loss of Cooling | Z - 345 minutes (+40 deg C) | Cat X | Cat X |
| 4.6 Altitude, Decompression and Overpressure Tests |  |  |  |
| 4.6.1 Altitude Test | Cat A2  15k ft (4.6km) | Cat A2/D1  50k ft (15.2km) | Cat D2  50k ft (15.2km) |
| 4.6.2 Decompression Test | 8000 ft (2400m) to  50k ft (15.2km) | 8000 ft (2400m) to  50k ft (15.2km) | Cat X |
| 4.6.3 Overpressure Test | - 15k ft (170 kPa) | - 15k ft (170 kPa) | Cat X |
|  |  |  |  |
| 5.0 Temperature Variation | Cat B (5 deg C/min) | Cat B (5 deg C/min) | Cat A (10 deg C/min) |
| 6.0 Humidity | Cat A (48 hrs) | Cat A (48 hrs) | Cat C (144 hrs) |
| 7.0 Operational Shock and Crash Safety | Cat B | Cat B | Cat B |
| 8.0 Vibration (Change 1) | Instrument Panel, Console, & Equipment  Rack  Cat S  Curve B | Instrument Panel, Console, & Equipment Rack  Cat R2  Curve B/B1 | Fuselage  Cat S  Curve C |
| 9.0 Explosion Proofness | Cat X | Cat X | Cat X |
| 10.0 Waterproofness | Cat X | Cat X | Cat S |
| 11.0 Fluids Susceptibility | Cat X | Cat X | Cat F |
| 12.0 Sand and Dust | Cat X | Cat X | Cat D |
| 13.0 Fungus | Cat X | Cat X | Cat F |
| 14.0 Salt Spray | Cat X | Cat X | Cat S  (35 deg C/48 hours) |
| 15.0 Magnetic Effects | Cat Z | Cat Z | Cat X |
| 16.0 Power Input (Change 2) | Cat A(WF) (note 3) | Cat A(WF) Type II only (note 3) | Cat X |
| 17.0 Voltage Spike | Cat A | Cat A | Cat A (note 2) |
| 18.0 Audio Frequency Susceptibility (Change 2) | Cat A(WF) (note 3) | Cat A(WF) Type II only  (note 3) | Cat X |
| 19.0 Induced Signal Susceptibility | Cat C | Cat C | Cat C  (note 2) |
| 20.0 Radio Frequency Susceptibility  (Radiated and Conducted)  (Change 1) | CS – R  RS – R  Pulse - R | CS – R  RS – R  Pulse – R | CS - R  RS - R  Pulse - R  (note 2) |
| 21.0 Emissions of Radio Frequency Energy | Cat B Cat M  (note 4) | Cat B Cat M  (note 4) | Cat H  (note 2) |
| 22.0 Lightning Induced Transient Susceptibility (Change 3)  (note 5) | B3K33  (note 1) | XXK33 | XXK44 (note 1, note 2) |
| 23.0 Lightning Direct Effects | Cat X | Cat X | Cat 1A |
| 24.0 Icing | Cat X | Cat X | Cat A |
| 25.0 Electrostatic Discharge (ESD) | Cat A | Cat A | Cat A |

Notes:

1. Lightning induced transient susceptibility. Pin injection test for primary power lines and chassis grounds. As a minimum, test at 1 MHz.
2. Applicable to active antennas only. Otherwise Cat X (no test performed).
3. For equipment designed for 115 Vac 400 Hz fixed frequency, Cat A (NF) may apply.
4. As determined by airframe manufacturer.
5. Waveform H may be required for unshielded cable.

Refer to RTCA DO-160 current version.

ATTACHMENT 8 Acronym List

ABV Above

ACAS Airborne Collision Avoidance System

ADS-B Automatic Dependent Surveillance – Broadcast

ADS-R Automatic Dependent Surveillance – Rebroadcast

AEEC Airlines Electronic Engineering Committee

AGL Above Ground Level

AIRB Airborne

AIWP Application Integrated Work Plan

ANP Actual Navigation Performance

APM Airplane Personality Module (ARINC 607)

ASAS Airborne Separation Assurance System

ASSA Airport Surface Situational Awareness (ASSA)

ATC Air Traffic Control

ATCRBS Air Traffic Control Radar Beacon System

ATE Automatic Test Equipment

AZIM Azimuth

BFE Buyer Furnished Equipment

BiDi Bi-Directional

BITE Built-In Test Equipment

BLW Below

CDS Cockpit Display System

CDTI Cockpit Display of Traffic Information

CFDS Central Fault Display System

CFIT Controlled Flight Into Terrain

CMC Central Maintenance Computer

CMS Crew Management System

CMU Communications Management System

CP Control Panel

CRC Cyclic Redundancy Check

DDM Difference in Depth of Modulation

DH Decision Height

DIN Data Input

DITS Digital Information Transfer System

DN Down

DOUT Data Output

DTIF Display Traffic Information File

ED EUROCAE Document

EFIS Electronic Flight Information System

EGPWS Enhanced Ground Proximity Warning Computer

ELAN Ethernet Local Area Network

EIA Electronic Industries Association

EVAcq Enhanced Visual Acquisition

EVApp Enhanced Visual Approach

FAROA Final Approach and Runway Occupancy Awareness

FCU Flight Control Unit

FLTA Forward Looking Terrain Avoidance

FMC Flight Management Computer

FMS Flight Management System

FWD Forward

G/S Glideslope

GICB Ground Initiated Comm-B

GLS GNSS Landing System

GND Ground

GNLU GNSS Navigation and Landing Unit

GNSS Global Navigation Satellite System

GNU GNSS Navigation Unit

GP General Purpose

GPWS Ground Proximity Warning Computer

GPS Global Positioning System

GSE Ground Support Equipment

HUD Head-Up Display System

Hz Hertz

ICSPA Independent Closely Spaced Parallel Approaches

ILS Instrument Landing System

ISO International Organization for Standardization

IRS Inertial Reference System

IRU Inertial Reference Unit

ISS Integrated Surveillance System

ISSPU ISS Processor Unit

ITP In-Trail Procedure

LBP Left Bottom Plug (ARINC 600)

LED Light Emitting Diode

LMP Left Middle Plug (ARINC 600)

LRU Line Replaceable Module

LTP Left Top Plug (ARINC 600)

MAX Maximum

MASP Minimum Aviation System Performance Standards

MCDU Multi-Purpose Control and Display Unit

MCU Modular Concept Unit

MCP Mode Control Panel

MDA Minimum Descent Altitude

MFD Multi-Function Display

MIN Minimum

MMR Multi-Mode Receiver

MOPS Minimum Operational Performance Standards

MSL Mean Sea Level

MTBF Mean Time Between Failure

MTBUR Mean Time Between Unscheduled Removal

NACv Navigation Accuracy Category – Velocity

ND Navigation Display

NFF No Fault Found

OMS On-board Maintenance System

PDA Premature Descent Alert

PFD Primary Flight Display

POA Position Offset Applied

PP Program Pin

PWS Predictive Windshear

RA (1) Radar Altimeter (2) Resolution Advisory

RAAS Runway Awareness and Advisory System

RBP Right Bottom Plug (ARINC 600)

RMP Right Middle Plug (ARINC 600)

RNP Required Navigation Performance

RTC Required Terrain Clearance

RTP Right Top Plug (ARINC 600)

RWS Reactive Windshear

RX Receive

SDA System Design Assurance

SDI Source/Destination Identifier

SFE Supplier Furnished Equipment

SIL Source Integrity Level

SSR Secondary Surveillance Radar

SURF-IA Surface Situational Awareness with Indications and Alerting

SYS System

TA Traffic Advisory

TAD Terrain Awareness Display

TAWS Terrain Awareness and Warning System

TAWC Terrain Awareness and Warning Computer

TCAS Traffic Alert and Collision Avoidance System

TCM TAWS Configuration Module

TIS-B Traffic Information Service - Broadcast

TSO Technical Standard Order

TX Transmit

UAT Universal Access Transceiver

VD Vertical Display

VDL VHF Digital Link

VHF Very High Frequency

VSWR Voltage Standing Wave Ratio

W/S Windshear

XPDR Transponder