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ADS-B UAT MOPS

Meeting #11

Section 2.1 of UAT MOPS
Draft 4

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SUMMARY

This document represents the 4th draft of Section 2.1 (General Requirements) for the UAT MOPS. This draft finalized the transmitter power and altitude categories, removes the receiver sensitivity table, and adds some commentary on antenna diversity and selection with regard to the on-ground condition.

UAT MOPS
Section 2.1

Draft 4

1 Purpose and Scope

2 Equipment Performance Requirements and Test Procedures

2.1 General Requirements

2.1.1 Airworthiness

In the design and manufacture of the equipment, the manufacturer shall provide for installation so as not to impair the airworthiness of the aircraft.

2.1.2 Intended Function

The equipment shall perform its intended function(s), as defined by the manufacturer, and its proper use shall not create a hazard to other users of the National Airspace System.

2.1.3 Federal Communications Commission Rules

All equipment shall comply with the applicable rules of the Federal Communication Commission.

2.1.4 Fire Protection

All materials used shall be self-extinguishing except for small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire.

Note: *One means of showing compliance is contained in Federal Aviation Regulations (FAR), Part 25, Appendix F.*

2.1.5 Operation of Controls

The equipment shall be designed so that controls intended for use during flight cannot be operated in any position, combination or sequence that would result in a condition detrimental to the reliability of the equipment or operation of the aircraft.

2.1.6 Accessibility of Controls

Controls that do not require adjustment during flight shall not be readily accessible to flight personnel.

2.1.7 Equipment Interfaces

The interfaces with other aircraft equipment shall be designed such that normal or abnormal ADS-B equipment operation shall not adversely affect the operation of other equipment, nor shall normal or abnormal operation of other equipment adversely affect the ADS-B equipment, except as specifically allowed.

2.1.8 Effects of Test

The equipment shall be designed so that the application of specified test procedures shall not be detrimental to equipment performance following the application of the tests, except as specifically allowed.

2.1.9 Integration with Other Avionics Equipment

In the event that ADS-B functions are partially or wholly incorporated within other avionics equipment, the design shall be partitioned such that any abnormal equipment operation does not adversely affect other function unrelated to ADS-B. Loss of ADS-B capability shall not inhibit other functions of the equipment.

2.1.10 Design Assurance

The equipment shall be designed to the appropriate design assurance level(s) based on the intended application of the equipment and aircraft class in which it is to be installed. The appropriate design assurance level(s) are determined by an analysis of the failure modes of the equipment and a categorization of the effects of the failure on the operation of the aircraft. For the purpose of this analysis, a failure is defined as either a loss of function or the output of misleading information. Guidance can be found in AC 23.1309 and 25.1309-1b.

Software included as part of the equipment shall be developed in compliance with the appropriate software level as defined in RTCA/DO-178B.

2.1.11 Equipage Classes

ADS-B equipment is categorized into aircraft system equipage classes as defined in the ADS-B MASPS (RTCA/DO-242, Table 3-1). For the UAT, the installed performance of these equipment classes shall be defined by Table 2.1.11. Certain of the class distinctions are implemented by applications supported by other equipment, rather than being inherent in the UAT itself.

The A1 equipment has been divided into two classes, based on the maximum altitude that the aircraft is operated under. For A1 aircraft that always operate below 18,000 feet MSL, the “A1 Low” class is created, and abbreviated throughout this document as “A1L”. For A1 aircraft that have no altitude operating restrictions, the “A1 High” class is created, and abbreviated throughout this document as “A1H”. The only equipment performance difference between these two classes is the Transmitter RF output power, as shown in Table 2.1.11.

The remainder of the classes used in this document are as defined in DO-242 (all of the transmit-only ‘B’ classes, and aircraft classes A0, A2, and A3).

Class ‘C’ receive-only equipment can be implemented by compliance with the requirements for the receiver portion of the ‘A’ classes, with the receiver antenna system configured per the specific application requirements.

Table 2.1.11 - UAT Installed Equipment Classes

Typical Application	DO-242 Equivalent Class	Tx RF Power Delivered to Antenna System	Antenna Diversity Minimum Requirements	
			Tx	Rx
Tx-Only Airborne Vehicle	B1	Per requirements for equivalent service for A0, A1 and A2		n/a
Surface Vehicle	B2	+28 to +32 dBm	Single Antenna	n/a
Fixed Obstructions	B3	+30 dBm (minimum)	Single Antenna	n/a
Aid to Visual Acquisition	A0	Low Power	Single Antenna (see Note 5)	Single Antenna (see Note 5)
Conflict Avoidance	A1L	Low Power (Altitude always below 18,000 feet)	Alternate	Alternate
	A1H	Medium Power	Alternate	Alternate
Separation and Sequencing	A2	Medium Power	Alternate	Dual Receiver
Deconfliction Planning	A3 (extended range)	High Power	Alternate	Dual Receiver

Notes:

1. *See Section 2.1.12 for definition of TX power levels.*

2. *Transmitter power requirement depends on the aircraft maximum altitude capability. Low-altitude aircraft (< 18,000 feet max altitude) need not support the High power transmitter requirement due to line-of-site limitations.*

3. *Class B3 (Fixed Obstructions) has minimum ERP of 1.0 watts.*

4. *Top antenna is not required if installation does not degrade signal propagation. This allows for single antenna installation on radio-transparent airframes.*

5. *For a single-antenna installation, antenna gain pattern performance should be shown at least equivalent to that of a quarter-wave resonant antenna mounted on the fuselage bottom surface.*

2.1.12 Transmitting Subsystem

An ADS-B transmitting subsystem is classified according to the unit's range capability and the set of parameters it is capable of transmitting. Table 2.1.12 shall define the transmitter power levels. Power levels are measured in terms of power presented to the transmitting antenna.

Table 2.1.12 - Transmitter Power Requirements

Power Classification	Minimum Power at Antenna	Maximum Power at Antenna
Low	7.0 watts (+38.5 dBm)	17.6 watts (+42.5 dBm)
Medium	15.8 watts (+42 dBm)	39.8 watts (+46 dBm)
High	63.0 watts (+48 dBm)	158.5 watts (+52 dBm)

Note: *These transmitter power requirements are referenced to the power delivered to the antenna, and assume transmit antenna gain of 0 dB. Alternate means that can demonstrate equivalent performance can be approved. Refer to Appendix E for guidance.*

Performance is specified over full environmental range for desired equipment application.

2.1.13 Receiving Subsystem

No distinction in receiver sensitivity by category is made; all receivers have the same sensitivity requirements. The receiver sensitivity is –93 dBm at the receiver antenna for 90% Message Success Rate for ADS-B messages, and –91 dBm at the receiver antenna for 90% probability of reception of Uplink messages.

Performance is specified over full environmental range for desired equipment application.

Receiver subsystem is capable of reception of both ADS-B reports and Uplink (ground-to-air) services.

2.1.14 Antenna Subsystem

Use of gain antennas for ADS-B is permitted and discussed in DO-242 (ADS-B MASPS) Section 3.3.1 and Appendix H, and Appendix E of this document. Antenna horizontal gain patterns shall not contain intentional nulls. Nulls created by airframe blockages should be minimized when antenna locations are selected.

2.1.14.1 Antenna Subsystem Diversity When Airborne

In multiple-antenna installations, transmit antenna diversity shall be achieved by alternating transmit antennas every other second. Receive antenna diversity can be

achieved by switching a single receiver between antennas, or by equipping the aircraft with two full-time receivers, as specified by the equipment class. When switching a single receiver between two antennas, the antenna shall be switched each second.

2.1.14.2 Antenna Subsystem Diversity On the Surface

When an aircraft is known to be operating on the airport surface, aircraft may wish to always select the top antenna (if so equipped) for all transmissions. If a single receiver is switched between two antennas, aircraft may wish to always select the top antenna for reception.

Note: *If the aircraft has no physical means of determining the on-ground condition, the equipment may use a low threshold of geometric velocity to enable or disable the antenna switch selection method, if it can be shown that such a method is appropriate for the intended application and aircraft operating characteristics.*