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RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #3

Draft 2 of Section 2.1 of UAT MOPS

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SUMMARY

This document represents the 2nd draft of Section 2.1 (General Requirements) for the UAT MOPS. New material in this draft is primarily in Section 2.1.11 (Equipment Classes). See the companion paper UAT-WP-3-01 for further guidance material on link budgets with regard to equipment classes.

**UAT MOPS
Section 2.1**

Draft 2

Date: 2 April 2001

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, these classes are summarized in the following Table 2-1. Certain of the class distinctions are implemented by applications supported by other equipment, rather than being inherent in the UAT itself.

Table 2-1 UAT Installed Equipment Classes

Application	DO-242 Equivalent Class	RF Effective Radiated Power (ERP)		Antenna Diversity minimum requirements	
		< FL150	> FL150	Tx	Rx
Tx-Only Airborne Vehicle	B1	Per rqmts for equivalent service for A0, A1 and A2			n/a
Surface Vehicles and Fixed Obstructions	B2 & B3	0.5 W (min) (note 3) 5.0 W (max)		Single Antenna	n/a
Aid to Visual Acquisition	A0	Low	Medium	Alternate or Bottom Only	Alternate
Conflict Avoidance	A1	Low	Medium	Alternate	Alternate
Separation and Sequencing	A2	Medium	Medium	Alternate	Alternate
Deconfliction Planning	A3 (extended range)	Medium	High	Alternate	Alternate or Dual Receiver (note 4)

Note 1: See Section 2.1.12 for definition of TX power levels.

Note 2: Transmitter power requirement depends on the aircraft maximum altitude capability. Low-altitude aircraft (< 15,000 feet max altitude) need not support the High power transmitter requirement due to line-of-site limitations.

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

Note 4: Alternate receive antenna diversity allows for economical deconfliction planning for A3 class aircraft that do not operate at high altitudes.

Note 5: Top antenna is not required if installation does not degrade signal propagation. This allows for single antenna installation on radio-transparent airframes.

Table 2-2 lists the types of ADS-B messages in the UAT ADS-B system.

Table 2-2 ADS-B Message Cross-Reference

Message	Content	Reference Section
Basic	Partial SV data	xx.xx.xx
Extended Type 0	Full SV data plus partial MS	xx.xx.xx
Extended Type 1	Full SV data plus Intent	xx.xx.xx
Extended Type 2 – 14	Reserved for Future Use	

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 2-3 shall define the transmitter power levels. Power levels are measured in terms of Effective Radiated Power.

Table 2-3 Transmitter Power Requirements

Power Classification	Minimum Effective Radiated Power (ERP)	Maximum ERP
Low	5 watts (+37 dBm)	25 watts (+44 dBm)
Medium	12.5 watts (+41 dBm)	62.5 watts (+48 dBm)
High	100 watts (+50 dBm) (note 1)	250 watts (+54 dBm)

Note 1: If 2 dB receiver gain antenna is assumed, then Minimum EPR for High power category is 63 watts (+48 dBm)

Allowance for maximum transmitter feedline loss is 3 dB. 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 requirements. Sensitivity requirements shall be -91 dBm at the receive antenna for 90% Message Success Rate for ADS-B messages.

Allowance for maximum receiver feedline loss is 3 dB. Performance is specified over full environmental range for desired equipment application.

Receiver subsystem is capable of reception of both ADS-B reports and 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. Antenna horizontal gain patterns shall not contain intentional nulls. Nulls created by airframe blockages should be minimized when antenna locations are selected.

Transmit antenna diversity shall be achieved by transmitting alternately on each installed antenna. Receive antenna diversity can be achieved by alternate antenna selection, or by equipping the aircraft with two full-time receivers, as specified by the equipment class.