

**RTCA Special Committee 186, Working Group 5**

**ADS-B UAT MOPS**

**Meeting #20**

**Proposed Clarifications and Updates to  
Receiver Performance Requirements**

**Presented by  
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**SUMMARY**

**This paper proposed clarifications and minor modifications to the receiver performance requirements in §2.2.8.2.2 and §2.2.8.2.3. The 'A' revision of this document includes a third proposal that was discussed at the meeting, and includes modifications to the proposals as adopted by WG-5 at Meeting 20.**

**Proposal 1: Receiver Dynamic Range test conditions.**

In §2.2.8.2.2 (Receiver Dynamic Range), clarify that the stated dynamic range requirement applies to reception of Long ADS-B messages only.

**Discussion:**

By referring to the Receiver Sensitivity requirements, we can see that for Long ADS-B messages, there is a 3 dB difference between the 90% MSR threshold at -93 dBm (see §2.2.8.2.1.1) and the 99% MSR reception requirements at -90 dBm.

However, for reception of the Uplink message, there is only a 1 dB margin between the 90% reception threshold at -91 dBm (see §2.2.8.2.1.2) and the 99% MSR reqmt at -90 dBm. Note that this is particularly inappropriate, since the Uplink messages have weaker forward error correction coding than the ADS-B messages, and therefore cannot possible work with less performance margin than for the ADS-B messages.

This leads to the conclusion that the intention of WG-5 in this requirement was that the low-signal end of the -90 dBm dynamic range requirement was intended to be measured using only Long ADS-B messages.

**Modify the requirement text of §2.2.8.2.2 as follows (changes underlined):**

The receiver shall achieve a Successful Message Reception rate for Long ADS-B messages of 99% or better when the desired signal level is between -90 dBm and -10 dBm at the antenna in the absence of any interfering signals.

**WG-5 Finding: Approved as proposed above.**

**Test Procedure Changes:**

The existing test procedure is already compliant with this recommendation.

## **Proposal 2: Receiver Selectivity requirements update**

In §2.2.8.2.3 (Receiver Selectivity), clarify that the desired signal for this requirement is the Long ADS-B message. In Table 2-65, reduce the minimum rejection ratio for the +1.0 MHz cases by 3 dB (from 18 dB to 15 dB).

### **Discussion:**

The values that appear for U/D ratio in Table 2-65 can be traced back to UAT-WP-4-13, Figure 6. This data was collected in March 2001 under the following test conditions:

Receiver performance threshold: 90% Message Success Rate

Message Type: Basic ADS-B

Message coding (current as of March 2001):

Basic - RS(27,17)

Long - RS(45,33) (for illustration, not used for this performance test)

These test conditions are substantially different from the requirements in §2.2.8.2.3. To wit:

- The type of message that is subject to this requirement is not stated. All other receiver performance tests specify which message type is applicable.
- The level of the desired signal is not stated.
- The means for measuring the minimum signal rejection ratios is not stated.

When the measurements in UAT-WP-4-13 Figure 6 were translated into the U/D ratios in MOPS Table 2-65, there was in fact a negative performance margin at the +1.0 MHz offsets, even for the test conditions as of March 2001.

After making accommodation for the differences in the system design between March 2001 and the published DO-282, most of the values in MOPS Table 2-65 are appropriate, except for the unresolved discrepancy at the +1.0 MHz offset. There is insufficient specification margin to allow for manufacturing of cost-effective TSO-compliant receiver equipment.

The type of interfering signal (un-modulated carrier) is stated in Note 1 to the requirement, but is a critical parameter that should be stated in the requirement itself.

### **WG-5 Discussion:**

Agreed with the Long ADS-B specification, and the 90% message success rate.

Modified the desired signal level to be the normal sensitivity threshold of -93 dBm for reception of Long ADS-B messages. Discussed whether 15 dB or 16 dB was more appropriate. Noted also that this 1.0 MHz offset test case in practice only affects the A2, A1, and A0 receiver types installed in states that have DME equipment allocations at 979 MHz (i.e. not North America). Further details of the test procedure modifications were also implemented.

**WG- 5 Finding: Proposal #2 was approved as amended and shown below:**

**Modify the requirement text of §2.2.8.2.3 as follows (changes underlined):**

The receiver shall provide the following minimum signal rejection ratios as a function of the frequency offset as listed in Table 2-65, for reception of Long ADS-B messages at a 90% Successful Message Reception rate, applied at a level of -93 dBm or less. The interference source is an un-modulated carrier applied at the frequency offset.

**Modify the values in Table 2-65 as follows:**

+1.0 MHz      15 dB

**Test Procedure Changes:**

- ◆ In Step 5 replace "99%" with "90%".
- ◆ Modify the test signal level to -93 dBm. Recompute the absolute signal levels given in the test setup table.

Since Step 2 already specifies the use of Long ADS-B messages, no other modification to the test setup is necessary.

- ◆ Modify Table 2-101 to match Table 2-65 as necessary.

### **Proposal #3: Receiver Sensitivity**

In §2.2.8.2.1.1, the receiver sensitivity requirement is specified under three simultaneous worst-case conditions of signal degradation.

- ◆ The air-to-air closure/opening rate is 1200 knots.
- ◆ The transmitted frequency offsets are maximum.
- ◆ The transmitted modulation deviation is at the minimum (560 KHz).

This triple-worst-case specification is an unnecessarily tight constraint, as only a statistically small number of participants will operate on all three margins simultaneously.

### **Proposed Modification:**

#### **§2.2.8.2.1.1 Long ADS-B Message As Desired Signal**

A desired signal level of  $-93$  dBm applied at the antenna end of the feedline shall produce a rate of Successful Message Reception of 90% or better under each of the following conditions:

- a. When the desired signal is of nominal modulation (i.e. FM deviation is 625 KHz) and at the maximum signal frequency offsets, and subject to air-to-air Doppler shift at 1200 knots opening/closure.
- b. When the desired signal is of maximum modulation distortion allowed in §2.2.2.4, at the nominal transmission frequency  $\pm 1$  ppm, and subject to air-to-air Doppler shift at 1200 knots opening/closure.

**Apply the same modification to the new section on Basic ADS-B message reception**

**Apply the same modification to the section on Uplink message reception**

(with the provision that the Doppler opening/closure is 850 knots)

### **WG- 5 Finding: Proposal #3 was approved outlined above:**

Note: Certain other minor text adjustments might have been made in the meeting that are not captured in this document.