

**RTCA Special Committee 186, Working Group 3**  
**EUROCAE WG-51, SG-1**

**ADS-B 1090ES MOPS Maintenance**

**Meeting #25**

**Eurocontrol Headquarters, Brussels Belgium**  
**17 – 20 February 2009**

**Summary of Required Changes to 1090 ES MOPS to Support Inclusion of**  
**Medium Power, Non-diversity Classes**  
**In Response to Action Item 24-14**

**Kurt Schueler**  
**Garmin International**

<b>Summary</b>
This Working Paper is in response to Action Item 24-14 and summarizes changes required to include medium power, non-diversity classes A1* and B1* to the 1090 ES MOPS.

## **1 Introduction**

This WP is in response to action item 24-14 arising from Meeting #24 of SC-186 WG #3. The purpose is to summarize changes to the 1090 ES MOPS that would be required to add medium power, non-diversity classes to the existing classes in the MOPS. The new classes, A1\* and B1\*, are equivalent to the existing A1 and B1 classes, save for being single antenna. The need for the new classes arises from the ADS-B Aviation Rulemaking Committee to the Federal Aviation Administration recommendations regarding the antenna diversity and power requirements of the ADS-B Out NPRM.

The list of changes is for RTCA/DO-260A including Change 1 and Change 2. The addition of new classes also affects changes proposed in 1090-WP23-03R1, and those effects are addressed. This list of changes does not account for other modifications to the MOPS currently under consideration.

## **2 Volume 1 Changes**

### **2.1 Section 2.1 Changes**

Changes in this section consist of adding definitions, descriptions and classifications for the new Classes. Many of the tables in this section correspond to tables in the ADS-B MASPS. Changes are:

1. In section 2.1.11 (Equipage Class Definitions), add a definition of class A1\* and B1\*. This can be done similarly to the UAT MOPS, DO-282A, where it is indicated that class A1 of the ADS-B MASPS is divided into two classes based on the maximum altitude that the aircraft is operated under.
2. In section 2.1.12 (Equipage Class Application Coverage), table 2-1, add classes A1\* and B1\* to the table of equipment classes and example applications. Some discussion is needed to determine the example applications foreseen to be supported by the new classes.
3. In section 2.1.12.1 (Transmitting Subsystem), add classes A1\* and B1\* to the tables of Transmit Message Coverage by equipment class (tables 2-3, 2-4 and 2-5). For changes to the tables, some discussion is needed to determine 'Example Operation' applicable to the new classes. In addition, table 2-5 introduces capability descriptions for Class A receivers such as 'Basic VFR' and 'Basic IFR'. Some discussion is needed to come up with one corresponding to Class A1\*, perhaps 'Enhanced VFR'.

### **2.2 Section 2.2 Changes**

Changes in this section are generally editorial, adding A1\* and B1\* where appropriate for the transmit power, receive sensitivity and bit declaration and confidence techniques.

1. In section 2.2.2.1 (Mode S Transponder Based Transmitters), add classes A1\* and B1\* to the list of classes based on Mode S transponders with greater than or equal to 125 W peak output power levels.
2. In section 2.2.2.1.1.2 (Class A1 ADS-B Transponder Based Transmitter Power), revise section title and text to include Class A1\*.
3. In section 2.2.2.1.1.5 (Class B ADS-B Transponder Based Transmitter Power), revise text to require 125 W minimum peak output power for Class B1\*.
4. In section 2.2.3.2.6.1.4 ("IFR Capability Flag" Subfield in Airborne Velocity Messages - Subtype "1"), text may need to be revised depending upon the meaning of "IFR Capable" and whether that implies diversity.
5. In section 2.2.3.3.1.4.6.1 (Event-Driven Message Scheduling Function), add Class A1\* as optional class for TC message in the note.
6. In section 2.2.4.3.1.1 (In-Band Acceptance), table 2-79, add Class A1\* with MTL less than or equal to -79 dBm.
7. In section 2.2.4.3.1.2 (Re-Triggerable Capability), add Class A1\* to requirement for re-triggering capability.
8. In section 2.2.4.4.2 (Enhanced Squitter Reception Technique Overview), add Class A1\* to requirement to comply with test procedures of 2.4.4.4.

9. In section 2.2.4.5 (ADS-B Received Message Error Protection), add Class A1\* to item c. requiring enhanced error correction techniques.
10. In table 2-82, add Class A1\* to all reports that are required by Class A1.
11. In section 2.2.9.1 (ADS-B Receiver Reporting Requirements for Class A Equipage) table 2-100, add Class A1\* to Class A equipment reporting requirements, and fix typo in note 2. The change to the table will be subject to applications decided upon for the new class.
12. In section 2.2.9.1.1 (ADS-B State Vector Reports for Class A Equipage), add Class A1\*.
13. In section 2.2.9.1.2 (ADS-B Mode Status Reports for Class A Equipage), add Class A1\*.
14. In section 2.2.9.1.3 (ADS-B Target State Reports for Class A Equipage), add Class A1\* as class not required to provide report.
15. In section 2.2.9.1.4 (ADS-B Air Referenced Velocity Reports for Class A Equipage), add Class A1\* to item b.
16. In section 2.2.10.5 (Minimum Number of Participant Track Files), table 2-105, add Class A1\* requiring at least 200 participant track files.

### **2.3 Section 2.3 Changes**

Changes in this section are editorial, adding classes A1\* and B1\* as needed for changes in Section 2.2.

1. In section 2.3.2.3.3 (Verification of Enhanced Squitter Reception Techniques), add Class A1\* to list of classes for which test procedures apply.
2. In the proposed change to section 2.3.2.4.3 (Verification of Re-Triggerable Capability) in 1090-WP23-03R1, add class A1\* to the proposed table of success criteria.
3. In the proposed addition of section 2.3.2.4.6.1 (Criteria for ADS-B Message Transmission Pulse Detection for Receivers not using Enhanced Reception Techniques) in 1090-WP23-03R1, add class A1\* to the list of ‘not applicable’ equipage classes.
4. In section 2.3.2.4.8.1 (Combined Preamble and Data Block Tests with A/C Fruit), add Class A1\* to steps 1 and 2, and title of table 2-114.
5. In section 2.3.2.4.8.2 (Data Block Tests with Mode S Fruit), add Class A1\* to step 1 and title of table 2-117.
6. In section 2.3.2.4.8.3 (Re-Triggering Performance), add Class A1\* to steps 1 and 2, and title of table 2-120.

### **2.4 Section 2.4 Changes**

Changes in this section are editorial, adding classes A1\* and B1\* as needed for changes in Section 2.2. It is assumed that requirement text will be removed from this section, so changes to that text are ignored.

1. In section 2.4.2.1 (Mode S Transponder Based Transmitters), add to note to address any altitude limit of Class A1\* and B1\*. This change is contingent on descriptions added in section 2.1.
2. In section 2.4.2.1.1.2 (Verification of Class A1 ADS-B Transponder Based Transmitter Power), add Class A1\* to section Title (and update TOC correspondingly).
3. In section 2.4.3.2.6.1.4 (Verification of “IFR Capability Flag” Subfield in Airborne Velocity Messages - Subtype “1”), update the description of value ‘1’ for ME bit 10 in a manner consistent with any change to section 2.2.3.2.6.1.4.
4. In the proposed change to section 2.4.4.3.1.2 (Verification of Re-Triggerable Capability) in 1090-WP23-03R1, add class A1\* to the proposed table of success criteria.
5. In the proposed change to section 2.4.4.3.4.7.1 (Verification of Criteria for ADS-B Message Transmission Pulse Detection) in 1090-WP23-03R1, add class A1\* to the list of ‘not applicable’ equipage classes.
6. In section 2.4.4.3.3 (Verification of Dynamic Minimum Trigger Level), update note to add class A1\*.
7. In section 2.4.4.4.2.4 (Combined Preamble and Data Block Tests with Mode A/C Fruit), add class A1\* to introduction, steps 1-4, and title of table 2-157.
8. In section 2.4.4.4.2.5 (Data Block Tests with Mode S Fruit), add class A1\* to step 1 and title of table 2-160.

9. In section 2.4.4.4.2.6 (Re-Triggering Performance), add class A1\* to steps 1-3, and titles of tables 2-163 and 2-166.
10. In section 2.4.8.1.21 (Verification of Surveillance Status / Discretes Reporting), update the description of IFR Capability flag in table 2-194 in a manner consistent with any change to section 2.2.3.2.6.1.4.
11. In section 2.4.9.1.3 (Verification of the ADS-B Target State Reports for Class A Equipage), update text to include class A1\*. Assuming requirement text will be removed from test, change is only needed in measurement procedure.
12. In section 2.4.10.5 (Verification of the Minimum Number of Participant Track Files), add class A1\* to A1 in Table 2-203.

## **2.5 Section 3 Changes**

Changes in this section are primarily editorial, reflecting changes to Section 2. The first change is a suggestion limiting Class A1\* and B1\* installations to bottom mounted antennas, arising from the ARC's recommendations. Consideration should be made for receive-only devices.

1. In section 3.3.1 (General Considerations), consider adding requirement that class A1\* and B1\* have bottom mounted antenna.
2. In section 3.3.4 (Antenna Gain Performance), add class A1\* to row with Class A1 in Table 3-2. This assumes Class A1\* has a 20 nm required receiving reliability range.
3. In section 3.3.4.5.3 (Dynamic Response), add class A1\* to note, and consider specifying bottom mount for class A1\*.
4. In section 3.3.4.6.1 (Verification of Transmit Pattern Gain), add class A1\* to 125 W minimum ERP verification in steps 2 and 4.
5. In section 3.3.4.6.2 (Verification of Receiver Pattern Gain), add class A1\* to classes A1, A2 and A3 in step 1.

## **3 Volume 2 Changes**

### **3.1 Appendix A Changes**

Changes in this section are primarily editorial, reflecting changes to volume 1, section 2.

1. In section A.1.4.5.4 (IFR Capability Flag (IFR) in Airborne Velocity Messages), update the description of IFR Capability flag in a manner consistent with any change to section 2.2.3.2.6.1.4.
2. In section A.1.8 (Formats for Extended Squitter), figure A-5 and figure A-6, update the description of IFR Capability flag in a manner consistent with any change to section 2.2.3.2.6.1.4.

### **3.2 Appendix E Changes**

Consider adding class A1\* to link budget range analysis.

### **3.3 Appendix I Changes**

In Appendix I.4.2.1 (Enhanced Bit and Confidence Declaration Overview), consider including class A1\* with class A1 as being appropriate for use of the center sample technique for bit and confidence declaration.

### **3.4 Appendix L Changes**

Consider adding error rate bound for class A1\*.

### **3.5 Appendix P Changes**

In Appendix P.1, consider adding description of how the addition of class A1\* affects the results of the APL and LL studies. Particularly, the effect of class A1\* transmitting and receiving from the bottom antenna (the APL study assumed class A0 transmitting and receiving from the top antenna). Alternatively, state that the studies were performed before the inclusion of Class A1\* in the MOPS.

