

**RTCA Special Committee 186, Working Group 3**

**ADS-B 1090ES MOPS Maintenance**

**Meeting #24**

**Honeywell Aerospace, Phoenix, AZ**

**13 – 15 January 2009**

**Issues with Extended Squitter Monitor Test Procedures**

**Robert H. “Bob” Saffell**

**Rockwell Collins, Inc.**

**Summary**

This document addresses issues with Extended Squitter Monitor Testing as written in RTCA DO-260A, §2.4.11.2.1. Problems with the Test Procedures are addressed and appropriate corrections are proposed. Likewise, problems with the requirements in §2.2.11.2.1 are addressed and appropriate corrections are proposed.

## Discussion

The following paragraph is replicated from RTCA DO-260A in regards to Extended Squitter Monitor Testing for Transponder based Equipment.

### **“2.2.11.2 Broadcast Monitoring**

#### **2.2.11.2.1 Transponder Based Equipment**

If the ADS-B Transmitting Subsystem is implemented as a non-broadcast only equipment installation, then a squitter monitor **shall** be provided to verify that DF=17 transmissions are generated at the rates specified in §2.2.3.3 through §2.2.3.3.2.10. If any of the DF=17 message types for which the equipment is certified is not transmitted at the specified rates, then the equipment shall be considered as failed and the appropriate “Fail/Warn” indicators **shall** be set to the “Fail/Warn” state.”

Initial inspection of the requirement does not show any real problem. However, review of the applicable test procedures provided in §2.4.11.2.1 surfaces multiple questions which will be addressed in the following paragraphs.

- a. First, RTCA DO-260A §2.4.11.2.1 is attached as Appendix A to this working paper. This Appendix should be reviewed thoroughly by the reader as it provides commentary as necessary in regards to errors in the tests and where corrections should be made.
- b. Of primary concern is the problem of consistency in the tests in establishing:
  - (1) The number of transmit intervals allowed to pass before declaring a fault
  - (2) The number of transmit intervals allowed to pass before clearing a fault
  - (3) The amount of processing time which should be 100 milliseconds to either set or clear the fault

Issues in these areas are all directly addressed in Appendix A with suggested corrections.

- c. A more serious problem exists in §2.4.11.2.1, Step 2.m. and 2.n where the term “**shall**” is imposed a total of 4 times.

In general, and in short, the issue exists where the “**real**” requirements for Extended Squitter Monitor Testing are being established in §2.4 (e.g., Test Procedures) as opposed to being presented properly in §2.2. To correct this situation, the proposal is made herein to modify §2.2.11.2.1 to read as follows:

#### **“2.2.11.2.1 Transponder Based Equipment**

If the ADS-B Transmitting Subsystem is implemented as a non-broadcast only equipment installation, then a squitter monitor **shall** be provided to verify that DF=17 transmissions are generated at the rates specified in §2.2.3.3 through §2.2.3.3.2.10. If any of the DF=17 message types for which the equipment is certified is not transmitted at the specified rates, then the equipment shall be considered as failed and the appropriate “Fail/Warn” indicators **shall** be set to the “Fail/Warn” state.”

In order to not induce unnecessary intermittent Fail Warn declarations, the squitter monitor **shall** implement appropriate “debounce” and recovery techniques provided for in Table 2-XXX. In these regards, “debounce” refers to the number of successive maximum transmit intervals that a particular squitter message can be missed (e.g., not transmitted) plus an additional time of 100 milliseconds to process and activate the Fail Warn mechanism. Likewise, “recovery” refers to the number of successive maximum transmit intervals within

which a particular squitter message must be transmitted plus 100 milliseconds to process and de-activate the Fail Warn mechanism.”

**Table 2-XXX. Extended Squitter Monitor Time Allocation**

Extended Squitter Message Type	Transmit Interval (seconds)	Maximum Time to Declare Fail Warn (seconds)	Number of Intervals to Declare Fail Warn	Maximum Time to Clear Fail Warn (seconds)	Number of Intervals To Clear Fail Warn
Airborne Position	0.4 –to- 0.6	1.9	3	1.9	3
Airborne Velocity	0.4 –to- 0.6	1.9	3	1.9	3
Aircraft Identification and Type	4.8 –to- 5.2	15.7	3	5.3	1
Aircraft Identification and Type	9.8 –to- 10.2	30.7	3	10.3	1
Surface Position	0.4 –to- 0.6	1.9	3	1.9	3
Surface Position	4.8 –to- 5.2	15.7	3	5.3	1
Target State and Status	1.2 –to- 1.3	5.3	4	4.0	3
Aircraft Operational Status	0.7 –to- 0.9	1.9	2	1.9	2
Aircraft Operational Status	2.4 –to- 2.6	5.3	2	2.7	1
Aircraft Operational Status	4.8 –to- 5.2	10.5	2	5.3	1
Extended Squitter Aircraft Status	0.7 –to- 0.9	1.9	2	1.9	2
Extended Squitter Aircraft Status	2.4 –to- 2.6	5.3	2	2.7	1

**Notes:**

1. All Maximum Time to Declare Fail Warn (column 3) conditions are based on the maximum transmit interval (column 2) multiplied by the Number of Intervals to Declare Fail Warn (column 4) plus an additional processing time of 100 milliseconds.
2. All Maximum Time to Clear Fail Warn (column 5) conditions are based on the maximum Transmit Interval (column 2) multiplied by the Number of Intervals to Clear Fail Warn (column 6) plus an additional processing time of 100 milliseconds.

**Special Table Note:** (To be removed once all actions are resolved.)

**No test procedures are provided in section 2.4.11.2.1 to address the line items that are highlighted in yellow above.**

Once section 2.2.11.2.1 is updated and the table added, then:

1. The existing procedures need to be updated as per recommendations in the Appendix
2. All existing procedures need to be reviewed for consistency with the above table, and
3. Appropriate procedures need to be developed for the cases that have not been covered as discussed in the Table Note above.

In closing, the Working Group is invited to review and comment on the presented materials as necessary. The Working Group should also be reminded that the material presented herein will need to be updated for DO-260A Change 3 if additional Extended Squitter messages are being added.

## Appendix A:

### 2.4.11.2.1 Verification of Non-Broadcast Only Equipment (§2.2.11.2.1)

#### Purpose/Introduction:

The following Test Procedures shall be used to verify that the ADS-B Transmitting Subsystem properly enunciates the “Fail Warn” state if DF=17 transmissions do not occur at the rates specified in §2.2.3.3 through §2.2.3.3.2.10.

#### Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of detecting and monitoring ADS-B broadcast messages. Provide a method of modifying the transmission rates of DF=17 transmitted messages such that the rates do not comply with the rates specified in §2.2.3.3 –through §2.2.3.3.2.10.

**Note:** *The test procedures provided in the following subparagraphs require the capability to vary the rate of ADS-B transmitted messages. It shall be acceptable for the manufacturer to demonstrate compliance to the following procedures by software verification.*

#### Measurement Procedure:

The following procedures shall be performed in the absence of other major operations being performed by the ADS-B Transmitting Subsystem. Specifically, if the ADS-B Transmitting Subsystem is a subset of the Mode-S transponder, then all interrogations of the transponder shall be terminated during the performance of the following tests.

#### Step 1: Minimum DF=17 transmissions for Airborne Participants

- a. Provide the ADS-B transmitting monitoring function with all necessary information to enable the transmitting function to generate the following DF=17 transmitted messages:
  - (1). Airborne Position Messages (§2.2.3.2.3),
  - (2). Aircraft Identification and Type Messages (§2.2.3.2.5), and
  - (3). Airborne Velocity Messages (§2.2.3.2.6)

Verify that the ADS-B transmitting monitoring function properly transmits Airborne Position, Aircraft Identification and Type, and Airborne Velocity Messages at the rates required in §2.2.3.3.2.2, §2.2.3.3.2.4, and §2.2.3.3.2.

Verify that the ADS-B transmitting monitoring function does not enunciate any “Fail Warn” conditions.

- b. Decrease the transmission rate of the Airborne Position Message below the acceptable rate provided in §2.2.3.3.2.2. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within no more than 1.9 seconds.

**Note:** *The time chosen is based on 3 times the accepted maximum time of 0.6 second with an allowance of an additional 100 milliseconds.*

**RHS Comment:** *Time to SET “FW” is based on not having the Airborne Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

- c. Increase the transmission rate of the Airborne Position Message to comply with the rates specified in §2.2.3.3.2.2. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 1.9 seconds after returning the rate to the acceptable rate.

## Appendix A:

**RHS Comment:** *Time to CLEAR “FW” is based on receiving an Airborne Position Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.*

*Effectively 3 consecutive intervals allowed to CLEAR the “FW”.*

- d. Increase the transmission rate of the Airborne Position Message such that it exceeds the acceptable rate provided in §2.2.3.3.2.2. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 1.9 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Airborne Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

- e. Decrease the transmission rate of the Airborne Position Message to comply with the rates specified in §2.2.3.3.2.2. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 1.9 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Airborne Position Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.*

*Effectively 3 consecutive intervals allowed to CLEAR the “FW”.*

- f. Decrease the transmission rate of the Aircraft Identification and Type Messages below the acceptable rate provided in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 15.7 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Aircraft Identification and Type Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 15.7 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

- g. Increase the transmission rate of the Aircraft Identification and Type Messages to comply with the rates specified in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

- h. Increase the transmission rate of the Aircraft Identification and Type Messages such that it exceeds the acceptable rate provided in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 15.7 seconds.

## Appendix A:

**RHS Comment:** *Time to SET “FW” is based on not having the Aircraft Identification and Type Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 15.7 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

- i. Decrease the transmission rate of the Aircraft Identification and Type Message to comply with the rates specified in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

- j. Repeat steps b through e for Airborne Velocity Messages using the rates specified in §2.2.3.3.2.5.
- k. Set the rates of all three messages, e.g., Airborne Position, Aircraft Identification and Type, and Airborne Velocity Messages, such that the rates exceed those specified in §2.2.3.3.2.2, §2.2.3.3.2.4, and §2.2.3.3.2.5 respectively.
- l. Verify that the ADS-B transmitting monitoring function properly enunciates the “Fail Warn” state within no more than 1.9 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Airborne Position or Airborne Velocity Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

- m. Set the rates of all three messages, e.g., Airborne Position, Aircraft Identification and Type, and Airborne Velocity Messages, to the rates specified in §2.2.3.3.2.2, §2.2.3.3.2.4, and §2.2.3.3.2.5 respectively. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rates to the acceptable rates.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

### Step 2: Minimum DF=17 transmissions for Surface Participants

- a. Provide the ADS-B transmitting monitoring function with all necessary information to enable the transmitting function to generate the following DF=17 transmitted messages:

- (1). Surface Position Messages (§2.2.3.2.3),
- (2). Aircraft Identification and Type Messages (§2.2.3.2.4), and

Establish sufficient Ground Speed Data to the ADS-B transmit monitoring function to establish the high rate for Surface Position and Aircraft Identification and Type messages.

## Appendix A:

Verify that the ADS-B transmitting monitoring function properly transmits Surface Position and Aircraft Identification and Type Messages at the rates required in §2.2.3.3.2.3 and §2.2.3.3.2.4 respectively.

- b. Decrease the transmission rate of the Surface Position Message below the acceptable high rate provided in §2.2.3.3.2.3. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn state within no more than 1.9 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Surface Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.  
Effectively 3 consecutive fails to SET the “FW”.*

- c. Increase the transmission rate of the Surface Position Message to comply with the high rates specified in §2.2.3.3.2.3. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 1.9 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Surface Position Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.  
Effectively 3 consecutive intervals allowed to CLEAR the “FW”.*

- d. Increase the transmission rate of the Surface Position Message such that it exceeds the acceptable high rate provided in §2.2.3.3.2.3. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 1.9 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Surface Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.  
Effectively 3 consecutive fails to SET the “FW”.*

- e. Decrease the transmission rate of the Surface Position Message to comply with the high rates specified in §2.2.3.3.2.3. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 1.9 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” is based on receiving the Surface Position Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.  
Effectively 3 consecutive intervals allowed to CLEAR the “FW”.*

- f. Decrease the transmission rate of the Aircraft Identification and Type Messages below the acceptable high rate provided in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 15.7 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Aircraft Identification and Type Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 15.7 seconds.  
Effectively 3 consecutive fails to SET the “FW”.*

## Appendix A:

- g. Increase the transmission rate of the Aircraft Identification and Type Messages to comply with the high rates specified in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rate to the acceptable rate.

***RHS Comment: Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.***

***Effectively 1 interval allowed to CLEAR the “FW”.***

- h. Increase the transmission rate of the Aircraft Identification and Type Messages such that it exceeds the acceptable high rate provided in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function properly enunciates the “Fail Warn” state within 15.7 seconds.

***RHS Comment: Time to SET “FW” is based on not having the Aircraft Identification and Type Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 15.7 seconds.***

***Effectively 3 consecutive fails to SET the “FW”.***

- i. Decrease the transmission rate of the Aircraft Identification and Type Message to comply with the high rates specified in §2.2.3.3.2.4. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rate to the acceptable rate.

***RHS Comment: Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.***

***Effectively 1 interval allowed to CLEAR the “FW”.***

- j. Set the rates of both messages, e.g., Surface Position and Aircraft Identification and Type Messages, such that the rates exceed the high rates those in §2.2.3.3.2.3 and §2.2.3.3.2.4, respectively. Verify that the ADS-B transmitting monitoring function properly enunciates the “Fail Warn” state within no more than 1.9 seconds.

***RHS Comment: Time to SET “FW” is based on not having the Surface Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 1.9 seconds.***

***Effectively 3 consecutive fails to SET the “FW”.***

- k. Set the rates of both messages, e.g., Surface Position and Aircraft Identification and Type Messages, to the high rates specified in §2.2.3.3.2.3 and §2.2.3.3.2.4, respectively. Verify that the ADS-B transmission monitoring function does not enunciate any “Fail Warn” conditions within 5.3 seconds after returning the rates to the acceptable rates.

***RHS Comment: Time to CLEAR “FW” is based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.***

***Effectively 1 interval allowed to CLEAR the “FW”.***

## Appendix A:

- l. Decrease Ground Speed Data to the ADS-B transmitting monitoring function to establish the low rate for Surface Position and Aircraft Identification and Type messages. Verify that the ADS-B transmitting monitoring function properly transmits Surface Position and Aircraft Identification and Type Messages at the low rates required in §2.2.3.3.2.3 and §2.2.3.3.2.4, respectively.
- m. Repeat steps b through e for Surface Position Messages using the low rates specified in §2.2.3.3.2.3 and applying the following exceptions:
  - (1). The response time to set the “Fail Warn” state **shall** not exceed **15.6** seconds in steps b and d.

**RHS Comment:** *Time to SET “FW” should be based on not having the Surface Position Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 15.7 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

*As such, the time of 15.6 seconds given above should be changed to 15.7 seconds.*

- (2). The response time to clear the “Fail Warn” state **shall** not exceed **5.4** seconds in steps c and e.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Surface Position Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

*As such, the time of 5.4 seconds given above should be changed to 5.3 seconds. There is no apparent justification for adding another 100 milliseconds.*

- n. Repeat steps f through i for Aircraft Identification and Type Messages using the low rates specified in §2.2.3.3.2.4 and applying the following exceptions:
  - (1). The response time to set the “Fail Warn” state **shall** not exceed **30.6** seconds in steps f and h.

**RHS Comment:** *Time to SET “FW” should be based on not having the Aircraft Identification and Type Message for 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 30.7 seconds.*

*Effectively 3 consecutive fails to SET the “FW”.*

*As such, the time of 30.6 seconds given above should be changed to 30.7 seconds. There is no apparent justification for not providing 100 milliseconds of processing time.*

- (2). The response time to clear the “Fail Warn” state **shall** not exceed **10.4** seconds in steps c and e.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Aircraft Identification and Type Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 10.3 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

## Appendix A:

*As such, the time of 10.4 seconds given above should be changed to 10.3 seconds. There is no apparent justification for adding another 100 milliseconds.*

### Step 3: Maximum DF=17 transmissions for Airborne Participants

- a. Provide the ADS-B transmitting monitoring function with all necessary information to enable the transmitting function to generate the following DF=17 transmitted messages:
  - (1). Airborne Position Messages (§2.2.3.2.3),
  - (2). Aircraft Identification and Type Messages (§2.2.3.2.5), and
  - (3). Airborne Velocity Messages (§2.2.3.2.6)
  - (4). Target State and Status Messages (§2.2.3.2.7.1)
  - (5). Aircraft Operational Status Messages (§2.2.3.2.7.2)
  - (6). Extended Squitter Aircraft Status Messages (TYPE=28) (§2.2.3.2.7.8)

Verify that the ADS-B transmitting monitoring function properly transmits Airborne Position, Aircraft Identification and Type, Airborne Velocity, Target State and Status, Aircraft Operational Status, and Extended Squitter Aircraft Status Messages at the rates required in §2.2.3.3.2.2, §2.2.3.3.2.4, §2.2.3.3.2.5, §2.2.3.3.2.6.1, §2.2.3.3.2.6.2, and §2.2.3.3.2.6.3 respectively.

Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions.

- b. Decrease the transmission rate of the Target State and Status Messages below the acceptable rate provided in §2.2.3.3.2.6.1. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in no more than 5.3 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Target State and Status Message for 4 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 4 consecutive fails to SET the “FW”.*

*I suspect that the number of consecutive fails was increased for the Target State and Status as it is an event driven message and can be prioritized.*

- c. Increase the transmission rate of the Target State and Status Messages to comply with the rates specified in §2.2.3.3.2.6.1. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions 3.9 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Target State and Status Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 4.0 seconds.*

*Effectively 3 intervals allowed to CLEAR the “FW”.*

*As such, the time of 3.9 seconds given above should be changed to 4.0 seconds. There is no apparent justification for not providing 100 milliseconds of processing time.*

## Appendix A:

- d. Increase the transmission rate of the Target State and Status Messages such that it exceeds the acceptable rate provided in §2.2.3.3.2.6.1. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in 5.3 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Target State and Status Message for 4 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 4 consecutive fails to SET the “FW”.*

- e. Decrease the transmission rate of the Target State and Status Messages to comply with the rates specified in §2.2.3.3.2.6.1. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions 3.9 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Target State and Status Message within 3 times the maximum interval plus 100 milliseconds processing time. Resulting in 4.0 seconds.*

*Effectively 3 intervals allowed to CLEAR the “FW”.*

*As such, the time of 3.9 seconds given above should be changed to 4.0 seconds. There is no apparent justification for not providing 100 milliseconds of processing time.*

- f. Decrease the transmission rate of the Aircraft Operational Status Messages below the acceptable rate provided in §2.2.3.3.2.6.2. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in no more than 5.3 seconds.

**RHS Comment:** *Time to SET “FW” is based on not having the Aircraft Operational Status Message for 2 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 2 consecutive fails to SET the “FW”.*

- g. Increase the transmission rate of the Aircraft Operational Status Messages to comply with the rates specified in §2.2.3.3.2.6.2. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions 3.7 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Aircraft Operational Status Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 2.7 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

*As such, the time of 3.7 seconds given above should be changed to 2.7 seconds. There is no apparent justification for allowing the additional second.*

- h. Increase the transmission rate of the Aircraft Operational Status Messages such that it exceeds the acceptable rate provided in §2.2.3.3.2.6.2. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in 5.3 seconds.

## Appendix A:

**RHS Comment:** *Time to SET “FW” is based on not having the Aircraft Operational Status Message for 2 times the maximum interval plus 100 milliseconds processing time. Resulting in 5.3 seconds.*

*Effectively 2 consecutive fails to SET the “FW”.*

- i. Decrease the transmission rate of the Aircraft Operational Status Messages to comply with the rates specified in §2.2.3.3.2.6.2. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions 3.7 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Aircraft Operational Status Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in 2.7 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

*As such, the time of 3.7 seconds given above should be changed to 2.7 seconds. There is no apparent justification for allowing the additional second.*

- j. Decrease the transmission rate of the Extended Squitter Aircraft Status Messages below the acceptable rate provided in §2.2.3.3.2.6.3. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in no more than 3.7 seconds.

**RHS Comment:** *The time to set the fail warn condition on this message is totally different than what has been established with the previous messages. The Question is \_\_\_WHY? First, if the Time to SET “FW” is based on not having the Extended Squitter Aircraft Status Message for 1 times the maximum interval plus 100 milliseconds processing time, then the resulting time should be 2.7 seconds and not 3.7 seconds. Bear in mind that it is ill advised to be setting “FW” on a single hit as this will result in intermittent fail warn indications to the crew which will not make them happy.*

*It would appear that the time to SET “FW” should be based on not having the Extended Squitter Aircraft Status Message for 2 times the maximum interval plus 100 milliseconds processing time. This results in a time of 5.3 seconds.*

*Effectively 2 consecutive fails to SET the “FW”.*

*Recommendation is herein made to change the time of 3.7 seconds to 5.3 seconds as there is no justification for the 3.7.*

- k. Increase the transmission rate of the Extended Squitter Aircraft Status Messages to comply with the rates specified in §2.2.3.3.2.6.3. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions 2.5 seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Extended Squitter Aircraft Status Message within 1 times*

## Appendix A:

*the maximum interval plus 100 milliseconds processing time. Resulting in 2.7 seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

*As such, the time of 2.5 seconds given above should be changed to 2.7 seconds. There is no apparent justification for establishing the time based on the minimum interval time plus 100 milliseconds which results in the 2.5 seconds. Establishing the time based on minimum interval time is not tenable as the interval time between squitter transmissions is random and bounded between 2.4 and 2.6 seconds.*

- l. Increase the transmission rate of the Extended Squitter Aircraft Status Messages such that it exceeds the acceptable rate provided in §2.2.3.3.2.6.3. Verify that the ADS-B transmission monitor function properly enunciates the “Fail Warn” state in no more than 3.7 seconds.

**RHS Comment:** *The time to set the fail warn condition on this message is totally different than what has been established with the previous messages. The Question is \_\_\_WHY? First, if the Time to SET “FW” is based on not having the Extended Squitter Aircraft Status Message for 1 times the maximum interval plus 100 milliseconds processing time, then the resulting time should be 2.7 seconds and not 3.7 seconds. Bear in mind that it is ill advised to be setting “FW” on a single hit as this will result in intermittent fail warn indications to the crew which will not make them happy.*

*It would appear that the time to SET “FW” should be based on not having the Extended Squitter Aircraft Status Message for 2 times the maximum interval plus 100 milliseconds processing time. This results in a time of 5.3 seconds.*

*Effectively 2 consecutive fails to SET the “FW”.*

*Recommendation is herein made to change the time of 3.7 seconds to 5.3 seconds as there is no justification for the 3.7.*

- m. Decrease the transmission rate of the Extended Squitter Aircraft Status Messages to comply with the rates specified in §2.2.3.3.2.6.3. Verify that the ADS-B transmission monitor function does not enunciate any “Fail Warn” conditions **2.5** seconds after returning the rate to the acceptable rate.

**RHS Comment:** *Time to CLEAR “FW” should be based on receiving the Extended Squitter Aircraft Status Message within 1 times the maximum interval plus 100 milliseconds processing time. Resulting in **2.7** seconds.*

*Effectively 1 interval allowed to CLEAR the “FW”.*

*As such, the time of 2.5 seconds given above should be changed to **2.7** seconds. There is no apparent justification for establishing the time based on the minimum interval time plus 100 milliseconds which results in the 2.5 seconds. Establishing the time based on minimum interval time is not*

**Appendix A:**

*tenable as the interval time between squitter transmissions  
is random and bounded between 2.4 and 2.6 seconds.*

**END OF DOCUMENT**