

RTCA Special Committee 209

Mode S Transponder MOPS

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Ambiguous Zero Type Code Squitters

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Summary

DO-181C and DO-260A require that Airborne Position, Surface Position, and Airborne Velocity Squitters all continue to be broadcast with TYPE Code Zero for 60 seconds after the source data has timed out. This presents an ambiguous decoding problem for an ADS-B receiver. Honeywell proposes to modify these requirements to only transmit Airborne Position Messages with TYPE Code ZERO. Surface Position and Airborne Velocity Messages would not be broadcast with TYPE Code ZERO.

Introduction:

The following list of MOPS paragraphs require that Airborne Position, Surface Position, and Airborne Velocity Squitters all continue to be broadcast with TYPE Code Zero for 60 seconds after the source data has timed out. The Airborne Position Message is required to continue to contain the pressure altitude. The Surface Position and Velocity Messages are required to be all ZEROS. This presents an ambiguous decoding problem for an ADS-B receiver. It depends on the TYPE code to distinguish between the incoming ADS-B messages. Therefore, it would not be able to tell a ZERO TYPE Code Airborne Position Message from any other ZERO TYPE Code Message. Honeywell proposes to modify these requirements and only transmit Airborne Position Messages with TYPE Code ZERO. Surface Position and Airborne Velocity Messages will not be broadcast with TYPE Code ZERO. Honeywell will present this issue paper to SC-209 and SC-186 WG3 proposing to make the following changes to DO-181C and DO-260A.

If accepted these requirements changes will drive changes in the corresponding test paragraphs. Honeywell will provide those text changes to the committee as needed.

DO-181C Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.16.2.6.2.3 Extended Squitter Rate

- a. Initialization. At power up initialization, the transponder shall commence operation in a mode in which it broadcasts only acquisition squitters (2.2.16.2.6.1). The transponder shall initiate the broadcast of extended squitters for airborne position, surface position, airborne velocity and aircraft identification when data are inserted into GICB registers 05, 06, 09 and 08 {HEX} respectively. This determination shall be made individually for each squitter type. The insertion of altitude data into register 05 by the transponder (2.2.16.2.6.2.8) shall not satisfy the minimum requirement for broadcast of the airborne position squitter.

Note 1: This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity information.

If input to the 05 register for the airbornea position squitter type stops for 60 seconds, broadcast of that extended squitter type will be discontinued until data insertion is resumed. The insertion of altitude by the transponder shall satisfy the minimum requirement for continuing to broadcast the airborne position squitter. After timeout (2.2.16.2.6.2.4.2), this squitter type may contain an ME field of all zeroes.

Note 2: Continued transmission for 60 seconds is required so that receiving aircraft will know that the data source for the message has been lost.

If input to the 06 or 09 register stops for 2 seconds, broadcast of those extended squitter types will be discontinued until data insertion is resumed.

Note 3: Previous versions of these MOPS required the surface position and velocity squitter to be transmitted for an additional 60 seconds with all zeros including the Type Code field. In the event of a loss of GPS data the airborne position squitter would have barometric altitude in it, the surface position and velocity squitter would not. However, a receiver could not determine the difference between these cases, therefore the transmitted altitude was not usable.

When extended squitters are broadcast, transmission rates shall be as indicated in the following paragraphs. Acquisition squitters shall be reported in addition to extended squitters as specified in 2.2.16.2.6.1.c. Acquisition squitters shall always be reported if no extended squitters are reported.

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.3.1.3.2 Broadcast of TYPE Code Equal to ZERO

Only the Airborne Position message shall be Broadcast with the TYPE Code equal to ZERO. The TYPE Code Equal to ZERO message may be required as a consequence of the following events:

- a. An ADS-B Airborne Position ~~or Surface Position Message~~ register has not been loaded with horizontal position data in the last 2 seconds. In this case, the ADS-B Message register shall be cleared (i.e., all 56 bits set to ZERO) once it has timed out. Transmission of the ADS-B Message that broadcasts the contents of the register shall be terminated if the ADS-B Message register has not been loaded in 60 seconds, except that transmission termination of Surface Position Messages does not apply to Non-Transponder devices on aircraft that are on the surface, on surface vehicles. Transmission termination of Airborne Position Messages does not apply when or if barometric altitude information is available. Broadcast of the ADS-B Airborne Position ~~or Surface Position~~ Message shall resume once data has been loaded into the ADS-B Message register.
- b. The data management function responsible for loading the ADS-B Message registers determines that all navigation sources that can be used for the Airborne ~~or Surface~~ Position Message are either missing or invalid. In this case the data management function shall clear (set all data fields to all ZEROS) the TYPE Code and all other fields of the Airborne ~~or Surface Position~~ Message and insert the ZEROed message into the appropriate ADS-B Message register. This should only be done once in support of the detection of the loss of data insertion and shall result in the suppression of the broadcast of the related ADS-B Message.
- e. Note:
~~that in all each of the cases discussed above, a TYPE Code of ZERO infers a message of all ZEROS with. The only exception is that the Airborne Position Message format shall contain of the barometric altitude code as set by the transponder when so implemented. There is no analogous case for the other Extended Squitter Message Types, since a ZERO value in any of the fields indicates that no valid information is available.~~

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.4.1.3.2 Broadcast of TYPE Code Equal to ZERO

Surface Position Messages are not transmitted with Type Code Equal to ZERO. If a data timeout or invalid data occurs that causes the Surface Position register to be ZEROED, the Surface Position Message broadcast will be terminated. The requirements provided in §2.2.3.2.3.1.3.2 apply equally to the ADS-B Surface Position Message except that subparagraph “e” is modified to read as follows:

- e. ~~Note that in all of the cases, a TYPE Code of ZERO infers a message of all ZEROS.~~

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.6.1 ADS-B Airborne Velocity Message – Subtype “1”

- a. The Airborne Velocity Message - Subtype “1” is illustrated in Figure 2-7 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is available, and the transmitting device is installed in an environment having NON-supersonic airspeed capability.
- b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype “2”) shall be used if either the East/West velocity OR the North/South velocity exceeds 1022 knots. A switch to the normal velocity message (i.e., Subtype “1”) shall be made if both the East/West and the North/South velocities drop below 1000 knots.
- c. The Airborne Velocity Message shall not be broadcast if the only valid data are the Intent Change and the IFR Capability Flags.
 - (1). Transponder based ADS-B Transmitting Subsystems shall suppress the broadcast by loading register 0,9 with all “ZEROS” and then discontinuing updating of the register until data input is available again. The Transponder will ZERO the Velocity Message after 2 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181C (EUROCAE ED-73B).~~
 - (2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2 seconds and terminate broadcast ~~after 60 seconds~~ as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

Each of the subfields of the Airborne Velocity Message - Subtype “1” is specified in the following subparagraphs.

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.6.2 ADS-B Airborne Velocity Message - Subtype “2”

- a. The Airborne Velocity Message - Subtype “2” is illustrated in Figure 2-7 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is available, and the transmitting device is installed in an environment having a Supersonic airspeed capability.
- b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype “2”) shall be used if either the East/West Velocity OR the North/South Velocity exceeds 1022 knots. A switch to the normal Airborne Velocity Message (i.e., Subtype “1”) shall be made if both the East/West and the North/South Velocities drop below 1000 knots.
- c. The Airborne Velocity Message shall not be broadcast if the only valid data are the Intent Change and the IFR Capability Flags.
 - (1). Transponder-Based ADS-B Transmitting Subsystems shall suppress the broadcast by loading register 0,9 with all “ZEROS” and then discontinuing updating of the register until data input is available again. The Transponder will ZERO the Velocity Message after 2 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181C (EUROCAE ED-73B).~~
 - (2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2 seconds and terminate the broadcast ~~after 60 seconds,~~ as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

Each of the subfields of the Airborne Velocity Message - Subtype “2” is specified in the following subparagraphs.

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.6.3 ADS-B Airborne Velocity Message - Subtype “3”

- a. The Airborne Velocity Message - Subtype “3” is illustrated in Figure 2-8 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is not available, and the transmitting device is installed in an environment having NON-supersonic airspeed capability.
- b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype “4”) shall be used if the airspeed exceeds 1022 knots. A switch to the normal Velocity Message (i.e., Subtype “3”) shall be made if the airspeed drops below 1000 knots.
- c. The Airborne Velocity Message shall not be broadcast if the only valid data is the Intent Change and the IFR Capability Flags.
 - (1). Transponder-Based ADS-B Transmitting Subsystems shall suppress the broadcast by loading register 0,9 with all “ZEROS” and then discontinuing updating of the register until data input is available again. The Transponder will ZERO the Velocity Message after 2 seconds and terminate the broadcast~~after 60 seconds, as specified in RTCA DO-181C (EUROCAE ED-73B).~~
 - (2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2 seconds and terminate the broadcast~~after 60 seconds,~~ as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

Each of the subfields of the Airborne Velocity Message - Subtype “3” is specified in the following subparagraphs.

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.2.6.4 ADS-B Airborne Velocity Message - Subtype “4”

- a. The Airborne Velocity Message - Subtype “4” is illustrated in Figure 2-8 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is NOT available, and the transmitting device is installed in an environment having Supersonic airspeed capability.
- b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype “4”) shall be used if the airspeed exceeds 1022 knots. A switch to the normal Velocity Message (i.e., Subtype “3”) shall be made if the airspeed drops below 1000 knots.
- c. The Airborne Velocity Message shall not be broadcast if the only valid data is the Intent Change and the IFR Capability Flags.
 - (1). Transponder-Based ADS-B Transmitting Subsystems shall suppress the broadcast by loading register 0,9 with all “ZEROS” and then discontinuing updating of the register until data input is available again. The Transponder will ZERO the Velocity Message after 2 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181C (EUROCAE ED-73B).~~
 - (2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2 seconds and terminate the broadcast ~~after 60 seconds,~~ as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

Each of the subfields of the Airborne Velocity Message - Subtype “4” is specified in the following subparagraphs.

DO-260A Existing Text with Suggested Changes Shown (use MS Word View Markup)

2.2.3.3.2.12 ADS-B Message Termination

- a. The ADS-B Transmitting Subsystem **shall** terminate broadcast transmissions of the Airborne Position, ~~Surface Position~~, Aircraft Identification and Type, ~~Velocity~~, Target State and Status, and/or Aircraft Operational Status Messages if input data necessary to update the particular ADS-B Message TYPE is not available for a period of 60 seconds, ~~except that transmission termination of Surface Position Messages does not apply to Non-Transponder Devices on aircraft that are on the surface, or on surface vehicles.~~

The ADS-B Transmitting Subsystem shall terminate broadcast transmissions of the Surface Position and Velocity Messages if input data necessary to update the ADS-B Message TYPE is not available for a period of 2 seconds.

Notes:

- 1. For the Airborne Position Message, specifically, Altitude Data alone is sufficient to maintain broadcast of the message once the message has been initiated.*
 - 2. For the Surface Position Message, the receipt of new Position and Integrity (i.e., Latitude, ~~and~~ Longitude, and HIL~~combined~~), ~~Movement, or Ground Track data~~ is sufficient to maintain broadcast of the message once the message has been initiated.*
 - 3. For all other ADS-B Messages, the receipt of new data necessary to update any single parameter of the message is sufficient to maintain broadcast of the message once the message has been initiated.*
- b. Each ADS-B Message type shall be terminated individually and independently of all other ADS-B Messages.
- c. Class B2 Non-Transponder-Based Transmitting Subsystems on Ground Vehicles shall provide an interface capable of putting the unit into a standby condition in which the unit suspends all message transmissions.

Notes:

- 1. This interface is intended to be used by a mapping function that will automatically trigger the interface if the Transmitting Subsystem is outside a user adaptable two-dimensional geographic area.*
- 2. If required because of spectrum considerations, the two-dimensional geographic area will be defined as the movement area (i.e., runways and taxiways) plus a reasonable buffer area (i.e., 50 foot buffer). Implementations of this feature should be designed such that a particular ground authority can specify a region that conserves spectrum without introducing risk of accidental termination within the movement area. Consideration should be given to precision and accuracy of the geographic region definition.*

3. *As a vendor option, this mapping function may be implemented integral to the Class B2 equipment. In this case, the interface is internal to the unit.*