

RTCA Special Committee 209

Mode S Transponder MOPS Maintenance

Working Group #1, Meeting #6

Engility Corporation, Washington DC

14 – 16 April 2008

**Proposed Resolution to Both DO-181D and ED-73C for
WG-49 Action Item A12/13**

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SUMMARY

This Working Paper proposes changes to both DO-181D and ED-73C for the resolution of WG-49 Action Item A12/13, which requests to “*verify altitude quantization in the new paragraph §3.27.4.c (DO-181D, §2.2.22.4.c).*” It also contains commentary from both Bob Saffell and Antoine Herve as resolution to the Action was reached.

Action Item: WG49_A12/13
Assigned to: R.H. “Bob” Saffell
Description: Verify altitude quantization in new paragraph §3.27.4.c (DO-181D, §2.2.24.c).

Revision A: Changed references to “DO-181D section 2.2.24.x” –to- “DO-181D section 2.2.22.4.x” and highlighted in “green”.
Changed quantization limits in DO-181D section 2.2.22.4.c to 25 feet for fine, and 100 feet or greater for coarse. Also highlighted change in “green”.

Introduction:

First, a look at what the applicable specifications have to say in regards to quantization of altitude data provided to TCAS by the Transponder.

RTCA DO-181A, Change 2, January 27, 1997 introduced the following requirement:

- “2.2.20.4 Data provided by the Mode S Transponder to the TCAS Equipment
The transponder shall provide the following data to the TCAS equipment:
- a. The aircraft discrete address.
 - b. The aircraft pressure altitude from the source that is the basis for own altitude in Mode S replies
 - c. Quantization for pressure altitude (fine or coarse, where fine is defined to be 10 feet or less, and coarse is defined to be greater than 10 feet).

RHS Commentary: You can’t have 10 feet for both fine and coarse, so this has to change, and will be changed in the Recommended Changes section of this document.

When selecting the altitude source used for Mode S replies and for TCAS, the transponder shall use the source that is valid and provides the finest quantization. The altitude data shall be provided to TCAS at the finest quantization available.”

RTCA DO-181D provides the same requirement in section 2.2.22.4.

Next, ED-73C has added the exact same requirement in section 3.27.4

ICAO Annex 10, Volume IV, July 2007, Chapter 4 provides:

“4.3.9.3 *Pressure-altitude source.* The altitude data for own aircraft provided to ACAS shall be obtained from the source that provides the basis for own Mode C or Mode S reports and they shall be provided at the finest quantization available.”

4.3.9.3.1 **Recommendation.**— *A source providing a resolution finer than 7.62 m (25 ft) should be used.*

4.3.9.3.2 Where a source providing a resolution finer than 7.62 m (25 ft) is not available, and the only altitude data available for own aircraft is Gilham encoded, at least two independent sources shall be used and compared continuously in order to detect encoding errors.

4.3.9.3.3 **Recommendation.**— *Two altitude data sources should be used and compared in order to detect errors before provision to ACAS.*

4.3.9.3.4 The provisions of 4.3.10.3 shall apply when the comparison of the two altitude data sources indicates that one of the sources is in error.”

Next, ICAO Annex 10, Volume IV, July 2002, Chapter 4 provides the exact same text.

Discussion:

1. The first issue to address is the statement made in parenthesis in DO-181A section 2.2.20.4.c, DO-181D section 2.2.22.4.c, or ED-73C section 3.27.4. The issue is “10 feet or less”. Note that the actual requirements provided in Annex 10, Volume IV have nothing to say about “10” feet. Rather, the SARPs specifically recommend that the quantization should be less than 25 feet.
2. The next issue to address is that presented by the final paragraph of DO-181A section 2.2.20.4, DO-181D section 2.2.22.4, and ED-73C section 3.27.4. The way the paragraph is written, infers that the transponder is totally in control of the selection and that it could possibly select the altitude source based on the source that has the finest quantization. This is not necessarily the case as selection of the altitude being reported is typically made by the flight crew in an RVSM environment.

Recommended Changes:

1. Recommend that DO-181D, section 2.2.22.4.c and ED-73C paragraph 3.27.4.c be changed to read as follows:

d. Quantization for pressure altitude (fine or coarse, where fine is defined to be 25 feet or less, and coarse is defined to be 100 feet or greater).

RHS Commentary: Note that Gillham altitude has a best resolution of 100 feet, so that is why I use “100 feet or greater” in the above.

Antoine Commentary: Fine or Coarse is not needed. Suggest to simplify text as below:

c. Quantization for pressure altitude (25ft or 100ft).

2. Recommend that the last paragraph of DO-181D be changed to read as follows:

The source selected to provide altitude data to the transponder for use in Mode C, Mode S Replies and by TCAS shall provide valid data at the finest quantization possible.

Note: Selection of the altitude source to be used for altitude reporting is typically made by the flight crew. As such, the requirements of the previous paragraph are a function of the operational installation and not the transponder directly.

Altitude data shall be provided to TCAS by the Transponder with the finest quantization possible.

3. Recommend that the last paragraph ED-73C paragraph 3.27.4 be changed to read as follows:

The source selected to provide altitude data to the transponder for use in Mode C, Mode S Replies and by ACAS shall provide valid data at the finest quantization possible.

Note: Selection of the altitude source to be used for altitude reporting is typically made by the flight crew. As such, the requirements of the previous paragraph are a function of the operational installation and not the transponder directly.

Altitude data shall be provided to ACAS by the Transponder with the finest quantization possible.

Antoine Commentary: such requirement is linked to the installation and should not be added in the MOPS. Delete this text from the MOPS (as agreed during the last joint meeting).

3. Last but not least, recommend that DO-181D, section 2.2.22.4.b and ED-73C paragraph 3.27.4.b be changed to read as follows:
 - b. The aircraft pressure altitude from the source that is the basis for own altitude in Mode C and Mode S replies

Antoine proposal:

3.27.4 Data Provided by the Mode S Transponder to the ACAS Equipment

The transponder **shall** provide the following data to the ACAS equipment:

- a. The 24 bit aircraft discrete address,
- b. The aircraft pressure altitude from the source that is the basis for own altitude in Mode C and Mode S replies,
- c. Quantization for pressure altitude (25ft or 100ft).

-END-

End of Action Item WG-49_A12/13 Work