

**RTCA Special Committee 209 and EUROCAE WG-49**

**ATCRBS / Mode S Transponder MOPS Maintenance**

**Meeting #12**

**In Joint Session with EUROCAE WG-49  
EUROCAE Headquarters, Malakoff near Paris France  
15 – 19 November 2010**

**Proposal for Setting Reserved Bits in Register 40<sub>16</sub> to Zero**

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**SUMMARY**

Working Paper SC209-WP11-13 was previously published on this topic, but was not reviewed during Meeting 11 because of time problems. This Working Paper suggests that there was an omission in DO-181D/ED-73C (and ICAO Doc 9871) where the status bits in Register 40<sub>16</sub>, bits 40 to 47 were not set to Zero. Also there needs to be a general requirement that data bits be set to Zero if the status bit is set to Zero.

## **1.0 Register 40<sub>16</sub> Reserved Bits**

The MOPS requirements for the formats of Register 40<sub>16</sub> is very detailed and consistent with the general requirements for Register formatting. However, there appears to be one omission in the requirements for the reserved bits to be set to zero.

As written, DO-181D, §2.2.25.5.2.5 [ED-73C, §3.30.5.2.5] requires that reserved bits 52 and 53 be set to ZERO. No mention is made of the other reserved field in this message, bits 40 to 47. For completeness, paragraph §2.2.25.5.2.5 [ED-73C, §3.30.5.2.5] should be revised to include bits 40 to 47 in the requirement for being set to ZERO.

Additionally, Table B-3-64 in both MOPS [ICAO Doc 9871, Table A-2-64] should be updated to reflect that these bits shall be set to ZERO.

For additional completeness, Section §B.4.4.4 [also ICAO Doc 9871 §D.2.4.4.5] should be added to the guidance for Register 40<sub>16</sub> by repeating the requirements in DO-181D, §2.2.25.5.2.5 [ED-73C, §3.30.5.2.5] as revised below.

## **2.0 Data Requirements for Future Transponder Register Formatting**

DO-181D, §2.2.26.2.1 [ED-73C, §3.31.2.1] states the general formatting requirements for future Register specification. As written, the list of requirements is not complete since the following requirements are omitted:

Setting data bits to ZERO if the Status Bit for that field is set to ZERO

Setting any Reserved Bits to ZERO

Note that (except for bits 40-47 of Register 40<sub>16</sub> as corrected in 1.0 above) both of the above requirements are consistent with the current MOPS formatting requirements for Registers 40<sub>16</sub>, 50<sub>16</sub> and 60<sub>16</sub>.

## **3.0 Proposed MOPS Change**

The tracked changes in the following paragraphs include revisions to implement both of the above corrections.

2.2.25.5.2.5 **Reserved Bits (Bits 40 to 47, 52 & 53)**

Bits 40 to 47, 52 and 53 of Register 40<sub>16</sub> “MB” field shall be set to ZERO (0).

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2.2.26.2 **Data Requirement**

2.2.26.2.1 **Data Field “y”**

- a. The transponder will process data from on-board aircraft data sources as provided in Appendix B, Table B-3-ddd of Register **XX**<sub>16</sub> definition table and format the data into field “y” of the Register **XX**<sub>16</sub> “MB” field as shown in that table.
- b. Field “y” will be encoded using two’s complement coding if it is a signed arithmetic field unless otherwise specified.
- c. The data loaded into the “MB” field will be rounded so as to preserve accuracy of the source data within ±1/2 LSB.
- d. Status Bit of field “y” will be set to ONE (1) whenever valid and up-to-date data (data not older than twice the maximum update interval specified in Table B-2-1 in Appendix B) is available in field “y”.
- e. Status Bit of field “y” will be set to ZERO (0) whenever there is no valid and up-to-date data with which to fill field “y”.

f The data bits of field “y” will be set to ZERO if the Status Bit is set to ZERO

g Any Reserved Bits will be set to ZERO.

**Note 1:** *On an ARINC platform, when data is available in BCD and in binary, transponders will preferably use binary data rather than BCD data.*

**Note 2:** *When multiple sources of data are available for a given field “y”, transponders will use the data source that is being used to manage the aircraft profile or the source selected by the flight crew. This general convention applies unless the highest integrity data is desired as in Automatic Dependent Surveillance – Broadcast (ADS-B). In such cases, the highest integrity source will be used for data.*

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**Table B-3-64: BDS Code 4,0 – Selected Vertical Intention**

**MB FIELD**

1	STATUS	<p><b>PURPOSE:</b> To provide ready access to information about the aircraft’s current vertical intentions, in order to improve the effectiveness of conflict probes and to provide additional tactical information to controllers.</p> <p>1) Target altitude shall be the short-term intent value, at which the aircraft will level off (or has leveled off) at the end of the current maneuver. The data source that the aircraft is currently using to determine the target altitude shall be indicated in the altitude source bits (54 to 56) as detailed below.</p> <p><b>Note:</b> This information which represents the real “aircraft intent,” when available, represented by the altitude control panel selected altitude, the flight management system selected altitude, or the current aircraft altitude according to the aircraft’s mode of flight (the intent may not be available at all when the pilot is flying the aircraft).</p> <p>2) The data entered into bits 1 to 13 shall be derived from the mode control panel/flight control unit or equivalent equipment. Alerting devices may be used to provide data if it is not available from “control” equipment. The associated mode bits for this field (48 to 51) shall be as detailed below.</p> <p>3) The data entered into bits 14 to 26 shall be derived from the flight management system or equivalent equipment managing the vertical profile of the aircraft.</p> <p>4) The current barometric pressure setting shall be calculated from the value contained in the field (bits 28 to 39) plus 800 mb. When the barometric pressure setting is less than 800 mb or greater than 1209.5 mb, the status bit for this field (bit 27) shall be set to indicate invalid data.</p> <p>5) <a href="#">Bits 40 to 47, 52 &amp; 53 shall be set to ZERO (0).</a></p> <p>6) Bits 48 to 56 shall indicate the status of the values provided in bits 1 to 26 as follows:</p> <p>Bit 48 shall indicate whether the mode bits (49, 50 and 51) are already being populated:  0 = No mode information provided  1 = Mode information deliberately provided</p> <p>Bits 49, 50 and 51:  0 = Not active  1 = Active</p> <p>Bit 54 shall indicate whether the target altitude source bits (55 and 56) are actively being populated:  0 = No source information provided  1 = Source information deliberately provided</p> <p>Bits 55 and 56 shall indicate target altitude source:  00 = Unknown  01 = Aircraft altitude  10 = FCU/MCP selected altitude  11 = FMS selected altitude</p> <p><b>Note:</b> Additional implementation guidelines are provided in §B.4.4 of this Appendix</p>
2	MSB = 32768 feet	
3		
4		
5	MCP/FCU SELECTED ALTITUDE	
6		
7	Range = [0, 65520] feet	
8		
9		
10		
11		
12		
13	LSB = 16 feet	
14	STATUS	
15	MSB = 32768 feet	
16		
17		
18	FMS SELECTED ALTITUDE	
19		
20	Range = [0, 65520] feet	
21		
22		
23		
24		
25		
26	LSB = 16 feet	
27	STATUS	
28	MSB = 204.8 mb	
29		
30		
31		
32	BAROMETRIC PRESSURE SETTING	
33	MINUS 800 mb	
34		
35	Range = [0, 410] mb	
36		
37		
38		
39	LSB = 0.1 mb	
40		
41		
42		
43		
44	RESERVED	
45		
46		
47		
48	STATUS OF MCP/FCU MODE BITS	
49	VNAV MODE	
50	ALT HOLD MODE      MCP/FCU Mode bits	
51	APPROACH MODE	
52	RESERVED	
53		
54	STATUS OF TARGET ALT SOURCE BITS	
55	MSB      TARGET ALT SOURCE	
56	LSB	

**DO-181D and ED-73C:**

**B.4.4.4 Setting of the Reserved Bits (Bits 40 to 47, 52 & 53)**

Bits 40 to 47, 52 and 53 of Register 40<sub>16</sub> “MB” field should be set to ZERO (0).

**ICAO Doc 9871, Edition 2:**

**D.2.4.4.5 Setting of the Reserved Bits (Bits 40 to 47, 52 & 53)**

Bits 40 to 47, 52 and 53 of Register 40<sub>16</sub> “MB” field should be set to ZERO (0).