

CHANGE ISSUE – RTCA/DO-242

MASPS for ADS-B Rev. A

Tracking Information (committee secretary only)	
Change Issue Number	69
Submission Date	04/16/03
Status (open/closed/deferred)	TBD
Last Action Date	04/16/03

Short Title for Change Issue:	Use of Horizontal and Vertical Mode Indicator fields in Target State Reports
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MASPS Document Reference:		Originator Information:	
Entire document (y/n)	N	Name	J. Stuart Searight
Section number(s)	3	Phone	(609) 485-5036
Paragraph number(s)	3.4.7.8 & 3.4.7.14	E-mail	Stuart.Searight@faa.gov
Table/Figure number(s)	3-19 & 3-23	Other	

Proposed Rationale for Consideration (originator should check all that apply):	
<input type="checkbox"/>	Item needed to support of near-term MASPS/MOPS development
	DO-260/ED-102 1090 MHz Link MOPS Rev A
	ASA MASPS
	TIS-B MASPS
	UAT MOPS
<input type="checkbox"/>	Item needed to support applications that have well defined concept of operation
	Has complete application description
	Has initial validation via operational test/evaluation
	Has supporting analysis, if candidate stressing application
X	Item needed for harmonization with international requirements
	Item identified during recent ADS-B development activities and operational evaluations
	MASPS clarifications and correction item
X	Validation/modification of questioned MASPS requirement item
	Military use provision item
	New requirement item (must be associated with traffic surveillance to support ASAS)

Nature of Issue:	<input type="checkbox"/>	Editorial	<input checked="" type="checkbox"/>	Clarity	<input type="checkbox"/>	Performance	<input type="checkbox"/>	Functional
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Issue Description:

The issue of how the Horizontal and Vertical Mode Indicator fields of the Target State Report (§3.4.7.8 and §3.4.7.14, respectively) are defined within the MASPS was raised by the SCRSP Technical Subgroup. These fields indicate if the aircraft is attempting to acquire a heading/track angle or altitude, or if it is maintaining a heading/track angle or altitude it has already achieved.

Horizontal and Vertical Mode Indicator Values

Value	Meaning
0	Unknown Mode or Information Unavailable
1	“Acquiring” Mode
2	“Capturing” or “Maintaining” Mode
3	Reserved

(Continued on next page.)

Issue Description (continued):

In particular to SCRSP TSG, there is a concern that the MASPS does not explicitly map the Vertical Mode Indicator field to BDS4,0. Such a mapping would make the field consistent with the corresponding field from the Enhanced Surveillance initiative.

The response to the SCRSP issue from both manufacturers and members of WG6 is that the mode indicator data defined in BDS4,0 and BDS6,2 is dependant upon the airframe within which the equipment is installed and the FMS and autopilot systems on-board. This means that unless a transponder or ADS-B box is manufactured to operate with a specific set of other avionics onboard a specific airframe, it can not unambiguously be programmed to retrieve the Mode Indicator fields without specific software loads for each installation environment. Therefore, manufacturers have indicated that they will need to set these fields to ZERO indicated the value for these fields is UNKNOWN. (See attachment A of this Issue Paper for a letter from two manufacturers stating the problems encountered with these fields.)

Originator's proposed resolution:

While it should acceptable to have the conceptual meaning of these fields as defined in DO-242A Tables 3-19 and 3-23 (i.e. acquiring or capturing/maintaining), there needs to be a more explicit and specific definition of how to obtain this information from FMS systems. This solution probably needs to be handled outside of ADS-B, either by having the FMS community define standardized mode status indicator words, or by ASA processing of ownship data in the Surveillance Transmit Processing (STP) functionality.

Working Group 6 Deliberations:

WG6 has not formally reviewed this Issue Paper to date.

AIRCRAFT INTENT ISSUE PAPER**Introduction / Background:**

Several issues exist for Mode S transponder manufacturers in attempting to provide aircraft intent mode information in both Downlink of Aircraft Parameter Comm B messages (BDS4,0) as well as the proposed RTCA/DO-260A “target state and status message” extended squitter. Both Vertical Mode Indicator (BDS4,0 and BDS6,2) and Horizontal Mode Indicator (BDS6,2) data are expected to be encoded by the transponder, however this data is not clearly defined/delineated in Flight Management System and Autopilot ARINC (or Eurocae) Equipment Characteristics. Early attempts by transponder manufacturers to interpret various bits from status words supplied by some, but not all autopilot systems have had limited success. As an example, the following note from a proposed update to ICAO Doc 9688 (now in ICAO Annex 10, Volume III, Chapter 5, Appendix) attempts to provide guidance to manufacturers on setting vertical intention mode bits. The following note was prepared in large part by the transponder manufacturers after reviewing available vertical mode data currently available from specific FMS/Autopilot systems

“There is at present no clear availability of coding of Target Altitude Source, but with knowledge of the aircraft type on which the transponder is installed the VNAV, Approach and Alt Hold mode bits can possibly be identified and used in transponder register 40₁₆. It is expected that standardised Mode Coding labels will be available from the FMC, Autopilot or Data Concentrator on the aircraft. Note that the referenced MCP has an equipment code of 01D_{HEX}.

Availability and coding of Autopilot Mode Status information varies from aircraft type to aircraft type. Note that the designer should take into account the specific aircraft’s flight systems when encoding these fields. The following logic is an example of how to set transponder register 40₁₆ Mode fields:

For the VNAV Mode encoding the following logic applies:

IF Label 272 Bit 13 = “1” (indicating VNAV is engaged)

THEN set transponder register 40₁₆ VNAV Mode field to “Active” (indicating that the A/C is in the VNAV state).

For the ALT HOLD Mode encoding the following logic applies:

IF Label 273 Bit 19 = “0” (indicating that Approach Mode is not engaged) AND

Label 272 Bit 9 = “1” (indicating that Altitude Hold Mode is engaged)

THEN set transponder register 40₁₆ ALT HOLD Mode field to “Active” (indicating that the A/C is in the Alt Hold state).

For the APPROACH Mode encoding the following logic applies:

IF Label 272 Bit 9 = “0” (indicating that Altitude Hold is not engaged) AND

Label 273 Bit 19 = “1” (indicating that Approach Mode is engaged)

THEN set transponder register 40₁₆ APPROACH Mode field to “Active” (indicating that the A/C is in the Approach state).”

The logic above, for setting Vertical Mode Bits only, is only valid on a limited aircraft type basis, for a single airframe manufacturer. Obviously, with the introduction of horizontal mode intent data, the encoding of these parameters will only become more complex and specific to limited aircraft types.

Industry Impact:

Until common mode status indicator word(s) are supplied to the transponder from the FMS/Autopilot, coding of vertical and horizontal mode status bits in the proposed target state and status message extended squitter will either have to be set to zero, or a proliferation of non-standard, aircraft type specific software loads will be required. Needless to say, such proliferation of approaches is non-tenable in the industry as it forces undue costs to be burdened by the avionics vendors and the airline operators.

Requested Industry Specification Conformance:

Industry participation, particularly FMS and Autopilot manufacturers, in defining a standard approach / data (including an ARINC Characteristic update) for external system(s) is requested (e.g., required) before the transponder manufacturers can consistently set mode bits in aircraft intent and target state reports. When these issues are appropriately addressed in regards to Selected Altitude and Selected Heading / Track parameters, they should also address the equivalent issue with Selected Airspeed / Mach as this parameter has high probability of being added to ADS-B or Mode-S Downlink Aircraft Parameters (DAPs) in the relative near future.

Because of early implementation of Enhanced Surveillance parameters (BDS4,0 in particular) by transponder manufacturers, care must be taken during the establishment of the requested specifications to ensure backward compatibility with existing transponder software. Any new or modified aircraft mode bit interpretation/implementation should not require modification of existing implementations.

Likewise, for Mode-S DAPs and ADS-B Target State to have utility in the industry applications, appropriate measures will need to be installed to ensure that the systems that control the navigation profiles of the aircraft adhere to the specifications developed.

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