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Minimum Operational Performance Standards (MOPS)
for
Air-to-Air Radar (ATAR)
for
Traffic Surveillance

RTCA DO-366B
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EXECUTIVE SUMMARY

This document contains the second update to the Minimum Operational Performance Standards (MOPS) for the air-to-air radar (ATAR) for traffic surveillance.

The intended function of the ATAR is to detect and generate tracks of airborne traffic. The intended application of these tracks supports Detect and Avoid (DAA) operations, including collision avoidance below 10,000' Mean Sea Level (MSL). These standards specify the radar system characteristics useful for designers, manufacturers, installers, and equipment users.

The onboard ATAR complements other airborne surveillance sensors by providing detection of non-cooperative traffic not available by other surveillance sensors. Tracks should be established at sufficient range and with sufficient accuracy to enable the system to plan and execute a maneuver to keep the Unmanned Aircraft (UA) well clear of other traffic and avoid collisions.

This document details the radar's minimum performance and environmental requirements, as well as verification methods. Verification includes bench tests, analysis, simulation, flight tests, and environmental tests. Recommendations and flight tests for installed performance are also provided.

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1 PURPOSE AND SCOPE

1.1 Introduction

This document is the Revision B update to the Minimum Operational Performance Standards (MOPS) for Air-To-Air Radar (ATAR) for Traffic Surveillance (RTCA Document 366 (DO-366), referenced as RTCA DO-366B. This revision:

- Adds a new radar class with smaller delay times
- Allows for customizing range requirements to the ownship speed and maneuverability
- Adds a discussion of radar clutter issues and zero intruder-closing-speed performance specifications
- Updates verification process

ATAR specifications were derived to meet the non-cooperative sensor requirements for Detect and Avoid (DAA) systems described in *Minimum Operating Performance Standard (MOPS) for Detect and Avoid (DAA) Systems (DO-365C)*. They include support for multiple classes of aircraft and include collision avoidance functions as described in the MOPS for Airborne Collision Avoidance System Xu (ACAS Xu), RTCA DO-386. These standards specify the radar system characteristics that are useful for designers, manufacturers, installers, and equipment users.

Compliance with these standards is recommended to ensure that the equipment will perform its intended function(s) satisfactorily under the conditions specified herein. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

Section 1 of this document provides information needed to understand the rationale for the equipment characteristics and requirements in Section 2. It describes typical equipment operations and operational goals as envisioned by the members of RTCA Inc. Special Committee (SC)-228 and establishes the basis for the standards stated herein. This section also provides definitions and assumptions essential to a proper understanding of this document.

Section 2 contains the equipment requirements. These standards specify the required performance under standard environmental conditions. Also included are recommended bench test procedures to demonstrate equipment compliance with the stated minimum requirements.

Section 3 describes the performance required of installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4 contains aircraft operational performance characteristics.

Section 5 contains an informative listing of SC-228 committee members who contributed to these MOPS.

Appendix A contains information on the proposed frequency bands for the radar, and their regulatory status.

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Appendix B contains analysis and simulations that derive the required Radar Declaration Range (RDR) for all radar classes, categories of intruders and different encounter geometries between the ownship and intruders. This document version introduces a new radar class, B2, which was added to take advantage of higher maneuverability and lower delay times that can significantly reduce radar range requirements. RDR requirements can be customized to the dynamics of the ownship and the ownship speed ranges over which the radar will be required to operate. Two tailored B2 Radar Class examples are provided.

Appendix C defines the conversion between the radar natural coordinate system and the coordinate system in Class B (ACAS Xu) radars.

Appendix D provides information on the tracker required for Class B (ACAS Xu) radars, its description, equations and performance.

Appendix E shows simulated results on the Radar Cross-Section (RCS) of different kinds of aircraft as guidance for radar design against expected intruders.

Appendix F – Reserved.

Appendix G provides validation of the Radar Declaration Range (RDR) against DAA alerting requirements for Class A1 and A2 (non-ACAS Xu, large and medium ownship).

Appendix H provides validation of the RDR against DAA alerting requirements for Class A3 (non-ACAS Xu, small ownship).

Appendix I analyzes the frequency of the cases where an intruder enters the radar Field of Regard (FOR) within the RDR for Class A1 and A2

Appendix J analyzes the frequency of the cases where an intruder enters the radar Field-of-Regard (FOR) within the RDR for Class A3.

Appendix K explains ATAR ground clutter as well as stationary and moving nuisances that must be dealt with for the ATAR to achieve RDR performance across all high-priority intruder encounters (opening, closing, and zero closing speeds) within the limits of the relative altitude between the ownship and the intruder. It also addresses look-down clutter and intruder detection issues when determining ATAR's minimum altitude for radar operation.

Appendix L provides a list of acronyms and abbreviations used in this document.

Appendix M contains two matrices: one for tracing Requirements to Test Procedures and one for tracing Test Procedures to Requirements.

This document sets performance standards for ATAR for traffic surveillance as part of a DAA system to satisfy non-cooperative surveillance requirements. Separate MOPS were developed for the DAA system.[1] This version of the ATAR MOPS, DO-366B, supports the ATAR functions described in DO-365 and the ACAS Xu DO-386 MOPS. The earlier version, DO-366, supports the ATAR functions described in DO-365 and DO-365A. The basic radar functions, e.g., power ON/OFF, transmit power ON/OFF, are controlled by the remote pilot in the Control Station (CS). Similarly, the radar provides its status to the CS during operation. The CS sends commands to the radar and receives status from it. Tracks generated by the radar are sent to the DAA system for further processing.

[1] Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems, RTCA DO-365B