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Approved by: Xu Chaoqun

China Civil Aviation Technical Standard Order

This China Civil Aviation Technical Standard Order (CTSO) is issued according to Part 37 of the China Civil Aviation Regulations (CCAR-37). Each CTSO is a criterion which the concerned aeronautical materials, parts or appliances used on civil aircraft must comply with when it is presented for airworthiness certification.

Traffic Alert and Collision Avoidance System(TCAS) Airborne Equipment, TCAS II with Hybrid Surveillance

1. Purpose.

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for TCAS II with hybrid surveillance airborne equipment CTSO authorization (CTSOA). This CTSO prescribes the minimum performance standards(MPS) that TCAS II with hybrid surveillance airborne equipment must first meet for approval and identification with the applicable CTSO marking.

2. Applicability.

This CTSO affects new application submitted after its effective date. Major design changes to article approved under this CTSO will require a new authorization in accordance with section 21.353 of CCAR-21-R4.

3. Requirements

New models of TCAS II identified and manufactured on or after the effective date of this CTSO must meet the MPS qualification and documentation requirements in these RTCA, Inc. documents: 1) RTCA/DO-185B, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II), dated June 19, 2008, Section 2, as modified by Change 1 dated July 1, 2009; Change 2 dated March 20, 2013, and appendix 1 of this CTSO; and 2) RTCA/DO-300A, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II) Hybrid Surveillance, dated March 20, 2013, section 2, as modified by Change 1 dated December 15, 2015 and appendix 2 of this CTSO.

a. **Functionality.** This CTSO's standards apply to equipment intended to be used in transponder equipped aircraft to provide a reliable traffic alert and collision avoidance function.

b. **Failure Condition Classifications.** Failure of the function defined in paragraph 3.a of this CTSO is a hazardous/severe-major failure condition. Develop the TCAS II to at least the design assurance level equal to this failure condition classification.

c. **Functional Qualification.** Demonstrate the required performance under the test conditions in RTCA/DO-185B, Section 2 as modified by Change 1 and Change 2, and RTCA/DO-300A, Section 2 as modified by

Change 1.

d. Environmental Qualification. Demonstrate the required performance under the test conditions specified in RTCA/DO-185B Section 2.3 using standard environmental conditions and test procedures appropriate for airborne equipment. Applicant may use a different standard environmental condition and test procedure than RTCA/DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment, dated December 8, 2010, provided the standard is appropriate for the TCAS II airborne equipment.

Note: The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph 3.g of this CTSO.

e. Software Qualification. If the article includes software, develop the software according to RTCA/DO-178C, Software Considerations in Airborne Systems and Equipment Certification, dated December 13, 2011, including referenced supplements as applicable, to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this CTSO. The applicant may also develop the software according to RTCA/DO-178B, dated December 1, 1992.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according

to RTCA/DO-254, dated April 19, 2000, Design Assurance Guidance for Airborne Electronic Hardware, to at least the design assurance level consistent with the failure condition classification defined in paragraph 3.b of this CTSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

g. Deviations. For using alternative or equivalent means of compliance to the criteria in this CTSO, the applicant must show that the equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 21.368(a) in CCAR-21-R4.

4. Marking.

a. Mark at least one major component permanently and legibly with all the information in 21.423(b) of CCAR-21-R4. The marking must include the serial number.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the CTSO number:

(1) Each component that is easily removable (without hand tools);
and,

(2) Each subassembly of the article that manufacturer determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware,

then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. The applicant may use electronic part marking to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. Application Data Requirements.

The applicant must furnish the responsible certification personnel with the related data to support design and production approval. The application data include a statement of conformance as specified in section 21.353(a)(1) in CCAR-21-R4 and one copy each of the following technical data:

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that

the TCAS II with hybrid surveillance airborne equipment, when installed according to the installation or operational procedures, still meet this CTSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

“This article meets the minimum performance and quality control standards required by a CTSO. Installation of this article requires separate approval.”

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

(a) Software part number including revision and design assurance level;

(b) Airborne electronic hardware part number including revision and design assurance level;

(c) Functional description.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the TCAS II with hybrid surveillance airborne equipment.

(7) List of replaceable components, by part number, that makes up the TCAS II with hybrid surveillance airborne equipment. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of the TCAS II with hybrid surveillance airborne equipment. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. If the article includes simple or complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary.

e. A drawing depicting how the article will be marked with the information required by paragraph 4 of this CTSO.

f. Identify functionality or performance contained in the article not evaluated under paragraph 3 of this CTSO (that is, non-CTSO functions). Non-CTSO functions are accepted in parallel with the CTSO authorization. For those non-CTSO functions to be accepted, the applicant must declare these functions and include the following information with CTSO application:

(1) Description of the non-CTSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-CTSO function(s) don't interfere with the article's compliance with the requirements of paragraph 3.

(2) Installation procedures and limitations sufficient to ensure that the non-CTSO function(s) meets the declared functions and performance specification(s) described in paragraph 5.f.(1).

(3) Instructions for continued performance applicable to the non-CTSO function(s) described in paragraph 5.f.(1).

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph 5.f.(1).

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting CTSO article is not affected by the non-CTSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-CTSO function(s) as described in paragraph 5.f.(1).

g. The quality system description required by section 21.358 of CCAR-21-R4, including functional test specifications. The quality system should ensure that it will detect any change to the approved design that

could adversely affect compliance with the CTSO MPS, and reject the article accordingly.

h. Material and process specifications list.

i. List of all drawings and processes (including revision level) that define the article's design.

j. Manufacturer's CTSO qualification report showing results of testing accomplished according to paragraph 3.c of this CTSO.

k. To address failure characteristics associated with the hybrid surveillance functionality, the TCAS installation guidance must include information alerting an installer of the requirement for either a failure annunciation on the flight deck when hybrid surveillance functionality has failed or a scheduled maintenance task to verify hybrid surveillance is (and has been) functional. For installations that do not annunciate to the pilot on the flight deck when the hybrid functionality has failed, the manufacturer must provide:

(1) The recommended interval for a scheduled maintenance check;

and,

(2) The recommended procedure for performing that task.

6. Manufacturer Data Requirements.

Besides the data given directly to the authorities, have the following technical data available for review by the authorities:

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- a. Functional qualification specifications for qualifying each production article to ensure compliance with this CTSO.
 - b. Equipment calibration procedures.
 - c. Schematic drawings.
 - d. Wiring diagrams.
 - e. Material and process specifications.
 - f. The results of the environmental qualification tests conducted according to paragraph 3.d of this CTSO.
 - g. If the article includes software, the appropriate documentation defined in the version of RTCA/DO-178 specified by paragraph 3.e of this CTSO, including all data supporting the applicable objectives in Annex A, Process Objectives and Outputs by Software Level.
 - h. If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.
 - i. If the article contains non-CTSO function(s), the applicant must also make available items 6.a through 6.h as they pertain to the non-CTSO function(s).

7. Furnished Data Requirements.

a. If furnishing one or more articles manufactured under this CTSO to one entity (such as an operator or repair station), provide one copy or technical data and information specified in paragraphs 5.a and 5.b of this CTSO. Add any data needed for the proper installation, certification, use, or for continued compliance with the CTSO, of the TCAS II with hybrid surveillance airborne equipment.

b. If the article contains declared non-CTSO function(s), include one copy of the data in paragraphs 5.f.(1) through 5.f.(4).

8. Availability of Referenced Documents.

a. Order RTCA documents from:

Radio Technical Commission for Aeronautics, Inc.

1150 18th Street NW, Suite 910, Washington D.C. 20036

You may also order them online from www.rtca.org.

APPENDIX 1. MODIFICATIONS TO RTCA/DO-185B CHANGE 2

This appendix lists the modifications to RTCA/DO-185B Change 2, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II).

When ownship is on the ground, clarification is required to allow the system to limit the output of TCAS intruders to the display to those within 3000 feet of own altitude. In lieu of section 2.2.2, System Performance, of RTCA/DO-185B Change 2, substitute the following:

2.2.2 System Performance

When operating within the maximum aircraft transponder population and electromagnetic interference levels defined in subparagraph 2.2.1.2, TCAS II will provide a level of performance for active surveillance of targets-of-interest that will support the requirements for generation of collision advisory information.

Specifically, TCAS II will generate a surveillance track in range and altitude on a target-of-interest at the range and with the track probability and range accuracy specified below. This is to ensure that a correct resolution advisory can be issued in time for the pilot to maintain adequate vertical separation at closest-point-of-approach.

TCAS II will also generate, whenever possible, a surveillance track in range and altitude on a target-of-interest at the range and with the track probability and range accuracy specified below such that a correct traffic

advisory can be issued as a precursor to the resolution advisory.

In addition to the surveillance requirements to support generation of resolution and traffic advisories, TCAS II will display the range and, if available, the altitude and bearing position information on targets that generate advisories. The bearing position information will be generated according to the accuracy requirement specified below.

TCAS II will also generate for display, whenever possible, surveillance range, altitude and bearing position information on Mode C and Mode S aircraft that are within the range specified below and within $\pm 10,000$ ft altitude relative to TCAS II when airborne, and within $\pm 3,000$ ft altitude relative to TCAS II when on the ground.

It is acceptable to limit the output of TCAS intruders to the display to those within 3000 feet of own altitude when own aircraft is on the ground. This is permitted (but not required) so that the altitude surveillance volume for TCAS Mode C intruders can be consistent with the Mode S surveillance altitude limits modified in RTCA/DO-185B Change 2 (section 2.2.4.6.2.2.1). This allowance to limit the display to ± 3000 feet does not modify surveillance altitude volumes which are defined in RTCA/DO-185B section 2.2.4.6.

The system shall use the definition of on-ground as defined in RTCA/DO-185B Volume II 2.1.14. Alternatively, the system may use the definition of “operating on Surface” in RTCA/DO-300A section 2.2.8 for

on-ground.

APPENDIX 2. MODIFICATIONS TO RTCA/DO-300A

This appendix lists the modifications to RTCA/DO-300A, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II Hybrid Surveillance).

To facilitate maintenance personnel with monitoring of the hybrid surveillance functionality, add the following requirement as the fifth paragraph (including the Note) in section 2.2.10, Monitoring Requirements:

TCAS II units shall provide a means for presenting logged hybrid surveillance faults to maintenance personnel to enable on-wing monitoring of hybrid surveillance functionality at periodic intervals.

Note: This requirement enables implementation of a scheduled maintenance task to ensure hybrid surveillance is functional on aircraft without a centralized warning system and/or an onboard maintenance computer.