



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C205

Effective
Date: 12/20/13

Technical Standard Order

Subject: Circuit Card Assembly Functional Class Delta Equipment Using The Satellite-Based Augmentation System For Navigation Applications.

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your circuit card assembly (CCA) functional class Delta sensor using the satellite-based augmentation system (SBAS) for navigation applications must first meet for approval and identification with the applicable TSO marking. TSO-C205 is intended as a means for end-use equipment manufacturers incorporating the Delta-4 CCA to streamline their TSO-C146d application for a Class Delta-4 sensor by using the TSO'd Delta-4 CCA for partial certification credit. TSO-C205 is only intended for navigation applications; it is not intended for non-navigation applications.

2. **APPLICABILITY.** TSO-C205 is applicable for new applications after December 20, 2013.

3. **REQUIREMENTS.** New models of TSO-C205 Delta CCA functional sensors identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in RTCA, Inc. Document No. RTCA/DO-229D, Change 1, “*Minimum Operational Performance Standards for Global Positioning System/Satellite-Based Augmentation System Airborne Equipment*,” dated February 1, 2013, Sections 2.1.1, 2.1.5, and 2.3. Functional class Delta is defined in RTCA/DO-229D, Change 1, section 1.4.

a. **Functionality.**

(1) This TSO's standards apply to equipment intended to provide localizer performance without vertical deviations (LP) and localizer performance with vertical deviations (LPV) guidance cues during the LP and LPV final approach segment. Pilots or autopilots will use the LP/LPV guidance cues to guide the aircraft.

(2) TSO-C205 equipment has a limitation requiring the end-use manufacturer to receive a TSO-C146d class Delta-4 TSOA. To receive a TSO-C146d class Delta-4 TSOA, the end-use equipment manufacturer is required to repeat selected performance tests in the end-use

equipment and perform the environmental qualification tests in RTCA/DO-229D, Change 1. These limitations must be documented in the installation/instruction manual (see paragraph **5.a**).

b. Failure Condition Classifications.

(1) Failure of the function defined in paragraph **3.a** resulting in misleading information for localizer performance without vertical guidance (LP), and approach localizer performance with vertical guidance (LPV) navigation data is a *Hazardous* failure condition, and

(2) Loss of the function defined in paragraph **3.a** for LP/LPV navigation data is a *Major* failure condition.

(3) Design the system to at least these failure condition classifications consistent with the operational capability.

c. Functional Qualification. Demonstrate the required functional performance under the test conditions specified in RTCA/DO-229D, Change 1, Section 2.5.

d. Environmental Qualification. None. The Delta CCA functional sensor has a limitation requiring environmental qualification by the end-use equipment manufacturer at the end-use equipment level.

e. Software Qualification. If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992. Develop the software to the design assurance level consistent with the failure condition classifications defined in paragraph **3.b** of this TSO.

Note: The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. Document RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware* to the design assurance level consistent with the failure condition classifications defined in paragraph **3.b** of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

Note: The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

g. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your

equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

h. Barometric-aided Fault Detection and Exclusion (FDE). If the equipment uses barometric-aiding to enhance FDE availability, then the equipment must meet the requirements in RTCA/DO-229D, Change 1, appendix G.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). 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 TSO number:

- (1) Each component that is easily removable (without hand tools); and,
- (2) Each subassembly of the article that you 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. You 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. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph 5.j) through their civil aviation authority.

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 CCA functional sensor, when installed in the end-use equipment according to the installation instructions, still meets this TSO's requirements for partial certification credit to the end-use equipment manufacturer. Limitations must identify any required equipment, inputs, and unique aspects of

the installation. The following specific limitations must be documented in the installation instructions:

- (a) “Delta CCA functional sensors are limited to navigation applications only.”
- (b) “Equipment manufacturers using the *<insert equipment model>* Delta CCA functional sensor for navigation end-use applications are required to receive a TSO-C146<latest revision> class Delta-4 TSOA. The end-use equipment manufacturer is required to perform the testing described in TSO-C146<latest revision> appendix 1 with the Delta CCA functional sensor installed in the end-use equipment to receive a TSO-C146<latest revision> authorization.”
- (c) “End-use equipment manufacturers are required to complete full environmental qualification at the end-use equipment level.”
- (d) “This article meets the minimum performance and quality control standards required by a technical standard order (TSO). This article is only intended for installation in other avionics equipment.”

(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; and,
- (c) Functional description.

(5) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the GPS equipment.

(6) List of major components, such as an antenna, by part number, that make up the SBAS CCA functional sensor complying with the standards prescribed under this TSO. Include vendor part number cross-references, when applicable.

- (a) If the equipment can satisfy the requirements of RTCA/DO-229D, Change 1 only when used with a particular antenna, make the use of that antenna (by part number) a requirement on the installation. Include this requirement in the IM as a limitation.
- (b) If the equipment can satisfy the requirements of RTCA/DO-229D, Change 1 with a standard antenna, include maximum tolerable currents and voltages into the antenna port. See TSO-C190, *Active Airborne Global Navigation Satellite System (GNSS) Antenna*, applicable to all equipment operational classes.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of the Delta CCA. 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 (or similar document, as applicable).

e. Nameplate drawing with the information required by paragraph **4** of this TSO.

f. Adequate specifics on the interface between the Delta CCA functional sensor and other systems to ensure proper functioning of the integrated system. This includes information on environmental characteristics necessary for reliable operation after integration such as maximum and minimum operating temperature of the Delta CCA. If the equipment depends on any inputs (like baro-aided FDE) to satisfy the requirements of RTCA/DO-229D, Change 1, make those inputs a requirement in the installation. Include this requirement in the IM as a limitation.

g. If the software qualification limits eligibility of the equipment to certain aircraft types, identify the qualification level, and that the equipment is not eligible for all aircraft types. For example, AC 23-1309-1(), *Equipment, Systems, and Installations in Part 23 Airplanes*, states that RTCA/DO-178B Level C software may be associated with a *hazardous* failure condition for certain aircraft types. Identify other limitations applicable to the failure condition classification-- for example, that two installed units are necessary.

h. If the equipment has not been demonstrated as compatible with satellite communications (SatCom) state in the limitations that the equipment should not be installed in SatCom equipped aircraft.

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

(1) Description of the non-TSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO 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-TSO function(s) meets the declared functions and performance specification(s) described in paragraph **5.i.(1)**. This includes a limitation that the CCA non-TSO function(s) shall be declared with the end-use equipment TSO application.

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

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

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

j. The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

k. Material and process specifications list.

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

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

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Schematic drawings.

d. Wiring diagrams.

e. Material and process specifications.

f. If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in Annex A, *Process Objectives and Outputs by Software Level*.

g. 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.

h. All the data necessary to evaluate the geo stationary (GEO) satellite bias as defined in RTCA/DO-229D, Change 1, Section 2.1.4.1.5.

7. FURNISHED DATA REQUIREMENTS.

a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a**, **5.b**, **5.f** through **5.h** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the GPS sensor.

b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.i**.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order copies of 14 CFR parts 21 and 45 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

c. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov/>. You will also find the TSO Index of Articles at the same site.



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