



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

**TSO-C154**

Effective  
Date: 11/18/02

# Technical Standard Order

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**Subject: TSO-C154, Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz**

- 1. PURPOSE.** This Technical Standard Order (TSO) tells persons seeking a TSO authorization or letter of design approval what minimum performance standards (MPS) their Universal Access Transceiver ADS-B equipment must first meet in order to obtain approval and be identified with the applicable TSO marking.
- 2. APPLICABILITY.** This TSO is effective for new applications submitted after the effective date of this TSO. Major design changes to UAT equipment approved under this TSO requires a new authorization under this TSO, per Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).
- 3. REQUIREMENTS.** New models of UAT equipment that are to be so identified and that are manufactured on or after the effective date of this TSO must meet the MPS set forth in Section 2. of RTCA Document No. (RTCA/DO)-282, “Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance Broadcast (ADS-B)”, dated August 27, 2002. UAT equipment classes applicable to this TSO are defined in Section 2.1.11 of RTCA/DO-282.

  - a. Functionality.** The standards of this TSO apply to equipment intended to broadcast, from both aircraft and approved surface vehicles/obstacles, ADS-B messages containing own-platform position (latitude/longitude), velocity, time, integrity, and other parameters, for shared use amongst similarly equipped operators, as well as ground-based facilities such as air traffic services. These ADS-B message parameters form the basis for various ADS-B reports as defined in RTCA/DO-242A, “Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B)”, dated June 25, 2002. Two major classes of UAT equipment are supported by this TSO; Class A( ) equipment which incorporates both a broadcast and receive subsystem, and Class B( ) equipment which supports broadcast only. Messages received by Class A( ) equipment are further processed into ADS-B reports to support cockpit applications such as the display of aircraft traffic, airborne conflict management, flight path deconfliction, airport surface movement, etc. Class A( ) equipment also supports the reception of the Flight Information Services – Broadcast (FIS-B) during the Ground Uplink segment of the UAT message frame. Data formats for FIS-B uplink services are defined in RTCA/DO-267, “Minimum Aviation System Performance Standards (MASPS) for Flight Information Service Broadcast (FIS-B)”, dated March 27, 2001.

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**DISTRIBUTION:** ZVS-326;A-W(IR)-3;A-X(FS)-3;A-X(CD)-4;  
A-FFS-1,2,7,8(LTD);A-FAC-0(MAX);AVN-1 (2 cys)

**b. Use of ADS-B Reports in Airborne Applications.** This TSO addresses only the broadcast transmission of ADS-B and Ground Uplink Messages, and the assembly of ADS-B Reports in UAT receiver subsystems. The MPS of this TSO do not address applications that use the information contained in ADS-B Reports. Therefore, manufacturers' whose UAT equipment contain functionality's beyond that described in the MPS of this TSO, will be required to seek either design approval via compliance to an appropriate TSO for the subject application; or, at the time of installation approval, via the type certification process (i.e., Type Certificate, Supplemental Type Certificate, etc.). In the latter case, UAT equipment approved under this TSO may require installation limitations to highlight the fact that some upper-layer functionality is required to be validated as part of the installation approval process.

**NOTE:** Industry recommended practices for the display of ADS-B Report information can be found in RTCA/DO-243, "Guidance for Initial Implementation of Cockpit Display of Traffic Information", dated February 19, 1998; and SAE Aerospace Recommended Practice, "Human Interface Criteria for Cockpit Display of Traffic Information", ARP5365, dated January 1999.

**c. Failure Condition Classification.** Failure of the function defined in paragraphs 3 and 3a of this TSO will depend on the intended airborne application or operation that uses the ADS-B report information. Therefore, for the least demanding applications and operations (e.g., aid to visual acquisition of aircraft), the failure condition classifications for the different classes of UAT equipment are as follows:

(1) For Class A0 receiver subsystems, an unannounced failure resulting in erroneous ADS-B reports being provided to onboard applications is a minor failure condition (an occurrence of less than  $10^{-3}$  per flight hour).

(2) For all other classes of UAT receiver subsystems, an unannounced failure resulting in erroneous ADS-B reports being provided to onboard applications is a major failure condition (an occurrence of less than  $10^{-5}$  per flight hour).

(3) For all classes of UAT transmitter subsystems, an unannounced failure resulting in erroneous ADS-B message being broadcast to other aircraft is a major failure condition and an unannounced failure resulting in loss of function is minor.

**NOTE:** The above failure condition classifications are driven by airspace considerations and are therefore independent of the aircraft on which the equipment is to be installed.

(4) The applicant must develop UAT equipment to at least the design assurance level commensurate with the above failure condition classifications, as follows:

(a) Minor failure conditions: all software that could contribute to a minor hazard classification must be developed to RTCA/DO-178B, Level D.

(b) Major failure conditions: all software that could contribute to a major hazard classification must be developed to RTCA/DO-178B, Level C.

(5) An applicant may develop equipment to a higher design assurance level in anticipation of more demanding applications. For example, if the UAT equipment is capable of broadcasting messages that include information about the status of own-ship Traffic Alert and Collision Avoidance System (TCAS), and this information could be used by other aircraft to make decisions about maneuvering, the failure condition classification for erroneous data of this type could be hazardous/severe-major. In this case, the applicant should state and include in the operating instructions and equipment limitations the hardware and software design assurance levels to which the equipment was developed.

(6) Any assumptions about the aircraft installation, interfacing software and hardware, or operation required to maintain the design assurance levels must also be stated and included in the operating instructions and equipment limitations.

d. **Functional Qualification.** The required performance shall be demonstrated under the test conditions specified in RTCA/DO-282, Section 2.4.

e. **Environmental Qualification.** The equipment shall be subjected to the test conditions specified in RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment", dated July 29, 1997. Equipment performance verification shall be consistent with the test procedures within RTCA/DO-282, Section 2.3.

f. **Software Qualification.** If the article includes a digital computer, the software must be developed in accordance with RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification", dated December 1, 1992.

g. **Deviations.** The FAA has provisions for using alternative or equivalent means of compliance to the criteria set forth in the MPS of this TSO. Applicants invoking these provisions shall demonstrate that an equivalent level of safety is maintained and shall apply for a deviation per 14 CFR § 21.609.

4. **MARKING.** Under 14 CFR § 21.607(d), articles manufactured under this TSO must be marked as follows:

a. At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR § 21.607(d), except for the following: the option in 14 CFR § 21.607(d)(2), where the name, type and part number must be used in lieu of the optional model number; and the option in 14 CFR § 21.607(d)(3), where the date of manufacture must be used in lieu of the optional serial number.

b. In addition to the requirements of 14 CFR § 21.607(d), each separate component that is easily removable (without hand tools), each interchangeable element, and each separate

sub-assembly of the article that the manufacturer determines may be interchangeable must be permanently and legibly marked with at least the name of the manufacturer, manufacturer's subassembly part number, and the TSO number.

c. The equipment class as defined in Section 2.1.11 of RTCA/DO-282.

d. If the component includes a digital computer, the part number must include hardware and software identification, or a separate part number may be utilized for hardware and software. Either approach must include a means for showing the modification status. Note that similar software versions, which have been approved to different software levels, must be differentiated by part number.

e. When applicable, identify the equipment as an incomplete system or that the appliance accomplishes additional functions beyond that described in paragraphs 3 and 3a of this TSO.

## **5. DATA REQUIREMENTS.**

a. **Application Data.** Under 14 CFR § 21.605(a)(2), the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), responsible for the manufacturer's facilities, one copy each of the following technical data to support the FAA design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the operational capability of the equipment. In particular, operational or installation limitations resulting from specific deviations granted must be described in detail.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the class of UAT equipment, when installed according to the installation procedures, continues to meet the requirements of this TSO. The limitations shall identify any unique aspects of the installation. Finally, the limitations also shall include a note with the following statement:

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

(3) Schematic drawings, as applicable to the installation procedures.

(4) Wiring diagrams, as applicable to the installation procedures.

(5) List of the components, by part number, that make up the UAT system complying with the standards prescribed in this TSO. Manufacturers should include vendor part number cross-references when applicable.

(6) Instructions, in the form of a Component Maintenance Manual (CMM) containing information on the periodic maintenance, calibration and repair, for the continued airworthiness of the installed UAT equipment, including recommended inspection intervals and service life. Details of deviations granted, as noted in paragraph 5a(1) of this TSO, may also be described in the CMM.

(7) Material and process specifications list.

(8) The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a) including functional test specifications to be used to test each production article to ensure compliance with this TSO.

(9) Manufacturer's TSO qualification test report.

(10) Nameplate drawing providing the information required by paragraph 4 of this TSO.

(11) A list of all drawings and processes, including revision level, necessary to define the article's design. In the case of a minor change, any revisions to the drawing list need only be made available upon request.

(12) An environmental qualifications form as described in RTCA/DO-160D for each component of the system.

(13) If the article includes a digital computer: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. The FAA recommends that the PSAC be submitted early in the software development process. Early submittal will allow timely resolution of issues such as partitioning and determination of software levels.

**b. Manufacturer Data.** In addition to the data to be furnished directly to the FAA, each manufacturer must have available for review by the manager of the ACO responsible for the manufacturer's facilities the following technical data:

(1) The functional qualification specifications to be used to qualify each production article to ensure compliance with this TSO.

(2) Equipment calibration procedures.

(3) Corrective maintenance procedures within 12 months after TSO authorization.

(4) Schematic drawings.

(5) Wiring diagrams.

(6) Material and process specifications.

(7) The results of the environmental qualification tests conducted in accordance with RTCA/DO-160D and RTCA/DO-282, Section 2.3.

(8) If the article includes a digital computer, the appropriate documentation as defined in RTCA/DO-178B, including all data supporting the applicable objectives found in Annex A of RTCA/DO-178B, "Process Objectives and Outputs by Software Level".

**c. Furnished Data.**

(1) One copy of the technical data and information specified in paragraphs 5a(1) through (6) of this TSO and any other data or information necessary for the proper installation, certification and use and/or for continued airworthiness of the UAT, must accompany each article manufactured under this TSO.

(2) If the appliance accomplishes any additional functions beyond that described in paragraphs 3 and 3a of this TSO, then a copy of the data and information specified in paragraphs 5a(11) through (13) must also go to each person receiving for use one or more articles manufactured under this TSO.

**6. AVAILABILITY OF REFERENCED DOCUMENTS.**

a. Copies of RTCA Document No.'s. DO-160D, DO-178B, DO-242A, DO-243, DO-267, and DO-282 may be purchased from RTCA Inc., 1828 L Street, N.W., Suite 805, Washington, DC 20036. Copies also can be obtained through the RTCA Internet website @ [www.rtca.org](http://www.rtca.org)

b. Copies of SAE Document ARP5365 may be purchased from SAE International, 400 Commonwealth Drive, Warrendale, PA, 15096-0001. Copies also can be obtained through the SAE Internet website @ [www.sae.org](http://www.sae.org).

c. You may buy copies of Federal Aviation Regulations 14 CFR part 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325. Copies also can be obtained from the Government Printing Office (GPO), electronic CFR Internet website @ [www.access.gpo.gov/ecfr/](http://www.access.gpo.gov/ecfr/).

d. Advisory Circular (AC) 20-110L (or latest revision), "Index of Aviation Technical Standard Orders", and AC 20-36S (or latest revision), "Index of Articles (Materials, Parts, Processes, and Appliances) Certified under the Technical Standard Order System", may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75<sup>th</sup> Avenue, Landover, MD 20785, telephone (301) 322-4477 or FAX (301) 386-5394. Copies also may be obtained from the FAA Internet website @ [www.faa.gov/certification/aircraft/air\\_index.htm](http://www.faa.gov/certification/aircraft/air_index.htm) and select from the "Aircraft Certification Related Information" search list.

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David W. Hempe  
Manager, Aircraft Engineering Division  
Aircraft Certification Service