



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

TSO-C163a

Effective
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Technical Standard Order

Subject: VDL MODE 3 COMMUNICATIONS EQUIPMENT OPERATING WITHIN THE FREQUENCY RANGE 117.975-137.000 MEGAHERTZ

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, or FAA) tell you what minimum performance standards (MPS) your very high frequency (VHF) digital link (VDL) Mode 3 communications equipment operating within the frequency range 117.975 to 137.000 megahertz must first meet for approval and identification with the applicable TSO marking.

2. **APPLICABILITY.** This TSO affects new applications submitted after its effective date.

a. All prior revisions to this TSO are no longer effective. Generally we will not accept applications after the effective date of this TSO. However, we may do so up to six months after it, if we know that you were working against the earlier MPS before the new change became effective.

b. VDL Mode 3 communication equipment approved under a previous TSOA may still be manufactured under the provisions of their original approval.

c. Major design changes to VDL Mode 3 communications equipment operating within 117.975 to 137.000 MHz approved under this TSO will require a new authorization. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

3. **REQUIREMENTS.**

a. New models of VDL Mode 3 communications equipment operating within 117.975 and 137.000 MHz identified and manufactured on or after the effective date of this TSO must meet the MPS in RTCA, Inc. document RTCA/DO-271C, *Minimum Operational Performance Standards for Aircraft VDL Mode 3 Transceiver Operating in the Frequency Range 117.975 - 137.000 MHz*, Section 2, dated November 8, 2005.

b. The MPS allow for different equipment classes as defined by RTCA/DO-271C, Section 2.1.8. There are three equipment classes, summarized below:

Table 1. Equipment Classes for VDL Mode 3

Equipment Class	Description
G	VDL Mode 3 receiver used in a 25 kilohertz (kHz) channel separation environment
9	VDL Mode 3 transmitter used in a 25 kilohertz (kHz) channel separation environment and intended to operate with a range of 200 nautical miles
10	VDL Mode 3 transmitter used in a 25 kilohertz (kHz) channel separation environment and intended to operate with a range of 100 nautical miles

(1) In addition to *equipment* classes above, the MPS allow for different *equipment architecture* classes as defined by RTCA/DO-271C, Section 2.1.9. Although RTCA/DO-271C defines seven equipment architecture classes, this TSO recognizes only the three summarized in Table 2 below.

(2) We expect these *equipment architecture* classes will also have functionality not covered by this TSO. Identify and describe all additional functionality according to paragraph 5.b of this TSO. Examples of additional functionality are other VHF digital link modes of operation such as Mode A, aeronautical operational control communications (ACARS), and controller – pilot data link communication.

Table 2. Equipment Architecture Classes for VDL Mode 3

Equipment Architecture Class	Equipment Name	Services	VDL Mode 3 Functionality (Layers/Sub Layers)
IB0	VHF digital radio (VDR)	Voice (basic)	Physical, MAC and a portion of LME
IV0	VHF digital radio (VDR)	Voice (basic and enhanced)	Physical, MAC and a portion of LME
SL0	VHF digital radio (VDR)	Voice (basic and enhanced) and data	Physical, MAC and a portion of LME and DLS

c. Functionality. This TSO's standards apply to equipment intended to operate within 117.975 to 137.000 MHz. VDL Mode 3 equipment covered by this TSO is primarily intended for air traffic services (ATS) safety communications. Equipment developed under this TSO will work with aircraft equipment used to communicate tactical and strategic information.

d. Failure Condition Classification. Failure of the function defined in paragraph 3.a, 3.b and 3.c of this TSO is a *major* failure condition. Develop the system to, at least, the design assurance level equal to this failure condition classification. See Appendix 1 for additional guidance on design assurance levels and quantitative safety objectives.

e. Functional Qualification. Demonstrate the required performance under the test conditions in RTCA/DO-271C, Section 2.4. RTCA/DO-271C, Appendix B, correlates the

verification tests to equipment architecture classes. The table in Appendix B simplifies the complexity introduced by having multiple equipment architecture classes that vary in VDL Mode 3 functionality.

f. Environmental Qualification. Demonstrate the required environmental performance under the test conditions specified in RTCA/DO-271C, Section 2.3. Environmental conditions used in these tests are in RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004.

g. Software Qualification. If the article includes a digital computer, develop the software according to RTCA document RTCA/DO-178B or EUROCAE document ED-12B, *Software Considerations in Airborne Systems and Equipment Certification*, both dated December 1, 1992.

h. Electronic Hardware Qualification. If the article includes a complex custom micro-coded component, develop the component to the guidance in FAA advisory circular (AC) 20-152, *RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*. The hardware design assurance level should be consistent with the failure condition classification defined in paragraph **3.d** of this TSO.

i. 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 14 CFR § 21.609 before submitting your data package.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d), except for the following:

(1) 14 CFR § 21.607(d)(2). Use the name, type, and part number. Do not use the optional model number; and

(2) 14 CFR § 21.607(d)(3). Use the date of manufacture. Do not use the optional 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),

(2) Each interchangeable element, and

(3) Each subassembly of the article that you determined may be interchangeable.

c. If the component includes a digital computer, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means to show the modification status.

NOTE: Similar software versions, approved to different software levels, must be differentiated by part number.

d. Describe any deviations that have been granted in the installation procedures and limitations of **5.b** of this TSO. You must, however, mark the component with the drawing number that provides the installation procedures and limitations.

e. Describing additional functions in the installation procedures and limitations of **5.b** of this TSO qualifies as an alternative to marking the component. You must, however, mark the component with the drawing number that provides the installation procedures and limitations.

f. To include other marking requirements unique to this TSO, you can use all or part of the statement: Optional marking is permitted to allow aircraft-specific or operational-specific installation limitations, such as: **“FOR USE ON {insert aircraft type or serial number} ONLY,” “FOR USE ON AIRCRAFT USED IN PART {insert number} OPERATIONS ONLY,”** or **“SEE DRAWING NO. XYZ FOR INSTALLATION LIMITATIONS.”**

5. APPLICATION DATA REQUIREMENTS. As a TSO manufacturer-applicant, you must give the FAA aircraft certification office (ACO) manager responsible for your facilities a statement of conformance, as specified in 14 CFR § 21.605(a)(1) and one copy each of the following technical data to support our design and production approval. (Under 14 CFR § 21.617(a)(2), LODA applicants submit the same data through their civil aviation authority:)

a. Operating instructions and equipment limitations in an installation/instruction manual (IM), sufficient to describe the equipment’s operational capability. Describe any deviations in detail. If needed, identify equipment by part number, version, revision, and criticality level of software/hardware, classification for use, and environmental categories.

b. Installation procedures and limitations in an IM, sufficient to ensure that the VHF digital link (VDL) Mode 3 communications equipment operating within 117.975 to 137.000 MHz, when installed according to the installation procedures, continues to meet the requirements of this TSO and will meet the airworthiness and operating requirements appropriate for the intended type of aircraft and operation. The limitations include:

(1) A note with the following statement:

The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must 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 according to

14 CFR part 43 or the applicable airworthiness requirements.

(2) Development assurance level(s) for the functions defined in paragraphs **3.a**, **3.b** and **3.c**, this TSO.

(3) Quantitative safety objectives for the functions defined in paragraphs **3.a**, **3.b** and **3.c**, this TSO

(4) When applicable, identify the equipment as an incomplete system or that the equipment accomplishes additional functions beyond that described in paragraphs **3.a**, **3.b** and **3.c** of this TSO. Also describe the functions provided by the equipment.

(5) Any unique aspects of the installation, including those relevant to any deviations that may have been granted.

(6) The equipment class(es) and architecture class(es) that the equipment has been qualified to perform and the functions provided by these class(es). Write the description so an installer of the equipment will know the equipment being installed meets the intentions of the installation.

c. Schematic drawings of the installation procedures.

d. Wiring diagrams of the installation procedures.

e. Equipment specification.

f. List of components, by part number, that make up the VHF digital link (VDL) Mode 3 communications equipment operating within 117.975 to 137.000 MHz complying with the standards prescribed under this TSO. Include vendor part number cross-references, when applicable.

g. A component maintenance manual (CMM), covering periodic maintenance, calibration, and repair, for the continued airworthiness of installed VHF digital link (VDL) Mode 3 communications equipment operating within 117.975 to 137.000 MHz. Include recommended inspection intervals and service life. Describe the details of deviations granted, as noted in paragraph **5.a** of this TSO.

h. Material and process specifications list.

i. The quality control system (QCS) description required by 14 CFR §§ 21.143 and 21.605(a)(3), including functional test specifications. The QCS should ensure that you will detect any change to the equipment that could adversely affect compliance with the TSO MPS, and reject the item accordingly. (Not required for LODA applicants.)

j. Manufacturer's TSO qualification test report.

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

l. List of all drawings and processes (including revision level) that define the article's design. For a minor change, follow the directions in 14 CFR § 21.611(a). Show any revisions to the drawing list only on our request.

m. An environmental qualifications form as described in the environmental qualifications document referenced in paragraph **3.f** of this TSO for each component of the system.

n. If the article includes a digital computer: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary. We recommend that you submit the PSAC early in the software development process. Early submittal allows us to quickly resolve issues, such as partitioning and determining software levels.

o. If the article includes a complex custom micro-coded component: a plan for hardware aspects of certification (PHAC), hardware verification plan; top-level drawing, and hardware accomplishment summary. We recommend that you submit the PHAC early in the software development process. Early submittal allows us to quickly resolve issues.

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

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

b. Equipment calibration procedures.

c. Corrective maintenance procedures within 12 months after TSOA or LODA.

d. Schematic drawings.

e. Wiring diagrams.

f. Material and process specifications.

g. The results of the environmental qualification tests conducted per RTCA/DO-160E.

h. If the article includes a digital computer, 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.

i. If the article includes a complex micro-coded component, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1.

7. FURNISHED DATA REQUIREMENTS. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one

copy of the data in paragraphs **5.a** through **5.g**. Add any other data needed for the proper installation, certification, use, or for continued airworthiness, of VDL Mode 3 communications equipment operating within 117.975 to 137.000 MHz.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1828 L Street NW, Suite 805, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.

c. Order copies of 14 CFR part 21, Subpart O from the Superintendent of Documents, Government Printing Office, P.O. Box 37154, Pittsburgh PA 15250-7954. 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."

d. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at www.airweb.faa.gov/rgl. You'll also find the TSO Index of Articles at the same site.

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APPENDIX 1. ADDITIONAL GUIDANCE ON DESIGN ASSURANCE LEVELS AND QUANTITATIVE SAFETY OBJECTIVES

1.1 PURPOSE. Although the major hazard classification remains the same regardless of an aircraft installation, the design assurance levels and quantitative safety objectives commensurate to the hazard classification may vary for different aircraft installations.

1.2 DESIGN ASSURANCE LEVELS. You'll find guidance on establishing design assurance levels for different installations in the latest versions of:

- For a *system*, see SAE International's Aerospace Recommended Practice (ARP) 4754, *Certification Considerations for Highly Integrated or Complex Aircraft Systems*, dated June 27, 1996.
- For *hardware*, see RTCA/DO-254, *Design Assurance Guidance For Airborne Electronic Hardware*, dated April 19, 2000.
- For *software*, see RTCA/DO-178B and EUROCAE document ED-12B, *Software Considerations In Airborne Systems and Equipment Certification*, dated December 1, 1992.

1.3 QUANTITATIVE SAFETY OBJECTIVES. You'll find guidance on establishing quantitative safety objectives for different installations in the latest versions of:

- AC 23.1309-1, latest revision, *Equipment, Systems And Installations In Part 23 Airplanes*,
- AC 25.1309-1, latest revision, *System Design And Analysis*,
- AC 27-1, latest revision, *Certification of Normal Category Rotorcraft*, and
- AC 29-2, latest revision, *Certification Of Transport Category Rotorcraft*, for aircraft certificated under the provisions of 14 CFR parts 23, 25, 27 or 29.