Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C163

Effective Date:
5/4/04

Technical Standard Order

Subject: **TSO-C163, 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 or letter of design approval for Very High Frequency (VHF) Digital Link (VDL) Mode 3 Communications Equipment operating within the frequency range of 117.975 and 137.000 Megahertz. In it, we tell you what minimum performance standards (MPS) your VDL Mode 3 communications equipment must first meet for approval and identification with the applicable TSO marking. See Title 14 of the Code of Federal Regulations (CFR) Part 21, Subpart O, for the requirements and rules governing TSO Authorizations.

2. APPLICABILITY. This TSO affects new applications submitted after this TSO's effective date.

3. REQUIREMENTS. New models of VDL Mode 3 equipment identified and manufactured on or after the effective date of this TSO must meet the MPS in Section 2 of the RTCA Document Number (RTCA/DO)-271B, "Minimum Operational Performance Standards for Aircraft VDL Mode 3 Transceiver Operating in the Frequency Range 117.975 -137.000 MHz," dated October 28, 2003. The MPS referenced below allows for different equipment classes as defined by RTCA/DO-271B, Section 2.1.8. Note that there are three equipment classes described in Table **1** of this TSO.

TABLE 1: EQUIPMENT CLASS 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

In addition to equipment classes, the MPS referenced above allows for different equipment architecture classes as defined by RTCA/DO-271B, Section 2.1.9. Although RTCA/DO-271B defines seven equipment architecture classes, this TSO recognizes only the three that are summarized in Table **2** of this TSO. We anticipate that these equipment architecture classes will

also contain functionality not covered by this TSO. Therefore, all additional functionality must be identified and described according to paragraph **5.b** of this TSO.

Examples of additional functionality might include other VHF digital link modes of operation such as Mode A, Aeronautical Operational Control Communications (ACARS), Controller – Pilot data link communication, etc.

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

a. Functionality. This TSO's standards apply to VDL Mode 3 equipment intended to operate in the radio frequency range of 117.975 MHz to 137.000 MHz communications. The VDL Mode 3 equipment covered by this TSO is primarily intended for Air Traffic Services (ATS) safety communications. The equipment developed pursuant to this TSO will play an integral role with the aircraft equipment used to communicate tactical and strategic information.

b. Failure Condition Classification. Failure of the function defined in paragraphs **3** and **3.a** of this TSO is a major failure condition. You must develop the system to, at least, the design assurance level equal to this failure condition classification.

c. Functional Qualification. Demonstrate the required performance under the test conditions specified in RTCA/DO-271B, Section 2.4. In RTCA/DO-271B, Appendix B, are the cross-references required to verify testing and equipment architecture classes. This table simplifies the complexity introduced by having multiple equipment architecture classes that vary in VDL Mode 3 functionality.

d. Environmental Qualification. Test the equipment according to RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment," dated July 29, 1997, including Change 1 dated Dec 14, 2000, Change 2 dated June 12, 2001 and Change 3 dated December 5, 2002. The applicable environmental performance requirements used during the environmental test procedures are in RTCA/DO-271B, Section 2.3.

e. Software Qualification. If the article includes a digital computer, develop the software according to RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," dated December 1, 1992.

f. Deviations. We have provisions for using alternative 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.

4. MARKING.

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

(1) 14 CFR § 21.607(d)(2): Where you must use the name, type and part number of the article, in lieu of the optional model number; and

(2) 14 CFR § 21.607(d)(3): Where you must use the date of manufacture instead of the optional serial number, when the date of manufacture is critical for maintenance or inspections determinations.

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 sub-assembly 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. In either case, 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. When applicable, identify the equipment as an incomplete system or that the appliance performs functions beyond that described in paragraphs **3** and **3.a** of this TSO. 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 that provides the installation procedures and limitations.

e. When any deviations are granted, place the additional permanent marking, "(Dev)," after the TSO number. Describe all 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 that provides the installation procedures and limitations.

f. Equipment Class(es) must be marked, as defined in RTCA/DO-271B, Section 2.1.8. An example marking that satisfies this requirement is as follows, "Equipment Class: G and 9." Equipment Class markings in the installation procedures and limitations of **5.b** of this TSO would qualify as an alternative to marking the component. You must, however, mark the component with the drawing that provides the installation procedures and limitations.

g. Equipment Architecture Class(es) must be marked, as defined in RTCA/DO-271B, Section 2.1.9. An example marking which satisfies this requirement is as follows, "Equipment Architecture Class: IV0." Equipment Architecture Class markings in the installation procedures and limitations of **5.b** of this TSO would qualify as an alternative to marking the component. You must, however, mark the component with the drawing that provides the installation procedures and limitations.

5. APPLICATION DATA REQUIREMENTS. Under 14 CFR 21.605(a)(2), you, as a manufacturer-applicant, must give the FAA's Aircraft Certification Office (ACO) manager responsible for your manufacturing facilities, one copy each of the following technical data to support our design and production approval:

a. Operating instructions and equipment limitations, sufficient to describe the equipment's operational capability.

b. Installation procedures and limitations, sufficient to ensure that the VDL Mode 3 communication equipment, when installed according to the installation procedures, still meets this TSO's requirements. The limitations must identify any unique aspects of the installation. Finally, the limitations must include a note with the following statement:

> The conditions and tests required 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. The article may be installed only if further evaluation by the applicant, i.e. user/installer, documents an acceptable installation and is approved by the Administrator.

c. If the appliance is an incomplete or multi-use system, provide a description of all functions the equipment is intended to provide.

d. Identify the Equipment Class(es) and Equipment Architecture Class(es) that the equipment has been qualified to perform. Also, identify the functions that these Class(es) intend to provide. You should write the description so that an installer of the equipment knows that the equipment being installed is appropriate.

e. The hardware and software design assurance requirements may vary, depending on equipment installation guidelines. The equipment manufacturer should identify the hardware and software design assurance for qualified equipment in the (IM) Installation Manual or (CMM) Component Maintenance Manual, or both. The IM or CMM entry should include the following statement, or equivalent:

> The VLF Mode 3 Communication Equipment has been designed to comply with a hardware quantitative probability of failure goal of [***insert probability goal (e.g., 1x10^{-5})***] and a RTCA/DO-178B Level [***insert software level (e.g., C)***] software development assurance. Those desiring to install this article (either on or within a specific type

or class of aircraft) are responsible for determining that the hardware quantitative probability of failure goal and RTCA/DO-178B software level, to which the equipment has been qualified, is appropriate for the aircraft installation.

f. Schematic drawings as applicable to the installation procedures.

g. Wiring diagrams as applicable to the installation procedures.

h. Equipment specifications.

i. List of components, by part number, that make up the VDL Mode 3 Communications Equipment complying with the standards in this TSO. Manufacturers should include vendor part number cross-references, when applicable.

j. A CMM, covering periodic maintenance, calibration and repair, for the continued airworthiness of installed equipment. Instructions should include recommended inspection intervals and service life. Details of deviations granted, as noted in paragraph **5.a** of this TSO, may also be described in the CMM. An IM, which details the installation methods used to properly install equipment on aircraft.

k. Material and process specifications list.

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

m. Manufacturer's TSO qualification test report.

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

o. A list of all drawings and processes (including revision level), to define the article's design. For a minor change, you only need to make the revisions to the drawing list available upon request.

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

q. 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 determination of software levels.

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

a. The 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 TSO authorization.

d. Schematic drawings.

e. Wiring diagrams.

f. The results of the environmental qualification tests conducted per RTCA/DO-160D.

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

7. FURNISHED DATA REQUIREMENTS. With each article manufactured under this TSO, provide one copy of the data in paragraphs **5.a** through **5.j** of this TSO. Add any other data necessary for the proper installation, certification, and use, or for continued airworthiness, or both of the VDL Mode 3 Communications Equipment.

8. HOW TO GET REFERENCED DOCUMENTS.

a. You can buy copies of RTCA/DO-160D (including Changes 1, 2 and 3), RTCA/DO-178B, DO-224A (including Changes 1 and 2), and RTCA/DO-271B, from the RTCA Inc., 1828 L Street NW, Suite 805, Washington, D.C. 20036-4001. You can also get copies from RTCA internet website at www.rtca.org.

b. You can buy copies of Federal Aviation Regulations 14 CFR Part 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325. You can also get copies from the Government Printing Office (GPO), electronic CFR Internet website @ www.access.gpo.gov/ecfr/.

c. You can get Advisory Circular (AC) 20-110L [or current revision], "Index of Aviation Technical Standard Orders," and AC 20-115B [or current revision], from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, Telephone (301) 322-4477 or FAX (301) 386-5394.

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