



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

**TSO-C155**

Effective  
Date: 2/3/05

# Technical Standard Order

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**Subject: Recorder Independent Power Supply**

1. **PURPOSE**. This Technical Standard Order (TSO) tells manufacturers seeking a TSO authorization or letter of design approval the minimum performance standards (MPS) their new models of Recorder Independent Power Supply (RIPS) must first meet to obtain approval and be identified with the TSO-C155 marking.

2. **APPLICABILITY**. This TSO is effective for new applications submitted after its effective date. Major design changes to RIPS equipment approved under this TSO will require a new TSO authorization per Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

3. **REQUIREMENTS**. New models of RIPS identified and manufactured on or after the effective date of this TSO must meet the MPS in appendix 1 of this document.

**a. Functionality.** This TSO applies to equipment intended to provide back-up power to an installed cockpit crash protected recorder, whether it is:

- Voice,
- Image,
- Data
- Combination voice/data,
- Combination voice/image, or
- Combination image/data.

**b. Failure Condition Classification.** Failure of the function defined in paragraph 3.a of this TSO is a “minor” failure condition. Develop the system to, at least, the design assurance level equal to this failure condition classification.

**NOTE:** You can use Figure 2 in advisory circular (AC) 23.1309-1C, “Equipment, Systems and Installations in Part 23 Airplanes” to determine the design assurance level. If you do this, your installation manual must contain a limitation as to which 14 CFR part 23 aircraft (make, model, and series) the installation of this TSO equipment is approved.

**c. Functional Qualification.** Demonstrate the performance of your equipment under the test conditions and procedures in appendix 1 of this document.

**d. Environmental Qualification.** Test the equipment to the conditions and procedures in RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment," Change 3, dated December 5, 2002 (or latest revision/change). The standards for these test procedures are in appendix 2 of this TSO.

**e. Digital Computers.** If your equipment includes a digital computer, develop the software according to RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," sections 3 through 11 and Annex A, dated December 1, 1992 (or latest revision/change). Substantiate software levels in the safety assessment process outlined in RTCA/DO-178B. If the equipment incorporates more than one software level, we require appropriate partitioning of different software levels.

**f. 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, 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 with all the information required by 14 CFR § 21.607(d) except for:

- 14 CFR §21.607(d)(2). Use the name, type and part number instead of the optional model number, and
- 14 CFR § 21.607(d)(3). Use both the date of manufacture and serial number.

**b.** To identify replacement components and parts that are easily removable (without hand tools), mark these items permanently and legibly with at least the manufacturer's name, subassembly part number, and the TSO number.

**c.** If the RIPS includes a digital computer, you must be able to identify the software modification status. You can do this by one of two ways:

- Use a top-level part number that provides both hardware and software identification, or
- Use separate hardware and software part numbers.

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

**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 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 RIPS, when installed according to the installation procedures, still meet 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 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.

**c.** Schematic drawings of the installation procedures.

**d.** Wiring diagrams of the installation procedures.

**e.** List of components, by part number, that make up the RIPS complying with the standards in this TSO. Manufacturers should include vendor part number cross-references, when applicable.

**f.** A component maintenance manual (CMM), covering periodic maintenance, calibration, and repair, for the continued airworthiness of installed RIPS. Include recommended inspection intervals and service life.

**g.** Material and process specifications list.

**h.** 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.

**i.** Manufacturer's TSO qualification test report.

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

**k.** 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 available on request.

**l.** An environmental qualifications form as described in RTCA/DO-160D (or latest revision/change) for each component of the system.

**m.** If the article includes a digital computer: 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.

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

**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.** Material and process specifications.

**g.** The results of the environmental qualification tests conducted per RTCA/DO-160D or latest revision/change.

**h.** If the article includes a digital computer, the appropriate documentation defined in RTCA/DO-178B (or latest revision). Include all data supporting the applicable objectives in RTCA/DO-178B, Annex A, "Process Objectives and Outputs by Software Level" (or latest revision).

**7. FURNISHED DATA REQUIREMENTS.** If furnishing one, or multiple articles to one entity (such as an operator or repair station), provide one copy of the data in paragraphs **5a** through **5g** for each article manufactured under this TSO. Add any other data needed for the proper installation, certification, use, or for continued airworthiness, of the RIPS.

**8. HOW TO GET REFERENCED DOCUMENTS.**

**a.** You can buy copies of the RTCA Documents from RTCA Inc., 1828 L Street NW, Suite 805, Washington DC 20036. Telephone (202) 833-9339. Copies can also be obtained through the RTCA Internet website at [www.rtca.org](http://www.rtca.org).

**b.** You can buy copies of Title 14 CFR part 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington D.C. 20402-9325. Telephone (202) 512-1800, fax (202) 512-2250. You can also obtain copies from the Government Printing Office (GPO), electronic CFR Internet website at: [www.access.gpo.gov/ecfr/](http://www.access.gpo.gov/ecfr/).

**c.** You can obtain FAA advisory circular (AC) 20.110L, “Index of Aviation Technical Standard Orders” and AC 20-36S, “Index of Articles Certified Under the Technical Standard Order System,” or any AC referenced in this TSO 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) 322-5377, fax (301) 386-5394. You can also get copies from our Regulatory and Guidance library at [www.airweb.faa.gov/rgl](http://www.airweb.faa.gov/rgl). On the RGL website, select “Advisory Circulars.” Then, select “By Number.”

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## APPENDIX 1

### MINIMUM PERFORMANCE STANDARD (MPS) FOR RECORDER INDEPENDENT POWER SUPPLY (RIPS)

RIPS supplies direct current (DC) voltage to an aircraft installed recorder for a specified time whenever the primary aircraft power is removed. RIPS ensures continued recording. RIPS supports recorders of cockpit voice, image, combination voice/data, combination voice/image, or combination image/data. RIPS doesn't distinguish between a normal shutdown and loss of electrical power from an emergency. It executes operational cycles regardless of the type of power loss. In the tables below are standards for RIPS classified by performance requirements:

<i>1. Power Requirements:</i>	<i>What the RIPS should do:</i>
Aircraft Voltage	Operate from either 115V <sub>AC</sub> single phase 360-800Hz variable frequency, or from 27.5V <sub>DC</sub> primary aircraft power, or both (depends on model). Operate within tolerances of RTCA/DO-160D sections 16.5.1.1, 16.5.1.4, 16.5.2.1, 16.5.2.3
Voltage	Conform to RTCA/DO-160D section 16.0 for category A(WF) equipment
Audio Frequency Conducted Susceptibility--Power Inputs	Conform to RTCA/DO-160D section 18.0 for category A(WF) equipment
Voltage Spike	Conform to RTCA/DO-160D section 17.0 for category A equipment
Availability	Power the recorder any time the airplane's electrical power is removed. Includes normal shutdown
<i>2. RIPS Power output:</i>	<i>What the RIPS should do:</i>
Supplied Voltage	Power the recorder continuously or only after aircraft power is lost. Output voltage should be 27.5V <sub>DC</sub> nominal but can vary from 18V <sub>DC</sub> to 32.2V <sub>DC</sub> . Ripple voltage will not exceed limits at <b>Figure 1.1</b> (shown after this table). Prevent output power from causing damage when short-circuited. Output power should not be hazardous to personnel during handling
Energy Requirements	Provide minimum 12 watts for the supply duration. Corresponds to stored energy of 6480 to 7920 watt-seconds (9 to 11 minutes times 60 seconds/minute= 12 watts)
Recharging	Be ready to function within 15 minutes from application or re-application of primary power. Since stored energy could be fully depleted, design the charging system to restore the stored energy source. Restoration should be from any initial charge state, back to the minimum energy level

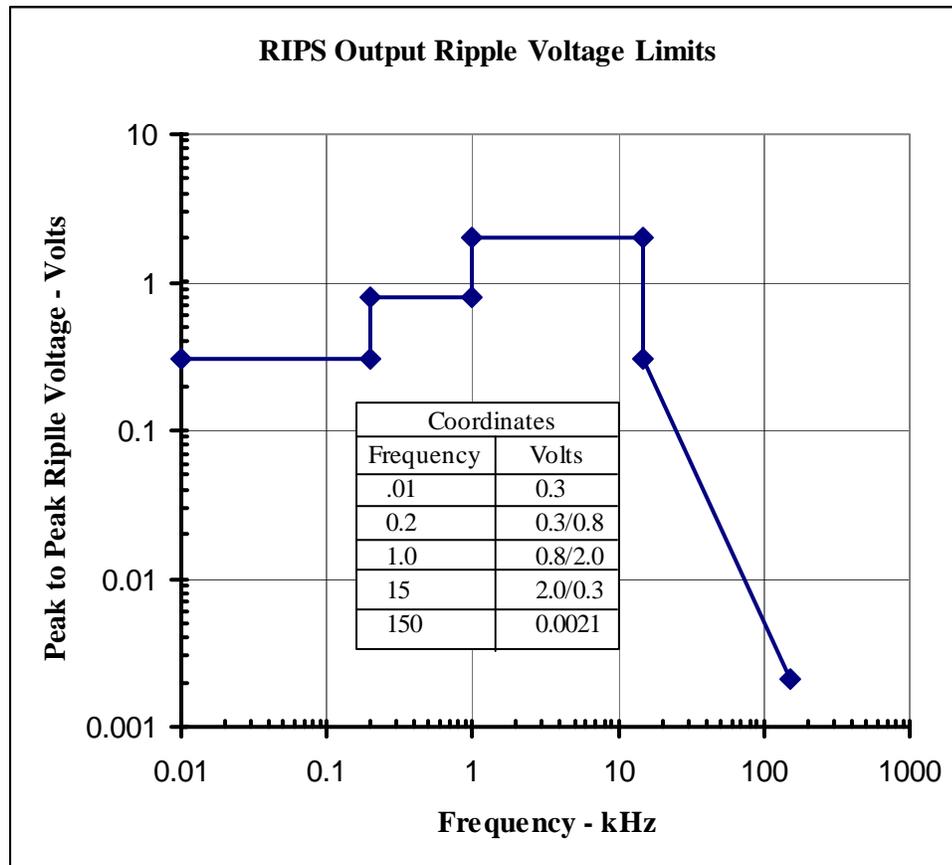
	specified above. Unit can provide full 10 minutes of power no more than 15 minutes from aircraft power restoration. Recharge time required for unit to provide 6 minutes of power: not more than 10 minutes
<b>3. Built In Monitoring:</b>	<p>Be equipped with built-in test equipment (BITE) to detect internal failures. Monitor the unit's condition. If maintenance is required based on any combination of the following aspects, monitor and log the maintenance. Manufacturers may add other operational aspects such as:</p> <ul style="list-style-type: none"> <li>• Energy source life expiration (number of hours operating time until battery replacement),</li> <li>• Other energy source failure,</li> <li>• Absence of energy source in the device, and</li> <li>• Number of energy source cycles</li> </ul>
<b>4. Maintenance Warning:</b>	<p>Issues a warning as discrete output, alerting of any inability to perform the intended function or that maintenance is required. To do this, RIPS provides an output that indicates:</p> <ul style="list-style-type: none"> <li>• A fail condition with an OPEN circuit. Resistance greater than 100,000 ohms or voltage greater than 18 V<sub>DC</sub> (36V<sub>DC</sub> Max, and</li> <li>• A normal operation by a standard GROUND. V<sub>OUT</sub> less than 3.5 V<sub>DC</sub></li> </ul>
<b>5. Operational Timing:</b>	Monitors the line voltage supplied to the recorder. When aircraft power is lost, the RIPS restores power to recorder from its stored energy no more than 50 milliseconds after the line voltage falls below the specified recorder minimum operating voltage (18 V <sub>DC</sub> or 100 V <sub>AC</sub> )
Tolerance	Tolerance on the 10-minute output is +/- 1 minute
Operational Reset	If input power to RIPS is restored before the 10-minute period ends, RIPS should reset the 10-minute timer to 0 and resume monitoring the recorder line voltage. The RIPS should recharge as required (see "Recharging," above)

<b>6. Environmental Conditions:</b>	<b>Ensure that the RIPS:</b>
Altitude	Can operate with specified performance at any pressure altitude from 1,000 to over 55,000 ft
Operating Temperature	Operates with specified performance at any temperature from $-20^{\circ}$ C to over $70^{\circ}$ C. For the electronic component without the energy source, the lower operating temperature is $-55^{\circ}$ C
Ground Survival Temperature	Storage at temperatures $-55^{\circ}$ C to over $85^{\circ}$ C shall not degrade performance
Temperature Variation	Operates during exposure to temperature variation as in RTCA/DO-160D section 5.0 for equipment category B
Decompression	Withstands exposure to rapid decompression from altitude 8,000 ft to 55,000 ft with no physical damage or change in RIPS performance
Overpressure	Withstands overpressure of 170kPa with no physical damage or change in RIPS performance
Humidity	Operates within performance specifications in 0 to 95% humidity at temperature $35^{\circ} \pm 5^{\circ}$ C
Waterproof	Operates where exposure to falling water is expected
Fluids Susceptibility	Withstands deleterious effects of exposure to fluids typically found in aviation environment--identified in RTCA/DO-160D section 11, Table 11-1
Magnetic Effect	Deflects a compass needle 1degree or less at distance of less than .03 meter
Crash Safety Shock	Mounting attachments retain RIPS in place after being subjected to loads of RTCA/DO-160D, section 7
Operational Shock	Operates within performance specs after exposure to mechanical shocks of magnitude 10g
Random Vibration	Operates within performance specs while exposed to spectrum defined in RTCA/DO-160D, category H, Curve C1, figure 8-4
Sinusoidal Vibration	Operates within performance specs while exposed to vibration spectrum defined in RTCA/DO-160D, Curve Y, figure 8-2
Explosion Proof	Operates safely in an environment where flammable mixtures can occur (RTCA/DO-160D, section 9, Environment II)
Fungus Resistance	Resists fungus growth

<b>7. Electromagnetic Compatibility:</b>	<b>Design RIPS to Conform to RTCA/DO-160D:</b>
Induced Signal Susceptibility	Section 19.0, equipment category C
Radio Frequency Susceptibility (Radiated or Conducted)	Section 20.0, equipment category V
Emission of Radio Frequency Energy	Section 21.0, equipment category M
Lightning Induced Transient Susceptibility	Section 22.0, equipment category A2C3

<b>8. Design and Construction Materials</b>	<b>Ensure that:</b>
	Processes and parts used in constructing this assembly conform to best commercial practices in aircraft industry. Use electronic components of industrial grade or better

**Figure 1.1 – DC Ripple Voltage Limits**



**APPENDIX 2****ENVIRONMENTAL QUALIFICATION FOR  
RECORDER INDEPENDENT POWER SUPPLY (RIPS)**

<i>Environmental Qualification</i>	<i>RTCA/DO-160 test</i>
Audio Frequency Conducted Susceptibility--Power Inputs	Section 18.0 for equipment category A(WF)
Decompression	Section 4.6.2 for equipment
Emission of Radio Frequency Energy	Section 21.0 for equipment category M
Explosion Proof	Section 9.0 for equipment category E for equipment intended for use in Environment II
Fluids Susceptibility	Section 11.0 for equipment category F
Fungus Resistance	Section 13.0 for equipment category F
Humidity	Section 6.0 for equipment category A
Induced Signal Susceptibility	Section 19.0 for equipment category C
Lightning Induced Transient Susceptibility	Section 22.0 for equipment category A2C3
Magnetic Effect	Section 15.0, Equipment Class Z
Operational Shocks and Crash Safety	Section 7.0 for Category B equipment to the levels specified in Appendix 1, para. 3.5.10
Overpressure	Section 4.6.3 for equipment
Power Input	Section 16.0 for equipment category A(WF), AC, and DC supply
Radio Frequency Susceptibility (Radiated and Conducted)	Section 20.0 for equipment category V
Temperature and Altitude	Section 4.0 for equipment category D2, operating at altitudes up to 55,000 ft
Temperature Variation	Section 5.0 for equipment category B. Test the control electronics over the entire temperature range. Test the energy source from a lower test limit of -20° C to the upper test limit

<i>Environmental Qualification</i>	<i>RTCA/DO-160 test</i>
Vibration	Section 8.0 for Category H, curve C1, and Y equipment
Voltage Spike	Section 17.0 for equipment category A
Waterproof	Section 10.0 for equipment category W