



Date: 11/26/76

Technical Standard Order

Subject: TSO-C93, AIRBORNE INTERIM STANDARD MICROWAVE LANDING SYSTEM CONVERTER EQUIPMENT

Airborne interim standard microwave landing system converter equipment — TSO-C93.

(a) *Applicability.* This technical standard order prescribes the minimum performance standards that airborne interim standard microwave landing system converter equipment must meet in order to be identified with the applicable TSO marking. Equipment that is to be so identified must meet the requirements of the “Federal Aviation Administration Standard, Airborne Interim Standard Microwave Landing System Converter Equipment” set forth at the end of this section.

(b) *Environmental standards.* Radio Technical Commission for Aeronautics (RTCA) Document No. DO-138, titled “Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments”, dated June 27, 1968, including Change Number 2, dated October 29, 1969, or RTCA Document No. DO-160, dated February 28, 1975, having the same title, must be used to determine the environmental conditions over which the equipment has been designed to operate.

(c) *Markings.* In addition to the markings specified in § 37.7(d), the equipment must be marked as follows:

(1) The environmental categories over which it has been designed to operate, as set forth in Appendix B of RTCA Document DO-138 or Appendix A of RTCA Document DO-160 must be permanently and legibly marked on the equipment. Where an environmental test procedure is not applicable and the test is not conducted, an “X” must be placed in the space assigned for that category.

(2) Each separate component of the equipment must be permanently and legibly marked with at least the name of the manufacturer, model or part number, the TSO number, and the environmental categories over which it has been tested. Where an environmental test procedure described in DO-138 or DO-160 is not applicable to that component and the test is not conducted, an “X” must be placed in the space assigned for that environmental category.

(d) *Data requirements.* In accordance with §37.5, the manufacturer must furnish to

the Chief, Engineering and Manufacturing Branch, Flight Standards Division (or in the case of the Western Region, Chief, Aircraft Engineering Division), Federal Aviation Administration, in the region in which the manufacturer is located, one copy of the following technical data, except that additional copies must be furnished upon request:

(1) Manufacturer's operating instructions and equipment limitations.

(2) Installation procedures with applicable schematic drawings, wiring diagrams, and specifications. Any limitations, restrictions, or other conditions pertinent to the installation must be included.

(3) Manufacturer's test reports of the tests conducted to show compliance with the requirements of this TSO.

(4) Equipment data sheets specifying, within the prescribed range of environmental conditions, the actual performance of equipment of that type with respect to each performance factor prescribed in the standard. If RTCA Document No. DO-160 is used under paragraph (b) of this section, the data sheets must identify the paragraph of

DO-160 used to show compliance with each of the requirements of paragraphs 4.1 through 4.10 of the standard set forth at the end of this section.

(5) A drawing list enumerating all the drawings and processes that are necessary to define the article design.

(e) *Data to be furnished with each manufactured unit.* A copy of the instructions specified in paragraphs (d)(1) and (d)(2) of this section must be furnished to each person receiving for use one or more articles manufactured under this TSO.

(f) *"Availability of Documents.* RTCA Document Nos. DO-138, including Change Number 2, and DO-160 are incorporated herein in accordance with 5 U.S.C. 552(a)(1) and § 37.23 of the Federal Aviation Regulations and are available for inspection as indicated in § 37.23. Additionally, RTCA Document Nos. DO-138 and DO-160 may be examined at any FAA Regional Office of the Chief, Engineering and Manufacturing Branch (or in the case of the Western Region, the Chief, Aircraft Engineering Division). RTCA Document Nos. DO-138 and DO-160 may also be obtained from the RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D.C. 20006, at a cost of \$16.00 per copy for DO-138 and \$20.00 per copy for DO-160.

FEDERAL AVIATION ADMINISTRATION STANDARD AIRBORNE INTERIM STANDARD MICROWAVE LANDING SYSTEM CONVERTER EQUIPMENT

1.0 Purpose. This standard contains minimum performance and test requirements for Airborne Interim Standard Microwave Landing System Converter Equipment (Converter equipment).

2.0 General Standards.

2.1 *Operations of Controls.* The operation of controls intended for use during flight must not, in any possible combination or sequence, result in a condition whose presence or continuation would be detrimental to the proper functioning of the equipment.

2.2 *Accessibility of Controls.* Controls not intended for in-flight adjustment must be located so as not to be readily accessible to flight personnel.

2.3 *Effects of Tests.* Except as expressly provided in this standard, the design of the equipment must be such that subsequent to the application of the specified tests, no condition may exist which would be detrimental to the proper functioning of the equipment.

3.0 Minimum Performance Standards Under Standard Conditions. The equipment must be tested to show compliance with the following minimum performance requirements under standard conditions.

3.1 *Sensitivity.* The noise figure of the equipment must not be more than 20 db over the frequency range for which the equipment is designed.

NOTE: Maximum cable attenuations of 3 db between the antenna and converter and 3 db

between the converter and ILS receivers were considered in developing this provision.

3.2 *Conversion Gain.* Input signals of not more than -54 dbm for localizer and -43 dbm for glide slope must produce outputs of at least -23 dbm for localizer and -17 dbm for glide slope. This standard must be met over the frequency range for which the equipment is designed.

3.3 *Spurious Response.* Spurious responses in the outputs must not exceed the values in the following table when input signals of -54 dbm for localizer and -43 dbm for glide slope are applied throughout the frequency bands specified.

Frequency Band (Megahertz)	Response Limit Relative to Center Response (db)
0.09-4599.99	-60
4600-4899.99	-45
4900-4998.99	-30
4999-5249.99*	-35
5250-5298.99	-40
5299-10,000	-60

*Exclusive of assigned input frequency band.

3.4 *Stability.* The frequency of the output must be within ± 5 kHz of the assigned VHF localizer/UHF glide slope frequencies when assigned microwave frequencies are applied throughout the frequency range for which the equipment is designed.

3.5 *Intermodulation.* When equal level two-tone test signals within the bands 5000 MHz to 5030 MHz for localizer and 5220 MHz to 5250 MHz for glide slope are applied at input signal levels of -54 dbm for localizer and -43 dbm for glide slope,

intermodulation products must be down at least 30 db from the desired output signals.

3.6 *Antenna Efficiency.*

(a) Over the frequency band from 5000 MHz to 5250 MHz, the desired component of the radiated signal in the forward direction must be at least +8.5 db when compared to an isotropic source.

(b) At any frequency from 5000 MHz to 5250 MHz, the desired component of the radiated signal must not be less than 0 db when compared to an isotropic source at any point in the principal horizontal plane from 60 degrees left to 60 degrees right of directly forward of the antenna or less than 5.5 db above an isotropic source at any point in the principal elevation plan from 17.5 degrees below to 17.5 degrees above directly forward of the antenna.

3.7 *Antenna Polarization.* Over the frequency range from 5000 MHz to 5250 MHz, the reception of signals with horizontal (H plane) polarization from the forward direction with respect to the antenna must be at least 20 db below the reception of signals with the vertical (E plane) polarization from the same direction.

3.8 *Voltage Standing Wave Ratio (Antenna).* The voltage standing wave ratio on the transmission line connecting the antenna and a signal source may not exceed a value of 2.2:1 over the frequency range from 5000 MHz to 5250 MHz.

3.9 *Voltage Standing Wave Ratio (Converter Input).* The voltage standing wave ratio on the transmission line connecting the receiver and a signal source

may not exceed a value of 2.2:1 over the frequency range for which the equipment is designed.

4.0 *Minimum Performance Requirements Under Environmental Conditions.* The equipment must be tested to show compliance with the following minimum performance requirements under environmental conditions.

Unless otherwise specified in this standard, the measurement procedures applicable to a determination of the performance of the equipment under the environmental conditions specified are those set forth in either RTCA Document DO-138 titled "Environmental Conditions and Test Procedures for Electronic/Electrical Equipment and Instruments" dated June 27, 1968, including Change Number 2, dated October 29, 1969, or RTCA Document No. 160 dated February 28, 1975, having the same title. Performance testing may be done following a series of environmental exposures. However, the order of tests must be in accordance with paragraph 3.2 of Document Nos. DO-138 or DO-160.

4.1 *Temperature—Altitude.*

(a) *Low Temperature.*

(1) When the equipment is subjected to this environment, the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met. All mechanical devices must perform their intended functions.

(2) After subjection to this environment, the requirements of paragraph 3.8 of this standard must be met.

(b) *High Temperature.*

(1) When operated at the High Short-time Operating Temperature, the equipment must operate both electrically and mechanically.

(2) When the equipment is exposed to the High Operating Temperature, the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met.

(3) After the equipment is subjected to the environments specified in subparagraphs (1) and (2) of this paragraph, the requirements of paragraph 3.8 of this standard must be met.

(c) *Altitude.*

(1) When the equipment is subjected to this environment, the requirements of paragraphs 3.1, 3.2 and 3.4 of this standard must be met.

(2) After subjection to this environment, the requirements of paragraph 3.8 of this standard must be met.

4.2 *Humidity.* After subjection to the humidity environment and—

(a) Within 15 minutes after the time primary power is applied, the noise figure may not be more than 26 db; and

(b) Within 4 hours from the time primary power is applied, the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met.

4.3 *Shock.*

(a) Following the application of the operational shocks, the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met.

(b) The equipment must remain in its mounting, and no part of the equipment or its mounting may become detached and free of the shock test table or the equipment under test during or following the application of the crash safety shocks. Paragraph 2.3 of this standard does not apply to the crash safety shock environment.

4.4 *Vibration.*

(a) When the equipment is subjected to this environment, the requirements of paragraph 3.2 of this standard must be met.

(b) After subjection to this environment, the requirements of paragraphs 3.1, 3.2, 3.4, and 3.8 of this standard must be met.

4.5 *Temperature Variation.* When subjected to this environment—

(a) The noise figure may not be more than 26 db;

(b) The requirements of paragraph 3.2 of this standard must be met; and

(c) The stability requirement of paragraph 3.4 of this standard must be met with in ± 2.5 kHz (± 7.5 kHz total).

4.6 *Electrical Input Variation.* When subjected to this environment, the

requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met.

4.7 *Low Voltage.*

(a) *AC and DC Equipment.* When the primary power voltages of DC operated equipment is 80% of the design voltages, and when that of AC operated equipment is 87½% of the design voltages, the equipment must operate both mechanically and electrically, the requirements of paragraph 3.1 of this standard must be met within 3 db, and the signal output requirements of paragraph 3.2 of this standard must be met within 3 db.

(b) *DC Equipment.*

(1) DC operated equipment must meet the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard within 2 minutes after the primary power voltages are returned to the design voltages after operating at 50% of the design voltages for at least 10 minutes.

(2) The reduction of the primary power voltages of DC operated equipment from 50% of design voltages to zero volts may not produce fire or smoke. Paragraph 2.3 of this standard does not apply after the exposure to zero volts.

4.8 *Conducted Voltage Transients.*

(a) *DC Equipment.*

(1) *Intermittent Transients.*

Following the application of the intermittent transients, the requirements of paragraphs 3.1, 3.2, and 3.4 of this standard must be met;

(2) *Repetitive Transients.* While the repetitive transients are being applied, the requirements of paragraph 3.1 of this standard must be met.

(b) *AC Equipment.* While the transients are being applied, the requirements of paragraph 3.1 of this standard must be met.

4.9 *Radio-Frequency Susceptibility.*

When subjected to this environment, the requirements of paragraph 3.1 of this standard must be met.

4.10 *Emission of Spurious Radio Frequency Energy.* The levels of conducted and radiated spurious radio frequency energy emitted by the equipment may not exceed those levels specified in Appendix A to RTCA Document No. DO-138 or paragraph 21 of Document No. DO-160.