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SUPERSEDING
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MILITARY SPECIFICATION

TRANSMITTER, RADIO AN/URT-23( )

This specification is approved for use by the Space and Naval Warfare Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a Radio Transmitter AN/URT-23( ), hereinafter referred to as the equipment, and associated accessories. This equipment is a digitally tuned transmitter, intended for general purpose voice, continuous wave (CW), radio teletype and data communications. The equipment operates in the 2.0 megahertz (MHz) to 30.0 MHz frequency range and provides transmission of single sideband (SSB), selectable upper sideband (USB), lower sideband (LSB), and independent sideband (ISB), CW, amplitude modulation (AM) (compatible), single and multichannel teletypewriter (TTY), and Naval Tactical Data System (NTDS) LINK 11 signals.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-C-17/75	Cables, Radio Frequency, Flexible, Coaxial, 50 Ohms, M17/75-RG214 And M17/75-RG365
MIL-S-901	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment And Systems, Requirements For
MIL-C-915	Cable And Cord, Electrical, For Shipboard Use General Specification For
MIL-M-7793	Meter, Time Totalizing
MIL-E-16400	Electronic, Interior Communication And Navigation Equipment, Naval Ship And Shore: General Specification For
MIL-W-16878	Wire, Electrical, Polytetrafluoroethylene (PTFE) Insulated, 200 Deg C, 600 Volts, Extruded Insulation
MIL-E-17555	Electronic And Electrical Equipment, Accessories, And Provisioned Items (Repair Parts): Packaging Of
MIL-F-19207	Fuseholder, Extractor Post Type Blown Fuse Indicating And Non-indicating, General Specification For
MIL-C-22954	Control, Radio Set C-1138( )/UR
MIL-R-23637	Receiver, Radio R-1051( )/URR
MIL-T-23645	Transmitter T-827( )/URT
MIL-C-28806	Coupler Group, Antenna, AN/URA-38( )
MIL-M-38510	Microcircuits, General Specification For
MIL-C-39012	Connectors, Coaxial, Radio Frequency, General Specification For

Benefical comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Space and Naval Warfare Systems Command (SPAWAR-8111), Washington, DC 20363-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

FSC 5820

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures And Tables For Inspection By Attributes
MIL-STD-109	Quality Assurance Terms And Definitions
MIL-STD-167-1	Mechanical Vibrations Of Shipboard Equipment (Type I - Environmental And Type II - Internally Excited)
MIL-STD-188-203-1	Subsystem Design And Engineering Standards For Tactical Digital Information Link (TADIL) A
MIL-STD-454	Standard General Requirements For Electronic Equipment
MIL-STD-461	Electromagnetic Emission And Susceptibility Requirements For The Control Of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement Of
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-781	Reliability Design Qualification And Production Acceptance Tests: Exponential Distribution
MIL-STD-965	Parts Control Program
DoD-STD-1399, Section 300	Interface Standard For Shipboard Systems, Electric Power, Alternating Current (Metric)
MIL-STD-1472	Human Engineering Design Criteria For Military Systems, Equipment And Facilities
MIL-STD-1633	Interface Standard For Shipboard Emission Monitor-Control Set, AN/SSQ-82(V) MUTE System

2.1.2 Other Government drawing. The following other Government drawing forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

RE-B-5034110	Installation Control Drawings, Data List, For AN/URT-23( )

(Copies of specifications, standards, drawings, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publication. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA RS-310-C-77	Racks, Panels And Associated Equipment

(Request for copies should be addressed to Electronic Industries Association, 2001 Eye Street, NW, Washington, DC 20006.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The equipment shall be in accordance with MIL-E-16400, to the extent specified herein.

3.1.1 First article. When specified (see 6.2.1), the contractor shall furnish sample unit(s) for first article inspection and approval (see 4.3 and 6.3). The sample(s) shall be suitable for complete evaluation of mechanical and electrical form, design, and performance. The sample shall be of final mechanical and electrical form, employ standard or nonstandard (when approved by the procuring activity) parts, and be completely representative of final production equipment.

3.1.2 Parts, materials, and processes. Parts, materials, and processes shall be in accordance with MIL-E-16400, except as otherwise specified in 3.1.2.1 through 3.1.2.7. Particular attention shall be given to the acceptable and unacceptable materials of MIL-E-16400.

3.1.2.1 Parts control. Parts to be incorporated into the equipment shall be controlled in accordance with MIL-STD-965, Procedure I.

3.1.2.2 Prior parts approval. The equipment furnished in accordance with this specification shall employ standard parts or approved nonstandard parts. Nonstandard part approvals previously granted under earlier contracts for equipments represented by Government-furnished equipment (GFE) shall not be construed as being extended to equipment furnished in accordance with this specification. Nonstandard parts specified in Government-furnished drawings (DWGs) shall not be construed as being approved for use in equipment furnished in accordance with this specification.

3.1.2.3 Individual selection. The performance of the equipment shall not be dependent on the selection of individual parts, unless such selection is specifically approved by the procuring activity.

3.1.2.4 Electron tubes. All electron tubes shall be selected from among approved types in accordance with the Tubes, electron paragraph of MIL-E-16400. Electron tubes shall be limited to applications corresponding to circuits of the GFE.

3.1.2.5 Microelectronic devices. Selection and application of microelectronic devices shall comply with MIL-STD-454, Requirement 64 requiring MIL-M-38510, Class B devices. When deviations from these requirements are necessitated due to availability or cost consideration, hermetically-sealed devices shall be screened and tested in accordance with the Other microcircuits paragraph of MIL-STD-454, Requirement 64.

3.1.2.6 Semiconductor devices. All semiconductor devices shall be made of silicon.

3.1.2.7 Type BNC and Type N radio frequency (RF) connectors. Where Type BNC and Type N RF coaxial connectors are specified herein, connectors shall be selected in accordance with MIL-C-39012.

3.1.3 Production equipment. Production equipment shall be identical to the equipment that has been subjected to and passed the first article examinations and tests (see 3.1.1 and 4.3).

3.1.4 Operation requirements. Each equipment shall give reliable performance within the limits specified herein, under conditions of intermittent or continuous operation during exposure to the adverse conditions normally encountered in naval ship and shore communications service. Mechanical and electrical ruggedness is of paramount importance for assurance of reliable performance.

3.2 GFE. GFE shall be as specified (see 6.4).

3.3 Interchangeability. Interchangeability requirements shall be as specified (see 6.2.1).

3.4 Composition. The equipment shall consist of one each of the equipment specified in a through g:

a. Transmitter (Exciter) T-827( )/URT in accordance with MIL-T-23645
b. RF Amplifier AM-3924( )/URT
c. Power Supply PP-3916( )/UR
d. Shock and Vibration Mounting Assembly MT-4670( )/URT-23( )
e. Set of cables (assembled) for complete system interconnection
f. Set of mating connectors, including cable clamps, for all receptacles for which interconnection cables of e. are not furnished
g. Set of mounting brackets for stack-mounting the equipment units

3.4.1 Accessories. In addition to the basic equipment specified in 3.4, the accessory items specified in a through c shall be furnished in the quantities specified (see 6.2.1):

a. Equipment plug-in assembly extension cables (see 3.15.1.33.1 and MIL-T-23645)
b. Printed circuit board (PCB) extender cards to permit servicing of each plug-in PCB in the equipment, except 1A1A11 and 1A1A13 (see 3.15.1.33.2 and MIL-T-23645). A single extender with multiple keying shall be provided for use in each card cage having differentially keyed PCBs using a common connector
c. Set of terminal strips and jumpers for 208 volts alternating current (VAC) operation (see 3.6.3)

3.4.2 Antenna Coupler Group AN/URA-38( ). The Antenna Coupler Group AN/URA-38( ) specified herein is an associated accessory antenna tuning device for use with the AN/URT-23( ). The AN/URA-38( ), as specified in MIL-C-28806, is not a part of the basic AN/URT-23( ) and is provided separately. The AN/URT-23( ) shall be capable of operation with or without the AN/URA-38( ) equipment (see 3.9.2).

3.5 Frequency range. The frequency (tuning) range of the equipment shall be from 2.0 MHz to 30.0 MHz. Each equipment shall be capable of adjustment to any frequency from 2.0000 MHz to 29.9999 MHz in 100 hertz (Hz) steps. The T-827( )/URT is a digitally tuned exciter, producing frequencies from 2.0000 MHz to 29.9999 MHz in 100 Hz steps. The RF amplifier shall be capable of amplifying inputs in the frequency range of 2.0 MHz to 30.0 MHz.

3.5.1 Method of tuning. Frequency selection over the complete frequency range of the equipment shall be accomplished in steps of 100 Hz, where changing the setting of digital tuning knobs of the T-827( )/URT is all that is required to tune the equipment. Frequency tuning of the RF amplifier shall be accomplished automatically when the digital tuning knobs of the T-827( )/URT are switched.

3.5.2 Primary frequency bands. The RF amplifier shall function over the operating frequency range in nineteen frequency bands, as specified in a through c:

a. Four bands of 0.5 MHz bandwidth from 2.0 MHz to 4.0 MHz
b. Four bands of 1.0 MHz bandwidth from 4.0 MHz to 8.0 MHz
c. Eleven bands of 2.0 MHz bandwidth from 8.0 MHz to 30.0 MHz

The driver amplifier output circuit and the final amplifier output circuit shall be tuned in these bands.

3.6 Primary power source. The equipment shall be designed to operate from electrical power having characteristics as specified for Type I of DoD-STD-1399, Section 300, and as specified herein. Each equipment shall be capable of operating and providing rated performance from a primary power source as specified in a and b:

a. 440 VAC ±10 percent, 60 Hz ±5 percent, 3-phase delta
b. 208 VAC ±10 percent, 48 Hz to 63 Hz, 3-phase wye

3.6.1 Transient protection. The equipment shall operate without damage or permanent change in characteristics due to transient voltage, transient frequency, and power interruption requirements of the Power source variations paragraph of MIL-E-16400 and the 2500-volt (V) spike requirement of DOD-STD-1399, Section 300. Protection shall be included against damage due to transients produced by operation of relays or tuning motors within the equipment. A transient protection network shall be incorporated at the interface connections between line filter load terminals and the AM-3924( ) case primary power wiring. Design and location of this network shall be such that failure of protection components shall not cause damage to case wiring or preclude user repair of the protection network. The network shall include resistors from each primary power line to case ground to discharge line filter or circuit capacitance when power is removed.

3.6.2 Electrical overload protection. Electrical overload protection shall be in accordance with MIL-E-16400, except as modified herein. The circuits specified in a through f shall be protected by fuses, as a minimum:

a. Each line of the alternating current (AC) power input
b. 115 VAC supply line to the T-827( )/URT and C-3698( )/URA-38( )
c. 22.5 VAC supply blower rectifier and inverter, or both
d. 28 volts direct current (VDC) rectifier
e. 500 VDC power supply
f. Each line of the primary power for the low voltage direct current (DC) power supplies of the AM-3924( )/URT

3.6.3 440 VAC operation. Unless otherwise specified herein, each equipment shall be delivered ready for 440 VAC operation. Terminal strips and jumpers required to permit operation from other inputs specified in 3.6 shall be supplied as part of the equipment, when specified (see 6.2.1).

3.6.4 Primary power safety interlocks. The three phases of primary power shall be interlocked so that all voltages will be removed from the frame when the frame is extracted from the case. The interlocks shall be manually resettable with the frame extracted for maintenance. The electrical contact rating for each interlock shall be 440 VAC, 25 amperes (A), 60 Hz (resistive load).

3.6.5 Line filter. A primary power line filter shall be provided at the power input to the equipment. The primary power cable connector shall be part of the filter. The filter shall be capable of accepting any of the primary power sources specified in 3.6. Capacitors used within the line filter shall be specified to withstand the DOD-STD-1399 2500-V spike test performed in accordance with 4.5.8.4. Each terminal of the line filter shall be subjected to a production (100 percent) high potential test to ground. Test voltage shall be a minimum of 2000 VDC; leakage at the test voltage shall be less than 1 microampere.

3.6.6 Leakage current. The equipment leakage current measured in accordance with the Leakage current paragraph of MIL-E-16400 shall not exceed 5 milliamperes (mA) AC or DC.

3.7 Operational requirements. Operational requirements shall be as specified in 3.7.1 and 3.7.2.

3.7.1 Types of emission. Each equipment shall provide for the transmission of the types of emission specified in a through j:

a. A1: Telegraphy without the use of a modulating audio frequency (CW)
b. A3a: Telephony, SSB, reduced carrier
c. A3b: Telephony, two ISBs, reduced carrier
d. A3h: Telephony, SSB, full carrier
e. A3j: Telephony, SSB, suppressed carrier
f. A9b: Two ISBs, combination of telephony and telegraphy (ISB and RATT)
g. F2j: Single channel voice frequency telegraphy (RATT)
h. F7J: Multichannel voice frequency telegraphy (RATT)
i. F9: Differentially coherent phase shift keying (DPSK); as specified in MIL-STD-188-203-1 double sideband (DSB)
j. F9j: DPSK; as specified in MIL-STD-188-203-1, SSB

3.7.2 Modes of operation. The equipment shall be capable of transmitting the emissions specified in 3.7.1 by selection of one of the modes of operation specified in a through g:

a. LSB
b. USB
c. ISB
d. AM (compatible)
e. CW telegraphy
f. RATT: Single or multichannel telegraph
g. ISB and RATT: LSB audio and USB single channel telegraphy

3.8 Equipment arrangement. The normal installation (stacking) arrangement for the equipment shall be as specified in a through f, starting from the bottom mounting surface:

a. Shock and Vibration Mounting Assembly MT-4670( )/URT-23
b. Power Supply PP-3916( )/URT
c. RF Amplifier AM-3924( )/URT
d. Transmitter T-827( )/URT
e. Coupler Control Unit C-3698( )/URA-38( ) (accessory). If AN/URA-38( ) is used with the AN/URT-23( ), the Coupler Control Unit C-3698( )/URA-38( ) may be mounted atop the AN/URT-23( ) stacking configuration
f. Mounting Assembly Stabilizer (see 3.4d)

3.8.1 Shock and vibration mounting assembly. A shock and vibration mounting assembly shall be employed for verifying conformance to the shock, vibration, and inclination requirements of this specification. The method of mounting the assembly to the deck or bulkhead and to the equipment shall be physically and mechanically interchangeable with the MT-4670/URT-23( ). Vibration isolators shall be bolted to mounting plates to permit field replacement of damaged isolators.

3.8.1.1 Deflection or sway. There shall be no more than 60.325 millimeters (mm) (2.375 inches (in.)) deflection or sway at the topmost unit, in any direction, when the equipment is mounted on its associated shock and vibration mounting assembly.

3.9 Radio transmitter system. The contractor shall be responsible for demonstrating complete system integration and system operation, including demonstration of operation with AN/URA-38( ). Equipment provisions for external cabling to the standard navy shipboard radio remote control, TTY, and LINK 11 NTDS systems is required. Standard navy cables shall be as specified in MIL-C-915. Mating connectors, including cable clamps, for all external cabling which require manufacture by the installing activity shall be furnished with each equipment. Interconnection cabling, plugs, and receptacles for the interconnection of the T-827( )/URT, AM-3924( )/URT, and PP-3916( )/UR units shall be supplied with each AN/URT-23( ) equipment. Additional information pertaining to a typical installation of the equipment is shown in DWG RE-B 5034110.

3.9.1 Radio remote control system. The equipment shall contain compatible provisions for remote control of the equipment in the standard navy radio remote control system (not frequency control) using a maximum of three Radio Set Control Units C-1138( )UR, in accordance with MIL-C-22954. Continuous simultaneous key-down operation from only two C-1138( )/UR units shall be required. Start-stop provisions are not required with use of C-1138( )/UR control units.

3.9.2 AN/URA-38( ) compatibility. The equipment shall include provisions for operation with Antenna Coupler Group AN/URA-38( ). Tests shall be conducted to ensure compatibility of AN/URT-23( ) and AN/URA-38( ).

3.9.3 Multiple unit for transmission elimination (MUTE). The AN/URT-23(V) shall be capable of interfacing with the MUTE system in accordance with MIL-STD-1633.

3.10 Dimensions and weights. The maximum dimensions and weights of the equipment shall not exceed those specified in TABLE I.

TABLE I. Dimensions and weight.

Units	Width cm 1/ (in.)	Depth 2/ cm (in.)	Height cm (in.)	Weight kg 3/ (lbs) 4/
Transmitter T-827( )/URT	44.13 (17.375)	47.0 (18.5)	17.75 (7)	34.0 (75)
RF Amplifier AM-3924( ) URT	44.13 (17.375)	48.0 (19)	31.0 (12.25)	45.4 (100)
Power Supply PP-3916( )/UR	44.13 (17.375)	48.0 (19)	17.75 (7)	68 (150)
Shock and vibration mounting assembly	50.0 (19.75)	43.0 (17)	10.75 5/ (4.25)	13.2 (29)

1/ Centimeters
2/ Exclusive of rear connectors
3/ Kilograms
4/ Pounds
5/ Maximum unloaded height of bedplate

3.11 Environmental service conditions. The equipment shall be capable of continuous, reliable operation, within the performance limits specified in 3.16, under the environmental conditions of MIL-E-16400 specified in 3.16. The equipment shall operate within tolerances throughout the tests specified in Section 4 for a through g without alignment or adjustment, other than external controls normally employed for operation of the equipment:

a. Operating temperature range (Range 4)
b. Nonoperating temperature range (Range 4)
c. Humidity (< 95 percent)
d. Salt fog (spray) (sheltered)
e. Shock (mounted on MT-4670/URT-23( ))
f. Vibration (mounted on MT-4670/URT-23( ))
g. Inclination (60 degrees)

3.12 Orientation. The equipment shall be capable of storage in any orientation.

3.13 Reliability. Reliability shall be as specified in 3.13.1.

3.13.1 Quantitative reliability. The upper test mean-time between-failure (MBTF), (θ_0 as defined in MIL-STD-781) for this equipment shall be 700 hours. The lower test MTBF (θ_1) shall be 350 hours.

3.14 Basic conditions. The basic conditions specified in 3.14.1 through 3.14.1.8 shall apply to the performance requirements specified in 3.16, except as modified by a particular test or test procedure specified herein. These conditions are specifically applicable to the measurement of the output power, spurious responses, intermodulation distortion, bandwidth and carrier suppression in the equipment and the measurement of the power output, harmonic output, and distortion in the RF amplifier unit.

3.14.1 Standard test conditions. Standard test conditions shall be as specified in 3.14.1.1 through 3.14.1.8.

3.14.1.1 Primary power. The primary power test condition shall be 440 VAC, 60-Hz, 3-phase delta.

3.14.1.2 Ambient temperature. The ambient temperature shall be between 20°Celsius (C) and 30°C.

3.14.1.3 Relative humidity. The relative humidity shall be less than 95 percent.

3.14.1.4 Equipment RF output. Equipment RF output shall be measured with a 50-ohm resistive load connected to the output terminal through a 1.5 meter (m) (5 foot (ft)) length of RG-214/U cable in accordance with MIL-C-17/75.

3.14.1.5 AM-3924( )/URT RF input. RF input to the AM-3924( )/URT shall be supplied from a 50-ohm nominal source.

3.14.1.6 RF amplifier bias. The amplifier bias shall be adjusted as required to ensure that the correct operating point has been set for the tubes.

3.14.1.7 Primary power line input adjustment. The equipment line voltage shall be adjusted as required to ensure that proper input voltage is applied to the equipment.

3.14.1.8 System test inputs. For all system tests, audio tones, keyline control, TTY loop currents, and LINK 11 data shall be applied to terminals of the appropriate connector associated with navy standard radio remote control system.

3.15 Mechanical design and construction. Mechanical design and construction shall conform to all applicable requirements of the Mechanical design and construction paragraph of MIL-E-16400 to the extent of being compatible with GFE.

3.15.1 General requirements. General requirements shall be as specified in 3.15.1.1 through 3.15.1.34.

3.15.1.1 Construction. Construction shall conform to the requirements of the Construction paragraph of MIL-E-16400. The RF amplifier shall consist basically of a chassis, a front panel, with two handles that will support the weight of the unit, a case, and associated circuitry. Retractable chassis slides shall be provided on the RF amplifier that will permit the chassis, when withdrawn from the case, to be oriented +90 degrees from its normal horizontal position. Locks on the slides shall be provided to maintain the chassis in the desired position. No damage to the chassis or case shall result from insertion or withdrawal of the chassis. The PP-3916( )/UR power supply shall consist basically of a case and an attached front panel with the components mounted within. The front panels shall be securely mounted to the chassis, with the two handles provided, one mounted on each side of the front panel and each capable of supporting the entire weight of the unit. All sharp corners and edges on cases, chassis, panels, and brackets shall be eliminated.

3.15.1.2 Case. The case shall be made of aluminum. The cases shall be of extruded construction, the same as that of the GFE. A filter box (integral to the RF amplifier), internal connectors and retractable cable assembly shall be provided to enable operation of the equipment when the RF amplifier chassis is removed from the case and oriented +90 degrees from its normal horizontal position. The internal connectors shall permit rapid removal of the RF amplifier chassis from the case. Additional accessory cables shall not be required for operation when the equipment is withdrawn from the case. The retractable cable shall be secured to the chassis by a cable clamp and installed so that it has no abrasion points and does not jam when the frame is inserted or withdrawn from the case.

3.15.1.2.1 Rack mounting. The equipment shall be designed for installation in a standard rack manufactured in accordance with EIA RS-310-C-77. This type of mounting is limited to shore station application. The case of the equipments shall be designed and constructed so that when mounting brackets are installed on the sides of the case, (see 6.2.1) and the equipment is installed in the rack and not subject to shock or vibration, no other support or reinforcing members will be required to preclude deformation of any part of the equipment.

3.15.1.3 Enclosure. The enclosure for the equipment shall be in accordance with the Enclosures paragraph of MIL-E-16400. The degree of enclosure of the equipment shall be totally enclosed, except that louvered openings for forced air ventilation shall be provided in the AM-3924( )/URT and PP-3916( )/UR. Dual density filter media, expanded aluminum alloy and coated with a water soluble adhesive, shall be provided to impede the flow of and collect free air contaminants. The enclosures for the filter media shall be constructed to permit removal of the filter media for cleaning and replacement.

3.15.1.3.1 External connections. External connections shall be the same as in the GFE.

3.15.1.4 Bonding and grounding. The equipment shall conform to the Bonding and grounding paragraph of MIL-E-16400, except as specified in 3.15.1.4.1 and 3.15.1.4.2.

3.15.1.4.1 Case bonding. Case bonding and grounding shall be accomplished by preparing mounting surfaces to provide metal contact between the case and mounting bracket, and between the mounting bracket and shock mount. The area around each threaded insert of the case used to secure the mounting bracket to the case shall be free of paint and chemically treated to preserve the metal and provide a ground. Mounting brackets and the shock mount used with the equipment shall be similarly treated to ensure bonding and grounding.

3.15.1.4.2 Grounding stud. The stud shall be a pressed-in captive insert made integral with the case and constructed of austenitic corrosion-resistant steel. The captive insert shall be flush with the outside surface of the case and shall contain a blind threaded hole to prevent the entrance of moisture into the case. A 25.4-mm (1-in.) diameter area around the threaded insert shall be free of paint and chemically treated to preserve the metal and provide a ground.

3.15.1.5 Corrosion protection, corrosion-resisting treatments and painting. Corrosion protection and corrosion-resisting treatments shall be in accordance with the Corrosion protection/corrosion resisting treatment paragraph of MIL-E-16400.

3.15.1.5.1 Painting. Painting shall be in accordance with the Painting paragraph of MIL-E-16400, except that the interior surfaces of each metal equipment enclosure shall be painted a flat black to improve thermal efficiency.

3.15.1.6 Terminal boards. Terminal boards shall be in accordance with the Terminals (terminal boards and strips, binding posts and lugs) paragraph of MIL-E-16400. Particular attention shall be given to the voltage ratings on the terminal boards.

3.15.1.7 Fastener hardware. Fastener hardware shall conform to the Fastener hardware paragraph of MIL-E-16400, except as otherwise specified herein. All screws, nuts, bolts, and other fastener hardware shall be of austenitic corrosion-resistant steel, except in applications requiring material capable of withstanding high tensile stresses. Captive-type bolts shall be used on equipment front panel and electronic plug-in assemblies. Cadmium plating is not acceptable on the captive-type bolts used on the equipment front panels and electronic plug-in assemblies.

3.15.1.8 Controls, indicators, and panel layouts. Controls, indicators, and panel layouts, including lights, receptacles, switches, meters (including functions) and fuseholders, shall be the same as furnished in the GFE, unless otherwise specified herein. A dimmer control for the equipment panel light is not required.

3.15.1.9 Electrical and RF connectors. Electrical and RF connectors shall be provided in accordance with the Electrical and RF connectors paragraph of MIL-E-16400. All nonRF connectors shall be of the solder-lug type; crimped pin types shall not be used except for 1A1J13 and 1A1A13. Mating connectors for nonRF connectors shall be provided with metal cable clamps which accommodate standard shipboard cables. All multipurpose connectors shall have 10 percent spare pins to the extent of compatibility with the GFE.

3.15.1.9.1 RF input and output connectors. The coaxial RF connectors for the receiving antenna input and transmitting antenna output shall be Type N for external cabling, and Type BNC for the cables from the antenna changeover relay within the case. Coaxial connectors for the RF output monitor sample (AM-3924 front panel) and the RF signal from the exciter shall be Type BNC. The receptacles shall be mounted at the rear of the equipment cases and shall be suitably labeled. The center pin of the Type N connectors shall made captive in all directions.

3.15.1.9.2 Multiconductor connectors. External multiconductor cable connectors shall be provided in accordance with the Connectors, flat multiconductor, cable paragraph of MIL-E-16400. Mating plugs for multiconductor cable connectors shall be provided with cable clamps. All external mounted connector receptacles shall be provided with a suitable protective plastic cap to prevent damage to the connector when the mating connector is not installed. The function of each terminal within a plug or connector and the function of each connector shall be the same as GFE.

3.15.1.9.3 External connectors. External connectors shall be interchangeable with corresponding items furnished in the GFE. In any conflict or inconsistency between the preceding requirements regarding interchangeability and other requirements of this specification, the other requirements of this specification shall govern.

3.15.1.10 Time meter. An elapsed time meter shall be required only for the RF amplifier AM-3924( )/URT. The meter shall indicate total filament on time, with elapsed time of up to 10,000 hours continuous operation before resetting. The time meter shall be mounted on, and be visible from, the front panel and shall conform to MIL-M-7793.

3.15.1.11 Locking devices. Locking devices on external operating controls are not required unless otherwise specified herein.

3.15.1.12 Panel lights. Panel lights shall be easily replaceable from the front panel without requiring removal of the unit from its enclosure.

3.15.1.13 Motors. Motors used in the equipment shall comply with the requirements of the Motors dynamotors, rotary power converters, and motor generators paragraph of MIL-E-16400, to the extent of compatibility with the GFE.

3.15.1.14 Fuses. Fuses shall be in accordance with the Fuses and fuseholder paragraph of MIL-E-16400, except that extra fuses are not required. Fuses shall be mounted on the front panel in blown fuse indicating fuseholders which conform to MIL-F-19207. Spare fuseholders are not required.

3.15.1.15 Cooling. A forced air method of heat removal shall be used in the RF amplifier and the PP-3916( )/UR (see 3.15.1.3).

3.15.1.15.1 RF amplifier heat exhaust vents. The heat exhaust vents of the RF amplifier shall be provided with drilled and tapped holes that will permit the attachment of a flexible heat duct that is to be supplied by the installing activity. This requirement shall permit the exhausting of the generated heat to another area.

3.15.1.16 Head telephone and plugs. Head telephones and telephone plugs are not required to be furnished by the contractor.

3.15.1.17 Hand key and plugs. Hand keys (CW) and plugs are not required to be furnished by the contractor.

3.15.1.18 Assembly identification. All assemblies to which the interchangeability requirements apply (see 3.3) shall be provided with the assigned National Stock Number, Manufacturer's Part Number (including revision indicator), Federal Supply Code number, and serial number. This information shall be inscribed on the baseplate of the assembly. Plug-in printed circuit assemblies shall be keyed to prevent incorrect mating with chassis receptacles, and assemblies and receptacles shall be identified with the assembly or receptacle number.

3.15.1.18.1 Dust covers. The dust covers of all assemblies employing PCBs shall indicate the location of all test points and all adjustments accessible through the dust cover.

3.15.1.19 Accessibility. In addition to the requirements of the Accessibility paragraph of MIL-E-16400, the circuit mounting boards, components, and tubes shall be easily accessible for maintenance, repair or replacement. The equipment shall conform to the extent of being compatible with the GFE. Components which require adjustment prior to start of operation shall be accessible without removal of dust covers or other coverings. All new printed wiring boards shall be removable without the unsoldering of any leads.

3.15.1.20 Test points. Test points shall be provided and located to permit the isolation of malfunctioning parts or subassemblies within any major unit or assembly without the unsoldering of any interconnection or wiring lead. Test points provided shall be identical to the test points in the GFE for existing circuitry.

3.15.1.21 Circuit alignment. Resonant circuits shall be provided with adjustable trimmers, or equally effective means, to permit accurate alignment. The trimmers shall provide sufficient means of adjustments to compensate for the effects of normal aging of electron tubes and other parts.

3.15.1.22 Factory adjustment controls. The design of the equipment shall include factory or sealed adjustment controls, unless specifically approved by the procuring activity.

3.15.1.23 Shock, vibration, and inclination. Shock, vibration, and inclination shall be as specified in 3.15.1.23.1 through 3.15.1.23.4.

3.15.1.23.1 Shock. The equipment shall be capable of withstanding the shock test for Grade A, deck-mounted, Class II, medium weight, Type A equipment as specified in MIL-S-901.

3.15.1.23.2 Vibration. The equipment shall be capable of withstanding the Type I vibration test of MIL-STD-167-1. During vibration testing, the equipment shall conform to the requirements of 3.16.1.4.1. The nameplate requirements of MIL-STD-167-1 are not applicable.

3.15.1.23.3 Inclination. The equipment shall conform to the requirements of 3.11 and the Inclination paragraph of MIL-E-16400.

3.15.1.23.4 Shock, vibration, and inclination distortion. The shock and vibration mounting assembly shall show no deformation, bottoming or leaning on completion of the shock, vibration, or inclination tests.

3.15.1.24 Printed wiring. The fabrication of printed wiring boards and the insertion of parts and assemblies thereon shall conform to the requirements of the Wiring, printed paragraph of MIL-E-16400, to the extent of being compatible with the GFE.

3.15.1.25 Welding. Welding shall conform to the requirements of the Welds, resistance (electrical connection) paragraph of MIL-E-16400.

3.15.1.26 Attachment of wire and leads. Attachment of wires and leads shall conform to the Attachments of wires and leads paragraph of MIL-E-16400.

3.15.1.27 Internal wiring and cabling. Internal wiring and cabling shall conform to the requirements of the Internal wiring and cabling paragraph of MIL-E-16400. All wiring shall be tetrafluoroethylene (TFE) insulated. Hook-up wire shall conform to MIL-W-16878/4. Hook-up wire used in applications exceeding voltage rating of MIL-W-16878/4 wire shall utilize TFE wire with appropriate voltage rating, procured in accordance with nonstandard part approval procedures.

3.15.1.28 Conductors. Conductors shall be in accordance with the Internal wire and cabling paragraph of MIL-E-16400, except that the number and purpose of conductors shall be tne same as those used in the GFE.

3.15.1.28.1 Conductor identification. Identification of conductors shall conform to the Conductor identification paragraph of MIL-E-16400. The method used for identification shall be consistent throughout the equipment.

3.15.1.29 Identification and marking. Identification and marking of all units, assemblies, electrical and moving mechanical parts, and any mechanical parts required to be removed for normal maintenance, shall be in accordance with the Identification and marking paragraph of MIL-E-16400. Hertz or Hz shall be used for all indications of frequency on hardware and associated software. Reference designators shall be the same as used in the GFE to the maximum extent practicable.

3.15.1.30 Part replacement. Part replacement shall conform to the Part replacement paragraph of MIL-E-16400.

3.15.1.31 Quartz crystal units. Quartz crystal units shall conform to the Quartz crystal units paragraph of MIL-E-16400.

3.15.1.32 Gears and cams. Gears and cams shall conform to the Gears and cams paragraph of MIL-E-16400, except that only metal gears shall be used.

3.15.1.33 Maintenance accessories. Extender cables or extender cards, as applicable, shall be furnished as required (see 6.2.1). Electronic assemblies and PCBs that plug in to chassis or other board receptacles, and on which the test points or components are not available for fault isolation, require extender cable or card, as applicable, for fault isolation.

3.15.1.33.1 Extender cables. Extender cables for the assemblies specified in 3.4.1a, and for new assemblies, shall be 610 mm (24 in.) long.

3.15.1.34 Thermal design. Thermal design shall be in accordance with the Thermal design paragraph of MIL-E-16400 to the extent of compatibility with the GFE.

3.15.2 Transmitter (Exciter) T-827( )/URT. The T-827( )/URT shall conform to the Mechanical design and construction paragraph of MIL-T-23645.

3.15.3 RF amplifier AM-3924( )/URT. The RF amplifier shall be as specified in 3.15.3.1.1 through 3.15.3.1.4.

3.15.3.1 Remote system interface receptacles. Remote system interface receptacles shall be as specified in 3.15.3.1.1 through 3.15.3.1.4.

3.15.3.1.1 Receiver audio input. A separate 2-terminal receptacle shall be provided on the rear of the AM-3924( )/URT case to accept a balanced 600-ohm audio input from an associated receiver at a maximum normal operating level of +10 decibels referred to one milliwatt (dBm). A transformer shall be provided within the AM-3924( )/URT and shall provide unity turns ratio between the balanced primary and the unbalanced secondary connection providing earphone audio to the associated T-827( )/URT local handset. The transformer shall not be damaged by continuous application of 1 watt (W), maximum.

3.15.3.1.2 Teletype input. A separate receptacle having three terminals (two active) shall be provided on the rear of the AM-3924( )/URT case to accept the DC input from the TTY system. A 1000-ohm, 14-W ungrounded terminating resistor shall be mounted to the AM-3924( )/URT case and connected between the two active connector pins.

3.15.3.1.3 Accessory receptacle. A separate rear-mounted accessory receptacle shall be provided which includes provision for the failures specified in a through g (as a minimum):

a. Ground keyline
b. Keyline interlock
c. Ground
d. Receiver muting (providing a ground by contact closure when equipment is keyed) used with R-1051( )/URR type receiver in accordance with MIL-R-23637
e. CW and RATT ground
f. Spare lead to RF amplifier
g. Four spare terminals

3.15.3.1.3.1 Spare shielded lead. A spare shielded lead shall be provided from the rear of the case to P14. The lead should then be continued from J14 to 1A1A9XA1-20. Four 6.35 mm (0.25 in.) diameter holes with removable plug buttons shall be provided in the filter box for field installation of extra feed-through capacitors.

3.15.3.1.4 Radio telephone inputs. A separate rear-mounted receptacle shall be provided which shall include the provisions specified in a through i:

a. 115 VAC 0.5 A, to remote for remote indicating lamp
b. 115 VAC common to remote
c. Ground to remote
d. CW or RATT keyline (provides ground to transmitter)
e. -12 VDC to remote for handset voltage and relay operation
f. +12 VDC to remote
g. USB or AM audio to transmitter 600 ohms balanced transformer center-tapped to ground
h. LSB audio to transmitter 600 ohms balanced transformer center-tapped to ground
i. +12 VDC to transmitter provides 12-V keyline relays for remote handset press-to-talk operation

3.15.3.2 Antenna changeover relay. The coaxial cables and the connectors associated with the antenna changeover relay assembly shall be such that, in the event of relay failure, the RF input cable to the relay may be removed and connected to the equipment output connector without unsoldering. The antenna changeover transmit or receive (T/R) relay assembly shall be readily removable for maintenance. NonRF connections shall be made by single miniature terminal board with spade lug connections. In addition to relays required for the antenna TR function, T/R relay assembly shall provide a separate isolated relay contact closure for muting an associated receiver during transmission. The assembly shall conform to the requirements of 3.16.5.5 and 3.16.3.14.

3.15.3.3 PCB extender cards. Extender cards shall be provided for all plug-in PCBs (see 3.4.1 and 3.15.1.33).

3.15.3.4 RF amplifier bias control. Bias control for the AM-3924( )/URT shall be located on the final amplifier chassis and shall be readily accessible with the chassis withdrawn from the case. The control shall be screwdriver adjustable, with a shaft lock.

3.15.4 Power Supply PP-3916( )/UR. The power supply shall be as specified in 3.15.4.1 through 3.15.4.7.

3.15.4.1 PP-3916( )/UR primary power input. The PP-3916( )/UR Power Supply shall operate from a primary power input source of 208 VAC ±10 percent, 48 Hz to 63 Hz, 3-phase wye or 440 VAC ±10 percent, 60 Hz ±5 percent, 3 phase delta in accordance with the Electrical power characteristics paragraph of MIL-E-16400.

3.15.4.2 PP-3916( )/UR outputs. The PP-3916( )/UR shall supply operating high voltages (plate and screen) and 400 Hz blower power for the AM-3924( )/URT, and single phase 115 VAC for system operation of the T-827( )/URT exciter and the AN/URA-38( ) antenna coupler.

3.15.4.3 PP-3916( )/UR protective circuits. In addition to the requirements of MIL-E-16400, the PP-3916( )/UR shall be designed to be adequately protected by the fusing and keyline interlock overload sensing circuits provided in the AM-3924( )/URT.

3.15.4.4 PP-3916( )/UR parts. Particular attention shall be paid to the design, application, and selection of parts, including solid-state devices, as specified in the Parts, materials, and processes paragraph of MIL-E-16400. Parts and devices shall be used in such a manner that overstressing of operation near maximum ratings shall not occur.

3.15.4.5 PP-3916( )/UR continuous operation. The design of the equipment shall permit operation of the power supply when the front panel is open. Continuous duty, with the front panel open, is required.

3.15.4.6 PP-3916( )/UR cooling. PP-3916( )/UR cooling shall be by filtered forced air. Filters shall be used on all air intakes. Filters shall be of a replaceable and cleanable type and shall be readily accessible from the front of the equipment (see 3.15.1.3). The equipment shall be protected from damage in case of obstructed filter or any failure of the air system. Filters shall conform to the requirement of the Filters, air, paragraph of MIL-E-16400 and 3.15.1.3.

3.15.4.7 PP-3916( )/UR interlock switches. Interlock switches which interrupt primary power shall have electrical contact voltage ratings as specified in 3.6.4.

3.15.5 Shock and vibration assembly. The shock and vibration assembly shall be as specified in 3.15.5.1 through 3.15.5.3.

3.15.5.1 Shock, vibration, and inclination. The equipment, when used with its associated mounting assembly, shall conform to the requirements of this specification when subjected to the shock, vibration, and inclination conditions specified in 3.15.1.23.

3.15.5.2 Corners and edges. The shock and vibration mounting assembly shall be streamlined to the extent that it shall have no sharp corners or edges. All corners shall be rounded.

3.15.5.3 Isolators. Shock and vibration isolators shall be bolted to the mounting trays and brackets to permit field replacement of isolators.

3.15.6 Mounting brackets. Mounting brackets, as specified in 3.4g, shall be streamlined to the extent that they have no sharp corners or edges. All corners shall be rounded.

3.15.7 Human engineering. The contractor shall comply with the human engineering operational and maintenance design criteria of MIL-STD-1472 and the requirements specified herein except that equipment shall be designed for use by the 5th percentile female to the 95th percentile male.

3.16 Performance. Detailed performance shall be as specified in 3.16.1 through 3.16.5.8.

3.16.1 General system requirements. General system requirements shall be as specified in 3.16.1.1 through 3.16.1.19.

3.16.1.1 Equipment maximum power output. The equipment shall be capable of transmitting the power output specified in TABLE II into a 50-ohm resistive load on a continuously keyed basis throughout the 2.0 MHz to 30.0 MHz frequency range. The output level variation limits in nondata modes are based on setting the power amplifier front panel power level control for maximum output (see 6.7.1), and inserting standard two-tone audio inputs to the T-827( )/URT in the SSB and ISB modes, and inserting a standard single tone audio input to the T-827( )/URT in the compatible AM mode. In the data modes (F9, F9j), audio input shall be as specified in MIL-STD-188-203-1 net test with a level (each sideband) of 0 dBm ±0.3 decibels (dB). Permissible variation specified in TABLE II includes effects of changes due to operating frequency only, and shall apply with primary supply voltage held constant at the nominal, and ambient temperature maintained at 25 ±5°C. Maximum permissible variation in power output due to variation in primary power voltage within the specified steady-state band shall be 0.5 dB (total). Maximum permissible variation in power due to temperature changes within the specified operating range shall not exceed 1 dB (total).

3.16.1.1.1 Voltage standing wave ratio (VSWR) requirements. The equipment shall be capable of operating at the power levels specified in TABLE II directly into an unbalanced 50-ohm transmission line. The equipment shall have provisions for automatically regulating the power output with an antenna system having an VSWR greater than 1:1 such that no damage will be caused due to the VSWR. The output power level shall be not less than 400 W average in the CW or RATT Modes with an antenna system having a VSWR of 4:1.

TABLE II. Power output.

Emission	Output level	Variation limits 1/
A1, F2j	1000 W average	0 to +1 dB
A3h	250 W carrier with no modulation, 1000 W PEP 2/ with modulation	0 to +1 dB
A3a, A3j, A9b	1000 W PEP	0 to +1 dB
A3b	1000 W PEP with 2 tones in each sideband	0 to +1 dB
F9	1000 W PEP, 100 W average	+2, -1 dB ±1 dB
F9j	1000 W PEP, W average	+2, -1 dB ±1 dB

1/ Variation with output frequency only; temperature and line voltage constant
2/ Peak envelope power

3.16.1.1.1 Voltage standing wave ratio (VSWR) requirements. The equipment shall be capable of operating at the power levels specified in TABLE II directly into an unbalanced 50-ohm transmission line. The equipment shall have provisions for automatically regulating the power output with an antenna system having a VSWR greater than 1:1 such that no damage will be caused due to the VSWR. The output power level shall be not less than 400 W average in the CW or RATT Modes with an antenna system having a VSWR of 4:1.

3.16.1.1.2 Power output range. Power output level control located on the AM-3924( )/URT amplifier front panel shall permit continuous adjustment of the output power to any desired level between 10 milliwatts (mW) PEP or average and the full output levels of TABLE II. The control shall provide both power control and appropriate power monitor switching. Power control shall be provided in five switch-selected ranges of 10 dB each (50 dB, total), with analog control providing adequate resolution within each range and sufficient overlap to ensure continuous control. Power output in the data modes in the 100 W to 1000 W range shall be fixed at the maximum level specified in TABLE II for data modes.

3.16.1.1.2.1 Power output variation with temperatures. Variation in power output shall not exceed a total of 1 dB over the 0°C to 50°C operating range for nominal power outputs of 100 W to 1000 W (maximum clockwise position of power control selector switch). For power setting of less than 100 W, variation shall not exceed ±1 dB (2 dB total) for the same temperature operating range.

3.16.1.1.2.2 Power output variation with supply voltage. For operating in the 100 W to 1000 W range, variation in power output shall not exceed 0.5 dB total over the range of steady-state line voltages and frequencies specified herein. For operation below 100 W, variation in power output over the same steady-state band of supply voltages and frequencies shall not exceed 6 dB (total).

3.16.1.1.2.3 Power control distortion. RF output distortion (excluding distortion due to intermodulation and harmonics) generated by interaction of average power control (APC), peak power control (PPC), and power amplifier closed loop power control circuits shall:

a. Produce distortion products reduced at least 30 dB below either tone of a two-tone output at 1000 W PEP
b. Produce not greater than 5 percent AM of a CW output at 1000 W

3.16.1.1.2.4 Keying and modulation transients. Transients shall comply with a and b:

a. Keying transients. No overshoot shall be present in the initial keyed envelope in the data mode. In the normal (nondata) modes, overshoot on initial keying shall be such that the ratio of the maximum to the steady-state envelope voltages shall not exceed 1.25:1. The keyed envelope shall not exhibit ringing.
b. Modulation transients. No overshoot shall be present in the data mode on initial application of modulating signals. In the normal (nondata) modes, overshoot on initial application of modulation shall be such that the ratio of the maximum to the steady-state envelope voltages shall not exceed 3.0:1. No ringing shall occur on the modulated envelope. These requirements are applicable at any setting of the power control in any normal operating mode for power control ranges below 100 W.

3.16.1.1.2.5 Power output monitoring. The output power monitor of the AM-3924( )/URT amplifier shall provide full scale forward or reflected power output indication of 150 mW to 1500 W in 10 dB steps (5 ranges). Reflected power monitoring shall also be possible at full scale indication of 0.1 of the full scale forward metering range selected. Selection of FORWARD POWER, REFLECTED POWER, or REFLECTED POWER X 0.1 shall be by a switch with spring return to the FORWARD POWER position. Meter indication shall be PEP.

3.16.1.1.2.5.1 Metering accuracy. Forward power delivery to a 50-ohm load shall be within ±1.5 dB of the indicated value when measured at the 1000 W, 100 W, 10 W, 1.0 W, and 0.1 W points on the appropriate meter range providing up scape indication. Maximum total meter error shall not exceed 3 dB at a forward power indication of 50 mW, or 6 dB at a forward power indication of 10 mW, into a 50-ohm load. Reverse power meter indications for a 50-ohm load shall not correspond to a VSWR greater than 1.4:1 at any operating frequency or power level.

3.16.1.1.2.5.2 Reverse power susceptibility. An available equipment power of 100 mW at any frequency in the range from 40 MHz to 1000 MHz, applied from a 50-ohm source to the equipment antenna terminals, shall not produce forward or reflected power indications greater than 5 mW.

3.16.1.1.2.5.3 RF output monitor sample. A sample of the radio transmitter RF output shall be provided to a receptacle located on the AM-3924( ) front panel. The sample port source impedance shall be nominally 50 ohms, and the sampling ration shall be -60 dB, ±8 dB, relative to the RF output delivered to a 50-ohm load connected to the antenna terminals.

3.16.1.2 Frequency stability. The frequency stability of the equipment system shall be as specified for the T-827( )/URT in MIL-T-23645.

3.16.1.3 Modes of operation. Modes of equipment operation shall be as specified in 3.7.2.

3.16.1.4 Intermodulation distortion (normal mode). All intermodulation products of the equipment, when operated as complete system, shall be reduced at least 33 dB below either tone of a two-tone envelope at a minimum of 1000 W PEP, from 2.0 MHz to 30.0 MHz, produced by using the standard two-tone input (see 6.7.2), except the limits shall be between 30 dB and 33 dB for 5 frequencies and between 27 dB and 30 dB for three additional frequencies in accordance with 4.5.8.2.

3.16.1.4.1 Vibration test distortion. Any vibration related AM shall be less than 3 percent of a single tone RF output of 250 W. There shall be no breakup of the RF output signal. Phase deviation over an averaging time of 9.09 milliseconds (ms) or 18.18 ms shall not exceed 6 degrees between any two successive frames of 13.3 ms, or 22 ms, respectively.

3.16.1.5 Harmonic suppression. Second harmonic output shall be reduced at least 42 dB below the reference output in the A1 mode at any operating frequency from 2 MHz to 30 MHz, and at any operating output power level from 1 kilowatt (kw) to 10 mW. All other harmonic outputs shall be at least 52 dB below the reference A1 output level.

3.16.1.6 Carrier suppression. In SSB or ISB modes of operation, with the carrier insertion switch in the full carrier suppression position, the carrier shall be suppressed a minimum of 40 dB below any desired RF output signal level by a 1300-Hz modulating signal inserted into USB, LSB, or both sidebands audio inputs. With the carrier insertion switch in the 0 dB (full carrier), -10 dB, or -20 dB position, the carrier shall be within 3 dB of the selected level relative to a single tone output in USB or LSB modes. These requirements are applicable to any power output specified in 3.16.1.1.2.

3.16.1.7 Opposite sideband suppression. The level of the opposite sideband signal (measured at a frequency 1 kilohertz (kHz) or more from the suppressed carrier) shall be suppressed a minimum of 50 dB below a single tone output at any level specified in the 3.16.1.1.2.

3.16.1.8 Narrowband spurious RF emissions. Narrowband spurious RF emissions when measured across a standard 50-ohm resistive load at the equipment RF output terminals, shall conform to the requirements specified in 3.16.1.8.1 and 3.16.1.8.2. Suppression requirements are relative to a single-tone output of 250 W in the 100-W power control range, and to a single-tone output at any level specified in 3.16.1.1.2 for power control ranges below 100 W. In no event is suppression of spurious narrowband products below -120 dBm required.

3.16.1.8.1 Out-of-band emissions. All out-of-band narrowband emissions with the exception of harmonics of the operating frequency shall be reduced as specified in a and b:

a. $f_o < 20$ MHz

$\frac{f_o}{1.025} < f_s < 1.10f_o$: 50 dB

$\frac{f_o}{1.10} \geq f_s \geq 1.10f_o$: 90 dB

$\frac{f_o}{1.15} \geq f_s \geq 1.15f_o$: 120 dB

b. $f_o \geq 20$ MHz

$\frac{f_o}{1.025} < f_s < 1.10f_o$: 50 dB

$\frac{f_o}{1.10} \geq f_s \geq 1.10f_o$: 90 dB

$\frac{f_o}{1.15} \geq f_s \geq 1.15f_o$: 110 dB

Where f_o is the equipment operating frequency, and f_s is the frequency of a spurious emission.

3.16.1.8.2 In-band products. Spurious emissions which fall within the information band shall be reduced at least 40 dB below a single-tone reference RF output in the A3j mode. The requirement is applicable for either modulated, or keyed but unmodulated equipment, and includes frequencies which are produced by modulation of the carrier by harmonics of the tone.

3.16.1.9 Noise. Equipment noise emissions, measured across a standard 50-ohm resistor load at the RF output terminal shall conform to the requirements specified in 3.16.1.9.1 through 3.16.1.9.3.

3.16.1.9.1 Key-up noise. With the audio input terminated in a 600-ohm resistance, no audio input signal, and the equipment unkeyed, the in-band noise output shall not exceed -115 dBm for the 3-kHz information band.

3.16.1.9.2 Keyed and modulated in-band noise. With a standard single-tone audio input in the normal mode (USB or LSB), broadband noise in a 1-Hz band within the selected 3-Hz sideband shall be a minimum of 75 dB below the single tone 250-W reference RF output. For power ranges below 100 W to 1000 W, in-band noise shall be further reduced by 10 log 250/P (W) dB.

3.16.1.9.3 Broadband noise spectral density (out-of-band). Broadband noise in a 3-kHz band removed from the operating frequency by 10 percent or more shall not exceed -60 dBm for operating frequencies below 6 MHz or -70 dBm for operating frequencies above 6 MHz. This requirement is applicable in any operating mode, at any power level specified in 3.16.1.1.2.

3.16.1.10 Power supply hum distortion. All hum distortion products shall be suppressed a minimum of 45 dB with respect to a single-tone RF output produced by a standard single-tone audio input. This requirement is applicable at any RF output power level specified in 3.16.1.1.2.

3.16.1.11 APC circuit. An APC circuit shall be provided to maintain the average power output within safe limits, when operated as a system, and to maintain the level of the re-inserted carrier in the A3h (compatible AM) mode.

3.16.1.12 PPC circuit. A PPC circuit shall be provided to limit the power output peaks to a level sufficient to safeguard the equipment, including the associated Antenna Coupler Group AN/URA-38( ), from damage.

3.16.1.13 CW keying. Keying speeds up to 80 baud shall be possible. The keyed wave shall be free from transients and splatter.

3.16.1.14 RATT keying. Keying speeds up to 80 baud, using total frequency shifts of either 850 Hz, or 170 Hz, centered on 2000 Hz, shall be possible. External RATT input shall be possible with a neutral input of 120 VDC, 50 mA to 75 mA. RATT emission shall be in USB of the equipment.

3.16.1.15 System efficiency. The overall equipment efficiency shall be no less than 20 percent when operating in the A1 mode at 1000-W average power output.

3.16.1.16 Regeneration. There shall be no evidence of unintended oscillation or instability under any operating conditions.

3.16.1.17 Oscillator radiation. Oscillator radiation shall conform to the Class A4 requirements of MIL-STD-461.

3.16.1.18 Electromagnetic compatibility (EMC). The equipment shall conform to the requirements of MIL-STD-461 for Class A4, communication-emission equipment. For CE03 power line conducted emissions, broadband limits of MIL-STD-461 are increased by 20 dB for frequencies below 2 MHz. The transmitter operating frequency is not included in CE03 requirements. Narrowband CE03 limits are increased by 30 dB for harmonics through the third. For RE02 electric field radiated emissions, the fundamental equipment frequency and its harmonics are not included.

3.16.1.19 Accelerated life. The equipment shall conform to the requirements of the Accelerated life paragraph of MIL-E-16400.

3.16.2 Transmitter (Exciter) T-827( )/URT. The T-827( )/URT shall conform to the performance requirements of MIL-T-23645.

3.16.3 RF Amplifier AM-3924( )/URT. The RF amplifier shall be as specified in 3.16.3.1 through 3.16.3.25.

3.16.3.1 Power output. The minimum power delivered to a standard dummy load (see 6.7.4) over the frequency range of 2 MHz to 30 MHz shall be at least as specified in TABLE III, when driven by a source having the maximum power output capability specified for the mode of operation being measured.

TABLE III. RF power inputs and outputs.

Signal type	Input level	Output level
SSB (A3j)	250 mW (PEP)	1000 W (PEP)
Compatible AM (A3h)	62.5 mW carrier, 250 mW (PEP) with sideband	250 W carrier, 1000 W PEP with sideband
CW (A1) and RATT (A7j)	250 mW (average)	1000 W (average)
ISB (A3b)	62.5 mW (PEP) per sideband	250 W (PEP) per sideband
0 +12.5 kHz (F9)	250 mW (average)	1000 W (average)

3.16.3.2 Frequency range and tuning. The frequency range shall be from 2.0 MHz to 30.0 MHz. The RF amplifier shall accept coded channel information from the T-827( )/URT and automatically select the proper operating band and mode in accordance with the requirements of this specification. The RF amplifier operating band shall also be selectable manually by a front panel switch.

3.16.3.3 RF amplifier modes of operation. RF amplifier modes of operation shall be as specified in 3.7.2.

3.16.3.4 Intermodulation distortion. Odd-order intermodulation products shall be at least 40 dB below either tone of a two-tone RF output at a minimum of 1000 W PEP into a 50-ohm resistive load. Amplifier RF drive shall consist of two equal tones in the selected frequency band, separated by a maximum of 1000 Hz.

3.16.3.5 Harmonic output. The second harmonic output shall be reduced at least 45 dB below a single tone RF output of 1000 W with the power amplifier conditioned for operation in the A1 or F2j mode. All other harmonics shall be reduced at least 55 dB below 1000 W.

3.16.3.6 RF amplifier broadband noise spectral density. Spurious broadband noise emissions into a 50-ohm termination measured in the A3j mode in a three kHz bandwidth, shall not exceed -70 dBm over the frequency range of 1 MHz to 32 MHz with the RF amplifier in a key-down condition and RF input terminated with a shielded 50-ohm resistor.

3.16.3.7 RF amplifier APC or transmitter gain control (TGC). Circuitry shall be provided in the AM-3924( )/URT to generate gain control voltages to automatically adjust the associated T-827( )/URT output, keeping the RF amplifier average power output at the desired level when operated in an AN/URT-23( ) system. For the normal (nondata) modes, the APC system shall control system gain. In the data modes, an infinite-memory TGC system shall be employed which holds system gain at the desired value during extended periods of key-up operation. The TGC system shall provide for slow surveillance, correcting for long-term drift in power output due to temperature or line voltage changes. For operation in the 100 W to 1000 W power control range, the APC or TGC system, as appropriate, shall provide a gain control loop around the complete AN/URT-23( ) signal path from the AM-3924( )/URT VSWR bridge to the T-827( )/URT IF amplifier. In power control ranges below 100 W the signal envelope sample input to the APC or TGC generator shall be obtained from the AM-3924( )/URT input drive line, closing the power control loop around only the T-827( )/URT exciter.

3.16.3.8 RF amplifier PPC. PPC circuitry shall be provided in the AM-3924( )/URT to generate control voltages to protect the AM-3924( )/URT output circuits and an associated antenna coupler from damage due to excessive peak RF output levels. In normal operation, excessive peak output shall result in a DC output voltage developed within the AM-3924( )/URT, which is supplied to the gain controlled IF amplifier in the associated T-827( )/URT exciter. Should a failure occur in this overall loop, a secondary PPC loop contained solely within the AM-3924( )/URT shall provide protection. Independent PPC threshold adjustments shall be provided for both internal and external loops. No adjustment of PPC thresholds shall be required when changing equipment operating modes, such as from A3j to A3h, and PPC action shall not produce carrier compression when modulation is added to the carrier in the A3b mode.

3.16.3.9 RF amplifier protection. The AM-3924( )/URT shall cntain internal protection against damage due to overdrive resulting from:

a. Loss of external APC or PPC control of the associated equipment T-827( )/URT, or overdrive by a signal source with no automatic output control capability.
b. Any condition in the power amplifier envelope detector or APC and PPC generation system which results in loss of both external and internal loop control voltages. Protection circuitry shall not produce increased intermodulation distortion under normal operating conditions.

3.16.3.10 RF amplifier input impedance. The AM-3924( )/URT input impedance shall be 50-ohms resistive (nominal).

3.16.3.11 RF amplifier regeneration. There shall be no evidence of unintended oscillation or instability under any condition of operation of the RF amplifier, particularly when used with a supply voltage 10 percent higher than the nominal primary line voltage.

3.16.3.12 Power supply hum distortion. All output hum distortion signals (see 6.7.5) shall be suppressed a minimum of 50 dB with respect to an RF output of 250 W produced with a single tone RF input signal at any frequency within the selected power amplifier frequency band.

3.16.3.13 Antenna tuning power level. In order to provide safe operation into an associated tuning device, provision shall be made to operate the RF amplifier at reduced adjustable power levels of 50 W to 250 W while the associated antenna tuning device is in a tune condition. This provision shall be automatic in operation when used with the associated antenna coupler.

3.16.3.13.1 Antenna coupler overload. Provision shall be included to unkey the RF amplifier when an overload occurs in the associated antenna coupler.

3.16.3.13.2 Local key. The RF amplifier shall be provided with a local key switch located on the front panel. The switch shall provide center off, momentary, and locked-key positions. The momentary (spring return to off) position shall provide a reduced power level suitable for tuning an associated antenna coupler without risk of damage to either the amplifier or coupler. In the locked-key position full equipment output shall be provided.

3.16.3.14 Transmit or receive (T/R) relay assembly. A high-speed T/R relay assembly shall be provided to permit rapid switching of a common antenna between the equipment and an associated receiver in a simplex system. A receiver antenna input receptacle shall be provided. The T/R relay assembly shall be designed so that an available power of 500 W delivered to the antenna port from a 50-ohm source at a single frequency anywhere in the 2 MHz to 30 MHz region (equipment unkeyed) shall not cause damage to the T/R relay assembly. Compliance with this requirement shall be demonstrated with the receiver port terminated in 50 ohms.

3.16.3.14.1 T/R relay assembly life. The high speed relay assembly shall be capable of at least 1 million operations without mechanical failure or excessive increase in contact resistance. Excessive contact resistance is resistance exceeding 0.050 ohms.

3.16.3.15 Antenna tuning equipment. The RF amplifier shall provide required interconnection circuitry and shall be capable of operation with Antenna Coupler Group AN/URA-38( ).

3.16.3.16 Primary power input. The RF amplifier shall conform to the primary power input requirements specified in 3.6.

3.16.3.17 Primary power outputs. The RF amplifier shall provide system prime power interconnections for 115-VAC 60-Hz power originating in the PP-3916( )/UR to the T-827( )/URT and AN/URA-38( ).

3.16.3.18 Warm-up time. The RF amplifier shall conform to all specification requirements after a 5 minute warm-up period, and shall contain a time-delay circuit to protect against operation before adequate warm-up.

3.16.3.19 Tune time. In automatic operation, tune time for the RF amplifier shall be not more than 10 seconds.

3.16.3.20 Protection. The equipment shall be protected from any condition of component overheating, overdrive, mistuning, improper loading, open circuiting, grounding, or short circuits of the RF output. Protection against excessive reflected power caused by mismatching a load presenting a VSWR outside the rated load matching capability shall be included (see 3.16.1.1.1).

3.16.3.21 Overload protection. Suitable overload circuits shall be included to prevent damage to the RM amplifier (including tubes) and power supply due to improper loading, circuit malfunction, or primary input power surge. This circuit shall protect the RF amplifier without the necessity of closed loop control to the exciter.

3.16.3.21.1 Overload indicator. An overload indicator shall be provided to give visual indication when an overload condition has occurred. An audible overload indicator is not required.

3.16.3.22 Tubes. The design of the equipment shall preclude a requirement for use of selected tubes. It shall be possible to install and operate any tube of the same type without special selection. Circuitry that will permit individual power amplifier tube adjustment to compensate for widely varying characteristics is permissible. Balancing of parallel operated tubes under dynamic conditions shall be possible.

3.16.3.23 RF amplifier primary frequency bands. The AM-3924( )/URT shall include 19 primary bands, as specified in a through c:

a. Four bands, of 0.5-MHz bandwidth from 2.0 MHz to 4.0 MHz
b. Four bands, of 1.0-MHz bandwidth from 4.0 MHz to 8.0 MHz
c. Eleven bands, of 2.0-MHz bandwidth from 8.0 MHz to 30.0 MHz

3.16.3.24 Push-to-talk (PTT) relay. The AM-3924( )/URT shall provide an ungrounded voltage to the PTT relay in the associated T-827( )/URT.

3.16.3.25 Final amplifier screen circuit protection. Positive protection shall be provided against damage to the final amplifier screen bias circuit components due to plate-to-screen arc-overs. Protection circuitry shall reset automatically when the arc extinguishes. Blowing of primary power fuses during plate-to-screen arc-overs is permissible.

3.16.4 Power Supply PP-3916( )/UR. The power supply shall be as specified in 3.16.4.1 and 3.16.4.2.

3.16.4.1 Efficiency. Power supply efficiency, under the conditions of driving the RF amplifier to full average power output, shall permit continuous operation at an ambient temperature of +500°C without degradation to component reliability due to excessive temperature. Efficiency shall be at least 80 percent.

3.16.4.2 Warm-up time. Conformance to all power supply requirements shall be achieved after one minute from equipment turn-on.

3.16.5 Data requirements. NTDS capability shall be provided in accordance with the requirements specified in 3.16.5.1 through 3.16.5.8.

3.16.5.1 Power output. (See 3.16.1.1 and TABLE II.)

3.16.5.2 Keyline operation. The exciter shall be held in the keyed condition continuously in the data mode. System keying in the data mode shall be possible by each of the methods specified in a through c:

a. +5 to +7 VDC applied to the primary center tap of the USB audio input transformer
b. +5 to +7 VDC applied to the primary center tap of the LSB audio input transformer
c. +5 to +7 VDC applied to an independent keyline input

The keyline detector circuits shall present a minimum load resistance of 3000 ohms to the data keyline. The equipment shall be unkeyed when all of the keyline inputs are between 0 VDC and 0.5 VDC. It shall be possible to supply the data key by any of the methods specified in a, b, or c with connections applied either through the modem connector (see 3.15.1.3.1), or from the switchboard connector of the AM-3924( )/URT. For independent keyline operation through the equipment switchboard connector, the normal mode CW or RATT connection shall be used, with switching of this function provided by the data-normal switch.

3.16.5.3 TGC. The TGC system shall automatically establish the proper gain to conform to the average power requirements of 3.16.1.1 by a tune keying command following initial turn-on or a change in operating frequency. The TGC system shall be of the infinite memory variety, preserving the proper exciter gain control voltage for subsequent rekeying of the system when no power interruption or change in operating frequency has occurred. Interlocks shall be provided as required to provide fail-safe protection against equipment damage.

3.16.5.4 PPC of multitone data signal. Equipment peak power control of the multitone data RF output shall be primarily a function of the average power determined by the TGC system and the peak to average power ratio of the data audio signal. The equipment closed-loop feedback PPC system shall function in the data mode only to provide back-up protection against equipment damage, and to reduce equipment output to safe levels when the load VSWR exceeds 1.5:1. When the closed loop PPC system is functional, it shall be unconditionally stable. No spurious modulation components shall result from PPC loop instability from any cause, including equipment loads producing VSWRs of 6:1 maximum. Attack and decay time constants of the envelope detector used to develop APC, TGC, and PPC control voltages shall be independent of the corresponding time constants for the power metering systems.

3.16.5.5 Data attack and release time. The high speed antenna T/R relay pull-in and AM-3924( )/URT keying attack time shall be such that the equipment RF output shall be within 1 dB of steady-state, without ringing, within 7 ms following keyline closure (audio applied continuously). The antenna T/R relay release time shall not exceed 7 ms. The relationship between T/R relay operate and release time and the corresponding AM-3924( )/URT bias keying time constant shall be such as to prevent hot switchng of equipment RF output. Hotshotting of the T/R relay coils shall not be employed to obtain compliance with the operate time requirement.

3.16.5.6 Receiver monitor sample. A monitor sample of the equipment RF output shall be provided to the input terminals of the receiver during transmissions. The amplitude of this RF output sample, measured into a 50-ohm load, shall be -40 dBm +6 dB over the full operating frequency range of 2 MHz to 30 MHz. Conformance to this requirement shall be achieved with the equipment in the USB or LSB mode, with a single tone audio input of 0 dBm to the appropriate audio input terminals, and with maximum equipment output power.

3.16.5.7 Data mode (multitone) intermodulation distortion. Intermodulation distortion products falling in any data tone channel shall be a minimum of 20 dB below the data reference tones when measured in accordance with the procedure of 4.5.8.28. This requirement applies to the peak value of the sum of all products which fall in vacant channel.

3.16.5.8 Data tune power. Provision shall be included to permit local tune-keying of the equipment while in the data mode, using the AM-3924( )/URT local or tune switch, to provide an AM carrier for tuning an associated antenna coupler. The amplitude of this signal shall be continuously adjustable by a data mode system to make appropriate corrections to the system gain during initial operation after local tune-keying, to correct for tune power departures from the nominal 200 W (SSB) data average power output.

3.17 Quantitative maintainability. This requirement applies to the GFE design. If the GFE design does not conform to this requirement, redesign of the equipment shall preserve compatibility with the GFE. The equipment shall have a mean-corrective-maintenance-time (M_{ct}) not exceeding 2.33 hours and a maximum-corrective-maintenance-time (M_{maxct}) (95th percentile) not exceeding 7.0 hours when corrective maintenance is accomplished at the organizational level of maintenance by the replacement of lowest subassemblies (modules, PCBs) and chasssis-mounted parts (electronic, electrical, electromechanical and mechanical parts). The corrective maintenance time includes localization, isolation, disassembly, interchange, reassembly, alignment and checkout for all corrective maintenance mode whenever a failure, including a malfunction that allows degraded operation, occurs.

3.18 Workmanship. Workmanship shall be as specified in 3.18.1 and 3.18.2.

3.18.1 General workmanship. Workmanship and soldering shall be in accordance with MIL-E-16400.

3.18.2 Workmanship screen. All equipment shall withstand a defect detection vibration screen of random type vibration at $0.04g^2/Hz$ ±3 dB from 80 Hz to 350 Hz and temperature cycling as specified in 4.5.3.2.2.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall conform to all requirements of Section 3 and Section 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Government verification. All quality assurance operations performed by the contractor will be subject to Government verification at any time. Verification will consist of, but is not limited to, a) surveillance of the operations to determine that practices, methods, and procedures of the written quality program are being properly applied, b) Government product inspection to measure quality of the product to be offered for acceptance, and c) Government inspection of delivered products to assure compliance with all inspection requirements of this specification. Failure of the contractor to promptly correct deficiencies discovered by him or of which he is notified shall be cause for suspension of acceptance until corrective action has been taken or until conformance of the product to prescribed criteria has been demonstrated.

4.1.3 Quality assurance terms and definitions. Quality assurance terms used in this specification shall be as defined in MIL-STD-109.

4.2 General inspection. Inspection shall be as specified in MIL-E-16400, except as otherwise specified in 4.2.1 through 4.4.4.

4.2.1 Classification of inspections. The inspection requirements specified herein are classified as specified in a through e:

a. First article inspection (see 4.3)
b. Quality conformance inspection
    1. Production inspection (Group A) (see 4.4.1)
    2. Production control inspection (Group B) (see 4.4.2)
    3. Environmental inspection (Group C) (see 4.4.3)
c. Reliability testing (see 4.6)
d. Maintainability demonstration (see 4.7)
e. Inspection of preparation for delivery (see 4.8)

4.3 First article inspection. Unless otherwise specified (see 6.2), two units shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. First article inspection shall include the tests specified in TABLE IV.

4.4 Quality conformance inspection. Quality conformance inspection shall be as specified in 4.4.1 through 4.4.4.

4.4.1 Production inspection (Group A). Production inspection shall be made on every item offered for delivery. This inspection shall comprise examinations and tests which will prove the workmanship and reveal omissions and errors of the production process such as: functional and performance tests at a limited number of points in the required range, tests which detect deviations from design, test or controls or adjustments, and tests which detect hidden defects of materials. Production inspection shall include the examinations and tests specified in Group A of TABLE IV, subject to the conditions specified in 4.4.1.1.

4.4.1.1 Group A tests. Group A tests shall be performed in accordance with the test methods specified in 4.5 except as specified in a through e:

a. Harmonic output 2 MHz, 4 MHz, 8 MHz, and 28 MHz bands
b. Carrier suppression 2 MHz, 15 MHz, and 29 MHz band, in A3j mode
c. Opposite sideband suppression 2 MHz, 15 MHz, and 29 MHz bands, in A3j mode
d. Spurious outputs. Twenty frequencies of highest output level determined by first article tests
e. Frequency stability (5 MHz). Verify that the output frequency is identical to the frequency selected on the equipment front panel

TABLE IV. Examinations and tests.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection		
				Group A	Group B	Group C
Surface examination	3.4	4.5.1	X	X		
Parts, materials, and processes	3.1.2	4.5.1	X	X		
Finish	3.1.2	4.5.1	X	X		
Deflection or sway	3.8.1.1	4.5.7	X			
Remote operation	3.9.1	4.5.6	X		X	
MUTE interface	3.9.3	4.5.8.9	X	X		
Weight	3.10	4.5.1	X		X	
Dimensions	3.10	4.5.1	X		X	
Mechanical design	3.15	4.5.1	X		X	
Drawer orientation	3.15.1.1	4.5.6	X	X		
Bonding and grounding	3.15.1.4	4.5.6	X	X		
Corrosion protection	3.15.1.5	4.5.6	X		X	

TABLE IV. Examinations and tests. (continued)

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection		
				Group A	Group B	Group C
Painting	3.15.1.5.1	4.5.1	X		X	
Welding	3.15.1.25	4.5.1	X		X	
Conductor identification	3.15.1.28.1	4.5.1	X		X	
Marking	3.15.1.29	4.5.1	X	X		
Maintainability	3.17	4.7				X
General workmanship	3.18.1	4.5.3.1	X	X		
Soldering	3.18.1	4.5.3.1	X	X		
Random vibration	3.18.2	4.5.3.2.1	X	X		
Temperature cycling	3.18.2	4.5.3.2.2	X	X		
System tests:						
Steady-voltage power	3.6	4.5.1, 4.5.8.3	X		X	
Steady-state frequency	3.6	4.5.1, 4.5.8.3	X		X	
Power and power factor	3.6	4.5.1, 4.5.8.3	X		X	
Transient voltage	3.6.1	4.5.1, 4.5.8.3	X		X	
Transient frequency	3.6.1	4.5.1, 4.5.8.3	X		X	
Power interruption	3.6.1, 3.6.6	4.5.1, 4.5.8.4, 4.5.4	X		X	
Modes of operation	3.7.2	4.5.6	X		X	
Remote operation	3.9.1	4.5.8.9	X			
Temperature sequence	3.11	4.5.1, 4.5.8.8	X			X
Low temperature	3.11	4.5.1, 4.5.8.8	X			X
High temperature	3.11	4.5.1, 4.5.8.8	X			X
Humidity	3.11	4.5.1, 4.5.8.8	X			X
Salt fog	3.11	4.5.1	X			X
Reliability	3.13	4.6	X			
Enclosure	3.11, 3.15.1.3	4.5.1, 4.5.8.5	X			X
Shock	3.11, 3.15.1.23.1	4.5.1, 4.5.8.6	X			X
Vibration	3.11, 3.15.1.23.2	4.5.1, 4.5.8.6	X			X
Inclination	3.11, 3.15.1.23.3	4.5.1, 4.5.8.6	X			X
Thermal design	3.15.1.34	4.5.1	X			
Power output	3.16.1.1	4.5.7, 4.5.8.1	X	X	X	
VSWR	3.16.1.1.1	4.5.7, 4.5.8.1.1	X		X	
Power level control	3.16.1.1.2	4.5.7	X		X	
Power output variation with temperature	3.16.1.1.2.1	4.5.7	X			
Power control distortion	3.16.1.1.2.3	4.5.7, 4.5.8.22	X		X	
Keying and modulation transients	3.16.1.1.2.4	4.5.7, 4.5.8.25	X			
RF monitor sample	3.16.1.1.2.5.3	4.5.8.34	X			
Leakage current	3.6.6	4.5.4	X			
Power output monitoring	3.16.1.1.2.5	4.5.7, 4.5.8.22, 4.5.8.26	X		X	
Reverse power susceptibility	3.16.1.1.2.5.2	4.5.7, 4.5.8.24	X			
Frequency stability	3.16.1.2	4.5.7	X	X		
Intermodulation distortion	3.16.1.4	4.5.7, 4.5.8.2	X	X		
Vibration test distortion	3.16.1.4.1	4.5.7	X			
Harmonic suppression	3.16.1.5	4.5.7, 4.5.8.10	X	X	X	

TABLE IV. Examinations and tests. (continued)

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection		
				Group A	Group B	Group C
Carrier suppression	3.16.1.6	4.5.7, 4.5.8.11	X	X	X	
Opposite sideband suppression	3.16.1.7	4.5.7, 4.5.8.11	X	X	X	
Out-of-band emissions	3.16.1.8.1	4.5.7, 4.5.8.12	X		X	
In-band spurious emissions	3.16.1.8.2	4.5.7, 4.5.8.12	X		X	
Noise	3.16.1.9	4.5.7, 4.5.8.13	X		X	
Hum distortion	3.16.1.10	4.5.7, 4.5.8.14	X		X	
APC	3.16.1.11	4.5.6, 4.5.8.15	X		X	
PPC	3.16.1.12	4.5.6, 4.5.8.16	X		X	
CW keying	3.16.1.13	4.5.7, 4.5.8.17	X		X	
RATT keying	3.16.1.14	4.5.7	X		X	
Efficiency	3.16.1.15	4.5.7	X		X	
Regeneration	3.16.1.16	4.5.6	X		X	
Oscillator radiation	3.16.1.17	4.5.7	X		X	
EMI	3.16.1.18	4.5.7, 4.5.8.19	X			X
Accelerated life	3.16.1.19	4.5.1, 4.5.8.20	X			
Data requirements:						
Keyline operation	3.16.5.2	4.5.7	X		X	
TGC	3.16.5.3	4.5.6	X		X	
PPC of multitone data signal	3.16.5.4	4.5.7	X		X	
Data attack and reverse time	3.16.5.5	4.5.7	X		X	
Receiver monitor sample	3.16.5.6	4.5.7	X		X	
Intermodulation distortion	3.16.5.7	4.5.7, 4.5.8.28	X		X	
Tune power	3.16.5.8	4.5.7	X		X	
T-827 tests	3.16.2	4.5.6, 4.5.7	X	X	X	X
AM-3924 tests:						
Power output	3.16.3.1	4.5.8.1, 4.5.8.20	X	X	X	
Protection	3.16.3.20	4.5.6	X			
Intermodulation	3.16.3.4	4.5.8.2, 4.5.8.20	X	X	X	
Harmonic output	3.16.3.5	4.5.8.10, 4.5.8.20	X		X	
Spectral density	3.16.3.6	4.5.7	X		X	
APC	3.16.3.7	4.5.6	X		X	
PPC	3.16.3.8	4.5.6	X		X	
RF amplifier protection	3.16.3.9	4.5.6	X		X	
Regeneration	3.16.3.11	4.5.6	X		X	
Hum distortion	3.16.3.12	4.5.7, 4.5.8.31, 4.5.8.32	X		X	
Tune power level	3.16.3.13, 3.16.3.14	4.5.7	X		X	
T/R relay assembly life	3.16.3.14.1	4.5.2, 4.5.8.27	X			
Tune time	3.16.3.19	4.5.7	X		X	
Overload protection	3.16.3.21	4.5.6	X			
Tubes	3.16.3.22	4.5.6	X			
Primary frequency bands	3.16.3.23	4.5.6	X			
Imput impedance	3.16.3.10	4.5.7	X			
PT relay	3.16.3.24	4.5.6	X			
PP-3916 tests:						
Efficiency	3.16.4.1	4.5.7	X		X	

4.4.2 Production control inspection (Group B). Production control inspection shall be conducted on a sampling basis in accordance with the inspection procedures of MIL-STD-105, using inspection level S-3 with an acceptable quality level of 6.5 percent for each attribute. Production control inspection shall consist of the examinations and tests which encompass functional and performance tests throughout the entire range of operation; tests which will detect any deterioration of the design by wear of such items as dies, molds, and jigs, and by substitution of different parts; tests which detect deviations in the processing of materials; tests to determine temperature rise produced in operation and ability of equipment to determine temperature rise produced in operation and ability of equipment to withstand this heat; tests of efficiency; and tests of performance with other equipment in a system. These tests shall be performed on the complete equipment as offered for delivery. Production control inspection shall include the examination and tests shown in Group B of TABLE IV. Production control inspection shall be conducted on inspection lots that have passed the production inspection specified in 4.4.1.

4.4.2.1 Rejected lots. If an inspection lot is rejected, the contractor may withdraw the lot from further inspection. The contractor may also rework a rejected lot to correct the defects or screen out the defective units and reinspect the lot, using tightened inspection. Rejected lots shall be kept separate from the new lots and shall not lose their identity.

4.4.3 Environmental inspection (Group C). Environmental inspection shall be conducted on a sampling basis as specified in 4.4.3.1. Environmental inspection shall encompass environmental tests to prove the durability of the materials, parts, units, and equipments as a whole; life tests, simulated service tests; tests of the effects of changes of environment (such as extremes of temperature and humidity, effect of salt air); and tests of the effects of shock, vibration, and inclination. Environmental inspection shall include the examination and tests shown in TABLE IV, Group C.

4.4.3.1 Sampling for environmental inspection. The equipment selected for environmental inspection shall pass all tests, except electromagnetic interference (EMI), prior to acceptance of a lot from which the sample is selected. One equipment from the first month's production lot, or from the first 50 units produced, shall be subjected to environmental inspection. One equipment from each successive production of 100, or one per month if less than 100 are produced monthly, shall be subjected to environmental inspection. One equipment from each 200 equipments produced shall be subjected to EMI tests. Environmental inspection shall be performed on equipments that have passed the production inspection specified in 4.4.1.

4.4.3.2 Nonconforming environmental inspection sample units. If a sample unit fails the inspection specified in 4.4.3, the contractor shall immediately investigate the cause of failure and shall report to the Quality Assurance Representative (QAR) the results thereof and details of the corrective action taken to correct units of product which were manufactured under the same conditions, with the same materials, processes, and so forth. If the QAR does not consider that the corrective action will enable the product to conform to specified requirements, or if the contractor cannot determine the cause of the failure, the matter shall be referred to the contracting officer (see 6.6).

4.4.4 Reinspection of conforming production control and environmental inspection sample units. Unless otherwise specified (see 6.2.1), sample units which have been subjected to, and have passed production control or environmental inspections, or both, may be accepted on the contract provided they are resubjected to, and pass, production inspection specified in 4.4.1 after repair of all defects.

4.5 Test methods. Examinations and tests shall be as specified in 4.5.1 through 4.5.8.34.

4.5.1 Examinations and tests. When 4.5.1 is specified in TABLE IV, the test method specified in MIL-E-16400 shall be applied.

4.5.2 Test by analysis. When 4.5.2 is specified in TABLE IV, the test may be performed by analysis or calculation, or both.

4.5.3 Workmanship. Workmanship shall be as specified in 4.5.3.1 through 4.5.3.2.2.

4.5.3.1 General workmanship and soldering. The equipment, including subassemblies and assemblies, shall be examined for workmanship and soldering during the fabrication and assembly process for conformance to the requirements specified in 3.18.1. Each solder connection and its associated wiring or leads shall be visually examined.

4.5.3.2 Workmanship screen. Workmanship screen shall be as specified in 4.5.3.2.1 and 4.5.3.2.2.

4.5.3.2.1 Random vibration. Prior to conducting temperature cycling, vibration screening shall be performed on each equipment. The vibration screening may be performed at the module, drawer, or end item level. All the hardware, including cables and connectors, shall be exposed to vibration. The vibration shall be random, or subject to procuring activity approval, pseudo-random or complex waveform vibration, for an accumulated time of ten minutes in the axis deemed most susceptible to vibration excitation. All items shall be hard-mounted (without shock isolators) and subjected to the vibration conditions of FIGURE 1. Input vibration levels shall be measured at the mounting points of the item under vibration. If variations are found at these points, the level used for control purposes shall be the average of the levels at the mounting points. Control equipment having a bandwidth no greater than 10 Hz for vibration frequencies up to 500 Hz, and 100 Hz for vibration frequencies above 500 Hz, shall be used for the control and analysis of the acceleration spectral density (ASD). The instantaneous acceleration peaks shall be limited to three times the root-mean-square (rms) acceleration level. All failures occurring during screening shall be corrected and the vibration resumed.

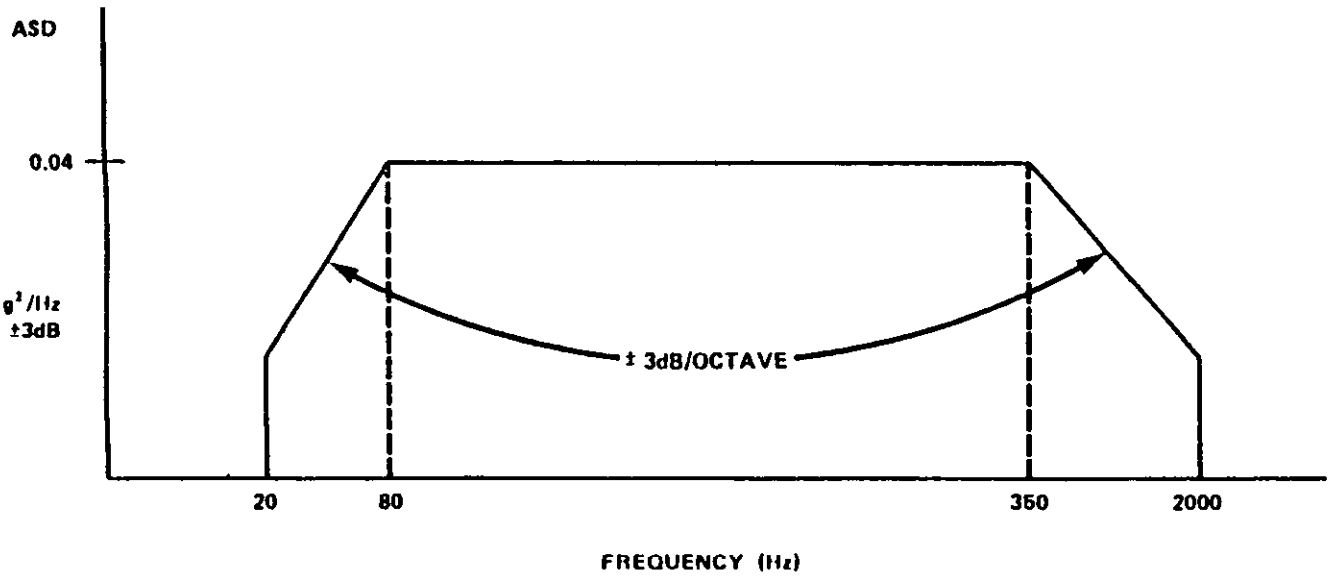


FIGURE 1. Random vibration curve.

4.5.3.2.2 Temperature cycling. Each unit shall be subjected to 10 cycles of the temperature curve shown in FIGURE 2. The temperature rate of change shall be not less than 5°C per minute. Unit power shall be turned on and off at the indicated times. The unit shall be positioned for maximum exposure to the changing temperature. Where performance measurements are called for, a minimal functional operating test shall be performed. The dwell time shall be maintained until the largest electrical or electronic part in the unit reaches 80 percent of the chamber temperature. When failures occur, the unit shall be reworked and the cycling continued for a cumulative total of 10 cycles. One hour of standby operation at 0°C shall precede the performance measurements at this temperature.

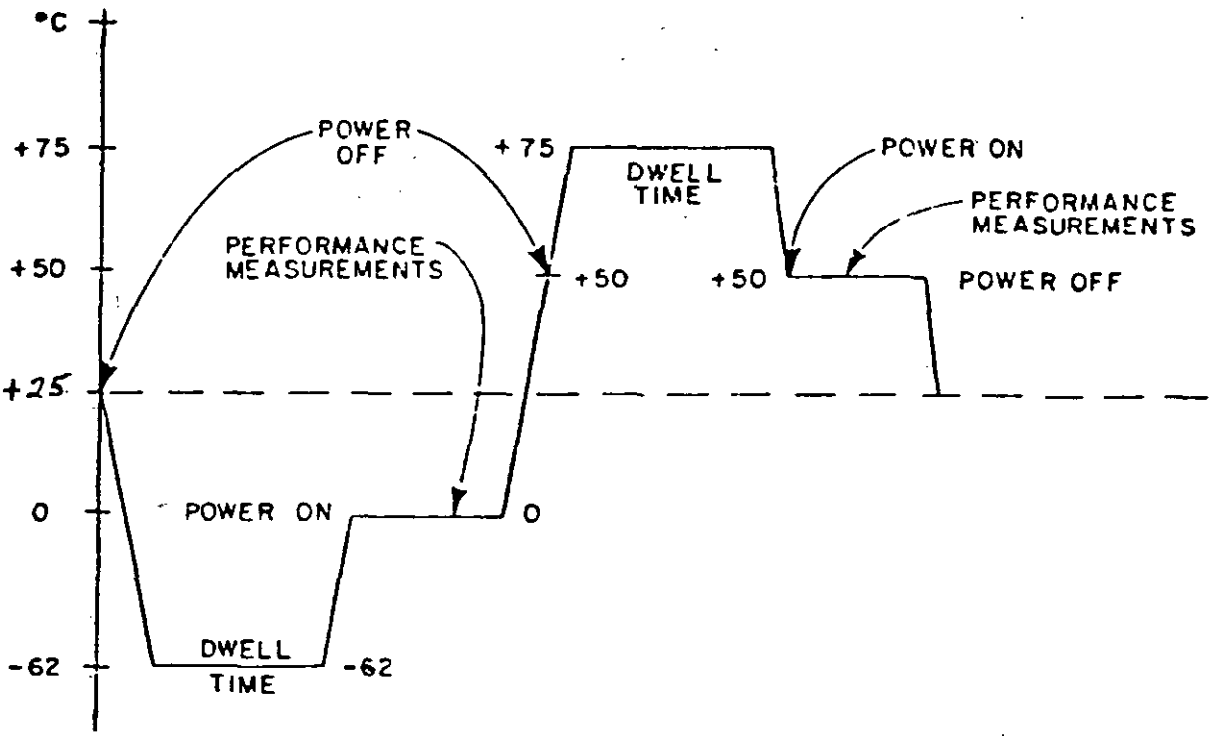


FIGURE 2. Temperature curve (one cycle) (not to scale).

4.5.4 Leakage current test. The leakage current test shall be as specified in 4.5.4.1 and 4.5.4.2.

WARNING

THIS TEST MAY BE HAZARDOUS DUE TO THE UNGROUNDED CONDITION OF THE EQUIPMENT DURING THE TEST. DO NOT TOUCH EXPOSED METAL SURFACES.

THE UNITED STATES GOVERNMENT NEITHER ASSUMES NOR ACCEPTS RESPONSIBILITY FOR ANY INJURY OR DAMAGE THAT MAY OCCUR DURING OR AS A RESULT OF THIS TEST.

4.5.4.1 Equipment connections. Each equipment directly connected to an external power source and units deriving power from the equipment shall be placed on an insulated surface. All safety ground conductors between the equipment and units deriving power from the equipment shall be intact. The safety ground conductor between the equipment under test and the source power shall be opened during the test. The equipment shall be connected as shown in FIGURE 3 if it is connected to single-phase source power, and as shown in FIGURE 4 if connected to three-phase source power.

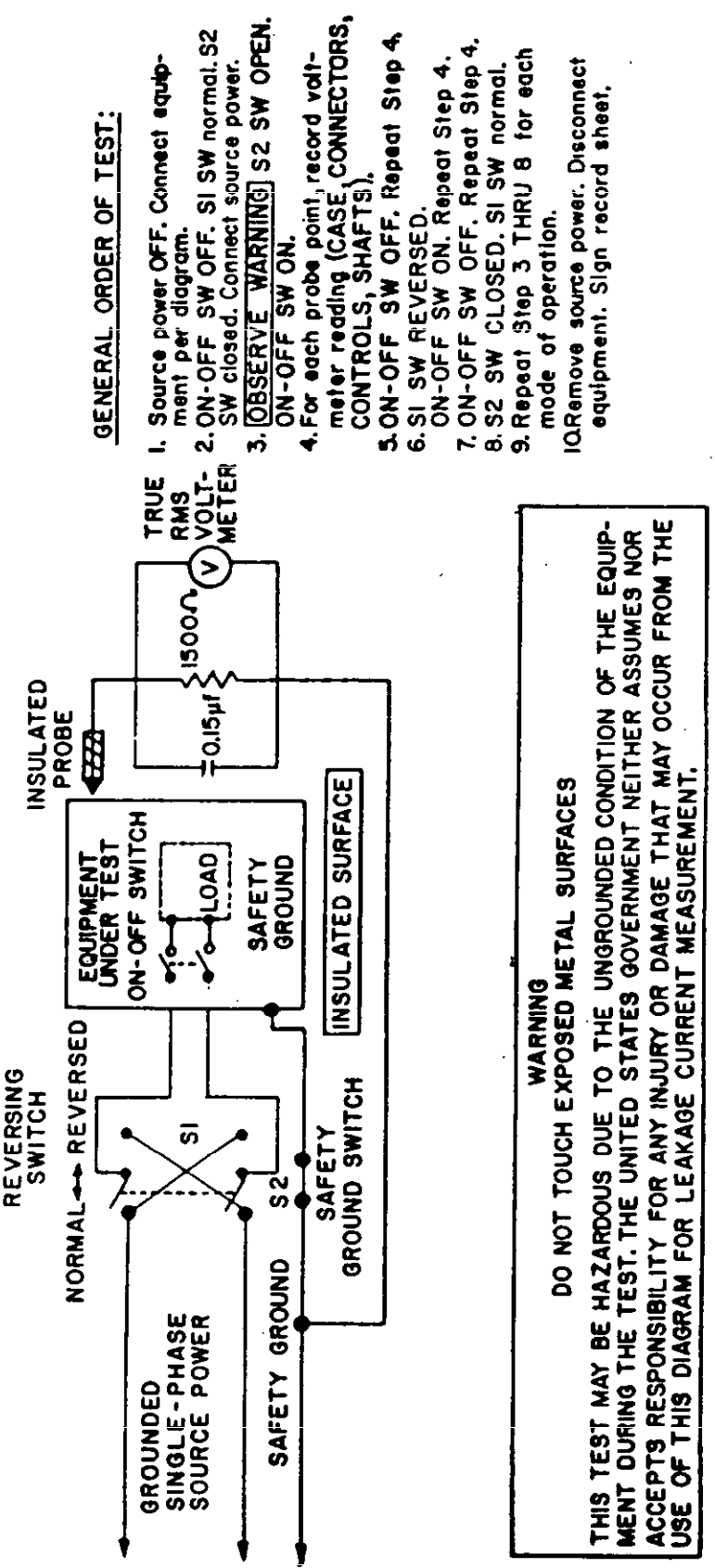
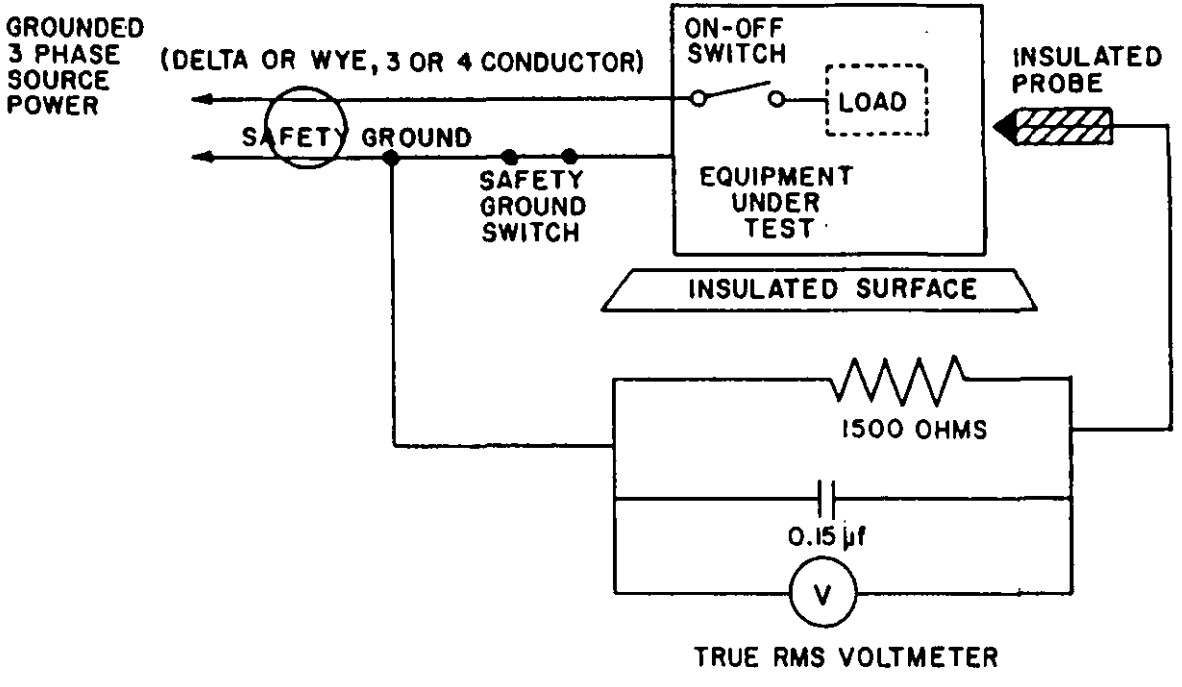


FIGURE 3. Single-phase test diagram for leakage current measurement.



GENERAL ORDER OF TESTS:

1. Source power OFF. Connect equipment per diagram.
2. ON-OFF SW OFF. Safety ground switch closed. Connect source power.
3. OBSERVE WARNING Safety ground switch OPEN. ON-OFF SW ON.
4. For each probe point, record voltmeter reading (CASE, CONNECTORS, CONTROLS, SHAFTS).
5. ON-OFF SW OFF. Repeat Step 4.
6. Safety ground switch closed.
7. Repeat Step 3 THRU 6 for each mode of operation.
8. Remove source power. Disconnect equipment. Sign record sheet.

NOTE: 1. All three phases shall be connected during measurement.
2. The safety ground conductor shall not carry load current.

WARNING
DO NOT TOUCH EXPOSED METAL SURFACES

THIS TEST MAY BE HAZARDOUS DUE TO THE UNGROUNDED CONDITION OF THE EQUIPMENT DURING THE TEST. THE UNITED STATES GOVERNMENT NEITHER ASSUMES NOR ACCEPTS RESPONSIBILITY FOR ANY INJURY OR DAMAGE THAT MAY OCCUR FROM THE USE OF THIS DIAGRAM FOR LEAKAGE CURRENT MEASUREMENT.

FIGURE 4. Three-phase test diagram for leakage current measurement.

4.5.4.2 Measurement. Leakage current shall be measured on the equipment in its normal operating configuration. Equipment controls in each operating mode shall be such that maximum power will be utilized during leakage current measurements. The leakage current shall be determined by the voltage-drop method. A true rms voltmeter shall be used. The voltage measured across the 1500-ohm resistor shall not exceed 7.5 V at the highest nominal power line voltage and the highest and lowest nominal power line frequencies for which the equipment is designed. The overall measurement error shall not exceed 5 percent. The probe shall be used for all external conduction parts such as case, connector housings, recessed calibration or adjustment controls, and control shafts with knobs removed, and the voltage measured for every combination of switch positions available in FIGURE 3 and FIGURE 4. The open safety ground conductor shall be reconnected immediately after the test is completed.

4.5.5 Cables. Interconnecting cables to be supplied with the end item shall be installed on the specific end item prior to any testing, and shall be used for the duration of all testing.

4.5.6 Contractor validation. The contractor shall inspect the equipment to determine technical compliance and adequacy for the specified characteristic or requirement. This validation shall include qualitative examination and testing whenever a function is specified.

4.5.7 Inspection by testing. When this paragraph is specified in TABLE IV, the contractor shall perform quantitative testing.

4.5.8 Detailed test methods. Detailed test methods shall be as specified in 4.5.8.1 through 4.5.8.34.

4.5.8.1 Equipment power output and power control range. Power output measurements shall be made at the extremes of each power control range at the end and mid-band frequencies of each AM-3924( )/URT amplifier frequency band and in A1, A3h (carrier only), A3j (standard two-tone modulation), F9j, and F9 modes of operation. Measurements in the F9j and F9 modes shall be with the net test modulating signal specified in JCS 10.

4.5.8.1.1 VSWR tests. VSWR protection shall be determined by measurements made by terminating the power amplifier output coaxial line with resistive loads to produce VSWRs of 1.5:1, 2:1, 3:1, and 4:1. Measure forward and reflected power with a directional wattmeter and monitor the power amplifier panel meter to detect combinations of VSWR, coaxial line length, and frequency that cause excessive power amplifier plate current.

4.5.8.2 Intermodulation distortion (normal mode). Measurements shall be made in the A3j (USB only) mode at the precise band edges of each AM-3924( )/URT band at an RF output of 1 kW PEP. Modulation shall be a standard two-tone audio input (see 6.7.2). Similar measurements shall be performed at RF outputs of 1 W PEP and 10 mW PEP for band edge frequencies in the 2-MHz to 2.5-MHz, 16-MHz to 18-MHz and 28-MHz to 30-MHz bands.

4.5.8.3 Supply line voltage, frequency variation, and transients tests. Reference power output and frequency measurements shall be made at nominal line voltage and frequency. Variation of equipment power output with changes in steady-state line voltage and frequency shall be measured against the requirements of 3.16.1.1.2.2. The equipment shall be operated at the T-827( )/URT low gain frequency for measurement of variation in power output due to changes in line voltage and frequency. Measurements shall be performed at maximum and minimum settings of the analog power control, in the 100-W to 1000-W and 1-W to 10-W power control ranges. Operation shall be in the CW and USB (standard 2-tone modulation) modes. Variation of equipment operating frequency as a function of steady-state supply line voltage and frequency shall be measured against applicable requirements of MIL-T-23645. Transient voltage and frequency tests shall be performed in accordance with requirements of MIL-E-16400.

4.5.8.4 Power interruption and spike tests. Power interruption tests shall be performed in accordance with the requirements of MIL-E-16400. The 2500-V spike test shall be performed in accordance with the requirements of DoD-STD-1399, Section 300. Source impedance for the spike shall be 25-ohms, resistive. Spike tests shall be performed with equipment operating from 440 V. Spikes shall be delivered line-line and line-ground for each of the three primary power lines. For each test, a positive-going spike shall be applied at the positive crest of the supply line voltage waveform and at the zero axis crossing, and a negative-going spike shall be applied at the negative crest.

4.5.8.5 Enclosure testing. Measurements of power output and frequency stability shall be made prior to and after testing. Measurements shall be within the limits specified in 3.16.1.1 for satisfactory completion of the test.

4.5.8.6 Shock, vibration, and inclination tests. Prior to and after completion of shock, vibration, and inclination tests, the tests specified in a through c shall be performed:

a. Power output range measurements in accordance with 4.5.8.1 in the A1 and A3j (USB only) modes for the 100-W to 1000-W and 10 mW to 100 mW power control ranges in the 2-MHz, 17-MHz, and 29-MHz bands

b. Synthesizer lock checks in accordance with MIL-T-23645

c. Intermodulation distortion in accordance with 4.5.8.2. During vibration tests, equipment operation and monitoring shall be in accordance with 3.16.1.4.1. Continuous key-down operation is required during all tests, unless otherwise specified herein. During the exploratory vibration portion of the test, the equipment power controls shall be set to produce maximum output in the 1-W to 10-W range. During the variable frequency and endurance portions of the test, operation shall be split equally between maximum output setting in the 100-W to 1000-W and 1-W to 10-W ranges.

4.5.8.7 Equipment configurations for shock, vibration, and inclination tests. Shock, vibration, and inclination testing using the stacking configuration as specified in 3.8 shall be conducted. An equivalent weight may be substituted for the Antenna Coupler Control Unit C-3698( )/URA-38( ) if a unit is not available for use at the time of the tests. The tests shall be in accordance with 3.15.1.23.

4.5.8.8 Temperature and humidity tests. The measurements specified in a through d shall be made before and after the temperature and humidity tests, and during temperature operating tests at the end of the period of operation at 0°C and at the end of the period of operation at +50°C:

a. Power output in the A1 and A3j modes
b. Intermodulation Jistortion at equipment high and low gain frequencies
c. Frequency stability
d. Synthesizer locks

Measurements shall be performed at maximum and minimum settings of the analog power control in the 100 W to 1000 W, 10 W to 100 W, and 10 mW to 100 mW control ranges. During the temperature operating test, except during the measurement period, the equipment shall be keyed continuously to produce rated CW output during operation at +50°C. During the last hour of the high temperature operating test, air flow produced by forced convection in the test chamber shall be eliminated. During this period, air temperature in the immediate vicinity of the equipment under test shall be controlled to 50°C by radiation-baffled heating and cooling sources as required. This test is intended to simulate the worst-case shipboard thermal environment. During humidity tests, measurements shall be made at the end of the second and fifth cycles.

4.5.8.8.1 Chamber temperature control provisions. The sources for maintaining the chamber environment shall be arranged or suitably baffled so that no surface at a temperature other than the desired ambient temperature is visible to the unit under test. The maximum allowable temperature difference between any two points in the chamber shall be 10°C. The chamber control provisions shall be capable of maintaining the temperature indicated by a selected chamber ambient sensor constant within ±1°C at any selected test temperature.

4.5.8.9 AN/URA-38( ) compatibility tests. An operational test of a complete AN/URT-23(V) system in conjunction with an AN/URA-38( ) Antenna Coupler Group shall be conducted. The AN/URT-23(V) shall be tested for compliance with the MUTE requirement of 3.9.3.

4.5.8.10 Harmonic suppression tests. Harmonic outputs shall be measured at precise band edges for each AM-3924( )/URT band. Measurements shall be made with reference outputs of 1 kW and 10 mW.

4.5.8.11 Carrier and opposite sideband suppression tests. Measurement shall be made at operating frequencies of 2.1 MHz, 17.1 MHz, and 29.9 MHz. Carrier rejection shall be measured in USB, LSB, and ISB modes. Opposite sideband rejection shall be measured for USB and LSB modes.

4.5.8.12 Spurious RF emissions tests. A search for spurious products shall be performed throughout the complete 2-MHz to 30-MHz operating frequency range in increments of not greater than 100 kHz. For each operating frequency, a search for coherent spurious products shall be made from $0F_o$ to $2F_o$, with a 250-W unmodulated AM carrier reference. For each spurious product detected which is less than 70 dB below the reference, behavior of the spurious product shall be investigated as a function of each smaller operating frequency increment to determine worst-case performance for that product. For each worst-case product which is less than 60 dB below the 250-W reference the measurement shall be repeated for reference levels of 2.5 W and 25 mW. Compliance with requirements for suppression of products removed by more than 10 percent of the operating frequency shall be demonstrated for operating frequencies of 4.5 MHz, 9.0 MHz, and 25.0 MHz using tunable notch filters to provide the required measurement dynamic range.

4.5.8.13 Noise tests. Equipment noise output shall be measured into a 50-ohm load. Unless otherwise specified herein, the reference output shall be a 250-W single-tone signal.

4.5.8.13.1 Key-up noise. Key-up noise shall be measured for operating frequencies of 2 MHz, 17 MHz and 29 MHz.

4.5.8.13.2 Keyed and modulated in-band noise. Keyed and modulated in-band noise shall be measured at the T-827( )/URT high gain frequency, on USB and LSB. Measurements shall be made within the region from F_o + 500 Hz to F_o + 3 kHz for USB, and F_o -500 Hz to F_o -3 kHz for LSB.

4.5.8.13.3 Broadband noise spectral density (out-of-band). Out-of-band noise spectral density measurements shall be made in the AM-3924( )/URT 2 MHz to 2.5 MHz, 5 MHz to 6 MHz, 8 MHz to 10 MHz, 14 MHz to 16 MHz, and 26 MHz to 28 MHz bands. For each band, the operating frequency shall be placed at the extreme band edges, and the broadband noise measured at 1.1 F_o at the lower band edge, and $F_o/1.1$ for F_o at the upper band edge. Measurements shall be made for an operating frequency output of 1 kW in the CW mode.

4.5.8.14 Power supply hum distortion tests. Power supply hum distortion shall be measured at the minimum gain frequency of the T-827( )/URT.

4.5.8.15 APC/TGC characteristics. Conformance with the requirements of 3.16.3.7 shall be verified.

4.5.8.16 PPC characteristics. Conformance with the requirements of 3.16.3.8 shall be verified.

4.5.8.17 CW keying tests. CW keying characteristics shall be measured for keying rates from 1 baud to 32 baud. Measurements shall be made at the T-827( )/URT high and low gain frequencies; and for equipment outputs of 1 kW and 100 mW. Oscilloscope photographs shall be made of the keyed RF output waveform, recording all pertinent data (operating frequency, output power, keying rate, oscilloscope scale factors) on the photographs.

4.5.8.18 External interface operation. Satisfactory operation shall be demonstrated using all alternate connectors to verify proper system interconnection and switching.

4.5.8.19 EMC test. Compliance with 3.16.1.18 shall be verified by tests performed in accordance with MIL-STD-462 (see 6.2.2).

4.5.8.20 Accelerated life tests. The measurements specified in a through c shall be performed at least once daily:

a. Power output and power control range in accordance with 4.5.8.1 at test frequencies of 2.1 MHz, 17.1 MHz, and 29.9 MHz
b. Intermodulation distortion at RF outputs of 1 kW and 100 mW PEP at each test frequency
c. Synthesizer lock checks in accordance with MIL-T-23645

4.5.8.21 AM-3924( )/URT tests. Tests of the RF Amplifier and power supply, without T-827( )/URT, shall be performed with signal inputs provided by an appropriate RF source.

4.5.8.22 Power control distortion. Measurements shall be performed at the T-827( )/URT high and low gain frequencies.

4.5.8.23 Metering accuracy tests. Accuracy shall be measured in the A1 and A3j (standard two-tone modulation) modes at operating frequencies of 2.1 MHz, 17.1 MHz, and 29.9 MHz.

4.5.8.24 Reverse power susceptibility tests. Measurements shall be made for the AM-3924( )/URT amplifier in the 2-MHz to 2.5-MHz, 16-MHz to 18-MHz, and 28-MHz to 30-MHz bands. The equipment shall be keyed in the A3j mode, but unmodulated, and the power controls adjusted for minimum output. A 100-mW test signal shall be applied to the antenna terminals and scanned continuously from 40 MHz to 1000 MHz.

4.5.8.25 Keying and modulation transient tests. Keying and modulation transients shall be measured at the equipment high gain frequency in the CW, A3j (USB), and F9j (USB) modes at maximum and minimum power control settings for the 100 W to 1000 W and 1 W to 100 mW power ranges. Separate oscilloscope photographs shall be obtained of keying and modulation characteristics, with oscilloscope sweep triggered by keyline closure or application of modulation, as appropriate. Keying characteristics measured shall include those for initial keying and maximum required keying rates. Modulation characteristics shall be recorded for initial application of modulation, following a period adequate to permit gain control voltages to decay to minimum output levels. Applied modulation shall be the standard single-tone audio test signal for the A3j mode, and a 1000 Hz, 0 dBm audio signal in the F9j mode.

4.5.8.26 Power output variation with supply voltage tests. The equipment shall be operated at the low gain frequency, and measurements shall be performed over the range of steady-state line voltages and frequencies specified herein. Measurements shall be performed at maximum and minimum settings of the analog power control, in the 100-W to 1000-W and 1-W to 10-W power control ranges. Operation shall be in the CW and USB (standard 2-tone modulation) modes.

4.5.8.27 T/R relay assembly operational life. Compliance with the requirements of 3.16.3.14 shall be demonstrated during first article testing on a minimum of six production T/R relay assemblies. During this test, T/R switching shall be at a rate of two operations per second. Operation shall be in the data or USB mode, with RF output of 200-W average, 1 kW PEP. Relay contact resistance shall be measured at least once per 100,000 operations.

4.5.8.28 Data mode intermodulation distortion (vacant channel). Intermodulation distortion shall be measured in USB, LSB, and ISB modes, at operating frequencies of 2.1 MHz, 17.1 MHz, and 29.9 MHz, for power output of 1 kW PEP. Measurements at 17.1 MHz shall be repeated for a power output of 100 mW PEP. Audio input shall be multitone signal (16 tones) in accordance with the frequency and amplitude requirements of JCS 10. Tones shall be unmodulated, with an average power of 0 dBm and a peak power of +11.5 dBm (each sideband). Measurement shall be performed by removing a centrally located tone (1705 Hz) from the composite data audio input and, with a spectrum analyzer, measuring the maximum amplitude of the distortion products in the vacant channel, relative to the remaining reference tones, at the radio operating frequency.

4.5.8.29 Receive monitor sample. Amplitude of the receive monitor sample shall be measured into a 50-ohm load connected to the receiver terminal of the antenna T/R switch. The measurement shall be made with maximum equipment output at operating frequencies of 2 MHz, 4 MHz, 8 MHz, 16 MHz, and 29.9999 MHz. The equipment shall be operated in the USB data mode, with a single tone 0 dBm signal at 1000 Hz applied to the USB audio input terminals.

4.5.8.30 Data attack and release time. Data attack time shall be measured by keying the equipment with a single tone audio input of 0 dBm at 1000 Hz continuously applied. The measurement shall be made after the TGC has been set. The keyline closure shall be used to trigger an oscilloscope, and a sample of the equipment RF output applied to the oscilloscope vertical input. Release time shall be similarly measured by triggering the oscilloscope sweep on keyline opening. Operate and release times shall be separately measured for the T/R relay in order to ensure freedom from hot switching. A permanent record of equipment attack and release times and T/R relay operate and release times shall be obtained by separate oscilloscope photographs.

4.5.8.31 T/R relay, antenna-induced power test. Tests shall be performed to verify damage-free operation with 500 W of antenna-induced signal as specified in 3.16.3.14. Measurements shall be performed with RF signals applied to the T/R assembly antenna port at 2 MHz, 17 MHz, and 29 MHz, with the equipment unkeyed, and the receiver port terminated in 50 ohms.

4.5.8.32 Antenna tuning power level. Measurements shall be performed to verify compliance with requirements of 3.16.3.13 and 3.16.5.8. Adjustment range of the data mode tune power control and the normal mode fixed tune power level shall be measured for operating frequencies of 2.1 MHz, 17.1 MHz, and 29.9 MHz.

4.5.8.33 Failure analysis. All failures shall be analyzed and the results of analysis shall be retained by the contractor and be available for Government review as required.

4.5.8.34 RF output monitor sample. Amplitude of the RF output monitor sample shall be measured into a 50-ohm load connected to the AM-3924( ) front panel monitor port. Measurement shall be made with a single tone 100-W RF output at operating frequencies of 2 MHz, 4 MHz, 8 MHz, 16 MHz, and 29.9999 MHz.

4.6 Reliability qualification test. A reliability qualification test shall be performed in accordance with Test Plan IVC of MIL-STD-781 on at least two units from the first month's production. Environmental conditions and operational duty cycles for reliability qulification testing shall be as specified herein.

4.6.1 Failure. For definition of failure (see 6.7.6). After the initial start of the test any parameter deviation which requires adjustments or alignments of the equipment under test shall be classified as a failure.

4.6.2 Environmental conditions for reliability testing. The environmental condition specified in a through d shall be maintained throughout the reliability qualification test:

a. Ambient temperature shall be +50°C, +0°C, -3°C
b. Vibration shall be 1G ±10 percent peak acceleration value at any nonresonant frequency between 20 Hz and 60 Hz measured at the mounting points on the equipment. The duration of vibration shall be at least 10 minutes during each hour of equipment operating time.
c. Input voltage shall be 440 VAC, 60 Hz. Input voltage shall be cycled in accordance with the 3-day cycle specified in 1 through 3:
    1. Nominal
    2. Nominal +10 percent
    3. Nominal -10 percent
d. Relative humidity: 75 percent

4.6.3 Performance tests. At least daily, system performance measures shall be made to verify the performance characteristics specified in a through e:

a. CW (A1) mode:
    1. Keying speed shall be at least 32 baud
    2. Output shall be at least 1 kW average power ±1.0 dB into a 50-ohm resistive load in key-down condition
    3. Keyed wave shall be free from transients and splatter
b. AM (A3h) mode:
    1. No adjustment of the internal percent modulation control shall be made during the test and the carrier power level shall remain within 250 W ±1.0 dB into a 50-ohm load
    2. It shall be possible to apply a standard single tone input sideband audio input so that the sideband output power equals the carrier (250 W ±1.0 dB) and the PEP is at least 1000 W
    3. Under the test conditions of b.2, the intermodulation distortion products shall be at least 30 dB below the carrier
c. SSB (A3a) mode:
    1. With a standard two-tone input applied to the USB remote input, the output of the equipment shall be at least 1000 W PEP ±1.0 dB into a standard dummy load
    2. The intermodulation distortion shall be not less than 30 dB below either tone specified in c.1
    3. Opposite sideband suppression shall be at least 50 dB below 250 W when a 150 millivolts (mV), 1300 Hz tone is inserted into the USB remote input
    4. Carrier suppression shall be at least 40 dB below a sideband tone of 1300 Hz having an input level of 150 mV applied to the USB remote input
    5. Repeat c.1 through c.4 with the input applied to the LSB remote input
d. RATT (A7j) mode:
    1. Keying rate shall be at least 80 baud
    2. Frequency shall be ±425 Hz ±20 Hz and ±85 Hz ±4 Hz shift from 2000 Hz with a neutral keying input
e. Data (F9 and F9j) modes of operation:
    1. Data average power and PEP output. Average power measurements shall be made in USB, LSB, and ISB modes, using a TADIL A (net test) audio input as specified in MIL-STD-188-203-1 to each sideband of 0 dBm, measured with a true rms voltmeter. Measurements shall be

performed at the fixed data output level obtained in the 100-W to 1000-W power control range, and at the maximum and minimum power control settings in the 10-mW to 100-mW power control range. Measurements shall be performed for test frequencies as specified in 4.6.4

2. Intermodulation distortion. Distortion shall be measured for each data power output measurement of e.1 using the procedure of 4.5.8.28.

3. Phase stability. Measurements shall be made on the unmodulated AM carrier (normal mode), using an averaging time of 9.09 milliseconds and obtaining sufficient samples to establish the performance specified in MIL-T-23645.

4.6.4 Test frequencies. During the reliability tests, at least one frequency shall be tested in each band as specified in a through d:

a. F1 = 2.0015 MHz
b. F2 = 5.3340 MHz
c. F3 = 10.6655 MHz
d. F4 = 29.9990 MHz

4.6.5 Test schedule. The test schedule specified in TABLE V shall consist of three 8-hour schedules per day, the first being manned where performance measurements shall be made. The other two schedules may be unmanned and pertinent data may be automatically recorded to the extent that instrumentation permits.

TABLE V. Test schedule.

Manned schedule	Unmanned schedule
0 hours to 2 hours, equipment ON	0 hours to 3 hours, euipment ON
2 hours to 3 hours, performance measurements	3 hours to 4 hours, equipment OFF
3 hours to 4 hours, equipment OFF	4 hours to 7 hours, equipment ON
4 hours to 6 hours, equipment ON	7 hours to 8 hours, equipment OFF
6 hours to 7 hours, performance measurements	
7 hours to 8 hours, equipment OFF	

4.6.5.1 Manned transmitting schedule. The mode of operation and frequency of transmission for each of the transmitting ON periods of the manned schedules shall occur in the sequence specified in TABLE VI.

TABLE VI. Transmitting schedules.

Day 1/	Frequency	Mode of transmission
1	F1 First 4 hours of manned schedule	CW (A1) 1000 W average power keyed at a rate of 32 baud
	F2 Remainder of the day	
2	F3 First 4 hours of manned schedule	AM (A3h) 250 W carrier modulated 30 percent to 50 percent with a 1000 Hz tone
	F4 Remainder of the day	

TABLE VI. Transmitting schedules. (continued)

Day 1/	Frequency	Mode of transmission
3	F1 First 4 hours of manned schedule	ISB (A3b) 1000 W PEP, two-tone modulation per sideband
	F2 Remainder of the day	
4	F3 First 4 hours of manned schedule	RATT (A7j) 1000 W average power keyed from space to mark at an 80 baud rate
	F4 Remainder of the day	

1/ The same sequence shall be used on the next 4 days, except that the sequence of frequencies shall be reversed. F4 and F3 on the fifth day, F2 and F1 on the sixth day, F4 and F3 on the seventh day, and F2 and F1 on the eighth day. The schedule specified in TABLE VII shall be repeated as necessary.

4.6.5.2 Unmanned transmitting schedule. The mode of operation during the unmanned transmitting periods shall be ISB (F9), using TABLE A input (net test) or unmodulated tones to both USB and LSB; output shall be 1000 W PEP into a 50-ohm load. The test frequency to be used during each unmanned period shall be the last frequency utilized during the previous manned period (see 4.6.5.1).

4.7 Maintainability demonstration. The maintainability demonstration shall be as specified in 4.7.1 through 4.7.8.

4.7.1 Maintainability equipment demonstration. The contractor shall perform a maintainability demonstration at the organizational level. The demonstration shall be performed by qualified technicians and shall be used to verify that the equipment conforms to the M_{ct} requirement of 3.17. The maintainability demonstration shall be performed just once, during the first 3 months production.

4.7.1.1 Demonstration conditions. Conformance to the equipment maintainability requirements shall be demonstrated in accordance with MIL-STD-471 by replacement of subassemblies (modules, individual PCBs) and chassis-mounted electronic, electrical, electromechanical, and mechanical components or parts at the organizational level. One hundred candidate corrective maintenance faults shall be determined in accordance with APPENDIX A of MIL-STD-471. The information shall be made available for each candidate task:

a. Designation of specific faulty part
b. Failure mode
c. Means of introducing fault (substitution of faulty part or simulation thereof)

The procuring activity or its authorized representative shall use the candidate tasks as a guide to select a sample of 50 tasks for the demonstration.

4.7.2 Accept or reject criteria. Accept or reject criteria shall be as specified in 4.7.2.1.

4.7.2.1 Corrective maintenance. The accept or reject criteria for the demonstration of the corrective maintenance times for the demonstration shall be as specified in TABLE VII.

TABLE VII. Acceptance criteria.

	M_{ct}	M_{maxct}
Acceptance level	20	0
Sample size	50	50

Acceptance shall occur when the number of observed corrective maintenance task times which exceed the required value of each specified index, M_{ct} and M_{maxct}, is less than or equal to that specified in TABLE VII corresponding to each index for the specified confidence level. The duration of each task shall be compared to the required value(s) and recorded as greater than or less than each index. The actual value shall also be recorded. An accept decision can be made only when an accept decision is made for M_{ct} and M_{maxct}. Accept or reject criteria for preventive maintenance shall be the capability to perform each preventive maintenance task with no degradation of system performance. If degradation of system operations exists, the preventive maintenance test will have resulted in a reject decision. More than one erroneous failure indication shall consitute failure of the demonstration.

4.7.3 Preventive maintenance. The demonstration shall qualitatively demonstrate that on-line preventive maintenance for the equipment shall not interfere with on-line operation.

4.7.4 Demonstration environment. The demonstration at the organizational level shall be performed in an environment similar to that in which the equipment will be installed.

4.7.5 Technicians. The procuring activity reserves the right to provide and select technicians to perform the maintainability demonstration.

4.7.6 Technical documentation. Technical documentation shall be limited to the technical manual and related maintenance documentation delivered with the equipment.

4.7.7 Rejection. Failure to conform to any of the requirements shall be cause for rejection of the demonstration. If a reject decision is reached, the procuring activity shall be immediately notified. The contractor shall, at no additional cost to the Government:

a. Develop an approach for redesign or correction of all deficiencies, and
b. Upon approval of an approach to the redesign or corrections, the contractor shall implement the approach and repeat the demonstration until an accept decision is reached.

4.7.8 Acceptance. The maintainability demonstration shall demonstrate that the equipment conforms to the accept criteria prior to delivery.

4.8 Inspection of preparation for delivery. Inspection shall be performed to ensure conformance with the requirements of Section 5.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation, packaging, packing, and marking. Unless otherwise specified herein, preparation for delivery shall be in accordance with the applicable levels of preservation, packaging, packing, and marking specified in MIL-E-17555 (see 6.2).

5.2 Packaging configuration. The equipment shall be packaged for delivery as a complete system, and shall be delivered in a single container except for the MT-4670( )/URT-23(V), including the stabilizer, which shall be packaged separately and delivered in a separate container, referencing its own National stock number.

6. NOTES

6.1 Intended use. The equipment is intended for general purpose voice, CW, radio TTY and data communications, and may be used for surface ship, submarine, and fixed shore installations. The accessory Antenna Coupler Group AN/URA-38( ) is normally used in surface ship and shore installations.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify:

a. Title, number, and date of this specification
b. GFE, if required (see 3.2)
c. Interchangeability requirement, if required (see 3.3)
d. Quantity of accessory items required (see 3.4.1)
   1. Terminal strips and jumpers (see 3.6.3)
   2. Extender cables (see 3.15.1.33.1)
   3. Extender cards (see 3.15.1.33.2)
e. Rack mounting brackets, as required (see 3.15.1.2.1)
f. Number of first article samples to be submitted if other than specified in 4.3
g. When reinspected production control and environmental sample units may not be accepted (see 4.4.4)
h. Levels of preservation, packaging, packing, and marking (see 5.1)

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DID) (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List, incorporated into the contract. When the provisions of DoD Federal Acquisition Regulations Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs:

Paragraph	Data requirement	Applicable DID
4.5.8.19	Electromagnetic Interference Control Plan	DI-R-7061
4.5.8.19	Electromagnetic Interference Test Report	DI-R-7062
4.5.8.19	Electromagnetic Interference Test Plan	DI-R-7063

(DIDs related to this specification, and identified in Section 6 will be approved and listed as such in DoD 5000.19L, Vol. II, AMSDL. Copies of DIDs required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article. When a first article inspection is required, the item(s) should be a first production item. The first article should consist of two units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 GFE. The contracting officer should arrange to furnish the GFE listed in 3.2.

6.5 Nomenclature. Nomenclature referred to herein and nomenclature assigned to GFE units may be subject to change on any contract resulting in equipment produced in accordance with this specification.

6.6 Environmental inspection. Approval to ship may be withheld at the discretion of the Government pending the decision from the contracting officer on the adequacy of corrective action.

6.7 Definitions. Definitions of terms used in this specification are given in 6.7.1 through 6.7.6.

6.7.1 Standard single-tone audio input. Standard single-tone audio input is a 1000-Hz tone, with a level of 150 mV at the remote input terminals.

6.7.2 Standard two-tone audio input. Standard two-tone audio input is two equal amplitude audio signals at 1000 Hz and 1625 Hz, with a level of 150 mV per tone supplied from a 600-ohm source.

6.7.3 Teletype input. Standard teletype input should be 60 mA DC for the mark signal and zero mA for space. The loop current source impedance should be 1000 ohms.

6.7.4 Standard dummy load. Unless otherwise specified herein, the equipment RF output should be dissipated in a 50-ohm resistance with sufficient power capacity to absorb at least an average of 1000 W without change of its electrical characteristics.

6.7.5 Hum signals. Hum signals are any output products produced by modulation at the primary power line frequencies, or power supply conversion frequencies, or harmonics of these frequencies.

6.7.6 Failure. Failure is any malfunction or parameter deviation that prevents the equipment from performing within the specified operational requirements.

6.8 Maintenance concept. The equipment is part of a family of HF communications equipments which are designed to minimize equipment down time through the use of plug-in assemblies. Combined with the maintenance complexity resulting from high density packaging, this results in a maintenance program entailing both organizational and depot level maintenance. Capabilities and limitations at these maintenance levels are as specified in a and b:

a. Organizational.
   1. Fault isolation, removal, and replacement of discrete circuit components such as tubes, transistors, resistors, coils, and capacitors (other than those contained in specified depot repairable modules); replacement of meters, indicator lamps, fuses, tuning, and alignment
   2. Fault location and isolation of plug-in assemblies and piece parts, removal and replacement with use of required test equipment, and diagnostic and repair procedures, unless plug-in assembly complexity reaches or exceeds integrated circuitry

b. Depot.
   1. Designated Naval shipyards and repair facilities will be required to perform any maintenance function required on piece-part component or end item, including emergency manufacture of nonavailable materials, provide technical assistance to lower levels and repair and restore the assemblies specified in A through I:
      A. Mode selector
      B. Intermediate frequency
      C. Audio frequency amplifier
      D. RF amplifier
      E. Frequency standard
      F. Translator-synthesizer
      G. RATT generator
      H. Final transformer assembly
      I. Driver transformer assembly

6.9 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
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3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
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5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

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7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
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