MILITARY SPECIFICATION

TRANSMITTER, RADIO, AN/FRT-85(V)
40 KW PEP HIGH-FREQUENCY,
HIGH-STABILITY INDEPENDENT SIDEBAND

1. SCOPE

1.1 This specification covers the design, construction and performance of Radio Transmitter AN/FRT-85(V). This equipment is a Navy general purpose transmitter used primarily for the Defense Communications Agency's (DCA) high frequency (HF) long-haul independent sideband (ISB) radio communications circuits ashore. The AN/FRT-85(V) is a 40 kilowatt (kW) PEP, frequency synthesized, ISB, forced air cooled radio transmitter which features complete automatic tuning to whatever frequency selected at the MD-777/FRT exciter unit. The AN/FRT-85(V) may be remote controlled when equipped with Decoder-Encoder KY-656/FRT and Control-Indicator, Transmitter C-7709/FRT. This transmitter features modular construction which permits removal/replacement of several subassemblies for operator maintenance. The transmitter operating frequency range is from 2 to 29.9999 megahertz (MHz) in 100 hertz (Hz) steps. The overall requirements of this specification shall be met in a straightforward manner embodying principles of the best engineering design practice. The transmitter shall feature the necessary design characteristics required to achieve an mean time between failure MTBF of not less than 600 hours.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposals form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-T-27	- Transformer and Inductor (Audio, Power, and High Power Pulse) General Specification for
MIL-T-4807	- Tests, Vibration and Shock, Ground Electronic Equipment (General Requirements for)
MIL-C-5015	- Connector, Electric, An Type
MIL-Q-9858	- Quality Program Requirements
MIL-M-15071	- Manuals, Technical, Equipment and Systems Content Requirements for
MIL-E-15090	- Enamel, Equipment, Light-gray (Formula No. 111)
MIL-E-16400	- Electronic Equipment, Naval Ship and Shore, General Specification (Navy)
MIL-E-17555	- Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of
MIL-E-21981	- Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of

STANDARDS

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-109	- Quality Assurance Terms and Definitions
MIL-STD-188	- Military Communication System Technical Standards
MIL-STD-189	- Racks, Electrical Equipment, 19 Inch and Associated Panels
MIL-STD-415	- Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for
MIL-STD-449	- Radio Frequency Spectrum Characteristics, Measurement of
MIL-STD-454	- Standard General Requirements for Electronic Equipment
MIL-STD-461	- Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-470	- Maintainability Program Requirements (for Systems and Equipments)
MIL-STD-471	- Maintainability Demonstration
MIL-STD-701	- List of Standard Semiconductor Devices
MIL-STD-781	- Reliability Tests Exponential Distribution
MIL-STD-785	- Reliability Program for Systems and Equipment Development and Production
MIL-STD-1345	- Data, Measurement, in Support of Maintenance, Calibration and Repair of Electronic Equipment
MIL-STD-1364	- Preferred General Purpose Electronic Test Equipment

HANDBOOKS

MILITARY

MIL-HDBK-472	- Maintainability Prediction

(Copies of specifications, standards, drawings, and publications required by suppliers in connections with specific procurement functions shall be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

ANSI S1.4-1961 - General Purpose Sound Level Meters

(Application for copies should be addressed to American National Standards Institute, 1430 Broadway, New York, N. Y. 10018)

FEDERAL

DEFENSE COMMUNICATIONS AGENCY
DCAC-330-175-1 - DCS Engineering-Installation Standards Manual

(Application for copies should be addressed to Defense Communications Agency, Washington, D. C. 20305)

3. REQUIREMENTS

3.1 General description. Radio Transmitter AN/FRT-85(V) shall be a frequency synthesized, ISB, forced air cooled, HF radio transmitter for fixed station or transportable use. The AN/FRT-85(V) shall consist of a Control-Modulator-Synthesizer Group OK-118(V)/FRT-85(V), Power Supply PP-6069/FRT-85(V) and Radio Frequency Amplifier AM-6048/FRT-85(V). The MD-777/FRT Modulator Synthesizer (also called the exciter) shall determine the frequency of the output signal, provide the modulation process, establish the output frequency stability, and furnish an output signal level compatible with the Government Furnished Equipment (GFE) amplifier including the output impedance of 50 ohms nonreactive. The equipment shall be in accordance with MIL-E-16400 to the extent specified herein.

3.1.1 Major components. The AN/FRT-85(V) shall consist of the following major components:

(a) Power Supply PP-6069/FRT-85(V) including instrument panel and the main equipment enclosure.
(b) Control-Modulator-Synthesizer Group OK-118(V)/FRT-85(V) consisting of the following basic components:

(1) Indicator - control panel, 1A5
(2) Control-Indicator Panel C-7705/FRT-85(V), 1A1
(3) Modulator-Synthesizer MD-777/FRT, 1A2
(4) Keyer, Frequency Shift, KY-655/FRT, 1A8
(5) Decoder-Encoder KY-656/FRT, 1A9 (This component is not to be included as a deliverable item under any contract resulting from this specification).
(6) Circuit Breaker Panel, 1A3
(7) Main equipment enclosure

(c) Radio Frequency Amplifier AM-6048/FRT-85(V) including the main equipment enclosure.
(d) Control-Indicator, Transmitter C-7709/FRT (This component is not to be included as a deliverable item under any contract resulting from this specification.)

3.1.2 First article sample. Prior to beginning production, a sample shall be tested as specified in 4.3 (see 6.2.1).

3.1.2.1 One first article sample (FAS) AN/FRT-85(V) shall be furnished by the supplier for the complete first article inspection as required by contract. The FAS shall be suitable for complete evaluation of mechanical and electrical

form, design, and electrical performance aspects as specified in the contract. The complete AN/FRT-85(V) shall be of final mechanical and electrical form, employ standard or nonstandard (when approved by the command or agency concerned) parts, and be completely representative of the final design that the supplier intends to provide under the contract as production equipment. The supplier is responsible for the correction of all problems discovered during evaluation of the FAS.

3.2 Mechanical considerations. Mechanical construction of the equipment furnished in accordance with this specification shall conform to all applicable requirements of MIL-E-16400.

3.2.1 Equipment size. The Exciter MD-777/FRT and Keyer KY-655 component units shall be designed for rack-mounting in the control cabinet provided under this specification or in a standard Navy type CY-597A/G 19 inch rack. The exciter shall be 8-23/32 inches in height at the panel and not exceed 22-1/2 inches in depth. The keyer shall be 3-1/2 inches at the panel and not exceed 22 inches in depth. MIL-STD-189 shall be used as a guide. The Linear Amplifier, Power Supply and Control System components shall be housed in separate cabinets designed for installation as a group in combination with the exciter and keyer. Under this specification, the contractor shall deliver the complete transmitter in 3 cabinets not exceeding the following overall maximum dimensions:

Height 84 inches	Width 132 inches (total)	Depth 44 inches (all cabinets)

The exciter, keyer, and the control indicator drawer (see 3.2.2.1) shall be mounted in the control cabinet. Blank panels shall be provided with each transmitter to install in place of the exciter, keyer KY-656 and keyer KY-655 when these units are mounted externally.

3.2.1.1 Design. Equipment configuration, panel layouts, and dimensions shall be as specified in 3.2.2.1 and 3.2.2.2 and shall be submitted to the command or agency concerned for approval prior to FAS approval (see 6.2.2).

3.2.2 Enclosures. The degree of enclosure shall be protected to the same degree as the GFE. Front and rear access to each cabinet through door shall be provided to make possible normal repair and maintenance. Cabinet surfaces shall be finished with enamel conforming to type III, class 2 of MIL-E-15090. Openings for inlet air shall be equipped with washable fireproof air filters, and outlet air openings shall be screened.

3.2.2.1 Enclosure configuration. The AN/FRT-85 transmitter system shall consist of 3 major enclosures: power supply, amplifier, and control cabinets. The low level RF circuitry, high power amplifier and associated filament supplies, and related components shall be located in the amplifier cabinet. All major power supplies and associated power control circuitry shall be located in the power supply cabinet. All panel controls, low level power controls, tuning control components and circuits, and the exciter, Keyer and Remote Control KY-656 receiver (when used) shall be located in the control cabinet.

3.2.2.2 Enclosure dimensions. The enclosure dimensions shall be in accordance with 3.2.1 and shall also not exceed the maximum individual cabinet dimensions noted in the table below.

Cabinet	Maximum dimensions		
	Length (inch)	Depth (inch)	Height (inch)
Linear Amplifier	66.12	44	84
Power Supply	41.62	44	84
Control	24.12	44	84

3.2.3 Cabinet construction. The transmitter cabinets and all internal panels, plates, enclosures and other fabrication materials shall be constructed from aluminum of strength sufficient to provide a rugged and durable enclosure adequate for either fixed station or mobile service.

3.2.3.1 All external walls and doors of the cabinets shall be double wall reinforced construction. The insulation for ensuring compliance with the acoustic noise requirements noted in 3.14.20 shall be placed between the external wall and the internal wall (liner).

3.2.3.2 All cabinets shall be assembled with captive nuts or nut bars and bolts to permit removal of damaged end, front, top or rear panel assemblies without the necessity for total disassembly (or replacement) of the individual cabinet. Corner post assemblies shall be included under the provisions of this paragraph and those of 3.2.3.1.

3.2.3.3 Cabinet doors and fasteners. Each of the 3 transmitter cabinets shall be accessible front and rear (except control cabinet front) via highly durable hinged doors. Door hinges shall be either full length and continuous or, at a minimum, positioned at 3 points and shall permit adjustment to the extent that the double walled doors can be adjusted for an air tight fit. Door fasteners (latches) shall be of quarter-turn-handle design and shall be attached at 2 places on the door to ensure reliable latching and air sealing.

3.2.3.4 Air seal. The transmitter cabinet design and construction shall be such that all openings into the cabinets, excluding duct interface openings, shall be sealed to the extent that air shall neither escape nor ingress when the transmitter blower is operating at its maximum rated air delivery.

3.2.3.5 Removable assemblies. It is a requirement of this specification that a maximum number of assemblies be removable as complete or identifiable entities for purposes of maintenance replacement. The following items, as a minimum, shall be considered within the provisions of this paragraph and shall be removable via plug-in connection, terminal boards or MS type connector. The removal of a soldered wire connection shall not be deemed as satisfying the provisions of this removable assembly requirement.

3.2.3.5.1 Low-level RF amplifiers (up to 50 watts Average) shall be readily removable via simple disconnects such as connectors or terminal boards. The disconnecting of soldered connections shall not be acceptable.

3.2.3.5.2 Control circuitry components and circuits shall be removable as circuit entities on plug-in type printed wiring boards. The following circuits, as a minimum, shall be considered within the provisions of the plug-in board requirements: alternating current (ac) line level fault sensing, servo amplifiers, low level metering and bias circuits, crowbar trigger, control relays, tuning control logic, exciter control, power level control and other similar circuits. Each of these removable cards shall be detailed within the technical manual such that each may be repaired and adjusted as a separate entity. The maximum dimensions of any printed wiring card shall not exceed 5 x 7 inches.

3.2.3.5.3 Power supplies whose output direct current (dc) voltage level lies within the range of between 50 and 5000 volts shall be removable as complete assemblies via either terminal board connections or approved MS type connectors.

3.2.3.5.4 Servo tuning motor drive assemblies shall be removable as complete and separable entities and shall not require removing more than 1 mechanical connection and 1 MS type connector. Each tuning motor drive assembly shall include the following elements, as a minimum, as a part of the removable assembly: motors, shafts, gears, bearings, digital type position read-out counters, follow-potentiometers and other necessary components.

3.2.3.5.5 All circuit breakers and elapsed time meters (excluding the primary line breaker) shall be located on a hinged panel assembly at the lower front of the control cabinet. Releasing the captive fasteners that open this enclosure shall de-energize the transmitter system by opening the ac interlock circuit.

3.2.3.5.6 The Power Amplifier Crowbar assembly shall be removable as a separate assembly. Additionally, the trigger circuitry, when located on the crowbar chassis, shall be a plug-in type printed wiring card as noted in 3.2.3.5.2.

3.2.4 Accessibility. The equipment shall be so constructed that parts, terminals, wiring, and so forth are accessible for circuit checking, adjustment, maintenance, repair, and replacement with a minimum disturbance to other parts and wiring, and with use of the minimum number of special tools. Parts shall be mounted so that their identification markings will be readily visible without disassembly of the equipment. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)).

3.2.5 Retractable cable harness. All cable harnesses associated with slide mounted assemblies, including the control-indicator drawer assembly and Modulater-Synthesizer Group MD-777/FRT equipment shall be equipped with a flat-pack type (molded) cable harness and retractable carrier assembly. The carrier assembly shall be constructed to preclude damage to the cable harness during all conditions of assembly removal, insertion, or (±90 degree) tilting. Drawings for this retractable carrier assembly shall be submitted to the command or agency concerned for approval prior to FAS (see 6.2.2).

3.2.6 Mountings. It is a requirement of this specification that all major front panel units shall be mounted on slides or tracks with stops to permit withdrawal of individual units for servicing from the front of the equipment. For all units weighing less than 50 pounds, the mountings shall also provide for a +90 degree and a -90 degree front-to-back tilting from a horizontal position step. The -90 degree tilting requirement shall not apply to the bottom slide/ track mounted units.

3.2.7 Nomenclature. Nomenclature shall be requested in accordance with MIL-E-21981.

3.2.8 Encapsulation. The use of plastic encapsulated transistors and microelectronic devices shall not be used in the design of equipment covered by this specification unless specifically approved, in writing, by the command or agency concerned.

3.2.8.1 Insulating compounds. Compounds which soften and flow at any temperature less than +75 degrees C (+167 degrees F) shall not be used unless contained in such manner that the compound will not flow from the container during service use. Compounds which crack at any temperature above -40 degrees C (-40 degrees F) shall not be used.

3.2.9 Electrical contacts. Friction or pressure contacts when used shall be designed to prevent erratic operation caused by the effects of vibration and temperature. Whenever practicable, electrical switch and relay contacts shall be of the self-cleaning type.

3.2.10 Power connectors. The power connectors used in the exciter rack shall be type MS-3102-165-P, conforming to MIL-C-5015. Pin B in the connector shall be used for the ground connection.

3.2.11 Test jacks, test cords and module extenders.

3.2.11.1 Test jacks. Test jacks provided in accordance with 3.11.1 and subject to the influence of interference shall be equipped so that shielded test leads can be used. When a test jack is to be used with a spectrum analyzer, the output of the test jack shall be of a sufficient magnitude to drive a panoramic model SSB-3 spectrum analyzer. The radio frequency (RF) test jack connections to the final amplifier shall be at the input to the transmission line. This will allow a dynamic display of the transmitted signal. All RF sampling voltages shall be developed across a capacitive voltage divider. A jack shall be provided to insert the output of a two-tone oscillator at each audio input of the transmitter.

3.2.11.2 Test cords and module extenders. All test cords and printed card or module extenders required for operation and maintenance of the transmitter shall be provided with the equipment.

3.2.11.3 General purpose test equipment (GPTE). GPTE used in all technical documentation (manuals, training aids and so forth) shall be the same as specified in GFE manuals. Test equipment not specified in GFE manuals may be used in technical documentation for the AN/FRT-85 only if the contractor submits a written request to the command or agency concerned and approval is granted.

3.2.12 Type of construction. The type of construction and design employed in any transmitter resulting from this specification shall be the same as that used in the GFE. Modular construction shall be utilized throughout the AN/FRT-85(V) radio transmitter. The transistorized exciter MD-777/FRT shall constitute one assembly (complete with its own power supply) which may be deployed independently from the 40 kW linear power amplifier. The power amplifier also shall be a separate and independent assembly with its associated high voltage power supply provided in a separate section of the main equipment enclosure. The internal construction of both assemblies shall be modularized to the same degree as the GFE and shall facilitate the rapid exchange of minor assemblies for rapid restoration of service in case of failure. The construction requirements of MIL-E-16400 apply.

3.2.13 Interchangeability of parts. Modules, assemblies, subassemblies, components and parts contained in the first article and production models of the AN/FRT-85(V) built to this specification shall be electrically and mechanically interchangeable with corresponding units contained in the GFE. Interchangeability of these units between transmitters of the same type shall be accomplished and demonstrated without the necessity for major realignment of the electrical circuits contained in the interchanged units and without major realignment of the circuits contained in adjacent modules of the transmitter. All units cited above shall be accessible for testing or replacement and shall facilitate rapid fault location and restoration of service by direct replacement. Like units, assemblies, subassemblies and replaceable parts shall be physically and functionally interchangeable without modification of the item or of the equipment. Individual items shall not be hand-picked for fit or performance; however, matched pairs or sets are permitted when interchangeable as such.

3.2.13.1 Commonality. Multiple use requirements within the equipment design shall utilize, to the maximum extent practical, common items to satisfy the requirements. To this end, servo amplifiers shall be limited to a single design and shall be interchangeable throughout the equipment. Other multiple use requirements shall be made common where possible to limit spare parts requirements.

3.2.13.2 MD-777/FRT exciter interchangeability. The MD-777/FRT Modulator Synthesizer which is a part of the AN/FRT-85(V) is also common to Radio Transmitter AN/FRT-84(V). The supplier shall be responsible to ensure that complete electrical and mechanical interchangeability of the exciter prevails between the AN/FRT-85(V) and the AN/FRT-84(V). The first article models of the AN/FRT-85(V) and the AN/FRT-84(V) equipment and the GFE AN/FRT-85(V) and AN/FRT-84(V) shall be used to demonstrate full compliance with this stated requirement.

3.2.13.3 Compatibility, encoder-decoder KY-656/FRT. The AN/FRT-85(V) may be operated from a remote location by appropriate use of the remote control system consisting of Encoder-Decoder KY-656/FRT and Control-Indicator, Transmitter C-7709/FRT. The supplier shall ensure that complete electrical and mechanical interface characteristics are maintained between these units. The supplier shall be required to demonstrate satisfactorily system compatibility prior to FAS approval of the AN/FRT-85(V).

3.2.14 Serial numbers. All major components of the equipment furnished with this specification shall have nomenclature and serial numbers.

3.3 Selection of parts.

3.3.1 If any GFE is provided for use on any contract resulting from this specification, it may include nonstandard parts. The equipment furnished in accordance with this specification shall employ standard parts or approved nonstandard parts.

3.3.2 Requests for approval for the use of nonstandard parts shall be submitted in strict accordance with the requirements stated in MIL-E-16400.

3.3.2.1 Nonstandard parts approvals, previously granted under earlier contracts for equipment represented by the GFE, shall not be construed as being extended to equipment furnished in accordance with this specification.

3.3.2.2 All approved nonstandard parts shall be subjected to Quality Conformance inspection, Group A only, in accordance with their pertinent component specification as specified in MIL-E-16400.

3.3.3 All nonstandard parts shall be approved and documented in accordance with the requirements of MIL-E-16400, prior to the submission of the FAS for Government approval. The FAS shall incorporate standard parts and approved nonstandard parts prior to the conduct of FAS inspection.

3.3.4 Parts. Selection of all parts shall be in accordance with MIL-E-16400.

3.3.4.1 Electron tubes and solid state devices. Solid state devices shall be employed instead of electron tubes, to the same extent as the GFE performance requirements of this specification for general specification application. The number of different types of solid state devices and electron tubes shall be kept to a minimum. All electron tubes and solid state devices shall be operated well below their maximum specified rating to ensure meeting the MTBF requirement of 3.10. Where applicable, overload protection shall be provided. Where use of solid state devices will not satisfy performance requirements of this specification, approval for use of vacuum tubes shall be obtained from the command or agency concerned with complete justification and specifications describing tubes to be employed. Contractor shall be guided by MIL-STD-701 in the selection of solid state devices.

3.3.4.2 Solid state devices in the exciter. The design of the MD-777/FRT exciter unit shall employ solid state devices exclusively for all applicable functions when meeting the performance requirements of this specification. The electrical design of the exciter shall preclude the use of vacuum tubes.

3.3.5 Inductors and capacitors.

3.3.5.1 Variable capacitors. Variable capacitors used for the higher power tuning elements (servo controlled) shall be vacuum or gas filled ceramic type and shall be rated to withstand at least 1.25 times the maximum voltage and current that might be encountered under the worst case operating conditions implied by the provisions noted within this specification.

3.3.5.2 Neutralizing capacitors. Neutralizing capacitors, whose failure would likely cause damage to other components within the transmitter, shall be vacuum or gas filled ceramic type and shall be rated to withstand at least 2 times the maximum voltage and currents that might be encountered under worst case operating conditions.

3.3.5.3 Feedback capacitors. Variable capacitors used for accomplishing negative feedback to improve linearity shall be locked (or otherwise fixed) at the correct value during equipment manufacture to preclude misadjustment during field maintenance operations.

3.3.5.4 Dc isolation capacitors. To preclude antenna or personnel damage, all capacitors used for RF output coupling (dc blocking from the output line) at the power amplifier plate shall be constructed to withstand a peak voltage stress equal to 3 times the operating dc voltage at the power amplifier plate. All such capacitors shall be tested under the stress noted before use in the AN/FRT-85(V) transmitter. Such tests shall be conducted continuously at 25 degrees C for a period of not less than 15 minutes.

3.3.5.5 Inductors. The inductor used as the power amplifier tank inductor shall not be varied in inductance during the presence of RF current through rolling or sliding contacts. Such a tank inductor shall be preset to the desired inductance for each operating frequency prior to the application of RF power at the plate of the power amplifier tube.

3.3.5.6 Transformers. All provisions of MIL-T-27 shall apply for all transformers employed in the transmitter and not available from the qualified products list (QPL).

3.3.5.7 Resistors. In the selection of fixed composition resistors, 10 percent tolerance resistors are preferred. Narrow tolerance resistors (having a tolerance of less than 10 percent) shall be limited to cases where circuit use makes them mandatory to attain the performance requirements of this specification.

3.3.5.8 Manuals. Technical manuals for the equipment shall be prepared in accordance with MIL-M-15071 (see 6.2.2).

3.3.6 Harmonic signal attenuation filters.

3.3.6.1 Lower harmonic filters. Tuned filters used for the attenuation of second and higher order harmonics at the transmitter output shall be removable as separable assemblies and be capable of being repaired, aligned, and tested as complete entities. It shall be possible to attach any associated automatic tuning motor drive to a variable filter network and repair, align, and adjust either or both the filter and tuning drive while removed from the transmitter enclosure.

3.3.6.2 VHF harmonic attenuation filters. A low-pass filter shall be included at the output of the linear amplifier (within the amplifier cabinet). The filter shall be removable as a separate entity and be capable of being repaired, aligned, and tested separately from the transmitter circuitry.

Attenuation characteristics shall be such that, when terminated with a 50 ohm resistive load, all signal frequencies between 40.0 MHz and 200 MHz shall be attenuated at least 40 decibels (dB). Voltage standing wave ratio (VSWR) over the 2 to 30 MHz frequency range shall not exceed 1.3 to 1 while the filter is terminated in the 50 ohm resistive load.

3.4 Controls/indicators.

3.4.1 General. All operational controls shall be located on the front panels and be so grouped, arranged, and integrated by function with the applicable meters and indicators that an orderly, simple, and efficient method of performing normal operating functions may be carried out by a single operator. Words or phrases, descriptive of the control functions, shall be marked adjacent to each operating control. Markings shall be permanent and of such size as to be easily readable at a distance of 24 inches, with an illumination as low as 1 foot candle.

3.4.2 Manual override. The equipment shall be provided with manual tuning controls. Override of the automatic controls is required to allow the use of manual tuning. Further, full manual control of linear amplifier tuning circuits is required.

3.4.3 Frequency selection. The frequency selection for the transmitter shall be entirely a function of the exciter. The absolute frequency of the RF carrier, whether present in the transmitter output or fully suppressed from it, shall be determined by the exciter and selected by manual controls on the front panel of the exciter. These controls shall be the digital, decimal, direct-reading type and indirectly illuminated and easily read at a distance of 24 inches in a darkened or lighted room.

3.4.3.1 Number and function of controls. There shall be 1 digital, decimal control for every digit of frequency to be controlled. This requires 6 controls, 1 for each of the following: (1) Tens of MHz, (2) Units of MHz, (3) Hundreds of kilohertz (kHz), (4) Tens of kHz, (5) Units of kHz, and (6) Tenths of kHz.

3.4.3.2 Readout or display. There shall be associated with every control a readout or display device showing the selected digit of the exciter such that the output carrier frequency, as indicated by a linear integrated number, will be clearly displayed and unambiguous.

3.4.4 Control-indicator drawer and panel. The control cabinet shall contain a drawer assembly to house the control circuit printed wiring cards and transmitter control indicator functions exclusive of those noted for power control and exciter/keyer control.

3.4.4.1 The Control-Indicator panel shall provide, as a minimum, the following control functions: manual tuning, semiautomatic tuning (operator control of transmitter sequencing), automatic tuning for local test, automatic tuning from exciter or remote system control, transmitter tuning mode sequence control (coarse or automatic), and low level meter control as required elsewhere in this specification.

3.4.4.2 The Control-Indicator panel shall provide, as a minimum, low level test meters to monitor the following circuit functions when the meter switch(s) are placed in the appropriate position: all grid bias voltages, power amplifier dc screen (or cathode) voltage; low level tube plate voltages; and input RF power level from exciter.

3.4.4.3 The Control-Indicator panel shall provide for manual control of each of the servo-tuned linear amplifier tuned circuits and shall include a manual tune enabling switch plus a digital readout position indicating potentiometer for each tuning control. It shall be possible, with the aid of prepared tuning charts, to preset each of the manual tuning potentiometers for a desired frequency and simultaneously activate the tuning system motor drives to position the tuned circuits with a high degree of accuracy. Manual tuning control position readout counters with 5 place resolution are required.

3.4.4.4 The Control-Indicator panel shall provide panel lamp indicators, with front removable bulbs, to show the status of the following transmitter protective interlock circuits: ac line level, external, internal, ground sticks, rear doors, front doors, cooling, RF load.

3.4.4.5 The Control-Indicator panel shall provide panel lamp indicators, with front removable bulbs, to show transmitter fault status as follows: low level amplifier over-current, power amplifier driver tube over-current, power amplifier ac supply over-current, power amplifier screen over-current, power amplifier cathode over-current, crowbar activation, RF arc, excessive VSWR, and tuning system excessive operating time (fault).

3.4.4.6 The Control-Indicator panel shall provide access, via a hinged panel cover, to adjust the following setup (nonoperating) adjustments and controls: transmitter gain control level (TGC), average power control (APC), peak power control (PPC), VSWR trip point (up to 4:1), amplifier RF output power level, and crowbar test switch.

3.4.4.7 The Control-Indicator panel shall provide sequencing controls/indicators to permit manual sequencing the transmitter to a coarse tune, fine tune, or ready (operate) mode. Power control sequencing shall include Main Power OFF, Standby (High Voltage dc OFF), High Voltage dc ON, and Fault status. Indicator lamps (front removable bulbs) shall be provided to display the status of each of the functions noted in this paragraph.

3.5 Meters and meter panels.

3.5.1 Meters. Meters shall be provided to indicate all critical circuit parameters where the function indicated is of the continuously variable type. Where not otherwise specified, meters shall be of an accuracy of 5 percent or better.

3.5.2 Elapsed time meters. An elapsed time meter shall be provided in the equipment to indicate operating hours defined as high voltage on time. A meter to record filament hours for the final power amplifier electron tubes shall also be provided.

3.5.3 Multi-test meters. Meters shall be provided in both the exciter and the amplifier which shall be capable of being switched to any circuit which does not require continuous monitoring but requires periodic maintenance, adjustment or monitoring inspection.

3.5.4 Automatic tuning meters. Meters shall be provided to indicate the output level and polarity of each of the phase discriminators, load comparators, or other sensing circuits used to automatically tune the transmitter.

3.5.5 Meter panels.

3.5.5.1 Control cabinet meter panel. The Control Cabinet Meter panel shall contain, as a minimum, meters for monitoring power amplifier screen grid current, power amplifier plate current, power amplifier plate RF voltage, VSWR, average forward power, average reflected power, peak forward power and peak reflected power. The VSWR metering shall require no recalibration due to a change in frequency, power output, or operating modes. The Control Cabinet Meter panel shall be hinged and released via captive fasteners to permit access to calibration adjustment for power and VSWR meter functions. The meter panels shall be removable as assemblies.

3.5.5.2 Power supply meter panel. The Power Supply Meter panel shall contain, as a minimum, meters for monitoring each phase of the 3-phase ac line voltage, each line of the 3-phase ac line current, power amplifier driver tube plate voltage, power amplifier driver tube plate current, power amplifier tube (final) filament current, power amplifier tube plate voltage, output of each automatic tuning sensor (phase discriminators and load comparators). The Power Supply Meter panel shall also contain indicator lamps to indicate activity (shaft movement) at each of the automatic tuning servo mechanisms and the status of band switches controlled by the band encoder.

3.5.5.3 Power amplifier meter panel. The Power Amplifier Meter panel shall provide access to an adjustment for setting the power amplifier static plate current. The adjustment shall be accessible through the panel and protected by a suitable dust cover. The internal static current control shall be mounted in such a manner as to preclude any possibility of operator access to dangerous potentials.

3.6 Protection equipment/personnel.

3.6.1 Equipment protection. The design and construction shall be of such character that damage to the equipment will not occur from operator error such as improper control sequencing, improper tuning, failure to respond to alarms of fault indicators, and failure to follow operating instructions. From a full-off standby or full power operation, it shall be possible to sequence any operating control, including power circuit breakers, to any position without causing damage to the equipment.

3.6.1.1 Protection of internal components. All major components of the equipment shall, upon failure, activate protective features preventing further damage. A minor component failure may cause other minor component failures but shall activate protective features before damage occurs to any major component.

All electrical indicating instruments with associated multipliers or transformers, except self-contained thermocouple instruments and devices, shall be protected by the use of bypass units against damage due to stray radio frequency currents or transient potentials. All delicate instruments and devices shall be mounted for protection from damage due to shock and vibration.

3.6.1.1.1 Tuning protection. Control circuitry shall be included to protect the transmitter against secondary component damage for any condition of mistuning caused by either operator or component failure in the control or tuning circuits. Sensing and control circuitry shall also be provided to inhibit continued RF output from the power amplifier when a condition of mistuning or other malfunction results in other than normal power output in the transmitter mode selected. Tuning circuitry shall also be included to shutdown the transmitter when the tuning cycle exceeds 30 ±5 seconds.

3.6.1.1.2 Power amplifier overload. An ignitron crowbar assembly shall be utilized to protect the power amplifier final stage. Trigger control for the crowbar shall be obtained from the anode current of the final amplifier tube and shall be set to trigger the crowbar at an anode current of 10 percent above the maximum rated current for the tube(s) employed. (Trigger circuitry shall be packaged on a removable plug-in module; see 3.2.3.5).

3.6.1.1.3 RF arc sensing. Control circuitry shall be included to detect an RF arc within the RF amplifier enclosure and instantaneously inhibit RF power output until the RF arc is extinguished. Successive RF arcs within a short period shall serve to shut down the transmitter and indicate a fault at the Control-Indicator panel.

3.6.1.1.4 Loss of RF load. Sensing and control circuitry shall be included to detect the loss-of-load at the transmitter output connector, either during or preceding RF power operation, and cause the transmitter to fault. Damage to the transmitter components shall not occur whenever attempts are made to operate the transmitter with the output load disconnected. Any condition of fault status with respect to loss of output load shall be displayed on the Control-Indicator panel.

3.6.1.1.5 VSWR protection. Provision shall be included for de-energizing the linear amplifier whenever the VSWR at the amplifier RF output fitting exceeds the value of 4.0 to 1. Provision shall also be included for a manual reset feature and for a manual calibrated adjustment of the VSWR sensing circuitry to provide for de-energizing the amplifier at any selected value of VSWR between the limits of 2.0 to 1 and 4.0 to 1. See 3.14.14 and 3.14.15 for additional requirements.

3.6.1.1.6 In-rush current limiting. The ac line in-rush current during equipment turn-on or when the crowbar is activated shall be limited to the extent that repetitive actuations shall not cause damage or evidence of damage to any component nor cause any circuit breaker or other protective device to actuate. This requirement shall apply under conditions of maximum in-rush current conditions (that is 200 VAC, 50 Hz and negligible line source impedance). Suitable tests shall be conducted during the demonstration of the first article equipment to prove conclusively to the command or agency concerned that the

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maximum in-rush current is controlled or limited to preclude both short-term and long-term equipment damage and, further, causes no equipment malfunctions under worst case conditions.

3.6.1.2 External circuit fault protection. All components shall be protected from damage in the event of failure or malfunction of any external circuit including prime power, audio input sources, output coaxial line or other portions of the load circuit. Failures or malfunctions of external circuits shall include all possible types such as open circuit, short circuit, intermittent open and short circuits, excessive VSWR, overvoltage, or undervoltage of prime power, improper phase rotation, loss of one or more phases and transients (see 3.2.).

3.6.1.3 Mechanical components protection. It shall be a requirement of this specification that damage to the mechanical components of the transmitter, including shafts, couplings, gears, drives, motors, motor-gearheads and other rotating or moving elements including the tuned circuit components (inductors and capacitors) shall not result from any condition of circuit malfunction or operator error. To this end, the first article test plan shall include suitable malfunction and operator error tests to demonstrate compliance with this requirement.

3.6.2 Safety to personnel. Provision shall be made to prevent personnel from contacting any potential in excess of 50 volts root mean square (rms). All compartments in which this potential is exceeded shall be enclosed and protected with interlocks on all access doors or panels which may be opened during operation or maintenance. Interlocks shall act to remove all potentials within the protected compartment which are in excess of 50 volts rms. In cases where the removal of a potential is impractical, such as line input terminals, the terminals shall be insulated and protected with a nonmetallic cover labeled CAUTION and stating the voltage. The transmitter interlock circuit shall have provision for extension externally. To this end, a pair of terminals shall be provided from which the interlock circuit may be extended for at least 200 feet, using the same size conductors as used within the internal interlock circuit. Interlock voltage shall not exceed 50 volts rms.

3.6.2.1 Capacitor discharge. Provisions shall be made to prevent access to any compartment of the transmitter without activation of a mechanical device to discharge any capacitor in which the product of the capacitance, in farads, and the square of the operating voltage, in volts, exceed 25, except that such device need not be provided for compartments where the maximum voltage in the compartment does not exceed 50 volts rms. Doors on the power supply and linear amplifier cabinets shall include the mechanical discharge devices.

3.6.2.2 Grounding switches. Mechanical actuated switches that short the output of each of the major power supplies shall be enabled whenever any door of the power supply or linear amplifier cabinets are open.

3.6.2.3 Shorting stick. An electrical shorting stick shall be provided with readily accessible stowage and cable of sufficient length to reach all high voltage capacitors in the Amplifier/Power Supply. Cable shall be permanently connected to a ground point having less than .01 ohm. Breakdown voltage for the

handle shall be at least twice the maximum peak voltage encountered. A shorting stick shall be located near each enclosure opening. Interlock switches shall be installed so as to present application of high voltage when a shorting stick is removed from its mounting.

3.7 Ventilation and cooling. The equipment shall be ventilated and cooled in such a manner that, under normal conditions of operation at the maximum ambient temperature of +54 degrees C (129 degrees F), no part will attain a temperature which will tend to damage it or reduce its useful life. Forced air cooling (with air filters which permit washing and reuse of the filter element provided at each air inlet) shall be used. Forced air cooling design is subject to the requirements of 3.2, 3.2.7, and 3.14.20. The acoustic noise requirement of 3.14.20 shall be fully met with a forced air cooling design.

3.7.1 Ducting. Each cabinet that requires cooling air shall be fitted for ducting such air away from the area. The forced air system used in the transmitter shall be capable of overcoming the added back pressure caused by 50 linear feet of smooth interior surfaced metallic ductwork having the same cross section areas as the exhaust opening of the transmitter unit. The inlet air duct shall be at the rear of the Power Supply cabinet. The outlet air duct shall be at the top of the power amplifier cabinet. Both cabinets shall be provided with inserts or captive nuts so that external ducts may be attached.

3.8 Environmental conditions. The equipment shall be capable of operating at full power, with performance as required by this specification under the following range of environmental conditions: Ambient temperature 0 to 54 degrees C (+32 degrees to 129 degrees F); humidity: 0 to 95 percent RH; elevation: sea level to 10,000 feet.

3.8.1 Thermal survey. The supplier shall conduct a complete thermal survey of the FAS equipment to determine the existence of hot spots which may prove to be injurious to the useful life of the equipment specified herein. The complete thermal survey shall be conducted with the equipment cabinets closed. The survey shall be completed and all required corrective measures taken by the supplier prior to acceptance of the FAS by the Government. For the purpose of this specification, a hot spot is defined as any component or part used in the equipment including, but not limited to, such devices as transistors, light emitting diodes, bulbs, fuses, diodes, integrated circuits, printed circuit boards, insulation, insulators, transformers, capacitors, chokes, coils, and resistors which attain a temperature in excess of that recommended by the component or part manufacturer, and by any applicable military specification, or that attain a temperature which shall cause accelerated deterioration. A thermal survey shall be made of the equipment while continuously operating in an environmental temperature of 54 degrees C and begin immediately after the equipment has thermally stabilized for a minimum of 24 hours at that temperature. The supplier shall take the necessary measures to prevent the environmental temperatures in which the thermal survey is being conducted, from decreasing to less than 52 degrees C while placing or rearranging the thermal sensing device(s) from one component or part to another. The equipment shall be fully operational during the entire thermal survey if practical. If it should become necessary to remove the ac power from the equipment for more than 1 period of up to 5 minutes per hour, the equipment must be thermally stabilized for at least 4 hours before proceeding with the survey. The complete thermal survey shall be

conducted with the ac input voltage set at 10 percent above the nominal specified voltage for the equipment under test. The ac line frequency shall be set for 47 Hz. The supplier shall accurately measure and record all thermal data pertaining to each of the above listed components or parts unless specifically exempted, in writing, from such measurement by the command or agency concerned. The thermal data shall include but not be limited to the actual operating temperature of the part or component and any visible evidence of deterioration of the equipment. The supplier shall provide a comparison between the thermal data taken during the survey and the thermal conditions recommended by the manufacturer of the part or component. The method used to measure the operating temperature of the component shall not affect the accuracy of the measurement as a result of the heat sink effect or for any other reason. The supplier shall use proper techniques such as thermocouples, infra-red photography, chemicals or calibrated thermal sensitive materials to accurately measure the temperature of each component or part included in the survey.

3.8.1.1 Waiver of survey. When it is determined by proper engineering analysis that a particular component or part could be exempted from the survey, the supplier may request a waiver from the command or agency concerned, which if granted, will exempt those items from the survey. In the request for waiver, the supplier shall provide a complete engineering rationale as to why the specific component(s) should be excluded from the thermal survey.

3.9 Shock and vibrations. The transmitting set shall be designed and constructed to withstand shock and vibration when tested in accordance with MIL-T-4807.

3.10 Reliability. The specified MTBF for each transmitter shall be 600 hours (including vacuum tubes).

3.10.1 Reliability program plan. The contractor shall establish and implement a reliability program in accordance with MIL-STD-785 (see 6.2.2).

3.11 Maintainability.

3.11.1 Quantitative maintainability requirements. The exciter/keyer shall have a mean time to repair (MTTR) of 30 minutes. The amplifier shall have a MTTR of 60 minutes.

3.11.2 Maintainability program plan. The contractor shall prepare and submit for approval by the command or agency concerned (see 6.2.2) a maintainability program plan in accordance with the requirements of MIL-STD-470. The maintainability program plan shall describe the tasks to be performed and the procedures for conducting and controlling the maintainability program. The plan shall address each paragraph of MIL-STD-470 in sequence.

3.11.3 Maintainability prediction. A maintainability prediction shall be performed on Parts A and B, Procedure II of MIL-HDBK-472 for the Radio Transmitter AN/FRT-85(V). The contractor shall document and justify all assumptions and the applicability of all data used in the prediction. The prediction shall include all mechanical, electro-mechanical, and electronic parts. The results of the prediction shall be compared to the required ERT and where the predicted

values do not achieve the requirements, the contractor shall accomplish such changes in design as are necessary to improve the predicted values sufficiently to achieve the requirements. The prediction shall be submitted to the command or agency concerned for approval (see 6.2.2).

3.12 Technical description.

3.12.1 Frequency range. The frequency range of the transmitter shall be incrementally continuous from 2.0 to 30 MHz in increments of 100 Hz, or less.

Note: The 30 MHz upperlimit stated here and elsewhere in this specification may be interpreted to be noninclusive; that is, the highest frequency required of the transmitter is 29,999.9 kHz.

3.12.2 Frequency stability. The frequency stability of the entire transmitter shall be determined by the exciter's 1 MHz internal standard having a stability which shall be no worse than 1 part in 10^8 when measured at the RF power output point during any 24 hour period. The absolute frequency error shall have a daily change of not more than 0.3 Hz. The rms phase deviation shall not exceed 3 degrees in 10 milliseconds (ms).

3.12.3 Operating modes. The equipment shall provide the following modes of operation or types of emission.

A0 - Absence of any modulation
A1 - Continuous wave telegraphy
A2 - Modulated continuous wave telegraphy
A3E - Compatible amplitude modulated telephony
A3A - Single sideband, reduced carrier
A3B - Two independent sidebands
A3J - Single sideband, suppressed carrier
A9B - Two independent sidebands with combined telephony and telegraphy
A9J - Four independent sidebands with combined telephony and telegraphy
F1 - Frequency shift keyer (FSK)
F4 - Facsimile (FAX)

3.12.4 Electrical noise. For purposes of this specification, electrical noise is defined as any signal present in the transmitter output whose frequency is within ±6.2 kHz of the carrier frequency when the transmitter is conditioned for normal operation (key down) and all audio inputs are terminated resistively in their characteristic impedance of 600 ±j0 ohms and no input signal is applied. Tolerance: the electrical noise of the transmitter shall be at least 60 dB below the transmitter's full rated average power output.

3.12.4.1 The transmitter shall be capable of being employed in a simplex operation without causing electrical interference to the corresponding radio receiver frequency while transmitter is in key-up or receive-mode condition.

3.12.4.2 When the transmitter is in the key-up or receive-mode condition, with no signal input to the exciter, the transmitter average noise power output measured in a 4,000 Hz bandwidth shall be at least 85 dB below-one-milliwatt (mW).

3.12.4.3 When the transmitter is changed from key-up or receive-mode condition to key down condition, not more than 10 ms of intelligence shall be lost.

3.12.4.4 A pair of terminals and circuitry shall be provided in the exciter rack for dry contact on-off keying of the exciter and the amplifier's key-up noise reduction circuitry during simplex operation. Keying terminal shall be provided with a means for a circuit closure when external push-to-talk control of transmitter is not required.

3.12.5 Spurious emission. The power level of all spurious emissions below the level of the unsuppressed level of the carrier frequency, including harmonic distortion, parasitic oscillations, and intermodulation products outside of the normally transmitted bandwidth of 12.6 kHz shall be as follows: Any emission appearing on any frequency removed from the unsuppressed level of the carrier frequency by at least 50 percent, but not more than 100 percent of the maximum authorized bandwidth, shall be attenuated not less than 40 dB; any spurious emission appearing on any frequency removed from the unsuppressed level of the carrier frequency by at least 100 percent, but not more than 300 percent of the maximum authorized bandwidth, shall be attenuated not less than 60 dB. Any spurious or harmonic emission appearing on any frequency removed from the unsuppressed level of the carrier frequency by at least 300 percent of the maximum authorized bandwidth shall be attenuated not less than 80 dB.

3.12.6 Intermodulation distortion. All intermodulation products shall be measured from the audio input to the RF output of the transmitter.

3.12.6.1 White noise loading. When all channels except the one under test are loaded to full rated rms output power, the average power measured in the unloaded channel at the RF output shall be at least 43 dB below rated average power output.

3.12.6.2 Two-tone test. The transmitter shall be tested by the Contractor at 40 kw PEP (20 kw average power) using a standard two-tone test as the modulating signals. The test tone frequencies for this test shall be 1000 Hz and 1625 Hz. When operated in accordance with the requirements of 3.14.3.1 for full rated PEP (two-tone) output, all intermodulation distortion products shall be at least 38 dB below either tone appearing at the output point of the transmitter.

3.12.7 Unwanted sideband. When operating in the single independent sideband mode, the unwanted sideband shall be attenuated to at least 70 dB below the level of the wanted sideband.

3.12.8 Interference. The radiated and conducted interference produced by the exciter when operated into a 50 ohm resistive load shall not exceed the limits set by MIL-STD-461 reprocurement requirement electronic equipment for all surface ships and shore sites. Measurement of the RF signature shall be made in accordance with MIL-STD-449.

3.12.9 Carrier suppression. The carrier shall be suppressed at least 60 dB below the rms power of a single tone at full rated output.

3.12.9.1 Carrier reinsertion. Means shall be provided for inserting the carrier at levels of 0 dB (no suppression), -6, -10, -20, and -40 dB.

3.12.10 Carrier change under modulation. When the carrier suppression is at maximum (60 dB or more), the carrier level shall not change more than ±2.5 dB at any output level between zero and full rated output power.

3.12.11 Carrier compression. When set for 20 dB carrier suppression, the carrier level shall not be compressed more than 1 dB at any power level from zero to full rated power output.

3.12.12 Equal sideband power. When operating in the independent sideband mode and with equal power input to each channel, the total power output shall be divided equally among the channels within ±5 percent.

3.13 Modulator - synthesizer and keyer group.

3.13.1 Description. The HF ISB Modulator-Synthesizer and Keyer Group (hereinafter also called the exciter and keyer) shall include all of the output frequency determining elements and all of the elements determining the output modulation characteristics. It shall provide the terminations for the audio input lines and shall furnish to the Linear Amplifier-Power Supply-Control Group AN-( )/FRT, (hereinafter also called the amplifier) a modulated RF excitation signal adjustable between zero and a maximum of not less than 250 mW PEP throughout the frequency range specified in 3.12.1 across 50 ohms nominal impedance. It shall provide to the amplifier any required tuning and condition information. It shall contain input signal processing devices. It shall be of a continuous duty, high reliability, high stability, independent sideband frequency synthesized type having self-contained provisions for accepting from one to four 3 kHz bandwidth audio input channels. The exciter output shall be capable of a maximum of 250 mW PEP RF power in the 3A9B to 12A9B modes depending upon the number of audio frequency inputs utilized. The VSWR shall not exceed 1.5:1, when terminated in 50 ohms. (Refer to 3.13.4.1 and 3.13.4.2 for keyer characterisitics and configuration.)

3.13.2 Frequency standards.

3.13.2.1 Internal frequency standard. The internal frequency standard shall have stability equal to that specified in 3.12.2. The internal frequency standard shall provide three 1 MHz outputs at a level of 1 volt rms when terminated into 3 individual 50 ohm loads. Outputs shall be as follows:

(a) One coaxial connector of 50 ohms impedance mounted on the rear panel of the exciter to allow connection via a trench duct and marked "BNC INT STD." The connector used for this output shall be self-terminating into a 50 ohms load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting.

(b) One coaxial connector of 50 ohms impedance mounted on the front panel of the exciter and marked 1 MHZ INT STD MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm "BNC" type fitting.

(c) One BNC type UG 290A/U coaxial connector mounted on the internal frequency standard module of the exciter and marked 1 MHZ OUT.

3.13.2.2 Absolute frequency error. For purposes of this specification the absolute frequency error is defined as the total deviation in Hz of the output carrier frequency (present in the output or fully suppressed from it) from that frequency indicated on the exciter frequency selection controls or their associated indicating devices.

3.13.2.2.1 The absolute frequency error shall have a daily change of not more than 0.3 Hz, except during the initial aging period. (The initial aging period shall have been completed prior to the time that the transmitter is offered for Government acceptance). The absolute frequency error shall also conform to the following limits:

Time since last frequency calibration	Allowable absolute error at 30 MHz
(a) less than 24 hours	0.3 Hz
(b) between 1 day and 7 days	0.3 Hz x days or 1.5 Hz, whichever is less
(c) between 7 days and 90 days	1.5 Hz x weeks or 3.0 Hz, whichever is less

3.13.2.3 External frequency standard. The exciter shall be provided with a means for connecting to an external 1 MHz prime frequency standard in lieu of the internal frequency standard at a level of 1 volt rms across an impedance of 50 ohms. The exciter shall fully meet performance requirements when using the external standard as long as the external standard delivers a signal equal to or better in stability, amplitude, and purity to that of the internal standard. Provision shall be included for feeding the incoming external standard to the front panel of the exciter at a level of 1 volt rms across 50 ohms and shall be marked 1 MHZ INT STD MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting.

3.13.2.4 Phase-locking. The synthesizer shall be equipped with a memory type phase-locking modular device for locking the internal frequency standard to the 1 MHz station standard. If either standard signal is lost or deteriorated, the active standard shall automatically switch and lock to its last corrected phase and frequency.

3.13.2.5 Automatic switching. A failure sensing modular device shall be provided to switch frequency control from the internal to the external standard upon failure of the internal standard. Automatic switching shall occur when the amplitude of the standard decreases 3 db below a 1 volt rms reference level. After restoration of the internal standard to at least 1 volt rms, the sensing device shall automatically switch back to the internal frequency standard. The allowed transit time for the switching device to function shall not exceed 10 ms. No degradation to the transmitter output shall occur as a result of the 3 db amplitude decrease at the output of the internal standard. The failure sensing module shall be provided with input and output signal connectors as follows:

(a) One BNC coaxial connector UG290A/U mounted on the chassis of the module and marked 1 MHZ EXT STD IN.
(b) One BNC coaial connector UG290A/U mounted on the chassis of the module and marked 1 MHZ INT STD MON.

3.13.2.6 Failure alarm. A front mounted visual/aural failure alarm device with provisions for remoting to other locations shall be provided to indicate the loss of internal frequency standard output. Terminals shall be provided in the transmitter for remoting this alarm feature.

3.13.2.7 Frequency/Calibration. For purposes of this specification, frequency calibration of the exciter is defined as a process for:

(a) determining the frequency stability,
(b) determining the absolute frequency error, and
(c) reducing the absolute frequency error to less than 0.3 Hz.

3.13.2.7.1 Monitoring output. A coaxial output of 50 ohms impedance shall be provided on the exciter for calibration. An output signal with a nominal frequency of 1.0 MHz shall be provided, with an absolute frequency error which is a simple arithmetic relationship to that of the output carrier frequency. The output signal level shall be at least 1.0 volt rms whenever the exciter is in use and shall be protected, or isolated, so that any load between an open circuit and a short circuit can be applied without affecting the normal operation of the exciter.

3.13.3 Operation modes. The exciter shall provide modes of emission as specified in 3.12.3. To accomplish this requirement a control marked SIDEBAND SELECTOR and a control marked CLASS OF EMISSION shall be provided on the exciter front panel. These controls shall be in the form of rotary selector switches.

3.13.3.1 Sideband selector control. This control shall provide selection of the following sideband operating combinations:

(a) Upper sideband (channel A_1) with voice frequency gate
(b) Upper sideband (channel A_1) with push-to-talk
(c) Upper sideband (channel A_1) continuously keyed
(d) Lower sideband (channel B_1) continuously keyed
(e) 2 channel independent sideband (channels A_1 and B_1) continuously keyed
(f) 4 channel indeptendent sideband (channels A_2, A_1, B_1 and B_2) continuously keyed

3.13.3.2 Class of emission control. This control shall provide carrier insertion levels and emission capabilities as follows:

(a) A$\emptyset$ operation, continuous carrier insertion at rated average power output; to modulation will be accepted
(b) A_1, F_1 or F_4 operation, providing the capability of the exciter accepting these forms of modulation in the A_1 channel
(c) A_2 or A_3 operation; this function shall be interlocked with the sideband selector control to provide operation with modulation in the A_1 channel and carrier insertion 6 dB below rated PEP output
(d) Carrier insertion 10 dB below rated PEP output
(e) Carrier insertion 20 dB below rated PEP output
(f) Carrier insertion 40 dB below rated PEP output
(g) Fully suppressed carrier (at least 60 dB below rated PEP output).

3.13.4 Signal inputs.

3.13.4.1 Continuous wave (CW), FSK and analog.

CW, single channel FSK and FAX (analog) keying shall be accomplished by means of the KY-655/FRT electronic keyer capable of accepting CW keying at speeds

up to 200 bauds, FSK up to 300 bauds, and an analog input at speeds up to 400 bauds.

3.13.4.1.1 Keyer interface. The exciter and the KY-655/FRT shall be provided with interface connectors so that, when the A_1, F1 or F_4 Class of Emission described in 3.13.3.2 is selected at the exciter, the KY-655/FRT is automatically placed in operation. Utilization of this requirement may be selected at the option of the installation or transmitting site personnel.

3.13.4.1.2 Electronic keyer KY-655/FRT description. The electronic keyer KY-655/FRT shall be located as an integral part of the transmitter equipment rack or shall be capable of being installed at a remote location. It shall be rack mounted on a standard type c 19 inch panel and be capable of being connected to the exciter by a single multi-wire cable. In addition to the foregoing, it shall include the following additional features: a front panel switch shall allow operator selection of teletypewriter (TTY), CW, or FAX modes of operation; a direct reading 10 turn TTY deviation control shall allow operator selection of deviations from 1 to 999 Hz; a front panel function test switch shall be provided to allow operator selection of TTY mark, TTY space, CW, FAX white, and FAX black for test purposes.,

3.13.4.1.3 Interface with MD-777/FRT. The keyer and the MD-777/FRT shall be provided with interfaces that will allow the keyer to be connected to and controlled by the MD-777/FRT. When so connected, selection of the A_1, F_1, F_4 Class of Emission described in 3.13.3.2 shall automatically place the keyer in operation. Terminal strips with appropriate connections shall be available within the keyer so that the utilization of this requirement may be selected by the installation or transmitting site personnel.

3.13.4.1.4 Automatic line transfer. The electronic keyer KY-655/FRT shall provide a means for automatically connecting the output to channel A_1 when A_1, F_1 or F_4 mode is selected. The automatic line transfer feature shall disconnect from the output of the keyer when any mode other then A_1, F_1 or F_4 is selected and select an external audio line which is terminated into channel A_1 of the exciter.

3.13.4.1.5 Keying speeds. The electronic keyer shall be capable of operation with CW keying up to 200 bauds, FSK (TTY) up to 300 bauds, and analog inputs (FAX) at speeds up to 400 bauds.

3.13.4.1.5.1 Keyer output frequencies. The keyer shall provide a 1000 Hz tone for CW on-off keying. In addition, the frequency-shift tones for teletype and FAX operation, provided by the keyer, shall be selectable about the following center frequencies, by means of a 4-position switch:

(a) 2550 Hz
(b) 2000 Hz
(c) 1900 Hz
(d) Internally adjustable from 400 Hz to 3000 Hz.

The separation between mark and space tones provided by the keyer for frequency-shift TTY operation shall be continuously adjustable from 1 to 999 Hz. Accuracy

of all output tones shall be within ± 1 Hz to ± 1 percent, whichever is greater. The stability of all tones shall be within 1 Hz per day.

3.13.4.1.6 Keyer input signals. The keying sense shall be front panel selectable. The electronic keyer shall accept the following types of signal input:

(a) 20 ma neutral (external battery)
(b) 60 ma neutral (external battery)
(c) 50 volts neutral (external battery)
(d) 100 volts neutral (external battery)
(e) Dry relay contacts (internal battery)
(f) Keyer shall accept FAX signal input which varies linearly between 1 volt and 10 volts dc and deliver a frequency shift tone which varies linearly from 400 Hz above to 400 Hz below the selectable rest frequency. Quasi analog data of MIL-STD-188 is applicable.
(g) Keyer shall also accept low level (± 6 volts) polar signals with input sensitivity of 0.5 volt, positive mark, external battery, with no internal ground.

3.13.4.1.7 Keyer input impedance. The exciter keyer shall have the following input impedances for input signals defined in 3.14.2.

(a) 150 ohms or less
(b) 150 ohms or less
(c) 47,000 ohms
(d) 100,000 ohms
(e) 47,000 ohms
(f) 47,000 ohms min.

3.13.4.1.8 Power source. The keyer shall operate from single phase power sources of 115 volts ± 10 percent or 230 volts ± 10 percent, 47 to 63 Hz. Conversion from operation at 115 volts to 230 volts or vice versa shall be accomplished by a single toggle switch located behind the keyer front panel protected by a guard to prevent inadvertent switching.

3.13.4.1.9 In addition to other requirements specified herein, a no-transition relay for cycling the transmitter to an off the air condition when the radio teletype circuit goes to a sustained MARK or receiving mode during simplex operation. The release time off the relay shall be manually adjustable and calibrated from 0 to at least 5 seconds. Activate time of the relay shall not exceed 1 ms. The control shall be mounted internally.

3.14.4.1.10 CW mode. The KY-655/FSK shall be designed sugh that CW operation is possible using either 60 ma, 20 ma, 100 volts ± 6 volt polar or dry contact input signals.

3.13.4.1.11 Dc isolation. The KY-655/FSK shall be designed such that the dc input loop, in all modes of operation, shall be isolated from ground.

3.13.4.2 Modulating signals (audio). The exciter shall be capable of being modulated with voice or composite audio frequency signals (from Navy terminal equipment) at a nominal level of 0 dBm. The nominal input level for each input shall be 0 dBm. Attenuators shall be provided for accommodation of input levels from + 10 dBm to -25 dBm in increments of not more than 1 dB.

3.13.4.2.1 Voice frequency-gate (VFG). Provision shall be made in the Exciter Audio Input Channel A_1 for a VFG circuit equipped with an internal screwdriver adjusted control for setting the gate sensitivity to any signal sensing level ranging from -5 to -20 dBm. The output of the VFG shall be translated to dry-contact keying of the transmitter push-to-talk control circuitry specified in 3.12.4.4.

3.13.4.2.2 The dry-contact keying line from the VFG shall be capable of being switched in or out of the transmitter's internal push-to-talk circuit.

3.13.4.3 Input impedance (keyer). The keyer shall have the following input impedance for input signals defined in the corresponding subparagraphs of 3.13.4.1:

(a) 150 ohms or less
(b) 150 ohms or less
(c) 47,000 ohms
(d) 100,000 ohms
(e) 47,000 ohms

3.13.4.4 Audio impedance. The input impedance for the composite voice frequency inputs to the exciter shall be 600 ohms balanced.

3.13.4.4.1 The electrical balance shall be such that longitudinal currents are at least 40 dB below the reference input level (0 dBm at 1000 Hz).

3.13.5 Exciter response characteristics (four 3 kHz channels).

3.13.5.1 Outer channel inversion. The four channels of the exciter shall be identified in accordance with figure 1.

3.13.5.1.1 Conversion frequency. The inversion of the outer spectra of channels A_2 and B_2 with respect to those of channels A_1 and B_1 shall be accomplished by a method which yields an output which conforms to the following:

(a) Frequency. The output frequency spectra of channels A_2 and B_2 shall be such that they are identical in frequency with those which would have been derived by appropriate sideband selection after modulation of a carrier frequency removed 6,290 Hz above and below the output carrier frequency, respectively.
(b) Stability. The frequency stability of channels A_2 and B_2 shall be identical with that of A_1 and B_1. This requirement means that whatever method of inversion is used it shall not cause the output to exceed the frequency stability limits of 3.13.2 or the absolute frequency error requirements of 3.13.2.2.1.
(c) Inversion carrier and spurious suppression. Regardless of whether actual carriers are used to accomplish the required spectra

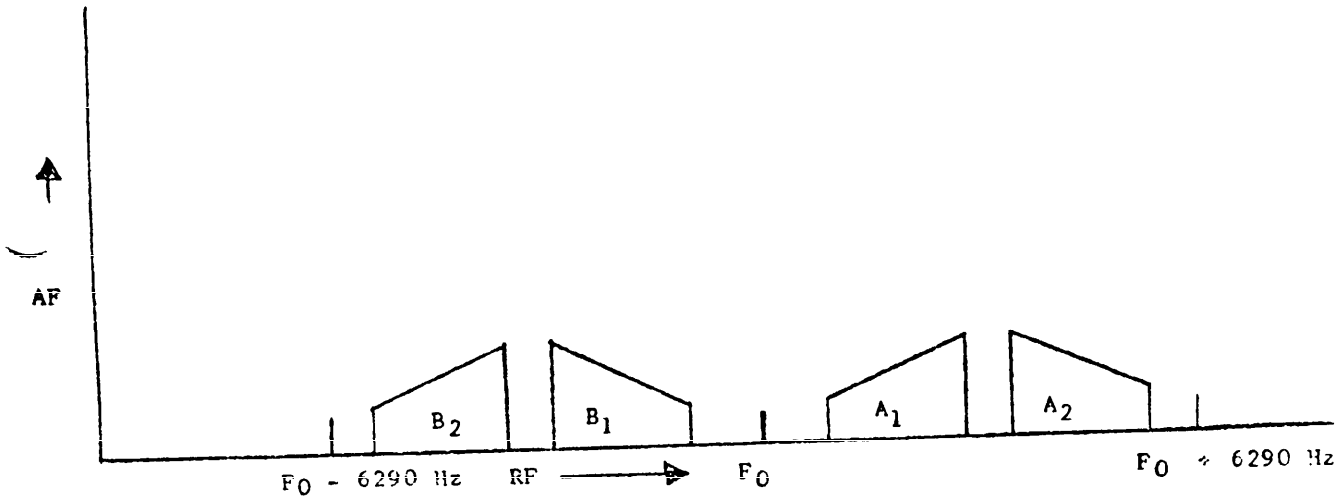

Figure 1. Transmitter AF channels.

inversion of channels A_2 and B_2, there shall be no degradation of the specified performance requirements of the transmitter. To this end, the carriers and any of the unwanted products of such processes will be included in the determination of specified tolerances for inter-modulation, spurious response, and so forth, for the transmitter.

3.13.5.2 Response (audio channel). The response of each audio channel shall be such that the output level of any single modulation frequency does not depart from the reference level by more than 0.5 dB over the range of 370 to 3040 Hc for channels, A_1, A_2, B_1, and B_2.

3.13.5.3 Stability of characteristics. The response of each audio channel of the exciter shall not exceed the limits of 3.13.5.2 under any allowable conditions of modulation. This requirement means that under any combination of allowable input types and levels in the other three channels, each of the channel's response curves shall not exceed the limits of 3.13.5.2.

3.13.5.4 Input and output references. The reference points for the exciter audio response characteristics shall be the RF output resulting from 0 dBm, 1000 Hz, sine wave at the audio input terminals of each exciter channel. The audio response of each channel shall be determined by measurement in its respective portion of the modulated RF output of the exciter.

3.13.6 Exciter response characteristics. (Two 6 kHz channels option item). When specified in the contract or order (see 6.2.1), the exciter response characteristics shall be as specified in 3.13.6.1 through 3.13.6.4.

3.13.6.1 Audio channel response. The response of each audio channel shall be such that the output level of any single modulation frequency does not depart from the reference level by more then .5 dB over the range of 250 to 6000 Hz for channels A and B.

3.13.6.2 Adjusted match characterisitcs. The response of each audio channel of the exciter shall not exceed the limits of 3.13.6.1 under any allowable conditions of modulation. This requirement means that under any combinations of allowable input types and levels in the other channels, each of the channel response curves shall not exceed the limits of 3.13.6.1.

3.13.6.3 The filters provided shall meet out-of-band performance as specified below over the temperature range 0 degree to 54 degrees (monotonic slopes):

Frequency	Attenuation
Fo	At least -20dB
Fo -250 Hz	At least -05 dB
Fo -350 Hz	At least -60 dB
Fo +3350 Hz	At least -20 dB
Fo +3590 Hz	At least -60 dB

3.13.6.4 Exciter input and output references. The reference points for each exciter input audio response characteristic shall be 0 dBm, 1000 Hz, sine wave at the audio input terminals of each exciter channel. The audio response of each cahnnel shall be determined by measurement in its respective portion of the modulated RF output of the exciter.

3.13.7 Envelop delay. Overall envelop delay distortion shall not exceed the following limits:

Delay	Frequency
500 microseconds (µs)	382 to 3020 Hz
1000 µs	370 to 382 Hz
1000 µs	3020 to 3040 Hz

3.13.8 Transfer time. It shall be possible to place the exciter in standby condition from full operating condition, or return it to full operating condition from standby condition, within 30 seconds using not more than one front panel control.

3.13.9 Exciter standby provisions. For purposes of this specification, exciter standby condition is defined as that condition wherein the maximum amount of power consuming circuitry in the exciter is deactivated while all circuitry which affects the stability and accuracy of the exciter output frequency remains in full operating condition.

3.13.9.1 Standby power. Power for the circuits in the exciter required to be active during standby condition shall be derived from the separate source described in 3.13.14 with automatic transfer to the source of 3.13.14.1 (when such is required by the equipment procurement documents) in the event of failure of the 3.13.14 source. Power drain of the exciter in standby condition shall not exceed 500 watts.

3.13.10 Control-indicators (exciter). The exciter shall provide, in addition to those already specified, the following control-indicators. These will function as the normal operating controls of the transmitter.

3.13.10.1 Amplifier off. This control-indicator will return the amplifier to a status below standby whereby the cooling, filaments, and so forth, are all off. The indicator shall show the actual status of the transmitter.

3.13.10.2 Standby. This control-indicator shall provide a command for the transmitter to go to a standby condition. The indicator shall show the actual status of the transmitter. Positive visual indication of both standby and full operational condition shall be provided on the front panel of the exciter. From the appearance of these 2 indicated conditions, it shall be possible to deduce the third operational condition: fully deactivated.

3.13.10.3 Operate. The operate control-indicator shall light to show transmitter operate condition. The control will command the transmitter above standby to a full operate (that is, all voltages applied) condition.

3.13.10.4 Tune. This control-indicator will illuminate to indicate the transmitter needs to be retuned (for example, change in frequency or class of emission). The control will initiate a tune sequence in the transmitter and automatically provide an operate command.

3.13.10.5 Ready. The ready indicator will illuminate to indicate the transmitter is in operate, has completed a tune sequence, and is ready for the beginning of data transmission.

3.13.10.6 Transmitter status read-back function. Provisions shall be made in the exciter for sensing, monitoring, and translating to dry contact control of a remote readout indicating system. The remote readout function shall be as follows:

(a) Modulation.

Channel	Condition	Contacts
A1	ON	CLOSED
B1	ON	CLOSED
A2 and B2	ON	CLOSED
B+	ON	CLOSED
RF	ON	CLOSED

3.13.11 Controls

3.13.11.1 Individual subchannel gain. Each of the audio-input channels shall be provided with a single control which controls the amount of output power in its respective portion of the output spectrum. It shall be possible, through the use of these controls, to allow from 5 to 85 per cent of the available output power in any one of the audio channels. Thus it shall be possible, by using these controls, to have any combination of power division (totaling not more than 100 percent) amoung the 4 (or 2) channels between the limits of 5 percent minimum and 85 percent maximum in any 1 channel. Such controls shall be continuous and shall be calibrated between 5 and 85 percent in 1 dB increments. Accuracy of calibration shall be 5 percent as measured in the transmitter output.

3.13.11.2 Automatic level control. The audio inputs shall be arranged so that each input signal, at any level above 0 dBm, shall automatically and independently be attenuated in a smooth transition to the point where a +10 dBm input signal level shall not exceed +3.0 dBm to the exciter. (The transmitter linear amplifier shall also be similarly automatically protected from high signal levels that would otherwise exceed the power limits of the transmitter and cause a shutdown.)

3.13.11.3 Exciter power control. The power output level of the exciter shall be variable from 0 to at least 250 mW by means of a single control, while retaining all of the performance characteristics required by this specification. The control shall be located in back of the front panel, readily accessible when the drawer is extended for maintenance or adjustment.

3.13.11.4 Calibration controls. Controls shall be provided for adjustment of the frequency of the prime standard of the exciter. Such controls shall have an adjustment range sufficient to allow reduction of the absolute frequency error as necessary once every 90 days for a period of at least 10 years. Controls shall be accessible for use while the exciter is in service but shall be so arranged or protected so that inadvertent movement of them is unlikely. Such controls shall have sufficient vernier spread to allow the minimum frequency increment to be small enough to reduce the absolute frequency error of the output carrier frequency to less than 0.3 Hz when the exciter is operating at any frequency between 2.0 and 30 MHz. Such controls shall have a scale or markings which allow a log to be obtained for long term calibration record purposes.

3.13.11.5 Frequency controls. The exciter controls and their associated controlled elements and display or indicator devices shall be so made that there is no possibility of any of them causing or allowing the exciter carrier output frequency to be other than that indicated. This requires that the control and its controlled element be interlocked so that they work as a true step function unit with no intermediate points possible between adjacent digital stops.

Note: It is permissible for the control and display unit to be the same unit, provided that the display portion clearly indicates which of its 10 possible digits has been selected.

3.13.12 Input meter. One industry standard volume unit (VU) meter shall be included with provision for switching to the input of any one of the audio circuits. This meter shall electrically follow the attenuators of 3.13.11.1 and be so arranged that the meter indicates 0 dBm at the audio input terminals when the attenuator is in the 0 dBm attenuation position. This meter shall have A scale calibration (per EIA standards) and 3 percent or better accuracy.

3.13.13 Exciter output impedance. The active output impedance of the exciter shall be 50 ohms nominal. Maximum VSWR at the exciter output fitting shall not exceed 1.5.1 throughout the required frequency range specified in 3.12.1.

3.13.14 Power supply (transmitter and synthesizer/exciter and keyer). The entire transmitter, with the exception of the synthesizer/exciter and keyer, shall be designed to take power from a single source at any of the following line voltages (Choice of line voltage shall be available to the Navy installer by means of internal power supply taps): 200, 208, 220, 230, 240, 440, 460, 480 volts--50/60 Hz cycles ±5 percent, 3 phase. The synthesizer/exciter and keyer shall accept power from a separate source at 115/230 volts ±10 percent, 50/60 Hz ±5 percent, single phase. Provision shall also be made for an alternate transformer-coupling of power input to the exciter/synthesizer and keyer from the prime power source.

3.13.14.1 Exciter power distribution. Primary power in the exciter rack shall be distributed by means of a standard commercial type multiple outlet strip, using grounding type outlets. A circuit breaker for interrupting both sides of the exciter/keyer line shall be provided.

3.14 Linear amplifier - power supply.

3.14.1 Frequency range and tuning. The frequency range of the HF Linear Amplifier AM-6048 - Power Supply Group PP-6069 (hereinafter also called the amplifier) shall be continuous from 2.0 to 30 MHz as a minimum. The amplifier shall use the RF signal from the exciter as a reference for tuning all circuits, including the antenna matching circuits, to the most efficient operating conditions for the frequency being used. Any required coarse tuning or conditioning information shall be provided to the amplifier by utilizing the RF frequency signal from the exciter. The transmitter shall be capable of being automatically tuned and loaded on any frequency from 2 to 30 MHz in 20 seconds or less.

3.14.2 Automatic tuning system. Provisions shall be made for disabling the automatic tuning system of the amplifier when the tuning sequence is complete. Those portions of the automatic tuning system concerned with output loading and matching shall not be completely disabled, but shall have their sensitivity reduced to the point where they do not operate until a threshold of approximately 10 percent change of the controlled parameter has been exceeded. Above this threshold, they shall operate at normal sensitivity until the proper condition of tuning or loading has been restored, at which point they shall revert to the less sensitive condition. The automatic tuning system shall be provided with local tuning controls on the front panel with which the transmitter may be completely tuned manually. Provisions shall also be included to tune each of the amplifier circuits via means of a mechanical shaft extension associated with each automatic tuning assembly.

3.14.3 Power output. The amplifier shall amplify any emission presented to its input from the exciter, in a linear manner within the limits of a 25 kHz bandwidth. The power output delivered to a 50 ohm unbalanced nonreactive load over the frequency range of 2.0 to 30 MHz shall be at least as specified in 3.14.3.1 when driven by the input power specified for each mode of operation. The equipment shall be demonstrated at the following power outputs:

Two tone	40 kW PEP
CW	20 kW average
White noise	8 kW average
High VSWR	VSWR of 4:1

3.14.3.1 Maximum power inputs required for specified outputs.

Input CW/FSK	Output
A1/F1: Less than 100 mW carrier	20 kW average carrier

Input SSB (Adj)	Output
Less than 200 mW (PEP 2-Tone)	40 kW (PEP 2-Tone)

3.14.3.2 Average power output rating. The minimum average power output level of the transmitter shall be 8,000 watts when measured in accordance with white noise loading conditions as specified in ~~BCAC-330-175-1~~. The intermodulation distortion shall be -43 dB or better when the transmitter output is terminated into a 50 ohm nonreactive load.

3.14.4 Efficiency. The overall efficiency of the amplifier shall be no less than 25 percent determined from total 50/60 Hz power input and the average power output with transmitter loaded under two-tone conditions.

3.14.5 Harmonic output. Output power at any harmonic shall be at least 80 dB below full rated power output.

3.14.6 Intermodulation, spurious, and hum. Intermodulation products and spurious emissions produced in the amplifier shall be limited to levels consistent with the overall requirements for the transmitter as defined in 3.12.5 for spurious emissions and in 3.12.6 for intermodulation distortion. Hum is included in the definition of the electrical noise, the tolerance for which was specified in 3.12.4.

3.14.7 Keying transient. Provision shall be made for eliminating any key down transients originating in the transmitter.

3.14.8 Regeneration. There shall be no evidence of unintended oscillation or instability under any condition of operation of the amplifier when employing tubes with the maximum transconductance specified for the type tubes used and with a supply voltage up to 10 percent higher than the rated primary voltage.

3.14.9 Information bandwidth. With an RF input signal of constant level driving the amplifier at any frequency between 2.0 and 30 MHz and the amplifier loaded into 50 ohms resistive, it shall be possible to change the driving frequency by plus or minus 12.5 kHz without causing more than 0.5 dB variation in the amplifier output level.

3.14.10 Output impedance. The active output impedance of the transmitter shall be 50 ohms nominal. No degradation of specified performance shall occur when the external load impedance is such that it produces up to 2.5 to 1 VSWR at the transmitter output when the external VSWR approaches a limit of 4 to 1. The transmitter shall be capable of delivering full rated power into any VSWR

of 4:1. The transmitter shall be fitted with a standard 50 ohm 3-1/8 inch EIA flange fitting at the transmitter output point which shall be located at the top of the amplifier cabinet.

3.14.11 Input impedance. Throughout the frequency range of 2.0 to 30 MHz, the amplifier input circuit impedance shall be 50 ohms resistive, with reactive components reduced to values which will cause a VSWR no higher than 1.3 to 1 at the exciter output.

3.14.12 Amplifier standby. The amplifier standby condition is defined identically with the exciter standby condition (see 3.13.9) with the following addition: all components and circuitry in the amplifier requiring more than 30 seconds to reach full operating condition shall remain activated during standby. All circuitry remaining active during the standby condition shall be so protected that cabinets may be opened for maintenance without violating any personnel safety requirement of 3.3.5 and 3.3.5.1.

3.14.13 RF sampling. Individual RF output sampling receptacles shall be provided to enable the monitoring of RF input and RF output spectrum of the amplifier. Sampling shall be provided at a level of approximately 1 volt rms into 50 ohm connectors. Output connectors shall be as follows:

(a) One coaxial connector of 50 ohms impedance mounted on the rear panel of the amplifier to allow connection via a trench duct and labeled INPUT MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting and connected internally to monitor the amplifier input. The 1 volt level shall be based on 100 mW average input.

(b) One coaxial connector of 50 ohms impedance mounted on the front panel of the amplifier and labeled INPUT MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting and connected internally to monitor the amplifier input. The 1 volt level shall be based on 100 mW average input.

(c) One coaxial connector of 50 ohms impedance mounted on the rear panel of the amplifier to allow connection via a trench duct and labeled OUTPUT MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting and connected internally to monitor the amplifier output. The 1 volt level shall be based on 20 kW average output.

(d) One coaxial connector of 50 ohms impedance mounted on the front panel of the amplifier labeled OUTPUT MON. The connector used for this output shall be self-terminating into a 50 ohm load when not in use. The connector shall be designed to mate with a standard 50 ohm BNC type fitting and connected internally to monitor the amplifier output. The 1 volt level shall be based on 20 kW average output.

3.14.14 RF power meters. The RF output power meter shall provide scales for measurement of forward and reflected power:

(a) Forward peak envelope power with a scale of 0-60 kW,
(b) Reflected peak envelope power with a scale of 0-20 kW,
(c) Forward average power with a scale of 0-30 kW,
(d) Reflected average power with a scale of 0-10 kW.

Switching shall be such that the reflected power position is spring loaded for automatic return of the switch to the forward power scale. Calibration of the RF output power meter shall be accurate to within 10 percent over the 2.0 to 30 MHz frequency range. Metering of the amplifier input from the exciter shall be provided on the amplifier's multipurpose meter. The input shall be measured on a 0 to 250 mW scale.

3.14.14.1 VSWR indicator. Provisions shall be included for visual indication of the VSWR at the amplifier output point. The meter indicator shall indicate VSWR values up to at least 4:1 and with an accuracy of ±10 percent for any VSWR including 1.5 to 1. This accuracy shall be maintained without recalibration when changing frequency, power output, or class of emission.

3.14.15 VSWR output monitor. A voltage standing wave ratio monitor circuit shall be provided for automatically reducing the amplifier output to a power level 2 dB below full rated power output when necessary to protect the equipment, without interruption of traffic, when the output VSWR is between 2.5 and 4.0 to 1. The circuit shall activate a visible alarm and disable the transmitter if the output VSWR exceeds 4.0 to 1. A remote and local indication of fault shall be provided. See 3.6.1.1.5.

3.14.16 Power controls.

3.14.16.1 Power level control. A power output level control shall be located on the amplifier front panel. This control shall be protected by a cover and shall permit adjustment of the output power in 1 dB steps between the limits of the amplifier's maximum power rating and 25 percent of that maximum. This control shall operate independently from any other control and shall not disturb any of the operating parameters of the amplifier or exciter.

3.14.16.2 Average power control (APC). An APC circuit shall be provided in the amplifier to generate a control voltage for automatically limiting the exciter power output to maintain the amplifier average power output below a 1 dB limit when operating as a system. The associated manual control shall be readily accessible and shall be equipped with a locking device.

3.14.16.3 Peak power control (PPC). A PPC circuit shall be provided in the amplifier to generate control voltage that will automatically limit the transmitter output. The associated manual control shall be equipped with a locking device. The PPC time constant shall be between 1 and 2 ms attack time with approximate critical damping and between 100 and 150 ms decay time. The circuitry shall be such that special readjustment of the controls is not required when changing operating modes, for example, changing from A3J to A3B.

3.14.17 Power supply. The power supply shall provide all the necessary operating voltages and shall be included as an integral part of the Linear Amplifier-Power Supply-Control Group. Circuit breakers, with resets on the front panel, shall protect all circuits from self-destruction. Short circuits applied to any power supply output shall cause no damage to the power supply. Tripped circuit breakers shall provide a visible indication of status. Solid state devices shall be used in lieu of vacuum tubes.

3.14.18 Filament reversing. If a dc filament supply is utilized for the amplifier tube(s), switches shall be provided for reversing the polarity to the tube filaments.

3.14.19 Automatic tuning monitors and status indicators. Individual meters, and any required electronic circuitry, shall be provided to continuously monitor the output of each phase discriminator and load comparator used to control the automatic tuning within the amplifier. Indicator lamps, visible from the front of the Amplifier, shall be provided to indicate activity (shaft movement) of each of the mechanical drive (tuning) assemblies. An indicator lamp shall also be provided to indicate the status of internal band switches controlled by the amplifier band encoder.

3.14.20 Acoustic noise. The transmitter shall produce no more than 60 dB of acoustic noise measured by instrumentation having 70 dB weighting characteristic (B weighting, ANSI S1.4-1961) at a distance of 10 feet in any direction normal to the nearest outer surface of the transmitter when it is installed and operated in a large transmitter room without special acoustic treatment and with an ambient noise level not greater than 50 dB. (Reference noise level is a free progressive 1000 Hz sound wave of 10^{-16} watts/cm^2.)

3.14.21 Electromagnetic field. The transmitter shall operate without derating or degradation of performance when immersed in a RF field whose power may equal 0.01 watt per square centimeter (cm). For protection of tuning and conditioning circuits, 3.14.2 applies.

3.14.22 Tune cycle counter. A digital recording counter shall be provided in the power amplifier to record the number of tune cycles which it has accomplished. This feature shall apply to automatic and manual tuning modes. This counter shall be capable of recording and displaying in an unambiguous manner up to 9999 events and shall be capable of being reset to 0 count. The reset feature shall be suitably protected so that the counter can not be inadvertently reset. The counter shall be mounted such that access may be easily obtained without interrupting service.

3.14.23 Remote control system. The AN/FRT-85(V) transmitter shall be capable of being remotely controlled by any system which meets the requirements of this section and which interfaces with the transmitter through the MD-777/FRT exciter. The extent of the remote control shall be limited to those functions described in tables I, II and III.

3.14.23.1 Primary power. All units of the Remote Control System shall operate from a 115 volt ±10 percent, single phase, 47 to 63 Hz primary power source.

3.14.23.2 Remote control interface. All interfacing of the Remote Control System to the AN/FRT-85(V) will be via the remote systems local control unit (LCU). This LCU shall be located in a space provided in the transmitter exciter cabinet adjacent to the MD-777/FRT. All control signals necessary to satisfy system operation shall be exchanged between the LCU and the MD-777/FRT.

3.14.23.2.1 Local control unit location. The exciter cabinet shall provide a space capable of accepting the LCU. The LCU shall be contained in an enclosed cabinet suitable for mounting in a standard 19 inch equipment rack. Its dimensions shall not exceed 7 inches high, 18 inches deep, and 17-1/8 inches wide exclusive of the front panel mounting. The LCU shall be located immediately below the KY-655/FRT and the MD-777/FRT in the exciter cabinet. Primary power for the LCU shall be available on the same exciter rack outlet strip described in 3.13.14.1.

3.14.23.2.2 Transmitter control. All information received by the LCU from the remote control unit (RCU) shall be converted to parallel data for application to the exciter control lines. The remote controlled signaling shall be decoded as necessary in the LCU to achieve compatibility with the exciter control lines and functions. Inversely, monitor information from the exciter shall be encoded by the LCU for transmission to the RCU.

3.14.23.2.2.1 Transmitter control and monitor connections. Actual control of the transmitter and monitoring of its state of operation when in a remote control mode shall be via 2 connectors located on the MD-777/FRT exciter rear panel. Cables shall be provided with the LCU to mate with these connectors. The connector types and pin functions are defined in tables I, II and III.

3.14.23.2.2.2 LCU/exciter interface signal levels.

3.14.23.2.2.2.1 LCU to exciter. Unselected (logical 0) state equals 0.0 to 0.5 volts (current sinking capability of 1.5 ma); selected (logical 1) state equals 1.5 to 5.0 volts (maximum current equals 100 microamperes (μa)). The exciter control input circuitry shall provide a current sink for the local control unit logic control circuitry. The 5.0 volts dc for the interface circuitry contained in the local control unit shall be provided by the exciter to minimize ground currents between units. A maximum current of 10 ma shall be required.

Table I. Exciter connector J7 MS3116E20-39P.

Terminal		
	A	
	B	
	C	100 Hz
	D	
	E	
	F	1 kHz
	G	
	H	
	J	
	K	10 kHz
	L	
	M	Frequency Selection

Table I. Exciter connector J7 MS3116E20-39P (continued).

Terminal N		
P	100 kHz	(See Table III)
R		
S		
T		
U	1 MHz	
V		
W		
X		
Y	10 MHz	
Z	VCO A	
a	VCO B	
b	AØ	
c	A_2, A3H	
d	A_1, F_1, F_4	Class of emission selection
e	SSB -10 dB Carrier	
f	SSB -20 dB Carrier	
g	SSB -40 dB Carrier	
h	SSB -∞ Carrier	
i	Stand By Command	
j	Operate Command	
k	Ground	
m	Ground	
n	PTT Command	

Table II. Exciter connector J8 MS3116E20-39PW.

A	USB Select Control
B	LSB Select Control
C	ISB (2) Select Control
D	ISB (4) Select Control
G	AØ Class of Emission readback
H	A_2, A_3H Class of Emission readback
J	A_1, F_1, F_4, Class of Emission readback
K	SSB -10 Class of Emission readback
L	SSB -20 Class of Emission readback
M	SSB -40 Class of Emission readback
N	SSB -∞ Class of Emission readback
P	Operate readback
R	Standby readback
S	USB readback
T	LSB readback
U	ISB (2) readback
V	ISB (4) readback
Y	Ready readback (common)
Z	Ready readback
a	Fault readback
b	Fault readback (common)
c	Local Status
d	Transmitter not available readback (common)

Table II. Exciter connector J8 MS3116E20-39PW (continued).

e	Tune Command
f	Tune Activate Common (ground)
g	+5 VDC
h	PTT readback
i	Transmitter Fail
j	VFG readback
k	Standby-operate readback (common)
m	Sideband Select (common)
n	Sideband readback (common)
q	Class of Emission readback (common)
v	VFG Command

Table III. Frequency selection tables.

100 Hz Digit Selection

Digit	J7-A	J7-B	J7-C	J7-D
0	0	0	0	1
1	1	0	0	1
2	0	0	1	1
3	1	0	1	1
4	0	1	1	0
5	1	1	1	0
6	0	1	0	0
7	1	1	0	0
8	0	0	0	0
9	1	0	0	0

1 kHz Digit Selection

Digit	J7-E	J7-F	J7-G	J7-H
0	1	0	0	1
1	0	0	0	1
2	1	0	1	1
3	0	0	1	1
4	1	1	1	0
5	0	1	1	0
6	1	1	0	0
7	0	1	0	0
8	1	0	0	0
9	0	0	0	0

Table III. Frequency selection tables (continued).

10 kHz Digit Selection

Digit	J7-J	J7-K	J7-L	J7-M
0	0	0	1	1
1	1	1	0	1
2	0	1	0	1
3	1	0	0	1
4	0	0	0	1
5	1	1	1	0
6	0	1	1	0
7	1	0	1	0
8	0	0	1	0
9	1	1	0	0

100 kHz Digit Selection

Digit	J7-N	J7-P	J7-R	J7-S
0	0	0	0	1
1	1	0	0	1
2	0	0	1	1
3	1	0	1	1
4	0	1	1	0
5	1	1	1	0
6	0	1	0	0
7	1	1	0	0
8	0	0	0	0
9	1	0	0	0

1 MHz Digit Selection

Digit	J7-T	J7-U	J7-V	J7-W
0	1	1	0	0
1	0	1	0	0
2	1	0	0	0
3	0	0	0	0
4	1	0	0	1
5	0	0	0	1
6	1	0	1	1
7	0	0	1	1
8	1	1	1	0
9	0	1	1	0

Table III. Frequency selection tables (continued).

10 MHz Digit Selection

Digit	J7-X	J7-Y
0	1	1
1	0	1
2	1	0

VCO Selection

Freq. Range (MHz)	J7-Z (VCO A)	J7-a (VCO B)
2.0000 to 11.9999	0	0
11.9999 to 21.9999	0	1
22.0000 to 29.9999	1	0

3.14.23.2.2.2.2 Exciter to LCU. Unselected (logical 0) state equals closed circuit to local control unit common line. When the status of the exciter is changed by the remote control system, readback lines associated with the changed parameters may provide invalid data for a period of up to 1.5 seconds.

3.14.23.2.2.3 Local/remote operation. A local remote switch exists on the MD-777/FRT exciter. In the local position, the data outputs from the local control unit shall be inhibited and system control shall be executed from the front panel of the exciter. The local control condition shall be encoded by the local control unit for notification to the remote control unit by means of the monitor message reply word. Status information, with the exception of frequency, shall be contained in the monitor message reply word when the system is in the local control mode.

3.15 Workmanship. Workmanship shall be in accordance with requirement 9 of MIL-STD-454.

3.16 Soldering. Soldering shall be in accordance with requirement 5 of MIL-STD-454.

3.17 Test points. The equipment shall be provided with adequate and well-defined test points to facilitate making performance measurements and for use in maintaining the equipment. Test points and test features shall be in accordance with the applicable requirements of MIL-STD-415. Test features to be included in the equipment shall be identical to the GFE.

3.18 Support maintenance test procedure verification.

3.18.1 The procedures and techniques developed to perform all types of maintenance tests for each level (organizational, intermediate, depot, special repair facilities, and calibration facilities) shall be verified prior to submitting: (a) final data of MIL-STD-1345, (b) Navy training instructions and (c) final Navy technical manuals.

3.18.2 The support maintenance test procedure verification shall be performed by a technician selected by the Government from contractor or Government personnel.

3.18.3 The test procedures used in the support maintenance test procedure verification may be preliminary procedures, pamphlets, or manuals (not necessarily in the required technical manual format) or preliminary manuals in the standard format.

3.18.4 Test equipment used to verify the support maintenance test procedures shall be selected from MIL-STD-1364. Test equipment not specified in MIL-STD-1364 may be used in the support maintenance test procedure verification only if the contractor submits a written request to command or agency concerned and approval is granted.

3.18.5 The support maintenance test procedure verification shall be performed on 1 of the early production models.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 Quality program requirement. The contractor shall provide and maintain a written quality program acceptable to the Government for supplies and services covered by this specification. The quality program shall be in accordance with MIL-Q-9858.

4.1.2 Quality plan. A quality plan, applicable to the equipments covered by this specification shall be prepared for Government approval.

4.1.3 Government verification. All quality assurance operations performed by the contractor will be subject to Government verification at any time. Verification will include (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 product to be offered for acceptance, and (c) Government product 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 made or until conformance of product to prescribed criteria has been demonstrated.

4.1.4 Test procedures. The contractor shall prepare test procedures for Government approval covering first article and quality conformance inspection.

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

4.2 Classification of inspection. The method of examination and testing shall be classified as follows:

(a) First article inspection (see 4.3)
(b) Quality conformance inspection (see 4.4)

(1) Production inspection (see 4.4.1)
(2) Production control inspection (see 4.4.2)
(3) Environmental inspection (see 4.4.3)
(4) Inspection of preparation for delivery (see 4.4.4)

(c) Reliability demonstration (see 4.5)
(d) Maintainability demonstration test (see 4.6)

4.3 First article inspection. Unless otherwise specified (see 6.2.1), one unit shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine conformance with the requirements of this specification. First article inspection shall include the examination and testing specified in production inspection, production control inspection, environmental inspection, and the additional first article inspections specified in table IV.

Table IV. First article inspection.

Inspection	Reference paragraph
Radio Transmitter AN/FRT-85(V) Electromagnetic field	3.14.21

4.3.1 First article inspection report. A first article inspection report shall be submitted to the Government covering the results of the contractor's first article inspection (see 6.2.2).

4.4 Quality conformance inspection.

4.4.1 Production inspection. Production inspection shall be made on every equipment offered for delivery. The inspection shall comprise such examination and testing as will prove the workmanship and reveal the omissions and errors of the production process such as functional and performance tests at a limited number of points, tests which detect deviations from design, tests of adjustment, and tests which detect hidden defects of material. Production inspection shall consist of the tests and examinations approved in accordance with 4.1.4 and shall include the requirements of table V.

Table V. Production inspection.

Inspection	Reference paragraph
(a) Inprocess inspections	4.4.1.1
(b) Radio transmitter AN/FRT-85(V)	
(1) Retractable cable harness	3.2.5
(2) Mountings	3.2.6
(3) Controls/indicators	3.4 (Incl)
(4) Meters and meter panels	3.5 (Incl)
(5) Protection equipment/personnel	3.6 (Incl)
(6) Frequency stability	3.12.2
(7) Operating modes	3.12.3
(8) Electrical noise	3.12.4 (Incl)
(9) Intermodulation distortion	3.12.6
(10) Unwanted sideband	3.12.7
(11) Carrier suppression	3.12.9
(12) Carrier change under modulation	3.12.10

Table V. Production inspection (continued).

Inspection	Reference paragraph
(13) Carrier compression	3.12.11
(14) Equal sideband power	3.12.12
(c) Modulator-synthesizer and keyer group	
(1) Internal frequency standard	3.13.2.1
(2) Absolute frequency error	3.13.2.2 (Incl)
(3) External frequency standard	3.13.2.3
(4) Phase-locking	3.13.2.4
(5) Automatic switching	3.13.2.5
(6) Failure alarm	3.13.2.6
(7) Frequency calibration	3.13.2.7
(8) Monitoring output	3.13.2.7.1
(9) Operation modes	3.13.3
(10) Continuous wave (CW), FSK and analog	3.13.4.1
(11) Keyer interface	3.13.4.1.1
(12) Modulating signals (audio)	3.13.4.2 (Incl)
(13) Exciter response characteristics (four 3 kHz channels)	
a. Outer channel inversion	
1. Frequency	3.13.5.1.1.(a)
2. Stability	3.13.5.1.1.(b)
b. Response (audio channel)	3.13.5.2 3.13.5.3 3.13.5.4
(14) Exciter response characteristics (two 6 kHz channels)	
a. Audio channel response	3.13.6.1 3.13.6.4
b. Adjusted match characteristics	3.13.6.2
(15) Envelope delay	3.13.7
(16) Transfer time	3.13.8
(17) Standby power	3.13.9.1
(18) Controls-indicators (exciters)	3.13.10 (Incl)
(19) Controls	3.13.11 (Incl)
(20) Input meter	3.13.12
(d) Linear amplifier-power supply	
(1) Frequency range and tuning	3.14.1

Table V. Production inspection (continued).

Inspection	Reference paragraph
(2) Automatic tuning system	3.14.2
(3) Power output	3.14.3
(4) Maximum power inputs required for specified outputs	3.14.3.1
(5) Average power output rating	3.14.3.2
(6) Efficiency	3.14.4
(7) Harmonic output	3.14.5
(8) Intermodulation, spurious, and hum	3.14.6
(9) Keying transient	3.14.7
(10) Regeneration	3.14.8
(11) Information bandwidth	3.14.9
(12) Output impedance	3.14.10
(13) Input impedance	3.14.11
(14) Amplifier standby	3.14.12
(15) RF sampling	3.14.13
(16) RF power meters	3.14.14
(17) VSWR indicator	3.14.14.1
(18) VSWR output monitor	3.14.15
(19) Power controls	
a. Power level control	3.14.16.1
b. Average power control (APC)	3.14.16.2
c. Peak power control (PPC)	3.14.16.3
(20) Filament reversing	3.14.18
(21) Automatic tuning monitors and status indicators	3.14.19
(e) Electronic keyer KY-655/FRT description	3.13.4.1.2
(1) Interface with MD-777/FRT	3.13.4.1.3
(2) Automatic line transfer	3.13.4.1.4
(3) Keying speeds	3.13.4.1.5
(4) Keyer output frequencies	3.13.4.1.5.1
(5) Keyer input signals	3.13.4.1.6 3.13.4.1.9
(f) Remote control system interface operating test	4.4.1.2

4.4.1.1 Inprocess inspections. The following inprocess inspections shall be required:

(a) Workmanship (see 3.15)
(b) Soldering (see 3.16)
(c) Marking
(d) Assembly and fit

(e) Finish
(f) Materials and parts
(g) Cables (see 4.4.1.1.1)

4.4.1.1.1 Cables. The cables supplied with the end items shall be subjected to a continuity and voltage test. The continuity test shall ensure that wires terminate on the correct connector pins. The voltage to be applied to each wire or cable for the voltage test shall be equal to the highest voltage rating, without exceeding the voltage rating for any constituent part of the cable assembly. As a measure of workmanship, leakage current during the voltage test shall not exceed one milliampere.

4.4.1.2 Remote control system interface operating test. The interface between the exciter and remote control system shall be functionally demonstrated by using a remote control system to control the exciter. If the Government provides a remote control system as GFE, the equipment shall be used in the operating test to verify the interface between the exciter and remote control system. If a remote control system is not provided as GFE, the contractor shall provide equivalent suitable instrumentation for the operating test. The operating test shall ensure qualitatively the correct control of Radio Transmitter, AN/FRT-85(V). All functions of the remote control system shall be included (see 3.17).

4.4.2 Production control inspection. Production control inspection, including sampling, shall conform to table VI below and to the inspection procedures of MIL-STD-105 using the special inspection levels. The inspection level shall be S-3 for normal, tightened, and reduced inspection. Production control inspection shall be performed on equipments that have passed production inspection. Production control inspection shall be approved in accordance with 4.1.4. The equipment shall satisfactorily meet the requirements of production control inspection prior to release for shipment.

Table VI. Production control inspection.

Inspection	Reference paragraph	AQL-%
(a) Radio Transmitter, AN/FRT-85(V)		
(1) Equipment size	3.2.1	6.5
(2) Enclosure dimensions	3.2.2.2	6.5
(3) Enclosures	3.2.2	6.5
(4) Removeable assemblies	3.2.3.5	6.5
(5) Interchangeability of parts	3.2.13 (Incl)	6.5
(6) VHF harmonics attenuation filters	3.3.6.2	6.5
(7) Spurious emission	3.12.5	6.5
(b) Modulator-Synthesizer		
(1) Input impedance (keyer)	3.13.4.3	6.5

Table VI. Production control inspection (continued).

Inspection	Reference paragraph	AQL-%
(2) Exciter output impedance	3.13.13	6.5
(3) Power supply (transmitter and synthesizer/exciter and keyer)	3.13.14	6.5
(c) Linear Amplifier-Power Supply		
(1) Power supply	3.14.17	6.5
(d) Electronic Keyer, KY-655( )/FRT		
(1) Power source	3.13.4.1.8	6.5
(2) Keyer input impedance	3.13.4.1.7	6.5

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

4.4.3 Environmental inspection. Environmental inspection shall be as listed in table VII and shall be performed on units which have been subjected to and passed production inspection. Environmental tests shall be approved in accordance with 4.1.4.

Table VII. Environmental inspection.

Inspection	Reference paragraph
(a) Radio Transmitter, AN/FRT-85(V)	
(1) Environmental conditions (ambient temperature, humidity, and elevation)	3.8
(2) Shock and vibration (Note 1)	3.9
(3) Survey (thermal) (Note 1)	4.4.3.4
(4) Interference	3.12.8

Note 1 Shock and vibration and thermal survey shall be performed as a first article inspection and need not be performed again as a quality conformance inspection. However, if first article inspection is not required, the tests shall be performed as a quality conformance inspection on the first sample equipment for environmental inspection and need not be performed again unless changes occur which might affect the measured characteristics.

Table VII. Environmental inspection (continued).

Inspection	Reference paragraph
(b) Modulator-Synthesizer, MD-777( )/FRT	
(1) Audio impedance (return loss and longitudinal current)	3.13.4.5.1
(2) Inversion carrier and spurious suppression	3.13.5.1.1.(c)
(c) Linear Amplifier-Power Supply	
(1) Acoustic noise	3.14.20

4.4.3.1 Sampling for environmental inspection. One equipment shall be selected from each successive 100 equipments produced or fraction thereof. The first sample equipment shall be selected from the first month's production.

4.4.3.2 Nonconforming environmental 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 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 quality assurance representative does not consider that the corrective action will enable the product to meet specified requirements, or if the contractor cannot determine the cause of failure, the matter shall be referred to the contracting officer (see 6.4).

4.4.3.3 Reinspection of conforming environmental sample units. Unless otherwise specified in the contract, sample units which have been subjected to, and passed, environmental tests may be accepted on the contract provided they are resubjected to, and pass, production inspection after repair of all damage.

4.4.3.4 Survey (thermal). The thermal survey shall be conducted in accordance with 3.8.1. After the supplier has completed the required thermal survey in accordance with approved procedures, the data and recommended corrections to any thermal problems revealed by the survey shall be submitted to the Command or agency concerned for review and approval (see 6.2.2). After the approved corrections have been installed, the supplier shall again conduct a thermal survey to confirm the effectiveness of the corrections made and submit the results along with any additional recommended corrective measures to the command or agency concerned for review and approval. The Government reserves the right to witness all phases of the thermal survey and to survey any component or part in the equipment that was exempted in previous contracts from test.

4.4.3.4.1 Responsibility for corrective action. Any design deficiency revealed during such survey shall be corrected by the supplier at no additional cost to the Government. The approved corrections to the thermal problems shall be implemented by the supplier on all end items to be delivered to the Government and in the case of first article inspection, implemented prior to first article approval.

4.4.3.5 Verification of support maintenance test procedure:

(a) A technician shall be given a complete set of boards and modules, all of which are completely unaligned.
(b) The technician shall align each of the modules and boards and verify that each board or module is operating properly. These tests will be done with the modules on the bench (modules or boards removed from the prime equipment). The alignment shall be performed in accordance with procedures and techniques required by 3.18.
(c) The technician shall install the modules or boards in the prime equipment and align the prime equipment as specified in the manual.
(d) The technician shall operate the equipment as specified in the approved test procedures.

4.4.4 Inspection of preparation for delivery. Inspections shall be conducted to ensure conformance with the requirements of Section 5 of this specification.

4.5 Reliability demonstration. Reliability demonstrations shall be performed using test level A-1, test plan VI of MIL-STD-781.

4.5.1 Reliability test plan and procedure. A reliability test plan and procedure shall be prepared in accordance with the Detail Requirements section of MIL-STD-781 and this specification. Reliability qualification and sampling tests shall be performed in accordance with these procedures.

4.5.1.1 Test frequencies. The following test frequencies shall be used.

F1	2.0005 MHz
F2	4.9995 MHz
F3	10.0001 MHz
F4	29.9999 MHz

4.5.1.2 Test schedule. The test shall consist of 3 8-hour schedules per day, the first being manned where performance measurements shall be made. The other 2 schedules may be unmanned and pertinent data may be automatically recorded to the extent that instrumentation permits. These schedules shall be as follows:

Manned schedule

0 to 2 hours	Transmitter "on" (see 4.5.1.3)
2 hours to 3 hours	Transmitter performance measurement (see 3.11.2.3)
3 hours to 4 hours	Transmitter "standby"
4 hours to 6 hours	Transmitter "on" (see 4.5.1.3)
6 hours to 7 hours	Transmitter measurement
7 hours to 8 hours	Transmitter "standby"

Unmanned schedule

0 to 3 hours	Transmitter "on"
3 hours to 4 hours	Transmitter "standby"
4 hours to 7 hours	Transmitter "on"
7 hours to 8 hours	Transmitter "standby"

4.5.1.3 Transmitting schedules. The mode of operation and frequency of transmission for each transmitting "on" period of the manned schedules shall occur in the following sequence:

Day	Frequency	
1	F1 - First 4 hours of manned schedule. F2 - Remainder of the day.	AM (A3h), 50 percent of rated average carrier 30-50 percent, 1000 Hz modulation, transmitting for 10 minutes out of each 15-minute period.
2	F3 - First 4 hours of manned schedule. F4 - Remainder of the day.	CW (A1), Full rated average power keyed at a speed of 25 dot Hz; transmitting for 10 minutes out of each 15-minute period.
3	F1 - First 4 hours of manned schedule. F2 - Remainder of the day.	FSK (f1), Full rated average power keyed from space to mark at a 30 Hz rate (RY's); transmitting for 10 minutes out of each 15-minute period.
4	F3 - First 4 hours of manned schedule. F4 - Remainder of the day.	ISB (A3b), 100 percent of rated PEP, two-tone modulation per sideband, transmitting for 10 minutes out of each 15-minute period.

The same frequency shall be used on the next 4 days, except that the sequence of frequencies shall be reversed, F4 and F3 on fifth day, F2 and F1 on sixth day, F4 and F3 on seventh day and F2 and F1 on eighth day. The above schedules shall be repeated as necessary.

4.5.2 Reliability qualification test. The reliability qualification test shall be performed on the first production unit. No equipment may be offered to the Government for acceptance until the successful completion of this test.

4.5.3 Reliability sampling tests. Reliability sampling tests shall be performed on 1 out of each 50 production units or portion thereof.

4.6 Maintainability demonstration test.

4.6.1 Maintainability demonstration. The exciter/keyer and amplifier maintainability requirements shall each be demonstrated in accordance with method 3 of MIL-STD-471. Each maintainability demonstration shall be

successfully completed prior to the delivery of any production equipment. The maintainability demonstration shall be completed prior to the start of reliability testing.

4.6.2 Maintainability demonstration test plan. The contractor shall prepare a detailed maintainability test plan in accordance with MIL-STD-471. The maintainability test at the organizational level shall be performed by a technician with experience equivalent to that of a third class naval electronics technician (ET-3). The maintainability requirements shall be demonstrated by replacement of modules and parts at the organizational level. A list of 50 faults shall be prepared for each maintainability demonstration in accordance with Appendix A, MIL-STD-471. For fault simulation, a number shall be assigned to each component/part within a module or assembly. The component/part to be faulted within each module or assembly shall then be selected through the use of a random number table. Fault simulation shall be accomplished by the introduction of faulted parts corresponding to the random number selected. The random number, for the parts to be faulted, shall be selected by the command or agency concerned or its representative immediately prior to the start of the demonstration. The command or agency concerned or its representative shall use this list only as a guide to select a sample of 20 faults to be used for the maintainability demonstrations. The command or agency concerned reserves the right to provide and select the technicians to perform the maintainability demonstrations. Technical documentation to be used shall be limited to the equipment technical manual.

The maintainability demonstration test plan, shall be submitted to the command or agency concerned prior to the start of the test (see 6.2.2).

4.6.3 Maintainability demonstration report. A maintainability demonstration report shall be prepared in accordance with MIL-STD-471 and shall be submitted for approval by the command or agency concerned (see 6.2.2).

5. PREPARATION FOR DELIVERY

(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 or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation - packaging and packing. Preservation - packaging and packing shall be in accordance with specification MIL-E-17555 at the level specified in the contract or order (see 6.2.1).

5.2 Marking. In addition to any special requirements of the contract or order, marking shall be in accordance with MIL-STD-129 (see 6.2.1).

6. NOTES

6.1 Intended use. This equipment is a Navy general purpose transmitter used primarily for the DCA's HF long-haul ISB radio communications circuits ashore.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Exciter response characteristics (see 3.13.6).
(c) Number of first article samples to be submitted if other than specified in 4.3.
(d) Marking, levels of preservation and packaging and packing required (see 5.1 and 5.2).

6.2.2 Contract data requirements. Data generated by this document are not deliverable unless specified on the Contract Data Requirements List (DD Form 1423) or the contract schedule. The data required by this specification include, but are not restricted to the following:

(a) Equipment configuration, panel layouts, and dimensions (see 3.2.1.1)
(b) Drawings for retractable carrier assembly (see 3.2.5)
(c) Technical manuals in accordance with MIL-M-15071, if required (see 3.3.5.8)
(d) Reliability program in accordance with MIL-STD-785 (see 3.10.1)
(e) Maintainability program plan in accordance with MIL-STD-470 (see 3.11.2)
(f) Maintainability prediction in accordance with MIL-HDBK-472 (see 3.11.3)
(g) First article inspection report (see 4.3.1)
(h) Data and recommended corrections to any thermal problems (see 4.4.3.4)
(i) Maintainability demonstration test plan in accordance with MIL-STD-471 (see 4.6.2)
(j) Maintainability demonstration report in accordance with MIL-STD-471 (see 4.6.3)

6.3 First article. Invitations for bids should provide that the Government reserves the right to waive the requirement for first article samples as to those bidders offering a product which has been previously procured 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 procurement.

6.4 Environmental inspection (approval to ship). 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.

6.4.1 Initial shipments. Initial shipment of end items will be contingent upon successful completion of the environmental inspection.

Preparing activity:
Navy - EC

(Proj. No. 5820-N556)

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE | CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)* | DATE

DD FORM 1 JAN 66 1426 REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

S/N-0102-014-1801 C-25254

VARIABLE TRANSFORMER (SEE TABLE III)

FOLD

DEPARTMENT OF THE NAVY
NAVAL ELECTRONIC SYSTEMS COMMAND
WASHINGTON, D. C. 20360

POSTAGE AND FEES PAID
NAVY DEPARTMENT

OFFICIAL BUSINESS

COMMANDER
NAVAL ELECTRONIC SYSTEMS COMMAND
DEFENSE STANDARDIZATION PROGRAM BRANCH
DEPARTMENT OF THE NAVY
WASHINGTON, D. C. 20360

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