MILITARY SPECIFICATION

TRANSMITTER,

PULSE-CODE MODULATION

(FOR SECURE TELEMETRY APPLICATIONS)

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

1. SCOPE.

1.1 Scope. This specification defines the performance and test requirements for a pulse-code modulation (PCM) airborne telemetry transmitter, referred to herein as the transmitter.

2. APPLICABLE DOCUMENTS.

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

SPECIFICATIONS

MILITARY

MIL-T-18303	Test Procedures; Preproduction Acceptance, and Life, for Aircraft Electronic Equipment, Format for.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Engineering Specifications and Standards Department (ESSD) Code 93, Lakehurst, New Jersey 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 5821

MIL-C-45662	Calibration System Requirements.
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities.

Naval Air Systems Command
(Code Ident 30003)

WS-6536	Procedures and Requirements for Preparation and Soldering of Electrical Connections.

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-109	Quality Assurance Terms and Definitions.
MIL-STD-129	Marking for Shipment and Storage.
MIL-STD-130	Identification Marking of US Military Property.
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of.
MIL-STD-454	Standard General Requirements for Electronic Equipment.
MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment.
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of.

MIL-STD-810	Environmental Test Methods.
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
MIL-STD-1695	Environments, Working, Minimum Standards for.

(Copies of specifications, standards, and publications required by contractors in connection with specific procurement functions should 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.

FEDERAL CATALOGING HANDBOOK

H4	Federal Supply Code for Manufacturers, Unites States and Canada.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

Inter-range Instrumentation Group
(IRIG) Range Commanders Council
(Code Ident 29669)

Document 106	Telemetry Standards.
Document 118	Test Methods for Telemetry Systems and Subsystems.

(Application for copies should be addressed to the Secretariat, Range Commanders Council, White Sands Missile Range, NM 88002.)

3. REQUIREMENTS.

3.1 Item definition. The item described herein is a miniature telemetry transmitter operating in the L-band (1435-1535 megahertz (MHz)) or S-band (2200-2300 MHz) microwave frequencies allocated for such use. The transmitter operates on the normal aircraft or missile 28-volt direct current (Vdc) power supply. Since the

transmitter is normally used on unmanned test equipment which includes missiles, bombs, and pilotless aircraft used as targets, the transmitter is normally destroyed in use. Input to the transmitter will be nonreturn-to-zero (NRZ) PCM data, at rates from 10,000 to 2,000,000 bits per second.

3.2 Characteristics.

3.2.1 Performance requirements. The transmitter, while mounted on a heat sink which simulates the subassembly mounting plate (see figure 1), shall meet the performance requirements specified herein with or without modulation by PCM signals in accordance with IRIG Document 106.

3.2.1.1 Input voltage and current. The transmitter shall operate over the voltage range of 22 and 34 Vdc. Unless otherwise specified in the contract or purchase order (see 6.2.1), maximum current consumption shall be 0.800 ampere (A) at all temperatures.

3.2.1.2 Signal input impedance. Signal input impedance shall be 75 ohms shunted by 50 picofarad maximum capacitance.

3.2.1.3 Overvoltage and power reversal. The transmitter shall not be damaged by an input voltage of +40 Vdc or a power polarity reversal for 3 minutes.

3.2.1.4 Warmup. The transmitter shall self-start and generate a radio frequency (RF) carrier output within the specified frequency limits within 1 second of application of primary power, and shall generate the minimum RF power output, in watts (W), specified herein within 10 seconds of application of primary power, at any temperature from -40 to +85 degrees Celsius (°C).

3.2.1.5 On-off lead. An external lead shall be provided that will cause the transmitter to operate only when the lead is connected to power ground.

3.2.1.6 Operating frequency. Operation shall be within the ultra high frequency telemetry bands from 2,200 to 2,300 MHz or 1,435 to 1,535 MHz. Unless otherwise specified in the contract or purchase order (see 6.2.1), center frequency tolerance shall be ±0.003 percent of the specified frequency with or without modulation. The operating frequency range will be specified in the contract or purchase order (see 6.2.1).

3.2.1.7 Frequency deviation range. Unless otherwise specified in the contract or purchase order, the transmitter shall be capable of a peak-to-peak deviation of ±1 MHz (see 6.2.1).

3.2.1.8 Input characteristics.

3.2.1.8.1 Modulation frequency response. The modulation frequency response shall be within ±2 decibels (dB) of the response at 10 kilohertz (kHz), for deviations to and including the maximum deviation, at frequencies from zero to 1 MHz, and within ±3 dB from 1 MHz to 1.5 MHz.

3.2.1.8.2 Deviation sensitivity. Unless otherwise specified in the contract or purchase order (see 6.2.1), deviation sensitivity from zero to 1 MHz shall be between 325 and 375 kHz per Vdc. A positive voltage shall cause an increase in frequency.

3.2.1.9 Incidental frequency modulation (IFM). IFM (see 6.3.1) shall not exceed 1.5 kHz root-mean-square (RMS) when tested with a receiver with 500 kHz intermediate frequency (IF) bandwidth and 200 kHz output filters, where RMS frequency is one standard deviation from center frequency in gaussian noise. The receiver functions as a frequency-to-voltage converter. If desired, the receiver may be assembled using a stable oscillator, double-balanced mixer and frequency demodulator. Receiver local oscillator frequency instability produces measurement system IFM.

3.2.1.10 Signal-induced incidental amplitude modulation (IAM). IAM shall not cause a peak-to-peak voltage excursion exceeding 3 percent of the carrier average voltage for any modulating frequency at any deviation up to and including maximum.

3.2.1.11 Output power. Unless otherwise specified in the contract or purchase order (see 6.2.1), the transmitter power output, with a 24 Vdc input, shall be 2 W minimum into a 50-ohm resistive load at any combination of electrical and environmental conditions. Power output shall be 1.5 W minimum at 22 Vdc under the same conditions.

3.2.1.12 Output impedance. During operation, transmitter output impedance shall be 50 ohms with a return loss not exceeding 10 dB.

3.2.1.13 Output load mismatch. When operating into an open or short circuit, the transmitter shall not be damaged nor its

operation impaired except for reduced power output. This mismatch applies to all load phase angles. Power so reflected shall be dissipated in an isolating device integral to the transmitter.

3.2.1.14 Electromagnetic interference (EMI). The generation of EMI by the transmitter and the vulnerability of the transmitter to EMI shall be within the limits of MIL-STD-461, equipment Class IB, except as specified below (see 3.3.2).

3.2.1.14.1 Antenna terminal conducted emission. All spurious and harmonically-related outputs over the frequency range of 150 kHz to 10 gigahertz (GHz), measured in the transmission line between the transmitter output and load, shall be at least 60 dB down in power from the carrier power level when tested in accordance with MIL-STD-462, Test Method CE06, and with voltage standing-wave ratios up to and including 1.5:1 at all phase angles.

3.2.1.14.2 Electric field radiated emission. Radiated emissions over the frequency range of 14 kHz to 10 GHz shall be within the limits of MIL-STD-461, Test Method RE02, except that narrowband emission over the range of 500 kHz to 10 GHz may exceed the limits of MIL-STD-461, figure 21, by no more than 35 dB.

3.2.1.15 Deviation linearity. The characteristic curve of peak-to-peak output frequency deviation versus input modulating voltage shall be linear within 2 percent of bandwidth for ±1.0 MHz deviation. Linearity shall be measured from the best straight line as determined by the least squares method.

3.2.1.16 Tilt. The tilt (the amount of rise or droop from horizontal 100 percent level measured in percent per microsecond (μs)) evidenced by the output response, shall not exceed 0.1 percent per μs at either test frequency specified in 4.5.14.

3.2.1.17 Power-supply induced frequency modulation. Power-supply induced frequency modulation shall be no greater than the limit specified in the contract or purchase order (see 6.2.1).

3.2.1.18 Power-supply induced amplitude modulation. Power-supply induced amplitude modulation shall be no greater than the limit specified in the contract or purchase order (see 6.2.1).

3.2.1.19 Isolated power ground. When specified in the contract or purchase order (see 6.2.1), the transmitter shall be provided with a power supply ground isolated from the case and radio-frequency ground by a resistance of greater than 1 megohm (case and radio-frequency ground may be common to each other). Isolation breakdown voltage shall be greater than 50 volts (V) in either polarity.

3.2.1.20 Differential modulation input. When specified in the contract or purchase order (see 6.2.1), the transmitter shall be provided with a differential modulation input such that common-mode signals are suppressed by a minimum of 60 dB up to 500 Hertz (Hz), and a minimum of 40 dB from 500 Hz to 10 kHz. The negative modulation input lead shall be connected to the shield of the modulation input connector, and the modulation input shall have a common-mode withstanding voltage of ±10 V.

3.2.1.21 Spike. The transmitter shall not be damaged by a power-line, over-voltage spike of amplitude up to 60 V (including normal power supply voltage) and duration up to 100 milliseconds (ms).

3.2.2 Physical characteristics.

3.2.2.1 Conformance to documents. Unless otherwise specified in the contract or purchase order (see 6.2.1), the transmitter shall conform to figure 2, and shall meet all of the requirements of this specification and the documents referenced to the extent specified herein.

3.2.2.2 External adjustments. No external adjustments shall be available on the transmitter.

3.2.2.3 Weight. The transmitter shall weigh no more than 1 pound.

3.2.2.4 Baseplate flatness. Baseplate flatness shall be maintained within 0.010 inch overall.

3.2.3 Reliability.

3.2.3.1 Shelf life. The transmitter shall be designed to meet the performance requirements specified herein after a storage period of up to 5 years.

3.2.3.2 Life. The transmitter shall have a total operating life of 200 hours minimum continuous or intermittent duty without necessity for any repair, replacement, or adjustment.

3.2.4 Maintainability. Units made to this specification are not required to be field-maintainable.

3.2.5 Environmental conditions. The transmitter shall meet all requirements specified herein before, during, and after exposure to the following environmental conditions or any natural combinations thereof.

3.2.5.1 Temperature-altitude. Reduced barometric pressure equivalent to 110,000 feet altitude at a temperature of -40°C.

3.2.5.2 Storage temperature. Temperatures ranging from +85 to -54°C.

3.2.5.3 Operating temperatures. Temperatures ranging from +85 to -40°C.

3.2.5.4 Temperature shock. Transitions within 5 minutes from temperature stabilization at +85 and -40°C to an environment stabilized at the opposite temperature extreme.

3.2.5.5 Humidity. Atmosphere containing 85 percent or greater relative humidity, at temperatures from +28 to +71°C.

3.2.5.6 Vibration. Levels of sinusoidal vibration up to and including 15 gravity units (g), or 0.06 inch double amplitude excursion, whichever is less, over a frequency spectrum from 50 to 2,000 Hz, and random vibration as specified in figure 3 in three mutually perpendicular axes.

3.2.5.7 Shock. Levels of 100 g acceleration sawtooth pulses with a duration of 6 ms, in all axes and in any direction.

3.2.5.8 Burn-in and screening. Each transmitter shall be subjected to a minimum of 6 cycles of burn-in and screening as shown in figure 4.

3.3 Design and construction.

3.3.1 Materials. All materials used in the construction of the transmitter shall be in accordance with MIL-STD-454, Requirement 3, Flammable Materials; Requirement 4, Fungus-Inert Materials; Requirement 15, Ferrous Alloys, Corrosion Resistance; and Requirement 16, Dissimilar Metals.

3.3.2 Electromagnetic radiation. Unless this requirement is waived in writing by the contracting officer (see 6.2.1), a representative transmitter shall be tested to MIL-STD-461 for electromagnetic emissions. Tests required are procedures CE01, CE02, CE03, CE04, CE05, CE06, RE02, and RE03. Testing of electromagnetic susceptibility is not required. When specified in the contract or purchase order, the results of these tests shall be provided with each preproduction lot (see 6.2.2).

3.3.3 Identification and marking. The transmitter shall be identified and marked in accordance with MIL-STD-130 and figure 2. Markings shall include, but shall not be limited to, the following:

(a) The number and revision of this specification, MIL-T-85138(AS).

(b) NAVAIR code identification number, 30003.

(c) Manufacturer's name and symbol or code identification from Federal Cataloging Handbook H4.

(d) A unique serial number.

(e) Operating frequency.

3.3.4 Workmanship. The transmitter, including all parts and accessories, shall be constructed and finished in a manner that will assure compliance with all requirements of this specification. Except where there is conflict with the applicable drawings or unless otherwise specified herein, fabricating and assembly practices shall be in accordance with MIL-STD-454, Requirement 9. Processes relative to soldering shall be in accordance with WS-6536.

3.3.5 Interchangeability. The transmitter interchangeability shall be in accordance with MIL-STD-454, Requirement 7.

3.3.6 Safety. Operation of this or any transmitter in the microwave region requires that the energy produced by the transmitter be absorbed by a dummy load, or (if an antenna is used) pointed in such a way that no personnel are illuminated by energy from the transmitter at close range. Prolonged exposure to such radiation will result in physical discomfort and may permanently damage living tissue.

3.3.7 Human performance/human engineering. The transmitter shall meet the requirements of MIL-STD-1472 and MIL-H-46855.

3.3.8 Standards of manufacture.

3.3.8.1 Production processing. The transmitter shall be manufactured, inspected, and tested under conditions and procedures meeting the following requirements.

3.3.8.1.1 Special working environment. The contractor shall provide adequate facilities for the fabrication, assembly, and testing of supplies to be delivered in accordance with this specification. The facilities used in the manufacture, testing and inspection of the transmitter shall be in accordance with MIL-STD-1695(AS).

3.3.8.1.2 Inspection and test planning. The contractor's program shall provide the necessary planning function for tests and inspections conducted during the entire phase of fabrication, processing, and assembly. The planning shall be based on a comprehensive study of the articles, the fabrication and processing operations, the methods of material integration, assembly, and checkout, and the final test and inspection procedures. Inspections shall be established at points which will minimize delays resulting from deficiencies, and in all cases shall be at or before the last point at which the acceptability of the operation or quality of the characteristics may be verified.

3.3.8.1.3 Process control procedures. Process control procedures shall be prepared when necessary to supplement applicable process specifications and to provide detailed performance and control methods. These procedures shall document the preparation;

fabrication details; conditions to be maintained during each phase of the process; the methods of verifying the adequacy of processing materials, solutions, equipment, and their associated control parameters, including statistical quality control plans where applicable; and the required records to indicate the results of such inspection and process verification. The contractor's quality organization shall review the written procedures for those process controls and conduct audits to determine that the actual operations conform with approved methods and procedures.

3.3.8.1.4 Material control. Material controls shall ensure that only conforming materials and articles are used. Materials and articles not conforming to or not required for the operation involved shall be removed from the work operations. Positive action shall be taken to protect controlled processes or operations from contamination by residue from nonconforming materials and from previous operations. The contractor shall ensure that each operation of inspection (and to the extent practicable, fabrication) is traceable to the individual responsible for its accomplishment.

3.4 First article.

3.4.1 Preproduction sample. Unless otherwise specified in the contract or purchase order, a preproduction sample consisting of four transmitters shall be delivered to the testing activity for preproduction inspection (see 6.2.1). The preproduction sample shall be manufactured using the same methods, materials, processes, and procedures proposed for production. Any production prior to acceptance of the preproduction sample shall be at the risk of the contractor.

3.5 Transmitter type approval. The transmitter shall be type approved by a national or service test range. Certification of type approval shall be available to the procuring activity prior to preproduction inspection.

3.6 Precedence. Specifications, standards, and drawings shall be used in the order of precedence established in MIL-STD-143. When the requirements of this specification and applicable

subsidiary documents are in conflict, the following precedence shall apply:

(a) Contract or purchase order. The contract or purchase order shall have precedence over any other document.

(b) This specification. This specification shall have precedence over all applicable subsidiary documents.

(c) Reference documents. Any documents referenced in this specification shall have precedence over all applicable subsidiary documents referenced therein.

4. QUALITY ASSURANCE PROVISIONS.

4.1 General.

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

4.1.1.1 Classification of inspection. The inspection and testing requirements for the transmitter shall be as follows:

(a) Preproduction inspection (see 4.1.2.1).

(b) Quality conformance inspection (see 4.2).

(1) Individual inspections (see 4.2.2).

(2) Sampling tests (see 4.2.3).

4.1.2 Special tests and examinations.

4.1.2.1 Preproduction inspection. Preproduction inspection shall consist of the examinations and tests of table I and shall be performed in the sequence specified therein. The sample shall be in accordance with 3.4.1.

TABLE I. Preproduction inspection.

Examination or test	Requirement paragraph	Method paragraph
Group I (all units)		
Visual and mechanical	3.2.2, 3.3.3, 3.3.4	4.4
Performance tests	3.2.1.1 to 3.2.1.21	4.5.1 to 4.5.20
Temperature-altitude	3.2.5.1	4.6.1
Post test	- - - -	4.1.2.1.4
Low temperature	3.2.5.3	4.6.2
Post test	- - - -	4.1.2.1.4
High temperature	3.2.5.3	4.6.3
Post test	- - - -	4.1.2.1.4
Group II (units 1 and 2)		
Temperature shock	3.2.5.4	4.6.4
Post test	- - - -	4.1.2.1.4
Humidity	3.2.5.5	4.6.5
Performance tests	3.2.1.1 to 3.2.1.21	4.5.1 to 4.5.20
Group III (units 3 and 4)		
Vibration	3.2.5.6	4.6.6
Post test	- - - -	4.1.2.1.4
Shock	3.2.5.7	4.6.7
Performance tests	3.2.1.1 to 3.2.1.21	4.5.1 to 4.5.20

4.1.2.1.1 Preproduction sample designation. The four preproduction sample transmitters shall be numbered units 1, 2, 3, and 4. Each numbered unit shall be subjected to the examinations and tests corresponding to the unit number specified in table I.

4.1.2.1.2 Acceptance criteria. Failure of any transmitter to pass any of the preproduction examinations and tests specified herein shall reject the preproduction sample.

4.1.2.1.3 Disposition of preproduction sample. Preproduction samples shall not subsequently be offered as part of any production lot.

4.1.2.1.4 Post tests. Post tests shall consist of verification of the following:

(a) Input power (see 4.5.2).

(b) Modulation frequency response (see 4.5.7).

(c) Center frequency (see 4.5.1).

(d) Deviation sensitivity (see 4.5.20).

(e) RF power output (see 4.5.2).

To be acceptable, the transmitter shall meet the requirements of 3.2.1.1, 3.2.1.8.1, 3.2.1.6 and 3.2.1.8.2.

4.2 Quality conformance inspections. All transmitter lots offered for acceptance shall be subjected to the quality conformance inspections specified in table II.

TABLE II. Quality conformance inspection.

Examination or test	Requirement paragraph	Method paragraph
Group A (individual inspections)		
Visual and mechanical	3.2.2.1, 3.3.3, 3.3.4	4.4
Burn-in and screening	3.2.5.8	4.6.8
Performance tests	3.2.1.1 to 3.2.1.21	4.5.1 to 4.5.20
Group B (sampling tests)		
Temperature shock	3.2.5.4	4.6.4
Vibration	3.2.5.6	4.6.6
Performance tests	3.2.1.1 to 3.2.1.21	4.5.1 to 4.5.20

4.2.1 Inspection lot. All transmitter lots offered for acceptance at one time shall be assembled into inspection lots as defined in MIL-STD-105.

4.2.2 Individual inspections. Individual inspections shall be performed prior to sampling tests. Each transmitter offered for acceptance shall be subjected to the tests of Group A of table II in the sequence specified therein. Any transmitter that fails to meet the specified requirements shall be rejected and removed from the lot. Additional transmitters may be added to the lot to provide the contract or purchase order quantity prior to quality conformance sampling tests.

4.2.3 Sampling tests. Upon completion of the individual inspections of 4.2.2, the lot shall be randomly sampled as follows:

Lot size	Sample size
1-50	2
51-150	4
151-300	6
301-500	8

The sample shall be subjected to the Group B tests of table II. Failure of the transmitter to pass any of the tests specified shall reject the lot represented.

4.3 Test documentation and test equipment.

4.3.1 Test documentation.

4.3.1.1 Test procedures. Test procedures shall conform to the requirements of MIL-T-18303 and, when specified in the contract or purchase order, shall be submitted to the procuring activity for approval prior to commencement of testing (see 6.2.2).

4.3.1.2 Test data. When specified in the contract or purchase order, test data shall be as specified on the data sheets (see figure 5) and shall accompany each transmitter delivered to the procuring activity (see 6.2.2).

4.3.1.3 Certification. The contractor shall have available for the Government representative written certification, accompanied by objective quality evidence (as defined in MIL-STD-109), that the components used as a part of the transmitter meet the applicable requirements.

4.3.2 Test equipment.

4.3.2.1 Maintenance and calibration. All test equipment shall be calibrated and maintained in accordance with the provisions of

MIL-C-45662. Certification to this effect shall be available for Government inspection.

4.3.2.2 Test equipment accuracy. All test equipment used in the performance of the specified electrical tests shall have an accuracy of at least one-fifth the tolerance for the variable to be measured.

4.4 Visual and physical examination.

4.4.1 Visual examination. The transmitter shall be visually examined to verify that marking and workmanship meet the requirements of 3.3.3 and 3.3.4.

4.4.2 Physical examination. A complete physical examination shall be performed on the transmitter to verify that all interface dimensions and the weight meet the requirements of figure 2 and 3.2.2, respectively.

4.5 Performance tests. Unless otherwise specified, the transmitter shall be tested in accordance with bench test procedures described in IRIG Document 118, Section 8, or equivalent tests approved by the purchasing agency, using the heat sink specified in figure 1. Figure 5(A) shall be used for recording test data. The input shall be 28 Vdc unless otherwise specified. The output shall be continuously monitored, and terminated with a nominal 50-ohm resistive load unless otherwise specified.

4.5.1 Center frequency. Transmitter center frequency measurements shall be made as follows:

(a) Apply 24 Vdc power to the unmodulated transmitter, and measure current.

(b) Commencing 10 seconds after power is applied, and at each 10-second interval through 3 minutes, record the output frequency observed on the electronic frequency counter on figure 5(B). Then observe and record the frequency at 1 minute intervals through 15 minutes. Average these frequencies. For the purpose of this test, the average of these frequencies is the center frequency.

(c) Repeat (b) for 28 Vdc.

(d) Repeat (b) for 32 Vdc.

(e) Repeat (c), except apply a 50 kHz square wave modulation, with ±250 kHz deviation to the transmitter input.

To be acceptable, the transmitter shall meet the requirements of 3.2.1.1 and 3.2.1.6.

4.5.2 Operating voltage range. Transmitter operation over the operating voltage range shall be measured in accordance with IRIG Document 118, Procedure 3-107. Record the data on figure 5(C). To be acceptable, the transmitter shall meet the requirements of 3.2.1.1.

4.5.3 Signal input impedance. Signal input impedance shall be measured in accordance with IRIG Document 118, Procedure 3-103. Record the data on figure 5(D). The square wave frequency shall be 1 MHz of amplitude to produce a deviation of ±400 kHz. To be acceptable, the transmitter shall meet the requirements of 3.2.1.2.

4.5.4 Primary voltage polarity reversal. Test in accordance with IRIG Document 118, Procedure 3-108. Record the data on figure 5(C). To be acceptable, the transmitter shall meet the requirements of 3.2.1.3.

4.5.5 Overvoltage. With the transmitter operating as in 4.5.2, primary voltage shall be increased to 40 Vdc for 60 seconds. Primary voltage shall be returned to 28 Vdc, and the transmitter shall be tested as specified in 4.1.2.1.4. Record the data on figure 5(C). To be acceptable, the transmitter shall meet the requirements of 3.2.1.3.

4.5.6 On-off lead. To verify proper operation of the on-off lead proceed as follows:

(a) Connect the positive lead of a +28 V power supply to the positive power lead of the transmitter.

(b) Connect the negative lead of the power supply to the power ground of the transmitter.

(c) Verify that the transmitter is off.

(d) Connect the on-off lead to the transmitter power ground and verify that the transmitter is on. Record the data on figure 5(E).

To be acceptable, the transmitter shall meet the requirements of 3.2.1.5.

4.5.7 Modulation frequency response. Modulation frequency response measurements shall be made in accordance with IRIG Document 118, Procedure 3-105. The applied signal shall be a sinusoid, and the deviation shall be ±700 kHz. Record the data on figure 5(D). To be acceptable, the transmitter shall meet the requirements of 3.2.1.8.1.

4.5.8 Deviation sensitivity. Measure the peak-to-peak voltage necessary to deviate the transmitter ±500 kHz. To be acceptable, the transmitter shall meet the requirements of 3.2.1.8.2.

4.5.9 Incidental frequency modulation. The receiver IF is 1 MHz and demodulator output filter is set at 500 kHz. Enter this value on figure 5(E).

4.5.9.1 Test procedure. Test can be made using peak deviation calibration or RMS deviation calibration. The contract will designate which procedure to use (see 6.2.1).

4.5.9.1.1 Calibration procedure. Calibration procedures are as follows:

(a) Set up equipment as shown in figure 6.

(b) Tune RF signal generator, spectrum analyzer, and receiver to the assigned frequency of the transmitter to be tested. (The RF signal generator may be a stable RF source which can be frequency modulated.)

(c) Set the receiver video bandwidth as specified in the procurement document.

(d) Set the receiver IF bandwidth equal to or greater than twice the video bandwidth.

(e) Frequency modulate the RF signal generator with a sinewave whose frequency is 4,160 ±10 Hz (for peak deviation calibration) or 5,880 ±10 Hz (for RMS deviation calibration).

(f) Assure that the RF signal generator output frequency is centered in the receiver pass band.

(g) Increase the amplitude of the modulating signal until the first carrier null is observed on the spectrum analyzer. The resulting carrier deviation is either 10 kHz peak or 10 kHz RMS, depending on the modulating frequency.

NOTE: 10 kHz peak deviation is equivalent to ±10 kHz deviation and 20 kHz peak-to-peak deviation.

(h) Adjust the receiver video output for a convenient voltage on the peak or RMS voltmeter.

(i) Measure and record the receiver video output voltage.

(j) Calculate and record the receiver demodulator sensitivity using the following equation:

Demodulator sensitivity = Video output/10

NOTE: The receiver demodulator sensitivity is now calibrated in either volts peak/kHz peak or volts RMS/kHz RMS. Do not adjust any receiver IF or video controls during test.

(k) Remove the modulating signal from the signal generator.

(l) Measure and record the receiver video output voltage.

(m) Calculate and record the measurement system IFM using the following equation:

system IFM = (video output volts) (demodulator sensitivity)

NOTE: Calibration accuracy is 5 percent if system IFM is 3 kHz.

4.5.9.1.2 Measurement procedure. Measurement procedures shall be as follows:

(a) Set up equipment as shown in figure 7.

(b) Record data on test data sheet, figure 8.

(c) Measure and record the receiver video output voltage.

(d) Calculate and record composite IFM using the following equation:

composite IFM = (video output volts) (demodulator sensitivity)

NOTE: The composite IFM includes both transmitter IFM and system IFM. Transmitter IFM is approximately equal to composite IFM if system IFM is much less than composite IFM. The transmitter RMS IFM can be calculated using the following equation:

$$\text{transmittal IFM} = \sqrt{(\text{composite IFM})^2 - (\text{system IFM})^2} \text{ (KHz RMS deviation)}$$

To be acceptable, the IFM shall meet the requirements of 3.2.1.9.

4.5.10 Signal-induced IAM. Measure in accordance with IRIG Document 118, Procedure 3-100. Record the data on figure 5(E). To be acceptable, the transmitter shall meet the requirements of 3.2.1.10.

4.5.11 Output load mismatch. Test in accordance with IRIG Document 118, Procedure 3-98. Record the data on figure 5(D). These parameters shall agree within allowable limits and with those obtained in 4.5.2. To be acceptable, output load mismatch shall be in accordance with 3.2.1.13.

4.5.12 Spurious emissions. Measure all spurious emissions on the output of the transmitter in accordance with MIL-STD-461, Equipment Class IB. Record data on figure 5(F). To be acceptable, the transmitter shall meet the requirements of 3.2.1.14.

4.5.13 Deviation linearity. Deviation linearity measurements shall be made in accordance with IRIG Document 118, Procedure 3-102. Record the data on figure 5(D). To be acceptable, the transmitter shall meet the requirements of 3.2.1.15.

4.5.14 Tilt. Pulse the transmitter with a bipolar square wave of 500 Hz, a risetime of 1 µs to the 99 percent point, and sufficient amplitude to deviate the transmitter frequency ±250 kHz. Repeat for a frequency of 50 kHz. Record the data on figure 5(F). To be acceptable, the transmitter shall meet the requirements of 3.2.1.16.

4.5.15 Power-supply induced frequency modulation. Connect an alternating current (ac) generator capable of a 1 V RMS output in series with the power input of the transmitter. (More than one generator may be required for the frequency range.) Vary the output frequency of the generator(s) from over the ranges specified in the contract or purchase order, and measure frequency modulation (FM) noise as in 4.5.9. The FM noise induced by the power supply modulation is the square root of the square of the RMS deviation with power supply modulation minus the square of the RMS deviation without power supply modulation. Record the maximum deviation encountered and its frequency on figure 5(G). To be acceptable, the transmitter shall meet the requirements of 3.2.1.17.

4.5.16 Power-supply induced amplitude modulation (AM). With the ac generator(s) connected as in 4.5.15, measure AM of the signal

using a calibrated crystal detector. Record the maximum amplitude variation measured and its frequency on figure 5(H). To be acceptable, the transmitter shall meet the requirements of 3.2.1.18.

4.5.17 Isolated power ground. Connect a 50 V power supply between the transmitter case and power ground, and measure and record the current drawn from this supply. Perform the tests of 4.1.2.1.4. Reverse polarity of the power supply, read and record the current drawn, and perform the tests of 4.1.2.1.4 again. To be acceptable, the transmitter shall meet the requirements of 3.2.1.19.

4.5.18 Differential input, common-mode withstanding voltage. Introduce a voltage of 10 V between the transmitter power ground and the signal negative lead, and perform the tests of 4.1.2.1.4. Reverse the polarity of the 10 V signal and repeat. To be acceptable, the transmitter shall meet the requirements of 3.2.1.20.

4.5.19 Differential input, common-mode rejection. Apply a 2 V peak-to-peak sinusoidal modulating voltage between the combination of the positive and negative modulation input leads (shorted together) and power ground, at frequencies of 100, 500, 1,000, 5,000, and 10,000 Hz, and measure deviation or receiver output. To be acceptable, the transmitter shall meet the requirements of 3.2.1.20.

4.5.20 Spike. With the transmitter operating normally on 28 Vdc, increase power supply voltage to 60 Vdc for 100 ms and then restore voltage to 28 Vdc, and perform the tests of 4.1.2.1.4. To be acceptable, the transmitter shall meet the requirements of 3.2.1.21.

4.6 Environmental.

4.6.1 Temperature-altitude. The transmitter shall be tested in accordance with MIL-STD-810, Method 504.1, Procedure I, Steps 2 and 3 only. The temperature for both Steps 2 and 3 shall be -40°C, and the altitude for Step 3 shall be 110,000 feet. Operational and performance checks are not required during exposure; however, external power shall be applied in accordance with the procedures of Steps 2 and 3. Following Step 3, the tests of 4.1.2.1.4 shall be performed.

4.6.2 Low temperature. The transmitter shall be tested in accordance with MIL-STD-810, Method 502.1, Procedure I. Storage temperature shall be -54°C and storage duration shall be 16 hours. Operating temperature shall be -40°C, and Step 4 duration shall be 16 hours. Step 5 shall consist of the application of external power for a period of 2 hours. Step 7 shall consist of the tests of 4.1.2.1.4.

4.6.3 High temperature. The transmitter shall be tested in accordance with MIL-STD-810, Method 501.1, Procedure I, except that Step 3 shall be 24 hours duration. Operating temperature shall be +85°C. Step 5 shall consist of the application of external power for a period of 2 hours, while maintaining the temperature at +85°C. Step 7 shall consist of the tests of 4.1.2.1.4.

4.6.4 Temperature shock. The transmitter shall be tested in accordance with MIL-STD-810, Method 503.1, Procedure I, except that Step 2 temperature shall be -40°C. Step 9 shall consist of the tests of 4.1.2.1.4.

4.6.5 Humidity. The transmitter shall be tested in accordance with MIL-STD-810, Method 507.1, Procedure I. Step 7 shall consist of the tests of 4.1.2.1.4.

4.6.6 Vibration. The transmitter shall be tested in accordance with MIL-STD-810, Method 514.2, Procedure IIA, except that the power spectral density levels shall be as shown in figure 3, and the test time shall be 1 hour per axis. (The free flight functional test shall not be performed.) External power shall be applied during all phases of the test. When operation is required, the tests of 4.1.2.1.4 shall be performed.

4.6.7 Shock. The transmitter shall be tested in accordance with MIL-STD-810, Method 516.2, Procedure IV, Flight Vehicle Equipment, Figure 516.2-1 100 g amplitude and a time duration of 6 ms. When operation is required, the tests of 4.1.2.1.4 shall be performed.

4.6.8 Burn-in and screening. Each transmitter shall be subjected to a minimum of 6 cycles of burn-in and screening as shown in figure 4.

4.6.8.1 Temperature cycling. Temperature cycling shall be as shown in figure 4. A thermal survey shall be performed prior to testing to determine the time required for the chamber air temperature to stabilize at the high and low temperatures indicated. The duration of one cycle shall be the sum of the stabilization times and the 2-hour dwell time at each temperature extreme.

4.6.8.2 Vibration subcycle. The vibration power spectral density shall be as shown in figure 9. Vibration shall be of 15 minutes duration for each exposure. Each exposure shall be in one axis only, with successive exposures in alternate axes, so the item will have been vibrated in each of three mutually perpendicular axes at least once during the screening test. The item may be removed from the temperature chamber for the performance of the vibration test, and the vibration exposure shall commence within 15 minutes of removal from the chamber.

4.6.8.3 Operation of the transmitter. As indicated in figure 4, the transmitter shall be operated during the heating subcycle. Operation shall consist of the application of nominal external power. Performance shall be monitored in a manner to detect any cessation of function, but parameter limits need not be verified during this operation.

4.7 Transmitter qualification. If the transmitter has not been qualified at a national or service test range, the contractor may submit a preproduction transmitter to the procuring activity for the scheduling of firing range qualification and certification (see 3.5).

4.8 Packaging, packing, marking, and labeling. Examination shall be made to ascertain that packaging, packing, and marking are in accordance with Section 5.

5. PREPARATION FOR DELIVERY.

5.1 Preservation and packaging.

5.1.1 Level C. The transmitter shall be preserved and packaged in a manner to afford protection against damage during direct shipment from the supply source to the first receiving activity for immediate use.

5.2 Packing.

5.2.1 Level C. Transmitters packaged as specified in 5.1 shall be packed in a manner to ensure carrier acceptance and safe delivery at destination.

5.3 Marking. In addition to any special markings required by the contract or purchase order, unit packages, intermediate packages and shipping containers shall be marked in accordance with MIL-STD-129 (see 6.2.1).

5.4 Labeling. A warning notice or decal shall be placed on the equipment at each point where a radiation hazard exists and near all shields, interlocks, or other protective devices where a potential radiation hazard exists should they be removed or bypassed. The warning notice or decal shall meet the material and process requirements of MIL-STD-130.

6. NOTES.

6.1 Intended use. The transmitter is a component of a digital telemetry system used to obtain flight performance information from missiles, bombs, and aircraft.

6.2 Ordering data. Procurement documents should specify the following:

6.2.1 Procurement requirements.

(a) Title, number, and date of this specification.

(b) Maximum input current consumption if other than as specified in 3.2.1.1.

(c) Center frequency tolerance if other than as specified in 3.2.1.6.

(d) Operating frequency range (see 3.2.1.6).

(e) Frequency deviation range if other than as specified in 3.2.1.7.

(f) Deviation sensitivity if other than as specified in 3.2.1.8.2.

(g) Output power if other than as specified in 3.2.1.11.

(h) Power-supply induced frequency modulation limit (see 3.2.1.17).

(i) Power-supply induced amplitude modulation limit (see 3.2.1.18).

(j) Isolated power ground (see 3.2.1.19).

(k) Differential modulation input (see 3.2.1.20).

(l) Transmitter exterior and interface if other than as shown in 3.2.2.1.

(m) Representative transmitter for electromagnetic radiation testing (see 3.3.2).

(n) When a preproduction sample is required, testing and approval will be under the appropriate provisions of 7-104.55 of the Armed Services Procurement Regulations. The preproduction sample should consist of 4 units. The contracting officer should include specific instructions in all procurement instruments, regarding arrangements for examinations, tests, and approval of the preproduction sample.

(o) Responsibility for performance of inspection requirements and testing facilities if other than as specified in 4.1.1.

(p) Bench test procedures if other than as shown in 4.5.

(q) IFM test procedures (see 4.5.9.1).

(r) Marking if other than as specified in 5.3.

6.2.2 Data requirements. When this specification is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Armed Services Procurement Regulations, the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of ASPR-7-104.9(n) are not invoked, the data specified below will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraph:

Paragraph	Data requirement	Applicable DID
3.3.2	Electromagnetic radiation	DI-T-2072
4.3.1.1	Test procedures	DI-T-5204
4.3.1.2	Test data	DI-T-2072

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

6.3 Definitions.

6.3.1 IFM. IFM is defined to be carrier deviation produced by frequency modulation when the modulating signals are unwanted and internal to the RF signal source. IFM may be specified and measured either as peak deviation or as RMS deviation. Traditionally, peak has been specified; however, IFM has random amplitude fluctuations and thus can be more accurately measured as RMS.

Preparing activity:
NAVY(AS)
Project number: 5821-N141

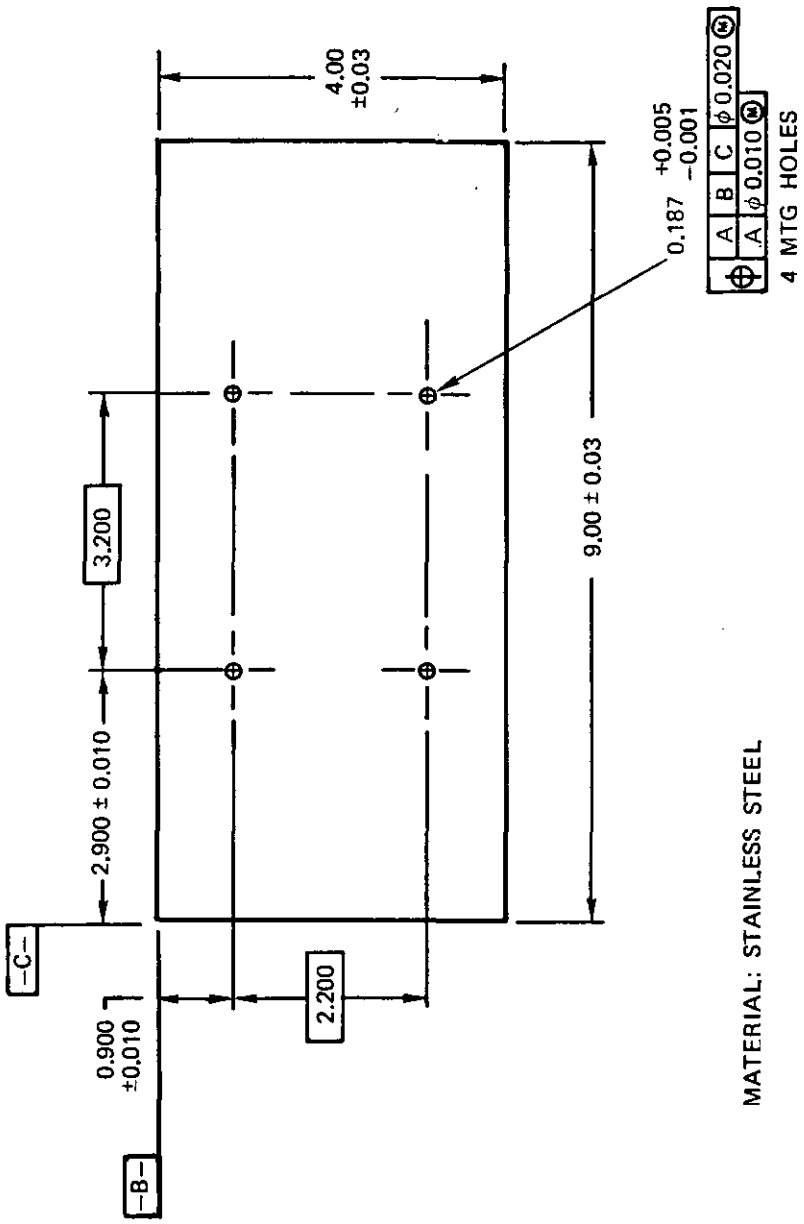


FIGURE 1. Heat sink.

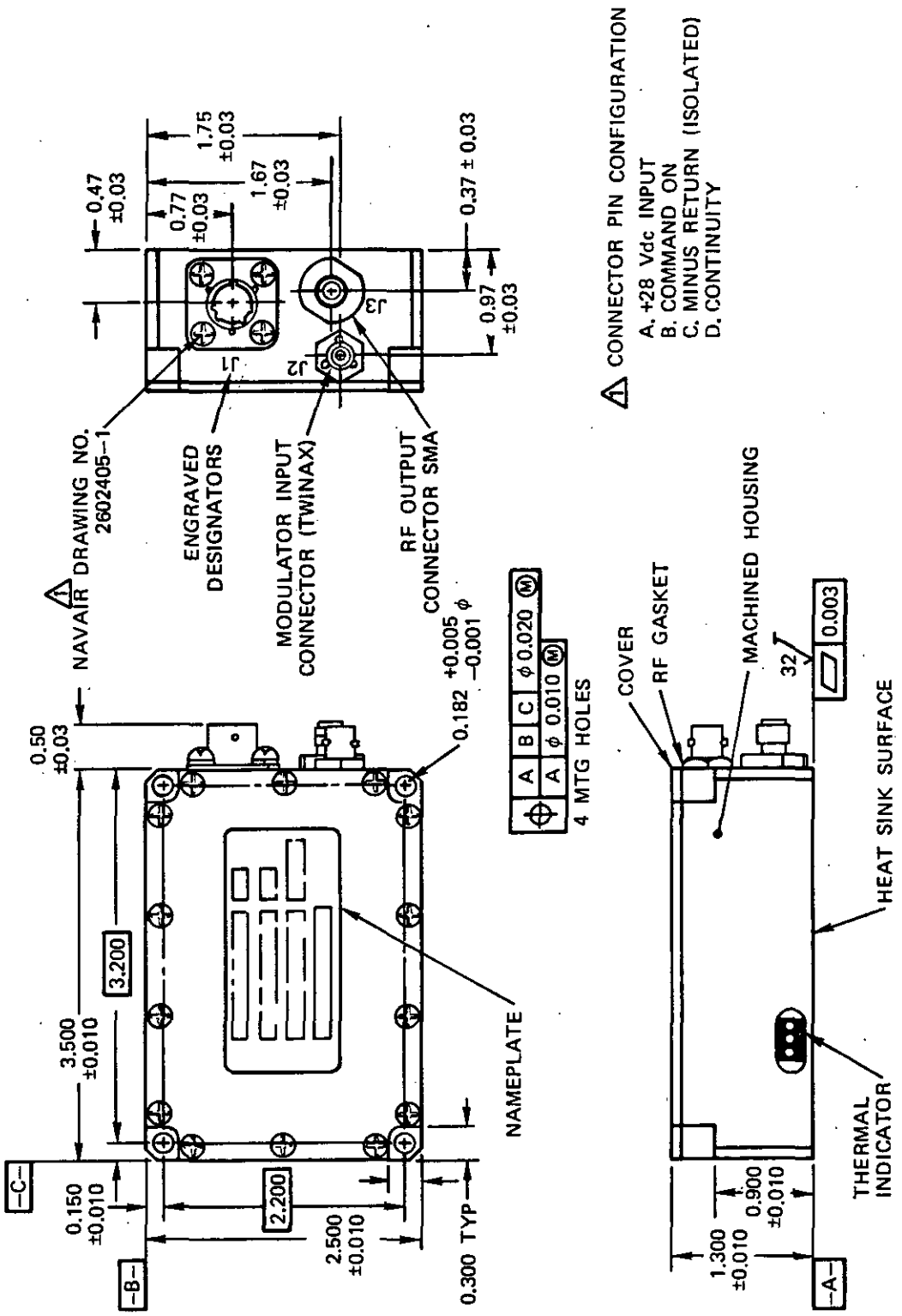


FIGURE 2. Transmitter exterior and interface.

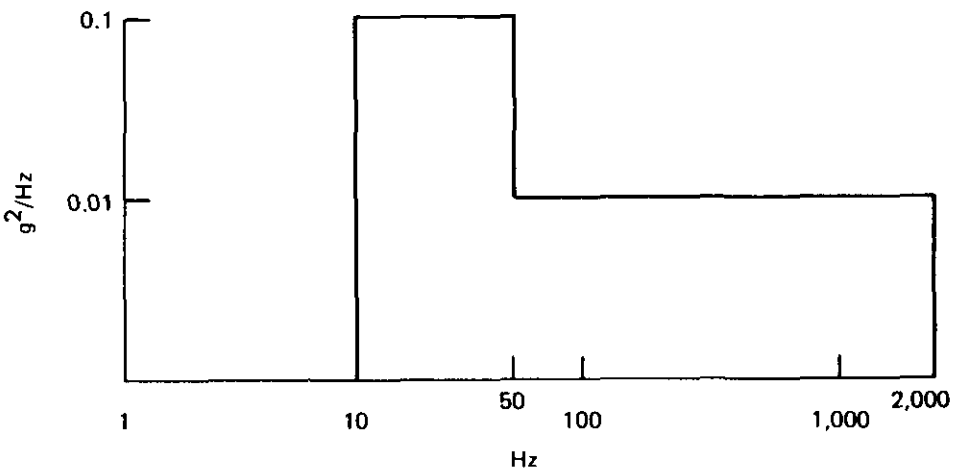
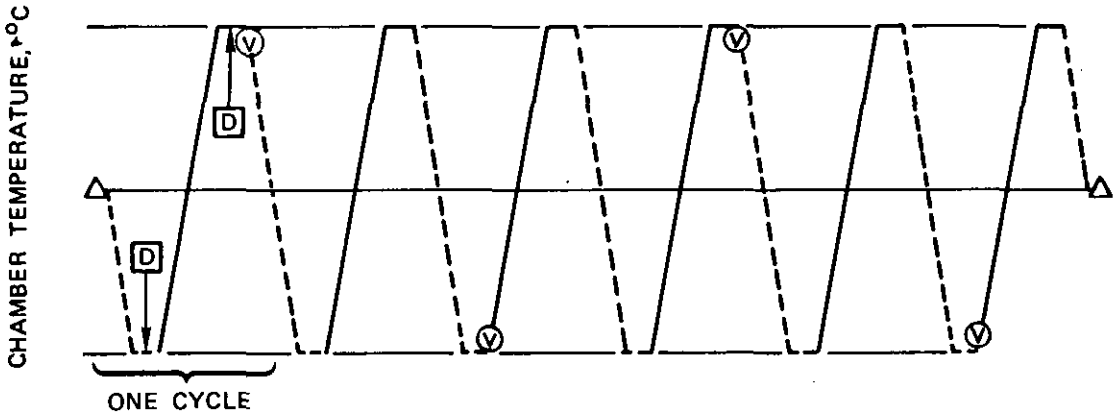


FIGURE 3. Random vibration.



LEGEND

△ = COMPLETE FUNCTIONAL PERFORMANCE TEST
[D] = DWELL TIME AT TEMPERATURE EXTREMES
Ⓥ = VIBRATION EXPOSURE SUBCYCLE
- - - = EQUIPMENT NONOPERATING (COOL DOWN)
—— = EQUIPMENT OPERATING (HEATING SUBCYCLE)

NOTES:

1. A COMPLETE PERFORMANCE TEST SHALL BE CONDUCTED PRIOR TO THE SCREENING TEST AND AT THE COMPLETION OF THE SIXTH CYCLE.
2. THE LAST TWO CYCLES SHALL BE FAILURE FREE – IF FAILURES OCCUR, REPAIRS SHALL BE PERFORMED, AND THE UNIT SUBJECTED TO A MINIMUM OF TWO ADDITIONAL CYCLES.
3. EQUIPMENT PERFORMANCE SHALL BE CONTINUOUSLY MONITORED DURING THE HEATING SUBCYCLES SUFFICIENTLY TO DETECT CESSATION OF FUNCTION.
4. DWELL TIME, AFTER CHAMBER STABILIZATION SHALL BE 2 HOURS MINIMUM.
5. TEMPERATURE CHAMBER SHALL BE ADEQUATE TO PROVIDE A RATE OF TEMPERATURE CHANGE OF 2°C/MINUTE MINIMUM.

FIGURE 4. Burn-in and screening profile.

QUALITY ASSURANCE DATA SHEETS

FOR

TRANSMITTER

MFD. BY _____

CONTRACT NO. _____

LOT NO. _____

SERIAL NO. _____

(A)

FIGURE 5. Sample QA data sheet.

Center frequency (see 4.5.1)

Frequency in Hz				
Time	Hz at 24 Vdc	Hz at 28 Vdc	Hz at 32 Vdc	28 Vdc W/modulation
10 seconds	___	___	___	___
1 minute	___	___	___	___
2 minutes	___	___	___	___
3 minutes	___	___	___	___
4 minutes	___	___	___	___
5 minutes	___	___	___	___
7 minutes	___	___	___	___
10 minutes	___	___	___	___
12 minutes	___	___	___	___
15 minutes	___	___	___	___

Verified_____
Date_____

(B)

FIGURE 5. Sample QA data sheet. - Continued

	Test voltage setting				
	22 Vdc	24 Vdc	28 Vdc	32 Vdc	40 Vdc
Operating voltage range (see 4.5.2)					
Input current (A)	_____	_____	_____	_____	
Input power (W)	_____	_____	_____	_____	
Center frequency (kHz)	_____	_____	_____	_____	
Deviation (kHz)	_____	_____	_____	_____	
RF power output (W)	_____	_____	_____	_____	
Primary voltage polarity reversal (see 4.5.4)				Verified ( ) _____	
Overvoltage (see 4.5.5)					
Input current (A)					_____
Input power (W)					_____
Center frequency (kHz)					_____
Deviation (kHz)					_____
RF power output (W)					_____

Verified_____
Date_____

(C)

FIGURE 5. Sample QA data sheet. - Continued

Output load mismatch (see 4.5.11)

	Voltage		
	24 Vdc	28 Vdc	32 Vdc
Center frequency	_____	_____	_____
Input current	_____	_____	_____
Output power	_____	_____	_____
Signal input impedance (see 4.5.3)			
	Resistor out		Resistor in
Deviation	_____ kHz		_____ kHz

Modulation frequency response (see 4.5.7)

Frequency	± 700 kHz	Frequency	± 700 kHz
10 Hz	_____Vac	50 kHz	_____Vac
20 Hz	_____	100 kHz	_____
50 Hz	_____	200 kHz	_____
100 Hz	_____	300 kHz	_____
200 Hz	_____	400 kHz	_____
500 Hz	_____	500 kHz	_____
1 kHz	_____	600 kHz	_____
2 kHz	_____	700 kHz	_____
5 kHz	_____	800 kHz	_____
10 kHz	_____	900 kHz	_____
20 kHz	_____	1 MHz	_____

Verified_____

Date_____

(D)

FIGURE 5. Sample QA data sheet. - Continued

Deviation linearity (see 4.5.13)

Deviation	Voltage (Vdc)	Deviation	Voltage (Vdc)
+ 50 kHz	_____	-50 kHz	_____
+ 100 kHz	_____	- 100 kHz	_____
+ 150 kHz	_____	- 150 kHz	_____
+ 200 kHz	_____	- 200 kHz	_____
+ 300 kHz	_____	- 300 kHz	_____
+ 500 kHz	_____	- 500 kHz	_____
+ 700 kHz	_____	- 700 kHz	_____
+ 1000 kHz	_____	- 1000 kHz	_____
Incidental modulation (see 4.5.9 and 4.5.10)			
Frequency modulation Amplitude modulation		_____ _____	
On-off lead (see 4.5.6)		Verified ( )_____	

Verified_____

Date_____

(E)

FIGURE 5. Sample QA data sheet. - Continued

Spurious emissions (see 4.5.12)

Frequency of emission	dB down from carrier
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Tilt (see 4.5.14)

Positive deflection, 500 Hz test frequency	_____ %
Positive deflection, 50 kHz test frequency	_____ %
Negative deflection, 500 Hz test frequency	_____ %
Negative deflection, 50 kHz test frequency	_____ %

Verified_____

Date_____

(F)

FIGURE 5. Sample QA data sheet. - Continued

Power-supply induced FM (see 4.5.15)

Power-supply input frequency	Deviation in Hz
10 Hz	
20 Hz	
50 Hz	
100 Hz	
200 Hz	
500 Hz	
1 kHz	
2 kHz	
5 kHz	
10 kHz	
20 kHz	
50 kHz	
100 kHz	
200 kHz	
500 kHz	
1 MHz	
2 MHz	
5 MHz	
10 MHz	
20 MHz	
50 MHz	
100 MHz	
200 MHz	
500 MHz	
1 GHz	

Verified_____

Date_____

(G)

FIGURE 5. Sample QA data sheet. - Continued

Power-supply induced AM (see 4.5.16)

Power-supply input frequency	Deviation in Hz
10 Hz	
20 Hz	
50 Hz	
100 Hz	
200 Hz	
500 Hz	
1 kHz	
2 kHz	
5 kHz	
10 kHz	
20 kHz	
50 kHz	
100 kHz	
200 kHz	
500 kHz	
1 MHz	
2 MHz	
5 MHz	
10 MHz	
20 MHz	
50 MHz	
100 MHz	
200 MHz	
500 MHz	
1 GHz	

Verified_____

Date_____

(H)

FIGURE 5. Sample QA data sheet. - Continued

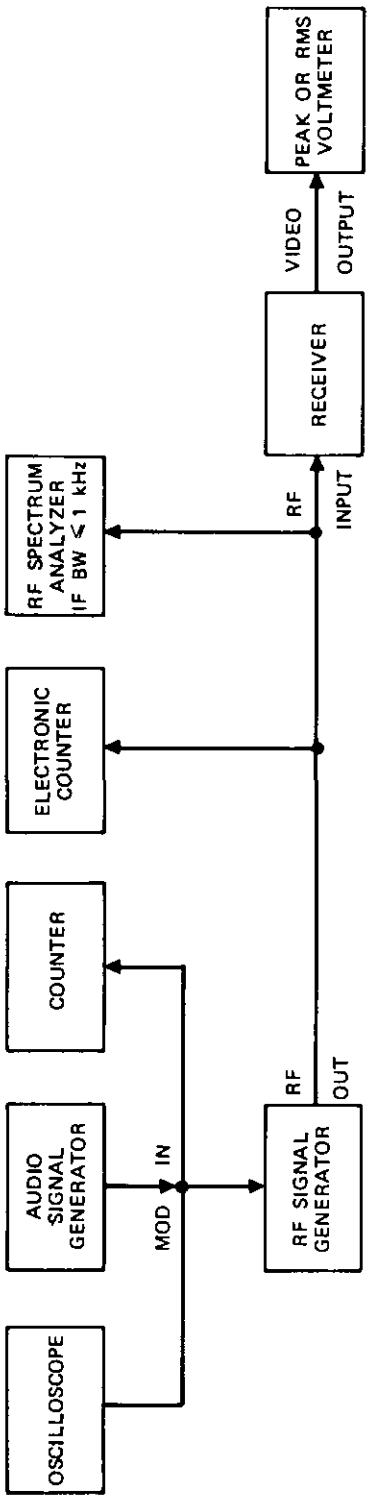


FIGURE 6. Incidental frequency modulation calibration.

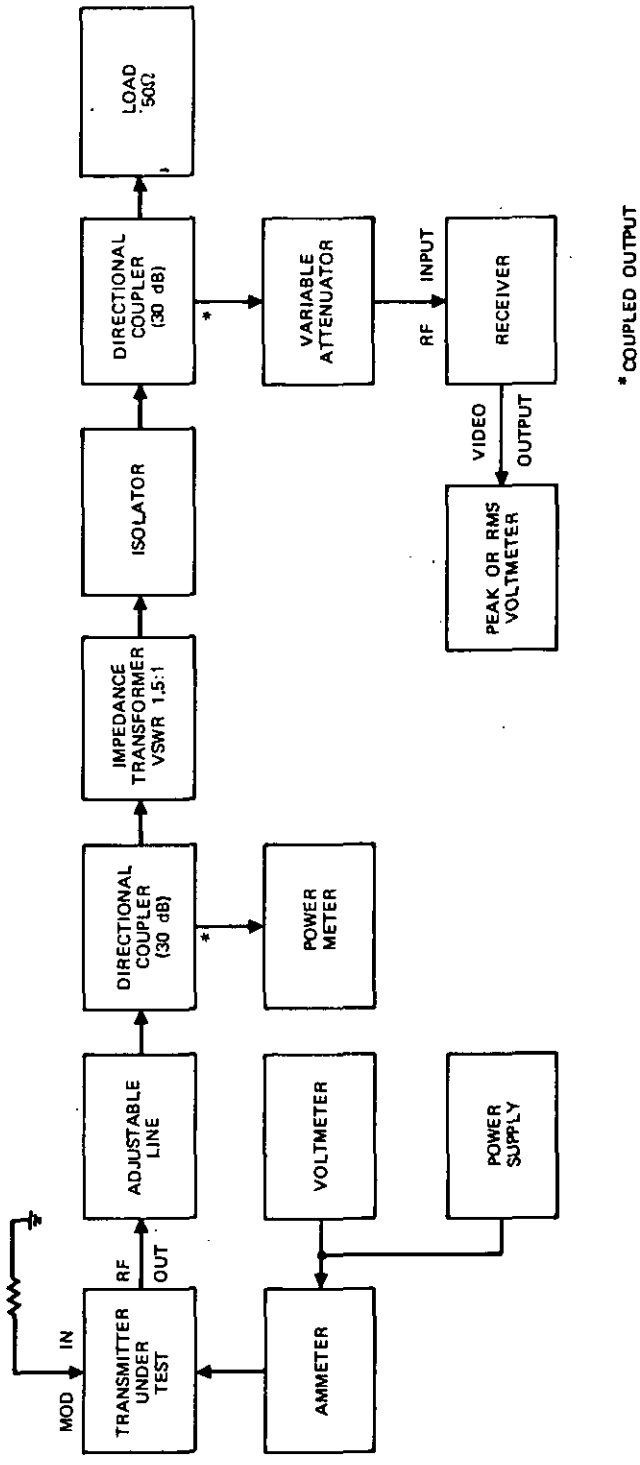


FIGURE 7. Incidental frequency modulation test.

Unit and Serial No. Date_____

_____ Tested by_____

Incidental Frequency Modulation Test

	Receiver video output (Volts*)	IFM (kHz*)	Demodulator Sensitivity (kHz*/volt*)	Limits (kHz*)
Demodulator calibration	_____		_____	
Measurement system IFM	_____	_____		
Composite IFM	_____	_____		
Transmitter IFM	_____	_____	as specified in 3.2.1.9	

*RMS as specified in 3.2.1.9

FIGURE 8. Test data sheet.

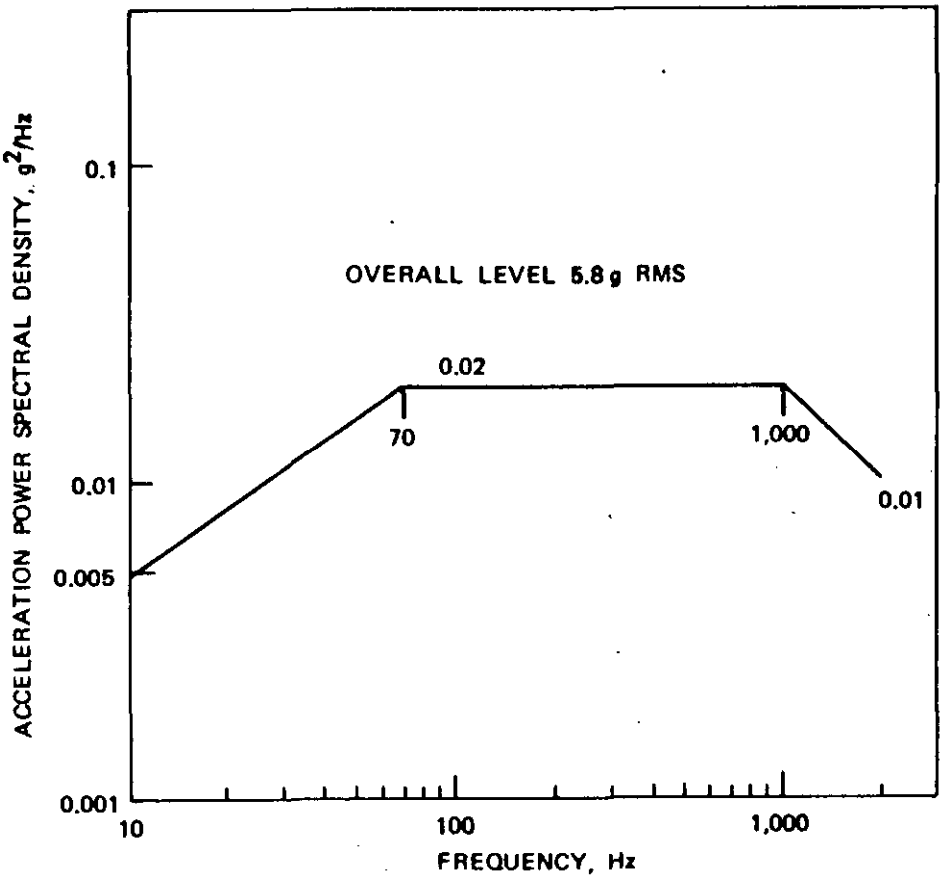


FIGURE 9. Vibration profile, screening.

* U. S. GOVERNMENT PRINTING OFFICE: 1979—603-022/4479

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