MILITARY SPECIFICATION

TRANSMITTER,

DIGITAL TELEMETRY

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 the Defense.

1. SCOPE.

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

1.2 Classification. Transmitter shall be one of the following types:

a. Type I - 3.500 inches x 2.500 inches

b. Type II - 3.213 inches x 2.000 inches

2. APPLICABLE DOCUMENTS.

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue

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

of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, 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.

STANDARDS

Federal

FED-STD-101	Test Procedures for Packaging Materials.
FED-STD-102	Preservation, Packaging, and Packing Levels.

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-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-781	Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution.

MIL-STD-810	Environmental Test Methods.
MIL-STD-1695	Environments, Working, Minimum Standards for.
MIL-STD-45662	Calibration Systems Requirements.

2.1.2 Other Government documents. The following other Government documents form a part of this specification to the extent specified herein.

DOCUMENTS

Naval Air Systems Command
(Code Ident 30003)

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

Federal Cataloging Handbook

H4	Federal Supply Code for Manufacturers, United 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.)

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

2.1.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. Requirements.

3.1 Item description. The item described herein is a fixed-deviation telemetry transmitter operating on a specified frequency in the P-band (216-265 megahertz (MHz)), L-band (400-900 and 1435-1535 MHz) or S-band (2200-2400 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 is transistor-transistor logic (TTL) signals formatted as PCM data, at specified rates from 10,000 to 3,000,000 bits per second.

3.2 First article. When specified, a sample shall be subjected to first article inspection (see 4.4 and 6.3). 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 first article inspection.

3.3 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.

3.4 Design and construction. The transmitter shall conform to one of the configurations shown in Figures 1 or 2 (see 6.2.1), and shall meet all the requirements of this specification and the referenced documents to the extent specified herein.

3.4.1 Standards of manufacture.

3.4.1.1 Product cleanliness. No oils or solid lubricants of any kind shall be used on any part of the transmitter after final cleaning of components, except as specified herein.

3.4.1.2 Soldering. Procedures and requirements for preparation and soldering of electrical connections shall be in accordance with WS-6536.

3.4.1.3 Working environment. The contractor shall provide adequate facilities for the fabrication, assembly, and testing of items to be delivered in accordance with this specification. The working environment shall meet the minimum levels and requirements specified in MIL-STD-1695.

3.5 Performance. The transmitter, while mounted on a heat sink which simulates the subassembly mounting plate (see Figure 3), shall meet the performance requirements specified herein with or without modulation by PCM signals in accordance with IRIG Document 106.

3.5.1 Input voltage and current. The transmitter shall operate over the voltage range of 22 to 34 Vdc. Unless otherwise specified in the contract or purchase order (see 6.2.1), maximum current consumption shall be 0.8 ampere (A) at all temperatures.

3.5.2 Signal input impedance. Signal input impedance shall be a single TTL load, or no less than 3,000 ohms referenced to +5 volts shunted by 25 picofarad maximum capacitance.

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

3.5.4 Warmup. The transmitter shall self-start and generate a radio frequency (RF) carrier output within the specified frequency limits within one 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).

3.5.5 On-off lead. An external lead shall be provided that will cause the transmitter to operate only when the lead is connected to a voltage less than one volt with respect to power ground. Maximum current, source or sink, shall be 5 milliamperes (mA).

3.5.6 Operating frequency. Operating frequency shall be within the telemetry bands (216 to 2,400 MHz). Specified operating frequency is the average frequency resulting from transmission of a steady-state digital "one" and "zero." The operating frequency shall be as specified in the contract or purchase order (see 6.2.1), and shall be an integral number of megahertz or half-way between.

3.5.7 Frequency deviation. Transmitter frequency deviation with input shall be as specified in the contract or purchase order. Input data rates shall be as specified (see 6.2.1).

3.5.8 Modulator characteristics.

3.5.8.1 Sense. Modulation sense shall be such that a "one" at the input of the transmitter shall cause the higher output frequency and a "zero" at the input shall cause the lower output frequency. With no input connected, the higher output frequency shall be transmitted.

3.5.8.2 Spectral characteristics. When modulated with an alternating "ones" and "zeros" signal at a rate equal to 1.4 times the deviation specified in 3.5.7, the transmitted radio frequency spectrum shall not produce any spectral products greater than 40 decibels (dB) below the level of the unmodulated carrier at frequencies greater than

2.2 times the bit rate removed from the center frequency, nor produce any frequency component of amplitude greater than -25 decibels referenced to one milliwatt (dBm) at any frequency other than the carrier when unmodulated.

3.5.8.3 Deviation as a function of input voltage. Output carrier frequency shall assume the lower of the two steady-state frequencies when input voltage is less than or equal to 0.8 volt, and the higher frequency when input voltage is greater than 2.4 volts and less than 5.5 volts. The two steady-state frequencies shall not be a function of voltages within these ranges, power supply voltage, nor environmental conditions to an extent greater than ±5 percent of the difference between each frequency and the average of the two, which shall be considered the center frequency.

3.5.8.4 TTL source voltage. When specified in the contract or purchase order (see 6.2.1), an internal 4.75 to 5.25-volt source capable of 40 mA loading shall be provided for powering of an external optoisolator. When this option is selected, a six-pin power connector shall be provided (see Figure 1 or 2, as applicable).

3.5.9 Incidental frequency modulation (IFM). IFM (see 6.4.1) shall not exceed 3 kilohertz (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.

NOTE

Receiver local oscillator freqency instability produces measurement system IFM.

3.5.10 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.

3.5.11 Output power. Unless otherwise specified in the contract or purchase order (see 6.2.1), the transmitter power output, with a 24 Vdc or greater 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.

3.5.12 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.

3.5.13 Power-supply induced frequency modulation. Power-supply induced frequency modulation shall be no greater than the limit specified in the contract or purchase order for any frequency above 440 Hz, and with the power input presumed to be a 50-ohm port (see 6.2.1).

3.5.14 Power-supply induced amplitude modulation. Power-supply induced amplitude modulation shall be no greater than the limit specified in the contract or purchase order for any frequency above 440 Hz, and with the power input presumed to be a 50-ohm port (see 6.2.1).

3.5.15 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.

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

3.5.17 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 A1, except as specified herein.

3.5.17.1 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, and with voltage standing-wave ratios up to and including 1.5:1 at all phase angles.

3.5.17.2 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 narrow band emission over the range of 500 kHz to 10 GHz may exceed the limits of MIL-STD-461, Figure 2-9, by no more than 35 dB.

3.6 Environmental requirements. The transmitter shall meet the requirements of 3.5.1, 3.5.6, 3.5.8.1, 3.5.8.2, and 3.5.8.3 before, during, or after exposure to the following environmental conditions or any natural combination thereof.

a. Vibration.

b. Shock.

c. Ejection shock.

d. Handling shock.

e. Temperature shock.

f. Temperature - altitude.

g. Low temperature.

h. High temperature.

i. Sand and dust.

j. Humidity.

k. Salt fog.

3.7 Burn-in and screening. Each transmitter shall complete a minimum of 6 cycles of burn-in and screening as shown in Figure 4.

3.8 Mean-time-between-failure (MTBF) demonstration. When specified in the contract or purchase order (see 6.2.1), transmitters supplied in accordance with this specification shall be capable of demonstrating a specified MTBF θ_o of 200 hours at a 90 percent confidence level.

3.8.1 MTBF determination. The transmitter operating time shall be used in MTBF determination. Each sample transmitter shall accumulate a minimum operating time of not less than one-half the average operating time of all sample transmitters submitted to the MTBF demonstration testing. For the purpose of MTBF determination, the transmitter operating time shall be that time during the thermal cycle of Figure 4 when the transmitter is operating.

3.9 Identification and marking. The transmitter shall be identified and marked in accordance with MIL-STD-130 and Figure 1 or 2, as applicable. Markings shall include, but shall not be limited to, the following:

a. The number and revision of this specification.

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.

f. Deviation.

3.10 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. Unless otherwise specified herein, fabricating and assembly practices shall be in accordance with MIL-STD-454, Requirement 9.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements specified herein (see 6.2.1). Except as otherwise specified, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the cognizant Government technical activity. The Government reserves the right to perform or witness any of the inspections set forth in this specification where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspections (see 4.4).

b. Quality conformance inspections (see 4.5).

4.3 Inspection conditions.

4.3.1 Test equipment. For performance of the tests specified herein, all test equipment utilized by the contractor shall be calibrated and maintained in accordance with MIL-STD-45662. When specified in the

contract or purchase order, the contractor shall prepare a calibration plan (see 6.2.2).

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

4.3.2 Test environment. Unless otherwise specified herein, the inspection methods of 4.6 shall be performed under the conditions specified in 3.4.1.3.

4.3.3 Test documentation.

4.3.3.1 Test procedures. Test procedures shall conform to the requirements of MIL-T-18303 and shall be prepared prior to commencement of testing (see 6.2.2).

4.3.3.2 Test data. Test data shall be prepared as specified on the data sheets (see Figure 5) (see 6.2.2).

4.3.3.3 Failure analysis and report. The testing activity shall prepare a failure analysis and report for all transmitter failures (see 6.2.2).

4.3.3.4 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.

4.4 First article inspection. Unless otherwise specified in the contract or purchase order, the contractor shall furnish a first article of four transmitters to the testing activity designated in the contract or purchase order for first article inspection and approval (see 6.3). First article approval is valid only on the contract under which it is granted, unless specifically extended by the procuring activity to other contracts. The first article shall be manufactured using the same methods, materials, processes, and procedures proposed for production. Any production prior to approval of the first article shall be at the risk of the contractor. After approval of the first article sample, changes in material, process procedures or design shall require prior written approval from the procuring activity and requalification may be required.

4.4.1 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 first article inspection.

4.4.2 First article inspection sequence. The first article sample of four transmitters shall be subjected to the inspections of Table I in the sequence shown. Upon completion of the first article inspections of Table I, one transmitter from the first article sample shall be subjected to the tests of 4.4.3..

TABLE I. First article inspection.

Inspection[1/]	Requirement paragraph	Method paragraph
Visual and mechanical	3.3, 3.4, 3.9, 3.10	4.6.1, 4.6.22
Performance tests	3.5.1 to 3.5.17	4.6.2 to 4.6.19
Vibration	3.6a	4.6.20.1
Post tests	---	4.4.2.1
Shock	3.6b	4.6.20.2
Post tests	---	4.4.2.1
Ejection shock	3.6c	4.6.20.3
Post tests	---	4.4.2.1
Handling shock	3.6d	4.6.20.4
Post tests	---	4.4.2.1
Temperature shock	3.6e	4.6.20.5
Temperature-altitude	3.6f	4.6.20.6
Low temperature	3.6g	4.6.20.7
High temperature	3.6h	4.6.20.8
Sand and dust	3.6i	4.6.20.9
Post tests	---	4.4.2.1
Humidity	3.6j	4.6.20.10
Salt fog	3.6k	4.6.20.11
Performance tests	3.5.1 to 3.5.17	4.6.2 to 4.6.19

[1/] Upon completion of the first article inspection, one transmitter from the first article sample shall be subjected to the tests of 4.4.3.

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

a. Input power (see 4.6.3).

b. Center frequency (see 4.6.2).

c. Deviation as a function of input (see 4.6.10).

d. RF power output (see 4.6.3).

4.4.3 Electromagnetic radiation. Unless waived in writing by the procuring activity (see 6.2.1), one first article sample 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. The results of these tests shall be documented and made available to the procuring activity (see 6.2.2).

4.4.4 First article acceptance and rejection criteria. Failure of any transmitter to pass any of the first article inspections specified herein shall cause rejection of the first article sample.

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

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

4.5.2 Quality conformance inspection sequence. Each transmitter offered for acceptance shall be subjected to the Group A inspections of Table II in the sequence specified. Upon completion of the Group A inspections, the lot shall be sampled as specified herein, and the sample subjected to the Group B inspections of Table II in the sequence specified. When MTBF is required by the contract or purchase order, the Group B inspection of Table II shall be replaced by the Group C MTBF testing of Table II.

4.5.2.1 Lot sampling. A lot sample shall be randomly selected as follows:

Lot size	Sample size
2-50	4
51-150	6
151-300	3-6
301-500	3-6

TABLE II. Quality conformance inspection.

Inspections	Requirement paragraph	Method paragraph
Group A		
Visual and mechanical	3.3, 3.4, 3.9, 3.10	4.6.1, 4.6.22
Burn-in and screening	3.7	4.6.21
Performance tests	3.5.1 to 3.5.17	4.6.2 to 4.6.19
Group B		
Temperature shock	3.6e	4.6.20.5
Vibration	3.6a	4.6.20.1
Performance tests	3.5.1 to 3.5.17	4.6.2 to 4.6.19
Group C		
MTBF testing	3.8	4.5.4
Performance tests	3.5.1 to 3.5.17	4.6.2 to 4.6.19

4.5.3 Quality conformance acceptance and rejection criteria. Any transmitter that fails to meet the specified requirements of the Group A inspections 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 the Group B inspections. Failure of any transmitter of the sample to meet the requirements of the Group B inspections shall cause rejection of the lot represented.

NOTE

4.5.3 does not apply if MTBF testing is imposed by the contract or purchase order.

4.5.4 MTBF demonstration test. When required by the contract or purchase order (see 6.2.1), the MTBF demonstration test shall be conducted in accordance with MIL-STD-781, Test Plan IIIc and the following:

a. Test sample. A minimum of three to a maximum of six transmitters shall be randomly selected from the inspection lot of 4.5.1 and shall have been subjected to and passed the Group A inspections of Table II in the sequence specified.

b. Environmental exposure and test profile shall be in accordance with Figures 4 and 6.

c. Failure categories shall be as specified in 4.5.5.

d. In the event a failure is detected during chamber testing, all operating time occurred to the point of failure shall be counted. In the event a failure is detected during performance verification, the failure shall be assumed to have occurred halfway between the point of detection and the last successful performance verification. All operating time and all relevant failures of all transmitters committed to MTBF testing shall be used in the MTBF determination of 3.8.1.

4.5.5 Failure categories. The following failure categories apply to 4.5.4.

4.5.5.1 Relevant failures. A relevant failure is any failure except those classified and listed herein as nonrelevant failures.

4.5.5.2 Nonrelevant failures. Nonrelevant failures are classified as follows:

a. Any failure caused by test equipment.

b. Any failure that results from operational or procedural error in testing.

c. Any failure resulting from rework, repair or investigation of failures during environmental or MTBF testing if detected prior to resubmission to environmental of MTBF testing.

d. Secondary failures when they are confirmed to be induced by failure of another part. However, at least one relevant failure shall be charged when one secondary failure is claimed.

e. When a failure results from a design incompatibility which has been determined to exist and has been concurred with the procuring activity, provided that the previously required corrective action for the incompatibility does not apply to the lot in question.

f. Repeated failures for which corrective action has been documented but, by direction of the procuring activity, the corrective action was not incorporated into the lot where the repeated failures occur.

g. Failure of approved limited life parts, when the failure occurs after the stipulated life period.

4.5.6 MTBF demonstration test acceptance and rejection criteria. MTBF acceptance/rejection criteria shall be in accordance with MIL-STD-781, Test Plan IIIc. Failure of the sample to meet the ACCEPT requirement of MIL-STD-781, Test Plan IIIc shall cause the rejection of the lot represented.

4.6 Inspection methods.

4.6.1 Physical examination. A complete physical examination shall be performed on the transmitter to verify that all interface dimensions meet the requirements of Figure 1 or 2, as applicable.

4.6.2 Center frequency and frequency deviation. Transmitter center frequency and frequency deviation measurements shall be made as follows:

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

b. Ground the transmitter input for a "one," open-circuit the input for a "zero."

c. Commencing 10 seconds after power is applied, and at each 10-second interval through 3 minutes, record on Figure 5(B) the high and low output frequencies observed on the electronic frequency counter. Observe and record the frequencies at 1 minute intervals through 15 minutes. The average of these high and low frequencies is the center frequency; the difference between them is the deviation (peak-to-peak).

d. Repeat c for 28 Vdc.

e. Repeat c for 32 Vdc.

To be acceptable, the transmitter shall meet the requirements of 3.5.1, 3.5.4, 3.5.6 and 3.5.7.

4.6.3 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 3.5.1 and 3.5.11.

4.6.4 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 at a bit rate 2.8 times the deviation of the transmitter (see 6.2.1). To be acceptable, the transmitter shall meet the requirements of 3.5.2.

4.6.5 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 3.5.3.

4.6.6 Overvoltage. With the transmitter operating as specified in 4.6.3, 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 4.4.2.1. Record the data on Figure 5(C). To be acceptable, the transmitter shall meet the requirements of 3.5.3.

4.6.7 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 and that maximum current is 5 mA. Record the data on Figure 5(E).

To be acceptable, the transmitter shall meet the requirments of 3.5.5.

4.6.8 Sense. Verify that a "one" on the transmitter input causes the higher of the two steady-state frequencies and that a "zero" causes the lower. Record the results on Figure 5(D). To be acceptable, the transmitter shall meet the requirements of 3.5.8.1.

4.6.9 Spectral characteristics. Modulate the transmitter with a series of alternating "ones" and "zeros" at a rate equal to 2.8 times the deviation specified in 3.5.7, and display the spectral products on a spectrum oscilloscope. Photograph the display, indicate unmodulated signal level and label the amplitude and frequency axes, and attach where indicated on Figure 5(E). With modulation removed, measure signal levels at frequencies other than the assigned carrier frequency and indicate on Figure 5(E). To be acceptable, the transmitter shall meet the requirements. of 3.5.8.2.

4.6.10 Deviation as a function of input. Measure the threshold voltages for the lower and upper steady-state frequency outputs. Record the results on Figure 5(E). To be acceptable, the transmitter shall meet the requirements of 3.5.8.3.

4.6.11 TTL source voltage. Connect a voltmeter from the TTL source voltage to ground. Measure and record the voltage on Figure 5(E). Place a 120-130 ohm load between the TTL source voltage and again measure and record the voltage. To be acceptable, the voltage in both instances shall meet the requirements of 3.5.8.4.

4.6.12 Incidental frequency modulation. The receiver IF bandwidth should be equal to the bit rate and demodulator output filter set at 0.75 to 1.0 times the bit rate, and set for constant delay (if applicable). Enter this value on Figure 5(E). Test can be made using peak deviation calibration or rms deviation calibration. The contract or purchase order will designate which procedure to use (see 6.2.1). Record the results on Figure 7. To be acceptable, the IFM shall meet the requirements of 3.5.9.

4.6.13 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 3.5.10.

4.6.14 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 4.6.3. To be acceptable, output load mismatch shall be in accordance with 3.5.12.

4.6.15 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 4.6.12. 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 3.5.13.

4.6.16 Power-supply induced amplitude modulation (AM). With the ac generator's connected as in 4.6.15, 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 3.5.14.

4.6.17 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 4.4.2.1. Reverse polarity of the power supply, read and record the current drawn and perform the tests of 4.4.2.1 again. To be acceptable, the transmitter shall meet the requirements of 3.5.15.

4.6.18 Spike. With the transmitter operating normally on +28 Vdc, increase power supply voltage to +60 Vdc for 100 ms and then restore the voltage to +28 Vdc and perform the tests of 4.4.2.1. To be acceptable, the transmitter shall meet the requirements of 3.5.16.

4.6.19 Spurious emissions. Measure all spurious emissions on the output of the transmitter in accordance with MIL-STD-462, Test Methods CS01, CS02, and CE06. Record the data on Figure 5(F). To be acceptable, the transmitter shall meet the requirements of 3.5.17.

4.6.20 Environmental. For the tests of 4.6.20.6, 4.6.20.7, and 4.6.20.8 the test item shall be enclosed in an enclosure that is a thermal simulation of the actual installation.

4.6.20.1 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 8, 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.

4.6.20.2 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.

4.6.20.3 Ejection shock. The transmitter shall be tested in accordance with Figure 9, one shock each axis, for a total of three shocks.

4.6.20.4 Handling shock. The transmitter shall be tested in accordance with FED-STD-101, Methods 5005, 5008, 5012, 5014, and 5019.

4.6.20.5 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 -50°C. Step 9 shall consist of the tests of 4.4.2.1.

4.6.20.6 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 -50°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 4.4.2.1 shall be performed.

4.6.20.7 Low temperature. The transmitter shall be tested in accordance with MIL-STD-810, Method 502.1, Procedure I. Storage temperature shall be -40°C and storage duration shall be 16 hours. Operating chamber temperature shall be -50°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 4.4.2.1.

4.6.20.8 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 chamber temperature shall be +60°C. Step 5 shall consist of the application of external power for a period of 2 hours, while maintaining the chamber temperature at +60°C. Step 7 shall consist of the tests of 4.4.2.1.

4.6.20.9 Sand and dust. The transmitter shall be tested in accordance with MIL-STD-810, Method 510, Procedure 1.

4.6.20.10 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 4.4.2.1.

4.6.20.11 Salt fog. The transmitter shall be tested in accordance with MIL-STD-810, Method 509, Procedure 1.

4.6.21 Burn-in and screening. Each transmitter shall be subjected to a minimum of six cycles of burn-in and screening as shown in Figure 4.

4.6.21.1 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. The test item shall be enclosed in an enclosure that is a thermal simulation of the actual installation.

4.6.21.2 Vibration subcycle. The vibration power spectral density shall be as shown in Figure 6. 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.

4.6.21.3 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.

4.6.22 Visual examination. The transmitter shall be visually examined to verify that marking and workmanship meet the requirements of 3.9 and 3.10.

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

5. PACKAGING

5.1 Preservation and packaging. Preservation and packaging shall be Level C in accordance with FED-STD-102.

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 package, intermediate packages and shipping containers shall be marked in accordance with MIL-STD-129 (see 6.2.1).

5.4 Test data. A copy of the completed, signed, dated, and serial number referenced data sheet (see Figure 5) prepared in accordance with 4.3.3.2 shall be placed with each transmitter in the shipping container.

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.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Transmitter configuration (see Figures 1 and 2, and 3.4).

c. Maximum input current consumption if other than as specified in 3.5.1.

d. Operating frequency (see 3.5.6).

e. Frequency deviation and input data rate (see 3.5.7 and 4.6.4).

f. TTL source voltage (see 3.5.8.4).

g. Output power if other than as specified in 3.5.11.

h. Power-supply induced frequency modulation limit (see 3.5.13).

i. Power-supply induced amplitude modulation limit (see 3.5.14).

j. Isolated power ground (see 3.5.15).

k. MTBF demonstration, if required (see 3.8 and 4.5.4).

l. Responsibility for inspections and inspection facilities, if other than 4.1.

m. Waiver of first article transmitter for electromagnetic radiation testing, if applicable (see 4.4.3).

n. IFM test procedures (see 4.6.12).

o. Marking if other than as specified in 5.3.

p. Mating connector for power and modulation input (see Figures 1 and 2.)

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9(n) (2) are invoked and

the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs.

Paragraph	Data requirement	Applicable DID
4.3.1	Calibration plan	DI-R-7064
4.3.3.1	Test procedures	DI-T-5204
4.3.3.2	Test data	DI-T-2072
4.3.3.3	Failure analysis and report	UDI-R-21136
4.4.3	Electromagnetic radiation	DI-T-2072

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

6.3 First article. When a first article is required, the item will be tested and should be a first article sample as specified in 4.4. The first article should consist of four units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test approval of the document's first article.

6.4 Definitions.

6.4.1 Incidental frequency modulation (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 5821-N161)

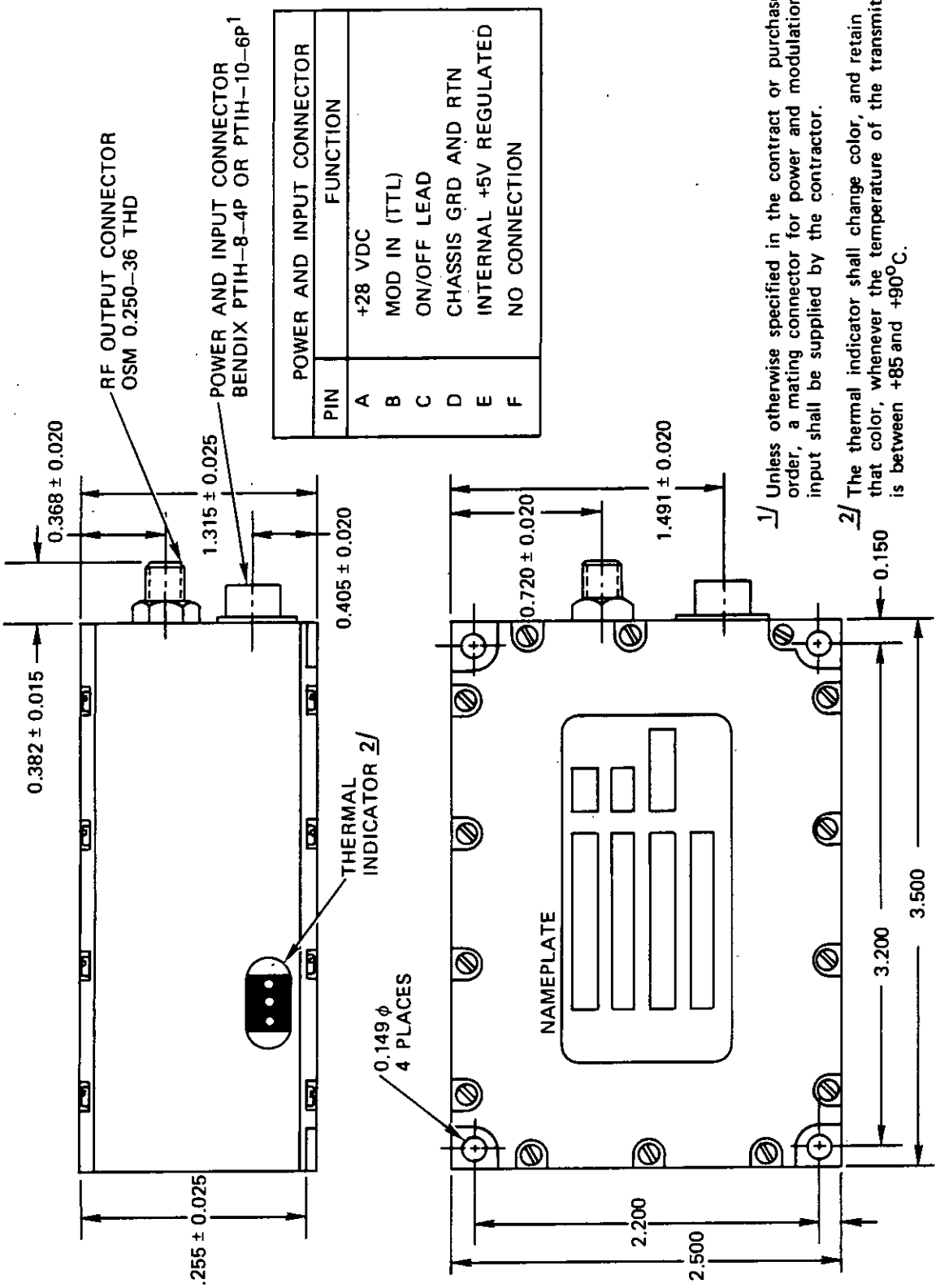


FIGURE 1. Transmitter exterior and interface (Type I).

POWER AND INPUT CONNECTOR	
PIN	FUNCTION
A	+28 VDC
B	MOD IN (TTL)
C	ON/OFF LEAD
D	CHASSIS GRD AND RTN
E	INTERNAL +5V REGULATED
F	NO CONNECTION

1/ Unless otherwise specified in the contract or purchase order, a mating connector for power and modulation input shall be supplied by the contractor.

2/ The thermal indicator shall change color, and retain that color, whenever the temperature of the transmitter is between +85 and +90°C.

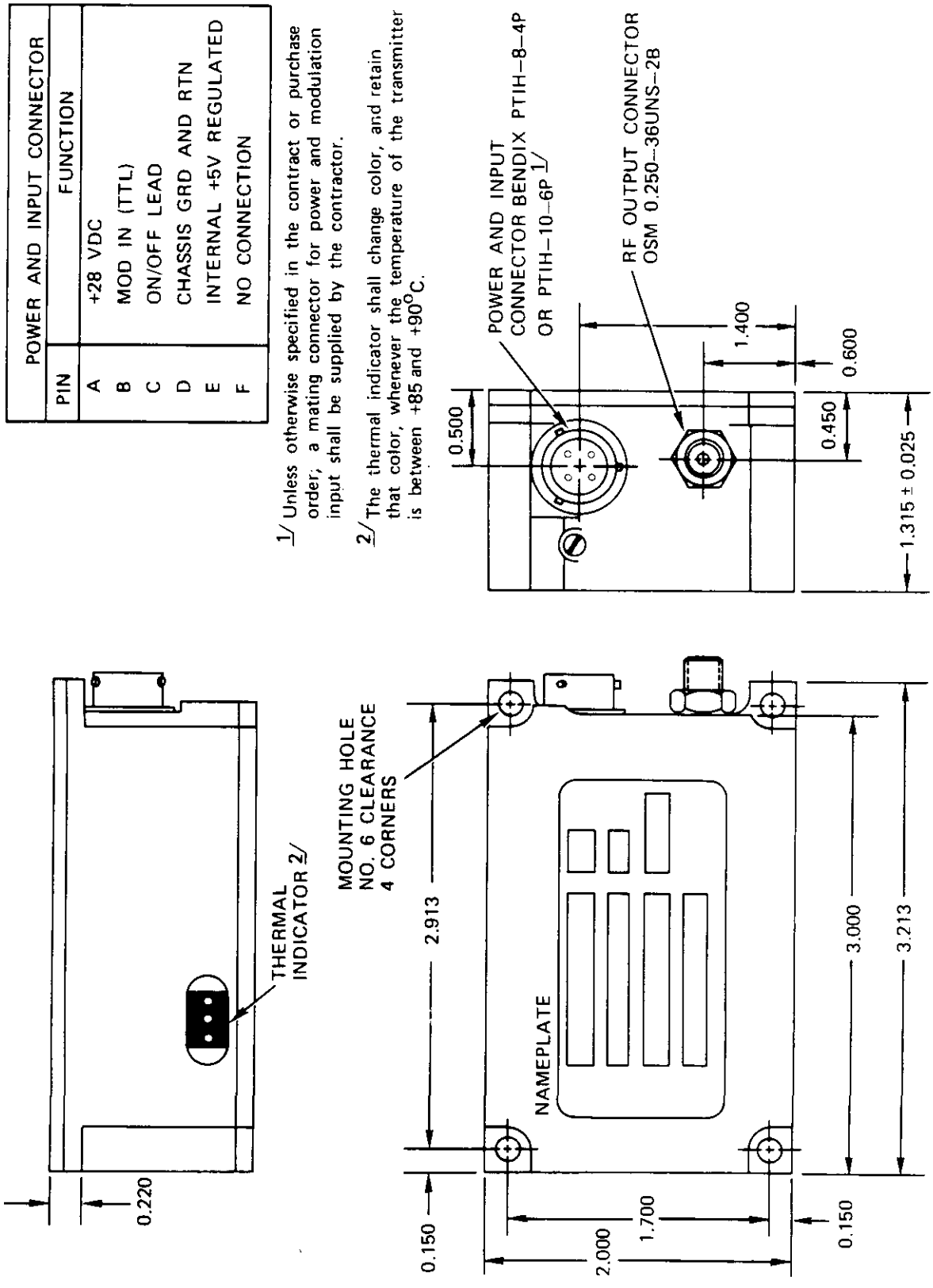
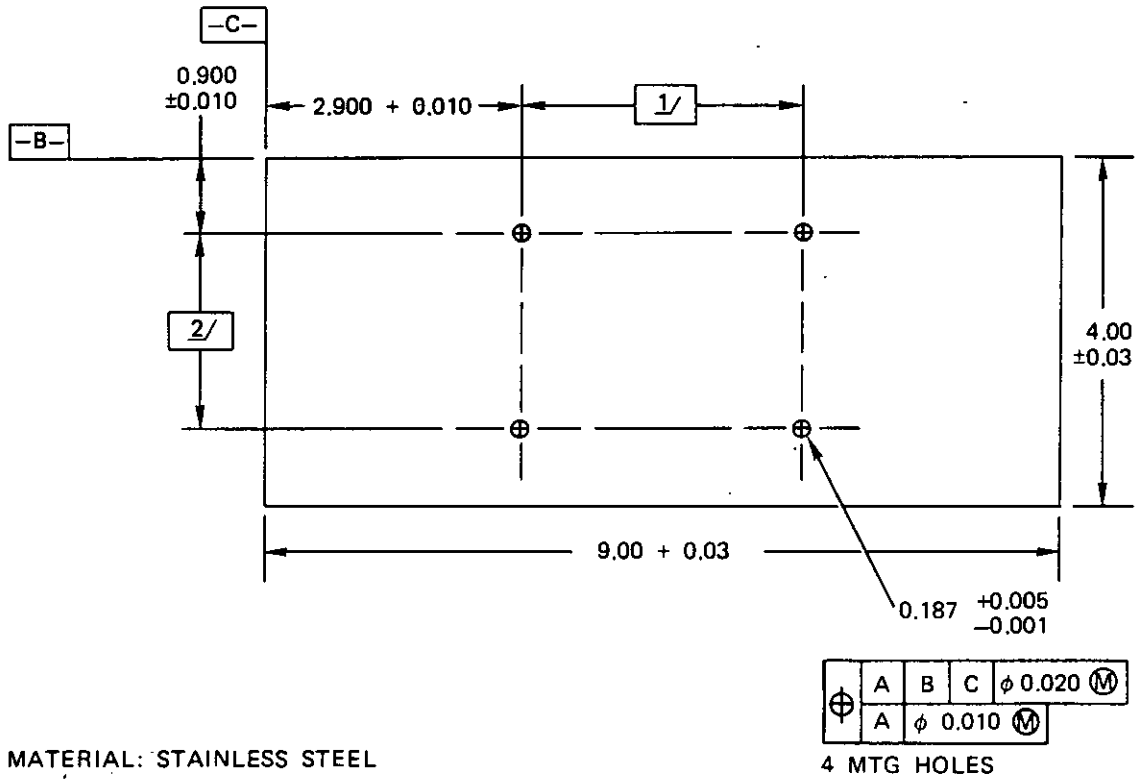


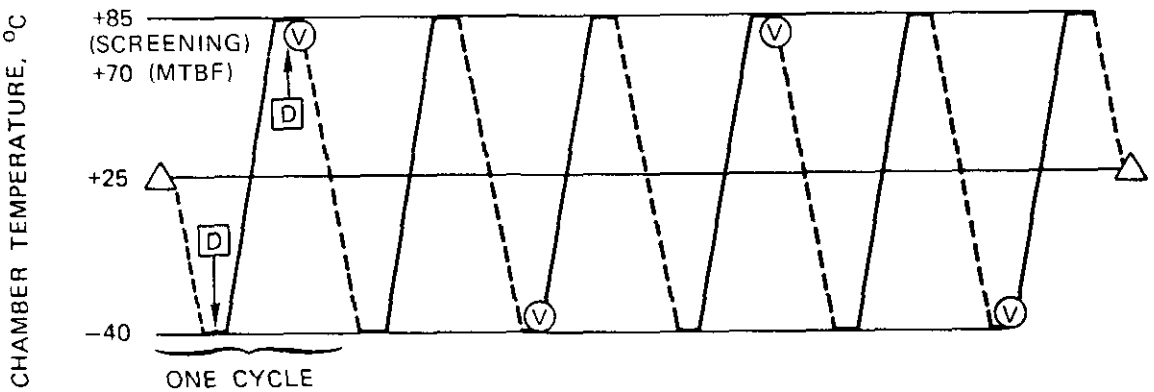
FIGURE 2. Transmitter exterior and interface (Type II).



1/ TYPE I – 3.500
TYPE II – 3.213

2/ TYPE I – 2.500
TYPE II – 2.000

FIGURE 3. Heat sink.



LEGEND

△ = COMPLETE FUNCTIONAL PERFORMANCE TEST
[D] = DWELL TIME AT TEMPERATURE EXTREMES
Ⓥ = VIBRATION EXPOSURE SUBCYCLE (SEE FIGURE 6)
– – – = EQUIPMENT NONOPERATING (COOL DOWN)
——— = EQUIPMENT OPERATING (HEATING SUBCYCLE)

NOTES:

1. A complete performance test shall be conducted prior to testing and at the completion of the sixth cycle for screening and each sixth cycle for MTBF testing.
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 two hours minimum.
5. Temperature chamber shall be adequate to provide a rate of temperature change of 2°C/minute minimum.
6. Note 2 does not apply to MTBF testing.

FIGURE 4. Burn-in and screening/MTBF profile.

QUALITY ASSURANCE DATA SHEET

FOR

TRANSMITTER

MFD. BY _____

CONTRACT NO. _____

LOT NO. _____

SERIAL NO. _____

(A)

FIGURE 5. Sample QA data sheet.

Center Frequency (see 4.6.2)

Frequency in Hz						
Time	Hz at 24 Vdc		Hz at 28 Vdc		Hz at 32 Vdc	
	Low	High	Low	High	Low	High
10 seconds						
1 minute						
2 minutes						
3 minutes						
4 minutes						
5 minutes						
6 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 4.6.3)					
Input current (A)	_____	_____	_____	_____	_____
Input power (W)	_____	_____	_____	_____	_____
Center frequency (kHz)	_____	_____	_____	_____	_____
Deviation (kHz)	_____	_____	_____	_____	_____
RF power output (W)	_____	_____	_____	_____	_____
Primary voltage polarity reversal (see 4.6.5)			Verified ( )	_____	
Overvoltage (see 4.6.6)					
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 4.6.14)

	Voltage		
	24 Vdc	28 Vdc	32 Vdc
Center frequency	_____	_____	_____
Input current	_____	_____	_____
Output power	_____	_____	_____
Signal input impedance (see 4.6.4)			
	Resistor out		Resistor in
Deviation	_____ kHz		_____ kHz
Sense (see 4.6.8)	Verified ( ) _____		

Verified _____

Date _____

(D)

FIGURE 5. Sample QA data sheet (continued).

Spectral characteristics (see 4.6.9)

Attach 2 1/4- by 3 1/4-inch Photograph of Spectrum Oscilloscope Presentation of Spectral Characteristics.

Spurious products < 25 dBm _____( )	
Deviation as a function of input voltage (see 4.6.10)	
Steady-state frequency (kHz)	Threshold voltage (Vdc)
Lower output _____	_____
Upper output _____	_____
Incidental modulation (see 4.6.12 and 4.6.13)	
Frequency modulation	_____
Amplitude modulation	_____
TTL source voltage (see 4.6.11) _____	_____
On-off lead (see 4.6.7)	Verified ( )_____
	Verified _____
	Date _____

(E)

FIGURE 5. Sample QA data sheet (continued).

Spurious emissions (see 4.6.19)

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

Verified _____
Date _____

(F)

FIGURE 5. Sample QA data sheet (continued).

Power-supply induced FM (see 4.6.15)

Power-supply input frequency	Deviation in Hz
440 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 FM (see 4.6.16)

Power-supply input frequency	Deviation in Hz
440 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).

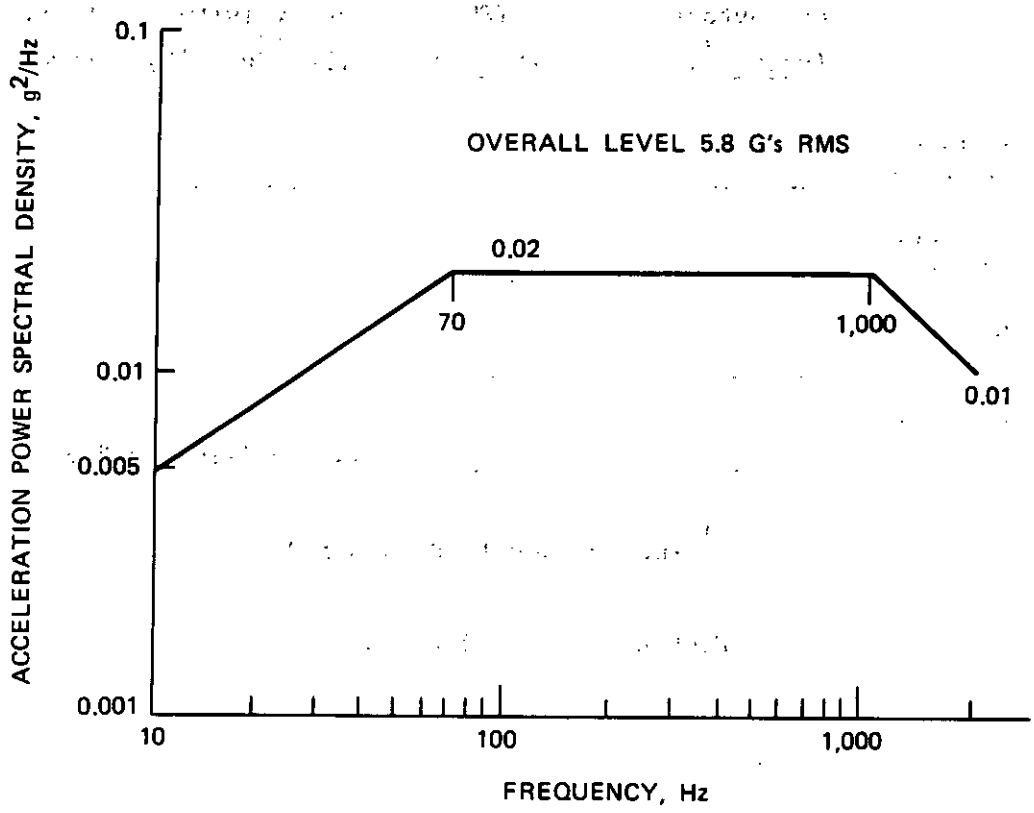


FIGURE 6. Vibration profile, screening.

Unit and Serial No. _____ Date _____

_____ Tested by _____

Incidental Frequency Modulation Test

	Receiver video output (volts ±1/)	IFM (kHz ±1/)	Demodulator sensitivity (kHz ±1/ / volt ±1/)	Limits (kHz ±1/)
Demodulator calibration	_____		_____	
Measurement system IFM	_____	_____		
Composite IFM	_____	_____		
Transmitter IFM	_____	_____	as specified in 3.5.9	

1/ rms as specified in 3.5.9

FIGURE 7. Test data sheet.

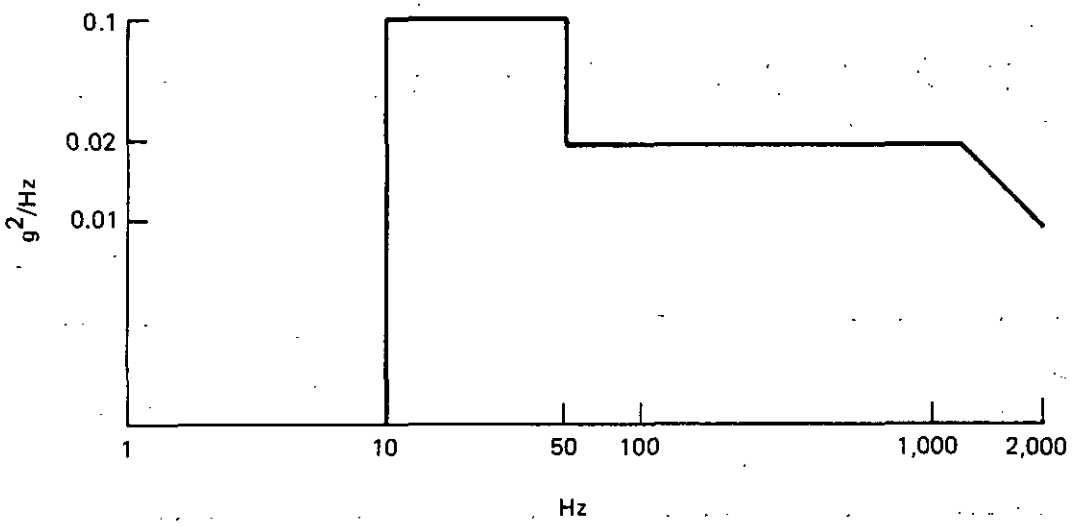


FIGURE 8. Random vibration.

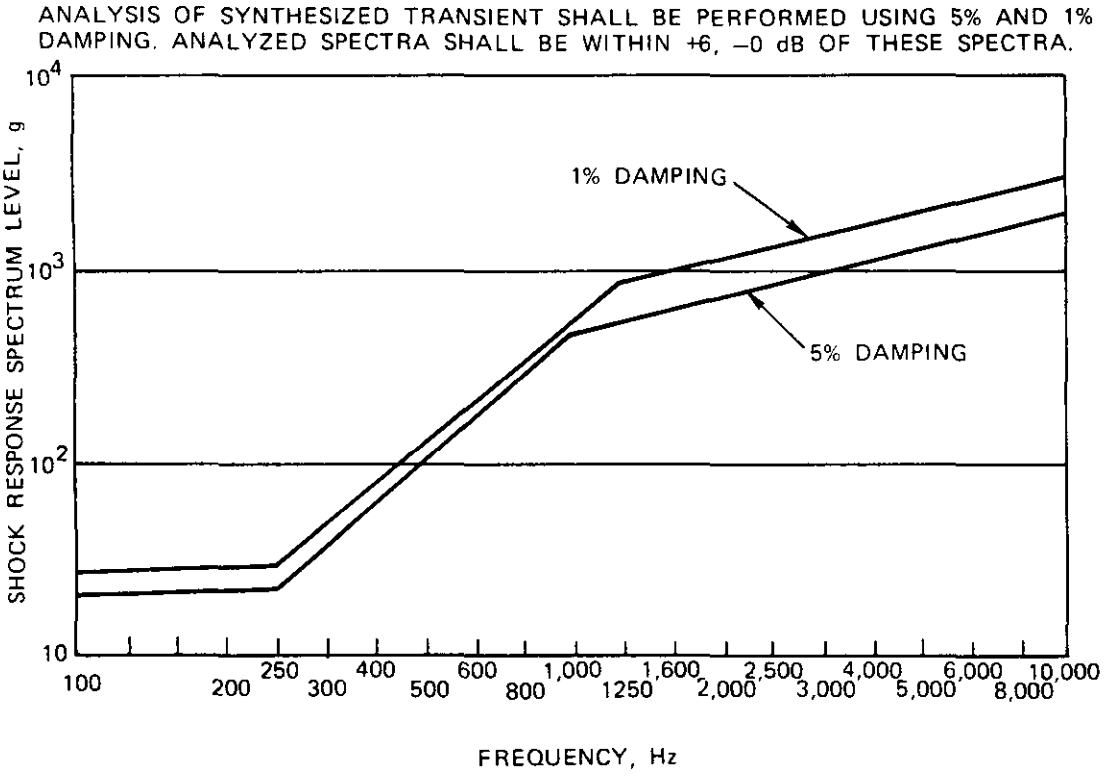


FIGURE 9. Maximum shock response spectra for launch ejection.

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