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MILITARY SPECIFICATION

RECEIVER-TRANSMITTER RADIO SET

AN/APX-100(V)

This specification is approved for use within the 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 establishes the performance, design, manufacture, and test requirements for the receiver-transmitter radio set, AN/APX-100(V).

1.2 Classification. A variety of AN/APX-100(V) types is provided to accomodate different platform mounting, control, and lighting requirements (See 3.5.1.6 and 3.5.2.7):

Unit	Type
Console	RT-1284()/APX-100(V), RT-1285()/APX-100(V), RT-1286()/APX-100(V), RT-1296()/APX-100(V), RT-1426()/APX-100(V)
Bay	RT-1157()APX-100(V), RT-1471()/APX-100(V)
Control	C-10009/APX-100(V), C-10532/APX-100(V), C-10533/APX-100(V), C-10534/APX-100(V),
Mount	MT-4811/APX-100(V)

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, Systems Engineering and Standardization Department (SESD) Code 93, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5821

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

Federal

QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-C-172	Cases, Bases, Mounting; and Mounts, Vibration
MIL-B-5087	Bonding, Electrical, and Lighting Protection, for Aerospace Systems
MIL-W-5088	Wiring; Aerospace Vehicle
MIL-E-5400	Electronic Equipment, Aerospace, Specification for
MIL-T-5422	Testing, Environmental,Airborne Electronic and Associated Equipment
MIL-C-6781	Control Panel; Aircraft Equipment, Rack or Console Mounted
MIL-P-7788	Panels, Information, Integrally Illuminated
MIL-M-7793	Meter, Time Totalizing
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of
MIL-T-18303	Test Procedures; Preproduction, Acceptance and Life for Aircraft Electronic Equipment, Format for
MIL-N-18307	Nomenclature and Identification Nameplates for Aeronautical Systems Including Joint Electronic Type Designated Systems and Associated Support

	Systems
MIL-S-19500	Semiconductor Devices, General Specification for
MIL-T-23103	Thermal Performance Evaluation Airborne Electronic Equipment and Systems; General Requirements for
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirement for
MIL-M-38510	Microcircuits, General Specification for
MIL-C-38999	Connectors, Electrical, Circular, Miniature, High Density, Quick-Disconnect, Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-P-55110	Printed Wiring Boards
MIL-L-85762	Lighting, Aircraft, Interior, AN/AVS-6, Aviator's Night Vision Imaging System (ANVIS) Compatible
WS-6536	Process Specification Procedures and Requirements for Preparation and Soldering of Electrical Connections

STANDARDS

Federal

FED-STD-595	Federal Standards Colors

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-210	Climatic Extremes for Military Equipment
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of

	Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470	Maintainability Program for Systems and Equipment
MIL-STD-471	Maintainability Demonstration
MIL-STD-701	List of Standard Semiconductor Devices
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-STD-965	Parts Control Program
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1553	Aircraft Internal Time Division Command/Response Multiplex Data Bus
MIL-STD-1562	List of Standard Microcircuits
MIL-STD-2074	Failure Classification for Reliability Testing
MIL-STD-2076	Unit Under Test Compatibility with Automatic Test Equipment, General Requirements for
MIL-STD-2077	Test Program Sets, General Requirements for
MIL-STD-2084	Maintainability of Avionics and Electronic Systems and Equipment, General Requirements for
MS-9140-3	Gasket-Type XIX Engine Accessory Drive

MS-14108-3	Fastner, Positive Self-Locking Case Mounting, Electronic Equipment
MS-17321	Meter, Time Totalizing, Miniature, Digital, 28 Vdc

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

Army Avionics Research and Development Activity

ICD8309	MIL-STD-1553 Interface Control Document for RT-1471()/APX-100(V) IFF Radar Receiver-Transmitter

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

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

3. REQUIREMENTS

3.1 First Article. When specified in the contract (see 6.2.1), a sample shall be subjected to first article inspection (see 4.3 and 6.4).

3.2 Parts. In the selection of parts, the prime considerations are fulfillment of performance requirements, logistics supportability, and reliability assurance in a cost effective design. The following shall govern in parts and material selection.

a. Subassemblies shall be designed and fabricated to be reparable. Maximum economic standardization of parts and materials shall be exercised. Parts selection shall be made in the following order of precedence:

(1) Military Standard Parts shall be selected in accordance with MIL-STD-454, Requirement 22.

(2) Nonstandard parts previously qualified for other programs.

(3) Nonstandard parts.

b. Nonstandard parts and nonestablished reliability military standard parts shall be screened to the requirements of the most similar military standard or standard nonestablished reliability part.

3.2.1 Nonstandard parts. Approval for the use of nonstandard parts shall be in accordance with MIL-E-5400 and MIL-STD-965, Procedure 1.

3.2.2 Microelectronic device selection. Microelectronic devices shall be selected and approved in accordance with MIL-STD-454, Requirement 64.

3.2.3 Semiconductor selection. Semiconductors shall conform to MIL-S-19500 with preference to MIL-STD-701 types. Only JAN or higher quality devices shall be used.

3.2.4 Modules. The electronic portions of the equipment shall be functionally modularized in accordance with MIL-STD-2084. Conformal coatings, encapsulants, embedments, or potting material used with modular assemblies (containing integrated circuits and discrete parts) shall be removable without damage to the assembly.

3.3 Design and construction. The equipment shall conform with all applicable requirements of MIL-E-5400, MIL-STD-454, MIL-STD-275, and MIL-P-55110 for design, construction and workmanship, and the manufacturing requirements of WS-6536 for electrical soldering workmanship.

3.3.1 Total weight. Weight of the equipment, excluding cables, shall be not greater than the following limits:

Unit	Type	Weight(lb)
a. Console-mounted	RT-()/APX-100(V)	8.4
b. Rack-mounted	RT-1157()/APX-100(V)	10.0
	RT-1471()/APX-100(V)	10.0
c. Control	C-()/APX-100(V)	1.7
d. Mount	MT-4811/APX-100(V)	1.0

3.3.2 Reliability. Unless otherwise specified in the contract or purchase order, the contractor shall conduct a reliability program using MIL-STD-785 (see 6.2.1). Task 104 of MIL-STD-785 shall be implemented to establish and maintain a closed-loop failure reporting system. This system shall identify failure trends and patterns at all levels of assembly prior to acceptance of the hardware and shall also identify failure trends related to field failures throughout the contract period. The reliability program shall include provisions for assuring the reliability of any portion of the equipment supplied for use as a spare or repair part.

3.3.2.1 Operational stability. The equipment shall operate with required performance for at least the specified (operating) time between failures without the necessity for readjustment of any controls or realignment.

3.3.2.2 Operating life. The equipment shall have a total operating life of 10,000 hours with no preventive or scheduled maintenance required.

3.3.2.3 Storage life. The equipment shall be designed to meet performance and operating life requirements of the specification after 5 years' storage under worldwide climatic conditions specified in MIL-STD-210 when packaged in accordance with MIL-E-17555.

3.3.2.4 Reliability in mean-time-between-failure(MTBF). The equipment including any Built-In-Test (BIT) provisions shall have a mean (operating) time between failures MTBF (Oo) of 1000 hours (as specified in MIL-STD-781) when tested and accepted in accordance with 4.3.12.

3.3.2.5 Time totalizing meter. Equipment-bay mounted RT units shall contain a time-totalizing meter in accordance with MIL-M-7793, except as reconfigured to fit physically. The meter shall be on the front face of the unit such that it may be read without removing any covers or equipment parts. The meter shall:

a. record "ON" time including standby;
b. have an operational range of 0 to 9,999 hours;
c. shall not be resettable.

3.3.2.6 Safety. The equipment safety requirements shall be in accordance with MIL-STD-454, Requirement 1, and MIL-STD-1472 .

3.3.3 Cables and connectors. The equipment shall provide for the use of cables and connectors in accordance with MIL-E-5400.

3.3.3.1 Interconnecting cabling. The equipment shall be capable of required operation using external wiring in accordance with the applicable requirements of MIL-W-5088. The external wiring shall be unshielded, except as necessary to meet interference control requirements and provided that assembly of cables and plugs can be accomplished easily. External cables and that portion of connectors attached to the cables shall not be supplied as part of the equipment.

3.3.3.2. Connectors. Connectors shall meet the environmental and maintenance tooling requirements of MIL-C-38999. The design of connectors shall be such that improper assembly, mating or installation is impossible. All external connectors, for new RT units or controls, shall be scoop-proof, have cadmium plating finish in accordance with QQ-P-416 (over a suitable underplating) to withstand a 500 hour salt spray test, and

provide 360 degrees circumferential grounding techniques for grounding prior to contact engagement. Non-scoop-proof connectors used on previously designed RT or controls shall not be changed.

3.3.4 Control panels. All control panels shall conform to the applicable requirements of MIL-C-6781 (Type 1) to the extent specified herein. If changed from a previously qualified design, the configuration of the panel shall be acceptable to the procuring activity prior to first article testing.

3.3.4.1 Watertightness. That portion of the panel in front of the control mounting surfaces shall be watertight when tested in accordance with MIL-STD-810. Water condensation may occur within the equipment; however, performance shall not be degraded due to water condensation. All water condensate shall be allowed to escape.

3.3.4.2 Control panel lighting. Console mounted units and remote control panels shall conform to MIL-P-7788, Class 1-R, 1-W, or 1-BW, or Air Force White(in accordance with MIL-L-27160), with either 5 or 28 volt (ac and dc) lamps installed. Separate input power pins shall be provided for the two lighting systems. Color of panel lighting shall be in accordance with MIL-C-25050. (See 3.5.1.6 and 3.5.2.7 for available color options.) ANVIS panels shall be illuminated in accordance with MIL-L-85762.

3.3.5 Interchangeability. The equipment shall meet the interchangeability requirements of MIL-E-5400.

3.3.6 Interference control. Generation of radio interference by the equipment, and vulnerability of the equipment to radio interference, shall be controlled within the combined severest, limits of MIL-STD-461, Notices 3 and 4, tests CE01, CE02, CE03, CE04, CE05, CE06, CS01, CS02, CS03, CS04, CS06, RS02, RS03, RE02, and RE02.1 as modified below, and when tested in accordance with 4.3.11.

a. CS04. Spurious signal rejection shall be as specified in 3.4.22.6.

b. RS03. Frequency range and maximum field levels shall be as follows:

Frequency Range	Equipment Bay RT(V/M)	Console RT(V/M)
10 KHz to 200 MHz	40	20
200 MHz to 450 MHz	65	20
450 MHz to 1000 MHz	40	20
1000 MHz to 12 GHz	100	20
12 GHz to 40 GHz	0.5	0.5

c. CEO6. The transmitter spurious output level (key-down) shall be at least 100 dB down relative to the fundamental for all extraneous and harmonic emissions less than 1035 MHz and greater than the third harmonic, and shall be 60 dB and 80 dB down for the second and third harmonics, respectively. These limits shall apply throughout the range of 0.15 MHz to 11.0 GHz, except at the fundamental, fo ± 5 percent, where these limits may be exceeded. Receiver spurious output at 1090 ± 4 MHz, with the equipment in Standby or Normal but not transmitting, shall be not greater than 15 dB microvolts/1 MHz and 36 dB microvolts/1 MHz at all other frequencies.

3.3.6.1 Connector pin assignments. Insofar as practical, connector pin assignments shall be such that the most susceptible circuits shall be on pins located at the connector center with less susceptible circuits graduated outward. Contacts carrying interference sources and power wiring shall be located on or near the connector periphery.

3.3.6.2 Grounding and bonding. All rack and console mounted units shall be electrically grounded in accordance with MIL-C-6781. Bonding to an external ground plane shall be in accordance with MIL-B-5087, Class R, requirements. Direct current (dc) bonding resistance to chassis, for console and control panel connectors and components, and resistance to the external ground plane through any mounting provisions, shall not exceed 2.5 milliohms.

3.3.7 Maintainability. When required by the contract, a Maintainability Program shall be conducted in accordance with MIL-STD-470 (Task 104). Construction and packaging, provisions for test points, and other maintainability parameters, shall be in accordance with MIL-STD-2084. Built-in- test performance shall be in accordance with 3.4.19.

3.3.7.1 Maintainability design. All electrical or electronic circuits and parts shall be packaged on replaceable and reparable, plug-in modules. Circuit breakers, indicators, and other items which may logically be bolted and soldered, or otherwise more rigidly electrically and mechanically fastened to the control housing or equipment chassis shall not be considered modules. SRAs (Shop Replaceable Assemblies) shall be QRAs (Quick Replaceable Assemblies) as specified in MIL-STD-2076. SRA arrangement shall be such that access to any SRA does not require removal of adjacent SRAs or parts other than access panels. The use of a special tool or tools for SRA removal is prohibited. All access panels and dust covers shall be retained by captive fasteners. Modules and connectors shall be keyed to prevent improper insertion. Fuses may be used in lieu of circuit breakers.

3.3.7.2 Adjustments. No adjustment or alignment shall be required at the organizational maintenance level. If required at a higher maintenance level (intermediate or depot), adjustment or

alignment shall not require the removal of the part to be adjusted or aligned, or of the hardware element to which it is attached.

3.3.7.3 ATE compatibility. The equipment shall be compatible with the Weapon System Test Station AN/USM-467. Access to maintenance test points shall be via quick-removable panels. Any buffering of these test points required for compatibility with the AN/USM-467 shall be accomplished in the Interconnecting Device of the Test Program Set.

3.3.7.4 Test program sets. Test Program Sets (when ordered by the contract or purchasing activity) shall be furnished in accordance with MIL-STD-2077(AS). When changes to the equipment are made which will affect the test fault diagnosis procedure, changes required to the existing Test Program Sets shall be addressed in the equipment change proposal. Insofar as possible, hardware changes shall be designed to not affect previously delivered Test Program Sets.

3.3.7.5 Human factors. MIL-STD-1472 and MIL-H-46855 shall be used as a guide for the equipment and all component parts therein.

3.3.7.6 Fault indicators. The equipment bay mounted RT units shall contain magnetic fault indicators that hold the fault indication until manually reset. These indicators shall be located on the front face of the unit for isolation of faults to the unit, external antenna lines, and crypto computer, KIT-1A.

3.3.8 Nomenclature, nameplates and identification marking. Nomenclature, serial number assignment, nameplate approval, and identification marking shall be in accordance with MIL-N-18307.

3.3.9 Standard conditions. The following conditions shall be used to establish normal performance characteristics under standard conditions during First Article laboratory bench tests:

a.	Temperature	Room ambient(15 to 35 degrees C)
b.	Altitude	Ground
c.	Vibration	None
d.	Humidity	Room ambient up to 90% relative humidity
e.	Input power	27.5 $\pm$ 0.5 Vdc
f.	Interrogation rate	500/sec unless otherwise specified

3.3.10 Service conditions. The equipment shall operate as prescribed under any of the environmental service conditions or combination of these conditions as specified in MIL-E-5400, for Class 2 equipment, as modified below.

3.3.10.1 Vibration. The equipment shall be capable of withstanding vibration encountered in both airplanes and helicopters. The equipment shall be designed for hard-mounting and shall operate as prescribed when subjected to the vibration requirements of 4.3.7.

3.3.10.2 Antenna mismatch. Anticipated service conditions of impedance mismatch shall include all values of load impedance that present a voltage-standing-wave ratio (VSWR) of up to 3.1:1 of any phase relationship at the antenna terminals of the RT unit.

3.3.10.3 Transmitter duty cycle. The equipment shall be capable of continuous operation at 1.0 percent duty cycle.

3.3.11 Warmup time. The time required for the equipment to warmup when switched from OFF to STANDBY shall be not greater than 30 seconds under standard, or 2 minutes under extreme service conditions. Full operation shall be provided immediately upon switching to NORMAL from STANDBY after the warmup period.

3.3.12 Operating power. The equipment shall be designed to operate from a MIL-STD-704, 28 Vdc power source, with voltage limits as specified therein. Input power (excluding switched power for external loads, and panel lighting) shall be not greater than 32 W under standard conditions (see 3.3.9), or 50 W under any worse case combination of service conditions and transmitter duty cycle. In STANDBY, input power shall not exceed 26 W with normal line voltage applied.

3.3.12.1 Power for external loads. The equipment shall interconnect MIL-STD-704, 115 Vac, single-phase, and 28 Vdc primary power to an external computer, KIT-1A. The switched ac and dc outputs shall be rated for 1.0 and 2.0 A, respectively. These outputs shall be interconnected to the computer when the MASTER control switch is placed in any position except OFF. In addition, the equipment shall be capable of sourcing up to 1.0 A, from the 28 Vdc input, to operate an external caution indicator.

3.3.12.2 Panel lighting power. The equipment connector shall provide separate 28 Vdc and 5 Vac input pins for panel lighting with a common return lead. Maximum current drain shall be not greater than 0.5 A at 28 Vdc or 2.0 A at 5 Vac.

3.3.12.3 Fusing. The equipment shall be fused (5 A) on the primary +28 V line. This fuse shall be easily removable and shall be located on the front panel of equipment-bay mounted units, and the rear panel of console-mounted units. Switched primary power shall not be fused.

3.3.12.4 Reduced performance. The equipment need not maintain required performance when supplied voltages are not within applicable surge limits, overvoltages and undervoltages, and transients of MIL-STD-704. However, exposure to these

voltages and transients shall not damage the equipment, and operation shall be automatically restored to normal after these conditions subside. Receiver minimum sensitivity shall not be reduced more than 6 dB nor transmitter power output by more than 3 dB when the input voltage is 18 Vdc. All relays shall function down to 18 Vdc.

3.3.13 Cooling. The equipment shall not require an internal blower or forced external air for cooling, and shall provide full performance when subjected to the ambient temperatures specified herein. A thermal analysis in accordance with MIL-T-23103 shall be performed when required by the contract.

3.3.14 Interrogation characteristics. The equipment shall accept RF interrogation signals with characteristics in accordance with Tables I, II, and VI (see 3.4.10).

Table I. Interrogation modes

Mode	Interrogation characteristics
1	2 pulses spaced 3 ±0.1 microseconds
2	2 pulses spaced 5 ±0.2 microseconds
3/A	2 pulses spaced 8 ±0.2 microseconds
Test	2 pulses spaced 6.5 ±0.2 microseconds
4	4 sync pulses and an optional P5 (ISLS) pulse spaced in multiples of 2 microseconds from P1, followed by up to 32 additional pulses spaced in multiples of 1 microsecond. A 1 microsecond spacing occurs only when P5 is followed within 1 microsecond by an AII pulse. All others are spaced at least 2 microseconds, leading edge to leading edge. Pulse position for all pulses is ±0.1 microseconds relative to P1 except P5 which is ± 0.15 microseconds.
C	2 pulses spaced 21.0 ±0.2 microseconds
	(Frequency in all modes is 1030 ±0.5 MHz)

Table II. Interrogation pulse characteristics

Mode	Value	
1,2,3/A, C and Test	Amplitude Variation	P3 = P1 ±1.0 dB
	Pulse Width	0.8 ±0.1 microsecond
	Rise Time	0.05 to 0.1 microsecond
	Decay Time	0.05 to 0.2 microsecond
4	Amplitude Variation	1 dB Max.
	Pulse Width	0.5 ±0.1 microsecond
	Rise Time	0.05 to 0.1 microsecond
	Decay Time	0.05 to 0.2 microsecond

3.3.15 Input protection. The equipment shall not be damaged by external signals of any frequency and type of modulation, up to 10 V p (0.1 percent duty cycle) or average CW power of +20 dBm applied directly to either antenna terminal.

3.4 Performance. Unless otherwise specified herein, values set forth herein to establish specified performance shall apply to performance under both standard and extreme service and input power conditions. When reduced performance under extreme conditions is acceptable, tolerances or values which set forth acceptable variations from performance under standard conditions, will be specified. The equipment shall be capable of meeting requirements stated herein without subsequent processing after completion of the tests of Section 4.

3.4.1 Operation. The equipment shall receive interrogations on either of two receiver channels; shall decode these interrogations and, in response, shall transmit appropriate pulse replies from that channel which received the interrogations. When an interrogation is simultaneously present in each channel, the equipment shall determine which channel received the strongest signal and shall transmit the reply from that channel.

3.4.2 Interference. The equipment shall operate in the presence of the interfering signal types specified in 3.4.2.1 , under the conditions of 3.4.2.2, with performance as specified in 3.4.2.3.

3.4.2.1 Anti-Jamming interfering signal characteristics.

a. CW Signals: At receiver center frequency and within ± 6 MHz of receiver center frequency.

b. AMCW: A CW signal which is amplitude-modulated by 1.02 kHz ± 10 percent tone at 30 percent modulation.

c. PNMCW: CW-modulated by 0 to 5 MHz noise to produce a 50 percent duty cycle pulse-noise-modulated signal.

d. Random NMCW: CW-modulated with 0 to 5 MHz noise to produce a 30 percent noise-modulated signal.

e. Pulse Jamming: Pulse jamming rates up to 20,000 pps with pulse width of 0.5 microsecond, regularly or randomly spaced.

3.4.2.2 Conditions for anti-jamming interfering signals.

a. All modes shall be enabled and monitored for replies. The sidelobe suppression pulse (P2 or P5, as applicable) shall be present at a level where not more than 1 percent sidelobe suppressions occur in the absence of interference.

b. A 10 dB signal-to-jamming (S/J) signal shall be applied to both channels simultaneously, but 6 dB weaker in one channel. The interfering signal shall be swept through the receiver bandpass with measurements taken at the point maximum reply countdown occurs.

c. Jamming tests shall be performed with jamming and signals in one channel only.

d. Jamming tests shall be performed with signal in one channel only and CW interference, at a +30 dB higher level, in the other channel.

e. Jamming tests shall be performed using positive J/S ratios.

3.4.2.3 Jamming performance.

a. For signal levels from MTL +3 dB to MTL +6 dB, the reply rate shall be greater than 20 percent in the mode tested. For MTL +6 to MTL +50 dB, the following performance shall apply (except for positive J/S ratios, where the reply rate may degrade):

Interference Jamming Signals	S/J at 50% Reply
CW/AMCW	10 dB
PNMCW	10 dB
Random NMCW	10 dB
Pulse	10 dB

b. No countdown shall be caused by pulses unless pulse combinations are either: (a) recognized as normal or sidelobe interrogation; (b) coincident with a Mode 4 data bit "zero"; or (c) spaced closer than 0.2 microseconds to a valid mode 4 data bit "one" or 0.32 microseconds to a sync pulse.

c. There shall be no random replies in other modes.

d. A spurious pulse spaced within 0.2 microseconds of a valid pulse shall not cause the valid pulse to shift.

e. The challenge video and enable trigger output lines shall be monitored to verify that, for each enable trigger generated, a third and fourth sync pulse occurs on the challenge video line. Spacing between the enable trigger, the fourth sync pulse, and the remainder of the challenge video, shall comply with the requirements of 3.4.20.3 and 3.4.20.4, including pulse widths.

f. No CAUTION indication (see 3.4.19.14b. (2)) shall occur.

g. In the presence of an interfering signal comprised of PNMCW power of more than -90 dBm noise peak, equipment shall reply on that channel which has the highest signal-to-noise ratio, for signals from MTL to 50 dB above MTL. In the presence of an interfering signal comprised of NMCW power with modulation level exceeding 30 percent, the equipment shall reply on the channel with the highest signal-to-noise ratio. Receiver noise circuits shall not be activated by replies in any mode nor during the M4 suppression period (see 3.4.7). A Disparity pulse during the M4 suppression period shall allow these circuits to operate again until blanked by a subsequent M4 suppression. Threshold sensitization beyond that specified in 3.4.3 shall not be employed to meet performance requirements.

3.4.3 Echo rejection. The equipment shall contain echo rejection circuitry designed to permit normal operation in the presence of echoes of interrrogation signals in space, and to be compatible with the requirements of 3.4.10.

3.4.3.1 Mode 1, 2, 3/A, C and test desensitization. Upon receipt of any pulse more than 0.4 microseconds in duration, and up to 50 dB above MTL in either receiving channel, both receiving channels shall be desensitized to a level that is 6 $\pm$ 1 dB below the amplitude of the desensitized pulse, and shall remain at that level for a period of 2.0 to 4.0 microseconds after the trailing edge of the desensitizing pulse. Following this period, receiver sensitivity shall recover linearly at a rate not greater than 4.5 dB/microsecond. The total recovery time to within 3 dB of MTL shall not exceed 15 microseconds.

3.4.3.2 Mode 4 desensitization. Upon receipt of the first pulse of the sync pattern (where the pulses are more than 0.4 microseconds in duration and spaced by 2 microseconds) with signal strength up to 50 dB above MTL in either channel, the decoding threshold in both channels shall be desensitized to a level that is 6 $\pm$ 1 dB below the amplitude of the desensitization pulse. This level shall be maintained unchanged during receipt of the second, third, and fourth sync pulses. If either the second, third, or fourth sync pulse is not decoded, sensitivity shall recover as specified in 3.4.3.1. Upon a Mode 4 decode, the

threshold shall remain at the desensitized level for the 75- to 95-microsecond Mode 4 suppression period (see 3.4.7) or until terminated. A Disparity pulse (see 3.4.20.2), or the end of the Mode 4 suppression period, shall cause the threshold to recover to within 3 dB of MTL, within 2 microseconds after termination. During this desensitized period, any pulse of amplitude greater than the desensitized level shall not change this level. The desensitized characteristic shall droop 1.0 dB, nominally, but not greater than 2.0 dB.

3.4.4 Minimum triggering level (MTL). MTL is that level of signal required for 90 percent replies. The MTL of the equipment at the receiver antenna jack, when measured with nominal interrogation modes and at a frequency of 1030 ± 0.5 MHz under standard service conditions (see 3.3.9) shall not be less than -90 dBV (-77 dBm into 50 ohms) for all modes. The total variation of MTL between Modes 1, 2, 3/A, C and Test shall not be greater than 1.0 dB when measured as above. The total variation of MTL between Mode 4 and the other Modes shall not be greater than 2.0 dB when measured as above. Also, the MTL of the equipment in Modes 1, 2, 3/A, C and Test shall not change by greater than ± 1.0 dB, or by greater than ± 2.0 dB in Mode 4 when interrogation pulse width is varied over the tolerance specified in 3.3.14 for each mode. In a given mode, the difference in MTL between the two receiver channels shall not be greater than 1 dB. MTL shall be internally adjustable from at least -82 dBV (-69 dBm) to -90 dBV (-77 dBm).

3.4.4.1 Triggering level drift. The triggering level, when set at -90 dBV (-77 dBm) under standard service conditions, shall not vary by more than ± 3 dB over all combinations of service conditions. The difference in MTL between the two receiver channels shall not exceed 2 dB under these same conditions.

3.4.5 Random triggering rate. The equipment shall not transmit more than 1 pulse train per second, averaged over 20 seconds, under the following conditions:

a. Each receiver antenna receptacle is terminated in a 50-ohm resistive load.

b. No external signal is present.

c. Triggering level (sensitivity) control is set for an MTL of at least -90 dBV (-77 dBm) with Modes 3/A and C enabled.

3.4.6 Automatic overload control (AOC). The equipment shall employ rate limiters to limit the number of replies in each channel to a preset rate, and cross-channel limiters that allow the total reply rate to exceed the single-channel rates by a fixed percentage. These limiters shall operate by means of threshold reduction to limit the number of replies.

3.4.6.1 Single channel AOC. Each channel shall contain two limiters: one for limiting number of replies to Mode 4 interrogations, and the other for limiting replies to the SIF modes. At 6 dB above MTL, these limiters shall be set to limit SIF replies to a 1080 Hz rate, and generation of Mode 4 Enable Triggers to a 1000 Hz rate with an applied signal interrogation rate which is 1.1 times the limit to be set. Increasing the applied signal rate to 1900 Hz, and signal level to 50 dB above MTL, shall not cause the value set at 6 dB to increase more than 11 percent. The limiters in each channel shall be adjustable from 500 to 2500 Hz minimum.

3.4.6.2 Cross-channel AOC. Cross-channel limiters shall be employed to permit a minimum number of SIF of Mode 4 replies to occur in one channel regardless of signal rate or strength in the other channel. When one channel is interrogated at a rate of 1900 Hz at a signal level 50 dB above MTL, an interrogation in the other channel at 3 dB above MTL shall not be counted down for interrogation rates up to 30 percent of the single-channel limit settings of 3.4.6.1. Mode 4 and SIF cross-channel limiters shall operate to limit total reply rate so that it does not exceed single-channel settings by more than 30 percent as signal level is increased to 50 dB above MTL and at rates up to 1900 Hz.

3.4.6.3 Mode 4 threshold reduction control. Mode 4 threshold reduction signal amplitude shall be proportional to the spacing of the Disparity pulse from the fourth sync pulse: the less the spacing, the less the reduction of replies. Upon acceptance of the first pulse of the sync pattern, and in the absence of a Disparity pulse, the duty limiter control signal shall not affect processing of the remainder of that interrogation. If either the second, third, or fourth sync pulse were not decoded, or if a Disparity occurs during the 75- to 95-microsecond Mode 4 suppression period, the Mode 4 duty limiter control circuit shall return to normal operation within 1.0 microsecond.

3.4.6.4 Duty cycle limiter. A duty cycle limiter control shall be provided to protect the equipment from damage should the duty cycle be caused to exceed 1.0 percent. The limiter, when activated, shall not affect the decoding of Mode 4 and Self-Test interrogations.

3.4.6.5 Sidelobe suppression rate limiter. This control shall limit the rate of sidelobe decoding in Modes 1, 2, 3/A and C in each channel by gradual reduction of triggering level to both channels. At a sidelobe suppression rate up to 5000 Hz, there shall be no effect on triggering level. With an interrogation signal 50 dB above MTL, maximum sidelobe suppression rate shall not exceed 10,000 pps. The sidelobe suppression rate limiter shall be activated only when either Mode 1, Mode 2, Mode 3/A, or Mode C is enabled but not when Mode 4 only is enabled. If Mode 4 is enabled together with another mode, suppression of the decoder shall be as specified in 3.4.10.1.

3.4.6.6 Automatic overload control action. If the interrogation rate into one channel is suddenly increased from 50 percent to 150 percent of the threshold settings established by the controls specified in 3.4.6.1, the sensitivity shall be reduced by 20 dB for interrogations 20 dB above MTL within 0.15 ± 0.1 seconds. Upon decreasing the interrogation rate back to 50 percent of threshold setting, the system shall return to within 3 dB of normal sensitivity within 0.025 ± 0.01 seconds. However, sensitivity shall be controlled as described in 3.4.6.1 after the .05 to 0.25 second capture time. Trigger level reduction shall be gradual to prevent weaker interrogations from denying transponder service to stronger interrogations as a result of over-interrogation. When an interrogation condition is made up of two non-synchronous signals of the same mode and differing by more than 10 dB, each with a PRF equal to 75 percent of selected rate limit, the sensitivity reduction shall limit replies to the weaker interrogation without reducing the reply rate by more than 10 percent to the stronger interrogation.

3.4.7 Suppression during mode 4 interrogation. Decoding of Modes 1, 2, 3/A, C and Test shall be suppressed for 75 to 95 microseconds when the first four pulses of a Mode 4 interrogation are received. Once a Mode 4 Enable Trigger (see 3.4.20.3) has been generated, generation of additional Mode 4 triggers shall be suppressed for 280 to 300 microseconds after the fourth sync pulse. If a Disparity pulse or reply (see 3.4.20.1) is received during this suppression period, suppression of Mode 4 decoding shall be ended within 2 microseconds after receipt of the reply. The suppression circuit shall be capable of being reinitiated -- for the full 280 to 300 microsecond period -- within 2 microseconds of termination. The Disparity pulse shall not terminate suppression of Modes 1, 2, 3/A, C, Test and the ISLS decoder, nor allow decoding of -- or replies to -- any interrogation pulses received before the end of the suppression period. The first two pulses of a Mode 4 interrogation, if they fit the correct pattern, shall be processed as specified in 3.4.10.1 and 3.4.6.3.

3.4.7.1 Suppression during transmission of mode 4 replies. Decoding of Modes 1, 2, 3/A, 4, C and Test shall be suppressed during transmission of Mode 4 replies. The equipment shall be capable of decoding again within 5 microseconds after the last transmitted pulse of the Mode 4 reply for signals 3 to 50 dB above MTL (see 3.4.21.7).

3.4.7.2 Suppression during transmission of mode 1, 2, 3/A, C, and test replies. Decoding of Modes 1, 2, 3/A, 4, C and Test shall be suppressed during transmission of replies in Modes 1, 2, 3/A, C and Test. Suppression shall continue for not less than 75 to 85 microseconds after the second transmitted framing pulse of a Normal, IDENT or Emergency reply.

3.4.8 Suppression input. A suppression pulse or auxiliary trigger input, with characteristics as listed in Table III, IV and VIII (see 3.4.16), shall inhibit decoding of Modes 1, 2, 3/A, C, Test and 4. Decoding shall be suppressed for an interval starting not more than 1 microsecond after the input pulse has reached an amplitude of 15 V or 6 V (as applicable for AIMS or TEWS) and shall continue for 35 ± 10 microseconds or the duration of the input pulse, whichever is greater. During the suppression period, equipment shall be insensitive to an RF pulse, at any frequency, of 10 V p input (0.1 percent duty cycle per second) and with an average power of +20 dBm at either antenna terminal. It shall also be insensitive to proper RF interrogation on all modes, with signal levels up to 20 dBm during the suppression period. Table IV input is not required for console-mounted RT units.

Table III. Suppression input pulse characteristics (AIMS)

Characteristics	Value
Polarity	+
Amplitude	15 to 70 V p
Duration	1.0 to 250 microseconds
Input Impedance	2200 ohms ± 10%, shunted ≤ 50 pF
Rise Time (slope)	≥ 10 V/microsecond
Decay Time (slope)	≥ 10 V/microsecond
Noise	No suppression shall occur for any input ≤ 5.0 V p

Table IV. Suppression input pulse characteristics (TEWS)

Characteristics	Value
Polarity	+
Amplitude	6 to 15 V
Duration	1.5 to 250 microseconds
Input Impedance	680 ohms ±10%
Rise Time	≤ 0.5 microseconds
Fall Time	≤ 1.5 microseconds
Noise	No suppression shall occur for any input ≤ 1.0 V p

3.4.9 Suppression output. The equipment shall generate a suppression pulse, for suppressing other equipment, during the Mode 1, 2, 3/A, C and 4 output reply train, and for the reply pulses generated by auxiliary trigger input (see 3.4.16). The suppression pulse shall have the characteristics listed in Table V.

Table V. Suppression output pulse characteristics

Characteristics	Value
Amplitude	18 to 30 V
Polarity	+
Synchronization	≥ 18 V by the time the first RF output pulse reaches its 10 % level.
Duration	≥ 18 V until the last RF pulse decays to its 10% level. 5 V or less, 5 microseconds after the 10 % level.
Rise Time	≥ 20 V/ microsecond
Decay Time	≥ 10 V /microsecond
Load Impedance	2200 ohms or 300 ohms, shunted by ≤ 1850 pF.
Spurious Output	≤ ± 1V

3.4.10 ISLS control pulse characteristics. ISLS control pulse characteristics are listed in Table VI.

Table VI. ISLS control pulse characteristics

Characteristics	Value
Pulsewidth	0.8 ±0.1 microsecond, Modes 1, 2, 3/A, and C; 0.5 ±0.1 microsecond, Mode 4
Pulse Position	2 ±0.15 microsecond after P1 of a Mode 1, 2, 3/A, or C interrogation. 8.0 ±0.15 microsecond after P1 of a Mode 4 interrogation.
Rise Time	0.05 to 0.1 microsecond
Decay Time	0.05 to 0.2 microsecond
Frequency	1030 ± 0.2 MHz

3.4.10.1 Conditions for ISLS. The decoding of Modes 1, 2, 3/A, or C shall be suppressed (not less than 99 percent efficiency for interrogations 3 dB or more above MTL) when the received amplitude of the ISLS control pulse is equal to, or in excess of, the amplitude of the first interrogation pulse received and is spaced 2 ± 0.15 microseconds from it. Suppression of the decoder shall be for a period of 35 ± 10 microseconds and shall be capable of being reinitiated for the full duration within 2 microseconds after the end of the suppression period. If the first two pulses of the Mode 4 sync pattern initiate the ISLS suppression gate, the 4th pulse of the Mode 4 sync pattern shall terminate the gate and inhibit further gates for the Mode 4 suppression period.

3.4.10.2 ISLS conditions for nonsuppression. Suppression of the decoder shall not take place when received amplitude of the first interrogation pulse is 9 dB or more in excess of received ISLS control pulse amplitude, or when spacing of the first interrogation pulse and the ISLS pulse is more than 2.6 microseconds, or less than 1.3 microseconds.

3.4.10.3 ISLS gray region. If the level of the received interrogation pulse is greater than the level of the received ISLS pulse but less than 9 dB greater, suppression may or may not take place.

3.4.10.4 ISLS dynamic range. ISLS suppression and nonsuppression characteristics shall apply over a received signal amplitude range from 3 dB above MTL, to greater than 50 dB above that level.

3.4.11 Pulsewidth discrimination. The transponder shall be capable of performing pulsewidth discrimination as described below. In any mode and under any conditions of processing, the pulsewidth discriminator circuits shall be capable of processing as separate pulses any two pulses which are separated by at least 0.2 microseconds (trailing-edge-to-leading edge). Mode 4 Challenge Video shall not be subject to wide pulse discrimination.

3.4.11.1 Narrow pulsewidth discrimination. Single pulses or nominally spaced interrogation signals 10 to 50 dB above MTL with pulses of duration less than 0.6 microseconds in SIF and less than 0.2 microseconds in Mode 4 shall not cause the transponder to initiate more than 1.0 percent trigger, reply or suppression action.

3.4.11.2 Wide pulsewidth discrimination. Any single pulse of received amplitude 3 to 50 dB above MTL, and of duration greater than 1.5 microseconds, or pulse pairs (3.5 microseconds wide with 2.5 microseconds rise and fall times, spaced 12, 24 or 36 microseconds apart at 30 to 150 Hz rates) shall not cause the transponder to initiate any trigger, reply, or suppression action -- with the exception of pulses with amplitude variations approximating a normal or suppression pulse pattern.

3.4.12 Transponder delay. Transponder delay from P3 of a Mode 1, 2, 3/A, or C interrogation received at the antenna terminal, to the first reply pulse delivered to the antenna terminal, shall be between 2.5 and 3.5 microseconds. Variation in delay between Modes 1, 2, 3/A and C shall not exceed 0.2 microseconds (for nominally spaced interrogations). Transponder delay for Mode 4, measured from reply video input from the KIT computer, to rf output to the antenna terminals, shall be less than 3.0 microseconds but greater than 2.0 microseconds including the delay of 3.4.21.7 for all interrogation signal levels more

than 3 dB above MTL. Computer delay time is referenced from the leading edge of the fourth sync pulse of the Mode 4 Challenge Video.

3.4.13 Range jitter. On any one of the Modes 1, 2, 3/A, C or Test, the total range jitter of the reply pulse code group with respect to P3 shall not be greater than 0.1 microsecond for any input signal level from 3 dB to 50 dB above MTL in each receiver channel. In addition, the difference between the earliest signal reply time from any one antenna channel and the latest signal reply time from the other channel shall be no greater than 0.15 microseconds -- for signals in the same mode and within 3 dB of each other -- which enter the two channels simultaneously.

3.4.14 Reply characteristics. Transmitted replies measured at the antenna terminal shall have the characteristics listed in Table VII.

Table VII. Reply pulse characteristics

Characteristics	Value
Duration	0.45 ±0.1 microsecond
Rise Time	0.05 to 0.1 microsecond
Decay Time	0.05 to 0.2 microsecond
Amplitude Jitter	≤ 5%

3.4.14.1 Mode 1 replies. For each Mode 1 decode, a pulse train shall be transmitted which contains from none to a maximum of five information pulses bracketed by 2 framing pulses which are spaced 20.3 ± 0.05 microseconds. Information pulse spacing shall be in increments of 2.9 microseconds from the initial framing pulse with a maximum allowable deviation from this spacing of ± 0.05 microseconds. The position where a sixth pulse would appear (17.4 ± 0.05 microseconds from the initial framing pulse) will not be used. The use of the seventh information pulse position (10.15 ± 0.05 microseconds after the framing pulse) is covered in 3.4.18.5. The specified 5 information pulses provide a total of 32 different codes for operator selection at the equipment control panel.

3.4.14.2 Mode 2 replies. For each Mode 2 decode, a pulse train shall be transmitted which contains from none to a maximum of 13 information pulses bracketed by two framing pulses which are spaced 20.3 ± 0.05 microseconds apart. The information pulse spacing shall be in increments of 1.45 microseconds from the initial framing pulse with a maximum allowable deviation from this spacing of ± 0.05 microseconds. The use of the seventh information pulse position (10.15 ± 0.05 microseconds after the framing pulse) is covered in 3.4.18.5. The 4096 available codes shall be selectable at the equipment.

3.4.14.3 Mode 3/A replies. For each Mode 3/A decode, a pulse train shall be transmitted which contains from none to a maximum of 13 information pulses bracketed by 2 framing pulses which are spaced 20.3 ± 0.05 microseconds apart. Information pulse spacing shall be in increments of 1.45 microseconds from the initial framing pulse with a maximum allowable deviation from this spacing of ± 0.05 microseconds. The use of the seventh information pulse position (10.15 ± 0.05 microseconds from the framing pulse) is covered in 3.4.18.5. From the specified 12 information pulses, a total of 4096 different codes shall be selectable by the operator at the equipment.

3.4.14.4 Test mode replies. When the RAD switch at the equipment control panel is enabled, each Test Mode decode shall cause a pulse train to be generated as specified in 3.4.14.3. A ground output to the external Mode 4 computer (Test bit input) shall be provided in the RAD position.

3.4.14.5 Mode 4 replies. Mode 4 reply encoding is performed in an external computer.

3.4.14.6 Mode C replies. When the equipment is connected to an altitude encoder, each Mode C interrogation decoded shall cause a pulse train to be generated which contains from 0 to a maximum of 11 information pulses, bracketed by 2 framing pulses spaced 20.3 ± 0.05 microseconds. The information pulses shall be referenced from the first framing pulse in increments of 1.45 microseconds with a maximum allowable deviation from this spacing of ± 0.05 microseconds. The position where a seventh pulse (X pulse) would appear (10.15 ± 0.05 microseconds after the initial framing pulse) and where a ninth pulse would appear (13.05 ± 0.05 microseconds after the initial framing pulse) will not be used. Control leads shall be provided to accept digitized altitude information from an encoding altimeter. The framing pulses shall be generated to Mode C interrogations whether the encoding altimeter is present or not. Provisions shall be made at the equipment control panel for disabling the information pulses.

3.4.14.7 Emergency replies, modes 1, 2, 3/A, 4, and C. When the receiver-transmitter is switched to Emergency, all modes except test shall be enabled and the coder shall generate multiple pulse trains as follows:

a. Mode 1 emergency. For each Mode 1 decode, the code in use will appear in the first train, followed by 3 sets of framing pulses with these pulses appearing at 24.65 ± 0.1, 44.95 ± 0.15, 49.30 ± 0.20, 69.60 ± 0.25, 73.95 ± 0.30, 94.25 ± 0.35 microseconds.

b. Mode 2 emergency. For each Mode 2 decode, the code in use will appear in the first train, followed by 3 sets of framing pulses with the pulses spaced as for Mode 1 Emergency.

c. Mode 3/A emergency. For each Mode 3/A decode, and regardless of the code selected, code number 7700 shall appear in the first train, followed by 3 sets of framing pulses, with the pulsea spaced as for Mode 1 Emergency.

d. Emergency modes 4 and C. The Emergency function shall enable Modes 4 and C regardless of control settings, but shall not otherwise affect the reply code format of these modes.

3.4.14.8 Identification of position replies. Provision shall be made for IDENT operation. A time delay shall be provided so that when the IDENT control lead is grounded at the control panel (regardless of duration of grounding period), IDENT action will be initiated and will continue for a preset period between 15 and 30 seconds. The IDENT timing operation shall be capable of being reinstated at any time. When the receiver-transmitter is switched to IDENT, the coder shall generate code replies with the following characteristics:

a. Mode 1 IDENT. For each Mode 1 decode, the code in use shall appear twice. The second pulse train shall be spaced 24.65 ± 0.05 microseconds as measured between the leading edges of the initial framing pulses of the two trains.

b. Mode 2 IDENT. For each Mode 2 decode, the code in use shall appear followed by a single pulse (SPI pulse) spaced 24.65 ± 0.05 microseconds from the initial framing pulse.

c. Mode 3/A IDENT. For each Mode 3/A decode, the code in use shall appear followed by a single pulse (SPI pulse) spaced 24.65 ± 0.05 microseconds from the first framing pulse.

d. IDENT Replies in other modes. The IDENT function shall not affect operation of Mode C and Mode 4.

3.4.15 Mode C altitude reporting provisions. When a Mode C interrogation is decoded, the coder shall generate a pulse train as described in 3.4.14.6. The reply shall contain information pulses that are inputted from an external encoding altimeter.

3.4.15.1 Mode C altitude-code control characteristics. Input connections shall be provided on the receiver-transmitter to accept Mode C code information from devices using either electronic keying or a disc-brush encoder. Mode C control characteristics shall be as follows:

a. A turnoff (information bit not present) shall occur when an external resistance in excess of 100,000 ohms is applied to the control lead.

b. A turnon (information bit present) shall occur when an external resistance of 3,000 ohms or less to ground is applied to the control lead. (This requirement applies to a single transponder operating alone and not paralleled with other transponders or remote altitude indicators).

c. Steady-state current in any control lead shall be between 1.0 to 1.4 mA when connected to ground.

3.4.15.2 Noise filtering on mode C leads. Suitable filtering shall be provided within the receiver-transmitter to limit capacitance discharge current from an external encoder disc brush to 1.5 mA or less in addition to steady-state brush current. The use of inductive type filtering shall not be permitted.

3.4.15.3 Mode C lead source and transient voltages. The source of the energizing voltages for the coding circuit within the receiver-transmitter shall be such that the open-circuit voltage on the control leads will not exceed 12 V. Transient protection on this source voltage shall be provided so that, irrespective of transients which might appear on the input power leads to the receiver-transmitter, the peak inverse voltage on the control leads shall not exceed 12 V.

3.4.16 Auxiliary trigger operation. An input shall be available with an input impedance of 90 ohms ± 10 percent for accepting external triggers with characteristics as listed in Table VIII. For each trigger received, the equipment shall transmit a single reply pulse with characteristics specified in 3.4.14. Maximum delay between an input trigger and corresponding RF pulse shall be less than 2 microseconds. The reply pulse shall be transmitted from the selected antenna channel (see 3.4.21.13) or, in diversity operation, from the bottom channel only and shall comply with 3.4.6.4 when subjected to auxiliary trigger rates above limiting. An auxiliary trigger input shall not interrupt any decoding or transmission of replies in process.

Table VIII. Auxiliary trigger pulse characteristics

Characteristics	Value
Amplitude	15 to 30 V
Rise Time	≤ 0.1 microsecond
Decay Time	≤ 0.2 microsecond
Polarity	+
Pulse Spacing	≥ 1.0 microsecond
Duration	0.3 to 1.5 microsecond
Noise	No output for inputs ≤ 5 V

3.4.17 Standby operation. In the STANDBY position of the master control switch, the equipment shall operate as follows:

a. Replies in all modes shall not be radiated if present.

b. The NO-GO indicator, and the remote NO-GO output shall enable if replies are present. The advisory signal output shall be enabled whether interrogated or not. All other indicators and remotes shall be disabled.

c. When self-test is enabled, operation shall be as in b.

d. Full functional capability shall be restored immediately on switching to Normal.

e. Caution light output shall enable if the replies are Mode 4.

3.4.18 Code number assignments. Every configuration of Mode 1, 2, and 3/A information pulses shall be assigned a code number. The following numbers shall be used:

3.4.18.1 Mode 1 codes. Code numbers 00(00) through 73(00) shall designate the Mode 1 codes. The applicable 5 information pulses shall be divided into 2 groups (A and B) with A containing the first 3 pulses and B containing the last 2 pulses. The information pulses in group A shall be numbered in serial order (1, 2, and 4) and the two pulses in group B shall be numbered in order (1 and 2). The appropriate code number shall be obtained by adding the pulse numbers (1, 2, and 4) of the pulses present within each group and combining the sums in order (A,B) to form the serial code numbers. For example, code 03(00) consists of no pulses in group A, and pulses 1 and 2 of group B; code 51(00) consists of pulses 1 and 4 of group A, and pulse 1 of group B.

3.4.18.2 Mode 2 codes. Code numbers 0000 through 7777 shall designate the Mode 2 codes. The applicable 12 information pulses shall be divided into 4 groups of 3 pulses. The individual pulses of each group shall be spaced 2.9 microseconds apart and numbered in order (1, 2, and 4). The position of the first pulse of each group measured from the initial framing pulse, shall be as specified in Table IX.

Table IX. Mode 2 pulse positions

Group	Time From First Framing Pulse
A	2.9 microseconds
B	11.6 microseconds
C	1.45 microseconds
D	13.05 microseconds

The appropriate code number shall be determined by adding the sum (1,2, and 4) of the pulses present within each group . These sums shall then be combined in order (A, B, C, D) to form a 4-digit serial number for the particular code, For example, code 2435 will have information pulses at the 1, 3, 4, 9, 12 and 13 information pulse positions.

3.4.18.3 Mode 3/A codes. Code numbers 0000 through 7777 shall designate the Mode 3/A codes. The same system shall apply to Mode 3/A as that specified in 3.4.18.2.

3.4.18.4 Mode C codes. The hybrid reflected binary (Gray) code shall designate the Mode C codes. The X and D1 pulse positions shall not be used.

3.4.18.5 X-Pulse codes. A pulse spaced 10.15 ± 0.05 microseconds from the initial framing pulse shall be designated as the "X" pulse. This pulse position is normally unused. Provisions shall be made that, when a single external control lead is grounded, all replies in Modes 1, 2, and 3/A will include this pulse in addition to the normal framing and information pulses .

3.4.19 BIT performance. The equipment shall incorporate Built-In-Test (BIT) in accordance with MIL-STD-2084 to perform internal dual test functions as follows:

a. Self-test. Generate RF interrogations upon command, detect and evaluate the response to these interrogations and indicate system performance on a GO/NO-GO basis by means of two indicators on the equipment control panel. Status indicators shall also be provided at the control panel for isolation of faults to the antenna lines, Mode 4 computer, and altitude encoder. Flag type indicators shall be provided on equipment-bay-mounted RT units for location of faults to the receiver-transmitter, antenna lines, and Mode 4 computer.

b. Monitor. When not in self-test, automatically monitor replies to externally generated interrogations and indicate unsatisfactory performance on a NO-GO basis by means of the same lamp used for self-test NO-GO. Additional monitor functions shall include an advisory output for all modes when in standby; and , for mode 4, an aural warning tone, and CAUTION and REPLY light indicators.

3.4.19.1 BIT self-test. The BIT circuit shall provide self-generated rf interrogation pulses upon activation of momentary contact switches at the equipment control panel or from a remote point as described in 3.4.19.6. Receiver frequency and decoding drifts shall be assumed to contribute to shifts of the specified receiver sensitivity. The presence of a reply from the transmitter to BIT interrogation will suffice as a GO/NO-GO check of receiver tuning, sensitivity, and decoding. Transmitter frequency drift, peak-power output, VSWR, encoding, and antenna selection shall be measured independently. Failure to decode and

encode BIT interrogations during self-test shall cause a NO-GO and RT fault indication to occur. The period of evaluation for each mode shall not exceed 0.5 second, or 2.5 seconds total for all five modes.

3.4.19.2 Self-test evaluator. An evaluator shall be provided for Mode 1, 2, 3/A and C reply and Mode 4 Disparity pulse input rates during self-test. A GO shall occur when the correct code (see 3.4.19.9) reply rate for Mode 1, 2, 3/A or C is 80 percent or more of the internal BIT interrogation rate -- provided that other conditions specified herein for a GO are met simultaneously. A NO-GO with RT fault flag shall occur when the incorrect reply rate is 50 percent or more, or any of the other conditions for a NO-GO are met. In Mode 4, the Disparity input rate shall be similarly evaluated and combined with other Mode 4 evaluations as specified in 3.4.19.12 to produce a GO/NO-GO with either an RT fault or computer status indication.

3.4.19.3 Evaluation of replies during in-flight testing. When the self-test function is soliciting replies, BIT shall evaluate only those replies resulting from self-generated interrogations. Replies to external interrogations shall be possible and of higher priority, but shall not be included in the evaluation. Moreover, BIT interrogation decodes shall be independently evaluated and shall not disturb or cancel normal system suppression and limiting actions that may be in process. Specifically, the self-test decodes shall not disturb or destroy the system AOC level when in limiting conditions. When the system AOC limiter is active, BIT decodes shall be counted toward total system AOC limiting action and duty cycle limiting. AOC action and duty cycle limiting shall not cause the BIT interrogation level (3.4.19.4) signal to be rejected. The BIT interrogations shall be timed with respect to transponder suppressions in Modes 1, 2, 3/A, C, Test and 4 so that these suppressions do not result in BIT cancellations. The only valid cancellations or modification to the BIT signal level are those caused by coincident interrogations from external sources that degrade, to an unacceptable level, BIT signal at the RF point of injection.

3.4.19.4 BIT interrogation level. The interrogation level injected into the receiver shall be -69 dBm $\pm$ 3 dB.

3.4.19.5 BIT interrogation frequency. The interrogation frequency of the test signal shall be 1030 $\pm$ 0.5 MHz under all specified service conditions and shall be enabled only when the BIT self-test is enabled.

3.4.19.6 BIT interrogation modes. The BIT circuit shall provide rf signals simulating Modes 1, 2, 3/A, C and Mode 4 sync interrogation signals with signal characteristics as follows:

Mode	Interrogation Code
1	2 pulses spaced 3.0 ± 0.1 microseconds
2	2 pulses spaced 5.0 ± 0.1 microseconds
3/A	2 pulses spaced 8.0 ± 0.1 microseconds
4	4 pulses, each spaced 2.0 ± 0.1 microseconds apart
C	2 pulses spaced 21.0 ± 0.1 microseconds

3.4.19.7 BIT interrogation rate. The interrogation rate shall be 135 ± 2 Hz applied to each channel alternately when the equipment is operated in the Diversity mode. Selection of the top or bottom channel shall cause the selected channel to be interrogated at a 270 ± 4 Hz rate.

3.4.19.8 BIT reply frequency discrimination. The BIT circuit shall determine, by heterodyne down-conversion, that the reply frequency for all modes is within acceptable limits over the range of input peak power levels, pulse widths, rise and fall times, and whether the replies are NORM or EMER. The reply frequency variations required for GO, NO-GO and RT fault indications shall be as follows:

a. A variation that is 3.0 MHz or less from 1090 MHz shall make a GO indication possible.

b. A variation that is 4 MHz or more from 1090 MHz shall cause a NO-GO and RT fault indication.

3.4.19.9 BIT reply pulse spacing. The BIT circuit shall determine that the Mode 1, 2, 3/A and C framing and information pulses are within acceptable position limits. A disagreement between the code transmitted and the required Mode 1, 2, 3/A code settings shall cause a NO-GO and RT fault indication whether the replies are NORMAL, IDENT or EMERGENCY. In EMER, the BIT circuit shall evaluate the Mode 3/A emergency code (7700) and the bracket pulses regardless of the code selection at the control. A NO-GO shall occur when the number of incorrect replies is 50 percent or more of the BIT rate. Pulse spacings required for GO, NO-GO and RT fault indications shall be as follows:

a. A variation in pulse position that is less than ± 0.100 microsecond from nominal shall make a GO indication possible.

b. A variation in pulse position that is more than ± 0.250 microseconds from nominal shall cause a NO-GO and RT fault indication.

3.4.19.10 BIT reply peak pulse power. The transmitter Mode 1, 2, 3/A, 4, and C peak rf power level required for GO, NO-GO indications shall be as follows (relative to the weakest reply pulse):

a. 24.0 dBw or greater shall cause a GO indication.

b. 21.0 dBw or less shall cause a NO-GO and RT fault indication.

3.4.19.11 BIT antenna systems check. Means shall be provided to check the equipment antenna system performance including the transmission line. The limits specified in paragraphs a. and b. below apply for all rf phase angles through 360 degrees. An indication of the VSWR characteristics at the antenna ports shall be given as follows:

a. A continuously variable VSWR of up to 1.5:1 during self-test shall make a GO indication possible. A momentary high VSWR of up to 4:1 for up to 2 ms shall not cause a NO-GO. A NO-GO condition shall enable the NO-GO and the ANT fault indicators.

b. The VSWR threshold shall be individually adjustable for each channel from 1.5:1 to 3.5:1 for GO/NO-GO indications and shall be stable to within 20 percent under all specified service conditions. The VSWR adjustments shall be accessible.

c. VSWR measurements shall be valid for reflected signals received within 150 ns of the incident signal.

3.4.19.12 Mode 4 BIT evaluation. The equipment BIT circuitry shall evaluate mode 4 operation of the receiver-transmitter and external computer, KIT-1A. Mode 4 sync (P1,P2,P3,P4) test patterns shall be injected into the equipment receivers to check nominal receiver tuning, sensitivity, and decoder tolerances. BIT initiation shall not interrupt the processing of any external interrogations. If external interrogations are present, the Mode 4 BIT signals shall not be injected until the end of the Mode 4 suppression period. A Disparity sensing circuit shall be provided for checking the operation and status of the KIT-1A. The Disparity sensing circuit shall be insensitive to voltages of ± 0.5 V or less on the disparity line input. When BIT is activated, the equipment shall generate an Enable Trigger (see 3.4.20.3) output, and a third and fourth sync pulse, on the challenge video output line (3.4.20.4), which shall cause the GO, NO-GO, and KIT flag status indicators to operate as follows:

a. An Enable Trigger and Challenge Video (P3/P4) followed within 7 microseconds by a disparity pulse with the latter at a rate 80 percent or greater of the BIT rate shall enable the GO lamp.

Table X. Mode 4 control/indicator functions

Controls		Indicators				
Mode 4 Switch	Audio/Light Switch	Caution Light	M4 Input To Test/Mon No-Go	KIT Fault	Audio Tone	Reply Light
On	Audio	Oper	Oper	Dis	Oper	Oper
On	Light	Oper	Oper	Dis	Dis	Oper
On/Off	Out	Dis	Dis	Dis	Dis	Dis
Off	Audio/Light	Oper	Oper	Dis	Dis	Dis
Test	Audio	Oper	Oper	Oper	Oper	Oper
Test	Light	Oper	Oper	Oper	Dis	Oper
Test	Out	Oper	Oper	Oper	Dis	Dis

(1) NO-GO. A NO-GO shall result whenever any one or more of the following conditions exist:

(a) Mode 4 replies are present, and any one or more of the conditions specified for a GO (in 3.4.19.8 thru 10) is not met.

(b) The equipment has failed to reply to valid Mode 4 interrogations four or more times within an 0.033-second interval or to valid Mode 4 interrogations at a rate greater than 50 replies per second for 0.25 seconds. A failure shall be considered to have occurred when a Mode 4 sync pattern is recognized but not followed within 270 microseconds by either a Mode 4 reply trigger (3.4.20.1) or a Disparity pulse (3.4.20.2) input. An exception to the "failure to reply" indication shall apply when the failure to reply to a valid Mode 4 interrogation occurs at a constant rate of less than 10Hz. The enabling circuits used to determine the presence of a disparity or reply shall be capable of being reinitiated at any time for the full duration.

(c) A zeroized Mode 4 code or computer alarm input is present from an external computer.

(2) Caution light. The equipment shall provide an output (+28 V) for enabling an external CAUTION light when one or more of the conditions of 3.4.19.14b.(1) is met. For the equipment-bay-mounted RTs, an additional enable output (ground) shall be provided. The latter output shall be operative only when the KIT computer is installed.

(3) Reply light. An indicator shall be provided at the control panel for monitoring Mode 4 replies. This indicator shall be enabled only when four or more replies are transmitted within a 0.033-second interval, or when replies are transmitted at a rate of 50 or more per second for 0.25 seconds, as indicated by the presence of Mode 4 reply inputs followed within 0.5

microseconds by the transmission of RF reply pulses. The REPLY indicator enabling voltage shall not be generated if replies are transmitted at a constant rate of less than 10 Hz.

(4) Audio. An audio signal shall be available between the audio output leads whenever all of the following conditions are satisfied:

(a) Control lead designated Audio is grounded at the equipment control panel.

(b) Presence of a Mode 4 Enable Trigger, followed by a Disparity pulse at 85 to 270 microseconds after the Enable Trigger.

(c) Reply indicator is off.

(5) Audio signal characteristics. The audio return lead shall not be grounded in the receiver-transmitter. The audio signal shall consist of pulses having characteristics as listed in Table XI.

Table XI. Audio output signal characteristics

Characteristic	Value
Amplitude	0 to 3 V (adjustable) into 150 ohms resistive load. Accessible for adjustment.
Noise	60 dBm less than desired signal
Frequency	Same as Mode 4 interrogation rate up to 1.0 kHz. 0.5 kHz to equal, above 1.0 kHz.
Pulsewidth	500 microseconds minimum for rates <200/s.

3.4.19.15 Indicator operation. The GO/NO-GO indicators shall be designed for fail-safe operation. During self-test and monitor operation, drive voltage for NO-GO and Status indicators shall be initiated by decodes, with illumination prevented by a GO evaluation. When enabled during monitor, the NO-GO, CAUTION, or Mode 4 REPLY indicators shall reset automatically within 2 to 5 seconds unless renewed by the same or another enable input. During self-test, the GO/NO-GO and Status indicators shall light only for the length of the test -- provided each mode test control is held at least 0.5 seconds before release. The status indicators shall be latched to prevent enabling unless the NO-GO indicator is first enabled. The GO/NO-GO indicators shall not enable simultaneously. The GO/NO-GO, Mode 4 Reply, Caution, Status (or fault flag) indicators, including the remote GO/NO-GO drivers and standby advisory output, shall be operative down to 18 V. A Suppression input (see 3.4.8), during self-test or operation, shall not enable the NO-GO, STATUS, REPLY, or CAUTION indicators or the REMOTE NO-GO output if a GO condition otherwise

exists. Self-Test of the SIF modes with all modes enabled and the Disparity line opened shall not enable the CAUTION and NO-GO indicators.

3.4.19.16 Remote BIT interface. The equipment shall provide pins at the equipment connector to permit self-test of each mode (except Test) and display of the Test GO, Test NO-GO and Monitor NO-GO signals at a remote panel (not supplied hereunder). After the equipment warm-up time (see 3.3.11) has been observed in STANDBY, a ground input at the pin of the mode to be tested shall cause a self-test to occur -- provided that ground is applied for at least 0.5 seconds, and the equipment is in NORM or EMER, and the POWER RELAY and the mode under test are enabled. The Test GO or Test NO-GO signal shall last the length of the test. The Monitor NO-GO signal output shall last for 2 to 5 seconds with automatic reset. Both the Test NO-GO and Monitor NO-GO shall be on the same pin output with the Test GO on a separate pin. A Mode C self-test shall require the Mode 3/A enable function (see 3.5.1.5) to be enabled simultaneously. A Test NO-GO shall occur if the mode under test is not enabled when all other conditions required for a self-test are met. With the equipment in STANDBY, the equipment shall provide an advisory signal output to the connector. Remote self-test enable pins are not required for the RT-1471(). Data bus control shall activate self-test. All self-test conditions as stated shall apply.

Characteristics of the signals used for remote interfacing are as specified in Tables XII and XIII.

Table XII. Remote BIT interface signals (RT-1157 and console units)

Function	Operation
Mode Enable (4 leads: M1, M2, 3/A & C, and 4)	Enabled at unit controls or by grounding control lines between C-() and RT-1157. Ground when enabled: < 0.7 V @ 1.6 mA. Open when disabled: > 3.6 V and 20 k ohms. Mode 3/ A line also enables Mode C.
Test Enable (5 leads: M1, M2, M3/A, MC, and 4)	Enabled by grounding appropriate pin at unit connector during self-test. Enabled: <0.4 V @ 1 mA except 2.25 mA for M4. Disabled: >3.6 V @ 20 k ohms.
Mode C Code Enable (One lead)	Enabled at unit controls or by grounding control line between control and RT-1157. Enables altitude data input to units during Mode 3 self-test or normal operation. Same logic level as Mode Enable.

Table XII. Remote BIT interface signals (RT-1157 and console units)-continued

Power Relay (One lead)	Enabled at unit controls or by grounding control line between control and RT-1157. Must be enabled for self-test. Ground when enabled: < 2.0 V @ 53 mA. Open when disabled (equipment OFF): > 2.5 V and 20 k ohms.
NORM/STBY (One lead)	NORM enabled at unit controls or by grounding control line between control and RT-1157. Must be enabled for self-test. NORM: < 0.4 V @ 1.5 mA. STBY: >2.5 V and 20 k ohms.
NORM SELECT (One lead)	Applicable to console units only. Allows remote selection of NORMAL operation before performing self-test if RT is initially in STBY. Ground to enable: < 0.4 V @ 1.5 mA. Open when disabled: > 2.5 V and 20 k ohms.
TEST GO (One lead)	Satisfactory self-test. Enabled: < 0.7 V @ 100 mA. Disabled: > 18 V and 20 k ohms.
Test NO-GO or Monitor NO-GO (Common lead)	Unsatisfactory self-test or detection of malfunction in monitoring operation. Enabled automatically in STANDBY. Same logic levels as TEST GO.
STBY (One lead)	Used by platform to inhibit remote self-test when transponder is in STBY. Alternative use is as a control signal to a status indicator. Same logic levels as Test GO.

Table XIII. Remote BIT interface signals (RT-1471)

Function	Operation
Power Relay Enable (One lead)	Ground when enabled: < 2.0 V @ 53 mA. Open when disabled: > 2.5 V and 20 k ohms. Must be enabled for self-test.
Test GO	Satisfactory self test. Enabled: < 0.7 V @ 100 mA. Disabled: > 18 V and 20 k ohms.
Test Mon NO-GO	Unsatisfactory evaluation during self-test or detection of malfunction while monitoring normal system operation. Enabled automatically in STBY. Same logic levels as TEST GO.

3.4.19.17 Transient conditions. The BIT lamp circuits, including the advisory status output, shall be designed to prevent false enabling by externally and internally induced voltage transients. Brief power line interruptions of 5 seconds or less and MIL-STD-704 type transients on the equipment power line inputs shall not cause these indicators or outputs to enable. Internal transients resulting from equipment turnon or turnoff, BIT switch movement from TEST to ON or OFF, and possible power supply output loading caused by high interrogation rates when all modes are enabled (10 kHz or greater with equipment not initially in AOC limiting) shall not enable these indicators or outputs nor damage the transmitter.

3.4.20 Mode 4 performance. The equipment shall be capable of automatically switching primary input power (ac and dc) to an external computer upon application of power to the system at the equipment control panel. All Mode 4 video processing circuits within the equipment shall be fully operative in all positions of the Master control switch except OFF. Mode 4 self-test, monitor, and standby operation shall be as specified in 3.4.19. The ON position of the Mode 4 OUT/ON/TEST switch shall provide an enable signal (open) to the KIT computer to enable computer processing of Mode 4 interrogations and reply trigger generation. The OUT position shall apply a ground signal on the same lead as for ON to disable computer processing. Shorts or opens on any of the following interface signal lines shall not damage the equipment.

3.4.20.1 Mode 4 reply input. A video input shall be provided for application of Mode 4 reply triggers with characteristics as listed in Table XIV. For each input trigger, an output pulse shall be generated with characteristics as described in 3.4.14.

Table XIV. Mode 4 reply trigger pulse characteristics

Characteristic	Value
Pulsewidth	0.3 to 0.7 microsecond
Rise time	$\leq$ 0.1 microsecond
Decay time	$\leq$ 0.25 microsecond
Polarity	+
Amplitude	3 to 5.0 V across impedance 90 ohms $\pm$ 10%
Pulse spacing	Three pulses spaced 1.75 $\pm$ 0.1 microsecond between adjacent pulses. Total spacing between first and third pulses does not differ from 3.5 microseconds (nominal) by more than 0.1 microsecond.
Undesired signal plus quiescent dc voltage	< $\pm$ 0.5 V
Negative overshoot	< 1.5 V

3.4.20.2 Disparity input. A video input shall be provided for application of Mode 4 Disparity pulses to the equipment. Characteristics of the Disparity pulse, when measured across 90 ohms ± 10 percent, shall be as shown in Table XV.

Table XV. Disparity pulse characteristics

Characteristic	Value
Amplitude	3 to 5.0 V
Polarity	+
Duration	0.3 to 1.0 microsecond
Rise Time	≤ 0.15 microsecond
Fall Time	≤ 0.5 microsecond
Undesired signals plus quiescent dc voltage	< ± 0.5 V
Negative overshoot	< 1.5 V
Timing from P4	≤ 200 microseconds

3.4.20.3 Mode 4 enable trigger. The equipment shall generate a Mode 4 Enable Trigger for an external computer upon recognition of the Mode 4 sync pulses specified in 3.3.14. For each trigger generated, the fourth sync pulse shall be present at the Challenge Video output with not less than the minimum pulse width specified in 3.4.20.4. The Mode 4 trigger pulse shall have characteristics as listed in Table XVI.

Table XVI. Mode 4 enable trigger pulse characteristics

Characteristic	Value
Amplitude	1.5 to 5.0 V into a 1.5 uF capacitor whose other plate is returned to ground through a 90 ohm ± 10 % resistor. These amplitudes apply under any pulse density or duty cycle condition and are referenced to the Enable Trigger baseline level.
Rise Time	≤ 0.1 microsecond
Decay Time	≤ 1.0 microsecond
Duration	0.5 to 3.0 microseconds
Polarity	+
Delay	+0.2 to 0.6 microseconds after the leading edge of P4 under all operating conditions.
Undesired signals plus quiescent dc voltage	< ± 0.5 V

3.4.20.4 Mode 4 challenge video. The equipment shall route interrogation signals to an external computer. The output pulses shall have the same characteristics as those specified in 3.3.14 for Mode 4, plus those in Table XVII. If necessary, this video shall be regenerated or stretched in width to meet the 0.45 microsecond minimum pulse width shown below for pulses 0.4 microseconds in width at the equipment RF input. Pulses 0.6 microseconds or wider at the RF input need not be stretched or regenerated in width. Interference (see 3.4.2) shall not cause additional stretching of these pulses. The output shall route only the third and fourth sync pulses and Challenge Video to the computer. Spurious video in the interval between the trailing edges of P1, P2, and P3, to 320 ns in advance of P2, P3, P4, shall not be outputted to the computer nor affect the generation of Mode 4 Enable Triggers. This output shall be renewable within 2 microseconds after receipt of a Disparity or Mode 4 Reply pulse.

Table XVII. Challenge video characteristics

Characteristic	Value
Duration (pulses other than P4)	0.45 to 0.65 microsecond for RF pulses 0.40 to 0.60 microsecond; and nominally equal, for RF pulses wider than 0.6 microsecond.
Duration P4	0.45 to 1.25 microseconds for nominal RF pulses. Leading edge of P4 pulse shall occur so that it is in time synchronization with the rest of the Challenge Video pulses (See 3.3.14 Table I). Width of the P4 challenge video shall be great enough to ensure that P4 is present at the leading edge of the Enable Trigger pulse (see 3.4.20.3).
Amplitude	1.5 to 5.0 V p-p into a 22 uF capacitor whose other plate is returned to ground through a 90 ohm ± 10% resistor. These amplitudes apply under any pulse density or duty cycle conditions, and are referenced to the Challenge Video baseline level.
Polarity	+
Quiescent dc Voltage	< ± 0.5 V.
Rise Time	≤ 0.1 microsecond
Decay Time	≤ 0.14 microsecond
Pulse Train Droop	≤ 16%

3.4.21 Diversity performance. The equipment shall include provisions for signal strength comparison between received signals of two receivers. This circuitry shall compare signals of each interrogation and select the antenna associated with the stronger signal channel for the reply.

3.4.21.1 Antenna selection. The signal comparison circuit shall be capable of selecting one channel or the other for the reply, provided that the difference in time between received signals at the two receiver channel inputs is 0.02 microseconds or less.

3.4.21.2 Bottom antenna reply. A bottom channel reply shall result not less than 90 percent of the time when:

a. No decodeable signal is present on the top channel.

b. The received signal at the bottom channel is 3.0 dB or more above top channel received signal. This shall apply for received signals at the bottom channel between 3 and 50 dB above MTL.

3.4.21.3 Top antenna reply. A top channel reply shall result not less than 90 percent of the time when:

a. No decodeable signal is present on the bottom channel.

b. The received signal at the top channel is 3.0 dB or more above the received signal on the bottom channel. This shall apply for received signals at the top channel between 3 and 50 dB above MTL.

3.4.21.4 Diversity gray region. The reply shall be directed to either antenna when decodeable signals within 3.0 dB of each other are received in the two receiver channels from 3 dB above MTL to 50 dB above MTL, provided that the time difference between them is 0.2 microseconds or less.

3.4.21.5 SIF reply channel decision. The reply channel decision shall be made during the duration of the last received pulse which results in an SIF decode. The decision shall be stored for the duration of the resulting reply. The reply channel decision shall be capable of being renewed or changed within 5.0 microseconds after the last transmitted pulse of a normal or emergency reply.

3.4.21.6 Mode 4 reply channel decision. The Mode 4 reply channel decision shall be stored within the duration of the last received pulse resulting in a Mode 4 sync pattern decode. Storage (separate from that provided for SIF). shall be provided to store the Mode 4 decision for the duration of the resulting Mode 4 reply or until receipt of a Mode 4 Disparity pulse within 74 microseconds after a Mode 4 Enable Trigger. Should no Reply or Disparity pulse occur in the Mode 4 reply interval, the Mode 4

storage circuit shall not prevent recognition and processing of subsequent mode 4 interrogations. The reply channel decision shall be capable of being reinitiated within 5.0 microseconds after the last transmitted pulse of the Mode 4 Reply and within 2.0 microseconds after receipt of the Mode 4 Disparity pulse. The top channel video shall be processed and the reply directed from the top channel whenever the decision on any one of the four sync pulses favors the top channel. Video shall be processed from the bottom channel and replies shall be radiated from the bottom antenna only if the decision favors the bottom channel on all four sync pulses.

3.4.21.7 SIF and mode 4 reply interlace. In the interval between the end of an SIF suppression due to a Mode 4 decode, and the beginning of the period during which Mode 4 replies are possible, the equipment shall be capable of recognizing SIF interrogations and generating SIF replies on the antenna receiving the stronger signal. Upon receipt of the Mode 4 reply (providing no Disparity pulse has been received), any SIF reply train then in process shall be terminated, and the Mode 4 reply transmitted from the antenna originally selected for the reply during receipt of the sync pattern. The equipment shall be capable of switching to the Mode 4 reply channel during the SIF pulse width without damage to the transmitter or RF switch. A gap of not less than 600 ns shall exist between the trailing edge of the terminated pulse and leading edge of the first pulse of the Mode 4 reply.

3.4.21.8 Isolation. The isolation between diversity signal channels shall be at least 20 dB in the transmit and 40 dB in the receive mode of operation, the latter to a pulsed or CW signal source.

3.4.21.9 Video processing. The primary and auxiliary receiver channels shall provide independent processing of signals prior to combining the signal channels. This processing shall include generation and application of AOC sensitivity control, MTL adjustment, signal delay compensation, and development of diversity comparison signals. Application of AOC sensitivity reduction signals shall not alter the diversity signal strength comparisons. Additional processing shall be included to select a channel video for the common video output based on compared signal strength. The selection shall be prevented from changing during a 2.15-microsecond interval to permit signals from only one channel to be compared in the sidelobe comparison circuit.

3.4.21.10 Cross-channel desensitization. The SIF and Mode 4 desensitization of 3.4.3, when developed due to signals in either channel, shall be applied equally to the other channel.

3.4.21.11 Mode 4 video routing. Following a Mode 4 reply channel decision, only video from the selected reply channel shall be routed to the TSEC/KIT-1A.

3.4.21.12 SIF and mode 4 correct channel decode. The decoding of an interrogation in a weak channel shall be prevented when the same interrogation is present in the stronger channel at a rate sufficient to initiate AOC action in the stronger channel.

3.4.21.13 Top/Bottom channel select. The equipment shall be designed such that when a control is operated at the equipment control panel, the transponder shall reply only on the selected channel and only when the selected channel signal is greater than the other channel. The receiver of the non-selected channel, however, shall remain fully operative and shall not contribute Mode 1, 2, 3/A, C or 4 decodes to the reply rate limiters.

3.4.22 Receiver type. The receiver in each channel shall be of the superheterodyne type.

3.4.22.1 Receiver frequency. The receiver shall operate at a fixed frequency of 1030 ± 0.5 MHz.

3.4.22.2 Receiver frequency stability. Under all combinations of service conditions specified herein, the frequency drift from that measured under standard conditions shall not exceed ± 1.5 MHz. Local oscillator drift shall remain within 200 kHz of its selected frequency under these same conditions.

3.4.22.3 Receiver noise figure. The receiver noise figure shall not exceed 8 dB when measured at the equipment RF input connector.

3.4.22.4 Receiver dynamic range. The receiver dynamic range shall be not less than 55 dB referenced from MTL.

3.4.22.5 Receiver bandwidth. Overall receiver bandwidth shall be as follows. The bandpass shall be essentially Gaussian.

a. -6 dB points 7 MHz to 10 MHz

b. -70 dB points Less than ± 35 MHz from Fo

3.4.22.6 Receiver RF rejection. The response to pulse and CW signals shall not be less than 70 dB below the response at 1030 MHz at all frequencies lower than 995 MHz and higher than 1065 MHz.

3.4.23 Transmitter type. The transmitter shall be of the solid-state type.

3.4.23.1 Transmitter frequency. The transmitter shall operate at a fixed frequency of 1090 MHz.

3.4.23.2 Transmitter frequency stability. Transmitter frequency shall be 1090 ± 0.5 MHz under standard conditions. When submitted to any combination of service conditions, the

transmitter frequency shall remain within ± 3 MHz of 1090 MHz. Extraneous and harmonic emissions shall be within levels specified in 3.3.6.c.

3.4.23.3 Transmitter power output. Under all service conditions, the transmitter shall deliver 27 ± 3 dBW into a mismatched load of 1.1:1 VSWR maximum. Output power shall not change by more than 1.0 dB when the duty cycle is varied from 0.1 to 1.0 percent over all service conditions.

3.4.23.4 Transmitter power output variation within a pulse train. The peak power of any pulse in a group of pulses specified shall not differ from the power of any other pulse in that group by more than 1.0 dB.

3.4.23.5 Transmitter replacement. The design shall permit the replacement of one or more transistors in the transmitter without the necessity of adjustments other than for power, frequency, and pulse shape. Tuning adjustments shall be possible with full operating voltage applied.

3.4.23.6 Transmitter protection. An open circuit or short circuit at the RF output, or a high VSWR load at any phase angle up to 360 degrees, shall not damage the transmitter or RF switch. The transmitter shall be capable of continuous operation at 1.0 percent duty cycle without damage. Additionally, the transmitter shall be protected against power line surges and transients that occur during normal operation, and under conditions of no-load during equipment turn-on, that may cause the maximum rated transistor collector voltage to be exceeded.

3.4.24 Power supply protection. The power supply shall be self-protecting against faults which place an overload or short circuit on any or all of the power supply outputs. The power supply need not operate during the presence of such faults, but the use of fuses for this protection is not allowed, and operation shall return to normal once the fault has cleared. A reversal in line voltage polarity, applied continuously, or an instantaneous drop in line voltage to zero potential and low source impedance, shall not damage the equipment.

3.4.25 Decoder operation. The decoder shall distinguish and cause replies to the six modes of interrogation specified in 3.3.14. In addition, interrogations made up of pulses of 0.9 to 1.2 microseconds in width with rise times of 0.2 microseconds and decay times of 0.3 microseconds, shall be decoded and replies shall be generated with no degradation in performance, except that decoder tolerance may be proportional to pulse width. This circuitry shall be such that the reply transmitted by the equipment shall always correspond to the mode of interrogation.

3.4.25.1 Decoder tolerance, mode 1. Interrogation pulses spaced at 2.9 to 3.1 microsecond intervals shall cause the equipment to generate Mode 1 replies. Pulses spaced less than 2.5, or greater than 3.8 microseconds shall not cause such replies.

3.4.25.2 Decoder tolerance, mode 2. Interrogation pulses spaced 4.8 to 5.2 microseconds shall cause the equipment to generate Mode 2 replies. Pulses spaced less than 4.2, or greater than 5.8 microseconds shall not cause such replies.

3.4.25.3 Decoder tolerance, mode 3/A. Interrogation pulses spaced 7.8 to 8.2 microseconds shall cause the equipment to generate Mode 3/A replies. Pulses spaced less than 7.2, or greater than 8.8 microseconds shall not cause such replies (except see 3.4.25.6).

3.4.25.4 Decoder tolerance, mode 4. Four interrogation pulses spaced within ± 0.1 microseconds from nominal positions shall cause the equipment to generate Mode 4 Enable Triggers. Pulses spaced ± 0.6 microseconds from nominal positions shall not cause such triggers.

3.4.25.5 Decoder tolerance, mode C. Interrogation pulses spaced 20.8 to 21.2 microseconds shall cause the equipment to generate Mode C replies. Pulses spaced less than 20.2, or greater than 21.8 microseconds shall not cause such replies.

3.4.25.6 Decoder tolerance, test mode. Interrogation pulses spaced 6.3 to 6.7 microseconds shall cause the equipment to generate Mode 3/A replies. Pulses spaced less than 5.7, or greater than 7.3 microseconds shall not cause such replies.

3.5 Detailed requirements.

3.5.1 Console-mounted AN/APX-100(V). The Console-Mounted AN/APX-100(V) consists of an integral receiver-transmitter/control unit that interfaces with the associated equipment listed in 6.5. Design requirements for the RT unit shall be as follows:

3.5.1.1 Function. The equipment shall receive RP energy from two antennas, compare the video output levels of two receivers, decode receiver video, and encode a reply for the transmitter to radiate from the antenna that received the stronger RP signal. All controls and displays including those for BIT shall be located on the front panel. Built-in-Test circuits shall automatically monitor and provide manual self-test capability for all interrogation modes. Also, remote BIT activation and display of the GO/NO-GO indicators shall be possible. The RT-()/APX-100(V) is intended for console mounting.

3.5.1.2 Form Factors. Overall dimensions shall be as specified by MIL-C-6781 for a Type 1 control panel except that the maximum depth shall not be greater than 6.750 inches (less connectors) as shown on Figure 1. Connector locations shall be as shown.

3.5.1.3 Weight. Weight of the console-mounted unit shall not be greater than 8.4 pounds.

3.5.1.4 Contents. The console-mounted RT shall be one self-contained unit with modularized functions. The equipment design shall allow module removal -- while under power without damage to the removed module or remaining modules. A BIT failure shall not prevent the equipment from replying to interrogations. Where practical, the design shall permit module replacement without adjustments to the equipment.

3.5.1.5 Controls. Controls required for operation of the equipment shall be located on the Control/Indicator Assembly at the front of the receiver-transmitter. Control knob lettering, location, and functions shall be as shown on Figure 1 and as follows:

a. Master. A detent-type selector switch, labeled MASTER, shall be provided. Detented positions shall be labeled OFF, STBY, NORM, and EMER. A mechanical interlock shall be incorporated in the device to prevent inadvertent switching to either EMER or OFF positions. In OFF position, all primary power supplies, except control and lighting circuits, shall be isolated from the equipment. When the mechanical interlock is released and the control is placed in the EMER position, all modes shall be enabled (except TEST) and the equipment shall transmit an emergency reply when interrogated. The switch top shall be labeled with the lettering: "PULL TO TURN".

b. Identification-of-position (MIC-IDENT) switch. A three-position toggle switch shall be provided for control of the identification-of-position function. The center position shall be the disabled position and shall be labeled OUT. The up position shall enable the IDENT function and shall be spring-loaded to return to the OUT position when manual pressure is removed from the handle. The down position shall be labeled MIC and shall transfer control of the IDENT function to a point remote from the control panel.

c. Mode 1 enable and test. A three-position toggle switch shall be provided for control of Mode 1 operation and test. This switch shall be labeled Mode 1. The first position (down) shall be the inoperative position and shall be labeled OUT. The second position (center) shall be the Mode 1 enable position, and shall be labeled ON. The third position (UP) shall be spring-loaded for momentary contact so that it may return to the enable position when pressure is removed from the handle. The third position shall be the TEST position and shall be labeled accordingly. In

the TEST position, the switch shall cause the GO/NO-GO built-in-test (BIT) self-test circuits to be energized, and shall override the BIT monitor function, provided that the Master switch is in NORM or EMER.

d. Mode 2 enable and test. A three-position toggle switch shall be provided for control of Mode 2 operation and test. The switch shall perform functionally for Mode 2 in the same manner as does the Mode 1 enable switch.

e. Mode 3/A enable and test. A three-position toggle switch shall be provided for control of Mode 3/A and Mode C operation. The switch shall enable Mode 3/A and Mode C (framing pulses only) simultaneously and shall perform functionally in the same manner as the Mode 1 switch except that in the TEST position of the Mode 3/A switch, only Mode 3/A is tested.

f. Mode C altitude reporting mode. A three-position toggle switch shall be provided for control of the Mode C altitude digitizer input to the equipment and Mode C testing. The center (ON) position shall enable the altitude digitizer input to the equipment. The down (OUT) position shall disable the altitude data input but shall not inhibit transmission of Mode C framing pulses. The TEST (UP) position shall enable testing of Mode C including the altitude data input -- provided that Mode 3/A mode enable control is enabled.

g. Monitor/Radiation-test enable. A two-position toggle switch shall be provided for control of the monitor and radiation test features. The down (OUT) and up (RAD) positions shall enable the equipment monitor circuits, provided the MASTER switch is in NORM or EMER. The RAD position shall be spring-loaded for momentary contact to permit return to the down position when manual pressure is removed from the handle. The radiation test position shall enable the equipment and crypto computer to respond to special interrogation test modes generated externally by a preflight ramp test set. Any one of the TEST positions of the Mode enable switches shall override the monitor function in RAD or OUT.

h. BIT indicator lights. TEST GO and TEST/MONITOR NO- GO indicators of the press-to-test and turn-to-dim type shall be provided to indicate satisfactory operation of the transponder for self-test of Modes 1, 2, 3/A, 4 and C, and for monitoring proper response to interrogations. The color of the filter for all non-ANVIS units shall be green for the GO lamp and red for the NO-GO. For ANVIS units, the filter shall be ANVIS green for the GO lamp, and ANVIS yellow for the NO-GO. The press-to-test feature shall be for testing the indicator lamps only.

i. Mode 3/A control code. Four in-line pushbutton switches shall be provided for selection of Mode 3/A codes. Each switch shall have 8 positions, numbered 0 through 7 consecutively. The numbers, illuminated by the panel lighting, shall appear on a

drum-shaped portion of each wheel. Each switch shall be continuously rotatable with no stops. Means shall be provided to illuminate the displayed position of the wheels.

j. Mode 1 code control. Two in-line push button switches shall be provided for selection of mode 1 codes. The first switch (from left to right) shall be 8-position, identical to those used for selection of M-3/A codes. The second switch shall be similar to the first except that the numbering shall be 0 through 3, appearing twice (once on each half of the drum). The switches shall be continuously rotatable with no stops. Means shall be provided to illuminate the displayed position of the wheels.

k. Mode 2 code control. Four in-line pushbutton switches shall be provided for selection of the Mode 2 codes. The switches shall be located between the Mode 3/A code switches and shall perform functionally in the same manner as the Mode 3/A code selection switches. Mode 2 code numbers shall appear between the Mode 3/A numbers shown on Figure 2 for the console-mounted unit. These numbers shall be covered by a plate which, when pushed upward, shall reveal the number. For the equipment-bay mounted unit, this control shall be located on the RT-( ) front face as shown on Figure 3.

l. Status indicators. Three status lamps shall be provided to locate faults to external interfaces. These lamps shall be operative in the TEST position of the Mode 1, 2, 3/A, 4 or C enable switches. Each lamp shall be red in color or ANVIS yellow -- depending on the set ordered.

m. Antenna selection switch. A three-position toggle switch shall be provided for selection of top, bottom, or diversity antenna operation. In all three positions, both receivers shall be enabled for signal reception and comparison; however, replies shall be possible only from the up (TOP) or down (BOT) antenna as selected. The middle (DIV) position shall enable replies from either antenna.

n. Mode 4 rotary function switch. A rotary detent type switch shall be provided with positions labeled HOLD, A, B, and ZERO. The HOLD position shall be spring-loaded for momentary contact to permit return to the A position when manual pressure is released from the knob. The ZERO position shall be guarded in such a manner that a mechanical latch must be released to turn the switch to ZERO. There shall be no guard from ZERO to B or A. The switch top shall be lettered: "PULL TO ZERO".

o. Mode 4 enable switch. A three-position toggle switch shall be provided for enabling and test of Mode 4. The up position (TEST) shall be spring-loaded for momentary contact to permit return to the middle (ON) position when manual pressure is removed. The bottom position shall be OFF with a mechanical interlock to prevent inadvertent switching to OFF.

p. Mode 4 monitor switch. A three-position toggle type switch shall be provided to permit monitoring of the Mode 4 REPLY light, Mode 4 Audio tone, and external caution light. The up (AUDIO) position shall allow monitoring of the audio tone, REPLY indicator, and external CAUTION indicator. The middle (LIGHT) position shall allow monitoring of the REPLY and external CAUTION lamps only. In the bottom (OUT) position, the REPLY and CAUTION indicators, and audio tone shall be disabled and Mode 4 contribution to the MONITOR NO-GO signal shall be inhibited. The OUT position shall not inhibit the GO/NO-GO signals during Mode 4 self-test or RAD operation. A mechanical interlock shall be provided to prevent inadvertent movement of the switch to OUT.

q. Mode 4 reply indicator. An indicator light identical to the GO, NO-GO indicators shall be provided to indicate Mode 4 replies that occur when the Mode 4 MONITOR switch is in either the AUDIO or LIGHT position. Color of the filter shall be ANVIS green for the ANVIS set and green for all other sets.

3.5.1.6 Panel lighting. Panel lighting voltage and color for each console-mounted AN/APX-100(V) shall be as follows:

	Nomenclature	Voltage	Color
a.	RT-1296()/APX-100(V)	5 V	Red
b.	RT-1284()/APX-100(V)	5 V	White (IPL)
c.	RT-1285()/APX-100(V)	28 V	Red
d.	RT-1286()/APX-100(V)	28 V	White (IPL)
e.	RT-1426()/APX-100A(V)	5 V	Blue/White
f.	RT-()/APX-100(V)	5 V	ANVIS
g.	RT-()/APX-100(V)	28 V	ANVIS

3.5.1.7 External connections. Connections to external circuits shall be as specified in Table XVIII.

Table XVIII. Console unit external connections

J1 Pin Function (I/O)			
1	Altimeter Interlock (I)	45	Mode 4 Challenge (O)
2	Altimeter Interlock (O)		
3	Remote Normal Select(I)	46	Coax Shield
4	Standby Advisory (GND)(O)	47	Mode 4 Enable(O)
5	Remote Bottom Chan Select(GND)(I)		Trigger
6	Remote Top Chan Select (GND)(I)	48	Coax Shield
7	Remote X Pulse Enable (GND)(I)	49	Mode 4 Reply (I)
8	Remote I/P Enable (GND)(I)	50	Coax Shield
9	Remote Emergency Enable (GND)(I)	51	Mode 4 Caution(O)
10	Auxiliary Trigger(I)		Light(+28 V dc)
11	Coax Shield	52	Mode 4 Code Alarm(I)
12	Ejection Enable (+28 V dc)(I)		& Zeroize(GND)

Table XVIII. Console unit external connections- continued

13 Panel Light Return	53 Mode 4 Code B(O) Enable(GND)
14 Panel Lights, +28 V dc(I)	54 Mode 4 Disable(O) (GND)
15 Panel Lights, 5 V ac (I)	55 Mode 4 Zeroize Return(Open)
16 Spare (I)	56 Mode 4 Refuel(O) Hold(GND)
17 Suppression (AIMS)(I)	57 Mode 4 Verify(O) Bit 1(GND)
18 Coax Shield	58 115 V ac(O) Switched
19 Suppression (O)	59 115 V ac(I)
20 Coax Shield	60 Remote Mode 1(I) Test Enable(GND)
21 Mode 4 Audio (O)	61 Remote Mode 2(I) Test Enable(GND)
22 Mode 4 Audio Shield	62 Remote Mode 3/A(I) Test Enable(GND)
23 Mode 4 Audio Common	63 Remote Mode C (I) Test Enable(GND)
24 Auxiliary Shield	64 Remote Mode 4(I) Test Enable (GND)
25 +28 V dc (I)	65 Remote TEST GO(O) (GND)
26 +28 V dc (I)	66 Remote TEST/MON(O) NO-GO(GND)
27/ 28 Ground	J3 Top Antenna
29 Mode C, A1 Enable (GND)(I)	J4 Bottom Antenna
30 Mode C, A2 Enable (GND)(I)	
31 Mode C, A4 Enable (GND)(I)	
32 Mode C, B1 Enable (GND)(I)	
33 Mode C, B2 Enable (GND)(I)	
34 Mode C, B4 Enable (GND)(I)	
35 Mode C, C1 Enable (GND)(I)	
36 Mode C, C2 Enable (GND)(I)	
37 Mode C, C4 Enable (GND)(I)	
38 Mode C, D2 Enable (GND)(I)	
39 Mode C, D4 Enable (GND)(I)	
40 +28 V dc Switched (O)	
41/42 Spare	
43 Mode 4 Disparity (I)	
44 Coax shield	

3.5.1.8 Mounting. The equipment shall mount in an aircraft console or instrument panel using quick-disconnect dzus fasteners. Guide pin holes shall be provided at the equipment rear surface.

3.5.2 Equipment-bay mounted AN/APX-100(V). The Equipment-Bay Mounted AN/APX-100(V) consists of an avionics-bay mounted Receiver-Transmitter RT-1157/APX-100(V) or RT-1471/APX-100(V), Mount MT-4811/APX-100(V), and Control C-()/APX-100(V). The control for the RT-1157/APX-100(V) may be either a C-10009/APX-100(V), C-10532/APX-100(V), C-10533/APX-100(V), or C-10534/APX-100(V). The RT-1471/APX-100(V) is controlled from the aircraft data bus. Design requirements for these units shall be as follows:

3.5.2.1 Function. The RT-1157 and RT-1471 interface with the associated equipment listed in 6.5. Each RT is functionally identical to the console-mounted unit. The RT cases shall be pressure-sealed and designed for installation in an aircraft avionics bay. Control of the RT-1157 shall be from a remote

panel, C-()/APX-100(V). The RT-1471 shall be designed for control from the aircraft MIL-STD-1553B data bus. The RT-1471 interface with the aircraft data bus shall be designed in accordance with ICD 8309. Magnetic indicators labeled "ANT", "RT", and "KIT" shall be provided on the receiver-transmitter for isolation of faults to the receiver-transmitter, antenna lines, and KIT-1A computer.

3.5.2.2 Form factors. The RT-1157, RT-1471, MT-4811, and C-() form factors shall be as shown on Figures 1, 3, 4, and 5.

3.5.2.3 Weight. Weights shall not be greater than:

a.	RT-1157()/APX-100(V)	10.0 lbs.
b.	RT-1471()/APX-100(V)	10.0 lbs.
c.	C-()/APX-100(V)	1.7 lbs.
d.	MT-4811/APX-100(V)	1.0 lb.

3.5.2.4 Contents. The RT-1157() contents shall be the same as that of the console-mounted RT except that a Remote Interface Module shall be included with control line filter and buffer circuits for operation with the external interfaces. All control lines shall be provided with ± 20 V switching transient protection. The RT-1471() is similar to the RT-1157() except that it contains a Serial Bus Interface Module in place of the Remote Interface Module of the RT-1157.

3.5.2.5 Controls. Controls required for operation of the RT-1157() shall be located on the C-() control panel as shown on Figure 1 and shall be functionally identical, except for the Mode 2 switches, to those of the console-mounted unit (see 3.5.1.5).

3.5.2.6 External connections. Connections to external circuits shall be provided on receptacles located on the RT front face , and control rear face, as specified in Tables XIX, XX, and XXI.

3.5.2.7 Panel lighting. Panel lighting for each nomenclatured control C-() shall be as follows. The front panel color shall be in accordance with FED-STD-595, Color No. 37038.

	Nomenclature	Voltage	Color
a.	C-10009/APX-100(V)	5 V	Red
b.	C-10532/APX-100(V)	5 V	White (IPL)
c.	C-10533/APX-100(V)	28 V	Red
d.	C-10534/APX-100(V)	28 V	White (IPL)

3.5.2.8 Mounting. The equipment mount (MT-4811) shall conform to the requirements of MIL-C-172 with form factor as shown on Figure 5. Case hooks shall conform to MS-9140-3 and the automatic locking devices to MS-14108-3. The controls for the equipment bay mounted RT shall mount the same as the console mounted RT except that guidepin holes are not required.

Table XIX. RT-1157/APX-100(V) external connections

J1 Pin Function

1	Mode C, C1 Enable In (GND)	43	Mode 3/A, D1 Enable In(GND)
2	Mode C, C2 Enable In (GND)	44	Mode 3/A, D2 Enable In(GND)
3	Mode C, C4 Enable In (GND)	45	Mode 3/A, D4 Enable In(GND)
4	Mode C, D2 Enable In (GND)	46	Mode 1, A1 Enable In(GND)
5	Mode C, D4 Enable In (GND)	47	Mode 1, A2 Enable In(GND)
6	Mode C, B1 Enable In (GND)	48	Mode 1, A4 Enable In(GND)
7	Mode C, B2 Enable In (GND)	49	Mode 1, B1 Enable In(GND)
8	Top Channel Select In (GND)	50	Mode 1, B2 Enable In(GND)
9	Bottom Channel Select In (GND)	51	Mode 3/A, A1 Enable In(GND)
10	KIT Interlock In (GND: KIT Installed)	52	Mode 3/A, A2 Enable In(GND)
		53	Mode 3/A, A4 Enable In(GND)
11	Mode 4 Caution Light Out (GND: OFF, KIT Not Installed)	54	115 V ac In
		55	GND
12	Mode 4 Reply Light Output (+28 V dc)	56	115 V dc Switched Out
		57	Mode C Test Enable In (GND)
13	TEST GO Out (Open: GO)	58	Mode 3/A Test Enable In(GND)
14	Cross Band Out (Signal)	59	Mode 2 Test Enable In (GND)
15	ALT NO-GO Out (GND)	60	Mode 1 Test Enable In (GND)
16	Mode 3/A, B1 Enable In (GND)	61	Mode 4 Test Enable In (GND)
17	Mode 3/A, B2 Enable In (GND)	62	X-Pulse Enable In (GND)
18	Mode 3/A, B4 Enable In (GND)	63	Mode 4 Light Disable In (GND)
19	Mode 3/A, C1 Enable In (GND)	64	Test Mode Enable In (GND)
20	Altimeter Interlock In (GND: Altimeter Installed and in "GO" Status")	65	Mode C Code Enable In (GND)
		66	Mode 3/A & C Enable In (GND)
		67	Mode 2 Enable In (GND)
21	GND	68	Mode 1 Enable In (GND)
22	GND	69	Mode 4 Code Zeroize and Alarm In (GND)
23	Power Relay Enable In (GND)		
24	+28 V dc In	70	Mode 4 Audio Enable In (GND)
25	+28 V dc Switched Out	71	EMER Enable In (GND)
26	Mode 4 Caution Light Out (+28 V dc)	72	I/P Enable In (GND)
		73	Spare
27	GND	74	STBY/NORM Enable In(GND:Normal
28	Spare	75	TEST GO Out (GND)
29	Spare	76	Standby Advisory Out (GND)
30	Mode C, B4 Enable In (GND)	77	Mode 4 Audio Shield
31	Mode C, A1 Enable In (GND)	78	Mode 4 Audio Common
32	Mode C, A2 Enable In (GND)	79	Mode 4 Audio Out
33	Mode C, A4 Enable In (GND)	J2-A	Suppression In (TEWS)
34	Ejection Enable In (+28 V dc)	B	Mode 4 Reply In
35	GND	C	Mode 4 Disparity In
36	Mode 4 Reply Light Enable Out (GND: ON)	D	Auxiliary Trigger In
		E	Suppression Out

Table XIX. RT-1157/APX-100 external connections - continued

37	TEST/MON NO-GO Out (GND: NO-GO)	F	Mode 4 Enable Trigger Out
38	ANT NO-GO Out (GND)	G	Mode 4 Challenge Video Out
39	KIT NO-GO Out (GND)	H	Suppression In (AIMS)
40	BIT GO Out (+28 V dc)	J	Spare
41	Mode 3/A, C2 Enable In (GND)	K	Spare
42	Mode 3/A, C4 Enable In (GND)	J3	Top Antenna
		J4	Bottom Antenna

Table XX. Control C-10000 (series) external connections

J1 pin function

1	Mode 4 Refuel Hold Out (GND)	37	Mode 3/A, B2 Enable Out
2	I/P Enable Out (GND)	38	Mode 3/A, B4 Enable Out(GND)
3	Mode 4 Verify Bit 1 Out (GND)	39	Spare
4	Mode C Code Enable Out (GND)	40	Mode 1 Test Enable Out(GND)
5	EMER Enable Out (GND)	41	Mode 2 Test Enable Out(GND)
6	Mode 3/A & C Enable Out (GND)	42	Mode 4 Reply Light Enable In (GND: ON)
7	Spare	43	Mode 3/A Test Enable Out(GND)
8	STBY/NORM Enable Out (GND: Normal)	44	Mode C Test Enable Out(GND)
9	Mode 2 Enable Out (GND)	45	Spare
10	Spare	46	TEST GO In (GND)
11	Power Relay Enable Out (GND)	47	Spare
12	Spare	48	Mode 4 Code B Enable Out(GND)
13	Remote I/P Enable Out (GND)	49	Spare
14	Spare	50	Panel Lights, +28 V dc In
15	Mode 3/A, C1 Enable Out (GND)	51	+28 V dc In
16	Mode 3/A, C2 Enable Out (GND)	52	Spare
17	Mode 3/A, C4 Enable Out (GND)	53	Ground
18	Mode 3/A, D1 Enable Out (GND)	54	Panel Light Return
19	Mode 3/A, D2 Enable Out (GND)	55	Mode 4 Audio Enable Out(GND)
20	Mode 3/A, D4 Enable Out (GND)	56	ALT NO-GO In (GND)
21	Spare	57	ANT NO-GO In (GRD)
22	Mode 4 Zeroize Return Out (Open)	58	KIT NO-GO In (GRD)
23	Mode 4 Disable Out (GND)	59	Spare
24	Test Mode Enable Out (GND)	60	TEST/MON NO-GO In (GND: NO-GO)
25	Mode 1 Enable Out (GND)	61	Spare
26	Mode 1, A1 Enable Out (GND)	62	Bottom Channel Select Out (GND)
27	Mode 1, A2 Enable Out (GND)	63	Top Channel Select Out (GND)
28	Mode 1, A4 Enable Out (GND)	64	Mode 4 Test Enable Out (GND)
29	Mode 1, B1 Enable Out (GND)	65	Panel Lights, 5 V ac In
30	Mode 1, B2 Enable Out (GND)	66	Mode 4 Light Disable Out(GND)
31	Spare		
32	Mode 3/A, A1 Enable Out (GND)		
33	Mode 3/A, A2 Enable Out (GND)		
34	Spare		
35	Mode 3/A, A4 Enable Out (GND)		
36	Mode 3/A, B1 Enable Out (GND)		

Table XXI. RT-1471 external connections

J1 pin function

1 Mode C, C1 Enable In (GND)	46 thru 53 Spare
2 Mode C, C2 Enable In (GND)	
3 Mode C, C4 Enable In (GND)	
4 Mode C, D2 Enable In (GND)	
5 Mode C, D4 Enable In (GND)	
6 Mode C, B1 Enable In (GND)	
7 Mode C, B2 Enable In (GND)	
8 Spare	
9 Spare	54 115 V ac In
10 Data Bus 1T+	55 GND
11 Data Bus 1T-	56 115 V ac Switched Out
12 GND	57 thru 62 Spare
13 Cross Band Output (Signal)	
14 Data Bus 2T+	
15 Data Bus 2T-	63 RT Address 2
16 GND	64 Spare
17 RT Address Parity	65 Mode 4 Code B Enable Out (GND)
18 RT Address 0	
19 RT Address 1	66 Spare
20 Altimeter Interlock In (GND: Altimeter in GO Status)	67 RT Address 3
	68 Mode 4 Disable Out (GND)
21 GND	69 Mode 4 Zeroize and Alarm In (GND)
22 GND	
23 Power Relay Enable In (GND)	
24 +28 V In	70 Mode 4 AB Common IN (GND: KIT installed)
25 +28 V Switched Output	
26 Mode 4 Caution Light Output (+28 Volts)	71 EMER Enable In (GND)
	72 Spare
27 GND	73 Spare
28 Spare	74 RT Address 4
29 Spare	75 Test GO Out (GND)
30 Mode C, B4 Enable In (GND)	76 Standby Advisory Out (GND)
31 Mode C, A1 Enable In (GND)	77 Mode 4 Audio Shield
32 Mode C, A2 Enable In (GND)	78 Mode 4 Audio Common
33 Mode C, A4 Enable In (GND)	79 Mode 4 Audio Out
34 Ejection Enable In (+28 Volts)	J2 A Suppression In
35 GND	B Mode 4 Reply In
36 Data Bus 1D+	C Mode 4 Disparity In
37 Data Bus 1D-	D Auxiliary Trigger In
38 Data Bus 2D+	E Suppression Out
39 Data bus 2D-	F Mode 4 Enable Trigger Out
40 GND	G Mode 4 Challenge Video
41 Mode 4 Verify Bit #1 Out (GND)	H Suppression In (AIMS)
42 Mode 4 Reply Light Enable Out (GND: ON)	J Spare
	K Spare
43 Spare	J3 Top ANT
44 Test/Monitor NO-GO Out (GND: ON)	J4 Bot ANT
45 Spare	

4. QUALITY ASSURANCE PROVISIONS

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

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

4.1.2 Test equipment and inspection facilities. The manufacturer shall insure that test and inspection facilities of sufficient accuracy, quality and quantity are established and maintained to permit performance of required inspections.

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

a. First article inspection (see 4.3)
b. Quality conformance inspection (see 4.6)

4.3 First article inspection. First article inspection shall be conducted by the contractor on units produced with equipment and procedures normally used in production. The First article units shall have first passed the Individual (see 4.6.2), Manufacturing Screening (see 4.6.3) and All Equipment Tests (see 4.6.4). First Article tests shall be accomplished under the authorized test procedures (see 4.7). No first article inspections shall be conducted prior to acceptance of the first article test procedure by the procuring activity.

4.3.1 First article test data. The contractor shall make available data collected in conducting the first article test to the procuring activity.

4.3.2 Scope of first article tests. First article tests shall include all tests in the approved test procedure to determine that the equipment meets all the requirements of this

specification, other applicable specifications, and the contract. First article tests shall provide evidence of compliance with each requirement of Section 3 of this specification, utilizing the Appendix Cross-Reference Index. First article tests shall include electrical bench tests, environmental tests in accordance with the procedures of MIL-T-5422, random and sinusoid vibration tests as specified in 4.3.7, and an electromagnetic compatibility test in accordance with MIL-STD-461 and MIL-STD-462, as modified in 4.3.11, and a reliability qualification test in accordance with 4.3.12.

4.3.3 First article approval. Approval of the first article sample will be by the procuring activity upon completion of all tests.

4.3.4 Electrical bench tests. Bench tests shall be conducted to demonstrate compliance with specified performance parameters. These tests shall be conducted under standard laboratory conditions of 3.3.9.

4.3.5 Environmental tests. Environmental tests shall be conducted on a sample of five console-mounted units in the sequence listed below. The RT-1157 or the RT-1471 (the latter when the RT-1471 is on order) shall be substituted for Unit #1 in the test sequence when bay mounted units are purchased with console units under the contract. Unless otherwise noted these tests shall be performed in accordance with MIL-T-5422 procedures. (Rain, Bench Handling, Fungus, Salt Fog, Dust, Shock, and Explosive tests are not required when the mechanical design and material used is unchanged from a previously qualified design.)

4.3.5.1 Test sequence.

Unit #1- Temperature-altitude, vibration (random), Shock, EMI (RS-03 only)
Unit #2 - Humidity, Dust, Rain, Vibration (sinusoid)
Unit #3 - Bench-handling, Shock, Explosive, Crash Safety, Salt Fog
Unit #4 - Fungus
Unit #5 - Electrical Bench, EMI (full)

4.3.6 Temperature/altitude test. The temperature/altitude test shall be performed in accordance with MIL-T-5422 except that the test temperature shall be not greater than 71 degrees C and the test altitude shall be not greater than 40,000 feet for console-mounted units.

4.3.7 Vibration test. Console mounted units shall be subjected to sinusoidal vibration in accordance with MIL-E-5400P, Curve IA, except that the acceleration level shall be limited to

5 G and the upper test frequency to 500 Hz. Rack or equipment bay mounted units shall receive random vibration in accordance with MIL-STD-810 and as specified in 4.3.7.1 through 4.3.7.4.

4.3.7.1 Test item operation. The test item shall be operated during application of random vibration so that the functional effects caused by these tests may be evaluated. The test item shall meet performance requirements, as specified, while the functional vibration levels are being applied and immediately preceding and following application of the endurance levels.

4.3.7.2 Mounting techniques. The test item shall be hard mounted (no isolators) to the vibration exciter or transition table by means of a MT-4811/APX-100(V) mount in the system's normal mounting configuration. Care shall be taken in the establishment of mechanical interfaces to minimize the introduction of extraneous responses in the test setup. The test load shall be distributed as uniformly as possible on the vibration exciter table in order to minimize the effects of unbalanced loads. The input control sensing device(s) shall be rigidly attached to the vibration table, or fixture if used, as near as possible to the attachment point(s) of the test item. Additional vibration sensors shall be located in or on the test item to determine resonant frequencies and amplification factors. Locations to be selected should include main structure, printed circuit boards, large components, and modules, where practicable. The sensor sizes and weights shall be limited so that their effect on the dynamic responses being measured is minimal.

4.3.7.3 Performance of test. The test item shall be subjected to broadband random vibration excitation with the power spectral density envelope shown in Figure 6. The test item shall be attached to the vibration exciter according to 4.3.7.2. Vibration shall be applied sequentially along each of the three orthogonal axes of the test item. Two test levels are required, a functional level and an endurance level. For each axis, one half of the functional test shall be conducted first, then the endurance test, followed by the second half of the functional test. The equipment shall perform according to the operating requirements as specified in 4.3.7.1. The acceleration power spectral density (g^2/Hz) of applied vibration, as measured on the test fixture at mounting points of the test item, shall be as specified in 4.3.7.4. Test times shall, for each axis, be one hour each for functional and endurance levels. The instantaneous random vibration acceleration peaks may be limited to three times the rms acceleration level. The power spectral density of the test control signal shall not deviate from the specified requirements by more than +100, -30 percent (+3 dB, -1.5 dB) below 500 Hz and +100, -50 percent ($\pm$3 dB) between 500 Hz and 2,000 Hz except that deviations as large as +300, -75 percent ($\pm$6 dB) shall be allowed over a cumulative bandwidth of 100 Hz maximum, between 500 and 2,000 Hz. Tolerance levels in terms of dB are specified as:

dB = 10 LOG $_{10}$ W1/WO ,where W1 equals power spectral density in g^2/Hz units, the term WO defines the specified level in g^2/Hz units. Confirmation of these tolerances shall be made by use of an analysis system providing statistical accuracies corresponding to a bandwidth-time constant product, BT = 50 minimum. Specific analyzer characteristics shall be as specified below or equivalent, subject to the BT = 50 limitation.

a. On-line, contiguous filter, equalization/analysis system having a bandwidth as follows:

B = 25 Hz, maximum between 20 and 200 Hz
B = 50 Hz, maximum between 200 and 1,000 Hz
B = 100 hz, maximum between 1,000 and 2,000 Hz

b. Swept frequency analysis systems characterized as follows:

(1) Constant bandwidth analyzer.

(a) Filter bandwidth as follows:

B = 25 Hz, maximum between 20 to 200 Hz
B = 50 Hz. maximum between 200 to 1,000 Hz
B = 100 Hz, maximum between 1,000 to 2,000 Hz

(b) Analyzer averaging time, T = 2RC = 1 second, where T = true averaging time constant

(c) Analysis sweep rate (linear) =

$R = B/4RC$ or $B^2/8$ (Hz/second)

(2) Constant percentage bandwidth analyzer

(a) Filter bandwidth, pfc = 0.1 of center frequency maximum, where p is percentage, and fc, is analyzer center frequency

(b) Analyzer average time = T = 50/pfc,

(c) Analysis sweep rate (logarithmic) =

$T = pfc/4RC$ or $(pfc)^2/8$

(Hz/second), maximum, whichever is smaller

c. Digital power spectral density analysis employing quantization techniques providing accuracies corresponding to the above approach.

4.3.7.3.1 Worst case axis. During the vibration test, data shall be obtained to identify the worst case axis for the purpose of vibration screening tests on production equipment.

4.3.7.4 Test levels. For the purpose of the random vibration test, the following test levels shall be used:

a. Functional level, $W_o = 0.05g^2/Hz$ (8.5g rms min)

b. Endurance level, $W_o = 0.12g^2/Hz$ (12.7g rms min)

4.3.8 Dust. A dust test shall be performed on the console unit front panel. MIL-T-5422 procedures shall be used except that in steps 1, 2, and 3, air velocity shall be 200 ± 100 ft/minute and step 3 may commence at once after stabilization in step 2.

4.3.9 Rain. A rain test shall be performed on the front panel of console mounted units in accordance with MIL-STD-810, Test Method 506.1, Procedure II, except that step 2 rate shall be 1±0.5 in./Hr. Within 2 minutes after the rain test, a BIT test shall be performed which the unit shall pass. Within 30 minutes of completing the rain test, open the unit. Water condensate may be present; however, performance shall not have been degraded.

4.3.10 Fungus. A fungus test shall be performed in accordance with MIL-T-5422. The equipment shall be in an "as ready" for delivery condition. The test model shall not be specially cleaned for the fungus test, except for the cleaning it receives during or after production. If it is necessary for the manufacturer after assembly to remove accumulated production and handling contaminants by cleaning prior to packaging and delivery, then the equipment shall not be tested for three days after cleaning to allow for complete evaporation of the cleaning compound. All enclosed or gasketed assemblies shall be opened and the interior shall be sprayed with the specified mixed-spore suspension. After 14 and 28 days of test, the control items shall show profuse growth over at least 50 percent of the area of the control items. After 28 days, based upon visual examination, the equipment assembly shall pass if it shows no more than only sparse microbial growth with restricted tubular growth development in an area of 1 to 10 percent or less of total area and no more than six unrelated, minute colonies with mycelial development in areas only in other than critical circuit portions; such as terminal spacings, printed circuit boards, etc.; with sparse growth due to random contamination or traces of unmixed material ingredients. The equipment shall fail if it shows more than the growth specified above. The test shall be repeated if the control items fail to show profuse growth after 14 and 28 days of test. Equipment operation is not required.

4.3.11 Interference tests. Compliance with the requirements of 3.3.6 and subparagraphs shall be demonstrated by tests. MIL-STD-461, Notice 4, requirements shall be demonstrated by

conducting MIL-STD-462, Notice 3, measurements, test methods CE01, CE02, CE03, CE04, CE05, CE06, CS01, CS02, CS03, CS04, CS06, RE02, RE02.1, RS02, and RS03. A measure of the dc bonding resistance shall be made using a Shallcross Model 670A milliohmmeter (or equal) and included in the first article test report.

The interfering RF signal for RS03 shall be modulated with a 1.0 kHz square wave, 50 percent duty cycle, and the following modulations:

a. 10 kHz to 1.9 MHz, 400 Hz square wave, 50 percent duty cycle
b. 2 Mhz to 75.9 MHz, FM ±8 kHz deviation, 1 kHz
c. 76 MHz to 400 MHz, AM 50 percent, 1 kHz tone
d. 400 MHz to 12.4 GHz, pulses, 1 to 10 microseconds wide, 400 pps

4.3.12 Reliability qualification test. A reliability qualification test (RQT) shall be conducted by the contractor. A minimum of four but not more than six equipment shall be tested in accordance with MIL-STD-781 using the reliability qualification test-mission profile of Figure 8 and vibration envelope of Figure 9. Each unit shall have first passed the Individual Test (see 4.6.2), Manufacturing Screening Test (see 4.6.3) and All Equipment Test (see 4.6.4) prior to start of RQT. The mission profile test cycle should begin at the "0 hour" point which is a cold day ground stabilization (-54 degrees C) prior to ground operation and flight in a cold day. Random vibration shall be applied with the units mounted on the MT-4811/APX-100(V) mount or fixture for console units. The accept-reject criteria imposed shall be those of MIL-STD-781, Test Plan III, with an upper test MTBF of 1000 hours.

4.4 Maintainability demonstration. When required by the contract (see 6.2.2), a maintainability demonstration for intermediate level requirements shall be conducted in accordance with MIL-STD-2084 and MIL-STD-471. Test Method 1, Test Plan B of MIL-STD-471, shall be used.

4.5 Production equipment. Equipment supplied under the contract shall in all respects, including design, construction, workmanship, performance and quality, be capable of sucessfully passing the First Article tests specified herein.

4.6 Quality conformance inspection. The contractor shall furnish all samples and shall be responsible for accomplishing the quality conformance tests. All inspection and testing may be under the supervision of the customer's representative. The contractor shall retain test data showing quantitative results for all quality conformance tests. Such tests shall be signed/stamped by an authorized representative of the contractor

or laboratory, as applicable. Acceptance or approval of material shall not be construed as a guarantee of the finished product. Quality conformance tests shall consist of the following:

a. Component rescreening (see 4.6.1)
b. Individual tests (see 4.6.2)
c. Manufacturing screening (see 4.6.3)
d. Reliability assurance tests (see 4.6.4)
e. Special tests (see 4.6.5)

4.6.1 Component rescreening. The producer of the equipment shall subject 100 % of all active components (semiconductors, microcircuits and hybrids) to an incoming inspection consisting of one thermal stress cycle with functional testing of critical parameters at ambient, - 55 degrees C and + 125 degrees C. Particle impact noise detection screening of devices with internal cavities shall be performed. Destructive physical analysis shall be conducted using Method 5001 of MIL-STD-883B as appropriate. Where the contractor can identify components by type and/or manufacturer that have defect rates of less than 100 parts per million, the contractor may provide that data to the procuring activity to obtain relaxation to the 100% parts rescreening requirements. When a relaxed rescreening program has been imposed, the contractor must ensure that the sampling plan provides acceptable confidence that the defect rate of 100 per million is not exceeded. If the sampling data indicate the defects exceed 100 parts per million, then 100% parts rescreening shall be reinitiated.

4.6.2 Individual tests. Each equipment submitted for acceptance shall be subjected to the individual tests. The tests shall be adequate to determine compliance with the requirements for materials, workmanship, operational adequacy and reliability. As a minimum, each equipment accepted shall have passed the following tests:

a. Examination of product (see 4.6.2.1)
b. Operational test (see 4.6.2.2)

4.6.2.1 Examination of product. Each equipment shall be examined carefully to determine that the material and workmanship requirements have been met.

4.6.2.2 Operational test. Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to check sufficient characteristics and record data to assure specified equipment operation.

4.6.3 Manufacturing screening. The contractor shall subject each equipment to a manufacturing screening/burn-in test. Manufacturing screening/burn-in shall consist of random vibration and temperature cycling. An additional burn-in period may be used at the option of the contractor. If an additional burn-in

period is used, the details thereof shall be included in the approved test procedures and shall be the same for all equipment, including units ordered as spares.

4.6.3.1 Random vibration. Prior to conducting temperature cycling, each receiver-transmitter unit shall complete a 10 minute failure-free vibration screen at 6.06g rms. Power spectral density shall cover 20 to 2,000 Hz. Psuedo-random vibration methods are acceptable. The equipment shall be hard mounted without vibration isolators and shall be operating throughout the test. Console units may be rotated 90 degees to avoid an unduly complicated vibration exciter fixture for production. Vibration shall be applied along the worst case axis (see 4.3.7). Vibration envelope is shown on Figure 7.

4.6.3.2 Temperature cycling. Each receiver-transmitter shall undergo 6 temperature cycles in accordance with Figure 8. The rate of temperature change between extremes shall be at least 5 degrees C per minute. The unit shall be energized throughout temperature cycling except during the cooldown period from +71 degrees C to -54 degrees C and during the soak at -54 degrees C. Unit performance shall be periodically checked and repairs made to correct failures. The last two consecutive temperature cycles shall be failure free.

4.6.4 Reliability assurance tests. The contractor shall submit each receiver-transmitter to a reliability assurance test as specified herein. The equipment shall have first passed the Individual and Manufacturing Screening tests.

4.6.4.1 All equipment test. Each receiver-transmitter shall be tested in accordance with MIL-STD-781 as modified herein. Environmental cycling shall be in accordance with Figure 8. Vibration and humidity is not required during environmental cycling. Each unit shall be tested for 80 hours with the last 20 hours failure-free. If a failure occurs during the 20-hour operating period, the equipment shall be repaired, proper operation verified and the test continued. The accumulation of failure-free time shall start at zero time upon resumption of testing. To determine whether the MTBF is being met at any time during the contract the operating time and the failures therein (not counting any burn-in failures or burn-in operating time) shall be totaled and the results compared with the reject line of Test Plan XVIII-C of MIL-STD-781. (Extend the line as necessary to accommodate the data.) These totals shall accumulate so that at any time the experience from the beginning of the contract is included. At any time that the current totals of test hours and test failures plotted on Test Plan XVIII-C curves show a reject situation, the procuring activity shall be notified. The procuring activity reserves the right to stop the acceptance of the equipment when a reject situation exists pending a review of the contractor's efforts to improve the

equipment, the equipment parts, or the equipment workmanship, so that the entire compilation will show other than a reject decision.

4.6.4.2 Test details. Test details such as the performance criteria to be measured, special failure criteria, and preventive maintenance to be allowed during the test, shall be part of the test procedures to be prepared and made available by the contractor prior to the beginning of the reliability assurance tests (see 6.2.2).

4.6.4.3 Reliability assurance for spares and repair parts. Equipment, components, or parts which are supplied as spares or repair parts shall receive a reliability screening test as specified in 4.6. Details of the reliability screening test to be performed shall be included in the reliability program plan, the drawing for the item, and in the contractor's test procedures.

4.6.5 Special tests. When specified in the contract, special tests shall be conducted for the purpose of checking the effect of any design or material change on the performance of the equipment and to assure quality control (see 6.2.1). The equipment selected for the special tests may be selected from equipment previously subjected to the reliability tests.

4.6.5.1 Special test schedule. Selection of equipment for special tests shall be made as follows:

a. On an early equipment after an engineering or material change.

b. Whenever failure reports or other information indicate that additional tests are required. (This information will be determined by the procuring activity.)

4.6.5.2 Scope of special tests. Special tests shall consist of such tests as authorized by the procuring activity. Test procedures previously approved for the first article tests shall be used where applicable.

4.6.6 Equipment failure. Should a failure occur during either the reliability qualification, reliability assurance, or special tests, the following action shall be taken:

a. Determine the cause of the failure and the equipment BIT performance in detecting and isolating the failure.

b. Determine if the failure is an isolated case or design defect or pattern failure.

c. Prepare and make available to the procuring activity for review, proposed corrective action intended to reduce the possibility of the same component or BIT failure(s) occurring in future tests, or documented justification where no corrective action is proposed.

d. Where practical, include a test in the individual test to check all equipment for this requirement until assurance is obtained that the defect has been corrected.

4.6.7 Failure classification. All incidents occurring during reliability assurance tests shall be classified and reported as either relevant or non-relevant in accordance with MIL-STD-2074 and MIL-STD-781. Only those incidents classified as relevant failures shall be acountable for making an accept/reject decision.

4.6.7.1 Relevant failures. All test incidents shall be considered as relevant failures unless detetrmined to be non-relevant in accordance with the criteria of MIL-STD-2074.

4.6.7.2 Non-relevant failures. Although non-relevant failures are not used for reliability assurance test accept/reject decisions, all test article incidents and equipment failures shall be recorded and reported.

4.7 Test procedures. The procedures used for conducting all tests required by Section 4 shall be prepared by the contractor and made available to the procuring activity for review and acceptance. The right is reserved by the procuring activity or the government representative to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of the specification or the contract (see 6.2.1). MIL-T-18303 shall be used as a guide for preparation of test procedures.

4.8 Testing of spares and repair parts. Equipment delivered as spares at the weapons replaceable assembly (WRA) or higher level shall receive performance, burn-in and reliability assurance tests commensurate with that afforded the original production equipment.

4.8.1 Shop replaceable assemblies All items to be delivered as spares at the shop replaceable assembly (SRA) or sub-SRA level shall receive functional checks and a burn-in under conditions and for a duration commensurate with that imposed on that assembly in the original production.

4.8.2 Repair parts. All electronic component parts to be delivered as repair parts shall receive functional and burn-in screening tests equivalent to those imposed for the nearest military standard part.

4.8.3 Test details. The details of acceptance tests to be performed on SRA's and WRA's supplied as spare or repair parts shall be incorporated into item specifications and drawings.

4.9 Presubmission testing. No item, part, or complete equipment shall be submitted until it has been previously tested by the manufacturer and found to comply, with all applicable requirements of this specification and the contract.

5. PACKAGING

5.1 General. All major units and parts of the equipment shall be preserved, packaged, packed, and marked in accordance with MIL-E-17555 for the level of shipment specified in the contract or purchase order (see 6.2.1).

5.2 Marking. Shipments shall be marked in accordance with requirements of MIL-STD-129.

6. NOTES

6.1 Intended use. The equipment is intended for use in rotary and fixed-wing aircraft that provide a MIL-E-5400, Class 2 (or less) environment. It provides aircraft identification and altitude reporting in response to challenges from other airborne, ground or surface platforms. The equipment may also be used for ship or submarine identification in response to ground, surface, or air-based challenges.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification

b. If a first article inspection is required (see 3.2, 6.3)

c. If a maintainability demonstration is required (see 4.4)

d. If a thermal analysis is required (see 3.3.13)

e. Test procedure modifications or additional tests, if required (see 4.7)

f. Selection of applicable levels of packaging and packing (see 5.1)

g. If a reliability program plan is required(see 3.3.2)

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

Paragraph	Data Requirement Title	Applicable DID NO. Option
4.3.2, 4.7	Procedures, Test	DI-T-21347
4.3.1, 4.3.3	Report, First Article (Preproduction) Test	DI-T-21349
4.6.4, 4.3.12	Procedures, Reliability Tests	DI-R-7035
4.3.12, 4.6.4	Reliability Test and Demonstration, Reports	DI-R-7034
3.3.7	Data Collection, Analysis and Corrective Action System, Reports	DI-R-7105
4.6.6c	Plan, Failure Data Collection, Analysis and Corrective Action	UDI-T-23719
4.6.7	Failed Item Analysis Report	DI-RELI-80253
4.4	Maintainability Demonstration Test Plan	DI-R-7112

(Data item descriptions related to this specification, and identified in Section 6, will be approved and listed as such in DoD 5010.12L, AMSDL. Copies of data item descriptions required by 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 Options. The following options are available:

a. An additional burn-in period is allowable at the option of the contractor (see 4.6.3)

b. Acceptance of equipment may be stopped anytime a reject situation exists in the All Equipment Test. This is at the option of the procuring activity (see 4.6.4.1).

6.4 First article. When a first article inspection is required, the contracting officer should include specific instructions in the contract regarding arrangements for examination, test, approval, disposition of the first article sample, and test report.

6.5 Associated equipment. The AN/APX-100 should operate with the associated equipment listed in Table XXII. These equipment are not supplied under this specification.

Table XXII. Associated equipment

Item	Type designation
Antenna	AS-133, AT-741A (or other equivalents)
Transponder-computer	KIT-1A/TSEC
Pressure-Altitude Air Data Computer	CPU-66()/A (or equivalent)

6.6 Subject term (key word) listing.

a. Identification, Friend or Foe (IFF)

b. Receiver-Transmitter

c. Selective Identification Feature (SIF)

d. Transponder

6.7 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing Activity:
Navy AS
(Project 5821-N189)

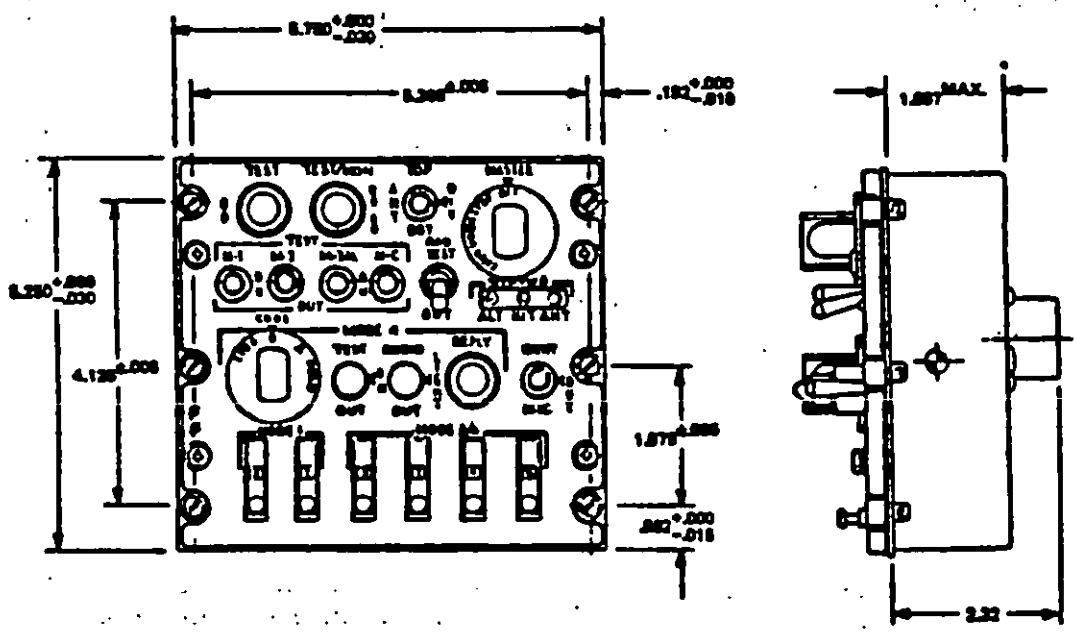

FIGURE 1. C-10000 series control, outline dimensions

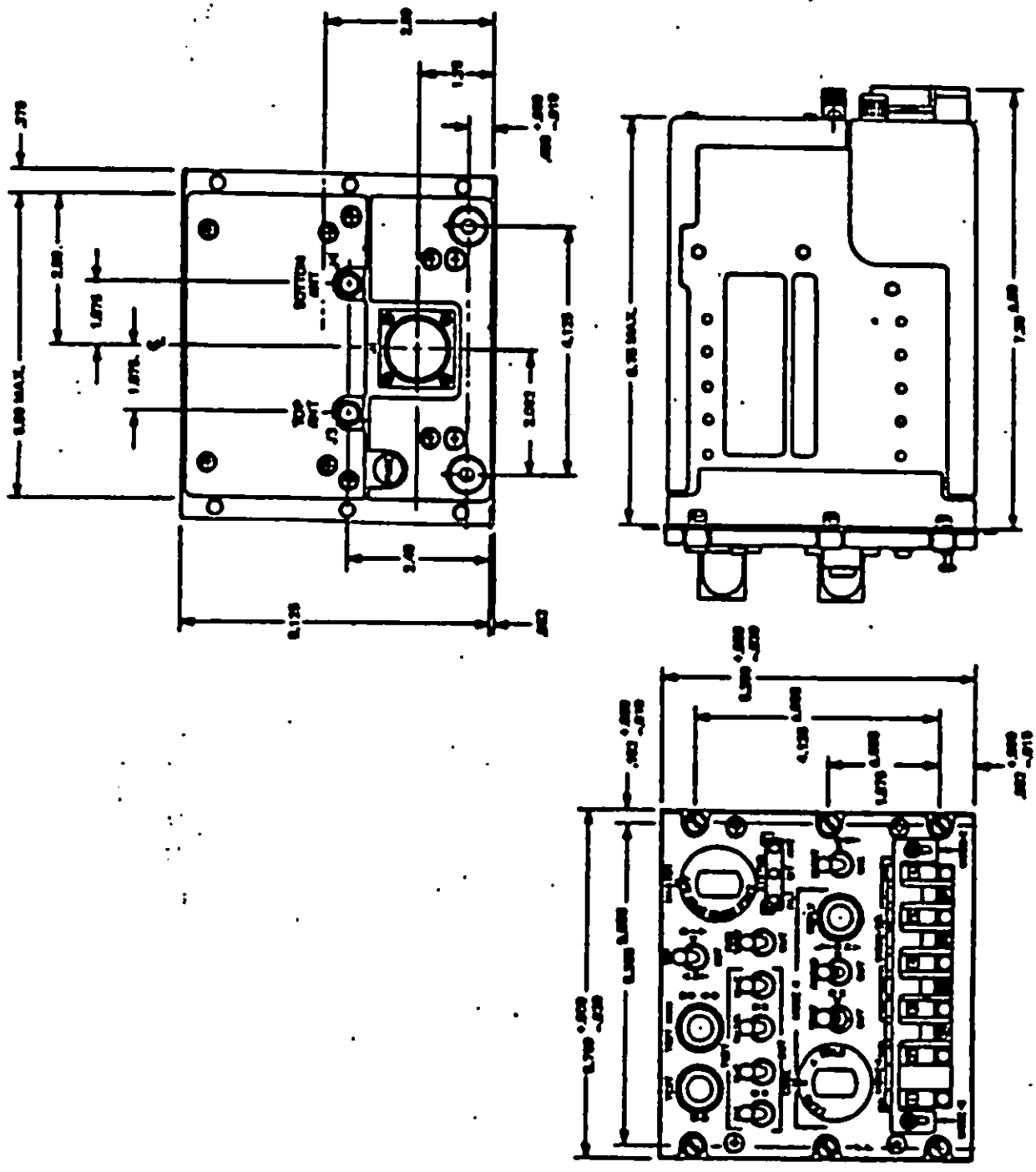

FIGURE 2. RT-1200 series, outline dimensions

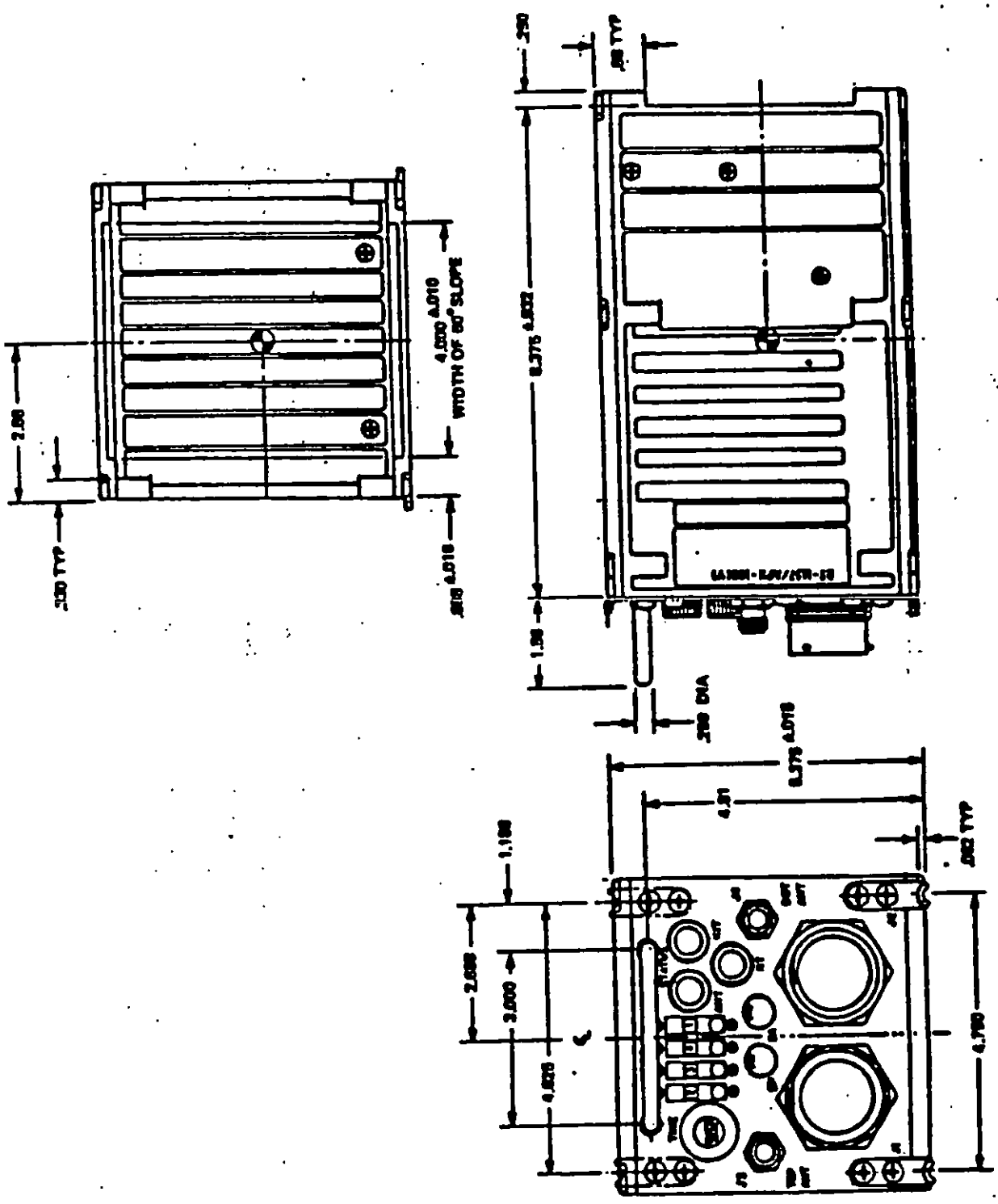

FIGURE 3. RT-1157/APX-100(V), outline dimensions

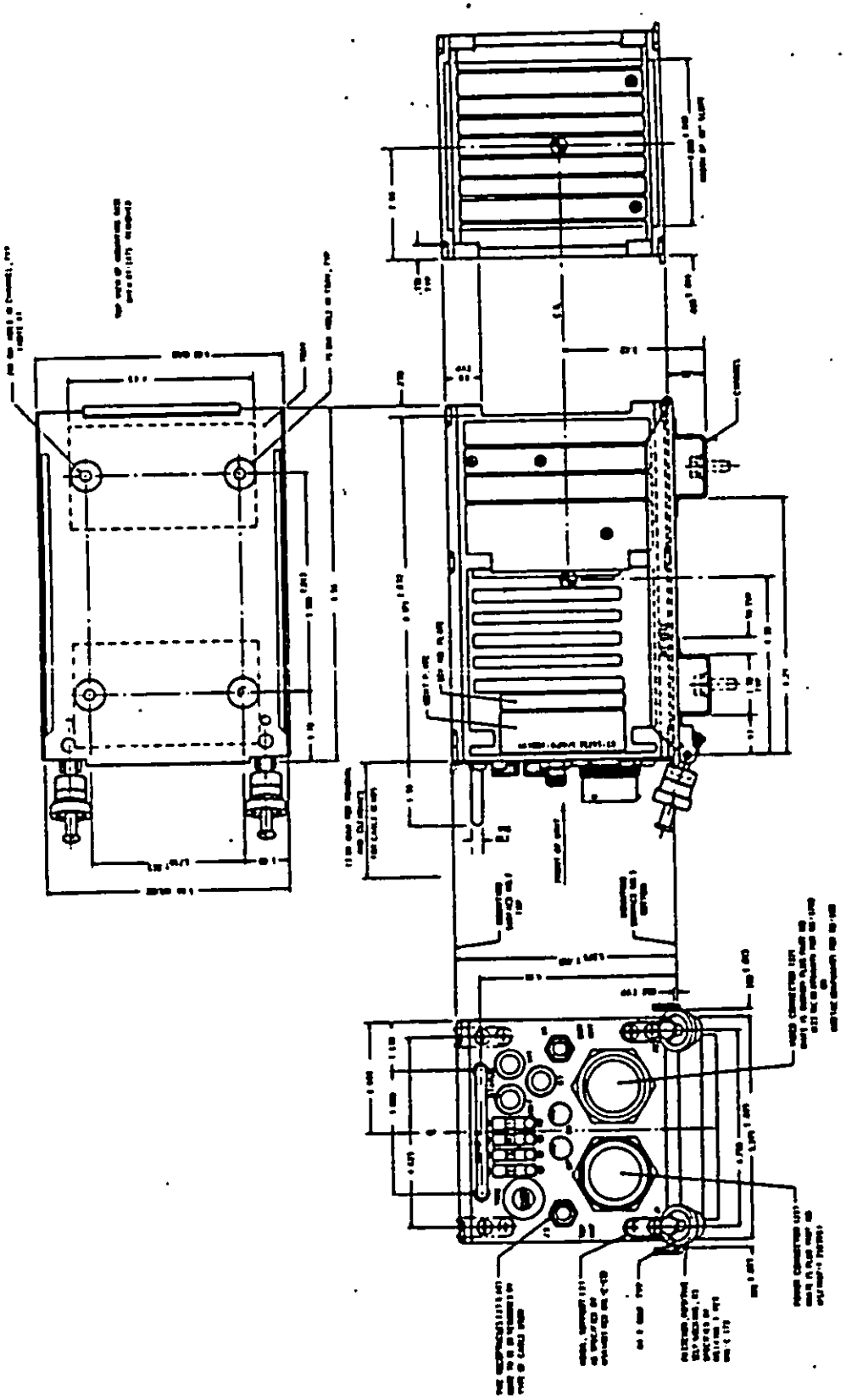

FIGURE 4. RT-1471/APX-100(V), outline dimensions

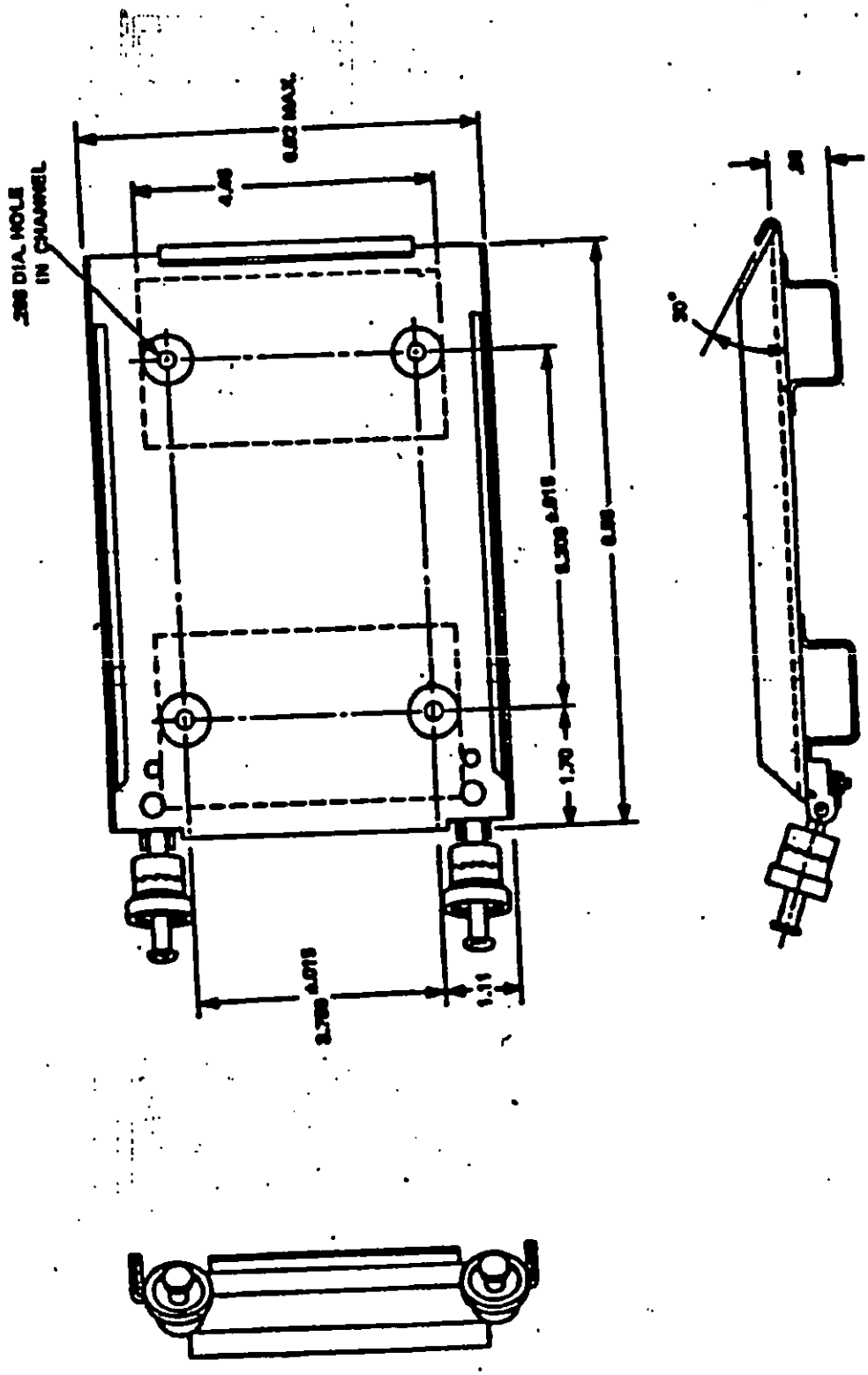

FIGURE 5. MT-4811/APX-100V, outline dimensions

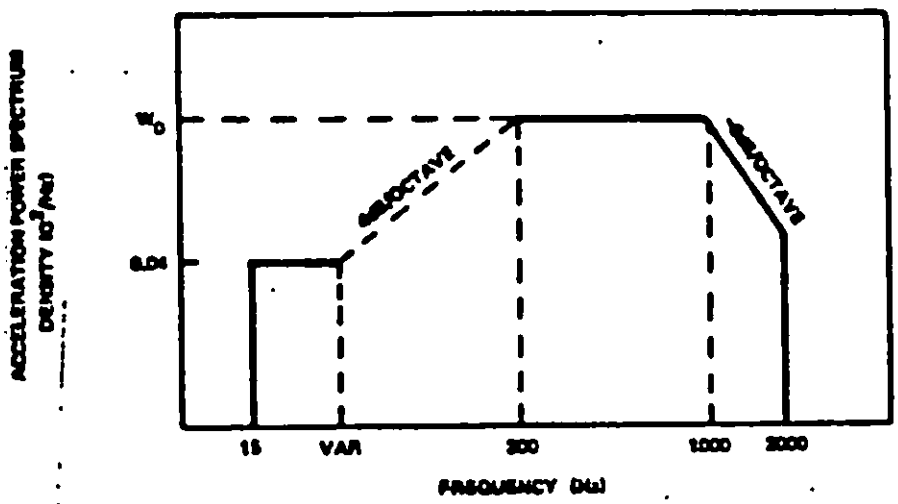

FIGURE 6. First Article random vibration envelope (see 4.3.7)

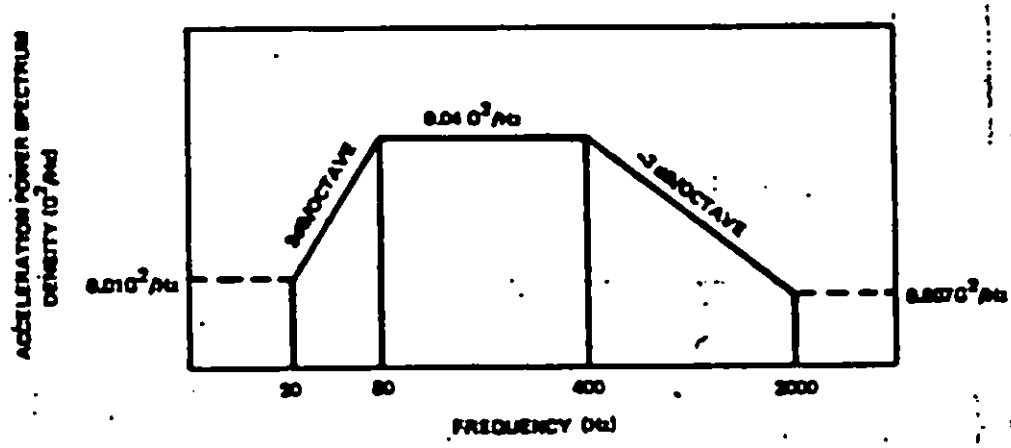

FIGURE 7. Manufacturing screening random vibration envelope (see 4.6.3.1)

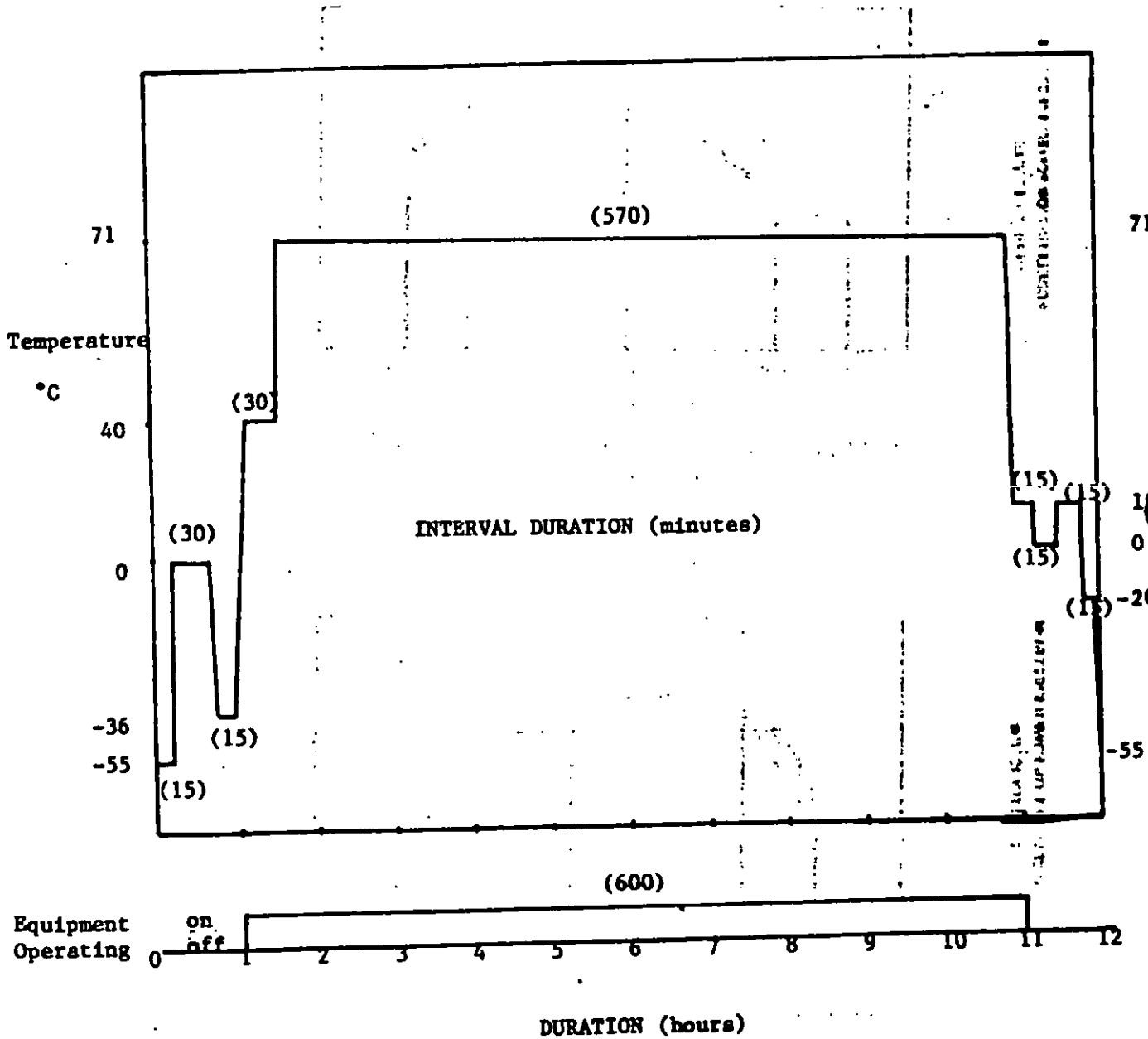

FIGURE 8. RQT, MST and AET mission profile test cycle (see 4.3.12, 4.6.3.2 and 4.6.4.1)

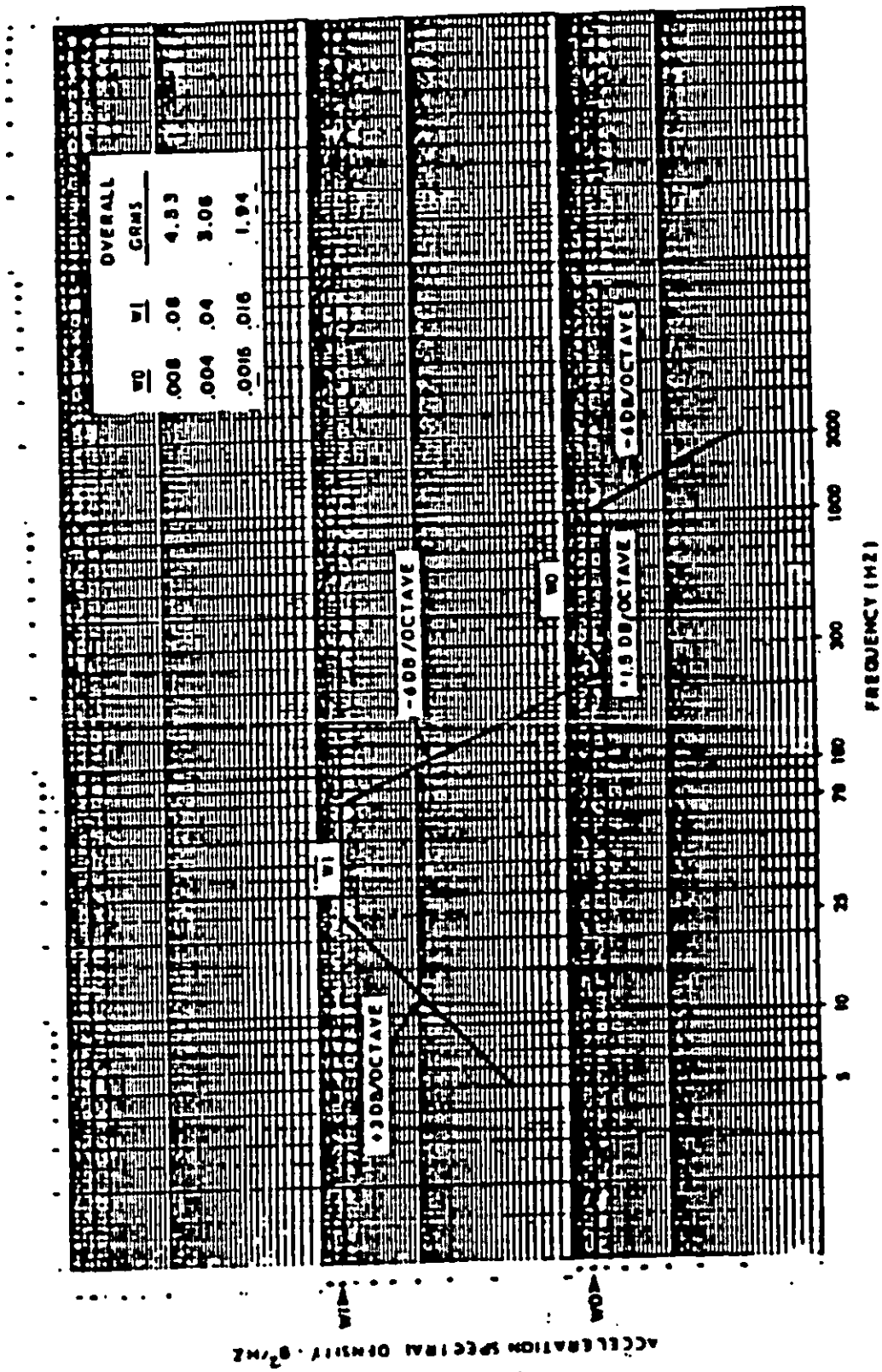

FIGURE 9. First article reliability qualification test random vibration envelope (see 4.3.12)

APPENDIX

CROSS REFERENCE INDEX

10. SCOPE

10.1 Scope. This appendix specifies performance parameters that shall be verified, as a minimum, during First Article and Production tests. Other specified requirements shall be subject to verification by inspection and analysis, or review of data submitted as required by the contract. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

30. SUBMISSION. This section is not applicable to this appendix.

40. EXTENT OF QUALIFICATION.

40.1 The following parameters shall be verified, as a minimum, during First Article Tests (FAT) and Production Acceptance Tests (PAT):

Requirement Paragraph		Test Phase	Notes
3.3.2.1	Operational Stability	F/P	
3.3.2.4	Reliability (MTBF)	F/P	1
3.3.4.2	Control Panel Lighting	F	1
3.3.6	Interference Control	F	
3.3.6.3	Grounding and Bonding	F	
3.3.7.6	Fault Indicators	F/P	
3.3.10.1	Vibration	F/P	
3.3.10.2	Antenna Mismatch	F/P	
3.3.10.3	Transmitter Duty Cycle	F/P	1
3.3.11	Warm-Up Time	F/P	1
3.3.12	Operating Power	F/P	
3.3.12.1	Power for External Loads	F/P	1
3.3.12.2	Panel Lighting Power	F/P	
3.3.12.3	Fusing	F/P	
3.3.12.4	Reduced Performance	F/P	
3.3.15	Input Protection	F	
3.4.2	Interference	F/P	
3.4.3	Echo Rejection	F/P	
3.4.3.1	Mode 1,2,3/A,C and Test Desensitization	F/P	
3.4.3.2	Mode 4 Desensitization	F/P	
3.4.4	Minimum Triggering Level	F/P	1
3.4.4.1	Triggering Level Drift	F/P	1
3.4.5	Random Triggering Rate	F/P	

APPENDIX

Requirement Paragraph		Test Phase	Notes
3.4.6	Automatic Overload Control	F/P	
3.4.6.1	Single Channel AOC	F/P	1, 2
3.4.6.2	Cross Channel AOC	F/P	1, 2
3.4.6.3	Mode 4 Threshold Reduction Control	F/P	1
3.4.6.4	Duty Cycle Limiter	F/P	
3.4.6.5	Sidelobe Suppression Rate Limiter	F/P	1
3.4.6.6	Automatic Overload Control Action	F/P	
3.4.7	Suppression During Mode 4 Interrogation	F/P	
3.4.7.1	Suppression During Transmission of Mode 4 Replies	F/P	
3.4.7.2	Suppression During Transmission of Mode 1,2,3/A C or Test replies	F/P	
3.4.8	Suppression Input	F/P	1
3.4.9	Suppression Output	F/P	1
3.4.10.1	Conditions for ISLS	F/P	1
3.4.10.2	ISLS Conditions for Nonsuppression	F/P	1
3.4.10.3	ISLS Gray Region	F/P	
3.4.10.4	ISLS Dynamic Range	F/P	
3.4.11	Pulse Width Discrimination	F/P	
3.4.11.1	Narrow Pulse Discrimination	F/P	
3.4.11.2	Wide Pulse Discrimination	F/P	
3.4.12	Transponder Delay	F/P	
3.4.13	Range Jitter	F/P	
3.4.14	Reply Characteristics	F/P	
3.4.14.1	Mode 1 Replies	F/P	1
3.4.14.2	Mode 2 Replies	F/P	1
3.4.14.3	Mode 3/A Replies	F/P	1
3.4.14.4	Test Mode Replies	F/P	
3.4.15.5	Mode 4 Replies	F/P	1
3.4.14.6	Mode C Replies	F/P	1
3.4.14.7	Emergency Replies Modes 1,2,3/A,4 and C	F/P	1
3.4.14.8	Identification of Position Replies	F/P	1
3.4.15	Mode C Altitude Reporting Provisions	F/P	

APPENDIX

Requirement Paragraph		Test Phase	Notes
3.4.15.1	Mode C Altitude-Code Control Characteristics	F/P	1
3.4.15.3	Mode C Lead Source and Transient Voltages	F	
3.4.16	Auxiliary Trigger	F/P	
3.4.17	Standby Operation	F/P	1
3.4.18	Code Number Assignments	F/P	
3.4.18.1	Mode 1 Codes	F/P	
3.4.18.2	Mode 2 Codes	F/P	
3.4.18.3	Mode 3/A Codes	F/P	
3.4.18.4	Mode C Codes	F/P	
3.4.18.5	X-Pulse Codes	F/P	
3.4.19	BIT Performance	F/P	
3.4.19.1	BIT Self-Test	F/P	
3.4.19.2	Self-Test Evaluator	F/P	
3.4.19.3	Evaluation of Replies During In-Flight Testing	F/P	
3.4.19.4	BIT Interrogation Level	F/P	
3.4.19.5	BIT Interrogation Frequency	F/P	
3.4.19.6	BIT Interrogation Modes	F/P	
3.4.19.7	BIT Interrogation Rate	F/P	
3.4.19.8	BIT Reply Frequency Discrimination	F/P	
3.4.19.9	BIT Reply Pulse Spacing	F/P	
3.4.19.10	BIT Reply Peak Pulse Power	F/P	
3.4.19.11	BIT Antenna System Check	F/P	1, 3
3.4.19.12	Mode 4 BIT Evaluation	F/P	1, 4
3.4.19.13	Mode C Test Evaluation	F/P	1, 5
3.4.19.14	Monitor	F/P	1, 6
3.4.19.15	Indicator Operation	F/P	
3.4.19.16	Remote BIT Interface	F/P	1
3.4.19.17	Transient Conditions	F/P	
3.4.20	Mode 4 Performance	F/P	
3.4.20.1	Mode 4 Reply Input	F/P	1
3.4.20.2	Disparity Input	F/P	1
3.4.20.3	Mode 4 Enable Trigger	F/P	1
3.4.20.4	Mode 4 Challenge Video	F/P	1
3.4.21	Diversity Performance	F/P	
3.4.21.1	Antenna Selection	F/P	
3.4.21.2	Bottom Antenna Reply	F/P	
3.4.21.3	Top Antenna Reply	F/P	
3.4.21.4	Diversity Gray Region	F/P	
3.4.21.5	SIF Reply Channel Decision	F/P	

Requirement Paragraph		Test Phase	Notes
3.4.21.6	Mode 4 Reply Channel Decision	F/P	
3.4.21.7	SIF and Mode 4 Reply Interlace	F/P	
3.4.21.8	Isolation	F/P	
3.4.21.9	Video Processing	F/P	
3.4.21.10	Cross Channel Desensitization	F/P	
3.4.22.1	Receiver Frequency	F/P	1
3.4.22.2	Receiver Frequency Stability	F	1
3.4.22.3	Receiver Noise Figure	F/P	
3.4.22.4	Receiver Dynamic Range	F/P	
3.4.22.5	Receiver Bandwidth	F/P	1
3.4.22.6	Receiver RF Rejection	F	
3.4.23.1	Transmitter Frequency	F/P	1
3.4.23.2	Transmitter Frequency Stability	F/P	1
3.4.23.3	Transmitter Power Output	F/P	1
3.4.23.4	Transmitter Power Output Variation within a Pulse Train	F/P	
3.4.23.5	Transmitter Replacement	F	
3.4.23.6	Transmitter Protection	F	
3.4.24	Power Supply Protection	F	
3.4.25	Decoder Operation	F/P	
3.4.25.1	Decoder Tolerance, Mode 1	F/P	
3.4.25.2	Decoder Tolerance, Mode 2	F/P	
3.4.25.3	Decoder Tolerance, Mode 3/A	F/P	
3.4.25.4	Decoder Tolerance, Mode 4	F/P	
3.4.25.5	Decoder Tolerance, Mode C	F/P	
3.4.25.6	Decoder Tolerance, Test Mode	F/P	
3.5.1.1	Function	F/P	
3.5.1.2	Form Factor	F	
3.5.1.5	Controls	F/P	
3.5.1.6	Panel Lighting	F	
3.5.2.1	Function	F/P	
3.5.2.2	Form Factors	F	
3.5.2.5	Controls	F/P	
3.5.2.6	External Connections	F	
3.5.2.7	Panel Lighting	F	
3.5.2.8	Mounting	F/P	

APPENDIX

Notes:

1/ In addition to verification during other FAT/PAT tests, these parameters shall be verified during Reliability Qualification Test and production All Equipment Test.

2/ Test shall operate self-test to verify "GO" when AOC is limiting.

3/ Limit check to verify NO-GO with antenna disconnected.

4/ Limit check to verify proper GO/NO-GO operation with disparity absent and present at specified spacing and rates.

5/ Check limited to interlock operation.

6/ Check that MON NO-GO does not enable with normal M4/SIF signals applied; check M4 reply rate criteria; and M4 audio

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)