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MILITARY SPECIFICATION

ALTIMETER SET, ELECTRONIC AN/APN194(V)

This specification is approved for use by 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 design performance and acceptance requirements for the AN/APN-194(v) Electronic Altimeter Set, herein referred to as the equipment. The equipment covered by this specification shall provide an accurate indication of absolute altitude of an aircraft at an altitude range of 0 to 5,000 feet over land and water. Altitude warnings are provided when the aircraft is at or below certain fixed or variable altitudes.

* 1.2 Classification. The equipment covered by this specification consists of the following Items:

Item	Type Designation
Receiver-Transmitter	RT-1015A/APN-194(V)
Receiver-Transmitter	RT-1042A/APN-194(V)
Indicator, Height	ID-1760B/APN-194(V)
Indicator, Height	ID-1768B/APN-194(V)
Indicator, Height	ID-1811A/APN-194(V)
Indicator, Height	ID-1879A/APN-194(V)
Indicator, Height	ID-1880A/APN-194(V)
Indicator, Height	ID-2206/APN-194(V)
Blanker, Interference	MX-9132A/APN-194(V)
Antenna	AS-2595/APN-194(V)
Antenna	AS-2728/APN-194(V)
Antenna	AS-2741/APN-194(V)
Antenna	AS-2742/APN-194(V)

1.3 Associated equipment. This equipment should operate with the associated equipment listed in 6.9.

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 Specifications and Standards Department (ESSD) Code 93, Lakehurst, NJ 08733, by using the self addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 5826

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-S-571	Solder; Tin Alloy; Lead-Tin Alloy; and Lead Alloy

MILITARY

Mil-G-174	Glass, Optical
MIL-W-5088	Wiring; Aircraft, Installation of
MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-T-5422	Testing, Environmental, Aircraft Electronic Equipment
MIL-P-7788	Panels, Information, Integrally Illuminated
MIL-M-7793	Meter, Time Totalizing
MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)
MIL-C-14806	Coating, Reflection Reducing, for Cover Glasses and Lighting Wedges
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-T-18303	Test Procedures; Preproduction and Acceptance for Aircraft Electronic Equipment, Format for
MIL-N-18307	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment
MIL-A-23887	Altimeter Set, Electronic AN/APN-141(V)
MIL-R-24011	Radar Altimeter Warning Set AN/APQ-107

MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
MIL-L-25467	Lighting, Integral, Instrument, General Specification for
MIL-L-27160	Lighting, Instrument, Integral, White, General Specification for
MIL-M-38510/104	Microcircuits, Linear, Line Drivers and Receivers, Monolithic Silicone
MIL-C-39012	Connectors, Coaxial, Radio Frequency, General Specification for

NAVAL AIR SYSTEMS COMMAND

MIL-STD-2084	Maintainability of Avionics Equipment and Systems, General Requirements for

STANDARDS

FEDERAL

FED-STD-595	Color

MILITARY

MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-463	Definitions and Systems of Units, Electromagnetic Interference Technology
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-781	Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution
MIL-STD-785	Reliability Program for System and Equipment Development and Production
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of

MIL-STD-810	Environmental Test Methods
MIL-STD-965	Parts Control Program
MIL-STD-2074	Failure Classification for Reliability Testing
MIL-STD-2076	Unit Under Test Compatability with Automatic Test Equipment, General Requirement for
MIL-STD-2077	Test Program Set, General Requirement for
MIL-STD-2084	Maintainability of Avionics Equipment and Systems. General Requirements for
MS3113	Connector, Receptacle, Electric Box Mounting, Miniature
MS17322	Meter, Time Totalizing, 115 Volt, 400-Cycle, Rev. B
MS25237	Lamp, Incandescent, Single Contact, Midget Flanged Base
MS25271	Relay, 10 amp, 4 PDT, Type I, Hermetically Sealed, Solder Hook
MS27478	Connector, Receptacle, Electric, Solder Type, Solder Mounting, Hermetic Seal, Pins, Bayonet Coupling Series IIA
MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of

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

PUBLICATIONS

NAVAL AIR SYSTEMS COMMAND

EI-566	Avionics Installation Instructions for Altimeter Set, Electronic AN/APN-194(V)
ET-566	Avionics Bench, Preflight and Flight Test Instructions for Altimeter Set, Electronic AN/APN-194(V)

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained upon application from the Commanding Officer, Publications and Forms Center, Code 105, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

3. REQUIREMENTS

* 3.1 First article. When specified, a sample(s) shall be subjected to first article inspection (see 4.2 and 6.3).

3.2 Parts and materials. In the selection of parts and materials, fulfillment of major design objectives shall be the prime consideration. In so doing, the following shall govern:

a. Microelectronic technology shall be considered and microelectronic items shall conform to requirements specified herein.

b. Other parts and materials requirements shall conform to MIL-E-5400.

c. Nonrepairable subassemblies shall be used in accordance with MIL-STD-2084 and as specified in MIL-E-5400.

d. When previously produced models of this equipment did not use nonrepairable subassemblies, the design shall not be changed to employ nonrepairable assemblies without the approval of the procuring activity.

* 3.2.1 Nonstandard parts and materials approval. Approval for the use of nonstandard parts and materials (including electron tubes, transistors and diodes) other than microelectronic devices shall be obtained as specified in MIL-E-5400. Microelectronic devices shall be approved as specified in MILSTD965, Procedure I.

* 3.2.2 Microelectronic modular assemblies. When used, Microelectronic Modular Assemblies shall meet the requirements of MIL-STD-965. Conformal coatings, encapsulants, embedments or potting materials used with modular assemblies containing integrated circuits and discrete parts shall be easily removable without damage to the assembly.

3.2.3 Modules. The electronic portions of the equipment shall be functionally modularized in accordance with MIL-STD-2084.

3.3 Design and construction. The equipment shall conform with all the applicable requirements of MIL-E-5400 for design, construction and workmanship, except as otherwise specified herein.

* 3.3.1 Total weight. The total weight of the AN/APN-194(V) Electronic Altimeter Set, excluding cables, shall be not greater than 6.8 pounds. This weight is predicated upon an Electronic Altimeter Set consisting of one Receiver-Transmitter, one Height Indicator, and two Antennas. For those Systems requiring an Interference Blanker, the total system weight shall be not greater than 8.55 pounds. The ID-2206/APN-194(V) height indicator will, if used, increase the above weights by 0.8 pounds per indicator. See EI-566 for typical unit weights.

3.3.2 Reliability. The contractor shall conduct a reliability program using MIL-STD-785 as a guide. On a reorder from a supplier who has previously produced the equipment, the program previously used may be continued unless otherwise specified in the contract (see 6.2.1).

3.3.2.1 Operational stability. The equipment shall operate with prescribed performance, continuously or intermittently for a period of at least 5000 hours without the necessity for readjustment of any controls which are inaccessible to the operator during normal use.

* 3.3.2.2 Operating Life. The equipment shall have a total operating life of 10,000 hours with minimal servicing and replacement of parts. (see 6.2.2).

* 3.3.2.3 Reliability in mean time between failure (MTBF). The system shall have 1500 hours of mean (operating) time between failures when tested and accepted as specified in 4.4.2. Allocation of MTBF for each item of the system shall be in accordance with 3.5.1.13, 3.5.2.18, 3.5.3.10 and 3.5.4.7.

* 3.3.2.4 Time totalizing meter. The following units shall contain a 10,000-hour time totalizing meter in accordance with MIL-M-7793.

Unit	Type of Meter
RT-1015A/APN-194(V)	M7793
RT-1042A/APN-194(V)	M7793

3.3.3 Cabling and connections

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

3.3.3.2 Interconnection cabling. The equipment shall be capable of prescribed operation using external wiring in accordance with MIL-W-5088. The external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements and provided the assembly of the cable to its plugs may be easily accomplished. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the equipment.

3.3.4 Interchangeability. The equipment shall meet the interchangeability requirements of MIL-E-5400 to the SRA/QRA level as defined by MIL-STD-2084.

* 3.3.4.1 Interchangeability with AN/APN-141(V). This equipment shall be interchangeable with the AN/APN-141(V) (MIL-A-23887) with respect to the following: (See 6.9).

a. Receiver-Transmitters RT-1015A/APN-194(V) and RT-1042A/APN-194(V) shall be physically and electrically interchangeable with the RT-

601B/APN-141(V) with the exception of electrical outputs to the Interference Blanker MX-9132A/APN-194(V) or RF Switching Unit SA-791A/APN-141(V) as applicable.

b. Height Indicator ID-1760B/APN-194(V) shall be electrically and mechanically interchangeable with Height Indicator ID-881B/APN-141(V).

c. Height Indicator ID-1768B/APN-194(V) shall be electrically and mechanically interchangeable with Height Indicator ID-1304/APN-141(V) except that a variable altitude aural warning function is added.

d. Height Indicator ID-1811A/APN-194(V) shall be electrically and mechanically interchangeable with Height Indicator ID-1015A/APN-141(V).

e. Height Indicator ID-1879A/APN-194(V) shall be electrically and mechanically interchangeable with Height Indicator ID-1687/APN-141(V).

f. Interference Blanker MX-9132A/APN-194(V) shall physically mount in the same position as RF Switching Unit, SA-791A/APN-141(V).

g. Antennas AS-2595/APN-194(V) and AS-2728/APN-194(V) shall be electrically interchangeable with Antennas AS-1233/APN-141(V) and AT-1015/APN-141(V), except that isolation shall be 85 dB minimum at spacings of 24 inches or greater.

h. Antenna AS-2741/APN-194(V) shall be electrically and mechanically interchangeable with Antenna AT-1015/APN-141(V), except that isolation shall be 85 dB minimum at center to center spacings of 24 inches or greater.

i. Antenna AS-2742/APN-194(V) shall be electrically and mechanically interchangeable with Antenna AT-1233/APN-141(V), except that isolation shall be 85 dB minimum at center to center spacings of 24 inches or greater.

j. External wiring and connectors for the AN/APN-141(V) shall be utilized without change to the extent required by the AN/APN-194(V) to achieve proper system operation and interface with other equipments. An installation kit is required for those Aircraft which presently have the AN/APN-141(V) Altimeter set installed. (See EI-566.)

3.3.5 Interference Control. The generation of radio interference by the equipment and the vulnerability of the equipment to radio interference shall meet the requirements of MIL-STD-461, MIL-STD-462, and MIL-STD-463 and as delineated herein. The upper frequency limit of test RS03 of MIL-STD-461 shall be extended from 10 to 20 GHz. The generation of interference during the operation of mechanical switch contacts in the Height Indicators is exempt from this requirement.

3.3.5.1 Conducted susceptibility and emissions, antenna terminal. The receiver performance requirements shall be met with the RF signals listed in Table I injected at the antenna input terminal individually

and collectively. Signals at the fundamental or necessary sidebands of the receiver are exempted. At each corresponding frequency, the transmitter peak power RF output shall be not greater than the levels shown in Table I. The power levels at the fundamental frequency and necessary sidebands shall be measured but are exempt from this requirement during the time period of intentional RF transmission. The levels shown in Table I supplement the requirements of MIL-STD-461. For frequency ranges and levels not shown, the requirements of MIL-STD-461 shall apply.

TABLE I. Conducted susceptibility and emissions limits.

Freq. (MHz)	Receiver	Transmitter
200 - 400	+ 3 dBm (peak)	-34 dBm
1000 - 1200	+20 dBm (peak)	-25 dBm
2100 - 2200	+21 dBm (peak)	-62 dBm
4200 - 4400	+15 dBm (peak)	-25 dBm
8000 - 9000	+29 dBm (peak)	-98 dBm

* 3.3.5.2 Transient radiated interference susceptibility test.

The equipment shall not exhibit any malfunction, degradation, or indication of other than normal performance when subjected to the transient susceptibility test. This test shall be performed using a test set-up in accordance with Figure 1. The relay used shall be type MS25271 or equal. No suppression shall be applied to the relay. The relay circuit shall be unshielded wire tightly coupled (TAPED) to and in parallel with the equipment power leads and shall be tightly looped about the units of the equipment comprising the test sample. The test shall be performed first with the Double Pole Double Throw (DPDT) switch in position A, then with the DPDT switch in position B.

3.3.5.3 Receiver cavity port radiation. Compliance with the receiver cavity radiation requirements of MIL-STD-461 shall not be required for the frequency band between 4290 and 4310 MHz. Emission at the receiver port of the receiver-transmitter shall be not greater than -17 dBm for the frequency range of 4290 to 4310 MHz.

* 3.3.5.4 Conducted and radiated emission limits. Conducted and radiated emissions shall be in accordance with MIL-STD-461. Levels shown in Table II, III and IV supplement the requirements of MIL-STD461 for Receiver-Transmitter RT-1015A/APN-194(V) only. For frequency ranges and levels not shown, the requirements of MIL-STD-461 shall apply.

TABLE II. Modified radiated emission limits - test RE02 (RT-1015A/APN-194(V) only).

Broadband		Narrowband	
Frequency	Max Limit	Frequency	Max Limit
15 KHz	107 dB	25 MHz	32 dB
78 MHz	63 dB	50 MHz	47 dB
82 MHz	60 dB	58 MHz	31 dB
93 MHz	69 dB	62 MHz	47 dB
98 MHz	77 dB	74 MHz	47 dB
105 MHz	60 dB	98 MHz	49 dB
120 MHz	69 dB	122 MHz	55 dB
124 MHz	79 dB	132 MHz	52 dB
140 MHz	61 dB	150 MHz	44 dB
146 MHz	65 dB	171 MHz	46 dB
149 MHz	74 dB	198 MHz	63 dB
171 MHz	73 dB	220 MHz	47 dB
198 MHz	80 dB	248 MHz	39 dB
220 MHz	61 dB	272 MHz	48 dB
245 MHz	60 dB	320 MHz	40 dB
272 MHz	62 dB	340 MHz	44 dB
292 MHz	63 dB		

TABLE III. Modified conducted emission limits - CE01 (RT-1015A/APN-194(V) only).

Narrowband	
Frequency, KHz	Max Limit, dB
1.2	101
7.6	70
10.0	65
10.8	67
11.6	66
12.4	66
13.2	65
14.0	64
14.8	63
15.6	60
16.4	58
17.2	56

TABLE IV. Modified conducted emission limits - test CE04 (RT-1015A/APN-194(V) only).

Broadband	
Frequency	Max Limit
1.5 MHz	60 dB
2.0 MHz	59 dB
3.0 MHz	62 dB
4.0 MHz	62 dB
5.0 MHz	63 dB
7.5 MHz	55 dB

3.3.6 Provisions for maintainability. The maintainability program, built-in test features, construction and packaging, provisions for test points, and other maintainability parameters shall be as specified in MIL-STD-2084. (See 3.4.12 and 3.5.2.12.3.1.)

* 3.3.6.1 Compatability with VAST. The equipment shall be compatible with the Versatile Avionic Shop Test System (VAST) and shall meet the requirements of MIL-STD-2076. When specified in the contract, (see 6.2.1) VAST Test Programs shall be included in accordance with MIL-STD-2077.

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

3.3.8 Standard conditions. The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

Temperature	Room ambient ($25^{o}C \pm 5^{o}C$)
Altitude	Normal ground
Vibration	None
Humidity	Room ambient up to 90% relative humidity
Input power voltage	115 ± 1.0 VAC 28 ± 1.0 VDC 5.0 ± 0.5 VAC

* 3.3.9 Service conditions. The equipment shall operate with prescribed performance under any of the environmental service conditions or reasonable combination of these conditions as specified in MIL-E-5400 for Class 3 equipment, except as modified herein and except that Height Indicators shall be Class 2. Antennas, except AS-2595/APN-194(V), shall be Class 4 except as modified herein.

* 3.3.9.1 Vibration. The equipment shall operate with prescribed performance when subjected to the vibration requirements of Curve IVA of MIL-E-5400.

* 3.3.9.1.1 Random vibration. The Receiver-Transmitter shall operate with prescribed performance when subjected to random vibration for 1 hour per axis in accordance with MIL-STD-810C, procedure 1A. The power spectral density (Wo) shall be $0.05G^2/Hz$. Antennas, except AS-2595/APN-194(V), shall operate satisfactorily when subjected to the test levels and durations specified on Figure 2.

* 3.3.9.2 Temperature-altitude. The equipment shall operate with prescribed performance at barometric pressures down to 1.32 inch Hg (approximately 70,000 feet altitude), and withstand without damage, barometric pressures down to 0.81 inch Hg (approximately 80,000 feet). Temperature extremes, combined temperature-altitude and temperature shock tests (equipment operating) of Table I, MIL-E-5400, listing temperatures higher than $+95^{\circ}C$ are not required for the Antenna AS-2595/APN-194(V), Interference Blanker, and Receiver-Transmitter and $+71^{\circ}C$ for the Height Indicators. Temperatures higher than $+150^{\circ}C$ shall not be required for Antennas AS-2728/APN-104(V), AS-2741/APN-194(V) and AS-2742/APN-194(V).

3.3.9.3 Shock. The Antennas, Interference Blanker, and Receiver-Transmitters must survive 18 (6 in each direction) impact shocks of 32g having a time duration of 11 $\pm$ 1 milliseconds. Although operation during the shock applications is not required, power must be applied to the equipment during the shock application and operation must be resumed with no reduction in accuracy in less than 1.0 second after cessation of the shock load.

3.3.9.4 Acoustical noise. When the Antennas, Interference Blanker, and Receiver-Transmitters are normally mounted, they shall operate with prescribed performance when subjected to the acoustical environment specified in MIL-STD-810, Grade B, except that the total exposure time shall be three hours and the overall sound pressure shall be 148 db.

3.3.9.5 Equipment nonoperation. Equipment shall not suffer damage or subsequently fail to provide the performance herein specified when subjected to the storage environment specified in 3.3.9.5.1.

3.3.9.5.1 Temperature. Temperature ranging from $-62^{\circ}C$ to $+125^{\circ}C$ for all units except the Indicators. Temperature ranging from $-62^{\circ}C$ to $+95^{\circ}C$ for Indicator only. Temperature shock of $125^{\circ}C$ delta temperature for all components.

* 3.3.9.6 Humidity. The Receiver-Transmitter shall operate with prescribed performance after exposure to humidity as specified in MIL-E-5400. After the humidity test the RF center frequency shall be 4300 $\pm$ 25 MHz, the 9 dB gain margin of 3.4.7 shall not be required and the unit must remain in track at a total loop attenuation of 112 dB. Normal performance shall resume after a maximum of four hours operation at an ambient temperature of $+55^{\circ}C$ or an equivalent drying period.

* 3.3.10 Warm-up time. The time required for equipment to warm-up prior to operation shall be kept to a minimum and shall be not greater than three minutes at -55°C. Normally, operation is immediate upon power-up, but outputs need not be within specified limits prior to the three minute warm up period.

3.3.11 *Input electrical power*

* 3.3.11.1 Operating power. The equipment shall meet all applicable requirements of MIL-STD-704 and shall give specified performance when energized from the following power sources having characteristics and limits as defined in MIL-STD-704. The power, excluding lighting, required for the equipment shall be not greater than the specified amounts.

a. AC Power (Single Phase), 115V, Category C.

Receiver-Transmitter - 40VA

b. DC Power, 28V, Category C.

ID-1760B/APN-194(V)	- NA
ID-1768B/APN-194(V)	- 2.5VA (per Indicator)
ID-1811A/APN-194(V)	- NA
ID-1879A/APN-194(V)	- NA
ID-1880A/APN-194(V)	- 2.5VA (per Indicator)
ID-2206/APN-194(V)	- 10VA (per Indicator)

3.3.11.2 Lighting power. Input power for lighting shall be not greater than 0.5 amp at 5.0 volts AC.

3.3.11.3 Degraded performance. Degraded performance will be permitted for voltage transients not greater than 0.5 second during normal electric system operation. Operation shall return to normal with no resulting damage to the equipment.

3.3.12 Cooling. Conduction cooling shall be employed. No cooling air shall be required.

3.3.13 Mounting. All items shall be hardmounted. No separate mountings shall be required.

3.3.14 Soldering. Soldering shall be in accordance with MIL-STD-454, Requirement 5, except that a flux equivalent to Type RA of QQ-S-571 may be used for making electrical connections by flow soldering methods providing that the contractor shall conduct a Resistivity-of-Water Extract Test which satisfies the requirements of MIL-F-14256 once each week and before any change in the cleaning solution.

* 3.4 Performance. Unless otherwise specified herein, values set forth to establish the requirements of prescribed performance apply to performance under standard, extreme service, and input power conditions. When reduced performance under the extreme conditions is acceptable,

tolerances or values setting forth acceptable variations from the performance under the standard conditions will be specified in 3.3.8.

3.4.1 Operation. The altimeter set shall transmit a radio frequency signal to the ground, receive the reflected signal, and derive and display an indication of absolute altitude in accordance with the performance requirements of this specification. Doppler and step errors shall be minimized. The set shall have search and track modes of operation. In the search mode, the complete altitude range is searched rapidly for a ground return. In the track mode, the set locks on and tracks a ground return giving continuous altitude information. Altitude information is obtained by measuring the time from the instant RF energy leaves the transmitter until the ground return signal is detected in the receiver. The set converts the time interval information to two DC output voltages and a serial digital output data word. One DC output is applied to a device(s) which indicates altitude (in feet) proportional to the amplitude of the DC voltage. The other DC output is a voltage proportional to altitude suitable for use as an input to the aircraft flight control or other systems. The digital output is provided to avionics systems requiring digital altitude and corresponds to the analog outputs. Other outputs provide analog altitude rates and blanking pulse signals to other equipments requiring such information. Altitude warnings are provided when the aircraft is at or below certain fixed or variable altitudes.

* 3.4.2 Altitude range. The set shall indicate absolute altitude from 0 to 5000 feet over water or land except those installations using the ID-2206/APN-194(V) Height Indicator shall indicate 0 to 1000 feet. For installations requiring an Interference Blanker, minimum altitude shall be less than 20 feet.

3.4.3 Altitude accuracy. The Receiver-Transmitter output altitude signal levels of 3.5.1.7.1, 3.5.1.7.2, and 3.5.1.7.7 herein under service conditions, shall be less than ± 3 feet or ± 4 percent of the correct terrain clearance, whichever is greater. The indicator shall display altitude in feet within the accuracy requirement of 3.5.2.2.

3.4.4 Frequency. The set shall operate within the allocated frequency range of 4200 to 4400 megahertz (MHz) with a center frequency of 4300 ± 10 MHz and with guard bands at both ends of the range to preclude interference with equipment operating outside this range.

3.4.5 Electrical tracking rate. The altitude signal (set less Indicator) shall follow changes in height at the rate of not less than ±2000 feet per second.

3.4.6 Ground speed limit. The set shall provide reliable operation at all ground speeds up to 2,000 knots.

3.4.7 Minimum reflected signal. Minimum reflected signal at 5,000 feet shall be not less than 9 dB above that required for reliable operation assuming 12 dB attenuation at reflection.

3.4.8 Aircraft attitude. The set shall operate normally and reliably in an aircraft when climbing and diving at 45^{0} angles, and when banking at 45^{0} angles. Flight maneuvers shall not cause detrimental effects. Operation of the set in any aircraft position shall not prevent normal operation when the aircraft returns to normal flight.

3.4.9 False indication. The system shall not lock on noise or any interfering or false signal(s).

3.4.10 Variable altitude limit index. A switching function shall be provided in each height indicator to provide a warning when the absolute altitude is lower than a preselected height. The switching function shall close and open at the variable altitude limit index setting within ±3 feet or ±3 percent of the indicated altitude, whichever is greater. The variable altitude limit index warning shall be given by a warning light on the indicator and connected to warning lights located on the aircraft instrument panel.

3.4.10.1 External variable altitude limit index connections. Two connector contacts shall be provided in the indicator for the switching function. The circuit shall provide for three parallel connected MS25237-327 incandescent lamps for external use.

* 3.4.10.2 Operation. The variable altitude limit index circuit shall not operate when:

a. the return signal to the Receiver-Transmitter becomes inadequate, or

b. the set is turned off, or

c. The altitude is above 5000 feet (1000 feet for the ID-2206/APN-194(V) Height Indicator), or

d. the indicated altitude is zero feet and the limit index is set to the minimum altitude to which it can be set without actuating the on-off switch to the off position.

3.4.11 Installation delay/adjustment (residual). The Receiver-Transmitter shall be externally adjustable to allow for an aircraft installation delay from 1 to 20 feet of antenna height above ground and for RF coaxial cable lengths.

3.4.12 Self-test provisions. A self-test shall be incorporated to provide inflight and preflight testing of the set. Self-test shall be activated by depressing the control knob on the Indicator and shall be capable of being energized continually with no degradation of performance. For self-test, the Indicator display shall be 100 ± 10 feet. The digital altitude shall be 100 ± 7 feet.

* 3.4.13 Sensitivity. The set must remain in the "track" mode (locked onto a simulated target) with a total loop attenuation of 121 dB at any simulated altitude greater than 1000 feet.

3.4.14 Indicator combinations. The set shall provide performance as specified herein with one to four Height Indicators of any type or combination of types specified herein.

3.5 Detailed requirements

* 3.5.1 Receiver-Transmitters RT-1015A/APN-194(V) and RT-1042A/APN-194(V). The Receiver-Transmitters shall meet the requirements specified in 3.5.1.1 through 3.5.1.13.

3.5.1.1 Function. The Receiver-Transmitter shall transmit a radio frequency signal, receive the reflected signal, and derive the proper voltage analogs for 0 to 5,000 feet radar altitude in accordance with the requirements of this specification. In addition, the Receiver-Transmitter shall provide analog altitude, altitude rate, blanking pulse, reliability signals, and an Indicator reference voltage. Receiver-Transmitter RT-1015/APN-194(V) shall also provide altitude in the digital format described in 3.5.1.7.7.1.

* 3.5.1.2 Form factor. The overall maximum dimensions for the Receiver-Transmitter shall be contained within the volume of EI-566-7.

* 3.5.1.3 Weight. The weight of the Receiver-Transmitter shall be not greater than 4.4 pounds.

* 3.5.1.4 Contents. The Receiver-Transmitter shall contain RF or microwave assemblies, plug-in modules, power supplies and RFI filters as necessary to comply with the requirements of this specification. Receiver-Transmitter RT-1042A/APN-194(V) shall be identical to Receiver-Transmitter RT-1015A/APN-194(V) in all respects except that the digital range computer module, providing altitude in digital format, is removed. Mounting and interconnection provisions for the digital range computer module shall be maintained in the RT-1042A/APN-194(V), thereby providing the capability of converting an RT-1042A/APN-194(V) to an RT-1015A/APN-194(V) as required. (A reversible nameplate shall be provided on each Receiver-Transmitter for change in identification when the installation or removal of the digital range computer module is made.)

3.5.1.5 Controls. There shall be no in-flight controls located on the Receiver-Transmitter.

3.5.1.6 Electrical connections. Connections to external circuits shall be provided as specified in table V. (See EI-566 for interconnect diagrams.)

Table V. Electrical Connections

Reference Designation	Receptacle Type or Equivalent	Function
J101	MS3113H14C19P	Power and Signal
J102	TNC Female per MILC39012	To Receive Antenna or Interference Blanker
J103	TNC Female per MILC39012	To Transmit Antenna
J104	MS27478Y10D13P	Vast Test and Modulator Pulse Output to Interference Blanker
J105	SMA Female per MILC39012	Blanking Pulse Input
J106	MS3113H14C19PW	Vast Test
J107	Polarized TNC	Blanking Pulse Output

3.5.1.7 Receiver-Transmitter outputs

3.5.1.7.1 Altitude-indicator. The Receiver-Transmitter shall provide an analog DC voltage proportional to altitude, having the characteristics specified herein, for driving one to four indicators described in 3.5.2. The DC voltage shall be +1.0 volt for zero feet of altitude, +9.0 volts for 400 feet of altitude and +21.006 volts for 5000 feet of altitude. The signal shall consist of two linear segments; one with a scale factor of +20 millivolts per foot for the segment representing zero to 400 feet and one with a scale factor of +2.61 millivolts per foot for the segment representing 400 feet to 5000 feet. This signal shall be +24.5 ± 1 volt during search or unreliable conditions, and shall operate into a minimum 12,500 ohm load. During self-test, this voltage shall be 3.0 ± 0.200 VDC.

* 3.5.1.7.2 Altitude-flight control. The Receiver-Transmitter shall provide a separate isolated linear DC voltage proportional to altitude, having a scale factor of +5 millivolts per foot with 0 to +25 VDC corresponding to 0 to 5,000 feet altitude respectively. This signal shall be -1 ± 0.5 VDC during search or unreliable conditions and shall operate into a minimum 5,000 ohm load. During self-test, this voltage shall be 0.50 ± 0.050 VDC.

3.5.1.7.3 Reliability signal. The Receiver-Transmitter shall provide a reliability signal for use by associated equipments. The reliability signal voltage shall be +4 ± 0.5 VDC into a load impedance of 180 ohms minimum during track or reliable operation and -0.75 ± 0.75 VDC during search or unreliable operation. During self-test, the reliability signal shall indicate in-track, or reliable, if the Receiver-Transmitter functions normally and out-of-track, or unreliable, if the Receiver-Transmitter is malfunctioning.

3.5.1.7.4 Altitude rate signal. The Receiver-Transmitter shall provide a separate isolated linear analog DC voltage proportional to altitude rate of change, having a scale factor of 10 mv/ft/sec with 0 to

±5 VDC corresponding to 0 ± 500 ft/sec altitude change respectively. The altitude rate signal shall operate into a minimum load of 2,000 ohms. The accuracy of the altitude rate signal shall be ±(5 ft/sec + 5 percent of actual rate). During self-test, the altitude rate signal shall be 0 ± 0.050 VDC within 1 second maximum after actuation of the self-test switch.

3.5.1.7.5 Indicator reference signal. The Receiver-Transmitter shall provide a 150 VDC ±1 percent reference signal for use by the Height Indicator(s). This signal shall be capable of operating a 30,000 ohm minimum load.

3.5.1.7.6 Blanking pulse. The Receiver-Transmitter shall produce a blanking pulse for each transmitted pulse. This blanking pulse shall have the following characteristics when looking into a 93-ohm terminated transmission cable with termination impedance tolerance of ±10 percent. (See 6.6 for list of definitions).

a.	Polarity	Positive
b.	Amplitude	7 ± 1 volts
c.	Rise Time	60 nanoseconds maximum
d.	Lag Time	200 ± 100 nanoseconds (Total width to be greater than 250 nanoseconds)
e.	Fall Time	120 nanoseconds maximum
f.	Lead Time	200 ± 100 nanoseconds
g.	Voltage Variation	±0.75 volt
h.	D.C. Level	0 to 0.3 volt between pulses
i.	Noise	+1 volt peak maximum between pulses
j.	Undershoot	Maximum of 0.5 volt

* 3.5.1.7.7 Altitude signal-digital (Receiver-Transmitter RT-1015A/APN-194(V) only). The Receiver-Transmitter shall provide separate isolated altitude in digital, serial form to interface with sundry computers used in Navy aircraft. The interface, altimeter to the computer is composed of the three signals; READ, DATA OUT, and SHIFT CLOCK. The READ line shall be capable of being operated as either a differential input receiver or a single wire discrete. The DATA OUT shall be received by a double ended receiver. The SHIFT CLOCK is received by the altimeter as a differential output from the computer. The READ line shall be simplexed to the altimeter and shall be valid at a minimum of 1.0 microsecond prior to the transmission of SHIFT CLOCKS. A maximum of 400 nanoseconds after the transmission of the first SHIFT CLOCK pulse, bit #1 of data shall be available on the DATA OUT lines. The Altimeter output register shall then be shifted once on each of the remaining 19 negative (voltage) transitions of the SHIFT CLOCK provided by the computer. The data will be received from the Altimeter serially at a rate of 5 KHz to 1 MHz. At a minimum of 1.0 microsecond after the 20th SHIFT CLOCK pulse from the computer, the READ line will be returned to zero Logic Level. When the READ line is in the logical "1" state, updating of the digital output register shall be inhibited following the 1.0 microsecond settling time. (The minimum time between the start of successive READ Commands shall be 50 milliseconds). Minimum and maximum times shall be measured between

the 90 percent point of the previous transition and the 10 percent point of the subsequent transition. (See Figure 3 for timing relationships.)

3.5.1.7.7.1 Data word format. The data shall be transferred to the computer in the format as follows:

TABLE VI

BIT	DESIGNATION	LOGICAL VALUE (True)
1	Control	1
2	Validity	1 = valid
3	Data LSB	1 = 1.0 feet
4	Data	
5	Data	
6	Data	
7	Data	
8	Data	
9	Data	Straight Binary (feet)
10	Data	
11	Data	
12	Data	
13	Data	
14	Data	
15	Data MSB	1 = 4096 feet
16	Spare	0
17	Spare	0
18	Spare	0
19	Spare	0
20	Parity	Odd

The transmission sequence shall be such that the control bit is transmitted first. All data shall be least significant bit justified and zeros shall be inserted into the remaining most significant data bits beyond the resolution requirements. The parity bit is assigned a value such that the total number of "ones" in the 20 bit word is odd.

* 3.5.1.7.7.2 Computer/altimeter data channel. The computer/altimeter data channel shall consist of the following signals:

a.

Signal Name	Signal Type
DATA OUT True	Differential NonReturntoZero (NRZ)
DATA OUT One's Complement	Differential NonReturntoZero (NRZ)
SHIFT CLOCK True	Differential 5 KHz to 1 MHz, 50 percent ± 10 percent Duty Cycle
SHIFT CLOCK One's complement	Differential 5 KHz to 1 MHz, 50 percent + 10 percent Duty Cycle
READ	Discrete "1" Read, Differential or single ended
SIGNAL GROUND	All signal grounds are common and tied to chassis ground

b.

Logic Levels	Characteristics
Logical "0"	True line 3.0V minimum positive with respect to the complement line
Logical "1"	True line 3.0V minimum negative with respect to the complement line

c. The complement data output shall follow true data output pulses 30 nanoseconds maximum

d. Common Mode Voltage — ±5 volts, maximum, with respect to ground

e. Rise/Fall Time — The rise/fall time of the SHIFT CLOCK shall be a maximum of 15 percent of the clock period

f. SHIFT CLOCK Delay — The complement clock pulses shall be delayed from the true clock pulses a maximum of 10 percent of the clock period

g. Load Resistance — The 130 ohms input resistor of the line receivers shall not be connected

* 3.5.1.7.7.3 Altimeter output differential transmitter. The Altimeter output differential transmitter shall be a differential line driver in accordance with MIL-M-38510/104, device type 03.

* 3.5.1.7.8 Modulator pulse output. The Receiver-Transmitter shall provide a pulse during each transmitted pulse for use by the Interference Blanker. The pulse output shall have the following characteristics when terminated in 51 ohm ±10 percent resistive load shunted by 470 picofarads ±10 percent. (See 6.6 for definitions.)

a.	Polarity	Positive
b.	Amplitude	8.5 volts peak minimum
c.	Source Impedance	Less than 15 ohms
d.	Lead Time	10 nanoseconds minimum
e.	Lag Time	20 nanoseconds maximum
f.	DC Level	0 to ±0.2 volts between pulses
g.	Pulse Width	Transmitted RF pulse width as a minimum

3.5.1.8 Receiver-Transmitter inputs

* 3.5.1.8.1 Altimeter input differential receiver (Receiver-Transmitter RT-1015A/APN-194(V) only). The altimeter SHIFT CLOCK receiver shall be a differential line receiver in accordance with MIL-M-38510/104 device type 04.

* 3.5.1.8.2 Altimeter input discrete receiver (Receiver-Transmitter RT-1015A/APN-194(V) only). The altimeter READ discrete input shall be a differential line receiver in accordance with MIL-M-38510/104, device type 04 and shall operate as either a differential receiver or as a single ended receiver. If the discrete input TRUE line becomes open circuited, the receiver shall operate as though a logical "0" were present at its inputs. The READ discrete receiver shall operate single ended when, with the READ COMPLEMENT line open circuited, signals referenced to signal ground having the following characteristics are applied to the READ TRUE input line.

a.	Logical "0"	+5 + 1.0 volts with the receiver sinking 6.5 milliamperes maximum.
b.	Logical "1"	0 + 0.5 volts with the receiver sourcing 6.5 milliamperes maximum.
c.	Rise/Fall Time	The rise/fall time of the read command shall be not greater than 20 percent of the Shift Clock period provided by the computer.

3.5.1.8.3 Blanking input. Blanking pulse input shall be provided to permit blanking of the equipment receiver and transmitter such that

the RF level to the transmit antenna terminal does not exceed the values indicated in Table I and the receiver does not respond to signal levels as great as +15 dbm during the blanking interval. This blanking pulse shall have the following characteristics: (See 6.6 for list of definitions):

a.	Polarity	Positive
b.	Amplitude	12 ± 1 volt
c.	Source Impedance	93 ohms ± 10 %
d.	Rise Time	20 nanoseconds max
e.	Fall Time	40 nanoseconds max
f.	Blanking Start Lag Time	750 nanoseconds max
g.	Width	100 nanoseconds to DC
h.	Unblank Lag Time	600 nanoseconds max
i.	Voltage Variation	±0.5 volts
j.	DC Level	±0.5 volts between pulses
k.	Noise	±1.0 volt peak
l.	Undershoot	1.0 volt max

3.5.1.8.4 Self-test input. The self-test input signal shall be ground (-0.5 ± 0.5 VDC) during self-test and open (5.0 to 30.0 VDC) during normal system operation.

3.5.1.9 Orientation. The Receiver-Transmitter shall operate to the accuracies required by this specification with no restriction in orientation.

3.5.1.10 Altitude memory. All "in track" outputs of the Receiver-Transmitter shall be maintained for 1 + 0.5 seconds after loss of return signal before reverting to the search (out of track) state.

3.5.1.11 Data lag. Data from the Receiver-Transmitter shall not lag any change by more than 0.1 second.

3.5.1.12 Output protection. Protective circuitry shall be included in the Receiver-Transmitter to prevent damage due to accidental short-circuits or open-circuits of the electrical signal outputs.

* 3.5.1.13 Allocated reliability and mean time between failure. To assure meeting the system requirement of 1500 hours MTBF, the receiver-transmitter when tested in accordance with paragraph 4.4.2 shall have 2500 hours Mean (operating) Time Between Failure.

* 3.5.2 Indicator, height, ID-1760B/APN-194(V), ID-1768B/APN-194(V), ID-1811A/APN-194(V), ID-1879A/APN-194(V), ID-1880A/APN-194(V), ID-2206/APN-194(V). The Indicators shall meet the requirements specified in 3.5.2.1 through 3.5.2.1.8.

* 3.5.2.1 Function. The Indicator shall indicate altitude from 0 to 5000 feet (except for the ID-2206/APN-194(V) Indicator) by means of a single pointer against a fixed dial. The ID-2206/APN-194(V) Indicator shall indicate altitude from 0 to 1000 feet. A movable marker positioned against the same dial shall indicate the preselected height below which the variable altitude limit index function operates. Unreliable operation shall be indicated by an "OFF" flag coming into view and the pointer shall go behind the masked portion of the Indicator dial when:

a. the signal strength to the Receiver-Transmitter becomes inadequate to provide reliable altitude information (see paragraph 3.5.1.7.1) or

b. the set is turned off, or

c. aircraft power to the system is lost.

Signal return at altitudes higher than 5000 feet (except for the ID-2206/APN-194(V) Indicator) shall also be indicated by movement of the pointer behind the masked portion of the Indicator dial. The ID-2206/APN-194(V) Indicator shall indicate altitudes higher than 1000 feet by movement of the pointer behind the masked portion of the Indicator dial.

3.5.2.2 Accuracy. The accuracy of the Indicators shall be ±1.0 foot or ±1 percent, whichever is greater, of the altitude voltage as supplied by the Receiver-Transmitter altitude signal. (See 3.5.1.7.1.)

* 3.5.2.3 Form factor. The ID-1760B/APN-194(V) and ID-1879(A)/APN-194(V) indicators shall conform to the dimensions of EI-566-8. The ID-1768B/APN-194(V) and ID-1880A/APN-194(V) indicators shall conform to the dimensions of EI-566-9. The ID-1811A/APN-194(V) indicator shall conform to the dimensions of EI-566-10. The ID-2206/APN-194(V) height indicator shall conform to the dimensions of EI-566-16.

* 3.5.2.4 Weight. The weight of each height indicator shall not exceed 1.6 pounds, except that the ID-2206/APN-194(V) height indicator shall be not greater than 2.4 pounds.

* 3.5.2.5 Contents. Each indicator shall include the necessary mechanism to rotate the altitude indicator pointer to a position corresponding to the altitude represented by the input voltage signal. Each indicator shall also include a dial mask, a variable altitude limit index, "OFF" flag indicator, instrument lighting, variable altitude warning index light and a self-test valid light. The ID-1768B/APN-194(V) and ID-1880A/APN-194(V) indicators shall include an aural-visual altitude warning system as detailed in 3.5.2.16. The ID-2206/APN-194(V) height indicator shall include an aural-visual warning system as detailed in 3.5.2.17.

3.5.2.6 Controls. A control knob located as shown on EI-566-8, EI-566-9, EI-566-10 and EI-566-16 shall control the variable altitude

limit index, actuate the self-test circuit, and function as the system power control knob. The variable altitude limit index shall be continuously adjustable throughout the range of the set. When the set is turned off this marker shall be located under the masked portion of the indicator display. When the equipment is turned on, the initial position of the limit index shall be no greater than zero feet. The self-test circuit shall be actuated by depressing the control knob. The control knob shall contain an integral clutch assembly to preclude damaging gearing should the knob be rotated so as to force the gearing against internal stops.

* 3.5.2.7 Electrical connections. Connections to external circuits shall be provided by multicontact connectors mounted on the rear of each indicator as shown on EI-566-8, EI-566-9, EI-566-10 and EI-566-16 and as follows: (See EI-566 for interconnecting diagrams.)

Reference Designation	Receptacle Type or Equivalent	Function
J1301 (Each indicator)	77820PT071418P	Power and Signal
J1302 (ID-1768B/APN-194(V), ID-1880A/APN-194(V), and ID-2206/APN-194(V) only)	77820-PT07-14-18PXS	Warning Signal Inputs and Outputs

* 3.5.2.8 Dial markings. The dials of the ID-1760B/APN-194(V), ID-1811A/APN-194(V), and ID-1879A/APN-194(V) Indicators shall be as shown in Figure 4. The dials of the ID-1768B/APN-194(V) and ID-1880A/APN-194(V) Indicators shall be as shown in Figure 5. The dial of the ID-2206/APN-194(V) Height Indicator shall be as shown in Figure 6. The tip of the pointer shall coincide with the innermost point of the minor graduations. The variable altitude limit index shall be in the form of an equilateral triangle and shall be positioned to provide a 0.020 inch (0.508 mm) clearance with the pointer tip. Letters and numbers shall be in accordance with MS33558.

3.5.2.9 Multiple indicator protection. Protection shall be provided in each indicator to prevent a failure in that indicator from affecting the operation of other indicators in the system.

* 3.5.2.10 Instrument lighting. The ID-1760B/APN-194(V), ID-1768B/APN-194(V) and ID-1811A/APN-194 height indicators shall incorporate integral red lighting in accordance with MIL-L-25467. The ID-1879A/APN-194(V) and ID-1880A/APN-194(V) indicators shall incorporate integral white lighting in accordance with MIL-L-27160. The ID-2206/APN-194(V) height indicator shall incorporate integral instrument and panel lighting (IPL) white lighting in accordance with MIL-C-25050, color Type 1(g). Lighting intensity and light distribution shall be in accordance with MIL-L-25467 with 5.0 $\pm$ 0.1V applied to the lighting terminals.

3.5.2.10.1 Coverglass and lighting wedge. The coverglass and lighting wedges shall conform to MIL-G-174 and shall not interfere with the readability of the instrument. It shall be properly sealed and shall be replaceable by removing the bezel. All reflecting glass surfaces shall be provided with a reflection-reducing coating which meets the requirements of MIL-C-14806, in addition to withstanding the environmental conditions specified herein, except that the following reflectance tolerances shall apply:

Angle of Incidence	Wavelength Millimicrons	Percent Reflectance
0^{o}	450675	0.6 absolute
0^{o}	425700	0.5 average
30^{o}	450625	1.0 absolute
30^{o}	425700	0.5 average

3.5.2.11 Fogging. The indicator face shall be free from any visible condensation when operating within the environmental service conditions specified in 3.3.9. A rapid change in environmental conditions shall not generate condensation on the face of the indicator.

3.5.2.12 Inputs, outputs, and special display features

3.5.2.12.1 Input signals

3.5.2.12.1.1 Altitude-indicator signal. The altitude-indicator input signal shall be as described in 3.5.1.7.1. The impedance presented to this signal shall be greater than 50,000 ohms.

3.5.2.12.1.2 Indicator reference signal. The indicator reference signal shall be 150 VDC ± 1 percent. The impedance presented to this signal shall be greater than 120,000 ohms.

3.5.2.12.1.3 External "OFF" flag control. Each indicator shall contain provisions for external control of the "OFF" flag. Control shall consist of a pair of externally located contacts which, when closed, prevent the flag from being withdrawn from view when power is applied to the set. When the contacts are open, the flag shall operate normally under the conditions described in 3.5.2.1.

3.5.2.12.2 Output signals

* 3.5.2.12.2.1 Self-test. The self-test output signal shall be ground when the self-test knob is actuated. At all other times, the voltage shall be +30.0 VDC ± 10 percent applied through 100,000 ohms, nominal.

3.5.2.12.3 Special display features

* 3.5.2.12.3.1 Self-test valid indicator. The self-test valid indicator shall be a green light which is illuminated if the indicator-altitude signal (see 3.5.1.7.1) is within the limits of 100 ± 13 feet (2.740 to 3.260 VDC) during actuation of the self-test function and extinguished at all other times. This lamp shall be located as shown in Figures 4, 5 and 6. The self-test valid light shall be externally dimmable by the same switch that controls the brightness of the Instrument Lighting specified in 3.5.2.10. Brightness shall be not less than 150 foot lamberts when integral lighting voltage is 4.5 volts or greater, and 1 ± 0.5 foot lamberts when integral lighting voltage is less than 4.0 volts. Brightness shall be measured at three points on the lens through an Opal glass diffuser. The points shall include the brightest and dimmest spots on the lens and the readings shall be corrected to reflect the transmissibility of the diffuser.

* 3.5.2.12.3.2 Variable altitude limit index warning light. The variable altitude limit index warning light shall be a red light which shall be illuminated under the conditions specified in 3.4.10. This lamp shall be located as shown in Figures 4, 5 and 6. The ground lead for the light shall not be grounded internally, but shall be brought out to a connector pin to permit external dimming of the light.

3.5.2.12.3.3 "OFF" flag. The "OFF" flag shall be controlled by the altitude-indicator voltage from the Receiver-Transmitter (see 3.5.1.7.1). The "OFF" flag shall read "OFF" for altitude voltages of 23.5 VDC or greater and shall not come into view for voltages less than 23 VDC. The "OFF" flag shall come into view within 0.5 second after the altitude voltage becomes 23.5 VDC or greater. The "OFF" flag shall also come into view when power is removed from the system.

3.5.2.13 Response. Full scale response of the indicator pointer shall be not greater than one second.

3.5.2.14 Damping. Each indicator shall be damped to prevent pointer overshoots in excess of one degree. The settling time of the pointer shall be not greater than 0.2 second.

3.5.2.15 Variable altitude limit index warning characteristics. When the aircraft is at or below the indicator variable altitude limit index setting, the low altitude warning switching function shall be continuously closed (the "ON" condition).

* 3.5.2.16 Altitude warning characteristics - ID-1768B/APN-194(V) and ID-1880A/APN-194(V) indicators. In addition to the warnings specified in paragraph 3.5.2.15, a separate aural warning output signal to the pilot's and copilot's interphone stations shall be provided.

3.5.2.16.1 Altitude index requirement. The altitude setting at which the warning output signal shall be initiated is determined by the variable altitude limit index setting per 3.5.2.6 and shall occur for descending altitude only.

* 3.5.2.16.2 Output signal requirements. The aural output signal, when enabled as described herein, shall be a 1000 ± 200 Hz sine wave voltage which is pulse modulated on and off at a rate of 2 ± 0.5 pulses per second with a pulse width of 0.2 ± 0.05 pulses per second. The voltage amplitude shall be ground adjustable through a range of 0 to 25 volts peak-to-peak and shall maintain the set level to an accuracy of ±20 percent. This level shall be attained when the output is terminated in an external resistance of 600 ohms or greater. The maximum residual output during the "OFF" portion of the cycle shall be less than 0.5 volts peak-to-peak across the external load. During the "ON" portion of the cycle the harmonic distortion shall be less than 40 percent and the amplitude modulation shall be less than 20 percent. The output signal gate shall be delayed 0.50 second ± 50 percent after the application of the enabling signal.

3.5.2.16.3 Provisions for enabling output signal

*a. Electronic altimeter limit indicator. The output signals described in 3.5.2.16.2 shall be enabled for 5 ± 1 pulses when the variable altitude limit index, as defined herein, is in the "ON" condition. For installations employing a single Height Indicator, the signal shall be distributed to both crew stations. For multiple Indicator installations, the signals shall be distributed to the crew stations associated with each Indicator as required by the individual variable altitude limit index setting. The distribution of signals to the crew stations shall be accomplished within the aircraft wiring harness.

b. Warning test command. The output signals described in paragraph 3.5.2.16.2 shall be enabled during the application of the test command signal as defined herein.

3.5.2.16.4 Description of input signals.

a. Warning test command input signals. The warning test command input signal will be +25 ± 4 VDC when the warning test switch is depressed and open circuited at all other times. The input impedance presented to this signal shall be greater than 200 ohms.

* 3.5.2.17 Altitude warning characteristics - Height indicator ID-2206/APN-194(V). In addition to the warnings specified in 3.5.2.15, the indicator shall provide an aural warning output signal to the pilots and copilots interphone stations, and a visual warning output signal to the visual warning feature at three discrete altitude index settings.

* 3.5.2.17.1 Altitude index requirements

a. High altitude index. The high altitude index shall be bench adjustable for altitudes between 0 and 1000 feet. The settings of the altitude index shall be maintained to an accuracy of ±5 feet for settings below 100 feet, and ±5 percent for settings above 100 feet. Access to the index adjustment shall be as shown in Drawing EI56616.

b. Low altitude index. The low altitude index shall be bench adjustable for altitudes between 0 and 300 feet. The setting of the altitude index shall be maintained to an accuracy of ±5 feet for settings below 100 feet, and ±5 percent for settings above 100 feet. Access to the index adjustment shall be as shown in Drawing E156616.

c. Variable altitude limit index. As described in 3.5.2.6 herein.

* 3.5.2.17.2 Output signal requirements

a. Electrical aural warning signal characteristics. The output signal when enabled as described herein shall be a 1000 ± 200 Hz sine wave voltage which is pulse modulated on and off at a rate of 2 ± 0.5 pulses per second with a pulse width of 0.2 ± 0.05 seconds. The voltage amplitude shall be ground adjustable through a range of 0 to 20.0 volts peak-to-peak and shall maintain the set level to an accuracy of ±20 percent. This level shall be attained when the output is terminated in an external resistance of 600 ohms or greater. The maximum residual output during the "OFF" portion of the cycle shall be less than 0.5 volts peak-to-peak across an external load of 100K ohms or less. During the "ON" portion of the cycle the harmonic distortion shall be less than 40 percent and the amplitude modulation shall be less than 20 percent. The first warning pulse shall be delayed 0.50 ± 0.20 seconds after application of the enabling signal as defined in 3.5.2.17.3. The output impedance of the aural warning signal shall be less than 275 ohms when energized and less than 425 ohms when deenergized. Maximum residual output when the aural warning signal is not activated shall be less than 30 millivolts RMS.

b. Electrical visual warning signal characteristics. The output signal when enabled as described herein shall consist of pulses of DC voltage which shall be gated on and off synchronously with the signal described in 3.5.2.17.2 (1). In the "ON" condition, the pulse amplitude shall be within 3 ± 1 VDC less than the D.C. input power level for a minimum of 75 percent of the pulse duration when the output is terminated with an external visual warning feature consisting of three parallel connected MS25237-327 incandescent lamps. When not gated "ON" the output signal shall be less than 0.5 volts. The first pulse shall be delayed 0.50 ± 0.20 seconds after application of the enabling signal as defined in 3.5.2.17.3.

* 3.5.2.17.3 Provisions for enabling output signals. For installations employing a single Height Indicator, the signal shall be distributed to both crew stations. For multiple indicator installations, the signals shall be distributed to the crew station associated with each indicator as required by the individual indicator limit setting. The distribution of signals to the crew stations shall be accomplished within the aircraft wiring harness. Enabling signals shall include the following:

a. High altitude. The output signals described in 3.5.2.17.2 (1) and (2) shall be enabled to produce 5 ± 1 warning pulses when the altitude input signal as defined herein has decreased to the high altitude index

setting. The output shall not be enabled when the altitude input signal is increased to the high altitude index setting from below this setting.

b. Low altitude. The output signals described in paragraphs 3.5.2.17.2 (1) and (2) shall be enabled and remain enabled while the altitude input signal is at or below the low altitude index setting.

c. Variable altitude limit index. The output signals described in paragraphs 3.5.2.17.2 (1) and (2) shall be enabled to produce 5 ± 1 warning pulses when the altitude input signal as defined herein has descended to the variable altitude limit index setting. The output shall not be enabled when the altitude input signal is increased to the variable altitude limit index setting from below the setting.

d. Altimeter unreliable. The output signals described in paragraphs 3.5.2.17.2 (1) and (2) shall be enabled when the reliability input signal is in the unreliable state except for absolute altitudes greater than 4700 ± 100 feet.

e. Self test. The output signals described in 3.5.2.17.2 (1) and (2) shall be enabled and remain enabled during the application of self-test as defined herein. Provisions for disabling the output signals (see 3.5.2.17.4) shall not apply to warnings generated by the self-test command.

* 3.5.2.17.4 Provisions for disabling output signals. The disabling functions herein defined shall be designed such that loss of any disabling signal shall not result in a failure to obtain the output signals under the conditions described in 3.5.2.17.3.

a. Landing gear inhibit. The aural output signal of 3.5.2.17.2 (1) shall be disabled under low altitude conditions (see 3.5.2.17.3 (2)) when all three landing gear down and locked input signals, as defined herein, are in the down and locked state and the AFCS engage signal, as defined herein, is in the "OFF" condition. The AFCS engage signal when in the "ON" condition shall nullify disablement of the aural output signal by the three landing gear being in the down and locked state.

b. High altitude warning inhibit. The aural and visual warning output signals of 3.5.2.17.2 (1) and (2) under high altitude conditions (see 3.5.2.17.3 (1)) shall be disabled when all three landing gear down and locked input signals are in the down and locked state and the High Altitude Index Warning signal, as defined herein, is in the "ON" condition.

c. Automatic flight control system (AFCS) engage. The aural and visual warning output signals of 3.5.2.17.2 (1) and (2) under high altitude conditions (see 3.5.2.17.3 (1)) shall be disabled when the ASCS engage input signal as defined herein, is in the "ON" condition.

d. Weight-on-wheels. The aural warning input signal of 3.5.2.17.2 (1) shall be disabled under altimeter unreliable conditions (See 3.5.2.17.3 (4), when weight-on-wheel input signal, as defined herein, is in the "ON" condition.

e. Low altitude warning inhibit. The aural and visual warning output signals of 3.5.2.17.2 (1) and (2) under the low altitude conditions of 3.5.2.17.3 (2) shall be disabled when all three landing gear down and locked signals are in the down and locked state and the low altitude index warning inhibit signal, as herein defined, is in the "ON" condition.

f. Indicator control knob. The aural and visual warning output signals of 3.5.2.17.2 (1) and (2) shall be disabled when the indicator control knob (see 3.5.2.6) is in the "OFF" position, except for the self-test warnings of 3.5.2.17.3 (5).

g. Variable altitude warning inhibit. The aural and visual warning output signals of 3.5.2.17.2 (1) and (2) under the variable altitude conditions of 3.5.2.17.3 (3) shall be disabled when all three landing gear down and locked signals are in the down and locked state and the variable altitude warning inhibit signal, as herein defined is in the "ON" condition.

* 3.5.2.17.5 Description of input signals. In addition to the Input Signals of 3.5.2.12.1, the ID-2206/APN-194(V) Indicator shall have the following inputs:

a. Reliability input signal. The reliability input signal is a DC voltage from the Receiver-Transmitter of 4.5 ± 1.0 VDC when the altimeter is reliable and less than one-half volt when the altimeter is unreliable. The input impedance to this signal shall be greater than 2000 ohms.

b. AFCS Engage Signal. The AFCS (Automatic Flight Control System) engage Signal is a DC voltage of +4 to +29 volts when the AFCS is engaged ("ON" condition) and zero volts or open circuit when the AFCS is disengaged ("OFF" condition). The input impedance presented to this signal shall be greater than 10,000 ohms.

c. Landing gear down and locked input signal. The landing gear down and locked input signal voltage is aircraft DC ground when the wheels are down and locked and is between +4.5 and +29 volts or open circuit when the wheels are not down and locked. The input impedance presented to each signal shall be greater than 10,000 ohms.

d. High altitude index warning inhibit signal. The high altitude index warning inhibit signal is 0 ± 0.5 VDC when on and +4 to +29 VDC or open circuit when off.

e. Low altitude index warning inhibit signal. The low altitude index warning inhibit signal is 0 ± 0.5 VDC when on and +4 to +29 VDC or open circuit when off.

f. Weight-on-wheel input signal. The weight-on-wheel input signal is aircraft DC ground in an "ON" condition and +4 to +29 VDC or open circuit in an "OFF" condition. The input impedance presented to this signal shall be greater than 20,000 ohms.

g. Variable altitude limit index warning inhibit signal. The variable altitude limit index warning signal is 0 ± 0.5 VDC when on and +4 to +29 VDC or open circuit when off.

* 3.5.2.18 Allocated reliability and mean time between failures. To assure meeting the system requirement of 1500 hours MTBF, the Height Indicator when tested in accordance with 4.4.2 shall have 6000 hours Mean (operating) Time Between Failure.

3.5.3 Blanker, Interference - MX9132A/APN-194(V). An interference blanker shall be required for those aircraft installations that do not provide a minimum of 85 dB isolation between antennas. The interference blanker shall meet the requirements specified in 3.5.3.1 through 3.5.3.7.4:

3.5.3.1 Function. The interference blanker shall use the modulator pulse from the Receiver-Transmitter to control the attenuation of the received signal coupled from the receiving antenna to the Receiver-Transmitter. Provisions shall be made for adjusting the maximum attenuation through the use of a preset screw adjustment which may be adjusted externally. Provisions shall be included to disable the effect of the modulator pulse by application of a ground to the disable signal input.

3.5.3.2 Form factor. The interference blanker shall conform to the dimensions of EI56615.

* 3.5.3.3 Weight. The weight of the interference blanker shall be not greater than 1.75 pounds.

3.5.3.4 Mounting. Each interference blanker shall have mounting provisions as shown in EI56615.

3.5.3.5 Electrical connections. Connections to external circuits shall be provided as specified in table VII. (See EI-566 for interconnecting diagrams.)

TABLE VII. Electrical Connections

Reference Designation	Receptacle Type or Equivalent	Function
J802	TNC Female per MILC39012	Attenuated RF to Receiver-Transmitter
J804	TNC Female per MILC39012	Modulator Pulse from ReceiverTransmitter
J805	TNC Female per MILC39012	RF from Receiving Antenna
J803	SMA Female per MILC39012	Disable Signal from Weight on Wheels

3.5.3.6 Contents. The interference blanker shall contain the necessary elements to switch between a low insertion loss state and a high insertion loss state as a function of the current injected at the control input. No external power other than that supplied by the modulator pulse input signal shall be required. The maximum value of the high insertion loss state shall be controlled by the disable signal as specified herein.

3.5.3.7 Attenuation characteristics. Attenuation shall be controlled by controlling the forward bias current through an RF diode. Minimum insertion loss shall occur with no pulse applied to J804.

3.5.3.7.1 Low insertion loss state. Low insertion loss shall be not greater than 2.25 dB.

3.5.3.7.2 High insertion loss state. The high insertion loss shall be capable of being adjusted to 45 dB minimum when an input pulse meeting the requirements of 3.5.1.7.8 is applied to J804 and the disable input signal is open. With the modulator pulse applied to J804 and the disable input signal applied to J803, the insertion loss shall be not greater than 5.25 dB.

3.5.3.7.3 Turn on Delay Time. The switching time from the low insertion loss state to the high insertion loss state shall be not greater than 15 nanoseconds from the 10 percent to the 90 percent points on the detected RF pulse.

3.5.3.7.4 Turn off delay time. Insertion loss shall be not greater than 15 db no later than 20 nanoseconds after the trailing edge of the modulator pulse reaches zero volts.

3.5.3.8 Description of input signals

3.5.3.8.1 Modulator pulse input signal. The modulator pulse input signal shall be in accordance with 3.5.1.7.8.

3.5.3.8.2 Disable signal input. The disable signal input shall be airframe ground applied to J803.

3.5.3.9 RF isolation. The interference blanker shall provide not less than 35 dB isolation at 4.3 GHz from the RF output port (J802) to the internal RF switch.

* 3.5.3.10 Allocated reliability and mean time between failures. To assure meeting the system requirement of 1500 hours MTBF, the interference blanker when tested in accordance with 4.4.2 shall have 12,000 hours Mean (operating) Time Between Failure.

3.5.4 Antenna AS-2595/APN-194(V), AS-2728/APN-194(V), AS-2741/APN-194(V), and AS-2742/APN-194(V). Two identical passive antennas shall be provided. The antennas shall meet the applicable requirements of the set and the detail requirements specified in 3.5.4.1 through 3.5.4.7.

3.5.4.1 Function. The antenna shall act as a transducer and impedance matching network between free space and the antenna cable.

3.5.4.2 Electrical characteristics

* 3.5.4.2.1 Power handling capability. Each antenna shall be capable of operating without damage or degradation with an input peak pulse power of 1000 watts at a .001 duty cycle.

* 3.5.4.2.2 Signal rejection. The signal rejection from input to antenna output shall be not less than as specified below.

a. 25 dB at 8.35 GHz and 8.85 GHz
b. 50 dB from 8.50 GHz to 8.70 GHz

3.5.4.3 Electrical connections. Connections to external circuits shall be provided as follows: (See EI-566 for interconnection diagrams.)

Reference Designation	Receptacle Type or Equivalent	Function
J1501	TNC Female per MILC39012	RF Signal to or from ReceiverTransmitter

3.5.4.4 Antenna characteristics AS-2595/APN-194(V)

* 3.5.4.4.1 Form factor. Each antenna shall be contained within the volume shown on EI-566-11.

* 3.5.4.4.2 Weight. The weight of each antenna shall be not greater than 0.65 pound.

* 3.5.4.4.3 Mounting. Each antenna shall have mounting provisions as shown on EI-566-11. Each antenna shall withstand a differential pressure of one atmosphere.

3.5.4.4.4 Spacing. Set accuracy requirements shall be met with antenna center to center spacings of 24 to 60 inches and with not less than 85 dB isolation between antennas.

* 3.5.4.4.5 Antenna gain. Each antenna shall provide E-plane and H-plane gain of not less than 10.5 dB at 4300 MHz. Gain at $\pm$ 22.5^{o} from electrical boresight shall be not less than 7.5 dB minimum.

3.5.4.4.6 Electromagnetic fields. The electromagnetic fields shall be oriented as shown in Figure 8.

* 3.5.4.4.7 Voltage standing wave ratio (VSWR). free space VSWR of each antenna and connector shall be not greater than 1.3 at 4300 MHz and 1.4 at 4250 MHz and 4350 MHz.

3.5.4.5 Antenna characteristics AS-2728/APN-194(V)

* 3.5.4.5.1 Form factor. Each antenna shall be contained within the volume shown on EI-566-12.

* 3.5.4.5.2 Weight. The weight of each antenna shall be not greater than 0.4 pound.

* 3.5.4.5.3 Mounting. Each antenna shall have mounting provisions as shown on EI-566-12. Each antenna shall withstand a differential pressure of one atmosphere.

3.5.4.5.4 Spacing. Set accuracy requirements shall be met with antenna center to center spacings of 24 to 60 inches and with not less than 85 dB isolation between antennas.

* 3.5.4.5.5 Gain. Each antenna shall provide E-plane and H-plane gain of not less than 9 dB at 4300 MHz. Gain at $\pm$25^{o} from electrical boresight shall be 6 dB minimum.

3.5.4.5.6 Electromagnetic field. The electromagnetic fields shall be oriented as shown in EI 566-12.

* 3.5.4.5.7 Voltage standing wave ratio (VSWR). The free space VSWR of each antenna and connector shall be not greater than 1.5 at 4300 MHz and 1.8 at 4250 MHz and 4350 MHz.

* 3.5.4.5.8 Side lobes. The side lobe radiation of each antenna shall be not greater than the maximum gain envelope described as follows:

a. The E-plane maximum gain shall be defined by a continuous envelope from 55^{o} off boresight to 305^{o} (-55^{o}) off boresight. The maxi-

mum gain shall be 25 dB below maximum gain from 120° to 240° (-120°) off boresight, 20 dB below maximum gain at ±110° off boresight, 17 dB below maximum gain at ±105° off boresight, 15 dB below maximum gain at ±95° off boresight, 12 dB below maximum gain at ±80° off boresight, 10 dB below maximum gain at ±70° off boresight, and 7 dB below maximum gain at ±55° off boresight.

b. The H-plane maximum gain shall be defined by a continuous envelope from 55° off boresight to 305° (-55°) off boresight. The maximum gain shall be 25 dB below maximum gain from 90° to 270° (-90°) off boresight, 20 dB below maximum gain ±75° off boresight, 15 dB below maximum gain at ±65° off boresight. 9 dB below maximum gain at ±55° off boresight, and 7 dB below maximum gain at ±50° off boresight.

3.5.4.6 Antenna characteristics AS-2741/APN-194(V) and AS-2742/APN-194(V)

3.5.4.6.1 Form factor. Each antenna shall be contained within the volume shown on EI-566-13 and EI-566-14 as applicable.

* 3.5.4.6.2 Weight. The weight of each antenna shall be not greater than 0.4 pound.

* 3.5.4.6.3 Mounting. Each antenna shall have mounting provisions as shown on EI-566-13 and EI-566-14 as applicable. Each antenna shall withstand a differential pressure of one atmosphere.

* 3.5.4.6.4 Spacing. Set accuracy requirements shall be met with antenna center to center spacings of 24 to 60 inches and with not less than 85 dB isolation between antennas.

* 3.5.4.6.5 Gain. Each antenna shall provide a minimum E-plane and H-plane gain of not less than 9 dB at 4300 MHz. Gain at ±25° from electrical boresight shall be not less than 6 dB minimum.

3.5.4.6.6 Electromagnetic fields. The electromagnetic fields shall be oriented as shown in EI 566-13 and -14 as applicable.

* 3.5.4.6.7 Voltage standing wave ratio (VSWR). The free space VSWR of each antenna and connector shall be not greater than 1.5 at 4300 MHz and 1.8 at 4250 MHz and 4350 MHz.

* 3.5.4.6.8 Side lobes. The side lobe radiation of each antenna shall be not greater than the maximum gain envelope described as follows:

a. The E-plane maximum gain shall be defined by a continuous envelope from 55° off boresight to 305° (-55°) off boresight. The maximum gain shall be 25 dB below maximum gain from 120° to 240° (-120°) off boresight, 20 dB below maximum gain at ±110° off boresight, 17 dB below maximum gain at ±105° off boresight, 15 dB below maximum gain at ±95° off boresight, 12 dB below maximum gain at ±80° off boresight, 10 dB below maximum gain at ±70° off boresight, and 7 dB below maximum gain at ±55° off boresight.

b. The H-plane maximum gain shall be defined by a continuous envelope from 55° off boresight to 305° (-55°) off boresight. The maximum gain shall be 25 dB below maximum gain from 90° to 270° (-90°) off boresight, 20 dB below maximum gain ±75° off boresight, 15 dB below maximum gain at ±65° off boresight, 9 dB below maximum gain at ±55° off boresight, and 7 dB below maximum gain at ±50° off boresight.

* 3.5.4.6.9 Color. To eliminate the possibility of confusion between the AS-2741/APN-194(V) and AS-2742/APN-194(V) antennas, the back surface of AS-2741/APN-194(V) shall be painted Lusterless Black, color No. 37038 in accordance with FED-STD-595. The back surface of AS-2742/APN-194(V) shall be painted Lusterless Gray, Color No. 36231 in accordance with FED-STD-595.

* 3.5.4.7 Allocated reliability and mean time between failures. To assure meeting the system requirement of 1500 hours MTBF, the antenna, when tested in accordance with 4.4.2, shall have 100,000 hours Mean (operating) Time Between Failure.

3.6 Fail safe provisions. The altimeter, AN/APN-194(V) shall be designed such that loss of any subsystem connected to the altimeter shall not result in a failure of other interconnected subsystems.

4. QUALITY ASSURANCE PROVISIONS

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

* 4.1.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. First Article inspection (See 4.2)
b. Initial Production Tests (See 4.3)
c. Acceptance Tests (See 4.4)
d. Life Tests (See 4.5)

* 4.2 First article inspection. First article inspection shall be conducted by the contractor on an equipment representative of production equipment to be supplied under contract. Preproduction testing shall be accomplished under the approved test procedures as described in 4.6. The contractor shall make available to the procuring activity all data collected in conducting these tests.

* 4.2.1 Scope of tests. First article inspection shall include all tests deemed necessary by the procuring activity to determine that

the equipment meets all the requirements of this specification, and the contract. First article inspection shall include environmental tests in accordance with the procedures of MIL-T-5422 and interference tests in accordance with MIL-STD-462. Acoustical noise and random vibration tests shall be conducted in accordance with the procedures of MIL-STD-810. WRA/SRA/Sub SRA interchangeability demonstration tests, with respect to other manufacturer components; P.G.S.E. compatability demonstration tests and flight tests shall also be conducted.

* 4.2.2 First article approval. Approval of the first article samples will be by the government representative upon satisfactory completion of all tests. No production equipments shall be delivered prior to the approval of the first article sample. Prefabrication of production equipment prior to the approval of the first article sample is at the contractor's own risk.

* 4.2.3 Production Equipments - Equipments supplied under the contract shall in all respects, including design, construction workmanship, performance and quality, be equal to the approved first article sample. Each equipment shall be capable of successfully passing the same tests as imposed on the first article sample. Evidence of non-compliance with the above shall constitute cause for rejection .

* 4.3 Initial production tests. At the Government's option, one of the first ten production equipments shall be selected and sent at the contractor's expense to a designated Government laboratory for tests (see 6.2.1). This equipment will be selected by the procuring activity after the equipment has successfully passed all individual tests. No other tests shall be conducted on the equipment prior to starting the Initial Production Tests. The first article sample shall not be selected for this test.

* 4.3.1 Scope of tests. This equipment may be subjected to any and all tests the procuring activity deems necessary to assure that the production equipment is equal to the previously approved first article sample in design, construction, workmanship, performance, and quality and that it meets all applicable requirements of this specification and the contract.

* 4.3.2 Accessory material. In addition to the complete equipment submitted for Initial Production Tests, the contractor shall provide such accessory material and include data necessary to test the equipment.

* 4.3.3 Initial production sample approval. Approval of the Initial Production Sample will be by the procuring activity upon satisfactory completion of all tests. Any design, material or performance defects made evident during this test shall be corrected by the contractor to the satisfaction of the procuring activity. Failure of the Initial Production Sample to pass any of the tests shall be cause for deliveries of equipment under the contract to cease until proper corrective action is approved and accomplished. Corrective action shall also be accomplished

on equipment previously accepted when specified in the contract (see 6.2.1).

* 4.4 Acceptance tests. The contractor shall be responsible for accomplishing the acceptance tests. All inspection and testing will be under the supervision of the Government representative. Contractors not having adequate facilities for conducting all required tests shall engage the service of a commercial testing laboratory acceptable to the procuring activity. The contractor shall include test reports, when specified by the contract, showing quantitative results for all acceptance tests. Such reports shall be signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during the source of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

a. Individual Tests (see 4.4.1)
b. Reliability Assurance Tests (see 4.4.2)
c. Special Tests (see 4.4.3)

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

a. Examination of Product
b. Operational Test

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

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

* 4.4.2 Reliability assurance tests. Reliability Assurance Tests shall be conducted in accordance with MIL-STD-781. Tests, as required by both the Qualification Phase and the Production Acceptance (Sampling) Phase, shall be conducted. Equipments selected for Reliability Assurance Tests shall first have passed the individual tests. Classification of failures shall be in accordance with MIL-STD-781 and MILSTD2074.

* 4.4.2.1 Reliability assurance (qualification phase) tests. Prior to the approval of the qualification sample and acceptance of equipment under contract or order, not less than three and a maximum of ten equipments shall be tested as outlined in MIL-STD-781, under the section entitled "Qualification Phase of Production Reliability Tests". For the Qualification Phase, Test Level F shall be used. The Accept-Reject Criteria for Test Plan III shall be used.

4.4.2.2 Reliability assurance (production acceptance phase) tests. Each production equipment shall be tested as outlined in MIL-STD-781 as modified herein), under the Section entitled Production Acceptance (Sampling) Phase of Production Reliability Tests. Test Level F shall be used.

* 4.4.2.2.1 All equipment test. Each WRA produced shall be tested for 56 hours, within which the environmental cycling intervals shall be not greater than four hours. The last 10 hours of the 56 hours shall be failure free. Prior to the 56-hour test on each WRA, a burn-in period may be used at the option of the contractor. If the burn-in period is to be used the details thereof shall be included in the approved test procedures. To determine whether the system MTBF is being met at any time during the contract, based on WRA testing, the test times shall be accumulated based on multiples of MTBF, i.e.; the test times in hours for any given WRA shall be divided by the WRA MTBF. This quotient is the test time expressed in multiples of MTBF. These test times (in multiples of MTBF) shall be accumulated, along with all failures occurring during the all equipment test and plotted on a single chart similar to that for Test Plan II of MIL-STD-781. This chart shall combine the test data for the various WRA's. In addition, a separate plot shall be maintained for each type of WRA, except the reject line for the WRA plot shall be increased (moved up) by 25 percent from the position specified by Test Plan II. These totals shall accumulate so that at any one time the experience from the beginning of the contract is included. The use of antennas during all equipment tests is not required. At the conclusion of each month the test results, when specified by the contract, shall be made available to the procuring activity. At any time that the current totals of test hours and test failures for the system or for the WRA's plotted on the above described curves show a reject situation, the government inspection shall be notified. The procuring activity reserves the right to stop the acceptance of equipment at any time that a reject situation exists pending a review of the contractor's efforts to improve the equipment, the equipment parts, the equipment workmanship, etc., so that the entire compilation will show other than a reject decision.

4.4.2.3 Test details. The test details such as the length of the test cycle, the length of the heat portion of the cycle, the performance characteristics to be measured, special failure criteria, etc., shall be part of the test procedures to be acceptable to the procuring activity prior to the beginning of the Qualification Test Phase of the Reliability Assurance Tests. No preventive or scheduled maintenance is permitted during the tests.

4.4.3 Special tests. 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 adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the reliability assurance tests.

4.4.3.1 Special test schedule. Selection of equipments for special tests shall be made as follows:

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

b. Whenever required by the procuring activity.

4.4.3.2 Scope of tests - Special tests shall consist of such tests as are specified in the contract (see 6.2.1). Test procedures approved for the qualification tests shall be used where applicable. When not applicable, the contractor shall prepare a test procedure data item for the procuring activity acceptance prior to conducting the tests.

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

a. Determine the cause of failure

b. Determine whether the failure is an isolated case or a design defect.

c. Make available to the qualifying activity, for acceptance, proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests.

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.

4.5 Life test. During the course of the contract, the contractor shall furnish two samples and shall be responsible for accomplishing the life test. The test shall be conducted on equipments that have passed the individual tests. Tests may be conducted at the system level or the WRA level, as specified in the contract (see 6.2.1).

4.5.1 Life test conditions - The life test shall be conducted in accordance with Test Level F of MIL-STD-781, as outlined under the Section entitled "Qualification Phase of Preproduction Tests".

4.5.2 Test periods - Each sample shall be subjected to one MTBF of operating time, i.e., if testing is to be conducted on a system basis, the test time shall be 1500 hours for each sample or if testing is to be on a WRA basis the test time shall be the allocated MTBF of that WRA, as defined herein.

4.5.3 Performance check. A periodic performance check in accordance with the requirements of MIL-STD-781 shall be conducted during the testing.

4.5.4 Test data. The contractor shall keep a daily record of the performance of the equipment, making particular note of any deficiencies or failures. In the event of part failures, the defective part shall be replaced and the operation resumed for the balance of the test period. A record shall be kept of all failures throughout the test. This record shall indicate the following:

a. Part type number
b. The circuit reference symbol number
c. The part function
d. Name of the manufacturer
e. Nature of the failure
f. The number of hours which the part operated prior to failure

4.5.4.1 Failure report. In the event of a failure, the Government inspector shall be notified immediately. A report shall be made available to the procuring activity upon completion of test. In this report, the contractor shall propose suitable and adequate design or material corrections for all failures which have occurred. The procuring activity will review such proposals and determine whether they are acceptable.

* 4.6 Test procedures. The procedures used for conducting qualification tests and acceptance tests 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 Inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification or the contract. MIL-T-18303 shall be used as a guide for preparation of test procedures. When approved test procedures are available from previous contracts, such procedures will be provided and may be used when their use is approved by the procuring activity. Moreover, the right is reserved by the procuring activity to require modification of such procedures, including additional tests, when deemed necessary.

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

5. PACKAGING

5.1 General (see 6.2.1). All major units and parts of the equipment shall be preserved, packaged, packed, and marked for the level of shipment specified in the contract or order in accordance with MIL-E-17555 and MIL-STD-794. In the event the equipment is not covered in MIL-E-17555, the method of preservation for Level A shall be determined in accordance with the selection chart in Appendix D of MIL-STD-794.

6. NOTES

6.1 Intended use. The Electronic Altimeter Set covered by this specification is intended to provide absolute altitude (terrain clearance) to aircraft and helicopters at altitudes up to 5000 feet.

6.2 Ordering data. Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

6.2.1 Acquisition requirements

a. Title, number, and date of this specification
b. Selection of applicable levels of packaging and packing (See 5.1)
c. Data
d. Type and quantity of Receiver-Transmitters
e. Type and quantity of Height Indicators
f. Type and quantity of Antenna
g. Quantity and Aircraft applications of Interference Blanker

6.3 Precedence of documents. When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence should apply:

(1) Contract. The contract should have precedence over any specification.

(2) This specification. This specification should have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, should be specifically approved in writing by the procuring activity.

(3) Reference specifications. Any reference specification should have precedence over all applicable subsidiary specifications referenced herein. All referenced specifications should apply to the extent specified herein.

6.4 Performance objectives. Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives which should be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance or reliability will result from the use of materials, parts and processes other than those specified in MIL-E-5400, it is desired their use be investigated. When investigation shows advantages can be realized, a request for approval should be submitted to the procuring activity for consideration. Each request should be accompanied by complete supporting information.

6.5 Type designations. The type designation may be modified by the procuring activity upon application by the contractor for assignment of nomenclature in accordance with 3.3.7. The correct type number should be used on nameplates, shipping records and instruction books, as applicable.

6.6 Terms and definitions

a Zero altitude. Zero (0) altitude is defined as the altitude of the aircraft when sitting on the ground.

b. Blanking pulse amplitude. Average amplitude of the positive voltage peaks.

c. Blanking pulse rise time. Interval between the 10 percent and 90 percent amplitude level on the leading edge of the pulse.

d. Blanking pulse lag time. Time interval from the 10 percent amplitude level on the trailing edge of the transmitter pulse to the 90 percent amplitude level on the trailing edge of the blanking pulse.

e. Blanking pulse lag time. Time interval between the 90 percent amplitude level and the 10 percent amplitude level on the trailing edge of the pulse.

f. Blanking pulse lead time. Time interval from the 90 percent amplitude level on the leading edge of the blanking pulse to the 10 percent amplitude level on the leading edge of the transmitter pulse.

g. Blanking pulse voltage variation. Changes in voltage, greater or less than the amplitude level, that occurs during the width of the pulse.

h. Blanking pulse noise. All deviations in voltage from the direct level that occurs between the 10 percent amplitude level on the trailing edge of one pulse and the 10 percent amplitude level on the following pulse, with the exception of undershoot.

i. Blanking pulse undershoot. Maximum negative voltage attained by the trailing edge of the pulse.

j. Blanking start lag time. Time interval from the 90 percent amplitude level on the leading edge of the input blanking pulse to the +15 dbm sensitivity level of the receiver or the 10 percent amplitude level on the trailing edge of the transmitter pulse, whichever is later.

k. Width. Time interval between the 90 percent amplitude level on the leading edge and the 90 percent amplitude level on the trailing edge of the pulse.

l. Unblank lag time. The time interval from the 90 percent amplitude level on the trailing edge of the input blanking pulse to the 10 percent amplitude level on the leading edge of the transmission pulse.

m. Modulator pulse lead time. The time interval from the 50 percent point on the leading edge of the modulator pulse to the 50 percent point on the leading edge of the detected RF pulse output.

n. Modulator pulse lag time. The time interval from the 50 percent point on the trailing edge of the detected RF pulse to the 50 percent point on the trailing edge of the modulator pulse.

6.7 Revisions. In specification revisions and superseding amendments, an asterisk "*" preceding a paragraph number denotes a paragraph in which changes have been made from the previous issue. This has been done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written, regardless of the asterisk notations and their relationship to the last previous issue.

* 6.8 Data requirements. When this specification is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of ASPR7-104.9(n) of the Federal Acquisition Regulations (FAR), the data requirements identified below will be developed as specified by an approved Date Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of ASPR-7-104.9(n) are not invoked, the data specified below will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraphs:

Paragraph No.	Data Requirement Title	Applicable DID No.	Option
3.2.1	NON-STANDARD PART AND MATERIAL APPROVAL	DI-E-7028A	
3.2.1	MICROELECTRONIC DEVICE APPROVAL	UDI-E-21337	
3.3.7	NOMENCLATURE, NAMEPLATES AND IDENTIFICATION MARKING		
4.2.1	TEST REPORTS	DI-T-4024	
4.6	TEST PROCEDURES	UDI-T-21347	

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the NAVAL Publications and forms center or as directed by the contracting officer.)

* 6.9 Associated equipment. The equipment, as defined by this specification, should be electrically interchangeable with the AN/APN-141(V) Electronic Altimeter and; therefore, should operate with any AN/APN-141(V) associated equipment in any aircraft installation. For those users of indicator ID-2206/APN-194(V), this equipment should also operate with the associated equipment of the AN/APQ-107 Altimeter Warning Set. (See Table VIII).

Table VIII AN/APN-194(V) Replacement Table

AN/APN-194(V) Unit	Note	May Replace
Receiver-Transmitter RT-1015A/APN-194(V) and RT-1042A/APN-194(V)	1	Receiver-Transmitter RT-601B/APN-141(V)
	3	R.F. Switching Unit SA-791A/APN-141(V)
	2	Linearizer Coupler CU-1464/APN-141(V)
	2	Indicator Coupler CU-1492/APN-141(V)
	2	Autopilot Coupler CU-1503/AP
	2	Signal Data Converter CU-2068/AP
	4	Receiver-Transmitter RT-1015/APN-194(V) and RT-1042/APN-194(V) respectively.
Height Indicator ID-1760B/APN-194(V)	4	Height Indicator ID-881B/APN-141(V)
	4	Height Indicator ID-1304/APN-141(V)
	4	Height Indicator ID-1760A/APN-194(V)
Height Indicator 1768B/APN-194(V)	1	Height Indicator ID-1304/APN-141(V)
	4	Height Indicator ID-1768A/APN-194(V)
Height Indicator ID-1811A/APN-194(V)	4	Height Indicator ID-1015A/APN-141(V)
	4	Height Indicator ID-1811/APN-194(V)

AN/APN-194(V) Replacement Table (Continued)

AN/APN-194(V) Unit	Note	May Replace
Height Indicator ID-1879A/APN-194(V)	4	Height Indicator ID-1687/APN-141(V)
	4	Height Indicator ID-1879/APN-194(V)
Height Indicator ID-1880A/APN-194(V)	4	Height Indicator ID-1880/APN-194(V)
Height Indicator ID-2206/APN-194(V)	3	Altimeter Warning Set AN/APQ-107
Interference Blanker MX-9132A/APN-194(V)	-	New unit replacing no existing unit.
Antenna AS-2595/APN-194(V)	-	New antenna replacing no existing antenna.
Antenna AS-2728/APN-194(V)	1	New antenna replacing no existing antenna.
Antenna AS-2741/APN-194(V)	1	Antenna AT-1015/APN-141(V)
Antenna AS-2742/APN-194(V)	1	Antenna AS-1233/APN-141(V)

NOTES:

1. Physically and electrically replaceable.

2. Electrically replaceable only. Eliminates requirement for unit when aircraft wiring can provide proper routing of signals from replacement unit.

3. Function eliminated.

4. Physically and electrically interchangeable.

6.10 Associated installation and test instructions. The AN/APN-194(V) Electronic Altimeter Set should be installed and tested in accordance with EI-566 and ET-566, respectively.

Preparing Activity
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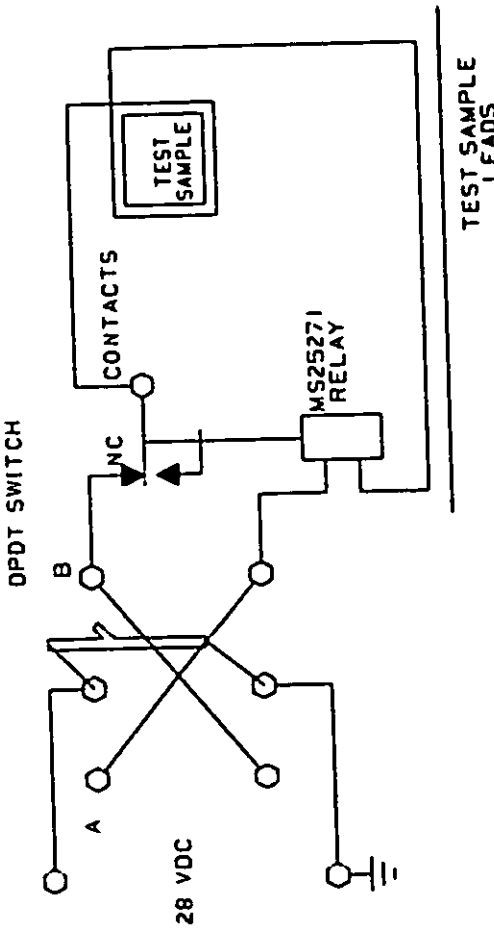
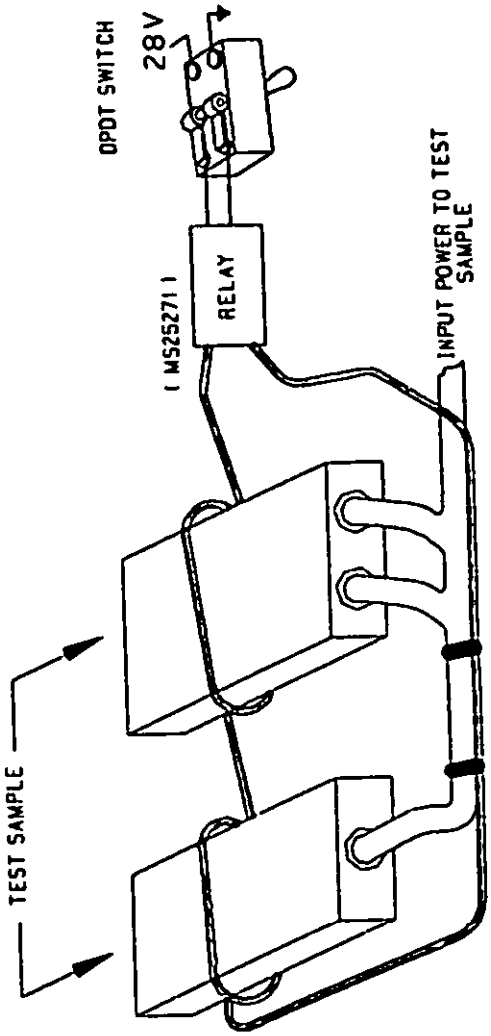
5826-N 184

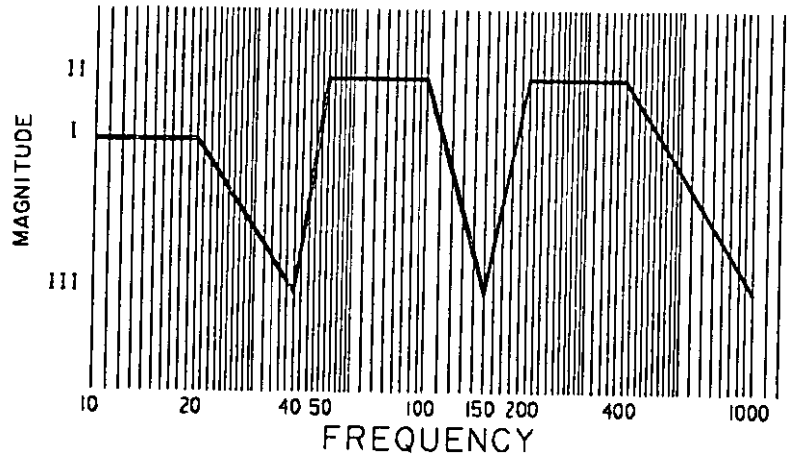


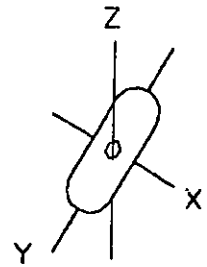
SCHEMATIC DIAGRAM



WIRING DIAGRAM

FIGURE 1. Transient radiated interference susceptibility.





SCHEDULE	TIME MINUTES	AXIS	I g^2/Hz	II g^2/Hz	III g^2/Hz	OVERALL GRMS
PERFORMANCE, A	5	X	5.0	5.0	.1	45.2
	5	Y	.15	1.5	.01	23.2
	5	Z	.15	1.5	.01	23.2
PERFORMANCE, B	25	X	.8	2.0	.1	29.9
	25	Y	.05	1.0	.01	19.2
	25	Z	.05	1.0	.01	19.3
ENDURANCE, C	180	X	7.0	7.0	.14	53.4
	180	Y	.21	2.11	.014	27.6
	180	Z	.21	2.11	.014	27.6

FIGURE 2. Random vibration test levels for antennas.

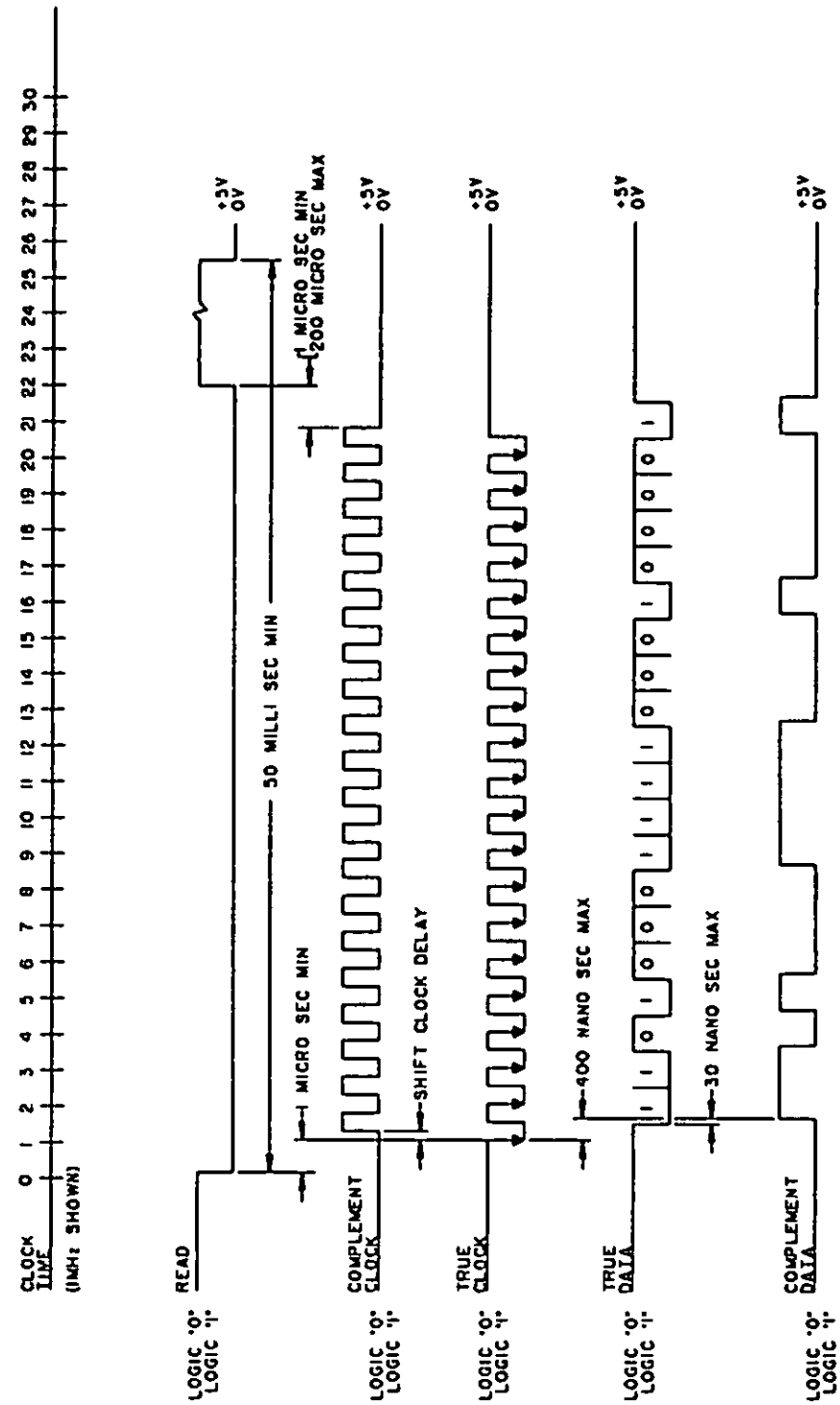
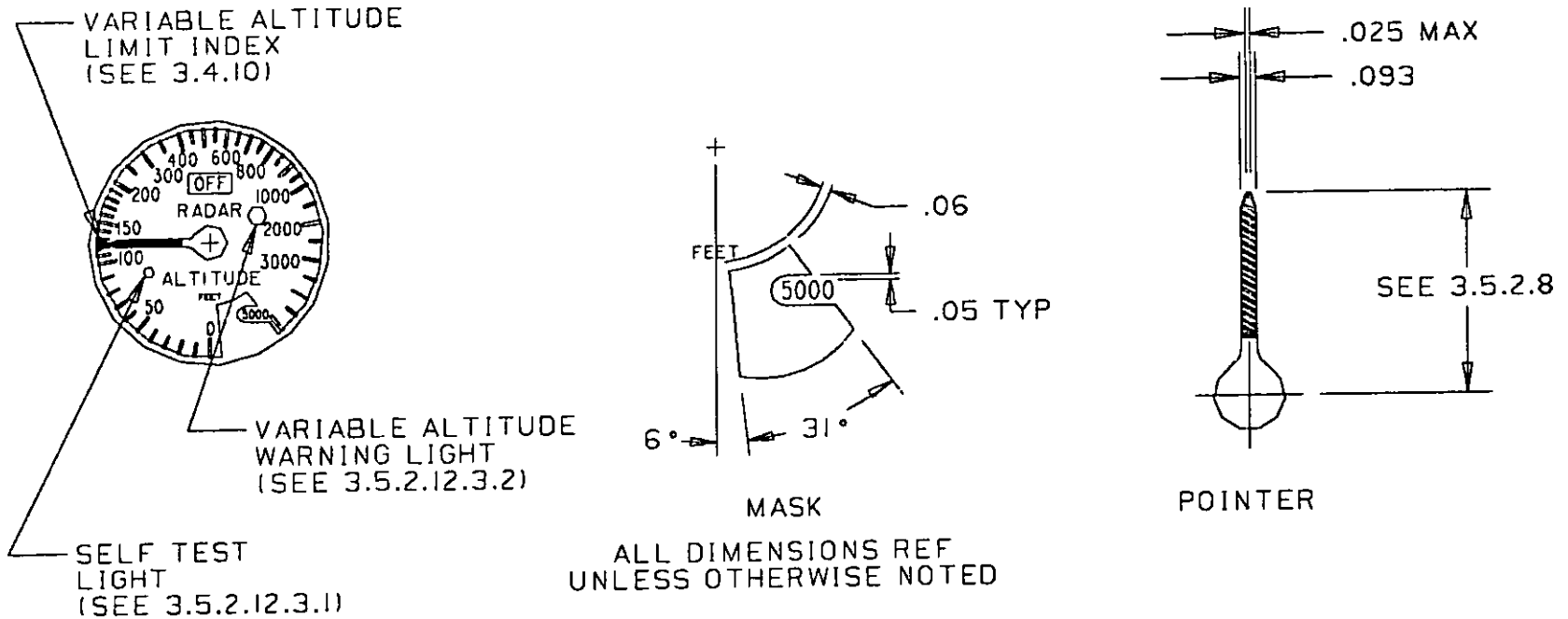


FIGURE 3. Digital timing relationships.



MARKING	HEIGHT ±.005
RADAR ALTITUDE	.150
FEET	.06
5000	.100
NUMERIALS EXCEPT 5000	.150
OFF (BLACK ON WHITE)	.150

CALIBRATION TABLE OF MAJOR GRADUATIONS
DEGREES : ±15 MIN CLOCKWISE FROM 0 FEET

FEET	DEGREES
0	0.0
50	40.0
100	80.0
150	101.5
200	123.0
300	143.5
400	164.0

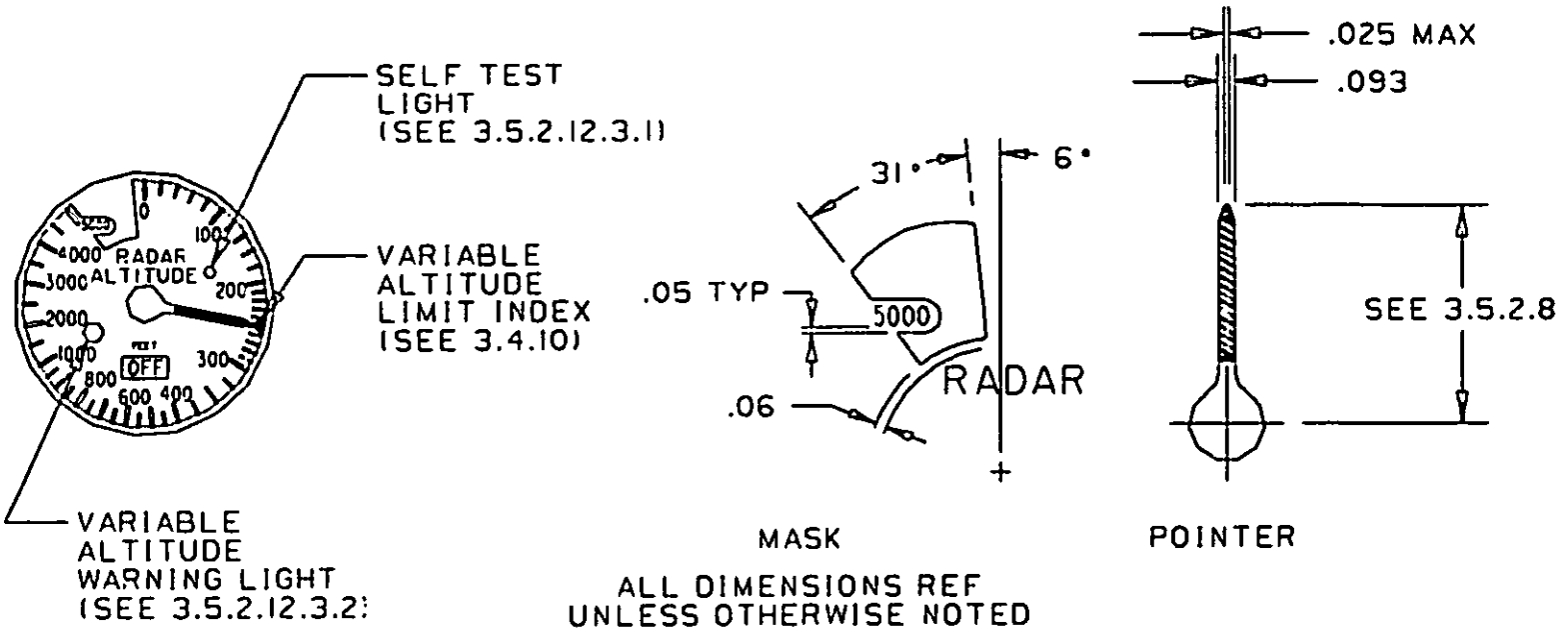
FEET	DEGREES
500	176.67
600	189.33
800	214.67
1000	240.0
2000	260.0
3000	280.0
5000	320.0

GRADUATIONS

INCREMENT	RANGE, FT.	LENGTH : ±.010	WIDTH : ±.010
10°	0-200	.160	.025
50°	200-1000		
500'	1000-5000		
50'	0-200	.220	.030
100'	200-1000		
1000'	1000-5000		

INCHES	MILLIMETERS	INCHES	MILLIMETERS
0	0	.100	2.540
.005	0.127	.150	3.810
.010	0.254	.160	4.064
.025	0.635	.220	5.588
.030	0.762		
.050	1.270		
.060	1.524		
.093	2.362		

FIGURE 4. ID-1760B/APN-194(V), ID-1811A/APN-194(V) and ID-1879A/APN-194(V) indicator dial configuration.



MARKING	HEIGHT ±.010
NUMERALS	.100
RADAR ALTITUDE	.120
FEET	.060
OFF (BLACK OR WHITE)	.150

CALIBRATION TABLE OF MAJOR GRADUATIONS
DEGREES : ±15 MIN CLOCKWISE FROM 0 FEET

FEET	DEGREES
0	0.0
100	41.0
200	82.0
300	123.0
400	164.0
600	189.33

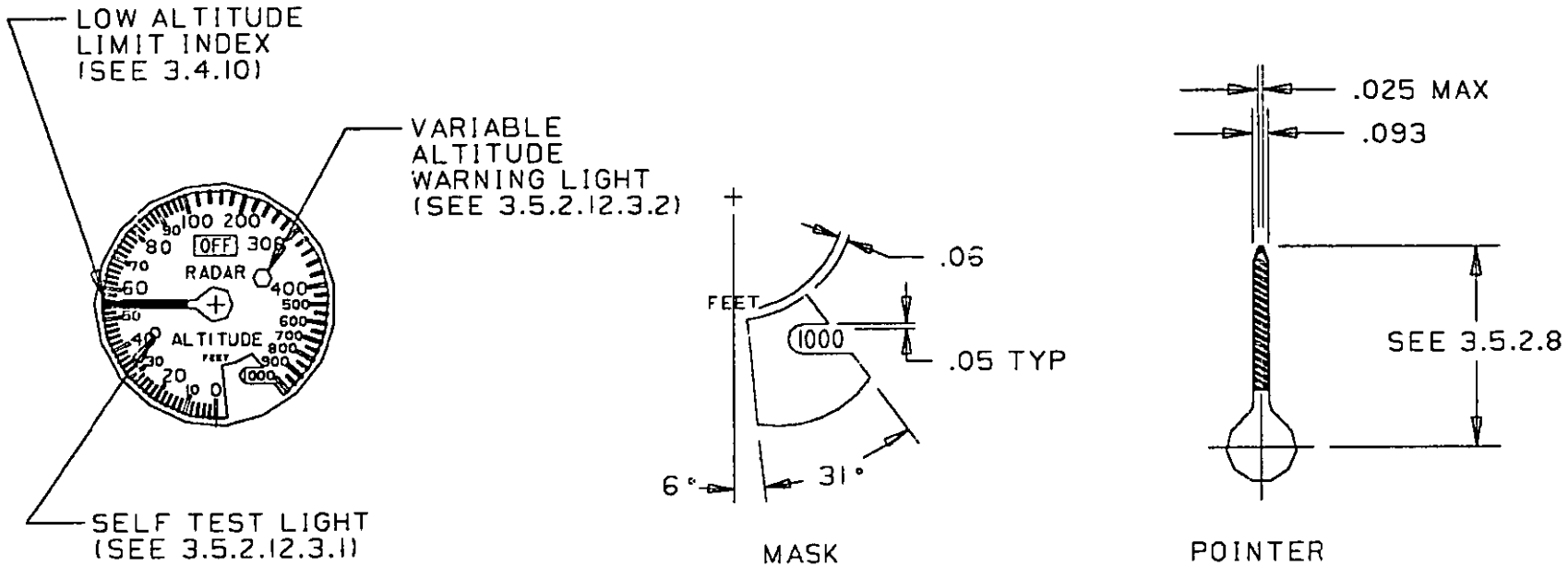
FEET	DEGREES
800	214.67
1000	240.0
2000	260.0
3000	280.0
4000	300.0
5000	320.0

GRADUATIONS

INCREMENT	RANGE, FT.	LENGTH : ±.010	WIDTH : ±.010
20' 50' 500'	0-400 400-1000 1000-5000	0.160	0.025
100' 1000'	0-1000 1000-5000	0.220	0.030

INCHES	MILLIMETERS	INCHES	MILLIMETERS
0	0	.120	3.048
.010	0.254	.150	3.810
.025	0.635	.160	4.064
.030	0.762	.220	5.588
.050	1.270		
.060	1.524		
.093	2.362		
.100	2.540		

FIGURE 5. ID-1768B/APN-194(V) and ID-1880A/APN-194(V) indicator dial configuration.



MARKING	HEIGHT ±.010
NUMERIALS 0,20,40,60,80, 100,200,300,400	.140
ALL OTHERS	.100
RADAR ALTITUDE	.140
FEET	.080
OFF (BLACK OR WHITE)	.150

CALIBRATION TABLE OF MAJOR GRADUATIONS
DEGREES : ±15 MIN CLOCKWISE FROM 0 FEET

FEET	DEGREES
0	0.0
20	32.8
40	65.6
60	98.4
80	131.2
100	164.0
200	196.0

FEET	DEGREES
300	228.0
400	260.0
500	270.0
600	280.0
700	290.0
800	300.0
900	310.0
1000	320.0

GRADUATIONS

INCREMENT	RANGE, FT.	LENGTH : ±.010	WIDTH : ±.010
2' 20'	0-100 100-400	0.160	0.020
10' 50'	0-100 400-1000	0.190	0.025
100'	0-1000	0.220	0.030

INCHES	MILLIMETERS	INCHES	MILLIMETERS
0	0	.093	2.362
.010	0.254	.100	2.540
.020	0.508	.140	3.556
.025	0.635	.150	3.810
.030	0.762	.160	4.064
.050	1.270	.190	4.826
.060	1.524	.220	5.588
.080	2.032		

FIGURE 6. ID-2206/APN-194(V) indicator dial configuration.

U.S. GOVERNMENT PRINTING OFFICE: 1988 - 550-058/20301

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-A-81605D(AS)	ALTIMETER SET, ELECTRONIC AN/APN 194(V)

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)*

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

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