MIL-I-6181B
29 MAY 1953

Superseding
MIL-I-6181
14 June 1950
MIL-I-6181A(USAF)
23 January 1953

MILITARY SPECIFICATION

INTERFERENCE LIMITS, TESTS AND DESIGN REQUIREMENTS, AIRCRAFT ELECTRICAL AND ELECTRONIC EQUIPMENT

This specification has been approved by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 This specification covers interference test procedures and limits for electrical and electronic equipment installed in or closely associated with aircraft. It shall apply to either components or systems as specified by the procuring activity or by the detailed specification.

2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS, AND PUBLICATIONS

2.1 The following specifications and drawing, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

Military

MIL-W-5086 Wire, Electrical, 600-Volt, Copper, Aircraft

Air Force-Navy Aeronautical

AN-I-27 Interference Limits; Aircraft and Vehicular Engine Radio

DRAWINGS

Air Force-Navy Aeronautical Standard Drawing

AN3102 Connectors - Electrical, Receptacles, Box Mounting

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

1254 - 1282

3. REQUIREMENTS

3.1 Operational.- Electrical and electronic equipment shall operate satisfactorily, not only independently, but also in conjunction with other such equipment which may be placed nearby. This requires that the operation of all such equipment shall not be adversely affected by radio interference voltages and fields reaching it from external sources, and also requires that such equipment shall not, itself, be a source of radio interference which might adversely affect the operation of other nearby equipments. The limits specified herein are designed to assure that such requirements will be complied with when the equipment is properly installed in a typical aircraft system.

3.1.1 Transients.- Transient disturbances under 1 second duration are not considered as radio interference if their recurrence during normal operation of the aircraft is less frequent than once every 3 minutes and if their amplitude is less than 20 db above the limits specified herein. They will be further exempted if they are of less than 3 seconds duration and do not occur more often than once per flight. (The burden of demonstration that a transient disturbance will occur only once per flight will be upon the contractor of the equipment in question.)

3.2 Design.-

3.2.1 Interference free design.- Interference minimization shall be considered in the basic design of all electronic and electrical equipment components, assemblies, and systems. This design should be such that before means of suppression are applied, the minimum amount of radio interference is inherently generated and propagated. The application of radio interference reduction components that must be used, such as filtering, shielding, and bonding shall conform to good engineering practice, and, wherever possible, shall be an integral part of the system. Whenever additional suppression is necessary, the use of miniaturized suppression components is encouraged.

3.2.2 Component placement.- Components shall be placed and circuitry arranged in order to result in a minimum of undesired coupling and in the use of a minimum of filter components.

3.2.3 Line shielding.- Whether a line shall be (a) shielded, or (b) filtered, shall depend upon which method results in the least weight and space penalty for the overall system. In general, however, it is preferred that interference reduction be accomplished inside the equipment units when such means give results equal to or better than the use of a shielded line. If shielding is used, it shall be prescribed as an installation requirement.

3.2.4 Case and mountings.- Enclosing case construction, where applicable, should provide enduring continuity of electrical shielding and conducting paths to prevent leakage through discontinuities in the shield. Mating bearing surfaces of the case and mounting shall be free of all insulating finishes to enable the installing activity to accomplish bonding contact to basic structure. Such surfaces shall be covered with strippable tape or other protective coating to prevent corrosion prior to installation. For bonding purposes, this requirement shall take precedence over any conflicting requirements in finish specifications.

3.2.5 Shielding antenna lead-in.- Equipments requiring antennas and not employing wave guides, shall be designed to utilize a shielded antenna lead-in.

3.2.6 Radio interference filters.- Where additional interference suppression is required, after careful design in conformance with the foregoing, the suppression components should be installed inside the enclosing case of the interference source. Interference filter assemblies not hermetically sealed, shall employ only hermetically sealed capacitors, and shall be capable of withstanding all of the service operating conditions of the interference source. As a second choice, where space does not permit the installation of filters within the case of the interference source, they may be attached to the outside of the case of the interference source provided that the wiring between the interference source and the filter is properly shielded and that the filter is permanently bonded thereto. Separately installed interference filters shall not be used unless specifically authorized by the detailed specification.

3.2.7 Susceptibility.- The equipment shall be designed to minimize susceptibility to radio and audio interference from other equipment. Where applicable, the enclosing case construction should be designed not only to minimize radio interference propagation, but should also be designed to minimize interference from external sources. Where conducted radio or audio frequency interference on the power leads or any external leads might cause interference, the leads shall be isolated from other leads to avoid coupling, and where necessary shall have a line interference isolation filter at their entry into the enclosing case. Receiving antenna input and any other low-level signal circuits should preferably be of low impedance, or of balanced design and, where applicable, with terminating connectors so that coaxial or special transmission lines can be used to insure an interference-free installation. Routing of receiving antenna input or any low-level signal circuit within the equipment should be so designed and installed that interference is not picked up from power or control leads due to circuit coupling. Antenna or low-level signal circuit return paths or ground paths should be so arranged that the interference will not occur due to common conductive paths with other circuits or with the enclosing case grounding path.

3.3 Interference measurement instruments.- The instruments employed to perform the measurement of radio interference voltages described in this specification shall be known as the interference measurement instruments. It shall be the option of the procuring activity concerned to specify the use of any specific instrument or instruments listed in table I. If not specified, any suitable combination of the instruments listed may be used except that instruments incapable of measuring peak interference values shall not be used to measure interference with a pulse repetition rate lower than 30 pulses per second. The use of instruments other than those listed in table I may be approved upon application to the procuring activity concerned provided limits for the proposed instrument are furnished and demonstrated to be equivalent to the standard limit or to the limit given in terms of an instrument which is already approved.

TABLE I

Interference measuring equipment 1/

Frequency range	Interference instrument	Classification 2/
150 kc to 20 mc	Radio test set AN/PRM-1	I
	Ferris Model 32A and 32B	IV
150 kc to 80 mc	Radio interference instrument AN/PRM-14	II
20 mc to 150 mc	Measurement Corp, Model 58 and 58A	IV
20 mc to 400 mc	Noise field intensity meter TS-587/U	IV
20 mc to 400 mc	Radio interference instrument AN/URM-7	II
40 mc to 1,000 mc	R-F interference test set AN/URM-28	IV
400 mc to 1,000 mc	Radio test set AN/URM-17	III

1/ This table is subject to change on reasonable notice to include new approved instrumentation having superior performance characteristics.

2/ See paragraph 6.2 for definition of each classification.

3.3.1 Calibration of interference measuring instruments.- The standard for calibration shall be the rms voltage obtained from a laboratory-type "standard" signal generator. The interference measurement instrument calibration shall, unless otherwise specified, be performed with a suitable standard sine-wave generator in accordance with instructions contained in the instruction manual for the instrument. Recalibration of the instrument shall be made when checks indicate a deviation in normal calibration greater than 10 percent.

3.4 Interference limits.-

3.4.1 Conducted.- Radio interference voltage generated by the equipment in excess of the values indicated in figure 1 between the frequencies of 0.15 and 20 mc shall not appear on any external conductor which could conduct interference to other equipment. Measurements may be omitted on leads deemed incapable of conducting interference into other equipment as designated in the detail specification.

3.4.1.1 Antenna conducted.-

3.4.1.1.1 Receiver or transmitter key-up.- The r-f output of any receiver or any transmitter under key-up or nontransmit condition shall not exceed 200 micro-microwatts (100 microvolts across 50 ohms, assuming an antenna impedance of 50 ohms) from 0.15 to 1,000 mc.

3.4.1.1.2 Transmitter key-down.- Under key-down or transmit conditions, the r-f output of any transmitter, at other than the fundamental (carrier plus minimum sideband frequencies required for the intelligence transmitted), shall be at least 80 db below the power of the fundamental, or less than 0.02 microwatts from 0.15 to 1,000 mc, whichever is greater, (1,000 microvolts across 50 ohms, assuming an antenna impedance of 50 ohms).

3.4.2 Radiated.- Over the frequency range of 0.15 to 1,000 mc, no radio frequency interference voltage in excess of the value indicated in figures 2, 3, and 4 shall radiate from any unit, cable, (including control, pulse, if., video, antenna transmission, and power cables) or interconnecting wiring of the equipment. This requirement exempts transmitter fundamental radiation but specifically includes oscillator radiation and other spurious emissions in addition to broad band interference. Equipments which do not utilize electronic circuits capable of producing r-f oscillations, either intentional or unintentional, are exempt from measurements above 150 mc. No measurements of broadband interference as determined by paragraph 4.1.11 are required above 150 mc, except on equipment producing pulsed cw signals.

3.4.3 Aircraft engine limits.- Aircraft engine and propeller systems or their components will be considered as meeting the requirements of this specification if they comply with the requirements of Specification AN-I-27 up to 150 mc. The conducted limits specified herein may be used in lieu of those specified in Specification AN-I-27.

3.5 Susceptibility limits radio frequency.- No change in indication, malfunctioning, or degradation of performance shall be produced in any equipment when an r-f signal of 10,000 microvolts from a source (see paragraph 4.4.3) having an impedance of 50 ohms is applied between each power lead and ground as shown in figure 8; nor when the complete equipment is subjected to a radiated field as illustrated in figure 9. The frequencies to be used are specified in paragraph 4.4.2. Equipment deemed incapable of being affected by extraneous r-f signals may be exempted from susceptibility tests.

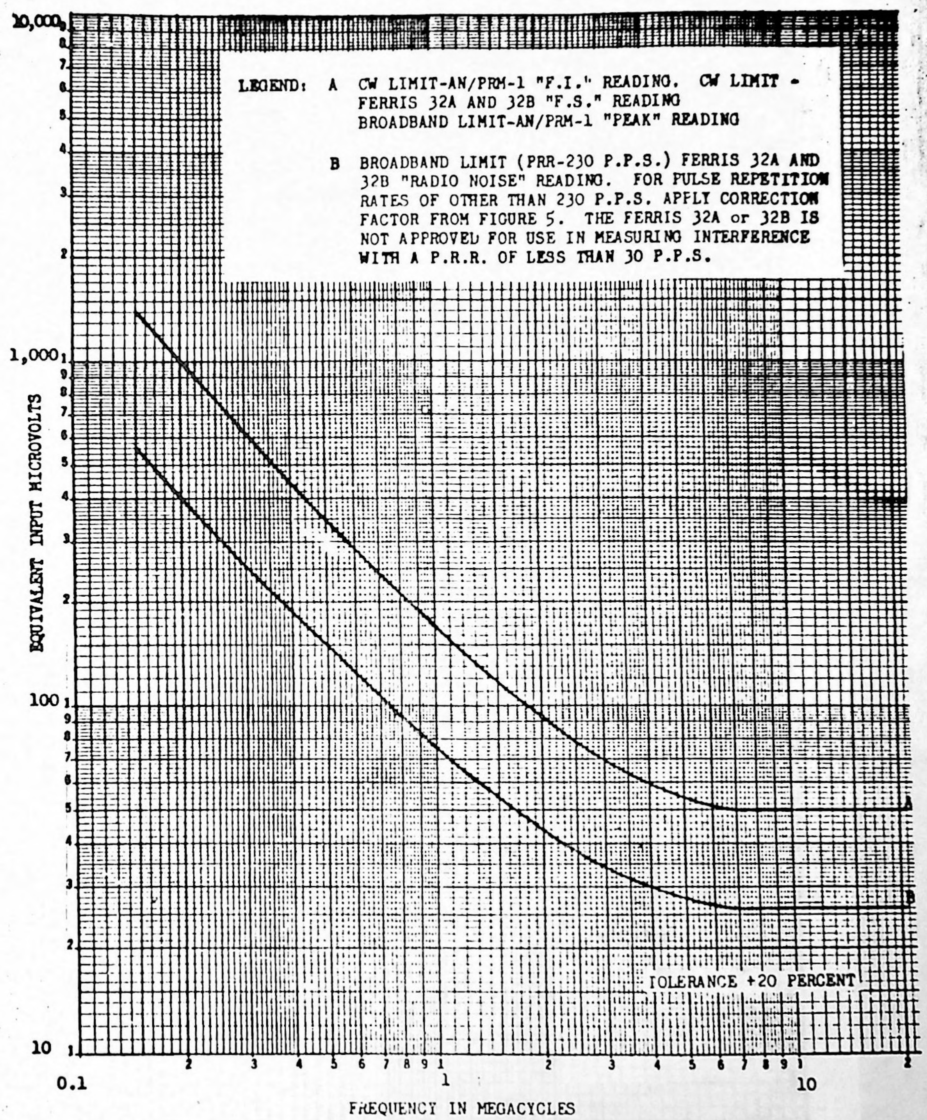


FIGURE 1. Conducted interference limits - broadband and cw

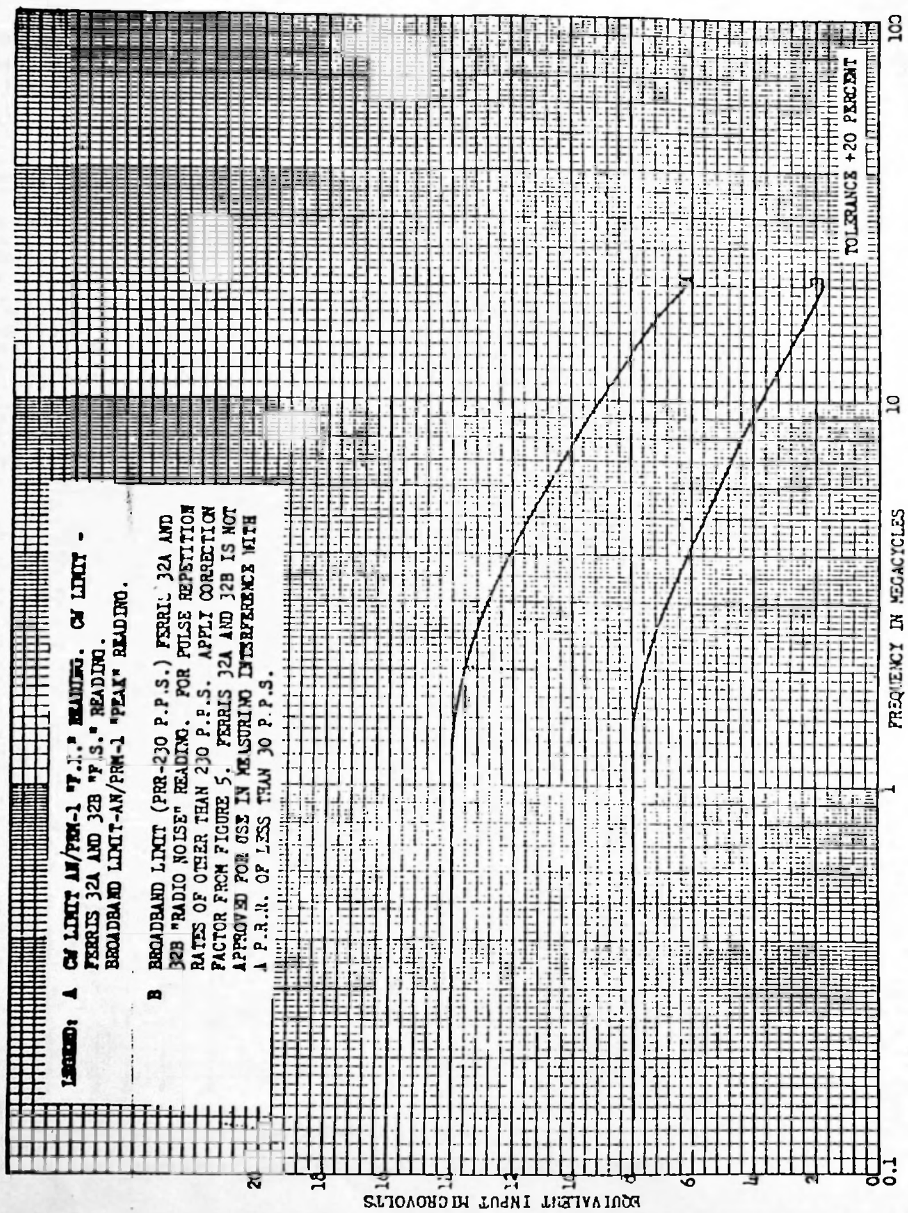


FIGURE 2. Radiated interference limits broadband and cw

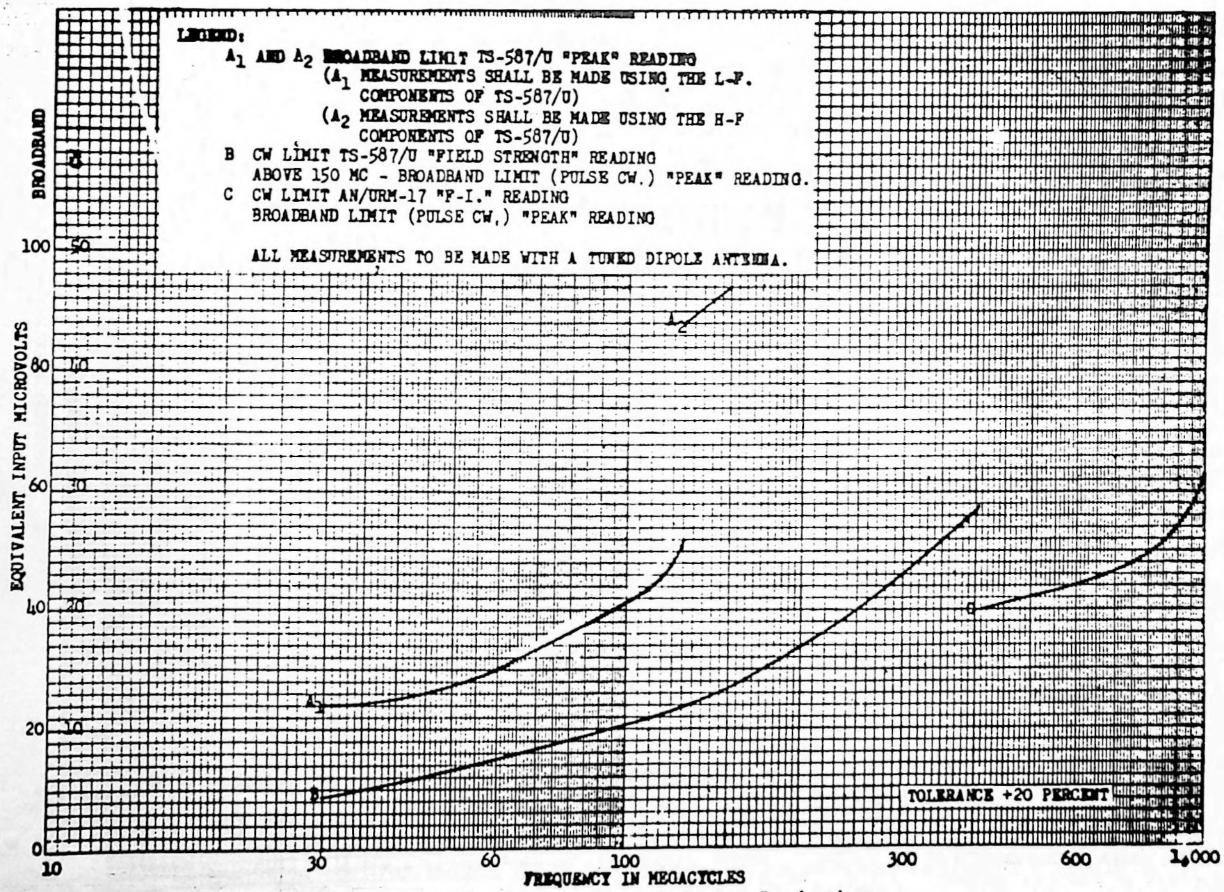


FIGURE 3. Radiated interference limits broadband and cw

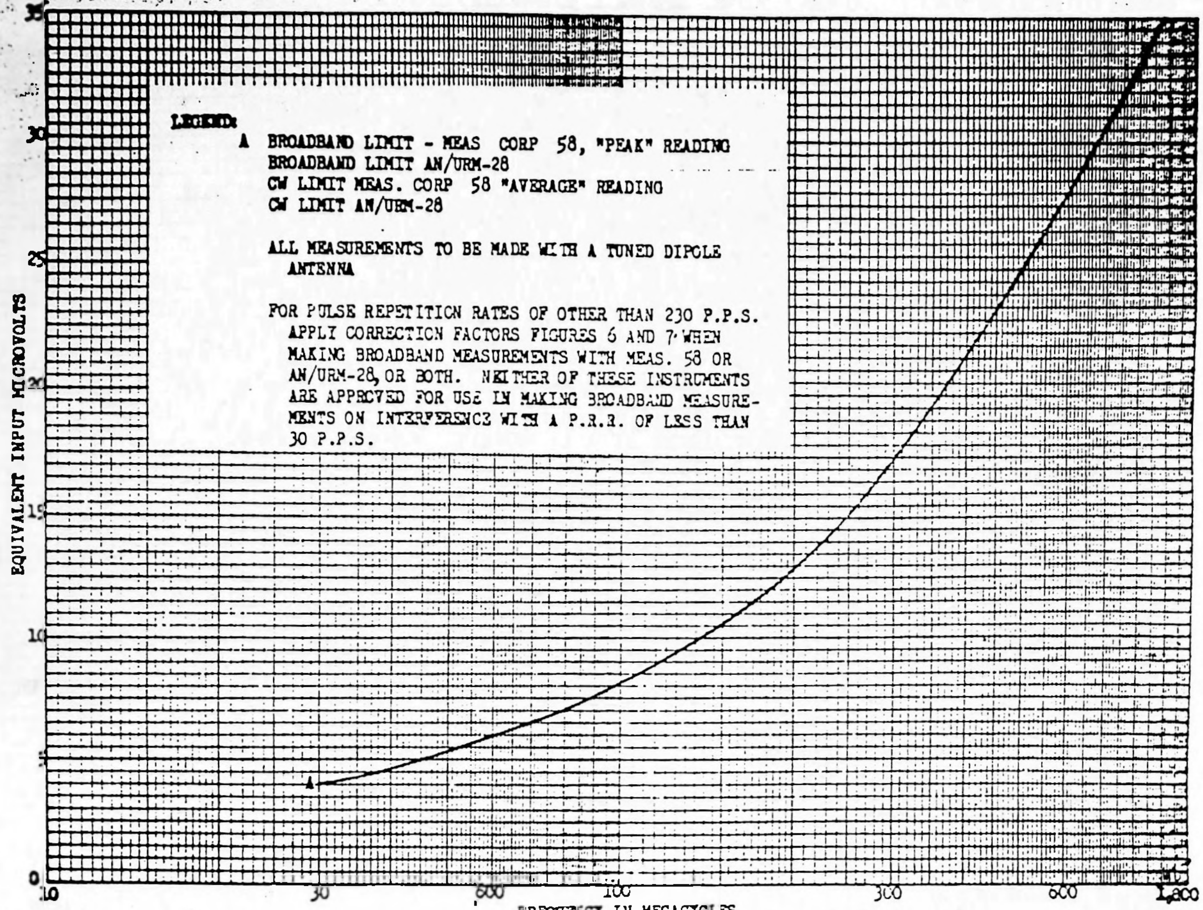


FIGURE 4. Radiated interference limits broadband and cw

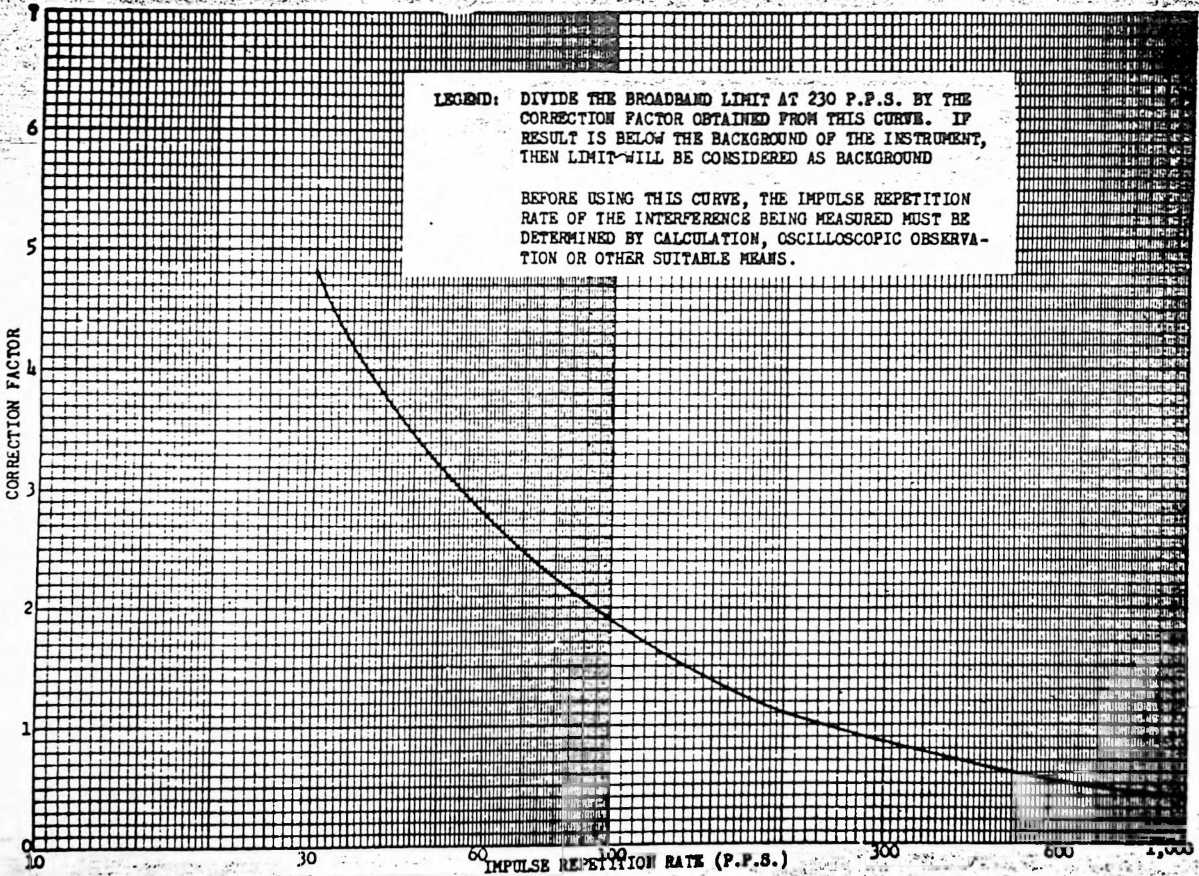


FIGURE 5. Correction factor for pulse repetition rate for Ferris 32A. and 32B. "Radio Noise" reading

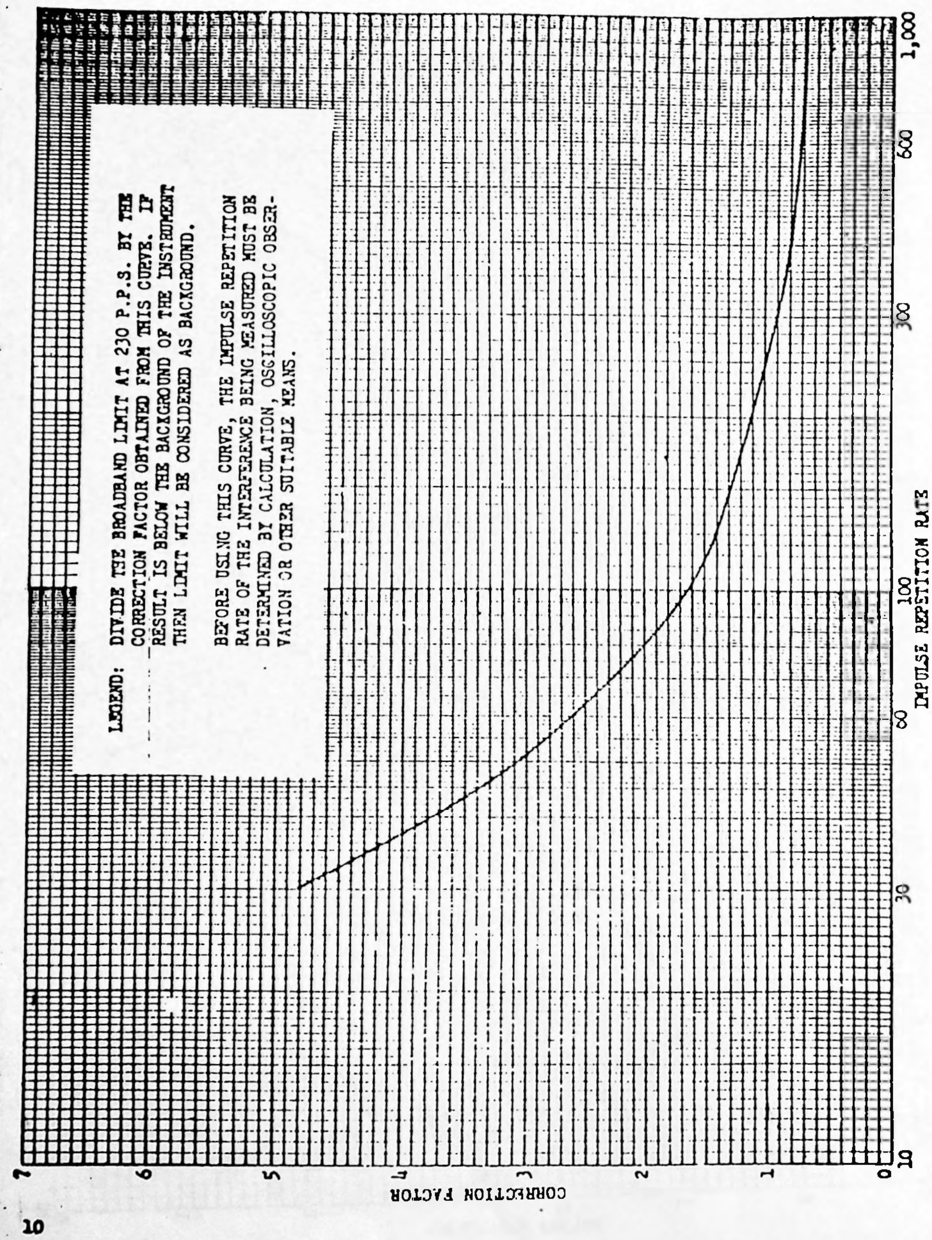


FIGURE 6. Correction factor for pulse repetition rate for Meas. Corp. 58. "Peak Reading"

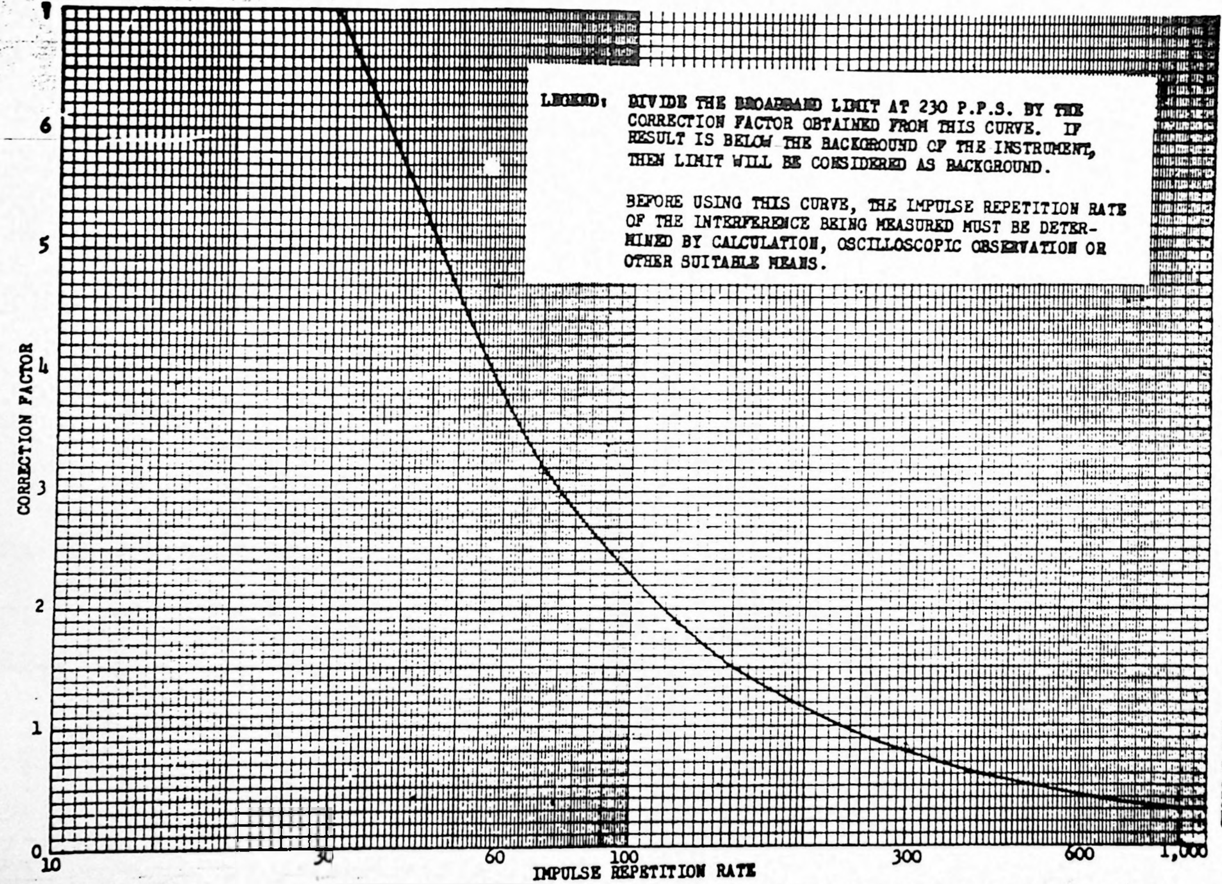


FIGURE 7. Correction factor for pulse repetition rate for AN/URM-28. Broadband interference measurements

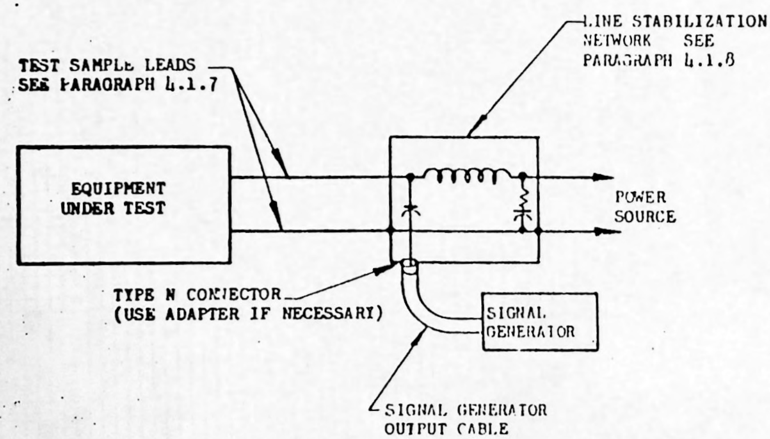
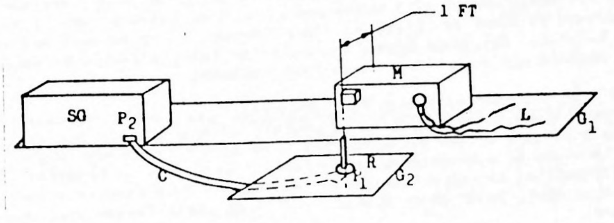


FIGURE 8. R-F susceptibility test setup (conducted)



M - EQUIPMENT UNDER TEST
SG - SIGNAL GENERATOR
L - TEST SAMPLE POWER LEADS TO STABILIZATION NETWORK SHOWN IN FIGURE 13
G_1 - COPPER GROUND PLANE
G_2 - 20-INCH SQUARE COUNTERPOISE, SAME LEVEL AS G_1
R - ROD ANTENNA RADIATOR
D - SHIELDED DUMMY ANTENNA
C - 50-OHM COAX CABLE PROPERLY TERMINATED AT BOTH ENDS
P_1, P_2 - RESISTIVE PADS, AS REQUIRED, FOR PROPERLY TERMINATING THE CABLE AT THE ANTENNA AND GENERATOR.

LENGTHS OF THE RADIATING ROD ANTENNA AND VOLTAGES TO BE APPLIED AT ITS BASE

Freq in MC	E (in UV)	Length (inches)
.015 - 2.0	100,000	20
2.0 - 20	50,000	20
20 - 100	20,000	10
100 - 300	15,000	10
300 - 500	10,000	3
500 - 1,000	5,000	3

THE VOLTAGES APPLIED AT THE BASE OF THE ROD ANTENNA ARE THOSE EXISTING BEFORE THE ROD IS CONNECTED WITH RESISTIVE PADS IN PLACE. THE ROD ANTENNA IS ORIENTED VERTICALLY AND POSITIONED AT A DISTANCE OF 1 FOOT FROM ANY PART OF THE EQUIPMENT CASE, POWER LEADS, OR INTERCONNECTING CABLES WHICH MAY RESULT IN MAXIMUM SUSCEPTIBILITY.

THE SIGNAL SHALL BE MCW, MODULATED 30 PERCENT WITH EITHER 400 OR 1,000 CYCLES. SEE PARAGRAPH 4.4.2

FIGURE 9. Susceptibility test setup (radiated)

3.5.1 Susceptibility limits, audio frequency.- No change in indication, malfunction, or degradation of performance shall be produced in any equipment when a sine wave audio-frequency signal of 2 volts rms is applied between each 28 volt d-c power lead and ground as shown in figure 10. The frequencies to be used are specified in paragraph 4.4.2.1. Equipment deemed incapable of being affected by extraneous audio-frequency signals are exempt from these requirements.

3.5.2 "Front-end" rejection for receivers.- Front-end rejection is a measurement of the degree to which the equipment is capable of rejecting at the antenna input terminal, those signals outside of the designed pass band of the receiver. Degree of rejection is expressed in terms of attenuation, in decibels relative to the desired signals, introduced as image frequencies or other responses with respect to a desired signal. This front-end rejection shall be 80 db or better, except at image frequencies where it shall be 60 db or better.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 General conditions.-

4.1.1 Tests.- All tests specified herein, conducted to determine compliance with this specification, shall be accomplished by the contractor under the supervision and subject to the approval of the Government Inspector. If reports are required by the contract, they shall contain a section stating the results of interference tests accomplished in accordance with this or related specifications.

4.1.2 Arrangement.- The general arrangement of equipment, interconnecting cable assemblies, and supporting structures shall be such as to simulate an actual installation insofar as practicable. Shielded leads or cables shall be used only where they will be so used in actual practice, except that shielded dummy antennas shall be used for receivers and transmitters.

4.1.3 Ambient interference level.- It is desirable that the ambient interference level during testing (measured with the sample deenergized) be at least 6 db below the allowable specified interference limit. However, in the event at the time of measurement the levels of ambient interference plus test item interference are not above the specified limit, such tested item shall be considered to comply with the specified requirements. This requirement shall apply equally to both radiated and conducted ambient interference levels. A shielded enclosure may be used if necessary or desired.

4.1.4 Ground plane.- A copper or brass ground plane, 0.01 inch thick minimum for copper, 0.025 inch thick minimum for brass, 12-square feet or more in area with a minimum width of 30 inches, shall be used in all cases where a shielded room is employed. The ground plane shall be bonded to the shielded room at intervals no greater than 3 feet and at both ends of the ground plane. The ground plane and screen room walls may be considered equivalent to an aircraft fuselage for purposes of simulating a normal installation. For large equipment systems normally mounted on a metal test stand, the test stand may be considered part of the ground plane and bonded accordingly. When a shielded room is not used, the test sample may be placed on a solid support for operation. The support may be solid earth, steel, or iron flooring, metal bedplate, metal sheet-covered planking, or the like.

4.1.5 Bonding.- Only the provisions included in the design of the equipment and specified in the installation directions shall be used to bond units, such as equipment case and mount, together. Where bonding straps are required to complete the test setup, as from support to screen room or mount to ground plane, the straps shall have a width-to-length ratio of 1 to 5, or greater, shall have a minimum thickness of 0.025 inches and shall be copper or brass metal straps, not braid. Such bond straps shall be attached by clean metal-to-metal contact.

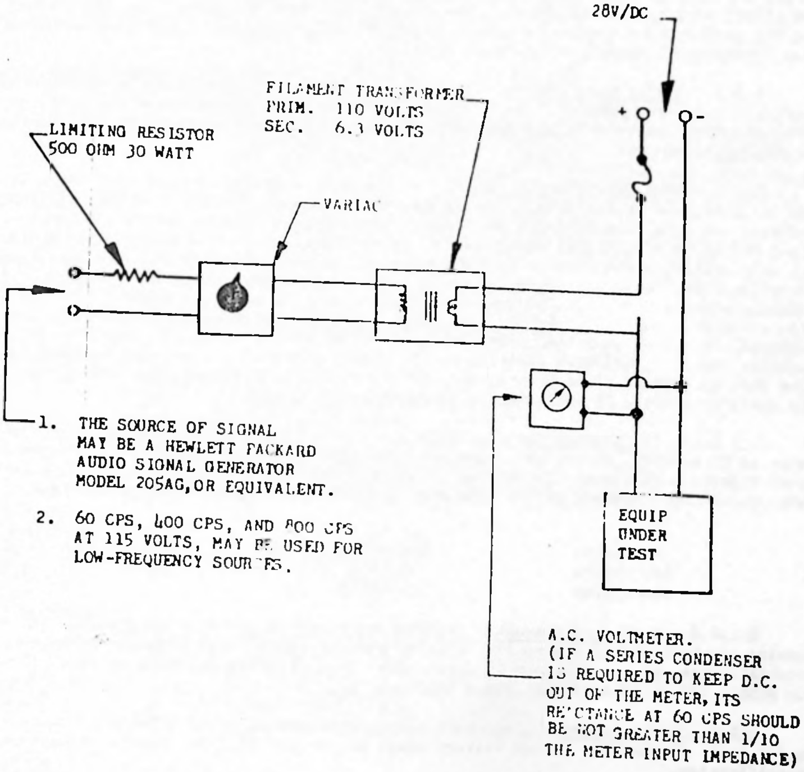


FIGURE 10. AF Susceptability test setup

4.1.5.1 Measuring instrument.- The case of the measuring instrument shall be bonded to the ground plane.

4.1.6 Internally grounded equipment.- When an internally grounded test item is furnished with an external ground terminal connection, and when this connection is used in actual installation conditions, the ground lead shall be brought out and connected to the ground plane simulating actual installation conditions in addition to grounding the framework or chassis of the test item.

4.1.7 Test sample leads.- The test sample leads to the line stabilization network specified in paragraph 4.1.8 shall be 24 inches ±1 inch in length and shall be so arranged that the distance between them and from each lead to ground or grounded enclosure is a nominal of 2 inches.

4.1.8 Line stabilization network.- The line stabilization network shown in figure 10 shall be used as illustrated in figures 11 through 15 for all radiated and conducted tests. One such network shall be inserted in each power supply lead and electrical load lead (if used) when making measurements. (See figure 12.) A terminal shall be provided on this device, fitted with a type N connector, to which the interference measurement instrument may be connected, by means of a 50-ohm (RG-9/U) cable, for conducted interference measurements. The 50-ohm cable shall always be properly terminated in 50 ohms for all conducted tests. For radiated tests, the 50-ohm cable and termination are omitted. The equipment under test shall always be connected to the same side of the network as the 0.1 microfarad capacitor. The ground plane of the network enclosure shall be the same as that of the test item or shall be made a part of the test item ground plane by means of bonding in accordance with paragraph 4.1.5.

4.1.8.1 Performance characteristics.- The current-carrying capacity of the network is 50 amperes, dc to 800 cycles ac. The maximum voltage drop at 50 amperes is not over 2 percent of the supply voltage. The performance characteristics of this device will permit measurements of test items of the following maximum voltage ratings:

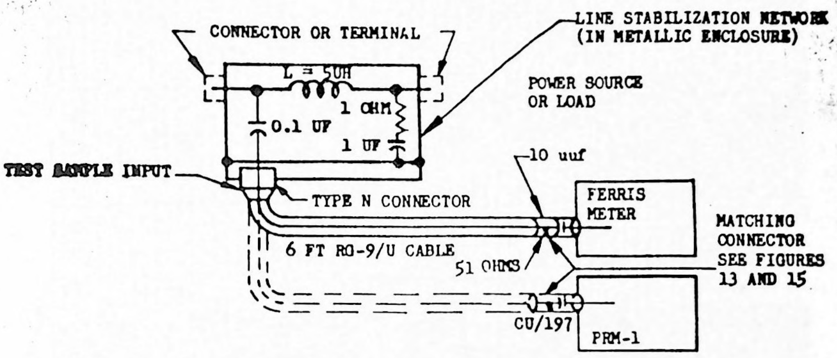
DC	600 volts
60 cycles	440 volts
400 cycles	230 volts
800 cycles	115 volts

4.1.8.2 Design of network.- Working data and an electrical schematic of this device are included in figure 11. A curve showing the average input impedance of the stabilization network is shown in figure 12. The network shall have an input impedance to within ±10 percent of that given in figure 12.

4.1.9 Power supply.- The power supply shall be at rated voltage of the equipment under test, ±5 percent. Rated voltage shall be as specified in the individual equipment specification.

4.1.10 Monitoring.- All interference measurements shall be monitored, using either a headset or loudspeaker with proper impedance matching.

4.1.11 Operation of measuring instruments.- For both conducted and radiated interference measurements, the instruments used shall be calibrated and operated as indicated in their respective instruction manuals, except as otherwise required by this specification. The function switch of the various instruments shall be set as indicated by the limit curves given for each instrument. For the purposes of this specification, all interference shall be classed as one of two types, cw or broadband. Whether the cw or broadband limit shall apply for a given interference shall be determined by the following criterion:



DATA FOR A TYPICAL 50-AMPERE NETWORK

1. COIL DATA:-
   INDUCTANCE = 5 uh
   TURNS = 13 SINGLE LAYER WOUND
   WIRE = AN16 SPEC MIL-W-5086
   LENGTH = 4 INCHES
   FORM LENGTH = 5-1/4 INCHES (DRILL 3/8 INCH DIA HOLE 7/16 INCH FROM EACH END FOR COIL ANCHORING PURPOSES)
   FORM DIAMETER ≐ 3 INCHES OD (0.125 WALL THICKNESS)

2. ENCLOSURE DATA:-
   MATERIAL = 0.064 INCH ALUMINUM
   SIZE = 4 x 4 x 9-3/8 INCHES

3. MATERIAL:-
   1 EA 1. UF/600 WORKING VOLTS DC/BATHTUB
   1 EA 0.1 UF/600 WORKING VOLTS DC/BATHTUB
   1 EA 1 OHM ±5 PERCENT, 2 WATT, FIXED, COMPOSITION RESISTOR (OR EQUIVALENT PARALLEL COMBINATION).
   1 EA UG-58A/U ("SAMPLE SIDE" CONNECTOR)
   2 EA AN3102-18-6S BOX MOUNTING ("POWER TERMINALS" CONNECTOR)

CONNECTIONS TO CONDENSERS SHOULD BE AS SHORT AS POSSIBLE

FOR USE ABOVE 50 AMPERES, REPLACE COIL WITH 5 UH COIL OF SUITABLE DIMENSIONS CAPABLE OF CARRYING DESIRED CURRENT.

THE VALUES GIVEN FOR THE COMPONENT PARTS OF THE NETWORK ARE NOMINAL. REGARDLESS OF THE CONSTRUCTION OR DEVIATION FROM NORMAL VALUES, THE NETWORK MUST HAVE AN INPUT INPEDANCE TO WITHIN 10 PERCENT OF THAT GIVEN IN FIGURE 12.

FIGURE 11. Line stabilization network and typical meter connection for conducted measurements

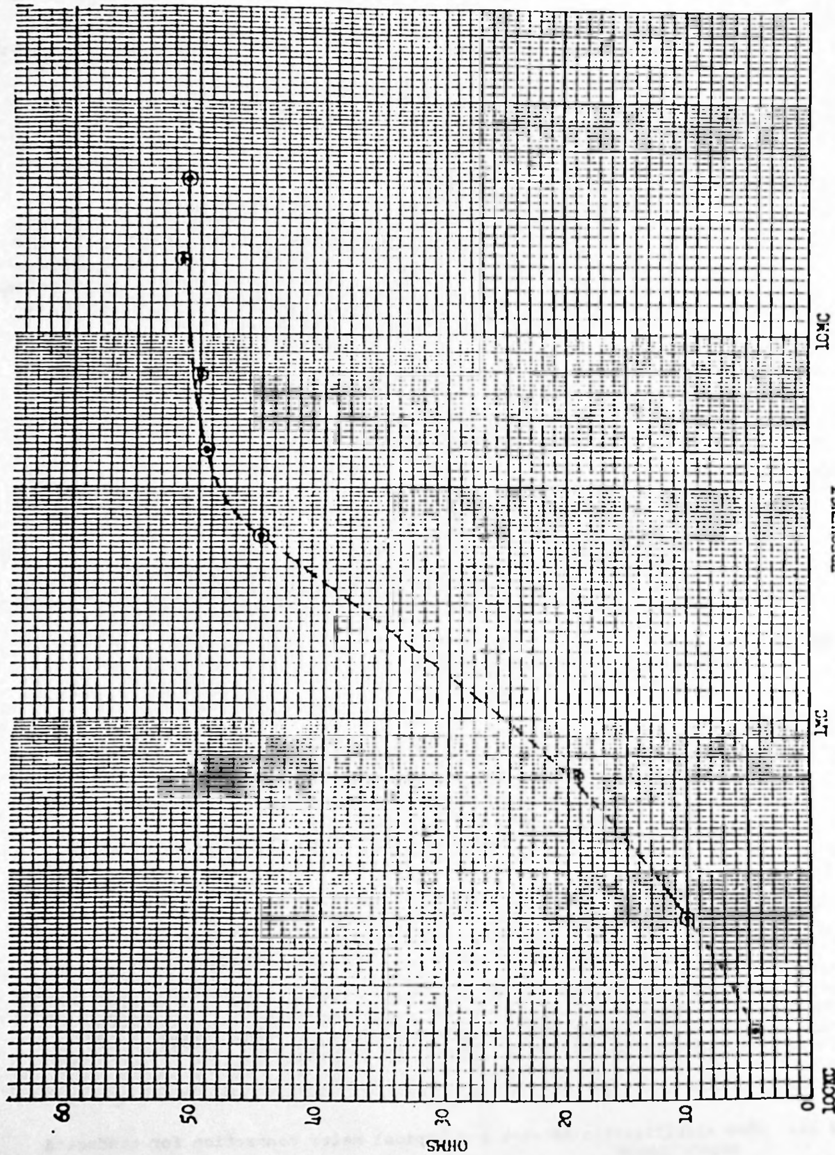
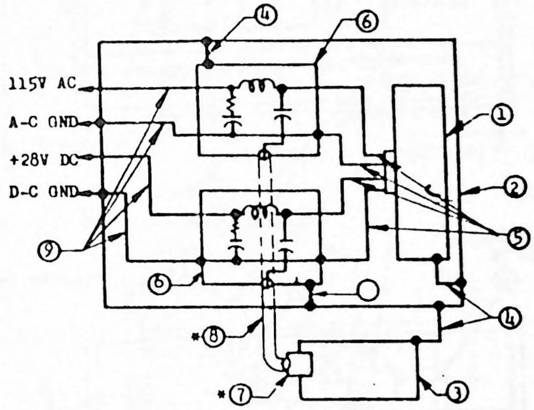


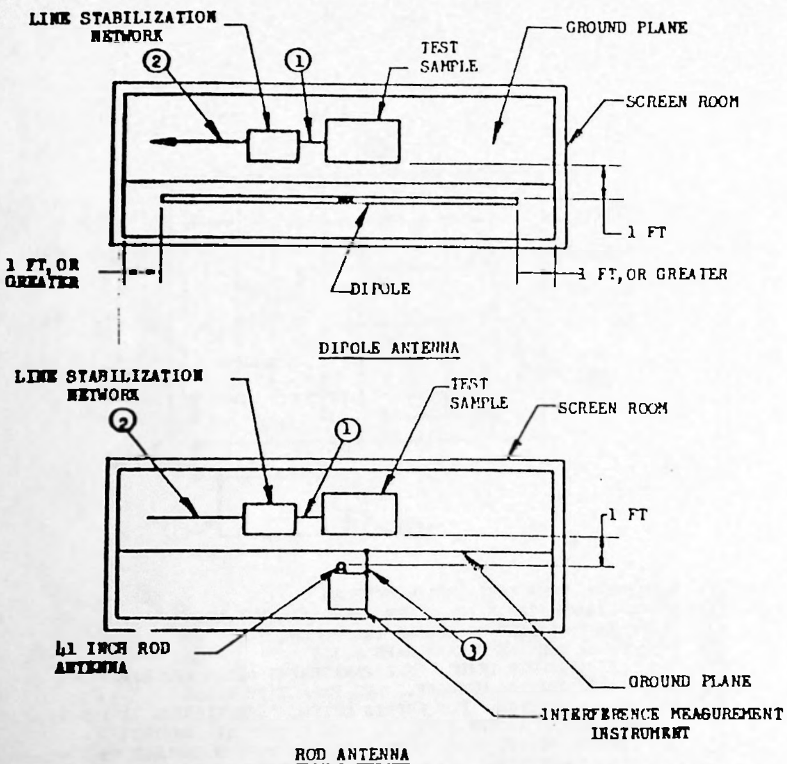
FIGURE 12. Average curve of input impedance measurements of the line stabilization network 6-ft RG-9/U cable



1. EQUIPMENT UNDER TEST (NOISE SOURCE)
2. GROUND PLANE (TABLE TOP) SEE PARAGRAPH 4.1.4
3. RADIO INTERFERENCE MEASURING INSTRUMENT
4. BONDING STRAPS. SEE PARAGRAPH 4.1.5
5. TEST SAMPLE POWER LEADS. SEE PARAGRAPHS 4.1.6 AND 4.1.7
6. LINE STABILIZATION NETWORK. SEE PARAGRAPH 4.1.8
7. MATCHING CONNECTOR. FOR FERRIS METER, SEE FIGURES 11 AND 15; FOR STODDARD AN/PRM-1 METER, SEE FIGURE 11 (CU/197)
8. SIX FEET OF RG-9/U CABLE TERMINATED IN TYPE N CONNECTORS
9. FILTERED POWER INPUT LEADS. SEE PARAGRAPH 4.1.9

* ITEMS 7 AND 8 ARE OMITTED WHEN MAKING RADIATED INTERFERENCE TESTS.

FIGURE 13. Typical test setup for radio interference tests



(1) TEST SAMPLE POWER LEADS. SEE PARAGRAPHS 4.1.6 AND 4.1.7
(2) FILTERED POWER INPUT LEADS. SEE PARAGRAPH 4.1.9
(3) BONDING STRAP. SEE PARAGRAPH 4.1.5

FIGURE 14. Antenna orientation and positioning

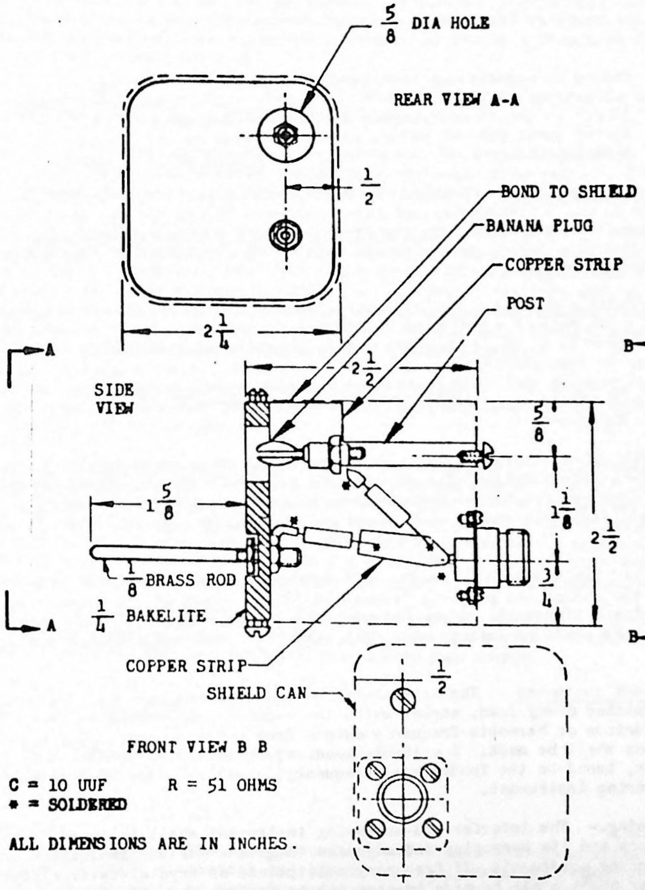


FIGURE 15. Drawing of a matching connector for use with the Ferris meter

Type	Monitoring	Meter indication
CW 1/	Sharply tunable	F.S. 0.8 Q.P. 2/
Broadband	Broad tuning	F.S. 0.8 Q.P. 2/

1/ Pulsed cw signals are considered broadband interference.

2/ "F.S." is the field strength or field intensity and "Q.P." is the quasi peak or radio-noise indication on the instrument used.

4.1.12 Test frequencies.- Not less than 1 frequency per octave in the frequency range of 0.15 and 20 mc, 2 frequencies per octave between 20 and 150 mc, and 3 frequencies per octave between 150 and 1,000 mc, representative of the most severe indication of interference or susceptibility found, shall be selected for test after completely scanning the specified frequency range.

4.1.13 Correction for P.R.R.- For interference measurements with a nonpeak-reading instrument (Ferris 32, Meas. Corp 58, and AN/URM-28) a correction shall be made in accordance with figure 5, 6, or 7, when the p.r.r. (pulse repetition rate) of the interference is greater or less than 230 p.p.s. The p.r.r. shall be determined by oscilloscopic observation where a sufficiently close estimation cannot be otherwise obtained. The p.r.r. of a compound interference source shall be considered the same as the p.r.r. of the pulses of highest amplitude.

4.1.14 Loads.- The equipment under test shall be loaded with the full mechanical and electrical load, or equivalent, for which it is designed. This requirement specifically includes electrical loading of the contacts of mechanisms which are designed to control electrical loads even though such loads are physically separate from the equipment under test.

4.2 Conducted interference.- Conducted interference measurements on power leads shall be made at the end of the properly terminated 50-ohm cable of the network specified in paragraph 4.1.8 and figure 11. A separate network shall be used for each ungrounded lead and all networks shall be left in place for complete radio interference tests. See figure 13.

4.2.1 Antenna conducted.- The transmitter or receiver antenna shall be operated into a properly matched dummy load, across which the required power measurements for measurement of spurious or harmonic frequency output from a transmitter under key-down or transmit conditions shall be made. A suitable band-reject filter as specified by the procuring activity, tuned to the fundamental frequency, shall be inserted between the dummy load and the measuring instrument.

4.2.1.1 Tuning.- The interference-measuring instrument shall be tuned to the oscillator frequency and its harmonics and adjusted to give a maximum indication on the meter of the measuring equipment. If frequency multipliers or crystal-saver circuits are employed, a further check shall be made by scanning to measure any signal that may appear at other than the oscillator frequency.

4.3 Radiated interference.- Radiated-interference measurements shall be made, using the rod or resonant dipole antenna supplied with the particular test instrument employed. The test setup shall be as illustrated in figure 11, except that the 6 ft RG-9/U cable and the matching connector shall be omitted and the appropriate antenna substituted. The instructions and limits specified in figures 2, 3, and 4 shall apply.

4.3.1 Antenna orientation and positioning.- Those interference-measuring instruments equipped with rod antennas shall be so placed that the rod antenna is in a vertical position and the base of the antenna is 1 foot from the nearest perimeter of the test item. Those interference measuring instruments equipped with resonant dipole antennas shall have the dipole positioned horizontally with the center of the dipole at a distance of 1 foot from the nearest perimeter of the test item. The dipole shall be so oriented that its length is tangential to the nearest perimeter. Within the limitations imposed by the test location and the above, the antenna and instrument shall be moved about in order to obtain maximum indication. In screen-room tests, the antennas should be at least 1 foot away from any wall. See figure 14.

4.4 Susceptibility tests.- The test setup shall be in accordance with figure 8 for r-f conducted tests and figure 9 for radiated tests.

4.4.1 Sensitivity adjustment.- All external and internal controls of the equipment under test shall be set for maximum signal plus noise-to-noise ratio. All external and internal controls for squelch or limiters shall be set to give minimum limiting action.

4.4.2 Selection of radio frequency test signal.- The range of radio frequencies chosen for test shall begin with the lowest frequency associated with the equipment (if., fundamental crystal frequency, etc) and shall extend through the highest frequency associated with the equipment up to 1,000 mc. The signal shall be mcw, modulated 30 percent with either 400 or 1,000 cycles, unless the equipment under test is designed to operate on a particular audio tone or with pulse modulation. In such cases, the test signal shall be modulated to correspond to the desired signal.

4.4.2.1 Selection of audio-frequency test signals.- The range of audio-frequency voltages applied between each 28 volt d-c power lead and ground shall be from 60 cycles per second to 10,000 cycles per second.

4.4.3 Conducted test voltages.- The voltages specified in paragraph 3.5 shall be those voltages which are calculated to exist across the output terminals of the signal source when no impedance, other than that necessary to meet the requirements as to source impedance, is connected to the signal generator. A shunt resistance shall be used to reduce source impedance when the signal generator has an internal impedance higher than that stipulated, and a series resistance shall be used to increase the source impedance when the signal generator has an impedance lower than that stipulated.

4.4.3.1 Blocking capacitors.- Blocking capacitors having negligible impedance at the test frequency may be inserted in the leads from the signal source to the equipment under test if required for the protection of the signal source.

5. PREPARATION FOR DELIVERY

5.1 Not applicable to this specification.

6. NOTES

6.1 Intended use.- The test procedures and limits specified herein are intended to insure that aircraft electrical and electronic equipments will operate properly in service use when subjected to certain radio and audio interference voltages, and also will not cause the malfunction of other equipments by undue generation of interference voltages.

6.2 Classification of interference measurement instruments.- Four classes of interference instruments are available at the date of this specification.

6.2.1 Class 1.- Radio interference field intensity meters which have been designed to conform with proposed standards and which have been approved by the Armed Forces.

6.2.2 Class 2.- Instruments which have been designed for special purposes and, insofar as the intended special purpose is concerned, conform to the specification for class 1 instruments and which have been approved for such special purpose by the Armed Forces.

6.2.3 Class 3.- Meters designed as class 1 or class 2 instruments, but which have not been evaluated. When approved by the Armed Forces, these will be redesignated as class 1 or class 2 instruments.

6.2.4 Class 4.- Existing meters which are in general use and which do not conform to the approved standards. Use of these instruments is permissible until conditions permit their replacement by class 1 or class 2 meters only if procured by the contractor prior to the effective date of this specification.

6.3 Definitions.-

6.3.1 Radio interference.- Radio interference is defined as undesired conducted or radiated electrical disturbances, including transients, which interfere with the operation of communication or other electrical or electronic equipment.

6.3.2 Susceptibility.- As used herein, susceptibility is defined as that characteristic which causes an equipment to malfunction or exhibit an undesirable response when its case or any external lead or circuit, excepting antenna or antennas, is subjected to a specified radio- or audio-frequency voltage or field.

6.3.2.1 Representative examples of equipment which are deemed incapable of being affected by extraneous radio- and audio-frequency signals are: Dynamotors, vibrators, navigation light flasher, windshield wiper, and fuel-pump motors.

6.3.3 Microvolts per kc.- The nearest approach to a standard or broadband radio interference voltage is in terms of microvolts per kilocycle. Interference intensity in microvolts per kc is equal to the number of rms sinewave microvolts (unmodulated), applied to the input of the measuring circuit at its center frequency, which will result in detector peak response in the circuit equal to that resulting from the interference pulse being measured, divided by the band width of the circuit in kilocycles. The band width is the area divided by the height of the voltage-response versus radio-frequency selectivity curve, from antenna to peak detector. This band width is approximately equivalent to the band width between half power points of this selectivity curve.

6.4 Correlation of meters.- Taking a given limit of radio interference in terms of microvolts per kilocycle, corresponding limits in terms of equivalent input sine wave microvolts for various meters have been determined. See figures 1, 2, 3, and 4. The differences in meter indications are due to differences in weighting characteristics, band width and pulse response for the average instrument of each type. However, since several of the instruments employed are not peak-reading instruments, this correlation is satisfactory only for an interference pulse repetition rate of 230 p.p.s., which was taken as most typical. For lower or higher p.r.r's, correction must be made to the readings of non-peak-reading instruments (Ferris 32, Meas. Corp 58, AN/URM-28) as indicated in the p.r.f. correction curves provided herein in order to obtain satisfactory correlation with peak-reading instruments (AN/PRM-1, TS-587/U, AN/URM-17, etc). See figures 5, 6, and 7.

6.4.1 Standard limits.- Figures 16, 17, 18, and 19 give the standard for broadband and cw interference limits, in peak uv per kc which form the basis of the practical equivalent uv input limits given in figures 1, 2, 3, and 4. In the event peak-reading meters other than those for which practical limits are given are used, compliance with the requirements of this specification can be determined by dividing the peak input uv measured by the average band width at the practical frequency and comparing the result with the standard limits.

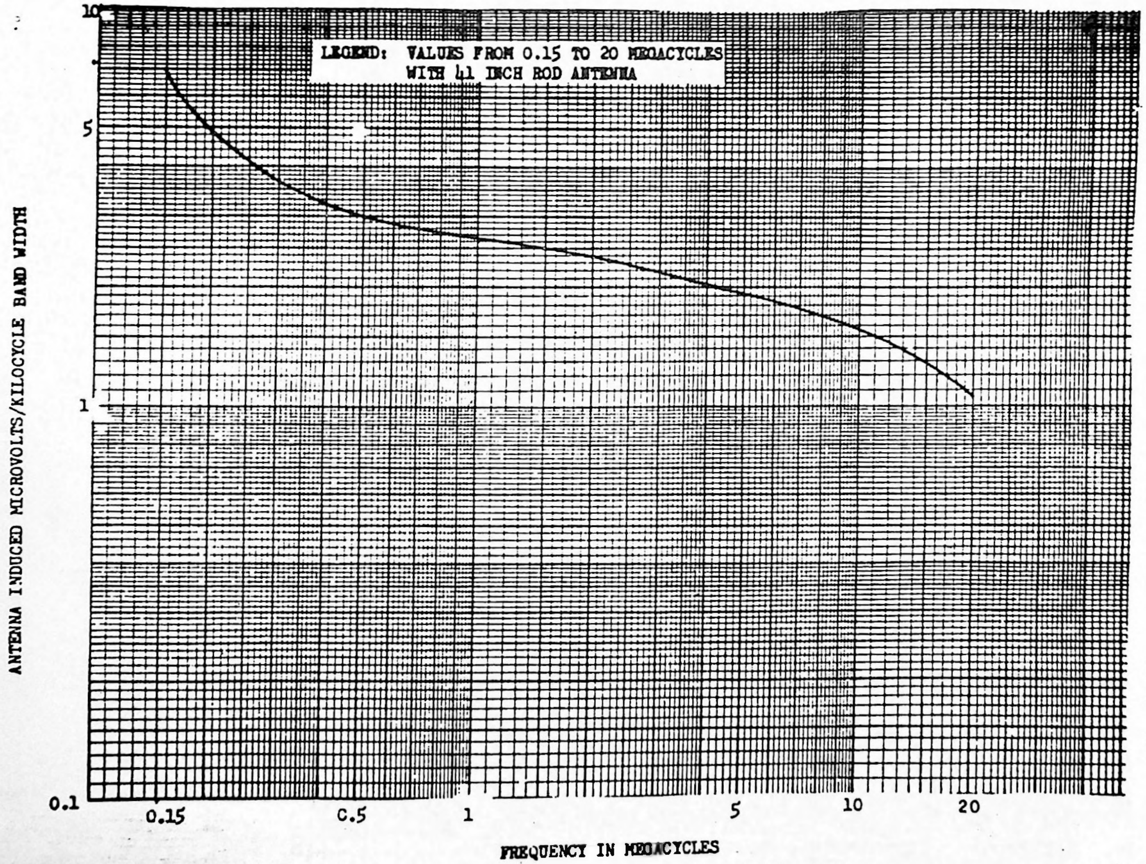


FIGURE 16. Standard limits broadband radiated interference

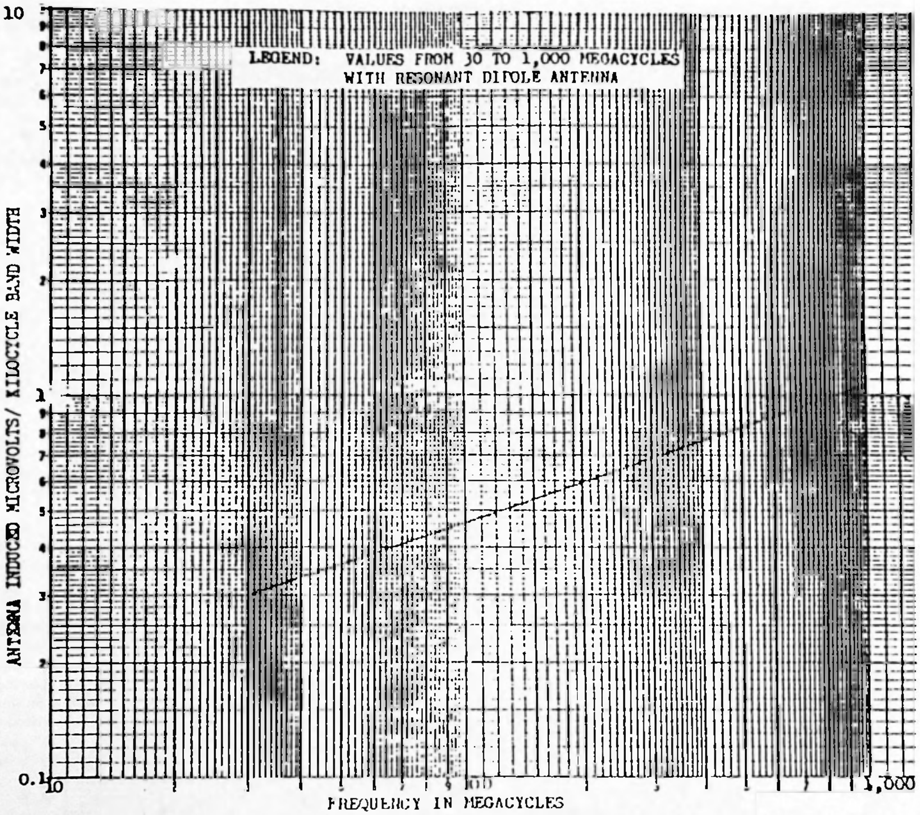


FIGURE 17. Standard limits broadband radiated interference

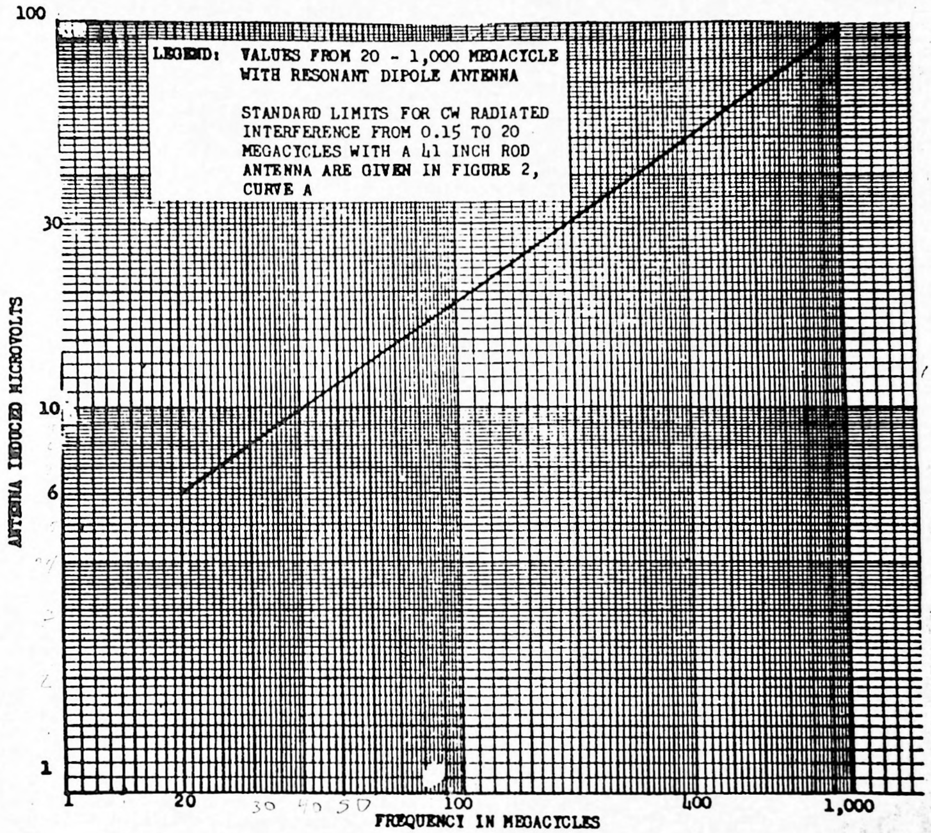


FIGURE 18. Standard limits cw radiated interference

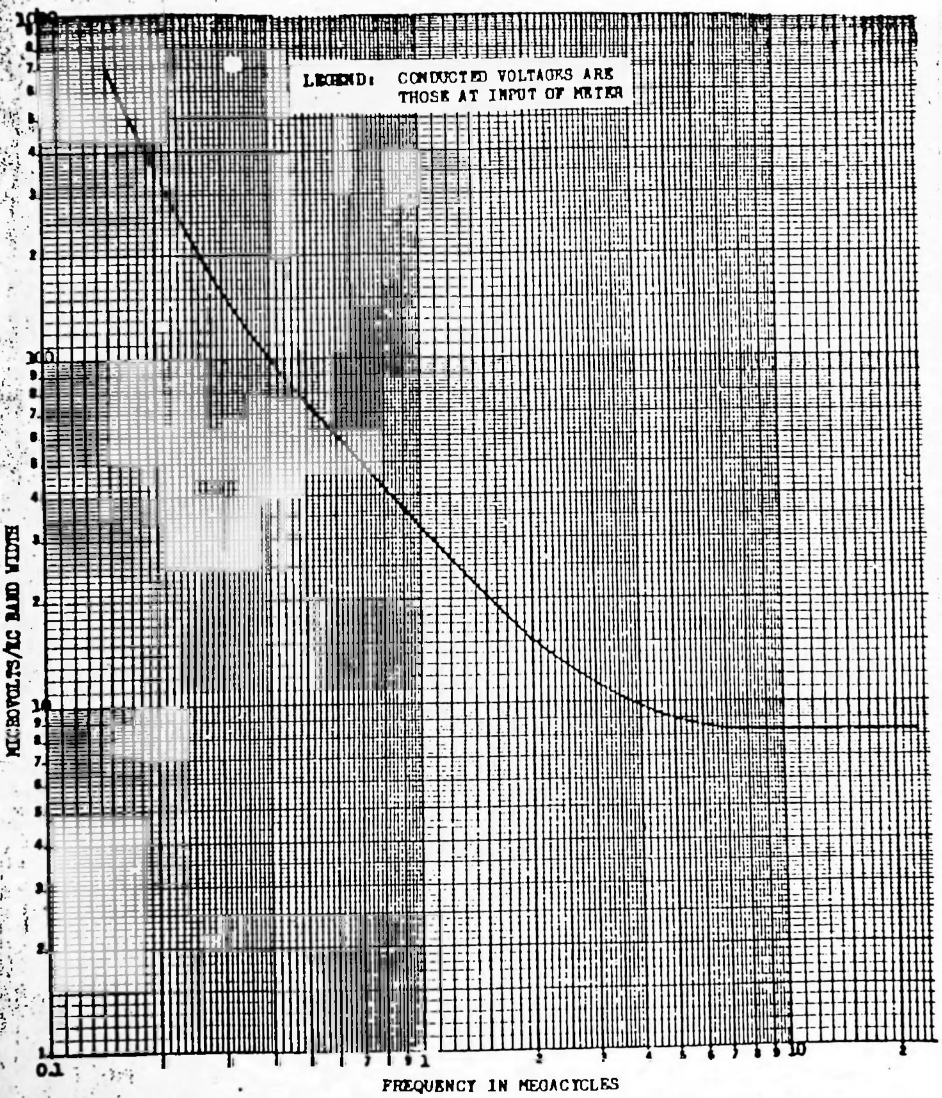


FIGURE 19. Standard limits for broadband conducted interference

6.4.2 Standard antennas.- Because of the nonuniformity of the electromagnetic field which usually exists close to a test sample, it is imperative that radiated interference tests be conducted with antennas identical to those specified. Attempts to correlate results obtained with other antennas by reducing the results to uv per meter based upon plane wave calculations of antenna effective height may be erroneous.

6.4.3 It will be noted that the frequency range from 20 to 30 megacycles has been omitted. This is due primarily to the unavailability of antennas suitable for screen room use over this range.

6.4.4 No broadband interference measurements are required above 150 mc. This is partly on account of the limited availability of test equipment above this range, and also in recognition of the fact that proper suppression of broadband interference to the levels required below 150 mc will generally also provide satisfactory attenuation of the higher frequency components.

6.4.5 Differences in the input impedance of the various meters used is such that for a given voltage generated in a resonant dipole antenna, different voltages will appear at the input to the meter. This explains the differences which appear in the expression of the limit in terms of equivalent input microvolts for cw interference over the 30-1,000 mc frequency range. All readings correspond to the same antenna-generated voltage when impedance matching factors are taken into account.

6.4.6 The calibration and test procedure for use of the AN/URN-28 is given in the legends of the calibration curve and instruction sheets shipped with the instrument.

Custodians:
Army - Signal Corps
Navy - Bureau of Aeronautics
Air Force