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MILITARY SPECIFICATION

INTERFERENCE CONTROL REQUIREMENTS, AIRCRAFT EQUIPMENT

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MILITARY SPECIFICATION

INTERFERENCE CONTROL REQUIREMENTS, AIRCRAFT EQUIPMENT

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. This specification covers design requirements, interference test procedures, and limits for electrical and electronic aeronautical equipment to be installed in or closely associated with aircraft.

1.2 Classification. The test procedures which are specified cover the following types of tests:

(a) Interference tests: Conducted and radiated tests which measure the magnitude of the interference signals emanating from the equipment under test.

(b) Susceptibility tests: Conducted, radiated, intermodulation and front-end rejection tests which determine whether an equipment will operate satisfactorily when exposed to external interference signals.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

MILITARY

MIL–I–6051—Interference Limits and Methods of Measurements, Electrical and Electronic Installation in Airborne Weapons Systems and Associated Equipment

MIL–T–9107—Test Reports, Preparation of

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

3. REQUIREMENTS

3.1 Definitions. For definitions of terms used in this specification, see section 6.

3.2 General.

3.2.1 *Operation.* Electrical and electronic equipment shall operate satisfactorily, not only independently but also in conjunction with other equipment which may be installed nearby. This requires that the operation of such equipment shall not be adversely affected by interference voltages and fields reaching it from external sources, and also requires that such equipment shall not, in itself, be a source of interference which might adversely affect the operation of other equipments. The limits specified herein are established to insure that the air vehicles will meet the requirements of Specification MIL–I–6051 or other applicable system specification.

3.2.2 *Short duration interference.* Interference resulting from manual operation of switches, but not including any electrical or electromechanical operations resulting from the manual switching, may deviate from the limits as indicated below. Ignition components used only during engine starting may deviate from the limits by 20 db. Other short duration interference may deviate from the limits as indicated below. Approval shall be obtained from the procuring activity before using these deviations.

Maximum duration	*Maximum recurrence*	*Deviation permitted*
1 second	Once in 3 minutes	20 db.
3 seconds	Twice per normal operational period.	No limitation.

3.3 Design.

3.3.1 *Interference-free design.* Interference control shall be considered in the basic design of all electronic and electrical equipment, components, assemblies, and systems. This design shall be such that, before interference control components are applied, the amount of interference internally generated and propagated is the minimum achievable. The application of interference control components that must be used, such as filtering, shielding, and bonding, shall conform to good engineering practice and, whenever possible, shall be an integral part of the system. Whenever additional interference control components are necessary, the use of miniaturized components is preferred.

3.3.2 *Susceptibility.* The equipment shall be designed to minimize susceptibility to interference from other sources. The enclosing case construction shall be designed not only to minimize interference propagation, but also to minimize interference pickup from external sources. Where conducted energy 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 line filters at their entry into the enclosing case. Receiving antenna inputs, or any other low-level signal circuits shall be low impedance, or of balanced design, so that coaxial or other shielded 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 shall be so designed and installed that interference is not picked up from power or control leads owing to coupling. Antenna or low-level signal circuit return paths or ground circuit paths shall be so arranged that interference will not occur owing to common conductive paths with other circuits, or with the enclosing case grounding path.

3.3.3 *Case shielding.* The number of mechanical discontinuities in the case (such as covers, inspection plates, and joints) shall be kept to a minimum. All necessary mechanical discontinuities in the case shall be electrically continuous across the interface of the discontinuity so as to provide low impedance current path. Multiple-point spring-located contacts are suggested as a desirable method of obtaining low impedance continuity. Ventilation openings shall be designed to permit conformance to the radiated interference limits. Electrical bonding shall be provided where access doors or cover plates form a part of the shielding. Hinges, in themselves, are not considered satisfactory conductive paths.

3.3.4 *Chassis, case, and mounting continuity.* The mating surface of the chassis, case, and mounting shall be free of all insulating finishes in order to provide a continuous electrical bond between these items and to enable the installing activity to accomplish bonding contact to the basic structure. Such surfaces shall be covered with removable protective coating to prevent corrosion prior to assembly. This requirement shall take precedence over any conflicting requirements in specifications on finishes.

3.3.5 *Component placement.* Components shall be placed and circuitry arranged to obtain minimum undesired coupling and to require a minimum number of filter components.

3.3.6 *Line shielding.* It is preferred that interference reduction be accomplished inside the equipment when such means give results equal to or better than the use of a shielded line. Any line shielding used shall be approved by the procuring activity and shall be prescribed as an installation requirement.

3.3.6.1 Under no condition shall line shielding be used for primary power leads to equipment.

3.3.6.2 Equipment requiring antennas, but not employing waveguides, shall be designed to utilize shielded coaxial cable as lead-in. When it has been determined that a single braid shield is not adequate, a double or triple braid or a solid shield shall be used as required.

3.3.7 *Interference control components.* When additional interference control components are required after careful design in accordance with the foregoing paragraphs, components shall be used that conform to the environmental requirements for the equipment. Hermetically sealed interference control components shall be used even though the equipment is not hermetically sealed. Separately installed and external components shall not be used unless specifically authorized by the procuring activity.

3.4 Subsystems. When the procuring activity requires that this specification be applied to a group of units or equipments that are designed to operate together, the group shall be tested as a subsystem, and each individual item does not have to be tested separately, unless individual units are so designed that they may be operated separately or as part of a different group or subsystem. It is recommended that each unit or equipment be designed to include adequate interference control measures.

3.5 Interference control plan. The contractor shall submit a detailed plan describing his interference control program and the engineering design procedures and techniques that will be used in complying with this specification. The design aspects of the interference control program shall be emphasized. Such information shall be included as the circuits to be shielded and filtered, methods of eliminating spurious emanations and responses, methods of eliminating spurious resonances, method of obtaining continuous shielding on equipment using pressure or hermetic seals, utilization of compartmentation, thickness of case material required to provide adequate shielding in high power RF equipment, selection of interference-free components to be used on equipment, and any other pertinent information. Any deviations from specified interference control requirements that are necessary or desirable because of the use of the equipment in the environment of a particular air vehicle shall be carefully delineated. This plan shall be submitted to the procuring activity within 90 days after the award of a contract. Addenda shall be submitted whenever it becomes necessary to revise or supplement the information in the interference control plan.

3.6 Interference control requirements. All equipment tested for compliance with this specification shall conform to the interference control requirements. For the purposes of this specification, all unwanted signals shall be considered as continuous wave (CW), pulsed CW, or broadband impulsive interference.

3.7 Interference measuring equipment. The interference measuring equipment listed in table I shall be used for determining conformance to the interference limits of this specification. Category B instruments which have been modified to meet category A requirements shall not be used as Category A instruments, unless a distinctive nonremovable label has been

TABLE I.[1]—*Acceptable interference measuring instruments*

Category	Frequency range	Commercial model	Notes	Basic military nomenclature	Manufacturer
A	0.15 to 25 mc	NM-20A, B	None	AN/PRM-1	Stoddart.
	0.15 to 30 mc	T-A/NF-105	([2])	None	Empire.
	0.15 to 1,000 mc	None	None	AN/URM-85	USA Sig Corps.
	20 to 400 mc	None	None	AN/URM-7	USA Sig Corps.
	20 to 400 mc	NM-30A	([3])	AN/URM-47	Stoddart.
	20 to 200 mc	T-1/NF-105	None	None	Empire.
	200 to 400 mc	T-2/NF-105	None	None	Empire.
	400 to 1,000 mc	T-3/NF-105	([4])	None	Empire.
	375 to 1,000 mc	NM-50A	None	AN/URM-17	Stoddart.
	1,000 to 10,000 mc	FIM, A, B	None	AN/TRM-6	Polarad.
B	0.15 to 30 mc	T-A/NF-105	([5] [6])	None	Empire.
	20 to 400 mc	NM-30A	([6])	AN/URM-47	Stoddart.
	400 to 1,000 mc	T-3/NF-105	([6] [7])	None	Empire.
	375 to 1,000 mc	NM-50A	([6])	AN/URM-17	Stoddart.
C-1	0.15 to 1,000 mc	NF-205	None	None	Empire.
	375 to 1,000 mc	NM-52A	None	AN/URM-17B	Stoddart.
C-2	None available at this time.				

[1] This table is subject to change upon reasonable notice to include new instruments having superior performance characteristics and to change the category of older instruments which have become obsolete.
[2] This category applies to tuning units purchased after 11 March 1957.
[3] This category applies when power supply 91226-1 is used with instruments numbered 191-1 and higher.
[4] This category applies to instruments purchased after 9 May 1956.
[5] This category applies to instruments purchased prior to 11 March 1957.
[6] These instruments can be modified to category A requirements by the manufacturer.
[7] This category applies to instruments purchased prior to 9 May 1956.

attached by the instrument manufacturer; any restrictions on the usuage of the modified instrument, or associated accessories, shall be indicated on the label. Instruments listed in table I are of the following categories:

(*a*) Category A: Category A instruments are those interference measuring instruments which adequately measure the parameters of interference signals as required by this specification and which are approved by the procuring activity. Any combination of category A instruments can be used for the required measurements. Category A instruments can be used without prior approval of the procuring activity.

(*b*) Category B: Category B instruments are those existing instruments which are in use but which do not adequately measure the parameters of interference signals as required by this specification.

(*c*) *Category C–1:* Category C–1 instruments are those which have recently been developed to meet category A requirements, but have not yet been evaluated by the procuring activity. These instruments shall not be used without prior approval of the procuring activity.

(*d*) *Category C–2:* Category C–2 instruments are those which have been recently developed but do not meet Category A requirements, and which can presumably be modified by the manufacturer to attain a category A rating. These instruments shall not be used without prior approval of the procuring activity.

3.7.1 *Antenna system correction.* All instrument readings of radiated interference levels shall be converted to antenna terminal open-circuit ("antenna induced") values, in accordance with correction factors furnished by the instrument manufacturer for the particular antenna type, frequency, and operating procedures used.

3.7.2 *Substitute measuring instruments.*— The use of substitute interference measuring instruments in the frequency range from 1 to 10 kilomegacycles will be considered by the procuring activity. The contractor shall submit, with the test plan, justification explaining why approved instrumentation cannot be used and shall propose substitute instrumentation and test procedures that are capable of measuring the limits. Approval for the use of substitute equipment might not be granted if a commercial test laboratoy can perform the required measurements with approved equipment within a reasonable period of time.

3.8 **Extension of frequency range.** If the contractor believes that some, or all, of the applicable interference requirements should be extended beyond the required frequency range, the interference control plan and the test plan shall be used to give proposed limits, instrumentation, methods of measurements, other pertinent information, and an explanation of the need for the extended frequency range.

4. QUALITY ASSURANCE PROVISIONS

4.1 General provisions.

4.1.1 *Testing.* All tests and test reports specified herein shall be accomplished by the contractor and shall be subject to approval and verification by the procuring activity. When the procuring activity waives verification, the tests and test reports shall be approved and verified by a qualified representative of the contractor's Quality Control department. Evidence of quality control verification and approval, either Government or contractor, shall be contained in the test report. The Government further reserves the right to have a technical representative of the procuring activity present during the testing.

4.1.2 *Test plan.* The contractor shall submit a detailed test plan to the procuring activity showing the means of implementation and the application of the test procedures in this specification to the equipment being procured. Included shall be the proposed method of testing and additional details such as:

(*a*) Nomenclature and serial numbers of test equipment to be used.

(*b*) Methods of calibration to be used.

(*c*) Detector function to be used on measuring equipment.

(*d*) Methods of loading and triggering.

(*e*) Operation of test sample.
(*f*) Control settings on test sample.
(*g*) Frequencies at which interference might be expected, local oscillator, intermediate frequencies, multipliers, etc.
(*h*) Other details requiring approval by the procuring activity.

This test plan shall be submitted before any interference testing is started.

4.1.3 *Test report.* A test report conforming to Specification MIL–T–9107 shall be submitted to the procuring activity prior to submission of the preproduction model for acceptance. In addition to the requirements in Specification MIL–T–9107, the test report shall include such details of testing as:

(*a*) Nomenclature of interference measuring equipment.
(*b*) Serial number of interference measuring equipment.
(*c*) Date of last calibration of interference measuring equipment.
(*d*) Detector functions used on interference measuring equipment.
(*e*) Internal noise level of instrument used on detector function at each test frequency.
(*f*) Descriptions of procedures used (methods of loading and triggering, etc, operation of and control settings on test sample, etc.).
(*g*) Measured line voltages to test sample.
(*h*) Test frequencies.
(*i*) Method of selection of test frequencies.
(*j*) Type of interference measured.
(*k*) Measured level of interference at each test frequency.
(*l*) Specification limit at each test frequency.
(*m*) Graphs showing items (e), (h), (k), and (l).
(*n*) Photographs of the test setup and test sample.
(*o*) Sample calculations (showing how item (k) was obtained for all antennas used).
(*p*) Description and size of screened enclosure.
(*q*) Ground plane used if test is not performed in screened enclosures.
(*r*) Description of open space area, if used.
(*s*) Ambient interference levels.
(*t*) Measured impedance of line stabilization network.
(*u*) Certification required in 4.1.7.

4.1.3.1 *Examples of sample calculation.*

(*a*) Interference measuring equipment ____ NF–105
Frequency of cw measurement ____ 460 mc
Antenna factor (DM antenna) ____ +8 db
Cable loss correction factor at 460 mc ____ +3 db
Meter reading ____ +40 db

Interference level = meter reading + cable loss + antenna factor = 40 + 3 + 8 = 51 db

(*b*) Interference measuring equipment ____ NM–20B
Frequency of broadband radiated measurement ____ 500 kc
Antenna factor ____ 1
Cable loss correction factor ____ 1
Meter reading ____ 9 microvolts
Effective random bandwidth ____ 3,400 cps

$$\text{Impulse bandwidth} = 1.4 \times 3{,}400 = 4{,}760 \text{ cps} = 4.760 \text{ kc}$$

$$\text{Interference level} = \frac{(\text{meter reading})\ (\text{antenna factor})\ (\text{cable loss})}{(\text{impulse bandwidth})}$$

$$= \frac{9 \times 1 \times 1}{4.76} = 1.89 \quad \frac{\text{Antenna induced microvolts}}{\text{kc}}$$

= 65.75 db above 1 microvolt per mc (antenna induced)

4.1.3.2 *Identification of test sample.* The test sample shall be completely identified in the test report with complete nomenclature, manufacturer, and serial number. All suppression work performed on the test sample during the interference tests shall be fully described in words as well as by the test data in the test report.

4.1.4 *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, unless otherwise permitted by this specification.

4.1.4.1 *Calibration.* Interference measuring instrumentation shall be maintained in a known condition of accuracy. Periodic checks on the calibration accuracy shall be made with laboratory generators. Recalibration shall be accomplished when the standardized gain setting fails to reflect a meter reading within ±20 percent of the known input signal. Substitution type measurements can be used in lieu of the calibrated method.

4.1.4.2 *Generator accuracy.* Laboratory-type signal generators and impulse generators capable of an output voltage accuracy of at least 20 percent shall be used to calibrate interference measuring instruments and for substitution measurements.

4.1.4.3 *Broadband interference measurement.* Broadband interference shall be measured by using an impulse generator with the substitution technique, or by calibrating the interference measuring instrument so that it reads directly in decibels above 1 microvolt per unit bandwidth. The peak detector function on the intereference measuring instruments shall be used for broadband and pulsed CW measurements.

4.1.4.4 *CW interference measurements.* CW interference shall be measured by calibrating the interference measuring instrument so that it reads directly in decibels above 1 microvolt or by using a signal generator with a substitution technique.

4.1.4.5 *Pulsed CW interference measurements.* Pulsed CW shall be measured in accordance with the procedures and limits used for broadband interference.

4.1.5 *Bonding measuring instrument.* Interference measuring instruments utilizing dipole antennas shall be bonded to the ground plane or shielded enclosure with the ground clip on the power cord. Instruments used for conducted measurements shall not be bonded to the ground plane except through the interconnecting coaxial cable.

4.1.5.1 The counterpoise on rod antennas shall be bonded to the ground plane with a strap of such length that the rod antenna can be positioned correctly. The strap shall be as wide as the counterpoise. This applies to rod antennas utilizing the interference measuring instrument as a counterpoise, and to rod antennas mounted on a separate counterpoise.

4.1.5.2 The interference measuring instruments shall be physically grounded with only one connection. If the copper strap is used, neither the ground clip, the ground terminals, nor the power supply shall be connected to ground.

4.1.5.3 *Test for leakage.* At any test frequency, when tuned and calibrated for a measurement, the measuring instrument, when used with a shielded dummy antenna, shall show no change from the internal background when the equipment under test is turned "on" and "off."

4.1.6 *Monitoring.* The interference measuring instrument shall be monitored with a headset, loudspeaker, oscilloscope, or other indicating devices, during all measurements. Precaution shall be taken to insure that the monitoring does not influence the meter reading on the interference measuring equipment.

4.1.7 *Test frequencies.* The interference measuring instrument or signal generator for susceptibility tests shall be slowly tuned through each continuous tuning range and the frequencies at which maximum interference or susceptibility is obtained shall be selected as test frequencies. Test frequencies shall not be selected prior to the interference test. The witnessing official or Government representative shall certify in the test report that the test frequencies were selected after each range was scanned. A minimum of three measurements shall be made in each continuous tuning range.

4.1.8 *Tuning.* The interference measuring instrument shall be tuned to and measurements made at the fundamental frequency and all harmonics of equipment containing oscillator circuits. Additional checks shall be made by scanning for and measuring any signal or spurious response that can be anticipated. (The test item shall be adjusted for mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference emanation.)

4.1.9 *Powerline stabilization network.* The powerline stabilization network is shown in figure 1. One network shall be inserted in each ungrounded power supply lead supplying power to the test sample, and shall be used for the complete radio interference tests. The network enclosure shall be bonded to the ground plane for safety and radio frequency purposes.

4.1.9.1 *Performance characteristics.* The current carrying capacity of the network shown 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 at the following maximum voltage ratings:

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

4.2 Test conditions.

4.2.1 *Ambient interference level.* It is desirable that the ambient interference level during testing, measured with the test sample deenergized, be at least 6 db below the allowable specified interefrence limit. However, in the event that at the time of measurement the levels of ambient interference plus test item interference are not above the specified limit, the tested item shall be considered to have met 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. If a shielded enclosure is used, the minimum length shall be such that a 35-mc tuned dipole can be placed in the room with at least 12 inches clearance between the antenna extremities and the shielded enclosure.

4.2.2 *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 a screen room, 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 mounted on a metal test stand, the test stand may be considered, for testing purposes, to be a part of the ground plane and shall be bonded accordingly. When a shielded room is not used, the measuring equipment may be placed on a solid support for operation. The support may be solid earth, steel or iron flooring, metal bedplate, metal-covered planking, or the like.

4.2.3 *Bonding.* Only the provisions included in the design of the equipment and specified in the installation instructions shall be used to bond units, such as equipment case and mount, together or to the ground plane. Where bonding straps are required to complete the test setup, they shall have a length not greater than 5 times the width, shall have a minimum thickness of 0.025 inch, and shall be copper or brass metal straps, not braid. Connections made with such bond straps shall have clean metal-to-metal contact.

4.2.3.1 *Shock and vibration isolators.* Test samples shall be secured to mounting bases incorporating shock or vibration isolators, if such mounting bases are used in the installation. The bonding straps furnished with the mounting base shall be connected to the ground plane. Where mounting bases do not incorporate bonding straps, bonding straps shall not be used in the test setup.

4.2.3.2 *External ground terminal.* When an external terminal or connector pin is available for a ground connection on the test sample, this terminal shall be connected to the ground plane if the terminal is normally grounded in the installation. If the installation conditions are unknown, the terminal shall not be grounded.

4.2.3.3 *Portable equipment.* Portable equipment shall be tested while it is bonded to the ground plane and also when it is not bonded to the ground plane. Portable equipments that are intended to be grounded through a power cord shall not be bonded to the ground plane by other means.

4.2.4 *Power supply voltage.* The power supply voltages shall be within the tolerance specified in the detail specification for the test sample. The voltages shall be measured at the test sample terminals on the line stabilization networks.

4.2.5 *Arrangement and operating conditions.*—The general arrangement of equipment, interconnecting cable assemblies, and supporting structures shall be such as to simulate actual installation and usage insofar as practicable. The front surface of each unit shall be located 4 inches ±½ inch from the edge of the ground plane; interconnecting cables shall be routed between the units and the edge of the ground plane. In those cases where equipment size exceeds the ground plane dimensions, or where more than two line stabilization networks are required, the above instructions shall be adhered to as closely as possible. The test item shall be adjusted for mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference emanation or susceptibility All receivers and transmitters shall be tested using a shielded dummy antenna.

4.2.5.1 *Dummy antennas.* Any dummy antenna used shall have electrical characteristics which closely simulate those of the normal antenna, and should be shielded where possible. The dummy antenna shall be capable of handling the power required and shall contain any unusual components which are used in the normal antenna (such as filters, crystal diodes, etc). When the nominal antenna impedance is 50 ohms, a 50-ohm (±20 percent from 0.15–1,000 mc) dummy antenna shall be used.

4.2.5.1.1 Acceptance test of the transmitter may be with cable and dummy antenna of negligible leakage. A test of leakage shall be made with a 5-foot length of double shielded coaxial cable, used between a transmitter and its dummy antenna, to provide information on acceptable cables for actual installations.

4.2.5.2 *Test sample leads.* The test sample leads to the powerline stabilization network shall be 24 inches ±1 inch in length and shall be so arranged that the distance between the leads and from each lead to ground or grounded enclosure is approximately 2 inches. In those cases where more than two impedance stabilization networks are required, the above instructions shall be adhered to as closely as possible.

4.2.5.2.1 *Interconnecting leads.* Whenever possible, interconnecting leads between boxes comprising a test sample shall be not less than 2 feet and not more than 5 feet long. However, if the interconnecting leads are furnished as a part of the equipment, they may be used instead.

4.2.6 *Antenna orientation and positioning in shielding enclosure.* For each measuring instrument, the following procedure shall be used to determine the horizontal positioning of the antennas of the measuring instruments relative to the test sample.

4.2.6.1 *Test samples generating only broadband interference (not intended to generate or receive signals).* The following procedures shall be employed in testing for broadband interference:

(*a*) Set up antenna in accordance with figure 3, 4, 5, or 6, as applicable, opposite the center of the test sample, but without a bond from the instrument to the ground plane.

(*b*) Scan the full frequency range of the lowest tuning band of the test instrument in use for the frequency of maximum interference or susceptibility.

(*c*) Move the antenna horizontally to the position of maximum indication at that frequency, except that dipole antennas of dimension longer than the test sample shall be placed opposite its center.

(*d*) Bond instrument to ground plane when required and proceed with measurement.

4.2.6.2 *Test samples intended to generate or receive signals.* The following procedures shall be employed in testing samples intended to generate or receive signals:

(*a*) Set up antenna in accordance with figure 3, 4, 5, or 6, as applicable, opposite the center of the test sample, but without a bond from the instrument to the ground plane.

(*b*) Adjust sample for a mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference or susceptibility.

(*c*) Scan the full frequency range of the test instrument in use for a maximum indication of interference or susceptibility.

(*d*) Move the antenna horizontally to the position of maximum indication of interference at that frequency.

(*e*) Bond instrument to ground plane when required and proceed with measurements.

4.2.7 *Antenna orientation and positioning (free space).* Those interference measuring instruments which use a rod antenna shall be so placed that the rod antenna is in a vertical position. Those interference measuring instruments which use a dipole antenna shall be so placed that the antenna is parallel with the test sample and on the same level as the midpoint of the test sample. The antenna shall be at the distance from the test sample specified in 4.2.6. The antenna shall be located at a point around the perimeter of the test sample where maximum interference or susceptibility signal is received. All provisions of paragraph 4.2.6 and its subparagraphs not in conflict herewith shall apply.

4.2.8 *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. Operation of voltage regulators and other circuits which operate intermittently is required. The loads used shall simulate the resistance, inductance, and capacitance of the actual load.

4.3 Test methods.

4.3.1 *Conducted interference.* Radio interference voltages, in the frequency range of 0.15 to 25 mc, generated by the equipment or system in excess of the values indicated in figures 7, 8, 9, and 10 shall not appear on any conductor, external to the system, which could conduct interference to other equipment. Typical test setups for these measurements are shown in figures 11 and 12. Measurements may be omitted on leads deemed by the procuring activity to be incapable of conducting interference into other equipment.

4.3.1.1 *Conducted interference using stabilization network, 50 amperes and under.* Conducted interference measurements on power leads, 50 amperes and under shall be made by connecting the interference measuring instrument to the noise meter terminal on the line stabilization network with a 50-ohm double-shield coaxial cable. The line stabilization network shall not be used on power frequencies over 800 cps since it will probably burn up. The current probe shall be used for this application.

4.3.1.2 *Conducted interference, over 50 amperes.* Conducted interference measurements on power leads over 50 amperes shall be made with a stabilization network, designed for high current (see fig. 1), or with the network shown in figure 13, at the discretion of the contractor.

4.3.1.3 *Interconnecting leads.* Conducted interference on interconnecting and signal leads and power lines over 800 cps shall be measured by using a clamp-on interference measuring device (current probe Stoddart Aircraft Radio Co. type 91550–1, or equal).

4.3.1.3.1 *Position of probe.* The current probe shall be positioned at the point of maximum interference on the lead to be tested. A maximum movement of 5 feet along power lines is considered adequate. This maximum interference point shall be located at each test frequency. The location of the current probe shall be fully described in the test report.

4.3.2 *Radiated interference.* Radiated interference fields in excess of the values given in figures 14, 15, 16, and 17 shall not radiate from any unit, cable (including control, pulse, IF, video, antenna transmission, and power cables), or interconnecting wiring over the frequency range of 0.15 to 10,000 mc for CW and pulsed CW interference, and 0.15 to 400 mc for broadband impulse interference. This requirement includes the transmitter fundamental frequency radiating from cases or cabling, oscillator radiation, other spurious emanations, and broadband interference. This does not include radiation emanating from antennas. Test setups are illustrated in figures 3, 4, 5, and 6.

4.3.3 *Antenna-conducted spurious emanations.*

4.3.3.1 *Transmitter keyup or receiver.* The RF output of any transmitter keyup or receiver shall not exceed 40 db above 1 microvolt for CW or 60 db above 1 microvolt per mc for pulse CW interference at any frequency between 0.15 and 10,000 mc. Normally, measurements are required up to the 20th harmonic or 1,000 mc, whichever is higher, but in no event above 10,000 mc, unless the contractor can show by scanning or other means that such measurements will not result in any significant data.

4.3.3.2 *Transmitter keydown.* The transmitter shall be operated into a dummy load. A suitable coupling device shall be used to sample the transmitter output and protect the measuring equipment. Bridge "T" rejection networks, filter rejection network, or other adequate devices shall have the approval of the procuring activity. Attention should be given to oscillator frequency and harmonics, outputs from frequency multipliers and crystal saver circuits, beat frequency oscillator outputs, etc. External filters shall not be used unless approval is obtained from the procuring activity. Normally, measurements shall be made up to the 10th harmonic or 1,000 mc, whichever is higher, but in no event above 10,000 mc, unless the contractor can show by scanning or other means that such measurements will not result in any significant data.

4.3.3.2.1 *Spurious emission limits.* The peak power output shall be as follows:

(*a*) Second and third harmonics: The peak power output of the second and third harmonics of the output fundamental frequency shall be at least 60 db below that of the fundamental, or 10^{-8} watts (707 μV into 50 ohms), whichever is greater, but in no event greater than 1 watt.

(*b*) Harmonics above the third, and other spurious emissions: The peak power output of any harmonic above the third, and of any nonharmonic emission, shall be at least 80 db below that of the fundamental, or 10^{-8} watts (707 μV into 50 ohms), whichever is greater, but in no event greater than 10^{-2} watts.

4.3.4 *Susceptibility.* Equipment, such as navigation light flashers, windshield wipers, fuel pump motors, etc., deemed incapable by the procuring activity of being affected by the applied extraneous signals are exempt from susceptibility requirements. On receivers, all external and internal controls shall be set for maximum signal plus noise-to-noise ratio. All external and internal controls for squelch or limiting action shall be set to give minimum limiting action. On other other equipment all external and internal controls shall be set for maximum indication of susceptibility or, if this causes an equipment to malfunction or to become inoperable as a result of such a control setting, the critical control shall be adjusted as directed in the instruction manual. The radio frequency signal shall be modulated 30 percent, 400 or 1,000 cps, on equipments that are not designed for other modulation frequencies or for special forms of modulation. When testing other equipment, the modulation frequency or any other special form of modulation shall be used to modulate the radio frequency.

4.3.4.1 *Conducted susceptibility powerline.* The voltage specified shall be those voltages which are calculated to exist across the output terminals of the signal source when no load, other than that necessary to meet the requirements as to source impedance, is connected to the signal generator. A matching network suitable for use at required test frequencies and voltages shall be used to obtain the proper source impedance. 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.

4.3.4.1.1 *Radio frequency conducted.* No change in indication, malfunctioning, or degradation of performance shall be produced in any equipment when an RF signal of 100,000 microvolts, from a source having an impedance of 50 ohms is applied to the test sample as shown in figure 18. Tests shall be made over the frequency range of 0.150 mc to 10,000 mc.

4.3.4.1.2 *Audio frequency conducted.* No change in indication, malfunctioning, or degradation of performance shall be produced in any equipment when a sine wave audio frequency signal of 3 volts rms, open circuit, is applied as shown in figure 19. Measurements shall be made over a frequency range of 50 to 15,000 cps.

4.3.4.2 *Radio frequency radiated.* No change in indications, malfunction, or degradation of performance shall be produced when the equipment is subjected to a radio frequency field. This field shall be established with a 50-ohm signal generator driving the antenna listed below. Care shall be taken to use matching networks when required. The test setup is shown in figure 20 for the rod antenna and is similar to figures 5 and 6 for the other antennas, with the signal source replacing the interference meter.

Frequency	*Open-circuit microvolts*	*Antenna*
0.15 to 25 mc	100, 000	41-inch rod.
25 to 35 mc	100, 000	35 mc dipole.
35 to 1,000 mc	100, 000	Tuned dipole.
1,000 to 10,000 mc	100, 000	Same as used for radiation test (4.3.2).

4.3.4.3 *Radio frequency radiated, alternate method (0.15 to 1,000 mc).* The open-circuit microvolts indicated in figure 21 are applied to the prescribed loop probe.

4.3.4.3.1 *Test procedure.* Test for compliance with the susceptibility limit requirements shall be made using shielded dummy antennas, shielded antenna lead-ins, and in accordance with the test procedure described in the following paragraph.

4.3.4.3.2 *Equipment required.*

(1) Loop probe MX-936/URM and 20-foot RG-9/U cable.

(2) RF signal generators covering the frequency range from 0.15 to 1,000 mc, followed by a network, if necessary, to obtain a source impedance of 50 ohms. A minimum output of 10,000 open-circuit microvolts is required.

(3) A line stabilization network for each powerline.

(4) Appropriate instruments for monitoring the normal output indication of the test sample.

(5) A shielded dummy antenna and shielded antenna lead-in.

4.3.4.3.3 *Test setup.* For radiated tests, the setup in figure 22 shall be used. The loop probe MX-936/URM is placed in close proximity at the point of maximum leakage of the equipment under test. The antenna input fitting is shown in this figure as an illustration of the point of maximum leakage. The equipment under test and all accessories shall be bonded to the ground plane as indicated. The output indicator used for monitoring, if not an integral part of the equipment under test, shall be properly shielded in order to insure that it does not constitute a point of leakage. If excessive leakage emanates from the signal generator case, tests should be made inside a shielded enclosure with the signal generator placed outside the enclosure. A shielded enclosure is recommended for all susceptibility tests in order to insure that the equipment under test is not affected by extraneous signals which may affect the internal background considerably.

4.3.4.3.4 *Test method.* The entire frequency range from 0.15 to 1,000 mc shall be scanned, using the appropriate signal generator set at maximum output and, if susceptibility occurs, the test frequency is recorded and the open-circuit microvolts of the generator is decreased to obtain threshold susceptibility. These open-circuit microvolts are now compared for compliance with the susceptibility limits of this specification. Other details of the test method are as follows:

(*a*) Locating point of maximum leakage: First the MX-936/URM loop probe is secured at close proximity to one of the following points of the case of the equipment under test; antenna input connector, any large opening, or powerline entry. The signal generator is set at maximum output and it is scanned until a frequency is found at which maximum leakage occurs. (During scanning, checks are made at the frequencies associated with the operation of the equipment.) The entire equipment is then probed at this frequency and a point is located at which maximum susceptibility is obtained.

(*b*) Placing of loop probe: The MX-936/URM loop probe is placed in close proximity at the point of maximum susceptibility determined above and oriented for maximun coupling, and then (firmly) secured.

4.3.4.4 *Receiver intermodulation.* The contractor shall test the intermodulation properties of receiving type equipment by either of the two tests following.

4.3.4.4.1 *Two-signal intermodulation test.* Receivers, preamplifiers, or antenna couplers shall not produce an output indication when two sine wave signals, representing undesired signals, are connected to the input terminals of the test sample. The two frequencies shall be chosen so that their sum or difference is equal to the test frequency and so that neither will give an output when applied alone. The magnitude of each shall be at least 100 db above 1 microvolt at the test sample terminal; one shall be modulated 30 percent with a 1,000-cycle signal, and other 30 percent with a 400-cycle signal. Impedance matching networks shall be used as required.

4.3.4.4.2 *Broadband intermodulation.* The test sample receiver shall be connected to the standard-impulse generator by means of a 50-ohm coaxial cable terminated with a 10-db resistive pi or T pad with negligible frequency characteristic in the region of the frequency of test. The impulse generator shall be turned on and the output attenuator reading for minimum perceptible receiver output, or other evidence of normal function, shall be noted. The receiver local oscillator (or each oscillator in turn for multiple-conversion superheterodyne receivers) shall be disabled and, if feasible, a 60-cycle voltage (or current) equal to the oscillator signal shall be injected into the mixer. The output of the impulse generator is then raised until the minimum perceptible receiver output, or other evidence of normal function, is again evident. This generator setting in db, less the original setting in db, is the broadband intermodulation in db. The intermodulation of undesired signals introduced across the antenna terminals shall be at least 30 db.

4.3.4.4.2.1 *Impulse generators.* Impulse generators used for intermodulation testing of receivers shall be as shown in table II.

4.3.4.5 *Receiver front-end rejection.* Front-end rejection of receivers shall be equal to or greater than the limit shown in figure 23 except that image frequencies outside the tuning range of the receiver shall be 60 db. This requirement shall apply to each tuning unit on receivers with plug-in or separate tuning units. This test shall be performed with any signal generators equipped with an accurate attenuator and capable of a signal output at least 80 db greater than the minimum signal perceptible at the tuned frequency of the particular receiver being tested. If necessary, matching networks shall be used to obtain a 50-ohm output. All measurements shall be corrected to account for any changes in output voltages owing to addition of matching networks and shall be equal to the open-circuit voltage at the output terminals. With the signal generator and receiver connected with a 50-ohm coaxial cable and tuned to the same frequency, the generator setting which gives the minimum perceptible reading above the receiver background noise shall be noted. Modulation may be used in conjunction with an output meter if the receiver is not equipped to give meter indications of CW signals. The frequency range between 150 kc and 10,000 mc shall then be scanned with the generator output preferably set at least 80 db above the output originally noted. Those frequencies at which output signals are obtained shall be investigated to obtain the generator reading which corresponds to the original receiver output signal. Since all signal generators emit a substantial amount of harmonics, care should be taken that the receiver is not erroneously rejected because of such spurious signal content.

TABLE II.—*Impulse generators*

Receiver tuning range in mc	Impulse generator type	Manufacturer
Below 500	IG-102	Empire Devices Products Corp.
	IG-115	Empire Devices Products Corp.
	Impulse generator incorporated in NF-105 or NF-205.	Empire Devices Products Corp.
	91263-1	Stoddart Aircraft Radio Co.
500-10,000	IG-118	Empire Devices Products Corp.

Front-end rejection is calculated with the following formula:

Front-end rejection = 20 log V_2/V_1

V_1 = Signal generator voltage required for minimum perceptible receiver output on channel or frequency under test.

V_2 = Signal generator voltage required for minimum perceptible receiver output at all other frequencies.

When this test cannot be accomplished owing to the possibility of crystal burnout or for other reasons, the test signals shall be injected into the test sample by using a suitable antenna fed from a signal generator. The test procedure to be used shall be included in the test plan.

5. PREPARATION FOR DELIVERY

5.1 This section is not applicable to this specification.

6. NOTES

6.1 **Intended use.** The test procedures and limits specified herein are intended to insure that aeronautical, electrical, and electronic equipments will operate properly in service use when subjected to certain radio and audio interference voltages, and will not cause the malfunction of other equipments by generation of interference voltages. This specification applies to components or systems as specified by the procuring activity or by the detail specification.

6.2 **Bonding.** The requirements of Specification MIL-B-5087 are recommended for study as a guide toward design for compliance with the bonding requirements of this specification.

6.3 **Additional information.** The information contained in the handbook "Design Techniques for Interference-Free Operation of Airborne Electronic Equipment," is recommended as a guide towards design for compliance with this specification. Organizations with a military contract can obtain the handbook, at no cost, from ASTIA, Publication No. ATI-159699. Organizations without a military contract can order the handbook as Report No. P. B. 111051 from the Department of Commerce, Office of Technical Services, Washington 25, D.C. A check for $11.50, payable to the Treasurer of the United States, must accompany the order.

6.4 **Definitions.**

6.4.1 *Interference.* Interference is defined as any electrical or electromagnetic disturbance, phenomenon, signal or emission, man-made or natural, which causes or can cause undesired response, malfunctioning or degradation of performance of electrical and electronic equipment, or premature and undesired location, detection or discovery by enemy forces, except deliberately generated interference (electronic countermeasures).

6.4.2 *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 antennas, is subjected to the specified radio or audio frequency voltage or field.

6.4.2.1 *Undesirable response.* Undesirable response is defined as a change in the normal output which causes no malfunctioning but is not required for the proper operation of the equipment.

6.4.2.2 *Threshold susceptibility.* Threshold susceptibility is defined as an undesirable response which is barely recognizable from the normal output.

6.4.2.3 *Malfunctioning.* Malfunctioning is defined as a change in the normal output which effectively destroys the proper operation of the equipment.

6.4.3 *Ambient interference.* Ambient interference, for the purpose of this specification, is the interference level emanating from sources other than the test sample, including the internal background noise of the interference measuring equipment.

6.4.4 *Internal background.* Internal background is the indication on the measuring instrument obtained when a shielded dummy antenna is connected at its input. A correct indication is obtained only if the ambient interference does not affect the instrument and the test for leakage.

6.4.5 *Antenna induced microvolts.* Antenna induced microvolts is that voltage which exists across the open-circuited antenna terminals.

6.4.6 *Impulsive interference.* For the purposes of this specification, all broadband noise, including random noise and pulsed CW is considered to be impulsive interference.

6.4.7 *Octave.* An octave is a frequency ratio of 1 to 2, i.e., from 1 to 2 mc, to 2 to 4 mc, 500 to 1,000 mc, etc.

6.4.8 *Microvolts per mc.* The nearest approach to a standard unit of measurement of broadband radio interference is in terms of microvolts per megacycle. Interference intensity in microvolts per megacycle is equal to the number of root mean square sine wave microvolts (unmodulated) applied to the input of the measuring circuit at its center frequency that will result in detector peak response in the circuit equal to that resulting from the interference pulse being measured, divided by the impulse bandwidth of the circuit in megacycles.

6.4.9 *Impulse bandwidth.* The impulse noise bandwidth of the interference measuring instrument should be used in calculation involving broadband noise. Effective (random) bandwidth should not be used. The impulse noise bandwidth of a receiver can be readily obtained by use of an impulse generator of known output in microvolts/kc. The peak response indication of the instrument in input microvolts divided by the output of the impulse generator in microvolts/kc. is the impulse noise bandwidth of the instrument in kc.

6.4.10 *Radio receiver front-end rejection.* Front-end rejection is the measured capability of a receiver, expressed in decibels, in rejecting signals at the antenna terminals that are outside the channel, or frequency, to which the receiver is tuned.

6.4.11 *Open space.* The term "open space," as used in this specification, is intended to designate an ideal site for radiated interference measurements. This ideal site should be open, flat terrain at a considerable distance (100 feet or more) from buildings, electric powerlines, fences, trees, underground cables, and pipe lines. This site should have a sufficiently low ambient level of radiated interference to permit testing to the governing radiated interference limit at any test frequency selected.

6.5 Standard antennas. Because of the nonuniformity of the electromagnetic field which usually exists close to a test sample, it is imperative that tests for radiated interference be conducted with antennas identical to those specified. Attempts to correlate results obtained with other antennas by reducing the results to microvolts per meter, based upon plane wave calculations and antenna effective height, may be erroneous and will not be accepted as indicating compliance with this specification.

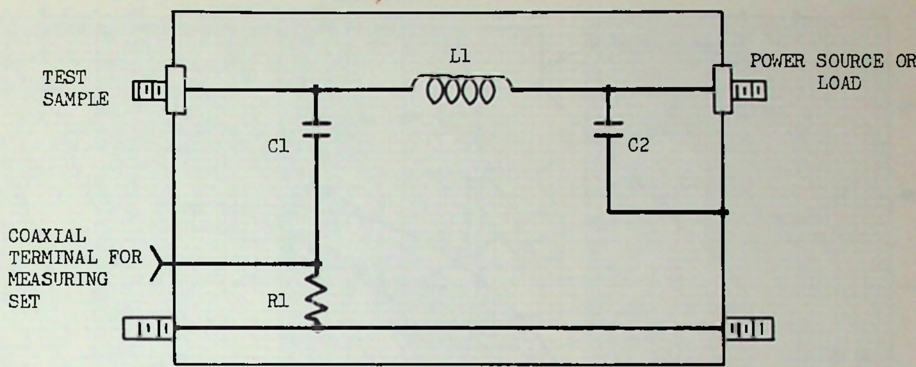
6.6 Operator and observer positions. In those cases where the operator's or observer's location seems to vary a measurement reading, a minimum distance of 3 feet should be maintained between his body and the antenna; the operator should change position slightly until a maximum reading is obtained. In all cases, as few observers as possible should be present in the screen room during the radiated measurements.

6.7 Impulse generators. Satisfactory impulse generators can be obtained from Empire Devices Products Corp., Amsterdam, N.Y., and from Stoddart Aircraft Radio Co., 6644 Santa Monica Boulevard, Hollywood 38, Calif.

6.8 Loop probe MX-936/URM. Loop probe MX-936/URM is commercially available from White Industries, Inc., 421 West 54th Street, New York, N.Y., or from National Co., Inc., 61 Sherman Street, Malden, Mass. (Part No. R8061-1.)

6.9 Coaxial switches. Coaxial switches can be used to advantage for measurements where many manipulations of coaxial cables are required during tests.

6.10 RF radiation hazard. A tri-service limit for exposure to RF radiation has been established at .01 watts/cm.^{2} at any frequency. It is possible to encounter even higher power densities than the established safe maximum limit during the course of tests required by this specification; however, these exceedingly high densities are usually localized. The human eye is highly vulnerable to RF radiation. Adequate safety precautions are recommended.



ENCLOSURE DATA: 14 GAGE (B&S) ALUMINUM SUGGESTED SIZE 9-3/8 IN. BY 4 BY 4 IN.
FORM DATA: 5-1/4 IN. LENGTH, 3 IN. DIA (OD), .125 IN. WALL DRILL 3/8 IN. HOLE 7/16 IN. FROM EACH END.
WIRE DATA: AWG 6, 600 VOLT, .310 IN. DIA (OD).
COIL DATA: L1 = 5 MICROHENRIES, 13 TURNS SINGLE LAYER, 4 IN. WINDING LENGTH.
CAPACITOR: C1 SHALL BE MOUNTED ON 1 IN. INSULATING BLOCK ABOVE GROUND.
CAPACITOR DATA: C1 = .1 UF, 600-VOLT DC, BATHTUB.
C2 = 1 UF, 600-VOLT DC, BATHTUB, SINGLE TERMINAL CASE MOUNTED ON GROUND.
RESISTOR DATA: R1 = 5,000-OHM, 5-WATT CARBON.

1. THE VALUES GIVEN FOR THE COMPONENT PARTS OF THE NETWORK ARE NOMINAL. REGARDLESS OF THE CONSTRUCTION OR DEVIATION FROM NOMINAL VALUES, THE NETWORK MUST HAVE AN IMPEDANCE WITHIN 20 PERCENT OF THAT GIVEN IN FIGURE 2.
2. CONNECTING LEADS TO CONDENSERS AND RESISTORS SHOULD BE AS NEARLY AS POSSIBLE TO ZERO LENGTH.
3. NETWORKS MAY ALSO BE CONSTRUCTED HAVING A 1-OHM SERIES RESISTOR BETWEEN THE LINE AND CAPACITOR C2. THIS 1-OHM RESISTOR SHALL BE MADE UP FROM TEN 10-OHM, 1-WATT COMPOSITION RESISTORS.
4. THE DATA GIVEN IN THIS FIGURE IS SUITABLE FOR THE CONSTRUCTION OF 50-AMPERE NETWORKS. LARGER CURRENT-CARRYING NETWORKS MAY BE CONSTUCTED BY INCREASING THE WIRE SIZE GIVEN FOR THE COIL AND THE SIZE OF THE OVERALL ENCLOSURE.
5. THE 50-OHM TRANSMISSION LINE SHOULD BE EXTENDED WITHIN THE ENCLOSURE RIGHT UP TO THE LOCATION WHERE IT CONNECTS WITH CAPACITOR C1.
6. CAUTION: THE NETWORK SHALL BE PROMINENTLY AND PERMANENTLY MARKED "CAUTION - SHOCK HAZARD - CONNECT CASE TO EARTH GROUND BEFORE CONNECTING A-C POWER LINE."
7. NETWORKS PROCURED PRIOR TO THE DATE OF THIS SPECIFICATION, BUT MEETING THE IMPEDANCE REQUIREMENTS OF FIGURE 2, MAY STILL BE USED.
8. EACH NETWORK SHALL BE PERMANENTLY LABELED WITH THE FOLLOWING DATA: CURRENT RATING IN AMPERES AND VOLTAGE RATING IN VOLTS AT DIRECT CURRENT, 60, 400, AND 800 CPS.

FIGURE 1. *Powerline stabilization network schematic diagram.*

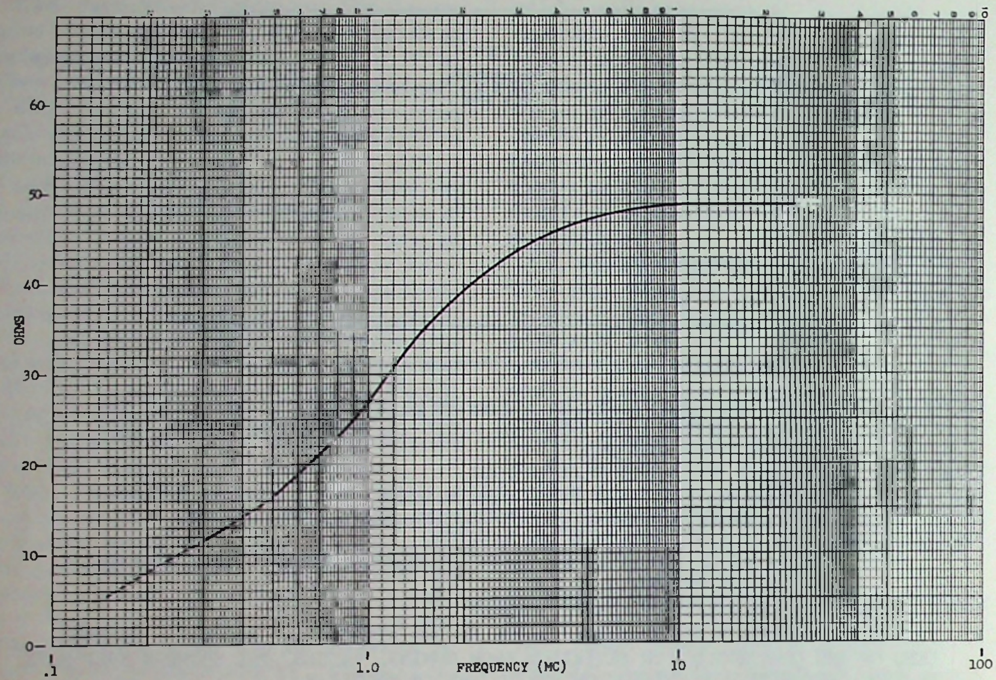


FIGURE 2. *Input impedance at test sample terminal of stabilization network with coaxial connector terminated in 50 ohms, power terminal open.*

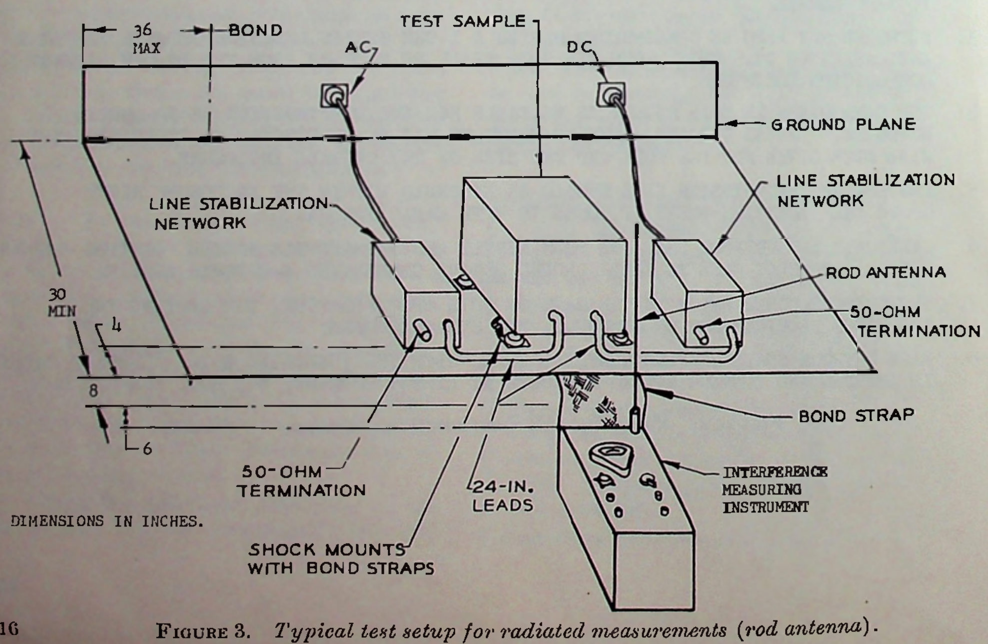


FIGURE 3. *Typical test setup for radiated measurements (rod antenna).*

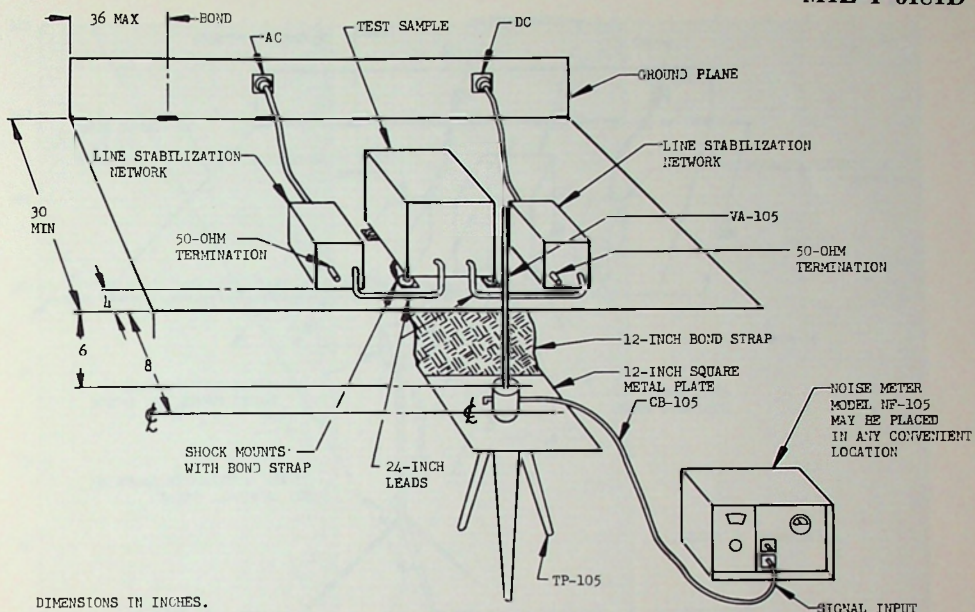


FIGURE 4. *Test setup for radiated measurements (rod antenna).*

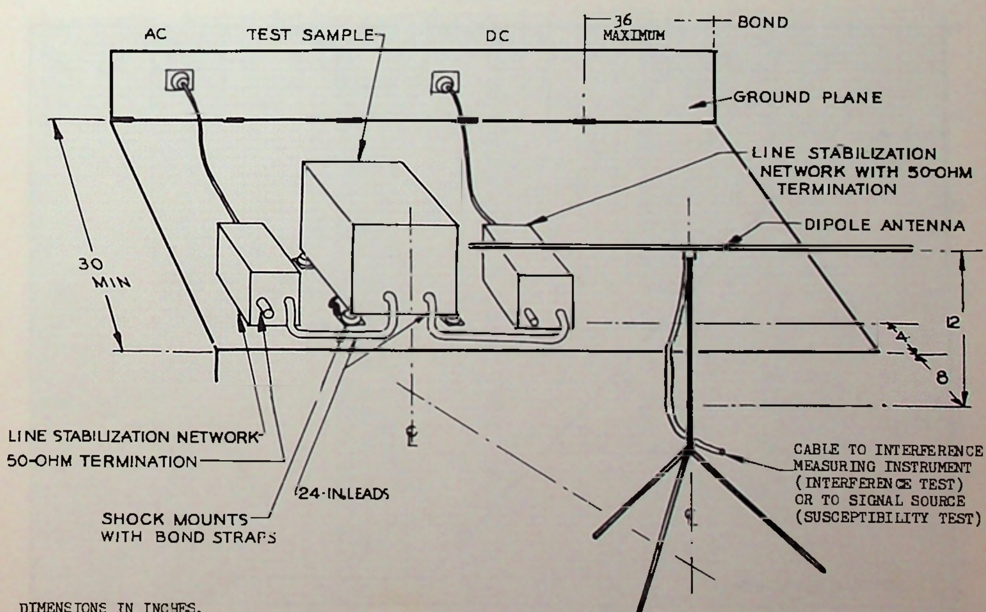


FIGURE 5. *Typical test setup for radiated and susceptibility measurements (dipole antenna).*

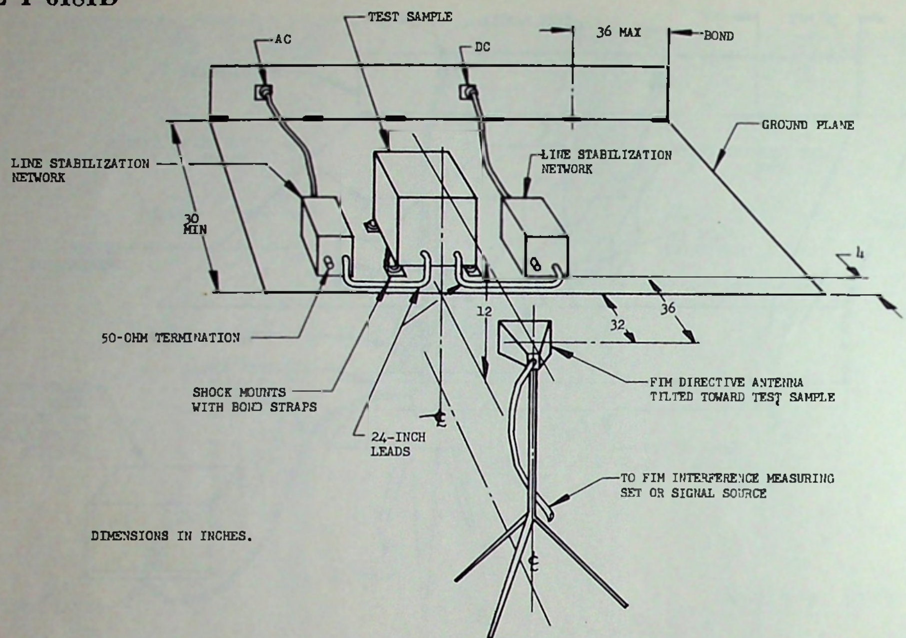


FIGURE 6. *Typical test setup for radiated and susceptibility measurements (microwave-directive antenna).*

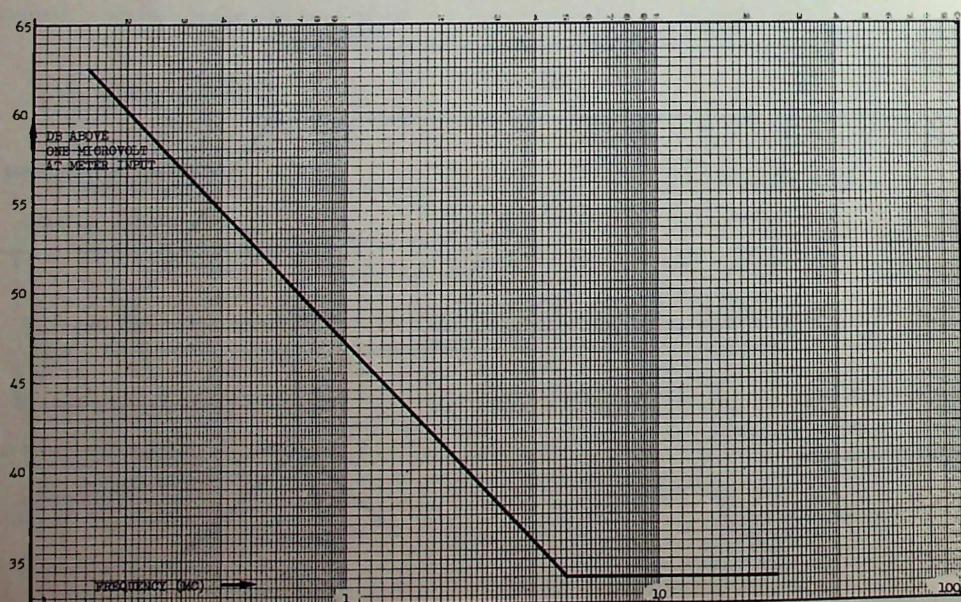


FIGURE 7. *Narrow band (CW) conducted interference limits using stabilization network.*

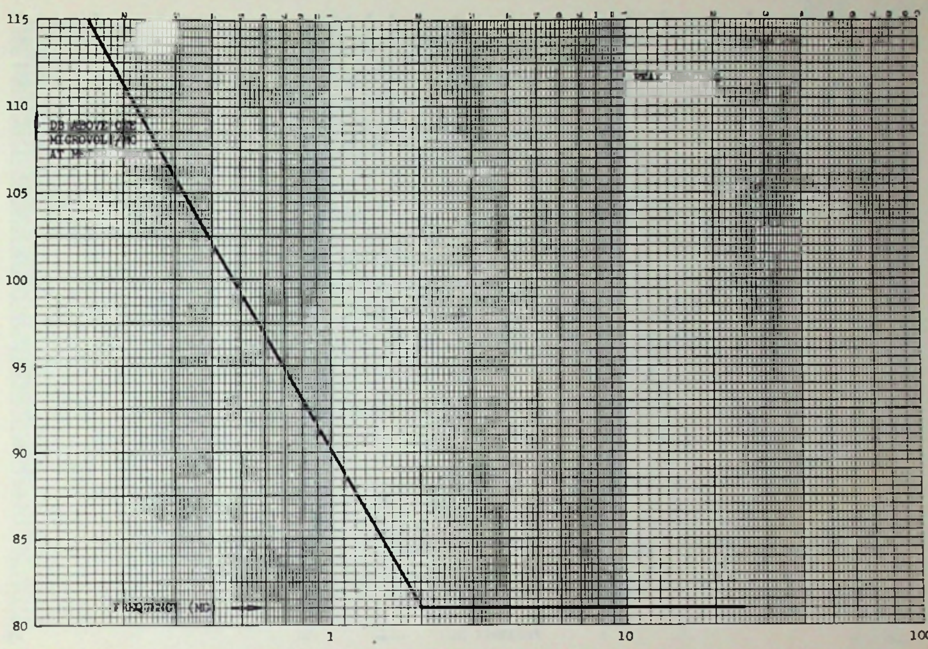


Figure 8. *Broadband and pulsed CW conducted interference limits using stabilization network.*

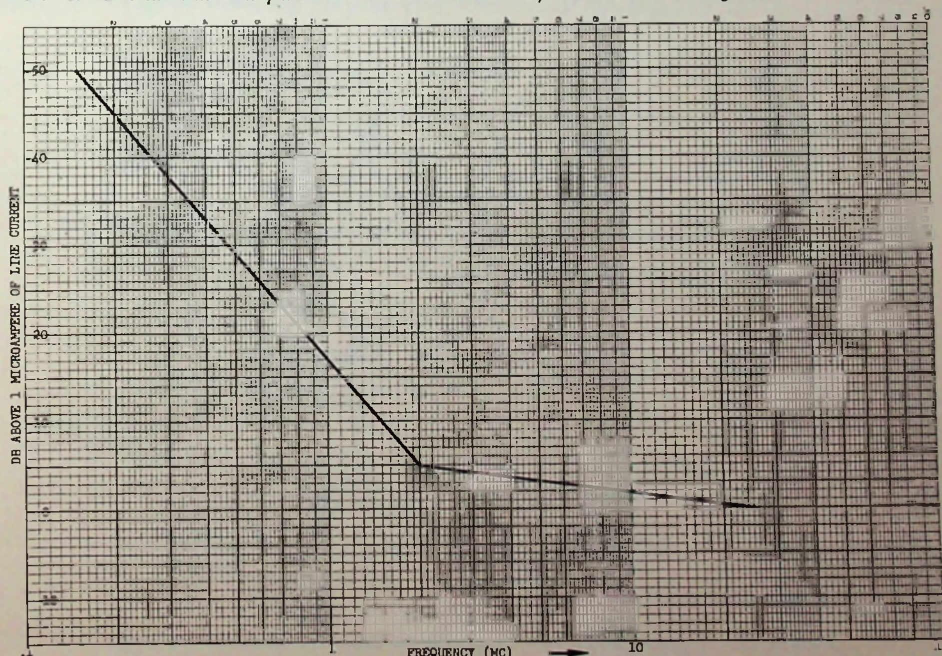


Figure 9. *Narrow band (CW) conducted interference limits using current probe.*

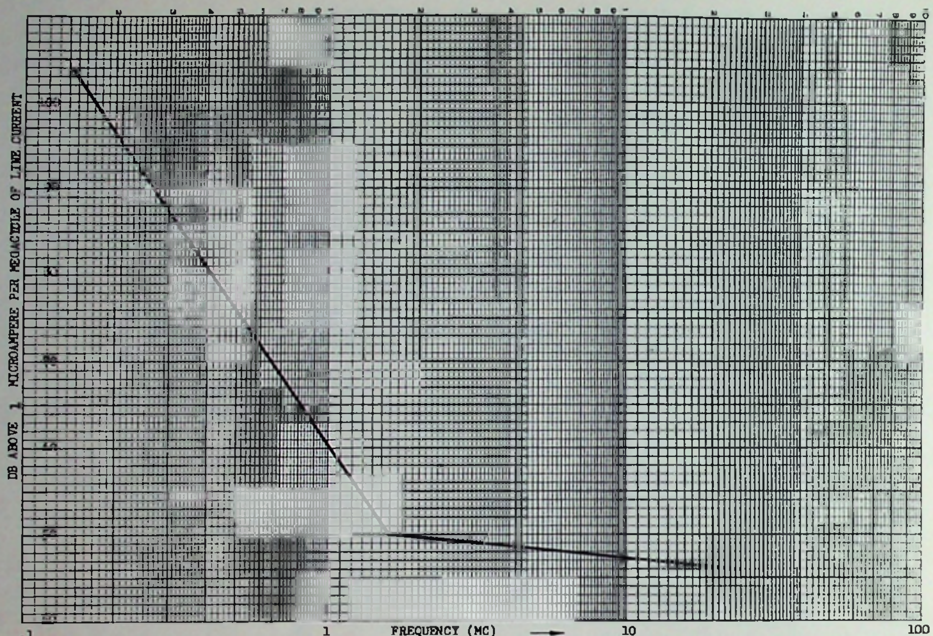


FIGURE 10. *Broadband and pulsed CW conducted interference limits using current probe.*

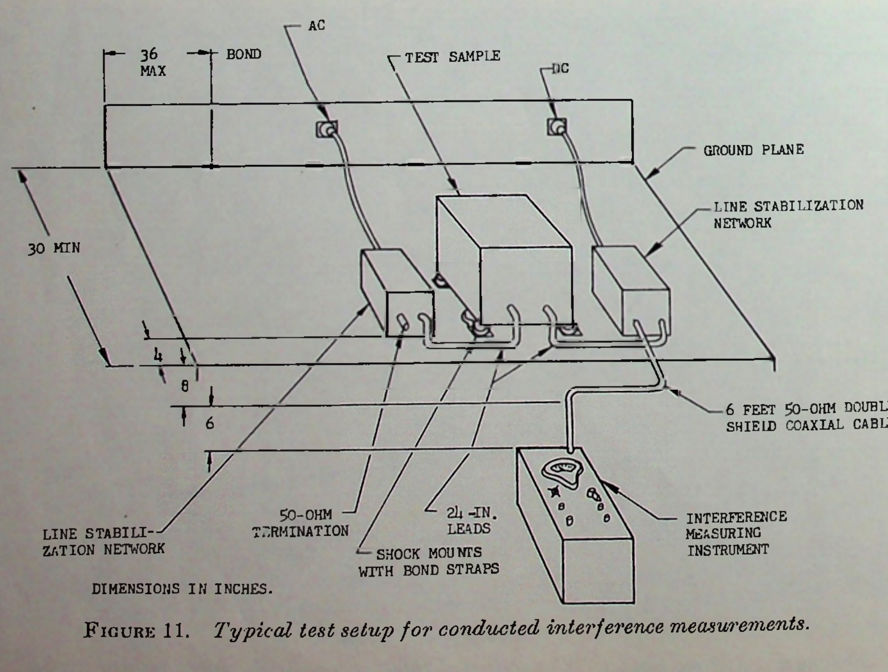


FIGURE 11. *Typical test setup for conducted interference measurements.*

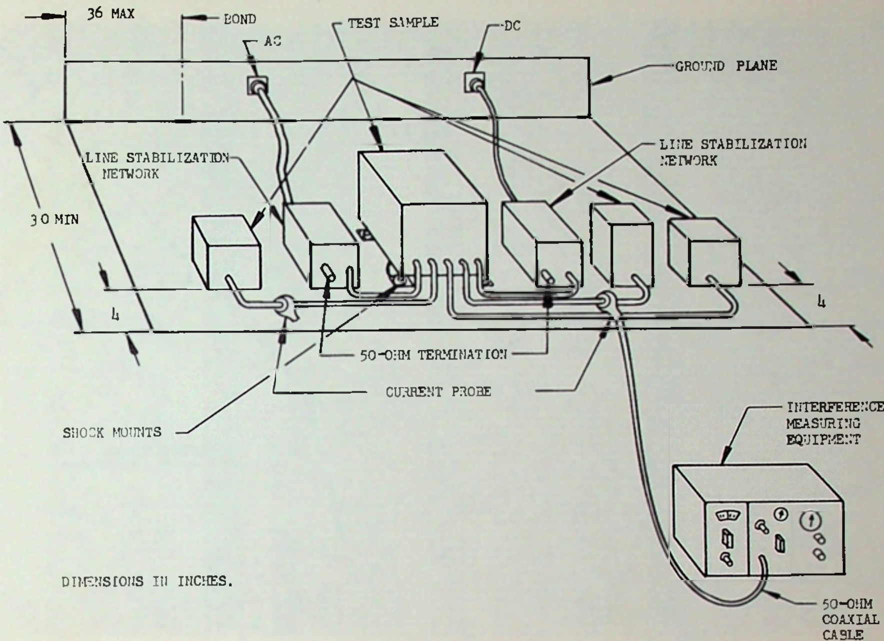
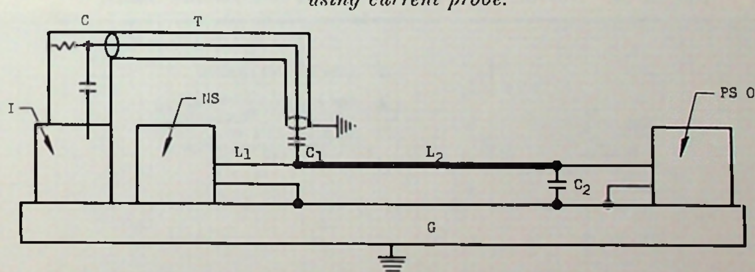


FIGURE 12. *Typical test setup for conducted interference measurements on interconnecting leads using current probe.*



I = AN/PRM-1 METER. G = GROUND COPPER TABLE.

C = CU-197/PRM-1 COUPLER (50-OHM AND 10-MMFD. DUMMY).

T = TRANSMISSION LINE CABLE, 50-OHM, RG-8/U.

C_1 = 0.1 MFD. C_2 = 1.0 MFD.

NS = NOISE SOURCE, TEST SAMPLE.

L_1 = TEST SAMPLE LEADS, 24 INCHES LONG, 2 INCHES APART, 2 INCHES ABOVE GROUND, UNSHIELDED.

L_2 = 10-FOOT LINE, UNSHIELDED, INSULATED, PLACED FLAT ON GROUND.

PS OR L = POWER SUPPLY OR LOAD.

L_1 AND L_2 OF PROPER SIZE TO CARRY LINE CURRENT.

L_2 MAY BE ZIGZAGGED IF DESIRED WHEN TABLE G IS NOT OF SUFFICIENT LENGTH.

FIGURE 13. *Network for conducted interference measurements, line current above 50 amps.*

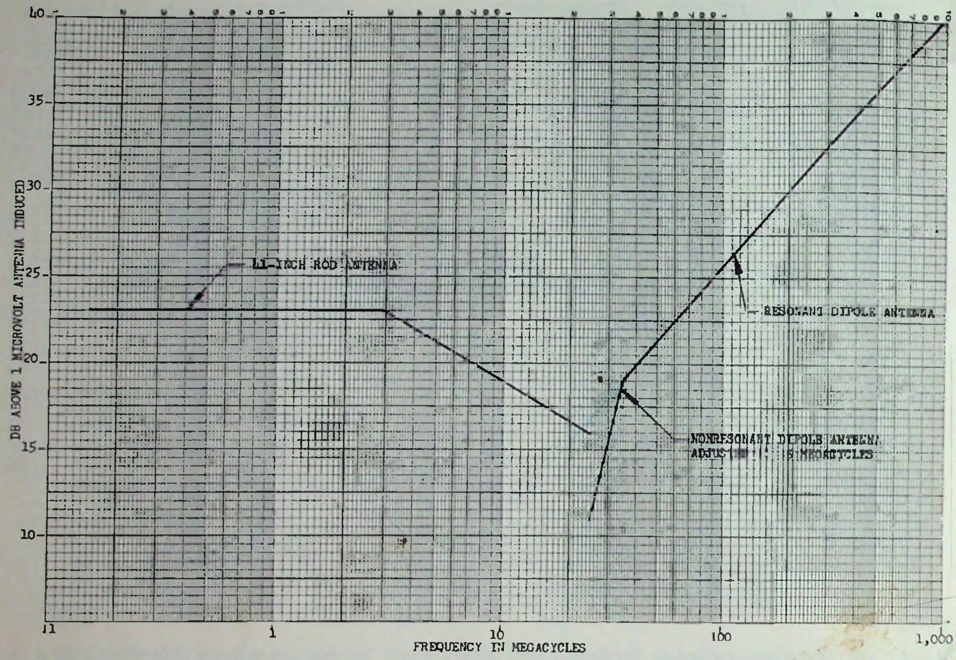


FIGURE 14. *Narrow band (CW) radiated interference limits.*

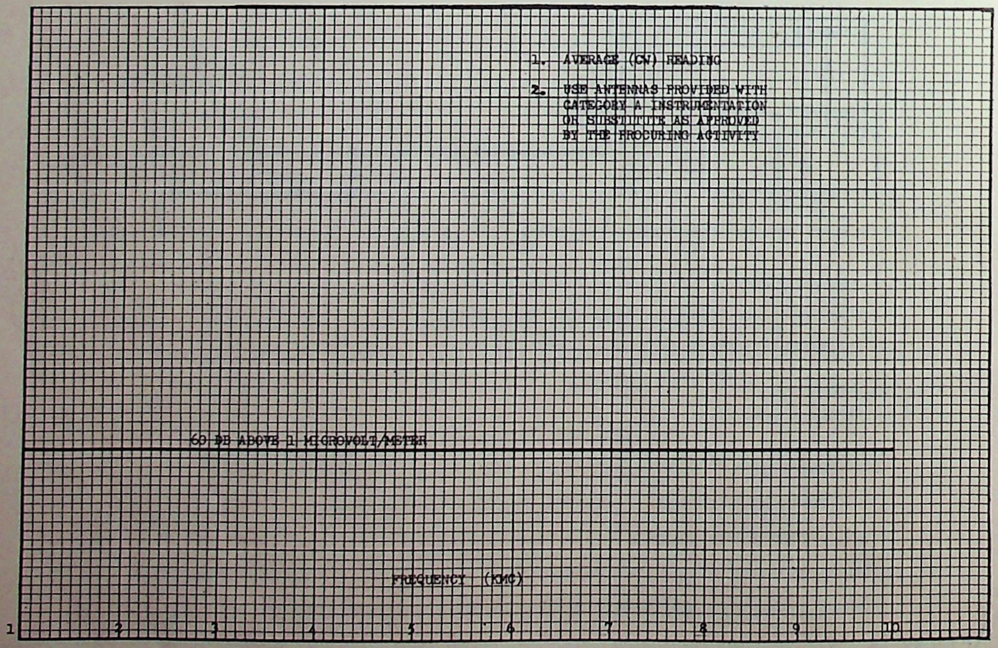


FIGURE 15. *Narrow band (CW) radiated limits.*

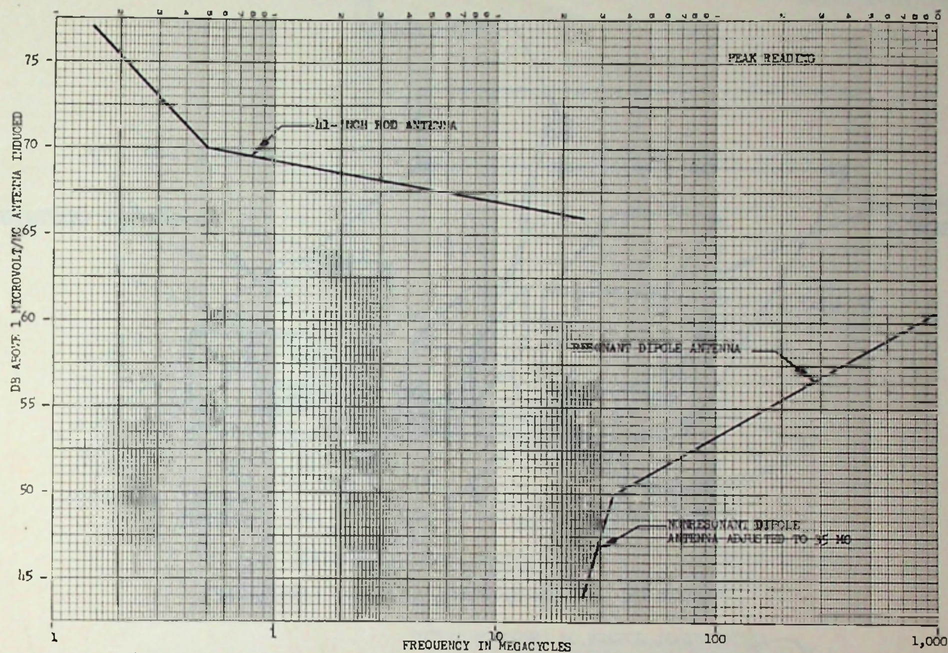


FIGURE 16. *Broadband and pulsed CW radiated interference limits.*

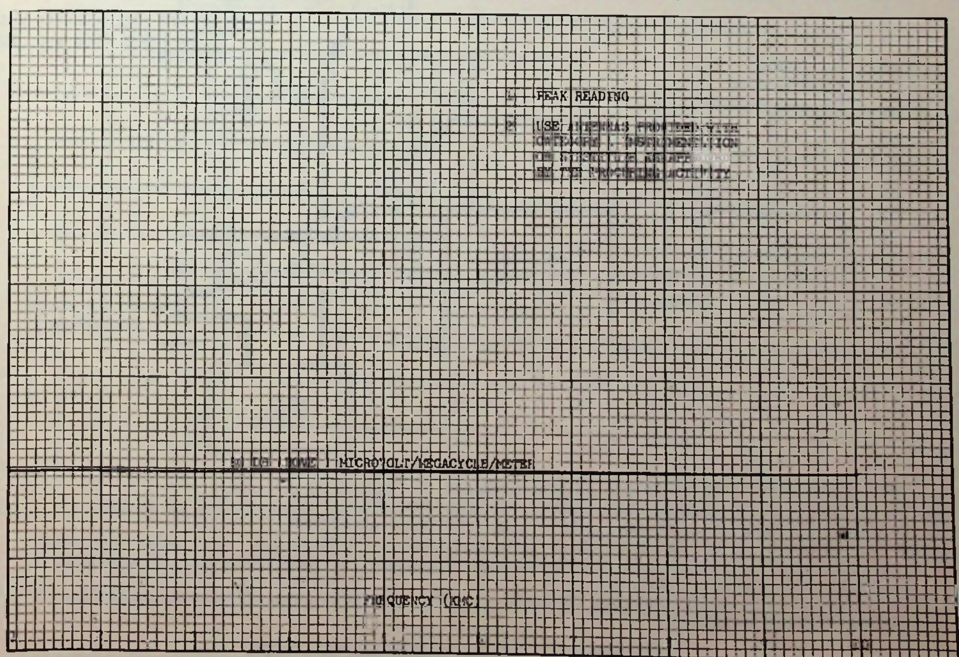


FIGURE 17. *Pulsed CW radiated limits.*

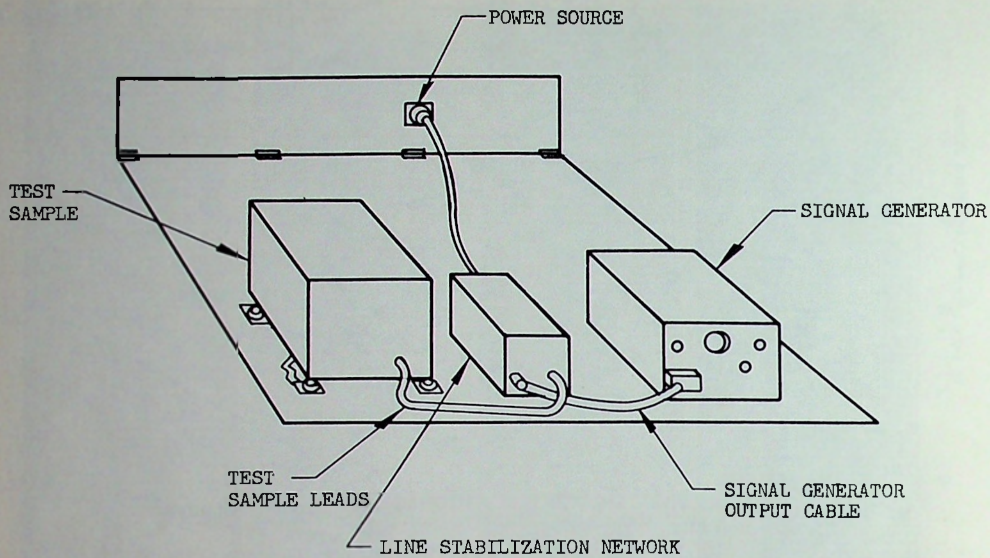
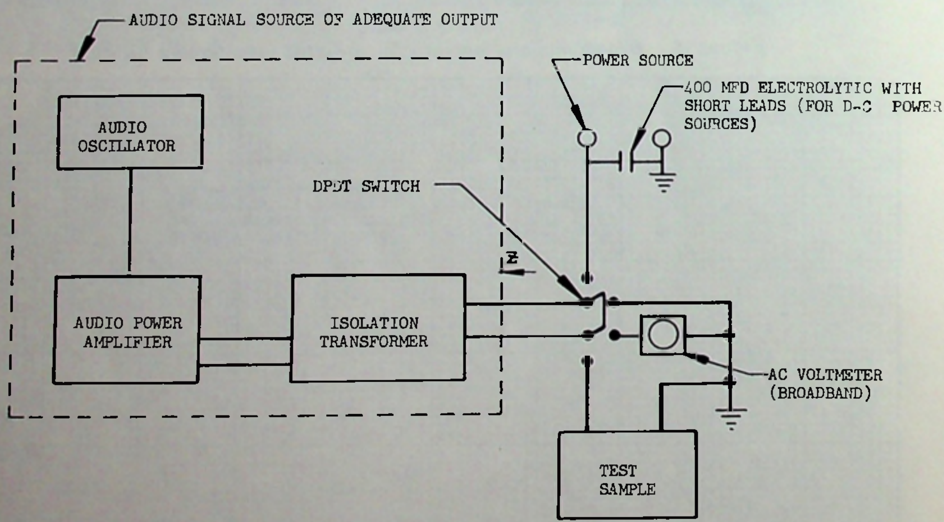


FIGURE 18. *RF susceptibility test setup (conducted).*



1. AUDIO SIGNAL SOURCE SHALL HAVE A SOURCE IMPEDANCE NOT EXCEEDING 0.6 OHM.
2. THE VOLTMETER SHALL READ AN OPEN-CIRCUIT VOLTAGE (TEST SAMPLE DISCONNECTED) OF 3V RMS.
3. ISOLATION TRANSFORMER SHALL CARRY ALL CURRENTS WITHOUT SATURATION.
4. SERIES CONDENSER ON AC VOLTMETER SHALL HAVE REACTANCE NOT GREATER THAN 1/10 METER IMPEDANCE.
5. A VARIABLE AUTOTRANSFORMER CAN BE USED BETWEEN THE ISOLATION TRANSFORMER AND THE AMPLIFIER TO ADJUST FOR THE REQUIRED IMPEDANCE.
6. THE ABOVE VARIABLE AUTOTRANSFORMER MAY ALSO BE USED TO PREVENT HIGH AC LINE VOLTAGES FROM FEEDING INTO THE AMPLIFIER.

FIGURE 19. *AF susceptibility test setup.*

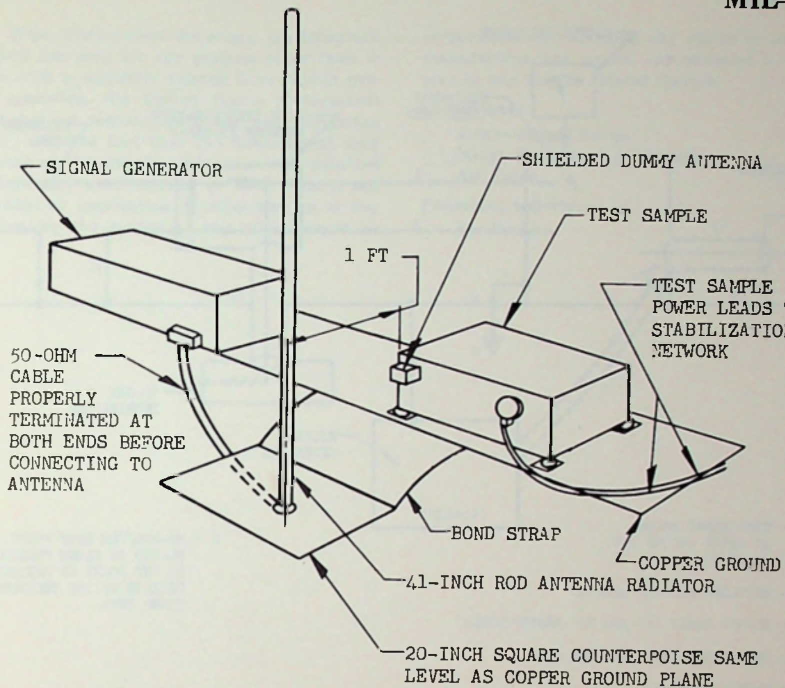


FIGURE 20. *Susceptibility radiated test setup (rod antenna).*

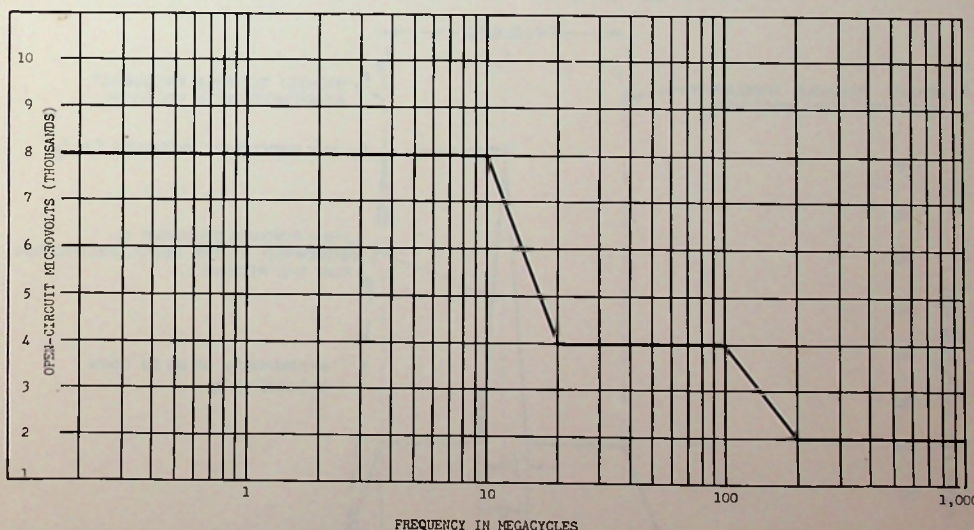


FIGURE 21. *Proposed limits for radiated RF susceptibility tests (equipments using shielded antenna lead-ins).*

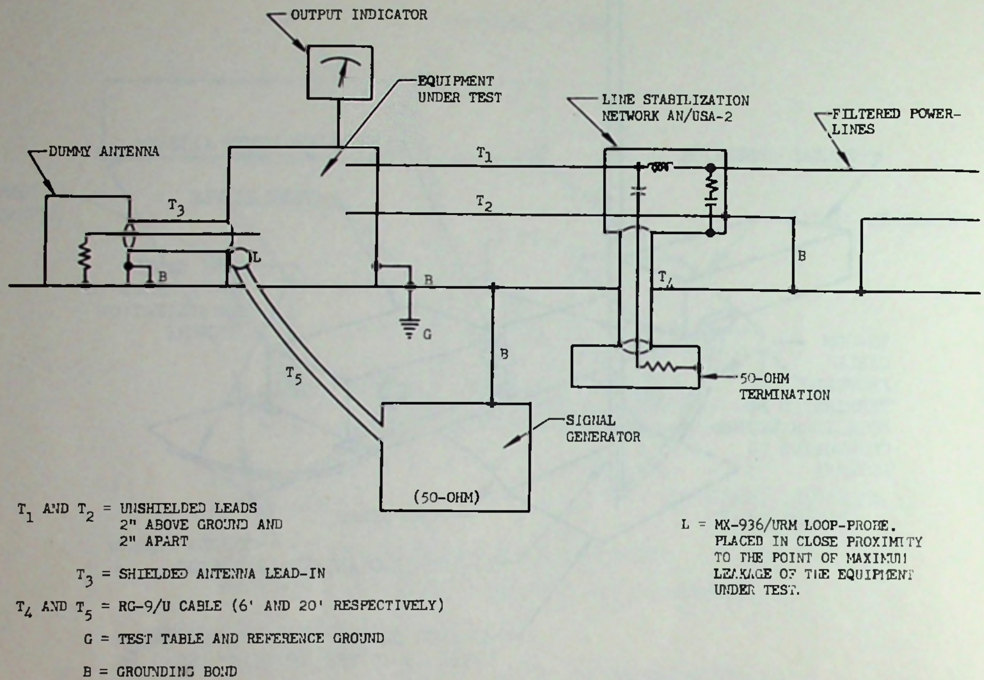


FIGURE 22. *Setup for radiated RF susceptibility tests.*

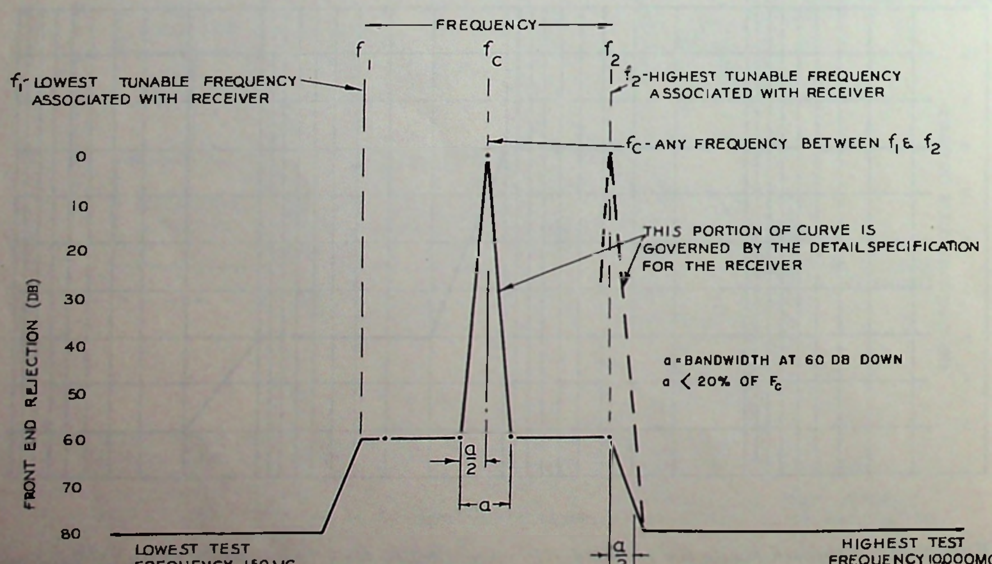


FIGURE 23. *Required receiver front-end rejection.*

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