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# MILITARY STANDARD

## RADIO FREQUENCY SPECTRUM CHARACTERISTICS MEA SUREMENT OF

FSC EMCS

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MIL-STD-449D
22 February 1973

MILITARY STANDARD
RADIO FREQUENCYSPECTRUM CHARACTERISTICS
MEASUREMENT OF

MIL-STD-449D

1. This military standard is approved for use by all Departments & Agencies of the Department of Defense.

2. Recommended corrections, additions or deletions should be addressed to the Commander, Naval Electronic Systems Command, ELEX-0517, Department of the Navy, Washington, D. C. 20360.

## FOREWORD

This military standard establishes uniform measurement techniques that are applicable to the determination of the spectral characteristics of transmitters, receivers, and antennas.

The data obtained from the measurements described in this standard will comprise one of the principle aids for, (a) predicting the EMC performance of equipment, subsystems and systems in an operational electromagnetic environment, and (b) predicting the effect of a particular equipment, subsystems, or systems on the electromagnetic environment of other equipments or systems. These data will also be used as aids for establishing the characteristics required of new equipment for compatible operation in present and future electromagnetic environment.

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# RADIO FREQUENCY SPECTRUM CHARACTERISTICS

# MEASUREMENT OF

## 1. SCOPE

1.1 Scope. This technical standard establishes uniform measurement techniques that are applicable to the determination of the special characteristics of transmitters, receivers, antennas, and system couplers.

1.2 Format.

1.2.1 Numbering system. The test methods contained in this standard are designated by a series of numbers in accordance with the numbering system described below, where:

R = Radiated
C = Conducted
E = Emission
S = Susceptibility

and ``--'' = numerical order of test from 101 to 201.

(a) Conducted Emission tests are designed by ``CE--.''

(b) Radiated Emission tests are designed by ``RE--.''

(c) Conducted Susceptibility tests are designated by ``CS--.''

(d) Radiated Susceptibility tests are designated by ``RS--.''

1.2.2 Method of reference. When applicable, test methods contained herein shall be referenced in the individual specification by specifying this standard and the method number.

1.3 Application. This measurement standard shall apply to all equipments, subsystems, and systems that are designed to emit or respond to electromagnetic energy in the frequency range of 0.014 MHz to 12 GHz. This document covers measurements over the frequency range of 0.014 MHz to 12 GHz, and wherever possible to 40 GHz. The frequency range of measurement should be expanded as instrumentation becomes available.

1.4 Number of equipment samples. The measurements described in this standard may be applied to one or more samples of a particular equipment nomenclature. It should be recognized the measurements on a single equipment sample may be insufficient to describing the general characteristics of that nomenclature. Whenever the situation permits, it is desirable to measure several samples of the same nomenclature.

1.5 Selection of tests. The measurements described in this standard may be applied in whole or in part to a particular test sample, depending on the needs associated with that sample. Agencies responsible for committing work in accordance with this standard are to specifically identify each test (or portion of each test) that is to be performed. In making this selection, the dependency of some of the tests in this standard on other tests in the standard should be recognized.

1.5.1 Phased array system. The CE104, CE108, CE110, RE102, CS107, CS109, CS115, and RS102 test methods and Paragraph 5.6 are not applicable for multiple transmitter/receiver phased array radars and phased array antennas.

1.6 Classification.

1.6.1 The general spectral characteristics measurements are a specified herein.

1.6.1.1 Conducted emission measurement (closed system). These measurements are intended to disclose the spectral characteristics of equipments designed either to transmit or receive electromagnetic energy by measurement of emissions at their antenna terminals.

1.6.1.2 Radiated emission measurement (open field). These measurements are intended to disclose the spectral characteristics of a complete system by measurement of emissions radiated by the system's antenna.

1.6.1.3 Conducted susceptibility measurements (closed system). These measurements are intended to disclose the spectral characteristics of equipments designed either to transmit or receive electromagnetic energy by measurement of their susceptibility to electromagnetic energy at their antenna terminals.

1.6.1.4 Radiated susceptibility measurements (open field). These measurements are intended to disclose the spectral characteristics of a complete system by measurement of its susceptibility to electromagnetic energy received by the system's antenna.

2. REFERENCED DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of the standard to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-463 - Definitions and Systems of Units, Electromagnetic Interference Technology
MIL-STD-469 - Radar Engineering Design Requirements, Electromagnetic Compatibility
MIL-STD-831 - Test Reports, Preparation of

HANDBOOK

MILITARY
MIL-HDBK-216 - RF Transmission Lines and Fittings

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

3. DEFINITIONS

3.1 Meaning of terms not defined herein are in accordance with MIL-STD-463 and MIL-STD-469.

3.1.1 Antenna. A device employed as a means for radiating or receiving electromagnetic energy.

3.1.2 Antenna, elevatable. An antenna designed to elevate, (either by use of a servo-mechanism or manual drive), through an angle. No more than routine effort should be employed to provide maneuverability in the vertical plane.

3.1.3 Antenna, fixed. An antenna designed to radiate a selected angle of elevation and cannot be adjusted except by removing or replacing mounting hardware.

3.2 Couplers.

(a) When used in connection with the system to be measured, a coupler is a frequency selective device ``couples" the system of equipment to be measured to its antenna.

(b) When used in connection with the test equipment set-up, a coupler is used to sample a portion of the signal to be measured (signal sampling device.)

3.3 Duty cycle. For a repetitive single-pulse transmitter (such as a radar transmitter), the ratio of the pulse width to the pulse period. For a repetitive multiple-pulse transmitter (such as an IFF interrogator), the ratio of the sum of the pulse widths of the pulses in the pulse group to the pulse period.

3.4 Emission spectrum. A power versus frequency distribution of a signal about its fundamental frequency which includes the fundamental frequency, the associated modulation sidebands, as well as non-harmonic and harmonic emissions and their associated sidebands.

3.5 Environment, elevated. The electromagnetic environment observed as a result of measurements made above the ground level specified in Paragraph 3.6.

3.6 Environment, ground level. The electromagnetic environment observed as a result of measurements taken at or below the height above the ground level of the systems antenna.

3.7 Far field distance. That distance between two antennas equal to D2/λ or 3λ, whichever is larger, where D is the maximum aperture dimension of the largest antenna, and λ is the wavelength at the fundamental frequency. If the test antenna aperture ($D_2$) is larger than one-tenth of the aperture of the antennas being measured ($D_1$), then this minimum test-site distance is $(D_1^2+D_2^2)/\lambda$.

3.8 Image response. The specific spurious response of a superheterodyne receiver to a signal that differs from the tuned frequency by twice the intermediate frequency.

3.9 Mid-pulse minimum visible signal (MPMVS). The minimum input pulse signal power level which permits visibility of the center of the output pulse. This level is obtained by initially setting the input signal above the detection threshold and then slowly decreasing the amplitude.

3.10 Minimum visible signal (MVS). The minimum input pulse signal power level which permits visibility of the output pulse. This level is obtained in the same manner as MPMVS.

3.11 Modulation types.

3.11.1 AM (amplitude modulation). Modulation in which the amplitude of a wave is the characteristic subject of variation.

3.11.2 CW (continuous wave). An electromagnetic wave that varies sinusoidally in amplitude and remains constant in frequency.

3.11.3 DSB (double sideband). The AM transmission of a carrier accompanied accompanied by both sidebands.

3.11.4 FM (frequency modulation). Modulation in which the instantaneous frequency of a wave differs from its carrier frequency by an amount proportional to the instantaneous amplitude of the modulating signal.

3.11.5 ISB (independent sideband). Amplitude modulation with the carrier either suppressed or reinserted, accompanied by both sidebands, each of which contains separate information.

3.11.6 SSB (single sideband). Amplitude modulation with the carrier and one sideband suppressed.

3.11.7 Pulse. Modulation of a carrier by a pulse train.

3.12 Notch filter. A filter which greatly attenuates frequencies within a narrow band and passes frequencies outside this narrow band.

3.13 Peak envelope power (PEP). PEP is the average power of a sinusoidal signal as the highest crest of the modulation envelope.

3.14 DBM/KHZ (decibels relative to 1 milliwatt per kilohertz). The power spectral density of non-coherent signals whose average power is proportional to bandwidth. Decibels relative to 1 milliwatt per kilohertz, dBm/kHz = 10 Log10 (P/B) where B is the bandwidth of concern in kHz.

3.15 Pulse width. The time interval between half voltage points in the time wave form of a pulsed signal.

3.16 Receiver. An equipment specifically designed to respond selectively to electromagnetic energy.

3.17 Reference frequency. The modulation frequency, RF frequency or (BFO) Beat-Frequency oscillator frequency that produces the maximum receiver audio output (maximum (S+N)/N) in accordance with the procedures of Test CS101-Sensitivity, and other receiver tests as required.

3.18 Spurious emission. Any undesired emission of electromagnetic energy.

3.19 Spurious response. Any undesired response to electromagnetic energy.

3.20 Standard response. As a 10 dB (S+N)/N output ratio for AM and SSB receivers and for FM receivers under modulated conditions, 20 dB of quieting for FM receivers under unmodulated conditions, and minimum or mid-pulse minimum visible signal for pulsed receivers.

3.20.1 Standard test frequencies. That group frequencies to which transmitters or receivers are tuned during the test procedures. At least three such frequencies exist in each equipment tuning band, located approximately at the 10 percent, 50 percent and 90 percent points in each band are referred to as the low, mid, and high X test frequencies, respectively.

3.21 Tuning band. The range of frequencies over which an equipment operates with a given band switch setting.

3.22 Waveguide cutoff frequency. That frequency below which wave propagation cannot occur in a waveguide. For a rectangular waveguide with broadwall dimension, a--equal to or greater than twice the narrow wall dimension, b--the cutoff frequency is defined by $f_c=c/2a$, where fc is the cutoff frequency of the guide, c is the velocity of light, and the distance dimensions of a and c are in the same units. For the methods of determining cutoff frequencies for other type waveguide, see MIL-HDBK-216.

## 4. GENERAL REQUIREMENTS.

4.1 Measurement setup. The equipment to be measured shall, in general, be set up so that it closely approximates the intended operating electrical condition and physical configuration.

4.2 Primary power supply voltage and frequency. Primary power supply voltage shall be maintained within 5 percent of the mean of the rated operating line voltage range and within 5 percent of the rated operating line frequency of the equipment being tested.

4.3 Interference free measurement areas. All field measurements shall be conducted, whenever possible, in areas sufficiently free from interference and reflections, and under conditions that will not adversely affect the results.

4.4 Preparation of equipment. Before any measurements are performed, the equipment shall be in operating condition. The steps specified in the operation and maintenance sections of the pertinent technical manual shall be performed, and any operating discrepancies shall be corrected before measuring is started. The equipment shall be aligned, if necessary, as specified in the pertinent operating instructions to ensure that, insofar as possible, it presents an average equipment in normal operating condition. Under no circumstances will the equipment be optimized with regard to alignment at the test frequencies. The readings should represent field conditions of operation.

4.5 Physical distinction between receiver, transmitter. When tests are to be performed on a receiver or transmitter with an integrated antenna system, establish a “plane of reference” so that the portion of the equipment on the antenna structure side of the plane is designated the antenna, and the portion of the equipment on the other side of the plane is designated as either the transmitter or receiver. It is at this reference plane that equipment separation will take place when necessary. The plane of reference shall remain fixed for an entire series of equipment tests. In the process of establishing the reference plane, no portion of the system under test shall be electrically removed from the system, nor shall extra electrical circuitry be added except as indicated in the measurement procedure. The plane of reference shall be established as close to the antenna as is practicable. Actual physical and electrical separation of the antenna and the transmission line may be required.

4.6 Reported data. Standardized formats for presenting equipment information, measurement and test results are provided as appendices to this document. The appendices serve as a guide only. The formats embody the minimum data delineated within this document. Blank forms are not available. Additional guidance in preparation of reports is provided in MIL-STD-831.

4.6.1 General data.

4.6.1.1 Nominal equipment technical information as presented by the equipment's technical manual or other appropriate reference shall be included. As a minimum, this information shall include, where applicable:

(a) Frequency coverage, the number of tuning bands, and frequency range of each band.

(b) The number of RF channels and the width of each channel.

(c) Nominal transmitter output power.

(d) Nominal receiver sensitivity, RF bandwidth, IF bandwidths.

(e) Rated modulation (AM), deviation (FM), the amount that the third order product is down from the two tone output (SSB) or other specifications regarding the manner in which the manufacturer rates the modulation scheme of the transmitter.

(f) Nominal antenna gain, beamwidth, polarization.

(g) System multiplexing capabilities.

Sample data forms for providing this type of information are contained in the appendix to this standard.

4.6.1.2 Measurement and calibration. Detailed identification of all measurement and calibration instruments, and pertinent auxiliary equipment used in the performance of these tests including data on instrumentation accuracies, calibration dates, stabilities, bandwidth, measured filter insertion loss vs. frequency, and attenuator and coupler characteristics across the applicable frequency range shall be provided in the report.

4.6.1.3 Laboratory test layouts. A description of all laboratory test layouts, and all field test deployments, including plans, drawings and photographs, where applicable, shall be presented in the spectrum signature report preceding the tabulated data. Input and output terminals shall be identified.

4.6.1.4 Descriptions. A description of the measurement location terrain by topographical map, and any pertinent features (mountains, buildings, and so forth), which may influence the measured data shall be provided in the report. The geographical location of measurement site shall be recorded on a topographical map. Photographs presenting a 360 degree panoramic view taken from the location of the equipment under test shall be presented in the report.

4.6.1.5 Test data. Test data, plus sample calculations employing actual measured data to show how the derived data were obtained shall be presented with each measurement.

4.6.1.6 List of failures. A list of failures that occurred in the equipment involved in the measurement program during the test period, and a description of the checks made to determine the condition of equipment performance following repairs shall be presented in the report.

4.6.1.7 Other data. Other information relevant to the test program which may affect measurements, such as peculiarities encountered in equipment performance, difficulties in performing tests, general weather conditions, and descriptions of measurement procedures shall be presented in the report. If any measurement cannot be performed, reasons why and efforts to surmount the problem will be covered in the report.

4.6.1.8 Block diagrams. A system of block diagrams should be furnished identifying the plane of reference employed for the tests as well as all other signal injection and monitoring points. Those controls whose settings are significant to a particular test method shall be identified and the control positions during the test shall be designated such as, "set to position 5", "turned fully clockwise", and so forth. A description of the system operation shall be included, along with peculiarities that are not normally encountered. The setup for each measurement shall be presented in block diagram form depicting the specific input terminals, output terminals, and test equipment interconnections.

4.6.1.9 Photographs. All measurement photographs shall be at least 2-1/2 by 3 inches with the graticule lines clearly visible and with each line accurately calibrated. Where measured data are not clear, larger photographs or higher resolution photographs shall be taken.

5. DETAILED REQUIREMENTS

5.1 Instrumentation.

5.1.1 Signal generators.

5.1.1.1 Frequency accuracy. The signal generator frequency shall be measured before and during the measurement procedures with a frequency meter or counter capable of assuring the desired degree of accuracy (see 5.1.7).

5.1.1.2 Output accuracy. The overall output calibration of the signal generator shall be correct to within 2 dB at any attenuator setting.

5.1.1.3 Output impedance. The signal generator output impedance shall be unbalanced 50 ohms, resistive, with a VSWR not to exceed 1.3.1. For this purpose, the generator may be adjusted with a matching network of known loss at the measurement frequency.

5.1.1.4 Modulation and deviation. For measurements where modulation or deviation is required, the percentage of modulation or deviation shall be known within 5 percent.

5.1.1.5 Harmonic content. Signal generator outputs contain harmonics of the fundamental frequency. These harmonic outputs should be attenuated sufficiently in order that false receiver responses will not be produced. In particular, low pass or bandpass filters of known insertion loss at the fundamental frequency should be used when spurious responses are being measured at frequencies well below the receiver tuned frequency. This technique is used to attenuate all generator harmonics to levels below the sensitivity of the receiver.

5.1.1.6 Leakage. Most signal generators exhibit some leakage that is particularly noticeable when the attenuator is near its maximum attenuation setting. Low-leakage signal generators shall be used to perform these measurements; adequate shielding, separation, and power line filtering shall be employed to eliminate the possibility of erroneous results caused by improper coupling of the signal generator to the receiver.

5.1.1.7 Interpulse CW leakage. Some pulse signal generators of the master-oscillator keyed amplifier type generates a CW output during the interval between pulses. This residual CW energy shall be below the MDS of the receiver for the pulse desensitization test and at least 50 dB below the peak value of the pulse for other tests.

5.1.1.8 Envelope distortion. Distortion shall not exceed 1 percent at 30 percent modulation for the receiver non-pulse selectivity. It may be necessary to modulate CW output of the generator with a low-distortion audio oscillator to meet this distortion requirement.

5.1.2 Equipment terminations.

5.1.2.1 Transmitter dummy loads. Dummy loads shall have adequate power handling capacity to terminate the transmitter. They shall have a VSWR that does not exceed 1.5.1 at any standard test frequency.

5.1.2.1.1 Balanced systems. For balanced systems there shall be one dummy load of 50 ohms resistive impedance applied from each output line to the ground unless otherwise specified.

5.1.2.1.2 Unbalanced systems. For unbalanced systems the impedance of the dummy load shall be 50 ohms resistive unless otherwise specified.

5.1.2.2 Receiver input couplers. The receiver input coupler shall be a shielded network whose insertion loss in known to within 1 dB at the measurement frequency when it is terminated in its nominal impedance. The coupler input impedance shall properly terminate the signal source (VSWR less than 1.3.1) independent of load. The output impedance of the receiver input coupler shall be as required in 5.1.2.2.1 and 5.1.2.2.2.

5.1.2.2.1 Balanced systems. The output impedance of the receiver input coupler for a balanced receiver system shall be 50 ohms resistive in each line to the ground.

5.1.2.2.2 Unbalanced systems. The output impedance of the receiver input coupler for an unbalanced receiver system shall be 50 ohms resistive.

5.1.3 Frequency selective voltmeters.

5.1.3.1 Calibration. Frequency selective voltmeters shall be calibrated as two terminal voltmeters at all measurement frequencies by reference to standard signal generators.

5.1.3.2 Output indications. Frequency selective voltmeters used in these measurements shall be monitored by aural as well as visual indicators. An oscilloscope shall be used as a visual indication device to insure that the frequency selective voltmeter indications are due to signals and not noise (especially applicable to pulse measurements).

5.1.3.3 Bandwidth.

5.1.3.3.1 Recovery of peak pulse. When making measurements requiring recovery of peak pulse level, the instrumentation 3 dB bandwidth in MHz shall be at least 2/T, where T is the nominal pulse width, in microseconds. For a pulse compression system, this bandwidth should be at least 2d/T, where d is the pulse compression ratio, and T refers to the expanded pulse width.

5.1.3.3.2 Acquisition of fine grain. When making measurements involving acquisition of fine grain spectrum details, the instrumentation 3 dB bandwidth in Megahertz shall be less than 1/10T or d/10T.

5.1.3.3.3 When making measurements involving recovery of the time waveform of a pulse signal, the instrumentation 3 dB bandwidth in MHz shall be greater than 1/T, where T is the pulse rise time in microseconds. A measurement objective shall be a bandwidth of approximately 10/T.

5.1.4 Attenuators.

5.1.4.1 Calibration. The calibration of attenuators external to signal generators shall be known within 1 dB at each measuring frequency when it is terminated in its nominal impedance. The attenuator shall have a VSWR less than 1.3.1 independent of load when driven by a 50 ohm source. The requirement for attenuator calibration can be waived if in the calibration process the attenuator insertion loss is included as part of the signal substitution source.

5.1.4.2 Use. An attenuator with at least 5 dB of insertion loss should be located at the input to a test receiver whenever it may be expected that the input impedance of the receiver will present a mismatch to the signal generator. This requirement may be waived where it inhibits the ability to provide specified input signal levels.

5.1.5 Transmitter signal sampling devices. For transmitter testing a sampling device shall be used, where needed, to measure the output level of each signal component emitted. This device may be a voltage divider, power attenuator, directional coupler, probe, or a suitable band reject filter, or combination thereof. The choice of sampling device is to be determined by the availability, the frequency of the transmitter, the power output level, the minimum level at which spurious responses can be detected and knowledge of the impedance characteristics of the transmitter output termination. The coupling loss of the device shall be known within 1 dB at each measurement frequency. The requirement for device calibration can be waived if in the calibration process the device insertion loss is included as part of the signal substitution source.

5.1.6 Spectrum analyzers. The spectrum analyzer shall be need with a signal generator for calibration purposes, and the resultant amplitude accuracy shall be within 2 dB. For bandwidth consideration, refer to 5.1.3.3.2.

5.1.7. Frequency accuracy. When an RF frequency is stated in a test, tabulation, test report, and so forth, it shall be taken to mean the stated frequency with an accuracy of 1 part in $10^6$ unless otherwise noted.

5.2 Transmitter measurements.

5.2.1 Externally modulated non-pulsed transmitters. It is recommended that, as a convenient aid in establishing the system being measured is in satisfactory operating condition, measurements generally be performed in the following sequence:

Method CE101 - Modulator Bandwidth

Method CE102 - Modulation Characteristics

Method CE103 - Power Output

Method CE105 - Carrier Frequency Stability

Method CE107 - Conducted Emission Spectrum Characteristics (Narrow-Bandwidth)

Method CE109 - Conducted Emission Spectrum Characteristics (Wide-Bandwidth)

Method CE111 - Intermodulation

Method RE101 - Radiated Emission Spectrum Characteristics.

5.2.1.1 Required modulation. The modulation used for these tests shall be as specified in the individual test procedures to follow. Independent sideband (ISB) modulation will use SSB techniques where applicable.

5.3 Internally modulated pulsed transmitters. It is recommended that measurements be performed in the sequence indicated unless otherwise noted:

Method CE104 - Power Output

Method CE112 - Conducted Amplitude versus Time Characteristics

Method CE108 - Conducted Emission Spectrum Characteristics (Narrow-Bandwidth)

Method CE110 - Conducted Emission Spectrum Characteristics (Wide-Bandwidth)

Method RE102 - Radiated Emission Spectrum Characteristics

Method CE106 - Carrier Frequency Stability

5.3.1 Required modulation. All tests with the exception of test CE1046 shall be performed under conditions of minimum and maximum duty cycle at each standard test frequency. These same tests shall also be performed at the mean standard test frequency using the mean pulse width and repetition rate of the system under test, unless otherwise specified.

5.4 Receiver measurements.

5.4.1 Multiplex receivers. Whenever possible, receivers intended for use in multiplex communication systems shall be measured at a point in the receiver after de-multiplexing has taken place. For receivers that operate with external de-multiplexing equipment, such devices should be connected to the receiver in accordance with normal installation instructions.

5.4.2 Non-pulsed receivers. It is recommended that measurements be performed in the following sequence, unless otherwise indicated.

Method CS101 - Sensitivity

Method CS103 - Dynamic Range

Method CS105 - Audio Selectivity

Method CS106 - Selectivity

Method CS108 - Conducted Spurious Response

Method RS101 - Radiated Spurious Response

Method CS110 - Intermodulation

Method CS112 - Oscillator Emission

Method CS114 - Adjacent Signal Interference

Method CS116 - Discriminator Bandwidth

5.4.2.1 Standard response. When a modulated test signal is used for AM, SSB, or FM the standard response criteria will be a receiver audio output(S+N)/N ratio of 10 dB. The signal portion (S) refers to the detected audio frequency associated with a modulated carrier at the receiver input. The noise portion (N) refers to the audio noise with a modulated carrier at the receiver input. When an unmodulated signal is used for FM, the standard response is 20 dB of quieting. For CW receivers, the standard response is 10 dB (S+N)/N using a BFO. Where a particular equipment or system, because of its unique configuration or type of modulation, cannot be measured in accordance with this definition, a different definition that is representative of the operational performance requirements of that equipment or system shall be designated and employed upon approval of the contracting officer's technical representative or other designated technical authority; this may be necessary in the case of digital data systems, multiplex systems, and others.

5.4.2.2 Measurement of standard response.

(a) For measurements in accordance with the 10 dB (S+N)/N standard response criterion, a distortion analyzer shall be used. The procedure involves comparing the receiver output level when the filter in the analyzer is removed from the circuit, to the output when the analyzer is tuned to the modulation frequency. If the receiver bandwidth is very limited, the distortion analyzer notch may remove a substantial portion of the noise power. Therefore, a power ratio of the noise without the notch filter to the noise with the notch filter inserted must be measured, expressed in dB, and added to the(S+N)/N ratio in dB to establish the (S +N)/N ratio at the receiver output.

(b) When an unmodulated signal is used for FM, the standard response is 20 dB of quieting as measured with a true rms voltmeter. The noise level reference is established with zero input signal.

(c) In all determinations of standard response, the measurement must be made with a meter that has a bandwidth greater than the overall audio bandwidth of the receiver being measured.

5.5 Pulsed receivers. It is recommended that measurements be performed in the following sequence, unless otherwise indicated.

Method CS102 - Sensitivity

Method CS104 - Dynamic Range

Method CS107 - Selectivity

Method CS109 - Conducted Spurious Response

Method RS102 - Radiated Spurious Response

Method CS111 - Intermodulation

Method CS113 - Oscillator Emission

Method CS115 - Adjacent Signal Interference

Method CS117 - Impulse Response Measurement

5.5.1 Standard response. The standard response will be the minimum visible signal (MVS), except for the Selectivity test, where the standard response will be the mid-pulse minimum visible signal (MPMVS). Where a particular equipment or system, because of its unique configuration or type of modulation, cannot be measured in accordance with this definition, a different definition that is representative of the operational performance requirements of that equipment or system shall be designated and employed upon approval of the contracting officer's technical representative or other designated technical authority; this may be necessary in the case of digital data systems, multiplex systems, and others.

5.6 Antenna measurements.

5.6.1 General requirement. The purpose of these measurements is to obtain a representation of the spatial distribution of power radiated into space or absorbed by a system. A complete set of characteristics for a system would provide absolute field patterns for all measurable transmitter-radiated signals, and for all receiver susceptible frequencies.

5.6.1.1 Objectives. Alternate objectives of these measurements are:

5.6.1.1.1 To determine the field patterns of transmitting or receiving equipment complete with antenna, with as little site effects as possible.

5.6.1.1.2 To determine the field patterns of transmitting or receiving equipment including the effects of the site. Where large find installations exist, this may be the only type of measurement that can be performed. The site can then be considered as part of the radiating or receiving system.

5.6.2. Antenna patterns.

5.6.2.1 General procedure. Antenna pattern information shall be obtained at the midband transmitter standard test frequency, and at all its harmonics up to 12 GHz, and when specifically requested, at non-harmonically related spurious responses above and below the midband standard test frequency. Adequate precautions must be provided to prevent extraneous energy and spurious responses in the measurement equipment from affecting the validity of the measurement system. A total measurement range of at least 70 dB is required for fundamental patterns; a minimum of 40 dB is required for fundamental patterns at other frequencies. The system antenna may be operated in either an active or passive state. Normally, the system antenna will be operated in the active state. If adequate power to provide the required measurement range is not present at non-fundamental frequencies, the system antenna may be driven by a suitably modulated signal generator, or may be used in the passive state. The measurement shall be made in an area unobstructed by buildings and trees. The antennas will be placed so as to minimize unusual ground reflections. In the placement of the test antenna, an objective is to avoid unusual reflections and the resulting complex waveform. A relative vertical profile measurement will aid in determining the magnitude of the reflection. The relative vertical profile is a plot of relative received power in dB versus test antenna height. It may be determined in accordance with Method RE101. Where the azimuth and elevation of the system antenna can be varied, both the system and test antenna orientation shall be positioned for maximum received energy. If the system antenna cannot be varied, the test antenna shall be oriented for ground level maximum received energy. Requirement for distance between antennas is given in 3.7. Information regarding antenna measurements for pulsed and non-pulsed equipments shall be in accordance with Appendix F.

5.6.2.1.1 Measurement below 20 MHz. The measurement antenna shall be a vertical rod, whip antenna, or calibrated loop equivalent to those furnished with field intensity measurement instruments.

5.6.2.1.2 Measurements between 20 and 400 MHz. The measurement antenna may be any calibrated antenna in the frequency range preferably a directive antenna tuned to the proper frequency. The measurement antenna shall be located as high above the ground as is practical, and shall be oriented for maximum response.

5.6.2.1.3 Measurements between 400 and 1000 MHz. The measurement antenna may be a dipole with a corner reflector or a waveguide horn.

5.6.2.1.4 Measurements above 1000 MHz. The measurement antenna shall be directive. Its side lobe attenuation shall be at least 16 dB below the main been unless otherwise specified.

5.6.2.2 Polarization. Horizontal and vertical polarization patterns are to be taken for all measurements.

5.6.2.3. Antenna types. For convenience, antenna types have been divided into a number of categories. Two primary groups are surface-based and airborne. The measurement techniques described in this section apply only to surface-based devices.

5.6.2.3.1 A further distinction is made between rotatable and non-rotatable antennas which are in turn categorized as non-scanning and scanning devices. Scanning may occur either in the horizontal (for example, sector scan) or vertical (for example, nodding) planes, and can generally be stopped. Vertical scanning devices shall be stopped in the lowest possible elevation angle. Horizontal scanning devices shall be stopped as close to the geometrical axis of the system antenna as possible. Polarization scanning shall not be stopped. A final breakdown of each of these sub-groups is made in regard to the degree of maneuverability with which the antenna can be positioned in the vertical plane.

5.6.2.4 Rotatable antennas. For rotatable antennas, the antenna shall be rotated over 360 degrees and measurements shall be recorded by a rapid operating technique. An azimuthal pattern shall be taken with the electrical centers of the test and system antennas at the same height. An additional pattern shall be taken, if possible, so as to intersect the peak of the main lobe. Data should be reported in rectangular coordinates as shown in Figure 14.

5.6.2.4.1 Fixed elevation antennas. Measure one azimuth pattern at the first vertical profile peak (if it exists) above the ground at each frequency.

5.6.2.4.2 Elevatable antennas. If the antenna is readily elevatable, additional azimuthal patterns shall be taken with the system antenna boresighted on the test antenna height. One pattern shall be taken with the system antenna at its maximum elevation angle. A minimum of four additional azimuthal patterns shall be taken at elevation angles at which peaks of elevation lobes are observed. These peaks may be located by searching in elevation along an azimuthal angle which intersects the main lobe. An example is shown in Figure 15.

5.6.2.4.3 Semi-elevatable antennas. If the antenna is elevatable through an angle of less than 80 degrees it shall be treated as an elevatable antenna. Patterns need not be taken at intervals less than 5 degrees. If the antenna is elevatable in steps, azimuthal patterns shall be taken for each available position not to exceed six.

5.6.2.5 Non-rotatable antennas.

5.6.2.5.1 Test antenna locations. For all non-rotatable antennas, the test antenna shall be placed at eight approximately equally spaced angular positions, with the electrical centers of the test and system antennas at the same height for the following tests. For antennas having a reflector or other directional arrangement, the locations shall be selected so as to include at least set of measurements on the electromagnetic axis of the main beam or beams.

5.6.2.5.2 Fixed elevation antennas. Readings shall be obtained at each of the eight positions specified in 5.6.2.5.1.

5.6.2.5.3 Elevatable antennas. If the antenna is elevatable, readings shall be taken at the position specified in 5.6.2.5.1. In addition, one set of readings shall be taken with the system antenna at its maximum elevation angle. A minimum of four additional sets of readings shall be taken at intermediate elevation angles, preferably at the peaks of any lobes as illustrated in Figure 15.

5.6.2.5.4 Semi-elevatable. Readings shall be taken as for elevatable antennas but need not be taken at intervals of less than 5 degrees; for example, with an antenna capable of being titled 15 degrees only four readings are required. In the case of incrementally stepped antennas, readings shall be taken at incremental positions but not to exceed six readings.

Custodians:
ARMY - WC
NAVY - EC
AIR FORCE - 10

Preparing activity:
NAVY - EC

(Project EMCS-0011)

Review activities:
NAVY - SH, AG
ARMY - TL, EL
AF - 11

User activities:

NAVY - MC

# METHOD CE101

## MODULATOR BANDWIDTH (Non-pulsed)

1. Purpose. The purpose of this test is to determine the frequency response of circuits which precede the modulator and establish whether the modulator has excessive bandwidth which can cause sidebands outside the assigned channel. This type of interference is usually adjacent-channel in nature and drops off rapidly with $\Delta f$. Because of this, the bandwidth of the modulator shall be no greater than one-half of the channel spacing, and at the frequency equal to one-half of the channel spacing the response should be down at least 20 decibels. The information obtained from this test will be used to select modulating frequencies for other transmitting tests.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 1.

3. Measurement procedure. The test procedures shall be as follows:

(a) Adjust the frequency of a constant amplitude audio signal to obtain a maximum percentage of modulation, frequency deviation or PEP. Refer to this frequency as $f_{max}$. Adjust the power level of $f_{max}$ to obtain 30 percent modulation (AM), 30 percent or rated deviation (FM), or 10 percent rated PEP (SSB). Record this audio input level and frequency.

(b) Keep the audio output of the signal generator constant and decrease the signal generator frequency until there is a 1 dB decrease in output power for SSB or 25 percent modulation for AM or 25 percent of rated deviation for FM.

(c) Repeat step (a) for decrease of 3, 6, 12, 18, and 24 dB for SSB or 15, 7.5, 3.25 and 1.0 percent modulation for AM or 15, 7.5, 3.25 and 1.0 percent of rated deviation for FM. Record data on both sides of $f_{max}$.

(d) This procedure shall be repeated for each modulation type input to the transmitter at the mean standard test frequency of each tuning band.

If the modulator incorporates clipping, AGC, ALC, or other type of signal limiting, a check should be made to assure that the above indicated percent modulation, deviation or PEP is not activating these circuits. This can be accomplished by monitoring the appropriate control or feedback threshold. If these circuits are being activated, a lower value of percent modulation, deviation or PEP shall be used that will enable the modulator to operate in a linear manner. Alternatively, the modulator AGC (or other) circuit may be stabilized by applying a fixed bias to the feedback or control circuit, or by using one tone at frequency fmax to set the bias level at a representative operating point, and a second test tone at a level approximately 10 dB below the level of $f_{max}$.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix A.

# METHOD CE102

## MODULATION CHARACTERISTICS (Non-pulsed)

1. Purpose. This test enables the measurement of the transmitter modulation characteristics as a function of modulation input voltage for SSB modulation and for AM or FM systems.

It is a check of the modulator power supply capability of AM transmitters, the system linearity of SSB transmitters, and the deviation linearity of FM transmitters, as well as the intermodulation characteristics of these transmitters with respect to the modulator.

2. Measurement setup. The test apparatus shall be set up as shown in Figure 1.

3. Measurement Procedure. The test procedures shall be as specified in 3.1 for AM or FM systems and in 3.2 for SSB modulation.

3.1 AM or FM systems.

(a) Adjust the frequency of the modulating audio signal generator to the $f_{max}$ obtained in the modulator bandwidth test. Set the transmitter input modulation signal level to zero and measure and record the percentage of modulation (AM), or deviation (FM). A spectrum analyzer may be required to observe low level modulation. This represents residual modulation.

(b) Slowly increase the modulating signal level and observe the modulation or deviation. Record sufficient values to plot a smooth curve of modulating signal input level versus percentage of modulation or deviation in kHz.

(b) This procedure shall be repeated for each modulation type input To the transmitter at the mean standard test frequency of each RF tuning band.

3.2 SSB modulation.

(a) Select two frequencies at approximately the upper and lower one decibel points of the modulator bandwidth curve. Insert both frequencies at the modulation input to the transmitter. Adjust both signal level to zero and measure and record the average power at the transmitter output. This represents the residual output.

(b) Increase both modulating signals in steps, so that they provide Equal RF emission components. Measure the average power and observe the two tones and the third order intermodulation product at the transmitter output with a spectrum analyzer. If the transmitter cannot dissipate an average power equal to one-half of the rated PEP continuously, a duty cycle device should be used to turn the modulating signal on and off. The modulating signal should be left on long enough to allow the test equipment to respond. Record enough points to plot a smooth curve of modulating signal input level versus PEP (PEP equals twice the average power for two equal amplitude tones) and modulating signal input level versus output signal to distortion ratio (fundamental tone to third order product).

(c) This procedure shall be repeated for each modulation type input To the transmitter at the mean standard test frequency of each tuning band.

4. Presentation of measurement results. The results shall be presented in the formal as specified in Appendix A.

# METHOD CE103

## POWER OUTPUT (Non-pulsed)

1. Purpose. This method is used to measure the power output at several frequencies spaced throughout the frequency coverage for SSB, AM and FM transmitters. Since the power output of a transmitter may vary considerably over the frequency coverage and, in multi-band transmitters may also vary from band to band, the power output should be measured at several frequencies spaced throughout the frequency coverage, that is, at least the standard frequencies of each tuning band.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 2.

3. Measurement procedures. The test procedures shall be as specified in 3.1 for AM and FM transmitters and in 3.2 for SSB transmitters.

3.1 AM and FM transmitters. The Am and FM transmitters shall be unmodulated and the procedure shall include:

(a) Tune the transmitter to a standard test frequency.

(b) Sample a portion of the transmitter power by adjusting the couplers and attenuators to obtain a convenient reading on a frequency selective voltmeter or calibrated average power meter. If a frequency selective voltmeter is used, signal substitution shall be performed using a calibrated signal generator. The amount of attenuation in dB between the transmitter output and the meter is added to the meter reading in dBm to determine the output power.

(c) Repeat for each standard test frequency of each tuning band.

3.2 SSB transmitters. The SSB transmitters shall be modulated by two equal tones which correspond to the tones used during the modulator characteristics test. The procedure shall include the following:

(a) Adjust transmitter to obtain rated PEP by following the equipment's technical manual. If the above information is not available, the modulation characteristics curve should be consulted and the point at which a further increase of audio tone level ceases to produce a decrease in the fundamental to third order intermodulation distortion ratio should be used to describe rated PEP.

(b) Tune the transmitter to a standard test frequency.

(c) Sample a portion of the transmitter power with an average power meter, or if possible measure directly with a high impedance true RMS voltmeter.

(d) Adjust the two audio tense each that the rated PEP is obtained. Measure the MS audio input and the average power output. Compute PEP as twice the average power output.

(e) This procedure shall be reposted for each standard test frequency of each tuning band.

4. Presentation of measurement results. The results shall be presented according to the format specified in Appendix A.

# METHOD CE104

## POWER OUTPUT (Pulsed)

1. Purpose. This method is used to measure the power output at several frequencies spaced throughout the frequency coverage. Since the fundamental power output of a transmitter may vary considerably over the frequency coverage and, in multi-band transmitters may also vary from band to band, the power output should be measured at several frequencies spaced throughout the frequency coverage, that is, at least the standard frequencies of each tuning band.

2. Measurement setup. The test apparatus shall be set up as shown in Figure 2.

3. Measurement procedures.

(a) Tune the transmitter to a standard test frequency.

(b) Sample a portion of the transmitter power by adjusting the coupler and attenuator to obtain a convenient reading on a frequency selective voltmeter or calibrated average power meter. If a frequency-selective voltmeter is used, signal substitution shall be performed using a calibrated signal generator.

(c) Repeat for each standard test frequency of each tuning band.

4. Presentation of measurement results. The data shall be presented in accordance to the format specified in Appendix B.

# METHOD CE105

## CARRIER FREQUENCY STABILITY (Non-pulsed)

1. Purpose. This test is used to determine the transmitter frequency stability. This test is not required for SSB transmitters.

2. Measurement setup. The measurement setup shall be in accordance with Figure 2.

3. Measurement procedure. The measurement procedure shall include the following:

(a) A frequency readout shall be obtained 15 minutes after the transmitter is turned on and at 15 minute intervals thereafter up to 4 hours. Instrumentation frequency accuracy of one part per million is required.

(b) Perform the frequency readout measurement at the mean test frequency of each band.

4. Presentation of measurement results. The results shall be presented in accordance with the format specified in Appendix A.

## METHOD CE106

## CARRIER FREQUENCY STABILITY (Pulsed)

1. Purpose. This test is to determine the frequency stability of the transmitter.

2. Measurement setup. The measurement setup shall be in accordance with Figure 2.

3. Measurement procedure.

(a) A frequency readout shall be obtained 15 minutes after the transmitter is turned on and at 15 minute intervals thereafter up to 4 hours. Instrumentation frequency accuracy of one part per million is required.

(b) Perform these measurements at the mean test frequency of each band.

4. Presentation of measurement results. The measurement results shall be presented in accordance with the format specified in Appendix B.

# METHOD CE107

## CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (NARROW-BAND WIDTH) (Non-pulsed)

1. Purpose. This test is performed to determine the closed system power versus frequency characteristics of a transmitter about its fundamental and second through fifth harmonics. If the transmitter being measured uses a waveguide system, harmonics above the cutoff frequency for the first higher order mode need not be measured. The test will be performed by modulating the transmitter first with two tones and then with shaped noise, except as indicated herein.

1.1 Frequency range.

(a) For coaxial systems the frequency ranges shall be in the vicinity of the fundamental and the second through fifth harmonics. Data shall be obtained about each of these frequencies over the range where transmitter emissions exceed analyzer noise.

(b) For waveguide systems, the frequency ranges for coaxial systems shall apply, except that harmonics above the cutoff frequency for the first higher order mode need not be measured.

1.2 Analyzer bandwidth considerations.

(a) Line spectrum. When two tones are used to modulate the transmitter, the analyzer bandwidth shall be less than one-half of the lower tone frequency.

(b) Distributed spectrum. When shaped noise is used as a modulating signal, two criteria shall determine the analyzer bandwidth:

(1) The analyzer bandwidth shall be less than one-tenth of the 3 dB spectrum width.

(2) The analyzer bandwidth, sweep time, and sweep width shall satisfy the following inequality:

$$\frac{2\ (\text{analyzer bandwidth})^2 \times \text{sweep time}}{\text{sweep width}} > 100$$

(c) Photographs shall be taken using a single sweep of the analyzer.

1.3 Amplitude and frequency considerations.

(a) The dynamic range of the measured data shall be at least 60 dB referenced to the maximum of the modulated spectrum.

(b) The sweep width shall be wide enough to encompass all spectral lines or modulation noise components above the analyzer noise.

(c) For two tones the amplitude and frequency display shall be such that every transmitted harmonic and intermodulation product of the two fundamental tones are clearly identifiable.

1.4 Modulating signals.

(a) Amplitude. The two tones and noise distribution will usually be Of equal amplitude. However, a few transmitters are specifically designed to accept modulating signals which are not the same amplitude across the modulating frequency band. An example would be a transmitter whose modulator input is equalized to match the output of a specific microphone. In such a case the amplitude versus frequency response curve which the transmitter is designed to accept should be determined and the amplitudes of the two tones and noise should correspond to the response curve as closely as possible.

(b) Frequency. The lower frequency of the two tones should be selected from approximately the lower frequency 1 dB point of the modulator bandwidth curve. The upper tone shall be selected using the following guidelines.

(1) Select a tone near the upper edge of the operating modulator bandwidth.

(2) The upper tone shall not be harmonically related to the lower tone.

(3) For AM and SSB the upper tone should be chosen to produce identifiable out-of-band harmonic and intermodulation product terms with readable power levels.

(4) For FM the upper tone should be chosen to correspond to the upper band limit specified by the manufacturer or to produce a good representation of the spectrum.

1.5 Modulation measurement.

(a) Amplitude modulation shall be measured at the RF output with a device which responds to the peak value of the waveform.

(b) Frequency modulation shall be measured at the RF output.

(c) Single sideband output shall be initially measured with a true RHS voltmeter or average power meter for two tones. Once the average value is established a peak reading shall be taken of the two tones. The one-half PEP and rated PEP value for the shaped noise test should be set up by equating the peak value of the noise to the peak value of two tones. All peak and average power measurements shall be taken at the RF output.

2. Measurement setup. The measurement setup shall be as shown in Figure 3.

3. Measurement procedure. The test procedure is as follows:

(a) Adjust the transmitter to the mean standard test frequency.

(b) For AM, FM, and SSB transmitters, insert two tones for each band, as described in 1.3 and adjust the tone levels to produce 50 percent modulation, deviation or PEP. For AM and SSB the tones should be equal in amplitude as viewed on the analyzer. Photograph the spectrum. For other than AM, FM and SSB transmitters, omit steps (b), (c), and (d) of this procedure.

(c) Repeat for 100 percent (or maximum) modulation, deviation, or PEP. Photograph the spectrum.

(d) For FM, record the positive and negative frequency deviations as well as the total deviation.

(e) Replace the two tone audio input with a random noise signal which is band-limited to equal the 3 dB points of the modulator band-width. Photograph the spectrum for 50 percent and 100 percent modulation or deviation, or one-half PEP and rated PEP whichever is appropriate. Modulation or deviation percentage is established on the peak levels of the noise.

(f) Band limit the noise with a band pass filter whose lower limit is 300 Hz and whose upper limit is NX3400 Hz (where N is the number of channels) and photograph the spectrum for 50 percent and 100 percent modulation or deviation, or one half PEP and rated PEP, whichever is appropriate. For multi-channel FM the filter characteristics in Table I shall be used.

Table I. Filter characteristics.

| Number of Channels | Bandpass Filter (kHz) |
|---|---|
| 24 | 12-108 |
| 60 | 60-300 |
| 120 | 60-552 |
| 300 | 60-1300 |
| 600 | 60-2660 |
| 960 | 60-4028 |
| 1800 | 316-8204 |

If the equipment has a specified number of channels other than those listed in the table, use a straight line interpolation to determine the bandpass filter for the specified number of channels. Photograph the spectrum for 50 percent and 100 percent deviation. Record positive and negative frequency deviations.

(g) Repeat the above procedure for each mode of operation. Perform these measurements at the mean test frequency of each band.

(h) Insert filters (at approximately $f_o$) between the transmitter and the spectrum analyzer that have sufficient rejection to prevent the transmitter fundamental from influencing harmonic measurements. Successively tune the analyzer to the second, third, fourth, and fifth harmonics, and repeat the above procedure.

(i) Harmonic spectrum are taken only at the mean test frequency of the highest band.

(j) The RMS modulating input voltage and the modulation in percent for AM, deviation in kHz for FM, and PEP for SSB will be record for each photograph.

(k) The abscissa of the spectrum photograph will be calibrated in terms of plus or minus kHz relative to the carrier or harmonic. The ordinate will be calibrated in terms of dBm for tone modulation and dBm/kHz for noise modulation.

4. Presentation of measurement results. The measurement results shall be presented in accordance with the format specified in Appendix A.

# METHOD CE108

## CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (NARROW-BANDWIDTH) (Pulsed)

1. Purpose. This method is used to obtain a detailed description of the closed system emission spectrum over the frequency range described below:

(a) For coaxial systems the frequency range covered shall be from the fundamental $f_o$ through the second harmonic or the cutoff frequency of the first higher order mode, whichever is lower, and from $f_o$ down to 0.8 $f_o$.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency or 0.5 $f_o$, whichever is higher. The upper frequency limit shall be either the second harmonic frequency or the cutoff frequency of the first higher order mode, whichever is lower.

2. Measurement setup. The measurement setup shall be presented as specified in Figure 3.

3. Measurement procedures.

(a) Tune the spectrum analyzer to the standard test frequency to which the transmitter is tuned.

(b) Set the analyzer controls to provide a display of $f_o$ with a frequency dispersion of approximately plus or minus 10/T, where T is the nominal transmitter pulse width. The analyzer bandwidth, sweep time and sweep width shall satisfy the following inequality:

$$\frac{2(\text{analyzer bandwidth})^2 \times \text{sweep time}}{\text{sweep width}} > 100$$

(c) Photograph the display and record all significant analyzer control settings.

(d) Calibrate the display using a CW signal. Provide sufficient power calibration points to define the linearity of the analyzer display in both frequency and amplitude.

(e) Determine the difference in sensitivity of the spectrum analyzer to a pulsed input signal of width between 2 and 10 microseconds versus its sensitivity to a CW signal. Record the pulse width and difference in sensitivity. Also determine the difference is sensitivity of the analyzer using a signal input whose pulse width approximates that of the transmitter.

(f) Repeat (a) through (e) for an analyzer frequency dispersion of approximately plus or minus 50/T. Multiple photographs may be necessary to record this information.

(g) Repeat (a) through (e) for maximum analyzer spurious free frequency dispersion if greater than (f).

(h) Tune the spectrum analyzer over the appropriate frequency range and record any emissions detected using the same procedure described in (a) through (e) and using maximum dispersion setting of the analyzer in item (g).

(i) Repeat Steps (a) through (f) for each standard test frequency.

4. Presentation of measurement results. The measurement results shall be presented in accordance with the format specified in Appendix B.

# METHOD CE109

## CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (WIDE-BANDWIDTH) (Non-pulsed)

1. Purpose. This method is used to determine the closed system power versus frequency characteristics of the transmitter over a wide frequency range for a closed system arrangement.

1.1 Frequency range.

(a) For coaxial systems the frequency range shall be at least 14 kHz. to 12 GHz.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit for the collection of emission amplitude and frequency data shall be either 12 GHz or the cutoff frequency of the first higher order mode, whichever is lower. The upper frequency limit for the collection of frequency data only shall be 12 GHz.

1.2 Required modulation. The transmitter will be unmodulated for AM and FM and modulated with two tones at rated PEP for SSB. The tones are identical to those used in the narrow-band conducted emission spectrum test, Method CE107.

1.3 Measurement sensitivity. The measurement system shall have a calibrated CW sensitivity greater than:

(a) Below 300 MHz .......... -90 dBm

(b) 300-1000 MHz .......... -80 dBm

(c) 1-3 GHz .......... -70 dBm

(d) 3-10 GHz .......... -60 dBm

(e) Above 10 GHz .......... -50 dBm

2. Measurement setup. The measurement setup shall be in accordance with Figure 3.

3. Measurement procedure.

(a) Adjust the transmitter to a standard test frequency.

(b) Using appropriate filters to assure the responses that are measured are transmitter emissions and not receiver spurious responses, locate an emission.

(c) If the emission is from a coaxial system; or is from a waveguide system, and is at a frequency that is below the cutoff frequency of the first higher order mode, obtain a convenient reading on the frequency selective voltmeter. Duplicate this reading with a calibrated signal generator to obtain the level of the emission, in dBm. Other methods which provide the same accuracy as the one described herein may be used.

(d) If the emission is from a waveguide system, and is at a frequency that is above the cutoff frequency of the first higher order mode, obtain only the frequency of the emission. This data will be used when conducting Test RE1 - Radiated Emission Spectrum Characteristics.

(e) With maximum measurement sensitivity, continue to tune the Measuring instrument through the entire tuning range until all emissions are detected.

(f) Repeat this procedure at each standard test frequency.

(g) All emissions should be identified in terms of the basic frequency synthesis scheme of the transmitter.

4. Presentation of measurement results. The results shall be presented in accordance with the format specified in Appendix A.

METHOD CE110

CONDUCTED EMISSION SPECTRUM CHARACTERISTICS
(WIDE-BANDWIDTH) (Pulsed)

1. Purpose. This measurement is used to obtain a detailed description of the spectrum surrounding all significant emissions not covered by Method CE108. Data shall be obtained at $f_o$ and at each harmonic of the tuned frequency and at a sufficient number of non-harmonic emissions to comprise a representative sample.

2. Measurement setup. The measurement setup shall be in accordance with Figure 3.

2.1 Frequency range.

(a) For coaxial systems the frequency range covered shall be at $f_o$ and From the second harmonic, 2 $f_o$, up the cutoff frequency of the first higher order mode and from 0.8 $f_o$ down to where the output falls below the minimum sensitivity level as specified in Method CE109.

(b) For waveguide systems the frequency range covered shall be at $f_o$ and from the second harmonic frequency to the cutoff frequency of the first higher order mode or 12 GHz, whichever is lower. If the cutoff frequency of the first higher order mode is less than the second harmonic frequency of the system being evaluated, this test need not be performed.

3. Measurement procedure.

(a) Tune the measuring instrument through the entire tuning range in appropriate increments so that significant changes in emission spectrum level can be observed.

(b) Duplicate each reading with a calibrated signal generator to obtain the equivalent level of the emission, in dBm. Other methods which provide the same accuracy as the one described herein may be used.

(c) Simultaneously monitor the video waveform at the output of the FSV, and photograph the waveform whenever significant changes occur.

(d) A narrow band measurement of a non-harmonic emission shall be made in accordance with Figure 3 whenever the observed pulse shape is similar to that of the fundamental.

3.1 Measurement sensitivity. The measurement system employed shall have a calibrated CW sensitivity in accordance with Method CE109.

4. Presentation of measurement results. The results shall be presented in accordance with the format specified in Appendix B.

# METHOD CE111

## INTERMODULATION (Non-pulsed)

1. Purpose. This test is used to evaluate the intermodulation generating properties of the output of a transmitter. For this test it is assumed that all parameters will be fixed except for the interfering frequency. Intermodulation product frequencies may be generated according to the equation:

$$f_s = nf_o \pm mf_i$$

where:

$f_s$ is the intermodulation frequency generated

$f_o$ is the transmitter frequency

$f_i$ is the interfering frequency

m,n are non-zero integers 1, 2, and so forth.

Intermodulation can occur in any of three equipments: the system transmitter, the interfering transmitter and the test receiver.

1.1 Required modulation. Unmodulated CW shall be used for AM and FM. Two tones, approximately the upper and lower 1 dB point of the modulator bandwidth curve shall be used for SSB. In all cases the interfering transmitter is CW.

2. Measurement setup. The measurement setup shall be in accordance with Figure 4. The test setup shall include filters and attenuators to insure that the intermodulation measured occurs only in the system transmitter.

3. Measurement procedure. The measurements in 3.1 are for the Frequency Selective Voltmeter and 3.2 are for Spectrum Analyzer.

3.1 Frequency selective voltmeter (FSV).

(a) Adjust the interfering transmitter until its power as measured at The system transmitter is 20 dB below the system transmitter power. This "20 dB of coupling" shall be maintained throughout the test.

(b) Adjust the interfering frequency until it is one percent higher than the system transmitter standard test frequency.

(c) Tune the FSV to each of the following intermodulation product frequencies: $2f_o-f_i$, $2f_i-f_o$, $f_i+f_o$, $f_i-f_o$.

(d) At each of the above four frequencies in (3) above, obtain a convenient level on the FSV and substitute a signal from a calibrated signal generator to determine the level of the intermodulation product. Notch filters must be used to reject

$f_o$ and $f_i$ in order to avoid intermodulation within the FSV during this measurement.

(e) To be sure that an intermodulation product is being measured, switch one of the transmitters off. If the FSV reading remains the same, the measured signal is not an intermodulation product and should not be recorded. Repeat for the other transmitter.

(f) Repeat the above procedure with the interfering frequency set to 5 percent, 10 percent, 30 percent, 45 percent, and 90 percent higher and 1 percent, 5 percent, 10 percent, 20 percent, 45 percent and 90 percent lower than the standard test frequency.

(g) Repeat the above steps for coupling values of 40 dB and 60 dB.

NOTE 1

According to the theoretical power relationship, when the interfering power is decreased by an increment of 20 dB (coupling changed from 20 dB to 40 dB to 60 dB), IM products containing $f_i$ in their identification should decrease by 20 dB, and those containing 2 $f_i$ should decrease by 40 dB; in general, those containing $mf_i$ should decrease by 20 m dB. The observed drops will not correspond exactly to the theoretical values, but they should be reasonably close. An observed drop of 35-45 dB in a product identified with $2f_i$ might be assumed to be reasonably close to the theoretical 40 dB; greater deviations should be viewed as an indication that something is wrong.

NOTE 2

These power relationships give a clue as to which products observed for 20 dB of coupling should also be observable for 40 dB and 60 dB of coupling. For example, if the product 2fo-fi is measured to be -10 dBm for 20 dB of coupling, it should be observable for both 40 and 60 dB of coupling with power levels of approximately -30 dBm and -50 dBm respectively. If the level of $f_o$-$2f_i$ is -20 dBm for 20 dB of coupling, it should be -60 dBm and -100 dBm for 40 dB and 60 dB of coupling respectively. The latter may be beyond the measurement sensitivity and unobservable. These power relationships should be continuously monitored during measurements to check the validity of the resulting information.

3.2 Spectrum analyzer.

(a) Adjust the interfering transmitter until its power, as measured At the system transmitter, is 20 dB below the system transmitter power. This “20 dB of coupling” shall be maintained throughout the test. Adjust the interfering frequency 5 percent higher than the standard test frequency.

(b) Tune the spectrum analyzer to the standard test frequency and photograph the results. The sweep width of the analyzer should be wide enough to encompass all intermodulation levels. The fundamental or harmonic being investigated shall be centered at the top of the display.

(c) Tune the spectrum analyzer to each harmonic of the standard test frequency and photograph the results. The search shall be limited to the 10th harmonic.

(d) Tune the spectrum analyzer to $\Delta f$, where $\Delta f = f_i - f_o$ and photograph the results.

(e) Repeat the above procedure (a) through (d) for the spectrum analyzer with the interfering frequency 5 percent below the standard test frequency.

(f) All intermodulation levels shall be calibrated with a CW signal generator.

3.3 Mean test frequency. When more than one band exists, perform these tests on the mean standard test frequency of each band. Perform all measurements at the mean test frequency of one band before changing to the mean test frequency of another band.

3.4 Level of intermodulation. The level of each intermodulation product as it appears at the system transmitter output, should be stated in dBm. In addition to the intermodulation product level, the corresponding frequency and identification should be listed in accordance with paragraph 4 below.

4. Presentation of measurement results. The data shall be presented in accordance with the format specified in Appendix A.

## METHOD CE112

### CONDUCTED AMPLITUDE VERSUS TIME CHARACTERISTICS (Pulsed)

1. Purpose. This method is used to recover closed-system information on the amplitude versus time characteristics of the fundamental transmitter output, using a broadband detector operating in its linear range.

2. Measurement setup. The measurement setup shall be in accordance with Figure 6.

3. Measurement procedure. A broadband crystal detection system shall be used for this test. The following precautions shall be observed when performing this measurement.

(a) The characteristic impedance of all interconnecting cables should match the impedance of the devices being connected.

(b) The oscilloscope input should be terminated to match the detector output and interconnecting cable impedance.

(c) The bandwidth requirement for both the crystal detection system and the oscilloscope shall be in accordance with 5.1.3.3.3

4. Presentation of measurement results. The measurement results shall be presented in the format as specified in Appendix B. One photograph showing the entire pulse should be taken at each test frequency. The delay and expanded sweep features of the scope should be utilized to provide additional detailed photographic information of the pulse leading and trailing edges.

# METHOD RE101

## RADIATED EMISSION SPECTRUM CHARACTERISTICS (Non-pulsed)

1. Purpose. The purpose of this measurement is to obtain a detailed description of transmitter emissions over a wide frequency range for the open field configuration.

2. Measurement setup. The test procedure shall be setup as shown in Figure 5.

3. Measurement considerations.

3.1 Prior to performing the required measurements, the antenna and transmitter shall be separated, modulated, positioned, and of the frequency indicated herein.

3.1.1 Antenna separations. The separation between the transmitter antenna and the test antenna shall be at least the far field distance (see 3.7), unless otherwise indicated and justified on the form specified in Appendix A.

3.1.2 Modulation. The transmitter will be unmodulated for AM and FM and modulated with two tones at rated PEP for SSB. The tones are identical to those used in the narrow-band conducted emission spectrum test, Method CS107.

3.1.3 Frequency range.

(a) For coaxial systems the frequency range shall normally be from 14 kHz to 12 GHz.

(b) For waveguide systems the frequency range shall normally be from 0.9 of the waveguide cutoff frequency to 12 GHz.

Upon approval of the contracting officer's technical representative or other designated technical authority, the frequency limits can be established as the frequency at which multiple-mode propagation within the system can exist.

3.1.4 Antenna positioning procedure. The following sequence shall be used for the orientation of the system and test antennas.

(a) Where azimuth and elevation of the system antenna can be varied, this shall be done to produce the maximum signal at each measurement frequency at the test antenna. The azimuth ($\theta$) and elevation ($\phi$) angles between the antenna boresight axis of the system and the test antenna shall be recorded after the signal is maximized.

(b) The test antenna shall be adjusted in height at each measurement frequency to obtain a maximum of received energy. Where possible, the adjustment should be made over a distance calculated to include two nulls in the elevation interference pattern resulting from ground reflection.

(c) All position information shall be recorded together with the test results on the form specified in appendix A.

4. Measurement procedure.

(a) If the transmitter is designed to operate into more than one type of antenna, the antenna with which the transmitter is most frequently used will be connected to the transmitter for this test. The transmitter antenna should be mounted in its normally used configuration (for example, jeep-mounted men-pack mounted, and so forth).

(b) Tune the transmitter to a standard test frequency.

(c) Search the entire frequency range with a frequency selective Voltmeter and test antenna or antennas and record all detected emissions, in dBm and converted to dBm/m$^2$. In particular, note the frequency-only data collected under the Wide-Band section of Test CE5 - Conducted Emission Spectrum Characteristics, and pay particular attention to the possibility of emissions at these frequencies.

(d) Perform these measurements at each standard test frequency with the test antenna first horizontally and then vertically polarized.

(e) Record all of the geometry associated with the system and test antenna (heights, separation distance, elevation and azimuth).

(f) Record the physical length and type of cable which connects the transmitter to the system antenna.

(g) All emissions should be identified in terms of the basic local oscillator scheme on the transmitter.

4.1 Measurement sensitivity. The measurement system employed shall have a calibrated CW sensitivity greater than:

(a) Below 300 MHz ............. -90 dBm/m$^2$

(b) 300-1000 MHz .............. -80 dBm/m$^2$

(c) 1-3 GHz ................... -70 dBm/m$^2$

(d) 3-10 GHz .................. -60 dBm/m$^2$

(e) Above 10 GHz .............. -50 dBm/m$^2$

4.2 Required modulation. All tests with the exception of test CE105 shall be performed under conditions of minimum and maximum duty cycle at each standard test frequency. These same tests shall also be performed at the mean standard test frequency using the mean pulse width and repetition rate of the system under test, unless otherwise specified.

5. Presentation of measurement results. The measurement results shall be presented as specified in Appendix A.

METHOD RE102

RADIATED EMISSION SPECTRUM CHARACTERISTICS (Pulsed)

1. Purpose. This method is used to obtain a detailed description of pulse transmitter emission characteristics for the open field configuration. Data shall be obtained at $f_o$ and each harmonic of the tuned frequency and at a sufficient number of non-harmonic emissions to comprise a representative sample.

2. Measurement setup. The measurement setup shall be in accordance with Figure 5. The separation between the transmitter antenna and the test antenna shall be at least the far-field distance (see 3.7), unless otherwise indicated and justified.

2.1 Frequency range.

(a) For coaxial systems the frequency range shall normally be from 14 kHz to 12 GHz.

(b) For waveguide systems the frequency range shall normally be from 0.9 of the waveguide cutoff frequency to 12 GHz.

Upon approval of the contracting officer's technical representative or other designated technical authority, the lower frequency limit can be established as the frequency at which multiple-mode propagation within the system can exist.

2.2 Antenna positioning procedure. The following sequence shall be used for the orientation of the system and test antennas:

(a) Where azimuth and elevation of the system antenna can be varied, this shall be done to produce the maximum signal at each measurement frequency at the test antenna. The azimuth ($\theta$) and elevation ($\phi$) angles between the antenna boresight axis of the system and the test antenna shall be recorded after the signal is maximized.

(b) The test antenna shall be adjusted in height at each measurement frequency to obtain a maximum of received energy. When possible, the adjustment should be made over a distance calculated to include two nulls in the elevation interference pattern resulting from ground reflection.

(c) All position information shall be recorded together with the test results.

3. Measurement procedure.

(a) If the transmitter is designed to operate into more than one type of antenna, the antenna with which the transmitter is most frequently used will be connected to the transmitter for this test. The transmitter antenna should be mounted in its normally used configuration (for example jeep-mounted, man-pack mounted, and so forth).

(b) Turns the transmitter to a standard test frequency.

(c) Search the frequency range with the frequency selective voltmeter and test antenna of antennas and record all detected emissions, in $dBm/m^2$.

(d) A narrow-band measurement of a non-harmonic emission shall be wide whenever the output exceeds 20 dB above the noise level of the measurement system.

(e) Perform these measurements at each standard test frequency with the test antenna first horizontally and then vertically polarized.

(f) Record all of the geometry associated with the system and test antenna (heights, separation distance, elevation and azimuth).

(g) Record the physical length and type of cable which connects the transmitter to the system antenna.

3.1 Measurement sensitivity. The measurement system employed shall have a calibrated CW sensitivity greater than:

(a) Below 300 MHz ......... -90 $dBm/m^2$

(b) 300-1000 MHz ......... -80 $dBm/m^2$

(c) 1-3 GHz ......... -70 $dBm/m^2$

(d) 3-10 GHz ......... -60 $dBm/m^2$

(e) Above 10 GHz ......... -50 $dBm/m^2$

4. Presentation of measurement results. The measurement results shall be presented in accordance with the format of Appendix B.

# METHOD CS101

## SENSITIVITY (Non-pulsed)

1. Purpose. This method is used to determine equipment sensitivity to the desired RF signals.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 7.

3. Measurement considerations. The power level in dBm necessary to cause a standard response should be recorded. This is the level delivered to the receiver antenna terminals. The sensitivity test data of the receiver should also be recorded.

4. Measurement procedures.

(a) Thirty percent modulation shall be used for AM. CW input and 30 percent deviation shall be used for FM. CW input shall be used for SSB and receivers with a BFO. If the test receiver is designed to operate with a particular audio frequency or waveform, the modulation shall be that particular type signal.

(b) Tune the receiver to a standard test frequency. Insert a desired signal frequency and vary the modulation frequency for AM and FM, or vary the RF frequency for SSB, or vary the BFO control (for CW operation with a BFO) to obtain a maximum audio output (maximum (S+N)/N). If the BFO is fixed, vary the RF input frequency. This modulating frequency (AM, FM) or RF signal (SSB) or BFO frequency (receivers with BFO) will henceforth be designated as the Reference Frequency for this and many of the other receiver tests.

(c) Using the required modulation at the Reference Frequency, vary the RF input level until a minimum level signal produces a standard response.

(d) Additionally for FM systems, insert an unmodulated signal and vary the input level and frequency until a minimum signal level produces 20 dB of quieting at the receiver audio output.

(e) Record the input signal levels and modulation characteristics used. Also record the audio output frequency for the case when the BFO is used.

(f) Repeat the measurements at each standard test frequency of each band, and for each modulation type.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

# METHOD CS102

## SENSITIVITY (Pulsed)

1. Purpose. This method is used to determine equipment sensitivity to the desired RF signals.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 7.

3. Required modulation. If the test sample is designed to operate with a particular pulse width, pulse repetition rate, or other unique modulation, the test modulation shall be that particular type signal, unless otherwise indicated. If ranges of particular modulation parameters are selectable (such as a choice of pulse widths from 1 to 10 microseconds), choices of parameter values should be made that correspond to the maximum and minimum Sensitivity limits of the receiver.

4. Measurement procedure.

(a) Tune the receiver to the standard test frequency.

(b) Inject the desired signal.

(c) Decrease the desired signal input level until the standard response is obtained at the receiver output.

(d) Record the minimum level signal that produces a standard response.

(e) Repeat the measurements at each standard test frequency of each band, and for each choice of modulation.

5. Presentation of measurement results. The power level in dBm necessary to cause a standard response should be recorded. This is the level delivered to the receiver antenna terminals, and the data should be presented in the format specified in Appendix D.

# METHOD CS103

## DYNAMIC RANGE (Non-pulsed)

1. Purpose. This method is used to give an indication of the receiver behavior between levels less than its standard response level and its limiting level. This test measures the effectiveness of the AGC or AVC system if one exists, and describes the receiver linearity over this range.

2. Measurement setup. The measurement setup shall be as shown in Figure 7.

3. Measurement procedures. Receivers should be measured as specified herein. Thirty percent modulation shall be used for AM. CW input and 30 percent deviation shall be used for FM. CW input shall be used for SSB and for AM receivers with BFO.

3.1 AM, SSB, and CW receivers.

(a) Perform the receiver sensitivity test. Record the (S+N)/N and RMS output voltage. Starting at S=O vary the input signal level and record enough points to describe the output (S+N)/N of the receiver as a function of input signal level. Include at least 6 dB steps of input signal level up to the point where the output (S+N)/N does not change with a further increase of input signal.

(b) The AGC or AVC shall be on during the test.

(c) The receiver RF gain control shall be optimized at each input level setting to produce a maximum (S+N)/N.

3.2 FM receivers.

(a) Perform the receiver sensitivity test METHOD CS101 with zero percent deviation (unmodulated). Vary the input signal level and record the correct number of points to describe the dB of quieting of the receiver as a function of input level. Include at least the 1, 3, 6, 12 and 20 dB points, and a point 3 dB below the maximum quieting of the receiver.

(b) Adjust the input to produce 3 dB of quieting and set the deviation to 30 percent. Record the RMS output voltage and (S+N)/N. Repeat for the RF input set to produce 6 dB, 12 dB, and 20 dB quieting, 3 dB below maximum quieting, and maximum quieting.

(c) Repeat with the deviation adjusted for 60 percent, 90 percent, 120 percent, and maximum. Maximum deviation occurs when limiting or clipping of the audio signal becomes noticeable on an oscilloscope.

(d) It is important to adjust the RF frequency slightly, especially At high power levels, to maintain maximum (S+N) /N

(e) Repeat these tests at the mean test frequency of each band for each receiver audio output.

3.3 Test equipment malfunction. If maximum (S+N)/N obtained in these measurements is less than 20 dB, a malfunction in either the test equipment or receiver under test should normally be suspect. The remaining measurements should not be performed until at least a 20 dB (S+N)/N is obtained from the receiver, unless the performance of the system can be otherwise justified.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

# METHOD CS104

## DYNAMIC RANGE (Pulsed)

1. Purpose. This test is to give an indication of the receiver behavior between its standard response level and its limiting level. It measures the effectiveness of the AGC or AVC system if one exists, and describes the receiver linearity over this range.

2. Measurement setup. The measurement shall be as shown in Figure 7.

3. Require modulation. The test sample is designed to operate with a particular pulse width, pulse repetition rate, or other unique modulation, and the test modulation shall be that particular type signal, unless otherwise indicated. If ranges of particular modulation parameters are selectable (such) as a choice of pulse widths from 1 to 10 microseconds), choices of parameter values should be made that correspond to the maximum and minimum Sensitivity limits of the receiver.

4. Measurement procedure.

(a) Perform the sensitivity test. Record the peak output voltage. Vary the input signal level and record enough points to describe the peak signal level of the receiver as a function of peak input signal level. Include at least 6 dB steps of input signal level up to the point where the peak output voltage does not change with a further increase of input signal.

(b) The AGC or AVC shall be on during the test.

(c) The receivers RF gain control shall be adjusted at each input level setting to produce a maximum signal output.

(d) Repeat these tests at the mean test frequency of each band, and for each choice of modulation.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix D. If a video limiter is a normal part of the equipment configuration, data should be taken at both the output of the detector (input to the limiter) and the output of the video limiter.

# METHOD CS105

## AUDIO SELECTIVITY (Non-pulsed)

1. Purpose. This method is used to measure the receiver audio bandwidth and shows the manner in which the receiver output depends upon the modulation of the input signal. The test is not applied to SSB and CW receivers with fixed BFOs (Beat-Frequency Oscillators).

2. Measurement setup. The test apparatus shall be setup as shown in Figure 7 and Figure 8.

3. Measurement procedures. Receivers shall be measured in accordance with the procedure covered herein. For AM and FM, the RF signal generator is externally modulated with the reference frequency of Method CS101 at 30 percent modulation or deviation. For CW receivers, the RF signal is unmodulated.

3.1 Procedure 1.

(a) By referring to the test data under Method CS102, adjust the RF signal generator to a level which corresponds to a value near the maximum (S+N)/N ratio.

(b) Maintain the RF signal generator output level constant, and vary the modulating frequency in discrete steps above and below the reference frequency (for CW receivers the BFO is varied about its zero best frequency). Record the receiver output in rms volts, the (S+N)/N, and the modulation frequency or audio output frequency for CW receivers in Hertz. Obtain enough information to plot a smooth curve to at least the 20 dB points.

(c) Perform this test at the mean test frequency of each band for each audio output.

3.2 Procedure 2 (alternative procedure). This test is to be performed using a audio signal generator coupled to the output of the receiver discriminator or final detector (see the measurement setup of Figure 7 and Figure 8. Tune the signal generator to the audio frequency that provides maximum output, and then adjust the generator level for approximately 20 dB (S+N)/N. Vary the generator frequency above and below this reference frequency, and record the same information specified in Procedure 1 (b) above. Repeat the test for a generator level that provides an output that is close to the maximum (S+N)/N that can be obtained.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

# METHOD CS106

## SELECTIVITY (Non-pulsed)

1. Purpose. This test gives an indication of the overall gain and sensitivity at the receiver center tuned frequency, as well as the response at frequencies slightly removed from the tuned frequency. This response for the most part is determined by the IF amplifier tuned circuits and should be fairly symmetrical about the center frequency. The selectivity is a measure of the receiver ability to discriminate against off-channel radiations, and in reality is a measure of the receiver bandpass characteristics.

2. Measurement setup. The measurement setup shall be as shown in Figure 7.

3. Measurement considerations.

(a) The overall selectivity of the receiver should vary very little with receiver tuned frequency because this selectivity is mainly provided by fixed-tuned stages. This may not be true for some VLF or LF sets, where the RF selectivity is narrower than the IF selectivity.

(b) If the receiver is provided with a manual selectivity control, the selectivity should be measured if the position of maximum and minimum bandwidth and for the intermediate position of the control, if practicable.

(c) The selectivity is adequately defined by a few measurements, for example, the -3, -6, -10, -20, -40 and -60 dB response frequencies. Where possible the measurement shall be extended beyond the -60 dB response frequencies in steps of 10 dB down to the -100 dB level.

4. Measurement procedures.

(a) The modulation used for the selectivity test will be 30 percent for AM receivers and CW for FM, SSB and CW receivers. The AM modulating frequency shall be in accordance with the Reference Frequency in the Sensitivity Test, Method CS101.

(b) Perform the receiver sensitivity test.

(c) Increase the RF signal generator output 3 dB and tune the generator below the receiver tuned frequency until a standard response is re-established at the receiver audio output. Record the change in signal generator frequency ($-\Delta f$).

(d) Tune the RF signal generator to the frequency above the receiver tuned frequency at which the output again drops to the standard response. Record the signal generator frequency difference ($+\Delta f$).

(e) Repeat the above steps for at least the 6, 10, 20, 40 and 60 dB points and, if possible, the 70, 80, 90 and 100 dB points. Additional measurements should be made if the levels measured do not determine the behavior of the curve.

(f) Measurements will be performed at the mean standard test frequency of each tuning band. If the receiver has multiple outputs, the measurements will be made on the output having the widest audio bandwidth, except that for a receiver designed for SSB, the measurement will be performed at each audio output.

5. Presentation of measurement results. The results shall be presented as specified in Appendix C.

METHOD CS107

SELECTIVITY (Pulsed)

1. Purpose. This test gives an indication of the overall gain and sensitivity at the receiver center tuned frequency to CW signals, as well as the CW response at frequencies slightly removed from the tuned frequency. The selectivity is a measure of the receiver ability to discriminate against off-channel radiations, and in reality is a measure of the receiver bandpass characteristics. From this CW information, it is possible to deduce the system pulse response to any pulse width.

2. Measurement setup. The measurement setup shall be as shown in Figure 7.

3. Measurement considerations. To obtain a selectivity curve of a pulsed system indicative of its CW selectivity, a pulsed signal sufficiently wide to provide a narrow energy spectrum in comparison with the receiver bandwidth but narrow enough to avoid erroneous bias build-up in the receiver gain control circuits shall be used. The pulse width is such that an increase or decrease in width by a factor of two will not appreciably change the receiver selectivity measurement. A rule of thumb for preliminary testing might be a pulse width of ten times the nominal system pulse width. The criteria for standard response will be the mid-pulse minimum visible signal (MPMVS). The pulse repetition rate used for this test shall be the nominal rate at which the receiver is designed to accept.

4. Measurement procedure.

(a) Perform the receiver sensitivity test.

(b) Increase the RF signal generator output 3 dB and tune the generator below the tuned frequency until a standard response is re-established at the receiver audio or video output. Record the change in the signal generator frequency ($-\Delta f$).

(c) Tune the RF signal generator to the frequency above the receiver tuned frequency at which the output again drops to the standard response. Record the signal generator frequency difference ($+\Delta f$).

(d) Repeat the above steps for at least the 6, 10, 20, 40 and 60 dB points and, if possible the 70, 80, 90, and 100 dB points. Additional data should be obtained if necessary to define the behavior of the curve.

(e) The measurement will be performed at the mean test frequency of each tuning band.

5. Presentation of measurement setup. The results shall be presented as specified in Appendix D.

METHOD CS108

CONDUCTED SPURIOUS RESPONSE (Non-pulsed)

1. Purpose. This method is used to identify the significant closed-system spurious response of a receiver.

2. Measurement setup. The test apparatus setup shall be as shown in Figure 7. Sufficient filtering shall be used to prevent unwanted signal generator outputs, including harmonics, from entering the receiver. For tests on CW receivers, set the BFO to the Reference Frequency position established by the Sensitivity Test, Method CS101.

3. Measurement considerations.

3.1 Spurious responses. Spurious responses occur when a receiver, due to its circuitry and construction, reacts to off-frequency signals. Spurious responses are often functions of internal frequencies inherent within the receiver combining with an external signal in such a manner as to cause a response. As such they constitute families of responses, varying with the frequency to which the receiver is tuned. Examples of these spurious responses, $f_{sp}$, include those signals which can be identified by the following relationships.

For a single conversion receiver:

$$f_{sp} = \frac{pf_{LO} \pm f_{IF}}{q}$$

For a dual-conversion receiver:

$$f_{sp} = \frac{p_1 f_{LO_1}}{q_1} \pm \frac{p_2 f_{LO_2} \pm f_{IF_2}}{q_1 q_2}$$

For a triple conversion receiver:

$$f_{sp} = \frac{p_1 f_{LO_1}}{q_1} \pm \frac{p_2 f_{LO_2}}{q_1 q_2} \pm \frac{p_3 f_{LO_3} \pm f_{IF_3}}{q_1 q_2 q_3}$$

where p is an integer denoting the harmonic of the local oscillator; q is an integer (not zero) denoting the harmonic of the mixer input signal; $f_{LO}$ and $f_{IF}$ are the local oscillator and intermediate frequencies respectively, the subscripts indicate the number of conversions preceding the section of the receiver of concern, and the positive and negative signs identify different spurious responses. Some responses may not be describable by the above relationships. Energy from any oscillator may mix with, other oscillators and the spurious signal in any mixer or non-linear element. If large p and q values are needed to identify responses the identification may be erroneous and one should look to the oscillator leakage phenomenon as a means of identifying the response.

3.2 Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, whichever is less. An exception to the low frequency limit indicated above shall be a requirement to test at all receiver IF frequencies.

4. Measurement procedures.

(a) Tune the receiver to the standard test frequency.

(b) Starting at the low end of the frequency range, slowly tune the signal generator across the range. Maintain the level of the generator at either +20 dBm, or at the maximum input level that will not cause front-end burnout or other damage to the receiver, whichever is less. However, when scanning within approximately three 3 dB bandwidths of the receiver tuned frequency, the generator level may be reduced to 0 dBm. When a spurious response is located, adjust the signal generator level to obtain a standard response, and record the signal generator level and frequency. For SSB, CW, and BFO receivers obtain a zero-beat at the audio output to help establish the frequency of the spurious response.

(c) Cases have been encountered where higher level inputs a particular spurious response can produce a lower receiver output (S+N)/N than a lower input level. When a spurious response is encountered that is below the receiver standard response level, the signal generator level should be reduced to see if a standard response can be obtained.

(d) When a spurious response is located whose level is the result of an input power less than -20 dBm, a spurious response dynamic range measurement shall be performed by increasing the spurious level in discrete steps and recording the receiver output(S+N)/N ratio or quieting. At least five spurious levels should be used to describe a smooth curve. The dynamic range test will be limited to five of the most sensitive spurious responses recorded. Attempts should be made to select these five responses where $q \neq 1$.

(e) Record the signal level and frequency for every spurious response, and the (S+N)/N or quieting levels for those responses whose dynamic ranges are measured.

(f) The measurements will be performed at the three standard test frequencies of each band. If the receiver has multiple audio outputs, the measurements will be made at the output having the narrowest audio bandwidth.

(g) When higher order mode (HOM) effects are suspected the reported power levels should be suffixed by the letters (HOM) to draw attention to the questionable method used to obtain conducted power levels under multiple mode conditions.

4.1 Required modulation. The modulation used for AM receivers shall be 30 percent, at the Reference Frequency in accordance with the Selectivity Test, Method CS104. An unmodulated signal shall be used for FM, SSB and CW receivers.

5. Presentation of measurement results. The results shall be presented as specified in Appendix C.

METHOD CS109

CONDUCTED SPURIOUS RESPONSE (Pulsed)

1. Purpose. This test is used to identify the significant closed-system spurious responses of a receiver.

2. Measurement setup. The test setup shall be as shown in Figure 7. Sufficient filtering shall be used to prevent unwanted signal generator outputs, especially harmonics, from entering the receiver.

3. Measurement considerations.

3.1 Spurious response. Spurious responses occur when a receiver, due to its circuitry and construction reacts to off-frequency signals. Spurious responses are often functions of internal frequencies inherent within the receiver, combining with an external signal in such a manner as to cause a response. As such, they constitute families of responses, varying with the frequency to which the receiver is tuned. Examples of these spurious responses, $f_{sp}$, include those signals which can be identified by the following relationships:

For a single conversion receiver:

$$f_{sp} = \frac{pf_{LO} \pm f_{IF}}{q}$$

For a dual-conversion receiver:

$$f_{sp} = \frac{p_1 f_{LO_1}}{q_1} \pm \frac{p_2 f_{LO_2} \pm f_{IF_2}}{q_1 q_2}$$

For a triple conversion receiver:

$$f_{sp} = \frac{p_1 f_{LO_1}}{q_1} \pm \frac{p_2 f_{LO_2}}{q_1 q_2} \pm \frac{p_3 f_{LO_3} \pm f_{IF_3}}{q_1 q_2 q_3}$$

Where p is an integer or zero denoting the harmonic order of the local oscillator; q is an integer (not zero) denoting the harmonic order of the mixer input signal; $f_{LO}$ and $f_{IF}$ denote the local oscillator and intermediate frequency, respectively; the subscripts indicate the number of conversions preceding the section of the receiver of concern, and the positive and negative signs identify different spurious responses.

3.2 Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, or the cutoff frequency of the first higher order mode, whichever is less. An exception to the lower frequency limit indicated above shall be a requirement to test at all receiver IF frequencies.

4. Measurement procedures.

(a) Tune the receiver to the standard test frequency.

(b) Starting at the low end of the frequency range, slowly tune the signal generator across the range. Initially set the level of the generator at either +20 dBm, or at the maximum input level that will not cause front-end burnout, or other damage to the receiver, whichever is less. However, when a scanning within approximately three (3) dB bandwidths of the receiver tuned frequency, the generator level may be reduced to 0 dBm. When a spurious response is located adjust the signal generator level to obtain a standard response, and record the peak signal generator level and frequency.

(c) When a spurious response is located whose level is the result of and input power less than -20 dBm, a spurious response dynamic range measurement shall be performed by increasing the spurious level in discrete steps and recording the receiver peak output voltage. At least 5 spurious levels should be used to describe a smooth curve. The dynamic range test will be limited to 5 of the most sensitive spurious responses.

(d) Record the signal level and frequency for every spurious response, and the peak output voltage for those responses whose dynamic ranges are measured.

(e) Under conditions of high level pulse input signal injection, an overloading of the receiver may occur such that high order spurious responses are indicated. This phenomenon may become apparent at signal levels of the order of -20 dBm to -10 dBm or higher for typical receivers. One method of determining this level may be to disable the first local oscillator and, with the first mixer biased at its normal operating level, to determine that level of input signal where the phenomenon becomes apparent. The higher order responses encountered may also be characterized by a sharp increase in the required value of “q” used to identify the responses by the appropriate spurious response equation. Record the input signal level at which this condition occurs. Under these circumstances, identification of measurements in accordance with p and q values and sign using the spurious response equations is waived. However, the requirement to collect data in accordance with this section of the specification still exists.

(f) The measurements will be performed at the three standard test frequencies of each band.

4.1 Required modulation. The signal generator shall be modulated with a pulse of the same width and repetition rate as the system pulse. Where modulation parameters are selectable, a nominal set of such parameters shall be used.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix D. The recorded data shall show the tuned frequency, the measured or calculated local oscillator frequencies, the spurious frequencies, the input signal level, the output signal level, and the p and q values and signs associated with each response.

METHOD CS110

INTERMODULATION (Non-pulsed)

1. Purpose. This method is used to determine the intermodulation characteristics of receivers that the result from the mixing of two or more undesired frequencies in the non-linear elements of the receiver. This mixing may result in the generation of a third signal at the receiver tuned frequency which is of sufficient amplitude to be detected as a potential interfering signal.

2. Measurement setup. The measurement setup shall be as specified in Figure 10. The use of appropriate filters will prevent unwanted signal generator outputs from creating undesired responses or intermodulation products.

3. Measurement considerations. The general form of the mathematical relationship required to produce such a response is:

$$f_o = mf_a \pm nf_b$$

$f_o$ is the tuned frequency of the receiver.
$f_a$ is the frequency of the interfering source nearest $f_o$, $\Delta f = (f_a - f_o)$.
m is an integer giving the multiple of $f_a$ involved.
$f_b$ is the frequency of another interfering source.
n is an integer giving the multiple of $f_b$ involved.

and the choice of the positive or negative sign identifies a different intermodulation response.

Another potential source of intermodulation is described by the following mathematical relationship:

$$f_{IF} = mf_a \pm nf_b$$

$f_{IF}$ is the receiver IF frequency.
$f_a$, m, $f_b$, n, and choice of positive or negative sign are as described above.

3.4 Frequency range. The measurements to be performed under this test shall be confined to second order positive and negative, and third, fifth and seventh order negative for the tuned frequency response, and second order negative for the IF response (order = m+n). Frequency limits for the measurements shall be as follows, where $\Delta f = f_a - f_o$.

(a) For coaxial systems, when $\Delta f$ is negative, the tests shall require both $f_a$ and $f_b$ > 14 KHz, and $f_a > 0.5 f_o$. When $\Delta f$ is positive, the tests shall require both $f_a$ and $f_b$ < 12 GHz, and $f_a < 10 f_o$.

(b) For waveguide systems, when $\Delta f$ is negative, the tests shall be further constrained such that both $f_a$ and $f_b$ are greater than 0.9 of the waveguide cutoff frequency. When $\Delta f$ is positive, the tests shall be further constrained such that both $f_a$ and $f_b$ are below the cutoff frequency of the first higher order mode.

(c) The intermodulation orders to be measured are:

| | | |
|---|---|---|
| Second order | $f_{IF} = f_b - f_a$ | $f_b > f_o > f_a$ |
| | $f_{IF} = f_a - f_b$ | $f_a > f_o > f_b$ |
| | $f_o = f_a + f_b$ | $f_o > f_a > f_b$ |
| | $f_o = f_b - f_a$ | $f_b > f_o > f_a$ |
| | $f_o = f_a - f_b$ | $f_a > f_o > f_b$ |
| | $f_o = f_b - f_a$ | $f_b > f_a > f_o$ |
| Third order | $f_o = 2f_a - f_b$, | $f_b > f_a > f_o$ |
| | $f_o = 2f_a - f_b$, | $f_o > f_a > f_b$ |
| Fifth order | $f_o = 3f_a - 2f_b$, | $f_b > f_a > f_o$ |
| | $f_o = 3f_a - 2f_b$, | $f_o > f_a > f_b$ |
| Seventh order | $f_o = 4f_a - 3f_b$, | $f_b > f_a > f_o$ |
| | $f_o = 4f_a - 3f_b$, | $f_o > f_a > f_b$ |

4. <u>Measurement procedures</u>.

(a) Tune the receiver to the standard test frequency.

(b) Adjust both signal generators to provide +20 dBm outputs, or to provide the maximum equal outputs that will not cause front-end burnout or other damage to the receiver, whichever is less. Note that the burnout or damage level may be a function of frequency, so that greater input signal levels could be used as $\Delta f$ is increased.

(c) Set the generator frequencies to obtain the desired intermodulation product with a small value of $\Delta f$. A small value of $\Delta f$ might be a value somewhat greater than one-half of the receiver 60 dB bandwidth.

(d) Maintain the equal signal generator levels established in (b) above, and vary the generator frequencies to retain the desired intermodulation product. The variation in frequencies shall be in a direction to increase $\Delta f$, and shall proceed until a standard response is reached, or until the frequency limit of 3.1 above is reached. When a standard response is obtained, record the equal interfering powers, frequencies and $\Delta f$ required to produce the standard response. (Note: If the frequency limit of 3.1 above is reached before the standard response is obtained, adjust the signal generator levels to obtain the standard response at the frequency limit.)

(e) Divide the $\Delta f$ by two, and again adjust the signal generator frequencies to obtain the desired intermodulation product. Adjust the equal levels to produce the standard response and record the data.

(f) Divide the Δf of (e) above by two and adjust the frequencies to produce a standard response.

(g) Continue the process of dividing Δf by two until $f_a$ falls inside the measured 60 dB receiver bandwidth.

(h) At each Δf, vary each generator frequency slightly to avoid spurious response frequencies, if necessary.

(i) For the IF response test, examine the two cases where $f_a = f_o$ and $f_b = f_o \pm f_{IF}$.

(j) To verify that each product is a receiver intermodulation product and not a signal generator spurious emission, signal generator intermodulation product, or a receiver spurious response, the following procedure should be followed:

(1) Alternately, turn off each signal generator (or greatly attenuate its output). If the receiver response remains when one generator is off, it is not an intermodulation product. If the response disappears, it may be either signal generator intermodulation or receiver intermodulation.

(2) After determining the levels for a standard response, increase the attenuation on the attenuator just ahead of the receiver by 3 dB. Receiver intermodulation products will vary non-linearly with the amount of inserted attenuation, while signal generator intermodulation products should vary by the amount of attenuation. Thus, if the receiver output level drops only 3 dB when 3 dB of attenuation is added, the response is not due to receiver intermodulation.

(3) Next, increase the signal generator output levels simultaneously by 3 dB. Note that with the signal generator levels increased by 3 dB and the step attenuator increased by 3 dB, a standard receiver response should exist for true receiver intermodulation products.

4.1 Required modulation. The frequency $f_a$ is unmodulated. The frequency $f_b$ is modulated 30 percent for AM receivers, using the Reference Frequency in accordance with the Selectivity Test, Method CS104. An unmodulated signal is to be used for FM, SSB and CW receivers.

4.2 Standard test frequencies. These tests will be performed at the three standard test frequencies of each band for second order and at the mid frequencies of each band for third, fifth and seventh orders. If the receiver has multiple audio outputs, the measurements will be made at the output having the narrowest audio bandwidth.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

METHOD CS111

INTERMODULATION (Pulsed)

1. Purpose. This method is used to determine the intermodulation characteristics of receivers that result from the mixing of two or more undesired frequencies in the non-linear elements of the receiver. This mixing may result in the generation of a third signal at the receiver tuned frequency which is of sufficient amplitude to be detected as a potential interfering signal. Paragraph 4 (a) of this method is used to determine the intermodulation characteristics of phased array antennas resulting from element interactions within the antenna.

2. Measurement setup. The measurement setup shall be as specified in Figure 10. The use of appropriate filters will prevent unwanted signal generator outputs from creating undesired responses or intermodulation products. 3. Measurement considerations. The general form of the mathematical relationship required to produce such a response is:

$$f_o = mf_a \pm nf_b$$

$f_o$ is the tuned frequency of the receiver.
$f_a$ is the frequency of the interfering source nearest $f_o$.
m is an integer giving the multiple of $f_a$ involved.
$f_b$ is the frequency of another interfering source.
n is an integer giving the multiple of $f_b$ involved.

the choice of the positive or negative sign identifies a different intermodulation response.

Another potential source of intermodulation is described by the following mathematical relationship:

$$f_{IF} = mf_a \pm nf_b$$

$f_{IF}$ is the receiver IF frequency.
$f_a$, m, $f_b$, n, and choice of positive or negative sign are as described above.

3.1 Frequency range. The measurements to be performed under this test shall be confined to second order positive and negative, and third order negative for the tuned frequency response, and second order negative for the IF response (order = m+n). At least the first two IF responses will be tested; for example, for a dual conversion receiver, two IF second order difference tests are required. Frequency limits for the measurements shall be as follows, where $\Delta f = |f_a - f_o|$.

(a) For coaxial systems, where $\Delta f$ is negative, the tests shall require both $f_a$ and $f_b$ > 14 kHz, and $f_a > 0.5\ f_o$. When $\Delta f$ is positive, the tests shall require both $f_a$ and $f_b$ < 12 GHz, and $f_a < 10\ f_o$.

(b) For waveguide systems, when $\Delta f$ is negative, the tests shall be further constrained such that both $f_a$ and $f_b$ are greater than

0.9 of the waveguide cutoff frequency. When $\Delta f$ is positive, the tests shall be further constrained such that both $f_a$ and $f_b$ are below the cutoff frequency of the first higher order mode.

4. Measurement procedure. These tests will be performed at the three standard test frequencies of each band for each intermodulation case specified in 3.1.

(a) Tune the receiver to the standard test frequency.

(b) Adjust both signal generators to provide +20 dBm outputs, or to provide the maximum equal outputs that will not cause front-end burnout or other damage to the receiver, whichever is less Note that the burnout or damage level may be a function of frequency, or that greater input signal levels could be used as $\Delta f$ is increased. In the case of the pulsed generator, the +20 dBm output(or any other power less than this value) shall be the power during the pulse interval.

(c) Set the generator frequencies to obtain the desired Intermodulation product with a small value of $\Delta f$. A small value of $\Delta f$ might be a value somewhat greater than one-half of the receiver 60 dB bandwidth.

(d) Maintain the equal signal generator levels established in (b) above, and vary the generator frequencies to retain the desired intermodulation product. The variation in frequencies shall be in a direction to increase $\Delta f$, and shall proceed until a standard response is reached, or until the frequency limit of 3.1 above is reached. When a standard response is obtained, record the equal interfering powers, frequencies and $\Delta f$ required to produce the standard response. (Note: If the frequency limit of 3.1 above is reached before the standard response is obtained, adjust the signal generator levels to obtain the standard response at the frequency limit).

(e) Divide the $\Delta f$ by two, and again adjust the signal generator frequencies to obtain the desired intermodulation product. Adjust the equal levels to produce the standard response and record the data.

(f) Divide the $\Delta f$ of (e) above by two and adjust the frequencies to produce a standard response.

(g) Continue the process of dividing $\Delta f$ by two until $f_a$ falls inside the measured 60 dB receiver bandwidth.

(h) At each $\Delta f$, vary each generator frequency slightly to avoid spurious response frequencies, if necessary.

(i) For the IF response test, examine the two cases where $f_a=f_o$ and $f_b=f_o \pm f_{IF}$.

(j) For third order intermodulation only, select a Δf (one which had been previously used) which corresponds to an input level slightly less than -20 dBm. Adjust the generator levels of $f_a$ and $f_b$ to equal values that will produce a standard response.

(k) Increase the level of $f_a$ in 5 discrete steps until 0 dBm is reached. At each level, record the voltage output.

(l) Return $f_a$ to its original level, and increase the level of $f_b$ in 5 discrete steps until 0 dBm is reached. At each level, record the peak output signal voltage.

(m) Repeat the procedure as described in (j) through (l) for the smallest value of Δf measured under (g) above.

(n) To verify that each product is a receiver intermodulation product and not a signal generator spurious emission, signal generator intermodulation product, or a receiver spurious response, the following procedure should be followed:

(1) Alternately turn off each signal generator (or greatly attenuate its output). If the receiver response remains when one generator is off, it is not an intermodulation product. If the response disappears, it may be either signal generator intermodulation or receiver intermodulation.

(2) After determining the levels for a standard response, increase the attenuation on the attenuator just ahead of the receiver by 3dB. Receiver intermodulation products will vary non-linearly with the amount of inserted attenuation, while signal generator intermodulation products should vary by the amount of attenuation. Thus, if the receiver output level drops only 3 dB when 3dB of attenuation is added, the response is not due to receiver intermodulation.

(3) Next, increase the signal generator output levels simultaneously by 3 dB. Note that with the signal generator levels increased by 3 dB and the step attenuator increased by 3 dB, a standard receiver response should exist for true receiver Intermodulation products.

(o) The following test may be made on phased array antennas to determine the existence of antenna element interaction within the antenna. A test transmitter will be placed 22.5 degrees off bore-sight of the array under test. The test transmitter will be prepared to transmit a phase modulated signal with a maximum phase deviation equivalent to the smallest increment of phase which an array element can be shifted. The rate of phase modulation will be made to vary between a low frequency called $f_{low}$ to one-half of the operating frequency of the array. The frequency $f_{low}$ will be the inverse of the time period defined be the velocity of light divided into the largest diameter of the array antenna under test. The rate of variation of the modulating frequency will not exceed the decay time constant of the first evanescent mode below the lowest propagating mode of a representative array element. The power density at the array under test will be the maximum power expected. The array under test will be electronically steered to point the main lobe toward the test transmitter. During the transmission of the phase modulated waveform to the array, the receiver amplifier power output will be monitored with a spectrum analyzer before the point of the first conversation.

4.1 Required modulation. The frequency $f_a$ shall be unmodulated. The frequency $f_b$ shall be a pulse signal having a pulse width and repetition rate equal to the nominal pulse characteristics of the system under test. Where modulation parameters are selectable, a nominal set of such parameters shall be used.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix D.

# METHOD CS112

## OSCILLATOR EMISSION (Non-pulsed)

1. Purpose. This method is used to measure the energy generated within a receiver by a local oscillator or oscillators.

2. Measurement setup. Receivers shall be setup as specified in Figure 3.

3. Measurement procedure. The receiver is considered a non-pulsed transmitter, and procedures similar to those specified in the transmitter WideBand Conducted Emission Spectrum Test, Method CE109 should be used. The test will be performed at the three standard test frequencies of each band. The BFO, if any, shall be on and set to its Reference Frequency position as defined in the sensitivity test.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

METHOD CS113

OSCILLATOR EMISSION (Pulsed)

1. Purpose. This method is used to measure the energy generated within a receiver by a local oscillator or oscillators while other frequency-producing circuits may be present at the antenna terminals.

2. Measurement setup. The measurement shall be setup as specified in Figure 3.

3. Measurement procedure. The receiver is considered a non-pulsed transmitter, and procedures similar to those specified in the transmitter Wide-Band Conducted Emission Spectrum Characteristics, and test Method CE109 should be used. The test will be performed at the three standard test frequencies of each band.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix D.

# METHOD CS114

## ADJACENT SIGNAL INTERFERENCE (Non-pulsed)

1. Purpose. The purpose of this test is to measure the receiver capability to perform in the presence of interfering signals either close to or far removed from the receiver tuned frequency.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 10.

3. Required modulation. The desired signal shall be modulated or deviated at 30 percent with the Reference Frequency for AM and FM receivers, respectively, and unmodulated for CW and SSB receivers. The interfering signal will be modulated or deviated 100 percent with noise with the modulation or deviation percentage established on the peak levels of the noise. The modulating bandwidth of the interfering signal will be equal to the 3 dB bandwidth of the receiver's widest audio selectivity characteristic. FM interference will be used for FM receivers. AM interference will be used for SSB, AM, and CW receivers.

3.1 Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, or the cutoff frequency of the first higher order mode, whichever is less.

4. Measurement procedure. This test shall be performed at the three standard test frequencies of each band. The procedure is as follows:

(a) The receiver AVC, AGC, and AFC (if such controls exist) shall remain on during the test. The receiver RF gain control shall be adjusted at each level of desired signal to obtain a maximum (S+N)/N before interference is introduced.

(b) Perform the Sensitivity test as specified in Method CS101.

(c) Increase the desired signal level 3 dB above the level obtained in the Sensitivity test.

(d) Inject an interfering signal of +30 dBm, or the maximum level that will not cause front-end burnout or other damage to the receiver, whichever is less. Adjust the interfering frequency and obtain a $\Delta f$, where $\Delta f = |f_i - f_o|$, above the tuned frequency which reestablishes the standard response. Record the desired signal level, interfering signal level and interfering frequency.

(e) Increase the desired signal level 7 dB (10 dB above the sensitivity level) while maintaining the f of Step (d), and adjust the interfering signal level to produce a standard response.

(f) Increase the desired signal level in steps of 10 dB and adjust the interfering level to produce a standard response until a desired signal level of -50 dBm is exceeded, or the interfering signal level limit of(d) above is reached. These measurements are made to investigate the possibility of a strong desired signal enhancing the possibility of cross modulation in the front end of the receiver.

(g) Return the desired signal output to 3 dB above the sensitivity level. Adjust the interfering signal such that Δf is one half the value used in (d) above. Adjust the interfering signal level to obtain a standard response.

(h) Increase the desired signal level 7 dB (10 dB above the sensitivity level) and adjust the interfering signal level to obtain a standard response.

(i) Continue to increase the desired level in 10 dB steps until a level of -50 dBm is exceeded, or the interfering signal level limit of (d) above is reached. Adjust the interfering signal level at each step to produce a standard response.

(j) Continue to divide the Δf by two and repeat (g), (h), and (i) until the interfering frequency falls within the receiver audio 3 dB bandpass.

(k) Repeat (c) through (j) for the interfering signal frequency adjusted below the tuned frequency.

(l) Repeat (g), (h) and (i) for Δf = 0.

(m) Repeat steps (g), (h), and (i) of this method with the interfering signal tuned to the receiver IF frequency.

(n) Repeat steps (g), (h), and (i) of this method with the interfering signal tuned to the five highest level spurious responses identified in Method CS109.

(o) Set the desired signal level to 10 dB above the sensitivity level. Adjust the interfering signal to produce the standard response of 10 dB (S+N)/N at a Δf above the receiver tuned frequency such that the interfering signal level will be 60 dB greater than the desired signal level. Increase the interfering signal level 3 dB and record the(S+N)/N at the receiver output. Increase the interfering signal level in discrete steps, so that a smooth curve of interference signal level versus (S+N)/N can be recorded.

(p) Repeat (o) for desired signal levels 20 dB and 30 dB above sensitivity. All three tests are performed at the same interfering signal frequency given in (o).

(q) The specific value of $\Delta f$ used should be adjusted slightly to avoid possible spurious responses.

5. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

METHOD CS115

ADJACENT SIGNAL INTERFERENCE (Pulsed)

1. Purpose. The purpose of this test is to measure the receiver capability to perform in the presence of interfering signals either close or far removed from the receiver tuned frequency. This test will be performed at the mid-standard test frequency of each band.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 10.

3. Required modulation. The desired signal shall be a pulsed signal having a pulse width and repetition rate equal to the nominal pulse characteristics of the system under test. In addition, where modulation parameters are selectable, combinations providing minimum and maximum duty cycle shall be used. The interfering signal used will be CW.

3.1 Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, or the cutoff frequency of the first higher order mode, whichever is less. An exception to the low frequency limit indicated above shall be a requirement to test at all receiver IF frequencies.

4. Measurement procedure.

(a) The receiver AGC and AFC should be on during the test. If a manual gain control exists, set the control to a normal operating position, if such a position can be established, or to the midpoint of its range.

(b) Perform the Sensitivity test as specified in Method CS102.

(c) Set the desired signal level 3 dB above the standard response level.

(c) Set the undesired CW signal to the tuned frequency of the receiver. Increase its level until the standard response is again obtained. Record both input signal levels.

(e) Vary the frequency of the CW signal in small increments within the 3 dB points of the receiver selectivity above and below the tuned frequency of the receiver. At a few frequencies, the standard response indication is likely to disappear. At each of these frequencies, reduce the CW signal to a level at which the standard response is noted. Record this level and the frequency at which it occurs. In other words, the minimum "on-tune" CW interfering level, required to cause a standard response is not likely to occur when the frequency of the CW signal and the center frequency of the pulsed emission are identical.

(f) Repeat (e) with the desired signal level 10 dB above MVS.

(g) Repeat (e) with the desired signal level 20 dB and 40 dB, above MVS.

(h) Set the desired signal level to a value 3 dB greater than MVS. Detune the CW signal generator to a frequency well above the tuned frequency and set it at the maximum available level, for example, + 20 dBm. Search for the frequency at which a standard response can be obtained and record the frequency, and the two power levels.

(i) Set the desired signal to a value 10 dB greater than MVS. Repeat (h)and record the values of frequency and power of the two generators.

(j) Set the CW signal generator at a frequency separation value 1/2 of the value determined in (i). Reduce the CW signal generator power to a level at which a standard response can be obtained and record the values.

(k) Continue (j), with the same desired signal level, reducing the frequency separation values by 1/2 until a $\Delta f$ value is obtained which is approximately 1/2 of the 60 dB bandwidth value of the CW selectivity curve.

(l) Repeat (i), (j), and (k) for a desired signal level 20 dB above MVS. Use the same interfering frequencies as were used for 10 dB above MVS.

(m) Repeat steps (h) through (l) using CW frequencies below the receiver tuned frequency.

(n) Adjust each interfering signal slightly to avoid spurious response.

5. Presentation of measurement results. The results shall be presented in the format specified in Appendix D.

# METHOD CS116

## DISCRIMINATOR BANDWIDTH (Non-pulsed)

1. Purpose. This method is used to measure the shape of the discriminator characteristic curve. It applies to FM receivers only.

1.1 Required modulation. An unmodulated carrier is required.

2. Measurement setup. The measurement setup shall be as specified in Figure 11. The discriminator output is monitored with a dc VTVM.

3. Measurement procedure.

(a) Perform the sensitivity test using 20 dB of quieting as the standard response. If the receiver has multiple audio outputs, the measurements will be made at the output having the narrowest audio bandwidth. Maintain the generator output at this level for the remainder of the test. Perform this test at the mean standard test frequency.

(b) Vary the signal generator frequency until approximately zero voltage is observed at the discriminator output and record the signal generator frequency. Vary the signal generator frequency in discrete increments above and below this point, recording frequency, and positive or negative discriminator output voltage. Obtain enough points to plot a smooth graph of the discriminator curve. Determine and record the frequency differential between the positive and negative peaks of curve.

4. Presentation of measurement results. The results shall be presented in the format as specified in Appendix C.

METHOD CS117

IMPULSE RESPONSE MEASUREMENT (Pulsed)

1. Purpose. This method provides a means of determining the receiver output as a function of any applied signal of a linear system. This test does not apply to systems employing logarithmic amplifiers or other non-linear stages.

2. Measurement setup. The measurement setup shall be as shown in Figure 12.

3. Measurement procedures.

(a) Adjust the impulse generator output until an adequate display is observed on the oscilloscope. Insure that the input signal level is low enough that operation in the linear portion of the receiver's dynamic range is maintained. The pulse width of the impulse generator shall at least be smaller than 1/10 B, where B is the nominal receiver 3 dB bandwidth.

(b) The test points to be monitored shall include but not necessarily be limited to the outputs of the last IF amplifier stage and the second detector.

(c) The impulse generator output is applied at the receiver input through a matching network to insure proper generate termination. The system time response function is monitored on an oscilloscope. For systems where it is impractical to inject the impulse signal at the receiver antenna terminals, inject the impulse function at the input to the first IF stage.

4. Presentation of measurement results. The measurement results shall be presented as specified in Appendix D. The above results shall consist of calibrated oscilloscope photographs of the receiver impulse – response time waveform. The receiver input level in dB relative to one microvolt/MHz, the receiver tuned frequency and the oscilloscope time base calibration.

METHOD RS101

RADIATED SPURIOUS RESPONSE (Non-pulsed)

1. Purpose. This method is used to determine the equipment open-field susceptibility at representative spurious response frequencies. This test is similar to the conducted spurious response test, except that the signals shall be generated in the far field. The receiver susceptibility shall be evaluated at a number of receiver spurious responses.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 9. The separation between the system antenna and the test antenna shall be at least the far-field distance (see 3.7) unless otherwise indicated and specified on the Format in Appendix C.

3. Measurement procedures.

3.1 Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency, or 12 GHz, whichever is less. An exception to the low frequency limit indicated above shall be a requirement to test at all receiver IF frequencies.

3.2 Required modulation. The modulation used for AM receivers shall be 30 percent, at a Reference Frequency required by the Selectivity Test, Method CS106. An unmodulated signal shall be used for FM, SSB, and CW receivers.

3.3 Antenna positioning procedure. The following sequence shall be used for the orientation of the system and test antennas.

(a) Where azimuth and elevation of the system antenna can be varied, this shall be done to produce the maximum signal at each measurement frequency at the test antenna. The azimuth ($\theta$) and elevation ($\phi$) angles between the antenna boresight axis of the system and the test antenna shall be recorded after the signal is maximized.

(b) The test antenna shall be adjusted in height at each measurement frequency to obtain a maximum of received energy. When possible the adjustment should be made over a distance calculated to include two nulls, in the elevation interference pattern resulting from ground reflection.

(c) All position information shall be recorded together with the test results.

3.4 Measurement procedure.

(a) If the receiver is designed to operate with more than one antenna, the antenna with which the receiver is most frequently used shall be connected to the receiver for this test. The receiver antenna shall be mounted in its normally used configuration (for example, jeep-mounted, man-pack mounted and so forth).

(b) The receiver shall be tuned to the mean standard test frequency.

(c) Adjust the signal generator output for maximum setting.

(d) Perform the Sensitivity Test, Method 101 to establish the signal generator output necessary to achieve a standard response at the receiver tuned frequency.

(e) Select a significant spurious response from the Conducted Spurious response data and tune the signal generator to this frequency. Adjust the signal generator output to produce a standard response at the receiver output. The same method for obtaining a standard response shall be used as specified in the Conducted Spurious Response test, Method CS108.

(f) Establish the received power density at the system antenna, by substituting a calibrated receiving antenna and frequency selective voltmeter for the receiver under test.

(g) Repeat (a) through (f) for representative spurious response frequencies. Include the image and IF responses.

(h) For waveguide systems, repeat (a) through (f) for spurious responses observed above the cutoff frequency of the first higher order mode.

(i) Repeat (a) through (h) at the three standard test frequencies of each band.

4. Presentation of measurement results. The measurements results shall be presented as specified in Appendix C.

# METHOD RS102

## RADIATED SPURIOUS RESPONSE (Pulsed)

1. Purpose. This method is used to determine the equipment open-field susceptibility at representative spurious response frequencies. This test is similar to the conducted spurious response test, except that the signals shall be generated in the far field. The receiver susceptibility shall be evaluated at a number of receiver spurious responses.

2. Measurement setup. The test apparatus shall be setup as shown in Figure 9. The separation between the system antenna and the test antenna shall be at least the far-field distance (see 3.7), unless otherwise indicated and specified on Format in Appendix C.

3. Frequency range.

(a) For coaxial systems the lower frequency limit shall be 14 kHz. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less.

(b) For waveguide systems the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be 20 times the receiver tuned frequency or 12 GHz, whichever is less. An exception to the low frequency limit indicated above shall be a requirement to test at all receiver IF frequencies.

3.1 Required modulation. The signal generator shall be modulated with a pulse of the same width and repetition rate as the system pulse. Where modulation parameters are selectable, a nominal set of such parameters shall be used.

3.2 Antenna positioning procedure. The following sequence shall be used for the orientation of the system and test antennas.

(a) Where azimuth and elevation of the system antenna can be varied, this shall be done to produce the maximum signal at each measurement frequency at the test antenna. The azimuth ($\theta$) and elevation ($\phi$) angles between the antenna boresight axis of the system and the test antenna shall be recorded after the signal is maximized.

(b) The test antenna shall be adjusted in height at each measurement frequency to obtain a maximum of received energy. When possible, the adjustment should be made over a distance calculated to include two nulls, in the elevation interference pattern resulting from ground reflection.

(c) All position information shall be recorded together with the test results.

4. Measurement procedure.

(a) If the receiver is designed to operate with more than one antenna the antenna with which the receiver is most frequently used shall be connected to the receiver for this test. The receiver antenna shall be mounted in its normally used configuration (for example, jeep-mounted, man-pack mounted, and so forth).

(b) The receiver shall be tuned to the mean standard test frequency.

(c) Adjust the signal generator output for the maximum setting.

(d) Perform the Sensitivity Test in Method CS102 to establish the signal generator output necessary to achieve a standard response at the receiver tuned frequency.

(e) Select a significant spurious response from the Conducted Spurious Response data and tune the signal generator to this frequency. Adjust the signal generator output to produce a standard response at the receiver output. The same method for obtaining a standard response shall be as specified in the Conducted Spurious Response test, Method CS109.

(f) Establish the received power density at the system antenna, by substituting a calibrated receiving antenna and frequency-selective voltmeter for the receiver under test.

(g) Repeat (a) through (f) for representative spurious response frequencies and include the image and IF frequencies.

(h) For waveguide systems, repeat (a) through (f) for spurious responses observed above the cutoff frequency of the first higher order mode.

(i) Repeat (a) through (h) at the mean test frequency of each band.

5. Presentation of measurement results. The measurement results shall be presented as specified in Appendix D.

METHOD CS118

COUPLER MEASUREMENTS

COUPLER SELECTIVITY

1. Purpose. This test is performed on all frequency-selective devices that are normally used with the receiver or transmitter being tested, but are not integral parts of these equipments. Examples of such devices are: pre-selectors, multicouplers, harmonic filters, bandpass filters, antenna impedance matching units, etc. This test is not a measure of receiver RF or transmitter output characteristic, but rather a measure of the coupler which precedes the receiver input or follows the transmitter output.

1.1 Frequency range. The frequency range of coupler measurement shall be as follows:

(a) For coaxial systems, the lower frequency limit shall be 0.5 $f_o$ and the upper frequency limit shall be either 10 $f_o$ or 12 GHz. whichever is less.

(b) For waveguide systems, the lower frequency limit shall be 0.9 of the waveguide cutoff frequency. The upper frequency limit shall be either 10 $f_o$, or 12 GHz, or the cutoff frequency of the first higher order mode, whichever is less.

1.2 Required modulation. A CW signal is required for this test.

2. Measurement setup. The measurement setup shall be presented in Figure 13.

3. Measurement procedure. The procedure for this test shall be as follows:

(a) If the coupler is a tunable device, tune it to a standard test frequency of its associated transmitter or receiver. Couplers which have multiple input and/or output terminals, or both, and in which more than one section of the device is tunable, shall be tuned to frequency combinations representative of coupler operational usage. Such frequency selections shall be subject to approval of the contracting officer's technical representative or other designated technical authority.

(b) Connect the signal generator and the FSV to the input and output of the coupler, respectively. If the coupler has multiple input and/or output ports, terminate the additional ports with matched loads.

(c) With the switches in position A of Figure 13, adjust the signal generator and the FSV to the tuned frequency, $f_o$, of the coupler, of the coupler, or to a frequency in the coupler passboard. Note the signal generator frequency.

(d) Adjust the signal generator to obtain a voltage level 6-10 dB above the noise indicated on the FSV at the tuned frequency. Record the frequency and output power level at the calibrated power signal generator and the amount of attenuation. Switch to position B to bypass the device and duplicate the reading on the FSV by readjusting the output of the signal generator or attenuator. Record the output power level of the signal generator and the amount of attenuation.

(e) Repeat steps (c) and (d) above at a sufficient number of frequencies to provide a smooth curve of the coupler characteristic. Maintain the same output voltage reference as initially established in (d). In particular, measure the characteristic of the coupler harmonic frequencies that are within the frequency range of the test.

(f) The measurements, (a) through (e) above, will be performed at all test frequencies of each band of the associated receiver or transmitter.

4. Presentation of measurement results. The measurement results shall be presented as specified in Appendix E.

# METHOD CS119

## COUPLER DYNAMIC RANGE

1. Purpose. This method is to give an indication of coupler behavior for a wide range of input signal levels. It is applied only to couplers that contain active circuit elements.

2. Measurement setup. The measurement setup shall be as specified in Figure 13.

3. Required modulation. A CW signal is required for this test.

4. Measurement procedure.

(a) If the coupler is a tunable device, tune it to a standard test frequency of its associated transmitter or receiver.
(b) Connect the signal generator and the FSV to the input and output of the coupler, respectively. If the coupler has multiple input and/or output ports, terminate the additional ports with matched loads.
(c) With the switches in position A of Figure 13, adjust the signal generator and the FSV to the tuned frequency, $f_o$, of the coupler, or to the frequency associated with the minimum input signal resulting from the Coupler Selectivity test.
(d) Adjust the signal generator to obtain a voltage level 6-10 dB above the noise indicated on the FSV. Record the output power level at the calibrated signal generator, the amount of attenuation, the input power level to the coupler, and the voltage level of the FSV. Switch to position B to bypass the device and duplicate the reading on the FSV by readjusting the output of the signal generator or attenuators. Increase the input signal, record the output power level of the signal generator voltage level does not change with a further increase of input signal.

(e) Record enough points to plot a smooth curve of input versus output.

(f) Perform this test at the mean test frequency of each band of the associated receiver or transmitter.

5. Presentation of measurement results. The measurement results shall be presented as specified in Appendix E.

# APPENDIX A

## SPECTRUM SIGNATURE DATA COLLECTION FORMS

For Use With MIL-STD 449(D)

## EXTERNALLY MODULATED NON-PULSED EQUIPMENTS

NOMINAL EQUIPMENT DATA
EXTERNALLY MODULATED NON-PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature______________________________Serial No. _______________

TRANSMITTER

Transmitter Nomenclature_________________________Serial No. _______________

Manufacturer_________________________________Function _____________________

Frequency Range_______________MHz Number of Bands _________________________

Master Oscillator Type_____________________________________________________

Number of Stages and Function______________________________________________

Type of Tuning_____________________________________________________________

Type of Modulation_________________________________________________________

Power Output: Average_____________dBm, Peak_____________________________dBm

Number of Audio Channels_______Number of Audio Bands______________________

Emission Bandwidth and Rated Deviation_____________________________________

Output Pulse width____________µsec. 1/2 Voltage     1/2 Power

Pulse Repetition Frequency_____________________pps.

Output Component______________________________Type__________________________

Type of Coupler____________________________________________________________

Type of Transmission Line__________________________________________________

Remarks: (Include information on any multiple transmitters, pulse train characteristics, interference reduction features, and any other features peculiar to this equipment.)________________________________________
___________________________________________________________________________

NOMINAL EQUIPMENT DATA (con't.)
EXTERNALLY MODULATED NON-PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature__________________________Serial No. ____________________

RECEIVER

Receiver Nomenclature________________________Serial No._____________________

Sensitivity: (State Criteria)_____________Noise Figure_____________________

Type Receiver ______________________________________________________________

Number of Bands_____________________________________________________________

Frequency Range___________________________________________________________MHz

RF Bandwith (3dB)_____________________________(6dB)__________________________

IF Bandwidths (3dB)___________________________(6dB)__________________________

IF Frequency(ies)___________________________________________________________

Local Oscillator Type(s)____________________________________________________

Injection Multiple_____________No. of Conversions__________________________

Number of RF Stages____________Number of IF Stages_________________________

Image Rejection________________Mixer Type__________________________________

Description of Interference Reduction Features______________________________

____________________________________________________________________________

NOMINAL EQUIPMENT DATA (con't.)
EXTERNALLY MODULATED NON-PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature________________________________Serial No.______________

ANTENNA

Antenna Nomenclature_______________________________Serial No.______________
*Type______________________________________________________________________
Dimensions: Horiz._________Ft. xVert._____________Ft.
Height Above Site:______________Ft., Site Elevation_____Ft.
Point of Reference on Antenna______________________________________________
Beamwidth: Horiz.______________, Vertical___________________
Polarization__________________Gain (@ Mid Band Freq.)_________________dB
Effective Area (@ Mid Band Freq.)_______________________________________$m^2$
Antenna Movement
RPM: Horiz.______________
Angular Limits: Horiz.___________________________Vertical_______________
Feed: Waveguide ☐ Coaxial ☐ Other____________________
Remarks____________________________________________________________________
___________________________________________________________________________
*Such as parabolic reflector, cassegrain, lens, parabolic-tours, etc.

This list of nominal data is minimal in nature and should be expanded as required by specific equipment. If reasonable, all possible combinations for the equipment should be reported with the normal one(s) so indicated.

In addition to this list a brief description of the operating characteristics of each subsystem is desired. Noted in this description should be any values which vary from nominal at this particular site or on this particular equipment. A detailed description of the test sites is also required.

TEST EQUIPTMENT CHARACTERISTICS
(For Use With MIL-STD-449D)

| Equipment and Manufacture | Model | Serial No. | Calibration Date | Frequency Range | Band Widths | Other Parameters (Accuracy, Stability.etc.) |
|---|---|---|---|---|---|---|
| | | | | | | |

TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS METHOD CE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature____________________
Type____________________Serial No.__________
Tuning Range or Band____________________
Modulation____________________
*Configuration____________________
Significant Control Positions____________________
____________________
____________________
____________________
____________________

Test Equipment

____________________
____________________
____________________
____________________

Significant Control Positions____________________
____________________
____________________
____________________

Test Information

Point of Signal Injection____________________
Point of Measurement____________________
____________________
____________________
____________________

* Indicate which of available circuitry was employed and any additional refinements, modifications, fixes, or unusual occurrences which might affect the measurement.

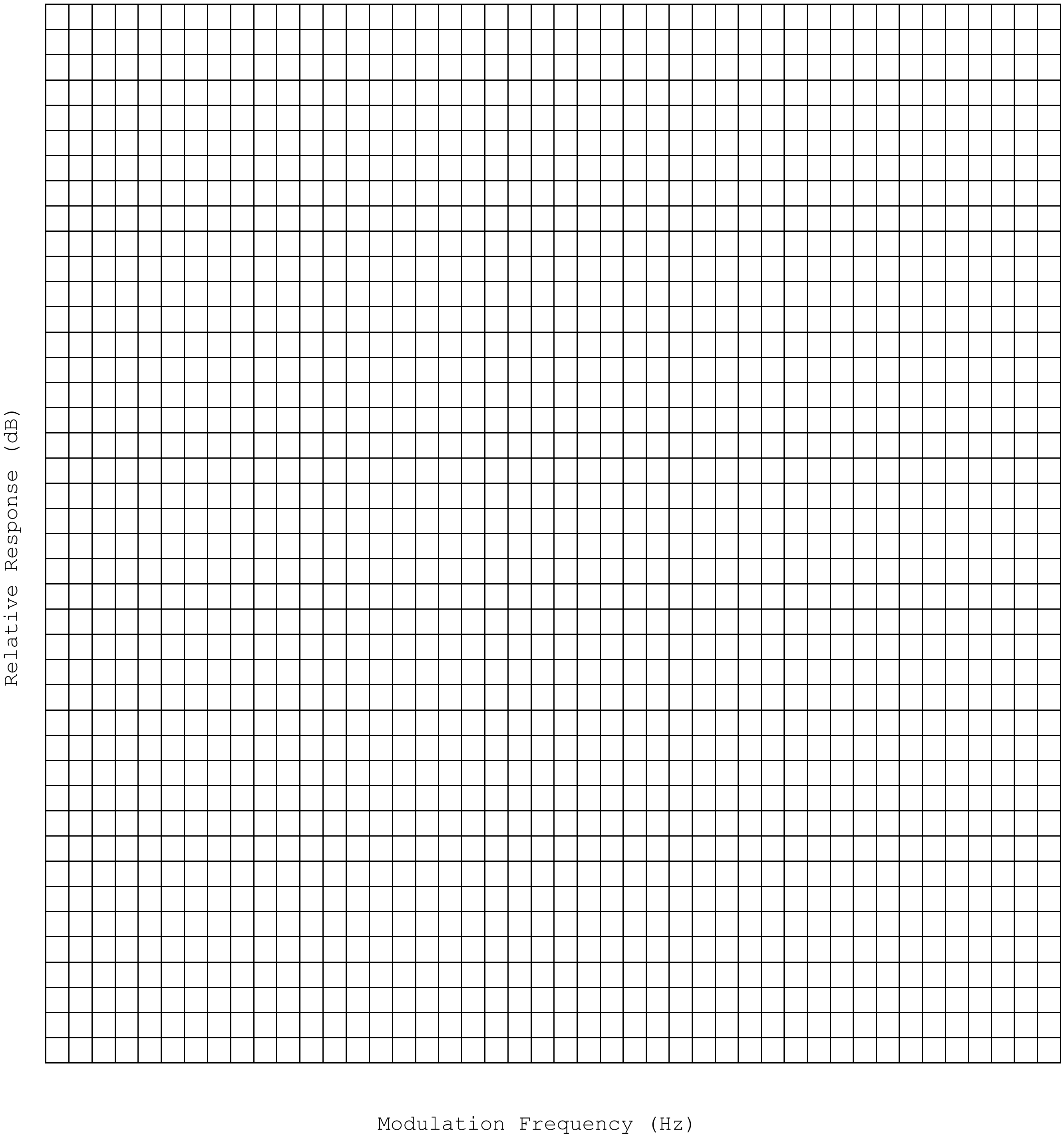
TRANSMITTER MEASUREMENTS
MODULATION BANDWIDTH METHOD CE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature______________________________________________ Serial No.________________
Tuning Frequency_____________________________MHz Date______________________
Modulator Input______________________________

| Modulating Frequency (Hz) | Modulation (%) or Deviation (kHz) or PEP (dBm) | Modulator | | Power Output (dBm) |
|---|---|---|---|---|
| | | Input (milivolts) | Relative Response (dB) | |
| | | | | |

TRANSMITTER MEASUREMENTS
MODULATION BANDWIDTH METHOD CE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature________________________________Serial No.__________________
Tuning Frequency_____________________________MHz
Modulator Input______________________________



TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS METHOD CE102
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature________________________________________________
Type__________________________________________Serial No.____________
Tuning Range or Band________________________________________________
Modulation__________________________________Mod. BW._________________
Pulse Width____________________µsec, PRF_________________pps
Configuration________________________________________________________
Significant Control Positions________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
__________________________________________________________________

Test Equipment

__________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Significant Control Positions________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Information

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS METHOD CE102
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature____________________________________Serial No.___________
Tuned Frequency______________________________MHz Date_________________
Modulation Input_____________________________

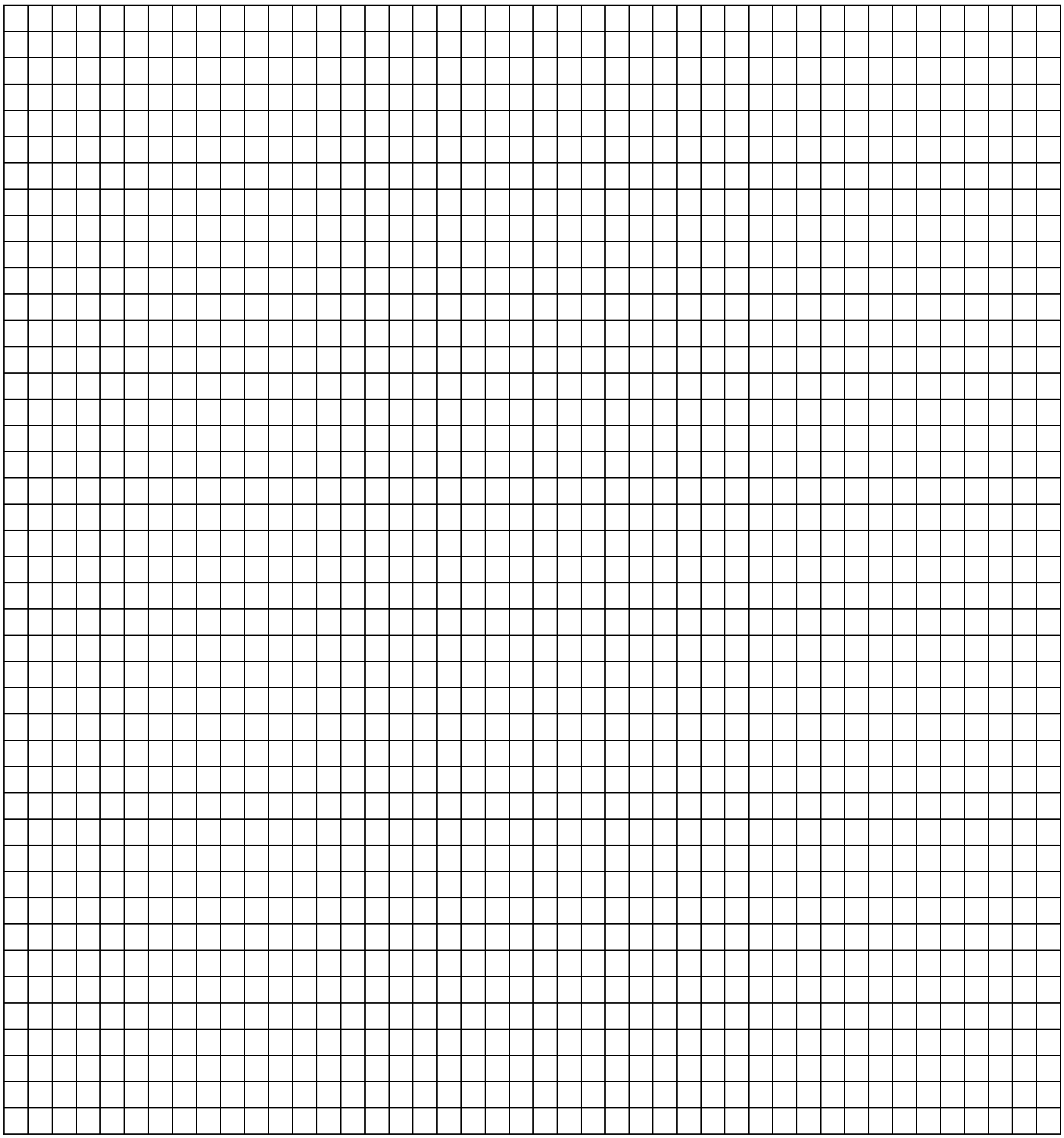
| Modulation Input (RMS mv) | Modulation (%) or Deviation (kHz) or PEP (dBm) | Power Output (dBm) | *Modulating Frequency (Hz) | **S/D Ratio (dB) |
|---|---|---|---|---|
| | | | | |

*List both Frequencies Used for Single Sideband
**Single Sideband Only

TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS METHOD CE102
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature_______________________________________Serial No._____________
Tuned Frequency_______________________________________MHz
Modulator Input_______________________________________

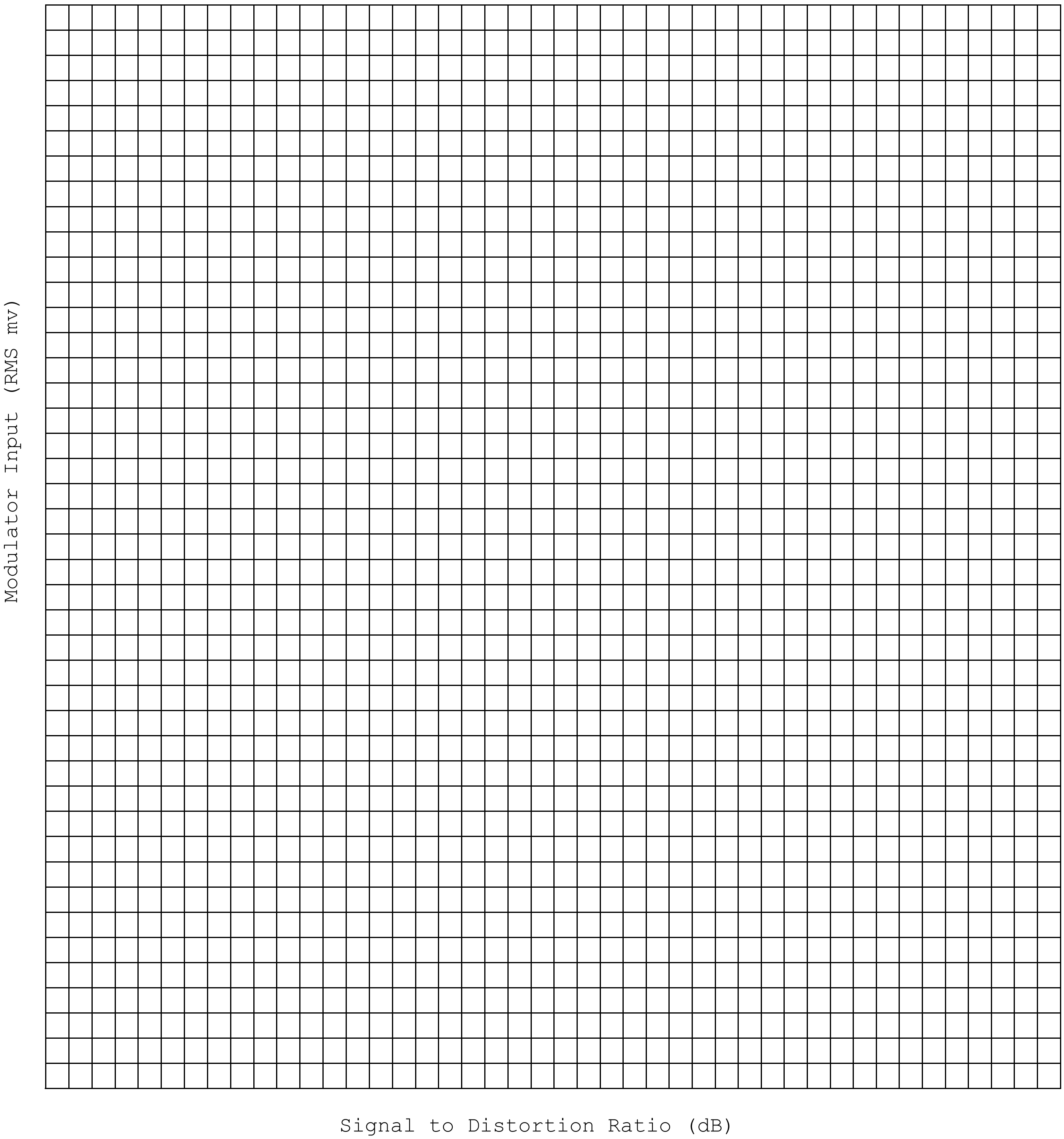
Modulator Input (RMS mv)



Percentage Modulation, Deviation (kHz) or PEP (dBm)

TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS METHOD CE102
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature_______________________________________Serial No._____________
Tuned Frequency_______________________________________MHz
Modulator Input_______________________________________



TRANSMITTER MEASUREMENTS
POWER OUTPUT METHOD CE103
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature____________________________________________
Type________________________________________Serial No._______________
Tuning Range or Band_________________________________________________
Rated Power Output (indicate Avg., Peak OR PEP)__________________dBm
Configuration_______________________________________________________
Significant Control Positions_______________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
Significant Control Positions_______________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Information

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

TRANSMITTER MEASUREMENTS
POWER OUTPUT METHOD CE103
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature______________________________________________________Serial No.________________
Date______________________

| Tuned Frequency (MHz) | Audio Input (RMS mv) | *Modulating Frequency (Hz) | Sig. Gen. Output (dBm) | Losses (dB) | Pwr. Out. **____________ (dBm) |
|---|---|---|---|---|---|
| | | | | | |

*Signal Sideband Only
**Indicate Average, Peak or PEP

# TRANSMITTER MEASUREMENTS
# CARRIER FREQUENCY STABILITY METHOD CE105
# EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

## Equipment Under Test

Transmitter Nomenclature____________________________________________
Type_________________________________________Serial No.______________
Tuned Freq.____________________________________MHz.
Configuration_________________________________________________________
Date and Time Equip. Last Operated___________________________________
Significant Control Positions________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

## Test Equipment

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
Frequency Stability_____________________________Parts/Million

Significant Control Positions________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

## Test Information

Point of Signal Injection____________________________________________
Point of Measurement_________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

TRANSMITTER MEASUREMENTS
CARRIER FREQUENCY STABILITY METHOD CE105
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature______________________________________________Serial No.________________
Tuning Frequency_____________________________MHz

| Date | Time | Frequency (Hz) | | Date | Time | Frequency (Hz) |
|---|---|---|---|---|---|---|
| | | | | | | |

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTIC (NARROW-BAND DATA) METHOD CE107,
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature_______________________________________________
Type_______________________________________Serial No.________________
Tuning Range or Band___________________________________________________
Rated Power Output (indicate Avg., Peak or PEP)__________________dBm
Modulation_____________________________________________________________
No. of Channels________________________, Number of Bands_____________
Configuration__________________________________________________________
Significant Control Positions__________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Test Equipment

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Significant Control Positions__________________________________________
Spectrum Analyzer:
3 dB Resolution BW:_______kHz. Sweep Rate______________________Hz
Sweep Range___________________to__________________________________
3 dB CW Bandwidth:____________kHz, Sensitivity_________________dBm
_______________________________________________________________________
_______________________________________________________________________

Test Information

Point of Signal Injection______________________________________________
Point of Measurement___________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (NARROW-BAND DATA) METHOD CE107,
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

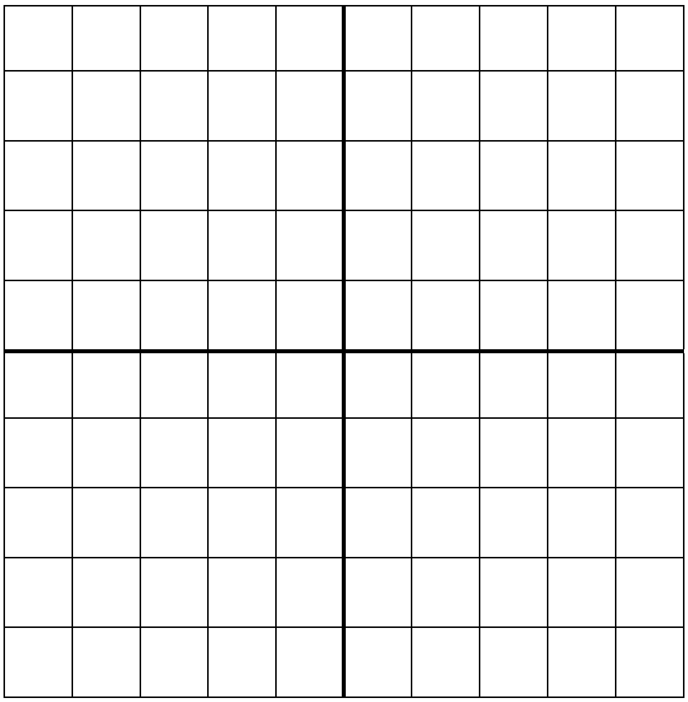
Xmtr. Nomenclature________________________________________________Serial No.______________________
Date____________________________

| Tuned Frequency (MHz) | Modulation(%) or*Deviation (kHz)or PEP(dBm) | Modulator Input (RMS mv) | Tone Frequencies (Hz) | | Noise Bandwidth (kHz) | Power Output (dBM) | Photo No. |
|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | |
| | | | | | | | |

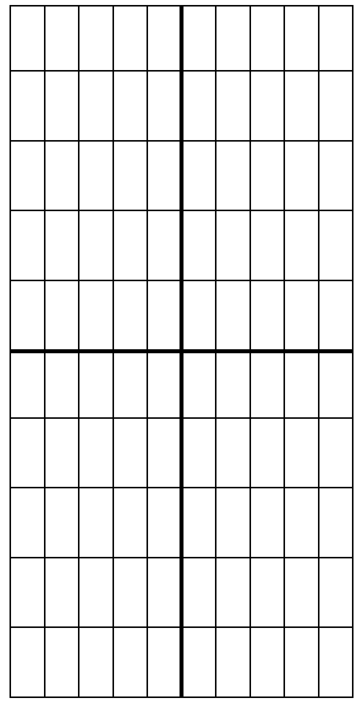
*Record ± Δf for FM

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (NARROW-BAND DATA) METHOD CE107
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Power (dBm)



Frequency Calibration (± kHz)



Power (dBm)
(Line Spectrum) or
Power Density (dBm/kHz)
(Distributed Spectrum)

Photo No.________________________________Date ____________________________
Xmtr. Nomenclature _____________________________Serial No.________________
Transmitter: Tuned Frequency________________(MHz)
Modulation (type)____________(Percentage)____________________
Harmonic No.________________
Spectrum Analyzer:
Resolution Bandwidth______________________kHz
Sweep Width___________________kHz Sweep time__________________________sec.
Comments__________________________________________________________________

NOTE: Each vertical and horizontal reticle should be calibrated either with an attached calibrated curve or by scaling the photograph.

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTIC (WIDE-BAND DATA) METHOD CE109
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature____________________________________________
Type_______________________________________Serial No.________________
Tuning Range or Band________________________________________________
Rated Power Output (indicate Avg., Peak or PEP)__________________dBm
Modulation__________________________________________________________
Configuration_______________________________________________________
Significant Control Position________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment (Closed System)

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Information (Closed System)

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTIC (WIDE-BAND DATA) METHOD CE109
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

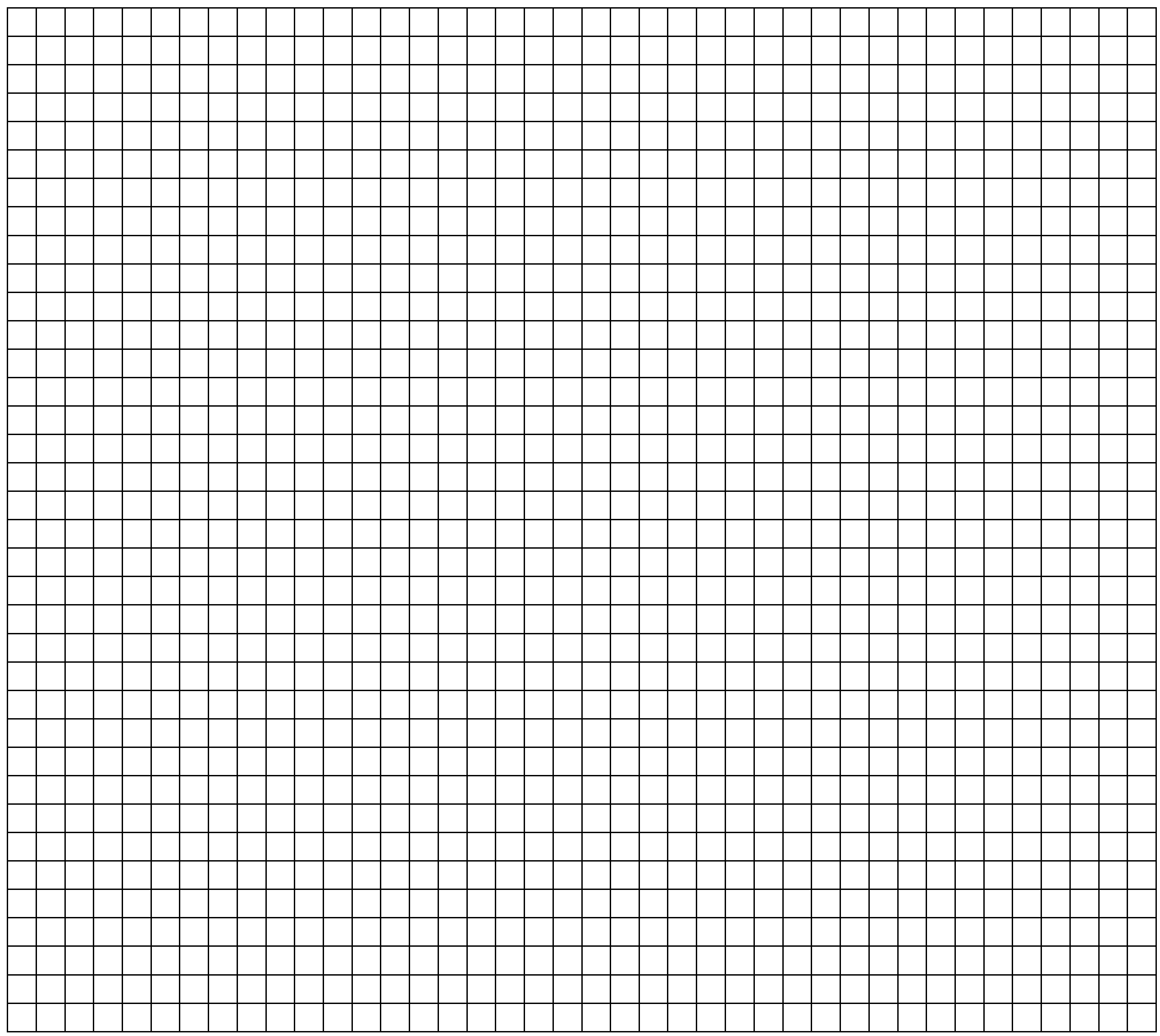
Xmtr. Nomenclature_______________________________________Serial No._________
Tuned Frequency_________________________MHz Date_______________
LO Frequency (s)________________________MHz

| Investigated Frequency (MHz) | Origin | Sig. Gen. Output (dBm) | Losses (dB) | *______Pwr. Output (dBm) |
|---|---|---|---|---|
| | | | | |

*Indicate Avg., Peak, or PEP

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTIC (WIDE-BAND DATA) METHOD CE109
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature_____________________________________Serial No._______________
Tuned Frequency________________________MHz




If spurious are too numerous, plot harmonics of the fundamental and other significant spurious only.

TRANSMITTER MEASUREMENTS
INTERMODULATION METHOD CE111
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature____________________________________________
Type__________________________________________Serial No.____________
Tuning Range or Band________________________________________________
Modulation_________________Rated Pwr. Out.______________________dBm
Configuration_______________________________________________________

Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Information

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

TRANSMITTERS MEASUREMENTS
INTERMODULATION METHOD CE111
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature________________________________________Serial No.________
Tuned Frequency__________________________MHz Date______________

| Investigated Freq. (fs) (MHz) | Spurious Power Output (dBm) | Identification | | | Δf \|fi-fo\| (MHz) | Interfering Frequency (fi) (MHz) |
|---|---|---|---|---|---|---|
| | | n | m | Sign | | |
| | | | | | | |

## TRANSMITTER MEASUREMENTS
## INTERMODULATION METHOD CE111
## EXTERNALLY MODULATE NON-PULSED TRANSMITTERS

Xmtr. Nomenclature_____________________________________Serial No.__________
Tuned Frequency___________________MHz Date________________
Analyzer Bandwidth______________kHz
Sweep Width___________________MHz/cm, Sweep Rate____________________sec/cm

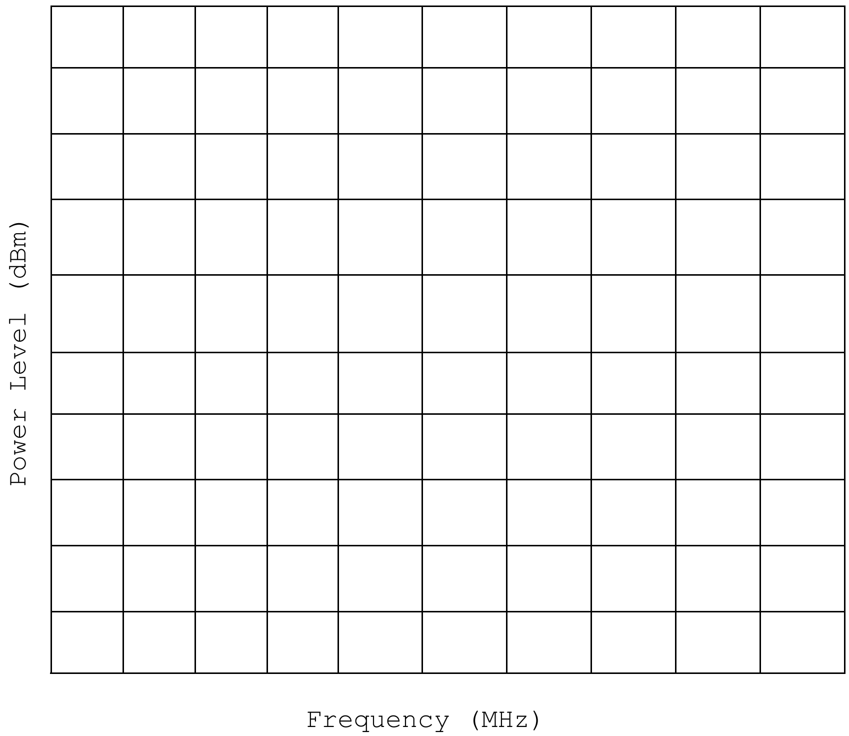



Photo No.___________________________Harmonic______________________________
Interfering Frequency ($f_i$)_________________________MHz

| Identification | Power level (dBm) |
| --- | --- |
| | |

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature___________________________________________
Type__________________________________________Serial No.____________
Tuning Range or Band________________________________________________
Rated Power Output (indicate Avg., Peak or PEP)__________________dBm
Modulation__________________________________________________________
Configuration_______________________________________________________
Far Field Distance____________ft.________________________meters
Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment (Conducted Emission Spectrum)

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Information (Conducted Emission Spectrum)

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature________________________________________________ Serial No._______________

Tuned Frequency_________________________________MHz Date_____________________

LO Frequency (s)________________________________MHz

| Investigated Frequency (MHz) | Origin | Antenna Position | | | Sig. Gen. Output (dBm) | Total Losses (dB) | Test Ant. Gain (dB) | Power Density ($dBm/m^2$) |
|---|---|---|---|---|---|---|---|---|
| | | θ | Φ | ω | | | | |
| | | | | | | | | |

θ - Azimuth
ϕ - Elevation
ω - Angle of rotation from true vertical reference to obtain polarization of maximum response.

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE101
EXTERNALLY MODULATED NON-PULSED TRANSMITTERS
(continued)

Test Equipment (Radiated Emission Spectrum)

FIM Type____________________________, BW Used_________________________
Detector Function Used________________________________________________
Antenna: Type_______________Height___________Ft. MSL
BW: Horiz.________________Vert.___________________________________

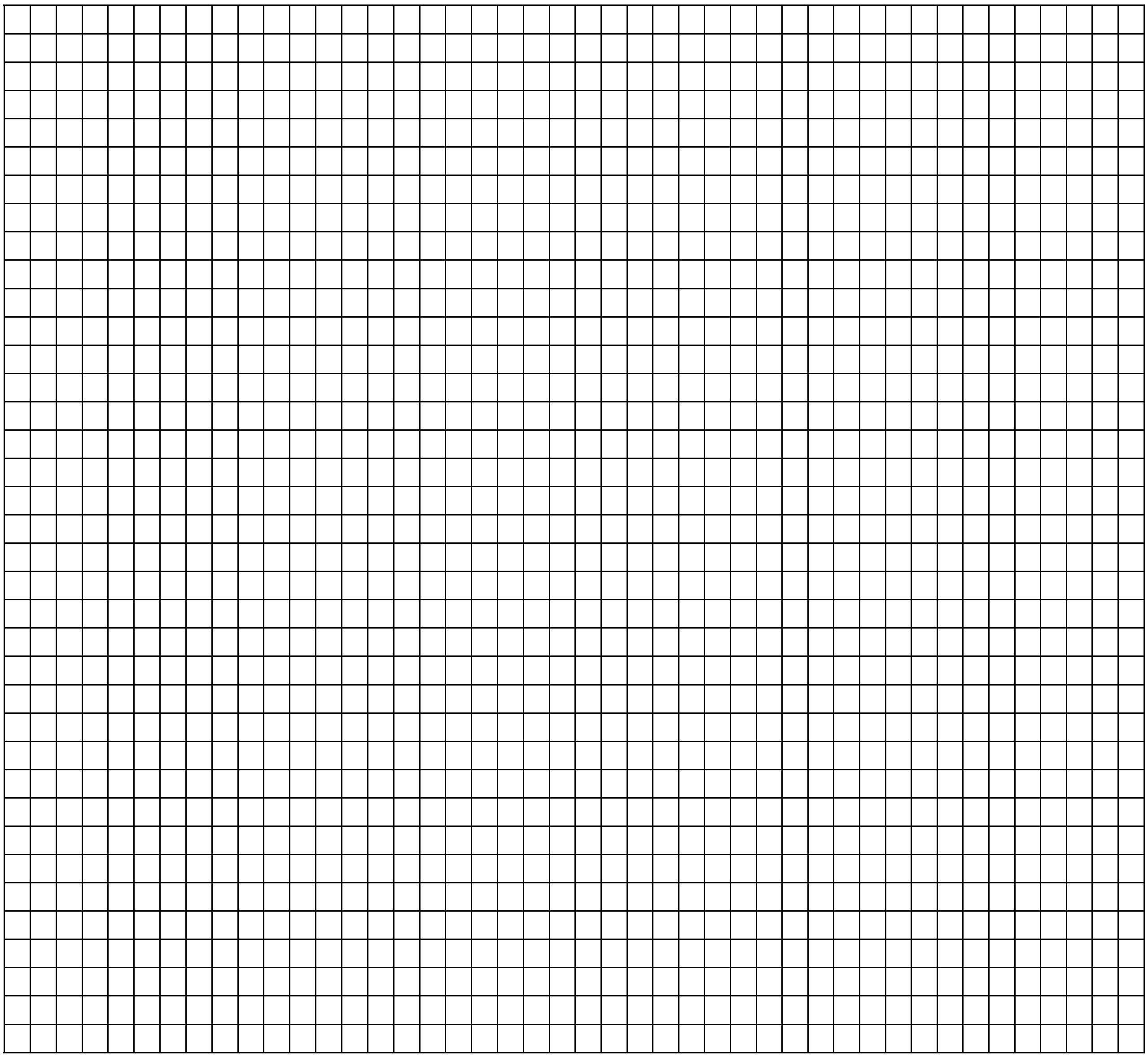
Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Information (Radiated Emission Spectrum)

Communication Site_________________Elev.___________Ft. MSL
Test Site__________________________Elev.___________Ft. MSL
Measurement Distance_______________Ft.
Cable types and lengths______________________________________________
_____________________________________________________________________
_____________________________________________________________________

# TRANSMITTER MEASUREMENTS
## RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE101
## EXTERNALLY MODULATED NON-PULSED TRANSMITTERS

Xmtr. Nomenclature___________________________________Serial No.__________________
Tuned Frequency_____________________________MHz



Frequency (MHz)

# APPENDIX B

## SPECTRUM SIGNATURE DATA COLLECTION FORMS

For Use With MIL-STD-449(D)

## INTERNALLY MODULATED PULSED EQUIPMENTS

NOMINAL EQUIPMENT DATA
INTERNALLY MODULATED PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature_____________________________Serial No.________________

TRANSMITTER

Transmitter Nomenclature________________________Serial No.________________

Manufacturer________________________________Function______________________

Frequency Range___________________MHz Number of Bands_____________________

Master Oscillator Type____________________________________________________

Number of Stages and Function_____________________________________________

Type of Tuning____________________________________________________________

Type of Modulation________________________________________________________

Power Output: Average___________________dBm, Peak______________________dBm

Number of Audio Channels______________Number of Audio Bands_______________

Emission Bandwidth and Rated Deviation____________________________________

Output Pulse width_________________µsec. 1/2 ☐ Voltage 1/2 Power ☐

Pulse Repetition Frequency_____________________________pps.

Output Component______________________________________Type________________

Type of Coupler___________________________________________________________

Type of Transmission Line_________________________________________________

Remarks: (Include information on any multiple transmitters, pulse train characteristics, interference reduction features, and any other features peculiar to this equipment.)______________________________________________

__________________________________________________________________________

NOMINAL EQUIPMENT DATA (con't.)
INTERNALLY MODULATED PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature___________________________________Serial No.__________

RECEIVER

Receiver Nomenclature_________________________________Serial No.__________

Sensitivity: (State Criteria)__________________Noise Figure_______________

Type Receiver_____________________________________________________________

Number of Bands___________________________________________________________

Frequency Range__________________________________________________________MHz

RF Bandwidth (3dB)____________________________________(6dB)________________

IF Bandwidths (3dB)___________________________________(6dB)________________

IF Bandwidth (3dB)____________________________________(6dB)________________

Local Oscillator Type (s)_________________________________________________

Injection Multiple_____________________No. of Conversions__________________

Number of RF Stages______________________Number of IF Stages______________

Image Rejection_________________________Mixer Type_________________________

Description of Interference Reduction Features_____________________________

___________________________________________________________________________

NOMINAL EQUIPMENT DATA (con't.)
INTERNALLY MODULATED PULSED EQUIPMENTS
(For Use With MIL-STD-449D)

System Nomenclature____________________________________Serial No.__________

ANTENNA

Antenna Nomenclature___________________________________Serial No.__________
*Type______________________________________________________________________
Dimensions: Horiz.__________Ft.xVert._________Ft.
Height Above Site:_____________Ft., Site Elevation___________Ft.
Point of Reference on Antenna_____________________________________________
Beamwidth: Horiz.____________________, Vertical___________________________
Polarization________________Gain (@ Mid Band Freq.)_____________________dB
Effective Area (@ Mid Band Freq.)_______________________________________$m^2$
Antenna Movement
RMP: Horiz._____________
Angular Limits: Horiz.________________Vertical________________________
Feed: Waveguide ☐ Coaxial ☐ Other____________________________
Remarks____________________________________________________________________
___________________________________________________________________________
*Such as parabolic reflector, cassegrain, lens, parabolic-torus, etc.

This list of nominal data is minimal in nature and should be expanded as required by specific equipment. If reasonable, all possible combinations for the equipment should be reported with the normal one(s) so indicated.

In addition to this list a brief description of the operating characteristics of each subsystem is desired. Noted in this description should be any values which vary from nominal at this particular site or on this particular equipment. A detailed description of the test sites is also required.

TEST EQUIPMENT CHARACTERISTICS
(For Use With MIL-STD-449D)

| Equipment & Manufacturer | Model | Serial No. | Calibration Date | Frequency Range | Band Widths | Other Parameters (Accuracy, Stability, etc.) |
|---|---|---|---|---|---|---|
| | | | | | | |

# TRANSMITTER MEASUREMENTS
# POWER OUTPUT METHOD CE104
# INTERNALLY MODULATED PULSED TRANSMITTERS

## Equipment Under Test

Transmitter Nomenclature________________________________________________
Type____________________________________________Serial No._____________
Tuning Range or Band____________________________________________________
Rated Power Output (indicate Avg., Peak OR PEP)__________________dBm
Configuration___________________________________________________________
Significant Control Positions___________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

## Test Equipment

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Significant Control Positions___________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

## Test Information

Point of Signal Injection_______________________________________________
Point of Measurement____________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

TRANSMITTER MEASUREMENTS
POWER OUTPUT METHOD CE104
INTERNALLY MODULATED PULSED TRANSMITTERS

Xmtr. Nomenclature_______________________________________________________Serial No.____________________
Date__________________________

| Frequency (MHz) | Pulse Width* | | PRF | | Measured Power | | Losses | Power Out | |
|---|---|---|---|---|---|---|---|---|---|
| | Nom (µsec) | Meas (µsec) | Nom (µsec) | Meas (µsec) | $P_{AVG}$ (dbm) | $P_{Pk}$ (dbm) | (db) | $P_{AVG}$ (dbm) | $P_{Pk}$ (dbm) |
| | | | | | | | | | |

* Indicate whether ½ power ☐ or ½ voltage ☐ point.

# TRANSMITTER MEASUREMENTS
# CONDUCTED AMPLITUDE VERSUS TIME CHARACTERISTICS METHOD CE112
# INTERNALLY MODULATED PULSED TRANSMITTERS

## Equipment Under Test

Transmitter Nomenclature________________________________________
Type________________________________________Serial No.____________
Tuning Range or Band______________________________________________
Modulation__________________________________Mod. BW.______________
Pulse Width__________μsec, PRF_________________________________pps
Configuration_____________________________________________________
Significant Control Positions_____________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

## Test Equipment

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
Significant Control Positions_____________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

## Test Information

Point of Signal Injection_________________________________________
Point of Measurement______________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

TRANSMITTER MEASUREMENTS
CONDUCTED AMPLITUDE VERSUS TIME CHARACTERISTICS METHOD CE112
INTERNALLY MODULATED PULSED TRANSMITTERS

Xmtr Nomenclature______________________________________ Serial No.______________

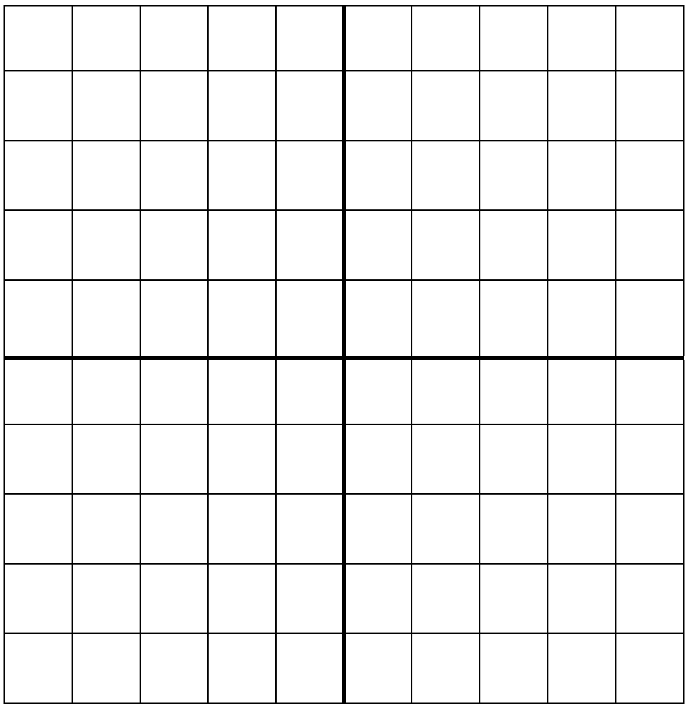
Date____________________

CA/TC ☐

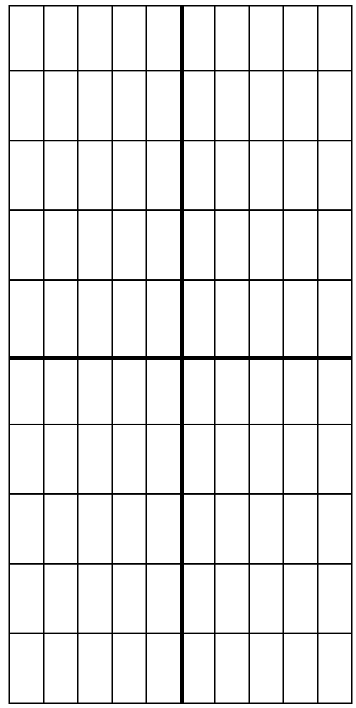
| Transmitter Tuned Freq. (MHz) | Photo No. | Time (24 Hr. Base) | Pulse Width of Fund. (μsec) | Spur. or Harmonic Freq. (MHz) |
|---|---|---|---|---|
| | | | | |

TRANSMITTER MEASUREMENTS
CONDUCTED AMPLITUDE VERSUS TIME CHARACTERISTICS METHOD CE112
INTERNALLY MODULATED PULSED TRANSMITTERS

CA/TC ☐



Time µsec/cm



Volts

Photo No.__________________________

Equipment Nomenclature____________________________

Serial No.__________________________Test Equip. Bandwidth________________

Tuned Frequency ($f_o$) ________________________MHz

Test Frequency ______________________________MHz

Measured Value (From Photograph)

*Pulsewidth____________________µsec PRF____________pps

**Rise Time______________________µsec Fall Time______µsec

Comments______________________________________________________________

______________________________________________________________

*50% Peak Voltage Point
**10% to 90% of Peak Voltage (Fall Time: Vice Versus)

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE108
INTERNALLY MODULATED PULSED TRANSMITTERS
(Narrow-Band Data)

Pulsed ☐ Coax ☐
Non Pulsed ☐ Waveguide ☐

Equipment Under Test

Xmtr Nomenclature____________________

Type____________________ Serial No.__________

Output Tube____________________

Type____________________ Serial No.__________

Significant control Positions____________________

____________________

____________________

____________________

Test Equipment

Spectrum Analyzer Used____________________ Serial No.__________

3 db Resolution BW__________kHz CW BW__________kHz

MDS__________dbm

Modulation Description____________________

Cable: Type__________Length__________Ft.

____________________

____________________

Significant Control Positions____________________

____________________

Test Information

Description of Analysis Pulse:

*PW __________PRF__________

Rise Time__________Fall Time__________

Compression Ratio____________________

____________________

*PW: 50% Voltage Point , Rise Time: 10% to 90% Pk Voltage (Fall Time Vice Versa)

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE108
INTERNALLY MODULATED PULSED TRANSMITTERS
(Narrow-Band Data)

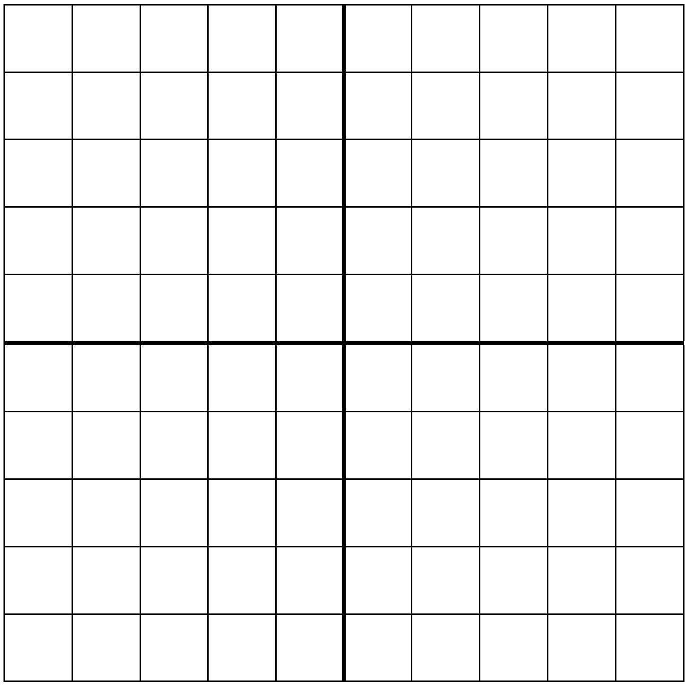
Pulsed ☐ Date________________ Coax ☐

Non Pulsed ☐ Waveguide ☐

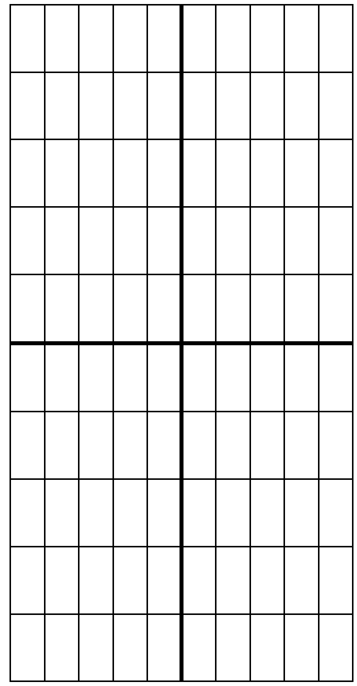
| Frequency | | Ident. | Sig. Gen. Output (dbm) | Losses (db) | Power Out *__________ (dbm) |
|---|---|---|---|---|---|
| Xmtr. Tuned (MHz) | Spurious (MHz) | | | | |
| | | | | | |

*Indicate: Average or Peak

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE108
INTERNALLY MODULATED PULSED TRANSMITTERS
(Narrow-Band Data)



Frequency (MHz)



Sig. Gen. Output (dbm)

Photo No.________________Date_____________________

Transmitter Tuned Frequency_______________________MHz

Spectrum Analyzer:

Bandwidth_________________kHz

Sweep Width_______________MHz Sweep Rate________________Hz

Comments________________________________________________________________

________________________________________________________________

________________________________________________________________

NOTE: Each vertical and horizontal retical should be calibrated either with an attached calibrated curve or by scaling the photograph.

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE110
INTERNALLY MODULATED PULSED TRANSMITTERS

Pulsed ☐ WIDE BANDWIDTH DATA Coax ☐
Non Pulsed ☐ Waveguide ☐

Equipment Under Test
Xmtr Nomenclature________________________________________________

Type______________________________Serial No.______________

Output Tube________________________________________________

Type______________________________Serial No.______________

Significant Control Positions______________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

Test Equipment
Receivers Used_________________________Serial No.______________
_________________________ ______________
_________________________ ______________

3 db Resolution BW ____________kHz CW BW____________________kHz

MDS________________dbm
Modulation Description______________________________________________
Cable: Type_______________________Length______________________Ft.
________________________________________________________________
________________________________________________________________

Significant Control Positions______________________________________
________________________________________________________________
________________________________________________________________

Test Information
Description of Analysis Pulse:

*PW ____________________PRF____________________________pps

Rise Time________________Fall Time__________________________

Compression Ratio__________________________________________
________________________________________________________________

*PW: 50% Voltage Pt. Rise Time: 10% to 90%, Fall Time Vice Versa

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE110
INTERNALLY MODULATED PULSED TRANSMITTERS
WIDE BAND WIDTH DATA

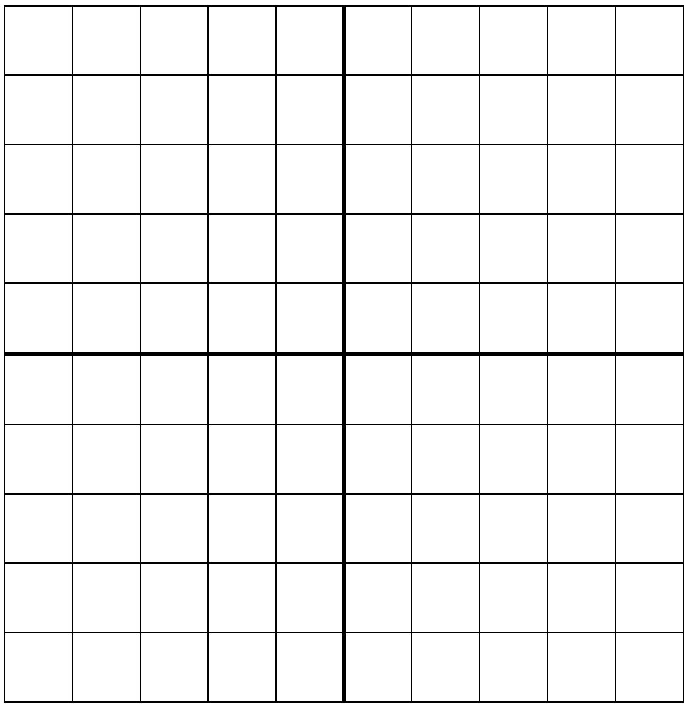
Pulsed ☐ Date________________ Coax ☐

Non Pulsed ☐ Waveguide ☐

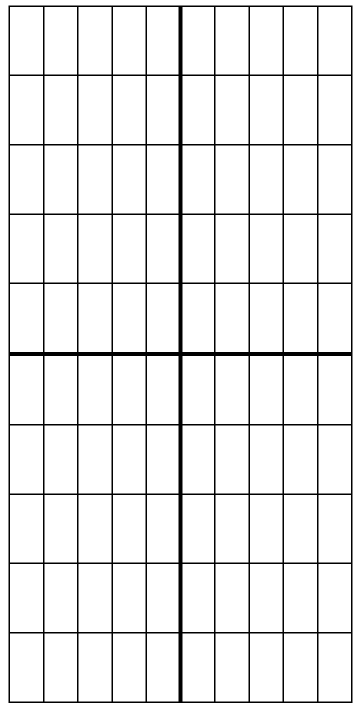
| Frequency | | Ident. | Sig. Gen. Output (dbm) | Losses (db) | Power Out * __________ (dbm) |
|---|---|---|---|---|---|
| Xmtr. Tuned (MHz) | Spurious (MHz) | | | | |
| | | | | | |

*Indicate: Average or Peak

TRANSMITTER MEASUREMENTS
CONDUCTED EMISSION SPECTRUM CHARACTERISTICS METHOD CE110
INTERNALLY MODULATED PULSED TRANSMITTERS
(WIDE BAND DATA)



Frequency (MHz)



Sig. Gen. Output

Photo No.________________Date_____________________

Transmitter Tuned Frequency_______________________MHz

Spectrum Analyzer:

Bandwidth_________________kHz

Sweep Width_______________MHz Sweep Rate________________Hz

Comments__________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

NOTE: Each vertical and horizontal reticle should be calibrated either with an attached calibrated curve or by scaling the photograph.

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE102
INTERNALLY MODULATED PULSED TRANSMITTERS

Pulsed ☐ Coax ☐

Non Pulsed ☐ Waveguide ☐

Equipment Under Test

Xmtr Nomenclature ____________________

Type ____________________ Serial No. __________

Output Tube ____________________

Type ____________________ Serial No. __________

Pwr. Out. __________ dbm Avg. __________ dbm Peak

Modulation ____________________

Far Field Distance __________ Ft., __________ Meters

Significant Control Positions ____________________

____________________

____________________

Test Equipment

Spectrum Analyzer Used __________, MDS __________ dbm

3 db Resolution BW __________ kHz CW BW __________ kHz

Test Antenna: Type __________ Polarity __________

Cable Type: __________ Length __________ Ft.

Significant Control Positions ____________________

____________________

____________________

Test Information

Radar Site Elevation __________ Ft. MSL.

Test Site Elevation __________ Ft. MSL.

Antenna Height __________ FT.

Measurement Distance ____________________

____________________

Unusual Terrain Features or Man Made Objects ____________________

____________________

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE102
INTERNALLY MODULATED PULSED TRANSMITTERS

Pulsed ☐ Coax ☐
Non Pulsed ☐ Waveguide ☐

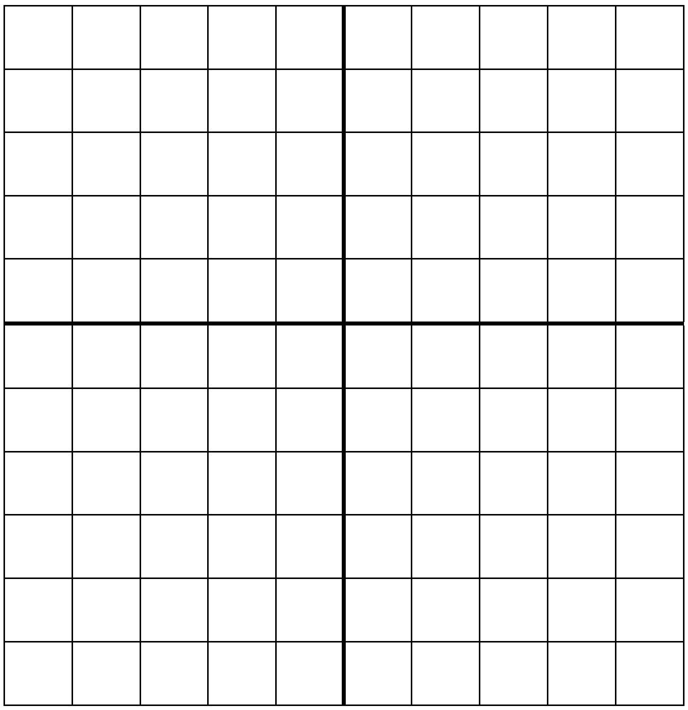
Xmtr Tuned Freq:________________________, Peak Power Output______________dbm
**Fundamental or Spurious Being Analyzed: Nominal PW___________________, Nominal PRF_______________________
Rise Time__________________________________ Fall Time_____________________________
Modulation_________________________________ Compression Ratio_____________________

| $\Delta f$ (± MHZ) | Date/ Time (24 hr. base) | Test Antenna Orientation | | | | S.G.* S/A Input (dbm) | Measured Cable Loss | | Attenu- ation Inserted (db) | Test Ant. Effective Aperture (db) | Power Density (Peak) ($dbm/m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $\theta$ (deg) | $\Phi$ (deg) | $\omega$ (deg) | Ht (deg) | | S.G.-S/A (db) | Ant.-S/A (db) | | | |
| | | | | | | | | | | | |

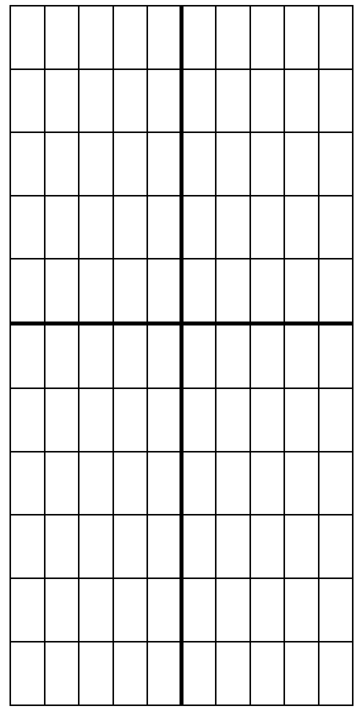
*State type of signal used.
** Rise: 10% to 90% of Peak Voltage; Fall: 90% to 10% Peak Voltage; P.W. 50% Voltage Points.

Note: Record received energy in units actually measured; if converted to other units, report raw data and calculations on separate sheet.

## TRANSMITTER MEASUREMENTS
## RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE102
## INTERNALLY MODULATED PULSED TRANSMITTERS



Frequency (MHz)



Sig. Gen. Output

Photo No.________________Date_____________________

Transmitter Tuned Frequency_________________MHz Peak Power Output____________dbm

Spectrum Analyzer:

Bandwidth_________________kHz

Sweep Width_______________MHz Sweep Rate________________Hz

Comments________________________________________________________________________

_________________________________________________________________________________

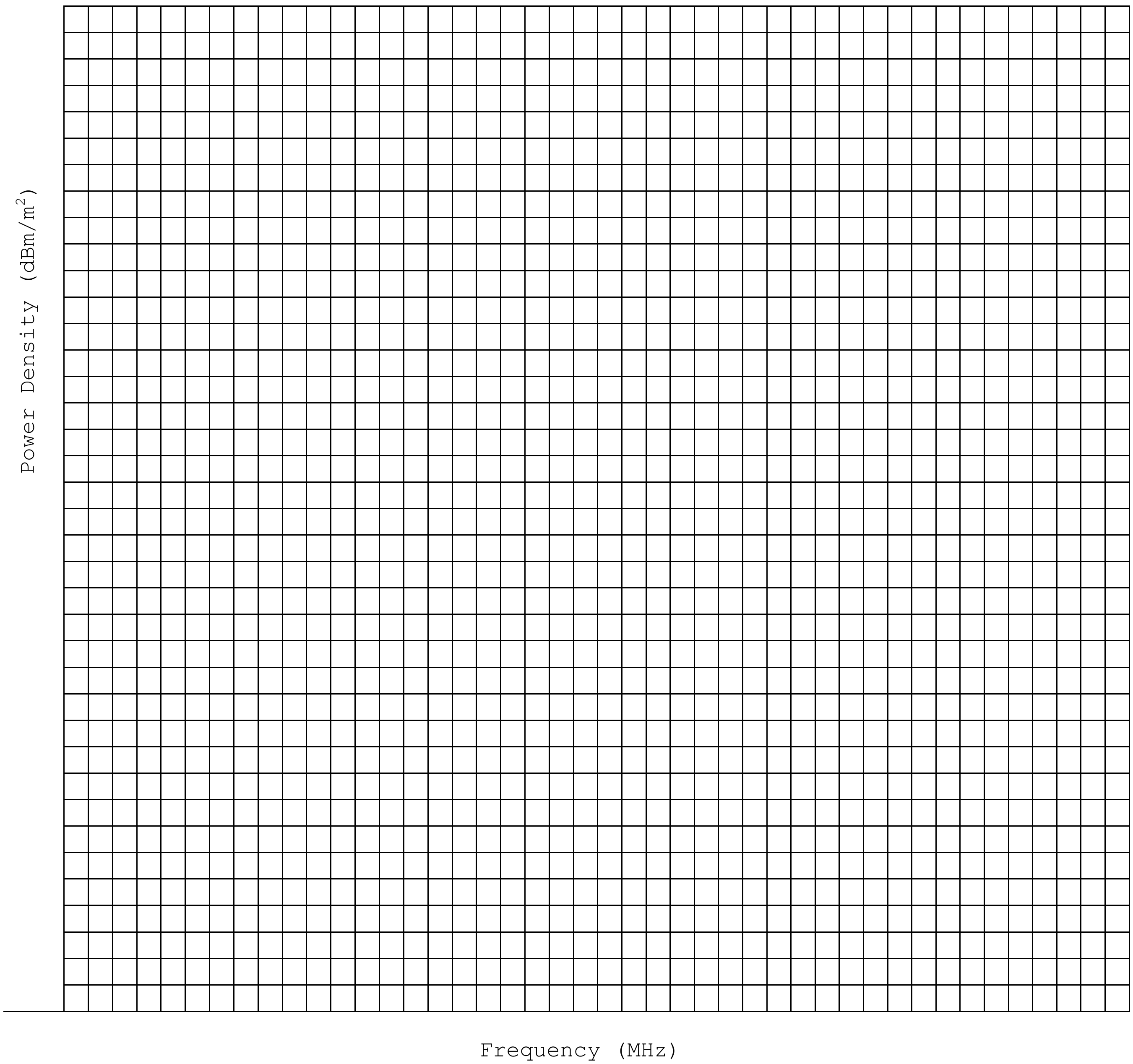
_________________________________________________________________________________

NOTE: Each vertical and horizontal reticle should be calibrated either with an attached calibrated curve or by scaling the photograph.

TRANSMITTER MEASUREMENTS
RADIATED EMISSION SPECTRUM CHARACTERISTICS METHOD RE102
INTERNALLY MODULATED PULSED TRANSMITTERS

Xmtr. Nomenclature________________________________Serial No.___________________
Tuned Frequency________________________________MHz Test Site___________________

Pulsed ☐ Coax ☐
Non Pulsed ☐ Waveguide ☐



## TRANSMITTER MEASUREMENTS
## CARRIER FREQUENCY STABILITY METHOD CE105
## INTERNALLY MODULATED PULSED TRANSMITTERS

Equipment Under Test

Transmitter Nomenclature______________________________________________
Type__________________________________________Serial No.___________
Tuned Freq._____________________________________MHz.
Configuration_________________________________________________________
Date and Time Equip. Last Operated____________________________________
Significant Control Positions_________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

Test Equipment

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
Frequency Stability______________________________Parts/Million

Significant Control Positions_________________________________________
______________________________________________________________________
______________________________________________________________________

Test Information
Point of Signal Injection_____________________________________________
Point of Measurement__________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

TRANSMITTER MEASUREMENTS
CARRIER FREQUENCY STABILITY METHOD CE105
INTERNALLY MODULATED PULSED TRANSMITTERS

Xmtr. Nomenclature________________________________________________Serial No.______________________
Tuned Frequency____________________________________MHz

| Date | Time | Frequency (Hz) | Date | Time | Frequency (Hz) |
|---|---|---|---|---|---|
| | | | | | |

APPENDIX C

NON-PULSED RECEIVERS

RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS101
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature_______________________________________________
Type_________________________________________Serial No._____________
Tuning Range or Band_______________________________________MHz
Nominal Sensitivity________________________dBm
3 dB Bandwidth_____________________________kHz
Configuration_______________________________________________________
Significant Control Positions_______________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions_______________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Information

Test Signal Modulation:
Frequency_________________________Hz, Percentage_______________%
Or PW ________________________µsec, PRF______________________pps
Point of Signal Injection____________________________________________
Point of Measurement_________________________________________________
Std. Response Used___________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS101
NON-PULSED RECEIVERS

Rcvr. Nomenclature__________________________________________Serial No.____________________
Audio modulating Frequency____________________ Date__________________________

| Tuned Frequency (MHz) | Sig. Gen. Power (dBm) | Attenuation Inserted (dB) | Cable Loss (dB) | Coupling Loss (dB) | Power Input (dBm) |
|---|---|---|---|---|---|
| | | | | | |

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS103
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature________________________________________________
Type_________________________________________Serial No.______________
Tuning Range or Band_________________________________________________
Tuned Frequency____________________________________________________MHz.
Configuration________________________________________________________
Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Information

Point of Signal Injection____________________________________________
Point of Measurement_________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS103
NON-PULSED RECEIVERS

Rcvr. Nomenclature________________________ Serial No.______________
Tuned Frequency________________________MHz Date______________

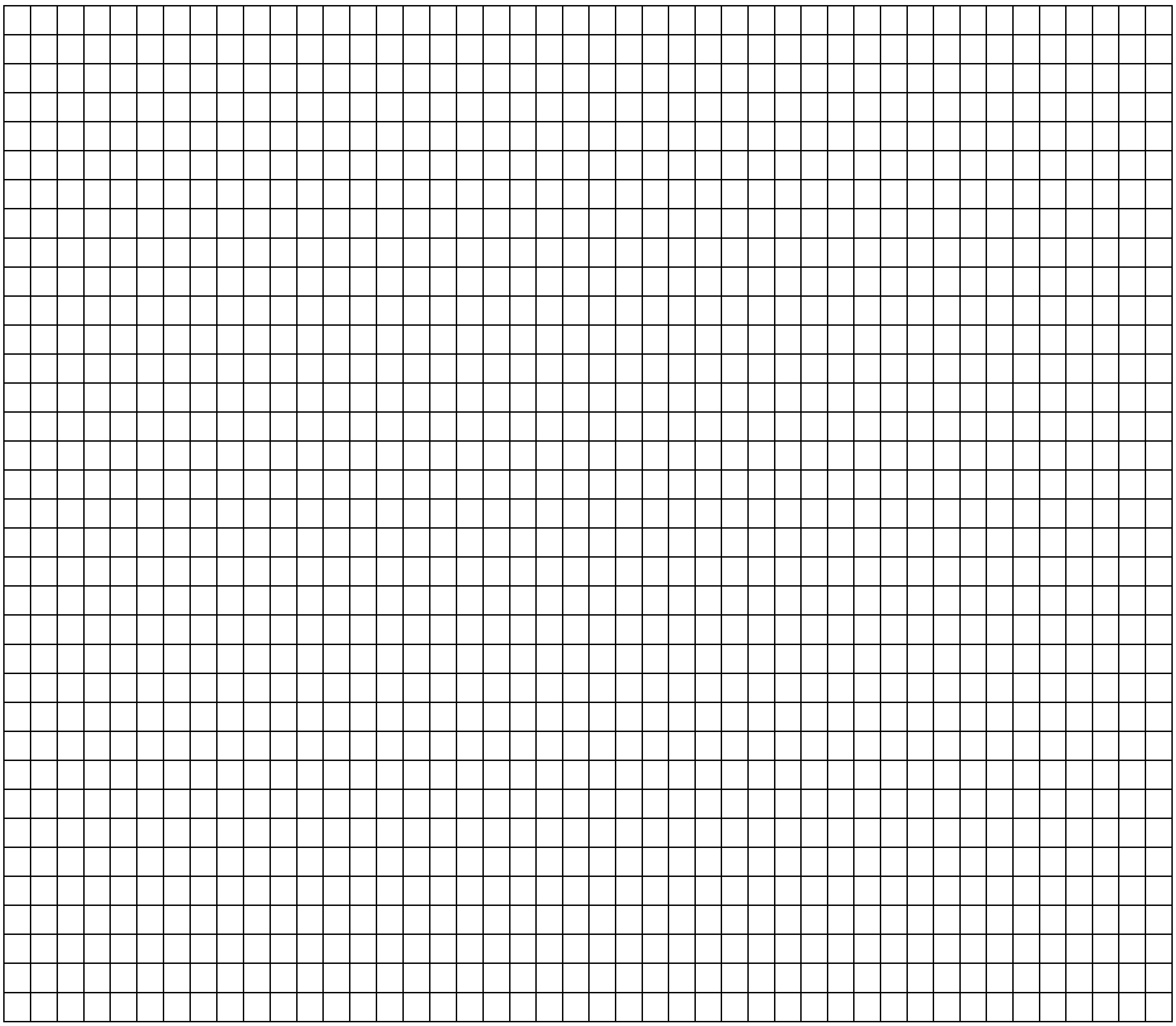
| Signal Gen. Output | Total Atten. SG-RCVR (dB) | Power Input (dBm) | Modulating or Audio Output Frequency (Hz) | *Modulation (%) or Deviation (kHz) | RMS Output (volts) | Peak Output (volts) | (S+N)/N (dB) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

* Not applicable for SSB receivers.

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS103
NON-PULSED RECEIVERS

Rcvr. Nomenclature_____________________________________Serial No._______________
Tuned Frequency___________________________MHz

RMS Output (Volts)

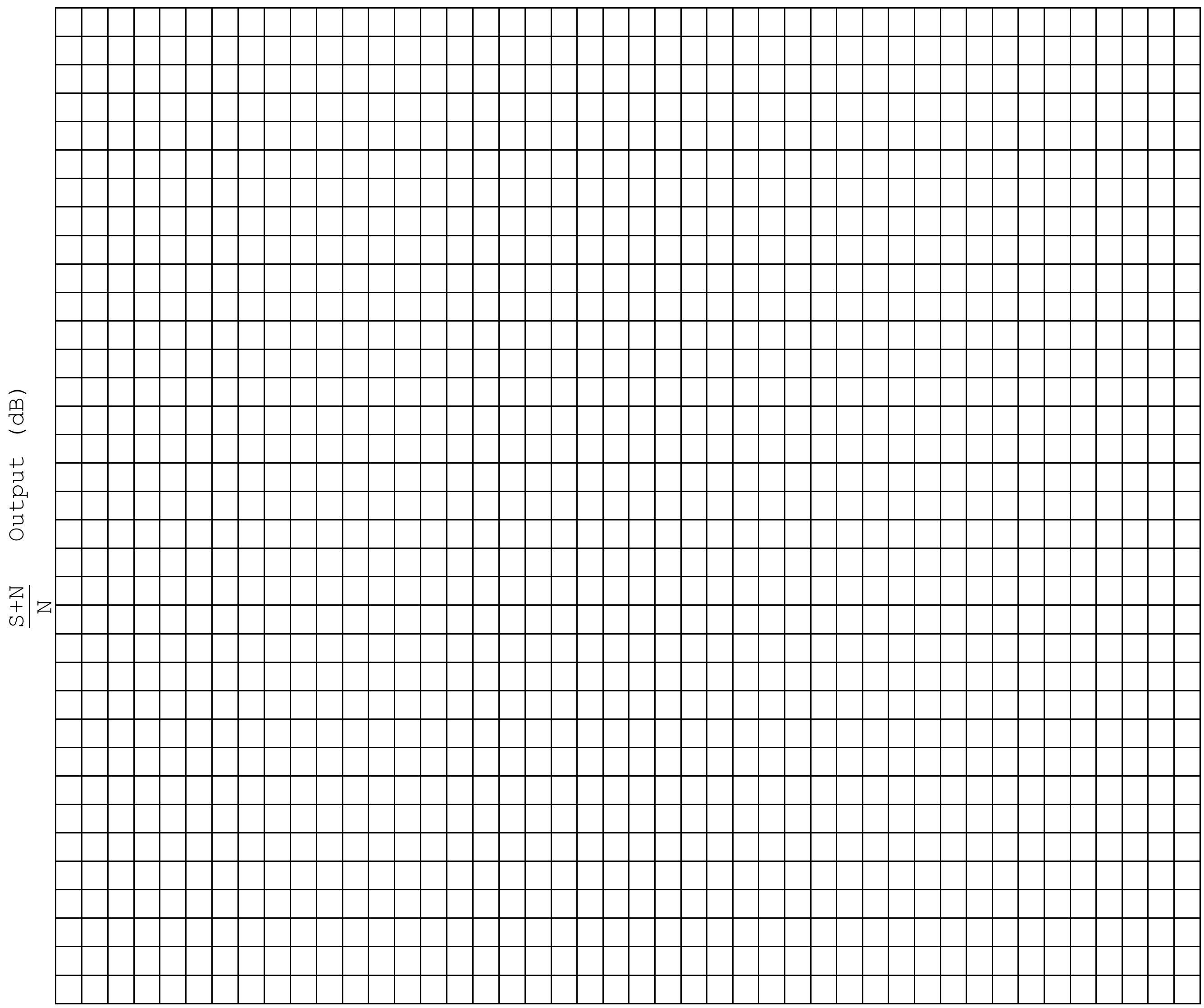


Power Input(dBm)

For FM only, plot curves for a family of deviations

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS103
NON-PULSED RECEIVERS

Rcvr. Nomenclature___________________________________Serial No.____________________
Tuned Frequency___________________________MHz




Input Power (dBm)

For FM only, plot curves for a family of deviations

RECEIVER MEASUREMENTS
AUDIO SELECTIVITY METHOD CS105
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature_______________________________________________
Type_______________________________________Serial No.______________
Tuning Range or Band________________________________________________
Tuned Frequency________________________________________________MHz.
Configuration_______________________________________________________
Nominal Sensitivity____________________________________________dBm.
Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Information

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

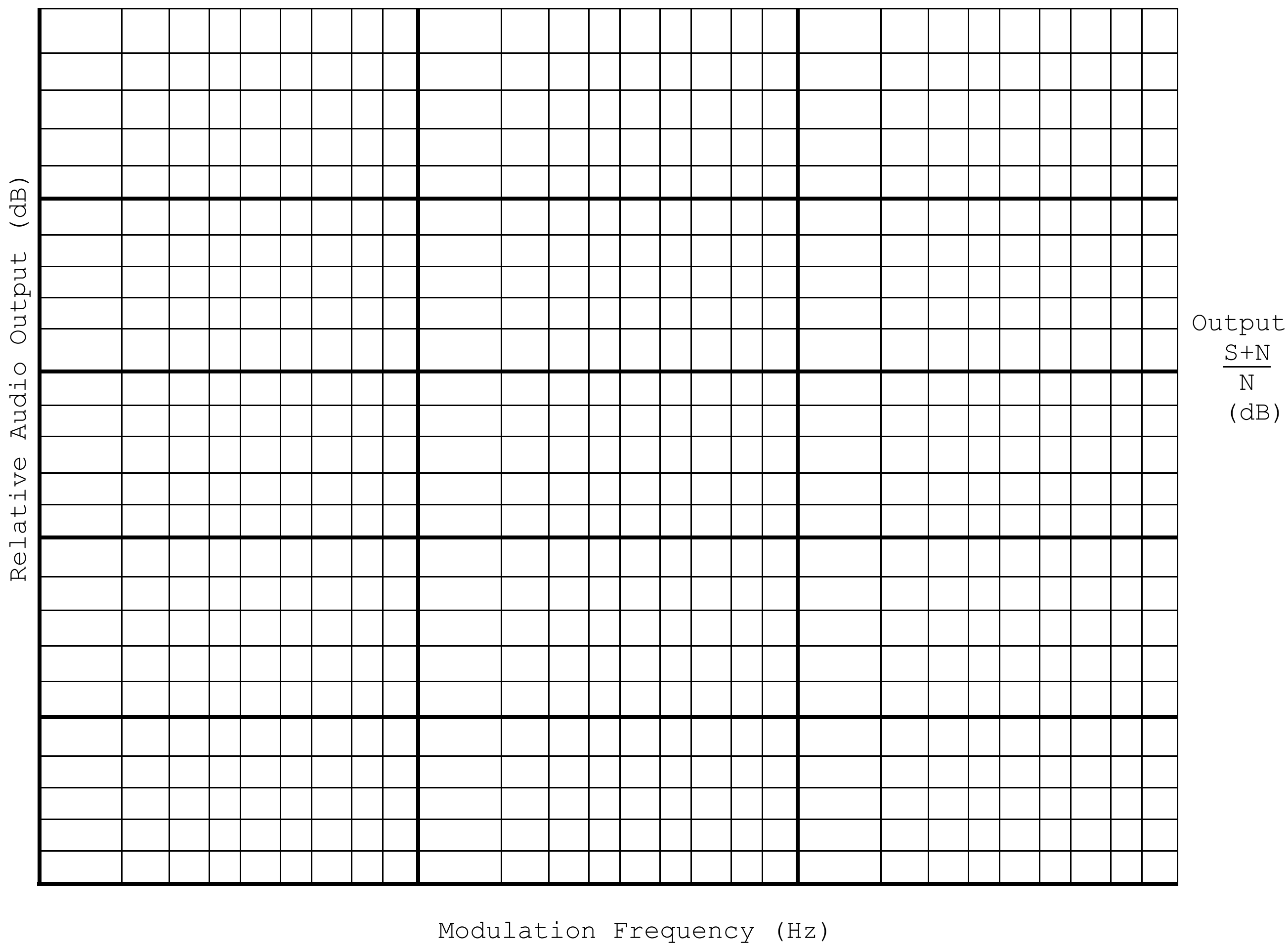
RECEIVER MEASUREMENTS
AUDIO SELECTIVITY METHOD CS105
NON-PULSED RECEIVERS

Rcvr. Nomenclature________________________________________________Serial No.________________
Tuned Frequency________________________________MHz Date______________________

| Signal Generator Output (dBm) | Total Attenuation SG - RCVR (dB) | Power Input (dBm) | Modulating or Audio Output Frequency (Hz) | RMS Output (volts) | Relative Output (dB) | (S+N)/N (dB) |
|---|---|---|---|---|---|---|
| | | | | | | |

RECEIVER MEASUREMENTS
AUDIO SELECTIVITY METHOD CS105
NON-PULSED RECEIVERS

Rcvr. Nomenclature______________________________Serial No.____________________
Tuned Frequency_________________MHz



# RECEIVER MEASUREMENTS
# SENSITIVITY METHOD CS106
# NON-PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature______________________________________________
Type_________________________________________Serial No.______________
Tuning Range or Band________________________________________________
Nominal: Bandwidth__________________________kHz.
Sensitivity_________________________dBm.
Configuration_______________________________________________________
Significant Control Positions_________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions_________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Information

Test Signal Modulation:
Frequency_________________________Hz, Percentage_______________%
Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
Std. Response Used__________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

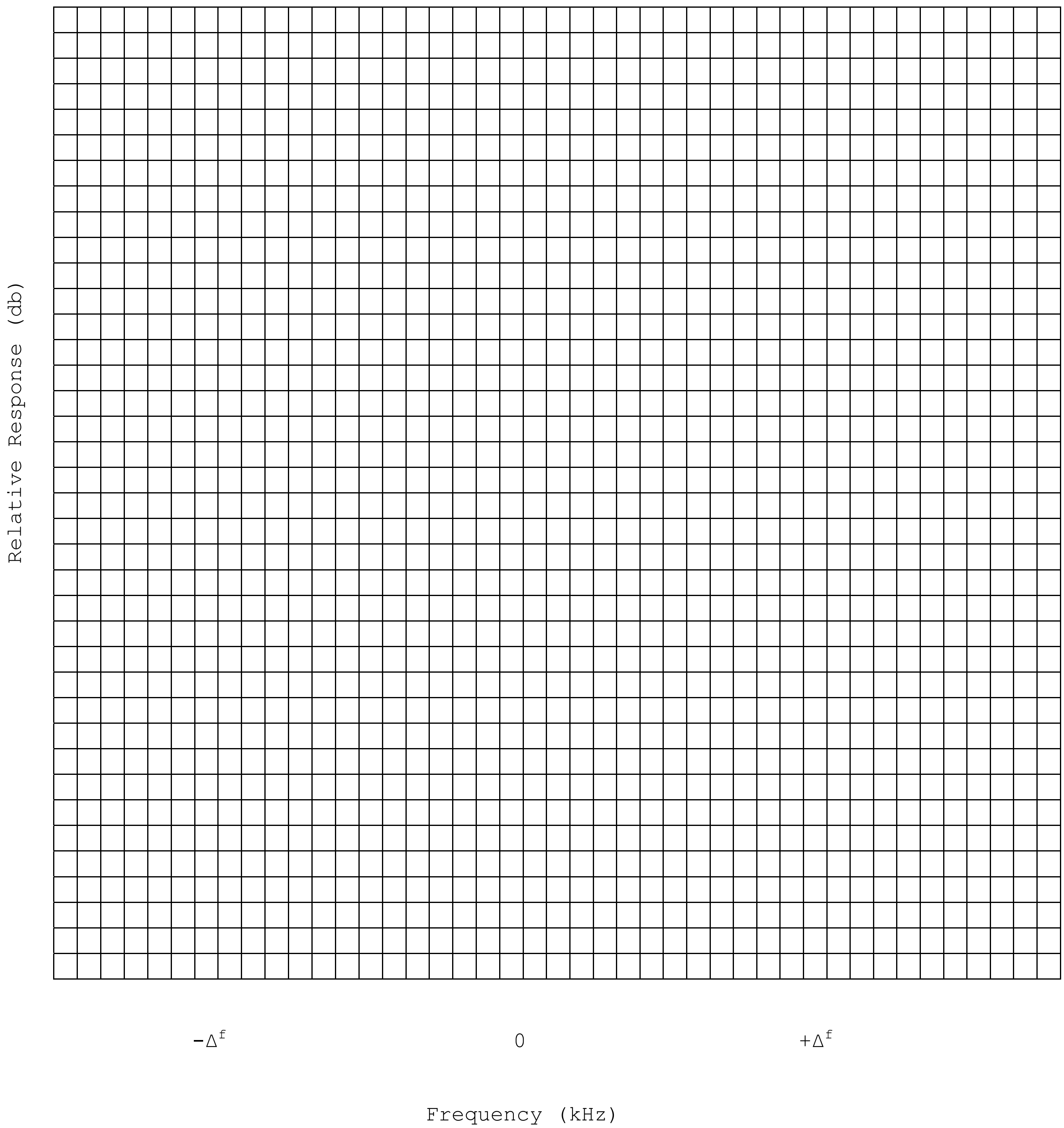
RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS106
NON-PULSED RECEIVERS

Rcvr. Nomenclature____________________________________Serial No.____________
Tuned Frequency______________________ MHz Date__________________
Tuning Band____________________________________________________________

| Relative Response (dB) | Absolute Freq. (MHz) | $-\Delta f$ (kHz) | Absolute Freq. (MHz) | $+\Delta f$ (kHz) | Bandwidth (kHz) |
|---|---|---|---|---|---|
| | | | | | |

RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS106
NON-PULSED RECEIVERS

Rcvr. Nomenclature_________________________________ Serial No.____________
Tuned Frequency_____________________ MHz



# RECEIVER MEASUREMENTS
# CONDUCTED SPURIOUS RESPONSE METHOD CS108
# NON-PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature____________________________________________
Type____________________________________Serial No.___________________
Tuning Band______________________________________________________

| LO Freq. | Injection Multiple | IF Freq. |
|---|---|---|
| 1.____________MHz | 1.______________________ | 1.____________MHz |
| 2.____________MHz | 2.______________________ | 2.____________MHz |
| 3.____________MHz | 3.______________________ | 3.____________MHz |

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Information

Test Signal Modulation:
Frequency__________________________________Hz, Percentage______%
or PW__________________________µsec, PRF______________pps
Point of Signal Injection_______________________________________
Point of Measurement____________________________________________
Std. Responses Used_____________________________________________
_______________________________________________________________
_______________________________________________________________
_______________________________________________________________

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS108
NON-PULSED RECEIVERS
(Continued)

Spurious Response Identification

The measured spurious response frequencies should be identified according to the appropriate relationship.

Single conversion receivers:

$$f_{SP} = \left| \frac{P f_{LO} + f_{IF}}{Q} \right|$$

Double conversion receivers:

$$f_{SP} = \left| \frac{P_1 f_{LO1}}{Q_1} \pm \left| \frac{P_2 f_{LO2} \pm f_{IF2}}{Q_1 Q_2} \right| \right|$$

Triple conversion receivers:

$$f_{SP} = \left| \frac{P_1 f_{LO1}}{Q_1} \pm \left| \frac{P_2 f_{LO2}}{Q_1 Q_2} \pm \left| \frac{P_3 f_{LO3} \pm f_{IF3}}{Q_1 Q_2 Q_3} \right| \right| \right|$$

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS108
NON-PULSED RECEIVERS
(continued)

The relationships may also be expressed is the following manner:

Single conversion receivers:

$$f_{IF} = \left| P f_{LO} \pm Q f_{SP} \right|$$

Double conversion receivers:

$$f_{IF2} = \left| Q_2 \left| P_1 f_{LO1} \pm Q_1 f_{SP} \right| \pm P_2 f_{LO2} \right|$$

Triple conversion receivers:

$$f_{IF3} = \left| Q_3 \left| Q_2 \left| P_1 f_{LO1} \pm Q_1 f_{SP} \right| \pm P_2 f_{LO2} \right| \pm P_3 f_{LO3} \right|$$

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS108
NON-PULSED RECEIVERS

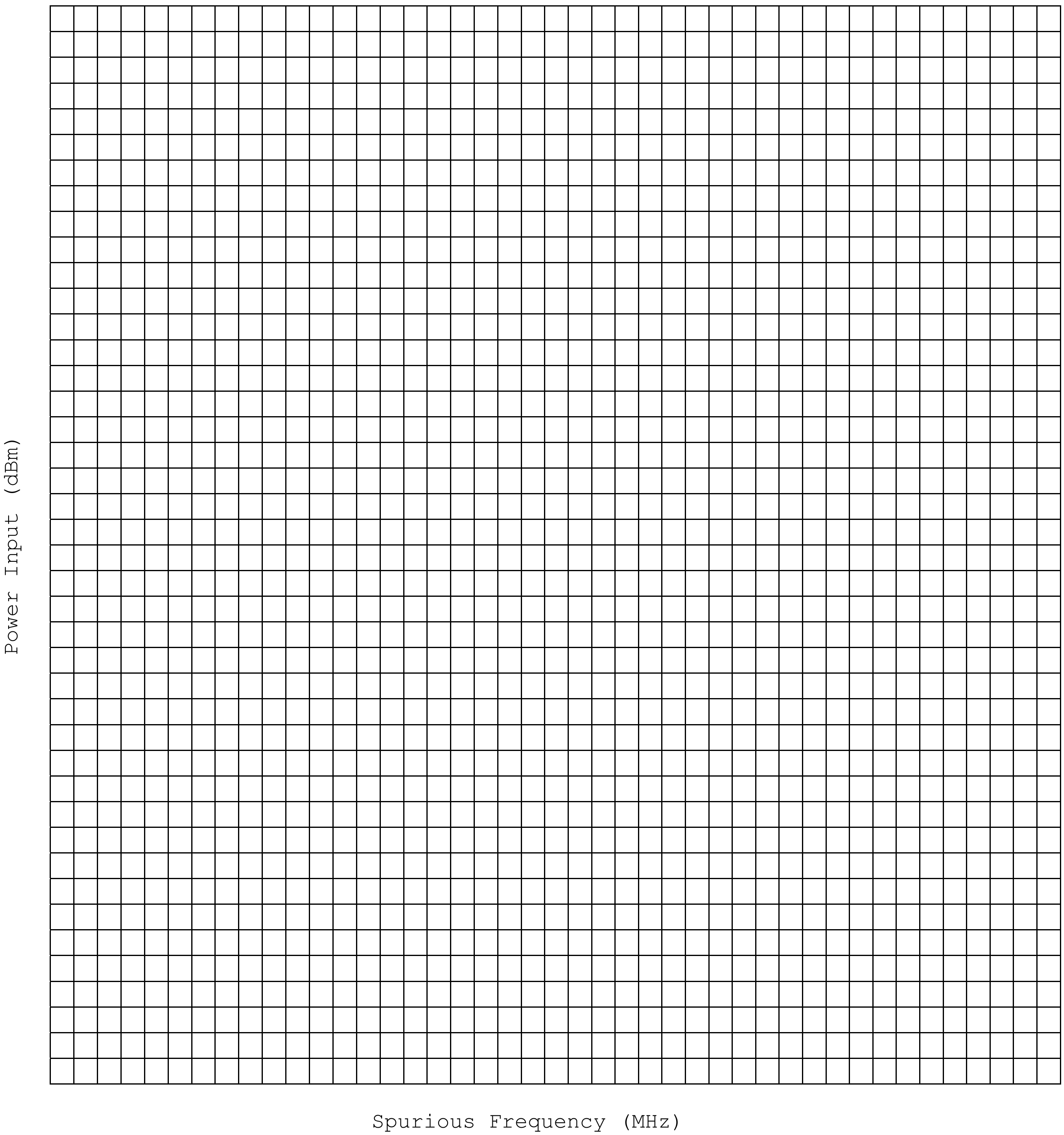
Rcvr. Nomenclature________________________________________________________Serial No.____________
Tuned Frequency_____________________________MHz                              Date__________________
Measured LO Frequency (1)_________________MHz (2)__________________MHz (3)_________________MHz
Injection Multiple (1)_________________ (2)__________________ (3)_________________
IF Frequency (1)_________________MHz (2)__________________MHz (3)_________________MHz

| Spurious Frequency (MHz) | Sig.Gen. Output (dBm) | Atten. SG-RCVR (dB) | Power Input (dBm) | Mixer Identification | | | | | | | | | Response (See Note) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | First | | | Second | | | Third | | | |
| | | | | P | Q | Sign | P | Q | Sign | P | Q | Sign | |
| | | | | | | | | | | | | | |

NOTE: For Spurious Response Dynamic Range Measurement Record:
1) Output (S+N)/N for communication receivers (dB)
2) Peak video output for radar receivers (volts)

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS108
NON-PULSED RECEIVERS

Rcvr. Nomenclature________________________________Serial No.______________________
Tuned Frequency_________________________MHz



RECEIVER MEASUREMENTS
RADIATED SPURIOUS RESPONSE METHOD RS101
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature_______________________________________________
Type________________________________________Serial No.______________
Tuning Range or Band________________________________________________
Configuration_______________________________________________________
Tuned Frequency___________________________________________________MHz
Modulation Frequency_____________________MHz, Percentage___________%
LO Frequency (1)_________MHz (2)_______MHz (3)_____________MHz
IF Frequency (1)_________MHz (2)_______MHz (3)_____________MHz
Far Field Distance__________________Ft.,______________________Meters
Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________

Test Information

Receiving Antenna Elevation___________________________________Ft. MSL
Test Antenna Elevation________________________________________Ft. MSL
Test Signal Modulation______________________________________________
Std. Response Used__________________________________________________
____________________________________________________________________
____________________________________________________________________

RECEIVER MEASUREMENTS
RADIATED SPURIOUS RESPONSE METHOD RS101
NON-PULSED RECEIVERS

Rcvr. Nomenclature______________________________________________Serial No._________________
Tuned Frequency____________________________MHz Date_______________________

| Fundamental or Spurious Frequency (MHz) | Sig. Gen. Power Output (dBm) | Test Antenna Gain (dB) | Total Attenuation SG-ANT. (dB) | Propagation Loss (dB) | *_______Power Density At System Antenna ($dBm/m^2$) |
|---|---|---|---|---|---|
| | | | | | |

* Indicate Avg. or Peak

# RECEIVER MEASUREMENTS
# INTERMODULATION METHOD CS110
# NON-PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature______________________________________________
Type__________________________________________Serial No.____________
Tuning Range or Band_________________________________________________
Configuration_______________________________________________________
Significant Control Positions________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

## Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions________________________________________
____________________________________________________________________
____________________________________________________________________

## Test Information

Point of Signal Injection____________________________________________
Point of Measurement________________________________________________
Standard Response Used______________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

RECEIVERS MEASUREMENTS
INTERMODULATION METHOD CS110
NON-PULSED RECEIVERS

Rcvr. Nomenclature______________________________________________ Serial No.______________________
Tuned Frequency__________________________MHz Date_____________________________
3 dB Bandwidth___________________________kHz

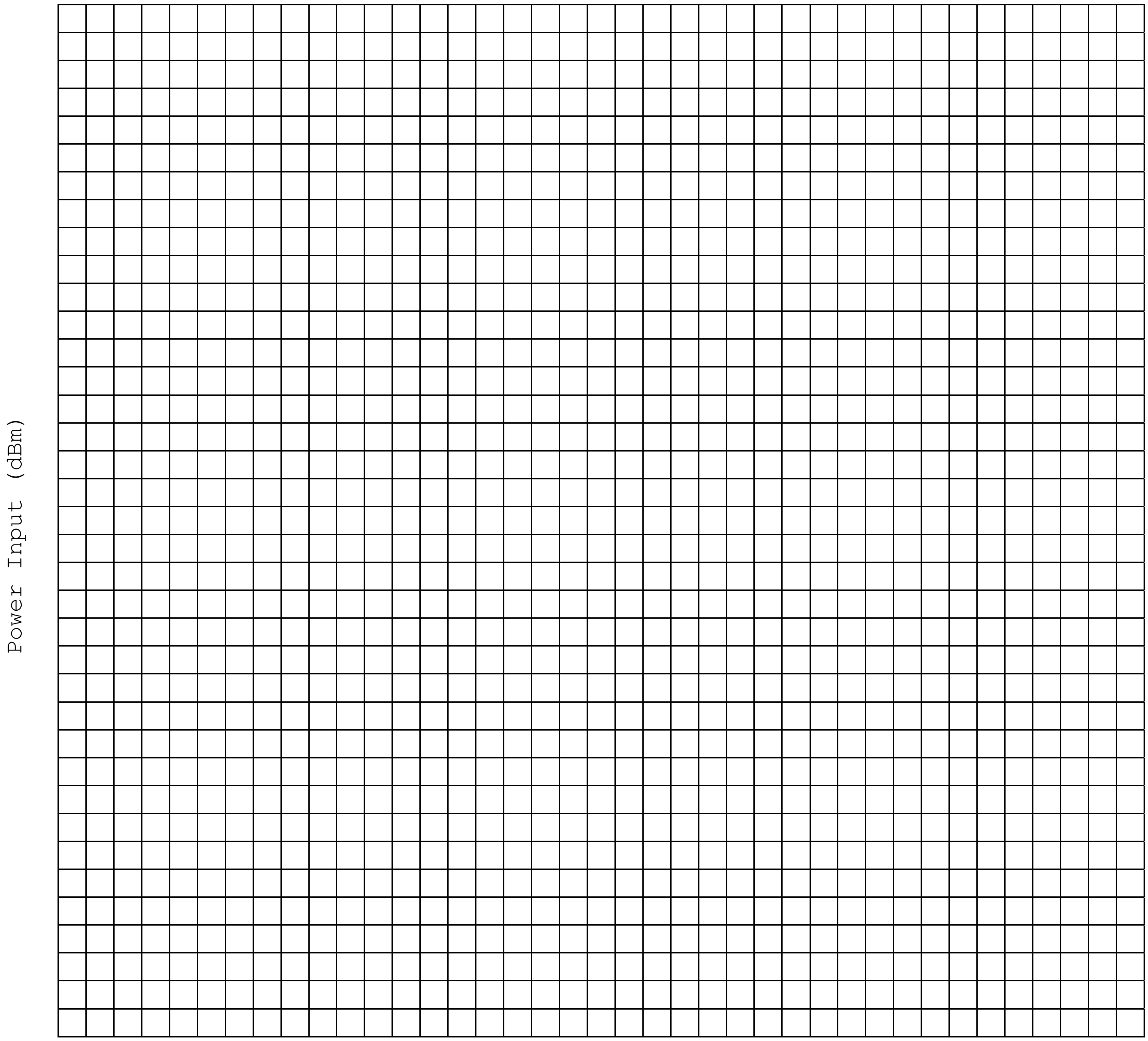
| Intermodulation Identification | *$f_a$ (MHz) | **$f_b$ (MHz) | ***$\Delta f$ (MHz) | Sig. Gen. Output (dBm) | | Attenuation (dB) | | Power Input (dBm) | Output Response (See Note) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $f_a$ | $f_b$ | $f_a$ | $f_b$ | | |
| | | | | | | | | | |

* $f_a$ Interfering Signal Frequency Closest to $f_o$ (CW)
** $f_b$ Other Interfering Signal Frequency (Modulation: frequency______________Hz____________%)
*** $\Delta f = f_a - f_o$______________________________ or PW_____________________µsec, PRF______________pps
$f_o = mf_a \pm nf_b$ ; $m + n$ = Intermodulation Order

Note: For AM/SSB use (S+N)/N in db.
For FM use quieting in dB.
For radar use peak video output in volts.

# RECEIVERS MEASUREMENTS
# INTERMODULATION METHOD CS110
# NON-PULSED RECEIVERS

Rcvr. Nomenclature________________________________Serial No.______________________
Tuned Frequency_________________________MHz




Frequency ± Δf (MHz)

Note: (1) Indicate and identify intermodulation orders on curves

(2) Use separate sheet for +Δf and -Δf

RECEIVER MEASUREMENTS
OSCILLATOR EMISSION METHOD CS112
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature________________________________________________
Type__________________________________________Serial No.____________
Tuning Range or Band_________________________________________________
Configuration________________________________________________________
Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________

Test Information

Point of Signal Injection____________________________________________
Point of Measurement_________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

# RECEIVERS MEASUREMENTS
## OSCILLATOR EMISSION METHOD CS112
## NON-PULSED RECEIVERS

Rcvr. Nomenclature__________________________________________________ Serial No.__________________

Tuned Frequency__________________________MHz Date_________________________

LO Frequency_____________________________MHz

| Radiated Frequency | Frequency Identification | Sig. Gen. Output (dBm) | Attenuation SG - FSV (dB) | Power Output (dBm) |
|---|---|---|---|---|
| | | | | |

RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS114
NON-PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature_______________________________________________
Type_________________________________________ Serial No.____________
Tuning Range or Band________________________________________________
Configuration_______________________________________________________
Significant Control Positions_______________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_______________________________________
Interfering Source:_________________________________________________
Noise bandwidth____________________kHz
Modulation______________% or deviation________________________kHz
____________________________________________________________________
____________________________________________________________________

Test Information

Point of Signal Injection___________________________________________
Point of Measurement________________________________________________
Std. Response Used__________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

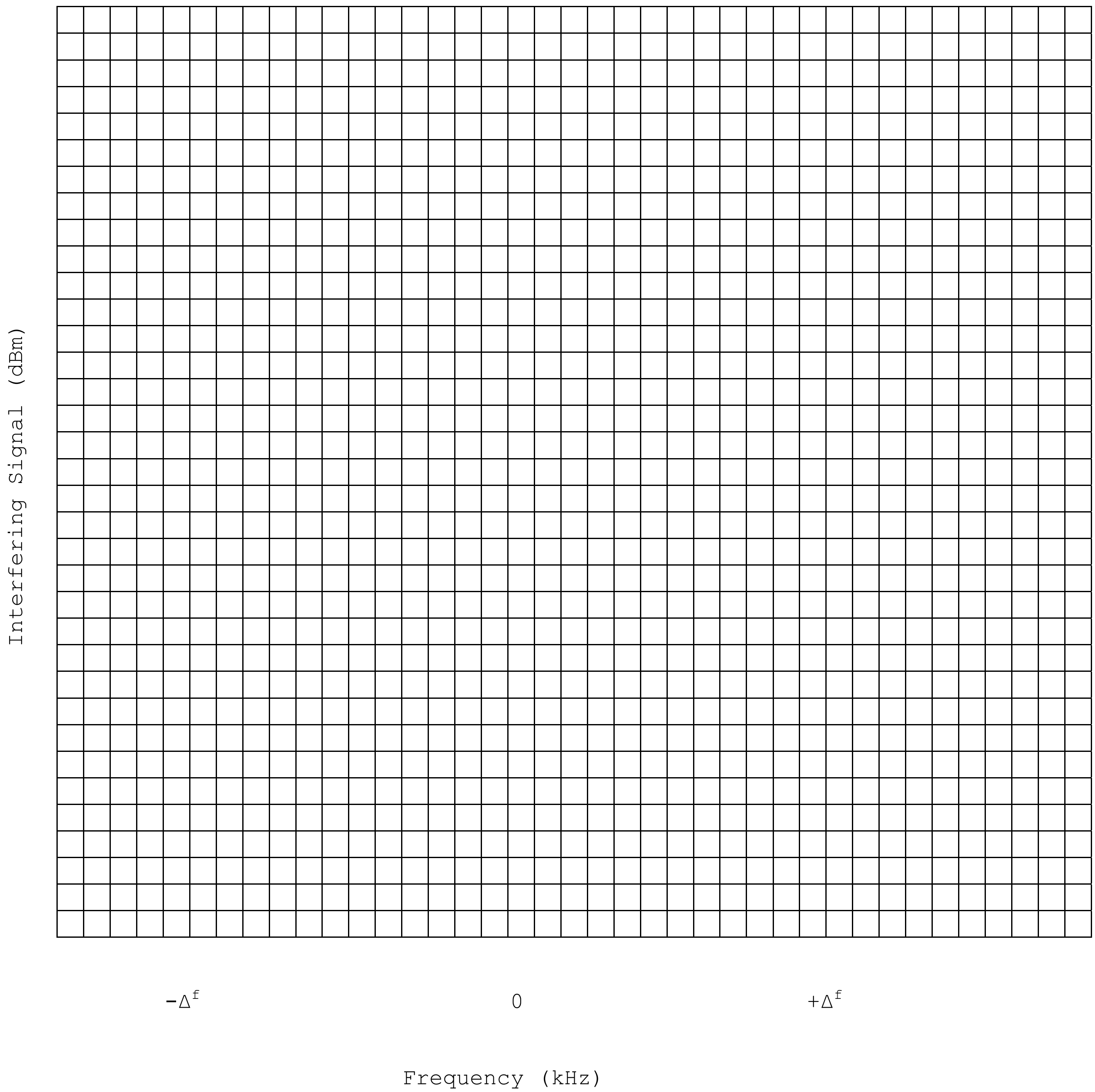
RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS114
NON-PULSED RECEIVERS

Rcvr. Nomenclature________________________________________Serial No._______
Tuned Frequency__________________________MHz Date______________
Sensitivity_____________________dBm

| Interfering Signal Frequency (MHz) | Desired Signal Frequency | ± Δf (MHz) | Interfering | | | Desired | | | $\frac{S+N}{N}$ (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Sig. Gen. Output (dBm) | Atten. SG-RVR (dBm) | RCVR Input (dBm) | Sig. Gen. Output (dBm) | Atten. SG-RVR (dBm) | RCVR Input (dBm) | |
| | | | | | | | | | |

RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS114
NON-PULSED RECEIVERS

Rcvr. Nomenclature_______________________________________Serial No.________________
Tuned Frequency____________________MHz

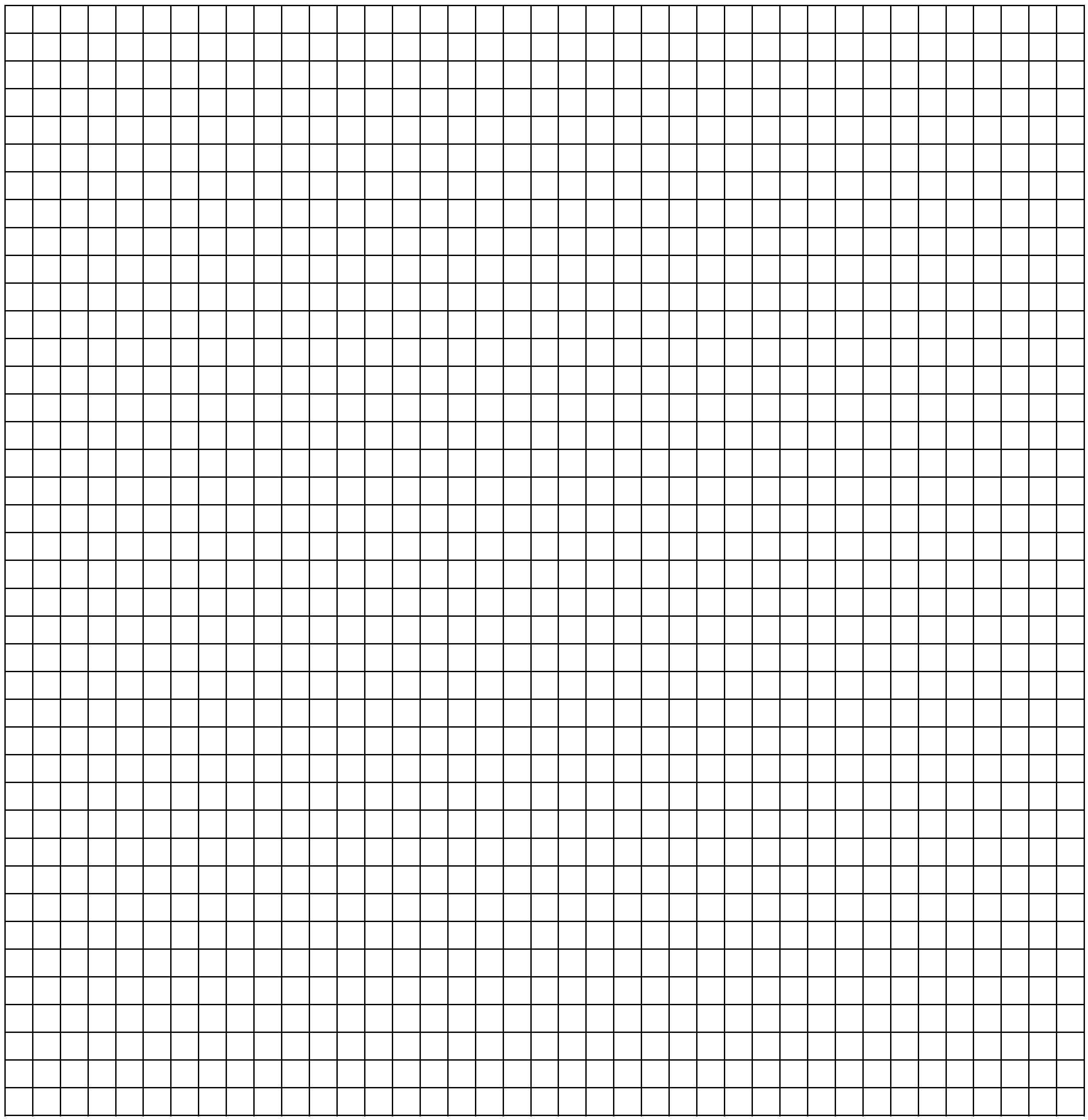



Plot curves for a family or desired receiver input powers (dBm).

## RECEIVER MEASUREMENTS
## ADJACENT SIGNAL INTERFERENCE METHOD CS114
## NON-PULSED RECEIVERS

Rcvr. Nomenclature____________________________________Serial No._________
Tuned Frequency___________________MHz       Δf = ____________________MHz

Output
$\frac{S+N}{N}$
(dB)



Interfering Signal Power (dBm)

Plot curves for a family of desired levels

# RECEIVER MEASUREMENTS
# DISCRIMINATOR BANDWIDTH METHOD CS116
# NON-PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature________________________________________________
Type_________________________________________Serial No.______________
Tuning Range or Band_________________________________________________
Tuned Frequency_____________________________________________________MHz
Nominal Sensitivity_________________________________________________dBm
Configuration________________________________________________________
Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Information

Point of Signal Injection____________________________________________
Measurement Point____________________________________________________
Std. Response Used___________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

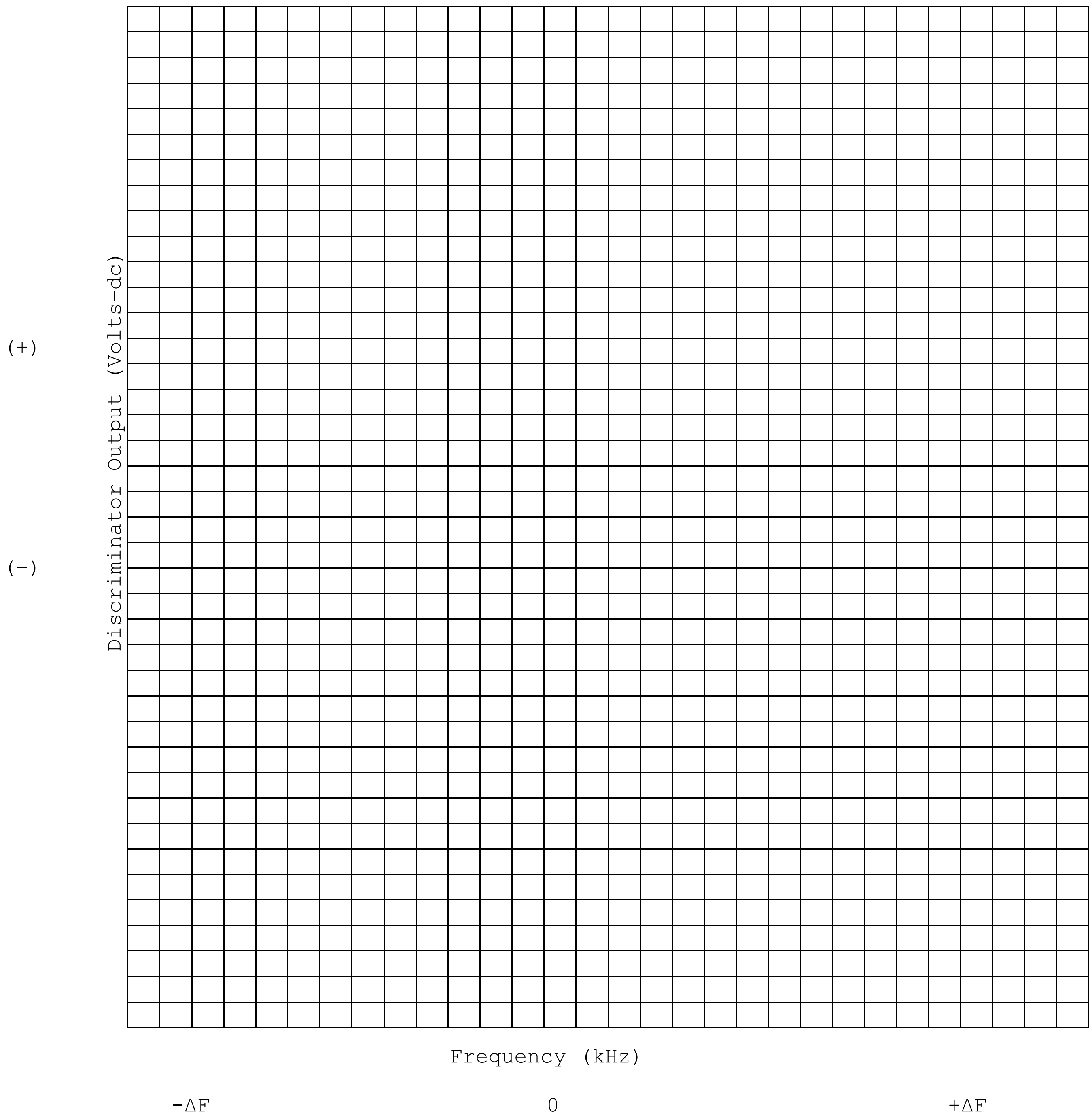
RECEIVER MEASUREMENTS
DISCRIMINATOR BANDWIDTH METHOD CS116
NON-PULSED RECEIVERS

Rcvr. Nomenclature____________________ Serial No.__________
Tuned Frequency____________________MHz Date__________

| Signal Frequency (MHz) | ± Δ f (kHz) | Signal Generator Output (dBm) | Total Attenuation SG-RCVR (dB) | Power Input (dB) | Discriminator Output (± Volts, DC) |
|---|---|---|---|---|---|
| | | | | | |

RECEIVER MEASUREMENTS
DISCRIMINATOR BANDWIDTH METHOD CS116
NON-PULSED RECEIVERS

Rcvr. Nomenclature_______________________________________Serial No.________________
Tuned Frequency_______________________MHz



# APPENDIX D

# PULSED RECEIVERS

RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS102
PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature________________________________________
Type______________________________________Serial No.__________
Tuning Range or Band__________________________________MHz
Nominal Sensitivity______________________dBm
3 dB Bandwidth__________________________kHz
Configuration_________________________________________________
Significant Control Positions_________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

Test Equipment

______________________________________________________________
______________________________________________________________
______________________________________________________________

Significant Control Positions_________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

Test Information

Test Signal Modulation:
Frequency_________________________Hz, Percentage__________%
or PW_______________________μsec, PRF_______________pps
Point of Signal Injection_____________________________________
Point of Measurement _________________________________________
Std. Response Used____________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

RECEIVER MEASUREMENTS
SENSITIVITY METHOD CS102
PULSED RECEIVERS

Rcvr. Nomenclature________________________________________Serial No.____________________
Audio modulating frequency______________________ Date__________________________

| Tuned Frequency (MHz) | Sig.Gen. Power (dBm) | Attenuation Inserted (dB) | Cable Loss (dB) | Coupling Loss (dB) | Power Input (dBm) |
|---|---|---|---|---|---|
| | | | | | |

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS104
PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature____________________________________________
Type_________________________________________Serial No.___________
Tuning Range or Band_____________________________________________
Tuned Frequency__________________________________________________MHz.
Configuration____________________________________________________
Significant Control Positions____________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Test Equipment

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Significant Control Positions____________________________________
_________________________________________________________________
_________________________________________________________________

Test Information

Point of Signal Injection________________________________________
Point of Measurement_____________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

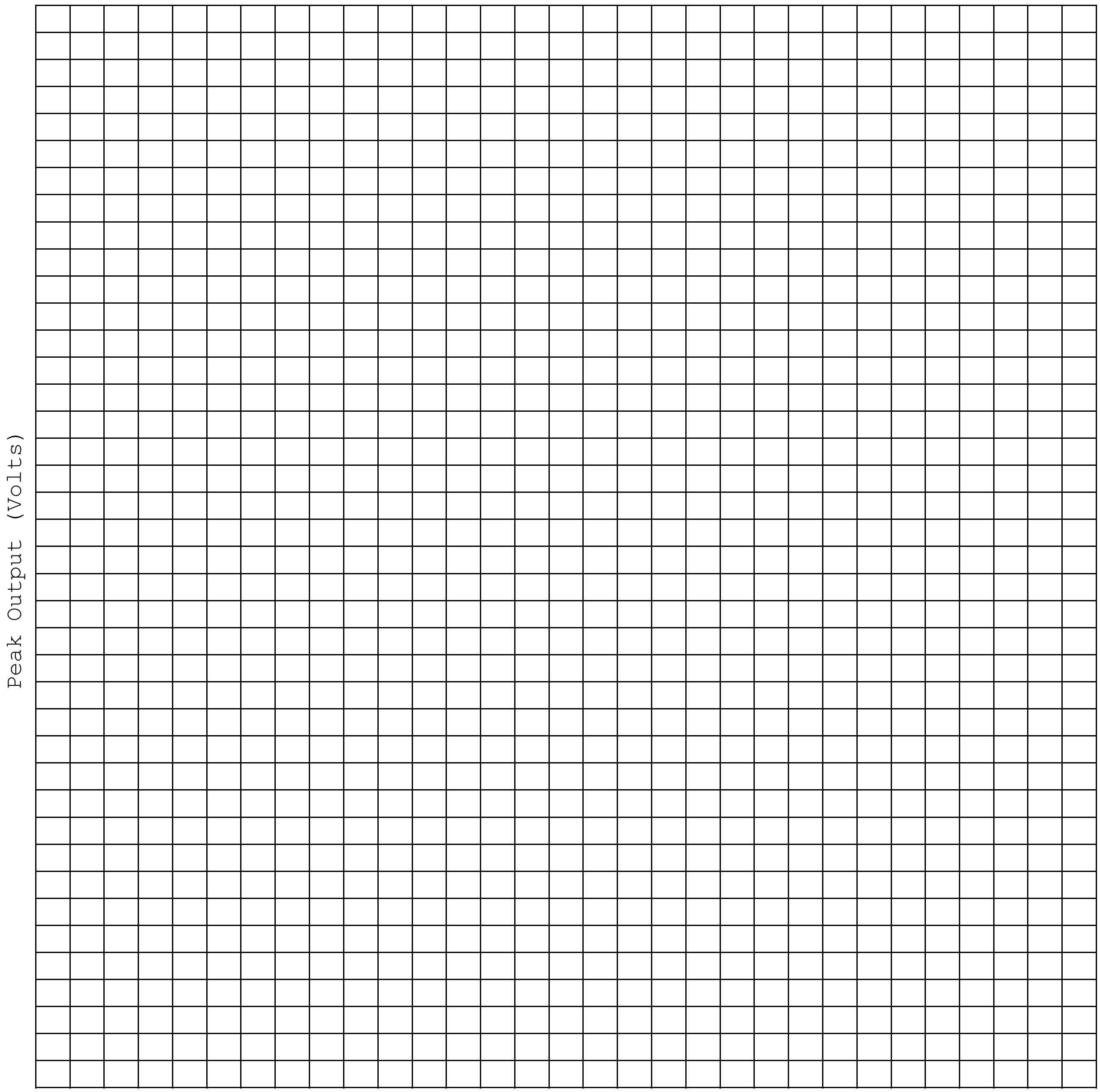
RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS104
PULSED RECEIVERS

Rcvr. Nomenclature________________________________________________Serial No.________________
Tuned Frequency__________________________________________MHz Date_______________________
Test Pulse: PW____________________________________μsec, PRF______________________________pps

| Sig.Gen. Power (dBm) | Total Atten. Inserted (dB) | Rcvr. Power Input (dBm) | Video Peak Output (Volts) | Video Limiter Peak Output (Volts) | IF Gain Control Setting |
|---|---|---|---|---|---|
| | | | | | |

RECEIVER MEASUREMENTS
DYNAMIC RANGE METHOD CS104
PULSED RECEIVERS

Rcvr. Nomenclature_____________________________________________Serial No.____________
Tuned Frequency______________________________________________MHz



## RECEIVER MEASUREMENTS
## SELECTIVITY METHOD CS107
## PULSED RECEIVERS

Equipment Under Test

Rcvr Nomenclature_______________________________________________
Configuration________________________________Serial No.________
Tuned Freq.________________________MHz, MDS______________dBm
Nominal Characteristics:
PW___________________________µsec, PRF________________pps
Sensitivity__________________dBm, Noise Figure_______________
3 dB Bandwidth____________________kHz
Local Osc. Freq.
1. ______________________________________, ☐ Above, Below ☐
2. ______________________________________, ☐ Above, Below ☐
3. ______________________________________, ☐ Above, Below ☐

Significant Control Positions_____________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Test Equipment

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Significant Control Positions_____________________________________
_________________________________________________________________
_________________________________________________________________

Test Information

Test Pulse: PW_______________________µsec, PRF____________pps
MDS w/Test Pulse______________________dBm
Point of Signal Injection_______________________________________
Measurement Point______________________________________________
Std. Response Used_____________________________________________

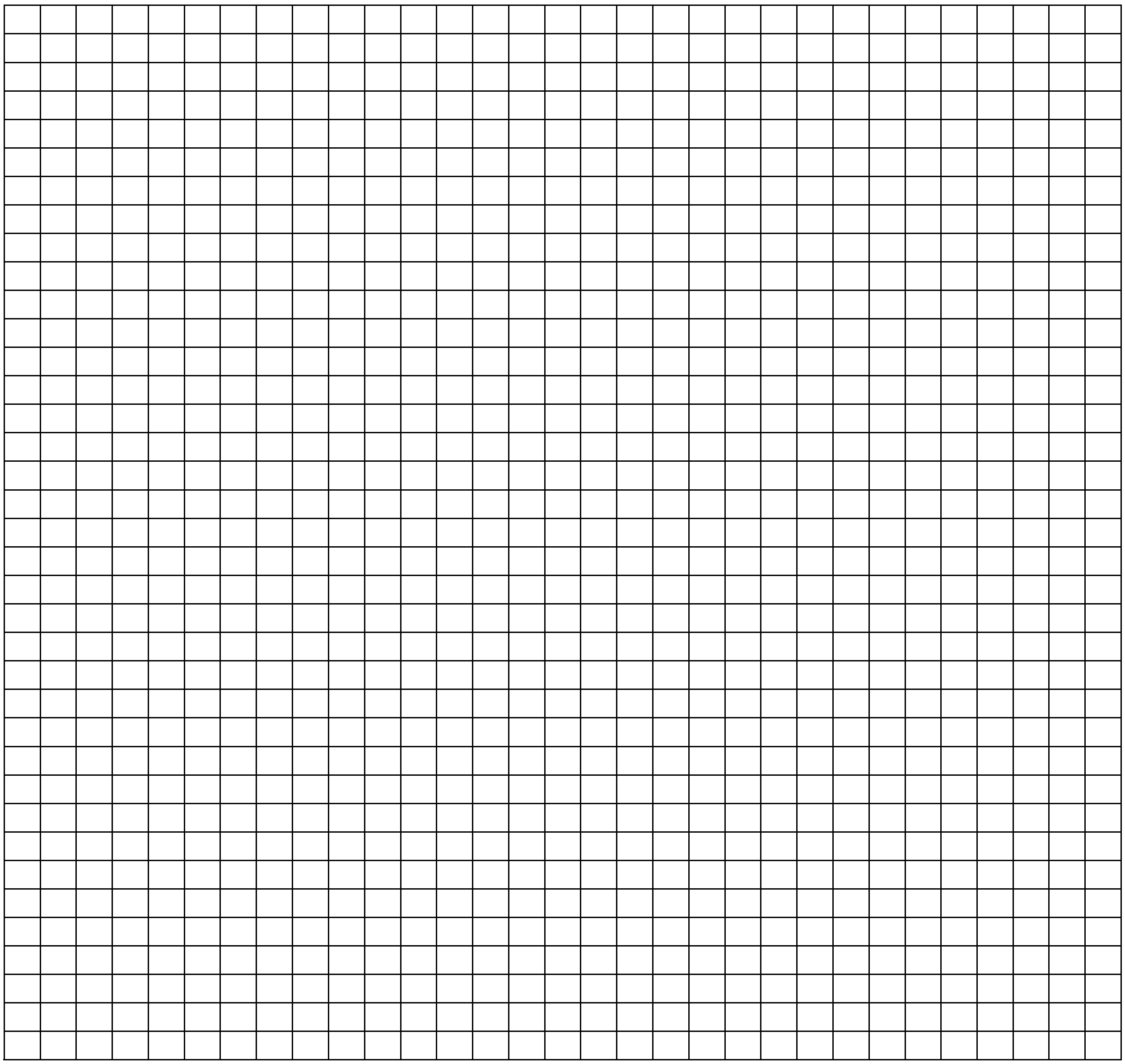
RECEIVER MEASUREMENTS
SELECTIVITY METHOD CS107
PULSED RECEIVERS

Rcvr. Nomenclature________________________________________Serial No.____________
Tuned Frequency_________________________MHz Date__________________

| Relative Response (dB) | Absolute Freq. (MHz) | $-\Delta f$ (kHz) | Absolute Freq. (MHz) | $+\Delta f$ (kHz) | Bandwidth (kHz) |
|---|---|---|---|---|---|
| | | | | | |

# RECEIVER MEASUREMENTS
# SELECTIVITY METHOD CS107
# PULSED RECEIVERS

Rcvr. Nomenclature____________________________________Serial No.________________
Tuned Frequency_________________________________MHz



Frequency (kHz)

-ΔF 0 +ΔF

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS109
PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature________________________________________
Type_______________________________Serial No.___________
Tuning Band ________________________________________________

| LO Freq. | Injection Multiple | IF Freq. |
|---|---|---|
| 1.__________MHz | 1.________________ | 1.__________________MHz |
| 2.__________MHz | 2.________________ | 2.__________________MHz |
| 3.__________MHz | 3.________________ | 3.__________________MHz |

Significant Control Positions_________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

Test Equipment

______________________________________________________________
______________________________________________________________
______________________________________________________________

Significant Control Positions_________________________________
______________________________________________________________
______________________________________________________________

Test Information

Test Signal Modulation:
Frequency______________________________Hz, Percentage______%
or PW____________________________μsec, PRF_______________pps
Point of Signal Injection_____________________________________
Point of Measurement__________________________________________
Std. Response Used____________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS109
PULSED RECEIVERS
(continued)

Spurious Response Identification

The measured spurious response frequencies should be identified according to the appropriate relationship.

Single conversion receivers:

$$f_{SP} = \left| \frac{P f_{LO} + f_{IF}}{Q} \right|$$

Double conversion receivers:

$$f_{SP} = \left| \frac{P_1 f_{LO1}}{Q_1} \pm \left| \frac{P_2 f_{LO2} \pm f_{IF2}}{Q_1 Q_2} \right| \right|$$

Triple conversion receivers:

$$f_{SP} = \left| \frac{P_1 f_{LO1}}{Q_1} \pm \left| \frac{P_2 f_{LO2}}{Q_1 Q_2} \pm \left| \frac{P_3 f_{LO3} \pm f_{IF3}}{Q_1 Q_2 Q_3} \right| \right| \right|$$

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS109
PULSED RECEIVERS
(continued)

The relationships may be also be expressed in the following manner:

Single conversion receivers:

$$f_{IF} = \left| P f_{LO} \pm Q f_{SP} \right|$$

Double conversion receivers:

$$f_{IF2} = \left| Q_2 \left| P_1 f_{LO1} \pm Q_1 f_{SP} \right| \pm P_2 f_{LO2} \right|$$

Triple conversion receivers:

$$f_{IF3} = \left| Q_3 \left| Q_2 \left| P_1 f_{LO1} \pm Q_1 f_{SP} \right| \pm P_2 f_{LO2} \right| \pm P_3 f_{LO3} \right|$$

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS109
PULSED RECEIVERS

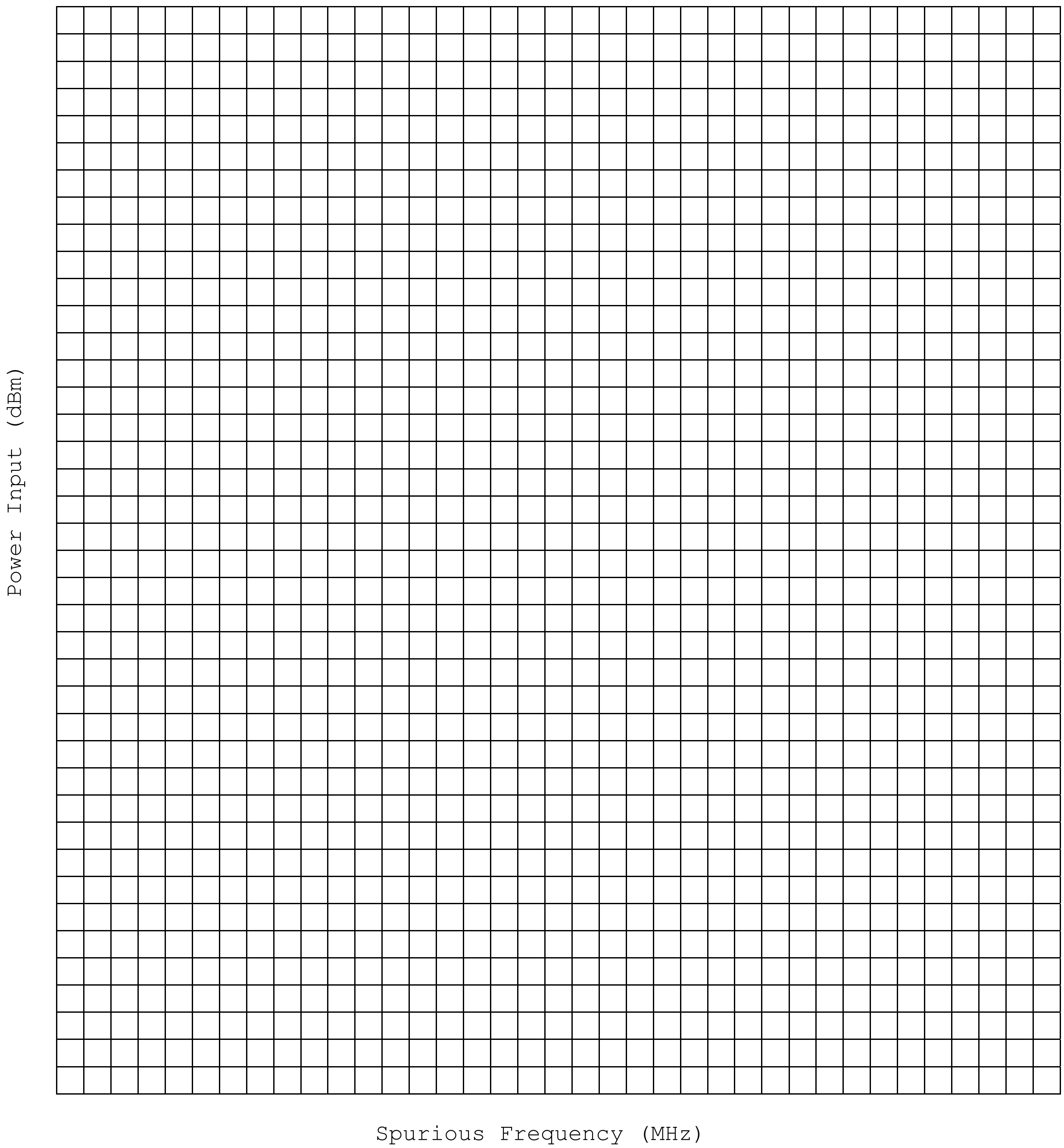
Rcvr. Nomenclature________________________________________________________Serial No.____________
Tuned Frequency_____________________________MHz Date___________________
Measured LO Frequency (1)_________________MHz (2)__________________MHz (3)_________________MHz
Injection Multiple (1)_________________ (2)__________________ (3)_________________
IF Frequency (1)_________________MHz (2)__________________MHz (3)_________________MHz

| Spurious Frequency (MHz) | Sig.Gen. Output (dBm) | Atten. SG-RCVR (dB) | Power Input (dBm) | Mixer Identification | | | | | | | | | Response (See Note) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | First | | | Second | | | Third | | | |
| | | | | P | Q | Sign | P | Q | Sign | P | Q | Sign | |
| | | | | | | | | | | | | | |

NOTE: For Spurious Response Dynamic Range Measurement Record:
1) Output (S+N)/N for communication receivers (dB)
2) Peak video output for radar receivers (volts)

RECEIVER MEASUREMENTS
CONDUCTED SPURIOUS RESPONSE METHOD CS109
PULSED RECEIVERS

Rcvr. Nomenclature__________________________________Serial No.__________________
Tuned Frequency_________________________________MHz



# RECEIVER MEASUREMENTS
# RADIATED SPURIOUS RESPONSE METHOD RS102
# PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature____________________________________________
Type____________________________________________Serial No.________
Tuning Range or Band_____________________________________________
Configuration____________________________________________________
Tuned Frequency________________________________________________MHz
Modulation Frequency_________________MHz, Percentage_____________%
LO Frequency (1)_____MHz (2)_____MHz (3)_________MHz
IF Frequency (1)_____MHz (2)_____MHz (3)_________MHz
Far Field Distance______________Ft.,________________________Meters
Significant Control Positions_______________________________________

## Test Equipment

Significant Control Positions_______________________________________

## Test Information

Receiving Antenna Elevation________________________________Ft. MSL
Test Antenna Elevation_____________________________________Ft. MSL
Test Signal Modulation__________________________________________
Std. Response Used______________________________________________

RECEIVER MEASUREMENTS
RADIATED SPURIOUS RESPONSE METHOD RS102
PULSED RECEIVERS

| Fundamental or Spurious Frequency (MHz) | Sig. Gen. Power Output (dBm) | Test Antenna Gain (dB) | Total Attenuation SG-ANT (dB) | Propagation Loss (dB) | *_______Power Density At System ($dBm/m^2$) |
|---|---|---|---|---|---|
| | | | | | |

*Indicate Avg. or Peak

# RECEIVER MEASUREMENTS
# INTERMODULATION METHOD CS111
# PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature________________________________________________
Type_____________________________________Serial No.________________
Tuning Range or Band_________________________________________________
Configuration________________________________________________________
Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Information

Point of Signal Injection____________________________________________
Point of Measurement_________________________________________________
Standard Response Used_______________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

# RECEIVER MEASUREMENTS
# INTERMODULATION METHOD CS111
# PULSED RECEIVERS

Rcvr. Nomenclature_______________________________________Serial No.___________________
Tuned Frequency______________________MHz Date_________________________
3 dB Bandwidth_______________________kHz

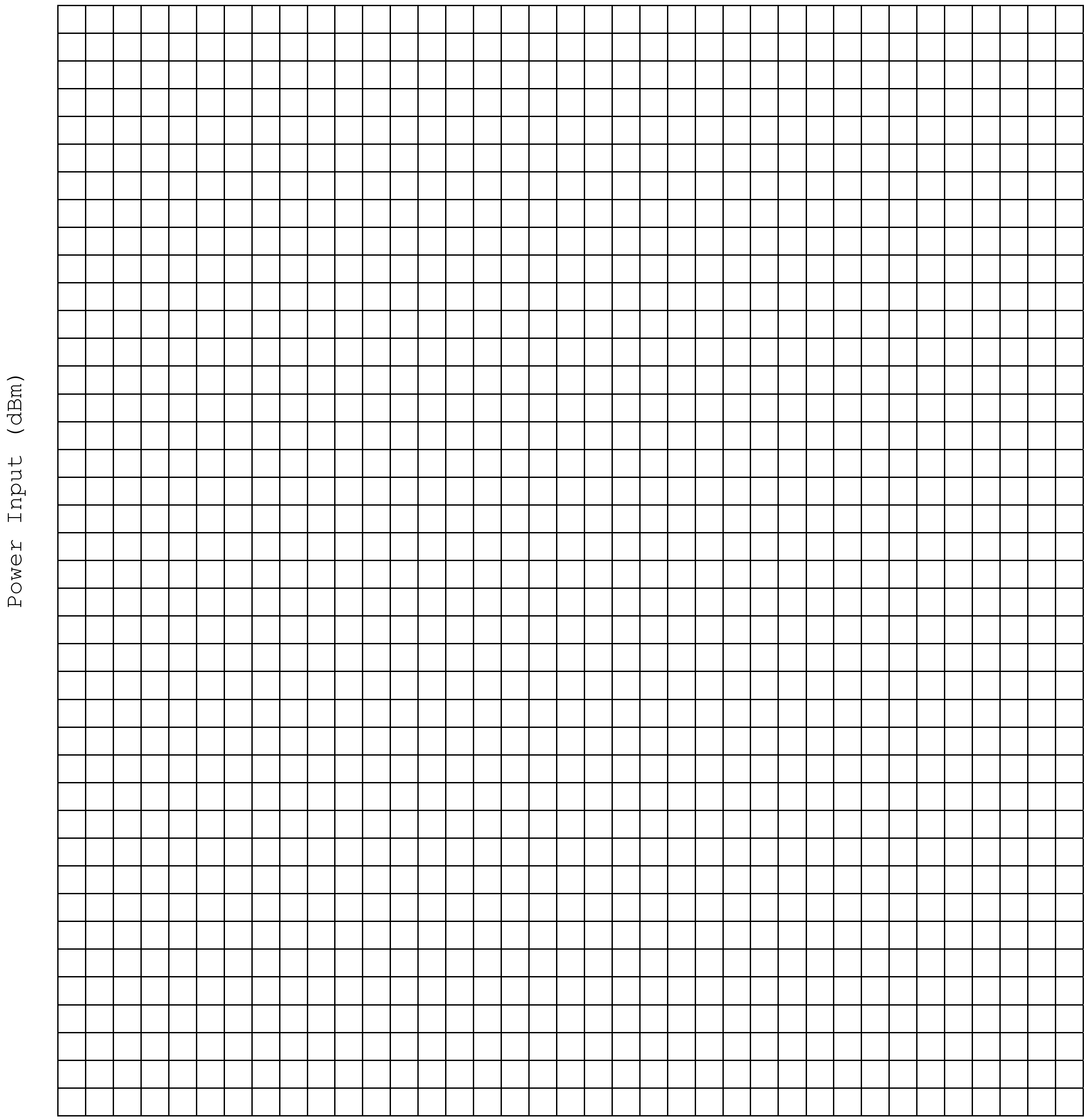
| Intermodulation Identification | *$f_a$ (MHz) | **$f_b$ (MHz) | ***$\Delta f$ (MHz) | Sig. Gen. Output (dBm) | | Attenuation (dB) | | Power Input (dBm) | Output Response (See Note) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $f_a$ | $f_b$ | $f_a$ | $f_b$ | | |
| | | | | | | | | | |

* $f_a$ Interfering Signal Frequency Closest to $f_o$ (CW)
** $f_b$ Other Interfering Signal Frequency (Modulation: frequency____________Hz___________%)
*** $\Delta f = f_a - f_o$___________________________ or PW___________________μsec, PRF_____________pps
$f_o = mf_a \pm nf_b$ ; m + n = Intermodulation Order

Note: For AM/SSB use (S+N)/N in db.
For FM use quieting in dB.
For radar use peak video output in volts.

RECEIVER MEASUREMENTS
INTERMODULATION METHOD CS111
PULSED RECEIVERS

Rcvr. Nomenclature________________________________Serial No.____________________
Tuned Frequency______________________________MHz




NOTE: (1) Indicate and identify intermodulation orders on curves

(2) Use separate sheet for $\pm_{\Delta} f$ and $-_{\Delta} f$

# RECEIVER MEASUREMENTS
# OSCILLATOR EMISSION METHOD CS113
# PULSED RECEIVERS

## Equipment Under Test

Receiver Nomenclature_______________________________________________
Type_____________________________________________Serial No._______
Tuning Range or Band________________________________________________
Configuration_______________________________________________________
Significant Control Positions_____________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Equipment

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Significant Control Positions_____________________________________
_____________________________________________________________________
_____________________________________________________________________

## Test Information

Point of Signal Injection_________________________________________
Point of Measurement______________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

RECEIVER MEASUREMENTS
OSCILLATOR EMISSION METHOD CS113
PULSED RECEIVERS

Rcvr. Nomenclature__________________________________________________Serial No.__________________
Tuned Frequency__________________________MHz Date________________________
LO Frequency_____________________________MHz

| Radiated Frequency | Frequency Identification | Sig. Gen. Output (dBm) | Attenuation SG - FSV (dB) | Power Output (dBm) |
|---|---|---|---|---|
| | | | | |

# RECEIVER MEASUREMENTS
# ADJACENT SIGNAL INTERFERENCE METHOD CS115
# PULSED RECEIVERS

Equipment Under Test

Rcvr Nomenclature____________________________________________________

Configuration______________________________Serial No.______________

Tuned Freq.__________________________MHz, MDS____________________dbm

Significant Control Positions________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Test Equipment

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Significant Control Positions________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Test Information

Signal No. 1; PW ____________µsec, PRF_________pps., Mod_______%

Signal No. 2; PW ____________µsec, PRF_________pps., Mod_______%

Point of Signal Injection; No. 1__________________, No. 2__________

Measurement Point____________________________________________________

MDS; Start________________________dbm, Finish_____________________dbm

Std. Response Used___________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

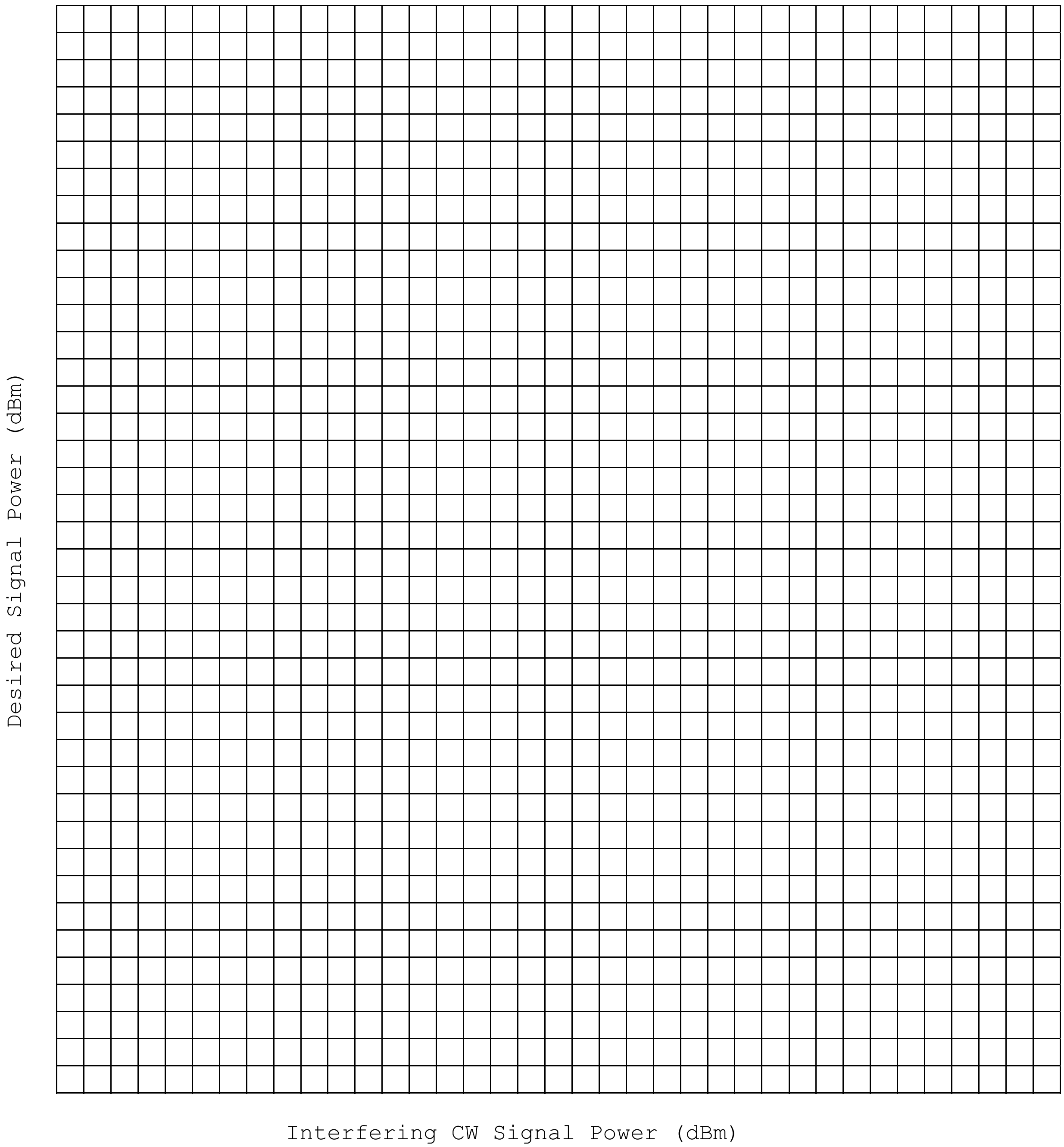
RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS115
PULSED RECEIVERS

Rcvr. Nomenclature______________________________ Serial No.______________
Date__________________

| Interfering Signal Frequency (MHz) | Desired Signal Freq. (MHz) | ± Δf (MHz) | Interfering Losses SG Out (dbm) | Atten (db) | Cable (db) | Other (db) | Rcvr. Input (dbm) | Interfering Losses SG Out (dbm) | Atten (db) | Cable (db) | Other (db) | CW Desensitization (db) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS115
PULSED RECEIVERS

Rcvr. Nomenclature________________________________Serial No.___________________
Tuned Frequency___________________________MHz

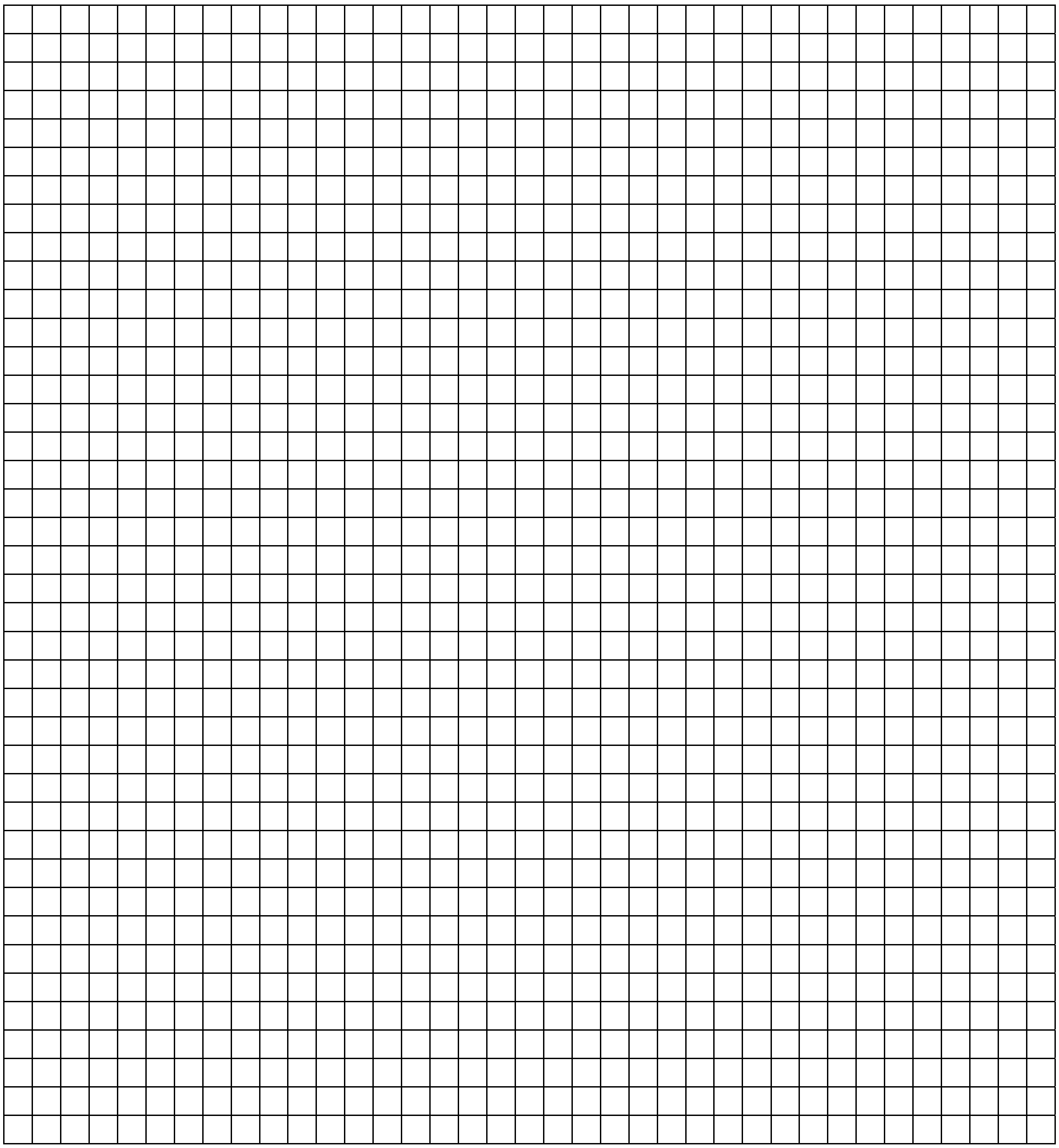


RECEIVER MEASUREMENTS
ADJACENT SIGNAL INTERFERENCE METHOD CS115
PULSED RECEIVERS

Rcvr. Nomenclature_____________________________________Serial No.________________
Tuned Frequency___________________________________MHz

Family of Curves, One for Each Interfering Frequency

Desired Signal Power (dBm)



Desired Signal Input (dBm)

CW Frequency (MHz)

Interfering Signal Power (dBm)

RECEIVERS MEASUREMENTS
IMPULSE RESPONSE METHOD CS117
PULSED RECEIVERS

Equipment Under Test

Receiver Nomenclature_______________________________________________
Type__________________________________________Serial No.__________
Tuning Range or Band________________________________________________
Tuned Frequency_________________________________________________MHz
Configuration_______________________________________________________
Significant Control Positions_____________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Test Equipment

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Significant Control Positions_____________________________________
____________________________________________________________________
____________________________________________________________________

Test Information

Point of Signal Injection_________________________________________
Measurement Point___________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

RECEIVER MEASUREMENTS
IMPULSE RESPONSE METHOD CS117
PULSED RECEIVERS

Rcvr. Nomenclature______________________________________Serial No.______
Tuned Frequency_________________________MHz Date____________

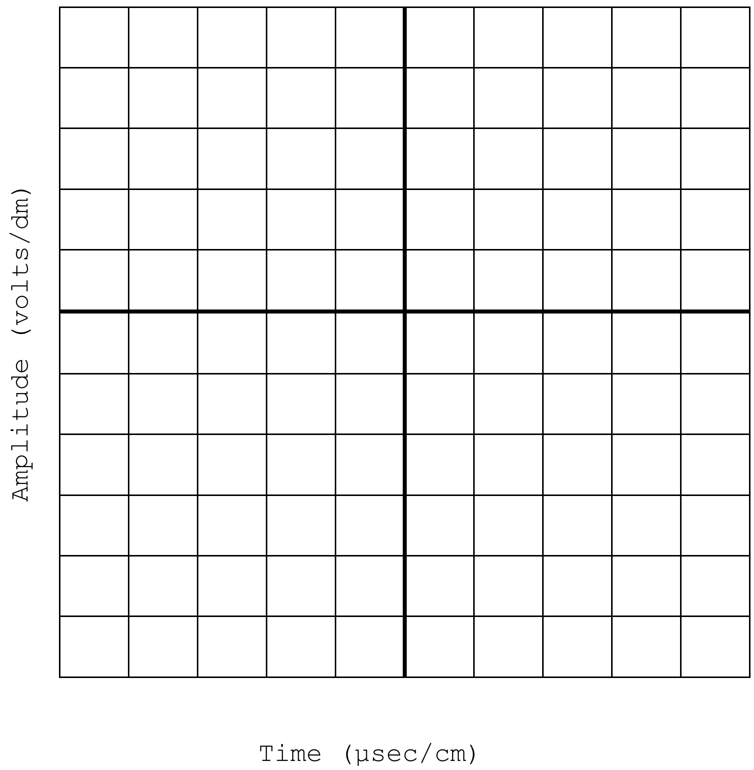



Photo No. __________________________
IF Frequency_________________________MHz
Impulse Generator Output______________dBm/MHz
RF Losses:
    Cables Losses________________________dB
    Attenuation__________________________dB
    Receiver Input Coupler Losses________dB
Receiver Input_______________________dBm/MHz
Comments________________________________________________________________
________________________________________________________________________
________________________________________________________________________

# APPENDIX E

## COUPLER MEASUREMENTS

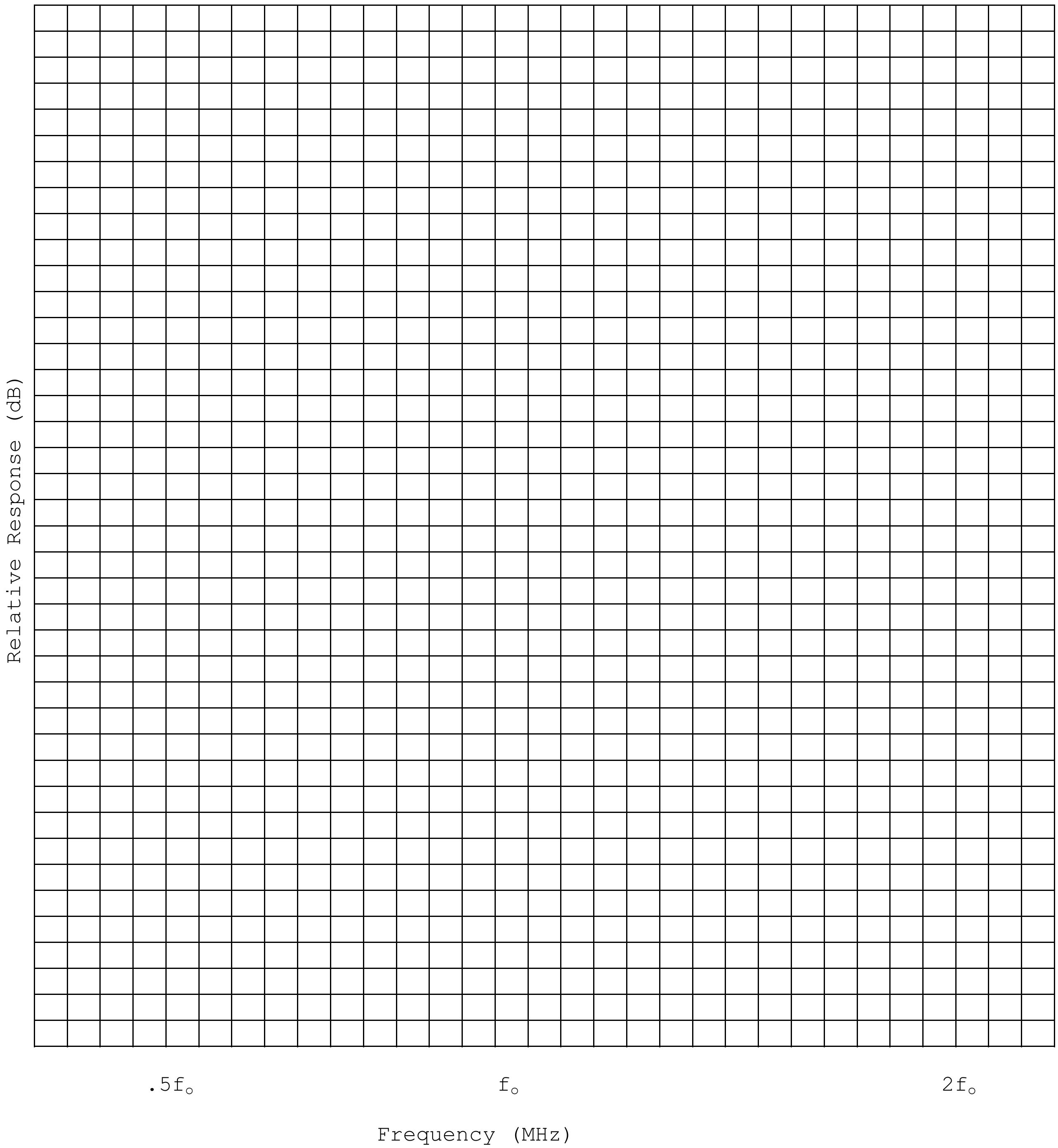
COUPLER MEASUREMENTS
INTERNALLY MODULATED PULSED EQUIPMENT

Device Nomenclature________________________________Serial No.____________
Tuned Frequency____________________________MHz Date__________________

| Frequency (MHz) | Sig. Gen. Output (dBm) | Total Attenuation (dBm) | Power Input (dBm) | Relative Response (dB) |
|---|---|---|---|---|
| | | | | |

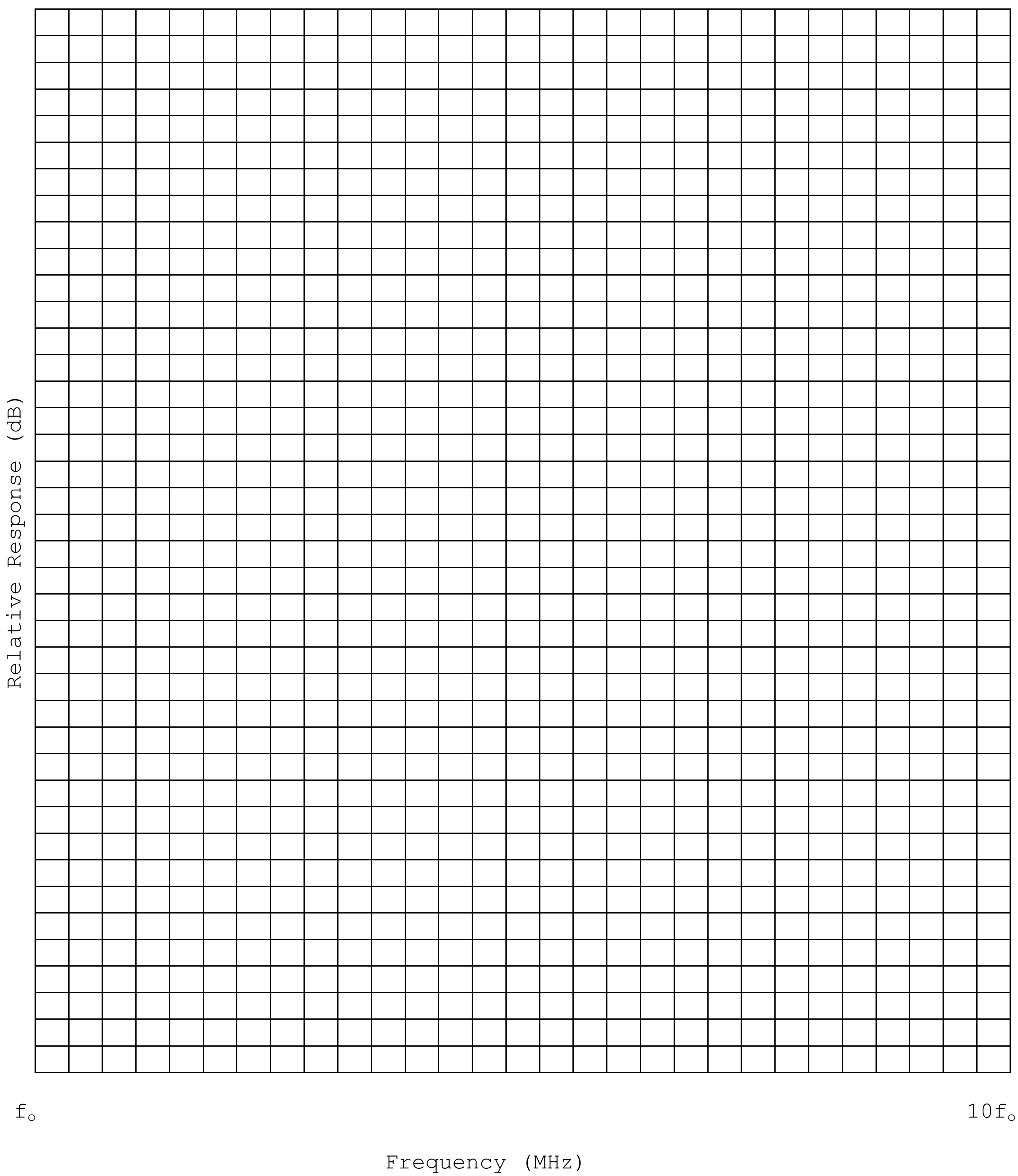
COUPLER MEASUREMENTS
INTERNALLY MODULATED PULSED EQUIPMENT

Device Nomenclature______________________________Serial No._____________
Tuned Frequency______________________________MHz



COUPLER MEASUREMENTS
INTERNALLY MODULATED PULSED EQUIPMENT

Device Nomenclature_____________________________________________Serial No.__________
Tuned Frequency________________________________________MHz



COUPLER MEASUREMENTS
SELECTIVITY METHOD CS118
SYSTEM COUPLERS

Device Under Test

Nomenclature______________________________Serial No.__________________
Associated Equipment___________________________________________________
Frequency Range________________________________________________________
Nominal Bandwidth________________________________________________________
Description____________________________________________________________
Significant Control Positions_________________________________________
_______________________________________________________________________
_______________________________________________________________________

Test Equipment

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
Significant Control Positions_________________________________________
_______________________________________________________________________
_______________________________________________________________________

Test Information

Point of Signal Injection_____________________________________________
Point of Measurement__________________________________________________
Standard Response Used________________________________________________
_______________________________________________________________________
_______________________________________________________________________

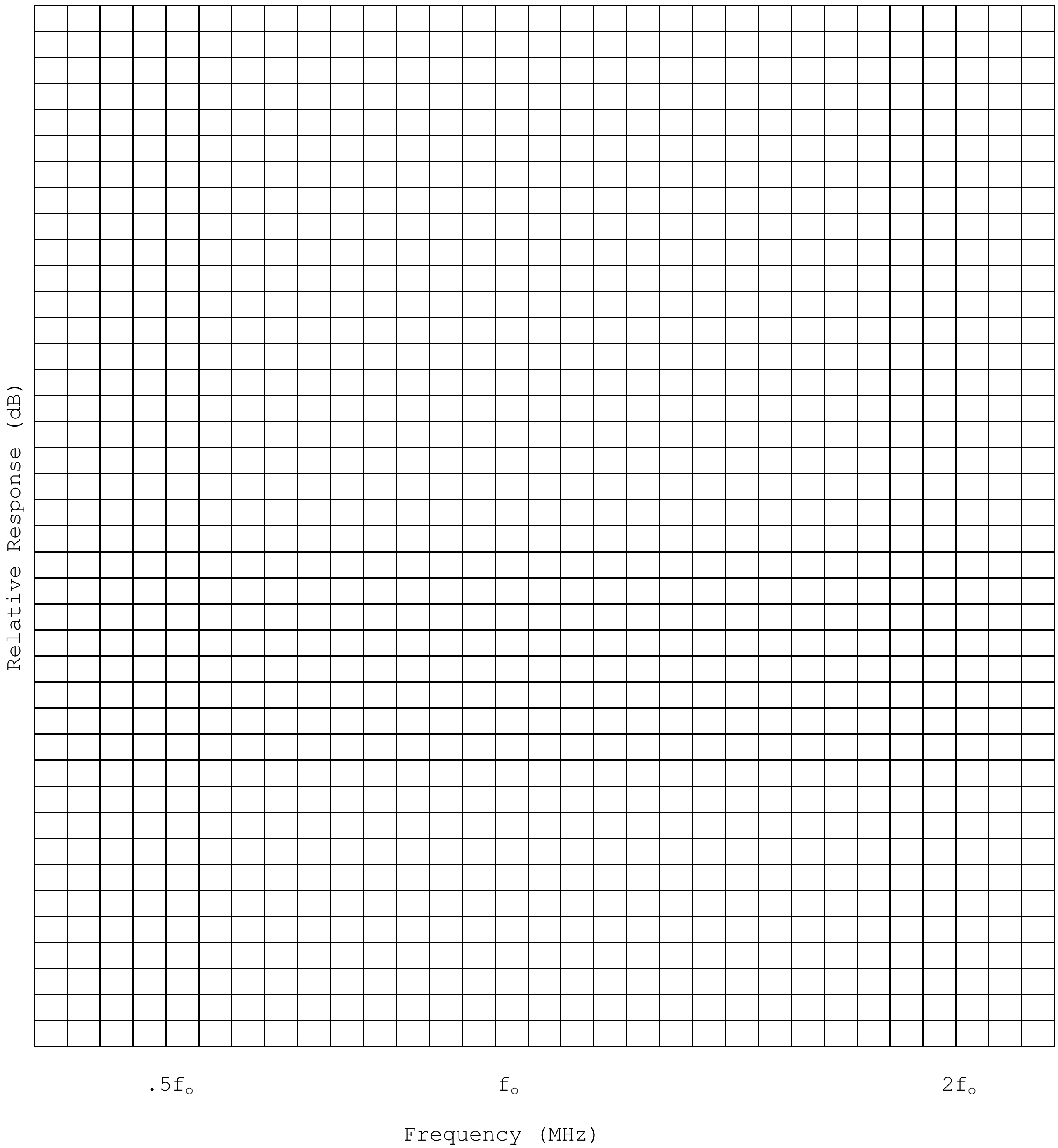
COUPLER MEASUREMENTS
SELECTIVITY METHOD CS118
SYSTEM COUPLERS

Device Nomenclature______________________________________Serial No.______________
Tuned Frequency_____________________________________MHz Date_____________________

| Frequency (MHz) | Switch Position A/B | Sig. Gen. Output (dBm) | Total Attenuation (dB) | Power Input (dBm) | Relative Response (dB) |
|---|---|---|---|---|---|
| | | | | | |

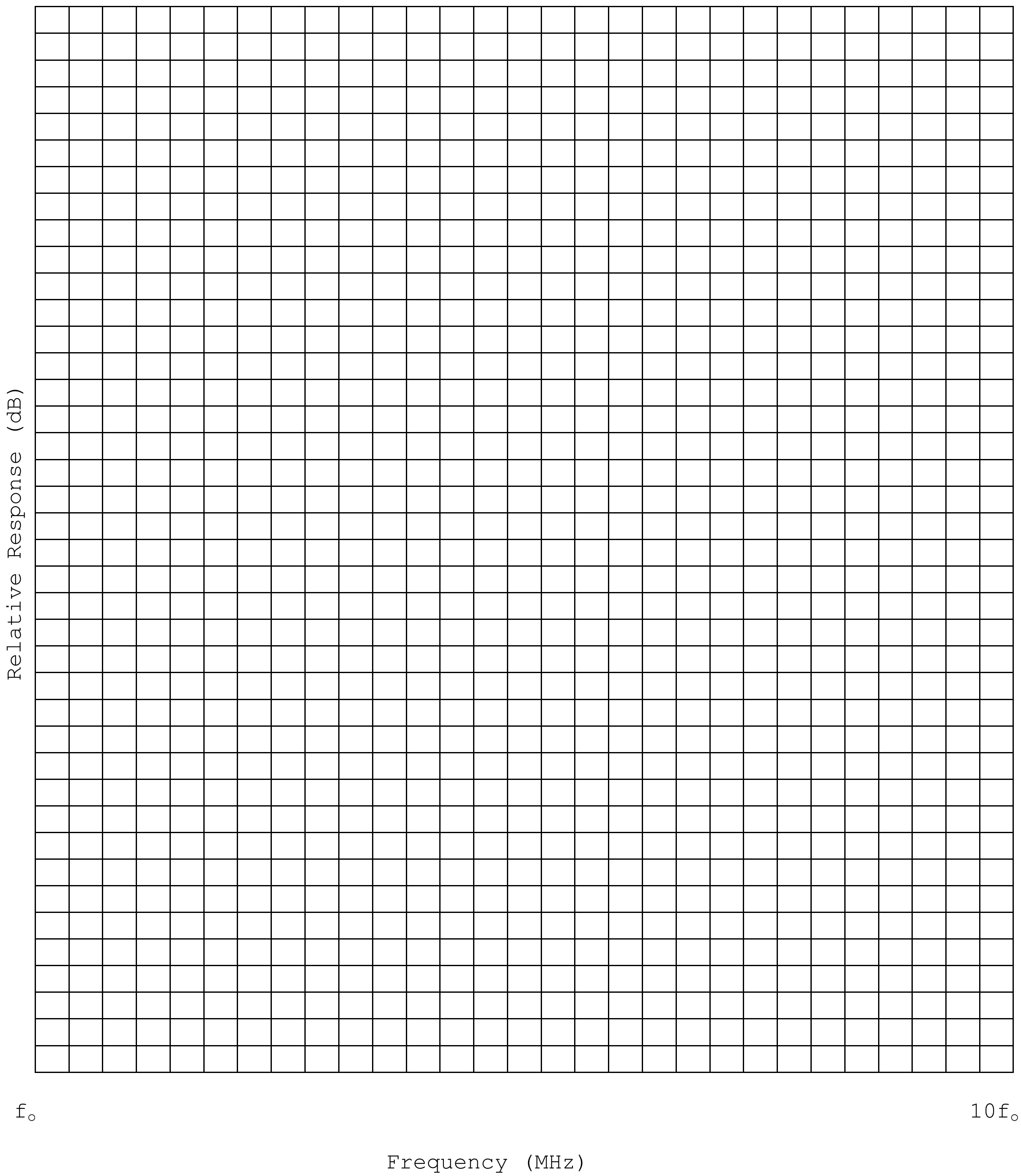
COUPLER MEASUREMENTS
SELECTIVITY METHOD CS118
SYSTEM COUPLERS

Device Nomenclature________________________________Serial No.____________________
Tuned Frequency________________________________MHz



# COUPLER MEASUREMENTS
# SELECTIVITY METHOD CS118
# SYSTEM COUPLERS

Device Nomenclature_______________________________Serial No.____________
Tuned Frequency_________________________MHz



# COUPLER MEASUREMENTS
# DYNAMIC RANGE METHOD CS119
# SYSTEM COUPLERS

## Device Under Test

Nomenclature___________________________________Serial No.___________
Associated Equipment___________________________________________________
Frequency Range________________________________________________________
Nominal Bandwidth______________________________________________________
Description____________________________________________________________
Significant Control Positions__________________________________________
_______________________________________________________________________
_______________________________________________________________________

## Test Equipment

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
Significant Control Positions__________________________________________
_______________________________________________________________________
_______________________________________________________________________

## Test Information

Point of Signal Injection______________________________________________
Point of Measurement___________________________________________________
Standard Response Used_________________________________________________
_______________________________________________________________________
_______________________________________________________________________

SUPPLEMENT-2

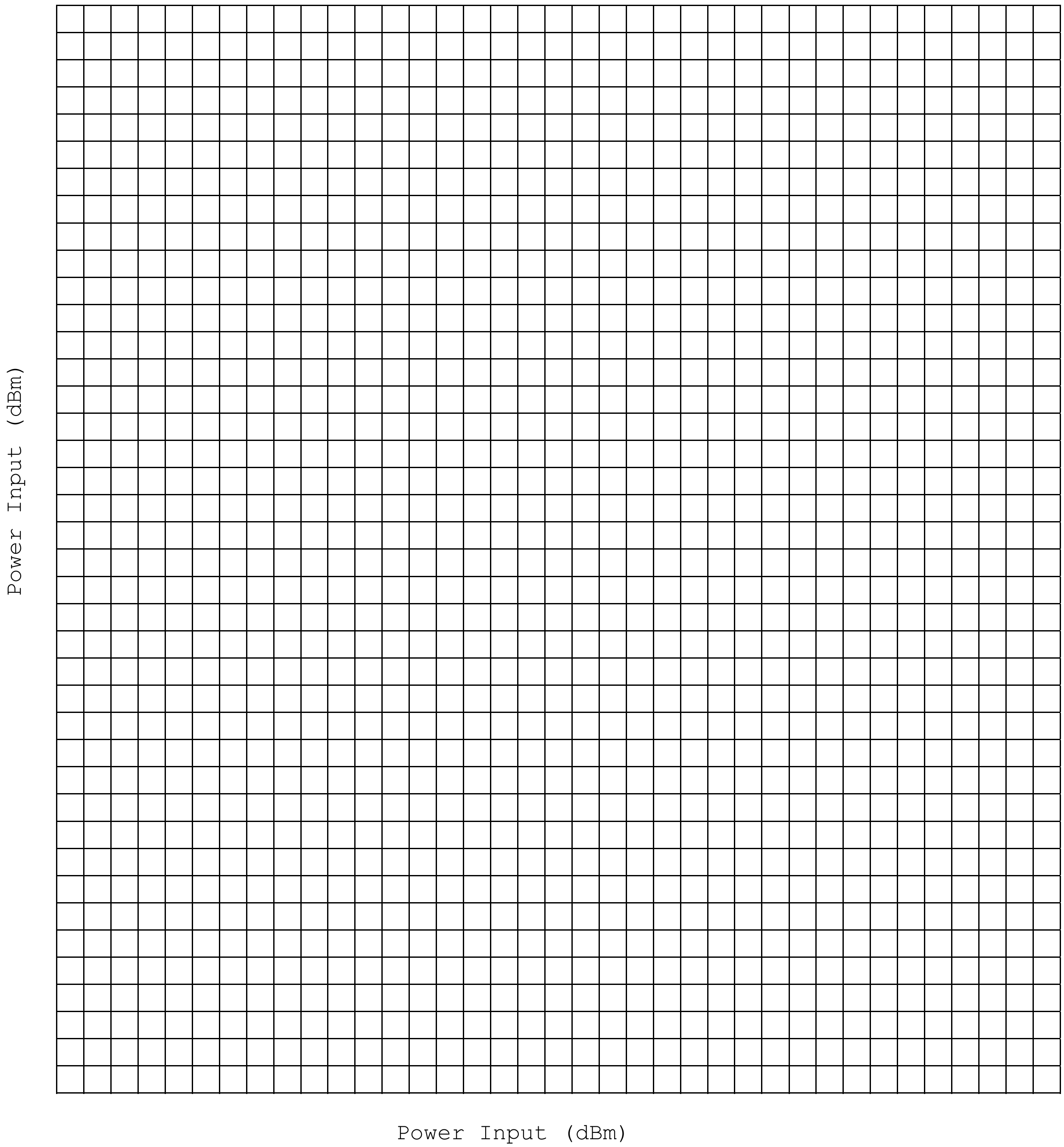
COUPLER MEASUREMENTS
DYNAMIC RANGE METHOD CS119
SYSTEM COUPLERS

Device Nomenclature________________________________Serial No.___________________
Tuned Frequency________________________MHz Date_________________________

| Switch Position A/B | Sig. Gen. Output (dBm) | Total Attenuation (dB) | Power Input (dBm) | Output Power (dBm) |
|---|---|---|---|---|
| | | | | |

COUPLER MEASUREMENTS
DYNAMIC RANGE METHOD CS119
SYSTEM COUPLERS

Device Nomenclature_______________________________Serial No.______________
Tuned Frequency_______________________________MHz



APPENDIX F

ANTENNA MEASUREMENTS

ANTENNA MEASUREMENTS
EXTERNALLY MODULATED NON-PULSED EQUIPMENT
Section 5.6

Equipment Nomenclature_____________________________Serial No.___________
Antenna Nomenclature_______________________________Serial No.___________
Tuned Frequency_________________________MHz
Far Field Distance______________________Ft__________________M
Tilt Angle: Elect_______________
Mech._______________
Beamwidth: Horizontal______________
Vertical________________
Polarization__________________________
Designed Gain_________________________dB
Special Characteristics__________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Test Site_________________________Elevation___________________Ft., MSL.
Measurement Distance______________Ft.________________M
Test Antenna Nomenclature____________Polarization_______Gain__________dB
Dimensions_____________Ft. Height above site___________________Ft.
Tilt Angle_____________Main Beam (@ 3 dB) Ver.________° Hor._______
Active Antenna; System ☐ Test ☐
Recorder Response Time___________________________________________________
Terrain Description______________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

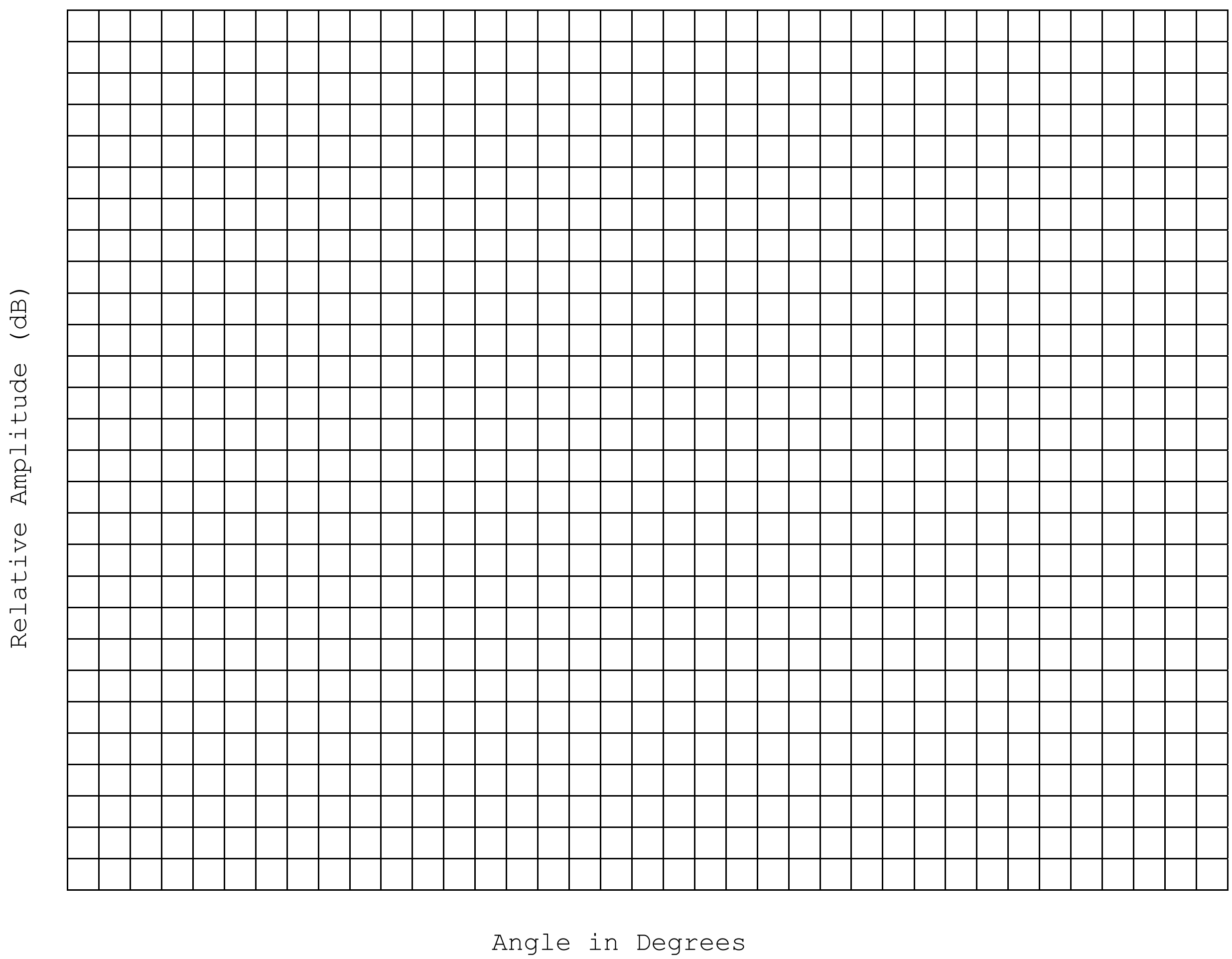
ANTENNA MEASUREMENTS
EXTERNALLY MODULATED NON-PULSED EQUIPMENT
Section 5.6.

Antenna Nomenclature____________________________________Serial No.______
Date____________

System Antenna:
Polarization___________________________
Scan Limits: Azimuth_______________° to_________________°
Elevation Angle_____________________________°

Test Antenna:
Type___________________________________________________________________
Polarization___________________________________________________________
Height_______________________________________ft.

ANTENNA PATTERN




Azimuth details must be adequate to define 2.5° increments. Attach separate pattern showing main beam detail.

ANTENNA MEASUREMENTS
INTERNALLY MODULATED PULSED EQUIPMENTS
Section 5.6

Equipment Nomenclature____________________________Serial No.________________
Antenna Nomenclature______________________________Serial No.________________
Tuned Frequency______________________MHz
Far Field Distance___________________Ft______________M
Tilt Angle: Elect______________
Mech.______________
Beamwidth: Horizontal________________
Vertical__________________
Polarization_____________________________
Designed Gain___________________________dB
Special Characteristics_____________________________________________________
____________________________________________________________________________
____________________________________________________________________________
Test Site___________________Elevation________________Ft., MSL.
Measurement Distance_______________Ft.____________M
Test Antenna Nomenclature______________Polarization_______Gain_______dB
Dimensions______________Pt. Height above site_______________________Ft.
Tilt Angle_______________Main Beam (@ 3 dB) Ver. _________ Hor.________
Active Antenna; System ☐ Test ☐
Recorder Response Time______________________________________________________
Terrain Description_________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

ANTENNA MEASUREMENTS
INTERNALLY MODULATED PULSED EQUIPMENTS
Section 5.6

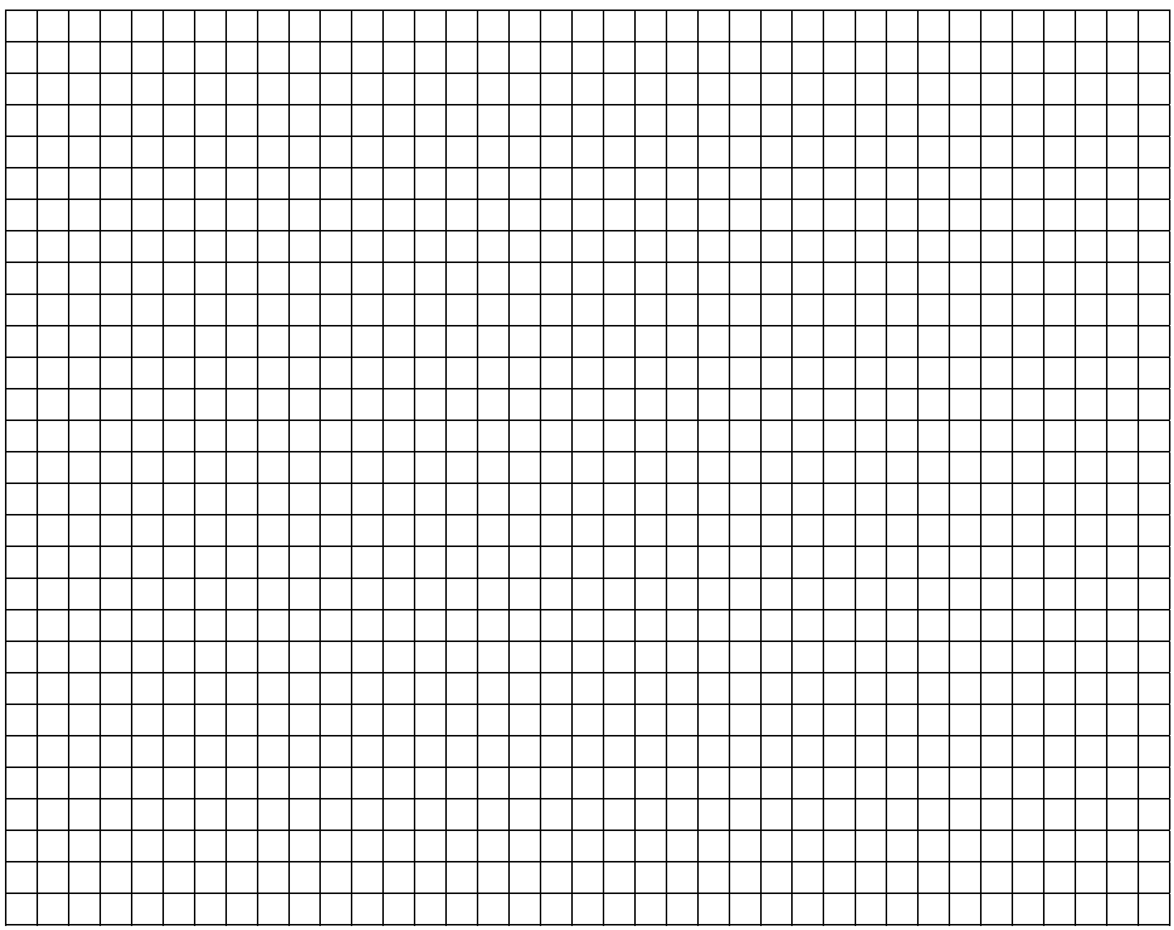
Antenna Nomenclature________________________________Serial No.___________
Date_________________

System Antenna:
Polarization____________________________
Scan Limits: Azimuth_________________to ____________
Elevation Angle________________________

Test Antenna:
Type___________________________________________________________________
Polarization___________________________________________________________
Height_________________________________ft.

ANTENNA PATTERN

Relative Amplitude (dB)



Angle in Degrees

Azimuth details must be adequate to define 2.5° increments. Attach separate pattern showing main beam detail.

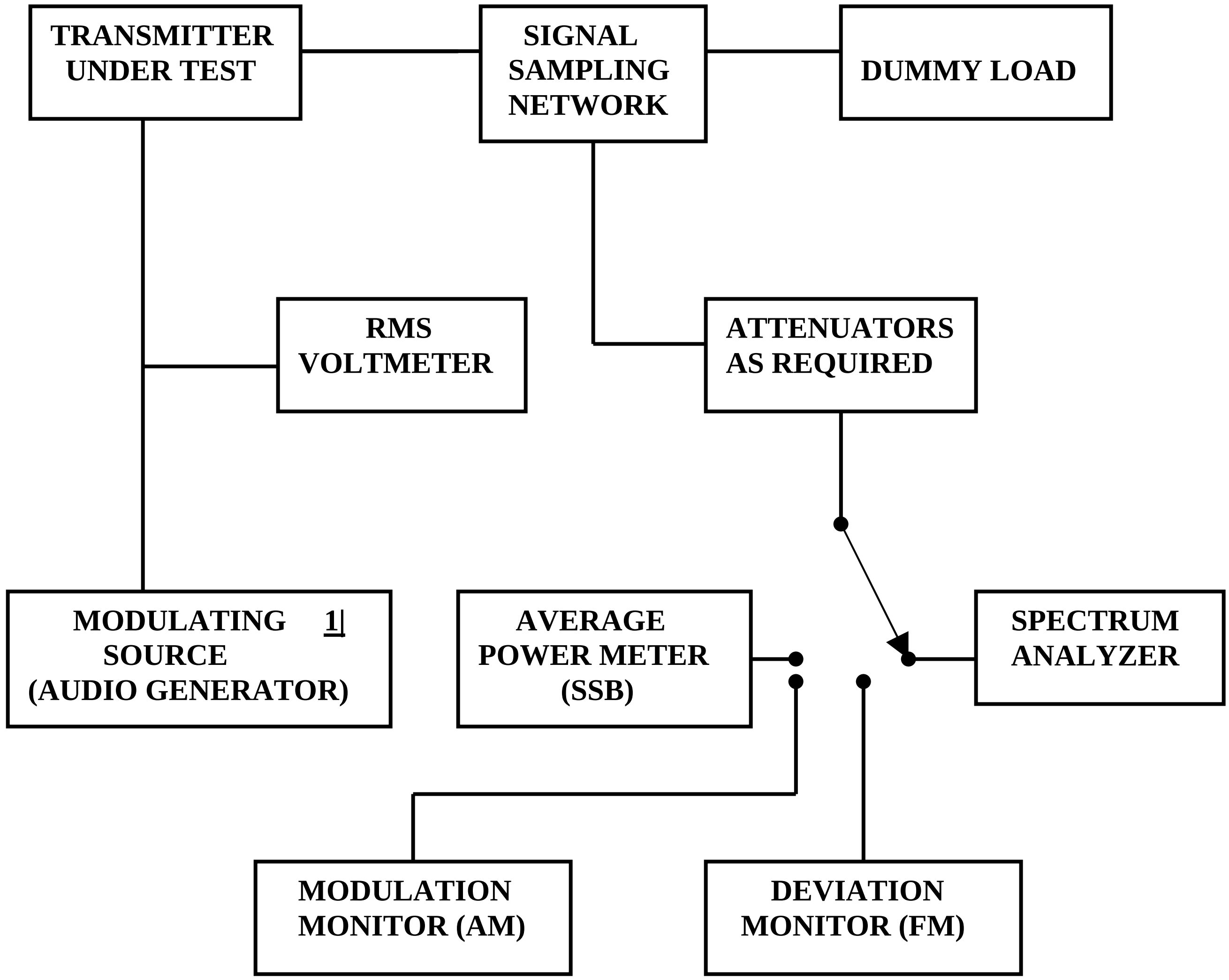



**FIGURE 1**

**MEASUREMENT SETUP**

**CE101 – MODULATION BANDWIDTH AND**

**CE102 – MODULATION CHARACTERISTICS**

**1| USE 2 TONES FOR SSB**

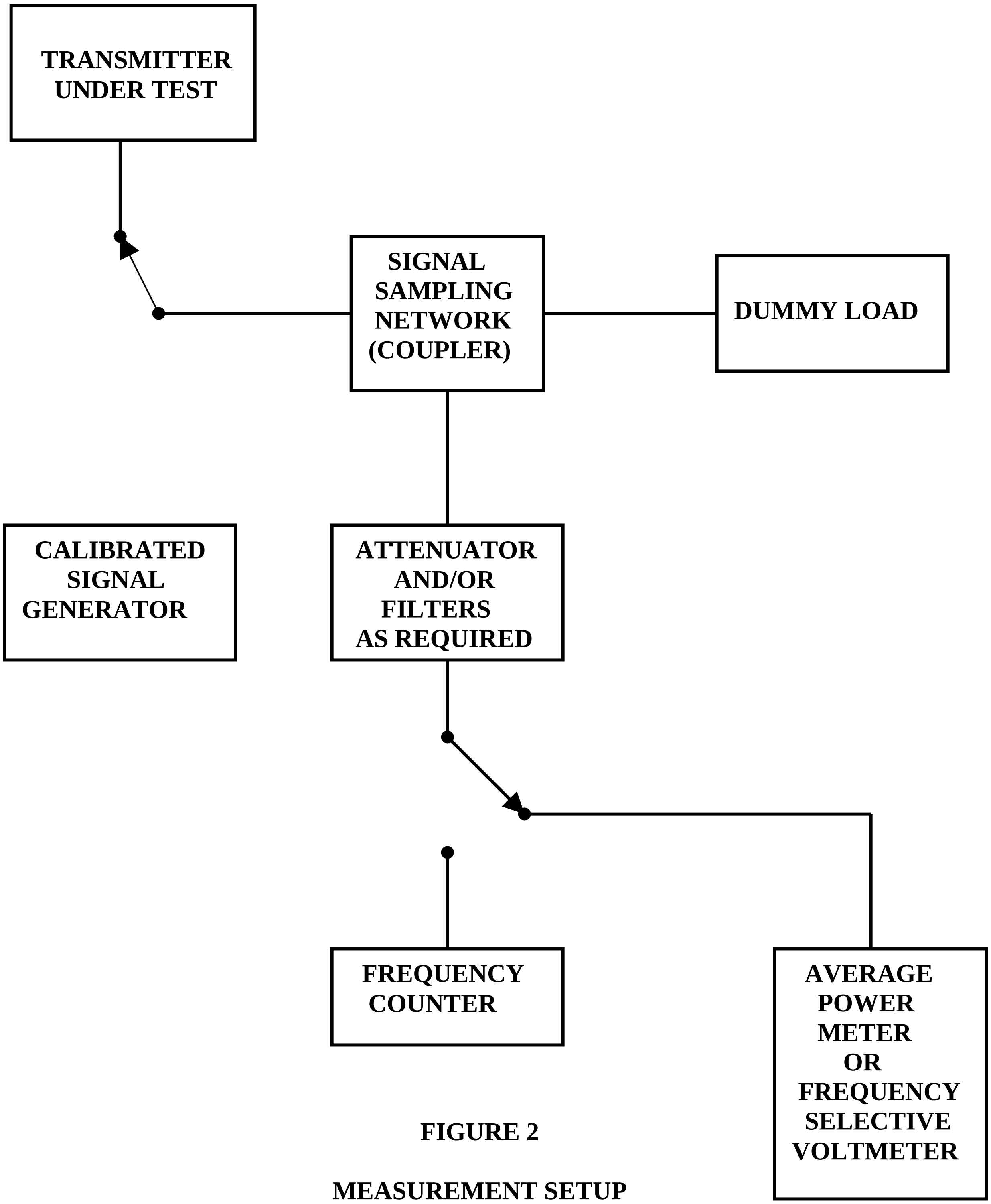
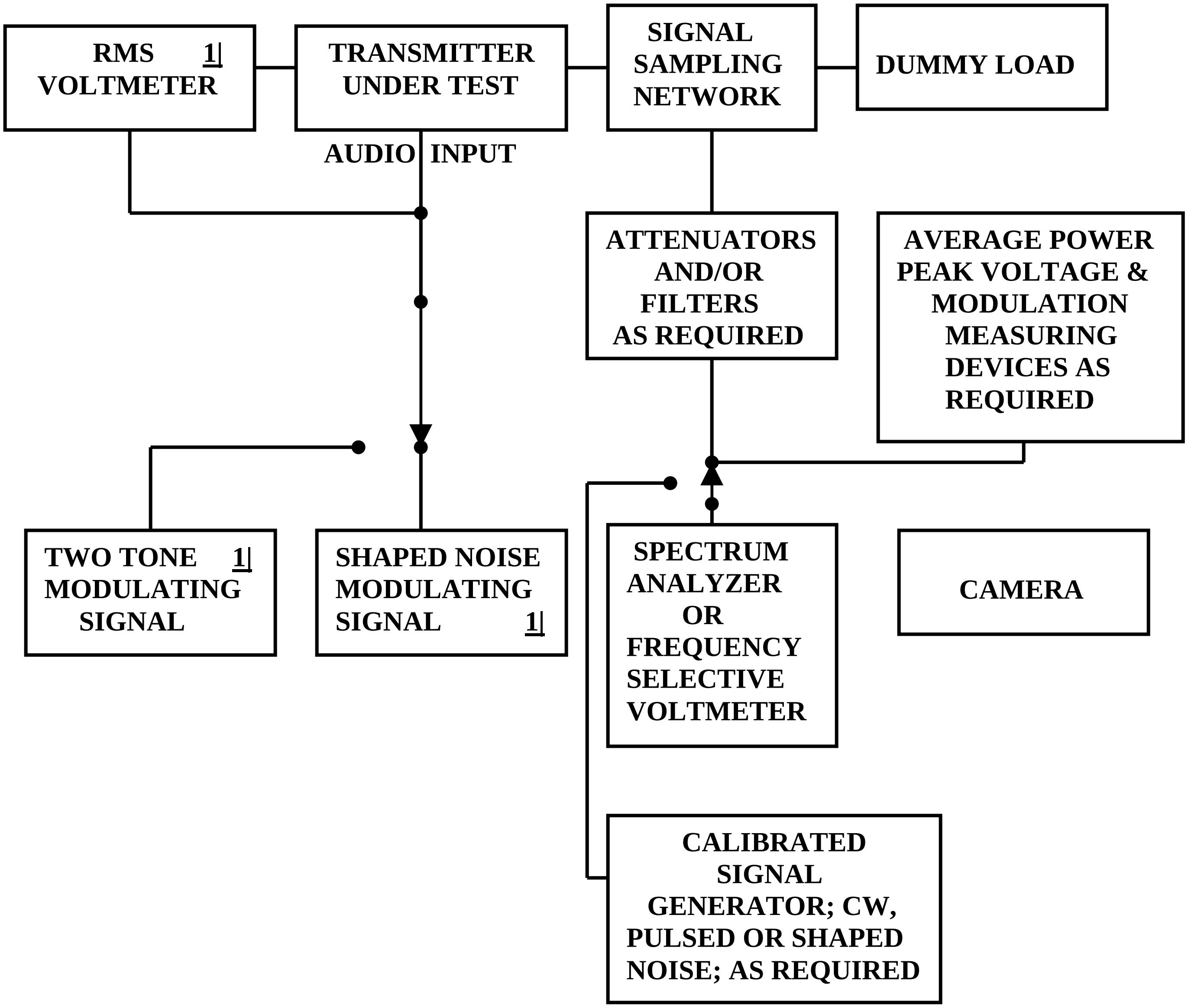



**FIGURE 2**

**MEASUREMENT SETUP**

**(FOR SSB MODULATION, REFER TO FIGURE 1)**
**CE103, CE104 – POWER OUTPUT**
**CE105, CE106 – CARRIER FREQUENCY STABILITY**




**1| USED FOR NON-PULSED MEASUREMENTS ONLY.**

**FIGURE 3**

**MEASUREMENT SETUP**

**CE107, CE108 – CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (NARROW-BANDWIDTH)**
**CE109, CE110 – CONDUCTED EMISSION SPECTRUM CHARACTERISTICS (WIDE-BANDWIDTH)**

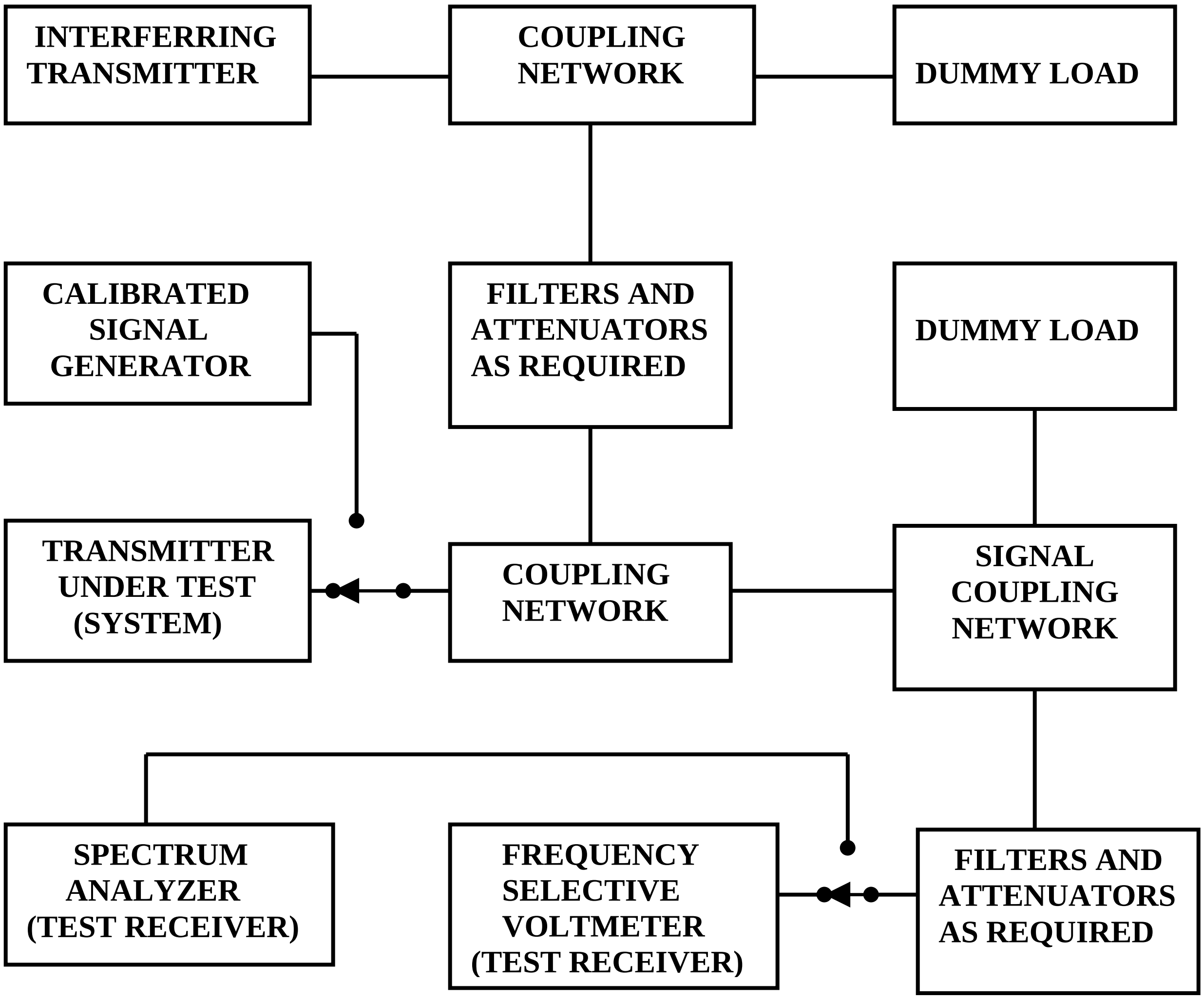



**FIGURE 4**

**MEASUREMENT SETUP**

**CE111 - INTERMODULATION**

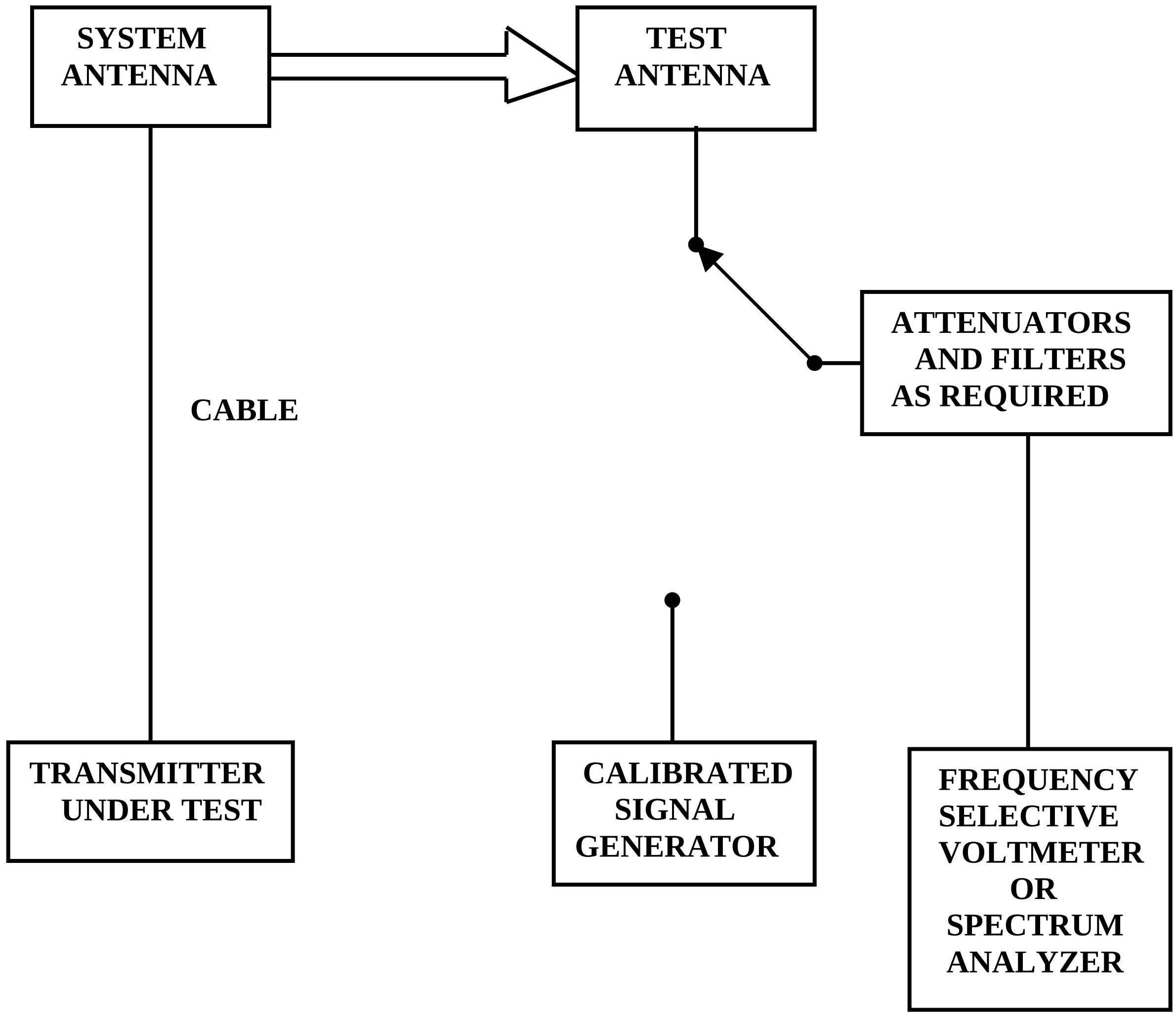



**FIGURE 5**

**MEASUREMENT SETUP**

**RE101, RE102 – RADIATED EMISSSION SPECTRUM CHARACTERISTICS**

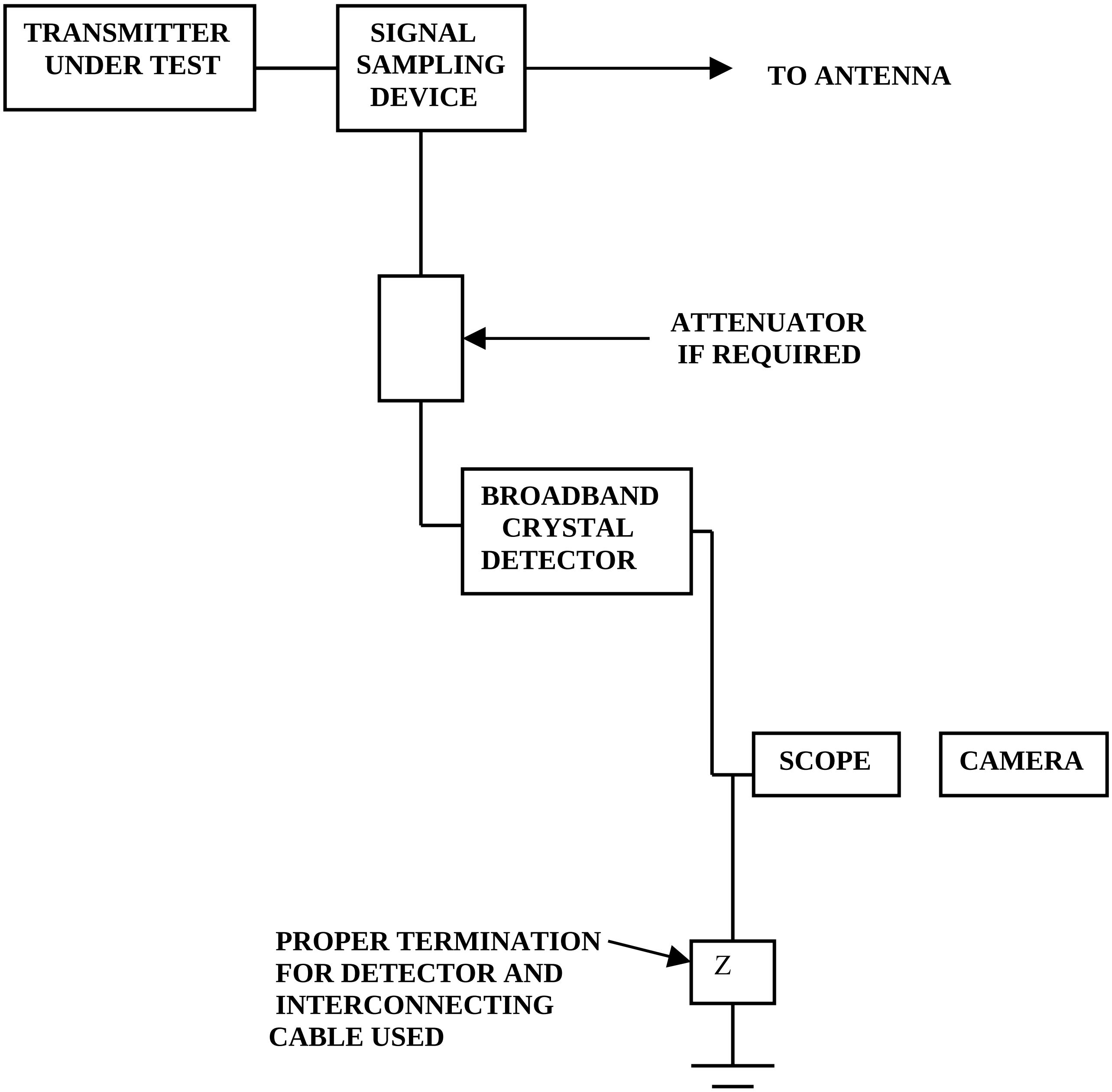



**FIGURE 5**

**MEASUREMENT SETUP**

**RE101, RE102 – RADIATED EMISSSION SPECTRUM CHARACTERISTICS**

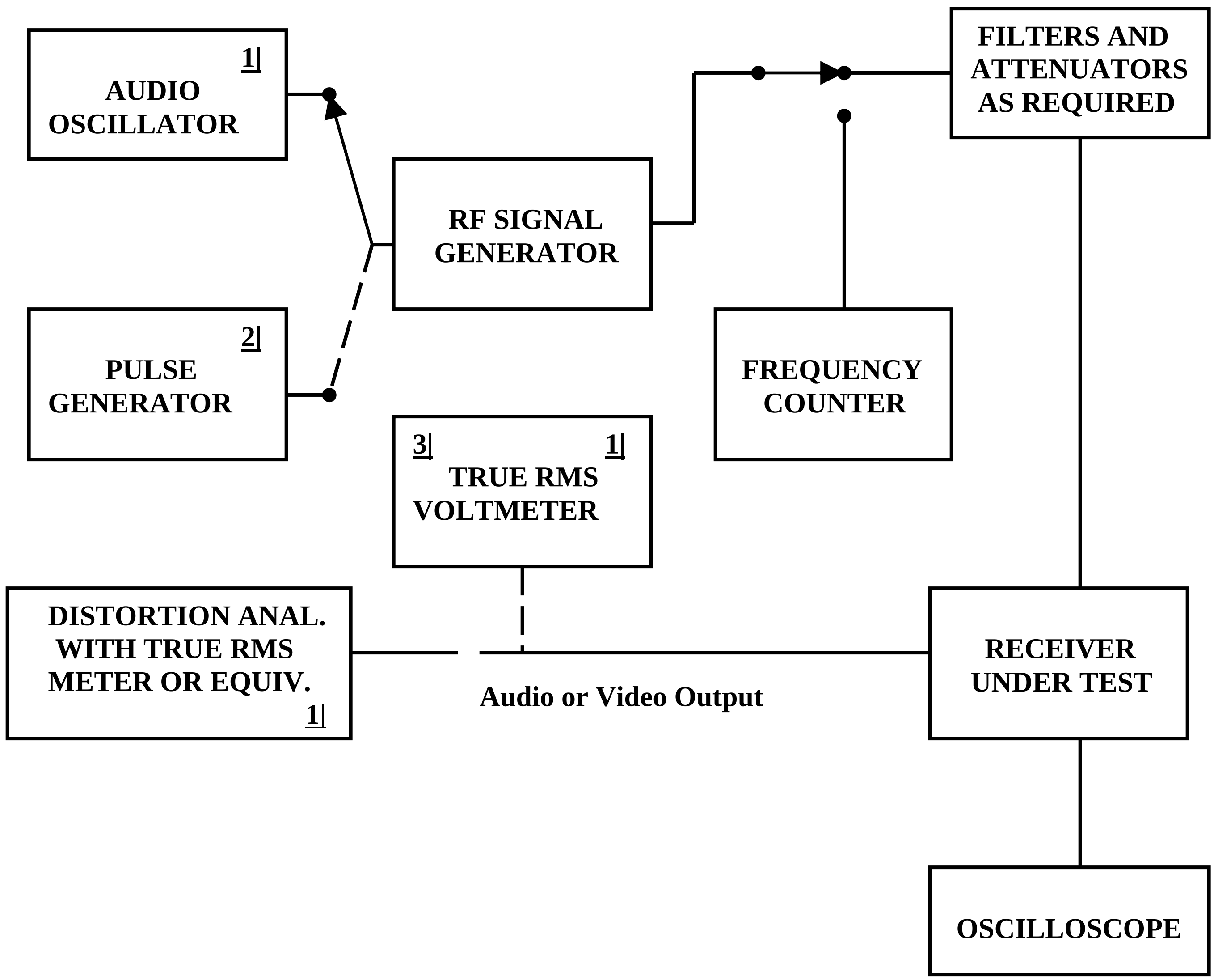
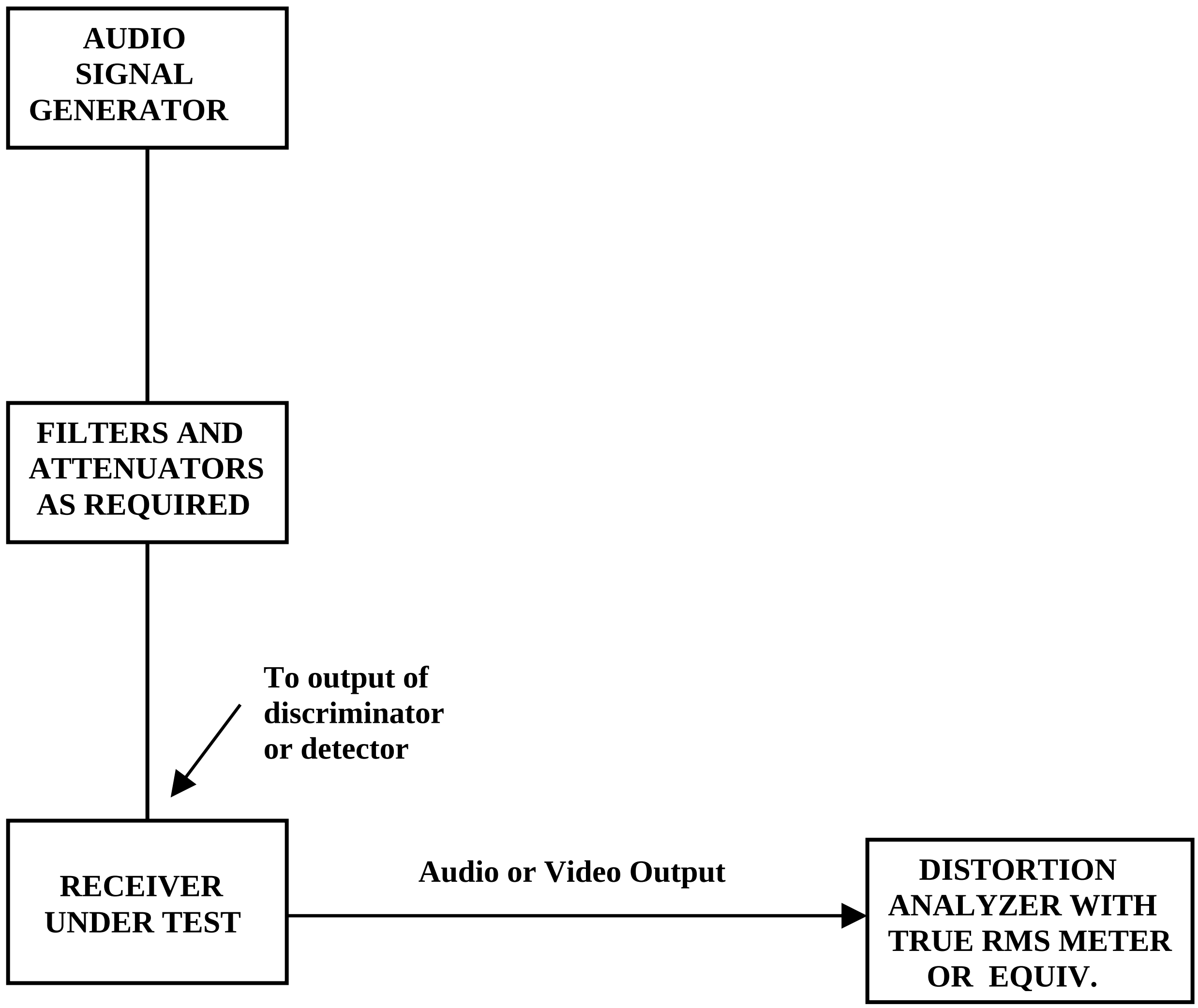



**FIGURE 7**

**MEASUREMENT SETUP**

**CS101,CS102 – SENSITIVITY,**
**CS103, CS104 – DYNAMIC RANGE,**
**CS105 – AUDIO SELECTIVITY,**
**CS106,CS107 – SELECTIVITY,**
**CS108,CS109 – CONDUCTED SPURIOUS RESPONSES**
**1| USED FOR NON-PULSED MEASUREMENTS ONLY.**
**2| USED FOR PULSED MEASUREMENTS ONLY.**
**3| USED WHEN RECEIVER AUDIO BANDWIDTH DISTORTION ANALYZER BROADBAND POSITION**




**FIGUIRE 8**

**MEASUREMENT SETUP**

**CS105 – AUDIO SELECTIVITY (Alternative)**

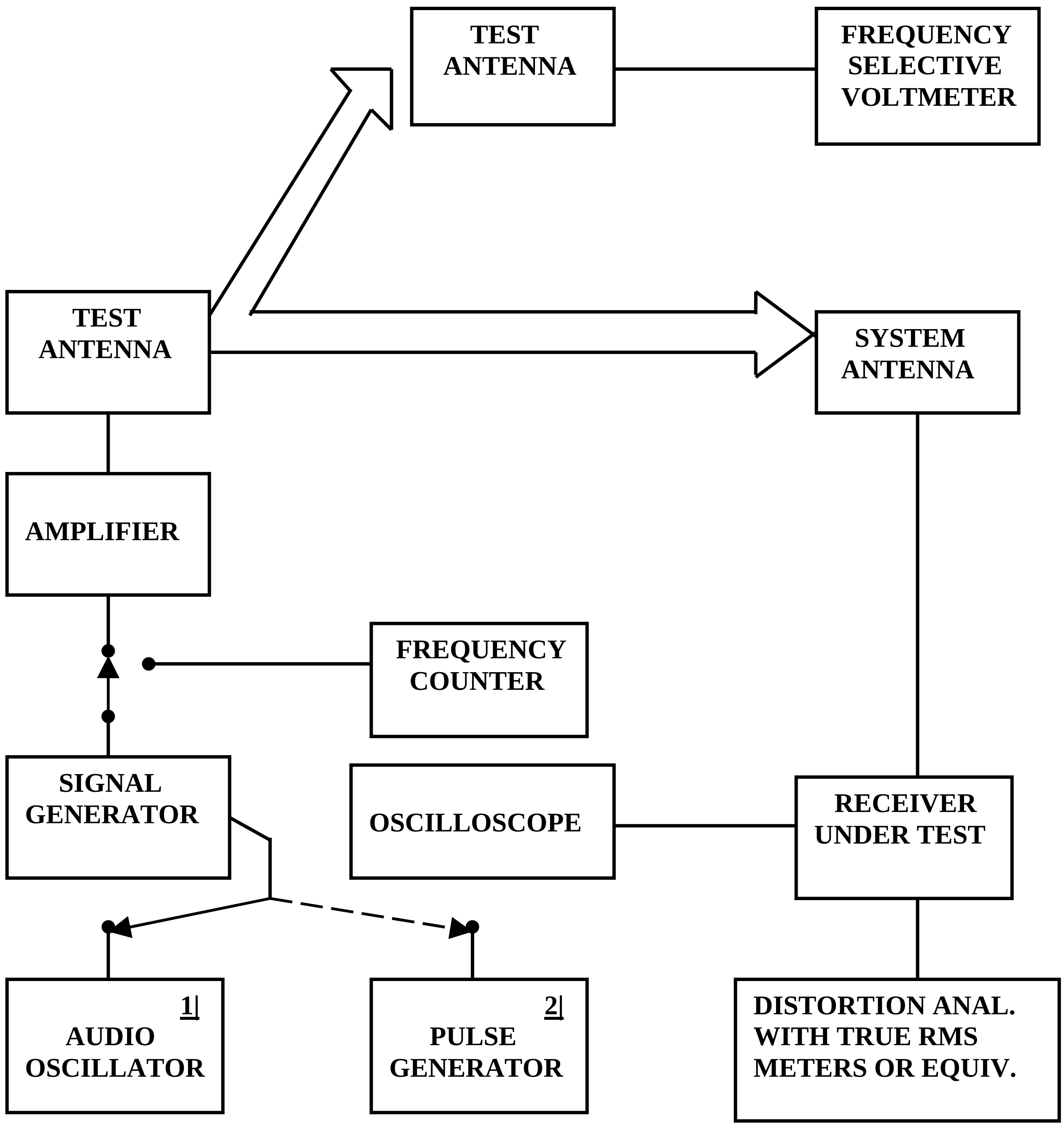



FIGURE 9

MEASUREMENT SETUP

RS101, RS102 – RADIATED SPURIOUS RESPONSE

1| USED FOR NON-PULSED MEASUREMENTS ONLY.
2| USED FOR PULSED MEASUREMENTS ONLY.

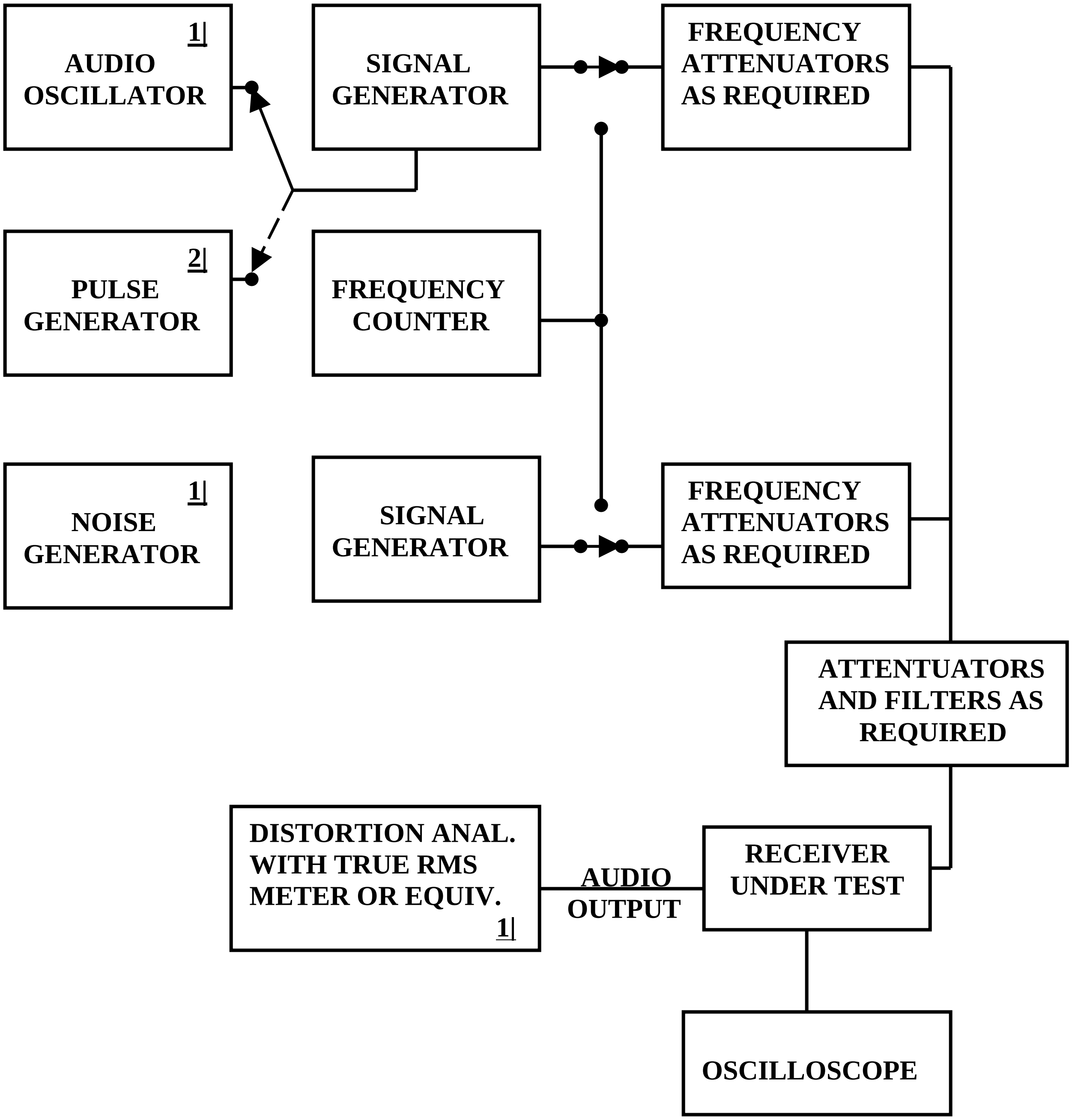



**FIGURE 10**

**MEASUREMENT SETUP**

**CS110, CS111 – INTERMODULATION**
**CS114, CS115 – ADJACENT SIGNAL INTERFERENCE**
**1| USED FOR NON-PULSED MEASUREMENTS ONLY.**
**2| USED FOR PULSED MEASUREMENTS ONLY.**

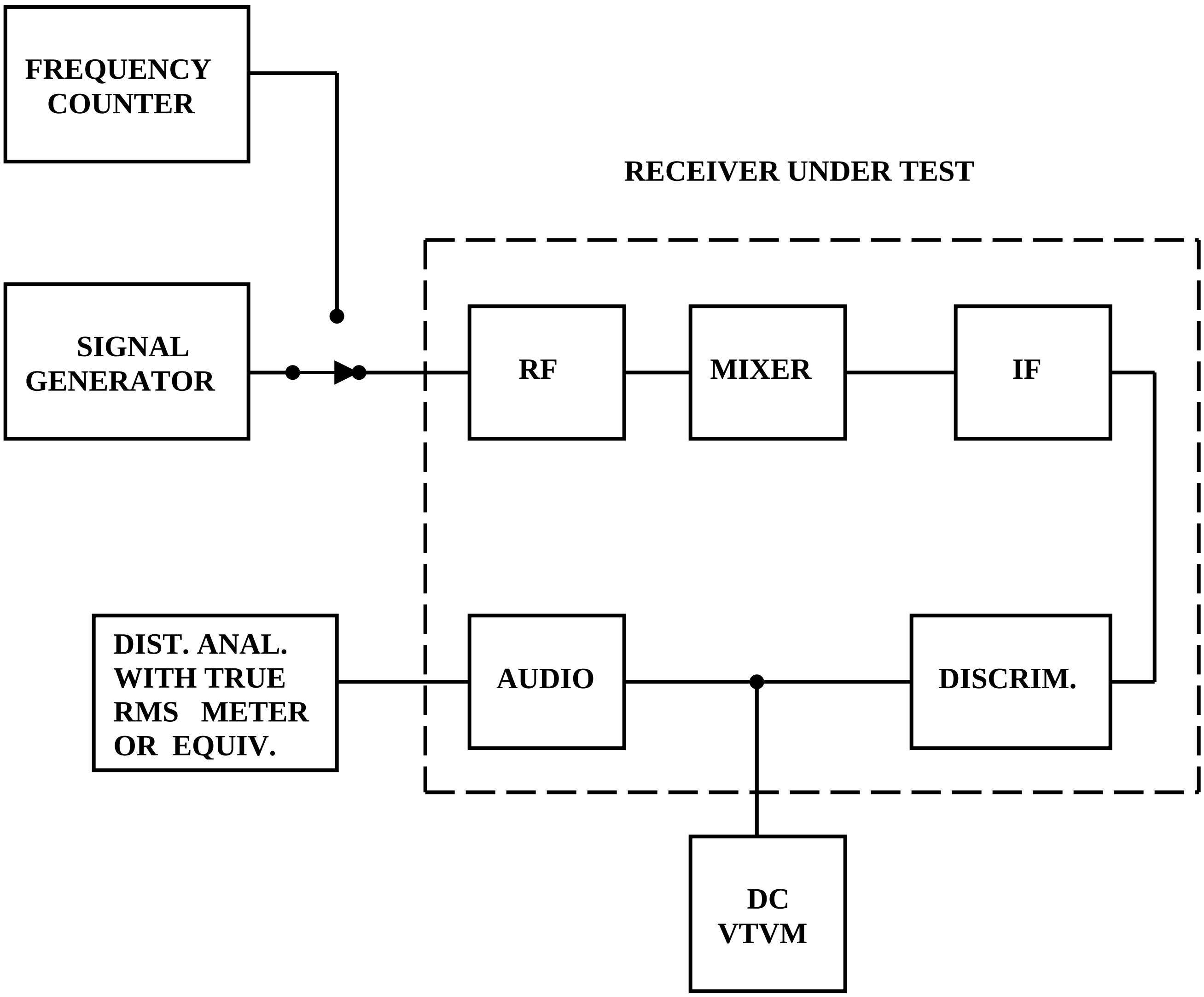



**FIGURE 11**

**MEASUREMENT SETUP**

**CS116 – DISCRIMINATOR BANDWIDTH**

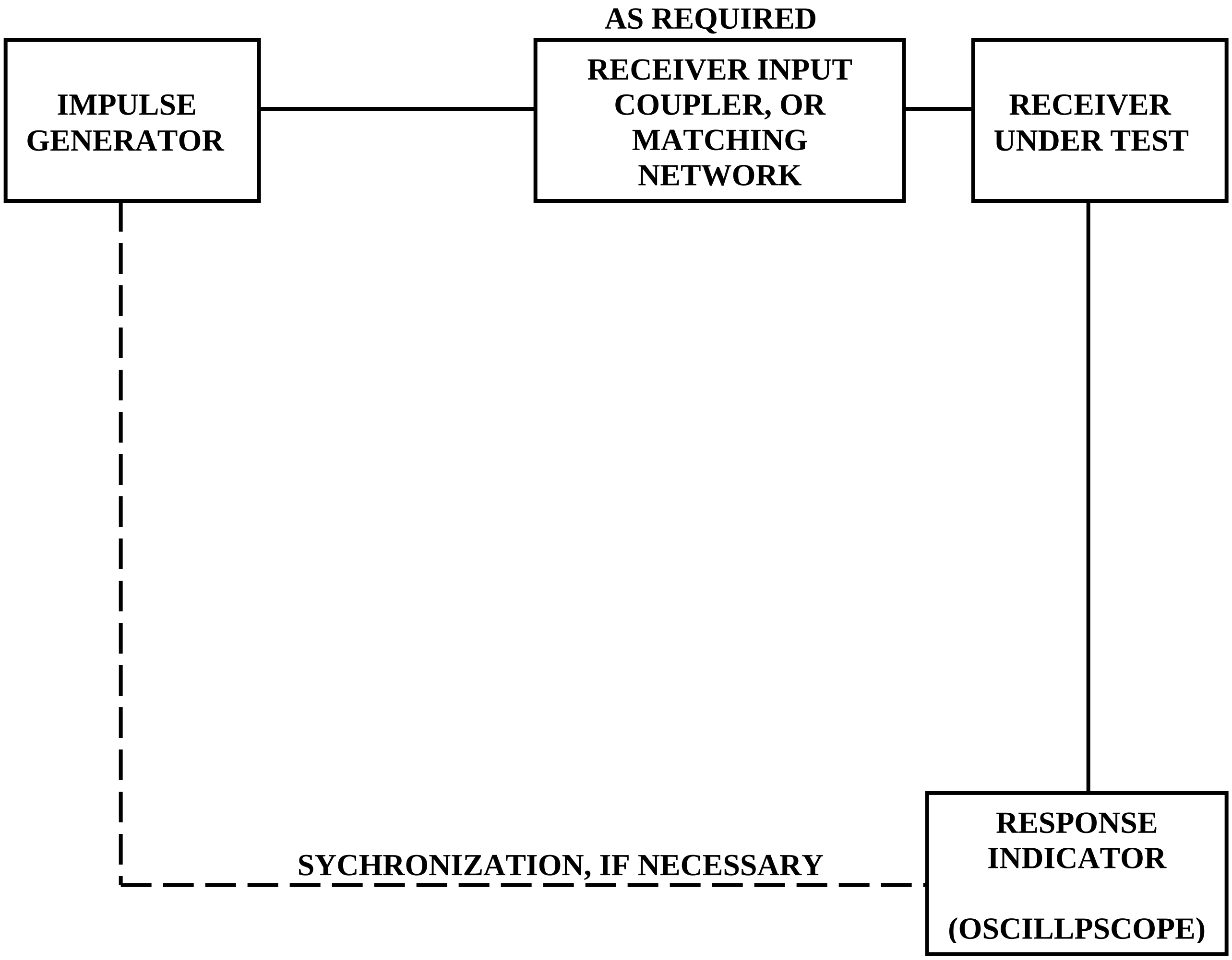



**FIGURE 12**

**MEASUREMENT SETUP**

**CS117 – IMPULSE RESPONSE**

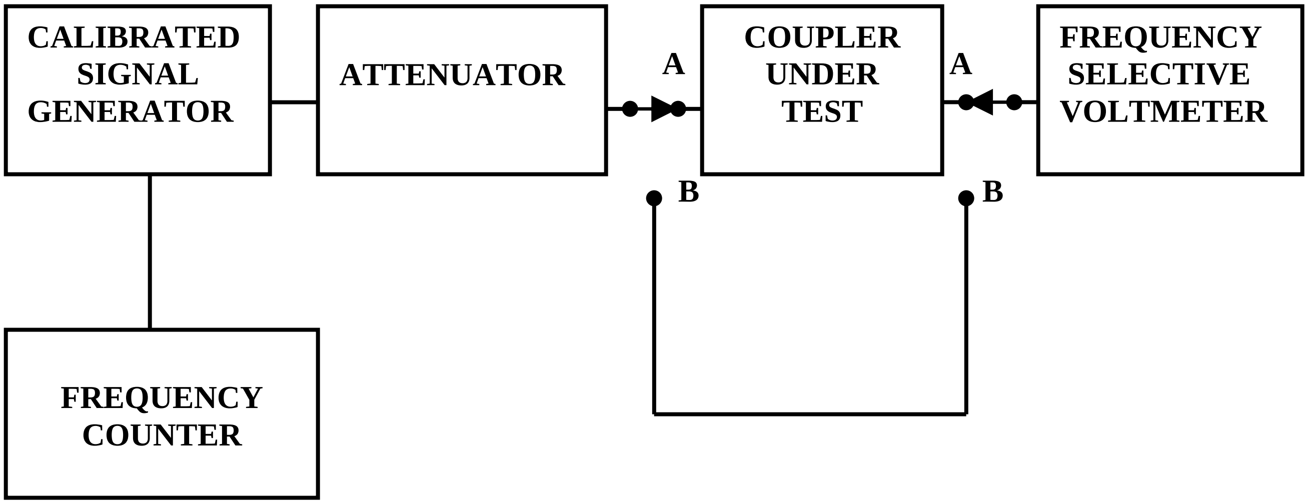



**FIGURE 13**

**MEASUREMENT SETUP**

**CS118 – COUPLER SELECTIVITY**

**CS119 – COUPLER DYNAMIC RANGE**

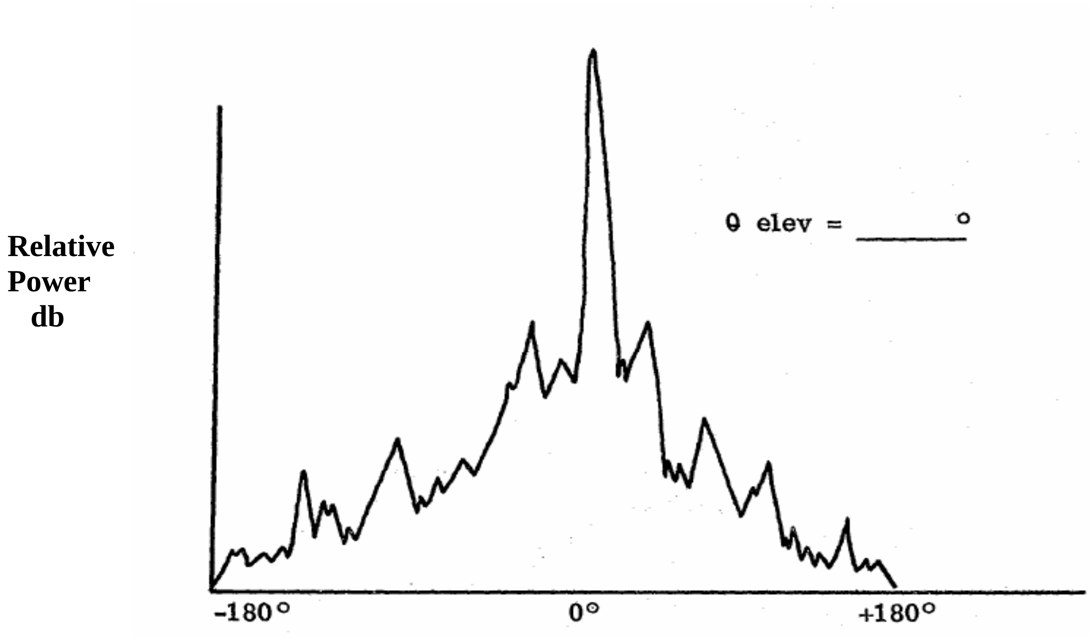



**FIGURE 14 Typical azimuth antenna pattern plot.**

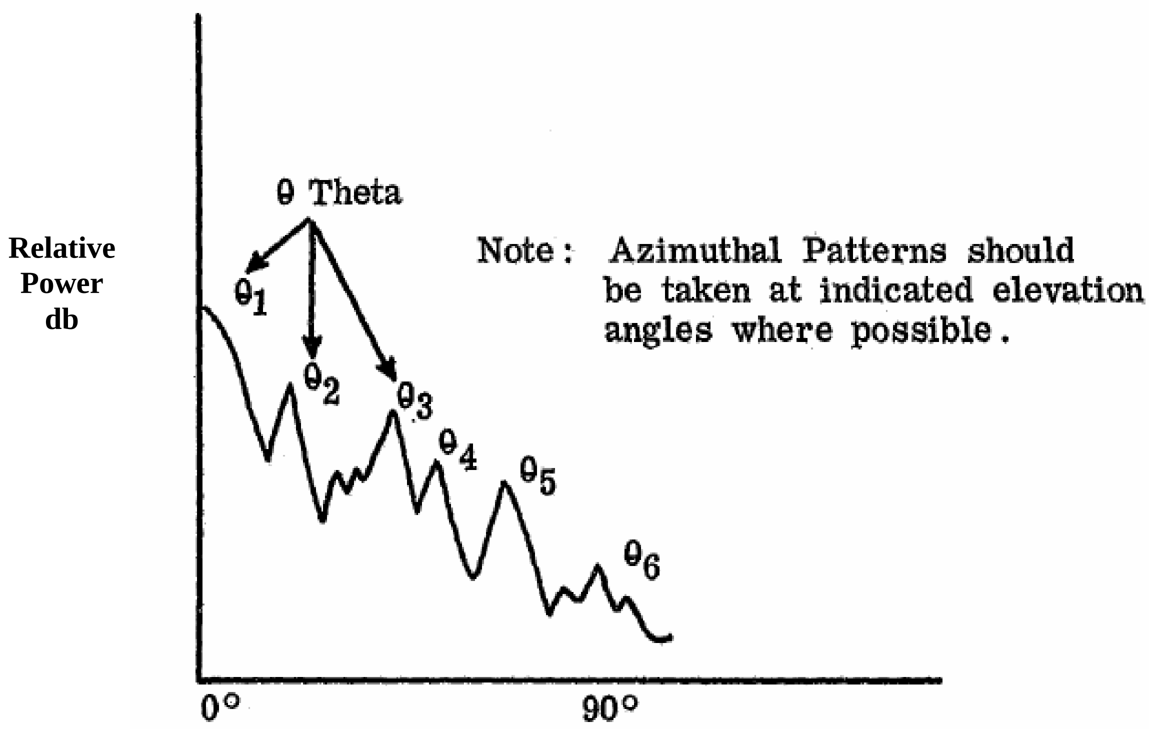



**FIGURE 15 Typical elevation antenna pattern plot.**