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CANADIAN STANDARDS ASSOCIATION
(INCORPORATED 1919)

# CANADIAN ELECTRICAL CODE
## PART IV

# RADIO

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C22.4 No. 101—1953

# RADIO NOISE MEASURING INSTRUMENTS AND GENERAL METHODS OF MEASUREMENT

(FIRST EDITION)

CSA STANDARD
1953


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## PART IV
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# RADIO NOISE MEASURING INSTRUMENTS AND GENERAL METHODS OF MEASUREMENT

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## CONTENTS

## MEMBERS OF PANEL 4
## CANADIAN ELECTRICAL CODE PART IV

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F. A. O. BANKS — Dominion Electrohome Industries Ltd., Kitchener. (*Representing* Radio-Television Manufacturers Association of Canada)

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S. BONNEVILLE — The Bell Telephone Co. of Canada, Montreal.

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W. M. MARSHALL — Department of Transport, Ottawa.

H. O. MERRIMAN — Department of Transport, Ottawa.

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J. A. OUIMET — Canadian Broadcasting Corporation, Montreal.

C. F. PATTENSON — National Research Council, Ottawa.

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CANADIAN STANDARDS ASSOCIATION

# PREFACE

This Standard is intended for the guidance of those desiring to measure radio frequency voltages or radio frequency fields. It is primarily intended for use in connection with the investigation of radio noise, which may give rise to radio interference. Broadly speaking, radio interference may be produced by any electrical disturbance which gives rise to radio frequency voltages or radio frequency fields of such a character as to cause undesired response of electronic apparatus.

It will be recognized that the degree of radio interference cannot readily be expressed in absolute terms, for a response considered intolerable by one individual may be considered tolerable by another. Prolonged investigations were, therefore, necessary to determine suitable methods and instruments for measuring radio frequency voltages and fields of an interfering character in such fashion as to make it possible to prescribe tolerable limits which would ensure reasonable freedom from interference. The tolerable limits for radio noise emanating from various sources are specified in appropriate standards of the Canadian Electrical Code, Part IV and this Standard is limited in scope to instruments and methods of measurement.

An instrument for measuring voltages or fields of an interfering character is not a simple meter. It must, of necessity, be essentially a radio receiver equipped with an indicating meter and amenable to calibration in terms of the voltage of the sine wave input required to obtain the same meter deflection as is caused by a noise input being measured. Since the instrument is to measure voltages of various wave shapes, repetition rates, etc., such factors as band-width, detector time constant, and overload capacity of the instrument must be considered. There are many other factors which cannot be evaluated and included at this time. Experience has shown that it is most convenient to calibrate noise measuring instruments in terms of the root-mean-square (rms) value of a sine wave input. Subjective listening tests have proven that the nuisance value of an interfering noise may be more accurately indicated by the quasi-peak or peak value of an interfering wave form. Consequently, it is desirable to have noise meters indicate rms, peak, and quasi-peak values of the applied signal. Which of these characteristics is used is dependent on the type of interference being measured and is indicated in the appropriate specification for the type and source of noise (Specifications C22.4 Nos. 102, 103, etc.).

For several years various groups have been studying the technical problems encountered in the design of a suitable instrument. Their work has been co-ordinated by the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission (IEC). At a meeting held in 1947 in Lucerne, Switzerland, a very comprehensive performance specification for a noise measuring instrument was prepared. However, there is still no instrument approved as an international standard, nor has any specification defining the pertinent circuit constants of such an instrument been finally adopted internationally.

The need of obtaining comparative measurements from different investigators is urgent, and the Panel, therefore, decided to incorporate in this Standard the pertinent characteristics of a measuring instrument as proposed at the last CISPR meeting together with certain recent improvements which are likely to be adopted in the future. These characteristics establish a performance standard which makes it possible to group commercially available instruments into two distinct classes.

Instruments having characteristics in conformity with the standard characteristics are referred to as Class I instruments and when properly calibrated may be used for measurements of radio frequency voltages and radio frequency fields of an interfering character, where a high degree of accuracy is required.



In order that investigators may make use of other instruments, information has been included herein to make possible the use of a Class II instrument or a calibrated receiver. The accuracy of the results obtained with these sub-standard instruments may be improved by comparing results obtained by their use with results obtained by the use of a Class I instrument, and preparing an appropriate correction table. It is essential, of course, that these comparisons be made using as a noise source the particular type of equipment that is to be investigated.

It should be recognized that these recommendations represent the voluntary contribution of radio and electrical manufacturers, radio communication services, and allied industries towards the solution of a problem which has arisen through the development of these services.

Comments or data bearing on this subject will be welcomed and correspondence on this matter should be sent in duplicate to:

The General Manager,
Canadian Standards Association,
National Research Building,
Sussex Street,
Ottawa, Ontario,

and will be recorded and brought to the attention of the appropriate committee. This Standard will be revised from time to time as the art develops.

This Standard was formally approved, by letter ballot, by Panel 4, CE Code Part IV in April, 1952; by the Committee on CE Code Part IV in June, 1952; and by the CSA Main Committee, with authority to publish it as a CSA Standard, in October, 1952.

OTTAWA, March, 1953.

# CANADIAN ELECTRICAL CODE

## PART IV

## RADIO

## C22.4 No. 101—1953

# RADIO NOISE MEASURING INSTRUMENTS AND GENERAL METHODS OF MEASUREMENT

## SECTION 1

### SCOPE

**Rule 101**

APPARATUS

**Apparatus**

(a) This Standard specifies apparatus for measuring radio frequency voltages and radio frequency fields of an interfering character and specifies conditions and limitations under which measurements should be made. An instrument whose standard of performance is in line with the latest developments of the art is classified as a Class I instrument and as such is approved as a standard noise measuring instrument.

(b) Class II instruments are approved for use in routine operations where the highest degree of accuracy is not required, provided that they shall be periodically checked against a Class I instrument on the particular type or types of noise on which they are to be used. Calibrated receivers are approved where the degree of accuracy desired is low: they are more suitable for determining the ratio of the intensity of two similar noises than for the determination of absolute values.

**Rule 102**

MEASUREMENTS

**Measurements**

(a) General methods of measuring radio frequency voltages and radio frequency fields emanating from various sources are specified as well as the standard method of measuring Insertion Loss Of Suppressors. For the purpose of this Standard, three measuring instruments are described for the various frequency ranges with overlapping frequency coverage. The overlapping frequency coverage is an advantage for investigation purposes. For measurement purposes, however, the following frequency ranges shall be used:

150 kc/s to 25 Mc/s
25 Mc/s to 100 Mc/s
100 Mc/s to 400 Mc/s

**Rule 103**

FREQUENCY BAND

**Frequency Band**

(a) The instruments to be used, and methods of measurement of field intensities are applicable to the frequency band of 150 kc/s to 400 Mc/s, and the methods of measurement of radio frequency voltages to the band 150 kc/s to 30 Mc/s.

## SECTION 2

## GENERAL REQUIREMENTS

**Rule 201**

GENERAL INFORMATION

**General Information**

(a) For general information regarding the Canadian Electrical Code Part IV, see Standard C22.4 No. 100 "General Requirements, Definitions, and Procedure Relative to the Control of Radio Interference".

## SECTION 3

## DEFINITIONS

**Rule 301**

DEFINITIONS

**Definitions**

(a) The following definitions are extracted from Standard C22.4 No. 100.

NOTE:—*Throughout this Standard the word "noise" means "radio noise". Radio noise is an electrical disturbance which may give rise to radio interference.*

**Standard Noise Measuring Instrument (or Class I Instrument)**

(1) **Standard Noise Measuring Instrument (or Class I Instrument)** is an instrument for measuring radio frequency voltages and radio frequency fields of an interfering character which has circuit characteristics in conformity with this Standard.

**Class II Instrument**

(2) **Class II Instrument** is a measuring instrument having circuit characteristics not in complete conformity with this Standard for a Class I Instrument but which the Department of Transport accepts as a Class II Instrument.

NOTE:—*For the purpose of controlling and measuring interference phenomena, the Department of Transport, Ottawa, has adopted certain instruments as standard Class I, or Class II, and recognizes the use of calibrated receivers. They have rated these instruments in accordance with the degree of agreement with the standards of performance herein set forth. A list of such rated instruments which are available may be obtained from the Department of Transport.*



**Standard Noise Measuring Instrument Characteristics**

(3) **Standard Noise Measuring Instrument Characteristics** are those circuit characteristics of a radio noise measuring instrument which determine the response of the indicating meter to any radio frequency voltage; the meter proper indicating the voltage in terms of the root-mean-square (rms) value of sine wave voltage required at the input terminals to produce the same deflection of the indicating meter as that given by the noise voltage.

**Equivalent Microvolts of Noise**

(4) **Equivalent Microvolts of Noise** is the rms value of the voltage of an unmodulated sine wave required to give the same meter deflection of the measuring instruments as is given by the noise voltage when the instrument is connected to the apparatus, line or system under investigation.

Unit — Microvolts

(i) Equivalent Microvolts of Noise gives a numerical value to the radio noise developed by the apparatus under the actual operating conditions in which it is found. This value is dependent on the associated circuits as well as on the apparatus under test.

(ii) Since many factors affect the reading, full details should be specified for each measurement including:

1. The points of measurements;
2. The component measured (line No. 1 to ground, line No. 2 to ground, etc.);

NOTE:—*A capacity ground (i.e., measuring instrument case ungrounded) is preferable unless a good physical radio frequency (rf) ground is readily available. The method of grounding should be noted.*

3. The operating conditions (line voltage, load on apparatus, etc.);
4. Circuit conditions (supply line type, size, etc.);
5. Type of measuring instrument used.

**Noise Field Intensity**

(5) **Noise Field Intensity** is the field intensity produced by an electrical disturbance of an interfering character.

Units — Microvolts per meter

(i) For the purpose of this Standard the Noise Field Intensity shall be expressed in terms of the indication of the Standard Noise Measuring Instrument.

**Signal Field Intensity**

(6) **Signal Field Intensity** is the rms value of the field intensity, at a point, due to the passage of radio waves of a specific frequency.

Units — Microvolts per meter

(i) If the direction and polarization, in which the field intensity is to be measured, are not specified they shall be those which produce the maximum indication on the meter.

Insertion Loss of a Suppressor

(7) **Insertion Loss of a Suppressor** is a voltage ratio expressed in db indicating the effectiveness of a suppressor, as measured by the method described in this Standard.

Units — ratio expressed in db.

## SECTION 4

## MEASURING INSTRUMENT

### Rule 401

### General

General

(a) This section of the Standard deals with the most important characteristics of measuring instruments and those pertinent circuit characteristics which constitute the standard instrument characteristics.

While the complete specification for a measuring instrument is beyond the scope of this Standard, certain pertinent circuit characteristics are listed herein as Standard Noise Measuring Instrument characteristics and as such constitute a basis for the classification of various commercial instruments.

(b) Noise measuring instruments may be classified on the basis of the relationship existing between their circuit characteristics and the standard instrument characteristics.

(1) Instruments used for the measurement of rf field intensities and rf voltages in accordance with this Standard, are essentially radio receivers incorporating stages of radio frequency amplification. The output of the detector circuit is utilized to operate an indicating meter. For monitoring purposes an audio amplifier and conventional output circuit are usually provided.

(2) The radio receiver section of the instrument shall be superheterodyne type. The radio frequency input circuit shall be designed to accommodate coaxial and/or balanced radio frequency input cable. Since the instruments are to be utilized both as two-terminal radio frequency voltmeters and as field intensity measuring instruments, provision shall be made for the instrument to be connected either to impedance matching networks for the measurement of radio frequency voltages or to suitable antennas for the measurement of field intensities.

(3) For use as a two-terminal voltmeter, coupling units shall be provided so that measurements may be made either across high impedance circuits or matched to specified low impedance circuits. The specified low impedances are usually 50 and 20 ohms. Data are supplied to permit correction of the meter reading, compensating for the network losses.



(4) In measuring field intensities the instrument indicates the voltages set up across the input terminals due to the field acting on an antenna of known effective height. The input circuit shall be designed to take loop, rod, or dipole antennas as are most appropriate.

(5) It is necessary that tables or graphs presenting all data necessary for applying corrections to the meter indications be included in the instructions supplied with the instrument.

(6) It is desirable that the instrument be capable of measuring radio frequency input voltages from 1 microvolt to 1 volt.

(7) A suitable attenuator shall be incorporated to permit a wide range of input levels. The attenuator shall be essentially resistive and so designed as to properly match its associated circuits. It is usual to use a step attenuator with ratios of 1, 10, 100, 1,000 and 10,000.

(8) Adequate shielding and efficient filtering shall be included where necessary in input and output circuits to ensure that the instrument will respond only to the desired voltages impressed across the signal input terminals.

(9) As the instrument is to be used for field work, size and weight of the complete equipment should be the minimum consistent with reliable operation. It is highly desirable that each instrument be capable of measuring the rms, quasi-peak, and peak values of the following:

(i) Signal Field Intensity of modulated or unmodulated continuous waves;

(ii) Noise Field Intensity;

(iii) Radio frequency voltage of modulated or unmodulated radio frequency energy on conductors.

(10) The accuracy of an instrument is not altogether determined by the classification into which it falls, as it must be properly aligned and accurately calibrated in accordance with the instructions supplied by the manufacturer.

### Rule 402

### Audio Channel Characteristics

Audio Channel Characteristics

(a) With the instrument having an rf input, 30 per cent sine wave modulated at 1,000 c/s, sufficient to give a meter deflection indicating 10 microvolts, the audio amplifier shall be capable of supplying to a 600-ohm non-inductive resistor load a power of 100 milliwatts with not more than 5 per cent distortion within the frequency band specified in paragraph (b).

(b) The overall audio response shall be flat within 4 db from at least 300 to 3,000 c/s.

**Rule 403**

OUTPUT CONNECTIONS

**Output Connections**

(a) Front panel connections shall be provided for the operation of a recorder, oscilloscope, and headphones or speaker and shall be made at a point in the equipment which will ensure minimum distortion.

**Rule 404**

SENSITIVITY

**Sensitivity**

(a) The sensitivity of radio noise and field intensity measuring equipment is that characteristic which determines the minimum strength of signal input capable of causing a desired deflection on the indicating meter. It shall be determined with the instrument set for field intensity measurements with correction for initial diode voltage but not internal noise. By initial diode voltage is meant the direct current (dc) voltage existing across the diode detector load resistor due only to the contact potential of the diode.

(b) The standard sensitivity of the instrument shall be such that a continuous wave (cw) signal of 1 microvolt across the rf input terminal at any frequency within the tuning range will provide an angular meter deflection of not less than 10 per cent of full scale in the absence of internal noise. Since in practice noise is always present, a deflection of more than 10 per cent will be observed in measuring sensitivity. Internal noise and externally applied (cw) signal add, not algebraically, but as the square root of the sum of their squares (rss).

**Rule 405**

SELECTIVITY

**Selectivity**

(a) The selectivity of the instrument is that characteristic which determines the extent to which the instrument is capable of differentiating between the desired signal and signals of other frequencies.

(b) Selectivity shall be expressed as the decrease in meter indication in terms of db as the instrument is tuned off resonance.

(c) For instruments covering the band 150 kc/s to 25 Mc/s the bandwidth shall be between 1.5 kc/s and 9 kc/s



at 6 db down; and not greater than 30 kc/s at 60 db down. The bandwidth of instruments for this range is a function of frequency. The 1.5 kc/s limit is for the 150 kc/s region, 9 kc/s for the 25 Mc/s region. Noise intensity is expressed in $\mu$v/m/kc bandwidth and noise voltage in $\mu$v/kc bandwidth, as explained in the instrument manuals.

(d) For instruments covering the band 15 Mc/s to 125 Mc/s the bandwidth shall be 150 kc/s at 6 db down.

(e) For instruments covering the band 88 Mc/s to 400 Mc/s the bandwidth shall be 210 kc/s at 6 db down.

(f) The selectivity should not be affected unduly by intensity of input signal.

**Rule 406**

SHIELDING

**Shielding**

(a) The shielding of the equipment and of those circuits contained therein and of those circuits to which external connections must be made by means of shielded cables, shall be such that when the equipment is tuned to a signal of any frequency and at any intensity not less than 60 db above tube noise within its normal range and the antennas, transmission lines, or loops are then disconnected, the meter indication shall decrease by a factor of at least 1,000 or 60 db.

**Rule 407**

INTERNAL CALIBRATOR

**Internal Calibrator**

(a) An internal calibrator shall be incorporated for standardization of this measuring equipment in the field. This calibrator may take the form of a calibrated electronic or impulse noise generator or tuned sine wave signal generator provided that the accuracy obtained shall be plus or minus 10 per cent.

**Rule 408**

IMAGE REJECTION

**Image Rejection**

(a) The image rejection ratio shall be 50 db or better in the frequency range 150 kc/s to 400 Mc/s.

**Rule 409**

INTERMEDIATE FREQUENCY REJECTION

**Intermediate Frequency Rejection**

(a) The intermediate frequency rejection ratio shall be 60 db or better.

**Rule 410**

SPURIOUS RESPONSE REJECTION

**Spurious Response Rejection**

(a) Spurious response rejection ratio shall be 50 db or better throughout the frequency range 150 kc/s to 400 Mc/s.

**Rule 411**

OVERLOAD CHARACTERISTICS

**Overload Characteristics**

(a) The overload characteristics of the equipment shall be such that the output voltage bears a linear relation to a sine wave input voltage within 10 per cent up to a point 12 db beyond full scale meter deflection, with the automatic gain control (agc) voltage held constant by independent means at the value obtained at full scale meter deflection.

**Rule 412**

SIGNAL TO NOISE RATIO

**Signal to Noise Ratio**

(a) The signal to noise ratio of the receiver shall not be less than unity throughout its tuning range for a cw signal of 1 microvolt across the rf input terminals.

**Rule 413**

INDICATING METER CHARACTERISTICS

**Indicating Meter Characteristics**

(a) The indicating meter shall be supplied with an approximately logarithmic, microvolt scale, a corresponding decibel scale for 40 db range and an appropriate scale for calibration purposes, if necessary. This meter shall be of the permanent magnet moving coil type with approximately equal increments of deflection for equal increments of direct current. The indicating meter shall read accurately in any position.

(b) The indicating meter shall have a time constant not greater than 350 milliseconds defined and measured as follows:

> A constant current, producing approximately ⅔ full scale deflection, shall be passed through the instrument and the exact final deflection noted. The circuit shall then be opened and after the pointer comes to rest at zero, the circuit shall again be closed. The time required for the pointer to move from zero to its equilibrium position, as previously noted on the first passage, is the time constant of the indicating instrument.

(c) The damping factor is defined as the ratio of the steady deflection, in angular degrees, to the difference between the maximum momentary deflection and the steady deflection, produced by the same current, also in angular degrees. The meter damping factor shall be between 16 and 100.

**Rule 414**

TYPES OF MEASUREMENT

**Types of Measurement**

(a) This equipment shall be capable of accurately making radio frequency measurements of the following types:



(1) Field intensities of continuous wave signals, modulated and unmodulated, with an accuracy of plus or minus 10 per cent at signal levels above 10 microvolts.

(2) Quasi-peak values of various types of noise by means of weighted detector circuits (Rule 702 (e)).

(3) Peak values of various types of radio noise and other signals by means of a slide-back voltage method of measurement (Rule 702 (f)).

**Rule 415**

DETECTOR TIME CONSTANT

**Detector Time Constant**

(a) In order that noise impulses may be evaluated in terms of the annoyance caused to listeners, special weighting circuits are required in the second detector. When these particular weighted circuits are in operation the instruments are said to be in quasi-peak position. The weighting circuit shall be as follows:

(1) Charge time constant shall not exceed 3 milliseconds.

(2) Discharge time constant shall be 600 milliseconds plus or minus 20 per cent.

(3) The charge time constant of the detector weighting circuit shall be the time required for the detector output voltage to build up to 63 per cent of its final value following a change in the radio frequency voltage which occurs in less than 1/10 millisecond.

(4) The discharge time constant of the detector weighting circuit shall be equal to the time required for this circuit to discharge to 37 per cent of its value when an energizing signal is suddenly removed.

NOTE:—*The agc circuit in quasi-peak position shall have a time constant which is short compared with the weighting circuit of the detector in order that the detector weighting circuit constants will be the determining constants.*

## SECTION 5

## CALIBRATED RECEIVER FOR USE UP TO 30 Mc/s

**Rule 501**

GENERAL

**General**

(a) A calibrated receiver may be used as an inexpensive means of investigating radio interference to the reception of amplitude modulated transmissions, and as a means of checking the noise potentialities of appliances during manufacture. It is also useful in locating sources of interference and in determining the reduction in interference levels brought about by shielding or the insertion of suppressors. The methods of connecting the indicating meter and the method of calibration preclude any possibility of using the calibrated receiver to determine the absolute value of noise and of most signals.

**Rule 502**

TYPE OF RECEIVER

**Type of Receiver**

(a) Any good quality radio receiver, equipped with a manual radio frequency gain control and with a means of rendering the agc circuit inoperative, may be calibrated, the only requirements being that the receiver will cover the desired frequency range and possess a good audio output amplifier. Prior to use the receiver should be accurately lined up and the radio frequency gain control knob should be replaced by a good quality graduated dial.

**Rule 503**

OUTPUT METER

**Output Meter**

(a) The output meter which is to be connected across the primary of the audio output transformer shall be a high impedance alternating current (ac) voltmeter. The instrument shall be multirange preferably 0 to 15 volts and 0 to 150 volts. A switch shall be provided to change from one range to the other. When receivers are used which have a direct current flowing through the primary of the output transformer an isolation transformer of reasonable audio fidelity or suitable isolating condensers shall be used. The indicating instrument shall be connected across the secondary of the isolation transformer.

**Rule 504**

METHOD OF CALIBRATING THE RECEIVER

**Method of Calibrating the Receiver**

(a) The receiver and associated output meter should be connected to a signal generator.

**Control Settings of the Receiver**

(b) In calibrating the receiver all the controls except the frequency control shall be fixed as follows:

(1) The audio gain shall be fixed at maximum;

(2) The automatic gain control shall be switched off or otherwise made inoperative;

(3) The beat frequency oscillator shall be switched off;

(4) Selectivity shall be set for normal broadcast reception;

(5) The tone control shall be set to normal position; i.e., no compensation included.



**Calibration Curves**

(c) Two calibration curves are required — a sensitivity curve and an rf gain control curve.

**Sensitivity Curve**

(d) The sensitivity curve displays the input, as a function of frequency, required to produce a predetermined output. The horizontal axis, usually divided logarithmically, is the frequency base; the vertical axis is the "input base". The latter axis may be arranged as is most convenient for the work in hand, e.g., it may be linear in db above one microvolt, logarithmic in microvolts, etc.

(e) All controls shall be set as previously specified and the rf gain control shall be adjusted as follows:

(1) The radio frequency gain control shall be adjusted so that the output meter reads a predetermined value. This predetermined value shall be selected so that overload due to high peaks of an interference surge will probably not occur.

(2) The output reading should not be greater than 12 db below maximum undistorted output. Maximum undistorted output shall be taken as that point at which the input versus output ratio departs from linearity by 1 db.

(f) The signal generator shall be connected directly to the receiver input terminals (no dummy antenna) and adjusted to inject a signal modulated 30 per cent at 400 c/s.

**Calibration of RF Gain Control**

(g) The rf gain control shall be calibrated to show the change in amplification (vertical scale) corresponding to a change in rf gain dial setting (horizontal scale). The zero of the vertical scale shall be so placed that the calibration curve crosses zero axis at a point on the horizontal scale representing the setting of rf gain control which was used during the sensitivity calibration. Greater sensitivity shall be indicated below the zero axis and lesser sensitivity shall be indicated above the zero axis. Suitable scales must be chosen. This usually means a linear scale for dial setting and a linear db or logarithmic ratio scale for amplification according as a linear or logarithmic scale was used for the sensitivity curve.

(h) Figures 1 and 2 represent typical calibration curves.

**Rule 505**

USE OF THE RECEIVER

**Use of the Receiver**

(a) The receiver should be connected to a suitable antenna or network as appropriate for the test to be made. Set all controls with the exception of the rf gain control to the positions for calibrating the receiver. Tune the instrument to the frequency under investigation and adjust the rf gain control until the indicating meter reads the predetermined value used during calibration. Note the rf gain control settings and from the two calibration curves determine the microvolts present at the input terminals of the receiver.

(b) The db reduction in noise due to the insertion of a suppressor may be determined by measuring the noise level before and after inserting the suppressor in the circuit being studied.

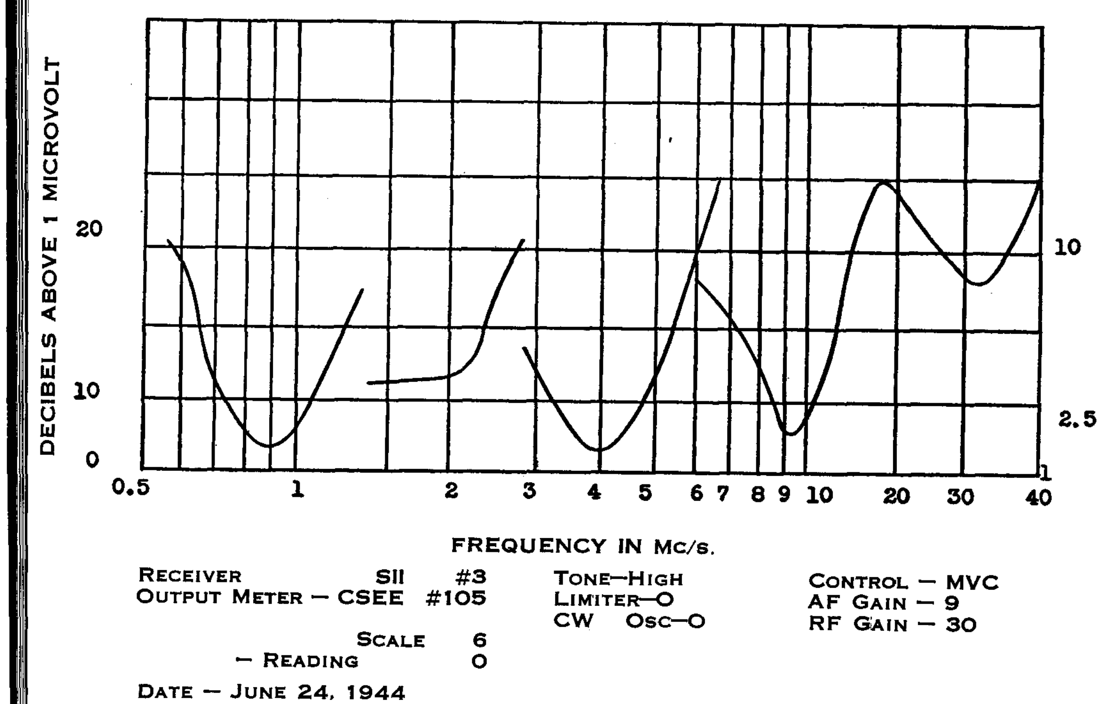
## SECTION 6

## MEASUREMENT OF EQUIVALENT MICROVOLTS OF NOISE

### Rule 601

### General

General (a) In many instances it is desirable to obtain some indication of the interference producing potentialities of a piece of electrical equipment.




**Typical Receiver Sensitivity Calibration Curve**

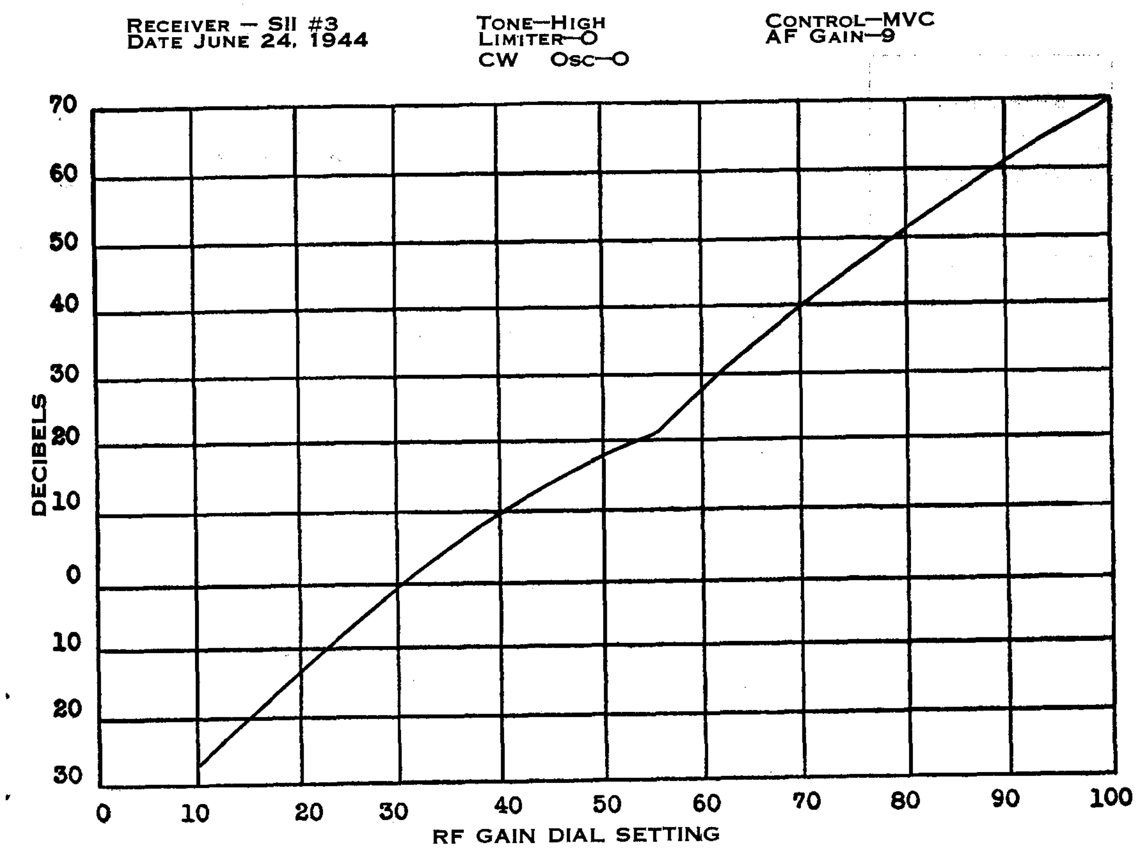
**Figure 1**



(b) It will be recognized that the indication obtained from either a Class I or Class II Instrument connected to any apparatus in actual service may be quite different from that obtained from the same type of apparatus when it is operated under the condition of simulated line impedance laid down herein.

(c) When measurements are made on apparatus in service, where the line impedance is unknown, the noise measuring instrument indicates Equivalent Microvolts of Noise.

(d) Readings must be taken between each line and ground and that condition which produces the maximum indication on the meter shall be taken as the standard test condition for Equivalent Microvolts of Noise. In measuring Equivalent Microvolts of Noise the instruments shall be set for



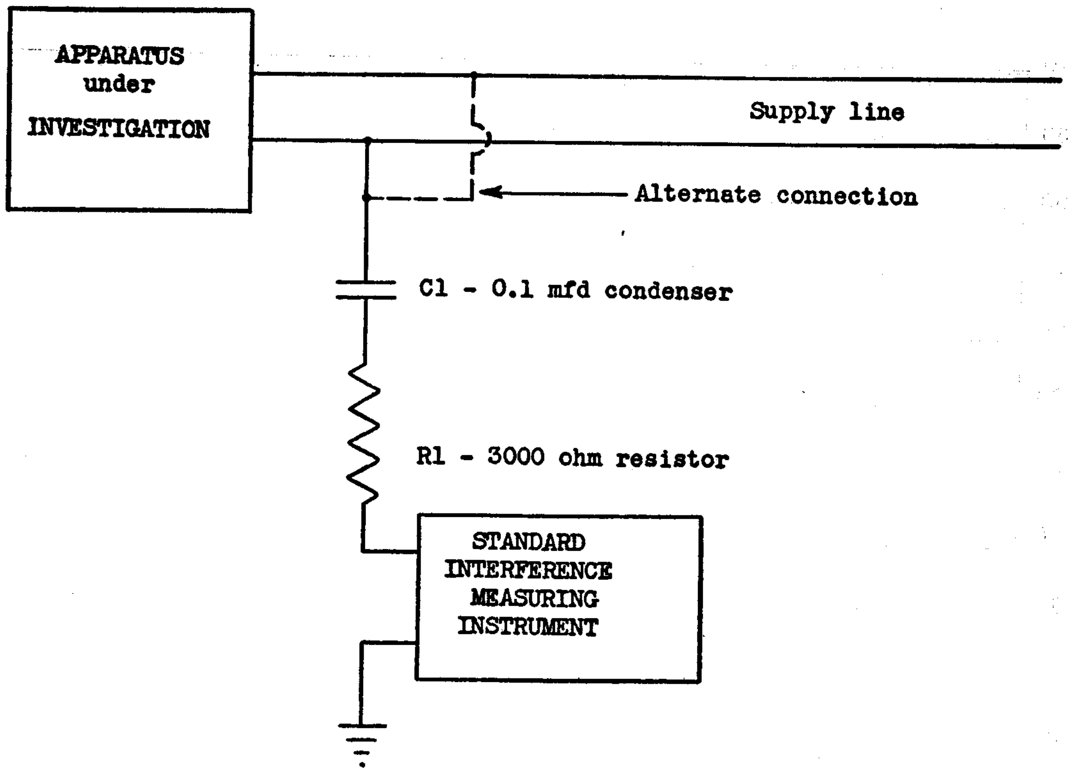

**Typical Receiver RF Gain Control Calibration Curve**

**Figure 2**

"quasi-peak" measurement and care shall be taken to ensure that the instrument is properly calibrated.

(e) Due to the various conditions which will be experienced in practice, it is not practicable to specify the lengths of lead to be employed between the meter and the terminals of the apparatus. However, it should be emphasized that in measuring Equivalent Microvolts of Noise the leads between the measuring instrument and the apparatus under investigation should be as short as possible.

(f) Connection of the measuring instrument should not change the normal noise voltage of the system under investigation by unduly altering the impedance of the system to ground. Any network which has an impedance that is high compared to the line-to-ground impedance of the apparatus



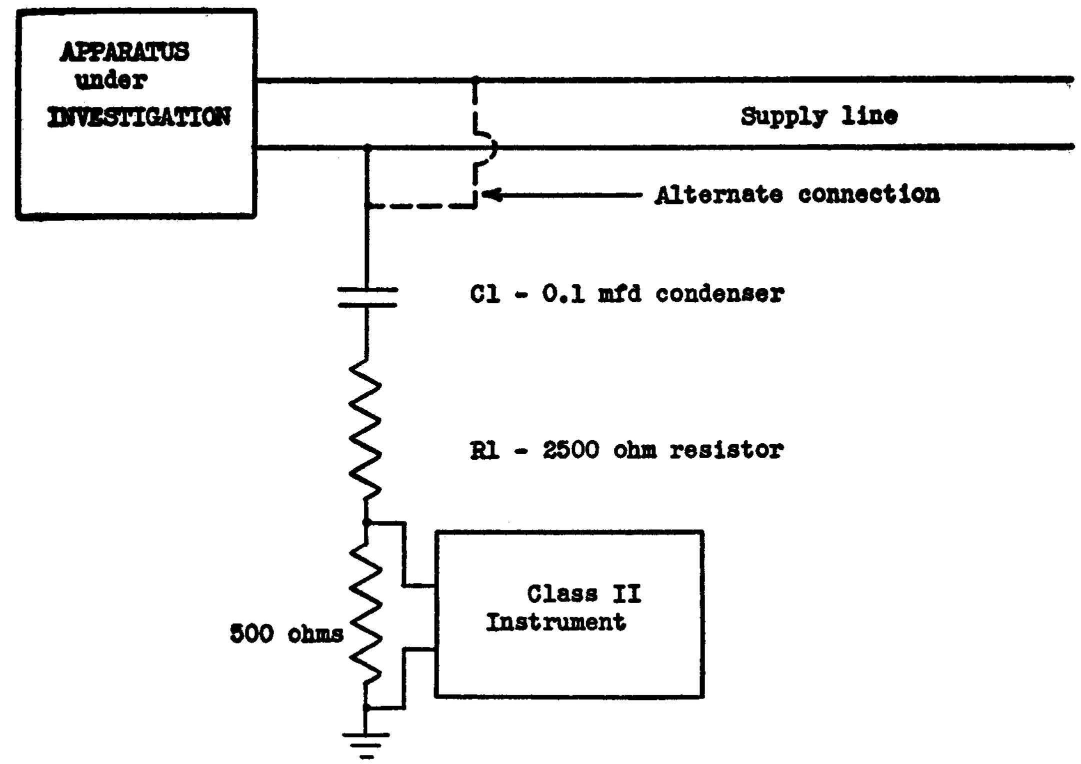

**Method of Connecting a Class I Instrument to Measure Equivalent Microvolts of Noise**

**Figure 3**



under investigation may be used. Figure 3 shows one method of connecting a Class I Instrument to the terminals of the apparatus under investigation. It will be noted that the measuring instrument is connected to each line in turn through a 3,000-ohm resistor and associated blocking condenser. In this instance since the meter input impedance is approximately 1/60 of the impedance from each line to ground, the meter reading must be multiplied by 60 to obtain the Equivalent Microvolts of Noise.

(g) When a Class II Instrument is used which has a high input impedance the instrument is connected as shown in Figure 4. In this instance the meter reading must be multiplied by 6. If the impedance of the instrument is not sufficiently high relative to 500 ohms, the multiplying factor should be calculated.




**Method of Connecting a Class II Instrument to Measure Equivalent Microvolts of Noise**

**Figure 4**

## SECTION 7

## MEASUREMENT OF FIELD INTENSITY

### Rule 701

### Signal Field Intensity

**Signal Field Intensity**

(a) In measuring Signal Field Intensity with either a Standard Noise Measuring Instrument or a Class II Instrument, the instrument should be operated in accordance with the instructions supplied by the manufacturer. All measurements shall be taken with the instrument set for field intensity measurements. With this setting the instrument indicates rms values. Specific instructions as to the methods to be employed in measuring signal field intensities are beyond the scope of this Standard.

### Rule 702

### Noise Field Intensity

**Noise Field Intensity**

(a) In the measurement of Noise Field Intensity, essentially the same procedure as in the measurement of Signal Field Intensity is used. However, most noise fields are complex, often containing components of various amplitudes, directions, and phases, so that results must be carefully analyzed.

(1) A noise field is usually distributed over a wide frequency range and since the noise measuring instrument is calibrated in terms of the rms value of a single frequency sinusoidal wave, the Noise Field Intensity is measured in terms of the equivalent effect of a single frequency and the measurement is influenced by the effective bandwidth of the instrument.

**Methods of Measuring Noise Field Intensity. Instruments**

(b) Either a Class I Noise Measuring Instrument or a Class II Instrument may be used for the measurement of Noise Field Intensity. It will be appreciated from the remarks made elsewhere that when Noise Field Intensity measurements are made with Class II Instruments, exact agreement may not be obtained between the readings of two instruments under similar conditions. However, it is felt that in general Class II Instruments can be used for the measurements of Noise Field Intensity under this Code and that a Class I Instrument need only be used in instances where extreme accuracy is required.

**Operation of Instrument**

(c) The noise measuring instruments shall be set up in accordance with the instructions supplied by the manufacturer. Care shall be taken to ensure that the calibration of the instrument is correct.



**Location of Instrument**

(d) Unless otherwise specified, measurements of Noise Field Intensity from apparatus shall be taken at a location 30 feet or more from the apparatus which is the source of the noise and 20 feet or more from any conductor which may act as a radiator. When these conditions cannot be fully met, the location at which measurements are made shall be recorded in detail, with as complete a description as possible of those factors affecting the field, such as, coupling from the source to the instrument, local structures, wire lines, etc.

**Quasi-Peak Reading**

(e) From experience gained from various measurements taken over several years it has been established that the disturbing effect caused in amplitude modulated signals carrying speech or music is more closely related to the peak intensity of a noise field than it is to the average intensity. Consequently, all measurements of Noise Field Intensity taken in relation to the effect on amplitude modulated signals carrying speech or music are taken so the reading on the instrument lies between the average field intensity and the peak intensity. The time constants which will produce such a reading have been established and the reading is referred to as a quasi-peak reading.

**Peak Field Intensity Readings**

(f) In investigating the effect of a noise field on the reception of signals, other than amplitude modulated (AM) audio signals, readings should be taken not only with the instrument set for quasi-peak but also with it set for peak field intensity readings. Peak values may best be measured by a slide-back voltage method. It is important to record all three readings and also to classify the type of noise under investigation; e.g., ignition, random, pulses, etc.

**Frequency**

(g) Noise Field Intensity shall be measured at the frequency specified in the appropriate Standard covering the noise under investigation. In general, several readings must be taken and the maximum reading obtained shall be considered as the level of noise for the band under investigation. Care shall be taken to ensure that this reading obtained on a noise measuring instrument is that produced by the noise and not by the combination of a noise field and a signal field. In instances where it is necessary to measure the Noise Field Intensity at a specific frequency and it is found that a signal is present on the exact frequency at which measurement is to be made, the measuring instrument shall be detuned slightly from the specified frequency and two measurements taken. One measurement shall be taken at a frequency slightly lower than the specified frequency and the other at a frequency slightly higher. These two measurements should be taken at frequencies which are as close as possible to the specified frequency, but which are clear of any signal field. The maximum indication obtained shall be

**Rule 803**

INSERTION LOSS

Insertion Loss

(a) The insertion loss of the suppressor — 20 log 10 $\frac{V_1}{V_2}$

**Rule 804**

GROUNDING

Grounding

(a) Care must be taken to ensure that no signal by-passes the suppressor from the signal generator to the measuring instrument by way of ground wires, or other conductors, or by direct radiation.

(b) It is essential that all ground connections have extremely low impedance.

(c) The standard signal generator should be thoroughly grounded, with a low impedance connection, to the ground plate, and the output terminal thoroughly shielded.

**Rule 805**

SIGNAL GENERATOR

Signal Generator

(a) Any high quality signal generator is suitable, provided that the calibration of the attenuator has an accuracy within plus or minus 2 db at any frequency below 25 Mc/s.

(b) The maximum output of the signal generator should preferably be one volt, although measurements of insertion loss up to 60 db may be taken with a generator having an output of 100,000 microvolts.

**Rule 806**

NOTES ON LABORATORY PROCEDURE

Notes on Laboratory Procedure

(a) Measurements should preferably be made in a screened room to avoid interference from uncontrollable sources. If a screened room is not available, suppressors which are totally shielded, including the terminal connections, may be tested in the open, provided that the background of interference is not too high. If it is found necessary, an additional covering shield may be used over the two networks and the test suppressor only.

(b) The top of the table on which the equipment is mounted shall be covered with a ground plate bonded to the interior screen of the room in many places, on two or three sides. A ground wire connecting the various pieces of apparatus is not sufficient, as the impedance of a wire at high frequency is not sufficiently low to ensure zero ground potential at all points.

(c) If it is found that the signal from the standard signal generator is by-passed to the measuring instrument by



means of the power supply, the coupling may be reduced by one of the following methods:

(1) Supply the standard signal generator and the measuring instrument from different power sources or different outlet terminals;

(2) Insert separate suppressors in the power circuits of each of these instruments;

(3) Supply one of the instruments from a separate battery.