23 MARCH 1961

CDE

CORNELL-DUBILIER ELECTRONICS DIVISION

FEDERAL PACIFIC ELECTRIC COMPANY · 1605 RODNEY FRENCH BLVD., NEW BEDFORD, MASS.

March 23, 1961

To: Members of IRE Sub-Committee 27.4

Enclosed please find the final draft of our proposed Standard for Measurement of Spurious Transmitter Output. This draft is in accordance with our agreements in the meeting of March 10, 1961.

A copy of this Standard will be sent for comments to all members of Committee 27 and to those which at our last meeting we agreed would be interested in commenting.

Very truly yours,

V.J. Mancino

V.J. Mancino, Chairman
Sub-Committee 27.4

VJM:js

March 17, 1961

SHI - OK

Proposed Standards on Radio-Frequency Interference: Methods of Measurement of Spurious Transmitter Output

OK

Contents

OK

SH-2-OK

Proposed Standards

Methods of Measurement of Spurious Transmitter Output

1. Introduction

This Standard covers Methods of Measurement of the Spurious Output from Radio Frequency Transmitters. The Spurious Output of any transmitter is a possible source of interference to other services. This interference may be caused by that part of the transmitter output which is incidental to, or the result of, the generation of the intended signal output.

Spurious transmitter output may appear:

(1) across the output terminals of the transmitter;

(2) on power supply, control, or other wiring emerging from the transmitter;

(3) by direct radiation from transmitter circuits due to imperfect shielding.

For practical reasons these Standards on Methods of Measurement are accordingly of three parts:

(1) Spurious Output from Transmitter Output Terminals.

(2) Spurious Output from the Transmitter to External Wiring.

(3) Spurious Output due to Transmitter Cabinet Radiation.

2. Definitions*

2.1 Spurious Transmitter Output. Any part of the radio frequency output which is not a component of the intended output as determined by the type of modulation and/or specified bandwidth limitations.

* To be made identical with the IRE Standards Committee's definitions, if available prior to the release of this standard.

(Retype)

2.2 Spurious Transmitter Output, Conducted. Any Spurious Output of a radio frequency transmitter conducted over a physical transmission path.

NOTE: Power lines, control leads, R.F transmission lines, coaxial lines, and wave guides are all considered as physical paths in the foregoing definition.

2.3 Spurious Transmitter Output, Radiated. Any Spurious Output radiated from a radio frequency transmitter.

NOTE: The radio frequency transmitter does not include associated antenna and transmission lines, unless the antenna is an integral part of the transmitter housing as in the case of a portable or personal transmitter.

2.4 Spurious Transmitter Output, Extraband. Spurious Output of a transmitter outside of its specified band of transmission.

2.5 Spurious Transmitter Output, Inband. Spurious Output of a transmitter within its specified band of transmission.

3. General

All five of the definitions relating to Spurious Output have been given because they accurately describe what Spurious Output is (2.1), how it emerges from a radio transmitter (2.2 Conducted and 2.3 Radiated), and its location with respect to the transmissio[n] band (2.4 Extraband and 2.5 Inband). This information determines where and how measurements are to be made. In the case of Conducted Output at the transmitter output terminals the relative power of the Spurious Output to the carrier is measured. In the case of Spurious Output conducted on the external wiring the voltage to ground is measured. In the case of radiated output it is necessary to make measurements of radiated field strength.

(retype)

3.1 Sources of Spurious Output. Some possible sources of Spurious Output are:

3.1.1 ~~(a)~~ Parasitic Oscillations.

3.1.2 ~~(b)~~ Harmonics of the Oscillator Frequency.

3.1.3 ~~(c)~~ Harmonics of the Carrier.

3.1.4 ~~(d)~~ Extra Band ~~Inter~~modulation Products.

3.15 Multiple Oscillator Intermodulation Products

3.16 Multiple Transmitter Intermodulation Products

3.17 ~~(e)~~ Power supply disturbances.

3.2 Modulation Conditions. Before proceeding with the measurement of transmitter Spurious Output it is necessary to adjust the transmitter to the operating conditions for which the measurement is being made. The modulation conditions should be in accordance with the appropriate specifications for the particular type transmitter under test. The modulation conditions must be included in the data recorded.

3.3 Measuring Instruments. The instruments used to perform the measurements shall be capable of Peak and RMS measurements.

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

3.4 Broadband Spurious Output Measurement. Broadband Output shall be measured by using the Peak position of the measuring instrument or by the substitution of an impulse generator, for a standard reference source of broadband impulse energy. For the broadband and pulsed cw measurements, the reading obtained is a function of frequency and is given in units of volts per cycle per second. ~~shall be referred to a unit bandwidth of the measuring instrument.~~ The reading can also be expressed in terms of microvolts per kilocycle per second and microvolts per megacycle per second.

3.5 CW Spurious Output Measurement. CW or narrow band spurious output shall be measured by using the RMS position of the measuring instrument, or by the substitution of a standard signal generator, for a standard reference source of CW energy.

3.6 Arrangement. The general arrangement of equipment, inter-

OK

OK

connecting cable assemblies, and supporting structures shall be such as to simulate an actual installation insofar as practicable. Shielded leads or cables shall be used only where they will be so used in actual practice, except that shielded dummy antennas may be used for transmitters.

3.6.1 Dummy Antennas. Any dummy antenna used shall have electrical characteristics which closely simulate those of the normal antenna, and should be shielded where possible. The dummy antenna shall be capable of handling the power required and shall contain any unusual components which are used in the antenna (such as filters, crystal diodes, etc.)

4. Spurious Output from Transmitter Output Terminals

4.1 General. The spurious output from the transmitter output terminals, which may consist of harmonic (or non-harmonic) components, may be measured by the application of a sample of the incident output energy to a calibrated frequency-selective voltmeter or receiver.

4.2 Equipment Required:

4.2.1 Sampling Device. Spurious output should be measured with the transmitter output connected to a load which has a reasonably low VSWR at all the frequencies of interest. The sampling device may be either a coupling loop, a capacitor divider, or a directional coupler, any of which should cause negligible change of VSWR on the transmitter output transmission line. A directional-coupler sampling device is recommended, since the VSWR can be determined and corrective action taken, if needed.

NOTE 1: The maximum measurement error due to load mismatc

(OK)

is less than 3 db when the load VSWR is less than 2.0 to 1.

NOTE 2: If the transmission path is such that propogation can occur in more than one mode, care should be exercised to insure that the sampling device is coupled to the mode normally energized by the transmitter at all frequencies of interest.

4.2.2. Variable Attenuator. A calibrated variable attenuator is needed to provide a means for adjusting the output of the sampling device so as not to overload the frequency selective voltmeter or receiver. It may also be useful in checking for spurious responses.

4.2.3. Frequency-Selective Voltmeter or Receiver. A frequency-selective voltmeter or receiver (may be more than one), which can tune to the carrier frequency and any spurious output frequency of interest, is needed. If a receiver is used, it must have an output indicator.

4.2.4. Coaxial Switches. Coaxial switches (or suitable means for changing connections) may be provided as shown (see Figure 1) to enable the carrier rejection filter (if used) to be removed from the circuit during carrier output measurement and to substitute the calibrated signal generator for the transmitter during calibration.

4.2.5. Measuring Equipment Enclosure. To prevent pickup of extraneous radiations during the measurements, the measuring equipment should (if necessary) be enclosed within a suitable shielded enclosure and the signal from the sampling device brought into the shielded enclosure through a well-shielded cable.

4.2.6. Carrier Rejection Filter. Since the transmitter spurious output is, in general, considerably less than the power level of the

(OK)

carrier output, it may be necessary to measure at a carrier output sampling level which can cause overloading of the measuring equipment with resultant generation of spurious frequencies. Either a band rejection or a series of high-pass and low-pass filters may then be needed between the sampling device output and measuring equipment input. This filter or filters should attenuate the transmitter carrier output without appreciably affecting the spurious output frequencies.

4.2.7. Calibrated Signal Generator. A calibrated signal generator (or generators) to cover the carrier frequency and any spurious frequencies of interest is needed.

4.2.8. Isolation Pads as shown in Figure 2.

4.3 Procedure

4.3.1 Standard Method, Conducted, at the Transmitter Output

4.3.1.1 Connect the equipment as shown in Figure 1. Place the switches (or other connection means) to disconnect the carrier rejection filter (if used) from the measuring circuit. Operate the transmitter through the sampling device to the dummy load.

4.3.1.2 With the transmitter operating in the intended manner, adjust the sampling device so that a suitable reference indication is obtained on the frequency-selective voltmeter or receiver output indicator when it is tuned to the carrier frequency and the variable attenuator is adjusted to approximately maximum attenuation.

4.3.1.3 Substitute the calibrated signal generator for the

OK

transmitter, adjust its output frequency to the carrier frequency, and operate it at a power level which will enable the reference level of 4.3.1.2 to be obtained with variation of the variable attenuator.

4.3.1.4. From the output level of the calibrated signal generator and the change of attenuation of the variable attenuator the power level of the carrier output can be determined. If the attenuator is calibrated in decibels, the carrier output power of the transmitter will be the change in attenuation in decibels above the power output of the signal generator. If the carrier output power of the transmitter is otherwise accurately known, as by means of a dummy load power indicator, correlation of the two power readings provides an indication of the correctness of the spurious output measuring setup.

4.3.1.5. Reconnect the transmitter to the dummy load through the sampling device.

CAUTION: In measuring devices such as frequency-selective voltmeters or receivers, spurious responses may occur. These responses must be known or determined for the particular devices used. Overloading in the measuring device may cause spurious responses which occur at harmonic multiples or at sums and differences of input frequencies. These can usually be identified by varying the amplitude of the input signal, by means of a calibrated attenuator, and noting the variation in the level indicated. If the indicated level varies more rapidly than the variation in input level, a spurious is indicated.

Other types of spurious response cannot be identified by the above test. The location and magnitude of all such responses must be determined by tests with a signal generator, or this

OK

information obtained from the manufacturer of the equipment. If the front end selectivity of the measuring device is not good enough to prevent the transmitter carrier frequency from overloading the device when it is properly adjusted for measurement of the various spurious outputs, a Carrier Rejection Filter must be used, as shown on Figure 1. If there is no danger of overloading the measuring device, the Carrier Rejection Filter may be dispensed with, and all references to this filter in the following procedure (s) may be disregarded.

If a Carrier Rejection Filter is used, place the switches (or other connection means) to insert the filter in the measuring circuit.

4.3.1.6. If the carrier rejection filter is used, and if it is tunable, adjust until maximum attenuation of the carrier output is obtained as indicated by the frequency-selective voltmeter or receiver output indicator.

If it is desirable to measure the attenuation obtained with the tunable filter, adjust the variable attenuator to obtain the same reference reading as under 4.3.1.2. The attenuation of the carrier output frequency by the rejection filter is the change of the attenuator adjustment or adjustments between 4.3.1.2 and 4.3.1.6. The same procedure can be used if bandpass filters are used in lieu of a tunable filter. In either case the attenuation to the carrier output frequency must be sufficient to prevent overloading of the measuring equipment when it is properly adjusted for measurement of spurious outputs.

4.3.1.7 Tune the frequency-selective voltmeter through the frequency

OK

range of interest with the variable attenuator adjusted for maximum sensitivity of the measuring circuit (minimum attenuation of the variable attenuator.) When a spurious output is found, adjust the attenuator to obtain a suitable reference reading on the output indicator.

4.3.1.8 Substitute the calibrated signal generator for the transmitter, adjust its output frequency to the spurious frequency, and operate it at a power output level which will enable the reference level of 4.3.1.7 to be obtained with variation of the variable attenuator.

4.3.1.9 Now from the output power level of the calibrated signal generator and the change of attenuation of the variable attenuator, the power level of the spurious output component can be determined. If the attenuator is calibrated in decibels, the spurious output power will be the change in attenuation in decibels above the power output of the signal generator.

4.3.1.10 The ratio of the fundamental output power as determined under 4.3.1.4 to the power of the spurious output component as determined under 4.3.1.9 is usually expressed in decibels.

4.3.2 <u>Alternate Method, Conducted at the Transmitter Output</u>

The following alternate method offers the advantage of a simplified procedure which is adequate for certain practical applications.

4.3.2.1 Connect the equipment as shown in Figure 2. The 10 db pads shown are used to insure proper termination of the interconnected devices so that the frequency characteristic of each can be specified. (Pads are not required in the standard method since the frequency characteristic is calibrated out by use of the signal generator.) Place the switches or other connection means to remove the carrier rejection filter (if used.) Operate the transmitter through the sampling device to the dummy load.

4.3.2.2 With the transmitter operating in the intended manner, adjust the sampling device so that a suitable reference indication is obtained on the frequency selective voltmeter or receiver output indicator when it is tuned to the carrier frequency and the variable attenuator is adjusted to approximately maximum attenuation. Note the setting of the calibrated variable attenuator. Tune the frequency-selective voltmeter or receiver through the frequency range of interest with the variable attenuator adjusted for maximum sensitivity of the measuring circuit. When a spurious output is found, adjust the attenuator to obtain the same indication as above. The spurious output level relative to the carrier is the difference between the attenuator setting found previously and the present attenuator setting plus corrections for the known frequency characteristics of the sampling device and frequency-selective voltmeter or receiver. All calibrations and corrections should be in db for ease of computation.

4.3.2.3 If necessary insert a carrier rejection filter between the sampling device and the measuring equipment input terminals. In this event, if the fundamental rejection filter produces any additional loss, this correction should be applied to the results of 4.3.2.2.

Add to Correct

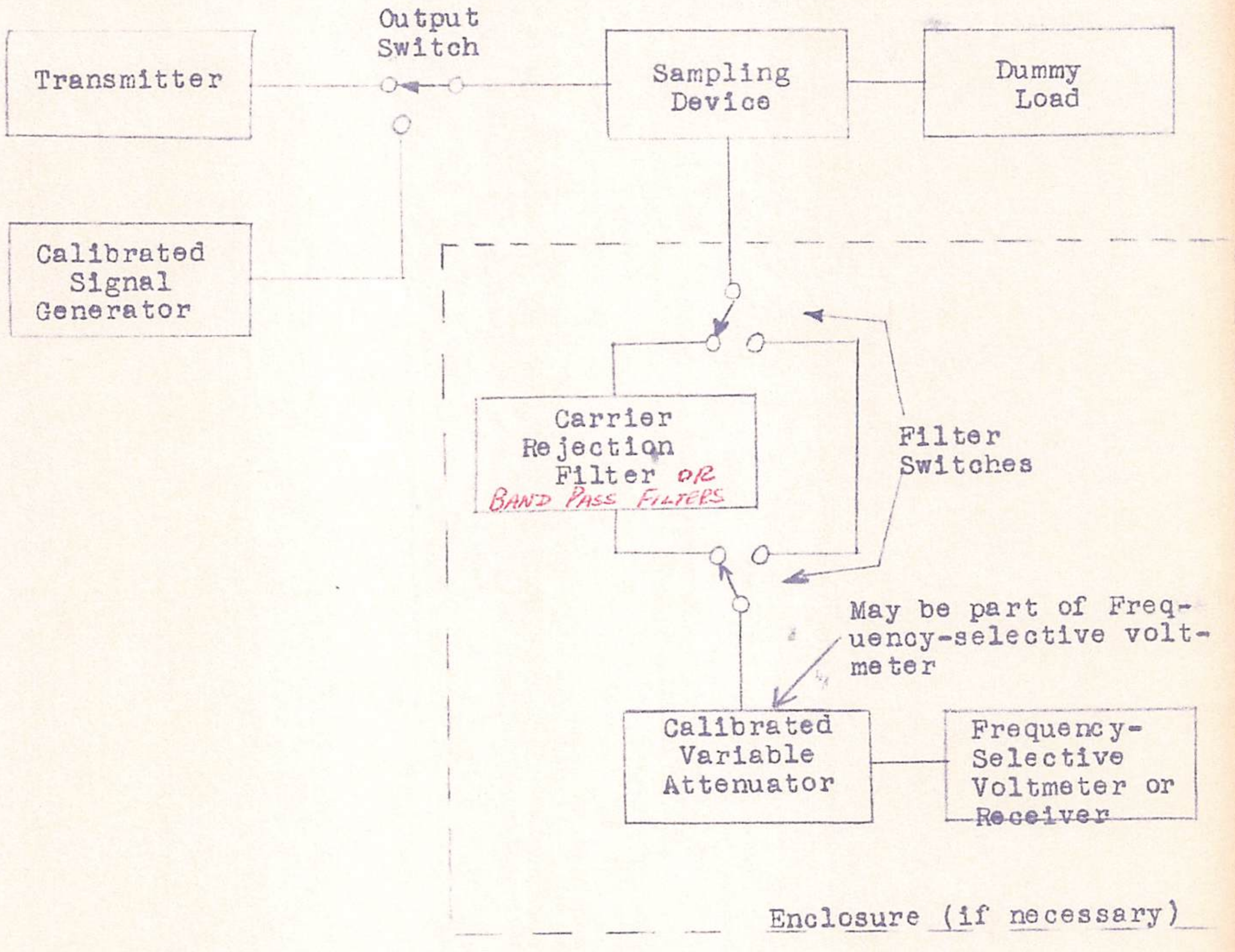


Figure I

Correct

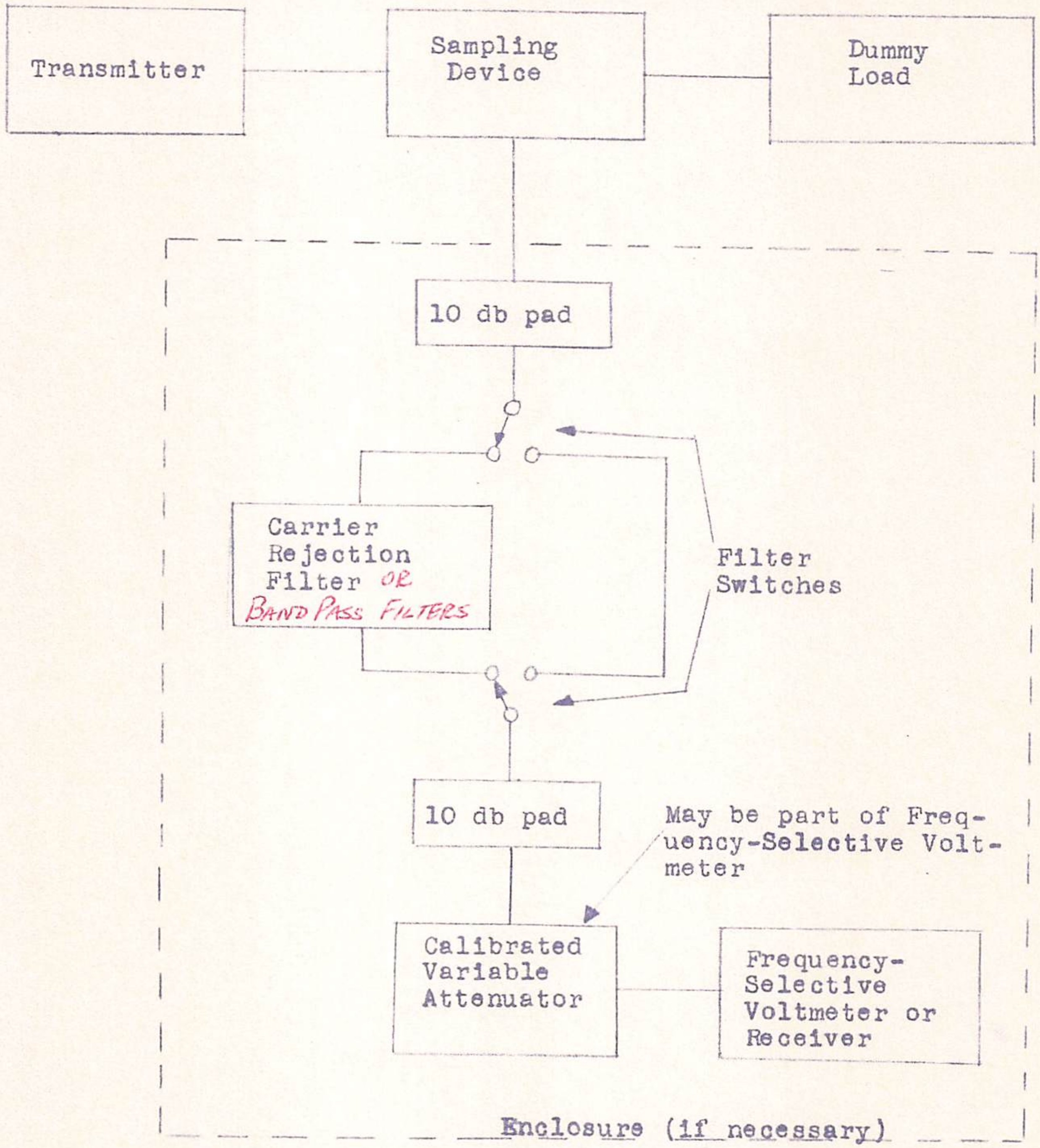


Figure 2

OK

5. Spurious Output Appearing on Transmitter External Wiring

5.1 General. The spurious output appearing on the external wiring of a transmitter which may consist of harmonic (or non-harmonic) components, may be measured by measuring the voltage developed across a known impedance network with the use of a calibrated frequency-selective voltmeter or receiver.

5.2 Equipment Required:

5.2.1 Impedance Network. The spurious output appearing on external wiring should be measured with the use of an impedance network whose characteristic is known. This network shall be inserted in the external wire whose spurious output is to be measured at a convenient point close to the point of entry of the wire to the transmitter hardware, such that the spurious output voltage is developed from the wire to ground. The network must have a connection means for cables to the calibrated frequency-selective voltmeter or receiver. The circuit of this network is shown in Figure 5, and its impedance curve is shown in Figure 6.

5.2.2 Variable Attenuator. A calibrated variable attenuator is needed to provide a means for adjusting the output indication level of the measuring instrument so as not to overload the frequency selective voltmeter or receiver. It may also be useful in checking for spurious responses.

5.2.3 Frequency-Selective Voltmeter or Receiver. A frequency-selective voltmeter or receiver (may be more than one) which can tune to the carrier and any spurious output frequency of interest, is needed.

OK

If a receiver is used, it must have an output indicator. The receiver cabinet should incorporate good shielding techniques and the power lines should be well filtered.

5.2.4 Coaxial Switches. Coaxial switches (or suitable means for changing connections) may be required when using a calibrated signal generator for calibration purposes.

5.2.5 Measuring Equipment Enclosure. To prevent pickup of extraneous radiations during the measurements, the measuring equipment should (if necessary) be enclosed within a suitable shielded enclosure and the signal from the pickup device brought into the shielded enclosure through a well shielded cable.

5.2.6 Calibrated Signal Generator. A calibrated signal generator (or generators) to cover the carrier frequency and any spurious frequencies of interest is needed.

5.3 Measurement Procedure:

5.3.1 Standard Method. NOTE: The standard method measures the voltage of the spurious output developed across a known impedance network.

5.3.1.1 Connect the equipment as shown in figure 3.

5.3.1.2 Operate the transmitter under test in its intended manner with it s output connected to a shielded dummy load.

5.3.1.3 Tune the frequency-selective voltmeter or receiver through the frequency range of interest with the calibrated variable attenuator adjusted for maximum sensitivity of the measuring circuit. When a spurious output is found, adjust the attenuator to obtain a suitable reference indication on the output indicator of the measuring instrument.

 Retype

CAUTION: In all frequency-selective voltmeters or receivers spurious responses may occur by:

(1) Desensitization of the receiver by the entry of a strong off-channel signal through the antenna input.

(2) The entry of a strong on-channel signal through the receiver case or power lines. Such signals by-pass the calibrated input attenuator.

These responses must be known or determined for the particular device used.

In addition care must be taken to insure that the spurious signal being measured can be actually attributed to the equipment under test. This is easily determined by momentarily turning off the equipment under test.

5.3.1.4 If a frequency-selective voltmeter is used, calibrate it according to the recommended manufacturer's procedure and measure the spurious output signal. If a receiver is used it must be calibrated by means of appropriate calibrated signal generators.

5.3.1.5 The level of the spurious output is calculated as follows:

5.3.1.5.1 CW Spurious Output. CW spurious output level (DB above 1 uV) = meter reading in DB above 1 uV (or substituted signal generator reading) + cable loss in DB (between the impedance network and the calibrated variable attenuator.)

5.3.1.5.2 Broadband Spurious Output. Broadband spurious output level (DB above 1 uV per Mc) = meter reading in DB above 1 uV (or substituted

= meter reading in uV (or substituted signal generator reading) x cable loss factor / impulse bandwidth (Mc)

~~signal generator reading)~~ × cable loss

factor ~~(DB) -10 log~~$_{10}$ ~~(impulse bandwidth in MC.)~~

5.3.2 Alternate Method. NOTE: The alternate method is used when it is inconvenient to use the standard method due to reasons of inaccessibility or other considerations. For this method a clamp-on current transformer of known characteristics is used. The spurious output is determined by measuring the current induced in the clamp-on current transformer. Due to the inherent limitations of this method, the results will require interpretation.

5.3.2.1 Connect the equipment as shown in figure 4.

5.3.2.2 Operate the transmitter under test in its intended manner with its output connected to a shielded dummy load.

5.3.2.3 Tune the frequency-selective voltmeter or receiver through the frequency range of interest with the calibrated variable attenuator adjusted for maximum sensitivity of the measuring circuit. When a spurious output is found, adjust the attenuator to obtain a suitable reference indication on the output indicator of the measuring instrument.

CAUTION: In all frequency-selective voltmeters or receivers spurious responses may occur by:

(1) Desensitization of the receiver by the entry of a strong off-channel signal through the antenna input.

(2) The entry of a strong on-channel signal through the receiver case or power lines. Such signals by-pass the calibrated input attenuator. These responses must be known or determined for the particular device used.

In addition care must be taken to insure that the spurious signal being measured can be actually attributed to the equipment under test. This is easily determined by momentarily turning off the equipment under test.

5.3.2.4 If a frequency-selective voltmeter is used, calibrate it according to the recommended manufacturer's procedure and measure the spurious output signal. If a receiver is used, it must be calibrated by means of appropriate calibrated signal generators.

5.3.2.5 The level of the spurious output is calculated as follows:

5.3.2.5.1 <u>CW Spurious Output</u>. Spurious output level (DB above 1 uA) = meter reading in DB above 1 uV (or substituted signal generator reading) + cable loss in DB (between the clamp-on current transformer and the calibrated variable attenuator) + current to voltage conversion factor in DB.

5.3.2.5.2 <u>Broadband Spurious Output</u>. Spurious output level (DB above 1 uA per Mc) = meter reading in DB above 1 uV (or substituted signal generator reading) + cable loss in DB+ current to voltage conversion factor in DB -10 $\log_{10}$ (impulse bandwidth in Mc)

= meter reading in uV × cable loss factor × impedance conversion factor / impulse bandwidth (mc)

OK

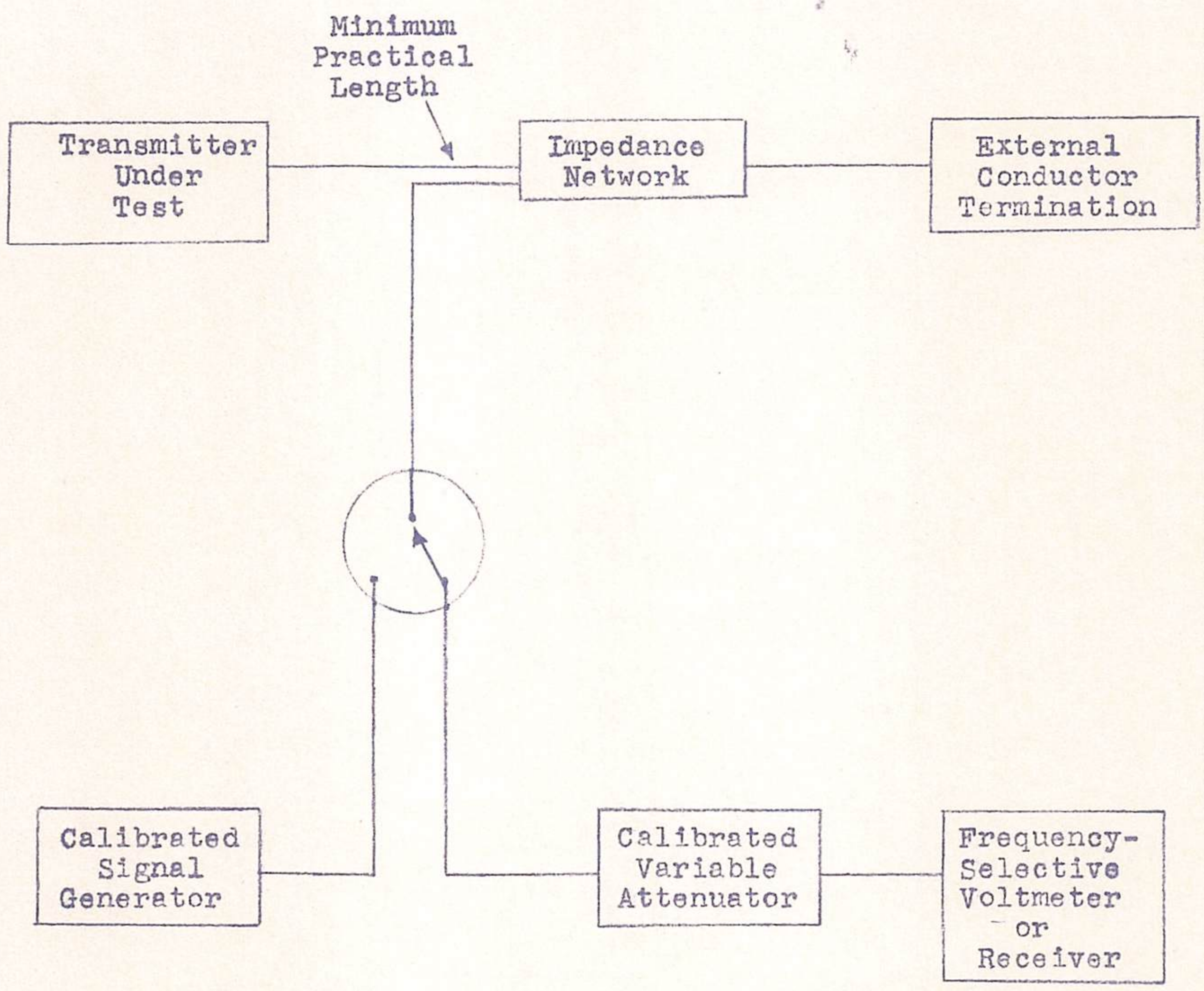

Minimum
Practical
Length
Transmitter
Under
Test
Impedance
Network
External
Conductor
Termination
Calibrated
Signal
Generator
Calibrated
Variable
Attenuator
Frequency-
Selective
Voltmeter
or
Receiver

Figure 3

OK

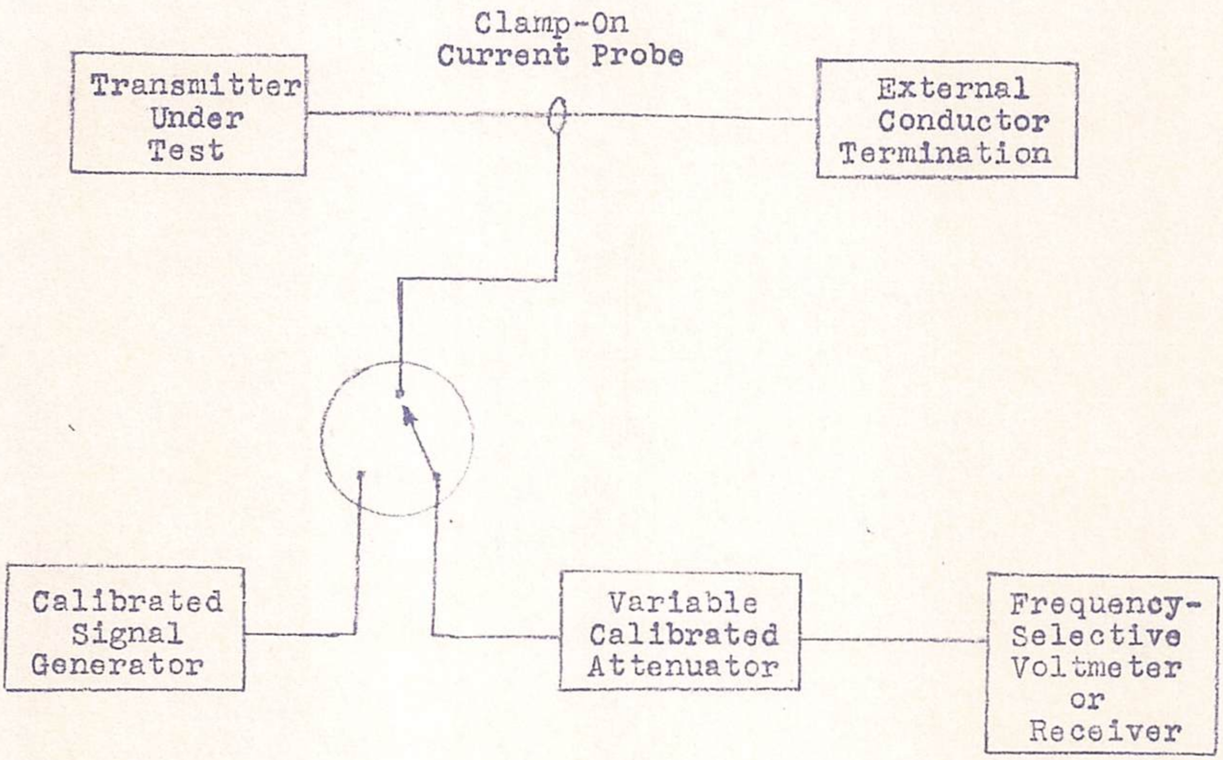
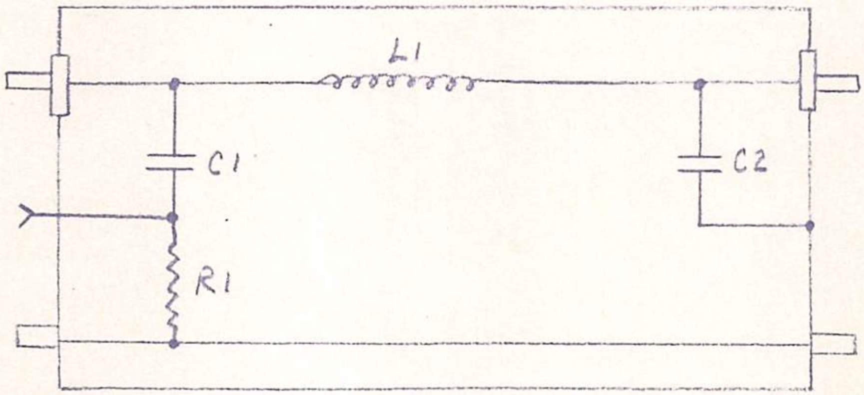

Clamp-On
Current Probe
Transmitter
Under
Test
External
Conductor
Termination
Calibrated
Signal
Generator
Variable
Calibrated
Attenuator
Frequency-
Selective
Voltmeter
or
Receiver

Figure 4

OK



ENCLOSURE DATA: 14 GAGE (B&S) ALUMINUM SUGGESTED SIZE 9-3/8 IN. BY 4 BY 4 IN.

FORM DATA: 5-$\frac{1}{4}$ IN. LENGTH, 3 IN. DIA (OD), .125 IN. WALL DRILL 3/8 IN. HOLE 7/16 IN. FROM EACH END.

WIRE DATA: AWG 6, 600 VOLT, .310 IN. DIA (OD).

COIL DATA: L1 5 MICROHENRIES, 13 TURNS SINGLE LAYER, 4 IN. WINDING LENGTH.

CAPACITOR: C1 SHALL BE MOUNTED ON 1 IN. INSULATING BLOCK ABOVE GROUND.

CAPACITOR DATA: C1 .1 UF, 600-VOLT DC, BATHTUB.
C2 1UF, 600-VOLT DC, BATHTUB, SINGLE TERMINAL CASE MOUNTED ON GROUND.

RESISTOR DATA: R1 5,000-OHM, 5-WATT CARBON.

1. THE VALUES GIVEN FOR THE COMPONENT PARTS OF THE NETWORK ARE NOMINAL. REGARDLESS OF THE CONSTRUCTION OR DEVIATION FROM NOMINAL VALUES, THE NETWORK MUST HAVE AN IMPEDANCE WITHIN 20 PERCENT OF THAT GIVEN IN FIGURE 6.
2. CONNECTING LEADS TO CONDENSERS AND RESISTORS SHOULD BE AS NEARLY AS POSSIBLE TO ZERO LENGTH.
3. NETWORKS MAY ALSO BE CONSTRUCTED HAVING A 1-OHM SERIES RESISTOR BETWEEN THE LINE AND CAPACITOR C2. THIS 1-OHM RESISTOR SHALL BE MADE UP FROM TEN 10-OHM, 1-WATT COMPOSITION RESISTORS.
4. THE DATA GIVEN IN THIS FIGURE IS SUITABLE FOR THE CONSTRUCTION OF 50-AMPERE NETWORKS. LARGER CURRENT-CARRYING NETWORKS MAY BE CONSTRUCTED BY INCREASING THE WIRE SIZE GIVEN FOR THE COIL AND THE SIZE OF THE OVERALL ENCLOSURE.

Figure 5. Powerline stabilization network schematic diagram.

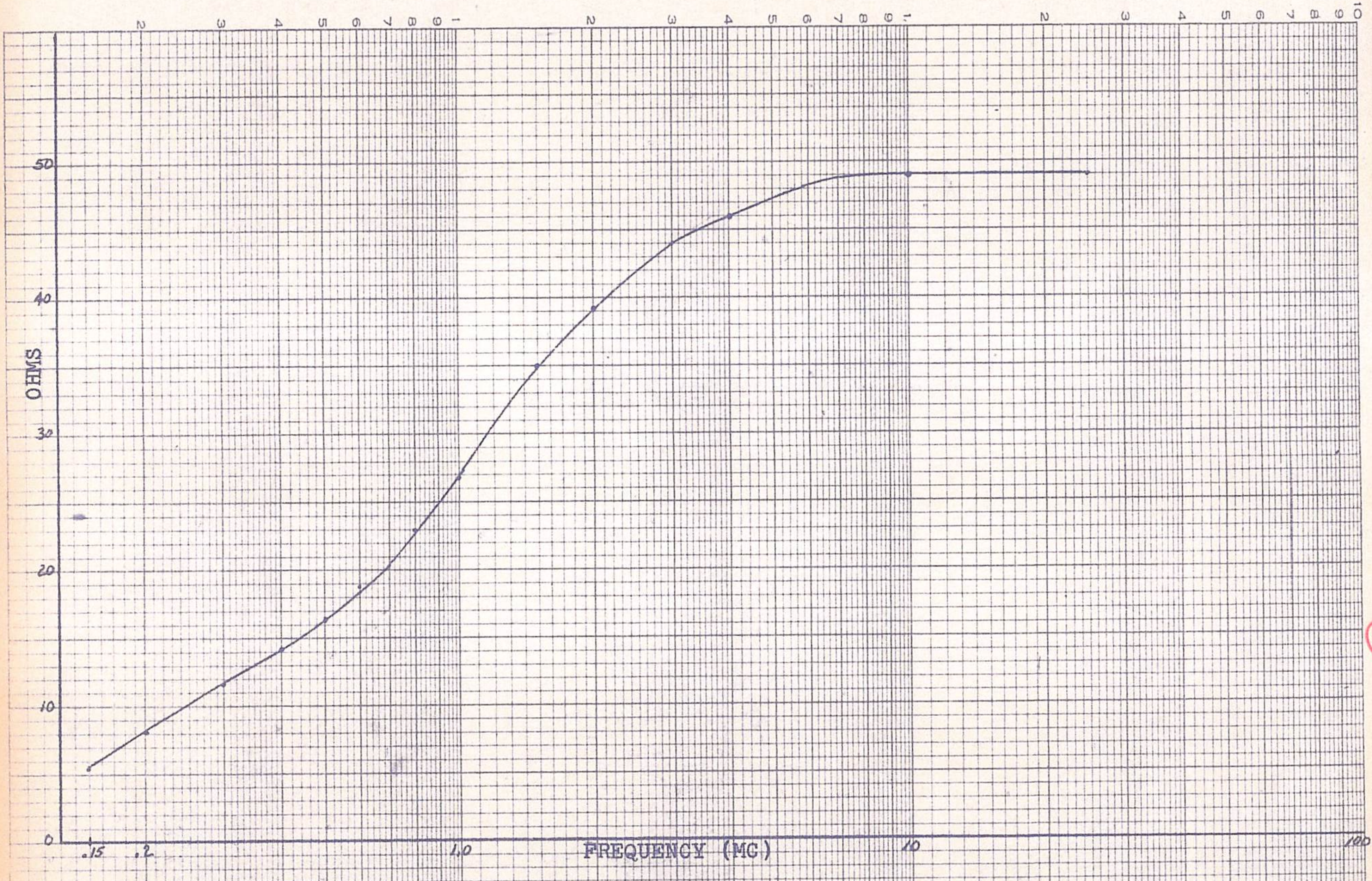


Figure 6. Input impedance at test sample terminal of stabilization network with coaxial connector terminated in 50 ohms, power terminal open.

 (OK)

6. Spurious Output Due to Transmitter Cabinet Radiation.

6.1 General. The spurious output radiated from a transmitter, which may consist of harmonic (or non-harmonic) components, may be measured by measuring the voltage induced in a receiving antenna with the use of a calibrated frequency-selective voltmeter or receiver.

6.2 Equipment Required:

6.2.1 Pickup Device. The radiated spurious output should be measured with a pickup device which is connected to a calibrated frequency-selective voltmeter or receiver by an impedance matching network or balun. This pickup device may be a rod or loop for frequencies below 25 Mc, a resonant dipole for frequencies from 25 Mc to 1000 Mc, and a horn antenna for frequencies above 1000 Mc. The pickup device must be calibrated over its useful frequency range so that it may be used to measure the intensity of the electromagnetic field.

6.2.2 Interference-Free Area. The radiated spurious output shall be measured in an area sufficiently free from ambient interference and physical obstructions for the purposes of this measurement. It is desirable that the ambient interference level during testing be at least 6 DB below the interference limits specified in the appropriate specifications. However, in the event that at the time of measurement the levels of ambient interference plus the spurious output of the item under test are not above the specified limit, such tested item shall be considered to comply with the specified requirements. In addition any frequency

(OK)

whose identity is definitely established, such as a broadcast station, is exempt from this requirement.

6.2.3 Variable Attenuator. A calibrated variable attenuator is needed to provide a means for adjusting the output indication level of the measuring instrument so as not to overload the frequency-selective voltmeter or receiver. It may also be useful in checking for spurious responses.

6.2.4 Frequency-Selective Voltmeter or Receiver. A frequency-selective voltmeter or receiver (may be more than one) which can tune to the carrier and any spurious output frequency of interest, is needed. If a receiver is used, it must have an output indicator. The receiver cabinet should incorporate good shielding techniques and the power lines should be well filtered.

6.2.5 Coaxial Switches. Coaxial switches (or suitable means for changing connections) may be required when using a calibrated signal generator for calibration purposes.

6.2.6 Measuring Equipment Enclosure. To prevent pickup of extraneous radiations during the measurements, the measuring equipment should (if necessary) be enclosed within a suitable shielded enclosure and the signal from the pickup device brought into the shielded enclosure through a well shielded cable.

6.2.7 Calibrated Signal Generator. A calibrated signal generator (or generators) to cover the carrier frequency and any spurious frequencies of interest is needed.

6.3 Measurement Procedure.

6.3.1 Standard Method. NOTE: The standard method measures

OK

the <u>absolute</u> level of the radiated spurious signal at the point of measurement without regard to the rated power output of the equipment under test. If the desired result is to be a measurement of the absolute field intensity, one must make the measurement in the "radiation field." Measurements made at lesser distances as may be required at low frequencies will involve the "induction field" and the results will require interpretation.

6.3.1.1 Connect the equipment as shown in Figure 7.

6.3.1.2 Operate the transmitter under test in its intended manner with its output connected to a shielded dummy load.

6.3.1.3 Tune the frequency-selective voltmeter or receiver through the frequency range of interest with the calibrated variable attenuator adjusted for maximum sensitivity of the measuring circuit. When a spurious output is found, orient the pickup device for maximum response and adjust the attenuator to obtain a suitable reference indication on the output indicator of the measuring instrument.

CAUTION: In all frequency-selective voltmeters or receivers spurious responses may occur by:

(1) desensitization of the receiver by the entry of a strong off-channel signal through the antenna input.

(2) the entry of a strong on-channel signal through the receiver case or power lines. Such signals by-pass the calibrated input attenuator. These responses must be known or determined for the particular device used.

In addition care must be taken to insure that the spurious signal being measured can be actually attributed to the equipment under test. This is easily determined by momentarily turning off the equipment under test.

6.3.1.4 If a frequency-selective voltmeter is used, calibrate it according to the recommended manufacturer's procedure and measure the spurious radiated signal. If a receiver is used it must be calibrated by means of appropriate calibrated signal generators.

6.3.1.5 The level of the spurious output is calculated as follows:

6.3.1.5.1 <u>CW Spurious Output</u>. CW spurious output level (field intensity, DB above 1 uV per meter) = meter reading in DB above 1 uV (or substituted signal generator reading) + cable loss (between the pickup device and the calibrated variable attenuator + antenna factor (DB.)

6.3.1.5.2 <u>Broadband Spurious Output</u>. Spurious output level (field intensity, DB above 1 uV per meter, per MC) = Meter reading (DB above 1 uV) + cable loss (DB) + Antenna Factor (DB) -10 $\log_{10}$ (impulse bandwidth in MC).

= Meter reading × cable loss factor × antenna factor / impulse bandwidth (MC)

6.3.1.6 To determine the radiation pattern and to evaluate path loss, a multiplicity of measurement points varying in azimuth and radius should be used.

6.3.2 <u>Alternate Method</u>. <u>NOTE:</u> The alternate method measures an equivalent radiated power of the spurious signal.

6.3.2.1 Connect the equipment as shown in Figure 8. It should be noted that the pickup device must be located in the "radiation field" of the transmitter.

6.3.2.2 Operate the transmitter under test in its intended manner with its output connected to a shielded dummy load.

6.3.2.3 At the point of measurement tune the frequency-selective voltmeter or receiver through the frequency range of interest with the variable attenuator adjusted for maximum sensitivity of the measuring circuit. When a spurious output is found, orient the pickup device for maximum response and adjust the attenuator to obtain a suitable reference indication on the output indicator of the measuring instrument.

6.3.2.4 De-energize the transmitter.

6.3.2.5 A calibrated signal generator or other suitable source of controlled oscillation is now used in

OK

conjunction with an appropriate radiating device to supply the substituted power. This radiating device is located at or in the near vicinity of the transmitter. Thus, essentially the same path is utilized for both the transmitter power and the substituted power.

6.3.2.6 Energize the calibrated signal generator and tune to the spurious frequency on the frequency-selective voltmeter or receiver obtained in 6.3.2.3.

6.3.2.7 Orient the radiating device for maximum signal into the frequency-selective voltmeter or receiver.

6.3.2.8 Adjust the level of the calibrated signal generator to give the same indication at the frequency-selective voltmeter or receiver which was noted in 6.3.2.3.

6.3.2.9 To determine the substituted power, the input impedance and the effective gain of the radiating device must be known. The equivalent power of the spurious signal in watts can now be calculated as follows:

(1) $P = I^2 Ra$

Where Ra = the radiation resistance of the radiating device

I = the current supplied by the signal generator

(2) $I = \frac{Eg}{Rg + (R + jX)}$

Where Eg = the signal generator open circuit voltage

Rg = the signal generator internal impedance

OK

(R + jX) = the terminal impedance of the radiating device

<u>NOTE</u>: If the radiating device is resonated and has negligible ohmic resistance, then (R + jX) = Ra.

6.3.2.10 To determine the radiation pattern a multiplicity of measurement points varying in azimuth and radius should be used.

OK

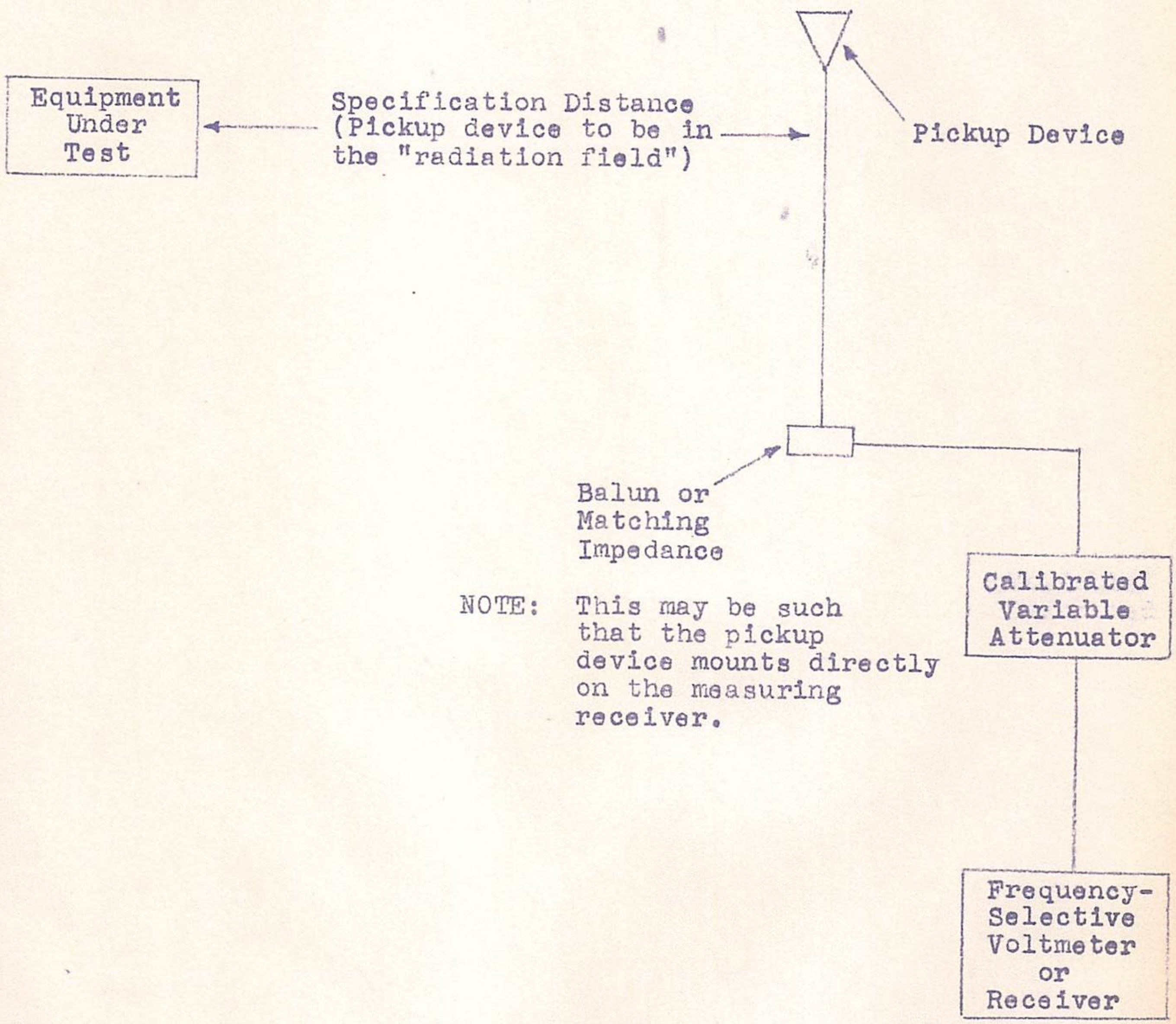

Equipment
Under
Test
Specification Distance
(Pickup device to be in
the "radiation field")
Pickup Device
Balun or
Matching
Impedance
NOTE: This may be such
that the pickup
device mounts directly
on the measuring
receiver.
Calibrated
Variable
Attenuator
Frequency-
Selective
Voltmeter
or
Receiver

Figure 7

OK

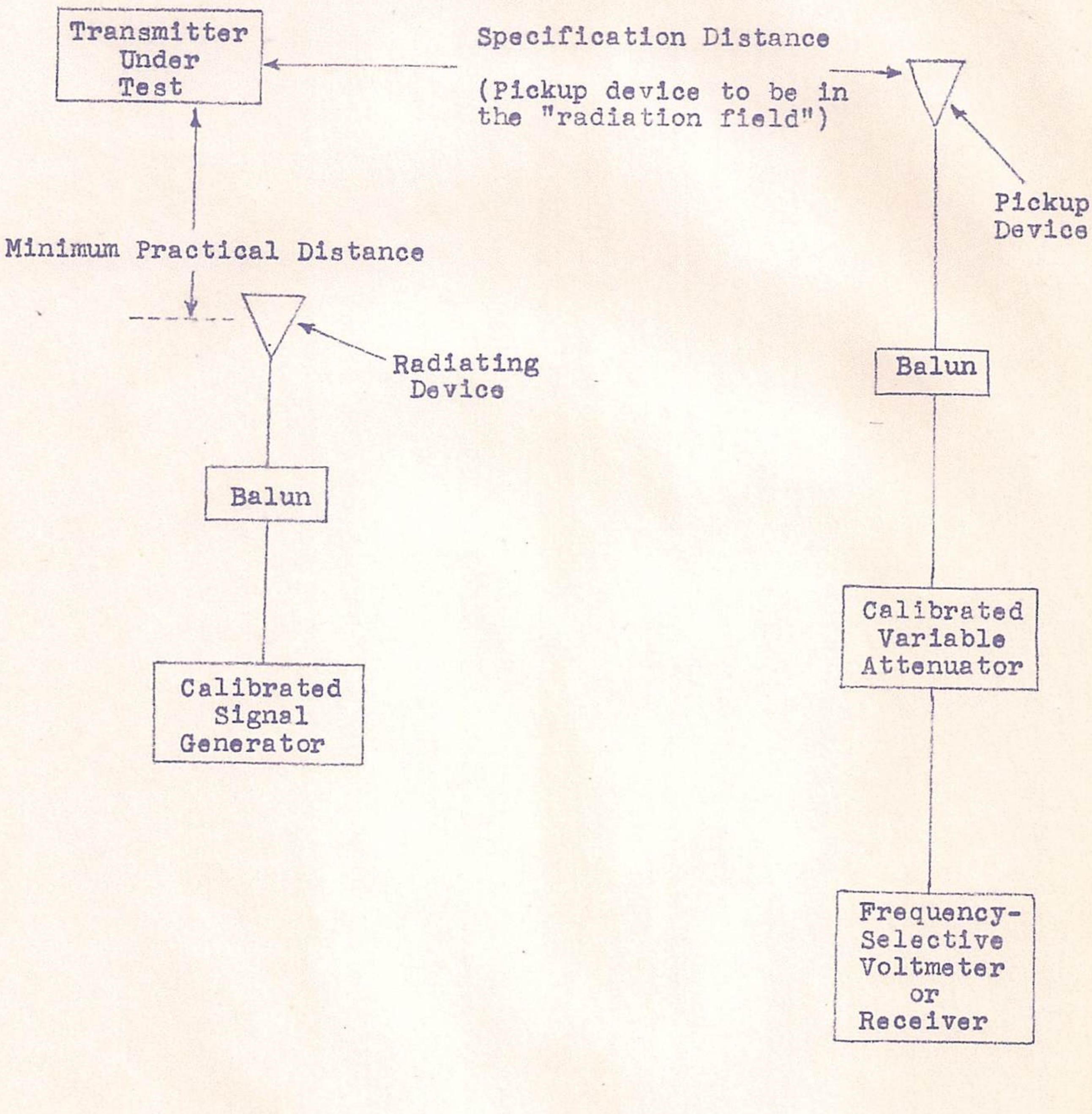

Transmitter
Under
Test
Specification Distance
(Pickup device to be in
the "radiation field")
Pickup
Device
Minimum Practical Distance
Radiating
Device
Balun
Balun
Calibrated
Signal
Generator
Calibrated
Variable
Attenuator
Frequency-
Selective
Voltmeter
or
Receiver

Figure 8

Marcano