Oct 4, 1960

Copy used at meeting 12/2/60

IRE 27.4 Proposed Standards

Methods of Measurement of Transmitter Cabinet Radiation

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 a matching impedance network or balun. This pickup device may be a rod or loop for frequencies below 25MC, a resonant dipole for frequencies from 25MC to 1000MC, and a horn antenna for frequencies above 1000MC. The pickup device must be calibrated over its useful frequency range so that it may be used to read open circuit voltage (antenna induced voltage).

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 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.

included in 6.2.1

~~6.2.8 Pickup Device Matching Network. A pickup device matching network may be needed to match the pickup device to the frequency-selective voltmeter or receiver.~~

6.3 Measurement procedure.

6.3.2 ~~Standard~~ Alternate Method. NOTE: The ~~standard~~ alternate method measures ~~the~~ an equivalent ~~of the~~ radiated power of the spurious signal.

6.3.2.1 Connect the equipment as shown in Figure 1. 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, adjust the attenuator to obtain a suitable reference ~~reading~~ output indication on the output indicator of the measuring instrument.

6.3.2.4 The pickup device is oriented for maximum signal into the frequency selective voltmeter or receiver and ~~a reading~~ an indication is obtained.

6.3.2.5 De-energize the transmitter.

6.3.2.6 A calibrated signal generator or other suitable source of controlled oscillation is now used in 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. ~~In particular, it is located at a distance no greater than three feet from the transmitter.~~ Thus, essentially the same path is utilized for both the transmitter power and the substituted power.

6.3.2.7 Energize the calibrated signal generator and tune to the ~~same~~ spurious frequency on the frequency selective voltmeter or receiver obtained in 6.3.2.3.

6.3.2.8 Rotate ~~both the pickup device and~~ the radiating device for maximum signal into the frequency-selective voltmeter or receiver. ~~the pickup device being rotated first.~~

6.3.2.9 Adjust the level of the calibrated signal generator to give the same ~~reading~~ indication at the frequency-selective voltmeter or receiver which was noted in 6.3.2.4.

6.3.2.10. To determine the substituted power, the input impedance

and the effective gain of the radiating device must be known. The equivalent radiated power of the spurious signal ~~relative to the peak transmitter power~~ in watts can now be calculated as follows: ~~by the formula~~

$$DB = 10 \log \frac{P \text{ Transmitter}}{P \text{ Substituted}}$$

6.3.1.11. Sample Calculation:

Frequency	110.5MC
Distance	155. Feet
Generator uV into antenna	160,000 uV
Receiver uV at antenna	14 uV
Power of Transmitter	2000 watts peak

a) Substituted Power at the Generator:

$$\text{Power} = \frac{V^2}{R} = \frac{(.16)^2}{50} = 0.000511 \text{ watts}$$

b) Relative Radiation Power of Spurious Signal:

$$DB = 10 \log \frac{2000}{0.000511} = 10 \log 3.92 \times 10^6$$

$$DB = 65.9 \text{ DB}$$

$$P = I^2 R_a$$

$$R_a = R_g + R + jX$$

6.3.1 Standard Method. NOTE: The standard method is used when it is desired to obtain the absolute level of the radiated spurious response 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 result will require interpretation.

6.3.1.1 Connect the equipment as shown in Figure 2.

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

6.3.1.3 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 a suitable reference reading on the output indicator.

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) By the entry of a strong on-channel signal through the receiver case or power lines and by-passing its 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.

output of the pickup device

6.3.1.5 The of the spurious output is calculated as follows:

6.3.1.5.1 Spurious Output (DB above 1uV per meter) = Field Intensity (DB above 1uV per meter) = meter reading (or substituted signal generator reading) + cable loss + antenna factor.

6.3.1.5.2 Spurious Output (DB above 1 uV per meter) = Field Intensity (DB above 1 uV per meter) = MR (DB above 1uV) + CL (DB) + AF (DB) − 10 log$_{10}$ (Impulse BW (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.

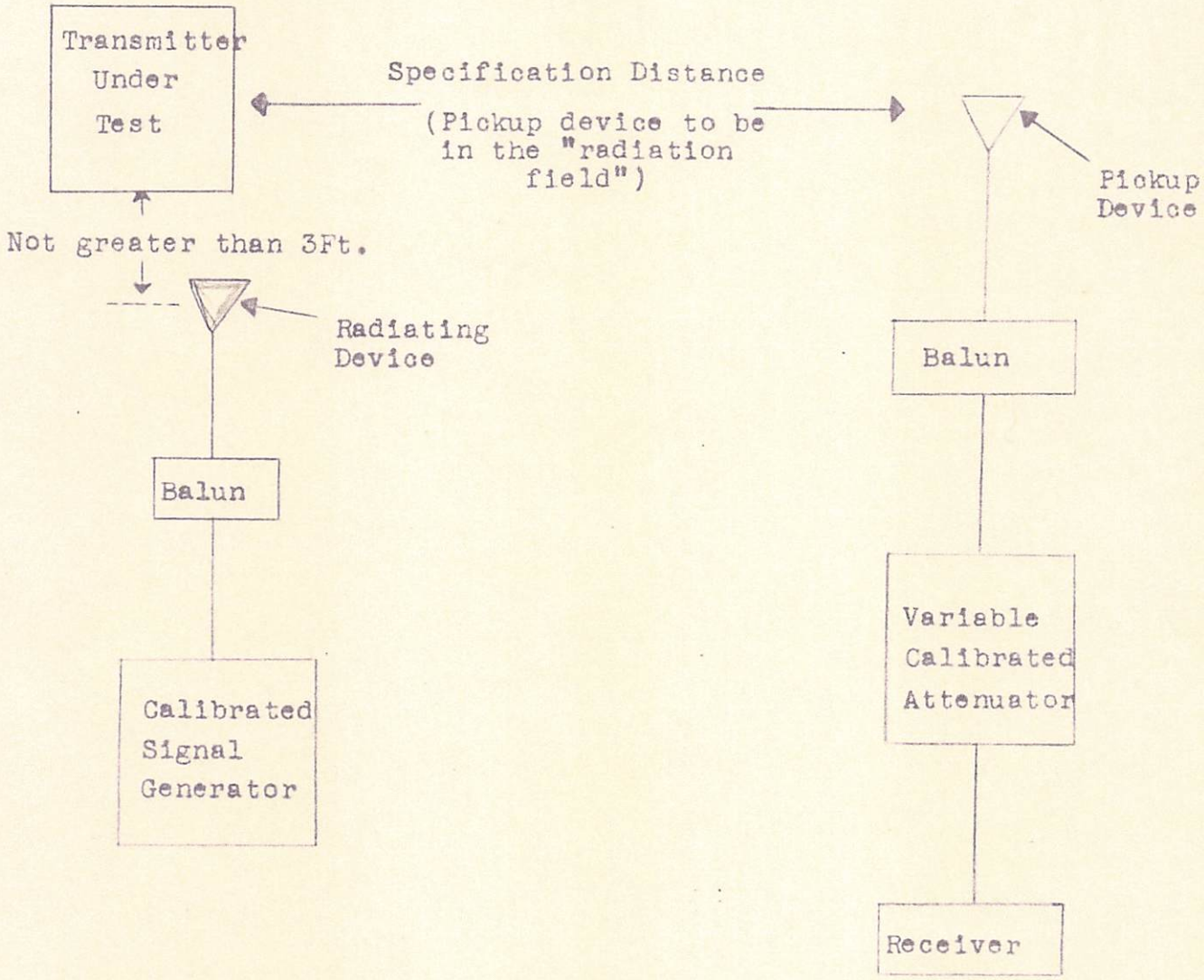
Transmitter Under Test
Specification Distance
(Pickup device to be in the "radiation field")
Pickup Device
Not greater than 3Ft.
Radiating Device
Balun
Balun
Calibrated Signal Generator
Variable Calibrated Attenuator
Receiver

FIGURE I

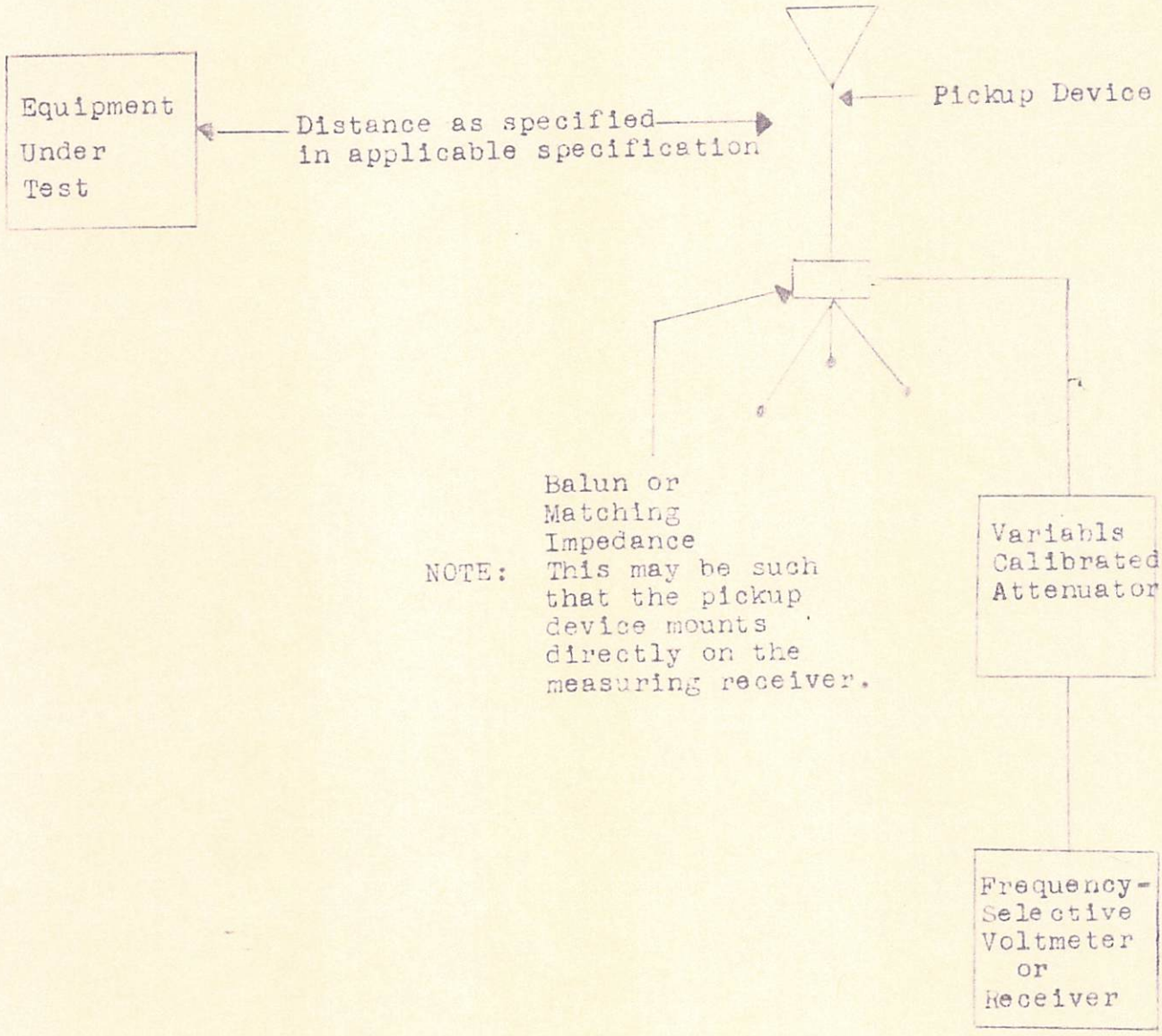
Equipment Under Test
Distance as specified in applicable specification
Pickup Device
Balun or Matching Impedance
NOTE: This may be such that the pickup device mounts directly on the measuring receiver.
Variable Calibrated Attenuator
Frequency-Selective Voltmeter or Receiver

Figure 2

MARC ME