

American National Standard

**methods of measurement of radio-noise
emissions from low-voltage electrical and
electronic equipment in the range of
10 kHz to 1 GHz**

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Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz

1. Scope

This standard sets forth uniform methods of measurement of radio noise emitted from low-voltage electrical and electronic equipment in the frequency range of 10 kHz to 1 GHz. Methods for the measurement of radiated and powerline conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods apply to the measurement of individual components, units, or systems comprised of components and units. Additional methods may be added to this standard to fulfill future requirements as needed. Unless specifically called out, this standard is not intended for certification/approval of avionic equipment.

2. References

Reference [1] shall form a part of this standard and when American National Standards referred to in this standard are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply.

[1] ANSI C63.2-1980, American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation, 10 kHz to 1 GHz

[2] ANSI/IEEE Std 100-1977, IEEE Standard Dictionary of Electrical and Electronics Terms

[3] ANSI/IEEE Std 213-1961 (R1974) Radio Interference; Methods of Measurement of Conducted Interference Output to the Power Line from FM and Television Broadcast Receivers in the range of 300 kHz to 25 MHz

[4] IEC, CISPR Pub 16-1977, Specification for Radio Interference Measuring Apparatus and Measurement Methods¹

[5] IEC Pub 106-1974, Methods of Measurement of Radiation from Receivers for Amplitude-Modulation, Frequency-Modulation and Television Broadcast Transmissions

3. Definitions

The following definitions apply specifically to the subject treated in this standard. For additional definitions, see ANSI/IEEE Std 100-1977 [2].²

ambient level. The values of radiated and conducted signal and noise existing at a specific test location and time when the test sample is not activated.

broadband radio noise. Radio noise having a spectrum broad in width as compared to the nominal bandwidth of the measuring instrument, and whose spectral components are sufficiently close together and uniform so that the measuring instrument cannot resolve them.

common-mode radio noise. Conducted radio noise that appears between a common reference plane (ground) and all wires of a transmission line causing their potentials to be changed simultaneously and by the same amount relative to the common reference plane (ground).

¹IEC Standards are available in the US from American National Standards Institute, 1430 Broadway, New York, NY 10018.

²The numbers in brackets correspond to the references listed in Section 2 of this standard.

conducted radio noise. Radio noise produced by equipment operation, which exists on the powerline of the equipment and measurable under specified conditions as a voltage or current.

differential-mode radio noise. Conducted radio noise that causes the potential of one side of the signal transmission path to be changed relative to another side.

emission. An act of throwing out or giving off, generally used here in reference to electromagnetic energy.

equipment under test (EUT). A representative component, unit or system to be used for evaluation purposes

ground plane. A conducting surface or plate used as a common reference point for circuit returns and electric or signal potentials.

individual-equipment test requirements. The set of explicit requirements specifying the test conditions, instrumentation, equipment under test (EUT) operation, etc, to be used in testing a specific EUT for conducted and radiated radio noise. Such requirements should take precedence over the requirements of this standard.

line-impedance stabilization network (LISN). A network inserted in the supply-mains lead of the equipment under test (EUT) that provides a specified measuring impedance for radio-noise voltage/current measurements and isolates the EUT from the supply mains at radio frequencies.

low-voltage electrical and electronic equipment. Electrical and electronic equipment with operating input voltages of up to 600 V dc or rms ac.

narrowband radio noise. Radio noise having a spectrum exhibiting one or more sharp peaks, narrow in width compared to the nominal bandwidth of, and far enough apart to be resolvable by, the measuring instrument (or the communication receiver to be protected).

occupied bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission. In some cases, for example multichannel frequency division systems, the percentage of 0.5%

may lead to certain difficulties in the practical application of the definition of occupied bandwidth; in such cases a different percentage may be useful.

radiated radio noise. Radio-noise energy in the form of an electromagnetic field including both the radiation and induction components of the field.

radio noise. An electromagnetic noise that may be superimposed upon a wanted signal and is within the radio-frequency range. For the purposes of this standard, an electromagnetic disturbance of a sinusoidal character is also considered radio noise.

random noise. Noise that comprises transient disturbances occurring at random.

NOTE: (The part of the noise that is unpredictable except in a statistical sense.) The term is most frequently applied to the limiting case where the number of transient disturbances per unit time is large, so that the spectral characteristics are the same as those of thermal noise (thermal noise and shot noise are special cases of random noise).

spurious radiation. Any emission from an electronic communications equipment at frequencies outside its occupied bandwidth.

4. General Test Conditions

4.1 Test Sites. An environment is required which assures valid, repeatable measurement results. A measurement is valid to the extent that it is a true representation of the characteristic being measured, and is repeatable when the same measurement approach yields the same measured value time-after-time. For testing representative samples of an equipment type, testing is normally conducted in an open field. Other alternatives are permitted (see 4.1.1.1 and 4.1.1.2). For equipment which can only be tested in its place of use, and the conditions of 4.1.1.1 cannot be satisfied, then the conditions of 4.1.2 shall apply.

4.1.1 Open-Field Tests. Tests shall be made in an open, flat area characteristic of cleared, level terrain. Such test sites shall be void of buildings, electric lines, fences, trees, etc, and free from underground cables, pipelines, etc, except as required to supply and operate the equipment under test (EUT). The ambient radio-noise levels and other undesired signals shall conform to the requirements of 4.6.1. A

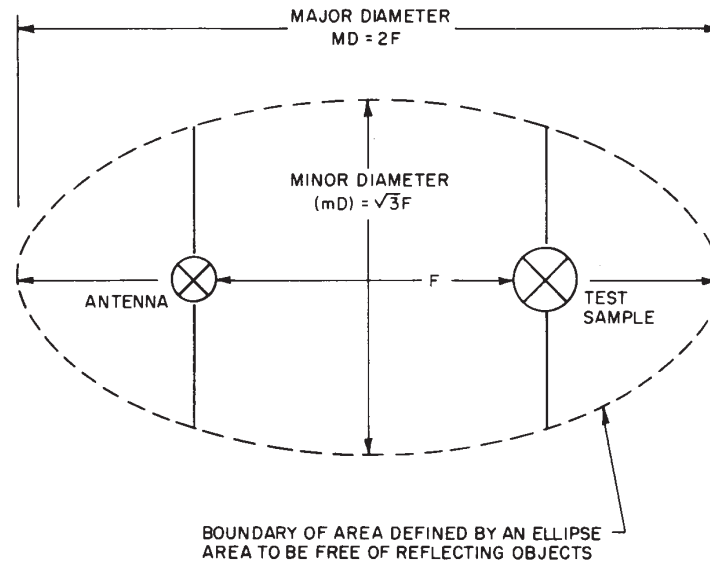


Fig 1
Open-Field Test Site

suggested layout of an open-field test site is shown in Fig 1, where the distance $F = 30$ m and where all reflecting objects lie outside the perimeter of the ellipse. If specified in the individual-equipment requirements, tests may also be made in a smaller open-field site, for example as described in IEC Pub 106-1974 [5] (3 m site) and the results extrapolated to those obtainable at 30 m.

4.1.1.1 Tests at Laboratory, Factory, or User's Premises. As an alternative to open-field tests, tests can be made in a laboratory or factory area, or at the user's premises when it can be demonstrated that the results achieved can be extrapolated to obtain open-field equivalents. Anechoic rooms and dedicated factory sites represent typical test areas.

4.1.1.2 Testing in a Shielded Enclosure. Tests may also be made in a shielded enclosure where specified in the individual-equipment requirements. Shielded-enclosure measurements of radiation are generally valid only at frequencies below the lowest-resonant frequency of the enclosure. Measurements below enclosure resonant frequency are permitted at a 1 m distance. When testing in a shielded enclosure it must be void of all excess equipment and personnel. Data taken in a shielded enclosure may be extrapolated to other distances

only if the extrapolation method used for the specific EUT can be shown to produce valid results.

4.1.2 Testing of User's Installation (Site Testing). Testing is permitted at the end-user's premises, even though the conditions of 4.1.1 or 4.1.1.2 cannot be satisfied. In this case, both the equipment and test premises in combination are considered the EUT. The radiated radio-noise results are unique to the installation site because site containment properties affect the measurement. The conducted radio-noise results may also be unique to the installation. See also 6.3.

4.2 Measuring Instrumentation. The radio-noise meters employed shall conform to requirements of ANSI C63.2-1980 [1]. Other instruments may be used for certain restricted or specialized measurements when correlation data have been taken to establish the methods of conversion of data to that achieved with instrumentation of ANSI C63.2-1980 [1].

4.2.1 Radio-Noise Meter Calibration. It is recommended that the calibration of the radio-noise meter be checked frequently to assure its accuracy. Adjustments should be made and correction factors applied in accordance with instructions contained in the manual for the radio-noise meter.