INTERNATIONAL STANDARD

IEC 61726

Second edition
1999-11

Cable assemblies, cables, connectors and passive microwave components – Screening attenuation measurement by the reverberation chamber method

Câbles, cordons, connecteurs et composants hyperfréquence passifs – Mesure de l'atténuation d'écran par la méthode de la chambre réverbérante

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International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CABLE ASSEMBLIES, CABLES, CONNECTORS AND PASSIVE MICROWAVE COMPONENTS – SCREENING ATTENUATION MEASUREMENT BY THE REVERBERATION CHAMBER METHOD

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International Standard IEC 61726 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, r.f. connectors and accessories for communication and signalling.

This second edition cancels and replaces the first edition, which was issued as a type 3 technical report in 1995. It constitutes a technical revision and now has the status of an International Standard.

The text of this standard is based on the following documents:

FDIS	Report on voting
46A/356/FDIS	46A/359/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B, C and D are for information only.

The committee has decided that this publication remains valid until 2005. At this date, in accordance with the committee's decision, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

The requirements of modern electronic equipment have indicated a demand for a method of testing screening attenuation of microwave components over their whole frequency range. Convenient test methods exist for low frequencies and components of regular shape and these test methods are described in the relevant product specifications.

For higher frequencies and for components of irregular shape a new test method has become necessary and such a test method is described in this International Standard.

CABLE ASSEMBLIES, CABLES, CONNECTORS AND PASSIVE MICROWAVE COMPONENTS – SCREENING ATTENUATION MEASUREMENT BY THE REVERBERATION CHAMBER METHOD

1 Scope

This International Standard describes the measurement of screening attenuation by the reverberation chamber test method, sometimes named mode stirred chamber, suitable for virtually any type of microwave component and having no theoretical upper frequency limit. It is only limited toward low frequencies due to the size of the test equipment, which is frequency dependent and is only one of several methods of measuring screening attenuation.

For the purpose of this standard, examples of microwave components are waveguides, phase shifters, diplexers/multiplexers, power dividers/combiners etc.

2 Basic description of the reverberation chamber method

The reverberation chamber method for measurement of the screening attenuation of microwave components consists of exposing the device under test (DUT) to an almost homogeneous and isotropic electromagnetic field and then measuring the signal level induced into the device.

These conditions are achieved by the use of a shielded enclosure, which acts as an oversized cavity (in terms of wavelength), with a high quality factor. Its boundary conditions are continuously agitated by a rotating reflective surface (mode stirrer), mounted within the chamber, which enables the field to approach homogeneous and isotropic conditions during one revolution.

Electromagnetic power is fed to the chamber by means of an input or transmitting antenna.

The strength of the field inside the chamber is measured through a reference antenna. The ratio of the injected power (input antenna) to the received power (reference antenna) is the insertion loss of the cavity. The insertion loss is strongly frequency dependent and is also dependent on the quality factor of the cavity.

It has been shown that, due to the isotropic field, any antenna placed inside the cavity behaves as if its gain was unity [1][1)], therefore no directional effect is to be expected. If the device under test is electrically short, its screening attenuation will be directly related to usual transfer parameters (Z_t and Z_f). If the device under test is not electrically short the screening attenuation may still be related to Z_t and Z_f in some simple cases (evenly distributed leakage, periodically distributed leakage) using summing functions derived from antenna network theory.

1) Figures in square brackets refer to the Bibliography.

3 Measurement of the screening attenuation of the device under test (DUT)

The measurement of screening attenuation is based on the comparison of the electromagnetic field power outside the DUT to the electromagnetic field power induced into the DUT. The screening attenuation is then defined as:

$$a_s = -10 \log_{10} \left(\frac{P_{DUT}}{P_{REF}} \right) \qquad (1)$$

or:

$$a_s = -10 \log_{10} \left(\frac{P_{DUT}}{P_{INJ}} \right) - \Delta_{ins} \qquad (2)$$

where

P_{DUT} is the power coupled to the device under test (W);

P_{REF} is the power coupled to the reference antenna (W);

P_{INJ} is the power injected into the chamber (W);

Δ_{ins} is the insertion loss of the chamber in decibels (dB).

4 Description of the test set-up

4.1 Reverberation chamber

The reverberation chamber is a shielded enclosure having any shape, provided that its smallest dimension exceeds three wavelengths at the lowest test frequency. A perfect cubic shape should be avoided for optimum performance at lower frequencies. It shall be made of conductive materials (copper, aluminium or steel) and shall not contain lossy materials.

The upper frequency limit depends only on the screening attenuation, which shall exceed 60 dB for the whole frequency range. However, this value is not critical if the spectrum analyzer and the connecting devices of the test set-up are sufficiently screened and if the quality factor of the cavity remains sufficiently high. The quality factor shall be checked to verify that during one revolution of the mode stirrer the ratio between the maximum and the minimum power at the output of the reference antenna exceeds 20 dB. As a minimum, the test chamber and the test instrumentation shall have a combined screening attenuation at each test frequency that is 10 dB greater than the screening requirement of the DUT.

The shielded enclosure is drilled with four coaxial feed-throughs: two for the output of the antennas and two for the output of the measuring loop. For further details see annex A.

4.2 Mode stirrer

The mode stirrer shall be large with respect to wavelength and be bent at angles to the walls of the chamber. The mode stirrer shall be at least two wavelengths from tip to tip at the lowest test frequency. An example of a mode stirrer is described in annex B.

4.3 Antennas

The reverberation chamber is equipped with input and reference antennas. Both antennas shall present limited resonances in the frequency range and shall not introduce losses; their return loss shall be better than 6 dB.

For convenience, the same antenna should be kept for the whole frequency range. However, strongly polarized and directional antennas may disturb measurements due to lack of isotropic field state. This may be checked by modifying the location and orientation of the antennas. It should have no noticeable effect on the insertion loss of the cavity.

A wire antenna can be used between 10 GHz and 20 GHz. Its length shall be greater than five wavelengths at the lowest test frequency. It shall be matched at both ends in order to avoid resonances. It shall travel along two sides of the chamber, at such a distance that its input impedance remains superior to 300 Ω. To avoid direct coupling between antennas, they shall neither be installed on the same panels nor be at the same level and orientation.

Horn antennas may also be used, especially for higher frequencies, provided that direct path coupling between antennas is avoided. If horns are used, they should be placed in different corners of the chamber and located so that they face into the corner.

4.4 Test equipment

The essential test equipment and components required for an automated screening attenuation measurement are shown in figure 1. Preamplifiers, amplifiers and other control equipment may also be included in order to improve performance.

The generator and the spectrum analyzer shall have a common, highly stable frequency reference.

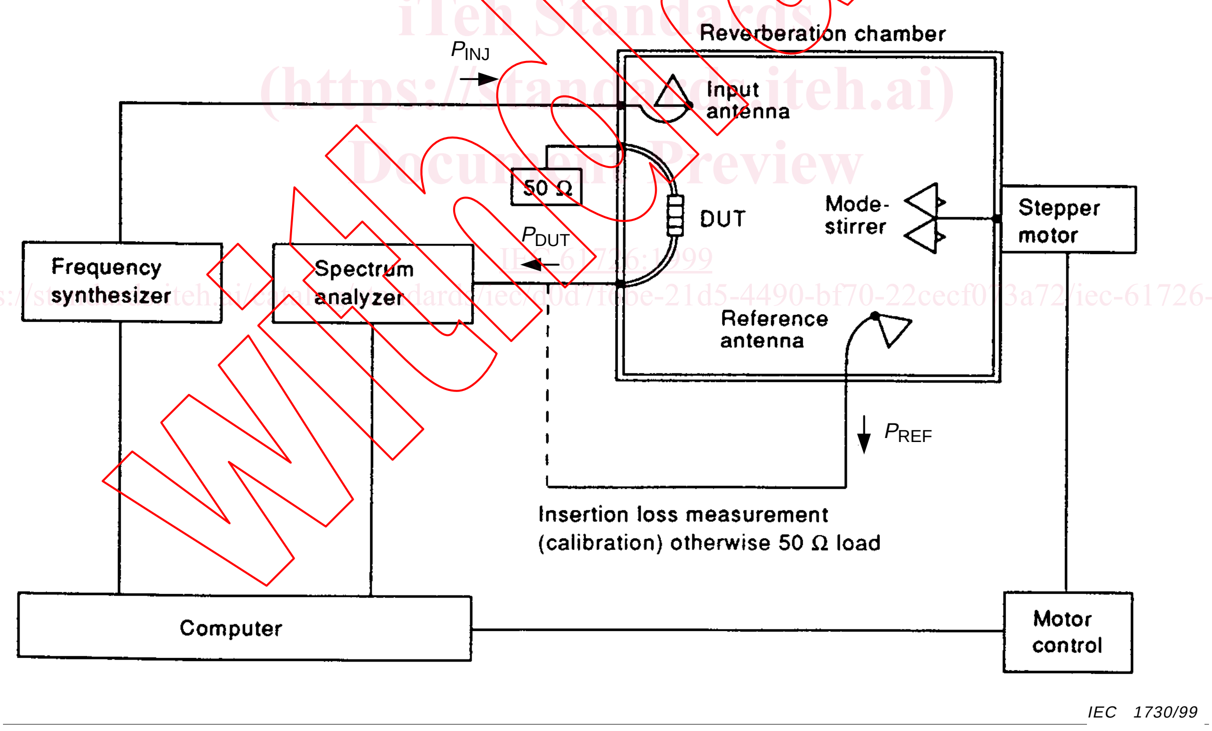

Figure 1 – Example of a test set-up