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NORME INTERNATIONALE

colour inside

Metallic communication cable test methods – Part 4-7: Electromagnetic compatibility (EMC) – Test method for measuring of transfer impedance Z_T and screening attenuation a_s or coupling attenuation a_C of connectors and assemblies up to and above 3 GHz – Triaxial tube in tube method

Méthodes d'essai des câbles métalliques de communication – Partie 4-7: Compatibilité électromagnétique (CEM) – Méthode d'essai pour mesurer l'impédance de transfert Z_T et l'affaiblissement d'écrantage a_s ou l'affaiblissement de couplage a_C des connecteurs et des cordons jusqu'à 3 GHz et au-dessus – Méthode triaxiale en tubes concentriques

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IEC 62153-4-7 edition 2.1 contains the second edition (2015-12) [documents 46/572/FDIS and 46/585/RVD], its corrigendum 1 (2016-04) and its amendment 1 (2018-05) [documents 46/679/FDIS and 46/682/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62153-4-7 has been prepared by IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

This second edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

The document is revised and updated. The changes of the revised IEC 62153-4-3:2013, and IEC 62153-4-4:2015, are included.

Measurements can be achieved now with mismatch at the generator site, impedance matching devices are not necessary.

This bilingual version (2016-03) corresponds to the monolingual English version, published in 2015-12.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62153 series, under the general title: *Metallic communication cable test methods*, can be found on the IEC website.

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INTRODUCTION

The shielded screening attenuation test set-up according to IEC 62153-4-3 and IEC 62153-4-4 have been extended to take into account the particularities of electrically short elements like connectors and cable assemblies. Due to the concentric outer tube of the triaxial set-up, measurements are independent of irregularities on the circumference and outer electromagnetic fields.

With the use of an additional resonator tube (inner tube respectively tube in tube), a system is created where the screening effectiveness of an electrically short device is measured in realistic and controlled conditions. Also a lower cut off frequency for the transition between electrically short (transfer impedance Z_T) and electrically long (screening attenuation a_S) can be achieved.

A wide dynamic and frequency range can be applied to test even super screened connectors and assemblies with normal instrumentation from low frequencies up to the limit of defined transversal waves in the outer circuit at approximately 4 GHz.

METALLIC COMMUNICATION CABLE TEST METHODS –

Part 4-7: Electromagnetic compatibility (EMC) – Test method for measuring of transfer impedance Z_T and screening attenuation a_s or coupling attenuation a_C of connectors and assemblies up to and above 3 GHz – Triaxial tube in tube method

1 Scope

This triaxial method is suitable to determine the surface transfer impedance and/or screening attenuation and coupling attenuation of mated screened connectors (including the connection between cable and connector) and cable assemblies. This method could also be extended to determine the transfer impedance, coupling or screening attenuation of balanced or multipin connectors and multicore cable assemblies. For the measurement of transfer impedance and screening- or coupling attenuation, only one test set-up is needed.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 62153-4-1, *Metallic communication cable test methods – Part 4-1: Electromagnetic compatibility (EMC) – Introduction to electromagnetic screening measurements*

IEC 62153-4-3, *Metallic communication cable test methods – Part 4-3: Electromagnetic Compatibility (EMC) – Surface transfer impedance – Triaxial method*

IEC 62153-4-4, *Metallic communication cable test methods – Part 4-4: Electromagnetic compatibility (EMC) – Shielded screening attenuation, test method for measuring of the screening attenuation as up to and above 3 GHz*

IEC 62153-4-15, *Metallic communication cable test methods – Part 4-15: Electromagnetic compatibility (EMC) – Test method for measuring transfer impedance and screening attenuation – or coupling attenuation with Triaxial Cell*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
surface transfer impedance
Z_T
for an electrically short screen, quotient of the longitudinal voltage U_1 induced to the inner circuit by the current I_2 fed into the outer circuit or vice versa, see figure 1

Note 1 to entry: The surface transfer impedance is expressed in ohms.

Note 2 to entry: The value Z_T of an electrically short screen is expressed in ohms [Ω] or decibels in relation to 1 Ω.

Note 3 to entry: See Figure 1.

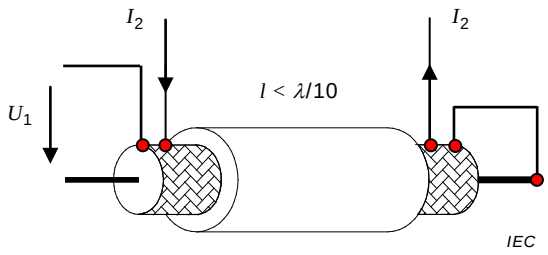

Figure 1 – Definition of Z_T

$$Z_T = \frac{U_1}{I_2} \tag{1}$$

$$Z_T \text{ dB}(\Omega) = +20 \times \log_{10}\left(\frac{|Z_T|}{1\Omega}\right) \tag{2}$$

3.2
effective transfer impedance
Z_{TE}
effective transfer impedance, defined as:

$$Z_{TE} = \max|Z_F \pm Z_T| \tag{3}$$

where

Z_F is the capacitive coupling impedance.

3.3
screening attenuation
a_s
for electrically long devices, i.e. above the cut-off frequency, logarithmic ratio of the feeding power P_1 and the periodic maximum values of the coupled power $P_{r,max}$ in the outer circuit

$$a_s = -10\log_{10}\left(\text{Env}\left|\frac{P_{r,max}}{P_1}\right|\right) \tag{4}$$

where

Env is the minimum envelope curve of the measured values in dB

Note 1 to entry: The screening attenuation of an electrically short device is defined as:

$$a_s = -20\log_{10}\frac{150\Omega}{Z_{TE}} \tag{5}$$

where

150 Ω is the standardized impedance of the outer circuit.

3.4
coupling attenuation
a_C
for a screened balanced device, the sum of the unbalance attenuation a_U of the symmetric pair and the screening attenuation a_S of the screen of the device under test

Note 1 to entry: For electrically long devices, i.e. above the cut-off frequency, the coupling attenuation a_C is defined as the logarithmic ratio of the feeding power P_1 and the periodic maximum values of the coupled power $P_{r,max}$ in the outer circuit.

3.5
coupling length
length of cable inside the test jig between the end of the extension tube and the screening cap (see Figure 2)

Note 1 to entry: the coupling length is electrically short, if

$$\lambda_o / l > 10 \cdot \sqrt{\varepsilon_{r1}} \quad \text{or} \quad f < \frac{c_o}{10 \cdot l \cdot \sqrt{\varepsilon_{r1}}} \tag{6}$$

or electrically long, if

$$\lambda_o / l \leq 2 \cdot \left| \sqrt{\varepsilon_{r1}} - \sqrt{\varepsilon_{r2}} \right| \quad \text{or} \quad f \geq \frac{C_o}{2 \cdot l \cdot \left| \sqrt{\varepsilon_{r1}} - \sqrt{\varepsilon_{r2}} \right|} \tag{7}$$

where

l is the effective coupling length in m;
λ_o is the free space wave length in m;
ε_{r1} is the resulting relative permittivity of the dielectric of the cable;
ε_{r2} is the resulting relative permittivity of the dielectric of the secondary circuit;
f is the frequency in Hz;
c_o is the velocity of light in free space.

3.6
device under test
device consisting of the mated connectors with their attached cables

4 Physical background

See respective clauses of IEC TS 62153-4-1, IEC 62153-4-3, IEC 62153-4-4 and Annexes C and D.

5 Principle of the test methods

5.1 General

The IEC 62153-4-x series describes different test procedures to measure screening effectiveness on communication cables, connectors and components with triaxial test set-up.

Table 1 gives an overview about IEC 62153-4-x test procedures with triaxial test set-up.