

Metallic communication cables test methods —

Part 4-2: Electromagnetic compatibility (EMC) — Screening and coupling attenuation — Injection clamp method

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National foreword

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Metallic communication cables test methods
Part 4-2: Electromagnetic compatibility (EMC) –
Screening and coupling attenuation –
Injection clamp method
(IEC 62153-4-2:2003)

Méthodes d'essai des câbles métalliques
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Partie 4-2: Compatibilité
électromagnétique (CEM) -
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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 46A/560/FDIS, future edition 1 of IEC 62153-4-2, prepared by SC 46A, Coaxial cables, of IEC TC 46, Cables, wires, waveguides, r.f. connectors, r.f. and microwave passive components and accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62153-4-2 on 2003-12-01.

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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62153-4-2:2003 was approved by CENELEC as a European Standard without any modification.

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METALLIC COMMUNICATION CABLE TEST METHODS –

Part 4-2: Electromagnetic compatibility (EMC) – Screening and coupling attenuation – Injection clamp method

1 Scope

This part of IEC 62153 describes the injection clamp test method which determines the screening attenuation (a_s) of coaxial cables and the coupling attenuation (a_c) of balanced shielded or unshielded data cables in a frequency range from 30 MHz up to 1 000 MHz and in a dynamic range up to 130 dB.

NOTE 1 Contrary to the absorbing clamp method, the method described here uses an injection clamp according to IEC 61000-4-6.

NOTE 2 Due to the low operational attenuation of the injection clamp, the coupling attenuation and the screening attenuation can be determined in a dynamic range up to 130 dB with common measuring equipment. Using an amplifier the dynamic range can be additionally improved.

2 Normative references

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

IEC 61000-4-6: *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

ITU-T Recommendation G.117:1996, *Transmission aspects of unbalance about earth*

ITU-T Recommendation O.9:1999, *Measuring arrangements to assess the degree of unbalance about earth*

3 Terms, definitions and symbols

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

3.1 Electrical symbols

Table 1 – Electrical symbols

a_{balun}	Operational attenuation of the balun transformer
a_{cable12}	Operational attenuation of the connecting coaxial cables
a_{c}	Coupling attenuation
a_{s}	Screening attenuation
a_{cal}	Operational attenuation of the test set-up
$a_{\text{cal,far}}$	Operational attenuation of the test set-up for far end
$a_{\text{cal,near}}$	Operational attenuation of the test set-up for near end
a_{clamp}	Operational attenuation of the clamp
$a_{\text{clamp,ref}}$	Reference attenuation of the clamp during calibration
a_{ferrite}	Ferrite common-mode rejection

a_{nm}	Unbalance attenuation of the balun transformers
a_{un}	Unbalance attenuation of the CUT
a_{CUTlong}	Operational attenuation of the CUT
a_{ref}	Reference attenuation of the calibration set-up
CUT	Cable under test
d	Screen diameter
$\epsilon_{\text{r,outer-system}}$	Relative dielectric permittivity of the outer system
f_{range}	Frequency
h	Height of the cable centre above groundplane
$P_{\text{in,clamp}}$	Feeding power into clamp
$P_{1,\text{max}}$	Max. received power at the inner system
$P_{1,\text{near}}$	Received power at the inner system for the near-end position
$P_{1,\text{far}}$	Received power at the inner system for the far-end position
$P_{2\text{com,max}}$	Max. feeding power of the outer system
$P_{2\text{com,near}}$	Feeding power of outer system for the near-end position
$P_{2\text{com,far}}$	Feeding power of outer system for the far-end position
R_{cm}	Common-mode impedance
R_1, R_2	Termination resistors for the inner system
R_{term}	Termination plates (150 Ω in the specified frequency range)
$Z_{\text{CUT,inn}}$	Characteristic impedance of the inner system
$Z_{\text{CUT,out}}$	Characteristic impedance of the outer system
$Z_{\text{in,clamp}}$	Input impedance of the clamp (50 Ω)
$Z_{\text{out,clamp}}$	Output impedance of the clamp (150 Ω)
$Z_{\text{out,gen}} (Z_o)$	Output impedance of the generator (50 Ω)
Z_{term}	Termination plates (150 Ω in the specified frequency range)

3.2 Definitions

3.2.1

inner system

system consisting of the inner conductor and the screen for coaxial lines and of the differential mode signal-carrying two-core conductor for twisted-pair cables (see Figure 1)

3.2.2

outer system

system consisting of the screen and the surrounding for coaxial lines, and represented by the common-mode propagation between the two-core conductor and the surrounding for unscreened twisted-pair cables and by the screen of the CUT and the surrounding for screened twisted-pair cables (see Figure 2)

3.2.3

screening and coupling attenuation

relation between the transmitted power through the conductor(s) and the maximum radiated peak power, conducted and generated by the excited common-mode currents or vice versa

3.2.4

coupling attenuation for coaxial cables

for coaxial cables coupling attenuation a_c is the same as screening attenuation a_s

Taking into account the maximum effect of either near- or far-end surface waves, the coupling attenuation a_c or screening attenuation a_s is specified by

$$a_c = a_s = 20 \log_{10} \left(\frac{P_{2com, max}}{P_{1, max}} \right)$$

where

$P_{1, max}$ is the maximum received power at the inner system;

$P_{2com, max}$ is the maximum feeding power of the outer system.

3.2.5

coupling attenuation for balanced cables

for screened balanced cables the coupling attenuation a_c is the sum of screening attenuation a_s and unbalance attenuation a_{un} .

$$a_c = a_s + a_{un}$$

For unscreened balanced cables the coupling attenuation a_c is equal to the unbalance attenuation a_{un} .

$$a_c = a_{un}$$

4 Principle

Using an injection clamp according to IEC 61000-4-6, it is equivalent if the power is injected or detected in the outer circuit (law of reciprocity). To qualify high-performance cables and to reach the high dynamic range, the power should be injected into the outer circuit. When testing CUT with a coupling attenuation of less than 90 dB the reverse (detecting) mode is also possible.

When testing high-performance cables in the injecting mode, the use of a screened chamber is recommended.