



BSI Standards Publication

Metallic communication cable test methods

Part 4-10: Electromagnetic compatibility (EMC) — Transfer impedance and screening attenuation of feed-throughs and electromagnetic gaskets — Double coaxial test method

National foreword

This British Standard is the UK implementation of IEC 62153-4-10:2015+A1:2020. It supersedes BS IEC 62153-4-10:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/46, Cables, wires and waveguides, radio frequency connectors and accessories for communication and signalling.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL STANDARD



**Metallic communication cable test methods –
Part 4-10: Electromagnetic compatibility (EMC) – Transfer impedance and
screening attenuation of feed-throughs and electromagnetic gaskets – Double
coaxial test method**

INTERNATIONAL
ELECTROTECHNICAL
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CONTENTS

FOREWORD	4
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Principle of the test method	9
5 Procedure.....	12
5.1 Equipment	12
5.2 Dynamic range.....	12
5.3 Verification of the test set-up	12
5.4 Sample preparation.....	12
6 Measurement.....	12
6.1 General.....	12
6.2 Screening attenuation	12
6.3 Transfer impedance	12
7 Expression of results	13
7.1 Transfer impedance	13
7.2 Screening attenuation	13
7.3 Requirements	13
Annex A (informative) Background for the measurement of the shielding effectiveness of feed-throughs and electromagnetic gaskets	14
A.1 General.....	14
A.2 Theoretical model of the test procedure	15
A.3 Performing measurements	16
A.3.1 Characteristic impedance uniformity of the test fixture	16
A.3.2 Measuring EMI-gaskets by using a NWA	16
A.3.3 Pictures and measurement results	17
Annex B (informative) Reference device for verification measurement	23
B.1 General.....	23
B.2 Design of the reference device.....	23
B.3 Verification measurement result.....	24
Annex C (informative) Impact of ground loops on low frequency measurements	25
C.1 General.....	25
C.2 Analysis of the test set-up.....	25
Annex D (informative) Measurement of the transfer impedance of conductive gaskets with controlled contact pressure.....	28
D.1 General.....	28
D.2 Measuring equipment and auxiliary measuring devices	28
D.3 Test setup.....	28
D.4 Test specimen	29
D.5 Measurement procedure	30
D.5.1 Test method A: matched RF-generator and test receiver	30
D.5.2 Test method B: un-matched NWA measurement	30
D.5.3 Both methods	30
D.6 Expression of results	31
D.6.1 Method A: matched RF-generator and test receiver measurement	31

D.6.2 Method B: un-matched NWA measurement.....	31
Bibliography.....	32
Figure 1 – A two-port	7
Figure 2 – Equivalent circuit of the test set-up and definition of Z_T	7
Figure 3 – Cross-section of a typical feed-through configuration	10
Figure 4 – Cross-section of the test fixture with a connector	10
Figure 5 – Cross-section of the test fixture with an electromagnetic gasket.....	11
Figure A.1 – Cross-section of a typical feed-through configuration	14
Figure A.2 – Cross-section of the test fixture with a connector	15
Figure A.3 – Equivalent circuit of the test setup with the shunt admittance y of the feed-through	15
Figure A.4 – TDR step response at input-port of test fixture	16
Figure A.5 – View of the test fixture connected to a network analyzer	18
Figure A.6 – Top view of the test fixture	18
Figure A.7 – Detailed view of the contact area	18
Figure A.8 – Detailed view of the captivation for the conductive O-ring test.....	19
Figure A.9 – Isolation of the network analyzer.....	20
Figure A.10 – Isolation of the test fixture when characterizing an ideal short (metal plate)	20
Figure A.11 – Measured operational screening transmission when characterizing a typical conductive O-ring.....	21
Figure A.12 – Transfer impedance Z_T of a typical conductive O-ring.....	21
Figure A.13 – Screening attenuation a_s of a typical conductive O-ring	22
Figure B.1 – Reference device, e.g. resistors soldered onto a PCB.....	23
Figure B.2 – Typical verification measurement result	24
Figure C.1 – Double coaxial test set-up	25
Figure C.2 – Equivalent circuits of the double coaxial test set-up.....	26
Figure C.3 – Results obtained with (green) and without ferrites on the test leads (blue).....	27
Figure D.1 – Test set-up	28
Figure D.2 – Details of the test fixture.....	29
Figure D.3 – Specimen size and shape	30
Table D.1 – Specimen size	29

INTERNATIONAL ELECTROTECHNICAL COMMISSION

METALLIC COMMUNICATION CABLE TEST METHODS –

Part 4-10: Electromagnetic compatibility (EMC) – Transfer impedance and screening attenuation of feed-throughs and electromagnetic gaskets – Double coaxial test method

FOREWORD

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International Standard IEC 62153-4-10 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 cancels and replaces the first edition published in 2009. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- addition of a new clause that describes a procedure for verification of the measurement set-up and further information regarding sample preparation;
- addition of a new Annex that describes how to improve measurement certainty in the very low frequency area.

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

FDIS	Report on voting
46/563/FDIS	46/580/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 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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

METALLIC COMMUNICATION CABLE TEST METHODS –

Part 4-10: Electromagnetic compatibility (EMC) – Transfer impedance and screening attenuation of feed-throughs and electromagnetic gaskets – Double coaxial test method

1 Scope

This part of IEC 62153 details a coaxial method suitable for determining the transfer impedance and/or screening attenuation of feed-throughs and electromagnetic gaskets.

The shielded screening attenuation test set-up according to IEC 62153-4-4 (triaxial method) has been modified to take into account the particularities of feed-throughs and gaskets.

A wide dynamic and frequency range can be applied to test even super screened feed-throughs and gaskets with normal instrumentation from low frequencies up to the limit of defined transversal waves in the coaxial circuits at approximately 4 GHz.

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.

Void.

3 Terms and definitions

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

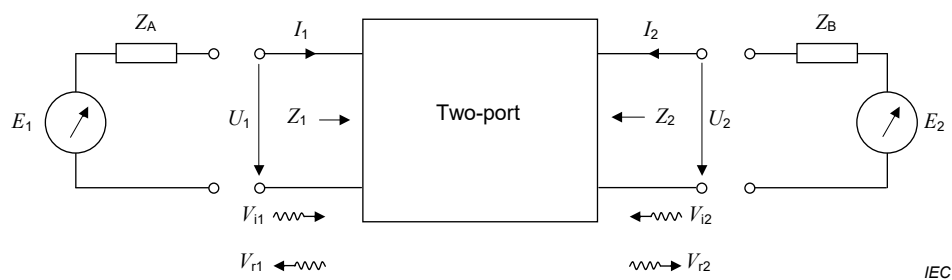
3.1

operational (Betriebs) transfer function in the forward direction H_{B21}

operational (Betriebs) scattering parameter S_{21}

quotient of the reflected square root of power wave fed into the reference impedance of the output of the two-port and the unreflected square root of the power wave consumed at the input of the two-port

EXAMPLE (see Figure 1)



Key

E_1, E_2	network analyzer at input, output respectively	V_{i1}, V_{i2}	incident square root of complex power waves (see note) at input and output, respectively
Z_A, Z_B	reference impedance at input and output respectively	V_{r1}, V_{r2}	reflected square root of complex power waves (see note) at input and output, respectively
I_1, I_2	current at input and output, respectively	Z_1, Z_2	impedance at input and output, respectively
U_1, U_2	voltage at input and output, respectively		

Figure 1 – A two-port

Note 1 to entry: Complex power is the product $U \cdot I$. Apparent power is the product $U \cdot I^*$, which is used in electrical power technique, where the angle between the voltage and current is of interest. I^* is the complex conjugate of the current I .

S_{21} or H_{B21} is the operational (Betriebs) transfer function in the forward direction defined as follows:

$$S_{21} = \frac{V_{r2}}{V_{i1}} \Big|_{V_{i2}=0} = \frac{2U_2}{E_1} \sqrt{\frac{Z_A}{Z_B}} = H_{B21}$$

See Annex C of IEC TR 62152:2009.

3.2

transfer impedance

equivalent circuit of the measurement of a feed-through or gasket, shunt impedance Z_T between the primary and secondary circuit

EXAMPLE The transfer impedance of an electrically short screen is defined as the quotient of the open circuit voltage U_2 induced to the secondary circuit by the current I_1 fed into the primary circuit or vice versa. See Figure 2.

Z_T of an electrically short screen is expressed in Ω or decibels in relation to 1 Ω .

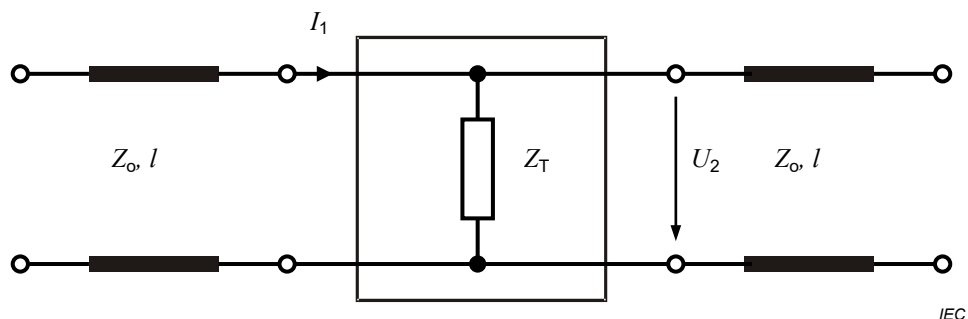


Figure 2 – Equivalent circuit of the test set-up and definition of Z_T

$$Z_T = \frac{U_2}{I_1} \quad (1)$$

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

3.3

operational (Betriebs) attenuation

the quotient of the unreflected square root of power wave fed into the reference impedance of the input of the two-port and the square root of the power wave consumed by the load of the two-port expressed in dB and radians

Note 1 to entry: See IEC TR 62152.

3.4

screening attenuation

a_s

logarithmic ratio of the incident (unreflected) square root of power wave fed into the nominal impedance of the primary circuit of the test set-up and the periodic maximum values of the square root of power wave $V_{r2, \max}$ coupled into the secondary circuit of the test set-up when its characteristic impedance Z_o is normalized to 150 Ω

EXAMPLE

$$\begin{aligned} a_s &= -20 \times \log_{10} \left(\text{Env} \left| \frac{V_{r2, \max}}{V_{i1}} \right| \right) + 20 \times \log_{10} \left| \frac{\sqrt{150 \Omega}}{\sqrt{Z_o}} \right| = \\ &= 20 \times \log_{10} \left| \frac{1}{\text{Env}(S_{21, \max})} \right| + 20 \times \log_{10} \left| \frac{\sqrt{150 \Omega}}{\sqrt{Z_o}} \right| = \\ &= \text{Min. Env} (A_{B21}) + 20 \times \log_{10} \left| \frac{\sqrt{150 \Omega}}{\sqrt{Z_o}} \right| \end{aligned} \quad (3)$$

where

a_s is the screening attenuation expressed in dB;

$\text{Env} (A_{B21})$ is the operational attenuation recorded as the envelope curve of the measured values in dB (See 7.1);

$\text{Min. Env} (A_{B21})$ is the operational attenuation recorded as the minimum envelope curve of the measured values in dB (See 7.1);

150 Ω is the standardized impedance of the secondary ("outer" or disturbed) circuit.

The screening attenuation, expressed in dB of an electrically short device is:

$$a_s \approx 20 \times \log_{10} \left| \frac{50 \Omega}{Z_T} \right| \quad (4)$$

where

a_s is the screening attenuation expressed in Ω ;

Z_T is the transfer impedance of the device under test.

Note 1 to entry: Formula (4) may be deduced from Formulas (3) and (5) as follows, assuming an electrically short device:

$$a_s = 20 \times \log_{10} \left| \frac{\sqrt{Z_o \times 150 \Omega}}{2 \times Z_T} \right|. \text{ If we assume that } 150 \Omega \approx 3 \times Z_o, \text{ then}$$

$$a_s = 20 \times \log_{10} \left| \frac{150 \Omega}{2\sqrt{3} \times Z_T} \right| \text{ and approximate } 2\sqrt{3} \approx 3 \text{ then } a_s \approx 20 \times \log_{10} \left| \frac{50 \Omega}{Z_T} \right| \text{ and Formula (4) is valid.}$$

In the measurement, both primary and secondary circuits are low impedance. This leads to a 6 dB lower A_{B21} than in e.g. the tube measurement of connectors; see IEC 62153-4-7.

3.5 **device under test** **DUT**

connector's body or screen, intended to be mounted to a shielding or screening wall (or box), or an electromagnetic gasket

3.6 **triaxial test method**

method for measuring the transfer impedance and screening attenuation of passive transmission components like cables and connectors in an triaxial arrangement

Note 1 to entry: Primarily used for components with elongated dimensions and therefore distributed coupling over the transfer impedance along the components.

See also IEC TS 62153-4-1.

3.7 **double coaxial test method**

method for measuring the transfer impedance and screening attenuation of passive transmission components like connector feed-throughs and electro magnetical gaskets in an cascaded arrangement

Note 1 to entry: Primarily used for short components with concentrated transfer impedance.

See also IEC TS 62153-4-1.

4 Principle of the test method

Figure 3 shows a typical feed-through construction where a coaxial connection is brought into a screened housing to a printed circuit board. Important are the coaxial connector body's and electromagnetic gasket's reliable connection to the screening or shielding box.

The electromagnetic tightness of a connector body's mounting or a gasket is measured as transfer impedance and/or screening attenuation.

The test set-up consists of two RF-tight coaxial systems separated by a metallic wall to which the DUT is mounted. The feed-through test set-up is shown in Figure 4. The gasket test set-up is shown in Figure 5. Here the gasket is pressed between two metallic plates.

The nominal impedances of both sides of the coaxial fixture should be the same as that of the test equipment. The generator side is called the primary circuit or inner circuit and the receiver side is called the secondary circuit or outer circuit.

The set-up is the same for measuring the transfer impedance and the screening attenuation.

Annex A gives a theoretical model of the test set-up. Useful information concerning the triaxial measurement technique is given in [3]¹.

¹ Figures in square brackets refer to the Bibliography.