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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Metallic ~~communication~~ cables and other passive components test methods – Part 4-6: Electromagnetic compatibility (EMC) – Surface transfer impedance – Line injection method

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

METALLIC ~~COMMUNICATION~~ CABLES AND OTHER PASSIVE COMPONENTS TEST METHODS –

Part 4-6: Electromagnetic compatibility (EMC) – Surface transfer impedance – Line injection method

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International Standard IEC 62153-4-6 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories cables, wires, waveguides, r.f. connectors and accessories for communication and signalling.

This second edition cancels and replaces the first edition, published in 2006.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
46/650/FDIS	46/654/RVD

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

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

A list of all parts in the IEC 62153 series, published 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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METALLIC ~~COMMUNICATION~~ CABLES AND OTHER PASSIVE COMPONENTS TEST METHODS –

Part 4-6: Electromagnetic compatibility (EMC) – Surface transfer impedance – Line injection method

1 Scope

This part of IEC 62153 determines the screening effectiveness of a shielded metallic communication cable by applying a well-defined current and voltage to the screen of the cable and measuring the induced voltage in order to determine the surface transfer impedance.

Measurements in the frequency range from a few kHz up to and above 1 GHz can be made with the use of normal high frequency instrumentation.

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 61196-1:2005, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*~~

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

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions ~~given in IEC 61196-1~~ apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
inner circuit
circuit consisting of the conductor(s) and the screen of the CUT and is denoted by the subscript 2

3.2
outer circuit (line injection circuit)
circuit consisting of the screen surface of CUT and the injection wire and is denoted by the subscript 1

3.3
transfer impedance
Z_T
quotient of the longitudinal voltage induced in the inner circuit of the electrically short cable under test to the current in the outer circuit (line injection circuit) – or vice versa – related to unit length

4 ~~General coupling considerations~~ Physical background

~~4.1 Inner and outer circuit~~

~~The outer circuit (line injection circuit) is fed and indicated by the subscript 1. It consists of the screen surface and the injection wire. The subscript 2 denotes the inner circuit (cable under test) where the induced voltage is measured.~~

~~4.2 Transfer impedance Z_T~~

One important element in the determination of the screening effectiveness of cables is the transfer impedance Z_T of its screen.

~~For an electrically short uniform cable, it is defined as the quotient of the longitudinal voltage induced in the inner circuit of the cable under test to the current in the outer circuit (line injection circuit) – or vice versa – related to unit length.~~

Most cables have a negligible capacitive coupling. But for loose single braided cables, capacitive coupling cannot be neglected. The coupling through the holes in the screen is described in terms of the through capacitance C_T or the capacitive coupling admittance Y_C. For an electrically short uniform cable, Y_C is defined as the quotient of the current induced in the inner circuit to the voltage developed in the outer circuit – formed by the screen under test and the injection wire – or vice versa related to the unit length.

In case of a non negligible capacitive coupling, the screening effectiveness is described by the equivalent transfer impedance Z_{TE}:

$$Z_{TE} = \max\left|Z_F \pm Z_T\right| \tag{1}$$

$$Z_F = j\omega C_T Z_1 Z_2 = Y_C Z_1 Z_2 \tag{2}$$

where

ω	is the radian frequency;
$\pm$	+ refers to near end, – refers to far end measurement;
C_T	is the through capacitance;
Y_C	is the capacitive coupling admittance;
~~Z_2~~ Z_1	is the characteristic impedance of the outer circuit (line injection circuit);
~~Z_1~~ Z_2	is the characteristic impedance of the inner circuit (cable under test);
Z_F	is the capacitive coupling impedance;
Z_T	is the transfer impedance;
Z_{TE}	is the equivalent transfer impedance.

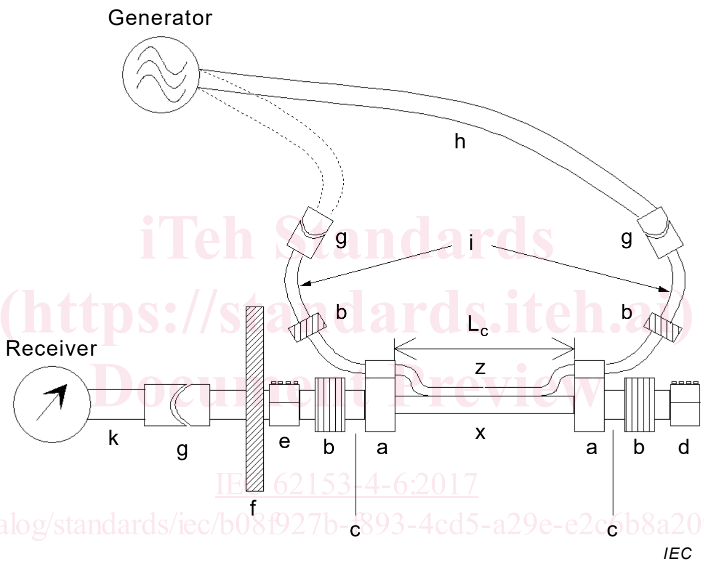
For more information, see the respective parts of IEC 62153-4-1.

5 Test set-up

5.1 General

As shown in Figure 1, the injection circuit is constructed as a transmission line using one or more parallel wires, a corrugated ~~copper strip~~ ribbon cable or a flat copper braid with the outer conductor of the cable under test. The injection circuit is connected to the coaxial line at each end via ~~a launcher~~ an injection feature. The injection wire shall be fitted tightly to the cable sample along the coupling length (e.g. with an adhesive tape). The characteristic impedance of the injection circuit shall be equal to the generator output resistance and the load resistance ~~R_2~~ R_1; this is achieved by choosing an appropriate conductor size and the type of insulation of the injection wire.

The reflection coefficient of the ~~launcher~~ injection feature and the injection circuit along the coupling length shall be less than 0,1 related to the generator output resistance, i.e. the return loss should be higher than 20 dB.



a	~~launcher~~ injection feature
b	ferrite
c	brass/copper tube for additional screening
d	screening box for the matching resistor of the cable under test
e	screening box for connecting the cable under test to the receiver
f	screened-room wall with screened coaxial feed-through (if needed)
g	connector (SMA, N, etc.)
h	feeding cable from the generator
i	feeding cables for injection wire
k	connecting cable to receiver
x	cable under test
z	injection line
L_c	coupling length

Figure 1 – Complete installation

5.2 Equipment

The measuring equipment consists of

a) a vector network analyser or alternatively

- a signal generator with the same characteristic impedance as ~~the (quasi) -coaxial system of the cable under test or with an impedance adapter and complemented~~ the line injection circuit and with a power amplifier if necessary for very low transfer impedance,
- a receiver with a calibrated step attenuator and complemented with a low noise amplifier for very low transfer impedance,

b) a time domain reflectometer (TDR) with a rise time of less than 350 ps or vector network analyser (at least 3 GHz) performing a return loss measurement transformed into the time domain.

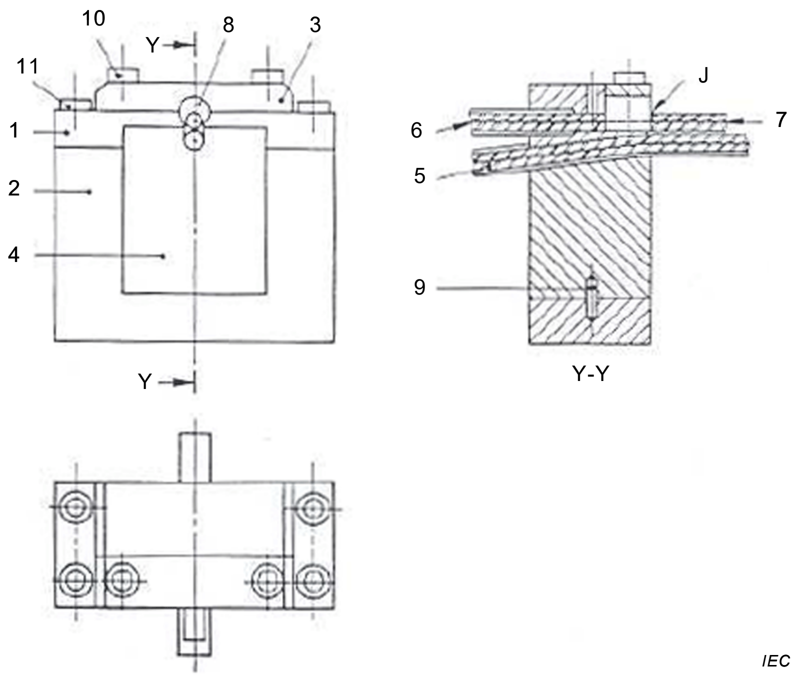
~~c) printing facility,~~

~~d) impedance matching circuit if necessary. The nominal impedance of the primary side is equal to the nominal impedance of the generator. The nominal impedance of the secondary side is equal to the nominal impedance of the (quasi) –coaxial system of the cable under test (see 5.4). The return loss measured from the primary side shall be minimum 10 dB.~~

5.3 ~~Launcher~~ Injection feature

The design of the ~~launchers~~ injection features is adjusted to allow an optimum matching of the symmetrical TEM in the coaxial feeding and terminating cables to the asymmetrical field along the parallel line whilst maintaining good mechanical strength for repeated use. Details of a possible ~~launcher~~ injection features are given in Figure 2 to Figure 6 (the figures are related for a coaxial cable connection of RG223). Fine tuning of the discontinuity can be made by varying the foam insert, item 8 of Figure 2.

Alternatively, a suitable ~~launcher~~ injection features can be made with a small connector (solder spill type) strapped to the CUT, or more easily by strapping the outer conductor of a small coaxial cable of appropriate characteristic impedance to the bared sheath of the CUT. In the test section itself, the centre conductor of the coaxial cable is continued using two or four parallel wires, corrugated ~~copper strip~~ ribbon cable or flat copper braid. Fine tuning of ~~a launcher~~ an injection feature discontinuity can be achieved by strapping the joint and the injection wire more closely onto the sheath of the CUT in the test section.



Quantity	Part	Pos.	Remarks, material
4	Metric screw M3 x 10mm	11	
2	Metric screw M3 x 6mm	10	
1	Pin: dia. 2mm length 8mm	9	
1	Foam dielectric	8	ε_r close to 1
1	Injection wire	7	
1	50 Ω coaxial cable	6	Impedance as required
1	Cable under test (CUT)	5	
1	Insert for CUT	4	Brass
1	Impedance matching part	3	Brass
1	Lower part	2	Brass
1	Upper part	1	Brass
	Test ~~launcher~~ injection feature (two required)		

Figure 2 – Assembled ~~launcher~~ injection feature for the transmission type line, Injection method – Parts list

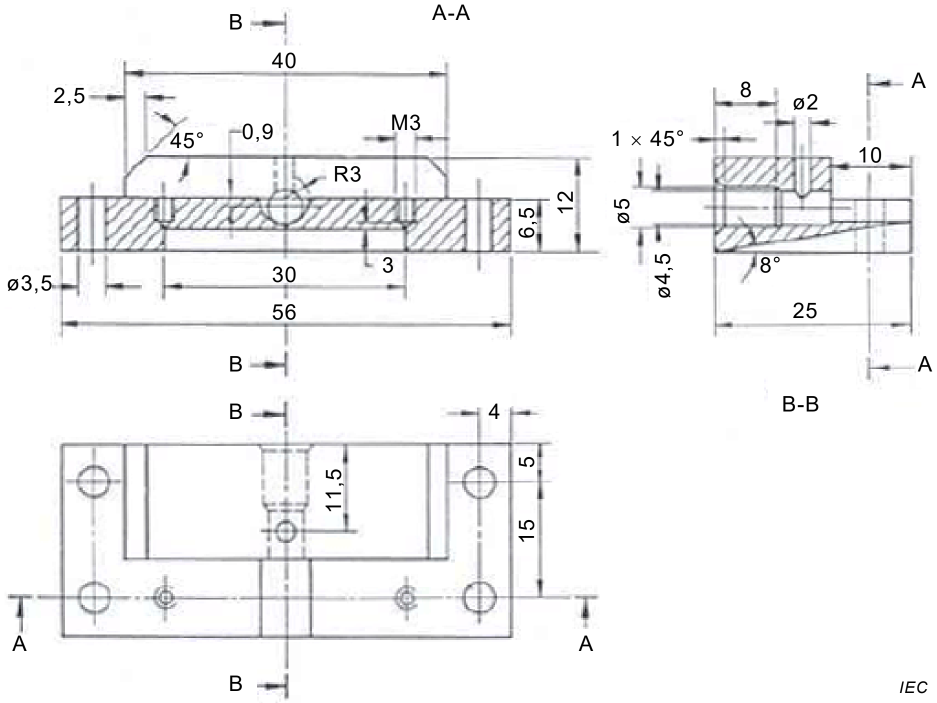


Figure 3 – Upper part of ~~launcher~~ injection feature – Position 1

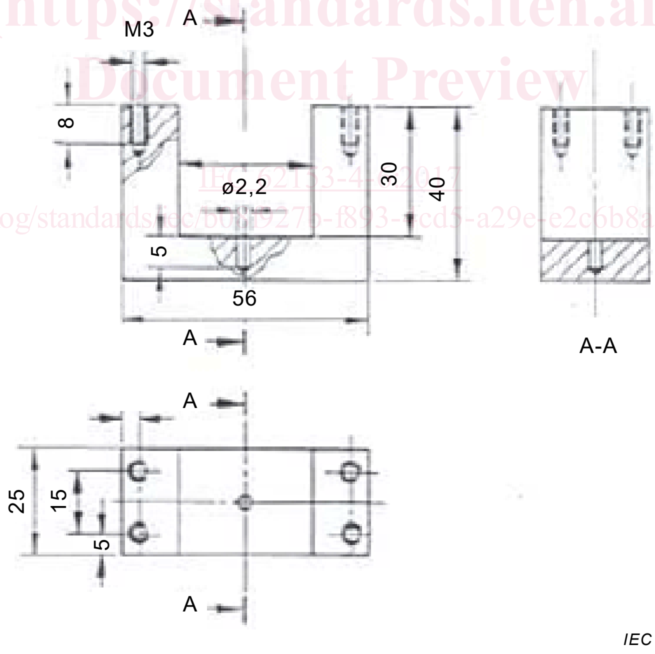


Figure 4 – Lower part of ~~launcher~~ injection feature – Position 2

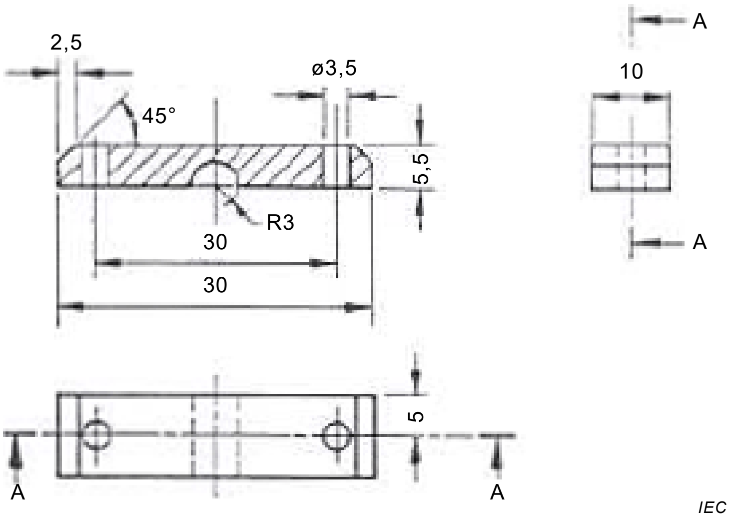


Figure 5 – Impedance matching part of ~~launcher~~ injection feature – Position 3

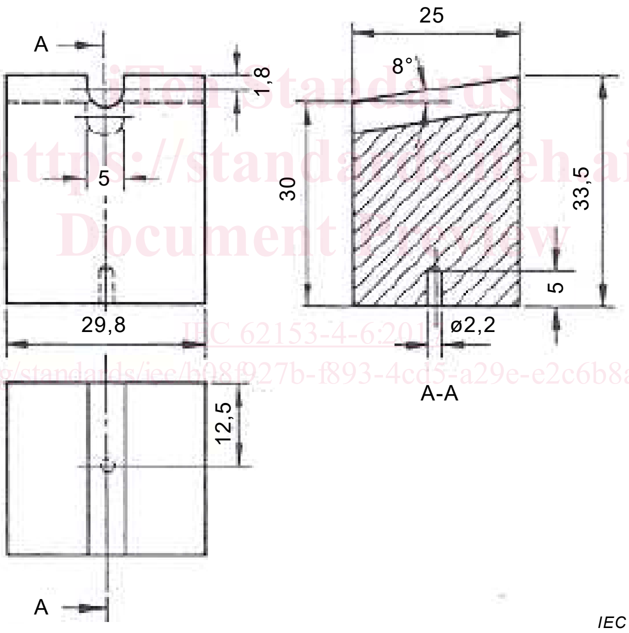


Figure 6 – Insert for adapting the different sizes of the cables under test – Position 4

5.4 Impedance ~~matching~~ of inner circuit

~~5.4.1 General~~

~~If the impedance of the cable under test Z_1 is not equal to the receiver input resistance (commonly 50 Ω) then an impedance matching circuit is needed. It shall be implemented as a two resistor circuit with one series resistor, R_s and one parallel resistor R_p. The value of the resistors and the configurations are shown in 5.4.2 to 5.4.5.~~