

INTERNATIONAL STANDARD



Metallic ~~communication~~ cables and other passive components –
Test methods –

Part 4-8: Electromagnetic compatibility (EMC) – Capacitive coupling admittance



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2018 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IECNORM.COM : Click to view the full PDF IEC 62154-8:2018 PLV

INTERNATIONAL STANDARD



**Metallic ~~communication~~ cables and other passive components –
Test methods –
Part 4-8: Electromagnetic compatibility (EMC) – Capacitive coupling admittance**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.100.10; 33.120.10

ISBN 978-2-8322-5851-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions	6
Test equipment.....	
 General.....	
 Capacitance bridge method.....	
 Pulse method.....	
Procedure	
 Capacitance bridge method.....	
 Pulse method.....	
Measurement precautions.....	
 Capacitance bridge method.....	
 Pulse method.....	
Expression of results.....	
Determination of the capacitive or capacitance transfer impedance Z_F.....	
Requirement.....	
4 Principle.....	14
5 Test method	14
5.1 General.....	14
5.2 Cut-off frequency	15
5.3 Test equipment	15
5.4 Coupling length.....	15
5.5 Sample preparation.....	15
5.6 Test set-up.....	16
5.7 Calibration procedure.....	17
5.8 Measuring procedure.....	18
5.9 Evaluation of test results	18
5.9.1 General	18
5.9.2 Test report.....	19
Bibliography	20
Figure – Layout of the test circuit for the measurement of through capacitance by capacitance bridge method.....	
Figure – Layout of test circuit for the measurement of through capacitance by pulse method.....	
Figure – Layout of test circuit for time domain measurement.....	
Figure 1 – Definition of Z_T	6
Figure 2 – Definition of Z_F	7
Figure 3 – Preparation of test sample for coaxial cables	11
Figure 4 – Preparation of test sample for symmetrical cables.....	12
Figure 5 – Triaxial set-up	12
Figure 6 – Connection to the vector network analyzer.....	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**METALLIC ~~COMMUNICATION~~ CABLES
AND OTHER PASSIVE COMPONENTS –
TEST METHODS –****Part 4-8: Electromagnetic compatibility (EMC) –
Capacitive coupling admittance**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62153-4-8 has been prepared by IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

- a) use of the triaxial set-up in a similar manner as for the measurement of the transfer impedance (see IEC 62153-4-3),
- b) use of vector network analyser instead of capacitance bridge or pulse generator.

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

FDIS	Report on voting
46/684/FDIS	46/690/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 of the IEC 62153 series, under the general title: *Metallic cables and other passive components – 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.

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~~ CABLES AND OTHER PASSIVE COMPONENTS – TEST METHODS –

Part 4-8: Electromagnetic compatibility (EMC) – Capacitive coupling admittance

1 Scope

This part of IEC 62153 ~~applies to metallic communications cables. It~~ specifies a test method for determining the capacitive coupling admittance ~~by the measurement of through capacitance using either a capacitance bridge or by a pulse method~~ the capacitive coupling impedance and the coupling capacitance by the use of a triaxial set-up in a similar manner as for the measurement of the transfer impedance (see IEC 62153-4-3). Most cables have negligible capacitive coupling; however, in the case of cables with loose single-braids, the coupling through the holes in the screen shall be determined by the measurement of the capacitive coupling admittance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-726, International Electrotechnical Vocabulary (IEV) – Part 726: Transmission lines and wave guides~~

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

~~IEC 62153-4-1, Metallic communication cable test methods – Part 4-1: Electromagnetic Compatibility (EMC) – Introduction to electromagnetic (EMC) screening measurements¹~~

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

3 Terms and definitions

For the purposes of this document the following terms and definitions ~~given in IEC 60050-726, IEC 61196-1 and IEC 62153-4-1, as well as the following~~ 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>.

¹~~To be published.~~

3.1

inner circuit

circuit consisting of the screens and the conductor(s) of the test specimen

Note 1 to entry: Quantities relating to the inner circuit are denoted by the subscript "1". See Figure 1 and Figure 2.

3.2

outer circuit

circuit consisting of the screen surface and the inner surface of a surrounding test jig

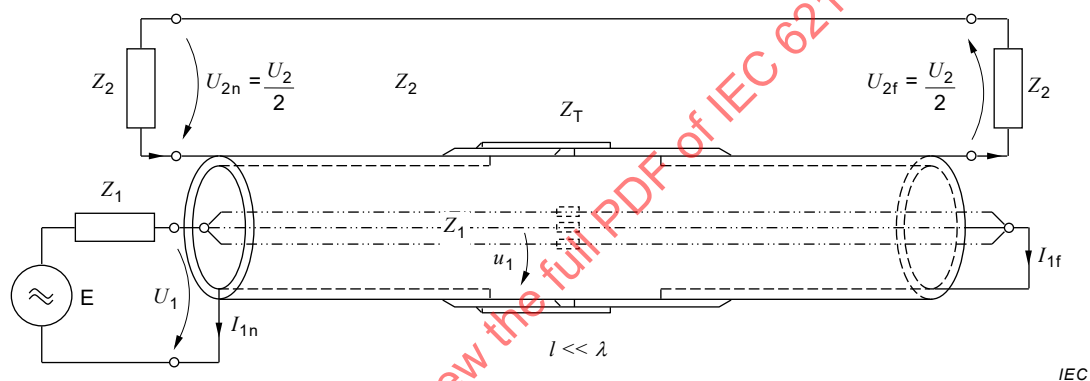
Note 1 to entry: Quantities relating to the outer circuit are denoted by the subscript "2". See Figure 1 and Figure 2.

3.3

transfer impedance

Z_T

quotient of the longitudinal voltage induced in the matched outer circuit – formed by the screen under test and the measuring jig – and the current fed into the inner circuit or vice versa (see Figure 1)



Key

- Z_1, Z_2 characteristic impedance of the inner and the outer circuits
- U_1, U_2 voltages in the inner and the outer circuits (n: near end, f: far end)
- I_1 current in the inner circuit (n: near end, f: far end)
- l length of the cable, respectively the length of the screen under test
- λ wavelength in free space

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

where

- Z_T is the transfer impedance;
- U_2 is the voltage in the inner and the outer circuits (n: near end, f: far end);
- I_1 is the current in the inner circuit (n: near end, f: far end).

Figure 1 – Definition of Z_T

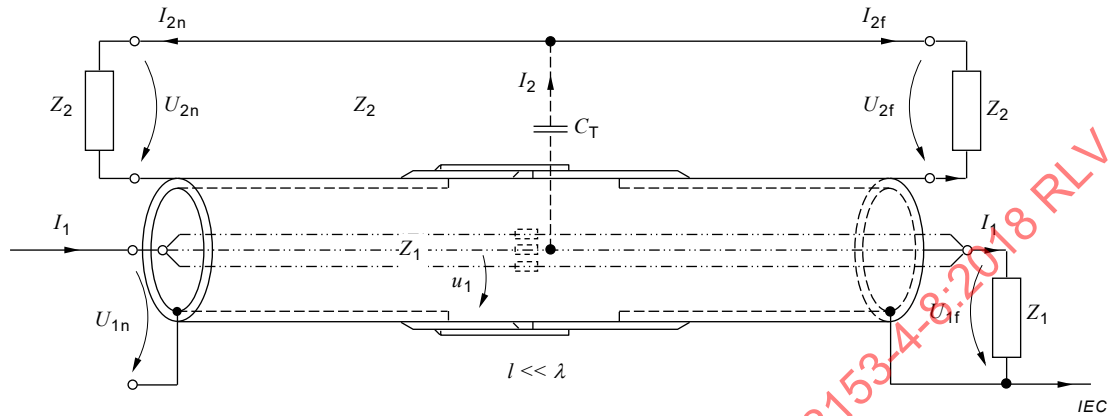
Note 1 to entry: Transfer impedance is expressed in $\text{m}\Omega/\text{m}$.

3.4

capacitive coupling impedance

Z_F

quotient of twice the voltage induced to the terminating impedance Z_2 of the matched outer circuit by a current I_1 fed (without returning over the screen) to the inner circuit and the current I_1 or vice versa (see Figure 2)



Key

- Z_1, Z_2 characteristic impedance of the inner and the outer circuits
 U_1, U_2 voltages in the inner and the outer circuits (n: near end, f: far end)
 I_1, I_2 current in the inner and the outer circuits (n: near end, f: far end)
 l length of the cable, respectively the length of the screen under test
 λ wavelength in free space

$$I_{2n} = I_{2f}$$

$$U_{1n} = U_{1f}$$

$$I_{2n} = I_{2f} = (1/2) \times I_2 = I_2/2$$

$$I_2 = I_{2n} + I_{2f}$$

$$Z_F = \frac{U_{2n} + U_{2f}}{I_1} = \frac{2U_{2f}}{I_1} = Z_1 Z_2 \times j\omega C_T \quad (2)$$

where

- Z_F is the capacitive coupling impedance;
 Z_1, Z_2 is the characteristic impedance of the inner and the outer circuits;
 U_2 is the voltage in the outer circuit (n: near end, f: far end);
 I_1 is the current in the inner circuit (n: near end, f: far end);
 C_T is the coupling capacitance.

Figure 2 – Definition of Z_F

Note 1 to entry: Capacitive coupling impedance is expressed in mΩ/m.

Note 2 to entry: For multiconductor cables, the inner conductors are shorted together.

Note 3 to entry: The coupling capacitance C_T is dependent on the dielectric permittivity and geometry of the outer circuit, whereas the capacitive coupling impedance is invariant with respect to the geometry of the outer circuit and nearly invariant with respect to the dielectric permittivity.

$$Z_F = Z_1 Z_2 j\omega C_T = j\omega C_T \frac{\sqrt{\epsilon_{r1}}}{C_1 c_0} \frac{\sqrt{\epsilon_{r2}}}{C_2 c_0} \quad (3)$$

where

Z_F is the capacitive coupling impedance;

C_T is the coupling capacitance;

ω is the circular frequency;

c_0 is the speed of light, 3×10^8 m/s;

ϵ_{r1} is the relative dielectric permittivity of the inner circuit (CUT);

ϵ_{r2} is the relative dielectric permittivity of the outer circuit (tube);

Z_1 is the impedance of the inner circuit (CUT);

Z_2 is the impedance of the outer circuit (tube);

C_1 is the capacitance of the inner circuit (CUT);

C_2 is the capacitance of the outer circuit (tube).

As $C_T \propto \frac{C_1 C_2}{\epsilon_{r1} + \epsilon_{r2}}$ one gets $Z_F \propto \frac{\sqrt{\epsilon_{r1} \epsilon_{r2}}}{\epsilon_{r1} + \epsilon_{r2}}$; and $\frac{\sqrt{\epsilon_{r1} \epsilon_{r2}}}{\epsilon_{r1} + \epsilon_{r2}} \approx 0,5$ for relative dielectric permittivity in the inner and outer circuit in the range from 1 to 3.

3.5

capacitive coupling admittance

Y_C

quotient of the current induced in the secondary (inner) circuit to the voltage development in the primary (outer) circuit. For electrically short uniform cables

$$Y_C = j\omega C_T \quad (4)$$

~~NOTE 1 — Although most cables have negligible capacitive coupling, in the case of a loose single braided cable, 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 .~~

~~NOTE 2 — For multiconductor cables, the inner conductors are shorted together.~~

3.6

effective transfer impedance

Z_{TE}

maximum absolute value of the sum or difference of the Z_F and Z_T at every frequency

$$Z_{TE} = \max |Z_F \pm Z_T| \quad (5)$$

Note 1 to entry: The effective transfer impedance is expressed in Ω .

3.7

effective transfer impedance related to a reference impedance of 1 Ω

Z_{TE}

maximum absolute value of the sum or difference of the Z_F and Z_T at every frequency expressed in dB (Ω)

$$Z_{TE} = +20 \times \log_{10} \left(\frac{|Z_{TE}|}{Z_{T,ref}} \right) \quad (6)$$

where

$Z_{T,ref}$ is the reference transfer impedance with a value of 1 Ω

Note 1 to entry: The effective transfer impedance is expressed in dB (Ω).

3.8 coupling length

L_c

length of cable which is inside the test jig, i.e. the length of the screen under test

3.9 cut-off frequency

maximum frequency up to which the capacitive coupling admittance can be measured

3.2 capacitive or capacitance transfer impedance

~~the capacitive or capacitance transfer impedance is derived as:~~

$$Z_F = j\omega C_T Z_{01} Z_{02}$$

where

~~Z_{01} is the characteristic impedance of the primary circuit (outer braid or tube and screen of the test sample);~~

~~Z_{02} is the characteristic impedance of the secondary circuit (test sample).~~

~~NOTE For multiconductor cables, the inner conductors are shorted together.~~

4 Test equipment

4.1 General

~~The apparatus is of the "triple coaxial" form. The inner conductor(s) of the test sample is shielded at one end by means of a metal disc connected to the screen or by means of a screened termination without its resistor. The test sample is coaxially mounted inside a test jig. The outer conductor of the test jig is either a metal tube or is formed by applying a braid over the sheath of the test sample (or over a further insulating tube if the test sample has no sheath). The tube or braid is open ended at the side opposite the metal disc.~~

4.2 Capacitance bridge method

~~The screen of the test sample is connected to the middle of a capacitance bridge, see Figure 1.~~

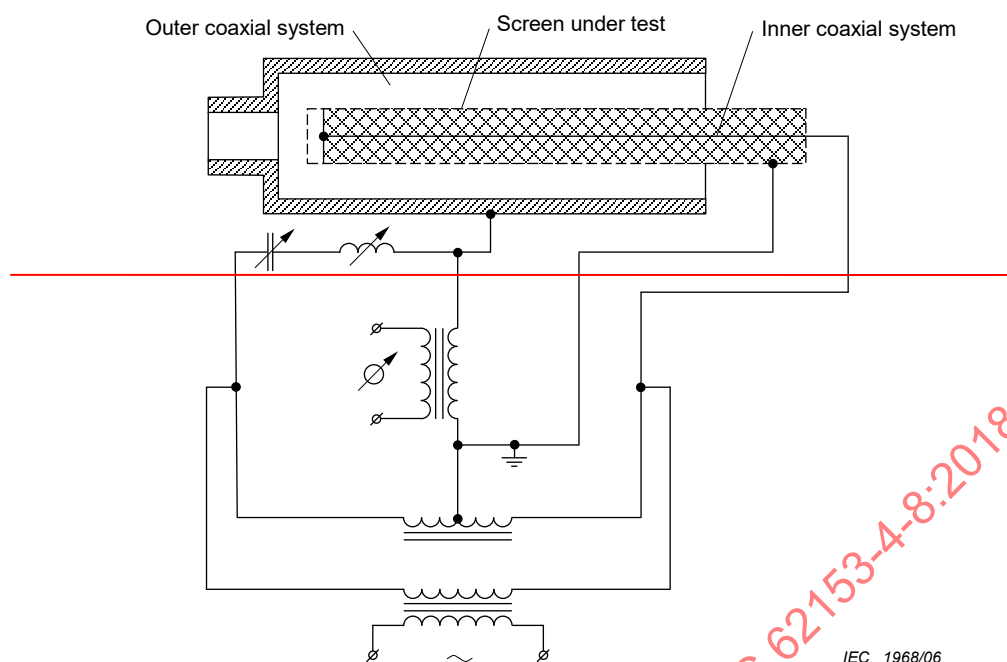


Figure 1 — Layout of the test circuit for the measurement of through capacitance by capacitance bridge method

4.3 — Pulse method

The equipment combinations given in Table 1 are suggested to achieve a sensitivity of about 1 division on an oscilloscope screen for a value of C_T equal to 10^{-15} F/m, which is typically equivalent to a resolution of 1 mΩ/m in the derived value of Z_T .

Table 1 — Equipment combinations

Pulse generator		Oscilloscope	
Output pulse	Rise time	Sensitivity	Bandwidth
10 V	100 ns	100 μV/div	1 MHz
100 V	100 ns	1 μV/div	1 MHz

5 — Procedure

5.1 — Capacitance bridge method

At a frequency of approximately 1 kHz, the capacitance is measured between the inner conductor(s) of the test sample and the metal tube or outer braid.

5.2 — Pulse method

The signal from a pulse generator is fed to the outer coaxial system (exciting circuit) and to one channel of the oscilloscope (V_1) (see Figure 2). The inner conductor(s) of the test sample is connected to the other channel of the oscilloscope (V_2). In order to avoid reflections from connector mismatch, V_2 is recorded as mean pulse height displayed 1 μs to 2 μs after the initiation of the pulse.

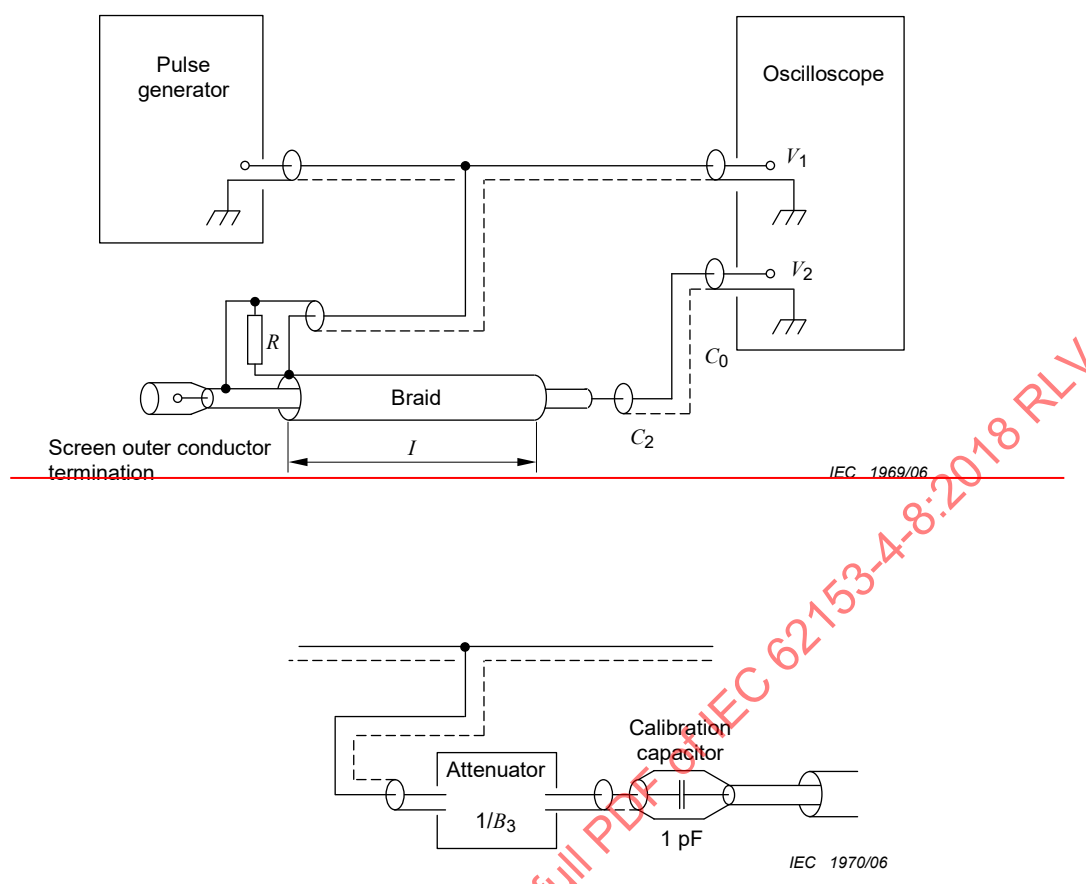


Figure 2 — Layout of test circuit for the measurement of through capacitance by pulse method

6 Measurement precautions

6.1 Capacitance bridge method

The screen under test shall have a length of between 0,5 m and 5 m to ensure that corrections for the connecting cable capacitance and measuring instrument capacitance do not unduly degrade the system accuracy.

6.2 Pulse method

The measuring circuit is not terminated in its characteristic impedance at either end so the overall length should be kept short to allow resonances to die away before the measurement is taken. The cable end is screened to avoid crosstalk from the pulse generator output. The exciting circuit is terminated to limit any resonances to the measuring circuit. The terminating resistance is placed at the drive end to avoid possible error from the surface transfer impedance contributions should any significant current flow in the screen under test.

To determine the sensitivity and calibrate the test equipment, an attenuator and a small calibration capacitor are used. To avoid introducing additional error, calibration can be effected at any level by substituting the calibration capacitor in place of the screened open circuit termination and connecting the pulse generator to it via the attenuator. In this way, the total measuring circuit capacitance is unchanged and the calibration level is C_2/B_3 , the attenuator again being $1/B_3$.

If the pulse is correctly terminated before calibration there will be no change in the value of V_4 , otherwise there will be a small change in V_4 as shown on the oscilloscope trace when the attenuator is substituted in place of the load resistor R_4 .

Crosstalk sensitivity, which may limit the minimum detectable signal, is established by disconnecting at point P_3 and observing the V_2 oscilloscope trace with other settings normal. Care should be taken to screen the open end of the measuring cable, to maintain screen continuity by touching the connector bodies together and to set the pulse generator and the oscilloscope gain for the maximum desired sensitivity.

7 Expression of results

If the bridge method is used, the value of C_T in pF/m is the bridge reading divided by the length of the test sample.

If the pulse method is used the value of the through capacitance C_T is determined from:

$$C_T = (C_2 + C_0 / l) V_2 / V_1$$

where

C_2 is the capacitance of the inner dielectric of the test sample in pF/m;

l is the length of the test sample under the injection braid in m;

C_0 is the stray capacitance in pF/m;

V_1 is the reference pulse voltage;

V_2 is the coupled pulse voltage.

The stray capacitance consists of coupling capacitance, the oscilloscope input capacitance and the additional capacitance of the test sample outside the test length.

The capacitive coupling admittance Y_C in S/m is derived from:

$$Y_C = 2\pi f C_T / l$$

where

C_T is the through capacitance in pF/m;

l is the length of the test sample in m;

f is the frequency in Hz.

8 Determination of the capacitive or capacitance transfer impedance Z_F

The capacitive or capacitance transfer impedance can be readily derived from a measurement of the through capacitance of a braid if the characteristic impedance of the inner and outer coaxial lines are known. Both Z_{01} and Z_{02} can be obtained using the equipment assembled (see Figure 3) as a time domain reflectometer (TDR) so long as the pulse generator rise time and the oscilloscope response are sufficiently fast.

NOTE For a 1 m test sample, the signal delay (go and return) is about 10 ns. A pulse generator with a rise time of 4 ns and an oscilloscope with a bandwidth of 100 MHz gives a net rise time of 5,5 ns which is sensibly shorter than the pulse length from the cable.

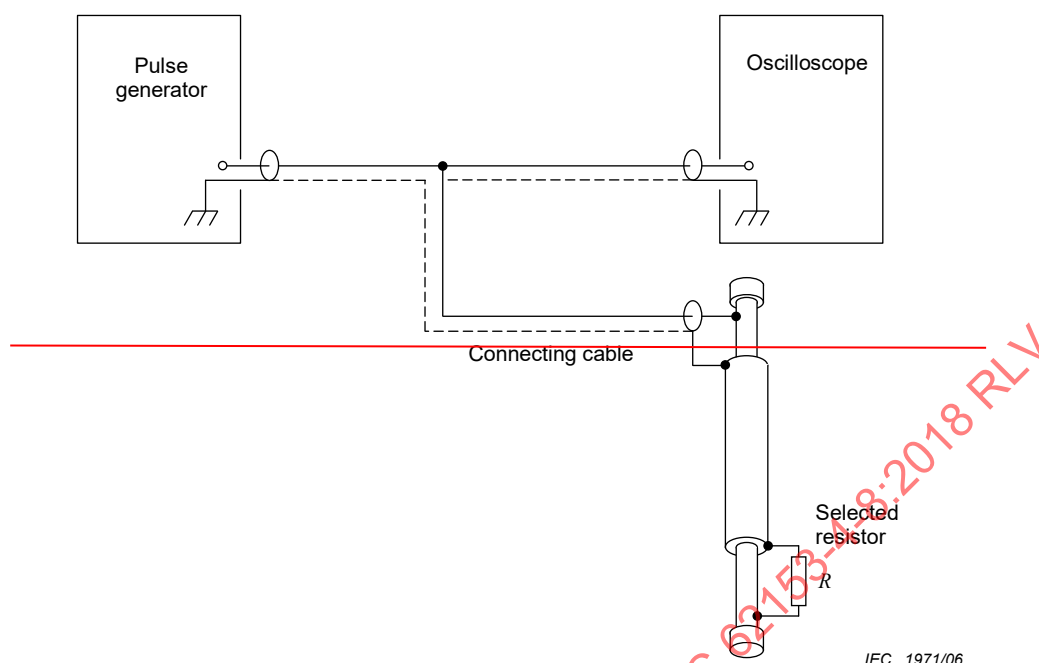


Figure 3 — Layout of test circuit for time domain measurement

The terminating resistor which is adjusted for minimum reflection becomes equivalent to the characteristic impedance of the circuit under test.

The capacitive or capacitance transfer impedance Z_F is derived from

$$Z_F = j\omega C_T Z_{01} Z_{02}$$

9 Requirement

The capacitive coupling admittance of the test sample shall comply with that indicated in the relevant cable specification.

4 Principle

The test determines the screening effectiveness of a shielded cable by applying a well-defined voltage to the screen of the cable and measuring the induced voltage in a secondary circuit in order to determine the capacitive coupling admittance. This test measures only the electrostatic component of the effective transfer impedance Z_{TE} . To measure the magnetic component (the surface transfer impedance), the method described in IEC 62153-4-3 shall be used.

5 Test method

5.1 General

If not otherwise specified, the measurements shall be carried out at the temperature of $(23 \pm 3) ^\circ\text{C}$.

The test method determines the capacitive coupling admittance of a cable screen by measuring the cable in a triaxial test set-up. A test configuration with an open circuit in the inner and outer circuit shall be used. This emphasizes the capacitive coupling compared to the magnetic coupling and results in a 6 dB higher signal compared to a configuration where the inner circuit is matched.

The test results are valid in a frequency range up to about 25 MHz, see 5.2. The coupling capacitance C_T is independent on the frequency. Therefore for frequencies above the cut-off frequency, the test results of the capacitive coupling admittance can be extrapolated with 20 dB/decade, see 3.5.

5.2 Cut-off frequency

The cut-off frequency length product is roughly:

$$f_{\text{cut}} \times l \approx \frac{1}{\sqrt{\varepsilon_{r1} + \varepsilon_{r2}}} \frac{c_0}{2\pi} \quad (7)$$

where

l is the coupling length of the cable under test;

c_0 is the speed of light, $3 \times 10^8 \text{ m/s}$;

ε_{r1} is the relative dielectric permittivity of the inner circuit (CUT);

ε_{r2} is the relative dielectric permittivity of the outer circuit (tube).

i.e. for a coupling length of 1 m and dielectric permittivities of 2,3 and 1,1 in the inner respectively outer circuit, the maximum frequency for the measurement of the capacitive coupling admittance is 25 MHz.

Another way to obtain the cut-off frequency is to observe the phase of the capacitive coupling admittance respectively measured forward transmission scattering parameter S_{21} , see 5.8. The cut-off frequency is reached when the phase starts to deviate from 90 degrees.

5.3 Test equipment

The measurement shall be performed using a vector network analyser.

5.4 Coupling length

The coupling length shall be not shorter than 0,5 m and not longer than 1,0 m.

5.5 Sample preparation

The test sample shall have a length not more than 50 % longer than the coupling length.

Coaxial cables are prepared as shown in Figure 3.

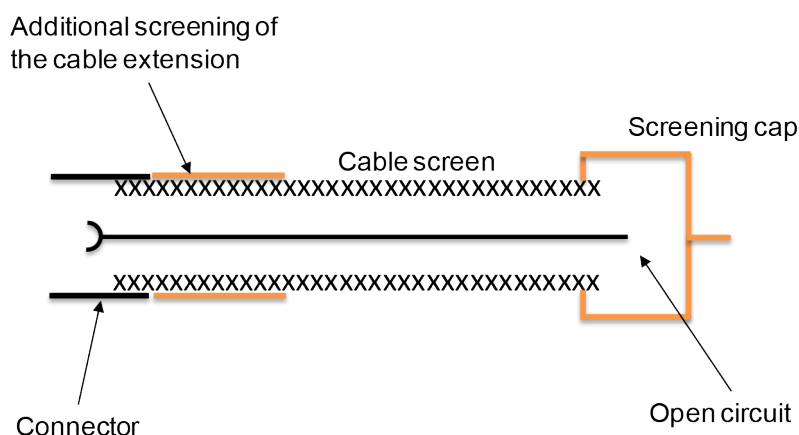


Figure 3 – Preparation of test sample for coaxial cables

One end of the coaxial cable is prepared with a connector to make a connection to the receiver. The other end of the coaxial cable is prepared with a well screened open circuit. The open circuit shall be made in a way resulting in a small stray capacitance. To minimize unwanted coupling into the tube, the exceeding length outside the tube shall be screened with an additional tight screen, which shall be in contact with the cable screen (e.g. by wrapping a metal foil with minimum 20 % overlap around the cable screen).

All connections shall be made RF tight and with low RF-contact resistance so that the impact of the sample preparation is negligible compared to the test results.

Screened symmetrical cables are treated as a quasi coaxial system, see Figure 4. Therefore the conductors of all pairs/quads shall be connected together at both ends. All screens, including those of individually screened pairs/quads, shall be connected together at both ends. The screens shall be connected over the whole circumference.

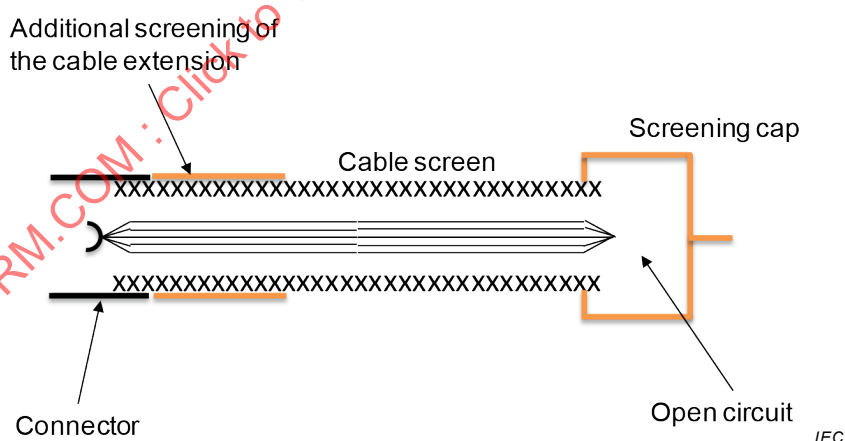


Figure 4 – Preparation of test sample for symmetrical cables

5.6 Test set-up

The test sample shall be fitted to the test set-up. The test set-up is an apparatus of a triple coaxial form. The cable screen forms both the outer conductor of the inner circuit and the inner conductor of the outer circuit. The outer conductor of the outer circuit is a well conductive tube of non-ferromagnetic metal (for example brass, copper or aluminium) with an open-circuit to the screen on the receiver side of the cable (see Figure 5). The test sample shall be well centered in the tube.

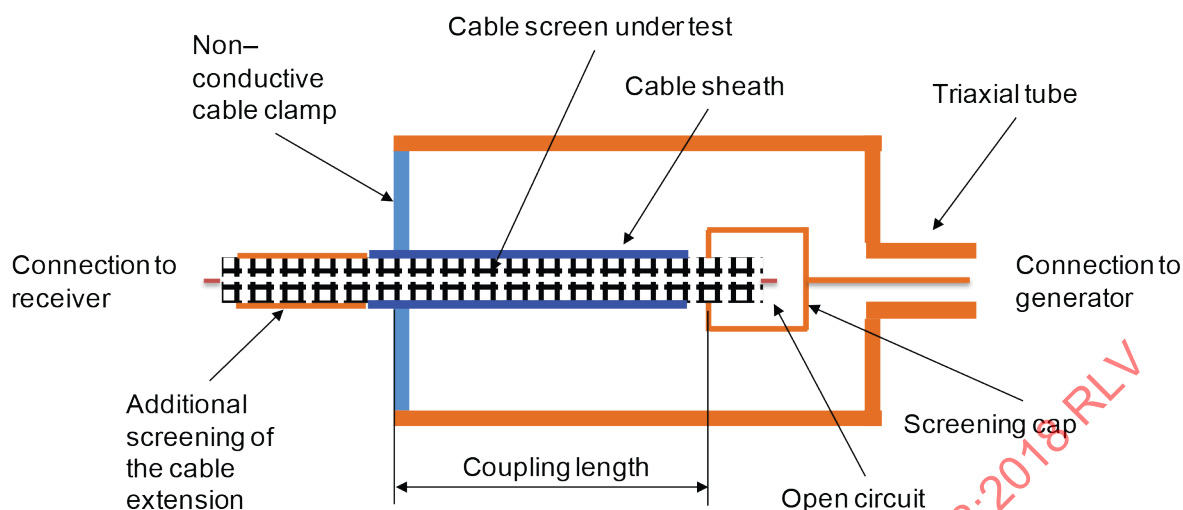


Figure 5 – Triaxial set-up

Due to the open circuit in the outer circuit (tube), external disturbers may couple into the tube. Therefore the generator signal is feeding the outer circuit (tube), guaranteeing a high signal to noise ratio. The coupled signal is measured in the inner circuit (cable), see Figure 6. The connection from the triaxial set-up to the vector network analyzer (VNA) shall be done with well screened cables, e.g. double braided cables, having a screening attenuation of minimum 80 dB up to 1 GHz and a transfer impedance of maximum 10 mΩ/m at 100 MHz. The connecting cables shall be as short as possible. The use of ferrites on the connecting cables is recommended in order to suppress resonance effects.

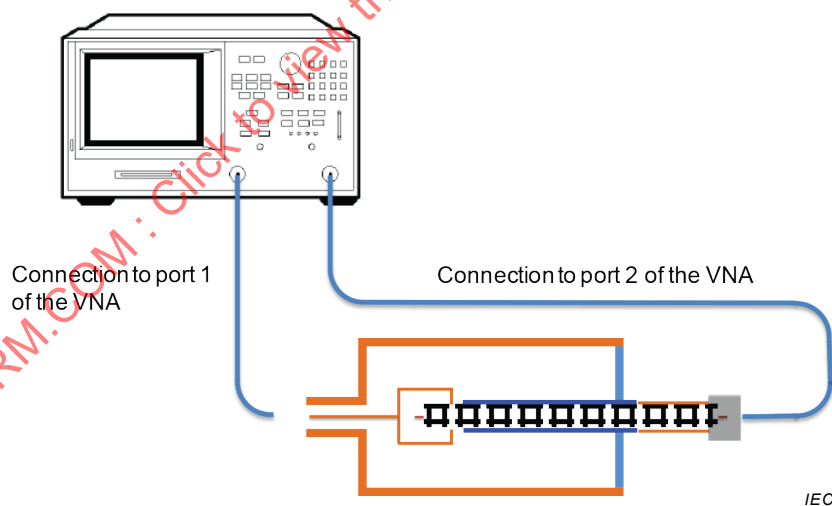


Figure 6 – Connection to the vector network analyzer

5.7 Calibration procedure

The calibration shall be established at the same frequency points at which the measurement of the transfer impedance is done, i.e. in a logarithmic frequency sweep over the whole frequency range, which is specified for the capacitive coupling admittance.

A full two-port calibration – including isolation – shall be established including the connecting cables used to connect the test set-up to the test equipment. The reference planes for the calibration are the connector interface of the connecting cables. Further details on how to perform a full two port calibration are found in the manual of the vector network analyzer.

5.8 Measuring procedure

The outer circuit (tube) of the triaxial set-up shall be connected to port 1 of the VNA. The inner circuit (sample) shall be connected to port 2 of the VNA, see Figure 6. The connection to the VNA shall be done with the same cables as used during the calibration, see 5.6 and 5.7.

The forward transmission scattering parameter S_{21} shall be measured in a logarithmic frequency sweep over the whole frequency range, which is specified for the capacitive coupling admittance and at the same frequency points as for the calibration procedure:

$$a_{\text{meas}} = 20 \log_{10} \left(\frac{\sqrt{P_1}}{\sqrt{P_2}} \right) = -20 \log_{10} (S_{21}) \quad (8)$$

where

P_1 is the fictive unreflected power fed to outer circuit;

P_2 is the power in the inner circuit.

5.9 Evaluation of test results

5.9.1 General

The conversion from the measured attenuation to the capacitive coupling admittance is given by the following formulae:

$$|Y_C| = \frac{1}{Z_0 L_c} 10^{\frac{a_{\text{meas}}}{20}} \quad (9)$$

$$Z_F = Z_1 Z_2 Y_T \quad (10)$$

$$C_T = \frac{|Y_T|}{\omega} \quad (11)$$

where

Y_C is the capacitive coupling admittance;

Z_F is the capacitive coupling impedance;

Z_1 is the impedance of the inner circuit;

Z_2 is the impedance of the outer circuit;

C_T is the coupling capacitance;

Z_0 is the system impedance (in general 50 Ω);

L_c is the coupling length;

a_{meas} is the attenuation measured at the measuring procedure;

ω is the circular frequency.

5.9.2 Test report

~~The test report shall give the test conditions:~~

- ~~— the used method (pulse or bridge);~~
- ~~— the length of the test sample;~~
- ~~— the frequency used to determine the capacitive coupling admittance,~~

~~and record the result of the measurement according to Clause 7 and Clause 8 of this part of IEC 62153.~~

The test report shall conclude if the requirements of the relevant cable specification are met and include:

- a) graph with logarithmic frequency scale of the magnitude (in dB) of the measured forward transmission scattering parameter S_{21} ;
- a) graph with logarithmic frequency scale of the phase (in degree) of the measured forward transmission scattering parameter S_{21} ;
- b) graph with double logarithmic scale of the derived capacitive coupling admittance Y_T ;
- c) graph with double logarithmic scale of the derived capacitive coupling impedance Z_F ;
- d) graph with double logarithmic scale of the derived coupling capacitance C_T ;
- e) value of the impedance and capacitance of the inner and outer circuit;
- f) value of the coupling length.

Bibliography

Optimierte Kabelschirme – Theorie und Messung; DISS. ETH Nr. 9354; Thomas Kley

IECNORM.COM : Click to view the full PDF of IEC 62153-4-8:2018 RLV

IECNORM.COM : Click to view the full PDF of IEC 62153-4-8:2018 RLV

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Metallic cables and other passive components – Test methods –
Part 4-8: Electromagnetic compatibility (EMC) – Capacitive coupling admittance**

**Câbles métalliques et autres composants passifs – Méthodes d'essai –
Partie 4-8: Compatibilité électromagnétique (CEM) – Admittance de couplage
capacitif**

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references.....	5
3 Terms and definitions	5
4 Principle	9
5 Test method	9
5.1 General.....	9
5.2 Cut-off frequency	9
5.3 Test equipment	9
5.4 Coupling length.....	9
5.5 Sample preparation	10
5.6 Test set-up.....	11
5.7 Calibration procedure	12
5.8 Measuring procedure.....	12
5.9 Evaluation of test results	12
5.9.1 General	12
5.9.2 Test report.....	13
Bibliography	14
Figure 1 – Definition of Z_T	6
Figure 2 – Definition of Z_F	7
Figure 3 – Preparation of test sample for coaxial cables	10
Figure 4 – Preparation of test sample for symmetrical cables.....	10
Figure 5 – Triaxial set-up	11
Figure 6 – Connection to the vector network analyzer	11

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**METALLIC CABLES AND OTHER PASSIVE COMPONENTS –
TEST METHODS –****Part 4-8: Electromagnetic compatibility (EMC) –
Capacitive coupling admittance**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62153-4-8 has been prepared by IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

- a) use of the triaxial set-up in a similar manner as for the measurement of the transfer impedance (see IEC 62153-4-3),
- b) use of vector network analyser instead of capacitance bridge or pulse generator.

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

FDIS	Report on voting
46/684/FDIS	46/690/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 of the IEC 62153 series, under the general title: *Metallic cables and other passive components – 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.

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 CABLES AND OTHER PASSIVE COMPONENTS – TEST METHODS –

Part 4-8: Electromagnetic compatibility (EMC) – Capacitive coupling admittance

1 Scope

This part of IEC 62153 specifies a test method for determining the capacitive coupling admittance, the capacitive coupling impedance and the coupling capacitance by the use of a triaxial set-up in a similar manner as for the measurement of the transfer impedance (see IEC 62153-4-3). Most cables have negligible capacitive coupling; however, in the case of cables with loose single-braids, the coupling through the holes in the screen shall be determined by the measurement of the capacitive coupling admittance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 62153-4-3, *Metallic communication cable test methods – Part 4-3: Electromagnetic compatibility (EMC) – Surface transfer impedance – Triaxial method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 screens and the conductor(s) of the test specimen

Note 1 to entry: Quantities relating to the inner circuit are denoted by the subscript “1”. See Figure 1 and Figure 2.

3.2

outer circuit

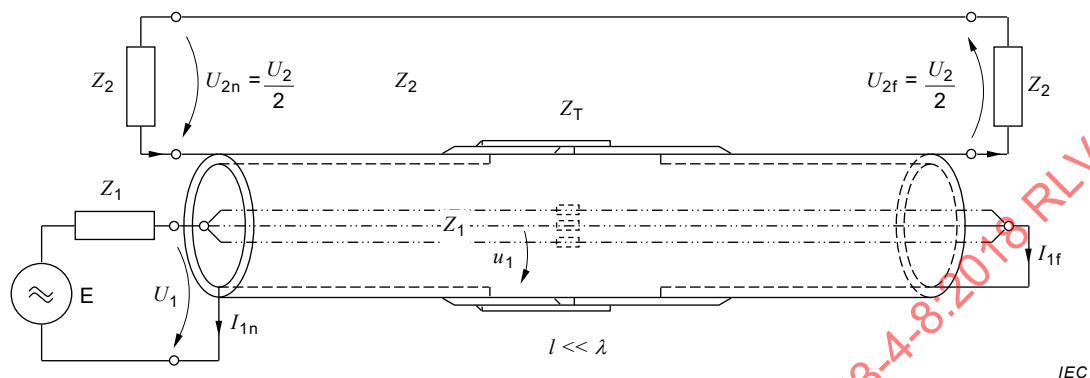
circuit consisting of the screen surface and the inner surface of a surrounding test jig

Note 1 to entry: Quantities relating to the outer circuit are denoted by the subscript “2”. See Figure 1 and Figure 2.

3.3 transfer impedance

Z_T

quotient of the longitudinal voltage induced in the matched outer circuit – formed by the screen under test and the measuring jig – and the current fed into the inner circuit or vice versa (see Figure 1)



Key

- Z_1, Z_2 characteristic impedance of the inner and the outer circuits
- U_1, U_2 voltages in the inner and the outer circuits (n: near end, f: far end)
- I_1 current in the inner circuit (n: near end, f: far end)
- l length of the cable, respectively the length of the screen under test
- λ wavelength in free space

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

where

- Z_T is the transfer impedance;
- U_2 is the voltage in the inner and the outer circuits (n: near end, f: far end);
- I_1 is the current in the inner circuit (n: near end, f: far end).

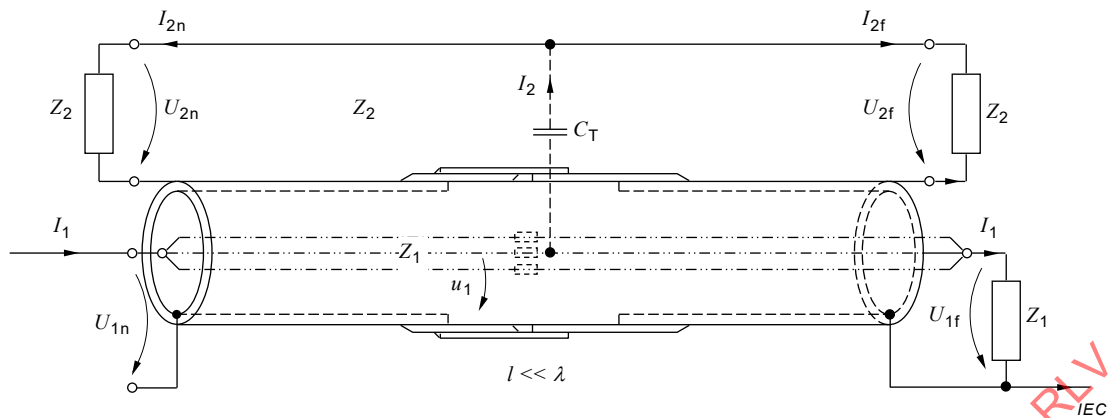
Figure 1 – Definition of Z_T

Note 1 to entry: Transfer impedance is expressed in mΩ/m.

3.4 capacitive coupling impedance

Z_F

quotient of twice the voltage induced to the terminating impedance Z_2 of the matched outer circuit by a current I_1 fed (without returning over the screen) to the inner circuit and the current I_1 or vice versa (see Figure 2)

**Key**

- Z_1, Z_2 characteristic impedance of the inner and the outer circuits
 U_1, U_2 voltages in the inner and the outer circuits (n: near end, f: far end)
 I_1, I_2 current in the inner and the outer circuits (n: near end, f: far end)
 l length of the cable, respectively the length of the screen under test
 λ wavelength in free space

$$I_{2n} = I_{2f}$$

$$U_{1n} = U_{1f}$$

$$I_{2n} = I_{2f} = (1/2) \times I_2 = I_2/2$$

$$I_2 = I_{2n} + I_{2f}$$

$$Z_F = \frac{U_{2n} + U_{2f}}{I_1} = \frac{2U_{2f}}{I_1} = Z_1 Z_2 \times j\omega C_T \quad (2)$$

where

- Z_F is the capacitive coupling impedance;
 Z_1, Z_2 is the characteristic impedance of the inner and the outer circuits;
 U_2 is the voltage in the outer circuit (n: near end, f: far end);
 I_1 is the current in the inner circuit (n: near end, f: far end);
 C_T is the coupling capacitance.

Figure 2 – Definition of Z_F

Note 1 to entry: Capacitive coupling impedance is expressed in mΩ/m.

Note 2 to entry: For multiconductor cables, the inner conductors are shorted together.

Note 3 to entry: The coupling capacitance C_T is dependent on the dielectric permittivity and geometry of the outer circuit, whereas the capacitive coupling impedance is invariant with respect to the geometry of the outer circuit and nearly invariant with respect to the dielectric permittivity.

$$Z_F = Z_1 Z_2 j\omega C_T = j\omega C_T \frac{\sqrt{\epsilon_{r1}}}{C_1 c_0} \frac{\sqrt{\epsilon_{r2}}}{C_2 c_0} \quad (3)$$

where

- Z_F is the capacitive coupling impedance;
 C_T is the coupling capacitance;
 ω is the circular frequency;

- c_0 is the speed of light, 3×10^8 m/s;
 ϵ_{r1} is the relative dielectric permittivity of the inner circuit (CUT);
 ϵ_{r2} is the relative dielectric permittivity of the outer circuit (tube);
 Z_1 is the impedance of the inner circuit (CUT);
 Z_2 is the impedance of the outer circuit (tube);
 C_1 is the capacitance of the inner circuit (CUT);
 C_2 is the capacitance of the outer circuit (tube).

As $C_T \propto \frac{C_1 C_2}{\epsilon_{r1} + \epsilon_{r2}}$ one gets $Z_F \propto \frac{\sqrt{\epsilon_{r1} \epsilon_{r2}}}{\epsilon_{r1} + \epsilon_{r2}}$; and $\frac{\sqrt{\epsilon_{r1} \epsilon_{r2}}}{\epsilon_{r1} + \epsilon_{r2}} \approx 0,5$ for relative dielectric permittivity in the inner and outer circuit in the range from 1 to 3.

3.5 capacitive coupling admittance

Y_C
 quotient of the current induced in the secondary (inner) circuit to the voltage development in the primary (outer) circuit. For electrically short uniform cables

$$Y_C = j\omega C_T \quad (4)$$

3.6 effective transfer impedance

Z_{TE}
 maximum absolute value of the sum or difference of the Z_F and Z_T at every frequency

$$Z_{TE} = \max |Z_F \pm Z_T| \quad (5)$$

Note 1 to entry: The effective transfer impedance is expressed in Ω .

3.7 effective transfer impedance related to a reference impedance of 1 Ω

Z_{TE}
 maximum absolute value of the sum or difference of the Z_F and Z_T at every frequency expressed in dB (Ω)

$$Z_{TE} = +20 \times \log_{10} \left(\frac{|Z_{TE}|}{Z_{T,ref}} \right) \quad (6)$$

where

$Z_{T,ref}$ is the reference transfer impedance with a value of 1 Ω

Note 1 to entry: The effective transfer impedance is expressed in dB (Ω).

3.8 coupling length

L_c
 length of cable which is inside the test jig, i.e. the length of the screen under test

3.9 cut-off frequency

maximum frequency up to which the capacitive coupling admittance can be measured

4 Principle

The test determines the screening effectiveness of a shielded cable by applying a well-defined voltage to the screen of the cable and measuring the induced voltage in a secondary circuit in order to determine the capacitive coupling admittance. This test measures only the electrostatic component of the effective transfer impedance Z_{TE} . To measure the magnetic component (the surface transfer impedance), the method described in IEC 62153-4-3 shall be used.

5 Test method

5.1 General

If not otherwise specified, the measurements shall be carried out at the temperature of $(23 \pm 3) ^\circ\text{C}$.

The test method determines the capacitive coupling admittance of a cable screen by measuring the cable in a triaxial test set-up. A test configuration with an open circuit in the inner and outer circuit shall be used. This emphasizes the capacitive coupling compared to the magnetic coupling and results in a 6 dB higher signal compared to a configuration where the inner circuit is matched.

The test results are valid in a frequency range up to about 25 MHz, see 5.2. The coupling capacitance C_T is independent on the frequency. Therefore for frequencies above the cut-off frequency, the test results of the capacitive coupling admittance can be extrapolated with 20 dB/decade, see 3.5.

5.2 Cut-off frequency

The cut-off frequency length product is roughly:

$$f_{\text{cut}} \times l \approx \frac{1}{\sqrt{\varepsilon_{r1} + \varepsilon_{r2}}} \frac{c_0}{2\pi} \quad (7)$$

where

- l is the coupling length of the cable under test;
- c_0 is the speed of light, $3 \times 10^8 \text{ m/s}$;
- ε_{r1} is the relative dielectric permittivity of the inner circuit (CUT);
- ε_{r2} is the relative dielectric permittivity of the outer circuit (tube).

I.e. for a coupling length of 1 m and dielectric permittivities of 2,3 and 1,1 in the inner respectively outer circuit, the maximum frequency for the measurement of the capacitive coupling admittance is 25 MHz.

Another way to obtain the cut-off frequency is to observe the phase of the capacitive coupling admittance respectively measured forward transmission scattering parameter S_{21} , see 5.8. The cut-off frequency is reached when the phase starts to deviate from 90 degrees.

5.3 Test equipment

The measurement shall be performed using a vector network analyser.

5.4 Coupling length

The coupling length shall be not shorter than 0,5 m and not longer than 1,0 m.

5.5 Sample preparation

The test sample shall have a length not more than 50 % longer than the coupling length.

Coaxial cables are prepared as shown in Figure 3.

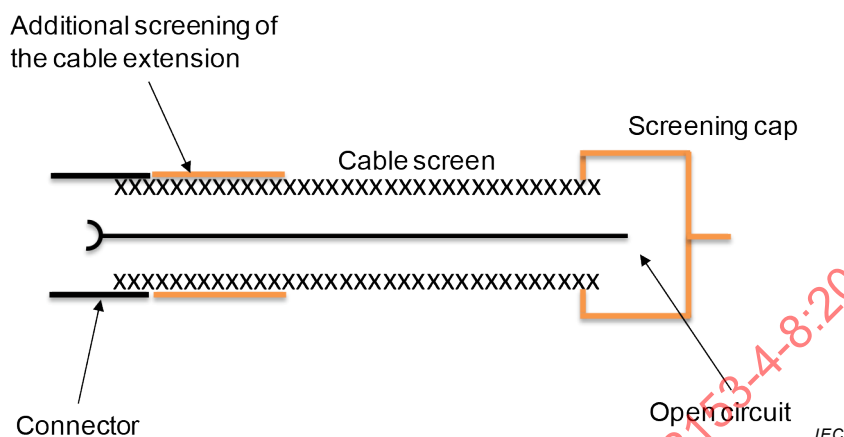


Figure 3 – Preparation of test sample for coaxial cables

One end of the coaxial cable is prepared with a connector to make a connection to the receiver. The other end of the coaxial cable is prepared with a well screened open circuit. The open circuit shall be made in a way resulting in a small stray capacitance. To minimize unwanted coupling into the tube, the exceeding length outside the tube shall be screened with an additional tight screen, which shall be in contact with the cable screen (e.g. by wrapping a metal foil with minimum 20 % overlap around the cable screen).

All connections shall be made RF tight and with low RF-contact resistance so that the impact of the sample preparation is negligible compared to the test results.

Screened symmetrical cables are treated as a quasi coaxial system, see Figure 4. Therefore the conductors of all pairs/quads shall be connected together at both ends. All screens, including those of individually screened pairs/quads, shall be connected together at both ends. The screens shall be connected over the whole circumference.

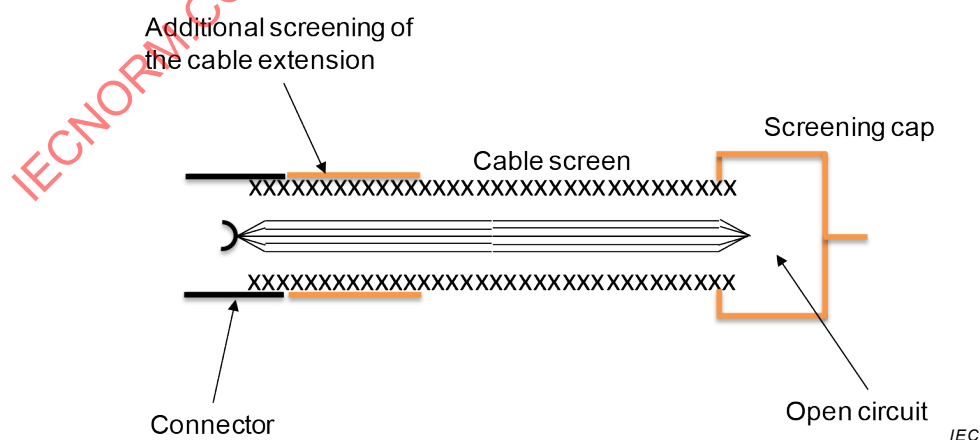
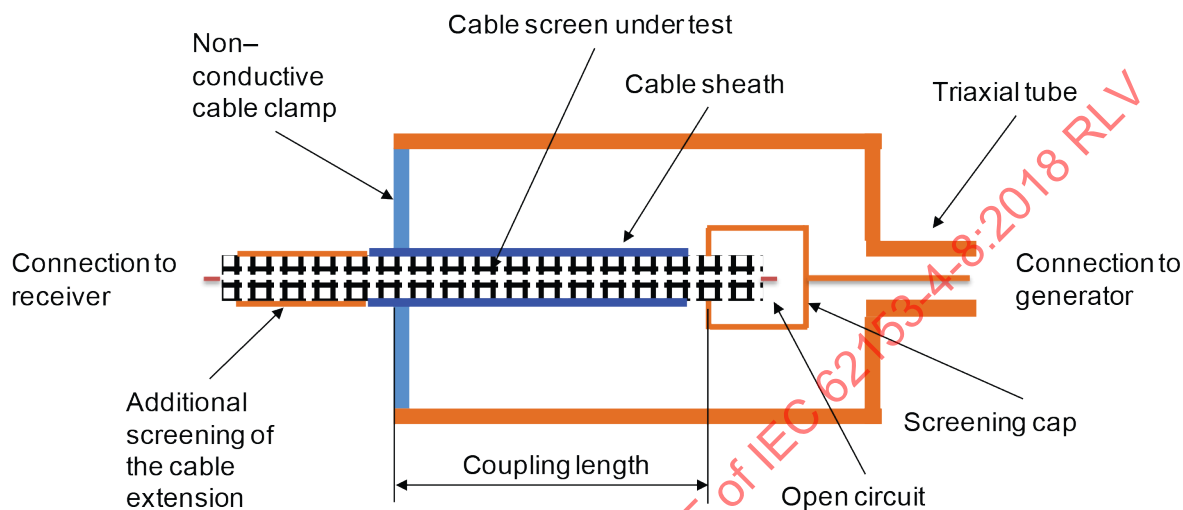


Figure 4 – Preparation of test sample for symmetrical cables

5.6 Test set-up

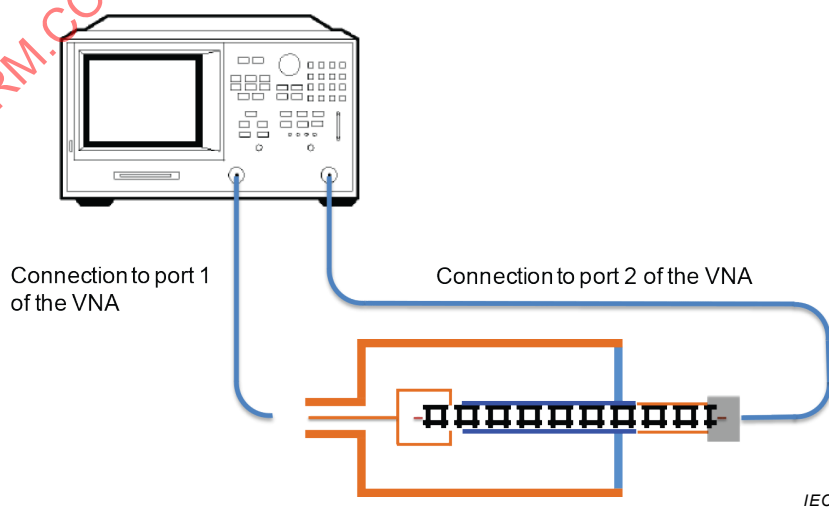
The test sample shall be fitted to the test set-up. The test set-up is an apparatus of a triple coaxial form. The cable screen forms both the outer conductor of the inner circuit and the inner conductor of the outer circuit. The outer conductor of the outer circuit is a well conductive tube of non-ferromagnetic metal (for example brass, copper or aluminium) with an open-circuit to the screen on the receiver side of the cable (see Figure 5). The test sample shall be well centered in the tube.



IEC

Figure 5 – Triaxial set-up

Due to the open circuit in the outer circuit (tube), external disturbers may couple into the tube. Therefore the generator signal is feeding the outer circuit (tube), guaranteeing a high signal to noise ratio. The coupled signal is measured in the inner circuit (cable), see Figure 6. The connection from the triaxial set-up to the vector network analyzer (VNA) shall be done with well screened cables, e.g. double braided cables, having a screening attenuation of minimum 80 dB up to 1 GHz and a transfer impedance of maximum 10 mΩ/m at 100 MHz. The connecting cables shall be as short as possible. The use of ferrites on the connecting cables is recommended in order to suppress resonance effects.



IEC

Figure 6 – Connection to the vector network analyzer

5.7 Calibration procedure

The calibration shall be established at the same frequency points at which the measurement of the transfer impedance is done, i.e. in a logarithmic frequency sweep over the whole frequency range, which is specified for the capacitive coupling admittance.

A full two-port calibration – including isolation – shall be established including the connecting cables used to connect the test set-up to the test equipment. The reference planes for the calibration are the connector interface of the connecting cables. Further details on how to perform a full two port calibration are found in the manual of the vector network analyzer.

5.8 Measuring procedure

The outer circuit (tube) of the triaxial set-up shall be connected to port 1 of the VNA. The inner circuit (sample) shall be connected to port 2 of the VNA, see Figure 6. The connection to the VNA shall be done with the same cables as used during the calibration, see 5.6 and 5.7.

The forward transmission scattering parameter S_{21} shall be measured in a logarithmic frequency sweep over the whole frequency range, which is specified for the capacitive coupling admittance and at the same frequency points as for the calibration procedure:

$$a_{\text{meas}} = 20 \log_{10} \left(\frac{\sqrt{P_1}}{\sqrt{P_2}} \right) = -20 \log_{10} (S_{21}) \quad (8)$$

where

P_1 is the fictive unreflected power fed to outer circuit;

P_2 is the power in the inner circuit.

5.9 Evaluation of test results

5.9.1 General

The conversion from the measured attenuation to the capacitive coupling admittance is given by the following formulae:

$$|Y_C| = \frac{1}{Z_0 \cdot L_c} 10^{\frac{a_{\text{meas}}}{20}} \quad (9)$$

$$Z_F = Z_1 Z_2 Y_T \quad (10)$$

$$C_T = \frac{|Y_T|}{\omega} \quad (11)$$

where

Y_C is the capacitive coupling admittance;

Z_F is the capacitive coupling impedance;

Z_1 is the impedance of the inner circuit;

Z_2 is the impedance of the outer circuit;

C_T is the coupling capacitance;

Z_0 is the system impedance (in general 50 Ω);

L_c is the coupling length;

a_{meas} is the attenuation measured at the measuring procedure;

ω is the circular frequency.

5.9.2 Test report

The test report shall conclude if the requirements of the relevant cable specification are met and include:

- a) graph with logarithmic frequency scale of the magnitude (in dB) of the measured forward transmission scattering parameter S_{21} ;
- b) graph with logarithmic frequency scale of the phase (in degree) of the measured forward transmission scattering parameter S_{21} ;
- c) graph with double logarithmic scale of the derived capacitive coupling admittance Y_T ;
- d) graph with double logarithmic scale of the derived capacitive coupling impedance Z_F ;
- e) graph with double logarithmic scale of the derived coupling capacitance C_T ;
- f) value of the impedance and capacitance of the inner and outer circuit;
- g) value of the coupling length.

IECNORM.COM : Click to view the full PDF of IEC 62153-4-8:2018

Bibliography

Optimierte Kabelschirme – Theorie und Messung; DISS. ETH Nr. 9354; Thomas Kley

IECNORM.COM : Click to view the full PDF of IEC 62153-4-8:2018 RLV

IECNORM.COM : Click to view the full PDF of IEC 62153-4-8:2018 RLV

SOMMAIRE

AVANT-PROPOS.....	17
1 Domaine d'application.....	19
2 Références normatives	19
3 Termes et définitions	19
4 Principe.....	23
5 Méthode d'essai	23
5.1 Généralités	23
5.2 Fréquence de coupure	23
5.3 Matériel d'essai.....	23
5.4 Longueur de couplage.....	24
5.5 Préparation de l'échantillon	24
5.6 Montage d'essai.....	25
5.7 Procédure d'étalonnage	26
5.8 Procédure de mesure	26
5.9 Évaluation des résultats d'essai.....	26
5.9.1 Généralités	26
5.9.2 Rapport d'essai.....	27
Bibliographie	28
Figure 1 – Définition de Z_T	20
Figure 2 – Définition de Z_F	21
Figure 3 – Préparation de l'échantillon d'essai pour les câbles coaxiaux	24
Figure 4 – Préparation de l'échantillon d'essai pour câbles à paires symétriques.....	25
Figure 5 – Montage triaxial.....	25
Figure 6 – Raccordement à l'analyseur de réseau vectoriel.....	26

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**CÂBLES MÉTALLIQUES ET AUTRES COMPOSANTS PASSIFS –
MÉTHODES D'ESSAI –****Partie 4-8: Compatibilité électromagnétique (CEM) –
Admittance de couplage capacitif****AVANT-PROPOS**

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 62153-4-8 a été établie par le comité d'études 46 de l'IEC: Câbles, fils, guides d'ondes, connecteurs, composants passifs pour micro-onde et accessoires.

Cette deuxième édition annule et remplace la première édition parue en 2006. Cette édition constitue une révision technique.

Les futures normes de cette série porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors de la prochaine édition.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) l'utilisation d'un montage triaxial similaire à celui utilisé pour le mesurage de l'impédance de transfert (voir l'IEC 62153-4-3),
- b) l'utilisation d'un analyseur de réseau vectoriel en lieu et place d'un pont capacitif ou d'un générateur d'impulsions.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
46/684/FDIS	46/690/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62153, publiées sous le titre général: *Câbles métalliques et autres composants passifs – Méthodes d'essai*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

CÂBLES MÉTALLIQUES ET AUTRES COMPOSANTS PASSIFS – MÉTHODES D'ESSAI –

Partie 4-8: Compatibilité électromagnétique (CEM) – Admittance de couplage capacitif

1 Domaine d'application

La présente partie de l'IEC 62153 spécifie une méthode d'essai pour la détermination de l'admittance de couplage capacitif, l'impédance de couplage capacitif et la capacité de couplage par l'utilisation d'un montage triaxial similaire à celui utilisé pour le mesurage de l'impédance de transfert (voir l'IEC 62153-4-3). La plupart des câbles présentent un couplage capacitif négligeable. Cependant, dans le cas d'un câble à tressage individuel détendu, le couplage à travers les trous de l'écran doit être déterminé par le mesurage de l'admittance de couplage capacitif.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

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

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

3.1

circuit interne

circuit composé des écrans et du ou des conducteurs de l'éprouvette

Note 1 à l'article: Les grandeurs relatives au circuit interne sont indiquées par l'indice «1». Voir la Figure 1 et la Figure 2.

3.2

circuit externe

circuit composé de la surface de l'écran et de la surface interne d'un montage d'essai enveloppant

Note 1 à l'article: Les grandeurs relatives au circuit externe sont indiquées par l'indice «2». Voir la Figure 1 et la Figure 2.