BS EN 60255-22-5:2011

BSI Standards Publication

Measuring relays and protection equipment

Part 22-5: Electrical disturbance tests — Surge immunity test

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National foreword

This British Standard is the UK implementation of EN 60255-22-5:2011. It is identical to IEC 60255-22-5:2008. It supersedes BS EN 60255-22-5:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/95, Measuring relays and protection systems.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Measuring relays and protection equipment - Part 22-5: Electrical disturbance tests - Surge immunity test

(IEC 60255-22-5:2008)

Relais de mesure et dispositifs de protection -
Partie 22-5: Essais d'influence électrique - Essais d'immunité aux ondes de choc
(CEI 60255-22-5:2008)

Messrelais und Schutzeinrichtungen -
Teil 22-5: Prüfung der elektrischen Störfestigkeit -
Prüfungen der Störfestigkeit gegen Stoßspannungen
(IEC 60255-22-5:2008)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 95/242/FDIS, future edition 2 of IEC 60255-22-5, prepared by IEC TC 95, Measuring relays and protection equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60255-22-5 on 2011-01-02.

This European Standard supersedes EN 60255-22-5:2002.

The main change with respect to EN 60255-22-5:2002 concerns line to earth tests (see Figures 8, 9, 10).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-10-02
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-02

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60255-22-5:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60255-27:2005 NOTE Harmonized as EN 60255-27:2005 (not modified).

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60255-6	1988	Electrical relays - Part 6: Measuring relays and protection equipment	EN 60255-6	1994
IEC 61000-4-5	2005	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006

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CONTENTS

MEASURING RELAYS AND PROTECTION EQUIPMENT –

Part 22-5: Electrical disturbance tests – Surge immunity test

1 Scope and object

This part of IEC 60255 is based on IEC 61000-4-5, referring to that publication where applicable, and specifies the general requirements for surge immunity tests for measuring relays and protection equipment for power system protection, including the control, monitoring and process interface equipment used with those systems.

The objective of the tests is to confirm that the equipment under test will operate correctly when energized and subjected to high-energy disturbances on the power and interconnection lines, caused by surge voltages from switching and lightning effects.

This standard does not intend to test the capability of the insulation to withstand high-voltage stress. The insulation test is covered by IEC 60255-27.

The requirements specified in this standard are applicable to measuring relays and protection equipment in a new condition and all tests specified are type tests only.

The object of this standard is to define:

- terms used;
- test severity levels;
- test equipment;
- test set-up;
- test procedures;
- criteria for acceptance;
- test report requirements.

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 60255-6:1988, *Electrical relays – Part 6: Measuring relays and protection equipment*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

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3 Terms and definitions

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

3.1
equipment under test
EUT
equipment which may be either a measuring relay or a protection equipment

3.2
auxiliary equipment
equipment necessary to provide the EUT with the signals required for normal operation and equipment to verify the performance of the EUT

3.3
communication port
interface with a communication and/or control system, using low energy signals, permanently connected to the EUT

3.4
input port
port through which the EUT is energised or controlled in order to perform its function(s), for example current and voltage transformer, status (binary) inputs, etc.

3.5
interconnection lines
these consist of input/output lines, communication lines and balanced lines

3.6
output port
port through which the EUT produces predetermined changes, for example contact, optocoupler, analogue outputs, etc.

3.7
port
particular interface of the EUT with the external electromagnetic environment (see Figure 1)

3.8
auxiliary power supply port
AC or DC auxiliary energising input of the EUT

3.9
transient
pertaining to or designating a phenomenon or a quantity which varies between two consecutive states during a time interval short compared with the time-scale of interest

[IEV 161-02-01]

3.10
surge
a transient wave of electrical current, voltage or power propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease

[IEV 161-08-11, modified]

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Figure 1 – Ports tested in this standard for measuring relays and protection equipment

4 Test severity level

The test voltages and coupling network for the appropriate ports are shown in Table 1.

Table 1 – Test voltages and source impedances for the EUT ports

Ports under test	Test conditions line to earth			Test conditions line to line [a]		
	Open-circuit test voltage ±10 % kV	Coupling network [c] R Ω	C μF	Open-circuit test voltage ±10 % kV	Coupling network [c] R Ω	C μF
Auxiliary power supply	0,5 1,0 2,0	10	9	0,5 1,0	0	18
Input[a]/output[a]	0,5 1,0 2,0	40	0,5	0,5 1,0	40	0,5
Communication[b]	0,5 1,0	0	0	No test	–	–

[a] No line to line test is advised on input/output ports which, according to the manufacturers functional specification, are always interfacing with twisted pair screened cables.

The application of the surge is to simulate a lightning strike and hence the surge is a short duration high energy pulse. This pulse may cause low impedance high sensitivity circuits, for example current transformers, to produce a start signal when it is applied. If this is the case and the relay has interpreted the pulse correctly as per their design, then the manufacturer shall state any time delays or setting limitations which should be applied to ensure immunity to the surge pulse.

[b] Not applicable for optical fibre communications and EUT communication ports where the specified cable length is less than 10 m as given in the EUT's specification.

[c] Alternative methods of coupling networks are allowed as described in IEC 61000-4-5, for example gas arrestors, where the coupling capacitor would have an effect on the operation of the circuit.

The test procedure shall consider the non-linear current-voltage characteristics of the EUT. Thus, the test voltage has to be increased in the steps specified in Table 1 from the lowest level to the highest, with the criteria for acceptance being met at each level.

The test voltage waveform shall be 1,2/50 μs under open-circuit conditions and the current waveform shall be 8/20 μs under short-circuit conditions.

Unless otherwise stated, no test is advised for ports interfacing with cables whose total length according to the manufacturers documentation is always less than 10 m.

NOTE For more severe environments, a severity level of 4 kV for common mode and 2 kV for differential mode may be agreed between manufacturer and user.

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5 Test equipment

The test equipment is described in IEC 61000-4-5:2005, Clause 6. This includes a description of the test generator, the verification of the characteristics (IEC 61000-4-5:2005, 6.1), and the coupling/decoupling networks (IEC 61000-4-5:2005, 6.3).

NOTE Particular EUTs may not operate correctly with the decoupling inductances as specified in IEC 61000-4-5. In such cases, the use of decoupling inductances less than the specified values is allowed. The exact value of the inductances used during the surge testing should be stated in the test report.

6 Test set-up

6.1 General

The general test set-ups are specified in IEC 61000-4-5:2005, Clause 7.

All auxiliary equipment used to provide the EUT with signals for normal operation, and to verify the correct operation of the EUT, shall be decoupled, so that the test voltage does not affect the auxiliary equipment. These decoupling networks shall also provide sufficient decoupling so that the specified test waveform may be developed only on the lines under test and does not significantly affect the open-circuit voltage or short-circuit current of the test generator.

The connections between the EUT and the test generator shall be less than 2 m, and, except in the case of the testing of the communications port (see Figure 8), connections between the EUT and the coupling/decoupling networks shall also be less than 2 m.

Normally, the EUT shall be individually tested with the EUT placed on an insulating support 0,1 m above the ground reference plane, and all parts of the EUT shall be at least 0,5 m from any metallic obstacles. If the EUT is to be tested on a non-conducting table, normally 0,8 m high, the ground reference plane may be placed on the table.

Where the EUT is exclusively mounted in a cubicle, the tests may be conducted with the EUT in the cubicle. No surge test shall be performed on the interconnecting cables between EUT which are completely within the cubicle, these being regarded as internal cables of the system. The cubicle should be placed on an insulating support, 0,1 m above the ground reference plane. Interconnecting cables greater than 1 m in length belonging to the EUT shall remain on the insulating support.

Specific details for measuring relays and protection equipment are as given below.

6.2 Tests applied to auxiliary power supply port

See Figures 2 and 3 for examples of a typical test set-up. The values for the coupling/decoupling networks are in line with 6.3.1 and 7.2 of IEC 61000-4-5:2005.

6.3 Tests applied to current/voltage transformer inputs

See Figures 4 and 5 for examples of a typical test set-up. The values for the coupling/decoupling networks are in line with 6.3.2 and 7.3 of IEC 61000-4-5:2005.

Synchronization of the application of the surge voltage with any a.c. waveforms on the current or voltage inputs is not required.

6.4 Tests applied to status inputs/output contacts

See Figures 6 and 7 for examples of a typical test set-up. The values for the coupling/decoupling networks are in line with 6.3.2 and 7.3 of IEC 61000-4-5:2005.

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6.5 Tests applied to communications port and other ports using shielded lines

See Figures 8 and 9 for the test set-up for shields grounded at both ends and at one end respectively.

See Figure 10 for the test set-up for testing single and bundled cables in a multi-shield configuration.

This coupling method is useful for multiple shielded cable wiring with multiple ground connections, in order to apply the surge to, either a particular cable or bundle of cables, depending on how they are bundled in an installation.

7 Test procedure

The tests shall be carried out at the reference conditions given in IEC 60255-6.

Time delay settings of the EUT shall be set to their minimum practical values as defined by their intended application.

The tests shall be carried out with auxiliary energizing quantities applied to the appropriate circuits, with values equal to rated conditions. The values of the input energizing quantities shall be within twice the assigned error of the transitional state. For practical reasons, the application of the surge test to the EUT in the transitional or operational state is not considered.

If the rated conditions of the EUT mean that the input energizing quantity is much lower than the relay operational value, the tests shall be performed at the continuous thermal withstand value.

The surges shall be applied line to line(s) and line to earth. When testing line to earth, the test voltage shall be applied successively between each of the lines and earth.

Where a port consists of many identical circuits, such as status inputs or output contacts, it is sufficient to apply the surge test only to three such circuits in order for the criteria for acceptance to be met.

Because of the possibility that the EUT has non-linear current-voltage characteristics, all lower test voltages up to and including the maximum test voltage shall be satisfied as shown in Table 1.

In the case of testing a.c. auxiliary power supply inputs, the surges shall be applied synchronized to the voltage phase at the zero crossing and the peak value of the a.c. voltage wave, both positive and negative.

The number of tests shall be at least five positive and five negative surges at the selected points. The repetition rate shall be a maximum of 1 surge/min.

8 Criteria for acceptance

The test result is positive if the EUT shows its immunity for all the period of the application of the tests, and, after the test has been completed, the EUT shall still comply with the relevant performance specification.

Table 2 lists the important functions that could apply to a measuring relay or protection equipment. These should be monitored during testing.

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Table 2 – Criteria for acceptance

Function	Criteria for acceptance
Protection	Normal performance within the specification limits
Command and control	Normal performance within the specification limits
Measurement	Temporary degradation during test, with self-recovery at the end of the test. No loss of stored data
Integral human-machine interface and visual alarms	Temporary degradation or loss of function during the test, with self-recovery at end of the test. No loss of stored data
Data communication	Possible bit error rate increase but no loss of transmitted data

9 Test report

The test report shall include those items listed in 60255-6 and also the following:

- the identification and configuration of the EUT;
- the test conditions including the repetition rate;
- the type of test facility used and the positions of the EUT, auxiliary equipment and coupling and decoupling devices;
- the type(s) and number of interconnecting wires used and the interface port (of the EUT) to which these are connected;
- the values of the decoupling inductances when these vary from the recommended values;
- the operating conditions of the EUT, for example, relay settings and values of input energizing quantities;
- the test equipment used;
- the test conclusion (pass/fail).

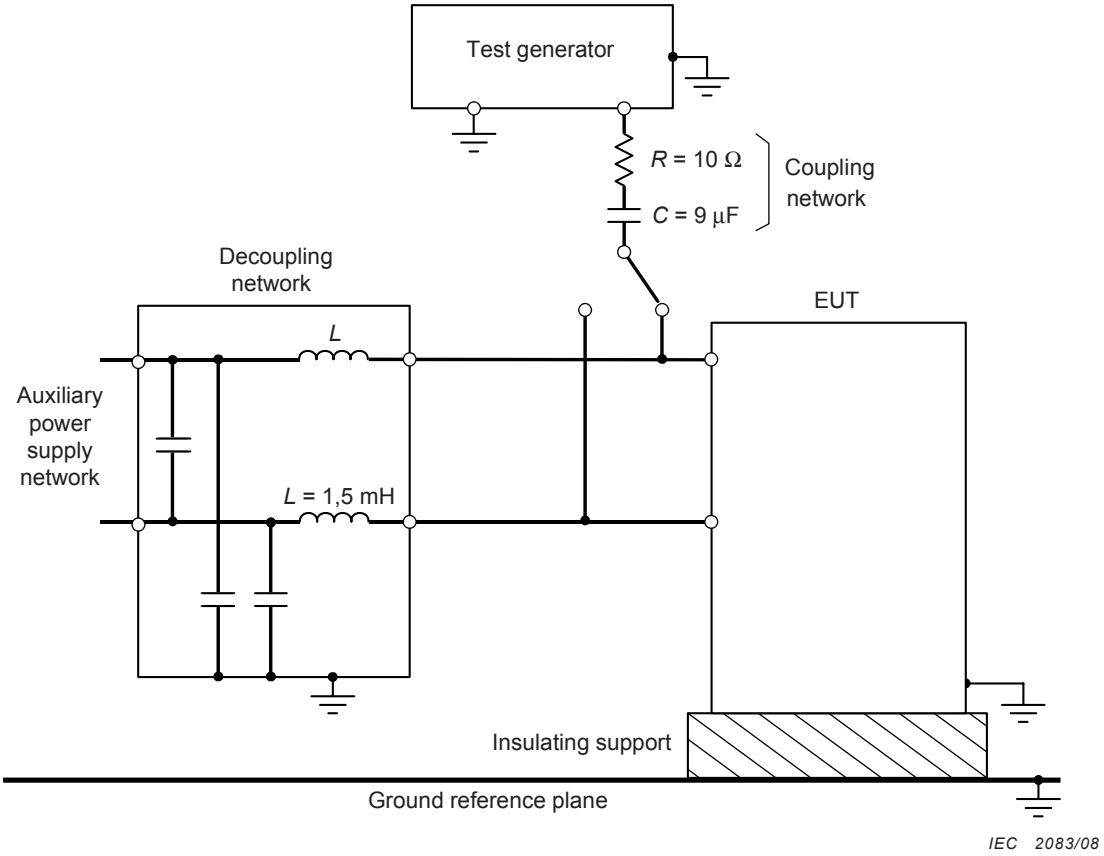


Figure 2 – Line to earth tests applied to the auxiliary power supply port

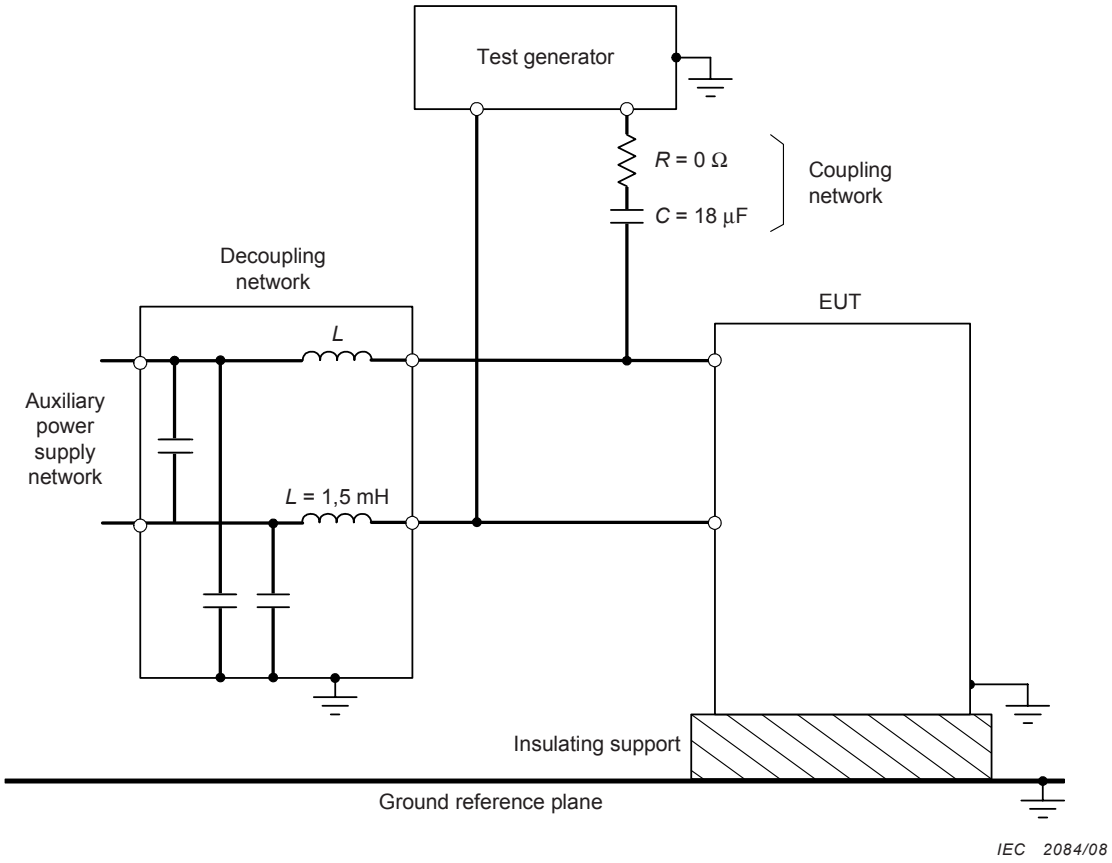


Figure 3 – Line to line tests applied to the auxiliary power supply port

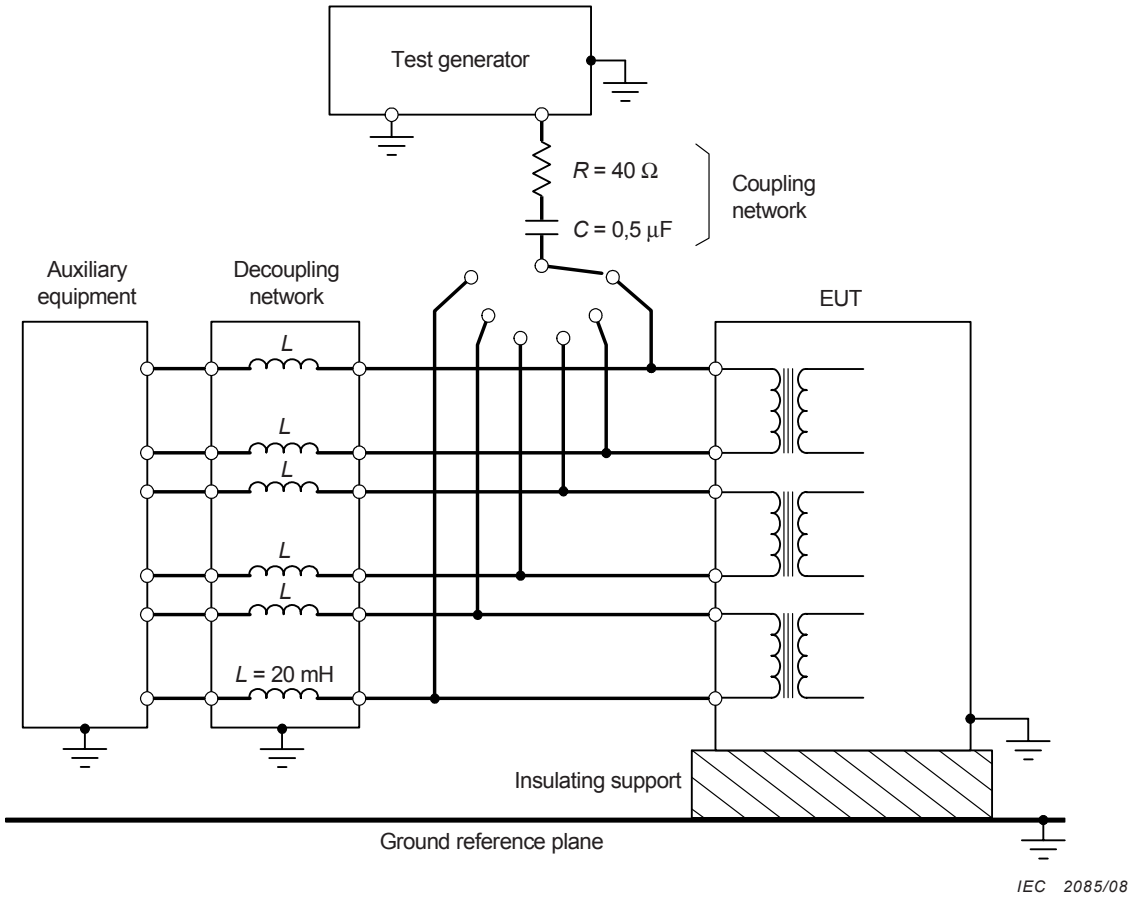


Figure 4 – Line to earth tests applied to current/voltage transformer inputs

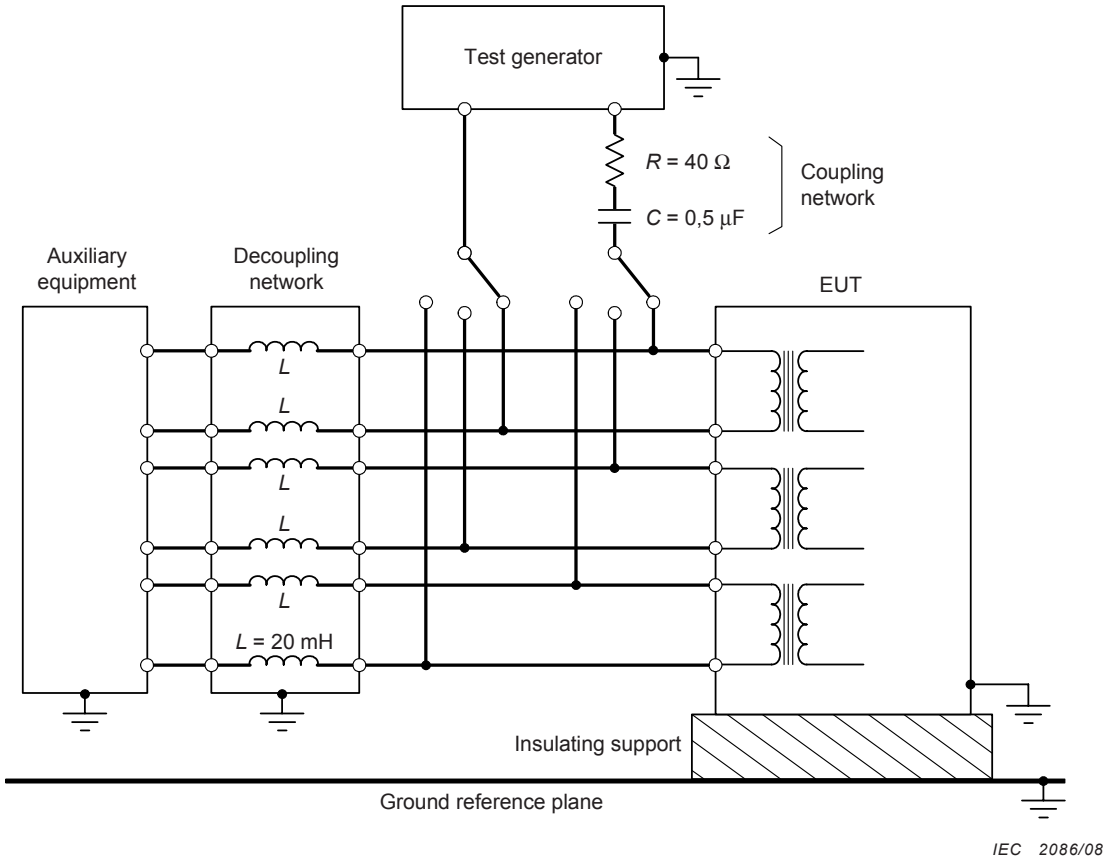


Figure 5 – Line to line tests applied to current/voltage transformer inputs

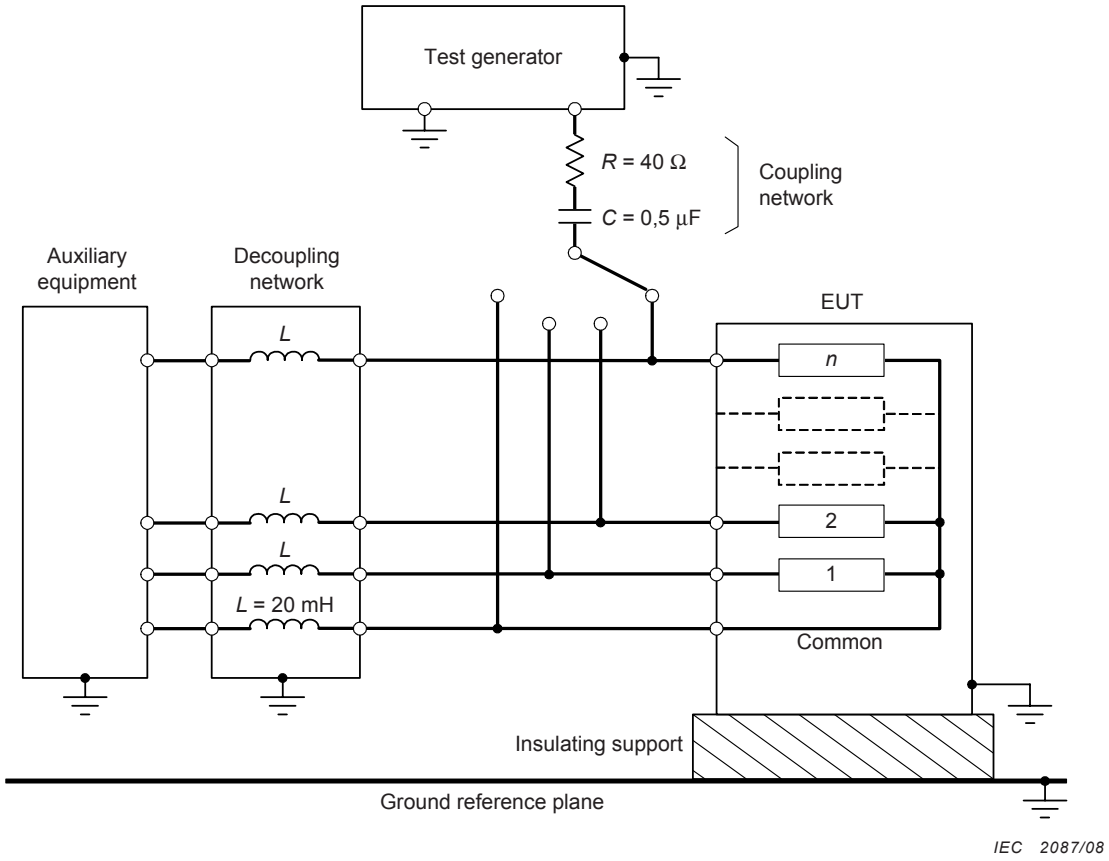


Figure 6 – Line to earth tests applied to status input/output contacts

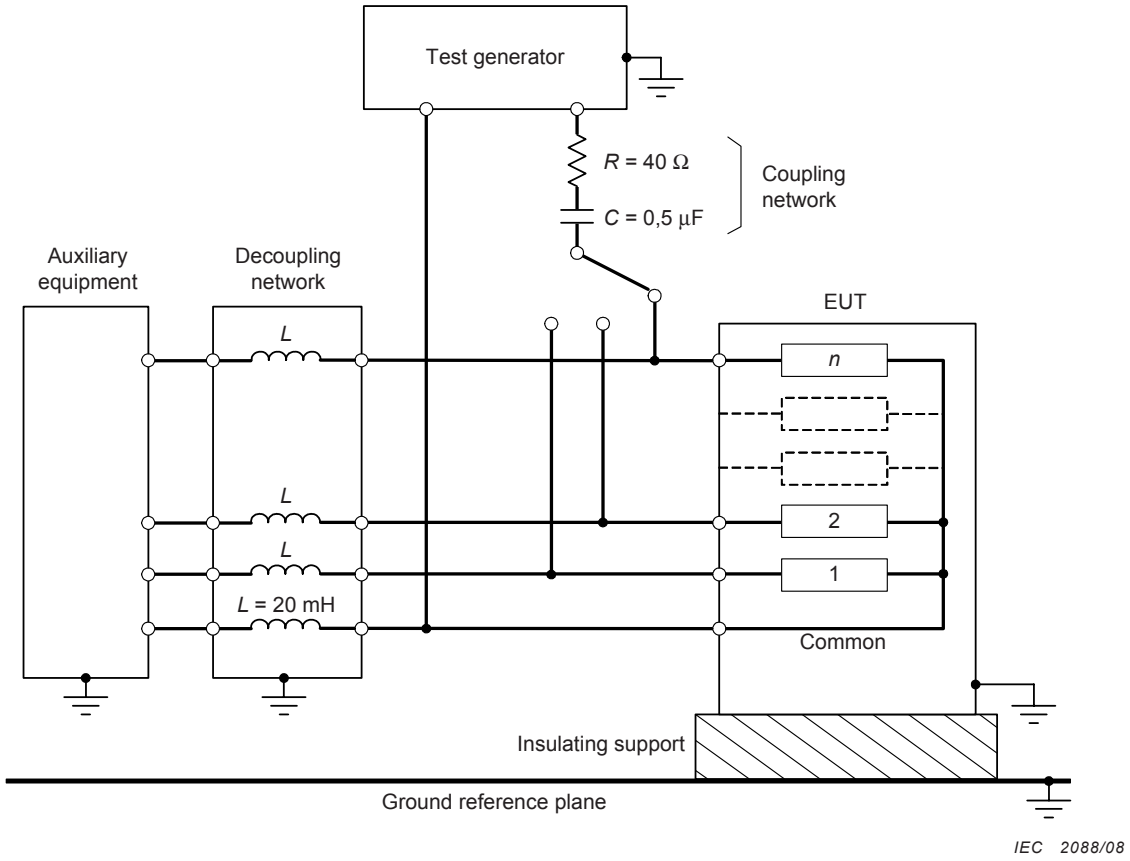


Figure 7 – Line to line tests applied to status input/output contacts

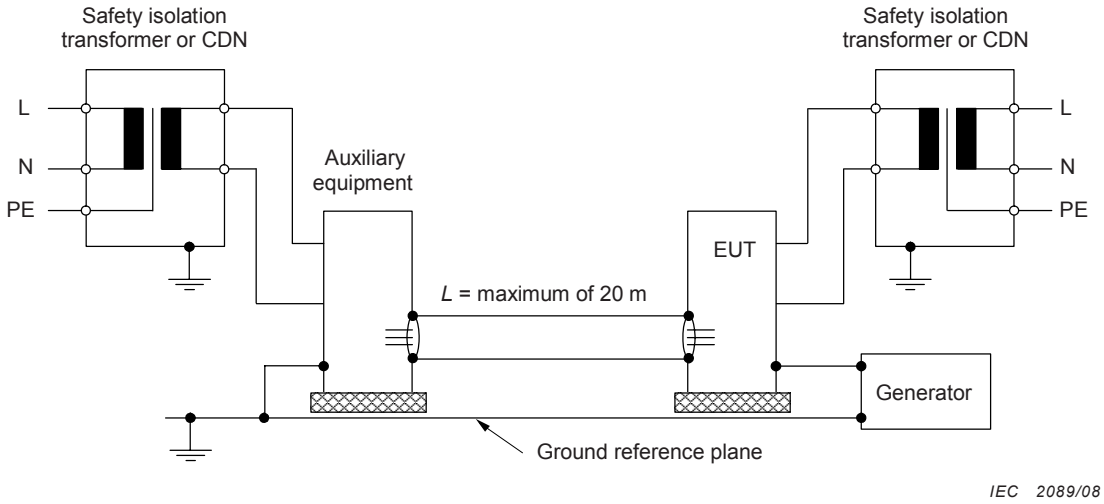


Figure 8 – Line to earth tests applied to communications port and other ports using shielded cables with the shields grounded at both ends

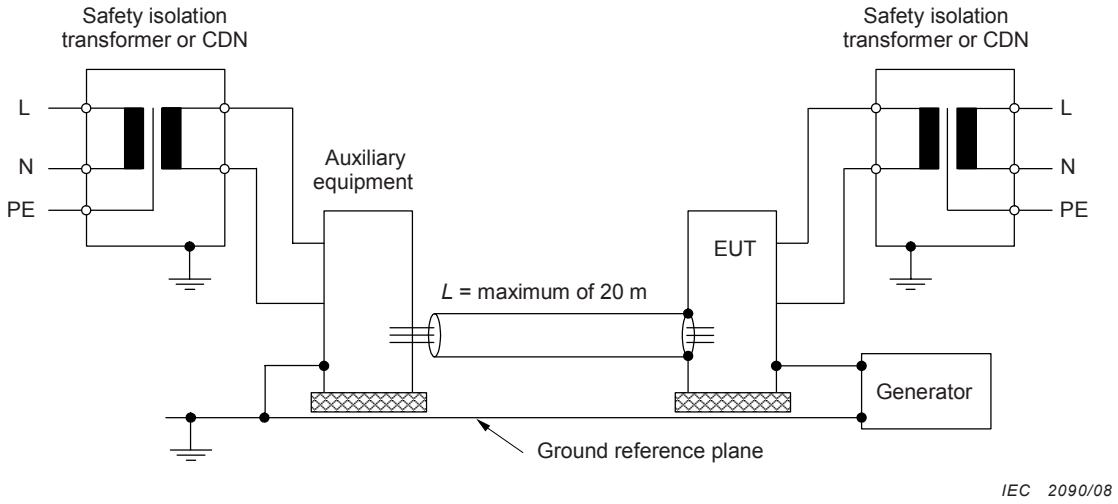
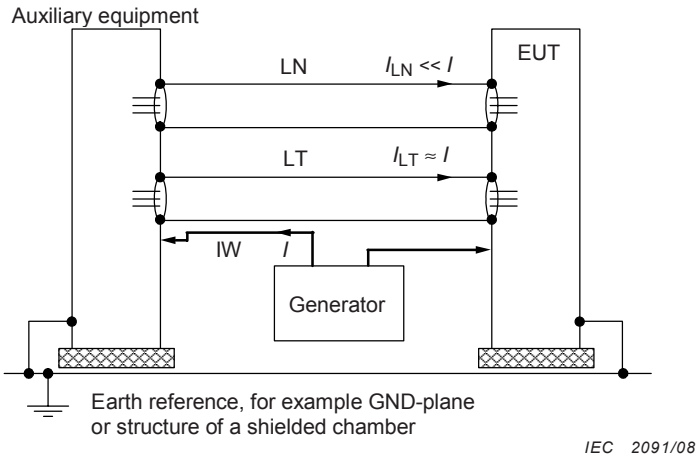


Figure 9 – Line to earth tests applied to communications port and other ports using shielded cables with the shield connected at one end only



Designations:

LT Signal interface line *especially* to be tested

LN Signal interface line *not intended* to be tested

IW Injection wire

NOTE This example of the test set-up also applies to d.c. supplied EUTs.

Characteristics of the test set-up:(auxiliary equipment shall be connected to GND)

The generator is located near the EUT.

"Common" output of the generator is connected to the structure of the EUT.

The impulse output of the generator is routed to the auxiliary equipment via an insulated injection line extremely close to the interface cable between EUT and auxiliary equipment. The cross-section of the injection cable is not critical.

With $I_{LT} \approx I$ and $I_{LN} << I$, the bulk injected current will run over the shield of the cable under test (proximity effect).

The cable lengths shall be chosen according to the installation with a maximum length of 20 m.

The cable to be tested should be kept at least 1 m from ground planes or walls of shielded enclosures.

The cables not being tested should be at least 0,4 m from the cable being tested and from ground planes or walls of shielded enclosures in order to avoid other return paths for the current.

Figure 10 – Line to earth tests applied to single and bundled cables in a multi-shield configuration

Bibliography

IEC 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

IEC 60255-27:2005, *Measuring relays and protection equipment – Part 27: Product safety requirements*

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