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TECHNICAL REPORT

colour inside

Low-voltage surge protective devices – Part 03: SPD testing guide

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LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 03: SPD Testing Guide

FOREWORD

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IEC TR 61643-03 has been prepared by subcommittee 37A: Low-voltage Surge Protective Devices, of IEC technical committee 37: Surge Arrestors. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
37A/XX/DTR	37A/XX/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61643, published under the general title Low-voltage surge protective devices, 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 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- withdrawn,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 document 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.

INTRODUCTION

It has been assumed in the preparation of this document that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

Throughout this document, when the “IEC 61643-x1 series” is mentioned, it refers to all parts of the IEC 61643 series of standards that deal with testing of SPDs, e.g. IEC 61643-01, IEC 61643-11.

This part of the IEC 61643 series addresses correct test execution and accurate interpretation of measurement results and is also intended to further enhance repeatability and comparability throughout different test laboratories and to establish an acceptable accuracy level for the test results obtained.

The new SPD classification T1 SPD, T2 SPD and T3 SPD is relating to the former test class oriented classification Class I tests, Class II tests and Class III tests.

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 03: SPD Testing Guide

1 Scope

This part of IEC 61643, which is a Technical Report, applies to SPD testing in accordance with the IEC 61643-x1 series and for SPD coordination and system level immunity purposes.

It aims to provide guidance and helpful information for correct test execution and accurate interpretation of measurement results. It is also intended to further enhance repeatability and comparability throughout different test laboratories and to establish an acceptable accuracy level for the test results obtained.

The main subjects are:

– Test application
– Test arrangement/setup
– Probe application
– SPD coordination testing
– System level immunity testing

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.

For the purposes of this document the normative references given in IEC 61643-01:— [1] and the following apply.

IEC 61643-01:—, *Low-voltage surge protective devices – Part 01: General requirements and test methods*

IEC 61643-11:—[2], *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 61643-12:2020, *Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power systems – Selection and application principles*

IEC 61643-41:—[3], *Low-voltage surge protective devices – Part 41: Surge protective devices connected to DC low-voltage power systems – Requirements and test methods*

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[1] Under preparation. Stage at the time of publication: IEC/ACDV 61643-01:2023.

[2] Under preparation. Stage at the time of publication: IEC/ACDV 61643-11:2023.

[3] Under preparation. Stage at the time of publication: IEC/ACDV 61643-41:2023.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61543-01:— 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

4 Correspondence between this document and the tests in IEC 61643-x1

Table 1 provides information on which clauses of this document should apply to certain tests from the IEC 61643-x1 series.

Table 1 – Correspondence between this document and the IEC 61643-x1 series

IEC 61643-03 clause reference	Relevance for test clauses in the IEC 61643-x1 series
5 Probe application – residual voltage measurements	9.1.1, Table 3, pass criterion D 9.3.4 measured limiting voltage, 9.3.5 operating duty test, 9.6.5.3 Measurement of voltage rate of rise d*u*/d*t*
6 Insulation resistance and dielectric withstand	9.3.7 Insulation resistance 9.3.8 Dielectric withstand
7 TOV testing	9.3.9 Behaviour under temporary overvoltages (TOVs)
7.1 TOV testing of SPDs for AC power systems	IEC 61643-11:—, 9.3.9.101 TOVs caused by faults in the high (medium) voltage system
7.2 TOV testing of SPDs for DC power systems	IEC 61643-41:—, 9.3.9 Behaviour under temporary overvoltages (TOVs)
8 Test application to SPDs with multiple components	General
Annex A Critical investigation on the impulse current specification for T1 SPDs when testing Metal Oxide Varistors	9.1.2 Impulse discharge current

5 Probe application – residual voltage measurements

5.1 Overview

Residual voltages measurements are very sensitive measurements due to the fact that they are carried out at high frequencies in presence of magnetic fields which may strongly interfere with the results of these measurements to such an extent that different measurements from one measurement to another one, or between different testing entities may not be comparable.

This clause intends to provide guidelines on testing techniques for making correct residual voltages measurements to limit these deviations and discrepancies.

5.2 General

According to the induction law, an alternating magnetic field induces a voltage into a conductor loop. The induced voltage depends on the loop size and the frequency and the amount of magnetic field. The intensity of a magnetic field decreases with increasing distance to its source.

The residual voltage is measured with 8/20 current impulses. The magnetic field generated by this 8/20 current impulse induces a voltage into the loop build up by the voltage measurement lines that are connected to the device under test. This voltage is added to the voltage drop between the two points where the measurement lines are connected to. This induced voltage depends on and is directly proportional to the size of the loop build by the voltage measurement lines and to the peak value of the 8/20 current impulse and may have values of several 10 V up to some kV. The wave shape of the induced voltage follows the derivative di/dt of the 8/20 current impulse and reaches its maximum at the beginning of the 8/20 current impulse. A zero crossing and therefore 0 V occurs at the crest value of the 8/20 current impulse. A typical waveshape of the induced voltage is shown in Figure 1.

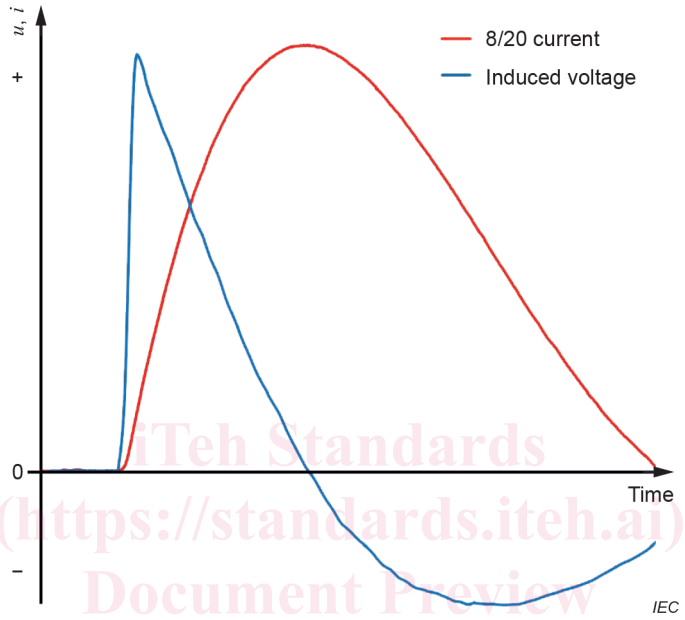


Figure 1 – 8/20 current impulse and induced voltage

In general, the test procedure to measure the residual voltage with 8/20 current impulses requires the connection of the voltage measuring system as close as possible to the SPD. This is caused by the fact that a voltage drop occurs along the length of a conductor when a current flows through. This voltage drop also influences the measured voltage between the two points to which the measurement lines are connected.

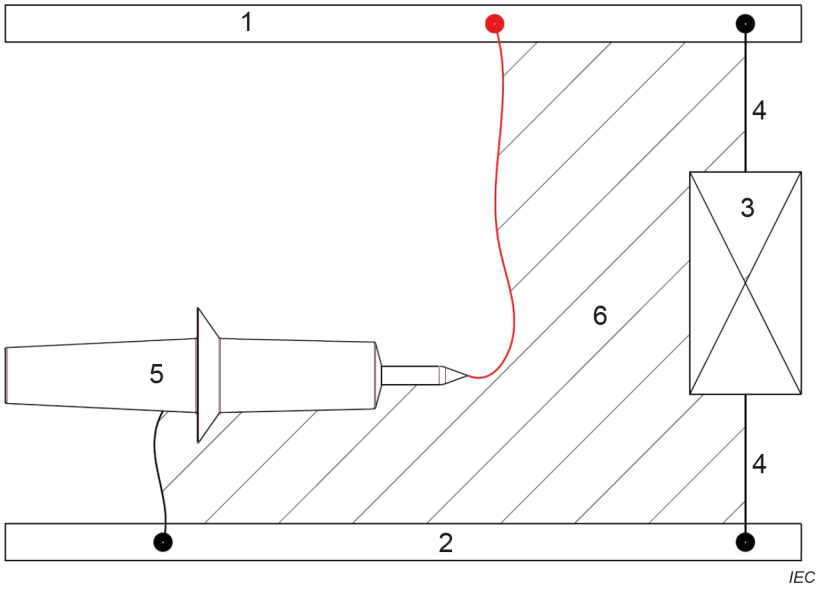
To show the influence of the loop size of the voltage measurement lines and the voltage drop of the conductors to the test sample when the 8/20 current impulse flows, three test arrangements are assumed.

Test arrangement A is given in Figure 2 and shows a large loop size of the voltage measurement lines that are connected far from the test sample.

Test arrangement B is given in Figure 3 and shows a smaller loop size of the voltage measurement lines that are connected directly to the test sample.

Test arrangement C is given in Figure 4 and shows a loop size as small as possible of the voltage measurement lines that are twisted and connected directly to the test sample.

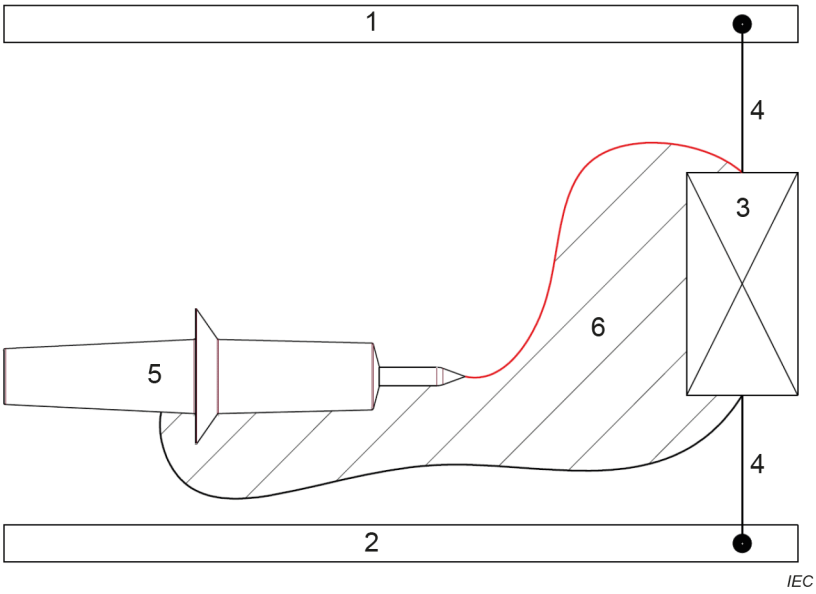
Figure 5 shows the measured voltage time behaviour of the test arrangements A, B and C during 8/20 current application when the device under test is a voltage limiting SPD.



Key

1 HV output connection of impulse current generator
2 Ground connection of impulse current generator
3 Device under test (SPD)
4 Conductor to connect the SPD to the impulse current generator
5 Voltage probe
6 Loop area created by the voltage measurement lines (hash shaded area)

Figure 2 – Test arrangement A



Key

1 HV output connection of impulse current generator
2 Ground connection of impulse current generator
3 Device under test (SPD)
4 Conductor to connect the SPD to the impulse current generator
5 Voltage probe
6 Loop area created by the voltage measurement lines (hash shaded area)

Figure 3 – Test arrangement B