IEC TS 61934

Edition 3.0 2024-01

TECHNICAL SPECIFICATION

colour inside

Electrical insulating materials and systems – Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses



IEC TS 61934:2024-01(en)



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Electrical insulating materials and systems – Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.220.99; 29.035.01; 29.080.30

ISBN 978-2-8322-8116-1

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
4 Measurement of partial discharge pulses during repetitive, short rise-time voltage impulses and comparison with power frequency 9
4.1 Measurement frequency 9
4.2 Measurement quantities 9
4.3 Test objects 10
4.3.1 General 10
4.3.2 Inductive test objects 10
4.3.3 Capacitive test objects 10
4.3.4 Distributed impedance test objects 10
4.4 Voltage impulse generators 10
4.4.1 General 10
4.4.2 Voltage impulse waveforms 11
4.5 Effect of testing conditions 11
4.5.1 General 11
4.5.2 Effect of environmental factors 12
4.5.3 Effect of testing conditions and ageing 12
5 PD detection methods 12
5.1 General 12
5.2 PD pulse coupling and detection devices 12
5.2.1 Introductory remarks 12
5.2.2 Coupling capacitor with multipole filter 13
5.2.3 HFCT with multipole filter 14
5.2.4 Electromagnetic couplers 15
5.2.5 Electromagnetic UHF antennae 15
6 Measuring instruments 16
7 Sensitivity check of the PD measuring equipment and high voltage source generator 16
7.1 General 16
7.2 Test diagram for sensitivity check 16
7.3 PD detection sensitivity check 17
7.4 Background noise check 17
7.5 Detection system and HVIG noise check 17
7.6 Sensitivity report 17
8 Test procedure for increasing and decreasing the repetitive impulse voltage magnitude 18
9 Test report 19
Annex A (informative) Voltage impulse suppression required by the coupling device 20
Annex B (informative) PD pulses extracted from a supply voltage impulse through filtering techniques 22
Annex C (informative) Results of round-robin tests of RPDIV measurement 24
Annex D (informative) Examples of noise levels of practical PD detectors 26

Bibliography 27

Figure 1 – Coupling capacitor with multipole filter 13
Figure 2 – Example of voltage impulse and ideal PD pulse frequency spectra before and after filtering 14
Figure 3 – HFCT between supply and test object with multipole filter 14
Figure 4 – HFCT between test object and earth with multipole filter 15
Figure 5 – Circuit using an electromagnetic coupler (e.g. an antenna) to suppress impulses from the test supply 15
Figure 6 – Circuit using an electromagnetic UHF antenna 16
Figure 7 – Test diagram for sensitivity check 17
Figure 8 – Example of relation between the outputs of LVPG and PD detector 18
Figure 9 – Example of increasing and decreasing the impulse voltage magnitude 19
Figure A.1 – Example of overlap between voltage impulse and PD pulse spectra (dotted area) 20
Figure A.2 – Example of voltage impulse and PD pulse spectra after filtering 20
Figure A.3 – Example of impulse voltage damping as a function of impulse voltage magnitude and rise time 21
Figure B.1 – Power supply waveform and recorded signal using an antenna during supply voltage commutation 22
Figure B.2 – Signal detected by an antenna from the record of Figure B.1, using a filtering technique (400 MHz high-pass filter) 23
Figure B.3 – Characteristic of the filter used to pass from Figure B.1 to Figure B.2 23
Figure C.1 – Sequence of negative voltage impulses used for RRT 24
Figure C.2 – PD pulses corresponding to voltage impulses 25
Figure C.3 – Dependence of normalized RPDIV on 100 data (NRPDIV/100) on relative humidity 25

Table 1 – Example of parameter values of impulse voltage waveform without load 11
Table D.1 – Examples of bandwidths and noise levels for practical PD sensors 26

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL INSULATING MATERIALS AND SYSTEMS – ELECTRICAL MEASUREMENT OF PARTIAL DISCHARGES (PD) UNDER SHORT RISE TIME AND REPETITIVE VOLTAGE IMPULSES

FOREWORD

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IEC TS 61934 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems. It is a Technical Specification.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

a) background information on the progress being made in the field of power electronics including the introduction of wide band gap semiconductor devices has been added to the Introduction;
b) voltage impulse generators; the parameter values of the voltage impulse waveform have been modified to reflect application of wide band gap semiconductor devices.
c) PD detection methods; charge-based measurements are not described in this third edition nor are source-controlled gating techniques to suppress external noise.

d) Since the previous edition in 2011, there have been significant technical advances in this field as evidenced by several hundreds of publications. Consequently, the Bibliography in the 2011 edition has been deleted in this third edition.

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

Draft	Report on voting
112/578/DTS	112/610/RVDTS

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 Specification 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.

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.

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INTRODUCTION

Power electronics has been developed along with both control theory and semiconductor technology. Switching is one of the essential features of power electronics control. For higher efficiency and smoother operation, switching times of devices such as an insulated-gate bipolar transistor (IGBT) tend to be shorter than microseconds. The introduction of wide band gap devices, such as those based on silicon carbide, can result in transients with rise times of the order of a few tens of nanoseconds. Such a short rise time can cause transient overvoltage impulses or surges in systems. When the voltage impulses reach the breakdown strength of an air gap, partial discharge (PD) can occur. In addition, the impulses are repetitive from power electronics modulation such as pulse width modulation (PWM). Since PD can cause degradation of electrical insulation parts in the system, it is one of the most important parameters to be measured.

The first edition of IEC TS 61934 was issued in April 2006. Because of rapid development in this field, the revision activity for the latest information was approved by TC 112 at their Berlin meeting in September 2006. The second edition of IEC TS 61934 was published in 2011. Owing to further advances in this area, a revision of the second edition was commenced formally in 2019 and has resulted in this third edition.

ELECTRICAL INSULATING MATERIALS AND SYSTEMS – ELECTRICAL MEASUREMENT OF PARTIAL DISCHARGES (PD) UNDER SHORT RISE TIME AND REPETITIVE VOLTAGE IMPULSES

1 Scope

This document is applicable to the off-line electrical measurement of partial discharges (PDs) that occur in electrical insulation systems (EISs) when stressed by repetitive voltage impulses generated from power electronics devices.

Typical applications are EISs belonging to apparatus driven by power electronics, such as motors, inductive reactors, wind turbine generators and the power electronics modules themselves.

NOTE Use of this document with specific products can require the application of additional procedures.

Excluded from the scope of this document are

– methods based on optical or ultrasonic PD detection,
– fields of application for PD measurements when stressed by non-repetitive impulse voltages such as lightning impulse or switching impulses from switchgear.

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 60270, *High-voltage test techniques – Partial discharge measurements*

3 Terms and definitions

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

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

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

3.1
repetitive voltage impulse
voltage impulse which is used as test voltage for the evaluation of switching surges from power electronics devices with a carrier or driven frequency

3.2
partial discharge
PD
localized electric discharge that only partially bridges the insulation between conductors and which can or cannot occur adjacent to a conductor

3.3
partial discharge pulse
current pulse in an object under test that results from a partial discharge occurring within the object under test

Note 1 to entry: The pulse is measured using suitable detector circuits, which have been introduced into the test circuit for the purpose of the test.

Note 2 to entry: A detector in accordance with the provisions of this document produces a current or a voltage signal at its output related to the PD pulse at its input.

[SOURCE: IEC 60270, 3.2, modified – “or voltage” has been deleted, the second part of the definition has been included in Note 1 to entry and Note 2 to entry has been revised.]

3.4
RPDIV
repetitive partial discharge inception voltage
minimum peak-to-peak impulse voltage at which more than five PD pulses occur on ten voltage impulses of the same polarity

Note 1 to entry: The RPDIV is a mean value for the specified test time and a test arrangement where the voltage applied to the test object is gradually increased from a value at which no partial discharges can be detected. Further explanation is mentioned in 8.

3.5
RPDEV
repetitive partial discharge extinction voltage
maximum peak-to-peak impulse voltage at which less than five PD pulses occur on ten voltage impulses of the same polarity

Note 1 to entry: The RPDEV is a mean value for a specified test time and a test arrangement where the voltage applied to the test object gradually decreases from a voltage at which PDs have been detected. Further explanation is mentioned in Clause 8.

3.6
impulse voltage polarity
polarity of the applied impulse voltage with respect to earth

3.7
unipolar impulse
repetitive voltage impulse, the polarity of which is either positive or negative

[SOURCE: IEC 62068:2013, 3.11, modified – “repetitive” has been added.]

3.8
bipolar impulse
repetitive voltage impulse, the polarity of which changes from positive to negative or vice versa

3.9
impulse voltage repetition rate
inverse of the average time between successive impulses of the same polarity, whether unipolar or bipolar

3.10
impulse rise time
time for the voltage to rise from 10 % to 90 %

3.11
impulse decay time
time interval between the instants at which the instantaneous value of an impulse decreases from a specified upper value to a specified lower value