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 Impulse generators ............................................................................................................ 10
    4.4.1 General ......................................................................................................................... 10
    4.4.2 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 Charge measurements .............................................................................................. 16
  5.3 Source-controlled gating techniques ................................................................................. 17
6 Measuring instruments ........................................................................................................... 17
7 Sensitivity check of the PD measuring equipment ................................................................. 17
  7.1 General .................................................................................................................................. 17
  7.2 Test diagram for sensitivity check ...................................................................................... 18
  7.3 PD detection sensitivity check ........................................................................................... 18
  7.4 Background noise check .................................................................................................... 19
  7.5 Detection system noise check ........................................................................................... 19
  7.6 Sensitivity report ................................................................................................................... 19
8 Test procedure for increasing and decreasing the repetitive impulse voltage magnitude .............................................................................................................................. 19
9 Test report ................................................................................................................................ 20
Annex A (informative) Voltage impulse suppression required by the coupling device ........... 22
Annex B (informative) PD pulses extracted from a supply voltage impulse through filtering techniques ........ ................................................................................................................................. 24
Annex C (informative) Result of round-robin tests of RPDIV measurement ................................ 26
Annex D (informative) Examples of noise levels of practical PD detectors ................................ 28
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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC/TS 61934, which is a technical specification, has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This second edition cancels and replaces the first edition, published in 2006, and constitutes a technical revision.
The principal changes with regard to the previous edition concern the addition of

- an Introduction that provides some background information on the progress being made in the field of power electronics;
- impulse generators;
- PD detection methods;
- a new informative Annex C covering practical experience obtained from round-robin testing (RRT);
- example of noise levels, as shown in new informative Annex D.

The text of this technical specification is based on the following documents:

<table>
<thead>
<tr>
<th>Enquiry draft</th>
<th>Report on voting</th>
</tr>
</thead>
<tbody>
<tr>
<td>112/163/DTS</td>
<td>112/175/RVC</td>
</tr>
</tbody>
</table>

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- 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.
INTRODUCTION

Power electronics has 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 the latest devices such as insulated-gate bipolar transistor (IGBT) tend to be shorter than microseconds. Such a short rise time may cause transient overvoltage impulses or surges in the systems. When the voltage impulses reach the breakdown strength of an air gap, partial discharge (PD) may occur. In addition, the impulses are repetitive from power electronics modulation such as pulse width modulation (PWM). Since PD may 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 in TC112 at the Berlin meeting in September 2006. In addition to technical and editorial changes, practical experience obtained through round-robin test (RRT) is also presented in Annex C.
1 Scope

IEC/TS 61934, which is a technical specification, is applicable to the off-line electrical measurement of partial discharges (PD) that occur in electrical insulation systems (EIS) when stressed by repetitive voltage impulses generated from electronic power devices.

Typical applications are EIS belonging to apparatus driven by power electronics, such as motors, inductive reactors and windmill generators.

NOTE 1 Use of this technical specification with specific products may require the application of additional procedures.

NOTE 2 The procedures described in this technical specification are emerging technologies. Experience and caution, as well as certain preconditions, are needed to apply it.

Excluded from the scope of this technical specification 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 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 60034 (all parts), Rotating electrical machines

IEC 60270:2000, High-voltage test techniques – Partial discharge measurements