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Safety requirements for power electronic converter  
systems and equipment - Part 1: General

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

<p>See Eesti standard EVS-EN IEC 62477-1:2023 sisaldab Euroopa standardi EN IEC 62477-1:2023 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 20.10.2023.</p> <p>Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.</p>	<p>This Estonian standard EVS-EN IEC 62477-1:2023 consists of the English text of the European standard EN IEC 62477-1:2023.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 20.10.2023.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p>
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**Safety requirements for power electronic converter systems and equipment - Part 1: General  
(IEC 62477-1:2022)**

Exigences de sécurité applicables aux systèmes et matériels électroniques de conversion de puissance -  
Partie 1: Généralités  
(IEC 62477-1:2022)

Sicherheitsanforderungen an Leistungselektronik-Umrichtersysteme und -betriebsmittel - Teil 1: Allgemeines  
(IEC 62477-1:2022)

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## European foreword

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## NORME INTERNATIONALE



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PUBLICATION GROUPEE DE SÉCURITÉ

**Safety requirements for power electronic converter systems and equipment –  
Part 1: General**

**Exigences de sécurité applicables aux systèmes et matériels électroniques de  
conversion de puissance –  
Partie 1: Généralités**



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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



GROUP SAFETY PUBLICATION  
PUBLICATION GROUPEE DE SÉCURITÉ

### **Safety requirements for power electronic converter systems and equipment – Part 1: General**

**Exigences de sécurité applicables aux systèmes et matériels électroniques de  
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Partie 1: Généralités**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY REQUIREMENTS FOR POWER ELECTRONIC  
CONVERTER SYSTEMS AND EQUIPMENT –****Part 1: General****FOREWORD**

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IEC 62477-1 has been prepared by IEC technical committee 22: Power electronic systems and equipment. It is an International Standard.

This document is developed according to the intent of ISO/IEC Guide 51 and IEC Guide 116.

It has the status of a group safety publication in accordance with IEC Guide 104.

This second edition cancels and replaces the first edition published in 2012 and Amendment 1:2016. This edition constitutes a technical revision.

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

- a) PECS emitting or receiving radio waves added in the Scope;
- b) simplification of the concept of DVC As including the voltage-time-zones;

- c) improved consistency of the concept "protection" versus "insulation" according to IEC 61140;
- d) limits for touch current updated and limits for PE conductor currents added;
- e) thin sheet of tape materials reworked and tests added;
- f) inner layers of multi-layer printed wiring boards added;
- g) mechanical hazards updated;
- h) requirements for enclosures updated;
- i) requirements for wiring and connections updated;
- j) polymeric enclosure requirements updated;
- k) requirements for components added;
- l) several test added (e.g. UV, working voltage, SPD, preconditioning);
- m) information and marking requirements updated;
- n) requirements for the contrast of symbols added;
- o) several annexes updated.

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

Draft	Report on voting
22/355/FDIS	22/356/RVD

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 International Standard 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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

A list of all the parts in the IEC 62477 series, published under the general title *Safety requirements for power electronic converter systems and equipment*, can be found on the IEC website.

In this document, terms in *italic* are defined in Clause 3.

NOTE Due to the requirement in ISO/IEC Directive Part 2, the defined term is in singular. In this document, also the plural is in *italic*.

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.**

## INTRODUCTION

This document relates to products that include *power electronic converters*, with a rated *system voltage* not exceeding 1 000 V AC or 1 500 V DC. It specifies requirements to reduce risks of fire, electric shock, thermal, energy and mechanical hazards, except functional safety as defined in IEC 61508 (all parts). The objectives of this document are to establish a common terminology and basis for the safety requirements of products that contain *power electronic converters* across several IEC technical committees.

During the update of the document, feedback from technical committees which used the IEC 62477-1 as reference document has been taken into consideration.

Modifications have been made to 4.4.2 and Annex A considering the safe to touch voltage *DVC As* under normal operating conditions and *single fault conditions*. On request from TCs using this document as a reference document, the determination of *DVC As* has been simplified. The determination of *DVC As* in IEC 62477-1:2012 and IEC 62477-1:2012/AMD1:2016 was developed based on IEC TS 60479-1:2005<sup>1</sup> and IEC TR 60479-5:2007 and in details taking different environmental condition, size of body contact area and body reaction into consideration. This change also included time-voltage zones in Annex A for relevant body reactions, environmental conditions and contact area.

NOTE See IEC 60479-1:2018 for further information about effects of current on human beings and livestock.

This document follows the simplified concepts of the basic safety standard IEC 61140:2016, 5.2.6, considering two situations in Table 2 of this document:

- a) dry and large contact areas;
- b) all other cases.

For the temporary increase of voltage during *single fault conditions*, it was decided to use the more simplified approach to limit the voltage to the maximum voltage of *DVC B* which is also used by other committees.

This document has been developed with the intention

- to be used as a reference document for product committees inside TC 22 in the development of product standards for *power electronic converter systems* and equipment,
- to replace IEC 62103<sup>2</sup> as a product family standard providing minimum requirements for safety aspects of *power electronic converter systems* and equipment in apparatus for which no product standard exists, and

NOTE The scope of IEC 62103 contains reliability and electromagnetic compatibility aspects, which are not covered by this document.

- to be used as a reference document for product committees outside TC 22 in the development of product standards of *power electronic converter systems* and equipment intended renewable energy sources. TC 82, TC 88, TC 105 and TC 114, in particular, have been identified as relevant technical committees at the time of publication.

Technical committees using this document should carefully consider the relevance of each paragraph in this document for the product under consideration and reference, add, replace or modify requirement as relevant. Product specific topics not covered by this document are in the responsibility of the technical committees using this document as reference document.

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<sup>1</sup> This publication has been withdrawn.

<sup>2</sup> This publication has been withdrawn.

This group safety standard will not take precedence over any product specific standard according to IEC Guide 104. IEC Guide 104 provides information about the responsibility of product committees to use group safety standards for the development of their own product standards.

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# SAFETY REQUIREMENTS FOR POWER ELECTRONIC CONVERTER SYSTEMS AND EQUIPMENT –

## Part 1: General

### 1 Scope

This part of IEC 62477 applies to *power electronic converter systems (PECS)*, any specified *accessories*, and their *components* for *electronic power conversion* and electronic power switching, including the means for their control, protection, monitoring and measurement, such as with the main purpose of converting electric power, with rated system *voltages* not exceeding 1 000 V AC or 1 500 V DC.

This document also applies to *PECS* which intentionally emit or receive radio waves for the purpose of radio communication.

This document can also be used as a reference standard for product committees producing product standards for:

- adjustable speed electric power drive systems (PDS);
- standalone uninterruptible power systems (UPS);
- *low voltage* stabilized DC power supplies;
- bidirectional power converters.

For *PECS* and their specified *accessories* for which no product standard exists, this document provides minimum requirements for safety aspects.

This document has the status of a group safety publication in accordance with IEC Guide 104 for *power electronic converter systems* for solar, wind, tidal, wave, fuel cell or similar energy sources.

According to IEC Guide 104, one of the responsibilities of technical committees is, wherever applicable, to make use of basic safety publications and/or group safety publications in the preparation of their product standards.

Guidance for use of this group safety publication for product committees is given in Annex S.

This document

- establishes a common terminology for safety aspects relating to *PECS*,
- establishes minimum requirements for the coordination of safety aspects of interrelated parts within a *PECS*,
- establishes a common basis for minimum safety requirements for the *PECS* portion of products that contain *PECS*,
- specifies requirements to reduce risks of fire, electric shock, thermal, energy and mechanical hazards, during use and operation and, where specifically stated, during service and maintenance, and
- specifies minimum requirements to reduce risks with respect to *PECS* designed as pluggable and *permanently connected equipment*, whether it consists of a system of interconnected units or independent units, subject to installing, operating and maintaining the *PECS* in the manner prescribed by the manufacturer.

This document does not cover

- telecommunications apparatus other than power supplies to such apparatus,
- functional safety aspects as covered by, for example, IEC 61508 (all parts), and
- electrical equipment and systems for railways applications and electric vehicles.

## 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 60050-112, *International Electrotechnical Vocabulary (IEV) – Part 112: Quantities and units* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-113, *International Electrotechnical Vocabulary (IEV) – Part 113: Physics for electrotechnology* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-114, *International Electrotechnical Vocabulary (IEV) – Part 114: Electrochemistry* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-192, *International Electrotechnical Vocabulary (IEV) – Part 192: Dependability* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-426, *International Electrotechnical Vocabulary (IEV) – Part 426: Explosive atmospheres* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-442, *International Electrotechnical Vocabulary (IEV) – Part 442: Electrical accessories* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-551, *International Electrotechnical Vocabulary (IEV) – Part 551: Power electronics* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 60050-601, *International Electrotechnical Vocabulary (IEV) – Part 601: Generation, transmission and distribution of electricity – General* (available at [www.electropedia.org](http://www.electropedia.org))

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### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-112:2010, IEC 60050-113:2011, IEC 60050-114:2014, IEC 60050-426:2020, IEC 60050-151:2001, IEC 60050-161:1990, IEC 60050-192:2015, IEC 60050-441:1984, IEC 60050-442:1998, IEC 60050-551:1998, IEC 60050-601:1985, IEC 60050-826:2004, IEC 60664-1:2020, and the following apply.

Table 1 provides an alphabetical cross-reference listing of terms.

**Table 1 – Alphabetical list of terms**

Term	Term number	Term	Term number	Term	Term number
abnormal operating condition abnormal operation	3.1	fire enclosure	3.29	power semiconductor device	3.57
accessible	3.2	functional insulation	3.30	prospective short-circuit current ( $I_{cp}$ )	3.58
accessory	3.3	hand-held equipment	3.31	protective equipotential bonding	3.59
adjacent circuit	3.4	hazardous live part	3.32	protective impedance	3.60
basic insulation	3.5	installation	3.33	electrically protective screening protective screening	3.61
basic protection	3.6	impulse withstand voltage	3.34	reinforced insulation	3.62
class I equipment	3.7	live part	3.35	restricted access area	3.63
class II equipment	3.8	low voltage (LV)	3.36	routine test	3.64
class III equipment	3.9	mains supply	3.37	sample test	3.65
clearance	3.10	minimum required prospective short-circuit current ( $I_{cp,mr}$ )	3.38	service access area	3.66
commissioning test	3.11	movable equipment	3.39	short-circuit backup protection	3.67
component	3.12	non-mains supply	3.40	short-circuit protective device (SCPD)	3.68