

STN	Fotovoltické energetické systémy Detegovanie a prerušenie jednosmerného oblúka	STN EN IEC 63027 36 4623
------------	---	--

Photovoltaic power systems - DC arc detection and interruption

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 08/23

Obsahuje: EN IEC 63027:2023, IEC 63027:2023

137252



EUROPEAN STANDARD

EN IEC 63027

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2023

ICS 27.160

English Version

**Photovoltaic power systems - DC arc detection and interruption
(IEC 63027:2023)**

Systèmes photovoltaïques - Détection et interruption d'arc
en courant continu
(IEC 63027:2023)

Gleichstrom-Lichtbogenerfassung und -Unterbrechung in
photovoltaischen Energiesystemen
(IEC 63027:2023)

This European Standard was approved by CENELEC on 2023-06-07. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN IEC 63027:2023 (E)**European foreword**

The text of document 82/2112/FDIS, future edition 1 of IEC 63027, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63027:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-03-07
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-06-07

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

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 63027:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 62606:2013 NOTE Approved as EN 62606:2013 (not modified)

IEC 62606:2013/AMD1:2017 NOTE Approved as EN 62606:2013/A1:2017 (not modified)

IEC 62606:2013/AMD2:2022 NOTE Approved as EN 62606:2013/A2:2022 (not modified)¹

¹ Under preparation. Stage at the time of publication: EN 62606:2023/FprA2:2022.

Annex A (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60730-1	2013	Automatic electrical controls - Part 1: General requirements	EN 60730-1	2016
+ A1	2015		+ A1	2019
+ A2	2020		+ A2	2022
IEC 60947-1	2020	Low-voltage switchgear and controlgear - Part 1: General rules	EN IEC 60947-1	2021
IEC 60947-3	2020	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch- disconnectors and fuse-combination units	EN IEC 60947-3	2021
IEC 61508	series	Functional safety of electrical/electronic/programmable electronic safety-related systems	EN 61508	series
IEC 62109-1	2010	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements	-	-
IEC/TS 61836	2016	Solar photovoltaic energy systems - Terms, definitions and symbols	-	-



IEC 63027

Edition 1.0 2023-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Photovoltaic power systems – DC arc detection and interruption

Systemes photovoltaïques – Détection et interruption d'arc en courant continu





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



IEC 63027

Edition 1.0 2023-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Photovoltaic power systems – DC arc detection and interruption

Systèmes photovoltaïques – Détection et interruption d'arc en courant continu

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.160

ISBN 978-2-8322-6743-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 Classification.....	12
4.1 General.....	12
4.2 Protection coverage.....	13
4.3 Method of implementation	13
4.3.1 PCE integrated device (I).....	13
4.3.2 Stand-alone device (S)	14
4.3.3 Distributed detection system (D).....	14
4.4 Functionality	14
4.4.1 AFPE: Detection and interruption capability provided.....	14
4.4.2 AFD: Only detection / no interruption capability provided	14
4.5 Number of monitored strings (S)	14
4.5.1 Single string	14
4.5.2 Parallel string	14
4.6 Number of input ports (I).....	14
4.7 Number of monitored channels (C).....	14
4.7.1 Single channel.....	14
4.7.2 Multi channel	15
4.8 Reconnection method	15
4.8.1 General	15
4.8.2 Manual reconnection	15
4.8.3 Remote manual reconnection	15
4.8.4 Automatic reconnection	15
5 Ratings of AFPEs and AFDs	15
5.1 General.....	15
5.2 PCE integrated AFPEs and AFDs	15
5.2.1 Rated and limiting values.....	15
5.3 Stand-alone AFPEs and AFDs	16
5.3.1 Rated and limiting values.....	16
5.3.2 Utilization category	17
6 Product information	17
6.1 General.....	17
6.2 PCE integrated devices.....	17
6.3 Stand-alone devices	18
6.3.1 Nature of information	18
6.3.2 Marking	18
6.3.3 Instructions for installation, operation and maintenance.....	18
7 Normal service, mounting and transport conditions.....	18
7.1 PCE integrated AFPEs.....	18
7.2 Stand-alone AFPEs.....	18
8 Construction and performance requirements.....	19

8.1	General requirements for PCE integrated AFDs/AFPEs and stand-alone AFDs/AFPEs.....	19
8.1.1	General	19
8.1.2	Construction requirements.....	19
8.1.3	Operation in case of series arc fault event.....	19
8.1.4	Reconnection capability of AFPE	19
8.1.5	Self-test function	20
8.2	PCE integrated AFDs and AFPEs	21
8.3	Stand-alone AFDs and AFPEs	21
9	Tests	21
9.1	General.....	21
9.2	Series arc fault test.....	21
9.2.1	General	21
9.2.2	Arc generator.....	22
9.2.3	DC source	23
9.2.4	Array line impedance network.....	24
9.2.5	Line impedance network	24
9.2.6	Test procedure	25
9.2.7	Arc energy and response time measurement	27
9.2.8	Self-test function	27
9.2.9	Reconnection test.....	28
Annex A	(informative) String and channel examples	29
A.1	General.....	29
A.2	PCE integrated AFDs and AFPEs	29
A.3	Stand-alone AFPEs.....	30
A.4	Distributed AFPEs.....	31
Annex B	(normative) Test setups following different application cases	32
B.1	General.....	32
B.1.1	Overview	32
B.1.2	PV source models.....	33
B.1.3	Flow chart for test selection	34
B.2	Application string inverter	36
B.3	Application micro inverter.....	37
B.4	Application module level DC/DC conversion.....	39
B.4.1	Input setups.....	39
B.4.2	Output setups	42
B.5	Application external combined strings	44
B.5.1	Input setups.....	44
B.5.2	Output setups	45
Annex C	(informative) Application examples	47
C.1	General.....	47
C.2	Example 1: String inverter with integrated AFPE (F-I-AFPE)	47
C.3	Example 2: Module level inverter with integrated AFPE (F-I-AFPE).....	48
C.4	Example 3: External AFPE (P-S-AFPE).....	49
C.5	Example 4: Module level DC-DC converter system with AFPE integrated (F-I-AFPE)	52
C.6	Example 5: String inverter with multiple Inputs (F-I-AFPE)	55
C.7	Example 6: String inverter with multiple Inputs (F-I-AFPE)	57
C.8	Example 7: String inverter with multiple Inputs (F-I-AFPE)	59

Annex D (informative) Cross reference application and test setup.....	64
Bibliography.....	65
Figure 1 – Schematic of the arc generator	22
Figure 2 – Dimensions of arc generator electrodes	23
Figure 3 – DC source decoupling network.....	24
Figure 4 – Array line impedance network	24
Figure 5 – Line impedance network.....	24
Figure 6 – Limitation input current.....	26
Figure A.1 – Schematic of string setting of PCE integrated AFDs and AFPEs	29
Figure A.2 – Schematic of parallel setting of PCE integrated AFDs and AFPEs.....	29
Figure A.3 – Schematic of string setting of stand-alone AFPEs	30
Figure A.4 – Schematic of parallel setting of stand-alone AFPEs	30
Figure A.5 – Schematic of single string, single channel distributed AFPEs.....	31
Figure A.6 – Schematic of single string, single channel (Inverter integrated AFD and controller)	31
Figure B.1 – PV source model	33
Figure B.2 – Flow chart to select applicable test cases	35
Figure B.3 – Single string test setup (tests 1, 2, 4).....	36
Figure B.4 – Parallel string test setup (tests 1 and 2).....	36
Figure B.5 – Parallel string test setup (tests 3 and 5).....	36
Figure B.6 – Single string test setup (tests 1 and 2).....	37
Figure B.7 – Single string test setup (tests 1 and 2) – series modules.....	37
Figure B.8 – Parallel string test setup (tests 1 and 2).....	37
Figure B.9 – Parallel string test setup (tests 1 and 2) – series modules.....	38
Figure B.10 – Parallel string test setup (tests 3 and 5).....	38
Figure B.11 – Single string test setup (tests 1, 2, 4).....	39
Figure B.12 – Single string test setup (tests 1, 2, 4) – series modules	39
Figure B.13 – Parallel string test setup (tests 1 and 2).....	40
Figure B.14 – Parallel string test setup (tests 1 and 2).....	41
Figure B.15 – Parallel string test setup (tests 3 and 5).....	42
Figure B.16 – Single string test setup (tests 1, 2, 4).....	42
Figure B.17 – Parallel string test setup (tests 1 and 2).....	43
Figure B.18 – Parallel string test setup (tests 3 and 5).....	43
Figure B.19 – Single string test setup (tests 1, 2, 4).....	44
Figure B.20 – Parallel string test setup (tests 1 and 2).....	44
Figure B.21 – Parallel string test setup (tests 3 and 5).....	45
Figure B.22 – Single string test setup (test 1 and 2).....	45
Figure B.23 – Parallel string test setup (tests 3 and 5).....	46
Figure C.1 – Example of a string inverter with single input	47
Figure C.2 – Example of a module level inverter with single input	48
Figure C.3 – Example of an external AFPE with multiple input ports	50
Figure C.4 – Example of a module level DC-DC converter system	52

Figure C.5 – Example of a string inverter with multiple input ports	55
Figure C.6 – Example string inverter with multiple inputs	58
Figure C.7 – Example string inverter with different channel classification	60
Table 1 – Classification of protection coverage	13
Table 2 – Combined classification of AFPEs and AFDs	17
Table 3 – Marking and documentation requirements	17
Table 4 – Requirements for documentation, marking and position of marking	18
Table 5 – Arcing test conditions	25
Table B.1 – General LRC component parameters	33
Table B.2 – LCR component parameters for different module configurations	34
Table C.1 – Overview tests F-I-AFPE string inverter	48
Table C.2 – Overview tests F-I-AFPE module level inverter	49
Table C.3 – Overview tests P-S-AFPE stand-alone AFPE	51
Table C.4 – Overview tests F-I-AFPE	55
Table C.5 – Overview tests F-I-AFPE	57
Table C.6 – Overview tests F-I-AFPE	59
Table C.7 – Overview tests F-I-AFPE	63
Table D.1 – Cross reference application and test setup	64

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC POWER SYSTEMS –
DC ARC DETECTION AND INTERRUPTION**

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.

IEC 63027 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

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

Draft	Report on voting
82/2112/FDIS	82/2133/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. 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.

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

This document provides requirements and testing procedures for arc-fault protection devices used in PV systems to reduce the risk of igniting an electrical fire.

A PV system contains a number of distributed DC sources (PV modules) and circuits. In AC systems series arc durations are limited by the alternating current crossing through zero ampere twice per cycle. In DC systems the arcing current may be constant and longer arc durations are expected. In contrast to a centralized power supply, where in case of a fault the circuit is disconnected at the connection to the supply, a PV system is made up of distributed power supplies which cannot disconnect circuits in a single location. For extinguishing series arcs, however, the location of the arc within the circuit is irrelevant as long as the current is interrupted. This arc fault protection may be located inside the inverter, on array circuits, subarray circuits, string circuits, or at the module level. Therefore, this document provides a range of test setups to cover the expected system topologies.

In PV systems earth fault protection is required according to the IEC installation standards. Moreover, single core cables with double or reinforced insulation are required (except ELV systems). Consequently, the risk of parallel arcs is quite low because in most cases an earth fault occurs first. As such, this document does not address requirements or testing for parallel arc detection. The larger risk for PV systems comes from series arcs, therefore the focus of this document is to provide requirements and tests for arc fault protection equipment to ensure that most series arcs in a PV system will be detected.

Many arc fault detectors detect arcs by analyzing and comparing the arc's HF signal emission. These devices may trip due to external disturbances from other equipment connected to the PV array, e.g. the inverter. Therefore, interoperability needs to be evaluated. Other external influences such as radio signals, sparks from trams, and load switching, among others, may also cause nuisance tripping. These causes are a performance issue and therefore not addressed by this document.

Arc fault detectors for PV systems have been introduced as a requirement in the USA since the 2011 U.S. National Electrical Code was published. This led to the development of a PV arc-fault protection product standard, UL 1699B. Experience derived from these documents and their application in the USA has been used as a basis for this document. This document was written in parallel to the maintenance of UL 1699B. Both writing teams considered the work of each other and aligned requirements as much as possible, including the dimensions of the electrodes.

Arc fault detectors have been mandatory for many years in the USA for certain AC installations. Within the IEC, arc fault detectors required according to IEC 62606 have been introduced for certain locations for AC circuits. For PV circuits there was no IEC product standard available. This document therefore now provides test procedures for PV system arc fault detectors, where required by installation standards.

This document was written for the special needs and characteristics of PV systems. The unique aspects of PV DC sources (group of distributed sources, current behavior, dependency to irradiance, system impedance, etc.) differ considerably from other DC sources and applications. Therefore, this PV specific standard was necessary, and equipment compliant to this document is not suitable for other DC sources and applications.

PHOTOVOLTAIC POWER SYSTEMS – DC ARC DETECTION AND INTERRUPTION

1 Scope

This document applies to equipment used for the detection and optionally the interruption of electric DC arcs in photovoltaic (PV) system circuits. The document covers test procedures for the detection of series arcs within PV circuits, and the response times of equipment employed to interrupt the arcs.

The document defines reference scenarios according to which the testing is conducted. This document covers equipment connected to systems not exceeding a maximum PV source circuit voltage of 1 500 V DC.

The detection of parallel circuit arcs is not covered in this document. This document is not applicable to DC sources or applications other than PV DC sources.

NOTE Parallel arc detection may be considered for a future edition.

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 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*
IEC 60730-1:2013/AMD1:2015
IEC 60730-1:2013/AMD2:2020

IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-3:2020, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC TS 61836:2016, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC 62109-1:2010, *Safety of power converters for use in photovoltaic power systems – Part 1: General requirements*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN