

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Photovoltaic (PV) arrays – Earth fault protection equipment – Safety and safety-related functionality**

**Groupes photovoltaïques (PV) – Matériel de protection contre les défauts à la terre – Sécurité et fonctionnalités relatives à la sécurité**



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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 27.160

ISBN 978-2-8322-9872-5

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC (PV) ARRAYS –  
EARTH FAULT PROTECTION EQUIPMENT –  
SAFETY AND SAFETY-RELATED FUNCTIONALITY**

## FOREWORD

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FDIS	Report on voting
82/1885/FDIS	82/1903/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).

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## INTRODUCTION

This document specifies the safety requirements that are applicable to Photovoltaic Earth-Fault Protection (PV-EFP) equipment (PV-EFPE) whose function is to detect, interrupt, and warn PV system operators of earth faults in solar photovoltaic arrays. A stand-alone standard on this topic is deemed necessary and appropriate because PV-EFPE may be designed as stand-alone equipment or may be integrated into other equipment such as PV inverters, charge controllers, combiner boxes, etc. Therefore it is not appropriate to continue the current standardization approach in which the PV-EFPE requirements are located only in an end-product standard specific to inverters: IEC 62109-2:2011. It is intended that in coordination with the publication of this document, IEC 62109-2 will be revised to refer to this document and to remove overlapping and conflicting requirements. With this approach, the PV-EFPE requirements will be more visible and will be usable for PV-EFPE that is not part of an inverter.

It is also desirable that in coordination with the publication of this document, the applicable IEC system and installation standards for PV arrays will be amended to refer to this document, to specify required functions and to remove overlapping and conflicting requirements. This work will be managed by TC82 for IEC 62548 and jointly by TC82 and TC64 through JWG32 for IEC 60364-7-712.

The appropriate functions, settings, responses, and timing for PV-EFP functions are dependent on the size and topology of the overall PV system. These array details are not known at the time the PV-EFPE is being evaluated to this product standard; therefore the required PV-EFP functions and settings need to be provided by local and international system and installation standards. As a result, this document does not require all PV-EFPE to implement all possible functions, and does not generally contain the required settings for the functions. The functions, settings, and ranges of adjustment that are claimed by the equipment manufacturer are tested and evaluated, and the documentation for the installer and user specifies what functions are and are not provided.

As well as requirements for the PV-EFP functions, this document includes product safety requirements covering the construction, environmental suitability, markings, documentation, and testing of the equipment. Since PV-EFPE is related to, and often integral to, PV power conversion equipment, references are made to product safety requirements in IEC 62109-1. However, those requirements may overlap or conflict with existing IEC standards for certain types of equipment related to PV-EFP (for example insulation monitoring devices and residual current monitoring equipment). Therefore, for some aspects, this document provides options for equipment to comply with those standards, where such standards exist.

NOTE Further information on the intent of this document and special aspects of PV earth faults are summarized in the (informative) Annex F.

# PHOTOVOLTAIC (PV) ARRAYS – EARTH FAULT PROTECTION EQUIPMENT – SAFETY AND SAFETY-RELATED FUNCTIONALITY

## 1 Scope

This document is applicable to low voltage Photovoltaic Earth-Fault Protection Equipment (PV-EFPE) whose function is to detect, interrupt, and warn system operators of earth faults in solar photovoltaic arrays.

NOTE 1 In the context of this document, the PV array may include connected wiring and equipment. The required coverage of the monitoring and protection is defined in PV installation codes and standards, including aspects such as whether or not the coverage is required to include battery circuits, the DC outputs of DC-DC converters, etc.

NOTE 2 The IEC definition of low voltage is 1 000 V or less for AC systems and 1 500 V or less for DC systems. PV-EFPE may be stand-alone or integrated into other equipment such as PV power conversion equipment, a PV combiner, etc.

This document specifies:

- the types and levels of the monitoring and protection functions that may be provided;
- the nature and timing of responses to earth faults;
- test methods for validating the monitoring and protection functions provided;
- requirements for functional safety and fault tolerance;
- requirements for product safety including construction, environmental suitability, markings, documentation, and 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.

IEC 60269-6, *Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems*

IEC 60417, *Graphical symbols for use on equipment – 12-month subscription to regularly updated online database comprising all graphical symbols published in IEC 60417*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*

IEC 60730-1:2013/AMD1:2015

IEC 60730-1:2013/AMD2:2020

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-2:2016/AMD1:2019

IEC 61008-1:2010, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61008-1:2010/AMD1:2012

IEC 61008-1:2010/AMD2:2013