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Low-voltage switchgear and controlgear assemblies -
Part 8: Assemblies for use in photovoltaic installations

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC 61439-8 has been prepared by subcommittee 121B: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage. It is an International Standard.

This first edition will replace Annex DD, Annex EE and Annex FF from IEC 61439-2 edition 3 published in 2020 to create IEC 61439-8 as a standalone document. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous Annex DD in IEC 61439-2:2020:

a) the scope has been modified to further define the characteristics of PVA;
b) addition of several definitions of different type of boxes and other technical terms;
c) consideration of IP code according to the different applications of PVA;

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

Draft	Report on voting
121B/224/FDIS	121B/227/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.

A list of all parts of the IEC 61439 series, under the general title *Low-voltage switchgear and controlgear assemblies* can be found on the IEC website.

This document is to be read in conjunction with IEC 61439-1:2020. The provisions of the general rules dealt with in IEC 61439-1 are only applicable to this document insofar as they are specifically cited. When this document states "addition", "modification" or "replacement", the relevant text in IEC 61439-1 is to be adapted accordingly.

Subclauses that are numbered with a 101 (102, 103, etc.) suffix are additional to the same subclause in IEC 61439-1.

Tables and figures in this document that are new are numbered starting with 101.

Annexes in this document are lettered AA, BB, etc.

In this document, general terms and definitions are defined in Subclause 3.1.

In this document, the term Photovoltaic Assembly (PVA) is defined in 3.1.101.

NOTE Throughout the IEC 61439 series of standards, the term assembly (see IEC 61439-1:2020, 3.1.1) is used for a low-voltage switchgear and controlgear assembly.

The reader's attention is drawn to the fact that Annex EE lists all the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

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, or
– revised.

INTRODUCTION

The photovoltaic technology enables electricity to be produced directly from sunlight, which is a source of renewable energy. Photovoltaic (PV) energy is one of the most promising technologies meeting the pressing need for green renewable energy and is a part of the answer to the challenge of sustainable development. Pushed by sustainable energy policies, extensive country engagement, technology development, and cost reduction, the number of photovoltaic (PV) installations according to IEC 60364-7-712 is increasing rapidly.

PV installations are usually split into two main categories:

– large scale-utility PV installations, where electricity production can be stored or exported to the grid.

– small PV installations, for example rooftop installation, where the produced energy can be consumed locally or exported to the grid.

PV applications have characteristics that require assemblies with specific performance. A typical arrangement of a PV installation is shown in Figure 101. Further examples are provided in Annex FF.

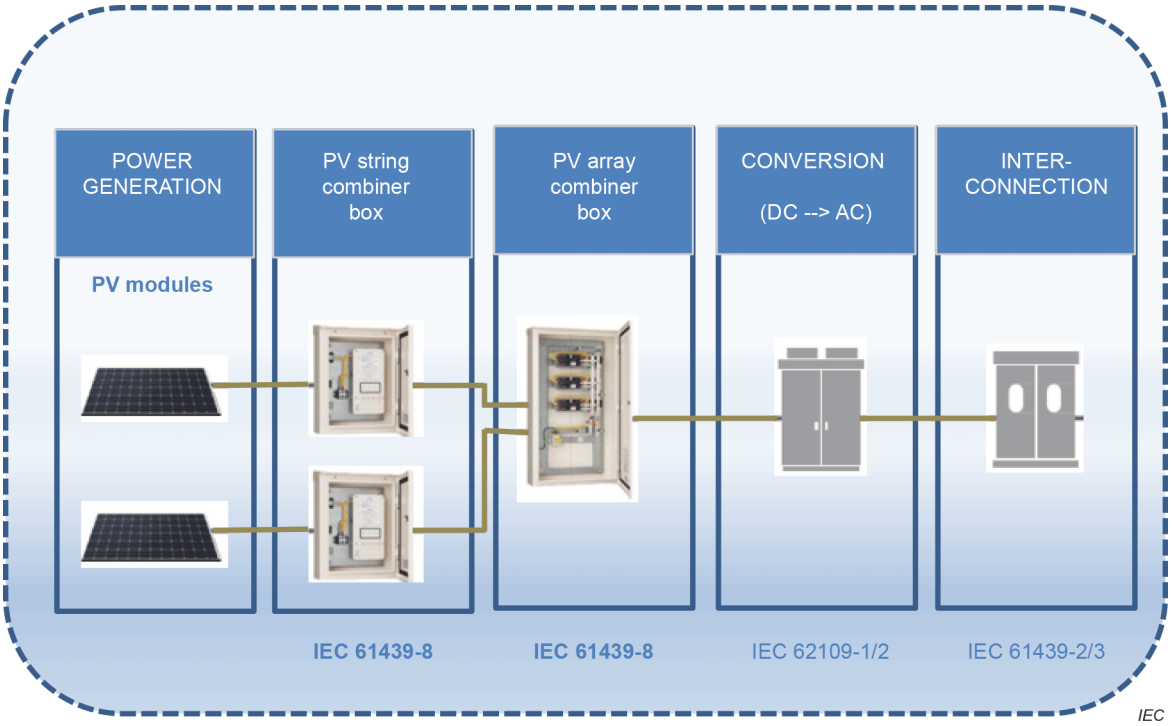

Figure 101 – Example of a large scale-utility PV installation

1 Scope

This part of the IEC 61439 series specifies requirements for the design and verification of low-voltage switchgear and controlgear assemblies for use in photovoltaic installations.

PVAs have the following characteristics:

– assemblies used for the combination of electrical energy in DC systems for which the input and output voltage does not exceed 1 500 V DC;

– assemblies supplied from an AC network where the voltage does not exceed 1 000 V AC for auxiliary and control purposes;

– stationary assemblies with an enclosure;

– assemblies intended for operation by authorised persons (see IEC 61439-1:2020, 3.7.17), but can be located in an area accessible to ordinary persons (see IEC 61439-1:2020, 3.7.16);

– suitable for indoor or outdoor installation.

NOTE 1 PV installations having PV modules with micro-inverters that are connected directly to inter-connection assemblies according to IEC 61439-2 or IEC 61439-3 are not covered by this document.

NOTE 2 Requirements for PVA including other types of DC distribution circuits, for example battery circuits, connected in the same assembly are under consideration.

This document identifies definitions, specifies the service conditions, details the construction requirements, defines the technical characteristics, and provides verifications for PVAs.

PVAs can also include control or signalling devices, or both, associated with the distribution of electrical energy.

This document applies to all PVAs whether they are designed and manufactured on a one-off basis or fully standardized and manufactured in quantity. Either the manufacture or assembly, or both, can be carried out by an entity other than the original manufacturer (see IEC 61439-1:2020, 3.10.1).

This document does not apply to:

– individual devices, for example, circuit-breakers, fuse switches and self-contained components such as, motor starters, switch mode power supplies (SMPS), uninterruptable power supplies (UPS), basic drive modules (BDM), complete drive modules (CDM), adjustable speed power drives systems (PDS), stand-alone energy storage systems (battery and capacitor systems), other electronic equipment which comply with their relevant product standards, such as junction boxes of photovoltaic modules. This document describes their integration into a PVA or an empty enclosure used as a part of a PVA;

– photovoltaic power conversion equipment (PCE) incorporating DC combination sub-systems, covered by the IEC 62109 series.

Some applications, such as either explosive atmospheres or functional safety, or both, can be subject to the requirements of other standards or local installation rules in addition to those specified in the IEC 61439 series.

This document does not apply to the specific types of assemblies covered by other parts of the IEC 61439 series.

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 61439-1:2020, Clause 2, is applicable in addition to the following:

Addition:

IEC 60068-2-14, *Environmental testing - Part 2-14: Tests - Test N: Change of temperature*

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

IEC 60364-7-712, *Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems*

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

IEC TR 60890, *A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation*

IEC 60898-2, *Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Part 2: Circuit-breakers for AC and DC operation*

IEC 60898-3, *Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Part 3: Circuit-breakers for DC operation*

IEC 60947-2:2024, *Low-voltage switchgear and controlgear - Part 2: Circuit-breakers*

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

IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies - Part 1: General rules*

IEC 62109 (all parts), *Safety of power converters for use in photovoltaic power systems*

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*
IEC 62262:2002/AMD1:2021

IEC 63027, *Photovoltaic power systems - DC arc detection and interruption*

IEC 63112, *Photovoltaic (PV) arrays - Earth fault protection equipment - Safety and safety related functionality*

Bibliography

The Bibliography of IEC 61439-1:2020 is applicable with the following additions:

Addition:

IEC 60092-302:1997, *Electrical installations in ships - Part 302: Low-voltage switchgear and controlgear assemblies*[1]

IEC 60092-302-2, *Electrical installations in ships - Part 302-2: Low voltage switchgear and controlgear assemblies - Marine power*

IEC 60269 (all parts), *Low-voltage fuses*

IEC 60898 (all parts), *Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60947 (all parts), *Low-voltage switchgear and controlgear*

IEC 61008 (all parts), *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)*

IEC 61009 (all parts), *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)*

IEC 61010-2-201, *Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment*

IEC 61427-1, *Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application*

IEC TR 61439-0, *Low-voltage switchgear and controlgear assemblies - Part 0: Guidance to specifying assemblies*

IEC 61439-2:2020, *Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies*

IEC TR 61641, *Enclosed low-voltage switchgear and controlgear assemblies - Guide for testing under conditions of arcing due to internal fault*

IEC 61800-5-1, *Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy*

IEC 62093, *Balance-of-system components for photovoltaic systems - Design qualification natural environments*

IEC 62124, *Photovoltaic (PV) stand alone systems - Design verification*

IEC 62423, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

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[1] This publication was withdrawn and replaced by IEC 60092-302-2:2019.

IEC 62446 (all parts), *Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance*

IEC 62446-1:2016, *Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection*
IEC 62446-1:2016/AMD1:2018

IEC 62548:2016, *Photovoltaic (PV) arrays - Design requirements*

IEC 62790, *Junction boxes for photovoltaic modules - Safety requirements and tests*

IEC TS 62738:2018, *Ground-mounted photovoltaic power plants - Design guidelines and recommendations*

IEC TS 63107, *Integration of internal arc-fault mitigation systems in power switchgear and controlgear assemblies (PSC - Assemblies) according to IEC 61439-2*

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