

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

Low-voltage switchgear and controlgear assemblies –  
Part 2: Power switchgear and controlgear assemblies

Ensembles d'appareillage à basse tension –  
Partie 2: Ensembles d'appareillage de puissance

IEC 61439-2:2020  
<https://standards.iteh.ai/catalog/standards/sist/07461813-b0eb-4ff2-8c0c-dc3144336ca2/iec-61439-2-2020>  
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IEC 61439-2

Edition 3.0 2020-07

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International Standard IEC 61439-2 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.

This third edition cancels and replaces the second edition published in 2011. It constitutes a technical revision.

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

- a) addition of Annexes DD, EE and FF for assemblies for use in photovoltaic installation;
- b) clarification of the requirements for forms of internal separation and the addition of the requirement, when the form of separation is higher than 1, all parts within the functional unit compartment that remain live when the functional unit is switched off shall be protected to at least IPXXB;
- c) alignment with the structure of IEC 61439-1:2020;

- d) addition of temperature-rise verification for; (i) temperature-rise verification of assemblies with natural cooling and circuits rated above 1 600 A by a combination of comparison with a reference design and calculation, and; (ii) temperature-rise verification of assemblies with active cooling and rated currents up to 1 600 A.
- e) consideration of IP with active cooling.

The text of this document is based on the following documents:

FDIS	Report on voting
121B/104/FDIS	121B/109/RVD

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

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

In this document, general terms and definitions are defined in Clause 3. Further terms and definitions specific to Annex DD are given in this annex to facilitate easier reading.

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

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.

New annexes in this document are lettered AA, BB, etc.

In this document, the term PSC-assembly is defined in 3.1.101.

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

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.

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.

# LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

## Part 2: Power switchgear and controlgear assemblies

### 1 Scope

This part of IEC 61439 defines the specific requirements for the power switchgear and controlgear assembly (abbreviated 'PSC-assembly' throughout this document see 3.1.101) as follows:

- assemblies for which the rated voltage does not exceed 1 000 V AC or 1 500 V DC;
- assemblies designed for a nominal frequency of the incoming supply or supplies not exceeding 1 000 Hz;

NOTE 1 Frequencies above 1 kHz are considered as high frequencies, see also IEC 60664-1:2007, 5.3.3.2.5 to take into account additional constraints to insulation coordination.

- assemblies intended for indoor and outdoor applications;
- stationary or movable assemblies with or without enclosures;
- assemblies intended for use in connection with the generation, transmission, distribution and conversion of electrical energy, and for the control of equipment consuming electrical energy and for associated data processing;
- assemblies designed for use under special service conditions, for example in ships and in rail vehicles, provided that the other relevant specific requirements are complied with;

NOTE 2 Supplementary requirements for assemblies in ships are covered by IEC 60092-302-2.  
<https://standards.iteh.ai/catalog/standards/sist/64abf813-b0eb-4ff2-8c0c-de3114f336c2/iec-61439-2-2020>

This document also applies to assemblies for use in photovoltaic installations, designated as photovoltaic assemblies (PVA). The particular characteristics, specific service conditions and the requirements for PVA's are included in Annexes DD, EE and FF.

This document provides supplementary requirements for PSC-assemblies intended for use as part of the electrical equipment of machines and can be applied in addition to the requirements given in IEC 60204-1.

This document applies to all assemblies whether they are designed, manufactured and verified on a one-off basis or fully standardised and manufactured in quantity.

The manufacture and/or assembly can be carried out by an entity other than the original manufacturer (see 3.10.1 of IEC 61439-1:2020).

This document does not apply to individual devices, for example, circuit-breakers, fuse switches and self-contained components such as, motor starters, power electronic converter systems and equipment (PECS), 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), and other electronic equipment which comply with their relevant product standards. This document describes their integration into a PSC-assembly or an empty enclosure used as a part of a PSC-assembly.

For some applications, such as, explosive atmospheres, functional safety, there may be a need to comply with the requirements of other standards or legislation 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 IEC 61439. For assemblies not covered by other parts, this part applies.

Unless local legislation details additional requirements, equipment within the scope of this document, which complies with this document, is deemed to meet essential safety requirements. This includes fully verified specifier options, for example user choice of protection against accidental contact with hazardous live parts of IPXXB or IP3XD. Where special requirements are agreed between the user and manufacturer, that are not fully specified within this document, for example, (i) part of the assembly is outside the scope of this document, (ii) exceptional vibration is present at the place of installation, (iii) exceptional voltage variations occur in service, or (iv) possible adverse effects from sonic or ultrasonic sources, a risk assessment and/or additional or more severe verifications may be required to demonstrate that the essential safety requirements have been fulfilled.

## 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.

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

Addition:

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61439-2:2020

IEC 60947-3:2008, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-3:2008/AMD1:2012

IEC 60947-3:2008/AMD2:2015

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

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

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

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61439-1:2020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

Clause 3 of IEC 61439-1:2020 is applicable, except as follows.



### 3.1 General terms

*Additional terms and definitions:*

#### 3.1.101

##### **power switchgear and controlgear assembly**

##### **PSC-assembly**

assembly used to distribute and control electrical energy for all types of loads, intended for industrial, commercial and similar applications where operation by ordinary persons is not intended

Note 1 to entry: It is not excluded for a PSC-assembly to be located in an area accessible to ordinary persons.

#### 3.1.102

##### **test situation**

condition of a PSC-assembly or part of it in which the relevant main circuits are open on its supply side but not necessarily isolated whilst the associated auxiliary circuits are connected, allowing operational tests of the incorporated device(s)

#### 3.1.103

##### **form of internal separation**

classification of physical separation within a PSC-assembly

#### 3.1.104

##### **(electric) actuator**

device that produces a specified movement when excited by an electric signal

[SOURCE: IEC 60050-151:2001, 151-13-49]

#### 3.1.105

##### **distribution circuit**

electric circuit supplying one or more distribution boards

[SOURCE: IEC 60050-826:2004, 826-14-02]

#### 3.1.106

##### **final circuit**

electric circuit intended to supply directly electric current to current using equipment or socket outlets

[SOURCE: IEC 60050-826:2004, 826-14-03]

### 3.2 Constructional units of assemblies

*Replacement of the title:*

#### 3.2 Constructional units of PSC-assemblies

*Additional terms and definitions:*

#### 3.2.101

##### **withdrawable part**

removable part intended to be moved from the connected position to the isolated position and to a test position, if any, whilst remaining mechanically attached to the PSC-assembly

### 3.2.102

#### **test position**

position of a withdrawable part in which the relevant main circuits are open on its supply side but not necessarily isolated and in which the auxiliary circuits are connected allowing operation tests of the incorporated device(s), the withdrawable part remaining mechanically attached to the PSC-assembly

Note 1 to entry: The opening can also be achieved without any mechanical movement of the withdrawable part by operation of a suitable device.

### 3.2.103

#### **isolated position**

position of a withdrawable part in which an isolating distance is established in main and auxiliary circuits on its supply side, the withdrawable part remaining mechanically attached to the PSC-assembly

Note 1 to entry: The isolating distance can also be established without any mechanical movement of the withdrawable part by operation of a suitable device, e.g. a disconnector in accordance with IEC 60947-3.

### 3.2.104

#### **isolating distance**

clearance between open contacts of withdrawable parts meeting the safety requirements specified for disconnectors

[SOURCE: IEC 60050-441:2000, 441-17-35, modified – The context information has been moved to after contacts and changed.]

## 3.4 Structural parts of assemblies

*Addition:*

[IEC 61439-2:2020](https://standards.iteh.ai/catalog/standards/sist/64abf813-b0eb-4ff2-8c0c-dc3144336ca2/iec-61439-2-2020)

<https://standards.iteh.ai/catalog/standards/sist/64abf813-b0eb-4ff2-8c0c-dc3144336ca2/iec-61439-2-2020>

### 3.4.101

#### **active cooling**

use of equipment mounted on or within the assembly, installed to reduce or control the assembly's internal air temperature during normal operation, which requires energization to operate

Note 1 to entry: Examples include fans, internal air conditioning, heat exchangers, etc.

### 3.4.102

#### **pressure relief flap**

mechanical component provided to limit the pressure rise in case of internal arc-faults

*Additional terms and definitions:*

## 3.101 Electrical connections of functional units

### 3.101.1

#### **disconnectable connection**

connection which is connected or disconnected by manual operation of the connecting means without a tool

### 3.101.2

#### **withdrawable connection**

connection which is connected or disconnected by bringing the functional unit into the connected or isolated position

### 3.102 Gangways within PSC-assemblies

#### 3.102.1

##### **operating gangway within a PSC-assembly**

space to be used by the operator for the proper operation and supervision of the PSC-assembly

#### 3.102.2

##### **maintenance gangway within a PSC-assembly**

space which is accessible to authorized personnel only and primarily intended for use when servicing the installed equipment

### 3.103 Location

#### 3.103.1

##### **location with restricted access**

location accessible for all persons who are permitted to have access to the location (e.g. private housing, private parking areas or similar places)

#### 3.103.2

##### **location with non-restricted access**

location accessible for all persons, e.g. the access is given in a public area

## 4 Symbols and abbreviations

Clause 4 of IEC 61439-1:2020 is applicable.

## 5 Interface characteristics

IEC 61439-2:2020

<https://standards.iteh.ai/catalog/standards/sist/64abf813-b0eb-4ff2-8c0c-de3114336ca2/iec-61439-2-2020>

Clause 5 of IEC 61439-1:2020 is applicable, except as follows.

### 5.1 General

#### *Replacement:*

The characteristics of the PSC-assembly shall ensure compatibility with the ratings of the circuits to which it is connected and the installation conditions. These characteristics shall be declared by the PSC-assembly manufacturer using the criteria identified in 5.2 to 5.6 of IEC 61439-1:2020, as amended by this document.

The specification schedule detailed in the informative Annex AA is intended to help the user and the PSC-assembly manufacturer to meet this objective, whether the user:

- selects catalogue products, the characteristics of which meet their needs, and the requirements of this document; and/or,
- makes a specific agreement with the manufacturer.

NOTE Annex AA also relates to the topics dealt with in Clauses 6 and 7.

In some cases, information provided by the PSC-assembly manufacturer may take the place of an agreement.

### 5.3.3 Group rated current of a main circuit ( $I_{ng}$ )

#### *Addition:*

For further information on the assumed loading of the outgoing circuits, see 5.4.

## 5.4 Rated diversity factor (RDF)

*Addition:*

In the absence of an agreement between the assembly manufacturer and the user concerning the actual load currents, the assumed loading of the outgoing circuits of the assembly or group of outgoing circuits may be based on the values in Table 101.

For a motor or electric actuator circuit, the assumed load current is the rated current of the motor multiplied with the loading factor of Table 101. If only the rated voltage and rated power of the motor is provided, then the rated current of the motor can be taken from IEC 60947-4-1:2018, Annex G.

For all other distribution and final circuits, it is assumed load current is the rated current of the protective device,  $I_n$ , as required by the user, multiplied with the loading factor of Table 101.

## 5.6 Other characteristics

Replacement of item f):

- f) degree of protection against contact with hazardous live parts, ingress of solid foreign bodies and water, IP code (See 8.2.2 of IEC 61439-1:2020), including the degree of protection for any distinct positions for removable and withdrawable parts;

*Replacement of item g):*

- g) intended for use by electrically skilled, competent or instructed persons (see 3.7.13, 3.7.14 and 3.7.15 of IEC 61439-1:2020);

*Replacement of item l):*

- l) type of construction – fixed, removable or withdrawable parts (see 8.5.1 of IEC 61439-1:2020 and 8.5.2);

*Addition:*

- aa) form of internal separation and associated degree of protection(s), IP code (see 8.101);
- bb) types of electrical connections of functional units (see 8.5.101);
- cc) mounting orientation (horizontal, vertical, etc.) if the assembly can be mounted in different positions from vertical.

## 6 Information

Clause 6 of IEC 61439-1:2020 is applicable, except as follows.

### 6.1 Assembly designation marking

*Replacement of the title and item g):*

#### 6.1 PSC-assembly designation marking

- g) IEC 61439-2;

## 6.2.2 Instructions for handling, installation, operation and maintenance

*Addition:*

A PSC-assembly that can be energized from more than one source shall carry a warning label indicating that the assembly is energized from more than one source, and that parts inside the assembly can still be live unless all supplies are isolated.

## 7 Service conditions

Clause 7 of IEC 61439-1:2020 is applicable.

## 8 Constructional requirements

Clause 8 of IEC 61439-1:2020 is applicable, except as follows.

### 8.1.1 General

*Addition:*

For assemblies intended to be used for machines, the requirements given in 11.4 of IEC 60204-1:2016 shall apply.

### 8.2 Degree of protection provided by an assembly enclosure

*Replacement of the title:*

### 8.2 Degree of protection provided by a PSC-assembly enclosure

#### 8.2.1 Protection against mechanical impact (IK code)

*Replacement of text:*

Where a degree of protection (IK code) provided by a PSC-assembly enclosure against mechanical impact is declared by the original manufacturer, this shall be verified in accordance with 10.2.6.

NOTE It is not mandatory for the manufacturer to declare an IK code.

*Additional subclause:*

#### 8.2.101 PSC-assembly with withdrawable parts

The degree of protection (IP code) indicated for PSC-assemblies normally applies to the connected position (see 3.2.3 of IEC 61439-1:2020) of withdrawable parts. The assembly manufacturer shall indicate the degree of protection (IP code) obtained in the other positions.

PSC-assemblies with withdrawable parts may be so designed that the degree of protection (IP code) applying to the connected position is also maintained in the test and in isolated positions.

If, after the removal of a withdrawable part, it is not possible to maintain the original degree of protection (e.g. by closing a door), the assembly manufacturer shall make available covers or similar to restore the original degree of protection. If these measures are not available, the IP tests shall be carried out without the removable part in place.

### 8.3.2 Clearances

*Addition:*

The isolating distance between the withdrawable unit's main contacts and their associated fixed contacts in the isolated position shall be capable of withstanding the test voltage for the declared impulse withstand voltage as specified in Table 102.

NOTE For altitudes above 2 000 m, refer to IEC 60664-1.

#### 8.4.3.2.2 Requirements for earth continuity providing protection against the consequences of faults within the class I assembly

*Replacement of the title.*

#### 8.4.3.2.2 Requirements for earth continuity providing protection against the consequences of faults within the class I PSC-assembly

*Replacement of last paragraph:*

When removable or withdrawable parts are equipped with a metal supporting surface that have suitable conductivity and corrosion resistance, these surfaces shall be considered sufficient for ensuring earth continuity, provided that the pressure exerted on them is sufficiently high. The continuity of the exposed conductive parts of a withdrawable part shall remain effective from the connected position to the isolated position inclusively.

#### 8.4.6.1 Devices to be operated or components to be replaced by ordinary persons

This subclause of IEC 61439-1 is not applicable.

#### 8.4.6.2 Requirements related to accessibility in service by authorized persons

##### 8.4.6.2.1 General

*Addition:*

The most appropriate form of internal separation for a PSC-assembly is determined by the operations to be undertaken when the assembly is energized and in service, but with individual circuits de-energized (see 8.101).

*Additional subclause:*

##### 8.4.6.2.101 Operating and maintenance gangways within a PSC-assembly

Operating and maintenance gangways (see 3.102.1 and 3.102.2) within a PSC-assembly shall comply with the requirements for basic protection as specified in IEC 61140.

Recesses up to one metre in depth within a PSC-assembly are not considered to be gangways.

### 8.5.2 Removable parts

*Replacement of the title:*

### 8.5.2 Removable and withdrawable parts

*Replacement of text:*

The removable and withdrawable parts shall be so constructed that their electrical equipment can be safely removed and/or isolated from or connected to the main circuit even if the circuit is live. The removable and withdrawable parts may be provided with an insertion interlock (see 3.2.5 of IEC 61439-1:2020).

Clearances and creepage distances (see 8.3.2 and 8.3.3 of IEC 61439-1:2020) shall be complied with in the different positions as well as during transfer from one position to another.

*Additional subclauses:*

#### 8.5.2.101 Withdrawable parts

Withdrawable parts shall, in addition, have an isolated position (see 3.2.103) and may have a test position (see 3.2.102), or a test situation (see 3.1.102). They shall be distinctly located in these positions. These positions shall be clearly discernible.

In PSC-assemblies with withdrawable parts all live parts shall be protected in such a manner that they cannot unintentionally be touched when the door, if any, is open and the withdrawable part is withdrawn from the connected position or removed. Where an obstacle or shutter is used they shall meet the requirements of 8.4.6.2.1 of IEC 61439-1:2020.

For the electrical conditions associated with the different positions of withdrawable parts, see Table 103.

#### 8.5.2.102 Interlocking and padlocking of removable and withdrawable parts

A removable or withdrawable part shall be fitted with a device that ensures that it can only be removed and inserted after its main circuit has been switched off from the load.

In order to prevent unauthorized operation, the removable and withdrawable parts or their associated assembly location may be provided with a lockable means to secure them in one or more of their positions.

### 8.5.3 Selection of switching devices and components

*Addition:*

NOTE 2 The standards with which components can comply, include, for example, IEC 60947 (all parts), IEC 60269 (all parts), IEC 60898 (all parts), IEC 61008 (all parts), IEC 61009 (all parts), IEC 62423, IEC 61800-5-1, IEC 61010-2-201.

*Additional subclauses:*

#### 8.5.101 Description of the types of electrical connections of functional units

A functional unit can have the same or different types of electrical connection for incoming and outgoing supplies; for example, a withdrawable connection can be used for the incoming and fixed or disconnectable for the outgoing.

NOTE 1 Particularly when multiple supplies are involved, the specifier carries out an assessment in order to choose the most appropriate connection.