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Edition 2.0 2024-03
EXTENDED VERSION

INTERNATIONAL STANDARD

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This extended version of IEC 61439-3:2024 includes the content of the references made to IEC 61439-1:2020

Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)



IEC 61439-3:2024-03 EXV(en)

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

Part 3: Distribution boards intended to be operated by ordinary persons (DBO)

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The specific content of IEC 61439-3:2023 is displayed on a blue background.

IEC 61439-3 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 second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

a) alignment with the structure of IEC 61439-1:2020;
b) inclusion in the scope of more examples of the type of protection and control devices;
c) deletion of type A and type B DBOs;
d) addition of a new Annex BB related to DBOs used in a prosumer's electrical installation (PEI);
e) addition of a new Annex CC related to rated current of a DBO with additional source of supply in parallel/simultaneously with another source that is connected to the DBO e.g. PV.

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

Draft	Report on voting
121B/193/FDIS	121B/195/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.

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 61439-1:2020 is to be adapted accordingly.

Subclauses that are numbered with a 101 (102, 103, etc.) suffix are additional to the same subclause in IEC 61439-1:2020.

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

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

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

A list of all parts in the IEC 61439 series, published 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

Part 3: Distribution boards intended to be operated by ordinary persons (DBO)

1 Scope

This part of IEC 61439 defines the specific requirements for distribution boards intended to be operated by ordinary persons (abbreviated DBO throughout this document, see 3.1.101) as follows:

– assemblies intended to be operated by ordinary persons (e.g. switching operations and replacing fuse-links), e.g. in domestic (household) applications;

– assemblies containing outgoing circuits with protective devices intended to be operated by ordinary persons, complying e.g. with IEC 60898-1, the IEC 61008 series, the IEC 61009 series, IEC 62606, IEC 62423 and IEC 60269-3;

– assemblies for applications where the nominal voltage to earth does not exceed 300 V AC (see Table G.1 of IEC 61439-1:2020);

NOTE The voltage limits for DC applications are under consideration.

– assemblies with a rated current (I_{nc}) of the outgoing circuits not exceeding 125 A and a rated current (I_{nA}) not exceeding 250 A;

– 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;

– enclosed, stationary assemblies;

– assemblies for indoor or outdoor use.

DBOs can contain protection devices, control devices, signalling devices alone or a combination of devices e.g. circuit-breakers, load shedding relay, energy management, communication devices, lighting control.

This document does not apply to an empty enclosure nor to individual devices and self-contained components, such as circuit-breakers, fuse-switches, electronic equipment. which comply with the relevant product standards, it describes the integration of devices, or self-contained components, or both, into a DBO or into an empty enclosure forming a DBO.

This document applies to DBOs designed, manufactured, and verified on a one-off basis or fully standardized and manufactured in quantity.

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

NOTE Enclosures for electrical accessories for household and similar fixed electrical installations are covered in IEC 60670-24.

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 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-11:1981*, Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41:2005*, Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-51:2005, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60364-5-52:2009, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-8-82, *Low-voltage electrical installations – Part 8-82: Functional aspects – Prosumer's low-voltage electrical installations*

IEC 60439 (all parts), *Low-voltage switchgear and controlgear assemblies*[1]

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*[2]
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60669-2-4, *Switches for household and similar fixed electrical installations – Part 2-4: Particular requirements – Isolating switches*

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1 Withdrawn. The IEC 60439 series has been cancelled and replaced by the IEC 61439 series.

2 There is a consolidated document edition 2.2 (2013) that includes IEC 60529 (1989) and its Amendment 1 (1999) and Amendment 2 (2013).

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products* (GWEPT)

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60865-1:2011, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC TR 60890:2014, *A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation*

IEC 60898-1, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

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

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio frequency, electromagnetic field immunity test*[3]
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*[4]
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

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[3] There is a consolidated edition 3.2 (2010) that includes IEC 61000-4-3 (2006) and Amendment 1 (2007) and Amendment 2 (2010).

[4] There is consolidated edition 3.1 (2017) that includes IEC 61000-4-5 (2014) and its Amendment 1 (2017).

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*
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IEC 61008 (all parts), *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)*

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IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

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

IEC 61921:2017, *Power capacitors – Low-voltage power factor correction banks*

IEC 62208:2011, *Empty enclosures for low-voltage switchgear and controlgear assemblies – General requirements*

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

IEC 62423:2009, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

IEC 62606, *General requirements for arc fault detection devices*

IEC 81346-1:2009, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

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CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*
CISPR 32:2015/AMD1:2019

ISO 178:2010, *Plastics – Determination of flexural properties*
ISO 178:2010/AMD1:2013

ISO 179-1:2010, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2:1997, *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*
ISO 179-2:1997/AMD1:2011

ISO 2409:2013, *Paints and varnishes – Cross-cut test*

ISO 4628-3:2016, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

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 terminology databases for use in standardization at the following addresses:

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

3.1 General terms

3.1.1
low-voltage switchgear and controlgear assembly
assembly
combination of one or more low-voltage switching devices together with associated control, measuring, signalling, protective, regulating equipment, with all the internal electrical and mechanical interconnections and structural parts, as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions

Note 1 to entry: Throughout this document, the term assembly(s) is used for a low-voltage switchgear and controlgear assembly(s)

Note 2 to entry: The term "switching device" includes mechanical switching devices and semiconductor switching devices, e.g. soft starters, semiconductor relays, frequency converters. The auxiliary circuits may also include electro-mechanical devices, e.g. control relays, terminal blocks, and electronic devices, e.g. electronic motor control devices, electronic measurement and protection devices, bus communication, programmable logic controller systems.

3.1.2
assembly system
full range of mechanical and electrical components (enclosures, busbars, functional units, auxiliary circuits and associated controls, etc.), as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions in order to produce various assemblies

3.1.3
main circuit
all the conductive parts of an assembly included in a circuit which is intended to transmit electrical energy

[SOURCE: IEC 60050-441:2000, 441-13-02]

3.1.4
auxiliary circuit
all the conductive parts of an assembly included in a circuit (other than the main circuit) intended to control, measure, signal, regulate and process data, etc.

Note 1 to entry: The auxiliary circuits of an assembly include the control and the auxiliary circuits of the switching devices.

[SOURCE: IEC 60050-441:2000, 441-13-03, modified – In the definition, “assembly of switchgear and controlgear” has been replaced with “assembly”, and at the end of the definition “and process data, etc.” has been added.]

3.1.5
busbar
low-impedance conductor to which several electric circuits can be connected at separate points

Note 1 to entry: The term "busbar" is generic and does not presuppose the material, the geometrical shape, size or dimensions of the conductor(s).

[SOURCE: IEC 60050-151:2001, 151-12-30, modified – The text of the note has been replaced.]

3.1.6
main busbar
busbar to which one or several distribution busbars and/or incoming and outgoing units are connected

Note 1 to entry: Conductors that are connected between a functional unit and a main busbar are not considered as a part of the main busbar.

3.1.7
distribution busbar
busbar within one section which is connected to a main busbar and from which outgoing units are supplied

Note 1 to entry: Conductors that are connected between a functional unit and a distribution busbar are not considered as a part of the distribution busbars.

3.1.8
functional unit
part of an assembly comprising all the electrical and mechanical elements including switching devices that contribute to the fulfilment of the same function

Note 1 to entry: The conductors connecting a functional unit to the main or distribution busbars and to the terminals for external conductors are part of the functional unit. Other conductors which are connected to a functional unit, but which are external to its compartment or enclosed protected space (e.g. auxiliary cables connected in a common compartment) are not considered to form part of the functional unit.

3.1.9
incoming unit
functional unit through which electrical energy is normally fed into the assembly

3.1.10
outgoing unit
functional unit through which electrical energy is normally supplied to one or more external circuits

3.1.11
short-circuit protective device
SCPD
device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them

[SOURCE: IEC 60947-1:2020, 3.4.21]

3.1.12
current-limiting device
SCPD that, within a specified range of current, prevents the let-through current from reaching the prospective peak value and which limits the let-through energy (I^2t)

Note 1 to entry: The let-through current is also referred to as the cut-off current (see IEC 60050-441:2000, 441-17-12).

Note 2 to entry: Examples of current-limiting devices are current-limiting circuit-breakers in accordance with IEC 60947-2 and fuses in accordance with IEC 60269-2.

3.1.13
non-current-limiting device
SCPD that, within a specified range of current, allows the let-through current to reach the prospective peak value and which can have a rated short-time withstand current (I_{cw}) enabling it to withstand the let-through energy for the duration of the short-time current

3.1.14
line conductor
L
DEPRECATED: phase conductor (in AC systems)
DEPRECATED: pole conductor (in DC systems)
conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-08]

3.1.15
relevant assembly standard
standard within the IEC 61439 series, Part 2 onwards, covering a generic type of assembly

EXAMPLE Power switchgear and controlgear assemblies (PSC-assemblies).

3.1.101
distribution board intended to be operated by ordinary persons
DBO
assembly used to distribute and control electrical energy for all types of electrical supplies and loads, intended for operation by ordinary persons

Note 1 to entry: For operation by ordinary persons, see 8.4.6.1 of IEC 61439-1:2020.

Note 2 to entry: Switching operations and replacing fuse-links are examples of operations intended to be carried out by ordinary persons.

Note 3 to entry: Definition 3.1.101 does not preclude the DBO from being operated by skilled or instructed persons, and also being used in non-domestic installations.

Note 4 to entry: DBOs can be assembled outside the factory of the original manufacturer. DBOs can be assembled by the original manufacturer or by an assembly manufacturer.

3.2 Constructional units of assemblies

3.2.1
fixed part
part consisting of components assembled and wired on a common support and which is designed for fixed installation

3.2.2
removable part
part consisting of components assembled and wired on a common support which is intended to be removed entirely from the assembly and replaced whilst the main circuit to which it is connected may be live

3.2.3
connected position
position of a removable part when it is fully connected for its intended function

3.2.4
removed position
position of a removable part when it is outside the assembly, and mechanically and electrically separated from it

3.2.5
insertion interlock
device preventing the introduction of a removable part into a location not intended for that removable part

3.2.6
fixed connection
connection which can be connected with or without a tool and only disconnected by means of a tool

3.2.7
section
constructional unit of an assembly between two successive vertical delineations

3.2.8
sub-section
constructional unit of an assembly between two successive horizontal or vertical delineations within a section

3.2.9
compartment
section or sub-section enclosed except for openings necessary for interconnection, control or ventilation

3.2.10
transport unit
part of an assembly or a complete assembly suitable for transportation without being dismantled

3.2.11
shutter
part of an assembly which can be moved between:

– a position in which it permits engagement of the contacts of a removable part with fixed contacts, and

– a position in which it becomes a part of a cover or a partition shielding the fixed contacts

[SOURCE: IEC 60050-441:2000, 441-13-07, modified – The text has been editorially reformatted into two bullet points.]

3.3 External design of assemblies

3.3.1
open-type assembly
assembly consisting of a supporting structure which supports the electrical equipment, the live parts of the electrical equipment being accessible

3.3.2
dead-front assembly
open-type assembly with a front cover, the live parts possibly being accessible from directions other than the front

3.3.3
enclosed assembly
assembly which is enclosed on all sides with the possible exception of its mounting surface in such a manner as to provide a defined degree of protection

3.3.4
cubicle-type assembly
enclosed assembly of the floor-standing type, which may comprise several sections, sub-sections or compartments

3.3.5
multi-cubicle-type assembly
combination of a number of mechanically joined cubicle-type assemblies

3.3.6
desk-type assembly
enclosed assembly with a horizontal or inclined control panel, or a combination of both, that incorporates control, measuring, and signalling apparatus, etc.

3.3.7
box-type assembly
enclosed assembly intended to be mounted on a vertical plane

3.3.8
multi-box-type assembly
combination of box-type assemblies mechanically joined together, with or without a common supporting frame, the electrical connections passing between two adjacent boxes through openings in the adjoining faces

3.3.9
wall-mounted surface type assembly
assembly for installation on the surface of a wall

3.3.10
wall-mounted recessed type assembly
assembly for installation into a wall recess, where the enclosure does not support the portion of wall above

3.3.11
floor-standing assembly
assembly for installation on the floor

3.4 Structural parts of assemblies

3.4.1
supporting structure
structure forming part of an assembly designed to support various components of the assembly and any enclosure

3.4.2
mounting structure
structure not forming part of an assembly, designed to support an assembly

3.4.3
mounting plate
plate designed to support various components and suitable for installation in an assembly

3.4.4
mounting frame
framework designed to support various components and suitable for installation in an assembly

3.4.5
enclosure
housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-195:1998, 195-02-35]

3.4.6
cover
external part of the enclosure of an assembly

3.4.7
door
hinged or sliding cover

3.4.8
removable cover
cover which is designed for closing an opening in the external enclosure and which can be removed for carrying out certain operations and maintenance work

3.4.9
cover plate
part of an assembly which is used for closing an opening in the external enclosure and designed to be held in place by screws or similar means

Note 1 to entry: It is not normally removed after the equipment is put into service.

Note 2 to entry: The cover plate can be provided with cable entries.

3.4.10
partition
part of an assembly separating one compartment from other compartments

[SOURCE: IEC 60050-441:2000, 441-13-06]

3.4.11
barrier
part providing protection against direct contact from any usual direction of access

[SOURCE: IEC 60050-195:1998, 195-06-15, modified – “(electrically) protective” has been deleted from the term.]

3.4.12
obstacle
part preventing unintentional direct contact, but not preventing direct contact by deliberate action

Note 1 to entry: Obstacles are intended to prevent unintentional contact with live parts but not intentional contact by deliberate circumvention of the obstacle. They are intended to protect skilled, competent, authorised or instructed persons but are not intended to protect ordinary persons.

[SOURCE: IEC 60050-195:1998, 195-06-16, modified – “(electrically) protective” has been deleted from the term. Note 1 to entry has been added.]

3.4.13
terminal shield
part enclosing terminals and providing a defined degree of protection against access to live parts by persons or objects

3.4.14
cable entry
part with openings which permit the passage of cables into the assembly

3.4.15
protected space
part of an assembly intended to enclose electrical components, and which provides defined protection against external influences and contact with live parts

3.5 Conditions of installation of assemblies

3.5.1
assembly for indoor installation
assembly that is designed for use in locations where the normal service conditions for indoor use as specified in 7.1 apply

3.5.2
assembly for outdoor installation
assembly that is designed for use in locations where the normal service conditions for outdoor use as specified in 7.1 apply

3.5.3
stationary assembly
assembly that is designed to be fixed at its place of installation, for instance to the floor or to a wall, and to be used at this place

3.5.4
movable assembly
assembly which is designed so that it can readily be moved from one place of use to another

3.6 Insulation characteristics

3.6.1
clearance
shortest distance in air between two conductive parts

Note 1 to entry: This distance can be measured along a string stretched the shortest way between these conductive parts.

[SOURCE: IEC 60050-581:2008, 581-27-76, modified – Note 1 to entry has been added.]

3.6.2
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

Note 1 to entry: A joint between two pieces of solid insulating material is considered part of the surface.

[SOURCE: IEC 60050-151:2001, 151-15-50, modified – Note 1 to entry has been added.]

3.6.3
overvoltage
voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[SOURCE: IEC 60664-1:2007, 3.7]

3.6.4
temporary overvoltage
overvoltage at power frequency of several seconds duration

3.6.5
transient overvoltage
short duration overvoltage of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[SOURCE: IEC 60050-614:2016, 614-03-14, modified – In the definition, “short duration overvoltage” has replaced “overvoltage with a duration”. Note 1 to entry and Note 2 to entry have been deleted.]

3.6.6
power-frequency withstand voltage
RMS value of a power-frequency sinusoidal voltage which does not cause breakdown under specified conditions of test

[SOURCE: IEC 60947-1:2020, 3.7.55]

3.6.7
impulse withstand voltage
highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60050-442:2014, 442-09-18]

3.6.8
pollution
addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60050-442:1998, 442-01-28, modified – In the definition, “can produce a permanent reduction of dielectric strength” has been replaced with “can result in a reduction of electric strength” and Note 1 to entry was deleted.]

3.6.9
pollution degree
<of environmental conditions> conventional number based on the amount of conductive or hygroscopic dust, ionized gas or salt, and on the relative humidity and its frequency of occurrence resulting in hygroscopic absorption or condensation of moisture leading to reduction in dielectric strength and/or surface resistivity

Note 1 to entry: The pollution degree to which the insulating materials of devices and components are exposed may be different from that of the macro-environment where the assemblies are located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

Note 2 to entry: For the purpose of this document, the pollution degree is of the micro-environment inside the assembly, unless otherwise stated in the applicable clause.

[SOURCE: IEC 60947-1:2020, 3.7.57, modified – Notes to entry have been adapted for the conditions associated with assemblies.]

3.6.10
environment

3.6.10.1
micro-environment
immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

Note 1 to entry: It is the effect of the micro-environment on the creepage and/or clearance distance that determines the selection of the insulation within the assembly. The micro-environment may be better or worse than the macro-environment.

[SOURCE: IEC 60050-851:2008, 851-15-16, modified – Note 1 to entry has been added.]

3.6.10.2
macro-environment
environment of the room or other location in which the assembly is installed or used

[SOURCE: IEC 60050-442:2014, modified – In the definition, the term “equipment” has been replaced by “assembly”.]

3.6.11
overvoltage category
<of a circuit or within an electrical system> conventional number based on limiting (or controlling) the values of prospective transient overvoltages occurring in a circuit (or within an electrical system having different nominal voltages) and depending upon the means employed to influence the overvoltages

Note 1 to entry: In an electrical system, the transition from one overvoltage category to another of lower category is obtained through appropriate means complying with interface requirements, such as an overvoltage protective device or a series-shunt impedance arrangement capable of dissipating, absorbing, or diverting the energy in the associated surge current, to lower the transient overvoltage value to that of the desired lower overvoltage category.

[SOURCE: IEC 60947-1:2020, 3.7.59]

3.6.12
surge protective device
SPD
device designed to protect the electrical apparatus from high transient overvoltages and to limit the duration and frequently the amplitude of the follow-on current

[SOURCE: IEC 60947-1:2020, 3.4.22, modified – The term "surge arrester" was replaced with "surge protective device" and "SPD".]

3.6.13
insulation coordination
mutual correlation of insulating characteristics of electrical equipment taking into account the expected micro-environment and other influencing stresses

[SOURCE: IEC 60050-442:2014, modified – In the definition, ‘electrical’ has replaced ‘electric’.]

3.6.14
inhomogeneous field
electric field which has not an essentially constant voltage gradient between electrodes

[SOURCE: IEC 60947-1:2020, 3.7.62]

3.6.15
tracking
progressive formation of conducting paths which are produced on the surface of a solid insulating material, due to the combined effects of electric stress and electrolytic contamination on this surface

[SOURCE: IEC 60947-1:2020, 3.7.63]

3.6.16
comparative tracking index
CTI
numerical value of the maximum voltage in volts which a material can withstand without tracking and without a persistent flame occurring under specified test conditions

Note 1 to entry: The value of each test voltage and the CTI should be divisible by 25.

[SOURCE: IEC 60947-1:2020, 3.7.64, modified – Note 1 to entry has been added.]

3.6.17
disruptive discharge
phenomenon associated with the failure of insulation under electrical stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly zero

Note 1 to entry: A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength; in a liquid or gaseous dielectric, the loss may be only temporary.

Note 2 to entry: The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

Note 3 to entry: The term "flashover" is used when a disruptive discharge occurs over the surface of a dielectric in a gaseous or liquid medium.

Note 4 to entry: The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

3.7 Protection against electric shock

3.7.1
live part
conductive part intended to be energized under normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This term does not necessarily imply a risk of electric shock. When the neutral conductor is effectively earthed it is not a hazardous live part and therefore not switched in TN-S or TN-C-S systems unless specifically required by other standards.

[SOURCE: IEC 61140:2016, 3.4, modified – Note 1 to entry has been replaced.]

3.7.2
hazardous live part
live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 61140:2016, 3.5, modified – Note 1 to entry was deleted.]

3.7.3
exposed-conductive-part
conductive part of the assembly, which can be touched and which is not normally live, but which can become live when basic insulation fails

Note 1 to entry: A conductive part of the assembly which can only become live through contact with an exposed-conductive-part which has become live, is not considered to be an exposed-conductive-part itself.

[SOURCE: IEC 60050-195:1998, 195-06-10, modified – In the definition, “equipment” has been replaced by “the assembly”. Note 1 to entry has been added.]

3.7.4
protective conductor
PE
conductor provided for purposes of safety, for example protection against electric shock

Note 1 to entry: As an example, the protective conductor can electrically connect the following parts:

– exposed-conductive-parts;
– extraneous conductive parts;
– main earthing terminal;
– earth electrode;
– earthed point of the source or artificial neutral.

Note 2 to entry: A protective conductor is sometimes referred to a protective earthing conductor.

[SOURCE: IEC 60050-826:2004, 826-13-22, modified – The note 1 has been replaced and note 2 added.]

3.7.5
neutral conductor
N
conductor electrically connected to the neutral point and capable of contributing to the distribution of electrical energy

[SOURCE: IEC 60050-195:1998, 195-02-06, modified – The abbreviated term “N” has been added and "electric" was replaced with "electrical".]

3.7.6
PEN conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

[SOURCE: IEC 60050-195:1998, 195-02-12]

3.7.7
fault current
current resulting from an insulation failure, the bridging of insulation or incorrect connection in an electrical circuit

3.7.8
basic protection
protection against electric shock under fault-free conditions

Note 1 to entry: Basic protection is intended to prevent contact with live parts and generally corresponds to protection against direct contact.

[SOURCE: IEC 60050-195:1998, 195-06-01 modified – Note 1 to entry has been added]

3.7.9
basic insulation
insulation of hazardous live parts, which provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:2004, 826-12-14]

3.7.10
fault protection
protection against electric shock under single-fault conditions

Note 1 to entry: Failure of basic insulation (3.7.9) is an example of a single fault condition.

Note 2 to entry: Fault protection generally corresponds to protection against indirect contact, mainly regarding failure of basic insulation.

[SOURCE: IEC 60050-195:1998, 195-06-02, modified – The notes to entry have been added.]

3.7.11
PELV system
electric system in which the voltage cannot exceed the values given in IEC 60364-4-41:2005, Clause 414;

– under normal conditions and
– under single fault conditions, except earth faults in other electric circuits

Note 1 to entry: PELV is the abbreviation for protective extra low-voltage.

Note 2 to entry: The PELV circuits and/or exposed-conductive-parts of equipment supplied by the PELV circuits can be earthed.

[SOURCE: IEC 60050-826:2004, 826-12-32, modified – The IEC 60364-4-41:2005 reference has been added to the definition. Note 2 to entry has been added.]

3.7.12
SELV system
electric system in which the voltage cannot exceed the values given in IEC 60364-4-41:2005, Clause 414:

– under normal conditions and
– under single fault conditions, including earth faults in other electric circuits

Note 1 to entry: SELV is the abbreviation for safety extra low-voltage.

Note 2 to entry: SELV circuits have basic insulation between live parts and earth.

[SOURCE: IEC 60050-826:2004, 826-12-31, modified – The IEC 60364-4-41:2005 reference has been added to the definition. Note 2 to entry has been added.]

3.7.13
(electrically) skilled person
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

[SOURCE: IEC 60050-826:2004, 826-18-01]

3.7.14
competent person
person who can judge the work assigned and recognize possible hazards on the basis of professional training, experience and knowledge of the relevant equipment

Note 1 to entry: Several years of practice in the relevant technical field may be taken into consideration in assessment of professional training.

[SOURCE: IEC 60050-851:2008, 851-11-10]

3.7.15
instructed person
person adequately advised or supervised by skilled persons to enable him or her to perceive risks and to avoid hazards electricity can create

[SOURCE: IEC 60050-826:2004, 826-18-02, modified – "(electrically)" was deleted from the main term.]

3.7.16
ordinary person
person who is neither a skilled person nor an instructed person

[SOURCE: IEC 60050-826:2004, 826-18-03]

3.7.17
authorized person
skilled or instructed person who is empowered to execute defined work

3.7.18
mid-point conductor
M
conductor electrically connected to the mid-point and capable of the transmission of electrical energy

Note 1 to entry: The term mid-point conductor is most frequently associated with DC applications.

[SOURCE: IEC 60050-195:1998, 195-02-07, modified – In the definition, "contributing to the distribution" has been replaced by "the transmission". Note 1 to entry has been added.]

3.7.19
PEM conductor
conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-13]

3.7.20
PEL conductor
conductor combining the functions of both a protective earthing conductor and a line conductor

[SOURCE: IEC 60050-195:1998, 195-02-14]

3.7.21
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:2004, 826-12-15]

3.7.22
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:2004, 826-12-16]

3.7.23
reinforced insulation
insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

Note 2 to entry: Reinforced insulation complies with IEC 60664-1:2007.

[SOURCE: IEC 60050-826:2004, 826-12-17, modified – New Note 2 to entry.]

3.7.24
class I assembly
assembly with at least one provision for a basic protection and a connection to a protective conductor as provision for a fault protection

Note 1 to entry: See IEC 61140:2016, 7.3 for further details.

Note 2 to entry: A class I assembly can have an insulated enclosure for basic protection and a protective conductor to facilitate fault protection for external circuits supplied through the class I assembly.

3.7.25
class II assembly
assembly which is provided with the following;

– basic insulation as provision for basic protection, and

– supplementary insulation as provision for fault protection,

or in which;

– basic protection and fault protection are provided by reinforced insulation

Note 1 to entry: See IEC 61140:2016, 7.4

3.8 Characteristics

3.8.1
nominal value
value of a quantity used to designate and identify a component, device, equipment or system

Note 1 to entry: The nominal value is generally a rounded value.

[SOURCE: IEC 60050-151:2001, 151-16-09]

3.8.2
limiting value
in a specification of a component, device, equipment or system, the greatest or smallest admissible value of a quantity

[SOURCE: IEC 60050-151:2001, 151-16-10]

3.8.3
rated value
value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

[SOURCE: IEC 60050-151:2001, 151-16-08]

3.8.4
rating
set of rated values and operating conditions

[SOURCE: IEC 60050-151:2001, 151-16-11]

3.8.5
nominal voltage
approximate value of voltage used to designate or identify an electrical system

[SOURCE: IEC 60050-601:1985, 601-01-21, modified – Deletion of "(of a system)" from the term and addition of "electrical" in the definition.]

3.8.6
short-circuit current
I_c
overcurrent resulting from a short-circuit due to a fault or an incorrect connection in an electric circuit

[SOURCE: IEC 60050-441:2000, 441-11-07]

3.8.7
prospective short-circuit current
I_{cp}
current which would flow if the supply conductors to the circuit are short-circuited by a conductor of negligible impedance located as near as practicable to the supply terminals of the assembly

Note 1 to entry: For AC and DC applications, the current is the RMS value and the mean value in sustained conditions, respectively.

3.8.8
cut-off current
let-through current
I_{lt}
maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

Note 1 to entry: This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[SOURCE: IEC 60050-441:2000, 441-17-12]

3.8.9
voltage ratings

3.8.9.1
rated voltage
U_n
highest nominal voltage of the electrical system, declared by the assembly manufacturer, to which the main circuit(s) of the assembly is (are) designed to be connected

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

Note 2 to entry: Transients are disregarded.

Note 3 to entry: The value of the supply voltage may exceed the rated voltage due to permissible system tolerances.

Note 4 to entry: The voltage is the RMS value and the mean value for AC and DC applications, respectively.

3.8.9.2
rated operational voltage
U_e
value of voltage, AC (RMS) or DC (mean value), declared by the assembly manufacturer for the assembly or a circuit of an assembly, which, combined with the rated current, determines its application

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

3.8.9.3
rated insulation voltage
U_i
RMS withstand voltage value, assigned by the assembly manufacturer (3.10.2) to the assembly or to a circuit of an assembly, characterizing the specified (long-term) withstand capability of the insulation

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

Note 2 to entry: The rated insulation voltage is not necessarily equal to the rated operational voltage of equipment, which is primarily related to functional performance.

[SOURCE: IEC 60664-1 2007, 3.9.1, modified – The symbol U_i has been added. In the definition, “manufacturer” has been replaced by “assembly manufacturer (3.10.2)” and ‘equipment or to a part of it’ has been replaced by ‘assembly or to a circuit of an assembly’. Note 1 to entry has been added.]

3.8.9.4
rated impulse withstand voltage
U_{imp}
impulse withstand voltage value, assigned by the assembly manufacturer for an assembly or a circuit of an assembly, characterizing the specified withstand capability of the insulation against transient overvoltages

[SOURCE: IEC 60664-1 2007, 3.9.2, modified – “withstand” has been added to term; the symbol U_{imp} has been added. In the definition, ‘to the equipment or to a part of it’ has been replaced by ‘for an assembly or a circuit of an assembly’.]

3.8.10
current ratings

3.8.10.1
rated current
value of uninterrupted current, declared by the assembly manufacturer which can be carried without the temperature-rise of various parts of the assembly exceeding specified limits under specified conditions

Note 1 to entry: For rated current of the assembly (I_{nA}) see 3.8.10.7 and 5.3.1; for rated current of a main circuit (I_{nc}) see 3.8.10.5 and 5.3.2; and for group rated current of a main circuit (I_{ng}) see 3.8.10.6 and 5.3.3.

Note 2 to entry: Normally it is not necessary to take into account the inrush currents for motors, transformers, etc. when determining the rated current of a circuit.

3.8.10.2
rated peak withstand current
I_{pk}
value of peak short-circuit current declared by the assembly manufacturer, that can be withstood under specified conditions

3.8.10.3
rated short-time withstand current
I_{cw}
RMS value of AC or mean value of DC short-time current, declared by the assembly manufacturer, that can be withstood under specified conditions, defined in terms of current and time

Note 1 to entry: Rated short-time withstand current is not the same as an internal arc fault rating as given in IEC TR 61641.

3.8.10.4
rated conditional short-circuit current
I_{cc}
value of the prospective short-circuit current, declared by the assembly manufacturer, that can be withstood for the total operating time (clearing time) of the SCPD under specified conditions

3.8.10.5
rated current of a main circuit
I_{nc}
rated current which a main circuit can carry when it is the only main circuit within a section of an assembly that is carrying current

Note 1 to entry: The rated current of a main circuit can be lower than the rated currents of the devices installed in the main circuit, according to the respective device standards.

Note 2 to entry: Due to the complex factors determining the rated currents, no standard values can be given.

Note 3 to entry: An assembly can comprise of only a single section.

3.8.10.6
group rated current of a main circuit
I_{ng}
rated current which a main circuit can carry considering the mutual thermal influences of the other circuits that are simultaneously loaded in the same section of the assembly

Note 1 to entry: I_{ng} can equal I_{nc} in some designs of assembly.

Note 2 to entry: An assembly can comprise only a single section.

3.8.10.7
rated current of an assembly
I_{nA}
rated current which can be distributed by an assembly without the temperature-rise of any of the parts exceeding specified limits

Note 1 to entry: The rated current of the assembly is not to be exceeded if further circuits are added in the future.

3.8.10.8
design current (of an electric circuit)
I_B
electric current intended to be carried by an electric circuit in normal operation

Note 1 to entry: I_B is normally provided by the user.

[SOURCE: IEC 60050-826:2004, 826-11-10, modified – Note 1 to entry has been added.]

3.8.11
rated diversity factor
RDF
value, calculated by dividing the group rated current of an outgoing main circuit I_{ng} by the rated current I_{nc} of the same outgoing main circuit, where I_{ng} and I_{nc} are derived by test

Note 1 to entry: RDF therefore represents the per unit value of I_{nc}, to which two or more outgoing circuits in the same section of an assembly can be continuously and simultaneously loaded taking into account the mutual thermal influences.

Note 2 to entry: For a group of circuits that are continuously and simultaneously loaded, the rated current of a circuit (I_{nc}) multiplied by the rated diversity factor (RDF) normally is not less than the design current (I_B) of the circuit normally provided by the user i.e. I_{nc} × RDF ≥ I_B.

3.8.12
rated frequency
f_n
value of frequency, declared by the assembly manufacturer, for which a circuit is designed and to which the operating conditions refer

Note 1 to entry: A circuit may be assigned a number or a range of rated frequencies or be rated for both AC and DC.

3.8.13
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

Note 1 to entry: For EMC related terms and definitions see Annex J.

[SOURCE: IEC 60050-161:2018, 161-01-07, modified – Note 1 to entry has been added.]

3.9 Verification

3.9.1
design verification
verification made on a sample of an assembly or on parts of assemblies to show that the design meets the requirements of the relevant assembly standard

Note 1 to entry: Design verification may comprise one or more equivalent methods. See 3.9.1.1, 3.9.1.2 and 3.9.1.3.

3.9.1.1
verification test
test conducted on a sample of an assembly or on parts of assemblies to verify that the design meets the requirements of the relevant assembly standard

Note 1 to entry: Verification tests are equivalent to type tests as in the IEC 60439 series of standards.

3.9.1.2
verification comparison
structured comparison of a proposed design for an assembly, or parts of an assembly, with a reference design(s) verified by test

3.9.1.3
verification assessment
design verification using strict design rules and/or calculations applied to an assembly or to parts of assemblies to show that the design meets the requirements of the relevant assembly standard

3.9.1.4
reference design
design of an assembly or parts of an assembly that has been verified by test

3.9.2
routine verification
verification of each assembly performed during and/or after manufacture to confirm whether it complies with the requirements of the relevant assembly standard

3.9.3
inspection
action comprising careful scrutiny, including visual scrutiny where conditions are obvious, of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item

[SOURCE: IEC 60050-426:2008, 426-14-02, modified – The definition has been modified.]

3.10 Manufacturer

3.10.1
original manufacturer
organization that has carried out the original design and the associated verification of an assembly in accordance with the relevant assembly standard

3.10.2
assembly manufacturer
organization taking the responsibility for the completed assembly

Note 1 to entry: The assembly manufacturer can be the same or a different organization to the original manufacturer.

3.11
user
party who will specify, purchase, use and/or operate the assembly, or someone acting on their behalf

4 Symbols and abbreviations

Alphabetical list of terms with symbols and abbreviations together with the subclause where they are first used: