

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



Junction boxes for photovoltaic modules – Safety requirements and tests

Boîtes de jonction pour modules photovoltaïques – Exigences de sécurité et essais

[IEC 62790:2014](#)

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## JUNCTION BOXES FOR PHOTOVOLTAIC MODULES – SAFETY REQUIREMENTS AND TESTS

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FDIS	Report on voting
82/876/FDIS	82/902/RVD

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## JUNCTION BOXES FOR PHOTOVOLTAIC MODULES – SAFETY REQUIREMENTS AND TESTS

### 1 Scope

This International Standard describes safety requirements, constructional requirements and tests for junction boxes up to 1 500 V dc for use on photovoltaic modules according to class II of IEC 61140:2001.

This standard applies also to enclosures mounted on PV-modules containing electronic circuits for converting, controlling, monitoring or similar operations. Additional requirements concerning the relevant operations are applied under consideration of the environmental conditions of the PV-modules. This standard does not apply to the electronic circuits of these devices, for which other IEC-standards apply.

NOTE For junction boxes according to classes 0 and III of IEC 61140:2001, in photovoltaic-systems, this standard can be used as a guideline.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- <https://standards.kennedy.com/standards/iec/62790-2014>  
IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*  
<https://standards.kennedy.com/standards/iec/60068-1>  
IEC 60068-1, *Environmental testing – Part 1: General and guidance*
- IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
- IEC 60068-2-70, *Environmental testing – Part 2: Tests – Test Xb: Abrasion of markings and letterings caused by rubbing of fingers and hands*
- IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*
- IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*
- IEC 60228, *Conductors of insulated cables*
- IEC 60352-2, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*
- IEC 60512-12-1, *Connectors for electronic equipment – Tests and measurements – Part 12-1: Soldering tests – Test 12a: Solderability, wetting, solder bath method*
- IEC 60512-12-2, *Connectors for electronic equipment – Tests and measurements – Part 12-2: Soldering tests – Test 12b: Solderability, wetting, soldering iron method*
- IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC/TR 60664-2-1, *Insulation coordination for equipment within low-voltage systems – Part 2-1: Application guide – Explanation of the application of the IEC 60664 series, dimensioning examples and dielectric testing*

IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

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

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20:1999, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods*

IEC/TR 60943, *Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals*

IEC 60947-7-1, *Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors*

IEC 60998-2-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units*

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IEC 60998-2-2, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

IEC 60999-1:2000, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm<sup>2</sup> up to 35 mm<sup>2</sup> (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm<sup>2</sup> up to 300 mm<sup>2</sup> (included)*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61730-1, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction*

IEC 61730-2:2004, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

IEC 62852, *Connectors for photovoltaic systems – Safety requirements and tests*

ISO 868:2003, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

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

ISO 4892-3:2006, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

EN 50618, *Electric cables for photovoltaic systems*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### **module junction box**

combination of parts, such as boxes, covers, cover-plates, lids, box extensions, accessories, etc., providing after assembly and installation at the photovoltaic-module in normal use, an appropriate protection against external influences, and a defined protection against contact with enclosed live parts from any accessible direction

##### 3.1.1

##### **junction box for re-opening**

junction box that can be opened at any time

Note 1 to entry: It may contain rewirable and non-rewirable connections.

##### 3.1.1.1

##### **junction box for factory wiring**

junction box which is attached and connected to the PV module under controlled conditions, usually at manufacturer's location

##### 3.1.1.2

##### **junction box for field wiring**

junction box containing wiring connections that are intended to be made in the field

##### 3.1.2

##### **junction box, not intended to be re-opened**

junction box that cannot be opened after mounting in the end application

Note 1 to entry: It may contain rewirable and non-rewirable connections.

#### 3.2

##### **cable gland**

device permitting the introduction of one or more electric cables into the junction box so as to maintain the relevant type of protection

[SOURCE: IEC 60050-426:2008, 426-04-18, modified – "and/or fibre optics" has been deleted and "an electrical apparatus" has been replaced by "the junction box".]

#### 3.3

##### **sealing**

method for providing the ability of a component to resist the ingress of contaminants

[SOURCE: IEC 60050-581:2008, 581-23-16]

**3.4****spout hub**

open entry of a box permitting the insertion and containment of a conduit

**3.5****cable anchorage**

ability to limit the displacement of a fitted flexible cable against pull and push forces and torques

**3.6****connector for photovoltaic-systems**

component suitable for use in PV-systems that terminates conductors for the purpose of providing connection to and disconnection from a suitable mating component

**3.7****intended use**

use of a junction box in accordance with the information for use provided by the manufacturer

[SOURCE: IEC 60050-903:2013, 903-01-13, modified – "product, process or service" has been replaced by "junction box" and "supplier" has been replaced by "manufacturer".]

**3.8****terminal**

part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts that are necessary to ensure the correct contact pressure

**3.9****clearance**

shortest distance in air between two conductive parts

[SOURCE: IEC 60050-426:2008, 426-04-12]

**3.10****creepage distance**

shortest distance along the surface of the insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50, modified – "a solid" has been replaced by "the".]

**3.11****overvoltage category**

numeral defining a transient overvoltage condition

[SOURCE: IEC 60050-581:2008, 581-21-02]

**3.12****pollution**

any 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]

**3.13****pollution degree**

numeral characterising the expected pollution of the micro-environment

[SOURCE: IEC 60050-581:2008, 581-21-07]

**3.14****rated voltage**

value of voltage assigned by the manufacturer to the junction box and to which operation and performance characteristics are referred

Note 1 to entry: Rated voltage is equivalent to the rated system voltage according to IEC 61730-1.

[SOURCE: IEC 60664-1:2007, 3.9, modified – "a component, device or equipment" has been replaced by "the junction box" and the note has been replaced by Note 1 to entry.]

**3.15****rated insulation voltage**

r.m.s. withstand voltage value assigned by the manufacturer to the junction box, characterising the specified (long term) withstand capability of its insulation

Note 1 to entry: The rated insulation voltage is not necessarily equal to the rated voltage, which is primarily related to functional performance.

[SOURCE: IEC 60664-1:2007, 3.9.1, modified – "equipment or to a part of it" has been replaced by "junction box".]

**3.16****rated impulse voltage**

impulse withstand voltage value assigned by the manufacturer to the junction box, characterising the specified withstand capability of its insulation against transient overvoltages

[SOURCE: IEC 60664-1:2007, 3.9.2, modified – "equipment or to a part of it" has been replaced by "junction box".]

**3.17****impulse withstand voltage**

highest peak value of impulse voltage of prescribed form and polarity that does not cause breakdown of the insulation under specified conditions

Note 1 to entry: The impulse withstand voltage is equal to or higher than the rated impulse voltage.

[SOURCE: IEC 60664-1:2007, 3.8.1 – Note 1 to entry has been added.]

**3.18****r.m.s. withstand voltage**

power-frequency withstand voltage

highest r.m.s. value of a voltage that does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60664-1:2007, 3.8.2]

**3.19****Current****3.19.1****rated current**

current value assigned by the manufacturer, which the junction box can carry continuously (without interruption) and simultaneously through all its contacts and bypass-diodes, if applicable, wired with the largest specified conductor, at the highest specified ambient temperature, without the upper limiting temperature being exceeded

### 3.19.2 reverse current

$I_{REV}$

current value assigned by the manufacturer, which the junction box can carry at the highest specified ambient temperature, without causing a hazardous situation

Note 1 to entry: The reverse current is comparable with the reverse test current of the photovoltaic module (see IEC 61730-2).

### 3.20 functional insulation

insulation between conductive parts that is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60664-1:2007, 3.17.1]

### 3.21 basic insulation

insulation applied to live parts to provide basic protection against electric shock

Note 1 to entry: Basic insulation does not necessarily include insulation used exclusively for functional purposes (see IEC 61140:2001, 3.10.1).

[SOURCE: IEC 60664-1:2007, 3.17.2, modified – " against electric shock " and Note 1 to entry have been added.]

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### 3.22 supplementary insulation (standards.iteh.ai)

independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation

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[SOURCE: IEC 60664-1:2007, 3.17.3, modified – "for fault protection" has been replaced by "in order to provide protection against electric shock in the event of a failure of basic insulation".]

### 3.23 double insulation

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60664-1:2007, 3.17.4]

### 3.24 reinforced insulation

single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in the relevant IEC standard (IEC 61140:2001, 3.10.4)

Note 1 to entry: A single insulation system does not imply that the insulation must be a homogeneous piece. It may comprise several layers that cannot be tested singly as basic or supplementary insulation.

[SOURCE: IEC 60664-1:2007, 3.17.5, modified – "insulation of hazardous live parts" has been replaced by "single insulation system applied to live parts" and "under the conditions specified in the relevant IEC standard" and Note 1 to entry have been added.]

### 3.25 working voltage

highest r.m.s. value of the dc voltage across any particular insulation which can occur inside the junction box when the it operates at rated voltage

[SOURCE: IEC 60664-1:2007, 3.5, modified – "a.c. or" has been removed and "when the equipment is supplied at rated voltage" has been replaced by "which can occur inside the junction box when it operates at rated voltage".]

### 3.26

#### **comparitive 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

[SOURCE: IEC 60050-212:2010, 212-11-59]

### 3.27

#### **accessible part**

part which can be touched by means of standard test finger

[SOURCE: IEC 60050-442:1998, 442-01-15]

## **4 Constructional requirements and performance**

### **4.1 General**

For junction boxes according to this standard, no values have been specified for electric rated voltage and current. These values shall be declared by the manufacturer.

Junction boxes shall be suitable for durable use outside in an ambient temperature area from –40 °C to + 85 °C.

Junction boxes shall be so designed and dimensioned that they can withstand the electrical, mechanical, thermal and corrosive stresses occurring in their intended use and present no danger to the user or the environment.

Compliance with these requirements is verified by specified tests of this International Standard.

### **4.2 Marking and identification**

#### **4.2.1 Identification**

Junction boxes shall be identified and characterised by the following:

- a) manufacturer's name, trademark or mark of origin;
- b) type identification;
- c) rated current;
- d) rated voltages or rated insulation voltages;
- e) rated impulse voltage, if specified;
- f) maximum working voltage;
- g) pollution degree;
- h) degree of protection by enclosure according to IEC 60529;
- i) range of temperature; (lowest and upper ambient temperature), if different from this standard;
- j) type of terminals;
- k) connectable conductors;
- l) reference to this standard, if applicable;