INTERNATIONAL STANDARD

IEC 60364-7-712

First edition
2002-05

Electrical installations of buildings –

Part 7-712:
Requirements for special installations or locations –
Solar photovoltaic (PV) power supply systems

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS OF BUILDINGS –

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60364-7-712 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

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

FDIS	Report on voting
64/1229/FDIS	64/1244/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

The requirements of this part of IEC 60364 supplement, modify or replace certain of the general requirements contained in parts 1 to 6 of IEC 60364.

The clause numbering appearing after 712 refers to the corresponding parts or clauses of IEC 60364, parts 1 to 6. Numbering of clauses does not, therefore, necessarily follow sequentially. Numbering of figures and tables takes the number of this part followed by a sequential number.

The absence of reference to a part or a clause means that the general requirements contained in parts 1 to 6 of IEC 60364 are applicable.

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems

712 Solar photovoltaic (PV) power supply systems

NOTE The abbreviation "PV" is used for "solar photovoltaic".

712.1 Scope

The particular requirements of this part of IEC 60364 apply to the electrical installations of PV power supply systems including systems with AC modules.

NOTE 1 Standards for PV equipment are being prepared by TC 82.

NOTE 2 Requirements for PV power supply systems which are intended for stand-alone operation are under consideration.

712.2 Normative references

The following referenced documents are indispensable for the application 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 60050(826):1982, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*

IEC 60439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*

IEC/TR 60755, *General requirements for residual current operated protective devices* Amendment 2 (1992)

IEC 60904-3, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 61215, *Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval*

712.3 Definitions

(See also figures 712.1 and 712.2).

For the purpose of this part of IEC 60364, the definitions of IEC 60050(826) as well as the following definitions apply.

712.3.1
PV cell
basic PV device which can generate electricity when exposed to light such as solar radiation

712.3.2
PV module
smallest completely environmentally protected assembly of interconnected PV cells

712.3.3
PV string
circuit in which PV modules are connected in series, in order for a PV array to generate the required output voltage

712.3.4
PV array
mechanically and electrically integrated assembly of PV modules, and other necessary components, to form a DC power supply unit

712.3.5
PV array junction box
enclosure where all PV strings of any PV array are electrically connected and where protection devices can be located if necessary

712.3.6
PV generator
assembly of PV arrays

712.3.7
PV generator junction box
enclosure where all PV arrays are electrically connected and where protection devices can be located if necessary

712.3.8
PV string cable
cable connecting PV modules to form a PV string

712.3.9
PV array cable
output cable of a PV array

712.3.10
PV DC main cable
cable connecting the PV generator junction box to the DC terminals of the PV inverter

712.3.11
PV inverter
device which converts DC voltage and DC current into AC voltage and AC current

712.3.12
PV supply cable

cable connecting the AC terminals of the PV inverter to a distribution circuit of the electrical installation

712.3.13
PV AC module
integrated module/inverter assembly where the electrical interface terminals are AC only. No access is provided to the DC side

712.3.14
PV installation
erected equipment of a PV power supply system

712.3.15
standard test conditions (STC)
test conditions specified in IEC 60904-3 for PV cells and PV modules

712.3.16
open-circuit voltage under standard test conditions $U_{OC\ STC}$
voltage under standard test conditions across an unloaded (open) PV module, PV string, PV array, PV generator or on the DC side of the PV inverter

712.3.17
short-circuit current under standard test conditions $I_{SC\ STC}$
short-circuit current of a PV module, PV string, PV array or PV generator under standard test conditions

712.3.18
DC side
part of a PV installation from a PV cell to the DC terminals of the PV inverter

712.3.19
AC side
part of a PV installation from the AC terminals of the PV inverter to the point of connection of the PV supply cable to the electrical installation

712.3.20
simple separation
separation between circuits or between a circuit and earth by means of basic insulation

712.30 Assessment of general characteristics

712.31 Purpose, supplies and structure

712.312 Types of distribution systems

712.312.2 Types of system earthing

Earthing of one of the live conductors of the DC side is permitted, if there is at least simple separation between the AC side and the DC side.

NOTE Any connections with earth on the DC side should be electrically connected so as to avoid corrosion.

712.4 Protection for safety

712.41 Protection against electric shock

PV equipment on the DC side shall be considered to be energized, even when the system is disconnected from the AC side.

The selection and erection of equipment shall facilitate safe maintenance and shall not adversely affect provisions made by the manufacturer of the PV equipment to enable maintenance or service work to be carried out safely.

712.411 Protection against both direct and indirect contact

712.411.1 Protection by extra-low voltage: SELV and PELV

For SELV and PELV systems, $U_{OC\ STC}$ replaces U_n and shall not exceed 120 V DC.

712.413 Fault protection

712.413.1 Protection by automatic disconnection of supply

NOTE Protection by automatic disconnection of supply on the DC side requires special measures which are under consideration.

712.413.1.1.1.1 On the AC side, the PV supply cable shall be connected to the supply side of the protective device for automatic disconnection of circuits supplying current-using equipment.

712.413.1.1.1.2 Where an electrical installation includes a PV power supply system without at least simple separation between the AC side and the DC side, an RCD installed to provide fault protection by automatic disconnection of supply shall be type B according to IEC 60755, amendment 2.

Where the PV inverter by construction is not able to feed DC fault currents into the electrical installation, an RCD of type B according to IEC 60755 amendment 2 is not required

712.413.2 Protection by use of class II or equivalent insulation should preferably be adopted on the DC side.

712.413.3 Protection by non-conducting locations is not permitted on the DC side.

712.413.4 Protection by earth-free local equipotential bonding is not permitted on the DC side.

712.433 Protection against overload on the DC side

712.433.1 Overload protection may be omitted to PV string and PV array cables when the continuous current-carrying capacity of the cable is equal to or greater than 1,25 times $I_{SC\ STC}$ at any location.

712.433.2 Overload protection may be omitted to the PV main cable if the continuous current-carrying capacity is equal to or greater than 1,25 times $I_{SC\ STC}$ of the PV generator.

NOTE The requirements of 712.433.1 and 712.433.2 are only relevant for protection of the cables. See as well the manufacturer's instructions for protection of PV modules.

712.434 Protection against short-circuit currents

712.434.1 The PV supply cable on the AC side shall be protected by a short circuit or an overcurrent protective device installed at the connection to the AC mains.

712.444 Protection against electromagnetic interference (EMI) in buildings

712.444.4.4 To minimize voltages induced by lightning, the area of all wiring loops shall be as small as possible.

712.5 Selection and erection of electrical equipment

712.51 Common rules

712.511 Compliance with standards

712.511.1 PV modules shall comply with the requirements of the relevant equipment standard, e.g. IEC 61215 for crystalline PV modules. PV modules of class II construction or with equivalent insulation are recommended if $U_{OC\ STC}$ of the PV strings exceeds 120 V DC.

The PV array junction box, PV generator junction box and switchgear assemblies shall be in compliance with IEC 60439-1.

712.512 Operational conditions and external influences

712.512.1.1 Electrical equipment on the DC side shall be suitable for direct voltage and direct current.

PV modules may be connected in series up to the maximum allowed operating voltage of the PV modules and the PV inverter, whichever is lower. Specifications for this equipment shall be obtained from the equipment manufacturer.

If blocking diodes are used, their reverse voltage shall be rated for $2 \times U_{OC\ STC}$ of the PV string. The blocking diodes shall be connected in series with the PV strings.

712.512.2.1 As specified by the manufacturer, the PV modules shall be installed in such a way that there is adequate heat dissipation under conditions of maximum solar radiation for the site.

712.52 Wiring systems

712.522 Selection and erection in relation to external influences

712.522.8.1 PV string cables, PV array cables and PV DC main cables shall be selected and erected so as to minimize the risk of earth faults and short-circuits.

NOTE This may be achieved for example by reinforcing the protection of the wiring against external influences by the use of single-core sheathed cables.

712.522.8.3 Wiring systems shall withstand the expected external influences such as wind, ice formation, temperature and solar radiation.

712.53 Isolation, switching and control

712.536 Isolation and switching

712.536.2 Isolation

712.536.2.1.1 To allow maintenance of the PV inverter, means of isolating the PV inverter from the DC side and the AC side shall be provided.

NOTE Further requirements with regard to the isolation of a PV installation operating in parallel with the public supply system are given in 551.7 of IEC 60364-5-55 [1].

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[1] IEC 60364-5-55, *Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment – Other equipment.*

712.536.2.2 Devices for isolation

712.536.2.2.1 In the selection and erection of devices for isolation and switching to be installed between the PV installation and the public supply, the public supply shall be considered the source and the PV installation shall be considered the load.

712.536.2.2.5 A switch disconnector shall be provided on the DC side of the PV inverter.

712.536.2.2.5.1 All junction boxes (PV generator and PV array boxes) shall carry a warning label indicating that active parts inside the boxes may still be live after isolation from the PV inverter.

712.54 Earthing arrangements, protective conductors and protective bonding conductors

Where protective equipotential bonding conductors are installed, they shall be parallel to and in close contact as possible with DC cables and AC cables and accessories.