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Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment

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Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment

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IEC 62920 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

This second edition cancels and replaces the first edition published in 2017 and Amendment 1:2021. This edition constitutes a technical revision.

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

a) PCE with radio functionality is added in the scope;
b) operating conditions for tests are revised to cover wired and wireless communications;
c) immunity requirements for antenna ports are added;
d) the surge test is added in the immunity requirements for wired and wireless network ports of class B PCE;

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e) performance criteria are revised to cover wired and wireless communications;

f) current limits are added in the table of disturbance limits at the DC power port for class A PCE to cover requirements of the measurement of common mode current when artificial networks are used as voltage probes;

g) limits of conducted common mode disturbance at the antenna port are added;

h) conditional measurement methods and limits of conducted common mode (asymmetric mode) disturbance at ports other than power ports are added;

i) electromagnetic radiation disturbance limits above 1 GHz are added;

j) an annex for the rational conditional measurement methods and limits of conducted common mode (asymmetric mode) disturbance at ports other than power ports is added.

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

Draft	Report on voting
82/2652/FDIS	82/2702/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.

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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

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INTRODUCTION

Background

Power conversion equipment (PCE) is indispensable for solar photovoltaic power energy systems in order to convert the DC electric power energy generated by solar photovoltaic modules into AC or DC electric power, and to feed the AC power energy into the AC mains network or loads. PCE consists of DC to DC, DC to AC or AC to DC converters and forms systems with or without DC-coupled electrical energy storage devices.

Manufacturers of PCE ensure the performance and reliability of PCE. Electromagnetic compatibility (EMC) is one aspect of performance which must be ensured wherever PCE is used in or exposed to an electromagnetic environment.

IEC Guide 107 specifies that TC 77 and CISPR, which are called EMC committees, have responsibility for the development of basic, product family and generic standards on EMC requirements, and product committees must use the emission limits developed by EMC committees and must refer to basic immunity standards for the specification of test techniques.

However, when the EMC standards which are developed by TC 77 and CISPR are not considered suitable for a particular product or electromagnetic environment, product committees must seek their assistance and advice for any change in either the emission limits or measurement requirements, or both. Product committees are responsible for selecting the appropriate immunity test items and levels for their products as well as for defining the relevant performance criteria for the evaluation of the immunity test results. Consequently, product committees, such as TC 22, TC 26, TC 9, and TC 69, have their own EMC standard to define EMC requirements and test methods for their particular types of products.

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TC 82 also has the responsibility to consider EMC requirements for PCE applying to the solar photovoltaic power energy systems, and TC 82 has taken action as follows to develop its own product EMC standards:

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a) selection of the immunity test items in accordance with EMC environments for the solar photovoltaic power energy systems;

b) supplement of generic standards with a detailed description of test conditions and test set up;

c) development of the conditional limits and alternative test methods in terms of installation environmental and operational conditions;

d) development of appropriate requirements and test method for high power equipment.

In 2017, TC 82 published IEC 62920 (ed.1.0) and covered the minimum EMC requirements for PCE applying to solar photovoltaic power energy systems in consideration with the above-mentioned items.

Following the state-of-the-art technology as well as the latest market needs, IEC 62920:2017 is amended to extend its scope by taking into account the following technical items:

– DC to DC power conversion equipment used in photovoltaic power energy systems;

– electrical energy storage devices connected to DC power ports of PCE used in photovoltaic power energy systems;

– 5 m antenna distance of radiated disturbance measurements for the medium size PCE.

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Maintenance of IEC 62920:2017 and IEC 62920:2017/AMD1:2017

For the purpose of keeping the consistency with EMC basic standards and considering market needs, TC 82 started the maintenance of IEC 62920:2017 and IEC 62920:2017/AMD1:2017 for the development of ed.2.0 in November 2021.

This document covers the following items:

– PCE with radio functionality is added in the scope;
– normative references are updated;
– some terms and definitions are updated or deleted;
– terms and definitions relevant to radio functionality are added;
– the classification of PCE is revised to introduce the location classes;
– the configurations of test setups are revised to cover the operation of the wired and wireless functions;
– setups for high frequency emission requirement test are updated to keep the consistency with EMC basic standards, such as CISPR 16-1-2 and CISPR 16-2-3;
– operating conditions for tests are revised to cover wired and wireless communications;
– immunity requirements for antenna ports are added;
– the surge test is added in the immunity requirements for wired and wireless network ports of class B PCE;
– immunity requirements regarding IEC 61000-4-3 are revised to fill the gap of frequency range;
– performance criteria are revised to cover wired and wireless communications;
– current limits are added in the table of disturbance limits at the DC power port for class A PCE to cover requirements of the measurement of common mode current when artificial networks are used as voltage probes;
– limits of conducted common mode disturbance at the antenna port are added;
– conditional measurement methods and limits of conducted common mode (asymmetric mode) disturbance at ports other than power ports are added;
– electromagnetic radiation disturbance limits above 1 GHz are added;
– an annex for the rational conditional measurement methods and limits of conducted common mode (asymmetric mode) disturbance at ports other than power ports is added.

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1 Scope

This document specifies electromagnetic compatibility (EMC) requirements for power conversion equipment (PCE) (e.g. DC to DC, DC to AC and AC to DC) for use in photovoltaic (PV) power systems with or without electrical energy storage devices.

PCE covered by this document can be grid-interactive, which is termed as a grid connected power converter (GCPC), or stand-alone. It can be supplied by single or multiple photovoltaic modules grouped in various array configurations. The PCE can be intended for use in conjunction with batteries or other forms of energy storage and therefore a uni- or bidirectional.

This document covers not only PCE connected to a public low voltage AC mains network or other low voltage AC mains installation, but also PCE connected to a medium or high voltage AC network with or without step-down power transformers. Requirements for the PCE connected to a medium or high voltage AC network are specified in this document. However, some requirements relevant to grid interconnection are addressed with other standards specifying power quality or their own grid codes in some countries.

This document provides test methods and test conditions for PCE at a test site, but not for photovoltaic modules and other balance of system components.

PCE which incorporates either radio transmit or receive, or both functions, as wireless communication functions, is included in the scope of this document as PCE with radio functionality. However, the emission requirements in this document are not intended to be applicable to the intentional transmissions from a radio transmitter as defined by the ITU including their spurious emissions.

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When compliance with EMC requirements at the test site cannot be shown due to technical reasons of the test site, PCE can be assessed in situ. However, only high frequency emission requirements for in situ assessment are specified in CISPR 11.

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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 60050-195:2021, *International Electrotechnical Vocabulary (IEV) - Part 195: Earthing and protection against electric shock*

IEC 60050-485:2020, *International Electrotechnical Vocabulary (IEV) - Part 485: Fuel cell technologies*

IEC 60050-601:1985, *International Electrotechnical Vocabulary (IEV) - Part 601: Generation, transmission and distribution of electricity - General*

IEC TS 61836:2025, *Solar photovoltaic energy systems - Terms, definitions and symbols*

IEC 61000-3-2:2018, *Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
IEC 61000-3-2:2018/AMD1:2020
IEC 61000-3-2:2018/AMD2:2024

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IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*
IEC 61000-3-3:2013/AMD1:2017
IEC 61000-3-3:2013/AMD2:2021

IEC 61000-3-11:2017, *Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*
IEC 61000-3-12:2011/AMD1:2021

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

IEC 61000-4-3, *Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*

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*
IEC 61000-4-5:2014/AMD1:2017

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IEC 61000-4-6:2023, *Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields*

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IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per* phase

IEC 61000-4-15, *Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications*

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009
IEC 61000-4-34:2005/AMD2:2025

IEC 61000-6-3:2026, *Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential locations*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments*

IEC 61000-6-8:2020, *Electromagnetic compatibility (EMC) - Part 6-8: Generic standards - Emission standard for professional equipment in commercial and light-industrial locations*

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IEC 62109-1:2010, *Safety of power converters for use in photovoltaic power systems - Part 1: General requirements*

CISPR 11:2024, *Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement*

CISPR 16-1-1:2019*, Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus*

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Coupling devices for conducted disturbance measurements*
CISPR 16-1-2:2014/AMD1:2017

CISPR 16-1-4:2025*, Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements*

CISPR 16-1-6:2014*, Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-6: Radio disturbance and immunity measuring apparatus - EMC antenna calibration*
CISPR 16-1-6 2014/AMD1:2017
CISPR 16-1-6 2014/AMD2:2022

CISPR 16-2-1:2014, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements*
CISPR 16-2-1:2014/AMD1:2017

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements*
CISPR 16-2-3:2016/AMD1:2019
CISPR 16-2-3:2016/AMD2:2023

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-195, IEC 60050-485, IEC 60050-601, IEC 60050-713, IEC 61000-6-3, IEC 61000-6-4, IEC TS 61836, IEC 62109-1 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
photovoltaic power generating system
PV system
electric power generating system which uses the photovoltaic effect to convert solar power into electricity

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3.2
power conversion equipment
PCE
electrical device converting one form of electrical power to another form of electrical power with respect to voltage, current, frequency, phase and the number of phases

[SOURCE: IEC 62109-1:2010, 3.66, modified – "one kind of electrical power from a voltage or current source into another kind of electrical power" has been replaced with "one form of electrical power to another form of electrical power", "with respect to voltage, current and frequency" has been replaced by "with respect to voltage, current, frequency, phase and the number of phases". The note has been deleted.]

3.3
photovoltaic module
PV module
basic DC power unit consisting of interconnected photovoltaic cells protected from the environment

[SOURCE: IEC TS 61836:2025, 3.1.44, modified – The notes to entry have been deleted.]

3.4
electrical energy storage device
device that is able to absorb electrical energy, to store it for a certain amount of time and to release electrical energy during which energy conversion processes can be included

3.5
port
physical interface of the PCE with the external electromagnetic environment

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Note 1 to entry: See Figure 1 for examples of ports.

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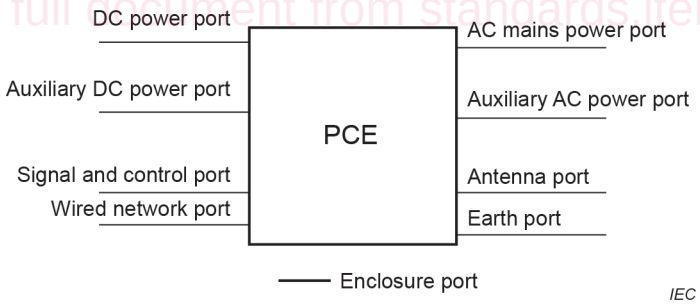


Figure 1 – Example of ports

3.6
enclosure port
physical boundary of the PCE product which electromagnetic fields can radiate through or impinge on

3.7
AC mains power port
port used to connect to a public low voltage AC mains power distribution network or other low voltage AC mains installation

3.8
auxiliary AC power port
additional low voltage AC power port for purposes other than feeding in AC power

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3.9
DC power port
port used to connect a local low voltage DC power generating system or electrical energy storage devices

3.10
auxiliary DC power port
additional low voltage DC power port for purposes other than supplying DC power for the DC to AC conversion or electrical energy storage devices

3.11
signal and control port
port intended for the interconnection of components of PCE, or between PCE and local auxiliary equipment, and used in accordance with relevant functional specifications

Note 1 to entry: Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE standard 1394 ("Fire Wire") and control pilot.

[SOURCE: CISPR 32:2015 and CISPR 32:2015/AMD1:2019, 3.1.30, modified – The slash has been replaced with "and" in the term; "an EUT" has been replaced with "PCE"; "EUT and local AE" has been replaced by "PCE and local auxiliary equipment"; "(for example for the maximum length of cable connected to it)" has been deleted; "waveguide ports used for interconnecting MME" has been replaced with “control pilot” in the note to entry.]

3.12
wired network port
point to connection for voice, data and signalling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network

Sample Document

Note 1 to entry: Examples include CATV, PSTN, ISDN, xDSL, LAN and similar networks. These ports can support screened or unscreened cables and can also carry AC or DC power where this is an integral part of the telecommunication specification.

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3.13
antenna port
port for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

[SOURCE: CISPR 32:2015, 3.1.3, modified – "other than a broadcast receiver tuner port" has been deleted.]

3.14
HPE
high power electronic equipment and system
one or more power conversion equipment with a combined rated power greater than 75 kVA, or a system containing such equipment

3.15
low voltage
LV
voltage not exceeding a conventionally adopted limit

Note 1 to entry: For AC, the conventionally adopted limit is 1 000 V.

Note 2 to entry: For DC, the conventionally adopted limit is 1 500 V.

[SOURCE: IEC 60050-195:2021, 195-05-25]

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