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Title: BS EN IEC 62920-1 Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment

Part 1: EMC requirements and test methods for power conversion equipment

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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IEC TC 82 : SOLAR PHOTOVOLTAIC ENERGY SYSTEMS	
SECRETARIAT: United States of America	SECRETARY: Mr George Kelly
OF INTEREST TO THE FOLLOWING COMMITTEES: SC 22E, SC 22H ,SC 77A, CIS/B	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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

NOTE FROM TC/SC OFFICERS: This project was discussed and supported by WG6 during their meeting in 2023-10.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC POWER GENERATING SYSTEMS –
EMC REQUIREMENTS AND TEST METHODS FOR
POWER CONVERSION EQUIPMENT****FOREWORD**

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

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

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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 panels 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 the emission limits and/or measurement requirements. 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.

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:

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

In 2017, TC82 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 (Ed.1.0) is amended to extend the scope of IEC 62920:2017 (Ed.1.0) 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.

Maintenance of IEC 62920 Ed.1.1

For the purpose of keeping the consistency with EMC basic standards and considering market needs, TC82 started the maintenance of IEC 62920 Ed.1.1 for the development of Ed.2.0 in November 2021.

The Ed. 2.0 of IEC 62920 covers the following items:

- PCE with radio functionality is added in the scope,
- normative references are updated,
- some terms and definitions are updated and deleted,
- terms and definitions relevant to radio functionality are added,
- the classification of PCE is revised to introduce the location class,
- 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,
- 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,
- Electromagnetic radiation disturbance limits above 1 GHz are added.

PHOTOVOLTAIC POWER GENERATING SYSTEMS – EMC REQUIREMENTS AND TEST METHODS FOR POWER CONVERSION EQUIPMENT

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 radio transmit/receive functions or wireless communication functions (PCE with radio functionality), is included in the scope of this document. 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.

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. Clause 7.6 of CISPR 16-2-1 specifies conditions of in situ measurements for conducted emission, and Clause 7.7 of CISPR 16-2-3 for radiated emission. Immunity tests are not required in the case of in situ.

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 61000-3-2:2020, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment with input current ≤ 16 A per phase)*

IEC 61000-3-3:2021, *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 61000-3-11:2017, *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 61000-3-12:2021, *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 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2020, *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 61000-4-5:2017, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

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

IEC 61000-4-7:2008, *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*

IEC 61000-4-34:2009, *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*

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

CISPR 16-1-2:2017, *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 32:2019, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminological 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

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 – The definition has been rephrased, and the note has been deleted.]

3.3

photovoltaic module

PV modules

complete and environmentally protected assembly of interconnected photovoltaic cells

[SOURCE: IEC TS 61836:2016, 3.1.45.g, modified – The note has been deleted.]

3.4

electrical energy storage devices

ESS

devices that are able to absorb electrical energy, to store it for a certain amount of time and to release electrical energy during which energy conversion processes may be included

[SOURCE: IEC 62933-1:2018, 3.1, modified - The example and the note have been deleted.]

3.5

port

physical interface of the PCE with the external electromagnetic environment

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

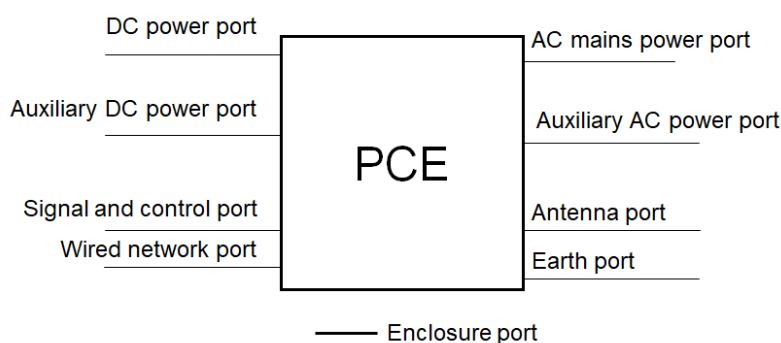


Figure 1 – Example of ports

184

185 **3.6**186 **enclosure port**

187 physical boundary of the PCE product which electromagnetic fields may radiate through or
188 impinge on

189 **3.7**190 **AC mains power port**

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

193 **3.8**194 **auxiliary AC power port**

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

196 **3.9**197 **DC power port**

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

200 **3.10**201 **auxiliary DC power port**

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

204 **3.11**205 **signal and control port**

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

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

210 **3.12**211 **wired network port**

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

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

217 **3.13**218 **antenna port**

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

221 [SOURCE: CISPR 32:2019, 3.1.3, modified]

222 **3.14**223 **high power electronic equipment and system**224 **HPE**

225 one or more power conversion equipment with a combined rated power greater than 75 kVA, or
226 a system containing such equipment

3.15**low voltage****LV**

set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V AC or 1 500 V DC

3.16**high voltage****HV**

1) in a general sense, the set of voltage levels in excess of low voltage

2) in a restrictive sense, the set of upper voltage levels used in power system for bulk transmission of electricity

[SOURCE: IEC 60050-601:1985, 601-01-27]

3.17**medium voltage****MV**

any set of voltage levels lying between low and high voltage

[SOURCE: IEC 60050-601:1985, 601-01-28, modified – The note has been deleted.]

3.18**small equipment under test**

small EUT

equipment under test, either positioned on a table top or standing on the floor, which, including its cables, fits in a cylindrical volume of 1,5 m in diameter and 1,5 m height (as measured from the floor)

Note 1 to entry: At an OATS or in a SAC, the radiated emission measurement distance of 3 m shall only be used for small EUT [SOURCE: CISPR 16-2-3:2019, 3.1.35, modified – only use the volume for 3 m measurement distance]

3.19**medium equipment under test**

medium EUT

equipment under test, either positioned on a table top or standing on the floor, which, including its cables, fits in a cylindrical volume of 2 m in diameter and 2 m height (as measured from the floor)

Note 1 to entry: At an OATS or in a SAC, the radiated emission measurement distance of 5 m shall only be used for medium EUT

3.20**residential location**

area of land designated for domestic dwellings where the mains power within these locations is directly connected to the low-voltage public mains network

Note 1 to entry: Examples of residential locations are: houses, apartments, farm buildings housing people.

Note 2 to entry: A dwelling can be a single building, separate building or a separate section of a larger building.

Note 3 to entry: Within these locations it is expected to operate a radio receiver within a distance of 10 m from the equipment.

Note 4 to entry: Domestic dwellings are places for one or more people to live.

[SOURCE: IEC 61000-6-3:2020]

3.21**commercial and light-industrial location**

location which are not residential in accordance with 3.20, where the mains supply is directly connected to the low-voltage public network or connected to a dedicated DC source which is intended to interface between the equipment and the low-voltage public mains network.

Note 1 to entry: Examples of commercial or light-industrial locations are:

- retail outlets,
- business premises,
- areas of public entertainment,
- places of worship,
- outdoor locations,
- general public locations,
- hospitals, educational institutions,
- public traffic area, railway stations, and public areas of an airport,
- specific common area of buildings, such as basements, control rooms, electrical service areas,
- workshops, laboratories, service centres.

Note 2 to entry: Within these locations, it is expected to operate a radio receiver within a distance of 30 m from the equipment. The risk of interference will be minimized by following the instructions defined in Clause 6 of IEC 61000-6-8.

[SOURCE: IEC 61000-6-8:2020]

3.22**industrial location**

location characterized by a separate power network, supplied from a high- or medium-voltage transformer, dedicated for the supply of the installation

[SOURCE: IEC 61000-6-4:2018]

3.23**PCE-MV**

PCE including a medium voltage transformer

3.24**artificial mains network****AMN**

network that provides a defined impedance to the equipment under test (EUT) at radio frequencies, couples the disturbance voltage to the measuring receiver and decouples the test circuit from the low voltage AC mains supply

3.25**artificial DC network****DC-AN**

artificial network used for defined termination of the EUT's port under test while also providing the necessary decoupling from conducted disturbances originating from the laboratory low voltage DC power source

3.26**PCE with radio functionality**

PCE (non-radio host equipment) including one or more radio devices or plug-in radio modules that can use host control function(s) and/or power supply

Note 1 to entry: The use of the included radio equipment can be for remote control (of the host equipment by an external equipment or vice versa) or for data exchange with external equipment.

3.27**radio device**

assembly consisting of one or more radio transmitters and/or receivers, capable to function on a stand-alone basis with or without additional accessories

Note 1 to entry: These accessories can be incorporated in the assembly or connected to it from outside. Examples of accessories are: external antenna, remote control, headsets, power supply, display, etc.

3.28 radio module

assembly consisting of one or more radio transmitters and/or receivers, intended to be incorporated in a host equipment

Note 1 to entry: A radio module can incorporate a power supply or any other accessories.

3.29 radio transmitter

device producing radio-frequency energy intended to be radiated by an antenna for the purpose of radiocommunication

[SOURCE: IEC 60050-713:1998, 713-08-01 – modified]

3.30 (radio) receiver

1 – a device for detecting radio-frequency radiation and extracting certain characteristics

2 – in radiocommunication, a device with associated antenna or including an antenna, used to select the desired radio-frequency signals from the incident radio-frequency radiation, to amplify them, demodulate them and if necessary convert the recovered signals into a directly usable form such as sounds or pictures

[SOURCE: IEC 60050-713:1998/AMD5:2021, 713-10-02 (Radiocommunications)]

3.31 rated power

maximum continuous electric power output and input that PCE is designed to achieve under normal operating conditions specified by the manufacturer

Note 1 to entry: The rated power is expressed in VA.

[SOURCE: IEC 60050-485:2020, 485-14-04 (Fuel cell technologies) – modified]

4 Classification of PCE

4.1 Category of locations

In consideration of the intended use of PCE at locations of installation and according to the definition of locations in the generic EMC standards, the following three locations are applied in this document for both emission and immunity requirements. Definitions of each location class are defined in Clause 3.

- Residential location (See 3.20)
- Commercial and light industrial location (See 3.21)
- Industrial location (See 3.22)

4.2 Division into classes

In order to harmonize with basic, generic and product family standards, this document defines two classes of equipment, such as class A PCE and class B PCE as follows.

- Class A PCE is suitable for use in the commercial and light industrial location, or industry location. If a public low voltage AC mains network supplies both locations, such as a commercial and light industrial location and a residential location designated for domestic dwellings, Class A PCE is not suitable, and only Class B PCE is suitable for use in this location. In addition, conditions in the scope of IEC 61000-6-8 applies.

- Class B PCE is suitable for use in the residential location.

4.3 Information for users

The manufacturer and/or supplier of PCE shall ensure that the user is informed of the class either by labelling or by the accompanying documentation.

PCE not suitable for residential environments shall include the following caution in an instruction manual.

Caution for the residential location: This PCE is not intended for use at the residential location, and this PCE may cause radio interference, in which case the user may be required to take additional mitigation measures against electromagnetic interference.

Caution for the industry location: Wireless communication may be disturbed within non-residential environment.

5 Test setup

5.1 General

Emission and immunity testing of PCE can be conducted with or without solar photovoltaic modules or storage devices. However, only the PCE is subject to testing. Therefore, the test may be conducted with a uni- or bi-directional appropriate DC power supply to simulate a PV module and a storage device. The DC power supply shall provide a continuous and stable DC voltage, load or power during testing. In addition, this alternative DC supply shall be designed in such a manner that harmonics and electromagnetic disturbance from the DC supply do not influence test results.

Similarly, a uni- or bi-directional appropriate AC power supply should be used so that continuous and stable AC voltage and frequency for the PCE can be supplied during testing. Harmonics and electromagnetic disturbance generated by the AC power source shall not influence test results.

The uni- or bi-directional appropriate DC power supply and AC power supply are connected to the DC power port and the AC mains power port respectively. Auxiliary power ports, if any, and if necessary to operate the PCE as intended, shall be connected to the appropriate power supply during testing.

The uni- or bi-directional AC and/or DC power supply shall support all operating modes of PCE to be tested.

5.2 Configuration of test setups

5.2.1 General

The PCE shall be set up within its actual installation condition during the evaluation of immunity and emission requirements. Connection of cables shall follow installation manuals to be applied. The installation manuals also include applicable instructions for mounting covers and/or access panels especially when the PCE is powered.

The basic standards define test setups. Hence, this document supplements the basic standards and provides descriptions regarding testing arrangement for wall-mounted PCE in Annex A.

Micro inverters can be tested as wall-mounted PCE. Configuration examples of test setup for wall-mounted PCE can be applied for micro inverters.