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Part 5: Power Quality and EMC

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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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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.	



82/2296/CD

COMMITTEE DRAFT (CD)

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SECRETARIAT:

United States of America

SECRETARY:

Mr George Kelly

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 8,TC 9,TC 22,TC 57,TC 69,TC 77,TC 88,TC 95,ACTAD

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Electromagnetic Compatibility

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TITLE:

Photovoltaic power generating systems connection with grid - Testing of power conversion equipment - Part 5: Power Quality and EMC

NOTE FROM TC/SC OFFICERS:

This project was discussed and supported by WG6 during their meeting in 2024-04.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC POWER GENERATING SYSTEMS CONNECTION WITH
THE GRID – TESTING FOR POWER CONVERSION EQUIPMENT****Part 5: Electromagnetic compatibility for low frequency conducted
disturbances**

FOREWORD

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IEC 6XXXX has been prepared by subcommittee XX: TITLE, of IEC technical committee XX: TITLE. It is [...an International Standard, a Technical Specification: specify document type...].

The text of this [...International Standard, Technical Specification: specify document type...] is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

162 The language used for the development of this [...International Standard, Technical
163 Specification: specify document type...] is English [change language if necessary].

164 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
165 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement,
166 available at https://www.iec.ch/members_experts/refdocs. The main document types
167 developed by IEC are described in greater detail at
168 <https://www.iec.ch/standardsdev/publications>.

169 The committee has decided that the contents of this document will remain unchanged until the
170 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
171 specific document. At this date, the document will be

- 172 • reconfirmed,
- 173 • withdrawn,
- 174 • replaced by a revised edition, or
- 175 • amended.

176

177

INTRODUCTION

178 Power conversion equipment (PCE) is indispensable for Photovoltaic (PV) power systems in
179 order to feed the AC power energy into the grid with conversion of solar power into electricity.
180 Therefore, manufacturers of PCE ensure the performance and reliability of PCE. The
181 electromagnetic compatibility (EMC) are important aspects for the preservation of the stability,
182 reliability and efficiency of the grid and must be ensured so that PV power systems can avoid
183 causing interference.

184 IEC 62920 has already existed as an international standard which specifies EMC
185 requirements for PCE for use in PV power systems. However, IEC 62920 specifies EMC
186 requirements relevant to protection of radio communications and emission and immunity
187 levels with respect to high frequency electromagnetic phenomena, which are not relevant to
188 the stability, reliability and efficiency of the grid.

189 This document complements EMC requirements for low frequency conducted disturbances
190 regarding the connection of PCE with the grid. Furthermore, the document proposes the
191 classification of environments and locations where PCE is connected so that required
192 emission and immunity levels for the stability, reliability and efficiency of the grid can be
193 clarified.

194

PHOTOVOLTAIC POWER GENERATING SYSTEMS CONNECTION WITH THE GRID – TESTING FOR POWER CONVERSION EQUIPMENT

Part 5: Electromagnetic compatibility for low frequency conducted disturbances

1 Scope

This part of the IEC 63409 series specifies the conditions and procedures to evaluate electromagnetic compatibility (EMC) requirements for low frequency conducted disturbances regarding the connection with the grid of power conversion equipment (PCE), which is used in photovoltaic power systems, with or without electrical energy storage devices.

This document covers the following low frequency conducted electromagnetic phenomena as the EMC requirements:

- harmonics and inter-harmonics,
- voltage fluctuations and flicker,
- voltage unbalance,
- frequency variation
- DC components.

This document does not cover EMC requirements relevant to high frequency electromagnetic phenomena and the protection of radio communications.

EMC requirements are different for each power supply network and each location. Referring to the existing IEC documents on EMC, annexes of this document summarize application points of EMC requirements, the classification of requirements specified with respect to electromagnetic environments, types of the grid, and locations of PCE.

Annex A summarizes reference points specified in the several EMC standards such as IEC 61000-2-2, IEC 61000-2-4, and IEC 61000-2-12. Figure A.4 shows the relation between compatibility, immunity, emission and planning levels, referring to Annex A of IEC 61000-2-2.

Annex B summarizes electromagnetic environment classes, compatibility levels for each electromagnetic phenomenon by referring to IEC 61000-2-2, IEC 61000-2-4, IEC 61000-2-12, and IEC TR 61000-2-5.

Annex C summarizes emission and immunity requirements for dispersed generation equipment up to 75 A proposed in IEC TR 61000-3-15.

Annex D briefly describes the minimum requirements for frequency measurements used to control distributed energy resources. This document takes some of them into account as the required immunity tests for PV PCE connected with the grid.

Annex E summarizes the classifications to be applied to each electromagnetic phenomenon.

In this document, emission and immunity requirements for PV PCE connected with grid are specified in consideration of Table E.1.

This document covers PCE which has the following electrical features:

- PCE is connected to a public low and medium voltage AC network or other low and medium voltage AC installation and therefore can be grid-interactive, which is termed as a grid connected power converter (GCPC),

- PCE can be supplied by single or multiple photovoltaic modules grouped in various array configurations, and
- PCE can be intended for use in conjunction with batteries or other forms of energy storage and therefore be uni- or bi-directional power conversion equipment.

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 61000-2-2:2018, *Electromagnetic compatibility (EMC) - Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-2-4:2024, *Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances*

IEC 61000-3-2:2020, *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 61000-3-12:2021, *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 61000-3-3:2020, *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 61000-4-13:2015, *Electromagnetic compatibility (EMC) - Part 4-13: Testing and measurement techniques - Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-28: 2009, *Electromagnetic compatibility (EMC) - Part 4-28: Testing and measurement techniques - Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-16:2015, *Electromagnetic compatibility (EMC) - Part 4-16: Testing and measurement techniques - Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-19:2014, *Electromagnetic compatibility (EMC) - Part 4-19: Testing and measurement techniques - Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports*

3 Terms and definitions

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

For the purposes of this document, the terms and definitions given in IEC 62934, IEC TS 62786 series, and the following apply.

276 ISO and IEC maintain terminology databases for use in standardization at the following
277 addresses:

- 278 • IEC Electropedia: available at <https://www.electropedia.org/>
- 279 • ISO Online browsing platform: available at <https://www.iso.org/obp>

280 **3.1**
281 **photovoltaic power generating system**
282 **PV system**

283 electric power generating system which uses the photovoltaic effect to convert solar power
284 into electricity

285 **3.2**
286 **power conversion equipment**
287 **PCE**

288 electrical device converting one form of electrical power to another with respect to voltage,
289 current, frequency, phase and the number of phases

290 [SOURCE: IEC 62109-1:2010, 3.66, modified – The definition has been rephrased, and the
291 note has been deleted.]

292 **3.3**
293 **Point of connection**
294 **POC**

295 reference point on the electric power network where the user's electrical facility is connected

296 [SOURCE: IEC 60050-617:2009, 617-04-01]

297 **3.4**
298 **point of common coupling**
299 **PCC**

300 point in an electric power system, electrically nearest to a particular load or the point of
301 connection (POC) of a power plant, at which other loads/power plants are, or may be,
302 connected

303 Note 1 to entry: These loads can be either devices, equipment or systems, or distinct customer's installations.

304 [SOURCE: IEC 62934:2021, 3.1.11]

305 **3.5**
306 **In-plant point of coupling**
307 **IPC**

308 point inside a non-public power distribution system, electrically nearest to a given load or a
309 power plant, at which loads or power plants from other branches are, or could be, connected

310 Note 1 to entry: The IPC is usually the point for which electromagnetic compatibility in industrial networks is to be
311 considered.

312 [SOURCE: IEC 61000-2-4:2024, 3.1.10, modified – The definition has been rephrased]

313 **3.6**
314 **power distribution systems in industrial locations**
315 **industrial power distribution system**

316 distribution network which is separated by at least one separation transformer from the public
317 power supply system to which other customer installations are connected

3.7 planning level

a level of a particular disturbance in a particular environment, adopted as a reference value for the limits to be set for the emissions from large loads and installations, in order to co-ordinate those limits with all the limits adopted for equipment intended to be connected to the power supply system

NOTE The planning level is locally specific and is adopted by those responsible for planning and operating the power supply network in the relevant area. For further information, see Annex A of IEC 61000-2-2

[SOURCE: IEC 61000-2-2:2018]

4 Requirements on electromagnetic compatibility

4.1 General

Figure 1 illustrates an example of the configuration of a PV system which consists of a single power generating unit. As Annex A describes, the electromagnetic compatibility level shall be applied at the point of common connection (PCC) or the in-plant point coupling (IPC) in a power supply system. To ensure that the disturbance level at the point of connection of the PV system does not exceed the compatibility level, stricter limits of disturbance emissions to individual equipment comprising the PV system are required. On the other hand, all equipment and devices in the PV system require to have immunity at least at the compatibility level.

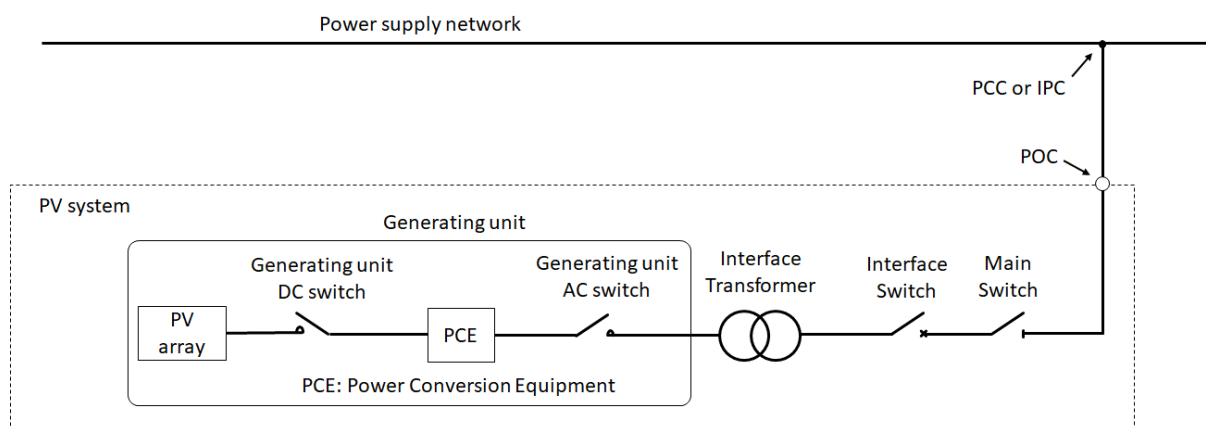


Figure 1 – Configuration of a PV system consisting of a single generating unit

Consequently, there are two requirements for PCE to:

- maintain the required emission level of electromagnetic disturbances in a location of a power supply system in which PCE operates,
- have the sufficient immunity levels to electromagnetic disturbances in a location of a power supply system in which PCE operates.

These emission and immunity requirements are applied at the AC power port of the PCE illustrated in Figure 2.

As described in Annex E, PCE shall comply with emission requirements concerning the following electromagnetic disturbances.

- harmonics and inter-harmonics,
- voltage fluctuations and flicker,
- voltage unbalance,