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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

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.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.	



22E/282/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 63497 ED1	
DATE OF CIRCULATION: 2024-11-15	CLOSING DATE FOR COMMENTS: 2025-01-10
SUPERSEDES DOCUMENTS: 22E/268/CD, 22E/277/CC	

IEC SC 22E : STABILIZED POWER SUPPLIES		
SECRETARIAT: Germany		SECRETARY: Mr Clemens Klemm
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 22,SC 22H,TC 33,TC 77		HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED: Electromagnetic Compatibility,Safety		

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TITLE: Shunt-Connected Active Correction Devices (ACD)
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SHUNT-CONNECTED ACTIVE CORRECTION DEVICES (ACD)

FOREWORD

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IEC 63497 has been prepared by IEC technical committee 22E: Stabilized power supplies

The text 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.

The language used for the development of this Technical Report 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 <http://www.iec.ch/standardsdev/publications>.

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

- 159 • reconfirmed,
- 160 • withdrawn,
- 161 • replaced by a revised edition, or
- 162 • amended.

163

INTRODUCTION

Loads with non-linear behaviour, causing power quality issues, are increasingly frequent in all industrial, commercial and residential installations and their percentage in overall electrical consumption is growing steadily.

Examples include:

- Industrial equipment (welding machines, arc and induction furnaces, battery chargers, rectifiers like electrolyzers, etc.),
- Variable Speed Drives (VSD) for AC or DC motors,
- Uninterruptible Power Supplies,
- Electric Vehicle charging system.

In power systems, where non-linear loads are permanently connected, they continuously generate harmonics, whose effects are described in IEC TS 63191. The major consequences of harmonics are the increase of the r.m.s. current in the different circuits and the deterioration of the supply voltage quality. The negative impact may remain un-noticed, but economical results may be compromised:

- increased overloading on the electrical system, thereby limiting usable capacity,
- increased energy losses,
- increased risks of outage,
- Overheating of equipment and cables in installation leading to reduction of equipment lifetime,
- Perturbation of some electronic systems.

The following pictures present typical current waveforms for single-phase (Figure 1) and three-phase non-linear loads (Figure 2), measured by devices such as Power Metering and Monitoring Devices (PMD) compliant to IEC 61557-12 or Power Quality Instruments (PQI) compliant to IEC 62586-1.

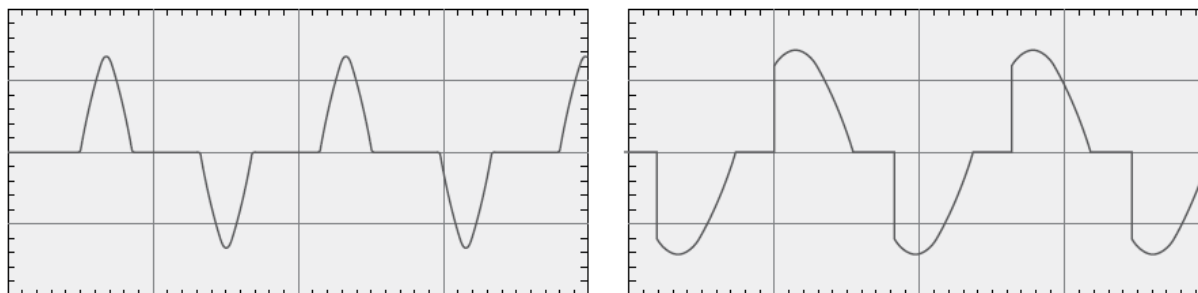


Figure 1 – Typical current waveforms for single-phase non-linear loads (for a single-phase power supply and a phase controlled rectifier)

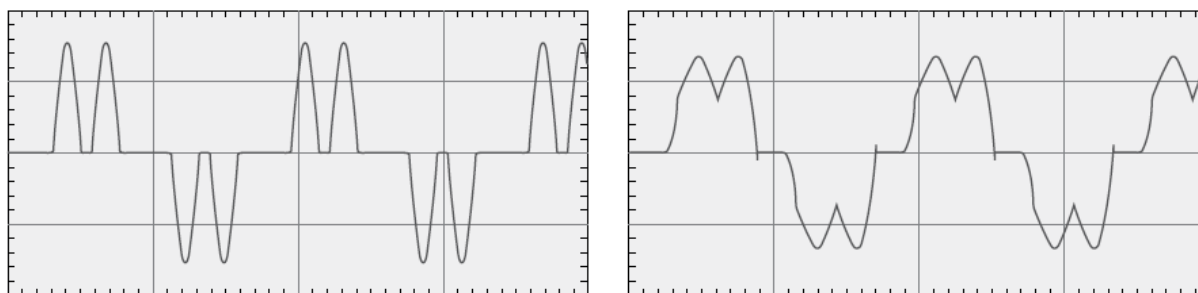


Figure 2 – Typical current waveforms for 3-phases non-linear loads (for a VSD)

Active shunt-connected filter is used in parallel with the load to minimize these distortions, in order to obtain an approximately sinusoidal waveform.

1 Scope

This document is a product standard intended to specify the EMC, performance and safety requirements of shunt-connected Active Correction Devices (ACD) with rated system voltages not exceeding 1 000 V AC or 1 500 V DC.

These devices are intended to be installed in industrial or commercial environments. These devices can be either cord or permanently connected. They can be movable, stationary, or fixed devices.

ACD includes both Static VAR Generator (SVG) and Active Harmonic Filter (AHF).

The primary function of a shunt connected ACD is to do one or more of the following:

- Active harmonic filtering;
- Reactive power compensation;
- Unbalanced load compensation;

Additional functions of a shunt connected ACD can be:

- Flicker compensation;
- Interharmonic component filtering.

In case of hybrid devices, combining a passive harmonic filter and an ACD, the standard covers only the active part.

This document does not cover:

- Active mitigation functions part of another device (Variable Speed Drive, Uninterruptible Power Supply, Dynamic Voltage Restorer, ...);
- Switched power capacitors;
- Switched inductors;
- Passive harmonic filters;
- Energy storage converters;
- Series-connected active correction devices.

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 60364-1, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions*

- 233 IEC 60529, *Degrees of protection provided by enclosures (IP Code)*
- 234 IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems -*
235 *Part 1: Principles, requirements and tests*
- 236 IEC 61000-4-13, *Electromagnetic compatibility (EMC) - Part 4-13: Testing and measurement*
237 *techniques - Harmonics and interharmonics including mains signalling at a.c. power port, low*
238 *frequency immunity tests*
- 239 IEC 61000-4-30, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement*
240 *techniques - Power quality measurement methods*
- 241 IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards -*
242 *Immunity for industrial environments*
- 243 IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards -*
244 *Emission standard for industrial environments*
- 245 IEC 61800-3, *Adjustable speed electrical power drive systems - Part 3: EMC requirements and*
246 *specific test methods for PDS and machine tools*
- 247 IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment*
248 *– Part 1: General*

249 **3 Terms and definitions**

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

251 ISO and IEC maintain terminological databases for use in standardization at the following
252 addresses:

- 253 • IEC Electropedia: available at <http://www.electropedia.org/>
- 254 • ISO Online browsing platform: available at <https://www.iso.org/obp/ui/>

255 **3.1 Terms related to devices**

256 **3.1.1** 257 **static var generator** 258 **SVG**

259 active device used for stepless reactive power compensation and/or load balancing

260 Note to entry - SVG can be called EVC (Electronic VAR Compensator)

261 **3.1.2** 262 **active harmonics filter** 263 **AHF**

264 active device used for fundamental compensation and harmonic filtering

265 **3.1.3** 266 **dynamic voltage restorer** 267 **DVR**

268 a system to mitigate the sags and swells in supply voltage

3.2 Terms related to device electrical parameters

3.2.1

rated voltage

rated value of the voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

Note 1 to entry: Equipment may have more than one rated voltage value or may have a rated voltage range.

Note 2 to entry: For three-phase power supply, the line-to-line voltage applies.

[SOURCE: IEC 442-09-10]

3.2.2

rated current

the current assigned by the manufacturer for a specified operating condition of a device

[SOURCE: IEC 442-01-02 modified, accessory replaced by device]

3.2.3

rated frequency

the frequency at which the device is designed to operate

3.2.4

operating range

environmental conditions (temperature range, EMC environment, ...) and use conditions (voltage range, current range, ...) for which a device is able to perform its intended function(s)

3.3 Terms related to electrical phenomena

3.3.1

total harmonic ratio

total harmonic distortion

THD (abbreviation)

ratio of the RMS value of the harmonic content to the r.m.s. value of the fundamental component or the reference fundamental component of an alternating quantity

Note 1 to entry – The total harmonic ratio depends on the choice of the fundamental component. If it is not clear from the context which one is used an indication should be given.

Note 2 to entry – The total harmonic ratio may be restricted to a certain harmonic order. This is to be stated.

[SOURCE: IEC 551-20-13]

3.3.2

commutation notch

a periodic voltage transient that may appear in the AC side voltage of a line or machine commutated converter due to the commutation

[SOURCE: IEC 551-16-06]

3.3.3

fundamental frequency

frequency, in the spectrum obtained from a Fourier transform of a time function, to which all the frequencies of the spectrum are referred. For the purposes of this standard, the fundamental frequency is the same as the power supply frequency

Note 1 to entry – In the case of a periodic function, the fundamental frequency is generally equal to the frequency of the function itself.

311 Note 2 to entry – In case of any remaining risk of ambiguity, the power supply frequency should be referred to the
312 polarity and speed of rotation of the synchronous generator(s) feeding the system.

313 Note 3 to entry – This definition may be applied to any industrial power supply network, without regard to the load it
314 supplies (a single load or a combination of loads, rotating machines or other loads), and even if the generator feeding
315 the network is a semiconductor converter.

316 [SOURCE: IEC 101-14-50]

317 **3.3.4**
318 **fundamental component**
319 **fundamental**
320 component whose frequency is the fundamental frequency

321 [SOURCE: IEC 61000-2-4:2002]

322 **3.3.5**
323 **harmonic frequency**
324 frequency which is an integer multiple of the fundamental frequency. The ratio of the harmonic
325 frequency to the fundamental frequency is named harmonic order. (Recommended notation "h")

326 [SOURCE: IEC 61000-2-4:2002]

327 **3.3.6**
328 **harmonic component**
329 any of the components having a harmonic frequency. Its value is normally expressed as an
330 r.m.s. value

331 Note to entry - For brevity, such a component may be referred to simply as a harmonic

332 [SOURCE: IEC 61000-2-4:2002, modified, note to entry added]

333 **3.3.7**
334 **interharmonic frequency**
335 any frequency which is not an integer multiple of the fundamental frequency

336 Note 1 to entry – By extension from harmonic order, the interharmonic order is the ratio of interharmonic frequency
337 to the fundamental frequency. This ratio is not an integer. (Recommended notation "m")

338 Note 2 to entry – In the case where $m < 1$, the term sub-harmonic frequency may also be used.

339 [SOURCE: IEC 61000-2-4:2002]

340 **3.3.8**
341 **interharmonic component**
342 component having an interharmonic frequency. Its value is normally expressed as an r.m.s.
343 value.

344 Note 1 to entry – For the purpose of this standard, and as stated in IEC 61000-4-7, the time window has a width of
345 10 fundamental periods (for 50 Hz systems) or 12 fundamental periods (for 60 Hz systems), i.e. approximately 200
346 ms. The difference in frequency between two consecutive interharmonic components is, therefore, approximately 5
347 Hz.

348 Note 2 to entry - For brevity, such a component may be referred to simply as an interharmonic

349 [SOURCE: IEC 61000-2-4:2002, modified, note to entry added]

350 **3.3.9**
351 **power factor**
352 under periodic conditions, ratio of the absolute value of the active power P to the apparent
353 power S:

$$\lambda = |P| / S$$

Note 1 to Entry – Under sinusoidal conditions, the power factor is the absolute value of the active power factor.

[SOURCE: IEC 131-11-46, modified, active factor replaced by active power factor in Note 1]

3.3.10

fundamental power factor

ratio of the absolute value of the fundamental active power P_1 to the fundamental apparent power S_1

$$\lambda_1 = |P_1| / S_1$$

Note 1 to entry: The fundamental power factor is also given by:

$$\lambda_1 = |\cos \phi_1|$$

Note 2 to entry: The fundamental power factor only refers to fundamental quantities.

Note 3 to entry: The fundamental power factor is sometimes called displacement factor or displacement power factor.

[SOURCE: IEC 845-27-127]

3.3.11

unbalanced state of a polyphase network

the condition in which the voltages and/or currents in the phase conductors do not form balanced polyphase sets

[SOURCE: IEC 603-02-19]

3.3.12

load balancing

improvement of the unbalanced state of a polyphase network

Note to entry – This term refers to the balancing of the source current.

3.3.13

negative (sequence) component (of a three-phase system)

one of the three symmetrical sequence components which exists only in an unsymmetrical three-phase system of sinusoidal quantities and which is defined by the following complex mathematical expression:

$$X_2 = 1/3(X_{L1} + a^2 X_{L2} + a X_{L3})$$

where a is the 120 degree operator, and X_{L1} , X_{L2} and X_{L3} are the complex expressions of the phase quantities concerned, and where X denotes the system current or voltage phasors

[SOURCE IEC 448 448-11-28]

3.3.14

zero (sequence) component (of a three-phase system)

one of the three symmetrical sequence components which exists only in an unsymmetrical three-phase system of sinusoidal quantities and which is defined by the following complex mathematical expression:

$$X_0 = 1/3 (X_{L1} + X_{L2} + X_{L3})$$

where X_{L1} , X_{L2} and X_{L3} are the complex expressions of the phase quantities concerned, and where X denotes the system current or voltage phasors