

TECHNICAL SPECIFICATION



Assessment of power quality – Characteristics of electricity supplied by public networks

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ASSESSMENT OF POWER QUALITY – CHARACTERISTICS
OF ELECTRICITY SUPPLIED BY PUBLIC NETWORKS**

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62749, which is a technical specification, has been prepared by IEC technical committee 8: System aspects of electrical energy supply.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
8/1512/DTS	8/1524/RVDTS

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

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

This second edition cancels and replaces the first edition published in 2015. This edition constitutes a technical revision.

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

- minimum number of remaining data for weekly analysis,
- improvement of the compatibility between EN 50160 and IEC TS 62749,
- further explanation of the conception of daily sliding window,
- further explanation of the aggregation method used for events,
- further explanation of the relation between Power Quality and EMC,
- addition of a new definition of mains communicating system (MCS),
- addition of a new Annex G: Other phenomena,
- transfer of the main content of IEC TR 62510 to IEC TS 62749.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The description of electricity is of fundamental importance within electricity supply systems. In ~~general~~ the past, its characteristics depended less on its generation than on the way in which it ~~is~~ was transported by networks and being used by the equipment of the multiple users. Faults or other events such as short-circuit and lightning strikes occurring within users' installations or public networks also disturb or degrade it.

Nowadays, Smart Grid construction and massive deployment of renewable energy sources increase the complexity of power quality management. For more information about power quality issues related to distributed generation and micro-grids, refer to Annex D.

NOTE For more information about role of stakeholders for power quality management, see Annex H.

There is a need for a common set of power quality (PQ) indices and measurement methods in order to allow different system operators to measure and report power quality in a consistent manner.

Regarding the limits or levels of power quality, the situation differs. Historically, the electrical systems in different countries/regions have been designed in different ways to cater for national/regional variations like different geographic, climatic or commercial conditions, etc. It is thus essential that any set of internationally agreed power quality limits or levels also recognize these differences, which depends namely on the system configuration, the transfer characteristics between the different voltage levels (attenuation or amplification), the actual disturbance levels on the system, etc.

~~Also, the level of power quality is not absolute rather it depends on the price that clients are willing to pay for it. Optimizing power quality should be carried out in a cost-effective manner in that if NETWORK USERS expect power quality to be an intrinsic characteristic of the product they also want it at the lowest price.~~

Also, the quality of power is not absolute. Optimizing power quality should be carried out in a cost-effective manner to balance network user power quality requirements and willingness to pay for it with power quality supply costs.

Therefore, some of the objectives recommended hereafter allow for a range of values, or options, while still ensuring the coordination of disturbance levels between different parts of the system or voltage levels.

Then, the requirements to be applied can be expressed by the association of the IEC Power Quality framework from the normative part of this document and profiles. Examples of profiles are given in Annex A.

ASSESSMENT OF POWER QUALITY – CHARACTERISTICS OF ELECTRICITY SUPPLIED BY PUBLIC NETWORKS

1 Scope

This Technical Specification specifies the expected characteristics of electricity at the ~~SUPPLY TERMINALS~~ point of supply of public low, medium and high voltage, 50 Hz or 60 Hz, networks, as well as power quality assessment methods.

NOTE 1 The boundaries between the various voltage levels ~~may~~ can be different for different countries/regions. In the context of this TS, the following terms for system voltage are used:

- low voltage (LV) refers to $U_N \leq 1$ kV;
- medium voltage (MV) refers to 1 kV $< U_N \leq 35$ kV;
- high voltage (HV) refers to 35 kV $< U_N \leq 230$ kV.

NOTE 2 Because of existing network structures, in some countries/regions, the boundary between medium and high voltage can be different.

This document applies to the phenomena listed in Table 1.

Table 1 – Classification of electromagnetic phenomena addressed by power quality indices

Continuous phenomena	Discontinuous phenomena – Events	Other phenomena
FREQUENCY DEVIATION	SUPPLY INTERRUPTION	MAINS COMMUNICATING VOLTAGES
SUPPLY VOLTAGE DEVIATION	VOLTAGE DIP	
VOLTAGE UNBALANCE	VOLTAGE SWELL	
HARMONIC VOLTAGE	TRANSIENT OVERVOLTAGE	
INTERHARMONIC VOLTAGE	RAPID VOLTAGE CHANGE	
FLICKER (VOLTAGE FLUCTUATION)		
MAINS-SIGNALLING-VOLTAGES		

NOTE 3 Specification of related measurement methods can be found in IEC 61000-4-30, ~~EMC – Testing and measurement techniques – Power Quality measurement methods.~~

NOTE 4 Specification of the performance of related measuring instruments can be found in IEC 62586, ~~Power quality measurement in power supply systems.~~

While power quality is related to EMC in a number of ways, especially because compliance with power quality requirements depends on the control of cumulative effect of electromagnetic emission from all/multiple equipment and/or installations, this document is not an EMC publication (see also Annex F).

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 60038, *IEC standard voltages*

IEC 60364-4-44, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-5-53, *Low-voltage electrical installations – of buildings – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and monitoring*

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-2-2:2002/AMD1:2017

IEC 61000-2-2:2002/AMD2:2018

~~IEC TR 61000-2-8, *Electromagnetic compatibility (EMC) – Part 1-8: Environment – Voltage dips and short interruptions on public electric power supply systems with statistical measurement results*~~

IEC 61000-2-12, *Electromagnetic compatibility (EMC) – Part 2-12: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems*

IEC TR 61000-2-14, *Electromagnetic compatibility (EMC) – Part 2-14: Environment – Overvoltages on public electricity distribution networks*

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

~~IEC 61000-3-3, *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*~~

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~~IEC TR 61000-3-6, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*~~

~~IEC TR 61000-3-7, *Electromagnetic compatibility (EMC) – Part 3-7: Limits – Assessment of emission limits for the connection of fluctuating load installations to MV, HV and EHV power systems*~~

~~IEC 61000-3-11, *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, *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 TR 61000-3-13, *Electromagnetic compatibility (EMC) – Part 3-13: Limits – Assessment of emission limits for the connection of unbalanced installations to MV, HV and EHV power systems*~~

~~IEC TR 61000-3-14, *Electromagnetic compatibility (EMC) – Part 3-14: Limits – Assessment of emission limits for the connection of disturbing installations to LV power systems*~~

~~IEC 61000-4-7:2009, 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 61000-4-15, Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications~~

IEC 61000-4-30:2008/2015, Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods

~~IEC 62586-1, Power quality measurement in power supply systems – Part 1: Power quality instruments (PQI)~~

~~IEC 62586-2, Power quality measurement in power supply systems – Part 2: Functional tests and uncertainty requirements~~

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 <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Terms are listed in alphabetical order.

3.1

code (in electric power system)

collection of rules concerning rights and duties of the parties involved in a certain part of the electric power system

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Note 1 to entry: For example: grid code, distribution code, code in electric power system.

[SOURCE: IEC 60050-617:2009, 617-03-03, modified – "code in electric power system" has been added in the Note to entry]

3.2

connection agreement

agreement entered between the system operator and a system user which governs the procedure and conditions for connection

[SOURCE: IEC 60050-617:2009, 617-04-03]

3.3

declared supply voltage

U_c

supply voltage agreed by the network operator and the network user

Note 1 to entry: Generally declared supply voltage U_c is the nominal voltage U_N but it may be different according to the agreement between the network operator and the network user.

3.4

electricity

set of the phenomena associated with electric charges and electric currents

[SOURCE: IEC 60050-121:1998, 121-11-76]

Note 1 to entry: In the context of electric power systems, electricity is often described as a product with particular characteristics.

[SOURCE: IEC 60050-121:1998, 121-11-76, modified – The note has been added]

3.5

electromagnetic environment

totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, the electromagnetic environment is time-dependent and its description can need a statistical approach.

[SOURCE: IEC 60050-161:2018, 161-01-01]

3.6

electromagnetic disturbance

electromagnetic phenomenon that can degrade the performance of a device, equipment or system, or adversely affect living or inert matter

Note 1 to entry: An electromagnetic disturbance can be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

Note 2 to entry: Electromagnetic disturbance in this TS refers to low frequency conducted phenomena.

[SOURCE: IEC 60050-161:2018, 161-01-05, modified – Note 2 to entry has been replaced and Note 3 to entry has been deleted]

3.7

electromagnetic compatibility

ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990/2018, 161-01-07]

3.8

(electromagnetic) compatibility level

specified electromagnetic disturbance level used as a reference level for co-ordination in the setting of emission and immunity limits

Note 1 to entry: By convention, the compatibility level is chosen so that there is only a small probability that it will be exceeded by the actual disturbance level.

[SOURCE: IEC 60050-161:1990, 161-03-10, modified – Note has been shortened and Note 2 has been deleted]

3.9

flagged data

data that has been marked to indicate that its measurement or its aggregation may have been affected by interruptions, dips, or swells

[SOURCE: IEC 61000-4-30:2015, 3.5, modified – modified to better understand this term]

3.10

flicker

impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time

Note 1 to entry: Voltage fluctuation cause changes of the luminance of lamps which can create the visual phenomenon called flicker. Above a certain threshold, flicker becomes annoying. The annoyance grows very rapidly with the amplitude of the fluctuation. At certain repetition rates, even very small amplitudes can be annoying.

Note 2 to entry: For the time being, flicker is qualified based on incandescent lamp's behaviour.

[SOURCE: IEC 60050-161:1990, 161-08-13, modified – Notes to entry have been added]

3.11

flicker severity

intensity of flicker annoyance evaluated by the following quantities:

- short term severity (P_{st}) measured over a period of ten minutes;
- long term severity (P_{lt}) calculated from a sequence of 12 P_{st} -values over a two hours interval, according to the following expression:

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$$

Note 1 to entry: For details of P_{st} and P_{lt} , see IEC 61000-4-15.

3.12

frequency deviation

difference between power supply frequency ($f_{H,1}$) and nominal frequency (f_N)

[SOURCE: IEC 60050-614:2016, 614-01-10, modified – "system frequency at a given instant and its nominal value" has been changed to "power supply frequency ($f_{H,1}$) and nominal frequency (f_N)"]

3.13

group total harmonic distortion

THDG (abbreviation)

$THDG_Y$ (symbol)

ratio of the RMS value of the harmonic groups ($Y_{g,h}$) to the RMS value of the group associated with the fundamental ($Y_{g,1}$):

$$THDG_Y = \sqrt{\sum_{h=2}^{h_{\max}} \left(\frac{Y_{g,h}}{Y_{g,1}} \right)^2}$$

Note 1 to entry: The symbol Y is replaced, as required, by the symbol I for currents or by the symbol U for voltages.

[SOURCE: IEC 61000-4-7:2009/AMD1:2008, 3.3.2]

3.14

harmonic frequency

$f_{H,h}$

frequency which is an integer multiple of the power supply (fundamental) frequency

[SOURCE: IEC 61000-4-7:2009/AMD1:2008, 3.2.1, modified – "fundamental frequency of the power system" has been changed to "power supply (fundamental) frequency", the formula and Note to entry have been removed]

3.15

harmonic order

h

(integer) ratio of a harmonic frequency ($f_{H,h}$) to the power supply frequency ($f_{H,1}$)