

TECHNICAL SPECIFICATION



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





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

TECHNICAL SPECIFICATION



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.220.99

ISBN 978-2-8322-7849-9

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	5
INTRODUCTION	7
1 Scope	8
2 Normative references	8
3 Terms and definitions	9
4 Recommended values for power quality indices	17
4.1 General	17
4.2 Frequency deviation	19
4.3 Supply voltage deviation	19
4.3.1 General	19
4.3.2 Low voltage systems	19
4.3.3 Medium voltage systems	20
4.3.4 High voltage systems	20
4.4 Voltage unbalance	20
4.5 Flicker	21
4.6 Harmonic and interharmonic voltage	21
4.6.1 General	21
4.6.2 Low voltage systems	21
4.6.3 Medium voltage systems	22
4.6.4 High voltage systems	23
4.7 Voltage dip	24
4.8 Voltage swell	25
4.9 Voltage interruption	25
4.10 Mains communicating voltage	26
4.11 Rapid voltage change	26
4.12 Transient overvoltage	27
4.12.1 Low voltage systems	27
4.12.2 Medium and high voltage systems	27
5 Objectives and methods for power quality assessment	27
5.1 General	27
5.2 Site power quality assessment	28
5.2.1 General	28
5.2.2 Continuous phenomena	28
5.2.3 For discontinuous phenomena (single event)	30
5.3 System aspect power quality assessment	31
5.3.1 General	31
5.3.2 For continuous phenomena	31
5.3.3 For discontinuous phenomena (events)	31
Annex A (informative) Examples of profiles for power quality specification	34
A.1 General	34
A.2 LV and MV public distribution networks in European countries	34
A.3 LV, MV and HV power supply system in China	35
A.4 Example of a transmission system in Canada	36
A.5 Examples of profiles in Australia	37
Annex B (informative) Additional information on power quality assessments	38

B.1	Weekly percentile values assessed on a daily sliding basis.....	38
B.2	Example on system aspect continuous disturbance evaluation.....	39
B.3	Aggregation method used for events.....	39
B.3.1	General.....	39
B.3.2	Time aggregation.....	39
Annex C (informative)	Main impact of poor power quality.....	42
C.1	General.....	42
C.2	Harmonic distortion.....	42
C.3	Voltage unbalance.....	42
C.4	Voltage deviation.....	43
C.5	Frequency deviation.....	43
C.6	Voltage fluctuation.....	43
C.7	Flicker.....	43
C.8	Voltage dip (or voltage sag).....	43
C.9	Transient overvoltages.....	43
Annex D (informative)	Power quality issues related to distributed generation and micro-grids.....	44
D.1	General.....	44
D.2	Voltage deviation.....	44
D.3	Harmonics.....	44
D.4	DG magnetic bias (DC current injection).....	44
D.5	Voltage fluctuation and flicker.....	45
D.6	High frequency conducted disturbances.....	45
Annex E (informative)	Methods to maintain and improve power quality.....	46
E.1	General.....	46
E.2	Voltage deviation.....	46
E.3	Harmonics.....	46
E.4	Flicker.....	47
E.5	Voltage unbalance.....	47
E.6	Voltage dip/swell/short time interruption.....	48
Annex F (informative)	Relation between power quality and EMC.....	49
F.1	General.....	49
F.2	Differences between power quality and compatibility levels.....	49
F.3	Example of power quality level versus compatibility level.....	50
Annex G (informative)	Other phenomena.....	53
G.1	General.....	53
G.2	Level behaviour over time.....	53
G.3	Duration.....	53
G.4	Periodicity.....	53
G.5	Bandwidth.....	54
Annex H (informative)	Role of stakeholders for power quality management – Coordination of the parties involved.....	55
H.1	General.....	55
H.2	Network operator – Network user.....	55
H.3	Network user – Equipment supplier.....	55
H.4	Network operator – Equipment supplier.....	56
Bibliography	57

Figure 1 – Mains communicating voltages recommended values in percent of U_N used in public LV networks (or U_C in public MV networks) 26

Figure 2 – Example for illustrating voltage *THD* assessment result trends 30

Figure 3 – Example showing information of single event assessment 31

Figure B.1 – Comparison of two methods of assessing weekly 95th percentile values 38

Figure B.2 – Example for illustrating the differences resulted by time aggregation method 40

Figure B.3 – Example of time sequence of voltage dips that can be aggregated in two different ways 41

Figure F.1 – Application points in a LV system (example) 50

Figure F.2 – Relation between disturbance levels (schematic significance only) 50

Figure F.3 – Cumulative distribution of all *THD* values recorded at 30 points of supply of the LV system, during one week 51

Figure F.4 – Weekly 95th percentile *THD* values evaluated at each monitored LV point of supply 52

Table 1 – Classification of electromagnetic phenomena addressed by power quality indices 8

Table 2 – Flicker severity P_{ft} recommended values 21

Table 3 – Recommended values of individual harmonic voltages at the low voltage points of supply for orders up to 50 given in percent of the fundamental voltage U_1 22

Table 4 – Recommended values of individual harmonic voltages at the medium voltage points of supply for orders up to 50 given in percent of the fundamental voltage U_1 23

Table 5 – Indicative values of individual harmonic voltages at the high voltage points of supply given in percent of the fundamental voltage U_1 24

Table 6 – Site power quality assessment methods 29

Table 7 – Example of single event assessment 30

Table 8 – List of individual events measured at a single monitoring site 32

Table 9 – *SARFI-X* indices coming out of Table 8 32

Table 10 – Magnitude-duration table format 33

Table A.1 – Examples of profiles in European countries 34

Table A.2 – Examples of profiles in China 35

Table A.3 – Examples of profiles in Canada 36

Table A.4 – Examples of profiles in Australia 37

Table B.1 – Listing of system power quality evaluation 39

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- 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:

- a) minimum number of remaining data for weekly analysis,
- b) improvement of the compatibility between EN 50160 and IEC TS 62749,
- c) further explanation of the conception of daily sliding window,
- d) further explanation of the aggregation method used for events,
- e) further explanation of the relation between Power Quality and EMC,
- f) addition of a new definition of mains communicating system (MCS),
- g) addition of a new Annex G: Other phenomena,
- h) 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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The description of electricity is of fundamental importance within electricity supply systems. In the past, its characteristics depended less on its generation than on the way in which it 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 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.