IEC TS 63222-1

Edition 2.0 2026-03

TECHNICAL SPECIFICATION

Power quality management -
Part 1: General guidelines

ICS 29.020

ISBN 978-2-8327-1125-5

IEC TS 63222-1:2026-03(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Power quality management - Part 1: General guidelines

FOREWORD

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IEC TS 63222-1 has been prepared by IEC technical committee 8: System aspects of electrical energy supply. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2022. This edition constitutes a technical revision.

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

a) this document completes the use cases planned in IEC 63222-1:2022: four business use cases and three system use cases are added;
b) this document makes adjustments to the wording of certain phrases and technical details in IEC 63222-1:2022.

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

Draft	Report on voting
8/1793/DTS	8/1803/RVDTS

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 Specification 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 www.iec.ch/publications.

A list of all parts in the IEC 63222 series, published under the general title *Power quality management*, can be found on the IEC website.

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

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

With the development of smart grid and massive deployment of renewable energy, power quality issues have received attention not only from system operators and customers (especially with sensitive power quality loads) but also from market regulators with the demands to provide information on the actual power quality level. Power quality management of the grid is a systematic project which includes the whole process of planning, operation, assessment and mitigation. The characteristics of power supplier, load characteristics of power consumer and external environment will affect the power quality of the grid. This document focuses on the whole process management and is the general guideline for the IEC 63222 series.

Traditional electrified railways, steel mills and other non-linear loads are the main pollution sources of the power quality. In recent years, the new loads such as new energy and electric vehicles have brought new challenges to power quality management. The rapid popularization and application of high-tech precision technology has also put forward new requirements for high-quality power supply and consumption system.

Power quality is an important issue for electricity supply network operators; it is also important to handle it at planning and operation stages. In order to achieve power quality target, reduce power quality impacts/losses and improve the economic efficiency of the system, power quality regulation and supervision of the operating power system is crucial, as well as a well-considered power quality planning before project implementation, such as system expansion, construction and grid connection of the distributed generation. Besides, the users at the end of power system should also be taken into consideration. Power quality problems can cause system instability, equipment abnormal operation and supply interruption. Power quality management is a method to avoid further power quality problems after project implementation.

The standard system in power quality management provides a technical basis for improving power management level and standardizing power quality industry and market. As the general guideline of the IEC 63222 series, this document summarizes the power quality indicators and assessment methods, and analyses the overall power quality level by monitoring assessment and predicted assessment. Monitoring system and field test are used to assess the power quality level at different nodes of the grid and solve users' power quality complaints and other practical problems. Connection and monitoring points are reasonably selected to assess the power quality levels of the grid in operation stage, and it also contributes to the power quality mitigation. In addition, the economical assessment of power quality is regulated in the document. Power quality management use cases in different typical scenarios are shown in Annex A.

1 Scope

This part of IEC 63222, which is a Technical Specification, is intended to provide provisions associated to the main use cases regarding recognized engineering practices applicable to power quality management in public electric power supply networks. It summarizes the operation in power quality management and investigates the current standards, for requirement of power quality assessment work, as well as to promote the development of power quality management best practices.

The power quality management domain groups use cases and associated power quality requirement common to network management, including customer support network operation, network and extension planning.

This document captures possible "common and repeated usage" of power quality management under the format of "use case". Use case implementations are given for information purpose only. This document derives the common requirement as provisions by further standardization activities, in terms of actors interacting with the given system. The interface requirement is considered for later standardization activities. The relationship of the stakeholders in power quality management, such as network operator, network user, etc, are discussed in the document. Table 1 highlights the domains and business use cases described.

Table 1 – Content of IEC TS 63222-1

Domain	Content	Scope
Power quality monitoring assessment	Described with 5 business use cases 1) Manage power quality over the grid. 2) Manage power quality through distribution or transmission grid interfaces with other network. 3) Take into account power quality constraints in network operation. 4) Provide reports on network power quality. 5) Manage complaints on power quality over the network. 6) Manage power quality through distribution or transmission grid interfaces with other network. Described with 4 system use cases 1) Measure power quality on a specific point of the network. 2) Monitor power quality on the network. 3) Engineer a power quality solution. 4) Assess power quality on the network.	Continuous monitoring operation for public power grid

Domain	Content	Scope
Power quality predicted assessment	Described with 7 business use cases 1) Manage power quality over the grid. 2) Connect new user to the grid. 3) Plan network development. 4) Take into account power quality constraints in connecting a user to the grid. 5) Take into account power quality constraints in network development. 6) Provide reports on network power quality. Described with 6 system use cases 1) Predict power quality impact of a construction work or maintenance. 2) Predict power quality impact of a new connection or network development. 3) Measure power quality on a specific point of the network. 4) Monitor power quality on the network. 5) Engineer a power quality solution. 6) Assess power quality on the network	Power quality assessment of new construction, reconstruction or expansion projects in the grid

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 (all parts), *Electromagnetic compatibility (EMC) - Part 3: Limits*

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 system, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC TS 61000-3-4, *Electromagnetic compatibility (EMC) - Part 3-4: Limits - Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC TS 61000-3-5, *Electromagnetic compatibility (EMC) - Part 3-5: Limits - Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 75 A*

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 61000-3-8, *Electromagnetic compatibility (EMC) - Part 3: Limits - Section 8: Signalling on low-voltage electrical installations - Emission levels, frequency bands and electromagnetic disturbance levels*

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) - Assessment of emission limits for harmonics, interharmonics, voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems*

IEC 61000-4 (all parts), *Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques*

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

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

IEC TR 61850-90-17:2017, *Communication networks and systems for power utility automation - Part 90-17: Using IEC 61850 to transmit power quality data*

IEC 61968-9:2024, *Enterprise business function interfaces for utility operations - Part 9: Interfaces for meter reading and control*

IEC TS 62749:2020, *Assessment of power quality - Characteristics of electricity supplied by public networks*

IEC TS 63222-2:2023, *Power quality management - Part 2: Power quality monitoring system*

ISO 10002:2018, *Quality management - Customer satisfaction - Guidelines for complaints handling in organizations*

3 Terms, definitions and abbreviated terms

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

ISO and IEC maintain terminology 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 Terms and definitions

3.1.1
power quality
characteristics of the electricity at a given point on an electrical power system, evaluated against a set of reference technical parameters

[SOURCE: IEC 60050-617:2009, 617-01-05, modified - The words "electric current, voltage and frequencies" have been replaced with "electricity". The note has been removed.]

3.1.2
power quality indices
technical parameters characterizing the quality of electricity, measured at a given point, relevant for the assessment of the quality of the electricity delivered by a network operator

[SOURCE: IEC TS 62749:2020, 3.29]

3.1.3
nominal voltage
voltage by which a system is designated or identified

[SOURCE: IEC 61000-4-30:2015, 3.18, modified - The symbol "U_n" has been removed.]

3.1.4
voltage unbalance
<polyphase system> condition in which the RMS values of the phase voltages (fundamental component) or the phase angles between consecutive phases are not all equal

Note 1 to entry: The degree of the inequality is usually expressed as the ratios of the negative- and zero-sequence components to the positive-sequence component.

Note 2 to entry: In this document, voltage unbalance is considered in relation to 3-phase systems.

[SOURCE: IEC 60050-161:1990, 161-08-09, modified - The words in parentheses "(fundamental component)" have been added, as well as the notes to entry.]

3.1.5
voltage deviation
difference between the supply voltage at a given instant and the declared supply voltage

3.1.6
flicker
impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time

[SOURCE: IEC 60050-161:1990, 161-08-13]

3.1.7
voltage dip
sudden reduction of the voltage at a point in an electrical system followed by voltage recovery after a short period of time from a few cycles to a few seconds

[SOURCE: IEC 60050-161:1990, 161-08-10]

3.1.8
short interruption
disappearance of the supply voltage for a time interval whose duration is between two specified limits

Note 1 to entry: A short interruption is considered to be a reduction of the supply voltage to less than 1 % of the nominal voltage, with the lower limit of the duration typically a few tenths of a second, and its upper limit typically in the order of one minute (or, in some cases up to three minutes).

[SOURCE: IEC 60050-161:1990,161-08-20]

3.1.9
harmonic component
sinusoidal component of a periodic quantity having a harmonic frequency

[SOURCE: IEC 60050-551:2001, 551-20-07, modified – The note has been deleted.]

3.1.10
harmonic frequency
frequency which is an integer multiple greater than one of the fundamental frequency or of the reference fundamental frequency

[SOURCE: IEC 60050-551:2001, 551-20-05]

3.1.11
interharmonic component
sinusoidal component of a periodic quantity having an interharmonic frequency

Note 1 to entry: For practical analysis, an approximation of the periodicity may be necessary.

[SOURCE: IEC 60050-551:2001, 551-20-08]

3.1.12
interharmonic frequency
frequency which is a non-integer multiple of the reference fundamental frequency

[SOURCE: IEC 60050-551:2001, 551-20-06]

3.1.13
system operator
network operator
party responsible for safe and reliable operation of a part of the electric power system in a certain area and for connection to other parts of the electric power system

[SOURCE: IEC 60050-617:2009, 617-02-09]

3.1.14
power network user
network user
power system user
system user
party supplying electric power and energy to, or being supplied with electric power and energy from, a transmission system or a distribution system

[SOURCE: IEC 60050-617:2009, 617-02-07, modified - The first and second preferred terms have been inverted.]

3.1.15
stakeholder
individual, group or organization that has an interest in an organization or activity

Note 1 to entry: Usually a stakeholder can affect or is affected by the organization or the activity.

[SOURCE: IEC 60050-904:2014, 904-01-10, modified - The note to entry has been deleted.]

3.1.16
system average RMS variation frequency index
power quality index that provides a count or rate of one or more of the following: voltage dips, swells, interruptions for a system

Note 1 to entry: See IEC TS 62749:2020.

3.1.17
distribution system operator
party operating a distribution system

[SOURCE: IEC 60050-617:2009, 617-02-10, modified - The equivalent terms "distribution network operator and "distributor" have been deleted.]

3.1.18
transmission system operator
party operating a transmission system

[SOURCE: IEC 60050-617:2009, 617-02-11, modified - The equivalent term "transmission network operator" has been deleted.]

3.2 Abbreviated terms

Abbreviated terms used in the text are defined in Table 2.

Table 2 – Abbreviated terms of IEC TS 63222-1

Abbreviated term	Definition
APF	active power filter
BESS	battery energy storage system
BUC	business use case
DVR	dynamic voltage restorer
EMC	electromagnetic compatibility
FACTS	flexible AC transmission systems
LN	logical node
POS	point of supply
PQ	power quality
RTC	real time clock
RVC	rapid voltage change
SARFI	system average RMS variation frequency index
SCADA	supervisory control and data acquisition
STATCOM	static synchronous compensator
SUC	system use case
SVC	static var compensator
UPS	uninterrupted power supply
VSC	voltage source converter

4 Use cases list

4.1 List of business use case and business roles of the domains

The business use cases list is not exhaustive, and it is likely to grow as new use cases come to light. The organisation of the use cases in the document and the links between them are shown in Figure 1. Annex A gives the details of use cases.

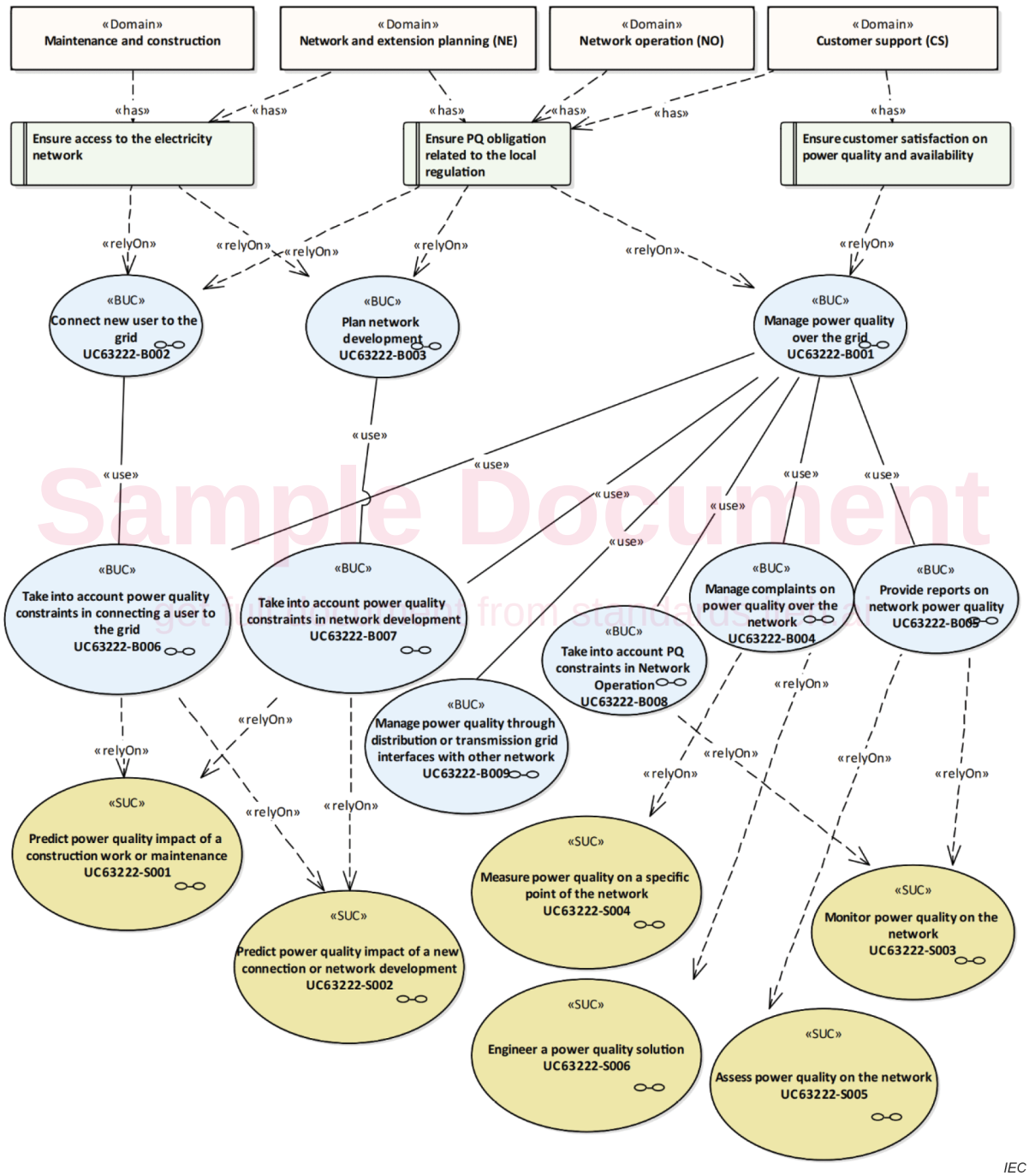

Figure 1 – Organisation of the use cases

Table 3 lists and provides a brief description of the business use cases. In Clause A.1, the business use cases are introduced in detail.