



BSI Standards Publication

## **Voltage characteristics of electricity supplied by public electricity networks**

---

## National foreword

This British Standard is the UK implementation of EN 50160:2022. It supersedes BS EN 50160:2010+A3:2019, which will be withdrawn on 3 July 2023.

The UK participation in its preparation was entrusted to Technical Committee GEL/8, Systems Aspects for Electrical Energy Supply.

A list of organizations represented on this committee can be obtained on request to its committee manager.

### Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023  
Published by BSI Standards Limited 2023

ISBN 978 0 539 16477 0

ICS 29.020; 29.240.01

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2023.

### Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

---

EUROPEAN STANDARD

**EN 50160**

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2022

ICS 29.020

Supersedes EN 50160:2010;  
EN 50160:2010/corrigendum Dec. 2010;  
EN 50160:2010/AC:2012; EN 50160:2010/A1:2015;  
EN 50160:2010/A2:2019; EN 50160:2010/A3:2019

English Version

## Voltage characteristics of electricity supplied by public electricity networks

Caractéristiques de la tension fournie par les réseaux  
publics d'électricité

Merkmale der Spannung in öffentlichen  
Energieversorgungsnetzen

This European Standard was approved by CENELEC on 2022-11-07. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## Contents

Contents .....	2
European foreword.....	3
1 Scope .....	4
2 Normative references .....	5
3 Terms and definitions .....	5
4 Low-voltage supply characteristics.....	12
5 Medium-voltage supply characteristics .....	19
6 High-voltage supply characteristics.....	25
7 Extra-high-voltage supply characteristics .....	30
Annex A (informative) Special nature of electricity .....	35
Annex B (informative) Indicative values for voltage events and single rapid voltage changes .....	37
Annex C (informative) Additional Information relating to “Other Phenomena” .....	41
Annex D (informative) Relationship between Power Quality and EMC.....	43
Annex E (informative) A-deviations.....	49
Bibliography .....	52

## European foreword

This document (EN 50160:2022) has been prepared by CLC TC8X "System aspects of electrical energy supply".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-11-07
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2025-11-07

This document supersedes EN 50160:2010 and all of its amendments and corrigenda (if any).

EN 50160:2022 includes the following significant technical changes with respect to EN 50160:2010:

- implementation of amendments A2 (new frequency range 2-150 kHz, amendment on power frequency) and A3 (changed value on 15th and 21st harmonic in LV);
- The Norway A-deviation (amendment A1) was slightly modified;
- slight clarifications in the scope;
- integration of a new clause "extra high voltage";
- clarification to dips and swells;
- new Annex D: PQ versus EMC.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

# 1 Scope

## 1.1 Application

This document specifies the main characteristics of the voltage at a network user's supply terminals in public low voltage, medium, high, and extra-high voltage AC electricity networks under normal operating conditions. This document specifies the limits or values within which the voltage characteristics can be expected to remain at any supply terminal in public European electricity networks, only. Industrial networks are excluded from the scope of EN 50160.

NOTE 1 If non-public networks (e.g. residential quarters, energy communities, office centres, shopping centres) have similar end-users as public networks, it is strongly advised to apply the same requirements as for public networks.

This document does not apply under abnormal operating conditions, including the following:

- a) a temporary supply arrangement to keep network users supplied during conditions arising as a result of a fault, maintenance and construction work, or to minimize the extent and duration of a loss of supply;
- b) in the case of non-compliance of a network user's installation or equipment with the relevant standards or with the technical requirements for connection, established either by the public authorities or the network operator, including the limits for the emission of conducted disturbances;

NOTE 2 A network user's installation can include load and generation.

- c) in exceptional situations, in particular:

- 1) exceptional weather conditions and other natural disasters;
- 2) third party interference;
- 3) acts by public authorities,
- 4) industrial actions (subject to legal requirements);
- 5) force majeure;
- 6) power shortages resulting from external events.

The voltage characteristics given in this document refer to conducted disturbances in public electric power networks. They are not intended to be used as electromagnetic compatibility (EMC) levels or product emission limits.

Power quality is related to EMC in several ways – especially because compliance with power quality requirements depends on the control of cumulative effect of electromagnetic emissions from all/multiple equipment and/or installations. Therefore, the voltage characteristics given in this document gives guidance for specifying requirements in equipment product standards and in installation standards.

NOTE 3 The performance of equipment might be impaired if it is subjected to supply conditions which are not specified in the equipment product standard.

NOTE 4 This document can be superseded in total or in part by the terms of a contract between the individual network user and the network operator.

The sharing of complaint management and problem mitigation costs between the involved parties is outside the scope of EN 50160.

Measurement methods to be applied in this document are described in EN 61000-4-30.

## 1.2 Objective

The objective of this document is to define, describe and specify the characteristics of the supply voltage concerning:

- a) Frequency;
- b) Magnitude;
- c) Waveform;
- d) Symmetry of the line voltages.

This document also covers the continuous characteristics of the supply voltage and other foreseeable phenomena which may influence the voltage characteristics, such as e.g. operational communication, monitoring or measurement signals which are transmitted via power lines.

These characteristics are subject to variations during the normal operation of a supply system due to changes of load, disturbances generated by certain equipment and the occurrence of faults which are mainly caused by external events.

The characteristics vary in a manner which is random in time, with reference to any specific supply terminal, and random in location, with reference to any given instant of time. Because of these variations, the values given in this document for the characteristics can be expected to be exceeded on a small number of occasions.

Some of the phenomena affecting the voltage are particularly unpredictable, which make it very difficult to give useful definite values for the corresponding characteristics. The values given in this document for the voltage characteristics associated with such phenomena, e.g. voltage dips and voltage interruptions, are interpreted accordingly.

## 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.

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

## 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:

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

### 3.1 Electric power network

#### 3.1.1

##### **public electric power network**

electric power network to which any network user has access, and which is operated by a regulated (licenced) network operator

#### 3.1.2

##### **closed distribution network**

system which distributes electricity within an industrial, commercial, or shared service or residential sites, that is geographically confined