

**NÕUDED JAOTUSVÕRKUDEGA PARALLEELSELT
ÜHENDATUD TOOTMISÜKSUSTELE. OSA 1: ÜHENDUS
MADALPINGEJAOTUSVÕRGUGA. TOOTMISÜKSUSED
KUNI TÜÜBINI B (KAASA ARVATUD)**

**Requirements for generating plants to be connected in
parallel with distribution networks - Part 1: Connection
to a LV distribution network - Generating plants up to
and including Type B**

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 50549-1:2019+A1:2023 sisaldab Euroopa standardi EN 50549-1:2019 ja selle muudatuse A1:2023 ja paranduse AC:2019 ingliskeelset teksti.	This Estonian standard EVS-EN 50549-1:2019+A1:2023 consists of the English text of the European standard EN 50549-1:2019 and its amendment A1:2023 and its corrigendum AC:2019.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas. Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 01.02.2019, muudatus A1 27.10.2023.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation. Date of Availability of the European standard is 01.02.2019, for A1 27.10.2023.
Muudatusega A1 lisatud või muudetud teksti algus ja lõpp on tekstis tähistatud sümbolitega A1 A1 . Parandusega AC lisatud või muudetud teksti algus ja lõpp on tekstis tähistatud sümbolitega AC AC . Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.	The start and finish of text introduced or altered by amendment A1 is indicated in the text by tags A1 A1 . The start and finish of text introduced or altered by corrigendum AC is indicated in the text by tags AC AC . The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 29.160.20

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autoriõiguse kaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about standards copyright protection, please contact the Estonian Centre for Standardisation and Accreditation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Requirements for generating plants to be connected in parallel
with distribution networks - Part 1: Connection to a LV
distribution network - Generating plants up to and including Type
B

Exigences relatives aux centrales électriques destinées à
être raccordées en parallèle à des réseaux de distribution -
Partie 1: Raccordement à un réseau de distribution BT -
Centrales électriques jusqu'au Type B inclus

Anforderungen für zum Parallelbetrieb mit einem Verteilnetz
vorgesehene Erzeugungsanlagen - Teil 1: Anschluss an
das Niederspannungsverteilstromnetz bis einschließlich Typ B

This European Standard was approved by CENELEC on 2018-08-09. Amendment A1 was approved by CENELEC on 2023-09-21. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard and its amendment 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 and its Amendment A1 exist 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	Page
European foreword	4
A1 Amendment A1 European foreword A1	5
Introduction.....	6
1 Scope.....	9
2 Normative references	10
3 Terms and definitions	10
3.1 General.....	10
3.2 Plant, module and unit.....	12
3.3 Power.....	15
3.4 Voltage.....	16
3.5 Circuit theory.....	18
3.6 Protection.....	20
3.7 Control	24
4 Requirements on generating plants	25
4.1 General.....	25
4.2 Connection scheme	27
4.3 Choice of switchgear	27
4.3.1 General	27
4.3.2 Interface switch	27
4.4 Normal operating range.....	28
4.4.1 General	28
4.4.2 Operating frequency range	28
4.4.3 Minimal requirement for active power delivery at underfrequency	28
4.4.4 Continuous operating voltage range	29
4.5 Immunity to disturbances.....	29
4.5.1 General	29
4.5.2 Rate of change of frequency (ROCOF) immunity	30
4.5.3 Under-voltage ride through (UVRT)	30
4.5.4 Over-voltage ride through (OVRT)	32
A1 4.5.5 Phase jump immunity A1	33
4.6 Active response to frequency deviation	34
4.6.1 Power response to overfrequency.....	34
4.6.2 Power response to underfrequency.....	37
4.7 Power response to voltage changes	40
4.7.1 General	40
4.7.2 Voltage support by reactive power	40
4.7.3 Voltage related active power reduction	45
4.7.4 Short circuit current requirements on generating plants	45
4.8 EMC and power quality	46
4.9 Interface protection	47
4.9.1 General	47
4.9.2 Void.....	49
4.9.3 Requirements on voltage and frequency protection.....	49
4.9.4 Means to detect island situation	51
4.9.5 Digital input to the interface protection	52

4.10	Connection and starting to generate electrical power	52
4.10.1	General	52
4.10.2	Automatic reconnection after tripping	52
4.10.3	Starting to generate electrical power	53
4.10.4	Synchronization	53
4.11	Ceasing and reduction of active power on set point	53
4.11.1	Ceasing active power	53
4.11.2	Reduction of active power on set point	53
4.12	Remote information exchange	54
4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	54
Annex A	(informative) Interconnection guidance	56
A.1	General	56
A.2	Network integration	56
A.3	Clusters of single-phase generating units	57
Annex B	(informative) Void	58
Annex C	(informative) Parameter Table	59
Annex D	(informative) List of national requirements applicable for generating plants	64
Annex E	(informative) Loss of Mains and overall power system security	66
Annex F	(informative) Examples of protection strategies	67
F.1	Introduction	67
F.1.1	General	67
F.1.2	Generalities	67
F.1.3	Detection of unwanted islands	67
F.1.4	Problems with uncontrolled islanding in MV networks	68
F.1.4.1	Safety	68
F.1.4.2	Grid parameters	68
F.1.4.3	Reclosing operations	68
F.1.4.4	Protection of islands against overcurrents	68
F.1.4.5	Protection against phase to earth faults	68
F.2	Example strategy 1	69
F.3	Example strategy 2	72
Annex G	(normative) Abbreviations	74
Annex H	(informative) Relationship between this European standard and the COMMISSION REGULATION (EU) 2016/631	75
Bibliography	76

European foreword

This document (EN 50549-1:2019) has been prepared by CLC/TC 8X "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) 2019-08-01
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2022-02-01

This document supersedes EN 50438:2013 and CLC/TS 50549-1:2015.

This European Standard relates to both the RfG European Network Code and current technical market needs. Its purpose is to give detailed description of functions to be implemented in products.

This European Standard is also intended to serve as a technical reference for the definition of national requirements where the RfG European Network Code requirements allow flexible implementation. The specified requirements are solely technical requirements; economic issues regarding, e.g. the bearing of cost are not in the scope of this document.

CLC/TC 8X plans future standardization work in order to ensure the compatibility of this European Standard (EN) with the evolution of the legal framework.

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.

A1 Amendment A1 European foreword

This document EN 50549-1:2019/A1:2023 has been prepared by TC 8X “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) 2024-09-21
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2026-09-21

This document amends EN 50549-1:2019.

This amendment includes the following significant technical changes:

- Introduction of a phase jump immunity requirement.
- Harmonizing the ROCOF immunity requirement for synchronous and non-synchronous generating technology.
- Modifying FRT for type A from recommendation to requirement.
- Providing additional detail for EESS in case of overfrequency.

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. **A1**

Introduction

Rationale for the content and structure of this document.

1. Foreword

This Explanatory Note explains the rationale behind the content and structure of prEN 50549-1 and prEN 50549-2. Due to the unique relationship between COMMISSION REGULATION 2016/631 (RfG) and the EN 50549 Series, and based on the comments received at the enquiry stage of prEN 50549-1 and prEN 50549-2, TC8X WG03 decided to draft this explanatory note in order to provide national committees and the wider public with an understanding of these rationale.

2. Increased Scope of EN 50549 in relation to RfG

In the tradition of EN 50438, TC8X WG03 intended, in writing of prEN50549, to include all capabilities of generating plants that are needed to operate these in parallel to distribution networks. This includes issues necessary for a stable distribution network management as well as the management of the interconnected system. As RfG is focused on the interconnected system, it is logical that, taking into account further needs for distribution network management, further aspects are included.

3. Introduction of “Responsible party”

During the national implementation process of COMMISSION REGULATION (EU) 2016/631, different types of responsible parties play a role in the refinement of the non-exhaustive requirements. In each member country, the National Regulatory Authority approves this national implementation. Depending on the national regulatory framework, this might result in a variety of documents: national laws, decrees or regulations, technical specifications, or requirements of transmission and distribution system operators. Therefore, as explained in the scope, EN 50549-1 and EN 50549-2 refer to the “responsible party” where requirements have to be defined by an actor other than the DSO. However when a generating plant is built and connected to the distribution network, typically the distribution system operator provides the plant developer all the technical requirements to be fulfilled.

4. Use of terms

Terms and definitions are selected to achieve consistency with EN 60050, IEV (cf. www.electropedia.org) and CENELEC terminology, recognizing that terms in COMMISSION REGULATION (EU) 2016/631 may deviate.

5. Additional requirements for distribution system management

The following requirements are stated in EN 50549 for distribution system management reasons, which might not be required in RfG or if required in RfG, are not required for type A. As Directive 714/2009 8(7) limits the scope of RfG to issues effecting the cross border trade of electricity, requirements included solely for the need of distribution system management are considered beyond the scope of RfG.

- Connection scheme and Coordination of switch gear,
- Voltage operating range,
- Reactive power capability and control modes,
- Voltage related active power reduction,
- Interface protection including the detection of island situations,
- Connection and reconnection to the grid,
- Generation curtailment,
- Remote information exchange,

6. Additional requirements for stability of the interconnected system

Additionally, requirements relevant for the stability of the interconnected systems are included in case of over voltage ride through (OVRT) as this is not dealt with in RfG. Due to the long duration of RfG development and the fast development of decentralised generation in Europe robustness to voltage swells is considered to be of high importance, but apparently could not be included into RfG.

As electrical energy storage system (EESS), are excluded from the scope of RfG, but are included in the scope of the EN 50549 Series, EN 50549 also includes the further requirement of active power frequency response to under frequency (LFSM-U) to electrical energy storage systems. This requirement is considered of great importance in view of the expected fast increase of electrical energy storage for the next years and is considered not to affect the cost of electrical energy storage systems if considered during their design.

7. Details on the operation of the LFSM-O

During the enquiry stage, some comments reported that certain details in the chapter regarding the operation of the LFSM-O (e.g. intentional delay, operation with deactivation threshold) were violating the RfG. These topics have been further evaluated consulting the European Stakeholder Committee (ESC-GC) and TC8X WG03 could not conclude in the same way. The fact that these operations are not foreseen in the RfG is considered not sufficient to state any violation. Therefore these details are kept with additional information on their use.

A1 8. Implementation of UVRT and LFSM-U to avoid legal conflict with RfG

Under Voltage Ride Through (UVRT) requirements are defined in RfG for modules type B, type C and type D. There is no mentioning of this topic for type A modules.

Nevertheless, UVRT is seen as an important requirement in some member states even for small generation modules like type A.

NOTE At the time of writing, LVRT requirements for type A modules have been implemented in the following countries: Austria, Czech Republic, Germany, Portugal (for PGM of 15 kW and higher), Switzerland.

From a legal point of view there are two contradicting opinions on whether it is allowed or forbidden to require UVRT for type A modules.

- Opinion 1: It can be required because the topic is not dealt with for type A modules.
- Option 2: It cannot be required because the topic UVRT is dealt within the RfG. Not mentioning UVRT for type A in RfG therefore means that it cannot be required for type A modules.

TC8X WG03 adopts the view of ACER as expressed in “ACER Monitoring of the Implementation of the Grid Connection Network Codes” 11 November 2021 Item 3.3.4 #D where it states the German UVRT requirement for Type A as compliant with NC RfG.

This same explanation can be applied to the requirements regarding Limited Frequency Sensitive Mode - Underfrequency (LFSM-U). In RfG, this LFSM-U is solely defined for type C and type D modules. In EN 50549, LFSM-U is defined as a recommendation (should) for generating modules of type A and type B. The sole exception is electrical energy storage systems having a requirement (shall). These systems are currently not within the scope of the RfG. **A1**

9. Annex H - Relationship between this European standard and the COMMISSION REGULATION (EU) 2016/631.

Manufacturers of generating units and plants shall comply with all relevant EU Directives and Regulations. For the specific function of connecting the generating plant with the electric system the reference regulation is COMMISSION REGULATION (EU) 2016/631 (NC RfG).

Since the EN 50549-1 and -2 are covering all technical requirements for type A and type B generating units, modules and plants, it is considered helpful to provide the information which clause of the standard supports which article of the RfG in a structured informative annex within the standard.

For other EU Directives and Regulations (e.g. LVD, MD or GAR) it is a formal task given to CCMC to include such an informative Annex ZZ based on a standardization request from the EU. It is finally reviewed by the new approach consultant (NAC) for the relevant Directive or Regulation, prior to the listing of the standard in the official journal of the EU (OJEU) providing then “presumption of conformity”. This means that if a product is compliant with the standard, the Directive or Regulations is fulfilled too.

CLC TC 8X is fully aware, that this official procedure is not included in the RfG. Therefore CLC TC 8X WG3 drafted Annex H. In Annex H the relationship between the clauses and the articles is shown. It is considered, that generating plants compliant with the clauses of the standards are also compliant with the articles in the RfG. Of course, this does not provide “presumption of conformity” as a listed standard in the OJEU would provide. Nevertheless it will be helpful for the industry when performing the conformity assessment against RfG.

1 Scope

This document specifies the technical requirements for the protection functions and the operational capabilities for generating plants, intended to operate in parallel with LV distribution networks.

For practical reasons this document refers to the responsible party where requirements have to be defined by an actor other than the DSO e.g. TSO, member state, regulatory authorities according to the legal framework. Typically the DSO will inform the producer about these requirements.

NOTE 1 This includes European network codes and their national implementation, as well as additional national regulations.

NOTE 2 Additional national requirements especially for the connection to the distribution network and the operation of the generating plant may apply.

The requirements of this European Standard apply, irrespective of the kind of energy source and irrespective of the presence of loads in the producer's network, to generating plants, generating modules, electrical machinery and electronic equipment that meet all of the following conditions:

- converting any energy source into AC electricity;
- generating modules capacity of type B or smaller according to COMMISSION REGULATION (EU) 2016/631 while considering national implementation for the decision regarding power limits between A and B types and B and C types;
- connected to and operated in parallel with an AC LV distribution network.

NOTE 3 Generating plants connected to a MV distribution network fall into the scope of EN 50549-2.

NOTE 4 Electrical energy storage systems (EESS) in meeting the conditions above are included

If generating modules of different type (A or B) are combined in one plant, different requirements apply for the different modules based on the type of each module.

EXAMPLE: If a generating plant consists of multiple generating modules (see 3.2.1), according to COMMISSION REGULATION (EU) 2016/631 the situation might occur, that some generating modules are of type A and some are of type B.

Unless specified otherwise by the DSO and the responsible party, generating plants connected to a medium voltage distribution network with a maximum apparent power up to 150 kVA can comply with this European Standard as alternative to the requirements of EN 50549-2. A different threshold may be defined by the DSO and the responsible party.

This document recognizes the existence of specific technical requirements (e.g. grid codes) of the DSO or another responsible party within a member state and these must be complied with.

Excluded from the scope are:

- the selection and evaluation of the point of connection;
- power system impact assessment e.g. assessment of effects on power quality, local voltage increase, impact on line protections operation;
- connection assessment, the set of technical verifications made as part of the planning of the connection;
- island operation of generating plants, both intentional and unintentional, where no part of the distribution network is involved;
- four-quadrant rectifier of drives feeding braking energy back into the distribution network for limited duration with no internal source of primary energy;
- uninterruptible power supply with duration of parallel operation limited to 100 ms;

NOTE 5 Parallel operation due to maintenance of uninterruptible power supply units is not seen as part of normal UPS operation and therefore not considered in this document.

- requirements for the safety of personnel as they are already adequately covered by existing European Standards.
- the connection of a generating unit, module or plant into a DC network

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 50549-2, *Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network - Generating plants up to and including Type B*

EN 50549-10, *Requirements for generating plants to be connected in parallel with distribution networks - Part 10: Tests for conformity assessment of generating units*

deleted text

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

HD 60364-1, *Low-voltage electrical installations — Part 1: Fundamental principles, assessment of general characteristics, definitions (IEC 60364-1)*

HD 60364-5-551, *Low-voltage electrical installations — Part 5-55: Selection and erection of electrical equipment — Other equipment — Clause 551: Low-voltage generating sets (IEC 60364-5-551)*

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 and definitions are selected to achieve consistency with IEV (cf. www.electropedia.org) and CENELEC terminology, recognizing that terms in COMMISSION REGULATION (EU) 2016/631 may deviate.

3.1 General

3.1.1

distribution network

AC electrical network, including closed distribution networks, for the distribution of electrical power from and to third parties connected to it, to and from a transmission or another distribution network, for which a DSO is responsible

Note 1 to entry: A distribution network does not include the producer's network.