

© Copyright SEK. Reproduction in any form without permission is prohibited.

## Fordringar på mindre generatoranläggningar för anslutning i paralleldrift med det allmänna elnätet

*Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks*

Som svensk standard gäller europastandarden EN 50438:2013. Den svenska standarden innehåller den officiella engelska språkversionen av EN 50438:2013.

### Nationellt förord

I bilaga A redovisas svensk avvikelser, vilken av CENELEC accepterats till följd av speciella nationella förhållanden.

I en nationell bilaga NA sist i standarden återges varningsskylten i figur 5 med texten översatt till svenska.

Tidigare fastställd svensk standard SS-EN 50438, utgåva 1, 2008, gäller ej fr o m 2016-11-04.

### *Standarder underlättar utvecklingen och höjer elsäkerheten*

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

### *SEK är Sveriges röst i standardiseringsarbetet inom elområdet*

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

### *Stora delar av arbetet sker internationellt*

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

### *Var med och påverka!*

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

### **SEK Svensk Elstandard**

Box 1284  
164 29 Kista  
Tel 08-444 14 00  
[www.elstandard.se](http://www.elstandard.se)

English version

## **Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks**

Exigences pour les installations de micro-génération destinées à être raccordées en parallèle avec les réseaux publics de distribution à basse tension

Anforderungen für den Anschluss von Klein-Generatoren an das öffentliche Niederspannungsnetz

This European Standard was approved by CENELEC on 2013-11-04. 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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# **CENELEC**

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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Contents

<b>Foreword</b> .....	<b>6</b>
<b>1 Scope</b> .....	<b>7</b>
<b>2 Normative references</b> .....	<b>7</b>
<b>3 Terms and definitions</b> .....	<b>8</b>
<b>4 Technical requirements</b> .....	<b>13</b>
<b>4.1 Electrical installation</b> .....	<b>13</b>
<b>4.1.1 General</b> .....	<b>13</b>
<b>4.1.2 Over-current protection</b> .....	<b>13</b>
<b>4.1.3 Earthing</b> .....	<b>13</b>
<b>4.2 Normal operating range</b> .....	<b>13</b>
<b>4.2.1 General</b> .....	<b>13</b>
<b>4.2.2 Continuous voltage operation range</b> .....	<b>14</b>
<b>4.2.3 Continuous frequency operation range</b> .....	<b>14</b>
<b>4.2.4 Response to under-frequencies</b> .....	<b>14</b>
<b>4.2.5 Power response to over-frequency</b> .....	<b>15</b>
<b>4.3 Reactive power capability</b> .....	<b>16</b>
<b>4.3.1 Inverter based micro-generator</b> .....	<b>16</b>
<b>4.3.2 Directly coupled micro-generator with no inverter</b> .....	<b>17</b>
<b>4.4 Reactive power control modes</b> .....	<b>17</b>
<b>4.4.1 General</b> .....	<b>17</b>
<b>4.4.2 Fix control mode <math>\cos \varphi</math> fix</b> .....	<b>17</b>
<b>4.4.3 Voltage related control mode Q(U)</b> .....	<b>18</b>
<b>4.4.4 Power related control mode <math>\cos \varphi</math> (P)</b> .....	<b>18</b>
<b>4.5 Voltage control by active power</b> .....	<b>18</b>
<b>4.6 Interface protection</b> .....	<b>18</b>
<b>4.6.1 General</b> .....	<b>18</b>
<b>4.6.2 Interface protection settings</b> .....	<b>20</b>
<b>4.6.3 Requirements regarding single fault tolerance of interface protection system</b>	<b>20</b>
<b>4.7 Connection and starting to generate electrical power</b> .....	<b>21</b>
<b>4.7.1 General</b> .....	<b>21</b>
<b>4.7.2 Automatic reconnection after tripping</b> .....	<b>21</b>
<b>4.7.3 Starting to generate electrical power</b> .....	<b>21</b>
<b>4.7.4 Synchronisation</b> .....	<b>21</b>
<b>4.8 Power quality</b> .....	<b>21</b>
<b>4.8.1 General</b> .....	<b>21</b>
<b>4.8.2 DC injection</b> .....	<b>22</b>
<b>5 Operation and safety of the micro-generator</b> .....	<b>22</b>
<b>5.1 General</b> .....	<b>22</b>
<b>5.2 Safety</b> .....	<b>23</b>
<b>5.3 Information plate</b> .....	<b>23</b>
<b>5.4 Labelling</b> .....	<b>23</b>
<b>5.5 Maintenance and routine testing</b> .....	<b>24</b>
<b>6 Commissioning</b> .....	<b>24</b>
<b>Annex A (informative) National settings and requirements</b> .....	<b>25</b>
<b>A.1 General</b> .....	<b>25</b>

<b>A.2</b>	<b>AT – Austria</b> .....	<b>25</b>
<b>A.3</b>	<b>BE – Belgium</b> .....	<b>26</b>
<b>A.4</b>	<b>CY – Cyprus</b> .....	<b>27</b>
<b>A.5</b>	<b>CZ – Czech Republic</b> .....	<b>27</b>
<b>A.6</b>	<b>DE – Germany</b> .....	<b>28</b>
<b>A.7</b>	<b>DK – Denmark</b> .....	<b>28</b>
<b>A.8</b>	<b>EE – Estonia</b> .....	<b>28</b>
<b>A.9</b>	<b>ES – Spain</b> .....	<b>29</b>
<b>A.10</b>	<b>FI – Finland</b> .....	<b>30</b>
<b>A.11</b>	<b>FR – France</b> .....	<b>30</b>
<b>A.12</b>	<b>GB – United Kingdom</b> .....	<b>31</b>
<b>A.13</b>	<b>IE – Ireland</b> .....	<b>32</b>
<b>A.14</b>	<b>IT – Italy</b> .....	<b>33</b>
<b>A.15</b>	<b>LV – Latvia</b> .....	<b>35</b>
<b>A.16</b>	<b>NL – The Netherlands</b> .....	<b>36</b>
<b>A.17</b>	<b>NO – Norway</b> .....	<b>36</b>
<b>A.18</b>	<b>PL – Poland</b> .....	<b>36</b>
<b>A.19</b>	<b>SI – Slovenia</b> .....	<b>37</b>
<b>A.20</b>	<b>SE – Sweden</b> .....	<b>38</b>
<b>Annex B</b>	<b>(informative) Loss of Mains and overall system security</b> .....	<b>39</b>
<b>Annex C</b>	<b>(informative) Example notification sheets</b> .....	<b>40</b>
<b>C.1</b>	<b>General</b> .....	<b>40</b>
<b>C.2</b>	<b>Application for connection of micro-generators</b> .....	<b>40</b>
<b>C.3</b>	<b>Notification of micro-generator decommissioning</b> .....	<b>43</b>
<b>Annex D</b>	<b>(informative) Compliance type testing</b> .....	<b>44</b>
<b>D.1</b>	<b>General</b> .....	<b>44</b>
<b>D.2</b>	<b>Type testing of the interface protection</b> .....	<b>44</b>
<b>D.2.1</b>	<b>Introduction</b> .....	<b>44</b>
<b>D.2.2</b>	<b>General</b> .....	<b>44</b>
<b>D.2.3</b>	<b>Over-/under-voltage</b> .....	<b>44</b>
<b>D.2.4</b>	<b>Over- /under-frequency</b> .....	<b>45</b>
<b>D.2.5</b>	<b>Loss of Mains (LoM) detection</b> .....	<b>46</b>
<b>D.3</b>	<b>Type testing of a micro-generator</b> .....	<b>47</b>
<b>D.3.1</b>	<b>Operating range</b> .....	<b>47</b>
<b>D.3.2</b>	<b>Active power feed-in at under-frequency</b> .....	<b>48</b>
<b>D.3.3</b>	<b>Power response to over-frequency</b> .....	<b>48</b>
<b>D.3.4</b>	<b>Reactive power capability</b> .....	<b>50</b>
<b>D.3.5</b>	<b>Voltage control by active power</b> .....	<b>52</b>
<b>D.3.6</b>	<b>Connection and starting to generate electrical power</b> .....	<b>52</b>
<b>D.3.7</b>	<b>Short-circuit current contribution</b> .....	<b>53</b>
<b>D.3.8</b>	<b>Harmonic current emission</b> .....	<b>54</b>
<b>D.3.9</b>	<b>Voltage fluctuations and flicker</b> .....	<b>54</b>
<b>D.3.10</b>	<b>DC injection</b> .....	<b>54</b>
<b>Annex E</b>	<b>(informative) Example test results sheet</b> .....	<b>55</b>
<b>E.1</b>	<b>General details</b> .....	<b>55</b>
<b>E.1.1</b>	<b>Micro-generator details</b> .....	<b>55</b>
<b>E.1.2</b>	<b>Test house details</b> .....	<b>55</b>
<b>E.1.3</b>	<b>Test details</b> .....	<b>55</b>

E.2	Type testing of the interface protection.....	56
E.2.1	General.....	56
E.2.2	Over-/under-frequency tests .....	56
E.2.3	Over-/under-voltage tests (single stage protection) .....	56
E.2.4	LoM test .....	56
E.3	Type testing of a micro-generator .....	57
E.3.1	Operating Range .....	57
E.3.2	Active power at under-frequency.....	57
E.3.3	Power response to over-frequency .....	57
E.3.4	Reactive power .....	58
E.3.5	Connection and starting to generate electrical power .....	59
E.3.6	Short-circuit current contribution.....	59
E.3.7	Power quality .....	60
E.4	Comments .....	60
Annex F (informative)	Commissioning .....	61
F.1	Installation.....	61
F.2	Notification procedure .....	61
F.2.1	Ordinary procedure .....	61
F.2.2	Inform and Fit for a single installation .....	61
Annex G (normative)	Countries allowing extension of the scope > 16 A.....	62
G.1	General .....	62
G.2	CY – Cyprus .....	62
G.3	FI – Finland.....	62
G.4	IE – Ireland .....	62
Annex H (informative)	Abbreviations .....	63
Annex I (informative)	A-deviations .....	64
Bibliography.....		65
Figure 1 —	Main times defining interface protection performance .....	10
Figure 2 —	Maximum allowable power reduction in case of under-frequency.....	15
Figure 3 —	Reactive power capability in load reference frame .....	17
Figure 4 —	Reactive power control characteristic.....	18
Figure 5 —	Example of a warning label both for size and content .....	24
Figure A.1 .....		34
Figure D.1 —	LoM test arrangement.....	47
Figure D.2 —	Example of testing the active power feed-in at over-frequency with $f_1 = 50,2$ Hz ..	49
Figure D.3 —	Power factor test arrangement .....	50
Table 1 —	Minimum time periods for operation in under-frequency situation .....	14
Table 2 —	Minimum time periods for operation in over-frequency situation .....	15

<b>Table 3 — Standard settings for power response to over-frequency .....</b>	<b>16</b>
<b>Table 4 — Default interface protection performance .....</b>	<b>20</b>
<b>Table 5 — Harmonics and flicker emission standards .....</b>	<b>22</b>

## Foreword

This document (EN 50438:2013) 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) 2014-11-04
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-11-04

This document supersedes EN 50438:2007.

EN 50438:2013 includes the following significant technical changes with respect to EN 50438:2007:

- introduction of a power reduction capability in case of over-frequency;
- introduction of reactive power capability
- update of national protection parameters settings in Annex A;
- modification of tests for the verification of interface protections (voltage and frequency);
- modification of the test for islanding detection;
- addition of a test for direct current injection.

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

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

This European Standard relates to both future European Network Codes and current technical market needs. Its purpose is to give detailed description of functions to be implemented in products and methods to verify the compliance of the products.

This European Standard is also intended to serve as a technical reference for the definition of national requirements where European Network Codes requirements allow flexible implementation, e.g. settings for power response to over frequency.

CLC/TC 8X plans to review the Standard periodically, in order to ensure its compatibility with the evolution of the legal framework.

---



## 1 Scope

This European Standard specifies technical requirements for the protection functions and the operational capabilities of micro-generating plants, designed for operation in parallel with public low-voltage distribution networks.

This European Standard applies irrespectively of the micro-generating plants' primary source of energy, where micro-generation refers to equipment with nominal currents up to and including 16 A per phase, single or multi phase 230/400 V or multi phase 230 V (phase-to-phase nominal voltage).

For practical reasons, this European Standard refers to the distribution system operator in case settings have to be defined and/or provided, even when these settings are to be defined and/or provided by another actor according to national and European legal framework.

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

NOTE 2 Further national requirements especially for the connection to the grid and the operation of the micro-generator can apply as long as they are not in conflict with this EN.

In some countries, this document may be applied to generators with higher nominal currents used mostly in domestic and small commercial installations. These countries are listed in Annex G.

The provisions of this European Standard are not intended to ensure by themselves the safety of DSO personnel or their contracted parties.

The following aspects are included in the scope:

- all micro-generation technologies are applicable.

The following aspects are excluded from the scope:

- multiple units that for one installation, in aggregate, exceed 16 A;
- issues of revenue rebalancing, metering or other commercial matters;
- requirements related to the primary energy source e.g. matters related to gas fired generator units;
- island operation of generating plants, both intentional and unintentional, where no part of the public distribution network is involved;
- active front ends of drives feeding energy back into the distribution network for short duration.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50110 (all parts), *Operation of electrical installations*

EN 50160, *Voltage characteristics of electricity supplied by public electricity networks*

HD 60364 (all parts), *Low-voltage electrical installations (IEC 60364 series)*

EN 61000-3-2:2006, *Electromagnetic compatibility (EMC) — Part 3-2: Limits — Limits for harmonic current emissions (equipment input current  $\leq$  16 A per phase) (IEC 61000-3-2:2005)*

EN 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  $\leq$  16 A per phase and not subject to conditional connection (IEC 61000-3-3)*

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

EN 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1)*

EN 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3)*

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 60364-5-55:2001/A2:2008 (CLAUSE 551))*

IEC 60255-127, *Measuring relays and protection equipment — Part 127: Functional requirements for over/under voltage protection*