



# SLOVENSKI STANDARD

## SIST EN 50438:2008

01-maj-2008

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### Zahteve za vzporedno vezavo mikro generatorjev z javnim nizkonapetostnim razdelilnim omrežjem

Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks

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

Prescriptions pour le raccordement de micro-générateurs en parallèle avec les réseaux publics de distribution à basse tension

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Ta slovenski standard je istoveten z: EN 50438:2007

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#### **ICS:**

29.160.20	Generatorji	Generators
29.240.01	Omrežja za prenos in distribucijo električne energije na splošno	Power transmission and distribution networks in general

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 50438**

December 2007

ICS 29.160.20

English version

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Prescriptions pour le raccordement  
de micro-générateurs en parallèle  
avec les réseaux publics de distribution  
à basse tension

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

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This European Standard was approved by CENELEC on 2007-09-11. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

# CENELEC

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

This European Standard was prepared by WG 2 of the Technical Committee CENELEC TC 8X, System aspects for electrical energy supply.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50438 on 2007-09-11.

This European Standard supersedes CWA 14642:2003.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2008-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-10-01

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## 1 Scope

This European Standard specifies technical requirements for connection and operation of fixed installed micro-generators and their protection devices, irrespective of the micro-generators primary source of energy, in parallel with public low-voltage distribution networks, where micro-generation refers to equipment rated up to and including 16 A per phase, single or multi phase 230/400 V or multi phase 230 V (phase-to-phase voltage).

This European Standard is intended for installation mainly in the domestic market.

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

Whenever the scope is extended to equipment rated greater than 16 A per phase additional standards could be applicable.

Inform and Fit is the recommended procedure for installation of micro-generation except in those countries where legislation precludes this approach e.g. where it is mandatory for the DNO to give prior permission for the connection.

**Table 1 – Countries allowing or not allowing Inform and Fit**

Inform and Fit				Inform and Fit			
Code	Country	Allowed	Not allowed	Code	Country	Allowed	Not allowed
AT	Austria			IS	Iceland	x	
BE	Belgium	x		IT	Italy		x
CH	Switzerland		x	LT	Lithuania	x	
CY	Cyprus	x		LU	Luxembourg	x	
CZ	Czech Republic		x	LV	Latvia	x	
DE	Germany		x	MT	Malta	x	
DK	Denmark	x		NL	Netherlands	x	
EE	Estonia	x		NO	Norway		x
ES	Spain		x	PL	Poland		x
FI	Finland		x	PT	Portugal	x	
FR	France		x	RO	Romania	x	
GB	United Kingdom	x		SI	Slovenia	x	
GR	Greece	x		SE	Sweden		x
HU	Hungary	x		SK	Slovakia	x	
IE	Ireland	x					

The electrical interface is the principal focus and this includes the method of connection, the settings and protection requirements for connection, the operation of the electrical interface under normal conditions, emergency shutdown, distribution network-independent operation, start-up and distribution network synchronisation.

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

The intention of this European Standard is to ensure that the micro-generator satisfies appropriate provisions for

- the requirements of the DNO e.g. the distribution network protection,
- information to electricians working inside the house,
- quality of supply.

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;
- generators never to be connected to the supply networks;
- requirements related to the primary energy source e.g. matters related to gas fired generator units;
- intended network independent operation.

NOTE If independent operation is intended, generally preliminary agreement of the DNO shall be obtained, however this is out of the scope of this document. Specific additional requirements most likely could be applicable.

## 2 Normative references

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The following referenced documents are indispensable for the application 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.

		<a href="https://standards.iteh.ai/catalog/standards/sist/549d9c4c-9cbb-4ce9-a583-8cb0e087500d/sist-en-50438-2008">https://standards.iteh.ai/catalog/standards/sist/549d9c4c-9cbb-4ce9-a583-8cb0e087500d/sist-en-50438-2008</a>	
EN 50110 series		Operation of electrical installations	
EN 50160		Voltage characteristics of electricity supplied by public distribution systems	
EN 60255-6		Electrical relays – Part 6 : Measuring relays and protection equipment (IEC 60255-6)	
EN 60664-1		Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests (IEC 60664-1)	
EN 61000-3-2		Electromagnetic compatibility (EMC) – Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase) (IEC 61000-3-2)	
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 ≤ 16 A per phase and not subject to conditional connection (IEC 61000-3-3)	
EN 61000-6-1		Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1, mod.)	
EN 61000-6-3 + A11	2001 2004	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:1996, mod.)	
HD 384 / HD 60364 series		Electrical installations of buildings (IEC 60364 series, mod.)	
IEC 60364-5-55		Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment - Other equipment	



### 3 Terms and definitions <sup>1)</sup>

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

#### 3.1

##### **clearance time**

total duration between the instant when the protection system is initiated and the instant when the cessation of supply to the network or disconnection of the micro-generator takes place

#### 3.2

##### **cease to energize the distribution network**

termination of the operational state where the micro-generator supplies power to the distribution network

#### 3.3

##### **cogeneration**

##### **combined heat and power (CHP)**

combined generation of electricity and heat by an energy conversion system and the concurrent use of the electric and thermal energy from the conversion system

NOTE In the context of small-scale generation this concept is sometimes referred to as "domestic CHP".

#### 3.4

##### **commissioning**

process of putting into operation a micro-generator, apparatus, equipment, building, or facility in accordance with the manufacturer's instruction

#### 3.5

##### **user <sup>2)</sup>**

person with responsibility for the premises in which the micro-generator is installed, normally referred to in other documentation as the customer / consumer / network user

#### 3.6

##### **decommissioning**

process of removing a micro-generator, apparatus, equipment, building, or facility from operation

#### 3.7

##### **disconnection**

separation of the active parts of the micro-generator from the network with mechanical contacts providing at least basic insulation

NOTE Passive components like filters, auxiliary power supply to the micro-generator and sense lines can remain connected.

#### 3.8

##### **LV distribution network**

low voltage part of the electric power system used for the transfer of electricity within an area of consumption to consumers

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<sup>1)</sup> Where possible IEC Multilingual Dictionary (on CD) is used.

<sup>2)</sup> Based on national regulations other terms may apply.

### 3.9

#### **distribution network operator (DNO)**

natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution network in a given area and, when applicable, its interconnections with other systems and for ensuring the long term ability of the system to meet reasonable demands for the distribution of electricity (DNO equals DSO, Distribution System Operator)

### 3.10

#### **electrical installation**

assembly of wiring and electrical equipment that is used within the domestic premises for the distribution and/or use of electric energy

### 3.11

#### **inform & fit**

process of installing and commissioning a micro-generator with prior notification of the DNO, followed by commencement of operation without the need of prior formal approval of the DNO

### 3.12

#### **fuel cell**

electrochemical device that converts chemical energy directly into heat and electricity

### 3.13

#### **installer<sup>3)</sup>**

person who has received sufficient training to apply safe methods of work to install a micro-generator in compliance with the requirements of this standard (in some countries it may be necessary to have recognized qualification and/or accreditation)

### 3.14

#### **interface protection**

electric protection required to ensure that the micro-generator is disconnected and/or ceases to energize for any event that could impair the integrity or degrade the safety of the distribution network

### 3.15

#### **islanding**

situation where a section of the electricity network, containing generation, becomes physically disconnected from the rest of distribution network or user's network and one or more generators maintain a supply of electrical energy to the isolated network

### 3.16

#### **isolation**

cut off for reasons of safety from all or a discrete section of the electrical installation by separating the electrical installation or section from every source of electrical energy

### 3.17

#### **Loss of Mains (LoM) protection**

protection system that will disconnect the micro-generator from the distribution network and/or ceases to energize in the event of loss of that supply

NOTE LoM protection will invariably involve sampling of the voltage wave form. In the event of a LoM situation, this sampling will introduce a time delay before a protection initiation signal can be issued.

### 3.18

#### **low voltage (LV)**

for the purpose of this standard a voltage, used for the supply of electricity, whose upper limit of nominal r.m.s. value is 1 kV

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<sup>3)</sup> Based on national regulations, other terms may apply.

**3.19****nominal voltage**

single phase 230 V, multi phase 230/400 V or multi phase 230 V (phase-to-phase voltage)

**3.20****micro-generator**

source of electrical energy including all interface units with a rated line-conductor electric current of up to and including 16 A low-voltage AC and designed to operate normally in parallel with a low voltage distribution network

**3.21****notification**

process of informing the DNO of the commissioning of a micro-generation system, or its decommissioning

**4 Connection requirements****4.1 The electrical installation**

The unit shall be connected in compliance with HD 384 series and the relevant national standards.

Low voltage electrical installations shall comply with national and local regulation whether the installation is supplied by generation running in parallel with the distribution network, solely by the distribution network or islanded.

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**4.1.1 Installation instructions (standards.iteh.ai)**

The micro-generator shall be installed and maintained in accordance with the instructions issued by the manufacturer.

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**4.1.2 Over-current protection**

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The micro-generator installation shall be protected against over-current according to HD 384 series. When selecting the overcurrent protection within the domestic installation it is necessary to ensure correct discrimination with the DNO's protection devices.

**4.1.3 Earthing**

Earthing shall be according to HD 384.5.54 / IEC 60364-5-55 and the relevant national standards.

When a micro-generator is operating in parallel with the distribution network, there shall be no direct connection between the generator winding (or pole of the primary energy source in the case of a DC sourced micro-generator) and the DNO's earth terminal. For installations where the customer provides his own earth terminal, e.g. when connected to a TT system, it is also advisable to avoid connecting the generator winding to this earth terminal. The reason for this precaution is to avoid damage to the generator during faults on the distribution network and to ensure correct operation of protective devices.

For a micro-generator which is designed to operate in parallel with a distribution network but which is connected via an inverter (e.g. a PV array or fuel cell) it is permissible to connect one pole of the DC side of the inverter to the distribution network if the insulation between the AC and the DC sides of the inverter meets the requirements of over voltage category IV as specified in EN 60664-1. In such cases the installer / Manufacturer shall take all reasonable precautions to ensure that the micro-generator unit will not impair the integrity of the distribution network and will not suffer unacceptable damage for all credible operating conditions, including faults on the distribution network.

## 4.2 Interface protection

### 4.2.1 General

The purpose of the interface protection is to ensure that the connection of a micro-generator unit will not impair the integrity or degrade the safety of the distribution network. The interface protection shall be insensitive to normal voltage and frequency variations in the distribution network.

The interface protection, monitoring and control functions may be incorporated into the micro-generator control system, or may be fitted as discrete separate mounted devices.

#### 4.2.1.1 Default settings versus national settings

If no national settings are provided for a particular country (Annex A), the default settings in Table 2 shall be applied.

#### 4.2.1.2 Response to protection operation

The interface protection shall ensure that the micro-generator ceases to energize the distribution network when any parameter exceeds the applied operating setting. Disconnection is required in case of any hardware malfunctioning.

The micro-generator shall cease to energize the network in response to an interface protection operation, this shall be achieved either by the separation of suitably rated mechanical contacts or by the operation of a suitably rated solid state switching device. Where a solid state switching device is used the micro-generator shall monitor the proper functioning of the device. In the event the solid state switching device fails to interrupt the current, the micro-generator shall disconnect or cease to energize. The solid state switching device shall be specified in accordance with the over-voltage category of the micro-generator as specified by the manufacturer and the leakage current in the off-state shall not be more than 0,1 mA regardless of the terminal voltage.

#### 4.2.1.3 Accessibility of isolation switching devices

Under HD 384 series there is a requirement that means shall be provided to enable a generator set to be isolated from the public supply. Where this means of isolation is not accessible for the DNO at all times it is acceptable to provide two means of automatic disconnection, with a single control. At least one of the means of disconnection must be afforded by the separation of mechanical contacts.

#### 4.2.1.4 Place of the interface protection

The interface protection can either be incorporated within the micro-generator or afforded by separate devices. In either case the interface protection shall meet the relevant requirements of EN 60255-6 or equivalent and the manufacturer of the micro-generator shall declare that the combined devices fulfil these requirements.

#### 4.2.1.5 Changing settings of the interface protection

The interface protection settings may only be altered, from those in place at the time of commissioning, with the written agreement of the DNO and then only in accordance with the manufacturer instructions.

It shall not be permissible for the user to alter the interface protection settings.

NOTE Alteration of the settings of the interface protection may cause a breach of the type-certificate making re-testing necessary unless the micro-generator is type-tested on the full setting range of the interface protection.

#### 4.2.1.6 Combined protection device for multiple generators

It is allowed to use a protection device that affords interface protection for 2 or more micro-generators up to and including 16 A per phase in aggregate. However the possibility to use Inform and Fit then depends on the conditions of the type certificate of the protection device.

If two or more micro-generators, each with their own interface device, are placed in parallel, the proper combined working of the protection devices shall be ensured.

In the case of adding a generator to the combined protection device the DNO shall be consulted.

#### 4.2.2 Interface protection settings

National settings are listed in Annex A. If no national settings are provided for a particular country, the default settings in Table 2 should be applied. The trip settings and clearance time in Table 2 and Annex A are maximum range values. Other values may be applied, subject to any national requirements given in Annex A. Settings should be as close as possible to the limits to avoid nuisance tripping.

The measurement point can be inside the micro-generator or anywhere between the micro-generator terminals and up to but not including the connection to the DNO network.

**Table 2 – Default interface protection settings**

Parameter	Maximum clearance time	Trip setting
Over voltage – stage 1 <sup>a</sup> (if required)	See Annex A	See Annex A
Over voltage – stage 2	0,2 s	230 V + 15 %
Under voltage	1,5 s	230 V - 15 %
Over frequency	0,5 s	51 Hz
Under frequency	0,5 s	47 Hz
LoM (if required)	See Annex A	See Annex A
<p>The stated currents and voltages are 'true r.m.s.'-values.            The voltages in this table are            - phase-to-neutral in 230 V single phase systems and 230/400 V systems,            - phase-to-phase in a multiphase 230 V system.</p>		
<p><sup>a</sup> Over voltage – stage 1: 10 min mean value corresponding to EN 50160.            Tolerances on trip values:            - voltage: ± 1 % of the nominal voltage;            - frequency: ± 0,5 % of the nominal frequency;            - clearance time: ± 10 %.</p>		

NOTE Voltage and frequency is referenced to the supply terminals.

#### 4.2.3 Loss of Mains (LoM) protection

Where LoM protection is required (see Annex A) it shall use rate of change of frequency or vector shift or any other method not precluded under the national requirements in Annex A. The trip setting shall ensure cease energizing within the prescribed clearance time irrespective of where the LoM takes place on the distribution network. This requirement is deemed to be satisfied by passing the test in C.2.3.

A LoM protection shall not disturb other LoM protections.

#### 4.2.4 Automatic reconnection after a network outage

The interface protection shall ensure that feeding power to the distribution network will only commence, after the voltage and frequency on the distribution network have been within the limits of the interface protection settings for a minimum of

- 3 min for mechanical AC generation,
- 20 s for inverter based systems.

In order to facilitate such automatic reconnection power input, the interface protection equipment and sensing connections to the interface protection may be made on the DNO side of the disconnecter (but on the micro-generator side of the isolator) that is initiated by the interface micro-generator protection.

#### 4.2.5 Synchronisation

The operation of synchronising a micro-generator with the distribution network shall be fully automatic i.e. it shall not be possible to manually close the switch between the two systems to carry out synchronisation.

## 5 Power quality

### 5.1 Electromagnetic emission / immunity

The micro-generator shall comply with the requirements of the EMC Directive. As no product specific EMC requirements are available in standards for micro-generators the generic EMC standards are applicable, in particular EN 61000-6-1 on immunity and EN 61000-6-3 (including A11) on emission.

In these standards reference is made to the product family emission standards listed in Table 3 below.

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**Table 3 – Product family emission standards**

Parameter	Micro-generator rating	Standard	Requirement
Harmonics	≤ 16 A	EN 61000-3-2	Class A
Voltage fluctuations and flicker	≤ 16 A	EN 61000-3-3	$d_c = 3,3 \%$ max.

NOTE The emission limits relate to the level of emissions from the micro-generator towards the distribution network.

### 5.2 DC injection

For inverter based systems only symmetrical control as defined in IEC 161-07-11 is permitted. Systems which inject DC current by design (e.g. half wave operation) are not permitted.

NOTE This requirement prohibits all systems which inject DC into the network by construction and will therefore lead to a minimal impact on the network. This technical requirement can be fulfilled with reasonable effort for a broad range of technologies.

### 5.3 Power factor

The power factor of the micro-generator at normal steady-state operating conditions across the statutory tolerance band of nominal voltage shall be between 0,95 leading and 0,95 lagging, provided the output active power of the micro-generator is above 20 % the rated output power of the unit.

NOTE Leading power factor is VARs absorbed by the micro-generator.

## 6 Operation and safety of the micro-generator

### 6.1 General

The micro-generator shall operate safely over the entire designed and declared operating range.

### 6.2 Safety

This standard does not cover the safety of DNO personnel or their contracted parties, as their safety is a combination of electrical conditions and working instructions.

General requirements for safety of persons at work in or near and operation of electrical installations are given in EN 50110, also national regulations can be applicable.

### 6.3 Information plate

The following information shall appear on the micro-generator information plate:

- manufacturer's name or trade mark;
- type designation or identification number, or any other means of identification making it possible to obtain relevant information from the manufacturer;
- rated power;
- nominal voltage;
- nominal frequency;
- phases;
- power factor.

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This information must be provided on a plate on or in the micro-generator and in the documentation. This information shall be copied in the users' manual as well. In addition a serial number may be added to the plate only.

This information could be part of the information plate of the entire micro-generator system.

All the information shall be given in the language and in accordance with the practice of the country in which the micro-generator is intended to be installed.

### 6.4 Labelling

A warning notice shall be placed in such a position that any person gaining access to live parts will be warned in advance of the need to isolate those live parts from all points of supply.

Special attention should be paid that the power supply, measuring circuits (sense lines) and other parts may not be isolated from the network when the switch of the interface protection is open.

As a minimum, warning labels shall be placed:

- on the switchboard (DNO panel and consumer unit) that has the micro-generator connected to it;
- on all switchboards in between the consumer unit and the micro-generator itself;
- on, or in the micro-generator itself;
- at all points of isolation for the micro-generator.