



**BUREAU  
VERITAS**

# TEST REPORT SUMMARY


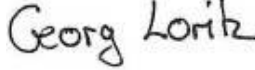
## EN 50438

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

<b>Report reference number</b> .....: 11TH0290-EN50438_SUM_2				
Date of issue .....: 2012-11-08				
Total number of pages .....: 15				
<b>Testing laboratory name</b> .....: <b>Bureau Veritas Consumer Products Services Germany GmbH</b>				
Address .....: Businesspark A96 86842 Türkheim Germany			 Deutsche Akkreditierungsstelle D-PL-12024-03-01	
<b>Applicant's name</b> .....: <b>SMA Solar Technology AG</b>				
Address .....: Sonnenallee 1, 34266 Niestetal				
<b>Test specification</b>				
Standard.....: EN 50438:2007, DIN EN 50438:2008 DIN V VDE V 0126-1-1:2006				
<b>Certificate</b> .....: <b>Certificate of compliance</b>				
Test report form number. ....: EN50438				
Master TRF .....: Bureau Veritas Consumer Products Services Germany GmbH				
<b>Test item description</b> .....: <b>Grid-tied photovoltaic and wind inverter</b>				
Trademark.....: 				
Model / Type .....: SB 3000TL-21, SB 3600TL-21, SB 4000TL-21, SB 5000TL-21 SB 2500TLST-21, SB 3000TLST-21 WB 3000TL-21, WB3600TL-21, WB 4000TL-21, WB 5000TL-21				
<b>Ratings</b> .....	<b>SB 3000TL-21</b>	<b>SB 3600TL-21</b>	<b>SB 4000TL-21</b>	<b>SB 5000TL-21</b>
MPP DC voltage range [V].....:	175V – 500V			
Input DC voltage range [V].....:	125V – 750V			
Input DC current [A] .....	2 x 15A			
Output AC voltage [V] .....	230 V / 50 Hz			
Output AC current [A].....:	nom. 13,1A max. 16A	nom. 16A max. 16A	nom. 17,4A max. 22A	nom. 20A max. 22A
Output power [VA].....:	nom. 3000W max. 3000VA	nom. 3680W max. 3680VA	nom. 4000W max. 4000VA	nom. 4600W max. 5000VA

<b>Ratings .....</b>	<b>SB 2500TLST-21</b>	<b>SB 3000TLST-21</b>
MPP DC voltage range [V]..... :	180V – 500V	213V – 500V
Input DC voltage range [V]..... :	125V – 750V	
Input DC current [A] .....	15A	
Output AC voltage [V] .....	230 V / 50 Hz	
Output AC current [A]..... :	nom. 10,9A max. 10,9A	nom. 13,1A max. 13,1A
Output power [VA]..... :	nom. 2500W max. 2500VA	nom. 3000W max. 3000VA

<b>Ratings .....</b>	<b>WB 3000TL-21</b>	<b>WB3600TL-21</b>	<b>WB 4000TL-21</b>	<b>WB 5000TL-21</b>
MPP DC voltage range [V]..... :	175V – 500V			
Input DC voltage range [V]..... :	80V – 550V			
Input DC current [A] .....	2 x 15A			
Output AC voltage [V] .....	230 V / 50 Hz			
Output AC current [A]..... :	nom. 13,1A max. 16A	nom. 16A max. 16A	nom. 17,4A max. 22A	nom. 20A max. 22A
Output power [VA]..... :	nom. 3000W max. 3000VA	nom. 3680W max. 3680VA	nom. 4000W max. 4000VA	nom. 4600W max. 5000VA

<b>Testing Location .....</b>	<b>Bureau Veritas Consumer Products Services Germany GmbH</b>
<b>Address .....</b>	Businesspark A96, 86842 Türkheim, Germany
<b>Tested by (name and signature) .....</b>	Frederic Schmitt 
<b>Approved by (name and signature) .....</b>	Georg Loritz 
<b>Manufacturer's name .....</b>	<b>SMA Solar Technology AG</b>
<b>Factory address .....</b>	Sonnenallee 1, 34266 Niestetal

<b>Document History</b>			
<b>Date</b>	<b>Internal reference</b>	<b>Modification / Change / Status</b>	<b>Revision</b>
2012-05-09	Frederic Schmitt	Initial report was written	0
2012-10-24	Frederic Schmitt	Output power of unit SB 3000TLST-21 updated	1
2012-11-06	Frederic Schmitt	Windy Boy inverter models WB 3000TL-21, WB3600TL-21, WB 4000TL-21, WB 5000TL-21 included	2
Supplementary information:			

<b>Test items particulars</b>		
Equipment mobility.....	Permanent connection	
Operating condition.....	Continuous	
Class of equipment .....	Class I	
Protection against ingress of water..	IP65 according to EN 60529	
Mass of equipment [kg].....	SB 3000TL-21	26kg
	SB 3600TL-21	26kg
	SB 4000TL-21	26kg
	SB 5000TL-21	26kg
	SB 2500TLST-21	23kg
	SB 3000TLST-21	23kg
	WB 3000TL-21	26kg
	WB3600TL-21	26kg
	WB 4000TL-21	26kg
	WB 5000TL-21	26kg
<b>Test case verdicts</b>		
Test case does not apply to the test object.....	N/A	
Test item does meet the requirement .....	P(ass)	
Test item does not meet the requirement .....	F(ail)	
<b>Testing</b>		
Date of receipt of test item .....	2012-04-04	
Date(s) of performance of test .....	2012-04-12 until 2012-04-18	
<b>General remarks:</b>		
<p>The test result presented in this report relate only to the object(s) tested.          This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.</p> <p>"(see Annex #)" refers to additional information appended to the report.          "(see appended table)" refers to a table appended to the report.</p> <p>Throughout this report a comma is used as the decimal separator.</p>		

Copy of marking plate:

SMA Solar Technology AG  
Sonnentallee 1  
34266 Niestetal  
Germany  
www.SMA.de

**SUNNY BOY**  
Solar inverter made in Germany  
by SMA Solar Technology AG

Model  
**SB 3000TL-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	175 - 500 V
AC	I <sub>DC max</sub>	2 x 15 A
	V <sub>AC,r</sub>	220/230/240 V
AC	P <sub>AC,r</sub>	3000 W
	S <sub>max</sub>	3000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	16 A
	cos(φ)	0.8 overexcited 0.8 underexcited

IP65 max. 26 kg  
Safety class I Overvoltage protection III

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SB 3000TL-21 SBF\$5RR\$1/2012  
0000000001

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Sonnentallee 1  
34266 Niestetal  
Germany  
www.SMA.de

**SUNNY BOY**  
Solar inverter made in Germany  
by SMA Solar Technology AG

Model  
**SB 3600TL-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	175 - 500 V
AC	I <sub>DC max</sub>	2 x 15 A
	V <sub>AC,r</sub>	220/230/240 V
AC	P <sub>AC,r</sub>	3680 W
	S <sub>max</sub>	3680 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	16 A
	cos(φ)	0.8 overexcited 0.8 underexcited

IP65 max. 26 kg  
Safety class I Overvoltage protection III

CE

N23114

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SB 3600TL-21 SBF\$5RR\$1/2012  
0000000001

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Model  
**SB 4000TL-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	175 - 500 V
AC	I <sub>DC max</sub>	2 x 15 A
	V <sub>AC,r</sub>	220/230/240 V
AC	P <sub>AC,r</sub>	4000 W
	S <sub>max</sub>	4000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	22 A
	cos(φ)	0.8 overexcited 0.8 underexcited

IP65 max. 26 kg  
Safety class I Overvoltage protection III

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SB 4000TL-21 SBF\$5RR\$1/2012  
0000000001

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Model  
**SB 5000TL-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	175 - 500 V
AC	I <sub>DC max</sub>	2 x 15 A
	V <sub>AC,r</sub>	220/230/240 V
AC	P <sub>AC,r</sub>	4600 W
	S <sub>max</sub>	5000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	22 A
	cos(φ)	0.8 overexcited 0.8 underexcited

IP65 max. 26 kg  
Safety class I Overvoltage protection III

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SB 5000TL-21 SBF\$5RR\$1/2012  
0000000001

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**SUNNY BOY**  
Solar Inverter made in Germany  
by SMA Solar Technology AG

Model  
**SB 2500TLST-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	180 - 500 V
	I <sub>DC max</sub>	15 A
AC	V <sub>AC,r</sub>	220 / 230 / 240 V
	P <sub>AC,r</sub>	2500 W
	S <sub>max</sub>	2500 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	10.9 A
COS(φ)		0.8 overrated 0.8 underrated

IP65 max. 23 kg  
Safety class I Overvoltage protection III

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**SUNNY BOY**  
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by SMA Solar Technology AG

Model  
**SB 3000TLST-21**

Serial No.  
**0000000001**

Date of manufacture  
2012-11-08

DC	V <sub>DC max</sub>	750 V
	V <sub>DC MPP</sub>	213 - 500 V
	I <sub>DC max</sub>	15 A
AC	V <sub>AC,r</sub>	220 / 230 / 240 V
	P <sub>AC,r</sub>	3000 W
	S <sub>max</sub>	3000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	13.1 A
COS(φ)		0.8 overrated 0.8 underrated

IP65 max. 23 kg  
Safety class I Overvoltage protection III

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**WINDY BOY**  
Wind Inverter made in Germany  
by SMA Solar Technology AG

Model  
**WB 5000TL-21**

Serial No.  
**0123456789**

Date of manufacture  
2012-09-06

DC	V <sub>DC max</sub>	550 V
	V <sub>DC MPP</sub>	175 - 500 V
	I <sub>DC max</sub>	2 x 15 A
AC	V <sub>AC,r</sub>	230 V
	P <sub>AC,r</sub>	4600 W
	S <sub>max</sub>	5000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	22 A
COS(φ)		0.8 overrated 0.8 underrated

IP65 max. 26 kg  
Safety class I Overvoltage protection III

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**WINDY BOY**  
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by SMA Solar Technology AG

Model  
**WB 4000TL-21**

Serial No.  
**0123456789**

Date of manufacture  
2012-09-06

DC	V <sub>DC max</sub>	550 V
	V <sub>DC MPP</sub>	175 - 500 V
	I <sub>DC max</sub>	2 x 15 A
AC	V <sub>AC,r</sub>	230 V
	P <sub>AC,r</sub>	4000 W
	S <sub>max</sub>	4000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	22 A
COS(φ)		0.8 overrated 0.8 underrated

IP65 max. 26 kg  
Safety class I Overvoltage protection III

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by SMA Solar Technology AG

Model  
**WB 3600TL-21**

Serial No.  
**0123456789**

Date of manufacture  
2012-09-06

DC	V <sub>DC max</sub>	550 V
	V <sub>DC MPP</sub>	175 - 500 V
	I <sub>DC max</sub>	2 x 15 A
AC	V <sub>AC,r</sub>	230 V
	P <sub>AC,r</sub>	3680 W
	S <sub>max</sub>	3680 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	16 A
COS(φ)		0.8 overrated 0.8 underrated

IP65 max. 26 kg  
Safety class I Overvoltage protection III


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 Sonnenallee 1  
 34266 Niestetal  
 Germany  
 www.SMA.de



**WINDY BOY**  
 Wind inverter made in Germany  
 by SMA Solar Technology AG  
 Model  
**WB 3000TL-21**  
 Serial No.  
**0123456789**  
 Date of manufacture  
 2012-09-06

DC	V <sub>DC max</sub>	550 V
	V <sub>DC MPP</sub>	175 - 500 V
AC	I <sub>DC max</sub>	2 x 15 A
	V <sub>AC,r</sub>	230 V
AC	P <sub>AC,r</sub>	3000 W
	S <sub>max</sub>	3000 VA
	f <sub>AC,r</sub>	50 / 60 Hz
	I <sub>AC max</sub>	16 A
	cos(φ)	0.8 overrated 0.8 underextended
IP65	max. 26 kg	
Safety class I	Overvoltage protection III	


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**WB 3000TL-21 / 09/2012**  
**0123456789**

**General product information:**

**Description of the power circuit:**

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the PV input and output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundantly by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of one error.

**Description of the differences of the models within a series:**

The units are identical in the control circuit and the internal supply. Generally the units provide the same hardware except of some components:

- Group 1) SB 3000TL-21, SB 3600TL-21, SB 4000TL-21, SB 5000TL-21, WB 3000TL-21, WB3600TL-21, WB 4000TL-21, WB 5000TL-21
- Group 2) SB 2500TLST-21, SB 3000TLST-21,

All models within one group provide the same hardware. The models with lower power are derated via software.

Group 1 provides two MPP-Tracker

Group 2 provides one MPP-Tracker. The EMV-Filter, the boost converter and the DC-connections have been omitted of the second MPP-Tracker.

The different configurations have no influence on the device behaviour. All types have the same software.



<b>Default interface protection settings according EN 50438:2007:</b>		
<b>Parameter</b>	<b>Max. clearance time</b>	<b>Trip setting</b>
<b>Over voltage</b>	0,2s	230V +15% (264,5V)
<b>Under voltage</b>	1,5s	230V -15% (195,5V)
<b>Over frequency</b>	0,5s	50Hz +2% (51,0Hz)
<b>Under frequency</b>	0,5s	50Hz -6% (47,0Hz)
<b>Reconnection time</b>	>=20s	
<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>*Over voltage – stage1: 10min 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>		

<b>EN 50438:2007</b>			
<b>Clause/§</b>	<b>Requirement:</b>	<b>Remark:</b>	<b>Verdict</b>

<b>1</b>	<b>Scope (Micro-generators up to 16A on the public low-voltage grid)</b>
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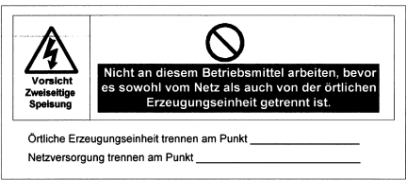
<b>2</b>	<b>Normative references</b>
	EN 50110 series
	EN 50160
	EN 60255-6
	EN 60664-1
	EN 61000-3-2
	EN 61000-3-3
	EN 61000-6-1
	EN 61000-6-3:2001 + A11:2004
	HD 384 / HD 60364 series
	IEC 60364-5-55

<b>3</b>	<b>Terms and definitions</b>
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<b>4</b>	<b>Connection requirements:</b>		
4.1	The electrical installation.....:	The installation shall be in compliance with HD 384 series and national and local regulation.	<b>P</b>
4.1.1	Installation instructions.....:	Maintenance in accordance with the instructions issued by the manufacturer	<b>P</b>
4.1.2	Over-current protection.....:	The manufacturer recommends an over-current protection device in the manual	<b>P</b>
4.1.3	Earthing.....:	Earthing shall be according to HD 384.5.54 / IEC 60364-5-55 and the relevant national standards.	<b>P</b>
4.2	Interface protection		<b>P</b>
4.2.1	General.....:	The interface protection, monitoring and control functions are integral part of the inverter.	<b>P</b>
4.2.1.1	Default settings versus national settings.....:	Default settings of table 2 are applied	<b>P</b>

<b>EN 50438:2007</b>			
<b>Clause/§</b>	<b>Requirement:</b>	<b>Remark:</b>	<b>Verdict</b>
4.2.1.2	Response to protection operation.....:	<p><b>Response to protection operation was tested by</b>            "Fachausschuss Elektrotechnik Prüf- und Zertifizierungsstelle im BG-PRÜFZERT"  <b>Report No.:</b>            UB.010.17/06-122 PL/Ow  <b>Adress:</b>            Berufsgenossenschaft Energie Textil Elektro            Gustav-Heinemann-Ufer 130            50968 Köln</p> <p>The requirements of functional safety with regard to the changeover to be met. The grid measures, the measures for detection and control of faults in the microprocessor system are described in (1) Section 3.1. These measures are based inter alia UI1998:1998-08, and are comparable with measures such as they were described in DIN V VDE 0801. The software is created in the (certified) integrated OMS. The VDE0126-1-1 test report is stored at the Bureau Veritas Consumer Products Services Germany Server; Project: 11TH0290.</p>	<b>P</b>
4.2.1.3	Accessibility of isolation switching devices.....:	The transformerless unit provides two disconnection devices in series.	<b>P</b>
4.2.1.4	Place of the interface protection.....:	The interface protection is integral part of the inverter and conform to EN 60255-6 or equivalent. The manufacturer declares conformity of his product to this standard within the CE declaration of conformity.	<b>P</b>
4.2.1.5	Changing settings of the interface protection.....:	It is not possible for the user to alter the interface protection settings	<b>P</b>
4.2.1.6	Combined protection devices for multiple generators.....:	The proper combined working of the protection is ensured	<b>P</b>
4.2.2	Interface protection settings.....:	Default interface protection settings are applied, see table 4.2.2 below	<b>P</b>

<b>EN 50438:2007</b>			
<b>Clause/§</b>	<b>Requirement:</b>	<b>Remark:</b>	<b>Verdict</b>
4.2.3	Loss of Mains protection.....:	<p><b>Loss of mains protection was tested by</b>            "Fachausschuss Elektrotechnik Prüf- und Zertifizierungsstelle im BG-PRÜFZERT"  <b>Report No.:</b>            UB.010.17/06-122 PL/Ow  <b>Adress:</b>            Berufsgenossenschaft Energie Textil Elektro            Gustav-Heinemann-Ufer 130            50968 Köln</p> <p>3.6 Recognition of an isolated operation.            A recognition of the island formation is the process of "escalating frequency drift." Here is an algorithm in the control ensured that a frequency drift is increased (up or down) in the current direction. This leads to an activation of the monitoring frequency. The tests performed are documented in (2) Section 6 and Annex 9. The trip time was under 500ms in all test cases. The limit of 5 seconds is observed.            The VDE0126-1-1 test report is stored at the Bureau Veritas Consumer Products Services Germany Server; Project: 11TH0290.</p>	<b>P</b>
4.2.4	Automatic reconnection after a network outage....:	>20s, see table 4.2.2 below	<b>P</b>
4.2.5	Synchronisation.....:	Automatic synchronisation of the inverter	<b>P</b>
<b>5</b>			
	Power quality:		
5.1	Electromagnetic emission / immunity.....:	The inverter complies with the requirements of the EMC directive, see attached EMC report in Annex 1	<b>P</b>
	EN 61000-6-1 (immunity)	See appended table and Annex No. 1 – EMC Test Report.	<b>P</b>
	EN 61000-6-3 + A11 (emission)	See appended table and Annex No. 1 – EMC Test Report.	<b>P</b>
	EN 61000-3-2 (harmonics)	See appended table and Annex No. 1 – EMC Test Report.	<b>P</b>
	EN 61000-3-3 (voltage fluctuations and flicker)	See appended table and Annex No. 1 – EMC Test Report.	<b>P</b>

<b>EN 50438:2007</b>			
<b>Clause/§</b>	<b>Requirement:</b>	<b>Remark:</b>	<b>Verdict</b>
5.2	DC injection.....:	<p><b>DC-Injection was tested by</b>            "Fachausschuss Elektrotechnik            Prüf- und Zertifizierungsstelle im            BG-PRÜFZERT"</p> <p><b>Report No.:</b>            UB.010.17/06-122 PL/Ow</p> <p><b>Adress:</b>            Berufsgenossenschaft Energie            Textil Elektro            Gustav-Heinemann-Ufer 130            50968 Köln</p> <p>3.5 DC monitoring            The disconnection takes place            through both channels with a DC            current from exceeding 0.7 A            within 175 ms.            The VDE0126-1-1 test report is            stored on Server Bureau Veritas            Consumer Products Services            Germany Server. Project:            11TH0290.</p> <p>The permanent DC injection see            table 5.2 below.</p>	<b>P</b>
5.3	Power factor.....:	See table 5.3 below	<b>P</b>
<b>6</b>	<b>Operation and safety of the micro-generator</b>		
6.1	General.....:	The unit operates safely over the declared operating range	<b>P</b>
6.2	Safety.....:	This standard does not cover safety of DNO personnel.	<b>P</b>
6.3	Information plate.....:	At least information of manufacturers name, identification, rated power, nom. voltage, nom. frequency, phases and power factor, see above marking plate.	<b>P</b>
6.4	Labelling.....:	<p>The unit provides the following warning label:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content;">  <p style="font-size: small;">Örtliche Erzeugungseinheit trennen am Punkt _____            Netzversorgung trennen am Punkt _____</p> </div>	<b>P</b>
6.5	Maintenance and routine testing.....:	The manufacturer provides information for maintainance in the manual. The units are routine tested in the factory.	<b>P</b>

<b>EN 50438:2007</b>			
<b>Clause/§</b>	<b>Requirement:</b>	<b>Remark:</b>	<b>Verdict</b>
<b>7</b>	<b>Commissioning</b>		
7.1	General		<b>P</b>
	The micro-generator (including the interface protection) shall fulfil the requirements of this standard and the other applicable standards.....:	Noticed	-
	The manufacturer shall provide an installation instruction in accordance with this standard and national or regional requirements.....:	Verified, see manual.	-
	Access to the interface protection shall be tamper-proof.....:	Access just via password, provided by the manufacturer	-
	The micro-generator shall be type tested against the interface requirements of this standard.....:	Noticed, see test tables below	-
	The installation shall be carried out by installer with recognised and approved qualification	Not scope of investigation	-
7.2	Installation	Not scope of investigation	<b>N/A</b>
7.3	Notification		<b>N/A</b>
7.4	Decommissioning arrangements		<b>N/A</b>
7.5	Replacement arrangements		<b>N/A</b>
<b>Annex</b>			
<b>A</b> (normative)	<b>Interface protection settings, national deviations</b>	No specific national settings are supplied, the default settings in 4.2.2, table 2 are applicable	<b>N/A</b>
<b>B</b> (informative)	<b>Notification sheets</b>		<b>N/A</b>
<b>C</b> (informative)	<b>Interface protection</b>	Noticed	<b>P</b>
<b>D</b> (informative)	<b>Type certification test results sheet</b>	Noticed	<b>P</b>
<b>E</b> (informative)	<b>Countries allowing extensions of the scope &gt;16A</b>		<b>N/A</b>
<b>F</b> (informative)	<b>Abbreviations</b>	Noticed	<b>P</b>
<b>G</b> (informative)	<b>A-deviations</b>		<b>N/A</b>

<b>EN 50438:2007</b>		
<b>Clause</b>	<b>Test</b>	<b>Result</b>
4.2.1.2	Response to protection operation	<b>P</b>
4.2.2	Interface protection settings	<b>P</b>
4.2.3	Loss of Mains protection	<b>P</b>
4.2.4	Automatic reconnection after a network outage	<b>P</b>
5.1	Harmonic current emission	<b>P</b>
5.1	Voltage fluctuation and flicker	<b>P</b>
5.2	DC injection	<b>P</b>
5.3	Power factor	<b>P</b>