





**BUREAU
VERITAS**

TEST REPORT DIN V VDE V 0126-1-1

**Automatic disconnection device between a generator and
the public low-voltage grid**

Report reference number	PVDE180712N013-2
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Testing laboratory name	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
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	  Certificate # 2951.01
Applicant's name	Shenzhen SOFAR SOLAR Co., Ltd.
Address	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China.
Test specification	
Standard.....	DIN VDE 0126-1-1 (VDE V 0126-1-1):2013-08
Certificate	Certificate of compliance
Test report form number.....	DIN VDE V 0126-2013
Master TRF	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Test item description	Solar Grid-tied Inverter
Trademark.....	
Model / Type	SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2, SOFAR 33000TL-G2
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Ratings	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2	SOFAR 33000TL-G2
Input DC voltage range [V]..... :	230-1100			
Full load MPPT DC voltage range [V]:	480-850	460-850	520-850	580-850
Input DC current [A]	24/24	28/28	30/30	30/30
Output AC voltage [V]	400V, 3/N/PE, 50Hz			
Output AC current [A]..... :	Max. 32	Max. 40	Max. 48	Max. 53
Output power [VA]..... :	22000	27500	33000	36300

Testing Location	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Address	No. 34, Chenwulu Section, Guantai Rd., Houjie Town, Dongguan City, Guangdong 523942, China
Tested by (name and signature)	Dora Zhang 
Approved by (name and signature)	James Huang 
Manufacturer's name	Shenzhen SOFAR SOLAR Co., Ltd.
Manufacturer address	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China.
Factory's name	Dongguan SOFAR SOLAR Co.,Ltd.
Factory address	1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City

Document History			
Date	Internal reference	Modification / Change / Status	Revision
2019-06-10	Dora Zhang	Initial report was written	--
Supplementary information:			

Test items particulars	
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].....	: Approx. 37
Test case verdicts	
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)
Testing	
Date of receipt of test item	: 2018-07-12
Date(s) of performance of test	: 2018-07-12 to 2019-04-20
General remarks:	
<p>The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the requirements of DIN VDE V 0126-1-1. This report shall 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.</p> <p>“(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>	
This Test Report consists of the following documents:	
<ol style="list-style-type: none"> 1. Test Results 2. Annex No. 1 – Pictures of the unit 3. Annex No. 2 – Test equipment list 	

Copy of marking plate:


SOFAR SOLAR Solar Grid-tied Inverter

Model No: SOFAR 20000TL-G2

Max. DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	24A/24A
Max. PV Isc	30A/30A
Nominal Grid Voltage	3/N/PE, 400Vac
Max. Output Current	3x32A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	20000W
Max. Output Power	22000VA
Power Factor	>0.99 (adjustable +/- 0.8)
Ingress Protection	IP65
Operating Temperature Range	-25°C~+60°C
Protective Class	Class I

Made in China

Manufacturer: Shenzhen SOFAR SOLAR Co., Ltd.
Address: 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community, XinAn Street,
BaoAn District, Shenzhen, China
VDE0126-1-1, VDE-AR-N4 105, G99, IEC61727,
IEC62116, UTE C 15-712-1, AS4777




SOFAR SOLAR Solar Grid-tied Inverter

Model No: SOFAR 25000TL-G2

Max. DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	28A/28A
Max. PV Isc	35A/35A
Nominal Grid Voltage	3/N/PE, 400Vac
Max. Output Current	3x40A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	25000W
Max. Output Power	27500VA
Power Factor	>0.99 (adjustable +/- 0.8)
Ingress Protection	IP65
Operating Temperature Range	-25°C~+60°C
Protective Class	Class I

Made in China

Manufacturer: Shenzhen SOFAR SOLAR Co., Ltd.
Address: 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community, XinAn Street,
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VDE0126-1-1, VDE-AR-N4 105, G99, IEC61727,
IEC62116, UTE C 15-712-1, AS4777




SOFAR SOLAR Solar Grid-tied Inverter

Model No: SOFAR 30000TL-G2

Max. DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	30A/30A
Max. PV Isc	37.5A/37.5A
Nominal Grid Voltage	3/N/PE, 400Vac
Max. Output Current	3x48A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	30000W
Max. Output Power	33000VA
Power Factor	>0.99 (adjustable +/- 0.8)
Ingress Protection	IP65
Operating Temperature Range	-25°C~+60°C
Protective Class	Class I

Made in China

Manufacturer: Shenzhen SOFAR SOLAR Co., Ltd.
Address: 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community, XinAn Street,
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VDE0126-1-1, VDE-AR-N4 105, G99, IEC61727,
IEC62116, UTE C 15-712-1, AS4777




SOFAR SOLAR Solar Grid-tied Inverter

Model No: SOFAR 33000TL-G2

Max. DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	30A/30A
Max. PV Isc	37.5A/37.5A
Nominal Grid Voltage	3/N/PE, 400Vac
Max. Output Current	3x53A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	33000W
Max. Output Power	36300VA
Power Factor	>0.99 (adjustable +/- 0.8)
Ingress Protection	IP65
Operating Temperature Range	-25°C~+60°C
Protective Class	Class I

Made in China

Manufacturer: Shenzhen SOFAR SOLAR Co., Ltd.
Address: 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community, XinAn Street,
BaoAn District, Shenzhen, China
VDE0126-1-1, VDE-AR-N4 105, G99, IEC61727,
IEC62116, UTE C 15-712-1, AS4777



General product information:

The Photovoltaic grid-interactive inverter converts DC voltage, generated by photovoltaic modules, into AC voltage.

The units are three-phases inverter.

Description of the power circuit (Figure 1):

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

The internal control is redundant built. It consists of Main DSP(UC20) and slave DSP(UC73).

The Main DSP(UC20) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.

The slave DSP(UC73) is using for detect residual current, also can open the relays independently and communicate with Main DSP(UC20).

The unit provides two relays in series on Line conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before start up. Both controllers(Main DSP(UC20), Slave DSP(UC73) can open the relays.

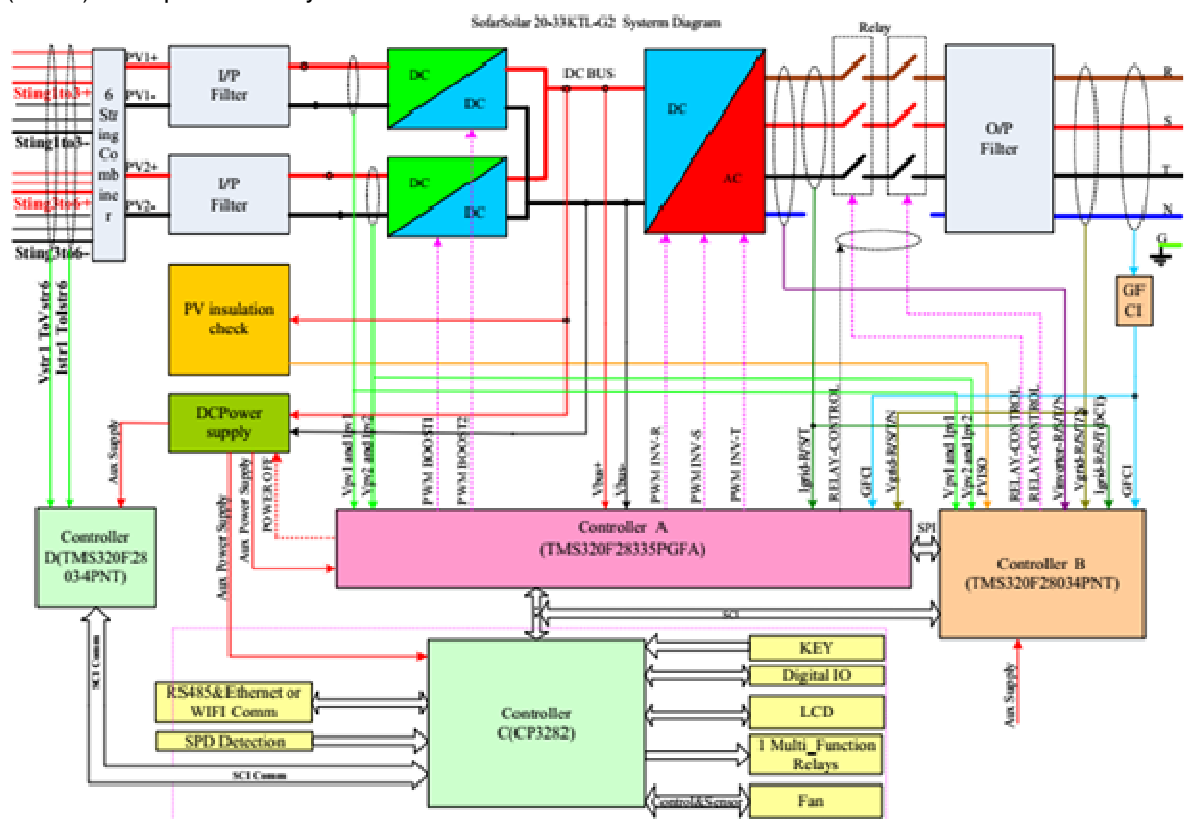


Figure 1 – Block diagram

The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before each start up.

Differences of the models

The models SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2 and SOFAR 33000TL-G2 are almost identical in hardware except the shown in the following table and the output power derated by software.

The difference in hardware			
Item	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2 / SOFAR 33000TL-G2
Number of PV terminal	2+2	3+3	
Number of BUS capacitance	8 capacitors: 550V/110 μ F 2 capacitors: 1100V/40 μ F		10 capacitors: 550V/110 μ F 24 capacitors: 1100V/40 μ F
INV inductance	785 μ H	735 μ H	
BUS board	Not the board	Have the board	
External fan	Not the board	2	3
Relay of output board	6pcs T9VV1K15-12S		3pcs AZSR250-2AE-12D

The product was tested on

Hardware version: V1.00

Software version: V1.40

DIN VDE 0126-1-1 (VDE V 0126-1-1):2013-08			
Clause/§	Requirement	Remark	Verdict
4	Requirements The following requirements apply for integrated and external disconnection means as long as it is not otherwise stated. The disconnection means must disconnect in case of:		P
	Voltage and frequency changes in the low voltage grid		P
	Injection of d. c. current in to the low voltage grid		P
	Unintentional islanding		P
	Intentional islanding with emergency stand by power systems		P
	The generation unit should provide at the a.c. port to the main two in series connected switches		P
4.1	Functional safety		P
	The requirements in clause 4.3 to 4.6 and if applicable in clause 4.8 are applicable to the disconnection means in all operation conditions of the mains	Type testing according clause 6 performed.	P
	The disconnection means can be integrated or external	The photovoltaic inverter provides an integrated disconnection means	P
4.1.1	Single fault safety		P
	The disconnection means must comply to the requirements of VDE-AR-N 4105, A.6	Type testing according clause 6 performed.	P
4.1.2	In case of integration of the disconnection means into a PV inverter, the requirements of DIN EN 62109-2, 4.4.4.15.2 apply	Type testing according clause 6 performed.	P
	In all other cases the requirements of VDE-AR-N 4105, 6.4 apply	Type testing according clause 6 performed.	P
4.2	Requirements for reconnection		P
	The requirements for reconnection after a grid vault must comply to VDE-AR-N 4105, 8.3.1 apply	Type testing according clause 6 performed.	P
4.3	Voltage monitoring		P
4.3.1	Voltage drop protection $U_{<}$		P
	The requirements of a voltage drop must comply to VDE-AR-N 4105, 6.5.1 and 6.5.2	Type testing according clause 6 performed.	P
4.3.2	Rise-in-voltage protection $U_{>>}$		P
	The requirements of a rise-in voltage must comply to VDE-AR-N 4105, 6.5.1 and 6.5.2	Type testing according clause 6 performed.	P
4.3.3	Rise-in-voltage protection $U_{>}$		P

	The requirements of a slow rise-in voltage (ten minutes mean value) must comply to VDE-AR-N 4105, 6.5.1 and 6.5.2	Type testing according clause 6 performed.	P
4.4	Frequency monitoring		P
	The disconnection in case of a decreasing or increasing frequency must comply to VDE-AR-N 4015, 6.5.1 and 6.5.2	Type testing according clause 6 performed.	P
4.5	d.c. current monitoring		P
	An injection of a 1 A d.c. current into the low voltage grid must lead to a disconnection	Type testing according clause 6 performed.	P
4.6	Detection of islanding		P
	The disconnection in case of an unintentional islanding must comply to VDE-AR-N 4105, 6.5.1 and 6.5.3	Type testing according clause 6 performed.	P
4.7	Marking		P
	The generation unit must be marked with "VDE 0126-1-1" this can be done - on the type label - via showing on a display - an additional marking	The information "VDE 0126-1-1" is showed on the display of product.	P
4.8	Requirements for photovoltaic inverters with integrated disconnection means		P
	The requirements of DIN EN 62109-2, 4.8 for the residual current monitoring and insulation monitoring of the PV-generator must be fulfilled	Type testing according clause 6 performed.	P

5.	General requirements		P
	The requirements of DIN EN 61000-6-3 and DIN EN 61000-6-2 must be fulfilled	See attached EMC report	P

6.	Type testing The following requirements apply for integrated and external disconnection means as long as it is not otherwise stated.		P
6.1	Functional safety		P
	The compliance must be tested according to V VDE 0124-100, 5.4.5.2	See table below	P
6.2	Voltage monitoring		P
	The compliance must be tested according to V VDE 0124-100, 5.5.1 and 5.5.2	See table below	P
6.3	Voltage monitoring		P
	The compliance must be tested according to V VDE 0124-100, 5.4.5.3	See table below	P
6.4	Frequency monitoring		P

	The compliance must be tested according to V VDE 0124-100, 5.4.5.4	See table below	P
6.5	Monitoring of d.c. injection into the mains		P
	a) a current of 1 A d.c. is injected into the measurement circuit of the disconnection means and must lead to a disconnection within 0,2 s	See table below	P
	b) a fault simulation with measurement shall show, that a d.c. of 1 A of the injected current will cause a disconnection within 0,2 s	See table below	P
6.6	Detection of islanding		
	The compliance must be tested according to V VDE 0124-100, 5.4.6	See table below	P

7.	Type testing		P
	Each manufacturer must perform type testing regarding the safety relevant parameters.	Type testing is performed in this document	P

8.	Requirements for installing		P
	Initial and resting is not required.	Relies in the responsibility of the DNO.	P
	If an external disconnection means is used it is not allowed to use it in a TN-C system. In this area must be built an TN-C-S system		P

Test Results

4.8	Requirements for photovoltaic inverters with integrated disconnection means	P
<p>The earth connection is comply the requirements according 7.3.6.3.3.1 Test current, duration and acceptance criteria of the IEC 62109-1 (DIN EN 62109-1).</p> <p>Messtabelle einfügen</p>		
<p>Note: The conditions and testing is performed according to EN 62109-2, 4.8.1</p>		

4.8	Requirements for photovoltaic inverters with integrated disconnection means				P
DC Voltage below minimum operating voltage [V]	DC Voltage for inverter begin operation [V]	Resistance between ground and PV input terminal [KΩ]	Required Insulation resistance $R = (V_{MAX} PV / 30mA)$ [KΩ]	Result	
DC+					
250	250	100K	37K	Error message:" Error:"ID56"(The insulation resistance is too low)" PV inverter does not start-up.	
250	480	100K	37K		
250	850	100K	37K		
250	953	100K	37K		
DC-					
250	250	100K	37K	Error message:" Error:"ID56"(The insulation resistance is too low)" PV inverter does not start-up.	
250	480	100K	37K		
250	850	100K	37K		
250	953	100K	37K		
Note:					
The conditions and testing is performed according to EN 62109-2, 4.8.2.1					
The test results refer to the original test report LD180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on Aug. 21, 2018.					
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.					

4.8	Requirements for photovoltaic inverters with integrated disconnection means	P
Note: The conditions and testing is performed according to EN 62109-2, 4.8.2.2		

4.8	Requirements for photovoltaic inverters with integrated disconnection means		N/A
	Condition	Current (mA)	Limit (30mA)
	DC+ to PE	--	--
	DC- to PE	--	--
Note: The conditions and testing is performed according to EN 62109-2, 4.8.3.2			

4.8	Requirements for photovoltaic inverters with integrated disconnection means		N/A
	Condition	Current (mA)	Limit (300mA or 10mA per kVA)
	DC+ to PE	--	--
	DC- to PE	--	--
Note: The conditions and testing is performed according to EN 62109-2, 4.8.3.3			

4.8	Requirements for photovoltaic inverters with integrated disconnection means		P	
Fault Current (mA)		Disconnection time (ms)		
Measured Fault Current	Limit 300 mA for output power ≤ 30 kVA 10 mA per kVA for output power > 30 kVA	Measured Disconnection time	Limit	
+ PV to N:				
234	363	264	300	
234	363	247	300	
232	363	268	300	
235	363	256	300	
232	363	276	300	
- PV to N:				
235	363	264	300	
235	363	208	300	
234	363	212	300	
234	363	253	300	
236	363	244	300	
Note:				
The conditions and testing is performed according to EN 62109-2, 4.8.3.5				
The test results refer to the original test report LD180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on Aug. 21, 2018.				
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.				

4.8	Requirements for photovoltaic inverters with integrated disconnection means	P
+PV to N		
Limit (mA)	Disconnection time (ms)	Limit (ms)
30	229	300
30	218	300
30	230	300
30	219	300
30	218	300
60	105	150
60	97	150
60	97	150
60	99	150
60	102	150
150	24	40
150	36	40
150	32	40
150	31	40
150	32	40
-PV to N		
Limit (mA)	Disconnection time (ms)	Limit (ms)
30	236	300
30	230	300
30	231	300
30	214	300
30	228	300
60	104	150
60	105	150
60	99	150
60	99	150
60	100	150
150	33	40
150	32	40
150	33	40
150	28	40
150	29	40
<p>Note: The conditions and testing is performed according to EN 62109-2, 4.8.3.5.3 The test results refer to the original test report LD180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on Aug. 21, 2018. The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.</p>		

6.1		Functional safety						P
component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Relay defect RYB1 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Relay defect RYB2 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Relay defect RYB3 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Relay defect RYB4 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Relay defect RYB5 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Relay defect RYB6 pin4-pin5	Short before start up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Error message"Relay test fail", PV inverter do not connect to the grid.
Grid voltage monitoring RB137	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 139	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 131	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 128	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 122	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 120	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Grid voltage monitoring RB 112	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
Grid voltage monitoring RB 110	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error".
RCMU detect defect RB 96	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect RB 11	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect RB 8	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect UB1 PIN5 to 6	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect QB1 PIN2 to 3	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect QB3 PIN2 to 3	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect UB2 PIN5 to 7	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect RB23	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect CB17	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect UB2 PIN12 to 14	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect RB25	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
RCMU detect defect UB2 PIN10 to 8	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"GFCI error".
Grid voltage monitoring RC6	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Grid voltage monitoring RC19	Open	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.
Grid voltage monitoring UC627 PIN2 to 3	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.
Grid voltage monitoring UC627 PIN5 to 7	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage sample error". No damaged.No hazard.
Grid voltage monitoring UC627 PIN8 to 10	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage sample error". No damaged.No hazard.
Grid voltage monitoring RC73	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.
Grid voltage monitoring UC629 PIN2 to 3	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.
Grid voltage monitoring RC70	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage error". No damaged.No hazard.
Grid voltage monitoring UC629 PIN8 to 10	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage sample error". No damaged.No hazard.
Grid voltage monitoring UC629 PIN5 to 7	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:"The grid voltage sample error". No damaged.No hazard.
ISO detect defect RC167	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The ISO error".
ISO detect defect RC98	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The ISO error".
ISO detect defect RC113	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The ISO error".

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
ISO detect defect RC116	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The ISO error".
ISO detect defect UC634 PIN6 to 7	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The ISO error".
DSP communication defect XLC1 PIN1 to 2	Short	230V 47.7 A	850V 40A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:"The SPI error"

Note:

The conditions and testing is performed according to V VDE 0124-100, 5.4.5.2

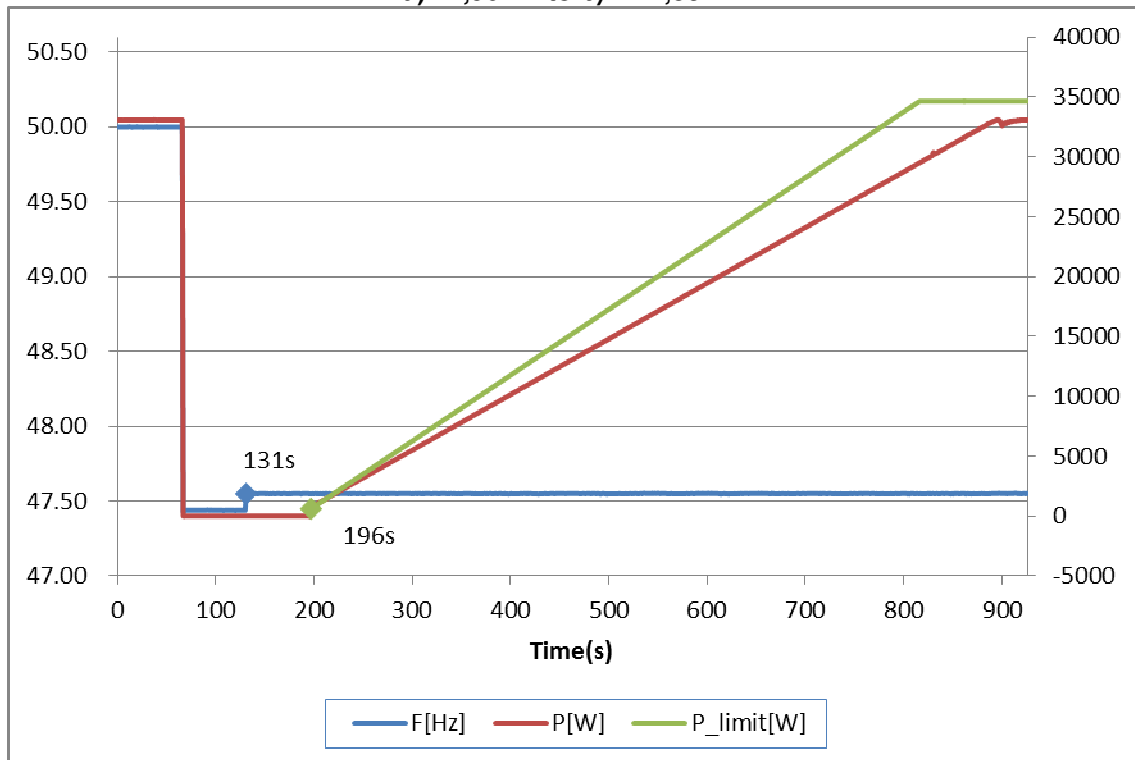
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

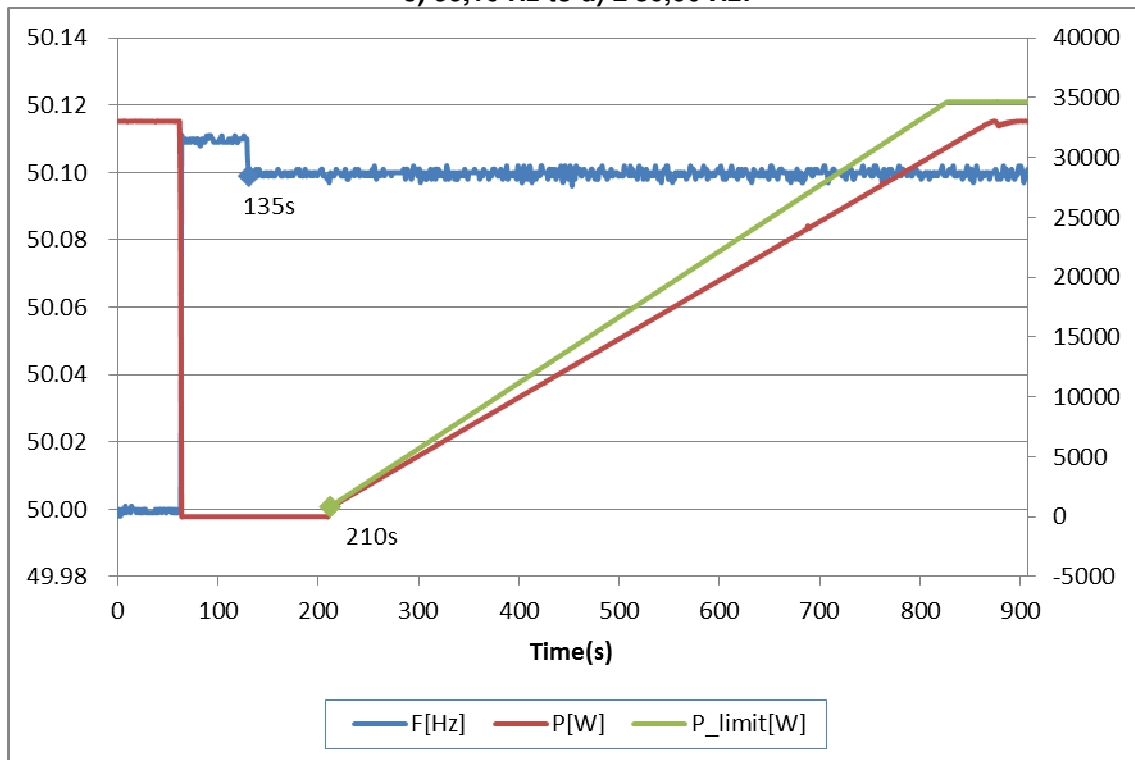
6.2		Voltage monitoring		P
Setting values:		Setting $T_{\text{reconnection}}$ 60s [s]:	70	
		Setting $f <$ [Hz]:	47,5	
		Setting $f >$ [Hz]:	51,5	
		Setting $V <$ [V]:	184,0	
		Setting $V >>$ [V]:	264,5	
Test:				
		Reset time:	Limit:	
Connecting conditions for frequencies:				
a)	47,45 Hz	No reconnection	No resetting allowed	
Switch to:				
b)	$\geq 47,55$ Hz	65 s	≥ 60 s	
c)	$\geq 50,10$ Hz	No reconnection	No resetting allowed	
Switch to:				
d)	$\geq 50,0$ Hz	75 s	≥ 60 s	
Connecting conditions for voltages: L1 phase				
e)	84%	No reconnection	No resetting allowed	
Switch to:				
f)	$\geq 86\%$	67 s	≥ 60 s	
g)	111 %	No reconnection	No resetting allowed	
Switch to:				
h)	$\leq 109\%$	71 s	≥ 60 s	
Connecting conditions for voltages: L2 phase				
e)	84%	No reconnection	No resetting allowed	
Switch to:				
f)	$\geq 86\%$	66 s	≥ 60 s	
g)	111 %	No reconnection	No resetting allowed	
Switch to:				
h)	$\leq 109\%$	66 s	≥ 60 s	
Connecting conditions for voltages: L3 phase				
e)	84%	No reconnection	No resetting allowed	
Switch to:				
f)	$\geq 86\%$	66 s	≥ 60 s	
g)	111 %	No reconnection	No resetting allowed	
Switch to:				

h)	≤ 109%	67 s	≥ 60 s
<p>Note: The conditions and testing is performed refer 0124 Ch 5.5.</p> <p>The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.</p> <p>The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.</p>			

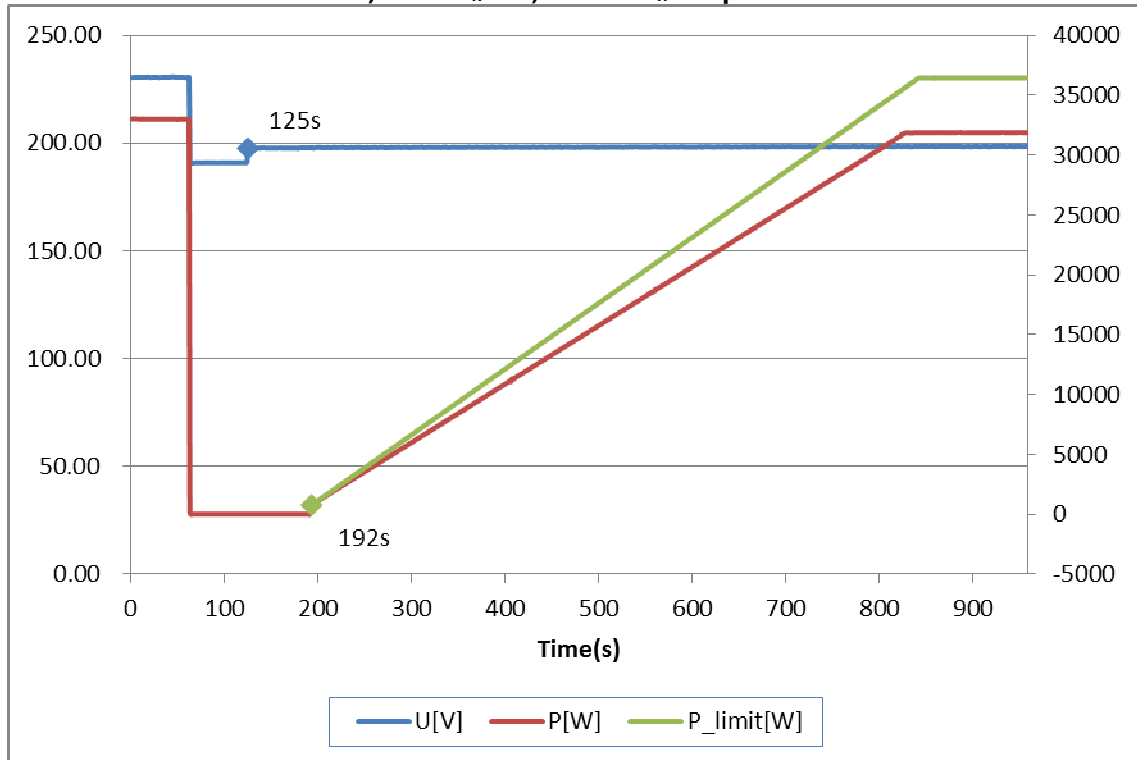
a) 47,50 Hz to b) $\geq 47,55$ Hz:



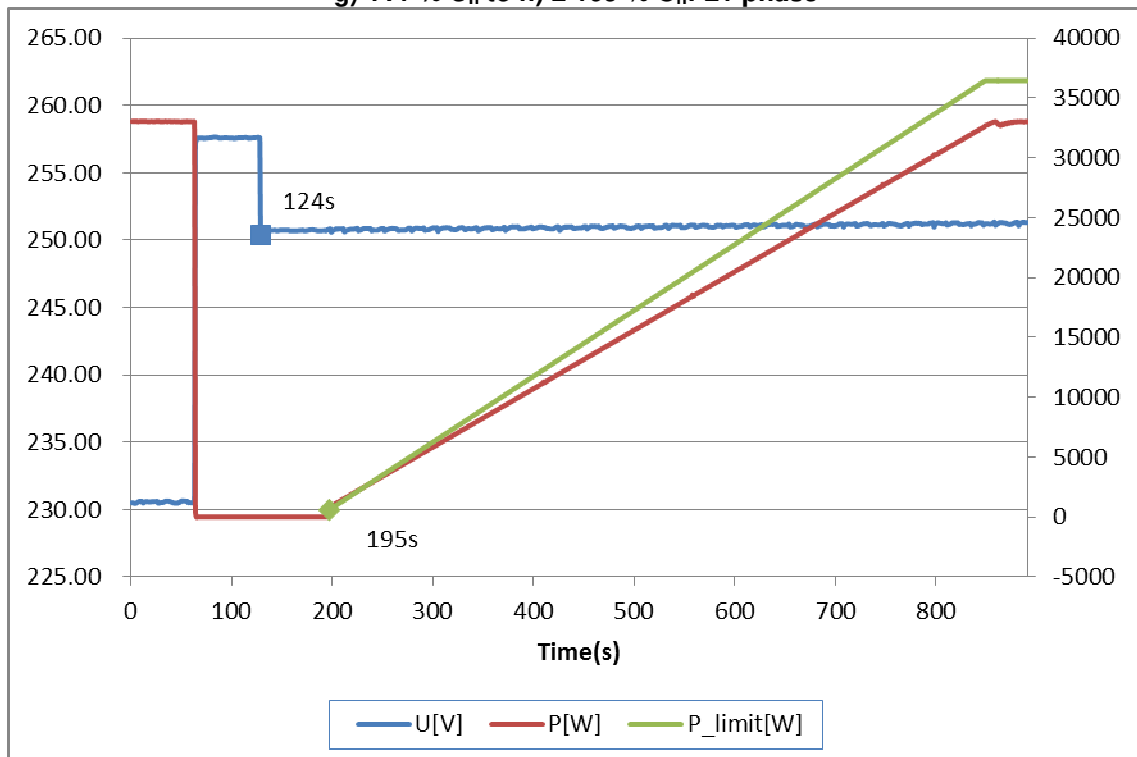
c) 50,10 Hz to d) $\leq 50,00$ Hz:

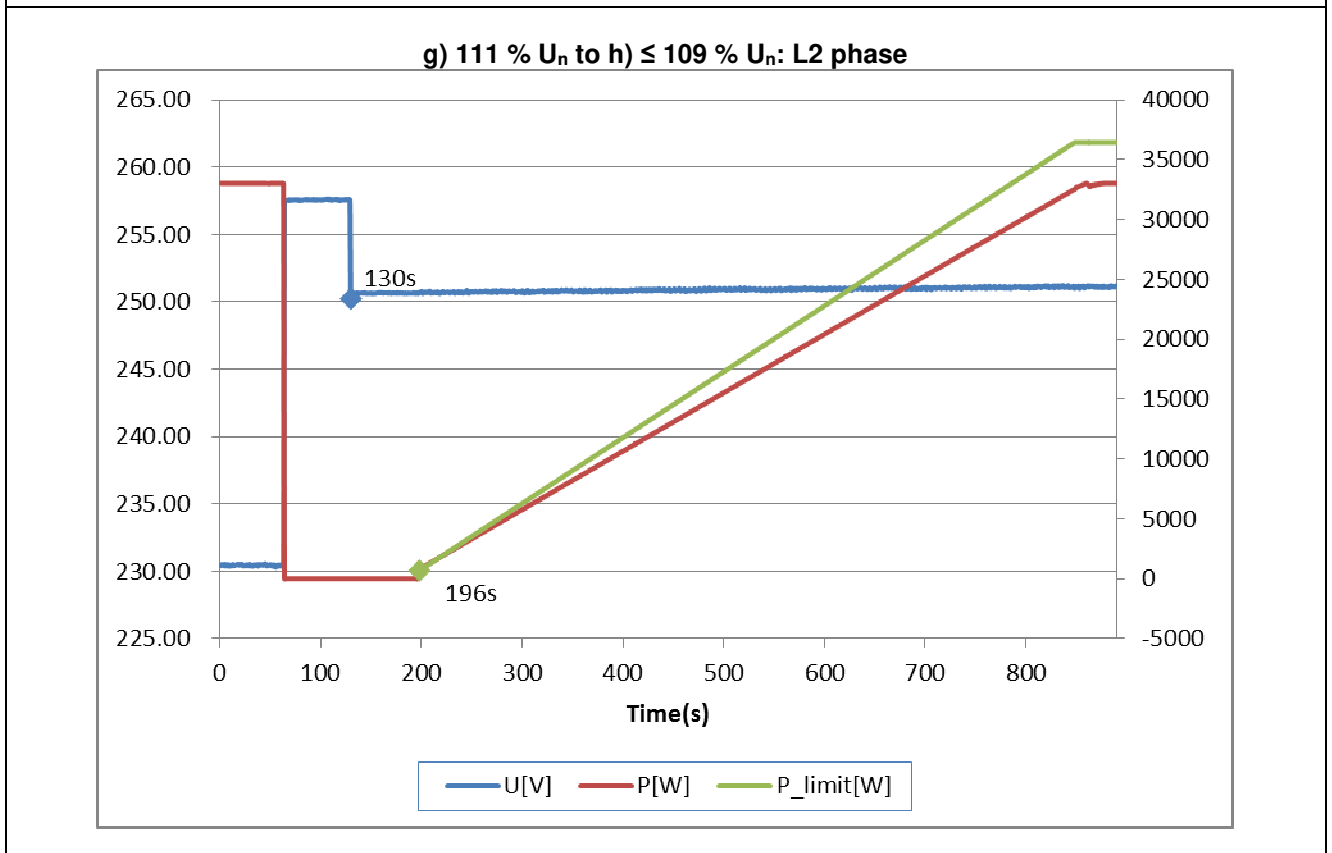
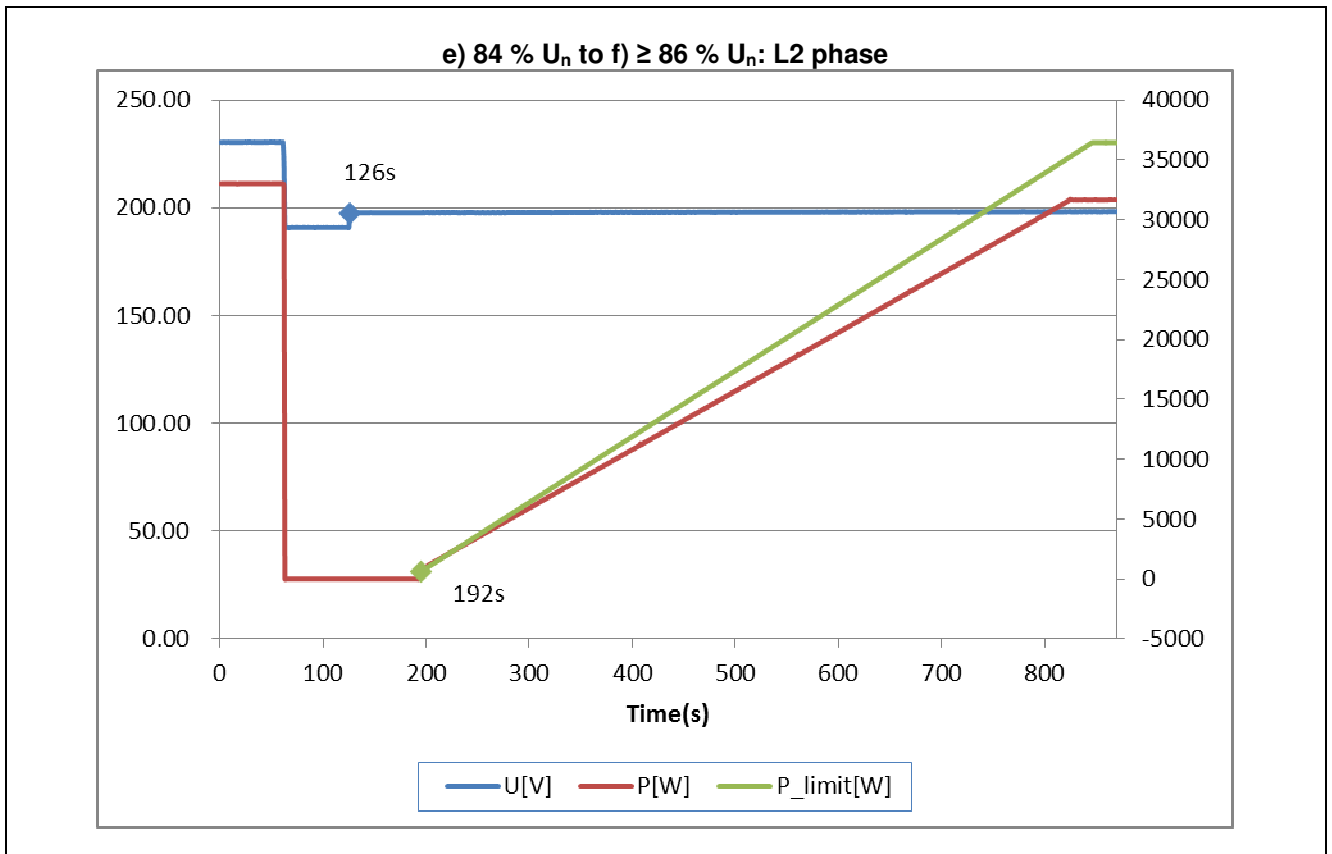


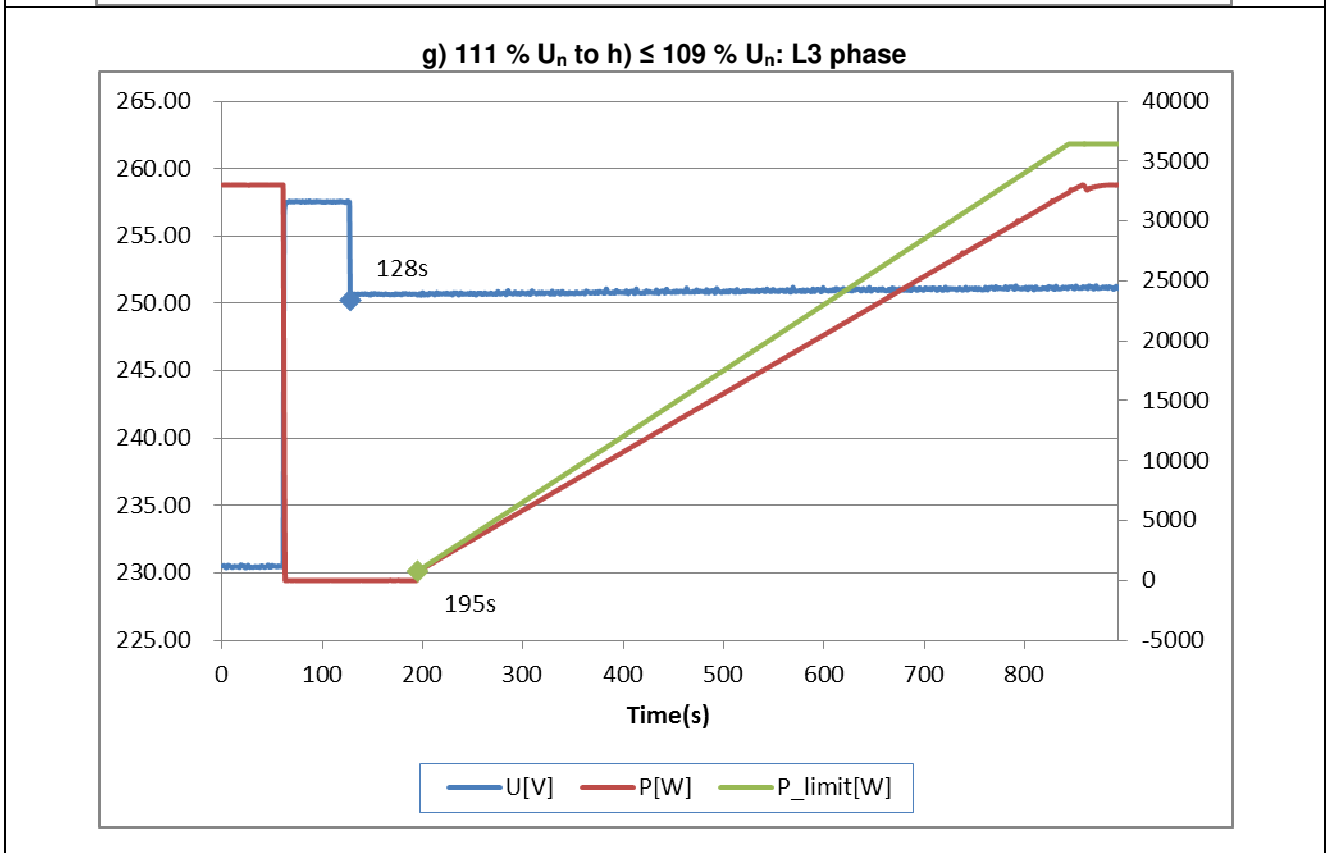
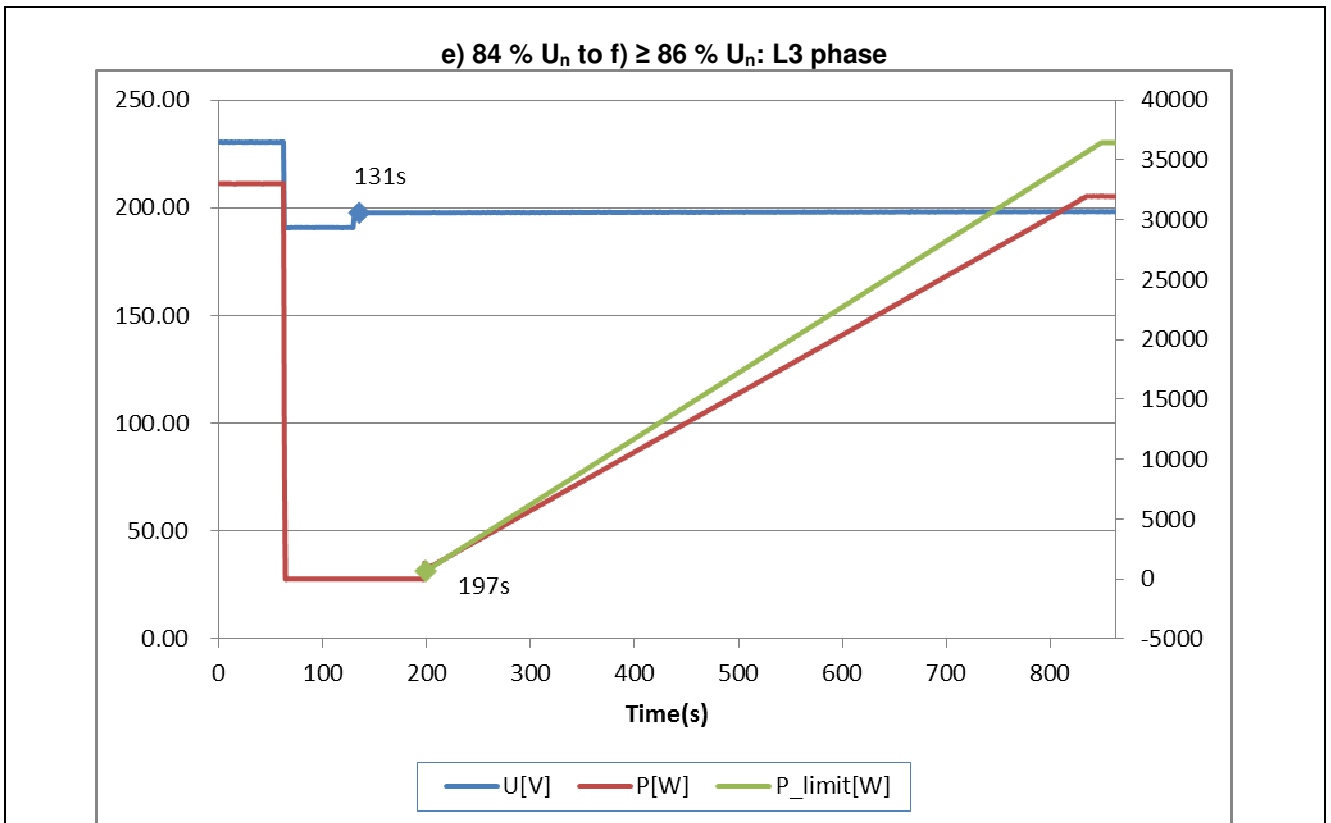
e) 84 % U_n to f) ≥ 86 % U_n : L1 phase



g) 111 % U_n to h) ≤ 109 % U_n : L1 phase

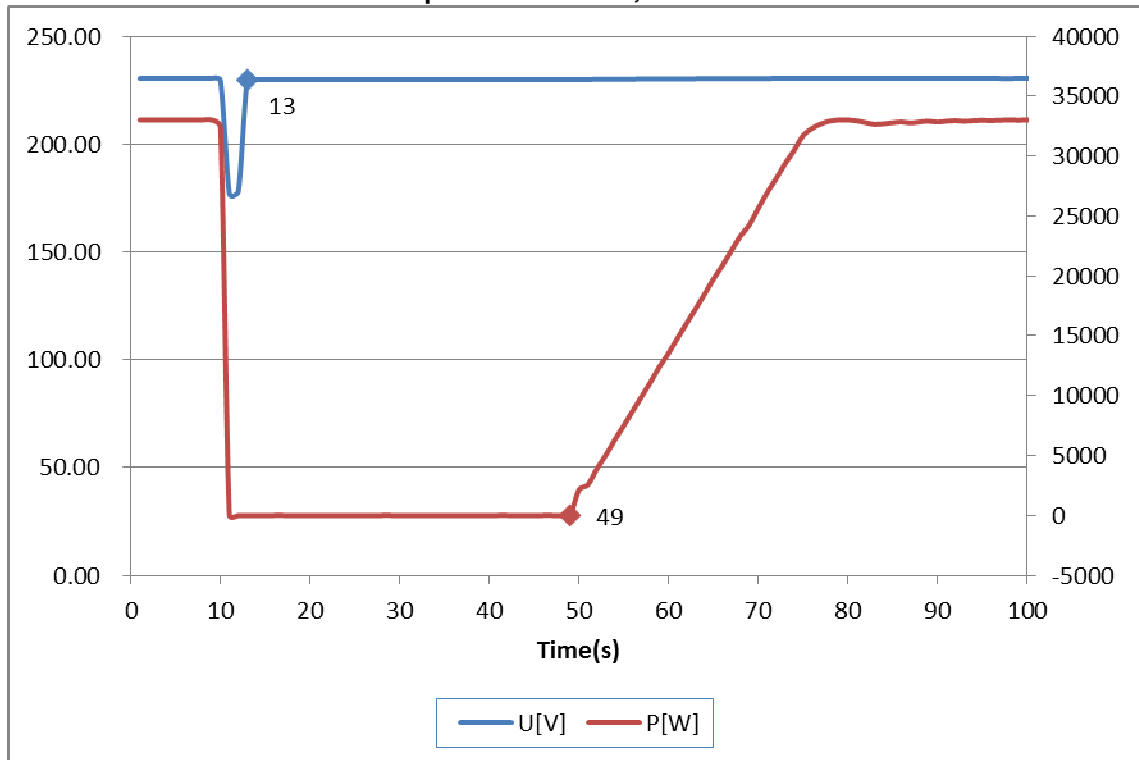




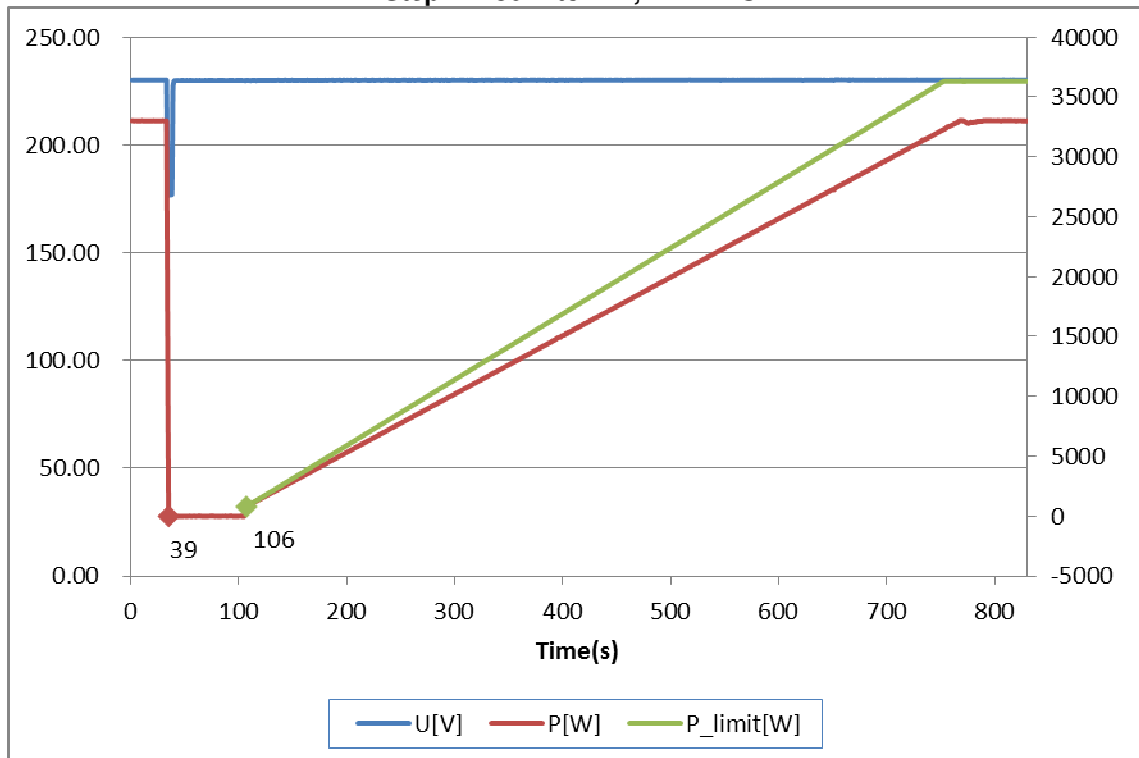


6.2	Voltage monitoring		P
Setting values:	Setting $T_{\text{disconnection}}$ 5s [s]:	30	
	Setting $T_{\text{reconnection}}$ 60s [s]:	70	
	Setting $V_{<}$ [V]:	184,0	
	Step 1:	Step 2:	
Step [V to V]	230 to 177,1		230 to 177,1
Jump Duration [s]:	2		4
Limit [s]:	≥ 5		≥ 60
Reconnection Time [s]:	36		67
Note:			
The conditions and testing is performed according to V VDE 0124-100, 5.5.2			
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.			
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.			

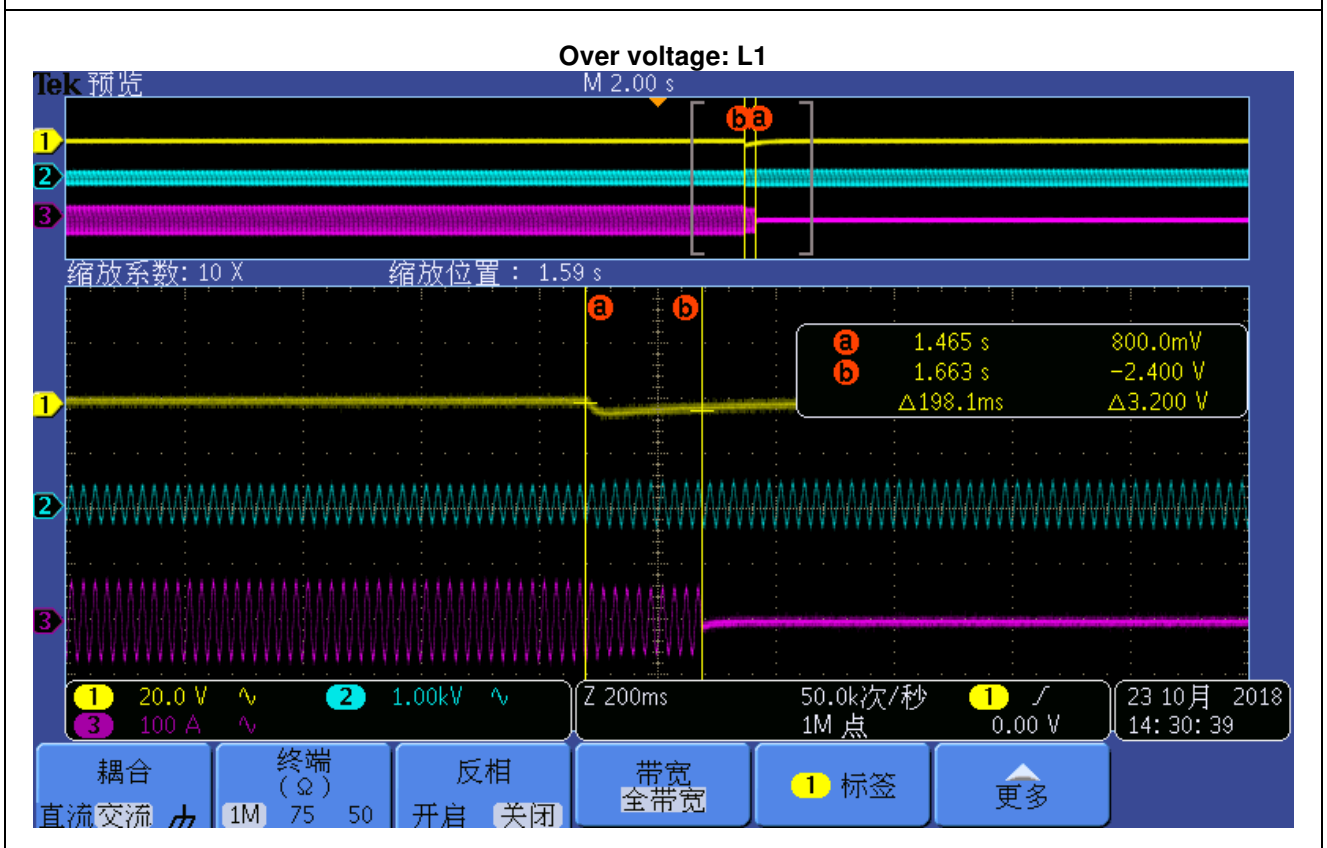
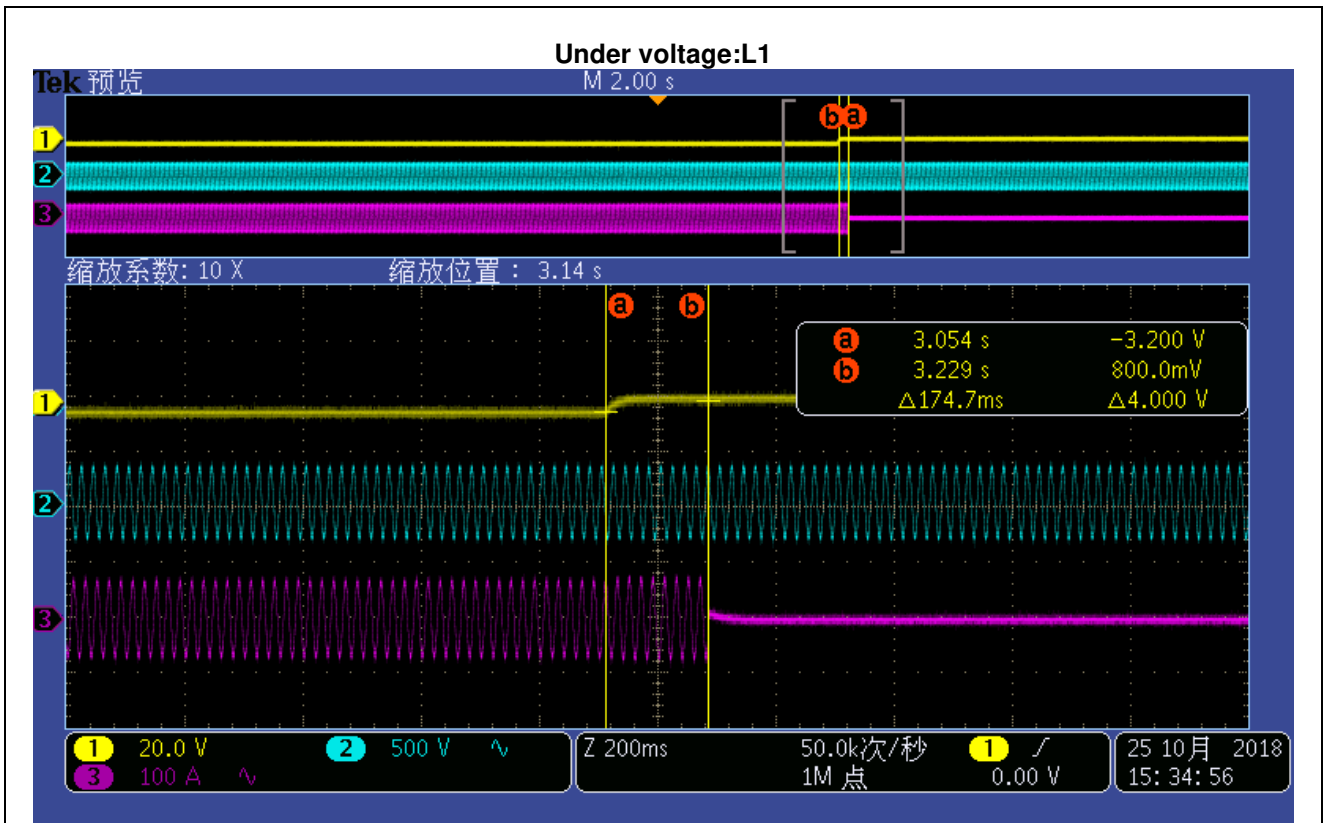
Step 1: 230 V to 177,1 V in 2 s:

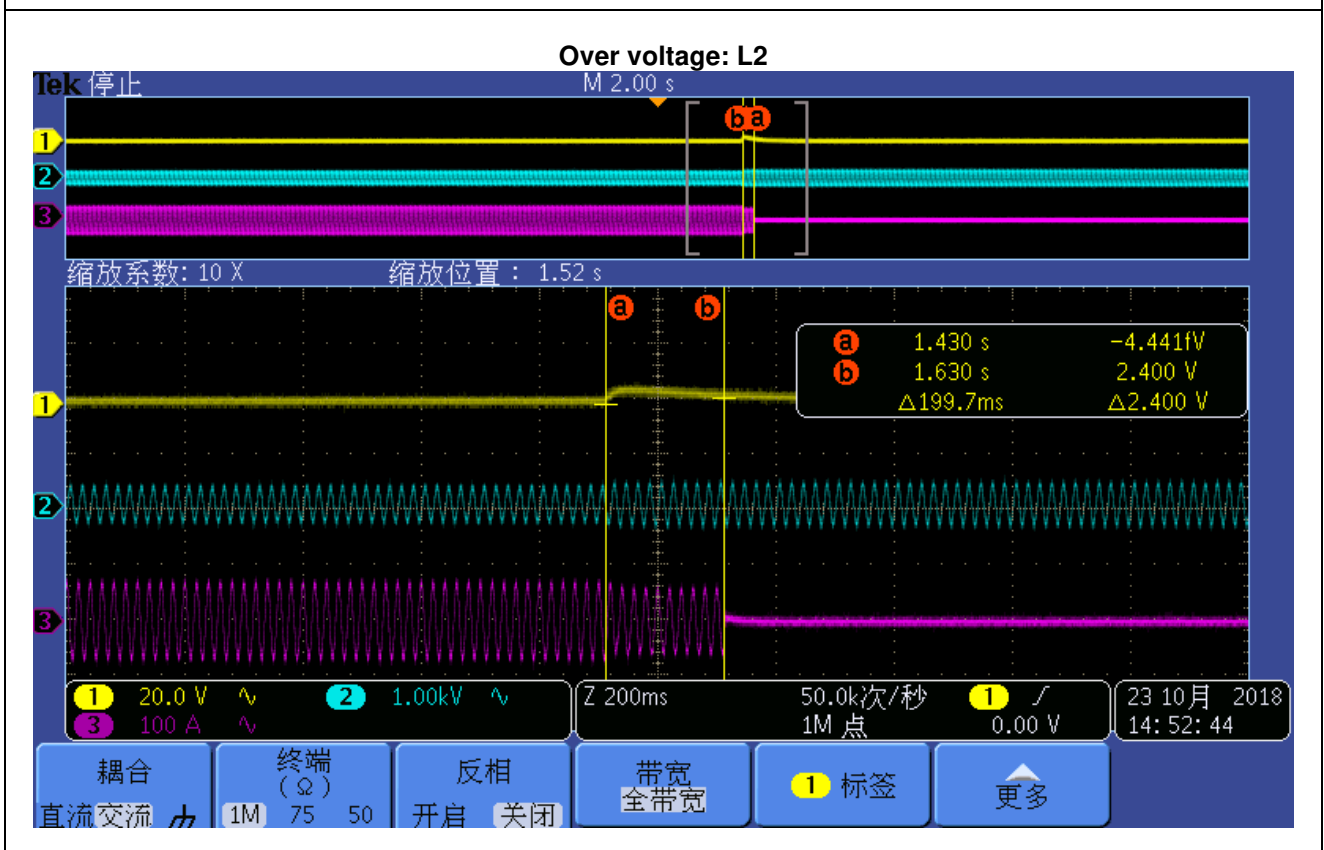
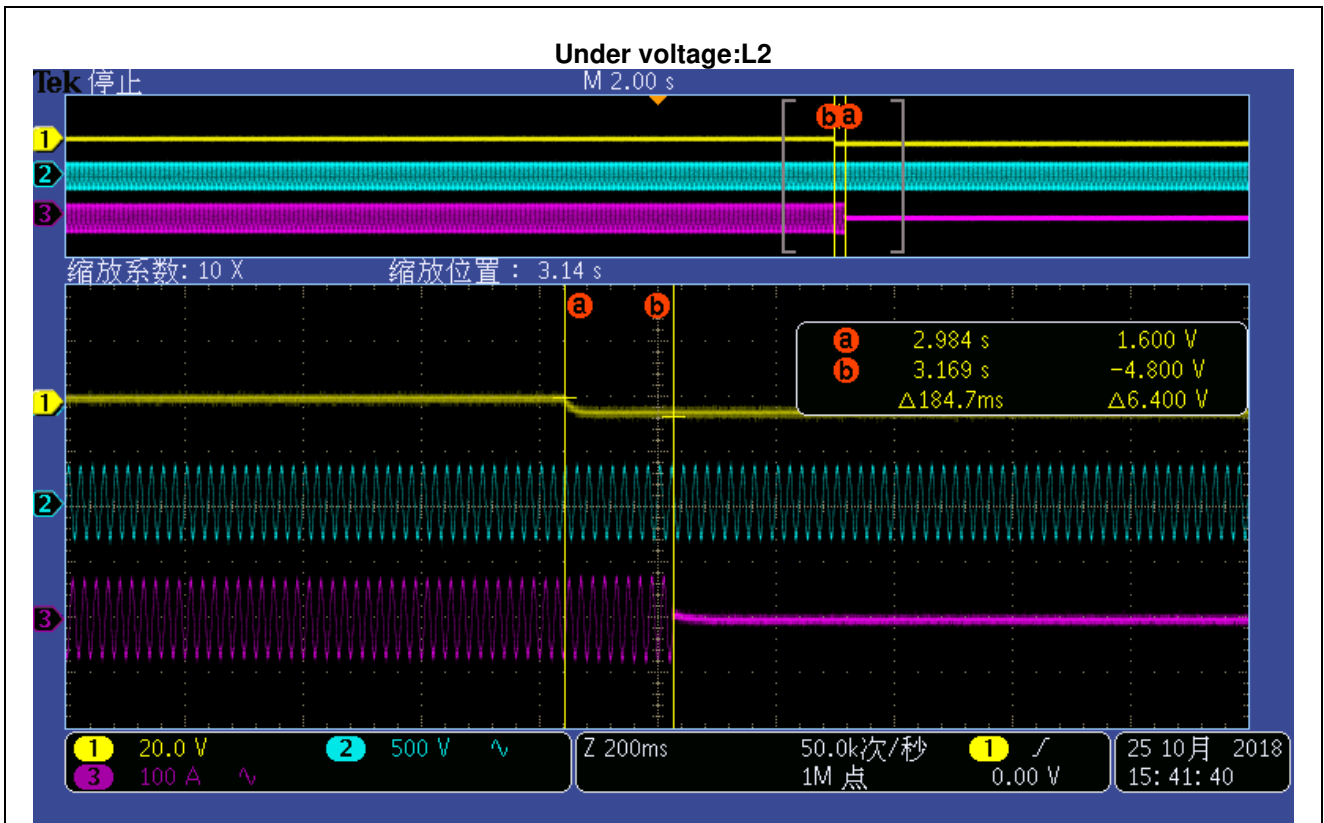


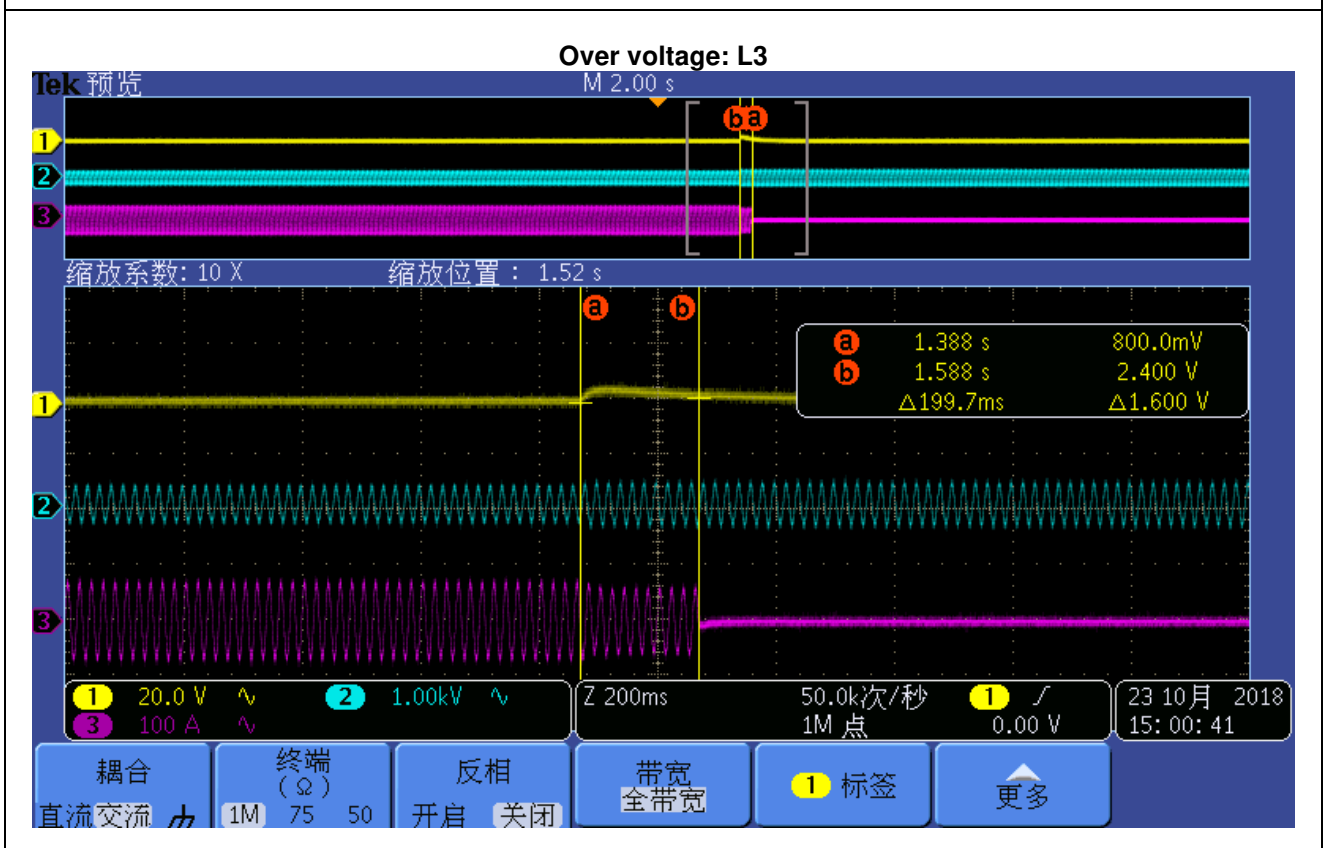
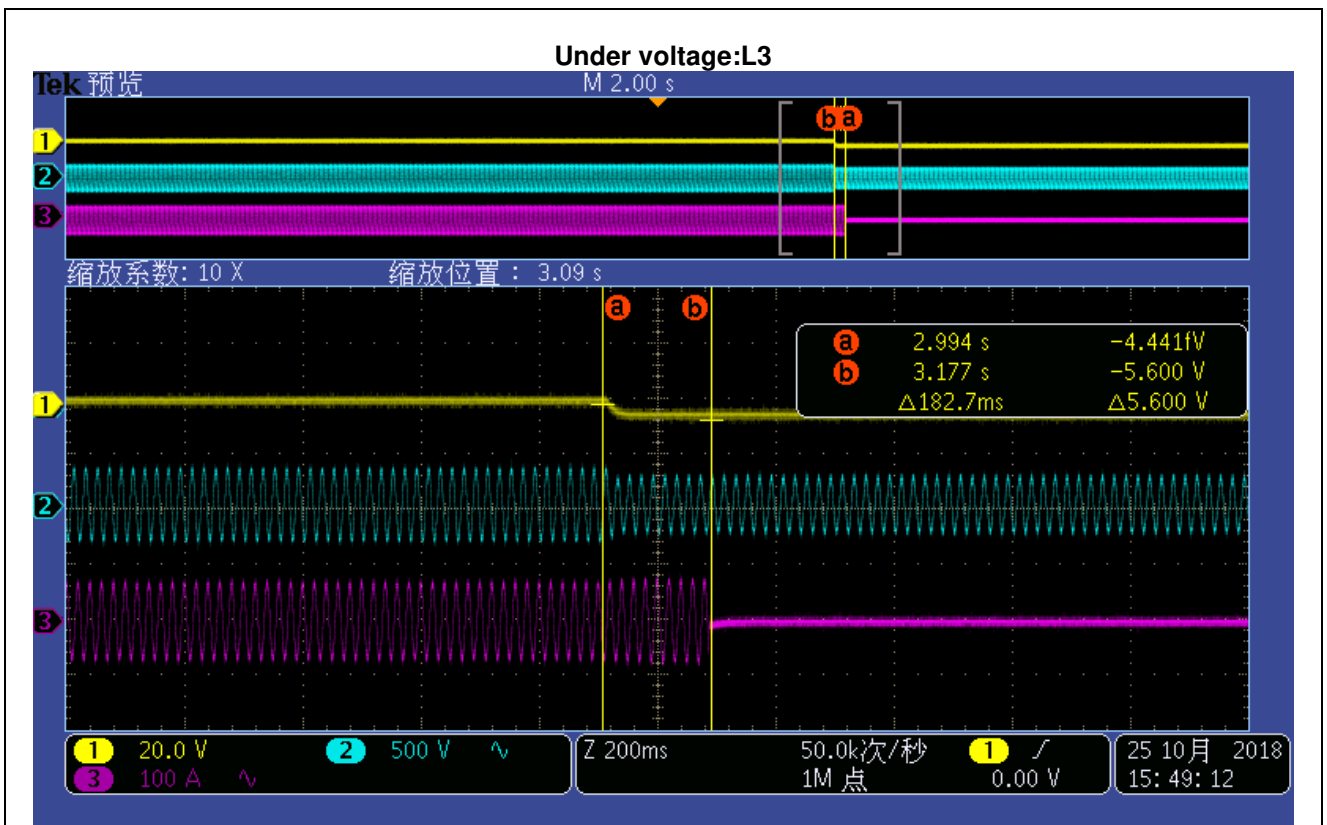
Step 2: 230 V to 177,1 V in 4 s:



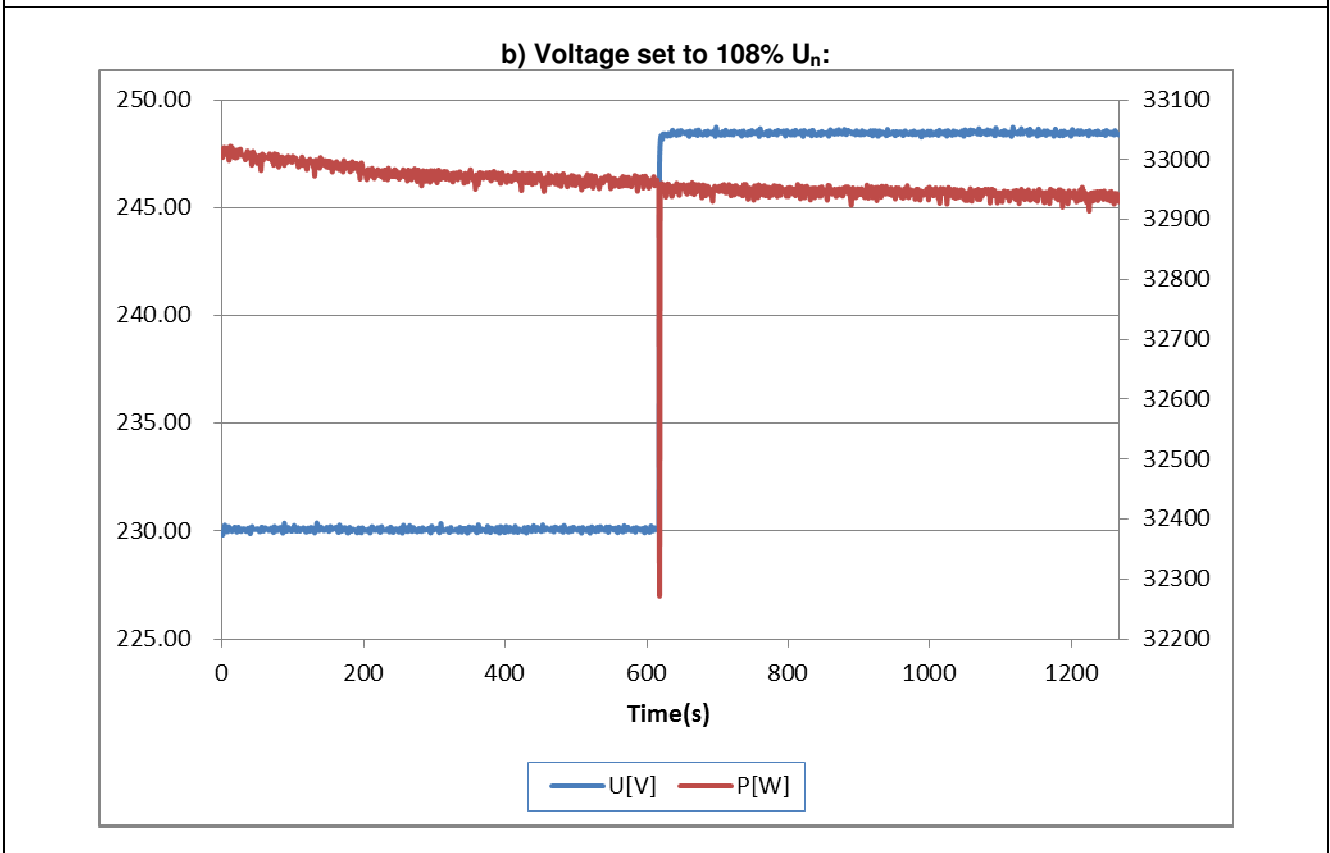
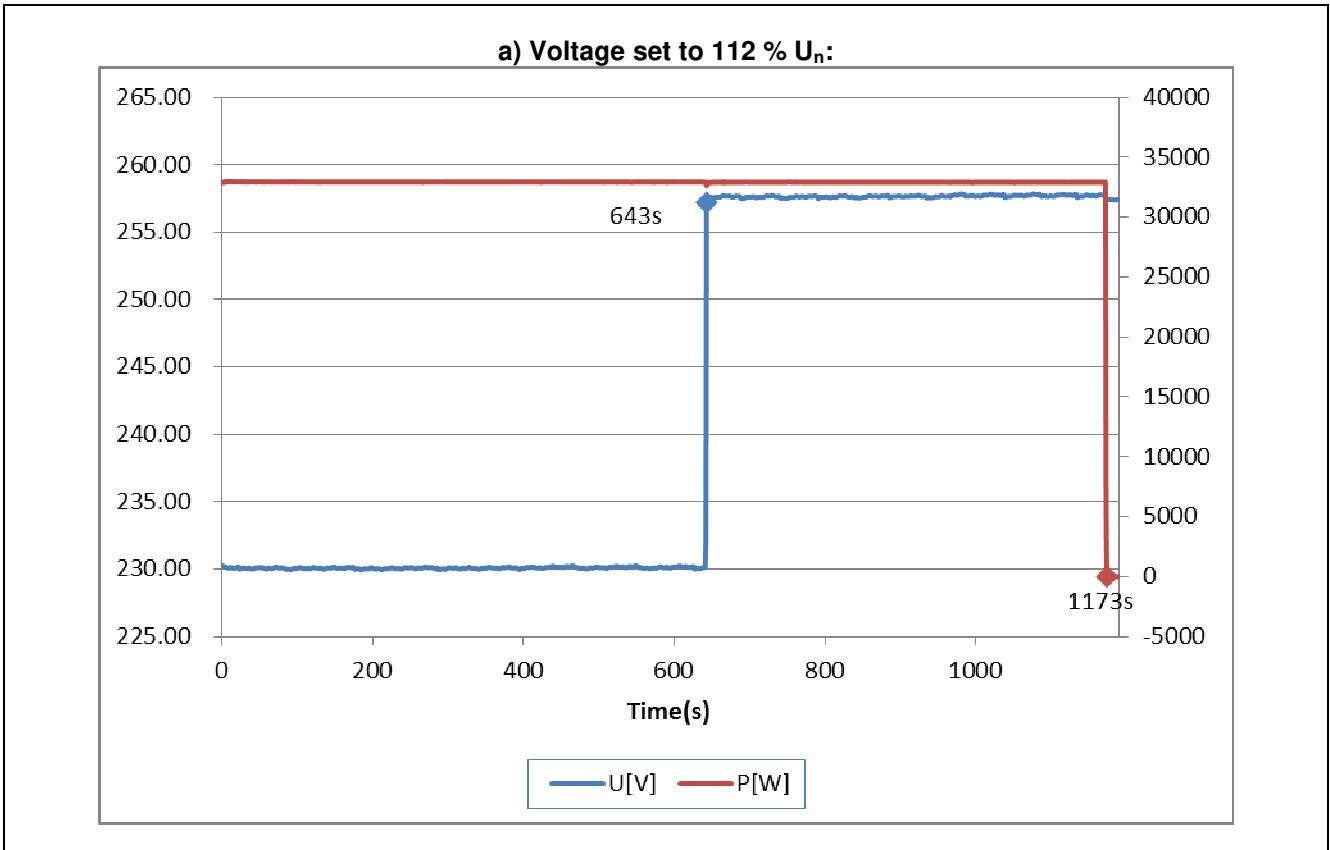
6.2		Voltage monitoring					P
Setting values:	Setting U _{<} [V]:	184,0					
	Setting U _{>>} [V]:	264,5					
	Setting T _{disconnection} [ms]:	150					
Operating time of the monitoring device:							
	Under voltage:			Over voltage:			
L1 to N:							
Step [V to V]:	230,0 to 177,1			230,0 to 271,4			
Limit [V]:	184,0			264,5			
Measurement [V:]	183,7	183,7	183,7	264,9	264,9	264,9	
Limit [ms]:	200			200			
Disconnection time [ms]:	160,5	161,5	174,7	196,1	198,1	197,7	
L2 to N:							
Step [V to V]:	230,0 to 177,1			230,0 to 271,4			
Limit [V]:	184,0			264,5			
Measurement [V:]	183,6	183,6	183,6	263,9	263,9	263,9	
Limit [ms]:	200			200			
Disconnection time [ms]:	184,7	160,7	162,7	193,7	197,7	199,7	
L3 to N:							
Step [V to V]:	230,0 to 177,1			230,0 to 271,4			
Limit [V]:	184,0			264,5			
Measurement [V:]	183,1	183,1	183,1	264,6	264,6	264,6	
Limit [ms]:	200			200			
Disconnection time [ms]:	182,7	172,7	168,7	193,7	199,7	198,5	
Note:							
The conditions and testing is performed according to V VDE 0124-100, 5.4.5.3							
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.							
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.							

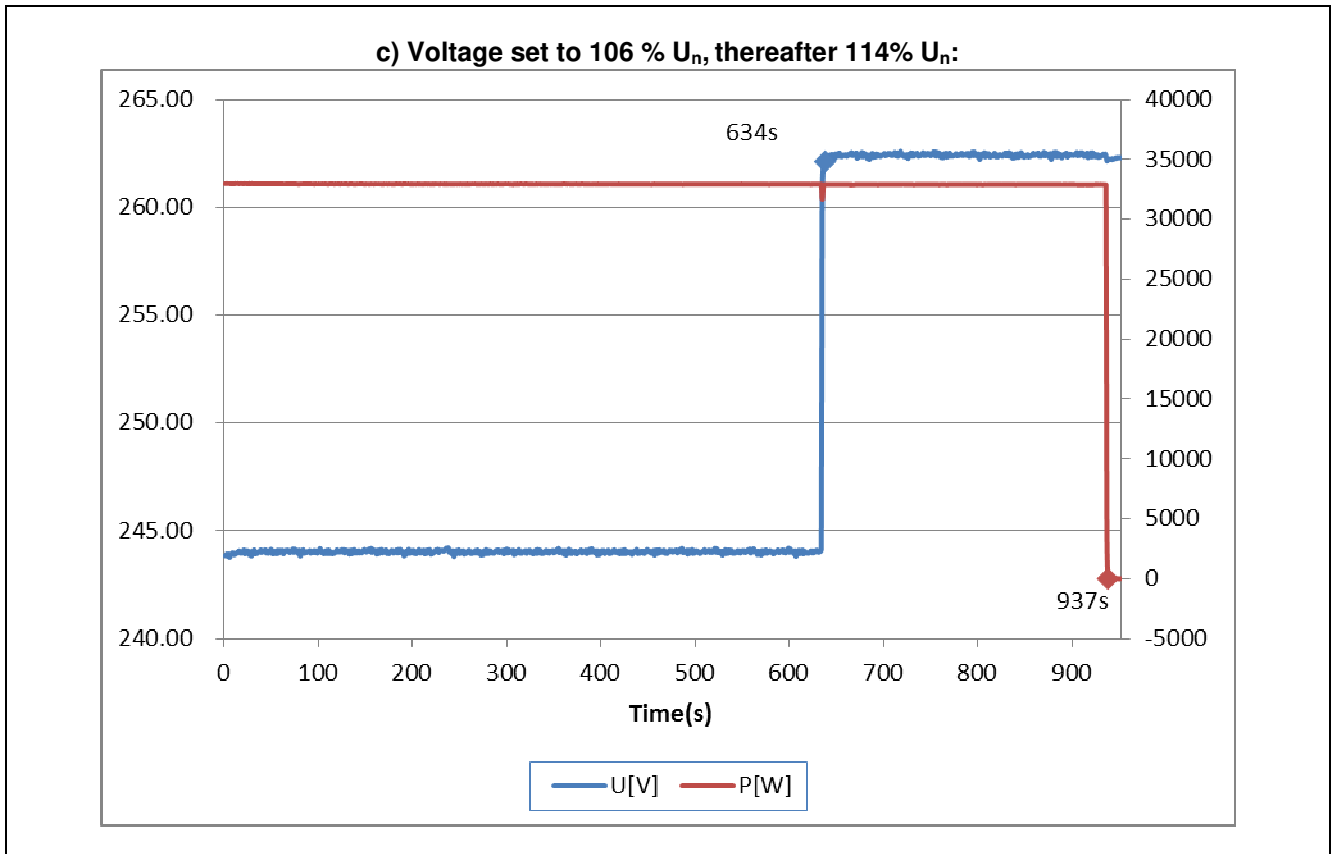






6.3		Voltage monitoring		P
Setting values:		Setting $U >$ [V]	253	
		Setting $T_{\text{disconnection } U >}$ [s]	600	
		Setting $T_{\text{disconnection}}$ [ms]	200	
Test:				
		Disconnection time:	Limit:	
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n . Disconnection must take place within 600 s.			
	Phase 1	484 s	≤ 600 s	
	Phase 2	530 s		
	Phase 3	482 s		
b)	The voltage is set to U_n for 600 s and then to 108% U_n for 600 s. No disconnection should take place.			
	Phase 1	No disconnected	Disconnection should not take place.	
	Phase 2	No disconnected		
	Phase 3	No disconnected		
c)	The voltage is set to 106 % U_n and held for 600 s. Thereafter the voltage is set to 114 % U_n . Disconnection must take place within 300 s or about 50 % of the disconnection time measured in point a).*			
	Phase 1	302 s	The disconnection time should be about 50 % of the value measured in a). *	
	Phase 2	245 s		
	Phase 3	271 s		
Note:				
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.				
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.				





6.4	Frequency monitoring						p
Setting values:	Setting f< [Hz]:			47,5			
	Setting f>[Hz]:			51,5			
	Setting Tdisconnection [ms]			120,0			
Operating time of the monitoring device							
	Under frequency			Over frequency			
Ramp [Hz to Hz]:	48,00 -> 47,00			51,00 -> 52,00			
Limit [Hz]:	47,50			51,50			
Measurement [Hz]:	47,50	47,50	47,50	51,50	51,50	51,50	
Limit [ms]:	200			200			
Disconnection time [ms]:	181	199	198	156	152	156	
Note:							
The conditions and testing is performed according to V VDE 0124-100, 5.4.5.4							
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.							
The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.							

Under frequency:



Over frequency:



6.5	Monitoring of d.c. injection into the mains			P	
DC Injection [A]	Limits	Trip Time [ms]			
+1,0A	I d.c.: > 1 A than disconnection within 0,2 sec	180	199	160	
-1,0A	I d.c.: > 1 A than disconnection within 0,2 sec	180	160	181	
<p>Note: A dc-current of 1A is injected, disconnection time of max. 0,2s</p> <p>The test results refer to the original test report 18TH0561-CEI-21_0 issued by Bureau Veritas Consumer Products Services, Germany GmbH, dated on Dec. 14, 2018.</p> <p>The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.</p>					

Positive DC-Injection:



Negative DC-Injection:



6.6		Detection of islanding			P
Test condition:		Frequency: 50+/-0,01 Hz U _n = 230+/-1% V a.c. RLC consumes inverter real power within ± 3 % Distortion factor of chokes < 3 % Quality Q > 2			
Disconnection limit:		5 s			
L1 phase					
Output power:		25%	50%	100%	
Osc. parameter					
- 5%		77,4	194,2	120,2	
- 4%		92,4	190,2	229,2	
- 3%		98,4	151,2	219,2	
- 2%		87,4	180,2	230,2	
- 1%		89,4	196,2	220,2	
0%		98,8	197,2	234,2	
+1%		89,4	147,2	216,2	
+2%		87,8	168,2	136,2	
+3%		88,8	181,2	201,2	
+4%		76,8	149,2	210,2	
+5%		85,8	151,6	135,2	
Parameter at 0%		L=32,26 mH R= 20,27 Ω C= 314,10μF	L= 14,93 mH R= 9,38 Ω C= 678,74 μF	L= 7,34 mH R= 4,61 Ω C= 1380,35 μF	
L2 phase					
Output power:		25%	50%	100%	
Osc. parameter					
- 5%		90,2	149,2	145,2	
- 4%		84,2	134,2	138,2	
- 3%		79,2	106,2	143,2	
- 2%		85,2	108,2	119,2	
- 1%		88,2	133,2	470,2	
0%		92,2	153,2	652,2	
+1%		82,2	120,2	138,2	
+2%		92,2	120,2	155,2	
+3%		83,2	146,2	147,2	
+4%		91,2	136,2	137,2	
+5%		88,2	137,2	121,2	
Parameter at 0%		L=32,38 mH	L= 16,64 mH	L= 8,34 mH	

	R= 20,35 Ω C= 312,89μF	R= 10,45 Ω C= 608,94 μF	R= 5,24Ω C= 1215,47 μF
L3 phase			
Output power:	25%	50%	100%
Osc. parameter			
- 5%	97,4	128,6	94,6
- 4%	77,4	128,4	216,0
- 3%	87,2	139,4	224,0
- 2%	72,6	129,4	218,0
- 1%	79,4	131,6	210,0
0%	88,4	143,4	268,6
+1%	80,4	123,6	210,6
+2%	87,4	123,6	217,6
+3%	86,4	110,6	194,6
+4%	82,4	95,4	226,6
+5%	88,4	137,6	202,6
Parameter at 0%	L=32,13 mH R= 20,19 Ω C= 315,30μF	L= 16,64 mH R= 10,45 Ω C= 608,94μF	L= 8,44 mH R= 5,31 Ω C= 1199,83 μF

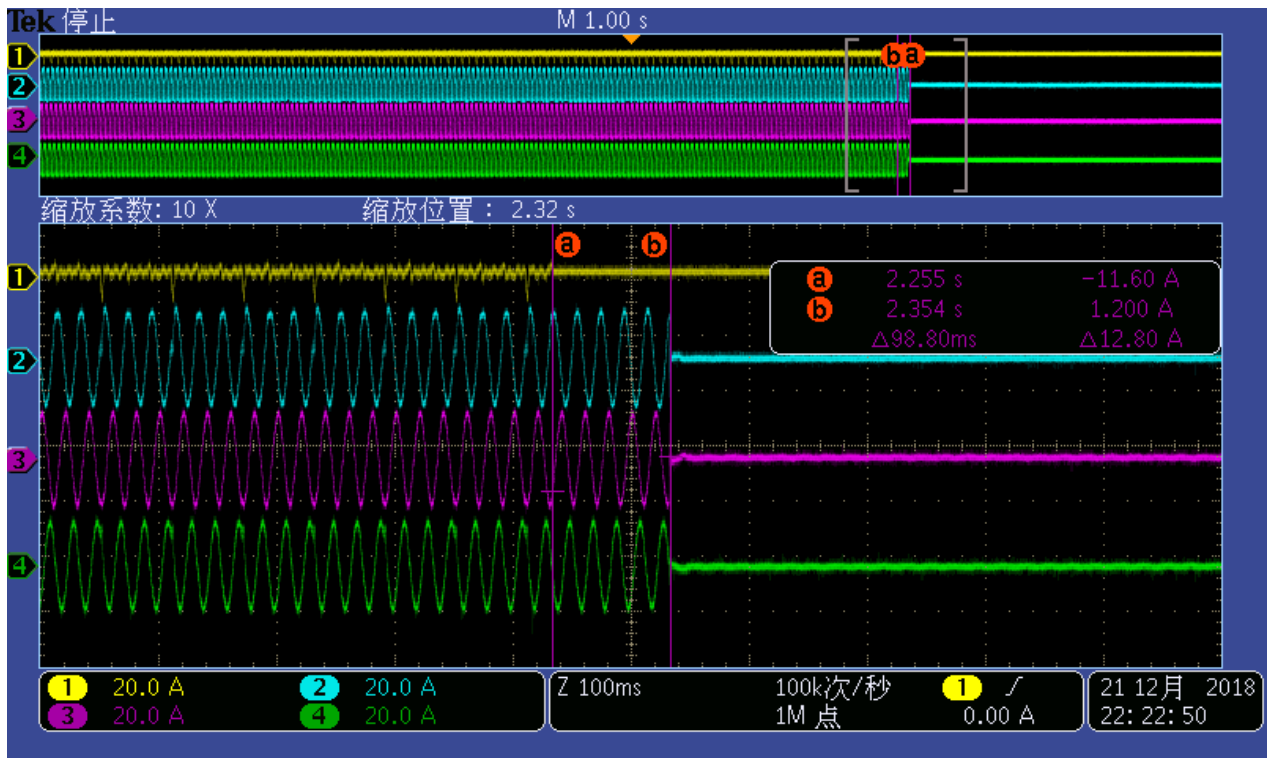
Note:

The conditions and testing is performed according to V VDE 0124-100, 5.4.6

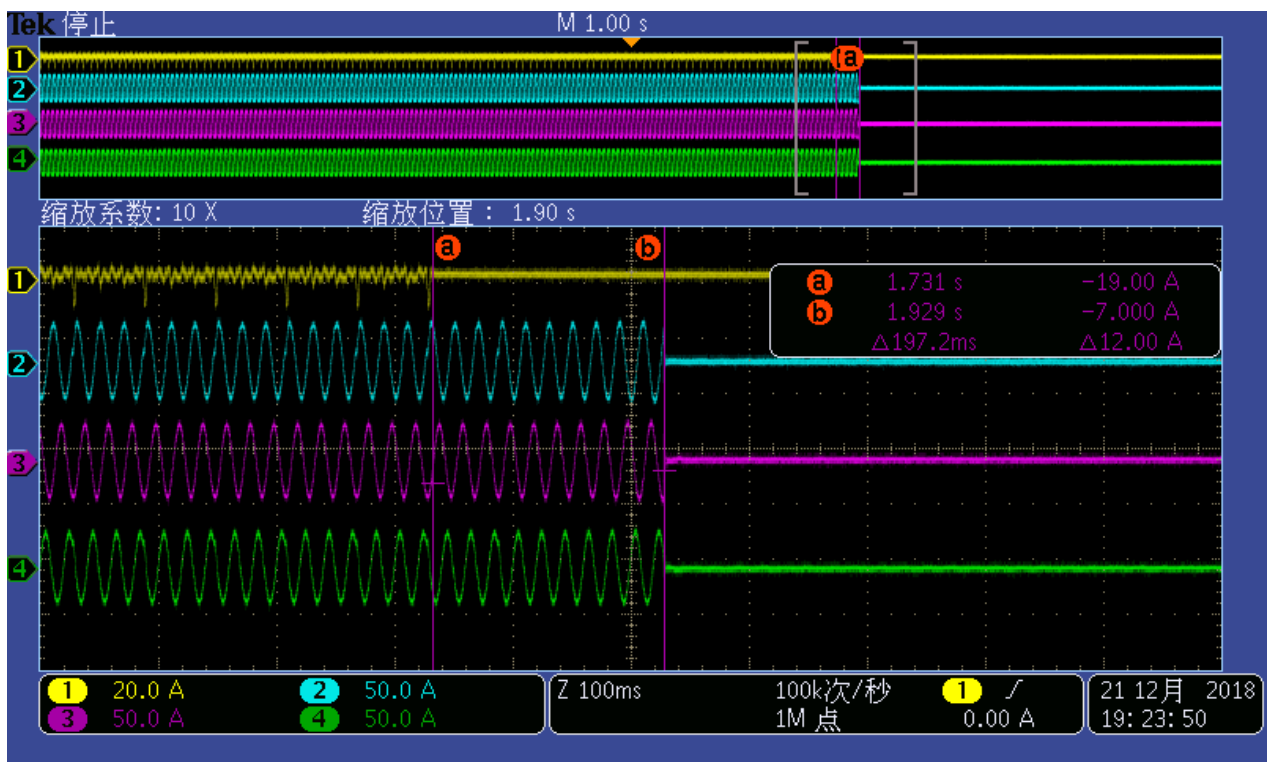
The test results refer to the original test report PVDE180712N013 issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on April. 24, 2019.

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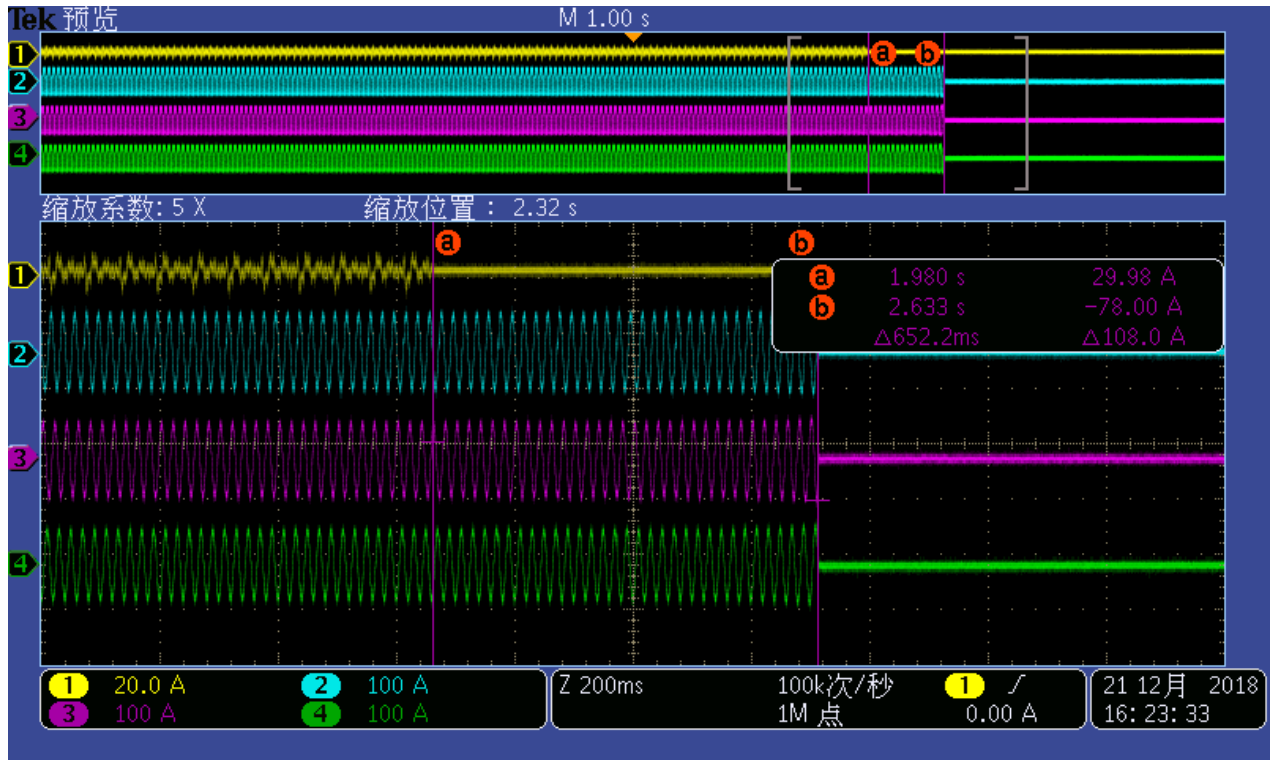
Oscillating circuit test: 25% output power



Oscillating circuit test: 50% output power



Oscillating circuit test: 100% output power



Annex 1

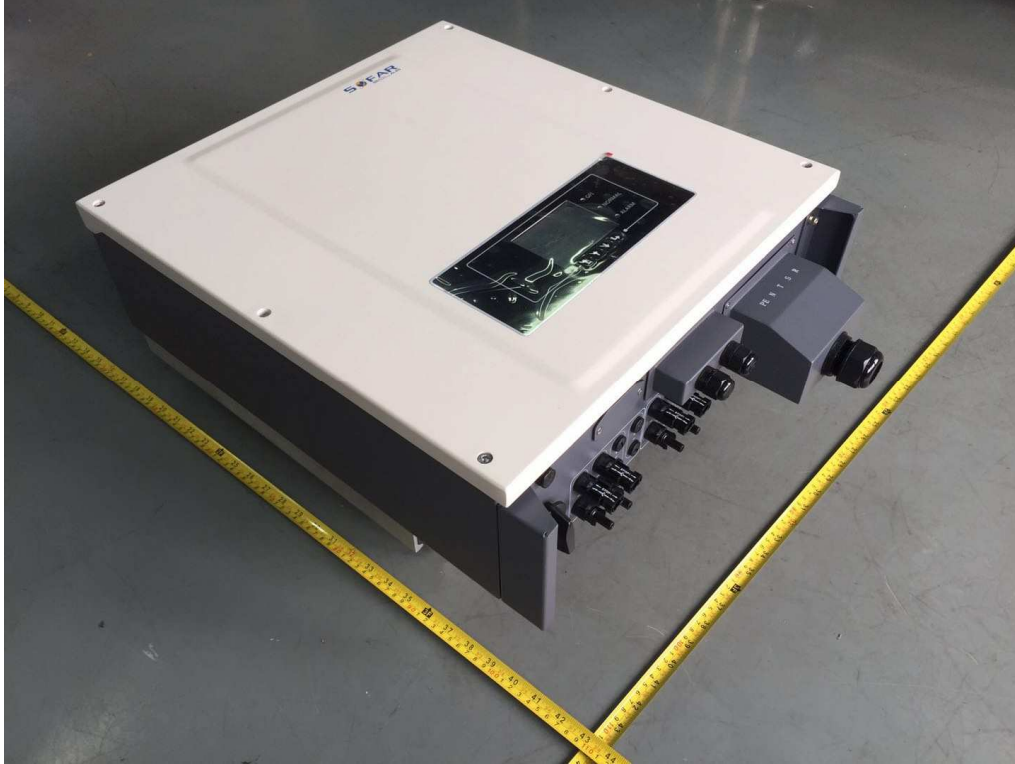
Pictures of the unit

The full pictures refer to PHOTO DOCUMENT

Project No.: 180712N013

Date: 20190424

Enclosure front view: SOFAR 20000TL-G2



Enclosure rear view: SOFAR 20000TL-G2



Enclosure front view: SOFAR 25000TL-G2



Enclosure rear view: SOFAR 25000TL-G2



Enclosure front view: SOFAR 3000TL-G2, SOFAR 33000TL-G2



Enclosure rear view: SOFAR 3000TL-G2, SOFAR 33000TL-G2



Annex 2

Test equipment list

Test location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Dates of performance test: 2018-07-12 to 2019-04-20

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Dec. 13, 2018
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
	A7040016DG	Chroma	62150H-1000S	62150EF00490	
	A7040017DG	Chroma	620028	620028EF00120	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 14, 2018
Four Channel Digital Phosphor Oscilloscope	A4089003DG	Tektronix	DPO4104B	C010624	Oct. 25, 2018
Oscilloscope probel	A1490009DG	YOKOGAWA	701901	//	Nov. 01, 2018
	A1490010DG	YOKOGAWA	701901	//	Nov. 01, 2018
	A1490011DG	YOKOGAWA	701901	//	Nov. 01, 2018
Current transducer	A1060008DG	YOKOGAWA	CT200	1130700017	Nov. 17, 2018
	A1060009DG	YOKOGAWA	CT200	1130700019	Nov. 17, 2018
	A1060009DG	YOKOGAWA	CT200	1130700019	Nov. 17, 2018