TEST REPORT
DIN V VDE V 0126-1-1:2013.08
Automatic disconnecting device

Report Reference No. .....:	140327081GZU-002
Date of issue.....:	22 May 2014, Revision 1: 15 Mar., 2019
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Testing Laboratory .....:	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
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Testing location/ address.....:	Same as above
Tested by (name + signature) .....:	Tommy Zhong Technical Manager
Approved by (+ signature) .....:	Jason Fu Senior Project Engineer
Applicant's name .....:	Shenzhen SOFARSOLAR Co., Ltd.
Address.....:	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Test specification:	
Standard .....:	DIN V VDE V 0126-1-1:2013.08
Test procedure.....:	Type test
Non-standard test method……..:	N/A
Test Report Form No. .....:	VDE0126-1-1b
Test Report Form(s) Originator .....:	Intertek
Master TRF.....:	Dated 2013-09

Test item description ..... :	Grid-connected PV inverter
Trade Mark .....:	
Manufacturer.....:	Same as applicant
Model/Type reference.....:	Sofar 20000TL-Sx, Sofar 17000TL-Sx, Sofar 15000TL-Sx, Sofar 10000TL-Sx (x=0-6)
Ratings.....:	Maximum d.c. input voltage: 1000 V Input voltage rang: 250-960 V Max. input current: 2×24 A (for Sofar 20000TL-Sx); 2×21 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×15 A (for Sofar 10000TL-Sx) Max. PV Isc: 2×30 A (for Sofar 20000TL-Sx); 2×27 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×20 A (for Sofar 10000TL-Sx) Nominal output voltage: 3/N/PE230V/400V Max. output current: 3×29 A (for Sofar 20000TL-Sx); 3×25 A (for Sofar 17000TL-Sx); 3×22 A (for Sofar 15000TL-Sx); 3×15 A (for Sofar 10000TL-Sx) Nominal frequency: 50 Hz Max. output power: 20000 W (for Sofar 20000TL-Sx); 17000 W (for Sofar 17000TL-Sx); 15000 W (for Sofar 15000TL-Sx); 10000 W (for Sofar 10000TL-Sx) Ingress protection: IP65 Operating temperature range: -25～60℃

Summary of testing:

Tests performed (name of test and test clause):

VDE0126-1-1 (VDE0124-100)	Test Description
6.1 (5.4.5.2)	Functional safety
6.3/6.4 (5.4.5.3 & 5.4.5.4)	Monitoring the voltage/ Monitoring the frequency
6.5	Monitoring the dc current
6.6 (5.4.6)	Detection of islanding operation
6.2 (5.5.1 & 5.5.2)	Connection conditions

Testing location:

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch

Copy of marking plate

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

2. Label is attached on the front surface of enclosure and visible after installation.

Test item particulars	:	
Temperature range	:	-25°C ~ +60 °C
Overvoltage category	:	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
IP protection class	:	IP65
Possible test case verdicts:		
- test case does not apply to the test object	:	N/A
- test object does meet the requirement	:	P (Pass)
- test object does not meet the requirement	:	F (Fail)
Testing	:	
Date of receipt of test item	:	27 Mar 2014
Date (s) of performance of tests	:	27 Mar 2014 – 09 May 2014

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a point is used as the decimal separator.

Clause numbers in parentheses derive from VDE-AR-N 4105:2011-08.

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

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The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.

Revision 1: This report is based on and superseded original report 140327081GZU-002, dated 22 May 2014, with below modified information:

1. Change the Applicant's Address from "3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China" to "401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China".

2. Change the factory from "Dongguan dingqiang Machinery & Electric Co., Ltd." to "Dongguan SOFAR SOLAR Co., Ltd.". Change factory's address from "No. 8, Fulong road, Qingxi town, Dongguan city, Guangdong, China" to "1F-6F, Building E, No.1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City".

General product information:

1. Product covered by this report is non-isolated grid-connected PV inverter for connection with low voltage grid in terms of DIN V VDE V 0126-1-1.
2. The inverters intended to operate at ambient temperature -25℃ - +60℃ and 250-960 Vdc input, which will be specified in the user manual, The inverters will output full power when operated at 45℃. If operated at higher than 45℃ temperature, the output power derating.
3. The firmware version used for testing is V1.00

For all models, if the DC input voltage is higher than 850 Vdc the output power will be derating.
For model Sofar 20000TL-Sx, if the DC input voltage is lower than 430 Vdc, the output power will be derating.
For model Sofar 17000TL-Sx, if the DC input voltage is lower than 420 Vdc, the output power will be derating.
For model Sofar 15000TL-Sx, if the DC input voltage is lower than 370 Vdc, the output power will be derating.
For model Sofar 10000TL-Sx, if the DC input voltage is lower than 350 Vdc, the output power will be derating.

For all models, if the AC output voltage is lower than 230 Vac the output current will be limited to not higher than rated output current.

Model difference:
All the models have identical mechanical and electrical construction except some componnents and some parameter of the software architecture in order to control the max output power. And refer to the following table for detail.

Model	DC Cable Gland	PV connector	DC inside connector	Fuse PCB+ String detection board	DC surge arrester	DC switch	AC switch	AC surge arrester
Sofar 20000TL-S0 Sofar 17000TL-S0 Sofar 15000TL-S0 Sofar 10000TL-S0	√		√					
Sofar 20000TL-S1 Sofar 17000TL-S1 Sofar 15000TL-S1 Sofar 10000TL-S1	√		√			√		
Sofar 20000TL-S2 Sofar 17000TL-S2 Sofar 15000TL-S2 Sofar 10000TL-S2		√	√			√		
Sofar 20000TL-S3 Sofar 17000TL-S3 Sofar 15000TL-S3 Sofar 10000TL-S3		√		√		√		
Sofar 20000TL-S4 Sofar 17000TL-S4 Sofar 15000TL-S4 Sofar 10000TL-S4		√		√	√	√		
Sofar 20000TL-S5 Sofar 17000TL-S5 Sofar 15000TL-S5 Sofar 10000TL-S5		√		√	√	√		√
Sofar 20000TL-S6 Sofar 17000TL-S6 Sofar 15000TL-S6 Sofar 10000TL-S6		√		√	√	√	√	√
√ denote incorporating this component								

Model Sofar 17000TL-Sx similar to Sofar 20000TL-Sx except amount of the DC-link capacitors, different of input and output sampling resistors and different inductance of Boost, invert inductor.

Model Sofar 15000TL-Sx similar to Sofar 17000TL-Sx except amount of the DC-link capacitors, different inductance of Boost, invert inductor and less PV input circuits (including PV terminal, fuse and sampling circuits of fuse).

Model Sofar 10000TL-Sx similae to Sofar 15000TL-Sx except amount of the DC-link capacitors and boost diode, different of input and output sampling resistors and different inductance of Boost, invert inductor.

Model Sofar 20000TL-Sx and Sofar 17000TL-Sx have two external fans.

Model Sofar 15000TL-Sx has one external fan and model Sofar 10000TL-Sx has not.

Unless other special note, model Sofar 20000TL-S6 used as representative sample for testing.

Factory information:

Factory: Dongguan SOFAR SOLAR Co., Ltd.
Address: 1F-6F, Building E, No.1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City.

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
4	**REQUIREMENTS**		P
4.0	**General**		P
	Comments:		P
	These requirements apply to integrated or separate (independent) disconnecting devices unless otherwise noted. The disconnection device has to cut off the power generating system on the ac side from the grid by two switches in series when: — the voltage and/or the frequency of the grid is deviating, — direct current (DC) is fed into the Grid. — unintentional islanding operation occurs, — intentional islanding operation using grid backup systems (emergency supplies).	Integrated interface switch used The PGU also monitor the state of voltage, direct current and unintentional islanding, once deviating and occurring, the PGU shall cut off the power by two switches in series.	P
4.1	**Functional safety**		P
	The safety must be assured under all operating conditions complying with the defined functions 4.3 to 4.6 and – if applicable – 4.8 of the disconnection device. The disconnection device can be an independent unit or an integrated part of the power generating unit and must switch off in case of a fault and indicate the fault status	Two relay in series inside the PGU used for disconnect L&N every phase from AC main in case of a fault and the LCD on the side of PGU will indicate the fault status	P
4.1.1	**Single fault tolerance**		P
	The disconnection device must comply with the single fault tolerance requirements of VDE-AR-N 4105:2011-08, A.6	(See appended table 6.1)	P
4.1.2	**Interface Switch**		P
	The interface switch must, in case it is integrated into a PV-inverter, comply with the requirements of DIN EN 62109-2(VDE 0126-14-2):2012-04, 4.4.4.15.2 and in all other cases with the requirements according to VDE-AR-N 4105:2011-08, 6.4.	Integrated Also refer to report No. 140327081GZU-001 for details	P
(6.4.1)	**General**		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
	For the connection of the power generation system to the network operator's low-voltage network or to the remaining customer system, it is necessary to use an interface switch. It consists of two electric switching devices connected in series and shall thus be constructed redundantly. The interface switch is controlled by the NS protection and activates automatically if at least one protective function responds. The breaking devices of the interface switch shall be designed to be short-circuit proof and shall be releasable without delay and with due regard to the protective devices required by clause 6.5. The breaking capacity of the two breaking devices of the interface switch shall be dimensioned at least in accordance with the responding range of the upstream safety fuse or the maximum short-circuit current contribution of the power generation system. Switches with at least breaking capacity shall be use for both breaking devices of the interface switch. In addition to that, all-pole disconnection shall be ensured.	Two electric switching connected in series and constructed redundantly Contact gap is >1.5 mm for each relay.	P
(6.4.2)	**Central interface switch**		N/A
	The two break devices of the central interface switch shall be executed as galvanic break devices. The two break devices of the interface switch shall be installed directly at the central meter panel in the circuit distributor of the power generation system.		N/A
(6.4.3)	**Integrated interface switch**		P
	Construction of the interface switch shall be carried out taking into consideration the single-fault tolerance. An interface switch ensures a single-fault tolerant all-phase galvanic breaking. For power generation systems with inverters, the interface switch shall be provided on the inverter's network side. A short circuit in the inverter shall not impair the switching function of the interface switch.		P
4.2	**Connection conditions**		P
	The connection, the reconnection after a grid-fault and the reconnection after short interruption shall be carried out according to VDE-AR-N 4105:2011-08, 8.3.1	(See appended table 6.2)	P
(8.3.1)	**General**		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
	A power generation system shall be connected to the network operator's network only if a suitable device determines that both the mains voltage and the mains frequency are within the tolerance range of 85 % Un to 110 % Un or 47.5 Hz to 50.05 Hz, respectively, for a period of at least 60 seconds. If decoupling protection devices are tripped because of a short interruption, then the power generation system is permitted to already reconnect as soon as the mains voltage and mains frequency have uninterruptedly remained within the tolerance ranges given above for a period of 5 seconds. Short time interruptions are characterised by the NS protection settings of the mains frequency and/ or network voltage being exceeded or undershot for a maximum period of 3 seconds. The power generation system being reconnected to the network operator's network at the tripping of the decoupling protection device, the active power of controllable power generation systems supplied to the network operator's network shall not exceed the gradient of 10 % of the active power per minute.	The equipment checked the voltage and frequency monitoring circuit, dc injection detection circuit as well as Isolation resistance circuits before connection. The measurement to the voltage and frequency of the grid is 75 sec before connection.	P
4.3	**Monitoring the voltage**	(See appended table 6.3)	P
4.3.1	**voltage drop U<**		P
	The disconnection because of a voltage drop shall be carried out according to VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2	Also refer to report No. 140327081GZU-001 for details	P
4.3.2	**rise-in-voltage U>>**		P
	The disconnection because of a rise-in-voltage shall be carried out according to VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2	Also refer to report No. 140327081GZU-001 for details	P
4.3.3	**slow rise-in-voltage U>**		P
	The disconnection because of a slow rise-in-voltage (10-minute-average) shall be carried out according to VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2		P
4.4	**Monitoring the frequency**	(See appended table 6.4)	P
	The disconnection because of a frequency decrease or a frequency increase shall be carried out according to VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2	Also refer to report No. 140327081GZU-001 for details	P
(6.5.1)	**General**		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
	The purpose of the NS protection is to disconnect the power generation system from the net in the event of inadmissible voltage and frequency values. This is intended to prevent an unintentional feed-in of the power generation system into a power-supply unit separated from the remaining distribution network as well as the feed-in of faults within this network. The system operator shall himself take precautions to prevent damages to his systems and installations as might be caused by switching actions, voltage fluctuations and automatic reclosings in the network connected upstream or other process in the network of the network operator. The following functions of the decoupling protection shall be implemented: - Voltage drop protection *U* <; - Rise-in-voltage protection *U* >; - Rise-in-voltage protection *U* >>; - Frequency decrease protection *f* <; - Frequency increase protection *f* >; - Islanding detection. The setting values of the protective functions and the last five dated failure reports shall be readable at the NS protection. Interruptions of supply with durations of 3 s or longer shall not lead to loss of any of the failure reports. Read-out shall be possible at the central NS protection irrespective of the operational state of the power generation system and without any additional aids. For integrated NS protection read-out may be carried out using a data interface.		P
(6.5.2)	**Protective functions**		P
	The protective functions of the NS protection shall be designed so that the disconnection time (the sum of the proper times of NS protection and interface switch plus a delay for the protection relay, which may or may not be adjustable) does not exceed 200 ms.		P
4.5	**Monitoring the dc current**	(See appended table 6.5)	P
	A feed in of d.c current into the low-voltage grid due to defective equipment must lead to a switch off within 0.2 seconds. For this purpose the fault itself or a measurement of the dc component of the current exceeding 1 A can be used as disconnection criteria.	The disconnection takes place immediately after the dc current injection is detected at 1.0 A, then the inverter cut off The Max. measured disconnection time is 0.168 s.	P
4.6	**Detection of islanding operation**		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
	The disconnection because of a detection of unintended islanding operation shall be carried out according to VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.3	(See appended table 6.6)	P
(6.5.3)	**Islanding detection**		P
	The islanding detection is implemented in the central NS protection or in the integrated NS protection of the power generation unit. If an islanding detection system acting on the integrated interface switch is integrated in all power generation units of a power generation system, then it is permitted to omit the islanding detection in the central NS protection regardless of the system power. Detection of an isolated network and disconnection of the power generation system by means of the interface switch shall be completed within 5 seconds.		P
4.7	**Markings**		P
	A generating system equipped with an automatic disconnecting device shall be marked with the information “VDE 0126-1-1” which is visible from the outside. This can be done by — the marking plate or — showing it on a display of the disconnection device or — a separate marking	“VDE 0126-1-1” marked on the marking label	P
4.8	**Requirements for disconnection devices integrated into PV-inverters**		P
	The requirements of the DIN EN 62109-2 (VDE 0126-14-2):2012-04, 4.8 regarding the residual current detection and the insulation detection of the PV-generator shall be complied with.	See report No. 130918053GZU-005 for details	P
5	**General Requirements**		P
	Limits according to DIN EN 61000-6-3 (VDE 0839-6-3) regarding radio interferences must be complied with. For disturbance-free operation disturbance limits according to DIN EN 61000-6-2 (VDE 0839-6-2) shall be complied with.		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
6	**TYPE TESTING**		**P**
6.0	**General**		P
	The following tests are valid for integrated and separated disconnecting devices unless otherwise noted. A separate disconnection device must be tested together with a suitable supply. It has to be ensured that the turn-off signal is caused by the disconnection device and not by the supply.		P
6.1	**Functional safety**		P
	The testing of the single fault tolerance and the error detection with following disconnection according to 4.1 is carried out according to DIN VDE V 0124-100 (VDE V 0124-100):2012-07, 5.4.5.2.	(See appended table)	P
6.2	**Connection conditions**	(See appended table)	P
	The testing of the connection and the reconnection is carried out according to DIN VDE V 0124-100 (VDE V 0124):2012-07, 5.5.1 and 5.5.2.		P
6.3	**Monitoring the voltage**	(See appended table)	P
	The testing of the voltage monitoring is carried out according to DIN VDE V 0124-100 (VDE V 0124-100):2012-07, 5.4.5.3.		P
6.4	**Monitoring the frequency**	(See appended table)	P
	The testing of the frequency monitoring is carried out according to DIN VDE V 0124-100 (VDE V 0124-100):2012-07, 5.4.5.4.		P
6.5	**Monitoring the dc current**	(See appended table)	P
	The testing of the disconnection due to feed in of direct current is carried out either by a) or b): a) The measuring device at the switching point (e.g. current transformer or resistance) is fed with direct current of 1 A. The cut-off must be carried out within 0.2 seconds. b) By means of a fault simulation it is measured if a defective system operation with a d.c. fault current of more than 1 A leads to cut-off within 0.2 seconds.		P
6.6	**Detection of islanding operation**	(See appended table)	P
	The testing of the disconnection due to unintended islanding operation is carried out according to DIN VDE V 0124-100 (VDE V 0124-100):2012-07, 5.4.6.		P

DIN V VDE V 0126-1-1:2013.08			
Clause	Requirement - Test	Result - Remark	Verdict
7	**Routine Test**		**P**
	The manufacturer has to carry out routine tests regarding all safety relevant functions before delivering an automatic disconnection device.	Manufacture declaration for this	P
8	**Construction Specification**		**P**
	Initial tests and re-examination in addition to the routine tests may be omitted. If the disconnection device is a separate unit it must not be used in a TN-C power system. In this case a TN-C-S power system must be created.		P

Appended Table - Testing Result

6.1 (5.4.5.2)	TABLE: General requirements	P

Design of functional safety:

Two series relays used in the line and neutral conductor , and it having 2 separate relay control circuits, each controlling one line relay and one neutral relay, in any single fault scenario involving one control circuit or one relay, the other control circuit can detect the fault and alarm.

Two series relays would be automatically checked before the inverter starts operation

String	1	U_{DC} = Un	850Vdc	Uac = Un	230Vac	P = (W)	20K

Component No.	Fault	Observation
CB18	S/C	Display " ID20" and can not start up
One output relay	S/C	Display " ID55" and can not connect to the grid
CEA4 (for DC Current transducer)	S/C	The unit operated normally at beginning. LCD displayed error input current, after about 3 min. And the unit shut down and disconnected from the grid. Error message:"permanent".
CC1	S/C	The unit shut down and disconnected from the grid immediately. Error message:"ID11". No damaged and no hazards.
QA1 Pin D-S	S/C	The unit operated normally. No damaged and no hazards.
CA37	S/C	The unit operated normally. No damaged and no hazards.
DA18 pin 1-2	S/C	The unit shut down and disconnected from the grid immediately. Error message:"permanent". No damaged and no hazards.
DA19 Pin 1-2	S/C	Output breaker opened. The unit shut down and disconnected from the grid immediately. Component DA19, QA19, QA20, DA20 damaged. LCD no display. No hazards.
QA29 Pin C-G	S/C	Output breaker opened. The unit shut down and disconnected from the grid immediately. Component QA29, QA28 damaged. LCD no display and no hazards.
QA19 Pin C-E	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
CA129	S/C	The unit shut down and disconnected from the grid immediately. Components QD1, QD2, QD3, DA19, DA20, QA19, QA20, DA24, DA25, QA28, QA29 damaged. LCD no display. No hazards.
CD1	S/C	The unit shut down and disconnected from the grid immediately. Output breaker opened. Components QD2, QD3, QD1 damaged. Error message:"ID66, ID27, ID26, ID02, ID70". No hazards
CB25	S/C	The unit operated normally. No damage and no hazard.
CB44 (for AC current transducer)	S/C	The unit shut down and disconnected from the grid immediately. No damaged and no hazards.

Appended Table - Testing Result

DA13	S/C	The unit shut down and disconnected from the grid immediately. DC fan stop. LCD no display. No damaged and no hazards.
DA8	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
DA6	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards
QA5 D-G	S/C	The unit shut down and disconnected from the grid immediately. Components QA5, RA146, RA145, RA152, RA153, RA154,QA12, DA6 damaged. LCD no display. No hazards
QA5 D-S	S/C	The unit shut down and disconnected from the grid immediately. Components QA5, RA146, RA145, RA152, RA153, RA154, UA12, CA85, DA6, RA124, QD1, QD2, QD3 damaged. LCD no display. No hazards.
UA14 Pin1-2	S/C	DC fan speeded up. After about 3 min, the unit shut down and disconnected from the grid immediately. Components DA15, RA47, QA6, CA110, CA114, UA12, QA9 damaged. LCD no display. No hazards.
UA14 pin 3-4	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin4-8	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin Pin 9-11	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin14-16	S/C	The unit shut down and disconnected from the grid immediately. No damaged and no hazards.
Supplementary information: SC: Short-circuited; OC: Open-circuited; O/L: Overloaded. During the test: Fire do not propagates beyond the EUT; Equipment do not emitt molten metal; Enclosures do not deform to cause non-compliance with the standard. Pass the dielectric test.		

6.2 (5.5.1 & 5.5.2)	**Connection conditions**	
DC input:	AC output:	Rated Output Power
750Vdc	230Vac; 50Hz	20kW

Measure Item	Reconnection?	Reconnection Time (>60s)
f_{ist} = 47,45Hz	☐ Yes ☒ No	Can not reconnection
f_{ist} ≥ 47,55Hz	☒ Yes ☐ No	74.4s
f_{ist} = 50,1Hz	☐ Yes ☒ No	Can not reconnection

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Appended Table - Testing Result

f_{ist} ≤ 50,0Hz	☒ Yes	☐ No	74.0s
U_{ist} < 85% U_n	☐ Yes	☒ No	Can not reconnection
U_{ist} ≥ 85% U_n	☒ Yes	☐ No	73.9s
U_{ist} > 110% U_n	☐ Yes	☒ No	Can not reconnection
U_{ist} ≤ 110% U_n	☒ Yes	☐ No	74.4s

6.2 (5.5.1 & 5.5.2)	**Short-time Interruption**								
	1			2			3		
	U_n (V)	Repeated Time (s)	Gradient (W/min)	U_n (V)	Repeated Time (s)	Gradient (W/min)	U_n (V)	Repeated Time (s)	Gradient (W/min)
After 2s of 77% Un	230	76.5	1825	230	76.0	1810	230	76.0	1804
After 4s of 77% Un	230	79.0	1892	230	76.0	1828	230	78.0	1836

6.3 (5.4.5.3)	**Monitoring the voltage (Results of Voltage monitoring)**					
Rated Voltage (Un)	230V		Rated Frequency		50 Hz	
	1		2		3	
Phase R	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	108.0	271.8	114.0	272.2	116.0
77% Un	176.8	123.8	177.1	115.0	176.8	134.0
Phase S	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	125.0	271.8	110.0	116.0	116.0
77% Un	176.8	129.0	177.1	121.0	176.8	130.0
Phase T	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	117.0	271.8	110.0	116.0	121.0
77% Un	176.8	107.5	177.1	121.0	176.8	123.0
Phase R,S,T	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	99.0	271.8	117.0	116.0	122.0
77% Un	176.8	116	177.1	108.0	176.8	131.0

6.3 (5.4.5.3)	**Monitoring the voltage (Results of the Protection of the Increase in Voltage as 10-min moving average)**		
	Output Voltage (V)	Switch	
		On/Off state Finally	Time until Switch off (s)
100% Un	231.11	☒On ☐Off	Work normally
112% Un	258.06	☐On ☒Off	475s
100% Un	230.0	☒On ☐Off	Work normally
108% Un	248.8	☒On ☐Off	Work normally
106% Un	243.9	☒On ☐Off	Work normally
114% Un	262.8	☐On ☒Off	263s

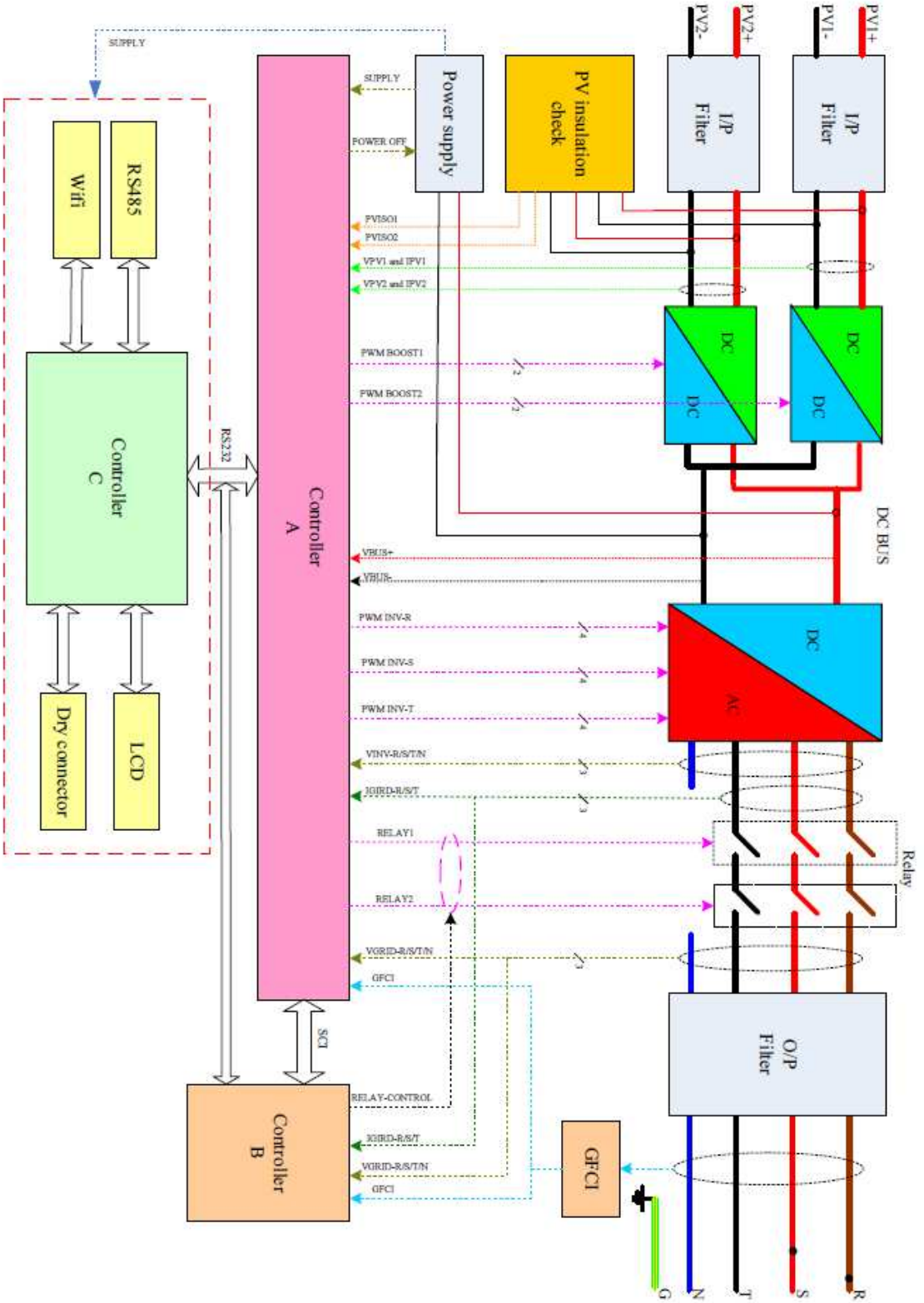
6.4 (5.4.5.4)	**Monitoring the frequency**					
	1		2		3	
	f (Hz)	Trip time (ms)	f (Hz)	Trip time (ms)	f (Hz)	Trip time (ms)
Frequency decrease	47.45	105.0	47.45	85.0	47.45	100.0
Frequency increase	51.55	112.0	51.55	106.0	51.55	114.0

Appended Table - Testing Result

6.5	TABLE: Monitoring the dc current			P
P = 0.25 P_N= (W)				5000W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)		156ms	166ms	168ms
P = 0.5 P_N= (W)				10000W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)		130ms	164ms	160ms1
P = 1.0 P_N= (W)				20000W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)		154ms	160ms	155ms
Supplementary information:				

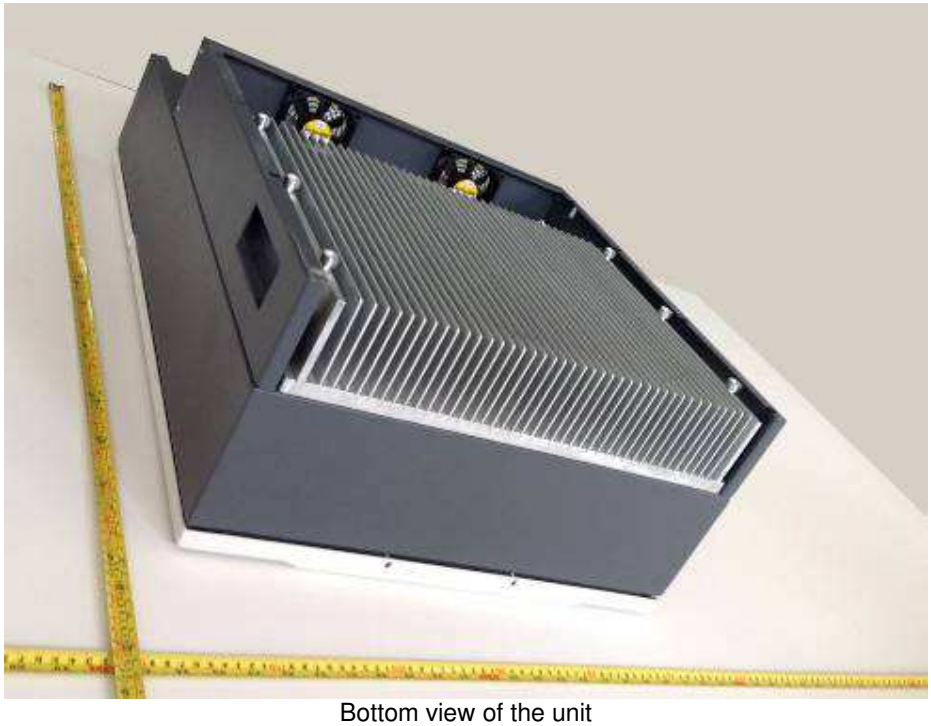
6.6 (5.4.6)	TABLE: Islanding detection				P
Q =	2.1		Klurfactor =	1.1	
L =	36.09 mH		C =	2529.8 uF	
P = 1.0 P_N = (W)	20000W	P = 0.5 P_N = (W)	10000W	P = 0.25 P_N = (W)	5000W
L =41.04KVar	Cut-off time (ms)	L =20.52KVar	Cut-off time	L =10.26KVar	Cut-off time
95%	289	95%	1080	95%	224
96%	375	96%	1150	96%	240
97%	413	97%	1170	97%	198
98%	318	98%	1120	98%	218
99%	412	99%	1150	99%	262
100%	412	100%	386	100%	836
101%	380	101%	362	101%	828
102%	370	102%	338	102%	775
103%	368	103%	1130	103%	804
104%	412	104%	980	104%	780
105%	374	105%	90	105%	764
Supplementary information:					

Appendix 1: Illustration of functional safety



Appendix 2: Photos

Overall view of the unit



Bottom view of the unit

PV connector (Sofar 20000TL-Sx and Sofar 17000TL-Sx has 3×2 pairs)
(Sofar 15000TL-Sx and Sofar 10000TL-Sx has 2×2 pairs)

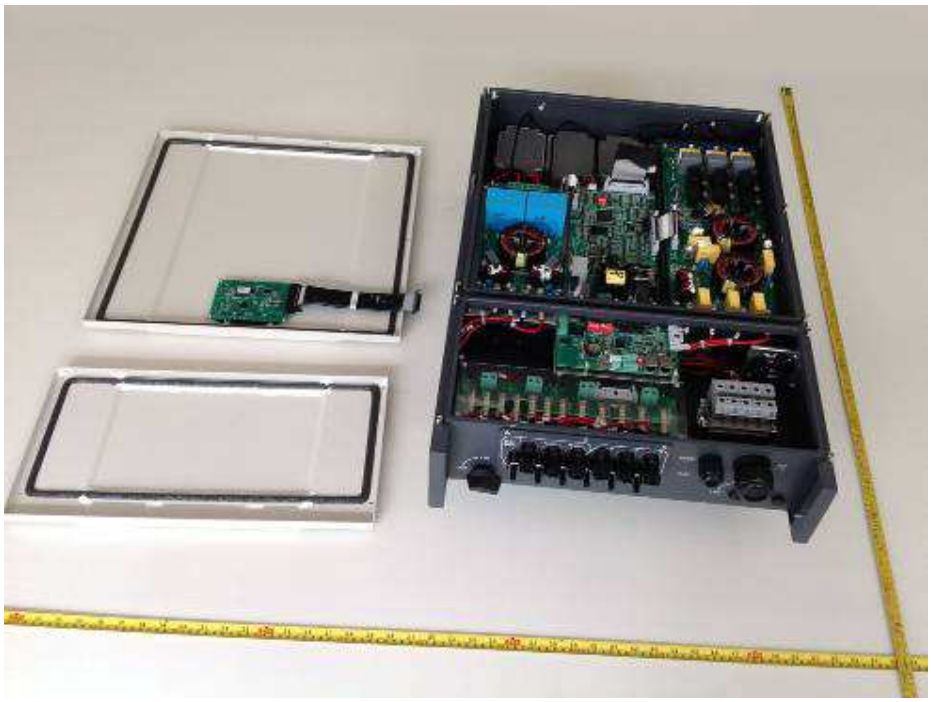
Terminals view of the unit (for models “-S2” to “-S6”)

Terminals view of the unit (without AC switch)

Terminals view of the unit for model Sofar 10000TL-Sx

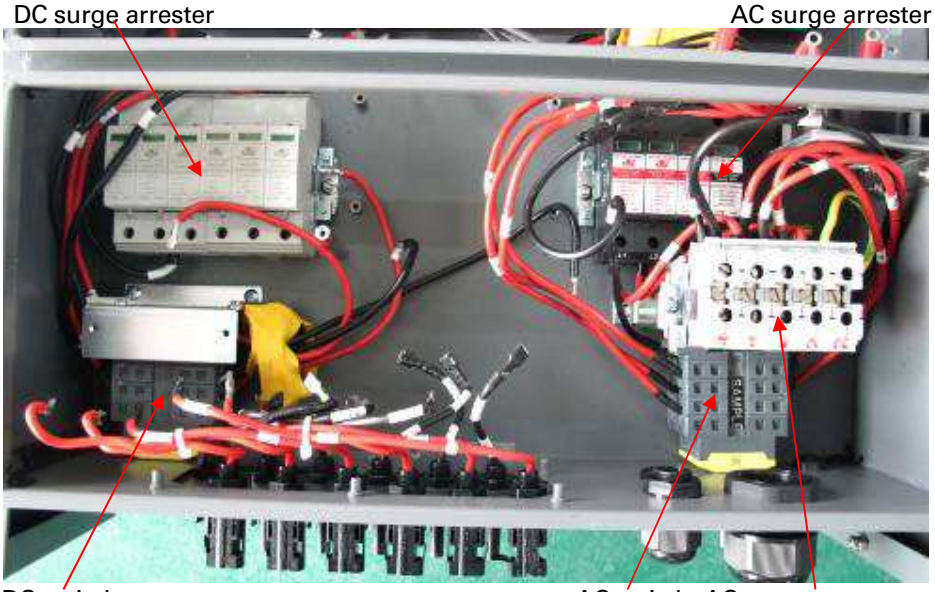
DC Cable Gland

Terminals view of the unit (for models “-S0” to “-S1”)

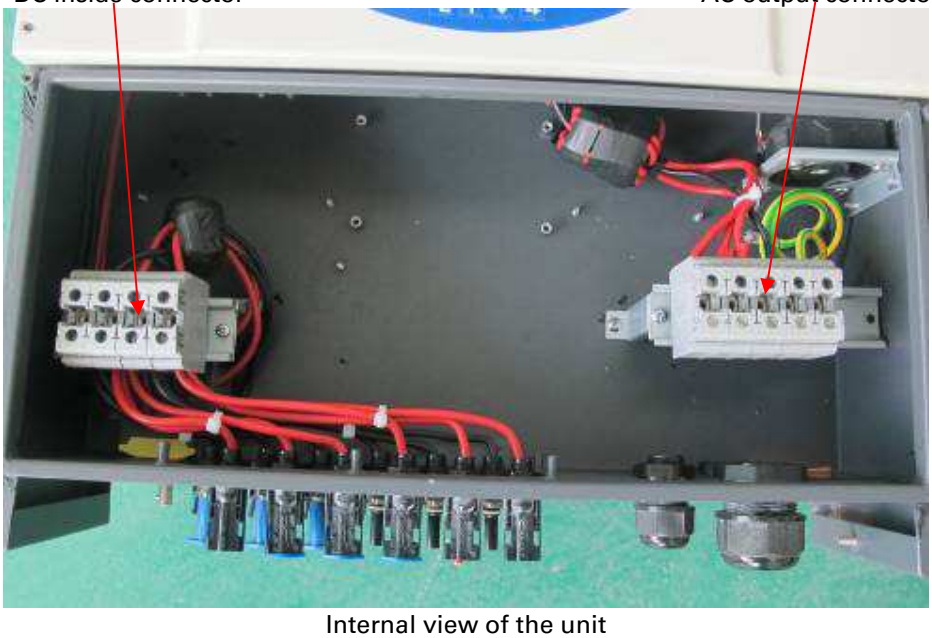


Internal view of the unit

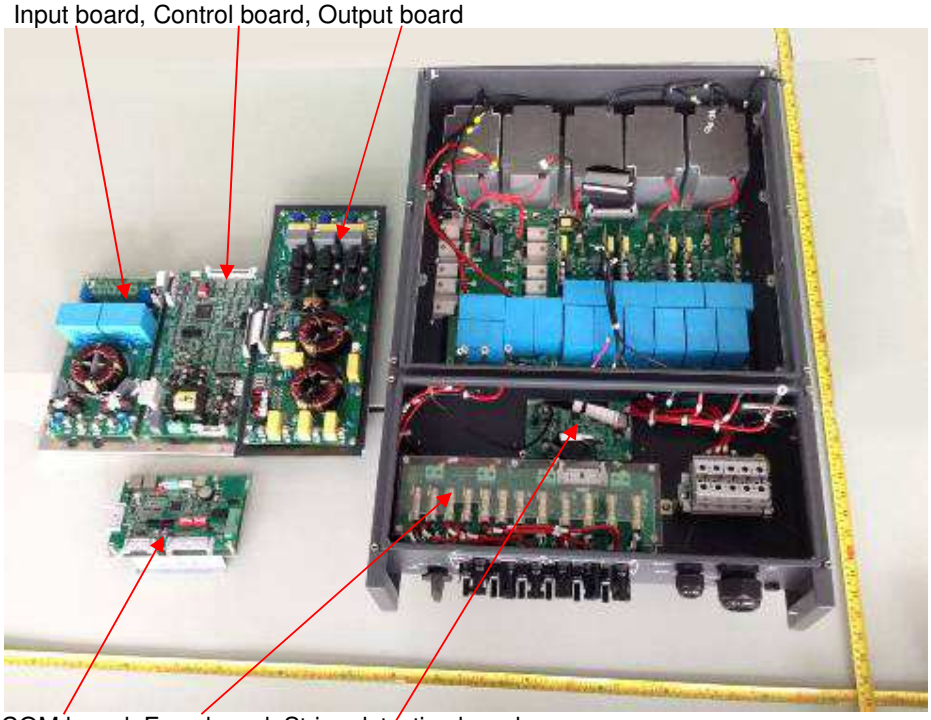
Internal view of the unit



Internal view of the unit

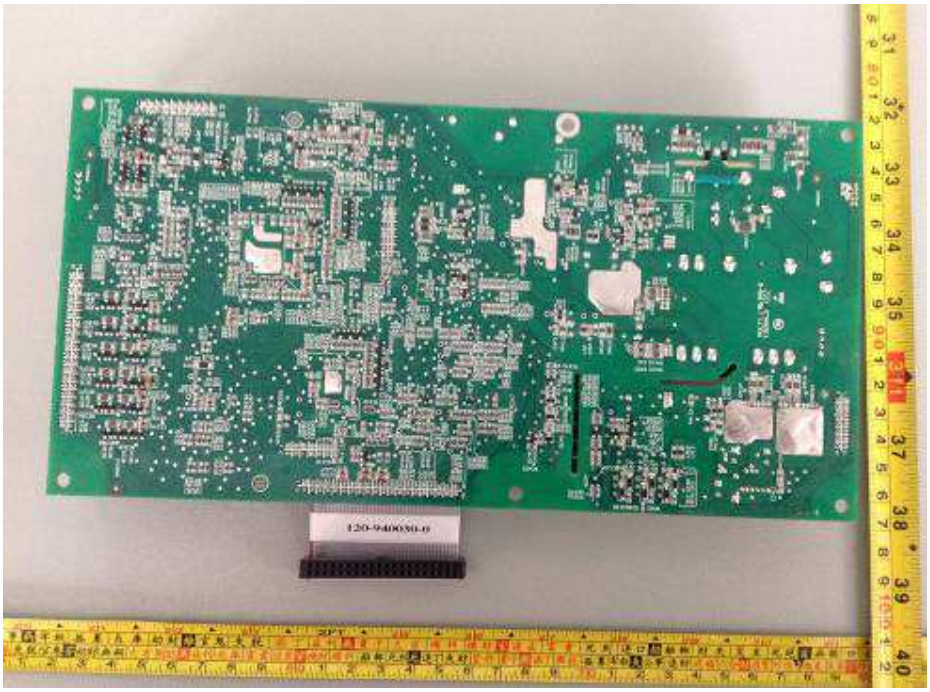


Internal view of the unit



Internal view of the unit

Front view of the control board



Bottom view of the control board

(End of report)