TEST REPORT
DIN V VDE V 0126-1-1:2006
Automatic disconnecting device

Report Reference No.....:	GZ10080033-1
Date of issue.....:	August 18, 2010
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Testing Laboratory.....:	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
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Applicant's name.....:	Zhejiang Tress Electronics Technology Co., Ltd.
Address.....:	Paiyantou Industrial Zone, Qiligang town, Yueqing, Wenzhou, Zhejiang, 325604 P.R.China
Test specification:	
Standard .....:	DIN V VDE V 0126-1-1: 2006
Test procedure.....:	Compliance testing
Non-standard test method……..:	N/A
Test Report Form No.....:	VDE0126-1-1A
Test Report Form(s) Originator .....:	Intertek
Master TRF.....:	Dated 2007-10

Test item description ..... :	Grid-connected PV inverter
Trade Mark .....:	TRESS
Manufacturer.....:	Same as applicant
Model/Type reference.....:	TLS-ZB 3KW, TLS-ZB 4KW
Ratings.....:	Input: 100-500Vdc, Nominal 360Vdc, MPPT 100-500Vdc; Protection against electric shock: Class I TLS-ZB 3KW: Output: 230V, 50Hz, Max 3000W TLS-ZB 4KW: Output: 230V, 50Hz, Max 4000W

Summary of testing:	
Tests performed (name of test and test clause): 6.2 monitoring the voltage 6.3 monitoring the frequency 6.4 Monitoring the current 6.5.2 Detection of islanding operation – Test with resonance circuit 6.6.2.2.2 Monitoring of fault current – Test due to constantly rising fault current 6.6.2.2.3 Monitoring o fault current – Test due to fault current that occurs suddenly 6.6.2.2.4 Monitoring of fault current – Test of the detection of an insulation fault	**Testing location:** Intertek Testing Services Shenzhen Ltd. Guangzhou Branch

Test item particulars.....:	
Overvoltage category.....:	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
IP protection class .....:	IP65 (self declaration)
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..... :	August 2, 2010
Date (s) of performance of tests..... :	August 2, 2010 ~ August 18, 2010

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 comma (point) is used as the decimal separator.

The product complied with the type testing requirements of DIN V VDE 0126-1-1: 2006

General product information:

The testing item is a grid-connected type PV inverter. The connection to the DC input is through screw terminals.

Model TLS-ZB 3KW is identical as TLS-ZB 4KW except for different model no and different rating. The hardware and software is all the same.

Factory information:

Zhejiang Tress Electronics Technology Co., Ltd.
Paiyantou Industrial Zone, Qiligang town, Yueqing, Wenzhou, Zhejiang, 325604 P.R.China

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict
4	**REQUIREMENTS** These requirements apply to integrated or separate (independent) disconnecting devices unless otherwise noted.		P
	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)	There are two relays connected in series in both poles of ac circuits.	P
	Before the connection is established it should be measured over a period of 30 seconds if the voltage and the frequency of the grid are in the tolerance range according to 4.2.1, 4.2.2, and 4.3. If this is the case, the connection can be established and power export can begin whereby from the beginning of the connection being established the criteria of 4.2 to 4.5 and 4.7 are fulfilled. After a cut-off due to one of the safety functions of the disconnection device the reconnection must be performed the same way. After a cut-off due to a short-time supply break, reconnection is allowed if the voltage and frequency have been in the range of tolerance for 5 seconds according to 4.2 and 4.3. A short-time supply break is defined by overshooting or undershooting the critical values (of voltage and/or frequency) for a maximum of three seconds. Unintentional Islanding must also be detected when there is no power export or import to or from the grid that is separated.	The measurement to the voltage and frequency of the grid is 90 sec before connection.	P
4.1	**Functional safety** The safety must be assured under all operating conditions complying with the defined functions (4.2 to 4.5 and 4.7) of the disconnection device. The disconnection device can be independent or an integrated part of the power generating unit and must switch off in case of a fault and indicate the fault status.	The disconnection device is an integral part of the PV inverter.	P
4.1.1	Single fault safety According to the basic safety principles the disconnection device has to be configured, constructed, selected, put together and combined in a way that it can withstand the expected operating demands (e.g. reliability regarding its capability and frequency of switching) and outside influences such as mechanical vibrations, external fields, interruptions or faults.	The disconnection device of the PV inverter complies with the operating demands and outside influences.	P

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict
	A single fault in the disconnection device must not lead to loss of the safety functions. Faults produced by the same cause have to be taken into consideration, if the probability of an occurrence of such a fault is significant. Whenever reasonably possible the single fault has to be displayed and must lead to a cut-off of the power generating system from the grid.	Single fault considered. See above comments.	P
4.1.2	**Disconnection device** The switches connected in series independently have to have a breaking capacity according to the rated current of the generating system. At least one of the switches must be of relay or contactor type and must be suitable for over voltage category 2. Switches of single phase systems must have a contact both in the neutral and the phase with this category. For all phase conductors of systems feeding in polyphase a contact with this overvoltage category is required. The second switch of the two required may consist of electronic switching elements e.g. of the inverter-bridge connection in case of an inverter being used or other circuits, provided the electronic switching element can be switched off by control signals and provided that a failure will be detected latest at the moment before next reconnection and reconnection is prevented in this case.	Both the relays have mechanical contacts, with the separation of the contacts of > 1.5 mm each. The switches are located both line and neutral poles.	P
4.2	**Monitoring of the voltage**		
4.2.1	**Undervoltage** (protective function) A voltage between outer conductors connected to the grid of ≤ 80% VN must lead to switch off within 0.2 seconds. This voltage limit must not be possible to be changed in the equipment.	The disconnection device switched off time test for undervoltage is less than 0.2 sec.	P
4.2.2	**Overvoltage** (protective function) A voltage between outer conductors connected to the grid of ≥ 115% VN must lead to switch off within 0.2 seconds. This voltage limit must not be possible to be changed in the equipment.	The disconnection device switched off time tested for overvoltage is less than 0.2 sec.	P
4.2.3	**Overvoltage** (Monitoring of the voltage quality) The objective is for the voltage to remain within the critical limits at the connection point. For every outer conductor of the connection point, a moving average over 10 minutes shall be measured. The point of triggering can vary between 110% VN and 115% VN to take the voltage drop between the installation point and the connection point into account. The equipment as delivered shall have a triggering point of 110% VN. Exceeding the set value must lead to switch off. The adjustment of this value is only to be performed in agreement with the network operator.	The disconnection device of the PV inverter has the function to monitor the overvoltage and cut off for a moving average time over 10 min.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.3	**Monitoring the frequency** Frequencies undershooting 47.5 Hz or exceeding 50.2 Hz must lead to a switch off within 0.2 seconds.	The switched off time tested for under/over frequency is less than 0.2 s.	P
4.4	**Monitoring the d.c. current** 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.	The measured disconnection time is less than 0.2 s.	P
4.5	**Detection of islanding**		
4.5.1	**Single equipment operation** Islanding operation must lead to switch off according to test conditions of the type test in 6.5.	MCPU of the inverter system is trying to change (increase) the mains frequency by adding a current disturbance to the output current. The mains frequency will be shifted outside the limit once the mains is not appeared and such deviation will be detected by CPU and the disconnection devices be switched off.	P
4.5.2	**Multiple equipment operation** The identification of separate mains (grids) operation can be realised individually for each system so that each system fulfils the requirements of 4.5.1. Alternatively the automatic disconnection device can receive orders requiring a cut-off from an equivalent protector with islanding detection function via an interface. A cut-off order must be carried out within 0.2 seconds. The protector giving the cut-off orders as well as the interface have to fulfil the requirements of 4.1.1 regarding functional safety.	The tested item is single equipment operation.	N/A
4.7	**Special requirements**		
4.7.1	**Photovoltaic** Inverters without a basic insulation (e.g. basic insulated transformer) between the grid and the photovoltaic-Generator must have a fault current monitoring unit (RCMU) installed. The d.c. and a.c. component of the fault current depend on the construction of the inverter and on the d.c. voltage of the PV-generator.		P
	A switching point without an integrated RCMU must have an external fault current protector. In this case the tests mentioned in 6.6 are not necessary. The required type of protector has to be specified in the manual by the manufacturer.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	The insulating resistance on the generator side before connecting to the grid must be ≥ 1kΩ/V relating to the maximal a.c. input voltage of the inverter, but must be at least 500 kΩ. Leakage currents more than 300 mA must lead to switch off within 0.3 seconds. Regardless of the rated output of the inverter sudden fault currents must lead to switch off according to table 1.		P
6	**TYPE TESTING**		
	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.		
6.1	**Functional safety** The testing of single fault safety and fault detection with subsequent cut-off according to 4.1 must be carried out by single fault simulation.	Single fault simulation considered. Test result see appended Table 6.1	P
6.2	**Monitoring the voltage** To test the process of monitoring the voltage the automatic disconnection device must be operated via an a.c. voltage source with variable amplitude at rated a.c. voltage and at any power. The actuating time stipulated in 4.2 must be complied with if voltage jumps do not undershoot the lower voltage limit by more than 3% of the rated voltage or exceed the upper limit by more then 3% of the rated voltage according to 4.2. Every outer input conductor must be tested.	Test result see appended Table 6.2	P
6.3	**Monitoring the frequency** To test the process of monitoring the frequency the automatic disconnection device must be operated via an alternating voltage source with variable amplitude and frequency at any rating. The actuating time stipulated in 4.3 of monitoring the frequency must be observed when changing the frequency constantly from the rated value to the respective critical value with a speed of 1 Hz/s. The function of monitoring the frequency must be carried out at the upper and lower limit within the defined voltage range according to 4.2.	Test result see appended Table 6.3	P

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Clause	Requirement - Test	Result - Remark	Verdict
6.4	**Monitoring the dc current** To test the process of cut-off due to feed in of direct current one of the followings may be chosen: 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.	Method a) was used. Test result see appended Table 6.4	P
6.5	**Detection of islanding operation** To test the process of cut-off due to unintentional islanding a test must be carried out according to one of the procedures described in 6.5.1 to 6.5.3. The applied procedure must comply with the requirements regarding functional safety described in 4.1.	Method of resonance circuit is used for testing.	P
6.5.1	**Measurement of the impedance**		N/A
6.5.1.1	Test circuit according to Figure 2.		N/A
6.5.1.2	Test procedure according to the standard.		N/A
6.5.2	Test with resonance circuit according to Figure 3.		P
6.5.2.2	Test procedure according to the standard.		P
6.5.3	**Monitoring of three phase voltage** Only single phase inverters may use three-phase monitoring of the outer voltages as criteria for islanding condition. As soon as one of the outer conductor voltages exceeds the critical value described in 4.2 by 80% UN or 115% UN a cut-off within 0.2 seconds must be carried out. Here the requirements of 4.1 regarding functional safety must also be fulfilled.	Complied by subclause 6.5.2	N/A
6.6	**Monitoring of fault current** All tests have to be carried out at 0.85 U_N, U_N, 1.10 U_N.	See appended table 6.6	P
6.6.1	**Separate disconnection device** Fault current detection that is not integrated in the inverter is tested according to DIN EN 0664-100 (VDE 0664-100): 2002-05.	Integral type disconnection device.	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	For this purpose 9.9.1 “testing circuit” to 9.9.3 “testing of function under load at reference temperature” must be applied. One has to be aware that the switch device can switch on with delay when testing according to 9.9.2.2 “Test of function when closing on a fault current”.		N/A
	The time between the automatic switch on and the cut-off due to fault current is considered to be the turn-off time.		N/A
	The function of pulsating d.c. fault currents is tested according to 9.21.1. The function of smooth d.c. fault currents is tested according to 9.21.2.1 “testing the function with a constant rise of the d.c. fault current” to 9.21.2.7 “testing the function with superimposed pulsating d.c. fault currents and smooth d.c. fault currents”.		N/A
6.6.2	**Integrated disconnection device** The fault current monitoring device of a disconnection device that is integrated in an inverter is tested at rated power and maximal input d.c. voltage according to the following sections.	See appended table 6.6	P
6.6.2.1	**Test circuit** An adjustable resistor with a switch is connected between one of the d.c. voltage conductors and the neutral conductor (N). An inverter with d.c. voltage connection PV+ and PV- has two configurations (see fig 4): N with PV+ (R1 fig. 4), N with PV- (R2 fig 4). In the test according to 6.6.2.2.3 an adjustable capacitor is in parallel with the resistor and switch combination. (C1, C2 see fig 4).		P
6.6.2.2	**Test Procedure** Tests are carried out for all connections between d.c. voltage connections and the neutral conductor as defined in to 6.6.2.1.		P
6.6.2.2.1	**Test circuit** The disconnection device is mounted as in normal use. The test circuit must have a negligible inductance and correspond to fig 4. The measuring devices for detecting the fault current must be at least class 0.5 and must display RMS values up to a frequency of 2 kHz. The time measuring devices must have a relative accuracy of 10% at the measured value or better.		P

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Clause	Requirement - Test	Result - Remark	Verdict
6.6.2.2.2	**Test of the function due to constantly rising fault current** Switch S1 is closed and S2 open. The residual current is constantly raised to reach the value of 300 mA within 30 seconds. The trip current is measured 5 times, all five values must be below 300 mA. The test is repeated with switch S2 closed and S1 open. When using more than 2 generator connections the circuit has to be extended and the test must be carried out for all switching positions.	Test result see appended Table 6.6.2.2	P
6.6.2.2.3	**Test the function due to fault current that occurs suddenly** This tests the function of RCMU with capacitive leakage current occurring under normal operating conditions, the capacitive current is overlaid by a sudden resistive fault current. To measure the maximal capacitive leakage current the capacitor C1 is increased with switches S1 and S2 open until the disconnection device turns off. C2 is not connected during this test. Then the capacitor is adjusted to a leakage current that is the measured trip value minus the value in table 1. The resistance R1 is adjusted to every value of resistive fault current in table 1. Switch S1 is switched on. The disconnection device must operate. 5 measurements of the turn-off time for each fault current level must be carried out. No value must exceed the turnoff time limit according to table 1. The test is repeated with switch S2 and capacitor C2. In this case C1 is not connected. When using more than 2 generator connections (e.g. Multiple PV panels) the circuit has to be extended and the test must be carried out for all the connections.	Test result see appended Table 6.6.2.3	P
6.6.2.2.4	**Test of the detection of an insulation fault** At least one PV-line connection of the inverter is connected to a voltage source with the maximal permissible generator voltage. The inverter is connected to the grid. Now each PV generator connection shall be connected via a resistance to the earth potential. The resistance shall be smaller than the value defined in 4.7.1. In every case the inverter must display the fault and must not start exporting power.	Test result see appended Table 6.6.2.2.4	P
8	**GUIDELINES FOR THE INSTALLATION**		

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Clause	Requirement - Test	Result - Remark	Verdict
	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.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict

Appended Table - Testing Result

6.1	**TABLE: Single fault test**	**P**
Component	Fault	Observation
C105	Short circuit	Inverter switch off Alarm and “Over voltage” registered in display panel
DCT102	Short circuit	Inverter switch off Alarm and “Over voltage” registered in display panel
DCT101	Short circuit	Inverter switch off Alarm and “Over current” registered in display panel
DCT103	Short circuit	Inverter switch off Alarm and “Over load” registered in display panel
U702	Short circuit	Inverter switch off Alarm and “Over heat” registered in display panel
D503	Short circuit	Inverter switch off
D507	Short circuit	Inverter switch off
Z605	Short circuit	Inverter switch off Alarm and “Line failure” registered in display panel
C105	Short circuit	Inverter switch off Alarm and “Fuse open” registered in display panel
D201	Short circuit	Inverter switch off Alarm and “Line failure” registered in display panel
D207	Short circuit	Inverter switch off Alarm and “Line failure” registered in display panel
Q15	Short circuit	Inverter switch off

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Clause	Requirement - Test	Result - Remark	Verdict

6.2.1	TABLE: Undervoltage test					P
P = 1.0 P_N = (W)				4000		W
Undervoltage, U =0.785 (Un)	195.5	Vac	Cut-off time = (ms)	16.0	ms	
Undervoltage, U = 0.5 (Un)	115	Vac	Cut-off time = (ms)	17.0	ms	
Undervoltage, U = 0 (Un)	0	Vac	Cut-off time = (ms)	--		
P = 0.5 P_N = (W)				2000		W
Undervoltage, U =0.785 (Un)	195.5	Vac	Cut-off time = (ms)	13.0	ms	
Undervoltage, U = 0.5 (Un)	115	Vac	Cut-off time = (ms)	19.0	ms	
Undervoltage, U = 0 (Un)	0	Vac	Cut-off time = (ms)	--		
P = 0.25 P_N = (W)				1000		W
Undervoltage, U =0.785 (Un)	195.5	Vac	Cut-off time = (ms)	14.0	ms	
Undervoltage, U = 0.5 (Un)	115	Vac	Cut-off time = (ms)	16.0	ms	
Undervoltage, U = 0 (Un)	0	Vac	Cut-off time = (ms)	--		
Supplementary information:						

6.2.2	TABLE: Overvoltage test					P
P = 1.0 P_N = (W)				4000		W
Overvoltage, U =1.165 (Un)	265	Vac	Cut-off time = (ms)	28.0	ms	
Overvoltage, U =1.3 (Un)	299	Vac	Cut-off time = (ms)	37.0	ms	
P = 0.5 P_N = (W)				2000		W
Overvoltage, U =1.165 (Un)	265	Vac	Cut-off time = (ms)	42.0	ms	
Overvoltage, U =1.3 (Un)	299	Vac	Cut-off time = (ms)	41.0	ms	
P = 0.25 P_N = (W)				1000		W
Overvoltage, U =1.165 (Un)	265	Vac	Cut-off time = (ms)	36.0	ms	
Overvoltage, U =1.3 (Un)	299	Vac	Cut-off time = (ms)	43.0	ms	
Supplementary information:						

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.3	TABLE: Monitoring the frequency (Exceeding 50.2 Hz)				P
P = 1.0 P_N = (W)		4000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	198 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	189 ms
P = 0.5 P_N = (W)		2000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	190 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	185 ms
P = 0.25 P_N = (W)		1000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	191 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	50.5 Hz	Cut-off time =	184 ms
Supplementary information:					

6.3	TABLE: Monitoring the frequency (undershooting 47.5 Hz)				P
P = 1.0 P_N = (W)		4000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	82 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	85 ms
P = 0.5 P_N = (W)		2000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	91 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	87 ms
P = 0.25 P_N = (W)		1000			W
Upper voltage, U = 1.10 U_N (Vac)	253 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	85 ms
Lower voltage, U = 0.85 U_N (Vac)	195.5 Vac	Frequency (Hz)	47.4 Hz	Cut-off time =	86 ms
Supplementary information:					

6.4	TABLE: Monitoring the current	P
P = 0.25 P_N= (W)	4000	W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)	19.4	ms
P = 0.5 P_N= (W)	2000	W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)	25.2	ms
P = 1.0 P_N= (W)	1000	W
Feed-in current = 1.0 A d.c., Cut-off current = (ms)	22.1	ms
Supplementary information:		

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.5.2	TABLE: Detection of Islanding Operation - Test with resonance circuit						P
Q =		2.0		Klirrfactor = (%)		-- %	
L = (mH)	-- mH	L = (Var)	6500 Var	C = (uF)	-- uF	C = (Var)	7115 Var
Rated Frequency = (Hz)		50 Hz		Rated Voltage = (Vac)		230 Vac	
P = 1.0 P_N = (W)				3250 W			

L Load	Q(Var)	C Load	Q(Var)	Cut-off time (ms)
100%	6500	100%	7115	912
101%	6436	100%	7115	864
102%	6373	100%	7115	880
103%	6311	100%	7115	912
104%	6250	100%	7115	864
105%	6190	100%	7115	904
99%	6566	100%	7115	810
98%	6633	100%	7115	924
97%	6701	100%	7115	876
96%	6771	100%	7115	796
95%	6842	100%	7115	772
100%	6500	101%	7186	880
100%	6500	102%	7257	856
100%	6500	103%	7328	920
100%	6500	104%	7400	888
100%	6500	105%	7471	912
100%	6500	99%	7044	892
100%	6500	98%	6973	532
100%	6500	97%	6902	500
100%	6500	96%	6830	556
100%	6500	95%	6759	492

Supplementary information:

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Clause	Requirement - Test	Result - Remark	Verdict

L = (mH)	-- mH	L = (Var)	3912 Var	C = (uF)	-- uF	C = (Var)	4462 Var
Rated Frequency = (Hz)	50 Hz			Rated Voltage = (Vac)	230 Vac		
P = 0.5 P_N = (W)	1956 W						

L Load	Q(Var)	C Load	Q(Var)	Cut-off time (ms)
100%	3912	100%	4462	800
101%	3873	100%	4462	832
102%	3835	100%	4462	800
103%	3798	100%	4462	784
104%	3762	100%	4462	768
105%	3726	100%	4462	800
99%	3952	100%	4462	594
98%	3992	100%	4462	743
97%	4033	100%	4462	542
96%	4075	100%	4462	590
95%	4118	100%	4462	598
100%	3912	101%	4507	768
100%	3912	102%	4551	752
100%	3912	103%	4596	748
100%	3912	104%	4640	764
100%	3912	105%	4685	64
100%	3912	99%	4417	698
100%	3912	98%	4373	666
100%	3912	97%	4328	662
100%	3912	96%	4284	665
100%	3912	95%	4239	684

Supplementary information:

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Clause	Requirement - Test	Result - Remark	Verdict

L = (mH)	-- mH	L = (Var)	2368 Var	C = (uF)	-- uF	C = (Var)	2794 Var
Rated Frequency = (Hz)	50 Hz			Rated Voltage = (Vac)	230 Vac		
P = 0.25 P_N = (W)	1184 W						

L Load	Q(Var)	C Load	Q(Var)	Cut-off time (ms)
100%	2368	100%	2794	912
101%	2344	100%	2794	864
102%	2322	100%	2794	880
103%	2299	100%	2794	912
104%	2277	100%	2794	864
105%	2255	100%	2794	904
99%	2392	100%	2794	810
98%	2416	100%	2794	924
97%	2441	100%	2794	876
96%	2467	100%	2794	796
95%	2493	100%	2794	772
100%	2368	101%	2822	880
100%	2368	102%	2850	856
100%	2368	103%	2878	920
100%	2368	104%	2905	888
100%	2368	105%	2934	912
100%	2368	99%	2766	892
100%	2368	98%	2738	532
100%	2368	97%	2710	500
100%	2368	96%	2682	556
100%	2368	95%	2654	492

Supplementary information:

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.6.2.2.2	**TABLE: Monitoring of Fault Current - Integrated disconnection device** **Test of the function due to constantly rising fault current**								**P**
String	--	Uac=0.85Un	195.5 Vac	P = P_N = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc		
S1 closed, S2 opened, trip current (mA)									
1		2		3		4		5	
125	mA	151	mA	150	mA	132	mA	125	mA
S2 closed, S1 opened, trip current (mA)									
1		2		3		4		5	
67	mA	80	mA	69	mA	87	mA	80	mA
String	A	Uac=Un	230 Vac	P = P_N = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc		
S1 closed, S2 opened, trip current (mA)									
1		2		3		4		5	
136	mA	117	mA	92	mA	128	mA	130	mA
S2 closed, S1 opened, trip current (mA)									
1		2		3		4		5	
51	mA	84	mA	63	mA	63	mA	49	mA
String	A	Uac=1.1Un	253 Vac	P = P_N = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc		
S1 closed, S2 opened, trip current (mA)									
1		2		3		4		5	
144	mA	139	mA	148	mA	142	mA	142	mA
S2 closed, S1 opened, trip current (mA)									
1		2		3		4		5	
92	mA	63	mA	48	mA	85	mA	84	mA
Supplementary information:									

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.6.2.2.3	**TABLE: Monitoring of Fault Current - Integrated disconnection device** **Test of the function due to fault current that occurs suddenly**						**P**
String	--	Uac=0.85Un	195.5 Vac	$P = P_N$ = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc

PV + and Neutral (R1 adjusted with the following value)				
R1 current = 30 mA, cut-off time (ms)				
1	2	3	4	5
21 ms	10 ms	15 ms	19 ms	25 ms
R1 current = 60 mA, Cut-off time				
1	2	3	4	5
18 ms	26 ms	6 ms	26 ms	16 ms
R1 current = 150 mA, cut-off time (ms)				
1	2	3	4	5
31 ms	14 ms	14 ms	12 ms	11 ms
PV - and Neutral (R2 adjusted with the following value)				
R2 current = 30 mA, cut-off time (ms)				
1	2	3	4	5
11 ms	14 ms	12 ms	15 ms	12 ms
R2 current = 60 mA, , cut-off time (ms)				
1	2	3	4	5
11 ms	16 ms	15 ms	13 ms	17 ms
R2 current = 150 mA, , cut-off time (ms)				
1	2	3	4	5
16 ms	11 ms	17 ms	18 ms	17 ms
Supplementary information:				

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.6.2.2.3	**TABLE: Monitoring of Fault Current - Integrated disconnection device** **Test of the function due to fault current that occurs suddenly**								**P**
String	A	Uac=Un	230 Vac	P = P_N = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc		
PV + and Neutral (R1 adjusted with the following value)									
R1 current = 30 mA, cut-off time (ms)									
1		2		3		4		5	
23	ms	19	ms	19	ms	20	ms	20	ms
R1 current = 60 mA, Cut-off time									
1		2		3		4		5	
22	ms	21	ms	13	ms	16	ms	16	ms
R1 current = 150 mA, cut-off time (ms)									
1		2		3		4		5	
25	ms	25	ms	8	ms	15	ms	22	ms
PV - and Neutral (R2 adjusted with the following value)									
R2 current = 30 mA, cut-off time (ms)									
1		2		3		4		5	
22	ms	8	ms	13	ms	26	ms	22	ms
R2 current = 60 mA, , cut-off time (ms)									
1		2		3		4		5	
11	ms	14	ms	17	ms	24	ms	12	ms
R2 current = 150 mA, , cut-off time (ms)									
1		2		3		4		5	
13	ms	7	ms	22	ms	18	ms	9	ms
Supplementary information:									

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

6.6.2.2.3	**TABLE: Monitoring of Fault Current - Integrated disconnection device** **Test of the function due to fault current that occurs suddenly**						**P**
String	A	Uac=1.1Un	253 Vac	P = P_N = (W)	4000 W	U_{DC} = (Vdc max)	450 Vdc

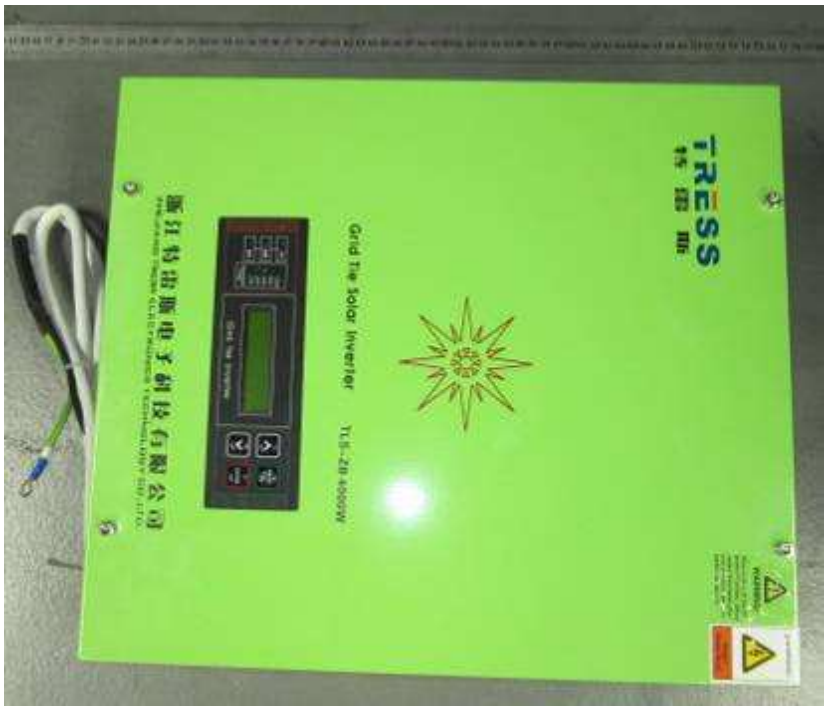
PV + and Neutral (R1 adjusted with the following value)					
R1 current = 30 mA, cut-off time (ms)					
1	2	3	4	5	
18 ms	32 ms	28 ms	20 ms	36 ms	
R1 current = 60 mA, Cut-off time					
1	2	3	4	5	
30 ms	24 ms	24 ms	27 ms	22 ms	
R1 current = 150 mA, cut-off time (ms)					
1	2	3	4	5	
18 ms	20 ms	24 ms	17 ms	16 ms	
PV - and Neutral (R2 adjusted with the following value)					
R2 current = 30 mA, cut-off time (ms)					
1	2	3	4	5	
21 ms	15 ms	14 ms	22 ms	13 ms	
R2 current = 60 mA, , cut-off time (ms)					
1	2	3	4	5	
18 ms	9 ms	13 ms	10 ms	12 ms	
R2 current = 150 mA, , cut-off time (ms)					
1	2	3	4	5	
15 ms	12 ms	13 ms	11 ms	13 ms	
Supplementary information:					

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

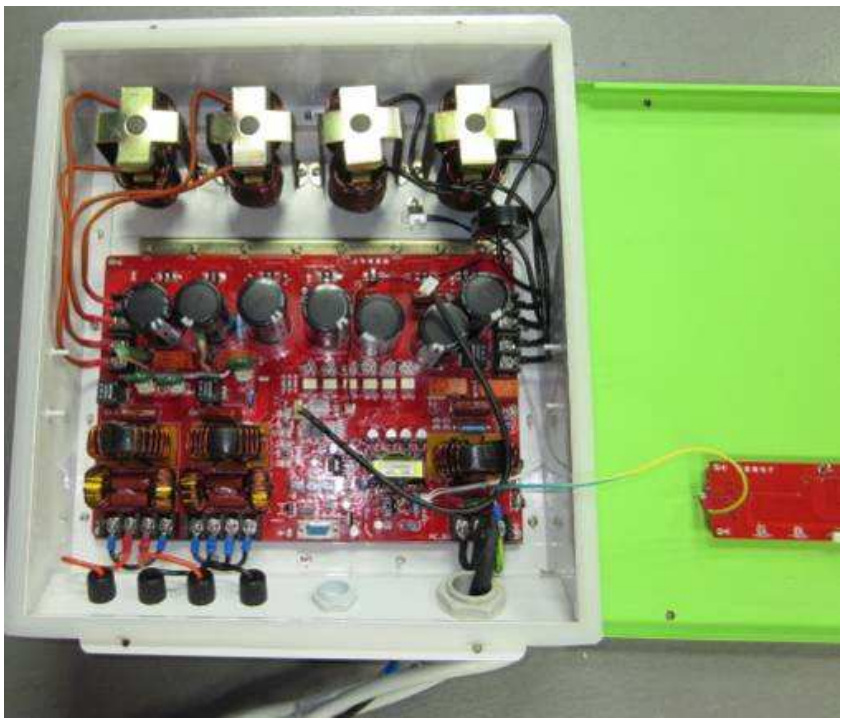
6.6.2.2.4	**TABLE: Monitoring of Fault Current - Integrated disconnection device** **Test of the detection of an insulation fault**					**P**
String	A	DC input current (A)	1.0 A	$U_{DC} = U_{DC\ MAX}$ (Vdc)	450	Vdc
DC (+) and earth						
Resistance value (kΩ)		Display the fault (Yes / No)			Start exporting power (Yes / No)	
700		Yes			No	
500		Yes			No	
300		Yes			No	
200		Yes			No	
100		Yes			No	
DC (-) and earth						
Resistance value (kΩ)		Display the fault (Yes / No)			Start exporting power (Yes / No)	
700		Yes			No	
500		Yes			No	
300		Yes			No	
200		Yes			No	
100		Yes			No	
Supplementary information:						

DIN V VDE V 0126-1-1:2006			
Clause	Requirement - Test	Result - Remark	Verdict

Product photos:



Overall view



Internal view