

TEST REPORT

DIN V VDE V 0126-1-1

DIN VDE V 0126-1-1 (VDE V 0126-1-1):2013-08

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

For the unit(s) **JIANGSU THINKPOWER NEW ENERGY CO.,LTD**

S1000TL, S1500TL, S2200TL, S3000TL, S3600TL, S4400TL, S5000TL, S6000TL

Test report no. **LS2A26080306EGDE01**

Date **2026-09-29**

ACCREDITED
Certificate # 5200.02

Lyns-tci Technology Guangdong Co., Ltd.
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Test report number.....:	**LS2A26080306EGDE01**
Date of issue.....:	2026-09-29
Total number of pages.....:	49
Testing laboratory .....:	**Lyns-tci Technology Guangdong Co., Ltd.**
Address.....:	Room 1201, Unit 2, Building 18, No. 7, Science and Technology Boulevard, Houjie Town, Dongguan City, Guangdong, 523960 P.R.C
Testing location / address.....:	Same as above
Applicant's name .....:	**JIANGSU THINKPOWER NEW ENERGY CO.,LTD**
Address.....:	1F, Building C3, Phase II, Entrepreneurship Park, No.11 Yongning Road, Yixing Economic and Technological Development Zone
Test specification	
Standard .....:	DIN VDE V 0126-1-1 (VDE V 0126-1-1):2013-08; VDE-AR-N 4105 (VDE-AR-N 4105):2018-11; DIN VDE V 0124-100 (VDE V 0124-100):2020-06; IEC 62109-1:2010; IEC 62109-2:2011.
Test report form number.....:	VDE V 0126-1-1:2013
Test report form(s) originator.....:	Lyns-tci Technology Guangdong Co., Ltd.
Master TRF.....:	Dated 2023-03-20
Test item description.....:	Solar Inverter
Trademark .....:	ThinkPower
Model / Type reference.....:	**S1000TL, S1500TL, S2200TL, S3000TL**, **S3600TL**, **S4400TL**, **S5000TL**, **S6000TL**
Technical data .....:	See section 3.1 on page 7
Dates of testing.....:	2026-08-04 to 2026-09-15

Tested by

(Biscuit Ren, Test engineer)

Approved by

(Lukes Lin, Project Manager)

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1 General information of test report

1.1 Important Note

General disclaimer

- The test results presented in this report relate only to the object tested.
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1.2 Revision history

Revision	Date	Editor	Modification / Change	Status
LS2A26080306EGDE01	2026-09-29	Biscuit Ren	Initial report was written	Active

2 General remarks for documentation

The test results presented in this report relate only to the object(**s**) tested.

Throughout this report a ☒ comma ',' / ☐ point '.' is used as decimal separator and a ☒ point '.' / ☐ comma ',' as thousands separator.

The following **suffixes/indices** are used for variables in tables and figures:

n	Nominal value
max	Maximum value
Lx	index of phase x
LxLy	phase-to-phase voltages of phase x and phase y

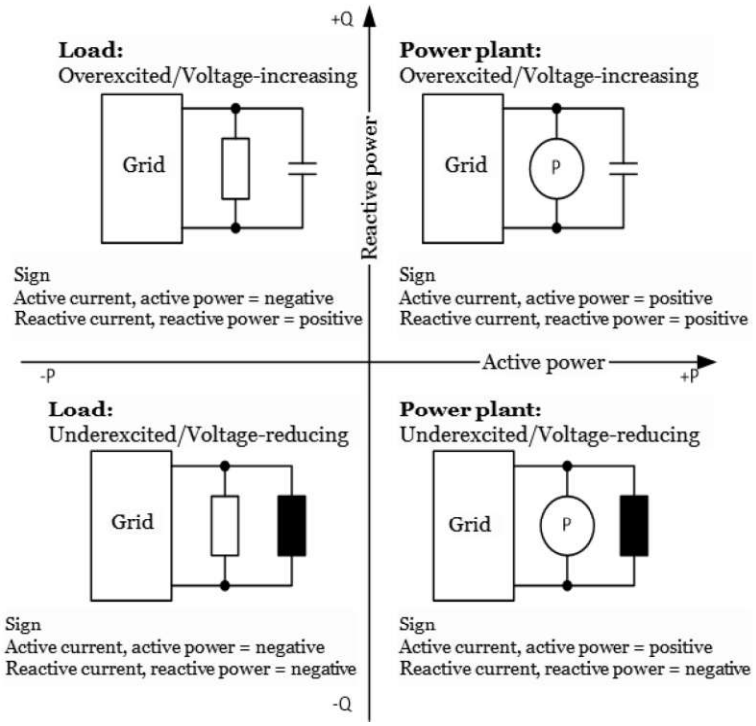
Abbreviations

AC	:	Alternating Current
DC	:	Direct Current
EUT	:	Equipment Under Test
LV	:	Low Voltage
MP	:	Measurement Point
MPP	:	Maximum Power Point
MV	:	Medium Voltage
PGF	:	Power Generating Facility
PGM	:	Power Generating Module
PGU	:	Power Generating Unit
P_{max}	:	Registered Capacity
PPM	:	Power Park Module
PWHD	:	Partial Weighted Harmonic Distortion
THD	:	Total Harmonic Distortion
PWHD	:	Partial Weighted Harmonic Distortion

Direction definition of P and Q

in this test report, the regarded system of the voltage and current vectors is the active sign convention system:

- If the inverter feeds to the grid the active power is measured with positive sign.
- If the inverter injects reactive power / current with leading power factor the reactive power / current is marked “leading” or “inductive” (under-excited) or has a negative sign.
- If the inverter injects reactive power / current with lagging power factor the reactive power / current is marked “lagging” or “capacitive” (over-excited) or has a positive sign.



3 General product information

Factory's name ..... : JIANGSU THINKPOWER NEW ENERGY CO.,LTD

Factory address ..... : 1F, Building C3, Phase II, Entrepreneurship Park, No.11 Yongning Road, Yixing Economic and Technological Development Zone

3.1 Technical data of the unit(s)

Model	S1000TL	S1500TL	S2200TL	S3000TL
DC input (PV)				
Max. DC input voltage [V]	550			
Operating MPPT voltage range [V]	70 ~ 450		100 ~ 450	
Max. input DC current [A]	18			
Max. input DC short current [A]	25			
AC connection				
No. of phases	☒ Single-phase		☐ Three-phase	
Nominal output AC voltage [V]	230V (L + N + PE, 50/60Hz)			
Max. output AC current [A]	6,0	8,0	12,0	16,0
Nominal active output power P_n [W]	1000	1500	2200	3000
Max. active output power P_{max} (*manufacturer's specification*) [W]	1100	1650	2420	3300
Max. apparent power S_{max} (*manufacturer's specification*) [VA]	1100	1650	2420	3300

Model	S3600TL	S4400TL	S5000TL	S6000TL
DC input (PV)				
Max. DC input voltage [V]	550			
Operating MPPT voltage range [V]	100 ~ 450	100 ~ 500		
Max. input DC current [A]	18	30		
Max. input DC short current [A]	25	40		
AC connection				
No. of phases	☒ Single-phase		☐ Three-phase	
Nominal output AC voltage [V]	230V (L + N + PE, 50/60Hz)			
Max. output AC current [A]	18,0	21,0	23,0	28,0
Nominal active output power P_n [W]	3600	4400	5000	6000
Max. active output power P_{max} (*manufacturer's specification*) [W]	3960	4840	5500	6600
Max. apparent power S_{max} (*manufacturer's specification*) [VA]	3960	4840	5500	6600

Software version	V101

Note:
All tests are performed at 230V,50Hz.

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]	:	S{1000~3600}TL: 5,2 kg S{4400~6000}TL: 9 kg
Type of internal transformer	:	Non-isolated (Transformerless)

Datasheet of the generating units (Relay-Interface switch):

Main materials: HF161F-W

HF161F-W SOLAR RELAY

c UL us
File No.:E134517

VDE
File No.:40031410

CQC
File No.:CQC10002050943
CQC18002203499



Features

- 31A switching capacity
- Applicable to inverter used for photovoltaic power generation systems
- Ideal for UPS
- 1.5mm contact gap (compliant to European Photovoltaic Standard VDE0126)
  1.8mm contact gap (compliant to IEC 62109-2-2011)
- The clearance distance between contact and coil is bigger than 6.4mm, the creepage distance is bigger than 8mm. (special code 477:7.5mm)
- Low coil holding voltage contributes to saving energy of equipment.
- UL insulation system: Class F

RoHS compliant

CONTACT DATA

Contact gap	1.5mm	1.8mm	2.0mm	2.3mm
Contact arrangement	1A			
Contact resistance 1)	≤ 100mΩ (1A 6VDC)			
Contact material	$AgSnO_2$			
Contact rating	Resistive: 26A 250VAC Inductive: 31A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC Inductive: 33A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC Inductive: 31A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC
Max. switching voltage	277VAC			
Max. switching current	31A	33A	31A	26A
Max. switching power	7750VA	8250VA	7750VA	7202VA
Mechanical endurance	1 x 10^6OPS	1 x 10^5OPS	1 x 10^5OPS	1 x 10^6OPS
Electrical endurance	HT type: 3 x 10^4OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3 x 10^4OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3 x 10^4OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3 x 10^4OPS (26A 250VAC Resistive Room temp. 1.5s on 1.5s off)

Notes: 1)The data shown above are initial values.

COIL

Coil power	Approx. 1.4W
Holding voltage	35% to 120% U_N (at 23°C) 45% to 80% U_N (at 85°C)

Notes: 1)The coil holding voltage is the voltage of coil after being applied rated voltage for 100ms
2)The relay coil does not allow applied more than maximum of holding voltage values for a long time (Eg: 120% Un at 23°C, 80% Un at 85°C), prevent overheating burned.

COIL DATA at 23°C

Nominal Voltage VDC	Pick-up Voltage VDC max. 1)	Drop-out Voltage VDC min. 1)	Max. Voltage VDC *2)	Coil Resistance Ω
9	6.3	0.9	10.8	58 x (1±10%)
12	8.4	1.2	14.4	103 x (1±10%)
18	12.6	1.8	21.6	230 x (1±10%)
24	16.8	2.4	28.8	410 x (1±10%)

Notes: 1) The data shown above are initial values.
2) *Maximum voltage refers to the maximum voltage which relay coil could endure in a short period of time.

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	4500VAC 1min
	Between open contacts	2500VAC 1min
Surge voltage (between coil & contacts)		10kV (1.2/50μs)
Operate time (at rated. volt.)		20ms max.
Release time (at rated. volt.)		10ms max.
Temperature rise (at rated. volt.)		95K max. (Contact load current 31A, rated voltage excitation, at 60°C)
		70K max. (Contact load current 31A, 80% of rated voltage excitation, at 85°C)
Shock resistance	Functional	196m/s²
	Destructive	980m/s²
Vibration resistance		10Hz to 55Hz 1.5mm DA
Ambient temperature		-40°C to 85°C (Apply holding voltage to coil, which is 45% to 80% that of rated voltage)
Humidity		5% to 85% RH
Termination		PCB
Unit weight		Approx. 21g
Construction		Flux proofed

Notes: The data shown above are initial values.

SAFETY APPROVAL RATINGS

UL/CUL	$AgSnO_2$	26A 277VAC at 75°C 22A 277VAC at 85°C
VDE	$AgSnO_2$	26A 277VAC at 75°C 22A 277VAC at 85°C 31A 250VAC cosø=0.8 0.1s:10s 33A 250VAC cosø=0.8 0.1s:10s (477)

Notes: 1) All values unspecified are at room temperature.
2) Only typical loads are listed above. Other load specifications can be available upon request.

HONGFA RELAY
ISO9001、ISO/TS16949、ISO14001、OHSAS18001、IECQ QC 080000 CERTIFIED 2019 Rev. 1.00

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ORDERING INFORMATION

	HF161F-W /	12	-H	T	(XXX)
Type					
Coil voltage	9, 12, 18, 24VDC				
Contact arrangement	H: 1 Form A				
Contact matcrial	T: $AgSnO_2$				
Special code[3]	XXX: Customer special requirement		Nil: Standard		

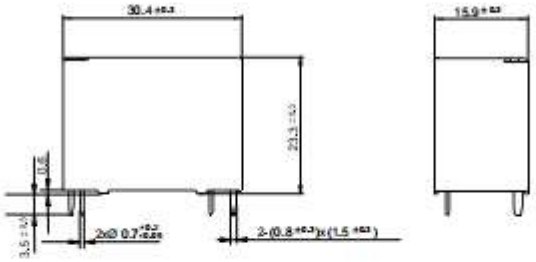
Notes: 1) Water cleaning or surface process is not suggested after the flux-proofed relays are assembled on PCB.
2) Flux-proofed relays can not be used in the environment with pollutants like H_2S, SO_2, NO_2, dust, etc.
3) The customer special requirement express as special code after evaluating by Hongfa. e.g. (414) stands for product with coil terminal of 1.4X0.4; e.g. (477) stands for Contact gap: 1.8mm,(456) stands for Contact gap: 2.0mm ,(704)stands for Contact gap: 2.3mm.

OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

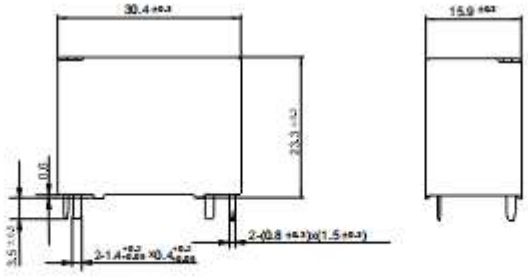
Unit: mm

Outline Dimensions

Standard type



(414) special code version



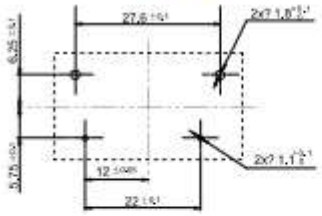
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OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

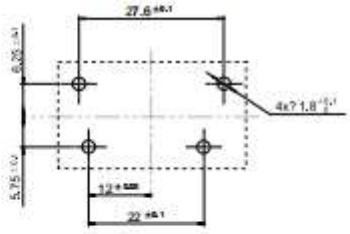
Unit: mm

PCB Layout (Bottom view)

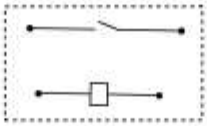
Standard type



(414) special code version



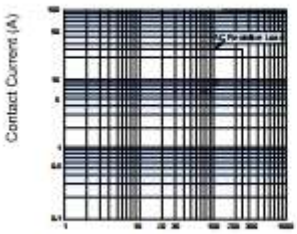
Wiring Diagram



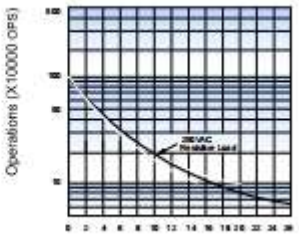
Remark: 1) In case of no tolerance shown in outline dimension: outline dimension ≤ 1mm, tolerance should be ±0.2mm; outline dimension > 1mm and ≤ 5mm, tolerance should be ±0.3mm; outline dimension > 5mm, tolerance should be ±0.4mm.
2) The tolerance without indicating for PCB layout is always ±0.1mm.

CHARACTERISTIC CURVES

MAXIMUM SWITCHING POWER



ENDURANCE CURVE



Test conditions:
at 75°C, 1.5s on 1.5s off.

Disclaimer

The specification is for reference only. See to "Terminology and Guidelines" for more information. Specifications subject to change without notice. We could not evaluate all the performance and all the parameters for every possible application. Thus the user should be in a right position to choose the suitable product for their own application. If there is any query, please contact Hongfa for the technical service. However, it is the user's responsibility to determine which product should be used only.

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3.2 Description of the differences of the models within the product series

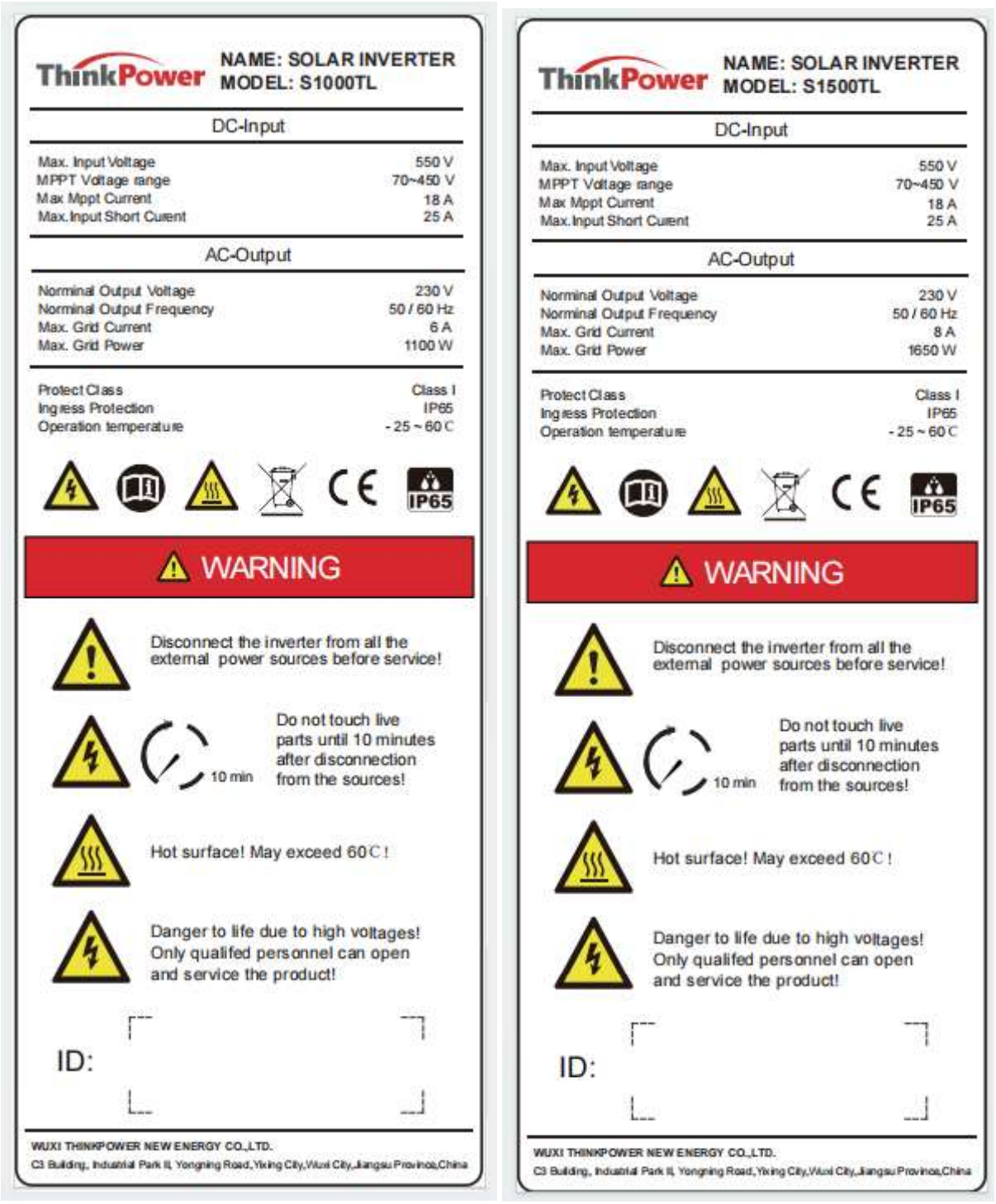
The units in the product series:

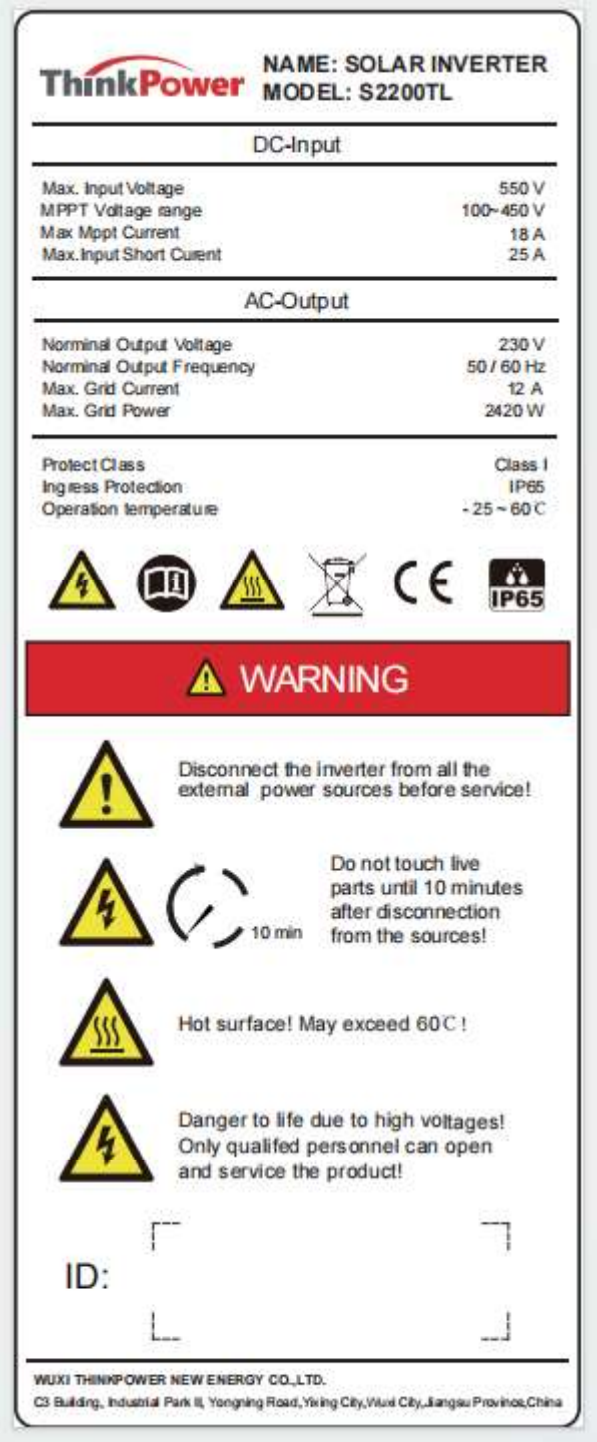
- sharing the same control electronics,
- with the same firmware,
- with the same construction solutions including the power part,
- with the same number of phases,
- with the same power electronics, filters and transducers.

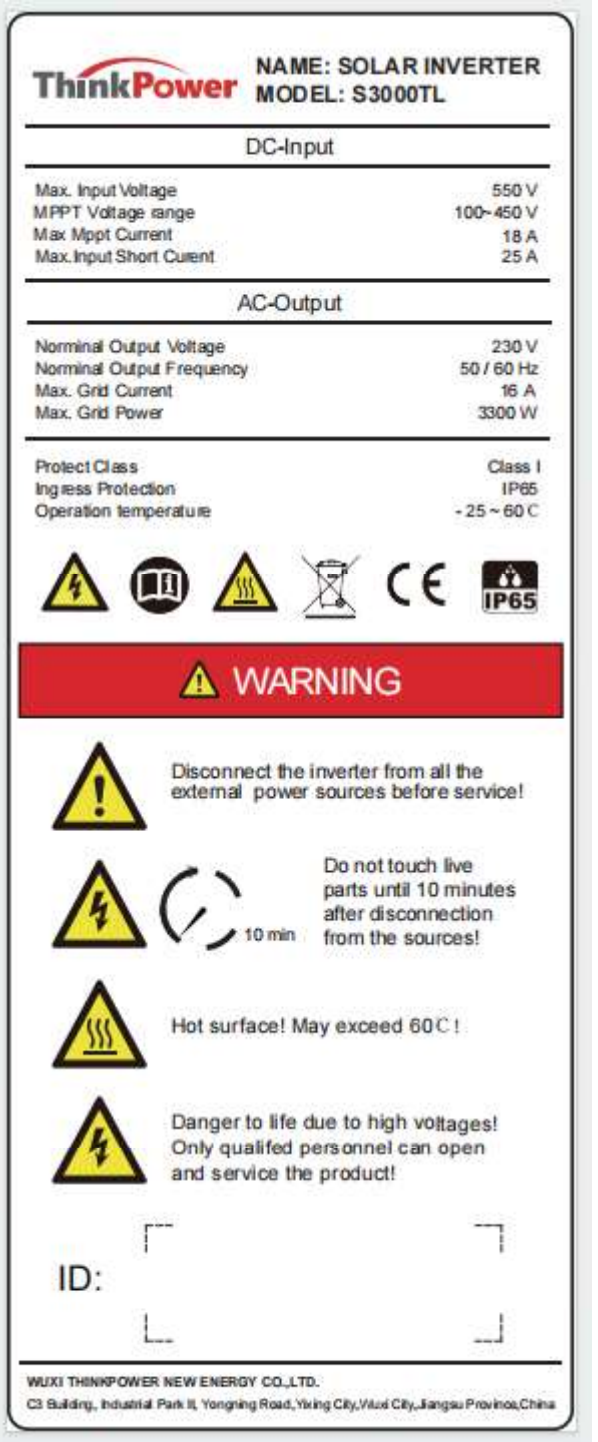
The models S1000TL, S1500TL, S2200TL, S3000TL, S3600TL, S4400TL, S5000TL and S6000TL use the same hardware platform and software which except the output power derating by software and the model name's due to the demand for commercial trade purposes. The model difference as show in below table for details.

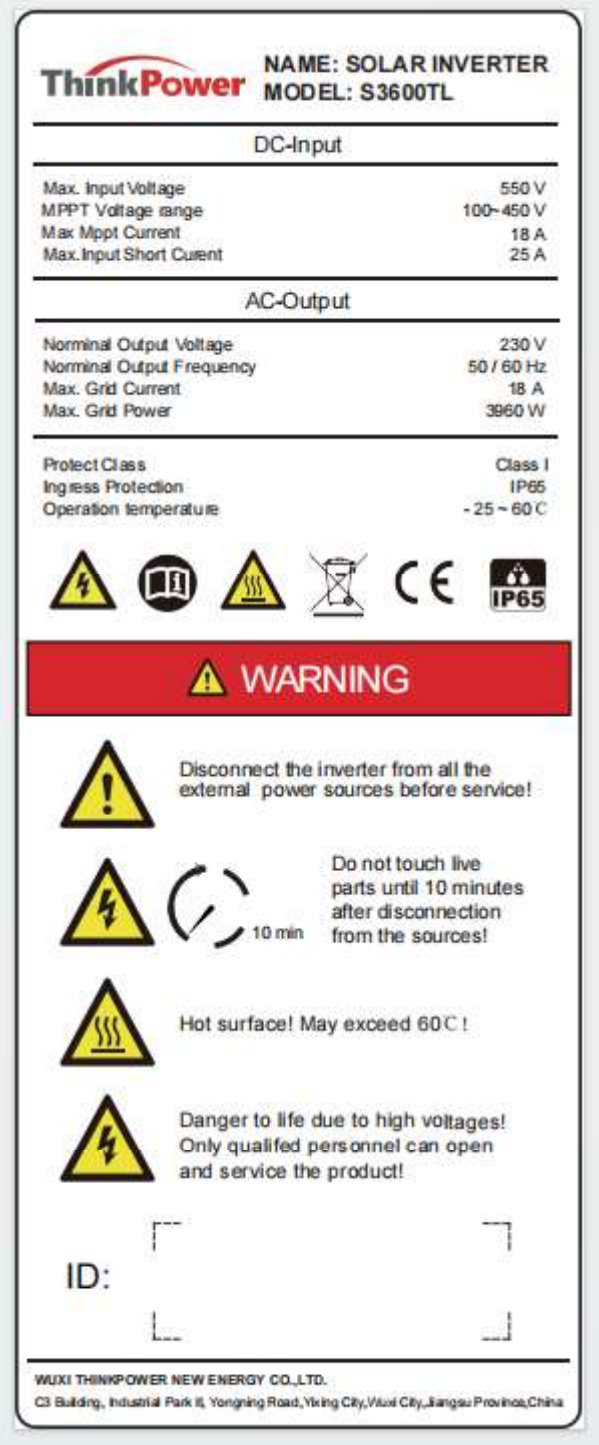
Difference term	S1000TL	S1500TL	S2200TL	S3000TL	S3600TL	S4400TL	S5000TL	S6000TL
Boost inductance	620uH	620uH	620uH	620uH	620uH	700uH	700uH	700uH
Inverter inductance	840uH*2	840uH*2	840uH*2	840uH*2	840uH*2	700uH*2	700uH*2	700uH*2
BUS Capacitors	550V, 470uF *2	550V, 470uF *2	550V, 470uF *2	550V, 470uF *2	550V, 470uF *2	550V, 470uF *4	550V, 470uF *4	550V, 470uF *4
B00ST DIODE	20A, 650V	20A, 650V	20A, 650V	20A, 650V	20A, 650V	30A, 650V	30A, 650V	30A, 650V
Dimension (L/W/H) [mm]	300 * 294 * 104					370 * 318.5 * 105.5		

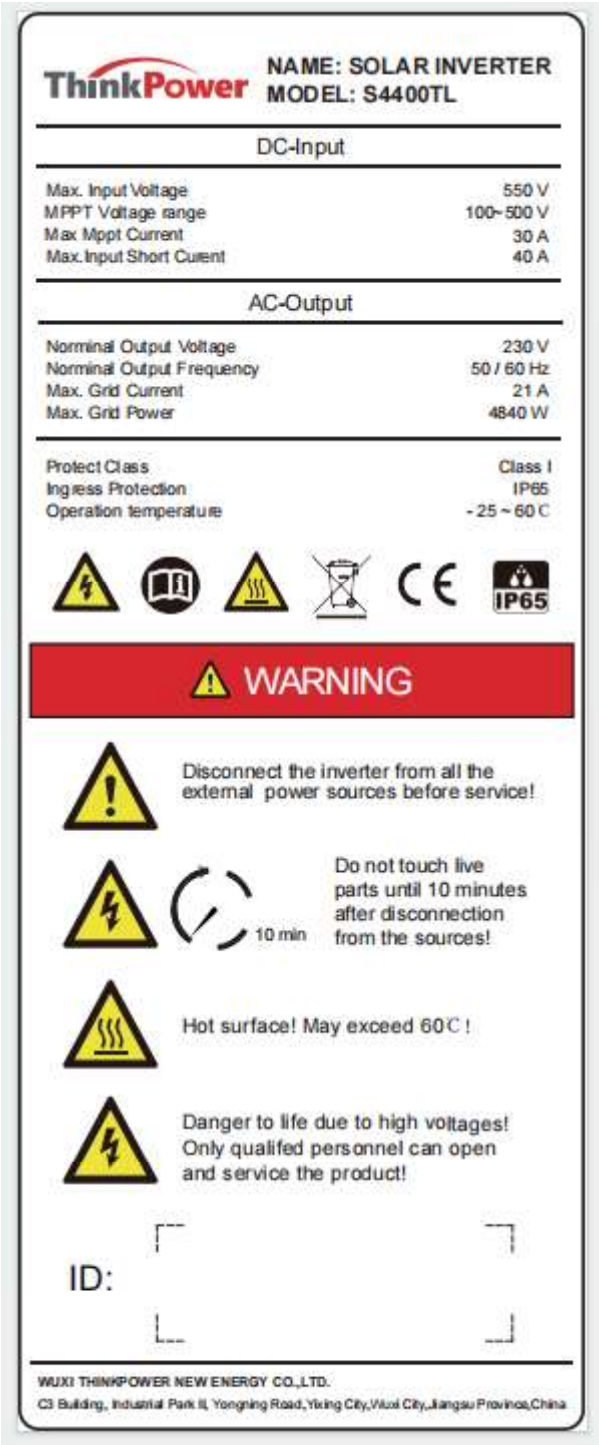
3.3 Copy of marking plate

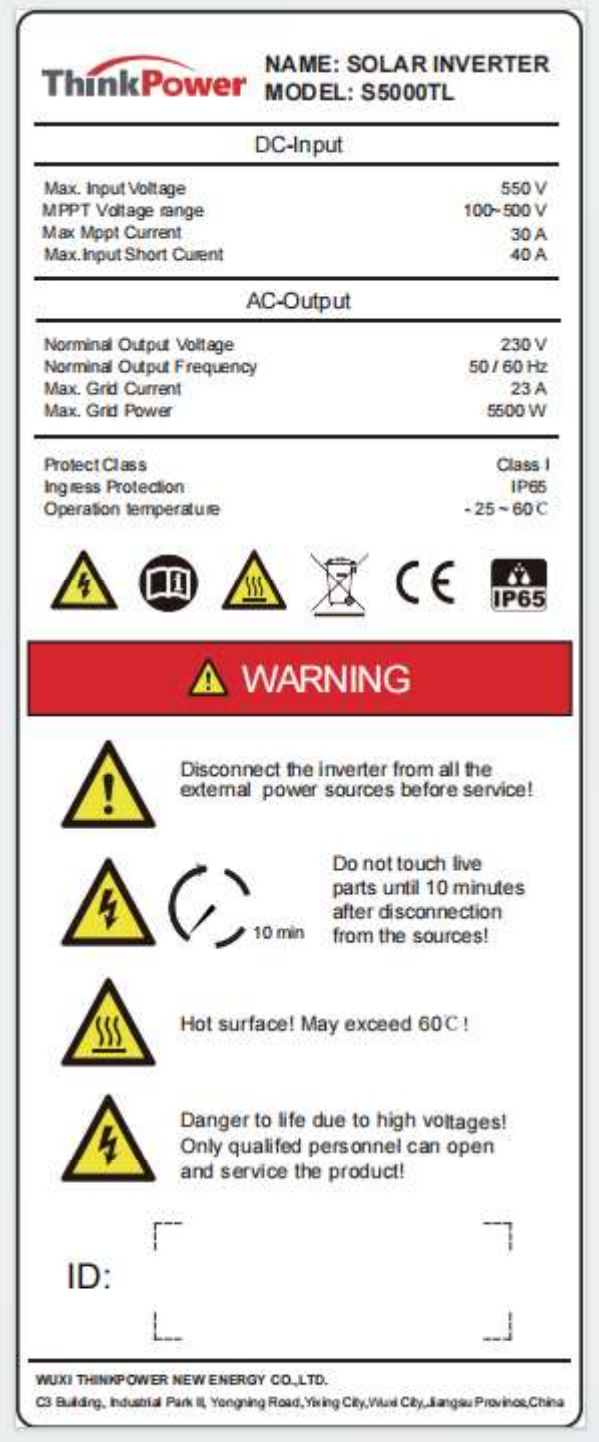


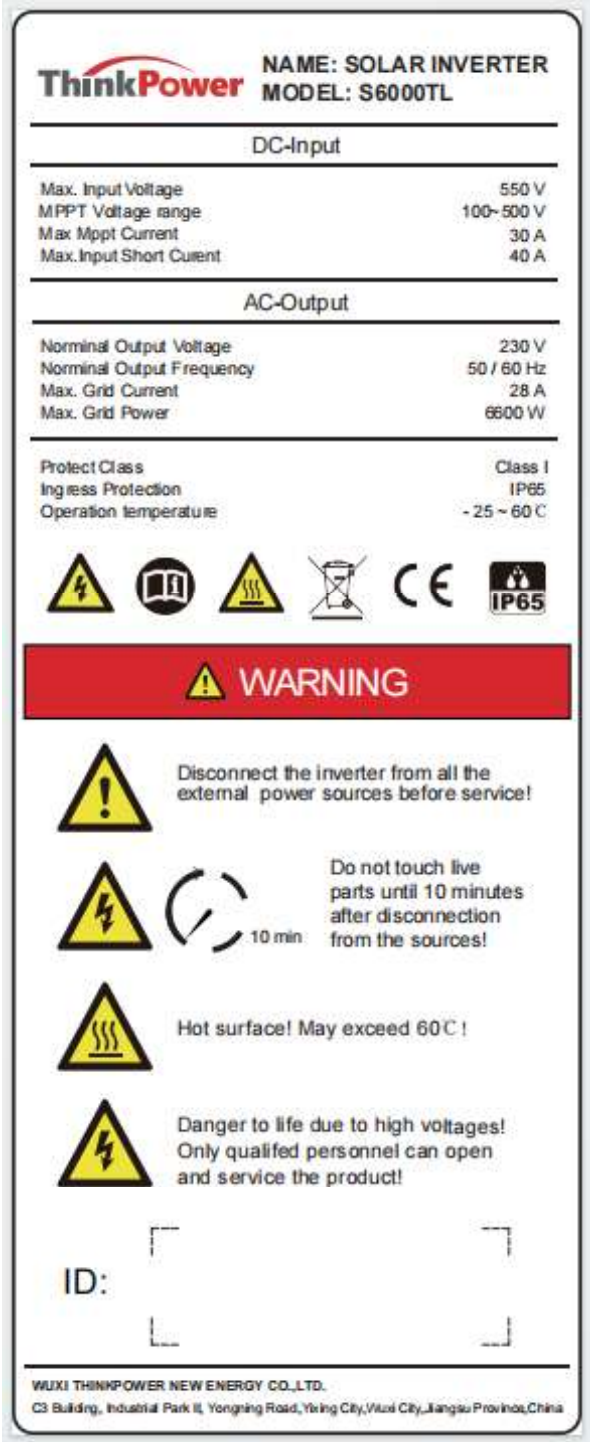

ThinkPower
NAME: SOLAR INVERTER
MODEL: S2200TL
DC-Input
Max. Input Voltage 550 V
MPPT Voltage range 100~450 V
Max Mppt Current 18 A
Max.Input Short Curent 25 A
AC-Output
Norminal Output Voltage 230 V
Norminal Output Frequency 50 / 60 Hz
Max. Grid Current 12 A
Max. Grid Power 2420 W
Protect Class Class I
Ingress Protection IP65
Operation temperature -25~60℃
IP65
WARNING
Disconnect the inverter from all the external power sources before service!
10 min
Do not touch live parts until 10 minutes after disconnection from the sources!
Hot surface! May exceed 60℃!
Danger to life due to high voltages! Only qualifed personnel can open and service the product!
ID:
WUXI THINKPOWER NEW ENERGY CO.,LTD.
C3 Building, Industrial Park II, Yongning Road, Yixing City, Wuxi City, Jiangsu Province, China


ThinkPower
NAME: SOLAR INVERTER
MODEL: S3000TL
DC-Input
Max. Input Voltage 550 V
MPPT Voltage range 100~450 V
Max Mppt Current 18 A
Max.Input Short Curent 25 A
AC-Output
Norminal Output Voltage 230 V
Norminal Output Frequency 50 / 60 Hz
Max. Grid Current 16 A
Max. Grid Power 3300 W
Protect Class Class I
Ingress Protection IP65
Operation temperature -25~60℃
IP65
WARNING
Disconnect the inverter from all the external power sources before service!
10 min
Do not touch live parts until 10 minutes after disconnection from the sources!
Hot surface! May exceed 60℃!
Danger to life due to high voltages! Only qualifed personnel can open and service the product!
ID:
WUXI THINKPOWER NEW ENERGY CO.,LTD.
C3 Building, Industrial Park II, Yongning Road, Yixing City, Wuxi City, Jiangsu Province, China


ThinkPower
NAME: SOLAR INVERTER
MODEL: S3600TL
DC-Input
Max. Input Voltage 550 V
MPPT Voltage range 100~450 V
Max Mppt Current 18 A
Max.Input Short Cuent 25 A
AC-Output
Norminal Output Voltage 230 V
Norminal Output Frequency 50 / 60 Hz
Max. Grid Current 18 A
Max. Grid Power 3960 W
Protect Class Class I
Ingress Protection IP65
Operation temperature -25~60℃
IP65
WARNING
Disconnect the inverter from all the external power sources before service!
10 min
Do not touch live parts until 10 minutes after disconnection from the sources!
Hot surface! May exceed 60℃!
Danger to life due to high voltages! Only qualifed personnel can open and service the product!
ID:
WUXI THINKPOWER NEW ENERGY CO.,LTD.
C3 Building, Industrial Park II, Yongning Road, Yixing City, Wuxi City, Jiangsu Province, China


ThinkPower
NAME: SOLAR INVERTER
MODEL: S4400TL
DC-Input
Max. Input Voltage 550 V
MPPT Voltage range 100~500 V
Max Mppt Current 30 A
Max.Input Short Cuent 40 A
AC-Output
Norminal Output Voltage 230 V
Norminal Output Frequency 50 / 60 Hz
Max. Grid Current 21 A
Max. Grid Power 4840 W
Protect Class Class I
Ingress Protection IP65
Operation temperature -25~60℃
IP65
WARNING
Disconnect the inverter from all the external power sources before service!
10 min
Do not touch live parts until 10 minutes after disconnection from the sources!
Hot surface! May exceed 60℃!
Danger to life due to high voltages! Only qualifed personnel can open and service the product!
ID:
WUXI THINKPOWER NEW ENERGY CO.,LTD.
C3 Building, Industrial Park II, Yongning Road, Yixing City, Wuxi City, Jiangsu Province, China





Note:

- The marking plates shown above may be only a draft. The use of certification marks on products must be approved by the respective NCBs to which these marks belong.
- The marking plate shown above are the minimum requirements required by the safety standards. For final production samples, additional certification marks may be added that do not cause misunderstanding.
- The marking plate is attached to the side surface or the back of the enclosure and is visible after installation.

3.4 Description of the power circuit

The internal control is redundant built, it consists of Microcontroller Main DSP (U18) and slave DSP(U21).

The Main DSP (U18) control the relays by switching signals; measures the PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground.

In addition, it tests the current sensors before each start up.

The slave DSP (U21) is measuring the grid voltage and grid frequency, also can switch off the relays independently, and communicate with Main DSP (U18) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Main DSP(U18). The Main DSP(U18) tests and calibrates before each start up all current sensors in each phase. The relays are tested before each start up.

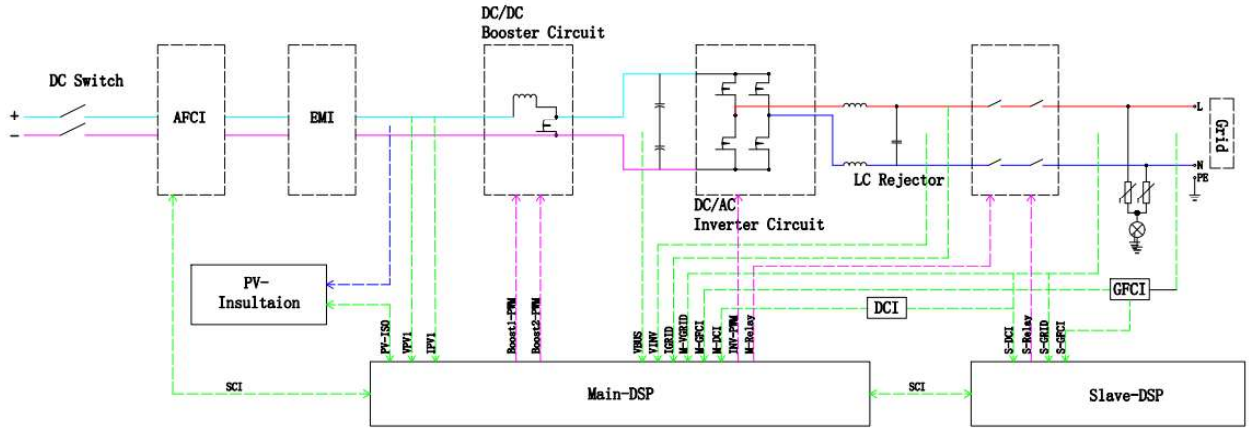


Figure 1 – Block diagram of the power circuit

4 General remarks for testing

4.1 Scope of measurements

During the test period stated above following environmental data were recorded:

- Temperature: 20.3 ~ 25.2°C
- Rel. humidity: 36.5 ~ 57.3%RH
- Air pressure: 985.2 ~ 1003.5 hPa

Test items	Testing requirements (Section DIN VDE 0126-1-1)	Section in this test report reference	Tests completed
1. Functional safety	4.1	6.1	☒
2. Reconnection	4.2	6.2	☒
3. Voltage monitoring	4.3	6.3	☒
4. Frequency monitoring	4.4	6.4	☒
5. DC current monitoring	4.5	6.5	☒
6. Detection of islanding	4.6	6.6	☒
7. Requirements for photovoltaic inverters with integrated disconnection means	4.8	6.7	☒

Note:

* Decision Rule for conformance with the prescribed limits:

in this report, a Simple Acceptance (measurement uncertainty associated with the measurement result is not taken into account) is utilized, and the statements of conformity are reported as:

• Pass - the measured value is below the acceptance limit

• Fail - the measured value is above the acceptance limit

unless otherwise normatively specified or contractually agreed with the client.

* According to DIN AR V 4105:2011 and DIN VDE V 0124-100:2012 requirement conditions and testing are performed.

since the rated power of **S1000TL**, **S1500TL**, **S2200TL**, **S3000TL**, **S3600TL**, **S4400TL**, **S5000TL** are between $1/\sqrt{10}\cdot P_{n,\mathbf{S6000TL}}$ and $2\cdot P_{n,\mathbf{S6000TL}}$, a family approach to type testing is acceptable.

* The tests were performed on AC Grid (Utility) Connection under PV input mode, AC output 230V, 50Hz.

4.2 Measurement setup

Tests documented in this test report were performed using the following test configuration:

☐ Measurements in the field on real grid

☐ Test bench tests on real grid

☒ Test bench tests on an AC grid simulator

The measurement setups are shown in Figure **2** and Figure **3**. The specific test and measurement devices are stated in section 4.3.

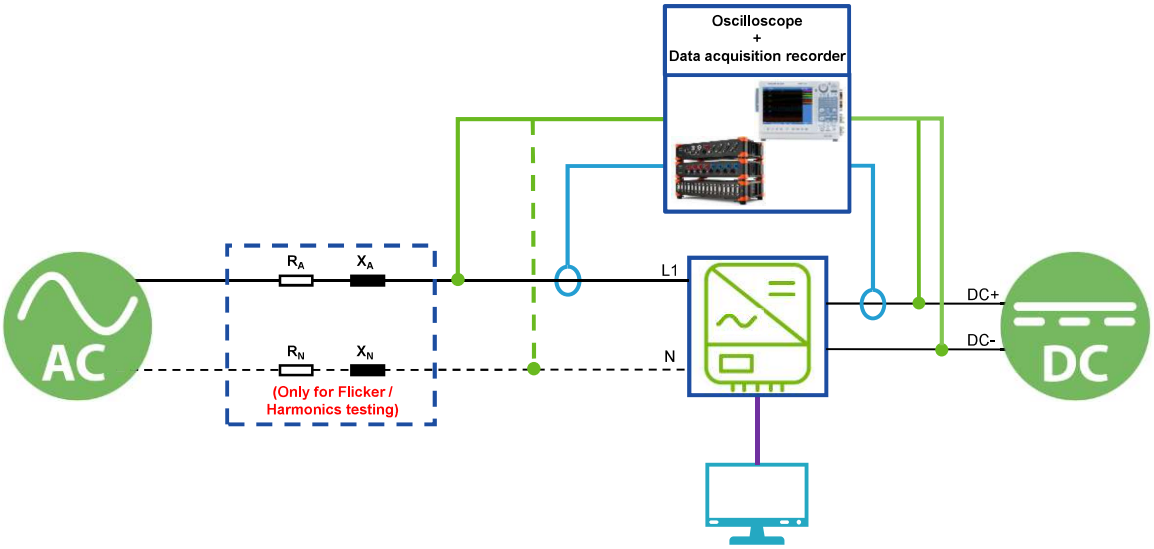


Figure 2 – Measurement setup used for tests except Loss of Mains test

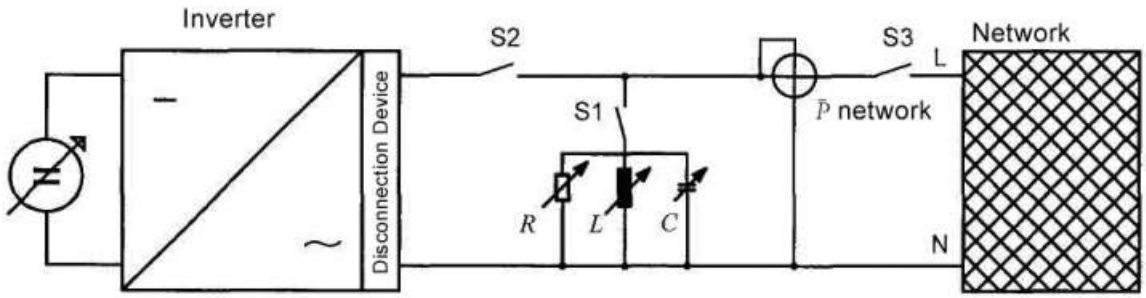


Figure 3 – Test circuit for Loss of Mains according to *DIN VDE V 0126-1-1*

4.3 Measurement equipment

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration
DC source	HC-ENG-043	KEWELL	S7000-21K-2000-0040	6018888221003326	Monitored by Power Analyzer
AC source	HC-ENG-030	KEWELL	KAC-45-345-33	6018888220300485	
RLC Load	HC-ENG-005	Qunling Energy Resources	ACLT-3803H	93H006289	
Power Analyzer	HC-ENG-029	DEWETRON	TRION-1820-POWER	A1228623/ C5220751	2027-03-18
Current transducer	HC-ENG-029-001	SIGNALTEC	CT 400	1221300587	
	HC-ENG-029-002	SIGNALTEC	CT 400	1221300588	
	HC-ENG-029-003	SIGNALTEC	CT 400	1221300595	
	HC-ENG-029-004	SIGNALTEC	CT 400	1221300596	
Humidity & Temperature recorder	HC-ENG-002	Jiangsu Jingchuang Electric Co., Ltd.	GSP-8A	CMA215000031	2027-03-24

Note:

All measurement equipment was used within the calibration period. Copy of calibration certificates are available at the laboratory for reference.

5 Assessment overview

Possible test case verdicts:

Test item does meet the requirement.....: P (Pass)

Test item does not meet the requirement....: F (Fail)

Test case does not apply to the test object...: N/A

Test case is not rated .....: N/R

Reference to declaration documents.....: R/D

Items	Technical requirements (Section VDE 0126-1-1)	Remark / Transfer of measurement results	Verdict
1. functional safety	4.1	See section 6.1 / The verified functional safety of the **S6000TL** can be applied to other units in the product series directly.	P
2. Reconnection	4.2	See section 6.2 / The measurement results of the **S6000TL** can be applied to other units in the product series directly.	P
3. Voltage monitoring	4.3	See section 6.3 / The measurement results of the **S6000TL** can be applied to other units in the product series directly.	P
4. Frequency monitoring	4.4	See section 6.4 / The measurement results of the **S6000TL** can be applied to other units in the product series directly.	P
5. DC current monitoring – DC injection	4.5	See section 6.5 / The measurement results of the **S6000TL** can be applied to other units in the product series directly.	P
6. Detection of islanding	4.6	See section 6.6 / The measurement results of the **S6000TL** can be applied to other units in the product series directly.	P
7. Marking	4.7	See **Copy of marking plate** according VDE 0126-1-1.	P
8. Requirements for photovoltaic inverters with integrated disconnection means	4.8	See section 6.7/ according clause 4.8 of DIN EN 62109-2 and the verified test of the **S6000TL** can be applied to other units in the product series directly. The inverters meet the requirements of IEC 62109-1 and IEC 62109-2. Details see reports No. 2412110607001-SF-LD-R1, HWA-HSING (DONGGUAN) TESTING CO., LTD. on 2025-03-28.	P

Items	Technical requirements (Section VDE 0126-1-1)	Remark / Transfer of measurement results	Verdict
9. General requirements for Electromagnetic compatibility	5.0	The requirement about standard DIN EN 61000-6-2 and DIN EN 61000-6-3 have been evaluated in EMC test report (No. 2408080221-01-RE-BR-01) Hwa-Hsing (Dongguan) Testing Co., Ltd. on 2024-09-12.	P

6 Measurement results

6.1 Functional safety

The safety of the functions of the automatic control device defined in 4.3 to 4.6 and - if applicable - 4.8 shall be ensured under all operating conditions of the network. shall be ensured under all operating conditions of the network. It may be installed as a stand-alone or as an integral part of the generating plant and shall switch off in the event of a fault condition and switch off in the event of a fault condition and indicate the fault condition.

Single-fault safety

The switching point shall meet the requirements of single-fault safety according to VDE-AR-N 4105:2011, A.6.

Disconnection device

In the case of integration into a PV inverter, the disconnection device must meet the requirements according to DIN EN 62109-2 (VDE 0126-14-2):2012-04, 4.4.4.15.2 in the case of integration into a PV inverter, and in all other cases the requirements according to VDE-AR-N 4105:2011, 6.4.

No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1.	Relay RY1 Pin3 and Pin4	short before start-up	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: P008 No damage. No hazard.
2.	Relay RY3 Pin3 and Pin4	short before start-up	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: P008 No damage. No hazard.
3.	Relay RY2 Pin3 and Pin4	short before start-up	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: P008 No damage. No hazard.
4.	Relay RY4 Pin3 and Pin4	short before start-up	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: P008 No damage. No hazard.
5.	DSP_INV_L Voltage monitoring R73	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P003 No damage. No hazard.
6.	DSP_INV_L Voltage monitoring R75	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P002 No damage. No hazard.
7.	DSP_INV_N Voltage monitoring R76	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P003 No damage. No hazard.
8.	DSP_INV_N Voltage monitoring R78	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P002 No damage. No hazard.
9.	PV1_V- Voltage monitoring R25	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P007 No damage. No hazard.

10.	PV1_V- Voltage monitoring R27	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: E002 No damage. No hazard.
11.	PV1_V+ Voltage monitoring R10	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P007 No damage. No hazard.
12.	PV1_V+ Voltage monitoring R8	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: E002 No damage. No hazard.
13.	INSULATION_R Voltage monitoring R20	Open	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: E001 No damage. No hazard.
14.	INSULATION_R Voltage monitoring R22	Short	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: E001 No damage. No hazard.
15.	U1B Pin 7 and Pin 6	Open	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: E001 No damage. No hazard.
16.	U1B Pin 7 and Pin 5	Short	230Vac; 500Vdc	10min	--	--	The inverter cannot start-up. Error message: E001 No damage. No hazard.
17.	DSP_GRID_L Voltage monitoring R39	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P003 No damage. No hazard.
18.	DSP_GRID_L Voltage monitoring R41	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P002 No damage. No hazard.
19.	DSP_GRID_N Voltage monitoring R48	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P003 No damage. No hazard.
20.	DSP_GRID_N Voltage monitoring R50	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P002 No damage. No hazard.
21.	U2 Pin 1 and Pin 3	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P001 No damage. No hazard.
22.	U2 Pin 2 and Pin 3	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P001 No damage. No hazard.

23.	U4 Pin 1	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
24.	Transformer TX1 Pin2 and Pin1	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
25.	Transformer TX1 Pin3 and Pin4	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. U3 damage. No hazard.
26.	Transformer TX1 Pin5 and Pin6	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
27.	Transformer TX4 Pin2 and Pin1	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
28.	Transformer TX4 Pin9 and Pin10	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
29.	Transformer TX4 Pin6 and Pin7	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
30.	Transformer TX2 Pin2 and Pin1	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
31.	Transformer TX2 Pin9 and Pin10	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
32.	Transformer TX2 Pin7 and Pin6	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. No damage. No hazard.
33.	BUS C4	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. D2 Q5 damage. No hazard.
34.	BUS D2 Pin 1 and Pin 2	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Q5 damage No hazard.
35.	Q7 C and G	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Q7, R23, R24, U3 damage No hazard.
36.	Q7 C and E	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Q11 damage No hazard.

37.	Q11 C and G	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Q11, R33, R34 damage No hazard.
38.	Q11 C and E	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Q7 damage No hazard.
39.	NS16801B U3 Pin 4 and Pin 5	Short	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P009 No damage. No hazard.
40.	Output L and N	Output short circuit	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P006 No damage. No hazard.
41.	Communication fault Between Main DSP and Slave ARM(R122)	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P010 No damage. No hazard.
42.	Communication fault Between Main DSP and Slave ARM(R123)	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P010 No damage. No hazard.
43.	Communication fault Between Main DSP and Slave ARM(R136)	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P010 No damage. No hazard.
44.	Communication fault Between Main DSP and Slave ARM(R138)	Open	230Vac; 500Vdc	10min	--	--	The inverter disconnecting from grid immediately. Error message: P010 No damage. No hazard.

Note:

The errors in the control circuit simulate that the safety is even ensured during a single fault.

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Assessment criterion:

The NS protection must send a shutdown command to the coupling switch.

If the error is detected, the device is switched off within 10 s after error detection.

If the auxiliary voltage fails with the central NS protection or if the control fails with the integrated NS protection, the switch-off command must be given immediately.

6.2 Reconnection

The connection, reconnection after a mains fault and reconnection after a short interruption must short interruption must be carried out in accordance with VDE-AR-N 4105:2011, 8.3.1 apply;

Note:

see points a) to h) for the test process.

The measurement was carried out with a programmable AC source.

Assessment criterion:

After actuating the NS protection, it should be checked that the system can only be switched within the tolerance ranges ((84% $U_n \leq U \leq 110\% U_n$) and (47,50Hz ≤f ≤50,05Hz)) at the earliest after 60s after voltage and frequency has remained within the tolerance ranges.

S6000TL

Connecting conditions and synchronisation

	Setting value	**Reconnection time [s]**	**Limit [s]**
Connecting conditions for frequencies:			
a)	47,45Hz	No reconnection	No resetting allowed
--	Switch to:	--	--
b)	≥47,55Hz	65 s	≥60s
c)	50,10Hz	No reconnection	No resetting allowed
--	Switch to:	--	--
d)	≤50,00Hz	65 s	≥60s
Connecting conditions for voltage:			
e)	<84% Un	No reconnection	No resetting allowed
--	Switch to:	--	--
f)	≥84%Un	65 s	≥60s
g)	111% Un	No reconnection	No resetting allowed
--	Switch to:	--	--
h)	≤109 Un	67 s	≥60s

Connecting conditions for short interruption

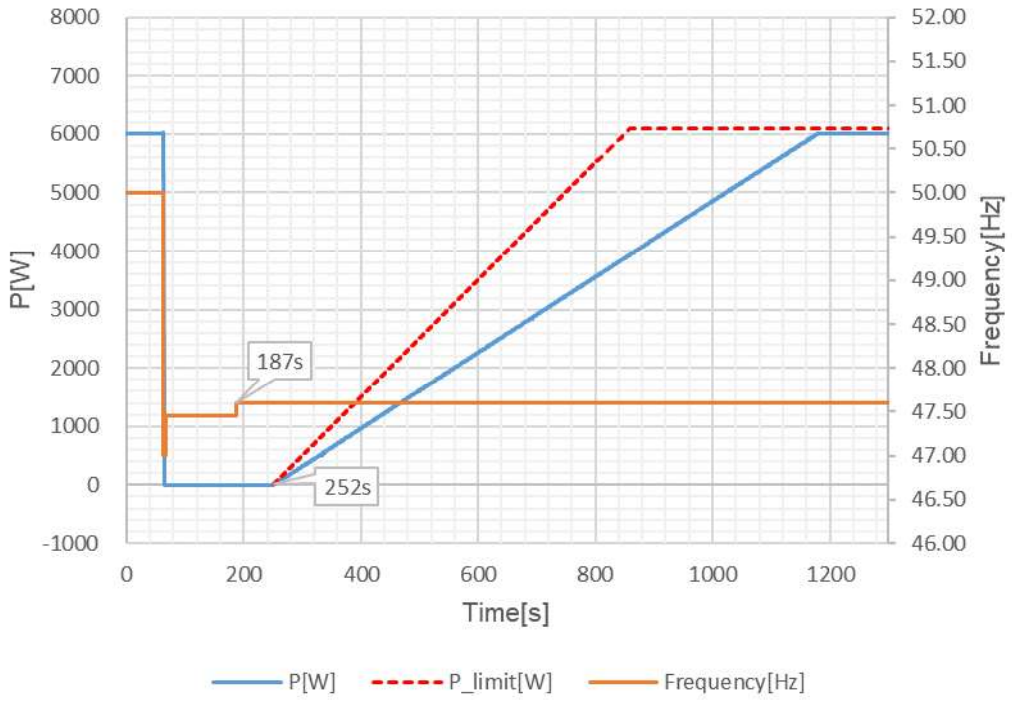
Step [V to V]	Jump Duration [s]:	Reconnection Time [s]:	Limit [s]
Step 1			
230 to 177,1	2,0	5	≥ 5
Step 2			
230 to 177,1	4,0	71	≥ 60

Note:

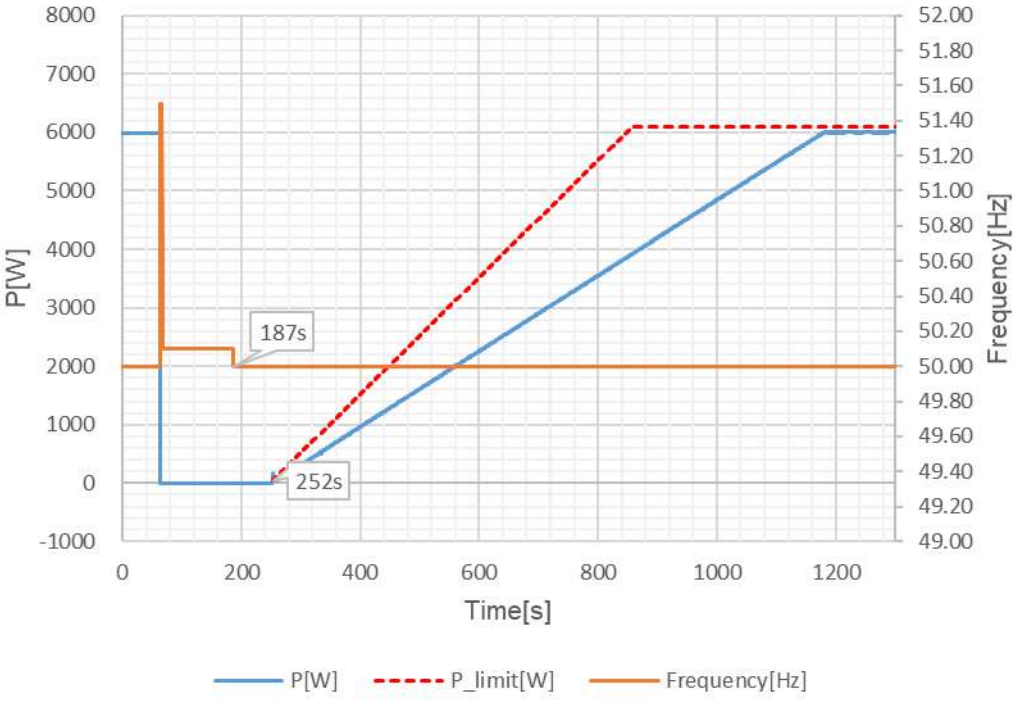
The conditions and testing are performed according to VDE V VDE 0124-100:2012, 5.5.1 and 5.5.2.

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

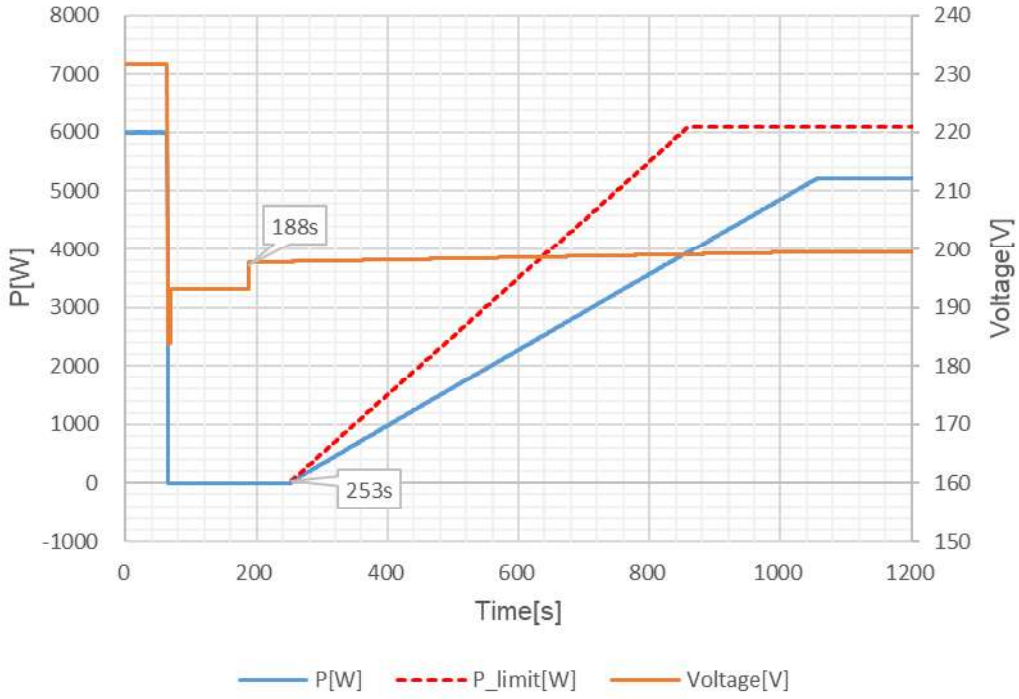
Connecting conditions for frequencies: ≥47,55Hz



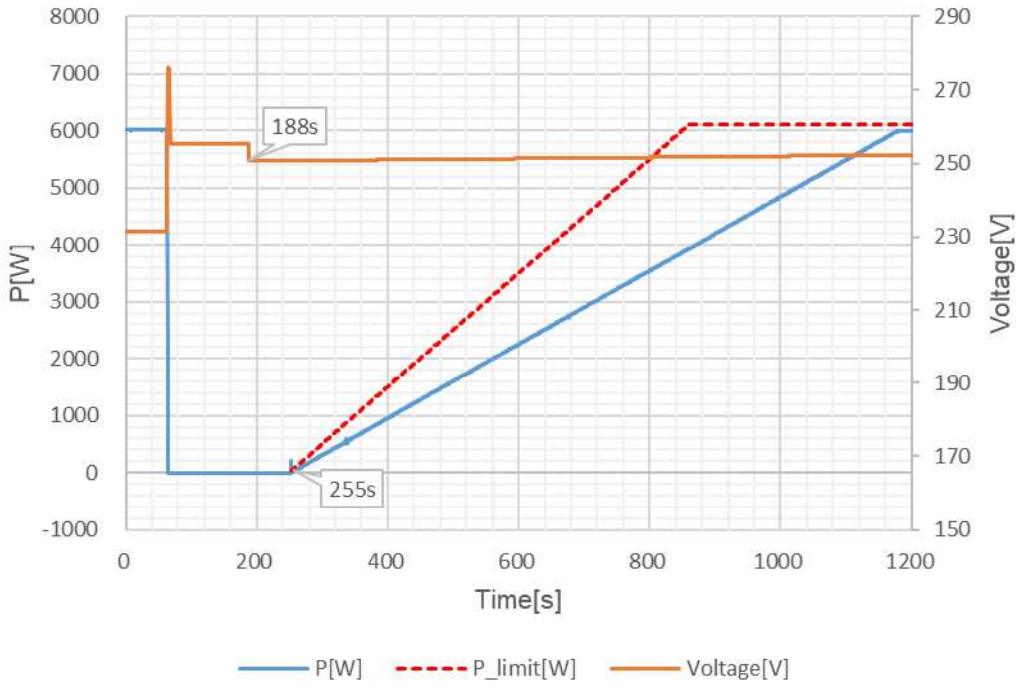
Connecting conditions for frequencies: 50,1Hz



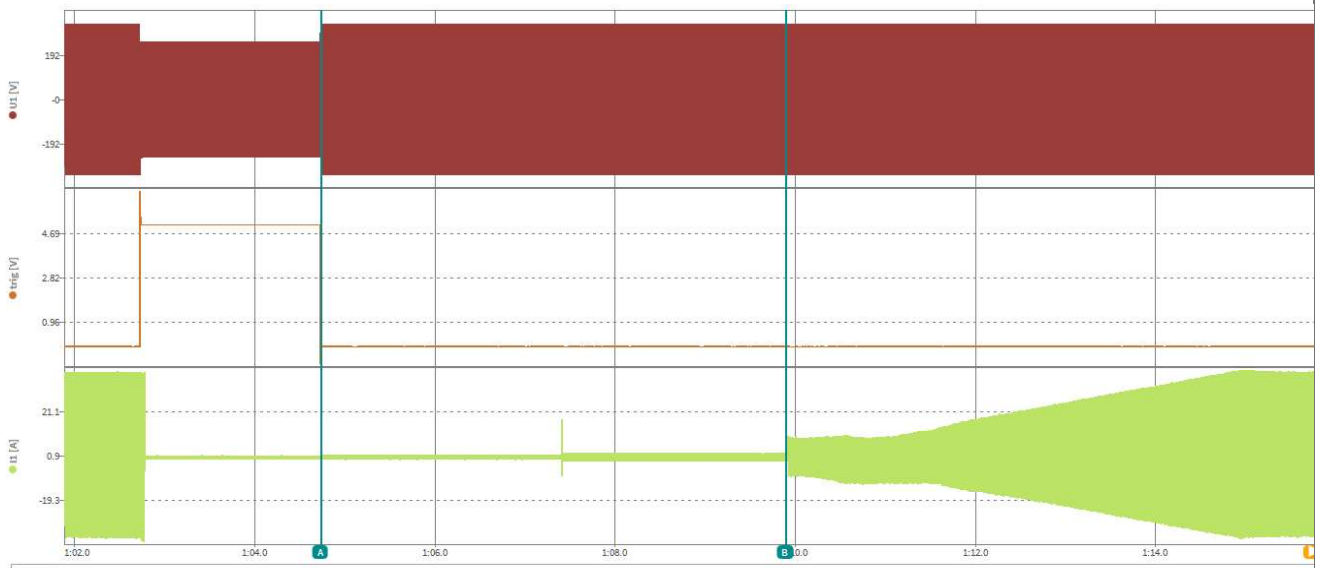
Connecting conditions for voltages: ≥84%Un



Connecting conditions for voltages: ≤109%Un

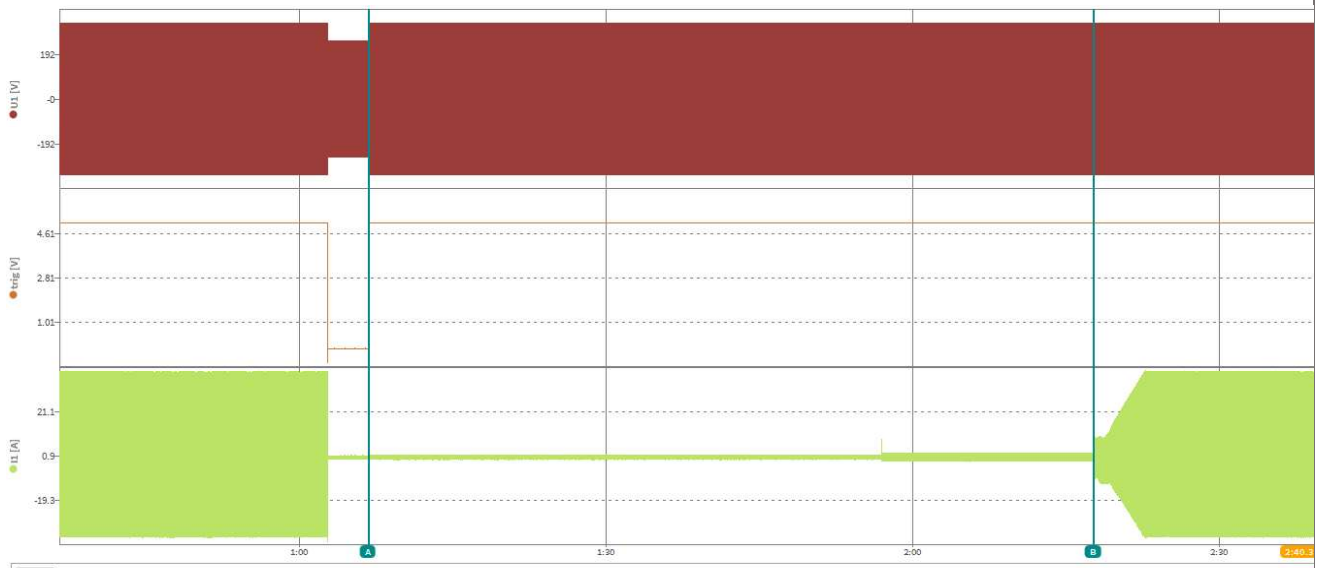


Jump duration time: 2s



	A	B	间隔
时间 [s]	1:04.73840	1:09.89760	5.15920
U1 [V]	-24.63201	56.81393	81.44594
trig [V]	-0.072002	-0.070333	1.669e-3
I1 [A]	0.996828	1.618743	0.621915

Jump duration time: 4s



	A	B	间隔
时间 [s]	1:06.77970	2:17.69300	1:10.91330
U1 [V]	324.0922	152.0708	477.0630
trig [V]	5.027771	5.028010	2.384e-4
I1 [A]	-0.022054	6.029487	6.051541

6.3 Voltage monitoring

4.3.1 Voltage drop U<

The disconnection due to a slow voltage drop shall be in accordance with VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2.

4.3.2 Voltage increase U>>

The disconnection due to a voltage increase shall be carried out in accordance with VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2.

4.3.3 Voltage rise U>

The disconnection due to a slow voltage rise (10-minute average value) shall be carried out in accordance with VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2.

- Test procedural:
- For a single-phase EZE, only the feed-in phase needs to be checked.
- Before each test step, the EZE must be operated symmetrically with rated voltage and rated frequency for at least 10 s in feed-in mode.
- The P setpoint was set by SW-Tool using RS485-interface.
- The conditions and testing are performed according to DIN VDE V 0124-100:2012-07, 5.4.5.3.

Assessment criterion:

- The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of Un. The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, limit is given with +0,100s according to Table 2 set values of the NS-protection according to VDE-AR-N 4105:2011-08.

Note:

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Integrated NS protection single-phase ≤30kVA

Setting values of the NS protection:	Setting	Value [V]	Time [s]	Setting	Value [V]	Time [s]
	U>	264,5	0,2	--	--	--
	U<	184,0	0,2	--	--	--

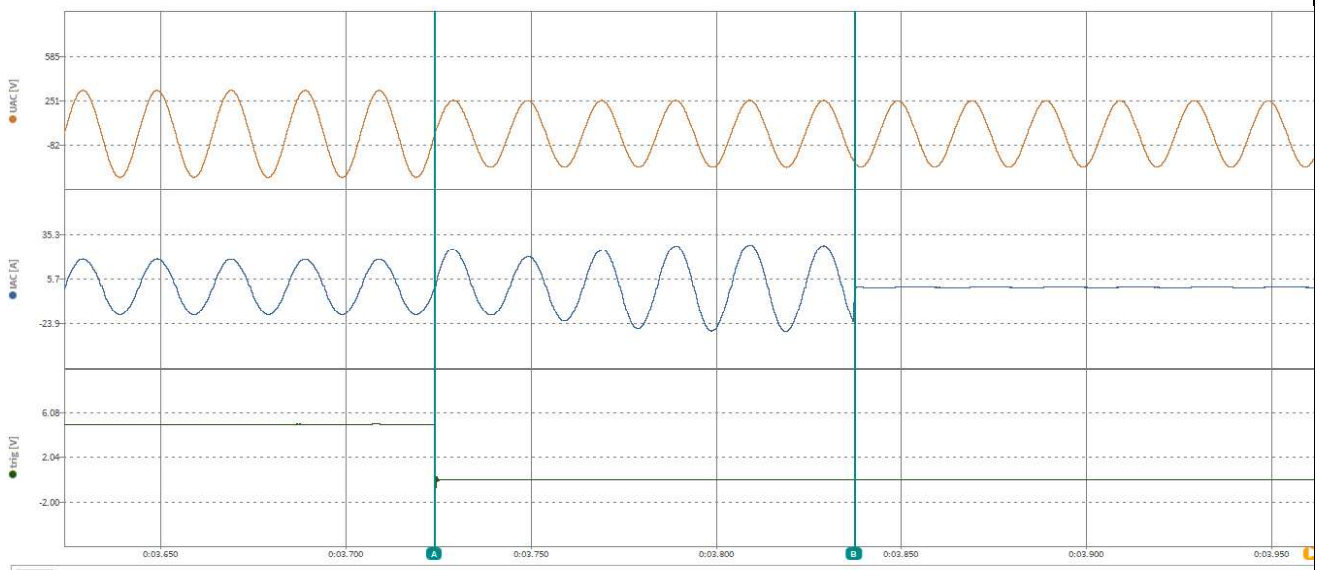
Operating time of the monitoring device:

S6000TL	Under voltage:			Over voltage:		
L to N:	**Under voltage 1 (4.2):**			**Over voltage 1 (1.2):**		
Step [V to V]:	230,0 to 177,1			230,0 to 271,4		
Limit [V]:	184,0			264,5		
Measurement [V:]	182,23	182,78	182,79	266,72	266,40	266,70
Limit [s]:	0,2			0,2		
Disconnection time [s]:	0,113	0,111	0,110	0,106	0,104	0,103

Note:

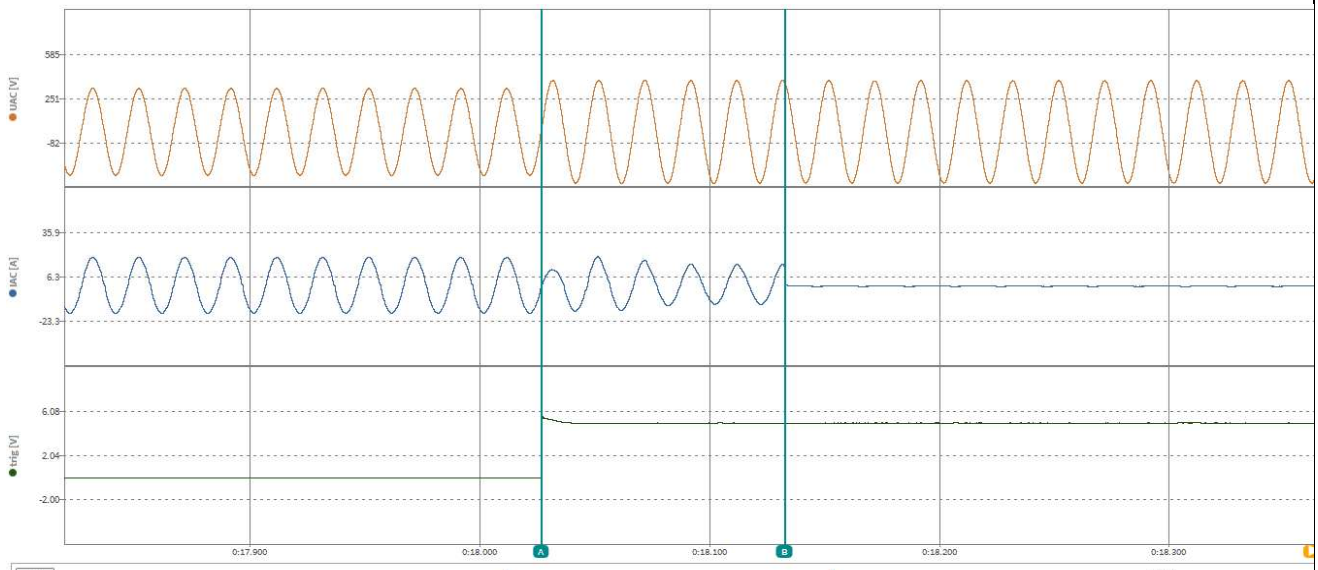
The conditions and testing is performed according to VDE V 0124-100 clause 5.4.5.3.

Under voltage 1 (4.2): L-N



	A	B	间隔
时间 [s]	3.7240000	3.8374000	0.1134000
UAC [V]	7.846117	206.4860	198.6399
IAC [A]	-1.013279	4.774332	5.787611
trig [V]	5.034685	-0.058413	-5.093098

Over voltage 1 (1.2): L-N



	A	B	间隔
时间 [s]	0:18.0270000	0:18.1328000	0.1058000
UAC [V]	28.44477	363.0352	334.5905
IAC [A]	-0.282526	1.008511	1.291037
trig [V]	6.442547	5.038977	-1.403570

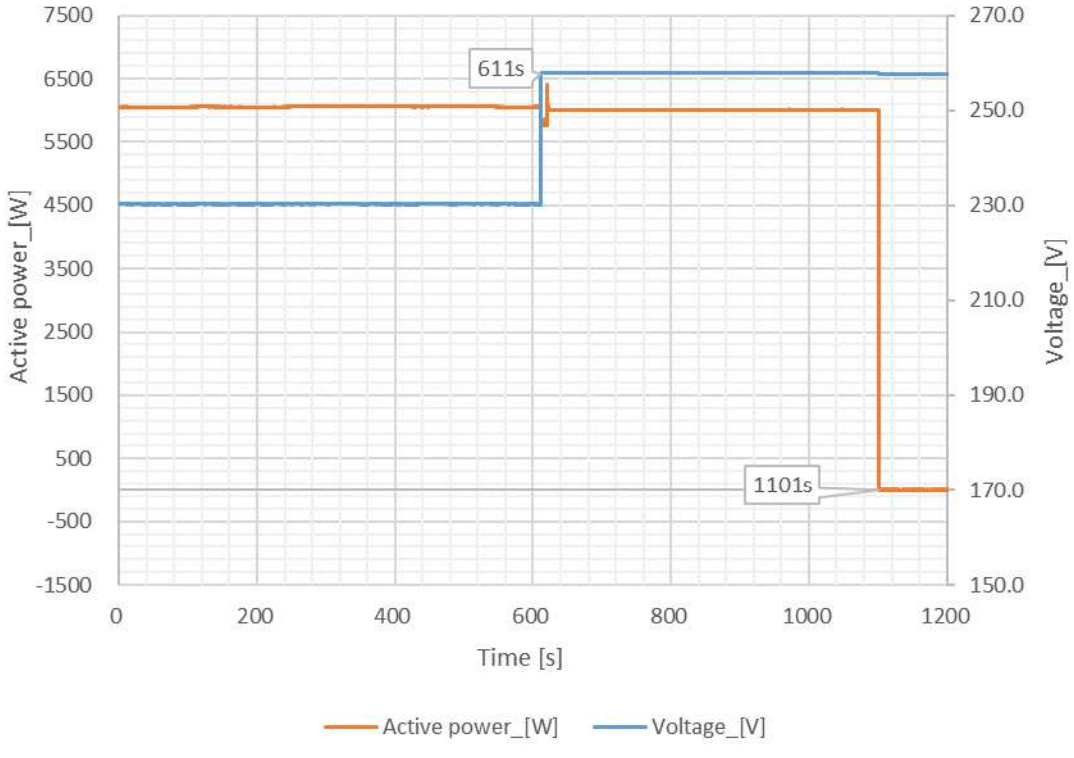
Measuring the rise-in voltage protection as a running 10-minute mean value			
Test:			
S6000TL		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% Un. Disconnection must take place within 600 s.		
	Phase L1	490s	≤ 600 s
	Phase L2	--	
	Phase L3	--	
b)	The voltage is set to U_n for 600 s and then to 108% Un for 600 s. No disconnection should take place.		
	Phase L1	No reconnection	≤ 600 s
	Phase L2	--	
	Phase L3	--	
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 L1	255s	≤ 600 s
	Phase L2	--	
	Phase L3	--	

Note:

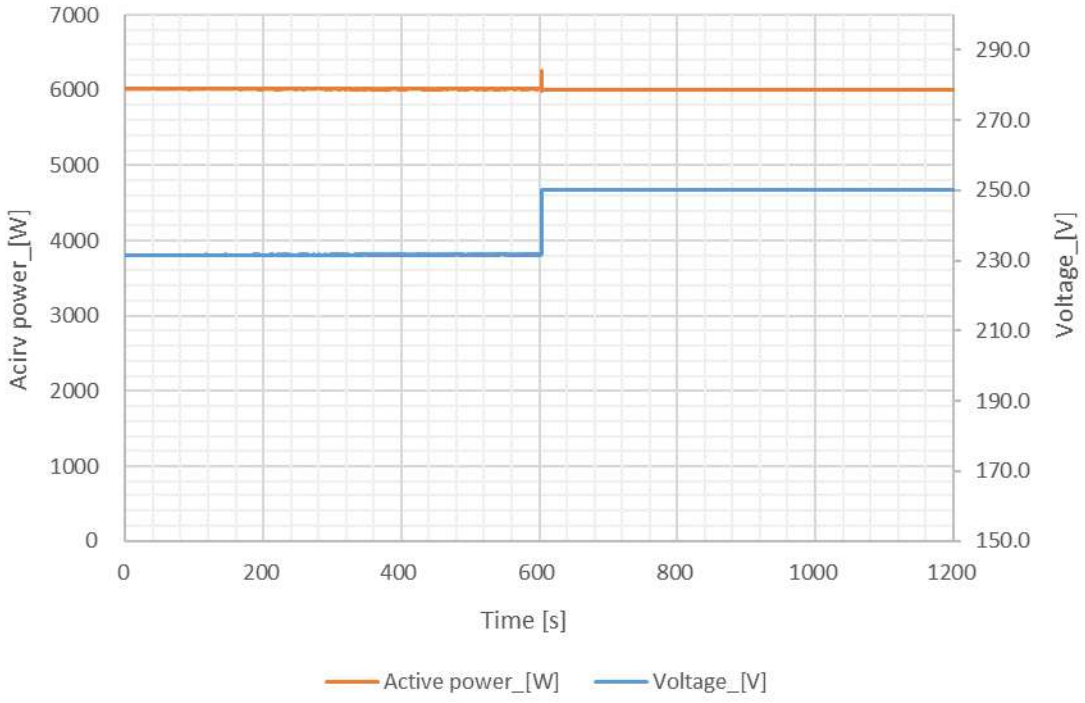
The conditions and testing is performed according to VDE V 0124-100 clause 5.4.5.3.3

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

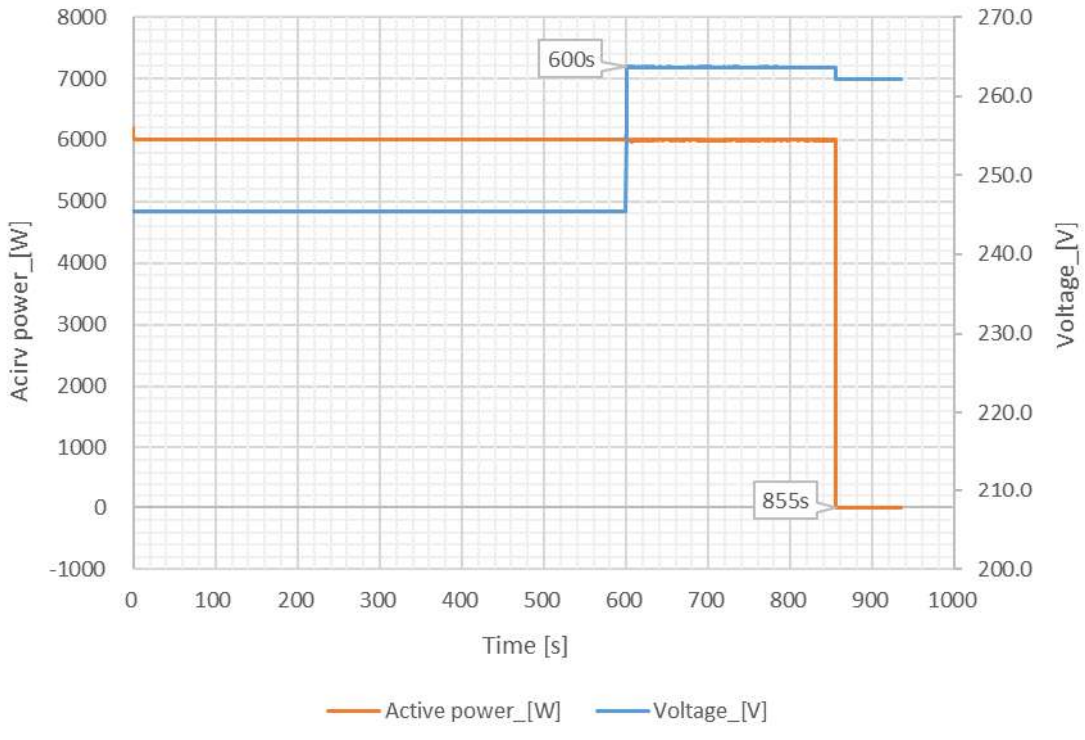
Over voltage 10-minute mean value (a):



Over voltage 10-minute mean value (b):



Over voltage 10-minute mean value (c):



6.4 Frequency monitoring

The disconnection due to a drop in frequency or an increase in frequency must be carried out in accordance with VDE-AR-N 4105:2011-08, 6.5.1 and 6.5.2.

Test procedural:

- For a single-phase EZE, only the feed-in phase needs to be checked.
- Before each test step, the EZE must be operated symmetrically with rated voltage and rated frequency for at least 10 s in feed-in mode.
- The P setpoint was set by SW-Tool using RS485-interface.
- The conditions and testing are performed according to DIN VDE V 0124-100:2012-07, 5.4.5.4.

Assessment criterion:

- The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of f_n.
- The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, the limit is given with +0,100s according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2011-08.

Note:

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

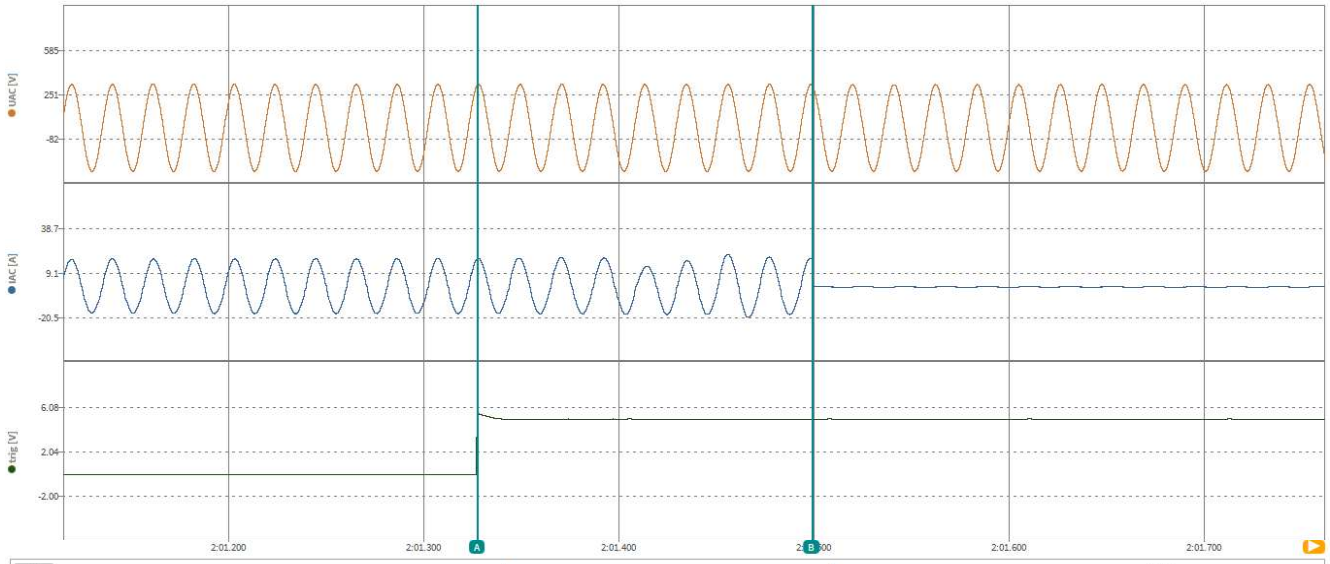
Integrated NS protection multi-phase ≤30kVA

Setting values of the NS protection:	Setting	Value [Hz]	Time [s]
	f<	47,5	0,2
	f>	51,5	0,2

Operating time of the monitoring device:

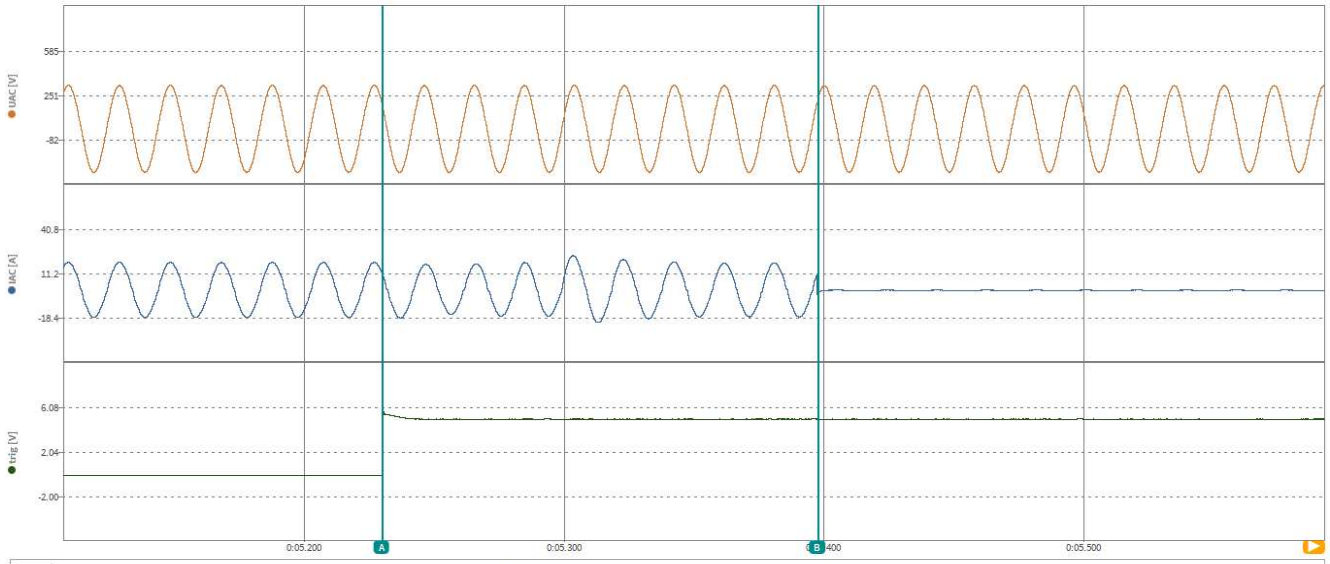
Setting value	**Reconnection time [s]:**			**Limit [s]**		
S6000TL	**Under frequency (10.1):**			**Over frequency (8.1):**		
Ramp [start Hz to stop Hz]	48,00 → 47,00			51,00 → 52,00		
Step size [Hz]	<0,025			<0,025		
Step length [s]	>0,4			>0,4		
Limit [Hz]	47,50 ±0,1% f_n			51,50 ±0,1% f_n		
Measurement [Hz]	47,50	47,50	47,50	51,49	51,49	51,49
	Under frequency (11.1):			**Over frequency (9.1):**		
Jump [start V to stop V]	48,00 → 47,00			51,00 → 52,00		
Step size [Hz]	>0,2			>0,2		
Step length [s]	>0,4			>0,4		
Limit [s]	t ≤0,200			t ≤0,200		
Measurement [s]	0,163	0,161	0,171	0,168	0,157	0,157

Under frequency (11.1):



	A	B	间隔
时间 [s]	2:01.3278000	2:01.4991000	0.1713000
UAC [V]	322.8626	307.1032	-15.75947
IAC [A]	18.22829	9.078980	-9.149314
trig [V]	5.723000	5.036116	-0.686884

Over frequency (9.1):



	A	B	间隔
时间 [s]	5.2300000	5.3977000	0.1677000
UAC [V]	193.7516	214.3042	20.55264
IAC [A]	11.45363	-3.219843	-14.67347
trig [V]	0.387430	5.041361	4.653931

6.5 DC current monitoring – DC injection

A direct current feed-in into the low-voltage grid due to a disturbed system operation must lead to disconnection within 0.2 s. For this purpose, either the fault itself or a measured DC component of the current of more than 1 A can be recorded as a tripping criterion.

Assessment criterion:

- A dc-current of 1A is injected, disconnection time of max. 0,2s

Note:

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

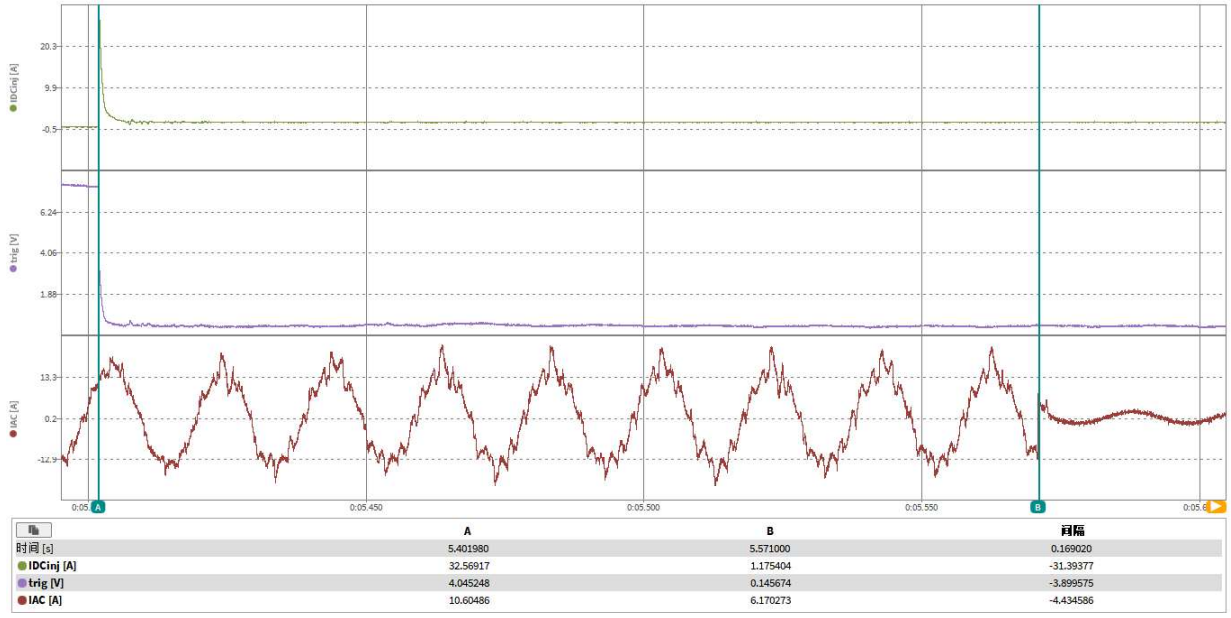
S6000TL

Monitoring of d.c. injection into the mains

DC Injection [A]	Limits	Trip Time [ms]		
+ I d.c.: > 1 A	disconnection within 0.2 sec	76	138	169
- I d.c.: > 1 A	disconnection within 0.2 sec	168	179	116

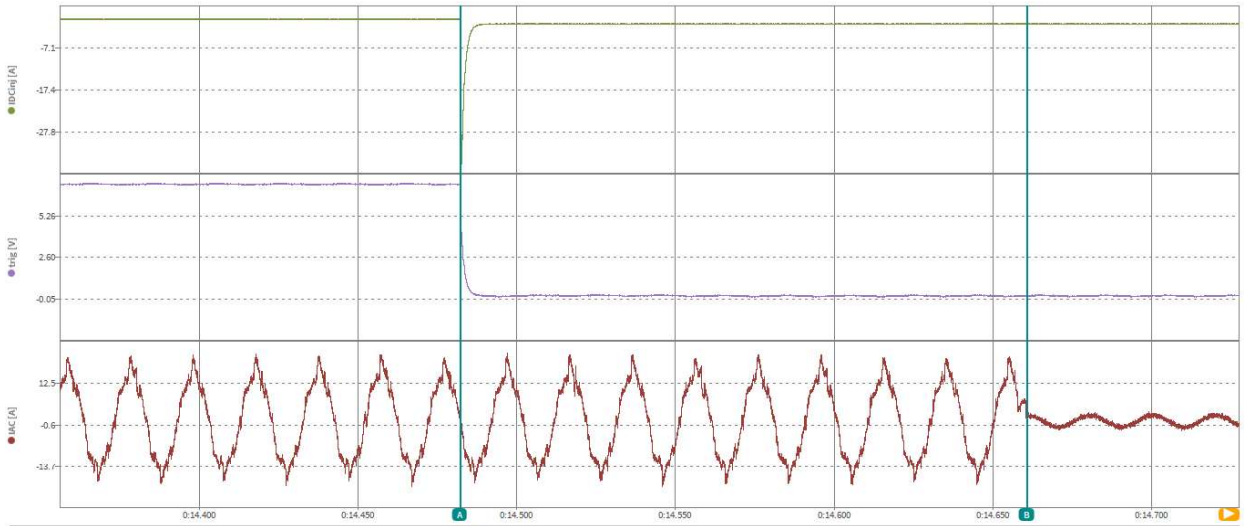
Note: For this test, there is no need the DC component of the current to get to 1A, and the product can be disconnected also.

DC-Injection (+ Id.c.: > 1 A):



	A	B	间隔
时间 [s]	5.401980	5.571000	0.169020
IDCinj [A]	32.56917	1.175404	-31.39377
trig [V]	4.045248	0.145674	-3.899575
IAC [A]	10.60486	6.170273	-4.434586

DC-Injection (- Id.c.: > 1 A):



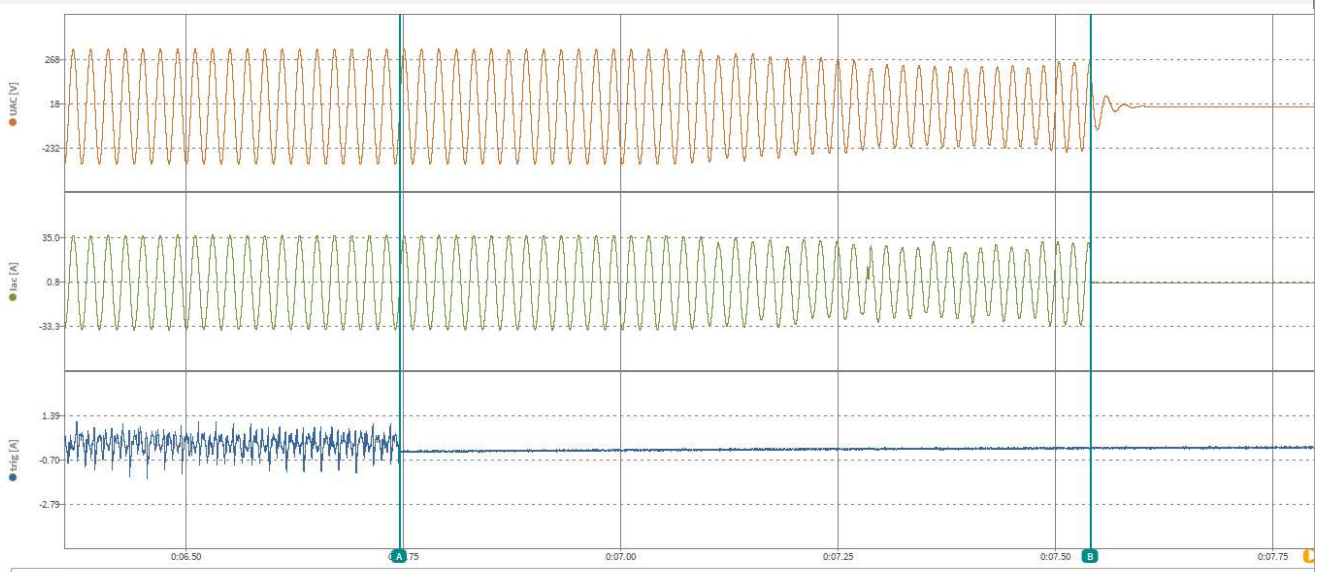
	A	B	间隔
时间 [s]	0:14.4822	0:14.6608	0.1785
IDCinj [A]	0.019073	-1.169443	-1.188517
trig [V]	7.263422	0.073195	-7.190228
IAC [A]	1.535416	2.460480	0.925064

6.6 Detection of islanding

Disconnection due to the detection of unintentional isolated system operation must be carried out in accordance with DIN VDE V 0126-1-1:2006-02, 6.5.2.
These tests should be carried out in accordance with DIN VDE V 0126-1-1:2006-02, 6.5.2.2
Test condition: Frequency: 50 ±0,1Hz U_n = 230 ±3%U_n RLC consumes inverter real power within ± 3 % Distortion factor of chokes <3% Quality factor Q_f >2
Note: The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.
S6000TL
The following sub set of tests should be recorded in the following condition.
Test results:

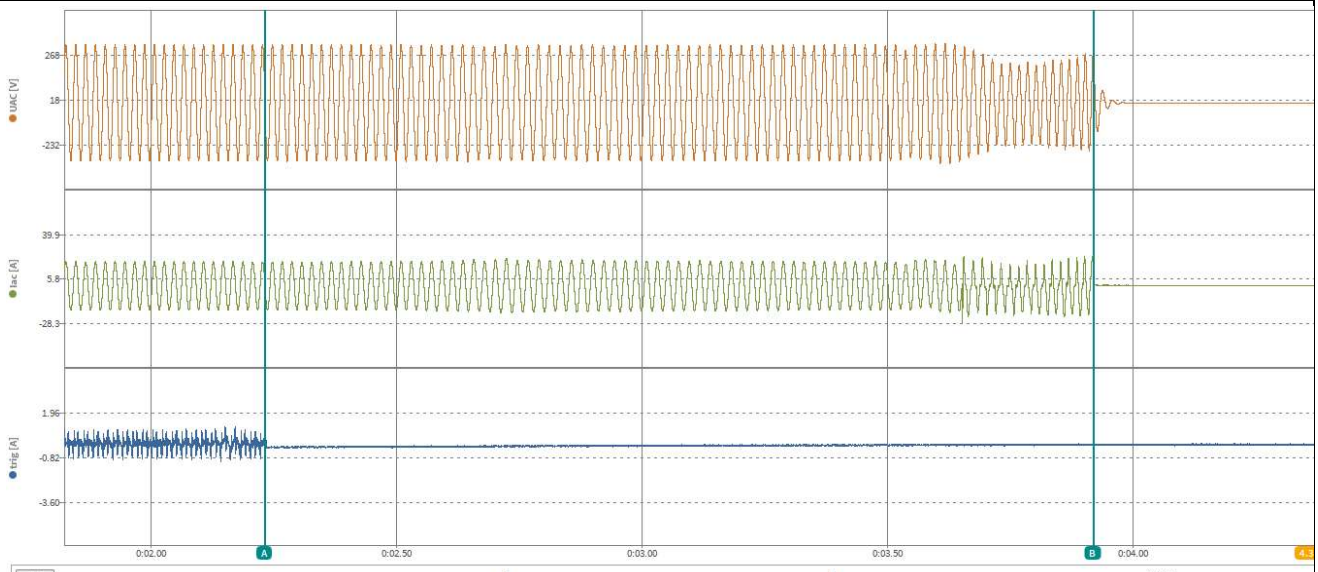
Disconnection limit:	5 s		
Test Power level [%P_n]: / Osc. Parameter	100%	50%	25%
	Disconnection time [ms]		
- 5%	388	417	423
- 4%	395	441	458
- 3%	466	483	479
- 2%	487	451	484
- 1%	537	1541	762
0 %	**794**	**1686**	**1676**
+1 %	465	1714	1631
+2 %	403	429	1676
+3 %	409	410	399
+4 %	361	360	449
+5 %	345	348	410
Parameter at 0%	L: 14,08 mH R: 8,85 Ω C: 719,66 µF	L: 27,90 mH R: 17,57 Ω C: 363,14 µF	L: 53,55 mH R: 33,70 Ω C: 189,22 µF
Udc [V]	288	215	128
Pac [W]	6000	3000	1500
Iac [A]	0,089	0,087	0,041

Disconnection at 0% reactive load and 100% nominal power



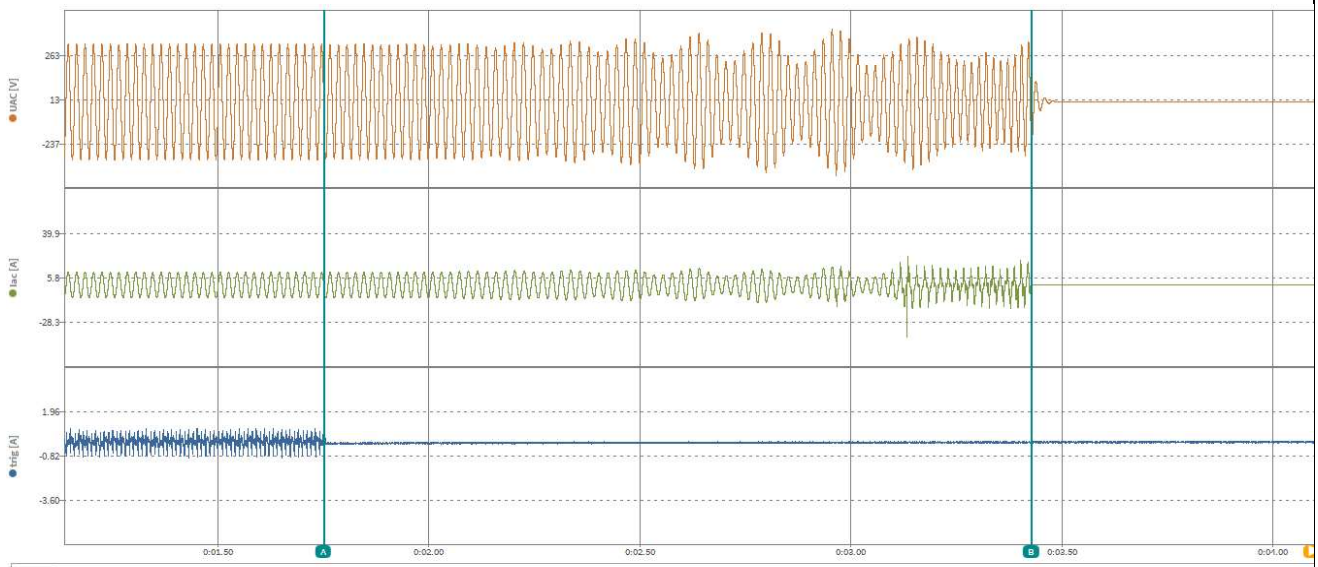
	A	B	间隔
时间 [s]	6.746600	7.540200	0.793600
UAC [V]	30.71090	197.0875	166.3706
Iac [A]	1.195669	0.548363	-0.647306
trig [A]	0.091791	-0.154972	-0.246763

Disconnection at 0% reactive load and 50% nominal power



	A	B	间隔
时间 [s]	2.233100	3.919300	1.686200
UAC [V]	56.40316	274.5409	218.1378
Iac [A]	3.644228	13.39555	9.751320
trig [A]	0.060797	-0.025034	-0.085831

Disconnection at 0% reactive load and 25% nominal power



	A	B	间隔
时间 [s]	1.752000	3.427900	1.675900
UAC [V]	40.77640	-254.2024	-294.9808
Iac [A]	1.752377	2.872944	1.120567
trig [A]	-0.439882	0.044107	0.483990

Note:

The inductance is adjusted so that $Q_f > 2$.

The capacity is adjusted so that $P_{QC}+P_{QL}=-P_{Q,\,WR}$.

The resistance is adjusted so that total real power accepted by the oscillating circuit is P_{WR}.

$$L=\frac{U^2}{2\pi\times f\times P\times Q} \qquad C=\frac{P\times Q}{2\pi\times f\times U^2} \qquad R=\frac{U^2}{P} \qquad Q=R\sqrt{\frac{C}{L}}$$

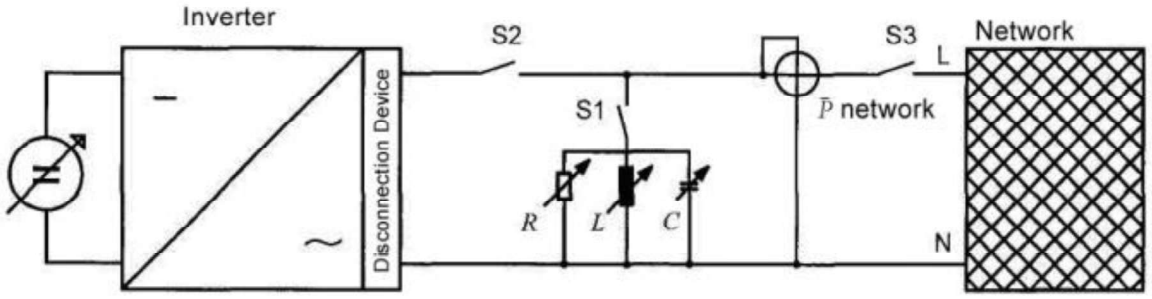


Figure 3 - Test circuit according to 6.5.2 - Example with an integrated disconnection device in the inverter

6.7 Requirements for photovoltaic inverters with integrated disconnection means

The requirements according to DIN EN 62109-2 (VDE 0126-14-2):2012-04, 4.8, for residual current monitoring and insulation monitoring of the PV generator must be fulfilled. and on the insulation monitoring of the PV generator must be fulfilled

6.7.1 Requirements for photovoltaic inverters with integrated disconnection means
(Array insulation resistance detection for inverters for ungrounded arrays)

The earth connection is complying the requirements according 7.3.6.3.3.1 Test current, duration and acceptance criteria of the IEC/EN 62109-1 (DIN EN 62109-1).

The conditions and testing are performed according to IEC/EN 62109-2, 4.8.2.1 Array insulation resistance detection for inverters for ungrounded arrays

DC Voltage below minimum operating voltage [V]	DC Voltage for inverter begin operation [V]	Resistance between ground and PV input terminal [Ω]	Required Insulation resistance R = (V_{MAX} PV / 30mA) [Ω]	Result
DC+				
70	75	16,5k	18,3k	PV1 When the fault applied, the inverter cannot start-up and LED light indicate display Red.
70	75	16,5k	18,3k	
70	75	16,5k	18,3k	
70	75	20,0k	18,3k	The inverter can start-up
70	75	20,0k	18,3k	
70	75	20,0k	18,3k	
DC-				
70	75	16,5k	18,3k	PV1 When the fault applied, the inverter cannot start-up and LED light indicate display Red.
70	75	16,5k	18,3k	
70	75	16,5k	18,3k	
70	75	20,0k	18,3k	The inverter can start-up
70	75	20,0k	18,3k	
70	75	20,0k	18,3k	

Note:

The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

6.7.2 Requirements for photovoltaic inverters with integrated disconnection means (30 mA touch current type test for isolated inverters)

The earth connection is complying the requirements according 7.3.6.3.3.1 Test current, duration and acceptance criteria of the IEC/EN 62109-1 (DIN EN 62109-1).

The conditions and testing are performed according to IEC/EN 62109-2, 4.8.3.2 30 mA touch current type test for isolated inverters

Test condition	Current (mA)	Limit (30mA)
DC+ to PE	--	30mA
DC- to PE	--	30mA

6.7.3 Requirements for photovoltaic inverters with integrated disconnection means (Fire hazard residual current type test for isolated inverters)

The earth connection is complying the requirements according 7.3.6.3.3.1 Test current, duration and acceptance criteria of the IEC/EN 62109-1 (DIN EN 62109-1).

The conditions and testing are performed according to IEC/EN 62109-2, 4.8.3.3 Fire hazard residual current type test for isolated inverters

Supplementary information:

☐ 300 mA RMS for inverters with rated continuous output power ≤ 30 kVA

☐ 10 mA RMS per kVA of rated continuous output power for inverters with rated continuous output power rating > 30 kVA.

☐ The it is acceptable (and may be necessary) to defeat array insulation resistance detection functions during this test, but must be confirmed the DC supply to the inverter must not have any connection to earth, and the mains supply to the inverter must have one pole earthed.

Test condition	Current (mA)	Limit (300mA or 10mA per kVA)
DC+ to PE	--	300mA
DC- to PE	--	300mA

6.7.4 Requirements for photovoltaic inverters with integrated disconnection means (Protection by residual current monitoring)

(Not applicable for inverters with isolation complying with the leakage current limits for both shock and fire hazards under "Minimum inverter isolation requirements" above)

The earth connection is complying the requirements according 7.3.6.3.3.1 Test current, duration and acceptance criteria of the IEC/EN 62109-1 (DIN EN 62109-1).

The conditions and testing are performed according to IEC/EN 62109-2, 4.8.3.5 Protection by residual current monitoring

Note:

– maximum 300mA for inverters with continuous output power rating ≤30 kVA;
– maximum 10mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.

This test shall be repeated 5 times, and for all 5 tests the time to disconnect shall not exceed 0,3s.
The test is repeated for each PV input terminal. It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel.

a) Continuous residual current:

Fault Current (mA)		Disconnection time (ms)	
Measured Fault Current [mA]	☒Limit 300 mA for output power ≤ 30 kVA or ☐10 mA per kVA for output power > 30 kVA	Measured Disconnection time [ms]	Limit [ms]
+ PV to N:			
184	300	263	300
172	300	261	300
185	300	275	300
214	300	247	300
181	300	251	300
- PV to N:			
245	300	266	300
207	300	255	300
177	300	259	300
97	300	259	300
164	300	249	300

b) Sudden changes in residual current:

Limit [mA]	Disconnection time [ms]		Limit [ms]
	+ PV to N:	**- PV to N:**	
30	270	277	300
30	275	271	300
30	266	267	300
30	275	273	300
30	277	273	300
60	107	127	150
60	120	116	150
60	131	132	150

60	116	130	150
60	124	134	150
150	23	33	40
150	29	39	40
150	21	37	40
150	31	29	40
150	28	31	40

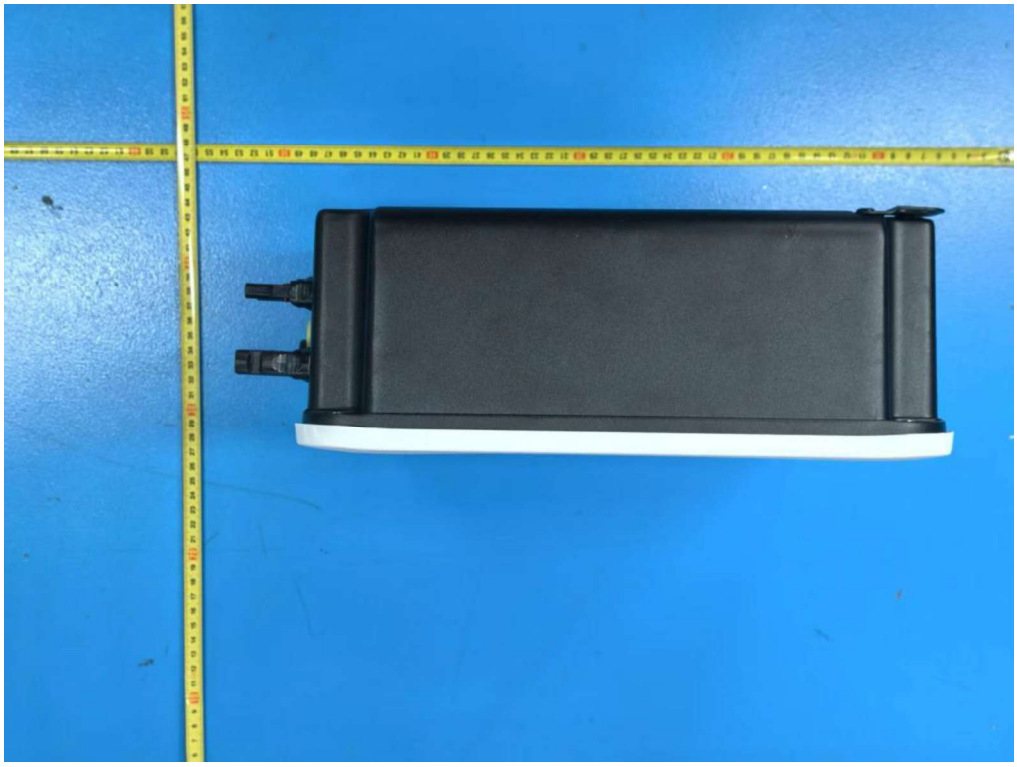
Note:
The test results of the **S6000TL** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Annex 1 - Photo of the unit

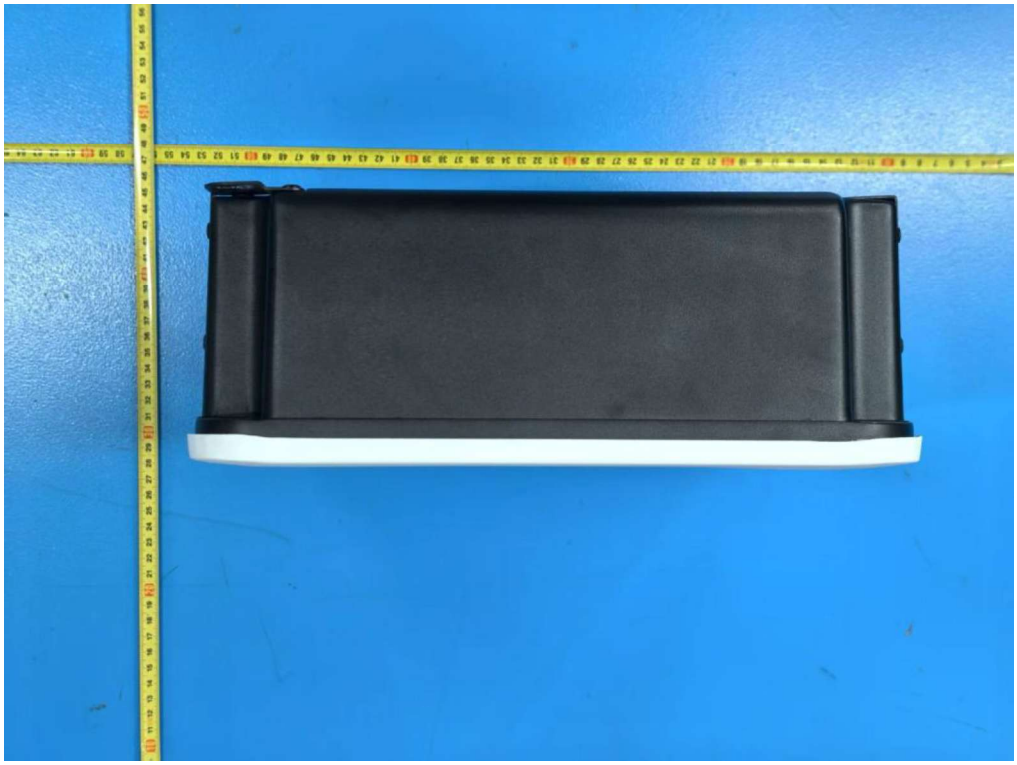
Enclosure front view-1



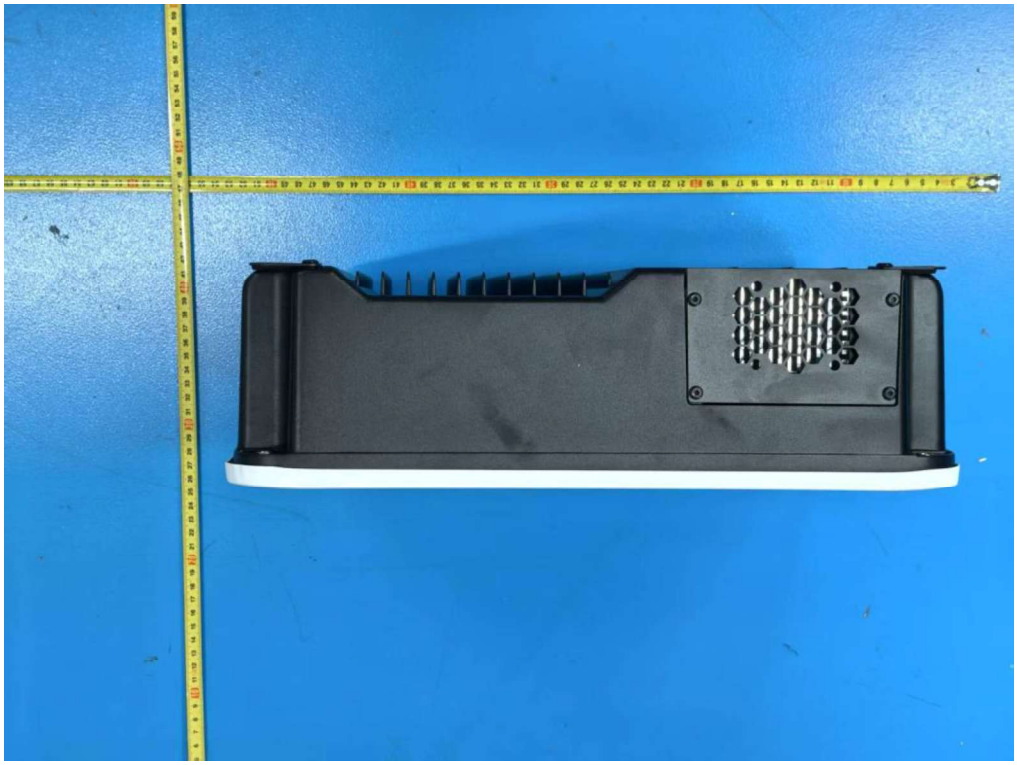
Enclosure side view-1



Enclosure side view-2



Enclosure top view



Enclosure bottom view



Enclosure rear view



Enclosure internal view



>>>> End of Test Report <<<<