TEST REPORT
C10/11: ed.2.1
SPECIFIC TECHNICAL PRESCRIPTIONS REGARDING POWER-GENERATING PLANTS OPERATING IN PARALLEL TO THE DISTRIBUTION NETWORK

Report Reference No..............:	200827077GZU-001
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Tested by (name + signature).........:	Max Gao Engineer
Approved by (name + signature)..	Jason Fu Technical Team Leader
Applicant's name	Shenzhen SOFAR SOLAR Co., Ltd.
Address..	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Test specification:	
Standard	C10/11: ed.2.1, 01 Sep 2019
Test procedure..............................	Type approval for type A
Non-standard test method..............:	N/A
Test Report Form No.	C10/11_a
Test Report Form(s) Originator.....	Intertek Guangzhou
Master TRF	Dated 2019-10

Test item description	Solar Grid-tied Inverter
Trade Mark....................................	SOFAR SOLAR
Manufacturer.................................	Same as Applicant
Model/Type reference....................	SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2, SOFAR 33000TL-G2

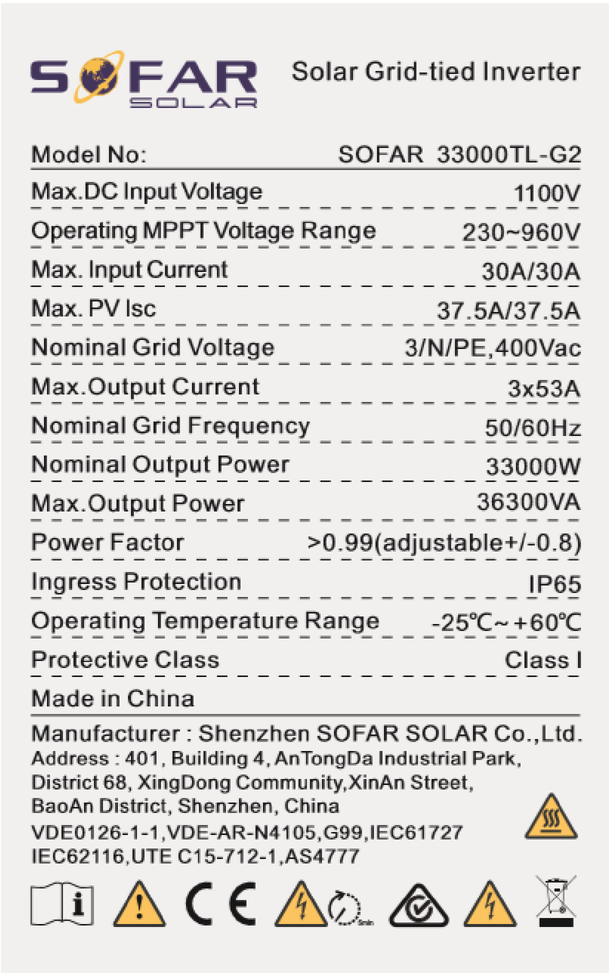
Ratings ....

Model	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2	SOFAR 33000TL-G2
Max. DC input Voltage	1100Vdc			
Operating MPPT voltage range	230Vdc – 960Vdc			
PV Isc	30A*2	35A*2	37.5A*2	37.5A*2
Max.input current	24A/24A	28A/28A	30A/30A	30A/30A
Nominal AC output Power	20000W	25000W	30000W	33000W
Max.Output Power	22000VA	27500VA	33000VA	36300VA
Nominal output voltage	3/N/PE 230Vac/400Vac			
Nominal output Frequency	50Hz			
Power factor range	0.8Leading – 0.8 lagging			
Safety level	Class I			
Ingress Protection	IP 65			
Operation Ambient Temperature	-25℃ - +60℃			
Software version	V2.20			

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
All applicable tests Remark: Other than special notice, for all clauses, the model SOFAR 33000TL-G2 is type tested and valid for other models.	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China

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 side surface of enclosure and visible after installation
3. The other model labels are identical with label above, except the model name and rating.

Test item particulars:					
Temperature range:	-25˚C ~ 60˚C				
AC Overvoltage category:	☐ OVC I	☐ OVC II	☒ OVC III	☐ OVC IV	
DC 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 (Not applicable)				
- test object does meet the requirement:	P (Pass)				
- test object does not meet the requirement:	F (Fail)				
Testing:					
Date of receipt of test item:	28 Aug 2020				
Date (s) of performance of tests:	29 Aug 2020 – 02 Sep 2020				

General remarks:

The test results presented in this report relate only to the object tested.
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"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

When determining for test conclusion, measurement uncertainty of tests has been considered.
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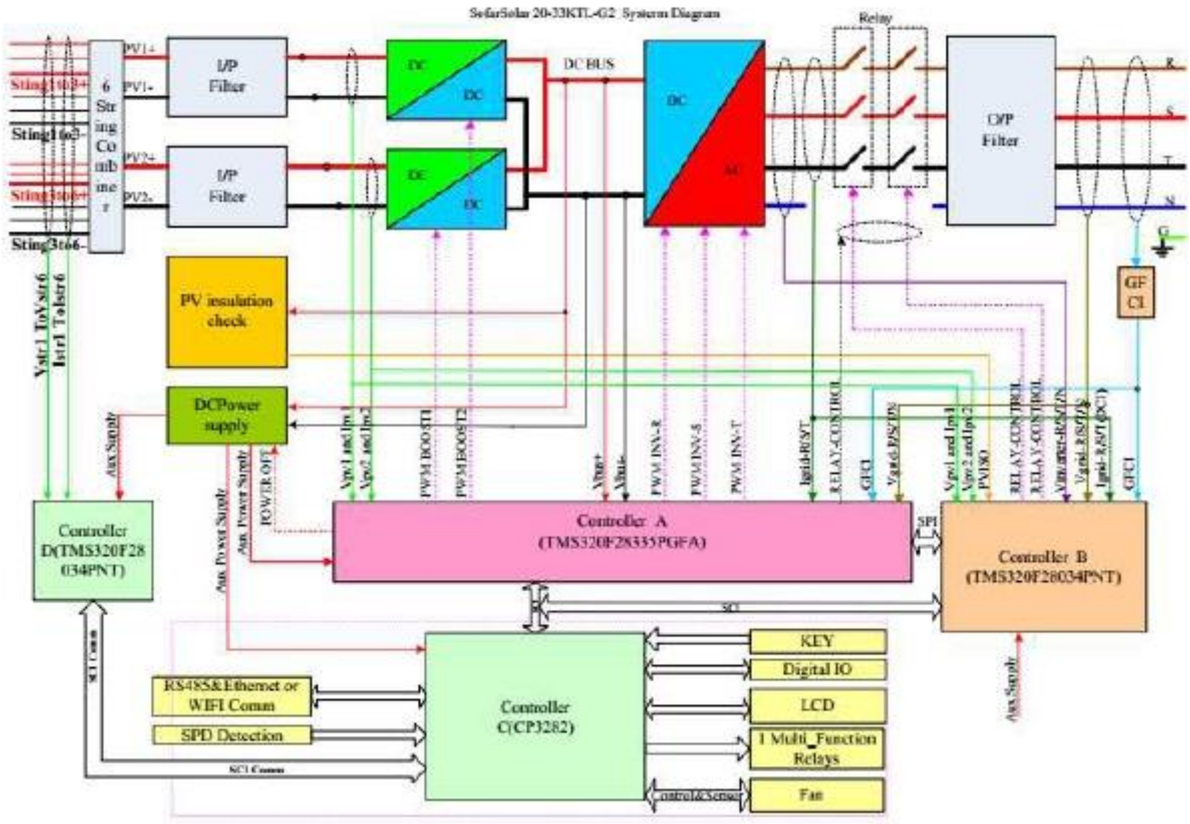
The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.

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

This report is based on report No. 190430035GZU-001, dated 02 Dec 2019 and perform additional tests as required by C10/11: ed.2.1, 01 Sep 2019.

General product information:
The Solar converter is a three-phase type.
The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of one error.



The internal control is redundant built. It consists of Main DSP(UC20) and slave DSP(UC73).
The Main DSP(UC20) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.
The slave DSP(UC73) is using for detecting residual current, also can open the relays independently and communicate with Main DSP(UC20).
The unit provides two relays in series on Line conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before starting up. Both controllers (Main DSP(UC20), Slave DSP(UC73) can open the relays

The product was tested on:
Hardware version: V1.00
Software version: V2.20

Model differences:

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

The difference in hardware			
Item	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2 / SOFAR 33000TL-G2
Number of PV terminal	2+2	3+3	
Number of BUS capacitance	8 capacitors: 550V/110μF 2 capacitors: 1100V/40μF		10 capacitors: 550V/110μF 4 capacitors: 1100V/40μF
INV inductance	785μH	735μH	
Combiner board	Not the board	Have the board	
External fan	Not the board	2	3
Relay of output board	6pcs T9VV1K15-12S		3pcs AZSR250-2AE-12D

The tests had been performed on the SOFAR 33000TL-G2 is valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2.

Factory information:

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C10/11: ed.2.1, 01 Sep 2019			
Clause	Requirement - Test	Result - Remark	Verdict

ANNEXE D	**Technical basic requirements regarding the power-generating units**		P
D.1	**General**	This report is only evaluated and tested for generating unit; The generating plant incorporated with the generating unit shall further consider this clause and sub-clause.	P
	In line with the scope of these technical specifications as well as the CENELEC standards EN 50549-1 and EN 50549-2, these requirements are applicable to all kinds of generation of electrical energy, including energy storage systems.	In line with the scope of EN 50549-1	P
D.2	**Order of priorities**		P
	If different requirements on the power-generating unit interfere with each other, the hierarchy listed in EN 50549-1 or EN 50549-2 shall be respected		P
	In brief, the standard specifies following hierarchy: 1. Generating unit protection, including regarding the prime mover. 2. Interface protection and protection against fault within the power-generating plant; 3. Voltage support during faults and voltage steps; 4. The lower value of: remote control command on active power limitation setpoint from the DSO and local response to overfrequency; 5. Local response to underfrequency if applicable; 6. Reactive power and active power (P(U)) controls; 7. Other control commands on active power set point for e.g. market, economic reasons, self-consumption optimization.		P
D.3	**Integrated automatic separation system**		P
	This clause is applicable to power-generating units with a maximum power ≤ 30 kVA.		P
	An integrated automatic separation system is strongly recommended in order to facilitate the installation procedure. Indeed, if the power-generating unit is not equipped with such an integrated system, an external device must be used	Incorporating integrated automatic separation system	P
	For the integrated automatic separation system, the requirements of this clause apply.		P
	Following protection functions are required: • Overvoltage 10 min mean • Overvoltage • Undervoltage • Overfrequency • Underfrequency • A means to detect island situation (LoM) according to EN 62116.	(See appended table D.3)	P

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Clause	Requirement - Test	Result - Remark	Verdict
	All of these protection functions must comply with the relevant requirements in EN 50549-1 (in edition 2019, section 4.9.3		P
	The integrated automatic separation system must have single fault tolerance according to EN 50549-1.	Two series relays in each line and may independent operation for each relay.	P
	The integrated automatic separation system must be set in accordance with the settings as specified in ANNEXE C		P
D.4	**Operating ranges**		P
	Generating plants shall have the capability to operate in the operating ranges specified below regard-less of the topology and the settings of the interface protection.		P
D.4.1	**Operating frequency range**		P
	This clause is not applicable to backup power systems as specified in § 2.2.1.	Not backup power system	N/A
	The power-generating unit must comply with the minimum requirements of the applicable standard EN 50549 or EN 5055-2 on the operating frequency range (edition 2019, see clause 4.4.2 « Operating frequency range »)	Comply with EN 50549-1	P
	In brief, the requirements in the standard are as follows: Frequency domain — Duration 47,5 Hz – 49,0 Hz — 30 minutes 49,0 Hz – 51,0 Hz — Permanent 51,0 Hz – 51,5 Hz — 30 minutes	(See appended table D.4.1)	P
	Additionally, the DSO shall be informed about the capability of the power-generating unit to operate in the frequency range from 51,5 Hz and 52,5 Hz and, where appropriate, the maximum duration of operation in this frequency range.		P
	The URD cannot without good reason refuse to apply wider frequency ranges or longer minimum operating periods than those specified above, provided that the technical and economic impact is limited.	Comply with above requirements	P
D.4.2	**Maximum admissible power reduction in case of underfrequency**		P
	This clause is not applicable to backup power systems as specified in § 2.2.1.	Not backup power system	N/A
	In general, a power-generating unit must continue to operate in case of a reduction of the frequency at the point of connection. This means that, in underfrequency, the power-generating unit should reduce the output power as little as possible and at least being capable of staying above the limit specified hereafter.		P

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Clause	Requirement - Test	Result - Remark	Verdict

	Where the technical capabilities of the power-generating unit are influenced by ambient conditions, these technical capabilities may be demonstrated using the following reference conditions: • Temperature: 0 °C • Altitude: between 400 and 500 m • Humidity: between 15 and 20 g H2O/kg air		P
D.4.2.1	**Limit for non-synchronous power-generating technology (Power Park Modules)**	(See appended table D.4.2.1)	P
	The power-generating unit must comply with the most stringent requirement of EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.4.3 « Minimal requirement for active power delivery at underfrequency »).	Comply with EN 50549-1	P
D.4.2.2	**Limits for synchronous power-generating technology**	Not synchronous power-generating	N/A
	In steady state (from t2 onwards), the power-generating unit must comply with the relevant default requirement of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see section 4.4.3 « Minimal requirement for active power delivery at underfrequency »).		N/A
	Additionally, in the transient time (between t1 and t2), the power-generating unit must comply with the relevant most stringent requirement of EN 50549-1 or EN 50549-2. (In edition 2019 of the standard, the relevant requirements can be found in clause 4.4.3 « Minimal requirement for active power delivery at underfrequency »).		N/A
D.4.3	**Continuous operating voltage range**		P
	The power-generating unit must comply with the relevant requirement of EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.4.4 « Continuous operating voltage range »).	Comply with EN 50549-1	P
	In brief, the requirement in the standard specifies the power-generating plant should be capable to operate continuously when he voltage at the point of connection is within the following range:	(See appended table D.4.3)	P
	• For a connection to the low voltage network: 85 % Un < U < 110 % Un where Un = 230 V		P
	• For a connection to the high voltage network: 90 % Uc < U < 110 % Uc where Uc is the declared voltage.		N/A
	It is also allowed to reduce apparent power in case of voltage is below respectively 95 % Un or 95 % Uc.		P
D.5	**Immunity to disturbances**		P
	Independent of the topology and the settings of the interface protection, a power-generating unit must have the following withstand capabilities.		P
D.5.1	**Rate of change of frequency (RoCoF) immunity**		P
	This clause does not apply to backup power systems as specified in § 2.2.1.	Not backup power system	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	The power-generating unit must comply with the relevant requirements of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see section 4.5.2 « Rate of change of frequency (RoCoF) im-munity ») taking the additional modifications and information specified hereunder into account.	(See appended table D.5.1)	P
	The power-generating unit shall have the capability to stay connected and operate when the frequen-cy at the point of connection changes with the frequency against time profiles as depicted in the fig-ures hereunder. When considering a sliding measurement window of 500ms, these profiles have a maximum RoCoF of 2 Hz/s.		P
	For synchronous generating technology, this requirement is more stringent than the default value in the applicable standard EN 50549-1 or EN 50549-2 (2 Hz/s instead of 1 Hz/s) as, in contrast with the standard, no distinction is made between power-generating technologies.	Not synchronous power-generating	N/A
D.5.2	**Under-voltage ride through UVRT**		P
	This section is not applicable to backup power systems as specified in § 2.2.1.	Not backup power system	N/A
	For a power-generating unit that is part of a power-generating module with a power ≥ 1 MW (type B in accordance with NC RfG) this paragraph is mandatory.		N/A
	For a power-generating unit that is part of a power-generating module with a power < 1 MW, this par-agraph is non-mandatory and to be considered as a orienting capability, not as a hard requirement. However, the real withstand capability to voltage dips shall be provided during the homologation process.	Considered as an orienting capability	P
	The power-generating unit must comply with the relevant requirements of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.5.3 « Under-voltage ride through (UVRT) »), with the following change: • The voltage-time profiles are to be replaced by the profiles hereunder.	(See appended table D.5.2)	P
	As a consequence, for synchronous generating technology this profile is more stringent than the de-fault requirement in EN 50549-1 or EN 50549-2.	Not synchronous power-generating	N/A
	For some power-generating technologies, the behaviour of the power-generating unit during and after voltage dips may be impacted by the short circuit power available at the point of connection.		N/A
	For such technologies different cases can be considered:		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	• Compliance with this UVRT requirement can be demonstrated considering a ratio of 10 be-tween the available short circuit power at the connection point and the maximum power of the considered power-generating module. In this case, no further checks are needed.		N/A
	• If not, the manufacturer must declare the minimum short-circuit power conditions for which the UVRT-requirement can be complied with. This value shall be considered during the installation process.		N/A
	In line with EN 50549-1 or EN 50549-2 at least 90% of the pre-fault power or 90% of the available power whichever is the smallest, shall be resumed as fast as possible, but at the latest within the following default time after the voltage returned to the continuous operating voltage range (85% Un < U < 110% Un for a connection to a low-voltage distribution network; 90% Uc < U < 110% Uc for a connection to a high-voltage distribution network):		P
	• 3 seconds for a power-generating unit with synchronous generating technology		N/A
	• 1 second for a power-generating unit with non-synchronous generating technology		P
	Another site specific maximum allowed time is to be agreed during the commissioning process. This decision must be taken with the DSO in coordination with the TSO.		N/A
	For a backup power system connected to the high voltage distribution network as specified in §2.2.1, the general requirement is this clause may be relaxed, replacing the voltage-time profile by the figure underneath.	Not backup power system	N/A
D.5.3	**Over-voltage ride through (OVRT)**		N/A
	Requirement under consideration for a future edition. No requirement in this edition.		N/A
D.6	**Active response to frequency deviations**		P
D.6.1	**Power response to overfrequency**		P
	This clause is not applicable to backup power system as specified in section §2.2.1	Not backup power system	N/A
	The power-generating unit must comply with the relevant requirements of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see 4.6.1 « Power response to overfrequency ») taking into account the additional modifications and information specified hereunder.	Comply with EN 50549-1	P
	Instead of the default maximum step response time of 30s specified in the standards EN 50549-1 and EN 50549-2, the following dynamic step response characteristics are required:		P

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Clause	Requirement - Test	Result - Remark	Verdict
	• For synchronous power-generating technologies For power-generating units base on a gas turbine or an internal combustion engine with tech-nical specificities not allowing compliance with the prescriptions applied by default as de-scribed above, the following alternative prescription, relating to a minimum power gradient in increasing or decreasing frequency, is applicable:		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	- If Pmax ≤2 MW at minimum 1,11 % Pmax per second		N/A
	- If Pmax >2 MW at minimum 0,33 % Pmax per second		N/A
	• For non-synchronous power-generating technology	(See appended table D.6.1)	P
	The figure hereunder clarifies the terms « Step response time» and « Settling time». In this clause, the 'Value' is the active power and the tolerance is 10%.		P
	In line with the default requirement of the applicable standard EN 50549-1 :2019 or EN 50549-2: 2019, power-generating units reaching their minimum regulating level shall, in the event of further frequency increase, maintain this power level until a frequency decrease results in a power setpoint which is again above this level.	Comply with EN 50549-1	P
	The optional deactivation threshold fstop is not required. In case fstop is implemented, it shall be deactivated.		P
	At the time of deactivation of the active power frequency response (= frequency goes down below the threshold frequency f1), the active power can be increased to up to the level of the available power. Nevertheless this shall be done respecting a power limit with a gradient of 10% Pmax/min.		P
	For energy storage systems with a connection to the high-voltage distribution network, the DSU might, for justified technical or security reasons, agree with the DSO on applicable minimum state of charge limits in his connection agreement.		N/A
	The settings must be protected from unpermitted interference (e.g. by a password or seal).		P
	Automatic disconnection and reconnection as alternative for the droop function are not permitted by default as per the TSO provisions.		P
D.6.2	**Power response to underfrequency**		P
	The power-generating unit must comply with the relevant requirements of the applicable EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.6.2 « Power response to underfrequency ») taking additional modifications and information as specified hereunder into account.		P
	This clause is applicable to energy storage systems. For justified technical or security reasons, the DSU might agree with the DSO (in his connection agreement is the power-generating plant is connected to the high-voltage distribution network) on applicable maximum state of charge limits in his connection agreement.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	This clause is optional for all other power-generating units. When, in such units, the capability of activating active power response to underfrequency is activated, the power-generating units must comply with the requirements of this clause.		N/A
	Instead of the default maximum step response time of 30s in EN 50549-1 and EN 50549-2, the re-quired dynamic step response characteristics (step response time and settling time) are identical to those stipulated above regarding the power response to overfrequency, including the alternative approach for power-generating units based on a gas turbine or an internal combustion engine (see D.6.1).		P
	The settings must be protected from unpermitted interference (e.g. by a password or seal).		P
D.7	**Power response to voltage changes**		P
D.7.1	**Voltage support by reactive power**		P
	A backup power system as referred to in section §2.2.1, must not comply with the requirements of this clause. Instead, for such a system, the power factor must be as close to 1 as possible and may definitely not fall below the limit of 0.85 during in-parallel operation. No control mode at all for the reactive power is imposed by the DSO.	Not backup power system	N/A
	The power-generating plant must at least comply with the corresponding requirements of the applicable standard EN 50549-1 or EN 50549-233 (edition 2019, see clause 4.7.2 « Voltage support by reactive power ») taking the modifications and additional information specified hereunder into account. It is usually the power-generating unit itself that meets this requirement, which is assessed at the time of the homologation. In the other cases, if for example additional equipment such as a capacitor bank is necessary in combination with the power-generating unit, this will be evaluated by the DSO during the procedure for commissioning.	Comply with EN 50549-1	P
	For a power-generating plant with a maximum power ≤ 250 kVA connected to the high-voltage distribution network, the DSU may decide to comply to the equivalent requirements of EN 50549-1 rather than those of EN 50549-2.		N/A
	The reactive power capability shall be evaluated at the terminals of the power-generating unit (including, when applicable, the step-up transformer specific to the power-generating unit).	(See appended table D.7.1)	P
	The real reactive power capabilities of the power-generating unit at the terminals should be communicated to the DSO. This can be done during the process of homologation.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	If the capabilities exceed the minimum requirement, and as far as this has only limited technical and economic impact, the DSU is not allowed to refuse without justification the DSO to make use of the reactive power capability (this is not applicable to a small power-generating plant (as defined in chapter 4)).		P
	The settings of the control mode must be protected from unpermitted interference (e.g. by a password or seal).		P
D.7.1.1	**Specific for a small power-generating plant**		P
	By default, the power generation unit must operate according to the following rules:		P
	• When the voltage ≤ 105 % Un: cos phi = 1 (Q=0)		P
	• When the voltage > 105 % Un: free operation with 1 ≥ cos phi > 0,9under-excited. (no over-excited operation allowed)		P
D.7.1.2	**Specific for another (not small) power-generating plant**		P
	If applicable, the details of the reactive power control mode to be activated in the power-generating unit shall be provided by the DSO during the installation procedure. This setting might be reviewed by the DSO during the lifetime of the power-generating module.		P
	If the power-generating plant is connected to the high voltage distribution network, it may be necessary to use additional resources such as, for example, a capacitor bank to meet the previous requirements related to the supply of reactive power. If the power-generating unit is disconnected, they must be disconnected as well.	Not connected to the high voltage distribution network	N/A
	For a synchronous power-generating unit that is part of a power-generating module with a maximum power of ≥ 1 MW (type B according to NC RfG), the following specific requirement is also applicable:	Not synchronous power-generating unit	N/A
	Alternatively to the Q(U) control mode specified above, a synchronous power-generating unit of type B (power ≥ 1 MW) shall be equipped with a permanent automatic excitation control system that can provide constant alternator terminal voltage at a selectable setpoint without instability over the entire operating range of the synchronous power-generating module. When the setpoint gives rise to a re-active power exchange beyond the capability requirements above, the reactive power exchange may be kept at the limits of the required capability.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict

	The setpoint must be selectable in the continuous operating voltage range (see section D.4.3) and is given by the DSO.		P
	The DSO can give the required instructions to make the selection of the setpoint possible remotely by the DSO's control center (see § 7.13), respecting the applicable regional legal framework.		P
D.7.2	**Voltage related active power reduction P(U)**	(See appended table D.7.2)	P
	Voltage relating active power reduction is allowed and even recommended in order to avoid disconnection due to the operation of the overvoltage protection. When implemented, the power-generating unit must comply with the relevant requirements of the applicable standard EN 50549-1 or EN50549-2 (edition 2019, see clause 4.7.3 « Voltage related active power reduction »).	Comply with EN 50549-1	P
D.7.3	**Provision of additional fast reactive current during faults and voltage steps**		P
	This Section is only applicable to non-synchronous power-generating units connected to a high volt-age distribution network and are not part of a small power-generating plant.		P
	For power-generating units that are part of a power-generating module with a maximum power <1 MW, there is no capability requirement. However, if such a generating module has the capability to provide additional fast reactive current during faults and voltage steps, this function must be deactivated by default.		P
	Power-generating units that are part of a power-generating module with a maximum power ≥ 1 MW must comply with the relevant requirements of the standard EN 50549-2 (edition 2019, see clause 4.7.4.2.1 « Voltage support during faults and voltage steps »), taking the additional information specified in this Section into account. By default, this function must be deactivated.		P
	A directly connected asynchronous machine cannot provide voltage support in a controlled manner with regard to short circuit currents as a consequence of faults or when there are sudden voltage variations. The DSO will include these elements in its assessment of the demand for connection.		N/A
D.8	**Connection and reconnection**		P

C10/11: ed.2.1, 01 Sep 2019			
Clause	Requirement - Test	Result - Remark	Verdict

	The power-generating unit must comply with the relevant requirements of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.10 « Connection and starting to generate electrical power ») taking the additional information specified hereunder into account.	Comply with EN 50549-1	P
	Connection and reconnection after tripping of the interface protection relay is subject to the conditions listed in the table hereunder. These settings are different than the default settings of EN 50549-1 and EN 50549-2.	(See appended table D.8)	P
	The automatic connection and reconnection is allowed if the abovementioned conditions are met.		P
	If, at the power-generating unit connected to the HV distribution network, no distinct sets of conditions can be applied, it is not possible to make a distinction between the two connection modes, the conditions must be chosen such as they meet both sets of conditions.	Not connected to the HV distribution network	N/A
D.9	**Ceasing and reduction of active power on set point**		P
	This clause is not applicable to the backup power systems specified in §2.2.1.	Not backup power system	N/A
D.9.1	**Ceasing active power**	(See appended table D.9)	P
	The power-generating unit must comply with the relevant requirements of the applicable standard EN 5054-1 or EN 50549-2 (edition 2019, see clause 4.11.1 « Ceasing active power ») taking into account the additional information specified hereunder.	Comply with EN 50549-1	P
	In brief, the requirements in the standards are the following:		P
	For modules with a power > 800 W, a logic interface to cease the production of active power within 5 seconds after receiving the instruction is required.		P
	Remote operation is optional		P
	Respecting the regional regulatory provisions, the DSO can request additional equipment for a remote operation of this logic interface.		P
	Unless defined otherwise by the DSO, this logic interface is based on a contact rather than using a communicated protocol.		P
D.9.2	**Reduction of active power on set point**	(See appended table D.9)	P
	The requirement of this Section is applicable only to the power-generating units that are part of:		P
	• a power-generating module with a maximum power of ≥ 1 MW		N/A

C10/11: ed.2.1, 01 Sep 2019			
Clause	Requirement - Test	Result - Remark	Verdict
	• a power-generating plant with a maximum power of > 250 kVA, if the DSO so requires, in accordance with the regional regulations.		P
	The power-generating module must comply with the relevant requirements of the applicable standard EN 50549-1 or EN 50549-2 (edition 2019, see clause 4.11.2 « Reduction of active power on set point ») taking into account the additional information specified hereunder. Generally, the power-generating unit complies with this requirement, which is assessed when homologated. Otherwise, if, for example, additional equipment such as a capacitor bank is required in combination with the power-generating unit, this will be evaluated by the DSO during the commissioning procedure.	Comply with EN 50549-1	P
	In brief, the requirements in the standard are the following: For type B modules: The settings of the limit must be possible with a maximum increment of 10%. Reduction of the power generation to the respective limit in a range of maximum 0,66 % Pn/ s and of minimum 0,33 % Pn/ s Deconnection of the network is allowed when below minimum regulating level Remote operation is optional		P
	Depending of the modalities specified in section D.10 hereafter, the DSO can request additional equipment for a remote operation of this reduction.		N/A
D.10	**Communication – Remote monitoring and control**		N/A

Appended Table - Testing Result

8.2.3	TABLE: Flicker			P
Flicker measurement According to EN 61000-3-3/EN 61000-3-11				
Model: SOFAR 33000TL-G2				
Value	P_{st}	P_{lt}	d_c	d_{max}
Limit	≤ 1	≤ 0.65	≤ 3.30%	4%
Test value	0.16	0.14	0.03	0.20

Test : SOFAR 33000TL-G2

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.02	0.17	0.00	0.13
2	0.01	0.18	0.00	0.13
3	0.01	0.19	0.00	0.14
4	0.03	0.18	0.00	0.13
5	0.02	0.19	0.00	0.13
6	0.00	0.12	0.00	0.13
7	0.01	0.20	0.00	0.16
8	0.02	0.18	0.00	0.14
9	0.02	0.20	0.00	0.16
10	0.03	0.20	0.00	0.16
11	0.02	0.20	0.00	0.14
12	0.02	0.18	0.00	0.14
				Plt
				0.14

8.2.3	TABLE: Flicker			P
Flicker measurement According to EN 61000-3-3/EN 61000-3-11				
Model: SOFAR 20000TL-G2				
Value	P_{st}	P_{lt}	d_c	d_{max}
Limit	≤ 1	≤ 0.65	≤ 3.30%	4%
Test value	0.11	0.11	0.06	0.11

Test: SOFAR 20000TL-G2

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.06	0.11	0.00	0.11
2	0.00	0.00	0.00	0.11
3	0.00	0.00	0.00	0.11
4	0.00	0.00	0.00	0.11
5	0.01	0.10	0.00	0.11
6	0.00	0.00	0.00	0.11
7	0.00	0.00	0.00	0.11
8	0.00	0.00	0.00	0.11
9	0.00	0.00	0.00	0.11
10	0.00	0.00	0.00	0.11
11	0.00	0.00	0.00	0.11
12	0.00	0.00	0.00	0.11

Plt
0.11

8.2.4	TABLE: Current harmonics emission test	P
Current harmonics emission test for class A limit (According to EN 61000-3-12)		
Model: SOFAR 20000TL-G2		
33% rating power condition:		

Normal ambient (EN 61000-3-12) Output power 33%									
Watts(kW)						2,198/ 2,198/ 2,192			
Vrms(V)						230,07/ 230,01/ 230,00			
Arms(A)						9,554/ 9,557/ 9,532			
Frequency(Hz)						50,00			
THD* (33% output power)						0,604%/ 0,575%/ 0,627%			
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	9,554	9,556	9,532	--	--	--	Three Phase	--
2nd	0,008	0,009	0,007	0,080	0,094	0,079	Three Phase	8,000
3rd	0,027	0,009	0,014	0,281	0,094	0,148	Three Phase	21,600
4th	0,008	0,01	0,009	0,087	0,102	0,090	Three Phase	4,000
5th	0,015	0,027	0,018	0,158	0,281	0,186	Three Phase	10,700
6th	0,01	0,008	0,01	0,101	0,080	0,101	Three Phase	2,667
7th	0,012	0,011	0,015	0,121	0,118	0,157	Three Phase	7,200
8th	0,008	0,006	0,007	0,079	0,068	0,076	Three Phase	2,000
9th	0,023	0,008	0,015	0,239	0,082	0,159	Three Phase	3,800
10th	0,004	0,005	0,004	0,042	0,050	0,043	Three Phase	1,600
11th	0,007	0,014	0,012	0,072	0,143	0,128	Three Phase	3,100
12th	0,004	0,004	0,005	0,042	0,045	0,051	Three Phase	1,333
13th	0,008	0,01	0,017	0,088	0,107	0,183	Three Phase	2,000
14th	0,003	0,003	0,004	0,035	0,030	0,040	Three Phase	8,000
15th	0,009	0,006	0,012	0,096	0,067	0,130	Three Phase	N/A
16th	0,003	0,003	0,003	0,030	0,030	0,030	Three Phase	N/A
17th	0,013	0,013	0,019	0,131	0,132	0,198	Three Phase	N/A
18th	0,003	0,003	0,003	0,031	0,034	0,036	Three Phase	N/A
19th	0,009	0,014	0,017	0,096	0,151	0,179	Three Phase	N/A
20th	0,003	0,003	0,002	0,027	0,028	0,026	Three Phase	N/A
21th	0,006	0,004	0,007	0,063	0,045	0,078	Three Phase	N/A
22th	0,002	0,003	0,002	0,025	0,027	0,025	Three Phase	N/A
23th	0,016	0,017	0,018	0,171	0,174	0,193	Three Phase	N/A
24th	0,003	0,003	0,003	0,033	0,028	0,035	Three Phase	N/A
25th	0,013	0,013	0,015	0,140	0,138	0,158	Three Phase	N/A
26th	0,003	0,003	0,003	0,027	0,031	0,028	Three Phase	N/A
27th	0,003	0,003	0,004	0,030	0,032	0,044	Three Phase	N/A
28th	0,003	0,002	0,002	0,027	0,025	0,026	Three Phase	N/A
29th	0,011	0,013	0,01	0,112	0,136	0,102	Three Phase	N/A
30th	0,003	0,003	0,003	0,027	0,028	0,028	Three Phase	N/A
31th	0,01	0,01	0,008	0,110	0,101	0,087	Three Phase	N/A
32th	0,002	0,002	0,002	0,024	0,025	0,026	Three Phase	N/A
33th	0,004	0,003	0,006	0,038	0,035	0,066	Three Phase	N/A
34th	0,002	0,002	0,002	0,024	0,025	0,025	Three Phase	N/A
35th	0,01	0,009	0,006	0,108	0,098	0,065	Three Phase	N/A
36th	0,003	0,003	0,003	0,029	0,031	0,030	Three Phase	N/A
37th	0,006	0,009	0,006	0,065	0,089	0,061	Three Phase	N/A
38th	0,002	0,002	0,002	0,023	0,024	0,024	Three Phase	N/A
39th	0,003	0,003	0,004	0,029	0,036	0,042	Three Phase	N/A
40th	0,002	0,002	0,002	0,033	0,031	0,028	Three Phase	N/A

66% rating power condition:

Normal ambient (EN 61000-3-12) Output power 66%								
Watts(kW)				4,424/ 4,412/ 4,400				
Vrms(V)				230,09/ 230,04/ 230,02				
Arms(A)				19,229/ 19,180/ 19,129				
Frequency(Hz)				50,00				
THD* (66% output power)				0,459%/0,518%/0,468%				
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	19,229	19,180	19,129	--	--	--	Three Phase	--
2nd	0,008	0,012	0,010	0,042	0,061	0,052	Three Phase	8,000
3rd	0,013	0,043	0,038	0,069	0,226	0,199	Three Phase	21,600
4th	0,010	0,011	0,011	0,052	0,058	0,056	Three Phase	4,000
5th	0,052	0,040	0,018	0,272	0,208	0,097	Three Phase	10,700
6th	0,011	0,009	0,012	0,057	0,047	0,061	Three Phase	2,667
7th	0,028	0,040	0,024	0,144	0,211	0,124	Three Phase	7,200
8th	0,009	0,008	0,008	0,046	0,042	0,041	Three Phase	2,000
9th	0,019	0,023	0,014	0,100	0,122	0,072	Three Phase	3,800
10th	0,005	0,007	0,006	0,026	0,035	0,029	Three Phase	1,600
11th	0,022	0,038	0,035	0,115	0,200	0,184	Three Phase	3,100
12th	0,006	0,004	0,007	0,031	0,023	0,039	Three Phase	1,333
13th	0,035	0,021	0,020	0,181	0,107	0,104	Three Phase	2,000
14th	0,005	0,004	0,005	0,027	0,019	0,024	Three Phase	8,000
15th	0,005	0,023	0,021	0,026	0,120	0,109	Three Phase	N/A
16th	0,004	0,005	0,004	0,021	0,025	0,018	Three Phase	N/A
17th	0,011	0,018	0,026	0,055	0,092	0,135	Three Phase	N/A
18th	0,004	0,003	0,004	0,020	0,017	0,019	Three Phase	N/A
19th	0,025	0,006	0,024	0,130	0,030	0,123	Three Phase	N/A
20th	0,003	0,003	0,003	0,016	0,016	0,016	Three Phase	N/A
21th	0,010	0,010	0,018	0,054	0,053	0,096	Three Phase	N/A
22th	0,003	0,003	0,003	0,015	0,015	0,015	Three Phase	N/A
23th	0,006	0,017	0,016	0,030	0,088	0,085	Three Phase	N/A
24th	0,003	0,003	0,003	0,017	0,014	0,016	Three Phase	N/A
25th	0,015	0,005	0,015	0,080	0,024	0,077	Three Phase	N/A
26th	0,003	0,003	0,003	0,015	0,016	0,015	Three Phase	N/A
27th	0,005	0,009	0,012	0,027	0,048	0,063	Three Phase	N/A
28th	0,003	0,003	0,003	0,013	0,013	0,014	Three Phase	N/A
29th	0,004	0,012	0,013	0,022	0,061	0,067	Three Phase	N/A
30th	0,003	0,002	0,003	0,013	0,013	0,013	Three Phase	N/A
31th	0,012	0,004	0,009	0,060	0,019	0,049	Three Phase	N/A
32th	0,002	0,002	0,003	0,013	0,012	0,014	Three Phase	N/A
33th	0,005	0,008	0,011	0,025	0,040	0,057	Three Phase	N/A
34th	0,003	0,003	0,003	0,014	0,014	0,014	Three Phase	N/A
35th	0,004	0,008	0,009	0,020	0,044	0,045	Three Phase	N/A
36th	0,003	0,003	0,003	0,014	0,015	0,014	Three Phase	N/A
37th	0,010	0,004	0,010	0,052	0,021	0,051	Three Phase	N/A
38th	0,002	0,002	0,002	0,013	0,013	0,013	Three Phase	N/A
39th	0,004	0,006	0,007	0,019	0,033	0,034	Three Phase	N/A
40th	0,002	0,002	0,002	0,012	0,012	0,012	Three Phase	N/A

100% rating power condition:

Normal ambient (EN 61000-3-12) Output power 100%								
Watts				6,735/ 6,713/ 6,700				
Vrms				230,12/ 230,06/ 230,05				
Arms				29,271/ 29,181/ 29,127				
Frequency				50,00				
THD				0,447%/ 0,462%/ 0,597%				
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	29,271	29,181	29,126	--	--	--	Three Phase	--
2nd	0,014	0,015	0,012	0,048	0,053	0,041	Three Phase	8,000
3rd	0,021	0,049	0,062	0,073	0,169	0,212	Three Phase	21,600
4th	0,009	0,013	0,013	0,032	0,044	0,045	Three Phase	4,000
5th	0,069	0,027	0,056	0,235	0,093	0,191	Three Phase	10,700
6th	0,012	0,010	0,011	0,040	0,035	0,038	Three Phase	2,667
7th	0,044	0,074	0,062	0,151	0,253	0,213	Three Phase	7,200
8th	0,008	0,010	0,009	0,026	0,034	0,032	Three Phase	2,000
9th	0,045	0,025	0,026	0,155	0,085	0,090	Three Phase	3,800
10th	0,005	0,005	0,007	0,017	0,019	0,023	Three Phase	1,600
11th	0,024	0,061	0,074	0,083	0,210	0,255	Three Phase	3,100
12th	0,006	0,004	0,006	0,022	0,014	0,020	Three Phase	1,333
13th	0,054	0,023	0,051	0,184	0,079	0,174	Three Phase	2,000
14th	0,005	0,005	0,007	0,018	0,018	0,024	Three Phase	8,000
15th	0,011	0,024	0,035	0,039	0,082	0,120	Three Phase	N/A
16th	0,004	0,006	0,004	0,015	0,021	0,014	Three Phase	N/A
17th	0,026	0,029	0,049	0,089	0,099	0,169	Three Phase	N/A
18th	0,005	0,005	0,003	0,016	0,017	0,011	Three Phase	N/A
19th	0,033	0,020	0,043	0,113	0,068	0,147	Three Phase	N/A
20th	0,003	0,005	0,004	0,011	0,016	0,014	Three Phase	N/A
21th	0,014	0,008	0,022	0,048	0,028	0,077	Three Phase	N/A
22th	0,004	0,004	0,003	0,013	0,015	0,011	Three Phase	N/A
23th	0,009	0,027	0,029	0,031	0,093	0,101	Three Phase	N/A
24th	0,003	0,003	0,004	0,011	0,011	0,012	Three Phase	N/A
25th	0,022	0,012	0,027	0,077	0,041	0,094	Three Phase	N/A
26th	0,004	0,004	0,003	0,012	0,014	0,010	Three Phase	N/A
27th	0,008	0,009	0,018	0,026	0,031	0,061	Three Phase	N/A
28th	0,003	0,003	0,003	0,011	0,012	0,009	Three Phase	N/A
29th	0,012	0,020	0,023	0,039	0,067	0,079	Three Phase	N/A
30th	0,003	0,003	0,003	0,009	0,012	0,009	Three Phase	N/A
31th	0,021	0,011	0,023	0,072	0,038	0,078	Three Phase	N/A
32th	0,003	0,003	0,003	0,009	0,011	0,009	Three Phase	N/A
33th	0,006	0,006	0,012	0,022	0,021	0,042	Three Phase	N/A
34th	0,004	0,004	0,004	0,012	0,013	0,012	Three Phase	N/A
35th	0,010	0,018	0,019	0,034	0,061	0,065	Three Phase	N/A
36th	0,003	0,003	0,003	0,010	0,011	0,009	Three Phase	N/A
37th	0,016	0,009	0,018	0,053	0,032	0,061	Three Phase	N/A
38th	0,002	0,003	0,002	0,009	0,009	0,009	Three Phase	N/A
39th	0,004	0,007	0,010	0,015	0,023	0,035	Three Phase	N/A
40th	0,002	0,002	0,002	0,009	0,008	0,008	Three Phase	N/A

8.2.4	TABLE: Current harmonics emission test	P
Current harmonics emission test for class A limit (According to EN 61000-3-12)		
Model: SOFAR 33000TL-G2		
33% rating power condition:		

Normal ambient (EN 61000-3-12) Output power 33%								
Watts(kW)				3,579/3,557/3,556				
Vrms(V)				230,19/229,55/230,05				
Arms(A)				15,552/15,495/15,461				
Frequency(Hz)				50,00				
THD* (33% output power)				0,908%/0,892%/0,776%				
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	15,552	15,495	15,461	99,996	99,996	99,997	Three Phase	--
2nd	0,029	0,015	0,027	0,186	0,099	0,173	Three Phase	8,000
3rd	0,037	0,046	0,063	0,235	0,297	0,408	Three Phase	21,600
4th	0,030	0,011	0,026	0,193	0,071	0,170	Three Phase	4,000
5th	0,071	0,059	0,025	0,456	0,379	0,164	Three Phase	10,700
6th	0,026	0,010	0,022	0,167	0,064	0,145	Three Phase	2,667
7th	0,055	0,064	0,034	0,353	0,413	0,221	Three Phase	7,200
8th	0,018	0,010	0,013	0,119	0,064	0,086	Three Phase	2,000
9th	0,025	0,033	0,021	0,162	0,216	0,137	Three Phase	3,800
10th	0,011	0,011	0,010	0,068	0,069	0,063	Three Phase	1,600
11th	0,027	0,051	0,030	0,175	0,328	0,192	Three Phase	3,100
12th	0,009	0,007	0,007	0,058	0,046	0,047	Three Phase	1,333
13th	0,038	0,028	0,013	0,246	0,184	0,083	Three Phase	2,000
14th	0,009	0,008	0,008	0,057	0,050	0,055	Three Phase	8,000
15th	0,012	0,026	0,024	0,077	0,170	0,154	Three Phase	N/A
16th	0,009	0,007	0,007	0,057	0,048	0,046	Three Phase	N/A
17th	0,008	0,016	0,018	0,050	0,103	0,114	Three Phase	N/A
18th	0,007	0,007	0,006	0,048	0,043	0,041	Three Phase	N/A
19th	0,015	0,008	0,014	0,096	0,050	0,094	Three Phase	N/A
20th	0,008	0,007	0,006	0,050	0,044	0,042	Three Phase	N/A
21th	0,010	0,010	0,021	0,067	0,063	0,135	Three Phase	N/A
22th	0,007	0,006	0,006	0,047	0,042	0,039	Three Phase	N/A
23th	0,009	0,011	0,012	0,055	0,069	0,075	Three Phase	N/A
24th	0,007	0,007	0,006	0,048	0,043	0,041	Three Phase	N/A
25th	0,010	0,008	0,011	0,063	0,050	0,068	Three Phase	N/A
26th	0,007	0,007	0,007	0,048	0,043	0,043	Three Phase	N/A
27th	0,008	0,012	0,010	0,050	0,078	0,065	Three Phase	N/A
28th	0,007	0,006	0,006	0,047	0,042	0,039	Three Phase	N/A
29th	0,010	0,007	0,009	0,066	0,045	0,058	Three Phase	N/A
30th	0,007	0,007	0,006	0,046	0,042	0,038	Three Phase	N/A
31th	0,008	0,009	0,009	0,050	0,059	0,061	Three Phase	N/A
32th	0,007	0,006	0,006	0,047	0,042	0,041	Three Phase	N/A
33th	0,007	0,007	0,010	0,046	0,048	0,066	Three Phase	N/A
34th	0,007	0,007	0,006	0,048	0,042	0,039	Three Phase	N/A
35th	0,010	0,007	0,008	0,064	0,048	0,052	Three Phase	N/A
36th	0,008	0,007	0,006	0,048	0,044	0,040	Three Phase	N/A
37th	0,010	0,009	0,012	0,063	0,055	0,076	Three Phase	N/A
38th	0,008	0,007	0,006	0,049	0,044	0,040	Three Phase	N/A
39th	0,007	0,009	0,007	0,046	0,057	0,048	Three Phase	N/A
40th	0,007	0,006	0,006	0,047	0,041	0,038	Three Phase	N/A

66% rating power condition:

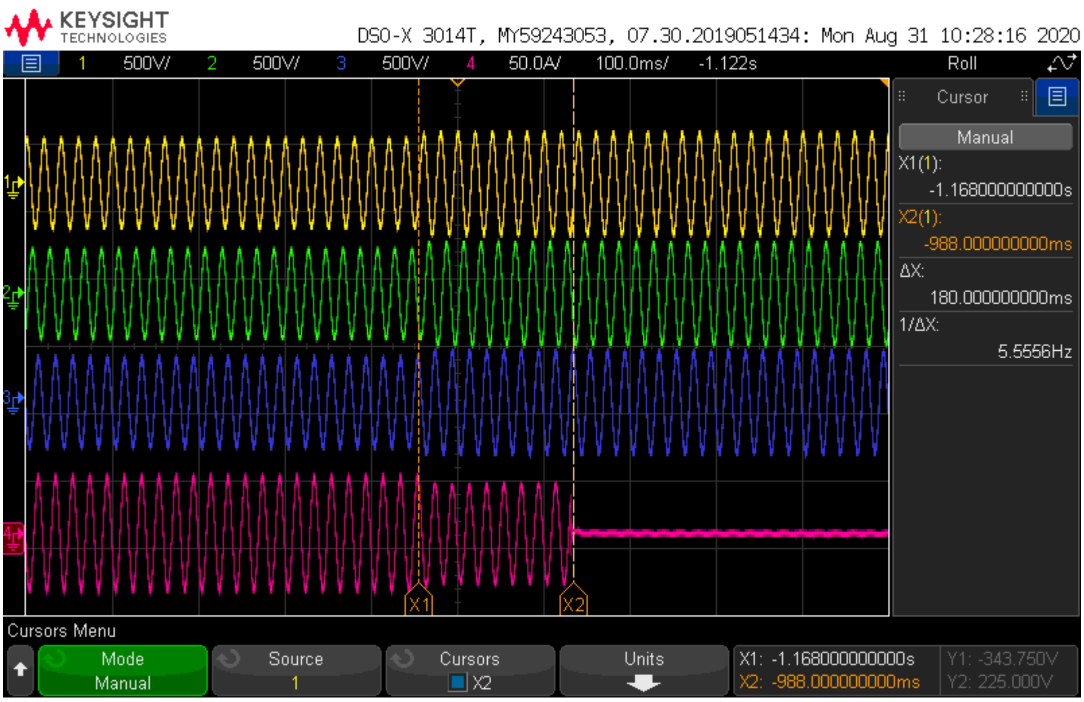
Normal ambient (EN 61000-3-12) Output power 66%								
Watts(kW)				7,289/7,242/7,249				
Vrms(V)				230,31/229,72/230,20				
Arms(A)				31,652/31,528/31,495				
Frequency(Hz)				50,00				
THD* (66% output power)				0,622%/0,592%/0,764%				
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	31,652	31,528	31,494	99,998	99,998	99,997	Three Phase	--
2nd	0,036	0,029	0,031	0,114	0,092	0,098	Three Phase	8,000
3rd	0,053	0,041	0,097	0,167	0,131	0,307	Three Phase	21,600
4th	0,037	0,015	0,032	0,115	0,048	0,101	Three Phase	4,000
5th	0,093	0,055	0,098	0,294	0,176	0,311	Three Phase	10,700
6th	0,025	0,011	0,024	0,078	0,036	0,077	Three Phase	2,667
7th	0,082	0,111	0,093	0,259	0,351	0,297	Three Phase	7,200
8th	0,018	0,014	0,016	0,057	0,043	0,050	Three Phase	2,000
9th	0,059	0,035	0,026	0,187	0,110	0,082	Three Phase	3,800
10th	0,011	0,012	0,010	0,036	0,039	0,031	Three Phase	1,600
11th	0,029	0,079	0,092	0,090	0,252	0,293	Three Phase	3,100
12th	0,011	0,009	0,007	0,035	0,027	0,022	Three Phase	1,333
13th	0,061	0,023	0,060	0,191	0,074	0,190	Three Phase	2,000
14th	0,007	0,010	0,010	0,024	0,031	0,032	Three Phase	8,000
15th	0,024	0,017	0,039	0,076	0,055	0,125	Three Phase	N/A
16th	0,009	0,009	0,007	0,030	0,029	0,023	Three Phase	N/A
17th	0,026	0,038	0,051	0,083	0,121	0,161	Three Phase	N/A
18th	0,008	0,007	0,006	0,024	0,024	0,020	Three Phase	N/A
19th	0,033	0,028	0,045	0,104	0,087	0,144	Three Phase	N/A
20th	0,008	0,008	0,006	0,025	0,026	0,020	Three Phase	N/A
21th	0,020	0,008	0,025	0,063	0,025	0,080	Three Phase	N/A
22th	0,008	0,007	0,006	0,024	0,024	0,019	Three Phase	N/A
23th	0,014	0,033	0,033	0,045	0,104	0,105	Three Phase	N/A
24th	0,007	0,007	0,006	0,023	0,022	0,018	Three Phase	N/A
25th	0,023	0,014	0,030	0,074	0,046	0,096	Three Phase	N/A
26th	0,007	0,007	0,006	0,023	0,023	0,019	Three Phase	N/A
27th	0,013	0,010	0,019	0,040	0,030	0,060	Three Phase	N/A
28th	0,007	0,007	0,005	0,023	0,021	0,017	Three Phase	N/A
29th	0,011	0,020	0,023	0,035	0,063	0,073	Three Phase	N/A
30th	0,007	0,006	0,005	0,021	0,019	0,017	Three Phase	N/A
31th	0,021	0,013	0,024	0,066	0,041	0,077	Three Phase	N/A
32th	0,007	0,006	0,006	0,023	0,021	0,018	Three Phase	N/A
33th	0,010	0,008	0,014	0,030	0,026	0,045	Three Phase	N/A
34th	0,007	0,006	0,005	0,022	0,020	0,017	Three Phase	N/A
35th	0,011	0,020	0,019	0,035	0,065	0,061	Three Phase	N/A
36th	0,007	0,007	0,006	0,023	0,022	0,019	Three Phase	N/A
37th	0,014	0,009	0,017	0,045	0,030	0,052	Three Phase	N/A
38th	0,007	0,007	0,006	0,022	0,021	0,018	Three Phase	N/A
39th	0,008	0,008	0,010	0,025	0,027	0,031	Three Phase	N/A
40th	0,007	0,006	0,005	0,022	0,020	0,017	Three Phase	N/A

100% rating power condition:

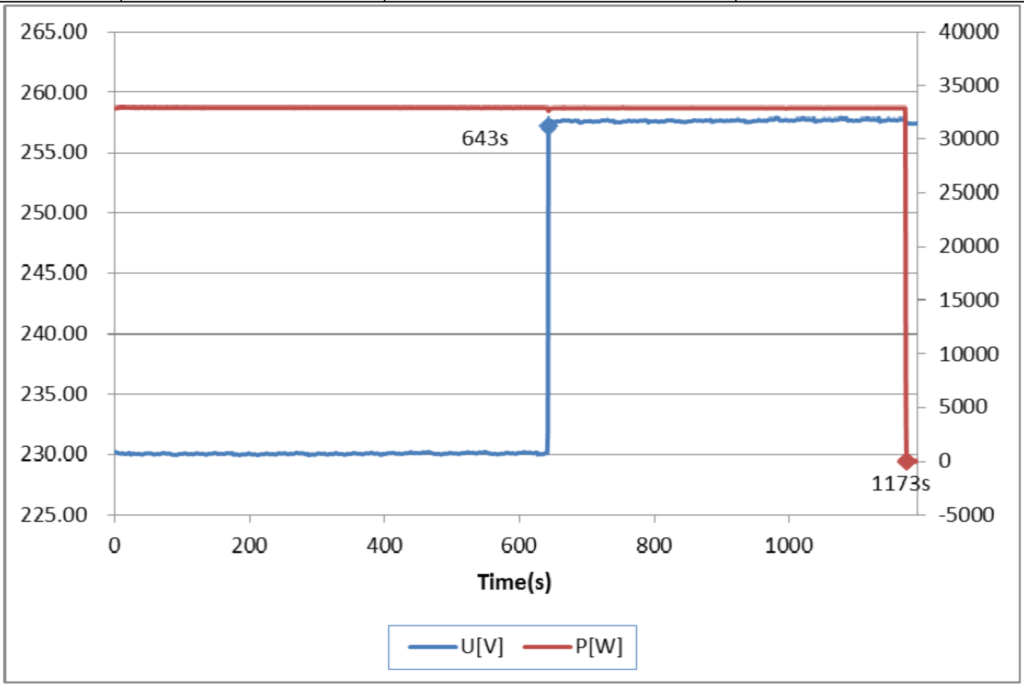
Normal ambient (EN 61000-3-12) Output power 100%									
Watts(kW)					11,043/10,972/10,980				
Vrms(V)					230,31/229,69/230,10				
Arms(A)					47,951/47,773/47,724				
Frequency(Hz)					50,00				
THD* (100% output power)					0,633%/0,624%/0,567%				
Harmonics	Current Magnitude (A)			% of Fundamental			Phase	Harmonic Current Limits (%)
	L1	L2	L3	L1	L2	L3		
1st	47,950	47,772	47,724	99,998	99,998	99,998	Three Phase	--
2nd	0,124	0,087	0,076	0,258	0,181	0,158	Three Phase	8,000
3rd	0,057	0,054	0,094	0,120	0,113	0,197	Three Phase	21,600
4th	0,066	0,047	0,037	0,138	0,099	0,077	Three Phase	4,000
5th	0,060	0,075	0,066	0,124	0,157	0,139	Three Phase	10,700
6th	0,043	0,013	0,035	0,090	0,028	0,073	Three Phase	2,667
7th	0,178	0,198	0,114	0,371	0,415	0,240	Three Phase	7,200
8th	0,052	0,017	0,042	0,108	0,036	0,088	Three Phase	2,000
9th	0,095	0,077	0,018	0,198	0,161	0,038	Three Phase	3,800
10th	0,027	0,011	0,023	0,056	0,024	0,047	Three Phase	1,600
11th	0,058	0,112	0,126	0,121	0,235	0,264	Three Phase	3,100
12th	0,019	0,010	0,012	0,039	0,021	0,025	Three Phase	1,333
13th	0,070	0,032	0,069	0,147	0,067	0,145	Three Phase	2,000
14th	0,014	0,013	0,007	0,030	0,027	0,014	Three Phase	8,000
15th	0,024	0,025	0,026	0,051	0,052	0,055	Three Phase	N/A
16th	0,017	0,012	0,008	0,035	0,025	0,016	Three Phase	N/A
17th	0,022	0,038	0,046	0,046	0,080	0,097	Three Phase	N/A
18th	0,014	0,011	0,006	0,029	0,023	0,012	Three Phase	N/A
19th	0,039	0,038	0,056	0,081	0,079	0,118	Three Phase	N/A
20th	0,009	0,007	0,007	0,018	0,015	0,014	Three Phase	N/A
21th	0,028	0,009	0,018	0,057	0,019	0,038	Three Phase	N/A
22th	0,007	0,006	0,007	0,015	0,012	0,014	Three Phase	N/A
23th	0,024	0,039	0,034	0,049	0,082	0,072	Three Phase	N/A
24th	0,007	0,006	0,005	0,014	0,012	0,011	Three Phase	N/A
25th	0,023	0,018	0,029	0,047	0,037	0,061	Three Phase	N/A
26th	0,006	0,006	0,005	0,014	0,012	0,011	Three Phase	N/A
27th	0,014	0,006	0,017	0,029	0,013	0,036	Three Phase	N/A
28th	0,007	0,006	0,005	0,014	0,013	0,011	Three Phase	N/A
29th	0,014	0,023	0,023	0,029	0,049	0,048	Three Phase	N/A
30th	0,006	0,006	0,005	0,013	0,012	0,011	Three Phase	N/A
31th	0,024	0,020	0,028	0,049	0,042	0,058	Three Phase	N/A
32th	0,006	0,006	0,005	0,013	0,012	0,010	Three Phase	N/A
33th	0,010	0,006	0,010	0,021	0,013	0,020	Three Phase	N/A
34th	0,006	0,006	0,005	0,013	0,012	0,010	Three Phase	N/A
35th	0,018	0,027	0,025	0,038	0,056	0,051	Three Phase	N/A
36th	0,006	0,006	0,005	0,013	0,012	0,010	Three Phase	N/A
37th	0,016	0,012	0,017	0,034	0,026	0,036	Three Phase	N/A
38th	0,006	0,005	0,005	0,013	0,011	0,010	Three Phase	N/A
39th	0,007	0,006	0,008	0,015	0,012	0,016	Three Phase	N/A
40th	0,006	0,005	0,005	0,013	0,011	0,010	Three Phase	N/A

D.3	Table: Overvoltage threshold stage				P
Parameter	**Settings**	**Test 1**	**Test 2**	**Test 3**	**Limits**
Trip value L1 [V]	264.5	263.51	263.59	263.73	264.5±2.3
Trip time [ms]	100	160	164	154	<200
Trip value L2[V]	264.5	263.44	264.30	264.36	264.5±2.3
Trip time [ms]	100	166	170	176	<200
Trip value L3[V]	264.5	264.38	263.44	263.86	264.5±2.3
Trip time [ms]	100	162	158	172	<200
Trip value L1L2L3 [V]	264.5	263.65	263.82	263.42	264.5±2.3
Trip time [ms]	100	166	172	180	<200

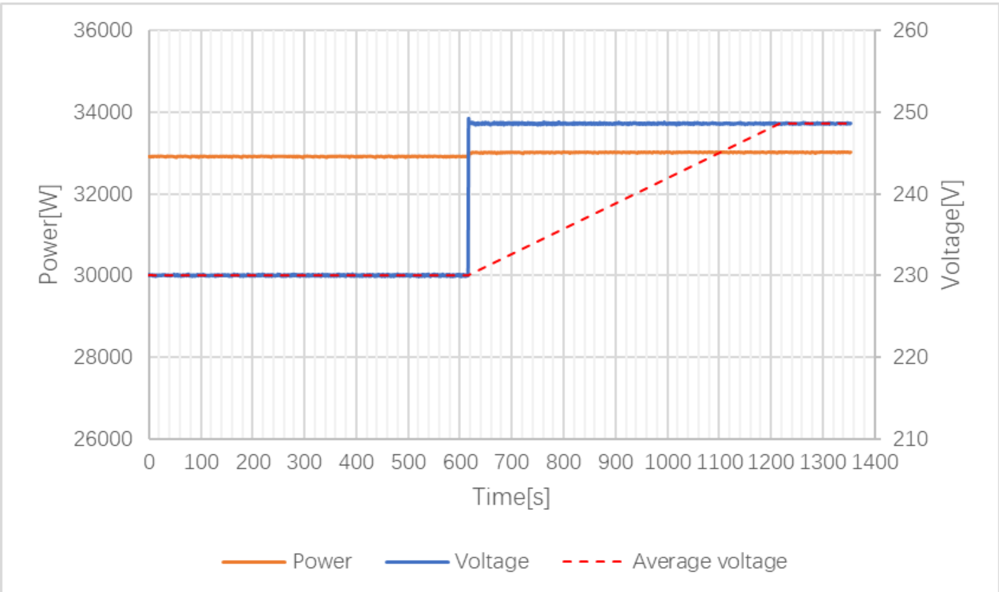
Trip time



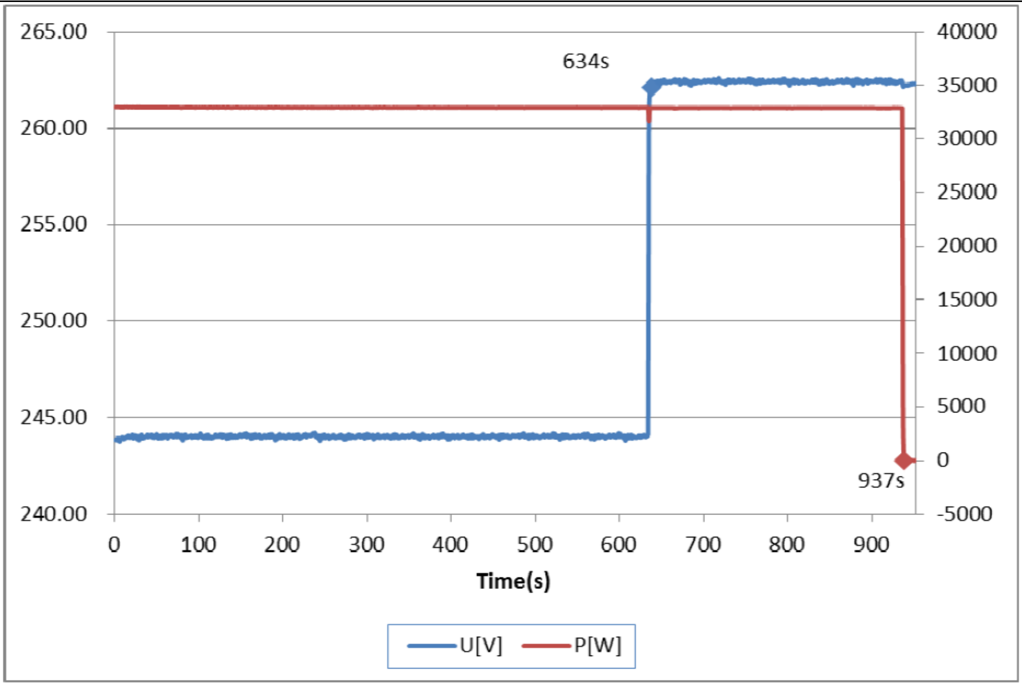
D.3	**Protective functions (Results of the Protection of the Increase in Voltage as 10-min moving average)**		
	Output Voltage (V)	Switch	
		On/Off state Finally	Time until Switch off (s)
100% Un	230.0	☒On ☐Off	Work normally
112% Un	257.6	☐On ☒Off	530
100% Un	230.0	☒On ☐Off	Work normally
108% Un	248.4	☒On ☐Off	Work normally
106% Un	243.8	☒On ☐Off	Work normally
114% Un	262.2	☐On ☒Off	302



Un to 1.12Un



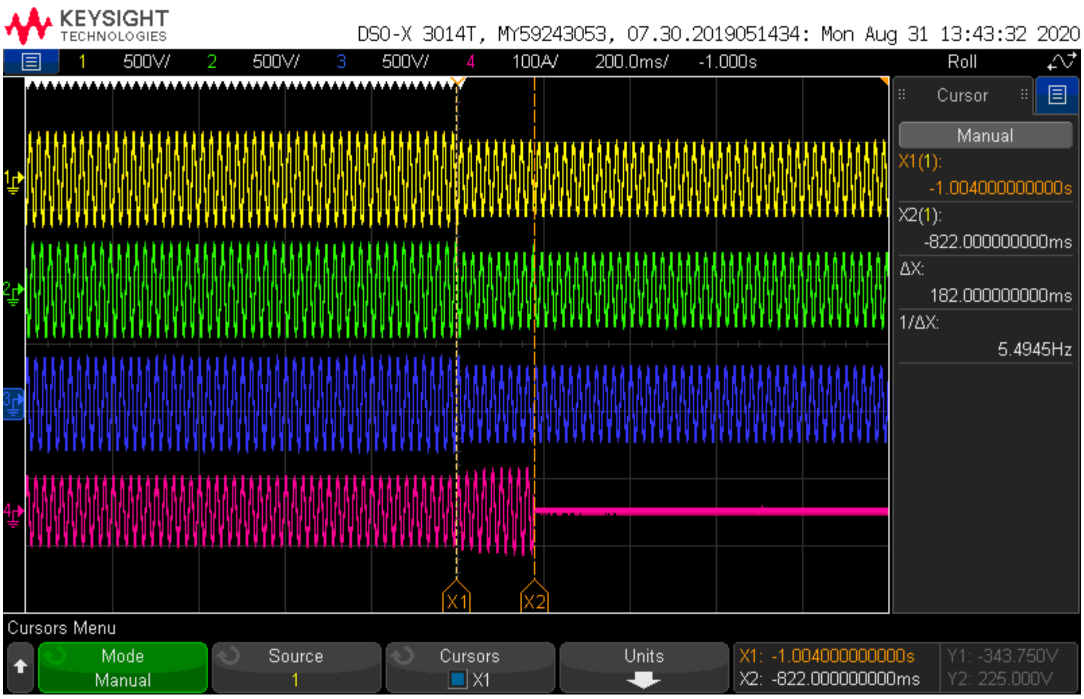
Un to 1.08Un



1.06 Un to 1.14Un

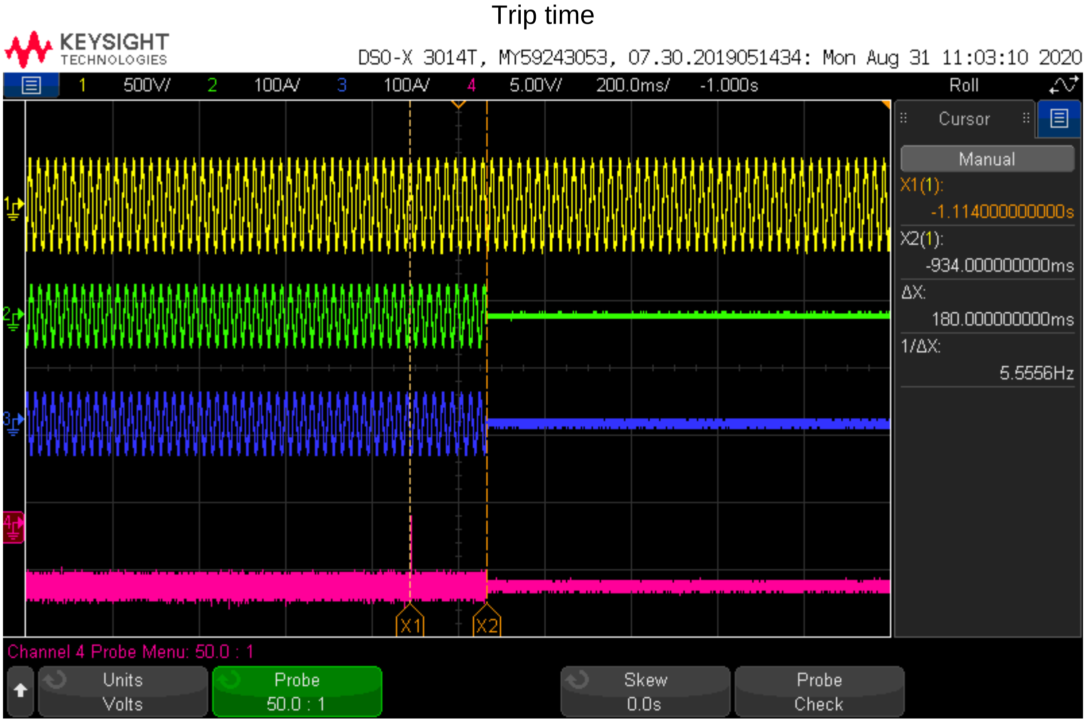
D.3	Table: Undervoltage threshold stage				P
Parameter	**Settings**	**Test 1**	**Test 2**	**Test 3**	**Limits**
Trip value L1 [V]	184	183.76	183.74	184.36	184±2.3
Trip time [ms]	100	164	174	176	<200
Trip value L2[V]	184	183.17	183.53	183.61	184±2.3
Trip time [ms]	100	180	174	160	<200
Trip value L3[V]	184	184.05	184.63	184.40	184±2.3
Trip time [ms]	100	168	154	162	<200
Trip value L1L2L3 [V]	184	184.91	184.99	184.50	184±2.3
Trip time [ms]	100	176	182	180	<200

Trip time



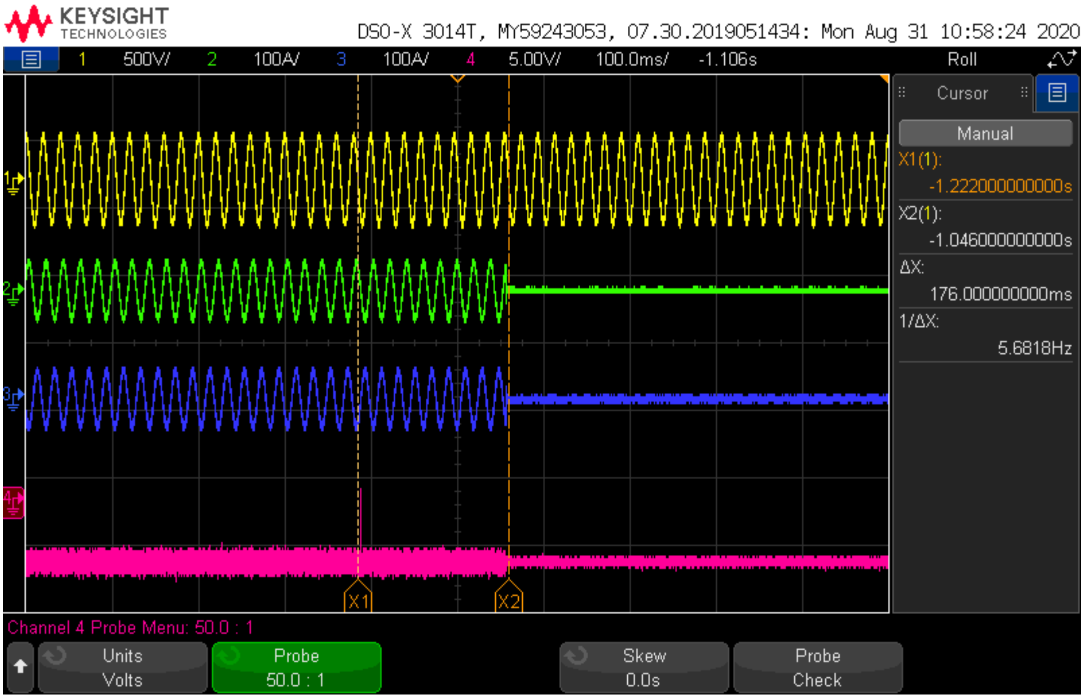
D.3	Table: Underfrequency threshold stage				P
Parameter	Settings	Test 1	Test 2	Test 3	Limits
Trip value [Hz]	47.5	47.51	47.53	47.50	47.5±0.05
Trip time [ms]	100	168	180	180	<200

Trip time



D.3	Table: Overfrequency threshold stage				P
Parameter	**Settings**	**Test 1**	**Test 2**	**Test 3**	**Limits**
Trip value [Hz]	51.5	51.46	51.45	51.49	51.5±0.05
Trip time [ms]	100	174	176	162	<200

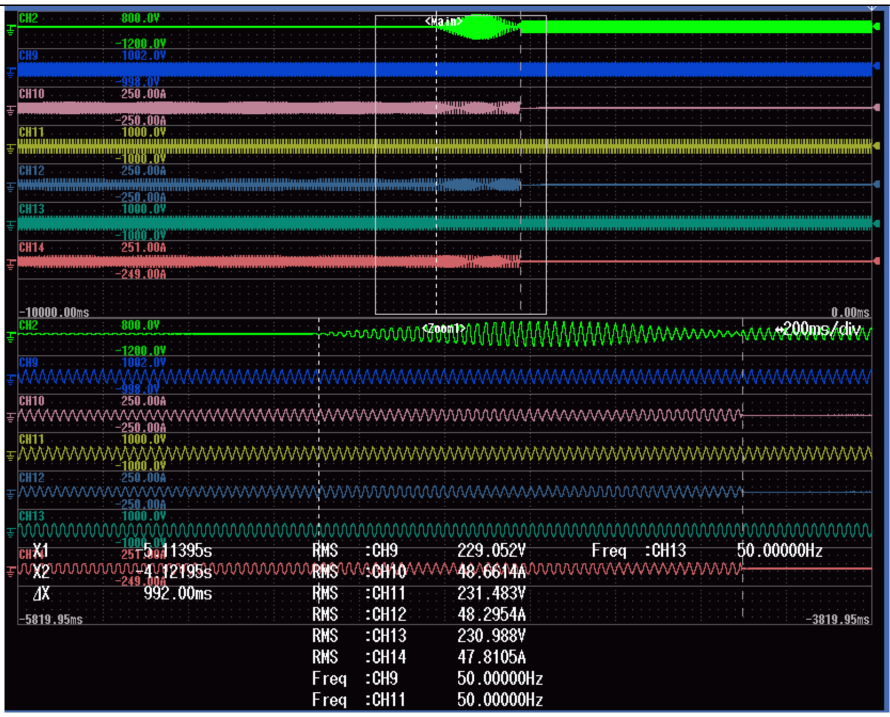
Trip time



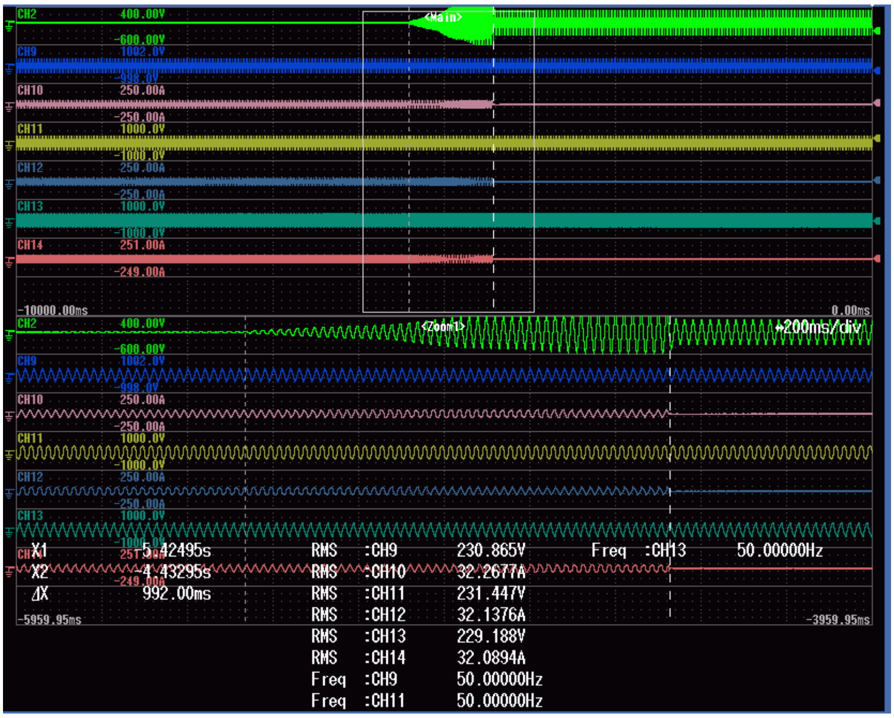
D.3	Table: Islanding								P
No.	PEUT[1] (% of EUT rating)	Reactive load (% of QL in 6.1.d)1)	PAC[2] (% of nominal)	QAC[3] (% of nominal)	Run on time (ms)	PEUT (KW)	Actual Qf	VDC	Remarks[4]
1	100	100	0	0	992.0	33.74	1.00	850	Test A at BL
2	66	66	0	0	779.0	21.96	1.00	600	Test B at BL
3	33	33	0	0	930.0	11.38	1.00	300	Test C at BL
4	100	100	-5	-5	523.0	33.74	0.98	850	Test A at IB
5	100	100	-5	0	663.0	33.74	0.95	850	Test A at IB
6	100	100	-5	5	637.0	33.74	0.93	850	Test A at IB
7	100	100	0	-5	956.0	33.74	1.03	850	Test A at IB
8	100	100	0	5	534.0	33.75	0.97	850	Test A at IB
9	100	100	5	-5	557.0	33.74	1.02	850	Test A at IB
10	100	100	5	0	951.0	33.74	1.08	850	Test A at IB
11	100	100	5	5	695.0	33.74	1.04	850	Test A at IB
12	66	66	0	-5	854.0	21.96	1.02	600	Test B at IB
13	66	66	0	-4	876.0	21.96	1.02	600	Test B at IB
14	66	66	0	-3	887.0	21.96	1.02	600	Test B at IB
15	66	66	0	-2	972.0	21.96	1.01	600	Test B at IB
16	66	66	0	-1	630.0	21.96	1.01	600	Test B at IB
17	66	66	0	1	992.0	21.96	0.99	600	Test B at IB
18	66	66	0	2	903.0	21.96	0.99	600	Test B at IB
19	66	66	0	3	979.0	21.96	0.98	600	Test B at IB
20	66	66	0	4	985.0	21.96	0.98	600	Test B at IB
21	66	66	0	5	946.0	21.96	0.97	600	Test B at IB
22	33	33	0	-5	916.0	11.38	1.03	300	Test C at IB
23	33	33	0	-4	930.0	11.38	1.03	300	Test C at IB
24	33	33	0	-3	905.0	11.38	1.02	300	Test C at IB
25	33	33	0	-2	946.0	11.38	1.01	300	Test C at IB
26	33	33	0	-1	836.0	11.38	1.01	300	Test C at IB
27	33	33	0	1	992.0	11.38	0.99	300	Test C at IB
28	33	33	0	2	984.0	11.38	0.99	300	Test C at IB
29	33	33	0	3	943.0	11.38	0.99	300	Test C at IB
30	33	33	0	4	953.0	11.38	0.98	300	Test C at IB
31	33	33	0	5	950.0	11.38	0.98	300	Test C at IB

Remark:

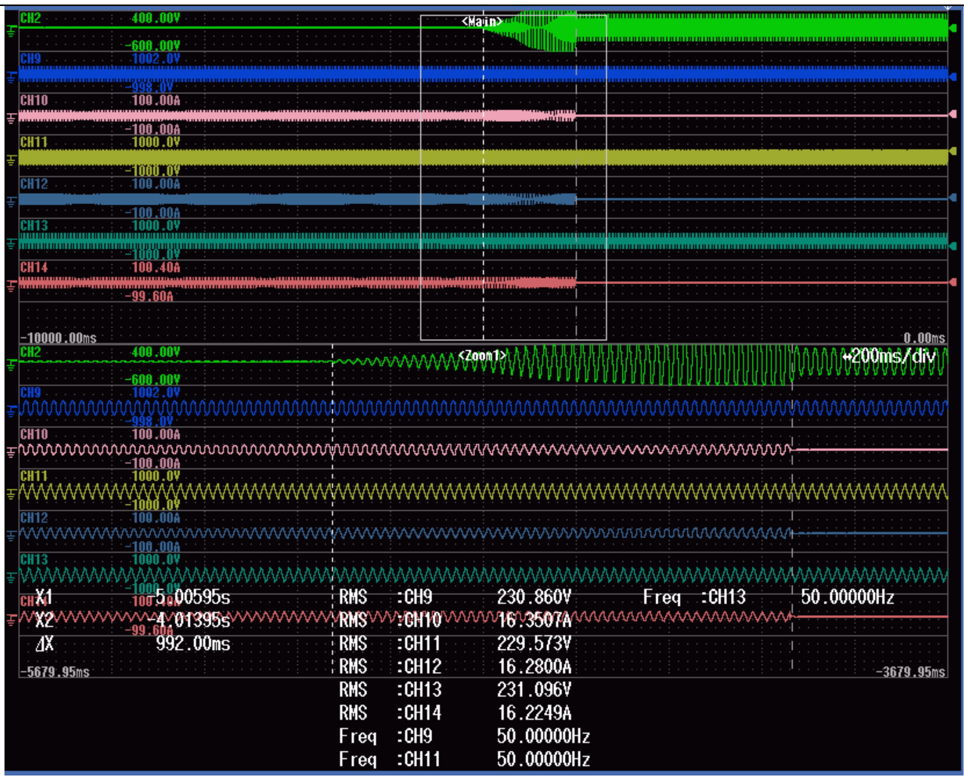
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.
4) BL: Balance condition, IB: Imbalance condition.
5) *Note: test condition A (100%): If any of the recorded run-on times are longer than the one recorded for the rated balance condition, i.e. test procedure 6.1 f), then the non-shaded parameter combinations (no.32~47) also require testing.



PEUT 100%, PAC 0%, QAC 0%, = 992ms



PEUT 66%, PAC 0%, QAC 1%, = 992.0ms



P_{EUT} 33%, P_{AC} 0%, Q_{AC} 1%, = 992.0ms

Note: CH10,CH12,CH14 denotes current of EUT; CH2 denotes Voltage of signal (the signal from switch), CH9,CH11,CH13 denotes Voltage of Grid

D.3	TABLE: Single fault tolerance Refer to EN 50549-1:2019							P
	ambient temperature (°C) :					25		
	model/type of power supply :					PV simulator		
No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result	
1.	XLC2 Pin 2 to 3	Short	850	10 min	--	--	Inverter operated normally. No damaged.No hazards.	
2.	RB 137	Open	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.	
3.	RB 139	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.	
4.	RB 131	Open	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.	
5.	RB 122	Open	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.	
6.	RB 110	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.	
7.	RB 96	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.	
8.	RB 11	Open	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.	
9.	RB 8	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.	

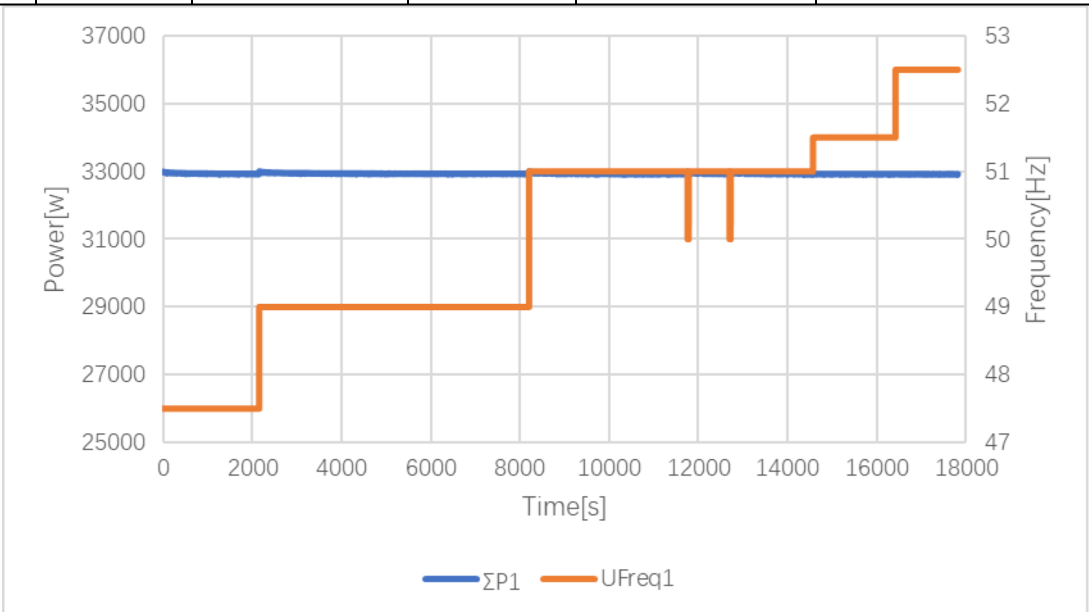
10.	UB1 PIN5 to 6	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.
11.	RB 23	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.
12.	QD1 PIN1 to 2	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”The DCI overcurrent”. No damaged.No hazard.
13.	XLC2 PIN1 to 2	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”The communication error”. No damaged.No hazard.
14.	DC 71	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”The communication error”. No damaged.No hazard.
15.	U13 PIN2 to 3	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”The communication error”. No damaged.No hazard.
16.	XLC1 PIN1 to 2	Short	850	10 min	--	--	Inverter did not start-up. Error message:”The SPI error”No damage.No hazard.
17.	RC6	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.
18.	RC19	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.
19.	UC627 PIN2 to 3	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:” The grid voltage error”. No damaged.No hazards.
20.	UC637 PIN12 to 13	Short	850	10 min	--	--	Inverter disconnected from grid immediately. Error message:”GFCI error”. No damaged.No hazard.

21.	RC 167	Short before start-up	850	10 min	--	--	Inverter did not start-up.Error message:"The ISO error"No damage.No hazard.
22.	RC 98	Short before start-up	850	10 min	--	--	Inverter did not start-up.Error message:"The ISO error"No damage.No hazard.
Supplement: s-c: short-circuited, o-c: open-circuited, o-l: overload							

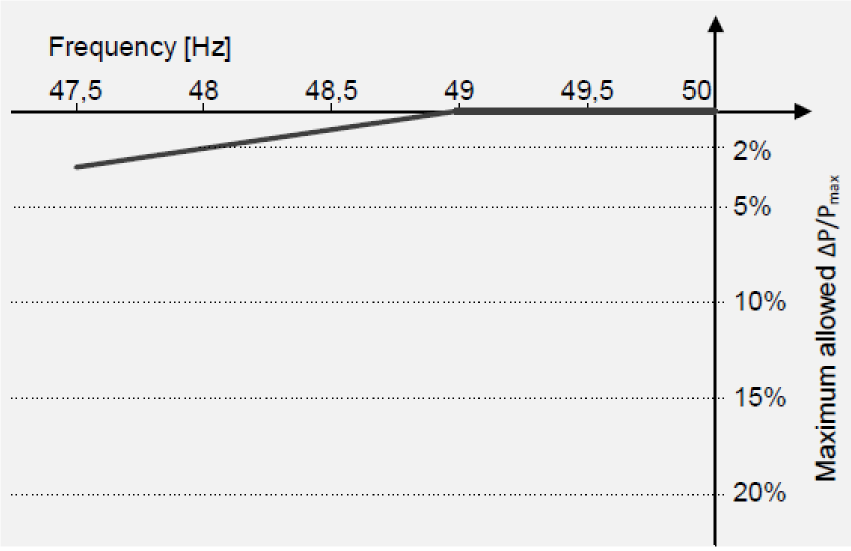
D.4.1	Table: Operating frequency range	P

Frequency domain	Duration
47,5 Hz – 49,0 Hz	30 minutes
49,0 Hz – 51,0 Hz	Permanent
51,0 Hz – 51,5 Hz	30 minutes

Steps	f (Hz)	f (Hz) Measured	Time	Time measured	Comments
1	47.5 Hz	47.50	>30 min	35.90 min	Operated normally.
2	49.0 Hz	49.00	Permanent	100.85 min	Operated normally.
3	51.0 Hz	50.99	Permanent	106.13 min	Operated normally.
4	51.5 Hz	51.50	>30 min	30.83 min	Operated normally.
5	52.5 Hz	52.50	>15 min*	23.32 min	Operated normally.

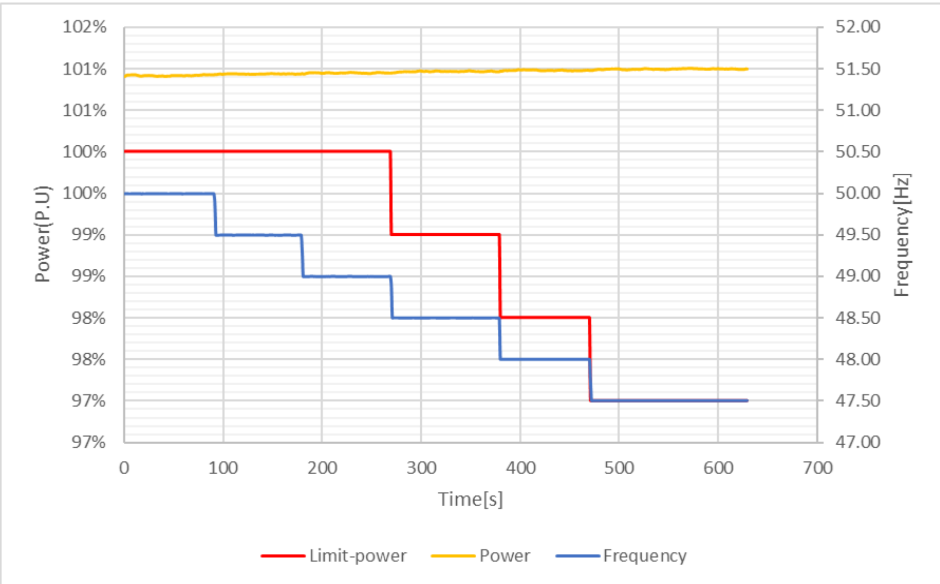


D.4.2	Table: Minimal requirements for active power delivery at underfrequency	P



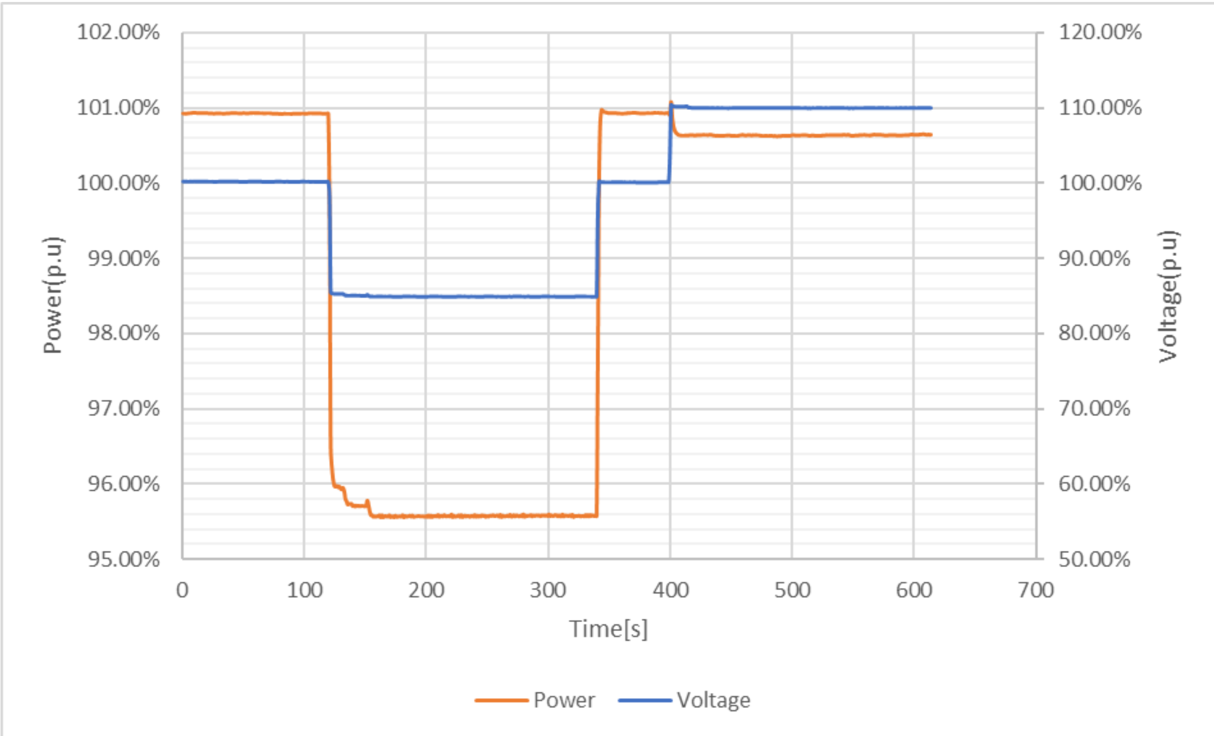
Step	f (Hz)	fmea. (Hz)	T (s)	T meas. (s)	P (%) - max	P (%) - min	P meas. (%)
1	50,00 ± 0,05	50.0	>60	90	100%	100%	100.92
2	49.50 ± 0,05	49.5	>60	90	100%	100%	100.94
3	49.00 ± 0,05	49.0	>60	90	100%	100%	100.95
4	48.50 ± 0,05	48.5	>60	90	100%	99%	100.97
5	48.00 ± 0,05	48.0	>60	90	100%	98%	100.99
6	47.50 ± 0,05	47.5	>60	90	100%	97%	100.00

Supplementary information:

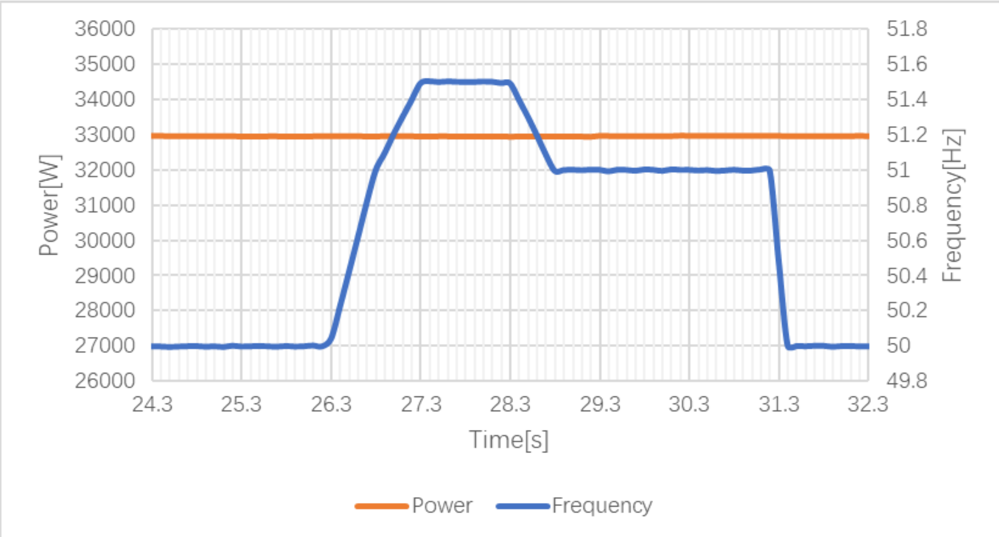


D.4.3	Table: Continuous voltage operation range				P
Step	Voltage (%)	P (%)	P meas. (%)	Time (s)	T meas (s)
1	100	100	100.93	>60	120.00
2	85	100 (*)	95.61	>120	219.00
3	100	100	100.92	>5	58.00
4	110	100	100.65	>120	214.00

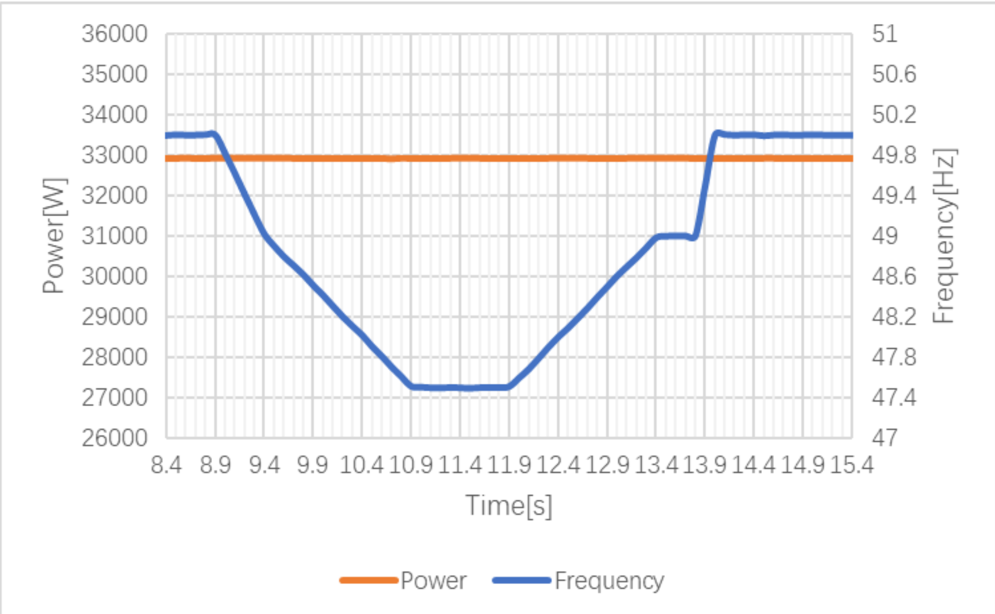
(*) Active power reduction is allowed due to current limitation.



D.5.1	Table: Rate of change of frequency (ROCOF)					P
Steps	Overfrequency			Underfrequency		
	f (Hz)	Step time (s)	Output power (W)	f (Hz)	Step time (s)	Output power (W)
1	50,0 to 51.0	0.5	32934.92	50,0 to 49.0	0.5	32922.96
2	51,0 to 51.5	0.5	32935.68	49,0 to 47.5	1.5	32929.99
3	51,5	1	32932.21	47,5	1	32929.21
4	51.5 to 51.0	0.5 s	32926.72	47.5 to 49.0	1.5	32922.36
5	51.0	3.0 s	32941.57	49.0	0.5	32931.52

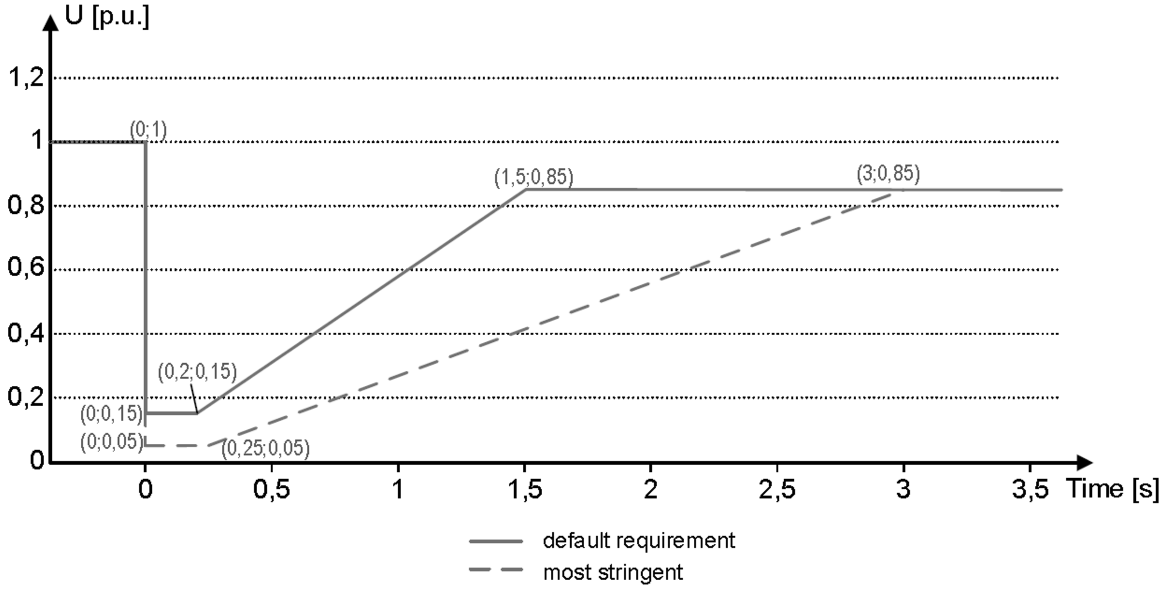


Overfrequency



Underfrequency

D.5.2	Table: UVRT	P

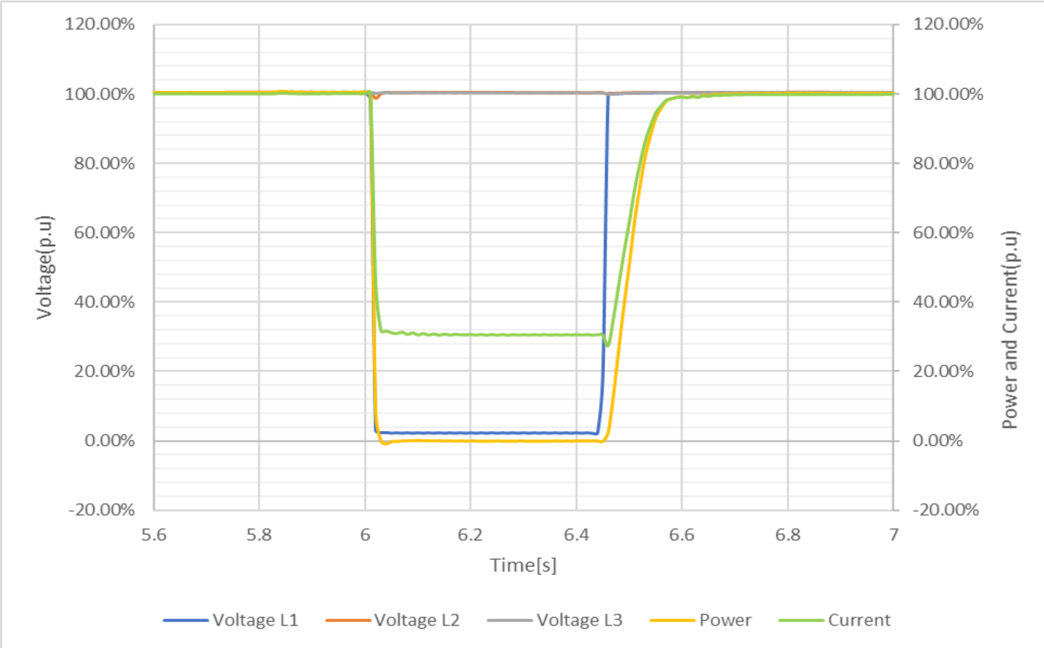


Test at full load (>90%)

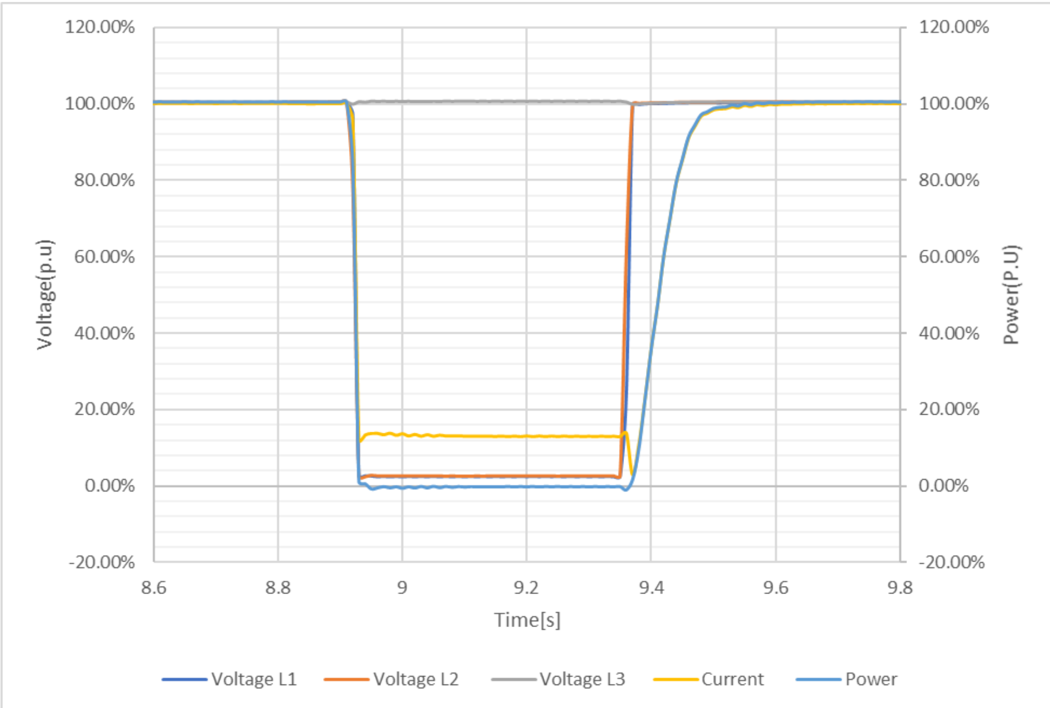
Udip	Type	t min (ms)	U meas. (%)			T meas.(ms)	P recover (s)
			R	S	T		
5%	L1-N	250	2.33	100.49	100.39	420	0.11
	L2-N		100.40	2.29	100.50	430	0.11
	L3-N		100.46	100.38	2.34	430	0.13
	L1-L2-N		2.52	2.61	100.73	430	0.19
	L2-L3-N		100.27	2.18	2.17	430	0.21
	L1-L3-N		2.66	100.68	2.54	430	0.19
	L1-L2-L3-N		2.77	2.80	2.83	430	0.17
25%	L1-N	938	24.79	100.26	100.24	1030	0.51
	L2-N		100.21	24.79	100.24	1030	0.53
	L3-N		100.20	100.22	24.78	1010	0.47
	L1-L2-N		25.04	25.02	100.25	1030	0.19
	L2-L3-N		100.29	25.04	25.03	1030	0.57
	L1-L3-N		25.03	100.26	25.04	1030	0.57
	L1-L2-L3-N		25.07	25.07	25.10	1030	0.23

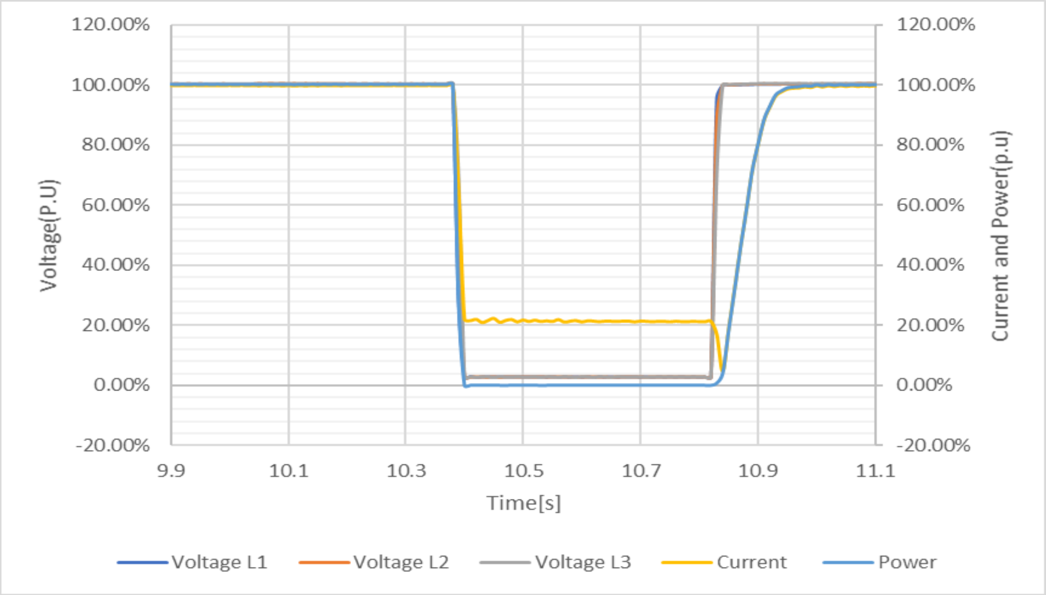
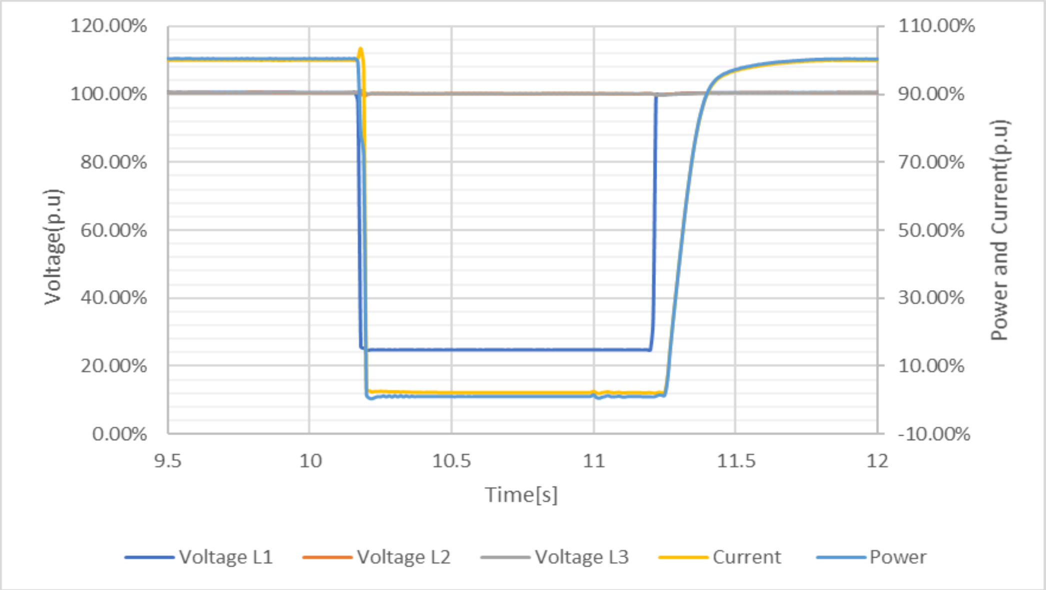
50%	L1-N	1797	50.04	100.21	100.19	1990	0.45
	L2-N		100.22	50.06	100.19	1990	0.55
	L3-N		100.25	100.21	50.04	1990	0.39
	L1-L2-N		50.07	50.07	100.22	1990	0.55
	L2-L3-N		100.25	50.07	50.07	1990	0.53
	L1-L3-N		50.1	100.23	50.08	1990	0.55
	L1-L2-L3-N		50.10	50.10	50.11	1990	0.21
75%	L1-N	2656	75.66	100.06	100.11	3040	0.3
	L2-N		100.22	74.98	100.26	3030	0.31
	L3-N		100.25	100.21	74.98	3030	0.31
	L1-L2-N		75.03	74.99	100.27	3030	0.71
	L2-L3-N		100.26	75.01	75.05	3030	0.72
	L1-L3-N		75.04	100.18	75.04	3030	0.42
	L1-L2-L3-N		75.05	75.04	75.04	3030	0.23

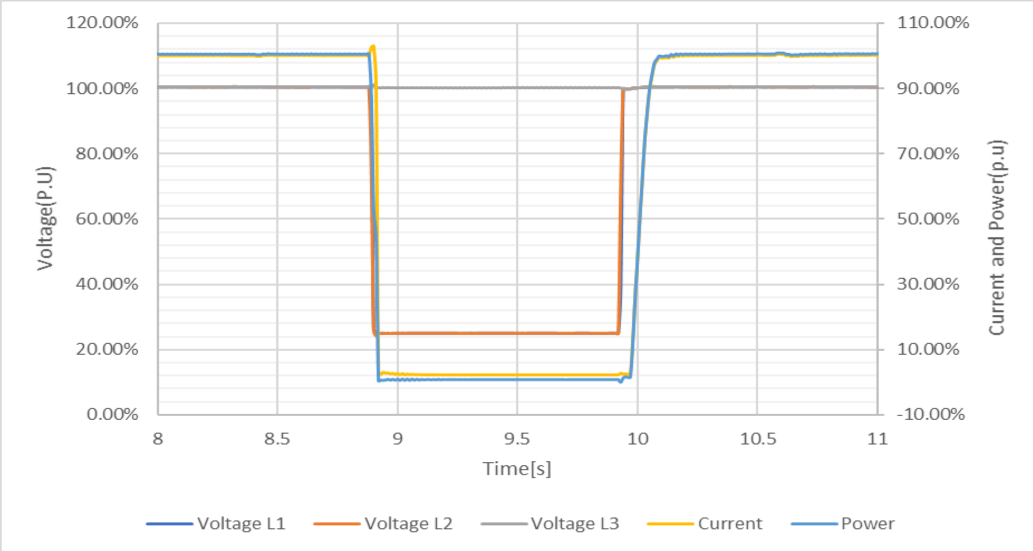
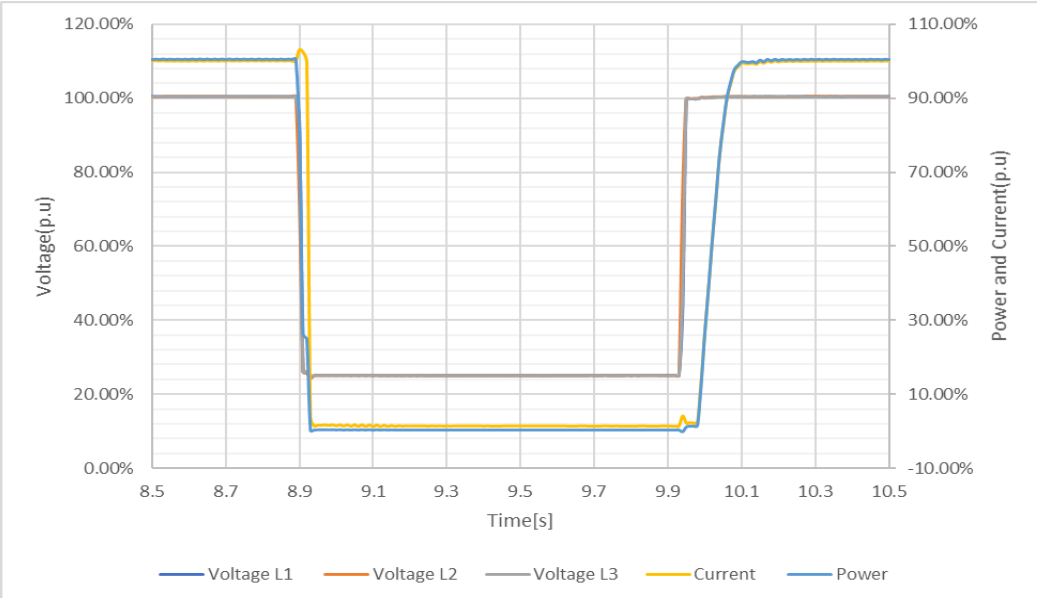
Graph_5%(L1-N)



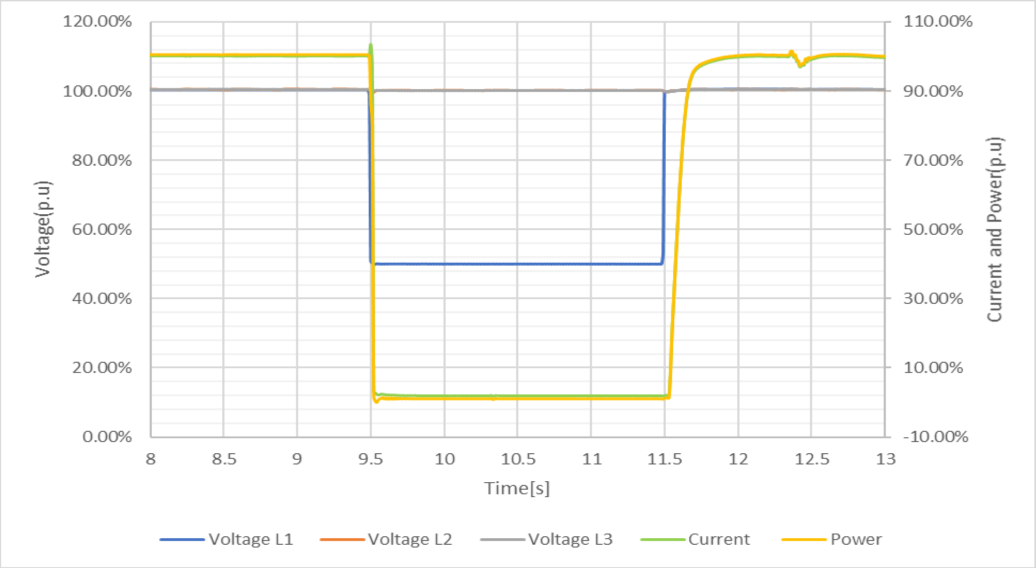
Graph_5%(L1-L2-N)



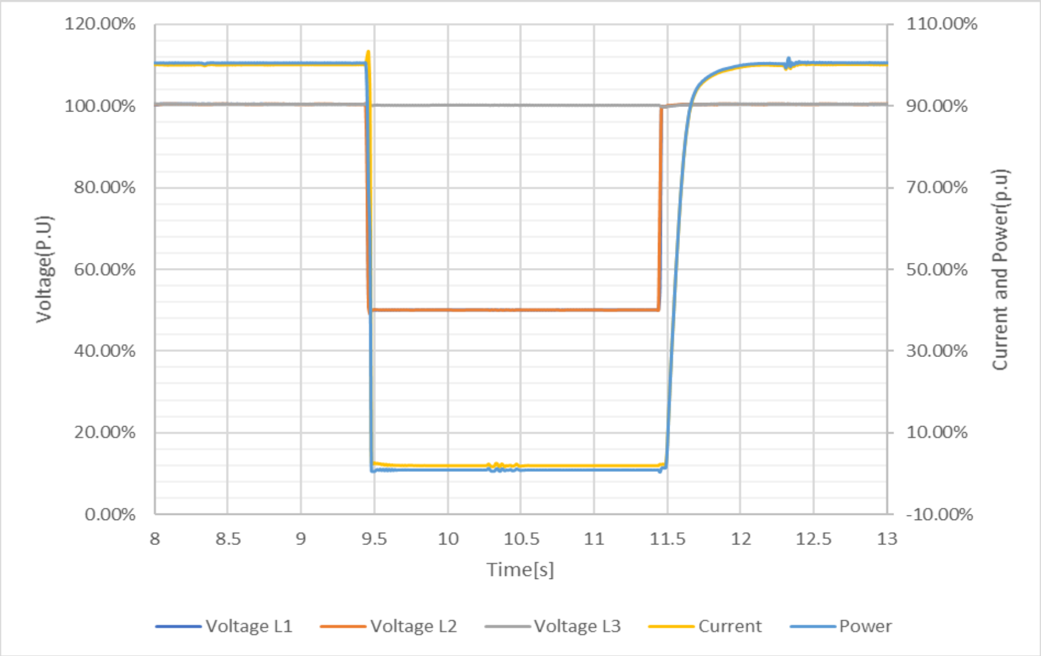
Graph_5%(L1-L2-L3-N)

Graph_25%(L1-N)


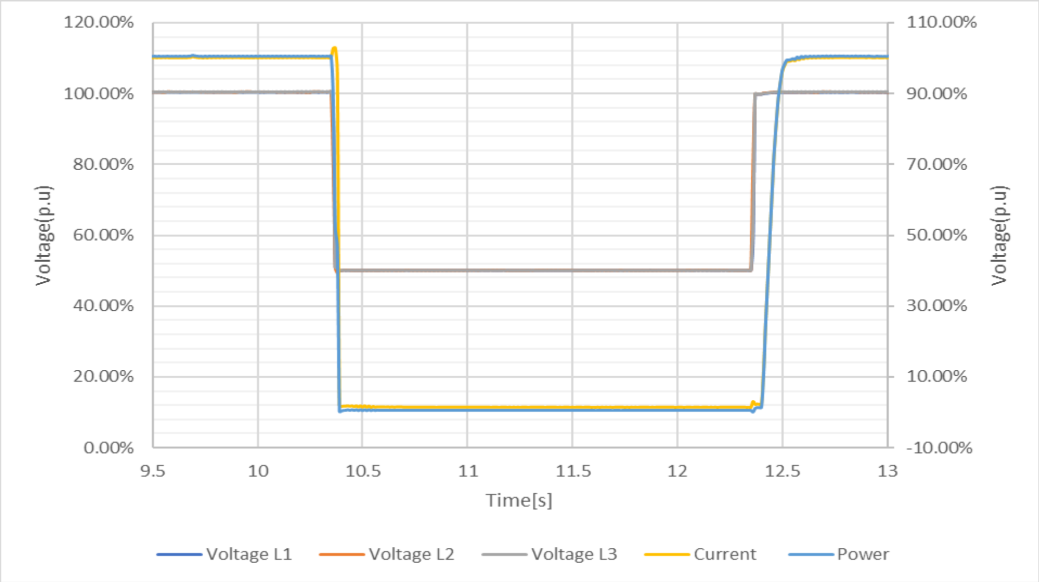
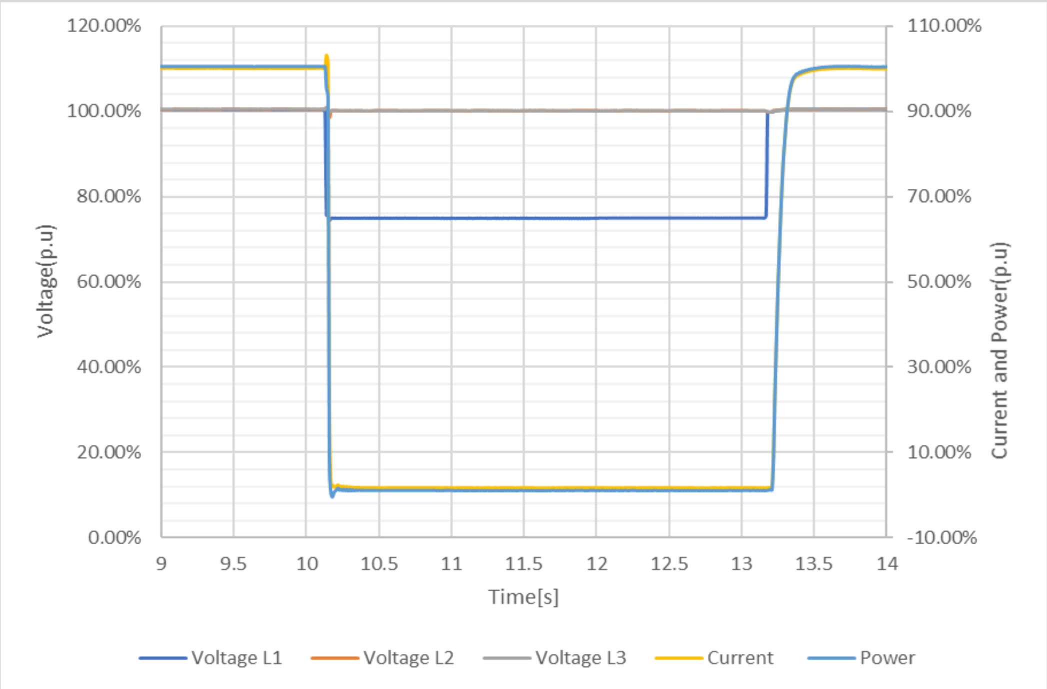
Graph_25%(L1-L2-N)

Graph_25%(L1-L2-L3-N)


Graph_50%(L1-N)

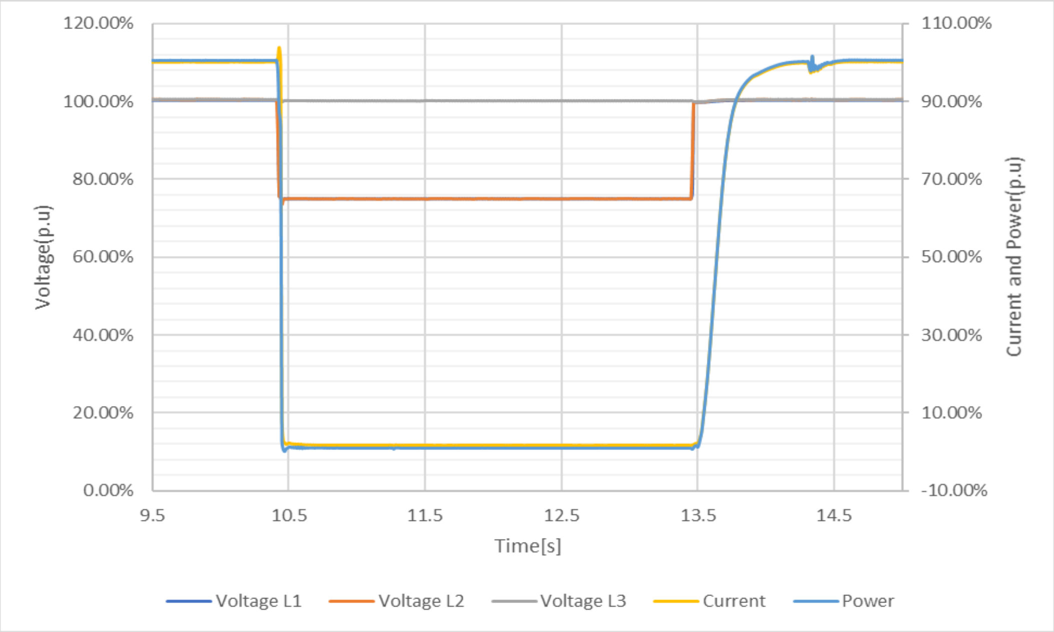


Graph_50%(L1-L2-N)

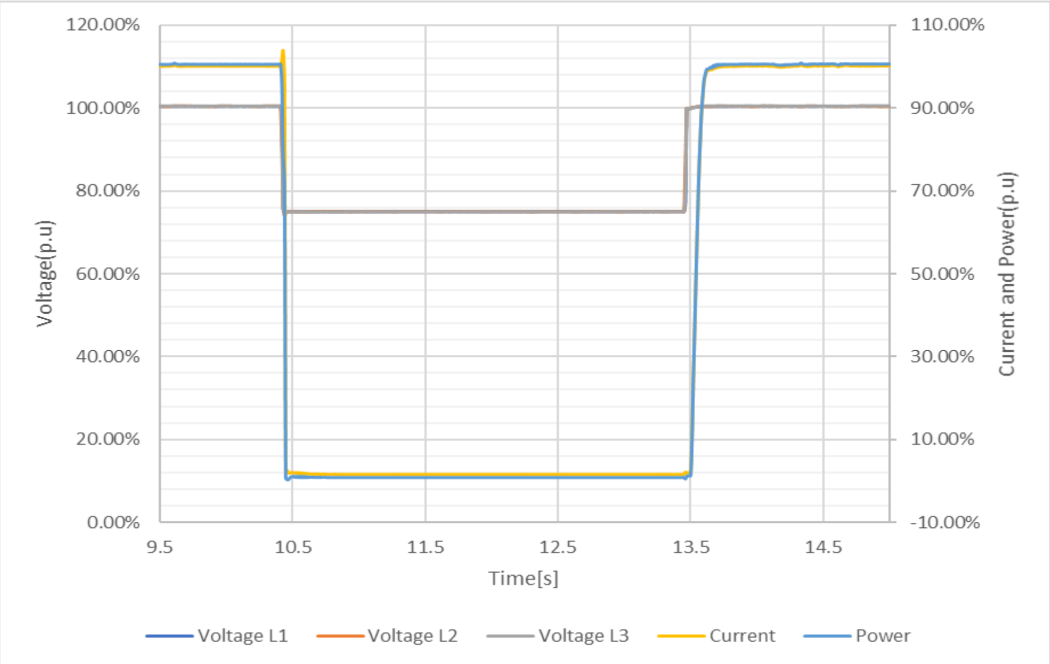


Graph_50%(L1-L2-L3-N)

Graph_75%(L1-N)


Graph_75%(L1-L2-N)



Graph_75%(L1-L2-L3-N)



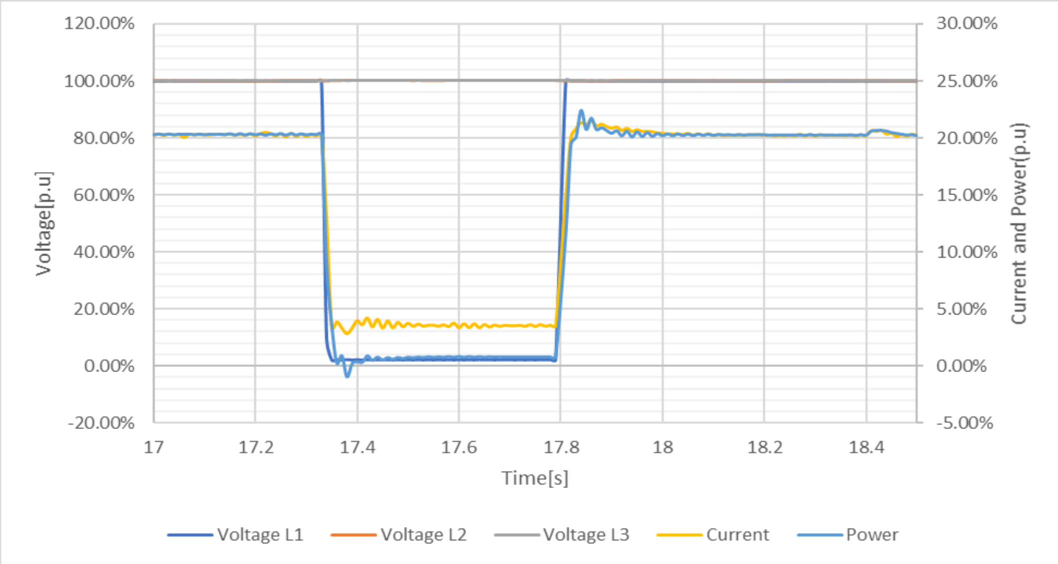
Test at partial load (20%)							
Udip	Type	t min (ms)	U meas. (%)			T meas.(ms)	P recover (s)
			R	S	T		
5%	L1-N	250	2.08	100.18	100.18	450	0.02
	L2-N		100.17	2.14	100.16	450	0.03
	L3-N		100.19	100.23	2.15	450	0.05
	L1-L2-N		2.21	2.15	100.30	450	0.04
	L2-L3-N		100.30	2.18	2.17	450	0.04
	L1-L3-N		2.20	100.28	2.21	450	0.04
	L1-L2-L3-N		2.17	2.16	2.18	450	0.03
25%	L1-N	938	24.97	100.15	100.18	1050	0.12
	L2-N		100.19	24.96	100.22	1050	0.11
	L3-N		100.19	100.18	25.01	1050	0.13
	L1-L2-N		25.01	24.98	100.24	1050	0.12
	L2-L3-N		100.16	24.98	24.99	1050	0.11
	L1-L3-N		25.00	100.20	24.99	1050	0.1
	L1-L2-L3-N		25.00	25.01	25.06	1050	0.16
50%	L1-N	1797	50.04	100.12	100.23	1890	0.10
	L2-N		100.20	50.02	100.19	1890	0.10
	L3-N		100.20	100.15	50.02	1890	0.10
	L1-L2-N		50.04	50.07	100.23	1890	0.12
	L2-L3-N		100.23	50.06	50.04	1890	0.10
	L1-L3-N		50.07	100.23	50.05	1890	0.12
	L1-L2-L3-N		50.05	50.08	50.07	1890	0.14
75%	L1-N	2656	74.91	100.20	100.22	3050	0.12
	L2-N		100.20	74.88	100.20	3050	0.12
	L3-N		100.16	100.17	74.88	3040	0.12
	L1-L2-N		74.91	74.90	100.23	3050	0.12

	L2-L3-N		100.20	74.90	74.91	3050	0.12
	L1-L3-N		74.94	100.17	74.90	3050	0.12
	L1-L2-L3-N		74.93	74.92	74.95	3050	0.12

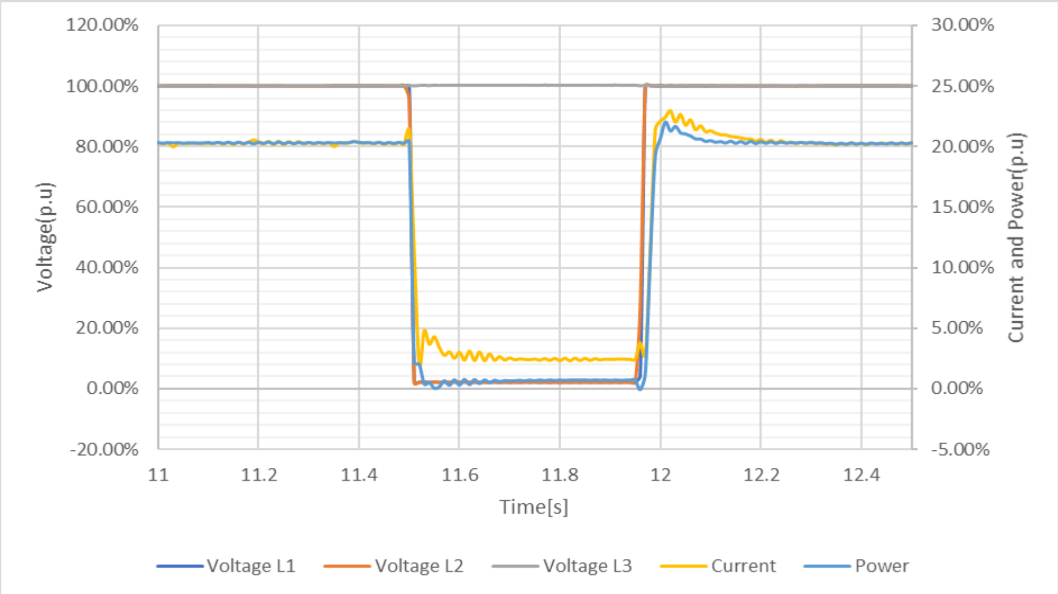
Remark:

The tests are performed together with clause 4.7.4.2.2 Zero current mode and enabling of default setting: undervoltage of 50%Un

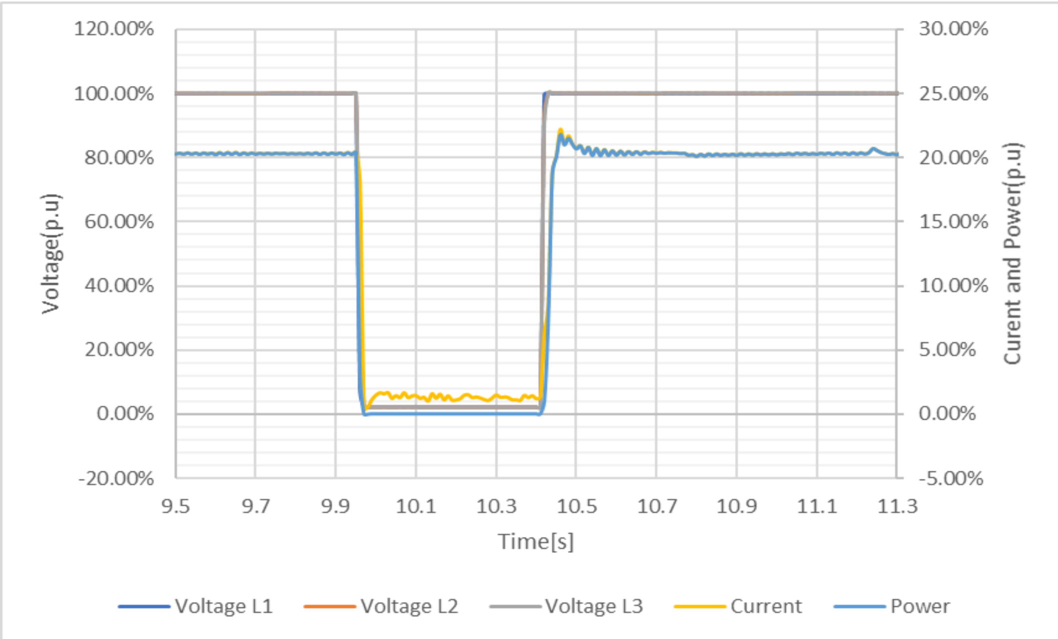
Graph_5%(L1-N)



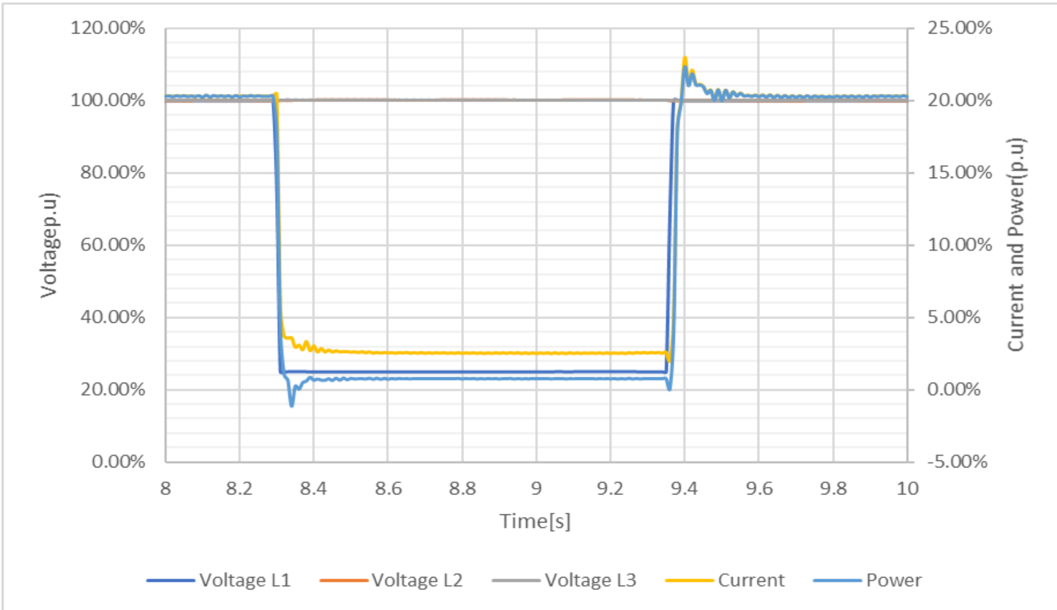
Graph_5%(L1-L2-N)



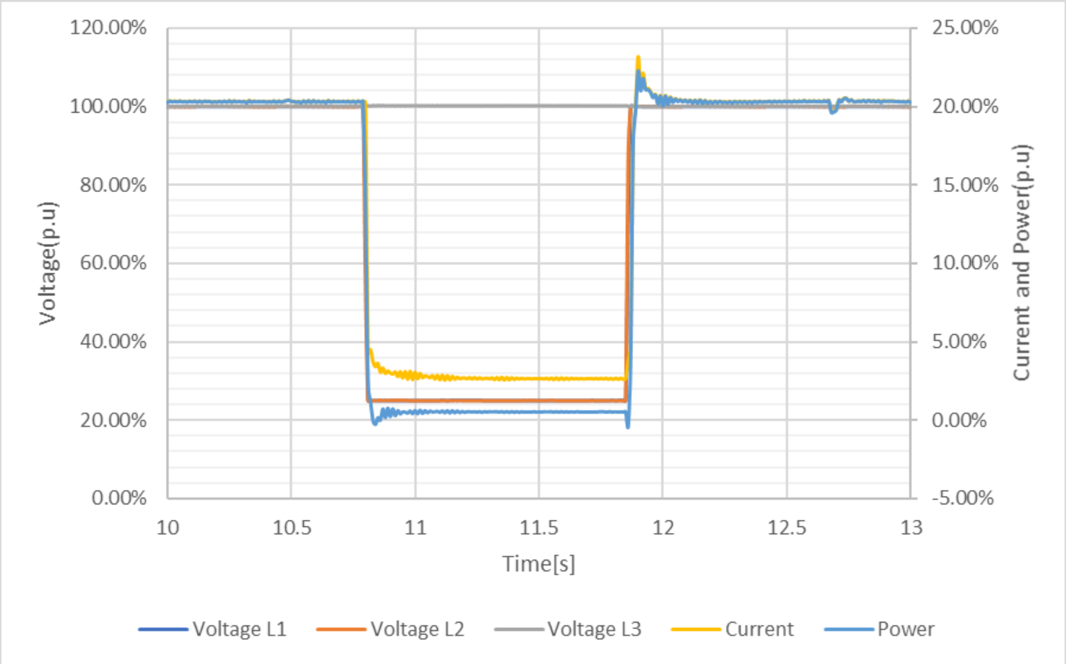
Graph_5%(L1-L2-L3-N)



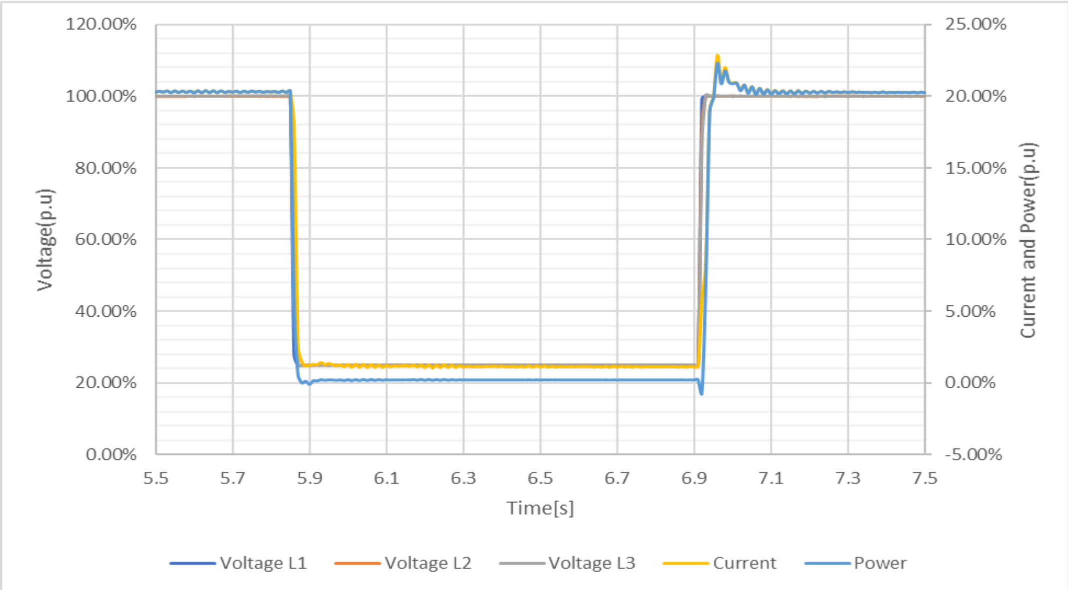
Graph_25%(L1-N)



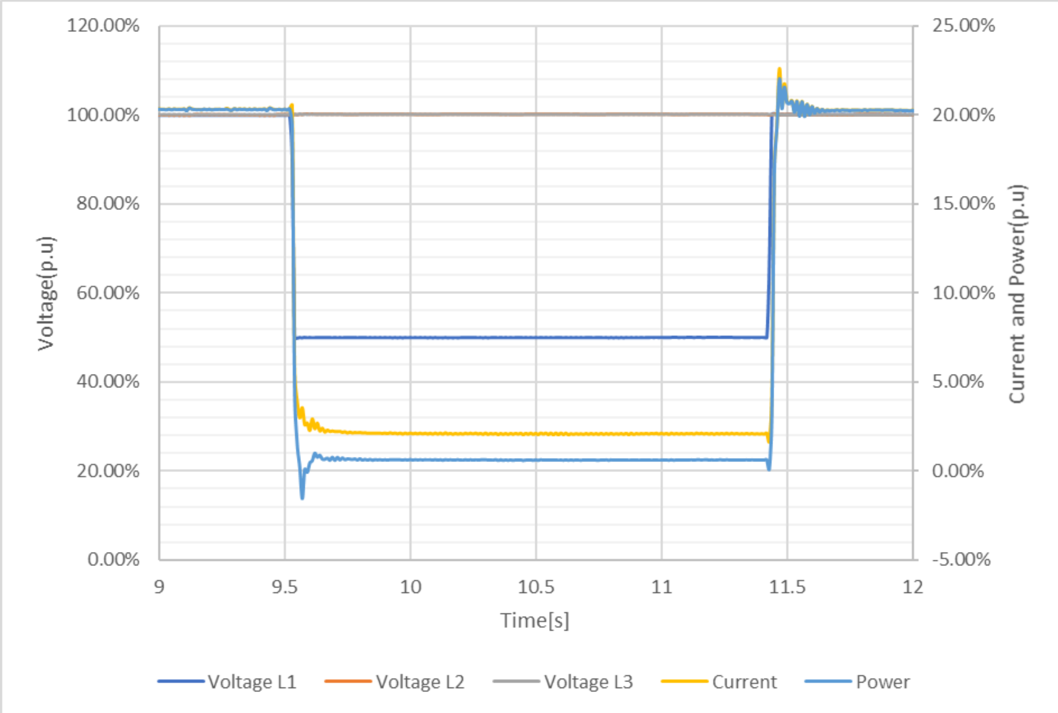
Graph_25%(L1-L2-N)



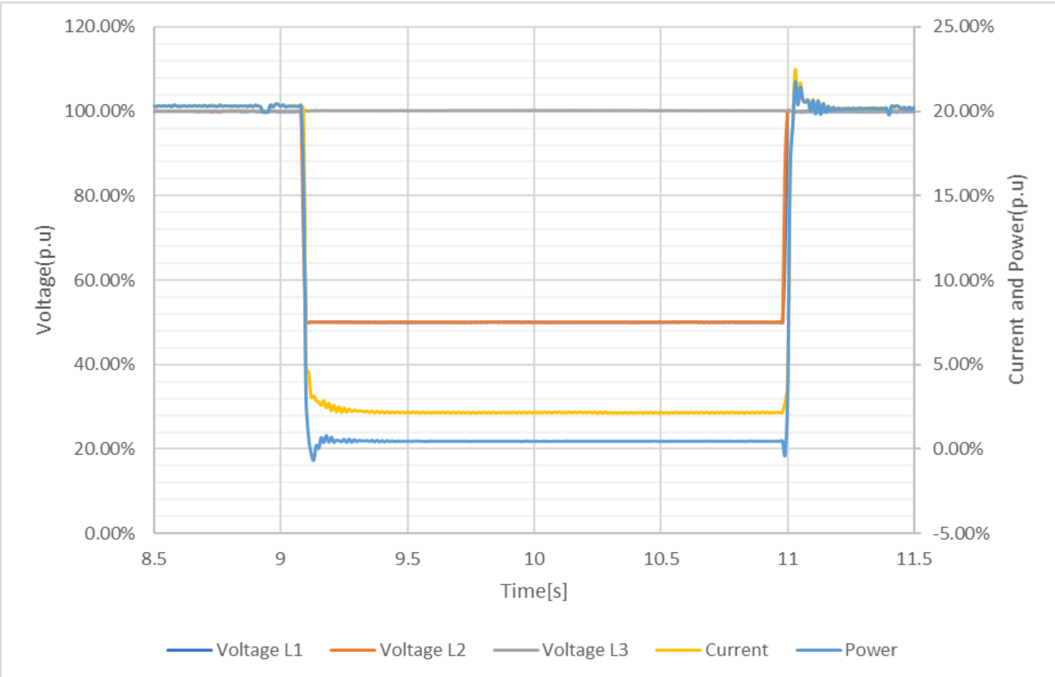
Graph_25%(L1-L2-L3-N)



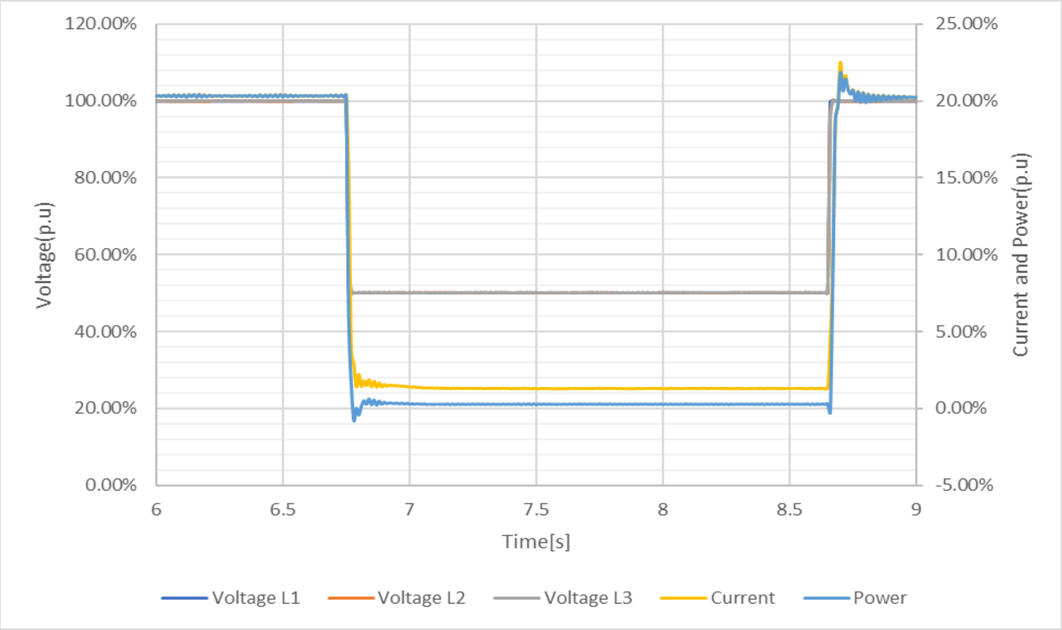
Graph_50%(L1-N)



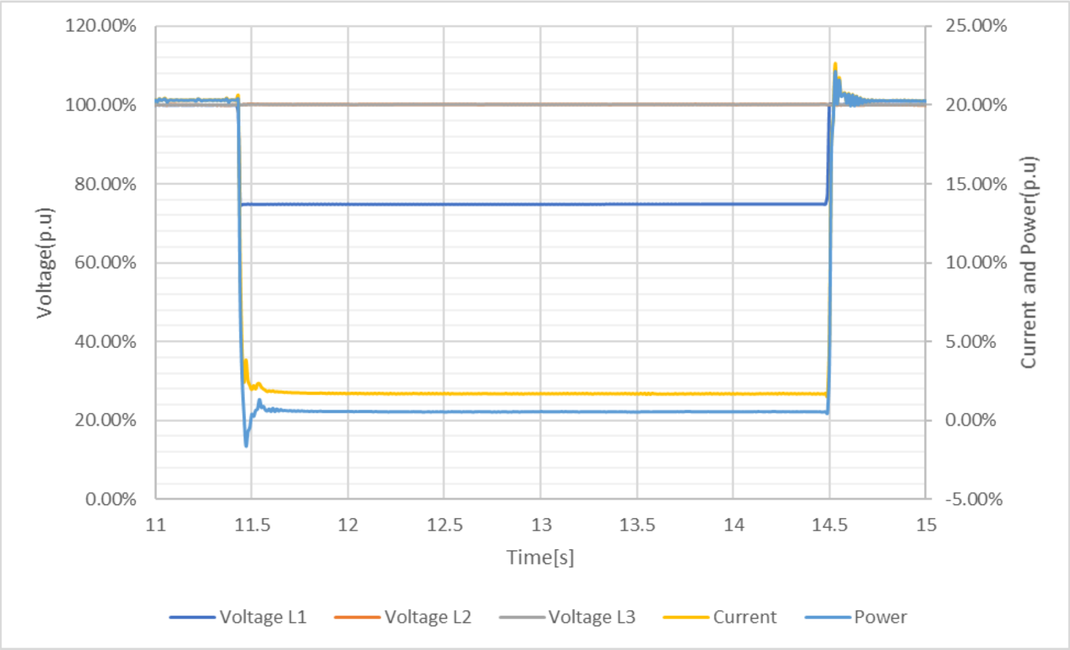
Graph_50%(L1-L2-N)



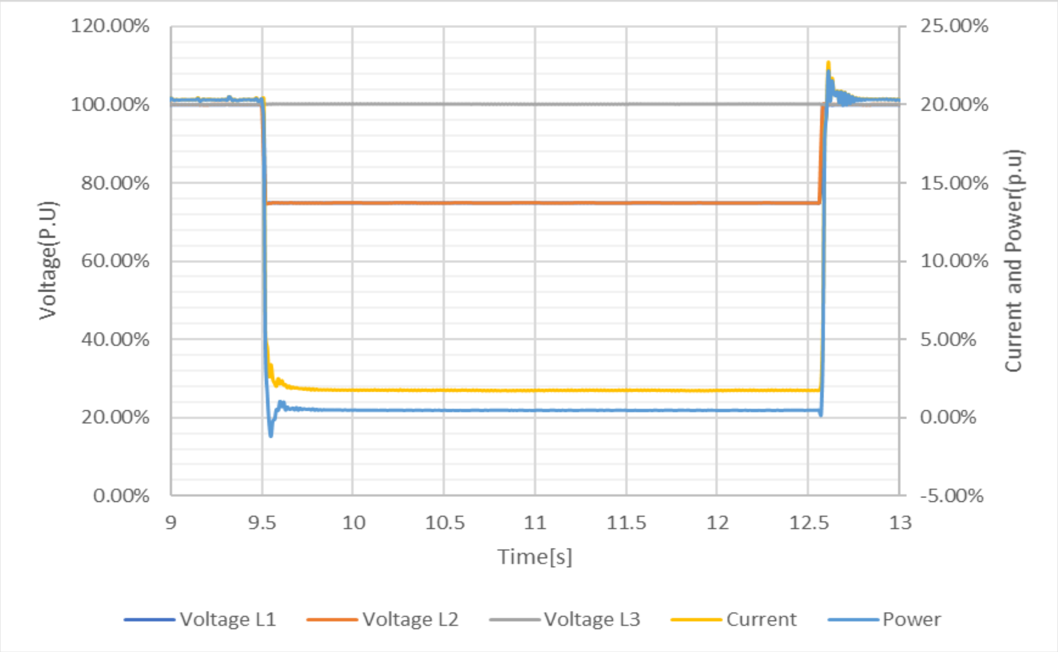
Graph_50%(L1-L2-L3-N)



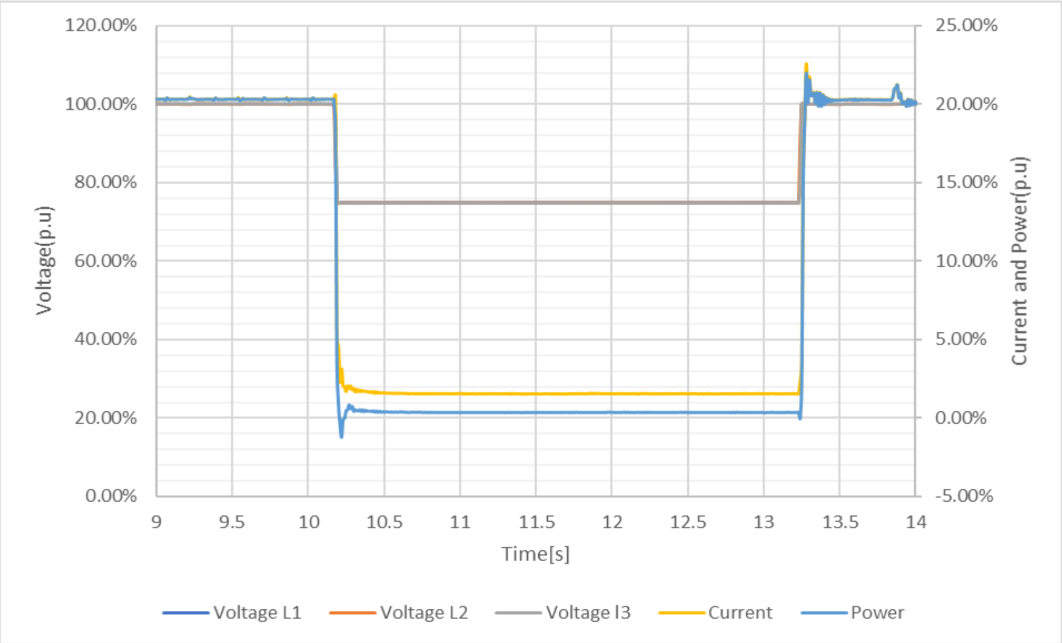
Graph_75%(L1-N)



Graph_75%(L1-L2-N)

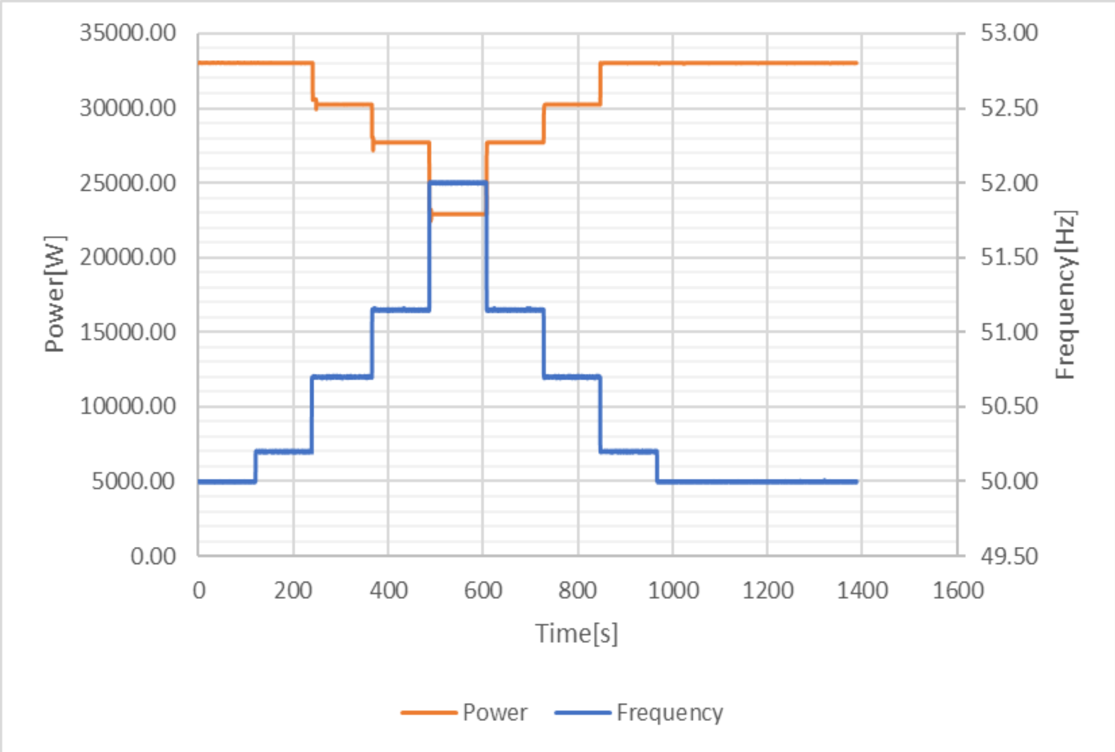


Graph_75%(L1-L2-L3-N)

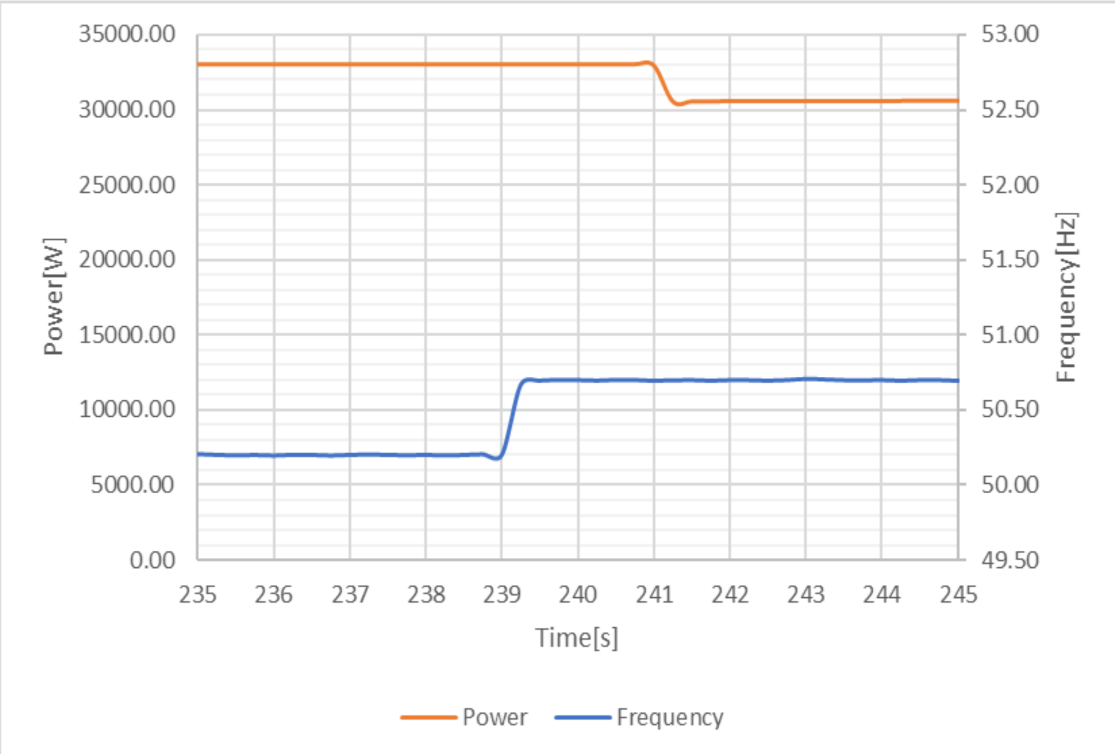


D.6.1	Table: Power response to over frequency						P
Test 1	100% Pn, f1 =50.2Hz; droop=12%; f-stop deactivated, with delay of 2 s						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <2s	For The settling times T≤20s
50Hz ± 0.01Hz	50.00	33040.99	33000.00	--	--	--	--
50.2Hz ± 0.01Hz	50.20	33037.79	33000.00	--	--	--	--
50.70Hz ± 0.01Hz	50.70	30267.75	30250.00	17.75	± 3300	0.5	8.3
51.15Hz ± 0.01Hz	51.15	27712.44	27775.00	-62.56	± 3300	0.1	0.2
52.0Hz ± 0.01Hz	52.00	22912.95	23100.00	-187.05	± 3300	0.4	4.5
51.15Hz ± 0.01Hz	51.15	27710.86	27775.00	-64.14	± 3300	0.8	1.0
50.70Hz ± 0.01Hz	50.70	30246.98	30250.00	-3.02	± 3300	1.1	2.0
50.2Hz ± 0.01Hz	50.20	33033.40	33000.00	--	--	--	--
50Hz ± 0.01Hz	50.00	33032.54	33000.00	--	--	--	--
Test 2	100% Pn, f1 =50.2Hz; droop=2%; f-stop deactivated, no delay						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <2s	For The settling times T≤20s
50Hz ± 0.01Hz	50.00	33027.02	33000.00	--	--	--	--
50.2Hz ± 0.01Hz	50.20	33010.88	33000.00	--	--	--	--
50.70Hz ± 0.01Hz	50.70	16556.06	16500.00	56.06	± 3300	0.4	0.5
51.15Hz ± 0.01Hz	51.15	1719.87	1650.00	69.87	± 3300	0.4	0.5
52.0Hz ± 0.01Hz	52.00	21.52	0.00	21.52	± 3300	0.5	4.5
51.15Hz ± 0.01Hz	51.15	1719.17	1650.00	69.17	± 3300	1.0	2.8
50.70Hz ± 0.01Hz	50.70	16568.14	16500.00	68.14	± 3300	0.4	2.7
50.2Hz ± 0.01Hz	50.20	33047.33	33000.00	--	--	--	--
50Hz ± 0.01Hz	50.00	33040.23	33000.00	--	--	--	--

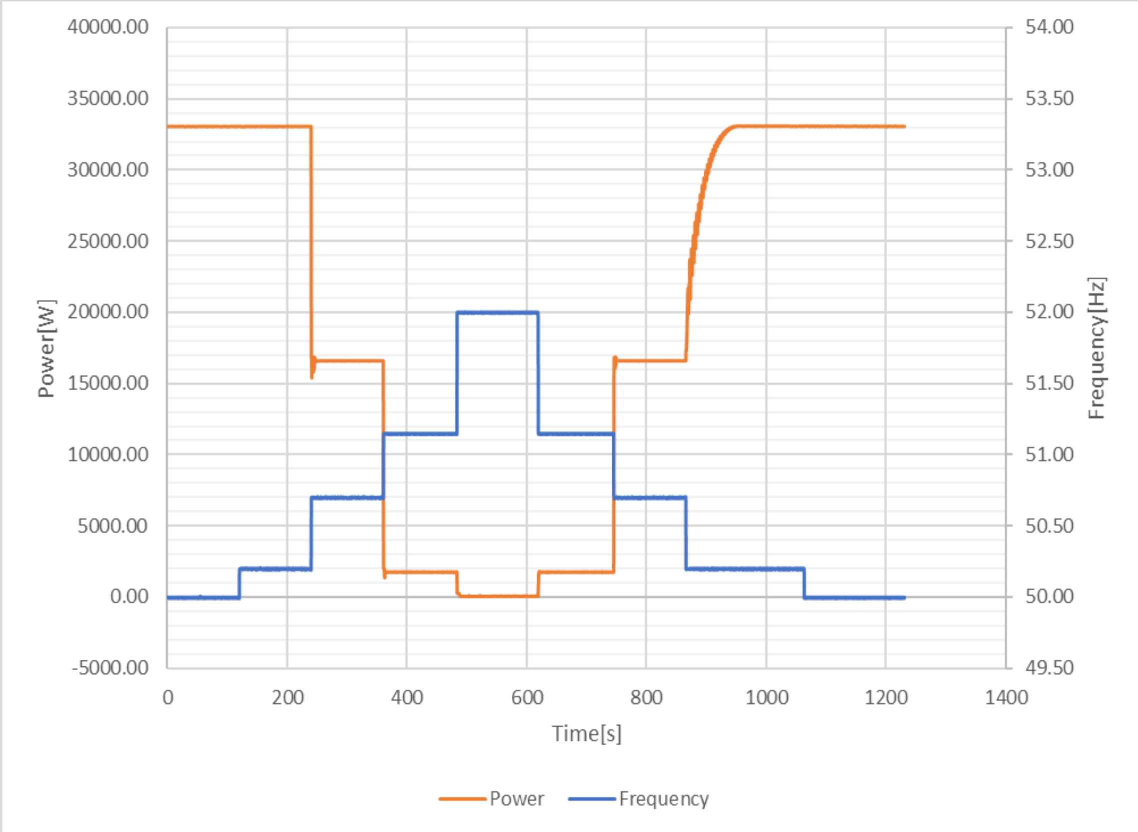
Test 3	50% Pn, f1 =52.0Hz; droop=5%; f-stop deactivated, no delay						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <2s	For The settling times T≤20s
50Hz ± 0.01Hz	50.00	16516.23	--	--	--	--	--
51.0Hz ± 0.01Hz	51.00	16514.68	16500.00	14.68	± 3300	--	--
51.70Hz ± 0.01Hz	51.70	16514.36	16500.00	14.36	± 3300	--	--
52.0Hz ± 0.01Hz	52.00	16514.75	16500.00	14.75	± 3300	--	--
51.70Hz ± 0.01Hz	51.70	16514.24	16500.00	14.24	± 3300	--	--
51.00Hz ± 0.01Hz	51.00	16513.23	16500.00	13.23	± 3300	--	--
50Hz ± 0.01Hz	50.00	16513.00	--	--	--	--	--
Test 4	100% Pn, f1 =50.2Hz; droop=5%; f-stop =50.1, no delay, Deactivation time t_{stop} 30s						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <2s	For The settling times T≤20s
50Hz ± 0.01Hz	50.00	33147.49	33000.00	--	--	--	--
50.2Hz ± 0.01Hz	50.20	33144.97	33000.00	--	--	--	--
50.70Hz ± 0.01Hz	50.70	26443.23	26400.00	43.23	± 3300	0.4	0.5
51.15Hz ± 0.01Hz	51.15	20419.18	20460.00	-40.82	± 3300	0.4	5.3
52.0Hz ± 0.01Hz	52.00	9212.16	9240.00	-27.84	± 3300	0.4	0.5
51.15Hz ± 0.01Hz	51.15	9212.34	9240.00	-27.66	± 3300	--	--
50.70Hz ± 0.01Hz	50.70	9212.29	9240.00	-27.71	± 3300	--	--
50.2Hz ± 0.01Hz	50.20	9212.35	9240.00	-27.65	± 3300	--	--
50Hz ± 0.01Hz	50.00	33145.23	9240.00	--	--	--	--



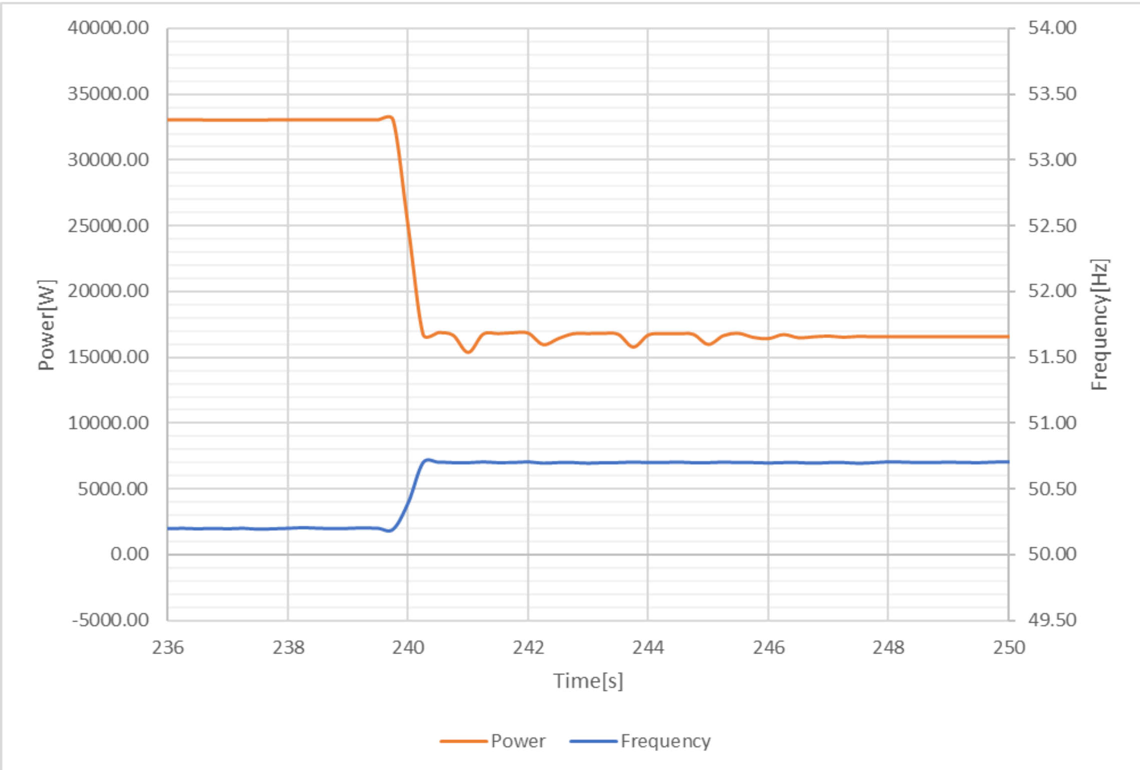
Intentional delay time (2s)



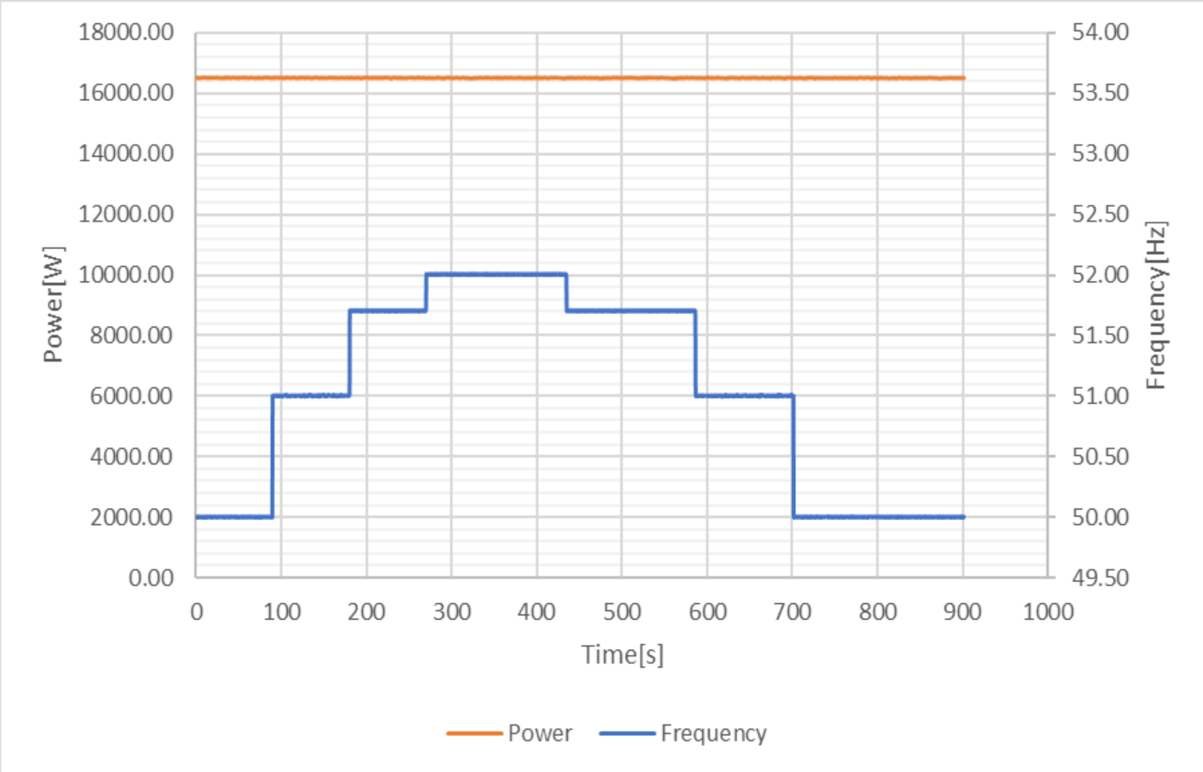
Test 2_Graph



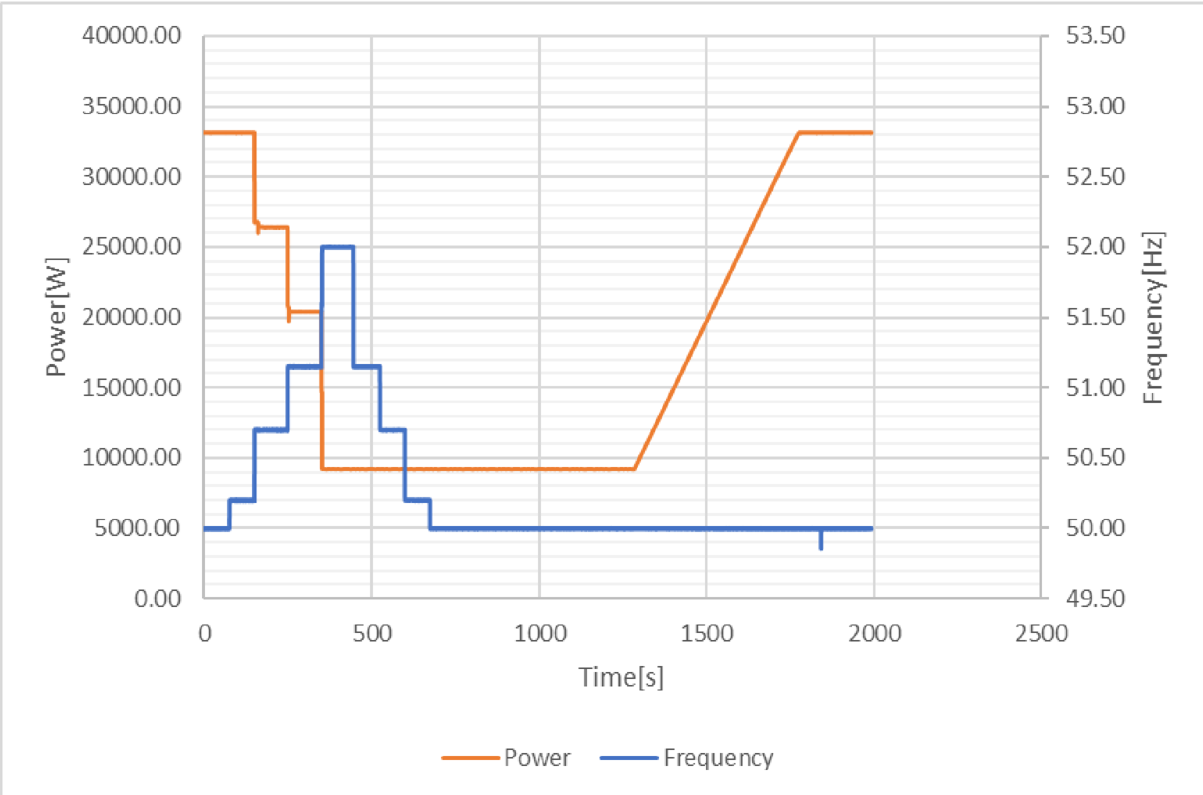
Intentional delay time (no delay)



Test 3_Graph



Test 4_Graph



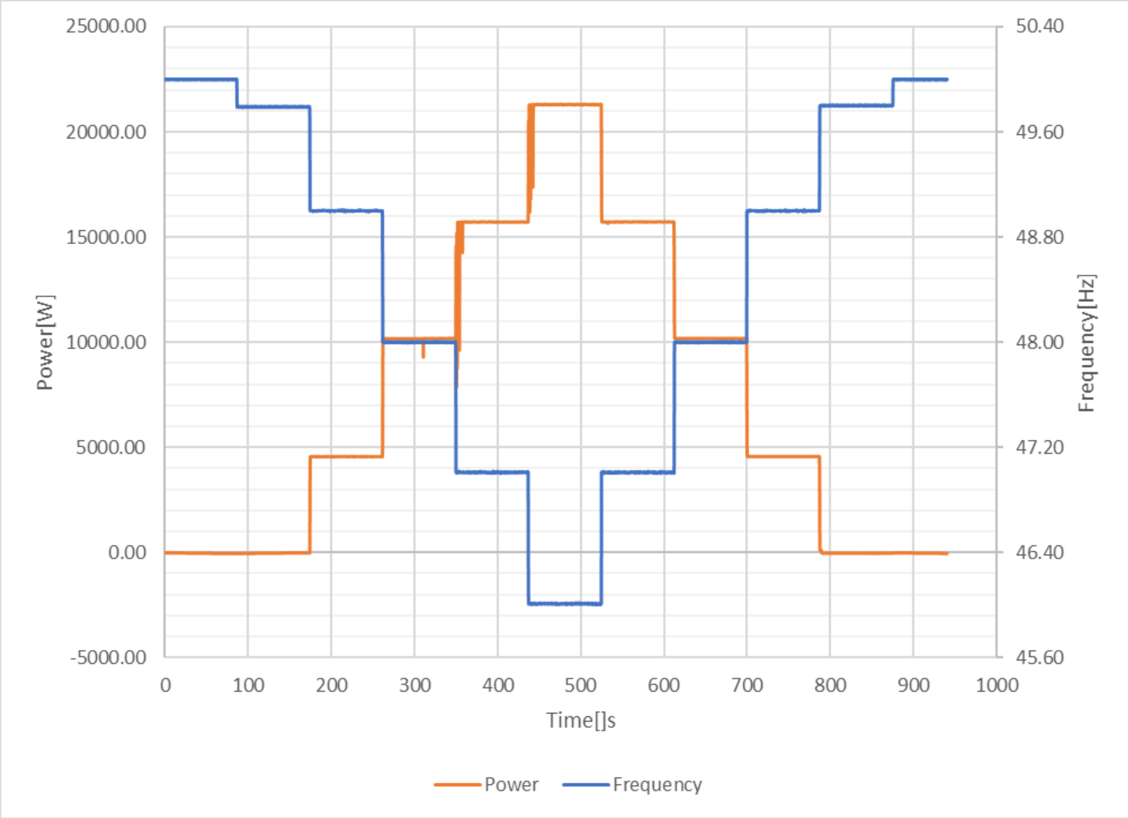
D.6.2	Table: Power response to under frequency						P
Test 1	0% Pn, f1 =49.8Hz; droop=12%; with delay of 2 s						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <10s	For The settling times T≤30s
50Hz ± 0.01Hz	50.00	-33.79	--	--	--	--	--
49.8Hz ± 0.01Hz	49.80	-31.39	0.00	-31.39	± 3300	--	--
49.0Hz ± 0.01z	49.00	4559.98	4400.00	159.98	± 3300	0.6	0.7
48.0Hz ± 0.01z	48.00	10144.96	9900.00	244.96	± 3300	0.6	0.7
47.0Hz ± 0.01z	47.00	15707.97	15400.00	307.97	± 3300	5.0	8.0
46.0Hz ± 0.01z	46.00	21283.06	20900.00	383.06	± 3300	4.2	6.1
47.0Hz ± 0.01z	47.00	15716.75	15400.00	316.75	± 3300	0.4	0.5
48.0Hz ± 0.01z	48.00	10156.45	9900.00	256.45	± 3300	0.8	1.0
49.0Hz ± 0.01z	49.00	4562.59	4400.00	162.59	± 3300	0.4	0.5
49.8Hz ± 0.01Hz	49.80	-33.67	0.00	-33.67	± 3300	0.4	2.5
50.0Hz ± 0.01Hz	50.00	-33.01	--	--	--	--	--

Test 2	0% Pn, f1 =49.8Hz; droop=5%; no delay						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <10s	For The settling times T≤30s
50Hz ± 0.01Hz	50.00	-32.63	--	--	--	--	--
49.8Hz ± 0.01Hz	49.80	53.02	0.00	53.02	± 3300	--	--
49.0Hz ± 0.01Hz	49.00	10682.14	10560.00	122.14	± 3300	0.6	0.8
48.0Hz ± 0.01Hz	48.00	24006.46	23760.00	246.46	± 3300	0.7	2.7
47.0Hz ± 0.01Hz	47.00	33021.13	33000.00	21.13	± 3300	--	--
46.0Hz ± 0.01Hz	46.00	33014.13	33000.00	14.13	± 3300	--	--
47.0Hz ± 0.01Hz	47.00	33016.29	33000.00	16.29	± 3300	--	--
48.0Hz ± 0.01Hz	48.00	23993.58	23760.00	233.58	± 3300	--	--
49.0Hz ± 0.01Hz	49.00	10686.46	10560.00	126.46	± 3300	0.4	0.5
49.8Hz ± 0.01Hz	49.80	-28.22	0.00	-28.22	± 3300	0.4	0.5
50.0Hz ± 0.01Hz	50.00	-33.29	--	--	--	--	--

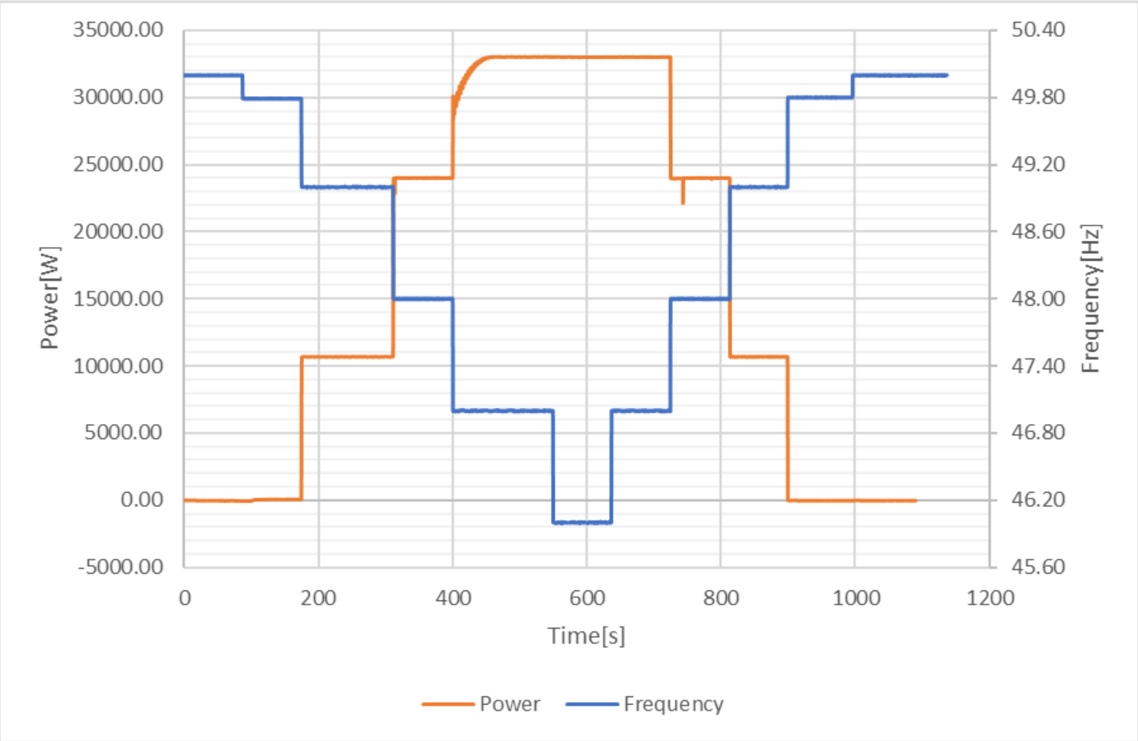
Test 3	50% Pn, f1 =46.0Hz; droop=5%; no delay						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <10s	For The settling times T≤30s
50Hz ± 0.01Hz	50.00	16541.15	--	--	--	--	--
49.0Hz ± 0.01Hz	49.00	16547.93	16500.00	47.93	± 3300	--	--
48.0Hz ± 0.01Hz	48.00	16548.49	16500.00	48.49	± 3300	--	--
47.0Hz ± 0.01Hz	47.00	16547.22	16500.00	47.22	± 3300	--	--
46.0Hz ± 0.01Hz	46.00	16404.66	16500.00	-95.34	± 3300	--	--
47.0Hz ± 0.01Hz	47.00	16546.08	16500.00	46.08	± 3300	--	--
48.0Hz ± 0.01Hz	48.00	16549.39	16500.00	49.39	± 3300	--	--
49.0Hz ± 0.01Hz	49.00	16549.98	16500.00	49.98	± 3300	--	--
50.0Hz ± 0.01Hz	50.00	16551.72	--	--	--	--	--

Test 4	50% Pn, f1 =49.8Hz; droop=5%;						
	f (Hz)	Measured output Power (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)	Tolerance Limit (W)	The response times Tan_90 % <10s	For The settling times T≤30s
50Hz ± 0.01Hz	50.00	16550.88	--	--	--	--	--
49.8Hz ± 0.01Hz	49.80	16715.59	16500.00	215.59	± 3300	--	--
49.0Hz ± 0.01Hz	49.00	27314.68	27060.00	254.68	± 3300	1.1	1.3
48.0Hz ± 0.01Hz	48.00	32956.94	33000.00	-43.06	± 3300	--	--
47.0Hz ± 0.01Hz	47.00	33016.36	33000.00	16.36	± 3300	--	--
46.0Hz ± 0.01Hz	46.00	33009.67	33000.00	9.67	± 3300	--	--
47.0Hz ± 0.01Hz	47.00	33012.08	33000.00	12.08	± 3300	--	--
48.0Hz ± 0.01Hz	48.00	33013.18	33000.00	13.18	± 3300	0.0	0.0
49.0Hz ± 0.01Hz	49.00	27319.57	27060.00	259.57	± 3300	0.4	0.5
49.8Hz ± 0.01Hz	49.80	16628.38	16500.00	128.38	± 3300	--	--
50.0Hz ± 0.01Hz	50.00	16610.11	--	--	--	--	--

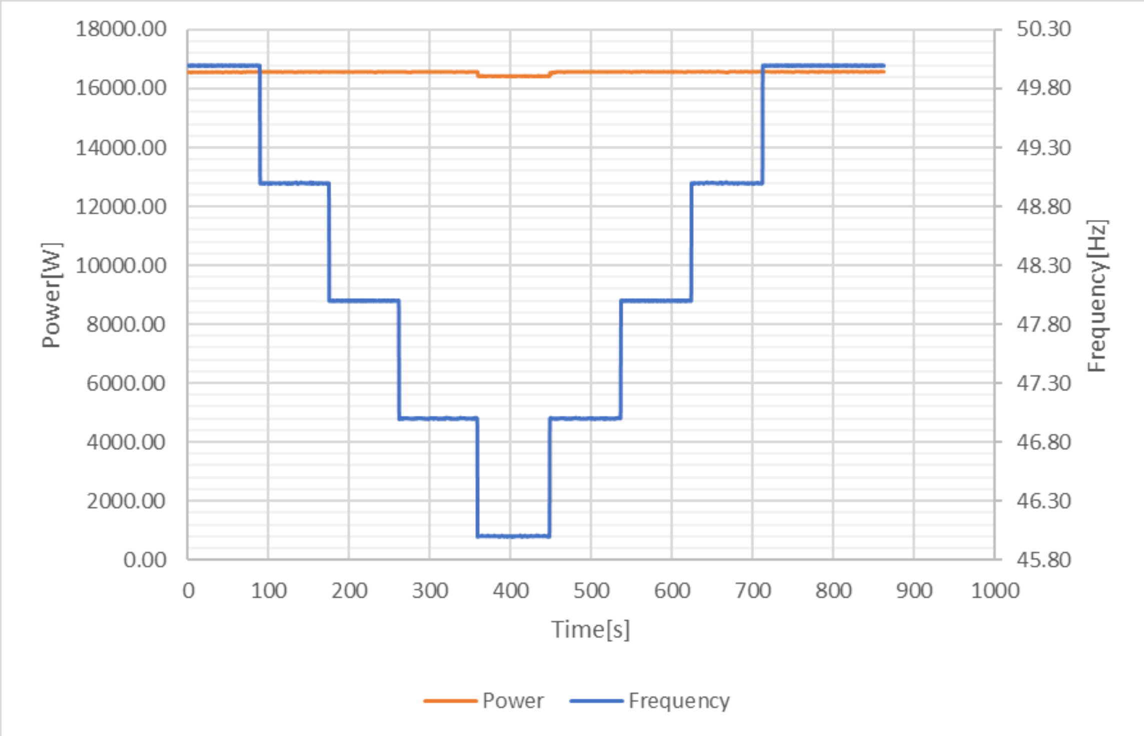
Test 1_Graph



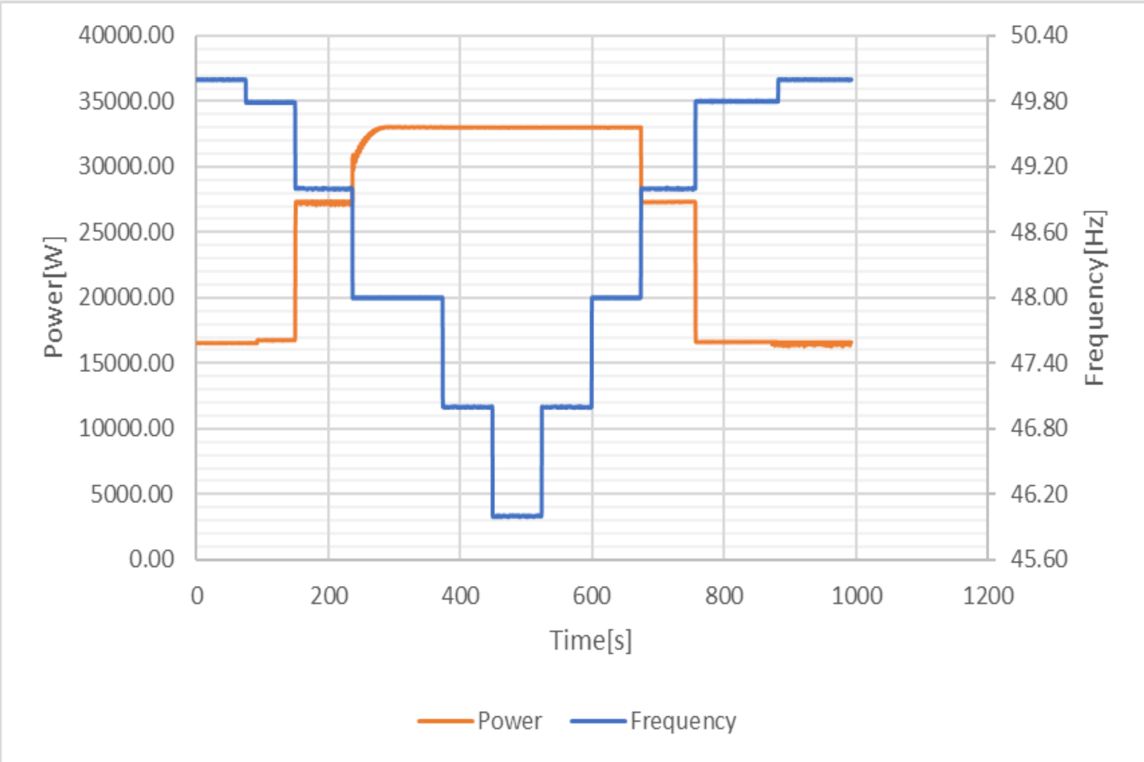
Test 2_Graph



Test 3_Graph



Test 4_Graph



D.7.1	Table: Q Capabilities (Power Factor)	P

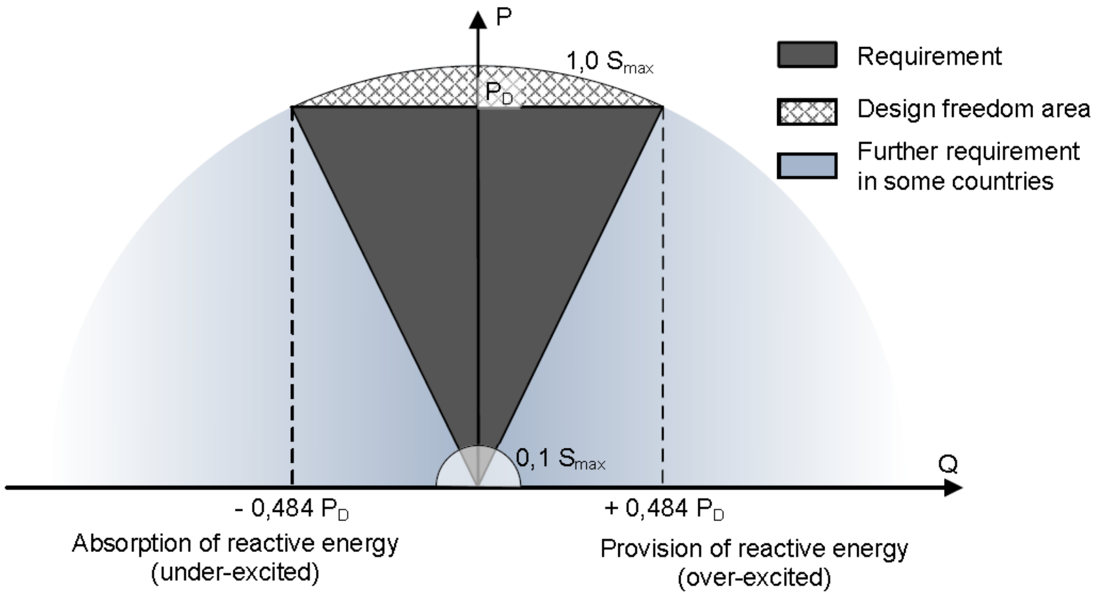
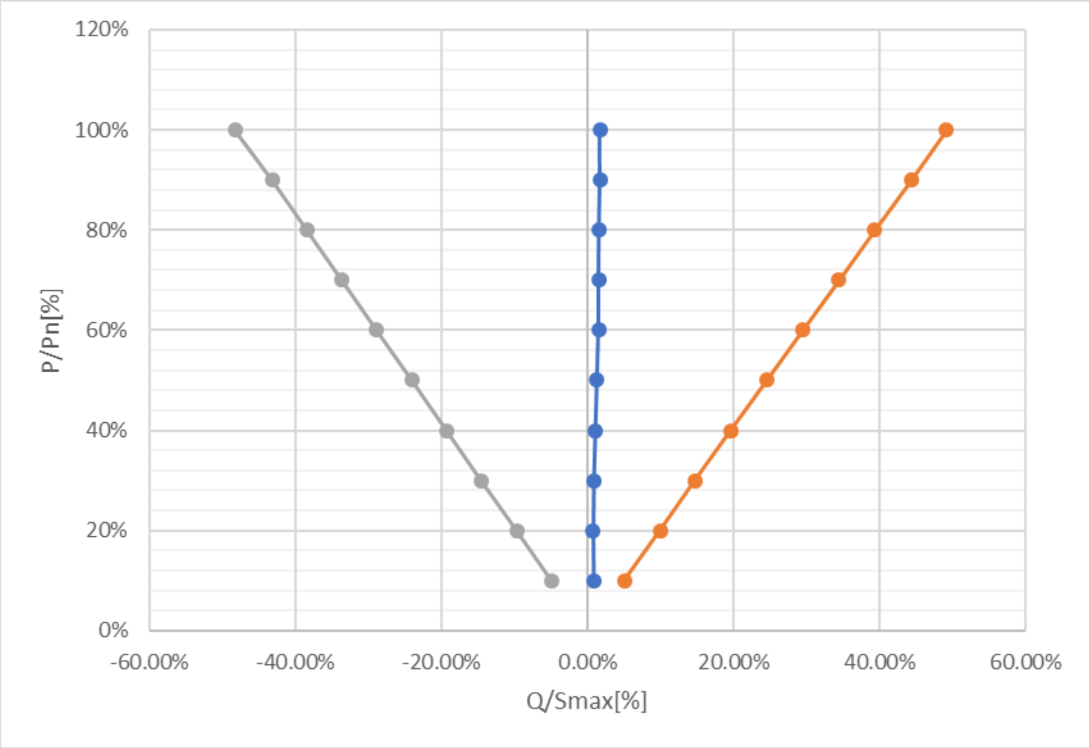


Figure 12 — Reactive power capability at nominal voltage

Lagging PF=0.9:

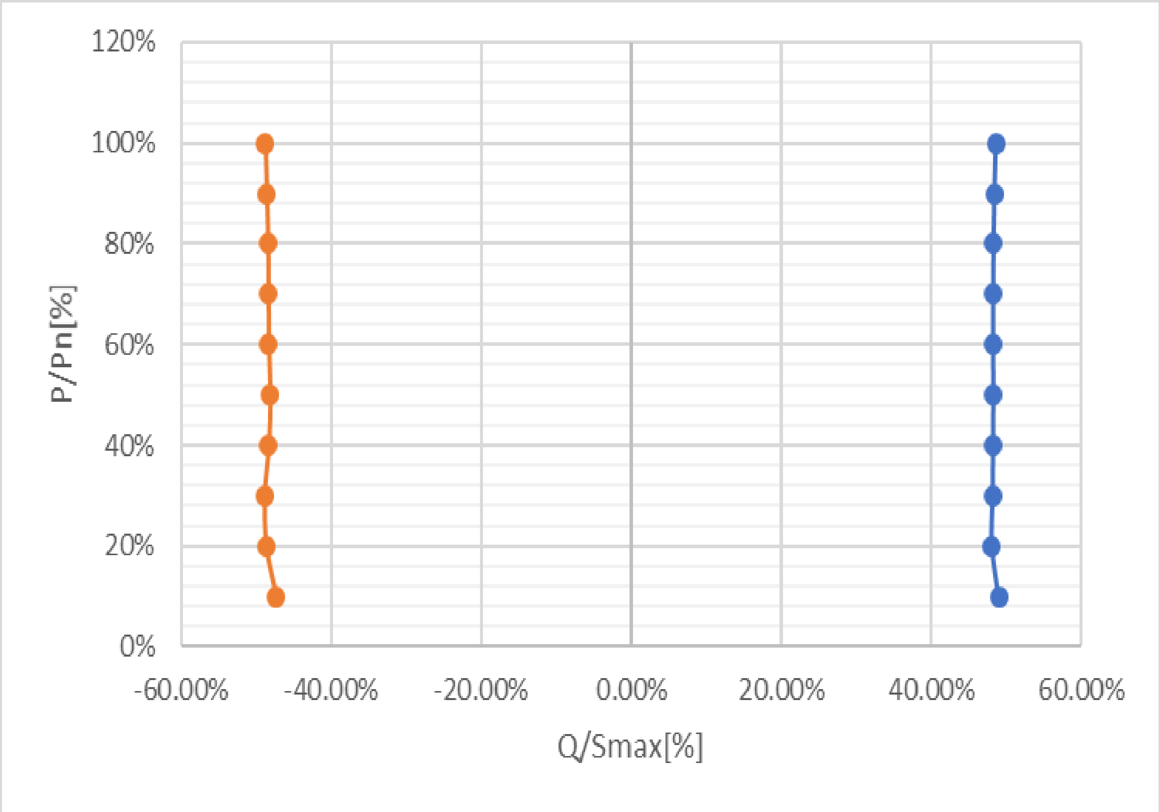
P/Pn[%] setpoint	P[W]	Q[Var]	Cosφ	Cosφ Set-point	Δcosφ	Q[Var] setpoint	ΔQ/S_{max} [%]	LIMITE [%]
10	3299.58	-1615.38	0.8981	0.9	-0.0019	-1598.26	-0.05	± 2
20	6664.14	-3192.30	0.9019	0.9	0.0019	-3196.53	0.01	± 2
30	10009.62	-4799.78	0.9017	0.9	0.0017	-4794.79	-0.02	± 2
40	13278.96	-6367.00	0.9017	0.9	0.0017	-6393.05	0.08	± 2
50	16539.46	-7927.87	0.9018	0.9	0.0018	-7991.31	0.19	± 2
60	19861.24	-9521.63	0.9017	0.9	0.0017	-9589.58	0.21	± 2
70	23137.17	-11095.37	0.9017	0.9	0.0017	-11187.84	0.28	± 2
80	26430.89	-12676.43	0.9017	0.9	0.0017	-12786.10	0.33	± 2
90	29686.86	-14251.15	0.9015	0.9	0.0015	-14384.37	0.40	± 2
100*	33152.44	-15940.10	0.9012	0.9	--	--	--	--

Leading PF=0.9:								
P/Pn[%] setpoint	P[W]	Q[Var]	Cosφ	Cosφ Set-point	Δcosφ	Q[Var] setpoint	ΔQ/S_{max} [%]	LIMITE [%]
10	3376.20	1677.25	0.8956	0.9	-0.0044	1598.26	0.24	± 2
20	6667.98	3289.68	0.8968	0.9	-0.0032	3196.53	0.28	± 2
30	9951.95	4862.60	0.8985	0.9	-0.0015	4794.79	0.21	± 2
40	13256.88	6483.10	0.8983	0.9	-0.0017	6393.05	0.27	± 2
50	16552.12	8118.57	0.8978	0.9	-0.0022	7991.31	0.39	± 2
60	19842.73	9747.75	0.8975	0.9	-0.0025	9589.58	0.48	± 2
70	23155.57	11385.27	0.8974	0.9	-0.0026	11187.84	0.60	± 2
80	26420.62	12999.83	0.8973	0.9	-0.0027	12786.10	0.65	± 2
90	29711.29	14643.69	0.8970	0.9	-0.0030	14384.37	0.79	± 2
100	32962.09	16238.42	0.8971	0.9	--	--	--	--
Q=0:								
P/Pn[%] setpoint	P[W]	Q[Var]	Cosφ	Cosφ Set-point	Δcosφ	Q[Var] setpoint	ΔQ/S_{max} [%]	LIMITE [%]
10	3315.72	278.80	0.9963	1	-0.0037	0.00	0.84	± 2
20	6678.68	249.80	0.9993	1	-0.0007	0.00	0.76	± 2
30	9968.89	280.76	0.9996	1	-0.0004	0.00	0.85	± 2
40	13256.93	357.67	0.9996	1	-0.0004	0.00	1.08	± 2
50	16593.57	430.99	0.9996	1	-0.0004	0.00	1.31	± 2
60	19887.97	506.41	0.9997	1	-0.0003	0.00	1.53	± 2
70	23192.74	512.80	0.9996	1	-0.0004	0.00	1.55	± 2
80	26495.98	530.98	0.9996	1	-0.0004	0.00	1.61	± 2
90	29793.59	579.14	0.9995	1	-0.0005	0.00	1.75	± 2
100	33121.91	566.09	0.9995	1	-0.0005	0.00	1.72	± 2

Graph


120%
100%
80%
60%
40%
20%
0%
P/Pn[%]
-60.00%
-40.00%
-20.00%
0.00%
20.00%
40.00%
60.00%
Q/Smax[%]

Q=48.43%Pn						
P/Pn[%] setpoint	P[W]	Q[Var]	Cosφ	Q[Var] setpoint	$\Delta Q/S_{max}$ [%]	LIMITE [%]
10	3261.93	16171.58	0.1977	15981.9	0.57	± 2
20	6660.33	15862.95	0.3871	15981.9	-0.36	± 2
30	9970.06	15898.96	0.5313	15981.9	-0.25	± 2
40	13240.08	15920.81	0.6394	15981.9	-0.19	± 2
50	16590.81	15935.38	0.7212	15981.9	-0.14	± 2
60	19843.31	15925.79	0.7799	15981.9	-0.17	± 2
70	23132.84	15930.05	0.8236	15981.9	-0.16	± 2
80	26456.71	15942.77	0.8565	15981.9	-0.12	± 2
90	29757.73	15982.68	0.8810	15981.9	0.00	± 2
100*	33079.34	16045.68	0.8997	15981.9	0.19	± 2
Q=-48.43%Pn						
P/Pn[%] setpoint	P[W]	Q[Var]	Cosφ	Q[Var] setpoint	$\Delta Q/S_{max}$ [%]	LIMITE [%]
10	3315.26	-15642.03	0.2073	-15981.9	1.03	± 2
20	6630.89	-16072.19	0.3814	-15981.9	-0.27	± 2
30	10008.91	-16147.80	0.5268	-15981.9	-0.50	± 2
40	13247.64	-15962.75	0.6386	-15981.9	0.06	± 2
50	16557.73	-15898.62	0.7213	-15981.9	0.25	± 2
60	19900.56	-15963.07	0.7801	-15981.9	0.06	± 2
70	23222.84	-15976.84	0.8239	-15981.9	0.02	± 2
80	26543.79	-15992.09	0.8566	-15981.9	-0.03	± 2
90	29757.31	-16044.16	0.8802	-15981.9	-0.19	± 2
100*	33120.63	-16107.28	0.8993	-15981.9	-0.38	± 2

Graph


120%
100%
80%
60%
40%
20%
0%
P/Pn[%]
-60.00%
-40.00%
-20.00%
0.00%
20.00%
40.00%
60.00%
Q/Smax[%]

D.7.1	Table: Q(U) Capabilities	P

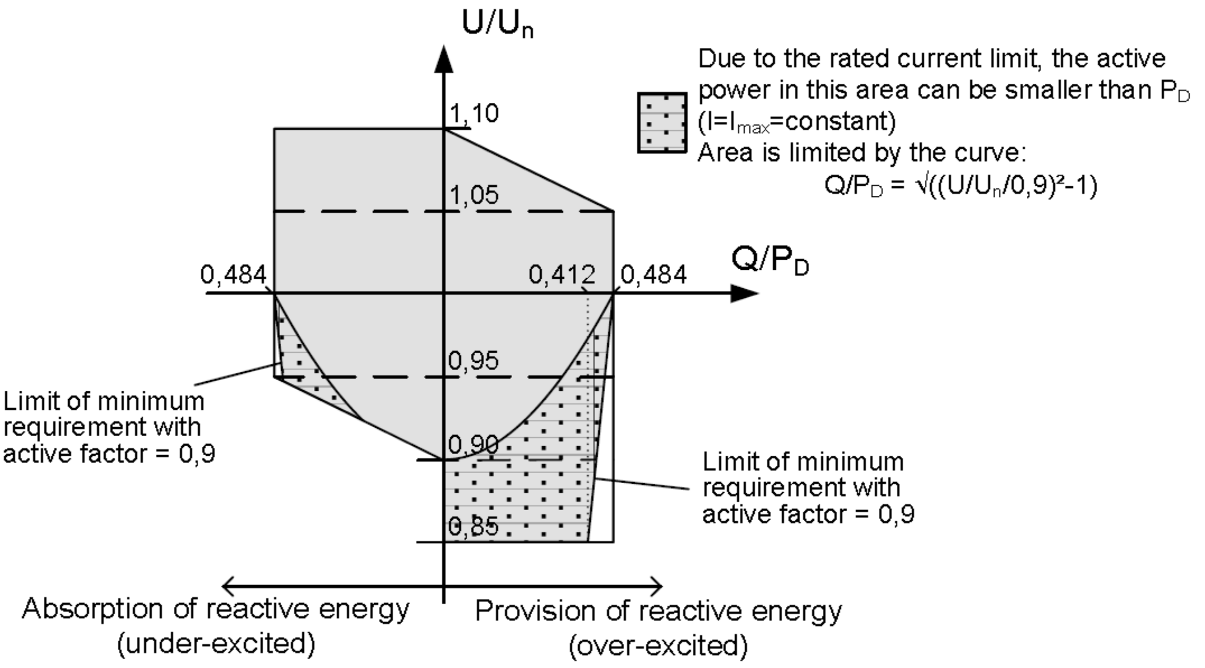


Figure 13 — Reactive power capability at active power P_D in the voltage range (positive sequence component of the fundamental)

Over-excited:

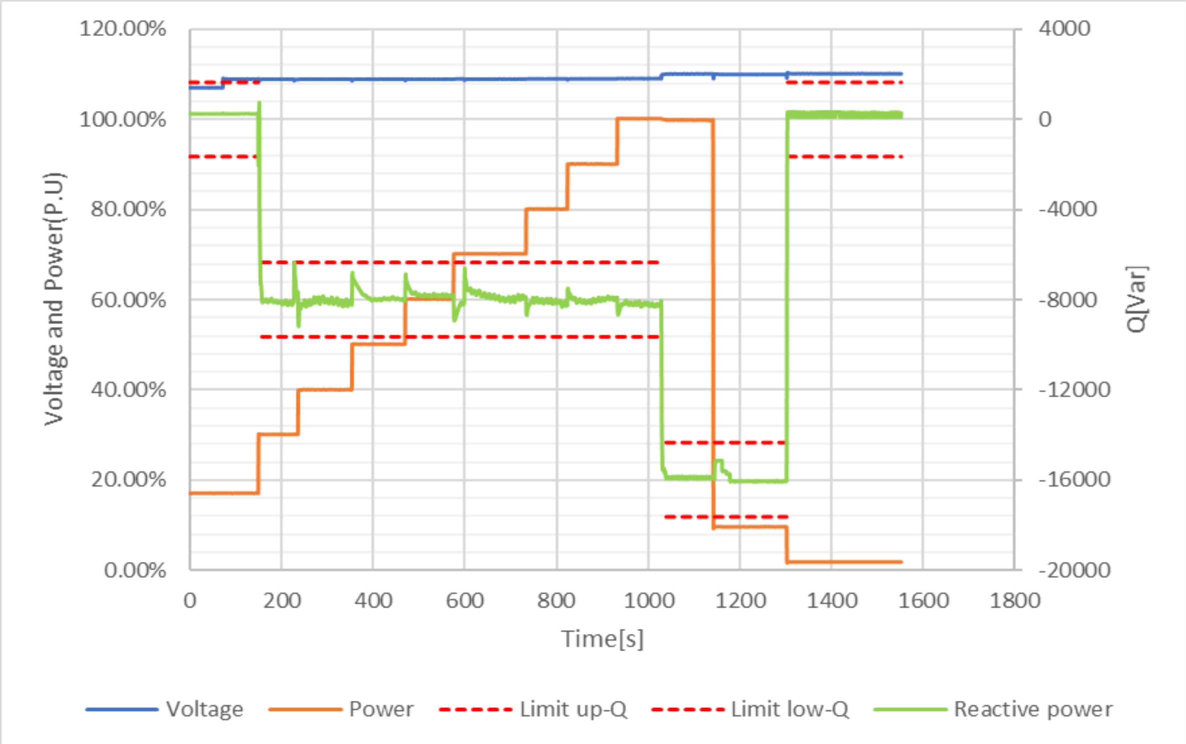
AC output				Reactive power measured		
Voltage setting [V/Vn]	Measured			Reactive power [Var]	Value [Q/Pn]	Limits
	Voltage [V]	[V/Vn]	Active power [W]			
1.10	253.27	1.10	33195.88	524.65	0.0159	±0.02
1.08	249.12	1.08	33198.13	6407.44	0.1942	0.194±0.02
1.05	241.75	1.05	33074.79	15929.96	0.4827	--
1.00	230.63	1.00	33105.58	15944.71	0.4832	--
0.95	218.79	0.95	31382.19	15987.57	0.4845	--
0.92	211.95	0.92	29879.21	15998.70	0.4848	--
0.90	207.27	0.90	29383.03	15983.78	0.4844	--
0.85	195.79	0.85	27319.06	16010.46	0.4852	--

Under-excited:						
AC output				Reactive power measured		
Voltage setting [V/Vn]	Measured			Reactive power [Var]	Value [Q/Pn]	Limits
	Voltage [V]	[V/Vn]	Active power [W]			
1.10	253.04	1.10	32979.96	-15956.08	-0.4835	--
1.08	248.25	1.08	33031.09	-15984.27	-0.4844	--
1.05	241.24	1.05	33029.22	-16016.13	-0.4853	--
1.00	230.13	1.00	32978.95	-16066.30	-0.4869	--
0.95	218.13	0.95	31243.10	-15883.35	-0.4813	--
0.92	211.52	0.92	31869.28	-5782.29	-0.1752	-0.175±0.02
0.90	207.24	0.90	32961.50	526.72	0.0160	±0.02

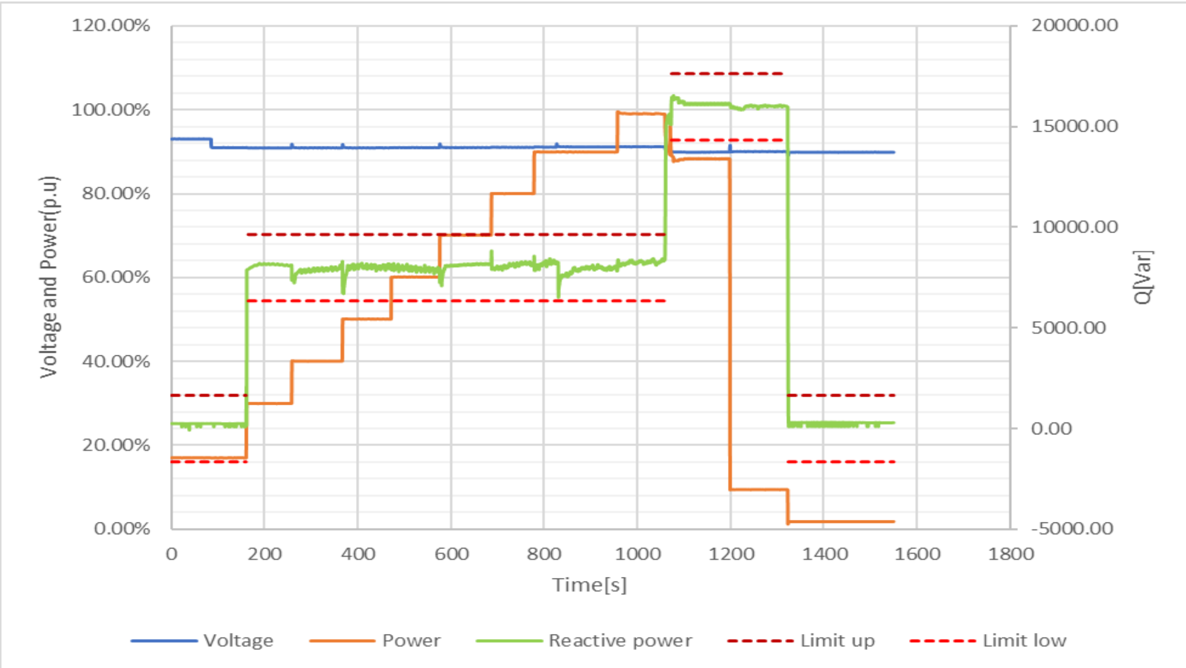
D.7.1	Table: Q Control. Voltage related control mode					P
P/Pn [%] Set-point	Vac [V] Set-point	P/Pn [%] measured	Vac [V] Measured	Q [VAr] measured	Q [Var] expected	Δ Q [Var] (≤ ± 5 % Pn)
< 20 %	1,07 Vn	17.09	246.23	251.93	≈0 (< ± 5 % Pn)	0.76
< 20 %	1,09 Vn	17.10	250.63	253.51	≈0 (< ± 5 % Pn)	0.77
<20 %→30 %	1,09 Vn	30.13	250.53	-8007.24	-7992.60 (within 10sec)	-0.04
40 %	1,09 Vn	40.06	250.59	-8085.07	-7992.60	-0.28
50 %	1,09 Vn	50.17	250.58	-7894.08	-7992.60	0.30
60 %	1,09 Vn	60.15	250.55	-7768.84	-7992.60	0.68
70 %	1,09 Vn	70.21	250.61	-7857.17	-7992.60	0.41
80 %	1,09 Vn	80.13	250.74	-8082.63	-7992.60	-0.27
90 %	1,09 Vn	90.13	250.75	-7988.91	-7992.60	0.01
100 %	1,09 Vn	100.20	250.86	-8191.61	-7992.60	-0.60
100 %	1,1 Vn	99.91	253.25	-15883.76	-15981.90	0.30
100 % →10 %	1,1 Vn	9.65	253.00	-15919.40	-15981.90	0.19
10 %→ ≤ 5 %	1,1 Vn	1.85	253.38	270.66	≈0 (< ± 5 % Pn)	0.82
P/Pn [%] Set-point	Vac [V] Set-point	P/Pn [%] measured	Vac [V] Measured	Q [VAr] measured	Q [Var] expected	Δ Q [Var] (≤ ± 5 % Pn)
< 20 %	0.93 Vn	17.04	214.03	241.36	≈0 (< ± 5 % Pn)	0.73
< 20 %	0.91 Vn	17.02	209.29	235.14	≈0 (< ± 5 % Pn)	0.71
<20 %→30 %	0.91 Vn	30.00	209.15	8128.06	7992.60 (within 10sec)	0.41
40 %	0.91 Vn	40.09	209.19	7879.79	7992.60	-0.34
50 %	0.91 Vn	50.12	209.19	8039.83	7992.60	0.14
60 %	0.91 Vn	60.14	209.30	7945.63	7992.60	-0.14
70 %	0.91 Vn	70.13	209.33	8113.97	7992.60	0.37
80 %	0.91 Vn	80.04	209.47	8102.79	7992.60	0.33
90 %	0.91 Vn	89.97	209.68	7907.07	7992.60	-0.26

100 %	0.91 Vn	99.10	209.77	8259.11	7992.60	0.81
100 %	0.90 Vn	88.31	206.82	16171.13	15981.90	0.57
100 % →10 %	0.90 Vn	9.47	207.10	15993.09	15981.90	0.03
10 % →≤ 5 %	0.91 Vn	1.82	206.76	281.09	≈0 (< ± 5 % Pn)	0.85

Graph: Lock-in at 1.08Vn

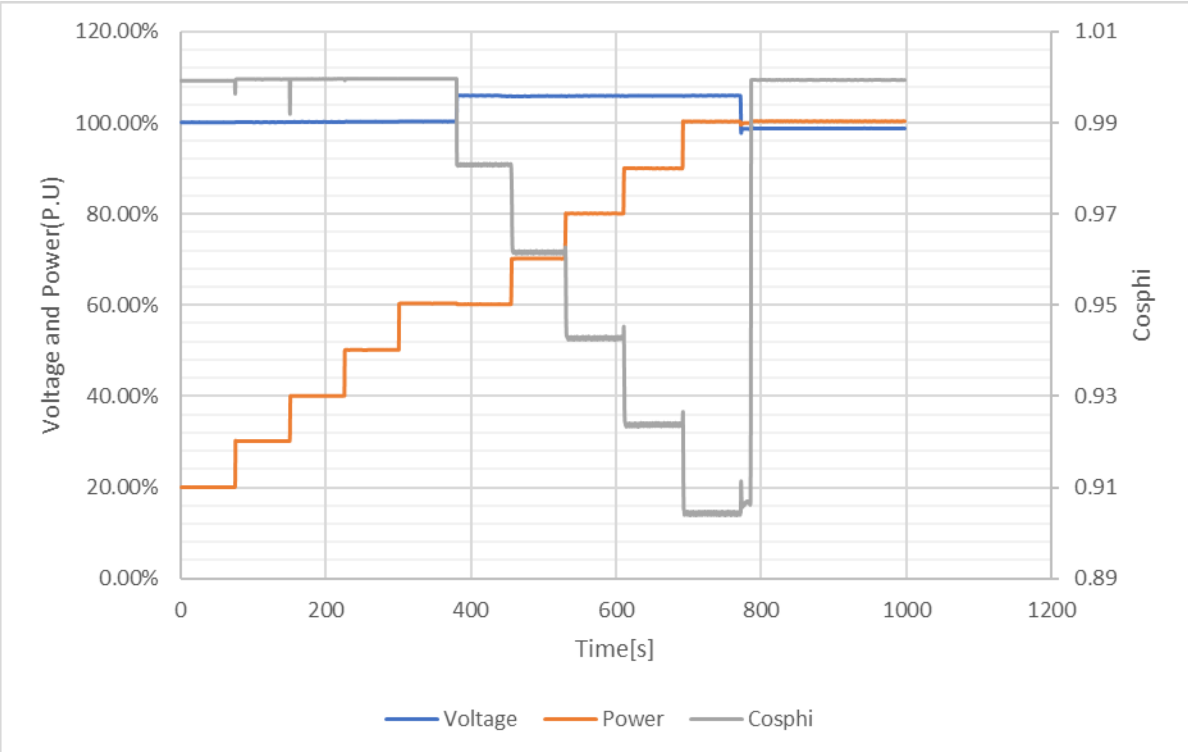


Graph: Lock-in at 0.92Vn



D.7.1	Table: Q Control Power related control modes							P
P Desired (%Sn)	**P measured (%Sn)**	**Q measured (Var)**	**Voltage Desired (%Un)**	**Voltage Measured (%Un)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**△Q ($\%S_{Max}$)**	**Limit ($\%S_{Max}$)**
20%	20.12	253.45	<105%	100.08	1.0000	0.9993	0.77	±2
30%	30.23	279.37	<105%	100.11	1.0000	0.9996	0.85	±2
40%	40.12	351.78	<105%	100.16	1.0000	0.9996	1.07	±2
50%	50.18	422.46	<105%	100.21	1.0000	0.9997	1.28	±2
60%	60.37	499.41	<105%	100.27	1.0000	0.9997	1.51	±2
60%	60.18	-3948.66	>105%	105.96	0.9800	0.9808	0.22	±2
70%	70.18	-6613.45	>105%	105.86	0.9600	0.9616	0.38	±2
80%	80.04	-9348.18	>105%	105.92	0.9400	0.9427	0.71	±2
90%	89.94	-12311.39	>105%	105.94	0.9200	0.9237	1.03	±2
100%	100.18	-15614.99	>105%	105.98	0.9000	0.9042	1.11	±2
100%	100.24	543.55	<100%	98.73	1.0000	0.9994	1.65	±2
Remark: Tested at lock-in voltage 1.05 Vn and lock-out voltage Vn. The Lock-in value is adjustable between Vn and 1.1Vn in 0.01V steps, the Lock-out value is adjustable between 0.9Vn and Vn in 0.01V steps								

Graph



D.7.2	Table: Voltage related active power reduction P(U)	P

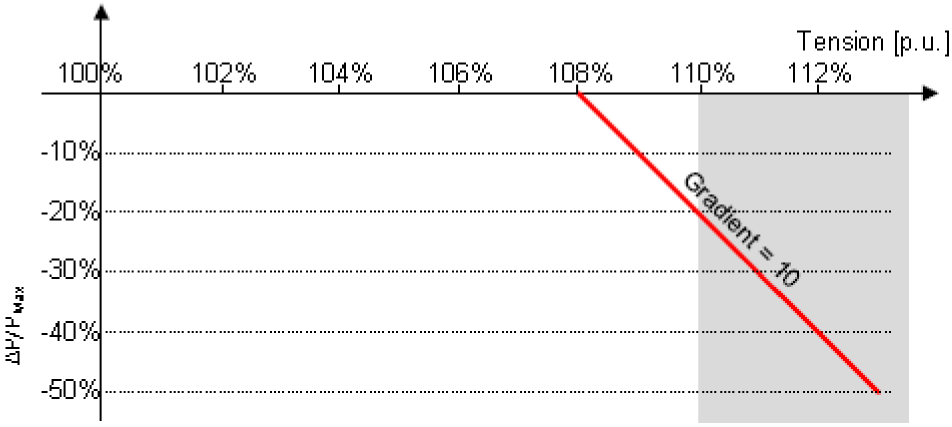
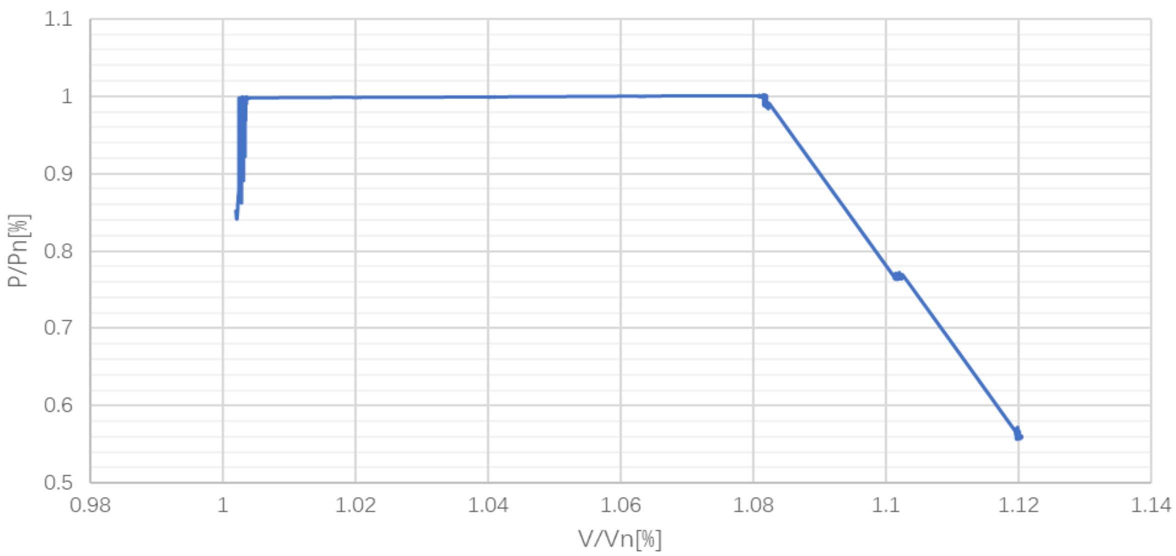


Figure 15 - Example curve for P(U)

Step #	Set voltage vaule V/Vn [%]	Measured voltage vaule V/Vn [%]	Measured power values [W]	Measured power bin [%]	Limit [%]	RESULT
1	100	100.32	32924.25	99.77	--	P
2	102	101.99	32944.78	99.83	--	
3	104	104.04	32969.12	99.91	--	
4	106	106.31	32995.63	99.99	--	
5	108	108.15	32879.62	99.64	--	
6	110	110.18	25517.58	77.33	<80	
7	112	111.98	18745.14	56.80	<60	



D.8	Table: Connection and reconnection	P

Parameter	Reconnection after tripping of the interface protection relay	Normal operation starting
Lower frequency	49,9 Hz	49,9 Hz
Upper frequency	50,1 Hz	50,1 Hz
Lower voltage	If connection to the LV distribution network: 85% U_n	If connection to the LV distribution network: 85% U_n
	If connection to the HV distribution network: 90 % U_c	If connection to the HV distribution network: 90 % U_c
Upper voltage	If connection to the LV distribution network: 110 % U_n	If connection to the LV distribution network: 110 % U_n
	If connection to the HV distribution network: 110 % U_c	If connection to the HV distribution network: 110 % U_c
Observation time	60 s	60 s
Maximum active power increase gradient	10 %/min*	20 %/min

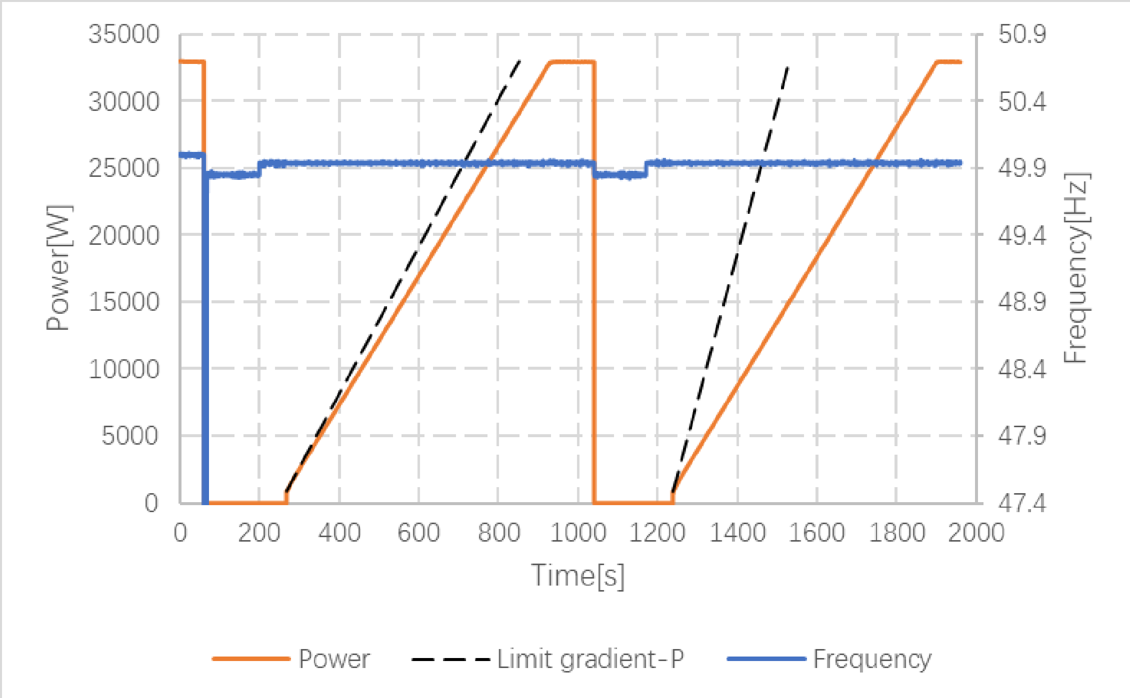
** Power-generating units that have not the ability to apply a certain gradient shall take into account an additional delay.*

Test sequence after trip	connection	connection allowed	Observation time (s)	Power gradient after connection (%/min)
Step a)	<49.9Hz	No	--	--
Step b)	≥49.9Hz	Yes	68.0	8.78
Step c)	>50.1Hz	No	--	--
Step d)	≤50.1Hz	Yes	67.4	8.80
Step e)	<195.5V	No	--	--
Step f)	≥195.5V	Yes	67.6	8.84
Step g)	>253V	No	--	--
Step h)	≤253V	Yes	68.6	8.76

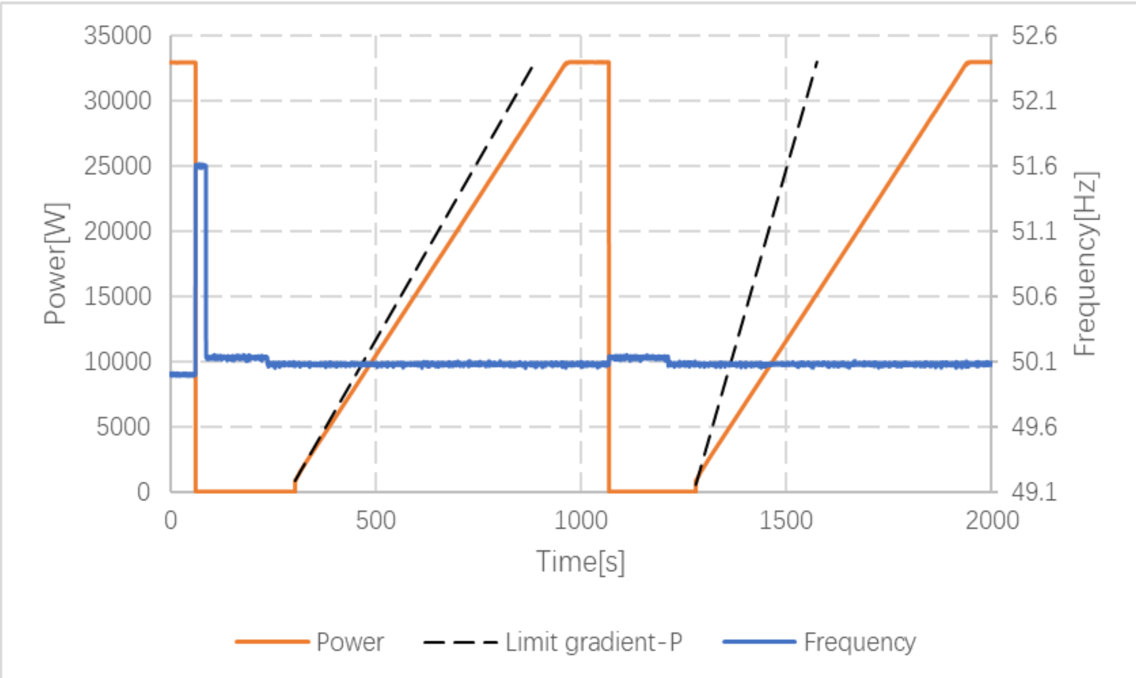
Remark: Maximum active power increase gradient 10 %/min.

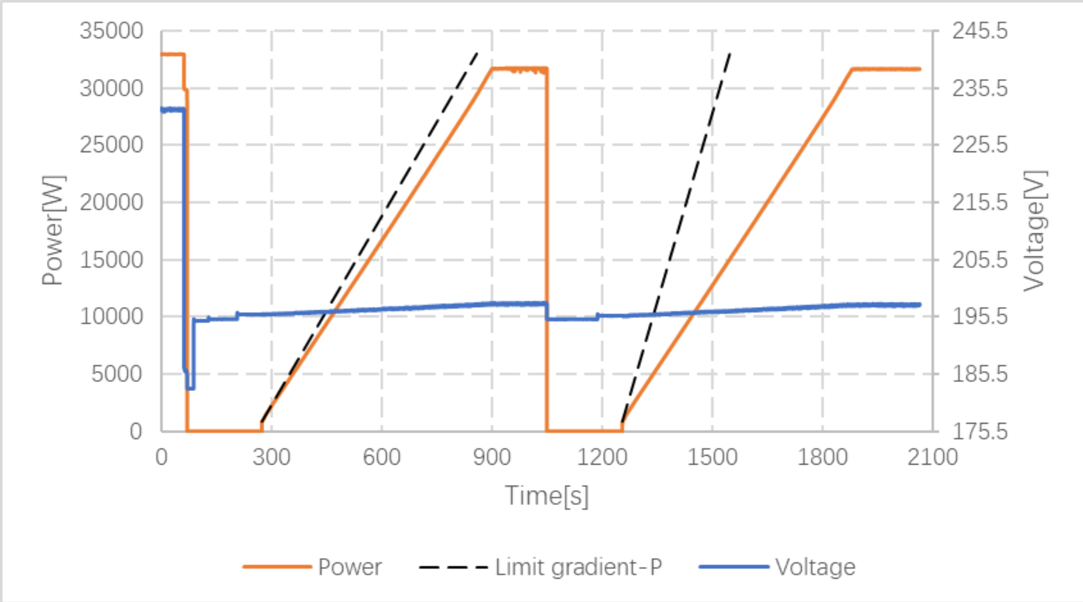
Test sequence at normal operation starting	connection	connection allowed	Observation time (s)	Power gradient after connection (%/min)
Step a)	**<49.9Hz**	**No**	--	--
Step b)	**≥49.9Hz**	**Yes**	67.6	8.77
Step c)	**>50.1Hz**	**No**	--	--
Step d)	**≤50.1Hz**	**Yes**	67.2	8.79
Step e)	**<195.5V**	**No**	--	--
Step f)	**≥195.5V**	**Yes**	67.6	8.85
Step g)	**>253V**	**No**	--	--
Step h)	**≤253V**	**Yes**	69.0	8.76
Remark: Maximum active power increase gradient 20 %/min.				

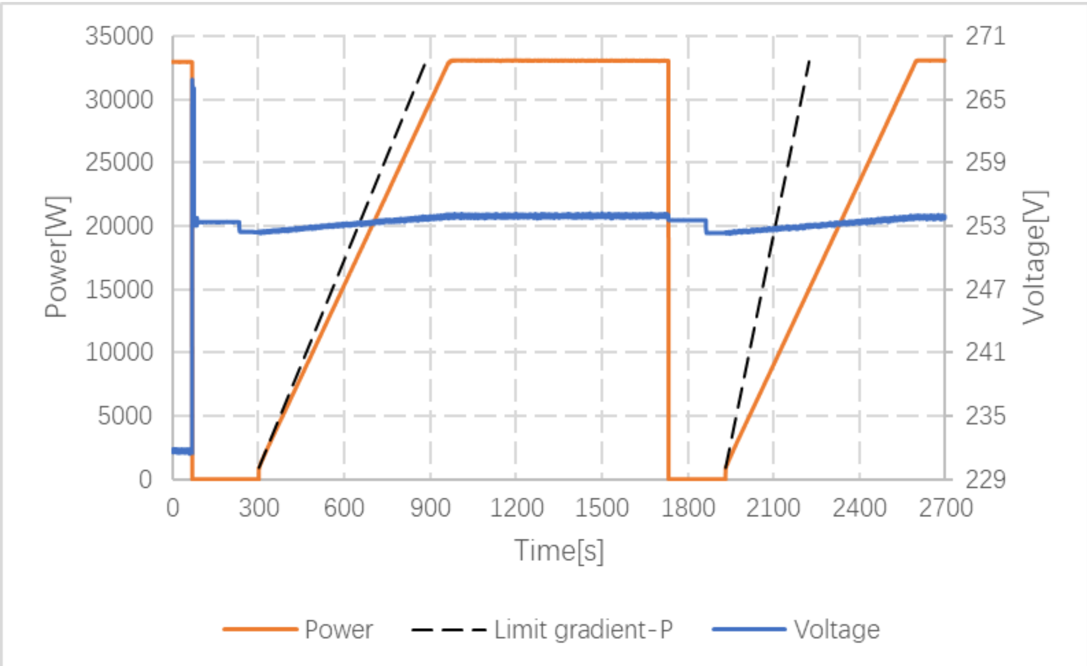
Graph_49.9Hz



Graph_50.1Hz

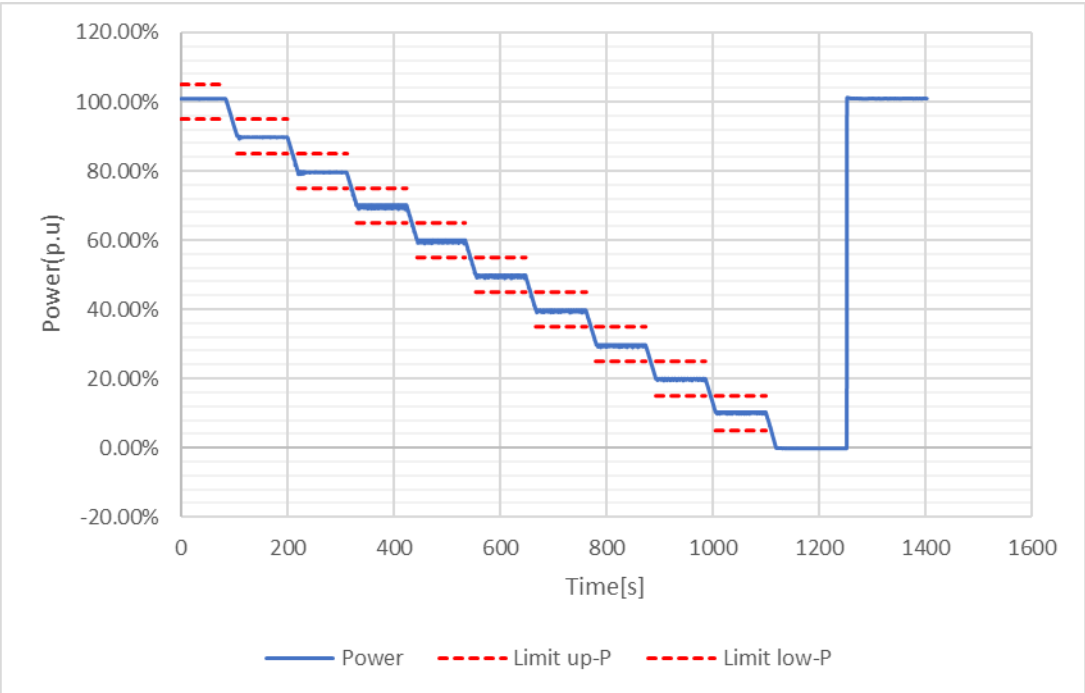


Graph_195.5V


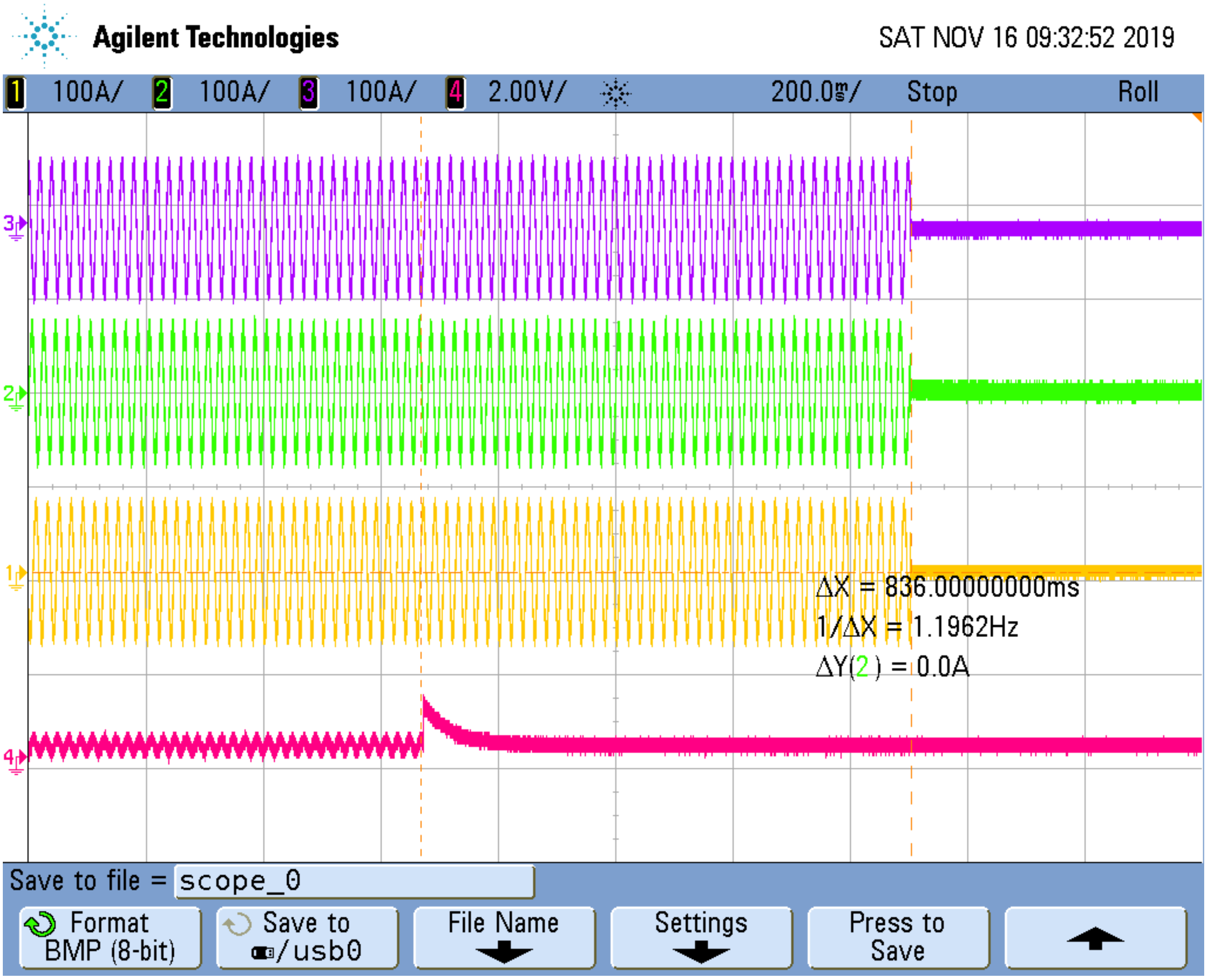
Graph_253V


D.9	Table: Ceasing and reduction of active power on set point (Logic interface)						P
String	1	U_{DC} =	800 Vdc	Uac = Un	230 Vac	P_{Emax} (KW)	33.0

1 min mean value P/Pn Psetpoint (%)	Pmeasured (%)	△Pmeasured (%)	Limit [%]
100%	100.88	0.88	±5%
90%	89.75	-0.25	±5%
80%	79.61	-0.39	±5%
70%	70.01	0.01	±5%
60%	59.88	-0.12	±5%
50%	49.79	-0.21	±5%
40%	39.73	-0.27	±5%
30%	29.69	-0.31	±5%
20%	19.93	-0.07	±5%
10%	10.27	0.27	±5%
The power gradient for increasing and reducing (%P_n/s)			0.50%P_n/s
Time for Logic interface (at input port) activated			0.836s



Waveform for logic interface



Remark: Once activation, the inverter will cease the power during 5s, detail also refer to instruction manual

Annex 1: Photo document

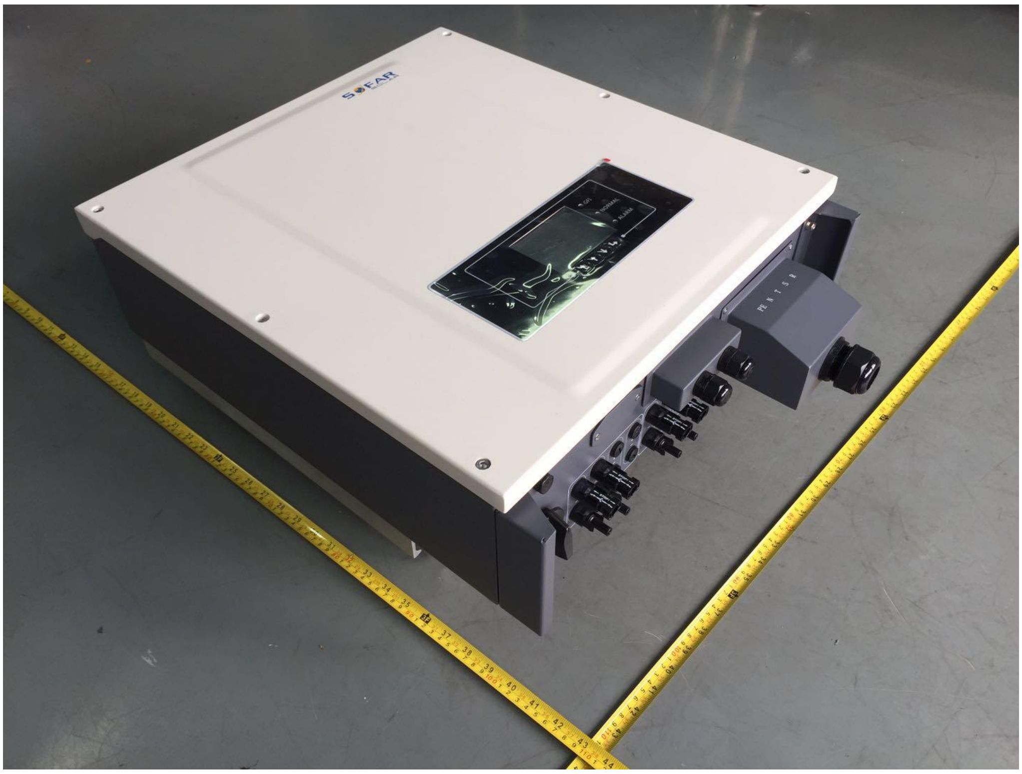


Photo 1 （Front view）SOFAR 20000TL

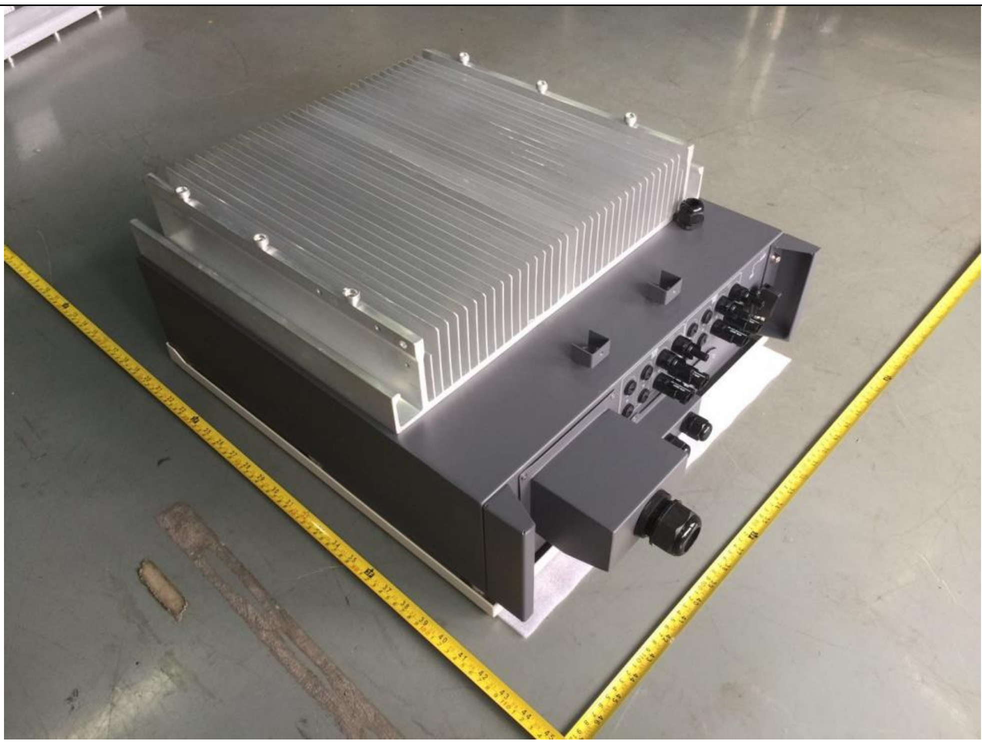


Photo 2 （Back view）SOFAR 20000TL

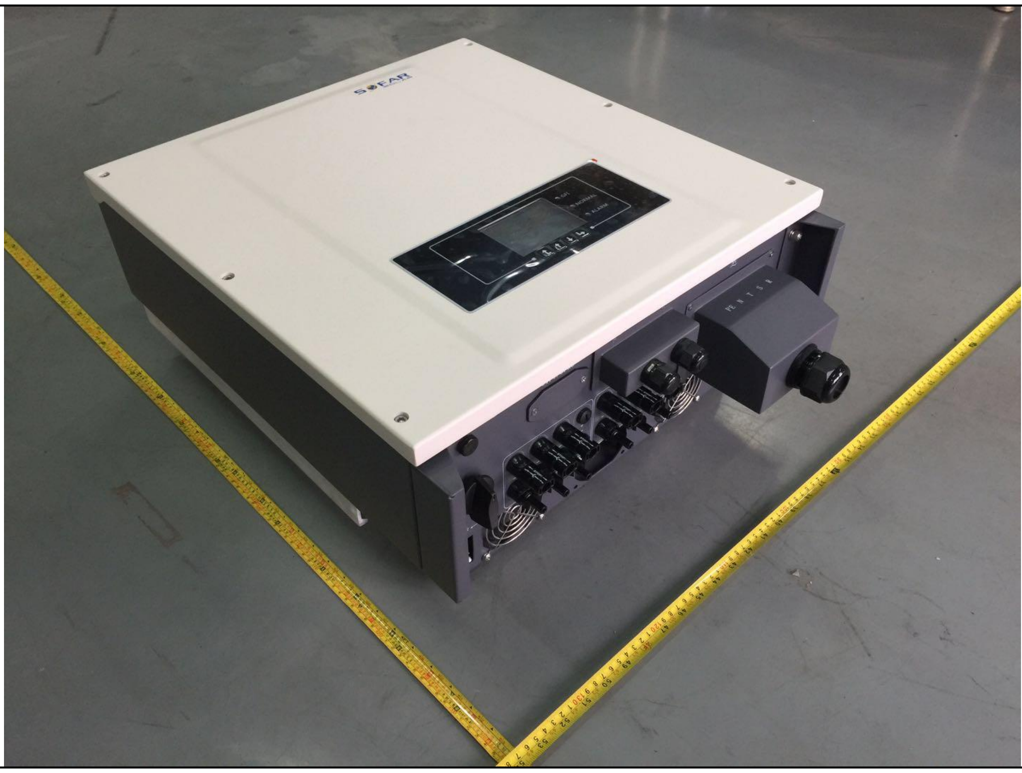


Photo 3 （Front view）SOFAR 25000TL

Photo 4 （Back view）SOFAR 25000TL

Photo 5 （Front view）SOFAR 30000TL、SOFAR 33000TL

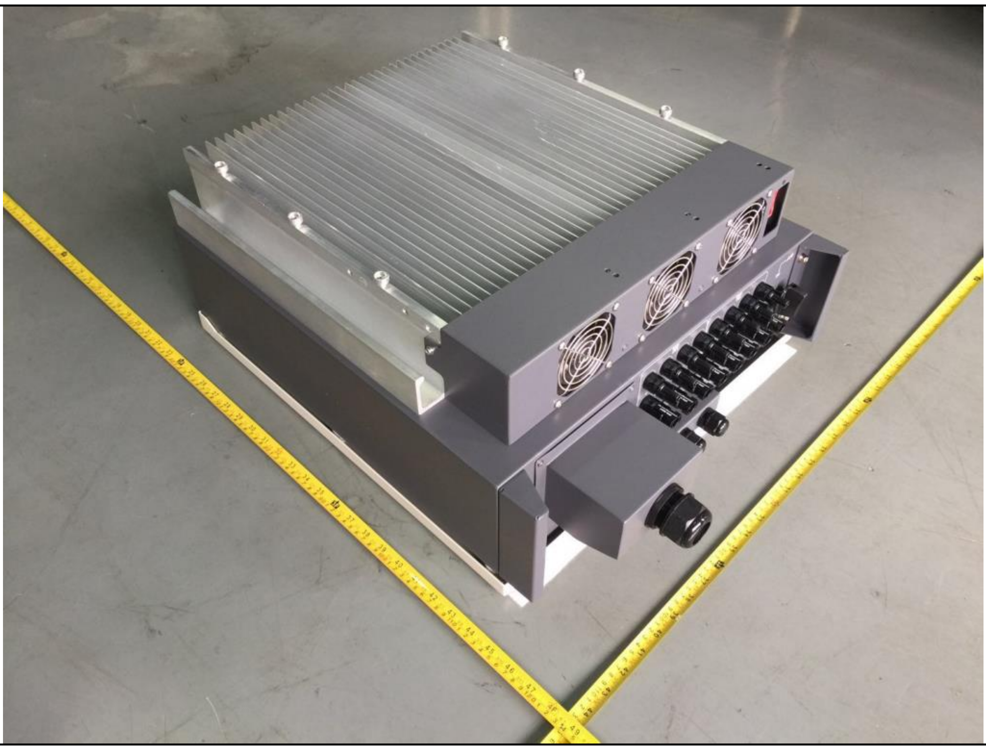


Photo 6 （Back view）SOFAR 30000TL、SOFAR 33000TL

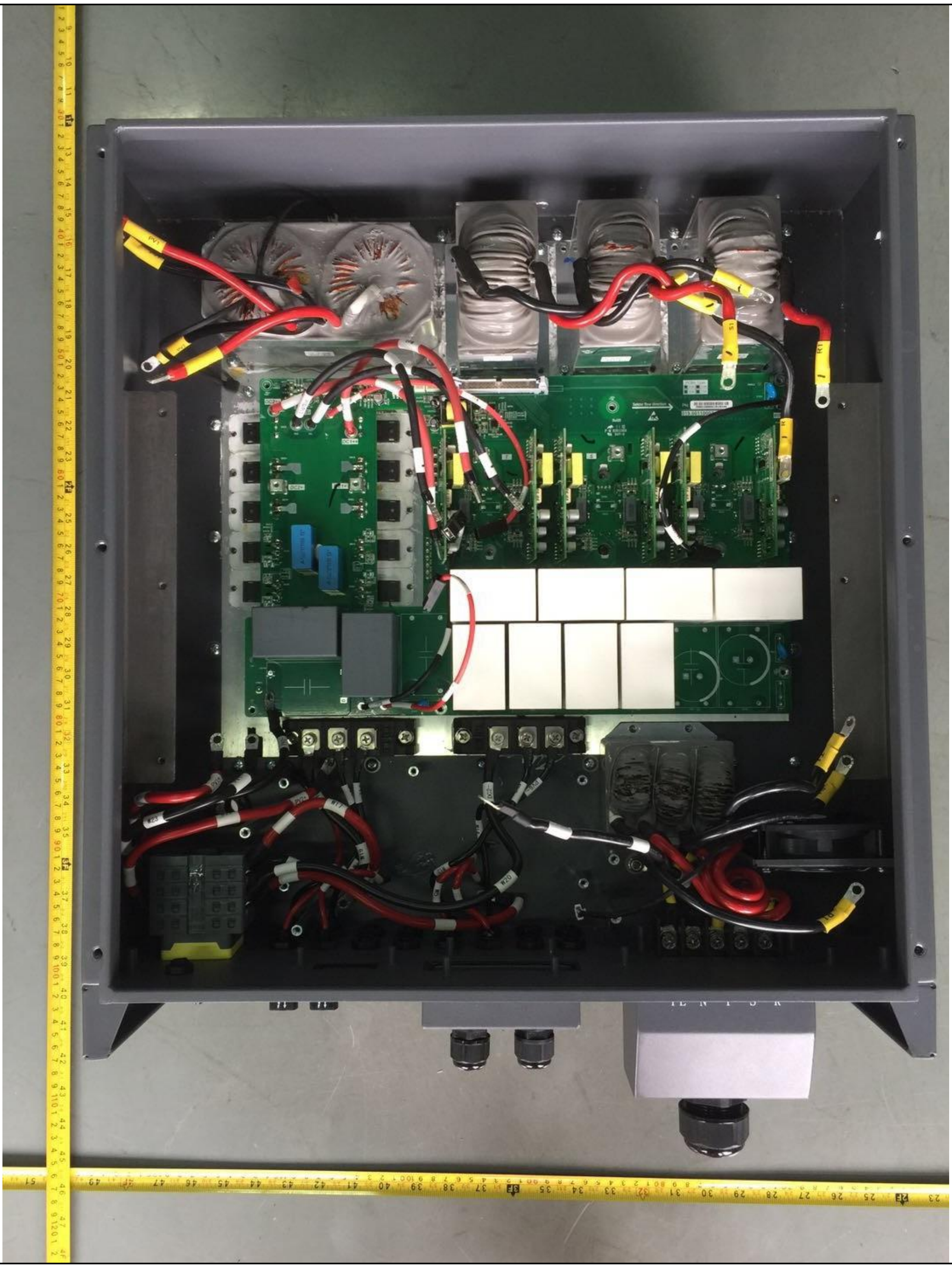


Photo 7（Internal structure view）SOFAR 20000TL

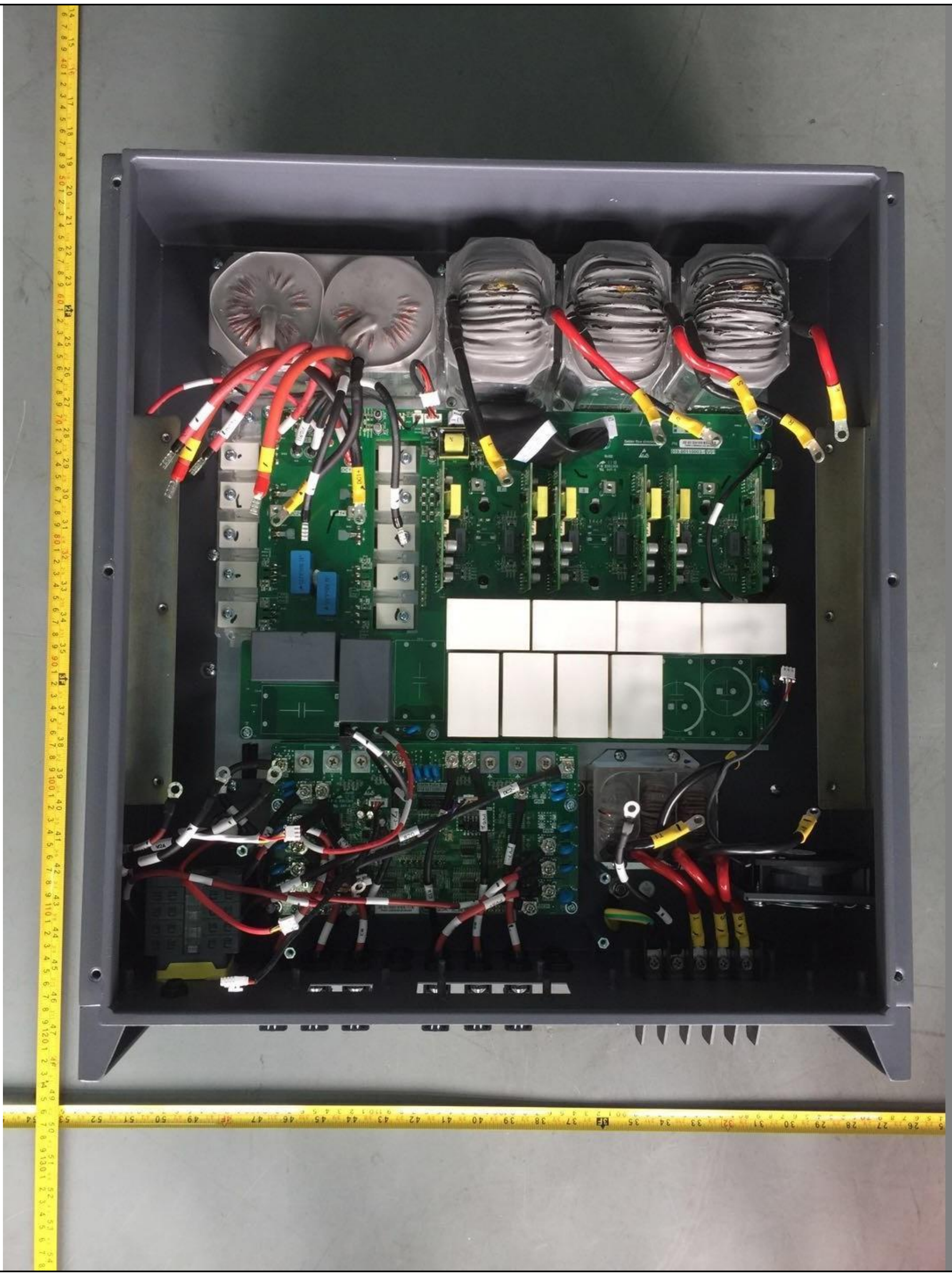


Photo 8 （Internal structure view）SOFAR 25000TL

Photo 9 （Internal structure view）SOFAR 30000TL、SOFAR 33000TL

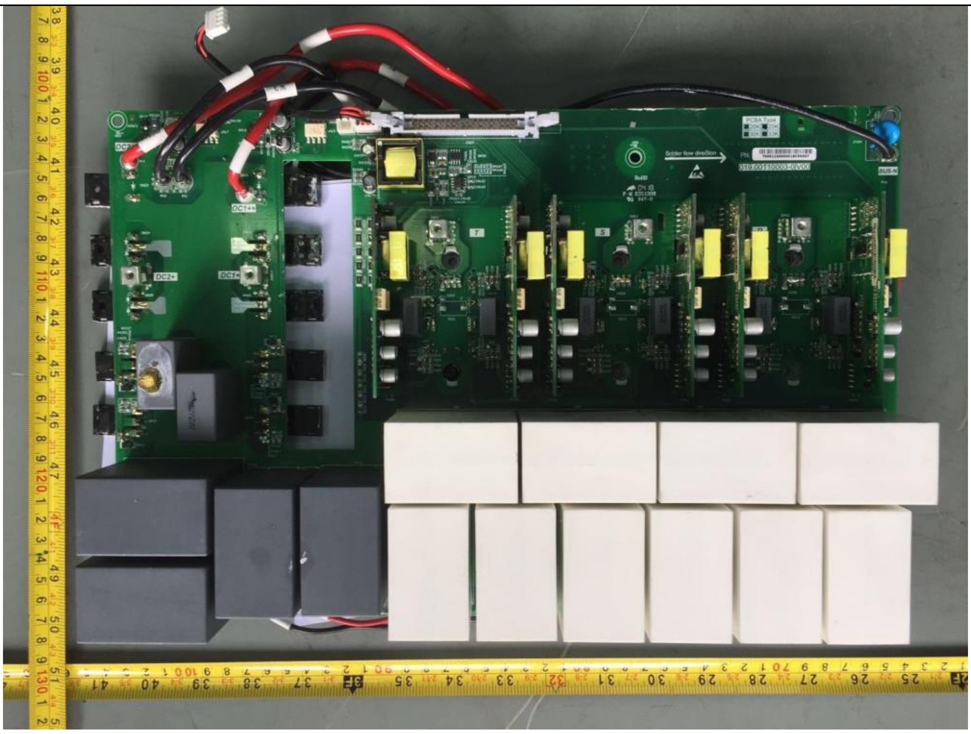


Photo10 （Motherboard front view）SOFAR30000TL、SOFAR 33000TL

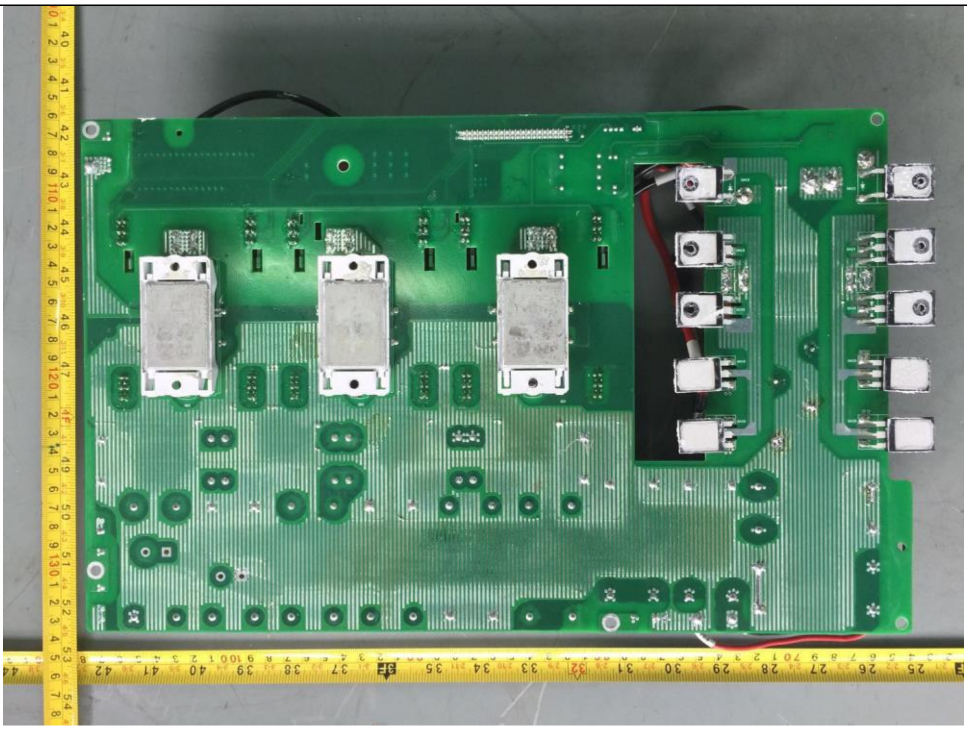


Photo11 （Motherboard back view）SOFAR30000TL、SOFAR 33000TL

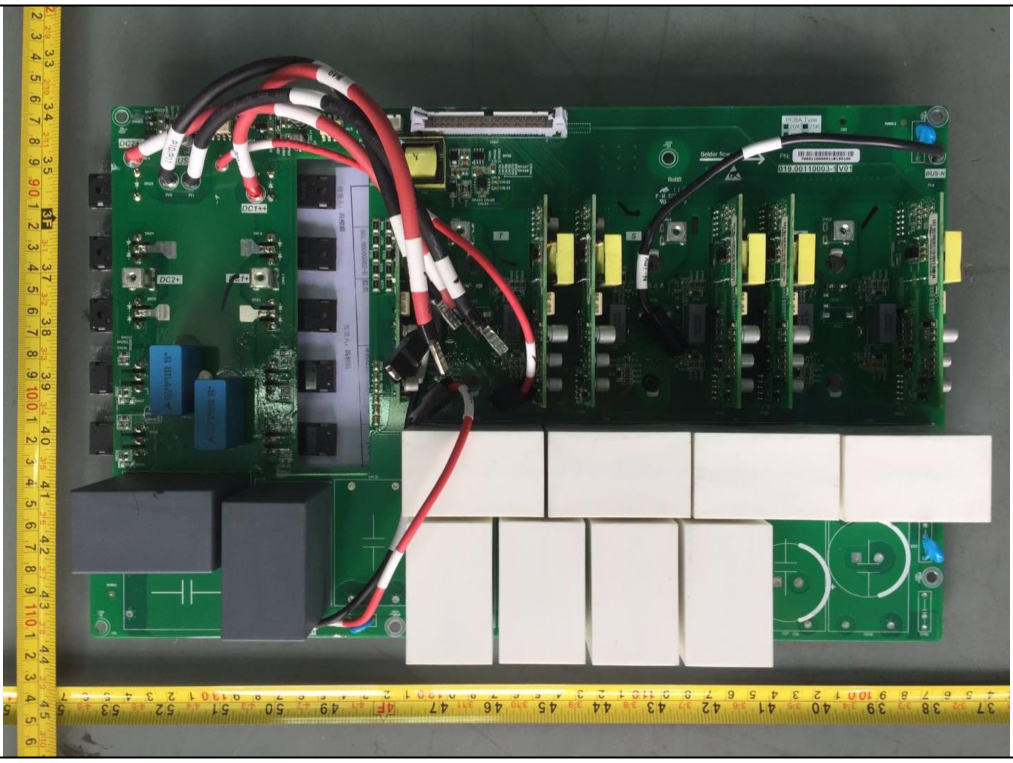


Photo12 （Motherboard front view）SOFAR20000TL、SOFAR 25000TL

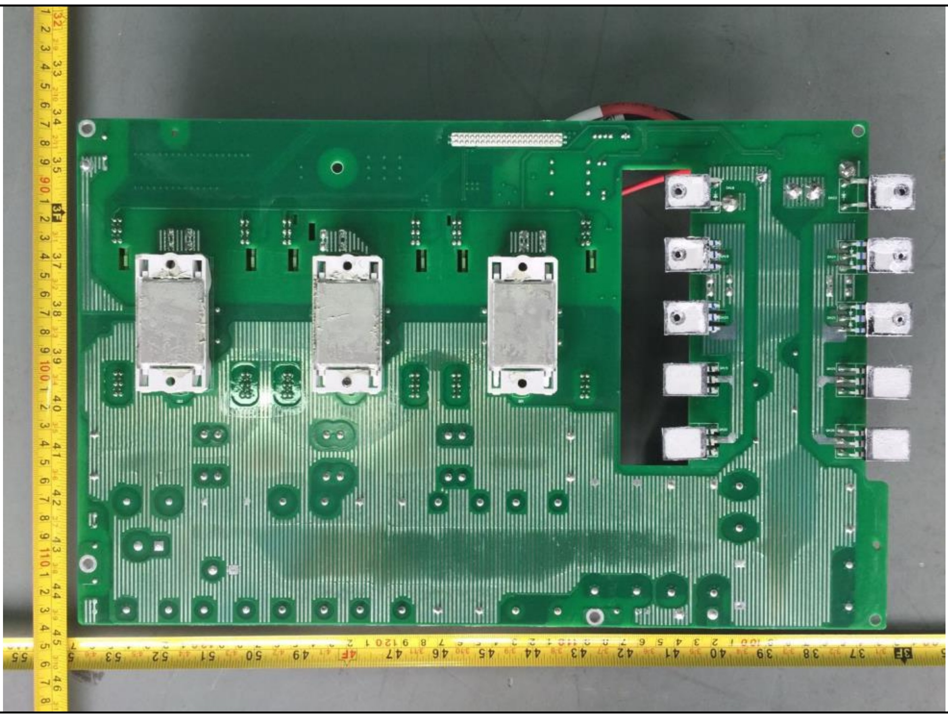


Photo13 （Motherboard back view）SOFAR20000TL、SOFAR 25000TL

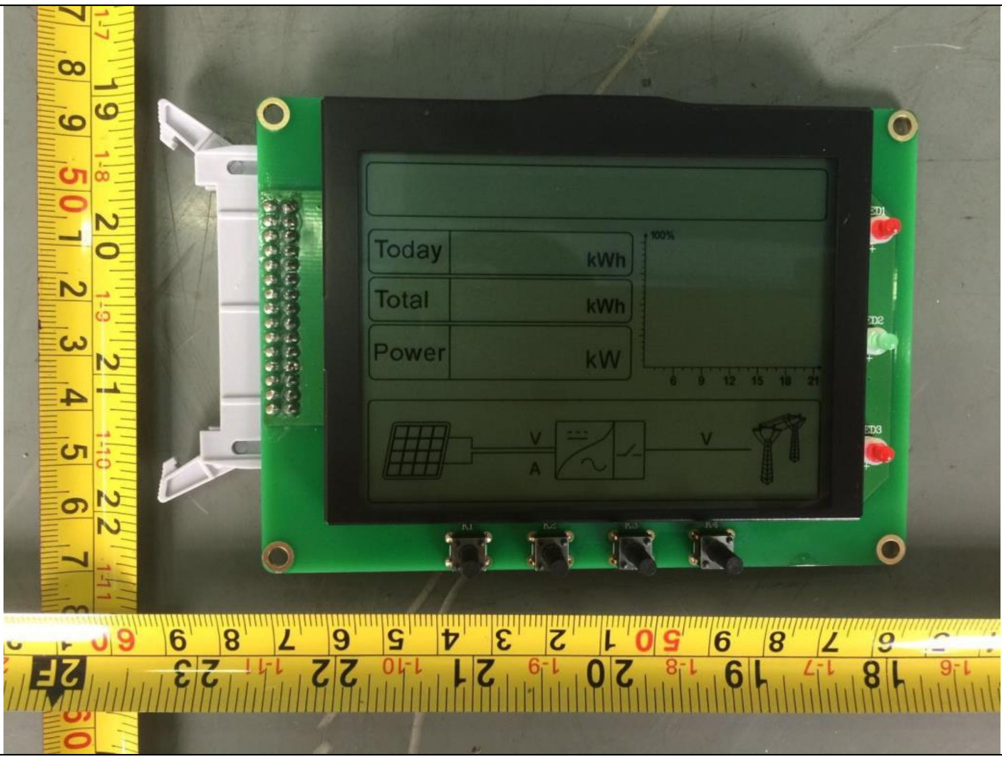


Photo14 （LCD front view）

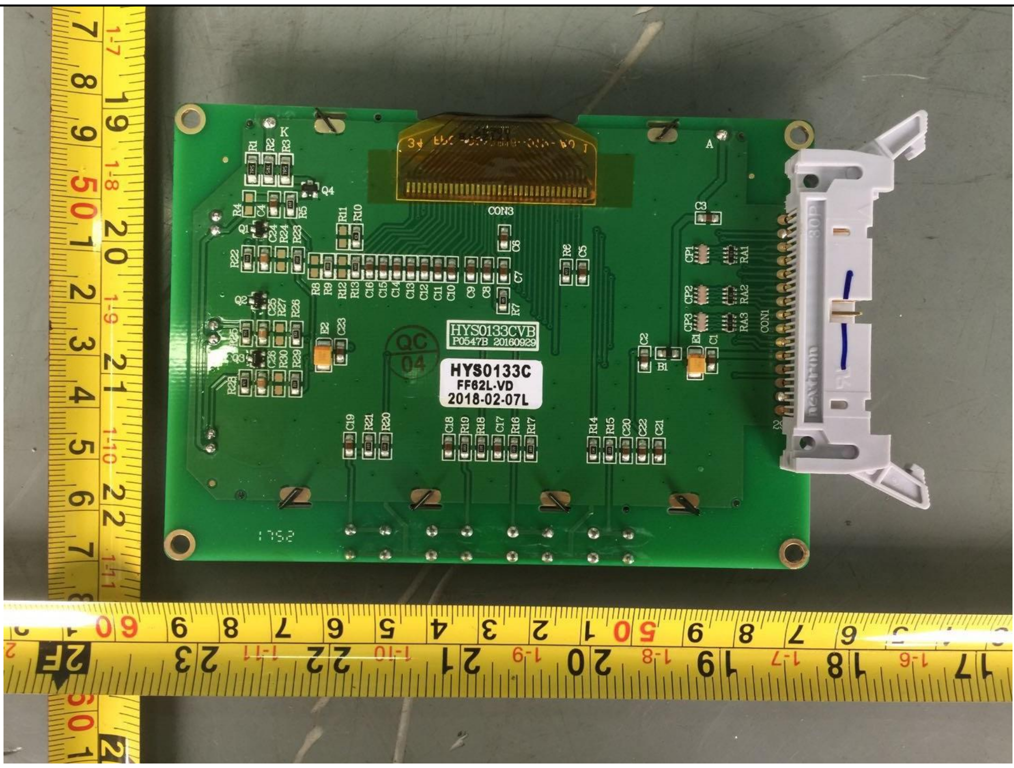


Photo15（LCD back view）

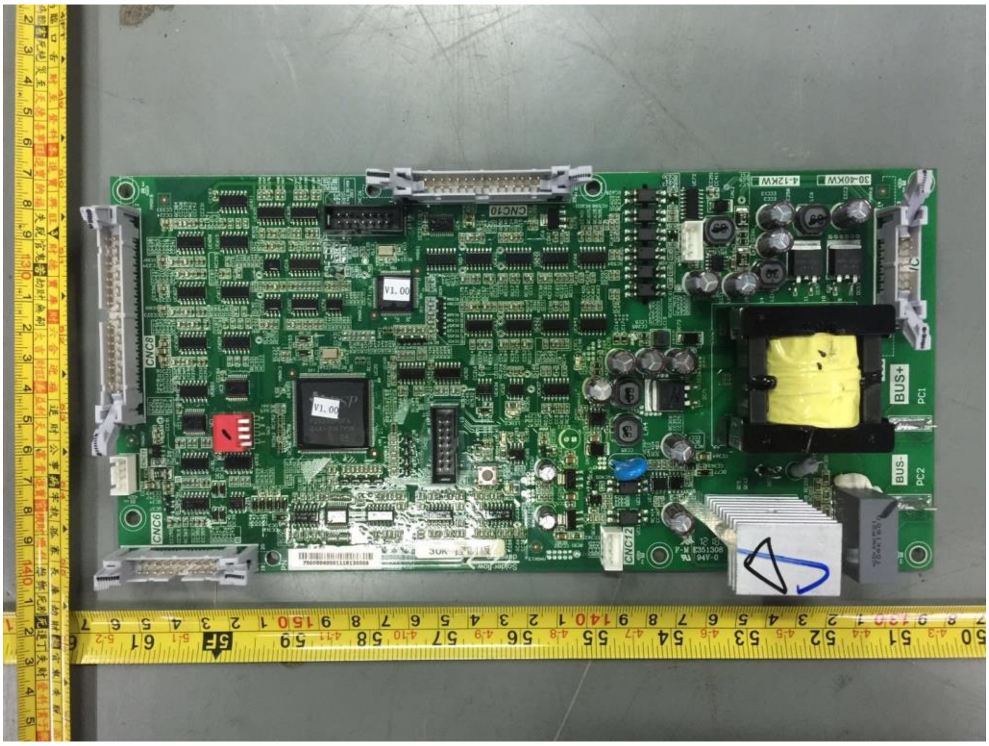


Photo16 （Control board front view）

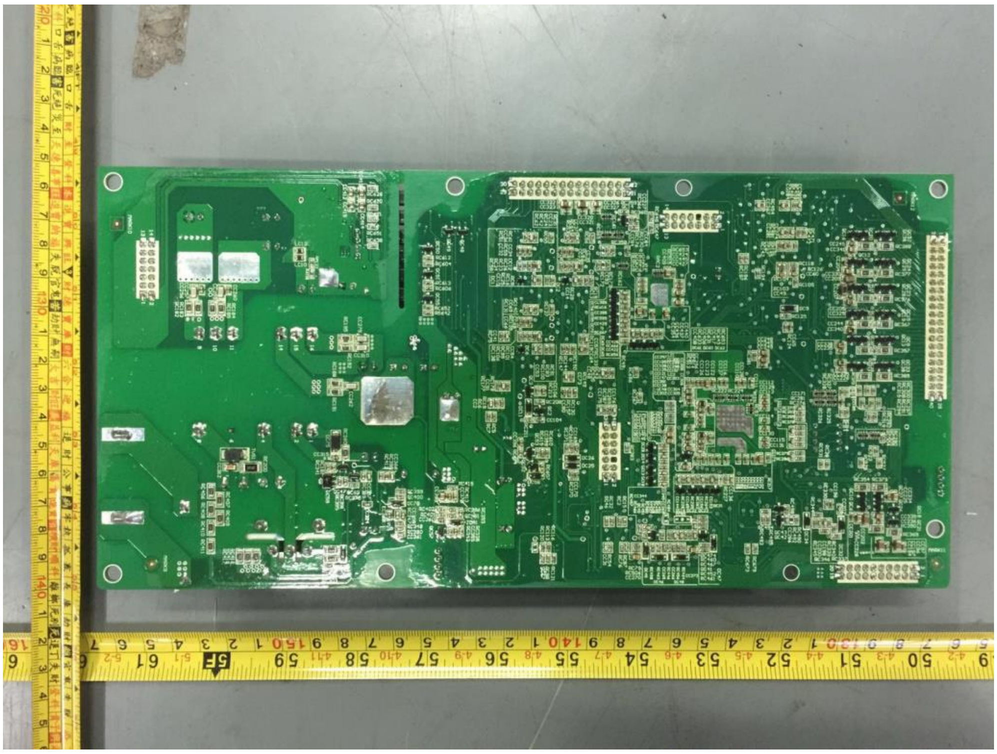


Photo17 （Control board back view）

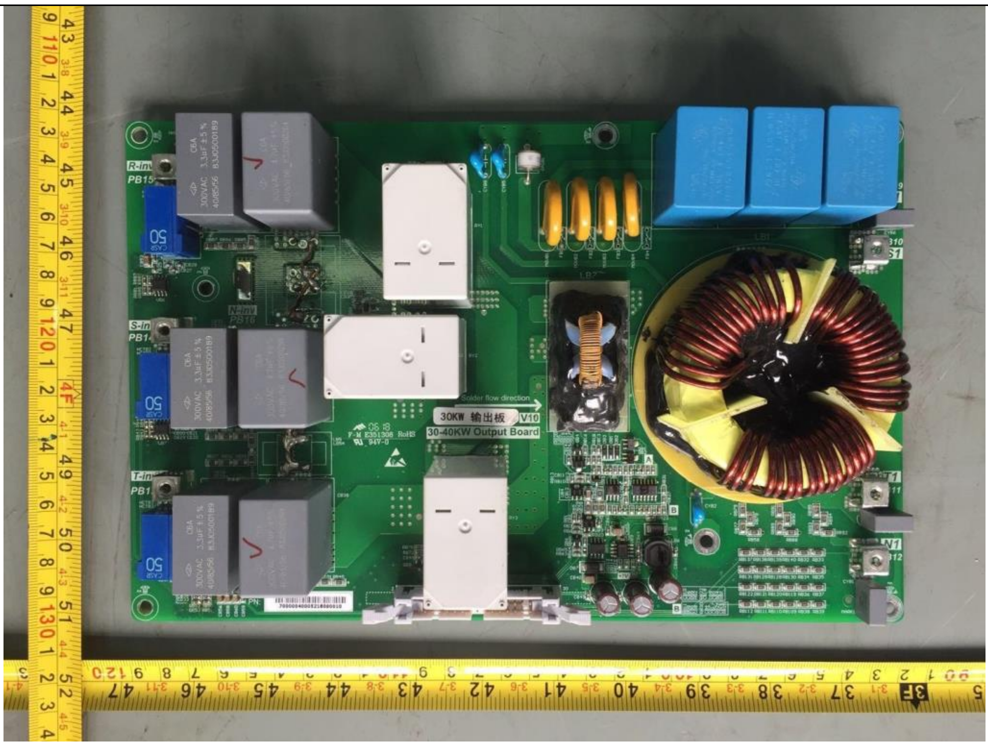


Photo18 （AC Output board front view）SOFAR30000TL、SOFAR 33000TL

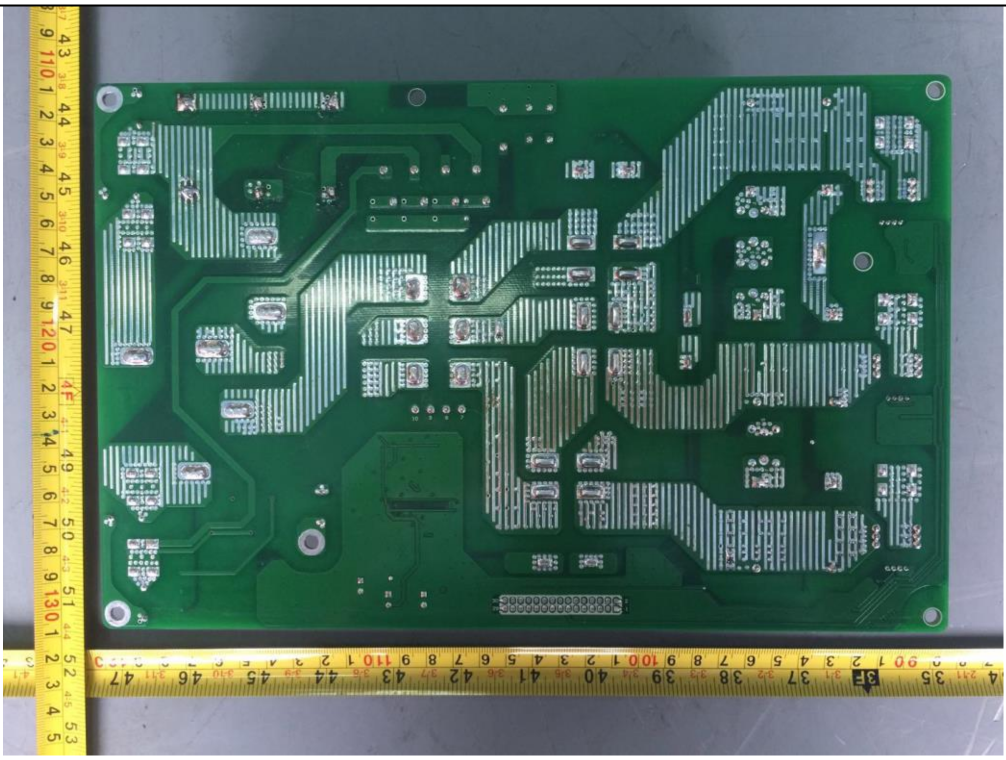


Photo19 （AC Output board back view）SOFAR30000TL、SOFAR 33000TL

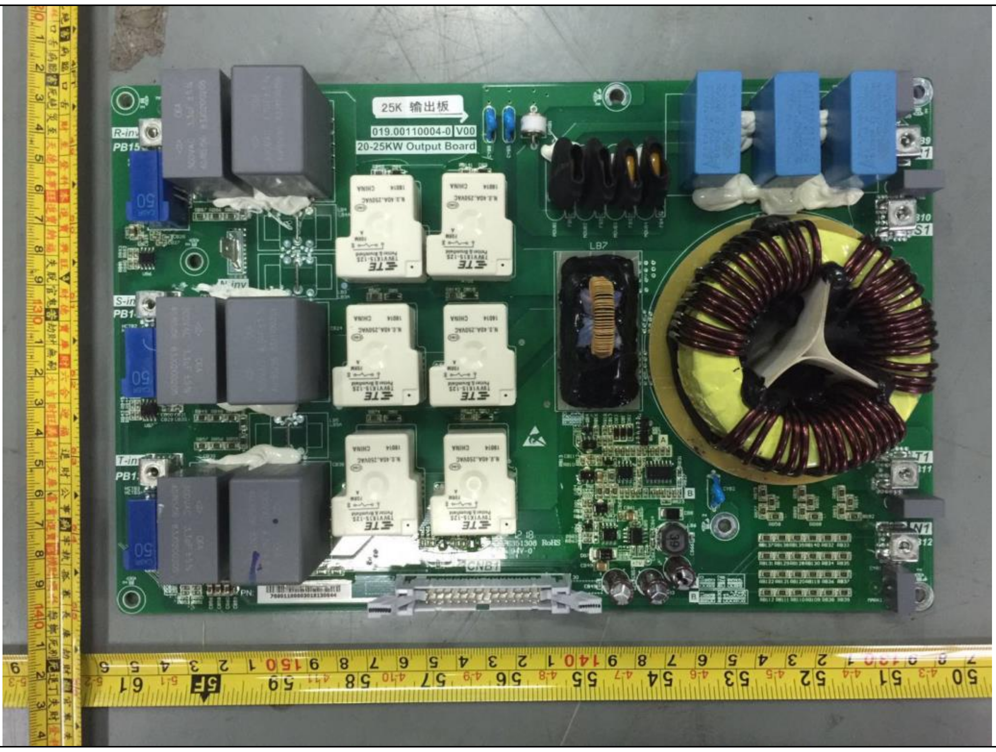


Photo20 （AC Output board front view）SOFAR20000TL、SOFAR 25000TL

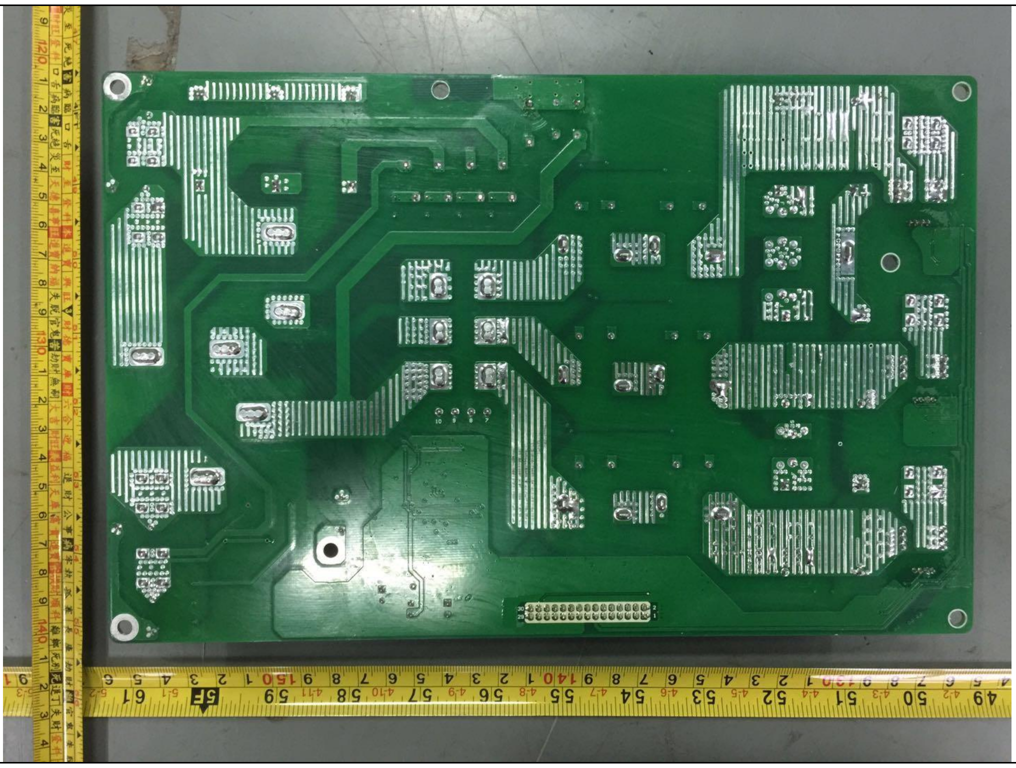


Photo21 （AC Output board back view）SOFAR20000TL、SOFAR 25000TL

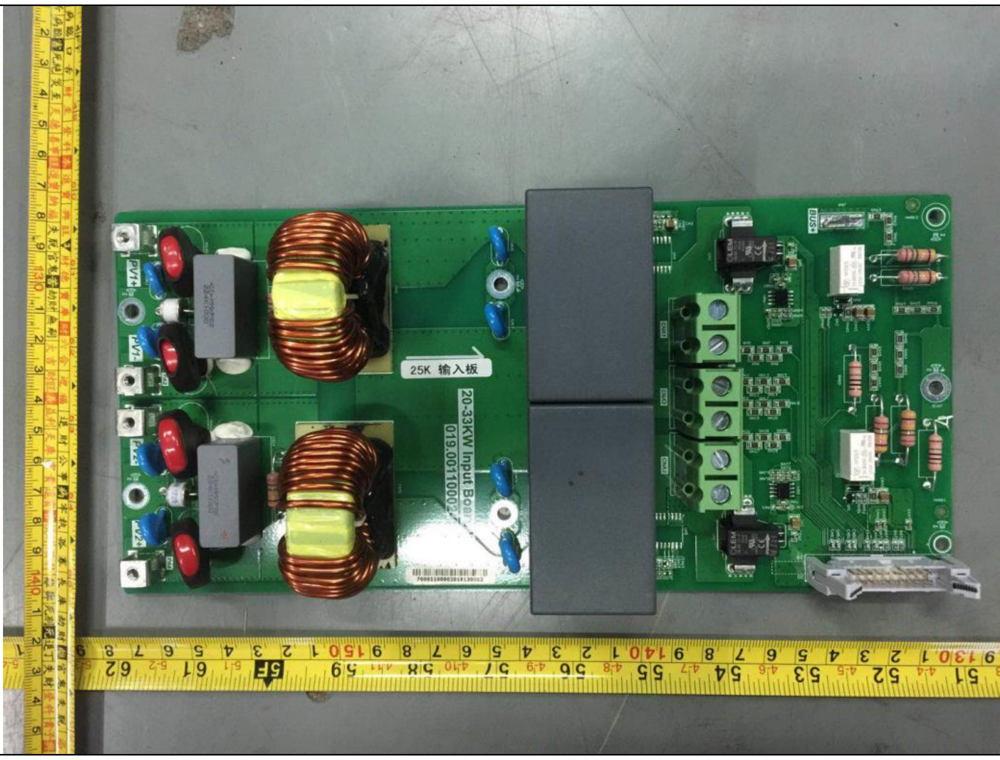


Photo22 （Input board front view）

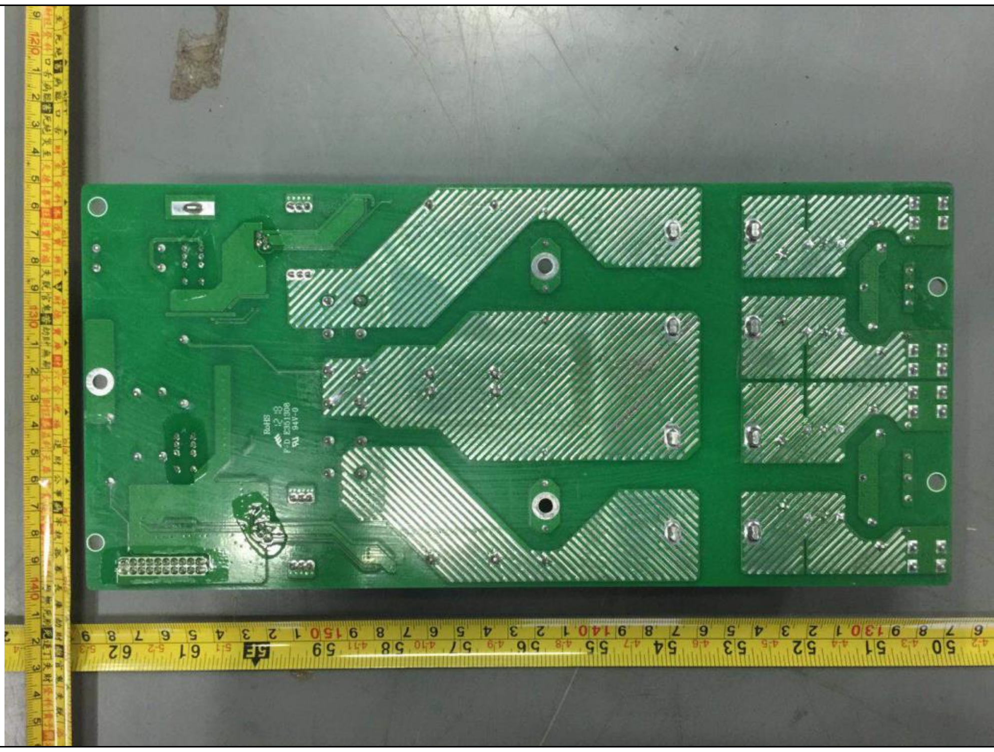


Photo23 （Input board back view）

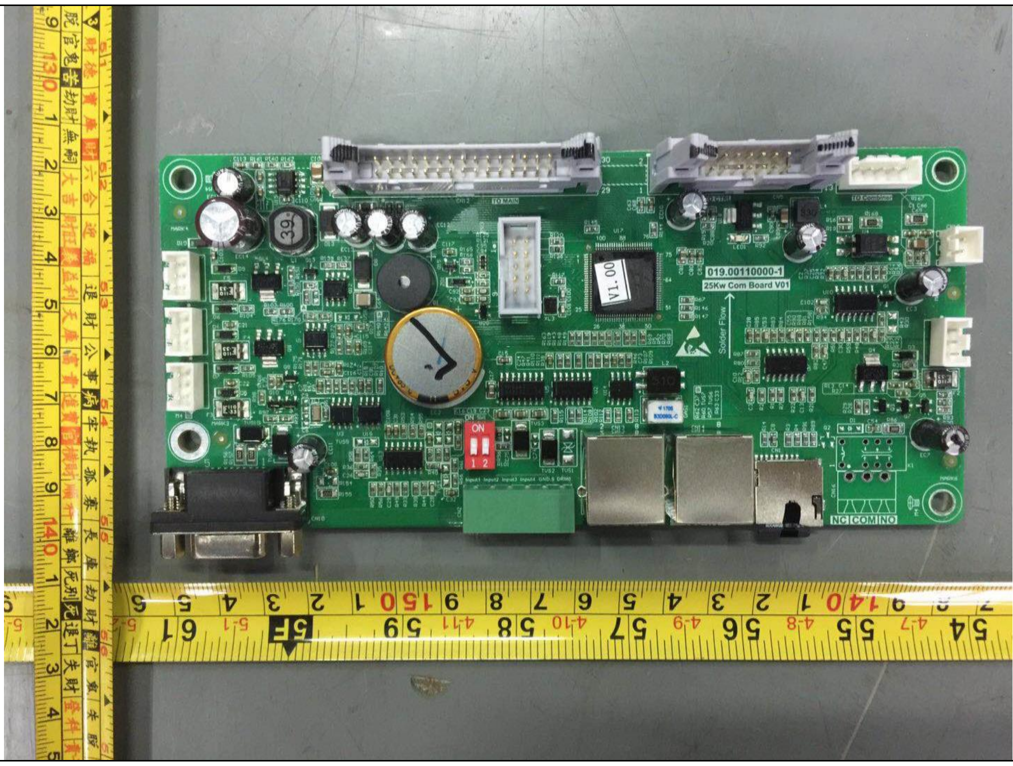


Photo24 （Communication board front view）

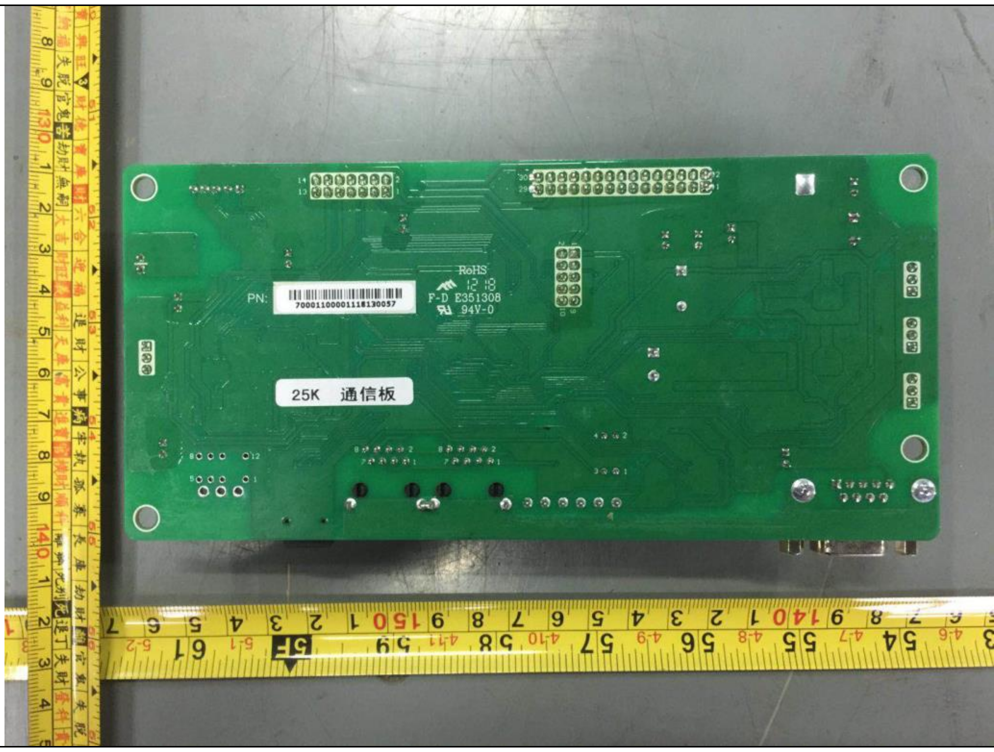


Photo25（Communication board back view）

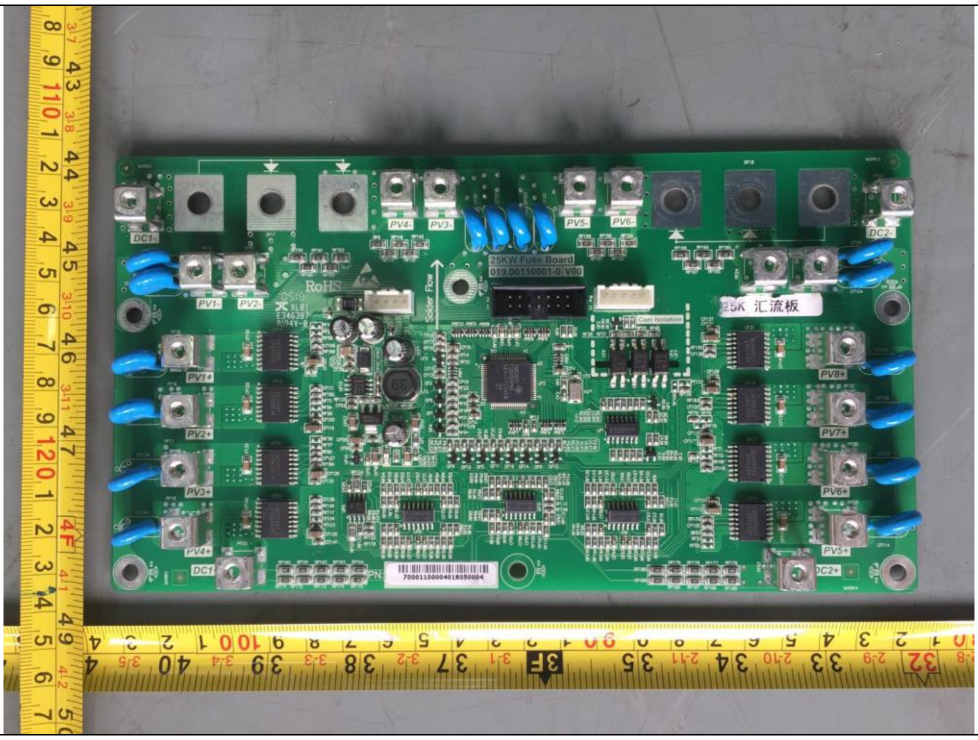


Photo26 （Current bus board front view）
SOFAR25000TL 、SOFAR30000TL、SOFAR 33000TL

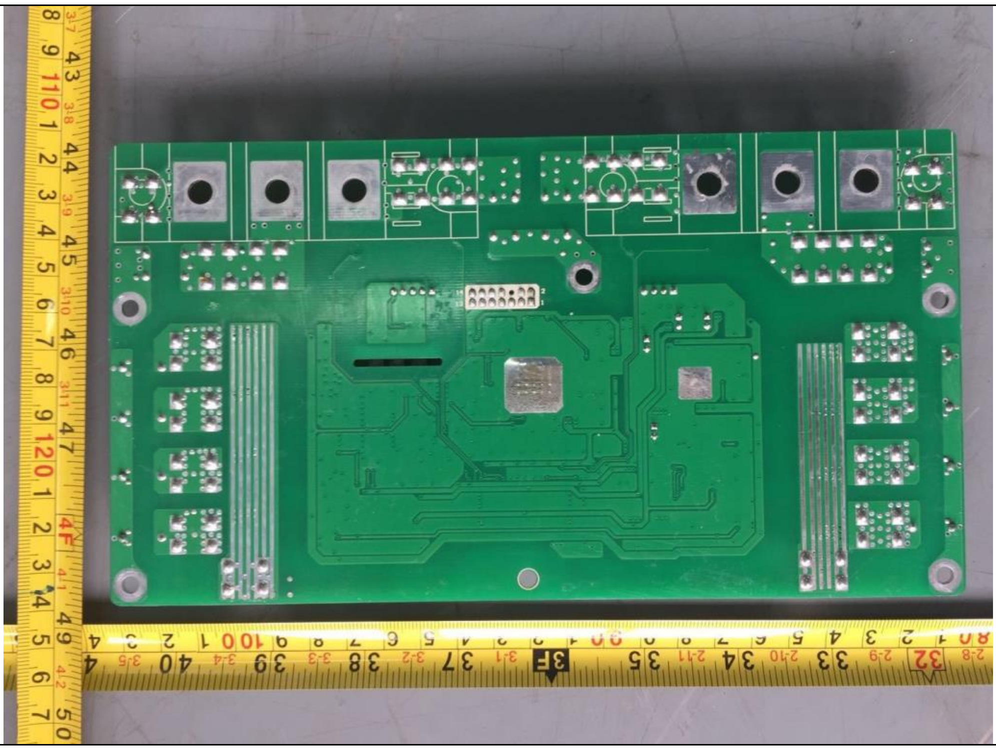


Photo27（Current bus board back view）
SOFAR25000TL 、SOFAR30000TL、SOFAR 33000TL

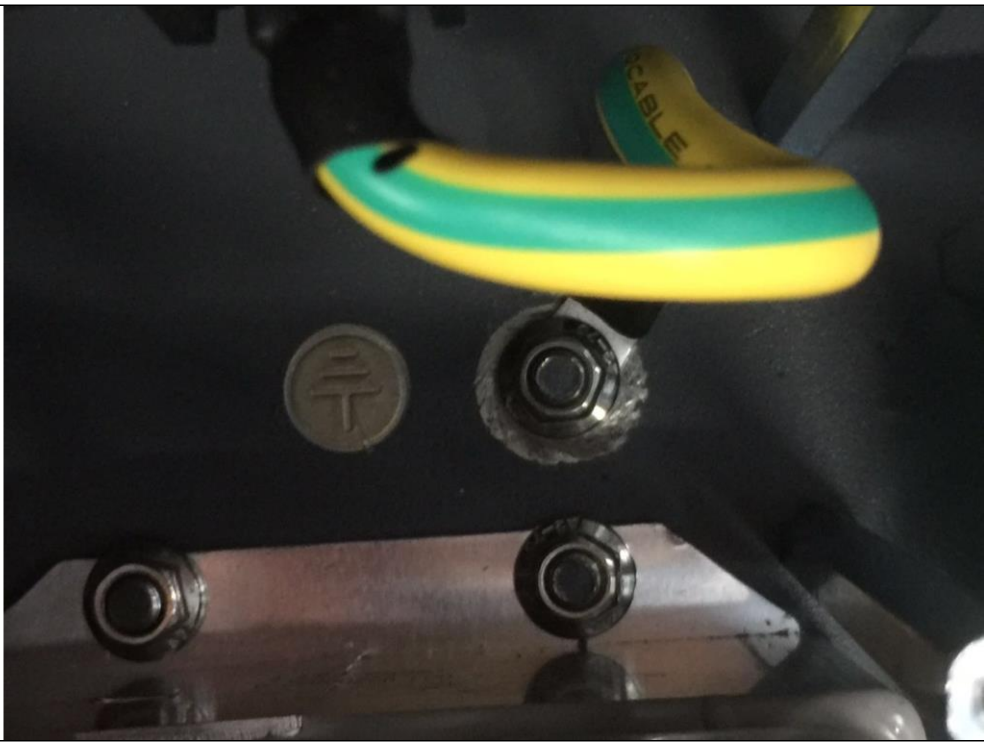


Photo28（Ground connection）

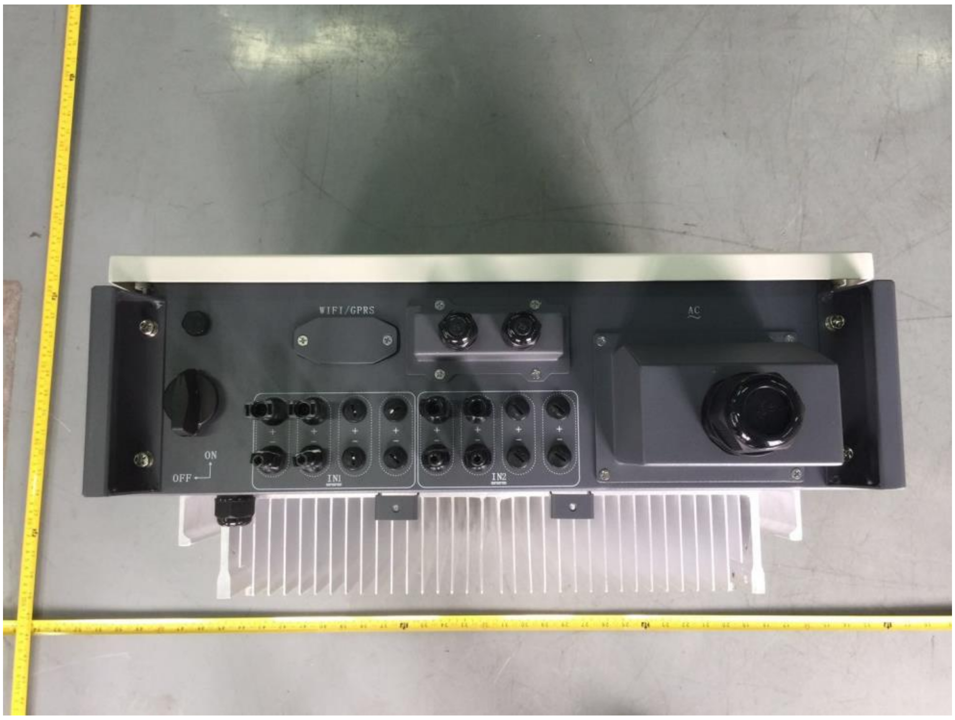


Photo29（Terminal interface）SOFAR 20000TL

Photo30（Terminal interface）SOFAR 25000TL

Photo31（Terminal interface）SOFAR 30000TL 、SOFAR 33000TL

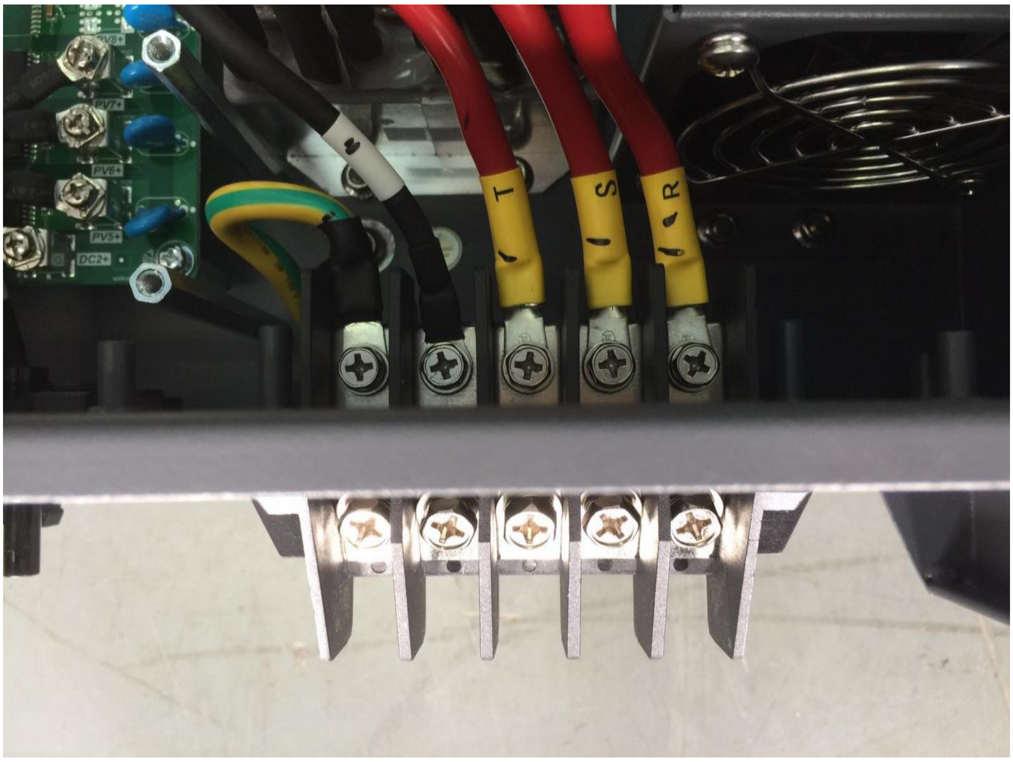


Photo32（AC output interface）

(End of Report)