TEST REPORT

EN 50549-1:2019

Requirements for generating plants to be connected in parallel with distribution networks - Part 1-1: Connection to a LV distribution network - Generating plants up to and including Type B

Report reference number ..... :	**PV2105WDG0105**
Date of issue ..... :	2021-07-23
Total number of pages ..... :	169
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Accrediation ..... :	ilac-MRA A2LA ACCREDITED Certificate # 2951.01
Applicant's name ..... :	**AISWEI New Energy Technology(Jiangsu) Co.,Ltd**
Address ..... :	Building 9,No.198 Xiangyang Road,215011 Suzhou,P.R.China
Test specification	
Standard..... :	EN 50549-1:2019
Test Report Form No. ..... :	EN 50549-1 VER.0
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2019-12-11
Test item description..... :	Solar Inverter
Trademark..... :	Solplanet
Model / Type ..... :	ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2, ASW17K-LT-G2, ASW20K-LT-G2

Ratings ..... :	**ASW8K-LT-G2**	**ASW10K-LT-G2**	**ASW12K-LT-G2**
Max. input DC voltage [V] ..... :	Max.1100V		
Input DC voltage range [V]..... :	150-1000V		
Input DC current [A] ..... :	26,0 / 13,0		26,0 / 26,0
Output AC voltage [V] ..... :	3/N/PE ~ 380/400/415V, 50/60Hz		
Output AC current [A]..... :	12,8	16,0	19,1
Nominal Output power [kW] ..... :	8,0	10,0	12,0
Maximum Output power [kVA] ..... :	8,0	10,0	12,0

Ratings ..... :	**ASW13K-LT-G2**	**ASW15K-LT-G2**	**ASW17K-LT-G2**
Max. input DC voltage [V] ..... :	Max.1100V		
Input DC voltage range [V]..... :	150-1000V		
Input DC current [A] ..... :	26,0A / 26,0A		
Output AC voltage [V] ..... :	3/N/PE ~ 380/400/415V, 50/60Hz		
Output AC current [A]..... :	20,7	24,0	27,1
Nominal Output power [kW] ..... :	13,0	15,0	17,0
Maximum Output power [kVA] ..... :	13,0	15,0	17,0

Ratings ..... :	**ASW20K-LT-G2**
Max. input DC voltage [V] ..... :	Max.1100V
Input DC voltage range [V]..... :	150-1000V
Input DC current [A] ..... :	26,0A / 26,0A
Output AC voltage [V] ..... :	3/N/PE ~ 400V, 50/60Hz
Output AC current [A]..... :	31,9
Nominal Output power [kW] ..... :	20,0
Maximum Output power [kVA] ..... :	20,0

Testing Location ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2021-07-23	Sean Tu	Initial report was written	0
Supplementary information:			

Test items particulars	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment ..... :	Class I
Protection against ingress of water .. :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	Approx. 18,6kg
Test case verdicts	
Test case does not apply to the test object ..... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)
Testing	
Date of receipt of test item ..... :	2021-05-11
Date(s) of performance of test ..... :	2021-05-11 to 2021-07-01

General remarks:

The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the requirements of EN 50549-1. This report shall not be reproduced in part or in full without the written approval of the issuing testing laboratory.

”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

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

This Test Report consists of the following documents:

1. Test Report

   4.4 Normal operating range

   4.5 Immunity to disturbances

   4.6 Active response to frequency deviation

   4.7 Power response to voltage variations and voltage changes

   4.8 EMC and power quality

   4.9 Interface protection

   4.10 Connection and starting to generate electrical power

   4.11 Ceasing and reduction of active power on set point

   4.13 Requirements regarding single fault tolerance of interface protection system and interface switch
2. Annex No. 1 – Pictures of the unit
3. Annex No. 2 –Datasheet of the relay
4. Annex No. 3 – Test equipment list

Copy of marking plate

Solplanet

Model: ASW8K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 26/13A
Isc PV(absolute maximum)	d.c. 40/20A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	8kW
Max. AC output apparent power	8kVA
Max. continuous output current	a.c. 12.8A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

For AS/NZS4777.2: 2015, Supported DRM0, DRM5, DRM6, DRM7, DRM8

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Solplanet

Model: ASW10K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 26/13A
Isc PV(absolute maximum)	d.c. 40/20A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	10kW
Max. AC output apparent power	10kVA
Max. continuous output current	a.c. 16A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

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Solplanet

Model: ASW12K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 2x26A
Isc PV(absolute maximum)	d.c. 2x40A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	12kW
Max. AC output apparent power	12kVA
Max. continuous output current	a.c. 19.1A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

For AS/NZS4777.2: 2015, Supported DRM0, DRM5, DRM6, DRM7, DRM8

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Solplanet

Model: ASW13K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 2×26A
Isc PV(absolute maximum)	d.c. 2×40A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	13kW
Max. AC output apparent power	13kVA
Max. continuous output current	a.c. 20.7A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

For AS/NZS4777.2: 2015, Supported DRM0, DRM5, DRM6, DRM7, DRM8

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Solplanet

Model: ASW15K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 2×26A
Isc PV(absolute maximum)	d.c. 2×40A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	15kW
Max. AC output apparent power	15kVA
Max. continuous output current	a.c. 24A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

For AS/NZS4777.2: 2015, Supported DRM0, DRM5, DRM6, DRM7, DRM8

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Solplanet

Model: ASW17K-LT-G2

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 150-1000V
Max. input current	d.c. 2×26A
Isc PV(absolute maximum)	d.c. 2×40A
Rated grid voltage	3/N/PE ~ 380/400/415V
Rated grid frequency	50/60Hz
Max. AC output active power	17kW
Max. AC output apparent power	17kVA
Max. continuous output current	a.c. 27.1A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

For AS/NZS4777.2: 2015, Supported DRM0, DRM5, DRM6, DRM7, DRM8

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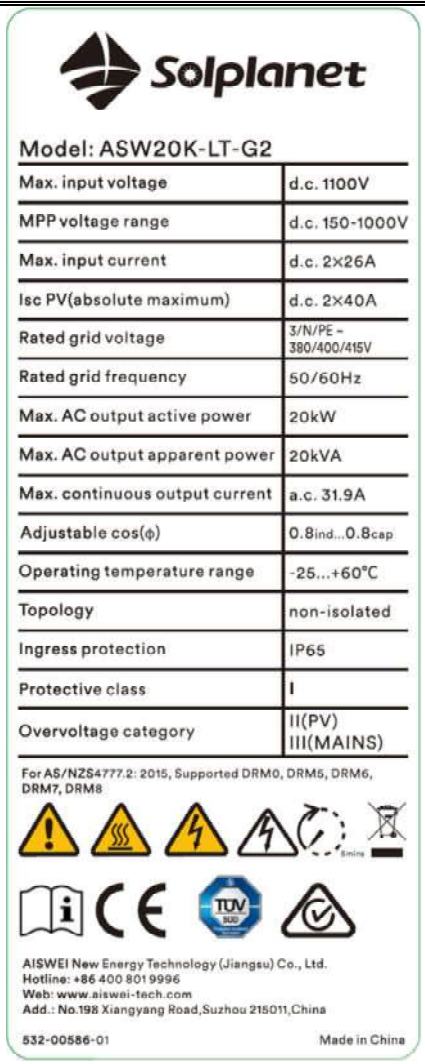

General product information:

The MPPT Solar Inverter converts DC voltage into AC voltage.
The DC input of MPPT Solar Inverter can be supply by PV array.
The MPPT Solar Inverter is three phase type.
The input and output are protected by Varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

Description of the electrical circuit:

The internal control is redundant built. It consists of Master DSP (U516) and Slave DSP (U521).

The Master DSP (U516) control the relays by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The Slave DSP (U521) can switch off the relays independently, and communicate with the master DSP (U516) each other to monitor the master DPS (U516).

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the DSP (U516). The DSP (U516) tests and calibrates before each start up all current sensors.

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

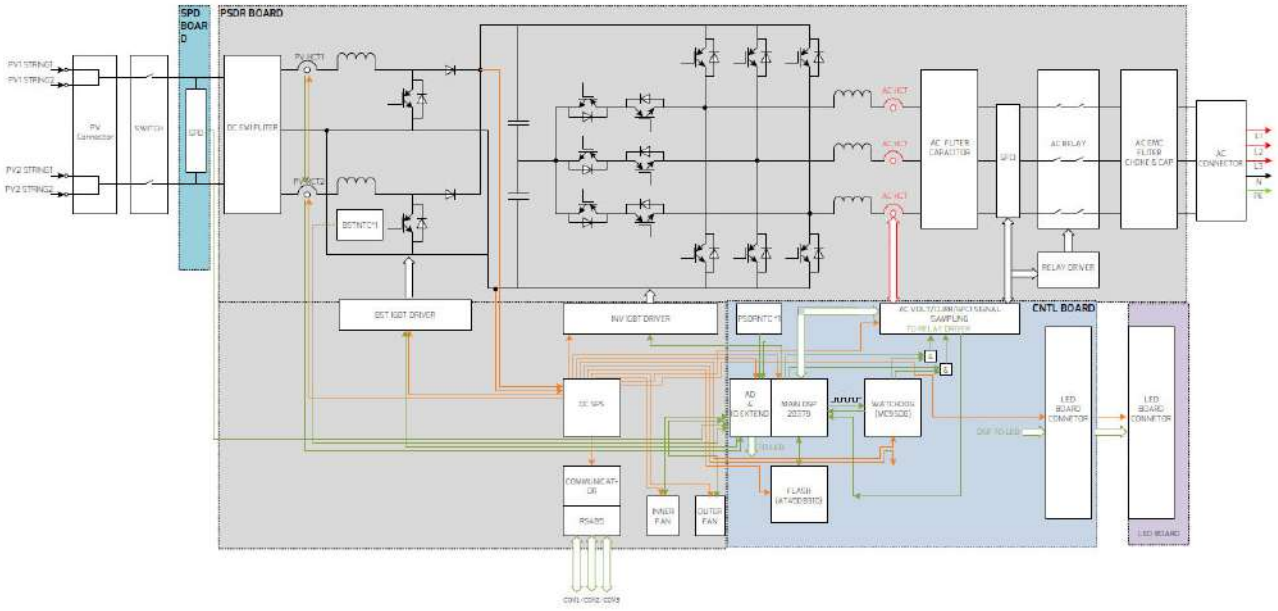

Figure 1 – Block diagram

Differences of the models:

The models ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2, ASW17K-LT-G2 and ASW20K-LT-G2 are identical in hardware and software, and the output power derated by software.

The tests had been performed on the ASW8K-LT-G2 and ASW20K-LT-G2 are valid for the ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

The product was tested on:

Hardware: V1.0
Software: V1.0

General remarks:

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

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

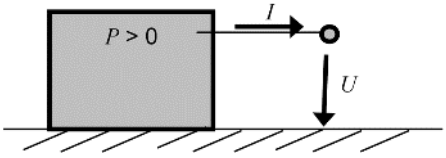
The following suffixes are used for variables in tables and figures:

- "P_n" for the nominal active power:
  $P_n = U_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3}\ U_n \times I_n \times \cos \varphi_n$ (three-Phase)
- "P_M" for the momentary power
- "(c)" for over-excited
- "(i)" for under-excited

Active and reactive power:

The regarded system of the voltage and current vectors is the load view (Figure 2):

- If the inverter feeds to the grid the active power is measured with negative sign. For the sake of reading the document the measured active infeed power has a positive sign



- If the inverter consumes inductive reactive power the reactive power is marked "inductive" or has a positive sign.
- If the inverter consumes capacitive reactive power the reactive power is marked "capacitive" or has a negative sign.

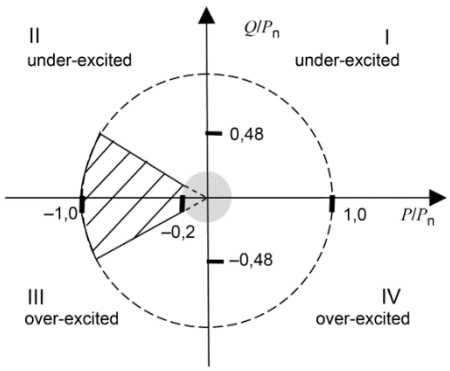


Figure 2

Default interface protection settings according EN 50549-1:2019:			
Parameter	**Max. disconnection time**	**Min. operate time**	**Trip value**
Over voltage – stage 1	3 s	0,1 s	230V +15% (264,5 V)
Over voltage – stage 2	0,2 s	0,1 s	230V +25% (287,5 V)
Under voltage – stage 1	5 s	0,1 s	230V -20% (184V)
Under voltage – stage 2	2 s	0,1 s	230V -50% (115V)
Over frequency – stage 1	0,5 s	0,3 s	51,5 Hz
Over frequency – stage 2	0,2 s	0,1 s	52,0 Hz
Under frequency– stage 1	0,5 s	0,3 s	47,5 Hz
Under frequency– stage 2	0,2 s	0,1 s	47,0 Hz
Reconnection settings for voltage		$0,85\ U_n \le U \le 1,10\ U_n$	
Connection settings for frequency (Normal operational start-up)		49,5 Hz ≤ f ≤ 50,1 Hz	
Reconnection settings for frequency (Automatic reconnection after tripping)		49,5 Hz ≤ f ≤ 50,2 Hz	
Reconnection time		≥ 60 s	
Active power gradient after reconnection		$10\%P_n$/min	
Permanent DC-injection		0,5% of rated inverter output current or 20mA	
Loss of mains according EN 62116		Inverter shall disconnect within 2 s.	
The stated currents and voltages are 'true r.m.s.'-values. The voltages in this table are - phase-to-neutral in 230 V single phase systems and 230/400 V systems, - phase-to-phase in a multiphase 230 V system.			
Tolerances on trip values: - Voltage: ± 1% of U_n - Frequency: ± 0,05 Hz - Disconnection time : ± 10%			

EN 50549:2019, clause 4: Tests		
Clause	**Test requirement (According to table C.1)**	**Result**
4.4	Normal operating range	**P**
4.5	Immunity to disturbances	**P**
4.6	Active response to frequency deviation	**P**
4.7	Power response to voltage variations and voltage changes	**P**
4.8	EMC and power quality	**P**
4.9	Interface protection	**P**
4.10	Connection and starting to generate electrical power	**P**
4.11	Ceasing and reduction of active power on set point	**P**
4.12	Remote information exchange	**P**
4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	**P**

EN 50549-1:2019: Normal operating range			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.4.2	Power response to over-frequency	EN 50438, Annex D.3.1	**P**
4.4.3	Power response to under-frequency	G99/1-4, clause A.7.3.2	**P**
4.4.4	Continuous operating voltage range	EN 50438, Annex D.3.1	**P**

4.4.2 Operating frequency range 4.4.4 Continuous operating voltage range			P
Setting values	Over-voltage [V]:	253,0	
	Under-voltage [V]:	195,5	
	Over-frequency [Hz]:	51,5	
	Under-frequency [Hz]:	47,5	

- Test 1: U = 195,5 V; f = 47,5 Hz; P = 1,00 S_n; cosφ = 1
- Test 2: U = 195,5 V; f = 48,5 Hz; P = 1,00 S_n; cosφ = 1
- Test 3: U = 253,0 V; f = 51,5 Hz; P = 1,00 S_n; cosφ = 1
- Test 4: U = 230,0 V; f = 50,0 Hz; Voltage Phase jumps Change +20 degrees P = 1,00 S_n; cosφ = 1
- Test 5: U = 230,0 V; f = 50,0 to 50,5 Hz;RoCoF=1Hz/s; P = 1,00 S_n; cosφ = 1

Test result: ASW20K-LT-G2

Test sequence	Voltage [V]	Frequency [Hz]	Output power [kW]	Cos φ
Test1	197,20	47,50	18,825	0,999
Test2	197,20	48,50	18,815	0,999
Test3	254,35	51,50	19,866	0,998
Test4	230,81	50,00	19,432	0,999
Test5	231,41	50,50	19,772	0,999

Note:

Test method refer clause D.3.1 of EN 50438:2013.

During the tests the interface protection was disabled.

Operation at reduced power is allowed during test 1, equal to the maximum power that can be supplied on reaching the maximum output current limit (P ≥ 0,85 S_n).

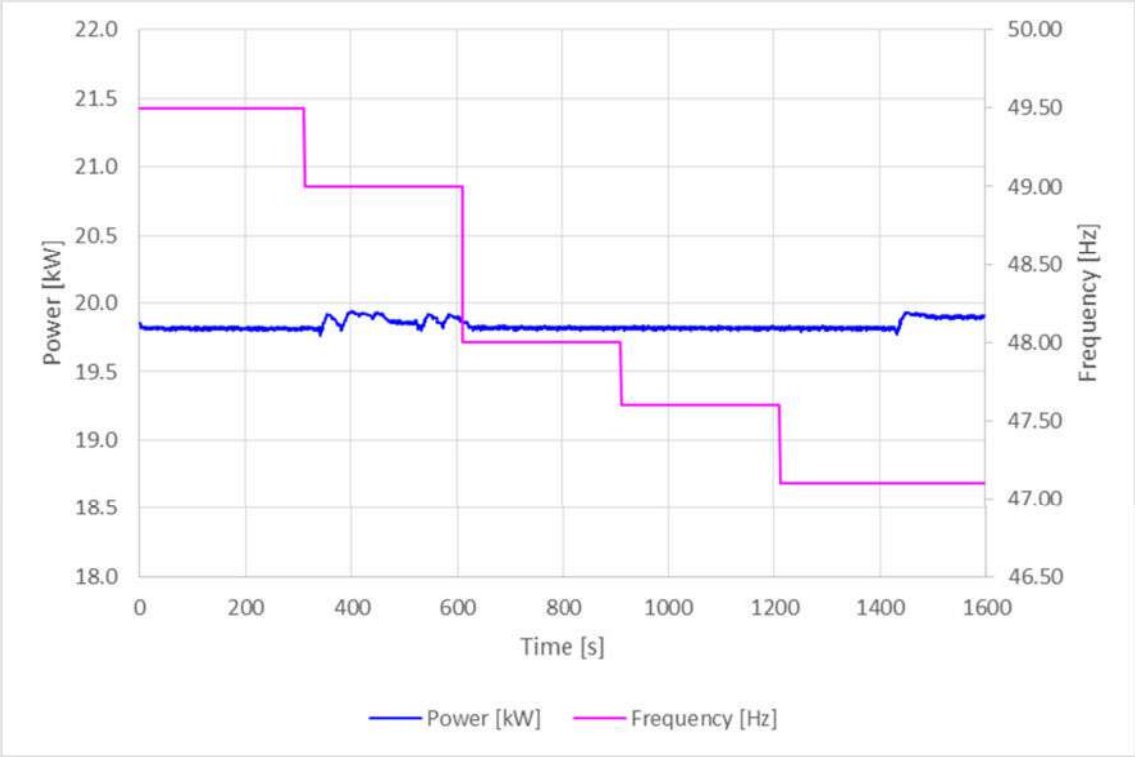
During the sequence of test 3, automatic adjustment to reduce power in the case of over-frequency was disabled.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.4.3	Minimal requirement for active power delivery at under-frequency	P

Test result: ASW20K-LT-G2

Graph of frequency a) to b) to c) to d) to e):



Test result:

	Switch to:				
5-min mean value (each)	a) 49,50 Hz	b) 49,00 Hz	c) 48,00 Hz	d) 47,60 Hz	e) 47,10 Hz
Frequency [Hz]:	49,50	49,00	48,00	47,60	47,10
Active power [kW]:	19,817	19,876	19,822	19,820	19,841
$\Delta P/P_n$ [%] :	-0,917	-0,622	-0,888	-0,902	-0,793

Assessment criterion:

Test method refer clause A.7.3.2 of G99/1-4

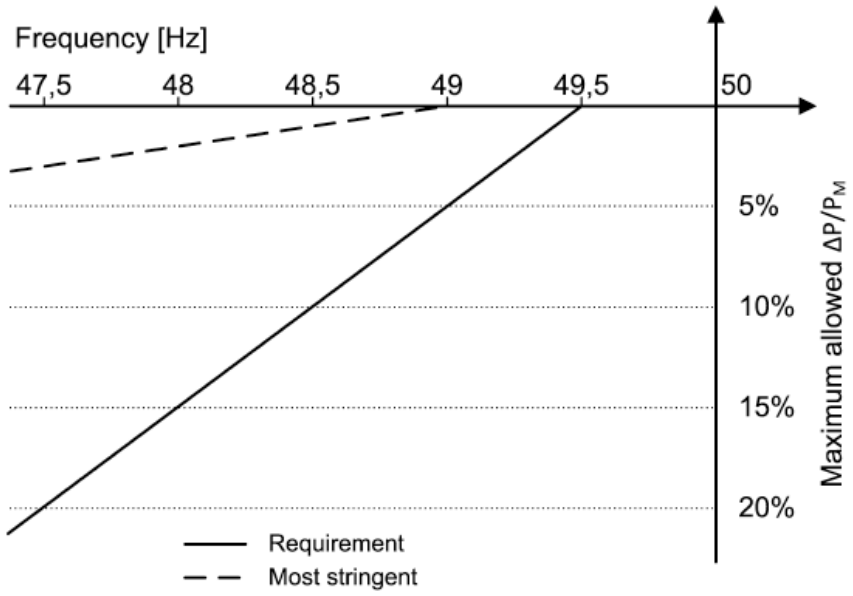
The frequency should then be set to 49,5 Hz for 5 minutes. The output should remain at 100% of registered Capacity.

The frequency should then be set to 49,0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 99% of registered Capacity.

The frequency should then be set to 48,0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 97% of registered Capacity.

The frequency should then be set to 47,6 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 96.2% of registered Capacity.

The frequency should then be set to 47,1 Hz and held at this frequency for 20s. The Active Power output must not be below 95,0% of registered Capacity and the Synchronous Power Generating Module must not trip in less than the 20s of the test.



Maximum allowable power reduction in case of under-frequency

Note:

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

EN 50549-1:2019: Immunity to disturbances			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.5.2	Rate of change of frequency (RoCoF) immunity	G99/1-4:2019, clause A.7.1.2.6	**P**
4.5.3	Low voltage ride through (LVRT)	VDE V 0124-100:2019-02 (Draft), clause 5.8.3.	**P**
4.5.4	High voltage ride through (HVRT)	VDE V 0124-100:2019-02 (Draft), clause 5.8.3.	**P**
4.7.4	Zero current mode for converter connected generating plants	VDE V 0124-100:2019-02 (Draft), clause 5.8.3.	**P**

4.5.2	Rate of change of frequency (ROCOF) immunity(default setting)	P

	Start Frequency	Change	End Frequency	Confirm no trip
Positive Frequency drift	49Hz	+2Hz/sec	51Hz	No trip
Negative Frequency drift	51Hz	-2Hz/sec	49Hz	No trip

Note:

Test method refer clause A.7.1.2.6 of G99/1-4:2019.

Hold for 10 s

Manufacturers considering new designs should allow for the RoCoF where stability is required to be increased to, up to 2Hz per second, as proposed in the new European network codes, which are expected to come into force over the period 2014/2015. Under these conditions RoCoF will cease to be an effective loss of mains protection and is unlikely to be permitted in future revisions of this document.

For the step change test the SSEG should be operated with a measureable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 seconds to complete the test. The SSEG should not trip during this test.

For frequency drift tests the SSEG should be operated with a measureable output at the start frequency and then the frequency changed in a ramp function at 0,95Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least10 seconds. The SSEG should not trip during this test.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.5.3 **4.5.4** **4.7.4**	**Low voltage ride through (LVRT)** **High voltage ride through (HVRT)** **Zero current mode for converter connected generating plants**	**P**

General:

If the voltage on the generator terminals falls below <0.8 U_n and if the generator terminals exceed the voltage of> 1.15 U_n (start of fault), generator must pass through voltage dips without any current being drawn into the grid Network operator (limited dynamic network support).

This requirement is met if, for a voltage dip below 0.8 U_n or at a voltage increase above 1.15 U_n, the injected current of the generating unit (s) and / or the memory 60 ms after occurrence of this voltage dip in any outer conductor 20% of the rated current I_r and does not exceed> 10% I_r after 100 ms.

After the voltage returned to continuous operating voltage range of -15% U_n to +10% U_n, 90 % of pre fault power or available power whichever is the smallest shall be resumed as fast as possible, but at the latest within 1 s unless the DSO and the responsible party requires another value.

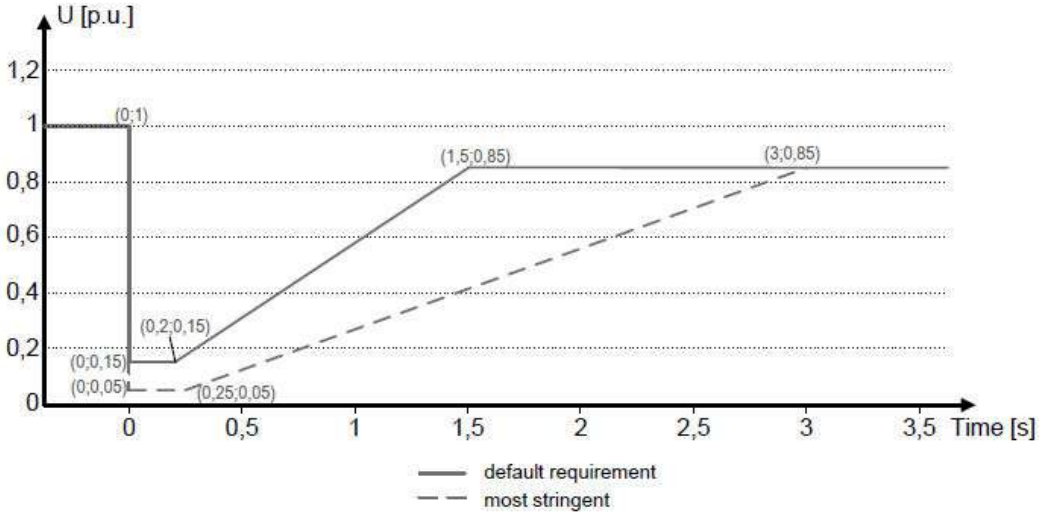


Figure 6 — Low voltage ride through capability for non-synchronous generating technology

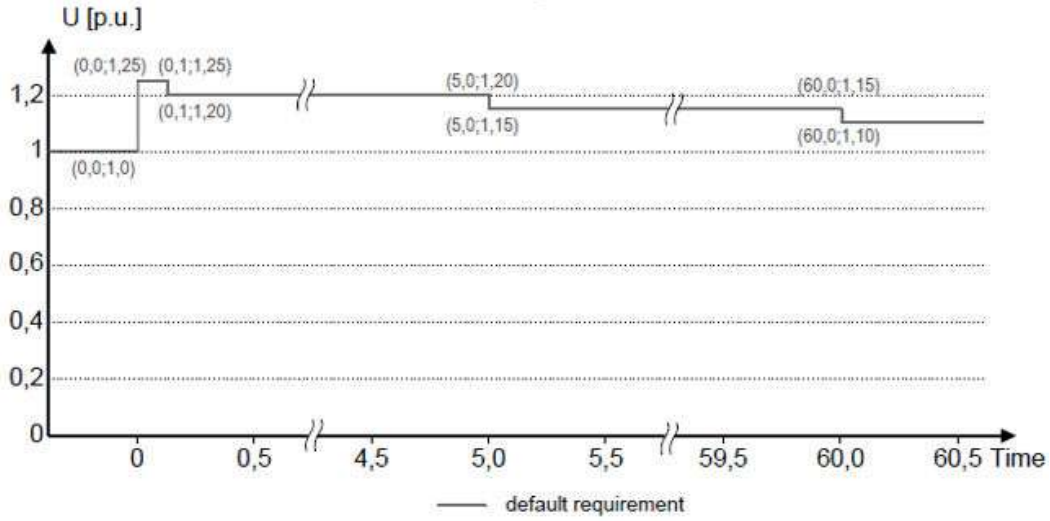


Figure 8 — Over-voltage ride through capability

Test	Drop depth requirement [p.u. U_n]	Symmetry	Fault duration [ms]	Output power level		k-factor	Test no.
				P set point (P_{rE} / p.u.)	Q set point (Q / p.u.)		
1.A.1	0,03	Symmetrical	250	1,0	0,00	0	1.A.1
1.A.2				0,2			1.A.2
1.D.1		Asymmetrical		1,0			1.D.1
1.D.2				0,2			1.D.2
1.B.1		Single phase*		1,0			1.B.1
1.B.2				0,2			1.B.2
2.A.1	0,31	Symmetrical	1300	1,0	0,00	0	2.A.1
2.A.2				0,2			2.A.2
2.D.1		Asymmetrical		1,0			2.D.1
2.D.2				0,2			2.D.2
2.B.1		Single phase*		1,0			2.B.1
2.B.2				0,2			2.B.2
3.A.1	0,82	Symmetrical	3000	1,0	0,00	0	3.A.1
3.A.2				0,2			3.A.2
3.D.1		Asymmetrical		1,0			3.D.1
3.D.2				0,2			3.D.2
3.B.1		Single phase*		1,0			3.B.1
3.B.2				0,2			3.B.2
OV1	1,25	Symmetrical	100	1,0	0,00	0	OV1
OV2	1,20		5000	1,0			OV2
OV3	1,15		60000	1,0			OV3

Note:

For every kind of voltage dip a test without load has to be performed in order to prove that the test condition was fulfilled. The voltage has to drop to AT LEAST the defined depth level. An exception can be considered in case no current is supplied during dips.

*** Single phase = "choose Typ 7 at BV-Lab Studio" ≙ LVRT Typ B**

Graph of FRT test one				
Test result:				
List of tests	**Residual amplitude of phase-to-phase voltage [p.u. U_n]**	**Duration limit [ms]**	**Duration [ms]**	**Result**
P_{Emax} in %	100% ±5%			
1.A.1- Symmetrical	0,03	250 ± 20	260	Pass
1.D.1- Asymmetrical	0,03	250 ± 20	262	Pass
1.B.1- Single phase	0,03	250 ± 20	263	Pass
2.A.1- Symmetrical	0,31	1300 ± 20	1310	Pass
2.D.1- Asymmetrical	0,31	1300 ± 20	1315	Pass
2.B.1- Single phase	0,31	1300 ± 20	1310	Pass
3.A.1- Symmetrical	0,82	3000 ± 20	3000	Pass
3.D.1- Asymmetrical	0,82	3000 ± 20	3000	Pass
3.B.1- Single phase	0,82	3000 ± 20	3000	Pass
P_{Emax} in %	20% ±5%			
1.A.2- Symmetrical	0,03	250 ± 20	268	Pass
1.D.2- Asymmetrical	0,03	250 ± 20	264	Pass
1.B.2- Single phase	0,03	250 ± 20	264	Pass
2.A.2- Symmetrical	0,31	1300 ± 20	1310	Pass
2.D.2- Asymmetrical	0,31	1300 ± 20	1310	Pass
2.B.2- Single phase	0,31	1300 ± 20	1310	Pass
3.A.2- Symmetrical	0,82	3000 ± 20	3000	Pass
3.D.2- Asymmetrical	0,82	3000 ± 20	3000	Pass
3.B.2- Single phase	0,82	3000 ± 20	3000	Pass
P_{Emax} in %	100% ±5%			
OV1- Symmetrical	1,25	100 ± 20	100	Pass
OV2- Symmetrical	1,20	5000 ± 20	5000	Pass
OV3- Symmetrical	1,15	60000 ± 20	60000	Pass

Test conditions:

Voltage simulator fall and rise time: < 20ms

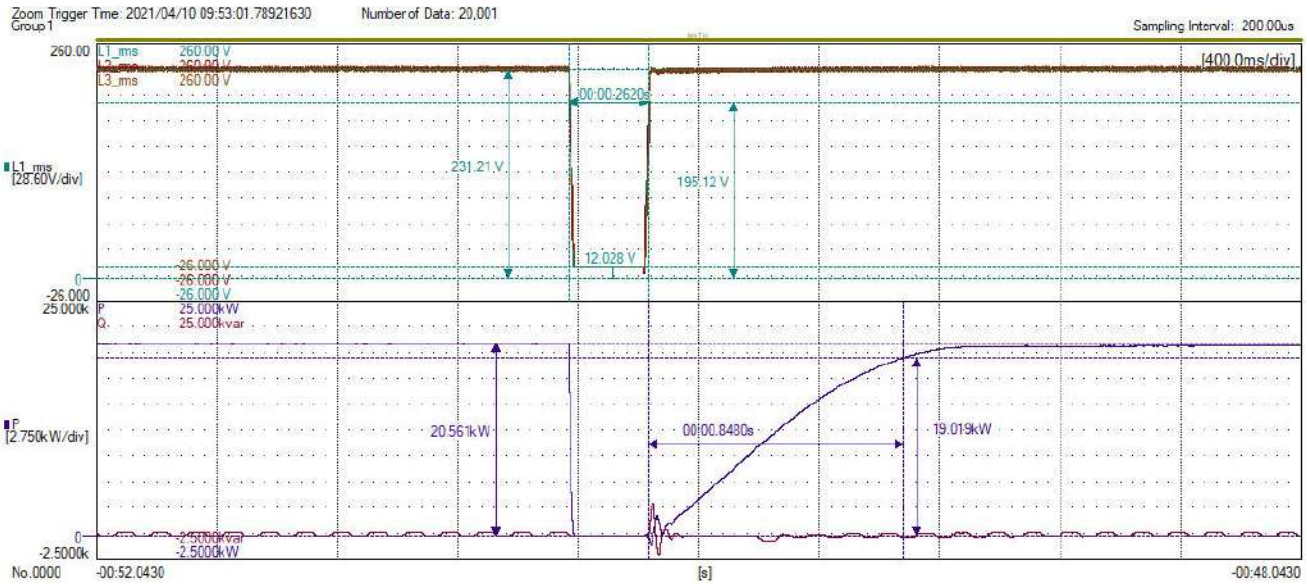
Used sample rate: 10 kHz

Note:

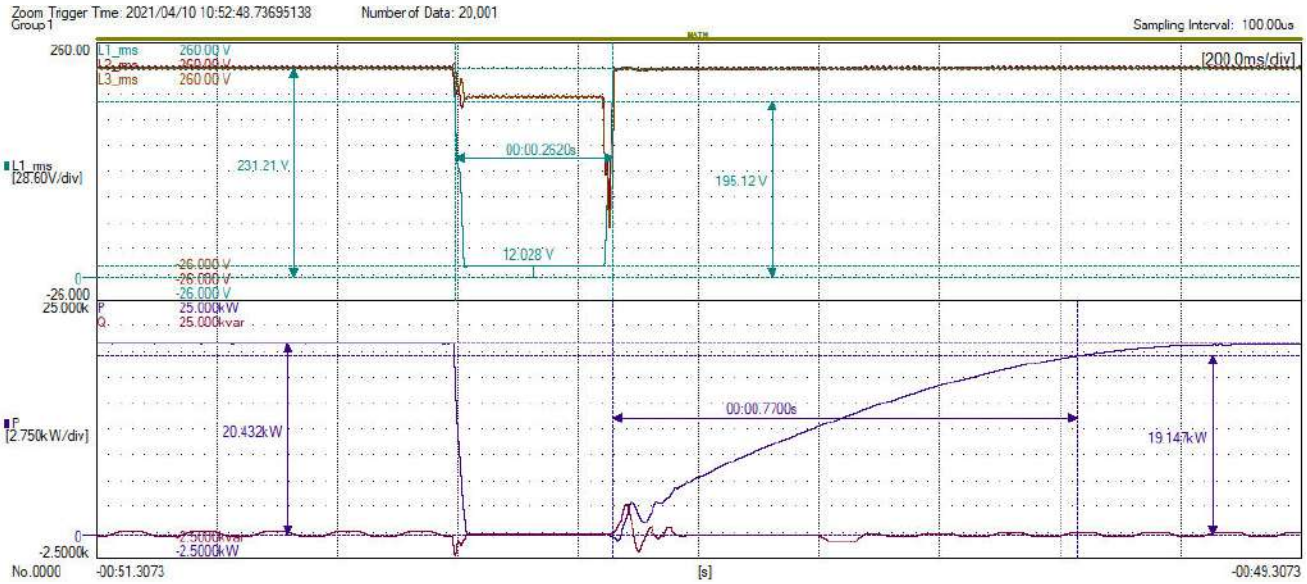
The test method refer to VDE V 0124-100:2019-02 (Draft), clause 5.8.3.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

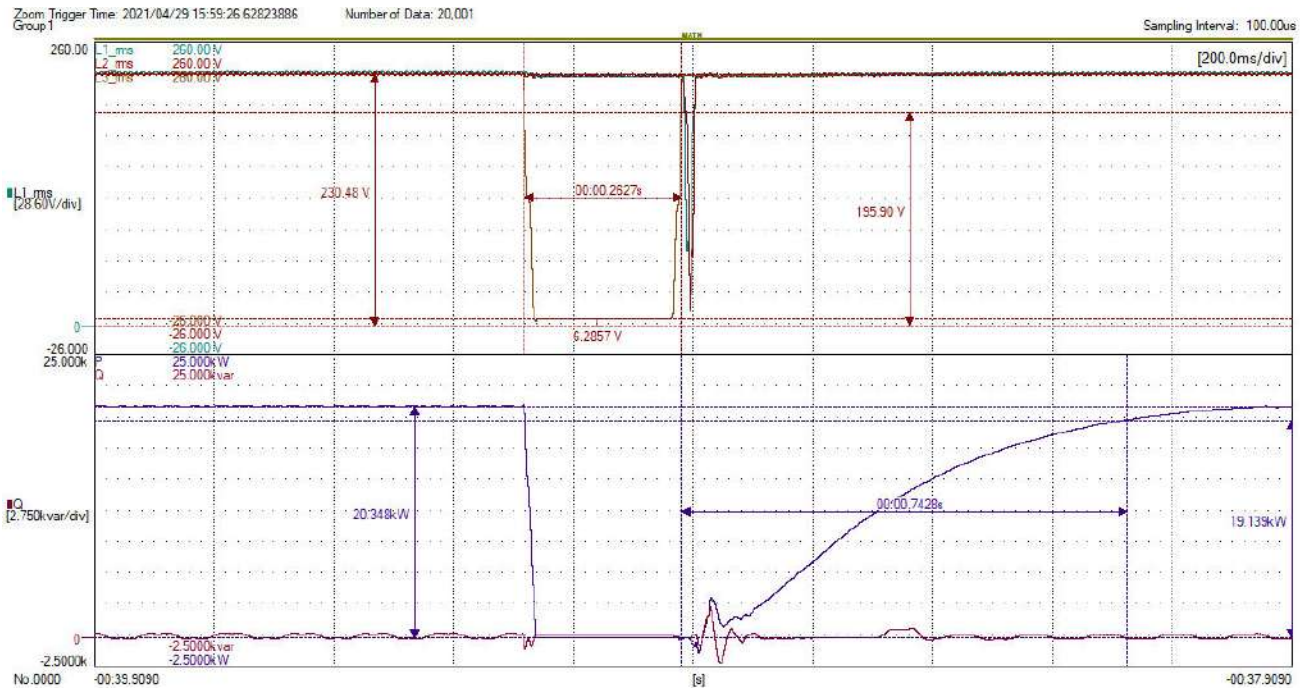
Test 1.A.1-Symmetrical fault (U/U_{nom} = 0,03); P = 100% ±5% P_n



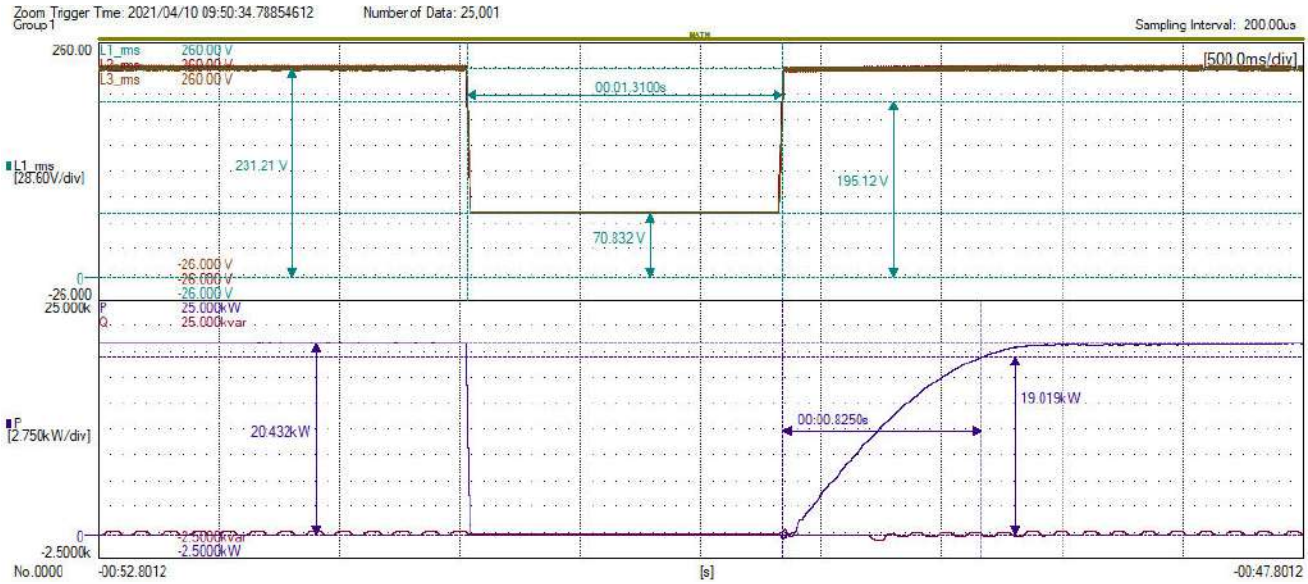
Test 1.D.1-Asymmetrical fault (U/U_{nom} = 0,03); P = 100% ±5% P_n



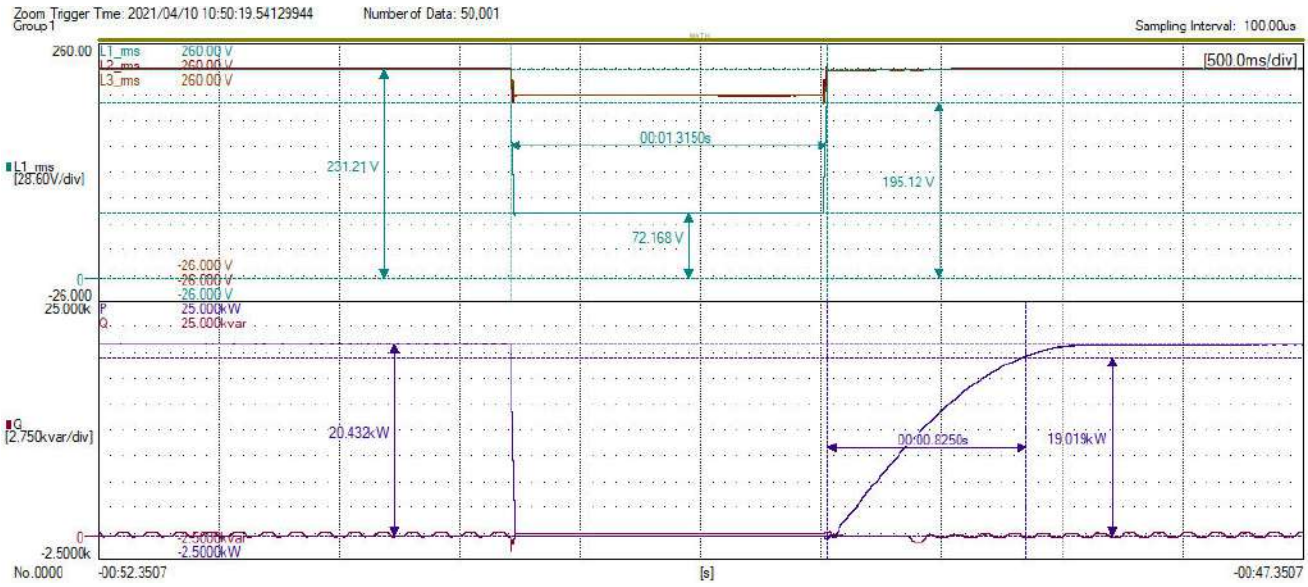
Test 1.B.1-Single phase fault (U/U_{nom} = 0,03); P = 100% ±5% P_n



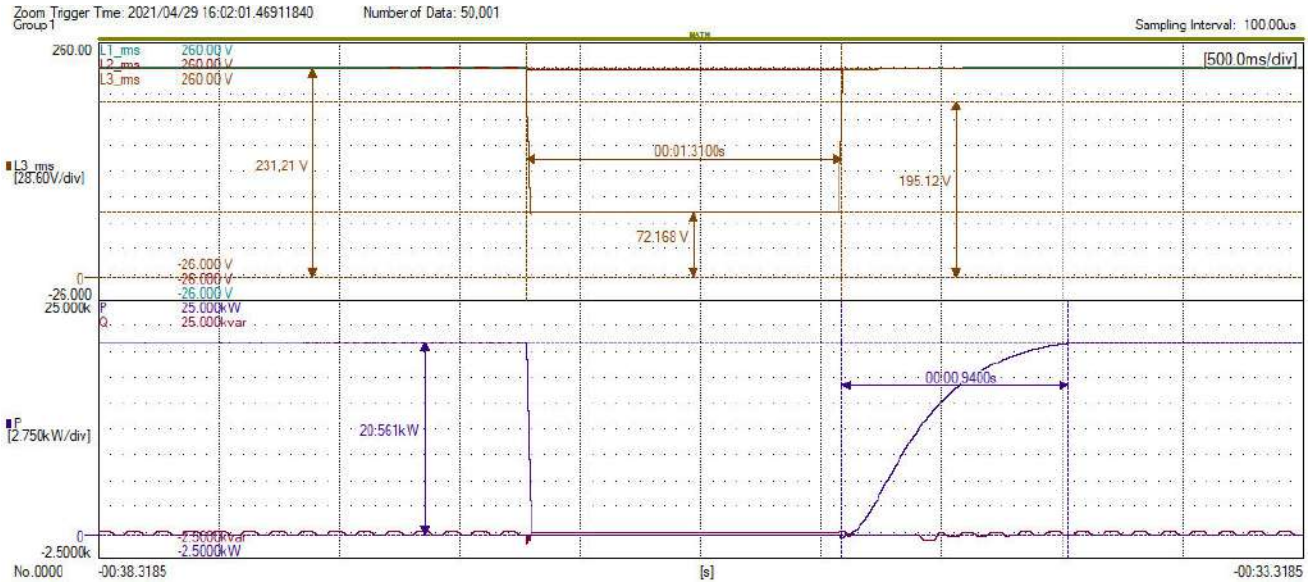
Test 2.A.1-Symmetrical fault (U/U_{nom} = 0,31); P = 100% ±5% P_n



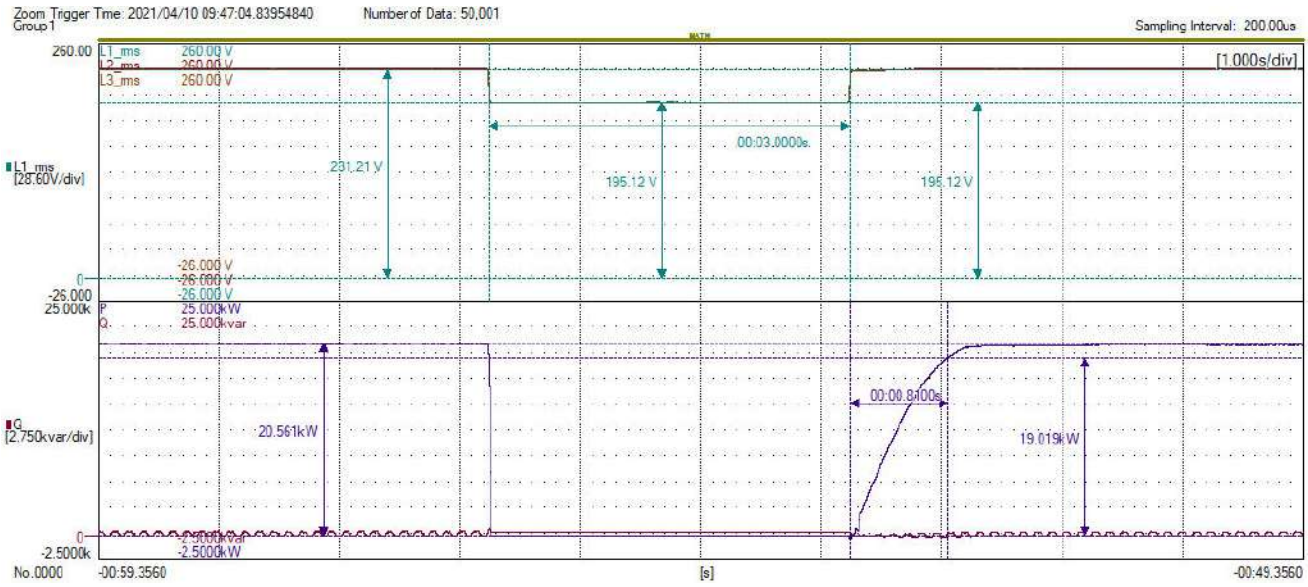
hoTest 2.D.1- Asymmetrical fault (U/U_{nom} = 0,31); P = 100% ±5% P_n



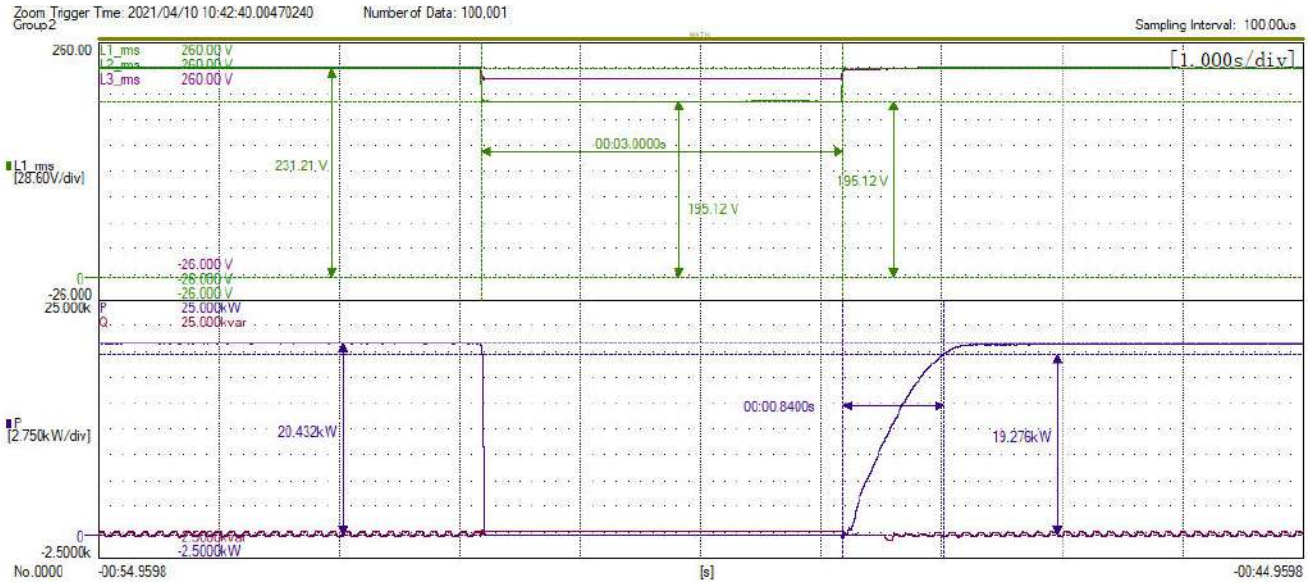
Test 2.B.1-Single phase fault (U/U_{nom} = 0,31); P = 100% ±5% P_n



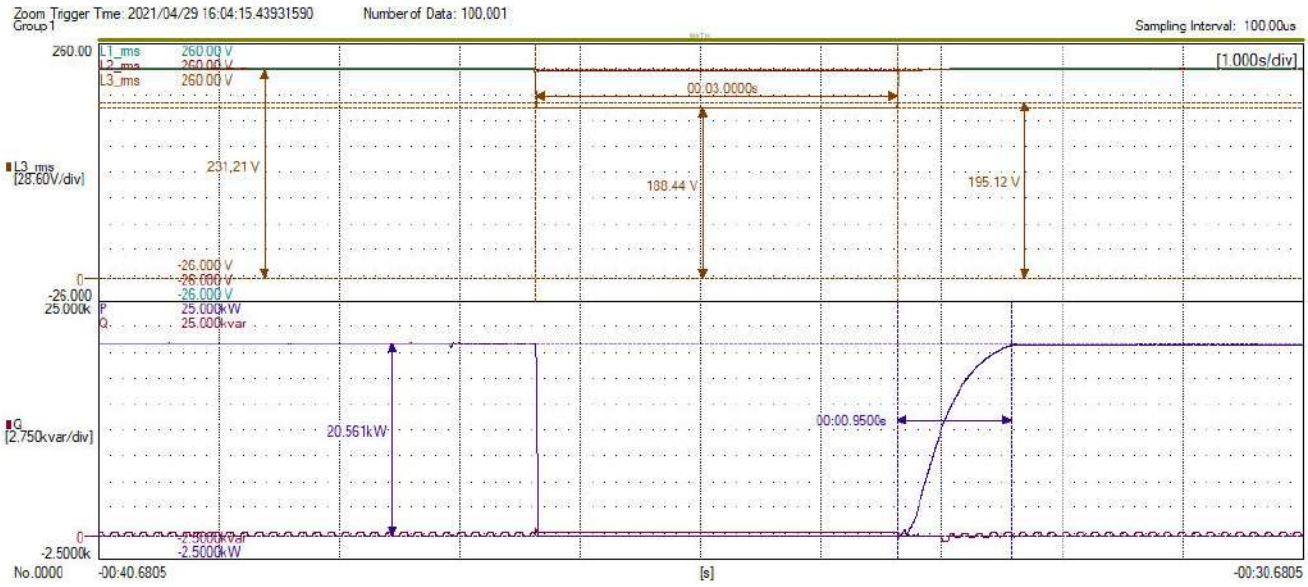
Test 3.A.1-Symmetrical fault (U/U_{nom} = 0,82); P = 100% ±5% P_n



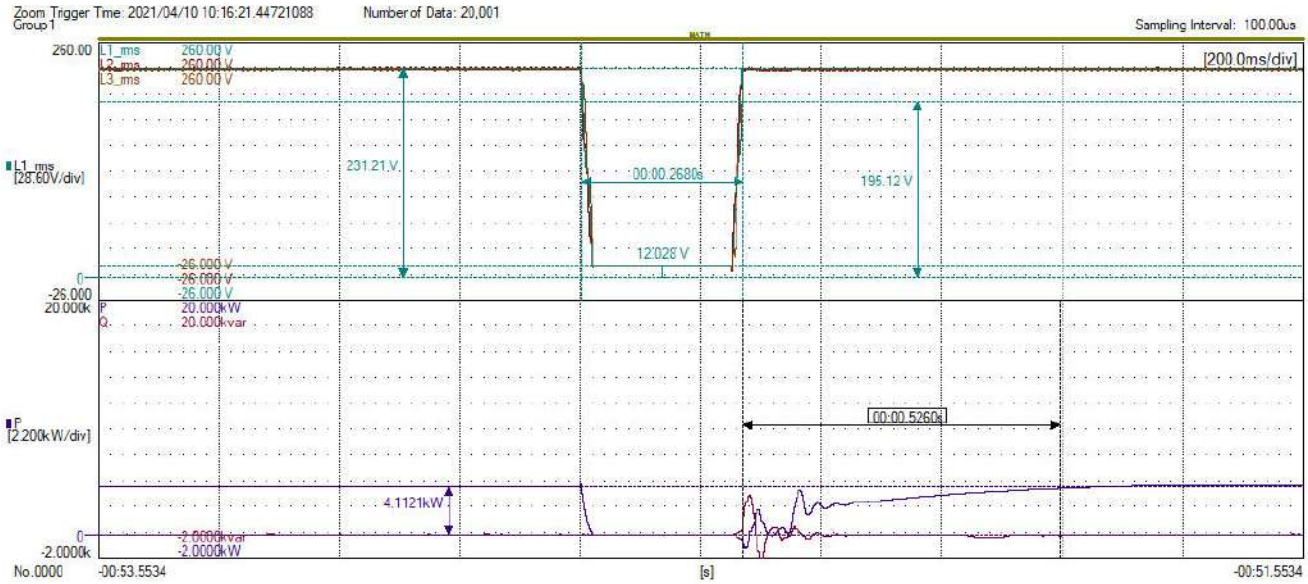
Test 3.D.1-Asymmetrical fault (U/U_{nom} = 0,82); P = 100% ±5% P_n



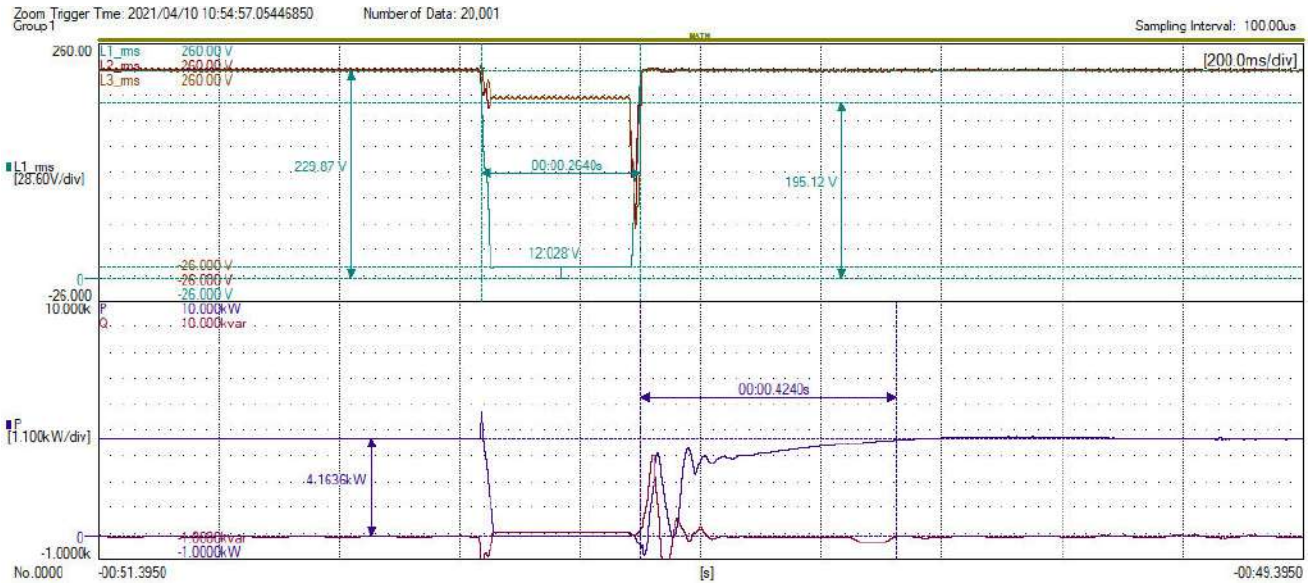
Test 3.B.1-Single phase fault (U/U_{nom} = 0,82); P = 100% ±5% P_n



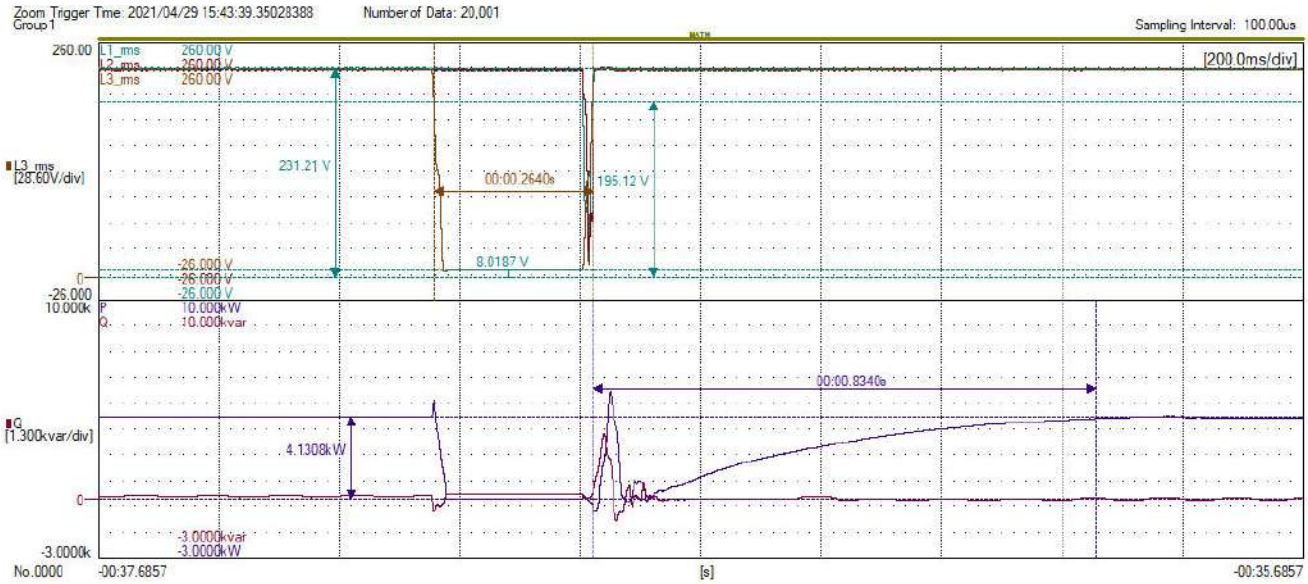
Test 1.A.2-Symmetrical fault (U/U_{nom} = 0,03); P = 100% ±5% P_n



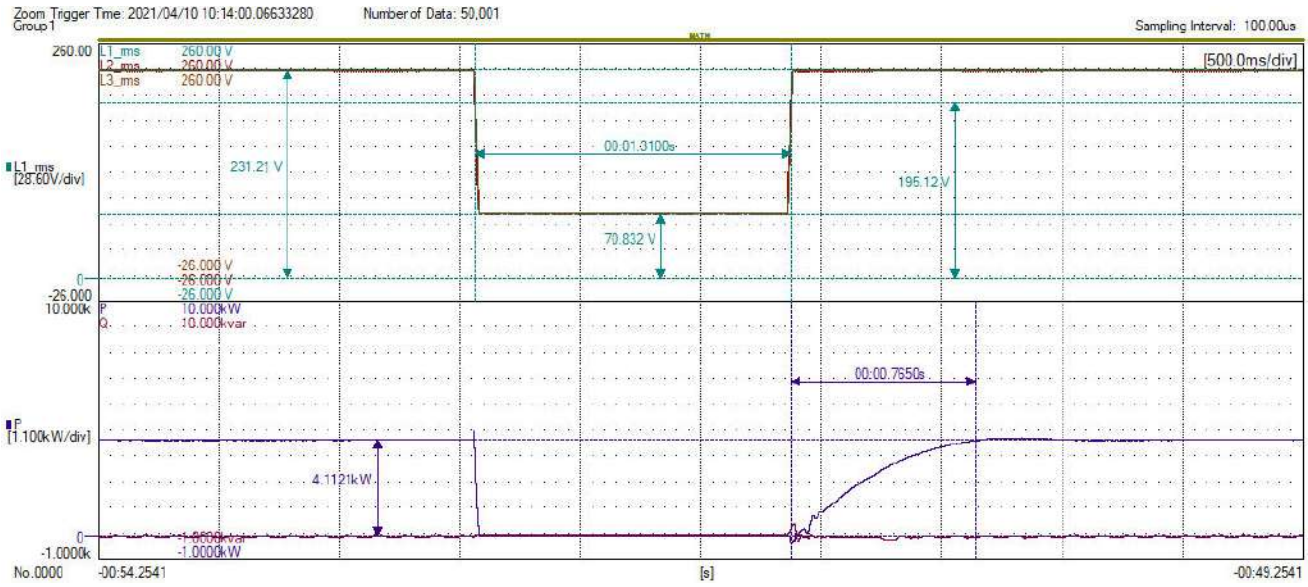
Test 1.D.2-Asymmetrical fault (U/U_{nom} = 0,03); P = 20% ±5% P_n



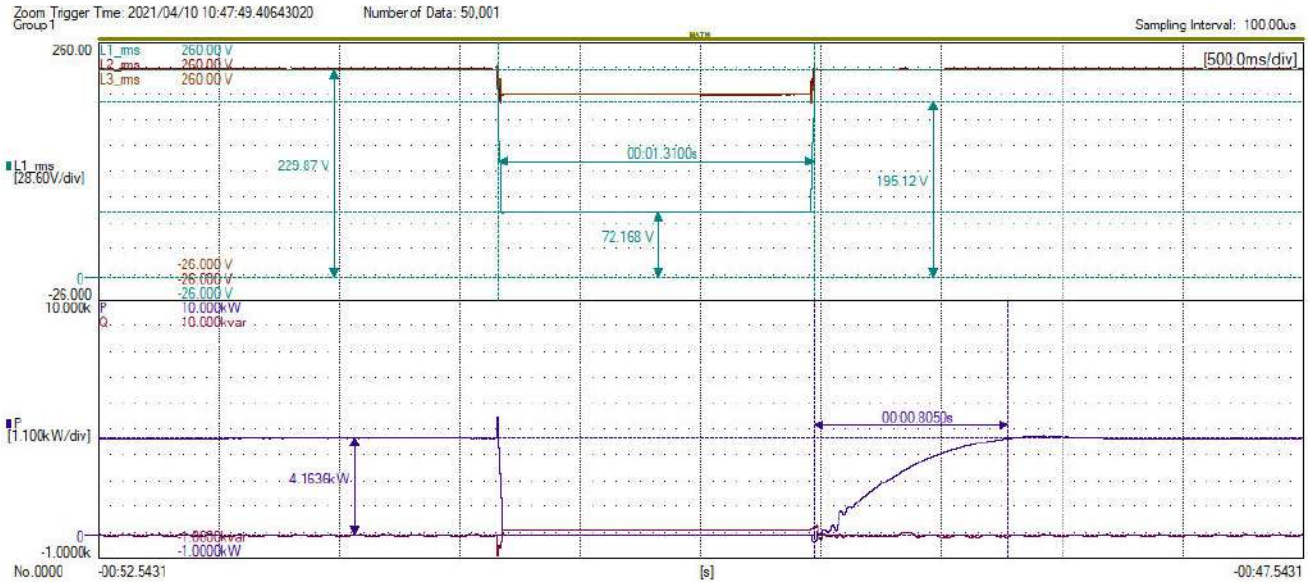
Test 1.B.2-Single phase fault (U/U_{nom} = 0,03); P = 20% ±5% P_n



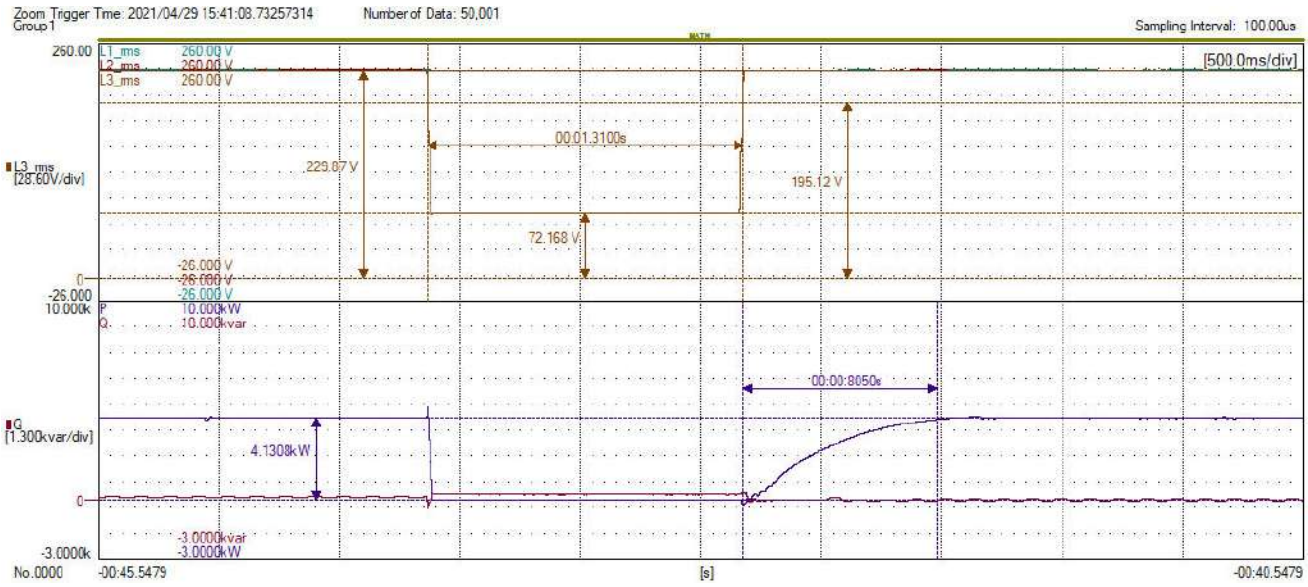
Test 2.A.2-Symmetrical fault (U/U_{nom} = 0,31); P = 20% ±5% P_n



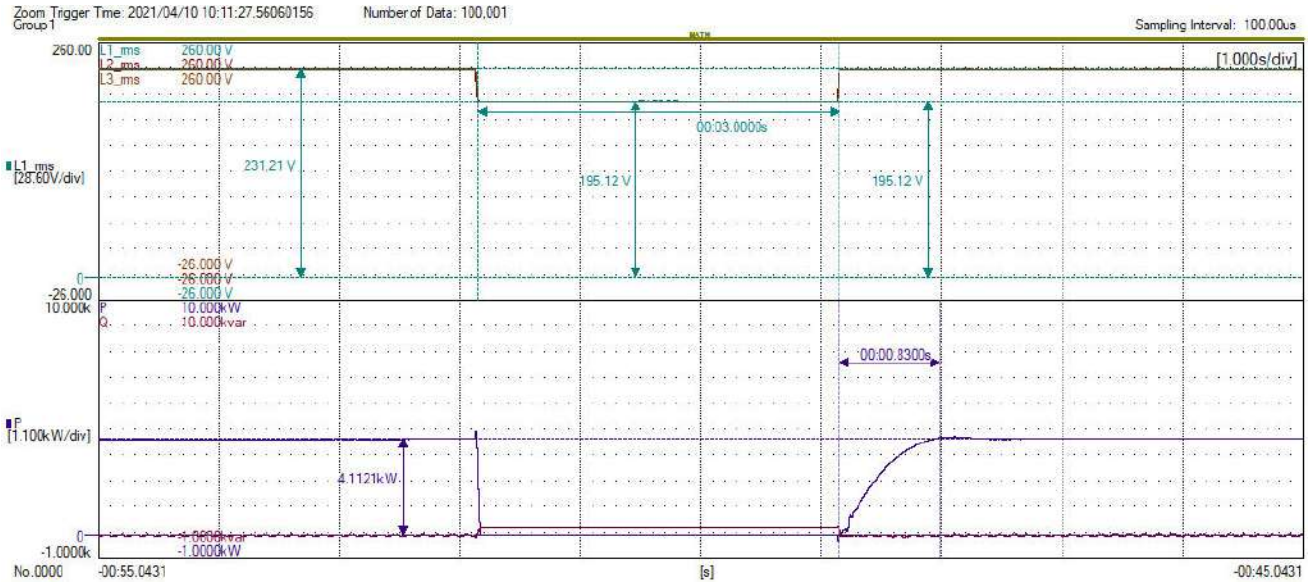
Test 2.D.2-Asymmetrical fault (U/U_{nom} = 0,31); P = 20% ±5% P_n



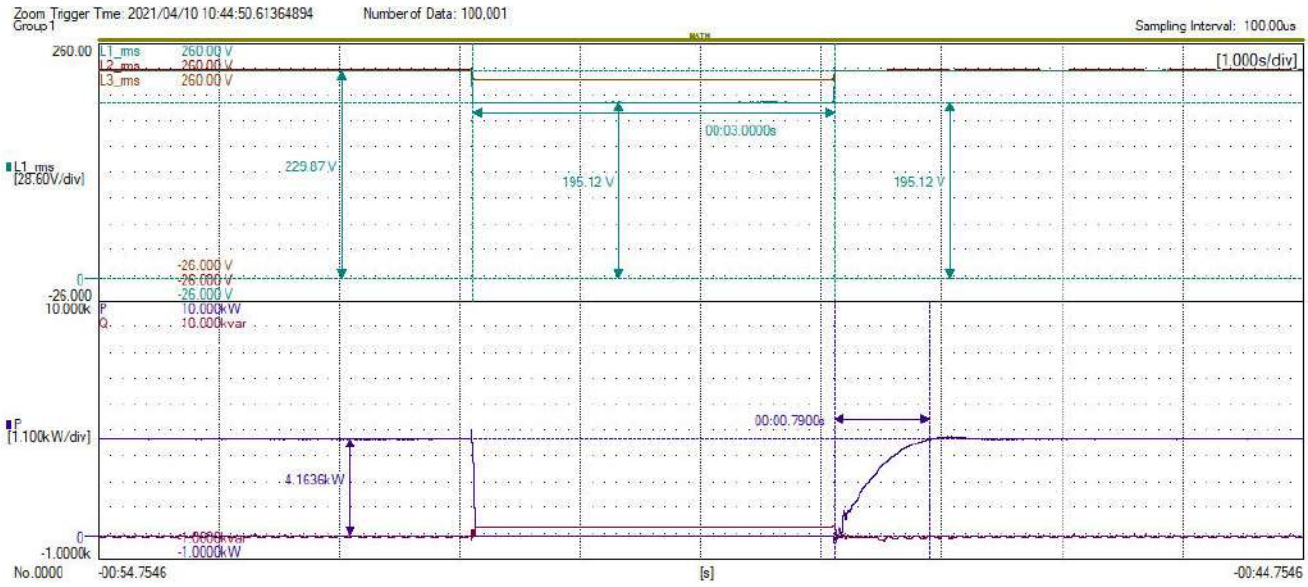
Test 2.B.2-Single phase fault (U/U_{nom} = 0,31); P = 20% ±5% P_n



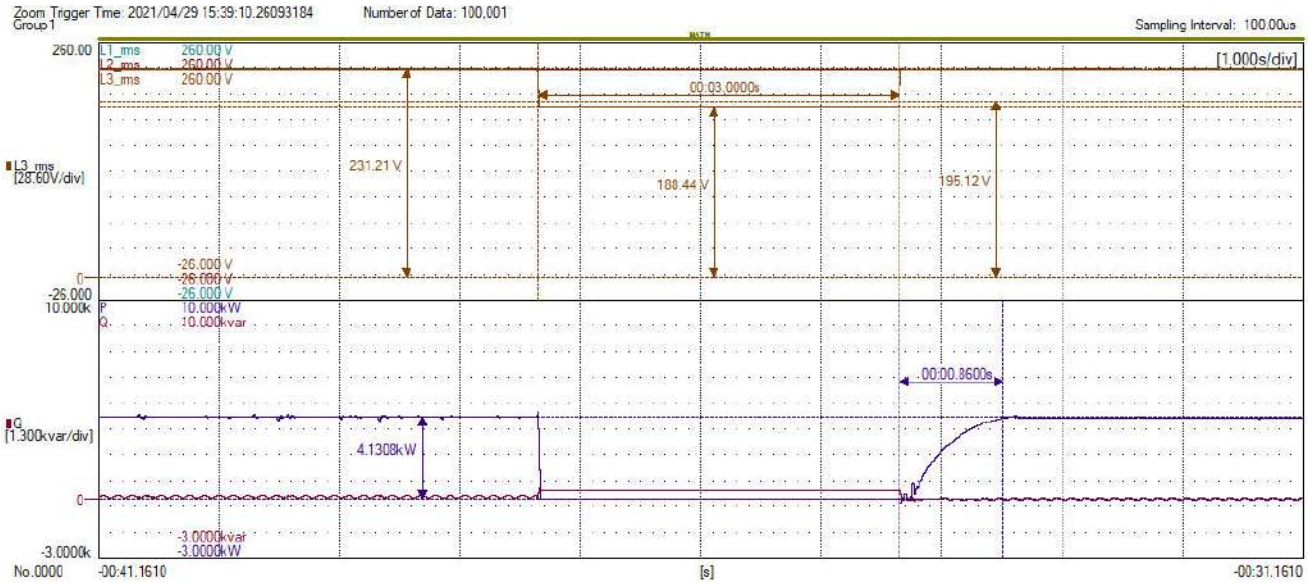
Test 3.A.2-Symmetrical fault (U/U_{nom} = 0,82); P = 20% ±5% P_n



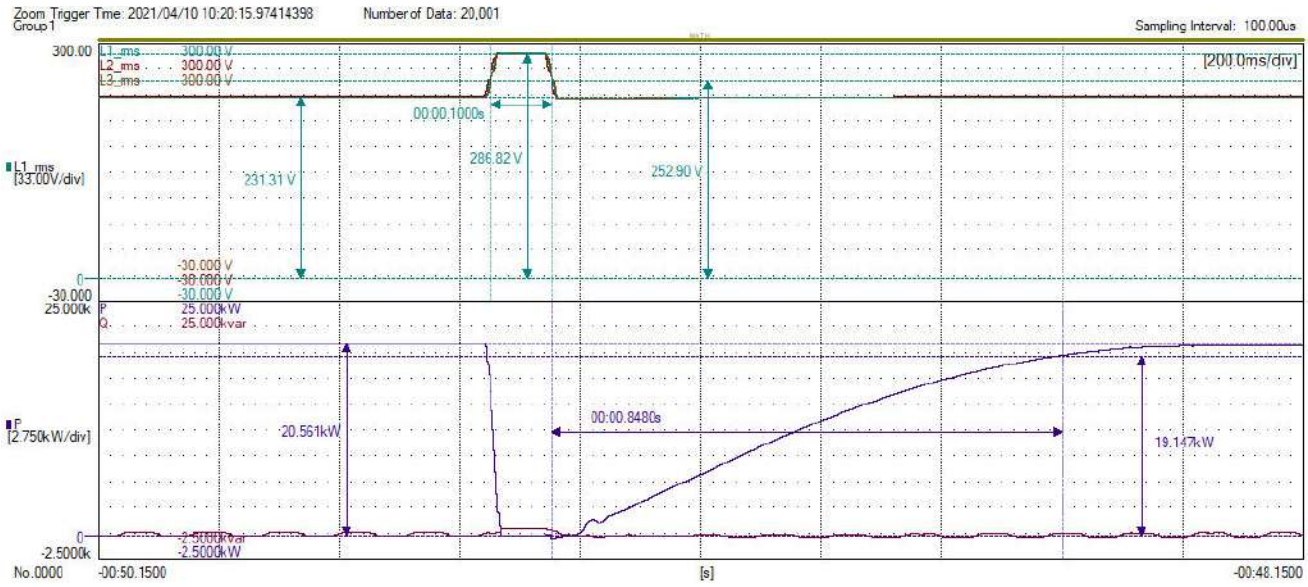
Test 3.D.2-Asymmetrical fault (U/U_{nom} = 0,82); P = 20% ±5% P_n



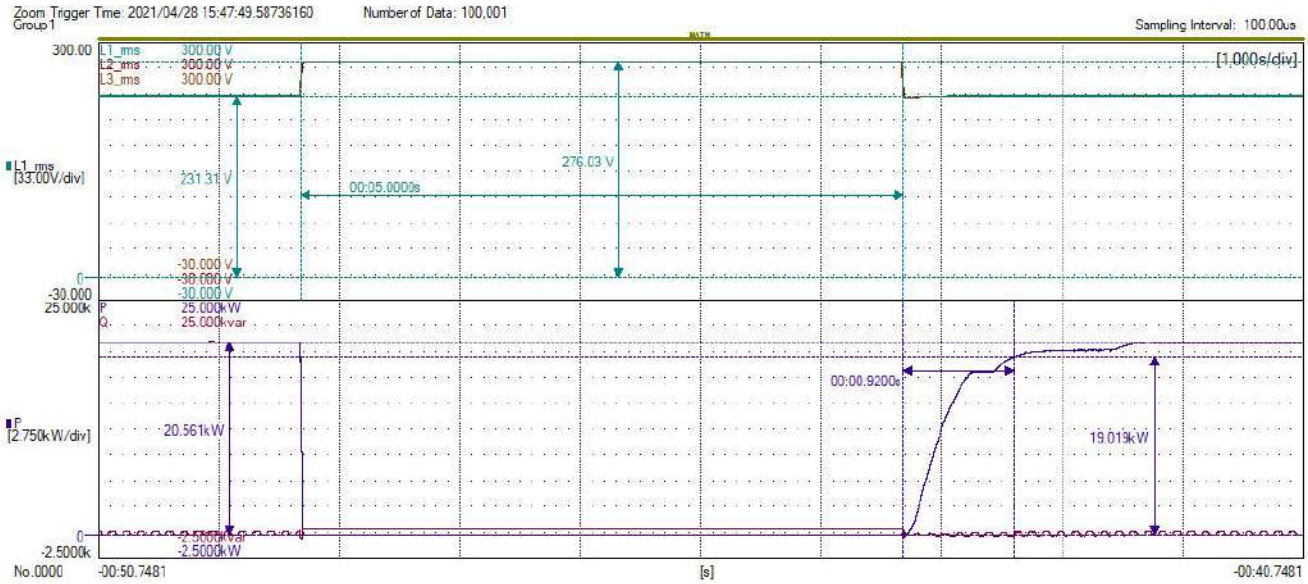
Test 3.B.2-Single phase fault (U/U_{nom} = 0,82); P = 20% ±5% P_n



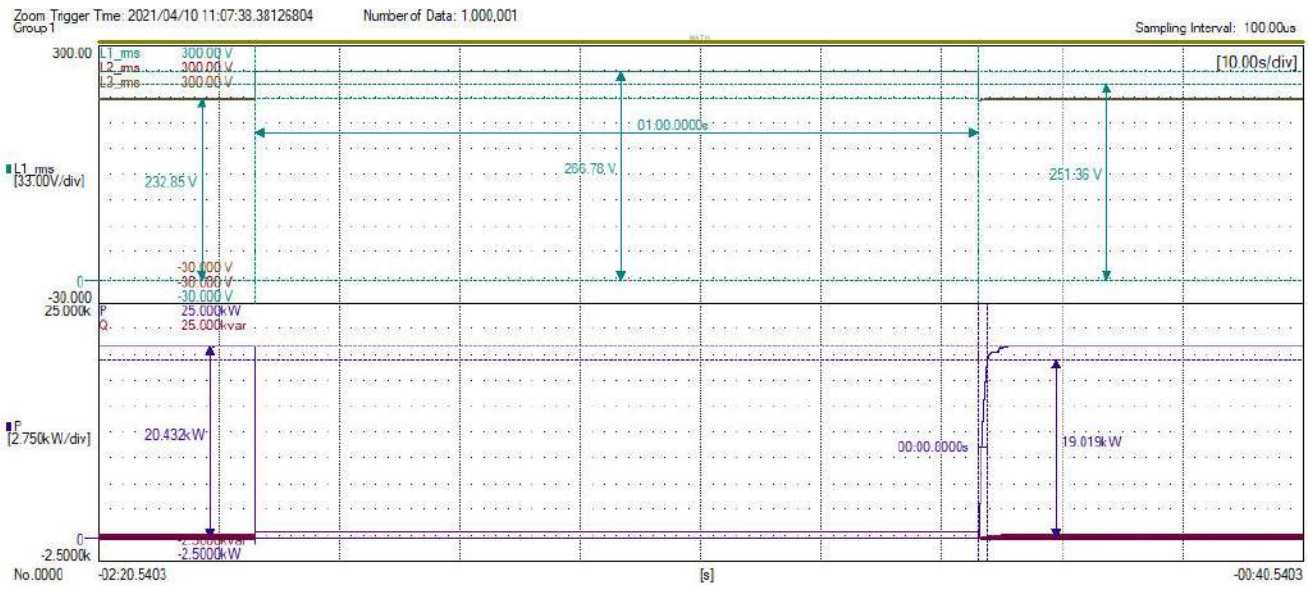
Test OV1-Symmetrical fault (U/U_{nom} = 1,25); P = 100% ±5% P_n



Test OV2-Symmetrical fault (U/U_{nom} = 1,20); P = 100% ±5% P_n

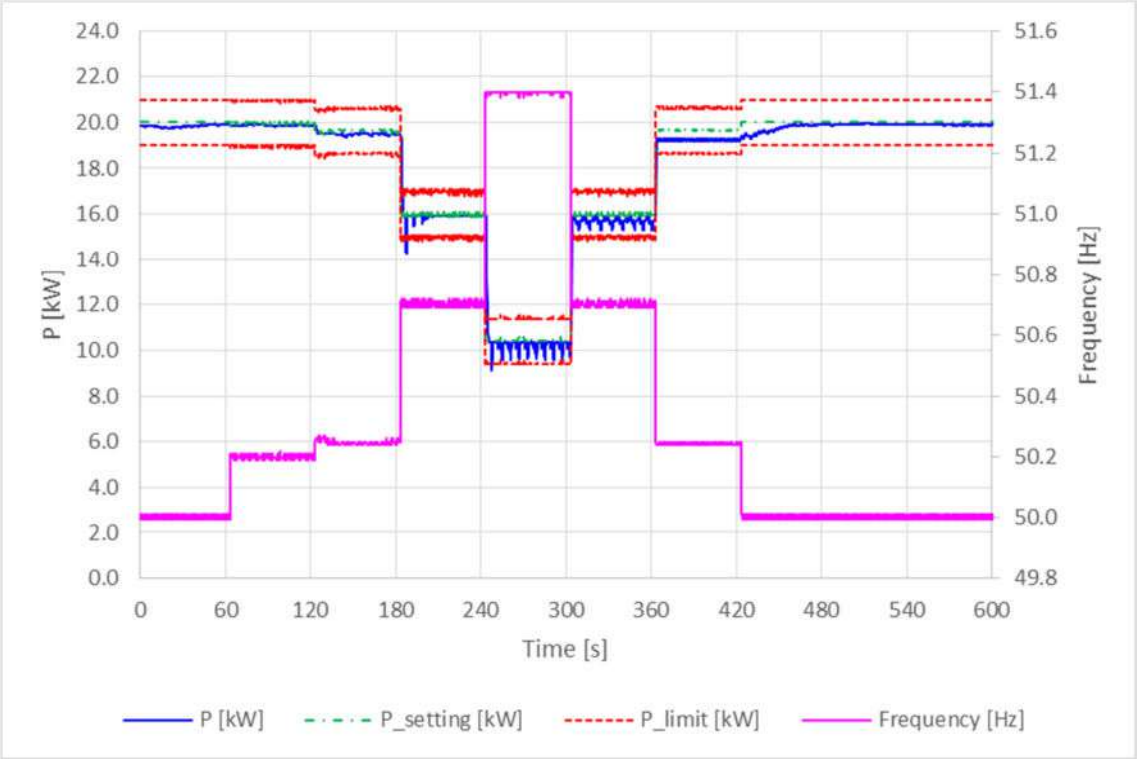


Test OV3-Symmetrical fault (U/U_{nom} = 1,15); P = 100% ±5% P_n

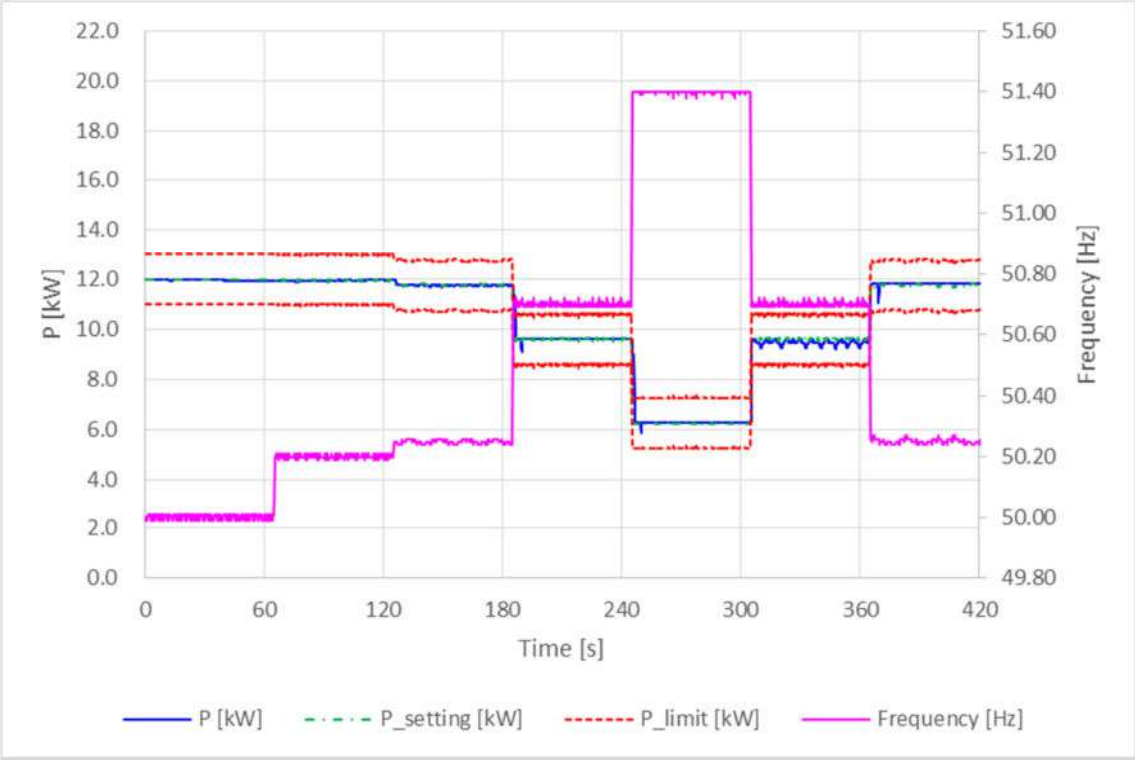


EN 50549-1:2019: Active response to frequency deviation			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.6.1	Power response to over-frequency	VDE V 0124-100:2019-02 (Draft), clause 5.4.4	**P**
4.6.2	Power response to under-frequency	VDE V 0124-100:2019-02 (Draft), clause 5.4.6	**N/A**

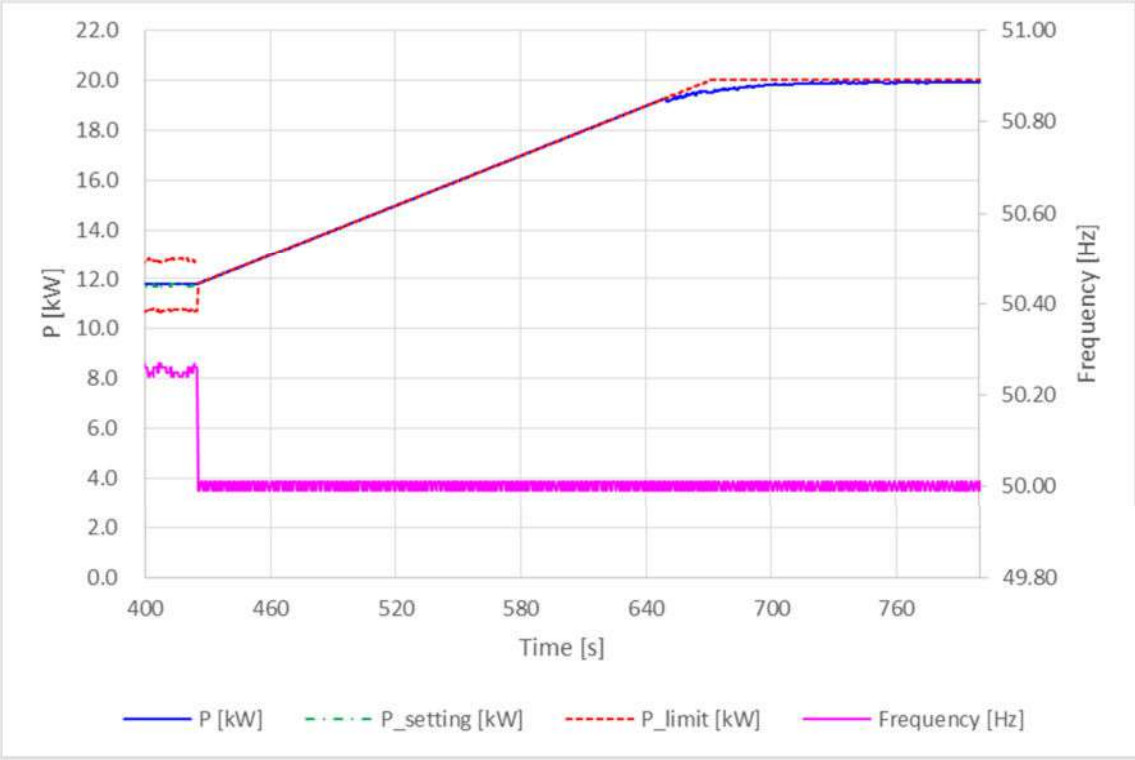
4.6.1	Power response to over-frequency						P
Test result:							
1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,40	e) 50,70	f) 50,25	g) 50,00
1. Measurement a) to g): Active power output =100% P_{Emax} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 50,2Hz							
Frequency [Hz]:	50,00	50,25	50,70	51,40	50,70	50,24	50,00
P_M [kW]:	N/A	19,620	16,000	10,403	15,995	19,646	N/A
P_{E60} [kW]:	19,835	19,494	15,927	10,302	15,640	19,227	19,853
$\Delta P_{E60}/P_M$ [%]:	N/A	0,633	0,364	0,502	1,775	2,097	N/A
Test result:							
1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,40	e) 50,70	f) 50,25	g) 50,00
2. Measurement a) to g): Active power output 60% after freezing = 100% P_{Emax} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 50,2Hz							
Frequency [Hz]:	50,00	50,25	50,70	51,40	50,70	50,25	50,00
P_M [kW]:	12,00	11,758	9,600	6,242	9,601	11,755	12,000
P_{E60} [kW]:	11,950	11,752	9,638	6,314	9,478	11,799	11,950
$\Delta P_{E60}/P_M$ [%]:	-0,252	-0,029	0,191	0,357	-0,620	0,219	-0,252
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}						
Graph of Measurement 1.: Active power output > 80% P_{Emax}							



Graph of Measurement 2.:Active power output 40% and 60% after freezing > 80% P_n



Graph of power gradient:



Test:

The test is conducted for two powers. First, the test must start at a power =100% P_{Emax} ("Measurement 1"), and in a second test, for a power 60% P_{Emax} ("Measurement 2"). In the second test, after freezing of the P_M, the available active power output must be increased to a value =100% P_{Emax}, and after the network frequency of 50,2 Hz is fallen below, the rise of the active power gradient must be recorded.

Point g) must be held until the micro-generator is again feeding in with the active power output available.

Assessment criterion:

For f = 50,2 Hz, the value of the P_M active power currently being generated is "frozen".

a) For adjustable micro-generators when:

1) the active power reduces between measuring points b) and f) given above with the set gradient P_M per Hz for a increasing frequency (or rises for a frequency decreasing again).

2) the maximum active power gradient occurring in point is less than the configured maximum active power per minute

3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_{Emax} by more than ± 10%.

4) the settling time is equal or below 2 s with an intentional delay set to zero

b) For partly adjustable micro-generators

1) when they behave as in a) within their adjustment range, and

2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

Note:

The test method refer to clause 5.4.4 of VDE V 0124-100:2019-02 (Draft).

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

EN 50549-1:2019: Power response to voltage variations and voltage changes			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.7.2.2	Capabilities	--	**P**
4.7.2.3.2	Fix control modes (cos φ setpoint mode)	FGW TG3, Revision 25, clause 4.2.2	**P**
4.7.2.3.2	Fix control modes (Q setpoint mode, 48,43%)	EN 50438:2013, Annex D.3.4.2.1	**P**
4.7.2.2	Q Response time	CEI 0-21:2019-04, Annex B.1.2.4	**P**
4.7.2.3.3	Voltage related control modes (Q (U) controls)	VDE AR 4105:2018-05, clause 5.7.2.4	**P**
4.7.2.3.4	Power related control modes (cos φ (P) curve)	VDE V 0124-100:2012, clause 5.3.6.4	**P**
4.7.3	Voltage related active power reduction (P(U) function)	CEI 0-21:2019-04, Annex B.1.3.1	**P**

4.7.2 Voltage support by reactive power 4.7.2.2 Capabilities 4.7.2.3.2 Fix control modes (cos φ setpoint mode)	P

Test result: ASW20K-LT-G2

PF = 0,8 / Inducitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,748	-1,354	0,791	230,05
20%	3,802	-2,817	0,804	230,22
30%	5,816	-4,321	0,803	230,36
40%	7,907	-5,830	0,805	230,52
50%	9,942	-7,300	0,806	230,68
60%	11,901	-8,749	0,806	230,83
70%	13,897	-10,199	0,806	230,99
80%	15,730	-11,558	0,806	231,13
90%	16,153	-11,966	0,804	231,17
100%	16,297	-11,872	0,808	231,16
PF = 0,8 / Capacitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,756	1,303	0,803	230,06
20%	3,775	2,803	0,803	230,21
30%	5,890	4,375	0,803	230,37
40%	7,871	5,837	0,803	230,54
50%	9,868	7,309	0,804	230,71
60%	11,842	8,763	0,804	230,87
70%	13,883	10,272	0,804	231,05
80%	15,892	11,768	0,804	231,25
90%	16,182	11,874	0,806	231,29
100%	16,215	11,862	0,807	231,28
Cos phi=1 no reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,666	-0,070	0,999	230,03
20%	3,825	-0,088	0,999	230,19
30%	5,944	-0,087	0,999	230,37
40%	7,971	-0,089	0,999	230,53
50%	10,011	-0,097	0,999	230,68
60%	11,993	-0,110	0,999	230,85
70%	13,998	-0,122	0,999	231,02
80%	15,998	-0,146	0,999	231,19
90%	17,921	-0,139	0,999	231,36
100%	19,869	-0,160	0,999	231,51

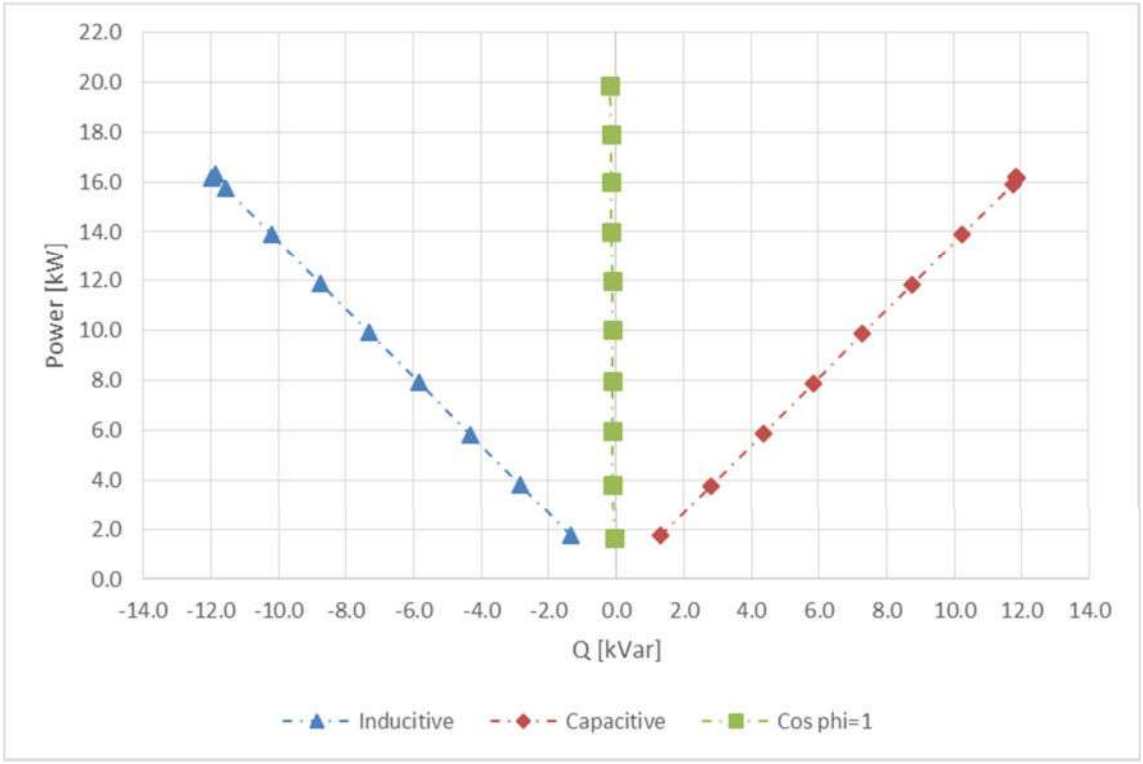
Test result: ASW8K-LT-G2				
PF = 0,8 / Inducitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,765	-0,571	0,801	230,07
20%	1,568	-1,161	0,803	230,17
30%	2,377	-1,757	0,804	230,25
40%	3,180	-2,349	0,804	230,31
50%	3,973	-2,932	0,804	230,39
60%	4,778	-3,525	0,805	230,44
70%	5,564	-4,102	0,805	230,51
80%	6,367	-4,693	0,805	230,56
90%	6,506	-4,794	0,805	230,57
100%	6,507	-4,793	0,805	230,56
PF = 0,8 / Capacitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,852	0,626	0,805	230,12
20%	1,575	1,164	0,804	230,20
30%	2,385	1,778	0,802	230,28
40%	3,187	2,392	0,800	230,35
50%	3,981	3,007	0,798	230,42
60%	4,787	3,540	0,804	230,48
70%	5,584	4,155	0,802	230,53
80%	6,377	4,777	0,800	230,60
90%	6,491	4,853	0,801	230,63
100%	6,491	4,854	0,801	230,63
Cos phi=1 no reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,809	0,043	0,996	230,08
20%	1,577	0,004	0,998	230,17
30%	2,385	-0,101	0,999	230,24
40%	3,197	-0,153	0,999	230,32
50%	3,994	-0,187	0,999	230,40
60%	4,807	-0,220	0,999	230,48
70%	5,599	-0,255	0,999	230,54
80%	6,408	-0,289	0,999	230,61
90%	7,201	-0,325	0,999	230,67
100%	8,004	-0,357	0,999	230,72

Assessment criterion:

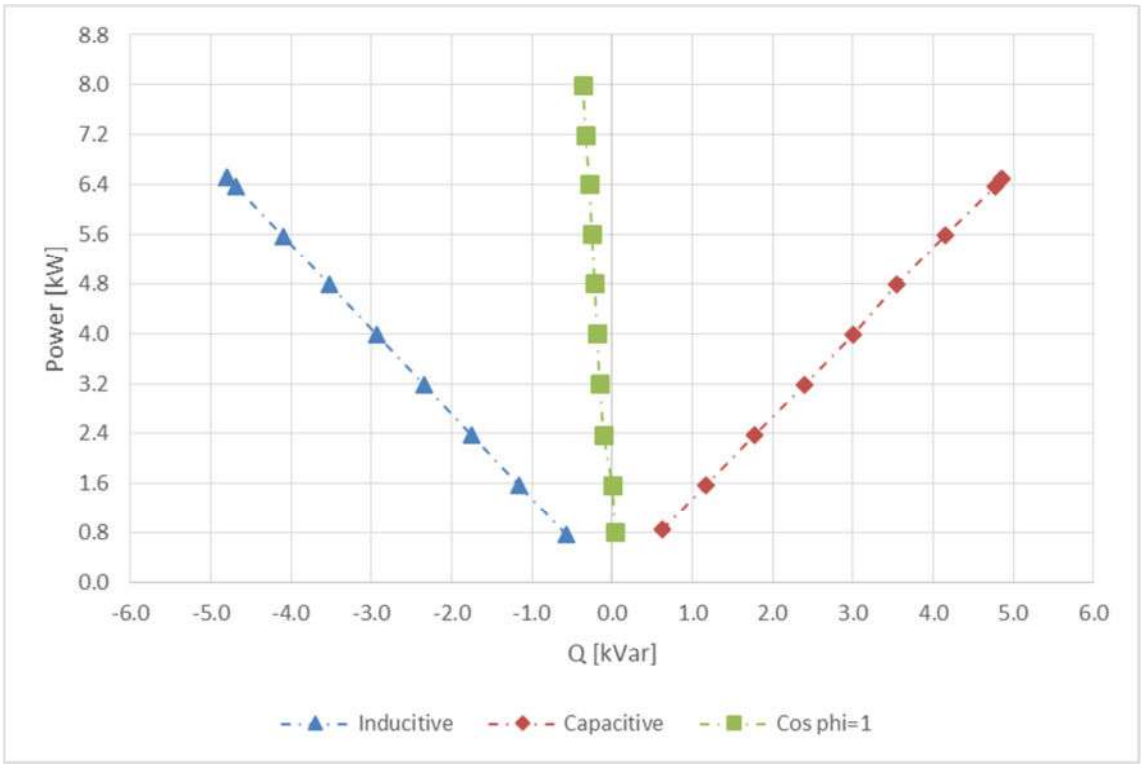
The power factor resulting in each of the measurement points between 20 % and 90 % of the nominal power is equal to or lower than 0,90 both in over excited and under excited operation.

The tests had been performed on the ASW8K-LT-G2 and ASW20K-LT-G2 are valid for the ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Diagram



ASW20K-LT-G2



ASW8K-LT-G2

4.7.2 Voltage support by reactive power 4.7.2.2 Capabilities 4.7.2.3.2 Fix control modes (Q setpoint mode, 48,43%)	P

Test result: ASW20K-LT-G2

Inducitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,912	-11,981	0,158	230,02
20%	3,829	-11,990	0,304	230,17
30%	5,950	-12,002	0,444	230,33
40%	7,993	-12,020	0,554	230,51
50%	11,863	-12,043	0,702	230,81
60%	11,863	-12,043	0,702	230,81
70%	13,835	-12,074	0,753	230,97
80%	15,848	-12,083	0,795	231,13
90%	16,153	-11,966	0,804	231,17
100%	16,297	-11,872	0,808	231,16
Capacitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,740	12,037	0,143	230,10
20%	3,883	12,010	0,308	230,27
30%	5,979	11,989	0,446	230,43
40%	8,012	11,968	0,556	230,61
50%	12,070	11,945	0,711	230,93
60%	12,070	11,945	0,711	230,93
70%	14,270	11,942	0,767	231,11
80%	15,892	11,768	0,804	231,25
90%	16,182	11,874	0,806	231,29
100%	16,215	11,862	0,807	231,28
Cos phi=1 no reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,666	-0,070	0,999	230,03
20%	3,825	-0,088	0,999	230,19
30%	5,944	-0,087	0,999	230,37
40%	7,971	-0,089	0,999	230,53
50%	11,993	-0,110	0,999	230,85
60%	11,993	-0,110	0,999	230,85
70%	13,998	-0,122	0,999	231,02
80%	15,998	-0,146	0,999	231,19
90%	17,921	-0,139	0,999	231,36
100%	19,869	-0,160	1,000	231,51

Test result: ASW8K-LT-G2

Inducitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,799	-4,733	0,166	230,06
20%	1,543	-4,765	0,308	230,13
30%	2,331	-4,797	0,437	230,21
40%	3,136	-4,829	0,544	230,28
50%	3,945	-4,739	0,640	230,36
60%	4,796	-4,772	0,709	230,44
70%	5,552	-4,802	0,756	230,51
80%	6,366	-4,799	0,799	230,58
90%	6,507	-4,808	0,804	230,57
100%	6,508	-4,807	0,804	230,57
Capacitive reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,849	4,849	0,172	230,10
20%	1,610	4,817	0,317	230,16
30%	2,411	4,863	0,444	230,24
40%	3,158	4,831	0,547	230,31
50%	3,957	4,877	0,630	230,38
60%	4,772	4,843	0,702	230,45
70%	5,567	4,810	0,757	230,52
80%	6,377	4,777	0,800	230,60
90%	6,491	4,853	0,801	230,63
100%	6,491	4,854	0,801	230,63
Cos phi=1 no reactive power supply				
Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	0,809	0,086	0,994	230,11
20%	1,577	0,072	0,999	230,20
30%	2,385	0,039	0,999	230,30
40%	3,198	0,012	0,999	230,35
50%	3,995	0,102	0,999	230,42
60%	4,807	0,058	0,999	230,48
70%	5,602	0,022	0,999	230,57
80%	6,403	-0,007	0,999	230,62
90%	7,211	-0,031	0,999	230,66
100%	8,002	-0,065	0,999	230,71

Assessment criterion:

The power factor resulting in each of the measurement points between 20 % and 90 % of the nominal power is equal to or lower than 0,90 both in over excited and under excited operation,

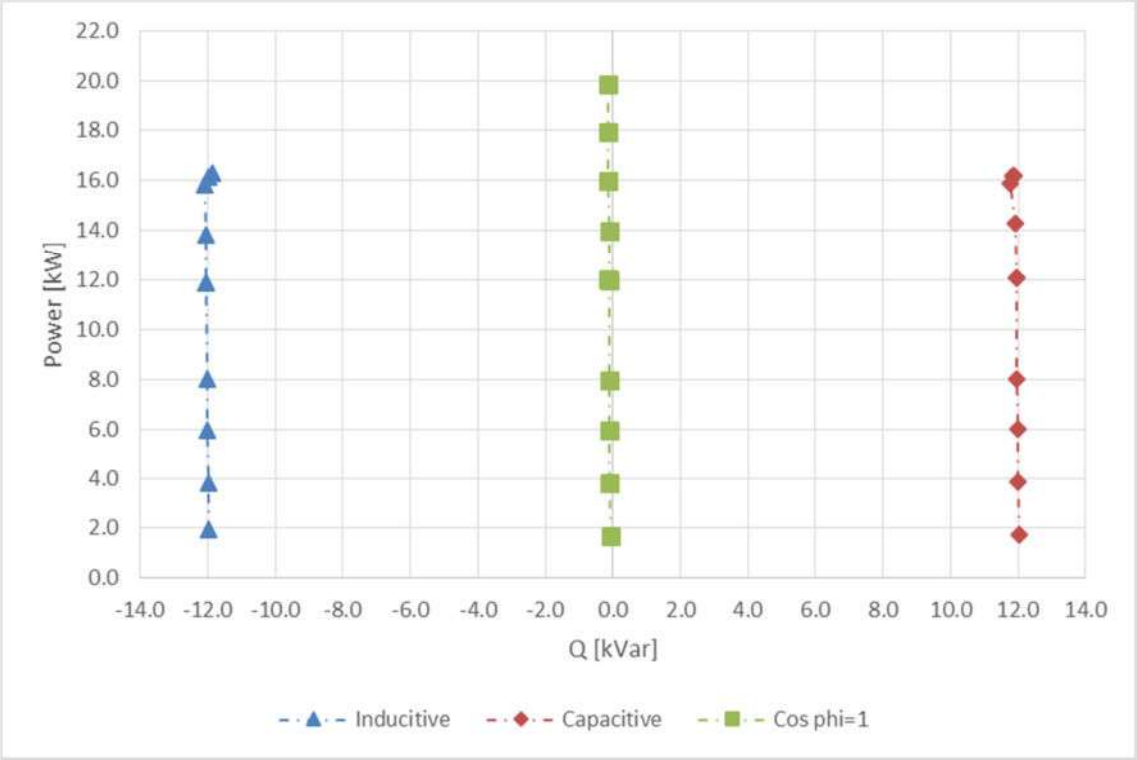
The test method refer to clause CEI0-21 / EN 50438:2013, Annex D,3,4,2,1,

Generating plants must meet the reactive power requirement regardless of the number of feeding phases under normal steady-state operating conditions in the voltage tolerance band +10%U_n and -15%U_n.

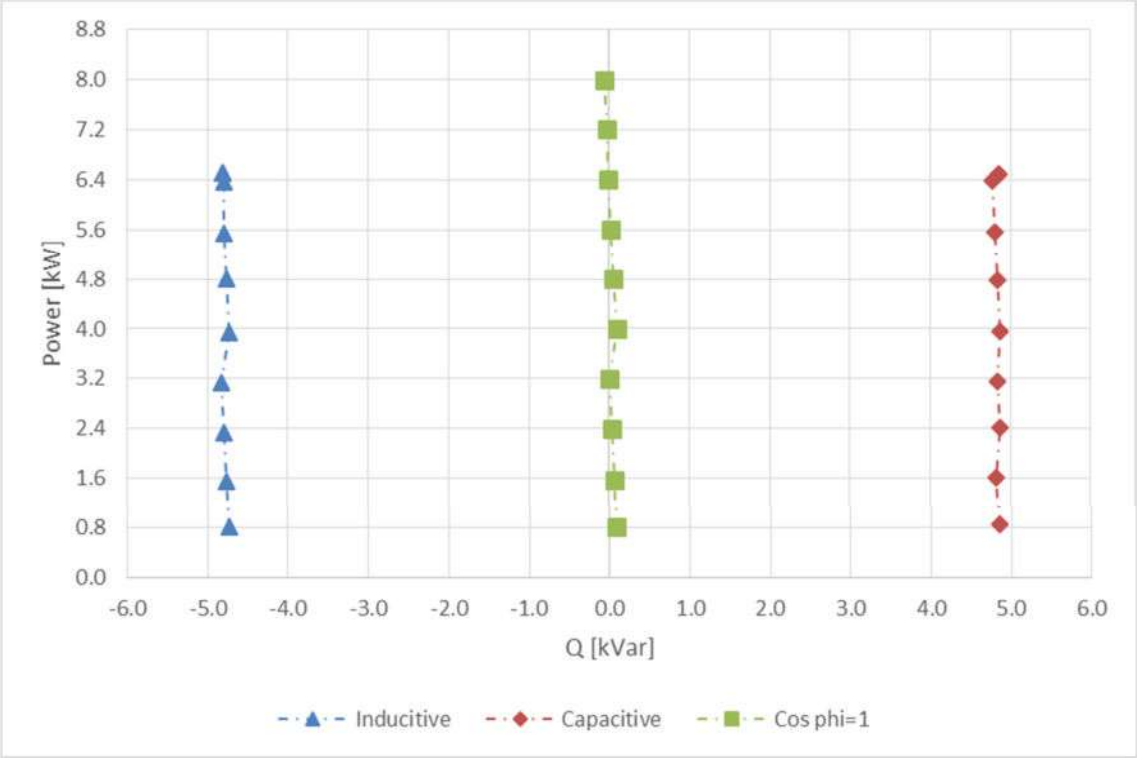
The tests had been performed on the ASW8K-LT-G2 and ASW20K-LT-G2 are valid for the ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and

just power derated by software.

Diagram



ASW20K-LT-G2



ASW8K-LT-G2

4.7.2.2 Capabilities Q Response time	P

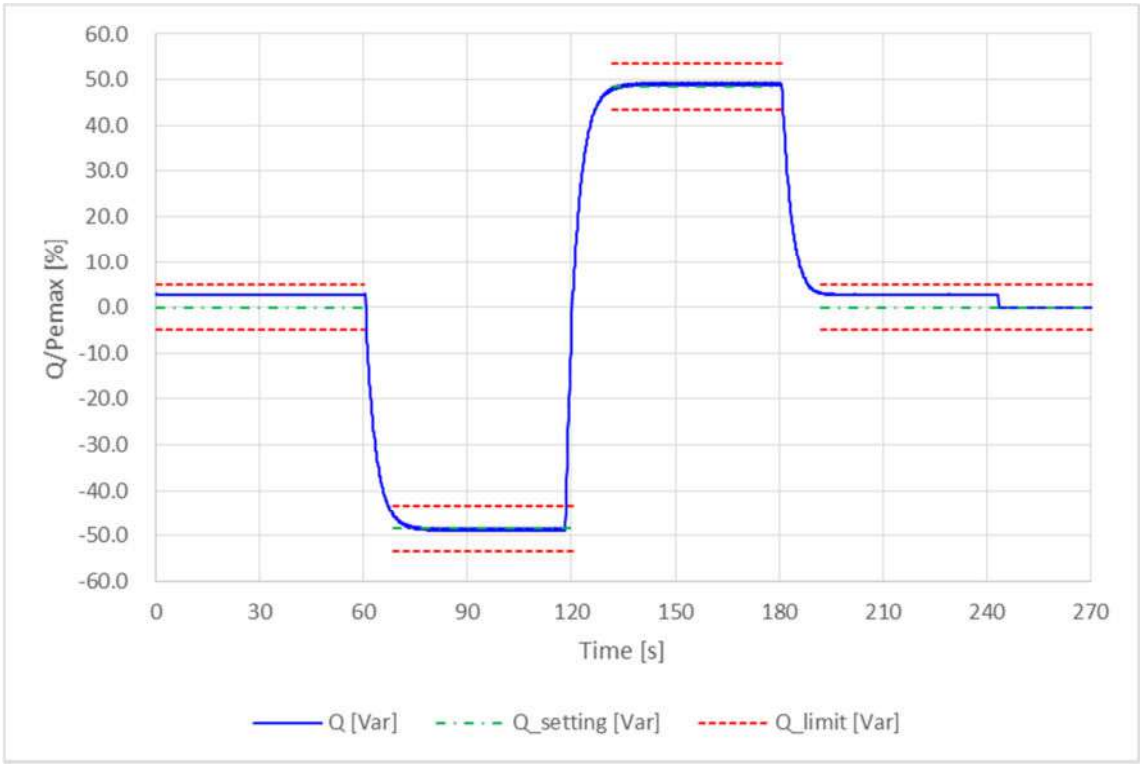
Reaction time

Test result: ASW20K-LT-G2

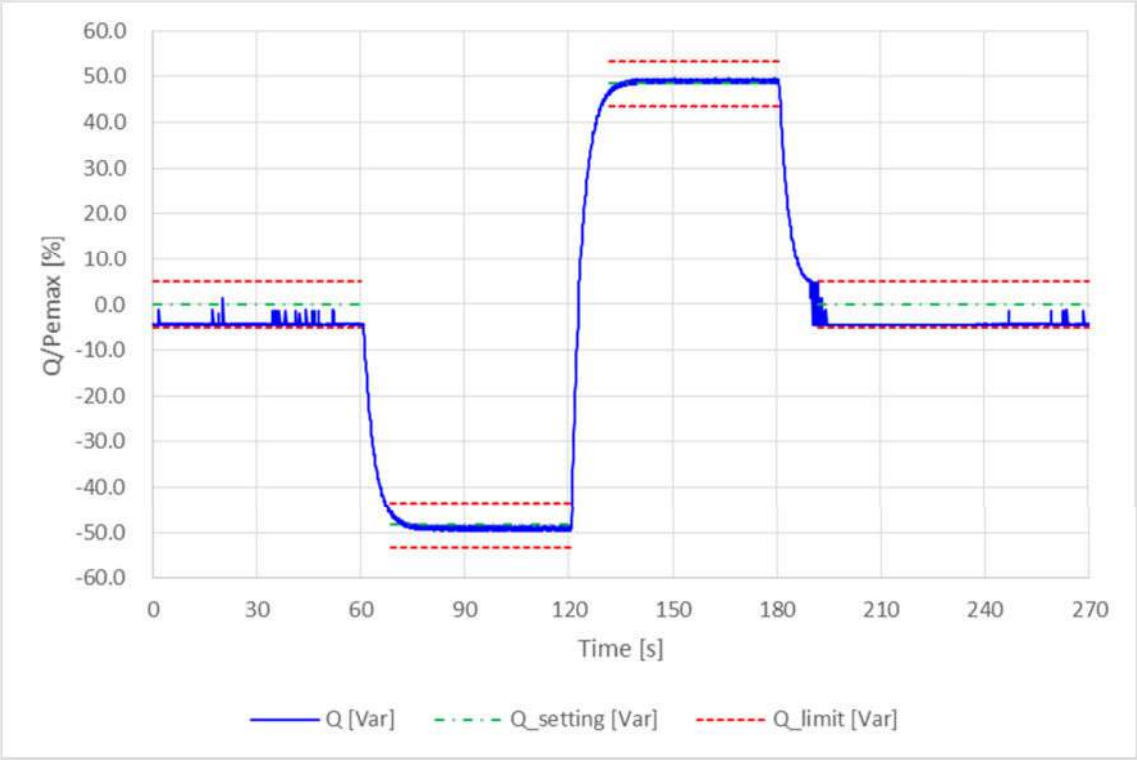
		Time	Result
1.	Reaction time Q=0 to Qmin (50% test)	6,2	P
2.	Reaction time Qmin to Qmax (50% test)	8,4	P
3.	Reaction time Qmax to Q=0 (50% test)	7,2	P
4.	Reaction time Q=0 to Qmin (100% test)	6,1	P
5.	Reaction time Qmin to Qmax (100% test)	8,6	P
6.	Reaction time Qmax to Q=0 (100% test)	9,1	P

Test result:

Graph 50%Pn



Graph 100%Pn



Assessment criterion:

DC source should be set to 50%(test1) and 100%(test2) output power micro-generator.

Starting with Q=0 then Qmin≤ -0,4843 Pn to to Qmax≥ 0,4843 Pn, and then back to Q=0 in doing so each point must be kept for at least 2 minute.

The total tolerance is ΔQ ≤ ±5,0% of Pn or Δcosφ ≤ ±0,01

The maximum response time is 10s.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.7.2.2 Capabilities **4.7.2.3.3 Voltage related control modes (Q (U) controls)** The validation of the Q (U) regulation according to VDE-AR-N 4105: 2018-05, 5.7.2.4 is divided into two partial tests, so that on the one hand the accuracy and on the other hand the dynamics of the Q (U) control is checked. For all inverter-coupled systems, only the inverter must be tested.	**P**

Test result:ASW8K-LT-G2

Test of the reactive power-voltage characteristic Q (U) — **P**

Vac [% U_n] Set point	Vac_L1 [V] measured	Vac_L2 [V] measured	Vac_L3 [V] measured	P [kW] measured	Q [kVar] measured	Q [kVar] expected	ΔQ [% P_{Emax}]
100	230,34	230,33	231,42	8,002	-0,281	0	-3,51
99	228,03	228,02	229,17	8,003	-0,280	0	-3,50
98	225,72	225,72	226,88	8,003	-0,280	0	-3,50
97	223,41	223,43	224,57	8,000	-0,229	0	-2,86
96	220,35	220,35	221,50	7,991	1,230	1,20	0,38
95	218,36	218,34	219,48	7,785	2,226	2,40	-2,17
94	216,02	216,04	217,11	7,359	3,379	3,60	-2,76
93	213,29	213,31	214,33	6,745	4,491	4,80	-3,86
92	211,30	211,31	212,33	6,743	4,496	4,80	-3,80
91	209,31	209,31	210,36	6,743	4,495	4,80	-3,81
90	207,30	207,32	208,38	6,743	4,494	4,80	-3,82
91	209,33	209,32	210,37	6,743	4,495	4,80	-3,81
92	211,32	211,31	212,32	6,743	4,496	4,80	-3,80
93	213,30	213,31	214,33	6,742	4,496	4,80	-3,80
94	216,00	216,03	217,11	7,327	3,448	3,60	-1,90
95	218,35	218,33	219,49	7,769	2,282	2,40	-1,47
96	220,33	220,33	221,53	7,986	1,289	1,20	1,11
97	223,42	223,42	224,60	7,999	-0,197	0	-2,46
98	225,72	225,73	226,91	8,003	-0,280	0	-3,50
99	228,01	228,03	229,20	8,003	-0,281	0	-3,51
100	230,32	230,32	231,50	8,002	-0,283	0	-3,54
101	232,62	232,62	233,79	8,014	-0,281	0	-3,51
102	234,92	234,92	236,10	8,012	-0,285	0	-3,56
103	237,22	237,22	238,39	8,014	-0,289	0	-3,61
104	239,51	239,50	240,67	8,088	-1,254	-1,20	-0,68
105	241,77	241,77	242,90	8,090	-2,336	-2,40	0,80
106	244,06	244,07	245,13	8,089	-3,412	-3,60	2,35

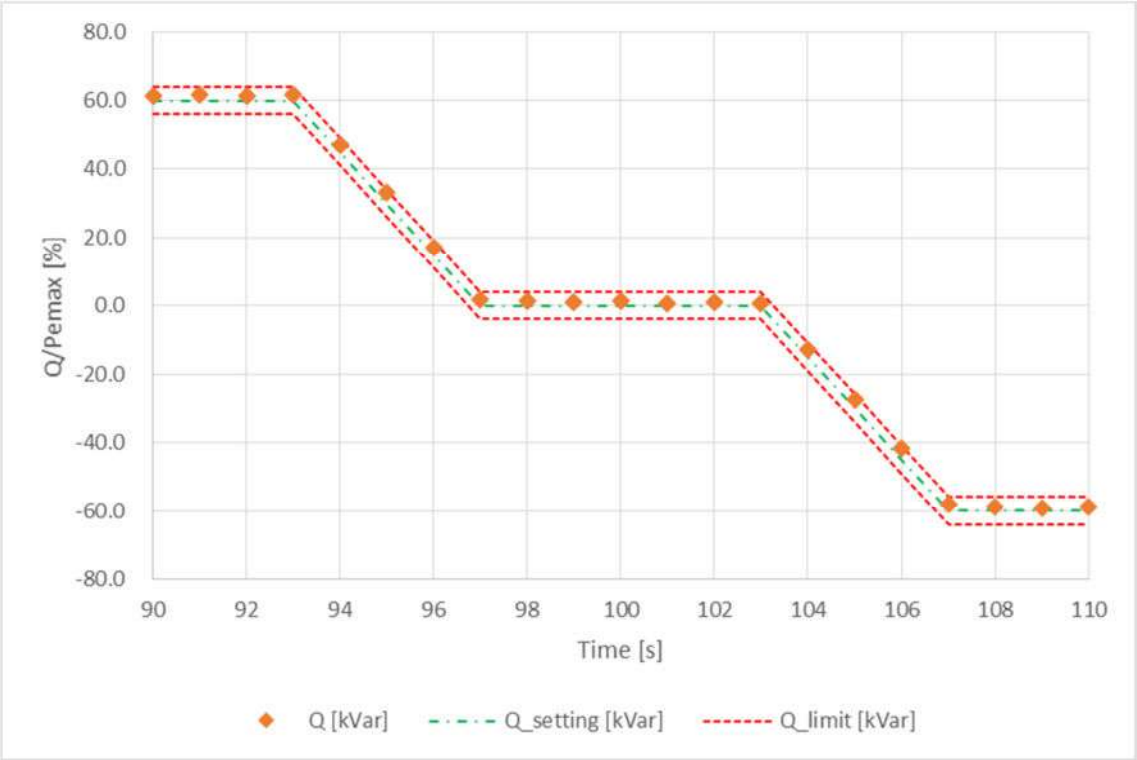
107	246,34	246,34	247,33	8,087	-4,481	-4,80	3,99
108	248,62	248,65	249,60	8,087	-4,843	-4,80	-0,54
109	250,92	250,96	251,90	8,087	-4,848	-4,80	-0,60
110	253,21	253,24	254,15	8,087	-4,851	-4,80	-0,64
109	250,92	250,95	251,84	8,086	-4,847	-4,80	-0,59
108	248,65	248,65	249,55	8,086	-4,843	-4,80	-0,54
107	246,35	246,36	247,30	8,086	-4,547	-4,80	3,16
106	244,07	244,10	245,14	8,087	-3,528	-3,60	0,90
105	241,77	241,82	242,93	8,089	-2,455	-2,40	-0,69
104	239,49	239,52	240,68	8,091	-1,365	-1,20	-2,06
103	237,21	237,22	238,39	8,014	-0,289	0	-3,61
102	234,91	234,91	236,11	8,010	-0,287	0	-3,59
101	232,61	232,63	233,78	8,014	-0,283	0	-3,54
100	230,32	230,32	231,48	8,009	-0,280	0	-3,50
Limit ΔQ:	± 4% P_{Emax}						

Test result:ASW20K-LT-G2

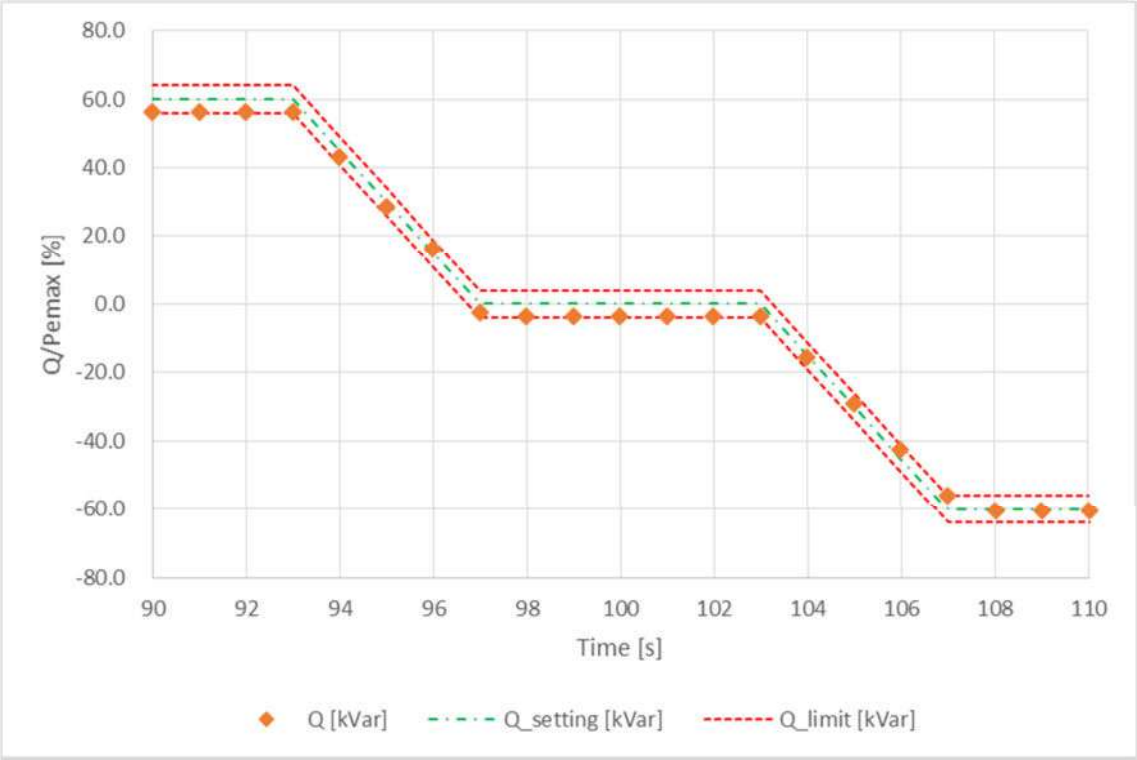
Test of the reactive power-voltage characteristic Q (U)							**P**
Vac [% U_n] Set point	Vac_L1 [V] measured	Vac_L2 [V] measured	Vac_L3 [V] measured	P [kW] measured	Q [kVar] measured	Q [kVar] expected	ΔQ [% P_{Emax}]
100	231,42	231,45	231,35	19,918	-0,292	0	-1,460
99	228,43	228,48	228,37	19,905	-0,264	0	-1,320
98	226,46	226,49	226,39	19,920	-0,263	0	-1,315
97	224,48	224,51	224,41	19,889	-0,298	0	-1,490
96	221,90	221,94	221,84	19,685	-3,527	-3,00	-2,635
95	219,78	219,82	219,72	19,006	-6,527	-6,00	-2,635
94	217,29	217,33	217,25	17,581	-9,733	-9,00	-3,665
93	214,81	214,85	214,79	16,047	-12,247	-12,00	-1,235
92	212,54	212,56	212,50	16,039	-12,280	-12,00	-1,400
91	210,26	210,28	210,21	16,020	-12,339	-12,00	-1,695
90	207,95	207,97	207,90	15,717	-12,289	-12,00	-1,445
91	210,24	210,26	210,19	15,814	-12,311	-12,00	-1,555
92	212,52	212,55	212,48	15,832	-12,296	-12,00	-1,480
93	214,82	214,85	214,78	16,033	-12,315	-12,00	-1,575
94	217,31	217,34	217,26	17,621	-9,404	-9,00	-2,020
95	219,79	219,80	219,71	18,842	-6,679	-6,00	-3,395

96	222,24	222,24	222,14	19,722	-3,416	-3,00	-2,080
97	224,61	224,61	224,51	19,900	-0,342	0	-1,710
98	226,88	226,90	226,79	19,947	-0,302	0	-1,510
99	228,45	228,48	228,38	19,955	-0,237	0	-1,185
100	231,37	231,45	231,35	19,968	-0,271	0	-1,355
101	233,65	233,71	233,63	19,971	-0,167	0	-0,835
102	235,93	235,98	235,91	19,958	-0,208	0	-1,040
103	238,22	238,26	238,20	19,949	-0,166	0	-0,830
104	240,56	240,59	240,53	19,837	2,584	3,00	-2,080
105	242,86	242,87	242,81	19,142	5,513	6,00	-2,435
106	245,10	245,11	245,06	18,156	8,294	9,00	-3,530
107	247,29	247,32	247,27	16,147	11,619	12,00	-1,905
108	249,57	249,58	249,52	16,196	11,773	12,00	-1,135
109	251,85	251,86	251,81	16,194	11,835	12,00	-0,825
110	254,12	254,14	254,08	16,190	11,792	12,00	-1,040
109	251,84	251,87	251,80	16,197	11,815	12,00	-0,925
108	249,57	249,60	249,52	16,194	11,805	12,00	-0,975
107	247,29	247,32	247,27	16,147	11,619	12,00	-1,905
106	245,12	245,15	245,04	18,045	8,497	9,00	-2,515
105	242,88	242,91	242,80	19,138	5,634	6,00	-1,830
104	240,59	240,62	240,50	19,725	2,792	3,00	-1,040
103	238,27	238,30	238,17	19,989	-0,159	0	-0,795
102	235,96	236,01	235,89	19,895	-0,203	0	-1,015
101	233,67	233,74	233,61	19,930	-0,264	0	-1,320
100	231,40	231,46	231,33	19,863	-0,240	0	-1,200
Limit ΔQ:	± 4% P_{Emax}						

Graph of characteristic Q (U):



ASW20K-LT-G2



ASW8K-LT-G2

Test:

The verification of the accuracy of the Q (U) control of the reactive power-voltage characteristic Un shown in VDE-AR-N 4105: 2018-11, 5.7.2.4, Figure 7 is effected by a slow variation of the line voltage U_n in the range 90% U_n to 110% U_n. Depending on the type of EZE (single- or three-phase), the voltage changes must be carried out simultaneously or symmetrically on all phases.

a) In order to check the stationary accuracy, the permissible voltage range shall be passed through within steps, with a step size of 1% U_n, but not greater than 2% U_n.
   1. Pass the voltage range from 100% U_n down to the under voltage range to 90% U_n.
   2. Pass the voltage range from 90% U_n up to the over voltage range to 110% U_n.
   3. Pass the voltage range from 110% U_n down to the Nominal Voltage U_n.

The procedure is analogous to Figure 3 in Section 5.4.3.2.

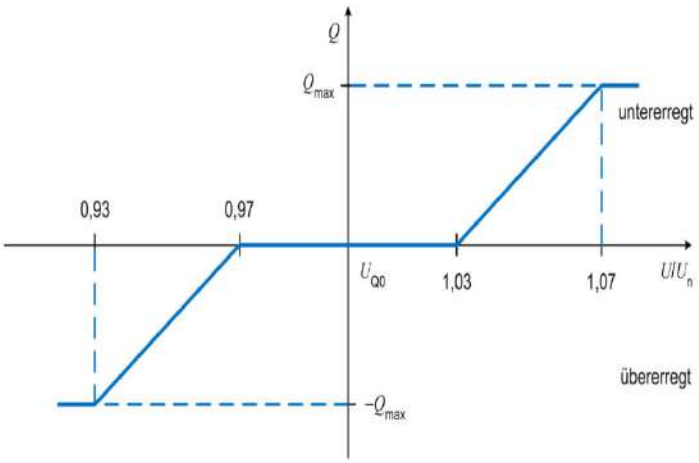


Bild 7 – Standard-$Q(U)$-Kennlinie

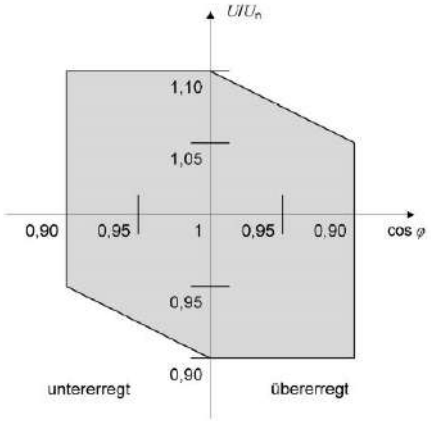


Bild 3 – Anforderungen an Erzeugungseinheiten bezüglich der Blindleistungsbereitstellung an den Generatorklemmen
$(\sum S_{Emax} > 4{,}6\,\text{kVA})$

The voltages are to be set with a maximum deviation of 0.25% U_n.

Assessment criterion:

In order to pass the Q (U) accuracy test, the measured stationary value pairs U_{PGU} and Q_{PGU}, under taking account to the correct sign in the consumer metering system, must be within VDE-AR-N 4105: 2018-11, in 5.7.2.4, Figure 7 Q (U) shown characteristic. The stationary value pairs U_{PGU} and Q_{PGU} are determined by averaging over 30 seconds at the end of the respective measuring section analogously to Chapter 5.4.3.2. The permissible deviations are with the maximum measuring error of the voltage of 1% U_n stated in VDE-AR-N 4105: 2018-11 and a setting accuracy of 4% P_{EMax} at

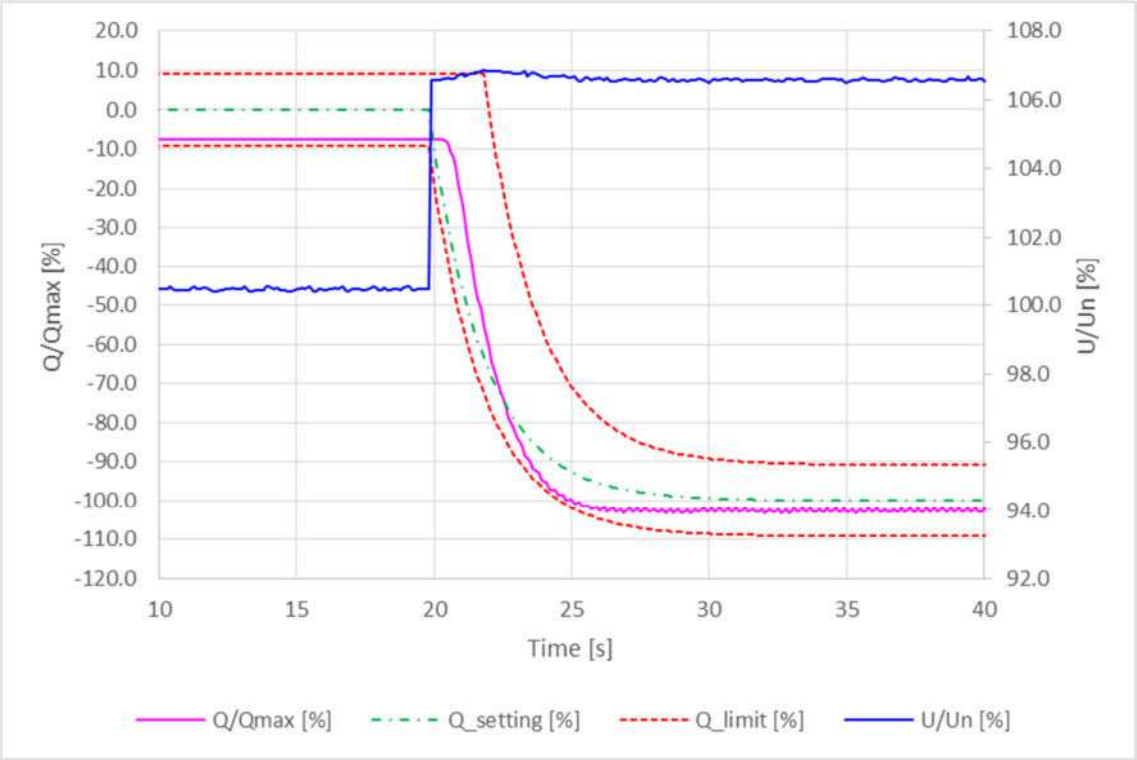
$$Q_{EZE,tol} = \pm(\,0.01 \cdot U_{N,Y} \cdot k_{QU} + 0.04 \cdot P_{EMax}) = \pm 0{,}25 \cdot P_{EMax} \cdot (\sin(\arccos(\varphi_{min})) + 0.16).$$

Note:

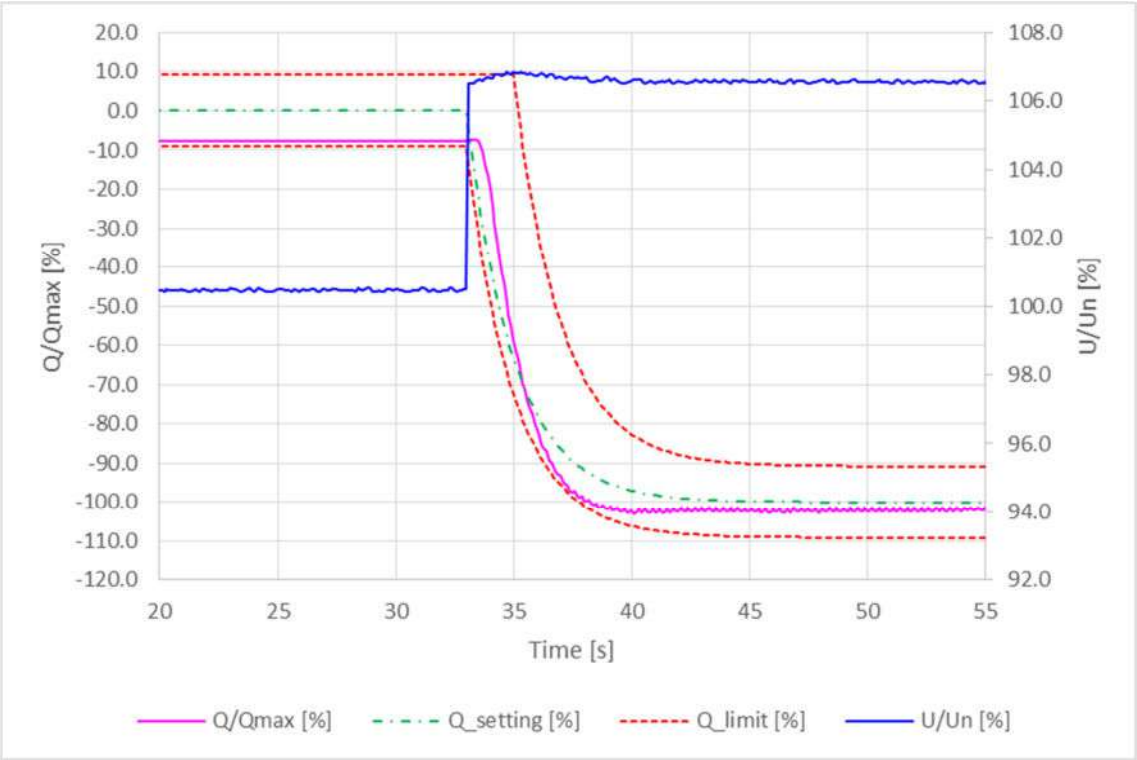
The tests had been performed on the ASW8K-LT-G2 and ASW20K-LT-G2 are valid for the ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Test of the dynamics of the Q (U) regulation			**P**
Test result: ASW20K-LT-G2			
Voltage jump Vac [% U_n]	Q [kVar] measured	Q [%Qmax] measured	T=3τmeasured
100 to 106,4	8,934	44,67	3,1 s
	8,894	44,47	2,9 s
	8,895	44,47	3,0 s
100 to 93,6	-8,805	-44,02	5,4
	-8,847	-44,23	5,6
	-8,884	-44,42	5,6

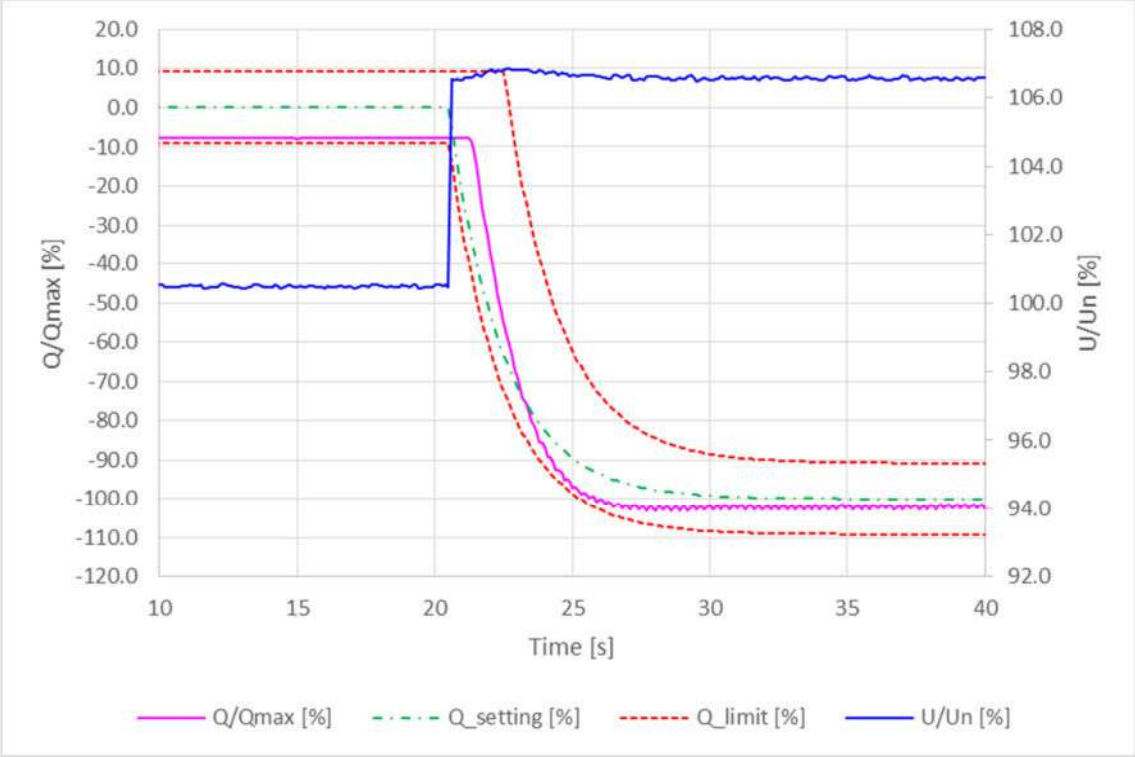
Graph of 100%U_n to 106,4% U_n: Test 1



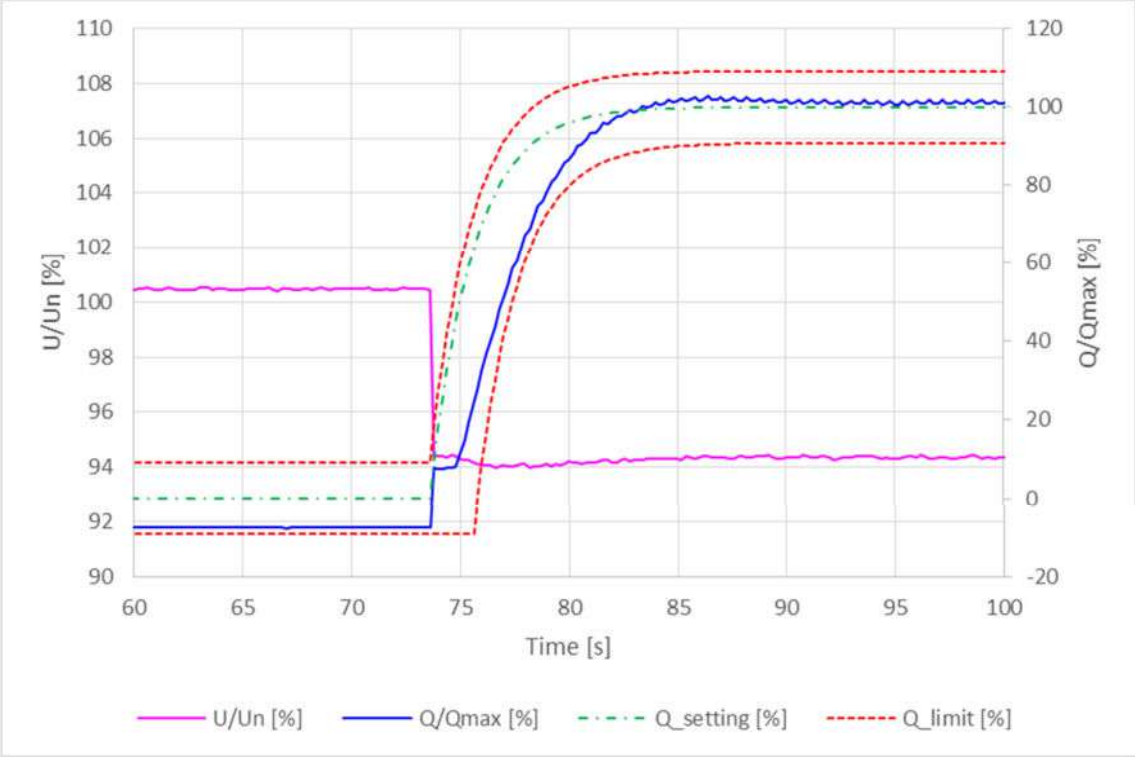
Graph of 100%U_n to 106,4% U_n: Test 2



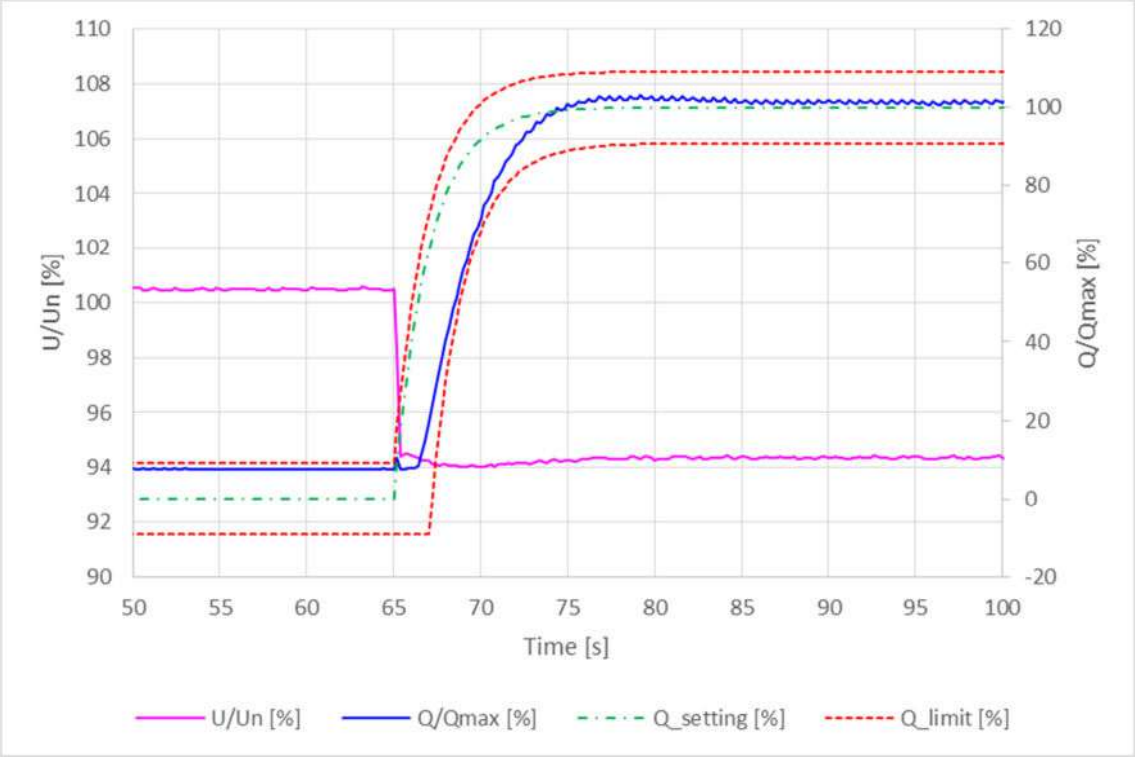
Graph of 100%U_n to 106,4% U_n: Test 3



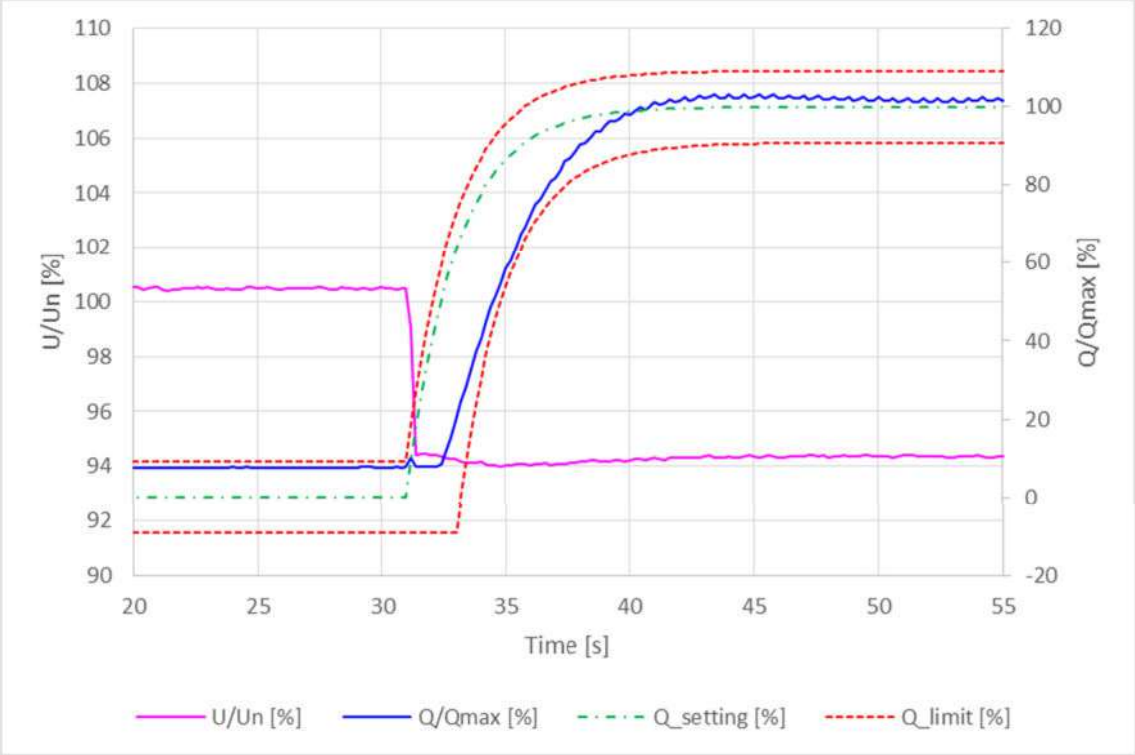
Graph of 100%U_n to 93,6% U_n: Test 1



Graph of 100%U_n to 93,6% U_n: Test 2



Graph of 100%U_n to 93,6% U_n: Test 3



4.7.2.2 Capabilities 4.7.2.3.4 Power related Control mode (cos φ (P) curve)	P

Test result: ASW8K-LT-G2

Test a):

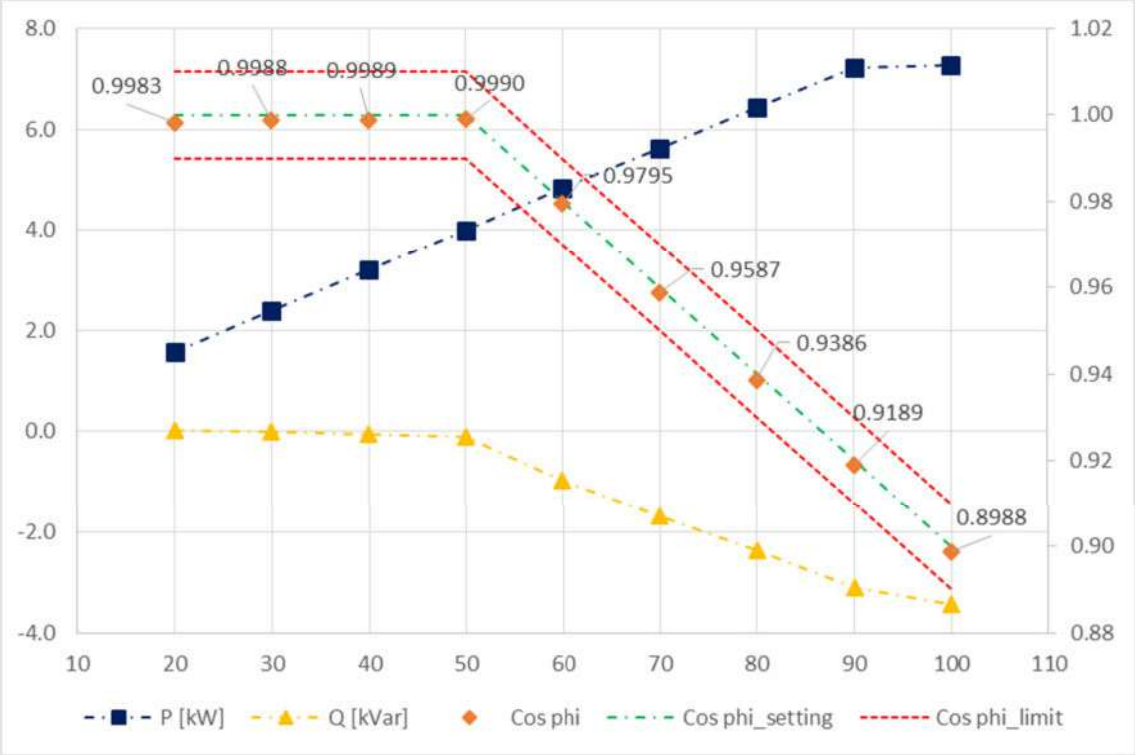
Pn/P [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	20% to 100% P_{Emax}									
U [V]:	N/A	230,15	230,24	230,31	230,39	230,49	230,57	230,67	230,72	230,65
P_{E30} [kW]:	N/A	1,578	2,390	3,198	4,003	4,825	5,627	6,424	7,212	7,269
P_{E30} of P_n [%]:	N/A	19,72	29,87	39,97	50,03	60,31	70,34	80,30	90,15	90,87
Q_{E30} [kVar]:	N/A	0,033	-0,005	-0,047	-0,113	-0,963	-1,669	-2,360	-3,096	-3,428
cos φ_{E30}:	N/A	0,998	0,999	0,999	0,999	0,979	0,959	0,939	0,919	0,899
cos $\varphi_{setpoint}$ of P_{E30}:	N/A	1,000	1,000	1,000	1,000	0,980	0,960	0,940	0,920	0,900
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0,01									

Test b):

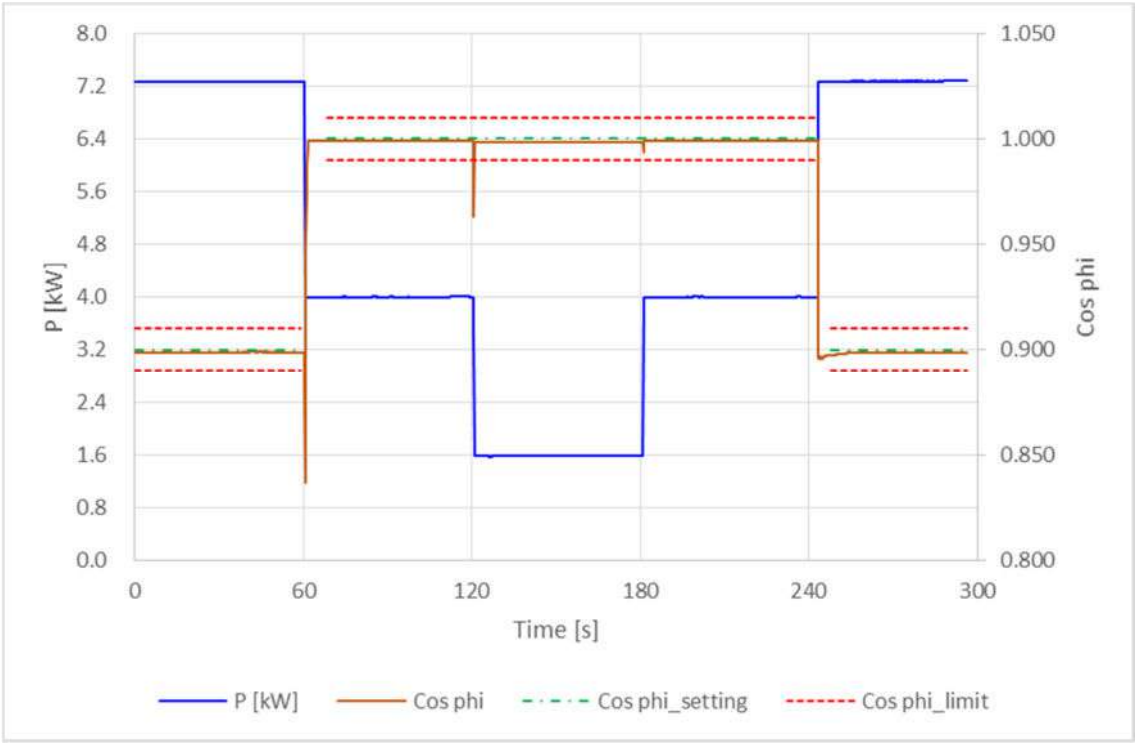
Pn/P [%]	20	50	100
30 s mean value	20% to 50% to 100% Pn		
U [V]:	230.16	230.40	230.63
P_{E30} [kW]:	1.578	4.002	7.271
P_{E30} of Pn [%]:	7.89	20.01	36.36
Q_{E30} [kVar]:	1.581	4.011	8.089
cos φ_{E30}:	0.998	0.998	0.899
cos $\varphi_{setpoint}$ of P_{E30}:	230.16	230.40	230.63
T_0[s]:	1,0 s		1,4 s
Pn/P [%]	100	50	20
30 s mean value	100% to 50% to 20% Pn		
U [V]:	230.63	230.37	230.16
P_{E30} [kW]:	7.271	4.002	1.578
P_{E30} [%]:	36.36	20.01	7.89
Q_{E30} [kVar]:	8.089	4.006	1.581
cos φ_{E30}:	0.899	0.999	0.998
cos $\varphi_{setpoint}$ of P_{E30}:	230.63	230.37	230.16
T_0 [s]:	1,6 s		1,0 s
Limit T_0 [s]:	10 s		
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0,02		

Test result:

Graph of cos φ(P): Test a)



Graph of setting (T_0) time: Test b): 100% to 50% to 20% to 50% to 100%Pn

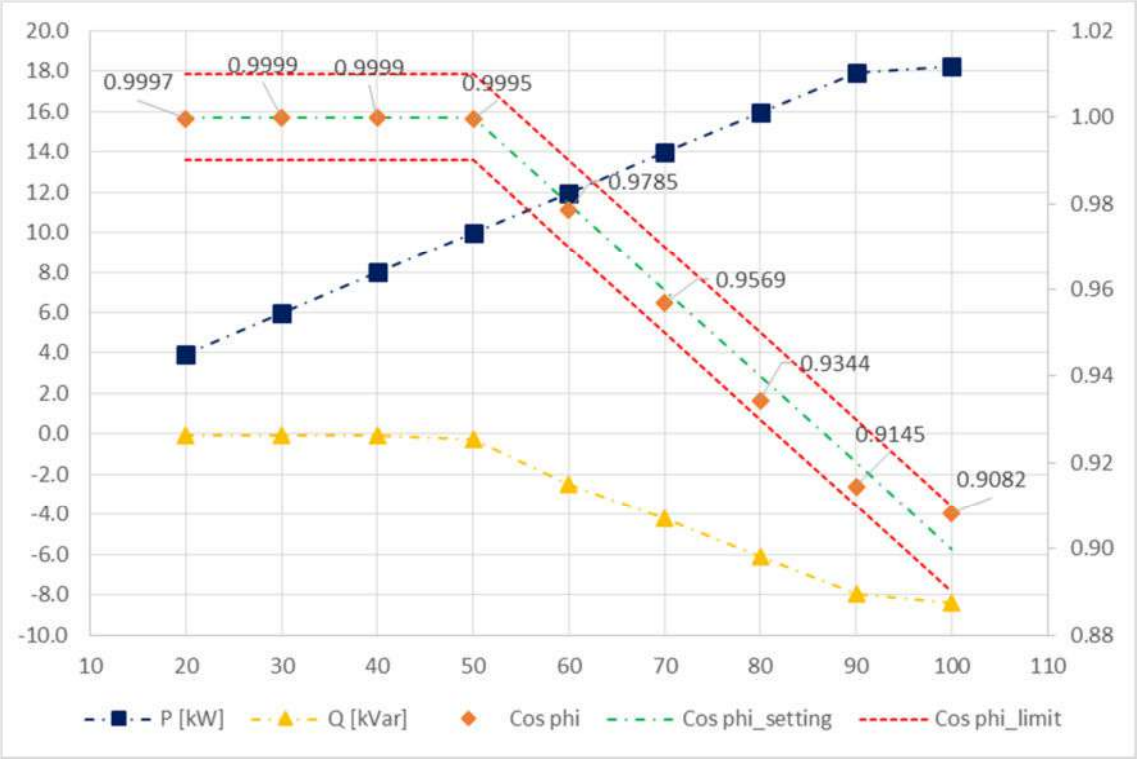


Test result: ASW20K-LT-G2										
Test a):										
Pn/P [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	20% to 100% P_{Emax}									
U [V]:	N/A	230,26	230,44	230,62	230,78	230,88	231,02	231,17	231,32	231,34
P_{E30} [kW]:	N/A	3,908	5,962	7,998	9,991	11,971	13,987	15,984	17,944	18,223
P_{E30} of P_n [%]:	N/A	19,54	29,81	39,99	49,95	59,85	69,94	79,92	89,72	91,12
Q_{E30} [kVar]:	N/A	-0,088	-0,063	-0,072	-0,288	-2,505	-4,239	-6,088	-7,933	-8,396
cos φ_{E30}:	N/A	0,9997	0,9999	0,9999	0,9995	0,9785	0,9569	0,9344	0,9145	0,9082
cos $\varphi_{setpoint}$ of P_{E30}:	N/A	1,000	1,000	1,000	1,000	0,980	0,960	0,940	0,920	0,900
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0,01									

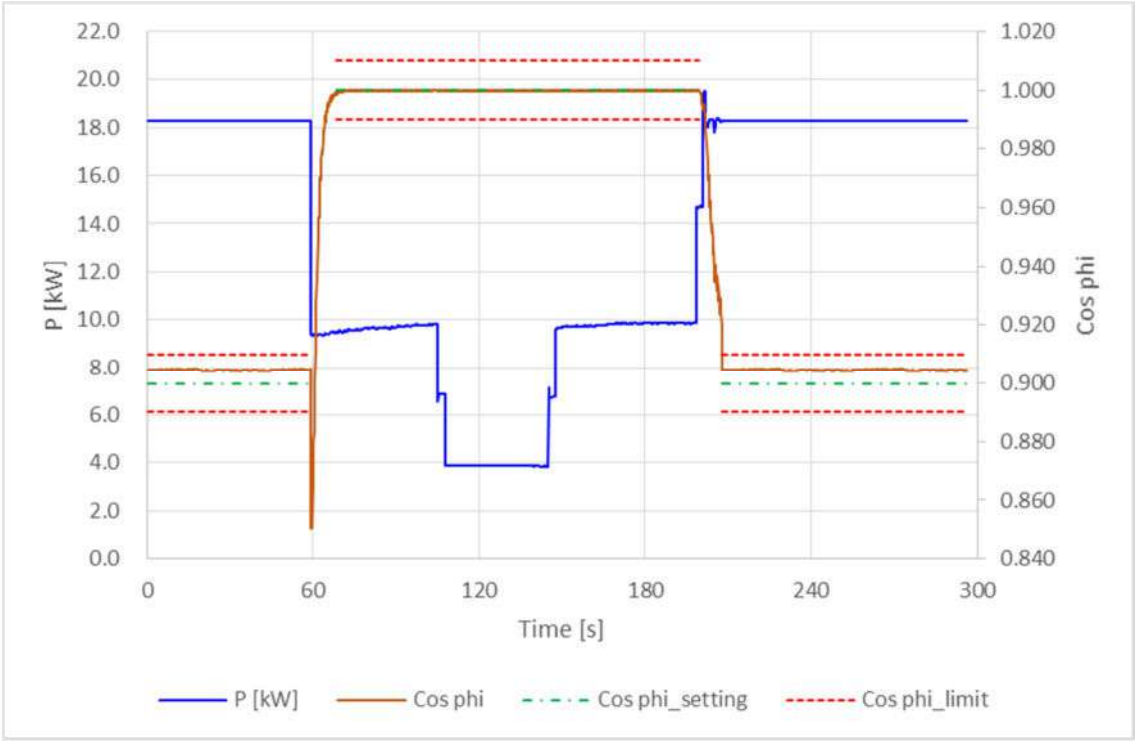
Test b):						
Pn/P [%]	20		50		100	
30 s mean value	20% to 50% to 100% Pn					
U [V]:	230,24		230,77		231,37	
P_{E30} [kW]:	3,877		9,767		18,290	
P_{E30} of Pn [%]:	19,39		48,83		91,45	
Q_{E30} [kVar]:	3,878		9,767		20,218	
cos φ_{E30}:	0,9998		0,9999		0,9046	
cos $\varphi_{setpoint}$ of P_{E30}:	1,00		1,00		0,90	
T_0[s]:	1,0			5,8 s		
Pn/P [%]	100		50		20	
30 s mean value	100% to 50% to 20% Pn					
U [V]:	231.37		230.76		230.24	
P_{E30} [kW]:	18.290		9.819		3.877	
P_{E30} [%]:	91.45		49.09		19.39	
Q_{E30} [kVar]:	20.218		9.820		3.878	
cos φ_{E30}:	0.9046		0.9999		0.9998	
cos $\varphi_{setpoint}$ of P_{E30}:	0,90		1,00		1,00	
T_0 [s]:	1,0			5,0 s		
Limit T_0 [s]:	10 s					
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0,02					

Test result:

Graph of cos φ(P): Test a)



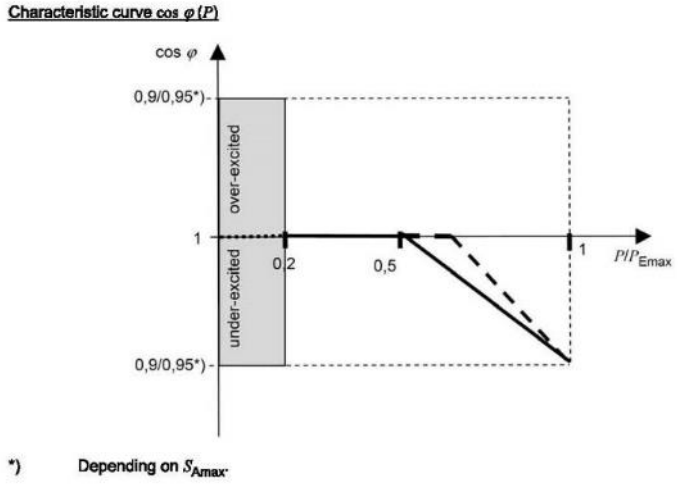
Graph of setting (T_0) time: Test b): 100% to 50% to 20% to 50% to 100%Pn



Test:

Test 1: Using the standard characteristic curve increases the active power from 20% Pn in increments of 10% Pn to P_{Emax}, The test is carried out in reverse.

Test 2: Using the standard characteristic curve increases the active power from 20% P_{Emax} to 50% P_{Emax} and to P_{Emax}, The test is carried out in reverse, After the PGU has settled, the end value reached is determined as a 30 s mean value.



Assessment criterion:

Test 1: cos φ accuracy cos φ (±0,01)

Test 2: cos φ accuracy cos φ (±0,02)

For the test to be passed, the cos φ setpoint from the active power must be measured at the terminals of the PGU within a settling time of 10 s.

Note:

The test method refer to clause 5,3,6,4 of VDE V 0124-100:2012-07.

The tests had been performed on the ASW8K-LT-G2 and ASW20K-LT-G2 are valid for the ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.7.3	Voltage related active power reduction (P(U) function)	P
Test result:		
5-min mean value / P/ P_n [%]	100% to 20%	
Settling time [s]:	300	
P_{E60} [%]:	19,6%	
$\Delta P_{E60}/P_{Setpoint}$ [%]:	20 % or less of P_{Emax}	
Limit settling time:	600s	

Test:

a) Set the voltage to 2% Vn lower than the activation threshold stated by the manufacturer.

b) Set the voltage to 112%Vn, The inverter now has to reduce its output power to value lower than 20%Pn within 5min.

c) Set the voltage back to 2%Vn lower than the activation threshold, Check that the active power will return to the value consistent with the power available from the primary source or simulated.

Assessment criterion:

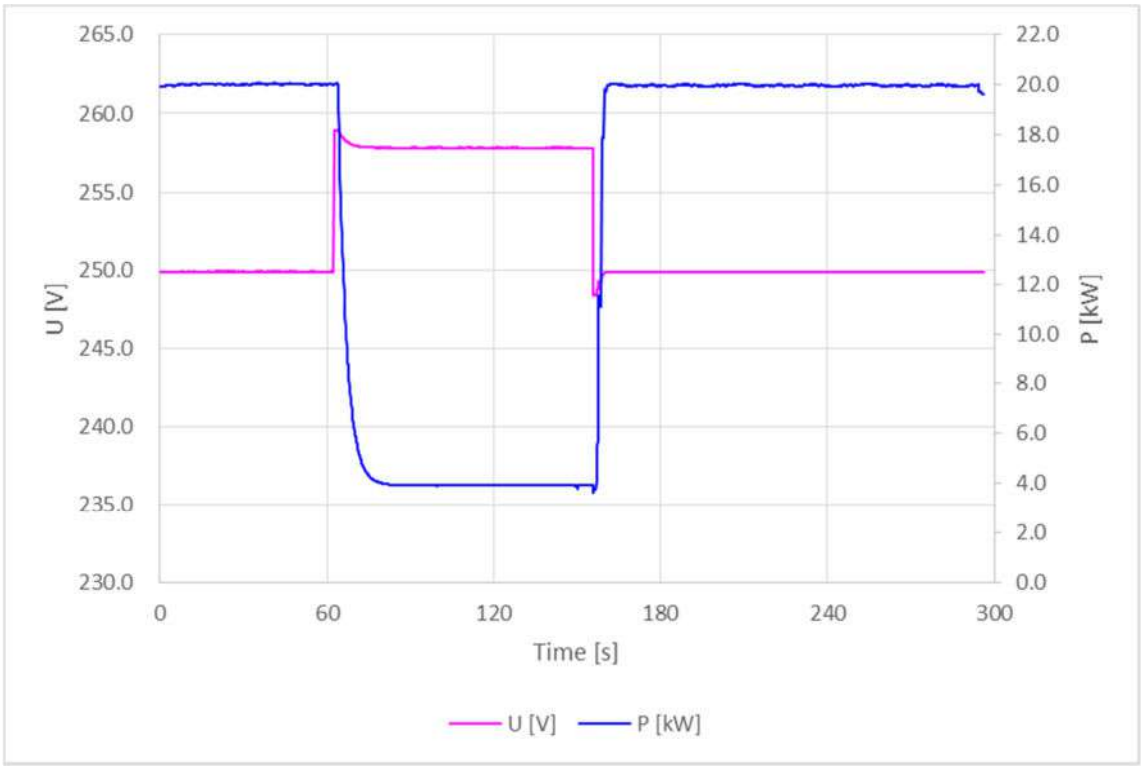
for adjustable PGUs:

- no network disconnection
- the active power value does not exceed the setpoint of 20% P_{Emax}
- the setting time determind is equal or less than 600s

Note:

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Graph:


265.0
260.0
255.0
250.0
245.0
240.0
235.0
230.0
U [V]
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
P [kW]
0
60
120
180
240
300
Time [s]
U [V]
P [kW]

EN 50549-1:2019: Power quality			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.8	EMC and power quality	--	**P**
	Harmonic current emission	EN 61000-3-2, EN 61000-3-12	**P**
	Harmonic current emission	EN 61000-4-7	**P**
	Switching operations	IEC 61400-21	**P**
	Voltage fluctuation and flicker	EN 61000-3-3, EN 61000-3-11	**P**
	Flicker and voltage fluctuations	IEC 61400-21	**P**
	DC injection	EN 50438, Annex D,3,10	**P**
	Immunity to voltage dips and short interruptions	G59/3-4:2018-05, clause 13.8.4.5	**P**
	Unbalance	BDEW TG3, Revision 25, clause 4.3.5	**P**

4.8	EMC and power quality Harmonic current emission (EN 61000-3-2)	P

Test result: ASW8K-LT-G2

Watts [KW]	2,696	2,663	2,680
Vrms [V]	222,00	221,00	220,78
Arms [A]	12,115	12,100	12,196
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	2,542	2,571	2,587

Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [A]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	12,127	12,070	12,146	--	--	--	Three Phase	--
2nd	0,039	0,051	0,045	0,320	0,422	0,370	Three Phase	1,080
3rd	0,028	0,030	0,030	0,234	0,248	0,246	Three Phase	2,300
4th	0,087	0,085	0,090	0,719	0,702	0,742	Three Phase	0,430
5th	0,021	0,028	0,024	0,176	0,229	0,201	Three Phase	1,140
6th	0,034	0,034	0,036	0,280	0,280	0,298	Three Phase	0,300
7th	0,026	0,026	0,029	0,212	0,216	0,236	Three Phase	0,770
8th	0,037	0,033	0,038	0,306	0,274	0,309	Three Phase	0,263
9th	0,043	0,047	0,046	0,356	0,388	0,375	Three Phase	0,400
10th	0,056	0,057	0,067	0,463	0,468	0,551	Three Phase	0,184
11th	0,064	0,062	0,060	0,526	0,513	0,495	Three Phase	0,330
12th	0,049	0,057	0,055	0,403	0,473	0,452	Three Phase	0,153
13th	0,188	0,179	0,184	1,548	1,485	1,519	Three Phase	0,210
14th	0,048	0,050	0,055	0,395	0,416	0,453	Three Phase	0,131
15th	0,037	0,041	0,035	0,307	0,342	0,292	Three Phase	0,150
16th	0,038	0,041	0,040	0,313	0,340	0,325	Three Phase	0,115
17th	0,121	0,130	0,127	0,994	1,077	1,050	Three Phase	0,132
18th	0,024	0,025	0,026	0,202	0,209	0,214	Three Phase	0,102
19th	0,042	0,045	0,037	0,347	0,369	0,301	Three Phase	0,188
20th	0,036	0,033	0,039	0,301	0,276	0,318	Three Phase	0,092
21th	0,019	0,018	0,017	0,156	0,152	0,143	Three Phase	0,107
22th	0,031	0,032	0,035	0,254	0,263	0,286	Three Phase	0,084
23th	0,063	0,055	0,062	0,519	0,457	0,507	Three Phase	0,098
24th	0,009	0,009	0,009	0,070	0,074	0,072	Three Phase	0,077
25th	0,050	0,048	0,042	0,408	0,399	0,346	Three Phase	0,090
26th	0,011	0,014	0,015	0,091	0,112	0,120	Three Phase	0,071
27th	0,016	0,018	0,017	0,132	0,150	0,137	Three Phase	0,080
28th	0,009	0,009	0,010	0,078	0,074	0,079	Three Phase	0,066
29th	0,028	0,033	0,033	0,228	0,270	0,272	Three Phase	0,078
30th	0,007	0,007	0,006	0,055	0,055	0,049	Three Phase	0,061
31th	0,024	0,027	0,022	0,202	0,223	0,181	Three Phase	0,073
32th	0,013	0,013	0,014	0,110	0,106	0,115	Three Phase	0,057
33th	0,013	0,011	0,011	0,107	0,094	0,090	Three Phase	0,068
34th	0,016	0,016	0,017	0,130	0,134	0,138	Three Phase	0,054
35th	0,022	0,021	0,019	0,183	0,171	0,156	Three Phase	0,064
36th	0,005	0,005	0,005	0,045	0,040	0,041	Three Phase	0,051
37th	0,020	0,019	0,017	0,163	0,161	0,144	Three Phase	0,061
38th	0,008	0,008	0,006	0,065	0,066	0,051	Three Phase	0,048
39th	0,009	0,010	0,009	0,078	0,086	0,076	Three Phase	0,058
40th	0,007	0,006	0,006	0,055	0,053	0,046	Three Phase	0,046

4.8	EMC and power quality Harmonic current emission (EN 61000-3-2)	P

Test result: ASW10K-LT-G2

Watts [KW]	3,377	3,350	3,363
Vrms [V]	222,00	221,00	221,00
Arms [A]	15,209	15,200	15,282
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	2,207	2,257	2,188

Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [A]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	15,226	15,183	15,261	--	--	--	Three Phase	--
2nd	0,054	0,064	0,045	0,356	0,423	0,292	Three Phase	1,080
3rd	0,030	0,031	0,030	0,200	0,205	0,194	Three Phase	2,300
4th	0,091	0,091	0,092	0,594	0,597	0,606	Three Phase	0,430
5th	0,023	0,028	0,029	0,151	0,185	0,187	Three Phase	1,140
6th	0,034	0,033	0,033	0,226	0,218	0,214	Three Phase	0,300
7th	0,024	0,028	0,031	0,156	0,182	0,201	Three Phase	0,770
8th	0,047	0,039	0,041	0,306	0,256	0,268	Three Phase	0,263
9th	0,048	0,049	0,041	0,314	0,320	0,270	Three Phase	0,400
10th	0,071	0,059	0,054	0,468	0,390	0,352	Three Phase	0,184
11th	0,086	0,080	0,087	0,567	0,525	0,568	Three Phase	0,330
12th	0,049	0,048	0,046	0,319	0,315	0,303	Three Phase	0,153
13th	0,189	0,202	0,196	1,238	1,332	1,282	Three Phase	0,210
14th	0,052	0,054	0,040	0,343	0,353	0,262	Three Phase	0,131
15th	0,038	0,038	0,038	0,250	0,249	0,247	Three Phase	0,150
16th	0,036	0,038	0,040	0,239	0,250	0,259	Three Phase	0,115
17th	0,112	0,116	0,120	0,737	0,763	0,787	Three Phase	0,132
18th	0,030	0,033	0,031	0,196	0,220	0,204	Three Phase	0,102
19th	0,072	0,065	0,066	0,473	0,429	0,432	Three Phase	0,188
20th	0,036	0,034	0,038	0,239	0,222	0,250	Three Phase	0,092
21th	0,022	0,023	0,023	0,142	0,154	0,150	Three Phase	0,107
22th	0,050	0,048	0,045	0,331	0,317	0,295	Three Phase	0,084
23th	0,082	0,087	0,079	0,536	0,572	0,518	Three Phase	0,098
24th	0,010	0,009	0,010	0,064	0,059	0,065	Three Phase	0,077
25th	0,048	0,055	0,052	0,314	0,359	0,340	Three Phase	0,090
26th	0,013	0,012	0,011	0,086	0,081	0,069	Three Phase	0,071
27th	0,019	0,018	0,017	0,127	0,122	0,114	Three Phase	0,080
28th	0,010	0,012	0,011	0,068	0,077	0,069	Three Phase	0,066
29th	0,037	0,031	0,042	0,246	0,206	0,273	Three Phase	0,078
30th	0,008	0,008	0,008	0,052	0,054	0,052	Three Phase	0,061
31th	0,041	0,038	0,034	0,269	0,250	0,220	Three Phase	0,073
32th	0,021	0,019	0,022	0,136	0,128	0,147	Three Phase	0,057
33th	0,016	0,014	0,013	0,105	0,095	0,087	Three Phase	0,068
34th	0,015	0,015	0,011	0,096	0,097	0,072	Three Phase	0,054
35th	0,027	0,028	0,024	0,178	0,183	0,159	Three Phase	0,064
36th	0,005	0,005	0,005	0,034	0,032	0,035	Three Phase	0,051
37th	0,020	0,024	0,025	0,135	0,157	0,164	Three Phase	0,061
38th	0,007	0,008	0,009	0,046	0,053	0,058	Three Phase	0,048
39th	0,012	0,010	0,011	0,077	0,066	0,073	Three Phase	0,058
40th	0,005	0,007	0,007	0,033	0,049	0,044	Three Phase	0,046

4.8	**EMC and power quality** **Harmonic current emission (EN 61000-3-2)**	**P**

Note:
The tests should be based on the limits of the EN 61000-3-2 for less than 16A.

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Test result: ASW12K-LT-G2

Watts [KW]	3,377	3,350	3,363
Vrms [V]	222,00	221,00	221,00
Arms [A]	15,209	15,200	15,282
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	2,225	2,275	2,209

Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [A]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	15,226	15,183	15,261	--	--	--	Three Phase	--
2nd	0,054	0,064	0,045	0,356	0,423	0,292	Three Phase	8,000
3rd	0,030	0,031	0,030	0,200	0,205	0,194	Three Phase	21,600
4th	0,091	0,091	0,092	0,594	0,597	0,606	Three Phase	4,000
5th	0,023	0,028	0,029	0,151	0,185	0,187	Three Phase	10,700
6th	0,034	0,033	0,033	0,226	0,218	0,214	Three Phase	2,667
7th	0,024	0,028	0,031	0,156	0,182	0,201	Three Phase	7,200
8th	0,047	0,039	0,041	0,306	0,256	0,268	Three Phase	2,000
9th	0,048	0,049	0,041	0,314	0,320	0,270	Three Phase	3,800
10th	0,071	0,059	0,054	0,468	0,390	0,352	Three Phase	1,600
11th	0,086	0,080	0,087	0,567	0,525	0,568	Three Phase	3,100
12th	0,049	0,048	0,046	0,319	0,315	0,303	Three Phase	1,333
13th	0,189	0,202	0,196	1,238	1,332	1,282	Three Phase	2,000
14th	0,052	0,054	0,040	0,343	0,353	0,262	Three Phase	N/A
15th	0,038	0,038	0,038	0,250	0,249	0,247	Three Phase	N/A
16th	0,036	0,038	0,040	0,239	0,250	0,259	Three Phase	N/A
17th	0,112	0,116	0,120	0,737	0,763	0,787	Three Phase	N/A
18th	0,030	0,033	0,031	0,196	0,220	0,204	Three Phase	N/A
19th	0,072	0,065	0,066	0,473	0,429	0,432	Three Phase	N/A
20th	0,036	0,034	0,038	0,239	0,222	0,250	Three Phase	N/A
21th	0,022	0,023	0,023	0,142	0,154	0,150	Three Phase	N/A
22th	0,050	0,048	0,045	0,331	0,317	0,295	Three Phase	N/A
23th	0,082	0,087	0,079	0,536	0,572	0,518	Three Phase	N/A
24th	0,010	0,009	0,010	0,064	0,059	0,065	Three Phase	N/A
25th	0,048	0,055	0,052	0,314	0,359	0,340	Three Phase	N/A
26th	0,013	0,012	0,011	0,086	0,081	0,069	Three Phase	N/A
27th	0,019	0,018	0,017	0,127	0,122	0,114	Three Phase	N/A
28th	0,010	0,012	0,011	0,068	0,077	0,069	Three Phase	N/A
29th	0,037	0,031	0,042	0,246	0,206	0,273	Three Phase	N/A
30th	0,008	0,008	0,008	0,052	0,054	0,052	Three Phase	N/A
31th	0,041	0,038	0,034	0,269	0,250	0,220	Three Phase	N/A
32th	0,021	0,019	0,022	0,136	0,128	0,147	Three Phase	N/A
33th	0,016	0,014	0,013	0,105	0,095	0,087	Three Phase	N/A
34th	0,015	0,015	0,011	0,096	0,097	0,072	Three Phase	N/A
35th	0,027	0,028	0,024	0,178	0,183	0,159	Three Phase	N/A
36th	0,005	0,005	0,005	0,034	0,032	0,035	Three Phase	N/A
37th	0,020	0,024	0,025	0,135	0,157	0,164	Three Phase	N/A
38th	0,007	0,008	0,009	0,046	0,053	0,058	Three Phase	N/A
39th	0,012	0,010	0,011	0,077	0,066	0,073	Three Phase	N/A
40th	0,005	0,007	0,007	0,033	0,049	0,044	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Test result: ASW13K-LT-G2

Watts [KW]	4,326	4,334	4,336
Vrms [V]	230,70	230,54	230,87
Arms [A]	18,795	18,801	18,801
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	1,333	1,323	1,346

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Phase	Harmonic Current Limits [A]
	L1	L2	L3	L1	L2	L3	--	--
1st	18,772	18,812	18,813	--	--	--	Three Phase	--
2nd	0,045	0,047	0,065	0,238	0,250	0,343	Three Phase	8,000
3rd	0,031	0,028	0,034	0,166	0,150	0,180	Three Phase	21,600
4th	0,081	0,079	0,082	0,432	0,418	0,437	Three Phase	4,000
5th	0,030	0,040	0,030	0,158	0,214	0,161	Three Phase	10,700
6th	0,036	0,033	0,033	0,191	0,175	0,178	Three Phase	2,667
7th	0,026	0,024	0,024	0,136	0,129	0,126	Three Phase	7,200
8th	0,042	0,040	0,041	0,223	0,212	0,218	Three Phase	2,000
9th	0,035	0,033	0,035	0,186	0,175	0,187	Three Phase	3,800
10th	0,040	0,036	0,039	0,212	0,192	0,205	Three Phase	1,600
11th	0,101	0,099	0,098	0,539	0,527	0,523	Three Phase	3,100
12th	0,029	0,030	0,031	0,153	0,160	0,163	Three Phase	1,333
13th	0,100	0,095	0,098	0,535	0,504	0,522	Three Phase	2,000
14th	0,033	0,032	0,031	0,173	0,172	0,167	Three Phase	N/A
15th	0,027	0,027	0,027	0,142	0,142	0,142	Three Phase	N/A
16th	0,032	0,031	0,033	0,171	0,167	0,173	Three Phase	N/A
17th	0,044	0,047	0,048	0,233	0,249	0,254	Three Phase	N/A
18th	0,026	0,028	0,026	0,138	0,147	0,136	Three Phase	N/A
19th	0,058	0,056	0,056	0,308	0,296	0,300	Three Phase	N/A
20th	0,035	0,037	0,036	0,184	0,199	0,194	Three Phase	N/A
21th	0,027	0,028	0,026	0,144	0,151	0,140	Three Phase	N/A
22th	0,038	0,040	0,037	0,204	0,215	0,196	Three Phase	N/A
23th	0,048	0,050	0,050	0,256	0,266	0,267	Three Phase	N/A
24th	0,026	0,027	0,026	0,139	0,145	0,136	Three Phase	N/A
25th	0,044	0,044	0,043	0,235	0,233	0,231	Three Phase	N/A
26th	0,010	0,010	0,010	0,053	0,056	0,052	Three Phase	N/A
27th	0,020	0,022	0,021	0,105	0,117	0,109	Three Phase	N/A
28th	0,012	0,013	0,013	0,065	0,071	0,067	Three Phase	N/A
29th	0,045	0,046	0,043	0,237	0,245	0,231	Three Phase	N/A
30th	0,019	0,018	0,018	0,100	0,097	0,098	Three Phase	N/A
31th	0,028	0,028	0,027	0,151	0,151	0,145	Three Phase	N/A
32th	0,017	0,018	0,018	0,093	0,095	0,097	Three Phase	N/A
33th	0,021	0,021	0,022	0,109	0,111	0,115	Three Phase	N/A
34th	0,007	0,008	0,007	0,039	0,040	0,039	Three Phase	N/A
35th	0,039	0,038	0,037	0,207	0,200	0,197	Three Phase	N/A
36th	0,009	0,010	0,009	0,048	0,054	0,050	Three Phase	N/A
37th	0,029	0,030	0,030	0,152	0,158	0,159	Three Phase	N/A
38th	0,008	0,009	0,008	0,043	0,046	0,044	Three Phase	N/A
39th	0,021	0,024	0,022	0,111	0,130	0,119	Three Phase	N/A
40th	0,006	0,006	0,006	0,032	0,033	0,031	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Test result: ASW15K-LT-G2

Watts [KW]	4,970	4,930	4,940
Vrms [V]	222,00	221,00	221,00
Arms [A]	22,400	22,300	22,383
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	1,530	1,583	1,583

Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [A]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	22,377	22,283	22,333	--	--	--	Three Phase	--
2nd	0,057	0,094	0,078	0,255	0,420	0,348	Three Phase	8,000
3rd	0,024	0,026	0,028	0,107	0,116	0,123	Three Phase	21,600
4th	0,086	0,082	0,076	0,384	0,369	0,341	Three Phase	4,000
5th	0,020	0,023	0,033	0,088	0,105	0,147	Three Phase	10,700
6th	0,029	0,028	0,028	0,129	0,125	0,126	Three Phase	2,667
7th	0,024	0,020	0,026	0,108	0,092	0,116	Three Phase	7,200
8th	0,037	0,031	0,034	0,165	0,140	0,154	Three Phase	2,000
9th	0,030	0,030	0,031	0,136	0,133	0,140	Three Phase	3,800
10th	0,042	0,047	0,037	0,187	0,213	0,165	Three Phase	1,600
11th	0,220	0,217	0,227	0,983	0,975	1,015	Three Phase	3,100
12th	0,033	0,034	0,038	0,146	0,154	0,172	Three Phase	1,333
13th	0,060	0,070	0,071	0,268	0,314	0,318	Three Phase	2,000
14th	0,039	0,042	0,040	0,175	0,186	0,180	Three Phase	N/A
15th	0,025	0,026	0,027	0,114	0,115	0,120	Three Phase	N/A
16th	0,042	0,033	0,041	0,189	0,147	0,183	Three Phase	N/A
17th	0,035	0,040	0,039	0,156	0,179	0,177	Three Phase	N/A
18th	0,023	0,022	0,026	0,103	0,100	0,115	Three Phase	N/A
19th	0,035	0,039	0,037	0,156	0,175	0,167	Three Phase	N/A
20th	0,053	0,054	0,047	0,238	0,243	0,211	Three Phase	N/A
21th	0,022	0,021	0,023	0,099	0,093	0,101	Three Phase	N/A
22th	0,055	0,052	0,051	0,247	0,235	0,230	Three Phase	N/A
23th	0,060	0,066	0,070	0,270	0,298	0,315	Three Phase	N/A
24th	0,020	0,019	0,022	0,088	0,085	0,097	Three Phase	N/A
25th	0,095	0,102	0,096	0,425	0,457	0,431	Three Phase	N/A
26th	0,018	0,018	0,018	0,078	0,079	0,081	Three Phase	N/A
27th	0,042	0,045	0,038	0,186	0,203	0,171	Three Phase	N/A
28th	0,031	0,033	0,026	0,140	0,149	0,118	Three Phase	N/A
29th	0,025	0,030	0,026	0,112	0,133	0,114	Three Phase	N/A
30th	0,014	0,012	0,014	0,064	0,056	0,063	Three Phase	N/A
31th	0,078	0,073	0,075	0,348	0,328	0,334	Three Phase	N/A
32th	0,017	0,021	0,023	0,076	0,096	0,102	Three Phase	N/A
33th	0,012	0,012	0,012	0,054	0,055	0,054	Three Phase	N/A
34th	0,023	0,020	0,018	0,101	0,091	0,083	Three Phase	N/A
35th	0,046	0,045	0,052	0,203	0,203	0,235	Three Phase	N/A
36th	0,011	0,011	0,009	0,050	0,049	0,042	Three Phase	N/A
37th	0,038	0,038	0,035	0,170	0,172	0,155	Three Phase	N/A
38th	0,012	0,010	0,011	0,054	0,043	0,049	Three Phase	N/A
39th	0,009	0,009	0,009	0,038	0,041	0,039	Three Phase	N/A
40th	0,010	0,009	0,008	0,042	0,042	0,037	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Test result: ASW17K-LT-G2

Watts [KW]	5,685	5,682	5,698
Vrms [V]	221,00	221,00	25,80
Arms [A]	25,700	25,700	25,800
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	2,334	2,275	2,280

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Phase	Harmonic Current Limits [A]
	L1	L2	L3	L1	L2	L3	--	--
1st	25,706	25,668	25,753	--	--	--	Three Phase	--
2nd	0,089	0,080	0,093	0,348	0,311	0,361	Three Phase	8,000
3rd	0,053	0,047	0,059	0,205	0,185	0,229	Three Phase	21,600
4th	0,107	0,104	0,114	0,414	0,406	0,442	Three Phase	4,000
5th	0,066	0,061	0,056	0,255	0,239	0,218	Three Phase	10,700
6th	0,076	0,064	0,075	0,295	0,251	0,290	Three Phase	2,667
7th	0,048	0,061	0,065	0,187	0,237	0,253	Three Phase	7,200
8th	0,054	0,061	0,066	0,209	0,238	0,258	Three Phase	2,000
9th	0,081	0,081	0,083	0,316	0,314	0,323	Three Phase	3,800
10th	0,106	0,106	0,099	0,411	0,414	0,385	Three Phase	1,600
11th	0,196	0,201	0,201	0,763	0,783	0,779	Three Phase	3,100
12th	0,072	0,075	0,074	0,281	0,291	0,289	Three Phase	1,333
13th	0,200	0,192	0,170	0,777	0,749	0,658	Three Phase	2,000
14th	0,094	0,094	0,093	0,364	0,366	0,359	Three Phase	N/A
15th	0,180	0,165	0,186	0,700	0,644	0,724	Three Phase	N/A
16th	0,108	0,102	0,093	0,418	0,396	0,360	Three Phase	N/A
17th	0,212	0,205	0,206	0,826	0,800	0,802	Three Phase	N/A
18th	0,089	0,096	0,092	0,346	0,376	0,357	Three Phase	N/A
19th	0,203	0,187	0,188	0,789	0,728	0,728	Three Phase	N/A
20th	0,089	0,089	0,092	0,346	0,347	0,358	Three Phase	N/A
21th	0,155	0,149	0,152	0,603	0,582	0,588	Three Phase	N/A
22th	0,076	0,075	0,077	0,297	0,293	0,301	Three Phase	N/A
23th	0,141	0,142	0,137	0,550	0,555	0,532	Three Phase	N/A
24th	0,032	0,029	0,027	0,123	0,112	0,106	Three Phase	N/A
25th	0,057	0,057	0,060	0,223	0,222	0,231	Three Phase	N/A
26th	0,026	0,027	0,026	0,101	0,107	0,100	Three Phase	N/A
27th	0,046	0,046	0,048	0,178	0,179	0,185	Three Phase	N/A
28th	0,025	0,024	0,025	0,098	0,092	0,097	Three Phase	N/A
29th	0,045	0,045	0,044	0,175	0,176	0,171	Three Phase	N/A
30th	0,021	0,019	0,021	0,083	0,075	0,081	Three Phase	N/A
31th	0,041	0,041	0,039	0,159	0,161	0,151	Three Phase	N/A
32th	0,019	0,020	0,020	0,073	0,078	0,079	Three Phase	N/A
33th	0,033	0,033	0,034	0,129	0,128	0,132	Three Phase	N/A
34th	0,018	0,019	0,020	0,072	0,073	0,078	Three Phase	N/A
35th	0,032	0,032	0,032	0,123	0,125	0,123	Three Phase	N/A
36th	0,011	0,010	0,010	0,043	0,041	0,040	Three Phase	N/A
37th	0,033	0,033	0,034	0,130	0,127	0,131	Three Phase	N/A
38th	0,010	0,010	0,010	0,040	0,039	0,039	Three Phase	N/A
39th	0,026	0,025	0,025	0,100	0,098	0,098	Three Phase	N/A
40th	0,010	0,010	0,010	0,037	0,038	0,038	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Test result: ASW20K-LT-G2

Watts [KW]	6,621	6,612	6,632
Vrms [V]	221,51	221,49	221,37
Arms [A]	29,903	29,862	29,969
Frequency [Hz]	50,00	50,00	50,00
THD50* (100% output power)	1,061	1,031	1,078

Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [A]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	29,913	29,881	29,958	--	--	--	Three Phase	--
2nd	0,093	0,062	0,099	0,312	0,209	0,330	Three Phase	8,000
3rd	0,039	0,030	0,054	0,131	0,100	0,181	Three Phase	21,600
4th	0,040	0,040	0,044	0,134	0,133	0,147	Three Phase	4,000
5th	0,024	0,038	0,045	0,079	0,126	0,151	Three Phase	10,700
6th	0,026	0,024	0,024	0,086	0,082	0,080	Three Phase	2,667
7th	0,026	0,024	0,027	0,086	0,081	0,091	Three Phase	7,200
8th	0,026	0,025	0,027	0,087	0,083	0,089	Three Phase	2,000
9th	0,027	0,026	0,029	0,090	0,087	0,096	Three Phase	3,800
10th	0,042	0,043	0,041	0,141	0,143	0,137	Three Phase	1,600
11th	0,138	0,137	0,142	0,462	0,460	0,475	Three Phase	3,100
12th	0,056	0,058	0,052	0,187	0,195	0,172	Three Phase	1,333
13th	0,109	0,116	0,108	0,365	0,388	0,360	Three Phase	2,000
14th	0,058	0,058	0,059	0,195	0,194	0,198	Three Phase	N/A
15th	0,050	0,044	0,050	0,166	0,147	0,167	Three Phase	N/A
16th	0,051	0,051	0,053	0,171	0,171	0,177	Three Phase	N/A
17th	0,098	0,089	0,090	0,327	0,299	0,299	Three Phase	N/A
18th	0,042	0,045	0,043	0,142	0,151	0,144	Three Phase	N/A
19th	0,083	0,087	0,085	0,277	0,290	0,283	Three Phase	N/A
20th	0,041	0,039	0,040	0,138	0,130	0,134	Three Phase	N/A
21th	0,032	0,031	0,034	0,108	0,102	0,112	Three Phase	N/A
22th	0,034	0,033	0,034	0,114	0,112	0,115	Three Phase	N/A
23th	0,065	0,060	0,062	0,217	0,202	0,208	Three Phase	N/A
24th	0,028	0,029	0,029	0,093	0,098	0,098	Three Phase	N/A
25th	0,057	0,055	0,056	0,189	0,185	0,187	Three Phase	N/A
26th	0,029	0,028	0,029	0,095	0,094	0,095	Three Phase	N/A
27th	0,024	0,023	0,026	0,080	0,076	0,086	Three Phase	N/A
28th	0,027	0,026	0,026	0,089	0,088	0,086	Three Phase	N/A
29th	0,047	0,045	0,044	0,156	0,151	0,148	Three Phase	N/A
30th	0,022	0,021	0,022	0,073	0,071	0,075	Three Phase	N/A
31th	0,041	0,042	0,042	0,137	0,141	0,139	Three Phase	N/A
32th	0,023	0,024	0,023	0,076	0,079	0,075	Three Phase	N/A
33th	0,019	0,017	0,020	0,065	0,058	0,067	Three Phase	N/A
34th	0,022	0,022	0,022	0,072	0,073	0,072	Three Phase	N/A
35th	0,034	0,032	0,032	0,114	0,107	0,108	Three Phase	N/A
36th	0,016	0,016	0,017	0,055	0,054	0,056	Three Phase	N/A
37th	0,030	0,029	0,030	0,101	0,098	0,101	Three Phase	N/A
38th	0,019	0,018	0,017	0,063	0,062	0,058	Three Phase	N/A
39th	0,015	0,013	0,014	0,049	0,043	0,048	Three Phase	N/A
40th	0,017	0,017	0,018	0,056	0,056	0,060	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)	P

Note:
The tests should be based on the limits of the EN 61000-3-12 for more than 16A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

The currents of the interharmonics to 2 kHz must be measured in accordance with DIN EN 61000-4-7 (VDE 0817-4-7), Annex A, The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with DIN EN 61000-4-7 (VDE 0847-4-7), Annex B.

Test result: ASW8K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	3,947	10,224	20,427	30,366	40,366	50,814	60,681	70,517	80,447	90,520	100,823
2	0,508	0,757	0,832	0,896	0,919	0,925	0,929	0,931	0,938	0,936	0,928
3	0,254	0,259	0,227	0,210	0,275	0,306	0,289	0,270	0,259	0,244	0,235
4	0,123	0,342	0,373	0,297	0,232	0,205	0,183	0,169	0,161	0,158	0,149
5	0,474	0,419	0,451	0,629	0,653	0,647	0,673	0,658	0,629	0,631	0,640
6	0,047	0,149	0,339	0,308	0,248	0,217	0,184	0,165	0,154	0,141	0,139
7	0,266	0,272	0,243	0,156	0,160	0,206	0,190	0,192	0,198	0,182	0,169
8	0,108	0,123	0,158	0,215	0,196	0,161	0,141	0,138	0,133	0,126	0,117
9	0,038	0,045	0,061	0,142	0,078	0,049	0,093	0,121	0,118	0,119	0,123
10	0,103	0,143	0,241	0,190	0,186	0,162	0,142	0,134	0,126	0,119	0,113
11	0,533	0,409	0,112	0,363	0,525	0,345	0,128	0,290	0,445	0,548	0,594
12	0,034	0,060	0,102	0,152	0,168	0,165	0,153	0,146	0,139	0,132	0,128
13	0,408	0,413	0,780	0,426	0,325	0,406	0,166	0,135	0,310	0,419	0,491
14	0,098	0,103	0,116	0,153	0,124	0,151	0,134	0,114	0,105	0,102	0,102
15	0,030	0,040	0,043	0,057	0,039	0,075	0,048	0,053	0,072	0,071	0,084
16	0,107	0,118	0,160	0,137	0,136	0,139	0,138	0,129	0,127	0,109	0,103
17	0,222	0,200	0,254	0,218	0,199	0,194	0,270	0,137	0,094	0,204	0,291
18	0,050	0,055	0,082	0,118	0,091	0,107	0,115	0,116	0,113	0,113	0,110
19	0,172	0,164	0,239	0,131	0,263	0,065	0,267	0,192	0,093	0,144	0,229
20	0,102	0,101	0,143	0,145	0,125	0,119	0,124	0,120	0,104	0,100	0,097
21	0,043	0,047	0,053	0,070	0,076	0,070	0,074	0,064	0,064	0,059	0,068
22	0,114	0,122	0,103	0,158	0,136	0,132	0,124	0,121	0,120	0,116	0,109
23	0,119	0,106	0,219	0,159	0,094	0,173	0,141	0,216	0,163	0,106	0,138
24	0,059	0,059	0,068	0,047	0,057	0,062	0,075	0,085	0,088	0,091	0,090
25	0,124	0,115	0,085	0,104	0,135	0,193	0,076	0,219	0,195	0,129	0,119
26	0,119	0,120	0,148	0,156	0,136	0,136	0,112	0,117	0,112	0,102	0,094
27	0,047	0,046	0,127	0,122	0,096	0,097	0,083	0,074	0,070	0,060	0,061
28	0,130	0,126	0,101	0,151	0,144	0,140	0,126	0,122	0,117	0,114	0,110
29	0,160	0,127	0,194	0,170	0,182	0,165	0,176	0,144	0,192	0,157	0,129
30	0,051	0,057	0,069	0,060	0,054	0,069	0,061	0,058	0,068	0,070	0,071
31	0,197	0,155	0,128	0,149	0,110	0,123	0,162	0,120	0,215	0,192	0,133
32	0,144	0,131	0,145	0,138	0,133	0,142	0,131	0,110	0,118	0,114	0,111
33	0,056	0,096	0,163	0,182	0,204	0,186	0,287	0,247	0,243	0,260	0,225
34	0,168	0,154	0,143	0,185	0,169	0,183	0,207	0,161	0,174	0,180	0,170
35	0,258	0,447	0,715	0,860	0,923	0,932	0,959	1,027	1,014	0,998	0,973
36	0,041	0,089	0,072	0,122	0,102	0,073	0,067	0,140	0,090	0,083	0,082
37	0,273	0,274	0,201	0,227	0,189	0,183	0,125	0,173	0,178	0,211	0,181
38	0,186	0,209	0,206	0,177	0,186	0,173	0,157	0,182	0,158	0,156	0,140
39	0,142	0,664	0,977	0,947	0,893	0,903	0,833	0,877	0,871	0,869	0,875

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
40	0,202	0,260	0,150	0,173	0,214	0,188	0,132	0,164	0,148	0,133	0,163
41	0,312	0,884	1,101	1,037	0,992	0,996	0,965	0,957	0,962	0,966	0,920
42	0,051	0,088	0,110	0,120	0,105	0,092	0,098	0,112	0,111	0,110	0,079
43	0,312	0,305	0,226	0,254	0,186	0,185	0,158	0,174	0,142	0,192	0,168
44	0,214	0,229	0,197	0,166	0,166	0,145	0,128	0,159	0,136	0,117	0,123
45	0,122	0,347	0,587	0,644	0,679	0,711	0,776	0,736	0,740	0,766	0,744
46	0,210	0,194	0,131	0,159	0,146	0,146	0,164	0,126	0,131	0,134	0,122
47	0,308	0,236	0,269	0,269	0,291	0,293	0,235	0,257	0,238	0,236	0,274
48	0,061	0,070	0,071	0,071	0,069	0,066	0,055	0,052	0,057	0,063	0,063
49	0,303	0,267	0,178	0,206	0,160	0,158	0,151	0,125	0,123	0,125	0,155
50	0,199	0,166	0,175	0,144	0,116	0,118	0,115	0,097	0,091	0,089	0,086
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,107	0,140	0,179	0,230	0,294	0,355	0,415	0,483	0,544	0,619	0,689
125	0,053	0,080	0,090	0,096	0,103	0,118	0,120	0,119	0,124	0,135	0,135
175	0,042	0,060	0,060	0,062	0,059	0,070	0,071	0,075	0,080	0,090	0,099
225	0,037	0,051	0,062	0,088	0,056	0,074	0,095	0,098	0,103	0,114	0,118
275	0,040	0,055	0,063	0,081	0,056	0,079	0,100	0,103	0,103	0,100	0,094
325	0,039	0,049	0,062	0,060	0,054	0,059	0,074	0,085	0,088	0,090	0,090
375	0,039	0,037	0,048	0,054	0,045	0,051	0,068	0,074	0,080	0,072	0,081
425	0,043	0,045	0,047	0,058	0,061	0,062	0,068	0,078	0,077	0,082	0,089
475	0,041	0,044	0,046	0,052	0,055	0,056	0,058	0,064	0,065	0,066	0,073
525	0,037	0,037	0,055	0,081	0,081	0,073	0,075	0,114	0,140	0,152	0,151
575	0,040	0,043	0,056	0,094	0,084	0,064	0,087	0,136	0,160	0,168	0,152
625	0,034	0,042	0,043	0,057	0,060	0,083	0,059	0,082	0,112	0,128	0,129
675	0,034	0,033	0,043	0,058	0,064	0,078	0,054	0,096	0,135	0,140	0,148
725	0,033	0,043	0,050	0,053	0,053	0,066	0,077	0,076	0,081	0,084	0,088
775	0,034	0,036	0,039	0,043	0,044	0,046	0,050	0,047	0,052	0,049	0,054
825	0,033	0,033	0,065	0,086	0,072	0,095	0,106	0,110	0,122	0,117	0,110
875	0,035	0,040	0,043	0,068	0,047	0,067	0,074	0,045	0,068	0,093	0,098
925	0,034	0,040	0,050	0,052	0,058	0,054	0,090	0,076	0,074	0,091	0,111
975	0,035	0,037	0,046	0,055	0,055	0,053	0,086	0,055	0,051	0,072	0,085
1025	0,034	0,053	0,055	0,092	0,091	0,102	0,104	0,103	0,098	0,100	0,088
1075	0,036	0,041	0,048	0,050	0,052	0,056	0,050	0,052	0,052	0,053	0,059
1125	0,034	0,056	0,065	0,147	0,140	0,170	0,159	0,162	0,140	0,129	0,142
1175	0,036	0,051	0,045	0,059	0,053	0,048	0,073	0,068	0,047	0,052	0,063
1225	0,040	0,059	0,063	0,088	0,089	0,107	0,115	0,109	0,103	0,097	0,148
1275	0,037	0,047	0,055	0,051	0,055	0,058	0,065	0,072	0,063	0,058	0,059
1325	0,037	0,058	0,197	0,176	0,170	0,149	0,135	0,126	0,108	0,100	0,090
1375	0,041	0,045	0,068	0,075	0,047	0,062	0,044	0,040	0,049	0,056	0,056
1425	0,040	0,060	0,253	0,314	0,271	0,243	0,181	0,153	0,118	0,117	0,120
1475	0,048	0,055	0,067	0,054	0,054	0,092	0,087	0,062	0,066	0,061	0,083
1525	0,048	0,076	0,138	0,150	0,146	0,177	0,162	0,117	0,125	0,105	0,164
1575	0,044	0,060	0,081	0,089	0,068	0,084	0,062	0,073	0,078	0,081	0,091
1625	0,068	0,144	0,238	0,336	0,347	0,383	0,397	0,468	0,471	0,463	0,490

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1675	0,049	0,073	0,145	0,132	0,118	0,127	0,224	0,141	0,157	0,179	0,140
1725	0,209	0,678	1,297	1,507	1,578	1,689	1,835	1,817	1,851	1,878	1,905
1775	0,056	0,178	0,194	0,235	0,282	0,246	0,205	0,303	0,301	0,288	0,257
1825	0,048	0,296	0,409	0,299	0,259	0,193	0,201	0,176	0,153	0,147	0,124
1875	0,056	0,156	0,171	0,171	0,142	0,137	0,109	0,176	0,160	0,155	0,139
1925	0,249	1,165	1,728	1,665	1,626	1,587	1,563	1,561	1,619	1,655	1,662
1975	0,065	0,300	0,270	0,272	0,298	0,284	0,186	0,279	0,254	0,231	0,272
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,559	1,823	2,199	2,085	2,111	2,078	1,956	1,970	1,989	2,006	2,017
2,3	0,451	0,806	1,184	1,348	1,463	1,516	1,586	1,609	1,618	1,634	1,661
2,5	0,406	0,384	0,375	0,377	0,304	0,292	0,277	0,235	0,242	0,242	0,256
2,7	0,391	0,367	0,378	0,319	0,292	0,272	0,238	0,211	0,217	0,211	0,227
2,9	0,253	0,257	0,273	0,231	0,223	0,224	0,206	0,179	0,172	0,171	0,166
3,1	0,236	0,261	0,238	0,213	0,210	0,202	0,196	0,178	0,170	0,172	0,172
3,3	0,255	0,277	0,311	0,276	0,230	0,230	0,211	0,192	0,183	0,178	0,170
3,5	0,201	0,211	0,246	0,220	0,184	0,185	0,172	0,160	0,155	0,153	0,149
3,7	0,237	0,254	0,239	0,245	0,194	0,195	0,183	0,167	0,160	0,157	0,153
3,9	0,247	0,254	0,222	0,219	0,217	0,216	0,207	0,192	0,181	0,173	0,169
4,1	0,161	0,296	0,194	0,192	0,202	0,204	0,190	0,178	0,172	0,175	0,175
4,3	0,123	0,214	0,145	0,151	0,166	0,170	0,165	0,154	0,150	0,151	0,152
4,5	0,091	0,108	0,097	0,101	0,102	0,108	0,111	0,109	0,109	0,111	0,112
4,7	0,085	0,101	0,097	0,100	0,098	0,101	0,101	0,099	0,100	0,102	0,104
4,9	0,062	0,075	0,066	0,065	0,062	0,063	0,064	0,062	0,064	0,066	0,069
5,1	0,058	0,065	0,063	0,061	0,059	0,059	0,057	0,058	0,059	0,060	0,061
5,3	0,050	0,057	0,055	0,055	0,053	0,053	0,053	0,051	0,052	0,054	0,056
5,5	0,048	0,053	0,051	0,051	0,048	0,050	0,049	0,047	0,048	0,049	0,051
5,7	0,048	0,050	0,049	0,050	0,048	0,050	0,049	0,047	0,048	0,049	0,050
5,9	0,045	0,048	0,045	0,047	0,045	0,047	0,046	0,043	0,045	0,046	0,047
6,1	0,047	0,049	0,047	0,047	0,047	0,049	0,048	0,045	0,046	0,047	0,048
6,3	0,045	0,047	0,044	0,044	0,044	0,046	0,045	0,043	0,043	0,044	0,045
6,5	0,046	0,048	0,045	0,043	0,043	0,046	0,044	0,043	0,043	0,044	0,045
6,7	0,044	0,045	0,048	0,048	0,045	0,045	0,044	0,042	0,043	0,044	0,044
6,9	0,042	0,043	0,042	0,043	0,047	0,046	0,044	0,042	0,042	0,043	0,044
7,1	0,046	0,063	0,070	0,070	0,074	0,080	0,085	0,086	0,094	0,106	0,103
7,3	0,042	0,065	0,070	0,065	0,087	0,086	0,089	0,087	0,078	0,063	0,071
7,5	0,080	0,077	0,081	0,092	0,081	0,084	0,087	0,089	0,090	0,090	0,091
7,7	0,042	0,044	0,041	0,041	0,042	0,043	0,043	0,045	0,046	0,052	0,051
7,9	0,041	0,042	0,040	0,042	0,042	0,043	0,045	0,049	0,050	0,047	0,044
8,1	0,046	0,048	0,048	0,045	0,050	0,051	0,050	0,049	0,050	0,049	0,049
8,3	0,048	0,048	0,049	0,052	0,051	0,052	0,052	0,051	0,051	0,050	0,049
8,5	0,048	0,057	0,055	0,055	0,053	0,053	0,053	0,051	0,050	0,051	0,049
8,7	0,053	0,048	0,049	0,049	0,047	0,051	0,046	0,044	0,044	0,045	0,048
8,9	0,048	0,055	0,054	0,050	0,047	0,046	0,045	0,044	0,044	0,045	0,046
Note: The normalization current is 11,594 A.											

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW10K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	4,693	10,276	20,083	29,833	40,200	50,122	61,189	70,805	80,446	90,499	100,647
2	0,490	0,564	0,640	0,689	0,705	0,718	0,729	0,730	0,736	0,743	0,746
3	0,213	0,211	0,211	0,232	0,261	0,264	0,235	0,225	0,221	0,218	0,225
4	0,113	0,330	0,257	0,196	0,164	0,147	0,129	0,124	0,121	0,127	0,128
5	0,374	0,336	0,386	0,469	0,482	0,473	0,460	0,437	0,437	0,422	0,426
6	0,042	0,164	0,245	0,202	0,169	0,140	0,124	0,114	0,108	0,098	0,095
7	0,214	0,223	0,211	0,125	0,176	0,175	0,176	0,168	0,155	0,157	0,143
8	0,089	0,084	0,127	0,144	0,134	0,117	0,109	0,104	0,094	0,085	0,083
9	0,033	0,033	0,037	0,079	0,038	0,079	0,099	0,098	0,097	0,091	0,091
10	0,086	0,107	0,137	0,134	0,130	0,112	0,103	0,099	0,094	0,087	0,083
11	0,419	0,351	0,257	0,399	0,328	0,097	0,291	0,420	0,475	0,504	0,514
12	0,035	0,046	0,107	0,134	0,131	0,120	0,109	0,103	0,096	0,092	0,089
13	0,320	0,315	0,414	0,139	0,347	0,142	0,171	0,305	0,384	0,441	0,471
14	0,079	0,073	0,086	0,101	0,107	0,106	0,093	0,086	0,084	0,078	0,076
15	0,026	0,034	0,068	0,040	0,061	0,042	0,052	0,061	0,063	0,064	0,064
16	0,088	0,089	0,088	0,115	0,108	0,115	0,102	0,090	0,084	0,085	0,076
17	0,175	0,158	0,258	0,235	0,108	0,227	0,082	0,115	0,209	0,277	0,316
18	0,042	0,037	0,043	0,070	0,083	0,090	0,088	0,085	0,083	0,079	0,077
19	0,137	0,136	0,121	0,162	0,064	0,221	0,128	0,077	0,151	0,228	0,280
20	0,083	0,071	0,096	0,096	0,095	0,099	0,093	0,089	0,082	0,074	0,071
21	0,035	0,038	0,072	0,048	0,050	0,065	0,057	0,052	0,056	0,059	0,060
22	0,094	0,093	0,088	0,110	0,113	0,106	0,105	0,097	0,090	0,081	0,075
23	0,096	0,091	0,107	0,128	0,157	0,109	0,168	0,111	0,094	0,135	0,181
24	0,047	0,032	0,050	0,037	0,046	0,058	0,066	0,067	0,066	0,066	0,064
25	0,101	0,100	0,114	0,159	0,142	0,069	0,187	0,135	0,085	0,109	0,155
26	0,095	0,090	0,118	0,107	0,109	0,099	0,095	0,090	0,084	0,081	0,075
27	0,038	0,048	0,097	0,079	0,079	0,074	0,072	0,058	0,050	0,053	0,056
28	0,107	0,105	0,077	0,111	0,110	0,106	0,105	0,100	0,092	0,088	0,083
29	0,126	0,110	0,122	0,150	0,131	0,136	0,144	0,153	0,106	0,085	0,096
30	0,041	0,032	0,044	0,051	0,034	0,035	0,048	0,051	0,051	0,052	0,051
31	0,152	0,131	0,095	0,151	0,140	0,148	0,140	0,180	0,140	0,107	0,091
32	0,116	0,116	0,145	0,130	0,117	0,113	0,096	0,096	0,089	0,087	0,082
33	0,047	0,093	0,106	0,112	0,134	0,142	0,169	0,180	0,182	0,165	0,156
34	0,138	0,143	0,089	0,152	0,146	0,140	0,137	0,137	0,132	0,124	0,111
35	0,209	0,427	0,644	0,665	0,726	0,768	0,816	0,828	0,831	0,850	0,864
36	0,035	0,061	0,069	0,062	0,086	0,091	0,079	0,094	0,077	0,090	0,081
37	0,213	0,267	0,168	0,174	0,139	0,121	0,135	0,165	0,166	0,141	0,099
38	0,157	0,156	0,203	0,150	0,139	0,124	0,143	0,148	0,137	0,146	0,104
39	0,164	0,715	0,823	0,777	0,761	0,773	0,794	0,799	0,819	0,863	0,924
40	0,171	0,206	0,119	0,174	0,180	0,187	0,134	0,177	0,162	0,127	0,201
41	0,263	0,858	0,886	0,858	0,838	0,810	0,878	0,855	0,874	0,933	0,884
42	0,057	0,089	0,094	0,087	0,086	0,068	0,097	0,083	0,086	0,105	0,069

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,244	0,243	0,166	0,161	0,157	0,139	0,146	0,110	0,143	0,161	0,125
44	0,172	0,147	0,181	0,130	0,132	0,122	0,119	0,126	0,114	0,112	0,109
45	0,101	0,382	0,459	0,519	0,555	0,564	0,590	0,593	0,608	0,620	0,625
46	0,171	0,170	0,073	0,134	0,122	0,113	0,108	0,098	0,097	0,092	0,083
47	0,244	0,212	0,267	0,222	0,225	0,217	0,183	0,197	0,205	0,193	0,203
48	0,048	0,045	0,047	0,055	0,050	0,050	0,045	0,045	0,049	0,046	0,039
49	0,242	0,237	0,118	0,160	0,135	0,135	0,118	0,101	0,113	0,123	0,115
50	0,158	0,131	0,155	0,103	0,102	0,097	0,086	0,079	0,076	0,072	0,067
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,088	0,110	0,181	0,224	0,278	0,341	0,421	0,487	0,545	0,623	0,687
125	0,054	0,074	0,072	0,087	0,091	0,099	0,097	0,106	0,121	0,129	0,134
175	0,039	0,045	0,047	0,050	0,055	0,062	0,067	0,069	0,076	0,088	0,091
225	0,036	0,058	0,047	0,042	0,055	0,076	0,084	0,086	0,093	0,095	0,106
275	0,041	0,048	0,052	0,043	0,058	0,081	0,087	0,084	0,086	0,080	0,083
325	0,037	0,042	0,045	0,043	0,044	0,060	0,069	0,072	0,072	0,075	0,077
375	0,033	0,036	0,036	0,038	0,040	0,054	0,064	0,063	0,065	0,058	0,065
425	0,037	0,033	0,047	0,049	0,048	0,051	0,062	0,067	0,072	0,075	0,077
475	0,038	0,033	0,037	0,043	0,045	0,049	0,053	0,054	0,058	0,056	0,060
525	0,033	0,034	0,057	0,061	0,064	0,059	0,103	0,119	0,129	0,117	0,131
575	0,037	0,030	0,052	0,069	0,061	0,070	0,119	0,135	0,136	0,127	0,135
625	0,030	0,031	0,045	0,041	0,066	0,046	0,080	0,095	0,101	0,108	0,111
675	0,030	0,030	0,043	0,041	0,071	0,047	0,091	0,118	0,118	0,117	0,133
725	0,028	0,031	0,042	0,046	0,052	0,057	0,065	0,067	0,069	0,073	0,073
775	0,030	0,031	0,033	0,036	0,039	0,041	0,042	0,044	0,043	0,047	0,047
825	0,029	0,032	0,045	0,057	0,068	0,082	0,094	0,093	0,095	0,097	0,102
875	0,032	0,032	0,034	0,052	0,049	0,061	0,040	0,063	0,081	0,086	0,097
925	0,032	0,033	0,042	0,044	0,046	0,074	0,058	0,066	0,076	0,083	0,088
975	0,029	0,034	0,037	0,044	0,042	0,071	0,042	0,054	0,069	0,080	0,097
1025	0,030	0,038	0,057	0,071	0,080	0,081	0,082	0,085	0,078	0,076	0,078
1075	0,030	0,032	0,042	0,043	0,043	0,044	0,045	0,042	0,042	0,045	0,048
1125	0,028	0,053	0,081	0,119	0,128	0,141	0,130	0,108	0,092	0,091	0,096
1175	0,030	0,034	0,045	0,038	0,045	0,051	0,052	0,037	0,049	0,062	0,067
1225	0,044	0,042	0,056	0,072	0,081	0,090	0,088	0,084	0,089	0,096	0,085
1275	0,031	0,038	0,043	0,046	0,048	0,048	0,057	0,046	0,051	0,057	0,072
1325	0,030	0,063	0,172	0,116	0,119	0,111	0,090	0,088	0,088	0,088	0,084
1375	0,034	0,040	0,050	0,047	0,044	0,041	0,044	0,038	0,037	0,040	0,042
1425	0,038	0,104	0,207	0,206	0,200	0,176	0,119	0,096	0,102	0,096	0,101
1475	0,036	0,039	0,043	0,074	0,051	0,046	0,051	0,049	0,042	0,050	0,055
1525	0,047	0,099	0,126	0,144	0,123	0,124	0,108	0,099	0,087	0,081	0,111
1575	0,036	0,048	0,063	0,063	0,062	0,057	0,057	0,064	0,059	0,069	0,057
1625	0,054	0,161	0,207	0,238	0,243	0,289	0,309	0,291	0,293	0,301	0,302
1675	0,046	0,073	0,074	0,092	0,079	0,064	0,115	0,091	0,114	0,109	0,068
1725	0,205	0,714	1,065	1,198	1,253	1,335	1,369	1,371	1,392	1,387	1,398
1775	0,055	0,118	0,210	0,155	0,200	0,210	0,250	0,235	0,233	0,270	0,267

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,075	0,331	0,255	0,197	0,164	0,155	0,130	0,152	0,145	0,150	0,141
1875	0,071	0,111	0,153	0,112	0,100	0,089	0,142	0,131	0,126	0,157	0,097
1925	0,288	1,192	1,401	1,334	1,321	1,320	1,361	1,411	1,431	1,445	1,438
1975	0,105	0,242	0,254	0,245	0,236	0,256	0,232	0,244	0,253	0,251	0,336
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,506	1,787	1,749	1,763	1,760	1,739	1,723	1,756	1,774	1,803	1,857
2,3	0,369	0,827	0,985	1,099	1,145	1,179	1,222	1,233	1,256	1,265	1,277
2,5	0,326	0,327	0,295	0,272	0,249	0,230	0,209	0,193	0,201	0,203	0,185
2,7	0,315	0,320	0,330	0,256	0,244	0,207	0,186	0,178	0,173	0,185	0,181
2,9	0,206	0,217	0,269	0,185	0,184	0,173	0,149	0,147	0,141	0,147	0,147
3,1	0,191	0,221	0,244	0,181	0,176	0,168	0,149	0,146	0,139	0,142	0,146
3,3	0,209	0,235	0,330	0,208	0,202	0,180	0,162	0,153	0,145	0,143	0,147
3,5	0,167	0,175	0,255	0,159	0,157	0,149	0,134	0,129	0,126	0,125	0,125
3,7	0,185	0,205	0,239	0,171	0,171	0,159	0,142	0,136	0,131	0,128	0,127
3,9	0,184	0,188	0,217	0,179	0,185	0,178	0,162	0,154	0,146	0,145	0,141
4,1	0,155	0,197	0,177	0,163	0,163	0,153	0,143	0,142	0,145	0,145	0,147
4,3	0,115	0,163	0,127	0,133	0,135	0,133	0,126	0,124	0,125	0,128	0,130
4,5	0,085	0,086	0,077	0,084	0,086	0,089	0,089	0,090	0,092	0,091	0,091
4,7	0,075	0,079	0,079	0,080	0,081	0,082	0,080	0,081	0,083	0,082	0,082
4,9	0,058	0,059	0,056	0,051	0,052	0,051	0,051	0,053	0,055	0,055	0,055
5,1	0,050	0,052	0,052	0,049	0,048	0,047	0,048	0,049	0,049	0,051	0,051
5,3	0,043	0,045	0,046	0,044	0,043	0,042	0,042	0,042	0,043	0,043	0,043
5,5	0,041	0,043	0,044	0,042	0,043	0,043	0,040	0,040	0,041	0,041	0,041
5,7	0,040	0,041	0,042	0,040	0,040	0,040	0,039	0,039	0,039	0,040	0,039
5,9	0,038	0,039	0,039	0,038	0,039	0,038	0,037	0,037	0,037	0,037	0,036
6,1	0,039	0,041	0,040	0,039	0,039	0,039	0,038	0,037	0,038	0,039	0,038
6,3	0,036	0,038	0,038	0,036	0,037	0,036	0,035	0,036	0,036	0,037	0,036
6,5	0,038	0,039	0,039	0,036	0,037	0,037	0,036	0,035	0,036	0,036	0,036
6,7	0,036	0,037	0,040	0,039	0,038	0,037	0,036	0,036	0,036	0,036	0,036
6,9	0,035	0,035	0,036	0,037	0,040	0,036	0,035	0,035	0,034	0,035	0,034
7,1	0,041	0,052	0,056	0,057	0,063	0,067	0,070	0,071	0,073	0,074	0,076
7,3	0,035	0,044	0,043	0,042	0,041	0,043	0,067	0,066	0,066	0,065	0,065
7,5	0,066	0,071	0,073	0,063	0,066	0,068	0,071	0,071	0,072	0,073	0,075
7,7	0,034	0,036	0,035	0,065	0,064	0,065	0,041	0,038	0,035	0,035	0,041
7,9	0,033	0,037	0,033	0,036	0,035	0,036	0,039	0,041	0,042	0,039	0,037
8,1	0,038	0,038	0,037	0,035	0,036	0,037	0,041	0,040	0,040	0,040	0,039
8,3	0,037	0,038	0,042	0,038	0,038	0,039	0,042	0,041	0,039	0,039	0,038
8,5	0,044	0,047	0,040	0,040	0,043	0,039	0,042	0,042	0,042	0,041	0,040
8,7	0,040	0,040	0,046	0,046	0,045	0,044	0,038	0,038	0,040	0,040	0,039
8,9	0,041	0,045	0,042	0,046	0,044	0,041	0,036	0,036	0,038	0,037	0,037

Note:

The normalization current is 14,493 A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW12K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	3,937	9,671	20,279	30,109	40,422	50,260	60,412	70,543	80,624	90,482	100,377
2	0,343	0,456	0,537	0,561	0,592	0,602	0,601	0,599	0,599	0,602	0,602
3	0,152	0,114	0,090	0,152	0,148	0,138	0,131	0,115	0,132	0,123	0,122
4	0,091	0,272	0,176	0,222	0,463	0,453	0,471	0,482	0,434	0,433	0,423
5	0,316	0,324	0,540	0,569	0,618	0,629	0,662	0,672	0,693	0,697	0,690
6	0,045	0,179	0,181	0,152	0,134	0,122	0,122	0,120	0,122	0,118	0,106
7	0,163	0,133	0,067	0,106	0,089	0,089	0,103	0,113	0,123	0,124	0,114
8	0,068	0,092	0,113	0,197	0,342	0,304	0,236	0,225	0,157	0,150	0,129
9	0,031	0,035	0,069	0,055	0,085	0,102	0,105	0,110	0,099	0,096	0,090
10	0,082	0,096	0,113	0,127	0,162	0,163	0,146	0,134	0,132	0,138	0,149
11	0,291	0,344	0,370	0,318	0,298	0,518	0,740	0,808	0,663	0,622	0,517
12	0,021	0,045	0,105	0,117	0,113	0,107	0,110	0,112	0,106	0,109	0,097
13	0,278	0,426	0,089	0,171	0,270	0,318	0,233	0,185	0,346	0,415	0,564
14	0,063	0,076	0,077	0,079	0,099	0,136	0,174	0,172	0,229	0,230	0,215
15	0,017	0,033	0,047	0,060	0,065	0,075	0,086	0,092	0,090	0,091	0,082
16	0,065	0,068	0,082	0,167	0,106	0,100	0,128	0,158	0,202	0,191	0,176
17	0,136	0,176	0,131	0,133	0,087	0,102	0,160	0,249	0,525	0,588	0,717
18	0,021	0,040	0,045	0,078	0,099	0,102	0,107	0,110	0,094	0,089	0,088
19	0,104	0,159	0,126	0,082	0,215	0,119	0,123	0,127	0,194	0,193	0,246
20	0,053	0,067	0,078	0,123	0,096	0,111	0,135	0,164	0,143	0,138	0,130
21	0,023	0,026	0,047	0,063	0,087	0,094	0,096	0,104	0,074	0,074	0,072
22	0,064	0,058	0,081	0,077	0,206	0,212	0,196	0,164	0,093	0,094	0,116
23	0,055	0,102	0,066	0,143	0,112	0,133	0,152	0,123	0,140	0,120	0,112
24	0,022	0,033	0,026	0,058	0,101	0,117	0,117	0,120	0,087	0,086	0,078
25	0,062	0,072	0,122	0,079	0,136	0,202	0,180	0,198	0,259	0,282	0,245
26	0,062	0,062	0,083	0,081	0,202	0,171	0,136	0,122	0,141	0,173	0,204
27	0,023	0,050	0,077	0,077	0,110	0,120	0,117	0,115	0,076	0,080	0,070
28	0,065	0,057	0,082	0,121	0,120	0,155	0,212	0,233	0,230	0,227	0,206
29	0,076	0,090	0,123	0,126	0,146	0,164	0,131	0,115	0,132	0,148	0,150
30	0,023	0,026	0,029	0,050	0,108	0,124	0,115	0,114	0,077	0,076	0,071
31	0,099	0,081	0,110	0,093	0,151	0,152	0,166	0,146	0,170	0,203	0,252
32	0,073	0,065	0,087	0,091	0,142	0,190	0,212	0,209	0,180	0,157	0,113
33	0,032	0,065	0,165	0,190	0,245	0,236	0,264	0,255	0,238	0,225	0,226
34	0,082	0,072	0,106	0,121	0,154	0,160	0,165	0,177	0,192	0,183	0,189
35	0,151	0,399	0,620	0,685	0,751	0,760	0,749	0,752	0,767	0,759	0,741
36	0,030	0,050	0,064	0,078	0,110	0,107	0,105	0,105	0,100	0,099	0,092
37	0,136	0,203	0,142	0,116	0,112	0,113	0,139	0,134	0,140	0,113	0,098
38	0,089	0,100	0,107	0,119	0,134	0,126	0,146	0,178	0,173	0,168	0,164
39	0,135	0,602	0,509	0,460	0,410	0,415	0,380	0,381	0,364	0,353	0,349
40	0,108	0,129	0,108	0,099	0,189	0,193	0,141	0,137	0,132	0,155	0,184
41	0,170	0,664	0,531	0,517	0,452	0,439	0,414	0,416	0,366	0,378	0,375
42	0,031	0,061	0,061	0,068	0,081	0,079	0,080	0,082	0,070	0,069	0,066

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,152	0,152	0,104	0,109	0,129	0,117	0,082	0,083	0,115	0,124	0,139
44	0,099	0,089	0,092	0,093	0,159	0,151	0,119	0,110	0,149	0,167	0,162
45	0,093	0,319	0,459	0,518	0,555	0,570	0,579	0,581	0,572	0,567	0,553
46	0,106	0,082	0,088	0,102	0,092	0,103	0,158	0,167	0,125	0,104	0,094
47	0,149	0,136	0,192	0,219	0,243	0,237	0,209	0,217	0,241	0,243	0,228
48	0,040	0,036	0,036	0,048	0,064	0,064	0,060	0,063	0,052	0,056	0,052
49	0,153	0,124	0,093	0,085	0,110	0,111	0,092	0,083	0,055	0,056	0,060
50	0,095	0,083	0,074	0,077	0,056	0,080	0,111	0,104	0,058	0,071	0,107
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,070	0,092	0,146	0,220	0,284	0,344	0,423	0,495	0,560	0,617	0,679
125	0,040	0,052	0,052	0,075	0,083	0,094	0,103	0,114	0,126	0,132	0,135
175	0,027	0,035	0,037	0,105	0,132	0,148	0,162	0,175	0,207	0,212	0,193
225	0,029	0,039	0,044	0,107	0,185	0,196	0,203	0,214	0,234	0,235	0,227
275	0,035	0,037	0,038	0,116	0,131	0,140	0,152	0,156	0,175	0,176	0,159
325	0,029	0,030	0,037	0,106	0,163	0,166	0,168	0,179	0,199	0,206	0,193
375	0,024	0,028	0,030	0,111	0,116	0,124	0,141	0,143	0,159	0,159	0,142
425	0,026	0,028	0,036	0,148	0,187	0,201	0,220	0,229	0,271	0,270	0,225
475	0,025	0,025	0,032	0,151	0,153	0,172	0,208	0,228	0,267	0,266	0,234
525	0,023	0,027	0,059	0,157	0,204	0,204	0,242	0,263	0,316	0,325	0,286
575	0,026	0,026	0,064	0,150	0,172	0,199	0,243	0,261	0,291	0,302	0,278
625	0,021	0,023	0,038	0,159	0,189	0,191	0,255	0,296	0,303	0,307	0,266
675	0,021	0,023	0,042	0,147	0,184	0,206	0,256	0,297	0,283	0,295	0,276
725	0,020	0,023	0,037	0,150	0,190	0,204	0,267	0,305	0,260	0,256	0,230
775	0,021	0,021	0,030	0,148	0,192	0,216	0,263	0,301	0,229	0,230	0,218
825	0,020	0,029	0,052	0,155	0,234	0,274	0,317	0,355	0,252	0,243	0,233
875	0,023	0,024	0,034	0,152	0,226	0,256	0,302	0,336	0,216	0,218	0,202
925	0,023	0,032	0,030	0,158	0,256	0,303	0,335	0,348	0,210	0,213	0,203
975	0,024	0,025	0,028	0,156	0,296	0,308	0,328	0,350	0,210	0,209	0,203
1025	0,023	0,032	0,075	0,170	0,321	0,353	0,337	0,332	0,179	0,185	0,174
1075	0,021	0,022	0,031	0,157	0,319	0,344	0,321	0,316	0,179	0,176	0,159
1125	0,021	0,032	0,103	0,195	0,377	0,407	0,342	0,317	0,210	0,219	0,204
1175	0,022	0,026	0,027	0,156	0,314	0,348	0,315	0,296	0,185	0,187	0,166
1225	0,034	0,033	0,048	0,165	0,344	0,383	0,315	0,266	0,208	0,218	0,189
1275	0,026	0,028	0,033	0,149	0,357	0,360	0,306	0,267	0,207	0,222	0,198
1325	0,030	0,090	0,144	0,184	0,356	0,373	0,293	0,252	0,208	0,207	0,179
1375	0,024	0,027	0,035	0,147	0,342	0,337	0,277	0,251	0,186	0,185	0,167
1425	0,026	0,111	0,222	0,236	0,390	0,375	0,283	0,263	0,213	0,208	0,180
1475	0,024	0,031	0,037	0,138	0,294	0,307	0,254	0,240	0,181	0,181	0,163
1525	0,033	0,087	0,104	0,159	0,305	0,320	0,248	0,248	0,181	0,174	0,152
1575	0,026	0,030	0,044	0,128	0,294	0,279	0,238	0,243	0,176	0,169	0,152
1625	0,052	0,114	0,307	0,380	0,457	0,492	0,441	0,445	0,423	0,429	0,438
1675	0,038	0,036	0,087	0,152	0,265	0,250	0,235	0,243	0,166	0,153	0,143
1725	0,193	0,646	1,057	1,177	1,295	1,343	1,382	1,402	1,407	1,440	1,465
1775	0,038	0,135	0,189	0,233	0,288	0,271	0,249	0,265	0,247	0,245	0,237

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,071	0,288	0,155	0,150	0,221	0,198	0,188	0,207	0,155	0,162	0,149
1875	0,040	0,093	0,119	0,145	0,198	0,180	0,174	0,181	0,140	0,148	0,133
1925	0,219	0,993	0,846	0,789	0,743	0,726	0,715	0,727	0,692	0,723	0,737
1975	0,069	0,225	0,173	0,168	0,191	0,187	0,178	0,171	0,177	0,159	0,154
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,349	1,407	1,069	1,050	0,985	0,941	0,894	0,895	0,878	0,891	0,900
2,3	0,272	0,672	0,962	1,093	1,175	1,205	1,245	1,268	1,278	1,293	1,301
2,5	0,214	0,213	0,215	0,212	0,257	0,260	0,251	0,263	0,219	0,223	0,223
2,7	0,217	0,207	0,213	0,193	0,223	0,205	0,202	0,217	0,201	0,197	0,191
2,9	0,156	0,147	0,141	0,161	0,173	0,161	0,164	0,162	0,173	0,189	0,186
3,1	0,150	0,144	0,128	0,143	0,160	0,153	0,157	0,162	0,176	0,172	0,173
3,3	0,167	0,167	0,135	0,150	0,165	0,157	0,158	0,164	0,169	0,172	0,173
3,5	0,129	0,130	0,123	0,123	0,141	0,136	0,139	0,146	0,169	0,165	0,155
3,7	0,134	0,142	0,131	0,132	0,144	0,135	0,139	0,147	0,170	0,175	0,181
3,9	0,143	0,134	0,141	0,144	0,160	0,148	0,147	0,151	0,171	0,178	0,180
4,1	0,135	0,132	0,131	0,138	0,144	0,135	0,140	0,146	0,174	0,178	0,195
4,3	0,090	0,103	0,106	0,115	0,124	0,121	0,125	0,130	0,149	0,157	0,177
4,5	0,065	0,063	0,068	0,075	0,089	0,093	0,097	0,101	0,111	0,114	0,117
4,7	0,060	0,065	0,066	0,071	0,081	0,085	0,090	0,093	0,084	0,086	0,085
4,9	0,045	0,044	0,042	0,045	0,057	0,063	0,064	0,065	0,054	0,053	0,052
5,1	0,037	0,037	0,037	0,038	0,048	0,053	0,053	0,051	0,045	0,045	0,046
5,3	0,033	0,033	0,034	0,035	0,041	0,045	0,044	0,042	0,040	0,041	0,040
5,5	0,032	0,031	0,032	0,034	0,040	0,042	0,041	0,040	0,036	0,038	0,036
5,7	0,031	0,030	0,031	0,034	0,040	0,041	0,040	0,040	0,038	0,039	0,037
5,9	0,031	0,031	0,031	0,033	0,041	0,041	0,039	0,040	0,038	0,039	0,044
6,1	0,033	0,032	0,031	0,034	0,041	0,041	0,040	0,041	0,044	0,050	0,044
6,3	0,032	0,031	0,035	0,035	0,046	0,049	0,042	0,046	0,051	0,043	0,045
6,5	0,047	0,043	0,036	0,040	0,048	0,047	0,055	0,053	0,034	0,037	0,037
6,7	0,031	0,037	0,041	0,044	0,034	0,037	0,037	0,036	0,033	0,034	0,036
6,9	0,028	0,029	0,031	0,033	0,034	0,035	0,035	0,036	0,034	0,034	0,035
7,1	0,035	0,047	0,049	0,053	0,059	0,061	0,063	0,065	0,065	0,068	0,069
7,3	0,031	0,038	0,050	0,053	0,057	0,056	0,058	0,058	0,060	0,060	0,060
7,5	0,034	0,048	0,059	0,063	0,066	0,068	0,070	0,071	0,073	0,075	0,076
7,7	0,027	0,028	0,030	0,031	0,031	0,032	0,032	0,033	0,033	0,032	0,033
7,9	0,026	0,026	0,027	0,031	0,030	0,030	0,030	0,030	0,030	0,031	0,030
8,1	0,026	0,026	0,027	0,028	0,033	0,030	0,030	0,030	0,030	0,030	0,031
8,3	0,027	0,027	0,028	0,028	0,031	0,032	0,030	0,031	0,030	0,031	0,030
8,5	0,030	0,030	0,031	0,031	0,030	0,031	0,031	0,031	0,032	0,030	0,030
8,7	0,027	0,031	0,029	0,028	0,030	0,033	0,033	0,032	0,030	0,029	0,030
8,9	0,031	0,038	0,034	0,029	0,031	0,032	0,032	0,032	0,033	0,034	0,031

Note:

The normalization current is 17,391 A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW13K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	2,429	10,303	21,085	30,875	40,461	50,219	60,713	70,405	80,454	90,650	100,443
2	0,312	0,424	0,502	0,528	0,551	0,551	0,577	0,578	0,588	0,594	0,596
3	0,156	0,108	0,119	0,142	0,139	0,137	0,112	0,104	0,098	0,105	0,104
4	0,076	0,245	0,154	0,233	0,415	0,294	0,451	0,443	0,433	0,431	0,423
5	0,292	0,314	0,503	0,516	0,547	0,494	0,605	0,577	0,578	0,640	0,661
6	0,029	0,193	0,160	0,133	0,120	0,102	0,107	0,099	0,096	0,110	0,110
7	0,163	0,130	0,069	0,102	0,087	0,095	0,101	0,094	0,101	0,118	0,128
8	0,066	0,086	0,107	0,199	0,330	0,249	0,228	0,245	0,255	0,177	0,158
9	0,024	0,033	0,049	0,058	0,090	0,088	0,100	0,092	0,088	0,099	0,099
10	0,063	0,097	0,104	0,117	0,165	0,139	0,129	0,143	0,145	0,116	0,122
11	0,328	0,137	0,320	0,236	0,220	0,354	0,713	0,721	0,726	0,734	0,737
12	0,021	0,043	0,101	0,105	0,100	0,093	0,100	0,093	0,089	0,098	0,100
13	0,251	0,508	0,172	0,115	0,235	0,226	0,191	0,158	0,130	0,210	0,246
14	0,060	0,061	0,071	0,081	0,085	0,095	0,152	0,125	0,112	0,186	0,201
15	0,019	0,033	0,026	0,055	0,062	0,065	0,086	0,078	0,076	0,091	0,093
16	0,066	0,062	0,078	0,169	0,143	0,182	0,115	0,103	0,094	0,165	0,171
17	0,137	0,097	0,139	0,134	0,093	0,109	0,159	0,187	0,180	0,391	0,440
18	0,031	0,043	0,049	0,077	0,089	0,087	0,102	0,095	0,089	0,097	0,090
19	0,106	0,200	0,147	0,120	0,185	0,124	0,122	0,183	0,234	0,134	0,155
20	0,063	0,061	0,069	0,127	0,091	0,139	0,134	0,133	0,130	0,147	0,142
21	0,026	0,026	0,050	0,061	0,081	0,070	0,097	0,096	0,095	0,094	0,090
22	0,070	0,054	0,070	0,062	0,137	0,080	0,178	0,187	0,185	0,109	0,101
23	0,074	0,116	0,065	0,116	0,123	0,116	0,122	0,113	0,135	0,120	0,134
24	0,036	0,030	0,025	0,058	0,087	0,083	0,112	0,117	0,117	0,097	0,092
25	0,076	0,085	0,091	0,086	0,147	0,120	0,164	0,190	0,215	0,259	0,274
26	0,073	0,067	0,069	0,074	0,165	0,092	0,127	0,150	0,155	0,125	0,125
27	0,029	0,061	0,081	0,069	0,092	0,075	0,112	0,121	0,131	0,095	0,090
28	0,080	0,047	0,076	0,117	0,097	0,104	0,208	0,188	0,183	0,189	0,186
29	0,099	0,116	0,108	0,119	0,129	0,140	0,120	0,139	0,172	0,133	0,142
30	0,032	0,028	0,031	0,056	0,090	0,077	0,116	0,129	0,136	0,094	0,088
31	0,121	0,077	0,074	0,073	0,116	0,116	0,156	0,140	0,156	0,159	0,162
32	0,089	0,081	0,071	0,093	0,105	0,101	0,212	0,212	0,217	0,149	0,141
33	0,034	0,092	0,186	0,210	0,208	0,204	0,236	0,226	0,245	0,220	0,228
34	0,103	0,086	0,120	0,133	0,164	0,125	0,157	0,156	0,161	0,210	0,221
35	0,158	0,374	0,557	0,614	0,697	0,697	0,729	0,744	0,766	0,782	0,791
36	0,025	0,032	0,046	0,053	0,114	0,081	0,116	0,125	0,128	0,108	0,093
37	0,168	0,137	0,071	0,099	0,102	0,127	0,141	0,127	0,124	0,129	0,143
38	0,115	0,112	0,091	0,098	0,128	0,103	0,138	0,136	0,140	0,191	0,182
39	0,087	0,543	0,430	0,402	0,426	0,449	0,387	0,431	0,431	0,407	0,403
40	0,124	0,088	0,085	0,084	0,148	0,103	0,140	0,190	0,198	0,104	0,123
41	0,192	0,638	0,481	0,473	0,404	0,454	0,418	0,419	0,446	0,425	0,421
42	0,031	0,064	0,052	0,058	0,066	0,060	0,081	0,079	0,088	0,079	0,074

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,192	0,145	0,095	0,089	0,131	0,077	0,090	0,095	0,088	0,075	0,074
44	0,132	0,098	0,082	0,080	0,123	0,082	0,117	0,137	0,133	0,132	0,149
45	0,075	0,331	0,448	0,502	0,501	0,522	0,554	0,558	0,567	0,587	0,600
46	0,129	0,082	0,091	0,111	0,086	0,090	0,153	0,119	0,121	0,121	0,102
47	0,189	0,127	0,191	0,186	0,230	0,221	0,196	0,226	0,208	0,194	0,202
48	0,037	0,040	0,039	0,043	0,056	0,052	0,059	0,067	0,066	0,058	0,057
49	0,187	0,102	0,098	0,093	0,072	0,084	0,093	0,119	0,106	0,061	0,065
50	0,122	0,086	0,061	0,070	0,062	0,067	0,107	0,098	0,107	0,068	0,070
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,066	0,092	0,153	0,226	0,291	0,349	0,428	0,481	0,538	0,624	0,683
125	0,033	0,043	0,055	0,074	0,090	0,096	0,100	0,104	0,105	0,133	0,146
175	0,026	0,033	0,033	0,112	0,143	0,161	0,147	0,147	0,147	0,192	0,202
225	0,023	0,035	0,034	0,113	0,209	0,152	0,190	0,196	0,189	0,226	0,243
275	0,025	0,033	0,032	0,118	0,134	0,150	0,135	0,136	0,137	0,169	0,174
325	0,024	0,033	0,030	0,114	0,181	0,139	0,156	0,161	0,163	0,187	0,202
375	0,024	0,028	0,026	0,118	0,115	0,139	0,122	0,121	0,118	0,146	0,153
425	0,026	0,029	0,037	0,153	0,206	0,187	0,194	0,198	0,198	0,249	0,260
475	0,025	0,025	0,031	0,154	0,148	0,178	0,188	0,184	0,179	0,253	0,262
525	0,023	0,029	0,048	0,163	0,231	0,208	0,217	0,206	0,201	0,316	0,351
575	0,025	0,028	0,044	0,150	0,166	0,213	0,220	0,212	0,209	0,292	0,315
625	0,021	0,026	0,033	0,167	0,194	0,204	0,226	0,205	0,195	0,317	0,326
675	0,021	0,024	0,034	0,154	0,161	0,206	0,244	0,212	0,198	0,316	0,326
725	0,020	0,023	0,037	0,152	0,160	0,199	0,242	0,209	0,182	0,292	0,295
775	0,021	0,022	0,028	0,158	0,165	0,219	0,244	0,215	0,199	0,270	0,272
825	0,020	0,043	0,052	0,167	0,186	0,243	0,306	0,272	0,239	0,320	0,321
875	0,022	0,024	0,033	0,164	0,191	0,234	0,289	0,263	0,244	0,286	0,272
925	0,021	0,030	0,035	0,170	0,202	0,241	0,317	0,298	0,282	0,285	0,259
975	0,021	0,029	0,031	0,171	0,257	0,255	0,319	0,298	0,292	0,289	0,274
1025	0,021	0,035	0,071	0,180	0,243	0,263	0,336	0,337	0,332	0,239	0,215
1075	0,022	0,026	0,034	0,166	0,277	0,263	0,320	0,324	0,344	0,234	0,211
1125	0,021	0,037	0,103	0,195	0,283	0,279	0,351	0,389	0,392	0,240	0,221
1175	0,022	0,026	0,026	0,168	0,277	0,260	0,321	0,341	0,359	0,224	0,203
1225	0,025	0,028	0,053	0,180	0,281	0,263	0,308	0,361	0,392	0,230	0,230
1275	0,023	0,036	0,032	0,167	0,335	0,259	0,307	0,355	0,394	0,239	0,240
1325	0,023	0,117	0,119	0,183	0,293	0,255	0,288	0,359	0,394	0,236	0,238
1375	0,025	0,026	0,046	0,159	0,322	0,244	0,272	0,324	0,372	0,226	0,223
1425	0,025	0,110	0,196	0,211	0,326	0,249	0,267	0,359	0,384	0,261	0,278
1475	0,030	0,041	0,047	0,156	0,278	0,224	0,247	0,299	0,341	0,232	0,239
1525	0,029	0,090	0,108	0,175	0,285	0,226	0,235	0,293	0,332	0,223	0,223
1575	0,027	0,050	0,032	0,141	0,304	0,216	0,229	0,277	0,309	0,225	0,228
1625	0,042	0,118	0,278	0,331	0,441	0,417	0,418	0,442	0,434	0,401	0,379
1675	0,030	0,089	0,118	0,189	0,263	0,191	0,229	0,234	0,267	0,208	0,196
1725	0,129	0,718	1,041	1,145	1,193	1,197	1,254	1,258	1,266	1,295	1,330
1775	0,035	0,075	0,124	0,184	0,282	0,257	0,256	0,268	0,287	0,256	0,245

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,030	0,287	0,155	0,153	0,227	0,182	0,187	0,200	0,196	0,168	0,158
1875	0,035	0,075	0,062	0,117	0,206	0,149	0,183	0,172	0,180	0,165	0,151
1925	0,153	0,987	0,793	0,739	0,681	0,754	0,659	0,686	0,746	0,666	0,695
1975	0,040	0,141	0,096	0,129	0,223	0,192	0,176	0,201	0,198	0,177	0,179
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,344	1,303	0,978	0,959	0,936	0,973	0,844	0,906	0,947	0,861	0,895
2,3	0,278	0,662	0,929	1,028	1,080	1,085	1,152	1,161	1,181	1,204	1,225
2,5	0,250	0,217	0,197	0,202	0,185	0,185	0,243	0,267	0,278	0,242	0,245
2,7	0,241	0,198	0,174	0,174	0,169	0,158	0,195	0,203	0,205	0,194	0,190
2,9	0,156	0,148	0,138	0,154	0,142	0,128	0,155	0,157	0,161	0,157	0,166
3,1	0,145	0,127	0,119	0,137	0,135	0,117	0,144	0,141	0,139	0,163	0,168
3,3	0,157	0,166	0,138	0,142	0,136	0,121	0,144	0,139	0,138	0,155	0,158
3,5	0,123	0,133	0,102	0,117	0,117	0,104	0,126	0,125	0,124	0,163	0,163
3,7	0,146	0,126	0,116	0,125	0,125	0,103	0,130	0,125	0,124	0,154	0,167
3,9	0,152	0,125	0,127	0,138	0,144	0,118	0,138	0,135	0,134	0,160	0,175
4,1	0,099	0,118	0,122	0,126	0,123	0,109	0,130	0,134	0,137	0,169	0,178
4,3	0,075	0,090	0,099	0,107	0,111	0,097	0,114	0,115	0,117	0,138	0,149
4,5	0,056	0,060	0,062	0,071	0,080	0,072	0,088	0,084	0,082	0,101	0,109
4,7	0,052	0,061	0,062	0,066	0,072	0,067	0,081	0,077	0,075	0,087	0,091
4,9	0,038	0,040	0,039	0,043	0,050	0,045	0,059	0,057	0,056	0,061	0,062
5,1	0,036	0,036	0,034	0,036	0,041	0,039	0,048	0,048	0,049	0,045	0,046
5,3	0,031	0,032	0,033	0,034	0,037	0,034	0,041	0,042	0,045	0,040	0,040
5,5	0,029	0,030	0,031	0,032	0,035	0,033	0,038	0,040	0,044	0,038	0,039
5,7	0,029	0,029	0,029	0,032	0,036	0,032	0,038	0,041	0,044	0,038	0,040
5,9	0,027	0,027	0,029	0,031	0,035	0,031	0,037	0,040	0,043	0,039	0,039
6,1	0,029	0,029	0,030	0,033	0,037	0,034	0,038	0,040	0,043	0,040	0,040
6,3	0,027	0,027	0,029	0,032	0,037	0,033	0,038	0,039	0,040	0,038	0,039
6,5	0,028	0,028	0,032	0,034	0,039	0,033	0,037	0,038	0,041	0,037	0,038
6,7	0,027	0,035	0,038	0,039	0,046	0,044	0,045	0,050	0,044	0,037	0,037
6,9	0,026	0,040	0,036	0,039	0,032	0,037	0,040	0,039	0,046	0,052	0,037
7,1	0,029	0,045	0,047	0,051	0,055	0,057	0,060	0,062	0,063	0,064	0,078
7,3	0,026	0,037	0,047	0,049	0,050	0,047	0,053	0,052	0,051	0,054	0,056
7,5	0,049	0,045	0,056	0,059	0,061	0,060	0,065	0,066	0,066	0,070	0,073
7,7	0,026	0,026	0,026	0,031	0,029	0,029	0,032	0,032	0,032	0,032	0,033
7,9	0,025	0,025	0,025	0,027	0,029	0,030	0,031	0,030	0,030	0,030	0,031
8,1	0,028	0,024	0,026	0,027	0,032	0,031	0,031	0,031	0,030	0,031	0,030
8,3	0,029	0,025	0,028	0,029	0,032	0,032	0,031	0,030	0,031	0,032	0,033
8,5	0,030	0,028	0,030	0,032	0,031	0,030	0,032	0,031	0,032	0,030	0,031
8,7	0,033	0,032	0,030	0,030	0,028	0,028	0,029	0,028	0,029	0,028	0,030
8,9	0,029	0,038	0,031	0,029	0,029	0,030	0,030	0,030	0,030	0,029	0,031

Note:

The normalization current is 11,594 A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW15K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	4,440	9,754	20,624	30,216	40,791	50,682	60,369	70,500	80,299	90,458	100,299
2	0,362	0,399	0,467	0,481	0,493	0,498	0,505	0,506	0,510	0,518	0,510
3	0,129	0,113	0,126	0,139	0,122	0,108	0,101	0,093	0,093	0,093	0,088
4	0,114	0,218	0,129	0,098	0,081	0,078	0,082	0,095	0,090	0,214	0,301
5	0,242	0,245	0,405	0,405	0,402	0,394	0,386	0,402	0,395	0,428	0,450
6	0,034	0,183	0,135	0,103	0,082	0,073	0,064	0,066	0,063	0,077	0,074
7	0,137	0,122	0,074	0,094	0,094	0,082	0,085	0,071	0,066	0,062	0,067
8	0,054	0,081	0,093	0,079	0,069	0,064	0,058	0,072	0,071	0,175	0,236
9	0,023	0,032	0,040	0,043	0,064	0,064	0,060	0,063	0,061	0,073	0,069
10	0,061	0,092	0,092	0,080	0,065	0,063	0,057	0,062	0,052	0,109	0,153
11	0,236	0,146	0,275	0,077	0,203	0,286	0,310	0,326	0,347	0,461	0,526
12	0,027	0,043	0,092	0,085	0,075	0,068	0,060	0,061	0,057	0,067	0,069
13	0,212	0,414	0,183	0,121	0,132	0,232	0,279	0,289	0,287	0,218	0,195
14	0,048	0,052	0,063	0,070	0,060	0,055	0,050	0,054	0,050	0,088	0,107
15	0,019	0,029	0,023	0,032	0,035	0,040	0,041	0,045	0,045	0,063	0,067
16	0,052	0,055	0,068	0,077	0,061	0,056	0,055	0,066	0,061	0,131	0,144
17	0,105	0,110	0,092	0,145	0,042	0,113	0,175	0,193	0,217	0,169	0,166
18	0,016	0,041	0,048	0,062	0,061	0,058	0,053	0,054	0,051	0,067	0,073
19	0,083	0,143	0,128	0,125	0,060	0,086	0,151	0,199	0,211	0,282	0,285
20	0,043	0,055	0,063	0,061	0,055	0,054	0,050	0,061	0,059	0,107	0,103
21	0,023	0,027	0,043	0,041	0,031	0,033	0,036	0,045	0,042	0,064	0,072
22	0,052	0,048	0,065	0,062	0,062	0,058	0,051	0,051	0,050	0,072	0,089
23	0,050	0,089	0,054	0,054	0,090	0,045	0,091	0,137	0,161	0,203	0,199
24	0,016	0,033	0,023	0,039	0,046	0,046	0,045	0,048	0,045	0,070	0,081
25	0,056	0,062	0,062	0,050	0,105	0,051	0,075	0,112	0,136	0,139	0,176
26	0,050	0,061	0,066	0,059	0,056	0,052	0,052	0,049	0,047	0,077	0,108
27	0,021	0,057	0,064	0,044	0,040	0,036	0,035	0,040	0,039	0,071	0,082
28	0,058	0,045	0,073	0,068	0,063	0,058	0,052	0,059	0,061	0,092	0,095
29	0,066	0,096	0,097	0,096	0,086	0,067	0,053	0,074	0,089	0,117	0,169
30	0,020	0,027	0,023	0,025	0,034	0,036	0,037	0,041	0,039	0,066	0,084
31	0,082	0,071	0,059	0,086	0,088	0,080	0,050	0,077	0,095	0,128	0,126
32	0,064	0,067	0,067	0,074	0,061	0,054	0,054	0,061	0,060	0,079	0,094
33	0,040	0,073	0,141	0,163	0,165	0,190	0,190	0,177	0,181	0,179	0,174
34	0,075	0,060	0,099	0,089	0,093	0,109	0,106	0,079	0,105	0,108	0,152
35	0,173	0,370	0,500	0,564	0,591	0,583	0,593	0,626	0,621	0,657	0,683
36	0,025	0,043	0,053	0,066	0,072	0,044	0,043	0,065	0,053	0,086	0,089
37	0,122	0,147	0,093	0,075	0,073	0,088	0,059	0,060	0,052	0,089	0,131
38	0,081	0,104	0,091	0,084	0,084	0,078	0,073	0,080	0,080	0,103	0,121
39	0,264	0,493	0,430	0,400	0,413	0,416	0,430	0,438	0,463	0,468	0,497
40	0,104	0,101	0,078	0,087	0,073	0,075	0,058	0,079	0,088	0,101	0,093
41	0,313	0,559	0,484	0,458	0,449	0,455	0,475	0,470	0,492	0,495	0,538
42	0,038	0,056	0,058	0,057	0,057	0,042	0,050	0,055	0,051	0,069	0,070

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,135	0,102	0,100	0,079	0,071	0,079	0,078	0,052	0,047	0,057	0,079
44	0,083	0,094	0,080	0,085	0,082	0,069	0,055	0,074	0,076	0,089	0,095
45	0,115	0,293	0,399	0,421	0,436	0,459	0,476	0,470	0,486	0,491	0,516
46	0,093	0,063	0,083	0,072	0,065	0,081	0,079	0,065	0,075	0,079	0,093
47	0,127	0,138	0,150	0,172	0,161	0,158	0,146	0,169	0,153	0,167	0,159
48	0,029	0,032	0,027	0,032	0,030	0,030	0,032	0,033	0,034	0,047	0,055
49	0,136	0,104	0,082	0,061	0,063	0,060	0,071	0,051	0,043	0,045	0,046
50	0,076	0,078	0,057	0,054	0,048	0,046	0,043	0,041	0,041	0,055	0,058
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,067	0,092	0,153	0,211	0,278	0,340	0,413	0,475	0,538	0,625	0,669
125	0,041	0,048	0,057	0,059	0,063	0,075	0,087	0,092	0,107	0,106	0,121
175	0,028	0,032	0,032	0,038	0,042	0,049	0,060	0,082	0,089	0,141	0,148
225	0,024	0,034	0,031	0,045	0,053	0,061	0,067	0,085	0,099	0,146	0,169
275	0,028	0,032	0,030	0,047	0,054	0,053	0,053	0,076	0,078	0,135	0,128
325	0,023	0,033	0,029	0,038	0,045	0,049	0,053	0,074	0,075	0,121	0,136
375	0,020	0,025	0,024	0,032	0,040	0,041	0,044	0,065	0,069	0,120	0,109
425	0,023	0,025	0,032	0,035	0,043	0,046	0,054	0,084	0,090	0,182	0,167
475	0,024	0,021	0,030	0,031	0,035	0,037	0,046	0,082	0,090	0,199	0,182
525	0,021	0,029	0,044	0,035	0,071	0,080	0,084	0,119	0,123	0,230	0,207
575	0,023	0,025	0,044	0,035	0,076	0,087	0,086	0,118	0,126	0,220	0,196
625	0,020	0,023	0,033	0,034	0,056	0,066	0,073	0,103	0,104	0,215	0,205
675	0,020	0,020	0,034	0,031	0,061	0,080	0,078	0,109	0,111	0,228	0,221
725	0,019	0,022	0,033	0,039	0,044	0,044	0,045	0,075	0,074	0,208	0,209
775	0,020	0,018	0,024	0,027	0,027	0,030	0,037	0,072	0,068	0,217	0,221
825	0,018	0,035	0,040	0,059	0,061	0,067	0,065	0,093	0,088	0,234	0,241
875	0,021	0,021	0,025	0,042	0,029	0,051	0,062	0,092	0,096	0,229	0,250
925	0,021	0,026	0,034	0,042	0,039	0,046	0,056	0,089	0,089	0,231	0,261
975	0,021	0,022	0,030	0,043	0,026	0,047	0,058	0,096	0,095	0,251	0,281
1025	0,026	0,032	0,057	0,054	0,054	0,047	0,046	0,070	0,067	0,231	0,279
1075	0,021	0,022	0,028	0,028	0,026	0,032	0,037	0,064	0,061	0,225	0,281
1125	0,026	0,026	0,089	0,085	0,078	0,066	0,059	0,082	0,084	0,238	0,297
1175	0,022	0,023	0,026	0,029	0,029	0,031	0,045	0,075	0,077	0,229	0,297
1225	0,035	0,033	0,044	0,051	0,052	0,053	0,055	0,081	0,073	0,227	0,297
1275	0,025	0,025	0,028	0,026	0,035	0,031	0,044	0,070	0,066	0,226	0,298
1325	0,024	0,106	0,093	0,071	0,052	0,046	0,052	0,065	0,059	0,207	0,285
1375	0,021	0,024	0,037	0,024	0,025	0,033	0,034	0,054	0,051	0,201	0,281
1425	0,033	0,120	0,153	0,104	0,066	0,059	0,045	0,064	0,074	0,204	0,281
1475	0,024	0,034	0,035	0,039	0,037	0,035	0,042	0,057	0,055	0,186	0,260
1525	0,034	0,081	0,074	0,064	0,059	0,067	0,060	0,070	0,070	0,177	0,260
1575	0,024	0,032	0,045	0,052	0,044	0,041	0,040	0,068	0,062	0,175	0,254
1625	0,061	0,123	0,235	0,257	0,302	0,274	0,273	0,280	0,264	0,310	0,356
1675	0,030	0,052	0,096	0,067	0,089	0,116	0,123	0,085	0,111	0,160	0,238
1725	0,254	0,632	0,893	0,956	1,001	1,036	1,046	1,040	1,079	1,106	1,157
1775	0,060	0,118	0,122	0,161	0,165	0,133	0,148	0,193	0,151	0,223	0,260

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,118	0,213	0,127	0,103	0,084	0,083	0,069	0,097	0,088	0,150	0,192
1875	0,041	0,093	0,070	0,072	0,083	0,061	0,062	0,090	0,074	0,142	0,185
1925	0,429	0,903	0,760	0,722	0,704	0,739	0,753	0,777	0,811	0,826	0,841
1975	0,096	0,157	0,115	0,107	0,124	0,096	0,101	0,125	0,122	0,164	0,193
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,653	1,176	0,963	0,929	0,883	0,899	0,912	0,946	0,982	1,018	1,050
2,3	0,295	0,606	0,810	0,873	0,905	0,925	0,939	0,957	0,973	1,011	1,041
2,5	0,198	0,197	0,164	0,132	0,123	0,121	0,126	0,115	0,110	0,149	0,173
2,7	0,192	0,185	0,157	0,128	0,106	0,105	0,113	0,106	0,101	0,124	0,137
2,9	0,135	0,134	0,121	0,108	0,086	0,082	0,089	0,088	0,085	0,106	0,115
3,1	0,133	0,120	0,113	0,101	0,090	0,087	0,087	0,087	0,091	0,106	0,115
3,3	0,142	0,152	0,123	0,114	0,098	0,091	0,088	0,092	0,093	0,104	0,109
3,5	0,108	0,121	0,100	0,095	0,084	0,080	0,077	0,080	0,082	0,091	0,097
3,7	0,123	0,116	0,106	0,100	0,087	0,083	0,080	0,081	0,084	0,092	0,098
3,9	0,133	0,111	0,118	0,114	0,100	0,092	0,090	0,090	0,093	0,100	0,104
4,1	0,148	0,099	0,105	0,103	0,092	0,091	0,094	0,098	0,104	0,113	0,117
4,3	0,099	0,075	0,086	0,086	0,080	0,080	0,081	0,082	0,087	0,095	0,100
4,5	0,061	0,051	0,054	0,057	0,056	0,058	0,057	0,056	0,058	0,061	0,065
4,7	0,053	0,051	0,053	0,053	0,053	0,055	0,055	0,054	0,056	0,058	0,061
4,9	0,041	0,034	0,033	0,033	0,033	0,036	0,035	0,035	0,036	0,039	0,042
5,1	0,034	0,031	0,030	0,031	0,031	0,032	0,032	0,034	0,033	0,036	0,038
5,3	0,031	0,029	0,030	0,027	0,028	0,028	0,029	0,028	0,029	0,031	0,033
5,5	0,028	0,026	0,027	0,025	0,025	0,027	0,026	0,027	0,027	0,030	0,032
5,7	0,026	0,026	0,027	0,025	0,025	0,027	0,027	0,025	0,027	0,030	0,033
5,9	0,025	0,023	0,025	0,024	0,023	0,024	0,024	0,025	0,027	0,030	0,034
6,1	0,025	0,024	0,025	0,025	0,024	0,025	0,025	0,025	0,027	0,030	0,037
6,3	0,023	0,023	0,024	0,023	0,023	0,023	0,023	0,024	0,025	0,029	0,036
6,5	0,023	0,022	0,023	0,023	0,022	0,023	0,023	0,023	0,025	0,028	0,035
6,7	0,025	0,025	0,023	0,023	0,022	0,023	0,023	0,023	0,028	0,029	0,033
6,9	0,023	0,023	0,026	0,022	0,022	0,024	0,025	0,024	0,042	0,029	0,033
7,1	0,032	0,037	0,040	0,046	0,059	0,060	0,060	0,054	0,053	0,068	0,068
7,3	0,024	0,029	0,042	0,047	0,039	0,038	0,037	0,044	0,035	0,041	0,040
7,5	0,030	0,037	0,049	0,051	0,051	0,051	0,052	0,053	0,055	0,059	0,062
7,7	0,033	0,040	0,022	0,024	0,026	0,026	0,025	0,026	0,025	0,029	0,029
7,9	0,033	0,023	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,027	0,028
8,1	0,023	0,022	0,026	0,027	0,027	0,027	0,025	0,025	0,026	0,027	0,028
8,3	0,024	0,024	0,029	0,025	0,024	0,025	0,024	0,024	0,024	0,026	0,028
8,5	0,023	0,029	0,024	0,023	0,023	0,024	0,024	0,025	0,025	0,027	0,027
8,7	0,031	0,027	0,022	0,022	0,022	0,023	0,023	0,023	0,023	0,024	0,027
8,9	0,030	0,027	0,023	0,023	0,023	0,025	0,024	0,023	0,024	0,025	0,026

Note:
The normalization current is 21,739 A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW17K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	5,048	10,246	20,564	30,274	40,461	50,431	60,476	70,515	80,539	90,637	100,423
2	0,350	0,368	0,416	0,433	0,439	0,447	0,451	0,457	0,469	0,471	0,483
3	0,134	0,107	0,126	0,119	0,104	0,086	0,084	0,079	0,079	0,087	0,082
4	0,166	0,172	0,106	0,079	0,072	0,077	0,073	0,096	0,200	0,078	0,294
5	0,154	0,244	0,330	0,350	0,338	0,351	0,349	0,354	0,377	0,358	0,409
6	0,064	0,157	0,113	0,081	0,067	0,062	0,052	0,057	0,067	0,046	0,066
7	0,166	0,116	0,082	0,082	0,082	0,073	0,066	0,062	0,055	0,050	0,069
8	0,055	0,073	0,081	0,067	0,059	0,058	0,048	0,078	0,164	0,046	0,228
9	0,022	0,018	0,024	0,051	0,056	0,056	0,051	0,059	0,064	0,049	0,062
10	0,053	0,085	0,080	0,062	0,058	0,053	0,048	0,052	0,100	0,048	0,147
11	0,125	0,110	0,227	0,093	0,227	0,271	0,272	0,313	0,410	0,336	0,475
12	0,027	0,057	0,080	0,071	0,063	0,058	0,051	0,052	0,060	0,041	0,058
13	0,213	0,300	0,193	0,041	0,167	0,228	0,261	0,241	0,191	0,286	0,183
14	0,037	0,048	0,058	0,057	0,049	0,047	0,044	0,044	0,080	0,043	0,097
15	0,023	0,027	0,028	0,022	0,034	0,037	0,036	0,041	0,055	0,040	0,059
16	0,056	0,049	0,058	0,060	0,051	0,056	0,045	0,064	0,119	0,048	0,127
17	0,061	0,158	0,044	0,100	0,059	0,137	0,174	0,179	0,149	0,203	0,145
18	0,019	0,027	0,046	0,054	0,052	0,050	0,045	0,047	0,058	0,038	0,060
19	0,122	0,051	0,088	0,115	0,036	0,114	0,160	0,189	0,245	0,197	0,244
20	0,040	0,055	0,058	0,055	0,049	0,051	0,042	0,062	0,092	0,045	0,086
21	0,020	0,045	0,033	0,036	0,029	0,033	0,032	0,042	0,055	0,035	0,063
22	0,050	0,053	0,064	0,060	0,052	0,046	0,044	0,042	0,065	0,045	0,086
23	0,040	0,089	0,075	0,084	0,056	0,066	0,104	0,145	0,173	0,153	0,166
24	0,019	0,029	0,025	0,038	0,041	0,042	0,038	0,043	0,061	0,035	0,074
25	0,073	0,056	0,041	0,060	0,070	0,048	0,090	0,112	0,127	0,139	0,177
26	0,048	0,060	0,056	0,051	0,048	0,045	0,042	0,043	0,072	0,045	0,104
27	0,030	0,065	0,044	0,036	0,029	0,028	0,029	0,040	0,061	0,032	0,078
28	0,056	0,046	0,062	0,054	0,055	0,052	0,046	0,059	0,080	0,049	0,091
29	0,047	0,091	0,093	0,054	0,076	0,038	0,057	0,073	0,107	0,104	0,159
30	0,017	0,030	0,017	0,023	0,030	0,034	0,031	0,038	0,059	0,033	0,082
31	0,084	0,049	0,080	0,062	0,087	0,058	0,051	0,081	0,108	0,104	0,111
32	0,062	0,079	0,068	0,055	0,057	0,053	0,052	0,056	0,071	0,051	0,094
33	0,045	0,057	0,113	0,137	0,139	0,152	0,144	0,173	0,141	0,137	0,163
34	0,071	0,060	0,079	0,083	0,074	0,078	0,071	0,101	0,105	0,078	0,129
35	0,221	0,368	0,461	0,517	0,538	0,546	0,555	0,548	0,567	0,583	0,620
36	0,039	0,037	0,048	0,066	0,065	0,053	0,048	0,043	0,083	0,060	0,095
37	0,113	0,110	0,091	0,086	0,071	0,078	0,044	0,045	0,090	0,071	0,124
38	0,077	0,097	0,079	0,082	0,054	0,070	0,056	0,071	0,096	0,075	0,112
39	0,360	0,488	0,417	0,391	0,408	0,388	0,413	0,407	0,411	0,461	0,456
40	0,101	0,075	0,099	0,074	0,103	0,067	0,082	0,059	0,076	0,097	0,107
41	0,461	0,507	0,461	0,425	0,387	0,411	0,413	0,445	0,444	0,474	0,485
42	0,042	0,046	0,049	0,052	0,031	0,047	0,037	0,046	0,071	0,047	0,078

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,113	0,093	0,064	0,060	0,064	0,078	0,050	0,043	0,064	0,044	0,073
44	0,065	0,090	0,073	0,073	0,072	0,067	0,054	0,054	0,080	0,072	0,091
45	0,196	0,278	0,346	0,378	0,389	0,405	0,421	0,442	0,421	0,427	0,463
46	0,083	0,049	0,061	0,058	0,050	0,058	0,054	0,075	0,072	0,057	0,078
47	0,100	0,145	0,149	0,141	0,154	0,148	0,160	0,118	0,129	0,128	0,136
48	0,026	0,028	0,029	0,025	0,029	0,028	0,031	0,031	0,041	0,029	0,047
49	0,120	0,066	0,081	0,060	0,054	0,060	0,056	0,048	0,041	0,029	0,044
50	0,056	0,080	0,054	0,045	0,041	0,037	0,038	0,041	0,052	0,039	0,052
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,066	0,082	0,145	0,207	0,274	0,348	0,407	0,479	0,548	0,596	0,689
125	0,038	0,045	0,050	0,052	0,065	0,075	0,074	0,096	0,109	0,114	0,116
175	0,029	0,027	0,026	0,032	0,039	0,060	0,054	0,098	0,135	0,075	0,140
225	0,028	0,028	0,027	0,043	0,049	0,063	0,060	0,102	0,135	0,086	0,165
275	0,025	0,027	0,027	0,044	0,048	0,057	0,049	0,087	0,120	0,060	0,115
325	0,020	0,029	0,024	0,036	0,041	0,052	0,050	0,082	0,112	0,059	0,125
375	0,018	0,021	0,020	0,030	0,036	0,047	0,038	0,079	0,110	0,043	0,094
425	0,021	0,024	0,032	0,033	0,039	0,059	0,044	0,111	0,157	0,055	0,148
475	0,019	0,020	0,024	0,027	0,031	0,054	0,038	0,113	0,175	0,053	0,156
525	0,022	0,031	0,040	0,042	0,070	0,085	0,074	0,131	0,198	0,096	0,181
575	0,021	0,029	0,038	0,048	0,074	0,086	0,078	0,127	0,189	0,103	0,171
625	0,020	0,024	0,034	0,027	0,056	0,074	0,065	0,115	0,188	0,084	0,173
675	0,018	0,021	0,036	0,028	0,064	0,075	0,079	0,117	0,199	0,092	0,184
725	0,023	0,022	0,031	0,036	0,037	0,052	0,038	0,092	0,179	0,050	0,171
775	0,017	0,018	0,020	0,021	0,024	0,045	0,032	0,093	0,193	0,039	0,179
825	0,020	0,026	0,040	0,051	0,054	0,065	0,058	0,099	0,204	0,069	0,199
875	0,018	0,019	0,020	0,028	0,035	0,060	0,058	0,106	0,203	0,076	0,211
925	0,019	0,022	0,027	0,040	0,035	0,059	0,055	0,103	0,209	0,068	0,223
975	0,017	0,019	0,023	0,034	0,028	0,058	0,057	0,102	0,221	0,075	0,248
1025	0,025	0,034	0,042	0,047	0,042	0,048	0,039	0,082	0,206	0,045	0,246
1075	0,020	0,022	0,023	0,023	0,024	0,041	0,030	0,079	0,202	0,036	0,255
1125	0,041	0,040	0,073	0,078	0,057	0,059	0,057	0,088	0,213	0,060	0,279
1175	0,022	0,021	0,026	0,033	0,022	0,046	0,041	0,085	0,210	0,061	0,274
1225	0,028	0,035	0,045	0,050	0,043	0,058	0,053	0,089	0,208	0,063	0,282
1275	0,022	0,021	0,026	0,031	0,029	0,041	0,041	0,080	0,205	0,058	0,294
1325	0,045	0,100	0,076	0,061	0,044	0,049	0,041	0,070	0,191	0,047	0,274
1375	0,024	0,036	0,022	0,021	0,024	0,034	0,028	0,067	0,185	0,030	0,279
1425	0,035	0,111	0,127	0,085	0,058	0,053	0,050	0,068	0,191	0,053	0,278
1475	0,025	0,051	0,022	0,020	0,030	0,035	0,035	0,070	0,176	0,046	0,264
1525	0,043	0,099	0,069	0,051	0,063	0,048	0,057	0,080	0,166	0,054	0,265
1575	0,024	0,034	0,029	0,034	0,037	0,045	0,049	0,062	0,163	0,048	0,261
1625	0,063	0,132	0,179	0,238	0,261	0,263	0,257	0,229	0,292	0,222	0,311
1675	0,033	0,043	0,058	0,072	0,040	0,084	0,054	0,123	0,159	0,071	0,232
1725	0,348	0,621	0,758	0,852	0,874	0,897	0,907	0,955	0,984	0,982	1,056
1775	0,067	0,096	0,135	0,146	0,150	0,165	0,161	0,131	0,197	0,172	0,265

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,204	0,157	0,115	0,080	0,089	0,074	0,073	0,074	0,139	0,078	0,203
1875	0,053	0,069	0,066	0,081	0,049	0,083	0,049	0,066	0,136	0,078	0,191
1925	0,623	0,799	0,722	0,642	0,630	0,632	0,667	0,702	0,724	0,809	0,798
1975	0,123	0,156	0,137	0,122	0,149	0,120	0,133	0,094	0,147	0,154	0,185
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,934	1,010	0,939	0,829	0,823	0,792	0,838	0,849	0,889	0,991	1,000
2,3	0,426	0,575	0,716	0,777	0,800	0,827	0,835	0,858	0,887	0,887	0,948
2,5	0,178	0,173	0,144	0,114	0,103	0,105	0,107	0,110	0,138	0,089	0,159
2,7	0,166	0,180	0,128	0,104	0,095	0,095	0,096	0,095	0,112	0,080	0,126
2,9	0,130	0,144	0,109	0,084	0,076	0,073	0,078	0,081	0,095	0,072	0,108
3,1	0,141	0,130	0,096	0,085	0,077	0,075	0,078	0,084	0,097	0,082	0,107
3,3	0,150	0,176	0,114	0,096	0,083	0,076	0,080	0,085	0,095	0,084	0,102
3,5	0,109	0,137	0,086	0,079	0,071	0,066	0,069	0,074	0,082	0,074	0,093
3,7	0,114	0,128	0,097	0,084	0,074	0,072	0,070	0,077	0,083	0,078	0,091
3,9	0,111	0,118	0,108	0,098	0,085	0,080	0,078	0,084	0,091	0,087	0,099
4,1	0,135	0,100	0,094	0,088	0,080	0,083	0,085	0,093	0,100	0,099	0,110
4,3	0,104	0,071	0,076	0,074	0,068	0,070	0,071	0,078	0,083	0,081	0,089
4,5	0,051	0,045	0,049	0,051	0,050	0,051	0,051	0,053	0,055	0,052	0,061
4,7	0,048	0,046	0,046	0,047	0,047	0,048	0,048	0,049	0,051	0,049	0,055
4,9	0,035	0,032	0,029	0,029	0,030	0,030	0,032	0,033	0,035	0,032	0,038
5,1	0,030	0,030	0,028	0,027	0,028	0,029	0,029	0,029	0,030	0,028	0,033
5,3	0,027	0,026	0,024	0,023	0,024	0,024	0,025	0,026	0,030	0,028	0,033
5,5	0,025	0,025	0,023	0,022	0,023	0,023	0,024	0,025	0,027	0,024	0,032
5,7	0,024	0,023	0,023	0,021	0,022	0,022	0,022	0,024	0,026	0,023	0,034
5,9	0,022	0,021	0,022	0,021	0,021	0,021	0,021	0,024	0,026	0,023	0,035
6,1	0,023	0,022	0,022	0,021	0,021	0,022	0,022	0,024	0,027	0,023	0,037
6,3	0,022	0,021	0,021	0,020	0,020	0,020	0,021	0,023	0,027	0,022	0,037
6,5	0,022	0,021	0,020	0,020	0,020	0,020	0,020	0,022	0,026	0,022	0,036
6,7	0,022	0,023	0,021	0,020	0,019	0,020	0,020	0,022	0,026	0,022	0,034
6,9	0,020	0,021	0,023	0,020	0,019	0,020	0,020	0,022	0,026	0,021	0,031
7,1	0,031	0,033	0,035	0,039	0,041	0,042	0,045	0,046	0,050	0,050	0,056
7,3	0,023	0,026	0,028	0,032	0,030	0,031	0,030	0,031	0,033	0,026	0,033
7,5	0,028	0,033	0,040	0,044	0,045	0,046	0,046	0,049	0,052	0,052	0,057
7,7	0,020	0,019	0,019	0,020	0,020	0,020	0,021	0,022	0,024	0,023	0,027
7,9	0,037	0,022	0,019	0,019	0,019	0,019	0,019	0,021	0,024	0,022	0,027
8,1	0,020	0,036	0,035	0,022	0,022	0,022	0,021	0,022	0,040	0,039	0,040
8,3	0,020	0,020	0,023	0,038	0,020	0,020	0,020	0,023	0,023	0,023	0,026
8,5	0,022	0,021	0,022	0,022	0,022	0,038	0,039	0,038	0,022	0,021	0,024
8,7	0,025	0,023	0,021	0,020	0,038	0,022	0,020	0,022	0,023	0,020	0,023
8,9	0,030	0,029	0,024	0,021	0,021	0,021	0,022	0,023	0,025	0,023	0,025

Note:

The normalization current is 24,638A.

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)	P

Test result: ASW20K-LT-G2

Harmonics

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	5,021	9,955	20,430	30,451	40,032	50,490	60,412	70,457	80,396	90,323	100,227
2	0,305	0,348	0,378	0,383	0,385	0,399	0,402	0,406	0,418	0,422	0,421
3	0,086	0,079	0,106	0,094	0,079	0,073	0,074	0,072	0,072	0,071	0,068
4	0,161	0,121	0,081	0,062	0,054	0,067	0,067	0,128	0,163	0,217	0,257
5	0,139	0,261	0,301	0,294	0,297	0,300	0,298	0,316	0,332	0,351	0,374
6	0,115	0,127	0,083	0,062	0,053	0,049	0,044	0,055	0,055	0,057	0,061
7	0,103	0,076	0,073	0,072	0,063	0,058	0,053	0,046	0,050	0,067	0,085
8	0,085	0,071	0,057	0,045	0,039	0,049	0,044	0,106	0,134	0,169	0,192
9	0,028	0,030	0,020	0,047	0,047	0,049	0,046	0,057	0,057	0,057	0,061
10	0,045	0,062	0,056	0,044	0,038	0,042	0,039	0,066	0,080	0,107	0,124
11	0,365	0,062	0,103	0,151	0,222	0,236	0,249	0,322	0,357	0,387	0,413
12	0,028	0,060	0,066	0,056	0,049	0,046	0,040	0,049	0,047	0,048	0,050
13	0,059	0,120	0,138	0,095	0,184	0,215	0,215	0,181	0,176	0,168	0,159
14	0,044	0,047	0,044	0,036	0,033	0,040	0,038	0,057	0,064	0,075	0,085
15	0,013	0,032	0,030	0,025	0,031	0,033	0,033	0,045	0,049	0,050	0,050
16	0,040	0,041	0,041	0,036	0,033	0,044	0,039	0,089	0,103	0,106	0,097
17	0,101	0,082	0,092	0,032	0,101	0,142	0,163	0,133	0,120	0,126	0,136
18	0,043	0,027	0,045	0,046	0,043	0,041	0,036	0,046	0,049	0,050	0,050
19	0,055	0,115	0,052	0,045	0,077	0,135	0,149	0,202	0,216	0,208	0,200
20	0,027	0,034	0,028	0,030	0,028	0,042	0,038	0,076	0,083	0,075	0,069
21	0,022	0,024	0,026	0,022	0,024	0,031	0,032	0,045	0,047	0,051	0,057
22	0,031	0,029	0,029	0,029	0,029	0,037	0,037	0,047	0,056	0,070	0,089
23	0,037	0,068	0,052	0,066	0,038	0,086	0,111	0,146	0,162	0,152	0,137
24	0,026	0,038	0,025	0,035	0,036	0,035	0,032	0,046	0,052	0,057	0,063
25	0,054	0,062	0,060	0,074	0,031	0,072	0,099	0,097	0,108	0,138	0,164
26	0,033	0,034	0,025	0,024	0,025	0,038	0,035	0,047	0,063	0,082	0,096
27	0,017	0,050	0,039	0,029	0,020	0,027	0,028	0,044	0,053	0,059	0,068
28	0,021	0,025	0,025	0,024	0,027	0,045	0,038	0,068	0,072	0,079	0,085
29	0,069	0,068	0,059	0,057	0,034	0,043	0,064	0,079	0,091	0,123	0,142
30	0,019	0,017	0,020	0,025	0,028	0,028	0,028	0,044	0,051	0,061	0,076
31	0,057	0,084	0,039	0,056	0,048	0,040	0,063	0,090	0,104	0,104	0,113
32	0,027	0,029	0,027	0,027	0,030	0,047	0,042	0,061	0,061	0,074	0,096
33	0,049	0,073	0,101	0,113	0,123	0,120	0,128	0,115	0,135	0,129	0,143
34	0,030	0,043	0,057	0,053	0,062	0,060	0,065	0,077	0,096	0,105	0,125
35	0,202	0,337	0,405	0,419	0,408	0,475	0,487	0,498	0,513	0,545	0,551
36	0,030	0,043	0,047	0,041	0,036	0,056	0,048	0,050	0,052	0,075	0,076
37	0,119	0,085	0,069	0,052	0,057	0,035	0,046	0,054	0,070	0,096	0,096
38	0,052	0,050	0,049	0,052	0,046	0,042	0,059	0,062	0,078	0,090	0,099
39	0,337	0,365	0,305	0,306	0,293	0,362	0,361	0,386	0,392	0,413	0,431
40	0,065	0,077	0,046	0,043	0,054	0,088	0,076	0,076	0,061	0,102	0,088
41	0,405	0,373	0,353	0,334	0,313	0,335	0,371	0,387	0,430	0,429	0,473
42	0,049	0,044	0,046	0,040	0,033	0,029	0,038	0,042	0,053	0,066	0,066

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
43	0,107	0,053	0,060	0,053	0,052	0,054	0,036	0,044	0,054	0,058	0,081
44	0,045	0,038	0,052	0,045	0,042	0,061	0,057	0,058	0,055	0,084	0,079
45	0,175	0,239	0,299	0,308	0,311	0,350	0,361	0,378	0,404	0,398	0,433
46	0,041	0,032	0,037	0,035	0,039	0,041	0,047	0,058	0,069	0,062	0,082
47	0,048	0,112	0,120	0,111	0,116	0,135	0,121	0,131	0,097	0,112	0,088
48	0,027	0,024	0,023	0,023	0,025	0,026	0,024	0,036	0,039	0,039	0,046
49	0,102	0,050	0,056	0,043	0,040	0,048	0,033	0,038	0,041	0,037	0,051
50	0,021	0,025	0,020	0,016	0,015	0,031	0,031	0,045	0,044	0,042	0,053
Interharmonics											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,060	0,081	0,141	0,207	0,274	0,343	0,411	0,483	0,536	0,618	0,663
125	0,030	0,034	0,042	0,045	0,057	0,067	0,078	0,088	0,101	0,120	0,126
175	0,026	0,023	0,026	0,031	0,041	0,056	0,057	0,105	0,122	0,121	0,122
225	0,023	0,025	0,029	0,039	0,045	0,059	0,060	0,106	0,120	0,140	0,161
275	0,022	0,025	0,031	0,040	0,040	0,050	0,048	0,096	0,102	0,101	0,101
325	0,021	0,022	0,024	0,034	0,035	0,047	0,046	0,089	0,094	0,107	0,117
375	0,019	0,016	0,020	0,029	0,030	0,042	0,037	0,090	0,094	0,090	0,083
425	0,017	0,023	0,026	0,032	0,036	0,053	0,046	0,134	0,140	0,141	0,143
475	0,015	0,017	0,022	0,026	0,029	0,051	0,042	0,145	0,154	0,147	0,139
525	0,016	0,025	0,029	0,053	0,061	0,076	0,075	0,168	0,178	0,179	0,179
575	0,016	0,018	0,023	0,057	0,065	0,076	0,081	0,157	0,167	0,153	0,149
625	0,015	0,018	0,030	0,042	0,051	0,064	0,067	0,153	0,171	0,168	0,164
675	0,015	0,016	0,029	0,045	0,060	0,074	0,075	0,159	0,182	0,173	0,159
725	0,017	0,024	0,029	0,032	0,034	0,044	0,041	0,138	0,163	0,162	0,146
775	0,013	0,015	0,017	0,019	0,023	0,043	0,033	0,143	0,171	0,162	0,147
825	0,015	0,025	0,042	0,047	0,047	0,057	0,055	0,155	0,185	0,180	0,162
875	0,015	0,023	0,029	0,022	0,042	0,056	0,062	0,146	0,181	0,181	0,167
925	0,014	0,020	0,024	0,028	0,042	0,055	0,054	0,144	0,182	0,190	0,173
975	0,013	0,016	0,022	0,019	0,037	0,057	0,059	0,160	0,202	0,213	0,204
1025	0,025	0,029	0,044	0,042	0,037	0,042	0,040	0,136	0,184	0,198	0,189
1075	0,019	0,018	0,020	0,019	0,021	0,038	0,031	0,129	0,180	0,206	0,206
1125	0,017	0,051	0,068	0,058	0,048	0,050	0,049	0,143	0,195	0,221	0,231
1175	0,015	0,022	0,016	0,021	0,026	0,044	0,048	0,135	0,188	0,217	0,223
1225	0,028	0,032	0,036	0,040	0,041	0,048	0,051	0,131	0,183	0,220	0,229
1275	0,017	0,020	0,021	0,027	0,028	0,043	0,045	0,132	0,186	0,232	0,265
1325	0,019	0,085	0,056	0,041	0,038	0,039	0,040	0,116	0,170	0,212	0,238
1375	0,021	0,018	0,021	0,019	0,021	0,033	0,027	0,113	0,162	0,212	0,241
1425	0,076	0,114	0,098	0,052	0,047	0,051	0,043	0,121	0,169	0,220	0,261
1475	0,036	0,019	0,024	0,026	0,020	0,036	0,035	0,109	0,156	0,202	0,239
1525	0,040	0,064	0,057	0,047	0,039	0,055	0,043	0,109	0,145	0,198	0,237
1575	0,038	0,023	0,025	0,033	0,027	0,039	0,039	0,107	0,147	0,205	0,257
1625	0,072	0,125	0,194	0,224	0,218	0,221	0,198	0,230	0,224	0,250	0,271
1675	0,030	0,041	0,057	0,065	0,066	0,039	0,061	0,100	0,151	0,180	0,231
1725	0,336	0,578	0,712	0,763	0,795	0,761	0,778	0,824	0,865	0,901	0,980
1775	0,079	0,099	0,110	0,131	0,109	0,131	0,141	0,150	0,165	0,211	0,224

4.8	EMC and power quality Harmonic current emission (EN 61000-4-7)										P
1825	0,190	0,132	0,074	0,060	0,059	0,072	0,061	0,082	0,108	0,154	0,180
1875	0,043	0,062	0,061	0,065	0,049	0,044	0,060	0,080	0,108	0,152	0,187
1925	0,598	0,654	0,542	0,564	0,581	0,539	0,601	0,607	0,664	0,711	0,760
1975	0,140	0,119	0,089	0,094	0,089	0,131	0,119	0,133	0,119	0,170	0,168
Higher Frequencies											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,858	0,794	0,710	0,695	0,695	0,702	0,744	0,772	0,821	0,892	0,942
2,3	0,390	0,513	0,645	0,676	0,696	0,707	0,722	0,747	0,777	0,813	0,852
2,5	0,128	0,129	0,097	0,078	0,076	0,086	0,076	0,110	0,126	0,128	0,158
2,7	0,138	0,127	0,087	0,068	0,066	0,082	0,073	0,089	0,104	0,104	0,118
2,9	0,090	0,099	0,080	0,056	0,051	0,065	0,063	0,078	0,085	0,087	0,099
3,1	0,118	0,082	0,066	0,055	0,051	0,066	0,067	0,080	0,086	0,090	0,097
3,3	0,132	0,121	0,080	0,066	0,057	0,067	0,070	0,078	0,084	0,087	0,093
3,5	0,089	0,086	0,066	0,056	0,051	0,058	0,061	0,071	0,073	0,076	0,083
3,7	0,106	0,097	0,067	0,056	0,052	0,060	0,062	0,071	0,075	0,078	0,085
3,9	0,095	0,086	0,081	0,071	0,063	0,067	0,070	0,078	0,082	0,085	0,091
4,1	0,096	0,075	0,076	0,064	0,063	0,073	0,077	0,086	0,090	0,094	0,102
4,3	0,072	0,062	0,066	0,059	0,057	0,060	0,063	0,071	0,073	0,076	0,082
4,5	0,037	0,037	0,043	0,042	0,041	0,043	0,043	0,047	0,050	0,053	0,057
4,7	0,038	0,038	0,040	0,039	0,040	0,041	0,041	0,044	0,046	0,047	0,052
4,9	0,026	0,024	0,025	0,026	0,026	0,026	0,026	0,030	0,032	0,033	0,039
5,1	0,024	0,024	0,023	0,022	0,023	0,023	0,023	0,026	0,027	0,029	0,033
5,3	0,020	0,020	0,020	0,020	0,020	0,022	0,023	0,025	0,026	0,028	0,031
5,5	0,019	0,019	0,018	0,018	0,019	0,019	0,020	0,023	0,024	0,026	0,032
5,7	0,019	0,019	0,019	0,018	0,018	0,019	0,019	0,022	0,024	0,028	0,036
5,9	0,019	0,018	0,018	0,018	0,018	0,018	0,019	0,022	0,024	0,030	0,041
6,1	0,019	0,018	0,018	0,018	0,019	0,018	0,019	0,022	0,025	0,033	0,046
6,3	0,018	0,017	0,017	0,017	0,018	0,017	0,018	0,022	0,025	0,033	0,047
6,5	0,017	0,018	0,018	0,016	0,021	0,017	0,017	0,022	0,025	0,032	0,044
6,7	0,018	0,027	0,028	0,017	0,022	0,017	0,017	0,021	0,024	0,029	0,039
6,9	0,030	0,023	0,019	0,032	0,025	0,017	0,017	0,022	0,024	0,027	0,034
7,1	0,029	0,030	0,032	0,035	0,037	0,038	0,039	0,042	0,046	0,049	0,054
7,3	0,021	0,025	0,028	0,025	0,026	0,025	0,024	0,027	0,028	0,028	0,030
7,5	0,026	0,031	0,037	0,037	0,038	0,039	0,040	0,045	0,047	0,050	0,054
7,7	0,022	0,018	0,017	0,020	0,019	0,018	0,018	0,021	0,023	0,024	0,025
7,9	0,018	0,017	0,016	0,018	0,017	0,017	0,018	0,020	0,022	0,024	0,026
8,1	0,016	0,016	0,016	0,017	0,016	0,031	0,017	0,020	0,025	0,031	0,035
8,3	0,018	0,018	0,018	0,019	0,017	0,020	0,032	0,034	0,031	0,027	0,025
8,5	0,017	0,018	0,017	0,017	0,019	0,019	0,020	0,020	0,020	0,021	0,022
8,7	0,017	0,017	0,016	0,017	0,017	0,018	0,018	0,019	0,020	0,020	0,022
8,9	0,022	0,020	0,017	0,017	0,017	0,020	0,019	0,020	0,020	0,021	0,023

Note:
The normalization current is 28,986 A.

4.8	EMC and power quality Switching operation (Refer IEC 61400-21)				P
Test result:					
Max. number of switching operations, N_{10}	10				
Max. number of switching operations, N_{120}	120				
Case of switching operation	Cut-in at 10%P_{Emax}				
Grid impedance angle, ψ_k	30°	50°	70°	85°	
Flicker step factor, $k_f(\psi_k)$	0,32	0,21	0,17	0,16	
Voltage change factor, $k_u(\psi_k)$	0,67	0,67	0,67	0,67	
Maximum inrush current factor k_{imax}	0,12				
Case of switching operation	Cut-in at 100%P_{Emax}				
Grid impedance angle, ψ_k	30°	50°	70°	85°	
Flicker step factor, $k_f(\psi_k)$	0,32	0,21	0,17	0,16	
Voltage change factor, $k_u(\psi_k)$	0,33	0,37	0,36	0,36	
Maximum inrush current factor k_{imax}	0,12				
Case of switching operation	Service disconnection at rated power				
Grid impedance angle, ψ_k	30°	50°	70°	85°	
Flicker step factor, $k_f(\psi_k)$	0,32	0,21	0,17	0,16	
Voltage change factor, $k_u(\psi_k)$	0,32	0,35	0,35	0,34	
Maximum inrush current factor k_{imax}	0,12				
Worst case over all switching operations, k_{imax}	0,12				

Note:

$S_{k,fic}/S_n$ in the fictitious grid was set to:20.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.8	Voltage fluctuation and flicker	P

Test result:

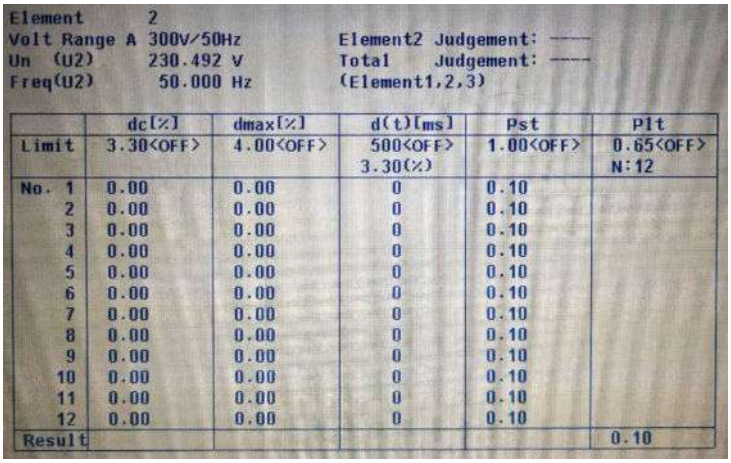
Test conditions:	Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100 % power) and flicker as per EN 61000-3-3 and/or EN 61000-3-11.

Test:ASW20K-LT-G2

Value	**P_{st}**	**P_{lt} 2 hours**	**d(t) 500ms**	**d_c**	**d_{max}**
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	See below				

Inverter >16A

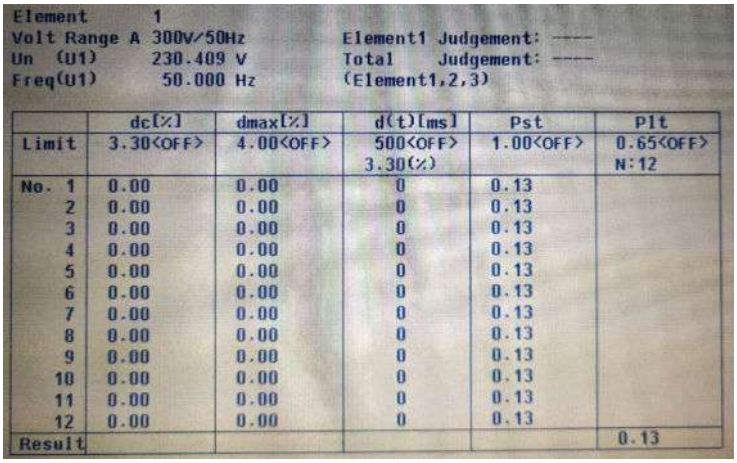
L1 phase



Element 2
Volt Range A 300V/50Hz
Un (U2) 230.492 V
Freq(U2) 50.000 Hz
Element2 Judgement: ----
Total Judgement: ----
(Element1,2,3)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30<OFF>	4.00<OFF>	500<OFF> 3.30(%)	1.00<OFF>	0.65<OFF> N:12
No. 1	0.00	0.00	0	0.10	
2	0.00	0.00	0	0.10	
3	0.00	0.00	0	0.10	
4	0.00	0.00	0	0.10	
5	0.00	0.00	0	0.10	
6	0.00	0.00	0	0.10	
7	0.00	0.00	0	0.10	
8	0.00	0.00	0	0.10	
9	0.00	0.00	0	0.10	
10	0.00	0.00	0	0.10	
11	0.00	0.00	0	0.10	
12	0.00	0.00	0	0.10	
Result					0.10

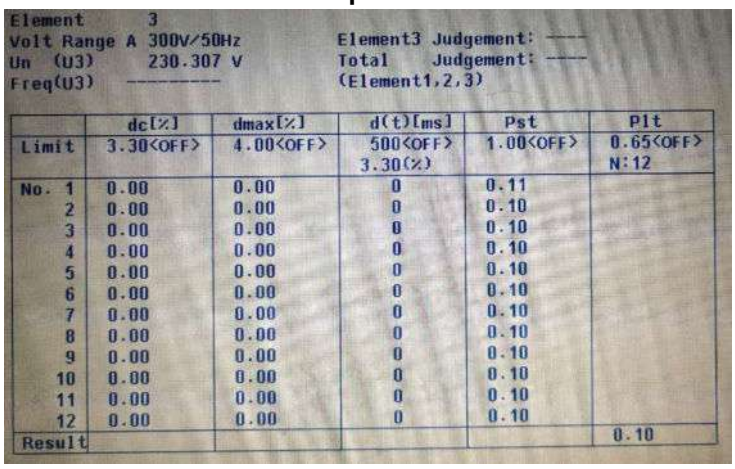
L2 phase



Element 1
Volt Range A 300V/50Hz
Un (U1) 230.409 V
Freq(U1) 50.000 Hz
Element1 Judgement: ----
Total Judgement: ----
(Element1,2,3)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30<OFF>	4.00<OFF>	500<OFF> 3.30(%)	1.00<OFF>	0.65<OFF> N:12
No. 1	0.00	0.00	0	0.13	
2	0.00	0.00	0	0.13	
3	0.00	0.00	0	0.13	
4	0.00	0.00	0	0.13	
5	0.00	0.00	0	0.13	
6	0.00	0.00	0	0.13	
7	0.00	0.00	0	0.13	
8	0.00	0.00	0	0.13	
9	0.00	0.00	0	0.13	
10	0.00	0.00	0	0.13	
11	0.00	0.00	0	0.13	
12	0.00	0.00	0	0.13	
Result					0.13

L3 phase



Element 3
Volt Range A 300V/50Hz
Un (U3) 230.307 V
Freq(U3) ----------
Element3 Judgement: ----
Total Judgement: ----
(Element1,2,3)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30<OFF>	4.00<OFF>	500<OFF> 3.30(%)	1.00<OFF>	0.65<OFF> N:12
No. 1	0.00	0.00	0	0.11	
2	0.00	0.00	0	0.10	
3	0.00	0.00	0	0.10	
4	0.00	0.00	0	0.10	
5	0.00	0.00	0	0.10	
6	0.00	0.00	0	0.10	
7	0.00	0.00	0	0.10	
8	0.00	0.00	0	0.10	
9	0.00	0.00	0	0.10	
10	0.00	0.00	0	0.10	
11	0.00	0.00	0	0.10	
12	0.00	0.00	0	0.10	
Result					0.10

Note:

*The stationary deviance of dc% is more relevant than the dynamic deviance of dmax at starting and stopping, Mains Impedance according EN61000-3-11:

Rmax = 0,24Ω; jXmax= 0,15Ω @50Hz (|Zmax| = 0,283/0,4717Ω) for single phase inverter use also

R_n = 0,16Ω; jX_n= 0,1Ω.

Calculation of the maximum permissible grid impedance at the point of common coupling based on dc:

$Z_{max} = Z_{ref}$ * 3,3% / $d_c(P_n)$.

The tests should be based on the limits of the EN 61000-3-11 for more than 16A.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.8	EMC and power quality Flicker and voltage fluctuations	P

Method: Measurement and evaluation was carried out according to the procedure in IEC 61400-21.

Test result:

Grid impedance angle, ψ_k	30°	50°	70°	85°
Operating point, P_a/P_{Emax} [%]	Flicker coefficient, $c(\psi_k)$			
3	2,12	1,38	1,13	1,06
10	2,12	1,38	1,13	1,06
20	2,12	1,38	1,13	1,06
30	2,12	1,38	1,13	1,06
40	2,12	1,38	1,13	1,06
50	2,12	1,38	1,13	1,06
60	2,33	1,52	1,24	1,17
70	2,33	1,52	1,24	1,17
80	2,33	1,52	1,24	1,17
90	2,33	1,52	1,24	1,17
100	2,54	1,66	1,35	1,28
Max. Flicker coefficient, c(ψk)	2,54	1,66	1,35	1,28
Max. Short-term flicker, Pst	0,14	0,09	0,07	0,07

Reactive power setpoint during testing [kVar]	0

P [$\%P_{Emax}$]	3	10	20	30	40	50	60	70	80	90	100
Number of data sets	1	1	1	1	1	1	1	1	1	1	1

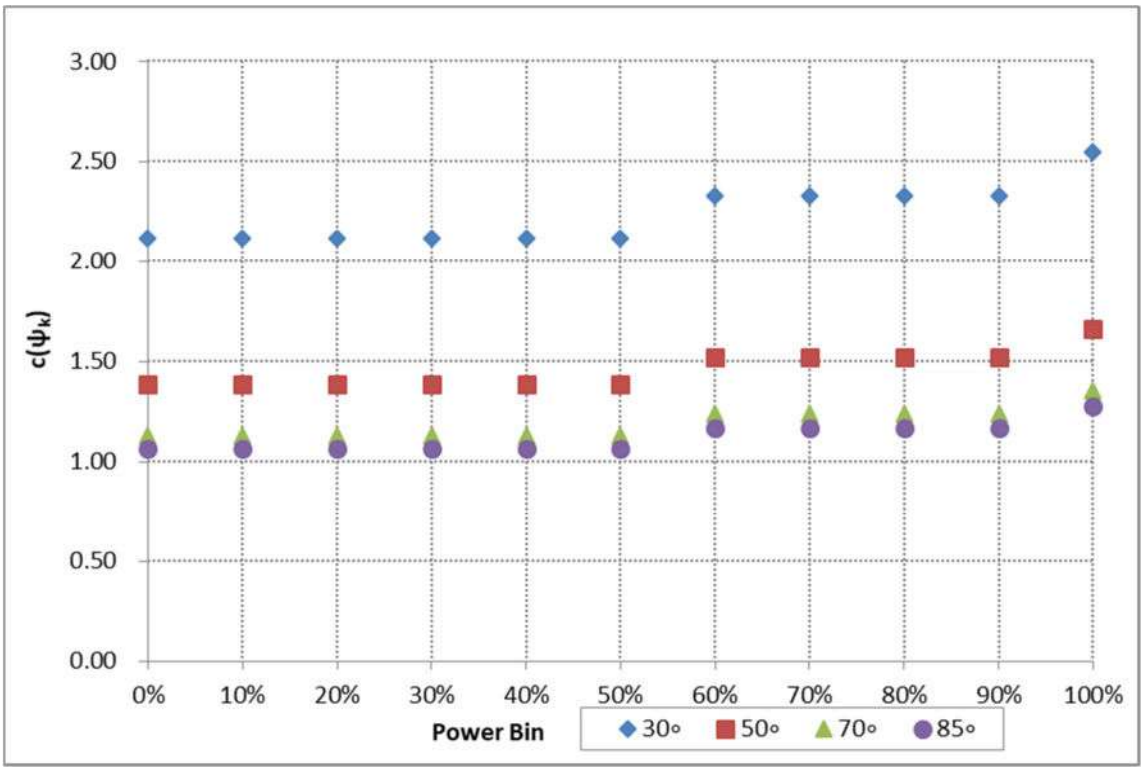
Note:

The table entries are worst case values.

$S_{k,fic}/S_n$ in the fictitious grid was set to:20.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Maximum Flicker coefficients c(ψ_k) vs. power bins



4.8	EMC and power quality DC-Injection	P

Test result: ASW8K-LT-G2

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (58mA)			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	5,0	4,0	17,0	38,0
Abs. Ave. Test Value:L1 [mA]	3,2	1,7	5,8	8,3
Abs. Max. Test Value:L2 [mA]	28,0	10,0	25,0	38,0
Abs. Ave. Test Value:L2 [mA]	24,2	3,4	7,8	8,8
Abs. Max. Test Value:L3 [mA]	5,0	5,0	22,0	42,0
Abs. Ave. Test Value:L3 [mA]	1,7	0,7	6,1	8,9

Test result: ASW10K-LT-G2

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (72,5mA)			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	19,0	37,0	37,0	30,0
Abs. Ave. Test Value:L1 [mA]	3,9	21,1	19,4	7,8
Abs. Max. Test Value:L2 [mA]	20,0	30,0	39,0	28,0
Abs. Ave. Test Value:L2 [mA]	4,4	6,9	7,4	9,0
Abs. Max. Test Value:L3 [mA]	28,0	20,0	36,0	27,0
Abs. Ave. Test Value:L3 [mA]	4,0	4,5	5,8	8,0

Test result: ASW12K-LT-G2

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (87mA)			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	54,0	48,0	70,0	63,0
Abs. Ave. Test Value:L1 [mA]	18,4	21,8	38,5	32,3
Abs. Max. Test Value:L2 [mA]	45,0	74,0	84,0	81,0
Abs. Ave. Test Value:L2 [mA]	12,6	43,4	47,8	41,9
Abs. Max. Test Value:L3 [mA]	34,0	78,0	75,0	85,0
Abs. Ave. Test Value:L3 [mA]	8,3	40,5	41,9	50,9

Test result: ASW13K-LT-G2

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (94,2mA)			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	54,0	64,0	70,0	64,0
Abs. Ave. Test Value:L1 [mA]	18,4	19,5	15,5	15,9
Abs. Max. Test Value:L2 [mA]	64,0	64,0	70,0	64,0
Abs. Ave. Test Value:L2 [mA]	19,5	19,5	15,5	15,9

Abs. Max. Test Value:L3 [mA]	34,0	53,0	63,0	47,0
Abs. Ave. Test Value:L3 [mA]	8,3	14,7	18,4	12,4
Test result: ASW15K-LT-G2				
Protection limit	**Tested at four power levels limit 0,5% of $I_{AC;nom}$ (109mA)**			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	56,0	57,0	57,0	56,0
Abs. Ave. Test Value:L1 [mA]	20,4	24,1	24,4	18,7
Abs. Max. Test Value:L2 [mA]	40,0	80,0	80,0	93,0
Abs. Ave. Test Value:L2 [mA]	10,1	43,3	41,7	42,9
Abs. Max. Test Value:L3 [mA]	40,0	82,0	85,0	80,0
Abs. Ave. Test Value:L3 [mA]	11,7	52,7	53,4	39,0
Test result: ASW17K-LT-G2				
Protection limit	**Tested at four power levels limit 0,5% of $I_{AC;nom}$ (123mA)**			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	59,0	66,0	53,0	66,0
Abs. Ave. Test Value:L1 [mA]	29,8	25,6	25,3	28,1
Abs. Max. Test Value:L2 [mA]	82,0	72,0	67,0	66,0
Abs. Ave. Test Value:L2 [mA]	50,8	36,4	33,7	28,4
Abs. Max. Test Value:L3 [mA]	74,0	87,0	93,0	103,0
Abs. Ave. Test Value:L3 [mA]	43,9	55,6	55,8	50,8
Test result: ASW20K-LT-G2				
Protection limit	**Tested at four power levels limit 0,5% of $I_{AC;nom}$ (145mA)**			
Output power	~25%	~50%	70%	~100%
Abs. Max. Test Value:L1 [mA]	10,0	63,0	56,0	81,0
Abs. Ave. Test Value:L1 [mA]	3,5	23,6	18,7	36,6
Abs. Max. Test Value:L2 [mA]	10,0	69,0	93,0	111,0
Abs. Ave. Test Value:L2 [mA]	3,4	33,9	42,9	50,3
Abs. Max. Test Value:L3 [mA]	8,0	82,0	80,0	102,0
Abs. Ave. Test Value:L3 [mA]	1,9	51,3	39,0	36,3

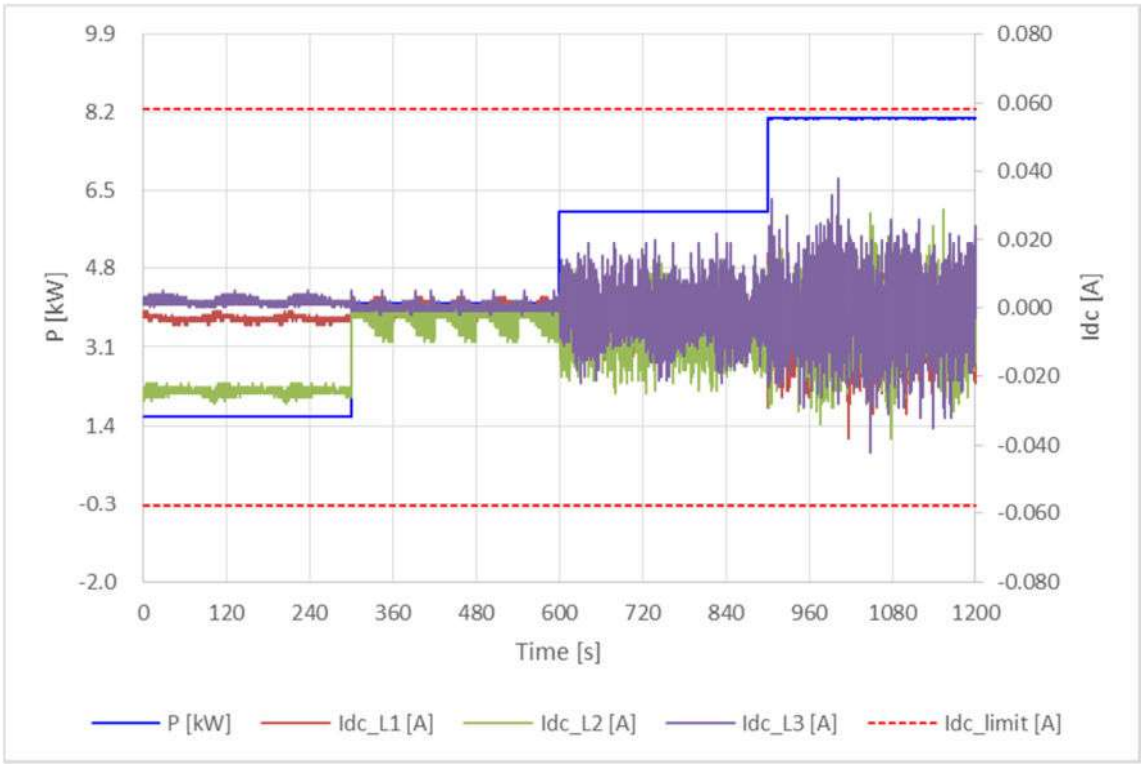
Note:

Test method and setting value refer Annex D.3.10 of EN 50438:2013.

Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized, No temperature drift of more than 2K within 1 hour is allowed.

Diagram of permanent dc-injection

ASW8K-LT-G2



ASW10K-LT-G2

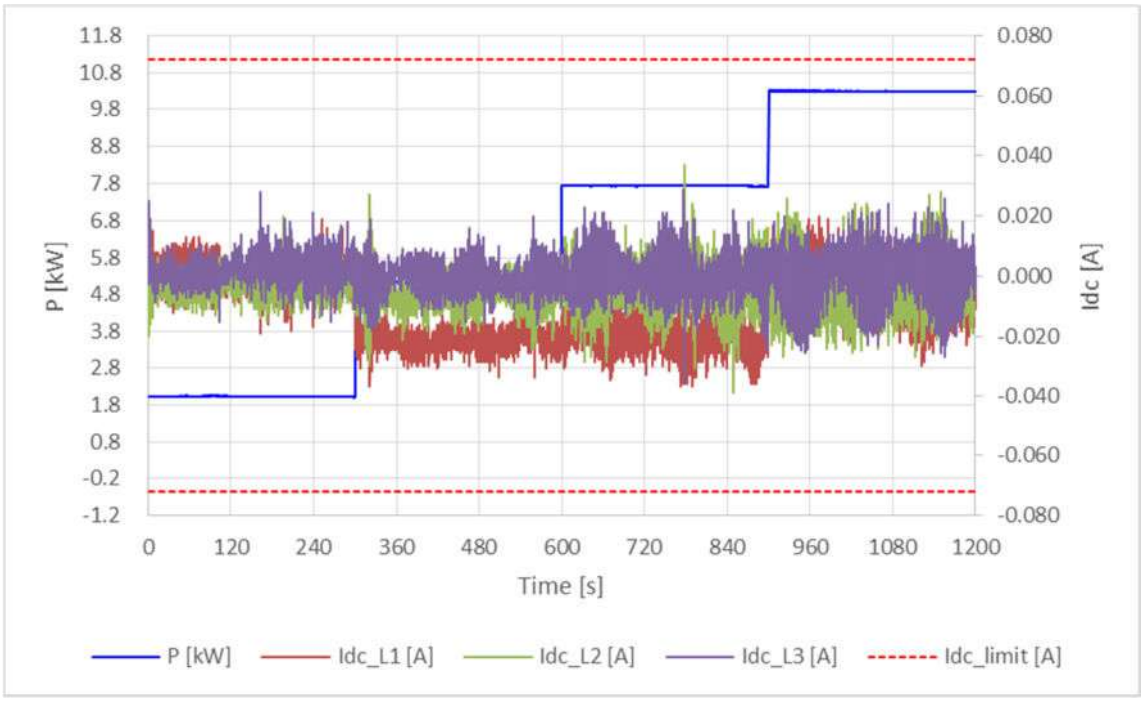
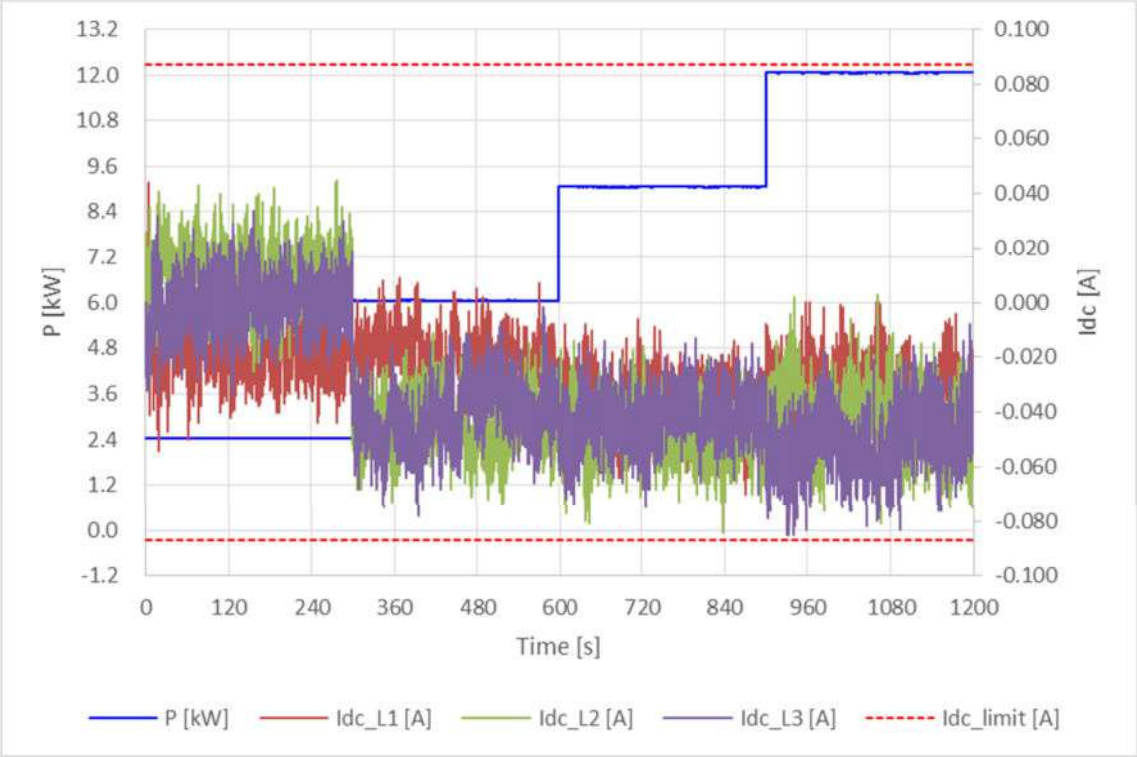


Diagram of permanent dc-injection

ASW12K-LT-G2



ASW13K-LT-G2

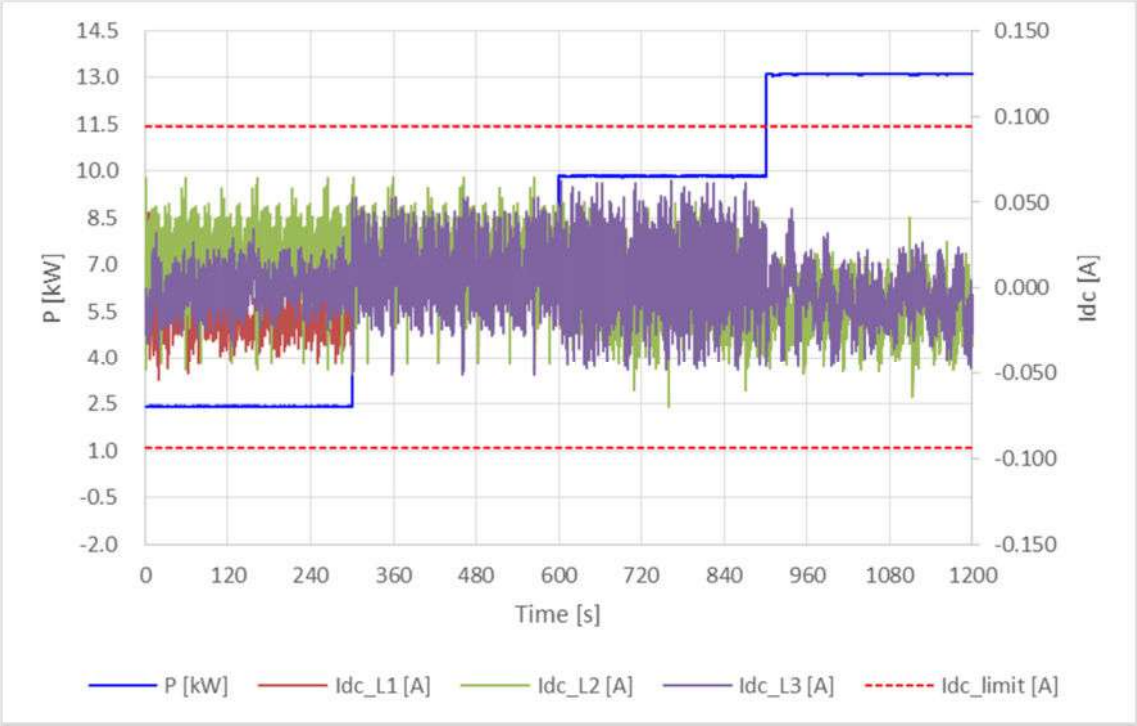
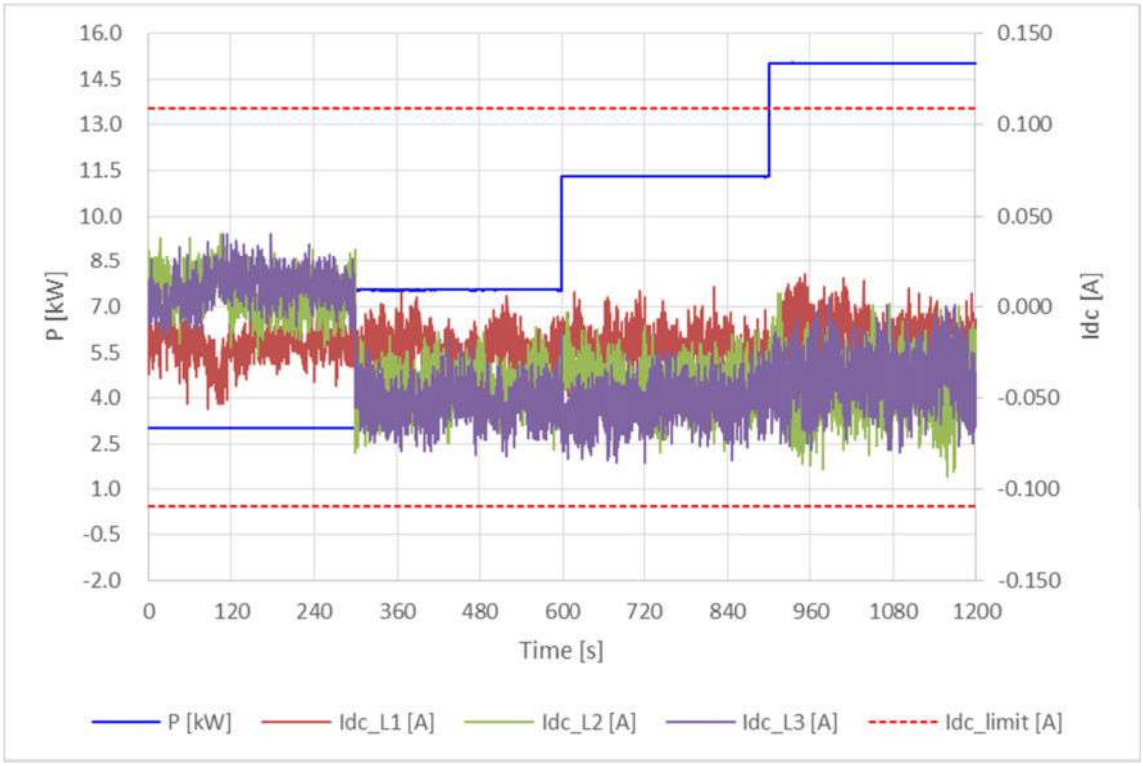


Diagram of permanent dc-injection

ASW15K-LT-G2



ASW17K-LT-G2

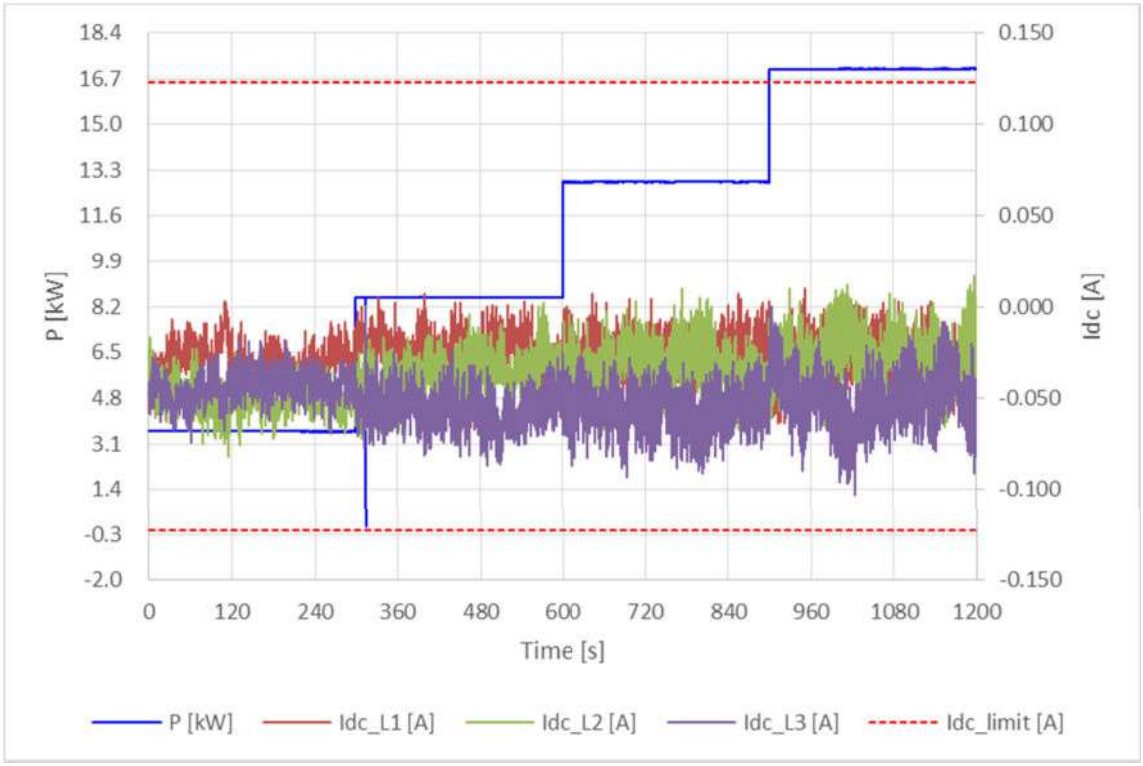
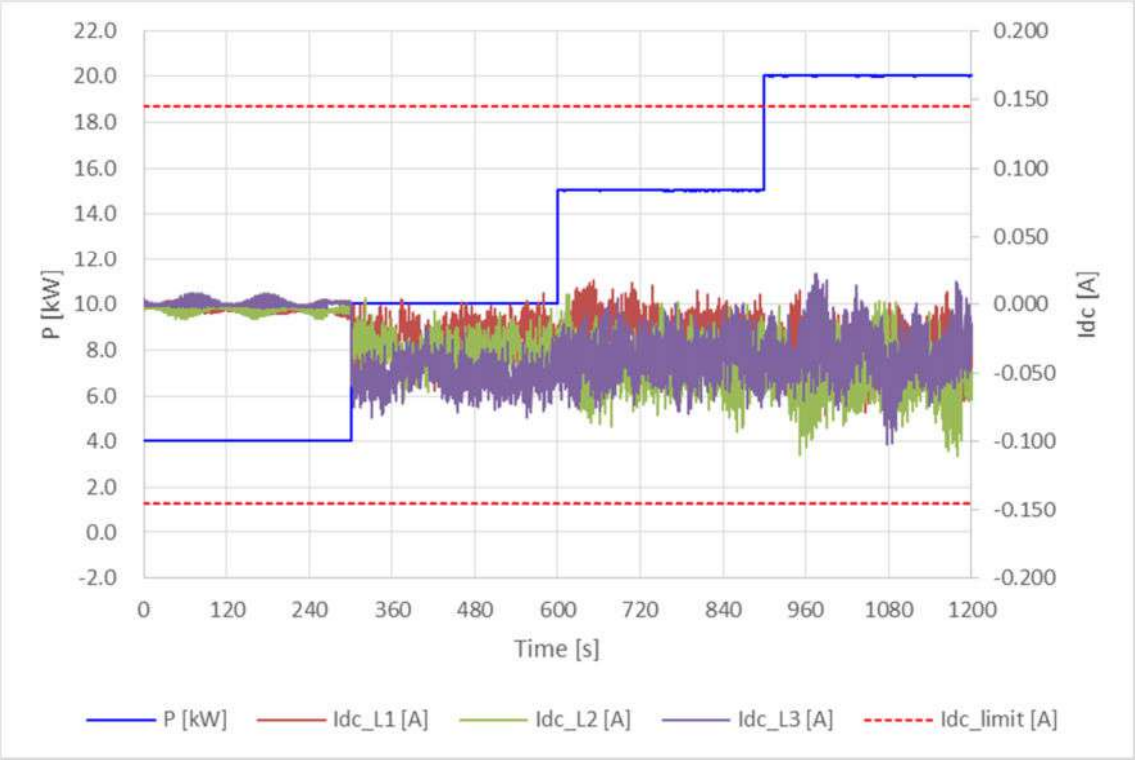


Diagram of permanent dc-injection

ASW20K-LT-G2



4.8	Immunity to voltage dips and short interruptions	P

For a directly coupled SSEG	For a Inverter SSEG

L1

Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	39,417Vac	4,351A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A

L2

Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	43,39Vac	5,428A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A

L3

Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	8,413Vac	1,156A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,002s	In seconds

Note:

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

4.8 Unbalance	P

Test: cos φ = 1

P [%P_{max}]	P* [kW]	U_{1+}* [V]	U_{1-}* [V]	I_{1+}* [A]	I_{1-}* [A]	u_i* [% I_{1+}]	$u_{i\ abs}$* [% I_n]	Number of data sets
0 - 5	0,336	229,95	0,042	0,464	0,056	12,069	0,002	3
10	1,867	230,07	0,047	2,542	0,013	0,511	0,001	3
20	4,308	230,25	0,040	6,195	0,044	0,710	0,002	3
30	6,328	230,40	0,037	9,121	0,049	0,537	0,002	3
40	8,399	230,58	0,031	12,008	0,051	0,425	0,002	3
50	10,272	230,73	0,038	14,888	0,058	0,390	0,002	3
60	12,419	230,87	0,020	17,864	0,042	0,235	0,001	3
70	14,537	231,04	0,025	20,973	0,050	0,238	0,002	3
80	16,501	231,19	0,029	23,792	0,038	0,160	0,001	3
90	18,429	231,34	0,028	26,544	0,043	0,162	0,001	3
100	20,364	231,50	0,036	29,322	0,062	0,211	0,002	3

Maximum unsymmetry u_{imax} (≥10%Pn)	0,002

Note:

*1 min-average values of positive and negative sequence data.

The unsymmetry is calculated according to following equation:

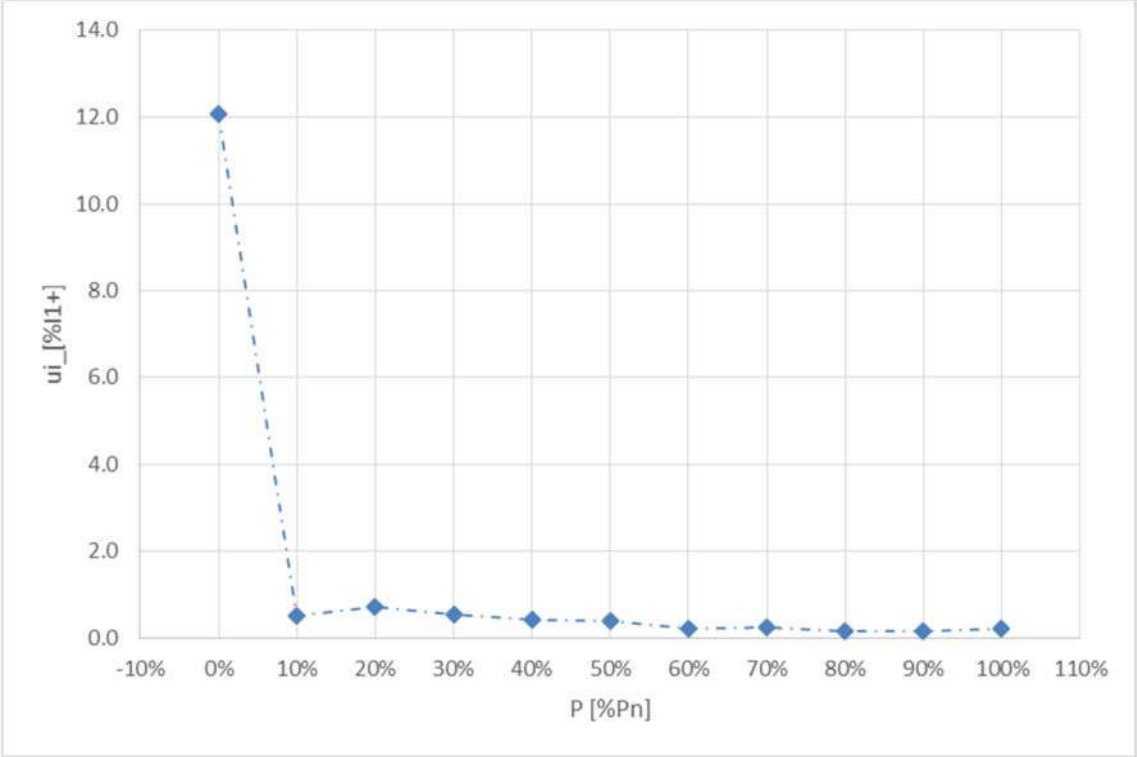
$$u_i = \frac{I_{1-}}{I_{1+}} \cdot 100\%$$

Additionally the unsymmetry is calculated relative to nominal current according to following equation:

$$u_{iabs} = \frac{I_{1-}}{I_n} \cdot 100\%$$

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Diagram


14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
ui_[%I1+]
-10%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
110%
P [%Pn]

EN 50549-1:2019: Interface protection			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.9.3	Requirements on voltage and frequency protection	CEI 0-21:2019-04, Annex A.3.1 to A.3.4	**P**
4.9.3.1	Undervoltage protection	EN 50438, Annex D.2.3	**P**
	Overvoltage protection	EN 50438, Annex D.2.3	**P**
	Overvoltage 10 min mean protection	EN 50160	**P**
	Underfrequency protection	EN 50438, Annex D.2.4	**P**
	Overfrequency protection	EN 50438, Annex D.2.4	**P**
4.9.4.2	Loss of Mains (LoM) detection	IEC 62116:2014	**P**

4.9.3	Requirements on voltage and frequency protection Checklist	P

Several points to check		
Clause 4.9.3.1 to 4.9.3.6	All thresholds must be adjustable	P

Voltage values						
Threshold	Stage 1 [27 <]			Stage 2 [27 <<]		
	Operate voltage	Operate time		Operate voltage	Operate time	
Range	0,2-1,0 U_n	0,1-100s		0,2-1,0 U_n	0,1-5s	
Steps	0,01 U_n	0,1 s		0,01 U_n	0,05s	
Threshold	Stage 1 [59 >]		Stage 2 [59 >>]		Overvoltage 10 min mean protection	
	Operate voltage	Operate time	Operate voltage	Operate time	Operate voltage	Operate time
Range	1,0-1,2 U_n	0,1-100s	1,0-1,3 U_n	0,1-5s	1,0-1,15 U_n	3s not adjustable
Steps	0,01 U_n	0,1s	0,01 U_n	0,05s	0,01 U_n	--

Frequency values				
Threshold	Stage 1 [81 <]		Stage 2 [81 <<]	
	Operate frequency	Operate time	Operate frequency	Operate time
Range	47,0-50,0Hz	0,1-100s	47,0-50,0Hz	0,1-5s
Steps	0,1 Hz	0,1 s	0,1 Hz	0,05s
Threshold	Stage 1 [81 >]		Stage 2 [81 >>]	
	Operate frequency	Operate time	Operate frequency	Operate time
Range	50,0-52,0Hz	0,1-100s	50,0-52,0Hz	0,1-5s
Steps	0,1 Hz	0,1 s	0,1 Hz	0,05s

4.9.2.6	Insensitive against 40ms frequency transients, so that the unit will not trip	P
Note:		

4.9.3 4.9.3.1	Requirements on voltage and frequency protection General (Interface protection: Over/under voltage) (Setting value refer EN 50438 for default settings)	P

Test conditions			Output power: 20,0kW Frequency: 50+/-0,2Hz		
Phase	**Limit [V]**	**Trip value [V]**	**Voltage step [V]**	**Disconnection time [s]**	**Limit [s]**
L1	Stage 1 115% of U_n = 264,5	264,6	230 to 269	0,162	≤3,0s
		264,5	230 to 269	0,156	
		264,6	230 to 269	0,167	
		264,5	230 to 269	0,158	
		264,6	230 to 269	0,159	
	Stage 2 125% of U_n = 287.5	287,5	230 to 292	0,165	0,1s ≤ t ≤ 0,2s
		287,5	230 to 292	0,165	
		287,5	230 to 292	0,160	
		287,5	230 to 292	0,170	
		287,5	230 to 292	0,165	
	Stage 80% of U_n = 184	183,7	230 to 189	2,532	2,0s ≤ t ≤ 5,0s
		183,8	230 to 189	2,532	
		183,7	230 to 189	2,532	
		183,7	230 to 189	2,532	
		183,6	230 to 189	2,532	
	Stage 2 50% of U_n = 115	115,8	230 to 120	0,160	0,1s ≤ t ≤ 2,0s
		115,9	230 to 120	0,150	
		115,9	230 to 120	0,150	
		115,8	230 to 120	0,165	
		115,8	230 to 120	0,165	
L2	Stage 1 115% of U_n = 264,5	264,3	230 to 269	0,152	≤3,0s
		264,3	230 to 269	0,152	
		264,2	230 to 269	0,145	
		264,3	230 to 269	0,147	
		264,3	230 to 269	0,147	
	Stage 2 125% of U_n = 287.5	287,6	230 to 292	0,165	0,1s ≤ t ≤ 0,2s
		287,6	230 to 292	0,165	
		287,5	230 to 292	0,165	
		287,6	230 to 292	0,150	
		287,6	230 to 292	0,150	
		183,6	230 to 189	2,532	2,0s ≤ t ≤ 5,0s

	Stage 80% of U_n = 184	183,6	230 to 189	2,532	
		183,6	230 to 189	2,532	
		183,6	230 to 189	2,532	
		183,6	230 to 189	2,532	
	Stage 2 50% of U_n = 115	115,8	230 to 120	0,165	
		115,9	230 to 120	0,165	
		115,8	230 to 120	0,165	0,1s ≤ t ≤ 2,0s
		115,8	230 to 120	0,165	
		115,9	230 to 120	0,175	
L3	Stage 1 115% of U_n = 264,5	264,6	230 to 269	0,147	
		264,6	230 to 269	0,146	
		264,6	230 to 269	0,161	≤3,0s
		264,6	230 to 269	0,163	
		264,6	230 to 269	0,145	
	Stage 2 125% of U_n = 287.5	288,0	230 to 292	0,165	
		288,1	230 to 292	0,165	
		288,1	230 to 292	0,155	0,1s ≤ t ≤ 0,2s
		288,1	230 to 292	0,155	
		288,1	230 to 292	0,150	
	Stage 80% of U_n = 184	183,6	230 to 189	2,532	
		183,5	230 to 189	2,532	
		183,5	230 to 189	2,517	2,0s ≤ t ≤ 5,0s
		183,5	230 to 189	2,517	
		183,5	230 to 189	2,517	
	Stage 2 50% of U_n = 115	115,8	230 to 120	0,160	
		115,8	230 to 120	0,165	
		115,9	230 to 120	0,170	0,1s ≤ t ≤ 2,0s
		115,8	230 to 120	0,160	
		115,8	230 to 120	0,145	

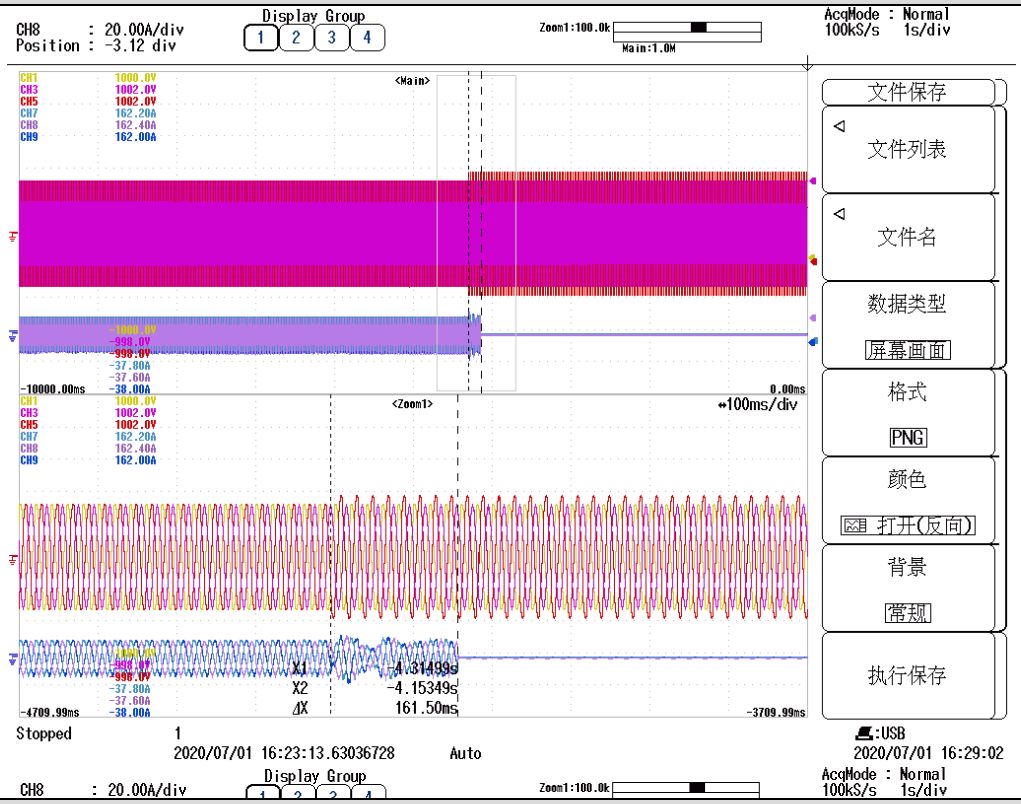
Note:

The trip values were evaluated by varying the applied voltage from U_n down to $U_{th\text{-}low}$ - 2% of U_n in steps of 0,5% of U_n for under-voltage testing as well as from U_n up to $U_{th\text{-}high}$ + 2% of U_n in steps of 0,5% of U_n for over-voltage testing, Lower and upper threshold voltage shall not fall or rise below or above 2,3V of the trip value itself, The disconnection time was measured by application of a negative voltage step from U_n to the operate value -5% of U_n as well as positive voltage step from U_n to the operate value +5% of U_n.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

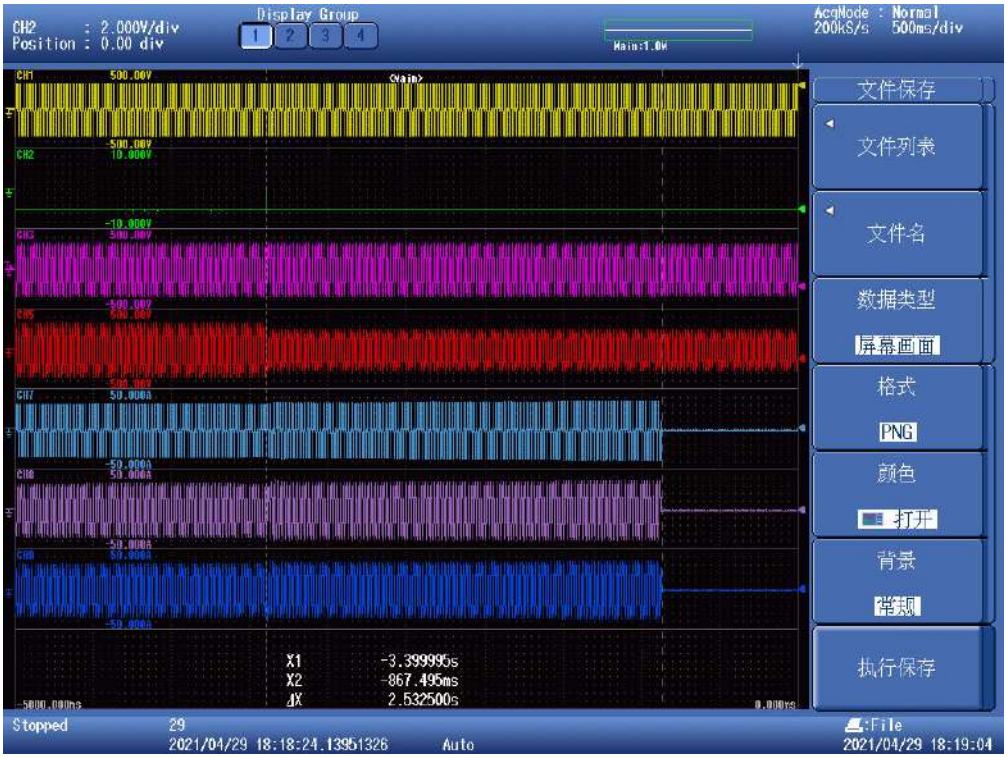
Scope pictures of the disconnection time

Over-voltage - Stage 1 (L1 phase)



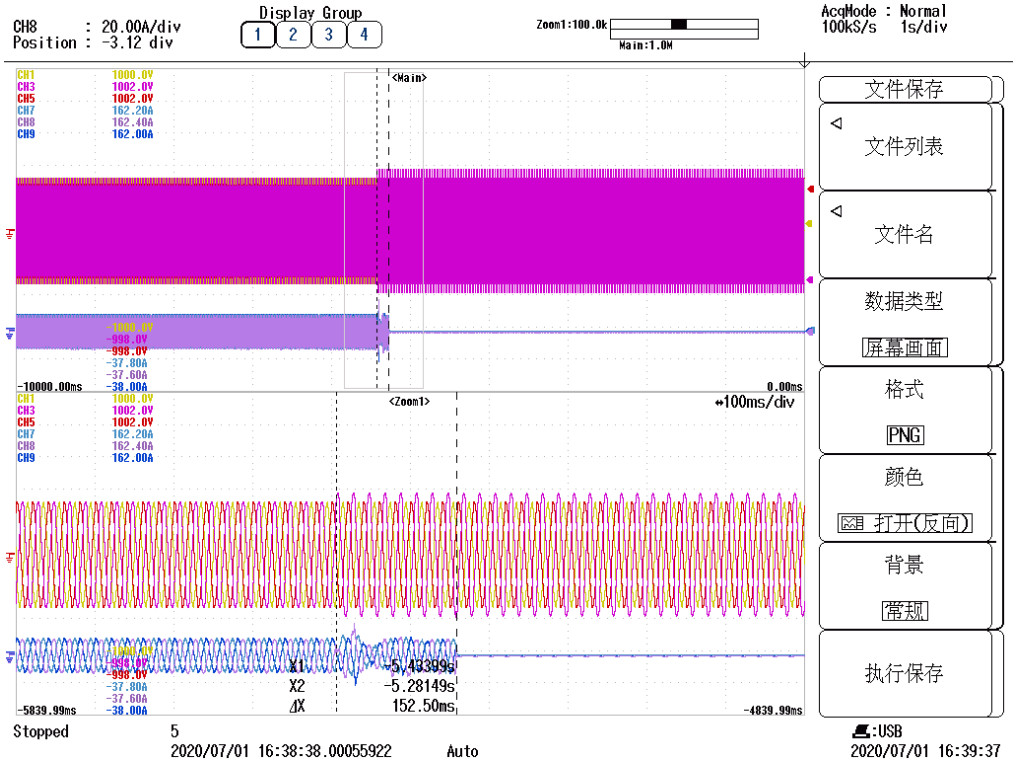
Over-voltage - Stage 2 (L1 phase)

Under-voltage - Stage 1 (L1 phase)



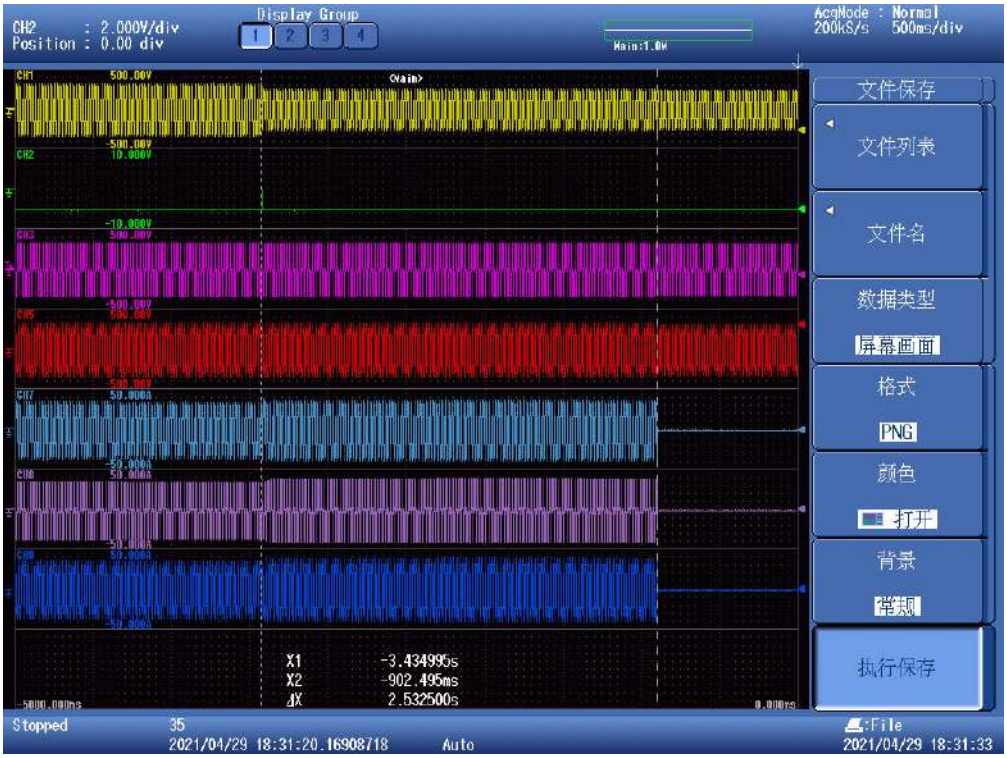
Under-voltage - Stage 2 (L1 phase)

Over-voltage - Stage 1 (L2 phase)



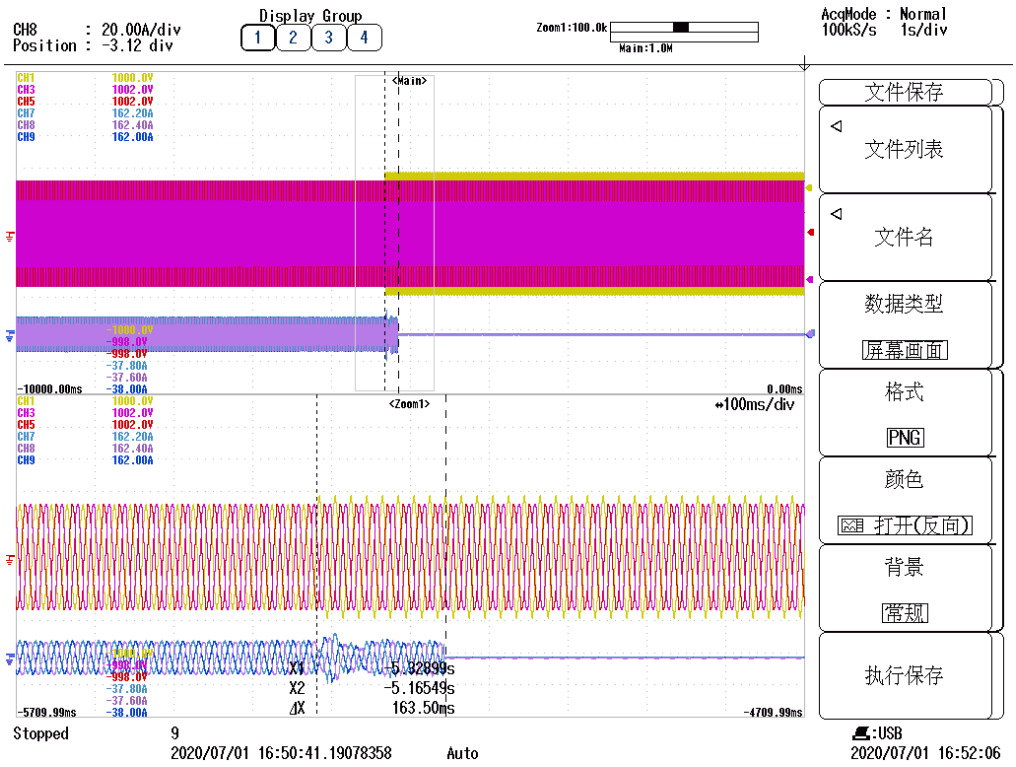
Over-voltage - Stage 2 (L2 phase)

Under-voltage - Stage 1 (L2 phase)

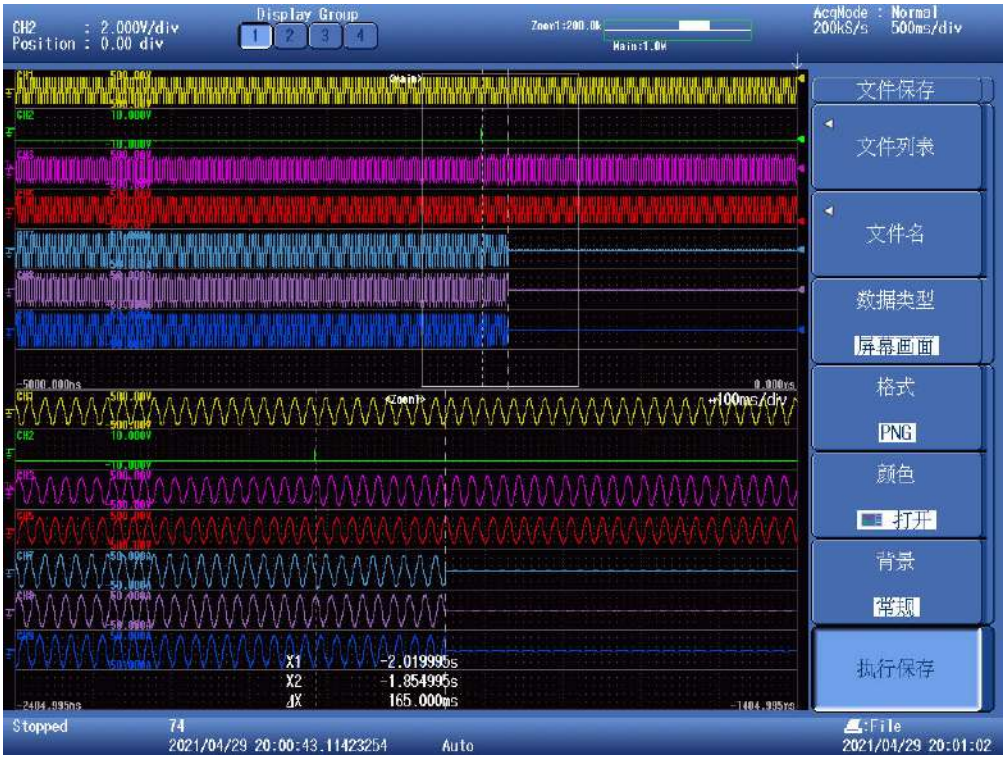


Under-voltage - Stage 2 (L2 phase)

Over-voltage - Stage 1 (L3 phase)



Over-voltage - Stage 2 (L3 phase)



Under-voltage - Stage 1 (L3 phase)


Under-voltage - Stage 2 (L3 phase)


4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Maximum voltage 10 min mean protection according to EN 50160) (Setting value refer EN 50438 for default settings)			P
Setting values of the protection:	Trip value Setting [V]	253	
	Setting $T_{disconnection\ trip\ value}$ [s]	600	
	Setting $T_{disconnection}$ [ms]	200	
Test:			
	Disconnection time [s]	Limit [s]	
a)	The voltage is set to 100% U_n and held for 600 s, Thereafter the voltage is set to 112% U_n, Disconnection must take place within 600 s,		
	Phase 1:	503 s	≤ 600 s
	Phase 2:	508 s	
	Phase 3:	506 s	
b)	The voltage is set to U_n for 600 s and then to 108% U_n for 600 s, No disconnection should take place,		
	Phase 1:	No Disconnection	Disconnection should not take place,
	Phase 2:	No Disconnection	
	Phase 3:	No Disconnection	
c)	The voltage is set to 106 % U_n and held for 600 s, Thereafter the voltage is set to 114 % U_n, The disconnection should last for half the period as in Point a)*		
	Phase 1:	309 s	The disconnection time should be about 50 % of the value measured in a), *
	Phase 2:	314 s	
	Phase 3:	311 s	

Test:

a) This test serves as proof of the measurement accuracy and the maximum set time.

b) This test serves as proof of the measurement accuracy.

c) This test serves as proof of the correct formation of the 1 minute running mean value.

Assessment criterion:

The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1 % of U_N.

Limit values:

Rise-in voltage protection 1,1 U_N after a max. 600 s, the switch off after 200 ms.

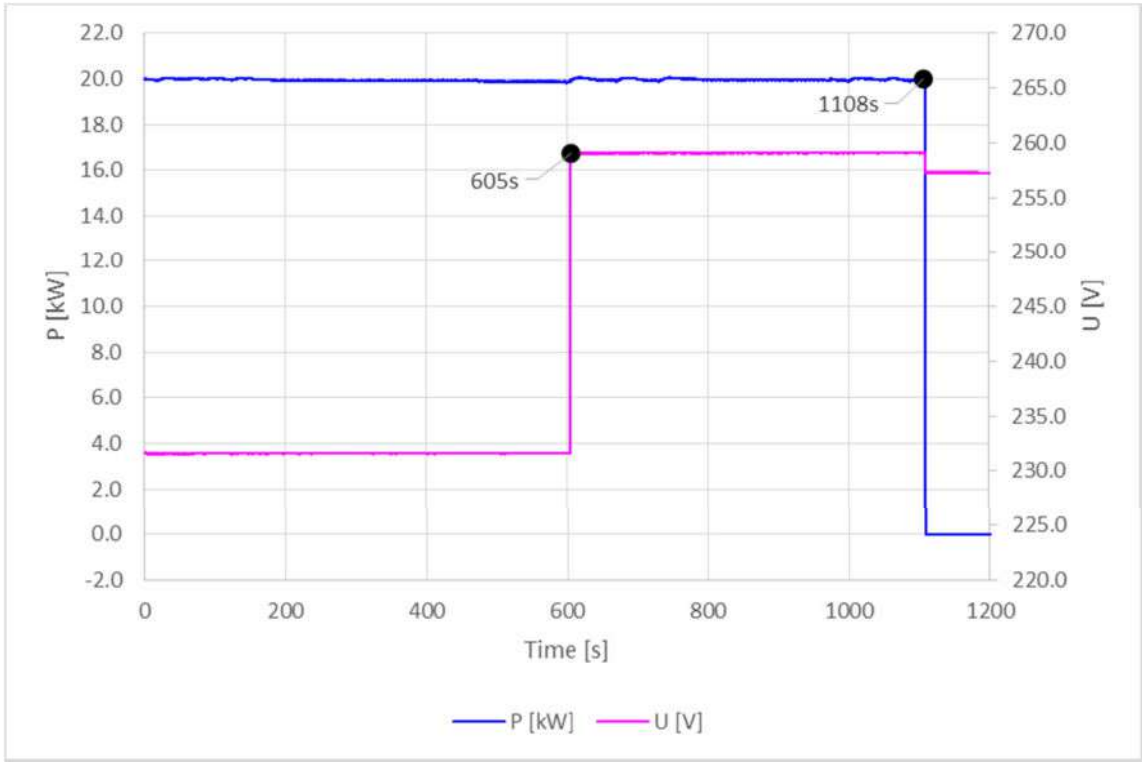
Note:

If only one integrated protection is used for the power generation systems, the value of the rise-in voltage protection of 1,1 U_N may not be changed.

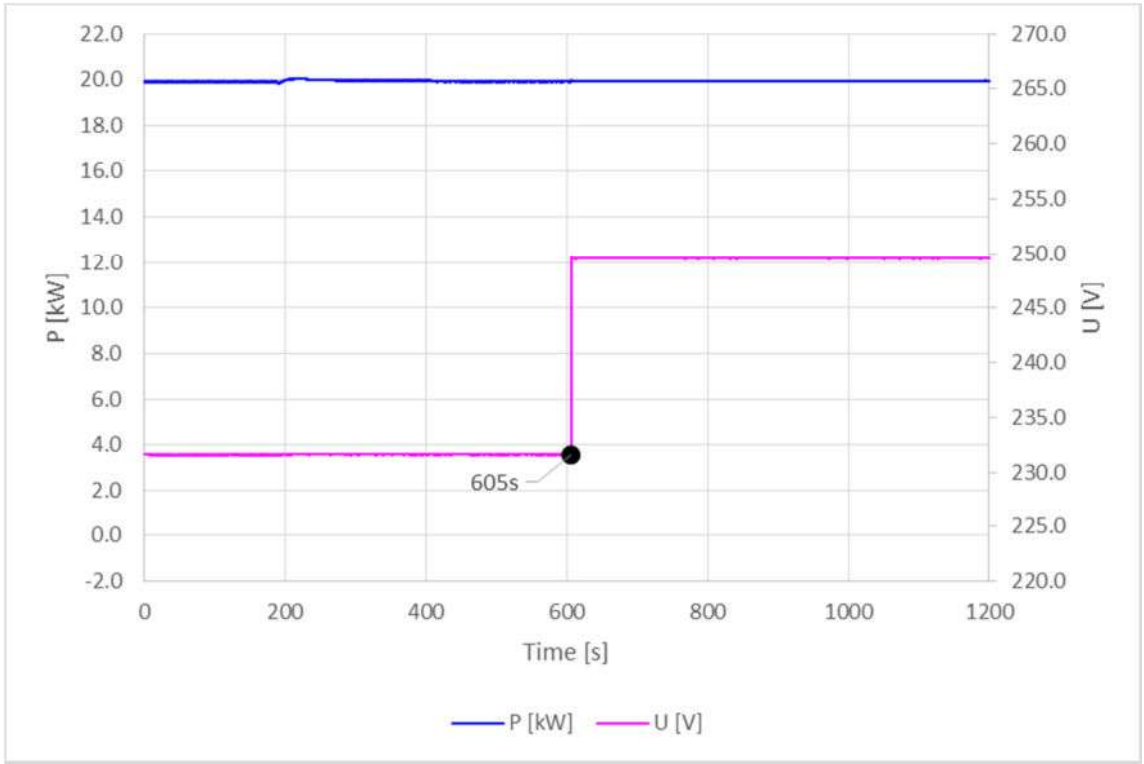
*If the setting value is set to 600 s, then the disconnection time can be in the range between 225 s and 375 s.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

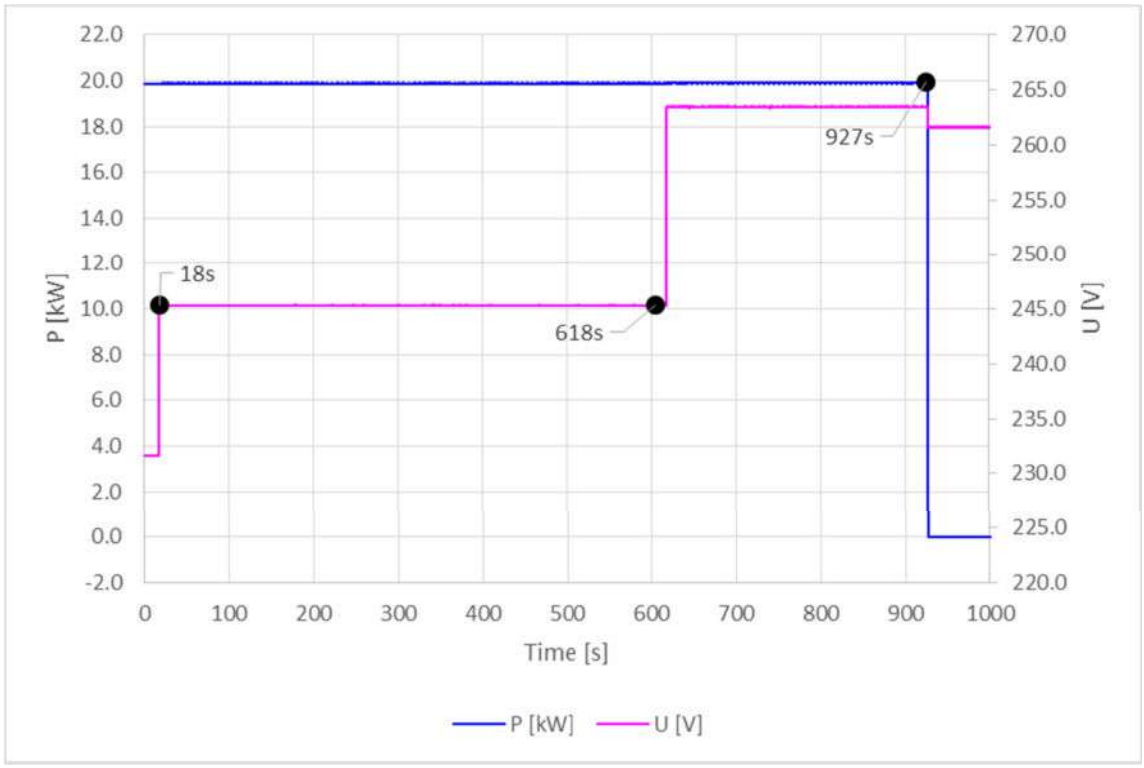
a) Voltage set to 112 % U_n:



b) Voltage set to 108% U_n:



c) Voltage set to 106 % U_n, thereafter 114% U_n:



4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under frequency)					P
Test conditions	Output power: 20,0kW U_n = 230Vac				
	Under-frequency		**Over-frequency**		
Parameter	**Stage 1 Under-Frequency**	**Time**	**Stage 1 Over-Frequency**	**Time**	
Limit	47,50 Hz	0,3 ≤ t ≤ 0,5 s	51,50 Hz	0,3 ≤ t ≤ 0,5 s	
Trip value [Hz]	47,49		51,50		
	47,49		51,50		
	47,49		51,50		
	47,49		51,50		
	47,49		51,50		
Disconnection time [s]	50,00 Hz to 47,40 Hz	0,432	50,00 Hz to 51,60 Hz	0,408	
		0,427		0,424	
		0,408		0,424	
		0,428		0,424	
		0,428		0,409	
Parameter	**Stage 2 Under-Frequency**	**Time**	**Stage 2 Over-Frequency**	**Time**	
Limit	47,00 Hz	0,1 ≤ t ≤ 0,2 s	52,00 Hz	0,1 ≤ t ≤ 0,2 s	
Trip value [Hz]	47,00		52,01		
	47,00		52,01		
	47,00		52,01		
	47,00		52,01		
	47,00		52,01		
Disconnection time [s]	50,00 Hz to 46,90 Hz	0,157	50,00 Hz to 52,10 Hz	0,162	
		0,152		0,162	
		0,147		0,147	
		0,162		0,162	
		0,152		0,152	

Note:

For under-frequency testing the applied frequency is varied from f_n down to $f_{th\text{-}low}$ -0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time, The operate value is the value of the applied frequency at switch the protection function trips and shall be within $f_{th\text{-}low}$ ± 0,05 Hz.

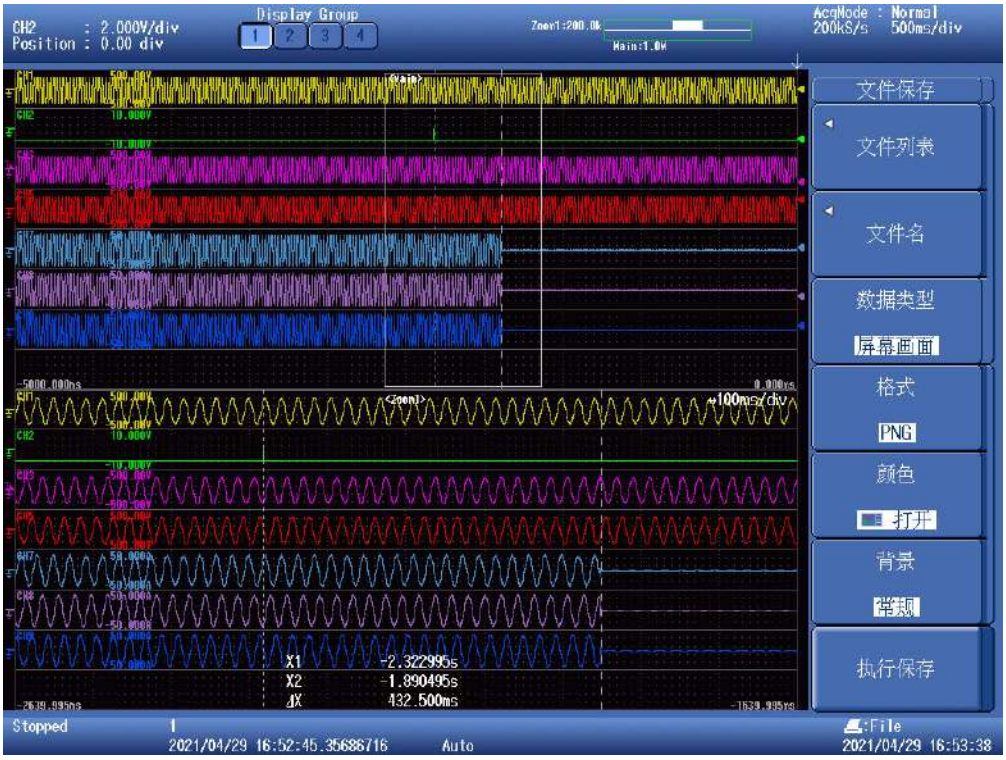
For over-frequency testing the applied frequency is varied from f_n up to $f_{th\text{-}high}$ + 0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time, The operate value is the value of the applied frequency at which the protection function trips and shall be within $f_{th\text{-}high}$ ± 0,05 Hz.

The disconnection time was measured by applying a negative or positive frequency ramp from f_n to the operate value -0,1 Hz or +0,1 Hz, e,g, from 50 Hz to 47,4 Hz, The time elapsed between the application of the frequency ramp and the opening of the interface switch was calculated by the measured time minus the 2500 ms from 50,0 Hz to 47,5 Hz.
The oscilloscope pictures below show the measured worst case disconnection times.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

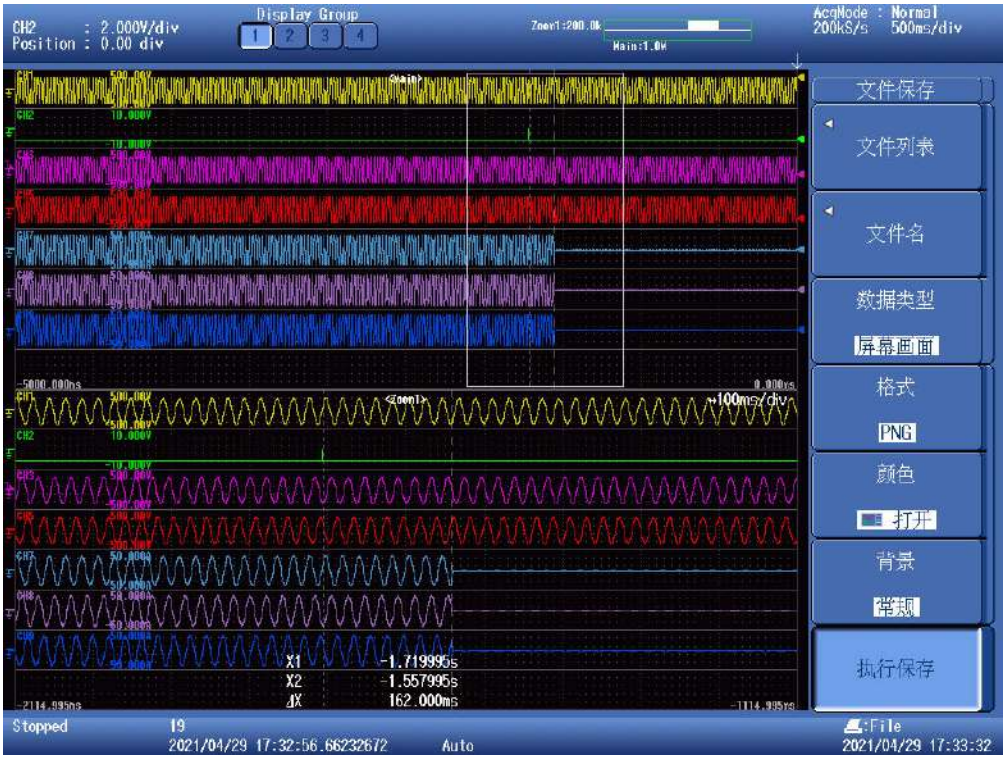
Scope pictures of the disconnection time

Under-frequency - Stage 1



Over-frequency - Stage 1

Under-frequency - Stage 2



Over-frequency - Stage 2

4.9.4.2 Loss of Mains (LoM) detection

Test circuit and parameters

Parameter	Symbol	Units
EUT DC Input		
DC voltage	V_{DC}	V
DC Current	I_{DC}	A
DC Power	P_{DC}	W
EUT AC ouput		
AC voltage	V_{EUT}	V
AC current	I_{EUT}	A
Real power	P_{EUT}	W
Reactive power	Q_{EUT}	VAr
Test Load		
Resistive load current	I_R	A
Inductive load current	I_L	A
Capacitive load current	I_C	A
AC (utility) power source		
Utility real power	P_{AC}	W
Utility reactive power	Q_{AC}	VAr
Utility current	I_{AC}	A

Block diagram test circuit IEC 62116:2014

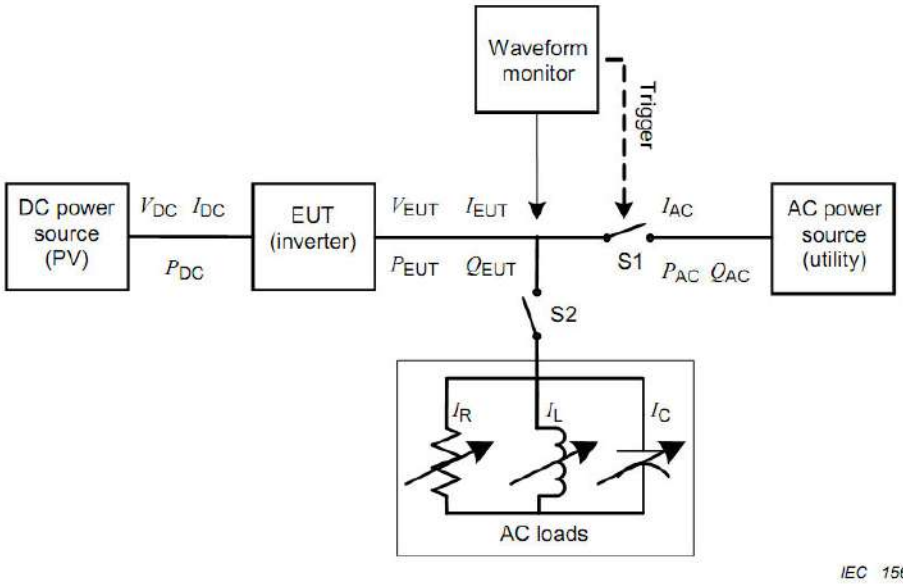


Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

Load imbalance (real, reactive load) for test condition A (EUT output = 100%)	**P**

Test :

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) [1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	I_{AC} [4] [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks [5]
1	100	100	0	0	0,105	19,527	735	1,000	356	BL
2	100	100	-5	-5	4,239	19,527	735	1,026	218	IB
3	100	100	-5	0	4,354	19,527	735	1,052	208	IB
4	100	100	-5	+5	4,247	19,527	735	1,078	292	IB
5	100	100	0	-5	0,210	19,527	735	0,974	296	IB
6	100	100	0	+5	0,203	19,527	735	1,024	284	IB
7	100	100	+5	-5	4,450	19,527	735	0,928	242	IB
8	100	100	+5	0	4,346	19,527	735	0,952	227	IB
9	100	100	+5	+5	4,443	19,527	735	0,976	210	IB

Parameter at 0% per phase	L= 8,62 mH	R= 2,71 Ω	C= 1174,98 µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

[1] P_{EUT}: EUT output power.

[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility, Nominal is the 0 % test condition value.

[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility, Nominal is the 0 % test condition value.

[4] Fundamental of I_{AC} when RLC is adjusted.

[5] BL: Balance condition, IB: Imbalance condition.

Condition A:

EUT output power P_{EUT} = Maximum [6]

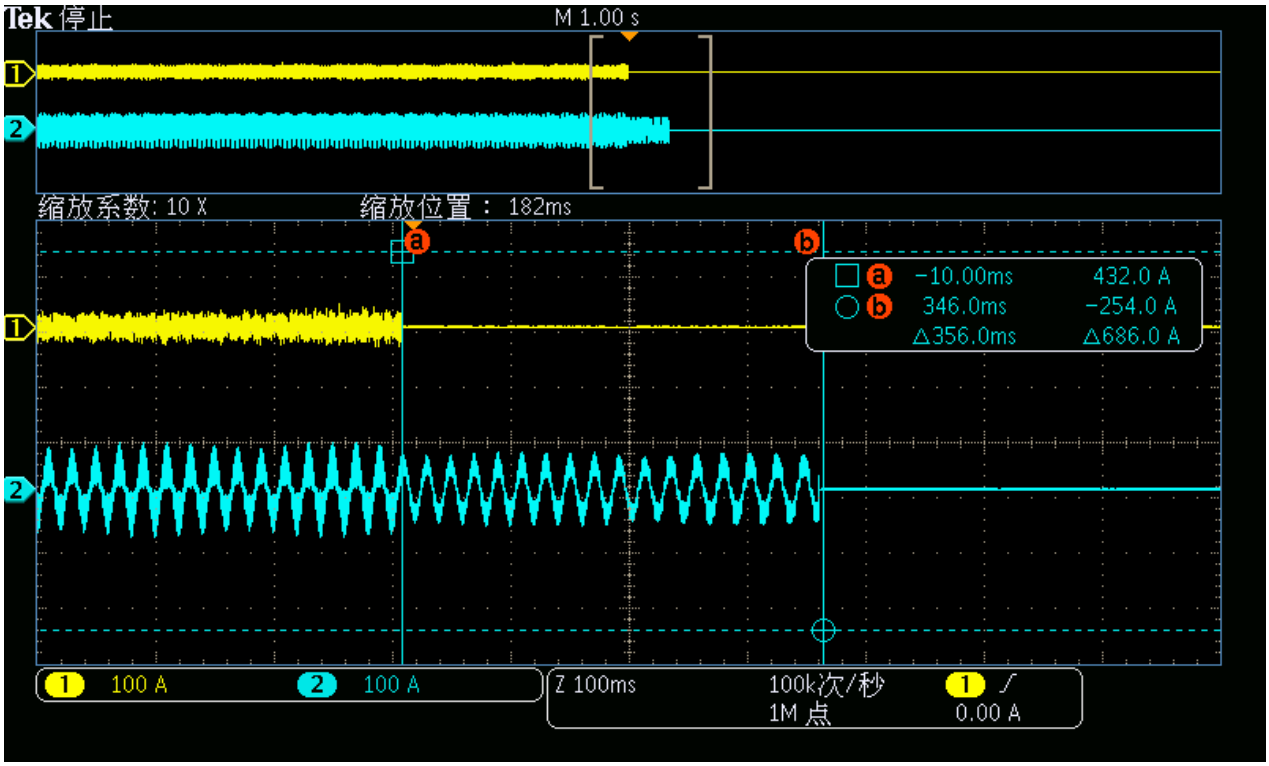
EUT input voltage [6] = >75% of rated input voltage range

[6] Maximum EUT output power condition should be achieved using the maximum allowable input power, Actual output power may exceed nominal rated output.

[7] Based on EUT rated input operating range, For example, If range is between X volts and Y volts, 75 % of range =X + 0,75 × (Y – X), Y shall not exceed 0,8 × EUT maximum system voltage (i,e,, maximum allowable array open circuit voltage), In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Scope pictures of the disconnection time
Disconnection at No. 1



Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

Test :

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1)	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks 5)
1	66	66	0	-5	0,201	13,118	475	0,975	215	IB
2	66	66	0	-4	0,176	13,118	475	0,980	218	IB
3	66	66	0	-3	0,156	13,118	475	0,985	266	IB
4	66	66	0	-2	0,143	13,118	475	0,990	236	IB
5	66	66	0	-1	0,134	13,118	475	0,995	246	IB
6	66	66	0	0	0,132	13,118	475	1,000	447	BL
7	66	66	0	+1	0,135	13,118	475	1,005	287	IB
8	66	66	0	+2	0,144	13,118	475	1,010	188	IB
9	66	66	0	+3	0,159	13,118	475	1,015	185	IB
10	66	66	0	+4	0,179	13,118	475	1,020	206	IB
11	66	66	0	+5	0,205	13,118	475	1,025	193	IB

Parameter at 0% per phase	L= 12,84 mH	R= 4,03 Ω	C= 789,34 µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

1) P_{EUT}: EUT output power.

2) P_{AC}: Real power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value.

3) Q_{AC}: Reactive power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value.

4) Fundamental of I_{AC} when RLC is adjusted.

5) BL: Balance condition, IB: Imbalance condition.

Condition B:

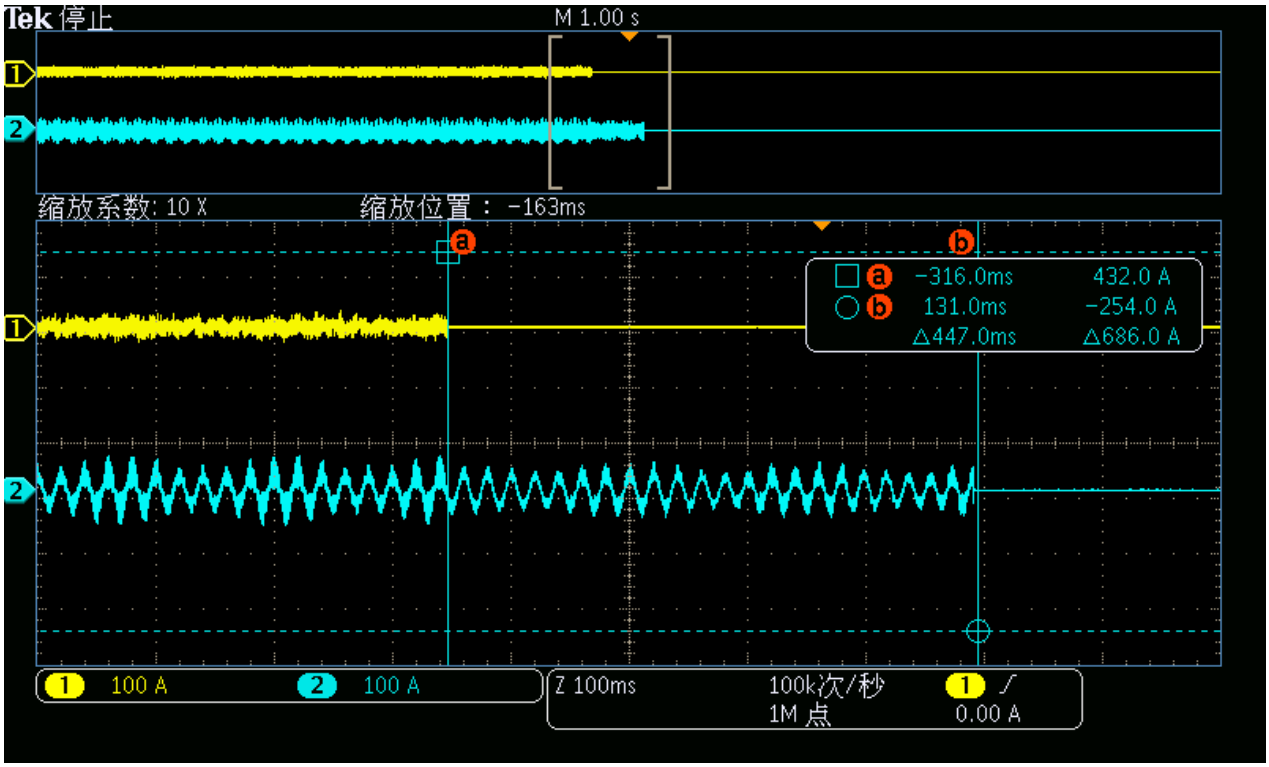
EUT output power P_{EUT} = 50 % – 66 % of maximum

EUT input voltage 6) = 50 % of rated input voltage range, ±10 %

6) Based on EUT rated input operating range, For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X), Y shall not exceed 0,8 × EUT maximum system voltage (i,e,, maximum allowable array open circuit voltage), In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Scope pictures of the disconnection time
Disconnection at No, 6



Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

Test :

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1)	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks 5)
1	33	33	0	-5	0.146	6,524	215	0.975	181	IB
2	33	33	0	-4	0.134	6,524	215	0.980	191	IB
3	33	33	0	-3	0.124	6,524	215	0.985	185	IB
4	33	33	0	-2	0.117	6,524	215	0.990	223	IB
5	33	33	0	-1	0.113	6,524	215	0.995	367	IB
6	33	33	0	0	0.112	6,524	215	1.000	393	BL
7	33	33	0	+1	0.114	6,524	215	1.005	260	IB
8	33	33	0	+2	0.118	6,524	215	1.010	224	IB
9	33	33	0	+3	0.126	6,524	215	1.015	211	IB
10	33	33	0	+4	0.136	6,524	215	1.020	216	IB
11	33	33	0	+5	0.149	6,524	215	1.025	190	IB

Parameter at 0% per phase	L= 25,81 mH	R= 8,11 Ω	C= 392,56 µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

1) P_{EUT}: EUT output power.

2) P_{AC}: Real power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value.

3) Q_{AC}: Reactive power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value.

4) Fundamental of I_{AC} when RLC is adjusted.

5) BL: Balance condition, IB: Imbalance condition.

Condition B:

EUT output power P_{EUT} = 25 % – 33 % 6) of maximum

EUT input voltage 7) = <20 % of rated input voltage range

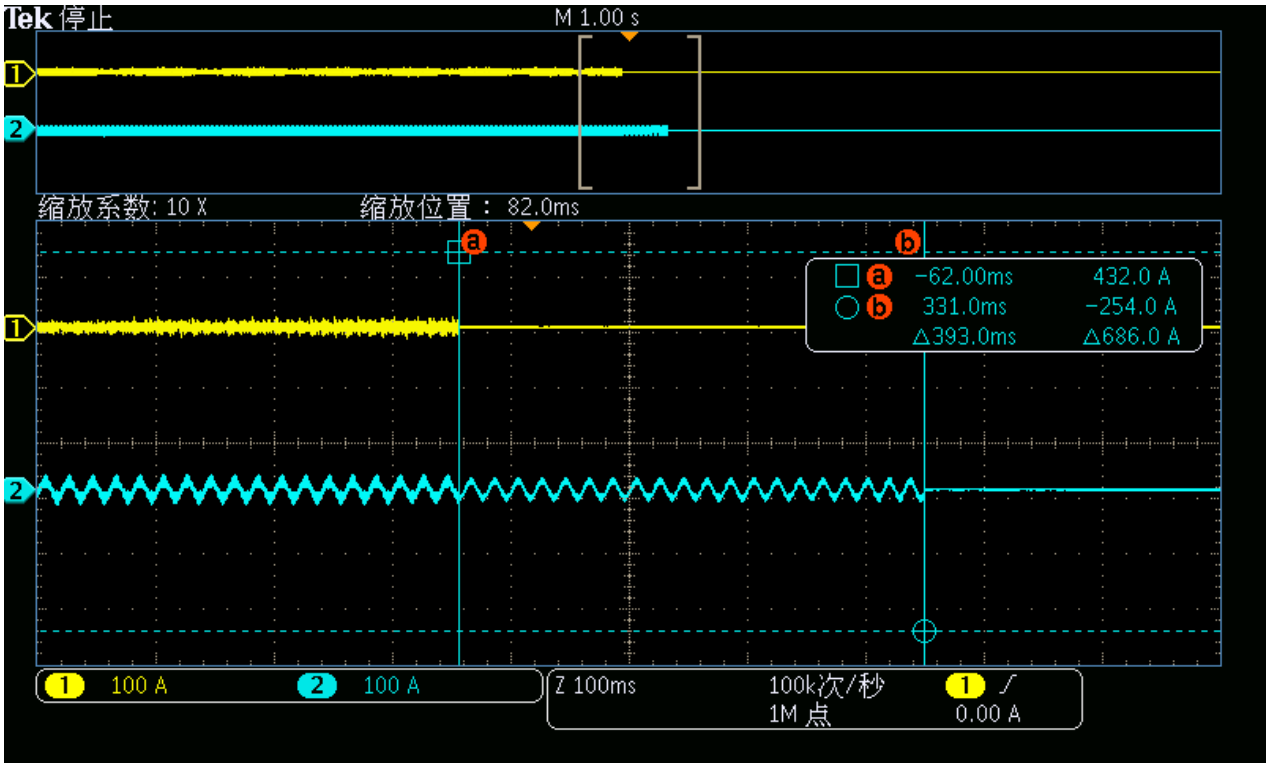
6) Or minimum allowable EUT output level if greater than 33 %.

7) Based on EUT rated input operating range, For example, If range is between X volts and Y volts, 20 % of range =X + 0,2 × (Y – X), Y shall not exceed 0,8 × EUT maximum system voltage (i,e,, maximum allowable

array open circuit voltage), In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Scope pictures of the disconnection time
Disconnection at No, 6



EN 50549-1:2019: Connection and starting to generate electrical power			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.10.2	Automatic reconnection after trippin	EN 50438, Annex D.3.6	**P**
4.10.3	Starting to generate electrical power	EN 50438, Annex D.3.6	**P**

4.10 Connection and starting to generate electrical power **4.10.2 Automatic reconnection after tripping** **4.10.3 Starting to generate electrical power**		**P**
Setting value	Min. voltage for connected to grid :	196
	Max. voltage for connected to grid :	253
	Min. frequency for connected to grid :	49,5
	Max. frequency for connected to grid (Normal operational start-up) :	50,1
	Max. frequency for connected to grid (Automatic reconnection after tripping) :	50,2
	Observation time (≥60s) :	60

Test:

	Voltage conditons	
a) Start up for voltage range	<85% Un for twice of observation time	>110% Un for twice of observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	≥85% Un within twice setting observation time	≤110% Un within twice setting observation time
Reconnection time [s]	70,0 s	70,0 s
Limit:	Connected after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: disable, For recorded gradient see diagram below,	
c) In voltage range after voltage failture	≥85% Un for twice of setting observation time	≤110% Un for twice of setting observation time
Reconnection time [s]	77,0 s	77,0 s
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P_{Emax}/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	
	Frequency conditions	
d) Start up for frequency range	<49,50 Hz for twice of setting observation time	>50,10 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	

e) In frequency range at start-up	≥49,50 Hz within twice of setting observation time	≤50,10 Hz within twice of setting observation time
Reconnection time [s]	71,0 s	71,0 s
Limit:	Connected after setting delay time(≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: disable. For recorded gradient see diagram below.	
f) In frequency range after frequency failture	≥49,50 Hz for twice of setting observation time	≤50,20 Hz for twice of setting observation time
Reconnection time [s]	70,0 s	65,0 s
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P_{Emax}/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	

Test:

Test condition b) and c): voltage within the limits of 85% to 110%U_n.

Test condition e): frequency within the limits of 49,50Hz to 50,1Hz.

Test condition f): frequency within the limits of 49,50Hz to 50,2Hz.

In order to avoid continuous starting and disengaging operations of the interface protection relay, the disengaging value of frequency and voltage functions shall be above 2 % deviating from the operate value.

Assessment criterion:

d) the micro generator connects respectively starts generating electrical power only in the permitted range of voltage and frequency and

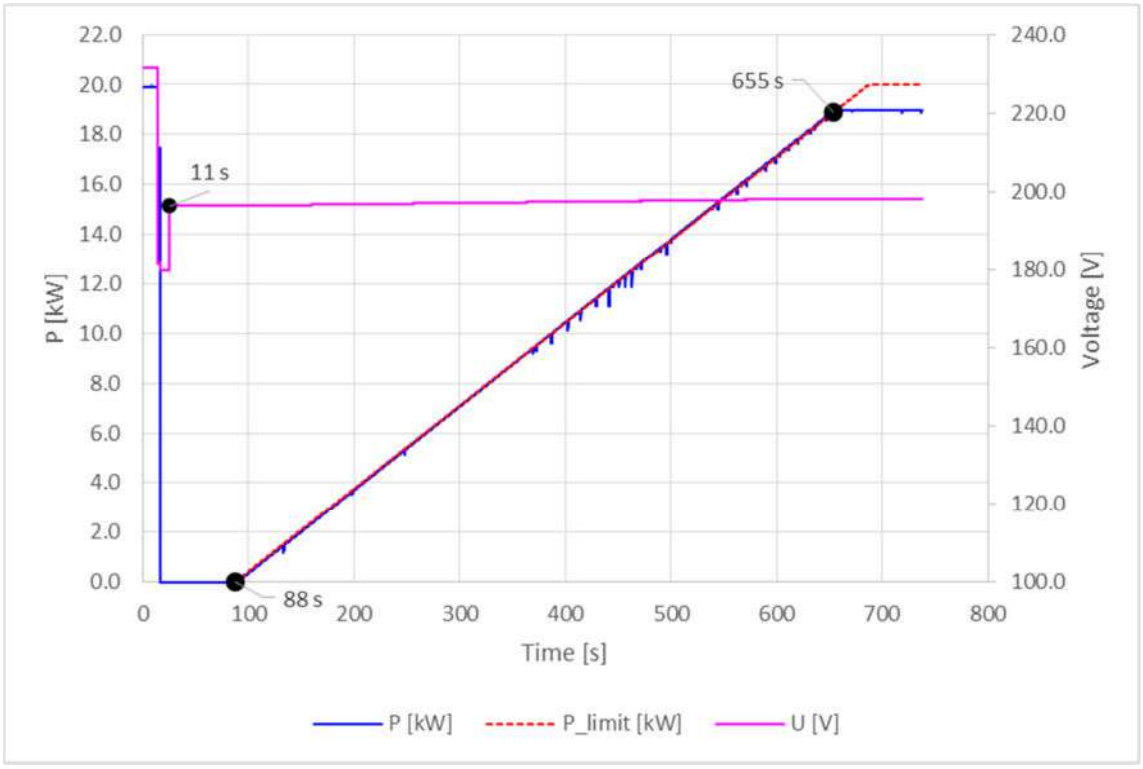
e) for adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute and

f) for non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min.

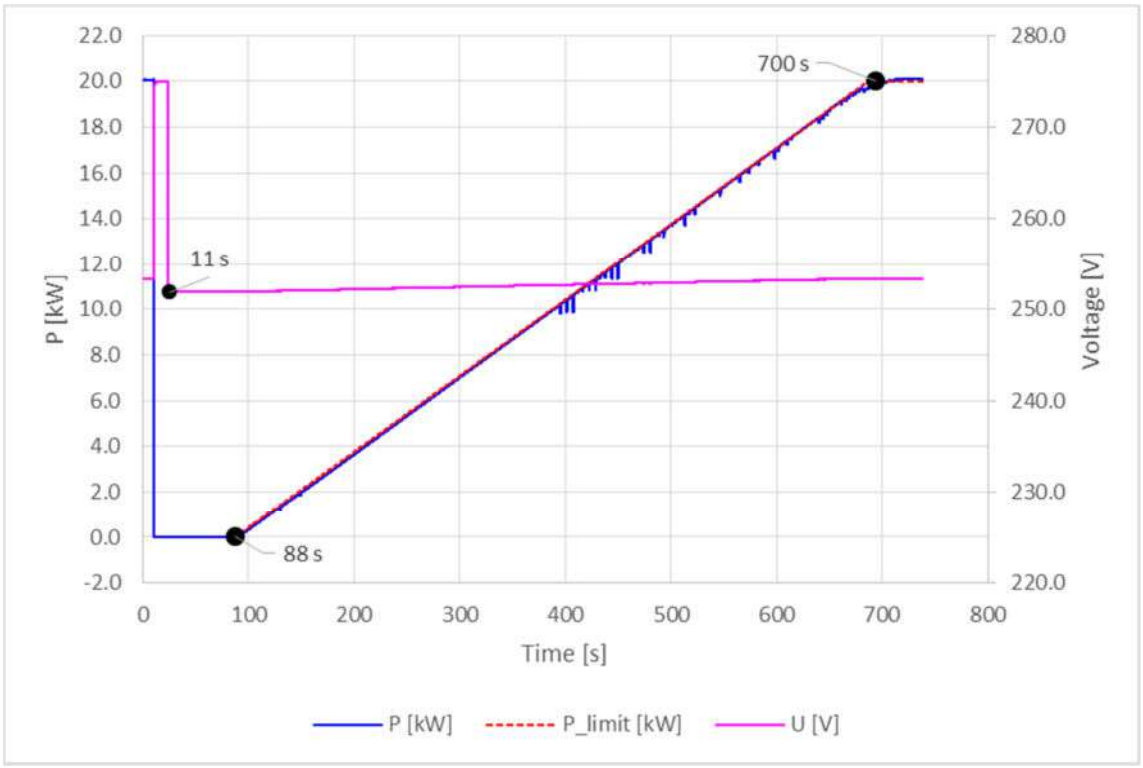
Note:

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

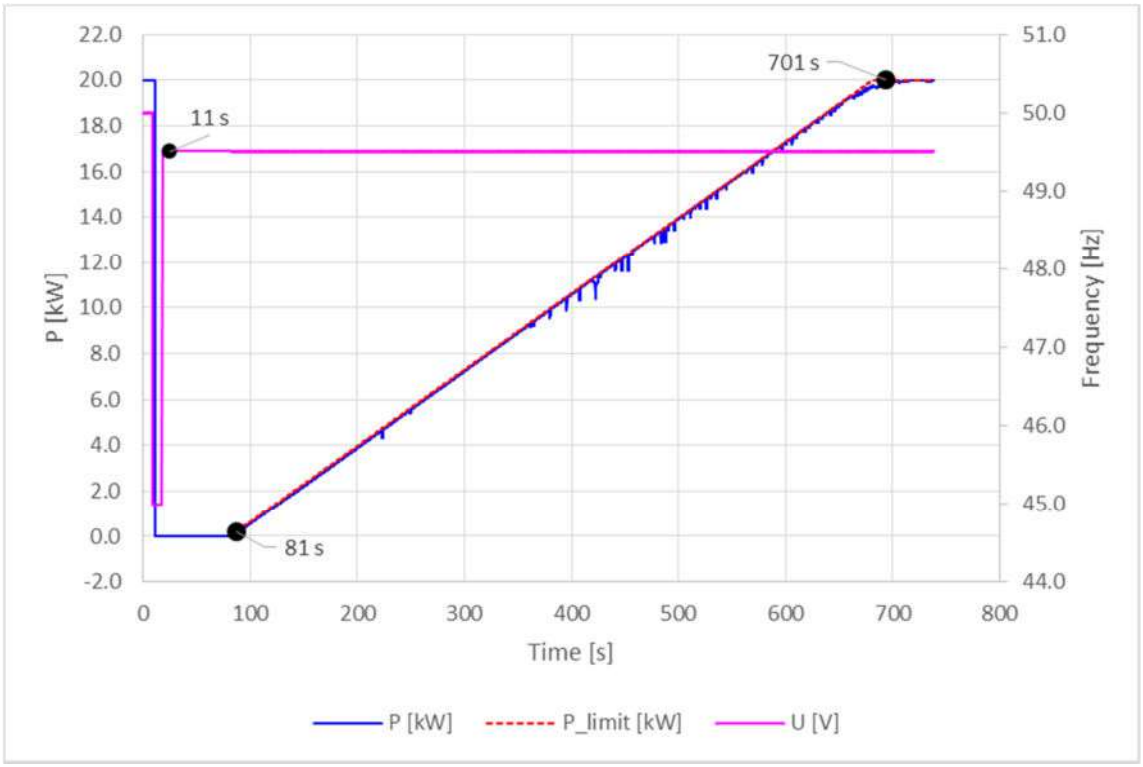
Graph of the gradual power supply : Test c) for ≥ 85% U_n



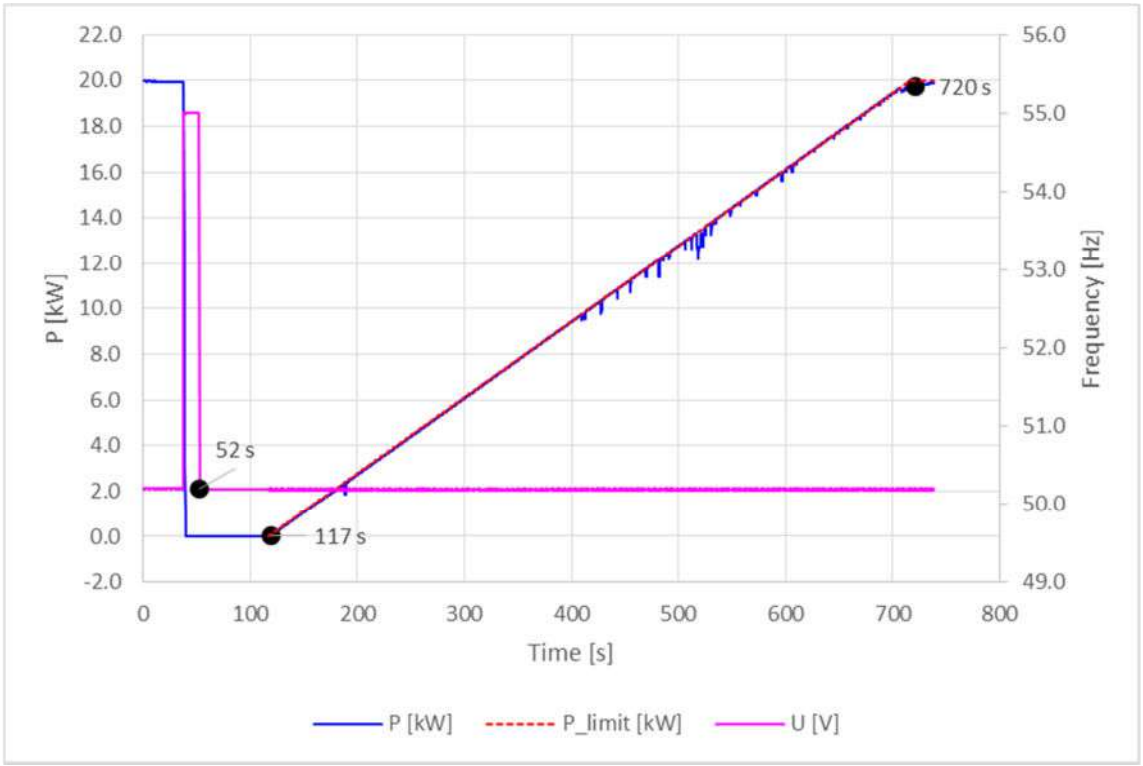
Graph of the gradual power supply : Test c) for ≤ 110% U_n



Graph of the gradual power supply : Test f) for ≥ 49,50Hz



Graph of the gradual power supply : Test f) for ≤ 50,20Hz



EN 50549-1:2019: Ceasing and reduction of active power on set point			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.11.1	Ceasing active power	CEI 0-21:2019-04, Annex A.4.3.3.2	**P**
4.11.2	Reduction of active power on a set point	FGW TG3, Revision 25, clause 4.1.2	**P**

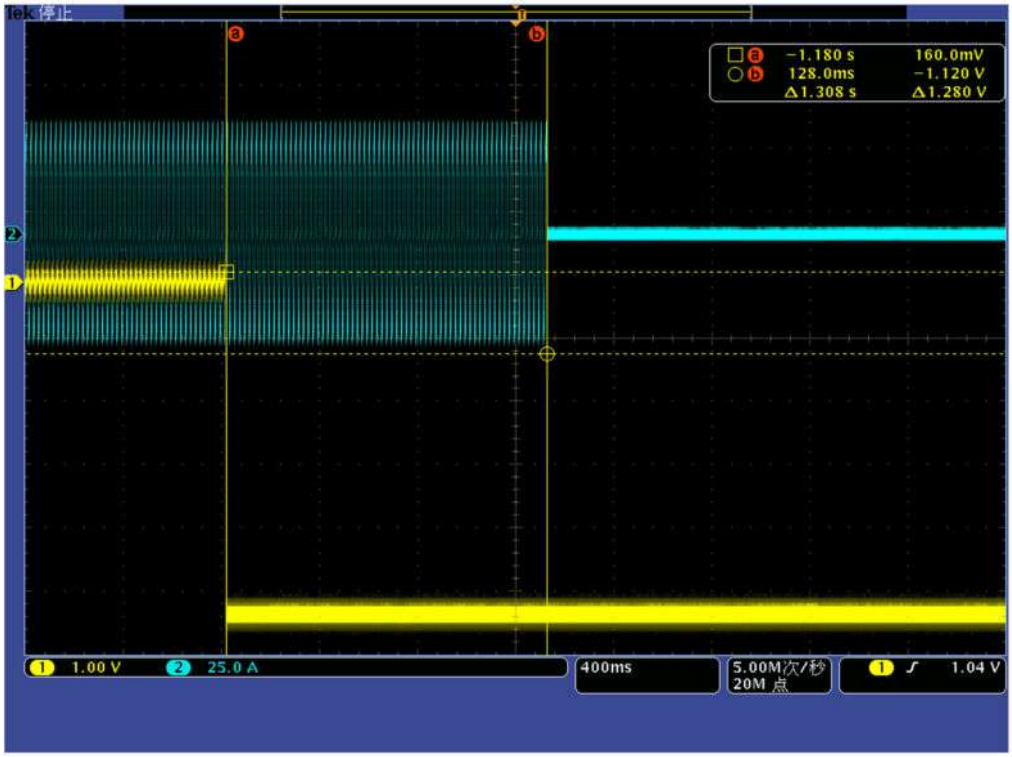
4.11.1 Ceasing active power		P
Operating time of the monitoring device		
Test:	Remote tripping signal for the external disconnection	
Limit [s]:	5 s	
Reaction time of the tripping value [s]:	1,308 s	

Note:

The test method refer to Annex A,4,3,2 of CEI 0-21:2019-04,
Generating plants shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port, If required by the DSO, this includes remote operation.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Graph of Remote trip signal :



4.11.2	Reduction of active power on set point	P

Test result: ASW20K-LT-G2

Setpoint power bin [%Pn]	P_{set} [kW]	P_{60} [kW]	Deviation [%Pn]
100%	19.834	20	-0.83
90%	18.067	18	0.34
80%	16.059	16	0.30
70%	14.036	14	0.18
60%	12.016	12	0.08
50%	10.005	10	0.03
40%	7.989	8	-0.06
30%	5.997	6	-0.02
20%	3.983	4	-0.08
10%	1.972	2	-0.14

	Setpoint power bin [%Pn]	Deviation [%Pn]
Max. deviation	10%	-0,83
Limit $\Delta P_{E60}/P_{Setpoint}$:	+ 5 % of P_{Emax}	

Test:

The setpoint signal must be reduced from 100% to 0% Pn:

a) for adjustable PGUs in increments of 10% Pn, 1 minute must elapse after every change to the setpoint setting so that the PGU can settle at the new setpoint, Then the active power of the PGU must be measured as a 1-min mean value.

b) For all other PGUs, in line with their adjustable steps, 5 minutes must elapse after the setpoint setting is changed so that the PGU can settle at the new setpoint, Then the active power of the PGU must be measured as a 1-min mean value.

Assessment criterion:

a) for adjustable PGUs:

- no network disconnection
- the active power value does not exceed the setpoint by more than 5% P_{Emax}
- the setting time determined this way is ≤ 1min

b) For all other PGUs:

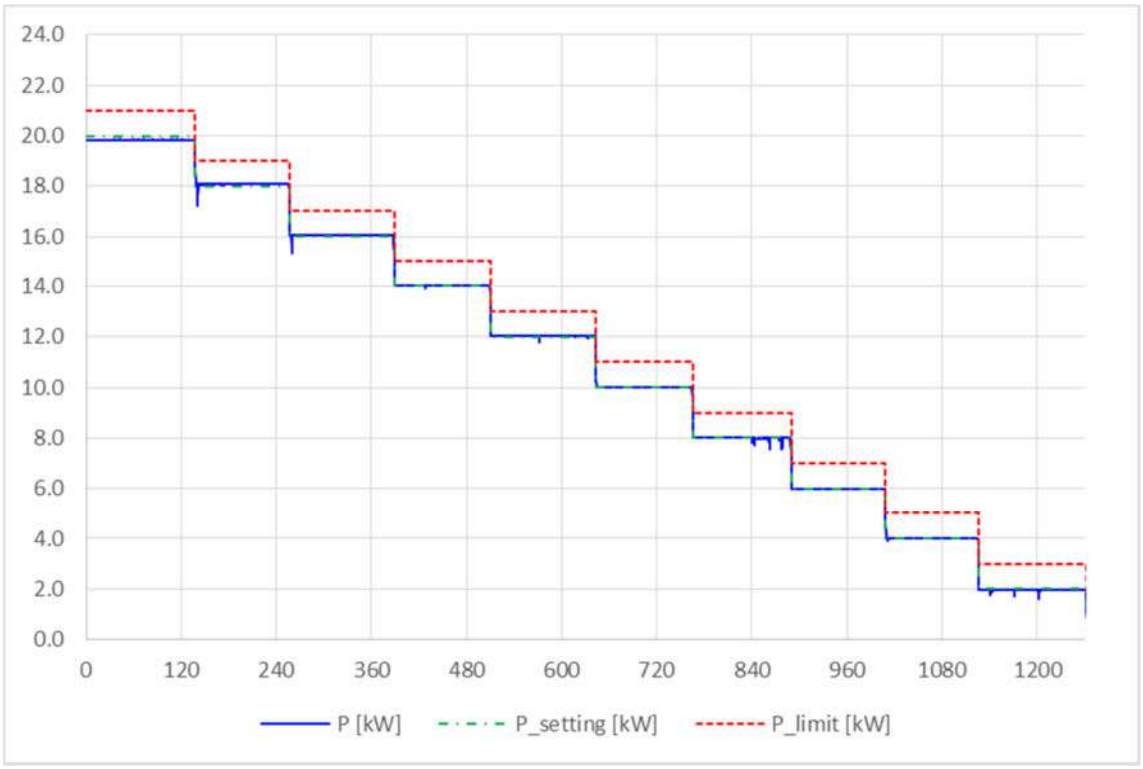
- the active power value does not exceed the setpoint by more than 5% P_{Emax} or
- the setpoint is fallen below within 5 minutes or the PGU has switched off

Note:

The setting time is ≤ 1min. See below “Graph of the setting accuracy”.

The tests had been performed on the ASW20K-LT-G2 are valid for the ASW8K-LT-G2, ASW10K-LT-G2, ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2and ASW17K-LT-G2 since it is same as in hardware and just power derated by software.

Graph of active power on set point



EN 50549-1:2019			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	VDE V 0124-100:2019-02 (Draft), clause 5.5.2	**P**

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
RY501 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
K503 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
K505 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
K507 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
K509 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
K511 defect	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Relay check Fail" No damage, No hazard.
L1 grid voltage monitor R500 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L1 grid voltage monitor R502 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L1 grid voltage monitor R474 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L1 grid voltage monitor R475 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
L2 grid voltage monitor R483defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L2 grid voltage monitor R485 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L2 grid voltage monitor R503 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L2 grid voltage monitor R505 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R507 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R508 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R489 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R488 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R510 defect		230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R515 defect		230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
L3 grid voltage monitor R516 defect		230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
L3 grid voltage monitor R520 defect		230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 34 grid voltage fault" No damage, no hazard.
PV voltage monitor R150 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R152 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R161 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R163 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R200 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R203 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R212 defect	Short	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.
PV voltage monitor R216 defect	Open	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message " 36 PV input voltage fault" No damage, no hazard.

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
PV array insulation resistance monitoring, Q552, C to E	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, R583	Open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation Resistance monitoring, R550	Open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, R557	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, R559	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, R570	open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, RY550(Pin5.8)	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, RY551(Pin3.4)	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
PV array insulation resistance monitoring, C554	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter can not start-up. Error message" Isolation Fault" No damage, No hazard.
RCMU detect, Q402	Short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message "Ground connect warning". No damage, No hazard.

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
RCMU detect, R423	Open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “Ground connect warning”. No damage, No hazard.
RCMU detect, R425	Open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “Ground connect warning”. No damage, No hazard.
RCMU detect, R441	Open before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “Ground connect warning”. No damage, No hazard.
RCMU detect, C433	short before start-up	230V 0,5A	850V 0,1A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “Ground connect warning”. No damage, No hazard.
Main CPU, U516	Short +3,3V power supply pin to GND	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “167 CPU self-test --RAM abnormal”. No damage, No hazard.
Main CPU, U516	Short +1,2V power supply pin to GND	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “167 CPU self-test --RAM abnormal”. No damage, No hazard.
Main CPU, U516	Oscillat orshort	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “167 CPU self-test --RAM abnormal”. No damage, No hazard.
Communication between DSPs	open R667	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “167 CPU self-test --RAM abnormal”. No damage, No hazard.
Slave CPU, U523	Short +3,3V power supply pin to GND	230V 28,7A	850V 14,2A	2min	--	230V 0,5A	850V 0,1A	PV inverter disconnected from grid immediately. Error message “167 CPU self-test --RAM abnormal”. No damage, No hazard.

The errors in the control circuit simulate that the safety is even under one error ensured,

4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	P

Component No.	Fault	Test condition		Test time	Fuse No,	Fault condition		Result
		AC	DC			AC	DC	
Addendum – Shutdown device								
Each active phase can be switched, (L and N)								Yes
If no galvanic separation between AC and DC (PV): Two relays in series on each active phase are necessary to fulfil the basic insulation or simple separation based on the PV working voltage,								Two relays in series on each active phase
Note:								

Annex No. 1

Datasheet of the relay

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RELAY SPECIFICATION

继电器规格书

(File No.: 001000 / Version: 00 / Issued Date: Jul. 14th, 2020)

Product Description（品名）	**CHFN-V-112HA2F(35A)**
Part Number（编码）	
Customer（客户）	

Customer Approval （客户批准）

STAMPING AREA （盖章处）

Issued（发行）	Checked（审核）	Approved（承认）
Helena.Gong	JianXiang Guo	Hiroharu Dan

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SAFETY STANDARD 安全标准	
UL certificate UL 证书	E341422
TUV certificate TUV 证书	R50220099
CQC certificate CQC 证书	CQC11002066606

COIL CHARACTERISTICS 线圈特性	
Coil resistance 线圈电阻	103±10% Ω
Rated voltage 额定电压	12VDC
Max. allowable voltage 最大允许电压	130% of rated coil voltage
Rated power 额定功率	1.4W
Operate voltage 吸合电压	≤9.0VDC
Release voltage 释放电压	≥0.6VDC

CONTACT RATINGS 触点规格	
Contact configuration 触点结构	1 Form A (SPST)
Contact material 触点材料	Ag Alloy
Initial contact resistance 初始接触电阻	≤100mΩ at 6VDC/1A
Rated switching voltage (Normally Open) 额定切换电压（常开触点）	277VAC
Rated switching voltage (Normally Close) 额定切换电压（常闭触点）	-
Rated current (Normally Open) 额定电流（常开触点）	35A
Rated current (Normally Close) 额定电流（常闭触点）	-
Rated switching power (Normally Open) 额定切换功率（常开触点）	9695VA
Rated switching power (Normally Close) 额定切换功率（常闭触点）	-

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Minimum applicable load (Normally Open) 最小使用负载（常开触点）	5VDC 100mA
Minimum applicable load (Normally Close) 最小使用负载（常闭触点）	-
Operate time 吸合时间	≤20ms, excluding bounce time ≤20ms，不含触点抖动时间
Release time 释放时间	≤10ms, excluding bounce time ≤10ms，不含触点抖动时间
Mechanical endurance 机械寿命	300K cycles, 180 cycles/minute
Electrical endurance (Resistive Load) 电气寿命（阻性负载）	35A, 277VAC, 30K cycles, 1s on/9s off 线圈通电 1 秒(12V/0.1 秒→下降 5.4~6.6V/0.9S) / 9 秒 OFF，（ @85℃）
Contact Gap 接点间隙	2.26mm 以上

INSULATION PERFORMANCE 绝缘性能

Dielectric strength 介电强度	2800VAC 1minute, between open contacts 2800VAC 1 分钟（断开触点间） 4,500VAC 1minute, between coil to contacts 4,500VAC 1 分钟（线圈与触点间）
Impulse withstand voltage 耐浪涌电压	10KV (1.2/50 μ s), between coil to contacts 10KV（线圈与触点间）
Insulation resistance 绝缘电阻	1000MΩ at 500VDC, between open contacts and coil to contacts 1000MΩ（断开触点间及线圈与触点间）
Insulation systems (UL) 绝缘系统	155℃(F)
Insulation type 绝缘类型	Basic insulation 基本绝缘

ENVIRONMENT PERFORMANCE 环境性能

Category of protection (IEC61810-1) 密封类型	RT II (Flux Tight) 防助焊剂渗入型
Operating temperature 工作温度	-40~85℃
Operating humidity 工作湿度	20~85%RH
Storage temperature 储藏温度	-40~85℃
Storage humidity 储藏湿度	20~85%RH

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Vibration resistance 耐振动	(1) Capability to function during vibration No opening or closing of any closed or opened contact circuit respectively exceed 10μs when the relay is subjected to vibration of 10~55Hz and 1.5mm dual amplitude in each of three mutually perpendicular axes for 10 minutes respectively, while it is in operate condition and in release condition. 抗误动作能力 动作/释放状态下，继电器在三个轴向耐受频率10~55Hz及振幅1.5mm的振动各10分钟，触点误动作不超过10微秒。 (2) Capability to function after vibration No trouble on structure and characteristics after the relay is subjected to vibration of 10~55Hz and 1.5mm dual amplitude in each of three mutually perpendicular axes for 2 hours respectively. 振动耐久能力 继电器在三个轴向耐受振幅1.5mm及频率10~55Hz的振动各2小时，产品构造和性能无异常发生。
Shock resistance 耐冲击	(1) Capability to function during shock No opening or closing of any closed or opened contact circuit respectively exceed 10μs when the relay is subjected to shock of 98.1m/s^2 for 11ms in both directions of each of three mutually perpendicular axes for 3 times respectively, while it is in operate condition and in release condition. 抗误动作能力 动作/释放状态下，继电器在三轴六方向耐受加速度98.1m/s^{2}及作用时间11毫秒的冲击各3次，触点误动作不超过10微秒。 (2) Capability to function after shock No trouble on structure and characteristics after the relay is subjected to shock of 981m/s^2 for 6ms in both directions of each of three mutually perpendicular axes for 3 times respectively. 冲击耐久能力 继电器在三轴六方向耐受加速度981m/s^{2}及作用时间6毫秒的冲击各3次，产品构造和性能无异常发生。

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Cold resistance 耐低温	No trouble on structure and characteristics after placed at -40℃ for 240 hours and 2 hours recovery in standard atmospheric conditions. -40℃中放置240小时并在标准大气条件中恢复2小时后继电器构造和特性无异常。
Thermal resistance 耐高温	No trouble on structure and characteristics after placed at 85℃ for 240 hours and 2 hours recovery in standard atmospheric conditions. 85℃中放置 240 小时并在标准大气条件中恢复 2 小时后继电器构造和特性无异常。
Humidity resistance 耐湿度	No trouble on structure and characteristics after placed at 40℃&95%RH for 240 hours and 2 hours recovery in standard atmospheric conditions. 40℃及95%相对湿度中放置240小时并在标准大气条件中恢复2小时后继电器构造和特性无异常。
Thermal shock resistance 耐冷热冲击	No trouble on structure and characteristics after endure 100 cycles of cyclic temperature and 2 hours recovery in standard atmospheric conditions, which the temperature cycle consists of -40℃ for 0.5 hour and 85℃ for 0.5 hour. -40℃和85℃中各放置0.5小时为一个温度周期，循环100次，在标准大气条件中恢复2小时后继电器构造和特性无异常。
Terminal robustness 引出端强度	No trouble on structure and characteristics after endure axial pushing/pulling force of 10N for 10 seconds. 继电器引出端承受 10 牛顿的轴向压入、拔出力，延时 10 秒，构造和性能无异常。
Terminal temperature rise 端子温升	65K(Under the condition of 85 ℃) 65K（85℃条件下）
Coil temperature rise 线圈温升	65K(Under the condition of 85 ℃) 65K（85℃条件下）

MARKING 产品标识

Position of marking 标识位置	Side of relay cover 外壳侧面
Cover color 外壳颜色	Black 黑色

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Ink color 字体颜色	Green 绿色
Trade mark 商标	Churod

MOUNTING INFORMANTION 安装信息

Solderability 可焊性	260±5℃ for 5±0.5 seconds
Resistance to soldering heat 耐焊接热	260±5□ for 10±1 seconds 350±10□ for 3.5±0.5 seconds
Standard direction 标准方向	Relay PCB terminals downward 继电器 PCB 型引出端朝下
Terminals assignment and outline dimensions 引出端脚位和外形尺寸	Refer to APPENDIX 请参考附件

ENGINEERING NOTES 注意事项

Unless otherwise explicitly stated, the standard environment conditions for measurement or testing are listed as followings:

除非特别申明，测量或试验的标准环境条件如下：

(1) Ambient temperature is 23±5℃;
环境温度为 23±5℃;

(2) Atmospheric pressure is 96±10% kPa;
大气压力为 96±10% kPa;

(3) Relative humidity is 50%±25% RH.
相对湿度为 50%±25% RH.

(4) When the ambient temperature > 23°C,coil voltage requires reduction to 5.4 to <6.6V after applying rate voltage for 100ms~200ms
当环境温度>23℃时，线圈施加额定电压 100ms~200ms 以后,电压需下降到 5.4~6.6V

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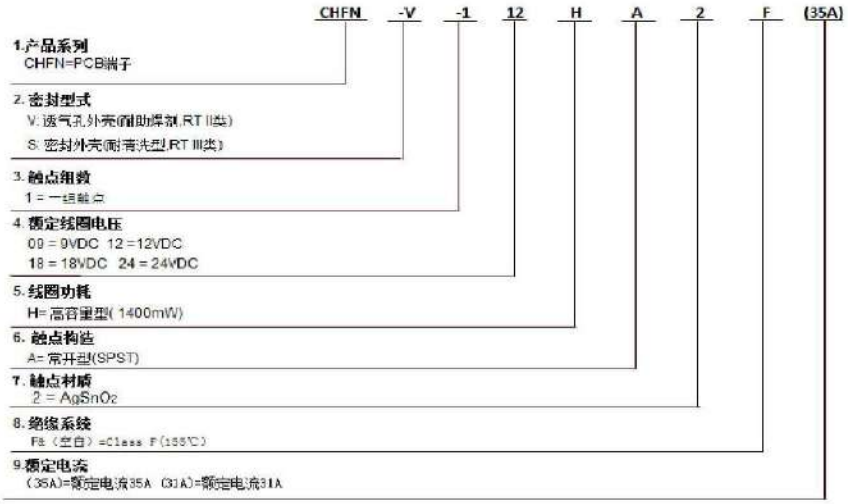
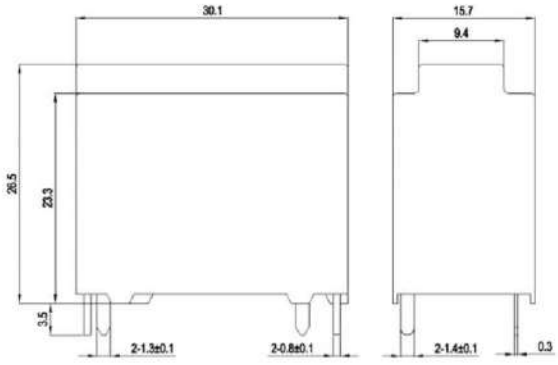
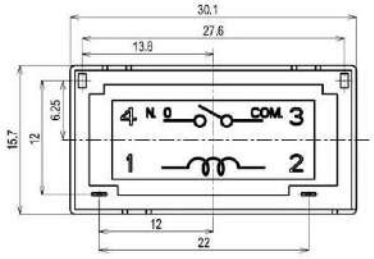
Nomenclature
命名规则



OUTLINE DIMENSION
外形尺寸图



Wiring diagram (Bottom View)
接线图（底视图）



Mounting dimensions (Bottom View)
安装孔尺寸图（底视图）

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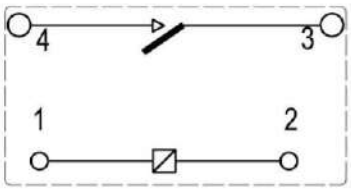
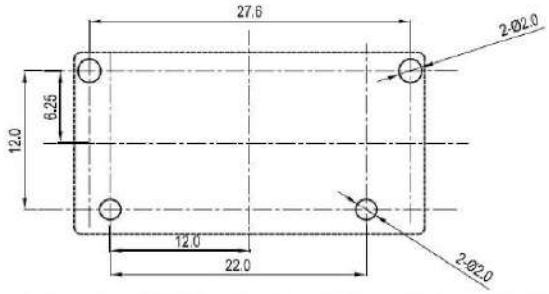




Note：All unspecified tolerance (including outline dimension and PC board dimension) according to following listing

备注：产品外形尺寸未标注尺寸公差及 PC 板未注尺寸公差按下表执行。

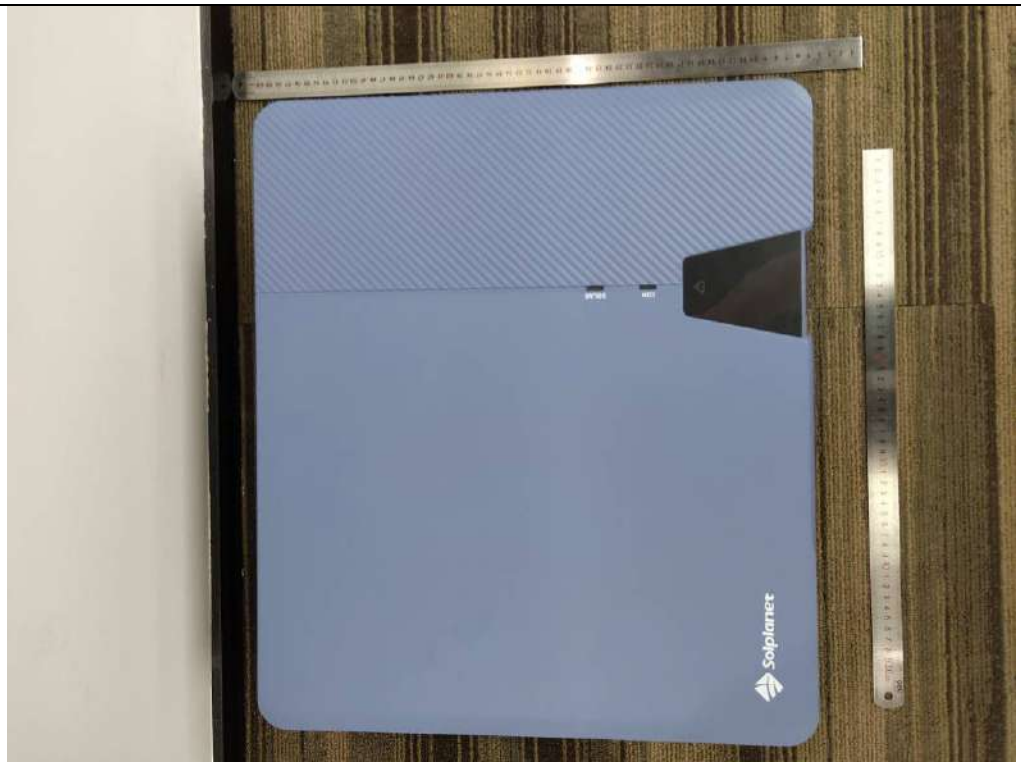
产品外形尺寸未注尺寸公差 Outline dimensions hadn't specified tolerance		PC 板未注尺寸公差 PC board dimensions hadn't specified tolerance
外形尺寸 Outline dimensions	公差 Tolerance	
≤0.3	±0.1	±0.1
≤1	±0.2	
≤5	±0.3	
>5	±0.5	

Annex No. 2

Pictures of the unit

Photo of EUT

Enclosure front view



Enclosure side view

Photo of EUT

Enclosure side view

Enclosure side view

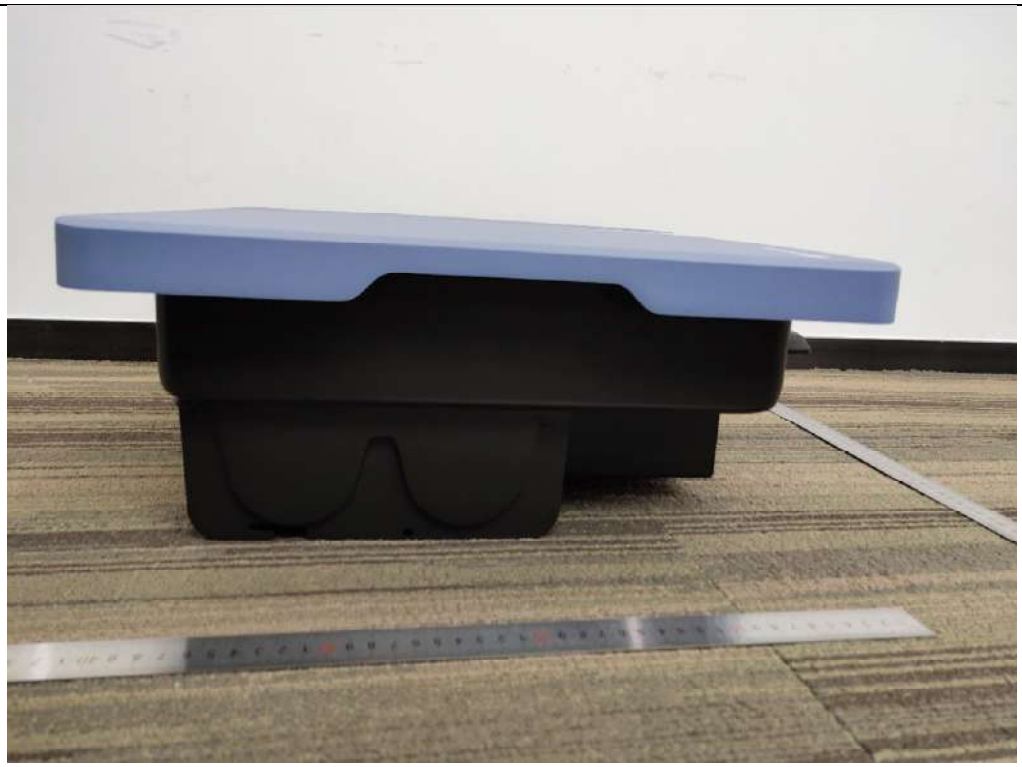


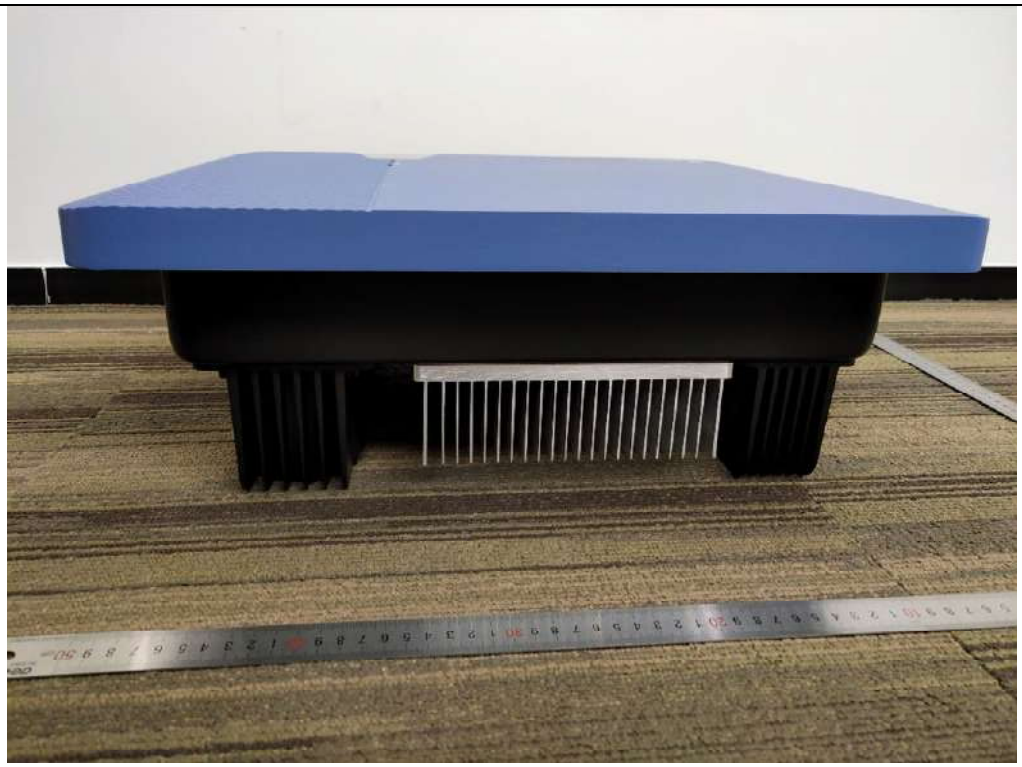
Photo of EUT

Enclosure bottom view
(ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2, ASW17K-LT-G2, ASW20K-LT-G2)

Enclosure bottom view
(ASW8K-LT-G2, ASW10K-LT-G2)

Photo of EUT

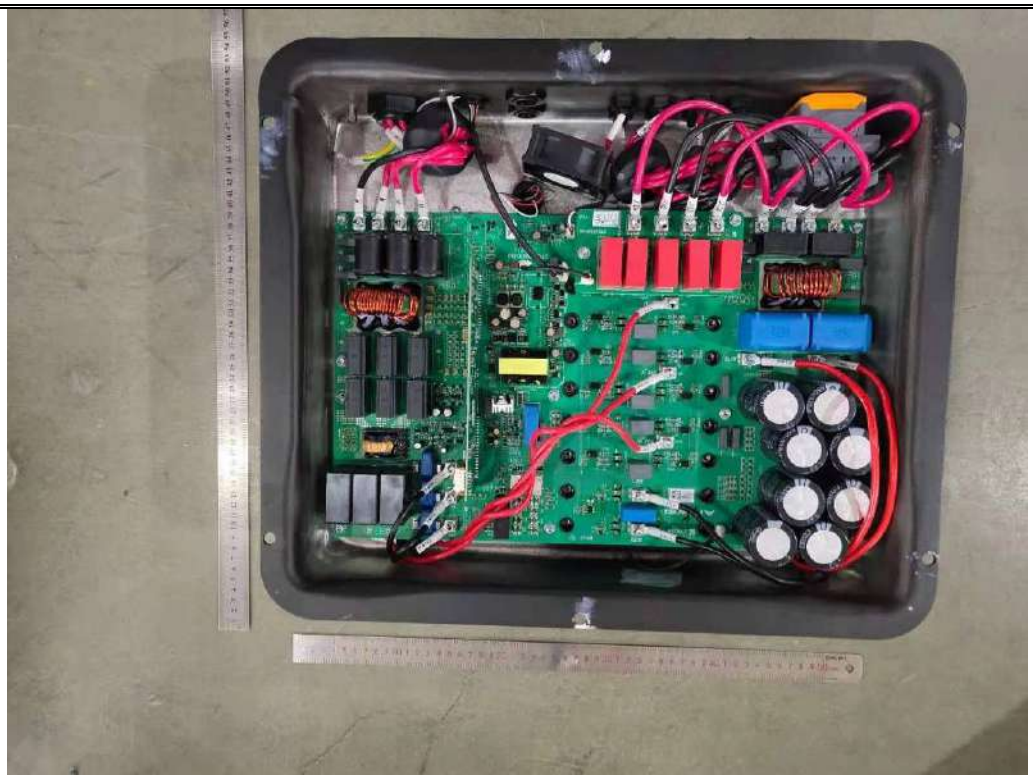
Enclosure top view



Enclosure rear view

Photo of EUT

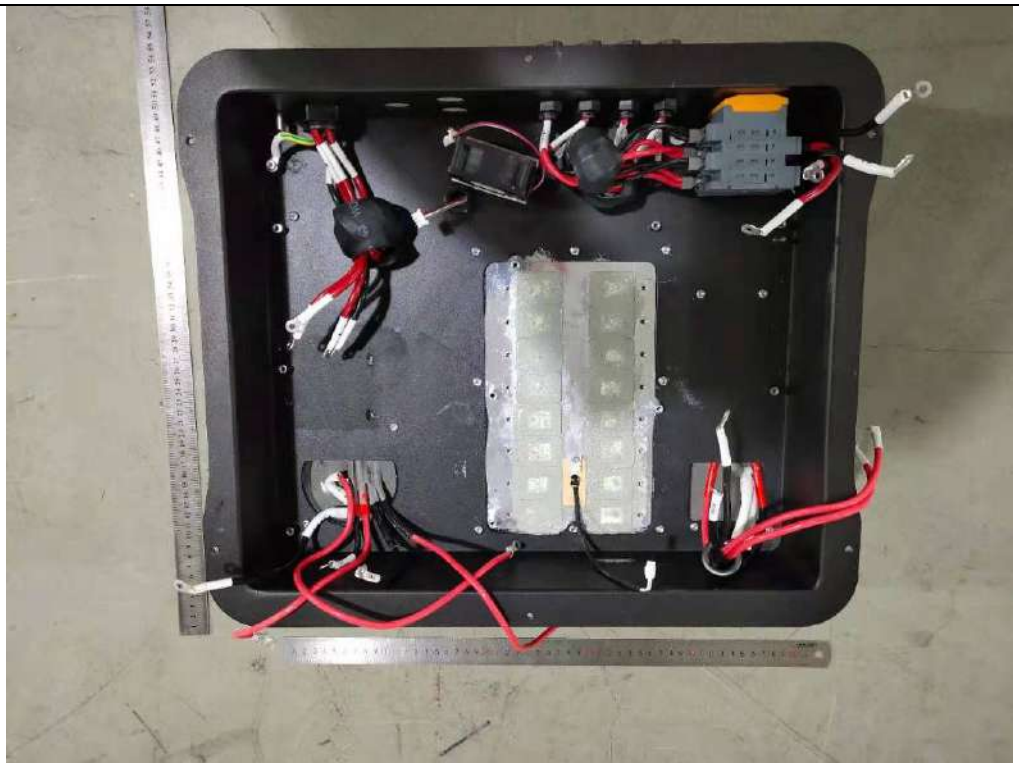
Internal view - 1



Internal view - 2

Photo of EUT

Internal view - 3



PCB view - 1
(ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2, ASW17K-LT-G2, ASW20K-LT-G2)

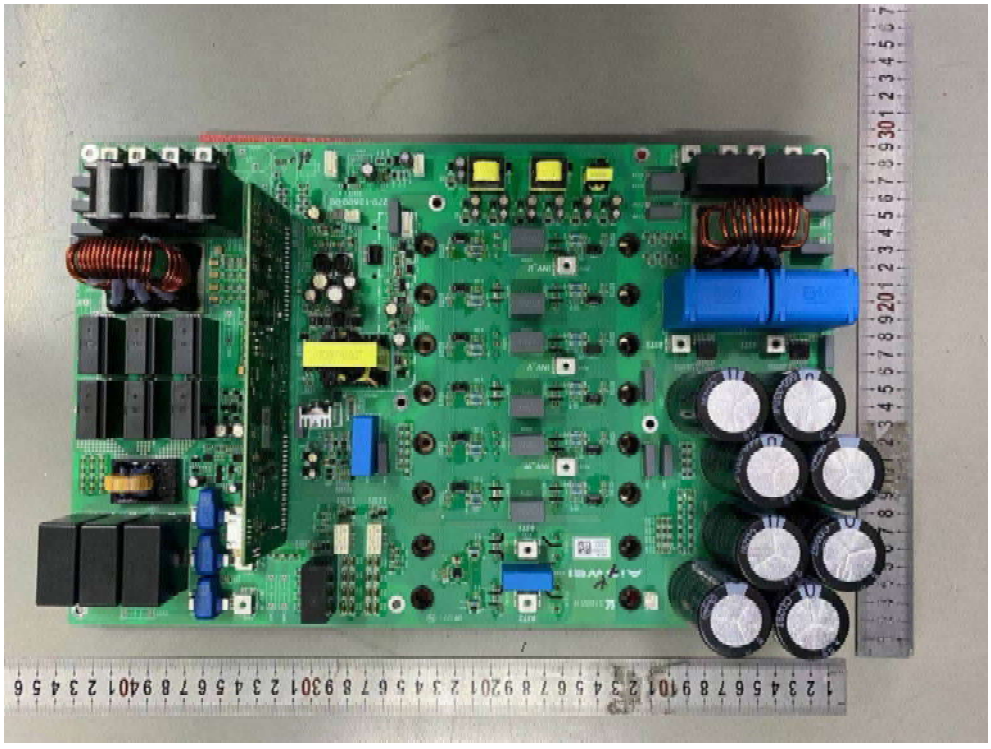
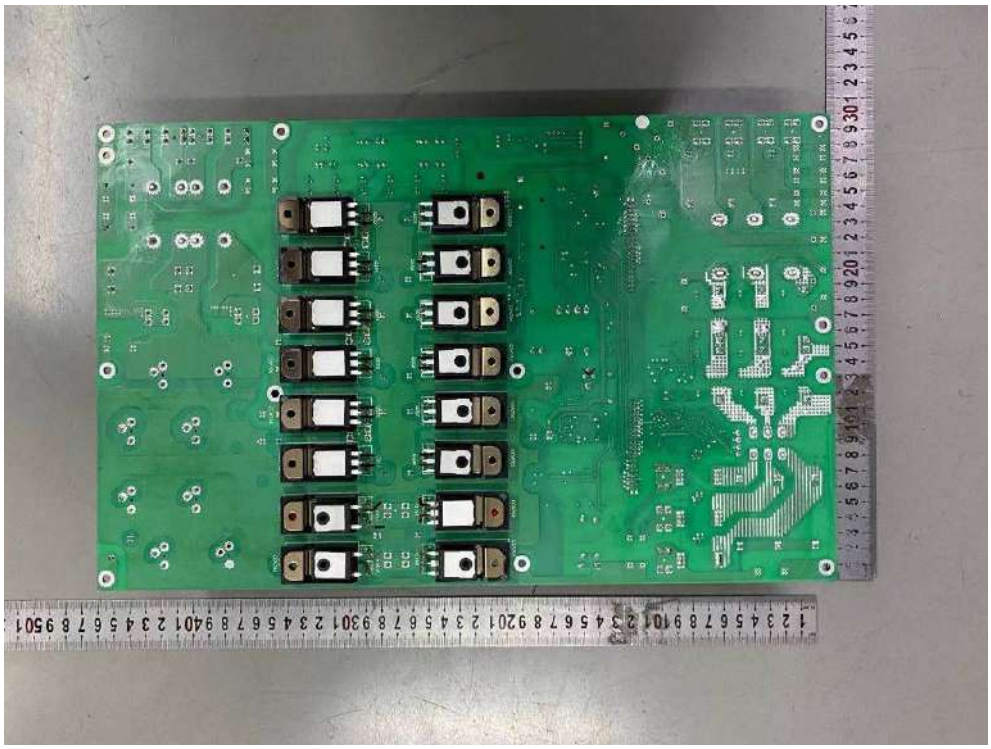


Photo of EUT

PCB view – 2
(ASW12K-LT-G2, ASW13K-LT-G2, ASW15K-LT-G2, ASW17K-LT-G2, ASW20K-LT-G2)



PCB view – 1
(ASW8K-LT-G2, ASW10K-LT-G2)

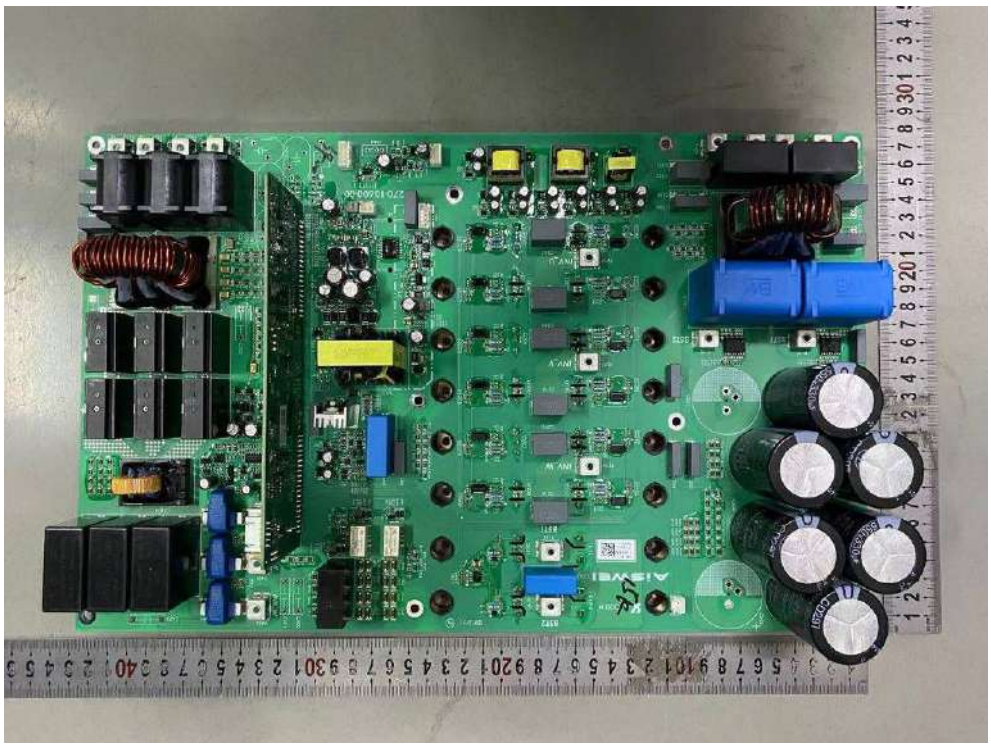
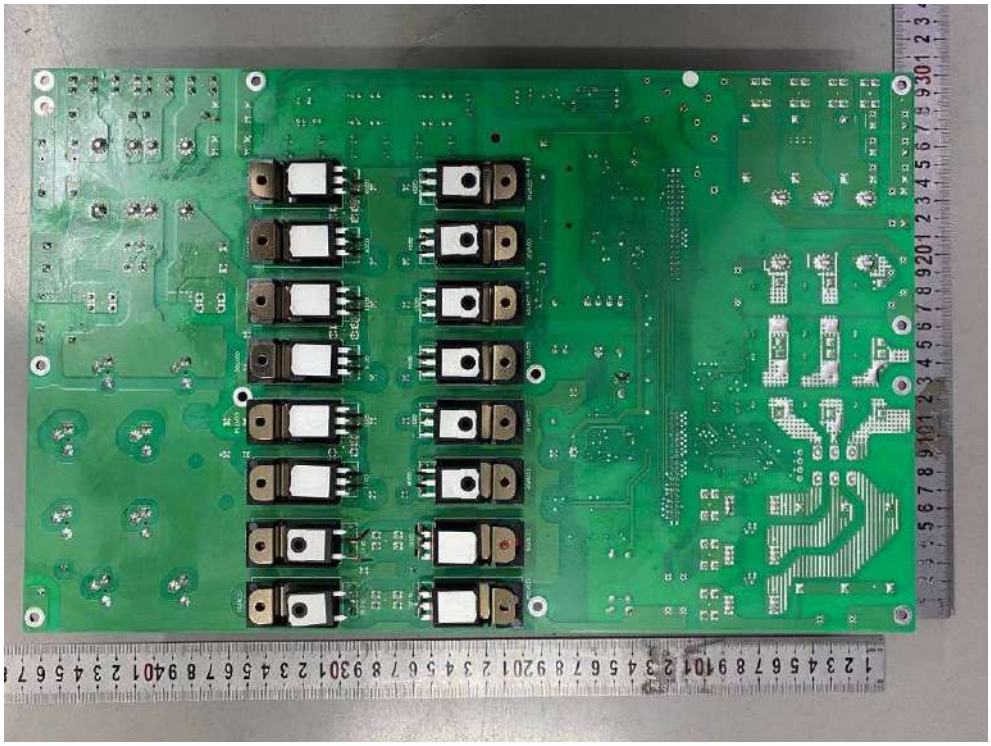


Photo of EUT

PCB view – 2
(ASW8K-LT-G2, ASW10K-LT-G2)



Annex No. 3

Test Equipment list

Date(s) of performance test: 2021-05-11 to 2021-07-01

Equipment	Internal No,	Manufacturer	Type	Serial No.	Last Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	2021-07-17
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
AC Source	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040016DG	Chroma	62150H-1000S	62150EF00490	
DC Simulation Power Supply	A7040017DG	Chroma	620028	620028EF00120	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Four Channel Digital Phosphor Oscilloscope	SB9146	TEKTRONIX	DP03034	C013936	2022-03-17
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	2021-09-23
Oscilloscope probel	A1490008DG	YOKOGAWA	701901	//	2021-09-21
Oscilloscope probel	A1490009DG	YOKOGAWA	701901	//	2021-09-21
Oscilloscope probel	A1490010DG	YOKOGAWA	701901	//	2021-09-21
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	2021-09-21
Current transducer	A1060008DG	YOKOGAWA	CT200	1130700017	2021-09-21
Current transducer	A1060009DG	YOKOGAWA	CT200	1130700019	2021-09-21