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.....:	**PV2204WDG0409-1**
Date of issue.....:	2022-06-14
Total number of pages.....:	155
Testing laboratory name.....:	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Accrediation.....:	ilac-MRA, ACCREDITED Certificate # 2951.01
Applicant's name.....:	**AISWEI Technology(Shanghai) Co.,Ltd**
Address.....:	Room 905B, 757 Mengzi Road, Huangpu District, 200023 Shanghai, P.R.China
Test specification	
Standard.....:	EN 50549-1:2019 for Type B
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.....:	ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3, ASW36K-LT-G3, ASW40K-LT-G3

Ratings..... :	**ASW25K-LT-G3**	**ASW27K-LT-G3**	**ASW30K-LT-G3**
Max. input DC voltage [V].....:	Max.1100V		
Input DC voltage range [V] .....:	180-1000V		
Input DC current [A].....:	32,0 / 32,0 / 32,0	32,0 / 32,0 / 32,0	32,0 / 32,0 / 32,0
Output AC voltage [V].....:	3/N/PE ~ 230/400V, 50Hz		
Output AC current [A] .....:	Max.39,9	Max.43,0	Max.47,8
Nominal Output power [kW].....:	25,0	27,0	30,0
Maximum Output power [kVA].:	25,0	27,0	30,0
Ratings..... :	**ASW33K-LT-G3**	**ASW36K-LT-G3**	**ASW40K-LT-G3**
Max. input DC voltage [V].....:	Max.1100V		
Input DC voltage range [V] .....:	180-1000V		
Input DC current [A].....:	32,0 / 32,0 / 40,0	32,0 / 32,0 / 40,0	32,0 / 32,0 / 40,0
Output AC voltage [V].....:	3/N/PE ~ 230/400V, 50Hz		
Output AC current [A] .....:	Max.52,6	Max.57,4	Max.63,8
Nominal Output power [kW].....:	33,0	36,0	40,0
Maximum Output power [kVA].:	33,0	36,0	40,0

Testing Location.....:	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address .....:	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Tested by (name and signature) .....:	Ryan He 
Approved by (name and signature) .....:	Ken Chan 
Manufacturer's name .....:	**AISWEI Technology(Shanghai) Co.,Ltd**
Manufacturer address.....:	Room 905B, 757 Mengzi Road, Huangpu District, 200023 Shanghai, P.R.China
Factory's name .....:	**AISWEI New Energy Technology (Yangzhong) Co., Ltd**
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Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2022-06-14	Ryan He	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 ..:	IP66 according to EN 60529
Mass of equipment [kg] .....:	Approx. 29,0kg for model ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3; Approx. 30,0kg for model ASW33K-LT-G3, ASW36K-LT-G3, ASW40K-LT-G3.
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 .....:	2022-04-10
Date(s) of performance of test.....:	2022-04-18 to 2022-06-09

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 – Datasheet of the relay
3. Annex No. 2 – Pictures of the unit
4. Annex No. 3 – Test equipment list

Copy of marking plate

Solplanet

Model: ASW25K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/32A
Isc PV(absolute maximum)	d.c. 48A/48A/48A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	25000W
Rated AC output apparent power	25000VA
Max. AC output apparent power	27500VA*1
Max. continuous output current	a.c. 39.9A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=25000VA

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Model: ASW27K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/32A
Isc PV(absolute maximum)	d.c. 48A/48A/48A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	27000W
Rated AC output apparent power	27000VA
Max. AC output apparent power	29700VA*1
Max. continuous output current	a.c. 43.0A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=27000VA

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Model: ASW30K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/32A
Isc PV(absolute maximum)	d.c. 48A/48A/48A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	30000W
Rated AC output apparent power	30000VA
Max. AC output apparent power	33000VA*1
Max. continuous output current	a.c. 47.8A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=30000VA

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Solplanet

Model: ASW33K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/40A
Isc PV(absolute maximum)	d.c. 48A/48A/60A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	33000W
Rated AC output apparent power	33000VA
Max. AC output apparent power	36300VA*1
Max. continuous output current	a.c. 52.6A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=33000VA

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Solplanet

Model: ASW36K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/40A
Isc PV(absolute maximum)	d.c. 48A/48A/60A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	36000W
Rated AC output apparent power	36000VA
Max. AC output apparent power	39600VA*1
Max. continuous output current	a.c. 57.4A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=36000VA

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Solplanet

Model: ASW40K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32A/32A/40A
Isc PV(absolute maximum)	d.c. 48A/48A/60A
Rated grid voltage	3/N/PE~ 380/400/415V
Rated grid frequency	50/60Hz
Rated AC output active power	40000W
Rated AC output apparent power	40000VA
Max. AC output apparent power	44000VA*1
Max. continuous output current	a.c. 63.8A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	Non-Isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1 For European market S_{max}=40000VA

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General product information:

The Solar Inverter converts DC voltage into AC voltage.
The Solar Inverter is three phase type and DC input supply by PV array.
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 (U133) and Slave DSP (U149).

The Master DSP (U133) control the relays by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current, 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 (U149) can switch off the relays independently, and communicate with the master DSP (U133) each other to monitor the master DPS (U133).

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the DSP (U133). The DSP (U133) 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.

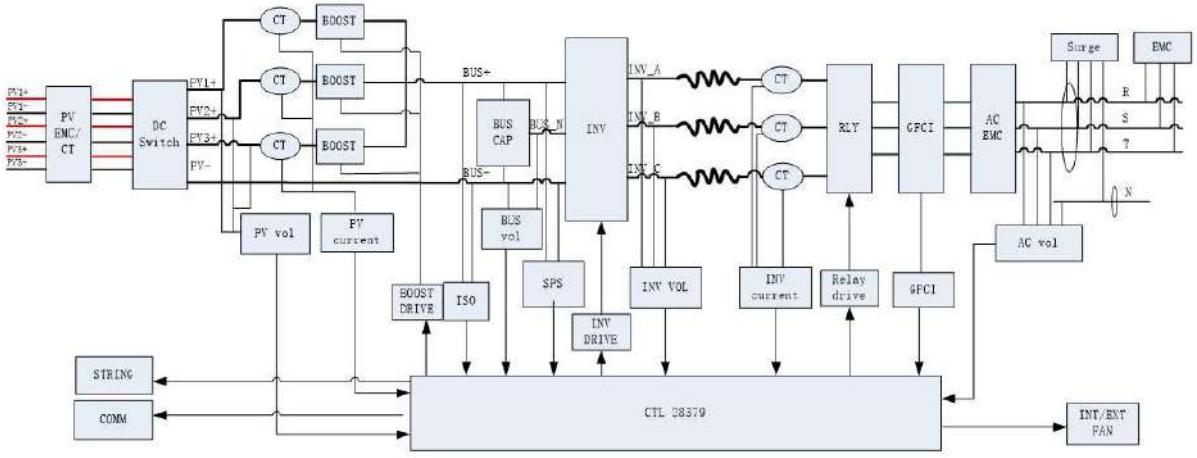

Figure 1 – Block diagram

Differences of the models:

The models ASW25K-LT-G3, ASW27K-LT-G3 and ASW30K-LT-G3, ASW33K-LT-G3, ASW36K-LT-G3 and ASW40K-LT-G3 are almost identical in hardware and software, expected the components are desctription as below table and the output power derated by software.

	ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3		ASW33K-LT-G3, ASW36K-LT-G3, ASW40K-LT-G3	
Item	Type	Quantity	Type	Quantity
AC current sensor	NACGL.50T-P6/VN	3	NACGL.75T-P6/VN	3
Relay	CHS01-V-112HA2(60G)	6	HF-176F/12-H3F	6
BUS CAP	Jianghai/ECS2YBB321MN4P23555E (2PIN)	10	Jianghai/ECS2YBB321MN4P23555E (2PIN)	14
INV inductor	P- CHOKE Taurus 220uH 1.2mm*6mm FeSi NPH60 CLASS F 30K INV U Yunlu/02-05-096-00	1	P- CHOKE Taurus 200uH 1.5mm*8mm FeSi NPH60 CLASS F 40K INV U Yunlu/02-05-087-00	1
	P- CHOKE Taurus 220uH 1.2mm*6mm FeSi NPH60 CLASS F 30K INV V Yunlu/02-05-104-00	1	P- CHOKE Taurus 200uH 1.5mm*8mm FeSi NPH60 CLASS F 40K INV V Yunlu/02-05-091-00	1
	P- CHOKE Taurus 220uH 1.2mm*6mm FeSi NPH60 CLASS F 30K INV W Yunlu/02-05-105-00	1	P- CHOKE Taurus 200uH 1.5mm*8mm FeSi NPH60 CLASS F 40K INV W Yunlu/02-05-092-00	1

The product was tested on:

Hardware: 270-13900-01
Main DSP Software version: V610-03041-05
Slave DSP Software version: V610-60009-00
Safety package (Flash) version: V610-11007-02

All tests were performed on ASW40K-LT-G3. Tests of the EUT of ASW40K-LT-G3 not applicable for the models ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 were performed on the concerned models and a statement is given at the relevant test.

General remarks:

The test results presented in this report relate only to the object(s) tested.
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Conformity statements are decided in accordance with IEC GUIDE 115:2021 Procedure 2 (accuracy method), unless otherwise normatively specified or contractually agreed.

"(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.

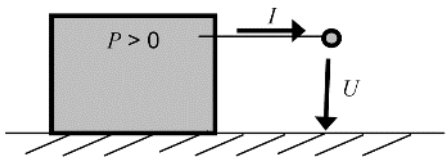
The following suffixes are used for variables in tables and figures:

- "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.

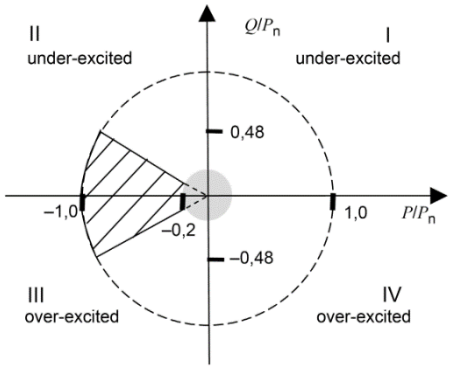


Figure 2

Test Results

Default interface protection settings according EN 50549-1:2019:			
Parameter	**Max. disconnection time**	**Min. operate time**	**Trip value**
Over voltage – stage 1	3,0 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	5,0 s	0,1 s	230V -20% (184V)
Under voltage – stage 2	2,0 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	**N/A**
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	G99/1-6, 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; Period of test 30 minutes
- Test 2: U = 195,5 V; f = 48,5 Hz; P = 1,00 S_n; cosφ = 1; Period of test 30 minutes
- Test 3: U = 253,0 V; f = 51,5 Hz; P = 1,00 S_n; cosφ = 1; Period of test 30 minutes
- 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; Period of test 0,5 seconds

Test result: ASW40K-LT-G3

Test sequence	Voltage [V]	Frequency [Hz]	Output power [kW]	Cos φ
Test1	196,59	47,50	37,65	1,000
Test2	196,58	48,50	37,63	1,000
Test3	253,48	51,50	39,86	1,000
Test4	231,45	50,00	39,81	1,000
Test5	231,04	50,00	39,72	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).

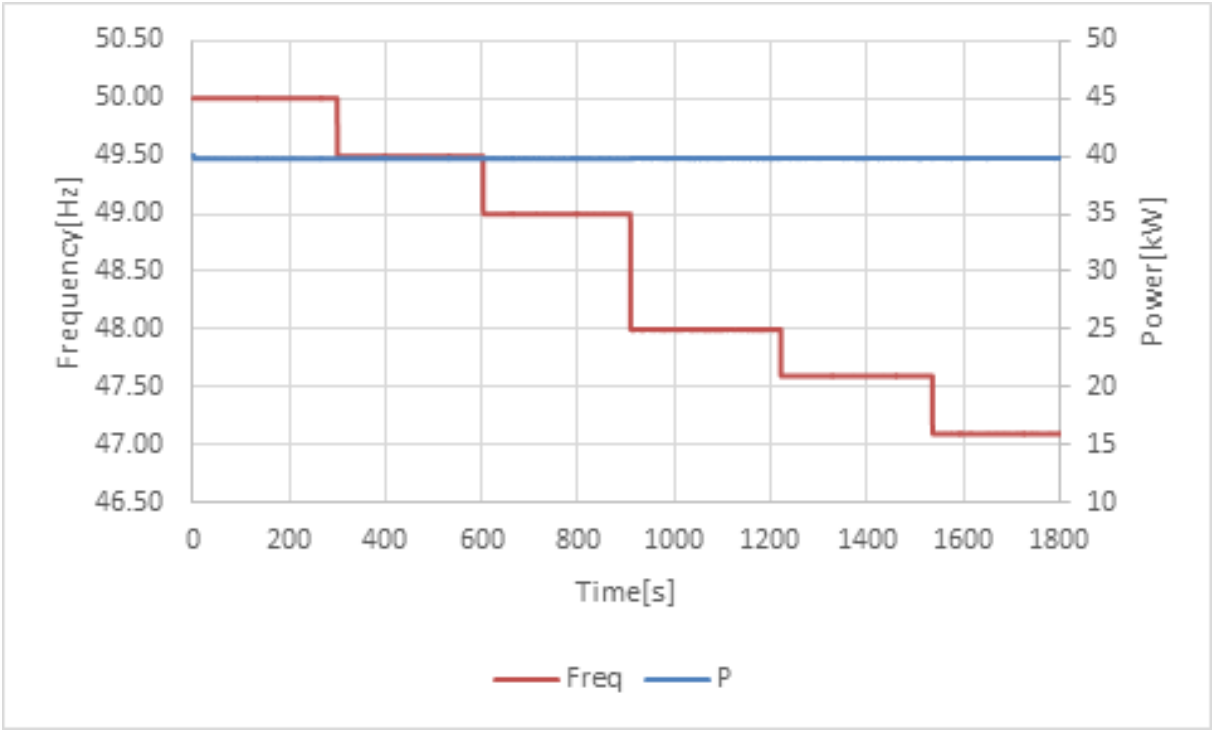
During the sequence of test 3, automatic adjustment to reduce power in the case of over-frequency was disabled.

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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: ASW40K-LT-G3

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]:	39,81	39,78	39,82	39,81	39,83
$\Delta P/P_n$ [%] :	-0,480	-0,543	-0,448	-0,473	-0,420

Assessment criterion:

Test method refer clause A.7.3.2 of G99/1-6.

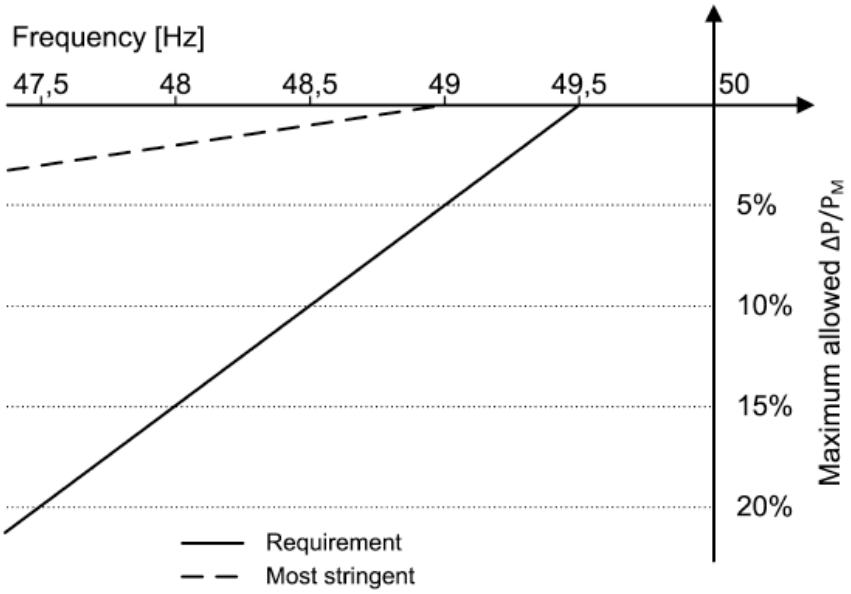
The frequency should then be set to 49,5 Hz for 5 minutes. The output should remain at 100% of registered Capacity.

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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	G99/1-6:2020, clause A.7.1.2.6	**P**
4.5.3	Low voltage ride through (LVRT)	VDE V 0124-100:2020, clause 5.8.3.	**P**
4.5.4	High voltage ride through (HVRT)	VDE V 0124-100:2020, clause 5.8.3.	**P**
4.7.4	Zero current mode for converter connected generating plants	VDE V 0124-100:2020, 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 G99/1-6:2020..

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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.

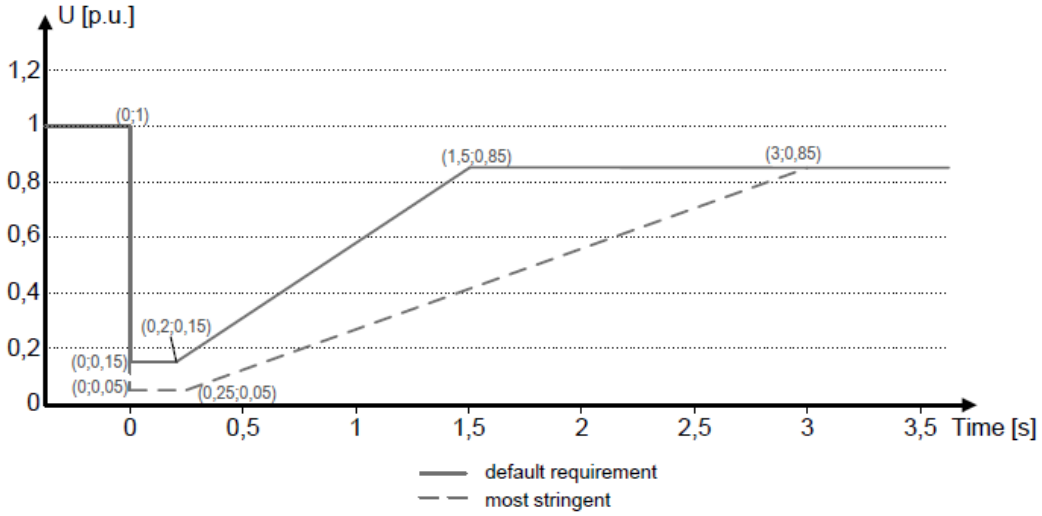


Figure 6 — Low voltage ride through capability for non-synchronous generating technology

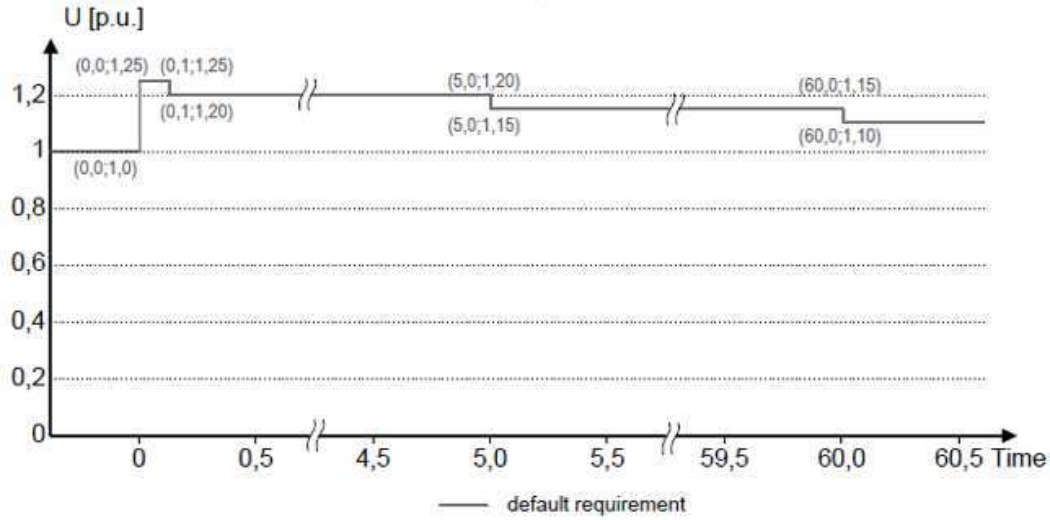


Figure 8 — Over-voltage ride through capability

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**

No Load				
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 %	No Load			
1.A.1- Symmetrical	0,03	≥ 250	259,0	Pass
1.D.1- Asymmetrical	0,03	≥ 250	257,7	Pass
1.B.1- Single phase	0,03	≥ 250	257,5	Pass
2.A.1- Symmetrical	0,31	≥ 1300	1305,2	Pass
2.D.1- Asymmetrical	0,31	≥ 1300	1302,2	Pass
2.B.1- Single phase	0,31	≥ 1300	1302,0	Pass
3.A.1- Symmetrical	0,82	≥ 3000	3003,1	Pass
3.D.1- Asymmetrical	0,82	≥ 3000	3008,8	Pass
3.B.1- Single phase	0,82	≥ 3000	3007,6	Pass
OV1- Symmetrical	1,25	≥ 100	101,1	Pass
OV2-Symmetrical	1,20	≥ 5000	5011,8	Pass
OV3-Symmetrical	1,15	≥ 60000	60001,3	Pass

Graph of FRT test one				
Test result: ASW40K-LT-G3				
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	264,9	Pass
1.D.1- Asymmetrical	0,03	≥ 250	257,7	Pass
1.B.1- Single phase	0,03	≥ 250	259,4	Pass
2.A.1- Symmetrical	0,31	≥ 1300	1310,1	Pass
2.D.1- Asymmetrical	0,31	≥ 1300	1304,7	Pass
2.B.1- Single phase	0,31	≥ 1300	1305,2	Pass
3.A.1- Symmetrical	0,82	≥ 3000	3001,0	Pass
3.D.1- Asymmetrical	0,82	≥ 3000	3001,0	Pass
3.B.1- Single phase	0,82	≥ 3000	3007,6	Pass
P_{Emax} in %	20% ±5%			
1.A.2- Symmetrical	0,03	≥ 250	255,8	Pass
1.D.2- Asymmetrical	0,03	≥ 250	258,1	Pass
1.B.2- Single phase	0,03	≥ 250	259,8	Pass
2.A.2- Symmetrical	0,31	≥ 1300	1319,8	Pass
2.D.2- Asymmetrical	0,31	≥ 1300	1303,7	Pass
2.B.2- Single phase	0,31	≥ 1300	1302,0	Pass
3.A.2- Symmetrical	0,82	≥ 3000	3017,1	Pass
3.D.2- Asymmetrical	0,82	≥ 3000	3006,2	Pass
3.B.2- Single phase	0,82	≥ 3000	3011,4	Pass
P_{Emax} in %	100% ±5%			
OV1- Symmetrical	1,25	≥ 100	121,0	Pass
OV2- Symmetrical	1,20	≥ 5000	5015,5	Pass
OV3- Symmetrical	1,15	≥ 60000	60004,6	Pass

Test conditions:

Voltage simulator fall and rise time: < 20ms

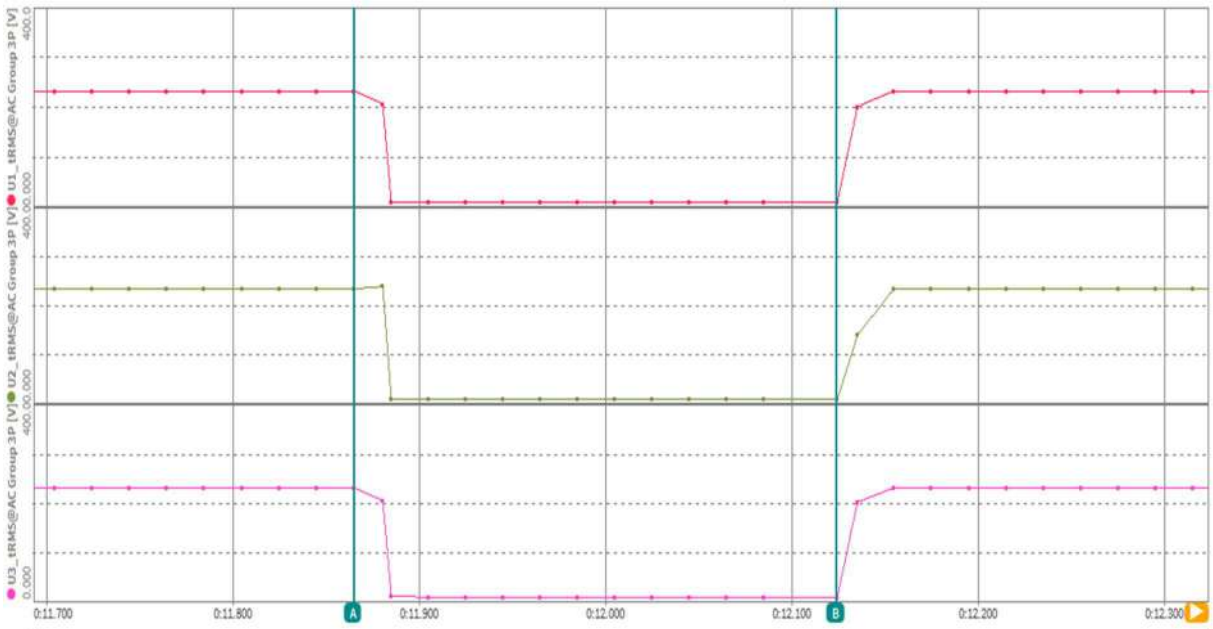
Used sample rate: 10 kHz

Note:

The test method refer to VDE V 0124-100:2020, clause 5.8.3.

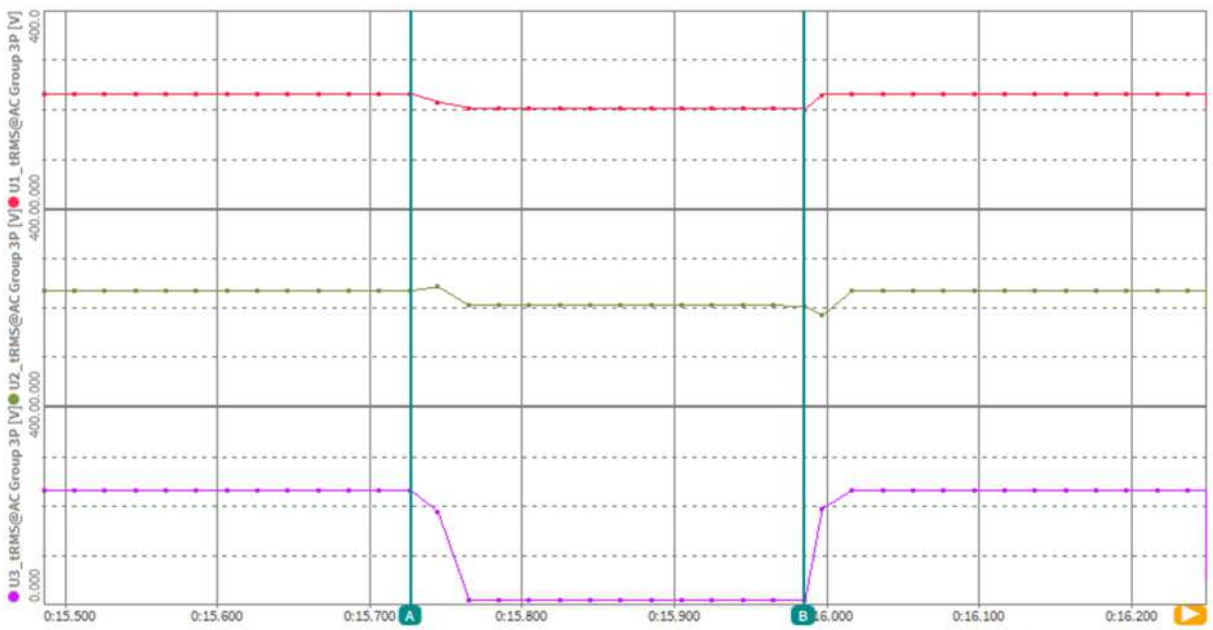
The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Test 1.A.1-Symmetrical fault (U/U_{nom} = 0,03); No load



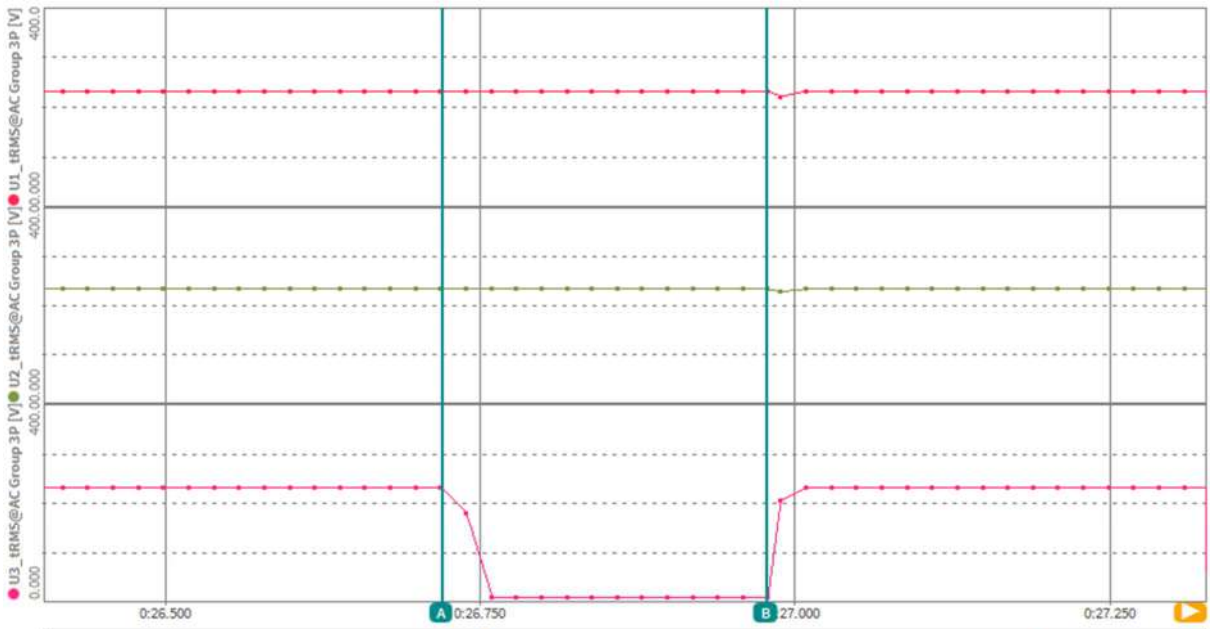
	A	B	Delta
Time [s]	0:11.864518	0:12.123502	0.258984
U1_tRMS@AC Group 3P [V]	230.5142	7.011518	-223.5027
U2_tRMS@AC Group 3P [V]	230.4477	7.007918	-223.4398
U3_tRMS@AC Group 3P [V]	230.3952	7.009193	-223.3860

Test 1.D.1-Asymmetrical fault (U/U_{nom} = 0,03); No load



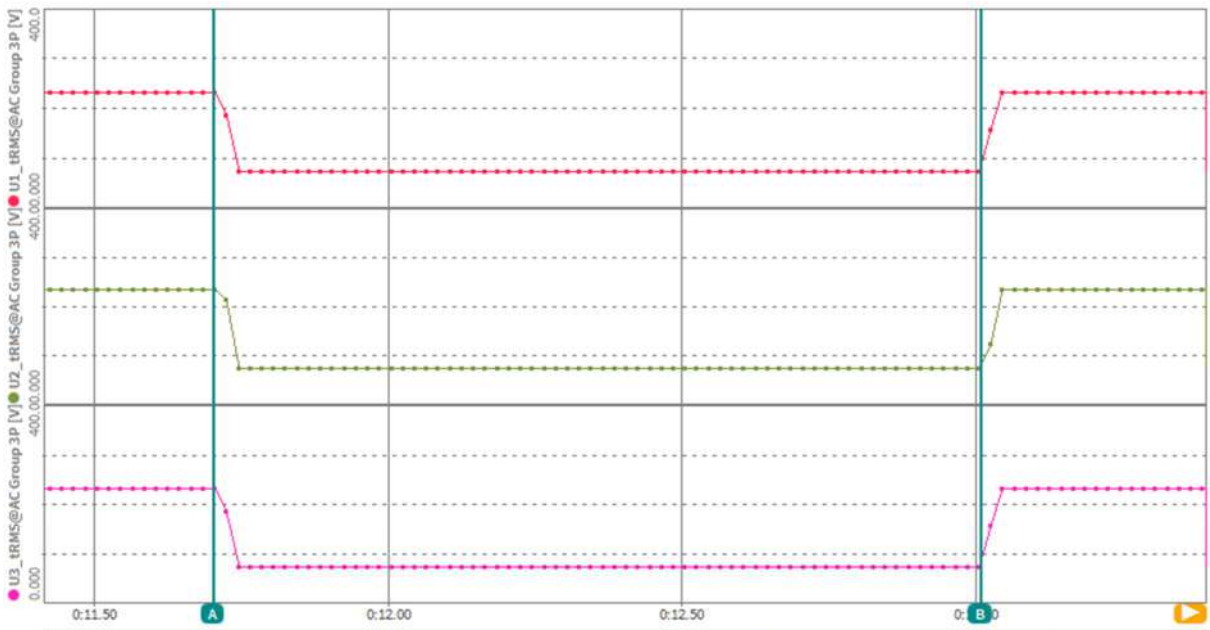
	A	B	Delta
Time [s]	0:15.727485	0:15.985204	0.257720
U1_tRMS@AC Group 3P [V]	230.6294	200.5393	-30.09006
U2_tRMS@AC Group 3P [V]	230.6164	200.5285	-30.08794
U3_tRMS@AC Group 3P [V]	230.5322	7.010211	-223.5220

Test 1.B.1-Single phase fault (U/U_{nom} = 0,03); No load



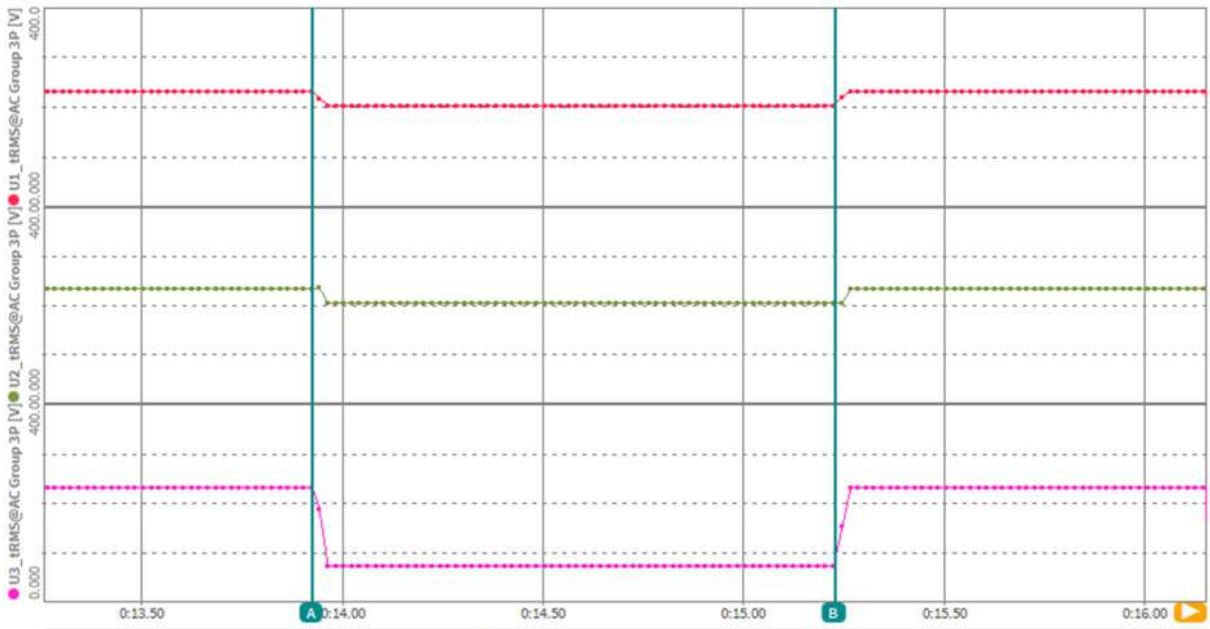
	A	B	Delta
Time [s]	0:26.719875	0:26.977332	0.257457
U1_tRMS@AC Group 3P [V]	230.5270	230.5918	0.064789
U2_tRMS@AC Group 3P [V]	230.4105	230.6174	0.206894
U3_tRMS@AC Group 3P [V]	230.3856	7.008517	-223.3771

Test 2.A.1-Symmetrical fault (U/U_{nom} = 0,31); No load



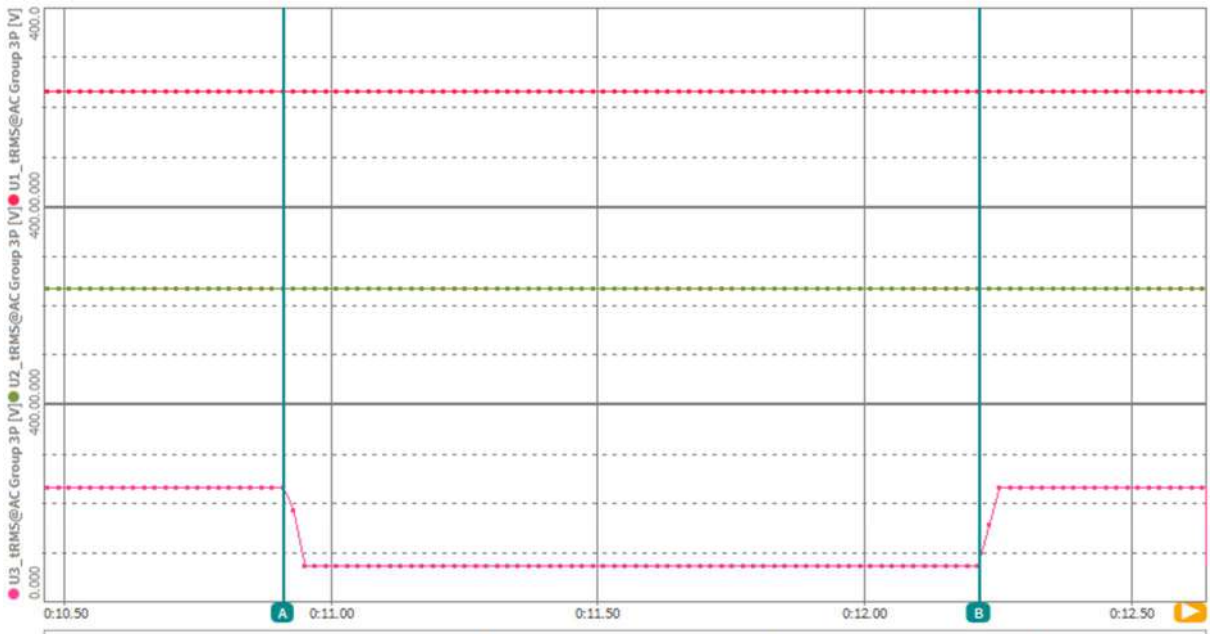
	A	B	Delta
Time [s]	0:11.703569	0:13.008760	1.305191
U1_tRMS@AC Group 3P [V]	230.5417	70.16534	-160.3764
U2_tRMS@AC Group 3P [V]	230.4847	70.18736	-160.2974
U3_tRMS@AC Group 3P [V]	230.3963	70.16018	-160.2362

Test 2.D.1-Symmetrical fault (U/U_{nom} = 0,31); No load



	A	B	Delta
Time [s]	0:13.92518	0:15.22741	1.30223
U1_tRMS@AC Group 3P [V]	230.6383	202.5462	-28.09210
U2_tRMS@AC Group 3P [V]	230.5686	202.5171	-28.05148
U3_tRMS@AC Group 3P [V]	230.5269	70.13522	-160.3917

Test 2.B.1-Asymmetrical fault (U/U_{nom} = 0,31); No load



	A	B	Delta
Time [s]	0:10.912447	0:12.214479	1.302032
U1_tRMS@AC Group 3P [V]	230.4873	230.6292	0.141907
U2_tRMS@AC Group 3P [V]	230.5070	230.6548	0.147812
U3_tRMS@AC Group 3P [V]	230.3959	70.16492	-160.2309

Test 3.A.1-Symmetrical fault (U/U_{nom} = 0,82); No load

	A	B	Delta
Time [s]	0:12.272403	0:15.275472	3.003070
U1_tRMS@AC Group 3P [V]	230.5692	188.4479	-42.12129
U2_tRMS@AC Group 3P [V]	230.5305	188.4899	-42.04068
U3_tRMS@AC Group 3P [V]	230.4480	188.4643	-41.98373

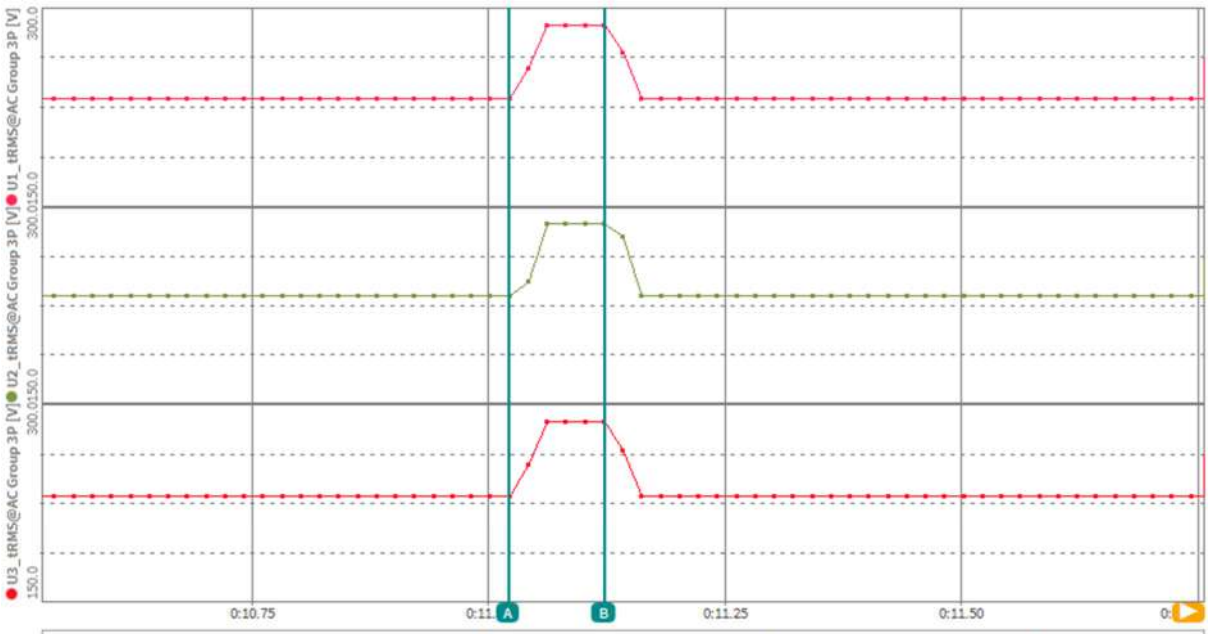
Test 3.D.1-Asymmetrical fault (U/U_{nom} = 0,82); No load

	A	B	Delta
Time [s]	0:14.352599	0:17.361399	3.008801
U1_tRMS@AC Group 3P [V]	230.5988	221.4017	-9.197113
U2_tRMS@AC Group 3P [V]	230.6359	221.4094	-9.226501
U3_tRMS@AC Group 3P [V]	230.5398	187.4513	-43.08849

Test 3.B.1-Symmetrical fault (U/U_{nom} = 0,82); No load

	A	B	Delta
Time [s]	0:17.892665	0:20.900282	3.007617
U1_tRMS@AC Group 3P [V]	230.5279	230.6016	0.073700
U2_tRMS@AC Group 3P [V]	230.5382	230.6082	0.069962
U3_tRMS@AC Group 3P [V]	230.4412	187.3973	-43.04388

Test OV1-Symmetrical fault (U/U_{nom} = 1,25); No load

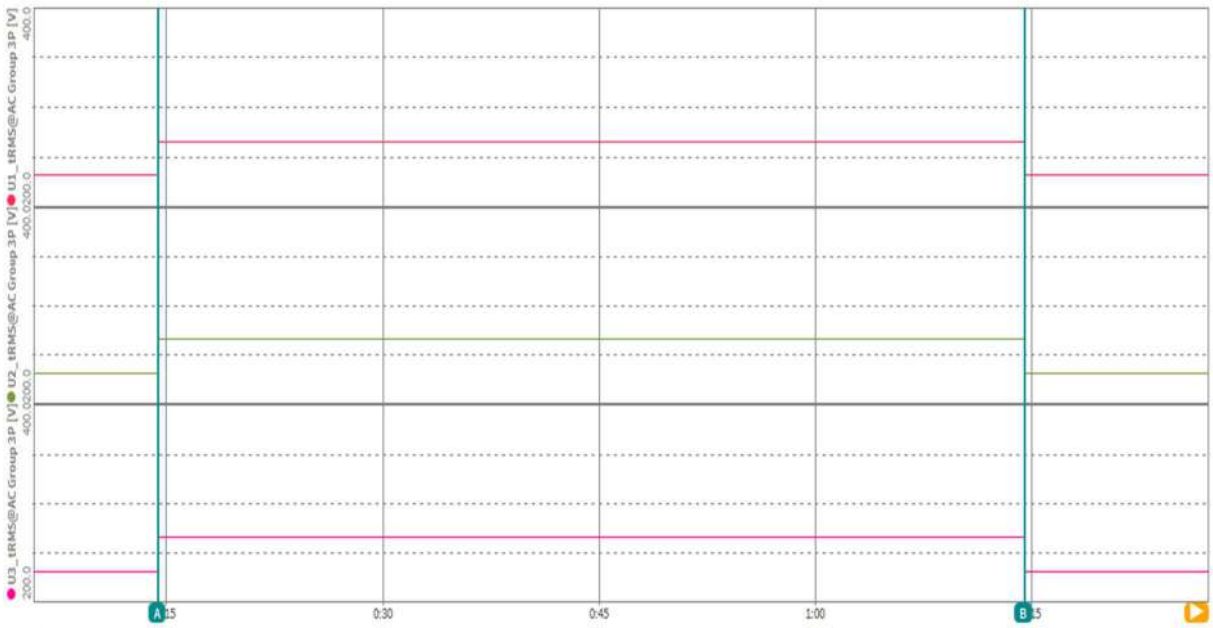


	A	B	Delta
Time [s]	0:11.021322	0:11.122436	0.101114
U1_tRMS@AC Group 3P [V]	230.6147	286.7912	56.17656
U2_tRMS@AC Group 3P [V]	230.5638	286.8354	56.27162
U3_tRMS@AC Group 3P [V]	230.3644	286.6323	56.26796

Test OV2-Symmetrical fault (U/U_{nom} = 1,20); No load

	A	B	Delta
Time [s]	0:12.185030	0:17.196872	5.011842
U1_tRMS@AC Group 3P [V]	230.5110	275.7519	45.24089
U2_tRMS@AC Group 3P [V]	230.5033	275.7189	45.21562
U3_tRMS@AC Group 3P [V]	230.4012	275.6706	45.26939

Test OV3-Symmetrical fault (U/U_{nom} = 1,15); No load

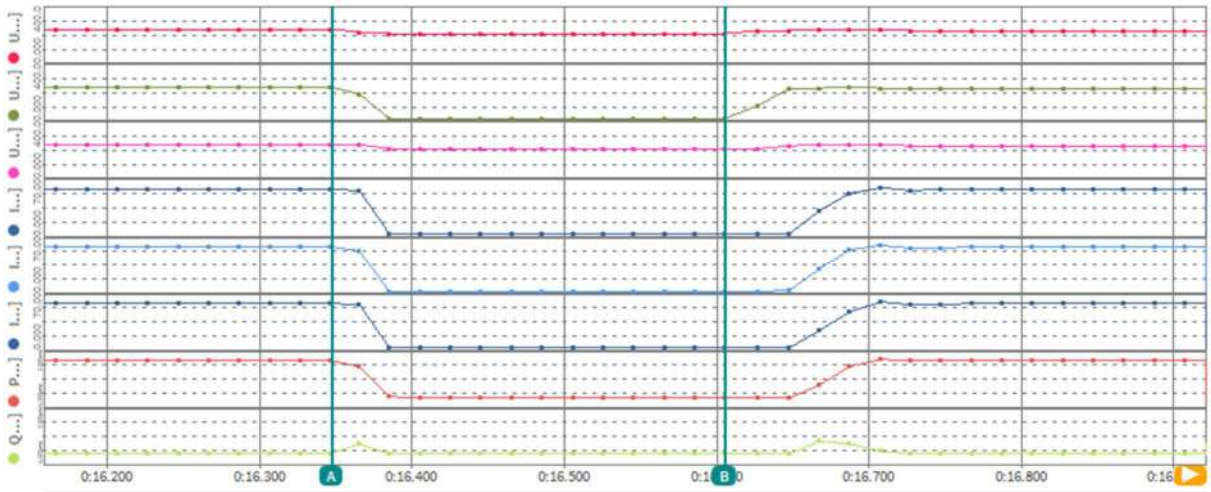


	A	B	Delta
Time [s]	0:14.4414	1:14.4427	1:00.0013
U1_tRMS@AC Group 3P [V]	230.5630	264.6937	34.13065
U2_tRMS@AC Group 3P [V]	230.4179	264.7431	34.32521
U3_tRMS@AC Group 3P [V]	230.3904	264.6465	34.25612

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

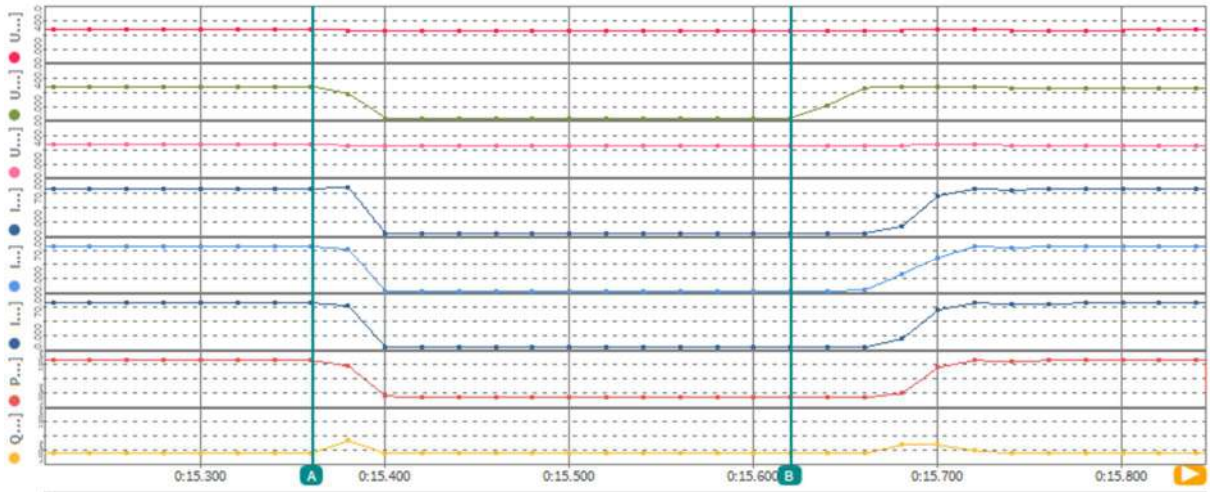
	A	B	Delta
Time [s]	0:12.660291	0:12.925228	0.264937
U1_tRMS@AC Group 3P [V]	230.5278	7.005670	-223.5221
U2_tRMS@AC Group 3P [V]	230.5457	7.007044	-223.5386
U3_tRMS@AC Group 3P [V]	230.6050	7.008666	-223.5963
I1_tRMS@AC Group 3P [A]	57.67883	0.101994	-57.57684
I2_tRMS@AC Group 3P [A]	57.62177	0.074230	-57.54753
I3_tRMS@AC Group 3P [A]	57.30701	0.093263	-57.21375
P_t@AC Group 3P [W]	39784.61	-0.020916	-39784.63
Q_t@AC Group 3P [var]	964.7054	1.888204	-962.8172

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



	A	B	Delta
Time [s]	0:16.3477774	0:16.6054723	0.2576949
U1_tRMS@AC Group 3P [V]	231.7407	200.6469	-31.09380
U2_tRMS@AC Group 3P [V]	231.4474	7.008105	-224.4393
U3_tRMS@AC Group 3P [V]	231.6212	200.6508	-30.97034
I1_tRMS@AC Group 3P [A]	57.30931	1.198582	-56.11073
I2_tRMS@AC Group 3P [A]	57.29356	0.089029	-57.20453
I3_tRMS@AC Group 3P [A]	57.13374	1.193499	-55.94024
P_t@AC Group 3P [W]	39768.96	-0.696780	-39769.66
Q_t@AC Group 3P [var]	677.2586	480.5916	-196.6670

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



	A	B	Delta
Time [s]	0:15.3611699	0:15.6206073	0.2594374
U1_tRMS@AC Group 3P [V]	231.7815	230.6112	-1.170319
U2_tRMS@AC Group 3P [V]	231.5537	7.060078	-224.4936
U3_tRMS@AC Group 3P [V]	231.6833	230.4511	-1.232178
I1_tRMS@AC Group 3P [A]	57.23530	1.245202	-55.99010
I2_tRMS@AC Group 3P [A]	57.38643	0.378038	-57.00839
I3_tRMS@AC Group 3P [A]	57.07145	1.242867	-55.82858
P_t@AC Group 3P [W]	39771.42	-1.200087	-39772.62
Q_t@AC Group 3P [var]	643.3343	576.2452	-67.08905

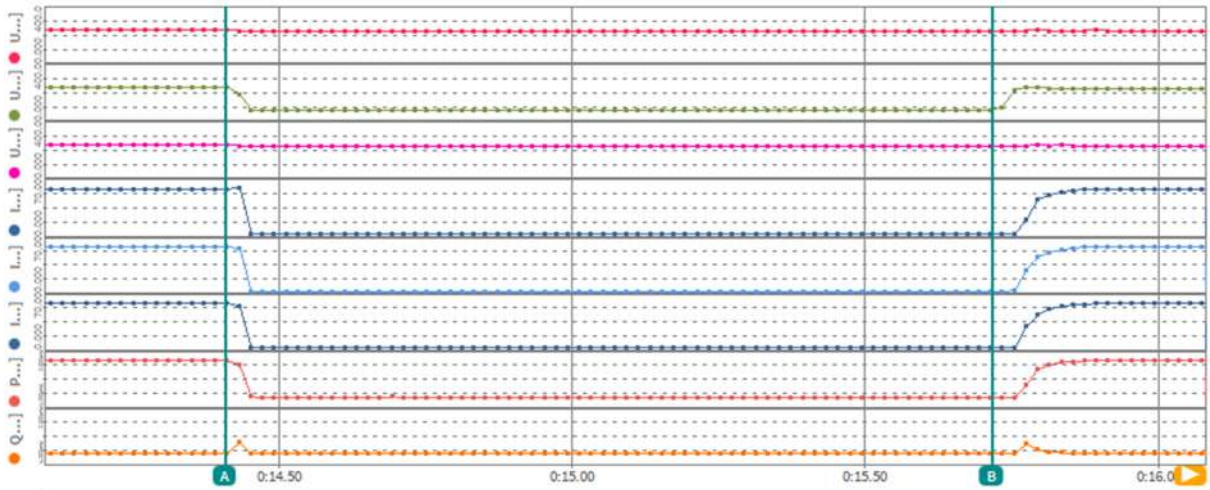
Test 2.A.1-Symmetrical fault (U/U_{nom} = 0,31); P = 100% ±5% P_n

	A	B	Delta
Time [s]	0:12.235299	0:13.545351	1.310053
U1_tRMS@AC Group 3P [V]	231.2095	70.18146	-161.0281
U2_tRMS@AC Group 3P [V]	230.3464	70.16732	-160.1791
U3_tRMS@AC Group 3P [V]	230.4696	70.20243	-160.2671
I1_tRMS@AC Group 3P [A]	57.57797	0.426381	-57.15159
I2_tRMS@AC Group 3P [A]	57.56689	0.421250	-57.14564
I3_tRMS@AC Group 3P [A]	57.42725	0.432236	-56.99501
P_t@AC Group 3P [W]	39797.23	-0.177249	-39797.41
Q_t@AC Group 3P [var]	931.7425	89.82588	-841.9166

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

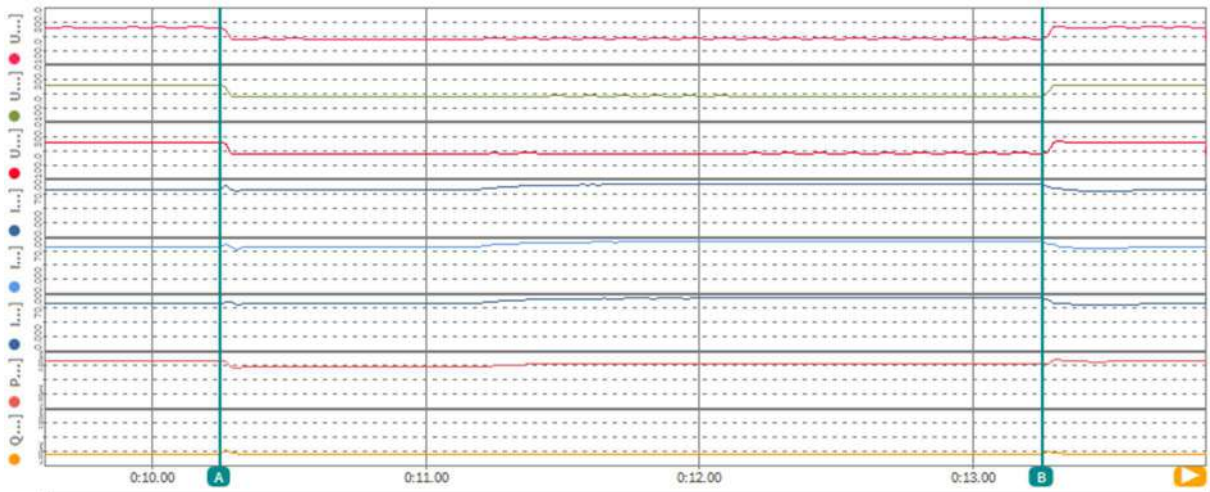
	A	B	Delta
Time [s]	0:14.937640	0:16.242345	1.304705
U1_tRMS@AC Group 3P [V]	231.4661	202.8361	-28.63004
U2_tRMS@AC Group 3P [V]	231.5567	71.14768	-160.4090
U3_tRMS@AC Group 3P [V]	231.5076	202.9866	-28.52095
I1_tRMS@AC Group 3P [A]	57.25477	1.212584	-56.04218
I2_tRMS@AC Group 3P [A]	57.35395	0.430510	-56.92344
I3_tRMS@AC Group 3P [A]	57.10322	1.211929	-55.89129
P_t@AC Group 3P [W]	39749.43	-0.038970	-39749.47
Q_t@AC Group 3P [var]	536.4639	522.5909	-13.87292

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



	A	B	Delta
Time [s]	0:14.410720	0:15.715912	1.305191
U1_tRMS@AC Group 3P [V]	231.7579	230.5474	-1.210480
U2_tRMS@AC Group 3P [V]	231.6973	71.21150	-160.4858
U3_tRMS@AC Group 3P [V]	231.7849	230.5678	-1.217087
I1_tRMS@AC Group 3P [A]	57.43207	1.273795	-56.15828
I2_tRMS@AC Group 3P [A]	57.49321	0.663579	-56.82963
I3_tRMS@AC Group 3P [A]	57.25460	1.271377	-55.98322
P_t@AC Group 3P [W]	39889.04	-0.707780	-39889.74
Q_t@AC Group 3P [var]	1021.572	634.0630	-387.5092

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



	A	B	Delta
Time [s]	0:10.249642	0:13.250628	3.000986
U1_tRMS@AC Group 3P [V]	230.5598	189.6777	-40.88213
U2_tRMS@AC Group 3P [V]	230.2830	189.5417	-40.74123
U3_tRMS@AC Group 3P [V]	230.4599	189.6303	-40.82962
I1_tRMS@AC Group 3P [A]	57.44692	64.01040	6.563477
I2_tRMS@AC Group 3P [A]	57.51010	64.01404	6.503941
I3_tRMS@AC Group 3P [A]	57.30091	63.90060	6.599693
P_t@AC Group 3P [W]	39690.74	36390.61	-3300.129
Q_t@AC Group 3P [var]	516.9583	335.9806	-180.9776

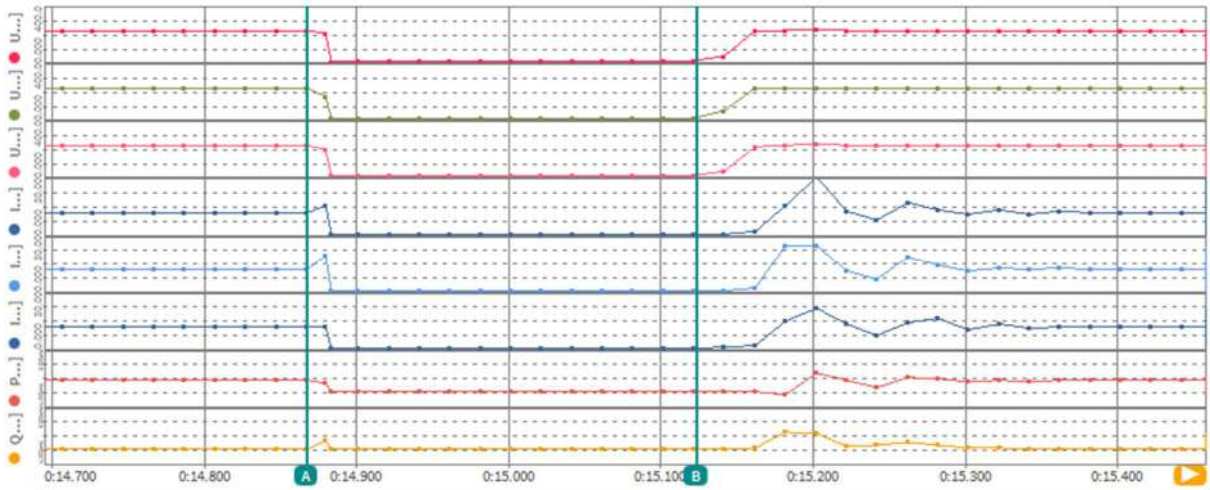
Test 3.D.1-Asymmetrical fault (U/U_{nom} = 0,82); P = 100% ±5% P_n

	A	B	Delta
Time [s]	0:16.821072	0:19.822058	3.000986
U1_tRMS@AC Group 3P [V]	231.7317	223.4668	-8.264954
U2_tRMS@AC Group 3P [V]	231.4763	190.0673	-41.40906
U3_tRMS@AC Group 3P [V]	231.5717	221.5691	-10.00258
I1_tRMS@AC Group 3P [A]	57.13412	63.12726	5.993134
I2_tRMS@AC Group 3P [A]	57.58899	63.67625	6.087261
I3_tRMS@AC Group 3P [A]	57.26625	61.84145	4.575195
P_t@AC Group 3P [W]	39826.88	39780.56	-46.31250
Q_t@AC Group 3P [var]	608.1439	3233.572	2625.428

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

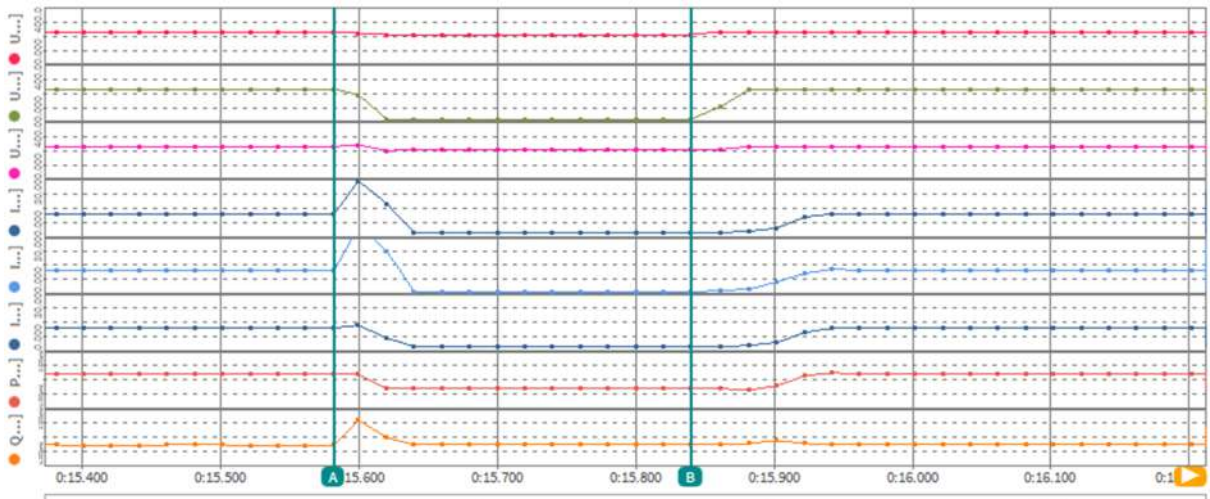
	A	B	Delta
Time [s]	0:15.061843	0:18.069460	3.007617
U1_tRMS@AC Group 3P [V]	231.7502	231.9854	0.235184
U2_tRMS@AC Group 3P [V]	231.6807	190.2850	-41.39575
U3_tRMS@AC Group 3P [V]	231.7192	231.7627	0.043549
I1_tRMS@AC Group 3P [A]	57.18111	60.84550	3.664391
I2_tRMS@AC Group 3P [A]	57.27162	60.81965	3.548031
I3_tRMS@AC Group 3P [A]	57.11303	60.13013	3.017105
P_t@AC Group 3P [W]	39743.39	39613.02	-130.3750
Q_t@AC Group 3P [var]	945.8849	943.5959	-2.288940

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



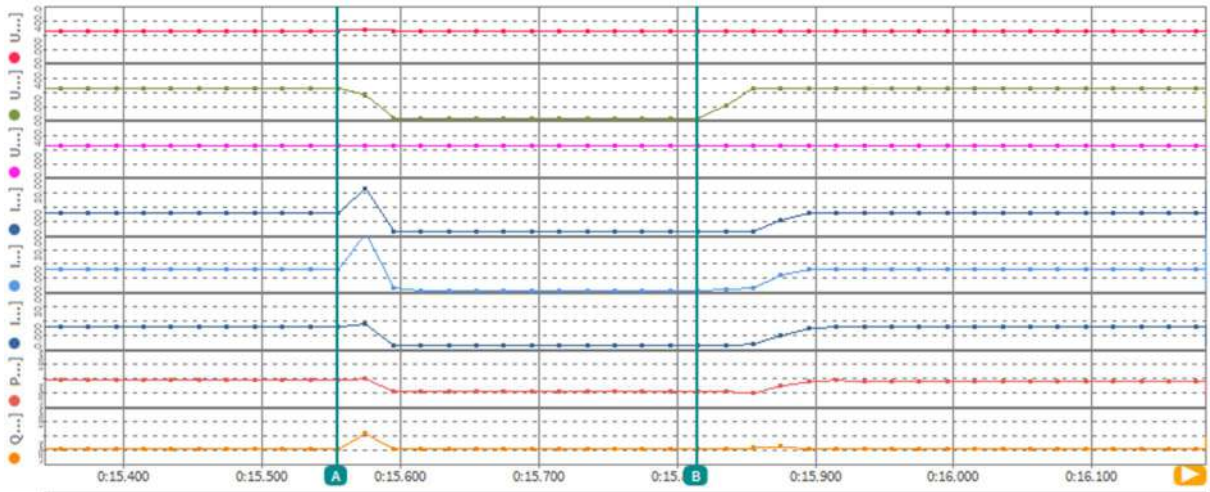
	A	B	Delta
Time [s]	0:14.8677260	0:15.1235467	0.2558207
U1_tRMS@AC Group 3P [V]	230.1204	7.003267	-223.1171
U2_tRMS@AC Group 3P [V]	229.8690	7.012040	-222.8569
U3_tRMS@AC Group 3P [V]	229.8860	7.012482	-222.8735
I1_tRMS@AC Group 3P [A]	11.71657	0.123858	-11.59272
I2_tRMS@AC Group 3P [A]	11.78093	0.071446	-11.70949
I3_tRMS@AC Group 3P [A]	11.47559	0.118754	-11.35683
P_t@AC Group 3P [W]	8016.938	-1.133e-3	-8016.940
Q_t@AC Group 3P [var]	639.0708	2.201154	-636.8696

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



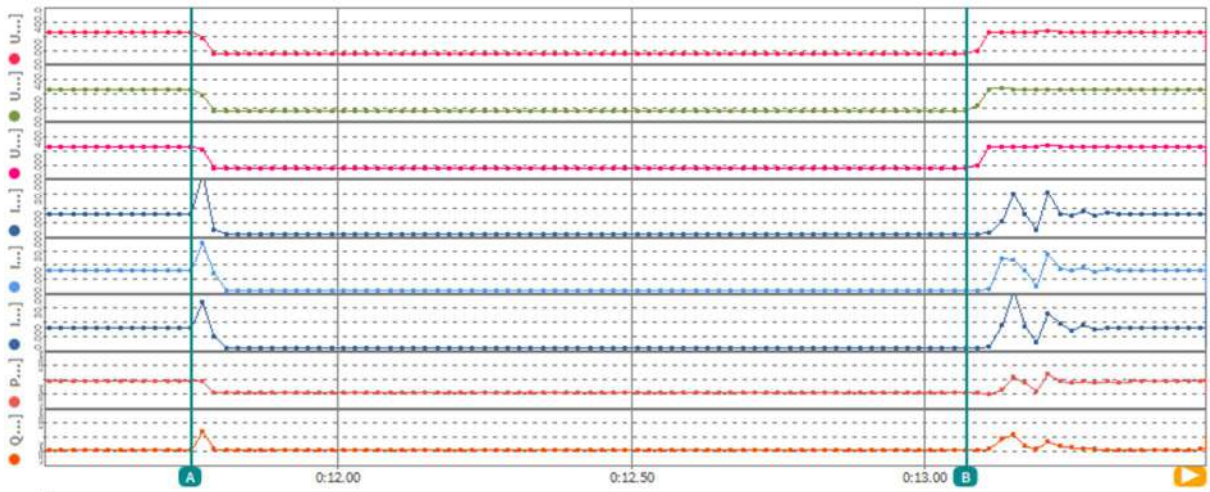
	A	B	Delta
Time [s]	0:15.582058	0:15.840162	0.258103
U1_tRMS@AC Group 3P [V]	230.6992	200.6502	-30.04903
U2_tRMS@AC Group 3P [V]	230.4435	7.010881	-223.4326
U3_tRMS@AC Group 3P [V]	230.5606	200.5277	-30.03293
I1_tRMS@AC Group 3P [A]	11.60442	1.199720	-10.40470
I2_tRMS@AC Group 3P [A]	11.68884	0.098974	-11.58987
I3_tRMS@AC Group 3P [A]	11.40087	1.199754	-10.20112
P_t@AC Group 3P [W]	7990.717	-0.658343	-7991.375
Q_t@AC Group 3P [var]	371.3670	482.0013	110.6343

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



	A	B	Delta
Time [s]	0:15.554458	0:15.814214	0.259756
U1_tRMS@AC Group 3P [V]	230.7544	230.6442	-0.110214
U2_tRMS@AC Group 3P [V]	230.5614	7.088907	-223.4725
U3_tRMS@AC Group 3P [V]	230.5701	230.5383	-0.031845
I1_tRMS@AC Group 3P [A]	11.59701	1.244613	-10.35240
I2_tRMS@AC Group 3P [A]	11.66213	0.381456	-11.28067
I3_tRMS@AC Group 3P [A]	11.38262	1.242127	-10.14049
P_t@AC Group 3P [W]	7981.657	-0.716065	-7982.373
Q_t@AC Group 3P [var]	351.3985	576.1243	224.7257

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



	A	B	Delta
Time [s]	0:11.750850	0:13.070625	1.319775
U1_tRMS@AC Group 3P [V]	229.9919	71.15954	-158.8323
U2_tRMS@AC Group 3P [V]	230.0469	71.16617	-158.8808
U3_tRMS@AC Group 3P [V]	229.9881	71.16499	-158.8231
I1_tRMS@AC Group 3P [A]	11.75438	0.433055	-11.32133
I2_tRMS@AC Group 3P [A]	11.79678	0.425623	-11.37116
I3_tRMS@AC Group 3P [A]	11.48899	0.428096	-11.06089
P_t@AC Group 3P [W]	8033.857	-0.237400	-8034.094
Q_t@AC Group 3P [var]	643.1223	91.57111	-551.5511

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

	A	B	Delta
Time [s]	0:15.674338	0:16.978054	1.303716
U1_tRMS@AC Group 3P [V]	230.5790	202.9316	-27.64740
U2_tRMS@AC Group 3P [V]	230.4834	71.11964	-159.3637
U3_tRMS@AC Group 3P [V]	230.5666	202.8516	-27.71494
I1_tRMS@AC Group 3P [A]	11.61127	1.212552	-10.39872
I2_tRMS@AC Group 3P [A]	11.68552	0.428527	-11.25699
I3_tRMS@AC Group 3P [A]	11.42773	1.216352	-10.21138
P_t@AC Group 3P [W]	7993.202	-0.899079	-7994.101
Q_t@AC Group 3P [var]	443.3057	523.2802	79.97449

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

	A	B	Delta
Time [s]	0:15.734522	0:17.036554	1.302032
U1_tRMS@AC Group 3P [V]	230.5669	230.5248	-0.042053
U2_tRMS@AC Group 3P [V]	230.4944	71.11330	-159.3811
U3_tRMS@AC Group 3P [V]	230.6285	230.5583	-0.070267
I1_tRMS@AC Group 3P [A]	11.58248	1.275780	-10.30670
I2_tRMS@AC Group 3P [A]	11.66030	0.662035	-10.99826
I3_tRMS@AC Group 3P [A]	11.39012	1.271002	-10.11912
P_t@AC Group 3P [W]	7977.287	-0.597192	-7977.884
Q_t@AC Group 3P [var]	352.2171	634.2181	282.0009

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

	A	B	Delta
Time [s]	6.366266	9.383355	3.017089
U1_tRMS@AC Group 3P [V]	230.0476	187.6082	-42.43939
U2_tRMS@AC Group 3P [V]	229.7904	187.5772	-42.21324
U3_tRMS@AC Group 3P [V]	229.9204	187.6497	-42.27069
I1_tRMS@AC Group 3P [A]	11.72463	14.20932	2.484686
I2_tRMS@AC Group 3P [A]	11.77623	14.21958	2.443357
I3_tRMS@AC Group 3P [A]	11.50958	13.99437	2.484791
P_t@AC Group 3P [W]	8021.563	7956.236	-65.32666
Q_t@AC Group 3P [var]	670.9661	213.2599	-457.7062

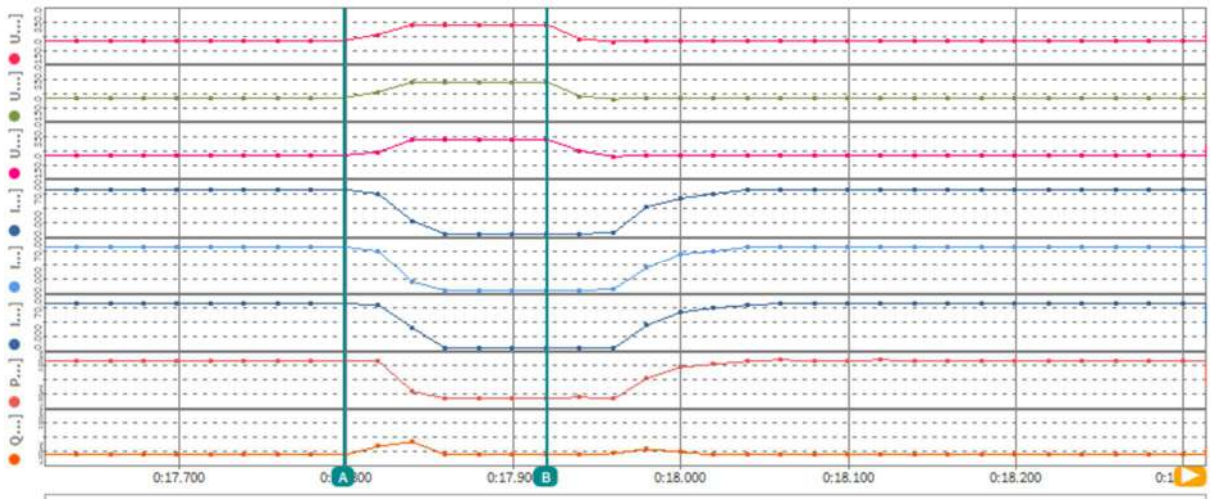
Test 3.D.2-Asymmetrical fault (U/U_{nom} = 0,82); P = 20% ±5% P_n

	A	B	Delta
Time [s]	0:16.674798	0:19.680994	3.006196
U1_tRMS@AC Group 3P [V]	230.6110	221.7236	-8.887405
U2_tRMS@AC Group 3P [V]	230.5084	189.0920	-41.41641
U3_tRMS@AC Group 3P [V]	230.6626	221.2435	-9.419098
I1_tRMS@AC Group 3P [A]	11.58677	12.91686	1.330091
I2_tRMS@AC Group 3P [A]	11.62980	13.05415	1.424354
I3_tRMS@AC Group 3P [A]	11.37817	12.45588	1.077708
P_t@AC Group 3P [W]	7969.280	8050.342	81.06201
Q_t@AC Group 3P [var]	358.1426	781.5724	423.4298

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

	A	B	Delta
Time [s]	0:15.693123	0:18.704529	3.011406
U1_tRMS@AC Group 3P [V]	230.5461	230.7588	0.212723
U2_tRMS@AC Group 3P [V]	230.5868	189.0401	-41.54663
U3_tRMS@AC Group 3P [V]	230.5735	230.6559	0.082443
I1_tRMS@AC Group 3P [A]	11.59263	12.49330	0.900669
I2_tRMS@AC Group 3P [A]	11.66823	12.66872	1.000486
I3_tRMS@AC Group 3P [A]	11.40129	12.13898	0.737690
P_t@AC Group 3P [W]	7984.526	8069.487	84.96094
Q_t@AC Group 3P [var]	345.7771	365.5393	19.76218

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

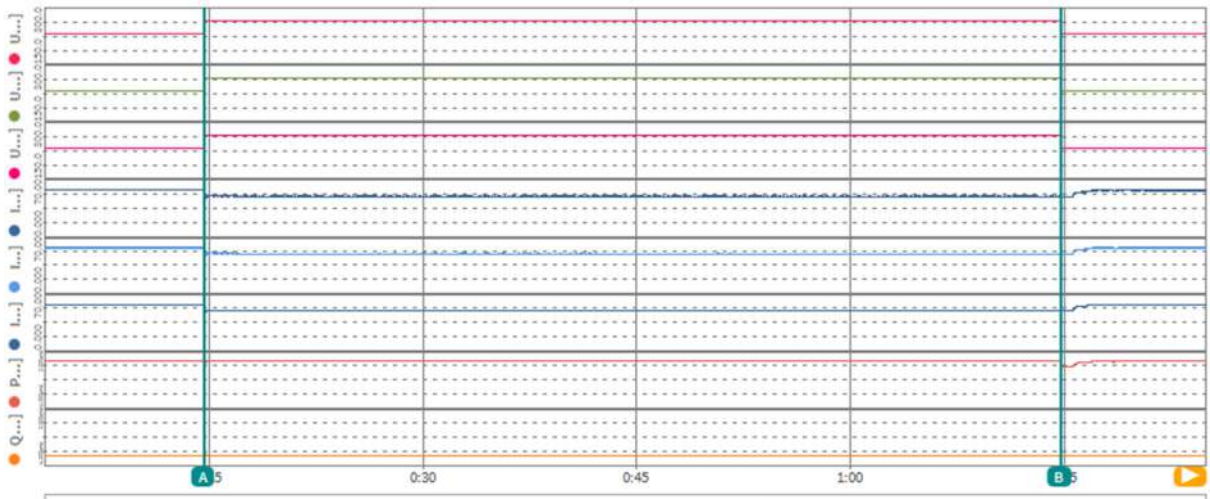


	A	B	Delta
Time [s]	0:17.7990303	0:17.9199979	0.1209675
U1_tRMS@AC Group 3P [V]	230.4816	288.2006	57.71901
U2_tRMS@AC Group 3P [V]	230.5140	288.0941	57.58009
U3_tRMS@AC Group 3P [V]	230.5117	288.1309	57.61925
I1_tRMS@AC Group 3P [A]	57.58301	1.720997	-55.86201
I2_tRMS@AC Group 3P [A]	57.76363	1.718473	-56.04516
I3_tRMS@AC Group 3P [A]	57.45440	1.717264	-55.73714
P_t@AC Group 3P [W]	39828.57	-1.571818	-39830.14
Q_t@AC Group 3P [var]	445.3900	1485.870	1040.480

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

	A	B	Delta
Time [s]	0:19.56666	0:24.58219	5.01553
U1_tRMS@AC Group 3P [V]	230.0180	276.7693	46.75122
U2_tRMS@AC Group 3P [V]	230.3228	276.5206	46.19780
U3_tRMS@AC Group 3P [V]	230.5034	276.7099	46.20651
I1_tRMS@AC Group 3P [A]	57.62250	1.650243	-55.97226
I2_tRMS@AC Group 3P [A]	57.67595	1.645431	-56.03052
I3_tRMS@AC Group 3P [A]	57.47723	1.646311	-55.83092
P_t@AC Group 3P [W]	39780.51	-2.761842	-39783.27
Q_t@AC Group 3P [var]	718.2274	1367.280	649.0521

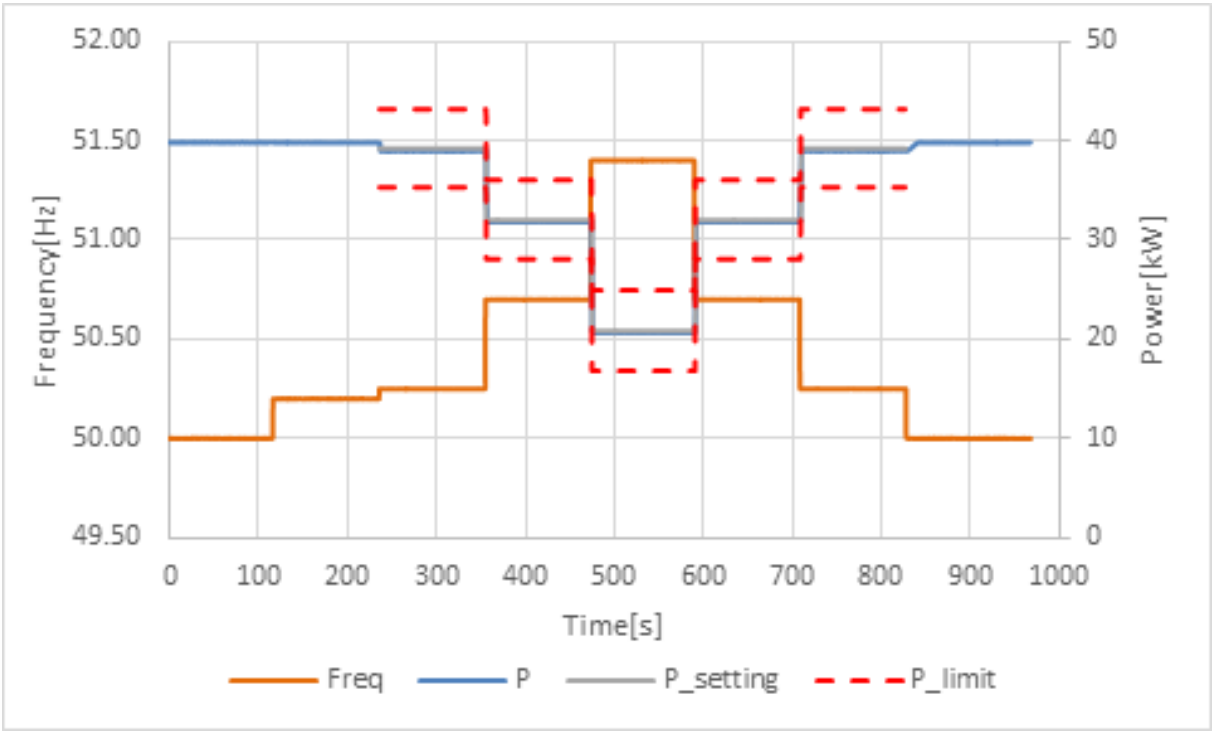
Test OV3-Symmetrical fault (U/U_{nom} = 1,15); P = 100% ±5% P_n



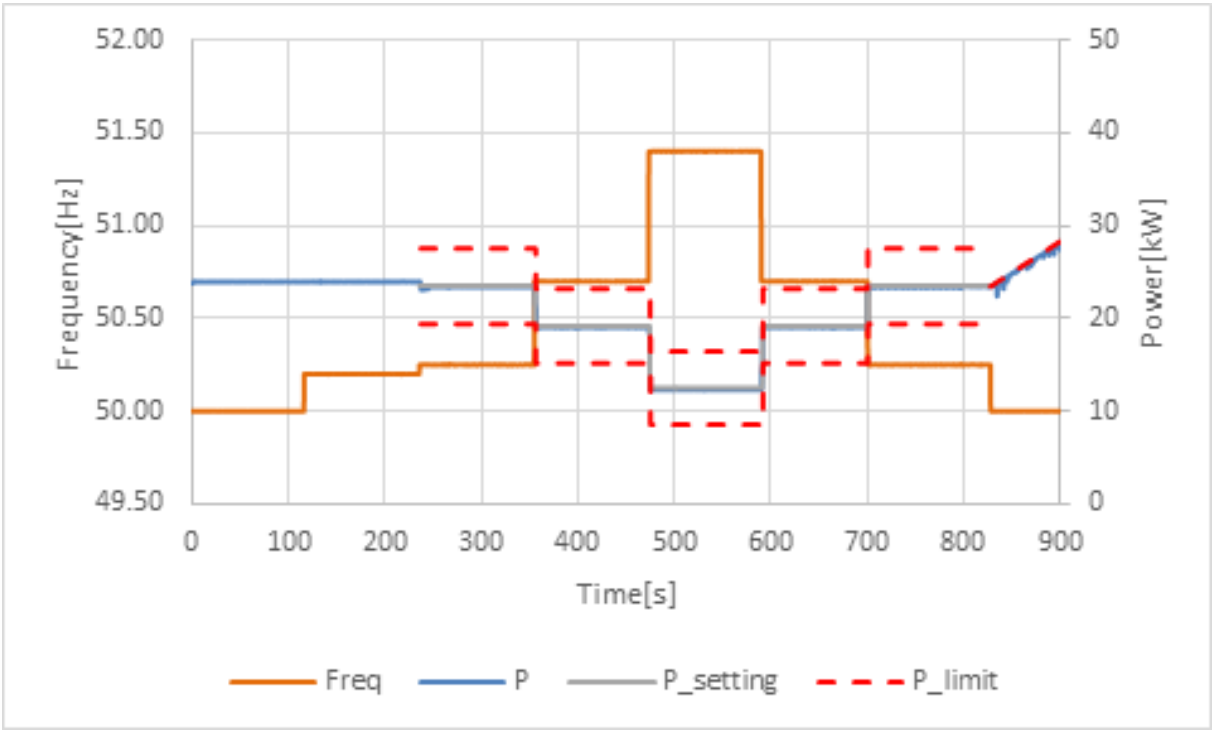
	A	B	Delta
Time [s]	0:14.67906	1:14.68361	1:00.00455
U1_tRMS@AC Group 3P [V]	231.4963	266.0676	34.57130
U2_tRMS@AC Group 3P [V]	231.4562	266.1795	34.72336
U3_tRMS@AC Group 3P [V]	231.3024	265.9973	34.69487
I1_tRMS@AC Group 3P [A]	57.37487	49.95120	-7.423672
I2_tRMS@AC Group 3P [A]	57.51109	50.08027	-7.430820
I3_tRMS@AC Group 3P [A]	57.30754	49.99869	-7.308849
P_t@AC Group 3P [W]	39834.74	39908.14	73.39453
Q_t@AC Group 3P [var]	1056.020	983.5046	-72.51526

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 0124-100:2020, clause 5.4.4	**P**
4.6.2	Power response to under-frequency	VDE V 0124-100:2020, clause 5.4.6	**N/A**

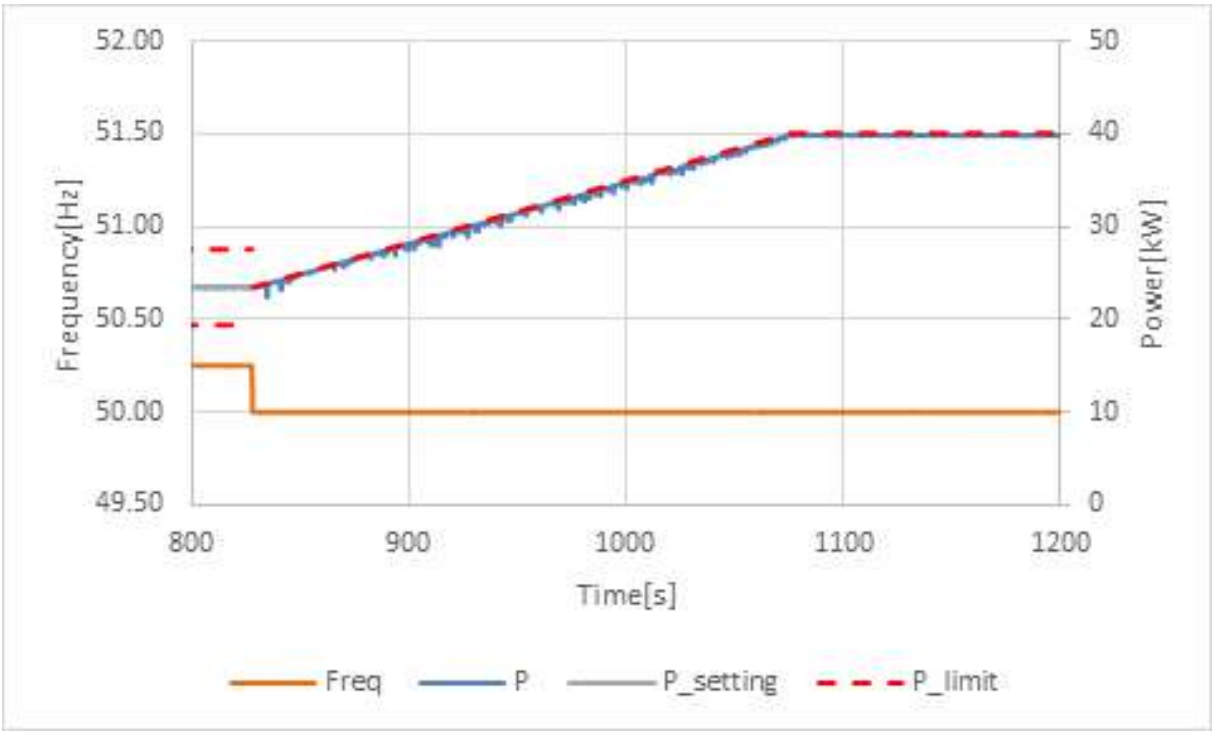
4.6.1	Power response to over-frequency						P
Test result: ASW40K-LT-G3							
1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,40	e) 50,70	f) 50,25	g) 50,00
1. Measurement a) to g): Active power output =100% P_{Emax} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 50,2Hz							
Frequency [Hz]:	50,00	50,25	50,70	51,40	50,70	50,25	50,00
P_M [kW]:	N/A	39,20	32,00	20,80	32,00	39,20	N/A
P_{E60} [kW]:	39,83	38,95	31,82	20,65	31,81	38,94	39,82
$\Delta P_{E60}/P_{Emax}$ [%]:	N/A	-0,63	-0,45	-0,37	-0,47	-0,640	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]:	N/A	23,52	19,20	12,48	19,20	23,52	N/A
P_{E60} [kW]:	23,97	23,39	19,01	12,30	19,02	23,30	39,83
$\Delta P_{E60}/P_{Emax}$ [%]:	N/A	-0,33	-0,47	-0,45	-0,46	-0,55	N/A
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 0124-100:2020.

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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 0124-100:2020, 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: ASW40K-LT-G3

PF = 0,8 / Inducitive reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,794	2,761	0,808	229,92
20%	8,182	6,114	0,801	229,92
30%	12,181	9,158	0,799	230,08
40%	16,173	11,798	0,808	230,11
50%	20,147	14,778	0,806	230,28
60%	24,095	17,700	0,806	230,29
70%	28,036	20,679	0,805	230,39
80%	31,954	23,680	0,803	230,51
90%	31,684	24,019	0,797	230,46
100%	31,679	24,025	0,797	230,44

PF = 0,8 / Capacitive reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,813	-2,808	0,805	229,98
20%	7,835	-5,798	0,804	230,05
30%	11,872	-8,786	0,804	230,06
40%	15,914	-11,773	0,804	230,13
50%	19,955	-14,755	0,804	230,18
60%	23,993	-17,725	0,804	230,24
70%	28,032	-20,683	0,805	230,32
80%	32,075	-23,623	0,805	230,41
90%	31,752	-24,069	0,797	230,36
100%	31,748	-24,073	0,797	230,36

Cos phi=1 no reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,802	-0,261	0,997	229,88
20%	7,791	-0,264	0,999	229,97
30%	11,810	-0,235	1,000	230,04
40%	15,832	-0,184	1,000	230,11
50%	19,844	-0,134	1,000	230,16
60%	23,846	-0,079	1,000	230,27
70%	27,835	-0,014	1,000	230,33
80%	31,809	0,073	1,000	230,40
90%	35,773	0,193	1,000	230,44
100%	39,838	0,406	1,000	230,54

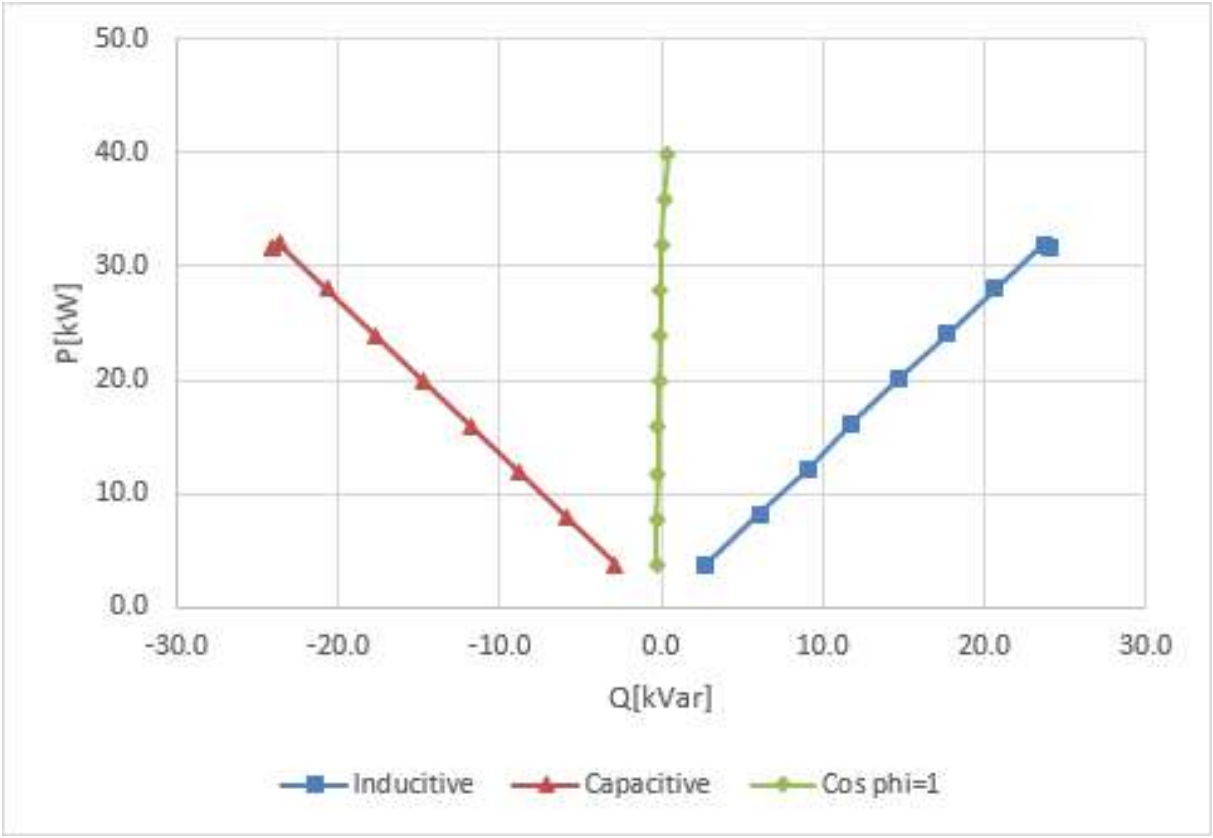
Assessment criterion:

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3,

ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Diagram



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

Test result: ASW40K-LT-G3

Inducitive reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,740	23,957	0,154	229,91
20%	7,750	23,965	0,308	230,02
30%	12,139	23,903	0,453	230,08
40%	16,130	23,939	0,559	230,17
50%	20,098	24,003	0,642	230,25
60%	24,114	23,952	0,710	230,33
70%	28,072	24,005	0,760	230,40
80%	32,012	23,917	0,801	230,46
90%	31,684	24,019	0,797	230,46
100%	31,679	24,025	0,797	230,44

Capacitive reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,871	-24,100	0,159	229,85
20%	7,911	-24,076	0,312	229,91
30%	11,945	-24,044	0,445	229,97
40%	15,972	-24,011	0,554	230,08
50%	19,998	-24,080	0,639	230,14
60%	24,013	-24,036	0,707	230,18
70%	28,023	-23,980	0,760	230,29
80%	32,030	-24,105	0,799	230,37
90%	31,752	-24,069	0,797	230,36
100%	31,748	-24,073	0,797	230,36

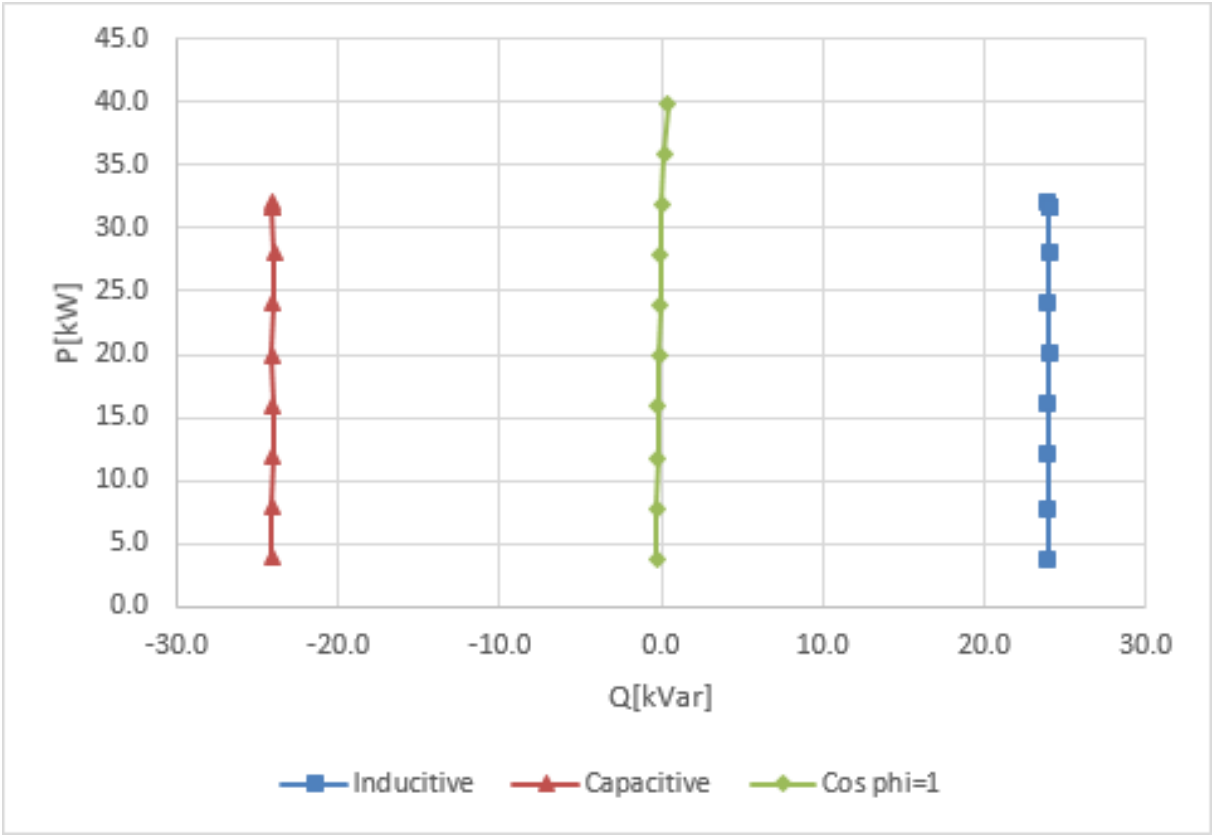
Cos phi=1 no reactive power supply

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	3,802	-0,261	0,997	229,88
20%	7,791	-0,264	0,999	229,97
30%	11,810	-0,235	1,000	230,04
40%	15,832	-0,184	1,000	230,11
50%	19,844	-0,134	1,000	230,16
60%	23,846	-0,079	1,000	230,27
70%	27,835	-0,014	1,000	230,33
80%	31,809	0,073	1,000	230,40
90%	35,773	0,193	1,000	230,44
100%	39,838	0,406	1,000	230,54

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 CEI 0-21 / EN 50438:2013, Annex D.3.4.2.1.

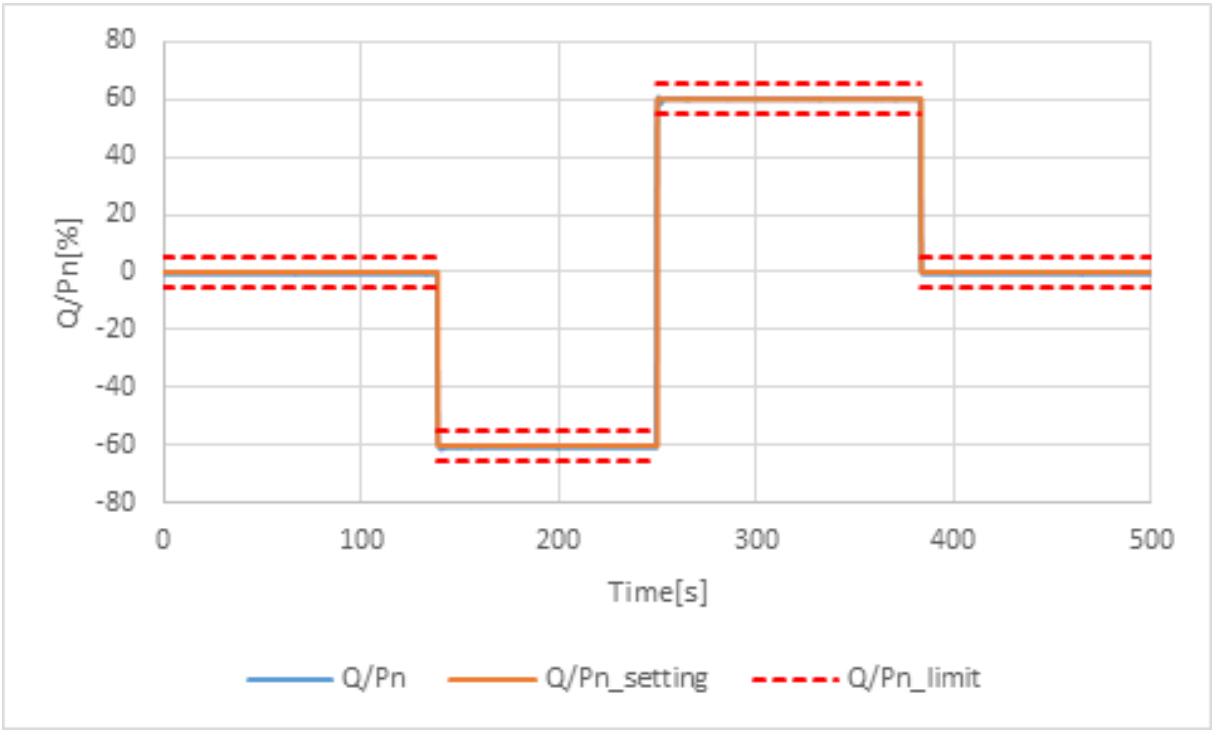
Generating plants must meet the reactive power requirement regardless of the number of feeding phases under normal steady-state operating conditions in the voltage tolerance band +10%U_n and -15%U_n.
The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Diagram

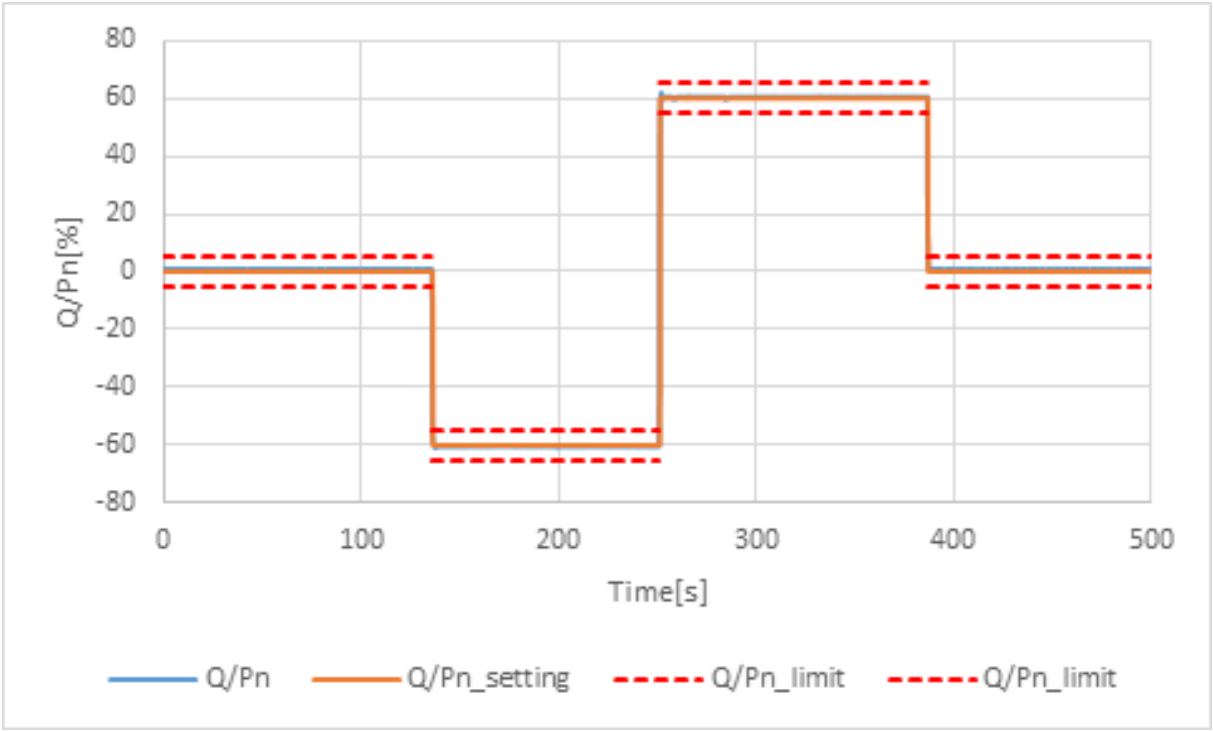


4.7.2.2 Capabilities Q Response time			P
Reaction time			
Test result: ASW40K-LT-G3			
		Time	**Result**
1.	Reaction time Q=0 to Qmin (50% test)	0,5 s	P
2.	Reaction time Qmin to Qmax (50% test)	0,6 s	P
3.	Reaction time Qmax to Q=0 (50% test)	0,5 s	P
4.	Reaction time Q=0 to Qmin (100% test)	0,5 s	P
5.	Reaction time Qmin to Qmax (100% test)	0,5 s	P
6.	Reaction time Qmax to Q=0 (100% test)	0,5 s	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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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: ASW40K-LT-G3

Qmin reactive power in accordance to standard characteristic curve Q=f(V)

P/Pn	Vac [% U_n] Set point	P/Pn [%]	Vac [V] measured	Q [kVar] measured	Q [kVar] expected	ΔQ [% P_{Emax}]
< 20%	1,05Vn	9,31	241,44	-0,28	≈0(<±2,5%Pn)	-0,88
< 20%	1,07Vn	9,23	246,07	-0,28	≈0(<±2,5%Pn)	-0,87
< 20%-30%	1,07Vn	29,56	246,07	-12,15	0,5 Qmin	-0,45
40%	1,07Vn	39,47	246,22	-11,95	0,5 Qmin	0,16
50%	1,07Vn	49,48	246,27	-11,95	0,5 Qmin	0,15
60%	1,07Vn	59,49	246,37	-11,87	0,5 Qmin	0,40
70%	1,07Vn	69,55	246,42	-11,83	0,5 Qmin	0,53
80%	1,07Vn	79,57	246,43	-11,86	0,5 Qmin	0,44
90%	1,07Vn	89,69	246,46	-11,76	0,5 Qmin	0,76
100%	1,07Vn	95,10	246,53	-11,54	0,5 Qmin	1,44
100%	1,08Vn	79,01	248,71	-24,01	Qmin	-0,04
100%-10%	1,08Vn	9,37	248,17	-24,39	Qmin	-1,23
10%→ ≤5%	1,08Vn	2,35	248,24	-0,29	≈0(<±2,5%Pn)	-0,92

Qmax reactive power in accordance to standard characteristic curve Q=f(V)

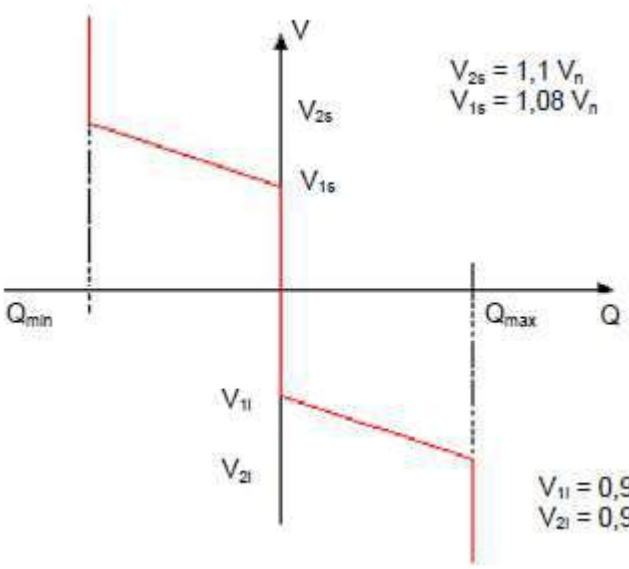
P/Pn	Vac [% U_n] Set point	P/Pn [%]	Vac [V] measured	Q [kVar] measured	Q [kVar] expected	ΔQ [% P_{Emax}]
< 20%	0.95Vn	9,68	218,38	-0,27	≈0(<±2,5%Pn)	-0,84
< 20%	0,93Vn	9,75	213,87	-0,24	≈0(<±2,5%Pn)	-0,76
< 20%-30%	0,93Vn	29,65	214,11	11,93	0,5 Qmax	-0,22
40%	0,93Vn	39,81	214,06	11,91	0,5 Qmax	-0,29
50%	0,93Vn	49,81	214,12	11,86	0,5 Qmax	-0,44
60%	0,93Vn	59,83	214,26	11,94	0,5 Qmax	-0,20
70%	0,93Vn	69,77	214,33	11,94	0,5 Qmax	-0,20
80%	0,93Vn	79,68	214,35	12,02	0,5 Qmax	0,06
90%	0,93Vn	89,48	214,47	12,14	0,5 Qmax	0,43
100%	0,93Vn	94,72	214,48	12,15	0,5 Qmax	0,47
100%	0,92Vn	79,57	211,60	24,21	Qmax	0,66
100%-10%	0,92Vn	9,74	210,93	23,97	Qmax	-0,11
10%→ ≤5%	0,92Vn	2,81	210,77	-0,25	≈0(<±2,5%Pn)	-0,78

Test:

The verification of the accuracy of the Q (U) control of the reactive power-voltage characteristic Un shown in CEI 0-21, B.1.2.6, 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 according above table.

The procedure is analogous to Figure 3 in Section 5.4.3.2.



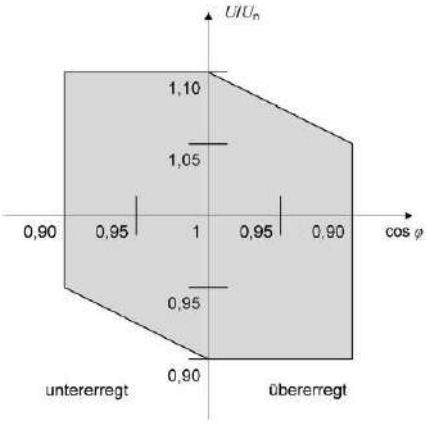


Bild 3 – Anforderungen an Erzeugungseinheiten bezüglich der Blindleistungsbereitstellung an den Generatorklemmen
($\sum S_{Emax} > 4{,}6$ kVA)

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

Assessment criterion:

The test method was performed like the Q(U) clause B1.2.6 of CEI 0-21 but with different voltage points and log in and log out values for P.

The value measured for each set point to the set value is ΔQ ≤ ± 5 %PD.

The above test data is according to the four set points: V_{1i}=0,94 Un and V_{2i}=0,92 Un, V_{1s}=1,06 Un and V_{2s}=1,08 Un, these set points are adjustable.

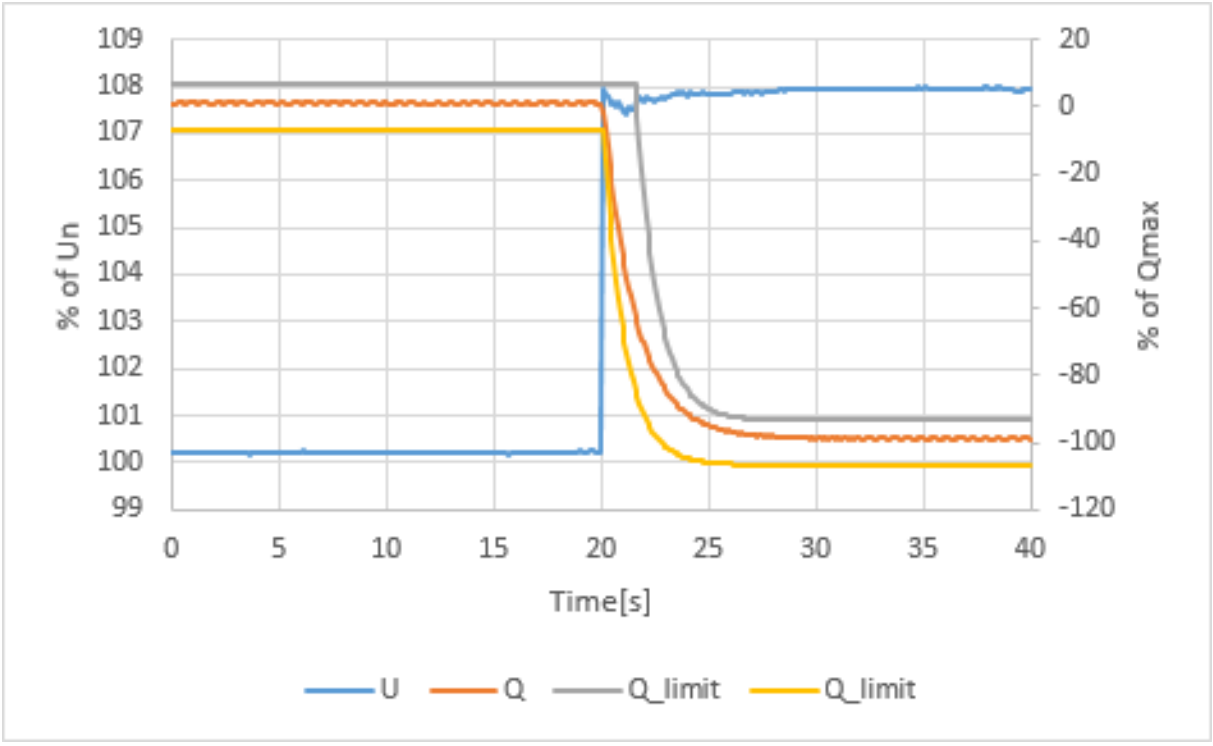
Note:

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

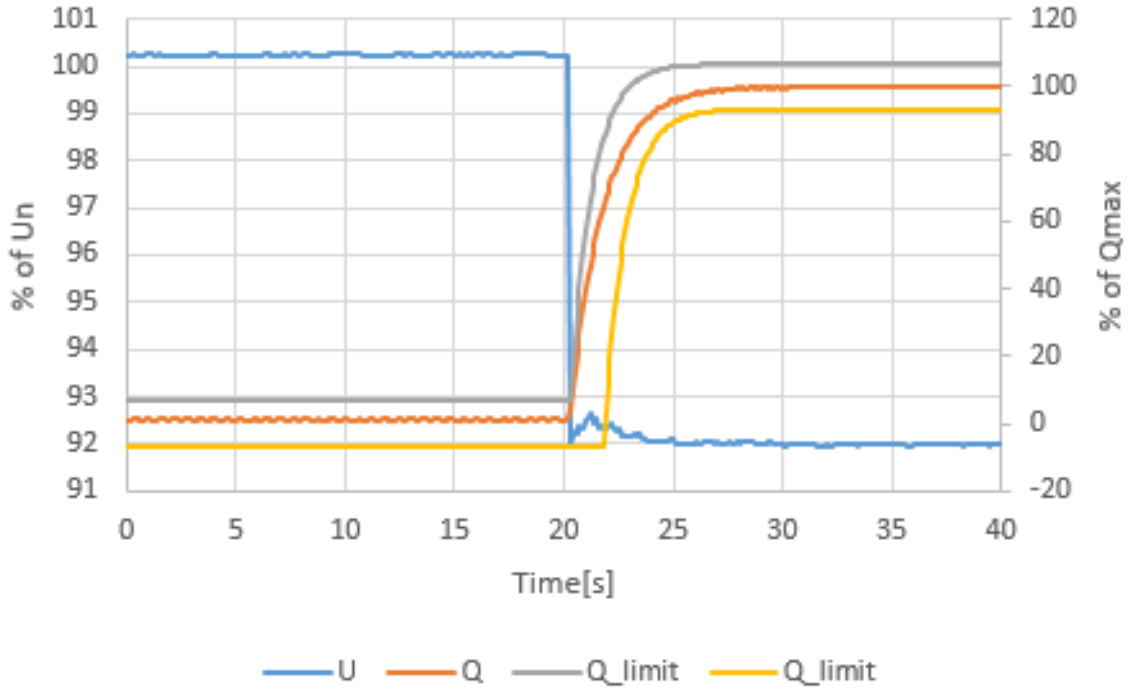
Test of the dynamics of the Q (U) regulation			P
Test result: ASW40K-LT-G3			
Voltage jump Vac [% U_n]	Q [kVar] measured	Q [%Qmax] measured	T=3τmeasured
100 to 108	-23,691	98,71	4,9 s
	-23,692	98,72	4,9 s
	-23,693	98,72	4,9 s
100 to 92	23,988	99,95	4,4 s
	23,992	99,97	4,4 s
	24,196	100,82	4,3 s

Note:
The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Graph of 100%U_n to 108% U_n:



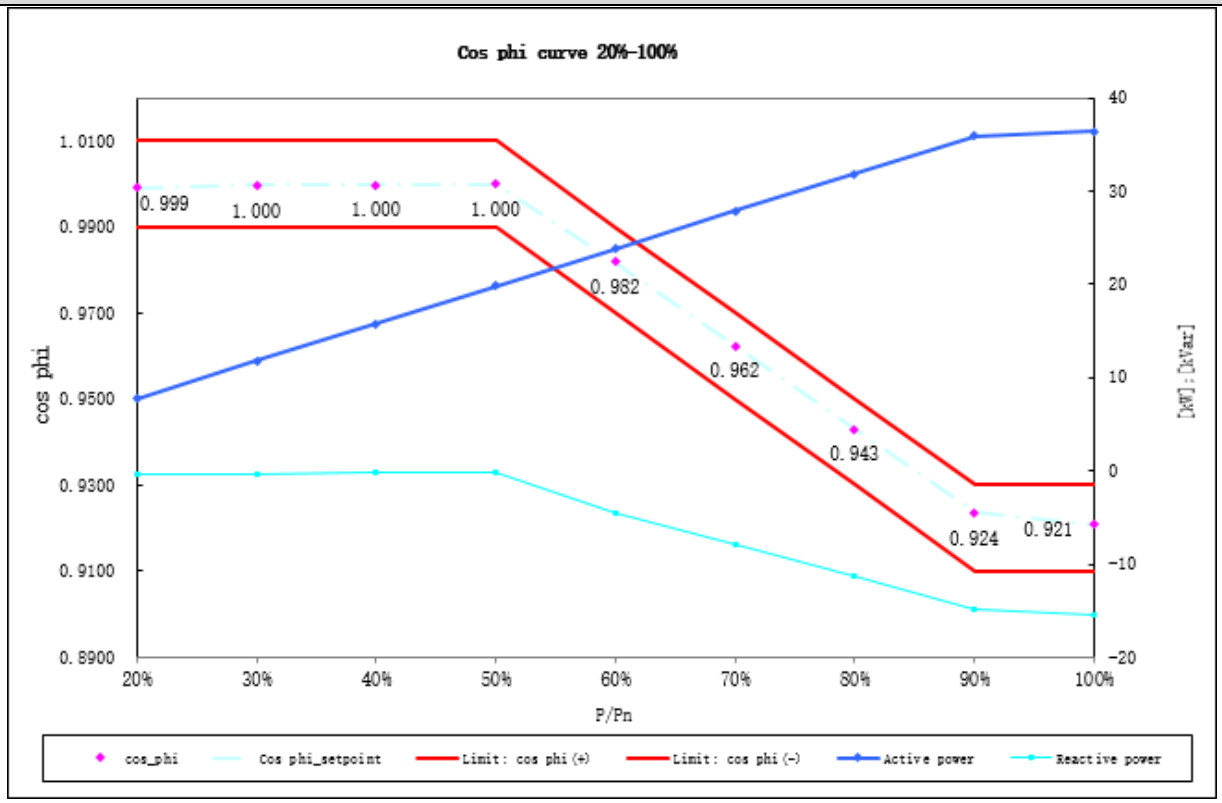
Graph of 100%U_n to 92% U_n:



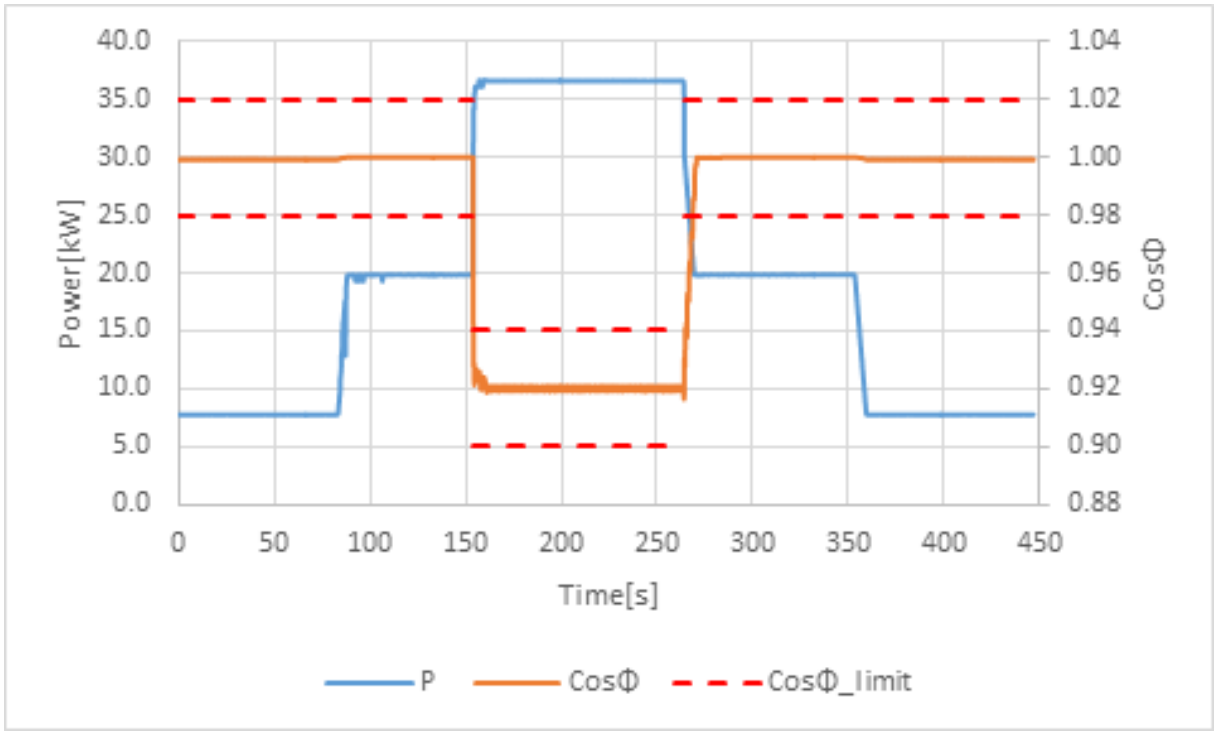
4.7.2.2 Capabilities 4.7.2.3.4 Power related Control mode (cos φ (P) curve)										P
Test result: ASW40K-LT-G3										
Test a):										
Pn/P [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	20% to 100% P_{Emax}									
U [V]:	N/A	229,96	230,10	230,12	230,23	230,20	230,31	230,33	230,37	230,44
P_{E30} [kW]:	N/A	7,78	11,80	15,82	19,83	23,86	27,88	31,89	35,91	36,45
P_{E30} of P_n [%]:	N/A	19,45	29,49	39,55	49,58	59,64	69,69	79,73	89,77	91,11
Q_{E30} [kVar]:	N/A	-0,28	-0,27	-0,24	-0,20	-4,60	-7,86	-11,25	-14,91	-15,42
cos φ_{E30}:	N/A	0,999	1,000	1,000	1,000	0,982	0,962	0,943	0,924	0,921
cos $\varphi_{setpoint}$ of P_{E30}:	N/A	1,00	1,00	1,00	1,00	0,98	0,96	0,94	0,92	0,92
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]:	229,97			230,21			230,42			
P_{E30} [kW]:	7,79			19,83			36,59			
P_{E30} of Pn [%]:	19,47			49,58			91,48			
Q_{E30} [kVar]:	-0,29			-0,21			-15,56			
cos φ_{E30}:	0,999			1,000			0,920			
cos $\varphi_{setpoint}$ of P_{E30}:	1,00			1,00			0,92			
T_0[s]:	0,1 s					0,1 s				
Pn/P [%]	100			50			20			
30 s mean value	100% to 50% to 20% Pn									
U [V]:	230,43			230,22			229,92			
P_{E30} [kW]:	36,59			19,84			7,79			
P_{E30} [%]:	91,48			49,60			19,47			
Q_{E30} [kVar]:	-15,57			-0,15			-0,29			
cos φ_{E30}:	0,920			1,000			0,999			
cos $\varphi_{setpoint}$ of P_{E30}:	0,92			1,00			1,00			
T_0 [s]:	4,8 s					0,1 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)



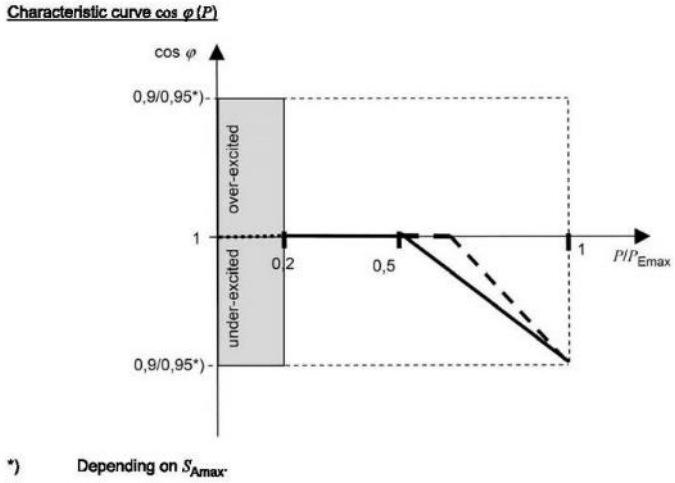
Graph of setting (T_0) time: Test b): 100% to 50% to 20% to 50% to 100%Pn



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 and: Using the standard characteristic curve increases the active power from 20% P_{Emax} to 50% P_{Emax} 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 0124-100:2020.

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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]:	17.5	
P_{E60} [%]:	19,2%	
$\Delta P_{E60}/P_{Setpoint}$ [%]:	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:

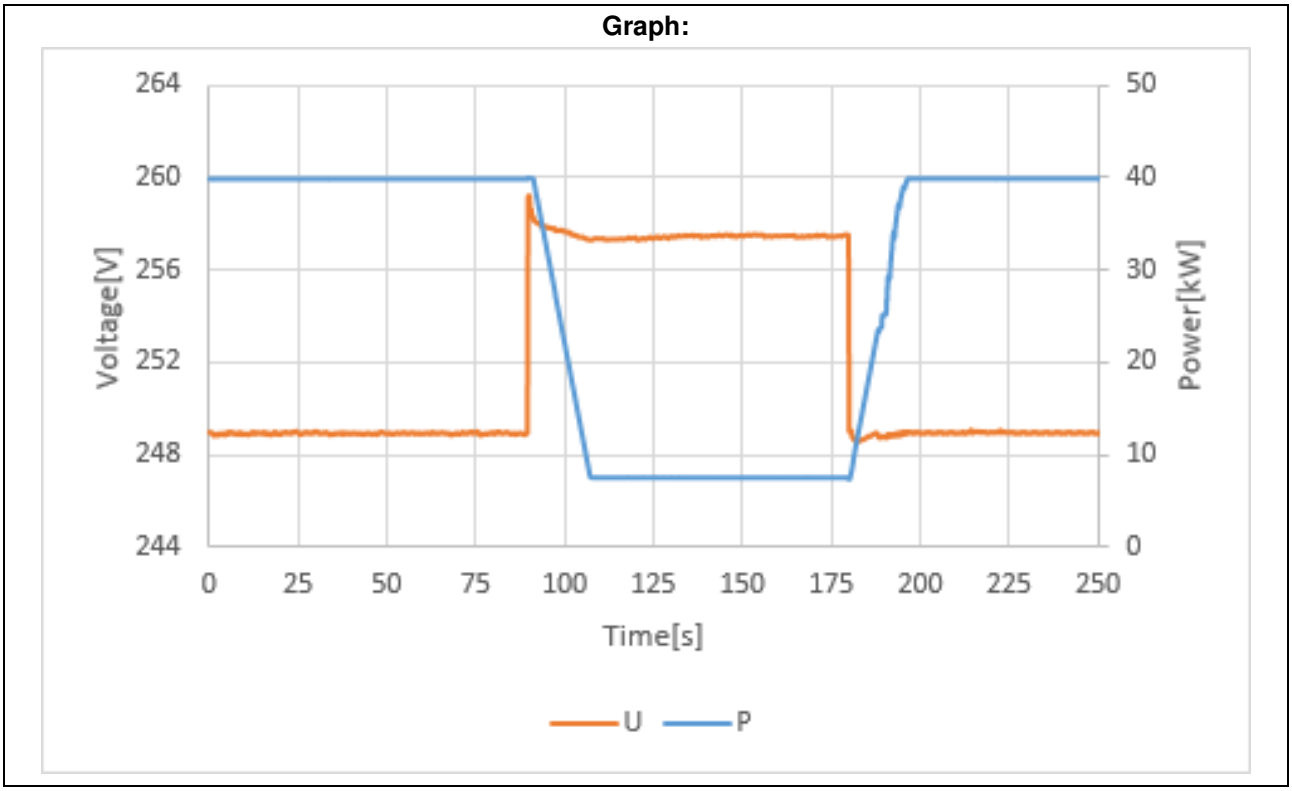
for adjustable PGUs:

- 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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Graph:


264
260
256
252
248
244
Voltage[V]
50
40
30
20
10
0
Power[kW]
0
25
50
75
100
125
150
175
200
225
250
Time[s]
U
P

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 61000-3-12)							P
Test result: ASW25K-LT-G3								
Watts [KW]				8,261		8,257		8,213
Vrms [V]				230,34		230,21		230,31
Arms [A]				35,87		35,88		35,67
Frequency [Hz]				50,00				
THD50 (100% output power)				0,539		0,503		0,499
Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [%]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	35,861	35,869	35,661	98,977	99,000	98,425	Three Phase	--
2nd	0,136	0,095	0,046	0,377	0,261	0,126	Three Phase	8,00
3rd	0,081	0,081	0,015	0,225	0,224	0,042	Three Phase	21,60
4th	0,011	0,007	0,009	0,030	0,020	0,026	Three Phase	4,00
5th	0,181	0,152	0,178	0,500	0,420	0,493	Three Phase	10,70
6th	0,007	0,008	0,006	0,020	0,021	0,018	Three Phase	2,67
7th	0,122	0,113	0,122	0,336	0,312	0,335	Three Phase	7,20
8th	0,015	0,009	0,014	0,040	0,024	0,039	Three Phase	2,00
9th	0,011	0,011	0,006	0,029	0,030	0,018	Three Phase	3,80
10th	0,009	0,009	0,012	0,025	0,026	0,033	Three Phase	1,60
11th	0,094	0,095	0,093	0,260	0,263	0,256	Three Phase	3,10
12th	0,004	0,007	0,008	0,011	0,019	0,021	Three Phase	1,33
13th	0,322	0,314	0,302	0,888	0,867	0,834	Three Phase	2,00
14th	0,013	0,006	0,010	0,036	0,017	0,026	Three Phase	N/A
15th	0,016	0,014	0,003	0,045	0,039	0,007	Three Phase	N/A
16th	0,007	0,008	0,010	0,021	0,023	0,029	Three Phase	N/A
17th	0,193	0,188	0,201	0,534	0,519	0,555	Three Phase	N/A
18th	0,003	0,005	0,005	0,007	0,013	0,013	Three Phase	N/A
19th	0,173	0,161	0,159	0,478	0,445	0,440	Three Phase	N/A
20th	0,012	0,008	0,009	0,034	0,021	0,026	Three Phase	N/A
21th	0,016	0,017	0,004	0,045	0,047	0,010	Three Phase	N/A
22th	0,007	0,011	0,010	0,021	0,030	0,029	Three Phase	N/A
23th	0,110	0,101	0,115	0,303	0,278	0,317	Three Phase	N/A
24th	0,002	0,004	0,004	0,006	0,010	0,011	Three Phase	N/A
25th	0,100	0,087	0,089	0,276	0,241	0,246	Three Phase	N/A
26th	0,011	0,009	0,008	0,030	0,024	0,023	Three Phase	N/A
27th	0,014	0,015	0,003	0,038	0,040	0,009	Three Phase	N/A
28th	0,008	0,011	0,010	0,022	0,031	0,027	Three Phase	N/A
29th	0,066	0,055	0,062	0,183	0,151	0,172	Three Phase	N/A
30th	0,002	0,004	0,004	0,007	0,011	0,011	Three Phase	N/A
31th	0,054	0,048	0,052	0,149	0,133	0,142	Three Phase	N/A
32th	0,009	0,009	0,008	0,025	0,026	0,022	Three Phase	N/A
33th	0,008	0,010	0,004	0,021	0,027	0,012	Three Phase	N/A
34th	0,009	0,011	0,009	0,024	0,029	0,024	Three Phase	N/A
35th	0,041	0,034	0,030	0,114	0,093	0,084	Three Phase	N/A
36th	0,002	0,003	0,003	0,007	0,009	0,009	Three Phase	N/A
37th	0,032	0,032	0,033	0,088	0,088	0,092	Three Phase	N/A
38th	0,008	0,009	0,008	0,023	0,025	0,022	Three Phase	N/A
39th	0,003	0,006	0,005	0,009	0,016	0,013	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
40th	0,009	0,010	0,008	0,025	0,029	0,022	Three Phase	N/A
41th	0,029	0,032	0,023	0,081	0,089	0,064	Three Phase	N/A
42th	0,003	0,003	0,003	0,007	0,008	0,007	Three Phase	N/A
43th	0,031	0,032	0,029	0,085	0,090	0,080	Three Phase	N/A
44th	0,008	0,008	0,008	0,021	0,022	0,021	Three Phase	N/A
45th	0,004	0,006	0,005	0,011	0,017	0,015	Three Phase	N/A
46th	0,008	0,008	0,007	0,023	0,023	0,020	Three Phase	N/A
47th	0,028	0,035	0,029	0,077	0,096	0,081	Three Phase	N/A
48th	0,003	0,002	0,002	0,007	0,006	0,006	Three Phase	N/A
49th	0,034	0,033	0,028	0,093	0,091	0,077	Three Phase	N/A
50th	0,006	0,007	0,007	0,017	0,018	0,019	Three Phase	N/A
Test result: ASW27K-LT-G3								
Watts [KW]					8,969	8,971	8,925	
Vrms [V]					230,38	230,31	230,37	
Arms [A]					38,94	38,96	38,75	
Frequency [Hz]					50,00			
THD50 (100% output power)					0,551	0,532	0,516	
Harmonic order n	**Current Magnitude [A] at 100% rated output power**			**% of Fundamental**			**Phase**	**Harmonic Current Limits [%]**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	--	--
1st	38,930	38,950	38,743	99,489	99,538	99,009	Three Phase	--
2nd	0,098	0,131	0,041	0,251	0,335	0,105	Three Phase	8,00
3rd	0,094	0,099	0,016	0,240	0,252	0,041	Three Phase	21,60
4th	0,009	0,008	0,007	0,023	0,021	0,018	Three Phase	4,00
5th	0,175	0,145	0,171	0,447	0,372	0,436	Three Phase	10,70
6th	0,010	0,007	0,006	0,026	0,017	0,016	Three Phase	2,67
7th	0,119	0,111	0,119	0,303	0,285	0,303	Three Phase	7,20
8th	0,015	0,012	0,012	0,038	0,031	0,031	Three Phase	2,00
9th	0,011	0,010	0,007	0,028	0,026	0,018	Three Phase	3,80
10th	0,013	0,009	0,011	0,032	0,023	0,027	Three Phase	1,60
11th	0,091	0,093	0,090	0,233	0,237	0,229	Three Phase	3,10
12th	0,005	0,005	0,005	0,012	0,013	0,014	Three Phase	1,33
13th	0,326	0,318	0,307	0,833	0,813	0,784	Three Phase	2,00
14th	0,013	0,009	0,008	0,032	0,022	0,020	Three Phase	N/A
15th	0,016	0,014	0,004	0,042	0,035	0,011	Three Phase	N/A
16th	0,009	0,006	0,010	0,024	0,017	0,024	Three Phase	N/A
17th	0,203	0,200	0,211	0,519	0,511	0,538	Three Phase	N/A
18th	0,004	0,004	0,004	0,011	0,011	0,009	Three Phase	N/A
19th	0,187	0,178	0,173	0,478	0,454	0,441	Three Phase	N/A
20th	0,012	0,009	0,008	0,030	0,022	0,020	Three Phase	N/A
21th	0,016	0,016	0,003	0,041	0,042	0,007	Three Phase	N/A
22th	0,010	0,008	0,010	0,024	0,020	0,026	Three Phase	N/A
23th	0,124	0,119	0,132	0,318	0,303	0,336	Three Phase	N/A
24th	0,003	0,003	0,003	0,009	0,007	0,007	Three Phase	N/A
25th	0,116	0,104	0,104	0,297	0,265	0,266	Three Phase	N/A
26th	0,011	0,010	0,008	0,027	0,026	0,020	Three Phase	N/A
27th	0,015	0,016	0,004	0,038	0,041	0,009	Three Phase	N/A
28th	0,010	0,010	0,010	0,025	0,024	0,026	Three Phase	N/A
29th	0,077	0,069	0,078	0,196	0,175	0,201	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
30th	0,003	0,003	0,003	0,008	0,009	0,007	Three Phase	N/A
31th	0,069	0,061	0,062	0,177	0,155	0,159	Three Phase	N/A
32th	0,010	0,011	0,008	0,025	0,028	0,021	Three Phase	N/A
33th	0,010	0,011	0,003	0,026	0,029	0,007	Three Phase	N/A
34th	0,010	0,010	0,010	0,024	0,024	0,027	Three Phase	N/A
35th	0,048	0,038	0,042	0,123	0,097	0,108	Three Phase	N/A
36th	0,003	0,003	0,002	0,007	0,008	0,006	Three Phase	N/A
37th	0,038	0,035	0,037	0,098	0,089	0,094	Three Phase	N/A
38th	0,009	0,010	0,008	0,022	0,025	0,021	Three Phase	N/A
39th	0,005	0,006	0,003	0,012	0,016	0,008	Three Phase	N/A
40th	0,009	0,009	0,010	0,024	0,024	0,026	Three Phase	N/A
41th	0,031	0,027	0,022	0,079	0,068	0,056	Three Phase	N/A
42th	0,002	0,003	0,002	0,006	0,007	0,005	Three Phase	N/A
43th	0,026	0,026	0,026	0,066	0,066	0,066	Three Phase	N/A
44th	0,008	0,009	0,008	0,020	0,022	0,020	Three Phase	N/A
45th	0,003	0,005	0,003	0,008	0,012	0,009	Three Phase	N/A
46th	0,008	0,008	0,009	0,021	0,021	0,022	Three Phase	N/A
47th	0,025	0,029	0,022	0,063	0,074	0,056	Three Phase	N/A
48th	0,003	0,002	0,002	0,007	0,006	0,005	Three Phase	N/A
49th	0,027	0,028	0,024	0,069	0,070	0,062	Three Phase	N/A
50th	0,007	0,008	0,007	0,017	0,019	0,018	Three Phase	N/A

Test result: ASW30K-LT-G3

Watts [KW]	9,967	9,965	9,922
Vrms [V]	230,45	230,32	230,42
Arms [A]	43,26	43,27	43,07
Frequency [Hz]	50,00		
THD50 (100% output power)	0,569	0,536	0,549

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Phase	Harmonic Current Limits [%]
	L1	L2	L3	L1	L2	L3	--	--
1st	43,250	43,266	43,061	99,474	99,512	99,039	Three Phase	--
2nd	0,108	0,031	0,124	0,249	0,070	0,285	Three Phase	8,00
3rd	0,089	0,097	0,021	0,205	0,224	0,049	Three Phase	21,60
4th	0,010	0,006	0,008	0,024	0,014	0,019	Three Phase	4,00
5th	0,167	0,138	0,163	0,385	0,316	0,376	Three Phase	10,70
6th	0,010	0,008	0,006	0,022	0,019	0,013	Three Phase	2,67
7th	0,109	0,102	0,109	0,252	0,235	0,252	Three Phase	7,20
8th	0,011	0,011	0,019	0,026	0,026	0,043	Three Phase	2,00
9th	0,012	0,009	0,008	0,028	0,020	0,017	Three Phase	3,80
10th	0,010	0,012	0,009	0,023	0,028	0,022	Three Phase	1,60
11th	0,085	0,087	0,083	0,195	0,199	0,192	Three Phase	3,10
12th	0,008	0,005	0,007	0,019	0,011	0,015	Three Phase	1,33
13th	0,329	0,322	0,312	0,757	0,740	0,717	Three Phase	2,00
14th	0,009	0,007	0,011	0,021	0,017	0,025	Three Phase	N/A
15th	0,015	0,012	0,005	0,035	0,028	0,012	Three Phase	N/A
16th	0,007	0,010	0,008	0,015	0,023	0,019	Three Phase	N/A
17th	0,207	0,206	0,214	0,476	0,473	0,493	Three Phase	N/A
18th	0,006	0,003	0,006	0,013	0,007	0,013	Three Phase	N/A
19th	0,196	0,189	0,182	0,452	0,435	0,418	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
20th	0,009	0,007	0,011	0,021	0,015	0,026	Three Phase	N/A
21th	0,016	0,015	0,002	0,037	0,034	0,005	Three Phase	N/A
22th	0,007	0,010	0,009	0,016	0,023	0,020	Three Phase	N/A
23th	0,139	0,136	0,147	0,320	0,312	0,338	Three Phase	N/A
24th	0,005	0,003	0,004	0,011	0,007	0,008	Three Phase	N/A
25th	0,135	0,124	0,122	0,311	0,286	0,281	Three Phase	N/A
26th	0,009	0,007	0,011	0,022	0,017	0,026	Three Phase	N/A
27th	0,015	0,016	0,003	0,035	0,037	0,008	Three Phase	N/A
28th	0,008	0,011	0,009	0,019	0,026	0,020	Three Phase	N/A
29th	0,092	0,087	0,098	0,212	0,200	0,225	Three Phase	N/A
30th	0,005	0,003	0,004	0,010	0,006	0,009	Three Phase	N/A
31th	0,089	0,079	0,079	0,205	0,181	0,181	Three Phase	N/A
32th	0,010	0,008	0,011	0,022	0,018	0,026	Three Phase	N/A
33th	0,013	0,013	0,003	0,030	0,030	0,006	Three Phase	N/A
34th	0,008	0,011	0,009	0,019	0,026	0,020	Three Phase	N/A
35th	0,061	0,053	0,061	0,141	0,123	0,140	Three Phase	N/A
36th	0,004	0,003	0,004	0,010	0,006	0,009	Three Phase	N/A
37th	0,056	0,049	0,050	0,129	0,114	0,115	Three Phase	N/A
38th	0,009	0,008	0,010	0,020	0,018	0,023	Three Phase	N/A
39th	0,008	0,008	0,002	0,018	0,019	0,004	Three Phase	N/A
40th	0,009	0,011	0,009	0,021	0,026	0,022	Three Phase	N/A
41th	0,040	0,032	0,034	0,091	0,073	0,079	Three Phase	N/A
42th	0,004	0,003	0,003	0,008	0,006	0,007	Three Phase	N/A
43th	0,033	0,028	0,031	0,075	0,066	0,071	Three Phase	N/A
44th	0,009	0,007	0,009	0,020	0,017	0,022	Three Phase	N/A
45th	0,004	0,005	0,002	0,010	0,012	0,005	Three Phase	N/A
46th	0,009	0,010	0,008	0,020	0,022	0,019	Three Phase	N/A
47th	0,026	0,023	0,019	0,059	0,053	0,045	Three Phase	N/A
48th	0,003	0,002	0,003	0,008	0,005	0,006	Three Phase	N/A
49th	0,022	0,021	0,021	0,050	0,047	0,049	Three Phase	N/A
50th	0,008	0,007	0,008	0,018	0,016	0,018	Three Phase	N/A

Test result: ASW33K-LT-G3

Watts [KW]	10,955	10,955	10,912
Vrms [V]	230,50	230,38	230,48
Arms [A]	47,54	47,56	47,35
Frequency [Hz]	50,00		
THD50 (100% output power)	0,571	0,546	0,567

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Phase	Harmonic Current Limits [%]
	L1	L2	L3	L1	L2	L3	--	--
1st	47,527	47,550	47,343	99,375	99,422	98,990	Three Phase	--
2nd	0,102	0,073	0,171	0,213	0,153	0,357	Three Phase	8,00
3rd	0,087	0,104	0,030	0,183	0,218	0,063	Three Phase	21,60
4th	0,012	0,007	0,010	0,025	0,014	0,022	Three Phase	4,00
5th	0,162	0,131	0,160	0,339	0,275	0,334	Three Phase	10,70
6th	0,010	0,012	0,005	0,021	0,025	0,011	Three Phase	2,67
7th	0,100	0,092	0,099	0,210	0,191	0,207	Three Phase	7,20
8th	0,007	0,015	0,020	0,016	0,031	0,042	Three Phase	2,00
9th	0,013	0,007	0,009	0,027	0,015	0,018	Three Phase	3,80

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
10th	0,011	0,014	0,009	0,024	0,030	0,019	Three Phase	1,60
11th	0,082	0,084	0,081	0,172	0,175	0,169	Three Phase	3,10
12th	0,009	0,007	0,006	0,020	0,014	0,012	Three Phase	1,33
13th	0,330	0,324	0,316	0,690	0,676	0,660	Three Phase	2,00
14th	0,007	0,010	0,011	0,015	0,020	0,024	Three Phase	N/A
15th	0,014	0,011	0,005	0,029	0,023	0,010	Three Phase	N/A
16th	0,008	0,011	0,008	0,017	0,024	0,016	Three Phase	N/A
17th	0,204	0,204	0,211	0,426	0,426	0,442	Three Phase	N/A
18th	0,007	0,004	0,005	0,015	0,009	0,011	Three Phase	N/A
19th	0,196	0,190	0,183	0,410	0,397	0,382	Three Phase	N/A
20th	0,008	0,009	0,012	0,017	0,018	0,025	Three Phase	N/A
21th	0,016	0,012	0,003	0,033	0,026	0,007	Three Phase	N/A
22th	0,008	0,012	0,009	0,017	0,024	0,018	Three Phase	N/A
23th	0,145	0,142	0,151	0,303	0,297	0,316	Three Phase	N/A
24th	0,007	0,004	0,004	0,014	0,009	0,008	Three Phase	N/A
25th	0,142	0,134	0,130	0,297	0,279	0,271	Three Phase	N/A
26th	0,009	0,009	0,013	0,018	0,019	0,026	Three Phase	N/A
27th	0,015	0,015	0,003	0,031	0,032	0,006	Three Phase	N/A
28th	0,009	0,012	0,009	0,019	0,026	0,018	Three Phase	N/A
29th	0,099	0,095	0,106	0,208	0,199	0,221	Three Phase	N/A
30th	0,005	0,004	0,003	0,011	0,008	0,006	Three Phase	N/A
31th	0,098	0,088	0,087	0,205	0,184	0,181	Three Phase	N/A
32th	0,009	0,009	0,013	0,018	0,019	0,027	Three Phase	N/A
33th	0,014	0,014	0,004	0,029	0,029	0,007	Three Phase	N/A
34th	0,009	0,012	0,009	0,018	0,025	0,018	Three Phase	N/A
35th	0,066	0,060	0,069	0,139	0,125	0,144	Three Phase	N/A
36th	0,006	0,004	0,003	0,012	0,008	0,007	Three Phase	N/A
37th	0,064	0,056	0,055	0,133	0,116	0,115	Three Phase	N/A
38th	0,008	0,008	0,012	0,016	0,018	0,025	Three Phase	N/A
39th	0,009	0,008	0,003	0,019	0,018	0,006	Three Phase	N/A
40th	0,010	0,012	0,009	0,021	0,024	0,018	Three Phase	N/A
41th	0,044	0,035	0,041	0,091	0,073	0,085	Three Phase	N/A
42th	0,005	0,003	0,003	0,011	0,007	0,006	Three Phase	N/A
43th	0,036	0,031	0,033	0,075	0,065	0,069	Three Phase	N/A
44th	0,009	0,007	0,011	0,018	0,015	0,023	Three Phase	N/A
45th	0,006	0,006	0,003	0,014	0,013	0,006	Three Phase	N/A
46th	0,009	0,009	0,008	0,018	0,020	0,017	Three Phase	N/A
47th	0,027	0,021	0,021	0,056	0,045	0,044	Three Phase	N/A
48th	0,005	0,003	0,003	0,010	0,006	0,006	Three Phase	N/A
49th	0,021	0,019	0,021	0,045	0,039	0,044	Three Phase	N/A
50th	0,008	0,007	0,009	0,016	0,014	0,019	Three Phase	N/A

Test result: ASW36K-LT-G3			
Watts [KW]	11,943	11,942	11,902
Vrms [V]	230,59	230,44	230,61
Arms [A]	51,80	51,83	51,62
Frequency [Hz]	50,00		
THD50 (100% output power)	0,590	0,560	0,564

Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic Current Limits [%]

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
	L1	L2	L3	L1	L2	L3	--	--
1st	51,791	51,821	51,609	99,265	99,323	98,918	Three Phase	--
2nd	0,128	0,059	0,076	0,246	0,113	0,146	Three Phase	8,00
3rd	0,085	0,110	0,040	0,162	0,210	0,076	Three Phase	21,60
4th	0,013	0,010	0,008	0,024	0,018	0,015	Three Phase	4,00
5th	0,156	0,126	0,157	0,299	0,242	0,302	Three Phase	10,70
6th	0,008	0,007	0,006	0,016	0,013	0,011	Three Phase	2,67
7th	0,089	0,079	0,086	0,171	0,152	0,165	Three Phase	7,20
8th	0,012	0,009	0,016	0,022	0,017	0,030	Three Phase	2,00
9th	0,015	0,005	0,010	0,028	0,010	0,020	Three Phase	3,80
10th	0,013	0,011	0,012	0,024	0,021	0,023	Three Phase	1,60
11th	0,079	0,080	0,078	0,151	0,153	0,149	Three Phase	3,10
12th	0,006	0,004	0,006	0,011	0,008	0,012	Three Phase	1,33
13th	0,337	0,332	0,326	0,646	0,636	0,624	Three Phase	2,00
14th	0,011	0,007	0,010	0,021	0,014	0,019	Three Phase	N/A
15th	0,012	0,009	0,004	0,023	0,018	0,008	Three Phase	N/A
16th	0,009	0,009	0,009	0,018	0,017	0,018	Three Phase	N/A
17th	0,205	0,206	0,213	0,394	0,395	0,408	Three Phase	N/A
18th	0,004	0,004	0,006	0,008	0,007	0,012	Three Phase	N/A
19th	0,198	0,193	0,186	0,380	0,369	0,357	Three Phase	N/A
20th	0,011	0,007	0,011	0,022	0,013	0,021	Three Phase	N/A
21th	0,015	0,011	0,004	0,029	0,020	0,008	Three Phase	N/A
22th	0,009	0,009	0,011	0,017	0,018	0,020	Three Phase	N/A
23th	0,151	0,148	0,156	0,289	0,284	0,299	Three Phase	N/A
24th	0,004	0,004	0,005	0,007	0,007	0,009	Three Phase	N/A
25th	0,151	0,144	0,139	0,289	0,276	0,267	Three Phase	N/A
26th	0,011	0,008	0,011	0,021	0,015	0,022	Three Phase	N/A
27th	0,014	0,014	0,003	0,027	0,026	0,005	Three Phase	N/A
28th	0,009	0,011	0,011	0,018	0,021	0,022	Three Phase	N/A
29th	0,111	0,107	0,116	0,212	0,205	0,223	Three Phase	N/A
30th	0,004	0,004	0,004	0,007	0,007	0,008	Three Phase	N/A
31th	0,109	0,100	0,098	0,210	0,193	0,189	Three Phase	N/A
32th	0,012	0,009	0,011	0,023	0,018	0,022	Three Phase	N/A
33th	0,013	0,013	0,004	0,025	0,026	0,008	Three Phase	N/A
34th	0,008	0,012	0,011	0,016	0,023	0,022	Three Phase	N/A
35th	0,077	0,071	0,081	0,147	0,136	0,155	Three Phase	N/A
36th	0,004	0,004	0,004	0,007	0,008	0,008	Three Phase	N/A
37th	0,075	0,066	0,066	0,143	0,127	0,127	Three Phase	N/A
38th	0,012	0,009	0,011	0,022	0,017	0,021	Three Phase	N/A
39th	0,012	0,010	0,004	0,022	0,019	0,007	Three Phase	N/A
40th	0,008	0,011	0,011	0,015	0,021	0,022	Three Phase	N/A
41th	0,051	0,044	0,051	0,098	0,083	0,097	Three Phase	N/A
42th	0,004	0,004	0,004	0,008	0,007	0,008	Three Phase	N/A
43th	0,047	0,040	0,042	0,091	0,077	0,080	Three Phase	N/A
44th	0,010	0,008	0,010	0,018	0,014	0,019	Three Phase	N/A
45th	0,007	0,006	0,003	0,013	0,011	0,006	Three Phase	N/A
46th	0,009	0,010	0,011	0,017	0,019	0,021	Three Phase	N/A
47th	0,034	0,027	0,029	0,065	0,051	0,056	Three Phase	N/A
48th	0,004	0,003	0,004	0,008	0,006	0,007	Three Phase	N/A
49th	0,026	0,022	0,025	0,050	0,042	0,047	Three Phase	N/A
50th	0,009	0,007	0,009	0,017	0,014	0,017	Three Phase	N/A

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

Test result: ASW40K-LT-G3

Watts [KW]	13,270	13,265	13,227
Vrms [V]	230,67	230,49	230,61
Arms [A]	57,49	57,54	57,56
Frequency [Hz]	50,00		
THD50 (100% output power)	0,674	0,671	0,668

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Phase	Harmonic Current Limits [%]
	L1	L2	L3	L1	L2	L3	--	--
1st	57,527	57,553	57,356	99,234	99,279	98,938	Three Phase	--
2nd	0,121	0,194	0,078	0,209	0,335	0,135	Three Phase	8,00
3rd	0,039	0,079	0,056	0,067	0,137	0,097	Three Phase	21,60
4th	0,097	0,084	0,082	0,167	0,146	0,141	Three Phase	4,00
5th	0,261	0,226	0,272	0,451	0,390	0,469	Three Phase	10,70
6th	0,018	0,017	0,017	0,032	0,030	0,030	Three Phase	2,67
7th	0,055	0,054	0,058	0,095	0,093	0,100	Three Phase	7,20
8th	0,067	0,069	0,064	0,116	0,118	0,110	Three Phase	2,00
9th	0,022	0,019	0,018	0,037	0,032	0,031	Three Phase	3,80
10th	0,039	0,038	0,037	0,066	0,065	0,065	Three Phase	1,60
11th	0,056	0,058	0,059	0,096	0,101	0,102	Three Phase	3,10
12th	0,015	0,014	0,014	0,026	0,024	0,024	Three Phase	1,33
13th	0,290	0,288	0,287	0,501	0,497	0,495	Three Phase	2,00
14th	0,035	0,033	0,028	0,060	0,057	0,049	Three Phase	N/A
15th	0,013	0,019	0,015	0,022	0,032	0,026	Three Phase	N/A
16th	0,028	0,027	0,028	0,048	0,046	0,049	Three Phase	N/A
17th	0,175	0,174	0,178	0,301	0,299	0,307	Three Phase	N/A
18th	0,013	0,012	0,011	0,022	0,021	0,019	Three Phase	N/A
19th	0,234	0,223	0,219	0,403	0,384	0,377	Three Phase	N/A
20th	0,027	0,027	0,024	0,046	0,047	0,042	Three Phase	N/A
21th	0,016	0,016	0,012	0,027	0,027	0,021	Three Phase	N/A
22th	0,034	0,031	0,031	0,058	0,054	0,054	Three Phase	N/A
23th	0,168	0,172	0,178	0,290	0,296	0,307	Three Phase	N/A
24th	0,013	0,012	0,011	0,023	0,021	0,019	Three Phase	N/A
25th	0,154	0,150	0,148	0,266	0,259	0,255	Three Phase	N/A
26th	0,032	0,035	0,034	0,055	0,060	0,059	Three Phase	N/A
27th	0,018	0,020	0,012	0,031	0,035	0,021	Three Phase	N/A
28th	0,032	0,032	0,031	0,055	0,056	0,054	Three Phase	N/A
29th	0,137	0,133	0,143	0,236	0,230	0,246	Three Phase	N/A
30th	0,016	0,017	0,014	0,027	0,029	0,025	Three Phase	N/A
31th	0,117	0,110	0,105	0,202	0,190	0,181	Three Phase	N/A
32th	0,036	0,035	0,042	0,062	0,060	0,073	Three Phase	N/A
33th	0,022	0,028	0,015	0,038	0,049	0,027	Three Phase	N/A
34th	0,036	0,034	0,033	0,062	0,060	0,057	Three Phase	N/A
35th	0,094	0,098	0,109	0,163	0,169	0,189	Three Phase	N/A
36th	0,021	0,024	0,019	0,037	0,042	0,033	Three Phase	N/A
37th	0,151	0,138	0,133	0,261	0,238	0,229	Three Phase	N/A
38th	0,035	0,034	0,048	0,061	0,059	0,084	Three Phase	N/A
39th	0,023	0,028	0,019	0,040	0,049	0,033	Three Phase	N/A
40th	0,049	0,043	0,040	0,085	0,075	0,069	Three Phase	N/A
41th	0,128	0,129	0,148	0,222	0,222	0,255	Three Phase	N/A
42th	0,024	0,029	0,022	0,041	0,050	0,038	Three Phase	N/A

4.8	EMC and power quality Harmonic current emission (EN 61000-3-12)							P
43th	0,105	0,101	0,094	0,181	0,174	0,162	Three Phase	N/A
44th	0,042	0,041	0,056	0,073	0,070	0,097	Three Phase	N/A
45th	0,024	0,029	0,020	0,042	0,049	0,035	Three Phase	N/A
46th	0,047	0,041	0,037	0,081	0,071	0,064	Three Phase	N/A
47th	0,067	0,075	0,083	0,116	0,129	0,143	Three Phase	N/A
48th	0,019	0,024	0,017	0,032	0,042	0,029	Three Phase	N/A
49th	0,089	0,084	0,084	0,154	0,145	0,145	Three Phase	N/A
50th	0,035	0,034	0,043	0,061	0,059	0,075	Three Phase	N/A
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: ASW25K-LT-G3

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	1,515	9,702	19,459	29,446	39,566	49,583	59,589	69,591	79,585	89,578	99,000
2	0,304	0,297	0,256	0,244	0,342	0,345	0,358	0,370	0,377	0,383	0,377
3	0,292	0,284	0,404	0,474	0,269	0,228	0,200	0,216	0,233	0,247	0,225
4	0,033	0,050	0,055	0,091	0,053	0,050	0,043	0,031	0,022	0,022	0,030
5	0,677	0,603	0,471	0,617	0,646	0,622	0,582	0,554	0,532	0,511	0,500
6	0,025	0,028	0,028	0,041	0,032	0,030	0,040	0,031	0,022	0,019	0,021
7	0,487	0,452	0,445	0,377	0,354	0,403	0,407	0,391	0,377	0,360	0,336
8	0,042	0,043	0,077	0,032	0,045	0,066	0,065	0,056	0,048	0,043	0,040
9	0,056	0,066	0,100	0,142	0,098	0,132	0,122	0,072	0,046	0,033	0,030
10	0,027	0,033	0,018	0,056	0,044	0,055	0,051	0,042	0,037	0,035	0,033
11	0,358	0,339	0,401	0,273	0,325	0,237	0,257	0,284	0,284	0,275	0,263
12	0,010	0,009	0,020	0,028	0,027	0,028	0,012	0,016	0,020	0,020	0,021
13	0,633	0,624	0,689	0,648	0,569	0,757	0,374	0,627	0,805	0,873	0,888
14	0,031	0,028	0,037	0,040	0,060	0,034	0,042	0,042	0,040	0,038	0,036
15	0,029	0,020	0,081	0,117	0,075	0,089	0,073	0,073	0,061	0,046	0,045
16	0,028	0,026	0,028	0,043	0,052	0,044	0,037	0,044	0,035	0,029	0,029
17	0,354	0,351	0,575	0,321	0,316	0,449	0,310	0,262	0,401	0,509	0,555
18	0,007	0,007	0,016	0,019	0,019	0,016	0,015	0,013	0,012	0,011	0,013
19	0,282	0,298	0,189	0,152	0,426	0,238	0,349	0,191	0,305	0,416	0,478
20	0,034	0,036	0,036	0,056	0,033	0,051	0,031	0,032	0,033	0,033	0,034
21	0,040	0,042	0,065	0,064	0,077	0,055	0,071	0,046	0,053	0,053	0,047
22	0,036	0,033	0,034	0,039	0,051	0,046	0,035	0,029	0,035	0,034	0,030
23	0,124	0,145	0,228	0,243	0,175	0,162	0,309	0,199	0,188	0,253	0,317
24	0,011	0,011	0,015	0,018	0,013	0,010	0,014	0,010	0,011	0,013	0,011
25	0,092	0,113	0,112	0,061	0,086	0,226	0,276	0,222	0,147	0,204	0,276
26	0,037	0,041	0,033	0,043	0,043	0,032	0,038	0,028	0,026	0,029	0,030
27	0,048	0,053	0,055	0,047	0,050	0,069	0,067	0,047	0,033	0,039	0,040
28	0,043	0,039	0,033	0,041	0,040	0,043	0,046	0,028	0,027	0,031	0,031
29	0,158	0,120	0,136	0,150	0,169	0,163	0,154	0,213	0,152	0,144	0,183
30	0,012	0,011	0,014	0,016	0,016	0,016	0,011	0,008	0,009	0,010	0,011
31	0,196	0,146	0,125	0,042	0,107	0,088	0,103	0,225	0,159	0,116	0,149
32	0,040	0,042	0,027	0,047	0,050	0,048	0,042	0,027	0,025	0,024	0,026
33	0,044	0,040	0,060	0,016	0,038	0,038	0,028	0,054	0,030	0,024	0,027
34	0,042	0,040	0,042	0,043	0,052	0,052	0,044	0,034	0,026	0,027	0,029
35	0,269	0,195	0,113	0,090	0,116	0,096	0,096	0,173	0,167	0,118	0,114
36	0,012	0,007	0,009	0,014	0,009	0,008	0,008	0,012	0,007	0,008	0,009
37	0,281	0,208	0,142	0,049	0,136	0,125	0,103	0,164	0,169	0,120	0,092
38	0,041	0,037	0,025	0,041	0,032	0,036	0,034	0,033	0,021	0,024	0,025
39	0,035	0,018	0,041	0,042	0,041	0,037	0,030	0,035	0,029	0,026	0,016

40	0,040	0,039	0,044	0,048	0,048	0,040	0,035	0,039	0,024	0,028	0,029
41	0,309	0,218	0,185	0,164	0,080	0,088	0,093	0,111	0,144	0,129	0,089
42	0,012	0,008	0,010	0,010	0,013	0,012	0,008	0,011	0,008	0,008	0,008
43	0,306	0,233	0,157	0,096	0,126	0,097	0,101	0,090	0,150	0,126	0,090
44	0,037	0,033	0,023	0,038	0,043	0,040	0,033	0,031	0,024	0,020	0,022
45	0,037	0,024	0,024	0,036	0,037	0,028	0,019	0,022	0,024	0,021	0,017
46	0,034	0,035	0,035	0,040	0,033	0,046	0,037	0,035	0,024	0,022	0,023
47	0,276	0,218	0,212	0,196	0,136	0,133	0,105	0,090	0,109	0,117	0,096
48	0,013	0,011	0,012	0,009	0,010	0,009	0,010	0,010	0,008	0,008	0,007
49	0,260	0,218	0,174	0,132	0,125	0,138	0,106	0,080	0,105	0,117	0,093
50	0,029	0,028	0,018	0,032	0,033	0,031	0,031	0,025	0,023	0,019	0,019
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	0,026	0,028	0,027	0,035	0,052	0,064	0,077	0,090	0,106	0,117	0,134
125	0,032	0,032	0,028	0,036	0,041	0,046	0,057	0,065	0,077	0,084	0,094
175	0,029	0,031	0,038	0,079	0,034	0,051	0,076	0,078	0,079	0,086	0,096
225	0,033	0,037	0,045	0,086	0,036	0,061	0,093	0,092	0,092	0,095	0,101
275	0,028	0,030	0,035	0,040	0,034	0,033	0,062	0,065	0,064	0,069	0,075
325	0,031	0,032	0,041	0,053	0,035	0,047	0,082	0,080	0,078	0,081	0,085
375	0,028	0,028	0,024	0,027	0,026	0,029	0,032	0,030	0,033	0,035	0,039
425	0,023	0,023	0,020	0,025	0,024	0,029	0,028	0,025	0,028	0,030	0,033
475	0,022	0,022	0,019	0,038	0,034	0,030	0,035	0,046	0,046	0,048	0,051
525	0,032	0,032	0,028	0,051	0,053	0,049	0,052	0,071	0,072	0,074	0,076
575	0,032	0,032	0,027	0,048	0,040	0,060	0,043	0,063	0,070	0,076	0,079
625	0,030	0,029	0,025	0,041	0,042	0,054	0,044	0,062	0,068	0,071	0,072
675	0,025	0,025	0,022	0,026	0,023	0,025	0,027	0,025	0,022	0,024	0,025
725	0,021	0,022	0,019	0,026	0,022	0,026	0,030	0,024	0,023	0,023	0,025
775	0,029	0,027	0,027	0,043	0,029	0,053	0,037	0,044	0,052	0,059	0,064
825	0,029	0,028	0,032	0,048	0,031	0,054	0,036	0,040	0,051	0,059	0,064
875	0,028	0,027	0,025	0,036	0,039	0,040	0,044	0,039	0,050	0,055	0,062
925	0,029	0,027	0,028	0,037	0,038	0,044	0,041	0,039	0,049	0,055	0,060
975	0,026	0,025	0,022	0,024	0,023	0,025	0,029	0,026	0,023	0,024	0,024
1025	0,022	0,021	0,019	0,022	0,022	0,024	0,032	0,026	0,023	0,024	0,023
1075	0,029	0,027	0,029	0,035	0,034	0,027	0,053	0,031	0,043	0,051	0,054
1125	0,032	0,030	0,034	0,033	0,034	0,027	0,052	0,030	0,041	0,049	0,055
1175	0,029	0,028	0,026	0,029	0,027	0,035	0,054	0,033	0,039	0,048	0,054
1225	0,031	0,029	0,029	0,032	0,028	0,034	0,052	0,031	0,039	0,047	0,052
1275	0,028	0,027	0,022	0,024	0,024	0,026	0,031	0,027	0,024	0,024	0,025
1325	0,025	0,022	0,020	0,022	0,024	0,028	0,031	0,029	0,025	0,024	0,024
1375	0,032	0,030	0,026	0,032	0,034	0,043	0,051	0,036	0,033	0,042	0,049
1425	0,036	0,033	0,029	0,034	0,034	0,042	0,048	0,037	0,031	0,040	0,047
1475	0,032	0,030	0,026	0,032	0,035	0,041	0,044	0,039	0,032	0,038	0,045
1525	0,035	0,032	0,028	0,032	0,038	0,044	0,043	0,039	0,032	0,038	0,044
1575	0,032	0,028	0,023	0,024	0,026	0,028	0,030	0,029	0,026	0,025	0,025
1625	0,038	0,037	0,033	0,033	0,036	0,039	0,040	0,042	0,039	0,039	0,037
1675	0,036	0,033	0,023	0,027	0,028	0,032	0,035	0,043	0,030	0,034	0,039
1725	0,041	0,036	0,026	0,032	0,031	0,031	0,033	0,044	0,029	0,032	0,037

1775	0,036	0,033	0,027	0,034	0,031	0,030	0,030	0,043	0,032	0,033	0,036
1825	0,038	0,034	0,028	0,036	0,032	0,031	0,032	0,044	0,033	0,033	0,036
1875	0,036	0,031	0,024	0,026	0,027	0,028	0,030	0,031	0,027	0,026	0,025
1925	0,094	0,095	0,088	0,090	0,101	0,104	0,107	0,110	0,110	0,111	0,111
1975	0,038	0,035	0,027	0,029	0,033	0,032	0,031	0,043	0,031	0,030	0,032
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	0,438	0,328	0,242	0,194	0,168	0,146	0,149	0,163	0,207	0,190	0,141
2,3	0,287	0,229	0,225	0,214	0,155	0,161	0,134	0,124	0,130	0,139	0,121
2,5	0,274	0,233	0,190	0,152	0,142	0,157	0,128	0,109	0,127	0,135	0,112
2,7	0,279	0,257	0,265	0,260	0,218	0,195	0,179	0,152	0,127	0,142	0,132
2,9	0,143	0,164	0,164	0,177	0,147	0,156	0,140	0,121	0,101	0,096	0,094
3,1	0,142	0,158	0,180	0,198	0,159	0,150	0,136	0,113	0,097	0,090	0,089
3,3	0,137	0,166	0,186	0,221	0,200	0,195	0,183	0,154	0,134	0,106	0,099
3,5	0,085	0,098	0,101	0,119	0,129	0,128	0,123	0,107	0,096	0,081	0,071
3,7	0,083	0,091	0,103	0,128	0,120	0,120	0,114	0,101	0,091	0,082	0,073
3,9	0,094	0,093	0,094	0,120	0,127	0,130	0,129	0,121	0,117	0,114	0,110
4,1	0,063	0,062	0,069	0,087	0,087	0,091	0,094	0,094	0,095	0,097	0,097
4,3	0,042	0,040	0,040	0,047	0,049	0,049	0,049	0,046	0,043	0,042	0,041
4,5	0,039	0,034	0,030	0,038	0,035	0,035	0,034	0,032	0,031	0,030	0,029
4,7	0,027	0,027	0,026	0,028	0,026	0,026	0,027	0,026	0,026	0,026	0,026
4,9	0,017	0,017	0,015	0,016	0,015	0,016	0,016	0,016	0,015	0,015	0,016
5,1	0,015	0,017	0,015	0,014	0,013	0,013	0,013	0,013	0,013	0,014	0,014
5,3	0,010	0,013	0,012	0,011	0,011	0,011	0,011	0,011	0,011	0,011	0,012
5,5	0,012	0,012	0,011	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,011
5,7	0,013	0,012	0,012	0,011	0,010	0,010	0,010	0,010	0,010	0,010	0,010
5,9	0,010	0,009	0,010	0,009	0,009	0,009	0,009	0,008	0,009	0,009	0,009
6,1	0,013	0,009	0,011	0,010	0,010	0,010	0,009	0,009	0,010	0,010	0,010
6,3	0,012	0,009	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,009
6,5	0,009	0,008	0,007	0,008	0,008	0,007	0,008	0,007	0,008	0,008	0,008
6,7	0,010	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,008
6,9	0,009	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007
7,1	0,011	0,010	0,011	0,011	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,3	0,036	0,036	0,034	0,032	0,036	0,036	0,037	0,039	0,039	0,041	0,039
7,5	0,009	0,007	0,008	0,008	0,007	0,008	0,008	0,008	0,008	0,008	0,008
7,7	0,009	0,008	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007
7,9	0,009	0,008	0,007	0,007	0,007	0,006	0,006	0,006	0,006	0,007	0,007
8,1	0,010	0,009	0,007	0,008	0,007	0,007	0,007	0,006	0,007	0,007	0,007
8,3	0,010	0,010	0,008	0,008	0,008	0,008	0,007	0,007	0,007	0,008	0,008
8,5	0,011	0,010	0,009	0,008	0,008	0,008	0,008	0,007	0,008	0,008	0,008
8,7	0,011	0,010	0,009	0,009	0,008	0,008	0,008	0,007	0,007	0,007	0,007
8,9	0,011	0,011	0,011	0,010	0,010	0,010	0,009	0,009	0,009	0,009	0,010

Note:

The normalization current is 36,232A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

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: ASW27K-LT-G3

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	1,400	9,720	19,482	29,557	39,601	49,613	59,623	69,625	79,615	89,598	99,538
2	0,251	0,246	0,225	0,244	0,290	0,296	0,310	0,318	0,324	0,331	0,335
3	0,268	0,260	0,393	0,311	0,244	0,192	0,194	0,213	0,224	0,238	0,252
4	0,034	0,047	0,036	0,049	0,048	0,041	0,025	0,023	0,021	0,021	0,023
5	0,628	0,554	0,466	0,573	0,596	0,559	0,526	0,501	0,479	0,461	0,447
6	0,024	0,022	0,019	0,034	0,015	0,021	0,021	0,020	0,022	0,024	0,026
7	0,452	0,417	0,406	0,318	0,346	0,380	0,370	0,355	0,339	0,320	0,303
8	0,038	0,034	0,072	0,019	0,044	0,058	0,048	0,042	0,039	0,037	0,038
9	0,054	0,065	0,105	0,072	0,101	0,132	0,087	0,052	0,034	0,030	0,028
10	0,028	0,032	0,018	0,039	0,034	0,047	0,040	0,034	0,029	0,029	0,032
11	0,332	0,313	0,335	0,298	0,277	0,213	0,255	0,265	0,258	0,248	0,237
12	0,009	0,007	0,019	0,029	0,016	0,019	0,012	0,013	0,014	0,013	0,014
13	0,587	0,576	0,823	0,401	0,700	0,535	0,448	0,692	0,794	0,829	0,833
14	0,031	0,028	0,042	0,050	0,045	0,033	0,042	0,033	0,033	0,033	0,032
15	0,027	0,018	0,015	0,069	0,064	0,081	0,069	0,062	0,048	0,043	0,042
16	0,028	0,025	0,024	0,037	0,045	0,029	0,036	0,030	0,026	0,025	0,024
17	0,329	0,323	0,376	0,411	0,167	0,436	0,201	0,316	0,443	0,513	0,538
18	0,005	0,005	0,009	0,012	0,012	0,012	0,011	0,011	0,008	0,009	0,011
19	0,262	0,278	0,242	0,143	0,284	0,379	0,220	0,225	0,355	0,437	0,478
20	0,031	0,030	0,045	0,042	0,027	0,040	0,031	0,032	0,029	0,028	0,030
21	0,036	0,040	0,049	0,046	0,070	0,072	0,050	0,047	0,050	0,047	0,042
22	0,031	0,031	0,031	0,030	0,033	0,044	0,026	0,028	0,027	0,025	0,026
23	0,117	0,135	0,111	0,237	0,274	0,166	0,247	0,155	0,214	0,282	0,336
24	0,006	0,006	0,006	0,009	0,012	0,011	0,008	0,009	0,010	0,008	0,009
25	0,086	0,106	0,103	0,174	0,141	0,103	0,258	0,147	0,162	0,242	0,297
26	0,034	0,034	0,043	0,047	0,049	0,041	0,027	0,026	0,028	0,027	0,027
27	0,043	0,051	0,051	0,039	0,043	0,042	0,060	0,030	0,036	0,038	0,041
28	0,037	0,036	0,031	0,046	0,045	0,037	0,028	0,024	0,024	0,025	0,026
29	0,147	0,109	0,076	0,096	0,119	0,131	0,207	0,172	0,125	0,160	0,201
30	0,007	0,008	0,008	0,009	0,008	0,009	0,009	0,008	0,007	0,010	0,009
31	0,181	0,131	0,088	0,111	0,162	0,148	0,189	0,173	0,110	0,124	0,177
32	0,039	0,037	0,037	0,035	0,031	0,034	0,033	0,023	0,024	0,026	0,028
33	0,040	0,038	0,042	0,039	0,054	0,048	0,048	0,033	0,023	0,025	0,029
34	0,036	0,037	0,029	0,050	0,043	0,038	0,035	0,023	0,024	0,024	0,027
35	0,249	0,174	0,054	0,097	0,047	0,077	0,117	0,161	0,127	0,100	0,123
36	0,007	0,007	0,008	0,010	0,011	0,012	0,008	0,006	0,008	0,007	0,008
37	0,261	0,185	0,127	0,119	0,075	0,064	0,084	0,171	0,128	0,085	0,098
38	0,037	0,034	0,030	0,032	0,043	0,042	0,037	0,023	0,022	0,023	0,025
39	0,033	0,015	0,030	0,034	0,037	0,024	0,022	0,035	0,024	0,017	0,016

40	0,035	0,036	0,028	0,042	0,036	0,040	0,036	0,024	0,025	0,024	0,026
41	0,286	0,193	0,135	0,102	0,108	0,100	0,084	0,130	0,130	0,094	0,079
42	0,008	0,007	0,007	0,007	0,009	0,008	0,007	0,007	0,007	0,008	0,007
43	0,284	0,208	0,170	0,138	0,103	0,108	0,079	0,126	0,128	0,094	0,066
44	0,032	0,030	0,024	0,033	0,035	0,033	0,029	0,024	0,020	0,021	0,022
45	0,033	0,020	0,022	0,031	0,026	0,029	0,024	0,022	0,021	0,020	0,012
46	0,029	0,030	0,024	0,028	0,042	0,033	0,028	0,028	0,018	0,022	0,022
47	0,256	0,195	0,173	0,120	0,120	0,105	0,095	0,093	0,110	0,101	0,074
48	0,010	0,007	0,008	0,008	0,010	0,008	0,008	0,008	0,008	0,008	0,007
49	0,242	0,199	0,160	0,129	0,132	0,111	0,096	0,081	0,111	0,096	0,070
50	0,025	0,024	0,017	0,035	0,029	0,032	0,025	0,022	0,019	0,018	0,019
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	0,024	0,026	0,029	0,049	0,051	0,064	0,075	0,088	0,098	0,111	0,131
125	0,029	0,030	0,030	0,046	0,038	0,045	0,059	0,070	0,076	0,086	0,100
175	0,026	0,030	0,035	0,047	0,033	0,060	0,074	0,076	0,079	0,087	0,094
225	0,031	0,035	0,042	0,052	0,036	0,073	0,087	0,085	0,087	0,093	0,097
275	0,026	0,028	0,037	0,028	0,029	0,044	0,061	0,060	0,063	0,069	0,074
325	0,029	0,030	0,044	0,031	0,030	0,062	0,077	0,073	0,074	0,081	0,086
375	0,026	0,026	0,024	0,032	0,025	0,030	0,029	0,030	0,032	0,035	0,041
425	0,021	0,022	0,021	0,030	0,024	0,028	0,025	0,025	0,028	0,031	0,036
475	0,020	0,020	0,020	0,032	0,033	0,023	0,039	0,042	0,044	0,047	0,051
525	0,030	0,030	0,029	0,056	0,052	0,036	0,060	0,067	0,067	0,071	0,073
575	0,029	0,029	0,026	0,040	0,048	0,047	0,049	0,062	0,069	0,074	0,075
625	0,029	0,027	0,027	0,034	0,046	0,041	0,051	0,062	0,064	0,068	0,068
675	0,022	0,023	0,021	0,021	0,022	0,024	0,024	0,021	0,023	0,024	0,025
725	0,020	0,020	0,021	0,020	0,021	0,028	0,025	0,021	0,022	0,023	0,025
775	0,026	0,025	0,028	0,035	0,024	0,053	0,034	0,045	0,052	0,060	0,061
825	0,027	0,026	0,031	0,035	0,025	0,051	0,032	0,043	0,051	0,058	0,061
875	0,026	0,025	0,031	0,024	0,031	0,055	0,031	0,043	0,050	0,057	0,061
925	0,027	0,025	0,034	0,027	0,028	0,053	0,031	0,043	0,048	0,056	0,059
975	0,023	0,024	0,021	0,020	0,021	0,026	0,024	0,021	0,022	0,023	0,022
1025	0,020	0,020	0,020	0,019	0,022	0,026	0,026	0,022	0,021	0,022	0,021
1075	0,027	0,025	0,028	0,030	0,039	0,041	0,035	0,035	0,046	0,051	0,053
1125	0,029	0,028	0,030	0,031	0,037	0,042	0,034	0,033	0,043	0,049	0,054
1175	0,027	0,026	0,027	0,030	0,032	0,032	0,040	0,031	0,042	0,049	0,053
1225	0,029	0,027	0,029	0,032	0,035	0,034	0,038	0,031	0,041	0,048	0,052
1275	0,026	0,025	0,020	0,023	0,023	0,026	0,027	0,024	0,023	0,023	0,022
1325	0,023	0,021	0,019	0,020	0,022	0,026	0,029	0,025	0,022	0,022	0,022
1375	0,029	0,027	0,025	0,026	0,025	0,026	0,045	0,029	0,036	0,045	0,049
1425	0,033	0,030	0,026	0,027	0,027	0,028	0,044	0,026	0,034	0,042	0,048
1475	0,030	0,028	0,023	0,031	0,032	0,033	0,045	0,030	0,033	0,041	0,048
1525	0,033	0,030	0,025	0,031	0,031	0,032	0,045	0,029	0,033	0,040	0,046
1575	0,029	0,027	0,021	0,023	0,025	0,027	0,029	0,026	0,023	0,024	0,022
1625	0,033	0,032	0,028	0,030	0,034	0,037	0,041	0,039	0,036	0,036	0,035
1675	0,033	0,030	0,024	0,027	0,033	0,035	0,045	0,031	0,030	0,036	0,041
1725	0,038	0,033	0,025	0,028	0,033	0,035	0,043	0,031	0,028	0,034	0,040

1775	0,034	0,031	0,024	0,028	0,030	0,037	0,041	0,033	0,030	0,033	0,039
1825	0,037	0,031	0,025	0,029	0,032	0,037	0,039	0,033	0,029	0,034	0,039
1875	0,033	0,029	0,023	0,024	0,026	0,028	0,028	0,027	0,024	0,025	0,023
1925	0,090	0,091	0,082	0,088	0,098	0,095	0,101	0,100	0,101	0,098	0,097
1975	0,035	0,032	0,027	0,028	0,028	0,031	0,036	0,033	0,028	0,031	0,034
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	0,406	0,292	0,209	0,177	0,161	0,150	0,129	0,186	0,186	0,146	0,123
2,3	0,266	0,206	0,184	0,139	0,145	0,128	0,120	0,116	0,129	0,124	0,100
2,5	0,254	0,212	0,169	0,148	0,148	0,129	0,116	0,102	0,127	0,115	0,092
2,7	0,258	0,236	0,214	0,210	0,181	0,186	0,148	0,121	0,128	0,129	0,117
2,9	0,131	0,153	0,152	0,161	0,146	0,140	0,118	0,105	0,088	0,092	0,090
3,1	0,132	0,148	0,136	0,158	0,136	0,134	0,114	0,097	0,080	0,089	0,085
3,3	0,127	0,157	0,164	0,190	0,179	0,181	0,155	0,130	0,103	0,097	0,096
3,5	0,078	0,092	0,099	0,116	0,116	0,118	0,105	0,092	0,082	0,070	0,068
3,7	0,077	0,086	0,083	0,111	0,110	0,111	0,100	0,089	0,079	0,071	0,069
3,9	0,087	0,088	0,086	0,118	0,120	0,126	0,119	0,113	0,104	0,095	0,093
4,1	0,060	0,059	0,063	0,081	0,082	0,087	0,088	0,089	0,095	0,103	0,107
4,3	0,039	0,038	0,035	0,045	0,046	0,047	0,044	0,042	0,041	0,041	0,040
4,5	0,036	0,032	0,028	0,034	0,032	0,032	0,031	0,030	0,028	0,028	0,027
4,7	0,025	0,025	0,023	0,024	0,024	0,025	0,025	0,024	0,024	0,025	0,026
4,9	0,016	0,016	0,013	0,015	0,014	0,015	0,014	0,014	0,015	0,015	0,016
5,1	0,014	0,016	0,012	0,013	0,012	0,012	0,012	0,013	0,013	0,013	0,014
5,3	0,009	0,012	0,010	0,010	0,010	0,010	0,010	0,011	0,011	0,011	0,012
5,5	0,011	0,011	0,010	0,010	0,009	0,009	0,009	0,010	0,010	0,010	0,011
5,7	0,012	0,012	0,010	0,010	0,009	0,009	0,009	0,010	0,010	0,010	0,011
5,9	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,009	0,009	0,010
6,1	0,012	0,009	0,009	0,009	0,009	0,009	0,009	0,009	0,009	0,010	0,010
6,3	0,011	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,009
6,5	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,009
6,7	0,010	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,008
6,9	0,008	0,007	0,007	0,007	0,007	0,007	0,006	0,007	0,007	0,007	0,008
7,1	0,010	0,010	0,010	0,010	0,009	0,009	0,009	0,009	0,009	0,009	0,010
7,3	0,033	0,035	0,031	0,032	0,036	0,035	0,034	0,034	0,036	0,037	0,036
7,5	0,009	0,007	0,008	0,007	0,007	0,007	0,008	0,007	0,008	0,008	0,008
7,7	0,009	0,007	0,008	0,007	0,006	0,006	0,006	0,006	0,007	0,007	0,007
7,9	0,008	0,007	0,008	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,007
8,1	0,010	0,008	0,007	0,007	0,007	0,006	0,006	0,006	0,007	0,007	0,007
8,3	0,010	0,009	0,009	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008
8,5	0,010	0,009	0,008	0,008	0,008	0,007	0,007	0,007	0,007	0,008	0,008
8,7	0,010	0,010	0,008	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,008
8,9	0,010	0,010	0,010	0,009	0,009	0,009	0,009	0,009	0,009	0,009	0,010

Note:

The normalization current is 39,130A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

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: ASW30K-LT-G3

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	1,251	9,742	19,528	29,621	39,647	49,665	59,660	69,657	79,635	89,609	99,512
2	0,199	0,196	0,165	0,237	0,246	0,255	0,266	0,271	0,278	0,281	0,285
3	0,243	0,229	0,376	0,246	0,208	0,167	0,185	0,197	0,206	0,217	0,224
4	0,031	0,052	0,039	0,040	0,044	0,034	0,022	0,018	0,019	0,022	0,024
5	0,570	0,492	0,476	0,532	0,525	0,486	0,459	0,436	0,418	0,400	0,385
6	0,013	0,020	0,022	0,020	0,018	0,037	0,031	0,028	0,025	0,024	0,022
7	0,409	0,373	0,368	0,284	0,330	0,339	0,324	0,309	0,290	0,272	0,252
8	0,036	0,033	0,055	0,031	0,052	0,050	0,042	0,039	0,040	0,043	0,043
9	0,048	0,061	0,113	0,074	0,105	0,099	0,055	0,033	0,027	0,025	0,028
10	0,022	0,028	0,031	0,039	0,037	0,039	0,031	0,029	0,028	0,030	0,028
11	0,300	0,281	0,207	0,281	0,211	0,214	0,237	0,234	0,224	0,213	0,199
12	0,008	0,008	0,019	0,016	0,021	0,012	0,018	0,017	0,018	0,020	0,019
13	0,530	0,510	0,768	0,246	0,677	0,314	0,567	0,705	0,748	0,762	0,757
14	0,025	0,025	0,041	0,044	0,032	0,039	0,032	0,028	0,027	0,027	0,025
15	0,023	0,016	0,074	0,053	0,072	0,061	0,059	0,045	0,038	0,039	0,035
16	0,025	0,022	0,043	0,032	0,037	0,031	0,031	0,025	0,023	0,023	0,023
17	0,297	0,284	0,337	0,390	0,304	0,258	0,244	0,381	0,460	0,492	0,493
18	0,005	0,007	0,009	0,016	0,012	0,009	0,010	0,013	0,013	0,014	0,013
19	0,238	0,254	0,191	0,307	0,139	0,289	0,174	0,300	0,391	0,437	0,452
20	0,027	0,030	0,033	0,043	0,040	0,028	0,029	0,025	0,025	0,027	0,026
21	0,033	0,038	0,058	0,045	0,047	0,060	0,039	0,045	0,043	0,039	0,037
22	0,032	0,032	0,041	0,041	0,038	0,028	0,024	0,027	0,026	0,024	0,023
23	0,107	0,118	0,155	0,114	0,196	0,258	0,143	0,181	0,251	0,307	0,338
24	0,009	0,010	0,014	0,008	0,012	0,017	0,006	0,009	0,011	0,013	0,011
25	0,083	0,096	0,108	0,203	0,229	0,232	0,164	0,137	0,214	0,272	0,311
26	0,032	0,032	0,039	0,026	0,028	0,032	0,023	0,023	0,023	0,026	0,026
27	0,040	0,049	0,019	0,055	0,061	0,057	0,033	0,031	0,033	0,038	0,037
28	0,036	0,037	0,028	0,039	0,037	0,034	0,023	0,021	0,025	0,026	0,026
29	0,138	0,094	0,038	0,051	0,092	0,130	0,173	0,112	0,143	0,184	0,225
30	0,011	0,010	0,010	0,007	0,012	0,013	0,008	0,007	0,009	0,011	0,010
31	0,169	0,112	0,091	0,082	0,034	0,087	0,179	0,109	0,109	0,162	0,205
32	0,036	0,033	0,043	0,036	0,041	0,037	0,026	0,020	0,022	0,024	0,026
33	0,037	0,034	0,015	0,038	0,036	0,024	0,039	0,022	0,021	0,026	0,030
34	0,037	0,036	0,025	0,031	0,037	0,036	0,024	0,022	0,021	0,026	0,026
35	0,230	0,147	0,112	0,049	0,095	0,080	0,151	0,124	0,090	0,112	0,141
36	0,011	0,008	0,009	0,011	0,007	0,007	0,008	0,006	0,008	0,009	0,010
37	0,240	0,155	0,038	0,058	0,102	0,085	0,150	0,123	0,078	0,090	0,129
38	0,033	0,029	0,044	0,039	0,028	0,031	0,025	0,021	0,019	0,023	0,023

39	0,031	0,012	0,023	0,028	0,036	0,026	0,033	0,022	0,015	0,015	0,019
40	0,036	0,034	0,027	0,037	0,035	0,031	0,025	0,021	0,022	0,024	0,026
41	0,263	0,160	0,171	0,106	0,067	0,078	0,100	0,119	0,087	0,072	0,091
42	0,009	0,007	0,007	0,006	0,011	0,007	0,010	0,006	0,008	0,008	0,008
43	0,260	0,178	0,089	0,096	0,091	0,084	0,090	0,121	0,086	0,060	0,075
44	0,029	0,026	0,036	0,028	0,035	0,028	0,027	0,018	0,019	0,021	0,022
45	0,030	0,018	0,036	0,025	0,027	0,017	0,021	0,020	0,018	0,010	0,012
46	0,030	0,029	0,023	0,037	0,033	0,028	0,027	0,018	0,020	0,020	0,022
47	0,234	0,170	0,182	0,129	0,112	0,087	0,073	0,099	0,093	0,066	0,059
48	0,008	0,008	0,007	0,007	0,006	0,009	0,009	0,007	0,006	0,008	0,008
49	0,221	0,175	0,120	0,123	0,109	0,089	0,067	0,099	0,088	0,064	0,050
50	0,024	0,022	0,031	0,025	0,024	0,025	0,021	0,019	0,017	0,017	0,018
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	0,022	0,024	0,027	0,041	0,051	0,062	0,074	0,086	0,100	0,118	0,130
125	0,027	0,027	0,026	0,032	0,036	0,047	0,058	0,066	0,078	0,087	0,099
175	0,024	0,027	0,029	0,026	0,038	0,063	0,066	0,069	0,078	0,084	0,089
225	0,028	0,033	0,033	0,029	0,044	0,078	0,078	0,077	0,083	0,088	0,089
275	0,023	0,026	0,033	0,030	0,026	0,052	0,053	0,055	0,061	0,067	0,070
325	0,026	0,027	0,038	0,033	0,033	0,069	0,067	0,066	0,072	0,077	0,077
375	0,023	0,023	0,021	0,022	0,023	0,027	0,026	0,028	0,031	0,036	0,039
425	0,019	0,020	0,019	0,019	0,023	0,024	0,021	0,023	0,027	0,031	0,035
475	0,018	0,019	0,026	0,024	0,027	0,030	0,038	0,038	0,042	0,046	0,047
525	0,027	0,026	0,041	0,037	0,044	0,044	0,060	0,060	0,063	0,068	0,065
575	0,026	0,026	0,030	0,025	0,050	0,036	0,054	0,061	0,067	0,068	0,066
625	0,025	0,023	0,033	0,027	0,046	0,037	0,054	0,057	0,061	0,062	0,060
675	0,021	0,021	0,019	0,018	0,020	0,023	0,019	0,020	0,021	0,022	0,024
725	0,018	0,019	0,018	0,018	0,019	0,025	0,019	0,019	0,020	0,023	0,024
775	0,024	0,022	0,023	0,031	0,037	0,031	0,039	0,046	0,053	0,056	0,055
825	0,024	0,023	0,024	0,031	0,037	0,030	0,036	0,045	0,053	0,056	0,053
875	0,023	0,023	0,027	0,030	0,025	0,036	0,035	0,044	0,051	0,056	0,056
925	0,024	0,023	0,024	0,031	0,028	0,034	0,036	0,042	0,050	0,054	0,053
975	0,022	0,021	0,019	0,019	0,020	0,024	0,020	0,019	0,020	0,020	0,020
1025	0,019	0,018	0,018	0,017	0,020	0,026	0,021	0,019	0,019	0,020	0,020
1075	0,024	0,022	0,029	0,021	0,027	0,044	0,028	0,039	0,045	0,048	0,049
1125	0,026	0,025	0,030	0,023	0,027	0,044	0,025	0,037	0,044	0,049	0,050
1175	0,024	0,023	0,022	0,027	0,035	0,045	0,026	0,036	0,044	0,049	0,050
1225	0,026	0,024	0,023	0,027	0,034	0,044	0,026	0,035	0,042	0,047	0,049
1275	0,024	0,022	0,019	0,019	0,022	0,026	0,022	0,020	0,020	0,020	0,019
1325	0,021	0,019	0,018	0,018	0,021	0,026	0,023	0,020	0,020	0,020	0,019
1375	0,027	0,025	0,027	0,027	0,034	0,043	0,028	0,030	0,039	0,044	0,046
1425	0,031	0,027	0,030	0,026	0,033	0,040	0,027	0,029	0,037	0,044	0,046
1475	0,027	0,025	0,023	0,023	0,028	0,037	0,029	0,028	0,036	0,044	0,046
1525	0,030	0,026	0,022	0,024	0,031	0,036	0,029	0,029	0,036	0,043	0,046
1575	0,028	0,024	0,021	0,020	0,022	0,025	0,024	0,020	0,021	0,021	0,019
1625	0,032	0,030	0,027	0,029	0,032	0,035	0,035	0,032	0,031	0,031	0,029
1675	0,031	0,027	0,025	0,026	0,023	0,029	0,032	0,026	0,031	0,038	0,042

1725	0,035	0,029	0,030	0,028	0,026	0,027	0,032	0,024	0,029	0,037	0,042
1775	0,030	0,028	0,024	0,027	0,028	0,025	0,033	0,026	0,030	0,036	0,041
1825	0,032	0,027	0,023	0,028	0,028	0,027	0,033	0,026	0,030	0,036	0,041
1875	0,031	0,026	0,023	0,022	0,024	0,025	0,025	0,023	0,022	0,022	0,020
1925	0,079	0,076	0,071	0,080	0,084	0,085	0,086	0,086	0,084	0,083	0,082
1975	0,032	0,029	0,027	0,024	0,030	0,026	0,033	0,025	0,026	0,031	0,036
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	0,372	0,247	0,202	0,153	0,129	0,124	0,150	0,171	0,133	0,114	0,139
2,3	0,243	0,180	0,192	0,147	0,130	0,112	0,100	0,114	0,112	0,090	0,084
2,5	0,232	0,188	0,141	0,137	0,122	0,105	0,086	0,114	0,105	0,087	0,077
2,7	0,235	0,215	0,221	0,182	0,169	0,148	0,120	0,113	0,117	0,108	0,087
2,9	0,121	0,143	0,174	0,133	0,130	0,116	0,099	0,079	0,083	0,083	0,073
3,1	0,119	0,136	0,147	0,132	0,121	0,111	0,090	0,073	0,079	0,080	0,069
3,3	0,116	0,146	0,182	0,168	0,163	0,151	0,123	0,098	0,086	0,088	0,084
3,5	0,072	0,085	0,110	0,108	0,105	0,102	0,086	0,078	0,063	0,063	0,061
3,7	0,071	0,079	0,088	0,099	0,098	0,095	0,082	0,072	0,064	0,064	0,063
3,9	0,080	0,081	0,094	0,108	0,109	0,108	0,100	0,095	0,083	0,083	0,086
4,1	0,055	0,055	0,067	0,075	0,080	0,085	0,085	0,083	0,093	0,098	0,104
4,3	0,036	0,035	0,036	0,042	0,042	0,042	0,039	0,036	0,036	0,036	0,037
4,5	0,033	0,028	0,031	0,030	0,029	0,029	0,027	0,025	0,025	0,024	0,026
4,7	0,023	0,023	0,023	0,022	0,022	0,022	0,022	0,022	0,022	0,022	0,024
4,9	0,014	0,014	0,013	0,013	0,013	0,013	0,013	0,012	0,013	0,014	0,016
5,1	0,013	0,014	0,013	0,011	0,011	0,011	0,011	0,011	0,012	0,012	0,014
5,3	0,008	0,011	0,011	0,009	0,009	0,009	0,009	0,009	0,010	0,011	0,012
5,5	0,010	0,010	0,010	0,008	0,008	0,008	0,008	0,009	0,009	0,010	0,011
5,7	0,011	0,010	0,011	0,009	0,008	0,008	0,008	0,008	0,009	0,009	0,011
5,9	0,008	0,008	0,009	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,010
6,1	0,011	0,008	0,010	0,008	0,008	0,008	0,008	0,008	0,009	0,009	0,010
6,3	0,010	0,007	0,009	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,009
6,5	0,007	0,006	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,008
6,7	0,009	0,006	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,008
6,9	0,007	0,007	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,008
7,1	0,009	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,009	0,010
7,3	0,029	0,031	0,028	0,028	0,030	0,032	0,030	0,033	0,031	0,032	0,034
7,5	0,008	0,006	0,007	0,006	0,006	0,007	0,006	0,007	0,007	0,007	0,008
7,7	0,008	0,006	0,006	0,006	0,005	0,006	0,006	0,006	0,006	0,006	0,007
7,9	0,008	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,006	0,006	0,007
8,1	0,009	0,007	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007
8,3	0,009	0,008	0,007	0,007	0,006	0,006	0,006	0,006	0,007	0,007	0,008
8,5	0,009	0,008	0,007	0,007	0,007	0,006	0,006	0,006	0,007	0,007	0,008
8,7	0,009	0,009	0,008	0,007	0,007	0,006	0,006	0,006	0,006	0,007	0,007
8,9	0,009	0,009	0,010	0,008	0,008	0,008	0,008	0,008	0,008	0,009	0,009

Note:

The normalization current is 43,478A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

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: ASW33K-LT-G3

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	1,151	9,763	19,564	29,667	39,687	49,687	59,681	69,658	79,613	89,554	99,422
2	0,236	0,219	0,195	0,283	0,294	0,310	0,320	0,332	0,340	0,349	0,357
3	0,219	0,201	0,338	0,208	0,163	0,162	0,177	0,188	0,202	0,211	0,218
4	0,027	0,059	0,047	0,034	0,038	0,034	0,020	0,019	0,021	0,022	0,025
5	0,512	0,438	0,459	0,491	0,463	0,428	0,405	0,386	0,366	0,346	0,339
6	0,017	0,026	0,034	0,019	0,028	0,034	0,033	0,031	0,028	0,027	0,025
7	0,368	0,334	0,321	0,270	0,310	0,302	0,287	0,270	0,252	0,235	0,210
8	0,031	0,029	0,033	0,031	0,052	0,043	0,039	0,038	0,041	0,042	0,042
9	0,043	0,068	0,055	0,074	0,106	0,064	0,036	0,024	0,022	0,025	0,027
10	0,021	0,028	0,045	0,033	0,040	0,029	0,028	0,028	0,028	0,029	0,030
11	0,272	0,252	0,162	0,248	0,173	0,210	0,215	0,206	0,197	0,186	0,175
12	0,008	0,010	0,021	0,019	0,012	0,019	0,020	0,019	0,021	0,020	0,020
13	0,477	0,450	0,492	0,408	0,485	0,386	0,601	0,666	0,684	0,692	0,690
14	0,023	0,024	0,025	0,046	0,031	0,032	0,029	0,027	0,027	0,025	0,024
15	0,021	0,020	0,061	0,057	0,068	0,054	0,046	0,034	0,035	0,033	0,029
16	0,023	0,020	0,051	0,038	0,029	0,028	0,025	0,023	0,022	0,024	0,024
17	0,268	0,234	0,221	0,252	0,368	0,168	0,294	0,397	0,438	0,448	0,442
18	0,006	0,008	0,023	0,013	0,018	0,005	0,013	0,015	0,015	0,015	0,015
19	0,213	0,240	0,217	0,326	0,284	0,163	0,221	0,329	0,384	0,408	0,410
20	0,023	0,028	0,032	0,025	0,036	0,026	0,024	0,025	0,026	0,026	0,025
21	0,029	0,040	0,068	0,057	0,053	0,038	0,040	0,039	0,035	0,034	0,033
22	0,028	0,029	0,034	0,033	0,032	0,026	0,022	0,023	0,024	0,024	0,024
23	0,096	0,100	0,136	0,116	0,112	0,192	0,137	0,201	0,263	0,300	0,316
24	0,009	0,012	0,017	0,009	0,006	0,009	0,007	0,011	0,014	0,013	0,014
25	0,070	0,090	0,146	0,078	0,102	0,201	0,109	0,168	0,230	0,273	0,297
26	0,028	0,030	0,036	0,035	0,033	0,029	0,021	0,022	0,024	0,026	0,026
27	0,036	0,052	0,066	0,041	0,036	0,047	0,024	0,029	0,034	0,034	0,032
28	0,032	0,035	0,033	0,030	0,033	0,027	0,020	0,020	0,023	0,025	0,026
29	0,119	0,077	0,042	0,125	0,116	0,172	0,119	0,114	0,151	0,191	0,221
30	0,012	0,010	0,008	0,011	0,010	0,012	0,005	0,008	0,011	0,013	0,011
31	0,147	0,100	0,030	0,069	0,122	0,162	0,125	0,088	0,130	0,173	0,205
32	0,031	0,030	0,035	0,038	0,028	0,026	0,022	0,020	0,023	0,025	0,027
33	0,034	0,033	0,034	0,025	0,041	0,042	0,023	0,018	0,022	0,027	0,029
34	0,033	0,034	0,022	0,037	0,032	0,025	0,023	0,018	0,021	0,024	0,025
35	0,202	0,124	0,085	0,089	0,052	0,102	0,129	0,080	0,091	0,116	0,144
36	0,011	0,007	0,009	0,007	0,010	0,012	0,009	0,008	0,009	0,011	0,012
37	0,211	0,125	0,088	0,098	0,051	0,080	0,132	0,082	0,070	0,100	0,133
38	0,030	0,026	0,032	0,024	0,035	0,030	0,022	0,018	0,021	0,023	0,025

39	0,028	0,009	0,028	0,031	0,023	0,022	0,024	0,017	0,013	0,017	0,019
40	0,032	0,030	0,018	0,031	0,033	0,029	0,020	0,020	0,019	0,022	0,024
41	0,232	0,131	0,105	0,068	0,086	0,064	0,110	0,092	0,060	0,070	0,091
42	0,008	0,006	0,007	0,010	0,006	0,009	0,006	0,005	0,008	0,009	0,011
43	0,230	0,148	0,096	0,098	0,090	0,059	0,112	0,089	0,056	0,057	0,075
44	0,025	0,023	0,037	0,034	0,027	0,026	0,020	0,019	0,018	0,021	0,023
45	0,027	0,016	0,018	0,030	0,022	0,018	0,018	0,016	0,010	0,010	0,014
46	0,026	0,025	0,023	0,027	0,027	0,024	0,020	0,017	0,018	0,019	0,020
47	0,208	0,145	0,126	0,093	0,083	0,077	0,080	0,087	0,067	0,048	0,056
48	0,007	0,007	0,006	0,007	0,008	0,008	0,009	0,005	0,007	0,008	0,010
49	0,196	0,158	0,097	0,091	0,090	0,077	0,075	0,086	0,064	0,046	0,045
50	0,021	0,020	0,034	0,024	0,024	0,022	0,019	0,015	0,016	0,018	0,019
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	0,020	0,021	0,025	0,040	0,051	0,065	0,077	0,090	0,103	0,111	0,129
125	0,025	0,025	0,026	0,031	0,036	0,047	0,055	0,064	0,076	0,083	0,091
175	0,021	0,025	0,031	0,024	0,046	0,059	0,059	0,066	0,076	0,077	0,083
225	0,025	0,031	0,040	0,026	0,056	0,071	0,069	0,072	0,079	0,082	0,081
275	0,021	0,023	0,024	0,025	0,033	0,049	0,048	0,052	0,057	0,060	0,061
325	0,024	0,024	0,027	0,026	0,046	0,062	0,058	0,062	0,067	0,068	0,068
375	0,022	0,020	0,020	0,019	0,024	0,023	0,024	0,026	0,029	0,030	0,033
425	0,018	0,017	0,018	0,018	0,022	0,020	0,020	0,022	0,025	0,027	0,029
475	0,016	0,017	0,024	0,024	0,020	0,032	0,034	0,036	0,040	0,041	0,042
525	0,024	0,024	0,036	0,039	0,031	0,050	0,054	0,056	0,059	0,061	0,060
575	0,023	0,023	0,028	0,029	0,041	0,042	0,052	0,057	0,061	0,060	0,058
625	0,023	0,021	0,030	0,030	0,036	0,043	0,051	0,053	0,055	0,055	0,053
675	0,019	0,018	0,016	0,016	0,019	0,019	0,017	0,018	0,018	0,019	0,020
725	0,017	0,016	0,016	0,016	0,021	0,019	0,016	0,017	0,018	0,019	0,021
775	0,022	0,020	0,028	0,023	0,045	0,029	0,039	0,046	0,050	0,050	0,049
825	0,022	0,021	0,031	0,023	0,043	0,026	0,037	0,045	0,050	0,049	0,047
875	0,021	0,020	0,026	0,029	0,043	0,025	0,037	0,043	0,049	0,051	0,050
925	0,022	0,021	0,027	0,029	0,042	0,026	0,036	0,042	0,048	0,048	0,047
975	0,019	0,019	0,016	0,017	0,021	0,020	0,017	0,018	0,017	0,017	0,018
1025	0,017	0,016	0,016	0,016	0,019	0,021	0,017	0,017	0,017	0,017	0,018
1075	0,022	0,021	0,026	0,024	0,028	0,026	0,032	0,039	0,043	0,046	0,046
1125	0,023	0,023	0,030	0,025	0,028	0,025	0,030	0,037	0,043	0,046	0,046
1175	0,022	0,021	0,030	0,020	0,022	0,030	0,028	0,037	0,043	0,046	0,047
1225	0,023	0,023	0,026	0,021	0,023	0,029	0,029	0,036	0,042	0,045	0,046
1275	0,022	0,019	0,017	0,017	0,021	0,022	0,019	0,019	0,018	0,018	0,019
1325	0,019	0,016	0,017	0,017	0,021	0,023	0,019	0,018	0,018	0,017	0,018
1375	0,024	0,023	0,023	0,026	0,025	0,035	0,025	0,033	0,039	0,043	0,044
1425	0,026	0,025	0,025	0,026	0,026	0,035	0,022	0,031	0,038	0,042	0,043
1475	0,024	0,022	0,020	0,026	0,030	0,036	0,024	0,030	0,037	0,042	0,044
1525	0,026	0,024	0,020	0,028	0,030	0,035	0,024	0,030	0,037	0,042	0,044
1575	0,024	0,020	0,019	0,019	0,022	0,023	0,020	0,019	0,019	0,019	0,020
1625	0,032	0,028	0,028	0,028	0,032	0,033	0,034	0,032	0,030	0,030	0,032
1675	0,027	0,024	0,023	0,021	0,031	0,037	0,023	0,026	0,033	0,039	0,041

1725	0,030	0,026	0,026	0,023	0,029	0,036	0,022	0,024	0,031	0,038	0,040
1775	0,027	0,024	0,023	0,023	0,029	0,034	0,025	0,025	0,031	0,037	0,042
1825	0,029	0,025	0,023	0,023	0,029	0,034	0,025	0,026	0,031	0,038	0,042
1875	0,027	0,022	0,021	0,019	0,022	0,023	0,021	0,020	0,020	0,021	0,021
1925	0,068	0,063	0,062	0,068	0,074	0,073	0,077	0,076	0,074	0,073	0,077
1975	0,029	0,025	0,025	0,024	0,024	0,031	0,024	0,023	0,027	0,033	0,037
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	0,329	0,205	0,155	0,131	0,127	0,105	0,157	0,136	0,100	0,113	0,142
2,3	0,216	0,154	0,141	0,109	0,107	0,098	0,099	0,106	0,088	0,076	0,087
2,5	0,206	0,169	0,118	0,105	0,107	0,094	0,093	0,100	0,084	0,074	0,077
2,7	0,210	0,199	0,200	0,166	0,153	0,121	0,095	0,107	0,104	0,087	0,081
2,9	0,107	0,136	0,159	0,112	0,113	0,094	0,078	0,073	0,075	0,073	0,065
3,1	0,107	0,126	0,152	0,119	0,111	0,090	0,074	0,069	0,073	0,071	0,064
3,3	0,104	0,137	0,179	0,149	0,149	0,125	0,103	0,080	0,081	0,082	0,077
3,5	0,064	0,079	0,096	0,098	0,097	0,086	0,074	0,059	0,057	0,058	0,057
3,7	0,062	0,073	0,096	0,090	0,090	0,080	0,069	0,060	0,057	0,060	0,060
3,9	0,070	0,073	0,088	0,093	0,099	0,092	0,085	0,081	0,074	0,073	0,073
4,1	0,049	0,052	0,065	0,072	0,076	0,077	0,077	0,077	0,080	0,088	0,092
4,3	0,034	0,033	0,036	0,037	0,039	0,037	0,034	0,033	0,032	0,033	0,034
4,5	0,029	0,026	0,029	0,027	0,027	0,026	0,024	0,023	0,022	0,021	0,022
4,7	0,021	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
4,9	0,013	0,012	0,012	0,012	0,012	0,012	0,012	0,011	0,012	0,012	0,011
5,1	0,012	0,012	0,011	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
5,3	0,007	0,010	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,009	0,009
5,5	0,009	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008
5,7	0,010	0,010	0,010	0,008	0,008	0,007	0,007	0,008	0,008	0,008	0,008
5,9	0,008	0,007	0,008	0,007	0,007	0,006	0,006	0,006	0,006	0,007	0,007
6,1	0,010	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007
6,3	0,009	0,006	0,008	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006
6,5	0,007	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006
6,7	0,008	0,005	0,006	0,005	0,006	0,005	0,005	0,005	0,005	0,006	0,006
6,9	0,007	0,006	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006
7,1	0,008	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008
7,3	0,028	0,025	0,023	0,025	0,025	0,027	0,029	0,029	0,028	0,029	0,032
7,5	0,007	0,006	0,006	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,007
7,7	0,007	0,005	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
7,9	0,007	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
8,1	0,008	0,006	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
8,3	0,008	0,007	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,005	0,005
8,5	0,008	0,007	0,006	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,005
8,7	0,008	0,008	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,005	0,005
8,9	0,008	0,009	0,008	0,007	0,008	0,007	0,007	0,007	0,007	0,007	0,007

Note:

The normalization current is 47,826A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

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: ASW36K-LT-G3

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	1,058	9,774	19,603	29,699	39,716	49,710	59,694	69,647	79,575	89,463	99,323
2	0,194	0,161	0,145	0,213	0,222	0,231	0,232	0,234	0,237	0,240	0,246
3	0,198	0,198	0,315	0,182	0,139	0,157	0,167	0,179	0,194	0,201	0,210
4	0,025	0,043	0,061	0,036	0,028	0,018	0,014	0,015	0,018	0,020	0,024
5	0,469	0,371	0,433	0,448	0,410	0,383	0,358	0,340	0,320	0,305	0,302
6	0,015	0,029	0,018	0,017	0,026	0,019	0,014	0,013	0,014	0,013	0,016
7	0,337	0,313	0,276	0,259	0,284	0,270	0,254	0,236	0,219	0,198	0,171
8	0,030	0,019	0,018	0,032	0,044	0,033	0,028	0,030	0,032	0,031	0,030
9	0,038	0,085	0,044	0,076	0,092	0,044	0,024	0,021	0,024	0,025	0,028
10	0,019	0,033	0,044	0,028	0,033	0,025	0,023	0,022	0,024	0,023	0,024
11	0,249	0,196	0,162	0,208	0,170	0,198	0,193	0,183	0,173	0,160	0,153
12	0,006	0,006	0,013	0,020	0,007	0,014	0,015	0,017	0,016	0,013	0,012
13	0,437	0,431	0,441	0,525	0,280	0,473	0,598	0,626	0,631	0,636	0,646
14	0,021	0,022	0,016	0,035	0,026	0,027	0,026	0,025	0,025	0,023	0,021
15	0,019	0,013	0,053	0,048	0,053	0,048	0,035	0,032	0,031	0,027	0,023
16	0,020	0,022	0,039	0,033	0,023	0,028	0,020	0,020	0,021	0,019	0,018
17	0,245	0,153	0,207	0,125	0,262	0,205	0,334	0,395	0,410	0,410	0,408
18	0,005	0,005	0,016	0,007	0,012	0,008	0,009	0,010	0,013	0,011	0,012
19	0,195	0,269	0,185	0,214	0,276	0,146	0,268	0,342	0,373	0,381	0,380
20	0,024	0,033	0,035	0,022	0,023	0,022	0,022	0,022	0,024	0,022	0,022
21	0,027	0,032	0,061	0,052	0,055	0,032	0,036	0,033	0,031	0,030	0,029
22	0,026	0,023	0,030	0,026	0,027	0,019	0,023	0,021	0,022	0,021	0,020
23	0,087	0,074	0,149	0,206	0,204	0,120	0,162	0,227	0,270	0,291	0,299
24	0,008	0,009	0,005	0,011	0,010	0,005	0,008	0,009	0,008	0,008	0,009
25	0,064	0,097	0,044	0,105	0,153	0,137	0,123	0,197	0,245	0,273	0,289
26	0,027	0,031	0,030	0,035	0,029	0,018	0,019	0,020	0,021	0,023	0,022
27	0,033	0,044	0,033	0,033	0,036	0,027	0,026	0,029	0,031	0,031	0,027
28	0,030	0,028	0,025	0,033	0,033	0,020	0,019	0,021	0,022	0,021	0,022
29	0,108	0,063	0,110	0,092	0,085	0,144	0,094	0,130	0,169	0,201	0,223
30	0,009	0,007	0,010	0,007	0,006	0,005	0,007	0,008	0,009	0,008	0,008
31	0,134	0,079	0,076	0,122	0,068	0,147	0,083	0,106	0,152	0,186	0,210
32	0,027	0,027	0,028	0,023	0,027	0,018	0,015	0,019	0,020	0,022	0,023
33	0,031	0,036	0,025	0,041	0,025	0,032	0,018	0,019	0,024	0,026	0,026
34	0,029	0,030	0,023	0,033	0,025	0,020	0,018	0,019	0,021	0,021	0,023
35	0,184	0,090	0,053	0,036	0,074	0,125	0,096	0,079	0,104	0,129	0,155
36	0,008	0,005	0,009	0,010	0,005	0,006	0,006	0,007	0,009	0,009	0,008
37	0,193	0,101	0,051	0,057	0,081	0,125	0,096	0,063	0,088	0,119	0,143
38	0,027	0,021	0,034	0,032	0,023	0,021	0,016	0,017	0,019	0,019	0,022

39	0,025	0,016	0,013	0,029	0,020	0,026	0,019	0,011	0,013	0,018	0,022
40	0,027	0,029	0,023	0,027	0,027	0,022	0,017	0,017	0,020	0,021	0,022
41	0,212	0,104	0,092	0,082	0,059	0,084	0,098	0,062	0,063	0,082	0,098
42	0,008	0,006	0,008	0,006	0,007	0,007	0,005	0,006	0,006	0,008	0,008
43	0,210	0,119	0,046	0,077	0,066	0,075	0,096	0,062	0,051	0,069	0,091
44	0,025	0,020	0,031	0,024	0,025	0,021	0,014	0,014	0,018	0,018	0,019
45	0,024	0,015	0,028	0,020	0,013	0,017	0,016	0,013	0,009	0,011	0,013
46	0,024	0,026	0,028	0,032	0,027	0,024	0,014	0,017	0,018	0,019	0,021
47	0,190	0,125	0,132	0,092	0,082	0,060	0,083	0,070	0,047	0,051	0,065
48	0,009	0,007	0,006	0,007	0,006	0,007	0,006	0,006	0,006	0,007	0,008
49	0,179	0,142	0,080	0,100	0,078	0,056	0,084	0,067	0,044	0,041	0,050
50	0,020	0,020	0,027	0,022	0,021	0,017	0,014	0,014	0,015	0,017	0,017
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	0,018	0,020	0,024	0,039	0,049	0,064	0,077	0,088	0,106	0,115	0,132
125	0,022	0,020	0,025	0,028	0,037	0,050	0,058	0,066	0,080	0,085	0,101
175	0,020	0,024	0,042	0,025	0,051	0,056	0,059	0,066	0,073	0,075	0,083
225	0,023	0,031	0,050	0,027	0,063	0,065	0,065	0,071	0,076	0,076	0,077
275	0,019	0,023	0,021	0,021	0,041	0,044	0,046	0,052	0,057	0,057	0,061
325	0,022	0,020	0,028	0,022	0,055	0,055	0,056	0,061	0,066	0,063	0,063
375	0,020	0,017	0,023	0,018	0,023	0,022	0,024	0,026	0,031	0,032	0,038
425	0,016	0,017	0,020	0,018	0,020	0,018	0,021	0,023	0,028	0,029	0,033
475	0,015	0,016	0,017	0,024	0,021	0,031	0,033	0,036	0,039	0,040	0,041
525	0,022	0,021	0,023	0,039	0,031	0,049	0,051	0,054	0,056	0,057	0,055
575	0,021	0,020	0,021	0,036	0,029	0,044	0,051	0,056	0,057	0,054	0,053
625	0,021	0,019	0,021	0,035	0,028	0,045	0,049	0,051	0,052	0,049	0,049
675	0,017	0,017	0,018	0,016	0,019	0,016	0,017	0,018	0,020	0,020	0,023
725	0,015	0,015	0,018	0,015	0,021	0,016	0,016	0,017	0,020	0,020	0,023
775	0,020	0,018	0,039	0,018	0,031	0,032	0,040	0,046	0,047	0,046	0,044
825	0,020	0,019	0,041	0,018	0,030	0,030	0,039	0,045	0,046	0,044	0,042
875	0,019	0,019	0,036	0,023	0,037	0,029	0,037	0,044	0,047	0,047	0,045
925	0,019	0,020	0,032	0,021	0,034	0,030	0,036	0,043	0,046	0,043	0,041
975	0,018	0,017	0,016	0,016	0,020	0,017	0,016	0,017	0,017	0,017	0,019
1025	0,015	0,015	0,015	0,016	0,021	0,017	0,016	0,016	0,017	0,017	0,020
1075	0,020	0,019	0,018	0,029	0,039	0,023	0,034	0,039	0,041	0,042	0,042
1125	0,021	0,022	0,020	0,029	0,039	0,021	0,032	0,038	0,043	0,042	0,042
1175	0,020	0,020	0,019	0,024	0,036	0,022	0,031	0,038	0,042	0,043	0,043
1225	0,021	0,021	0,022	0,027	0,036	0,021	0,031	0,037	0,041	0,042	0,042
1275	0,020	0,018	0,016	0,017	0,021	0,018	0,017	0,017	0,017	0,018	0,020
1325	0,017	0,015	0,015	0,016	0,020	0,019	0,017	0,016	0,017	0,017	0,019
1375	0,022	0,020	0,022	0,019	0,029	0,023	0,027	0,035	0,038	0,040	0,040
1425	0,024	0,023	0,023	0,020	0,027	0,022	0,025	0,033	0,038	0,040	0,040
1475	0,022	0,021	0,020	0,023	0,023	0,024	0,025	0,033	0,039	0,040	0,041
1525	0,024	0,022	0,020	0,023	0,023	0,024	0,025	0,032	0,039	0,040	0,041
1575	0,022	0,018	0,017	0,018	0,020	0,020	0,017	0,018	0,018	0,018	0,021
1625	0,029	0,024	0,026	0,028	0,030	0,032	0,030	0,030	0,029	0,029	0,029
1675	0,025	0,020	0,021	0,025	0,020	0,027	0,023	0,028	0,034	0,037	0,038

1725	0,027	0,024	0,022	0,024	0,021	0,027	0,021	0,027	0,034	0,037	0,038
1775	0,025	0,022	0,021	0,022	0,022	0,027	0,023	0,027	0,033	0,037	0,040
1825	0,025	0,023	0,022	0,024	0,022	0,028	0,023	0,027	0,034	0,038	0,040
1875	0,025	0,019	0,018	0,018	0,020	0,021	0,019	0,019	0,019	0,020	0,023
1925	0,064	0,052	0,058	0,066	0,068	0,071	0,072	0,071	0,071	0,071	0,070
1975	0,026	0,021	0,022	0,020	0,023	0,028	0,021	0,023	0,028	0,033	0,037
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	0,300	0,159	0,113	0,121	0,096	0,125	0,141	0,098	0,102	0,127	0,154
2,3	0,197	0,133	0,147	0,112	0,102	0,085	0,099	0,090	0,074	0,079	0,094
2,5	0,188	0,153	0,094	0,112	0,094	0,072	0,097	0,083	0,069	0,071	0,083
2,7	0,191	0,189	0,186	0,135	0,128	0,100	0,098	0,097	0,082	0,075	0,082
2,9	0,098	0,133	0,135	0,109	0,100	0,083	0,067	0,070	0,068	0,060	0,062
3,1	0,098	0,116	0,135	0,101	0,098	0,075	0,061	0,069	0,066	0,059	0,059
3,3	0,094	0,127	0,157	0,135	0,131	0,102	0,077	0,075	0,076	0,072	0,068
3,5	0,058	0,072	0,081	0,087	0,087	0,071	0,061	0,053	0,054	0,053	0,054
3,7	0,057	0,066	0,092	0,082	0,081	0,068	0,059	0,054	0,056	0,055	0,057
3,9	0,065	0,067	0,083	0,089	0,091	0,082	0,077	0,073	0,076	0,077	0,079
4,1	0,044	0,046	0,058	0,061	0,065	0,066	0,065	0,065	0,067	0,070	0,073
4,3	0,029	0,030	0,033	0,034	0,035	0,032	0,029	0,028	0,028	0,029	0,033
4,5	0,027	0,023	0,026	0,024	0,024	0,022	0,021	0,020	0,020	0,020	0,023
4,7	0,019	0,018	0,019	0,018	0,018	0,018	0,018	0,018	0,019	0,019	0,021
4,9	0,012	0,011	0,011	0,011	0,011	0,011	0,011	0,011	0,012	0,011	0,014
5,1	0,011	0,011	0,010	0,009	0,009	0,009	0,009	0,009	0,011	0,010	0,012
5,3	0,007	0,009	0,008	0,008	0,008	0,008	0,008	0,008	0,009	0,009	0,010
5,5	0,008	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,009
5,7	0,009	0,009	0,008	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,009
5,9	0,007	0,007	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,008
6,1	0,009	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,009
6,3	0,009	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,008
6,5	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,008
6,7	0,007	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,007
6,9	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,008
7,1	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,007	0,009
7,3	0,026	0,022	0,023	0,024	0,024	0,026	0,026	0,027	0,028	0,029	0,031
7,5	0,007	0,006	0,005	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,008
7,7	0,007	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,005	0,007
7,9	0,006	0,005	0,005	0,005	0,004	0,004	0,005	0,005	0,006	0,005	0,006
8,1	0,007	0,005	0,006	0,005	0,005	0,005	0,005	0,005	0,006	0,005	0,007
8,3	0,007	0,006	0,006	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,007
8,5	0,007	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,006	0,006	0,007
8,7	0,007	0,007	0,006	0,006	0,005	0,005	0,005	0,005	0,006	0,005	0,006
8,9	0,007	0,008	0,007	0,007	0,007	0,006	0,006	0,007	0,007	0,007	0,008

Note:

The normalization current is 52,174A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

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: ASW40K-LT-G3

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	0,943	9,696	19,691	29,729	39,728	49,723	59,682	69,611	79,495	89,340	99,279
2	0,200	0,167	0,189	0,232	0,246	0,254	0,261	0,269	0,273	0,285	0,335
3	0,182	0,193	0,216	0,152	0,127	0,148	0,160	0,175	0,181	0,187	0,137
4	0,025	0,025	0,043	0,027	0,022	0,018	0,016	0,015	0,016	0,020	0,167
5	0,425	0,269	0,383	0,394	0,355	0,331	0,312	0,292	0,276	0,277	0,469
6	0,018	0,024	0,032	0,011	0,021	0,017	0,019	0,020	0,020	0,021	0,032
7	0,306	0,340	0,213	0,248	0,250	0,235	0,217	0,202	0,180	0,152	0,100
8	0,026	0,022	0,016	0,036	0,033	0,025	0,025	0,025	0,025	0,023	0,118
9	0,036	0,049	0,060	0,077	0,061	0,027	0,019	0,022	0,023	0,026	0,037
10	0,020	0,032	0,033	0,027	0,025	0,021	0,022	0,026	0,027	0,027	0,066
11	0,225	0,231	0,199	0,157	0,170	0,177	0,168	0,158	0,146	0,137	0,102
12	0,008	0,018	0,027	0,010	0,013	0,011	0,011	0,011	0,011	0,010	0,026
13	0,397	0,185	0,303	0,506	0,289	0,508	0,559	0,567	0,568	0,572	0,501
14	0,021	0,013	0,035	0,027	0,030	0,022	0,020	0,022	0,021	0,019	0,060
15	0,019	0,019	0,052	0,052	0,046	0,037	0,028	0,027	0,023	0,019	0,032
16	0,020	0,030	0,026	0,026	0,021	0,018	0,018	0,020	0,021	0,021	0,049
17	0,221	0,149	0,264	0,228	0,135	0,254	0,344	0,367	0,369	0,363	0,307
18	0,004	0,011	0,009	0,010	0,007	0,008	0,008	0,009	0,008	0,007	0,022
19	0,175	0,232	0,078	0,105	0,158	0,195	0,292	0,332	0,342	0,339	0,403
20	0,021	0,022	0,031	0,032	0,022	0,021	0,020	0,020	0,020	0,020	0,047
21	0,025	0,031	0,036	0,035	0,035	0,032	0,031	0,029	0,027	0,026	0,027
22	0,023	0,028	0,022	0,024	0,017	0,017	0,017	0,019	0,021	0,020	0,058
23	0,077	0,124	0,165	0,145	0,173	0,120	0,187	0,237	0,261	0,267	0,307
24	0,005	0,006	0,009	0,007	0,006	0,007	0,007	0,007	0,007	0,006	0,023
25	0,056	0,109	0,102	0,171	0,179	0,093	0,159	0,211	0,243	0,260	0,266
26	0,023	0,030	0,032	0,025	0,020	0,017	0,019	0,020	0,020	0,020	0,060
27	0,029	0,032	0,023	0,044	0,042	0,021	0,023	0,028	0,028	0,023	0,035
28	0,026	0,031	0,031	0,027	0,019	0,015	0,016	0,019	0,019	0,022	0,056
29	0,099	0,072	0,066	0,070	0,138	0,094	0,106	0,145	0,178	0,199	0,246
30	0,005	0,004	0,007	0,009	0,006	0,005	0,006	0,006	0,007	0,007	0,029
31	0,123	0,040	0,069	0,024	0,122	0,098	0,081	0,129	0,164	0,187	0,202
32	0,026	0,032	0,029	0,032	0,025	0,016	0,017	0,019	0,020	0,023	0,073
33	0,027	0,022	0,025	0,025	0,030	0,018	0,015	0,019	0,023	0,023	0,049
34	0,026	0,030	0,035	0,026	0,023	0,017	0,015	0,018	0,019	0,019	0,062
35	0,169	0,084	0,071	0,071	0,077	0,105	0,066	0,088	0,114	0,139	0,189
36	0,005	0,005	0,006	0,006	0,005	0,006	0,005	0,005	0,006	0,007	0,042
37	0,177	0,092	0,075	0,077	0,054	0,106	0,059	0,072	0,104	0,129	0,261
38	0,024	0,023	0,024	0,025	0,025	0,014	0,015	0,017	0,019	0,020	0,084

39	0,022	0,008	0,023	0,026	0,014	0,018	0,011	0,011	0,015	0,021	0,049
40	0,023	0,030	0,030	0,027	0,022	0,015	0,015	0,018	0,019	0,018	0,085
41	0,194	0,053	0,080	0,048	0,059	0,091	0,065	0,054	0,071	0,086	0,255
42	0,005	0,005	0,006	0,007	0,005	0,006	0,005	0,005	0,006	0,008	0,050
43	0,192	0,115	0,095	0,067	0,057	0,094	0,065	0,044	0,059	0,085	0,181
44	0,020	0,018	0,023	0,027	0,021	0,014	0,014	0,015	0,017	0,017	0,097
45	0,023	0,010	0,017	0,018	0,017	0,015	0,013	0,008	0,011	0,008	0,049
46	0,019	0,028	0,021	0,022	0,019	0,015	0,014	0,016	0,017	0,022	0,081
47	0,173	0,091	0,087	0,084	0,064	0,071	0,069	0,045	0,044	0,060	0,143
48	0,006	0,004	0,006	0,007	0,006	0,006	0,005	0,005	0,005	0,006	0,042
49	0,163	0,132	0,090	0,081	0,065	0,067	0,066	0,042	0,037	0,043	0,154
50	0,016	0,016	0,024	0,019	0,017	0,014	0,012	0,012	0,015	0,016	0,075
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	0,016	0,017	0,034	0,038	0,049	0,064	0,077	0,088	0,102	0,120	0,139
125	0,020	0,019	0,034	0,029	0,037	0,047	0,057	0,065	0,078	0,090	0,129
175	0,017	0,021	0,036	0,028	0,048	0,051	0,057	0,063	0,069	0,074	0,116
225	0,021	0,027	0,041	0,034	0,060	0,057	0,061	0,065	0,067	0,068	0,107
275	0,017	0,020	0,019	0,019	0,041	0,040	0,045	0,049	0,051	0,053	0,090
325	0,020	0,019	0,020	0,025	0,052	0,049	0,054	0,055	0,057	0,056	0,101
375	0,017	0,016	0,022	0,018	0,020	0,021	0,023	0,025	0,029	0,033	0,083
425	0,014	0,014	0,020	0,018	0,017	0,018	0,020	0,022	0,026	0,029	0,073
475	0,013	0,013	0,024	0,021	0,026	0,029	0,032	0,034	0,036	0,037	0,072
525	0,020	0,020	0,040	0,033	0,040	0,045	0,048	0,049	0,050	0,049	0,089
575	0,020	0,019	0,029	0,038	0,033	0,044	0,049	0,050	0,049	0,047	0,101
625	0,019	0,018	0,025	0,034	0,034	0,042	0,045	0,045	0,044	0,043	0,094
675	0,016	0,014	0,015	0,016	0,016	0,014	0,015	0,016	0,018	0,019	0,069
725	0,014	0,013	0,014	0,015	0,017	0,014	0,015	0,016	0,018	0,020	0,064
775	0,018	0,017	0,023	0,028	0,023	0,033	0,039	0,042	0,042	0,040	0,091
825	0,018	0,018	0,023	0,028	0,021	0,032	0,039	0,041	0,040	0,037	0,082
875	0,017	0,018	0,017	0,019	0,022	0,031	0,038	0,042	0,042	0,040	0,091
925	0,018	0,018	0,018	0,021	0,021	0,030	0,037	0,040	0,039	0,037	0,088
975	0,016	0,015	0,014	0,015	0,017	0,014	0,015	0,015	0,016	0,017	0,065
1025	0,014	0,014	0,014	0,015	0,018	0,014	0,015	0,014	0,015	0,017	0,061
1075	0,018	0,016	0,021	0,020	0,025	0,027	0,033	0,037	0,038	0,038	0,091
1125	0,019	0,019	0,021	0,020	0,025	0,026	0,033	0,037	0,038	0,037	0,084
1175	0,018	0,019	0,020	0,026	0,029	0,025	0,033	0,037	0,038	0,039	0,090
1225	0,020	0,020	0,021	0,025	0,027	0,024	0,031	0,036	0,038	0,037	0,091
1275	0,018	0,016	0,016	0,017	0,019	0,015	0,015	0,015	0,016	0,017	0,068
1325	0,016	0,014	0,015	0,017	0,019	0,015	0,015	0,015	0,015	0,017	0,069
1375	0,020	0,017	0,018	0,026	0,032	0,021	0,029	0,034	0,036	0,036	0,099
1425	0,022	0,021	0,019	0,025	0,031	0,019	0,028	0,033	0,036	0,035	0,097
1475	0,020	0,019	0,022	0,022	0,031	0,021	0,027	0,034	0,036	0,037	0,113
1525	0,023	0,021	0,022	0,023	0,031	0,020	0,027	0,033	0,036	0,037	0,112
1575	0,020	0,016	0,016	0,017	0,020	0,016	0,016	0,016	0,016	0,018	0,086
1625	0,023	0,020	0,021	0,024	0,027	0,025	0,025	0,024	0,024	0,024	0,093
1675	0,022	0,018	0,018	0,017	0,030	0,019	0,023	0,030	0,034	0,034	0,132

1725	0,025	0,021	0,019	0,019	0,028	0,019	0,022	0,029	0,033	0,034	0,129
1775	0,022	0,019	0,020	0,021	0,027	0,021	0,023	0,029	0,033	0,036	0,142
1825	0,024	0,020	0,020	0,021	0,026	0,021	0,022	0,029	0,034	0,036	0,142
1875	0,022	0,016	0,017	0,018	0,019	0,017	0,017	0,018	0,018	0,019	0,106
1925	0,061	0,054	0,058	0,065	0,066	0,067	0,068	0,066	0,065	0,066	0,134
1975	0,023	0,019	0,019	0,022	0,023	0,019	0,020	0,025	0,030	0,033	0,144
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	0,274	0,133	0,125	0,097	0,090	0,131	0,100	0,087	0,111	0,138	0,438
2,3	0,179	0,100	0,100	0,097	0,081	0,084	0,084	0,065	0,069	0,085	0,290
2,5	0,172	0,142	0,103	0,092	0,079	0,081	0,078	0,062	0,062	0,072	0,278
2,7	0,175	0,184	0,144	0,125	0,101	0,081	0,088	0,077	0,067	0,072	0,206
2,9	0,089	0,138	0,109	0,098	0,080	0,062	0,062	0,062	0,055	0,053	0,135
3,1	0,089	0,123	0,111	0,091	0,078	0,060	0,060	0,060	0,054	0,053	0,111
3,3	0,086	0,139	0,130	0,121	0,105	0,082	0,065	0,068	0,065	0,061	0,104
3,5	0,053	0,078	0,077	0,078	0,071	0,059	0,047	0,048	0,047	0,048	0,094
3,7	0,052	0,058	0,076	0,074	0,068	0,056	0,048	0,048	0,050	0,050	0,095
3,9	0,059	0,061	0,076	0,078	0,074	0,067	0,061	0,061	0,064	0,063	0,111
4,1	0,039	0,041	0,054	0,055	0,057	0,056	0,055	0,056	0,059	0,060	0,124
4,3	0,026	0,028	0,030	0,031	0,030	0,027	0,026	0,024	0,026	0,028	0,088
4,5	0,024	0,021	0,023	0,021	0,021	0,019	0,018	0,017	0,018	0,019	0,057
4,7	0,017	0,016	0,016	0,016	0,016	0,016	0,016	0,016	0,017	0,018	0,044
4,9	0,011	0,010	0,010	0,010	0,010	0,009	0,009	0,010	0,010	0,011	0,034
5,1	0,010	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,009	0,010	0,031
5,3	0,006	0,008	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,009	0,031
5,5	0,007	0,007	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,008	0,032
5,7	0,008	0,008	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,008	0,030
5,9	0,006	0,006	0,006	0,005	0,005	0,005	0,005	0,006	0,006	0,007	0,026
6,1	0,008	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,023
6,3	0,008	0,005	0,006	0,005	0,005	0,005	0,005	0,005	0,006	0,007	0,023
6,5	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,021
6,7	0,006	0,005	0,005	0,005	0,004	0,005	0,005	0,005	0,005	0,006	0,018
6,9	0,005	0,004	0,005	0,004	0,004	0,004	0,004	0,005	0,005	0,006	0,016
7,1	0,007	0,006	0,007	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,016
7,3	0,023	0,021	0,021	0,022	0,022	0,024	0,024	0,025	0,027	0,028	0,037
7,5	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,007	0,015
7,7	0,006	0,005	0,005	0,004	0,004	0,004	0,004	0,004	0,005	0,005	0,014
7,9	0,006	0,005	0,005	0,004	0,004	0,004	0,004	0,004	0,004	0,005	0,013
8,1	0,007	0,005	0,005	0,004	0,004	0,004	0,004	0,004	0,005	0,005	0,014
8,3	0,007	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,014
8,5	0,007	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,013
8,7	0,007	0,006	0,005	0,005	0,005	0,004	0,004	0,004	0,005	0,005	0,012
8,9	0,007	0,007	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,012

Note:

The normalization current is 57,971A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

4.8 EMC and power quality Switching operation (Rapid voltage changes)	P

The purpose of the test is to determine k_i and k_{imax}.

The following three cases must be tested (where applicable).

- Switch-on for any capacity
- Unfavourable case when switching the generator step
- Switch-on for nominal capacity
  Note: For PV-plants the inverter is the generator
- Switch-off for nominal capacity (no emergency shutdown, but operative shutdown)

If the manufacturer knows more critical cases (e.g. different cos φ parameters) then these additional have to be tested

Test conditions:

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

Test:

ASW40K-LT-G3

Switch-on for any capacity (10% PEmax)

Phase	L1			L2			L3		
Single period effective values of the current [A]	1,117	2,051	1,634	2,047	1,827	1,455	2,245	1,291	2,001
Single period effective values of the voltage [V]	230,53	229,41	229,71	228,4	230,11	228,74	230,14	229,43	230,69
k_i value [1]	0,019	0,035	0,028	0,035	0,032	0,025	0,039	0,022	0,035
k_{imax} value [1]	0,039								

Unfavourable case when switching the generator step (not necessary for electronic inverter)

Phase	L1			L2			L3		
Single period effective values of the current [A]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Single period effective values of the voltage [V]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
k_i value [1]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
k_{imax} value [1]	N/A								

Switch-on for nominal capacity

Phase	L1			L2			L3		
Single period effective values of the current [A]	1,866	1,991	1,869	1,838	1,796	1,627	1,226	1,302	1,418

4.8 EMC and power quality Switching operation (Rapid voltage changes)									P
Single period effective values of the voltage [V]	229,8	229,2	230,02	230,48	230,83	229,94	228,76	229,13	229,13
k_i value [1]	0,032	0,034	0,032	0,032	0,031	0,028	0,021	0,022	0,024
k_{imax} value [1]	0,034								
Switch-off for nominal capacity									
Phase	**L1**			**L2**			**L3**		
Single period effective values of the current [A]	1,341	2,160	6,365	2,411	0,808	6,413	1,460	2,372	0,805
Single period effective values of the voltage [V]	228,7	228,1	228,19	228,01	227,98	227,94	228,51	228,33	228,17
k_i value [1]	0,023	0,037	0,110	0,042	0,014	0,111	0,025	0,041	0,014
k_{imax} value [1]	0,111								

Grid Frequency [Hz]	50,0
Grid voltage [V]	230,0
Rated current I_r [A]	57,97
Highest k_{imax} value for all switching operations [1]	0,111

Note:

Limits:

k_{imax} = 1,2 for synchronous generators with fine synchronization, converter; (electronic inverter)

k_{imax} = 4 for asynchronous generators, which are switched on at 95% to 105% of their synchronous speed, if no further details are available regarding the type of current limitation. With regard to short-term compensation processes, the condition mentioned below for very short voltage changes must also be observed.

K_{imax} = 8 for asynchronous generators that are powered up by the network if I_a is unknown. (I_a = starting current)

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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: ASW40K-LT-G3

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	**L1**	0,414	0,376	0,000	0,207	1,115
	L2	0,311	0,308	0,000	0,172	0,746
	L3	0,306	0,304	0,000	0,153	0,748

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| = 0,283Ω) 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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

4.8	EMC and power quality DC-Injection	P

Test result: ASW25K-LT-G3

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (181,1mA)			
Output power	~20%	~50%	~75%	~100%
Abs. Max. Test Value:L1 [mA]	142,5	130,0	151,0	126,8
Abs. Ave. Test Value:L1 [mA]	118,7	99,5	93,1	71,2
Abs. Max. Test Value:L2 [mA]	126,2	117,1	120,9	130,6
Abs. Ave. Test Value:L2 [mA]	103,4	84,4	76,5	71,5
Abs. Max. Test Value:L3 [mA]	174,1	175,6	167,1	165,9
Abs. Ave. Test Value:L3 [mA]	150,8	136,3	115,2	99,3

Test result: ASW40K-LT-G3

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$ (289,9mA)			
Output power	~20%	~50%	~75%	~100%
Abs. Max. Test Value:L1 [mA]	178,5	197,8	227,1	245,3
Abs. Ave. Test Value:L1 [mA]	153,4	144,3	146,9	130,9
Abs. Max. Test Value:L2 [mA]	144,8	172,0	208,7	239,6
Abs. Ave. Test Value:L2 [mA]	110,7	106,3	111,7	122,0
Abs. Max. Test Value:L3 [mA]	215,6	230,7	276,4	280,2
Abs. Ave. Test Value:L3 [mA]	179,3	167,8	209,6	169,4

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.

The tests had been performed on the ASW25K-LT-G3 and ASW40K-LT-G3 are valid for the ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Diagram of permanent dc-injection(ASW25K-LT-G3)

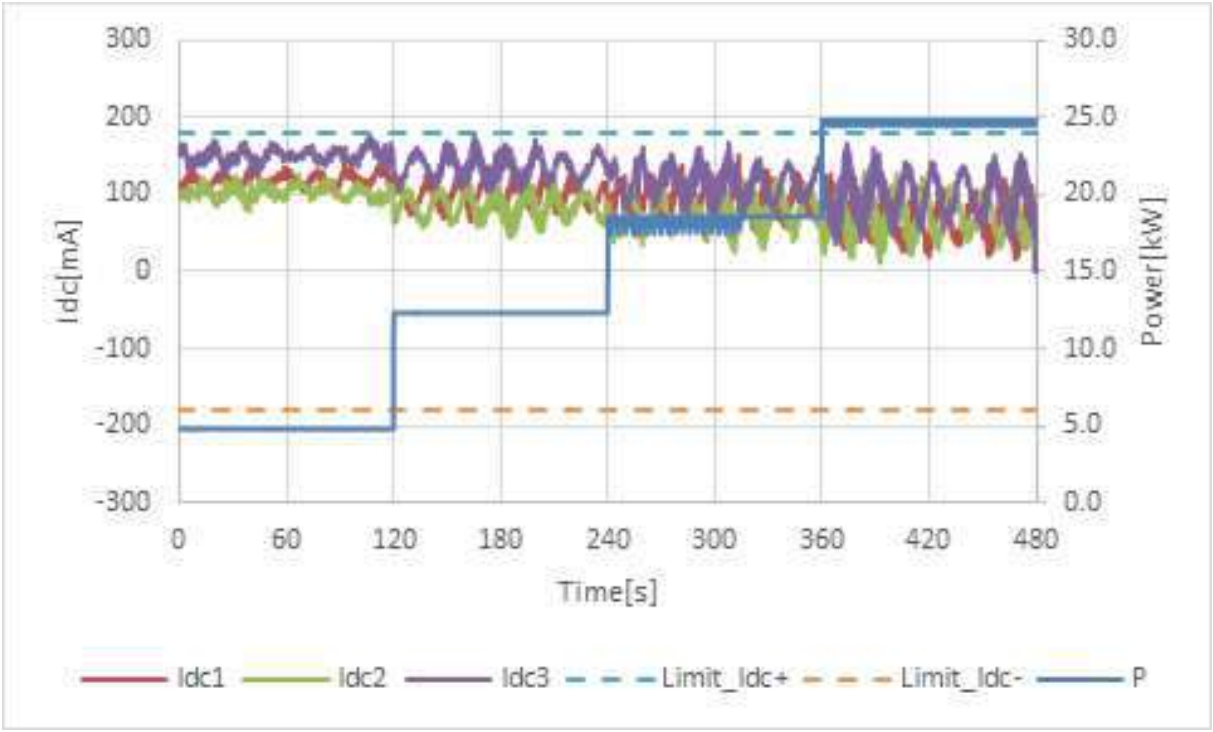
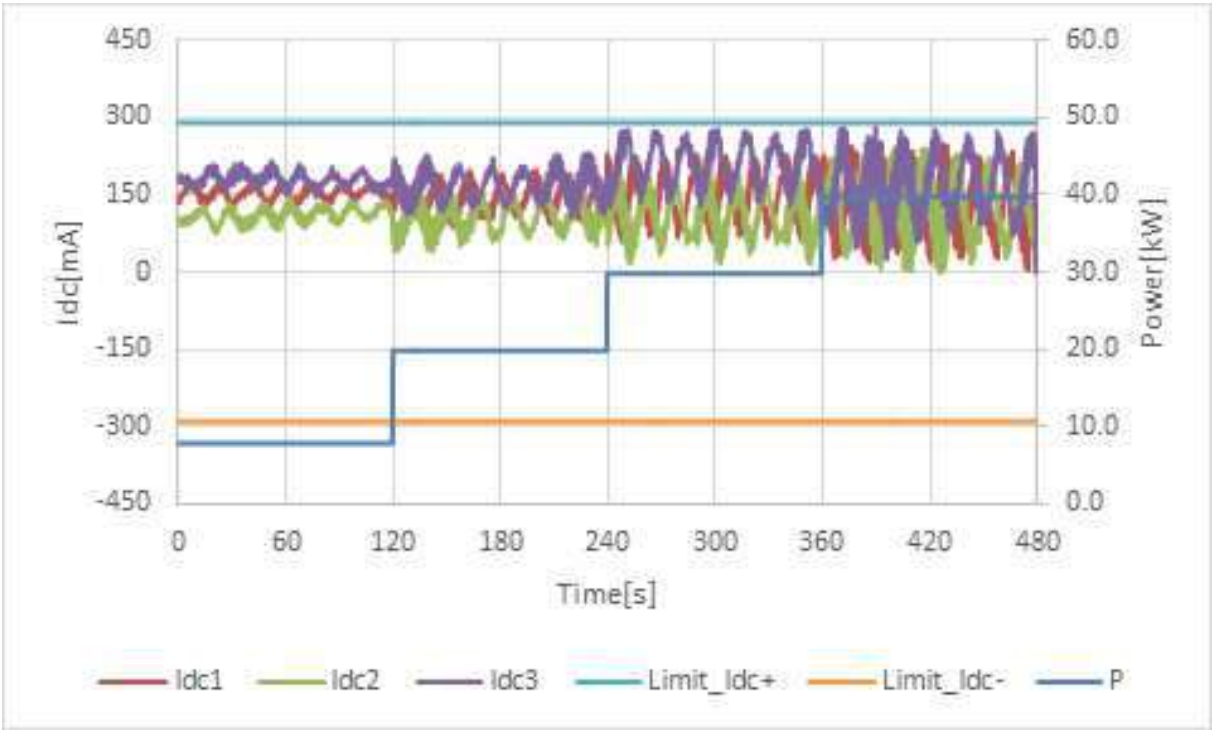


Diagram of permanent dc-injection(ASW40K-LT-G3)



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	8,17Vac	-2,10A
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	5,82Vac	0,57A
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	-13,73Vac	0,57A
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	0,078s	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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

4.8 Unbalance	P

Test: ASW40K-LT-G3

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	-0,141	229,79	0,097	0,446	0,157	35,172	0,271	3
10	3,802	229,88	0,097	5,526	0,198	3,585	0,342	3
20	7,791	229,97	0,081	11,299	0,177	1,571	0,306	3
30	11,811	230,04	0,084	17,118	0,154	0,902	0,266	3
40	15,833	230,11	0,077	22,937	0,142	0,618	0,244	3
50	19,845	230,16	0,075	28,742	0,145	0,504	0,250	3
60	23,847	230,27	0,081	34,520	0,146	0,423	0,252	3
70	27,836	230,33	0,080	40,285	0,145	0,360	0,250	3
80	31,810	230,40	0,078	46,022	0,149	0,324	0,257	3
90	35,774	230,44	0,089	51,749	0,152	0,293	0,262	3
100	39,840	230,54	0,078	57,605	0,152	0,265	0,263	3

Maximum unsymmetry u_{imax} (≥10%Pn)	0,342

Note:

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

The unsymmetry is calculated according to following equation:

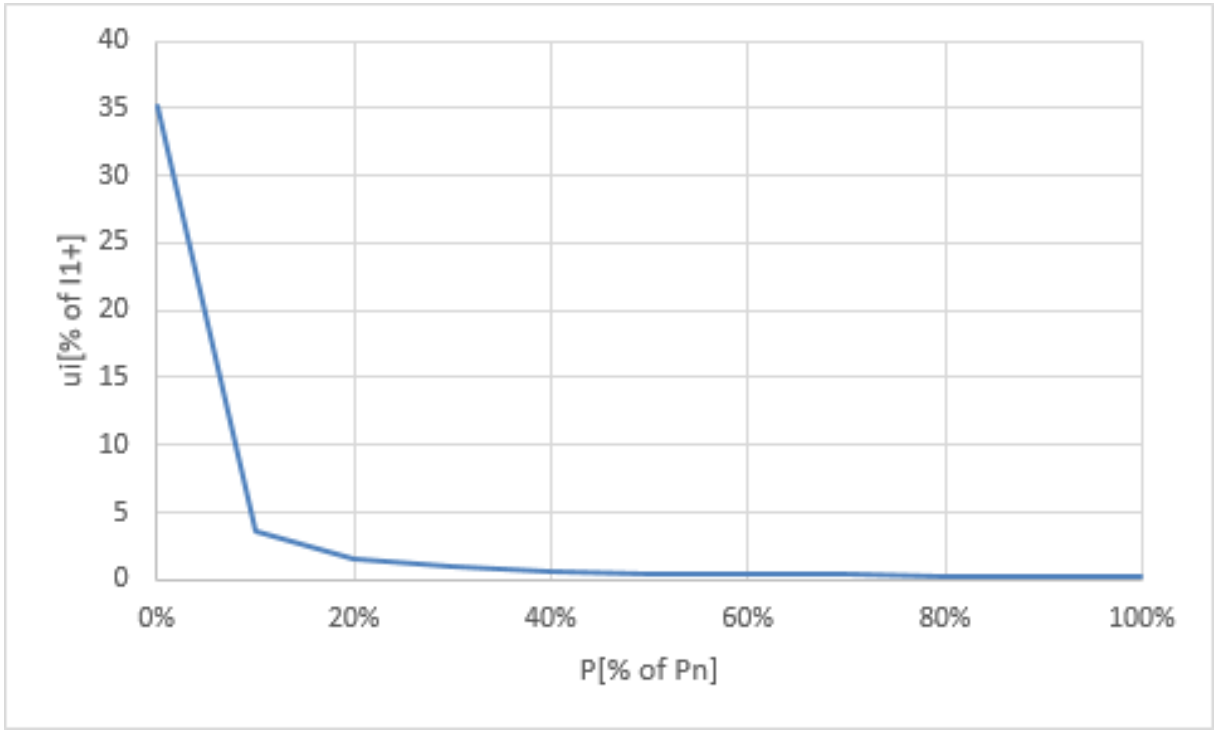
$$u_i = \frac{I_{1-}}{I_{1+}} \cdot 100\%$$

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Diagram



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 50549-1 for default settings)	P

Test conditions			Output power: 40,0kW 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	263,2	230 to 269	0,148	≤3,0s
		263,3	230 to 269	0,153	
		263,4	230 to 269	0,151	
		263,8	230 to 269	0,131	
		266,1	230 to 269	0,130	
	Stage 2 125% of U_n = 287,5	287,1	230 to 292	0,133	0,1s ≤ t ≤ 0,2s
		287,3	230 to 292	0,134	
		287,5	230 to 292	0,130	
		287,5	230 to 292	0,138	
		287,2	230 to 292	0,139	
	Stage 80% of U_n = 184	183,5	230 to 189	2,428	2,0s ≤ t ≤ 5,0s
		183,4	230 to 189	2,428	
		183,7	230 to 189	2,435	
		183,9	230 to 189	2,418	
		183,2	230 to 189	2,426	
	Stage 2 50% of U_n = 115	115,8	230 to 120	1,424	0,1s ≤ t ≤ 2,0s
		115,5	230 to 120	1,417	
		115,7	230 to 120	1,401	
		115,3	230 to 120	1,397	
		115,6	230 to 120	1,414	
L2	Stage 1 115% of U_n = 264,5	264,8	230 to 269	0,127	≤3,0s
		264,8	230 to 269	0,134	
		264,7	230 to 269	0,133	
		264,3	230 to 269	0,149	
		264,5	230 to 269	0,150	
	Stage 2 125% of U_n = 287,5	287,5	230 to 292	0,125	0,1s ≤ t ≤ 0,2s
		287,4	230 to 292	0,143	
		287,1	230 to 292	0,142	
		287,8	230 to 292	0,123	
		287,6	230 to 292	0,122	
	Stage 80% of U_n = 184	185,2	230 to 189	2,440	2,0s ≤ t ≤ 5,0s
		185,3	230 to 189	2,442	
		185,2	230 to 189	2,418	
		185,8	230 to 189	2,422	
		185,2	230 to 189	2,418	
	Stage 2 50% of U_n = 115	115,3	230 to 120	1,414	0,1s ≤ t ≤ 2,0s
		115,2	230 to 120	1,401	
		115,6	230 to 120	1,397	
		115,9	230 to 120	1,397	
		115,5	230 to 120	1,404	

4.9.3 4.9.3.1	Requirements on voltage and frequency protection General (Interface protection: Over/under voltage) (Setting value refer EN 50549-1 for default settings)	P

Test conditions			Output power: 40,0kW Frequency: 50+/-0,2Hz		
Phase	**Limit [V]**	**Trip value [V]**	**Voltage step [V]**	**Disconnection time [s]**	**Limit [s]**
L3	Stage 1 115% of U_n = 264,5	263,3	230 to 269	0,144	≤3,0s
		264,9	230 to 269	0,145	
		263,6	230 to 269	0,141	
		263,8	230 to 269	0,140	
		263,7	230 to 269	0,130	
	Stage 2 125% of U_n = 287,5	287,1	230 to 292	0,126	0,1s ≤ t ≤ 0,2s
		287,9	230 to 292	0,125	
		287,6	230 to 292	0,125	
		287,5	230 to 292	0,126	
		287,4	230 to 292	0,140	
	Stage 80% of U_n = 184	185,2	230 to 189	2,405	2,0s ≤ t ≤ 5,0s
		185,3	230 to 189	2,414	
		185,7	230 to 189	2,432	
		185,1	230 to 189	2,428	
		185,1	230 to 189	2,415	
	Stage 2 50% of U_n = 115	115,5	230 to 120	1,417	0,1s ≤ t ≤ 2,0s
		115,9	230 to 120	1,408	
		115,3	230 to 120	1,397	
		115,8	230 to 120	1,414	
		115,2	230 to 120	1,404	

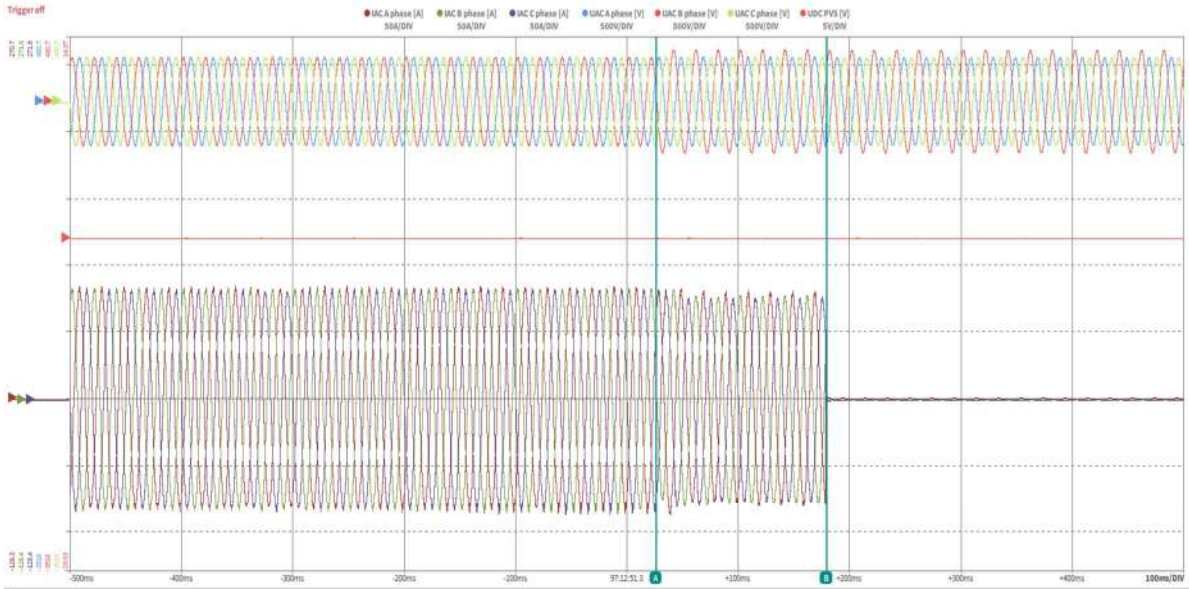
Note:

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

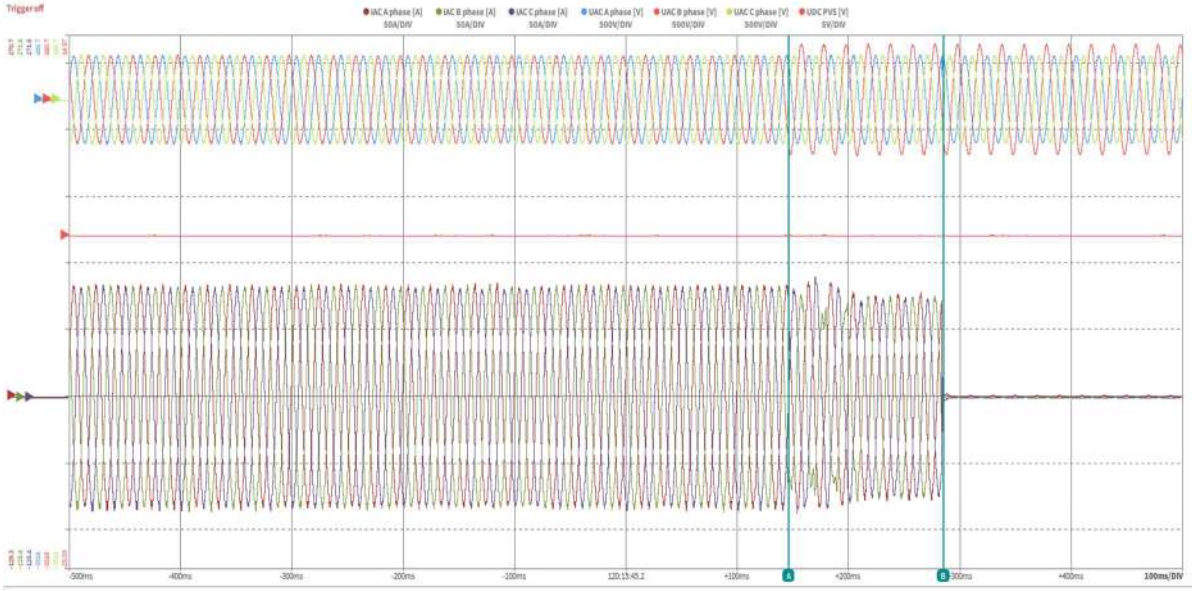
Scope pictures of the disconnection time

Over voltage - Stage 1 (L1 phase)



Time [s]	A 97:12:51.3714808	B 97:12:51.5245081	Delta 0.1530273
IAC A phase [A]	63.13204	-1.268638	-64.40068
IAC B phase [A]	11.74528	-1.249012	-12.99429
IAC C phase [A]	-75.32501	1.996286	77.32130
UAC A phase [V]	256.2626	-317.0311	-573.2937
UAC B phase [V]	43.65257	273.5167	229.8641
UAC C phase [V]	-302.3620	82.80657	385.1686
UDC PV1 [V]	-2.502331	-8.949e-3	2.493382

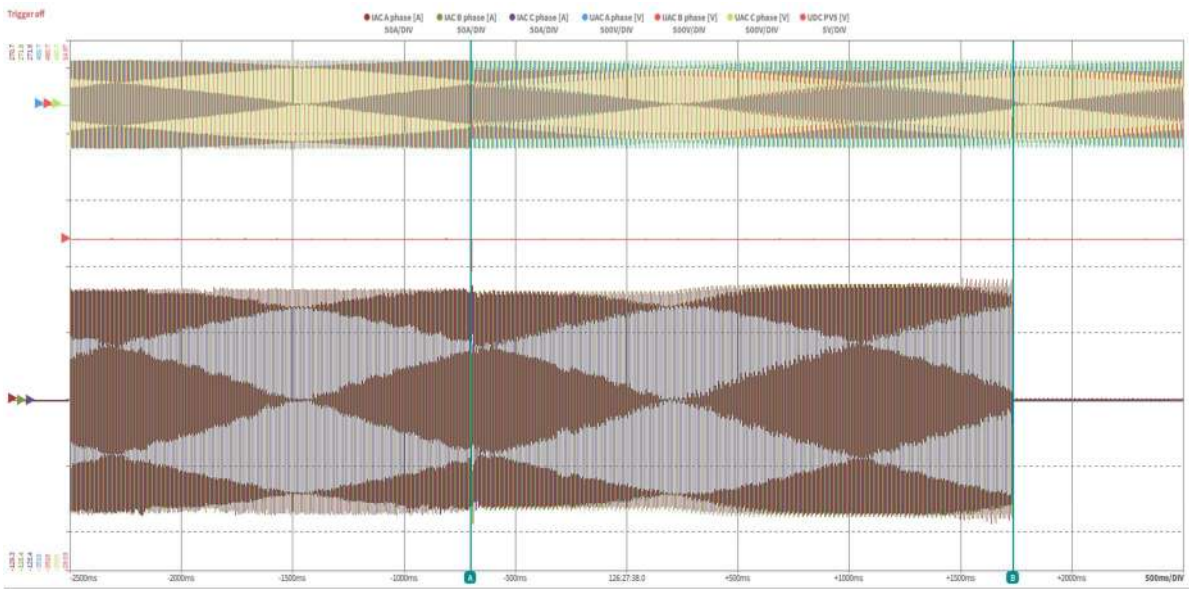
Over voltage - Stage 2 (L1 phase)



Time [s]	A 120:15:45.3353081	B 120:15:45.4743634	Delta 0.1390552
IAC A phase [A]	67.72207	0.854718	-66.86736
IAC B phase [A]	-71.95801	1.445833	73.40384
IAC C phase [A]	4.044302	-2.583019	-6.627322
UAC A phase [V]	272.4381	315.8196	43.38146
UAC B phase [V]	-290.9512	-283.2861	7.665158
UAC C phase [V]	20.46726	-91.34581	-111.8131
UDC PV1 [V]	-2.131352	-0.013241	2.118111

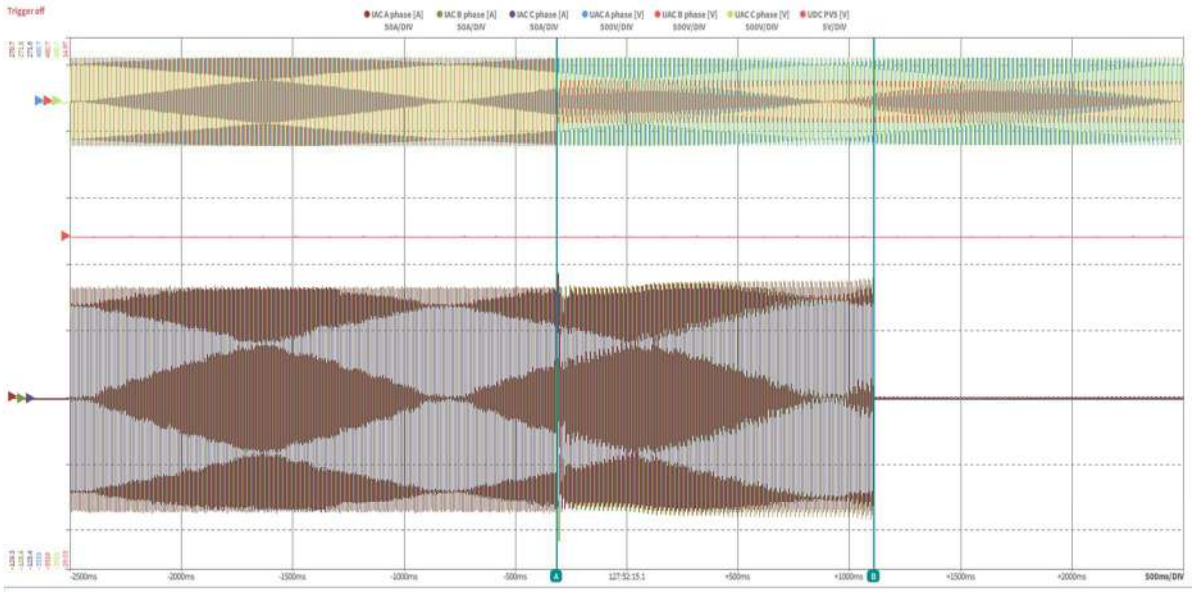
Scope pictures of the disconnection time

Under voltage - Stage 1 (L1 phase)



	A	B	Delta
Time [s]	126:27:37.339639	126:27:39.774769	2.435130
IAC A phase [A]	-76.12659	1.447188	77.57378
IAC B phase [A]	63.25681	-1.309332	-64.56614
IAC C phase [A]	12.44450	-0.561707	-13.00621
UAC A phase [V]	-303.8597	-114.9050	188.9546
UAC B phase [V]	252.2495	-160.4609	-412.7105
UAC C phase [V]	49.46540	319.9360	270.4706
UDC PV5 [V]	-0.015387	-0.010618	4.768e-3

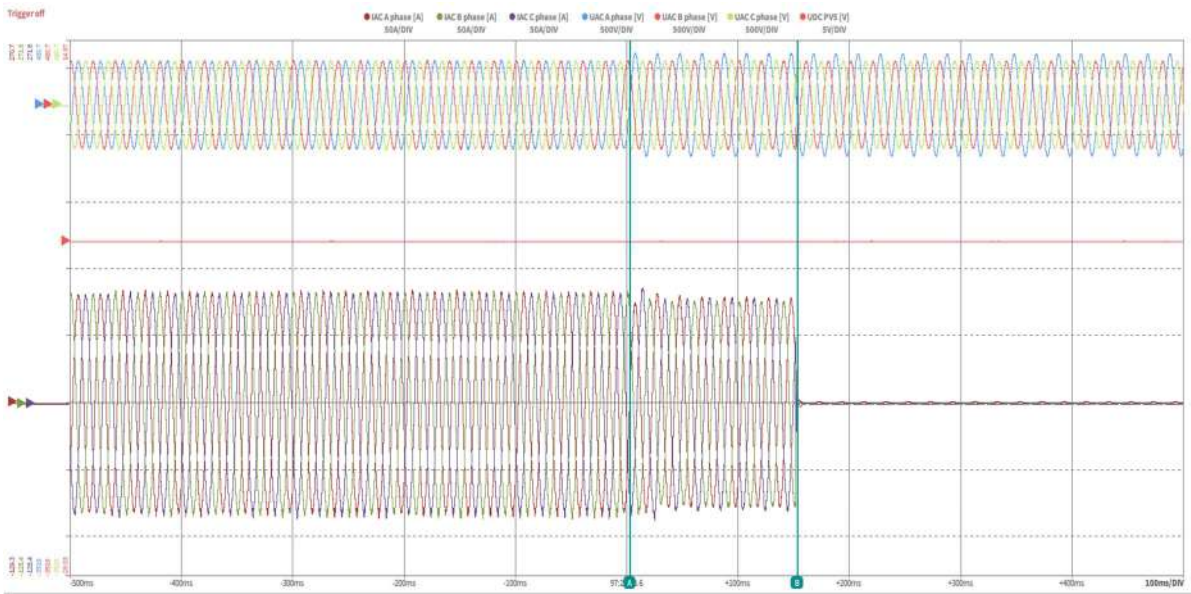
Under voltage - Stage 2 (L1 phase)



	A	B	Delta
Time [s]	127:52:14.770729	127:52:16.194548	1.423819
IAC A phase [A]	-19.24898	-1.089109	18.15987
IAC B phase [A]	78.28314	1.015249	-77.26789
IAC C phase [A]	-59.63444	-0.640862	58.99358
UAC A phase [V]	-66.17324	264.0248	330.1981
UAC B phase [V]	311.8914	15.65150	-296.2399
UAC C phase [V]	-242.1024	-296.6419	-54.53945
UDC PV5 [V]	-0.019440	-0.014910	4.530e-3

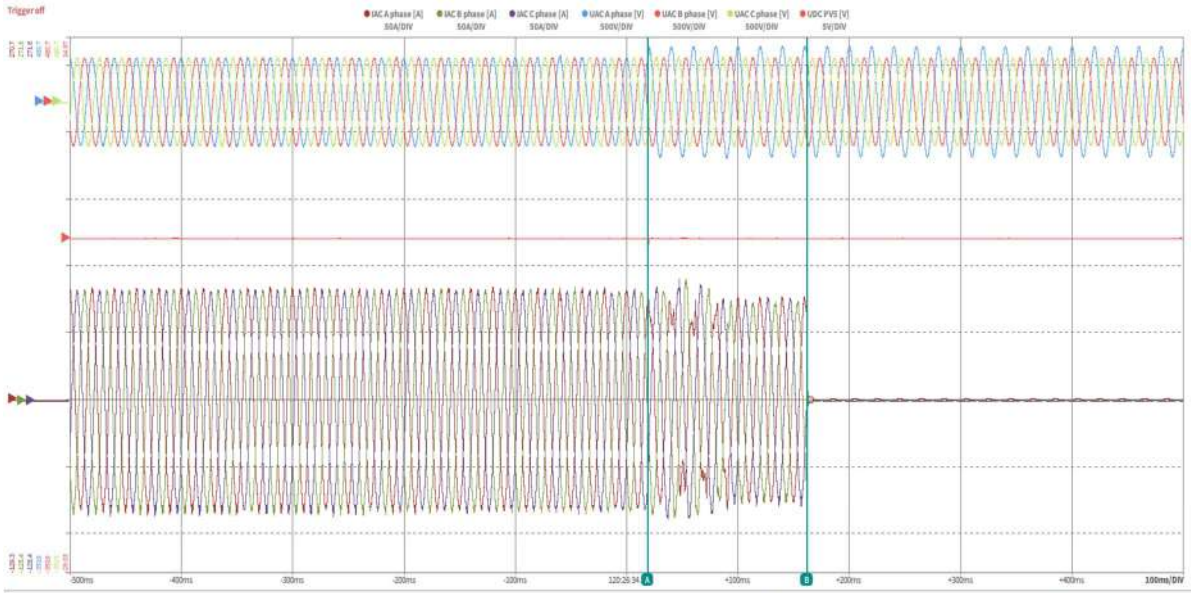
Scope pictures of the disconnection time

Over voltage - Stage 1 (L2 phase)



Time [s]	A 97:28:38.6064960	B 97:28:38.7568619	Delta 0.1503659
IAC A phase [A]	0.715482	1.580464	0.864983
IAC B phase [A]	69.38631	-0.527081	-69.91339
IAC C phase [A]	-70.37902	-1.385681	68.99333
UAC A phase [V]	3.942330	-39.99035	-43.93268
UAC B phase [V]	280.3827	-258.7371	-539.1198
UAC C phase [V]	-282.0738	292.0303	574.1041
UDC PVS [V]	-0.053295	-0.014910	0.038385

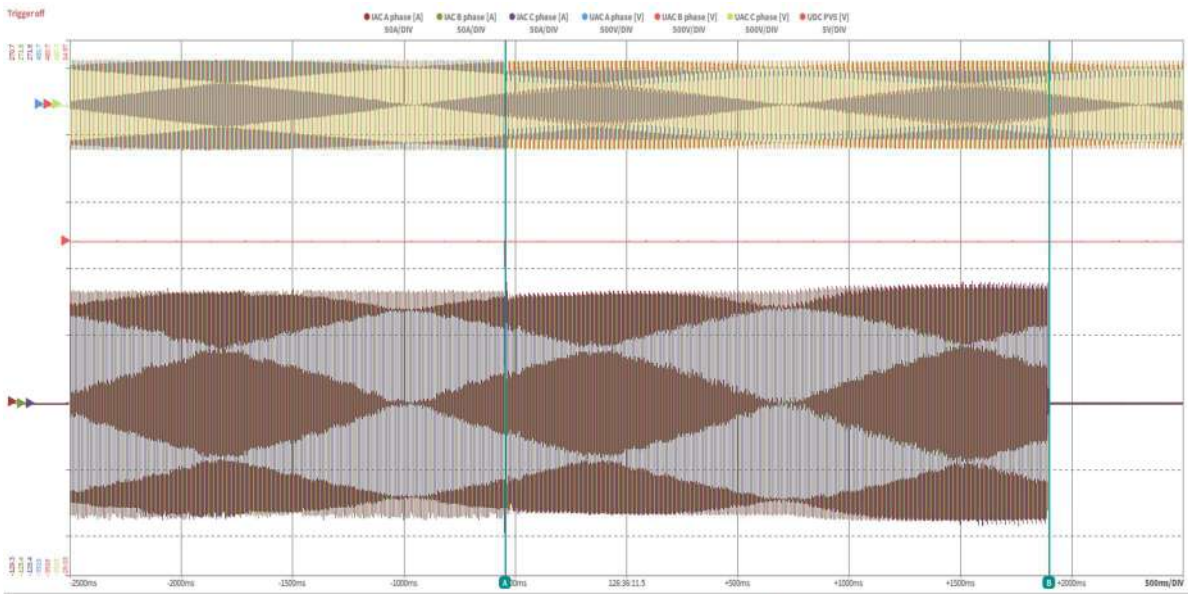
Over voltage - Stage 2 (L2 phase)



Time [s]	A 120:26:34.8311621	B 120:26:34.9742093	Delta 0.1430472
IAC A phase [A]	78.96399	11.34132	-67.62267
IAC B phase [A]	-22.03959	-13.34351	8.696080
IAC C phase [A]	-57.31749	2.050884	59.36838
UAC A phase [V]	317.6540	199.6172	-118.0368
UAC B phase [V]	-93.14749	-170.6679	-77.52038
UAC C phase [V]	-226.4259	35.32432	261.7502
UDC PVS [V]	-0.012287	-5.135e-3	7.153e-3

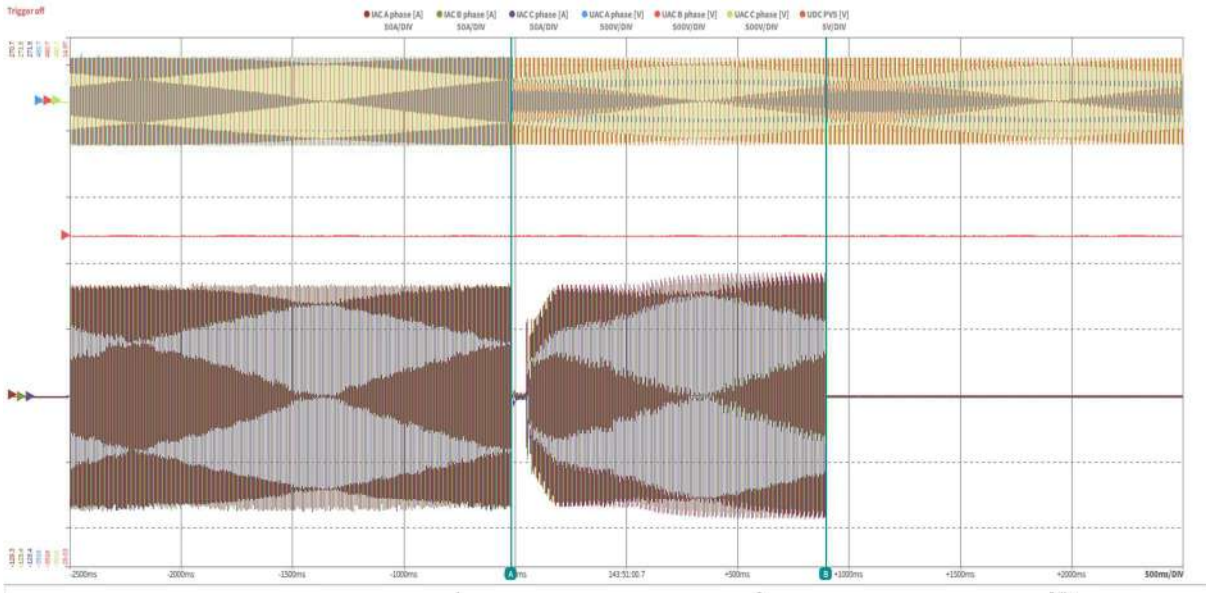
Scope pictures of the disconnection time

Under voltage - Stage 1 (L2 phase)



Time [s]	A 126:36:10.938904	B 126:36:13.380687	Delta 2.441783
IAC A phase [A]	-80.92357	-1.505626	79.41795
IAC B phase [A]	76.87695	-0.258622	-77.13557
IAC C phase [A]	3.936775	1.446016	-2.490759
UAC A phase [V]	-216.7107	-133.4118	83.29893
UAC B phase [V]	281.9632	323.8314	41.86821
UAC C phase [V]	-6.426355	-153.8179	-147.3916
UDC PVS [V]	-0.022539	-0.013241	9.298e-3

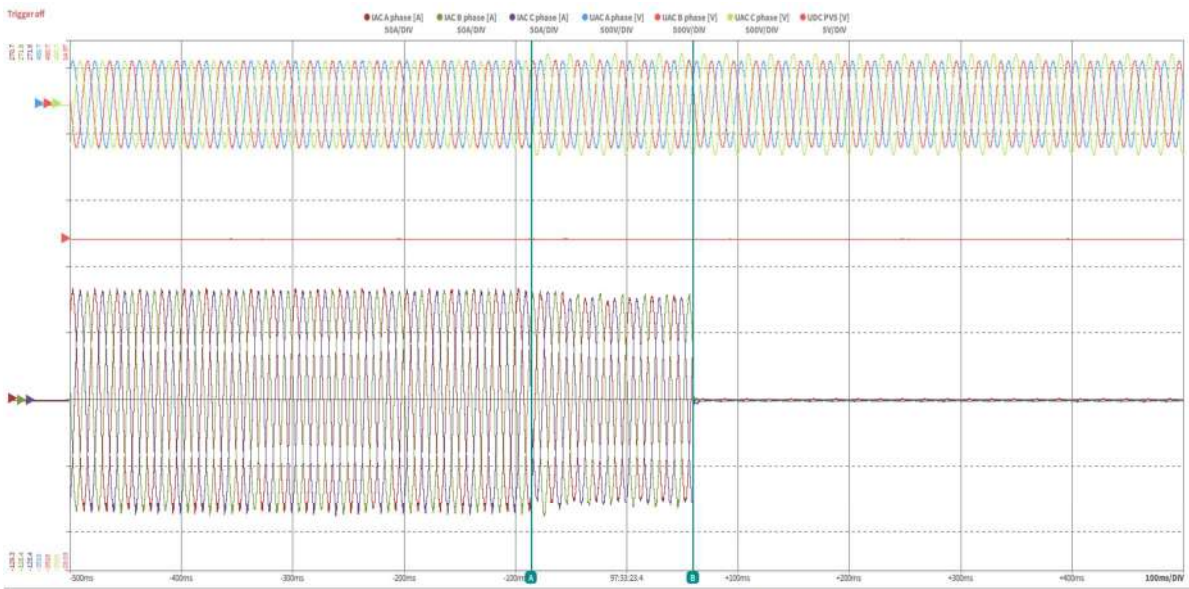
Under voltage - Stage 2 (L2 phase)



Time [s]	A 143:51:00.221601	B 143:51:01.635440	Delta 1.413839
IAC A phase [A]	-0.767005	-0.045312	0.721693
IAC B phase [A]	-1.071629	-0.284609	0.787020
IAC C phase [A]	1.585491	-0.258200	-1.843691
UAC A phase [V]	-127.1235	-37.09118	90.03234
UAC B phase [V]	295.9338	-234.1344	-530.0682
UAC C phase [V]	-29.72414	311.2135	340.9376
UDC PVS [V]	-0.010141	-6.565e-3	3.576e-3

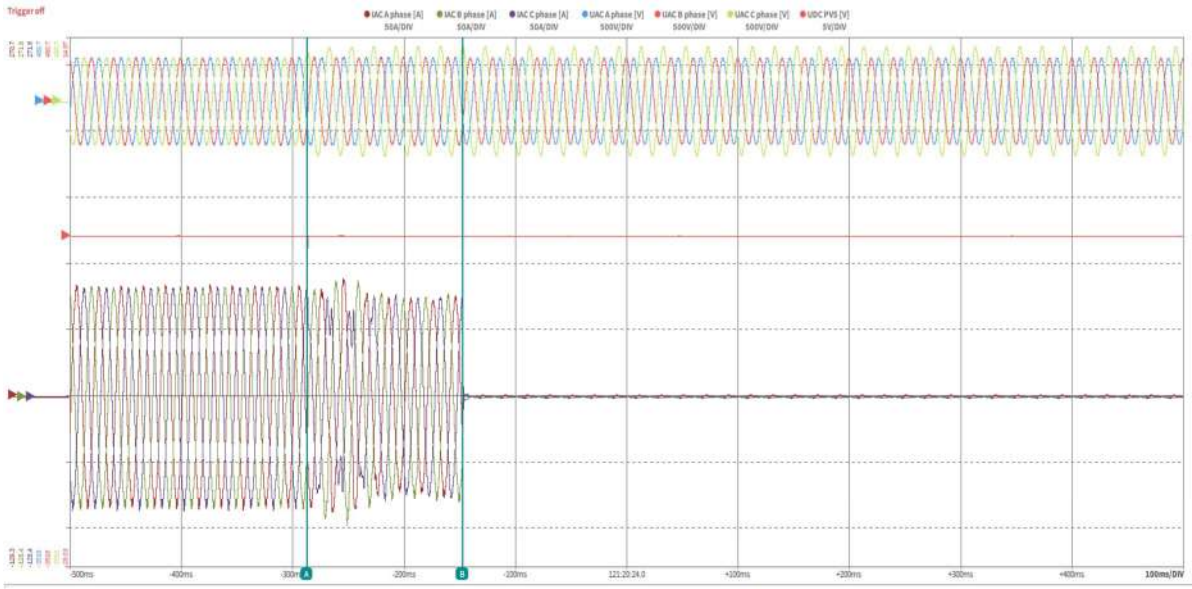
Scope pictures of the disconnection time

Over voltage - Stage 1 (L3 phase)



Time [s]	A 97:33:23.3027734	B 97:33:23.4481493	Delta 0.1453759
IAC A phase [A]	-67.60480	0.034797	67.63959
IAC B phase [A]	72.39539	2.768341	-69.62705
IAC C phase [A]	-5.188458	-3.438465	1.749992
UAC A phase [V]	-265.1784	207.5079	472.6863
UAC B phase [V]	298.2226	98.67743	-199.5452
UAC C phase [V]	-36.37841	-361.6171	-325.2387
UDC PVS [V]	-1.945385	-0.012049	1.933336

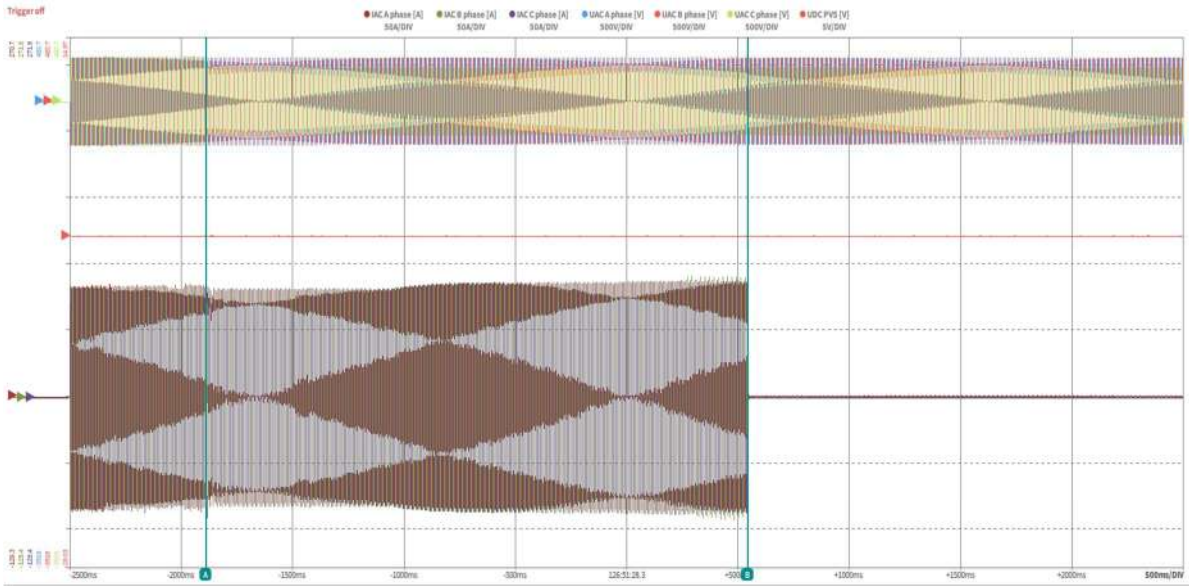
Over voltage - Stage 2 (L3 phase)



Time [s]	A 121:20:23.6709759	B 121:20:23.8106965	Delta 0.1397206
IAC A phase [A]	-35.04349	-27.13920	7.904292
IAC B phase [A]	-46.68850	-48.71148	-2.022982
IAC C phase [A]	81.23900	75.18960	-6.049395
UAC A phase [V]	-144.3116	-115.4198	28.89180
UAC B phase [V]	-181.1986	-207.3519	-26.15333
UAC C phase [V]	324.6844	403.9042	79.21982
UDC PVS [V]	-0.013241	-0.016579	-3.338e-3

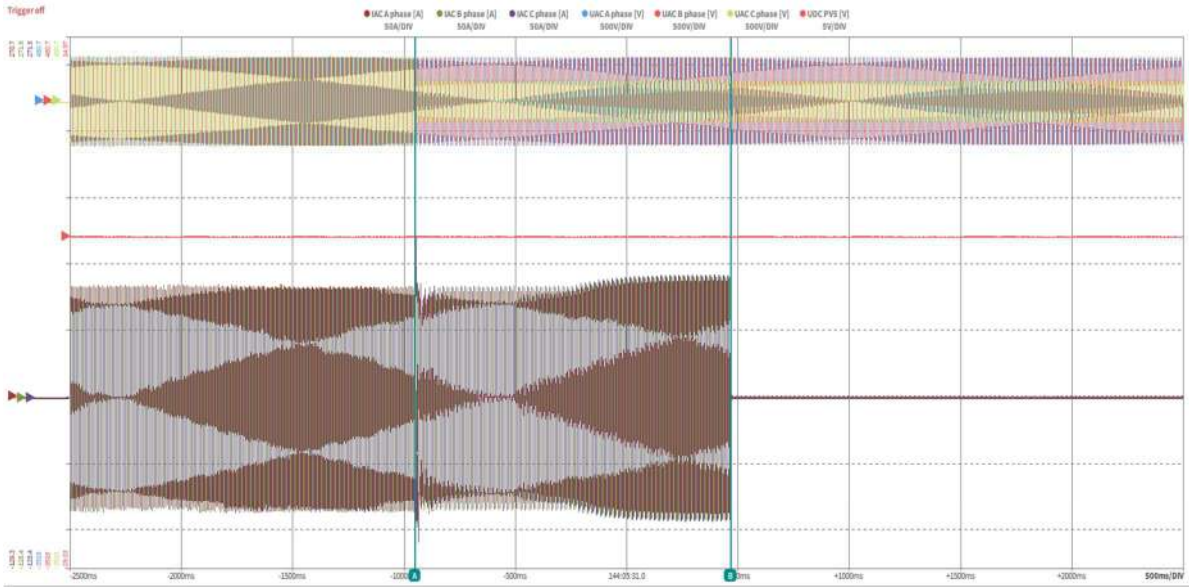
Scope pictures of the disconnection time

Under voltage - Stage 1 (L3 phase)



Time [s]	A 126:51:26.378809	B 126:51:28.810612	Delta 2.431803
IAC A phase [A]	-26.17074	1.744496	27.91524
IAC B phase [A]	84.72092	-1.309571	-86.03049
IAC C phase [A]	-59.08417	-0.797741	58.28643
UAC A phase [V]	-126.8296	-43.36969	83.45986
UAC B phase [V]	326.3722	-257.1263	-583.4985
UAC C phase [V]	-158.0341	234.7836	392.8178
UDC PVS [V]	-0.012287	-0.016102	-3.815e-3

Under voltage - Stage 2 (L3 phase)



Time [s]	A 144:05:30.052833	B 144:05:31.469999	Delta 1.417166
IAC A phase [A]	-4.165662	0.875461	5.041123
IAC B phase [A]	-67.75826	0.347200	68.10546
IAC C phase [A]	71.63311	-1.299612	-72.93272
UAC A phase [V]	-32.14900	245.1042	277.2532
UAC B phase [V]	-266.4687	-307.0953	-40.62653
UAC C phase [V]	296.5076	29.63732	-266.8703
UDC PVS [V]	-7.757e-3	-7.519e-3	2.384e-4

4.9.3 4.9.3.1	**Requirements on voltage and frequency protection** **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:	493 s	
	Phase 3:	495 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:	319 s	The disconnection time should be about 50 % of the value measured in a), *
	Phase 2:	328 s	
	Phase 3:	328 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.

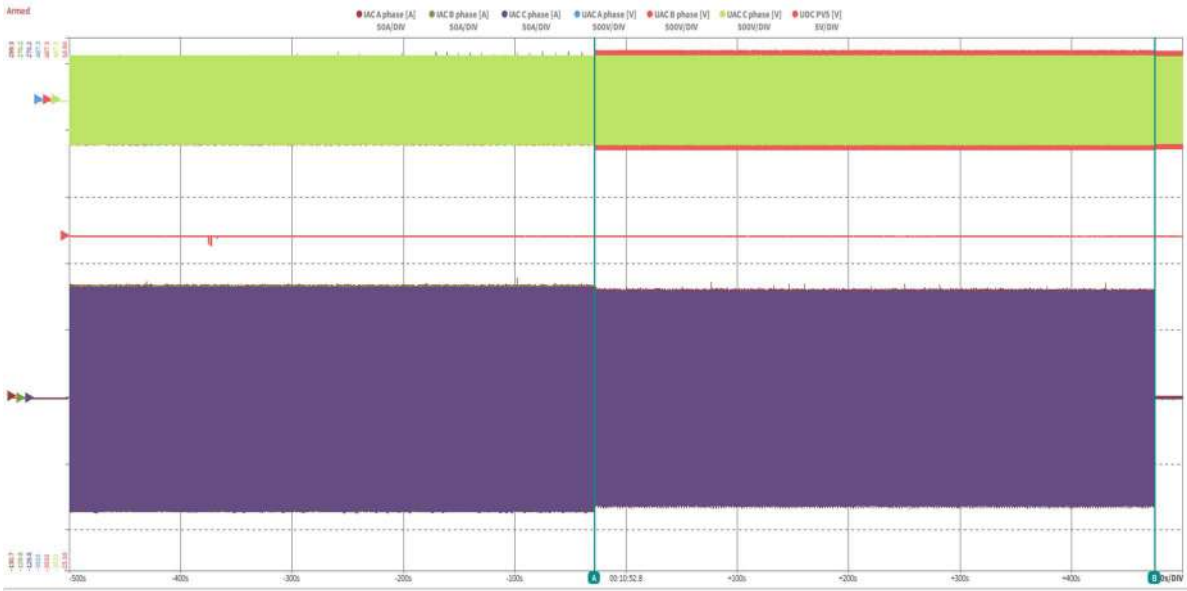
Note:

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.

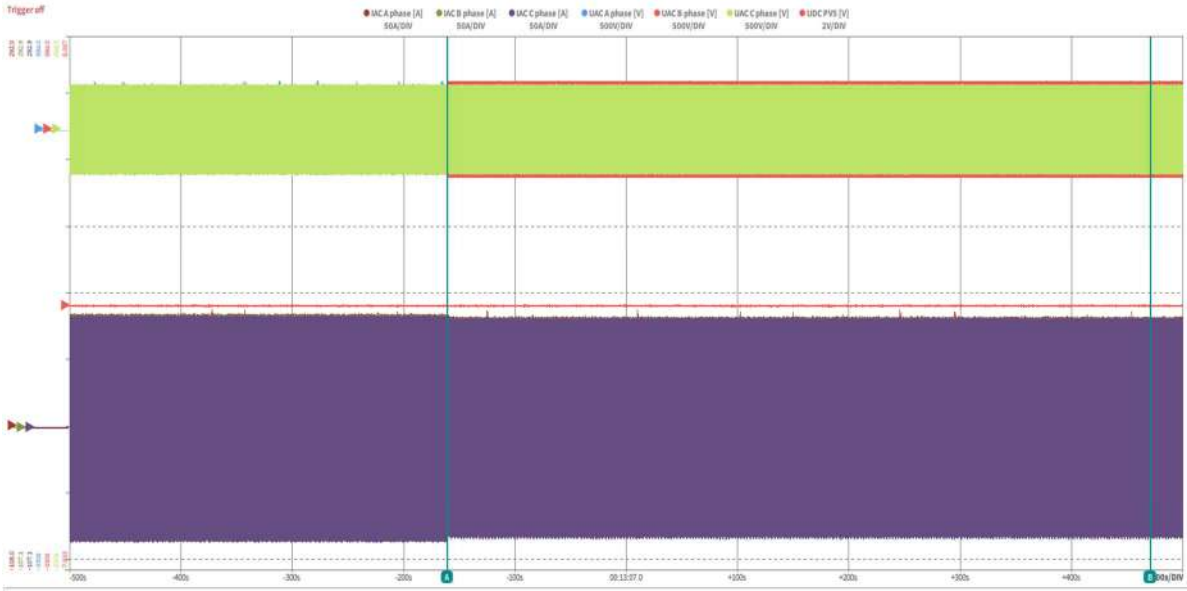
The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

a) Voltage set to 112 % U_n for phase 1:



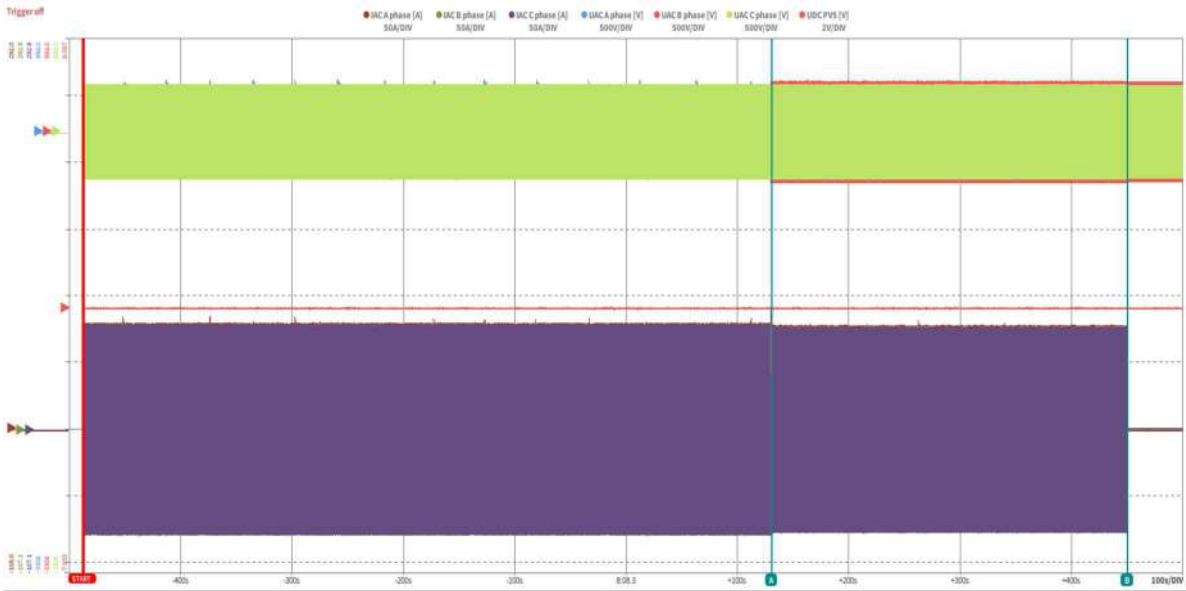
	A	B	Delta
Time [s]	00:10:24.5042	00:18:47.4982	8:22.9940
IAC A phase [A]	56.17713	-51.65769	-107.8348
IAC B phase [A]	19.79930	77.87354	58.07424
IAC C phase [A]	-76.25007	-26.85928	49.39080
UAC A phase [V]	234.9535	-215.8167	-450.7702
UAC B phase [V]	74.29556	356.6108	282.3153
UAC C phase [V]	-310.9768	-104.6739	206.3029
UDC PV5 [V]	-0.010618	-0.013956	-3.338e-3

b) Voltage set to 108% U_n phase 1:



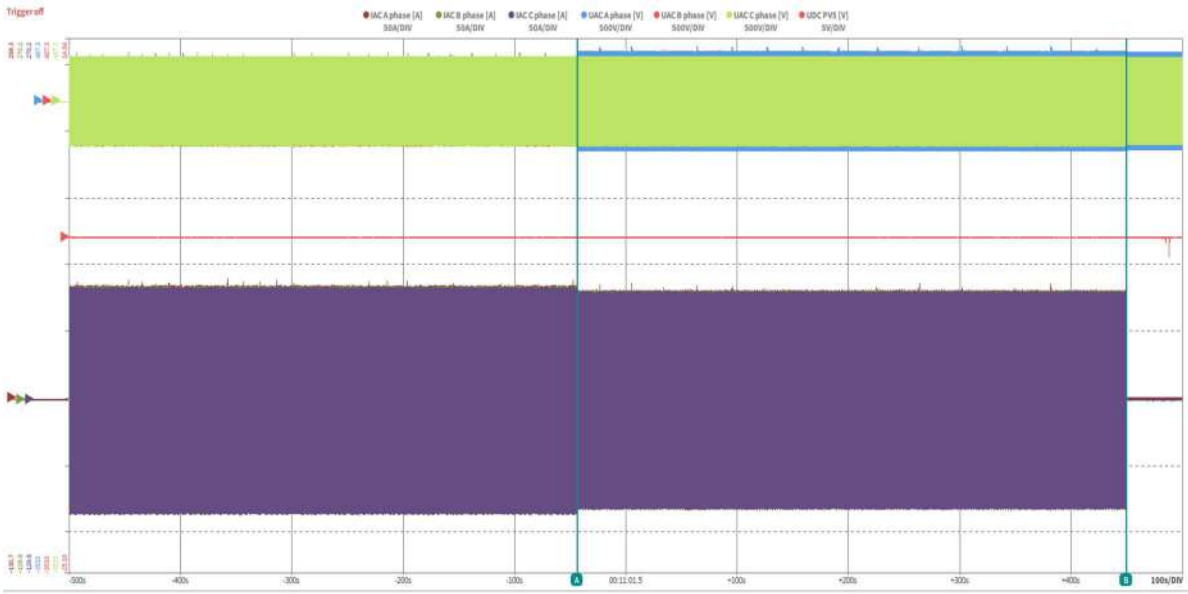
	A	B	Delta
Time [s]	00:10:26.5429	00:20:57.7532	00:10:31.2103
IAC A phase [A]	19.69265	22.19509	2.502442
IAC B phase [A]	-76.84320	54.27510	131.1183
IAC C phase [A]	56.78297	-77.12650	-133.9095
UAC A phase [V]	78.60001	91.64366	13.04364
UAC B phase [V]	-314.1045	250.8848	564.9894
UAC C phase [V]	231.7572	-320.8371	-552.5942
UDC PV5 [V]	-0.016340	-0.011334	5.007e-3

c) Voltage set to 106 % U_n, thereafter 114% U_n phase 1:



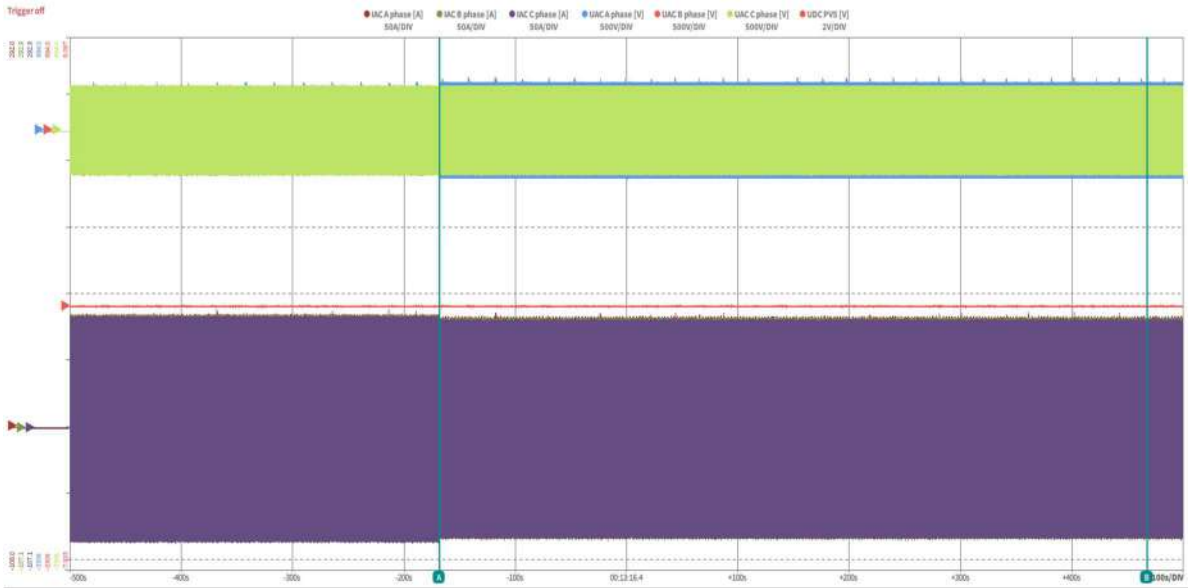
Time [s]	A 00:10:19.0736	B 00:15:38.4349	Delta 5:19.3613
IAC A phase [A]	25.18462	60.84060	35.65598
IAC B phase [A]	47.43201	4.635159	-42.79685
IAC C phase [A]	-73.11225	-65.99640	7.115841
UAC A phase [V]	118.6653	286.3198	167.6545
UAC B phase [V]	244.3469	21.55212	-222.7948
UAC C phase [V]	-340.8091	-308.5912	32.21798
UDC PVS [V]	-0.014671	-0.010857	3.815e-3

a) Voltage set to 112 % Un for phase 2:



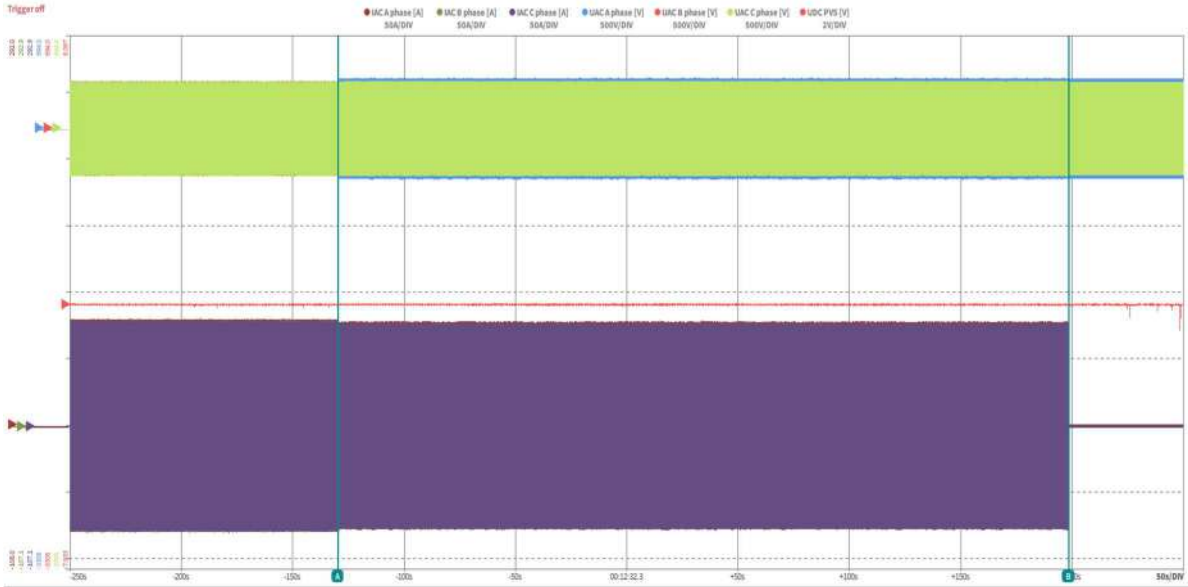
Time [s]	A 00:10:17.8921	B 00:18:30.9061	Delta 8:13.0140
IAC A phase [A]	-70.67801	-40.39599	30.28202
IAC B phase [A]	68.92426	-38.07014	-106.9944
IAC C phase [A]	1.295336	78.21752	76.92218
UAC A phase [V]	-286.6537	-189.8417	96.81202
UAC B phase [V]	280.1047	-159.2893	-439.3940
UAC C phase [V]	2.928237	332.5813	329.6530
UDC PVS [V]	-0.011810	-0.012764	-9.537e-4

b) Voltage set to 108% Un phase 2:



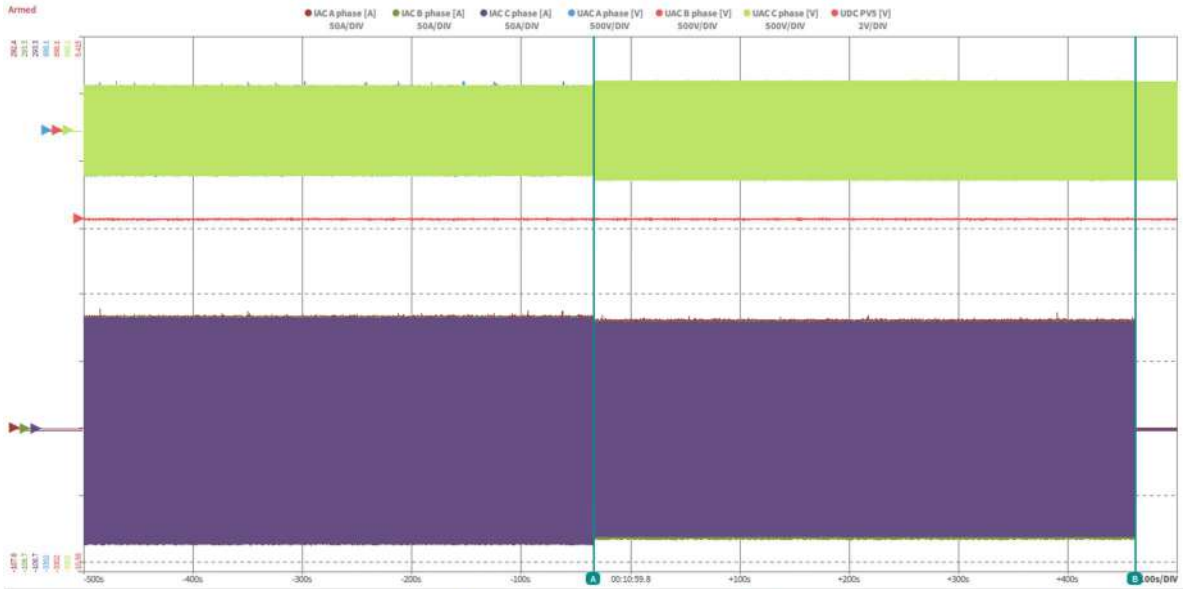
Time [s]	A 00:10:28.2612	B 00:21:03.7638	Delta 00:10:35.5026
IAC A phase [A]	24.89160	-66.13399	-91.02560
IAC B phase [A]	-80.14745	-2.978978	77.16847
IAC C phase [A]	54.80577	68.70772	13.90195
UAC A phase [V]	96.50263	-293.5175	-390.0202
UAC B phase [V]	-316.2706	-14.85011	301.4205
UAC C phase [V]	219.6147	290.7746	71.15984
UDC PVS [V]	-0.011572	-7.757e-3	3.815e-3

c) Voltage set to 106 % Un, thereafter 114% Un phase 2:



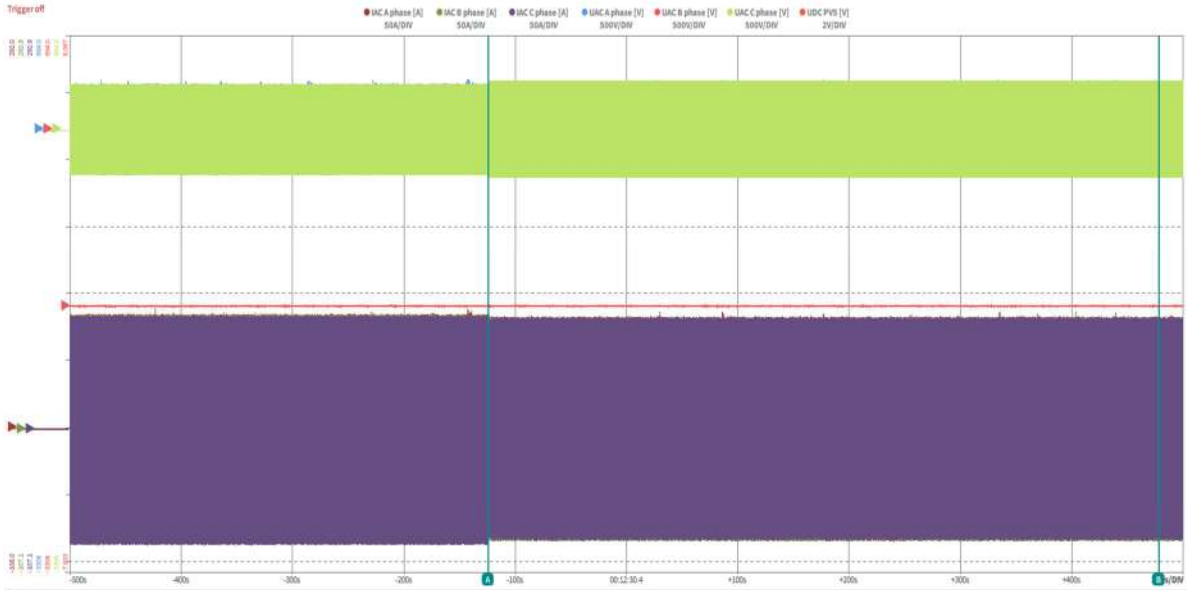
Time [s]	A 00:10:22.7614	B 00:15:50.7721	Delta 5:28.0106
IAC A phase [A]	-52.52220	72.09419	124.6164
IAC B phase [A]	-22.62586	-13.61435	9.011508
IAC C phase [A]	74.57925	-58.78257	-133.3618
UAC A phase [V]	-242.0399	346.9664	589.0062
UAC B phase [V]	-94.17579	-55.98042	38.19537
UAC C phase [V]	334.9600	-269.8756	-604.8355
UDC PVS [V]	2.972e-3	-1.082e-3	-4.053e-3

a) Voltage set to 112 % Un for phase 3:



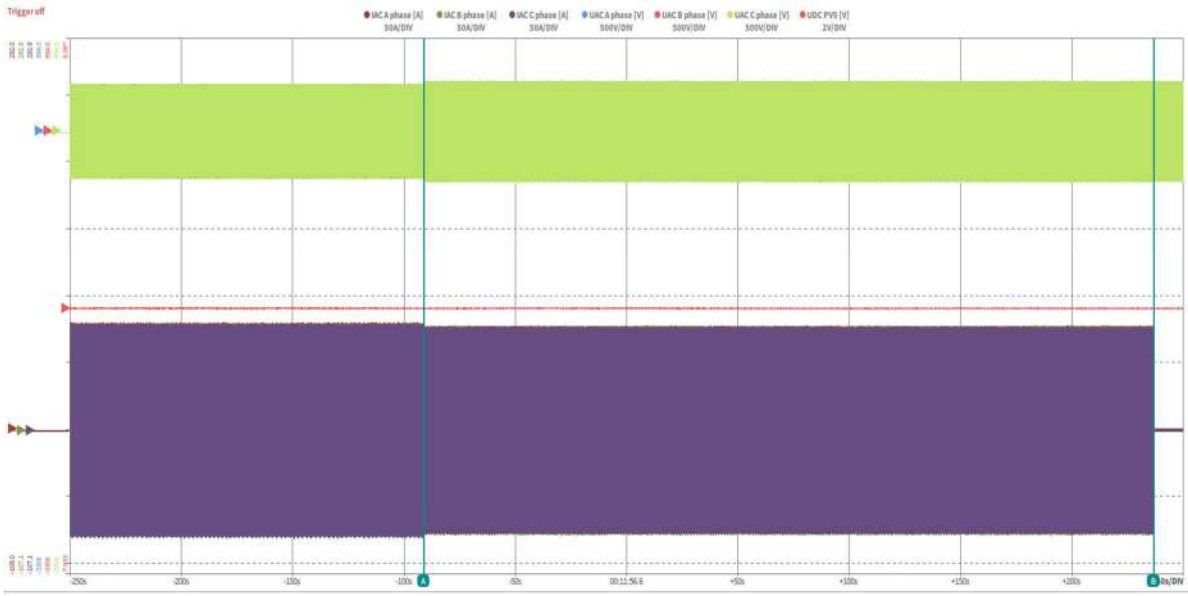
Time [s]	A 00:10:26.2779	B 00:18:41.3679	Delta 8:15.0900
IAC A phase [A]	69.93841	-0.075353	-70.01377
IAC B phase [A]	-9.491620	-0.559983	8.931637
IAC C phase [A]	-61.02538	0.290163	61.31554
UAC A phase [V]	296.0483	-324.1162	-620.1644
UAC B phase [V]	-32.38961	134.4264	166.8160
UAC C phase [V]	-299.6505	212.2738	511.9243
UDC PV5 [V]	-0.019917	-8.949e-3	0.010967

b) Voltage set to 108% Un phase 3:



Time [s]	A 00:10:26.4199	B 00:20:28.5489	Delta 00:10:02.1291
IAC A phase [A]	78.56321	-78.75301	-157.3162
IAC B phase [A]	-32.19002	42.57733	74.76736
IAC C phase [A]	-46.91123	35.72536	82.63660
UAC A phase [V]	323.2406	-326.0044	-649.2451
UAC B phase [V]	-129.1780	174.7613	303.9394
UAC C phase [V]	-194.4883	162.1447	356.6330
UDC PV5 [V]	-0.011572	-0.015864	-4.292e-3

c) Voltage set to 106 % Un, thereafter 114% Un phase 3:



Time [s]	A 00:10:25.5692	B 00:15:53.2472	Delta 5:27.6780
IAC A phase [A]	-35.30432	0.416266	35.72059
IAC B phase [A]	-41.56107	-0.394520	41.16655
IAC C phase [A]	76.60795	-0.363581	-76.97154
UAC A phase [V]	-163.6488	-12.42940	151.2194
UAC B phase [V]	-182.7395	-290.6861	-107.9466
UAC C phase [V]	348.0461	327.8441	-20.20192
UDC PV5 [V]	2.256e-3	1.541e-3	-7.153e-4

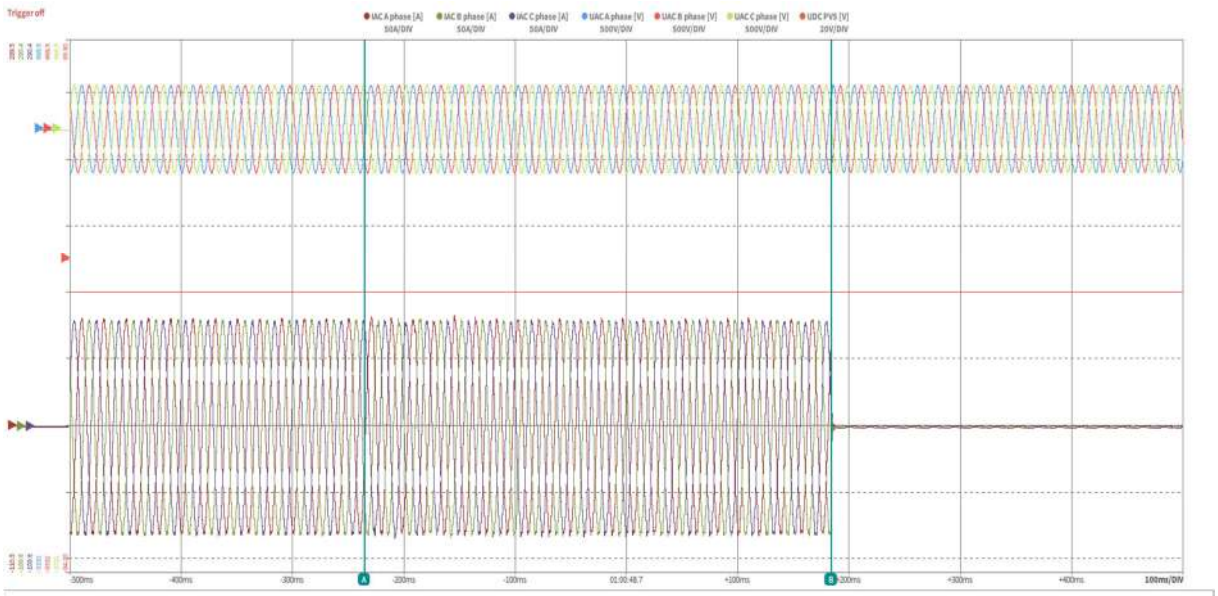
4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under frequency)					P
Test conditions	Output power: 40,0kW U_n = 230Vac				
	Under-frequency		**Over-frequency**		
Parameter	**Stage 1 Under-Frequency**	**Time**	**Stage 1 Over-Frequency**	**Time**	
Limit	47,50 Hz	0,3 ≤ t ≤ 0,5 s	51,50 Hz	0,3 ≤ t ≤ 0,5 s	
Trip value [Hz]	47,50 Hz		51,50 Hz		
	47,50 Hz		51,50 Hz		
	47,50 Hz		51,50 Hz		
	47,50 Hz		51,50 Hz		
	47,50 Hz		51,50 Hz		
Disconnection time [s]	50,00 Hz to 47,40 Hz	0,417	50,00 Hz to 51,60 Hz	0,418	
		0,411		0,419	
		0,416		0,420	
		0,419		0,407	
		0,406		0,410	
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 Hz		52,00 Hz		
	47,00 Hz		52,00 Hz		
	47,00 Hz		52,00 Hz		
	47,00 Hz		52,00 Hz		
	47,00 Hz		52,00 Hz		
Disconnection time [s]	50,00 Hz to 46,90 Hz	0,144	50,00 Hz to 52,10 Hz	0,146	
		0,132		0,146	
		0,143		0,146	
		0,152		0,153	
		0,131		0,151	

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

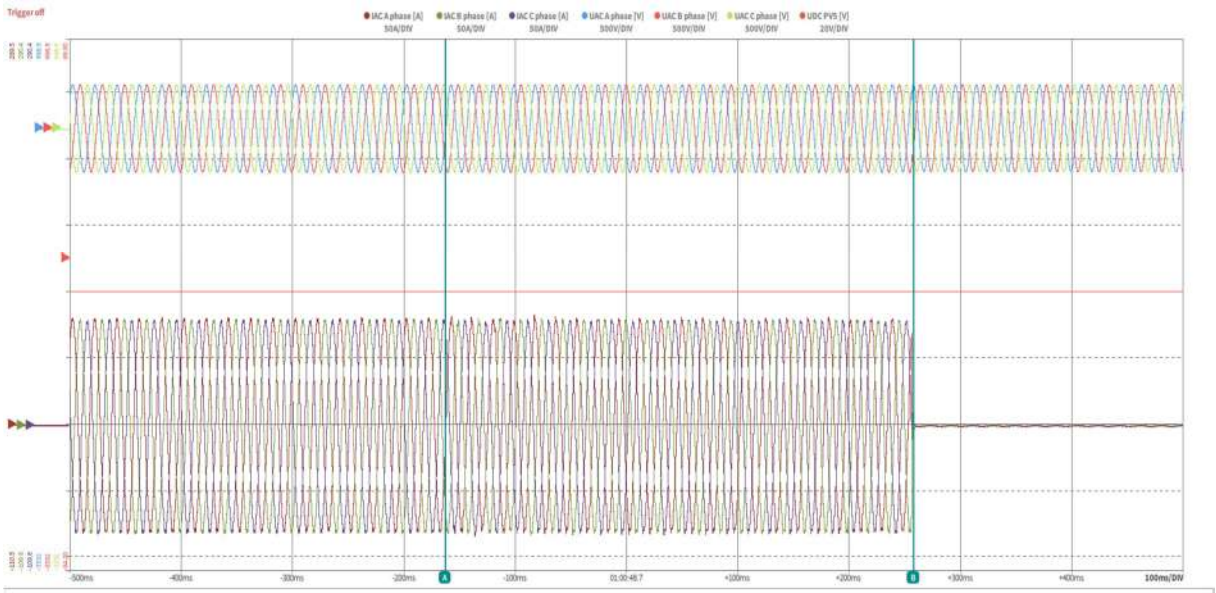
Scope pictures of the disconnection time

Under frequency - Stage 1



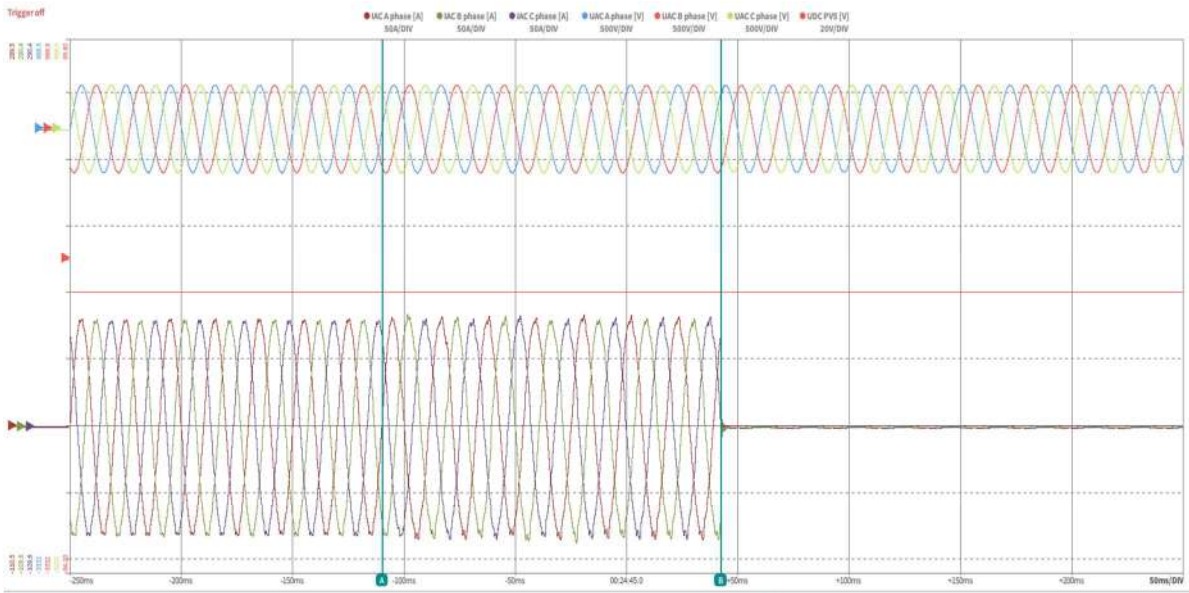
Time [s]	A 01:00:48.5033946	B 01:00:48.9225562	Delta 0.4191617
IAC A phase [A]	-31.78526	60.74833	92.53359
IAC B phase [A]	-48.63145	-74.11076	-25.47932
IAC C phase [A]	79.21862	12.24684	-66.97178
UAC A phase [V]	-134.4752	255.7760	390.2512
UAC B phase [V]	-191.7467	-302.0995	-110.3528
UAC C phase [V]	325.8255	44.43262	-281.3928
UDC PVS [V]	-10.01419	-10.00727	6.914e-3

Over frequency - Stage 1



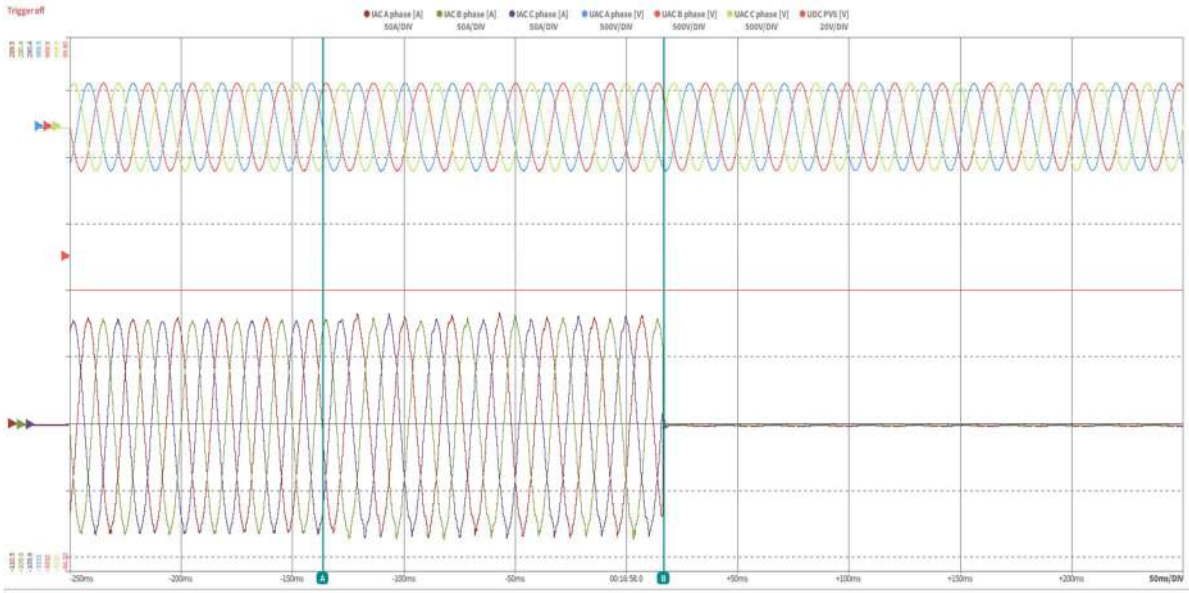
Time [s]	A 01:00:48.5040168	B 01:00:48.9245092	Delta 0.4204923
IAC A phase [A]	-15.12123	-1.252425	13.86881
IAC B phase [A]	-60.46368	-0.530017	59.93367
IAC C phase [A]	74.45406	0.787961	-73.66610
UAC A phase [V]	-64.66214	322.1563	386.8184
UAC B phase [V]	-244.2443	-165.2009	79.04339
UAC C phase [V]	310.1897	-157.6360	-467.8257
UDC PVS [V]	-10.02682	-10.01466	0.012159

Under frequency - Stage 2



	A	B	Delta
Time [s]	00:24:44.9340859	00:24:45.0861152	0.1520293
IAC A phase [A]	11.69609	4.648912	-7.047177
IAC B phase [A]	-74.81553	-5.986465	68.82906
IAC C phase [A]	61.93375	0.562417	-61.37133
UAC A phase [V]	40.35099	265.3151	224.9642
UAC B phase [V]	-300.8950	-258.4660	42.42897
UAC C phase [V]	261.3220	-9.576818	-270.8988
UDC PVS [V]	-9.320626	-10.01800	-0.697374

Over frequency - Stage 2



	A	B	Delta
Time [s]	00:16:57.8422073	00:16:57.9952346	0.1530273
IAC A phase [A]	-9.393944	-6.212009	3.181935
IAC B phase [A]	71.94780	5.511510	-66.43629
IAC C phase [A]	-63.70188	-0.642074	63.05981
UAC A phase [V]	-22.77080	-305.4575	-282.6867
UAC B phase [V]	293.5591	224.5889	-68.97021
UAC C phase [V]	-271.1335	76.87925	348.0127
UDC PVS [V]	-7.462630	-10.01252	-2.549887

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

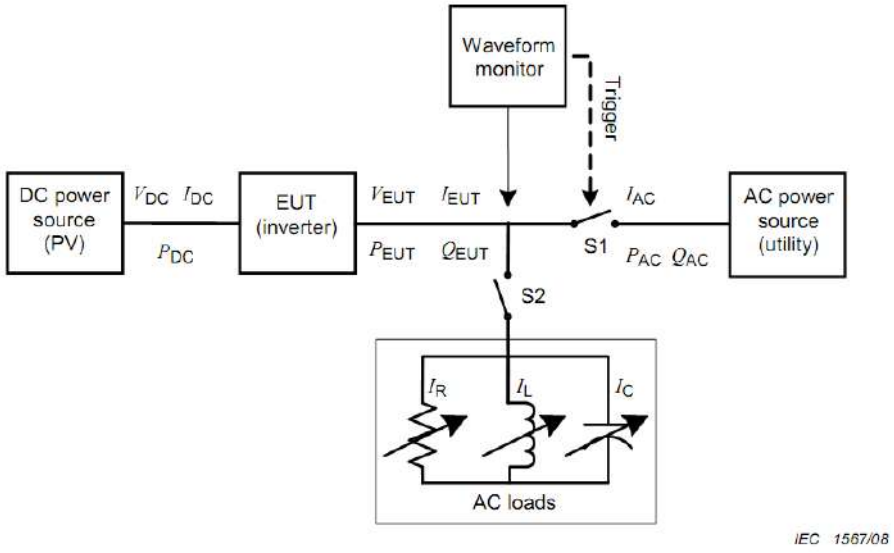


Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

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)

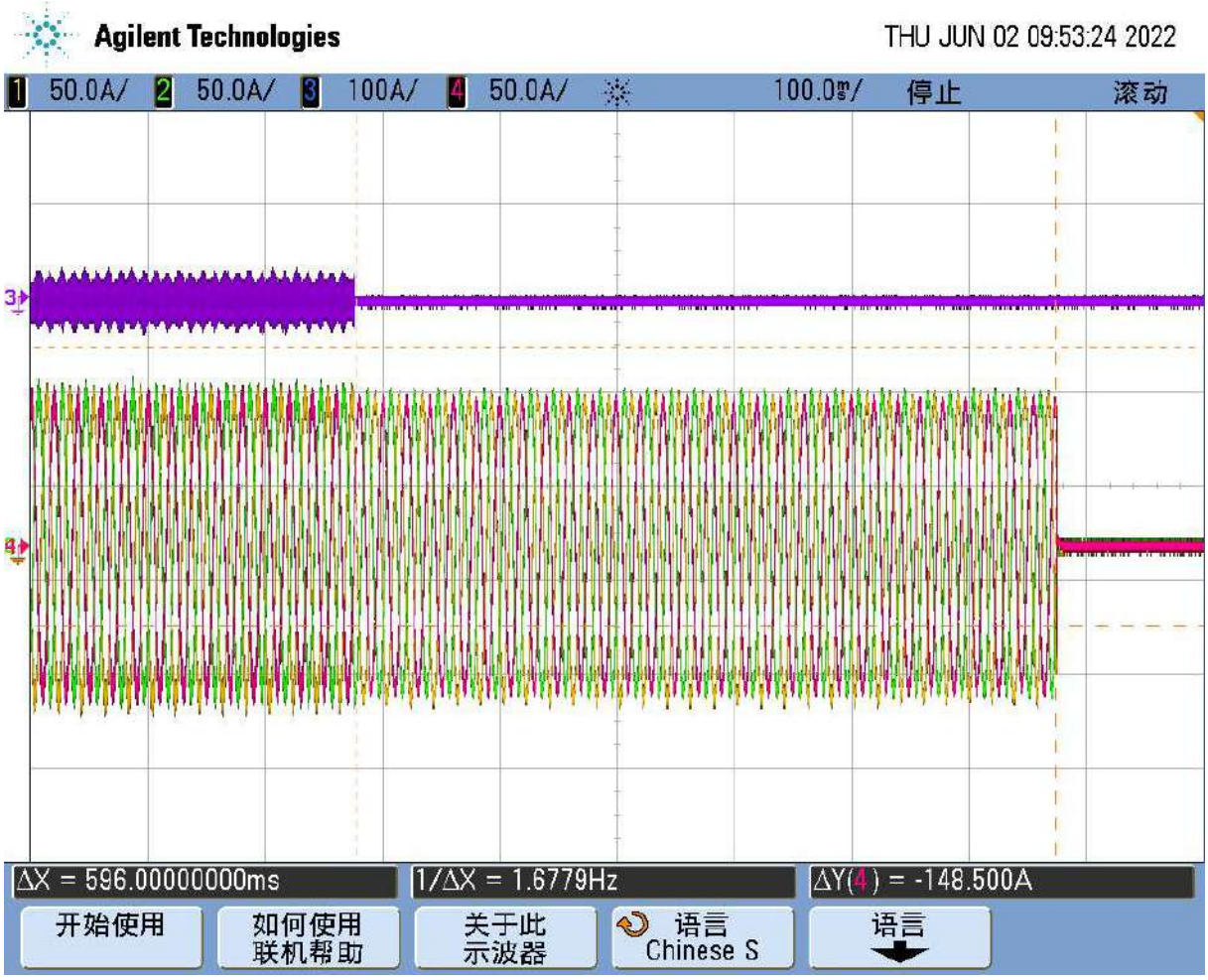
No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1)	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks 5)
1	100	100	0	0	0,54	13,333	750	0,993	596	BL
2	100	100	-10	-10	--	--	--	--	--	IB
3	100	100	-10	-5	--	--	--	--	--	IB
4	100	100	-10	0	--	--	--	--	--	IB
5	100	100	-10	+5	--	--	--	--	--	IB
6	100	100	-10	+10	--	--	--	--	--	IB
7	100	100	-5	-10	--	--	--	--	--	IB
8	100	100	-5	-5	4,13	13,333	750	1,020	493	IB
9	100	100	-5	0	2,96	13,333	750	1,029	575	IB
10	100	100	-5	+5	4,09	13,333	750	1,054	466	IB
11	100	100	-5	+10	--	--	--	--	--	IB
12	100	100	0	-10	--	--	--	--	--	IB
13	100	100	0	-5	2,96	13,333	750	0,967	477	IB
14	100	100	0	+5	2,90	13,333	750	1,000	547	IB
15	100	100	0	+10	--	--	--	--	--	IB
16	100	100	+5	-10	--	--	--	--	--	IB
17	100	100	+5	-5	4,12	13,333	750	0,919	499	IB
18	100	100	+5	0	2,89	13,333	750	0,930	538	IB
19	100	100	+5	+5	4,18	13,333	750	0,951	501	IB
20	100	100	+5	+10	--	--	--	--	--	IB
21	100	100	+10	-10	--	--	--	--	--	IB
22	100	100	+10	-5	--	--	--	--	--	IB
23	100	100	+10	0	--	--	--	--	--	IB
24	100	100	+10	+5	--	--	--	--	--	IB
25	100	100	+10	+10	--	--	--	--	--	IB

Parameter at 0% per phase	L= 4,21mH	R= 1,32Ω	C= 2408,10µF

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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	1,93	8.800	650	0,993	480	IB
2	66	66	0	-4	1,59	8.800	650	0,998	517	IB
3	66	66	0	-3	1,18	8.800	650	1,000	541	IB
4	66	66	0	-2	0,83	8.800	650	1,008	545	IB
5	66	66	0	-1	0,52	8.800	650	1,014	602	IB
6	66	66	0	0	0,34	8.800	650	1,021	610	BL
7	66	66	0	+1	0,47	8.800	650	1,024	599	IB
8	66	66	0	+2	0,84	8.800	650	1,030	584	IB
9	66	66	0	+3	1,19	8.800	650	1,022	546	IB
10	66	66	0	+4	1,55	8.800	650	1,040	534	IB
11	66	66	0	+5	1,95	8.800	650	1,043	522	IB

Parameter at 0% per phase	L= 6,38mH	R= 2,00Ω	C= 1589,35µF

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

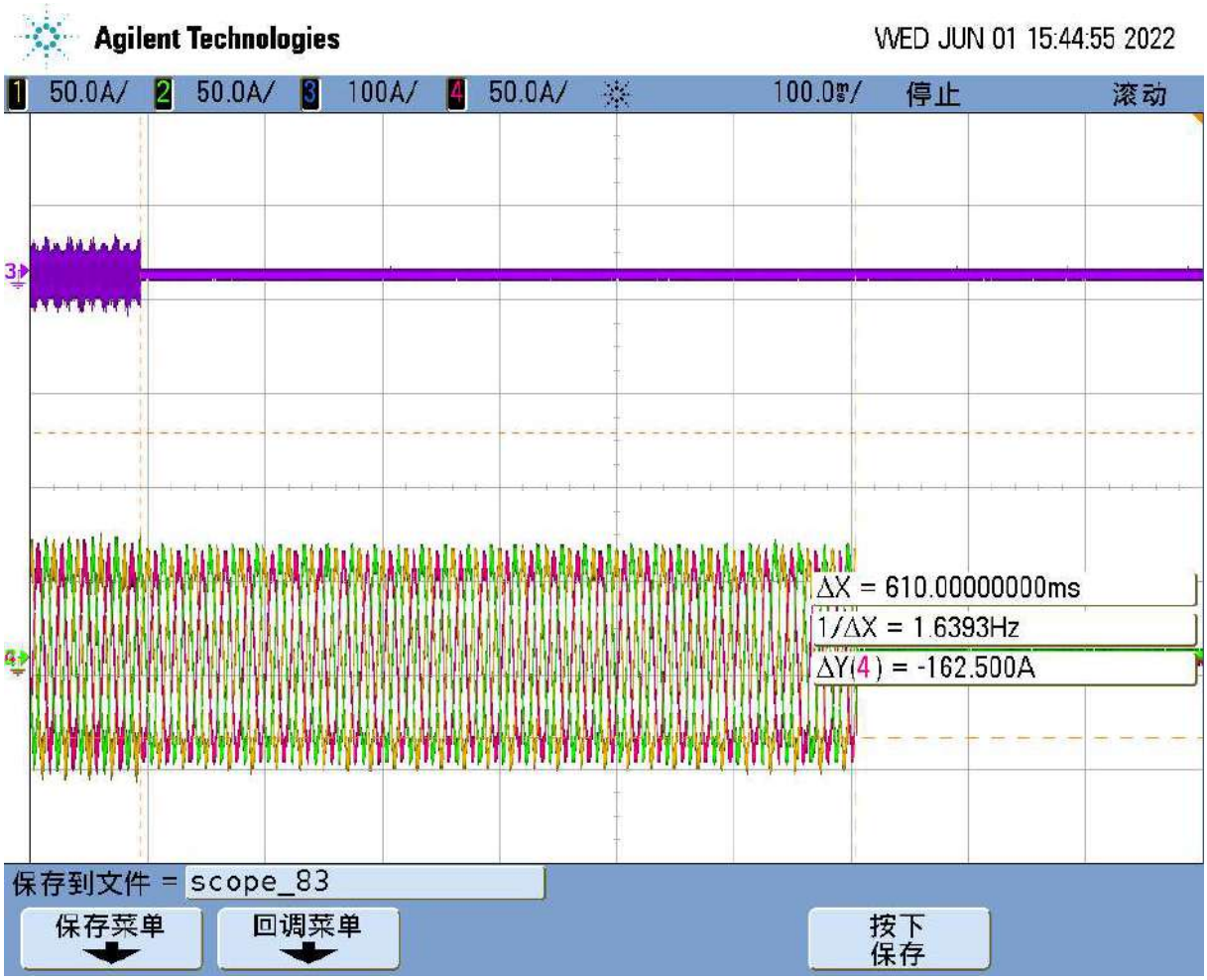
EUT input voltage 6) = 50 % of rated input voltage range, ±10 %

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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 :

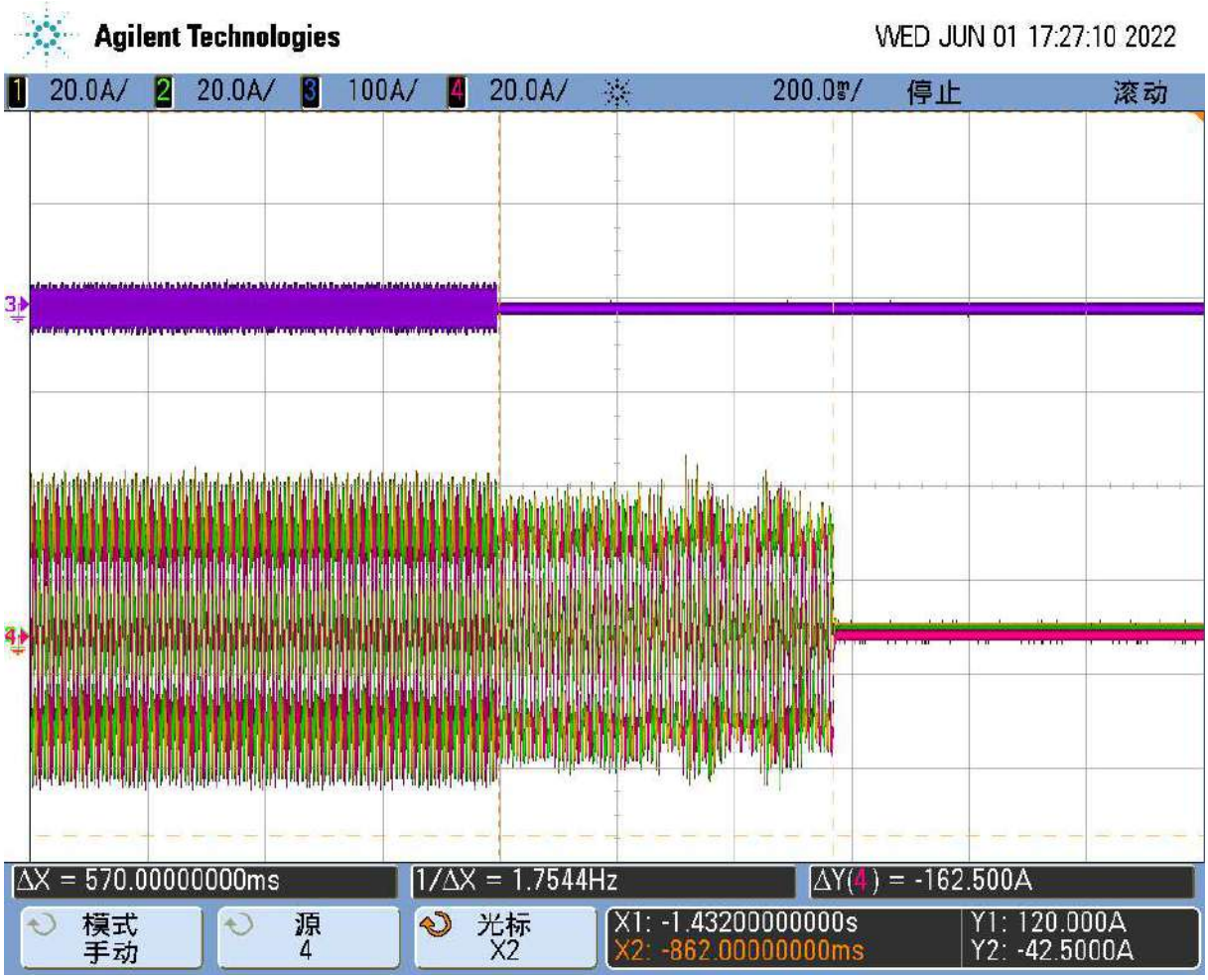
Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

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	0,92	4.400	480	1,019	466	IB
2	33	33	0	-4	0,76	4.400	480	1,019	480	IB
3	33	33	0	-3	0,56	4.400	480	1,030	436	IB
4	33	33	0	-2	0,42	4.400	480	1,035	549	IB
5	33	33	0	-1	0,28	4.400	480	1,040	524	IB
6	33	33	0	0	0,20	4.400	480	1,040	570	BL
7	33	33	0	+1	0,25	4.400	480	1,045	565	IB
8	33	33	0	+2	0,41	4.400	480	1,051	562	IB
9	33	33	0	+3	0,56	4.400	480	1,057	513	IB
10	33	33	0	+4	0,73	4.400	480	1,060	508	IB
11	33	33	0	+5	0,89	4.400	480	1,066	155	IB

Parameter at 0% per phase	L= 12,76mH	R= 4,01Ω	C= 794,67µF

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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 :	195,5
	Max. voltage for connected to grid :	253,0
	Min. frequency for connected to grid :	49,50
	Max. frequency for connected to grid (Normal operational start-up) :	50,10
	Max. frequency for connected to grid (Automatic reconnection after tripping) :	50,20
	Observation time (≥60s) :	60,00

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]	61,0 s	61,0 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]	65,0 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.	
	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]	65,0 s	62,0 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]	61,0 s	62,0 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 50,10Hz.

Test condition f): frequency within the limits of 49,50Hz to 50,20Hz.

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.

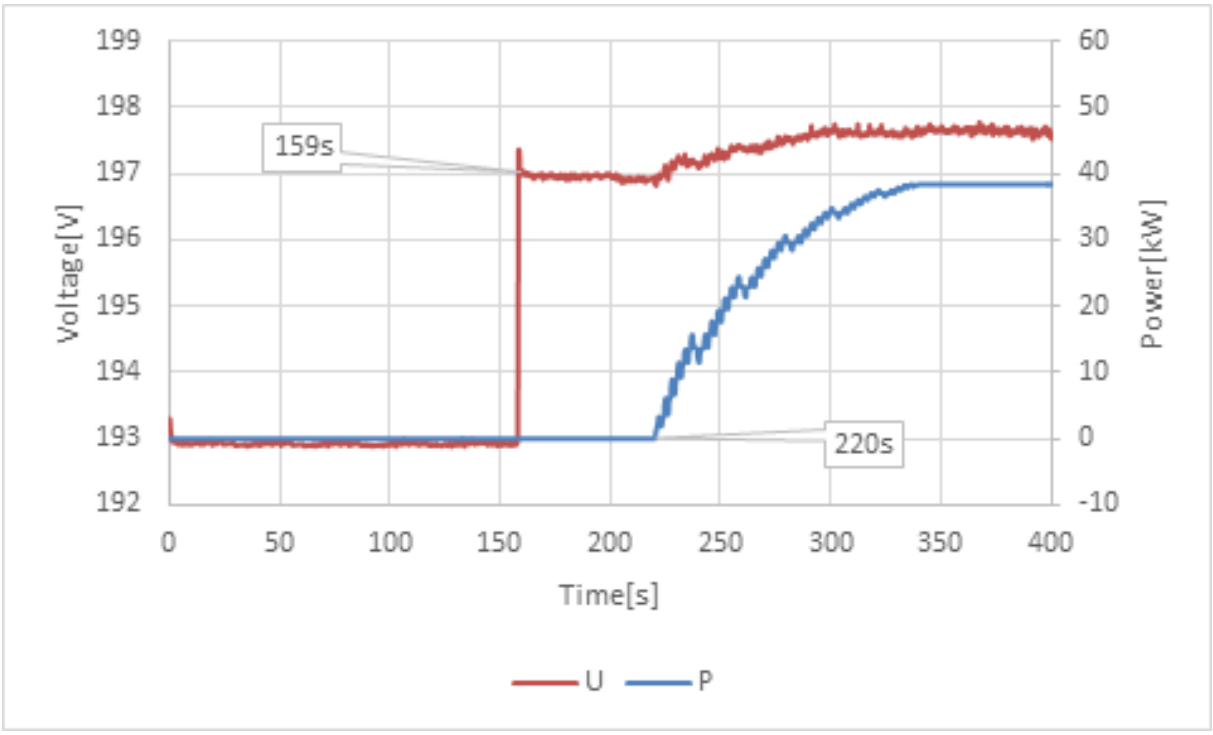
Assessment criterion:

a) the micro generator connects respectively starts generating electrical power only in the permitted range of voltage and frequency and
b) 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
c) 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.

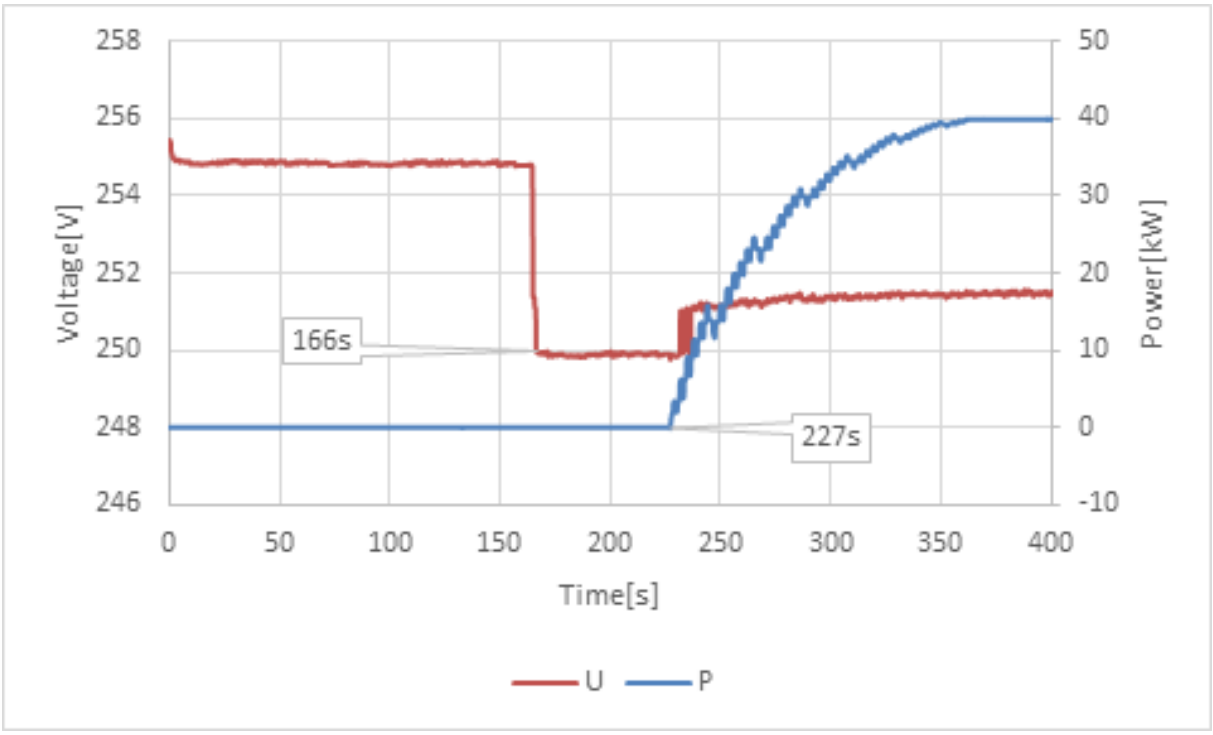
Note:

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

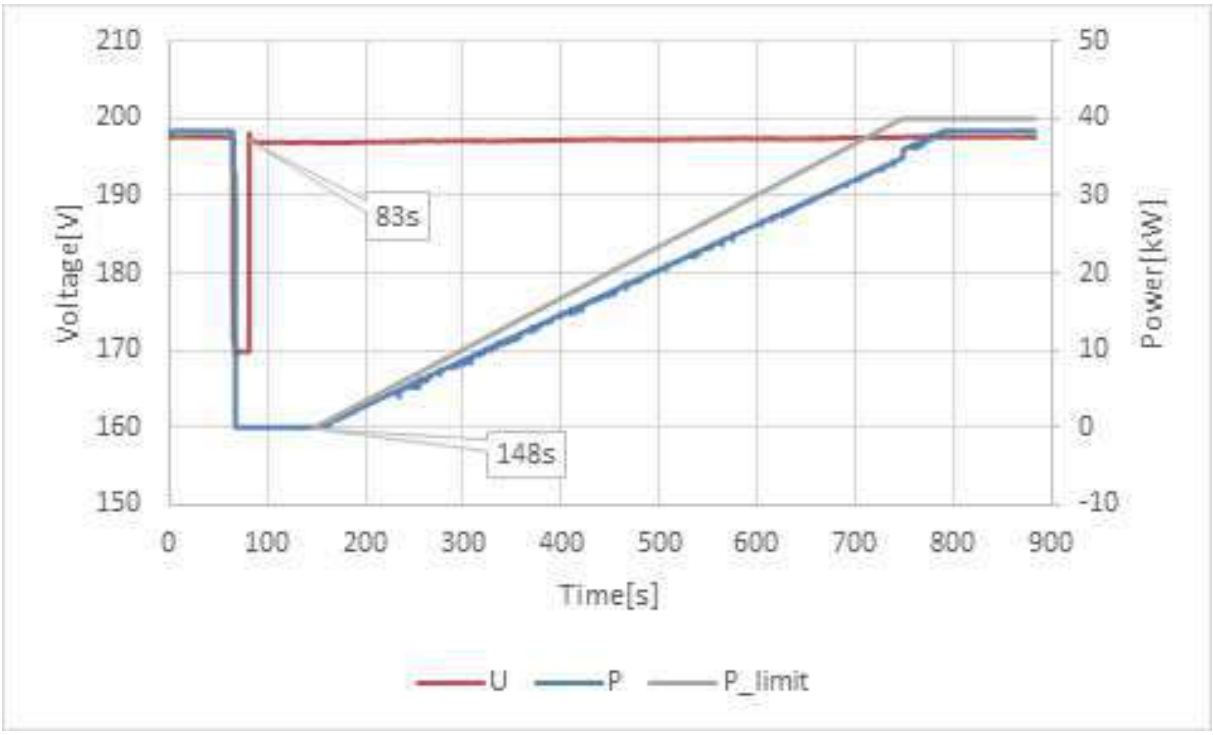
Graph of the gradual power supply : Test b) for ≥ 85% U_n



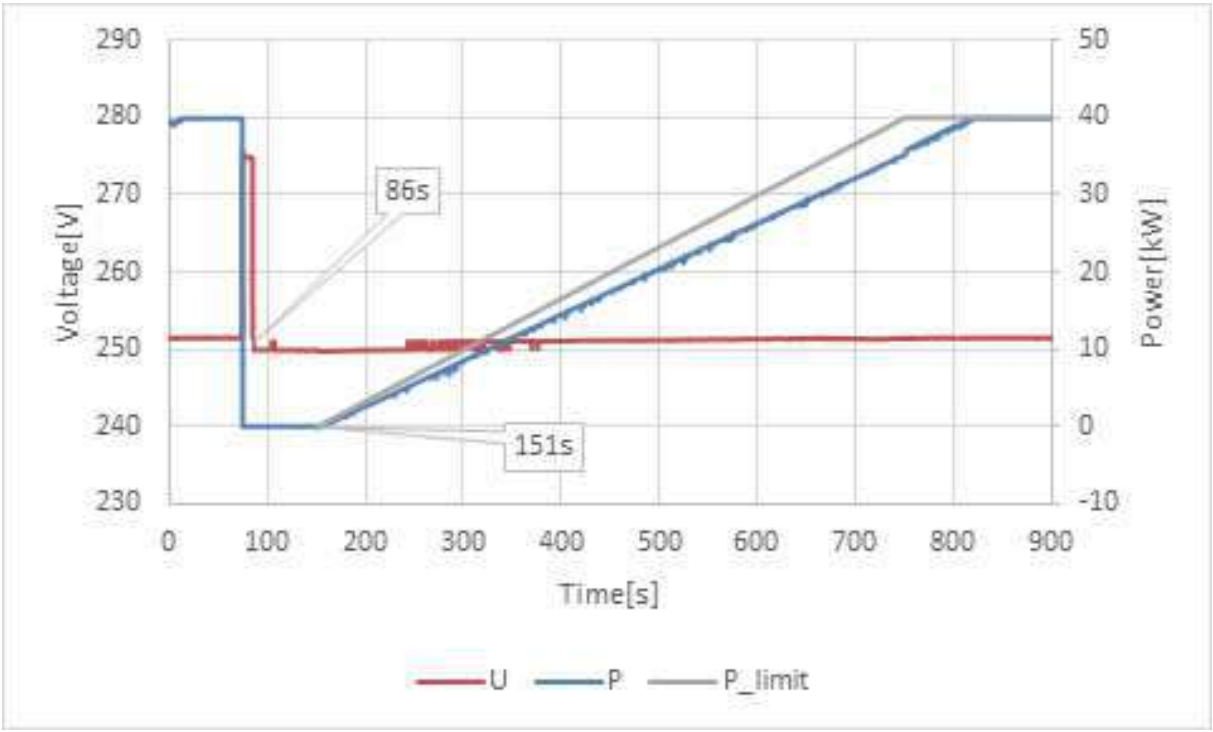
Graph of the gradual power supply : Test b) for ≤ 110% U_n



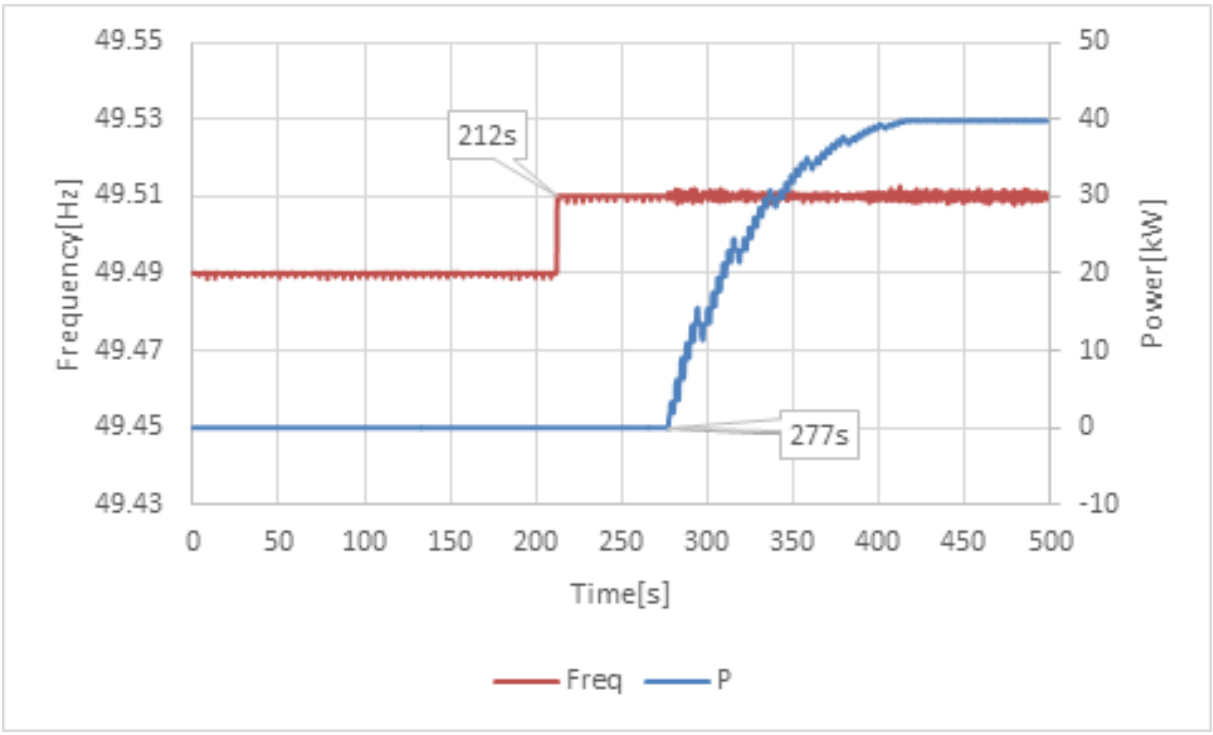
Graph of the gradual power supply : Test c) for ≥ 85% U_n



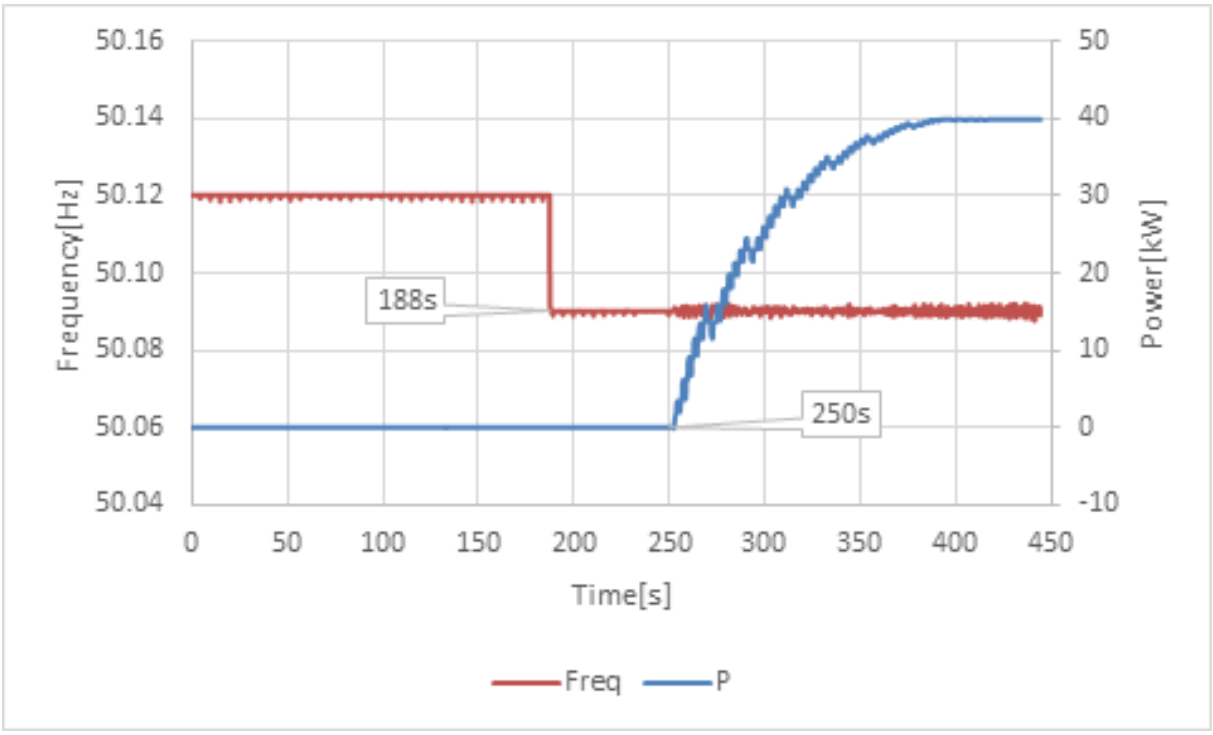
Graph of the gradual power supply : Test c) for ≤ 110% U_n



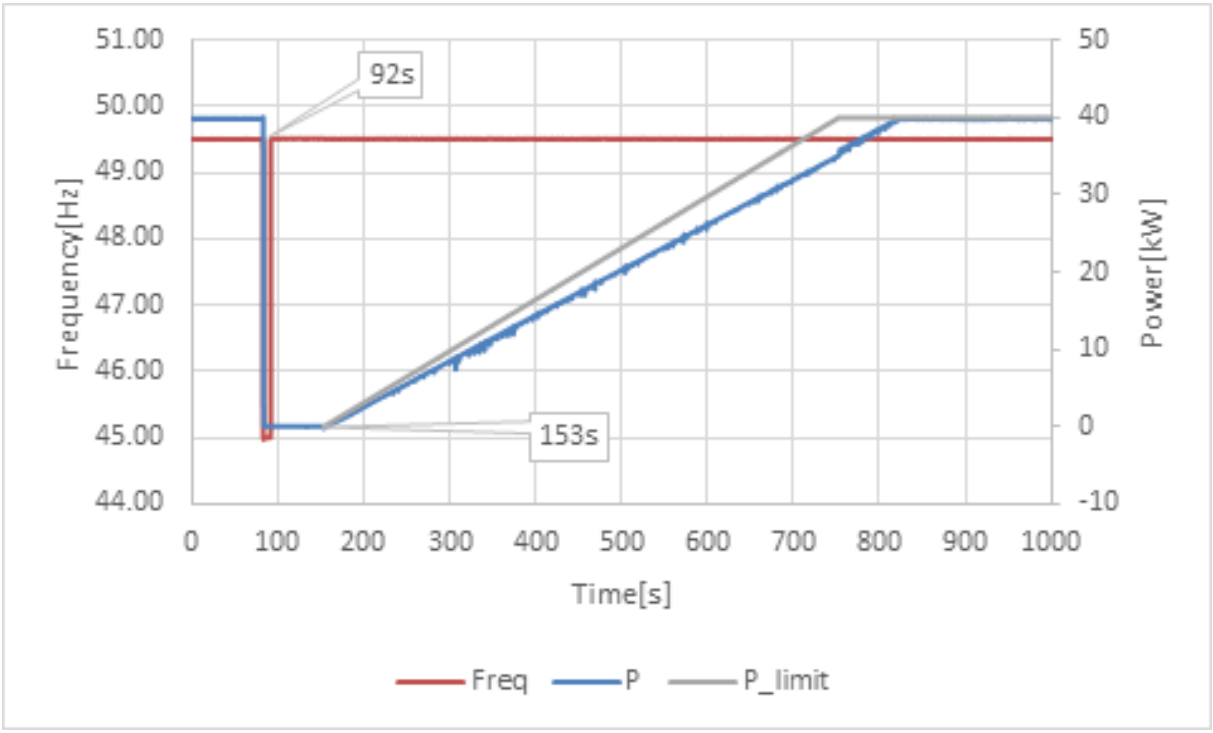
Graph of the gradual power supply : Test e) for ≥ 49,50Hz



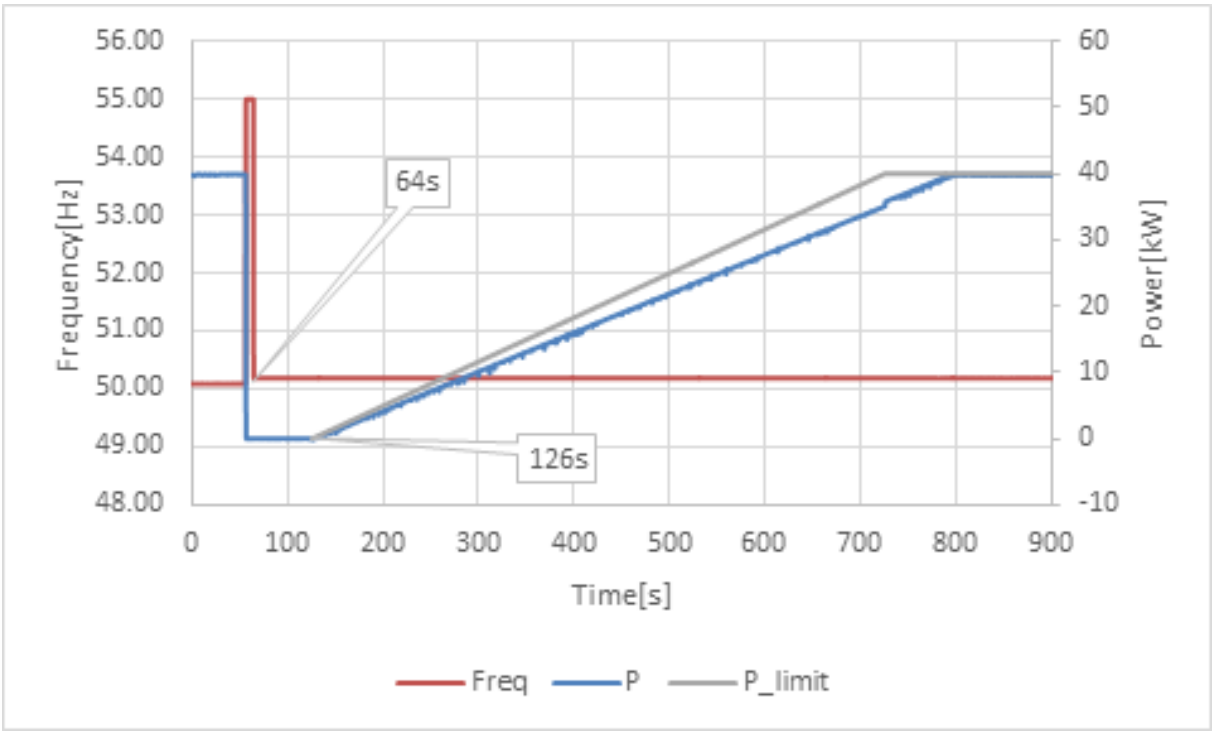
Graph of the gradual power supply : Test e) for ≤ 50,10Hz



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



Graph of the gradual power supply : Test f) for ≤ 50,2Hz



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**

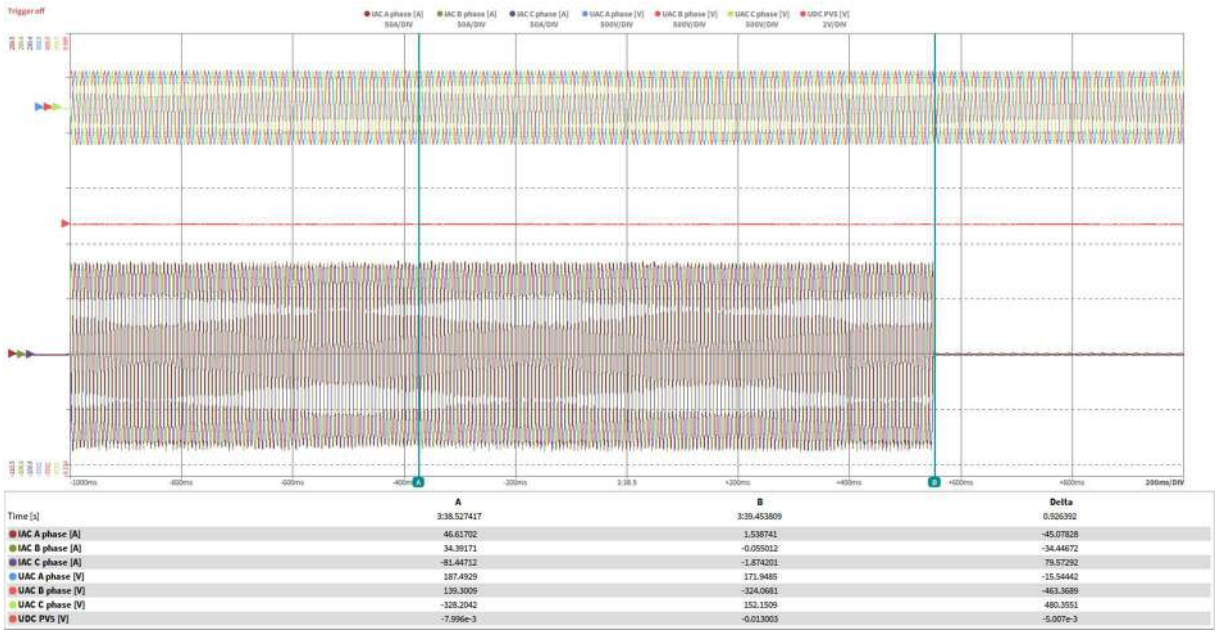
4.11.1 Ceasing active power		P
Operating time of the monitoring device		
Test:	Remote tripping signal for the external disconnection	
Limit [s]:	5 s	
Reaction time of the tripping value [s]:	0,926 s	

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 ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Graph of Remote trip signal :



Time [s]	A 3:38.527417	B 3:39.453809	Delta 0.926392
IAC A phase [A]	46.61702	1.538741	-45.07828
IAC B phase [A]	34.39171	-0.055012	-34.44672
IAC C phase [A]	-81.44712	-1.874201	79.57292
UAC A phase [V]	187.4929	171.9485	-15.54442
UAC B phase [V]	139.3009	-324.0681	-463.3689
UAC C phase [V]	-328.2042	152.1509	480.3551
UDC PV1 [V]	-7.996e-3	-0.013003	-5.007e-3

4.11.2 Reduction of active power on set point	P

Test result: ASW40K-LT-G3

Setpoint power bin [%Pn]	P_{set} [kW]	P_{60} [kW]	Deviation [%Pn]
100%	40,00	39,81	-0,48
90%	36,00	35,77	-0,58
80%	32,00	31,81	-0,48
70%	28,00	27,83	-0,43
60%	24,00	23,84	-0,41
50%	20,00	19,84	-0,41
40%	16,00	15,83	-0,43
30%	12,00	11,81	-0,49
20%	8,00	7,79	-0,53
10%	4,00	3,80	-0,49
0%	0,00	-0,15	-0,38

	Setpoint power bin [%Pn]	Deviation [%Pn]
Max. deviation	90%	-0,58
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) setting be For all other PGUs, in line with their adjustable steps, 5 minutes must elapse after the setpoint is changed so that the PGU can settle at the new setpoint, Then the active power of the PGU must 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:

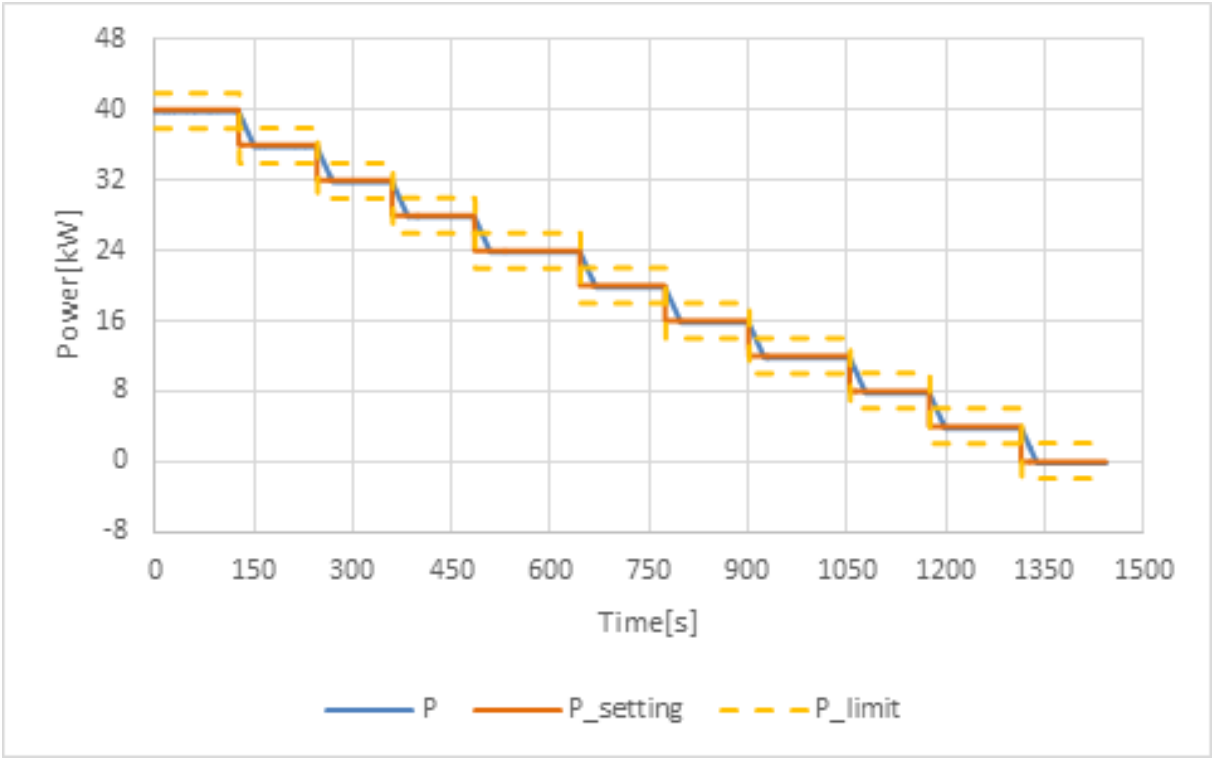
- the active power value does not exceed the setpoint by more than 5% P_{Emax} or
- the setpoint is fallen below within 5 minutes or the PGU has switched off

Note:

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

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost 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 0124-100:2020, 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	
Output L to N	Phase mis-wiring grid connection	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code “Utility Loss”. No damage, No hazard.
Output L to L	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
Output L to N	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
Output L to G	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
DC+ to DC -	Reversed	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code ”Relay check Fail”. No damage, No hazard.
DSP failure (control DSP)	+3.3V power supply disable	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
DSP failure (control DSP)	10MHz oscillator disable	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
DSP failure (control DSP)	Reset	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
MCU failure	+3.3V power supply disable	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. 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/DC Voltage detector	Short before start-up	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code “Utility Loss” No damage, No hazard.
PV/DC Current detector	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
Bus Voltage detector	Short before start-up	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. No damage, No hazard.
Grid/AC Voltage detector	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
Grid/AC Current detector	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. No damage, no hazard.
DC isolation device function detector	Short before start-up	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code “Isolation Failure”. No damage, No hazard.
Residual current monitor unit detector	Short before start-up	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code “Device fault”. No damage, No hazard.
Relay function detector	Short before start-up	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter can not start-up. Red fault LED light. Error code “Relay Check Failure”. No damage, No hazard.
Boost Diode D109 (A-K)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. D109 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	
Boost MOSFET Q102 (D-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q102 damage, no hazard.
Boost MOSFET Q102 (G-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q102 damage, no hazard.
Boost MOSFET Q102 (G-D)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q102 damage, no hazard.
Inverter Bridge Q108 (D-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q108 damage, no hazard.
Inverter Bridge Q108 (G-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q108 damage, no hazard.
Inverter Bridge Q108 (G-D)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q108 damage, no hazard.
Inverter Bridge Q111 (D-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q111 damage, no hazard.
Inverter Bridge Q111 (G-S)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q111 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	
Inverter Bridge Q111 (G-D)	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Q111 damage, no hazard.
Bus capacitors C170	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. C170 damage, no hazard.
LC filter capacitor C734	Short	230V 0,1A	450V 0,1A	10min	--	230V 0,1A	450V 0,1A	PV inverter disconnected from grid immediately. Red fault LED light. Error code “Utility Loss”. No damage, no hazard.
The errors in the control circuit simulate that the safety is even under one error ensured.								

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:

The tests had been performed on the ASW40K-LT-G3 are valid for the ASW25K-LT-G3, ASW27K-LT-G3, ASW30K-LT-G3, ASW33K-LT-G3 and ASW36K-LT-G3 since it is almost same as in hardware and just power derated by software.

Annex No. 1

Datasheet of the relay

HF176F SOLAR RELAY

c UL us
File No:E133481

File No.: R50411032

Features

- 65A swithing capitable.
- Applicable to solar photovoltaic inverter
- 3mm contact gap
- Low coil hoilding voltage contributes to saving energy of equipment.
- UL insulation system: class F.

RoHS compliant

CONTACT DATA

Contact arrangement	1A
Contact resistance (Initial)	≤10mΩ max(6VDC 20A)
Contact material	$AgSnO_2$, AgNi
Contact rating (Res. load)	Making 20A, Carrying 65A, Breaking 20A, 277VAC 85°C
Max. switching voltage	400VAC
Max. switching current	65A
Max. switching power	18005VA
Mechanical endurance	1 x 10^6 OPS
Electrical endurance	3 x 10^4 OPS (Making 20A, Carrying 65A, Breaking 20A, Resistive load, at 85°C, 1s on 9s off)

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	5000VAC 1min
	Between open contacts	2000VAC 1min
Surge voltage (between coil & contacts)		10kV(1.2 / 50μs)
Operate time (at nomi. volt.)		30ms max.
Release time (at nomi. volt.)		10ms max.
Temperature rise (at nomi. volt.)		70K max.(Contact load current 65A, 50% to 60% of rated voltage excitation, at 85°C)
Shock resistance	Functional	98m/s²
	Destructive	980m/s²
Vibration resistance		10Hz to 55Hz 1.5mm DA
Humidity		5% to 85% RH
Ambient temperature		-40°C to 85°C (Apply holding voltage to coil)
Termination		PCB
Unit weight		Approx.100g
Construction		Flux proofed

Notes: The data shown above are initial values.

COIL

Coil power	Approx.1.92W
Holding voltage	40% to 100%U_N(at 25°C) 50% to 60%U_N(at 85°C)

Notes: 1)The coil holding voltage is the voltage applied to coil 100ms after the rated voltage.
2)To avoid overheating and burning, the coil can not be consistently applied to with voltage larger than maximum holding voltage.

COIL DATA at 23°C

Nominal Voltage VDC 1)	Pick-up Voltage VDC max.1)	Drop-out Voltage VDC min.1)	Max. Voltage VDC 2)	Coil Resistance Ω
6	≤4.2	≥0.6	6.6	18.8 x (1±10%)
9	≤6.3	≥0.9	9.9	42.2 x (1±10%)
12	≤8.4	≥1.2	13.2	75 x (1±10%)
24	≤16.8	≥2.4	26.4	300 x (1±10%)

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

SAFETY APPROVAL RATINGS

UL/CUL	AgNi	Making 20A,Carrying 65A,Breaking 20A,400VAC Resistive at 85°C 48A 277VAC General use at 85°C 60A 277VAC General use at 85°C
	$AgSnO_2$	Making 20A,Carrying 65A,Breaking 20A,400VAC Resistive at 85°C 65A 277VAC Resistive at 85°C 65A 30VDC Resistive at 85°C 65A 60VDC Resistive at 85°C
TÜV	AgNi	Making 20A,Carrying 65A,Breaking 20A,400VAC Resistive at 85°C 48A 277VAC 85°C,cosΦ =0.8 60A 277VAC 85°C,cosΦ =0.8
	$AgSnO_2$	Making 20A,Carrying 65A,Breaking 20A,400VAC Resistive at 85°C 65A 277VAC 85°C,cosΦ =0.8 65A 30VDC 85°C,L/R=0 65A 60VDC 85°C,L/R=0

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

HONGFA RELAY
ISO9001、ISO/TS16949、ISO14001、OHSAS18001、IECQ QC 080000 CERTIFIED 2020 Rev. 1.01

367

ORDERING INFORMATION

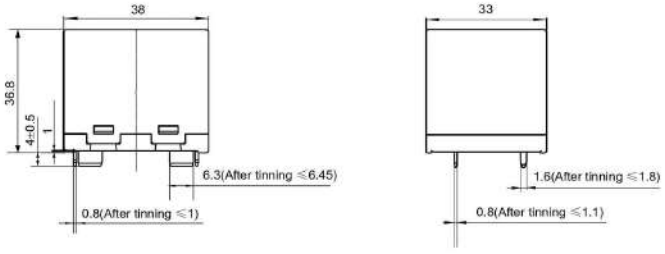
	HF176F/	12	-H	3	F	(XXX)
Type						
Coil voltage	6, 9, 12, 24VDC					
Contact arrangement	H:1 Form A					
Contact matcrial	3: AgNi T: $AgSnO_2$					
Insulation standard	F: Class F					
Special code	XXX: Customer special requirement		Nil: Standard			

Notes: 1) Water cleaning or surface process is not suggested after the flux-proofed relays are assembled on PCB.
2) Flux-proofed relays can not be used in the environment with pollutants like H_2S, SO_2, NO_2, dust, etc.
3) The customer special requirement express as special code after evaluating by Hongfa.

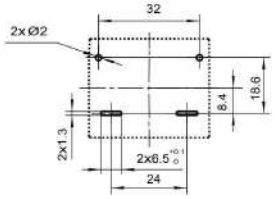
OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

Unit: mm

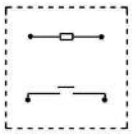
Outline Dimensions



PCB Layout (Bottom view)



Wiring Diagram
(Bottom view)



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

368

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RELAY SPECIFICATION

继电器规格书

(File No.: 001273 / Version: 01 / Issued Date: Aug. 30th, 2021/ Updated Date: Oct. 8th, 2021)

Product Description（品名）	**CHS01-V-112HA2(60G)**
Part Number（编码）	
Customer name（客户）	**爱士惟**

Customer Approval （客户批准）

STAMPING AREA （盖章处）

Issued（发行）	Checked（审核）	Approved（承认）
Hanhua Li	**Hefei Chen**	**Andy Tang**

a

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CHANGE RESUME 变更记录			
序号	更改内容	更改原因	更改时间
01	接点 Ag alloy 变更为详细接点材质	客户要求	2021-10-08

SAFETY STANDARD 安全标准	
UL certificate UL 证书	E341422
TUV certificate TUV 证书	R 50271657
CQC certificate CQC 证书	CQC13002102346

COIL CHARACTERISTICS 线圈特性

Coil resistance 线圈电阻	64±10% Ω
Rated voltage 额定电压	12VDC
Max. allowable voltage 最大允许电压	110% of rated coil voltage
Rated power 额定功率	2.25W
Operate voltage 吸合电压	≤9.0VDC
Release voltage 释放电压	≥0.6VDC
Hold Voltage (See Notes 4) 保持电压	⩽6VDC

CONTACT RATINGS 触点规格

Contact configuration 触点结构	1 Form A (SPST)
Contact material 触点材料	AgSnO
Initial contact resistance 初始接触电阻	≤100mΩ at 6VDC/1A
Rated voltage (Normally Open) 额定电压（常开触点）	277VAC
Rated current (Normally Open) 额定电流（常开触点）	60A
Rated Carrying power (Normally Open)	16,620VA

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额定载流功率（常开触点）	
Minimum applicable load (Normally Open)	5VDC 100mA
最小使用负载（常开触点）	
Operate time	≤15ms, excluding bounce time
吸合时间	≤15ms，不含触点抖动时间
Release time	≤15ms, excluding bounce time
释放时间	≤15ms，不含触点抖动时间
Mechanical endurance	100K cycles, 300 cycles/minute
机械寿命	
Electrical endurance (Resistive Load)	15A-60A-15A, 277VAC, Make-Carry-Break,
电气寿命（阻性负载）	30k cycles, 6 cycles/minute;
	15A-60A-15A, 277VAC，导通-载流-断开，
	3 万次， 6 次/分钟;
Contact Gap	≥2.26mm
接点间隙	

INSULATION PERFORMANCE 绝缘性能

Dielectric strength	2500VAC 1minute, between open contacts
介电强度	2500VAC 1 分钟（断开触点间）
	2500VAC 1minute, between coil to contacts
	2500VAC 1 分钟（线圈与触点间）
Impulse withstand voltage	3KV (1.2/50 μs), between coil to contacts
耐浪涌电压	3KV（线圈与触点间）
Insulation resistance	1000MΩ at 500VDC, between open contacts and coil
绝缘电阻	to contacts
	1000MΩ at 500VDC（断开触点间及线圈与触点间）
Insulation systems (UL)	155 (F)
绝缘系统	
Insulation type	Basic insulation
绝缘类型	基本绝缘

ENVIRONMENT PERFORMANCE 环境性能

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

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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/s2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。

MARKING 产品标识

Position of marking 标识位置	Top of relay cover 外壳顶面
Cover color 外壳颜色	White 白色
Marking type 标记类型	Laser 激光
Trade mark 商标	Churod

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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 6V 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 6~6.6V.

(5) This product can only be used for one module ,not more than one product at the same time;
此产品只适用于一个模块单独使用一只，不可多只产品同时使用.

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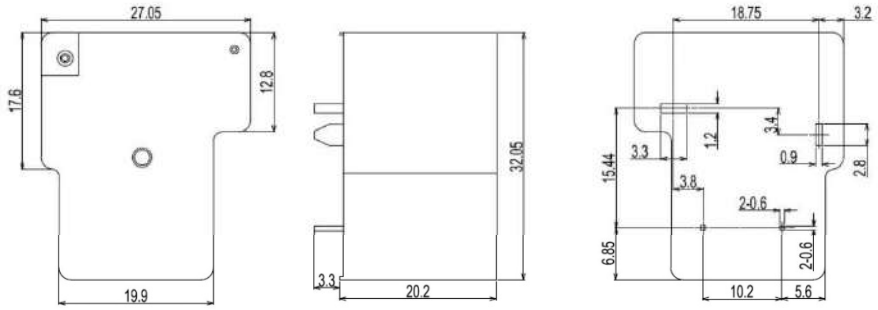
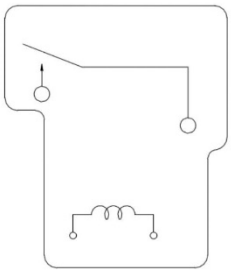
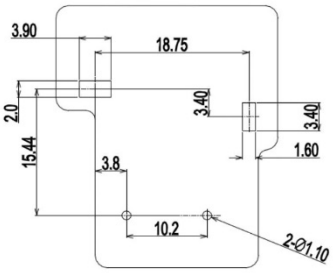
Outline dimension
外形尺寸图



Wiring diagram (bottom view)



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



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 top view

Photo of EUT

Enclosure bottom view

Internal view

Annex No. 3

Test Equipment list

Date(s) of performance test: 2022-04-18 to 2022-06-09

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Jul. 18, 2022
Power Analyser	A4080004DG	DEWESoft	X	DB19104221	Jul. 18, 2022
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
	A7040016DG	Chroma	62150H-1000S	62150EF00490	
	A7040017DG	Chroma	620028	620028EF00120	
	A7040021DG	Chroma	62150H-1000S	62150EF00609	
	A7040022DG	Chroma	62150H-1000S	62150EF00595	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	Aug. 20, 2022
	A1060008DG	YOKOGAWA	CT200	1130700017	Aug. 08, 2022
	A1060009DG	YOKOGAWA	CT200	1130700019	Aug. 08, 2022
	A10600010DG	YOKOGAWA	CT200	1130700016	Aug. 20, 2022
	A10600011DG	YOKOGAWA	CT200	1130700011	Aug. 08, 2022
	A10600012DG	YOKOGAWA	CT200	1130700018	Aug. 20, 2022
Eight Channel Digital Phosphor	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 07, 2022
Oscilloscope probe	A1490008DG	YOKOGAWA	701901	//	Aug. 12, 2022
Oscilloscope probe	A1490009DG	YOKOGAWA	701901	//	Aug. 12, 2022
Oscilloscope probe	A1490010DG	YOKOGAWA	701901	//	Aug. 12, 2022
Oscilloscope probe	A1490010DG	YOKOGAWA	701901	//	Aug. 12, 2022
Temp. & Humi. Recorder	A7440034DG	HUATO	S580-TH	HT20103923	Jan. 27, 2023

--End of Test Report--