TEST REPORT

CEI 0-21

Reference technical rules for the connection of active and passive users to the LV networks of electrical distribution companies

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Accreditation.....:	ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12024-03-00
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Test specification	
Standard.....:	CEI 0-21:2022-03 + V1:2022 + V2:2024 + V2/EC:2024 + V2/EC2:2025 Note: The device is for plants of each power Annex Bbis Testing of storage systems
Certificate.....:	**Certificate of compliance**
Template number standard .....:	CEI 0-21
Master TRF originator.....:	Bureau Veritas Consumer Products Services Germany GmbH
Test item description .....:	**Hybrid inverter**
Trademark.....:	DAH Solar
Model / Type.....:	DHN-LVEH3P8K-EU-G1, DHN-LVEH3P10K-EU-G1, DHN-LVEH3P12K-EU-G1

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Characteristics of the static converter and storage system (SdA)			
Static converter model	DHN-LVEH3P8K-EU-G1	DHN-LVEH3P10K-EU-G1	DHN-LVEH3P12K-EU-G1
Input (PV DC)			
MPP voltage range [V]	200-650		
Max. input voltage [V]	800		
Max. input current per MPP tracker [A]	16+16	26+16	26+16
Input (battery DC)			
DC voltage range [V]	40-60		
Max. DC voltage [V]	60		
Max. DC current per DC input [A]	190	210	240
AC connection			
Nominal AC voltage [V]	3L/N/PE, 230/400 Va.c., 50/60 Hz		
Rated output current [A]	11,6	14,5	17,4
Max. output current [A]	12,8	15,9	19,1
Nominal output power converter (P_{NINV}) [W]	8000	10000	12000
Rated apparent output power converter [VA]	8000	10000	12000
On-grid battery mode			
P_{sn} (nominal discharge power) [W].	6800	10000	11000
P_{cn} (nominal charging power) [W]	8000	10000	12000
P_{smax} (max. discharge power) [W]	6800	10000	11000
P_{cmax} (max. charging power) [W]	8000	10000	12000
Type	Bidirectional		
Off-grid battery mode			
P_{sn} (nominal discharge power) [W]	6800	10000	11000
P_{smax} (max. discharge power) [W]	6800	10000	11000

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Batteries that can be used with the above static converters	
Brand	DAH New Energy Technology Co. Ltd
Technology	LiFePO4
Model	DHN-LVWES15-G1
CUS Module (kWh)	14,34
Version firmware BMS	P16S200A-41495-1.06
No. of modules	1-16
Note	
Batteries are not integrated in the inverter and must be installed according to local regulations.	

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Testing Location.....:	**LCIE China Company Limited**
Address .....:	Building 4, No. 518, Xinzhuan Road, Caohejing Songjiang High-Tech Park, Shanghai, P.R. China (201612)
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Manufacturer's name .....:	**DAH New Energy Technology Co. Ltd**
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Document History

Date	Internal reference	Modification / Change / Status	Revision
2025-12-01	Joell Qin	Initial report was written	0

Supplementary information:

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TEMP-0058-TG-EAW-ES-V01

Test items particulars	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment..... :	Class I
Protection against ingress of water..... :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	36,2kg for all models
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..... :	2025-09-10
Date(s) of performance of test..... :	2025-09-10 to 2025-11-20

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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 CEI 0-21. This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.

All information in this test report limited to the type label, warning markings, trademark, block diagram, manual and datasheets are provided by the customer.

Conformity statements are decided in accordance with IEC GUIDE 115:2021 Procedure 2 (accuracy method), unless otherwise normatively specified or contractually agreed. The measurement result is considered as "pass" according to the requirement if it is within the prescribed limit or exactly on the limit.

”(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.

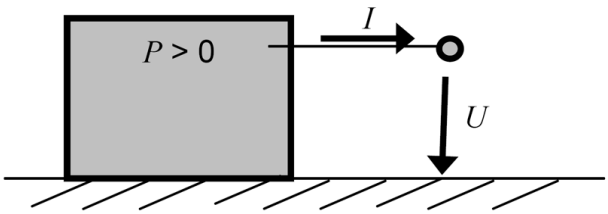
- “P_{rE}” for the rated active power:
- “P_{rE}” = U_n x I_r x cos φ (single-Phase); P_{rE} = √ 3 U_n x I_r x cos φ (three-Phase)
- “P_{ref}” for the momentary power
- “P_n” nominal active output power
- “f_n” is the nominal frequency
- “S_n” is the nominal Apparent power
- “CUS” (Useful Capacity of the Storage System): quantity of energy available at the terminals of the storage system between the minimum and maximum states of charge of the system
- “P_{SN}” (Nominal Discharge Power): the maximum power the system can discharge throughout the
- “P_{CN}” (Nominal Charge Power): the maximum power the system can charge throughout the CUS
- $2P_{SMAX}$” (Maximum Discharge Power): the discharge power that the system must guarantee within the range 10 % - 90 % of the CUS.
- “P_{CMAX}” (Maximum Charge Power): the charging power that the system must guarantee within the range 10 % - 90 % of the CUS.
- “P_{NINV}”=(Nominal power of bidirectional inverter/converter): the nominal power of the inverter or of the bidirectional converter which connects the storage system to the network.
- “ΔP_{E60}” in [%] = ($P_{Setpoint}$ – P_{E60}) / P_{rE}
- “ΔQ_{E60}” in [%] = ($Q_{expected}$ – Q_{E60}) / P_{Emax}
- “$_{E0,2}$” for gliding average values over 200 milliseconds
- “$_{E60}$” for gliding average values over 60 seconds
- “$_{E600}$” for gliding average values over 10 minutes
- “(c)” for over-excited
- “(i)” for under-excited

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Active and reactive power

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

- if the inverter feeds to the grid the active power is measured with positive sign.



For the representation in quadrants, a power circle is chosen whose representation is compatible with mathematical representations of trigonometry and complex numbers (see Figure 2). Angles are counted positively counter-clockwise as in mathematics. The phase angle is defined as the angle from the current pointer to the voltage pointer. The current pointer is always in the real axis; the position of the voltage pointer corresponds to the apparent power and the phase angle.

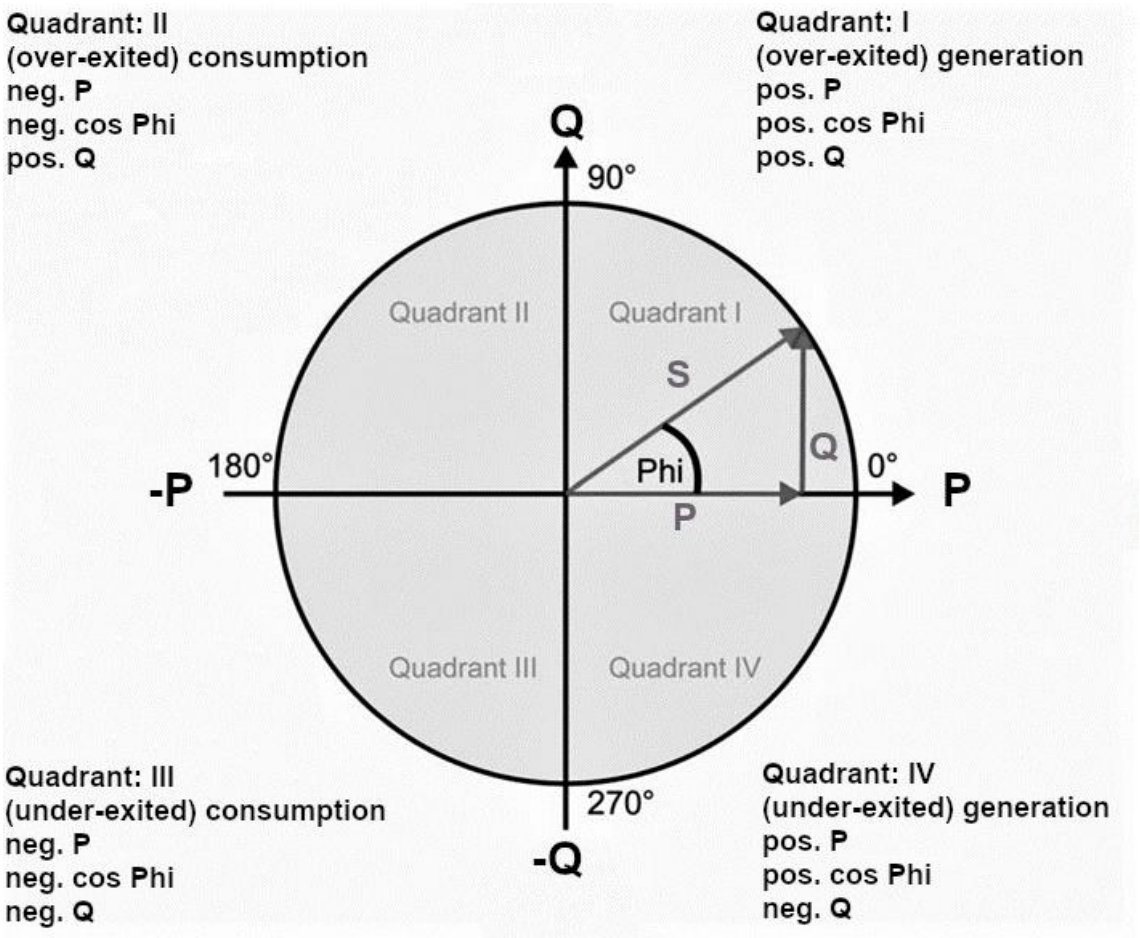


Figure 2

The different operating states can be represented in quadrants I to quadrant IV. The quadrants are named in a counter-clockwise direction.

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This Test Report consists of the following documents

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Copy of marking plate

DAH Solar Hybrid Inverter

Model : DHN-LVEH3P8K-EU-G1

PV Input

Max. PV Input Voltage	800V
MPPT Input Range	200V ~ 650V
Max. PV Input Current	16A+16A
Max. PV Input Power	12800W
Max. PV I_{sc}	20A+20A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	190A

AC Input/Output

AC Input/Output Voltage	3L/N/PE 230/400V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	11.6A
Max. AC Input/Output Current	12.8A
AC Input/Output Rated Power	8000W
Max. Apparent Input/Output Power	8800VA
AC Power Factor	0.8 leading to 0.8 lagging

Load

AC Output Voltage	3L/N/PE 230/400V
AC Output Frequency	50/60Hz
Max. AC Output Current	17.4A
Max. Apparent Output Power	8800VA
Peak Output Power	16000W

Others

Ingress Protection	IP65
Ambient Temperature	-40 ℃ ~ +60℃
Protection Level	Class I
Over Voltage Category	III (AC), II (DC)
Inverter topology	Non-isolated
AFCI	F-I-AFPE-1-1-2

5 min

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Made in China

DAH Solar Hybrid Inverter

Model : DHN-LVEH3P10K-EU-G1

PV Input

Max. PV Input Voltage	800V
MPPT Input Range	200V ~ 650V
Max. PV Input Current	26A+16A
Max. PV Input Power	16000W
Max. PV I_{sc}	34A+20A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	210A

AC Input/Output

AC Input/Output Voltage	3L/N/PE 230/400V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	14.5A
Max. AC Input/Output Current	15.9A
AC Input/Output Rated Power	10000W
Max. Apparent Input/Output Power	11000VA
AC Power Factor	0.8 leading to 0.8 lagging

Load

AC Output Voltage	3L/N/PE 230/400V
AC Output Frequency	50/60Hz
Max. AC Output Current	21.7A
Max. Apparent Output Power	11000VA
Peak Output Power	20000W

Others

Ingress Protection	IP65
Ambient Temperature	-40 ℃ ~ +60℃
Protection Level	Class I
Over Voltage Category	III (AC), II (DC)
Inverter topology	Non-isolated
AFCI	F-I-AFPE-1-2/1-2

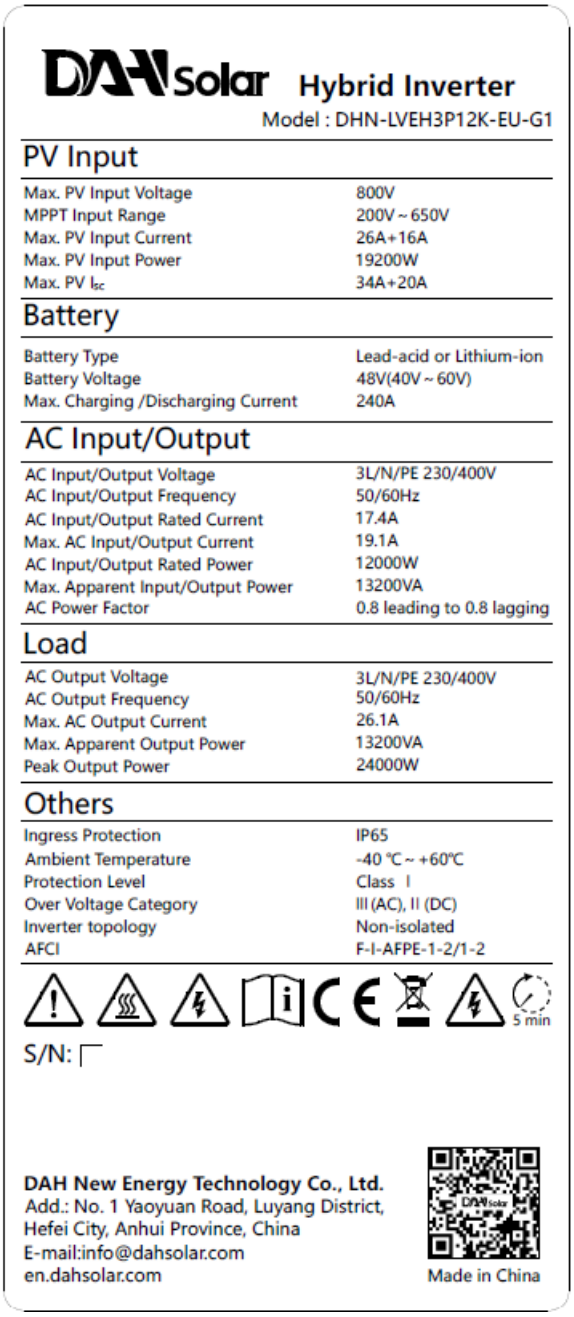
5 min

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DAH Solar Hybrid Inverter

Model : DHN-LVEH3P12K-EU-G1

PV Input

Max. PV Input Voltage	800V
MPPT Input Range	200V ~ 650V
Max. PV Input Current	26A+16A
Max. PV Input Power	19200W
Max. PV I_{sc}	34A+20A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	240A

AC Input/Output

AC Input/Output Voltage	3L/N/PE 230/400V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	17.4A
Max. AC Input/Output Current	19.1A
AC Input/Output Rated Power	12000W
Max. Apparent Input/Output Power	13200VA
AC Power Factor	0.8 leading to 0.8 lagging

Load

AC Output Voltage	3L/N/PE 230/400V
AC Output Frequency	50/60Hz
Max. AC Output Current	26.1A
Max. Apparent Output Power	13200VA
Peak Output Power	24000W

Others

Ingress Protection	IP65
Ambient Temperature	-40 ℃ ~ +60℃
Protection Level	Class I
Over Voltage Category	III (AC), II (DC)
Inverter topology	Non-isolated
AFCI	F-I-AFPE-1-2/1-2

5 min

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Note

Example of marking plate

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General product information

DAH Solar

Hybrid Inverter Series

USER MANUAL

DHN-LVEH3P8/10/12K-EU-G1



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6 - DATASHEET

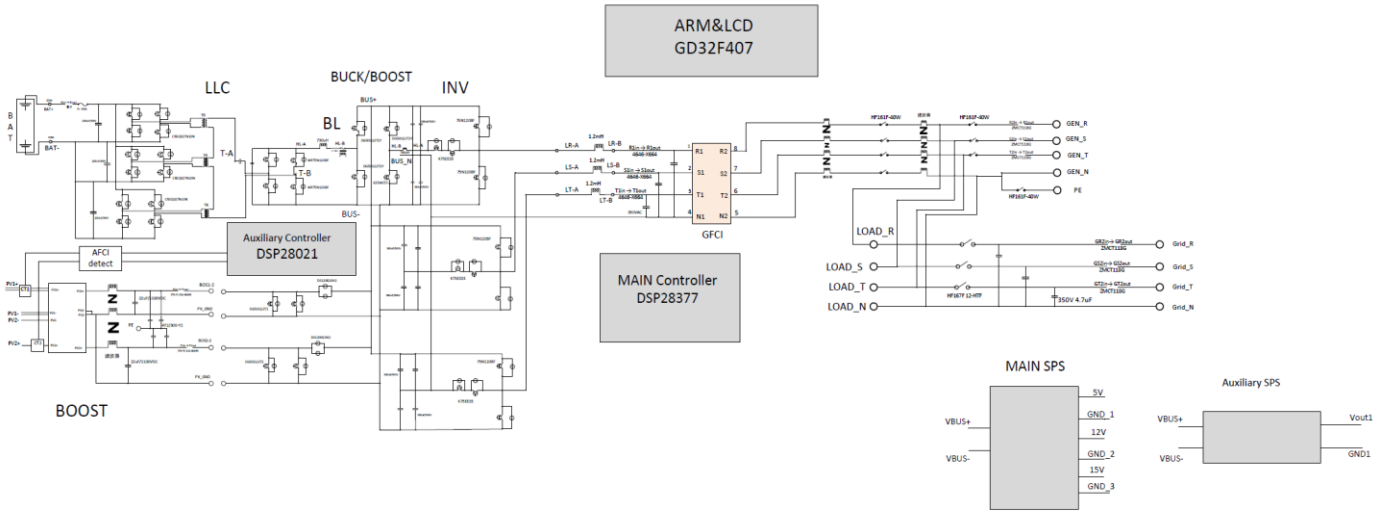
Model	DHN-LVEH3P8K-EU-G1	DHN-LVEH3P10K-EU-G1	DHN-LVEH3P12K-EU-G1
Battery Input Data			
Battery Type	Lead-acid/Li-ion		
Battery Voltage Range (V)	40-60		
Max. Charging Current (A)	190	210	240
Max. Discharging Current (A)	190	210	240
Charging Strategy for Li-ion Battery	Self-adaption to BMS		
Number of Battery Input	1		
PV String Input Data			
Max. PV Input Power (W)	12800	16000	19200
Max. PV Input Voltage (V)	800		
Start-up Voltage (V)	150		
MPPT Voltage Range (V)	200-650		
Rated voltage (V)	550		
Max. Operating PV Input Current (A)	16+16	26+16	26+16
Max. Input Short-Circuit Current (A)	20+20	34+20	34+20
No. of MPP Trackers/No. of Strings MPP Tracker	1+1	2+1	2+1
AC Input/Output Data			
Rated AC Input/Output Active Power (W)	8000	10000	12000
Max. AC Input/Output Apparent Power (VA)*	8800	11000	13200
Rated AC Input/Output Current (A)	12.1/11.6	15.2/14.5	18.2/17.4
Max. AC Input/Output Current (A)*	13.3/12.8	16.7/15.9	20/19.1
Peak Power (off-grid) (W)	2 times of rated power		
Power Factor Adjustment Range	0.8 leading to 0.8 lagging		
Rated Input/Output Voltage/Range (V)	220/380, 230/400 0.85Un-1.1Un		
Rated Input/Output Grid Frequency/Range(Hz)	50/45-55, 60/55-65		
Grid Connection Form	3L+N+PE		
Total Current Harmonic Distortion THDi	<2% (of nominal power)		
DC Injection Current	0.5% In		
Efficiency			
Max. Efficiency	97.57%		
Euro Efficiency	96.85%		
MPPT Efficiency	>99.99%		
Equipment Protection			
Integrated	DC Polarity Reverse Connection Protection, AC Output Overcurrent Protection, Thermal Protection, AC Output Overvoltage Protection, AC Output Short Circuit Protection, DC Component Monitoring, Overvoltage Load Drop Protection, Ground Fault Current Monitoring, Arc Fault Circuit Interrupter (optional), Power Network Monitoring, Island Protection Monitoring, Earth Fault Detection, DC Input Switch, DC Terminal Insulation Impedance Monitoring, Residual Current (RCD) Detection, Surge protection leve		
Surge Protection Level	TYPE II (DC), TYPE II (AC)		
Interface			
Communication Interface	RS485/CAN		
Monitor Mode	WIFI/Bluetooth		
General Data			
Operating Temperature Range (℃)	-40 to +60		
Permissible Ambient Humidity	0-100%		
Permissible Altitude (m)	2000		
Ingress Protection(IP) Rating	IP 65		
Inverter Topology	Non-Isolated		
Over Voltage Category	OVC II (DC), OVC III (AC)		
Cabinet Size (WxHxD mm)	450*677*255		
Weight (kg)	36.2		
Type of Cooling	Intelligent Air Cooling		
Warranty	5 Years the Warranty Period Depends the Final Installation Site of Inverter, More Info Please Refer to Warranty Policy		
Grid Regulation	Ordinance No.140 / Ordinance No.515		
Safety / EMC Standard	IEC/EN 61000-6-1:2019, IEC/EN 61000-6-3:2021, IEC/EN 62109-1:2010, IEC/EN 62109-2:2011, IEC 63027:2023		

Note: *It is only implemented under specific safety regulations and working conditions.

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Block diagram of the utility interactive inverter:

The DC input of solar converter can be supplied from PV array and Batteries.
The charging current to batteries can from PC array or Grid through the inversion circuit, battery management unit is integrated in External Energy storage system.
The Solar inverter is a three-phase type, the unit is providing EMC filtering at the output toward mains. The unit doesn't provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of on error. And the battery is charged from PV array or Grid.
The internal control is redundant built. It consists of Main DSP(U23) and slave DSP(U300).
The main DSP(U23) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, in addition it tests RCMU circuit before each start up.
The slave DSP(U300) is used for controlling the relays, measuring the voltage, frequency, inject a dc AC current, the residual current, and communicating with the master DSP(U23). And if the communication with the master DSP, the slave DSP will disconnect the relays.
The unit provides two relays in series on Line and Neutral conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the battery and the mains. All the relays are tested before start up. Both controllers Main DSP(U23), Slave DSP(U300) can open the relays.



Differences of the models in the series

The PGUs DHN-LVEH3P8K-EU-G1, DHN-LVEH3P10K-EU-G1 and DHN-LVEH3P12K-EU-G1 use the same hardware platform.

The PGUs use the same control unit, control system and software.
The tests had been performed on model DHN-LVEH3P12K-EU-G1 are valid for model DHN-LVEH3P8K-EU-G1 and DHN-LVEH3P10K-EU-G1 since it is identical in hardware and just power derated by software.

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The product was tested on
The product(s) was/were tested on Hardware: DHN-LVEH3P12K-EU-G1 Software: DSP:0117 ARM:1434

TOPOLOGY OF THE DEVICE, WHICH THIS CERTIFICATE IS BASED ON			
Disconnection Device	**Interface Protection Device**	**Device For Static Conversion**	**Rotating Generator Device**
X	**X**	**X**	

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Test Results

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
A.2	Features of the SPI	**P**
A.3.1-3.4	Adjustable ranges of the interface protection system	**P**
A.4.3	Functional tests on the interface protection system (SPI)	**P**
A.4.4	Self-test	**P**
A.4.5	Single fault tolerance	**P**
A.4.6	EMC compatibility tests	**P**
A.4.7	Climatic compatibility tests	**P**
A.4.8	Insulation tests	**P**
A.4.9	Tests for the overload capacity of measuring circuits	**P**
A.4.10	Compliance of equipment	**N/A**
A.4.11	Automatic mechanism to prevent current imbalance during production	**N/A**

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A.2	Features of the SPI	P

The SPI must provide

- a minimum voltage protection function with two thresholds;

- a maximum voltage protection function with two thresholds;

- a minimum frequency protection function with two thresholds;

- a maximum frequency protection function with two thresholds;

- a signal processing function in the case of installation of a dedicated device (protective relay);

- a presence signal processing function;

- a self-diagnosis function;

- a self-test function (obligatory if integrated in the inverter control system of a production plant with a total power output of up to 11,08 kW); any transducers for the acquisition of voltage signals;

- an opening circuit of the interface device;

- for the external SPI only, an auxiliary power supply system which allows it to operate for at least 5 s in the absence of the main power supply. The auxiliary power supply system must be suitably dimensioned to allow, in the absence of the main power supply, the operation of the SPI, the closing of the DDI and for the backup control device (if any), at least the time defined above (63). The integrated SPI must meet the "single fault tolerance" requirement. This requirement implies that in the event of failure of a component of the SPI, the device must continue to ensure its proper functioning or cause the DDI to open and signal the fault condition.

The rated voltage and frequency for all protective functions are:

Rated voltage: (230/400) V(64)

Nominal frequency: 50 Hz

SPI accuracies are:

Voltage: ± 1 % Vn

Frequency: ± 20 mHz

(63) It is intended that, when the power supply returns, the relay will check the mains parameters (voltage; frequency) before allowing the DDI to close again.

(64) For networks operated at different voltages, SPI adjustments must be referred to the operating voltage.

Note

The SPI is an internal SPI.

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TEMP-0058-TG-EAW-ES-V01

A.3	Setting ranges for the SPI							P
Adjustable ranges								
All thresholds must be adjustable								
Voltage values								
Threshold	85% (27.S1)	t_{min} (27.S1)	15% (27.S2)	T_{min} (27.S2)	110% (*) (59.S1)	t_{max} (59.S1)	115% (59.S2)	T_{max} (59.S2)
Range	0,2-1,0 V_n	0,05-5 s	0,05-1,0 V_n	0,05-5 s	1,0-1,2 V_n	≤ 3 s	1,0-1,3 V_n	0,5-1,0 s
Steps	0,05 V_n	0,05 s	0,05 V_n	0,05 s	0,01 V_n	--	0,01 V_n	0,05 s
Note: (*) The maximum voltage function (59.S1) must be configured for protection based on the calculation of the average value of 10 minutes in accordance with the standard EN 61000-4-30. A new average value over the previous 10 minutes must be calculated at least every 3 s for comparison with the threshold value for protection 59.S1 as indicated in Table 13.								
Frequency values								
Threshold	49,80 Hz (81<.S1)	tmin (81<.S1)	47,50 Hz (81<.S2)	tmin (81<.S2)	50,20 Hz (81>.S1)	tmax (81>.S1)	51,50 Hz (81>.S2)	tmax (81>.S2)
Range	47,0-50,0 Hz	0,05-5 s	47,0-50,0 Hz	0,05-5 s	50,0-52,0 Hz	0,05-5s	50,0-52,0 Hz	0,05-5 s
Steps	0,1 Hz	0,05 s	0,1 Hz	0,05 s	0,1 Hz	0,05 s	0,1 Hz	0,05 s

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
A.4.3	**Functional tests on the interface protection system (SPI)**	
A.3.1-3.4	Checking the adjustable values and the description in the user manual	**P**
A.4.3.1	Checking of connection and reconnection conditions	**P**
A.4.3.2	Checking gradual supply of active power	**P**
A.4.3.3	Additional requirements for functional tests	**P**
A.4.3.3.1	Insensitivity to harmonics of the frequency relay	**P**
A.4.3.3.2	Remote trip signal	**P**
A.4.3.3.3	Communication signal	**P**
A.4.3.4	Verification of insensitivity to the frequency derivative	**P**

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A.4.3	Functional tests on the interface protection system (SPI)	P

Purpose of testing

The tests for checking the functions and the measurement of accuracy are listed below:

a) checking all functions;

b) measuring the accuracy of tripping thresholds;

c) measuring the accuracy of trip times;

d) measuring the accuracy of the falling ratio (not required for an interface protection system (SPI) integrated into the inverter up to a maximum of 11,08 kW);

e) Measuring accuracy of the falling time (not required for an interface protection system (SPI) integrated into the inverter up to a maximum of 11,08 kW).

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A.4.3.1 A4.3.2	Test procedure for maximum/minimum frequency						P
Operating time of the monitoring device							
	Under frequency (81<.S2)			**Over frequency (81>.S2)**			
A) STEPS for trip value [Hz to Hz]	1,01 threshold -> decrease by max 10 mHz steps			0,99 threshold -> increase by max 10 mHz steps			
D) STEP trip time [Hz to Hz]	1,01 threshold -> 0,99 threshold			0,99 threshold -> 1,01 threshold			
	Ambient temperature						
Limit [Hz]	47,50			51,50			
Measurement accuracy of the tripping value [Hz]	47,50	47,50	47,50	51,51	51,51	51,51	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,116	0,115	0,114	0,116	0,116	0,115	
	-10°C temperature						
Limit [Hz]	47,50 Hz			51,50 Hz			
Measurement accuracy of the tripping value [Hz]	47,50	47,50	47,50	51,50	51,50	51,50	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,116	0,115	0,114	0,114	0,115	0,114	
	+55°C temperature						
Limit [Hz]	47,50 Hz			51,50 Hz			
Measurement accuracy of the tripping value [Hz]	47,49	47,49	47,50	51,50	51,50	51,50	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,115	0,117	0,117	0,113	0,115	0,114	

Test

To measure the disconnection time a step of 1% f_n is taken from the nominal frequency for underfrequency and overfrequency.

Assessment criterion

For frequencies of between 47,5 Hz and 51,5 Hz (±0,1% f_n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.

Limit values:

Frequency decrease protection f<47,5 Hz 0,100 s

Frequency increase protection f<51,5 Hz 0,100 s

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Note

The setting value and the trip value of the frequency may not vary by more than **±20 mHz** and **3% of the disconnection limit ±20 ms**. Differences between the test values: **±20 mHz** and **1% of the disconnection limit ±20ms.**

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A.4.3.1 A4.3.2	Test procedure for maximum/minimum frequency						P
Operating time of the monitoring device							
	Under frequency (81<.S1)			**Over frequency (81>.S1)**			
A) STEPS for trip value [Hz to Hz]	1,01 threshold -> decrease by max 10 mHz steps			0,99 threshold -> increase by max 10 mHz steps			
D) STEP trip time [Hz to Hz]	1,01 threshold -> 0,99 threshold			0,99 threshold -> 1,01 threshold			
	Ambient temperature						
Limit [Hz]	49,80			50,20			
Measurement accuracy of the tripping value [Hz]	49,79	49,79	49,79	50,20	50,20	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,117	0,115	0,116	0,115	0,115	0,115	
	-10°C temperature						
Limit [Hz]	49,80			50,20			
Measurement accuracy of the tripping value [Hz]	49,78	49,80	49,80	50,20	50,19	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,115	0,115	0,114	0,116	0,115	0,115	
	+55°C temperature						
Limit [Hz]	49,80			50,20			
Measurement accuracy of the tripping value [Hz]	49,79	49,79	49,79	50,20	50,20	50,22	
Disconnection limit [ms]	0,100			0,100			
Measurement the trip time [ms]	0,114	0,114	0,114	0,116	0,115	0,114	

Test

To measure the disconnection time a step of 1% f_n is taken from the nominal frequency for underfrequency and overfrequency.

Assessment criterion

For frequencies of between 49,5 Hz and 50,5 Hz (±0,1% f_n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.

Limit values:

Frequency decrease protection f<49,5 Hz 0,100 s

Frequency increase protection f< 50,5 Hz 0,100 s

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Note

The setting value and the trip value of the frequency may not vary by more than **±20 mHz** and **3%of the disconnection limit ±20 ms**. Differences between the test values: **±20 mHz** and **1% of the disconnection limit ±20 ms.**

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage		P
Operating time of the monitoring device			
Phase 1	**Under voltage (27.S2)**		
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 0,5% V_n steps		
D) STEP for trip time [V to V]	V_n-> 0,15 Vn		
	Ambient temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,4	36,6	36,4
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,206	0,197	0,206
	-10°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,4	36,6	36,4
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,205	0,205	0,200
	+55°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,4	36,6	36,4
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,198	0,210	0,211

Assessment criterion

Limit values:

Voltage drop protection 27.S2 0.15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Note

The indicated value for the tripping time must be adopted when the total power is greater than 11,08kW, while for lower powers a tripping time without intentional delay may optional be used. In the case of synchronous generators, the value may be raised to 0,7 Vn and t = 0,150s.

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage		P
Operating time of the monitoring device			
Phase 2	**Under voltage (27.S2)**		
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 0,5% V_n steps		
D) STEP for trip time [V to V]	V_n-> 0,15 Vn		
	Ambient temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,3	36,1	36,1
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,194	0,194	0,197
	-10°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,3	36,1	36,1
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,205	0,197	0,195
	+55°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,3	36,1	36,1
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,199	0,199	0,194

Assessment criterion

Limit values:

Voltage drop protection 27.S2 0.15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Note

The indicated value for the tripping time must be adopted when the total power is greater than 11,08kW, while for lower powers a tripping time without intentional delay may optional be used. In the case of synchronous generators, the value may be raised to 0,7 Vn and t = 0,150s.

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage		P
Operating time of the monitoring device			
Phase 3	**Under voltage (27.S2)**		
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 0,5% V_n steps		
D) STEP for trip time [V to V]	V_n-> 0,15 Vn		
	Ambient temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,6	36,6	36,5
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,196	0,199	0,209
	-10°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,6	36,6	36,5
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,205	0,212	0,211
	+55°C temperature		
Limit [V]	34,5 V		
Measurement accuracy of the tripping value [V]	36,6	36,6	36,5
Disconnection limit [s]	0,200		
Measurement the trip time [s]	0,196	0,198	0,200

Assessment criterion

Limit values:

Voltage drop protection 27.S2 0.15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Note

The indicated value for the tripping time must be adopted when the total power is greater than 11,08kW, while for lower powers a tripping time without intentional delay may optional be used. In the case of synchronous generators, the value may be raised to 0,7 Vn and t = 0,150s.

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage						P
Operating time of the monitoring device							
Phase 1	**Under voltage (27.S1)**			**Over voltage (59.S2)**			
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 5 V steps			0,9 threshold -> increase by max 5 V steps			
D) STEP for trip time [V to V]	1,1 threshold -> 0,9 threshold			0,9 threshold -> 1,01 threshold			
	Ambient temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	193,4	193,6	193,7	262,9	262,9	262,8	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,509	1,507	1,506	0,197	0,198	0,196	
	-10°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	193,4	193,6	193,7	262,9	262,9	262,8	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,510	1,512	1,506	0,197	0,195	0,200	
	+55°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	193,4	193,6	193,7	262,9	262,9	262,8	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,512	1,512	1,511	0,197	0,201	0,196	

Test

To measure the disconnection time a step of 84% V_n is taken from the nominal voltage and of 116% V_n from the nominal voltage for undervoltage and overvoltage.

The voltages should be measured per phase conductor, in which current is fed between the line conductor and the neutral conductor.

Assessment criterion

Limit values

Voltage drop protection 27.S1 0,85 V_n 1,500 s

Rise-in voltage protection 59.S2 1,15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20 ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage						P
Operating time of the monitoring device							
Phase 2	**Under voltage (27.S1)**			**Over voltage (59.S2)**			
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 5 V steps			0,9 threshold -> increase by max 5 V steps			
D) STEP for trip time [V to V]	1,1 threshold -> 0,9 threshold			0,9 threshold -> 1,01 threshold			
	Ambient temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	194,8	194,8	194,8	264,3	264,3	264,3	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,510	1,505	1,506	0,199	0,199	0,196	
	-10°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	194,8	194,8	194,8	264,3	264,3	264,3	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,509	1,509	1,507	0,195	0,196	0,194	
	+55°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	194,8	194,8	194,8	264,3	264,3	264,3	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,509	1,510	1,507	0,199	0,195	0,195	

Test

To measure the disconnection time a step of 84% V_n is taken from the nominal voltage and of 116% V_n from the nominal voltage for undervoltage and overvoltage.

The voltages should be measured per phase conductor, in which current is fed between the line conductor and the neutral conductor.

Assessment criterion

Limit values

Voltage drop protection 27.S1 0,85 V_n 1,500 s

Rise-in voltage protection 59.S2 1,15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20 ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

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A.4.3.1 A.4.3.2	Test procedure for maximum/minimum voltage						P
Operating time of the monitoring device							
Phase 3	**Under voltage (27.S1)**			**Over voltage (59.S2)**			
A) STEPS for trip value [V to V]	1,1 threshold -> decrease by max 5 V steps			0,9 threshold -> increase by max 5 V steps			
D) STEP for trip time [V to V]	1,1 threshold -> 0,9 threshold			0,9 threshold -> 1,01 threshold			
	Ambient temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	195,1	195,1	195,1	265,0	264,9	265,0	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,511	1,504	1,507	0,198	0,198	0,199	
	-10°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	195,1	195,1	195,1	265,0	264,9	265,0	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,510	1,509	1,508	0,197	0,197	0,197	
	+55°C temperature						
Limit [V]	195,5			264,5			
Measurement accuracy of the tripping value [V]	195,1	195,1	195,1	265,0	264,9	265,0	
Disconnection limit [s]	1,500			0,200			
Measurement the trip time [s]	1,506	1,511	1,509	0,199	0,198	0,196	

Test

To measure the disconnection time a step of 84% V_n is taken from the nominal voltage and of 116% V_n from the nominal voltage for undervoltage and overvoltage.

The voltages should be measured per phase conductor, in which current is fed between the line conductor and the neutral conductor.

Assessment criterion

Limit values

Voltage drop protection 27.S1 0,85 V_n 1,500 s

Rise-in voltage protection 59.S2 1,15 V_n 0,200 s

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **3% of the disconnection limit ±20 ms**.

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

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A.4.3.1 A.4.3.2	Test procedure for falling time						N/A
Operating time of the monitoring device							
	Falling time at under voltage			**Falling time at over voltage**			
B) STEP [V to V]	real threshold (of A)-> increase by one step to 1,1 threshold			real threshold (of A)-> decrease by one step to 0,9 threshold			
	Ambient temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	
	-10°C temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	
	+55°C temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	
	Falling time at under frequency			**Falling time at over frequency:**			
B) STEP [Hz to Hz]	real threshold (of A)-> increase by one step to 1,01 threshold			real threshold (of A)-> decrease by one step to 0,99 threshold			
	Ambient temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	
	-10°C temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	
	+55°C temperature						
Limit [s]	0,040 – 0,100			0,040 – 0,100			
Falling time [s]	--	--	--	--	--	--	

Note

The measuring points are the trip signal of the AC source and the output of the SPI to control the relays (DDI).

For each repetition of the tests, the max tolerances of the values are:

Voltage: 2% for voltages

Frequency: ±20 mHz for frequency trip thresholds

Trip times: 1% ±20 ms for disconnection times

Test only for external SPI!

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A.4.3.1 A.4.3.2	Test procedure for falling ratio (voltage)	N/A

Operating time of the monitoring device

	Falling ratio at under voltage			Falling ratio at over voltage		
C) STEP [V to V]	0,8 threshold -> increase by max 5 V steps until reset value is reached			1,2 threshold -> decrease by max 5 V steps until reset value is reached		
	Ambient temperature					
Limit of ratio	1,03-1,05			0,95-0,97		
Measurement reset value [V]	--	--	--	--	--	--
	100			100		
Calculated falling ratio V_{in}/V_{end}	--	--	--	--	--	--
	-10°C temperature					
Limit of ratio	1,03-1,05			0,95-0,97		
Measurement reset value [V]	--	--	--	--	--	--
	100			100		
Calculated falling ratio V_{in}/V_{end}	--	--	--	--	--	--
	+55°C temperature					
Limit of ratio	1,03-1,05			0,95-0,97		
Measurement reset value [V]	--	--	--	--	--	--
	100			100		
Calculated falling ratio V_{in}/V_{end}	--	--	--	--	--	--

Test

To measure the falling ratio, the voltage or frequency brought out the operation range by 20% of the nominal and in-/decrease in maximal 10 mHz or 5 V steps until the SPI connects.

Assessment criterion

Calculation:

V_{in} (reset value) f_{in} (reset value)

V_{end} (trip value) f_{end} (trip value)

Limit values

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **±20 ms**.

The value of the falling ratio may not vary by more than **≤ 2%**.

The ratio limits: 85% (27.S1) between 1.03 and 1.05

115% (59.S2) between 0.95 and 0,97

49,50 Hz (81<S1) 1,001-1,003

50,50 Hz (81>S1) 0,997-0,999

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A.4.3.1 A.4.3.2	Test procedure for falling ratio (frequency)	N/A

Operating time of the monitoring device

	Falling ratio at under frequency			Falling ratio at over frequency		
C) STEP [Hz to Hz]	0,8 threshold -> increase by max 10 mHz steps until reset value is reached			1,2 threshold -> decrease by max 10 mHz steps until reset value is reached		
Limit of ratio	**Ambient temperature**					
	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--
	-10°C temperature					
Limit of ratio	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--
	+55°C temperature					
Limit of ratio	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--

Test

To measure the falling ratio, the voltage or frequency brought out the operation range by 20% of the nominal and in-/ decrease in maximal 10 mHz or 5 V steps until the SPI connects.

Assessment criterion

Calculation:

V_{in} (reset value) f_{in} (reset value)

V_{end} (trip value) f_{end} (trip value)

Limit values:

The setting value and the trip value of the frequency may not vary by more than **≤ 5% V_n** and **± 20ms**.

The value of the falling ratio may not vary by more than **≤ 2%**.

The ratio limits: 85% (27.S1) between 1.03 and 1.05

115% (59.S2) between 0.95 and 0,97

49,50 Hz (81<S1) 1,001-1,003

50,50 Hz (81>S1) 0,997-0,999

Test only for external SPI!

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A.4.3.1 A.4.3.2	Test procedure for falling ratio (frequency)	N/A

Operating time of the monitoring device

	Falling ratio at under frequency			Falling ratio at over frequency		
C) STEP [Hz to Hz]	0,8 threshold -> increase by max 10mHz steps until reset value is reached			1,2 threshold -> decrease by max 10mHz steps until reset value is reached		
Limit of ratio	**Ambient temperature**					
	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--
	-10°C temperature					
Limit of ratio:	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--
	+55°C temperature					
Limit of ratio	1,001-1,003			0,997-0,999		
Measurement reset value [Hz]	--	--	--	--	--	--
Calculated falling ratio f_{in}/f_{end}	--	--	--	--	--	--

Test

To measure the falling ratio, the voltage or frequency brought out the operation range by 20%of the nominal and in-/decrease in maximal 10 mHz or 5 V steps until the SPI connects.

Assessment criterion

Calculation:

V_{in} (reset value) f_{in} (reset value)

V_{end} (trip value) f_{end} (trip value)

Limit values:

The setting value and the trip value of the frequency may not vary by more than **≤5% V_n** and **±20 ms**.

The value of the falling ratio may not vary by more than **≤ 2%**.

The ratio limits: 85% (27.S1) between 1.03 and 1.05

115% (59.S2) between 0.95 and 0,97

49,50 Hz (81<S1) 1,001-1,003

50,50 Hz (81>S1) 0,997-0,999

Test only for external SPI!

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	Measuring the rise-in voltage protection as a running 10-minute mean value		P
Test			
(59.S1) moving average measurement over 10min according to EN 61000-4-30			
		Disconnection time	Limit
a)	The voltage is set to 100% V_n and held for 600 s. Thereafter the voltage is set to 112% V_n. Disconnection must take place within 600 s.		
	Phase 1	474,8 s	≤ 600 s
	Phase 2	474,8 s	
	Phase 3	474,8 s	
b)	The voltage is set to V_n for 600 s and then to 108% V_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 % V_n and held for 600 s. Thereafter the voltage is set to 114 % V_n. Disconnection must take place within 300 s or about 50 % of the disconnection time measured in point a).*		
	Phase 1	295,0 s	The disconnection time should be about 50 % of the value measured in a). *
	Phase 2	314,2 s	
	Phase 3	286,8 s	
Note			
*If the setting value is set to 600 s, then the disconnection time can be in the range between 225 s and 375 s.			

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A.4.3.3.1	Insensitivity to harmonics of the frequency relay							P
AC-Source Setting	Harmonics order:	2nd	3rd	5th	7th	9th	11th	13th	17th
	$\%V_n$:	4,0	10,0	12,0	10,0	3,0	7,0	6,0	4,0

Operating time of the monitoring device							
	Under frequency			**Over frequency**			
A) STEPS for trip value [Hz to Hz]	1,01 threshold -> decrease by max 10mHz steps			0,99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]	1,01 threshold -> 0,99 threshold			0,99 threshold -> 1,01 threshold			
Limit [Hz]	47,50			51,50			
Measurement accuracy of the tripping value [Hz]	47,50	47,50	47,50	51,49	51,49	51,49	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,111	0,115	0,109	0,112	0,109	0,114	
Limit [Hz]	49,80			50,20			
Measurement accuracy of the tripping value [Hz]	49,78	49,78	49,78	50,20	50,20	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,117	0,120	0,120	0,118	0,119	0,119	

Test:

The test setup for the harmonic distortion, was set with the fallowing values:

Harmonics order:	2nd	3rd	5th	7th	9th	11th	13th	17th
$\%V_n$:	4,0	10,0	12,0	10,0	3,0	7,0	6,0	4,0

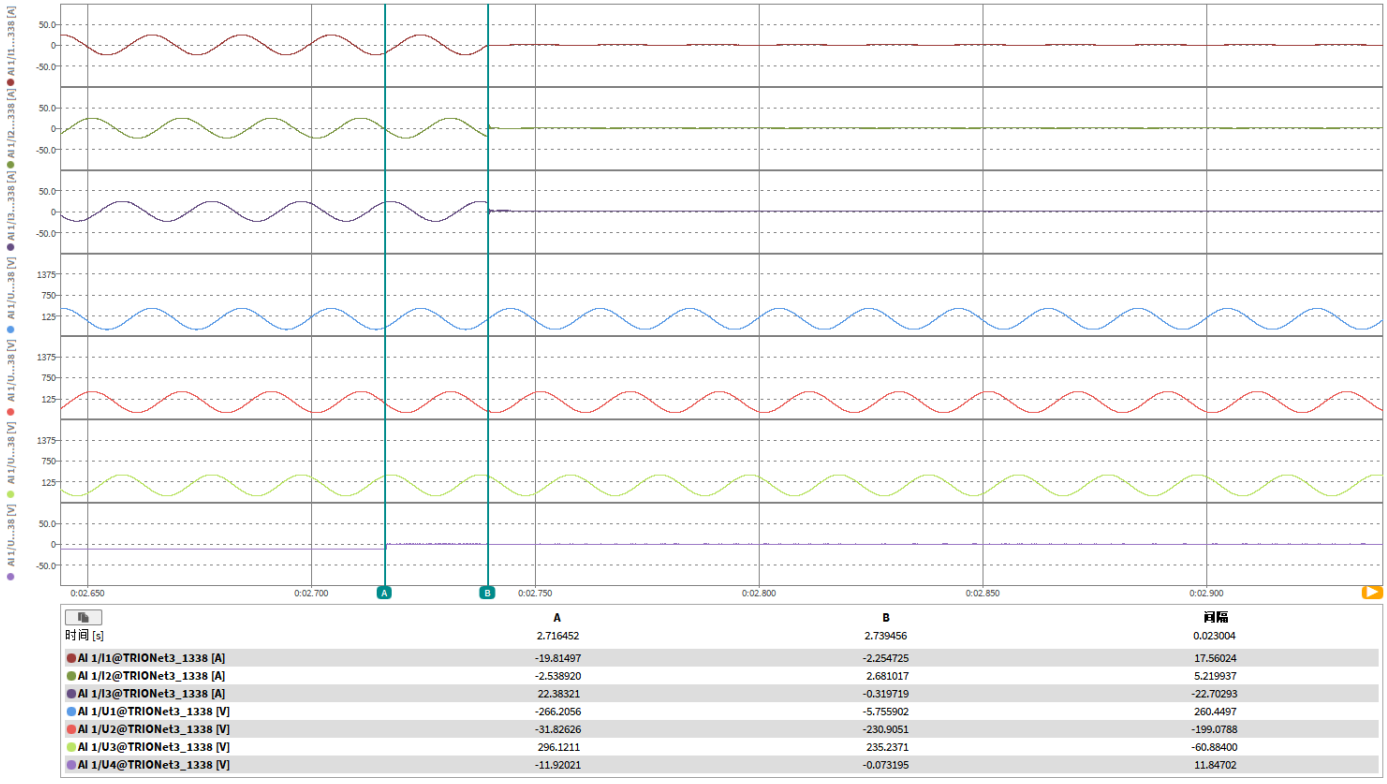
The frequency test was performed as in A.4.3

Note

The setting value and the trip value of the frequency may not vary by more than **±20 mHz** and **3% of the disconnection limit ±20 ms**. Differences between the test values: **±20 mHz** and **1% of the disconnection limit ±20 ms.**

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A.4.3.3.2	Remote trip signal	P
Operating time of the monitoring device		
Test	Remote tripping signal for the external disconnection	
Limit [s]	0,050	
Reaction time of the tripping value [s]	0,023	
Graph		



时间 [s]	A 2.716452	B 2.739456	间隔 0.023004
AI 1/I1@TRIONet3_1338 [A]	-19.81497	-2.254725	17.56024
AI 1/I2@TRIONet3_1338 [A]	-2.538920	2.681017	5.219937
AI 1/I3@TRIONet3_1338 [A]	22.38321	-0.319719	-22.70293
AI 1/U1@TRIONet3_1338 [V]	-266.2056	-5.755902	260.4497
AI 1/U2@TRIONet3_1338 [V]	-31.82626	-230.9051	-199.0788
AI 1/U3@TRIONet3_1338 [V]	296.1211	235.2371	-60.88400
AI 1/U4@TRIONet3_1338 [V]	-11.92021	-0.073195	11.84702

Note

The protection interface has to have a maximum delay of the remote tripping signal from receiving to transmitting to the DDI of 50 ms.

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A.4.3.3.3	Communication Signal	P
Operating time of the monitoring device		
Without communication signal		
f_{soll}	**f_{ist}**	**Limit:**
49,80 Hz	49,80 Hz	<81.S1
50,20 Hz	50,20 Hz	>81.S1
With communication signal		
f_{soll}	**f_{ist}**	**Limit:**
47,50 Hz	47,50 Hz	<81.S2
51,50 Hz*	51,50 Hz	>81.S2
Note		

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A.4.3.4	Verification of insensitivity to the frequency derivative	P

Test result

	Start and End Frequency [Hz]	Change	Confirm
Positive Frequency drift	47,550 – 51,450	+2,5 Hz/sec	No trip and inverter continue operation
Negative Frequency drift	51,450 – 47,550	-2,5 Hz/sec	No trip and inverter continue operation

Note

Frequency protection settings:

81>: tripping threshold 51,5 Hz, tripping time 0,15 s

81<: tripping threshold 47,5 Hz, tripping time 0,15 s

1) Apply a symmetrical triad of direct cyclic sequence voltages having a modulus of 100 % of the nominal voltage and a frequency of 47,550 Hz;

2) increase the frequency of the three ramp voltages, with ramp steps having an amplitude of 12,5 mHz and a duration of 5 ms, until a frequency value of 51,450 Hz is reached (*);

3) decrease the frequency of the three ramp voltages, with ramp steps having an amplitude of 12,5 mHz and a duration of 5 ms until the frequency value of 47,550 Hz is reached (*);

4) repeat the tests in 2 and 3 above four times, for a total of five positive and negative ramps.

The test is deemed to have been passed if the minimum and maximum frequency protection is not triggered.

If the SPI is integrated in the inverter, in addition to the absence of minimum and maximum frequency protection trips, it must also be verified that the inverter continues to operate.

(*) These ramp settings produce a frequency derivative of 12,5 mHz / 5 ms = 2,5 Hz/s.

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A.4.4	Self-test	P

Self-test function

If the interface protection functions are integrated in the inverter, at least one self-test system must be provided which checks the maximum/minimum frequency and maximum/minimum voltage functions provided in the interface protection system (SPI), as described below:

- for each frequency and voltage protection function, the tripping threshold varies linearly upward or downward with a slope of ≤ 0,05 Hz/s or ≤ 0,05 V_n/s respectively for the frequency and voltage protection;
- This will determine, at a certain point in the test, whether the threshold and the actual value of the controlled parameter (frequency or voltage) coincide, and thus whether the protection was triggered and the interface device subsequently opened.

For each test, the person conducting the test must be able to view the quantity and trip time values, in addition to the current value of the voltage and frequency detected by the converter.

The tests must measure the:

- accuracy of tripping thresholds;
- accuracy of trip times.

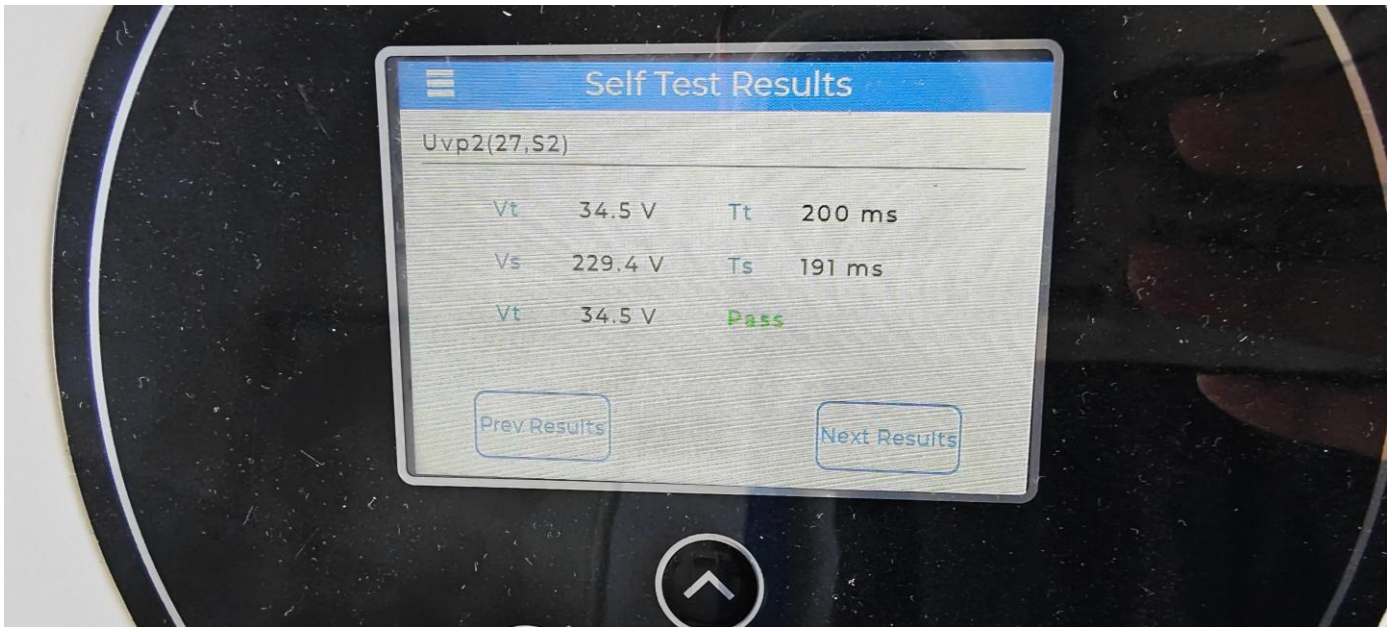
After each test, the inverter must exit the test mode, reset the normally used settings and automatically reconnect to the network when the conditions are appropriate.

Any user must be able to activate the procedure and it must be clearly described in the converter user manual.

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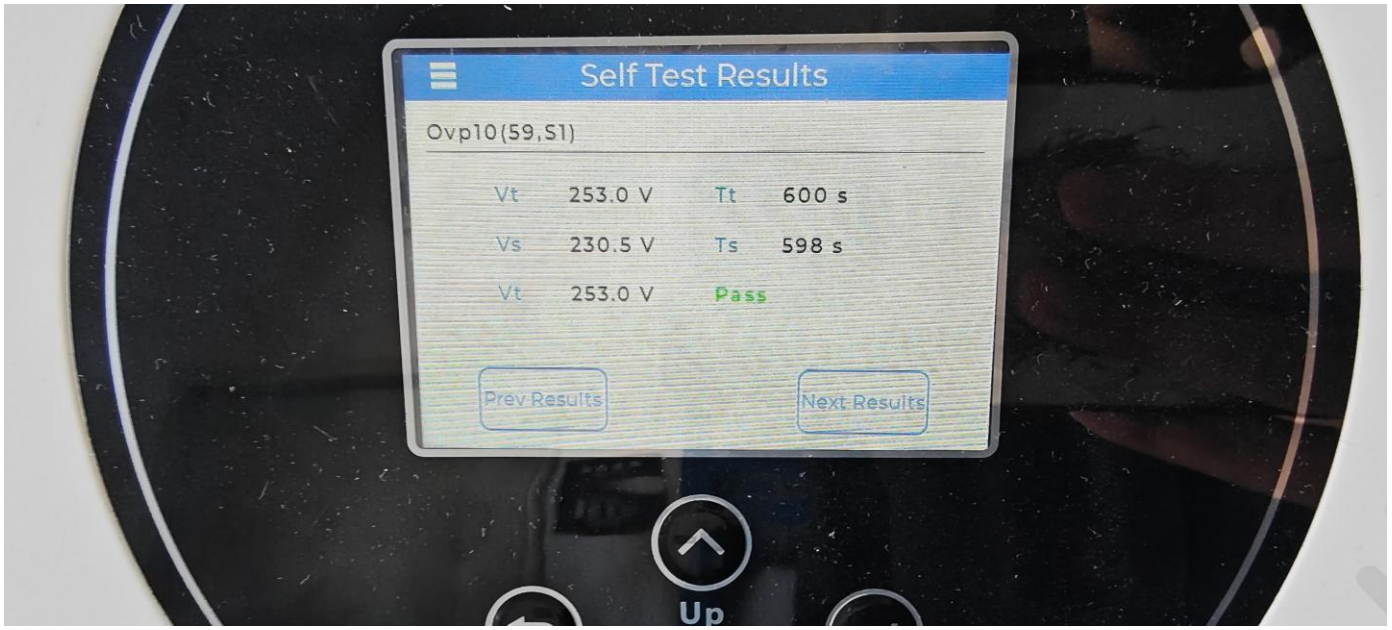
A.4.4	Self-test	P
Description of the Self-test		

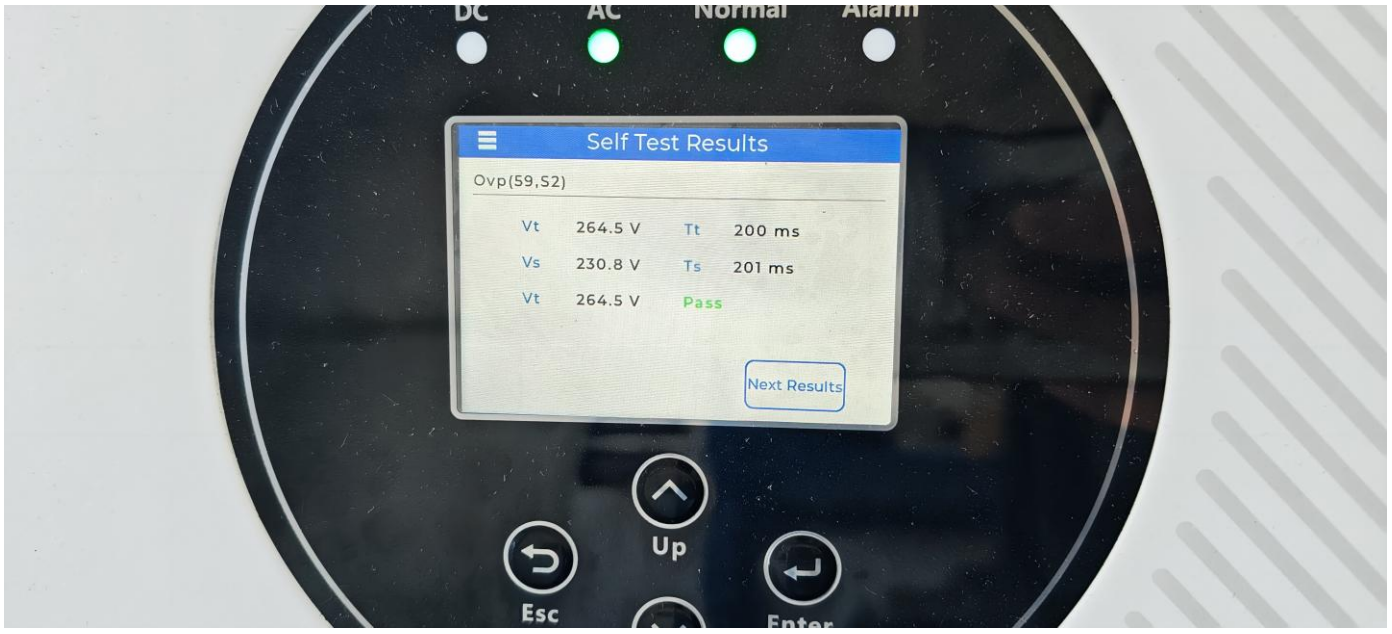




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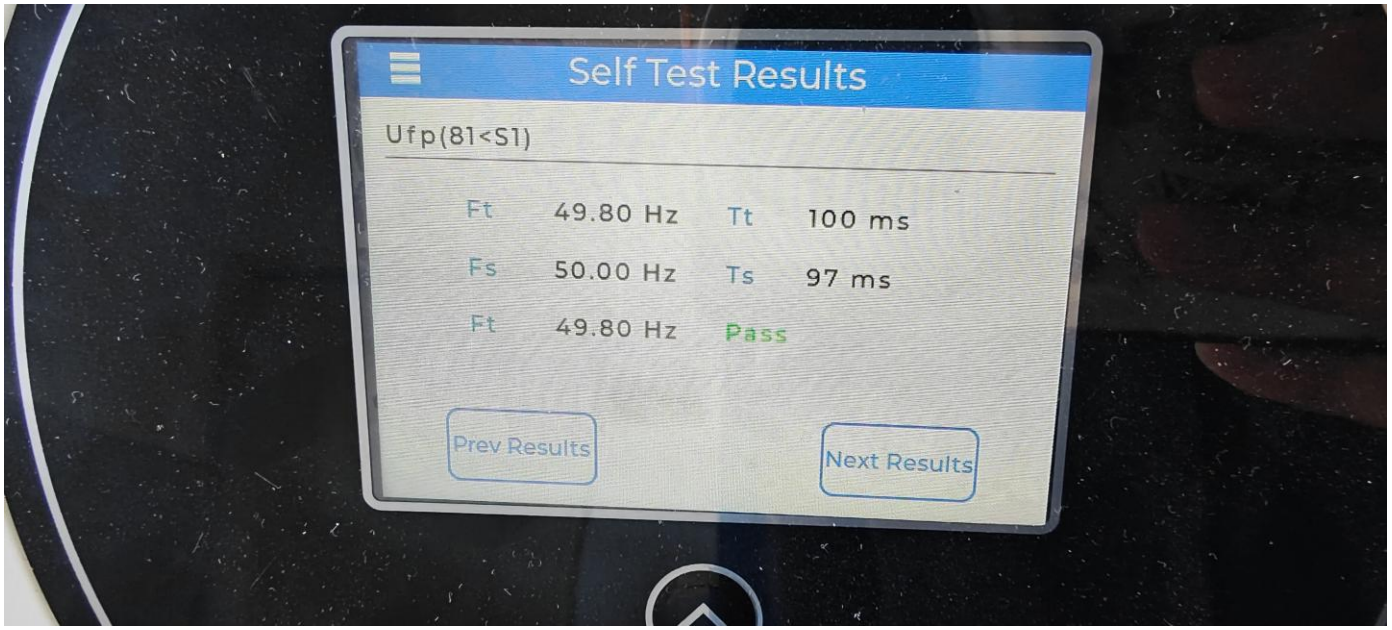
A.4.4	Self-test	P

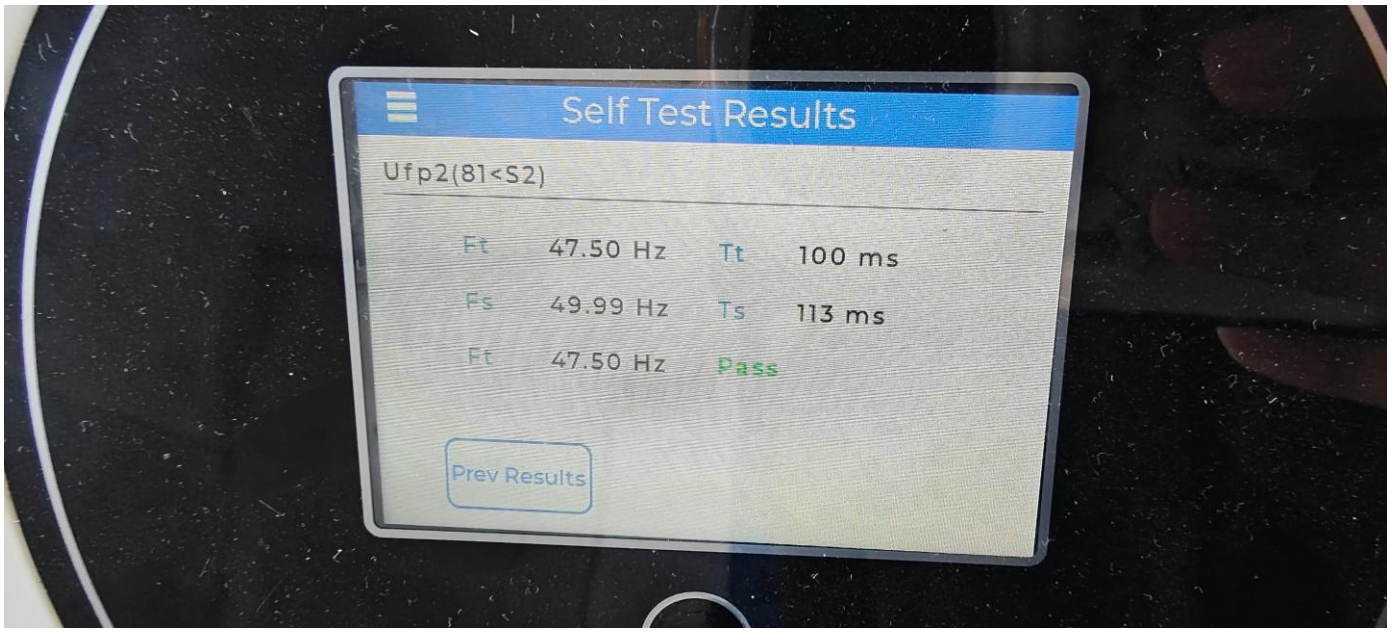




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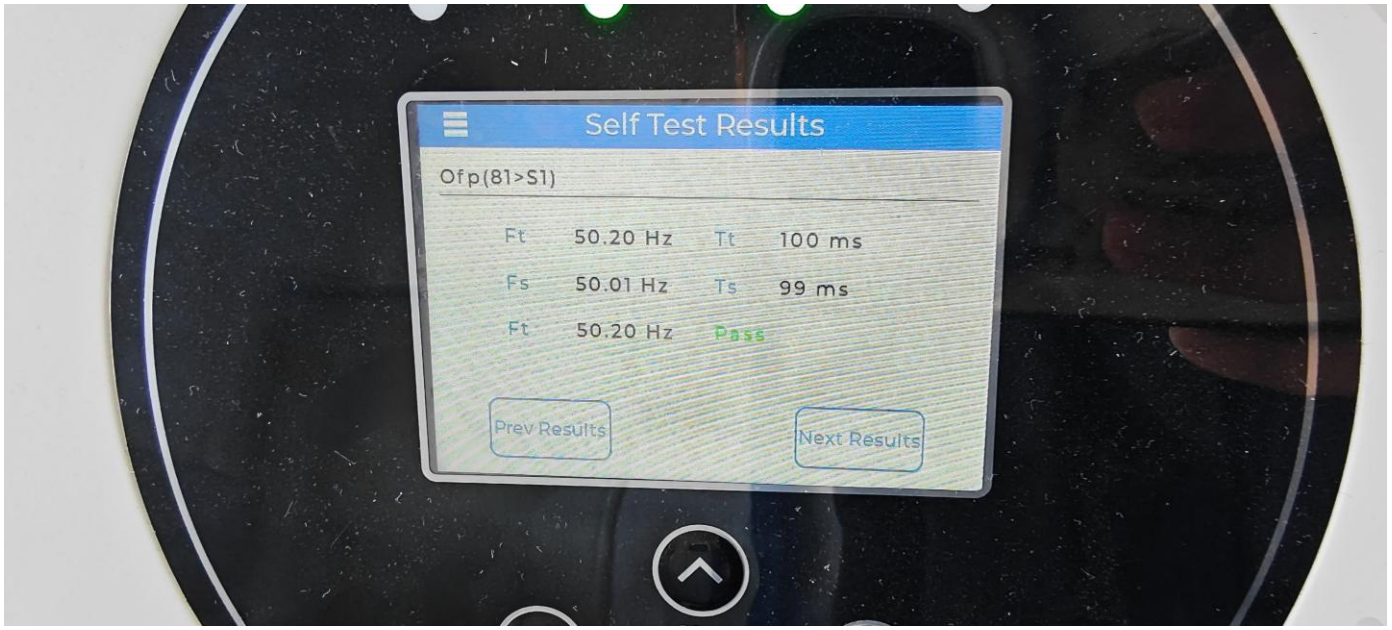
A.4.4	Self-test	P

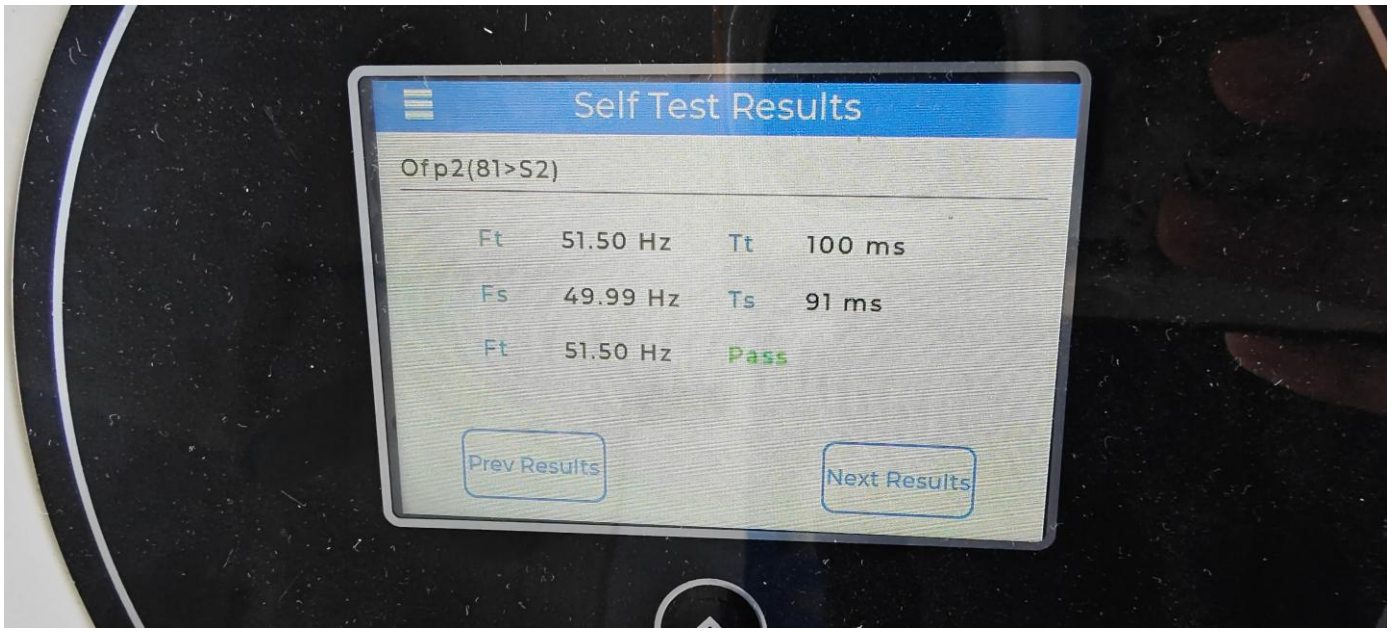




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A.4.4	Self-test	P





Note

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A.4.5	Single fault tolerance	P
The "single fault tolerance" intended function integrated SPI must be verified by examination of documentation provided by the manufacturer, and additional evidence on the immunity to single event of failure of the SPI. The test is successful if the SPI, in the face of a failure of a single component (for example, CPU, power supply, main electronic components, etc.), - maintains its protective functions unaltered indicating the place of an internal fault or event - It outputs the opening command of the DDI		

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A.4.5	Single fault tolerance	P

4.4	TABLE: fault condition tests						P
	ambient temperature (°C) ..... :	25					—
Component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result	
R160	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT shut down, “Phase A overvoltage fault” error, no damage, no hazard, no fire	
C66	open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.	
R316	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT shut down, “Phase C current is too large” error, no damage, no hazard, no fire	
C302	open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.	
R367	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	PV1 sampling voltage is too large, max power is limited to 9,7 kW operation, no hazard, no fire, no damage.	
R367	open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT Protective shutdown, no damage, no hazard, no fire	
C30	Open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.	
R111	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT Protective shutdown, no damage, no hazard, no fire	
C89	Open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.	
R18	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT Protective shutdown, BUS voltage sampling is 0, no damage, no hazard, no fire	
C24	Open	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.	
C1+C2	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT Protective shutdown, no damage, no hazard, no fire	
R130	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT Protective shutdown, no damage, no hazard, no fire	

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A.4.5	Single fault tolerance	P

Q3, B-E	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
Q3, E-C	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
50 mA boot self-test R161	Open before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
Q10, B-E	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
Q10, E-C	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
QR1, B-E	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
QR1, E-C	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY2 pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY5 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY6 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY7 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY8 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY9 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY3 Pin1-pin2	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT fault report, no damage, no hazard, no fire.
RY7 Pin3-pin4	Short before start up	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.

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A.4.5	Single fault tolerance	P

C37	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	ETU report ISO failure, no hazard, no fire, no damage.
U6 Pin1-pin2	OPEN	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
U12 Pin1-pin2	OPEN	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	Power failure, no hazard, no fire, no damage.
U6 Pin1-pin2	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
U12 Pin1-pin2	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	Power failure, no hazard, no fire, no damage.
T1 Pin7-8	Short	BAT-50V	10 min	-	-	Power failure, no hazard, no fire, no damage.
T2 Pin33-34	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin29-30	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin25-26	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin21-22	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin18-19	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin4-5	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
T2 Pin2-3	Short	PV-800V	10 min	-	-	Power supply no output, no hazard, no fire, no damage.
L1/L2/L3 to N	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT shutdown immediately, short-circuit current: rms: 37,3 A, time: 2,0 ms, no damage, no hazard, no fire
L1, L2, L3 and N together	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT shutdown immediately, short-circuit current: rms: 36,2 A, time:3,3 ms, no hazard, no damage to enclosure, no fire
L1/L2/L3 to Ground	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT shutdown immediately, short-circuit current: rms: 46,5 A, time: 1,8 ms no damage, no hazard, no fire
N to Ground	Short	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.

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A.4.5	Single fault tolerance	P

Grounding wire disconnected	-	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal, no hazard, no fire, no damage.
DC side feedback current	AC short circuit	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	No feedback current.
AC side feedback current	DC short circuit	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	No feedback current.
AC output	Overload 20 A	PV: 800 V AC: 230 V BAT: 48 V	1 h	-	-	EUT protected when current is more than 20 A, EUT normal operation, no error, no damage, no hazard, no fire.
FAN	disconnected	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal. The machine runs derated, report fan failure.
FAN	Stopped	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT normal. Overtemperature machine derating.
PV-/+	Reverse	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT can not startup. Report reverse connection fault, no hazard, no fire, no damage.
BAT+/-	Reverse	PV: 800 V AC: 230 V BAT: 48 V	10 min	-	-	EUT can not startup, no hazard, no fire, no damage.

Assessment criterion

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

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

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

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A.4.6	EMC compatibility testing	P

Table 18 - List of immunity tests on measuring relays and protective devices according to IEC EN 50263 and IEC EN 60255-26 Class B severity levels (industrial environment)

Electrical disturbance tests on relays: acceptance criteria and test procedures		IEC Basic Standard	Enclosure	Auxiliary power supply (Note a)	Communication (Note b)	Entry/Exit (Note c)	Functional earth (Note d)	Acceptance criterion
IEC EN 60255-22-1 (2008-10)	Oscillation train immunity tests at 1 MHz	61000-4-18		1 kV diff. mode 2.5 kV m. com.	1 kV m. common	1 kV diff. mode 2.5 kV m. com.		B
IEC EN 60255-22-2 (2009-05)	Electrostatic discharge tests	61000-4-2	6 kV air 8 kV contact					B
IEC EN 60255-22-3 (2009-02)	Immunity to radiated electromagnetic fields	61000-4-3	10 V/m (80 MHz - 2.7 GHz) Includes 900 MHz					A
IEC EN 60255-22-4 (2008-09)	Testing for immunity to fast electrical transients/pulse trains	61000-4-4		2 kV	1 kV	2 kV	2 kV	B
IEC EN 60255-22-5 (2002-12)	Impulse test	61000-4-5		1 kV phase-to-phase 2 kV phase-to-ground (next steps)	1 kV phase-to-ground (successive steps)	1 kV phase-to-phase 2 kV phase-to-ground (next steps)		B
IEC EN 60255-22-6 (2001-11)	Immunity to conducted disturbances induced by radio frequency fields	61000-4-6		10 V	10 V	10 V	10 V	A
IEC EN 60255-22-7 (2003-09)	Mains frequency immunity tests	61000-4-16				100 V rms diff 300 V rms com. (10 s only on binary inputs)		A
EN 60255-11 (2010-01)	Interruption of auxiliary DC voltage	61000-4-29		100 % reduction for 50 ms (*) Requirements for VRT with UPS				B
IEC 61000-4-8 (2009-09)	Mains frequency magnetic field	61000-4-8	30 A/m (continuous) 300 A/m (1 s)					A

NOTE a): in the case of integrated SPI, this refers to the AC power supply of the inverter
NOTE (b): In the case of an integrated SPI, this refers to the inverter signal intended to perform the communication function with the integrated SPI
NOTE (c): Examples of input signal: local command, telescope signal, DDI status. Examples of output signal: DDI command
NOTE d): in the case of integrated SPI, this refers to the functional earth of the inverter

Note

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A.4.7	Climatic compatibility tests	P

Test result

Detail	Notes/Evidence Levels	Standards	Acceptance criterion
Non-powered equipment	dry heat +70 °C ± 2 °C (16 hours)	EN 60068-2-2	B
	humid heat +40 °C ± 2 °C, RH = 93 % ± 3 % (4 days)	EN 60068-2-78	B
	Cold -10 °C ± 2 °C (16 hours)	EN 60068-2-1	B
	temperature change -10/+70 °C ± 2 °C (3 hours + 3 hours)	EN 60068-2-14	B
Powered equipment	dry heat + 55 °C ± 2 °C (16 hours)	EN 60068-2-2	A
	humid heat + 40 °C ± 2 °C, RH = 93 % ± 3 % (4 days)	EN 60068-2-78	A
	Cold -10 °C ± 2 °C (16 hours)	EN 60068-2-1	A
	temperature change -10 °C/+55 °C ± 2 °C (3 hours + 3 hours)	EN 60068-2-14	A

Assessment criterion

For acceptance, during the climatic tests the following must be checked

- all functions;
- measuring the accuracy of tripping thresholds;
- measuring the accuracy of trip times.

Note

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A.4.8	Insulation tests	P

Rigidity of electricity		
Location	Test voltage	Result
AC to PE	2,8kV	No breakdown of insulation
DC to PE	2kV	No breakdown of insulation
Impulse test		
AC and DC inputs	4kV (1,2 / 50 µs)	No breakdown of insulation
Measurement of the insulation resistance		
AC and DC inputs	>100MΩ at 500Vdc	>100 MΩ

Criteria

Location	Verification of dielectric properties	Notes/Evidence Levels	Technical Standard
Input Power supply, both AC and DC	Impulse hold	Overvoltage category IV see V2 IEC Standard 0-16	IEC EN 60255-27
Input AC power supply	Dielectric strength	Test voltage 2 kV for AC circuits	IEC EN 60255-27
Input Power supply, both AC and DC	Insulation resistance	>100MΩ at 500Vdc	IEC EN 60255-27

Note

In the case of an SPI integrated in the inverter (see definition in note 70), unless it is realised with a dedicated board whose power supply is accessible from the outside, reference shall be made to CEI EN 60146-1-1 for the purposes of insulation tests.

The expected altitude oversea for the test values above is 2000m.

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A.4.9	Tests for the overload capacity of measuring circuits	P
Voltage	Test time	Result
≥130% V_n	permanent	No breakdown
≥150% V_n	1 s	No breakdown
Note No external protectors by the meaning of this clause present.		

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A.4.10	Equipment compliance	N/A
Note		
The equipment compliance declaration is issued by the manufacturer and not part of the test report.		

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A.4.11	Automatism to avoid current imbalances in production	N/A
Test result		
Test No. 1	Imbalance 6 kW to 10 kW	Limit 30 min.
Measured values	-	-
Test No. 2	Imbalance above 10 kW	Limit 1 min.
Measured values	-	-
Criteria		

The following tests are only to be performed if the entire production plant can be operated with power imbalances of less than 10 kW (test 1) or more than 10 kW (test 1 and 2).

On completion of the system and before final parallel connection to the network, the following two test conditions must be verified.

Test No. 1

- plant in operation at its nominal conditions;
- creation of a permanent artificial imbalance of more than 6 kW and less than 10 kW;
- verification of the disconnection of the entire production plant via the DDI within a maximum time of 30 min.

Test No. 2:

- plant in operation at its nominal conditions;
- creation of a permanent artificial imbalance greater than 10 kW;
- verification of the disconnection of the entire production plant via the DDI within a maximum time of 1 min.

(74) The temporary connection for testing purposes must be agreed between the DSO and the Active User.

Note

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1	Tests on the inverter	**P**
a)	Harmonic emission	**P**
b)	Harmonic emission exceeding 75A per phase	**P**
c)	Flicker emission	**P**
B.1.1	Conditions of connection, reconnection and gradual power supply	**P**
B.1.2	Reactive power exchange	**P**
B.1.3	Limitation of active power	**P**
B.1.4	Output of DC component in the output current	**P**
B.1.5	Checking insensitivity to voltage dips (LVRT capability)	**P**
	Checking insensitivity to overvoltage dips (OVRT capability)	**P**
B.1.6	Checking the insensitivity to automatic reclosing during phase accordance	**P**

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TEMP-0058-TG-EAW-ES-V01

B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1340,1		2608,3		4012,6		
AC Voltage [V]	230,65		230,82		231,01		
AC Current [A]	5,81		11,30		17,37		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,048		1,113		1,130		
PWHD	2,065		4,238		3,579		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,802	-	11,298	-	17,369	-	-
2nd	0,019	0,109	0,013	0,074	0,031	0,180	8,00
3rd	0,012	0,069	0,010	0,056	0,013	0,075	N/A
4th	0,024	0,139	0,018	0,105	0,038	0,217	4,00
5th	0,095	0,549	0,074	0,424	0,099	0,571	10,70
6th	0,004	0,024	0,004	0,025	0,007	0,041	2,67
7th	0,115	0,660	0,084	0,486	0,060	0,347	7,20
8th	0,031	0,180	0,034	0,196	0,021	0,123	2,00
9th	0,003	0,017	0,004	0,025	0,005	0,030	N/A
10th	0,026	0,148	0,034	0,193	0,036	0,209	1,60
11th	0,036	0,207	0,028	0,159	0,047	0,269	3,10
12th	0,006	0,036	0,003	0,020	0,005	0,028	1,33
13th	0,024	0,135	0,028	0,160	0,050	0,289	2,00
14th	0,024	0,140	0,018	0,105	0,022	0,128	N/A
15th	0,003	0,017	0,003	0,016	0,003	0,018	N/A
16th	0,020	0,115	0,010	0,055	0,013	0,074	N/A
17th	0,026	0,150	0,009	0,049	0,036	0,210	N/A
18th	0,002	0,011	0,002	0,014	0,004	0,022	N/A
19th	0,033	0,190	0,017	0,096	0,039	0,224	N/A
20th	0,015	0,086	0,007	0,041	0,007	0,043	N/A
21th	0,003	0,017	0,002	0,012	0,004	0,021	N/A
22th	0,015	0,086	0,010	0,055	0,014	0,078	N/A
23th	0,024	0,136	0,030	0,172	0,033	0,192	N/A
24th	0,002	0,013	0,004	0,026	0,004	0,020	N/A
25th	0,031	0,181	0,083	0,479	0,068	0,389	N/A
26th	0,009	0,049	0,005	0,030	0,012	0,071	N/A
27th	0,002	0,012	0,003	0,020	0,006	0,036	N/A
28th	0,011	0,065	0,016	0,093	0,005	0,031	N/A
29th	0,024	0,139	0,093	0,536	0,066	0,379	N/A
30th	0,002	0,009	0,002	0,012	0,012	0,066	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
31th	0,013	0,074	0,035	0,199	0,028	0,164	N/A
32th	0,005	0,028	0,003	0,015	0,004	0,024	N/A
33th	0,002	0,012	0,002	0,013	0,003	0,016	N/A
34th	0,005	0,026	0,004	0,021	0,003	0,016	N/A
35th	0,006	0,034	0,022	0,125	0,021	0,120	N/A
36th	0,002	0,012	0,002	0,011	0,003	0,016	N/A
37th	0,009	0,052	0,021	0,123	0,007	0,043	N/A
38th	0,003	0,016	0,003	0,017	0,003	0,015	N/A
39th	0,002	0,009	0,002	0,012	0,002	0,011	N/A
40th	0,002	0,014	0,003	0,019	0,002	0,014	N/A
41th	0,010	0,060	0,013	0,076	0,004	0,022	N/A
42th	0,002	0,009	0,002	0,011	0,003	0,014	N/A
43th	0,009	0,053	0,013	0,075	0,015	0,083	N/A
44th	0,003	0,015	0,004	0,020	0,002	0,012	N/A
45th	0,002	0,010	0,001	0,008	0,002	0,011	N/A
46th	0,003	0,016	0,004	0,020	0,002	0,013	N/A
47th	0,007	0,043	0,010	0,055	0,009	0,053	N/A
48th	0,002	0,009	0,002	0,010	0,002	0,011	N/A
49th	0,010	0,059	0,006	0,032	0,007	0,039	N/A
50th	0,003	0,020	0,004	0,023	0,003	0,019	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1333,2		2601,3		4003,4		
AC Voltage [V]	230,65		230,82		231,01		
AC Current [A]	5,78		11,27		17,33		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1.063		1.107		1.133		
PWHD	2.073		4.185		3.468		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,774	-	11,266	-	17,327	-	-
2nd	0,018	0,101	0,011	0,066	0,033	0,189	8,00
3rd	0,016	0,090	0,016	0,091	0,015	0,084	N/A
4th	0,025	0,144	0,024	0,137	0,041	0,233	4,00
5th	0,098	0,563	0,071	0,406	0,105	0,605	10,70
6th	0,007	0,038	0,011	0,063	0,009	0,049	2,67
7th	0,116	0,665	0,085	0,489	0,056	0,320	7,20
8th	0,029	0,169	0,033	0,188	0,017	0,098	2,00
9th	0,002	0,012	0,004	0,024	0,005	0,026	N/A
10th	0,029	0,167	0,034	0,193	0,041	0,234	1,60
11th	0,037	0,213	0,027	0,156	0,046	0,265	3,10
12th	0,003	0,017	0,005	0,027	0,006	0,034	1,33
13th	0,022	0,125	0,029	0,164	0,050	0,289	2,00
14th	0,023	0,133	0,018	0,105	0,021	0,123	N/A
15th	0,003	0,018	0,002	0,014	0,003	0,015	N/A
16th	0,019	0,108	0,011	0,062	0,009	0,052	N/A
17th	0,029	0,165	0,006	0,037	0,037	0,213	N/A
18th	0,003	0,017	0,003	0,019	0,005	0,027	N/A
19th	0,034	0,195	0,015	0,083	0,034	0,198	N/A
20th	0,015	0,085	0,009	0,050	0,010	0,060	N/A
21th	0,005	0,028	0,007	0,041	0,008	0,044	N/A
22th	0,015	0,084	0,012	0,070	0,012	0,071	N/A
23th	0,024	0,141	0,030	0,175	0,035	0,201	N/A
24th	0,003	0,017	0,003	0,017	0,005	0,029	N/A
25th	0,028	0,163	0,078	0,446	0,064	0,367	N/A
26th	0,009	0,051	0,005	0,029	0,012	0,071	N/A
27th	0,007	0,038	0,020	0,118	0,009	0,052	N/A
28th	0,011	0,066	0,015	0,084	0,005	0,032	N/A
29th	0,024	0,139	0,094	0,541	0,066	0,382	N/A
30th	0,002	0,014	0,002	0,014	0,011	0,065	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
31th	0,014	0,082	0,030	0,172	0,020	0,117	N/A
32th	0,005	0,029	0,003	0,017	0,005	0,027	N/A
33th	0,002	0,010	0,002	0,009	0,002	0,014	N/A
34th	0,004	0,025	0,003	0,017	0,004	0,022	N/A
35th	0,005	0,028	0,024	0,140	0,021	0,121	N/A
36th	0,002	0,011	0,002	0,014	0,003	0,017	N/A
37th	0,009	0,054	0,020	0,117	0,008	0,043	N/A
38th	0,004	0,022	0,004	0,023	0,003	0,017	N/A
39th	0,002	0,011	0,002	0,010	0,003	0,015	N/A
40th	0,003	0,017	0,003	0,019	0,003	0,015	N/A
41th	0,011	0,065	0,014	0,082	0,004	0,022	N/A
42th	0,002	0,013	0,003	0,017	0,002	0,013	N/A
43th	0,009	0,053	0,014	0,079	0,014	0,081	N/A
44th	0,003	0,015	0,003	0,020	0,002	0,014	N/A
45th	0,002	0,013	0,002	0,013	0,003	0,020	N/A
46th	0,002	0,014	0,004	0,024	0,002	0,013	N/A
47th	0,007	0,042	0,011	0,062	0,009	0,054	N/A
48th	0,001	0,008	0,002	0,010	0,002	0,010	N/A
49th	0,010	0,056	0,006	0,032	0,007	0,038	N/A
50th	0,004	0,021	0,004	0,025	0,003	0,019	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1328,5		2592,1		3991,9		
AC Voltage [V]	230,65		230,82		231,01		
AC Current [A]	5,76		11,23		17,28		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,060		1,138		1,139		
PWHD	2,084		4,345		3,575		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,749	-	11,226	-	17,275	-	-
2nd	0,016	0,094	0,015	0,085	0,035	0,202	8,00
3rd	0,005	0,029	0,006	0,035	0,005	0,032	N/A
4th	0,021	0,123	0,018	0,103	0,039	0,224	4,00
5th	0,099	0,571	0,071	0,407	0,102	0,589	10,70
6th	0,009	0,054	0,013	0,076	0,013	0,075	2,67
7th	0,115	0,664	0,088	0,507	0,057	0,329	7,20
8th	0,026	0,152	0,032	0,183	0,019	0,109	2,00
9th	0,005	0,027	0,005	0,031	0,005	0,029	N/A
10th	0,030	0,173	0,039	0,223	0,041	0,234	1,60
11th	0,036	0,207	0,024	0,137	0,045	0,259	3,10
12th	0,008	0,047	0,008	0,048	0,009	0,053	1,33
13th	0,023	0,131	0,032	0,181	0,051	0,292	2,00
14th	0,023	0,133	0,016	0,092	0,022	0,126	N/A
15th	0,002	0,009	0,003	0,017	0,004	0,025	N/A
16th	0,020	0,116	0,012	0,068	0,015	0,085	N/A
17th	0,028	0,159	0,010	0,056	0,035	0,202	N/A
18th	0,003	0,020	0,004	0,024	0,005	0,031	N/A
19th	0,033	0,189	0,015	0,088	0,037	0,214	N/A
20th	0,015	0,084	0,008	0,046	0,010	0,056	N/A
21th	0,005	0,031	0,005	0,031	0,007	0,040	N/A
22th	0,015	0,085	0,012	0,068	0,012	0,067	N/A
23th	0,026	0,148	0,027	0,154	0,034	0,196	N/A
24th	0,004	0,020	0,004	0,021	0,005	0,031	N/A
25th	0,028	0,164	0,085	0,489	0,067	0,385	N/A
26th	0,009	0,053	0,005	0,029	0,013	0,075	N/A
27th	0,005	0,032	0,019	0,108	0,012	0,072	N/A
28th	0,011	0,066	0,014	0,083	0,008	0,045	N/A
29th	0,025	0,146	0,098	0,564	0,068	0,389	N/A
30th	0,003	0,018	0,003	0,014	0,012	0,068	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (Ambient)						P
DHN-LVEH3P12K-EU-G1							
31th	0,013	0,073	0,030	0,171	0,022	0,125	N/A
32th	0,004	0,022	0,003	0,018	0,005	0,029	N/A
33th	0,002	0,014	0,002	0,013	0,004	0,022	N/A
34th	0,005	0,031	0,003	0,017	0,004	0,026	N/A
35th	0,005	0,030	0,023	0,133	0,022	0,127	N/A
36th	0,002	0,011	0,002	0,013	0,004	0,025	N/A
37th	0,010	0,059	0,019	0,107	0,005	0,028	N/A
38th	0,004	0,021	0,003	0,016	0,003	0,016	N/A
39th	0,002	0,013	0,002	0,012	0,002	0,013	N/A
40th	0,003	0,016	0,003	0,020	0,003	0,019	N/A
41th	0,011	0,062	0,013	0,075	0,005	0,027	N/A
42th	0,002	0,014	0,002	0,014	0,003	0,018	N/A
43th	0,011	0,064	0,012	0,067	0,011	0,064	N/A
44th	0,003	0,018	0,004	0,023	0,003	0,016	N/A
45th	0,002	0,014	0,003	0,020	0,004	0,021	N/A
46th	0,003	0,015	0,004	0,021	0,003	0,015	N/A
47th	0,008	0,048	0,010	0,056	0,011	0,060	N/A
48th	0,002	0,009	0,002	0,012	0,002	0,014	N/A
49th	0,010	0,055	0,004	0,021	0,005	0,028	N/A
50th	0,004	0,026	0,003	0,017	0,003	0,017	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)						P
DHN-LVEH3P12K-EU-G1							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1340,1		2633,8		4012,8		
AC Voltage [V]	230,65		230,83		231,02		
AC Current [A]	5,81		11,41		17,37		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,048		1,120		1,130		
PWHD	2,072		4,274		3,586		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,803	-	58,45	--	17,367	-	-
2nd	0,019	0,112	0,453	0,511	0,031	0,180	8,00
3rd	0,012	0,070	1,204	1,384	0,013	0,077	N/A
4th	0,024	0,138	0,230	0,265	0,038	0,217	4,00
5th	0,095	0,548	1,229	1,409	0,099	0,569	10,70
6th	0,004	0,025	0,182	0,216	0,007	0,039	2,67
7th	0,114	0,658	0,860	0,982	0,060	0,347	7,20
8th	0,031	0,180	0,142	0,160	0,021	0,123	2,00
9th	0,003	0,017	0,609	0,703	0,005	0,028	N/A
10th	0,026	0,149	0,103	0,120	0,037	0,210	1,60
11th	0,036	0,207	0,444	0,512	0,047	0,269	3,10
12th	0,006	0,036	0,135	0,162	0,005	0,028	1,33
13th	0,023	0,135	0,365	0,424	0,051	0,291	2,00
14th	0,024	0,141	0,110	0,124	0,022	0,129	N/A
15th	0,003	0,018	0,350	0,401	0,003	0,019	N/A
16th	0,020	0,114	0,113	0,127	0,013	0,075	N/A
17th	0,026	0,150	0,253	0,292	0,037	0,211	N/A
18th	0,002	0,011	0,093	0,109	0,004	0,022	N/A
19th	0,033	0,191	0,205	0,236	0,039	0,225	N/A
20th	0,015	0,087	0,070	0,082	0,007	0,042	N/A
21th	0,003	0,017	0,210	0,250	0,004	0,023	N/A
22th	0,016	0,093	0,062	0,073	0,014	0,079	N/A
23th	0,024	0,137	0,165	0,195	0,034	0,193	N/A
24th	0,002	0,012	0,066	0,072	0,003	0,016	N/A
25th	0,032	0,181	0,163	0,182	0,068	0,392	N/A
26th	0,009	0,051	0,050	0,054	0,010	0,057	N/A
27th	0,002	0,011	0,169	0,195	0,007	0,041	N/A
28th	0,011	0,064	0,050	0,061	0,005	0,029	N/A
29th	0,024	0,139	0,135	0,146	0,066	0,381	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)						P
DHN-LVEH3P12K-EU-G1							
30th	0,002	0,009	0,044	0,045	0,008	0,047	N/A
31th	0,013	0,073	0,115	0,129	0,029	0,164	N/A
32th	0,005	0,027	0,043	0,044	0,004	0,024	N/A
33th	0,002	0,012	0,147	0,175	0,003	0,018	N/A
34th	0,005	0,026	0,037	0,047	0,002	0,014	N/A
35th	0,006	0,034	0,081	0,102	0,021	0,121	N/A
36th	0,002	0,012	0,043	0,049	0,002	0,012	N/A
37th	0,009	0,051	0,081	0,095	0,007	0,042	N/A
38th	0,003	0,016	0,036	0,039	0,003	0,015	N/A
39th	0,002	0,009	0,140	0,160	0,003	0,015	N/A
40th	0,002	0,014	0,041	0,042	0,003	0,014	N/A
41th	0,010	0,060	0,072	0,087	0,004	0,022	N/A
42th	0,002	0,010	0,032	0,040	0,002	0,014	N/A
43th	0,009	0,053	0,083	0,086	0,014	0,083	N/A
44th	0,002	0,014	0,038	0,039	0,002	0,011	N/A
45th	0,002	0,010	0,123	0,147	0,002	0,011	N/A
46th	0,003	0,016	0,031	0,038	0,002	0,013	N/A
47th	0,008	0,044	0,078	0,086	0,009	0,053	N/A
48th	0,002	0,010	0,034	0,034	0,002	0,011	N/A
49th	0,010	0,058	0,081	0,097	0,007	0,039	N/A
50th	0,004	0,021	0,038	0,039	0,003	0,018	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)	P

DHN-LVEH3P12K-EU-G1

Phase 2

Power Level	33%	66%	100%
AC Power [W]	1333,2	2626,8	4003,6
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,78	11,38	17,33
Frequency [Hz]	50,00	50,00	50,00
THD [%]	1,060	1,111	1,131
PWHD	2,064	4,221	3,466

Harmonic	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Harmonic Current Limits [%]
1st	5,775	-	11,372	-	17,326	-	-
2nd	0,017	0,100	0,012	0,069	0,033	0,188	8,00
3rd	0,016	0,089	0,016	0,091	0,014	0,082	N/A
4th	0,025	0,144	0,024	0,139	0,040	0,232	4,00
5th	0,098	0,563	0,072	0,412	0,105	0,605	10,70
6th	0,007	0,042	0,011	0,063	0,009	0,049	2,67
7th	0,115	0,664	0,084	0,481	0,055	0,317	7,20
8th	0,029	0,168	0,033	0,188	0,017	0,098	2,00
9th	0,002	0,014	0,004	0,024	0,005	0,026	N/A
10th	0,029	0,166	0,033	0,191	0,041	0,234	1,60
11th	0,037	0,212	0,027	0,154	0,046	0,265	3,10
12th	0,003	0,018	0,005	0,027	0,006	0,035	1,33
13th	0,022	0,126	0,028	0,161	0,050	0,289	2,00
14th	0,023	0,132	0,018	0,105	0,021	0,123	N/A
15th	0,003	0,018	0,002	0,014	0,003	0,018	N/A
16th	0,019	0,107	0,010	0,060	0,009	0,052	N/A
17th	0,029	0,165	0,006	0,033	0,037	0,214	N/A
18th	0,002	0,014	0,003	0,019	0,005	0,026	N/A
19th	0,034	0,195	0,015	0,086	0,035	0,199	N/A
20th	0,015	0,085	0,009	0,050	0,010	0,058	N/A
21th	0,004	0,021	0,007	0,042	0,008	0,045	N/A
22th	0,014	0,080	0,012	0,072	0,013	0,073	N/A
23th	0,024	0,140	0,031	0,178	0,035	0,202	N/A
24th	0,003	0,016	0,003	0,016	0,005	0,028	N/A
25th	0,028	0,163	0,079	0,452	0,064	0,369	N/A
26th	0,009	0,050	0,005	0,030	0,010	0,057	N/A
27th	0,007	0,038	0,020	0,117	0,009	0,051	N/A
28th	0,011	0,065	0,015	0,088	0,005	0,027	N/A
29th	0,024	0,139	0,095	0,544	0,067	0,384	N/A
30th	0,002	0,013	0,002	0,014	0,009	0,050	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)						P
DHN-LVEH3P12K-EU-G1							
31th	0,014	0,081	0,030	0,172	0,021	0,119	N/A
32th	0,005	0,029	0,003	0,016	0,004	0,024	N/A
33th	0,002	0,010	0,002	0,009	0,003	0,016	N/A
34th	0,004	0,025	0,003	0,018	0,003	0,019	N/A
35th	0,005	0,028	0,025	0,141	0,021	0,122	N/A
36th	0,002	0,012	0,003	0,015	0,002	0,013	N/A
37th	0,009	0,054	0,021	0,119	0,007	0,043	N/A
38th	0,004	0,022	0,004	0,021	0,003	0,016	N/A
39th	0,002	0,011	0,002	0,010	0,003	0,016	N/A
40th	0,003	0,017	0,003	0,019	0,003	0,014	N/A
41th	0,011	0,065	0,015	0,084	0,004	0,021	N/A
42th	0,002	0,013	0,003	0,017	0,002	0,013	N/A
43th	0,009	0,053	0,014	0,081	0,014	0,081	N/A
44th	0,003	0,015	0,003	0,019	0,002	0,014	N/A
45th	0,002	0,013	0,002	0,013	0,003	0,020	N/A
46th	0,002	0,014	0,004	0,023	0,002	0,013	N/A
47th	0,007	0,042	0,011	0,064	0,009	0,053	N/A
48th	0,001	0,008	0,001	0,009	0,002	0,009	N/A
49th	0,010	0,056	0,005	0,031	0,007	0,039	N/A
50th	0,004	0,021	0,004	0,023	0,003	0,018	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)	P

DHN-LVEH3P12K-EU-G1

Phase 3

Power Level	33%	66%	100%
AC Power [W]	1328,5	2617,6	3992,0
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,76	11,34	17,28
Frequency [Hz]	50,00	50,00	50,00
THD [%]	1,048	1,146	1,137
PWHD	2,072	4,389	3,571

Harmonic	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Harmonic Current Limits [%]
1st	5,750	-	11,332	-	17,274	-	-
2nd	0,016	0,093	0,015	0,088	0,035	0,202	8,00
3rd	0,005	0,030	0,006	0,034	0,006	0,035	N/A
4th	0,022	0,124	0,018	0,103	0,039	0,224	4,00
5th	0,099	0,568	0,072	0,416	0,102	0,586	10,70
6th	0,010	0,059	0,013	0,076	0,013	0,074	2,67
7th	0,115	0,663	0,087	0,501	0,057	0,325	7,20
8th	0,027	0,153	0,032	0,183	0,019	0,107	2,00
9th	0,004	0,023	0,005	0,030	0,004	0,026	N/A
10th	0,030	0,173	0,039	0,222	0,041	0,234	1,60
11th	0,036	0,208	0,024	0,138	0,045	0,260	3,10
12th	0,008	0,048	0,008	0,047	0,009	0,053	1,33
13th	0,023	0,130	0,031	0,179	0,051	0,293	2,00
14th	0,023	0,133	0,016	0,094	0,022	0,126	N/A
15th	0,002	0,009	0,003	0,016	0,005	0,027	N/A
16th	0,020	0,115	0,012	0,067	0,015	0,084	N/A
17th	0,028	0,158	0,009	0,053	0,035	0,202	N/A
18th	0,003	0,016	0,004	0,023	0,005	0,031	N/A
19th	0,033	0,189	0,016	0,091	0,038	0,216	N/A
20th	0,015	0,085	0,008	0,045	0,009	0,054	N/A
21th	0,004	0,022	0,006	0,033	0,008	0,045	N/A
22th	0,015	0,085	0,012	0,069	0,012	0,067	N/A
23th	0,026	0,147	0,028	0,159	0,034	0,196	N/A
24th	0,003	0,018	0,003	0,019	0,004	0,022	N/A
25th	0,028	0,163	0,086	0,496	0,067	0,388	N/A
26th	0,009	0,054	0,005	0,029	0,011	0,062	N/A
27th	0,005	0,031	0,019	0,108	0,013	0,072	N/A
28th	0,011	0,066	0,014	0,082	0,007	0,038	N/A
29th	0,025	0,145	0,099	0,568	0,068	0,389	N/A
30th	0,003	0,017	0,002	0,014	0,009	0,050	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (-10°C)						P
DHN-LVEH3P12K-EU-G1							
31th	0,013	0,073	0,030	0,170	0,022	0,127	N/A
32th	0,004	0,022	0,003	0,017	0,004	0,026	N/A
33th	0,002	0,013	0,002	0,013	0,005	0,028	N/A
34th	0,005	0,031	0,003	0,016	0,003	0,018	N/A
35th	0,005	0,031	0,023	0,135	0,022	0,128	N/A
36th	0,002	0,011	0,002	0,013	0,003	0,015	N/A
37th	0,010	0,058	0,019	0,110	0,005	0,032	N/A
38th	0,004	0,021	0,003	0,015	0,002	0,014	N/A
39th	0,002	0,012	0,002	0,012	0,003	0,020	N/A
40th	0,003	0,016	0,003	0,019	0,003	0,019	N/A
41th	0,011	0,062	0,014	0,079	0,005	0,028	N/A
42th	0,003	0,015	0,003	0,015	0,003	0,019	N/A
43th	0,011	0,063	0,012	0,071	0,011	0,065	N/A
44th	0,003	0,018	0,004	0,023	0,003	0,016	N/A
45th	0,002	0,013	0,004	0,020	0,004	0,021	N/A
46th	0,003	0,016	0,004	0,021	0,003	0,016	N/A
47th	0,008	0,048	0,010	0,060	0,010	0,060	N/A
48th	0,002	0,009	0,002	0,010	0,002	0,012	N/A
49th	0,010	0,055	0,003	0,019	0,005	0,030	N/A
50th	0,004	0,026	0,005	0,026	0,003	0,020	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1340,1		2633,8		4015,1		
AC Voltage [V]	230,65		230,83		231,02		
AC Current [A]	5,81		11,41		17,38		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,049		1,121		1,131		
PWHD	2,077		4,283		3,594		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,803	-	11,406	-	17,373	-	-
2nd	0,019	0,108	0,013	0,077	0,031	0,178	8,00
3rd	0,012	0,070	0,009	0,055	0,013	0,077	N/A
4th	0,024	0,138	0,018	0,105	0,038	0,216	4,00
5th	0,095	0,548	0,075	0,432	0,099	0,569	10,70
6th	0,004	0,023	0,004	0,023	0,007	0,040	2,67
7th	0,115	0,659	0,083	0,479	0,060	0,347	7,20
8th	0,031	0,180	0,034	0,197	0,021	0,123	2,00
9th	0,003	0,017	0,004	0,025	0,005	0,029	N/A
10th	0,026	0,148	0,034	0,194	0,037	0,210	1,60
11th	0,036	0,209	0,028	0,160	0,047	0,270	3,10
12th	0,006	0,036	0,003	0,018	0,005	0,028	1,33
13th	0,024	0,136	0,027	0,158	0,050	0,290	2,00
14th	0,024	0,140	0,018	0,106	0,022	0,129	N/A
15th	0,003	0,018	0,003	0,014	0,003	0,018	N/A
16th	0,020	0,114	0,009	0,053	0,013	0,076	N/A
17th	0,026	0,150	0,008	0,046	0,037	0,211	N/A
18th	0,002	0,010	0,002	0,013	0,004	0,022	N/A
19th	0,033	0,191	0,018	0,101	0,039	0,227	N/A
20th	0,015	0,087	0,007	0,042	0,007	0,043	N/A
21th	0,003	0,018	0,002	0,014	0,003	0,020	N/A
22th	0,016	0,093	0,010	0,056	0,013	0,076	N/A
23th	0,024	0,137	0,031	0,176	0,034	0,193	N/A
24th	0,002	0,013	0,004	0,023	0,003	0,017	N/A
25th	0,032	0,182	0,085	0,486	0,068	0,393	N/A
26th	0,009	0,050	0,005	0,032	0,010	0,058	N/A
27th	0,002	0,012	0,003	0,019	0,006	0,037	N/A
28th	0,011	0,064	0,016	0,092	0,005	0,030	N/A
29th	0,024	0,139	0,094	0,540	0,067	0,383	N/A
30th	0,002	0,009	0,002	0,011	0,008	0,049	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
31th	0,013	0,074	0,034	0,198	0,028	0,163	N/A
32th	0,005	0,026	0,002	0,014	0,005	0,027	N/A
33th	0,002	0,012	0,002	0,013	0,003	0,015	N/A
34th	0,005	0,027	0,004	0,021	0,003	0,016	N/A
35th	0,006	0,033	0,022	0,127	0,021	0,121	N/A
36th	0,002	0,012	0,002	0,011	0,002	0,013	N/A
37th	0,009	0,052	0,022	0,128	0,007	0,043	N/A
38th	0,003	0,017	0,003	0,016	0,003	0,016	N/A
39th	0,002	0,009	0,002	0,012	0,002	0,011	N/A
40th	0,003	0,015	0,003	0,018	0,003	0,015	N/A
41th	0,011	0,061	0,014	0,080	0,004	0,023	N/A
42th	0,002	0,011	0,002	0,011	0,002	0,013	N/A
43th	0,009	0,053	0,014	0,078	0,015	0,083	N/A
44th	0,003	0,015	0,004	0,022	0,002	0,014	N/A
45th	0,002	0,010	0,001	0,008	0,002	0,010	N/A
46th	0,003	0,017	0,003	0,019	0,002	0,013	N/A
47th	0,008	0,044	0,010	0,056	0,009	0,052	N/A
48th	0,002	0,010	0,002	0,010	0,002	0,012	N/A
49th	0,010	0,060	0,005	0,030	0,007	0,039	N/A
50th	0,004	0,024	0,004	0,023	0,004	0,021	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1333,2		2626,8		4005,9		
AC Voltage [V]	230,65		230,83		231,02		
AC Current [A]	5,78		11,38		17,34		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,060		1,111		1,132		
PWHD	2,072		4,224		3,473		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,776	-	11,373	-	17,332	-	-
2nd	0,018	0,101	0,012	0,067	0,033	0,188	8,00
3rd	0,015	0,088	0,016	0,090	0,014	0,083	N/A
4th	0,025	0,144	0,024	0,138	0,040	0,232	4,00
5th	0,098	0,562	0,072	0,412	0,105	0,604	10,70
6th	0,008	0,044	0,011	0,063	0,008	0,049	2,67
7th	0,115	0,663	0,084	0,481	0,055	0,318	7,20
8th	0,029	0,167	0,033	0,188	0,017	0,098	2,00
9th	0,003	0,019	0,004	0,025	0,004	0,026	N/A
10th	0,029	0,166	0,033	0,191	0,041	0,234	1,60
11th	0,037	0,211	0,027	0,154	0,046	0,265	3,10
12th	0,003	0,017	0,005	0,027	0,006	0,035	1,33
13th	0,022	0,126	0,028	0,161	0,050	0,289	2,00
14th	0,023	0,131	0,018	0,105	0,022	0,124	N/A
15th	0,003	0,018	0,002	0,014	0,003	0,015	N/A
16th	0,019	0,108	0,010	0,060	0,009	0,052	N/A
17th	0,029	0,165	0,006	0,033	0,037	0,215	N/A
18th	0,002	0,013	0,003	0,019	0,005	0,028	N/A
19th	0,034	0,195	0,015	0,088	0,034	0,198	N/A
20th	0,015	0,084	0,009	0,051	0,010	0,058	N/A
21th	0,004	0,024	0,007	0,041	0,007	0,040	N/A
22th	0,015	0,084	0,012	0,067	0,013	0,077	N/A
23th	0,025	0,141	0,031	0,178	0,035	0,202	N/A
24th	0,003	0,016	0,003	0,016	0,005	0,028	N/A
25th	0,028	0,164	0,079	0,453	0,064	0,369	N/A
26th	0,009	0,051	0,005	0,030	0,010	0,060	N/A
27th	0,007	0,038	0,020	0,118	0,008	0,047	N/A
28th	0,011	0,064	0,015	0,087	0,005	0,028	N/A
29th	0,024	0,140	0,095	0,544	0,067	0,385	N/A
30th	0,002	0,013	0,002	0,014	0,009	0,051	N/A
31th	0,014	0,082	0,030	0,171	0,021	0,118	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
32th	0,005	0,029	0,003	0,017	0,004	0,025	N/A
33th	0,002	0,010	0,002	0,009	0,002	0,013	N/A
34th	0,004	0,025	0,003	0,019	0,004	0,020	N/A
35th	0,005	0,028	0,025	0,141	0,021	0,123	N/A
36th	0,002	0,011	0,003	0,015	0,002	0,013	N/A
37th	0,009	0,054	0,021	0,119	0,007	0,043	N/A
38th	0,004	0,022	0,004	0,022	0,003	0,018	N/A
39th	0,002	0,011	0,002	0,009	0,003	0,015	N/A
40th	0,003	0,018	0,003	0,019	0,003	0,016	N/A
41th	0,011	0,065	0,015	0,085	0,004	0,022	N/A
42th	0,002	0,012	0,003	0,016	0,003	0,015	N/A
43th	0,010	0,055	0,014	0,082	0,014	0,081	N/A
44th	0,003	0,016	0,004	0,020	0,003	0,015	N/A
45th	0,002	0,013	0,002	0,014	0,003	0,019	N/A
46th	0,003	0,016	0,004	0,023	0,002	0,013	N/A
47th	0,008	0,043	0,011	0,064	0,009	0,054	N/A
48th	0,002	0,009	0,002	0,010	0,002	0,009	N/A
49th	0,010	0,057	0,005	0,031	0,007	0,039	N/A
50th	0,004	0,021	0,004	0,024	0,003	0,018	N/A
Note							

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1328,5		2617,6		3992,0		
AC Voltage [V]	230,65		230,83		231,02		
AC Current [A]	5,76		11,34		17,28		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,060		1,146		1,137		
PWHD	2,086		4,392		3,573		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,751	-	11,333	-	17,280	-	-
2nd	0,016	0,092	0,015	0,086	0,035	0,201	8,00
3rd	0,006	0,033	0,006	0,034	0,006	0,033	N/A
4th	0,021	0,124	0,018	0,103	0,039	0,225	4,00
5th	0,099	0,568	0,072	0,417	0,102	0,586	10,70
6th	0,011	0,061	0,013	0,075	0,013	0,075	2,67
7th	0,116	0,665	0,087	0,500	0,056	0,324	7,20
8th	0,027	0,153	0,032	0,183	0,019	0,106	2,00
9th	0,004	0,024	0,005	0,031	0,005	0,027	N/A
10th	0,030	0,172	0,039	0,222	0,041	0,234	1,60
11th	0,037	0,210	0,024	0,138	0,045	0,260	3,10
12th	0,008	0,047	0,008	0,047	0,009	0,053	1,33
13th	0,023	0,130	0,031	0,179	0,051	0,291	2,00
14th	0,023	0,133	0,016	0,093	0,022	0,127	N/A
15th	0,002	0,009	0,003	0,018	0,004	0,022	N/A
16th	0,020	0,116	0,012	0,067	0,015	0,086	N/A
17th	0,028	0,159	0,009	0,053	0,035	0,203	N/A
18th	0,002	0,013	0,004	0,023	0,006	0,033	N/A
19th	0,033	0,189	0,016	0,092	0,038	0,216	N/A
20th	0,015	0,084	0,008	0,045	0,009	0,054	N/A
21th	0,004	0,025	0,006	0,033	0,006	0,036	N/A
22th	0,015	0,087	0,012	0,069	0,012	0,068	N/A
23th	0,026	0,148	0,028	0,160	0,034	0,197	N/A
24th	0,003	0,018	0,004	0,021	0,004	0,025	N/A
25th	0,029	0,164	0,086	0,497	0,067	0,387	N/A
26th	0,009	0,055	0,005	0,029	0,011	0,063	N/A
27th	0,005	0,031	0,019	0,109	0,012	0,069	N/A
28th	0,011	0,066	0,014	0,082	0,007	0,039	N/A
29th	0,025	0,146	0,099	0,569	0,068	0,390	N/A
30th	0,003	0,017	0,002	0,014	0,009	0,053	N/A

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B.1 a) b)	Emission Test Harmonics DIN EN 61000-3-12 (≥16 A and ≥75 A per Phase) (+55°C)						P
DHN-LVEH3P12K-EU-G1							
31th	0,013	0,074	0,029	0,169	0,022	0,124	N/A
32th	0,004	0,023	0,003	0,017	0,005	0,030	N/A
33th	0,002	0,014	0,002	0,013	0,004	0,020	N/A
34th	0,005	0,031	0,003	0,016	0,004	0,023	N/A
35th	0,005	0,030	0,023	0,134	0,022	0,128	N/A
36th	0,002	0,011	0,002	0,013	0,003	0,017	N/A
37th	0,010	0,059	0,019	0,111	0,005	0,029	N/A
38th	0,004	0,021	0,003	0,016	0,003	0,017	N/A
39th	0,002	0,013	0,002	0,012	0,003	0,015	N/A
40th	0,003	0,016	0,003	0,019	0,004	0,023	N/A
41th	0,011	0,063	0,014	0,078	0,005	0,028	N/A
42th	0,003	0,015	0,002	0,014	0,004	0,022	N/A
43th	0,011	0,064	0,012	0,071	0,011	0,065	N/A
44th	0,003	0,018	0,004	0,024	0,003	0,020	N/A
45th	0,002	0,013	0,004	0,020	0,004	0,021	N/A
46th	0,003	0,017	0,004	0,021	0,003	0,017	N/A
47th	0,008	0,049	0,010	0,059	0,011	0,061	N/A
48th	0,002	0,011	0,002	0,012	0,002	0,014	N/A
49th	0,010	0,055	0,003	0,019	0,005	0,029	N/A
50th	0,004	0,023	0,004	0,023	0,003	0,016	N/A
Note							

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B.1 c)	Flicker emission			P
Ambient				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,095	0,127	0,000
66%	EN 61000-3-11	0,092	0,096	0,000
100%*	EN 61000-3-11	0,104	0,145	0,000
-10°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,082	0,073	0,000
66%	EN 61000-3-11	0,090	0,094	0,000
100%*	EN 61000-3-11	0,090	0,093	0,000
+55°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,073	0,075	0,000
66%	EN 61000-3-11	0,084	0,094	0,000
100%*	EN 61000-3-11	0,519	0,707	0,000

Note

Mains Impedance according EN61000-3-11:

R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283 Ω)

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

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

The tests are based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.

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B.1.1 Conditions of connection, reconnection and gradual power supply		
Clause	**Test**	**Result**
B.1.1.1	Checking of connection and reconnection conditions	**P**
B.1.1.2	Checking gradual supply of active power	**P**

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B.1.1.1 B.1.1.2	**Conditions of connection, reconnection and gradual power supply and gradual supply of active power**	**P**

Test result

	Voltage conditions	
a) Out of voltage range	84% V_n for 30 s	111% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n > V	V < 110% V_n
Reconnection time [s]	301,6	30,4
Limit	Reconnection after 30s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n/min For recorded gradient see diagram underneath	
c) In voltage range at start-up	85% V_n > V	V < 110% V_n
Reconnection time [s]	301,6	301,8
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n/min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	50,12 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n/min For recorded gradient see diagram underneath	
e) In frequency range at start-up	49,90 Hz > f	f < 50,10 Hz
Reconnection time [s]	33,2	32,4
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n/min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz > f	f < 50,10 Hz
Reconnection time [s]	301,6	302,2
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n/min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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B.1.1.1 B.1.1.2	Conditions of connection, reconnection and gradual power supply and gradual supply of active power	P

Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

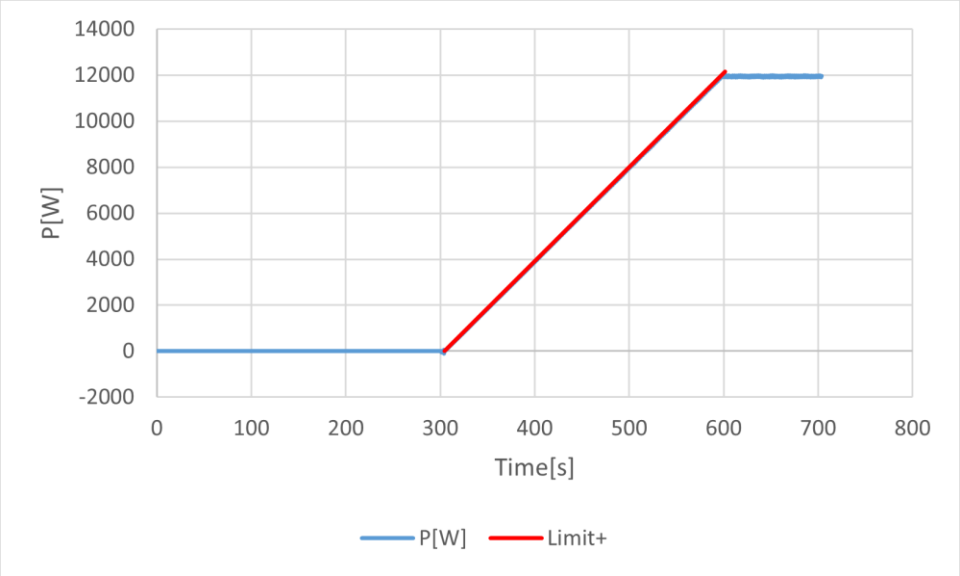
- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49,00 Hz and 51,00 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

In the case of systems with power lower than 800 W:

- the power output must have a positive gradient from a delivered power no greater than 50 W.
- a fixed interval is selected (not adjustable) for the frequency in the phases of Start-Up, Reconnection and Return from a temporary over-frequency of between 49,90 Hz and 50,10 Hz and a residence time in this range equal to 300 s.

Graph of the gradual power supply



Note

The verification of the gradual output with ramp-up from "no load" to the rated value in at least 300 s is carried out by recording during test sequences b), c), e) and f) with the network analyser the output parameters to the inverter at a rate of one sample equal to the mean value every 200 ms (5 samples/s). The samples recorded from the instant the inverter exceeds a power output level of 5% of the nominal power P_n, shown on a graph, shall all be below the limiting curve P< (0,333* P_n)/s with a maximum positive deviation of +2,5 % * P_n.

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1.2	**Reactive power exchange (not applicable for installations less 800 W)**	
B.1.2.1	Checking construction standards: Reactive power capability	**P**
B.1.2.2	Test performance and recording mode	**P**
B.1.2.2.1	Inverters in systems with total power up to 11,08 kW	**N/A**
B.1.2.2.2	Inverters in systems with total capacity greater than 11,08 kW	**P**
B.1.2.3	Reactive power exchange at a given level	**P**
B.1.2.3.1	Procedures for preforming tests and recording results	**P**
B.1.2.4	Response time to an assigned step level change	**P**
B.1.2.5	Automatic supply of reactive power according to a characteristic curve cos φ = f(P)	**P**
B.1.2.5.1	Checking compliance with the rule for implementing the standard supply curve	**P**
B.1.2.6	Automatic exchange of reactive power according to a characteristic curve Q = f(V)	**P**
B.1.2.6.1	Checking compliance with the rules for the implementing the characteristic curve Q = f(V)	**P**

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B.1.2.1	Checking construction standards: Reactive power capability		
Type of generator	Rated Power	Reactive power absorption	Reactive power delivery
asynchronous non-self-excited	any	cos φ ≥ 0,95 (*)	cos φ ≥ 0,95 (*)
synchronous	any	cos φ ≥ 0,95 (*) adjustable	cos φ ≥ 0,95 (*) adjustable
inverter	≤11,08 kW	capability triangular in Fig. 13 (*)	
inverter	>11,08 kW	capability rectangular Fig. 13 (**)	

(*) For output powers less than 20% of the rated power the generator must not exchange a reactive power higher than 10% of the rated power.

(**) For output powers less than 10% of the rated power the generator must not exchange a reactive power higher than 10% of the rated power.

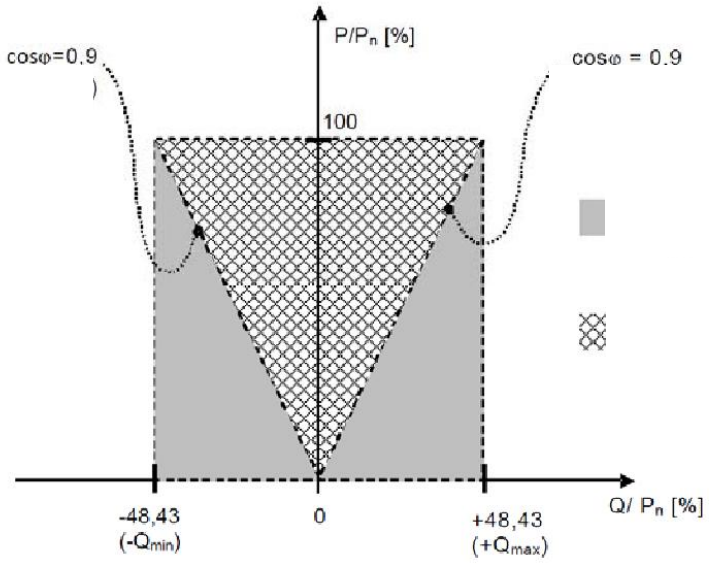


Figure 13 - “Triangular” and “rectangular” capability curves

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B.1.2.2	Test performance and recording mode

- The converter must be set so that it can, respectively, absorb (induction) and supply (resistance) the maximum reactive power available at each level of active power supplied according to its capability.
- At this point the DC source must be regulated so that the converter can supply active power in sequence included in the 10 intervals [0-10]%; [10-20]%;...; [90-100]% of nominal power (1-min average values calculated on the basis of the values measured at the fundamental frequency in a 200-ms window).
- For each of the 10 levels of active power at least 3 values for inductive reactive power and 3 for capacitive power shall be reported as 1-min average values calculated based on measurements at the fundamental frequency of a 200-ms window.
- In addition to measurements of reactive power limit values, the measured values should be recorded by setting the reactive power supplied to 0 (cos φ = 1).

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B.1.2.2.2	Test performance and recording mode more than 11,08 kW	P

Inductive reactive power absorption

Power-BIN [%]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 -10 (*)	1128.6	5805.3	0.1908	1880.4
10 -20 (**)	2346.6	5821.8	0.3738	3119.1
20 -30	3558.7	5834.5	0.5207	4357.9
30 -40	4754.6	5849.8	0.6307	5594.4
40 -50	5946.6	5865.2	0.7120	6825.1
50 -60	7145.6	5875.0	0.7724	8061.9
60 -70	8357.8	5889.1	0.8175	9326.9
70 -80	9535.3	5927.0	0.8493	10558.3
80 -90	10561.0	5907.7	0.8727	11632.4
90 -100 (***)	10566.0	5910.2	0.8727	11632.6

Capacitive reactive power absorption

Power-BIN [%]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 -10 (*)	1178.9	-5907.6	0.1957	1856.0
10 -20 (**)	2357.6	-5889.8	0.3716	3057.2
20 -30	3570.4	-5872.2	0.5195	4296.7
30 -40	4763.3	-5859.7	0.6308	5530.3
40 -50	5940.5	-5821.0	0.7143	6729.8
50 -60	7156.9	-5827.6	0.7754	8000.0
60 -70	8340.1	-5812.9	0.8204	9230.9
70 -80	9513.8	-5804.3	0.8537	10451.1
80 -90	10766.3	-5784.9	0.8809	11761.7
90 -100 (***)	10802.9	-5784.1	0.8816	11805.2

cos φ = 1

Power-BIN [%]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 -10 (*)	1160.5	-95.9	0.9895	1280.3
10 -20 (**)	2381.4	-85.0	0.9974	2516.9
20 -30	3588.4	-72.4	0.9989	3758.1
30 -40	4797.1	-57.9	0.9995	5012.5
40 -50	5976.1	-44.0	0.9997	6229.5
50 -60	7195.0	-28.7	0.9998	7496.0
60 -70	8385.0	-12.0	0.9998	8730.4
70 -80	9557.9	-2.4	0.9998	9953.0
80 -90	10773.1	13.0	0.9998	11226.6
90 -100 (***)	11950.5	29.9	0.9998	12475.9

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B.1.2.2.2	Test performance and recording mode more than 11,08 kW	P

Note

(*) For output powers of less than 10% of rated power the generator must not exchange a reactive

power higher than 10% of the rated power.

(**) For output powers of less than 20% of rated power the generator must not exchange a reactive power higher than 10% of the rated power.

(***) Check that the minimum requirement is supported cos φ steadily to reach a thermal balance.

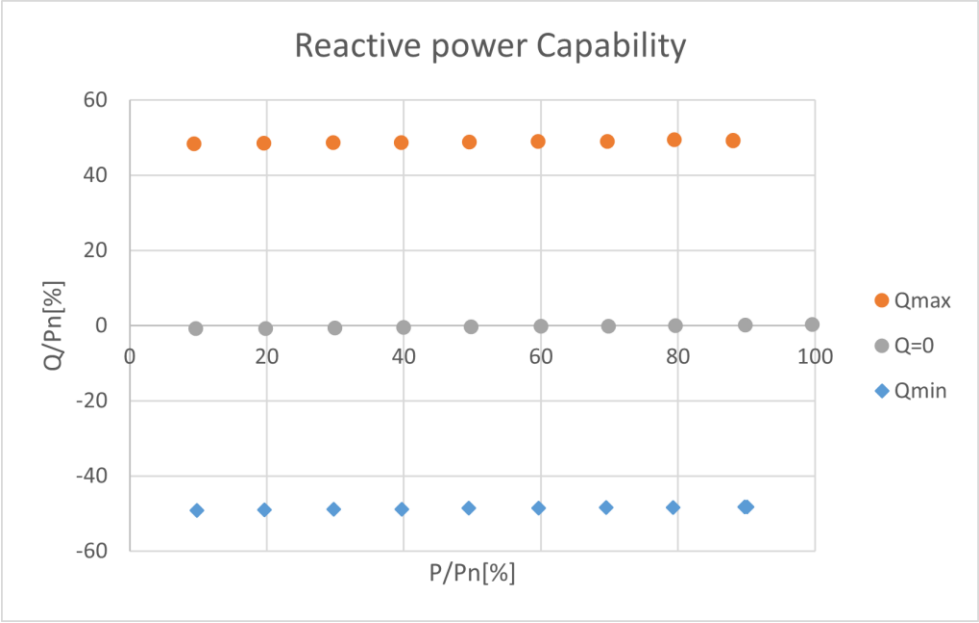
The cos φ must be 0,9 or less at the 10 levels

The reactive power must be 48,43% or more at the 10 levels.

Example sentence blow if active power is derated to reach reactive power!

The inverter was power derated of 10% of the nominal output power to reach the reactive power!

Graph



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B.1.2.3	Reactive power exchange at the given level

The diffuse generation units (GD) must participate in controlling the network voltage. For inverters used in systems with total capacity greater than 11,08 kW it is possible to implement a centralized control strategy by remote control signal, supplied by the Distributor.

The tests covered in this section are mandatory only for inverters used in systems with capacity greater than 11,08 kW, but can, at the request of the manufacturer, be performed and documented also for converters with lower capacity.

The purpose of the test is to check the ability of the converter's control system to run the command to adjust the level of reactive power between the maximum capability limits (rectangular capability, as defined in 8.4.4.2 and shown in Figure 22) both for absorption and supply of reactive power and to check the accuracy of adjustment.

If there is no protocol defined for the exchange of adjustment commands, the manufacturer can determine the manner in which the commands shall be run to set the operating point of the reactive power, both in terms of the physical signal (analogue, serial protocol, etc.) and for the adjustment parameter adopted (setting according to an absolute value of the reactive power Q, or as a cos φ value).

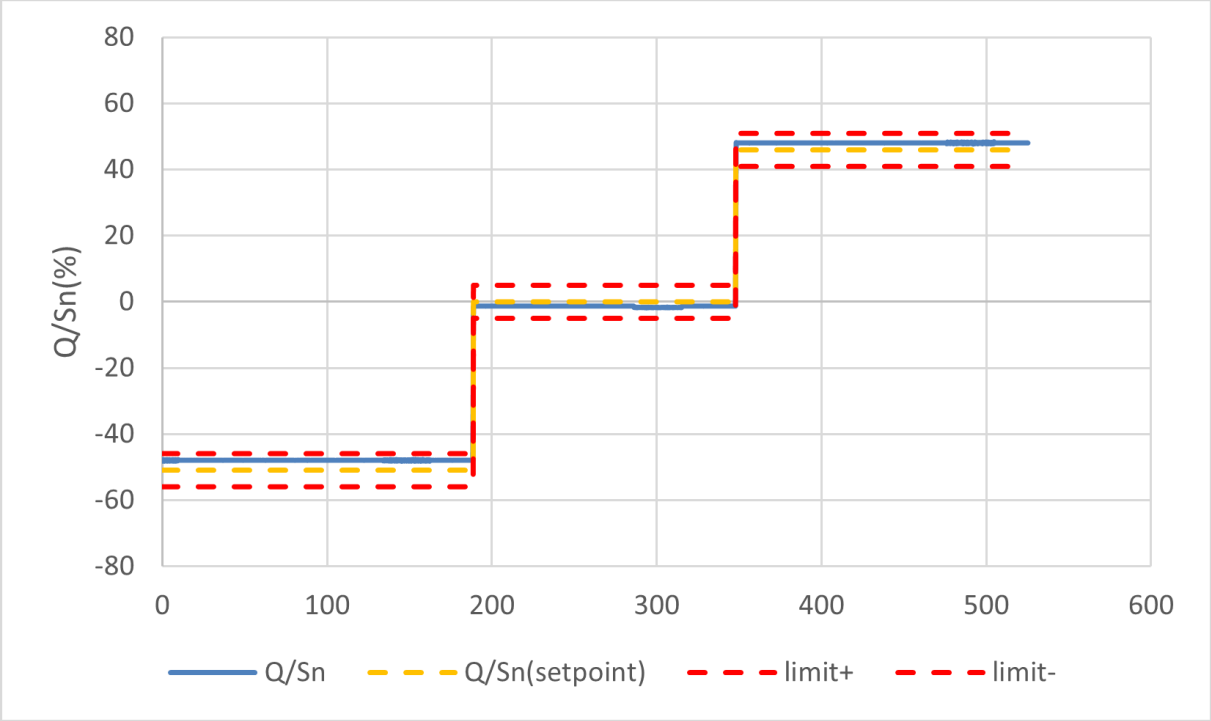
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B.1.2.3.1	**Procedures for performing tests and recording results (hypothesis of adjustment by Q)**	**P**

Test result

	Reactive Power set point Q / P_n [%]	Measured reactive power Q / P_n [%]	Deviation compared to setpoint ΔQ / P_n [%]
$-Q_{min}$	-48,43	-47,91	0,52
0	0	-1,27	-1,27
$+Q_{max}$	+48,43	48,04	-0,39

Graph



Assessment Criteria

The test is passed successfully if the maximum deviation between the assigned level and the actual value measured for reactive power is equal to:

- ΔQ ≤ ± 2,5% of the nominal active power of the converter (direct setting of the reactive power level)

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B.1.2.4	Response time to an assigned step level change	

Reaction time

		Measured reactive power [Var]	Time [s]	Result
1	Reaction time Q = 0 to Q_{min} (100% test)	-5605,8	4,6	P
2	Reaction time Q_{min} to Q_{max} (100% test)	5800,4	4,2	P
3	Reaction time Q_{max} to Q = 0 (100% test)	100,2	3,8	P
4	Reaction time Q = 0 to Q_{min} (50% test)	-5765,1	4,0	P
5	Reaction time Q_{min} to Q_{max} (50% test)	5746,7	4,8	P
6	Reaction time Q_{max} to Q = 0 (50% test)	148,4	4,4	P

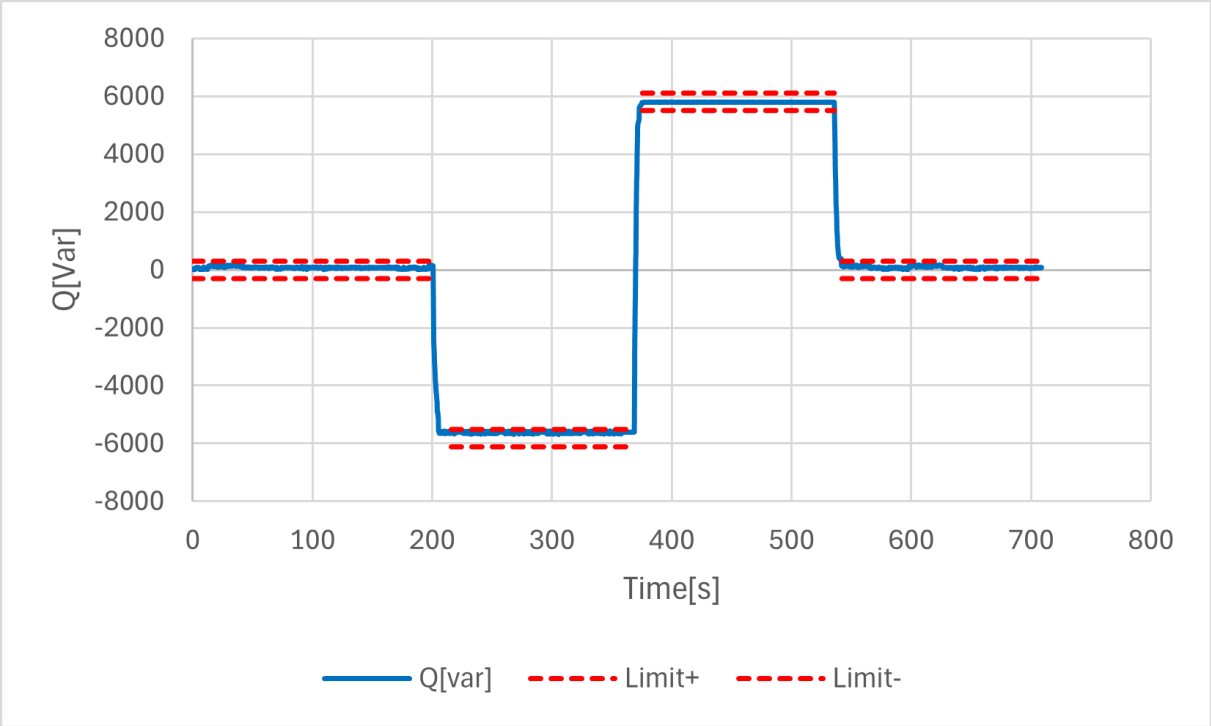
Method used to send command to control reactive power:

RS485.

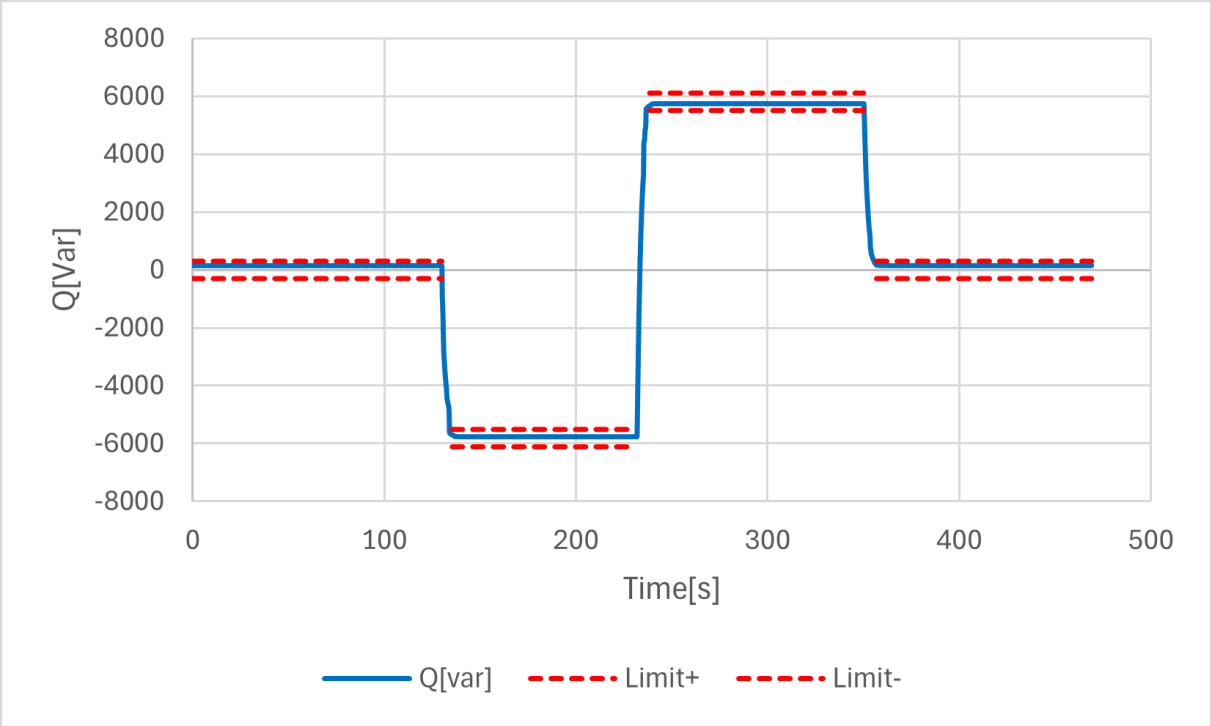
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B.1.2.4	Response time to an assigned step level change	

Graph 100%



Graph 50%



Note:

Two tests should be performed. At 50% P_n and 100% P_n with $\Delta Q \leq \pm 5\%$

Max response time 10 s.

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B.1.2.5	Automatic supply of reactive power according to a characteristic curve cos φ = f(P)

All static converters in systems able to absorb reactive power automatically and independently (local control logic) in accordance with a characteristic curve of the power/active power factor = f(P).

The purpose of the test is to check that the converter follows the methods for automatic supply of reactive power according to the standard characteristic curve cos φ = f(P) outlined in E.2, according to method a).

The standard curve is uniquely defined by linear interpolation of the three characteristic points:

A: P = 0,2 P_n; cos φ = 1

B: P = 0,5 P_n; cos φ = 1

C: P = P_n; cos φ = cos φ_max = 0,9 (inductive)

Adjustment along the characteristic curve is enabled when the voltage detected at the output terminals exceeds the "critical" lock-in value (e.g. set to V_n = 1,05 V_n, see paragraph E.2).

The lock-in voltage value that enables the automatic supply of reactive power and that during testing must be set to 1,05 V_n (default setting also for production), must be adjustable in the range between V_n and 1,1 V_n at intervals of 0,01 V_n.

The Distributor shall specify the required lock-in voltage value in the Operating Regulations.

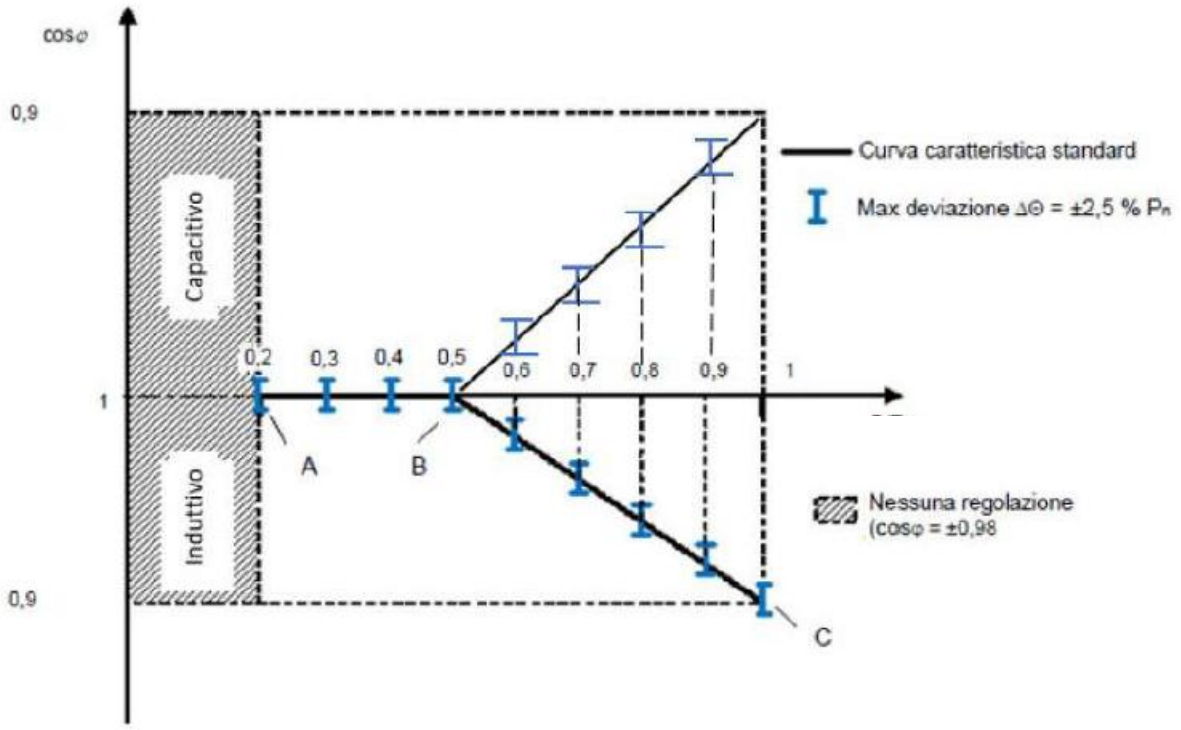


Figure 27 - Standard characteristic curve cos φ= f(P)

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B.1.2.5.1	Checking compliance with the rules for implementing of the standard supply curve	P

Test result

Inductive reactive power absorption

Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	2366,2	-186,0	0,9970	1,0000	-0,0030
30	3584,6	-183,2	0,9990	1,0000	-0,0010
40	4812,0	-173,7	0,9990	1,0000	-0,0010
50	6044,5	-181,5	1,0000	1,0000	0,0000
60	7233,1	-179,6	1,0000	1,0000	0,0000
60	7229,7	-1666,7	0,9740	0,9800	-0,0060
70	8444,8	-2684,6	0,9530	0,9600	-0,0070
80	9613,4	-3739,7	0,9320	0,9400	-0,0080
90	10800,7	-4831,7	0,9130	0,9200	-0,0070
100	10890,2	-4979,3	0,9090	0,9185	-0,0095
100	11912,8	319,3	1,0000	1,0000	0,0000

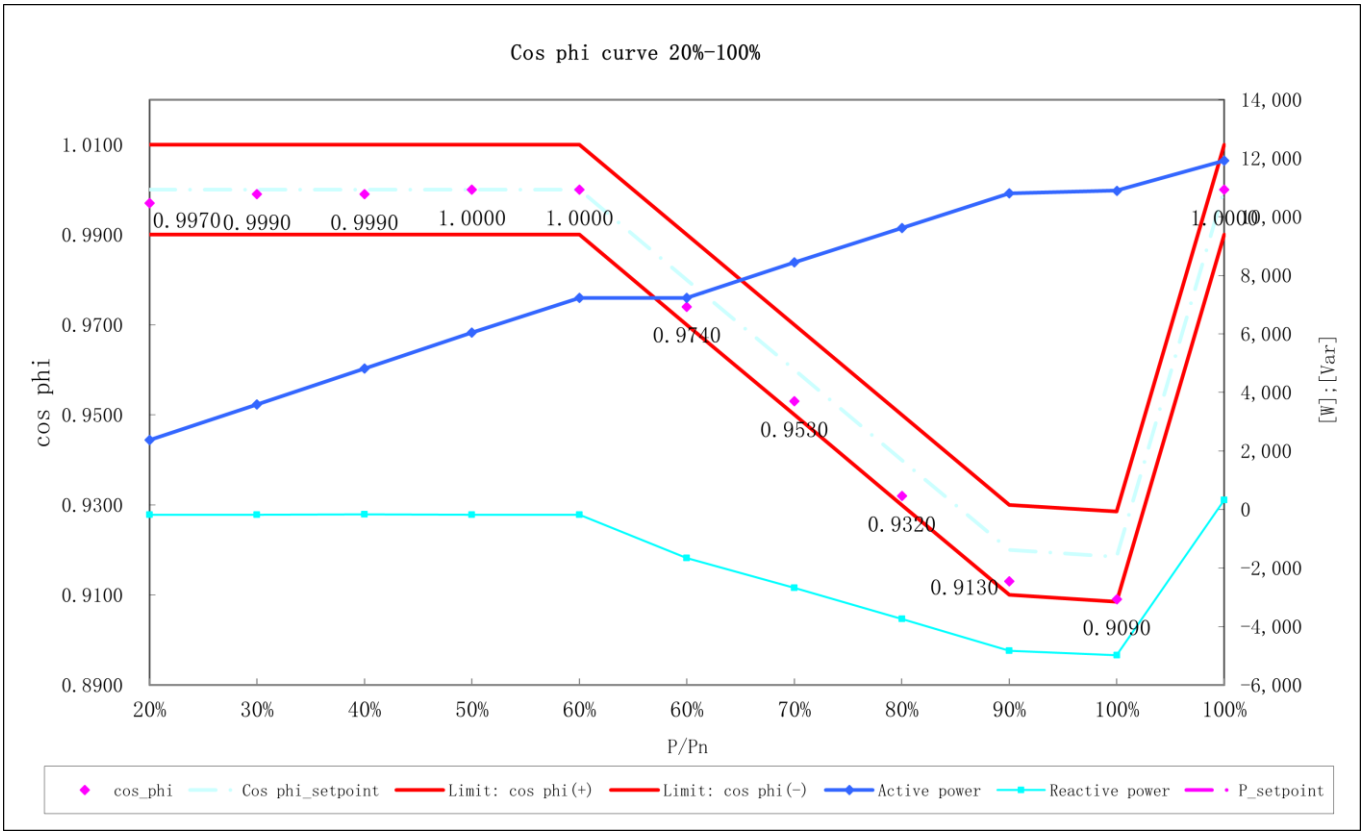
Capacitive reactive power absorption

Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	2378,5	-184,5	0,9970	1,0000	-0,0030
30	3587,4	-215,6	0,9982	1,0000	-0,0018
40	4815,4	-189,6	0,9992	1,0000	-0,0008
50	6049,1	-170,6	0,9996	1,0000	-0,0004
60	7235,0	-166,5	0,9997	1,0000	-0,0003
60	7238,8	1609,3	0,9762	0,9800	-0,0038
70	8449,1	2664,5	0,9537	0,9600	-0,0063
80	9620,4	3748,1	0,9318	0,9400	-0,0082
90	10741,0	4803,2	0,9129	0,9200	-0,0071
100	10749,7	4804,4	0,9130	0,9185	-0,0055
100	11979,9	216,0	0,9998	1,0000	-0,0002

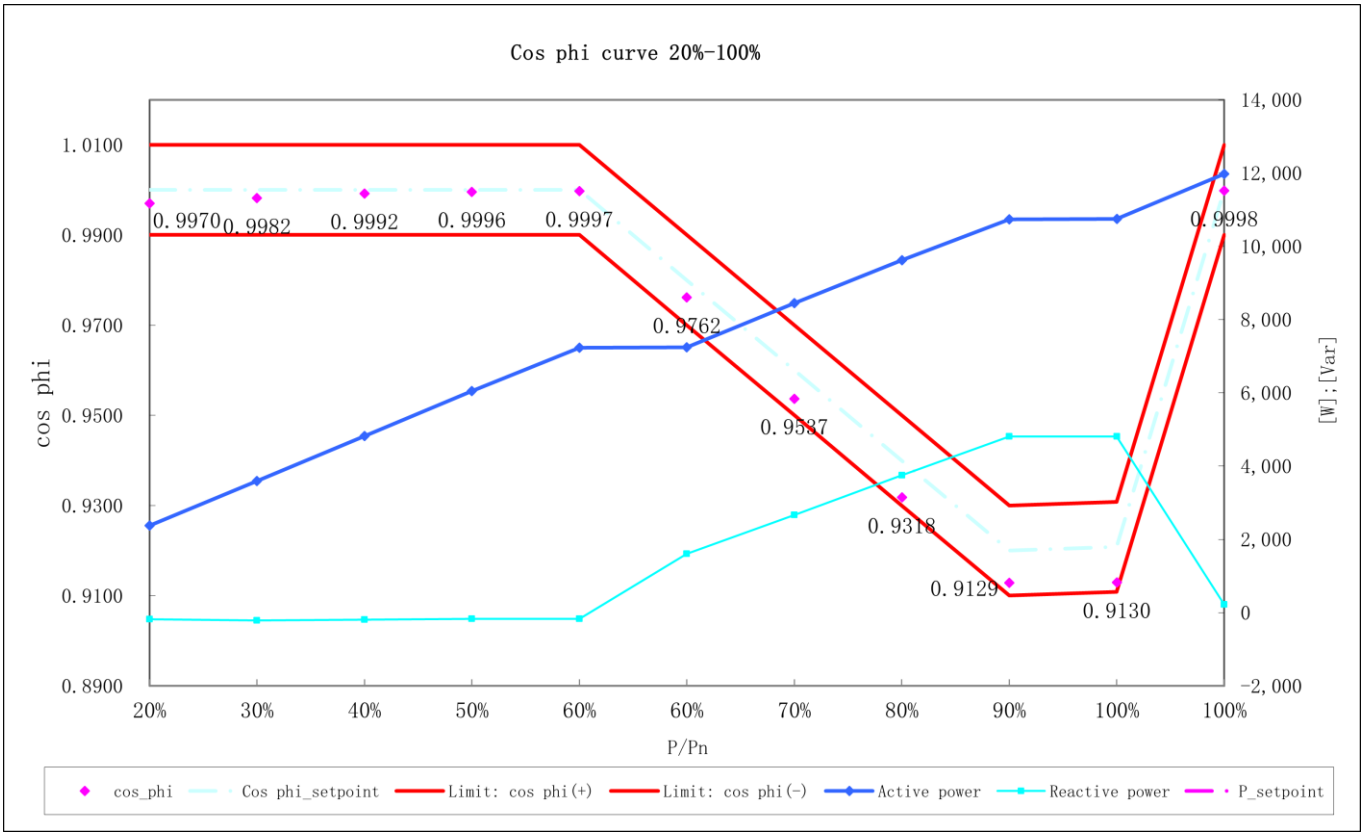
Graph of cos φ(P)

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B.1.2.5.1	Checking compliance with the rules for implementing of the standard supply curve	P



Inductive



Capacitive

Note

The lock-in value is adjustable between V_n and $1{,}1V_n$ and the lock-out value between V_n and $0{,}9V_n$ in 0,01V steps.

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B.1.2.6	Automatic exchange of reactive power according to a characteristic curve Q = f(V)

As defined in 8.4.4.2, all static converters in systems with capacity greater than 11,08 kW must be able to absorb or supply reactive power automatically and independently (local control logic) according to the characteristic curve Q = f(V) indicated by way of example in E.2 (Figure 28).

The purpose of the test is to ensure that the converter complies with the methods for automatically supplying reactive power according to the standard characteristic curve Q = f(V) indicated in E.2, according to method c).

Because operation according to this adjustment criterion can be assimilated to a network service provided by the Active User at the Distributor's request, the following applies.

Activation is subordinated to the availability of suitable regulations published by the ARERA (activation and operating mode; economic conditions).

Activation must be at the Distributor's request, when the Operating Regulations are issued. The Distributor shall also specify the values of the parameters that uniquely characterise the curve, i.e.: V1i, V2i, V1s and V1s as well as the lock-in value of active power (default value P = 0,2 P_n).

The parameters V1i, V2i, V1s and V1s should be set in the range between 0,9 and 1.1 with 0,01 V_n steps. In order to facilitate execution of the type tests, the characterising parameters are conventionally set as follows:

V1s = 1,08 V_n; V2s = 1,1 V_n

V1i = 0,92 V_n; V2i = 0,9 V_n

and the active power lock-in value (default value P = 0,2 P_n).

Note

The adjustment has an activation delay which can be set from 0 to 30 s in steps of 1 s (default setting: 3 s).

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B.1.2.6.1	Checking compliance with the rules for implementing the standard curve Q = f(V)	P

Test result

Q_{min} reactive power in accordance to standard characteristic curve Q = f(V)

P/Pn	Vac Set point	P/Pn [%]	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [%]
< 20%	1,07 V_n	17,67	246,0	-162,3	≈0(<±2,5%P_n)	-1,35
< 20%	1,09V_n	17,64	250,5	-173,8	≈0(<±2,5%P_n)	-1,45
< 20%-30%	1,09V_n	26,64	250,5	-2660,3	-0,5 Q_{max}	2,05
40%	1,09V_n	40,22	250,6	-2751,8	-0,5 Q_{max}	1,28
50%	1,09V_n	50,84	250,6	-2748,9	-0,5 Q_{max}	1,31
60%	1,09V_n	60,45	250,7	-2847,6	-0,5 Q_{max}	0,48
70%	1,09V_n	70,33	250,7	-2847,3	-0,5 Q_{max}	0,49
80%	1,09V_n	79,90	250,8	-2934,4	-0,5 Q_{max}	-0,24
90%	1,09V_n	89,60	250,8	-2935,2	-0,5 Q_{max}	-0,24
100%	1,09V_n	95,99	250,9	-3126,8	-0,5 Q_{max}	-1,84
100%	1,1V_n	87,88	253,3	-5710,9	-Q_{max}	0,84
100%-10%	1,1V_n	9,98	252,9	-5740,7	-Q_{max}	0,59
10%→ ≤5%	1,1V_n	4,78	252,9	-175,8	≈0(<±2,5%P_n)	-1,46

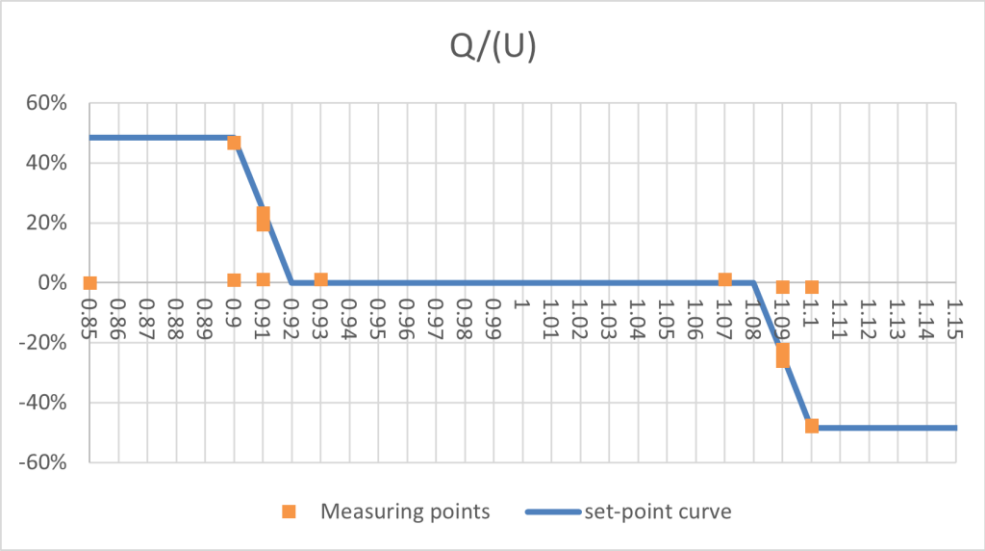
Q_{max} reactive power in accordance to standard characteristic curve Q = f(V)

P/Pn	Vac [V] Set point	P/Pn [%]	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [%]
< 20%	0,93V_n	17,68	214,0	131,0	≈0(<±2,5%P_n)	1,09
< 20%	0,91V_n	17,70	209,2	126,7	≈0(<±2,5%P_n)	1,06
< 20%-30%	0,91V_n	26,86	209,3	2794,6	0,5 Q_{max}	-0,93
40%	0,91V_n	40,36	209,3	2719,3	0,5 Q_{max}	-1,55
50%	0,91V_n	50,96	209,4	2634,1	0,5 Q_{max}	-2,26
60%	0,91V_n	60,22	209,5	2531,3	0,5 Q_{max}	-3,12
70%	0,91V_n	70,13	209,5	2526,6	0,5 Q_{max}	-3,16
80%	0,91V_n	79,61	209,6	2427,0	0,5 Q_{max}	-3,99
90%	0,91V_n	87,92	209,6	2327,2	0,5 Q_{max}	-4,82
100%	0,91V_n	87,92	209,6	2323,8	0,5 Q_{max}	-4,85
100%	0,90V_n	77,70	207,1	5602,7	Q_{max}	-1,74
100%-10%	0,90V_n	10,16	206,7	5621,6	Q_{max}	-1,58
10%→ ≤5%	0,90V_n	4,90	206,6	107,3	≈0(<±2,5%P_n)	0,89

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B.1.2.6.1	Checking compliance with the rules for implementing the standard curve Q = f(V)	P

Graph



Note

The lock-in value is adjustable between V_n and $1{,}1V_n$ and the lock-out value between V_n and $0{,}9V_n$ in 0,01V steps.

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TEMP-0058-TG-EAW-ES-V01

CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1.3	**Limitation of power**	
B.1.3.1	Automatic limitation of active power for voltage values close to 110% of the rated voltage	**P**
B.1.3.2	Adjusting active power in the presence of transients on the transmission network	**P**
B.1.3.2.1	Testing procedure	**P**
B.1.3.2.2	Test results	**P**
B.1.3.3	Checking the operating range in voltage and frequency	**P**
B.1.3.3.1	Reduction of the active power in the presence of transients under frequency on the transmission network	**P**
B.1.3.4	Limitation of the active power by an external control from the distributer	**P**

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B.1.3.1	Automatic limitation of active power for voltage values close to 110% of the rated voltage	P
Test result		
1-min mean value / P_n/P [%]	100% to under 20%	
Activation threshold [%]	112	
1-min mean value / P/ P_n [%]	100% to 20%	
Settling time [s]	23,8	
P_{E60} [%]	13,6%	
$\Delta P_{E60}/P_{Setpoint}$ [%]	20 % or less of P_n	
Limit settling time [s]	300	

Test:

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

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

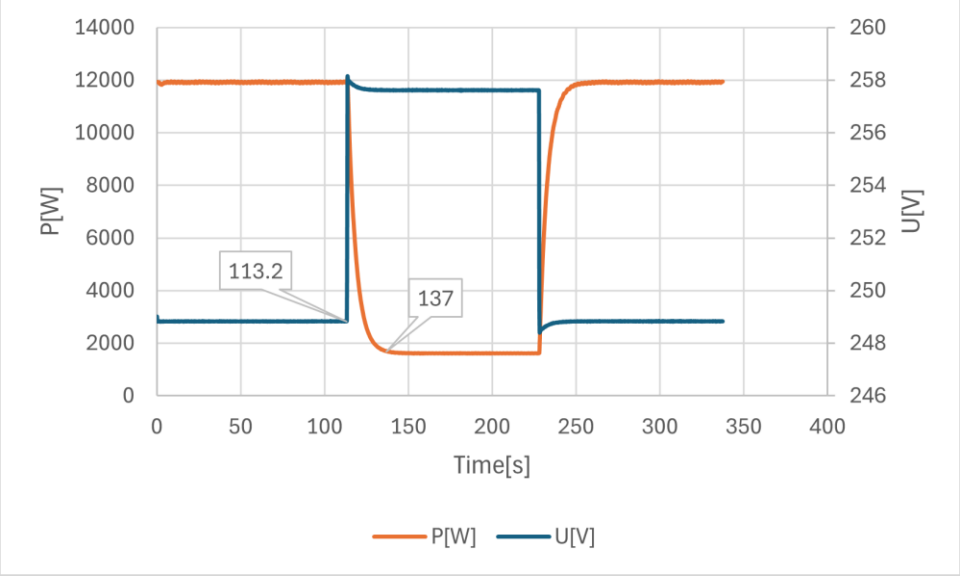
c) Set the voltage back to 2% V_n lower than the activation threshold. Check that the active power will return to the value consistent with the power available from the primary source or simulated.

Assessment criterion

for adjustable PGUs:

- no network disconnection
- the active power value does not exceed the setpoint of 20% P_n
- the setting time determined is equal or less than 300 s

Graph



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B.1.3.2	Adjusting active power in the presence of transients on the transmission network

The purpose of the test is to check the function that reduces active power automatically in case of over-frequency by extrapolating a P graph as a function of the frequency.

Two measurement sequences must be performed: starting from 100% nominal power (sequence A) and starting from 50% (sequence B).

For each measurement sequence, the frequency must be gradually increased, and the power value measured (average values over 0,2 s). A network simulator must be used for the measurement. The test can be carried out either with a network simulator capable of changing the frequency parameters available at the inverter output terminals, or directly on the electrical network. In this case, the frequency parameters controlling the power regulation system in the event of over-frequency may be adjusted, in order to simulate a progressive increase in the frequency and subsequent return to around the nominal value.

At the end of each sequence the frequency must be reduced to a value close to the nominal value to ensure that the timing requirements are met for the gradual recovery of power supplied before the frequency transient (i.e., before exceeding the 50,3 Hz limit).

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B.1.3.2.1	Testing procedure

- Connect the test object following the manufacturer's instructions.
- Set all parameters of the simulated network to the respective normal operation values.
- Set all the parameters of the test object to the respective normal operation values, so that the output AC power of the inverter is equal to the maximum AC output for sequence A, and 50% in the case of sequence B.
- Take measurements at 7 points (the frequency value should have a maximum uncertainty of ± 10 mHz) consecutively over time:

1) f = 47,51 Hz (t1 for sequence A, t'1 for sequence B)

2) f =50 Hz + 0,15 Hz (t2 for sequence A, t'2 for sequence B)

3) f =50 Hz + 0,40 Hz (t3 for sequence A, t'3 for sequence B)

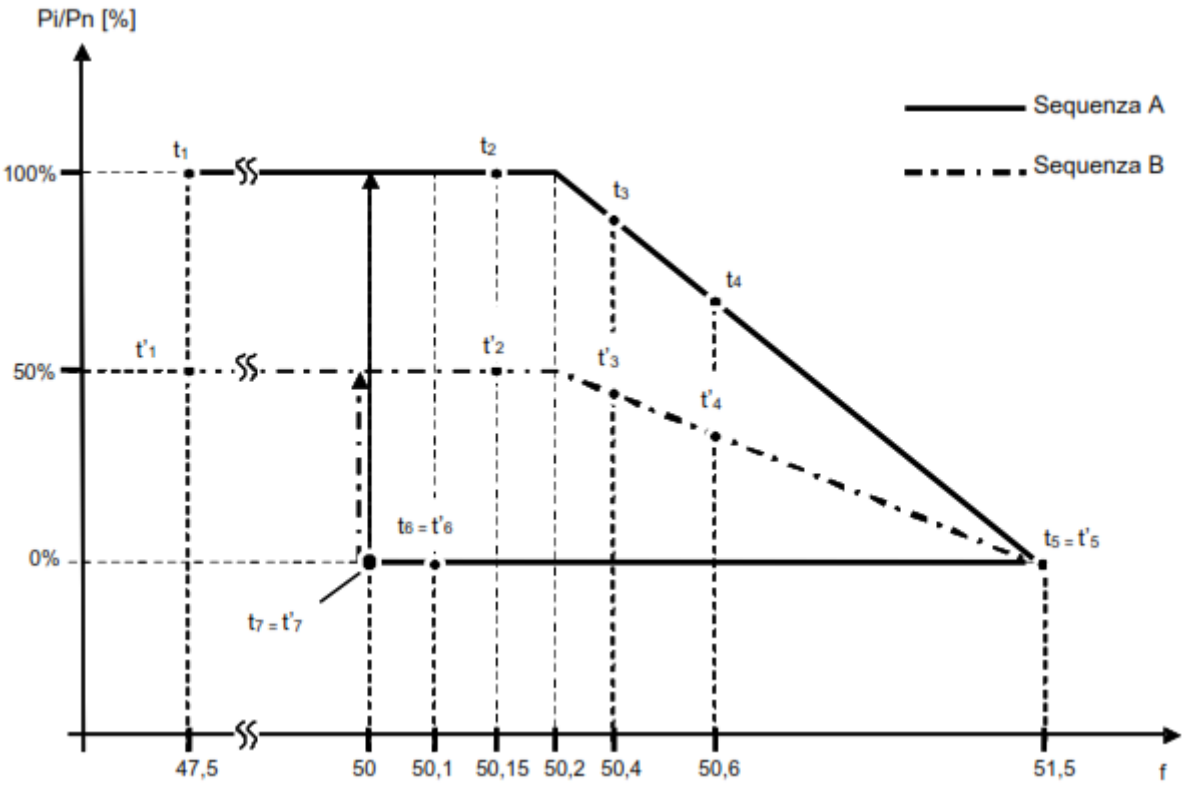
4) f =50 Hz + 0,60 Hz (t4 for sequence A, t'4 for sequence B)

5) f =50 Hz + 1,49 Hz (t5 for sequence A, t'5 for sequence B)

6) f =50 Hz + 0,11 Hz (t6 for sequence A, t'6 for sequence B)

At this point, perform step 7 bringing the frequency back to the nominal value in order to check the conditions for a gradual recovery of the maximum supply (sequence A), or 50% of the maximum power (sequence B).

7) f = 50 Hz (t7 for sequence A, t'7 for sequence B)



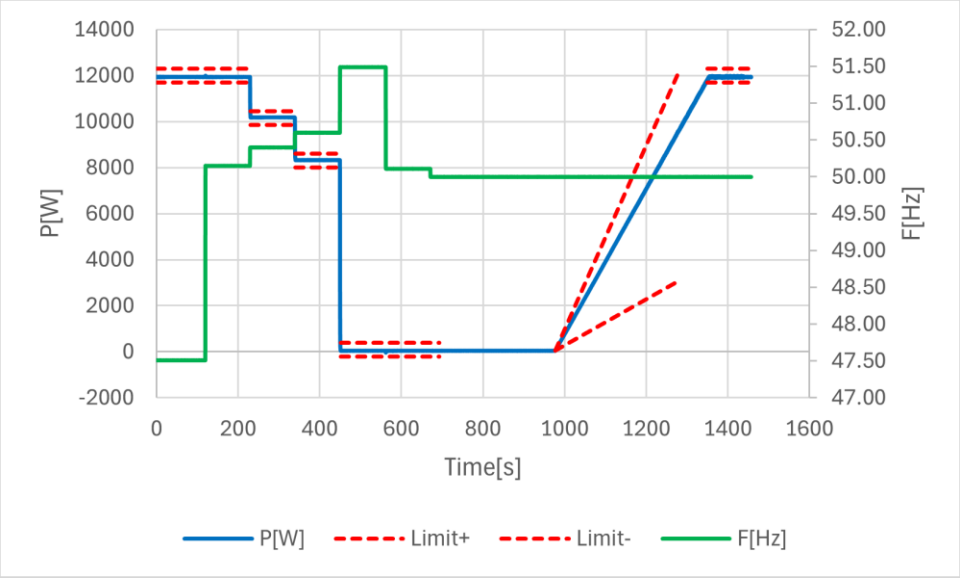
Note

The inverter is able to set a delay for the activation of the curve from 0 s – 1 s (in 50 ms steps / default setting: 0)

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B.1.3.2.2	Adjusting active power in the presence of transients on the transmission network						P
Test result							
1-min mean value [Hz]	1) 47,51	2) 50,15	3) 50,40	4) 50,60	5) 51,49	6) 50,11	7) 50,00
1. Measurement 1) to 7): Active power output > 100% P_{nx}							
Frequency [Hz]	47,51	50,15	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	12000,0	12000,0	10154,4	8308,8	91,2	91,2	12000,0
P_{E60} [W]	11949,4	11939,2	10184,3	8328,6	46,9	44,9	11943,9
ΔP_{E60} [%]	-0,42	-0,51	0,25	0,17	-0,37	-0,39	-0,47
2. Measurement 1) to 7): Active power output 50%							
Frequency [Hz]	47,51	50,15	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	6000,0	6000,0	5077,2	4154,4	45,6	45,6	6000,0
P_{E60} [W]	6017,1	6010,4	5087,7	4144,9	-46,9	-48,1	6011,8
ΔP_{E60} [%]	0,14	0,09	0,09	-0,08	-0,77	-0,78	0,10
Limit							
ΔP_{E60}	± 2,5% of P_n						

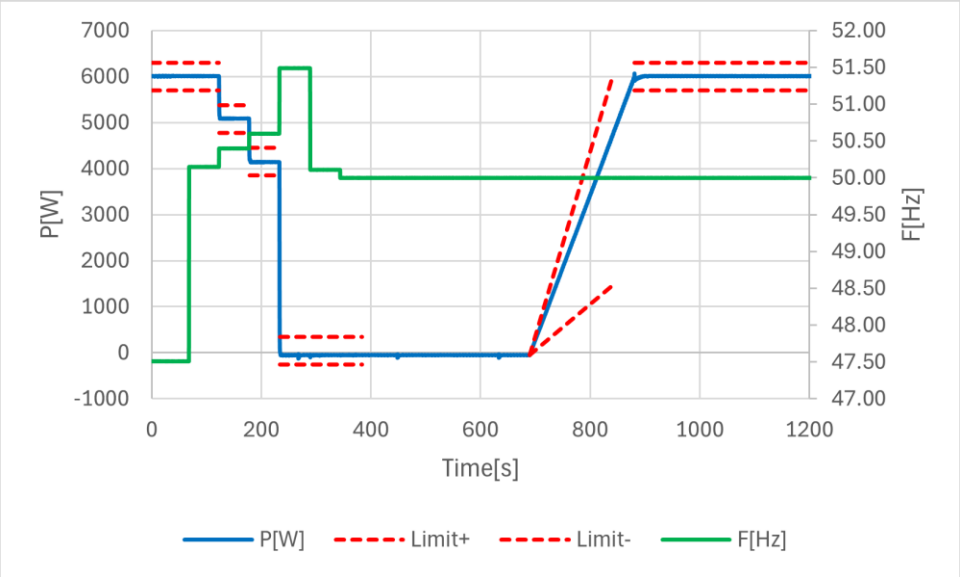
Graph of Measurement 1.: Active power output reduction 100% P_{nom}



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B.1.3.2.2	Adjusting active power in the presence of transients on the transmission network	P

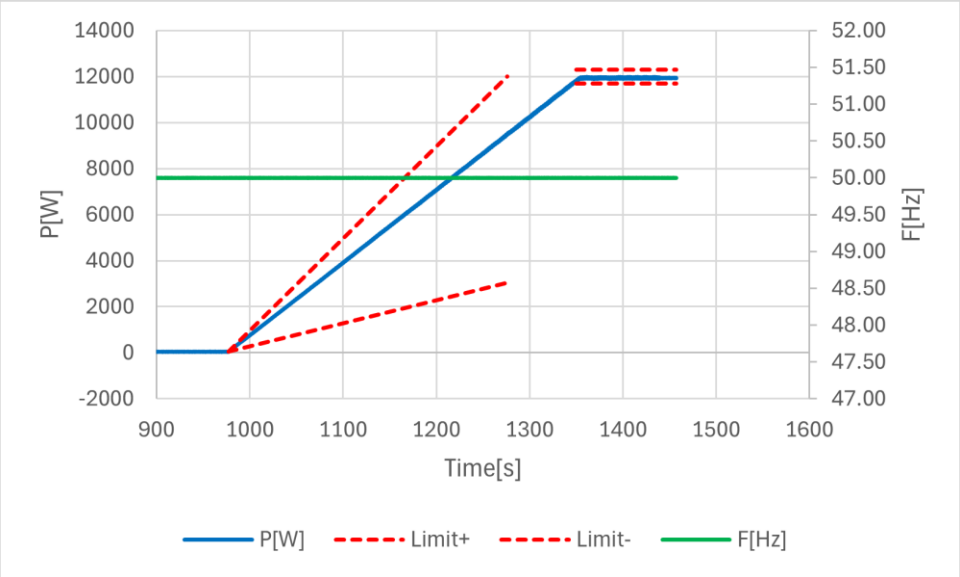
Graph of Measurement 2.: Active power output reduction 50% P_{nom}



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B.1.3.2.2	Adjusting active power in the presence of transients on the transmission network	P

Graph of Measurement 2.: Power gradient 100% P_{nom}



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B.1.3.3	Checking the operating range in voltage and frequency			P
Test result				
Test 1	V = 110% * Vn; f = 51,5 Hz; P = 100% * P_n; cos φ = 1 (duration: at least 5 minutes)			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	252,98	51,50	11903,6	0,9997
Limit	No disconnection allowed			
Test 2	V = 85% * V_n; f = 47,5 Hz; P = 100% * P_n; cos φ = 1 (duration: at least 5 minutes)			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	195,32	47,50	10680,1	0,9995
Limit	No disconnection allowed			

Test

(*) Unit can operate at reduced power of P ≥ 85% * S_n

(**) Over frequency reduction function must be deactivated

Supplied power must remain stable within ± 5% S_n at the entire duration

Assessment criterion

The test is intended to check the capacity of the generator to maintain the connection with the grid for an indefinite time in the field of voltage and frequency

85% V_n = V = 110% V_n

47,5 Hz = f = 51,5 Hz

The test should provide for the test of stable operation at the extreme limits of voltage and frequency for a minimum time of 5 minutes, for each working point (limited to 3 minutes in the field of tensions between 85% Vn = V = 90% Vn for only wind power generators).

Note

During the tests the interface protection was disabled.

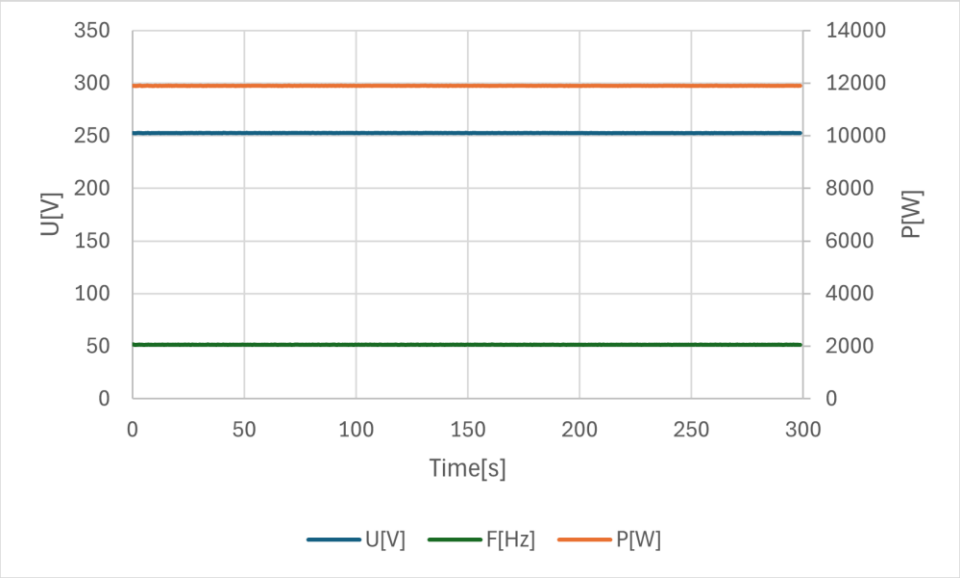
Operation at reduced power is allowed during test 1, equal to the maximum power that can be supplied on reaching the maximum output current limit (P ≥ 0,85 S_n).

During the sequence of test 2, automatic adjustment to reduce power in the case of over-frequency was disabled.

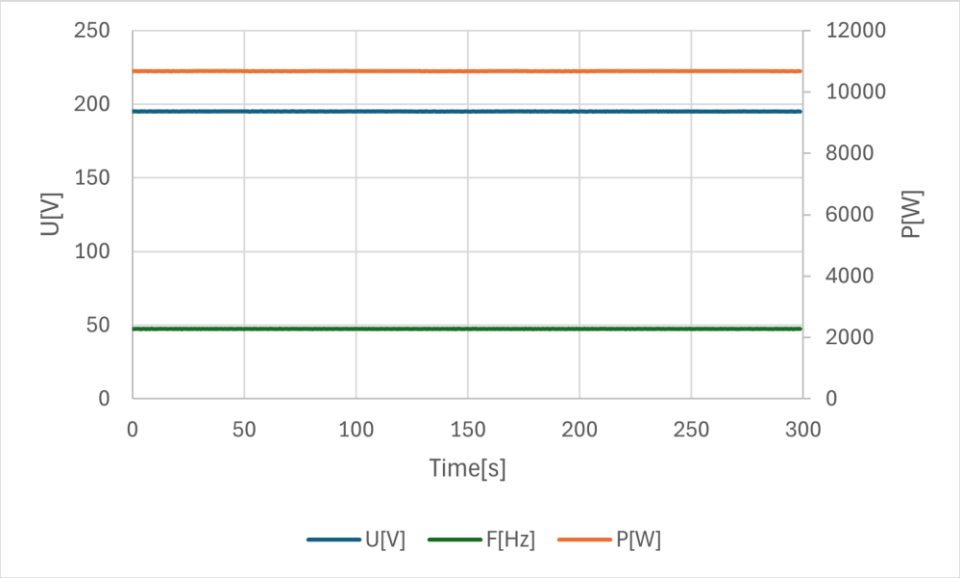
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B.1.3.3	Checking the operating range in voltage and frequency	P

Graph Test 1



Graph Test 2



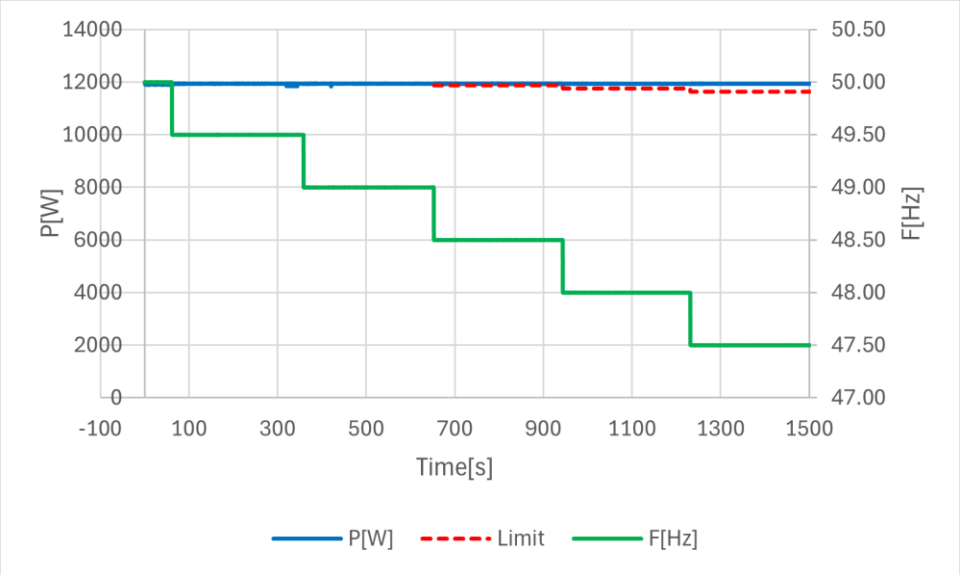
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B.1.3.3.1	Reduction of the active power in the presence of transients under frequency on the transmission network	P

Test result

	Switch to:					
1-min mean value (each) [Hz]	a) 50 ± 0,01	b) - 0,4 to – 0,5	c) – 0,9 to – 1,0	d) - 1,4 to – 1,5	e) - 1,9 to – 2,0	f) - 2,4 to – 2,5
Frequency [Hz]	50,00	49,50	49,00	48,50	48,00	47,50
Active power [W]	11979,5	11945,9	11933,0	11935,0	11935,1	11939,7
$\Delta P_{E60}/P_n$ [%]	-0,17	-0,45	-0,56	-0,54	-0,54	-0,50

Graph

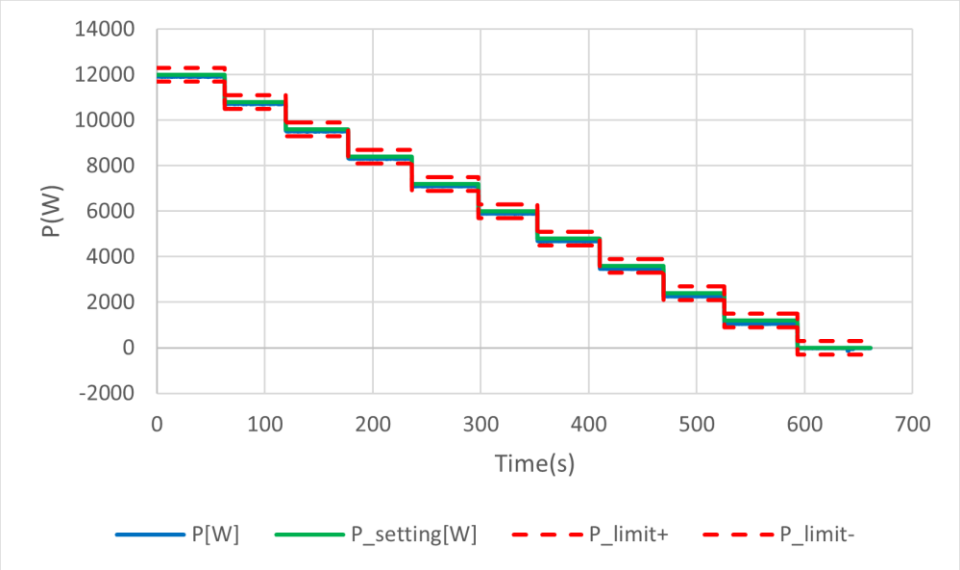


Note

SPI deactivated for the test.

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B.1.3.4	Limitation of the active power by an external control from the distributer										P
Test result											
1-min mean value / P_n/P [%]	100	90	80	70	60	50	40	30	20	10	0
$P_{Setpoint}$ [W]	12000,0	10800,0	9600,0	8400,0	7200,0	6000,0	4800,0	3600,0	2400,0	1200,0	0,0
P_{E60} [W]	11927,4	10739,2	9542,6	8326,8	7110,6	5915,4	4687,7	3476,3	2266,1	1057,2	-15,781
ΔP [%]	-0,61	-0,51	-0,48	-0,61	-0,74	-0,71	-0,94	-1,03	-1,12	-1,19	-0,13
Limit											
ΔP [%]	± 2,5% % of P_n										
Graph of the setting accuracy											



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B.1.3.4	Limitation of the active power by an external control from the distributer	P

Test

The setpoint signal must be reduced from 100% to 10% P_n:

For adjustable PGUs in increments of 10% P_n. 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.

Assessment criterion

for adjustable PGUs

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

Note

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

This paragraph did not apply for installations less 800W.

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1.4	**Output of the DC component in the output current**	
B.1.4.1	Checking the DC component output	**P**
B.1.4.2	Checking the protection against DC input	**P**

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B.1.4.1	Checking the DC component output		P
Phase 1 (Ambient)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1340,1	2608,3	4012,6
AC Voltage [V]	230,65	230,82	231,01
AC Current [A]	5,81	11,30	17,37
PF [1]	0,9981	0,9994	0,9997
Cosφ [1]	0,9981	0,9994	0,9997
DC Current in AC [mA]	21,6	27,0	25,9
DC Current in AC [% of I_r]	0,12	0,16	0,15
Phase 2 (Ambient)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1333,2	2601,3	4003,4
AC Voltage [V]	230,65	230,82	231,01
AC Current [A]	5,78	11,27	17,33
PF [1]	0,9984	0,9995	0,9996
Cosφ [1]	0,9984	0,9995	0,9996
DC Current in AC [mA]	66,2	65,0	68,7
DC Current in AC [% of I_r]	0,38	0,37	0,40
Phase 3 (Ambient)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1328,5	2592,1	3991,9
AC Voltage [V]	230,65	230,82	231,01
AC Current [A]	5,76	11,23	17,28
PF [1]	0,9983	0,9993	0,9995
Cosφ [1]	0,9983	0,9993	0,9995
DC Current in AC [mA]	7,2	11,3	16,2
DC Current in AC [% of I_r]	0,04	0,07	0,09

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B.1.4.1	Checking the DC component output		P
Phase 1 (-10°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1340,1	2633,8	4012,8
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,81	11,41	17,37
PF [1]	0,9981	0,9994	0,9997
Cosφ [1]	0,9981	0,9994	0,9997
DC Current in AC [mA]	20,7	26,2	24,3
DC Current in AC [% of I_r]	0,12	0,15	0,14
Phase 2 (-10°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1333,2	2626,8	4003,6
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,78	11,38	17,33
PF [1]	0,9984	0,9995	0,9996
Cosφ [1]	0,9984	0,9995	0,9996
DC Current in AC [mA]	68.3	67.7	72.2
DC Current in AC [% of I_r]	0.39	0.39	0.42
Phase 3 (-10°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1328,5	2617,6	3992,0
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,76	11,34	17,28
PF [1]	0,9983	0,9993	0,9995
Cosφ [1]	0,9983	0,9993	0,9995
DC Current in AC [mA]	7,6	12,4	16,5
DC Current in AC [% of I_r]	0,04	0,07	0,09

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B.1.4.1	Checking the DC component output		P
Phase 1 (+55°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1340,1	2633,8	4015,1
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,81	11,41	17,38
PF [1]	0,9981	0,9994	0,9997
Cosφ [1]	0,9981	0,9994	0,9997
DC Current in AC [mA]	20,8	25,6	24,3
DC Current in AC [% of I_r]	0,12	0,15	0,14
Phase 2 (+55°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1333,2	2626,8	4005,9
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,78	11,38	17,34
PF [1]	0,9984	0,9995	0,9996
Cosφ [1]	0,9984	0,9995	0,9996
DC Current in AC [mA]	67,7	68,0	73,19
DC Current in AC [% of I_r]	0,39	0,39	0,42
Phase 3 (+55°C)			
Power Level [% of VA_r]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1328,5	2617,6	3992,0
AC Voltage [V]	230,65	230,83	231,02
AC Current [A]	5,76	11,34	17,28
PF [1]	0,9983	0,9993	0,9995
Cosφ [1]	0,9983	0,9993	0,9995
DC Current in AC [mA]	6,4	12,0	16,5
DC Current in AC [% of I_r]	0,04	0,07	0,09

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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B.1.4.2	Checking the protection against DC injection			P
Test result				
Actual Power	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [s]
I_{dc} = 0,5% of I_n (Positive)				
33%	0,5% I_n / 1 s	115	87	0,400
66%	0,5% I_n / 1 s	174	87	0,400
100%	0,5% I_n / 1 s	136	87	0,600
I_{dc} = 0,5% of I_n (Negative)				
33%	0,5% I_n / 1 s	127	87	0,600
66%	0,5% I_n / 1 s	143	87	0,650
100%	0,5% I_n / 1 s	136	87	0,650
I_{dc} = >1 A (Positive)				
33%	1 A / 0,2 s	1119	1000	0,150
66%	1 A / 0,2 s	1045	1000	0,150
100%	1 A / 0,2 s	1157	1000	0,150
I_{dc} = >1 A (Negative)				
33%	1 A / 0,2 s	1077	1000	0,150
66%	1 A / 0,2 s	1142	1000	0,150
100%	1 A / 0,2 s	1102	1000	0,150

Note

Checking the switch-off of the converter, if the first protection threshold Idc> (>0,5% In; in the case of systems with a power of less than 800 W: >20 mA)

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TEMP-0058-TG-EAW-ES-V01

CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1.5	**Checking insensitivity to voltage dips (LVRT capability)**	
B.1.5	Checking insensitivity to voltage dips (LVRT capability)	**P**
B.1.5	Checking insensitivity to voltage dips (OVRT capability)	**P**

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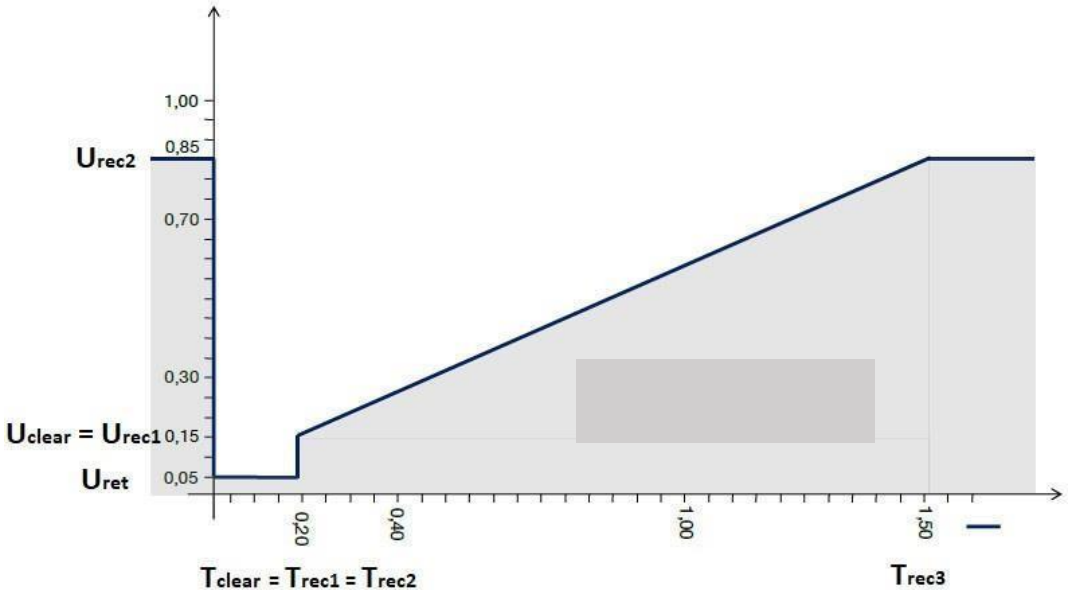
B.1.5	Checking insensitivity to voltage dips (LVRT capability)	P

General

The purpose of these tests is to verify that the converter, if used in systems with a maximum power exceeding 11,08 kW, is insensitive to voltage drops according to the time-amplitude profile indicated in Fig. 14b.

In particular, the tests must verify that the following functional requirements are met:

- the generator must not disconnect from the network in the white area above and along the points of the LVRT characteristic (V-t) indicated in Figure 14b, where V is the concatenated voltage at the connection point. In this area it is allowed to temporarily interrupt the supply of active and reactive power delivered before the onset of the fault.
- in the area below (grey) the generator can disconnect from the network.
- within 400 ms from the restoration of a mains voltage level between + 10% and - 15% of the nominal voltage, the generator must resume the supply of active and reactive power fed into the grid before the onset of the fault with a maximum tolerance of ± 10% of the nominal power. In the range between 85% and 90% of the rated voltage, a reduction in the power supplied based on the limits of the maximum output current from the generator is allowed.



List of tests	Residual amplitude of phase-to-phase voltage V/V_n			Duration [s]	Form (*)
1s – three-phase symmetrical fault	0,10	± 0,05	(V1/Vn)	0,200 ± 0,020	
1a – asymmetrical fault phase	0,10	± 0,05	(V1/Vn)	0,200 ± 0,020	
2s – three-phase symmetrical fault	0,25	± 0,05	(V2/Vn)	0,400 ± 0,020	
2a – asymmetrical fault phase	0,25	± 0,05	(V2/Vn)	0,400 ± 0,020	
3s – three-phase symmetrical fault	0,50	± 0,05	(V3/Vn)	0,850 ± 0,020	
3a – asymmetrical fault phase	0,50	± 0,05	(V3/Vn)	0,850 ± 0,020	
4s – three-phase symmetrical fault	0,75	± 0,05	(V4/Vn)	1,300 ± 0,020	
4a – asymmetrical fault phase	0,75	± 0,05	(V4/Vn)	1,300 ± 0,020	
5 – LV two-phase asymmetrical fault	0,10	± 0,05	(V5/Vn)	0,200 ± 0,020	
6 – LV two-phase asymmetrical fault	0,50	± 0,05	(V6/Vn)	0,850 ± 0,020	

* Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms

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B.1.5	Checking insensitivity to voltage dips (LVRT capability)	P

Overvoltage V-t Characteristic (OVRT) of Figure 30

1) the generator must not disconnect from the grid in the area below and along the points of the indicated characteristic (V-t), where V is the chained voltage at the point of connection. These values are expressed as a percentage of the nominal voltage

2) in the area above (in grey) the generator can disconnect from grid

3) The behaviour provided for by the curve in Figure 30 must be ensured in the event of a voltage rise of one or more voltages, i.e. the disconnection logic must be of the type 1 out of 3: it can be triggered for both symmetrical and dissymmetrical faults when one of the three voltage measurements exceeds in height and duration the permissible peak voltage.

The FRT characteristic required of generation plants over 11,08 kW is shown in Figure 30

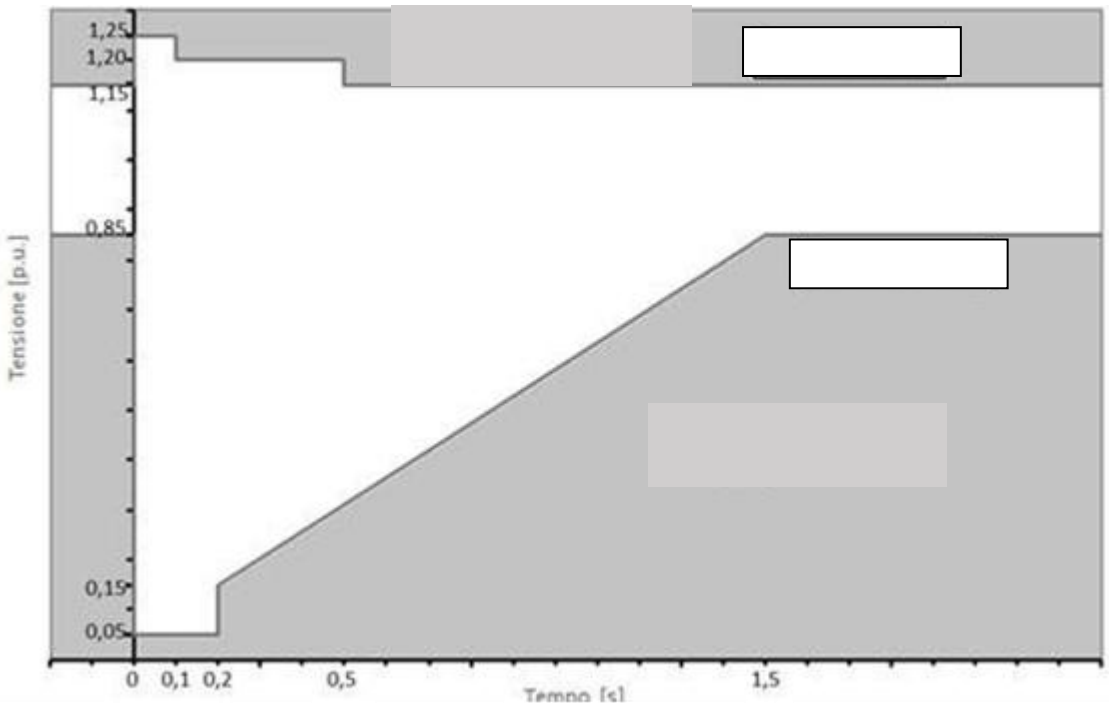


Figure 30 - Characteristic (V - t): UVRT and OVRT for generating parks over 11,08 kW

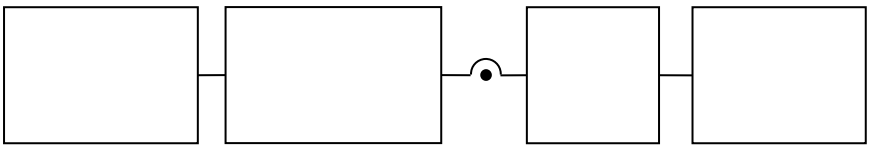
Verifications of the compliance of motor-drive converters with the requirements for immunity to voltage sags shall be carried out in accordance with Annex B, Article B.1.

List of tests	Residual amplitude of phase-to-phase voltage V/V_n			Duration [s]	Form (*)
OV1 – three-phase symmetrical fault	1,25	± 0,05	(V1/Vn)	0,100 ± 0,020	
OV2 – three-phase symmetrical fault	1,20	± 0,05	(V1/Vn)	0,500 ± 0,020	
* Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms					

Note

For large generators (> 100kW), it is permissible to carry out the tests at reduced power, as long as this exceeds 30% of the nominal power of the generator.

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B.1.5	Checking insensitivity to voltage dips (LVRT capability)	P
Test setup		
Grid simulator (grid conditions varied)		☒
Test bench		☐
Identifier of test setup		See Annex 6 – Test equipment list
Schematic of test setup: 		Note on test setup: Instead of an LVRT test bench a low-voltage AC simulator was used.
Note: Evaluation of data measured at MP. Used sample rate: 10 kHz		
Grid parameters at MP		
Nominal voltage PCC // U_G [V]		230 V (P-N) / 400 V (P-P)
Nominal apparent power of test setup // S_n [kVA]		75
Short-circuit power of the test setup // S_{sc} [kVA]		≥ 3x$S_{n,PGU}$
Grid reactance X_G [Ω]		5,56
Grid impedance R_G [Ω]		1,81
Test conditions Voltage simulator fall and rise time: < 10 ms		

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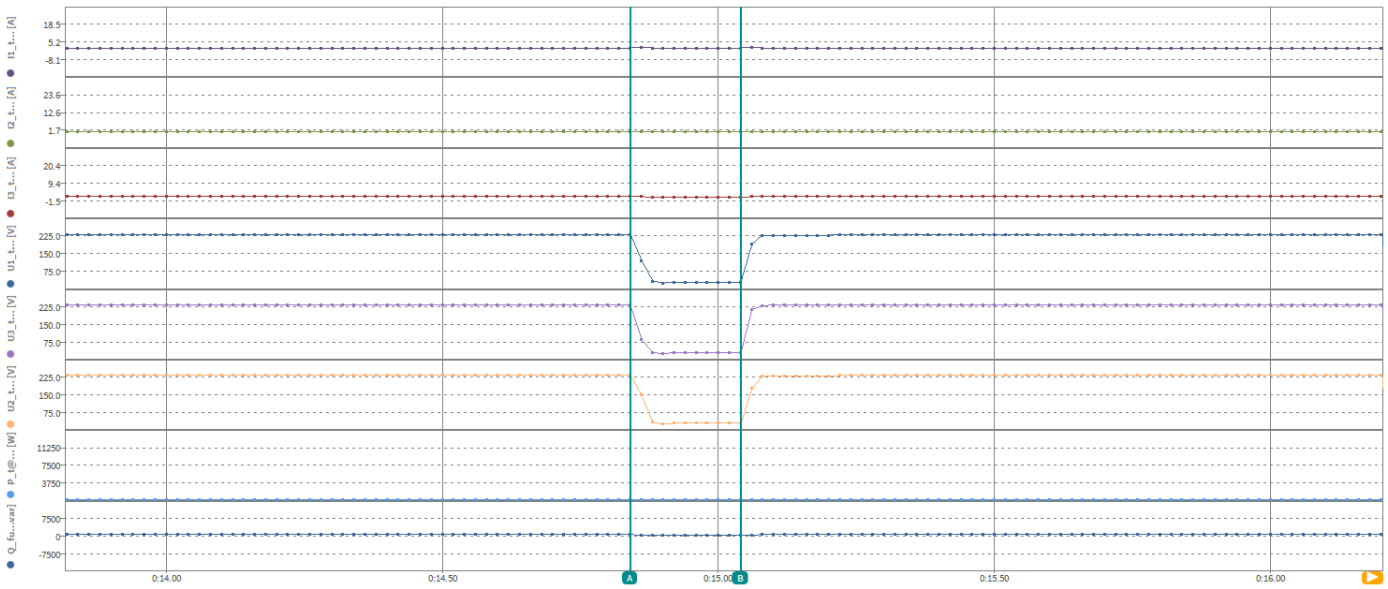
B.1.5	Checking insensitivity to voltage dips (LVRT capability)	P

No Load Test 1a – two-phase asymmetrical fault (V/Vn = 0,10; duration = 0,200 s)



	A	B	间隔
时间 [s]	8.326812	8.527056	0.200244
I1_tRMS@AC侧 [A]	0.400834	0.334916	-0.065918
I2_tRMS@AC侧 [A]	0.363378	0.349890	-0.013487
I3_tRMS@AC侧 [A]	0.349794	0.063101	-0.286692
U1_tRMS@AC侧 [V]	230.1807	200.2986	-29.88211
U2_tRMS@AC侧 [V]	230.3664	200.5543	-29.81212
U3_tRMS@AC侧 [V]	230.6873	23.10719	-207.5801
P_t@AC侧 [W]	-26.28102	-27.26280	-0.981779
Q_fund@AC侧 [var]	228.0679	115.3600	-112.7079

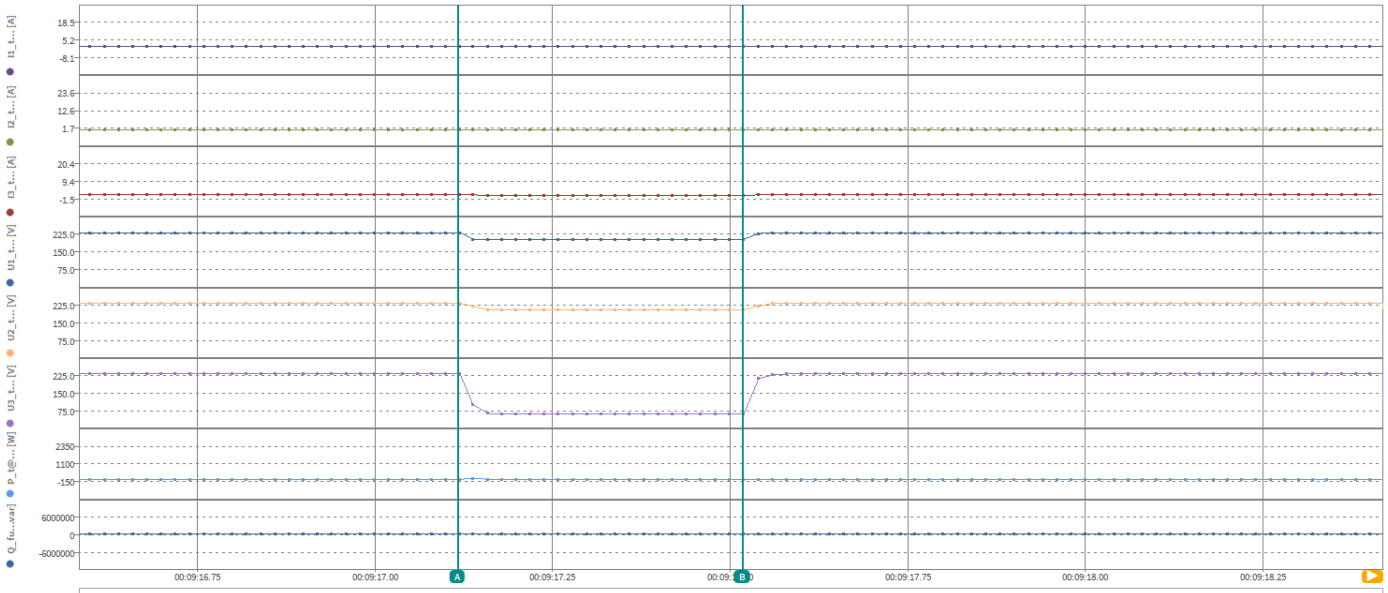
No Load Test 1s – three-phase symmetrical fault (V/Vn = 0,10; duration = 0,200 s)



	A	B	间隔
时间 [s]	0:14.840585	0:15.040763	0.200178
I1_tRMS@AC侧 [A]	0.400191	0.070945	-0.329246
I2_tRMS@AC侧 [A]	0.362283	0.084309	-0.277974
I3_tRMS@AC侧 [A]	0.349081	0.060920	-0.288161
U1_tRMS@AC侧 [V]	230.1081	23.03449	-207.0736
U3_tRMS@AC侧 [V]	230.7536	23.17422	-207.5794
U2_tRMS@AC侧 [V]	230.3914	23.12668	-207.2647
P_t@AC侧 [W]	-26.66562	0.113392	26.77902
Q_fund@AC侧 [var]	227.9784	2.290333	-225.6881

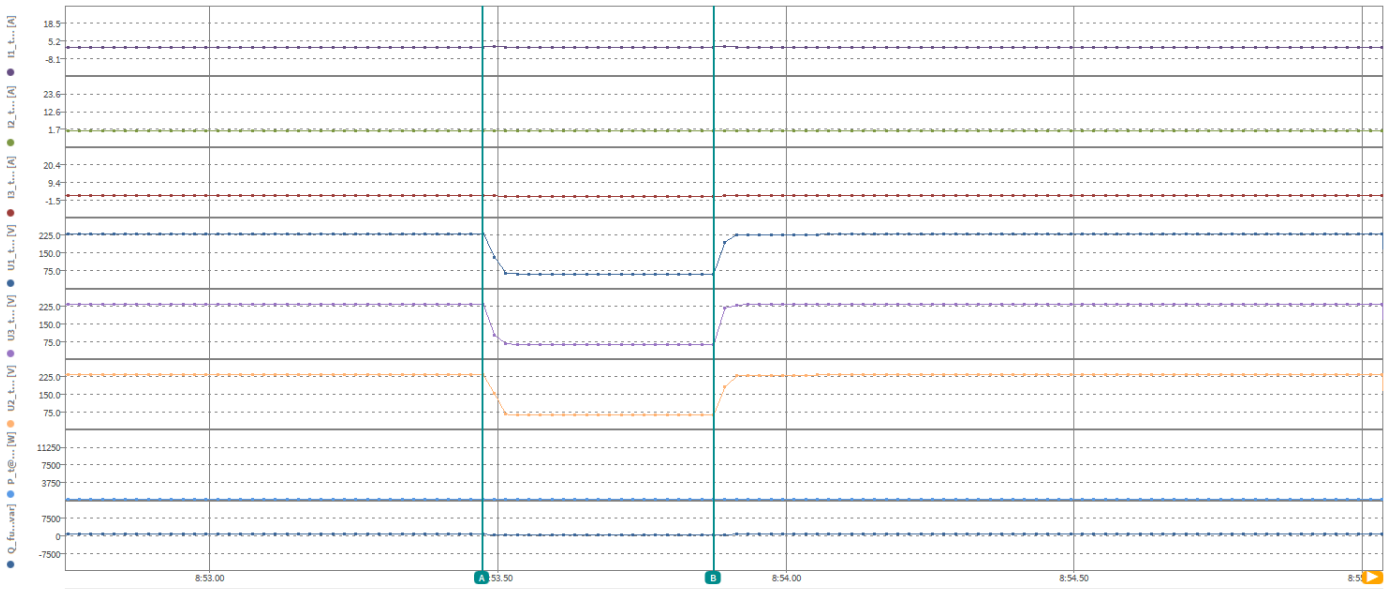
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No Load Test 2a – two-phase asymmetrical fault (V/Vn = 0,25; duration = 0,400 s)



时间 [s]	A 9:17.117212	B 9:17.517847	间隔 0.400635
I1_tRMS@AC侧 [A]	0.400635	0.341226	-0.059409
I2_tRMS@AC侧 [A]	0.361904	0.346964	-0.014940
I3_tRMS@AC侧 [A]	0.348717	0.105470	-0.243247
U1_tRMS@AC侧 [V]	230.0770	202.2458	-27.83122
U2_tRMS@AC侧 [V]	230.4149	203.3194	-27.09557
U3_tRMS@AC侧 [V]	230.6652	57.16386	-173.5013
P_t@AC侧 [W]	-26.81610	-27.78637	-0.970261
Q_fund@AC侧 [var]	227.8312	121.9566	-105.8746

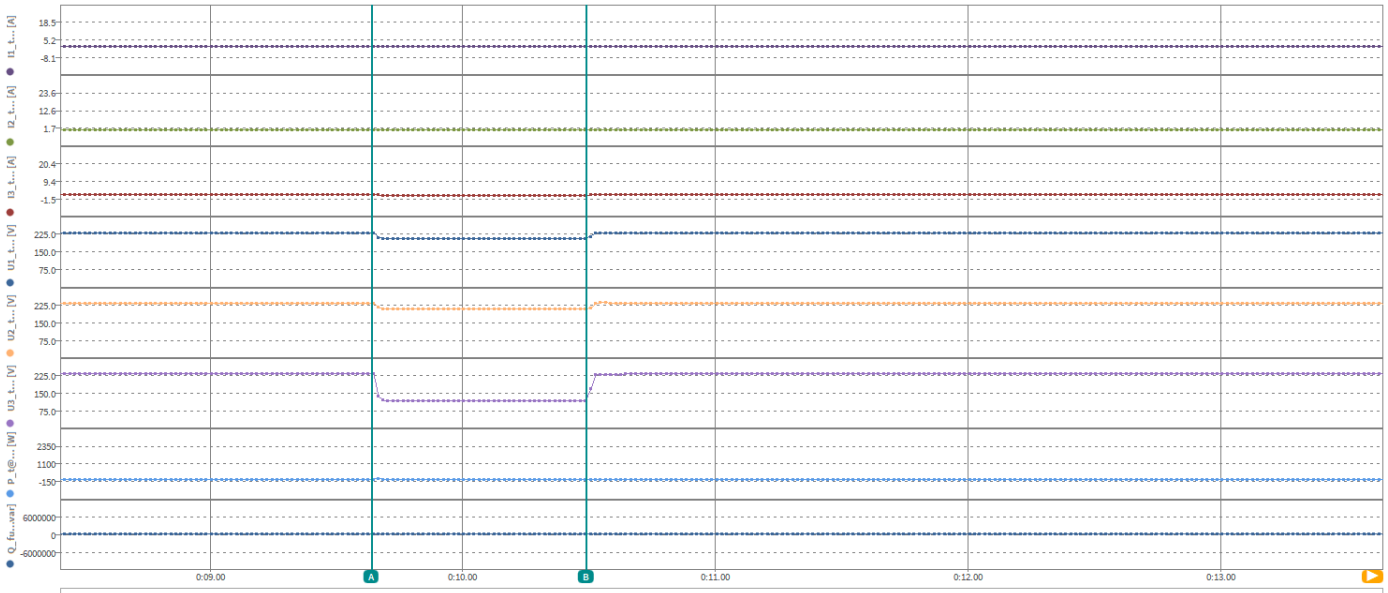
No Load Test 2s – three-phase symmetrical fault (V/Vn = 0,25; duration = 0,400 s)



时间 [s]	A 8:53.473442	B 8:53.874706	间隔 0.401264
I1_tRMS@AC侧 [A]	0.400980	0.106485	-0.294495
I2_tRMS@AC侧 [A]	0.362803	0.117143	-0.245661
I3_tRMS@AC侧 [A]	0.348905	0.100452	-0.248454
U1_tRMS@AC侧 [V]	230.0685	57.56394	-172.5046
U3_tRMS@AC侧 [V]	230.7339	57.70578	-173.0282
U2_tRMS@AC侧 [V]	230.4143	57.74746	-172.6668
P_t@AC侧 [W]	-26.98229	0.065587	27.04787
Q_fund@AC侧 [var]	227.8108	14.25392	-213.5569

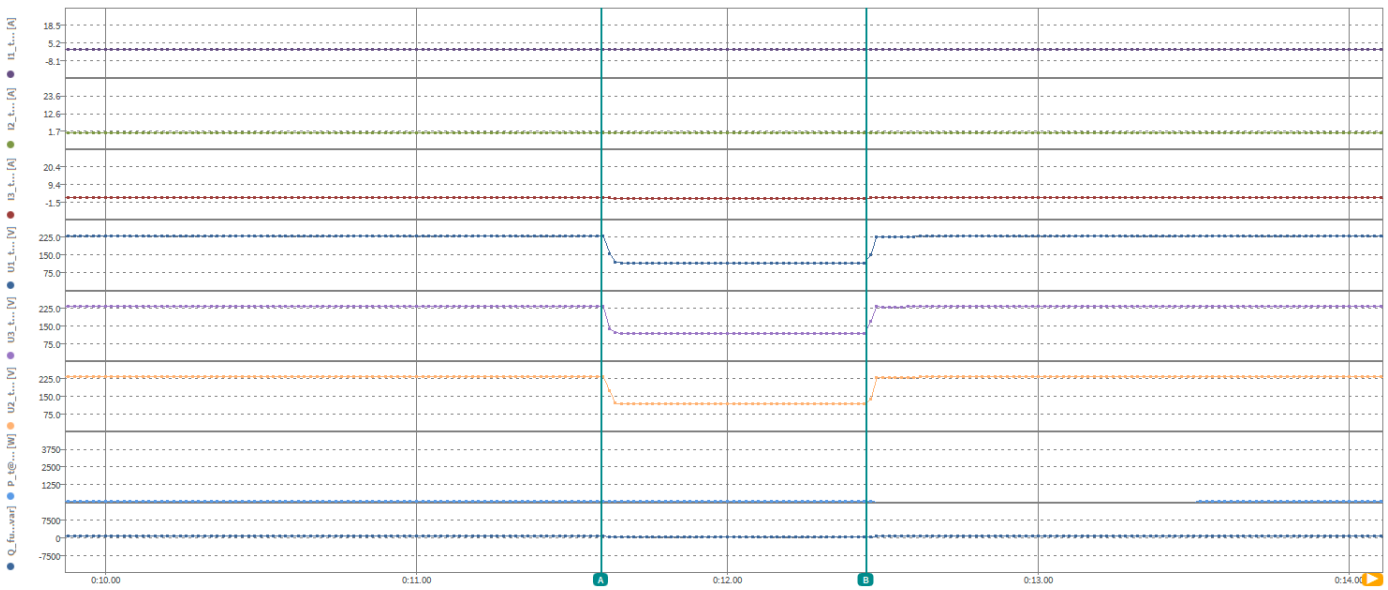
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No Load Test 3a – two-phase asymmetrical fault (V/Vn = 0,50; duration = 0,850 s)



时间 [s]	A 9.641445	B 0:10.491519	间隔 0.850074
I1_tRMS@AC侧 [A]	0.400547	0.352906	-0.047641
I2_tRMS@AC侧 [A]	0.362810	0.343220	-0.019590
I3_tRMS@AC侧 [A]	0.349490	0.188894	-0.160595
U1_tRMS@AC侧 [V]	230.1357	206.9264	-23.20932
U2_tRMS@AC侧 [V]	230.4170	207.7775	-22.63942
U3_tRMS@AC侧 [V]	230.6550	115.2428	-115.4122
P_t@AC侧 [W]	-26.23133	-26.11831	0.113010
Q_fund@AC侧 [var]	228.0463	141.7255	-86.32080

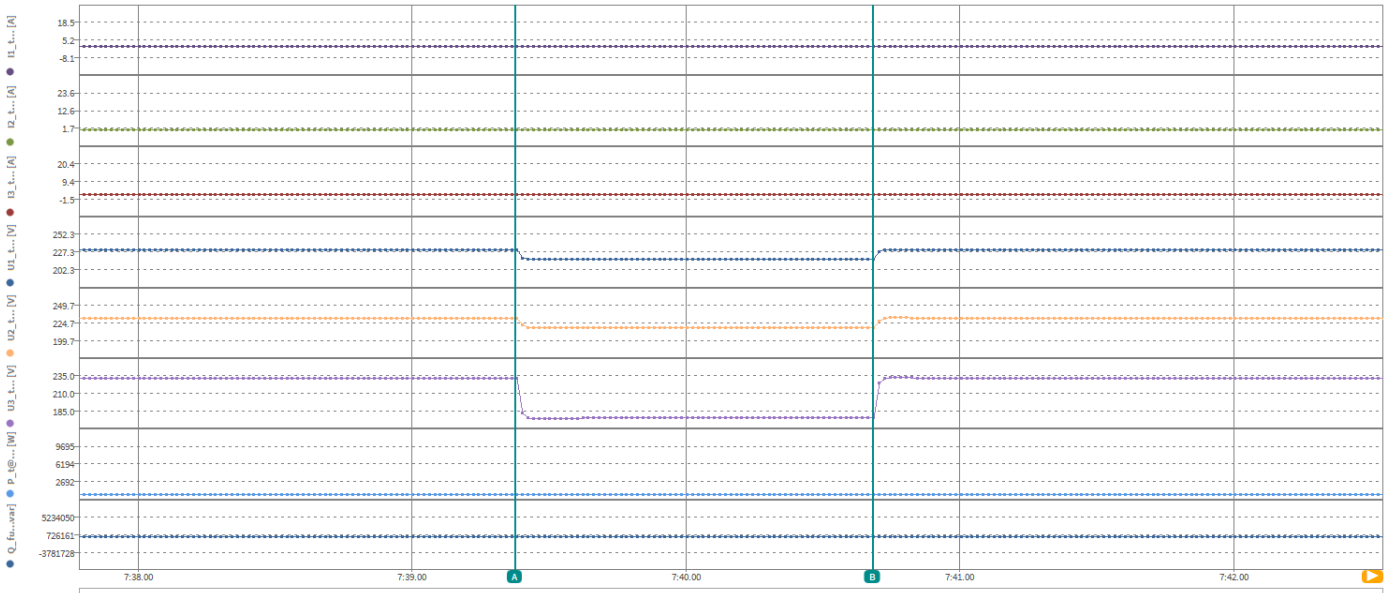
No Load Test 3s – three-phase symmetrical fault (V/Vn = 0,50; duration = 0,850 s)



时间 [s]	A 0:11.595544	B 0:12.447619	间隔 0.852075
I1_tRMS@AC侧 [A]	0.401102	0.184363	-0.216740
I2_tRMS@AC侧 [A]	0.362378	0.192413	-0.169965
I3_tRMS@AC侧 [A]	0.349651	0.181382	-0.168269
U1_tRMS@AC侧 [V]	230.0979	115.0962	-115.0017
U3_tRMS@AC侧 [V]	230.6773	115.3382	-115.3391
U2_tRMS@AC侧 [V]	230.4312	115.3505	-115.0807
P_t@AC侧 [W]	-27.28489	-0.295287	26.98960
Q_fund@AC侧 [var]	228.0767	56.96550	-171.1112

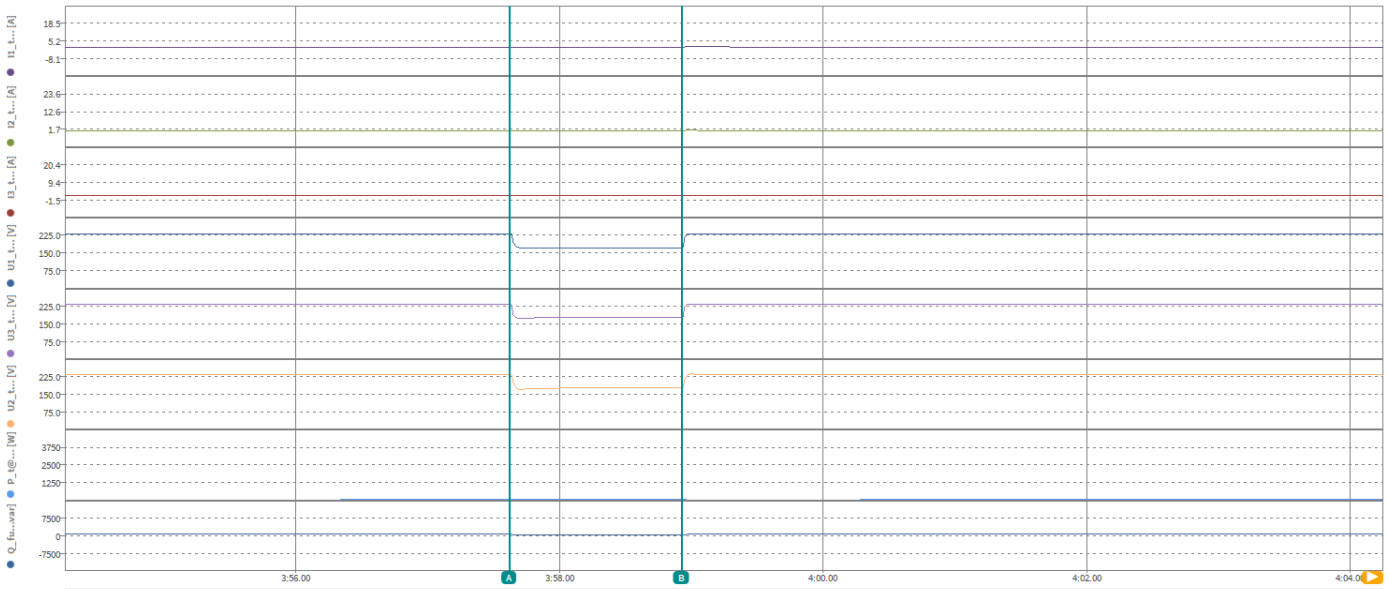
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No Load Test 4a – two-phase asymmetrical fault (V/Vn = 0,75; duration = 1,300 s)



	A	B	间隔
时间 [s]	7:39.376866	7:40.681886	1.305020
I1_tRMS@AC侧 [A]	0.399507	0.371823	-0.027684
I2_tRMS@AC侧 [A]	0.361405	0.347806	-0.013599
I3_tRMS@AC侧 [A]	0.348823	0.270213	-0.078610
U1_tRMS@AC侧 [V]	230.1364	216.2965	-13.83995
U2_tRMS@AC侧 [V]	230.4511	216.9031	-13.54807
U3_tRMS@AC侧 [V]	230.6615	172.9811	-57.68039
P_t@AC侧 [W]	-26.40286	-26.06714	0.335718
Q_fund@AC侧 [var]	227.9328	176.9322	-51.00058

No Load Test 4s – three-phase symmetrical fault (V/Vn = 0,75; duration = 1,300 s)



	A	B	间隔
时间 [s]	3:57.622798	3:58.929099	1.306302
I1_tRMS@AC侧 [A]	0.404949	0.265675	-0.139274
I2_tRMS@AC侧 [A]	0.363549	0.271972	-0.091577
I3_tRMS@AC侧 [A]	0.349246	0.263508	-0.085738
U1_tRMS@AC侧 [V]	230.2411	172.1848	-58.05632
U3_tRMS@AC侧 [V]	230.7653	172.5523	-58.21303
U2_tRMS@AC侧 [V]	230.4552	172.3847	-58.07047
P_t@AC侧 [W]	-28.42661	-0.408539	28.01807
Q_fund@AC侧 [var]	228.1163	127.4342	-100.6821

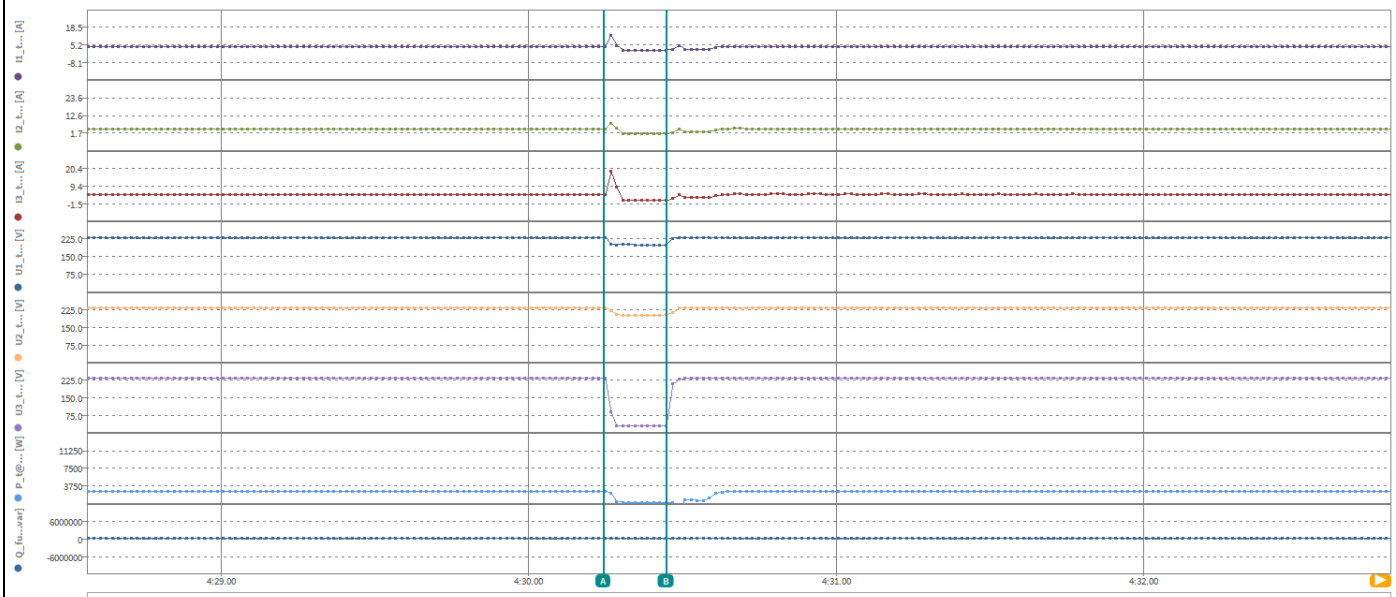
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Test Results

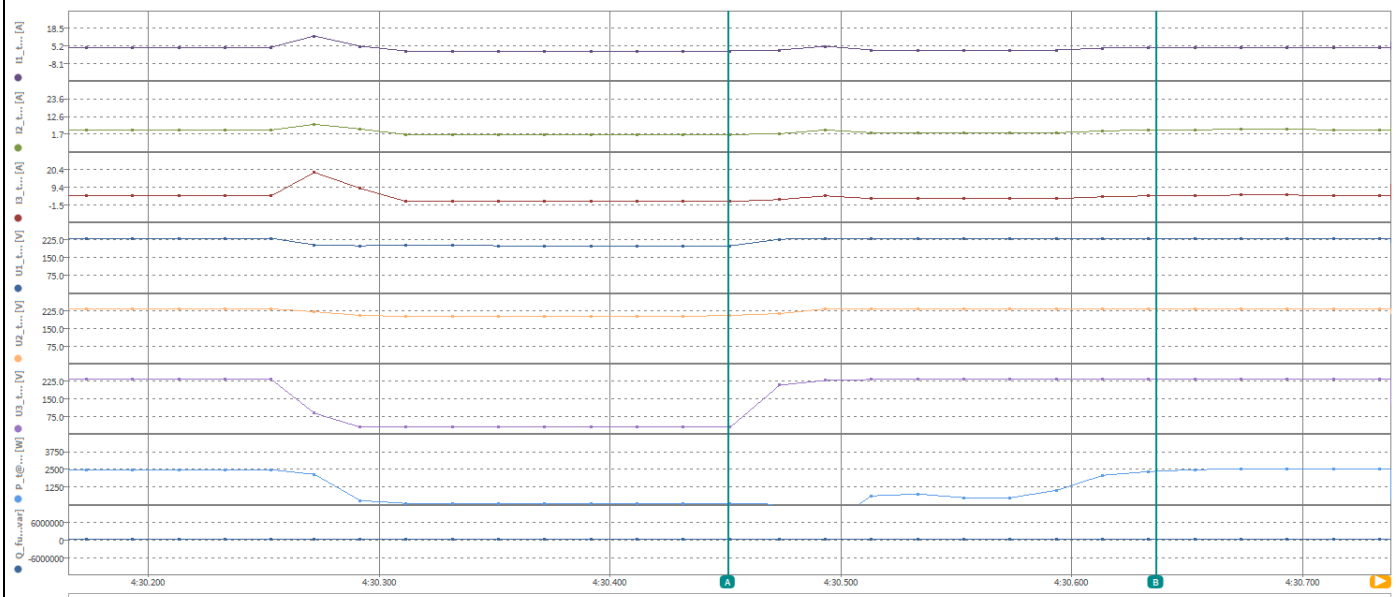
List of tests	Residual amplitude of phase-to-phase voltage V/V_n	Duration limit of Voltage dips [s]	Dip time measured [s]	Recovery time measured [s]	Result
1a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,10 ± 0,05	0,200 ± 0,020	0,204	0,185	P
1a – two-phase asymmetrical fault (P > 0,9)	0,10 ± 0,05	0,200 ± 0,020	0,201	0,246	P
1s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,10 ± 0,05	0,200 ± 0,020	0,200	0,215	P
1s – three-phase symmetrical fault (P > 0,9)	0,10 ± 0,05	0,200 ± 0,020	0,200	0,298	P
2a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,25 ± 0,05	0,400 ± 0,020	0,403	0,191	P
2a – two-phase asymmetrical fault (P > 0,9)	0,25 ± 0,05	0,400 ± 0,020	0,400	0,217	P
2s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,25 ± 0,05	0,400 ± 0,020	0,401	0,182	P
2s – three-phase symmetrical fault (P > 0,9)	0,25 ± 0,05	0,400 ± 0,020	0,405	0,107	P
3a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,50 ± 0,05	0,850 ± 0,020	0,850	0,183	P
3a – two-phase asymmetrical fault (P > 0,9)	0,50 ± 0,05	0,850 ± 0,020	0,857	0,230	P
3s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,50 ± 0,05	0,850 ± 0,020	0,854	0,219	P
3s – three-phase symmetrical fault (P > 0,9)	0,50 ± 0,05	0,850 ± 0,020	0,851	0,159	P
4a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,75 ± 0,05	1,300 ± 0,020	1,304	0,165	P
4a – two-phase asymmetrical fault (P > 0,9)	0,75 ± 0,05	1,300 ± 0,020	1,308	0,193	P
4s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,75 ± 0,05	1,300 ± 0,020	1,308	0,190	P
4s – three-phase symmetrical fault (P > 0,9)	0,75 ± 0,05	1,300 ± 0,020	1,303	0,246	P
5 – LV two-phase asymmetrical fault (P = 0,1 - 0,3)	0,10 ± 0,05	0,200 ± 0,020	0,201	0,206	P
5 – LV two-phase asymmetrical fault (P > 0,9)	0,10 ± 0,05	0,200 ± 0,020	0,200	0,185	P
6 – LV two-phase asymmetrical fault (P = 0,1 - 0,3)	0,50 ± 0,05	0,850 ± 0,020	0,850	0,200	P
6 – LV two-phase asymmetrical fault (P > 0,9)	0,50 ± 0,05	0,850 ± 0,020	0,853	0,226	P
OV1 – three-phase symmetrical fault (P > 0,9)	1,25 ± 0,05	0,100 ± 0,020	0,100	0,128	P
OV2 – three-phase symmetrical fault (P > 0,9)	1,20 ± 0,05	0,500 ± 0,020	0,501	0,210	P

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Test 1a – two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) P = 0,1 - 0,3



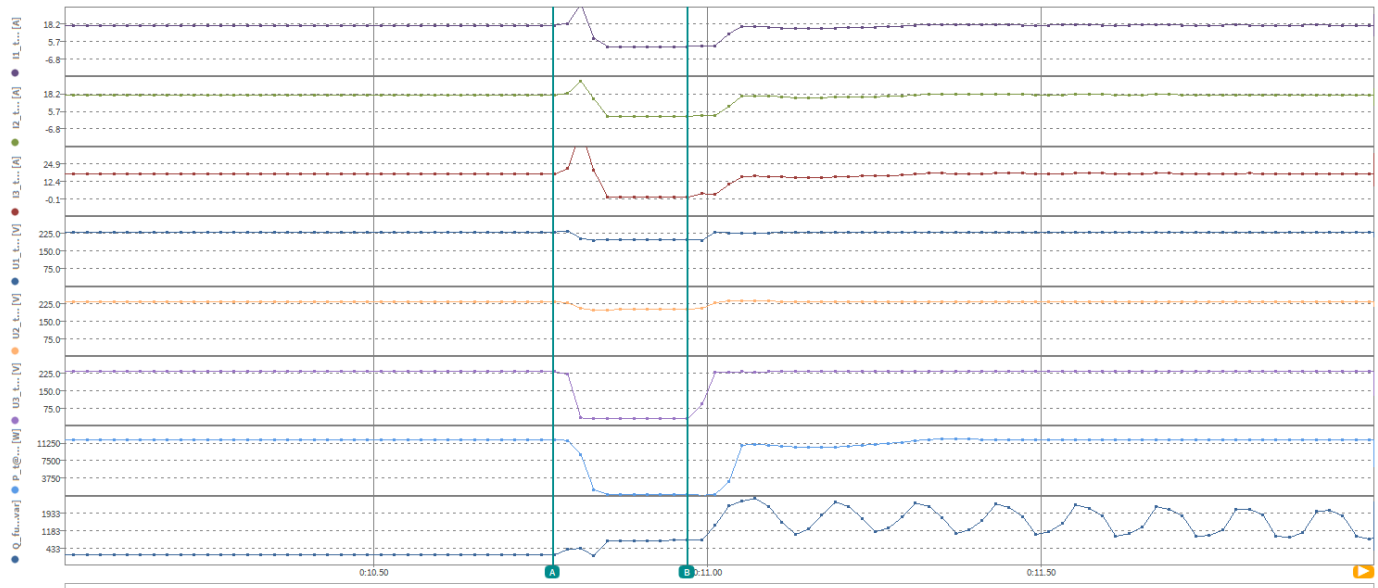
时间 [s]	A 4:30.244462	B 4:30.448363	间隔 0.203900
I1_tRMS@AC侧 [A]	3.519829	1.022061	-2.497768
I2_tRMS@AC侧 [A]	3.489065	1.029445	-2.459620
I3_tRMS@AC侧 [A]	3.505085	0.133632	-3.371453
U1_tRMS@AC侧 [V]	230.2379	200.1136	-30.12431
U2_tRMS@AC侧 [V]	230.5717	200.5708	-30.00090
U3_tRMS@AC侧 [V]	230.7986	23.10409	-207.6945
P_t@AC侧 [W]	2416.803	-0.787471	-2417.590
Q_fund@AC侧 [var]	102.8289	411.6082	308.7793



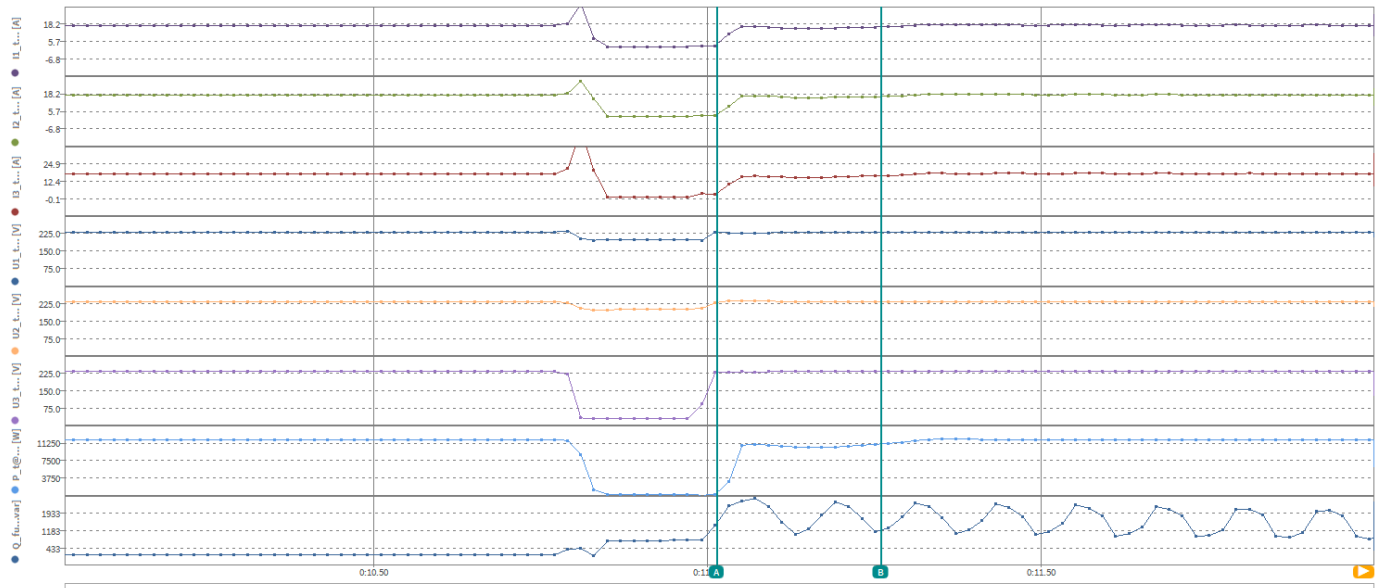
时间 [s]	A 4:30.451186	B 4:30.636526	间隔 0.185341
I1_tRMS@AC侧 [A]	1.022061	3.513092	2.491031
I2_tRMS@AC侧 [A]	1.029445	3.696575	2.667129
I3_tRMS@AC侧 [A]	0.133632	3.377177	3.243545
U1_tRMS@AC侧 [V]	200.1136	230.3382	30.22455
U2_tRMS@AC侧 [V]	200.5708	231.3220	30.75121
U3_tRMS@AC侧 [V]	23.10409	231.2742	208.1701
P_t@AC侧 [W]	-0.787471	2275.546	2276.333
Q_fund@AC侧 [var]	411.6082	870.0989	458.4907

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Test 1a – two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) P > 0,9



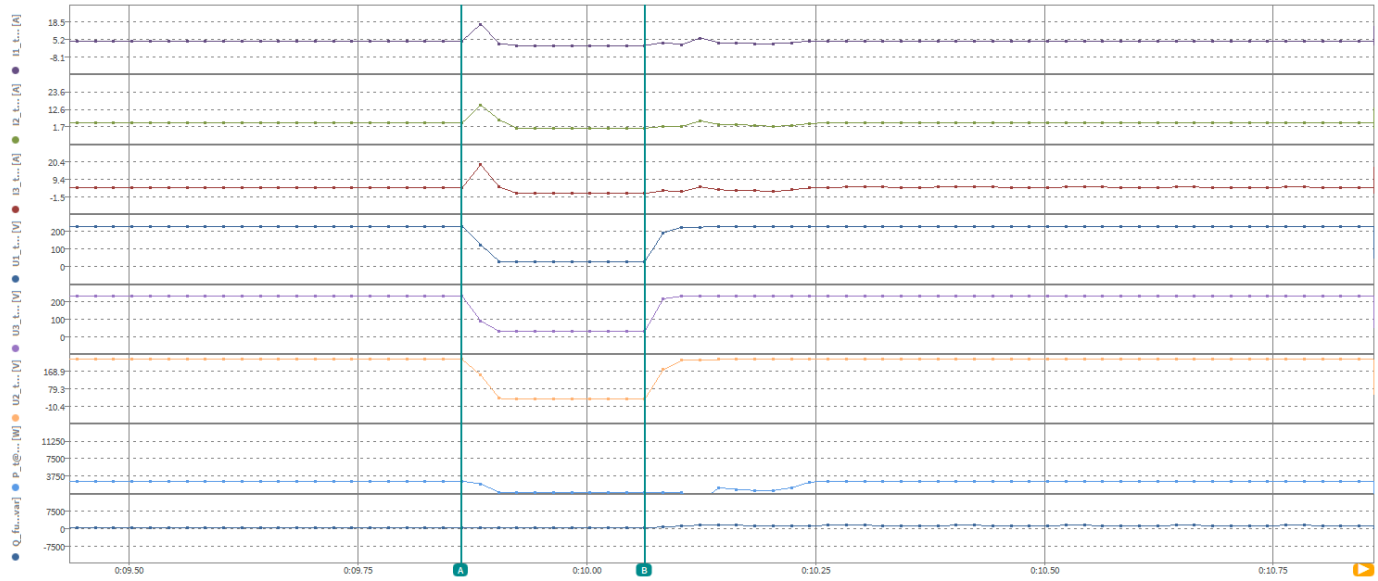
时间 [s]	A 0:10.769550	B 0:10.970792	间隔 0.201242
I1_tRMS@AC侧 [A]	17.18861	1.796244	-15.39237
I2_tRMS@AC侧 [A]	17.13759	1.802238	-15.33536
I3_tRMS@AC侧 [A]	17.17245	0.235639	-16.93681
U1_tRMS@AC侧 [V]	230.4466	199.1394	-31.30719
U2_tRMS@AC侧 [V]	230.6320	199.8250	-30.80708
U3_tRMS@AC侧 [V]	230.9367	23.00266	-207.9341
P_t@AC侧 [W]	11875.84	-1.561675	-11877.40
Q_fund@AC侧 [var]	89.63551	718.7827	629.1472



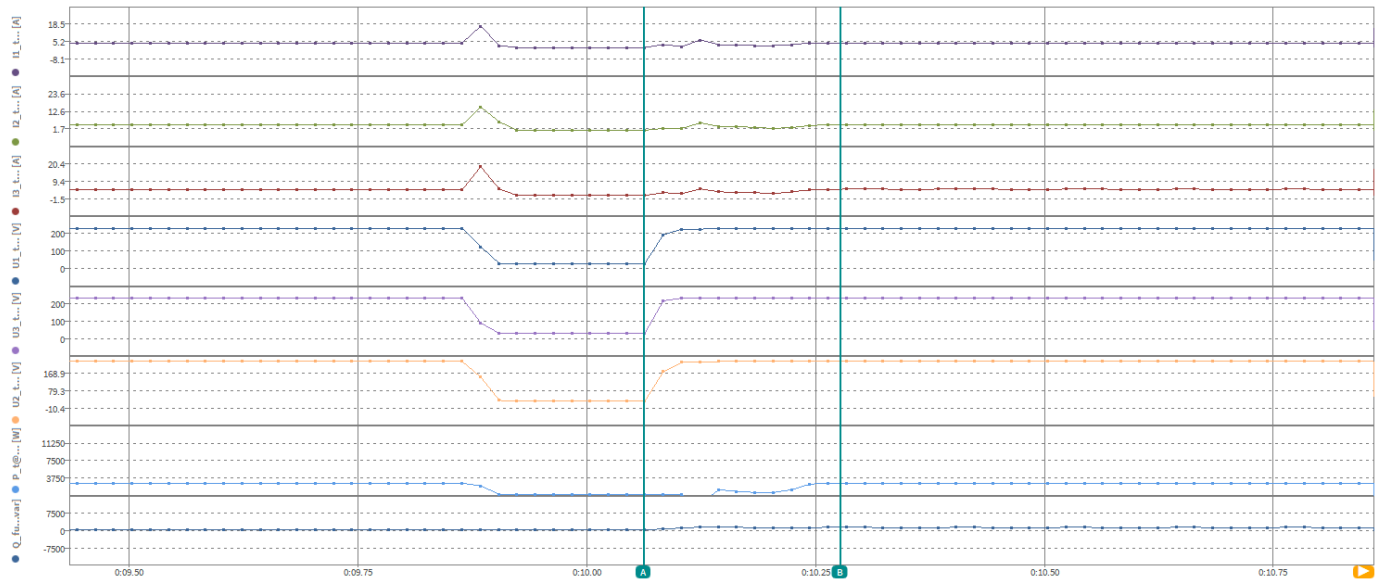
时间 [s]	A 0:11.015204	B 0:11.260858	间隔 0.245654
I1_tRMS@AC侧 [A]	2.060607	15.85961	13.79901
I2_tRMS@AC侧 [A]	2.068437	15.97592	13.90749
I3_tRMS@AC侧 [A]	2.043252	15.70036	13.65711
U1_tRMS@AC侧 [V]	229.5583	230.2551	0.696808
U2_tRMS@AC侧 [V]	228.0948	230.8934	2.798645
U3_tRMS@AC侧 [V]	227.3103	230.7717	3.461395
P_t@AC侧 [W]	-4.069077	10905.18	10909.25
Q_fund@AC侧 [var]	1401.964	1092.438	-309.5260

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Test 1s – three-phase symmetrical fault (V/V_n = 0,10; duration = 0,200 s) P = 0,1 - 0,3



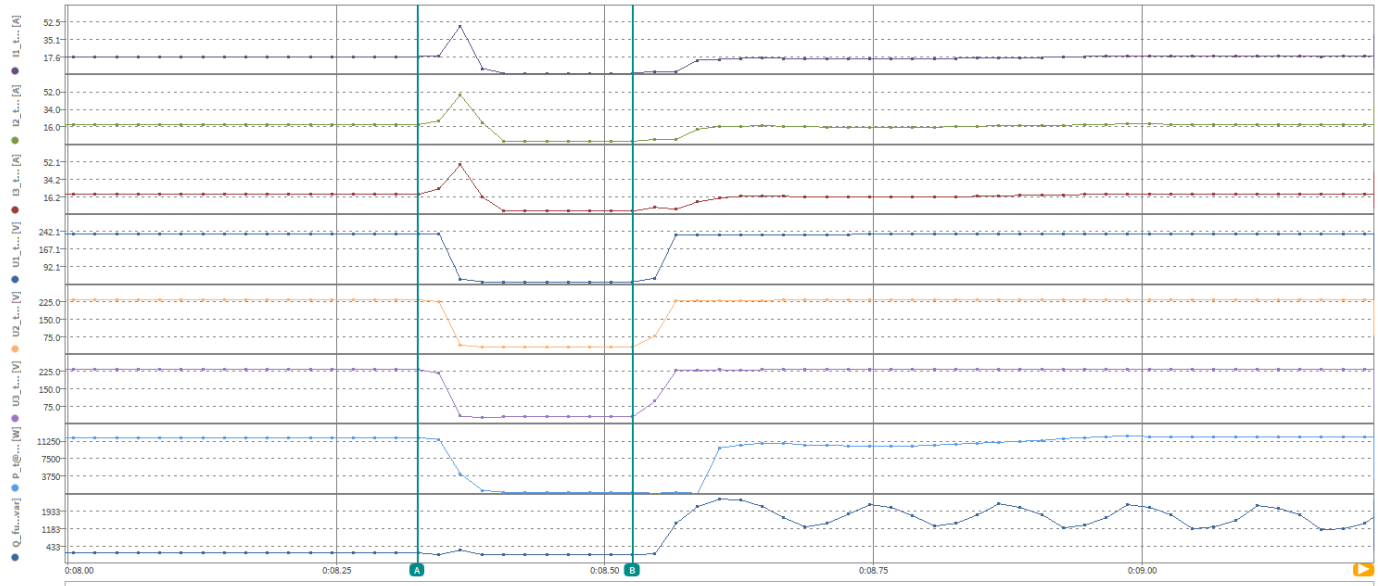
时间 [s]	A	B	间隔
	9.862899	0:10.063316	0.200416
I1_tRMS@AC侧 [A]	3.500379	0.140361	-3.360018
I2_tRMS@AC侧 [A]	3.481331	0.149911	-3.331419
I3_tRMS@AC侧 [A]	3.478979	0.138051	-3.340928
U1_tRMS@AC侧 [V]	230.2229	22.96220	-207.2607
U3_tRMS@AC侧 [V]	230.8105	23.14739	-207.6631
U2_tRMS@AC侧 [V]	230.5077	23.17129	-207.3364
P_t@AC侧 [W]	2404.348	0.097556	-2404.251
Q_fund@AC侧 [var]	102.3134	8.111856	-94.20153



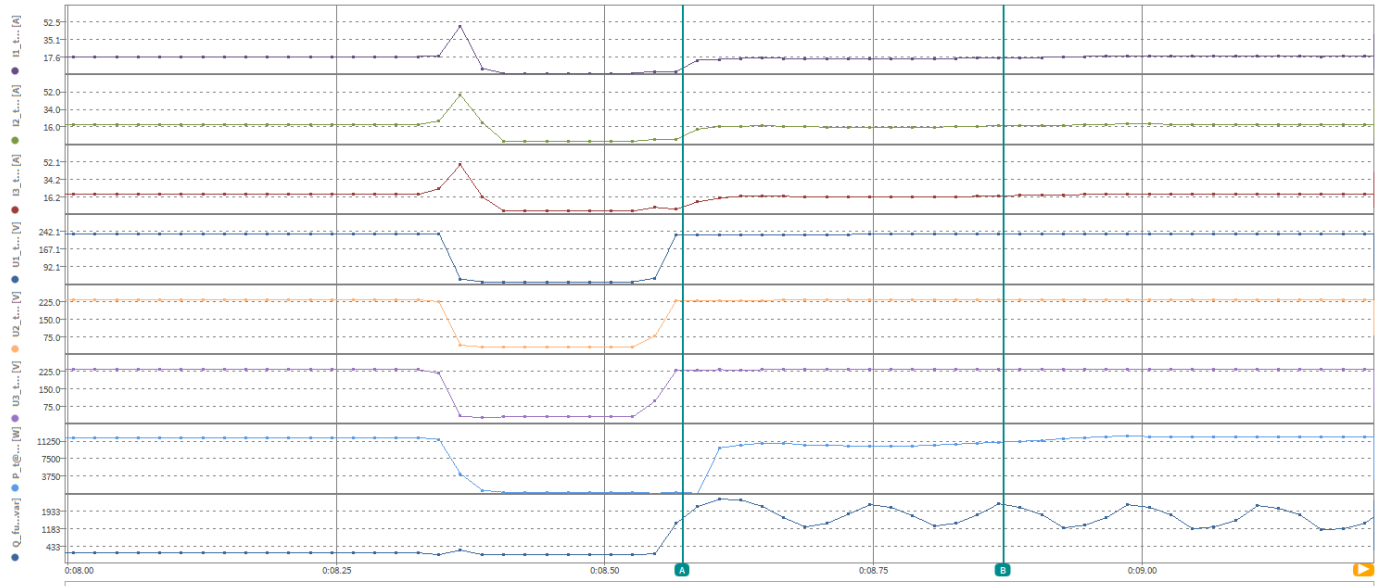
时间 [s]	A	B	间隔
	0:10.062303	0:10.276890	0.214587
I1_tRMS@AC侧 [A]	0.140361	3.857133	3.716772
I2_tRMS@AC侧 [A]	0.149911	3.825089	3.675178
I3_tRMS@AC侧 [A]	0.138051	3.734603	3.596552
U1_tRMS@AC侧 [V]	22.96220	229.8665	206.9043
U3_tRMS@AC侧 [V]	23.14739	231.2442	208.0968
U2_tRMS@AC侧 [V]	23.17129	230.0809	206.9096
P_t@AC侧 [W]	0.097556	2400.192	2400.095
Q_fund@AC侧 [var]	8.111856	1055.933	1047.821

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Test 1s – three-phase symmetrical fault (V/V_n = 0,10; duration = 0,200 s) P > 0,9



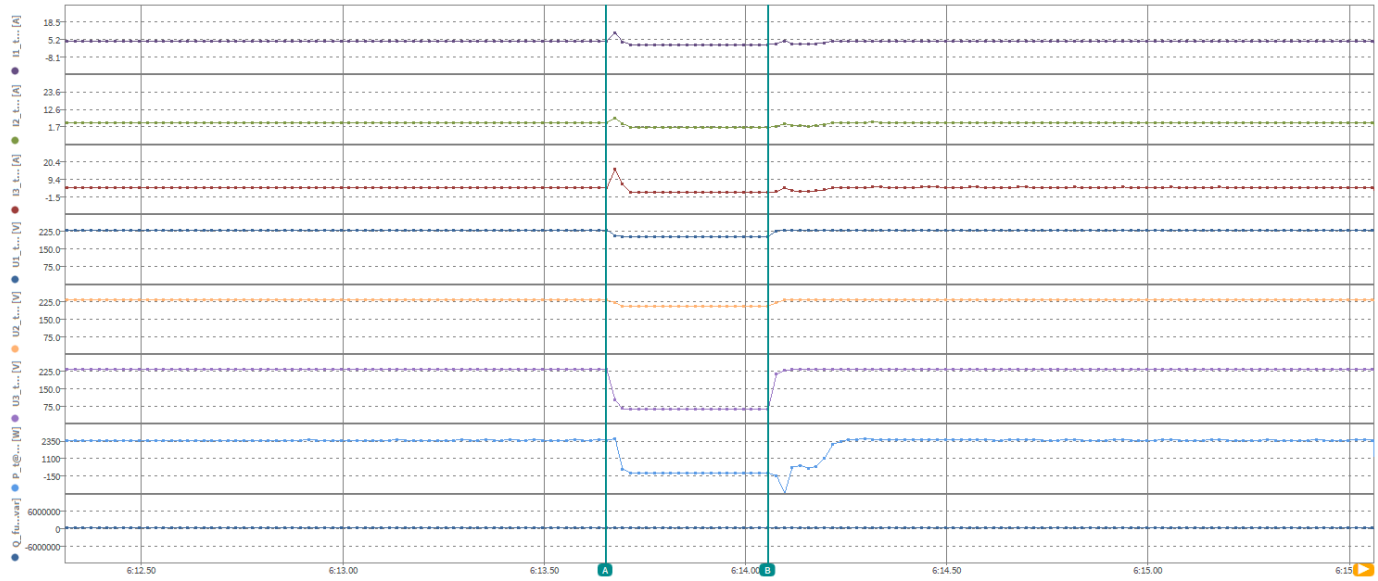
时间 [s]	A	B	间隔
I1_tRMS@AC侧 [A]	17.41767	0.247830	-17.16984
I2_tRMS@AC侧 [A]	17.36539	0.254847	-17.11054
I3_tRMS@AC侧 [A]	17.40215	0.243676	-17.15848
U1_tRMS@AC侧 [V]	230.3617	23.03968	-207.3220
U2_tRMS@AC侧 [V]	230.6399	22.95619	-207.6837
U3_tRMS@AC侧 [V]	230.9829	23.12003	-207.8629
P_t@AC侧 [W]	12033.77	0.038358	-12033.73
Q_fund@AC侧 [var]	92.62528	14.12620	-78.49908



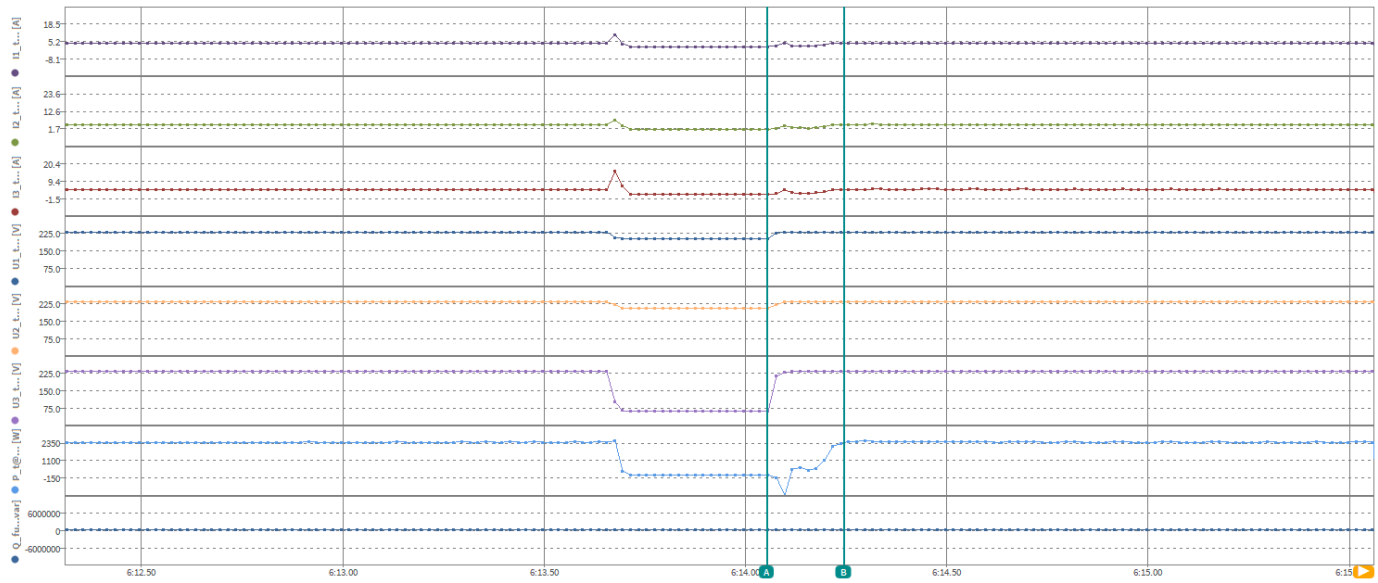
时间 [s]	A	B	间隔
I1_tRMS@AC侧 [A]	2.025922	16.12336	14.09744
I2_tRMS@AC侧 [A]	2.026512	16.05324	14.02673
I3_tRMS@AC侧 [A]	2.028183	16.06175	14.03357
U1_tRMS@AC侧 [V]	225.9932	230.3484	4.355209
U2_tRMS@AC侧 [V]	225.0322	230.6882	5.655975
U3_tRMS@AC侧 [V]	227.0423	230.9441	3.901871
P_t@AC侧 [W]	-3.916769	10899.80	10903.72
Q_fund@AC侧 [var]	1367.030	2220.705	853.6743

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Test 2a – two-phase asymmetrical fault (V/V_n = 0,25; duration = 0,400 s) P = 0,1 - 0,3



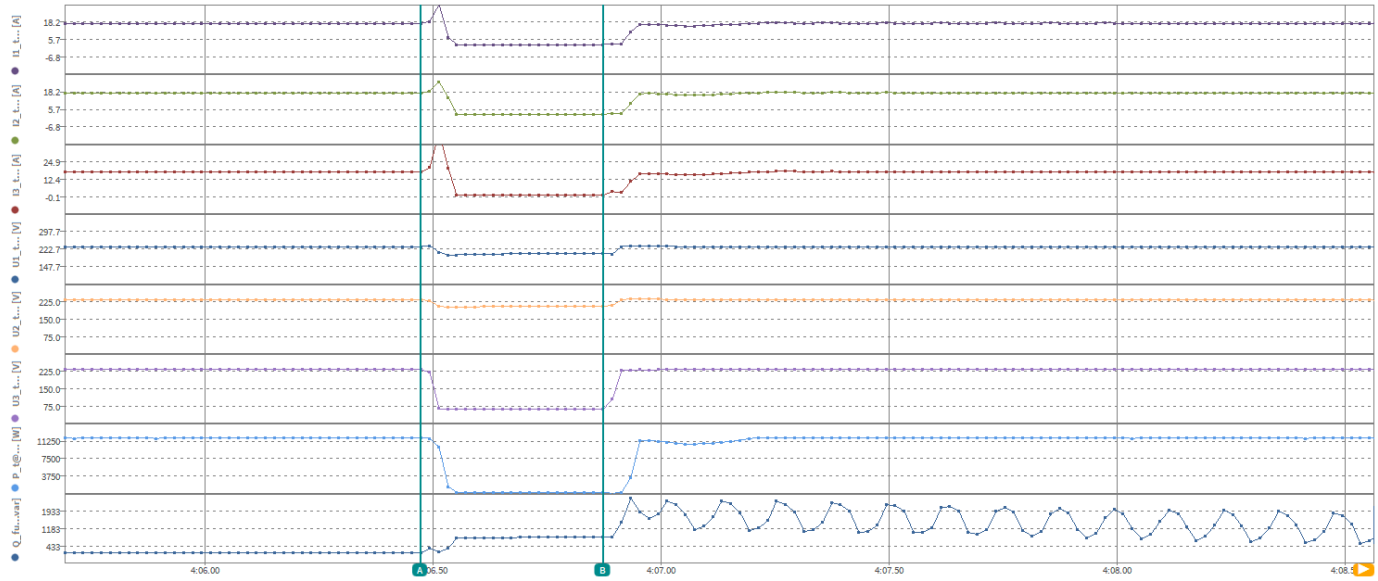
时间 [s]	A 6:13.653832	B 6:14.056392	间隔 0.402560
I1_tRMS@AC网 [A]	3.522701	1.034035	-2.488666
I2_tRMS@AC网 [A]	3.486292	1.042465	-2.443828
I3_tRMS@AC网 [A]	3.509205	0.296812	-3.212393
U1_tRMS@AC网 [V]	230.2629	202.2485	-28.01440
U2_tRMS@AC网 [V]	230.5957	203.3454	-27.25031
U3_tRMS@AC网 [V]	230.8199	57.16724	-173.6526
P_t@AC网 [W]	2418.088	-0.839243	-2418.927
Q_fund@AC网 [var]	103.7180	435.5688	331.8507



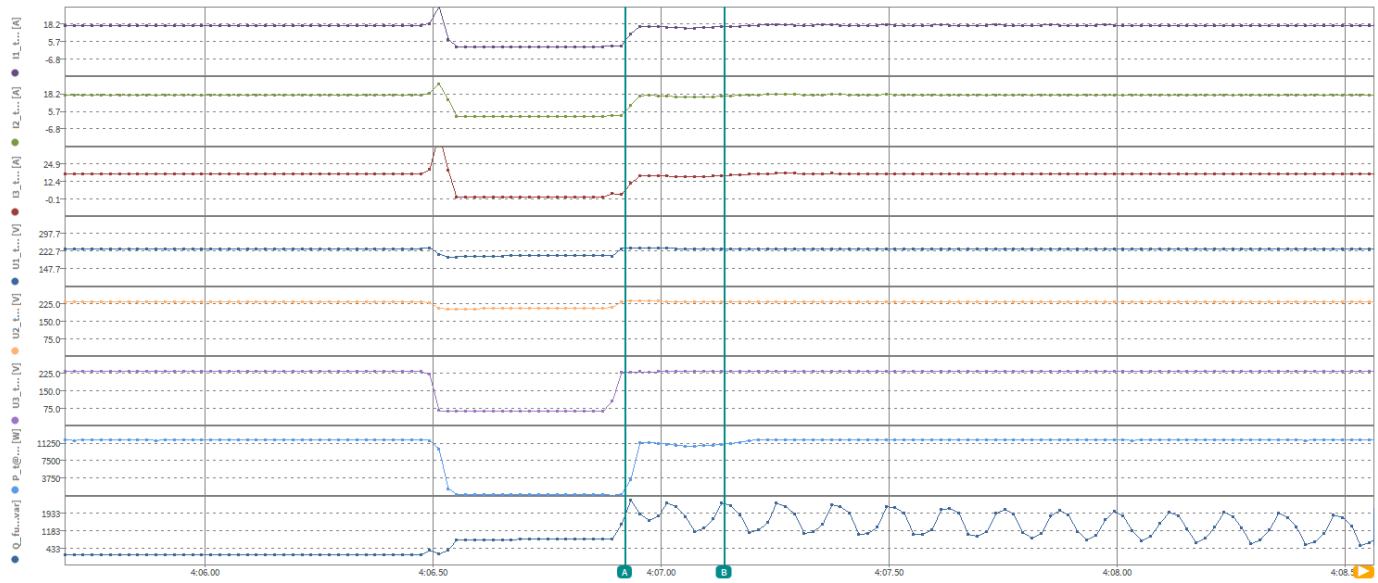
时间 [s]	A 6:14.054092	B 6:14.245020	间隔 0.190928
I1_tRMS@AC网 [A]	1.034035	3.611847	2.577812
I2_tRMS@AC网 [A]	1.042465	3.789217	2.746752
I3_tRMS@AC网 [A]	0.296812	3.565441	3.268628
U1_tRMS@AC网 [V]	202.2485	230.3509	28.10246
U2_tRMS@AC网 [V]	203.3454	231.3017	27.95634
U3_tRMS@AC网 [V]	57.16724	231.3740	174.2068
P_t@AC网 [W]	-0.839243	2319.942	2320.781
Q_fund@AC网 [var]	435.5688	998.5610	562.9922

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Test 2a – two-phase asymmetrical fault (V/V_n = 0,25; duration = 0,400 s) P > 0,9



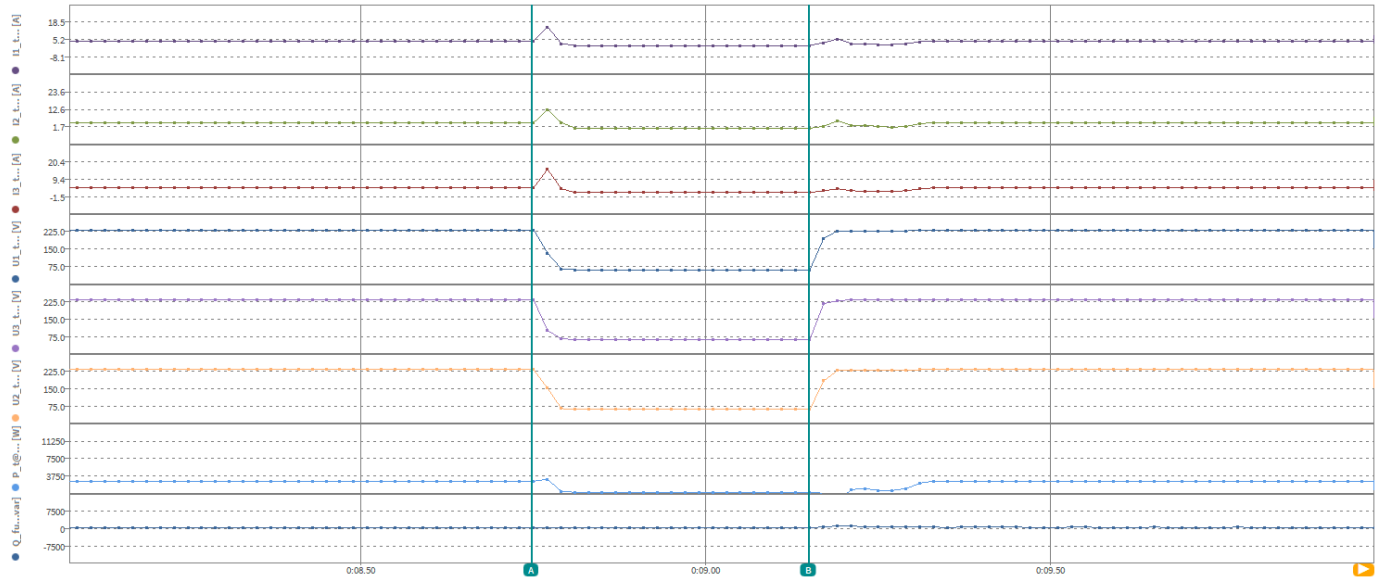
时间 [s]	A 4:06.472494	B 4:06.872795	间隔 0.400301
I1_tRMS@AC侧 [A]	17.17174	1.818442	-15.35329
I2_tRMS@AC侧 [A]	17.14545	1.831450	-15.31400
I3_tRMS@AC侧 [A]	17.16454	0.526901	-16.63763
U1_tRMS@AC侧 [V]	230.4806	201.7827	-28.69785
U2_tRMS@AC侧 [V]	230.6971	202.8497	-27.84731
U3_tRMS@AC侧 [V]	231.0147	57.17947	-173.8353
P_t@AC侧 [W]	11874.90	-1.651701	-11876.55
Q_fund@AC侧 [var]	90.92900	763.9322	673.0032



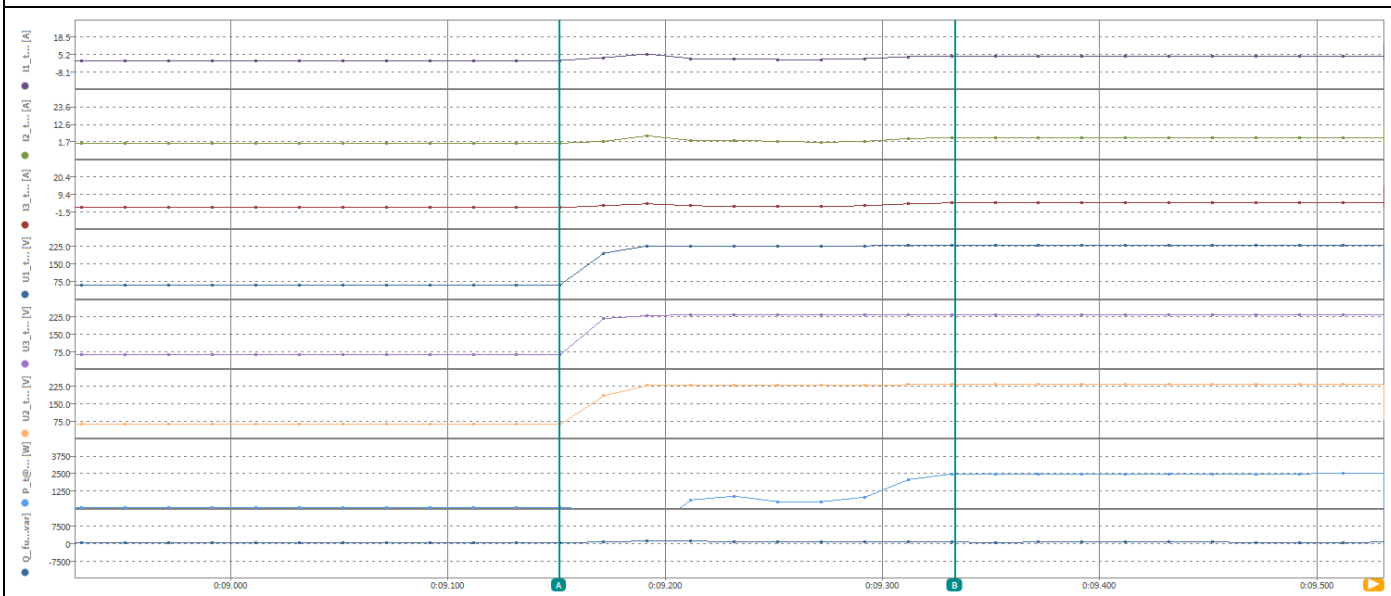
时间 [s]	A 4:06.921563	B 4:07.138985	间隔 0.217423
I1_tRMS@AC侧 [A]	2.123909	16.23346	14.10955
I2_tRMS@AC侧 [A]	2.132943	16.36934	14.23640
I3_tRMS@AC侧 [A]	2.043846	16.02321	13.97936
U1_tRMS@AC侧 [V]	230.0006	231.0039	1.003281
U2_tRMS@AC侧 [V]	229.8365	231.1113	1.274826
U3_tRMS@AC侧 [V]	228.0698	230.8562	2.786392
P_t@AC侧 [W]	-60.50984	10978.41	11038.92
Q_fund@AC侧 [var]	1423.267	2356.635	933.3684

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Test 2s – three-phase symmetrical fault (V/V_n = 0,25; duration = 0,400 s) P = 0,1 - 0,3



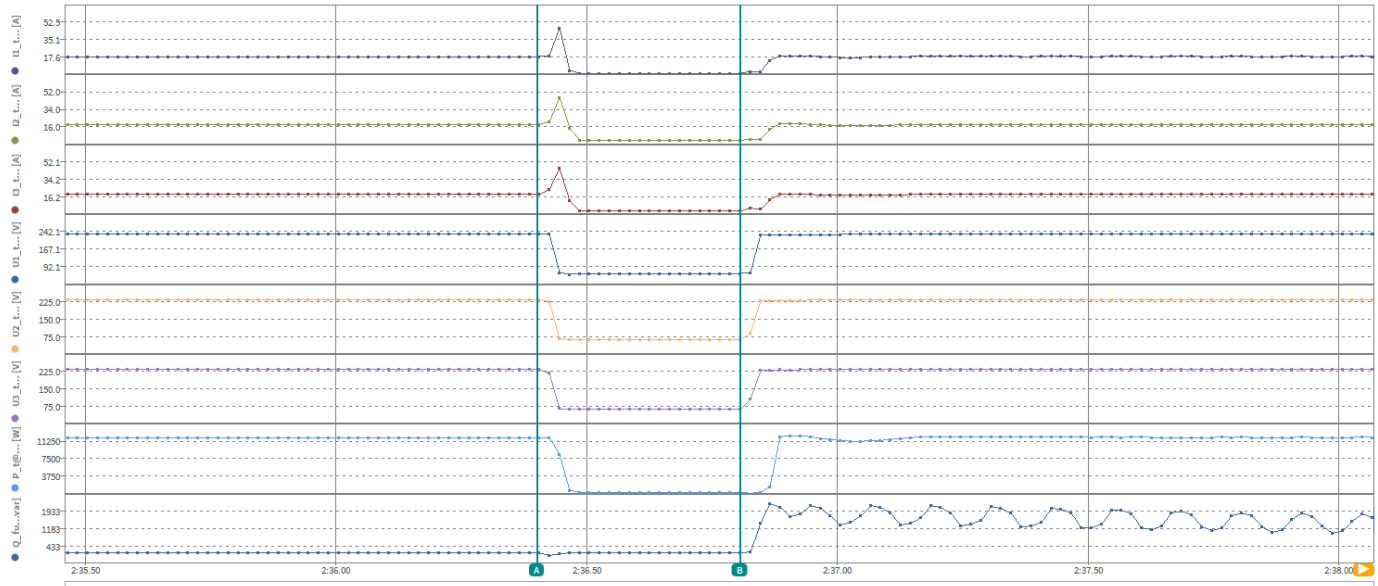
时间 [s]	A	B	间隔
	8.747925	9.149364	0.401439
I1_tRMS@AC树 [A]	3.524718	0.300958	-3.223760
I2_tRMS@AC树 [A]	3.495517	0.306380	-3.189137
I3_tRMS@AC树 [A]	3.526757	0.299351	-3.227406
U1_tRMS@AC树 [V]	230.2195	57.53811	-172.6814
U3_tRMS@AC树 [V]	230.7876	57.66862	-173.1190
U2_tRMS@AC树 [V]	230.5217	57.75368	-172.7680
P_t@AC树 [W]	2425.506	0.013994	-2425.492
Q_fund@AC树 [var]	19.90334	50.55308	30.64973



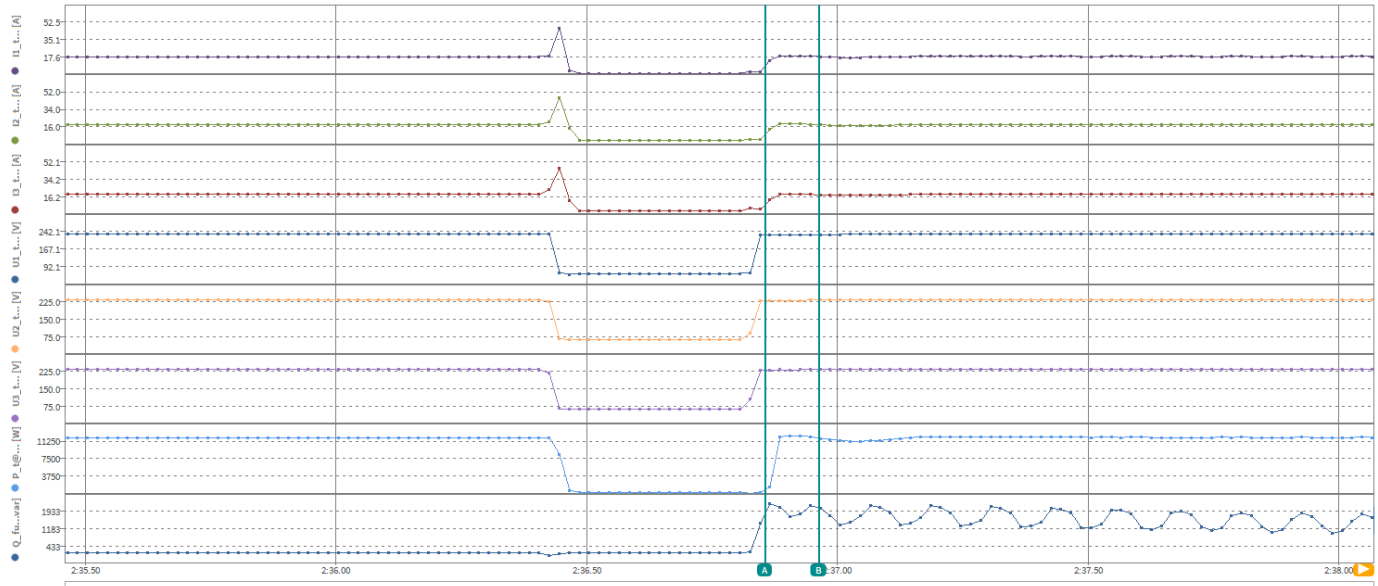
时间 [s]	A	B	间隔
	9.151383	9.333405	0.182022
I1_tRMS@AC树 [A]	0.300958	3.544223	3.243265
I2_tRMS@AC树 [A]	0.306380	3.567113	3.260733
I3_tRMS@AC树 [A]	0.299351	3.463912	3.164561
U1_tRMS@AC树 [V]	57.53811	229.5555	172.0174
U3_tRMS@AC树 [V]	57.66862	231.3601	173.6915
U2_tRMS@AC树 [V]	57.75368	229.8570	172.1033
P_t@AC树 [W]	0.013994	2398.993	2398.979
Q_fund@AC树 [var]	50.55308	342.7492	292.1962

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Test 2s – three-phase symmetrical fault (V/V_n = 0,25; duration = 0,400 s) P > 0,9



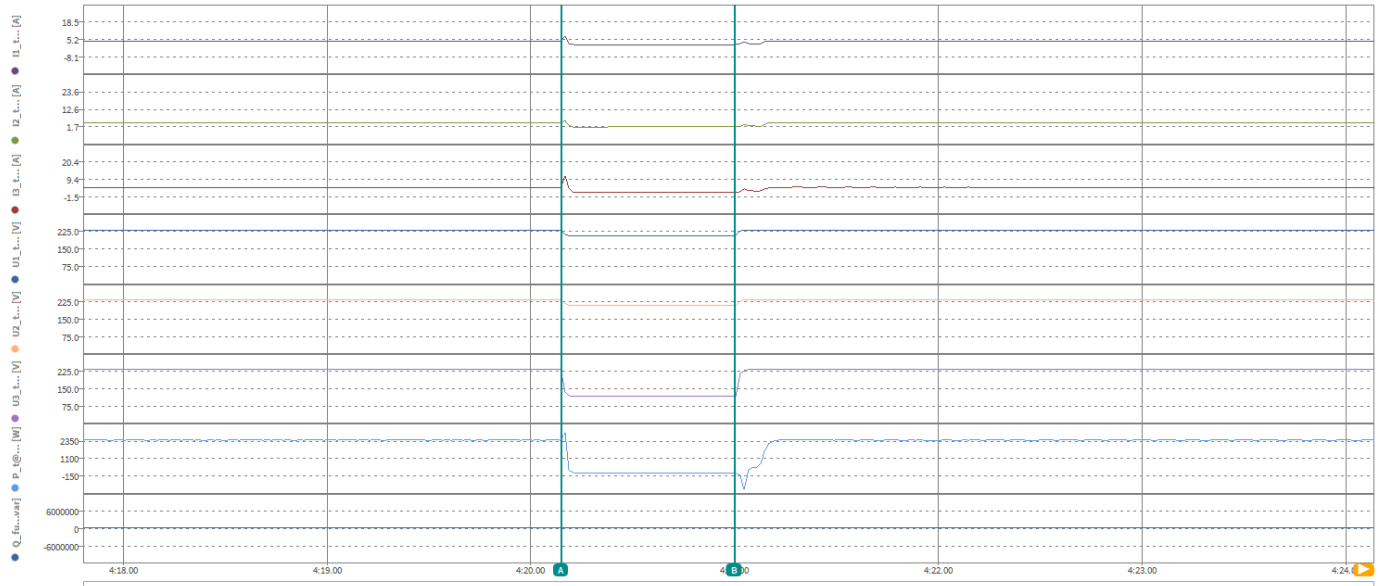
时间 [s]	A 2:36.401914	B 2:36.806465	间隔 0.404550
I1_tRMS@AC侧 [A]	17.39796	0.528082	-16.86988
I2_tRMS@AC侧 [A]	17.34242	0.532254	-16.81017
I3_tRMS@AC侧 [A]	17.39468	0.521082	-16.87359
U1_tRMS@AC侧 [V]	230.4373	57.12190	-173.3154
U2_tRMS@AC侧 [V]	230.6207	57.06956	-173.5511
U3_tRMS@AC侧 [V]	230.9425	57.16951	-173.7730
P_t@AC侧 [W]	12022.37	-0.289652	-12022.65
Q_fund@AC侧 [var]	87.97359	86.88966	-1.083931



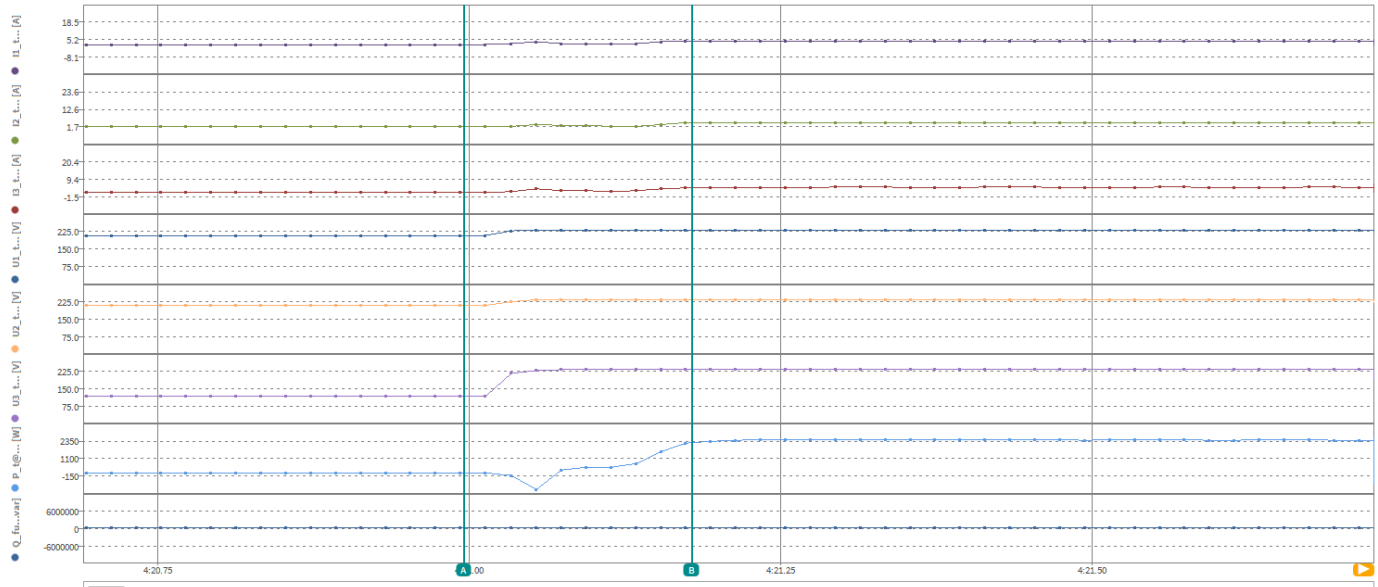
时间 [s]	A 2:36.856341	B 2:36.963482	间隔 0.107141
I1_tRMS@AC侧 [A]	2.067740	17.91769	15.84995
I2_tRMS@AC侧 [A]	2.078489	17.85779	15.77930
I3_tRMS@AC侧 [A]	2.013531	17.62784	15.61431
U1_tRMS@AC侧 [V]	227.8105	229.5192	1.708740
U2_tRMS@AC侧 [V]	227.0517	229.5576	2.505875
U3_tRMS@AC侧 [V]	227.9122	230.0407	2.128510
P_t@AC侧 [W]	-28.20419	12062.89	12091.10
Q_fund@AC侧 [var]	1387.990	2154.365	766.3743

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Test 3a – two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) P = 0,1 - 0,3



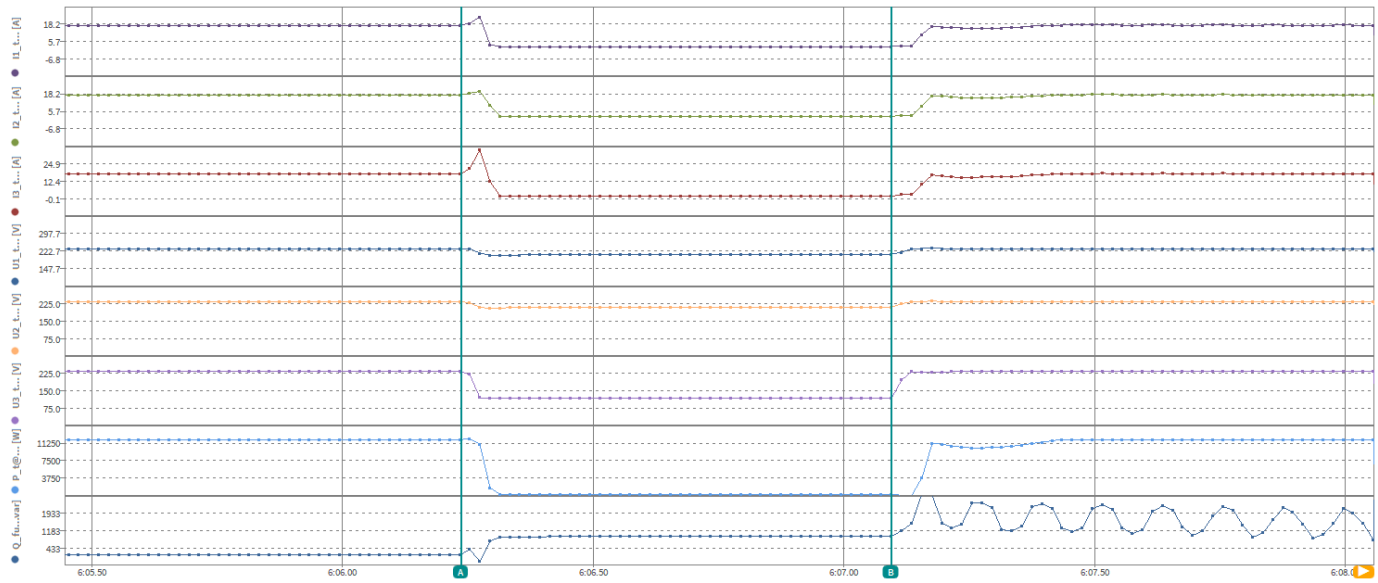
时间 [s]	A 4:20.150931	B 4:21.001234	间隔 0.850303
I1_tRMS@AC侧 [A]	3.512105	1.058538	-2.453566
I2_tRMS@AC侧 [A]	3.502861	1.065764	-2.437098
I3_tRMS@AC侧 [A]	3.510215	0.589557	-2.920658
U1_tRMS@AC侧 [V]	230.2861	207.0423	-23.24384
U2_tRMS@AC侧 [V]	230.5711	207.8795	-22.69160
U3_tRMS@AC侧 [V]	230.8489	115.3561	-115.4928
P_t@AC侧 [W]	2419.524	-1.830666	-2421.354
Q_fund@AC侧 [var]	106.7978	505.8630	399.0652



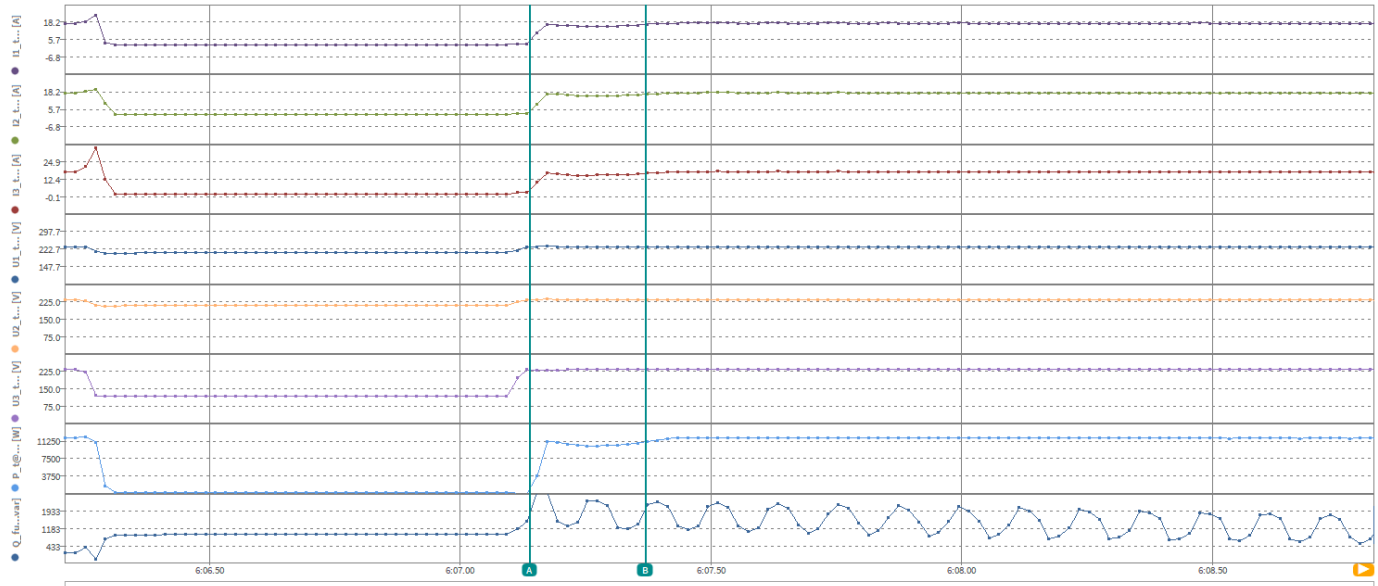
时间 [s]	A 4:20.996687	B 4:21.179246	间隔 0.182559
I1_tRMS@AC侧 [A]	1.058538	3.667547	2.609009
I2_tRMS@AC侧 [A]	1.065764	3.729079	2.663315
I3_tRMS@AC侧 [A]	0.589557	3.493216	2.903659
U1_tRMS@AC侧 [V]	207.0423	230.6044	23.56207
U2_tRMS@AC侧 [V]	207.8795	231.3442	23.46474
U3_tRMS@AC侧 [V]	115.3561	231.5968	116.2406
P_t@AC侧 [W]	-1.830666	2172.704	2174.535
Q_fund@AC侧 [var]	505.8630	1257.424	751.5610

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Test 3a – two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) P > 0,9



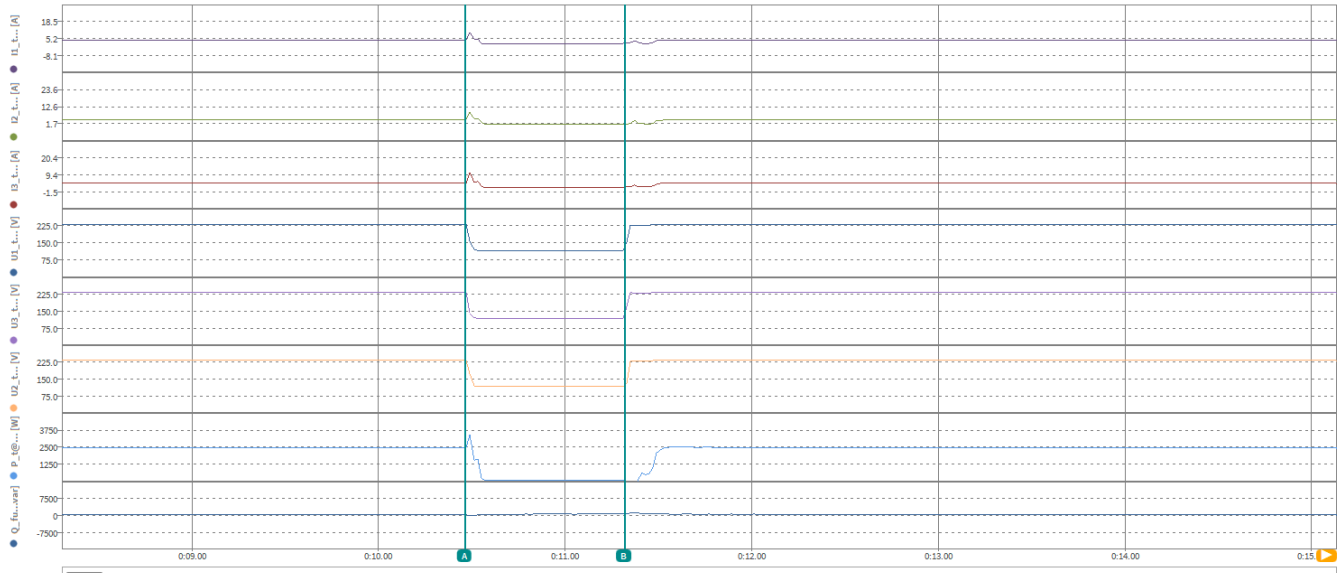
时间 [s]	A 6:06.237158	B 6:07.094287	间隔 0.857129
I1_tRMS@AC侧 [A]	17.17689	1.863322	-15.31357
I2_tRMS@AC侧 [A]	17.12591	1.879235	-15.24667
I3_tRMS@AC侧 [A]	17.16130	1.038197	-16.12310
U1_tRMS@AC侧 [V]	230.4355	206.9782	-23.45729
U2_tRMS@AC侧 [V]	230.6545	207.8128	-22.84171
U3_tRMS@AC侧 [V]	230.9846	115.2876	-115.6970
P_t@AC侧 [W]	11868.94	-2.274505	-11871.21
Q_fund@AC侧 [var]	93.50745	890.6536	797.1461



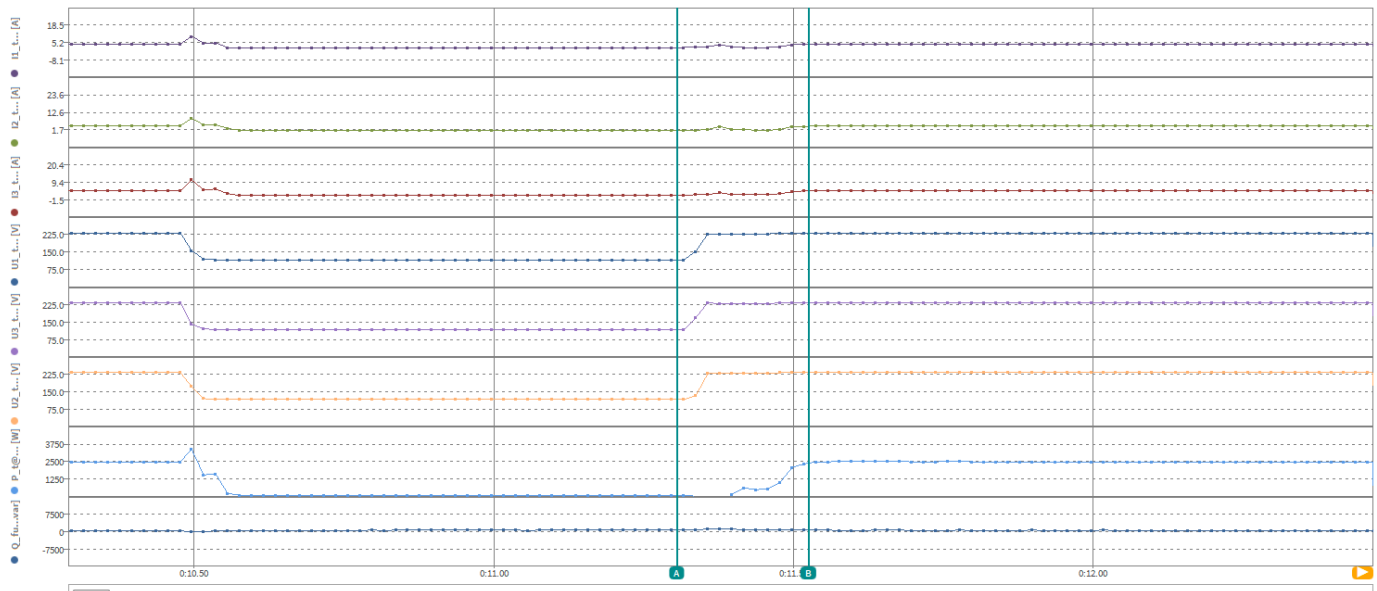
时间 [s]	A 6:07.140469	B 6:07.370569	间隔 0.230100
I1_tRMS@AC侧 [A]	2.221131	15.90972	13.68859
I2_tRMS@AC侧 [A]	2.223485	15.78532	13.56184
I3_tRMS@AC侧 [A]	2.209425	15.61754	13.40812
U1_tRMS@AC侧 [V]	229.8285	230.6706	0.842072
U2_tRMS@AC侧 [V]	230.1032	230.8453	0.742065
U3_tRMS@AC侧 [V]	229.0651	230.8184	1.753281
P_t@AC侧 [W]	-195.0702	10829.39	11024.46
Q_fund@AC侧 [var]	1462.345	1357.692	-104.6530

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Test 3s – three-phase symmetrical fault (V/V_n = 0,25; duration = 0,400 s) P = 0,1 - 0,3



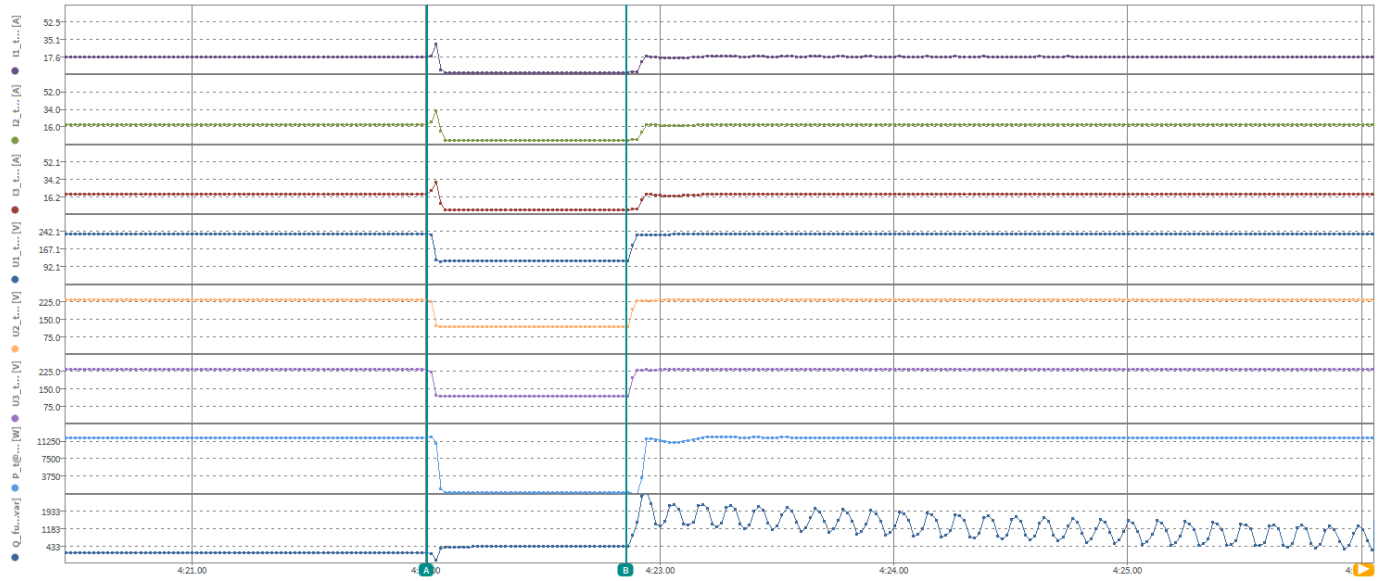
时间 [s]	A 0:10.464673	B 0:11.319019	间隔 0.854346
I1_tRMS@AC侧 [A]	3.524889	0.593255	-2.931634
I2_tRMS@AC侧 [A]	3.490200	0.596608	-2.893592
I3_tRMS@AC侧 [A]	3.511022	0.591319	-2.919703
U1_tRMS@AC侧 [V]	230.2959	115.1490	-115.1469
U3_tRMS@AC侧 [V]	230.8163	115.3515	-115.4648
U2_tRMS@AC侧 [V]	230.5737	115.3107	-115.2630
P_t@AC侧 [W]	2421.835	-0.481932	-2422.317
Q_fund@AC侧 [var]	24.66382	202.9417	178.2779



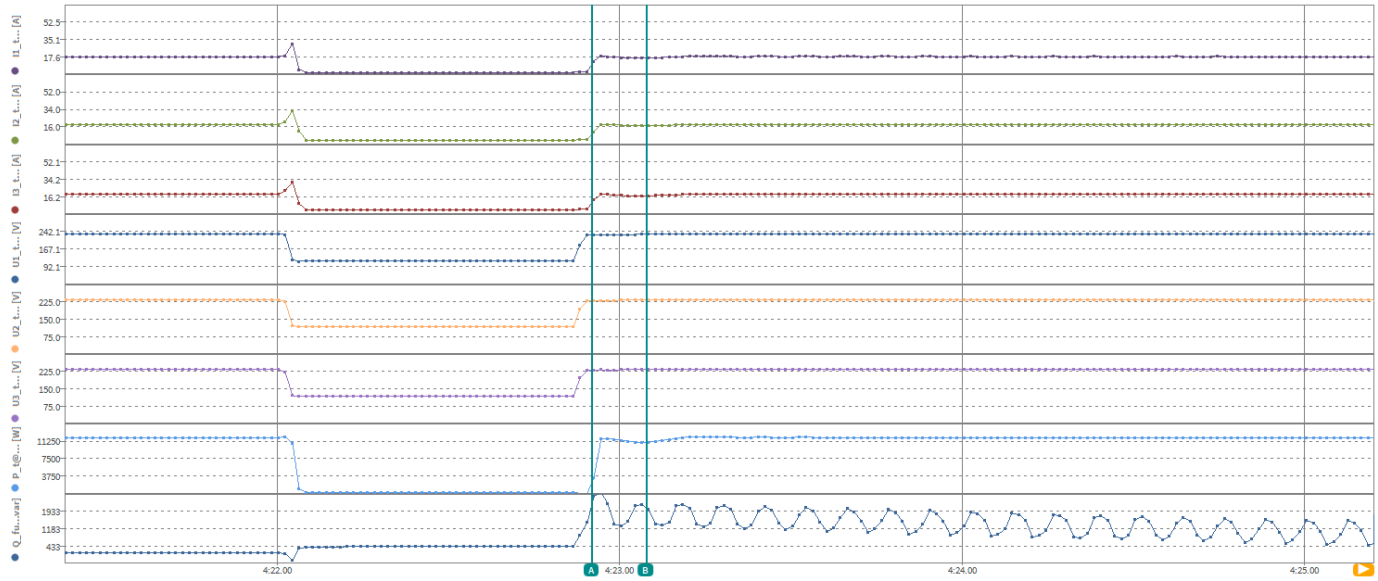
时间 [s]	A 0:11.306560	B 0:11.525964	间隔 0.219404
I1_tRMS@AC侧 [A]	0.593255	3.423379	2.830124
I2_tRMS@AC侧 [A]	0.596608	3.393545	2.796937
I3_tRMS@AC侧 [A]	0.591319	3.379432	2.788113
U1_tRMS@AC侧 [V]	115.1490	229.7613	114.6124
U3_tRMS@AC侧 [V]	115.3515	230.3935	115.0420
U2_tRMS@AC侧 [V]	115.3107	229.9940	114.6833
P_t@AC侧 [W]	-0.481932	2322.549	2323.031
Q_fund@AC侧 [var]	202.9417	266.0894	63.14766

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Test 3s – three-phase symmetrical fault (V/V_n = 0,50; duration = 0,850 s) P > 0,9



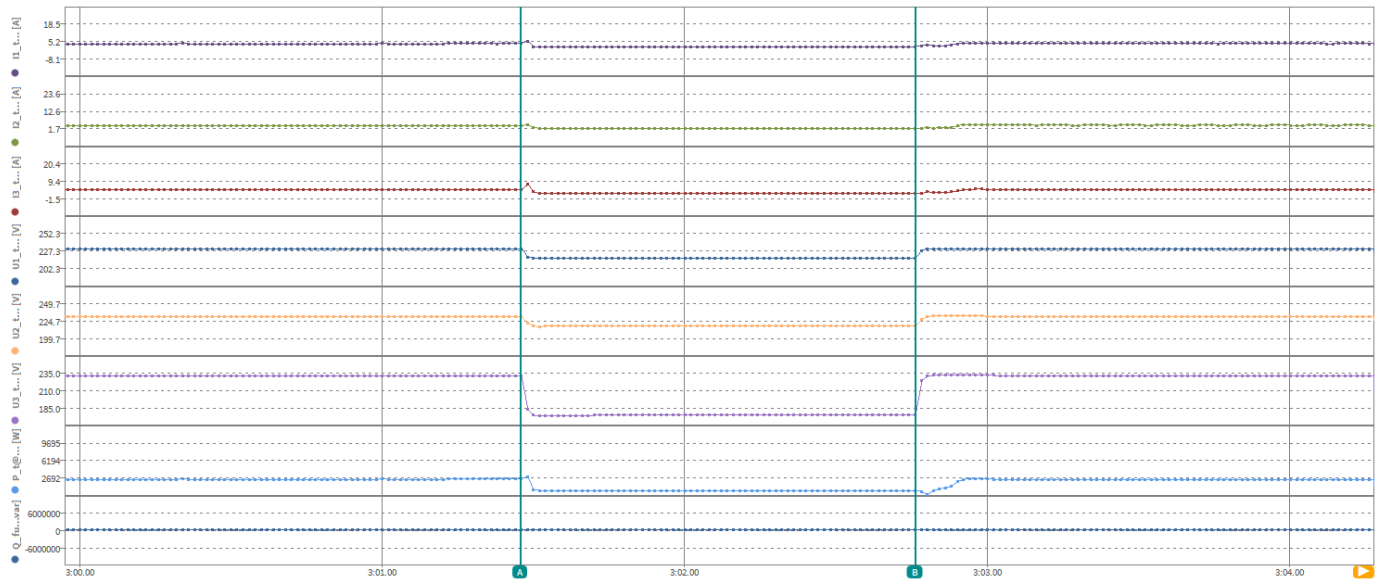
时间 [s]	A 4:22.005509	B 4:22.856859	间隔 0.851350
I1_tRMS@AC侧 [A]	17.39105	1.033974	-16.35708
I2_tRMS@AC侧 [A]	17.31951	1.045297	-16.27421
I3_tRMS@AC侧 [A]	17.37348	1.031948	-16.34154
U1_tRMS@AC侧 [V]	230.4544	115.1327	-115.3217
U2_tRMS@AC侧 [V]	230.7646	115.3130	-115.4516
U3_tRMS@AC侧 [V]	230.9167	115.2763	-115.6404
P_t@AC侧 [W]	12013.04	-1.154820	-12014.19
Q_fund@AC侧 [var]	91.01621	354.3253	263.3091



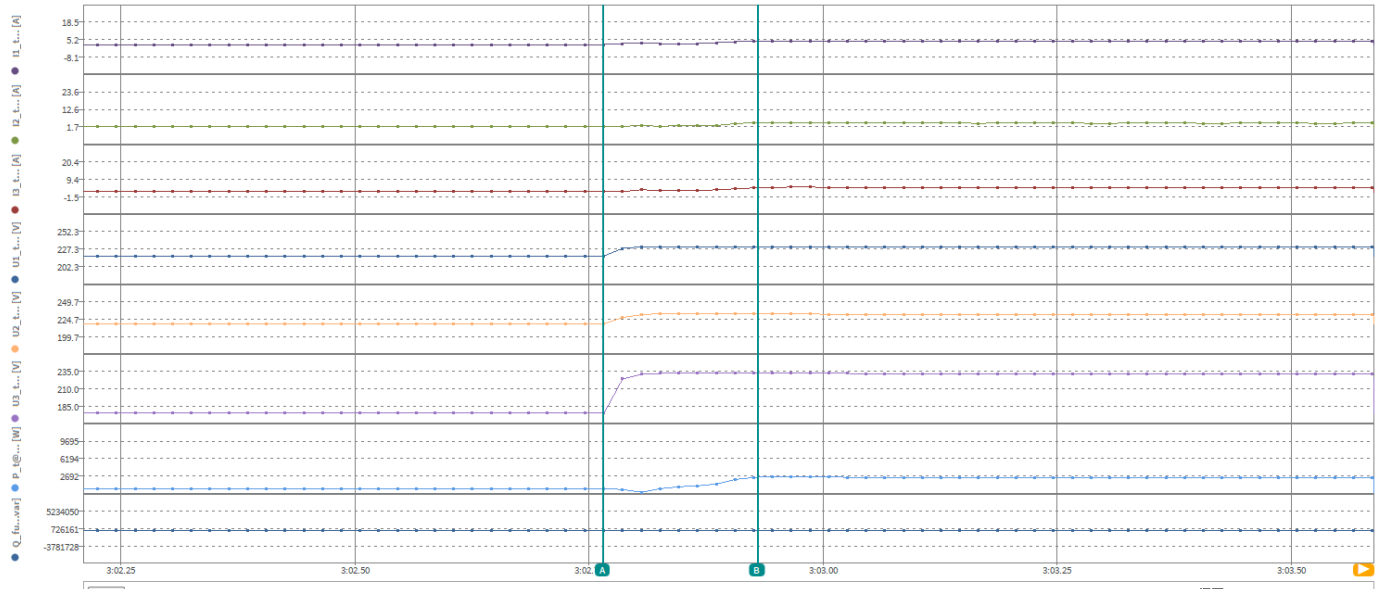
时间 [s]	A 4:22.919965	B 4:23.078606	间隔 0.158641
I1_tRMS@AC侧 [A]	2.113324	16.17839	14.06506
I2_tRMS@AC侧 [A]	2.114811	16.14590	14.03109
I3_tRMS@AC侧 [A]	2.108205	16.14373	14.03553
U1_tRMS@AC侧 [V]	228.3257	229.9952	1.669510
U2_tRMS@AC侧 [V]	228.4287	230.1848	1.756180
U3_tRMS@AC侧 [V]	228.9945	230.5294	1.534912
P_t@AC侧 [W]	-129.3613	10937.71	11067.07
Q_fund@AC侧 [var]	1412.965	2194.714	781.7495

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Test 4a – two-phase asymmetrical fault (V/V_n = 0,75; duration = 1,300 s) P = 0,1 - 0,3



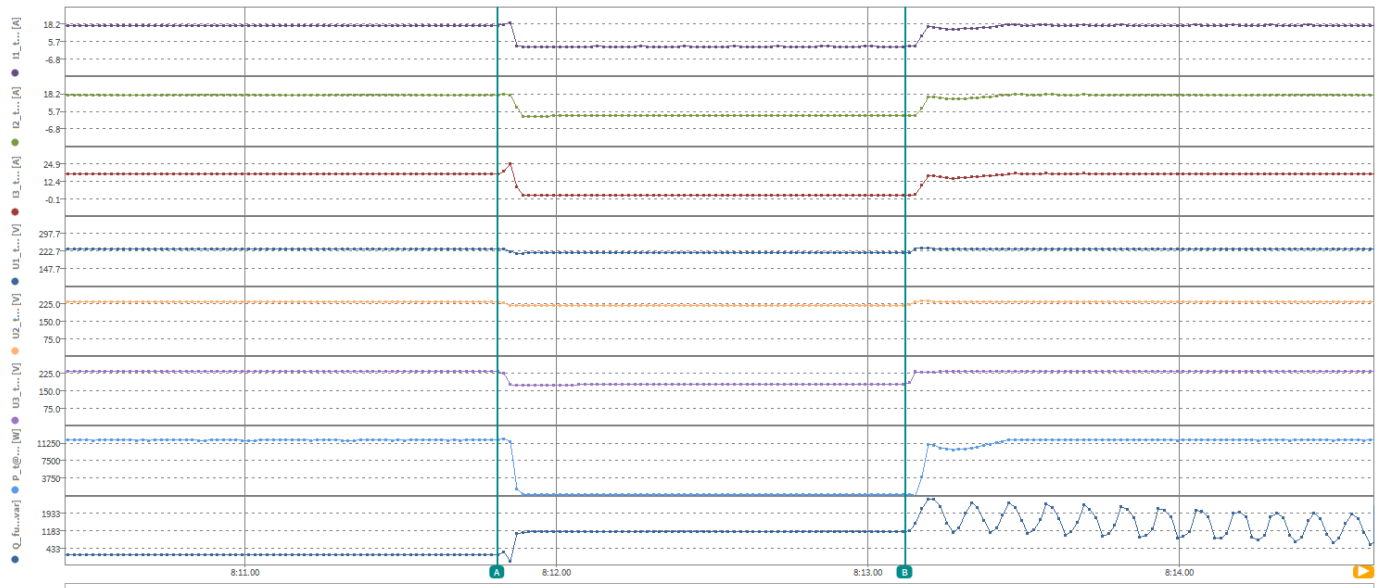
时间 [s]	A 3:01.458736	B 3:02.763043	间隔 1.304307
I1_tRMS@AC侧 [A]	3.379786	1.165284	-2.214502
I2_tRMS@AC侧 [A]	3.355723	1.093773	-2.261951
I3_tRMS@AC侧 [A]	3.376112	0.939952	-2.436160
U1_tRMS@AC侧 [V]	230.3164	216.3351	-13.98131
U2_tRMS@AC侧 [V]	230.5530	216.8881	-13.66492
U3_tRMS@AC侧 [V]	230.8161	173.0242	-57.79193
P_t@AC侧 [W]	2323.785	-34.55147	-2358.336
Q_fund@AC侧 [var]	98.68150	638.0103	539.3288



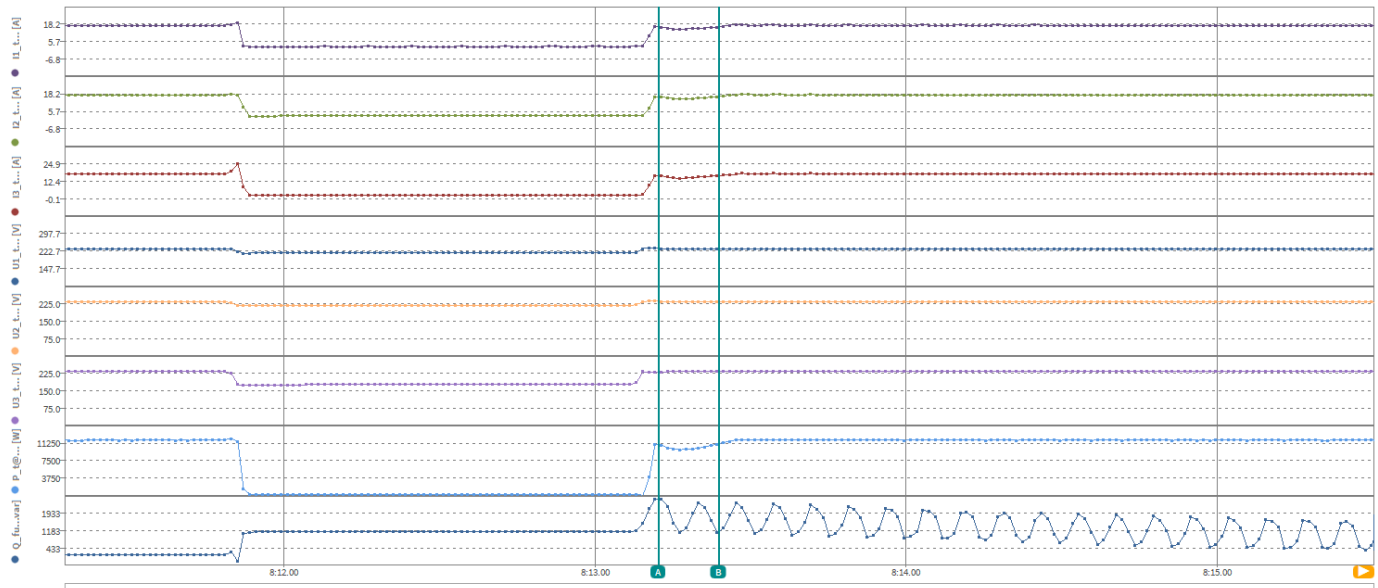
时间 [s]	A 3:02.765142	B 3:02.930342	间隔 0.165200
I1_tRMS@AC侧 [A]	1.165284	3.469538	2.304255
I2_tRMS@AC侧 [A]	1.093773	3.449186	2.355413
I3_tRMS@AC侧 [A]	0.939952	3.357755	2.417804
U1_tRMS@AC侧 [V]	216.3351	230.6324	14.29729
U2_tRMS@AC侧 [V]	216.8881	231.0529	14.16486
U3_tRMS@AC侧 [V]	173.0242	231.3212	58.29698
P_t@AC侧 [W]	-34.55147	2254.397	2288.949
Q_fund@AC侧 [var]	638.0103	725.2747	87.26434

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Test 4a – two-phase asymmetrical fault (V/V_n = 0,75; duration = 1,300 s) P > 0,9



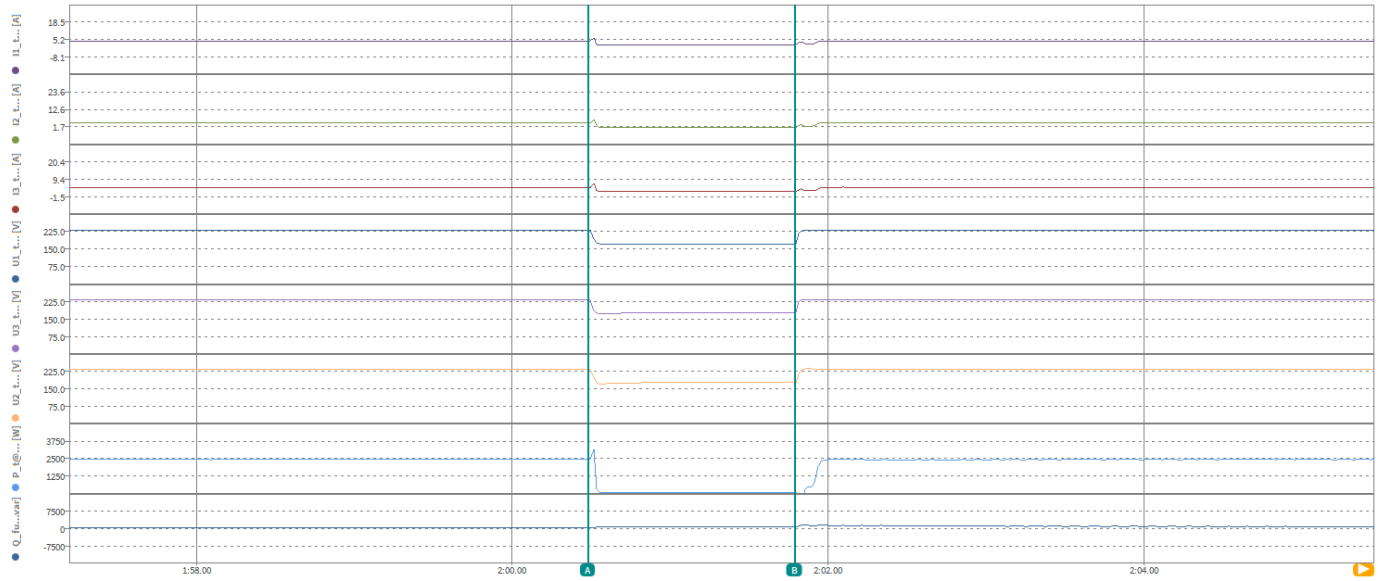
时间 [s]	A 8:11.812879	B 8:13.121058	间隔 1.308179
I1_tRMS@AC网 [A]	17.18116	1.948078	-15.23308
I2_tRMS@AC网 [A]	17.11471	1.957205	-15.15750
I3_tRMS@AC网 [A]	17.14355	1.548026	-15.59553
U1_tRMS@AC网 [V]	230.4475	216.0511	-14.39641
U2_tRMS@AC网 [V]	230.7000	216.6824	-14.01756
U3_tRMS@AC网 [V]	231.0884	172.5186	-58.56989
P_t@AC网 [W]	11866.22	-2.877209	-11869.10
Q_fund@AC网 [var]	94.11498	1105.794	1011.679



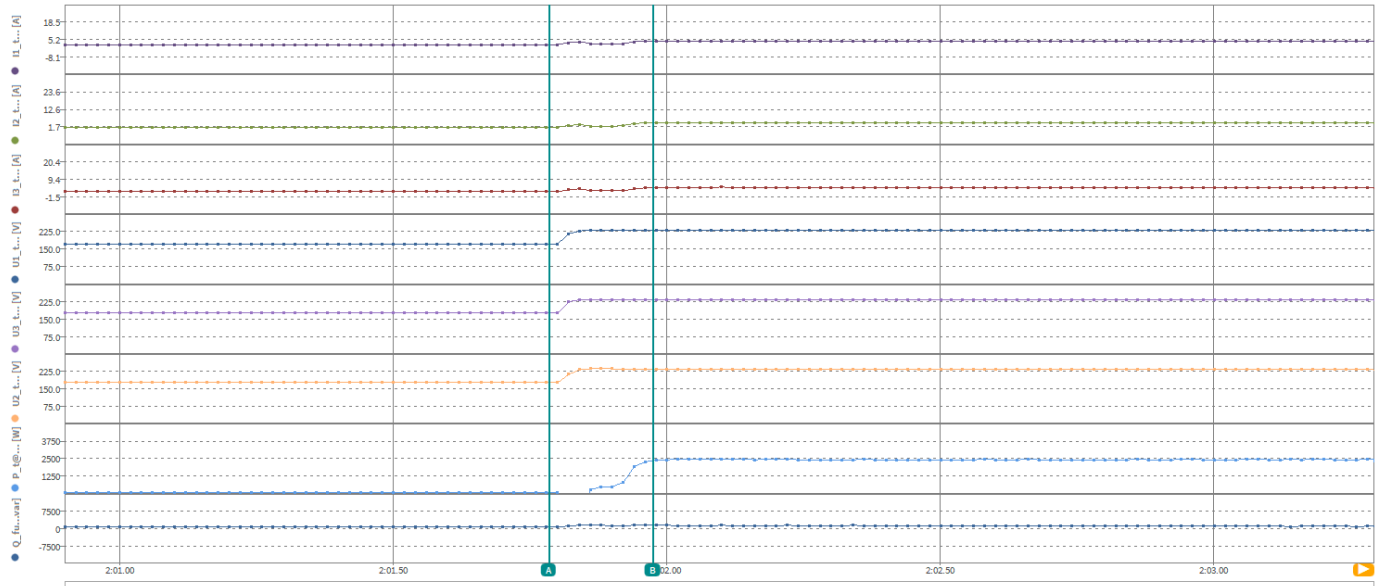
时间 [s]	A 8:13.205538	B 8:13.398915	间隔 0.193377
I1_tRMS@AC网 [A]	16.20006	15.96740	-0.232656
I2_tRMS@AC网 [A]	15.96059	15.89518	-0.065403
I3_tRMS@AC网 [A]	15.96883	15.83235	-0.136477
U1_tRMS@AC网 [V]	234.3083	230.6929	-3.615494
U2_tRMS@AC网 [V]	234.1821	230.8627	-3.319458
U3_tRMS@AC网 [V]	229.0104	230.8774	1.867065
P_t@AC网 [W]	10890.29	10951.23	60.94336
Q_fund@AC网 [var]	2530.094	1080.128	-1449.965

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Test 4s – three-phase symmetrical fault (V/V_n = 0,75; duration = 1,300 s) P = 0,1 - 0,3



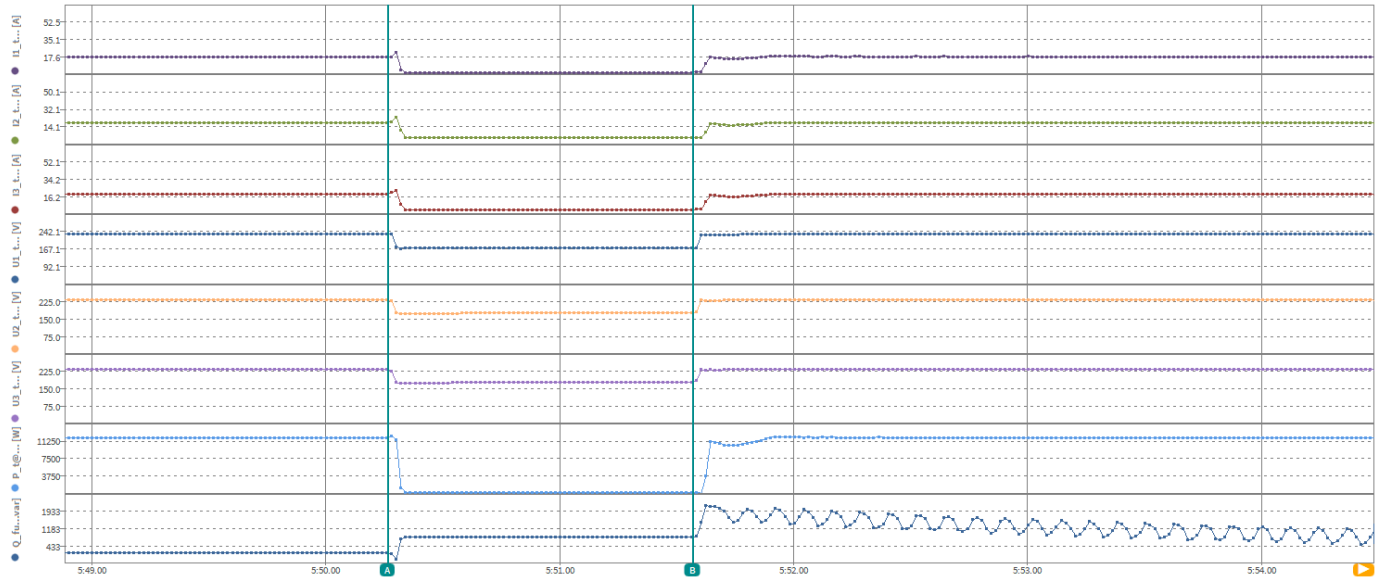
时间 [s]	A 2:00.482241	B 2:01.790655	间隔 1.308414
I1_tRMS@AC侧 [A]	3.491959	0.882327	-2.609632
I2_tRMS@AC侧 [A]	3.484203	0.886460	-2.597744
I3_tRMS@AC侧 [A]	3.480005	0.881357	-2.598648
U1_tRMS@AC侧 [V]	230.2791	172.2063	-58.07288
U3_tRMS@AC侧 [V]	230.8773	172.5628	-58.31451
U2_tRMS@AC侧 [V]	230.6095	172.4399	-58.16960
P_t@AC侧 [W]	2403.436	-1.009695	-2404.445
Q_fund@AC侧 [var]	113.8549	453.8689	340.0140



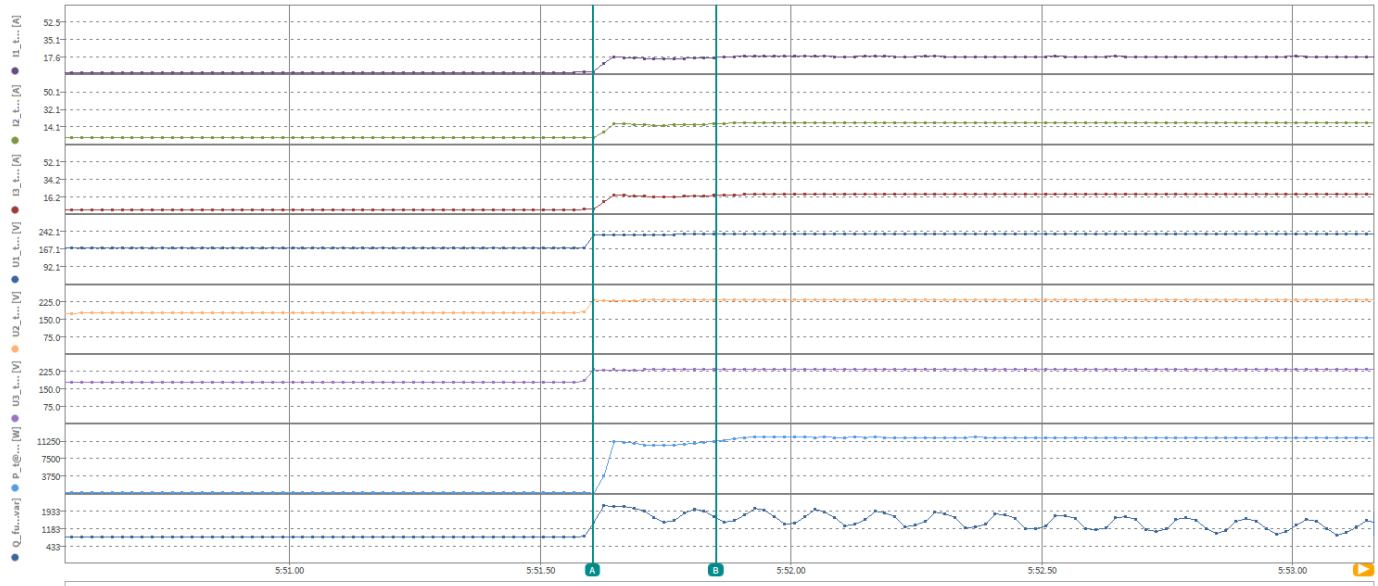
时间 [s]	A 2:01.784787	B 2:01.975025	间隔 0.190237
I1_tRMS@AC侧 [A]	0.882327	3.609894	2.727567
I2_tRMS@AC侧 [A]	0.886460	3.594242	2.707782
I3_tRMS@AC侧 [A]	0.881357	3.519574	2.638217
U1_tRMS@AC侧 [V]	172.2063	231.4005	59.19421
U3_tRMS@AC侧 [V]	172.5628	231.4700	58.90727
U2_tRMS@AC侧 [V]	172.4399	232.1231	59.68317
P_t@AC侧 [W]	-1.009695	2224.679	2225.689
Q_fund@AC侧 [var]	453.8689	1088.585	634.7164

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Test 4s – three-phase symmetrical fault (V/V_n = 0,75; duration = 1,300 s) P > 0,9



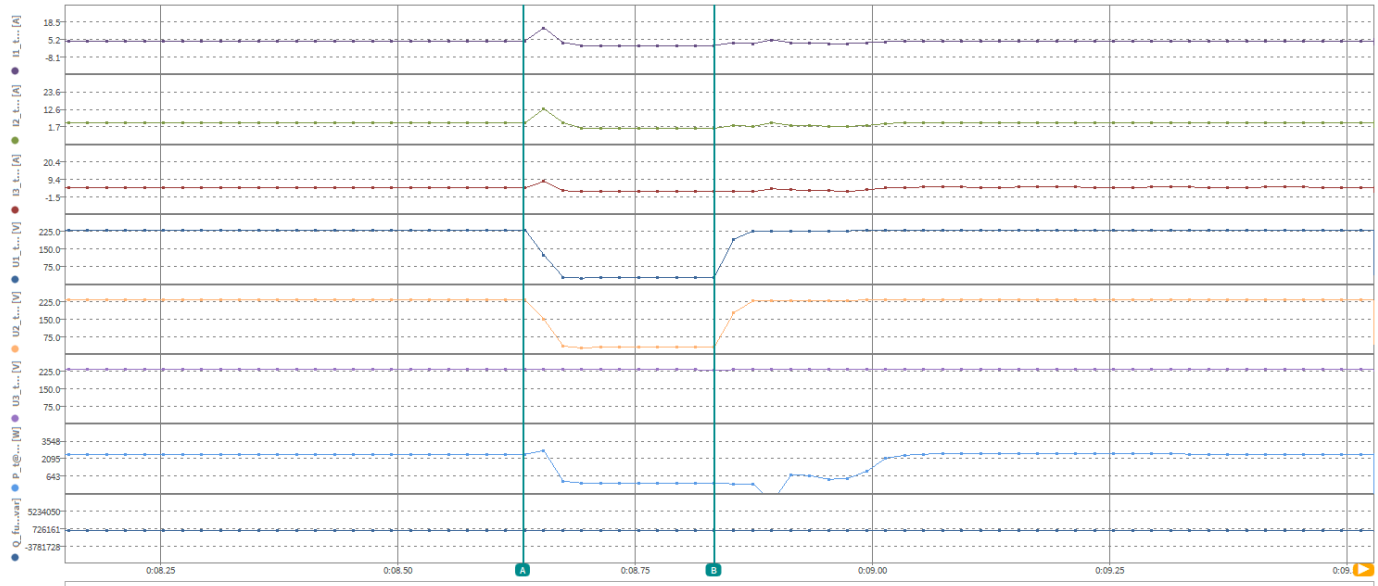
时间 [s]	A 5:50.267909	B 5:51.570673	间隔 1.302764
I1_tRMS@AC侧 [A]	17.40308	1.545068	-15.85801
I2_tRMS@AC侧 [A]	17.33376	1.547772	-15.78599
I3_tRMS@AC侧 [A]	17.36736	1.542294	-15.82507
U1_tRMS@AC侧 [V]	230.3656	172.0829	-58.28264
U2_tRMS@AC侧 [V]	230.6846	172.4073	-58.27730
U3_tRMS@AC侧 [V]	230.9779	172.4391	-58.53879
P_t@AC侧 [W]	12015.86	-1.710903	-12017.57
Q_fund@AC侧 [var]	89.96925	793.2061	703.2369



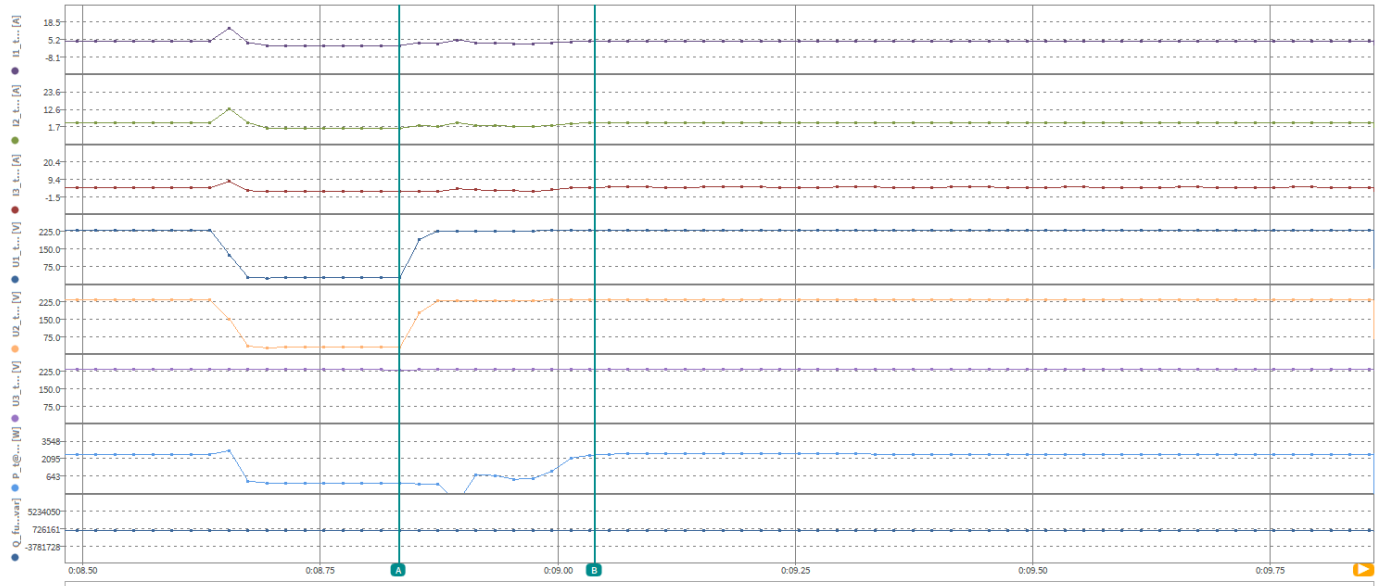
时间 [s]	A 5:51.606311	B 5:51.852003	间隔 0.245692
I1_tRMS@AC侧 [A]	1.669491	16.31386	14.64437
I2_tRMS@AC侧 [A]	1.736340	16.27270	14.53636
I3_tRMS@AC侧 [A]	1.854339	16.37312	14.51878
U1_tRMS@AC侧 [V]	172.9156	230.2899	57.37425
U2_tRMS@AC侧 [V]	177.5505	230.6304	53.07997
U3_tRMS@AC侧 [V]	181.9223	230.8754	48.95314
P_t@AC侧 [W]	-51.03846	11162.83	11213.87
Q_fund@AC侧 [var]	836.1843	1650.989	814.8045

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Test 5 – LV two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) P = 0,1 - 0,3



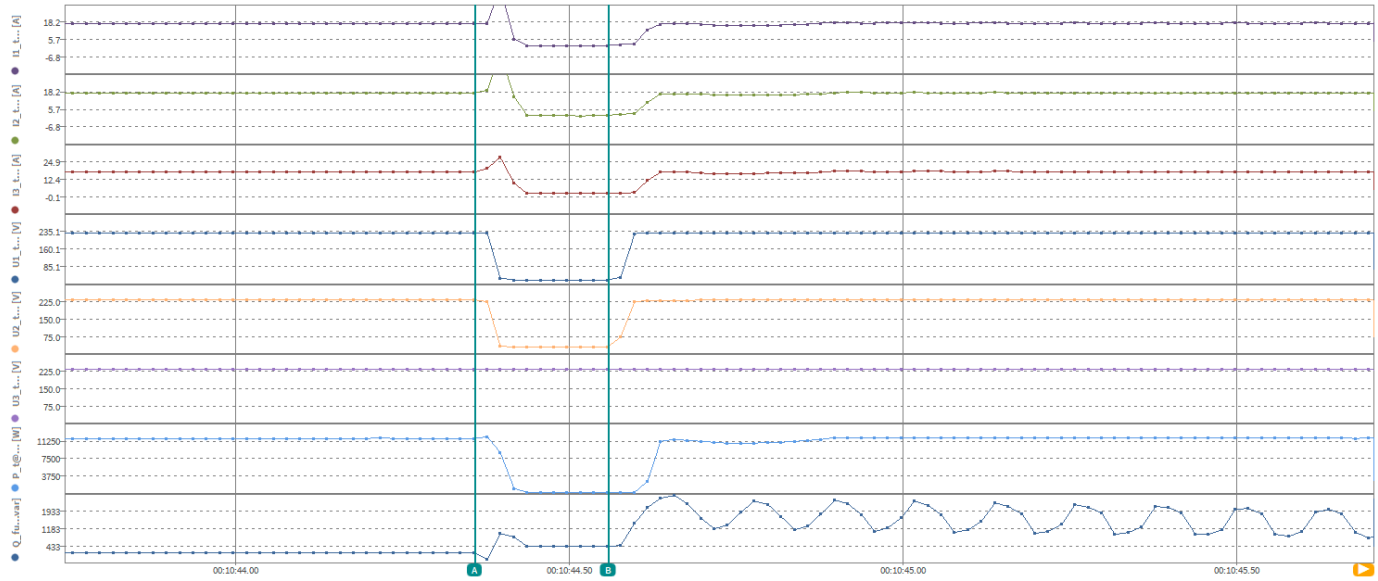
	A	B	间隔
时间 [s]	8.63269	8.83365	0.20097
I1_tRMS@AC侧 [A]	3.509939	0.344550	-3.165389
I2_tRMS@AC侧 [A]	3.495840	0.343677	-3.152164
I3_tRMS@AC侧 [A]	3.489587	0.931421	-2.558165
U1_tRMS@AC侧 [V]	230.2494	23.35232	-206.8971
U2_tRMS@AC侧 [V]	230.4219	23.08005	-207.3418
U3_tRMS@AC侧 [V]	230.7875	230.1612	-0.626266
P_t@AC侧 [W]	2411.511	-0.444112	-2411.956
Q_fund@AC侧 [var]	113.3721	222.8006	109.4285



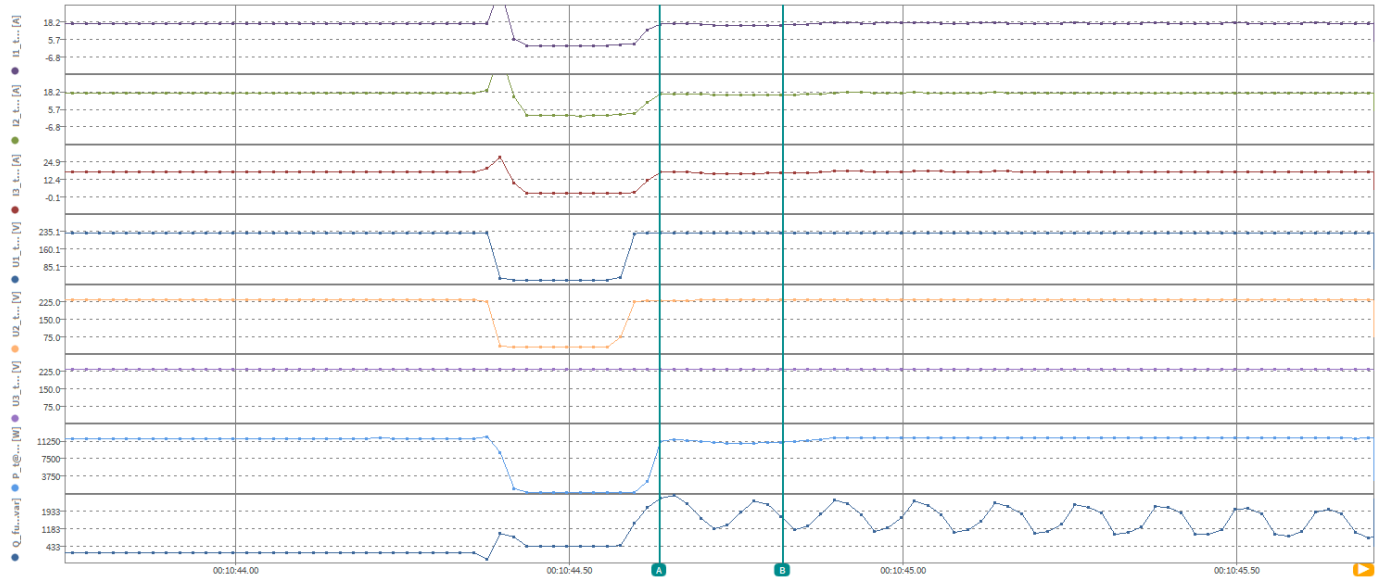
	A	B	间隔
时间 [s]	8.83295	9.03913	0.20618
I1_tRMS@AC侧 [A]	0.344550	3.744964	3.400414
I2_tRMS@AC侧 [A]	0.343677	3.631564	3.287887
I3_tRMS@AC侧 [A]	0.931421	3.668170	2.736749
U1_tRMS@AC侧 [V]	23.35232	229.9187	206.5664
U2_tRMS@AC侧 [V]	23.08005	230.0578	206.9778
U3_tRMS@AC侧 [V]	230.1612	231.1044	0.943207
P_t@AC侧 [W]	-0.444112	2296.983	2297.427
Q_fund@AC侧 [var]	222.8006	1065.578	842.7779

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Test 5 – LV two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) P > 0,9



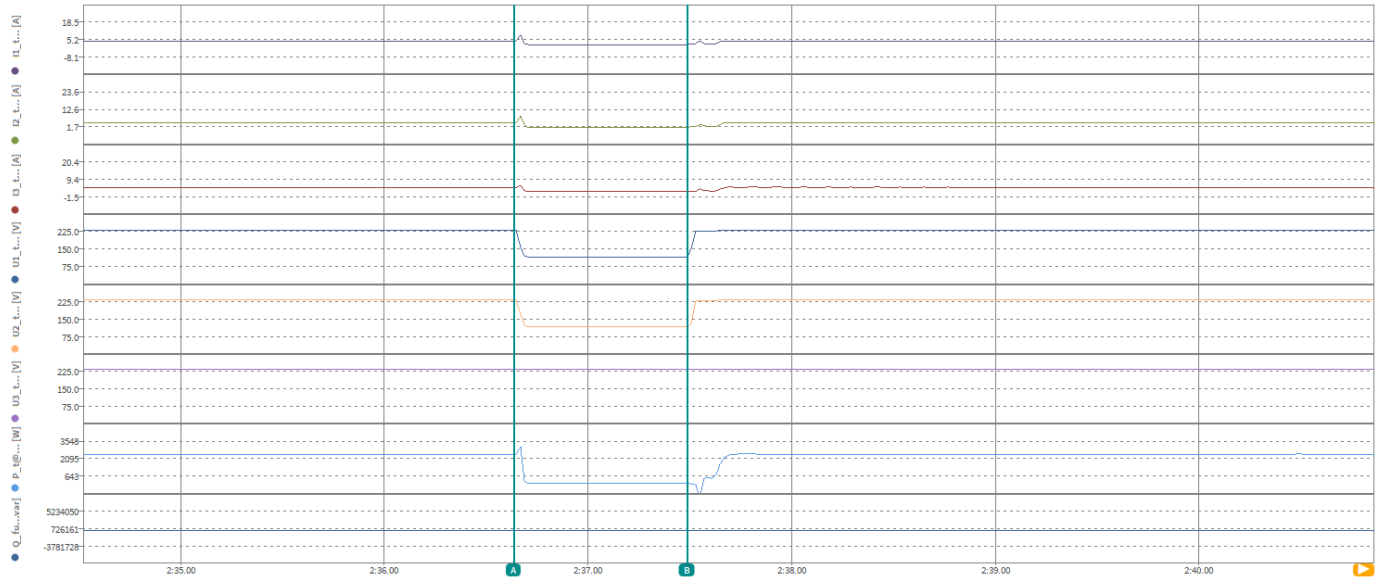
时间 [s]	A 00:10:44.359948	B 00:10:44.559801	间隔 0.199854
I1_tRMS@AC侧 [A]	17.13210	0.607872	-16.52423
I2_tRMS@AC侧 [A]	17.07567	0.601017	-16.47465
I3_tRMS@AC侧 [A]	17.11973	1.638206	-15.48152
U1_tRMS@AC侧 [V]	230.5010	23.47559	-207.0254
U2_tRMS@AC侧 [V]	230.6920	22.89198	-207.8000
U3_tRMS@AC侧 [V]	230.9761	229.7805	-1.195541
P_t@AC侧 [W]	11838.96	-1.527930	-11840.49
Q_fund@AC侧 [var]	98.51320	391.2542	292.7410



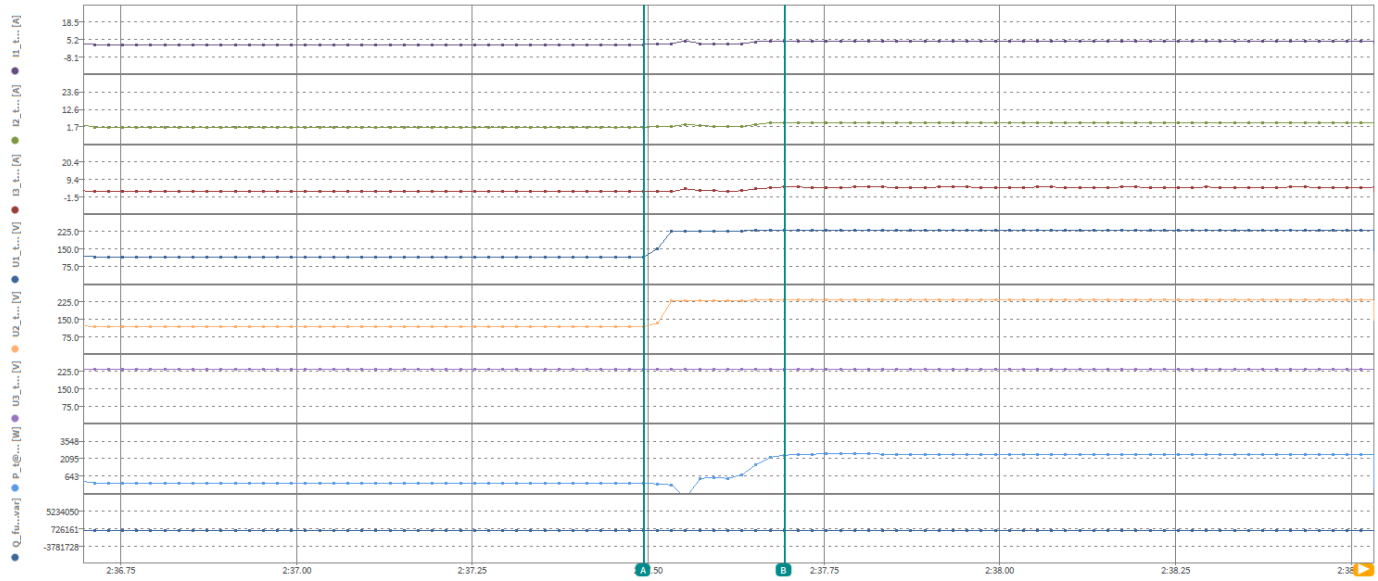
时间 [s]	A 00:10:44.636135	B 00:10:44.820722	间隔 0.184587
I1_tRMS@AC侧 [A]	12.31479	16.07835	3.763565
I2_tRMS@AC侧 [A]	10.45048	15.97582	5.525345
I3_tRMS@AC侧 [A]	11.27321	16.29726	5.024052
U1_tRMS@AC侧 [V]	228.0216	230.2480	2.226410
U2_tRMS@AC侧 [V]	227.5939	230.4528	2.858902
U3_tRMS@AC侧 [V]	231.3366	230.9714	-0.365204
P_t@AC侧 [W]	2342.760	11011.37	8668.608
Q_fund@AC侧 [var]	2076.480	1665.041	-411.4384

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Test 6 – LV two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) P = 0,1 - 0,3



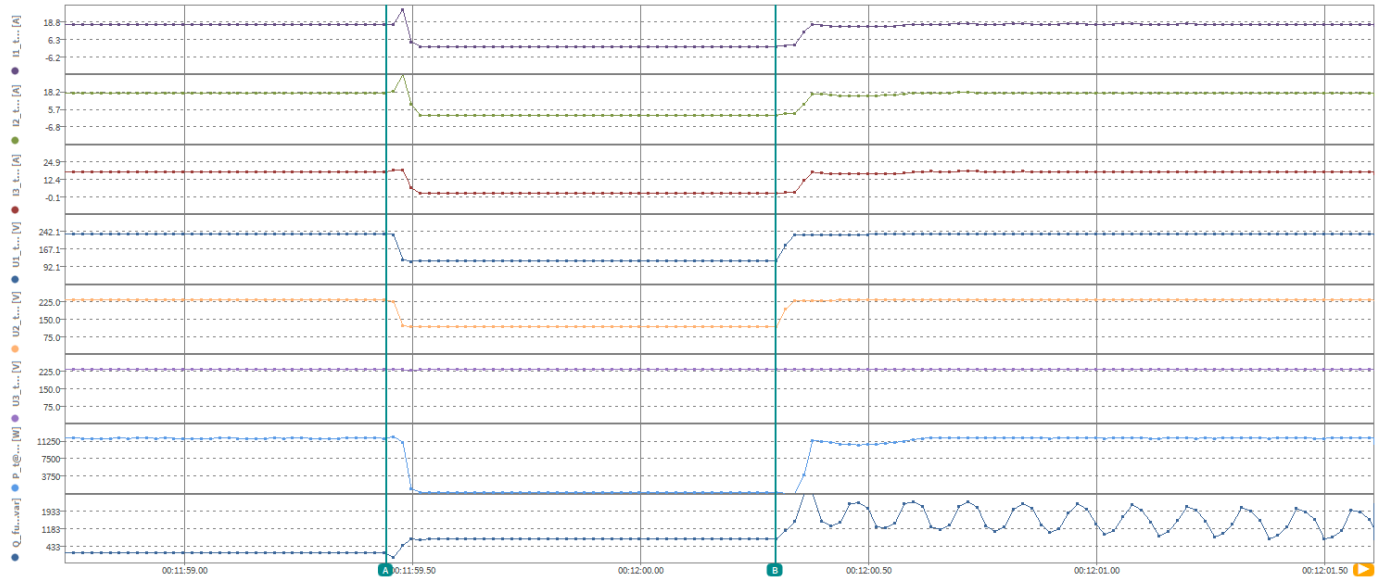
时间 [s]	A 2:36.638785	B 2:37.489088	间隔 0.850303
I1_tRMS@AC侧 [A]	3.519569	0.673213	-2.846357
I2_tRMS@AC侧 [A]	3.500041	0.673521	-2.826520
I3_tRMS@AC侧 [A]	3.506623	1.036196	-2.470427
U1_tRMS@AC侧 [V]	230.2477	115.3037	-114.9440
U2_tRMS@AC侧 [V]	230.5491	115.3048	-115.2443
U3_tRMS@AC侧 [V]	230.8336	230.4222	-0.411407
P_t@AC侧 [W]	2419.659	-1.003994	-2420.663
Q_fund@AC侧 [var]	101.6808	388.8092	287.1284



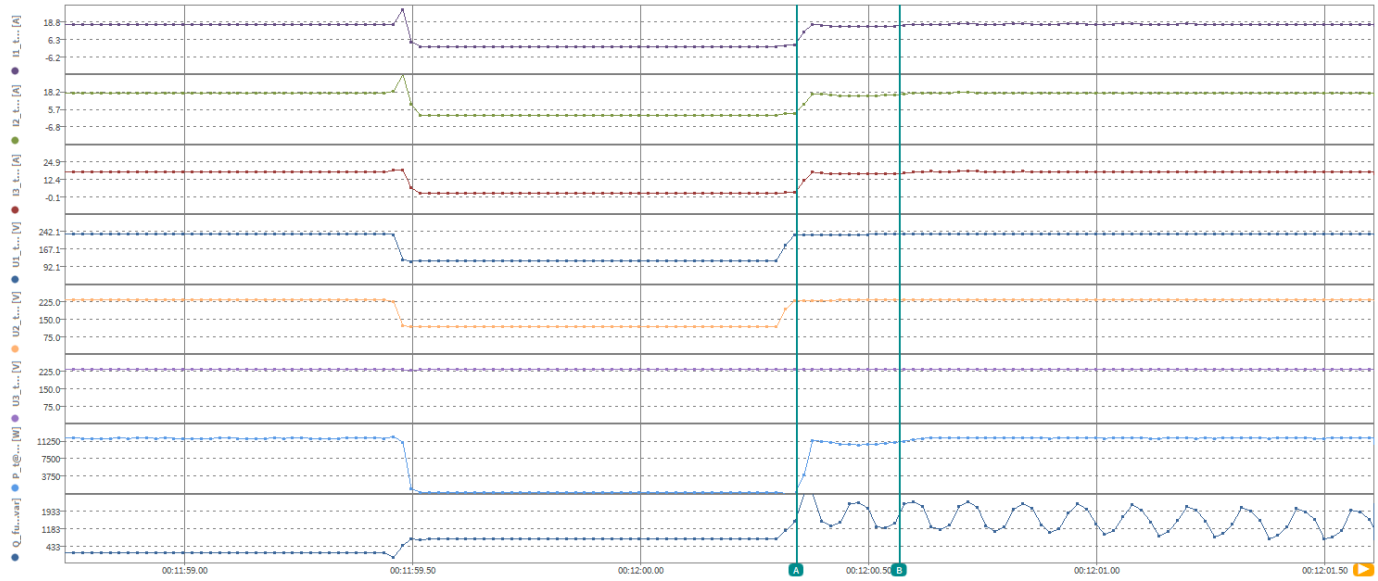
时间 [s]	A 2:37.493635	B 2:37.693706	间隔 0.200071
I1_tRMS@AC侧 [A]	0.673213	3.707859	3.034646
I2_tRMS@AC侧 [A]	0.673521	3.640813	2.967292
I3_tRMS@AC侧 [A]	1.036196	3.669930	2.633734
U1_tRMS@AC侧 [V]	115.3037	229.7350	114.4313
U2_tRMS@AC侧 [V]	115.3048	229.9870	114.6822
U3_tRMS@AC侧 [V]	230.4222	231.1677	0.745499
P_t@AC侧 [W]	-1.003994	2211.269	2212.273
Q_fund@AC侧 [var]	388.8092	1233.011	844.2014

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Test 6 – LV two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) P > 0,9



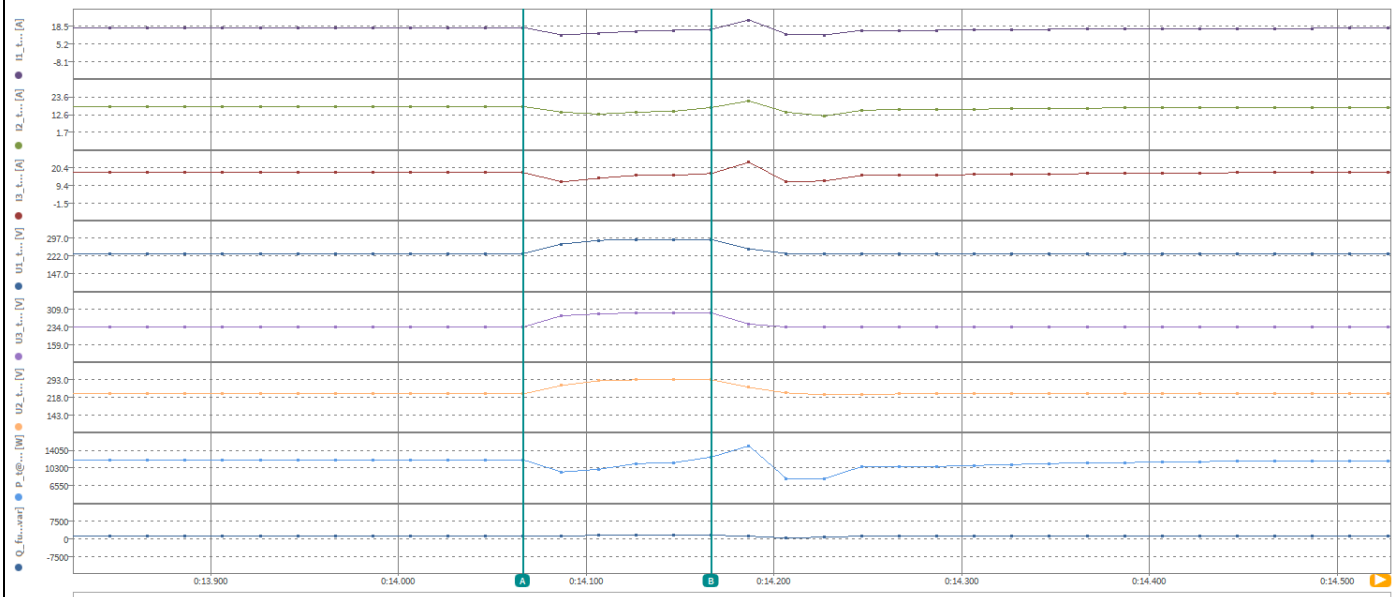
时间 [s]	A 00:11:59.442176	B 00:12:00.295610	间隔 0.853435
I1_tRMS@AC侧 [A]	17.17170	1.183468	-15.98823
I2_tRMS@AC侧 [A]	17.10622	1.183977	-15.92225
I3_tRMS@AC侧 [A]	17.13309	1.828041	-15.30504
U1_tRMS@AC侧 [V]	230.4203	115.3081	-115.1122
U2_tRMS@AC侧 [V]	230.6565	115.2367	-115.4198
U3_tRMS@AC侧 [V]	230.9161	230.3465	-0.569550
P_t@AC侧 [W]	11855.20	-1.268624	-11856.47
Q_fund@AC侧 [var]	97.54380	684.5381	586.9943



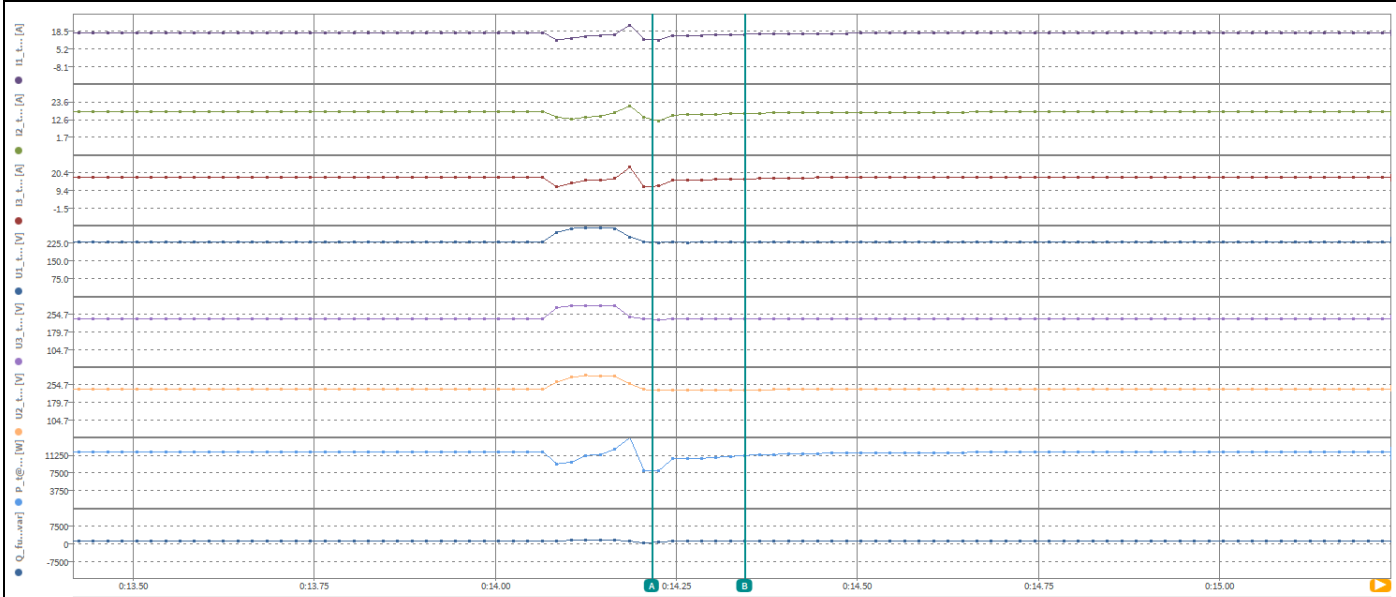
时间 [s]	A 00:12:00.342346	B 00:12:00.567896	间隔 0.225551
I1_tRMS@AC侧 [A]	2.206807	16.06215	13.85534
I2_tRMS@AC侧 [A]	2.212415	15.80965	13.59724
I3_tRMS@AC侧 [A]	2.203717	16.13391	13.93020
U1_tRMS@AC侧 [V]	228.3789	230.2770	1.898071
U2_tRMS@AC侧 [V]	228.3983	230.4658	2.067474
U3_tRMS@AC侧 [V]	230.5830	231.0071	0.424149
P_t@AC侧 [W]	-191.7099	10978.49	11170.20
Q_fund@AC侧 [var]	1453.641	1385.363	-68.27783

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Test: OV1 – three-phase symmetrical fault (V/Vn = 1,25; duration = 0,100 s) P > 0,9



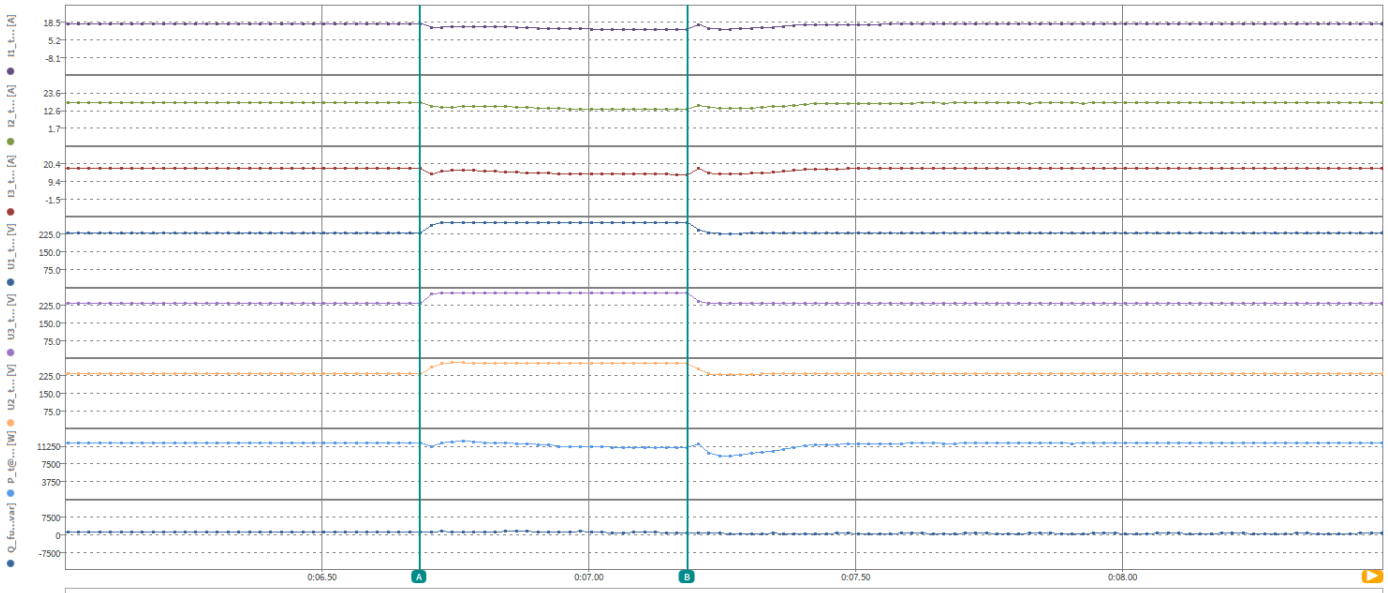
	A	B	间隔
时间 [s]	0:14.066541	0:14.166712	0.100170
I1_tRMS@AC侧 [A]	17.28872	15.21496	-2.073766
I2_tRMS@AC侧 [A]	17.24783	14.29501	-2.952826
I3_tRMS@AC侧 [A]	17.22967	15.59811	-1.631559
U1_tRMS@AC侧 [V]	230.6467	290.0859	59.43916
U3_tRMS@AC侧 [V]	231.2397	288.7985	57.55882
U2_tRMS@AC侧 [V]	230.7909	291.0114	60.22044
P_t@AC侧 [W]	11925.37	11364.50	-560.8721
Q_fund@AC侧 [var]	754.5485	1325.665	571.1160



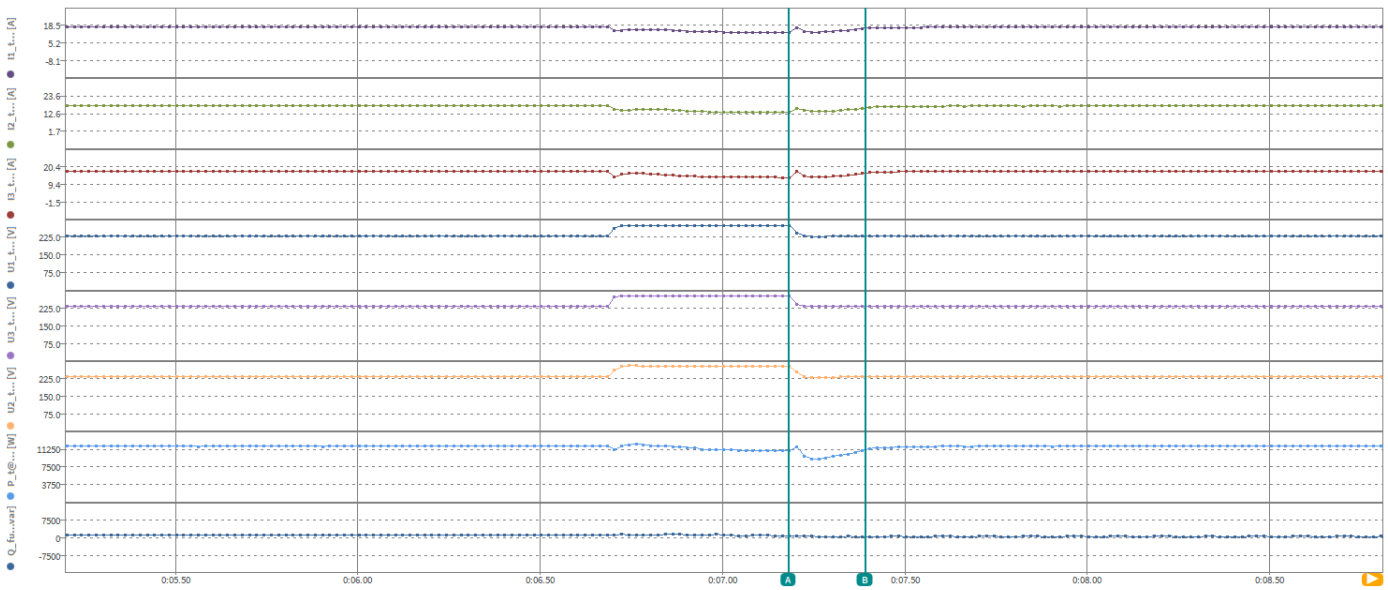
	A	B	间隔
时间 [s]	0:14.216844	0:14.345054	0.128210
I1_tRMS@AC侧 [A]	12.40656	15.92700	3.520441
I2_tRMS@AC侧 [A]	13.61232	15.93722	2.324896
I3_tRMS@AC侧 [A]	10.94198	15.95635	5.014366
U1_tRMS@AC侧 [V]	231.2345	230.0357	-1.198715
U3_tRMS@AC侧 [V]	230.9571	231.0003	0.043152
U2_tRMS@AC侧 [V]	232.2968	229.7997	-2.497070
P_t@AC侧 [W]	7849.274	10983.14	3133.871
Q_fund@AC侧 [var]	44.82794	739.4705	694.6425

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Test: OV2 – three-phase symmetrical fault (V/V_n = 1,20; duration = 0,500 s) P > 0,9



时间 [s]	A	B	间隔
	6.684193	7.185468	0.501275
I1_tRMS@AC侧 [A]	17.33602	13.30319	-4.032834
I2_tRMS@AC侧 [A]	17.26431	13.21491	-4.049401
I3_tRMS@AC侧 [A]	17.30548	13.27434	-4.031138
U1_tRMS@AC侧 [V]	230.7392	275.9236	45.18433
U3_tRMS@AC侧 [V]	231.2239	276.1437	44.91985
U2_tRMS@AC侧 [V]	230.8087	275.3158	44.50717
P_t@AC侧 [W]	11961.54	10967.69	-993.8506
Q_fund@AC侧 [var]	727.8432	239.5002	-488.3430



时间 [s]	A	B	间隔
	7.181963	7.391798	0.209835
I1_tRMS@AC侧 [A]	13.30319	15.93429	2.631105
I2_tRMS@AC侧 [A]	13.21491	15.86664	2.651730
I3_tRMS@AC侧 [A]	13.27434	16.04380	2.769454
U1_tRMS@AC侧 [V]	275.9236	230.5561	-45.36746
U3_tRMS@AC侧 [V]	276.1437	231.2786	-44.86507
U2_tRMS@AC侧 [V]	275.3158	230.3858	-44.92998
P_t@AC侧 [W]	10967.69	11034.78	67.09277
Q_fund@AC侧 [var]	239.5002	111.8757	-127.6245

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CEI 0-21		
Clause	**Requirement – Test**	**Verdict**
B.1.6	**Checking the insensitivity to automatic reclosing during phase accordance**	
B.1.6.1	Test on the simulation network	**P**

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B.1.6	Checking the insensitivity to automatic reclosing during phase accordance

General

This type of test can be performed in two ways:

1. with the inverter connected to a simulated network (B.1.6.1)
2. with the inverter connected to the distribution network (B.1.6.2 and alternatively B.1.6.3).

The generator must not be damaged as a result of the tests. Protective devices may be switched off or released.

With reference to the diagram in Figure 35 – Using the simulated network:

- The network simulator should be able to produce phase shifts in of the output voltage at the inverter terminals of 90° and 180°, respectively.
- Generator: inverter operating at nominal power with unity power factor (cos φ= 1)
- VR: simulated network voltage
- The generator must start operating at nominal power. Let the system operate under the conditions set for at least 5 minutes or the time needed to stabilise the internal temperature of the converter.

After the stabilisation period two tests should be performed in sequence, by inducing the transient that produces a phase shift angle on the simulated network voltage VR of 180° and 90°.

In the test report the following data for each of the two test sequences shall be indicated:

- the angle between the voltage before and after the phase shift, with an instrument with a 1° error;
- the generator current on a time window starting from 20 ms before until at least 200 ms after the phase shift of the simulated network voltage.

Note

The inverter was restarted after the test has been performed.

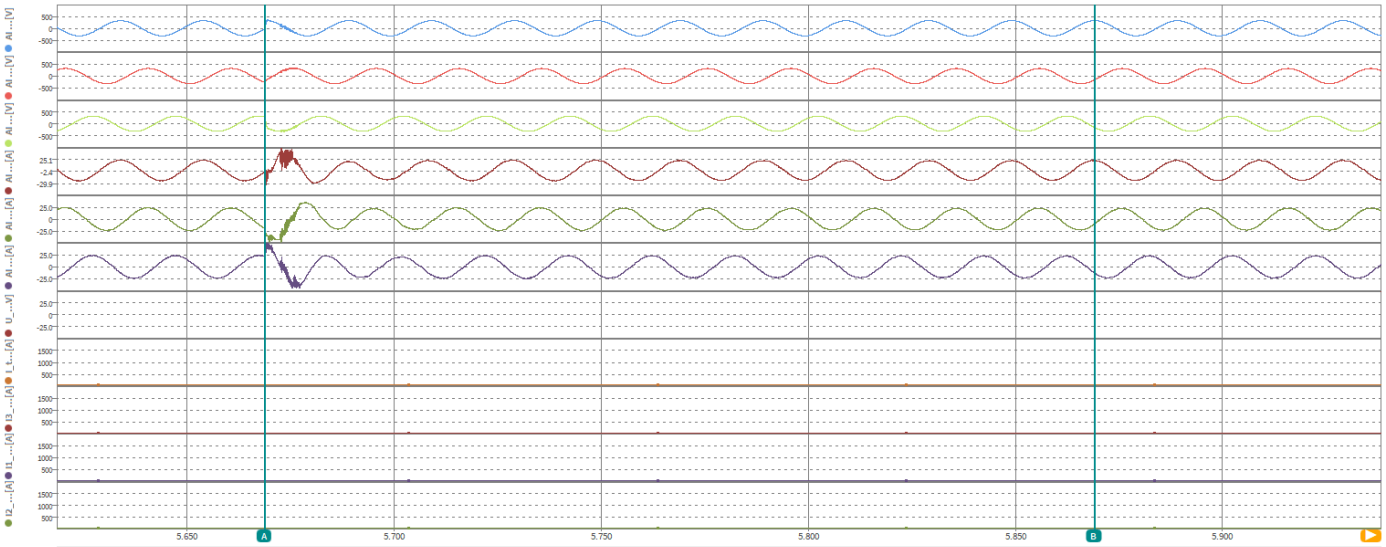
There are no damages on the complete system.

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B.1.6.1	Test on the simulation network	P

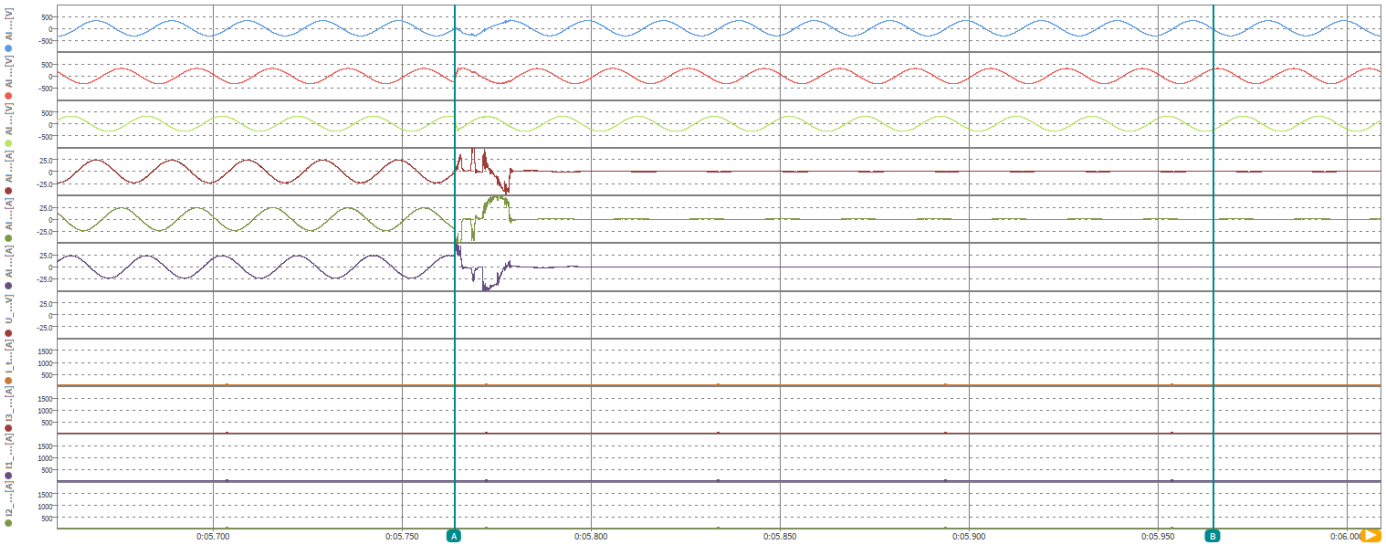
Test results

90° phase shift



时间 [s]	A 5.66884206	B 5.86910228	间隔 0.20026022
AI 1/U1@TRIONet3_1338 [V]	-24.16349	328.2976	352.4611
AI 1/U2@TRIONet3_1338 [V]	-269.4693	-164.6667	104.8026
AI 1/U3@TRIONet3_1338 [V]	294.6208	-163.8930	-458.5138
AI 1/I1@TRIONet3_1338 [A]	-2.386332	23.52119	25.90752
AI 1/I2@TRIONet3_1338 [A]	-19.74940	-9.535790	10.21361
AI 1/I3@TRIONet3_1338 [A]	22.30525	-13.59844	-35.90369
U_tRMS@DC侧 [V]	373.4716	378.4391	4.967499
I_tRMS@AC侧 [A]	17.32240	16.49648	-0.825922
I3_tRMS@AC侧 [A]	17.31936	16.50056	-0.818796
I1_tRMS@AC侧 [A]	17.31028	16.59948	-0.710804
I2_tRMS@AC侧 [A]	17.33756	16.38939	-0.948168

180° phase shift



时间 [s]	A 5.7638134	B 5.9645081	间隔 0.2006947
AI 1/U1@TRIONet3_1338 [V]	-25.76852	-39.87742	-14.10890
AI 1/U2@TRIONet3_1338 [V]	-268.8484	299.6712	568.5196
AI 1/U3@TRIONet3_1338 [V]	295.4238	-261.7502	-557.1740
AI 1/I1@TRIONet3_1338 [A]	-2.368927	0.439882	2.808809
AI 1/I2@TRIONet3_1338 [A]	-20.15329	-0.087023	20.06626
AI 1/I3@TRIONet3_1338 [A]	22.53533	-0.421286	-22.95661
U_tRMS@DC侧 [V]	357.2422	365.1921	7.949890
I_tRMS@AC侧 [A]	17.20048	0.345217	-16.85526
I3_tRMS@AC侧 [A]	17.17041	0.343183	-16.82722
I1_tRMS@AC侧 [A]	17.23136	0.343704	-16.88766
I2_tRMS@AC侧 [A]	17.19967	0.348763	-16.85091

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Annex Bbis Tests on storage systems		
Clause	**Test**	**Result**
Bbis.3	List of tests and reference conditions	
	a)Harmonic emission	**P**
	b)Harmonic emission exceeding 75A	**N/A**
	c)Flicker emission	**P**
Bbis.4	Verification of the voltage and frequency operating range	**P**
Bbis.5	Conditions for connection, reconnection and phased power supply	**P**
Bbis.5.1	Verification of connection and reconnection conditions	**P**
Bbis.5.2	Verification of gradual output/absorption of active power	**P**
Bbis.6	Reactive Power Exchange	**P**
Bbis.6.1	Verification of construction requirements: reactive power capability	**P**
Bbis.6.2	Method of performing and recording the test	**P**
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	**N/A**
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	**P**
Bbis.6.3	Reactive power exchange according to an assigned level	**P**
Bbis.6.4	Method of performing the test and recording the results (Q-setting hypothesis)	**P**
Bbis.6.5	Response time to a step change in the assigned level	**P**
Bbis.6.6	Automatic reactive power output according to a characteristic curve cos φ = f(P)	
Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)	**P**
Bbis.6.8	Automatic exchange of reactive power according to a characteristic curve Q = f(V)	**P**
Bbis.6.9	Verification of compliance with characteristic curve Q = f(V) (greater 11,08kW systems)	**P**
Bbis.7	Active Power Control	**P**
Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	**P**
Bbis.7.2	Verification of automatic active power reduction in the presence of over-frequency transients on the grid	**P**
Bbis.7.2.1	Performance of tests	
Bbis.7.2.2	Test Results	**P**
Bbis.7.3	Verification of automatic active power increase in the presence of under-frequency transients on the grid	**P**
Bbis.7.3.1	Performance of tests	
Bbis.7.3.2	Test Results	
Bbis.7.4	Verification of active power control on external control from DSO	**P**
Bbis.7.4.1	Checking the settling time to a power increase/decrease command	**P**
Bbis.8.1	Verification of emission of continuous component	**P**
Bbis.8.2	Verification of Protection against Continuous Component Input	**P**
Bbis.9	Verification of UVRT capability	**P**
	Verification of OVRT capability	**P**
Bbis.10	Verification of insensitivity to automatic reclosure in phase discordance	**P**
Bbis.10.1	Simulated network test	**P**

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1242,7		2487,8		3702,1		
AC Voltage [V]	230,30		230,57		230,86		
AC Current [A]	5,40		10,79		16,04		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,037		1,057		1,402		
PWHD	2,388		4,086		5,908		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,396	-	10,789	-	16,038	-	-
2nd	0,023	0,131	0,018	0,102	0,027	0,155	8,00
3rd	0,004	0,023	0,005	0,031	0,007	0,041	N/A
4th	0,018	0,106	0,012	0,070	0,033	0,190	4,00
5th	0,091	0,522	0,066	0,382	0,090	0,519	10,70
6th	0,008	0,048	0,009	0,051	0,009	0,051	2,67
7th	0,110	0,633	0,079	0,455	0,070	0,401	7,20
8th	0,028	0,161	0,032	0,187	0,024	0,137	2,00
9th	0,004	0,023	0,003	0,015	0,005	0,030	N/A
10th	0,031	0,180	0,038	0,221	0,039	0,225	1,60
11th	0,034	0,195	0,027	0,155	0,046	0,265	3,10
12th	0,003	0,020	0,005	0,027	0,011	0,061	1,33
13th	0,021	0,121	0,020	0,116	0,038	0,219	2,00
14th	0,027	0,156	0,020	0,115	0,025	0,144	N/A
15th	0,005	0,026	0,006	0,037	0,006	0,034	N/A
16th	0,026	0,148	0,014	0,079	0,016	0,089	N/A
17th	0,027	0,157	0,010	0,057	0,024	0,136	N/A
18th	0,015	0,085	0,011	0,065	0,009	0,051	N/A
19th	0,032	0,185	0,023	0,131	0,027	0,156	N/A
20th	0,018	0,102	0,011	0,063	0,018	0,103	N/A
21th	0,003	0,018	0,005	0,031	0,005	0,027	N/A
22th	0,022	0,128	0,020	0,117	0,022	0,128	N/A
23th	0,032	0,186	0,033	0,188	0,027	0,153	N/A
24th	0,002	0,012	0,004	0,025	0,022	0,128	N/A
25th	0,031	0,177	0,075	0,434	0,065	0,372	N/A
26th	0,012	0,070	0,010	0,059	0,103	0,590	N/A
27th	0,006	0,034	0,010	0,055	0,009	0,051	N/A
28th	0,014	0,080	0,016	0,094	0,011	0,063	N/A
29th	0,024	0,140	0,088	0,507	0,066	0,380	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,002	0,013	0,005	0,026	0,114	0,658	N/A
31th	0,011	0,064	0,030	0,172	0,019	0,108	N/A
32th	0,006	0,037	0,005	0,027	0,026	0,147	N/A
33th	0,003	0,018	0,002	0,013	0,007	0,038	N/A
34th	0,006	0,036	0,004	0,021	0,006	0,033	N/A
35th	0,012	0,068	0,023	0,133	0,017	0,097	N/A
36th	0,002	0,009	0,002	0,014	0,018	0,105	N/A
37th	0,016	0,091	0,020	0,116	0,009	0,054	N/A
38th	0,003	0,018	0,004	0,023	0,014	0,078	N/A
39th	0,003	0,017	0,003	0,016	0,004	0,026	N/A
40th	0,003	0,019	0,003	0,016	0,004	0,026	N/A
Note							
For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1237,8		2481,3		3692,9		
AC Voltage [V]	230,25		230,48		230,73		
AC Current [A]	5,38		10,77		16,01		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,138		1,189		1,561		
PWHD	3,205		4,793		6,691		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,377	-	10,767	-	16,006	-	-
2nd	0,015	0,089	0,007	0,041	0,026	0,151	8,00
3rd	0,010	0,056	0,013	0,074	0,015	0,089	N/A
4th	0,020	0,116	0,014	0,081	0,036	0,207	4,00
5th	0,093	0,535	0,067	0,386	0,090	0,515	10,70
6th	0,010	0,060	0,013	0,074	0,012	0,066	2,67
7th	0,107	0,614	0,074	0,425	0,063	0,363	7,20
8th	0,026	0,149	0,031	0,180	0,025	0,146	2,00
9th	0,003	0,019	0,004	0,022	0,006	0,036	N/A
10th	0,031	0,179	0,039	0,223	0,040	0,232	1,60
11th	0,033	0,192	0,026	0,150	0,046	0,264	3,10
12th	0,003	0,017	0,003	0,015	0,008	0,048	1,33
13th	0,020	0,112	0,020	0,114	0,037	0,212	2,00
14th	0,029	0,166	0,020	0,112	0,024	0,136	N/A
15th	0,003	0,016	0,003	0,016	0,004	0,023	N/A
16th	0,025	0,144	0,013	0,072	0,016	0,093	N/A
17th	0,028	0,162	0,009	0,050	0,027	0,156	N/A
18th	0,014	0,082	0,015	0,085	0,011	0,066	N/A
19th	0,036	0,204	0,020	0,113	0,026	0,150	N/A
20th	0,089	0,512	0,106	0,608	0,124	0,710	N/A
21th	0,003	0,020	0,006	0,033	0,008	0,045	N/A
22th	0,021	0,118	0,020	0,114	0,016	0,094	N/A
23th	0,029	0,166	0,032	0,185	0,030	0,171	N/A
24th	0,002	0,010	0,003	0,018	0,015	0,088	N/A
25th	0,030	0,170	0,069	0,395	0,057	0,329	N/A
26th	0,014	0,079	0,009	0,053	0,102	0,585	N/A
27th	0,007	0,041	0,022	0,126	0,014	0,083	N/A
28th	0,014	0,082	0,017	0,095	0,040	0,227	N/A
29th	0,020	0,116	0,084	0,481	0,062	0,357	N/A
30th	0,002	0,012	0,005	0,027	0,114	0,658	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,008	0,046	0,029	0,166	0,020	0,114	N/A
32th	0,007	0,038	0,005	0,028	0,022	0,126	N/A
33th	0,001	0,007	0,005	0,029	0,007	0,040	N/A
34th	0,007	0,039	0,006	0,032	0,004	0,024	N/A
35th	0,009	0,049	0,024	0,139	0,020	0,116	N/A
36th	0,001	0,008	0,002	0,012	0,017	0,097	N/A
37th	0,013	0,073	0,025	0,142	0,014	0,083	N/A
38th	0,003	0,020	0,004	0,025	0,014	0,081	N/A
39th	0,002	0,009	0,003	0,017	0,005	0,030	N/A
40th	0,004	0,024	0,003	0,018	0,003	0,018	N/A
Note For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1237,9		2480,2		3690,4		
AC Voltage [V]	230,27		230,54		230,80		
AC Current [A]	5,38		10,76		15,99		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,176		1,217		1,562		
PWHD	3,418		4,897		6,701		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,376	-	10,757	-	15,992	-	-
2nd	0,014	0,081	0,015	0,088	0,033	0,191	8,00
3rd	0,007	0,037	0,010	0,056	0,010	0,055	N/A
4th	0,020	0,116	0,014	0,083	0,034	0,198	4,00
5th	0,093	0,532	0,065	0,372	0,090	0,516	10,70
6th	0,018	0,102	0,020	0,117	0,017	0,095	2,67
7th	0,110	0,630	0,079	0,452	0,063	0,362	7,20
8th	0,028	0,162	0,034	0,193	0,023	0,134	2,00
9th	0,007	0,038	0,004	0,021	0,006	0,033	N/A
10th	0,031	0,177	0,038	0,218	0,039	0,225	1,60
11th	0,033	0,187	0,026	0,150	0,046	0,265	3,10
12th	0,005	0,030	0,005	0,028	0,008	0,048	1,33
13th	0,022	0,129	0,022	0,127	0,035	0,204	2,00
14th	0,029	0,166	0,022	0,126	0,024	0,140	N/A
15th	0,002	0,013	0,003	0,019	0,005	0,030	N/A
16th	0,024	0,139	0,012	0,071	0,015	0,087	N/A
17th	0,030	0,172	0,011	0,064	0,026	0,147	N/A
18th	0,016	0,090	0,012	0,069	0,008	0,043	N/A
19th	0,036	0,206	0,018	0,103	0,025	0,147	N/A
20th	0,095	0,545	0,104	0,598	0,120	0,691	N/A
21th	0,007	0,038	0,007	0,037	0,007	0,041	N/A
22th	0,020	0,113	0,020	0,115	0,016	0,094	N/A
23th	0,032	0,186	0,031	0,178	0,029	0,167	N/A
24th	0,005	0,029	0,006	0,033	0,017	0,099	N/A
25th	0,028	0,159	0,074	0,427	0,059	0,339	N/A
26th	0,014	0,079	0,008	0,045	0,107	0,617	N/A
27th	0,010	0,060	0,021	0,121	0,011	0,063	N/A
28th	0,015	0,087	0,019	0,107	0,034	0,196	N/A
29th	0,024	0,135	0,089	0,512	0,064	0,365	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,004	0,020	0,005	0,027	0,117	0,674	N/A
31th	0,009	0,054	0,027	0,157	0,018	0,104	N/A
32th	0,008	0,046	0,005	0,031	0,012	0,067	N/A
33th	0,002	0,013	0,003	0,015	0,005	0,028	N/A
34th	0,007	0,038	0,005	0,028	0,004	0,025	N/A
35th	0,012	0,067	0,022	0,128	0,020	0,115	N/A
36th	0,002	0,013	0,002	0,013	0,015	0,085	N/A
37th	0,017	0,100	0,024	0,137	0,009	0,054	N/A
38th	0,004	0,022	0,004	0,025	0,012	0,067	N/A
39th	0,003	0,017	0,002	0,013	0,003	0,017	N/A
40th	0,004	0,024	0,003	0,018	0,005	0,030	N/A

Note

For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1321,0		-2641,5		-4002,3		
AC Voltage [V]	229,71		229,41		229,06		
AC Current [A]	5,76		11,52		17,48		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	0,949		1,456		1,989		
PWHD	1,857		3,825		3,641		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,758	-	11,524	-	17,514	-	-
2nd	0,015	0,089	0,016	0,092	0,064	0,368	8,00
3rd	0,005	0,031	0,006	0,037	0,007	0,040	N/A
4th	0,021	0,121	0,032	0,185	0,105	0,604	4,00
5th	0,112	0,643	0,176	1,011	0,233	1,340	10,70
6th	0,013	0,074	0,013	0,075	0,013	0,075	2,67
7th	0,066	0,380	0,098	0,565	0,143	0,822	7,20
8th	0,027	0,154	0,025	0,142	0,006	0,035	2,00
9th	0,003	0,017	0,003	0,015	0,003	0,017	N/A
10th	0,033	0,188	0,043	0,245	0,053	0,305	1,60
11th	0,036	0,206	0,039	0,222	0,079	0,454	3,10
12th	0,003	0,017	0,002	0,014	0,007	0,040	1,33
13th	0,040	0,229	0,032	0,185	0,063	0,362	2,00
14th	0,024	0,135	0,022	0,126	0,029	0,167	N/A
15th	0,004	0,022	0,004	0,022	0,003	0,017	N/A
16th	0,021	0,122	0,014	0,082	0,014	0,081	N/A
17th	0,025	0,142	0,030	0,174	0,053	0,305	N/A
18th	0,015	0,085	0,016	0,093	0,017	0,098	N/A
19th	0,013	0,074	0,022	0,127	0,032	0,184	N/A
20th	0,018	0,104	0,014	0,082	0,014	0,081	N/A
21th	0,004	0,025	0,006	0,033	0,005	0,029	N/A
22th	0,025	0,146	0,025	0,147	0,022	0,127	N/A
23th	0,016	0,090	0,023	0,134	0,022	0,127	N/A
24th	0,003	0,015	0,004	0,024	0,004	0,023	N/A
25th	0,021	0,118	0,075	0,430	0,056	0,322	N/A
26th	0,010	0,056	0,011	0,065	0,046	0,265	N/A
27th	0,005	0,027	0,008	0,045	0,007	0,040	N/A
28th	0,009	0,053	0,004	0,021	0,012	0,069	N/A
29th	0,023	0,133	0,075	0,431	0,048	0,276	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,002	0,014	0,006	0,032	0,041	0,236	N/A
31th	0,008	0,046	0,025	0,144	0,015	0,086	N/A
32th	0,006	0,032	0,004	0,021	0,012	0,069	N/A
33th	0,003	0,018	0,009	0,049	0,006	0,035	N/A
34th	0,009	0,049	0,004	0,020	0,006	0,035	N/A
35th	0,008	0,043	0,025	0,144	0,013	0,075	N/A
36th	0,002	0,012	0,002	0,014	0,008	0,046	N/A
37th	0,007	0,041	0,021	0,121	0,011	0,063	N/A
38th	0,006	0,035	0,002	0,013	0,008	0,046	N/A
39th	0,004	0,023	0,004	0,024	0,005	0,029	N/A
40th	0,005	0,029	0,002	0,012	0,003	0,017	N/A

Note

For test result (discharge mode P_{SMAX}, P_{NINV}) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1322,2		-2641,7		-4002,5		
AC Voltage [V]	229,75		229,50		229,23		
AC Current [A]	5,76		11,52		17,47		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,039		1,567		2,098		
PWHD	2,650		4,564		4,536		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,762	-	11,521	-	17,503	-	-
2nd	0,022	0,124	0,032	0,185	0,086	0,495	8,00
3rd	0,008	0,044	0,009	0,049	0,009	0,052	N/A
4th	0,018	0,103	0,030	0,173	0,104	0,598	4,00
5th	0,114	0,657	0,178	1,021	0,233	1,340	10,70
6th	0,011	0,064	0,014	0,078	0,015	0,086	2,67
7th	0,064	0,369	0,098	0,564	0,142	0,817	7,20
8th	0,024	0,140	0,023	0,133	0,006	0,035	2,00
9th	0,005	0,026	0,004	0,021	0,004	0,023	N/A
10th	0,034	0,196	0,042	0,241	0,052	0,299	1,60
11th	0,035	0,199	0,036	0,209	0,078	0,449	3,10
12th	0,003	0,017	0,003	0,015	0,006	0,035	1,33
13th	0,036	0,207	0,029	0,169	0,059	0,339	2,00
14th	0,025	0,143	0,022	0,126	0,029	0,167	N/A
15th	0,004	0,025	0,007	0,040	0,006	0,035	N/A
16th	0,019	0,112	0,014	0,080	0,013	0,075	N/A
17th	0,024	0,139	0,029	0,165	0,052	0,299	N/A
18th	0,014	0,080	0,016	0,094	0,018	0,104	N/A
19th	0,010	0,060	0,021	0,123	0,031	0,178	N/A
20th	0,078	0,447	0,101	0,578	0,106	0,610	N/A
21th	0,003	0,014	0,003	0,017	0,004	0,023	N/A
22th	0,025	0,145	0,024	0,140	0,022	0,127	N/A
23th	0,017	0,096	0,019	0,110	0,021	0,121	N/A
24th	0,004	0,021	0,004	0,023	0,004	0,023	N/A
25th	0,016	0,091	0,069	0,399	0,053	0,305	N/A
26th	0,011	0,062	0,013	0,072	0,040	0,230	N/A
27th	0,009	0,050	0,020	0,115	0,015	0,086	N/A
28th	0,008	0,047	0,006	0,033	0,016	0,092	N/A
29th	0,021	0,123	0,075	0,433	0,052	0,299	N/A
30th	0,002	0,012	0,005	0,030	0,042	0,242	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,011	0,062	0,028	0,164	0,015	0,086	N/A
32th	0,006	0,033	0,004	0,022	0,012	0,069	N/A
33th	0,003	0,018	0,005	0,031	0,007	0,040	N/A
34th	0,007	0,042	0,004	0,023	0,005	0,029	N/A
35th	0,007	0,041	0,025	0,144	0,012	0,069	N/A
36th	0,003	0,015	0,002	0,013	0,007	0,040	N/A
37th	0,007	0,040	0,021	0,120	0,015	0,086	N/A
38th	0,006	0,035	0,002	0,014	0,006	0,035	N/A
39th	0,003	0,016	0,002	0,010	0,004	0,023	N/A
40th	0,006	0,032	0,003	0,014	0,003	0,017	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1319,8		-2636,7		-3995,4		
AC Voltage [V]	229,71		229,42		229,12		
AC Current [A]	5,75		11,50		17,45		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,060		1,597		2,106		
PWHD	2,747		4,711		4,772		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,753	-	11,505	-	17,479	-	-
2nd	0,017	0,101	0,022	0,128	0,064	0,098	8,00
3rd	0,006	0,033	0,009	0,051	0,012	0,035	N/A
4th	0,018	0,106	0,028	0,163	0,099	0,104	4,00
5th	0,114	0,654	0,180	1,033	0,236	0,656	10,70
6th	0,023	0,134	0,026	0,149	0,027	0,132	2,67
7th	0,066	0,377	0,097	0,560	0,141	0,380	7,20
8th	0,027	0,155	0,026	0,147	0,005	0,155	2,00
9th	0,005	0,028	0,004	0,024	0,004	0,029	N/A
10th	0,034	0,197	0,044	0,251	0,053	0,196	1,60
11th	0,033	0,192	0,037	0,214	0,078	0,190	3,10
12th	0,004	0,023	0,003	0,019	0,007	0,023	1,33
13th	0,039	0,224	0,032	0,182	0,062	0,224	2,00
14th	0,025	0,141	0,024	0,137	0,030	0,144	N/A
15th	0,002	0,011	0,004	0,020	0,004	0,012	N/A
16th	0,019	0,112	0,015	0,085	0,014	0,109	N/A
17th	0,025	0,141	0,029	0,169	0,054	0,144	N/A
18th	0,014	0,079	0,015	0,088	0,018	0,081	N/A
19th	0,011	0,065	0,021	0,120	0,032	0,063	N/A
20th	0,081	0,467	0,105	0,602	0,114	0,466	N/A
21th	0,006	0,033	0,006	0,034	0,006	0,035	N/A
22th	0,026	0,152	0,025	0,143	0,022	0,150	N/A
23th	0,016	0,093	0,021	0,122	0,026	0,092	N/A
24th	0,004	0,023	0,003	0,018	0,004	0,023	N/A
25th	0,017	0,099	0,075	0,430	0,055	0,098	N/A
26th	0,011	0,064	0,014	0,079	0,045	0,063	N/A
27th	0,006	0,037	0,020	0,115	0,014	0,035	N/A
28th	0,009	0,050	0,005	0,029	0,016	0,052	N/A
29th	0,023	0,130	0,077	0,445	0,052	0,132	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,017	0,006	0,033	0,046	0,017	N/A
31th	0,007	0,043	0,023	0,131	0,014	0,040	N/A
32th	0,007	0,040	0,004	0,024	0,010	0,040	N/A
33th	0,003	0,019	0,002	0,010	0,004	0,017	N/A
34th	0,009	0,053	0,004	0,023	0,006	0,052	N/A
35th	0,005	0,029	0,025	0,144	0,012	0,029	N/A
36th	0,003	0,020	0,002	0,013	0,007	0,017	N/A
37th	0,009	0,052	0,022	0,125	0,014	0,052	N/A
38th	0,007	0,041	0,002	0,014	0,006	0,040	N/A
39th	0,002	0,013	0,002	0,011	0,003	0,012	N/A
40th	0,006	0,034	0,003	0,015	0,003	0,035	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1244,8		2487,5		3700,2		
AC Voltage [V]	230,30		230,57		230,85		
AC Current [A]	5,41		10,79		16,03		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,041		1,053		1,359		
PWHD	2,398		4,045		5,683		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,404	-	10,722	-	15,920	-	-
2nd	0,022	0,129	0,018	0,106	0,028	0,160	8,00
3rd	0,003	0,019	0,005	0,029	0,006	0,036	N/A
4th	0,019	0,109	0,013	0,074	0,032	0,183	4,00
5th	0,091	0,525	0,066	0,379	0,088	0,508	10,70
6th	0,008	0,046	0,009	0,050	0,009	0,050	2,67
7th	0,110	0,635	0,079	0,457	0,068	0,388	7,20
8th	0,027	0,157	0,033	0,191	0,025	0,146	2,00
9th	0,004	0,023	0,003	0,020	0,004	0,024	N/A
10th	0,031	0,180	0,039	0,223	0,039	0,224	1,60
11th	0,034	0,195	0,027	0,154	0,044	0,255	3,10
12th	0,004	0,022	0,004	0,025	0,009	0,052	1,33
13th	0,021	0,122	0,021	0,120	0,037	0,214	2,00
14th	0,028	0,159	0,020	0,115	0,024	0,139	N/A
15th	0,004	0,024	0,006	0,037	0,006	0,033	N/A
16th	0,025	0,147	0,014	0,079	0,016	0,093	N/A
17th	0,028	0,162	0,011	0,061	0,023	0,133	N/A
18th	0,016	0,089	0,013	0,073	0,009	0,053	N/A
19th	0,031	0,181	0,022	0,126	0,027	0,158	N/A
20th	0,018	0,105	0,011	0,063	0,019	0,108	N/A
21th	0,003	0,016	0,005	0,028	0,005	0,027	N/A
22th	0,022	0,126	0,018	0,104	0,020	0,113	N/A
23th	0,033	0,187	0,033	0,188	0,026	0,150	N/A
24th	0,003	0,016	0,005	0,030	0,017	0,100	N/A
25th	0,031	0,179	0,074	0,426	0,064	0,369	N/A
26th	0,012	0,070	0,010	0,055	0,099	0,569	N/A
27th	0,006	0,032	0,010	0,055	0,011	0,064	N/A
28th	0,014	0,081	0,016	0,093	0,011	0,066	N/A
29th	0,025	0,143	0,088	0,505	0,066	0,382	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,016	0,005	0,029	0,108	0,619	N/A
31th	0,011	0,062	0,030	0,173	0,019	0,110	N/A
32th	0,006	0,036	0,004	0,024	0,023	0,131	N/A
33th	0,003	0,019	0,002	0,013	0,005	0,031	N/A
34th	0,006	0,036	0,004	0,022	0,004	0,024	N/A
35th	0,012	0,067	0,022	0,128	0,017	0,099	N/A
36th	0,002	0,011	0,002	0,014	0,016	0,094	N/A
37th	0,016	0,091	0,020	0,113	0,009	0,054	N/A
38th	0,003	0,020	0,003	0,018	0,013	0,076	N/A
39th	0,003	0,015	0,003	0,017	0,003	0,019	N/A
40th	0,003	0,016	0,003	0,019	0,003	0,019	N/A
Note							
For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1240,1		2480,8		3691,2		
AC Voltage [V]	230,25		230,48		230,71		
AC Current [A]	5,39		10,70		15,89		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,122		1,159		1,516		
PWHD	3,096		4,623		6,449		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,385	-	10,699	-	15,891	-	-
2nd	0,015	0,088	0,006	0,036	0,024	0,137	8,00
3rd	0,009	0,052	0,013	0,075	0,015	0,085	N/A
4th	0,020	0,114	0,014	0,082	0,035	0,201	4,00
5th	0,093	0,536	0,067	0,385	0,088	0,506	10,70
6th	0,011	0,063	0,013	0,075	0,012	0,071	2,67
7th	0,107	0,617	0,074	0,428	0,062	0,357	7,20
8th	0,026	0,147	0,031	0,180	0,025	0,143	2,00
9th	0,003	0,018	0,004	0,025	0,006	0,035	N/A
10th	0,031	0,177	0,039	0,223	0,040	0,232	1,60
11th	0,033	0,190	0,026	0,151	0,044	0,255	3,10
12th	0,003	0,017	0,003	0,018	0,009	0,049	1,33
13th	0,019	0,112	0,021	0,120	0,035	0,202	2,00
14th	0,029	0,166	0,020	0,112	0,025	0,142	N/A
15th	0,003	0,017	0,003	0,017	0,003	0,019	N/A
16th	0,025	0,141	0,013	0,076	0,015	0,089	N/A
17th	0,028	0,162	0,009	0,051	0,027	0,154	N/A
18th	0,015	0,086	0,013	0,077	0,009	0,051	N/A
19th	0,036	0,205	0,019	0,111	0,025	0,146	N/A
20th	0,082	0,471	0,097	0,557	0,124	0,714	N/A
21th	0,003	0,019	0,006	0,032	0,007	0,042	N/A
22th	0,021	0,119	0,018	0,103	0,016	0,089	N/A
23th	0,028	0,160	0,032	0,182	0,031	0,178	N/A
24th	0,003	0,015	0,004	0,023	0,016	0,094	N/A
25th	0,029	0,167	0,068	0,390	0,058	0,335	N/A
26th	0,013	0,077	0,010	0,055	0,094	0,541	N/A
27th	0,007	0,039	0,022	0,125	0,016	0,093	N/A
28th	0,015	0,085	0,016	0,095	0,034	0,194	N/A
29th	0,021	0,123	0,083	0,478	0,065	0,373	N/A
30th	0,002	0,014	0,005	0,026	0,104	0,599	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,008	0,048	0,029	0,166	0,023	0,133	N/A
32th	0,006	0,036	0,005	0,028	0,022	0,125	N/A
33th	0,002	0,009	0,005	0,027	0,006	0,035	N/A
34th	0,007	0,042	0,005	0,029	0,004	0,025	N/A
35th	0,009	0,054	0,024	0,138	0,021	0,118	N/A
36th	0,002	0,011	0,002	0,013	0,016	0,094	N/A
37th	0,015	0,086	0,023	0,129	0,015	0,088	N/A
38th	0,004	0,021	0,004	0,024	0,014	0,081	N/A
39th	0,002	0,010	0,003	0,019	0,003	0,018	N/A
40th	0,004	0,025	0,003	0,018	0,003	0,018	N/A
Note For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1240,3		2479,8		3688,9		
AC Voltage [V]	230,27		230,54		230,80		
AC Current [A]	5,39		10,76		15,88		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,151		1,239		1,544		
PWHD	3,241		4,965		6,616		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,385	-	10,755	-	15,875	-	-
2nd	0,014	0,082	0,015	0,087	0,034	0,196	8,00
3rd	0,007	0,038	0,011	0,061	0,011	0,066	N/A
4th	0,020	0,115	0,015	0,084	0,033	0,189	4,00
5th	0,092	0,528	0,064	0,369	0,087	0,500	10,70
6th	0,018	0,104	0,020	0,115	0,018	0,103	2,67
7th	0,110	0,633	0,079	0,456	0,063	0,361	7,20
8th	0,028	0,161	0,034	0,195	0,025	0,143	2,00
9th	0,006	0,037	0,007	0,038	0,004	0,025	N/A
10th	0,031	0,178	0,039	0,224	0,039	0,225	1,60
11th	0,032	0,187	0,026	0,147	0,045	0,257	3,10
12th	0,006	0,033	0,005	0,029	0,010	0,057	1,33
13th	0,023	0,131	0,025	0,143	0,035	0,202	2,00
14th	0,029	0,165	0,021	0,123	0,025	0,143	N/A
15th	0,002	0,013	0,004	0,024	0,003	0,018	N/A
16th	0,025	0,141	0,013	0,075	0,015	0,087	N/A
17th	0,030	0,171	0,013	0,076	0,026	0,147	N/A
18th	0,015	0,084	0,013	0,072	0,009	0,053	N/A
19th	0,035	0,202	0,017	0,097	0,027	0,158	N/A
20th	0,086	0,497	0,114	0,654	0,121	0,694	N/A
21th	0,004	0,020	0,008	0,043	0,007	0,038	N/A
22th	0,021	0,123	0,019	0,107	0,017	0,096	N/A
23th	0,030	0,175	0,032	0,184	0,030	0,174	N/A
24th	0,005	0,030	0,006	0,032	0,022	0,129	N/A
25th	0,029	0,166	0,072	0,414	0,062	0,355	N/A
26th	0,013	0,076	0,008	0,045	0,101	0,583	N/A
27th	0,008	0,045	0,019	0,111	0,014	0,081	N/A
28th	0,015	0,089	0,018	0,104	0,035	0,201	N/A
29th	0,024	0,141	0,088	0,504	0,066	0,379	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,020	0,005	0,027	0,112	0,642	N/A
31th	0,009	0,050	0,027	0,158	0,016	0,092	N/A
32th	0,007	0,041	0,006	0,033	0,013	0,072	N/A
33th	0,002	0,011	0,003	0,019	0,006	0,033	N/A
34th	0,007	0,040	0,005	0,031	0,004	0,021	N/A
35th	0,011	0,064	0,022	0,126	0,021	0,119	N/A
36th	0,002	0,014	0,002	0,013	0,016	0,092	N/A
37th	0,016	0,090	0,020	0,115	0,012	0,069	N/A
38th	0,004	0,024	0,004	0,025	0,012	0,071	N/A
39th	0,002	0,013	0,002	0,010	0,003	0,018	N/A
40th	0,004	0,024	0,004	0,021	0,004	0,023	N/A
Note							
For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1323,2		-2641,9		-4012,0		
AC Voltage [V]	229,71		229,41		229,08		
AC Current [A]	5,77		11,52		17,52		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	0,948		1,456		1,986		
PWHD	1,852		3,824		3,551		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,761	-	11,517	-	17,515	-	-
2nd	0,016	0,093	0,016	0,093	0,065	0,376	8,00
3rd	0,005	0,031	0,006	0,037	0,007	0,042	N/A
4th	0,021	0,121	0,032	0,185	0,106	0,609	4,00
5th	0,112	0,641	0,176	1,012	0,233	1,339	10,70
6th	0,013	0,074	0,013	0,075	0,013	0,074	2,67
7th	0,066	0,381	0,098	0,565	0,143	0,820	7,20
8th	0,027	0,153	0,025	0,142	0,006	0,034	2,00
9th	0,003	0,017	0,002	0,013	0,003	0,016	N/A
10th	0,033	0,188	0,043	0,245	0,053	0,304	1,60
11th	0,036	0,205	0,039	0,222	0,079	0,454	3,10
12th	0,003	0,017	0,002	0,014	0,006	0,036	1,33
13th	0,040	0,230	0,032	0,186	0,063	0,360	2,00
14th	0,024	0,136	0,022	0,126	0,029	0,164	N/A
15th	0,004	0,022	0,004	0,023	0,003	0,019	N/A
16th	0,021	0,121	0,014	0,082	0,014	0,081	N/A
17th	0,025	0,142	0,030	0,173	0,053	0,304	N/A
18th	0,015	0,085	0,017	0,095	0,016	0,094	N/A
19th	0,013	0,074	0,022	0,128	0,032	0,186	N/A
20th	0,018	0,104	0,014	0,081	0,014	0,081	N/A
21th	0,004	0,024	0,006	0,035	0,005	0,028	N/A
22th	0,025	0,146	0,026	0,148	0,022	0,125	N/A
23th	0,016	0,089	0,023	0,133	0,022	0,127	N/A
24th	0,003	0,015	0,004	0,025	0,004	0,021	N/A
25th	0,021	0,118	0,075	0,429	0,055	0,318	N/A
26th	0,010	0,055	0,011	0,065	0,043	0,246	N/A
27th	0,005	0,027	0,008	0,044	0,007	0,041	N/A
28th	0,009	0,052	0,004	0,020	0,012	0,071	N/A
29th	0,023	0,133	0,075	0,431	0,048	0,277	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,002	0,014	0,006	0,033	0,037	0,213	N/A
31th	0,008	0,046	0,025	0,145	0,015	0,085	N/A
32th	0,006	0,032	0,004	0,021	0,012	0,071	N/A
33th	0,003	0,018	0,008	0,048	0,006	0,035	N/A
34th	0,009	0,050	0,003	0,020	0,006	0,034	N/A
35th	0,008	0,043	0,025	0,144	0,013	0,074	N/A
36th	0,002	0,012	0,002	0,014	0,007	0,039	N/A
37th	0,007	0,041	0,021	0,120	0,011	0,064	N/A
38th	0,006	0,034	0,002	0,013	0,008	0,044	N/A
39th	0,004	0,023	0,004	0,024	0,005	0,028	N/A
40th	0,005	0,029	0,002	0,012	0,003	0,017	N/A
Note							
For test result (discharge mode P_{SMAX}, P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1324,1		-2642,0		-4012,0		
AC Voltage [V]	229,75		229,49		229,22		
AC Current [A]	5,77		11,52		17,51		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,039		1,573		2,092		
PWHD	2,645		4,599		4,418		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,764	-	11,514	-	17,505	-	-
2nd	0,021	0,122	0,032	0,186	0,090	0,515	8,00
3rd	0,008	0,045	0,008	0,049	0,009	0,053	N/A
4th	0,018	0,104	0,030	0,173	0,105	0,604	4,00
5th	0,114	0,657	0,178	1,022	0,233	1,339	10,70
6th	0,011	0,062	0,014	0,079	0,015	0,085	2,67
7th	0,064	0,369	0,098	0,564	0,142	0,817	7,20
8th	0,024	0,141	0,023	0,134	0,006	0,033	2,00
9th	0,004	0,026	0,003	0,019	0,004	0,024	N/A
10th	0,034	0,196	0,042	0,241	0,052	0,299	1,60
11th	0,034	0,198	0,036	0,209	0,078	0,448	3,10
12th	0,003	0,017	0,003	0,015	0,005	0,031	1,33
13th	0,036	0,208	0,029	0,168	0,059	0,338	2,00
14th	0,025	0,143	0,022	0,127	0,029	0,167	N/A
15th	0,004	0,026	0,007	0,039	0,006	0,035	N/A
16th	0,019	0,112	0,014	0,080	0,013	0,072	N/A
17th	0,024	0,138	0,028	0,164	0,052	0,300	N/A
18th	0,014	0,080	0,017	0,096	0,017	0,096	N/A
19th	0,010	0,060	0,021	0,123	0,031	0,181	N/A
20th	0,078	0,446	0,103	0,592	0,103	0,593	N/A
21th	0,003	0,014	0,003	0,019	0,004	0,022	N/A
22th	0,025	0,144	0,025	0,142	0,022	0,125	N/A
23th	0,017	0,096	0,019	0,109	0,021	0,123	N/A
24th	0,003	0,020	0,004	0,023	0,004	0,023	N/A
25th	0,016	0,091	0,069	0,399	0,053	0,303	N/A
26th	0,011	0,062	0,013	0,073	0,037	0,213	N/A
27th	0,009	0,051	0,020	0,115	0,015	0,085	N/A
28th	0,008	0,047	0,006	0,034	0,016	0,093	N/A
29th	0,022	0,124	0,075	0,433	0,051	0,295	N/A
30th	0,002	0,012	0,005	0,031	0,039	0,223	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,011	0,062	0,029	0,164	0,015	0,088	N/A
32th	0,006	0,033	0,004	0,022	0,012	0,068	N/A
33th	0,003	0,017	0,005	0,030	0,007	0,040	N/A
34th	0,007	0,042	0,004	0,022	0,006	0,032	N/A
35th	0,007	0,041	0,025	0,143	0,012	0,071	N/A
36th	0,003	0,015	0,002	0,013	0,006	0,036	N/A
37th	0,007	0,039	0,021	0,119	0,015	0,084	N/A
38th	0,006	0,035	0,002	0,014	0,006	0,033	N/A
39th	0,003	0,016	0,002	0,011	0,004	0,025	N/A
40th	0,006	0,032	0,002	0,014	0,003	0,019	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1321,9		-2637,4		-4004,4		
AC Voltage [V]	229,71		229,42		229,11		
AC Current [A]	5,76		11,50		17,48		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,059		1,603		2,096		
PWHD	2,738		4,746		4,633		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,756	-	11,498	-	17,480	-	-
2nd	0,017	0,096	0,022	0,129	0,064	0,368	8,00
3rd	0,006	0,034	0,009	0,050	0,012	0,069	N/A
4th	0,019	0,107	0,029	0,164	0,101	0,581	4,00
5th	0,114	0,655	0,180	1,034	0,236	1,357	10,70
6th	0,023	0,132	0,026	0,149	0,027	0,155	2,67
7th	0,066	0,377	0,097	0,560	0,142	0,817	7,20
8th	0,027	0,155	0,025	0,146	0,005	0,029	2,00
9th	0,005	0,027	0,003	0,017	0,005	0,029	N/A
10th	0,034	0,197	0,044	0,252	0,053	0,305	1,60
11th	0,033	0,192	0,037	0,214	0,079	0,454	3,10
12th	0,004	0,023	0,003	0,020	0,007	0,040	1,33
13th	0,039	0,224	0,032	0,182	0,062	0,357	2,00
14th	0,025	0,141	0,024	0,137	0,030	0,173	N/A
15th	0,002	0,011	0,004	0,021	0,004	0,023	N/A
16th	0,019	0,112	0,015	0,084	0,014	0,081	N/A
17th	0,025	0,142	0,029	0,167	0,054	0,311	N/A
18th	0,014	0,078	0,016	0,091	0,017	0,098	N/A
19th	0,011	0,066	0,021	0,122	0,032	0,184	N/A
20th	0,081	0,464	0,107	0,617	0,110	0,633	N/A
21th	0,006	0,033	0,006	0,037	0,005	0,029	N/A
22th	0,027	0,153	0,025	0,145	0,022	0,127	N/A
23th	0,016	0,093	0,021	0,122	0,026	0,150	N/A
24th	0,004	0,023	0,003	0,019	0,004	0,023	N/A
25th	0,017	0,099	0,075	0,429	0,055	0,316	N/A
26th	0,011	0,064	0,014	0,079	0,041	0,236	N/A
27th	0,007	0,038	0,020	0,115	0,014	0,081	N/A
28th	0,009	0,050	0,005	0,030	0,016	0,092	N/A
29th	0,023	0,130	0,077	0,445	0,052	0,299	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,017	0,006	0,034	0,042	0,242	N/A
31th	0,007	0,043	0,023	0,132	0,015	0,086	N/A
32th	0,007	0,039	0,004	0,024	0,011	0,063	N/A
33th	0,003	0,018	0,002	0,010	0,004	0,023	N/A
34th	0,009	0,052	0,004	0,022	0,006	0,035	N/A
35th	0,005	0,029	0,025	0,144	0,012	0,069	N/A
36th	0,003	0,019	0,002	0,013	0,006	0,035	N/A
37th	0,009	0,051	0,021	0,123	0,014	0,081	N/A
38th	0,007	0,041	0,002	0,014	0,006	0,035	N/A
39th	0,002	0,014	0,002	0,012	0,003	0,017	N/A
40th	0,006	0,034	0,003	0,015	0,003	0,017	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1243,7		2471,9		3664,9		
AC Voltage [V]	230,30		230,56		230,84		
AC Current [A]	5,41		10,72		15,88		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,040		1,052		1,372		
PWHD	2,394		4,039		5,773		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,401	-	10,721	-	15,877	-	-
2nd	0,023	0,131	0,018	0,106	0,028	0,160	8,00
3rd	0,004	0,022	0,005	0,029	0,006	0,036	N/A
4th	0,019	0,109	0,013	0,075	0,032	0,182	4,00
5th	0,091	0,523	0,066	0,379	0,088	0,507	10,70
6th	0,008	0,049	0,009	0,050	0,009	0,050	2,67
7th	0,111	0,636	0,080	0,457	0,068	0,390	7,20
8th	0,027	0,158	0,033	0,191	0,026	0,148	2,00
9th	0,004	0,024	0,003	0,017	0,004	0,025	N/A
10th	0,031	0,180	0,039	0,223	0,039	0,225	1,60
11th	0,034	0,195	0,027	0,154	0,044	0,253	3,10
12th	0,004	0,023	0,005	0,027	0,009	0,052	1,33
13th	0,021	0,122	0,021	0,119	0,037	0,212	2,00
14th	0,028	0,159	0,020	0,115	0,024	0,140	N/A
15th	0,004	0,025	0,007	0,037	0,006	0,032	N/A
16th	0,025	0,146	0,014	0,079	0,016	0,093	N/A
17th	0,028	0,162	0,010	0,059	0,023	0,129	N/A
18th	0,015	0,088	0,012	0,071	0,009	0,054	N/A
19th	0,031	0,181	0,022	0,124	0,027	0,156	N/A
20th	0,018	0,103	0,011	0,064	0,020	0,113	N/A
21th	0,003	0,016	0,005	0,028	0,005	0,027	N/A
22th	0,022	0,126	0,018	0,101	0,020	0,114	N/A
23th	0,033	0,187	0,033	0,188	0,026	0,148	N/A
24th	0,003	0,015	0,005	0,028	0,017	0,100	N/A
25th	0,031	0,179	0,074	0,426	0,063	0,364	N/A
26th	0,012	0,069	0,009	0,055	0,102	0,588	N/A
27th	0,006	0,032	0,010	0,056	0,011	0,064	N/A
28th	0,014	0,082	0,016	0,093	0,012	0,067	N/A
29th	0,025	0,144	0,088	0,505	0,066	0,378	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,016	0,005	0,029	0,110	0,634	N/A
31th	0,011	0,063	0,030	0,173	0,019	0,108	N/A
32th	0,006	0,036	0,004	0,024	0,024	0,136	N/A
33th	0,003	0,018	0,002	0,013	0,005	0,031	N/A
34th	0,006	0,035	0,004	0,022	0,004	0,024	N/A
35th	0,011	0,066	0,022	0,128	0,017	0,098	N/A
36th	0,002	0,010	0,002	0,014	0,017	0,096	N/A
37th	0,016	0,089	0,020	0,113	0,010	0,055	N/A
38th	0,003	0,020	0,003	0,018	0,014	0,079	N/A
39th	0,002	0,014	0,003	0,017	0,003	0,019	N/A
40th	0,003	0,015	0,003	0,019	0,003	0,018	N/A
Note							
For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	1239,1		2465,6		3656,2		
AC Voltage [V]	230,24		230,48		230,71		
AC Current [A]	5,39		10,70		15,85		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,120		1,161		1,543		
PWHD	3,076		4,636		6,608		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,382	-	10,698	-	15,849	-	-
2nd	0,016	0,090	0,006	0,035	0,023	0,135	8,00
3rd	0,009	0,054	0,013	0,075	0,015	0,085	N/A
4th	0,020	0,116	0,014	0,083	0,035	0,199	4,00
5th	0,093	0,536	0,067	0,385	0,088	0,504	10,70
6th	0,011	0,065	0,013	0,076	0,013	0,072	2,67
7th	0,107	0,617	0,074	0,428	0,062	0,358	7,20
8th	0,026	0,149	0,031	0,180	0,025	0,144	2,00
9th	0,003	0,019	0,004	0,025	0,006	0,036	N/A
10th	0,031	0,178	0,039	0,223	0,040	0,233	1,60
11th	0,033	0,191	0,026	0,150	0,044	0,252	3,10
12th	0,003	0,018	0,003	0,019	0,009	0,051	1,33
13th	0,020	0,112	0,021	0,120	0,035	0,200	2,00
14th	0,029	0,166	0,020	0,113	0,025	0,143	N/A
15th	0,003	0,017	0,003	0,016	0,003	0,020	N/A
16th	0,025	0,142	0,013	0,077	0,015	0,088	N/A
17th	0,028	0,161	0,009	0,050	0,026	0,151	N/A
18th	0,015	0,084	0,014	0,078	0,009	0,052	N/A
19th	0,035	0,204	0,019	0,110	0,025	0,143	N/A
20th	0,081	0,466	0,098	0,561	0,131	0,752	N/A
21th	0,003	0,017	0,006	0,032	0,007	0,043	N/A
22th	0,021	0,118	0,018	0,101	0,016	0,091	N/A
23th	0,028	0,160	0,032	0,183	0,031	0,176	N/A
24th	0,003	0,014	0,004	0,021	0,017	0,098	N/A
25th	0,029	0,167	0,068	0,390	0,058	0,331	N/A
26th	0,013	0,077	0,009	0,054	0,096	0,555	N/A
27th	0,007	0,038	0,022	0,126	0,016	0,092	N/A
28th	0,015	0,085	0,017	0,095	0,034	0,196	N/A
29th	0,022	0,124	0,083	0,479	0,064	0,368	N/A
30th	0,003	0,015	0,004	0,024	0,107	0,617	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,009	0,049	0,029	0,167	0,023	0,133	N/A
32th	0,006	0,037	0,005	0,028	0,023	0,129	N/A
33th	0,002	0,010	0,005	0,026	0,006	0,036	N/A
34th	0,007	0,040	0,005	0,029	0,004	0,025	N/A
35th	0,009	0,054	0,024	0,138	0,020	0,117	N/A
36th	0,002	0,012	0,002	0,013	0,017	0,097	N/A
37th	0,015	0,086	0,023	0,130	0,015	0,086	N/A
38th	0,004	0,021	0,004	0,025	0,015	0,083	N/A
39th	0,002	0,010	0,003	0,019	0,003	0,018	N/A
40th	0,004	0,025	0,003	0,017	0,003	0,018	N/A
Note For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)	P

Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmax battery

Phase 3

Power Level	33%		66%		100%		
AC Power [W]	1239,2		2464,3		3653,9		
AC Voltage [V]	230,27		230,54		230,80		
AC Current [A]	5,39		10,69		15,84		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,150		1,206		1,573		
PWHD	3,215		4,817		6,782		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,381	-	10,689	-	15,832	-	-
2nd	0,014	0,081	0,017	0,097	0,034	0,197	8,00
3rd	0,007	0,038	0,011	0,062	0,011	0,065	N/A
4th	0,021	0,118	0,015	0,085	0,033	0,188	4,00
5th	0,092	0,528	0,065	0,373	0,087	0,498	10,70
6th	0,019	0,107	0,020	0,118	0,018	0,104	2,67
7th	0,110	0,634	0,078	0,447	0,063	0,361	7,20
8th	0,028	0,163	0,034	0,193	0,025	0,143	2,00
9th	0,007	0,039	0,005	0,029	0,005	0,026	N/A
10th	0,031	0,180	0,038	0,220	0,039	0,226	1,60
11th	0,033	0,187	0,027	0,153	0,044	0,255	3,10
12th	0,006	0,035	0,006	0,033	0,010	0,058	1,33
13th	0,023	0,132	0,024	0,137	0,035	0,201	2,00
14th	0,029	0,165	0,021	0,120	0,025	0,144	N/A
15th	0,002	0,012	0,004	0,022	0,003	0,019	N/A
16th	0,024	0,140	0,013	0,076	0,015	0,087	N/A
17th	0,029	0,170	0,011	0,066	0,025	0,144	N/A
18th	0,014	0,083	0,014	0,080	0,010	0,055	N/A
19th	0,035	0,201	0,017	0,100	0,027	0,157	N/A
20th	0,086	0,492	0,102	0,588	0,127	0,730	N/A
21th	0,003	0,018	0,006	0,034	0,007	0,038	N/A
22th	0,021	0,122	0,017	0,099	0,017	0,097	N/A
23th	0,030	0,173	0,031	0,178	0,030	0,171	N/A
24th	0,005	0,029	0,007	0,038	0,023	0,134	N/A
25th	0,029	0,166	0,073	0,419	0,061	0,351	N/A
26th	0,013	0,075	0,008	0,048	0,104	0,597	N/A
27th	0,008	0,044	0,020	0,117	0,014	0,079	N/A
28th	0,015	0,088	0,019	0,108	0,036	0,206	N/A
29th	0,025	0,142	0,088	0,507	0,065	0,374	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,019	0,005	0,028	0,115	0,664	N/A
31th	0,009	0,051	0,028	0,159	0,016	0,093	N/A
32th	0,007	0,041	0,005	0,031	0,013	0,074	N/A
33th	0,002	0,011	0,002	0,014	0,006	0,034	N/A
34th	0,007	0,039	0,005	0,030	0,004	0,020	N/A
35th	0,011	0,063	0,022	0,128	0,021	0,119	N/A
36th	0,002	0,013	0,003	0,016	0,016	0,094	N/A
37th	0,015	0,088	0,021	0,119	0,012	0,070	N/A
38th	0,004	0,023	0,004	0,024	0,013	0,073	N/A
39th	0,002	0,012	0,002	0,011	0,003	0,018	N/A
40th	0,004	0,023	0,004	0,022	0,004	0,022	N/A

Note

For test result (discharge mode $P_{SMAX,}$ P_{NINV}) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1320,7		-2641,8		-4014,0		
AC Voltage [V]	229,71		229,41		229,08		
AC Current [A]	5,75		11,52		17,53		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	0,947		1,455		1,987		
PWHD	1,856		3,817		3,534		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,750	-	11,517	-	17,524	-	-
2nd	0,015	0,084	0,016	0,094	0,066	0,381	8,00
3rd	0,005	0,032	0,006	0,036	0,007	0,042	N/A
4th	0,021	0,121	0,032	0,185	0,106	0,611	4,00
5th	0,112	0,642	0,176	1,012	0,233	1,339	10,70
6th	0,013	0,073	0,013	0,075	0,013	0,074	2,67
7th	0,066	0,381	0,098	0,564	0,143	0,820	7,20
8th	0,027	0,154	0,025	0,142	0,006	0,033	2,00
9th	0,003	0,018	0,002	0,012	0,003	0,015	N/A
10th	0,033	0,187	0,043	0,247	0,053	0,304	1,60
11th	0,036	0,207	0,039	0,222	0,079	0,455	3,10
12th	0,003	0,018	0,003	0,015	0,006	0,036	1,33
13th	0,040	0,228	0,032	0,184	0,063	0,360	2,00
14th	0,023	0,134	0,022	0,126	0,029	0,164	N/A
15th	0,004	0,021	0,004	0,021	0,003	0,019	N/A
16th	0,021	0,123	0,014	0,082	0,014	0,082	N/A
17th	0,025	0,142	0,030	0,172	0,053	0,303	N/A
18th	0,015	0,086	0,017	0,095	0,016	0,093	N/A
19th	0,013	0,073	0,022	0,125	0,032	0,186	N/A
20th	0,018	0,103	0,014	0,082	0,014	0,080	N/A
21th	0,004	0,025	0,006	0,033	0,005	0,028	N/A
22th	0,026	0,148	0,026	0,147	0,022	0,126	N/A
23th	0,015	0,088	0,023	0,133	0,022	0,127	N/A
24th	0,003	0,015	0,004	0,025	0,004	0,021	N/A
25th	0,020	0,117	0,074	0,428	0,055	0,317	N/A
26th	0,010	0,056	0,011	0,065	0,042	0,242	N/A
27th	0,005	0,026	0,008	0,044	0,007	0,041	N/A
28th	0,009	0,053	0,003	0,020	0,012	0,072	N/A
29th	0,023	0,134	0,075	0,431	0,048	0,276	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,014	0,006	0,033	0,036	0,209	N/A
31th	0,008	0,047	0,025	0,145	0,015	0,085	N/A
32th	0,006	0,032	0,004	0,021	0,013	0,072	N/A
33th	0,003	0,018	0,008	0,048	0,006	0,036	N/A
34th	0,008	0,049	0,004	0,020	0,006	0,034	N/A
35th	0,008	0,045	0,025	0,143	0,013	0,076	N/A
36th	0,002	0,012	0,002	0,014	0,007	0,039	N/A
37th	0,007	0,040	0,021	0,120	0,011	0,063	N/A
38th	0,006	0,036	0,002	0,013	0,008	0,044	N/A
39th	0,004	0,023	0,004	0,024	0,005	0,027	N/A
40th	0,005	0,029	0,002	0,012	0,003	0,018	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1321,6		-2641,8		-4013,4		
AC Voltage [V]	229,75		229,49		229,22		
AC Current [A]	5,76		11,52		17,52		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,040		1,570		2,094		
PWHD	2,665		4,581		4,420		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	5,754	-	11,513	-	17,512	-	-
2nd	0,022	0,124	0,033	0,187	0,090	0,517	8,00
3rd	0,008	0,045	0,008	0,047	0,009	0,054	N/A
4th	0,018	0,103	0,030	0,174	0,105	0,606	4,00
5th	0,114	0,654	0,178	1,022	0,233	1,340	10,70
6th	0,011	0,063	0,014	0,079	0,015	0,084	2,67
7th	0,064	0,370	0,098	0,563	0,142	0,817	7,20
8th	0,024	0,139	0,023	0,133	0,006	0,032	2,00
9th	0,005	0,026	0,003	0,019	0,004	0,023	N/A
10th	0,034	0,196	0,042	0,242	0,052	0,299	1,60
11th	0,035	0,200	0,036	0,208	0,078	0,448	3,10
12th	0,003	0,017	0,003	0,017	0,005	0,031	1,33
13th	0,036	0,207	0,029	0,168	0,059	0,338	2,00
14th	0,025	0,143	0,022	0,127	0,029	0,167	N/A
15th	0,004	0,025	0,007	0,038	0,006	0,035	N/A
16th	0,019	0,112	0,014	0,080	0,012	0,072	N/A
17th	0,024	0,138	0,028	0,164	0,052	0,300	N/A
18th	0,014	0,081	0,017	0,096	0,017	0,097	N/A
19th	0,010	0,059	0,021	0,122	0,032	0,182	N/A
20th	0,078	0,451	0,102	0,588	0,104	0,595	N/A
21th	0,002	0,014	0,003	0,017	0,004	0,023	N/A
22th	0,025	0,146	0,025	0,141	0,022	0,127	N/A
23th	0,016	0,094	0,019	0,109	0,021	0,123	N/A
24th	0,004	0,021	0,004	0,023	0,004	0,023	N/A
25th	0,016	0,090	0,069	0,398	0,053	0,303	N/A
26th	0,011	0,062	0,013	0,072	0,037	0,210	N/A
27th	0,009	0,050	0,020	0,114	0,015	0,085	N/A
28th	0,008	0,047	0,006	0,034	0,016	0,093	N/A
29th	0,021	0,123	0,075	0,432	0,051	0,295	N/A
30th	0,002	0,013	0,005	0,031	0,038	0,219	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
31th	0,011	0,063	0,028	0,163	0,016	0,090	N/A
32th	0,006	0,034	0,004	0,022	0,012	0,069	N/A
33th	0,003	0,018	0,005	0,030	0,007	0,040	N/A
34th	0,007	0,042	0,004	0,023	0,006	0,032	N/A
35th	0,007	0,042	0,025	0,143	0,012	0,071	N/A
36th	0,003	0,015	0,002	0,013	0,006	0,036	N/A
37th	0,007	0,039	0,021	0,118	0,015	0,087	N/A
38th	0,006	0,035	0,003	0,014	0,006	0,033	N/A
39th	0,003	0,017	0,002	0,011	0,004	0,025	N/A
40th	0,006	0,033	0,002	0,014	0,003	0,019	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-1319,4		-2637,2		-4005,7		
AC Voltage [V]	229,71		229,42		229,11		
AC Current [A]	5,75		11,50		17,49		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,061		1,600		2,097		
PWHD	2,757		4,732		4,628		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	5,745	-	11,497	-	17,486	-	-
2nd	0,019	0,108	0,023	0,130	0,065	0,371	8,00
3rd	0,006	0,034	0,009	0,049	0,012	0,069	N/A
4th	0,018	0,105	0,029	0,164	0,101	0,582	4,00
5th	0,113	0,652	0,180	1,032	0,236	1,358	10,70
6th	0,023	0,132	0,026	0,149	0,026	0,151	2,67
7th	0,066	0,377	0,097	0,560	0,142	0,816	7,20
8th	0,027	0,156	0,026	0,147	0,005	0,027	2,00
9th	0,005	0,029	0,003	0,017	0,005	0,031	N/A
10th	0,034	0,197	0,044	0,254	0,053	0,306	1,60
11th	0,034	0,194	0,037	0,212	0,079	0,452	3,10
12th	0,004	0,023	0,004	0,023	0,007	0,038	1,33
13th	0,039	0,223	0,031	0,180	0,062	0,355	2,00
14th	0,024	0,140	0,024	0,138	0,029	0,169	N/A
15th	0,002	0,011	0,003	0,015	0,004	0,021	N/A
16th	0,020	0,112	0,015	0,085	0,014	0,079	N/A
17th	0,024	0,141	0,029	0,166	0,054	0,308	N/A
18th	0,014	0,080	0,016	0,091	0,017	0,096	N/A
19th	0,011	0,065	0,021	0,119	0,032	0,186	N/A
20th	0,082	0,470	0,107	0,615	0,110	0,634	N/A
21th	0,006	0,033	0,006	0,033	0,005	0,032	N/A
22th	0,027	0,154	0,025	0,143	0,022	0,129	N/A
23th	0,016	0,092	0,021	0,121	0,026	0,151	N/A
24th	0,004	0,025	0,003	0,019	0,004	0,022	N/A
25th	0,017	0,098	0,074	0,428	0,055	0,314	N/A
26th	0,011	0,062	0,013	0,078	0,041	0,235	N/A
27th	0,006	0,036	0,020	0,113	0,014	0,078	N/A
28th	0,009	0,050	0,005	0,030	0,016	0,091	N/A
29th	0,023	0,130	0,077	0,444	0,052	0,297	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmax battery							
30th	0,003	0,018	0,006	0,034	0,041	0,238	N/A
31th	0,008	0,043	0,023	0,132	0,015	0,087	N/A
32th	0,007	0,041	0,004	0,025	0,011	0,062	N/A
33th	0,003	0,019	0,002	0,010	0,004	0,021	N/A
34th	0,009	0,053	0,004	0,023	0,006	0,035	N/A
35th	0,005	0,029	0,025	0,143	0,012	0,069	N/A
36th	0,003	0,020	0,002	0,013	0,006	0,036	N/A
37th	0,008	0,049	0,021	0,122	0,015	0,085	N/A
38th	0,007	0,041	0,002	0,014	0,006	0,032	N/A
39th	0,002	0,013	0,002	0,012	0,003	0,017	N/A
40th	0,006	0,034	0,003	0,015	0,003	0,017	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	750,7		1498,0		2282,4		
AC Voltage [V]	230,18		230,35		230,51		
AC Current [A]	3,27		6,51		9,90		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,730		1,795		1,749		
PWHD	3,922		4,165		6,203		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,262	-	6,503	-	9,901	-	-
2nd	0,020	0,199	0,019	0,198	0,012	0,124	8,00
3rd	0,004	0,036	0,004	0,042	0,004	0,045	N/A
4th	0,021	0,208	0,019	0,198	0,016	0,158	4,00
5th	0,086	0,877	0,080	0,816	0,064	0,653	10,70
6th	0,007	0,071	0,007	0,076	0,007	0,069	2,67
7th	0,098	0,994	0,113	1,151	0,084	0,857	7,20
8th	0,028	0,281	0,028	0,287	0,033	0,334	2,00
9th	0,006	0,065	0,004	0,044	0,003	0,027	N/A
10th	0,030	0,301	0,029	0,294	0,038	0,383	1,60
11th	0,031	0,310	0,037	0,373	0,028	0,286	3,10
12th	0,004	0,042	0,004	0,037	0,004	0,045	1,33
13th	0,037	0,379	0,022	0,220	0,023	0,238	2,00
14th	0,029	0,299	0,024	0,242	0,021	0,208	N/A
15th	0,005	0,047	0,004	0,038	0,006	0,058	N/A
16th	0,027	0,273	0,023	0,238	0,015	0,150	N/A
17th	0,031	0,311	0,027	0,275	0,015	0,153	N/A
18th	0,020	0,200	0,019	0,194	0,018	0,186	N/A
19th	0,025	0,255	0,031	0,316	0,012	0,123	N/A
20th	0,017	0,173	0,019	0,189	0,012	0,117	N/A
21th	0,002	0,024	0,004	0,037	0,005	0,050	N/A
22th	0,024	0,246	0,024	0,242	0,020	0,201	N/A
23th	0,024	0,244	0,031	0,317	0,028	0,280	N/A
24th	0,002	0,019	0,003	0,032	0,005	0,048	N/A
25th	0,022	0,228	0,026	0,262	0,058	0,585	N/A
26th	0,017	0,168	0,012	0,126	0,009	0,090	N/A
27th	0,007	0,076	0,006	0,062	0,009	0,088	N/A
28th	0,017	0,169	0,016	0,159	0,017	0,175	N/A
29th	0,023	0,235	0,029	0,298	0,078	0,794	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,002	0,021	0,004	0,039	0,005	0,053	N/A
31th	0,014	0,144	0,015	0,154	0,033	0,336	N/A
32th	0,003	0,031	0,007	0,071	0,004	0,043	N/A
33th	0,002	0,019	0,004	0,036	0,002	0,018	N/A
34th	0,006	0,063	0,007	0,074	0,005	0,048	N/A
35th	0,006	0,060	0,005	0,048	0,015	0,151	N/A
36th	0,002	0,022	0,002	0,022	0,002	0,019	N/A
37th	0,009	0,089	0,011	0,112	0,008	0,083	N/A
38th	0,004	0,044	0,003	0,033	0,004	0,036	N/A
39th	0,002	0,022	0,003	0,030	0,004	0,042	N/A
40th	0,003	0,032	0,003	0,033	0,004	0,040	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	746,8		1492,6		2276,0		
AC Voltage [V]	230,15		230,29		230,44		
AC Current [A]	3,25		6,49		9,88		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,956		2,050		2,081		
PWHD	5,580		6,206		7,977		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,246	-	6,481	-	9,877	-	-
2nd	0,021	0,213	0,017	0,168	0,009	0,090	8,00
3rd	0,008	0,086	0,010	0,101	0,012	0,125	N/A
4th	0,022	0,223	0,020	0,199	0,017	0,173	4,00
5th	0,089	0,906	0,082	0,831	0,066	0,673	10,70
6th	0,010	0,104	0,009	0,089	0,011	0,113	2,67
7th	0,098	0,991	0,109	1,108	0,080	0,812	7,20
8th	0,028	0,279	0,027	0,272	0,033	0,332	2,00
9th	0,003	0,027	0,003	0,034	0,005	0,046	N/A
10th	0,029	0,290	0,029	0,296	0,038	0,387	1,60
11th	0,028	0,285	0,036	0,364	0,028	0,283	3,10
12th	0,004	0,038	0,004	0,036	0,004	0,038	1,33
13th	0,035	0,354	0,020	0,205	0,024	0,239	2,00
14th	0,030	0,304	0,025	0,254	0,021	0,212	N/A
15th	0,002	0,025	0,002	0,025	0,003	0,030	N/A
16th	0,026	0,267	0,023	0,230	0,014	0,145	N/A
17th	0,031	0,317	0,027	0,272	0,014	0,143	N/A
18th	0,019	0,195	0,018	0,187	0,018	0,186	N/A
19th	0,031	0,316	0,035	0,351	0,014	0,140	N/A
20th	0,091	0,928	0,105	1,069	0,118	1,201	N/A
21th	0,003	0,026	0,004	0,038	0,005	0,056	N/A
22th	0,023	0,232	0,023	0,236	0,019	0,193	N/A
23th	0,019	0,193	0,026	0,264	0,025	0,256	N/A
24th	0,002	0,017	0,003	0,028	0,004	0,041	N/A
25th	0,020	0,204	0,024	0,241	0,053	0,533	N/A
26th	0,018	0,185	0,015	0,148	0,011	0,109	N/A
27th	0,007	0,071	0,009	0,095	0,019	0,192	N/A
28th	0,018	0,180	0,017	0,172	0,016	0,165	N/A
29th	0,019	0,189	0,026	0,262	0,073	0,738	N/A
30th	0,003	0,025	0,004	0,036	0,004	0,044	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,011	0,111	0,013	0,130	0,030	0,309	N/A
32th	0,003	0,030	0,008	0,085	0,005	0,053	N/A
33th	0,003	0,026	0,002	0,016	0,005	0,051	N/A
34th	0,007	0,067	0,009	0,087	0,005	0,052	N/A
35th	0,004	0,041	0,002	0,025	0,017	0,172	N/A
36th	0,003	0,025	0,002	0,020	0,002	0,020	N/A
37th	0,008	0,084	0,011	0,112	0,012	0,125	N/A
38th	0,005	0,047	0,004	0,044	0,004	0,040	N/A
39th	0,002	0,021	0,002	0,019	0,003	0,029	N/A
40th	0,003	0,035	0,004	0,042	0,004	0,038	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,6		1492,8		2275,4		
AC Voltage [V]	230,16		230,31		230,49		
AC Current [A]	3,26		6,49		9,88		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	2,006		2,105		2,156		
PWHD	5,879		6,470		8,372		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,249	-	6,481	-	9,872	-	-
2nd	0,016	0,165	0,013	0,132	0,010	0,103	8,00
3rd	0,006	0,058	0,007	0,068	0,010	0,101	N/A
4th	0,020	0,203	0,020	0,206	0,017	0,168	4,00
5th	0,089	0,900	0,080	0,811	0,064	0,649	10,70
6th	0,016	0,158	0,015	0,152	0,017	0,171	2,67
7th	0,099	1,004	0,113	1,144	0,082	0,832	7,20
8th	0,028	0,289	0,029	0,294	0,033	0,340	2,00
9th	0,007	0,070	0,007	0,068	0,005	0,047	N/A
10th	0,029	0,293	0,029	0,294	0,038	0,387	1,60
11th	0,028	0,283	0,035	0,359	0,027	0,278	3,10
12th	0,007	0,068	0,006	0,059	0,006	0,065	1,33
13th	0,039	0,392	0,023	0,234	0,026	0,268	2,00
14th	0,031	0,312	0,025	0,257	0,021	0,214	N/A
15th	0,003	0,035	0,002	0,022	0,003	0,031	N/A
16th	0,027	0,271	0,022	0,226	0,014	0,144	N/A
17th	0,033	0,335	0,028	0,289	0,016	0,166	N/A
18th	0,019	0,188	0,018	0,184	0,018	0,186	N/A
19th	0,028	0,279	0,034	0,346	0,011	0,110	N/A
20th	0,098	0,998	0,111	1,123	0,125	1,272	N/A
21th	0,004	0,037	0,003	0,034	0,005	0,051	N/A
22th	0,022	0,227	0,023	0,232	0,019	0,194	N/A
23th	0,019	0,197	0,029	0,296	0,024	0,244	N/A
24th	0,003	0,030	0,005	0,051	0,006	0,062	N/A
25th	0,021	0,210	0,023	0,236	0,057	0,578	N/A
26th	0,018	0,186	0,015	0,147	0,010	0,097	N/A
27th	0,008	0,082	0,009	0,091	0,018	0,179	N/A
28th	0,018	0,187	0,018	0,179	0,019	0,191	N/A
29th	0,022	0,220	0,028	0,287	0,077	0,785	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,004	0,044	0,004	0,045	N/A
31th	0,013	0,127	0,013	0,129	0,030	0,305	N/A
32th	0,003	0,030	0,009	0,089	0,005	0,050	N/A
33th	0,002	0,023	0,002	0,018	0,002	0,022	N/A
34th	0,006	0,061	0,008	0,085	0,005	0,055	N/A
35th	0,005	0,056	0,005	0,052	0,016	0,165	N/A
36th	0,003	0,028	0,003	0,026	0,002	0,024	N/A
37th	0,010	0,103	0,011	0,113	0,010	0,105	N/A
38th	0,005	0,055	0,004	0,044	0,005	0,048	N/A
39th	0,002	0,022	0,002	0,021	0,002	0,020	N/A
40th	0,003	0,033	0,004	0,040	0,004	0,043	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-890,8		-1789,7		-2704,0		
AC Voltage [V]	229,82		229,63		229,42		
AC Current [A]	3,88		7,80		11,79		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,359		1,677		2,317		
PWHD	2,834		3,474		6,016		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,877	-	7,795	-	11,789	-	-
2nd	0,016	0,137	0,023	0,199	0,025	0,217	8,00
3rd	0,005	0,039	0,007	0,061	0,007	0,060	N/A
4th	0,028	0,240	0,027	0,233	0,039	0,334	4,00
5th	0,090	0,778	0,143	1,233	0,190	1,637	10,70
6th	0,014	0,121	0,013	0,113	0,012	0,108	2,67
7th	0,071	0,616	0,068	0,583	0,099	0,857	7,20
8th	0,022	0,193	0,025	0,220	0,022	0,193	2,00
9th	0,004	0,032	0,003	0,025	0,002	0,019	N/A
10th	0,036	0,310	0,040	0,342	0,046	0,400	1,60
11th	0,051	0,437	0,027	0,235	0,038	0,331	3,10
12th	0,003	0,025	0,003	0,022	0,003	0,024	1,33
13th	0,033	0,286	0,035	0,305	0,032	0,280	2,00
14th	0,030	0,258	0,024	0,207	0,024	0,203	N/A
15th	0,004	0,038	0,004	0,032	0,004	0,031	N/A
16th	0,022	0,192	0,018	0,155	0,015	0,127	N/A
17th	0,014	0,121	0,029	0,246	0,032	0,275	N/A
18th	0,019	0,160	0,020	0,170	0,020	0,172	N/A
19th	0,011	0,094	0,018	0,154	0,022	0,191	N/A
20th	0,014	0,125	0,016	0,136	0,014	0,122	N/A
21th	0,004	0,031	0,004	0,033	0,006	0,051	N/A
22th	0,027	0,232	0,028	0,245	0,028	0,241	N/A
23th	0,009	0,075	0,019	0,164	0,024	0,203	N/A
24th	0,002	0,018	0,004	0,032	0,005	0,044	N/A
25th	0,013	0,108	0,034	0,293	0,077	0,666	N/A
26th	0,011	0,098	0,009	0,078	0,012	0,106	N/A
27th	0,003	0,026	0,005	0,044	0,009	0,077	N/A
28th	0,011	0,096	0,006	0,052	0,004	0,030	N/A
29th	0,026	0,223	0,039	0,335	0,078	0,670	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,023	0,004	0,033	0,007	0,060	N/A
31th	0,015	0,133	0,013	0,113	0,028	0,238	N/A
32th	0,006	0,054	0,003	0,027	0,004	0,033	N/A
33th	0,004	0,031	0,006	0,050	0,009	0,073	N/A
34th	0,008	0,073	0,005	0,044	0,004	0,031	N/A
35th	0,016	0,135	0,010	0,083	0,027	0,235	N/A
36th	0,002	0,014	0,002	0,016	0,003	0,024	N/A
37th	0,003	0,025	0,004	0,034	0,023	0,199	N/A
38th	0,005	0,044	0,003	0,026	0,003	0,023	N/A
39th	0,002	0,019	0,005	0,044	0,005	0,043	N/A
40th	0,005	0,042	0,003	0,029	0,003	0,023	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-891,7		-1790,0		-2703,7		
AC Voltage [V]	229,83		229,66		229,48		
AC Current [A]	3,89		7,80		11,79		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,577		1,926		2,566		
PWHD	4,520		5,338		7,665		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,881	-	7,795	-	11,784	-	-
2nd	0,028	0,244	0,040	0,341	0,043	0,370	8,00
3rd	0,007	0,060	0,008	0,068	0,008	0,073	N/A
4th	0,023	0,201	0,023	0,202	0,037	0,319	4,00
5th	0,093	0,802	0,145	1,253	0,191	1,650	10,70
6th	0,014	0,117	0,014	0,121	0,016	0,139	2,67
7th	0,069	0,598	0,067	0,576	0,100	0,859	7,20
8th	0,020	0,175	0,024	0,204	0,021	0,179	2,00
9th	0,003	0,025	0,004	0,033	0,003	0,030	N/A
10th	0,036	0,311	0,039	0,339	0,045	0,388	1,60
11th	0,049	0,425	0,025	0,218	0,036	0,310	3,10
12th	0,002	0,019	0,002	0,018	0,002	0,019	1,33
13th	0,029	0,248	0,031	0,272	0,029	0,254	2,00
14th	0,031	0,270	0,024	0,208	0,024	0,208	N/A
15th	0,004	0,036	0,005	0,043	0,007	0,060	N/A
16th	0,022	0,188	0,017	0,146	0,015	0,125	N/A
17th	0,015	0,131	0,027	0,233	0,030	0,256	N/A
18th	0,018	0,154	0,019	0,164	0,020	0,174	N/A
19th	0,011	0,097	0,016	0,140	0,022	0,188	N/A
20th	0,095	0,823	0,108	0,932	0,125	1,080	N/A
21th	0,003	0,022	0,002	0,018	0,003	0,027	N/A
22th	0,027	0,235	0,028	0,241	0,027	0,236	N/A
23th	0,007	0,064	0,020	0,176	0,019	0,165	N/A
24th	0,003	0,026	0,003	0,030	0,005	0,041	N/A
25th	0,007	0,058	0,031	0,263	0,072	0,621	N/A
26th	0,013	0,110	0,010	0,083	0,014	0,121	N/A
27th	0,004	0,033	0,009	0,077	0,021	0,178	N/A
28th	0,011	0,097	0,007	0,064	0,007	0,061	N/A
29th	0,022	0,193	0,036	0,314	0,078	0,677	N/A
30th	0,002	0,016	0,003	0,024	0,007	0,056	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,015	0,128	0,019	0,164	0,031	0,270	N/A
32th	0,005	0,045	0,003	0,027	0,004	0,034	N/A
33th	0,003	0,022	0,004	0,036	0,006	0,049	N/A
34th	0,007	0,057	0,004	0,032	0,004	0,035	N/A
35th	0,011	0,091	0,008	0,069	0,027	0,234	N/A
36th	0,002	0,019	0,002	0,016	0,003	0,022	N/A
37th	0,005	0,046	0,006	0,050	0,023	0,202	N/A
38th	0,006	0,049	0,003	0,030	0,003	0,026	N/A
39th	0,002	0,017	0,002	0,020	0,003	0,025	N/A
40th	0,005	0,042	0,003	0,029	0,003	0,027	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-890,4		-1786,8		-2698,7		
AC Voltage [V]	229,80		229,61		229,41		
AC Current [A]	3,88		7,79		11,77		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,605		1,955		2,612		
PWHD	4,642		5,539		7,923		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,876	-	7,783	-	11,767	-	-
2nd	0,021	0,183	0,026	0,227	0,029	0,253	8,00
3rd	0,005	0,044	0,007	0,059	0,009	0,077	N/A
4th	0,025	0,216	0,024	0,206	0,035	0,302	4,00
5th	0,093	0,805	0,146	1,257	0,194	1,670	10,70
6th	0,027	0,230	0,026	0,225	0,028	0,238	2,67
7th	0,070	0,605	0,066	0,568	0,099	0,851	7,20
8th	0,022	0,186	0,026	0,225	0,023	0,201	2,00
9th	0,005	0,041	0,004	0,034	0,003	0,028	N/A
10th	0,036	0,311	0,041	0,352	0,048	0,410	1,60
11th	0,048	0,411	0,025	0,219	0,038	0,324	3,10
12th	0,004	0,032	0,003	0,025	0,003	0,022	1,33
13th	0,031	0,267	0,035	0,301	0,032	0,273	2,00
14th	0,031	0,268	0,025	0,214	0,026	0,221	N/A
15th	0,002	0,016	0,003	0,022	0,004	0,034	N/A
16th	0,022	0,191	0,017	0,148	0,016	0,135	N/A
17th	0,014	0,123	0,028	0,241	0,031	0,264	N/A
18th	0,017	0,151	0,018	0,156	0,019	0,160	N/A
19th	0,010	0,086	0,017	0,148	0,021	0,182	N/A
20th	0,099	0,855	0,113	0,973	0,131	1,126	N/A
21th	0,005	0,043	0,005	0,045	0,006	0,051	N/A
22th	0,027	0,233	0,029	0,247	0,027	0,236	N/A
23th	0,007	0,063	0,023	0,194	0,022	0,190	N/A
24th	0,005	0,040	0,006	0,048	0,004	0,034	N/A
25th	0,010	0,086	0,032	0,277	0,077	0,667	N/A
26th	0,013	0,116	0,011	0,096	0,015	0,130	N/A
27th	0,002	0,017	0,009	0,078	0,022	0,186	N/A
28th	0,011	0,099	0,008	0,067	0,006	0,054	N/A
29th	0,022	0,193	0,038	0,328	0,080	0,694	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,027	0,005	0,039	0,007	0,059	N/A
31th	0,015	0,130	0,015	0,126	0,026	0,223	N/A
32th	0,007	0,059	0,004	0,033	0,005	0,042	N/A
33th	0,003	0,026	0,002	0,020	0,003	0,025	N/A
34th	0,007	0,061	0,004	0,037	0,004	0,036	N/A
35th	0,008	0,067	0,007	0,059	0,027	0,236	N/A
36th	0,002	0,019	0,003	0,022	0,002	0,021	N/A
37th	0,005	0,043	0,006	0,054	0,024	0,209	N/A
38th	0,007	0,057	0,004	0,038	0,003	0,025	N/A
39th	0,003	0,025	0,003	0,027	0,004	0,038	N/A
40th	0,005	0,046	0,004	0,035	0,004	0,033	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	750,5		1499,5		2302,3		
AC Voltage [V]	230,18		230,35		230,52		
AC Current [A]	3,27		6,51		9,99		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,730		1,792		1,762		
PWHD	3,914		4,170		6,339		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,261	-	6,510	-	9,988	-	-
2nd	0,020	0,198	0,020	0,202	0,011	0,116	8,00
3rd	0,004	0,036	0,004	0,043	0,005	0,048	N/A
4th	0,020	0,207	0,020	0,198	0,016	0,160	4,00
5th	0,087	0,878	0,080	0,810	0,064	0,652	10,70
6th	0,007	0,068	0,008	0,078	0,007	0,071	2,67
7th	0,098	0,995	0,113	1,148	0,084	0,852	7,20
8th	0,028	0,281	0,028	0,289	0,033	0,334	2,00
9th	0,006	0,062	0,004	0,044	0,003	0,030	N/A
10th	0,030	0,301	0,029	0,293	0,038	0,384	1,60
11th	0,031	0,310	0,037	0,373	0,028	0,281	3,10
12th	0,004	0,041	0,004	0,037	0,005	0,046	1,33
13th	0,037	0,380	0,022	0,221	0,023	0,230	2,00
14th	0,029	0,299	0,024	0,242	0,020	0,205	N/A
15th	0,005	0,047	0,004	0,037	0,006	0,061	N/A
16th	0,027	0,273	0,023	0,237	0,015	0,148	N/A
17th	0,031	0,311	0,027	0,275	0,014	0,143	N/A
18th	0,020	0,198	0,019	0,196	0,019	0,188	N/A
19th	0,025	0,255	0,031	0,314	0,012	0,125	N/A
20th	0,017	0,173	0,019	0,189	0,012	0,118	N/A
21th	0,003	0,027	0,004	0,036	0,005	0,051	N/A
22th	0,024	0,239	0,024	0,242	0,020	0,205	N/A
23th	0,024	0,244	0,031	0,317	0,028	0,284	N/A
24th	0,002	0,021	0,003	0,035	0,005	0,048	N/A
25th	0,023	0,231	0,026	0,262	0,060	0,609	N/A
26th	0,017	0,168	0,012	0,126	0,009	0,091	N/A
27th	0,007	0,074	0,006	0,064	0,009	0,095	N/A
28th	0,017	0,170	0,016	0,159	0,018	0,179	N/A
29th	0,023	0,233	0,030	0,301	0,080	0,809	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,002	0,022	0,004	0,040	0,005	0,055	N/A
31th	0,014	0,143	0,015	0,156	0,033	0,333	N/A
32th	0,003	0,033	0,007	0,072	0,004	0,045	N/A
33th	0,002	0,018	0,004	0,036	0,002	0,022	N/A
34th	0,006	0,062	0,007	0,073	0,005	0,048	N/A
35th	0,006	0,062	0,004	0,046	0,016	0,159	N/A
36th	0,002	0,023	0,002	0,024	0,002	0,021	N/A
37th	0,009	0,088	0,011	0,111	0,010	0,097	N/A
38th	0,004	0,045	0,003	0,033	0,004	0,038	N/A
39th	0,002	0,023	0,003	0,030	0,004	0,041	N/A
40th	0,003	0,032	0,003	0,033	0,004	0,043	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	746,6		1494,3		2296,0		
AC Voltage [V]	230,15		230,29		230,45		
AC Current [A]	3,25		6,49		9,97		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,952		2,052		2,104		
PWHD	5,565		6,248		8,150		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,245	-	6,489	-	9,963	-	-
2nd	0,021	0,216	0,017	0,171	0,008	0,083	8,00
3rd	0,008	0,085	0,010	0,102	0,012	0,124	N/A
4th	0,022	0,219	0,019	0,197	0,017	0,174	4,00
5th	0,089	0,905	0,081	0,824	0,066	0,668	10,70
6th	0,010	0,105	0,009	0,091	0,012	0,117	2,67
7th	0,098	0,991	0,109	1,105	0,080	0,808	7,20
8th	0,028	0,279	0,027	0,274	0,033	0,334	2,00
9th	0,003	0,028	0,003	0,034	0,005	0,046	N/A
10th	0,029	0,290	0,029	0,297	0,038	0,387	1,60
11th	0,028	0,286	0,036	0,363	0,028	0,280	3,10
12th	0,004	0,039	0,003	0,035	0,004	0,038	1,33
13th	0,035	0,352	0,020	0,207	0,023	0,233	2,00
14th	0,030	0,301	0,025	0,254	0,021	0,210	N/A
15th	0,002	0,025	0,002	0,025	0,003	0,035	N/A
16th	0,026	0,266	0,023	0,231	0,014	0,144	N/A
17th	0,031	0,317	0,027	0,270	0,013	0,135	N/A
18th	0,019	0,193	0,018	0,187	0,019	0,190	N/A
19th	0,031	0,316	0,034	0,348	0,013	0,136	N/A
20th	0,091	0,927	0,107	1,081	0,120	1,218	N/A
21th	0,002	0,025	0,004	0,038	0,006	0,063	N/A
22th	0,022	0,224	0,023	0,236	0,019	0,197	N/A
23th	0,019	0,194	0,026	0,262	0,026	0,263	N/A
24th	0,002	0,017	0,003	0,028	0,004	0,041	N/A
25th	0,020	0,203	0,024	0,240	0,055	0,560	N/A
26th	0,018	0,183	0,014	0,147	0,011	0,110	N/A
27th	0,007	0,074	0,010	0,097	0,020	0,198	N/A
28th	0,018	0,180	0,017	0,174	0,016	0,164	N/A
29th	0,019	0,190	0,026	0,265	0,074	0,755	N/A
30th	0,002	0,024	0,004	0,037	0,005	0,046	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,011	0,109	0,013	0,133	0,031	0,310	N/A
32th	0,003	0,030	0,008	0,085	0,005	0,053	N/A
33th	0,002	0,025	0,002	0,018	0,005	0,053	N/A
34th	0,007	0,067	0,009	0,088	0,005	0,050	N/A
35th	0,004	0,043	0,003	0,026	0,018	0,183	N/A
36th	0,002	0,024	0,002	0,021	0,002	0,021	N/A
37th	0,009	0,087	0,011	0,110	0,014	0,144	N/A
38th	0,005	0,048	0,004	0,044	0,004	0,042	N/A
39th	0,002	0,021	0,002	0,020	0,003	0,032	N/A
40th	0,004	0,038	0,004	0,044	0,004	0,040	N/A
Note For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,5		1494,4		2295,2		
AC Voltage [V]	230,16		230,32		230,50		
AC Current [A]	3,26		6,49		9,96		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,998		2,108		2,180		
PWHD	5,827		6,514		8,535		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,249	-	6,488	-	9,957	-	-
2nd	0,016	0,163	0,012	0,118	0,010	0,106	8,00
3rd	0,006	0,058	0,007	0,069	0,010	0,101	N/A
4th	0,020	0,203	0,020	0,204	0,016	0,166	4,00
5th	0,089	0,899	0,080	0,808	0,064	0,645	10,70
6th	0,015	0,156	0,015	0,154	0,017	0,174	2,67
7th	0,099	1,006	0,112	1,140	0,082	0,832	7,20
8th	0,028	0,287	0,029	0,296	0,034	0,340	2,00
9th	0,007	0,068	0,007	0,068	0,005	0,051	N/A
10th	0,029	0,292	0,029	0,293	0,038	0,389	1,60
11th	0,028	0,281	0,035	0,358	0,027	0,276	3,10
12th	0,007	0,068	0,006	0,057	0,006	0,066	1,33
13th	0,039	0,391	0,023	0,235	0,026	0,265	2,00
14th	0,031	0,312	0,025	0,257	0,021	0,210	N/A
15th	0,003	0,028	0,002	0,021	0,004	0,038	N/A
16th	0,027	0,270	0,022	0,225	0,014	0,143	N/A
17th	0,033	0,335	0,028	0,288	0,015	0,155	N/A
18th	0,018	0,186	0,018	0,186	0,019	0,189	N/A
19th	0,027	0,279	0,034	0,343	0,010	0,103	N/A
20th	0,097	0,987	0,112	1,135	0,127	1,289	N/A
21th	0,004	0,038	0,003	0,034	0,006	0,059	N/A
22th	0,022	0,222	0,023	0,231	0,020	0,198	N/A
23th	0,019	0,196	0,029	0,293	0,024	0,248	N/A
24th	0,003	0,033	0,005	0,053	0,006	0,064	N/A
25th	0,021	0,208	0,023	0,236	0,060	0,604	N/A
26th	0,019	0,188	0,015	0,148	0,010	0,098	N/A
27th	0,008	0,086	0,009	0,093	0,018	0,182	N/A
28th	0,018	0,185	0,018	0,181	0,019	0,190	N/A
29th	0,022	0,220	0,029	0,290	0,079	0,802	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,002	0,025	0,004	0,046	0,005	0,047	N/A
31th	0,012	0,126	0,013	0,133	0,030	0,305	N/A
32th	0,003	0,029	0,009	0,089	0,005	0,052	N/A
33th	0,002	0,023	0,002	0,025	0,003	0,026	N/A
34th	0,006	0,062	0,008	0,086	0,005	0,055	N/A
35th	0,006	0,058	0,005	0,052	0,017	0,176	N/A
36th	0,003	0,027	0,003	0,028	0,002	0,025	N/A
37th	0,009	0,093	0,011	0,109	0,012	0,120	N/A
38th	0,006	0,056	0,004	0,045	0,005	0,048	N/A
39th	0,002	0,023	0,002	0,023	0,002	0,025	N/A
40th	0,003	0,034	0,004	0,042	0,005	0,047	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-892,1		-1796,4		-2715,7		
AC Voltage [V]	229,82		229,63		229,41		
AC Current [A]	3,89		7,83		11,84		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,360		1,685		2,341		
PWHD	2,830		3,488		6,044		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,883	-	7,824	-	11,839	-	-
2nd	0,016	0,139	0,024	0,204	0,027	0,229	8,00
3rd	0,005	0,039	0,007	0,059	0,007	0,063	N/A
4th	0,028	0,241	0,027	0,236	0,040	0,347	4,00
5th	0,090	0,779	0,144	1,241	0,193	1,661	10,70
6th	0,014	0,121	0,013	0,113	0,012	0,107	2,67
7th	0,071	0,615	0,067	0,582	0,100	0,860	7,20
8th	0,023	0,194	0,025	0,219	0,022	0,190	2,00
9th	0,004	0,032	0,003	0,023	0,003	0,028	N/A
10th	0,036	0,311	0,040	0,344	0,047	0,405	1,60
11th	0,051	0,438	0,027	0,233	0,038	0,330	3,10
12th	0,003	0,025	0,003	0,023	0,003	0,022	1,33
13th	0,033	0,285	0,035	0,303	0,032	0,278	2,00
14th	0,030	0,259	0,024	0,207	0,024	0,204	N/A
15th	0,004	0,038	0,004	0,032	0,003	0,029	N/A
16th	0,022	0,192	0,018	0,155	0,015	0,127	N/A
17th	0,014	0,123	0,028	0,246	0,032	0,275	N/A
18th	0,019	0,160	0,020	0,171	0,020	0,174	N/A
19th	0,011	0,095	0,018	0,154	0,022	0,190	N/A
20th	0,014	0,125	0,016	0,135	0,014	0,121	N/A
21th	0,004	0,031	0,004	0,032	0,006	0,052	N/A
22th	0,027	0,229	0,029	0,247	0,028	0,241	N/A
23th	0,008	0,073	0,019	0,166	0,024	0,203	N/A
24th	0,002	0,018	0,004	0,033	0,005	0,045	N/A
25th	0,013	0,108	0,034	0,294	0,077	0,667	N/A
26th	0,011	0,097	0,009	0,077	0,012	0,106	N/A
27th	0,003	0,026	0,005	0,043	0,008	0,072	N/A
28th	0,011	0,096	0,006	0,052	0,003	0,030	N/A
29th	0,026	0,223	0,039	0,337	0,078	0,675	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,023	0,004	0,036	0,007	0,062	N/A
31th	0,015	0,133	0,013	0,114	0,028	0,240	N/A
32th	0,006	0,054	0,003	0,026	0,004	0,032	N/A
33th	0,003	0,030	0,006	0,051	0,008	0,072	N/A
34th	0,008	0,072	0,005	0,043	0,004	0,032	N/A
35th	0,016	0,135	0,010	0,082	0,027	0,237	N/A
36th	0,002	0,015	0,002	0,016	0,003	0,025	N/A
37th	0,003	0,024	0,004	0,035	0,023	0,202	N/A
38th	0,005	0,044	0,003	0,026	0,003	0,026	N/A
39th	0,002	0,019	0,005	0,044	0,005	0,040	N/A
40th	0,005	0,042	0,003	0,028	0,003	0,025	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-893,0		-1796,7		-2715,5		
AC Voltage [V]	229,83		229,66		229,48		
AC Current [A]	3,89		7,83		11,84		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,578		1,939		2,593		
PWHD	4,517		5,385		7,720		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,887	-	7,824	-	11,835	-	-
2nd	0,028	0,245	0,041	0,350	0,045	0,389	8,00
3rd	0,007	0,059	0,008	0,067	0,009	0,074	N/A
4th	0,023	0,201	0,024	0,204	0,038	0,330	4,00
5th	0,093	0,804	0,146	1,262	0,194	1,673	10,70
6th	0,013	0,116	0,014	0,123	0,016	0,142	2,67
7th	0,069	0,598	0,067	0,574	0,100	0,861	7,20
8th	0,020	0,174	0,024	0,203	0,020	0,174	2,00
9th	0,003	0,024	0,004	0,034	0,004	0,032	N/A
10th	0,036	0,312	0,040	0,341	0,045	0,392	1,60
11th	0,049	0,426	0,025	0,216	0,036	0,309	3,10
12th	0,002	0,019	0,002	0,018	0,002	0,017	1,33
13th	0,029	0,248	0,031	0,270	0,029	0,254	2,00
14th	0,031	0,270	0,024	0,208	0,024	0,211	N/A
15th	0,004	0,036	0,005	0,044	0,007	0,059	N/A
16th	0,022	0,189	0,017	0,146	0,015	0,125	N/A
17th	0,015	0,131	0,027	0,233	0,030	0,256	N/A
18th	0,018	0,156	0,019	0,167	0,020	0,174	N/A
19th	0,011	0,097	0,016	0,140	0,022	0,187	N/A
20th	0,095	0,822	0,109	0,941	0,126	1,088	N/A
21th	0,002	0,021	0,002	0,018	0,003	0,023	N/A
22th	0,027	0,232	0,028	0,242	0,028	0,238	N/A
23th	0,007	0,064	0,021	0,178	0,019	0,164	N/A
24th	0,003	0,026	0,004	0,032	0,005	0,043	N/A
25th	0,007	0,057	0,031	0,267	0,072	0,624	N/A
26th	0,013	0,111	0,009	0,081	0,014	0,121	N/A
27th	0,004	0,032	0,009	0,076	0,021	0,178	N/A
28th	0,011	0,096	0,007	0,064	0,007	0,063	N/A
29th	0,023	0,194	0,037	0,317	0,079	0,682	N/A
30th	0,002	0,016	0,003	0,025	0,007	0,058	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,015	0,129	0,019	0,165	0,031	0,271	N/A
32th	0,005	0,044	0,003	0,027	0,004	0,034	N/A
33th	0,002	0,021	0,004	0,036	0,006	0,048	N/A
34th	0,007	0,057	0,004	0,032	0,004	0,036	N/A
35th	0,011	0,093	0,008	0,068	0,027	0,236	N/A
36th	0,002	0,019	0,002	0,016	0,003	0,023	N/A
37th	0,005	0,046	0,006	0,050	0,024	0,211	N/A
38th	0,006	0,049	0,003	0,028	0,003	0,029	N/A
39th	0,002	0,016	0,002	0,019	0,002	0,017	N/A
40th	0,005	0,042	0,003	0,028	0,003	0,029	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-891,6		-1793,5		-2710,4		
AC Voltage [V]	229,80		229,60		229,40		
AC Current [A]	3,89		7,82		11,82		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,606		1,967		2,635		
PWHD	4,651		5,584		7,958		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,881	-	7,813	-	11,817	-	-
2nd	0,021	0,180	0,027	0,234	0,031	0,267	8,00
3rd	0,005	0,046	0,007	0,059	0,009	0,078	N/A
4th	0,025	0,217	0,024	0,209	0,036	0,314	4,00
5th	0,093	0,806	0,147	1,265	0,196	1,693	10,70
6th	0,027	0,230	0,026	0,226	0,028	0,240	2,67
7th	0,070	0,605	0,066	0,567	0,099	0,853	7,20
8th	0,021	0,185	0,026	0,224	0,023	0,198	2,00
9th	0,005	0,040	0,004	0,034	0,003	0,030	N/A
10th	0,036	0,312	0,041	0,355	0,048	0,416	1,60
11th	0,048	0,411	0,025	0,216	0,037	0,323	3,10
12th	0,004	0,031	0,003	0,025	0,002	0,020	1,33
13th	0,031	0,267	0,035	0,298	0,032	0,273	2,00
14th	0,031	0,268	0,025	0,214	0,026	0,224	N/A
15th	0,002	0,015	0,002	0,021	0,003	0,023	N/A
16th	0,022	0,190	0,017	0,148	0,016	0,136	N/A
17th	0,014	0,123	0,028	0,241	0,030	0,262	N/A
18th	0,018	0,151	0,018	0,158	0,019	0,160	N/A
19th	0,010	0,085	0,017	0,148	0,021	0,178	N/A
20th	0,099	0,857	0,114	0,984	0,132	1,135	N/A
21th	0,005	0,042	0,005	0,045	0,006	0,050	N/A
22th	0,027	0,229	0,029	0,248	0,027	0,237	N/A
23th	0,007	0,062	0,023	0,196	0,022	0,190	N/A
24th	0,005	0,039	0,006	0,052	0,004	0,037	N/A
25th	0,010	0,087	0,032	0,279	0,077	0,667	N/A
26th	0,013	0,115	0,011	0,094	0,015	0,132	N/A
27th	0,002	0,017	0,009	0,077	0,021	0,182	N/A
28th	0,011	0,099	0,007	0,064	0,006	0,055	N/A
29th	0,023	0,195	0,038	0,330	0,081	0,699	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,027	0,005	0,043	0,007	0,061	N/A
31th	0,015	0,131	0,015	0,127	0,026	0,221	N/A
32th	0,007	0,059	0,004	0,033	0,005	0,041	N/A
33th	0,003	0,026	0,002	0,020	0,002	0,016	N/A
34th	0,007	0,062	0,004	0,036	0,005	0,040	N/A
35th	0,008	0,068	0,007	0,059	0,027	0,235	N/A
36th	0,002	0,020	0,003	0,022	0,002	0,019	N/A
37th	0,005	0,045	0,006	0,054	0,025	0,213	N/A
38th	0,007	0,057	0,004	0,037	0,004	0,031	N/A
39th	0,003	0,025	0,003	0,027	0,002	0,018	N/A
40th	0,005	0,047	0,004	0,034	0,004	0,036	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	750,3		1499,9		2299,4		
AC Voltage [V]	230,18		230,34		230,51		
AC Current [A]	3,27		6,52		9,98		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,731		1,788		1,760		
PWHD	3,918		4,160		6,320		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,261	-	6,512	-	9,975	-	-
2nd	0,020	0,202	0,020	0,206	0,012	0,119	8,00
3rd	0,004	0,036	0,004	0,042	0,005	0,049	N/A
4th	0,020	0,207	0,020	0,199	0,016	0,160	4,00
5th	0,086	0,877	0,079	0,806	0,064	0,650	10,70
6th	0,007	0,072	0,008	0,079	0,007	0,071	2,67
7th	0,098	0,996	0,113	1,146	0,084	0,852	7,20
8th	0,028	0,280	0,029	0,292	0,033	0,335	2,00
9th	0,006	0,064	0,004	0,044	0,003	0,030	N/A
10th	0,030	0,300	0,029	0,294	0,038	0,385	1,60
11th	0,031	0,310	0,037	0,373	0,028	0,280	3,10
12th	0,004	0,044	0,004	0,037	0,005	0,048	1,33
13th	0,038	0,381	0,022	0,222	0,023	0,232	2,00
14th	0,029	0,298	0,024	0,242	0,020	0,205	N/A
15th	0,005	0,048	0,004	0,038	0,006	0,060	N/A
16th	0,027	0,273	0,023	0,237	0,015	0,150	N/A
17th	0,031	0,313	0,027	0,275	0,014	0,142	N/A
18th	0,019	0,197	0,019	0,195	0,018	0,187	N/A
19th	0,025	0,253	0,031	0,313	0,012	0,126	N/A
20th	0,017	0,176	0,019	0,189	0,012	0,119	N/A
21th	0,003	0,028	0,004	0,037	0,005	0,048	N/A
22th	0,024	0,239	0,024	0,240	0,020	0,205	N/A
23th	0,024	0,246	0,031	0,315	0,028	0,283	N/A
24th	0,002	0,020	0,003	0,035	0,005	0,049	N/A
25th	0,023	0,230	0,026	0,262	0,060	0,606	N/A
26th	0,017	0,170	0,012	0,124	0,009	0,091	N/A
27th	0,008	0,076	0,006	0,063	0,009	0,093	N/A
28th	0,017	0,169	0,016	0,160	0,018	0,182	N/A
29th	0,023	0,234	0,030	0,301	0,079	0,806	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,002	0,021	0,004	0,040	0,005	0,056	N/A
31th	0,014	0,142	0,016	0,159	0,033	0,333	N/A
32th	0,003	0,031	0,007	0,071	0,004	0,044	N/A
33th	0,002	0,018	0,004	0,036	0,002	0,021	N/A
34th	0,006	0,062	0,007	0,073	0,005	0,048	N/A
35th	0,006	0,063	0,004	0,045	0,016	0,159	N/A
36th	0,002	0,023	0,002	0,024	0,002	0,020	N/A
37th	0,009	0,088	0,011	0,108	0,009	0,096	N/A
38th	0,004	0,045	0,003	0,033	0,004	0,038	N/A
39th	0,002	0,021	0,003	0,030	0,004	0,041	N/A
40th	0,003	0,032	0,003	0,034	0,004	0,043	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	746,4		1494,7		2293,0		
AC Voltage [V]	230,15		230,29		230,45		
AC Current [A]	3,25		6,50		9,95		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,955		2,046		2,103		
PWHD	5,562		6,220		8,144		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,244	-	6,491	-	9,951	-	-
2nd	0,022	0,222	0,017	0,175	0,008	0,082	8,00
3rd	0,009	0,088	0,010	0,103	0,012	0,124	N/A
4th	0,022	0,221	0,019	0,196	0,017	0,174	4,00
5th	0,089	0,904	0,081	0,820	0,066	0,666	10,70
6th	0,010	0,105	0,009	0,094	0,012	0,118	2,67
7th	0,098	0,993	0,109	1,103	0,080	0,807	7,20
8th	0,028	0,280	0,027	0,275	0,033	0,334	2,00
9th	0,003	0,027	0,004	0,036	0,005	0,046	N/A
10th	0,029	0,290	0,029	0,298	0,038	0,388	1,60
11th	0,028	0,286	0,036	0,362	0,027	0,279	3,10
12th	0,004	0,038	0,003	0,034	0,004	0,040	1,33
13th	0,035	0,353	0,020	0,208	0,023	0,232	2,00
14th	0,030	0,303	0,025	0,254	0,021	0,211	N/A
15th	0,002	0,024	0,003	0,026	0,003	0,031	N/A
16th	0,026	0,267	0,023	0,230	0,014	0,146	N/A
17th	0,031	0,316	0,026	0,269	0,013	0,133	N/A
18th	0,019	0,193	0,018	0,186	0,019	0,189	N/A
19th	0,031	0,315	0,034	0,347	0,013	0,136	N/A
20th	0,091	0,926	0,106	1,075	0,120	1,222	N/A
21th	0,002	0,025	0,004	0,038	0,006	0,058	N/A
22th	0,022	0,224	0,023	0,234	0,019	0,198	N/A
23th	0,019	0,195	0,026	0,262	0,026	0,263	N/A
24th	0,002	0,018	0,003	0,029	0,005	0,046	N/A
25th	0,020	0,204	0,024	0,240	0,055	0,555	N/A
26th	0,018	0,183	0,014	0,146	0,011	0,111	N/A
27th	0,007	0,071	0,009	0,095	0,019	0,196	N/A
28th	0,018	0,178	0,017	0,173	0,016	0,167	N/A
29th	0,019	0,189	0,026	0,266	0,074	0,753	N/A
30th	0,002	0,023	0,004	0,038	0,005	0,048	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,011	0,110	0,013	0,136	0,030	0,308	N/A
32th	0,003	0,030	0,008	0,086	0,005	0,054	N/A
33th	0,002	0,025	0,002	0,020	0,005	0,052	N/A
34th	0,007	0,067	0,008	0,084	0,005	0,051	N/A
35th	0,004	0,042	0,002	0,025	0,018	0,181	N/A
36th	0,002	0,024	0,002	0,021	0,002	0,022	N/A
37th	0,008	0,085	0,011	0,108	0,014	0,140	N/A
38th	0,005	0,049	0,004	0,045	0,004	0,042	N/A
39th	0,002	0,021	0,002	0,020	0,003	0,031	N/A
40th	0,004	0,038	0,004	0,042	0,004	0,041	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,3		1494,8		2292,3		
AC Voltage [V]	230,16		230,32		230,50		
AC Current [A]	3,26		6,50		9,95		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,999		2,103		2,179		
PWHD	5,829		6,497		8,526		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,248	-	6,490	-	9,945	-	-
2nd	0,015	0,156	0,011	0,110	0,010	0,106	8,00
3rd	0,006	0,060	0,007	0,072	0,010	0,101	N/A
4th	0,020	0,202	0,020	0,204	0,016	0,166	4,00
5th	0,089	0,900	0,079	0,803	0,063	0,642	10,70
6th	0,015	0,157	0,015	0,157	0,017	0,174	2,67
7th	0,099	1,008	0,112	1,138	0,082	0,831	7,20
8th	0,028	0,285	0,029	0,297	0,034	0,342	2,00
9th	0,007	0,069	0,007	0,070	0,005	0,051	N/A
10th	0,029	0,291	0,029	0,294	0,038	0,390	1,60
11th	0,028	0,282	0,035	0,356	0,027	0,274	3,10
12th	0,007	0,069	0,006	0,056	0,007	0,070	1,33
13th	0,039	0,393	0,023	0,235	0,026	0,265	2,00
14th	0,031	0,313	0,025	0,258	0,021	0,211	N/A
15th	0,003	0,028	0,002	0,022	0,003	0,033	N/A
16th	0,027	0,270	0,022	0,224	0,015	0,147	N/A
17th	0,033	0,336	0,028	0,286	0,015	0,154	N/A
18th	0,018	0,187	0,018	0,186	0,019	0,189	N/A
19th	0,028	0,280	0,034	0,342	0,010	0,106	N/A
20th	0,097	0,985	0,111	1,131	0,127	1,292	N/A
21th	0,004	0,037	0,004	0,036	0,005	0,053	N/A
22th	0,022	0,223	0,023	0,230	0,020	0,200	N/A
23th	0,019	0,196	0,029	0,292	0,025	0,250	N/A
24th	0,003	0,032	0,005	0,055	0,006	0,066	N/A
25th	0,021	0,210	0,023	0,236	0,059	0,599	N/A
26th	0,019	0,190	0,014	0,147	0,010	0,101	N/A
27th	0,008	0,081	0,009	0,092	0,017	0,177	N/A
28th	0,018	0,185	0,018	0,180	0,020	0,199	N/A
29th	0,022	0,220	0,029	0,292	0,079	0,798	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,005	0,047	0,005	0,051	N/A
31th	0,013	0,127	0,013	0,135	0,030	0,303	N/A
32th	0,003	0,029	0,009	0,090	0,005	0,051	N/A
33th	0,002	0,021	0,003	0,028	0,002	0,024	N/A
34th	0,006	0,061	0,008	0,086	0,006	0,056	N/A
35th	0,006	0,057	0,005	0,051	0,017	0,175	N/A
36th	0,003	0,027	0,003	0,029	0,003	0,026	N/A
37th	0,010	0,098	0,010	0,106	0,012	0,118	N/A
38th	0,006	0,056	0,004	0,045	0,005	0,050	N/A
39th	0,002	0,022	0,002	0,023	0,002	0,024	N/A
40th	0,003	0,035	0,004	0,041	0,005	0,048	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-893,4		-1783,5		-2724,1		
AC Voltage [V]	229,83		229,62		229,41		
AC Current [A]	3,89		7,77		11,88		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,364		1,657		2,353		
PWHD	2,845		3,473		6,068		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,888	-	7,768	-	11,876	-	-
2nd	0,016	0,138	0,021	0,181	0,027	0,233	8,00
3rd	0,004	0,035	0,007	0,060	0,007	0,060	N/A
4th	0,028	0,242	0,026	0,224	0,041	0,354	4,00
5th	0,091	0,785	0,140	1,208	0,194	1,673	10,70
6th	0,014	0,121	0,013	0,112	0,012	0,104	2,67
7th	0,071	0,612	0,068	0,587	0,100	0,863	7,20
8th	0,023	0,198	0,026	0,224	0,022	0,190	2,00
9th	0,004	0,035	0,003	0,026	0,002	0,017	N/A
10th	0,036	0,311	0,039	0,336	0,047	0,405	1,60
11th	0,051	0,440	0,028	0,242	0,038	0,328	3,10
12th	0,003	0,026	0,002	0,017	0,003	0,026	1,33
13th	0,033	0,285	0,036	0,311	0,032	0,276	2,00
14th	0,030	0,259	0,023	0,198	0,024	0,207	N/A
15th	0,004	0,035	0,004	0,035	0,003	0,026	N/A
16th	0,022	0,190	0,018	0,155	0,015	0,129	N/A
17th	0,014	0,121	0,028	0,242	0,032	0,276	N/A
18th	0,019	0,164	0,020	0,173	0,020	0,173	N/A
19th	0,011	0,095	0,018	0,155	0,022	0,190	N/A
20th	0,014	0,121	0,016	0,138	0,014	0,121	N/A
21th	0,004	0,035	0,004	0,035	0,006	0,052	N/A
22th	0,027	0,233	0,029	0,250	0,028	0,242	N/A
23th	0,008	0,069	0,018	0,155	0,023	0,198	N/A
24th	0,002	0,017	0,003	0,026	0,005	0,043	N/A
25th	0,013	0,112	0,034	0,293	0,078	0,673	N/A
26th	0,011	0,095	0,009	0,078	0,012	0,104	N/A
27th	0,003	0,026	0,005	0,043	0,009	0,078	N/A
28th	0,011	0,095	0,006	0,052	0,004	0,035	N/A
29th	0,026	0,224	0,039	0,336	0,078	0,673	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,004	0,035	0,007	0,060	N/A
31th	0,016	0,138	0,013	0,112	0,028	0,242	N/A
32th	0,006	0,052	0,003	0,026	0,004	0,035	N/A
33th	0,004	0,035	0,006	0,052	0,008	0,069	N/A
34th	0,008	0,069	0,005	0,043	0,004	0,035	N/A
35th	0,016	0,138	0,010	0,086	0,028	0,242	N/A
36th	0,002	0,017	0,002	0,017	0,003	0,026	N/A
37th	0,003	0,026	0,004	0,035	0,024	0,207	N/A
38th	0,005	0,043	0,003	0,026	0,003	0,026	N/A
39th	0,002	0,017	0,005	0,043	0,005	0,043	N/A
40th	0,005	0,043	0,004	0,035	0,003	0,026	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-894,3		-1783,9		-2723,9		
AC Voltage [V]	229,83		229,66		229,48		
AC Current [A]	3,90		7,77		11,88		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,585		1,902		2,598		
PWHD	4,551		5,334		7,710		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,892	-	7,769	-	11,872	-	-
2nd	0,029	0,248	0,033	0,288	0,045	0,387	8,00
3rd	0,007	0,058	0,008	0,067	0,008	0,069	N/A
4th	0,023	0,201	0,022	0,193	0,039	0,332	4,00
5th	0,093	0,806	0,142	1,229	0,195	1,681	10,70
6th	0,014	0,118	0,014	0,120	0,017	0,143	2,67
7th	0,069	0,598	0,067	0,582	0,100	0,864	7,20
8th	0,020	0,174	0,024	0,206	0,020	0,171	2,00
9th	0,003	0,025	0,004	0,032	0,003	0,030	N/A
10th	0,036	0,312	0,039	0,333	0,046	0,394	1,60
11th	0,049	0,425	0,026	0,227	0,036	0,310	3,10
12th	0,002	0,019	0,002	0,018	0,002	0,019	1,33
13th	0,029	0,248	0,032	0,275	0,029	0,254	2,00
14th	0,032	0,272	0,024	0,204	0,025	0,213	N/A
15th	0,004	0,036	0,005	0,044	0,007	0,061	N/A
16th	0,022	0,189	0,017	0,148	0,015	0,126	N/A
17th	0,015	0,132	0,027	0,233	0,030	0,257	N/A
18th	0,018	0,157	0,019	0,165	0,020	0,173	N/A
19th	0,011	0,097	0,016	0,137	0,022	0,187	N/A
20th	0,096	0,830	0,108	0,933	0,125	1,081	N/A
21th	0,003	0,022	0,002	0,021	0,003	0,027	N/A
22th	0,027	0,233	0,028	0,242	0,027	0,237	N/A
23th	0,007	0,063	0,020	0,171	0,019	0,166	N/A
24th	0,003	0,026	0,003	0,029	0,005	0,045	N/A
25th	0,007	0,059	0,030	0,259	0,073	0,628	N/A
26th	0,013	0,111	0,010	0,086	0,014	0,122	N/A
27th	0,004	0,032	0,009	0,082	0,021	0,180	N/A
28th	0,011	0,096	0,007	0,063	0,007	0,064	N/A
29th	0,022	0,194	0,036	0,314	0,079	0,682	N/A
30th	0,002	0,016	0,003	0,023	0,007	0,057	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
31th	0,015	0,129	0,019	0,163	0,032	0,272	N/A
32th	0,005	0,045	0,004	0,030	0,004	0,035	N/A
33th	0,003	0,022	0,004	0,034	0,006	0,049	N/A
34th	0,007	0,057	0,004	0,035	0,004	0,037	N/A
35th	0,011	0,093	0,008	0,070	0,027	0,236	N/A
36th	0,002	0,019	0,002	0,016	0,003	0,026	N/A
37th	0,005	0,047	0,005	0,047	0,024	0,205	N/A
38th	0,006	0,049	0,004	0,031	0,003	0,030	N/A
39th	0,002	0,016	0,002	0,020	0,002	0,016	N/A
40th	0,005	0,042	0,004	0,030	0,003	0,029	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-892,9		-1780,8		-2718,7		
AC Voltage [V]	229,80		229,61		229,40		
AC Current [A]	3,89		7,76		11,86		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,614		1,939		2,642		
PWHD	4,692		5,536		7,967		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,887	-	7,757	-	11,853	-	-
2nd	0,021	0,184	0,025	0,219	0,031	0,270	8,00
3rd	0,005	0,045	0,007	0,058	0,009	0,078	N/A
4th	0,025	0,219	0,023	0,201	0,037	0,316	4,00
5th	0,094	0,809	0,143	1,232	0,197	1,700	10,70
6th	0,027	0,230	0,026	0,225	0,028	0,240	2,67
7th	0,070	0,604	0,067	0,576	0,099	0,856	7,20
8th	0,021	0,184	0,027	0,229	0,023	0,197	2,00
9th	0,005	0,042	0,004	0,035	0,004	0,031	N/A
10th	0,036	0,312	0,040	0,342	0,048	0,417	1,60
11th	0,048	0,411	0,026	0,224	0,038	0,325	3,10
12th	0,003	0,030	0,003	0,025	0,003	0,025	1,33
13th	0,031	0,267	0,035	0,305	0,032	0,273	2,00
14th	0,031	0,269	0,024	0,210	0,026	0,225	N/A
15th	0,002	0,015	0,004	0,032	0,003	0,030	N/A
16th	0,022	0,190	0,017	0,146	0,016	0,137	N/A
17th	0,014	0,124	0,028	0,242	0,030	0,262	N/A
18th	0,018	0,152	0,018	0,156	0,018	0,159	N/A
19th	0,010	0,086	0,017	0,146	0,021	0,178	N/A
20th	0,101	0,867	0,113	0,974	0,131	1,129	N/A
21th	0,005	0,042	0,006	0,049	0,006	0,055	N/A
22th	0,027	0,231	0,029	0,246	0,027	0,237	N/A
23th	0,007	0,062	0,022	0,191	0,022	0,193	N/A
24th	0,005	0,040	0,005	0,043	0,005	0,041	N/A
25th	0,010	0,087	0,032	0,274	0,078	0,670	N/A
26th	0,013	0,116	0,011	0,096	0,015	0,130	N/A
27th	0,002	0,016	0,010	0,085	0,022	0,188	N/A
28th	0,011	0,099	0,008	0,069	0,007	0,058	N/A
29th	0,023	0,195	0,038	0,329	0,081	0,699	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P12K-EU-G1 with Cmin battery							
30th	0,003	0,027	0,004	0,035	0,007	0,060	N/A
31th	0,015	0,131	0,015	0,126	0,026	0,225	N/A
32th	0,007	0,059	0,004	0,034	0,005	0,045	N/A
33th	0,003	0,027	0,003	0,022	0,002	0,019	N/A
34th	0,007	0,062	0,004	0,038	0,004	0,038	N/A
35th	0,008	0,068	0,007	0,062	0,028	0,239	N/A
36th	0,002	0,020	0,003	0,022	0,003	0,029	N/A
37th	0,005	0,045	0,006	0,051	0,025	0,215	N/A
38th	0,007	0,058	0,005	0,039	0,004	0,033	N/A
39th	0,003	0,025	0,003	0,026	0,002	0,020	N/A
40th	0,005	0,046	0,004	0,036	0,004	0,035	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	751,4		1498,1		2258,4		
AC Voltage [V]	230,18		230,34		230,51		
AC Current [A]	3,27		6,51		9,80		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,733		1,833		1,734		
PWHD	3,912		4,224		6,095		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,265	-	6,505	-	9,797	-	-
2nd	0,021	0,209	0,018	0,186	0,012	0,118	8,00
3rd	0,004	0,038	0,004	0,044	0,004	0,045	N/A
4th	0,021	0,209	0,020	0,204	0,015	0,157	4,00
5th	0,087	0,880	0,084	0,857	0,063	0,643	10,70
6th	0,007	0,068	0,007	0,074	0,007	0,070	2,67
7th	0,098	0,995	0,115	1,166	0,085	0,862	7,20
8th	0,028	0,281	0,029	0,290	0,033	0,336	2,00
9th	0,006	0,061	0,004	0,044	0,003	0,029	N/A
10th	0,030	0,301	0,030	0,300	0,038	0,381	1,60
11th	0,030	0,309	0,038	0,386	0,028	0,286	3,10
12th	0,004	0,043	0,004	0,041	0,005	0,046	1,33
13th	0,038	0,383	0,022	0,220	0,024	0,241	2,00
14th	0,029	0,298	0,025	0,254	0,021	0,210	N/A
15th	0,005	0,047	0,004	0,045	0,006	0,058	N/A
16th	0,027	0,274	0,023	0,238	0,015	0,154	N/A
17th	0,031	0,313	0,027	0,274	0,016	0,158	N/A
18th	0,020	0,203	0,019	0,192	0,018	0,188	N/A
19th	0,025	0,255	0,031	0,314	0,012	0,118	N/A
20th	0,017	0,174	0,019	0,191	0,012	0,120	N/A
21th	0,003	0,029	0,004	0,041	0,005	0,050	N/A
22th	0,024	0,241	0,024	0,239	0,020	0,204	N/A
23th	0,024	0,242	0,032	0,328	0,027	0,275	N/A
24th	0,002	0,020	0,003	0,031	0,005	0,051	N/A
25th	0,023	0,229	0,029	0,289	0,056	0,567	N/A
26th	0,017	0,168	0,011	0,113	0,009	0,089	N/A
27th	0,007	0,074	0,006	0,060	0,009	0,088	N/A
28th	0,017	0,171	0,015	0,152	0,017	0,177	N/A
29th	0,023	0,232	0,029	0,298	0,076	0,776	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,021	0,004	0,037	0,005	0,052	N/A
31th	0,014	0,143	0,015	0,151	0,033	0,338	N/A
32th	0,003	0,031	0,006	0,066	0,005	0,047	N/A
33th	0,002	0,018	0,003	0,032	0,002	0,022	N/A
34th	0,006	0,061	0,007	0,069	0,005	0,050	N/A
35th	0,006	0,060	0,006	0,063	0,014	0,146	N/A
36th	0,002	0,023	0,002	0,021	0,002	0,022	N/A
37th	0,009	0,087	0,012	0,125	0,008	0,076	N/A
38th	0,004	0,043	0,003	0,034	0,003	0,035	N/A
39th	0,002	0,022	0,003	0,031	0,004	0,043	N/A
40th	0,003	0,032	0,003	0,035	0,004	0,040	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,5		1493,0		2252,2		
AC Voltage [V]	230,15		230,29		230,44		
AC Current [A]	3,26		6,49		9,78		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,959		2,074		2,071		
PWHD	5,604		6,141		7,903		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,248	-	6,484	-	9,774	-	-
2nd	0,021	0,211	0,016	0,160	0,009	0,092	8,00
3rd	0,008	0,086	0,010	0,099	0,012	0,123	N/A
4th	0,022	0,220	0,021	0,211	0,017	0,172	4,00
5th	0,089	0,907	0,086	0,874	0,065	0,663	10,70
6th	0,010	0,101	0,010	0,098	0,011	0,115	2,67
7th	0,098	0,990	0,111	1,126	0,081	0,817	7,20
8th	0,028	0,282	0,028	0,280	0,033	0,332	2,00
9th	0,003	0,027	0,004	0,040	0,005	0,046	N/A
10th	0,029	0,290	0,030	0,300	0,038	0,385	1,60
11th	0,028	0,284	0,038	0,382	0,028	0,282	3,10
12th	0,004	0,038	0,003	0,033	0,004	0,040	1,33
13th	0,035	0,356	0,021	0,214	0,024	0,242	2,00
14th	0,030	0,303	0,026	0,261	0,021	0,213	N/A
15th	0,002	0,024	0,003	0,026	0,003	0,030	N/A
16th	0,026	0,267	0,022	0,226	0,015	0,149	N/A
17th	0,031	0,317	0,027	0,274	0,015	0,150	N/A
18th	0,020	0,199	0,018	0,186	0,018	0,186	N/A
19th	0,031	0,314	0,035	0,352	0,014	0,143	N/A
20th	0,093	0,940	0,103	1,046	0,119	1,203	N/A
21th	0,003	0,026	0,004	0,042	0,006	0,057	N/A
22th	0,022	0,225	0,022	0,226	0,019	0,195	N/A
23th	0,019	0,193	0,028	0,281	0,025	0,250	N/A
24th	0,002	0,016	0,003	0,031	0,004	0,041	N/A
25th	0,020	0,202	0,026	0,267	0,051	0,516	N/A
26th	0,018	0,183	0,013	0,127	0,011	0,113	N/A
27th	0,007	0,070	0,009	0,089	0,018	0,185	N/A
28th	0,018	0,178	0,015	0,156	0,017	0,169	N/A
29th	0,019	0,188	0,026	0,266	0,071	0,720	N/A
30th	0,002	0,024	0,003	0,032	0,005	0,046	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,011	0,109	0,012	0,126	0,030	0,309	N/A
32th	0,003	0,029	0,007	0,073	0,005	0,055	N/A
33th	0,003	0,026	0,002	0,023	0,005	0,051	N/A
34th	0,007	0,067	0,008	0,077	0,005	0,052	N/A
35th	0,004	0,041	0,004	0,042	0,016	0,167	N/A
36th	0,002	0,024	0,002	0,019	0,002	0,023	N/A
37th	0,008	0,080	0,012	0,119	0,012	0,117	N/A
38th	0,005	0,049	0,004	0,038	0,004	0,040	N/A
39th	0,002	0,021	0,002	0,018	0,003	0,030	N/A
40th	0,004	0,038	0,004	0,041	0,004	0,039	N/A
Note For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	748,3		1494,5		2251,5		
AC Voltage [V]	230,16		230,32		230,49		
AC Current [A]	3,26		6,49		9,77		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	2,008		2,133		2,145		
PWHD	5,874		6,449		8,295		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,252	-	6,483	-	9,768	-	-
2nd	0,016	0,164	0,015	0,153	0,010	0,105	8,00
3rd	0,006	0,059	0,008	0,079	0,010	0,100	N/A
4th	0,020	0,205	0,021	0,214	0,016	0,163	4,00
5th	0,089	0,903	0,084	0,852	0,063	0,638	10,70
6th	0,015	0,153	0,016	0,158	0,017	0,171	2,67
7th	0,099	1,008	0,114	1,159	0,083	0,839	7,20
8th	0,028	0,286	0,029	0,295	0,034	0,342	2,00
9th	0,007	0,067	0,007	0,070	0,005	0,047	N/A
10th	0,029	0,293	0,030	0,301	0,038	0,385	1,60
11th	0,028	0,279	0,037	0,373	0,027	0,278	3,10
12th	0,007	0,068	0,006	0,060	0,007	0,066	1,33
13th	0,039	0,394	0,024	0,242	0,027	0,271	2,00
14th	0,031	0,313	0,026	0,264	0,021	0,216	N/A
15th	0,003	0,027	0,002	0,025	0,003	0,032	N/A
16th	0,027	0,270	0,022	0,223	0,015	0,148	N/A
17th	0,033	0,336	0,028	0,288	0,017	0,169	N/A
18th	0,019	0,190	0,018	0,185	0,019	0,189	N/A
19th	0,028	0,279	0,034	0,347	0,011	0,112	N/A
20th	0,099	1,000	0,109	1,107	0,125	1,271	N/A
21th	0,004	0,036	0,005	0,051	0,006	0,056	N/A
22th	0,022	0,223	0,022	0,226	0,019	0,196	N/A
23th	0,019	0,193	0,030	0,307	0,024	0,242	N/A
24th	0,003	0,031	0,005	0,056	0,007	0,066	N/A
25th	0,020	0,207	0,026	0,262	0,055	0,559	N/A
26th	0,019	0,188	0,013	0,127	0,010	0,101	N/A
27th	0,008	0,082	0,009	0,095	0,017	0,175	N/A
28th	0,018	0,186	0,017	0,169	0,019	0,193	N/A
29th	0,022	0,219	0,029	0,298	0,076	0,767	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,025	0,004	0,042	0,005	0,049	N/A
31th	0,013	0,127	0,013	0,127	0,030	0,308	N/A
32th	0,003	0,030	0,008	0,076	0,005	0,052	N/A
33th	0,002	0,021	0,003	0,026	0,003	0,027	N/A
34th	0,006	0,061	0,007	0,075	0,006	0,058	N/A
35th	0,005	0,055	0,006	0,058	0,016	0,163	N/A
36th	0,003	0,026	0,003	0,028	0,003	0,030	N/A
37th	0,010	0,098	0,012	0,124	0,010	0,097	N/A
38th	0,006	0,057	0,004	0,042	0,005	0,049	N/A
39th	0,002	0,022	0,002	0,025	0,003	0,027	N/A
40th	0,003	0,034	0,004	0,044	0,005	0,048	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-882,7		-1759,8		-2670,6		
AC Voltage [V]	229,82		229,63		229,42		
AC Current [A]	3,85		7,67		11,65		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,369		1,672		2,319		
PWHD	2,838		3,426		5,965		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,842	-	7,665	-	11,642	-	-
2nd	0,019	0,160	0,026	0,221	0,028	0,246	8,00
3rd	0,004	0,035	0,007	0,058	0,007	0,060	N/A
4th	0,028	0,245	0,028	0,238	0,040	0,345	4,00
5th	0,092	0,794	0,142	1,229	0,192	1,653	10,70
6th	0,014	0,123	0,013	0,113	0,012	0,108	2,67
7th	0,071	0,611	0,067	0,576	0,097	0,838	7,20
8th	0,022	0,191	0,026	0,220	0,022	0,189	2,00
9th	0,004	0,032	0,003	0,026	0,002	0,019	N/A
10th	0,037	0,318	0,040	0,344	0,047	0,404	1,60
11th	0,050	0,432	0,027	0,235	0,037	0,318	3,10
12th	0,002	0,020	0,003	0,022	0,003	0,022	1,33
13th	0,032	0,280	0,035	0,305	0,032	0,275	2,00
14th	0,031	0,263	0,024	0,208	0,024	0,206	N/A
15th	0,005	0,040	0,004	0,034	0,004	0,031	N/A
16th	0,023	0,194	0,018	0,155	0,015	0,127	N/A
17th	0,015	0,126	0,028	0,245	0,032	0,273	N/A
18th	0,019	0,163	0,020	0,169	0,020	0,174	N/A
19th	0,011	0,098	0,018	0,154	0,022	0,189	N/A
20th	0,014	0,123	0,016	0,138	0,014	0,124	N/A
21th	0,004	0,031	0,004	0,032	0,006	0,054	N/A
22th	0,026	0,228	0,028	0,244	0,028	0,243	N/A
23th	0,008	0,070	0,020	0,169	0,024	0,203	N/A
24th	0,002	0,019	0,004	0,031	0,005	0,044	N/A
25th	0,013	0,114	0,033	0,285	0,076	0,651	N/A
26th	0,011	0,098	0,009	0,078	0,012	0,105	N/A
27th	0,003	0,027	0,005	0,044	0,009	0,076	N/A
28th	0,011	0,097	0,006	0,049	0,003	0,028	N/A
29th	0,026	0,224	0,038	0,325	0,077	0,667	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,020	0,004	0,032	0,007	0,059	N/A
31th	0,016	0,134	0,013	0,110	0,028	0,241	N/A
32th	0,006	0,052	0,003	0,025	0,004	0,031	N/A
33th	0,004	0,033	0,006	0,049	0,008	0,071	N/A
34th	0,008	0,066	0,005	0,043	0,003	0,028	N/A
35th	0,015	0,130	0,009	0,077	0,027	0,235	N/A
36th	0,002	0,013	0,002	0,016	0,003	0,024	N/A
37th	0,003	0,024	0,004	0,037	0,023	0,195	N/A
38th	0,005	0,042	0,003	0,025	0,003	0,025	N/A
39th	0,002	0,020	0,005	0,044	0,005	0,042	N/A
40th	0,005	0,041	0,003	0,029	0,003	0,024	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-883,7		-1760,2		-2670,4		
AC Voltage [V]	229,84		229,67		229,49		
AC Current [A]	3,85		7,67		11,64		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,587		1,912		2,570		
PWHD	4,549		5,289		7,642		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,846	-	7,666	-	11,638	-	-
2nd	0,026	0,223	0,037	0,315	0,045	0,390	8,00
3rd	0,007	0,058	0,008	0,066	0,008	0,071	N/A
4th	0,024	0,210	0,023	0,200	0,038	0,325	4,00
5th	0,095	0,821	0,145	1,251	0,193	1,666	10,70
6th	0,013	0,116	0,014	0,123	0,016	0,141	2,67
7th	0,069	0,593	0,066	0,567	0,097	0,840	7,20
8th	0,020	0,172	0,023	0,200	0,020	0,172	2,00
9th	0,003	0,024	0,004	0,036	0,004	0,032	N/A
10th	0,037	0,317	0,040	0,342	0,046	0,393	1,60
11th	0,049	0,422	0,025	0,218	0,034	0,297	3,10
12th	0,002	0,020	0,002	0,018	0,002	0,018	1,33
13th	0,028	0,244	0,032	0,272	0,029	0,249	2,00
14th	0,032	0,272	0,024	0,209	0,024	0,210	N/A
15th	0,004	0,037	0,005	0,042	0,007	0,059	N/A
16th	0,022	0,189	0,017	0,148	0,015	0,126	N/A
17th	0,016	0,135	0,027	0,233	0,030	0,255	N/A
18th	0,019	0,161	0,019	0,164	0,020	0,174	N/A
19th	0,012	0,100	0,016	0,138	0,022	0,187	N/A
20th	0,096	0,831	0,108	0,928	0,125	1,082	N/A
21th	0,002	0,021	0,003	0,023	0,003	0,027	N/A
22th	0,027	0,229	0,028	0,240	0,028	0,238	N/A
23th	0,007	0,059	0,021	0,183	0,020	0,169	N/A
24th	0,003	0,026	0,003	0,028	0,005	0,039	N/A
25th	0,007	0,061	0,030	0,256	0,071	0,609	N/A
26th	0,013	0,110	0,010	0,084	0,014	0,119	N/A
27th	0,004	0,031	0,008	0,073	0,021	0,177	N/A
28th	0,011	0,093	0,007	0,059	0,007	0,061	N/A
29th	0,023	0,196	0,035	0,302	0,078	0,672	N/A
30th	0,002	0,016	0,003	0,022	0,006	0,054	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,015	0,129	0,018	0,158	0,032	0,276	N/A
32th	0,005	0,047	0,003	0,027	0,004	0,033	N/A
33th	0,003	0,023	0,004	0,034	0,006	0,049	N/A
34th	0,006	0,055	0,004	0,033	0,004	0,032	N/A
35th	0,010	0,087	0,007	0,063	0,027	0,235	N/A
36th	0,002	0,017	0,002	0,016	0,002	0,021	N/A
37th	0,005	0,047	0,006	0,051	0,023	0,200	N/A
38th	0,006	0,048	0,003	0,030	0,003	0,028	N/A
39th	0,002	0,016	0,002	0,020	0,002	0,016	N/A
40th	0,005	0,042	0,003	0,028	0,003	0,028	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-882,3		-1757,0		-2665,3		
AC Voltage [V]	229,81		229,62		229,41		
AC Current [A]	3,85		7,66		11,63		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,619		1,944		2,613		
PWHD	4,692		5,491		7,889		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,840	-	7,653	-	11,620	-	-
2nd	0,021	0,183	0,025	0,217	0,031	0,267	8,00
3rd	0,005	0,043	0,007	0,058	0,009	0,076	N/A
4th	0,026	0,227	0,025	0,213	0,036	0,309	4,00
5th	0,095	0,820	0,145	1,251	0,195	1,685	10,70
6th	0,027	0,231	0,026	0,227	0,028	0,238	2,67
7th	0,070	0,601	0,065	0,561	0,097	0,833	7,20
8th	0,021	0,185	0,026	0,224	0,023	0,198	2,00
9th	0,005	0,041	0,004	0,039	0,004	0,031	N/A
10th	0,037	0,318	0,041	0,350	0,048	0,416	1,60
11th	0,047	0,409	0,025	0,218	0,036	0,312	3,10
12th	0,003	0,027	0,003	0,025	0,002	0,020	1,33
13th	0,030	0,262	0,035	0,302	0,031	0,269	2,00
14th	0,032	0,272	0,025	0,216	0,026	0,224	N/A
15th	0,002	0,015	0,003	0,023	0,004	0,031	N/A
16th	0,022	0,186	0,017	0,148	0,016	0,134	N/A
17th	0,015	0,127	0,028	0,242	0,030	0,261	N/A
18th	0,018	0,153	0,018	0,156	0,019	0,161	N/A
19th	0,010	0,087	0,017	0,149	0,021	0,177	N/A
20th	0,100	0,867	0,113	0,971	0,131	1,129	N/A
21th	0,005	0,041	0,006	0,049	0,006	0,055	N/A
22th	0,027	0,231	0,028	0,244	0,028	0,238	N/A
23th	0,007	0,058	0,023	0,199	0,023	0,195	N/A
24th	0,004	0,038	0,005	0,044	0,004	0,034	N/A
25th	0,011	0,092	0,031	0,268	0,076	0,653	N/A
26th	0,013	0,116	0,011	0,093	0,015	0,129	N/A
27th	0,002	0,016	0,008	0,071	0,021	0,181	N/A
28th	0,011	0,099	0,007	0,063	0,006	0,053	N/A
29th	0,023	0,195	0,037	0,317	0,080	0,690	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,004	0,035	0,007	0,058	N/A
31th	0,015	0,132	0,014	0,122	0,026	0,227	N/A
32th	0,006	0,055	0,004	0,031	0,005	0,039	N/A
33th	0,003	0,026	0,002	0,021	0,002	0,021	N/A
34th	0,007	0,062	0,005	0,039	0,004	0,035	N/A
35th	0,007	0,064	0,006	0,053	0,027	0,237	N/A
36th	0,002	0,021	0,003	0,022	0,002	0,021	N/A
37th	0,005	0,047	0,007	0,056	0,024	0,207	N/A
38th	0,007	0,057	0,004	0,035	0,003	0,026	N/A
39th	0,003	0,025	0,003	0,025	0,002	0,019	N/A
40th	0,005	0,047	0,004	0,034	0,004	0,033	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	751,3		1498,4		2253,1		
AC Voltage [V]	230,18		230,35		230,51		
AC Current [A]	3,27		6,51		9,78		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,732		1,833		1,735		
PWHD	3,917		4,235		6,104		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,265	-	6,506	-	9,775	-	-
2nd	0,020	0,205	0,018	0,184	0,012	0,121	8,00
3rd	0,004	0,037	0,005	0,047	0,005	0,046	N/A
4th	0,020	0,208	0,020	0,205	0,016	0,159	4,00
5th	0,087	0,878	0,084	0,856	0,063	0,640	10,70
6th	0,007	0,069	0,007	0,074	0,007	0,071	2,67
7th	0,098	0,995	0,115	1,166	0,085	0,862	7,20
8th	0,028	0,282	0,029	0,291	0,033	0,336	2,00
9th	0,006	0,062	0,005	0,048	0,003	0,029	N/A
10th	0,030	0,300	0,030	0,300	0,038	0,382	1,60
11th	0,030	0,309	0,038	0,387	0,028	0,283	3,10
12th	0,004	0,044	0,004	0,041	0,005	0,046	1,33
13th	0,038	0,383	0,022	0,221	0,024	0,241	2,00
14th	0,029	0,298	0,025	0,255	0,021	0,210	N/A
15th	0,005	0,048	0,004	0,046	0,006	0,059	N/A
16th	0,027	0,272	0,023	0,238	0,015	0,155	N/A
17th	0,031	0,313	0,027	0,274	0,016	0,158	N/A
18th	0,020	0,202	0,019	0,192	0,018	0,184	N/A
19th	0,025	0,254	0,031	0,311	0,012	0,121	N/A
20th	0,017	0,174	0,019	0,190	0,012	0,120	N/A
21th	0,003	0,029	0,004	0,036	0,005	0,051	N/A
22th	0,024	0,241	0,024	0,242	0,020	0,201	N/A
23th	0,024	0,244	0,032	0,328	0,027	0,275	N/A
24th	0,002	0,020	0,003	0,034	0,005	0,049	N/A
25th	0,023	0,229	0,028	0,285	0,056	0,566	N/A
26th	0,017	0,169	0,012	0,120	0,009	0,091	N/A
27th	0,007	0,075	0,006	0,058	0,009	0,091	N/A
28th	0,017	0,170	0,015	0,155	0,018	0,179	N/A
29th	0,023	0,233	0,029	0,296	0,076	0,776	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,021	0,005	0,055	0,005	0,052	N/A
31th	0,014	0,144	0,015	0,147	0,034	0,341	N/A
32th	0,003	0,031	0,007	0,069	0,005	0,050	N/A
33th	0,002	0,018	0,003	0,031	0,002	0,020	N/A
34th	0,006	0,061	0,007	0,074	0,005	0,050	N/A
35th	0,006	0,061	0,006	0,060	0,014	0,146	N/A
36th	0,002	0,023	0,002	0,024	0,002	0,025	N/A
37th	0,009	0,087	0,013	0,128	0,008	0,077	N/A
38th	0,004	0,043	0,003	0,035	0,004	0,038	N/A
39th	0,002	0,022	0,004	0,038	0,004	0,041	N/A
40th	0,003	0,032	0,004	0,041	0,004	0,040	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,4		1493,3		2247,0		
AC Voltage [V]	230,15		230,29		230,44		
AC Current [A]	3,26		6,49		9,75		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,959		2,073		2,059		
PWHD	5,605		6,140		7,847		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,248	-	6,485	-	9,751	-	-
2nd	0,021	0,212	0,016	0,160	0,009	0,090	8,00
3rd	0,009	0,087	0,010	0,099	0,012	0,122	N/A
4th	0,022	0,222	0,021	0,212	0,017	0,172	4,00
5th	0,089	0,906	0,086	0,873	0,065	0,659	10,70
6th	0,010	0,102	0,010	0,097	0,012	0,118	2,67
7th	0,098	0,991	0,111	1,125	0,081	0,819	7,20
8th	0,028	0,282	0,028	0,280	0,033	0,334	2,00
9th	0,003	0,026	0,004	0,040	0,005	0,047	N/A
10th	0,029	0,290	0,030	0,300	0,038	0,386	1,60
11th	0,028	0,286	0,038	0,381	0,028	0,279	3,10
12th	0,004	0,038	0,003	0,032	0,004	0,039	1,33
13th	0,035	0,355	0,021	0,214	0,024	0,239	2,00
14th	0,030	0,302	0,026	0,260	0,021	0,214	N/A
15th	0,002	0,025	0,003	0,028	0,003	0,032	N/A
16th	0,026	0,267	0,022	0,224	0,015	0,151	N/A
17th	0,031	0,316	0,027	0,274	0,015	0,150	N/A
18th	0,019	0,197	0,018	0,187	0,018	0,185	N/A
19th	0,031	0,314	0,035	0,351	0,014	0,142	N/A
20th	0,093	0,939	0,103	1,046	0,117	1,183	N/A
21th	0,003	0,025	0,004	0,040	0,006	0,058	N/A
22th	0,022	0,224	0,023	0,230	0,019	0,195	N/A
23th	0,019	0,193	0,028	0,280	0,025	0,250	N/A
24th	0,002	0,017	0,004	0,043	0,004	0,045	N/A
25th	0,020	0,202	0,026	0,264	0,051	0,514	N/A
26th	0,018	0,183	0,013	0,133	0,011	0,113	N/A
27th	0,007	0,070	0,008	0,086	0,018	0,185	N/A
28th	0,018	0,179	0,016	0,159	0,017	0,169	N/A
29th	0,019	0,189	0,026	0,264	0,071	0,721	N/A
30th	0,002	0,024	0,005	0,049	0,005	0,046	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,011	0,110	0,012	0,124	0,031	0,312	N/A
32th	0,003	0,030	0,007	0,076	0,006	0,056	N/A
33th	0,003	0,026	0,002	0,024	0,005	0,050	N/A
34th	0,007	0,066	0,008	0,077	0,005	0,054	N/A
35th	0,004	0,042	0,004	0,042	0,016	0,167	N/A
36th	0,002	0,025	0,002	0,022	0,003	0,026	N/A
37th	0,009	0,089	0,011	0,114	0,011	0,114	N/A
38th	0,005	0,049	0,004	0,039	0,004	0,042	N/A
39th	0,002	0,021	0,002	0,019	0,003	0,030	N/A
40th	0,004	0,038	0,004	0,042	0,004	0,040	N/A
Note For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	748,2		1493,2		2246,2		
AC Voltage [V]	230,16		230,32		230,48		
AC Current [A]	3,26		6,49		9,75		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	2,007		2,136		2,138		
PWHD	5,873		6,471		8,265		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,252	-	6,485	-	9,746	-	-
2nd	0,016	0,164	0,015	0,155	0,010	0,103	8,00
3rd	0,006	0,058	0,008	0,080	0,010	0,100	N/A
4th	0,020	0,204	0,021	0,214	0,016	0,165	4,00
5th	0,089	0,901	0,084	0,852	0,063	0,637	10,70
6th	0,015	0,154	0,015	0,157	0,017	0,173	2,67
7th	0,099	1,008	0,114	1,159	0,083	0,841	7,20
8th	0,028	0,286	0,029	0,296	0,034	0,341	2,00
9th	0,007	0,067	0,007	0,071	0,005	0,048	N/A
10th	0,029	0,292	0,030	0,300	0,038	0,386	1,60
11th	0,028	0,280	0,037	0,373	0,027	0,276	3,10
12th	0,007	0,069	0,006	0,060	0,006	0,066	1,33
13th	0,039	0,394	0,024	0,241	0,027	0,272	2,00
14th	0,031	0,314	0,026	0,265	0,021	0,217	N/A
15th	0,003	0,027	0,002	0,024	0,004	0,037	N/A
16th	0,027	0,270	0,022	0,225	0,015	0,150	N/A
17th	0,033	0,335	0,028	0,286	0,017	0,173	N/A
18th	0,019	0,191	0,018	0,185	0,018	0,184	N/A
19th	0,028	0,280	0,034	0,344	0,011	0,114	N/A
20th	0,098	0,998	0,109	1,106	0,124	1,254	N/A
21th	0,004	0,037	0,004	0,038	0,006	0,062	N/A
22th	0,022	0,223	0,023	0,238	0,019	0,196	N/A
23th	0,019	0,194	0,030	0,304	0,024	0,241	N/A
24th	0,003	0,032	0,007	0,070	0,007	0,067	N/A
25th	0,021	0,208	0,025	0,257	0,055	0,559	N/A
26th	0,018	0,188	0,014	0,144	0,010	0,102	N/A
27th	0,008	0,083	0,009	0,091	0,018	0,179	N/A
28th	0,018	0,186	0,017	0,173	0,019	0,197	N/A
29th	0,022	0,219	0,029	0,292	0,076	0,768	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,009	0,086	0,005	0,047	N/A
31th	0,013	0,128	0,012	0,124	0,031	0,312	N/A
32th	0,003	0,029	0,008	0,085	0,006	0,060	N/A
33th	0,002	0,020	0,002	0,021	0,002	0,023	N/A
34th	0,006	0,062	0,008	0,079	0,006	0,058	N/A
35th	0,005	0,056	0,005	0,055	0,016	0,166	N/A
36th	0,003	0,027	0,003	0,031	0,004	0,037	N/A
37th	0,010	0,098	0,012	0,125	0,010	0,101	N/A
38th	0,006	0,057	0,005	0,048	0,005	0,055	N/A
39th	0,002	0,023	0,002	0,021	0,003	0,027	N/A
40th	0,003	0,035	0,005	0,051	0,005	0,046	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-882,7		-1762,8		-2676,3		
AC Voltage [V]	229,82		229,63		229,42		
AC Current [A]	3,85		7,68		11,67		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,370		1,675		2,298		
PWHD	2,836		3,428		5,935		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,842	-	7,678	-	11,667	-	-
2nd	0,019	0,162	0,026	0,223	0,026	0,227	8,00
3rd	0,004	0,035	0,007	0,059	0,007	0,062	N/A
4th	0,028	0,246	0,027	0,236	0,039	0,335	4,00
5th	0,092	0,796	0,143	1,232	0,189	1,629	10,70
6th	0,014	0,122	0,013	0,113	0,013	0,109	2,67
7th	0,071	0,610	0,067	0,577	0,098	0,845	7,20
8th	0,022	0,191	0,025	0,219	0,023	0,197	2,00
9th	0,004	0,031	0,003	0,025	0,002	0,019	N/A
10th	0,037	0,318	0,040	0,344	0,046	0,399	1,60
11th	0,050	0,433	0,027	0,232	0,037	0,322	3,10
12th	0,002	0,020	0,002	0,022	0,003	0,024	1,33
13th	0,032	0,280	0,036	0,307	0,032	0,275	2,00
14th	0,031	0,263	0,024	0,209	0,023	0,202	N/A
15th	0,004	0,039	0,004	0,032	0,003	0,029	N/A
16th	0,023	0,195	0,018	0,154	0,015	0,126	N/A
17th	0,015	0,126	0,029	0,246	0,031	0,270	N/A
18th	0,019	0,161	0,020	0,169	0,020	0,175	N/A
19th	0,011	0,098	0,018	0,154	0,022	0,188	N/A
20th	0,014	0,123	0,016	0,138	0,014	0,123	N/A
21th	0,004	0,030	0,004	0,031	0,006	0,052	N/A
22th	0,026	0,228	0,028	0,244	0,028	0,245	N/A
23th	0,008	0,069	0,020	0,169	0,023	0,200	N/A
24th	0,002	0,019	0,004	0,031	0,006	0,048	N/A
25th	0,013	0,113	0,033	0,287	0,076	0,652	N/A
26th	0,011	0,098	0,009	0,078	0,012	0,103	N/A
27th	0,003	0,027	0,005	0,042	0,008	0,073	N/A
28th	0,011	0,096	0,006	0,050	0,003	0,029	N/A
29th	0,026	0,225	0,038	0,325	0,077	0,663	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,020	0,004	0,032	0,007	0,063	N/A
31th	0,016	0,135	0,013	0,110	0,028	0,237	N/A
32th	0,006	0,052	0,003	0,025	0,004	0,034	N/A
33th	0,004	0,033	0,006	0,049	0,008	0,072	N/A
34th	0,008	0,066	0,005	0,043	0,003	0,030	N/A
35th	0,015	0,130	0,009	0,076	0,027	0,230	N/A
36th	0,002	0,014	0,002	0,016	0,003	0,024	N/A
37th	0,003	0,023	0,004	0,037	0,022	0,193	N/A
38th	0,005	0,042	0,003	0,026	0,003	0,023	N/A
39th	0,002	0,020	0,005	0,044	0,005	0,041	N/A
40th	0,005	0,041	0,003	0,028	0,003	0,022	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-883,8		-1763,3		-2676,1		
AC Voltage [V]	229,84		229,67		229,48		
AC Current [A]	3,85		7,68		11,67		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,586		1,915		2,558		
PWHD	4,537		5,286		7,653		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,846	-	7,679	-	11,663	-	-
2nd	0,026	0,224	0,037	0,319	0,044	0,381	8,00
3rd	0,007	0,058	0,008	0,068	0,008	0,071	N/A
4th	0,024	0,209	0,023	0,201	0,037	0,315	4,00
5th	0,095	0,823	0,145	1,255	0,190	1,643	10,70
6th	0,014	0,118	0,014	0,123	0,016	0,137	2,67
7th	0,069	0,592	0,066	0,568	0,098	0,848	7,20
8th	0,020	0,172	0,023	0,199	0,021	0,178	2,00
9th	0,003	0,023	0,004	0,033	0,003	0,030	N/A
10th	0,037	0,317	0,040	0,343	0,045	0,388	1,60
11th	0,049	0,423	0,025	0,217	0,035	0,302	3,10
12th	0,002	0,021	0,002	0,018	0,002	0,020	1,33
13th	0,028	0,244	0,031	0,272	0,029	0,251	2,00
14th	0,032	0,272	0,024	0,210	0,024	0,207	N/A
15th	0,004	0,036	0,005	0,042	0,007	0,058	N/A
16th	0,022	0,188	0,017	0,147	0,015	0,125	N/A
17th	0,016	0,135	0,027	0,233	0,029	0,253	N/A
18th	0,018	0,157	0,019	0,163	0,021	0,177	N/A
19th	0,012	0,099	0,016	0,139	0,021	0,185	N/A
20th	0,096	0,828	0,107	0,925	0,127	1,095	N/A
21th	0,003	0,022	0,002	0,019	0,003	0,025	N/A
22th	0,027	0,229	0,028	0,242	0,028	0,240	N/A
23th	0,007	0,059	0,021	0,183	0,019	0,165	N/A
24th	0,003	0,026	0,003	0,030	0,005	0,044	N/A
25th	0,007	0,060	0,030	0,257	0,071	0,610	N/A
26th	0,013	0,110	0,010	0,084	0,014	0,120	N/A
27th	0,004	0,031	0,009	0,074	0,020	0,175	N/A
28th	0,011	0,093	0,007	0,060	0,007	0,060	N/A
29th	0,023	0,197	0,035	0,304	0,077	0,667	N/A
30th	0,002	0,016	0,003	0,023	0,007	0,058	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,015	0,130	0,018	0,159	0,031	0,269	N/A
32th	0,005	0,047	0,003	0,026	0,004	0,037	N/A
33th	0,003	0,023	0,004	0,035	0,006	0,048	N/A
34th	0,006	0,055	0,004	0,033	0,004	0,035	N/A
35th	0,010	0,087	0,007	0,062	0,027	0,231	N/A
36th	0,002	0,018	0,002	0,016	0,003	0,022	N/A
37th	0,005	0,046	0,006	0,052	0,023	0,198	N/A
38th	0,006	0,048	0,003	0,030	0,003	0,027	N/A
39th	0,002	0,016	0,002	0,020	0,002	0,017	N/A
40th	0,005	0,042	0,003	0,029	0,003	0,026	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-882,3		-1760,1		-2671,1		
AC Voltage [V]	229,81		229,62		229,41		
AC Current [A]	3,85		7,67		11,65		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,618		1,947		2,600		
PWHD	4,677		5,486		7,906		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,840	-	7,667	-	11,645	-	-
2nd	0,021	0,185	0,026	0,223	0,029	0,250	8,00
3rd	0,005	0,043	0,007	0,058	0,009	0,078	N/A
4th	0,026	0,228	0,025	0,212	0,035	0,300	4,00
5th	0,095	0,822	0,146	1,255	0,193	1,661	10,70
6th	0,027	0,231	0,026	0,227	0,027	0,236	2,67
7th	0,070	0,600	0,065	0,561	0,097	0,839	7,20
8th	0,021	0,184	0,026	0,224	0,023	0,202	2,00
9th	0,005	0,040	0,004	0,035	0,003	0,028	N/A
10th	0,037	0,318	0,041	0,352	0,048	0,411	1,60
11th	0,047	0,409	0,025	0,216	0,036	0,314	3,10
12th	0,003	0,029	0,003	0,025	0,003	0,025	1,33
13th	0,030	0,261	0,035	0,303	0,031	0,268	2,00
14th	0,031	0,271	0,025	0,217	0,025	0,219	N/A
15th	0,002	0,015	0,002	0,020	0,003	0,023	N/A
16th	0,022	0,186	0,017	0,148	0,016	0,136	N/A
17th	0,015	0,128	0,028	0,240	0,030	0,257	N/A
18th	0,017	0,151	0,018	0,155	0,019	0,165	N/A
19th	0,010	0,087	0,017	0,149	0,020	0,177	N/A
20th	0,100	0,864	0,112	0,968	0,133	1,144	N/A
21th	0,005	0,042	0,005	0,044	0,006	0,051	N/A
22th	0,027	0,230	0,028	0,244	0,028	0,243	N/A
23th	0,007	0,058	0,023	0,200	0,022	0,188	N/A
24th	0,004	0,038	0,005	0,047	0,005	0,041	N/A
25th	0,011	0,091	0,031	0,271	0,076	0,653	N/A
26th	0,013	0,115	0,011	0,093	0,015	0,132	N/A
27th	0,002	0,016	0,009	0,074	0,021	0,178	N/A
28th	0,011	0,098	0,007	0,062	0,006	0,054	N/A
29th	0,023	0,195	0,037	0,316	0,079	0,684	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (-10°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,004	0,034	0,008	0,070	N/A
31th	0,015	0,131	0,014	0,121	0,025	0,219	N/A
32th	0,007	0,056	0,004	0,031	0,005	0,047	N/A
33th	0,003	0,027	0,002	0,021	0,002	0,016	N/A
34th	0,007	0,062	0,005	0,039	0,004	0,037	N/A
35th	0,007	0,064	0,006	0,052	0,027	0,229	N/A
36th	0,002	0,021	0,003	0,022	0,002	0,021	N/A
37th	0,005	0,047	0,007	0,058	0,024	0,207	N/A
38th	0,007	0,056	0,004	0,036	0,003	0,025	N/A
39th	0,003	0,025	0,003	0,025	0,002	0,018	N/A
40th	0,005	0,047	0,004	0,033	0,004	0,031	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	751,0		1496,2		2296,5		
AC Voltage [V]	230,18		230,34		230,51		
AC Current [A]	3,27		6,50		9,97		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,731		1,833		1,759		
PWHD	3,920		4,219		6,316		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,264	-	6,497	-	9,962	-	-
2nd	0,020	0,204	0,018	0,186	0,011	0,117	8,00
3rd	0,004	0,036	0,004	0,045	0,005	0,048	N/A
4th	0,021	0,208	0,020	0,206	0,016	0,161	4,00
5th	0,086	0,876	0,085	0,858	0,064	0,650	10,70
6th	0,007	0,072	0,007	0,075	0,007	0,072	2,67
7th	0,098	0,996	0,115	1,166	0,084	0,852	7,20
8th	0,028	0,280	0,029	0,290	0,033	0,335	2,00
9th	0,006	0,065	0,005	0,047	0,003	0,030	N/A
10th	0,029	0,299	0,030	0,301	0,038	0,384	1,60
11th	0,031	0,310	0,038	0,387	0,028	0,281	3,10
12th	0,004	0,045	0,004	0,042	0,005	0,047	1,33
13th	0,037	0,380	0,022	0,221	0,023	0,231	2,00
14th	0,029	0,298	0,025	0,254	0,020	0,205	N/A
15th	0,005	0,047	0,004	0,044	0,006	0,061	N/A
16th	0,027	0,272	0,023	0,237	0,015	0,149	N/A
17th	0,031	0,312	0,027	0,275	0,014	0,143	N/A
18th	0,020	0,202	0,019	0,191	0,019	0,188	N/A
19th	0,025	0,254	0,031	0,311	0,012	0,124	N/A
20th	0,017	0,174	0,019	0,190	0,012	0,119	N/A
21th	0,003	0,027	0,004	0,037	0,005	0,053	N/A
22th	0,024	0,241	0,024	0,240	0,020	0,205	N/A
23th	0,024	0,245	0,032	0,327	0,028	0,283	N/A
24th	0,002	0,020	0,003	0,031	0,005	0,049	N/A
25th	0,022	0,227	0,028	0,285	0,060	0,604	N/A
26th	0,017	0,168	0,012	0,117	0,009	0,091	N/A
27th	0,007	0,075	0,006	0,058	0,009	0,095	N/A
28th	0,017	0,170	0,015	0,153	0,018	0,178	N/A
29th	0,023	0,236	0,029	0,297	0,079	0,806	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,021	0,004	0,043	0,006	0,056	N/A
31th	0,014	0,144	0,015	0,149	0,033	0,334	N/A
32th	0,003	0,030	0,007	0,068	0,004	0,045	N/A
33th	0,002	0,018	0,003	0,031	0,002	0,021	N/A
34th	0,006	0,062	0,007	0,072	0,005	0,048	N/A
35th	0,006	0,061	0,006	0,064	0,016	0,158	N/A
36th	0,002	0,023	0,002	0,021	0,002	0,021	N/A
37th	0,009	0,089	0,012	0,127	0,009	0,094	N/A
38th	0,004	0,043	0,003	0,034	0,004	0,038	N/A
39th	0,002	0,022	0,003	0,033	0,004	0,041	N/A
40th	0,003	0,031	0,004	0,038	0,004	0,043	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,1		1491,1		2290,1		
AC Voltage [V]	230,15		230,29		230,45		
AC Current [A]	3,26		6,48		9,94		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,959		2,073		2,101		
PWHD	5,600		6,133		8,136		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,247	-	6,476	-	9,938	-	-
2nd	0,021	0,212	0,016	0,159	0,008	0,082	8,00
3rd	0,009	0,088	0,010	0,098	0,012	0,124	N/A
4th	0,022	0,225	0,021	0,212	0,017	0,174	4,00
5th	0,089	0,906	0,086	0,873	0,066	0,665	10,70
6th	0,010	0,103	0,010	0,097	0,012	0,118	2,67
7th	0,098	0,992	0,111	1,126	0,080	0,808	7,20
8th	0,028	0,281	0,028	0,280	0,033	0,334	2,00
9th	0,003	0,027	0,004	0,039	0,005	0,047	N/A
10th	0,029	0,290	0,030	0,300	0,038	0,388	1,60
11th	0,028	0,284	0,038	0,381	0,027	0,278	3,10
12th	0,004	0,037	0,003	0,031	0,004	0,038	1,33
13th	0,035	0,354	0,021	0,216	0,023	0,233	2,00
14th	0,030	0,304	0,026	0,260	0,021	0,211	N/A
15th	0,002	0,024	0,003	0,032	0,003	0,032	N/A
16th	0,026	0,267	0,022	0,224	0,014	0,146	N/A
17th	0,031	0,317	0,027	0,274	0,013	0,137	N/A
18th	0,019	0,197	0,018	0,187	0,019	0,189	N/A
19th	0,031	0,316	0,035	0,351	0,013	0,137	N/A
20th	0,092	0,936	0,103	1,045	0,120	1,220	N/A
21th	0,002	0,025	0,004	0,043	0,006	0,061	N/A
22th	0,022	0,225	0,022	0,227	0,020	0,198	N/A
23th	0,019	0,193	0,028	0,280	0,026	0,261	N/A
24th	0,002	0,016	0,003	0,034	0,004	0,043	N/A
25th	0,020	0,204	0,026	0,264	0,054	0,553	N/A
26th	0,018	0,183	0,013	0,132	0,011	0,110	N/A
27th	0,007	0,069	0,008	0,085	0,020	0,198	N/A
28th	0,018	0,178	0,016	0,158	0,016	0,165	N/A
29th	0,019	0,188	0,026	0,263	0,074	0,752	N/A
30th	0,002	0,024	0,004	0,037	0,005	0,046	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,011	0,110	0,012	0,125	0,031	0,311	N/A
32th	0,003	0,030	0,007	0,075	0,005	0,054	N/A
33th	0,002	0,025	0,002	0,023	0,005	0,051	N/A
34th	0,007	0,066	0,008	0,077	0,005	0,052	N/A
35th	0,004	0,043	0,004	0,042	0,018	0,182	N/A
36th	0,002	0,025	0,002	0,019	0,002	0,023	N/A
37th	0,009	0,091	0,012	0,117	0,014	0,140	N/A
38th	0,005	0,048	0,004	0,037	0,004	0,042	N/A
39th	0,002	0,021	0,002	0,019	0,003	0,031	N/A
40th	0,004	0,037	0,004	0,042	0,004	0,041	N/A

Note

For test result (discharge mode PSMAX, PNINV) see B.1 a), b).

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	747,9		1491,0		2289,3		
AC Voltage [V]	230,16		230,32		230,50		
AC Current [A]	3,26		6,48		9,94		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	2,005		2,132		2,179		
PWHD	5,863		6,435		8,529		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,251	-	6,475	-	9,932	-	-
2nd	0,016	0,164	0,015	0,156	0,010	0,103	8,00
3rd	0,006	0,058	0,008	0,080	0,010	0,099	N/A
4th	0,020	0,203	0,021	0,214	0,016	0,167	4,00
5th	0,089	0,901	0,084	0,853	0,063	0,642	10,70
6th	0,015	0,157	0,016	0,157	0,017	0,175	2,67
7th	0,099	1,006	0,114	1,159	0,082	0,830	7,20
8th	0,028	0,286	0,029	0,296	0,033	0,339	2,00
9th	0,007	0,070	0,007	0,071	0,005	0,053	N/A
10th	0,029	0,292	0,030	0,300	0,038	0,389	1,60
11th	0,028	0,283	0,037	0,372	0,027	0,274	3,10
12th	0,007	0,070	0,006	0,060	0,006	0,066	1,33
13th	0,039	0,393	0,024	0,242	0,026	0,264	2,00
14th	0,031	0,314	0,026	0,264	0,021	0,210	N/A
15th	0,003	0,028	0,002	0,025	0,004	0,042	N/A
16th	0,027	0,269	0,022	0,224	0,014	0,144	N/A
17th	0,033	0,334	0,028	0,286	0,016	0,161	N/A
18th	0,019	0,189	0,018	0,184	0,019	0,190	N/A
19th	0,028	0,280	0,034	0,345	0,010	0,102	N/A
20th	0,098	0,996	0,109	1,106	0,127	1,293	N/A
21th	0,004	0,037	0,004	0,039	0,006	0,063	N/A
22th	0,022	0,223	0,023	0,229	0,020	0,198	N/A
23th	0,019	0,196	0,030	0,305	0,024	0,248	N/A
24th	0,003	0,030	0,006	0,060	0,006	0,066	N/A
25th	0,021	0,210	0,025	0,257	0,059	0,597	N/A
26th	0,018	0,187	0,013	0,134	0,010	0,098	N/A
27th	0,008	0,080	0,009	0,091	0,018	0,184	N/A
28th	0,018	0,186	0,017	0,171	0,019	0,195	N/A
29th	0,022	0,220	0,029	0,291	0,079	0,798	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (P_{SMAX}, or P_{NINV} for integrated EESS)							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,006	0,057	0,005	0,048	N/A
31th	0,013	0,128	0,012	0,124	0,030	0,304	N/A
32th	0,003	0,029	0,008	0,082	0,005	0,052	N/A
33th	0,002	0,021	0,002	0,022	0,002	0,024	N/A
34th	0,006	0,062	0,008	0,076	0,005	0,055	N/A
35th	0,005	0,055	0,006	0,057	0,017	0,174	N/A
36th	0,003	0,027	0,003	0,027	0,003	0,027	N/A
37th	0,009	0,096	0,012	0,123	0,012	0,117	N/A
38th	0,006	0,056	0,004	0,043	0,005	0,049	N/A
39th	0,002	0,023	0,003	0,026	0,002	0,023	N/A
40th	0,003	0,034	0,004	0,044	0,005	0,047	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-887,4		-1762,2		-2675,2		
AC Voltage [V]	229,82		229,63		229,42		
AC Current [A]	3,87		7,68		11,67		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,365		1,640		2,304		
PWHD	2,838		3,422		5,943		
Harmonic	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Current Magnitude [A]**	**% of Funda-mental**	**Harmonic Current Limits [%]**
1st	3,862	-	7,675	-	11,663	-	-
2nd	0,019	0,161	0,019	0,166	0,026	0,226	8,00
3rd	0,004	0,037	0,007	0,058	0,007	0,062	N/A
4th	0,028	0,241	0,025	0,219	0,039	0,337	4,00
5th	0,091	0,785	0,138	1,192	0,190	1,635	10,70
6th	0,014	0,123	0,013	0,114	0,012	0,107	2,67
7th	0,071	0,613	0,068	0,589	0,098	0,844	7,20
8th	0,022	0,192	0,026	0,224	0,023	0,194	2,00
9th	0,003	0,030	0,003	0,025	0,002	0,019	N/A
10th	0,036	0,314	0,038	0,330	0,046	0,400	1,60
11th	0,050	0,434	0,028	0,244	0,037	0,320	3,10
12th	0,002	0,021	0,003	0,022	0,002	0,021	1,33
13th	0,033	0,283	0,036	0,312	0,032	0,276	2,00
14th	0,030	0,261	0,024	0,205	0,024	0,203	N/A
15th	0,005	0,040	0,004	0,032	0,003	0,029	N/A
16th	0,023	0,194	0,018	0,156	0,014	0,125	N/A
17th	0,014	0,123	0,028	0,245	0,031	0,270	N/A
18th	0,019	0,165	0,020	0,171	0,021	0,178	N/A
19th	0,011	0,095	0,017	0,150	0,022	0,188	N/A
20th	0,014	0,124	0,016	0,141	0,014	0,122	N/A
21th	0,004	0,032	0,004	0,033	0,006	0,051	N/A
22th	0,027	0,231	0,029	0,246	0,028	0,245	N/A
23th	0,008	0,072	0,018	0,155	0,023	0,199	N/A
24th	0,002	0,018	0,003	0,030	0,005	0,045	N/A
25th	0,013	0,110	0,033	0,284	0,076	0,654	N/A
26th	0,011	0,098	0,009	0,081	0,012	0,102	N/A
27th	0,003	0,027	0,005	0,043	0,008	0,073	N/A
28th	0,011	0,097	0,006	0,054	0,003	0,027	N/A
29th	0,026	0,222	0,038	0,326	0,077	0,663	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,002	0,020	0,004	0,032	0,007	0,061	N/A
31th	0,015	0,133	0,013	0,110	0,028	0,240	N/A
32th	0,006	0,053	0,004	0,031	0,004	0,031	N/A
33th	0,004	0,033	0,006	0,048	0,008	0,071	N/A
34th	0,008	0,068	0,005	0,047	0,003	0,029	N/A
35th	0,016	0,134	0,010	0,083	0,027	0,232	N/A
36th	0,002	0,014	0,002	0,015	0,003	0,024	N/A
37th	0,003	0,024	0,004	0,033	0,022	0,192	N/A
38th	0,005	0,043	0,003	0,029	0,003	0,022	N/A
39th	0,002	0,020	0,005	0,043	0,005	0,040	N/A
40th	0,005	0,041	0,004	0,033	0,003	0,022	N/A
Note							
For test result (discharge mode PSMAX, PNINV) see B.1 a), b).							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 2							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-888,4		-1762,3		-2675,2		
AC Voltage [V]	229,83		229,66		229,49		
AC Current [A]	3,87		7,68		11,66		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,586		1,890		2,564		
PWHD	4,580		5,287		7,676		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,866	-	7,675	-	11,659	-	-
2nd	0,025	0,215	0,037	0,315	0,044	0,382	8,00
3rd	0,007	0,059	0,008	0,068	0,008	0,070	N/A
4th	0,024	0,206	0,022	0,189	0,037	0,318	4,00
5th	0,094	0,811	0,141	1,214	0,191	1,648	10,70
6th	0,013	0,116	0,014	0,119	0,016	0,138	2,67
7th	0,069	0,595	0,067	0,581	0,098	0,846	7,20
8th	0,020	0,172	0,024	0,209	0,020	0,175	2,00
9th	0,003	0,024	0,004	0,032	0,003	0,030	N/A
10th	0,036	0,314	0,038	0,328	0,045	0,388	1,60
11th	0,049	0,425	0,026	0,228	0,035	0,301	3,10
12th	0,002	0,020	0,002	0,019	0,002	0,018	1,33
13th	0,029	0,246	0,032	0,277	0,029	0,251	2,00
14th	0,031	0,269	0,024	0,204	0,024	0,208	N/A
15th	0,004	0,036	0,005	0,042	0,007	0,058	N/A
16th	0,022	0,189	0,017	0,146	0,015	0,126	N/A
17th	0,015	0,132	0,027	0,232	0,029	0,252	N/A
18th	0,019	0,161	0,019	0,166	0,021	0,178	N/A
19th	0,011	0,097	0,016	0,134	0,021	0,185	N/A
20th	0,097	0,839	0,108	0,929	0,128	1,101	N/A
21th	0,003	0,022	0,002	0,020	0,003	0,025	N/A
22th	0,027	0,232	0,028	0,241	0,028	0,241	N/A
23th	0,007	0,062	0,019	0,167	0,019	0,165	N/A
24th	0,003	0,027	0,003	0,027	0,005	0,040	N/A
25th	0,007	0,058	0,029	0,253	0,071	0,612	N/A
26th	0,013	0,112	0,010	0,085	0,014	0,118	N/A
27th	0,004	0,032	0,009	0,077	0,020	0,175	N/A
28th	0,011	0,093	0,007	0,064	0,007	0,060	N/A
29th	0,023	0,195	0,035	0,305	0,077	0,668	N/A
30th	0,002	0,015	0,003	0,022	0,006	0,056	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
31th	0,015	0,128	0,018	0,159	0,032	0,272	N/A
32th	0,005	0,047	0,003	0,029	0,004	0,034	N/A
33th	0,003	0,023	0,004	0,033	0,006	0,048	N/A
34th	0,007	0,056	0,004	0,036	0,004	0,035	N/A
35th	0,010	0,091	0,008	0,067	0,027	0,231	N/A
36th	0,002	0,018	0,002	0,016	0,003	0,022	N/A
37th	0,005	0,046	0,005	0,047	0,023	0,198	N/A
38th	0,006	0,049	0,004	0,034	0,003	0,027	N/A
39th	0,002	0,017	0,002	0,020	0,002	0,017	N/A
40th	0,005	0,042	0,004	0,032	0,003	0,026	N/A
Note							

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
Phase 3							
Power Level	**33%**		**66%**		**100%**		
AC Power [W]	-887,0		-1759,4		-2670,2		
AC Voltage [V]	229,81		229,61		229,41		
AC Current [A]	3,87		7,67		11,65		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,619		1,921		2,605		
PWHD	4,721		5,483		7,924		
Harmonic	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Current Magnitude [A]**	**% of Fundamental**	**Harmonic Current Limits [%]**
1st	3,861	-	7,664	-	11,641	-	-
2nd	0,020	0,176	0,024	0,211	0,030	0,256	8,00
3rd	0,005	0,044	0,007	0,058	0,009	0,076	N/A
4th	0,026	0,221	0,022	0,192	0,035	0,302	4,00
5th	0,094	0,813	0,141	1,216	0,193	1,665	10,70
6th	0,027	0,231	0,026	0,224	0,027	0,237	2,67
7th	0,070	0,604	0,067	0,575	0,097	0,838	7,20
8th	0,021	0,185	0,026	0,228	0,023	0,199	2,00
9th	0,005	0,039	0,004	0,035	0,003	0,028	N/A
10th	0,036	0,313	0,039	0,340	0,048	0,411	1,60
11th	0,047	0,409	0,026	0,227	0,036	0,314	3,10
12th	0,003	0,028	0,003	0,026	0,002	0,021	1,33
13th	0,031	0,265	0,036	0,306	0,031	0,268	2,00
14th	0,031	0,269	0,024	0,210	0,025	0,220	N/A
15th	0,002	0,016	0,003	0,022	0,003	0,022	N/A
16th	0,022	0,186	0,017	0,148	0,015	0,134	N/A
17th	0,014	0,124	0,028	0,240	0,030	0,257	N/A
18th	0,018	0,155	0,018	0,156	0,019	0,164	N/A
19th	0,010	0,085	0,017	0,144	0,021	0,178	N/A
20th	0,101	0,875	0,112	0,970	0,134	1,151	N/A
21th	0,005	0,042	0,005	0,047	0,006	0,050	N/A
22th	0,027	0,232	0,029	0,246	0,028	0,242	N/A
23th	0,007	0,060	0,021	0,185	0,022	0,189	N/A
24th	0,004	0,038	0,005	0,044	0,004	0,034	N/A
25th	0,010	0,090	0,031	0,267	0,076	0,655	N/A
26th	0,013	0,116	0,011	0,099	0,015	0,129	N/A
27th	0,002	0,017	0,009	0,078	0,021	0,177	N/A
28th	0,012	0,099	0,008	0,066	0,006	0,054	N/A
29th	0,022	0,193	0,037	0,319	0,079	0,684	N/A

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Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (+55°C)						P
Bidirectional converters (charge mode P_{CMAX})							
DHN-LVEH3P8K-EU-G1 with Cmin battery							
30th	0,003	0,026	0,004	0,036	0,007	0,062	N/A
31th	0,015	0,131	0,014	0,121	0,026	0,220	N/A
32th	0,007	0,058	0,004	0,035	0,005	0,042	N/A
33th	0,003	0,026	0,002	0,021	0,002	0,016	N/A
34th	0,007	0,064	0,005	0,040	0,004	0,036	N/A
35th	0,008	0,068	0,007	0,059	0,027	0,230	N/A
36th	0,002	0,022	0,002	0,021	0,002	0,020	N/A
37th	0,005	0,046	0,006	0,052	0,024	0,206	N/A
38th	0,007	0,058	0,005	0,039	0,003	0,024	N/A
39th	0,003	0,024	0,003	0,026	0,002	0,018	N/A
40th	0,006	0,048	0,004	0,039	0,004	0,032	N/A
Note							

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Bbis.3 c)	Flicker emission	P

Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmax battery

Ambient

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,020	0,024	0,000
66%	EN 61000-3-11	0,030	0,032	0,000
100%*	EN 61000-3-11	0,026	0,045	0,000

-10°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,028	0,039	0,000
66%	EN 61000-3-11	0,030	0,060	0,000
100%*	EN 61000-3-11	0,029	0,044	0,000

+55°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,025	0,034	0,000
66%	EN 61000-3-11	0,024	0,032	0,000
100%*	EN 61000-3-11	0,024	0,032	0,000

Bidirectional converters (charge mode P_{CMAX})

Ambient

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,018	0,025	0,000
66%	EN 61000-3-11	0,030	0,060	0,000
100%*	EN 61000-3-11	0,026	0,032	0,000

-10°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,028	0,043	0,000
66%	EN 61000-3-11	0,030	0,060	0,000
100%*	EN 61000-3-11	0,029	0,044	0,000

+55°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,027	0,045	0,000
66%	EN 61000-3-11	0,029	0,046	0,000
100%*	EN 61000-3-11	0,029	0,044	0,000

Note

Mains Impedance according EN61000-3-3 / EN61000-3-11:

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Bbis.3 c)	Flicker emission	P

R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283 Ω)

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

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

The tests are based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.

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Bbis.3 c)	Flicker emission	P

Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmin battery

Ambient

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,019	0,022	0,000
66%	EN 61000-3-11	0,070	0,078	0,000
100%*	EN 61000-3-11	0,081	0,085	0,000

-10°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,017	0,018	0,000
66%	EN 61000-3-11	0,078	0,068	0,000
100%*	EN 61000-3-11	0,081	0,085	0,000

+55°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,017	0,019	0,000
66%	EN 61000-3-11	0,067	0,068	0,000
100%*	EN 61000-3-11	0,082	0,085	0,000

Bidirectional converters (charge mode P_{CMAX})

Ambient

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,019	0,025	0,000
66%	EN 61000-3-11	0,077	0,078	0,000
100%*	EN 61000-3-11	0,083	0,086	0,000

-10°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,046	0,086	0,000
66%	EN 61000-3-11	0,074	0,078	0,000
100%*	EN 61000-3-11	0,080	0,085	0,000

+55°C

Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,017	0,019	0,000
66%	EN 61000-3-11	0,071	0,078	0,000
100%*	EN 61000-3-11	0,080	0,085	0,000

Note

Mains Impedance according EN61000-3-3 / EN61000-3-11:

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Bbis.3 c)	Flicker emission	P

R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283 Ω)

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

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

The tests are based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.

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Bbis.3 c)	Flicker emission			P
Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)				
DHN-LVEH3P8K-EU-G1 with Cmin battery				
Ambient				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,021	0,034	0,000
66%	EN 61000-3-11	0,043	0,095	0,000
100%*	EN 61000-3-11	0,083	0,086	0,000
-10°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,019	0,022	0,000
66%	EN 61000-3-11	0,018	0,020	0,000
100%*	EN 61000-3-11	0,083	0,085	0,000
+55°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,019	0,023	0,000
66%	EN 61000-3-11	0,019	0,024	0,000
100%*	EN 61000-3-11	0,082	0,084	0,000
Bidirectional converters (charge mode P_{CMAX})				
Ambient				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,071	0,072	0,000
66%	EN 61000-3-11	0,077	0,079	0,000
100%*	EN 61000-3-11	0,083	0,086	0,000
-10°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,071	0,073	0,000
66%	EN 61000-3-11	0,081	0,112	0,000
100%*	EN 61000-3-11	0,081	0,086	0,000
+55°C				
Location	Test voltage	Result		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,071	0,074	0,000
66%	EN 61000-3-11	0,316	0,580	0,000
100%*	EN 61000-3-11	0,457	0,928	0,000
Note				
Mains Impedance according EN61000-3-3 / EN61000-3-11:				

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Bbis.3 c)	Flicker emission	P

R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283 Ω)

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

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

The tests are based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.

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Bbis.4	Verification of the voltage and frequency operating range			P
Test results				
	Conditions			
Test 1(*)	V = 85% * V_n; f = 47,5 Hz; P = 100% * P_{SMAX} (P_{NINV} for integrated EESS); cos φ = 1 for at least 300 s			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	195,88	47,50	10217,2	0,9994
Limit	no disconnection allowed			
Test 2(**)	V = 110% * V_n; f = 51,5 Hz; P = 100% * P_{SMAX} (P_{NINV} for integrated EESS); cos φ = 1 for at least 300 s			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	253,11	51,50	10955,7	0,9997
Limit	no disconnection allowed			
Test 3	V = 85% * V_n; f = 47,5 Hz; P = 100% * P_{CMAX}; cos φ = 1 for at least 300 s			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	195,31	47,50	-10177,9	-0,9987
Limit	no disconnection allowed			
Test 4	V = 110% * V_n; f = 51,5 Hz; P = 100% * P_{CMAX}; cos φ = 1 for at least 300 s			
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]
	252,83	51,50	-12087,3	-0,9996
Limit	no disconnection allowed			

Test

(*) Unit can operate at reduced power of $P_{SMAX} \geq 85\% * S_n$

(**) Over frequency reduction function must be deactivated

Supplied power must remain stable within ±5% S_n at the entire duration

Only Test 1 and Test 2 apply to storage systems connected to one-way converters

Assessment criterion

The test is intended to check the capacity of the generator to maintain the connection with the grid for an indefinite time in the field of voltage and frequency

85% V_n = V = 110% V_n

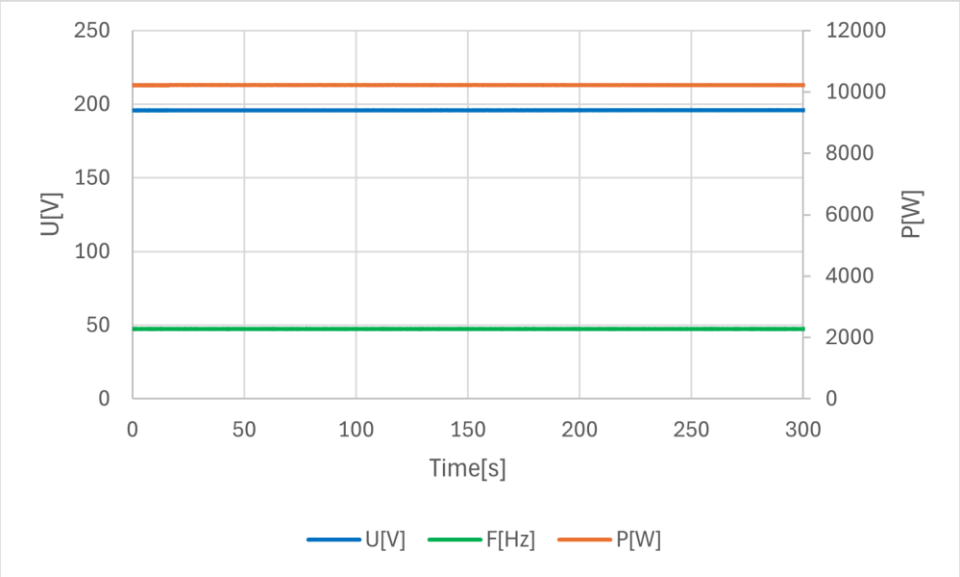
47,5 Hz = f = 51,5 Hz

The test should provide for the test of stable operation at the extreme limits of voltage and frequency for a minimum time of 5 minutes, for each working point (limited to 3 minutes in the field of tensions between 85% V_n = V = 90% V_n for only wind power generators).

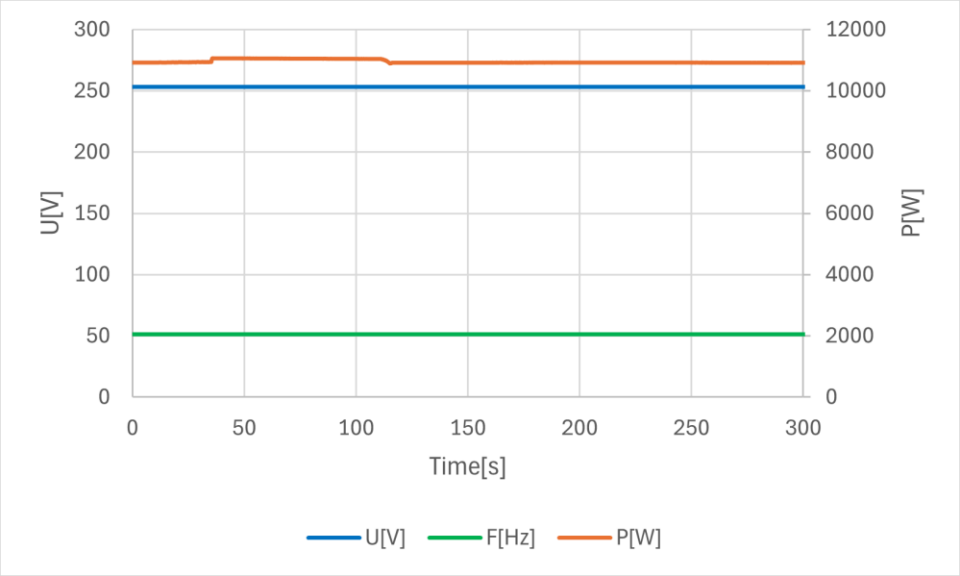
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Bbis.4	Verification of the voltage and frequency operating range	P

Graph of conditions of test 1



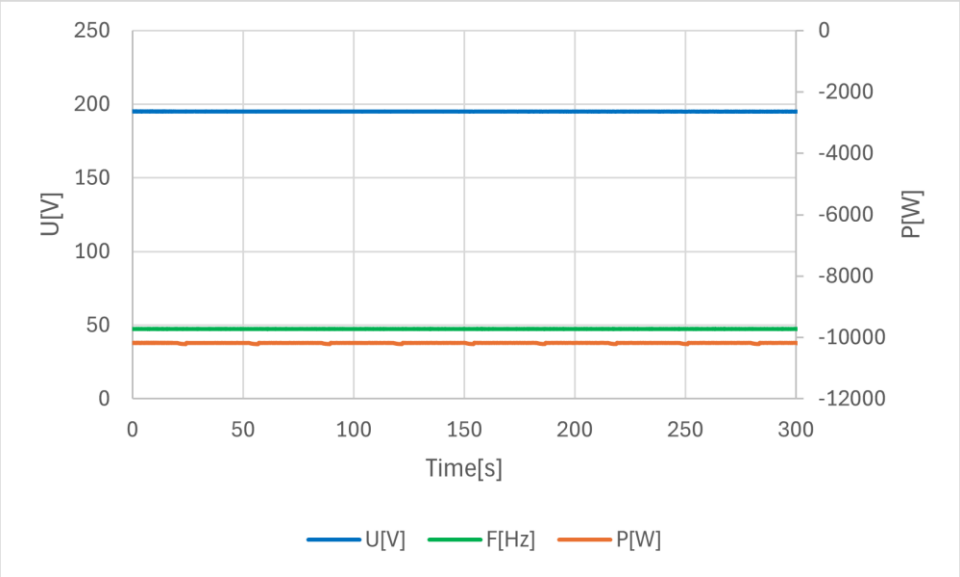
Graph of conditions of test 2



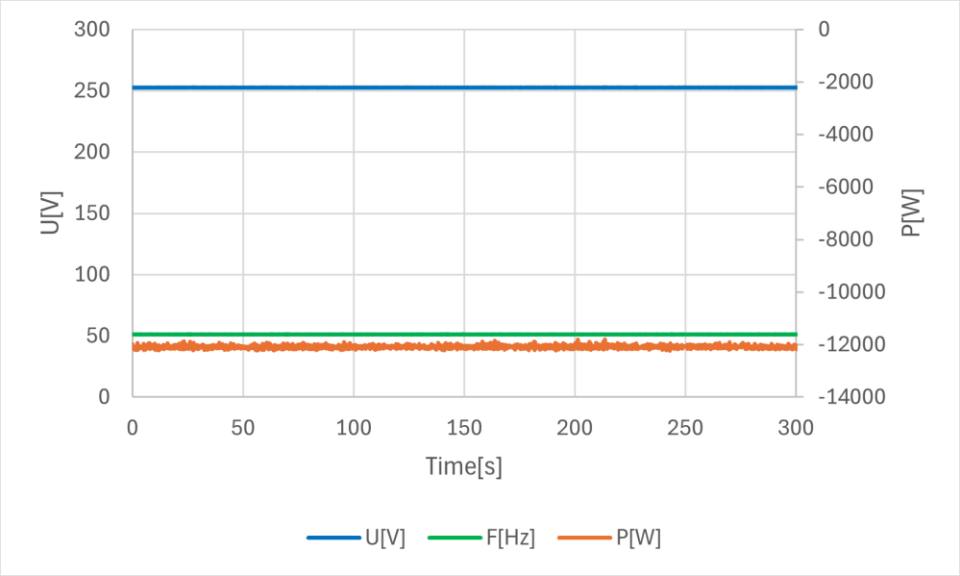
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Bbis.4	Verification of the voltage and frequency operating range	P

Graph of conditions of test 3



Graph of conditions of test 4



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmax battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	110% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	335,8	33,2
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	307,2	331,8
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	31,2	38,4
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	308,0	308,4
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

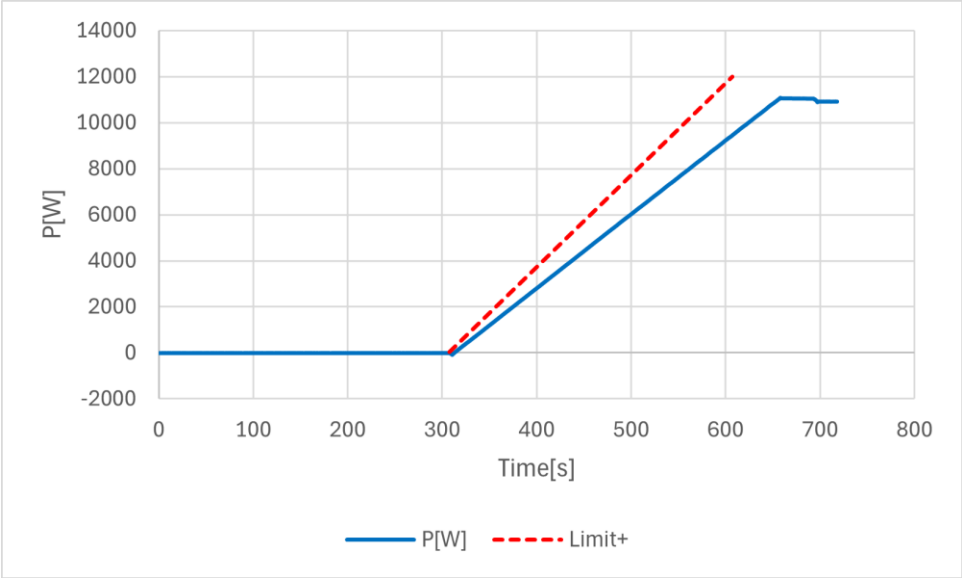
Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49 Hz and 51 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (charge mode P_{CMAX})

DHN-LVEH3P12K-EU-G1 with Cmax battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	111% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	335,6	38,0
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	306,8	307,4
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	32,2	33,4
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	327,0	308,8
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

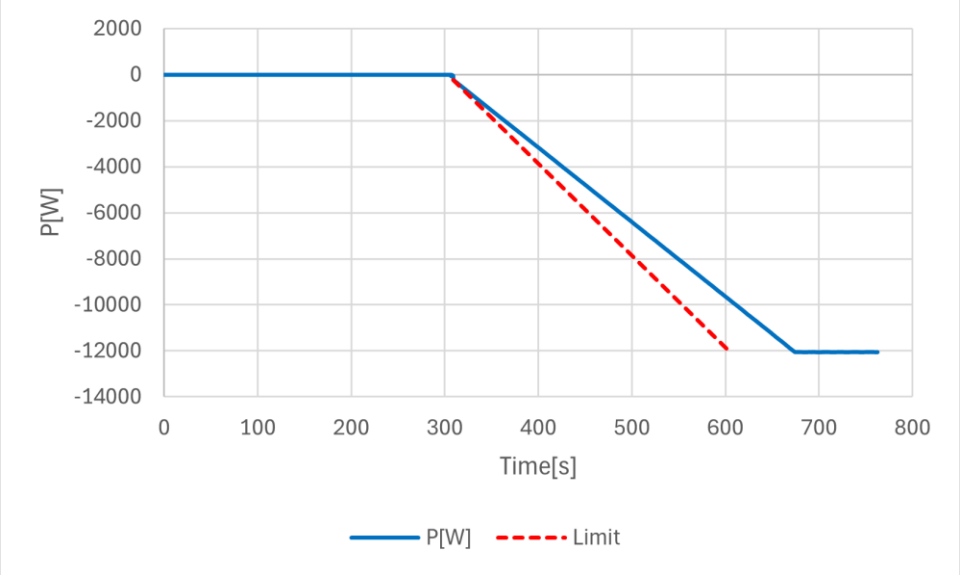
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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49,00 Hz and 51,00 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)		
DHN-LVEH3P12K-EU-G1 with Cmin battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	110% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	298,1	41,2
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	308,2	301,0
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	37,0	34,6
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	306,0	305,6
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1	**Verification of connection and reconnection conditions**	**P**
Bbis.5.2	**Verification of gradual output/absorption of active power**	

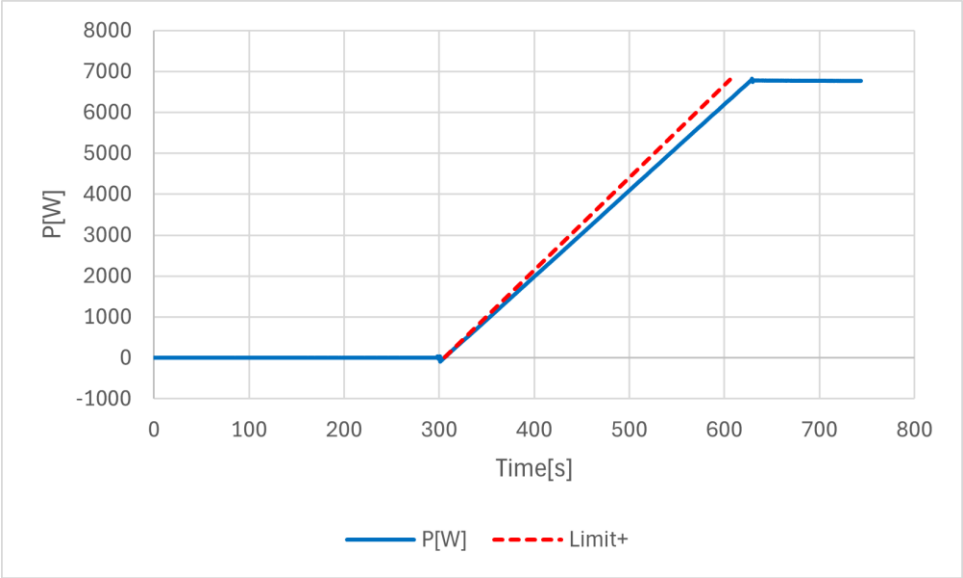
Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49 Hz and 51 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (charge mode P_{CMAX})

DHN-LVEH3P12K-EU-G1 with Cmin battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	111% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	327,0	36,4
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	310,0	305,8
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	33,0	33,2
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	303,8	302,4
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

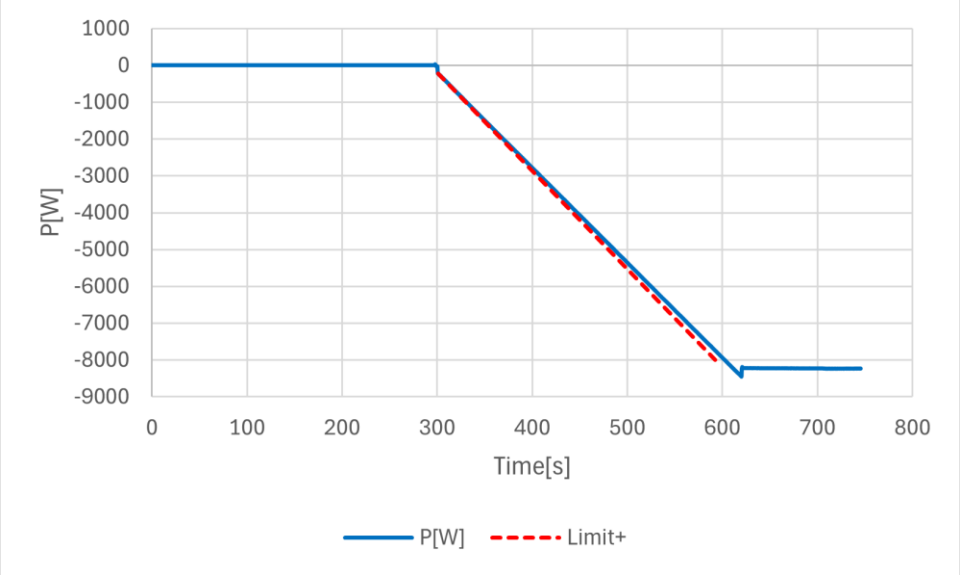
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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49,00 Hz and 51,00 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P8K-EU-G1 with Cmin battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	110% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	298,1	41,2
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	308,2	301,0
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	37,0	34,6
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	306,0	305,6
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1	**Verification of connection and reconnection conditions**	**P**
Bbis.5.2	**Verification of gradual output/absorption of active power**	

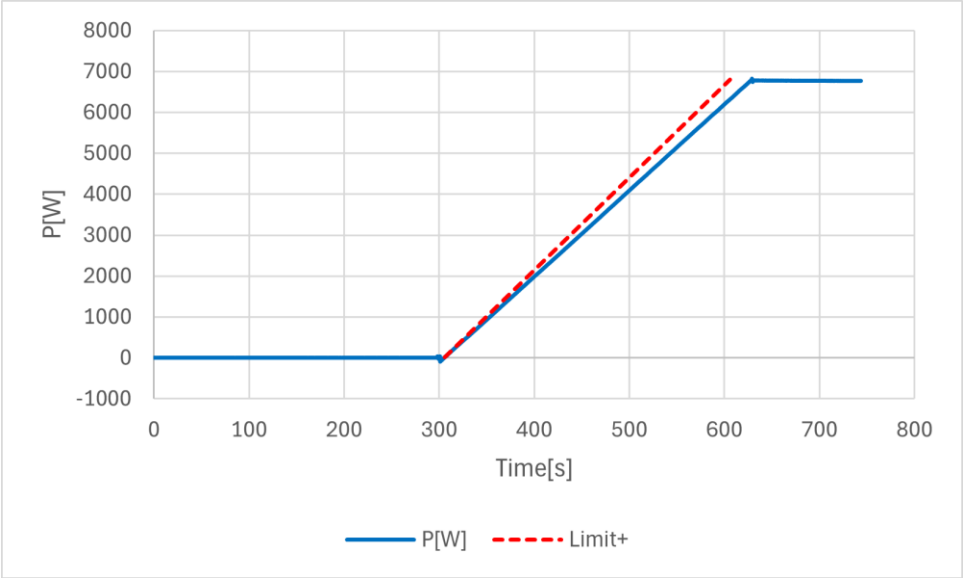
Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49 Hz and 51 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

Test: Bidirectional converters (charge mode P_{CMAX})

DHN-LVEH3P8K-EU-G1 with Cmin battery	**Voltage conditions**	
a) Out of voltage range	84% V_n for 30 s	111% V_n for 30 s
Connection	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% V_n < V	V <110% V_n
Reconnection time [s]	327,0	36,4
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
c) In voltage range after voltage failure	85% V_n < V	V <110% V_n
Reconnection time [s]	310,0	305,8
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
	Frequency conditions	
d) Out of frequency range	49,88 Hz ± 0,01 Hz	49,88 Hz ± 0,01 Hz
Connection	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	33,0	33,2
Limit	Reconnection after 30 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	
f) In frequency range after frequency failure	49,90 Hz < f	f < 50,10 Hz
Reconnection time [s]	303,8	302,4
Limit	Reconnection after 300 s	
Gradient	Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20% P_n / min For recorded gradient see diagram underneath	

Test

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

Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

Assessment criterion

In order to prevent network disruptions, operation in parallel of generators of any kind must take place ONLY when the frequency and voltage detected at the output terminals remain within the following limits for 300 s (or not less than 30 s, in accordance with the specifications in 8.4.1.3, letter a):

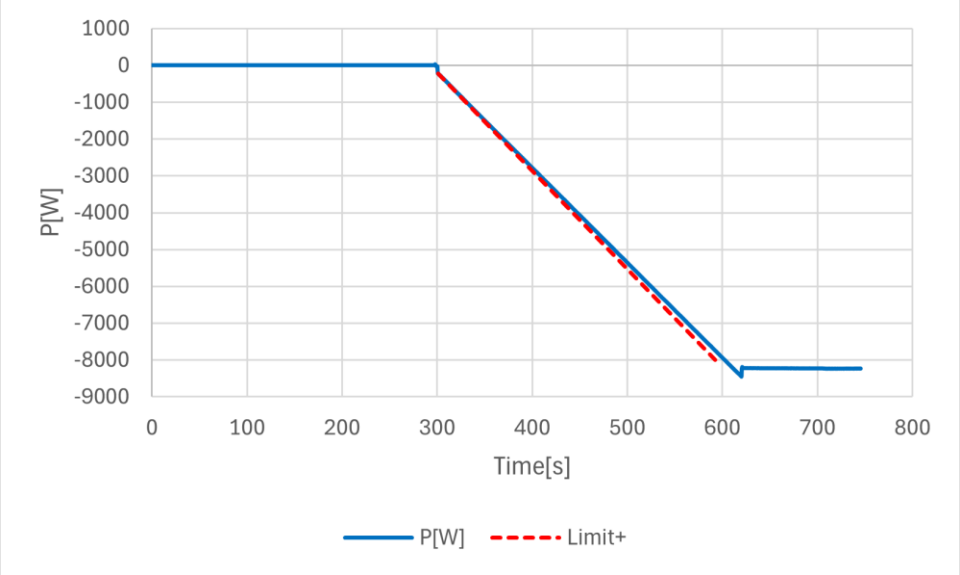
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Bbis.5	**Connection conditions, reconnection and gradual power supply**	**P**
Bbis.5.1 **Bbis.5.2**	**Verification of connection and reconnection conditions** **Verification of gradual output/absorption of active power**	**P**

- voltage between 85% and 110% of V_n; frequency between 49,90 Hz and 50,10 Hz (default setting, adjustment range between 49,00 Hz and 51,00 Hz).

In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

Graph of gradual power supply



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Bbis.6	Reactive Power Exchange
Bbis.6.1	Verification of construction requirements: reactive power capability

As stipulated in 8.4.4.2, storage systems used in plants designed for continuous operation in parallel with the DSO's grid must be able to operate with a power factor other than 1. The exchange of reactive power with the grid may take place at the request of the DSO in the following cases

- if there are network management requirements, in particular to help limit the voltage at the output terminals or on the LV line to which other EESS and/or GD sources may also be connected;
- with the purpose of providing a network service; requirement applicable only for plants with a total power output of more than 11,08 kW and under the conditions that will be regulated by ARERA.

The purpose of the tests referred to in this paragraph is to verify the reactive power capability of the storage systems as the active power varies, in order to ensure compliance with the minimum construction requirements set out in 8.4.4.2, at least equal to

a) for all storage systems in installations with a total capacity of up to 11.08 kW an instantaneous power factor between cos f = 0,90 in reactive absorption (inductive behaviour) and cos f = 0.90 in reactive output (capacitive behaviour), according to the "triangular" capability curve shown in the example in Figure 62 (valid for a storage system with bidirectional inverter). In this case, the reactive exchange is aimed at limiting grid overvoltage or undervoltage caused by its own active power input/output,

b) for all storage systems in plants with a total power greater than 11.08 kW an instantaneous power factor between cos f = 0,90 in reactive absorption (inductive behaviour) and cos f = 0.90 in reactive supply (capacitive behaviour), according to the "rectangular" capability curve shown in the example in Figure 62 aimed at the supply of a grid service requested by the DSO, under the conditions subject to regulation by ARERA.

For the purposes of this test (minimum requirements), the manufacturer must indicate and set the maximum available reactive power regulation as the active power output varies, in order to make it possible to characterise the maximum capabilities of the storage system (as smaller machines can also be used on systems with a total power output of more than 11,08 kW).

This paragraph and its sub-sections do not apply to static converters for installations with a power output of less than 800 W.

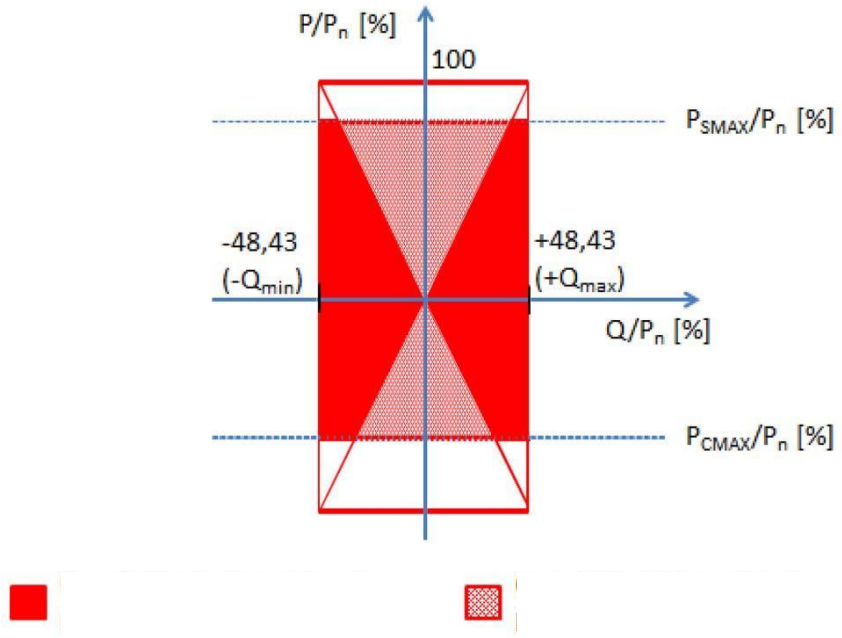


Figure 62 - Capability for a storage system with bidirectional inverter

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Bbis.6.2	Method of performing and recording the test

The following requirements are given for the execution of the test.

- The storage system must be set so that it can absorb respectively (inductive behaviour) and deliver (capacitive behaviour) the maximum reactive power available to each of the active power level output / consumption according to its capability.
- It regulates at this point the EESS (and the eventual source DC) in order to make available the full power injection / withdrawal available: P_{SMAX} (for accumulation of integrated systems, P_{NINV}), or, in the case of systems of accumulation associated with bidirectional converters, P_{CMAX}.
- They regulate (via the control logic of EESS and / or via the source control), the active power for values in 5 intervals [10-20]%; [30-40]%; ...; [90-100]% of P_{SMAX} (for integrated storage systems, P_{NINV}) and, if the system is connected to a bidirectional converter, in 5 intervals the power take intervals [10-20]%; ...; [90-100]% of P_{CMAX}. It carries out the measurement of the active power in stationary conditions, after 1 min. approximately from the execution of adjustment (to 1 min average values calculated on the basis of the measured values at the fundamental frequency of 200 ms) window.
- For each of the active power levels (equal to 10 levels, in the case of executing at full power tests with bi-directional storage systems) you will have to record a value of the inductive reactive power and one for the capacitive, as average values for 1 min calculated on the basis of measurements at the fundamental frequency of 1 s window. Even the power factor must be detected and reported as average to 1 min.
- In addition to measurements of reactive power limit values, the measured values should be recorded by setting the reactive power supplied to 0 ($\cos \varphi = 1$).

The maximum capability in absorption capability (Q_{min}) and delivery (Q_{max}) of reactive power resulting from the sequence of the above measures and that for Q = 0 must be documented in tabular form below, in each of active power output level ranging between 0% and power of the maximum available discharge and, if required, between 0% and power of maximum charge available, the corresponding level of reactive power consumption (and delivered), expressed both in absolute terms and as a p.u. the rated power of the converter and cos φ terms. The test is passed successfully under the conditions expressed herein.

- Storage systems in plants with a total power output of up to 11,08 kW: the value of the instantaneous power factor at each of the 5 (or 10) measurement points is equal to or less than 0,90 in both reactive power absorption (inductive behaviour) and delivery (capacitive behaviour) modes.
- storage in total power plants greater than 11,08 kW systems: the value of the absorbed reactive power (inductive behaviour) and delivered (capacitive behaviour) resulting in each of the 5 (or 10) measurement points is at least equal in absolute value to 48,43% of the rated active power of the inverter.

The maximum value of the absorbed reactive power (inductive behaviour) and delivered (capacitive behaviour) resulting in each of the measuring points to be reported in a table similar to Table. 4BBIS - capacitive reactive power distribution follows, which refers, for example, to the case of the test at full power on a non-integrated system of accumulation. It will then generate tables 3, for the cases of maximum inductive reactive power, maximum capacitive and the behaviour with the set-point Q = 0. For each measured point is allowed a maximum deviation of reactive power $\Delta Q = \pm 5\% * S_n$.

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Test result: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmax battery

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	1123,9	-5896,6	0,1872	1342,5
10 - 20	2254,0	-5878,4	0,3582	2495,9
20 - 30	3363,0	-5860,1	0,4979	3642,7
30 - 40	4456,5	-5841,5	0,6067	4786,6
40 - 50	1867,7	-5827,6	0,6920	5972,2
50 - 60	6650,9	-5814,7	0,7530	7104,3
60 - 70	7792,9	-5796,8	0,8025	8358,9
70 - 80	8817,3	-5782,1	0,8364	9471,3
80 - 90	9915,8	-5771,0	0,8644	10687,5
90 - 100	10615,4	-5761,9	0,8790	11447,8

Limit	$\Delta Q \leq \pm 5$ % of S_n

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	1175,3	6073,3	0,1901	1369,7
10 - 20	2247,9	6084,3	0,3467	2465,5
20 - 30	3371,1	6093,8	0,4842	3625,8
30 - 40	4454,1	6102,3	0,5897	4765,8
40 - 50	5592,9	6116,4	0,6750	5963,2
50 - 60	6644,8	6128,2	0,7353	7095,3
60 - 70	7742,7	6141,6	0,7836	8275,2
70 - 80	8861,6	6150,1	0,8217	9502,0
80 - 90	9972,8	6164,7	0,8508	10720,4
90 - 100	10036,0	6165,7	0,8522	10800,4

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Q = 0

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	1103,7	85,2	0,9970	1237,8
10 - 20	2232,2	96,5	0,9986	2456,7
20 - 30	3355,3	109,4	0,9995	3566,2
30 - 40	4476,8	124,1	0,9996	4745,2
40 - 50	5582,5	136,3	0,9997	5918,1
50 - 60	6667,8	150,1	0,9997	7080,3
60 - 70	7724,5	162,7	0,9998	8239,9
70 - 80	8833,1	176,7	0,9998	9439,1
80 - 90	9936,6	190,2	0,9998	10638,6
90 - 100	11110,1	204,1	0,9998	11915,0

Limit	$\Delta Q \leq \pm 5$ % of S_n

Test result: Bidirectional converters (charge mode P_{CMAX})

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-1267,5	-5898,3	-0,2102	-1029,7
10 - 20	-2489,5	-5916,0	-0,3881	-2211,8
20 - 30	-3623,8	-5931,1	-0,5216	-3296,7
30 - 40	-4871,6	-5945,1	-0,6340	-4490,0
40 - 50	-6019,3	-5956,4	-0,7110	-5571,4
50 - 60	-7251,3	-5973,8	-0,7720	-6727,4
60 - 70	-8434,6	-5991,9	-0,8154	-7820,8
70 - 80	-9627,2	-6010,5	-0,8484	-8926,1
80 - 90	-10447,7	-6019,6	-0,8666	-9677,6
90 - 100	-10443,9	-6020,5	-0,8665	-9679,5

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-1222,1	6067,0	-0,1976	-1009,8
10 - 20	-2441,5	6054,7	-0,3742	-2192,4
20 - 30	-3625,8	6040,4	-0,5149	-3331,4
30 - 40	-4879,4	6027,9	-0,6294	-4522,1
40 - 50	-6040,3	6014,1	-0,7088	-5621,4
50 - 60	-7215,2	6006,5	-0,7685	-6712,0
60 - 70	-8385,5	5993,4	-0,8137	-7812,2
70 - 80	-9630,8	5982,9	-0,8494	-8950,9
80 - 90	-10384,2	5973,4	-0,8669	-9650,6
90 - 100	-10383,6	5973,7	-0,8669	-9640,8

Limit	$\Delta Q \leq \pm 5$ % of S_n

Q = 0

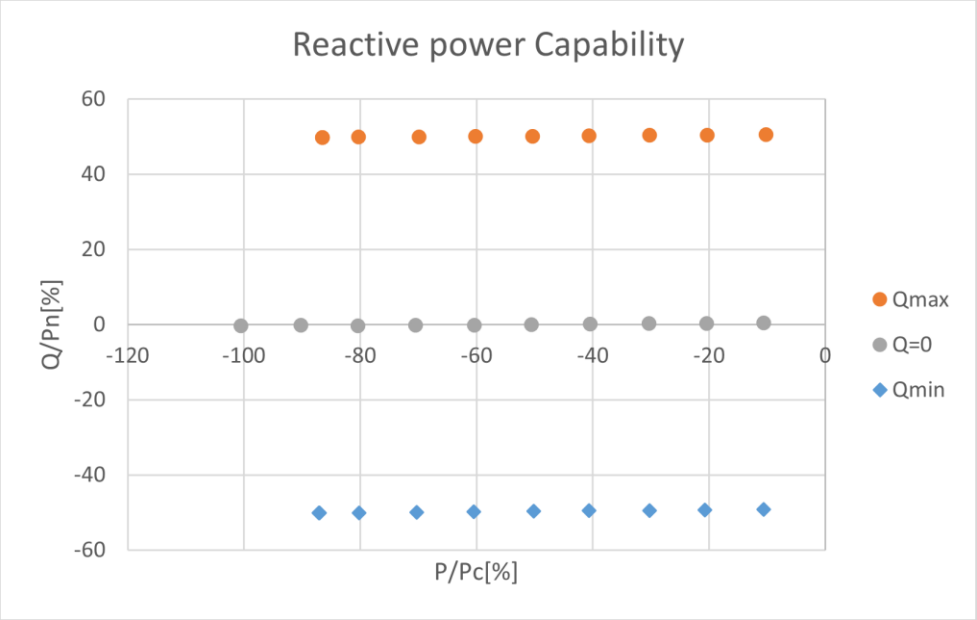
Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-1269,4	51,5	-0,9943	-1113,3
10 - 20	-2446,9	40,6	-0,9984	-2247,5
20 - 30	-3641,9	29,3	-0,9992	-3390,3
30 - 40	-4857,6	16,4	-0,9999	-4534,9
40 - 50	-6069,1	2,7	-0,9999	-5683,7
50 - 60	-7249,3	-13,0	-0,9999	-6782,2
60 - 70	-8456,4	-27,3	-0,9999	-7895,3
70 - 80	-9648,8	-42,4	-0,9999	-9004,9
80 - 90	-10825,6	-22,8	-0,9999	-10064,6
90 - 100	-12063,1	-40,0	-0,9999	-11192,7

Limit	$\Delta Q \leq \pm 5$ % of S_n

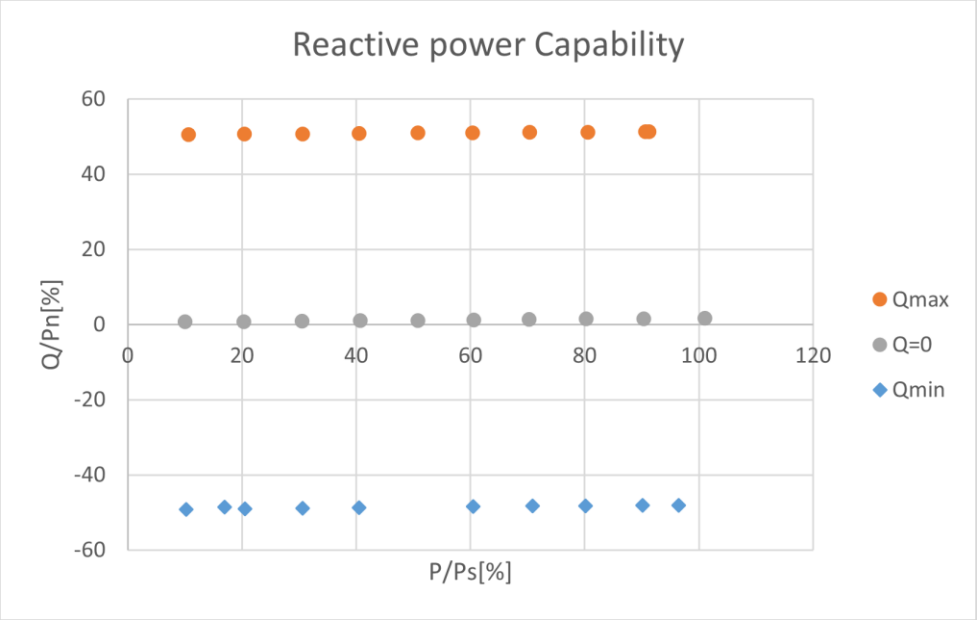
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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Graph of capability curves valid for inverter Charge mode P_{CMAX}



Graph of capability curves valid for inverter Discharge mode P_{SMAX}



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Bbis.6.2	**Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW**	**P**

Note

The inverter produces reactive power according to the circular characteristic. The priority is always given by the reactive power.

Maximum inductive and capacitive reactive power delivered as a function of active power (here the case of a storage system with a power greater than 11,08 kW is represented, which must be able to absorb or deliver at any active power level a reactive power of at least 48,43 % of the rated active power, Q_{min}/P_n = 48,43 % P_n)

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Test result: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P12K-EU-G1 with Cmin battery

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	668,8	-5899,6	0,1127	884,0
10 - 20	1382,5	-5890,1	0,2286	1601,7
20 - 30	2043,7	-5881,2	0,3284	2279,7
30 - 40	2749,4	-5869,8	0,4243	3007,0
40 - 50	3440,1	-5859,0	0,5065	3722,7
50 - 60	4079,4	-5848,1	0,5723	4389,4
60 - 70	4755,7	-5840,4	0,6316	5104,0
70 - 80	5475,4	-5831,4	0,6847	5863,4
80 - 90	6123,3	-5821,2	0,7249	6561,3
90 - 100	6790,6	-5813,8	0,7598	7261,5

Limit	$\Delta Q \leq \pm 5$ % of S_n

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	689,3	6049,7	0,1132	878,6
10 - 20	1368,7	6056,8	0,2205	1552,8
20 - 30	2037,2	6064,4	0,3186	2244,2
30 - 40	2748,5	6072,4	0,4125	2986,4
40 - 50	3452,1	6079,7	0,4939	3709,3
50 - 60	4076,0	6083,5	0,5568	4361,0
60 - 70	4734,2	6091,9	0,6138	5054,3
70 - 80	5433,5	6101,3	0,6652	5796,8
80 - 90	6106,5	6110,8	0,7071	6527,3
90 - 100	6660,8	6113,6	0,7369	7109,7

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Q = 0

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	710,4	82,4	0,9767	827,0
10 - 20	1366,9	87,8	0,9929	1493,1
20 - 30	2073,6	94,0	0,9965	2217,2
30 - 40	2720,1	103,2	0,9977	2886,6
40 - 50	3407,0	111,0	0,9985	3602,1
50 - 60	4087,0	119,1	0,9989	4315,8
60 - 70	4755,7	126,9	0,9992	5032,4
70 - 80	5465,6	134,8	0,9994	5787,0
80 - 90	6122,5	141,9	0,9995	6489,7
90 - 100	6758,3	150,3	0,9995	7177,6

Limit	$\Delta Q \leq \pm 5$ % of S_n

Test result: Bidirectional converters (charge mode P_{CMAX})

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-826,5	-5923,7	-0,1383	-597,9
10 - 20	-1656,6	-5934,4	-0,2690	-1404,6
20 - 30	-2447,0	-5947,2	-0,3807	-2169,4
30 - 40	-3239,6	-5959,3	-0,4778	-2932,4
40 - 50	-4040,8	-5966,9	-0,5607	-3700,3
50 - 60	-4812,4	-5977,3	-0,6271	-4425,2
60 - 70	-5622,2	-5987,6	-0,6845	-5201,2
70 - 80	-6456,4	-5996,7	-0,7327	-5991,8
80 - 90	-7293,7	-5825,9	-0,7813	-6774,3
90 - 100	-8072,7	-6016,5	-0,8018	-7484,9

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-830,9	6035,7	-0,1365	-632,4
10 - 20	-1639,7	6028,9	-0,2626	-1418,8
20 - 30	-2415,2	6027,7	-0,3721	-2168,8
30 - 40	-3203,1	6019,1	-0,4700	-2926,5
40 - 50	-3997,4	6007,4	-0,5542	-3685,7
50 - 60	-4809,7	5999,9	-0,6257	-4456,6
60 - 70	-5631,2	5991,1	-0,6851	-5232,0
70 - 80	-6467,4	5983,6	-0,7342	-6014,4
80 - 90	-7208,9	5976,7	-0,7700	-6716,3
90 - 100	-8087,1	5967,4	-0,8048	-7529,6

Limit	$\Delta Q \leq \pm 5$ % of S_n

Q = 0

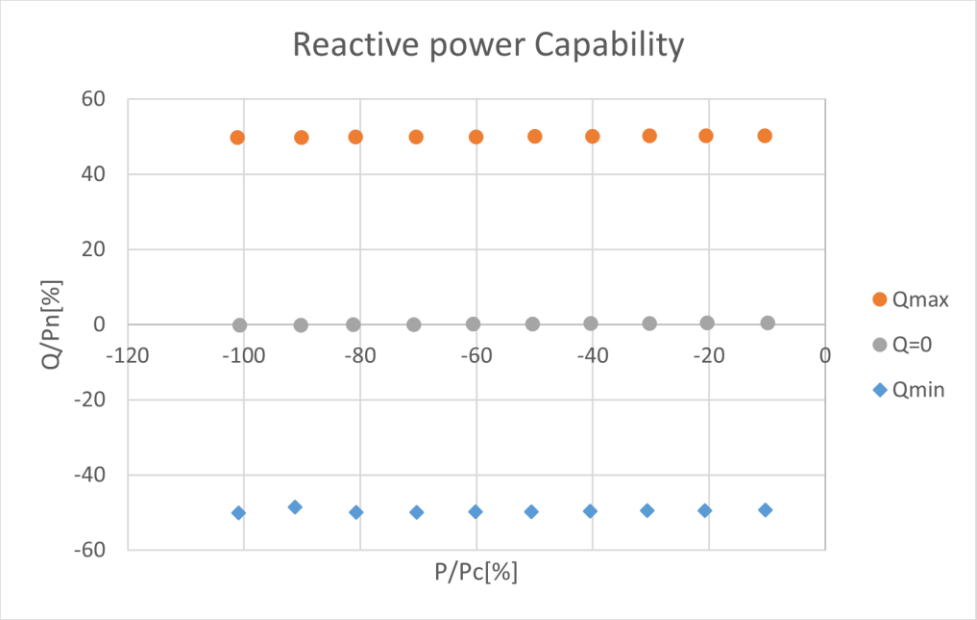
Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-790,3	54,9	-0,9834	-650,4
10 - 20	-1626,6	46,7	-0,9965	-1457,2
20 - 30	-2419,1	41,5	-0,9984	-2219,6
30 - 40	-3224,0	34,3	-0,9991	-2988,8
40 - 50	-4028,7	25,9	-0,9993	-3755,1
50 - 60	-4842,3	15,0	-0,9995	-4529,4
60 - 70	-5663,2	7,0	-0,9996	-5303,9
70 - 80	-6494,4	-1,7	-0,9996	-6079,8
80 - 90	-7214,2	-11,0	-0,9996	-6758,5
90 - 100	-8061,2	-22,1	-0,9996	-7554,5

Limit	$\Delta Q \leq \pm 5$ % of S_n

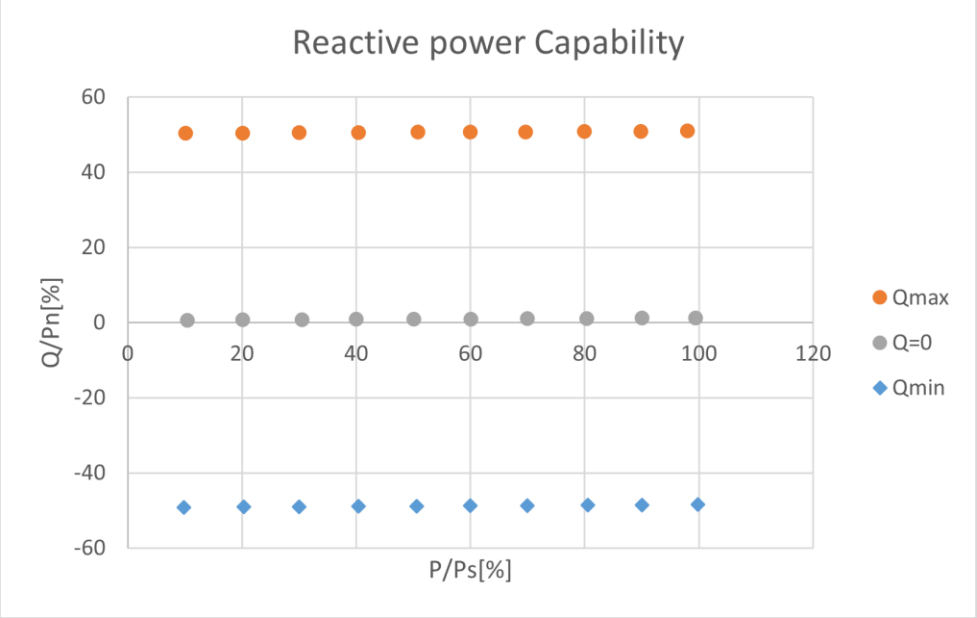
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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Graph of capability curves valid for inverter Charge mode P_{CMAX}



Graph of capability curves valid for inverter Discharge mode P_{SMAX}



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Bbis.6.2	**Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW**	**P**

Note

The inverter produces reactive power according to the circular characteristic. The priority is always given by the reactive power.

Maximum inductive and capacitive reactive power delivered as a function of active power (here the case of a storage system with a power greater than 11,08 kW is represented, which must be able to absorb or deliver at any active power level a reactive power of at least 48,43 % of the rated active power, Q_{min}/P_n = 48,43 % P_n)

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Test result: Bidirectional converters (Discharge mode P_{SMAX}, or P_{NINV} for integrated EESS)

DHN-LVEH3P8K-EU-G1 with Cmin battery

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	696,6	-3752,4	0,1825	871,3
10 - 20	1404,4	-3742,2	0,3514	1585,3
20 - 30	2054,6	-3733,5	0,4821	2252,6
30 - 40	2748,4	-3709,1	0,5954	2969,7
40 - 50	3436,3	-3701,2	0,6804	3684,7
50 - 60	4062,2	-3694,6	0,7398	4340,1
60 - 70	4728,5	-3686,8	0,7886	5041,6
70 - 80	5433,6	-3677,7	0,8281	5797,7
80 - 90	6134,4	-3669,5	0,8582	6540,0
90 - 100	6688,0	-3664,9	0,8770	7139,1

Limit	$\Delta Q \leq \pm 5$ % of S_n

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	630,7	3893,6	0,1599	775,7
10 - 20	1346,6	3901,9	0,3262	1497,0
20 - 30	2064,4	3910,0	0,4669	2229,8
30 - 40	2766,4	3919,5	0,5766	2954,4
40 - 50	3456,9	3929,4	0,6605	3682,3
50 - 60	4138,5	3938,4	0,7244	4395,2
60 - 70	4800,5	3944,0	0,7727	5093,4
70 - 80	5493,7	3952,4	0,8118	5832,1
80 - 90	6129,7	3958,6	0,8401	6514,6
90 - 100	6717,4	3965,9	0,8611	7155,4

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Q = 0

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	710,4	82,4	0,9767	827,0
10 - 20	1366,9	87,8	0,9929	1493,1
20 - 30	2073,6	94,0	0,9965	2217,2
30 - 40	2720,1	103,2	0,9977	2886,6
40 - 50	3407,0	111,0	0,9985	3602,1
50 - 60	4087,0	119,1	0,9989	4315,8
60 - 70	4755,7	126,9	0,9992	5032,4
70 - 80	5465,6	134,8	0,9994	5787,0
80 - 90	6122,5	141,9	0,9995	6489,7
90 - 100	6758,3	150,3	0,9995	7177,6

Limit	$\Delta Q \leq \pm 5$ % of S_n

Test result: Bidirectional converters (charge mode P_{CMAX})

Inductive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-805,1	-3773,2	-0,2087	-630,1
10 - 20	-1629,7	-3785,2	-0,3954	-1419,4
20 - 30	-2405,2	-3797,7	-0,5351	-2169,4
30 - 40	-3190,5	-3807,9	-0,6422	-2923,0
40 - 50	-4043,9	-3817,1	-0,7272	-3737,7
50 - 60	-4841,8	-3827,2	-0,7845	-4494,5
60 - 70	-5660,2	-3837,0	-0,8277	-5259,6
70 - 80	-6476,1	-3835,3	-0,8604	-6037,1
80 - 90	-7064,4	-3841,7	-0,8785	-6583,5
90 - 100	-7064,0	-3840,5	-0,8786	-6593,7

Limit	$\Delta Q \leq \pm 5$ % of S_n

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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Capacitive reactive power absorption

Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-794,5	3894,9	-0,1999	-640,3
10 - 20	-1612,5	3890,5	-0,3829	-1436,0
20 - 30	-2451,1	3886,0	-0,5335	-2245,5
30 - 40	-3247,1	3876,4	-0,6421	-3008,6
40 - 50	-4054,5	3871,1	-0,7233	-3769,6
50 - 60	-4863,8	3864,3	-0,7832	-4536,5
60 - 70	-5617,4	3855,0	-0,8245	-5246,3
70 - 80	-6457,1	3845,0	-0,8592	-6032,3
80 - 90	-7012,0	3854,0	-0,8765	-6552,7
90 - 100	-7012,1	3853,6	-0,8766	-6563,1

Limit	$\Delta Q \leq \pm 5$ % of S_n

Q = 0

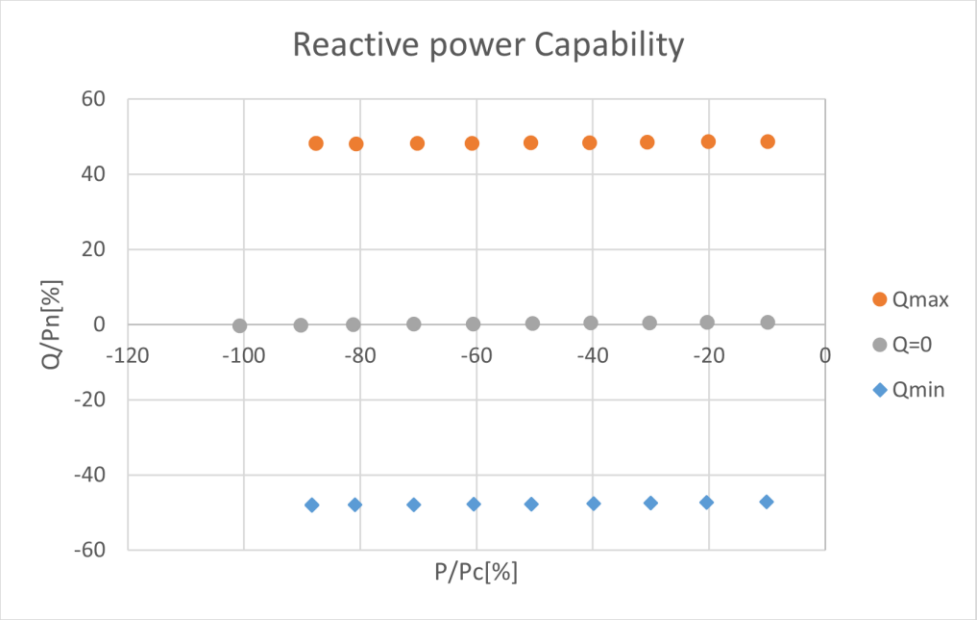
Power-BIN [%P_n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-790,3	54,9	-0,9834	-650,4
10 - 20	-1626,6	46,7	-0,9965	-1457,2
20 - 30	-2419,1	41,5	-0,9984	-2219,6
30 - 40	-3224,0	34,3	-0,9991	-2988,8
40 - 50	-4028,7	25,9	-0,9993	-3755,1
50 - 60	-4842,3	15,0	-0,9995	-4529,4
60 - 70	-5663,2	7,0	-0,9996	-5303,9
70 - 80	-6494,4	-1,7	-0,9996	-6079,8
80 - 90	-7214,2	-11,0	-0,9996	-6758,5
90 - 100	-8061,2	-22,1	-0,9996	-7554,5

Limit	$\Delta Q \leq \pm 5$ % of S_n

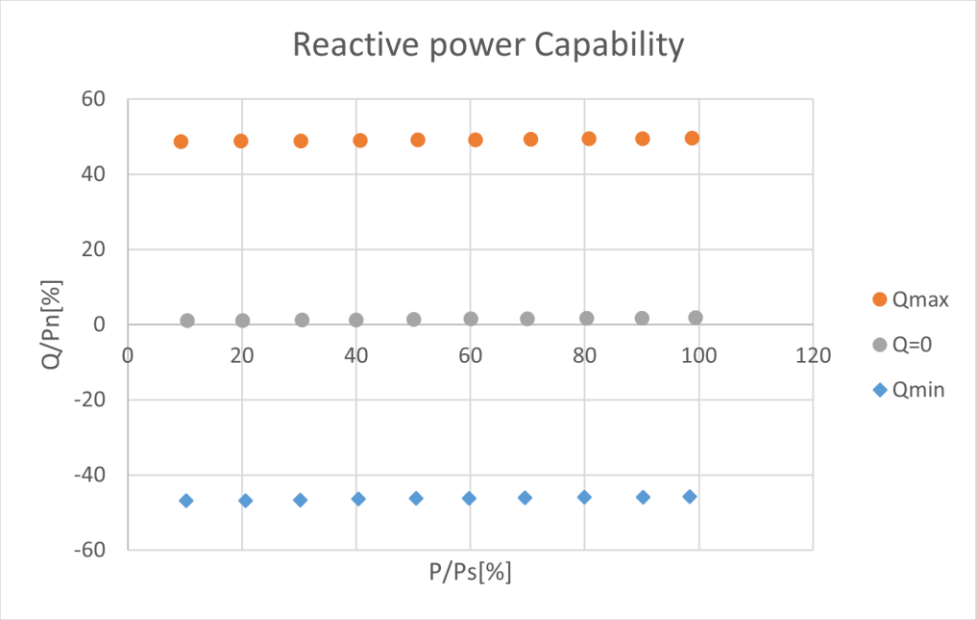
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Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	P

Graph of capability curves valid for inverter Charge mode P_{CMAX}



Graph of capability curves valid for inverter Discharge mode P_{SMAX}



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Bbis.6.2	**Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW**	**P**

Note

The inverter produces reactive power according to the circular characteristic. The priority is always given by the reactive power.

Maximum inductive and capacitive reactive power delivered as a function of active power (here the case of a storage system with a power greater than 11,08 kW is represented, which must be able to absorb or deliver at any active power level a reactive power of at least 48,43 % of the rated active power, Q_{min}/P_n = 48,43 % P_n)

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Bbis.6.3	Reactive power exchange according to an assigned level	P

Storage systems must participate in the control of the mains voltage. For storage systems used in plants with a total output of more than 11,08 kW, a centralised control strategy via a remote-control signal provided by the DSO is possible.

The tests covered in this paragraph are only mandatory for EESS used in systems above 11,08 kW, but at the manufacturer's request they can also be carried out and documented for smaller storage systems.

The purpose of the test is to verify the ability of the storage system control system to execute the reactive power level regulation command between the maximum capability limits ("rectangular" capability, according to the definition given in 8.4.4.2 and shown in the example in Figure 62) both in absorption and in delivery of reactive power and to verify the accuracy of the regulation.

In the absence of a defined protocol for the exchange of control commands, it is up to the manufacturer to establish the way in which the commands for setting the reactive power operating point are to be carried out, both in terms of the physical signal (analogue, serial protocol, etc.) and the control parameter adopted (setting according to an absolute value of reactive power Q, or as a cos f value).

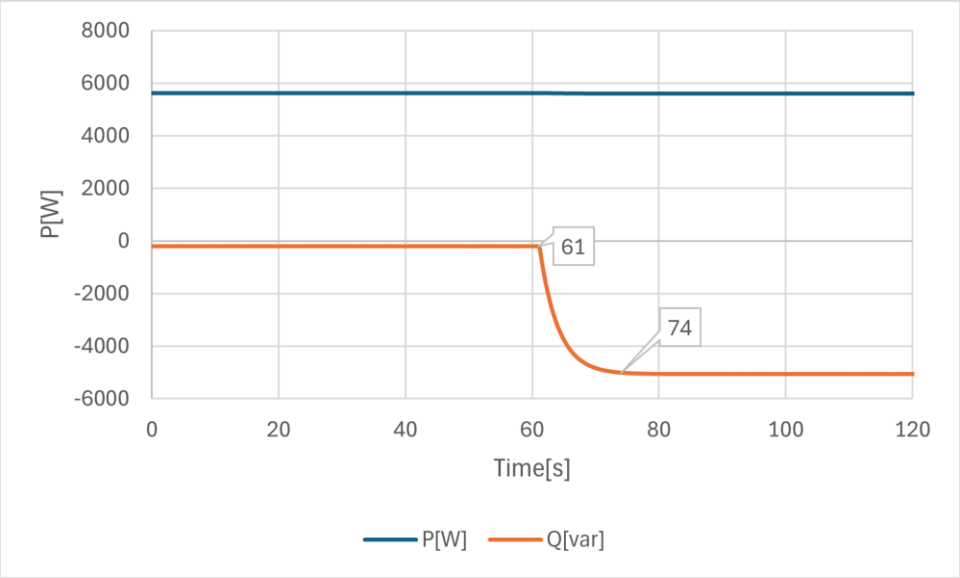
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Bbis.6.4	Method of performing the test and recording the results (Q-setting hypothesis)	P
Bidirectional converters		
Test: 50% P_{SMAX}		
1-min mean value	50% P_{SMAX} Q = 0% S_n to Q_{ind} = 40% S_n	
Q_{E60} [%]:	42,1	
Limit ΔQ_{E60} [%]:	Q_{ind} = 40% S_n ± 5 % of S_n	
Settling time [s]:	13,0	
Limit settling time [s]:	30	
Test: 50% P_{CMAX}		
1-min mean value	50% P_{CMAX} Q = 0% S_n to Q_{ind} = 40% S_n	
Q_{E60} [%]:	41,5	
Limit ΔQ_{E60} [%]:	Q_{ind} = 40% S_n ± 5 % of S_n	
Settling time [s]:	14,4	
Limit settling time [s]:	30	

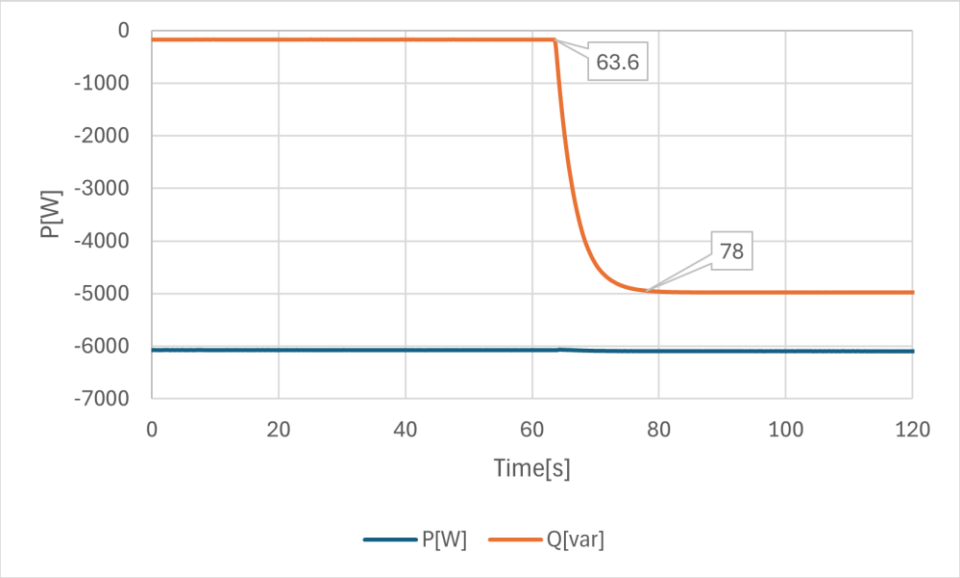
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Bbis.6.4	Method of performing the test and recording the results (Q-setting hypothesis)	P

Graph



Graph



Note:

- ΔQ ≤ ± 2,5%
- Δcosφ ≤ ± 0,01

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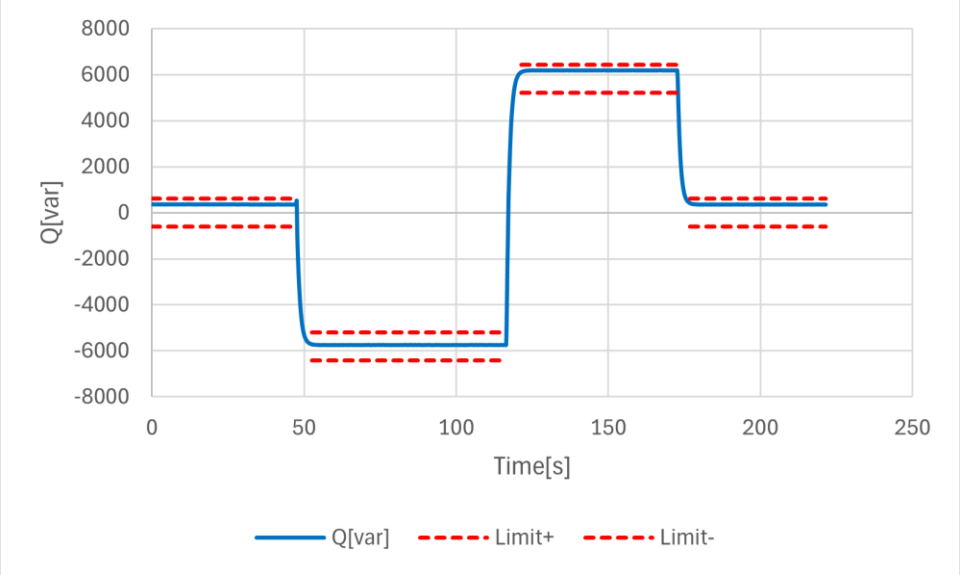
Bbis.6.5	Response time to a step variation of the assigned level	P

Bidirectional Inverter

Test Result: 50 % and 100 % of the maximum active power of discharge (P_{SMAX})

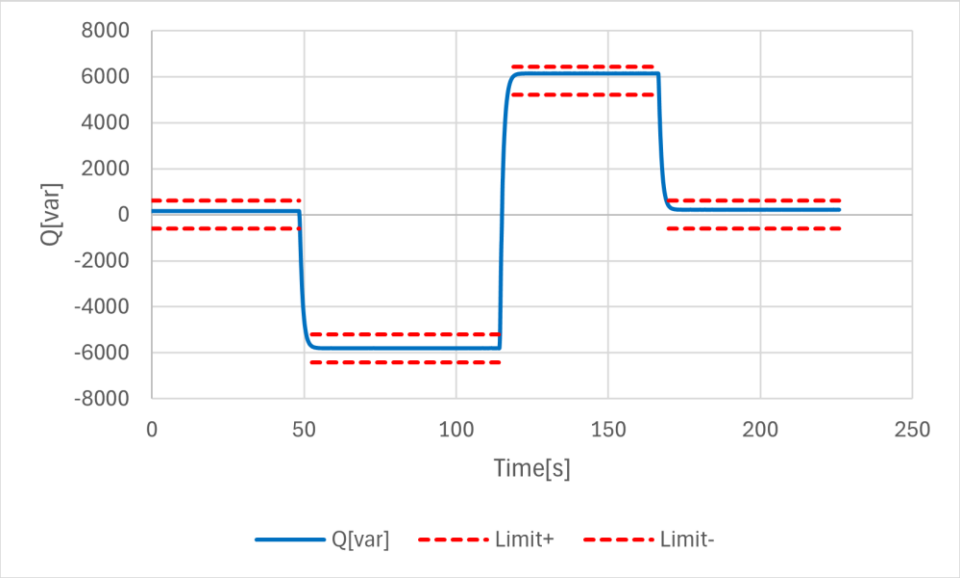
No	Condition	Measured reactive power [Var]	Time [s]	Result
1	Reaction time Q = 0 to Q_{min} (100% test)	-5739,2	3,8	P
2	Reaction time Q_{min} to Q_{max} (100% test)	6175,4	3,4	P
3	Reaction time Q_{max} to Q = 0 (100% test)	356,6	3,8	P
4	Reaction time Q = 0 to Q_{min} (50% test)	-5797,2	4,2	P
5	Reaction time Q_{min} to Q_{max} (50% test)	6129,3	3,4	P
6	Reaction time Q_{max} to Q = 0 (50% test)	213,5	3,0	P

Graph 100%:



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Bbis.6.5	Response time to a step variation of the assigned level	P
Graph 50%		



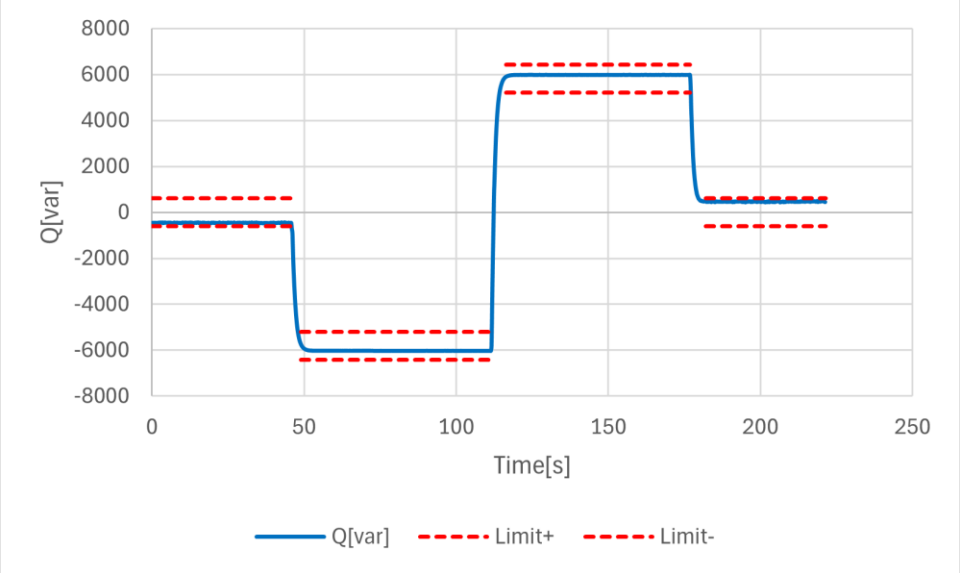
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Bbis.6.5	Response time to a step variation of the assigned level	P

Test Result: 50 % and 100 % of the maximum active power of charge (P_{CMAX})

No	Condition	Measured reactive power [Var]	Time [s]	Result
1	Reaction time Q = 0 to Q_{min} (100% test)	-6022,4	2,6	P
2	Reaction time Q_{min} to Q_{max} (100% test)	5979,3	4,4	P
3	Reaction time Q_{max} to Q = 0 (100% test)	464,1	3,8	P
4	Reaction time Q = 0 to Q_{min} (50% test)	-5960,2	3,0	P
5	Reaction time Q_{min} to Q_{max} (50% test)	6017,0	3,8	P
6	Reaction time Q_{max} to Q = 0 (50% test)	168,1	3,5	P

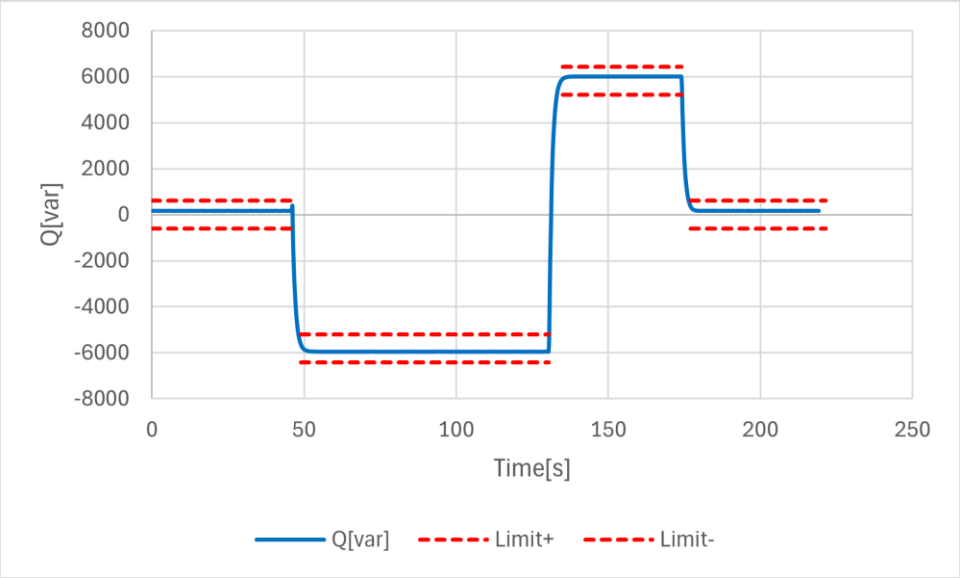
Graph 100%:



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Bbis.6.5	Response time to a step variation of the assigned level	P

Graph 50%:



Note

Two test should be performed. At 50% P_n and 100% P_n

- $\Delta Q \leq \pm 5\%$
- Max response time 10s

For test results and diagram (discharge mode P_{SMAX}) see B.1.2.4

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Bbis.6.6	Automatic reactive power output according to a characteristic curve cos φ = f(P)

Storage systems in plants must be able to absorb reactive power automatically and autonomously (local control logic) according to a power factor characteristic curve as a function of active power = f(P).

For integrated storage systems, the test must be carried out with the photovoltaic field delivering such a power that, together with the nominal power of the storage, the nominal power of the inverter is obtained.

The purpose of the test is to verify that the storage system, through its converter, follows the automatic reactive power delivery mode according to the standard characteristic curve cos φ = f (P) given in E.2, according to method a).

A: P = 20%*P_{SMAX}; cos φ = 1

B: P = 50%*P_{SMAX}; cos φ = 1

C: P = P_{SMAX}; cos φ = cos $\varphi_{\_min}$ = 0,9

Where cos φ_{min} is 0,90 (inductive)

Adjustment along the characteristic curve is enabled when the voltage detected at the output terminals exceeds the "critical" lock-in value (e.g. set to V_n = 1,05 V_n, see paragraph E.2).

The lock-in voltage value that enables the automatic supply of reactive power and that during testing must be set to 1,05 V_n (default setting also for production), must be adjustable in the range between V_n and 1,1 V_n at intervals of 0,01 V_n.

The Distributor shall specify the required lock-in voltage value in the Operating Regulations.

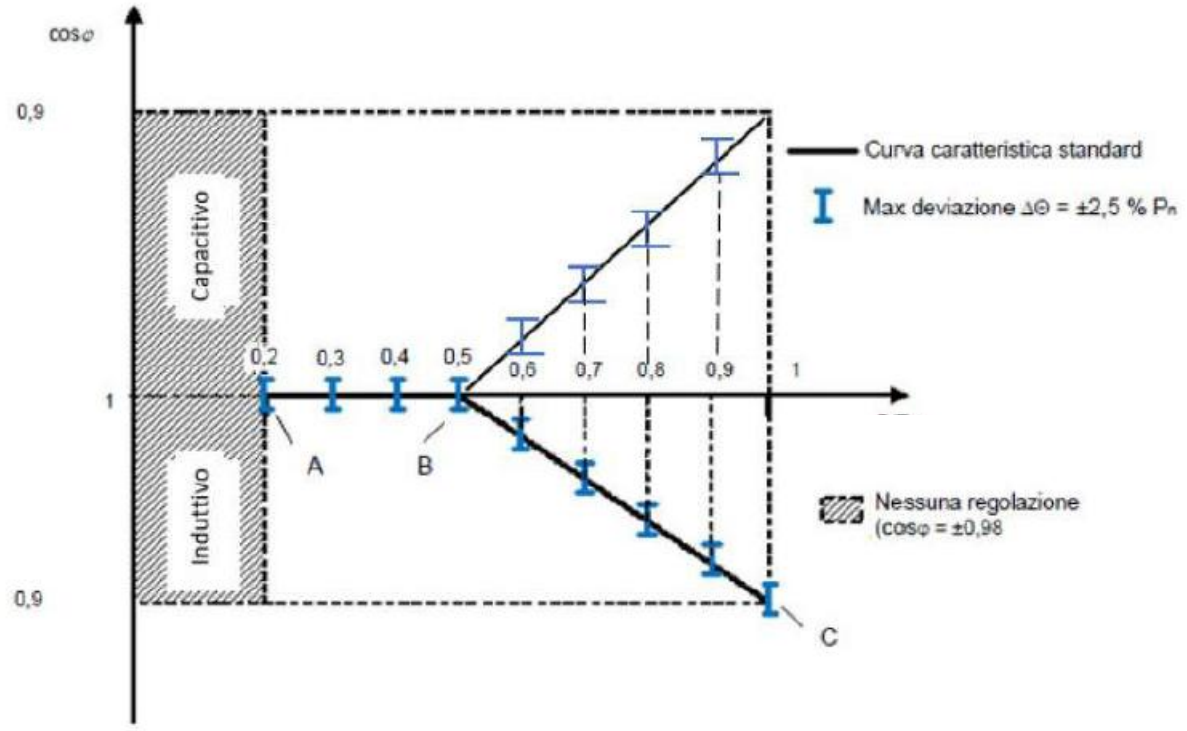


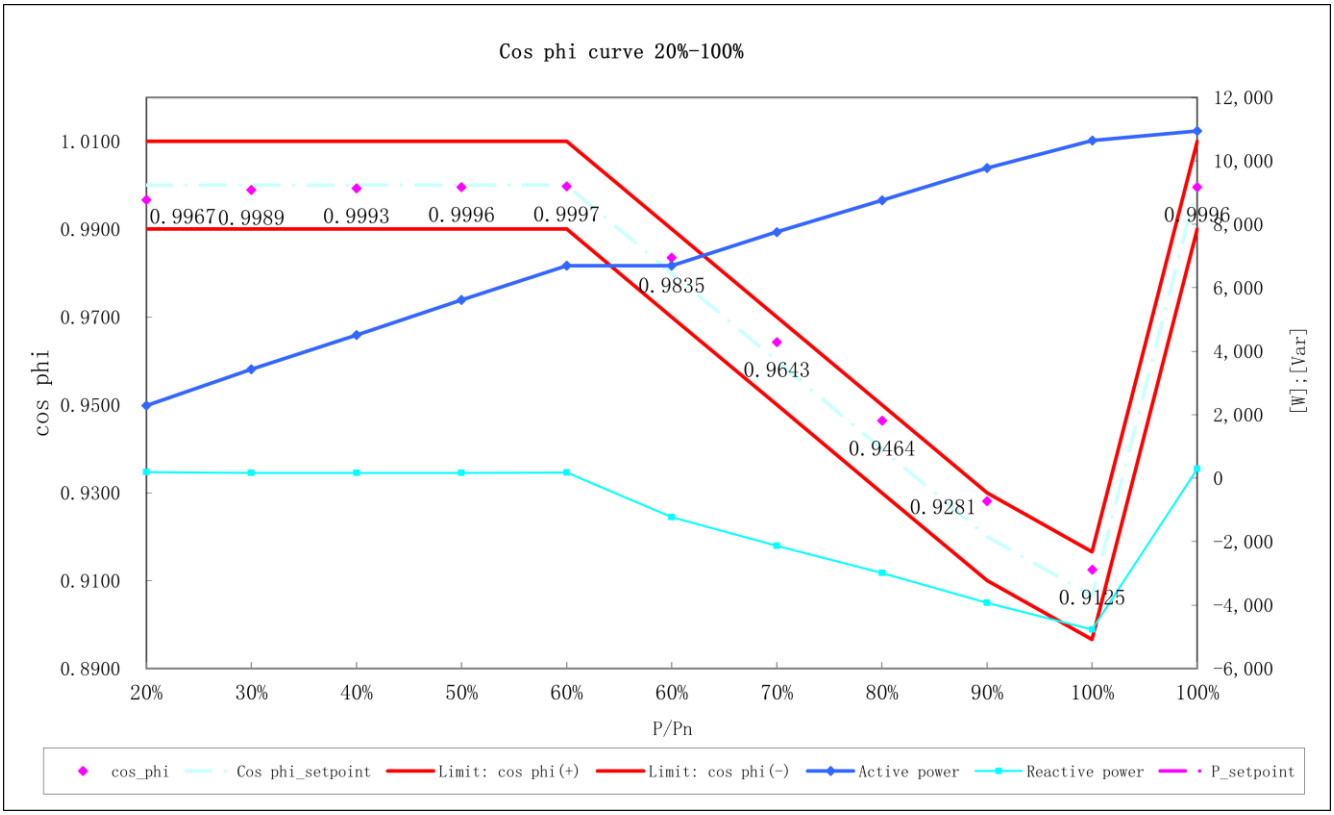
Figure 66 - Standard characteristic curve cosφ= f(P)

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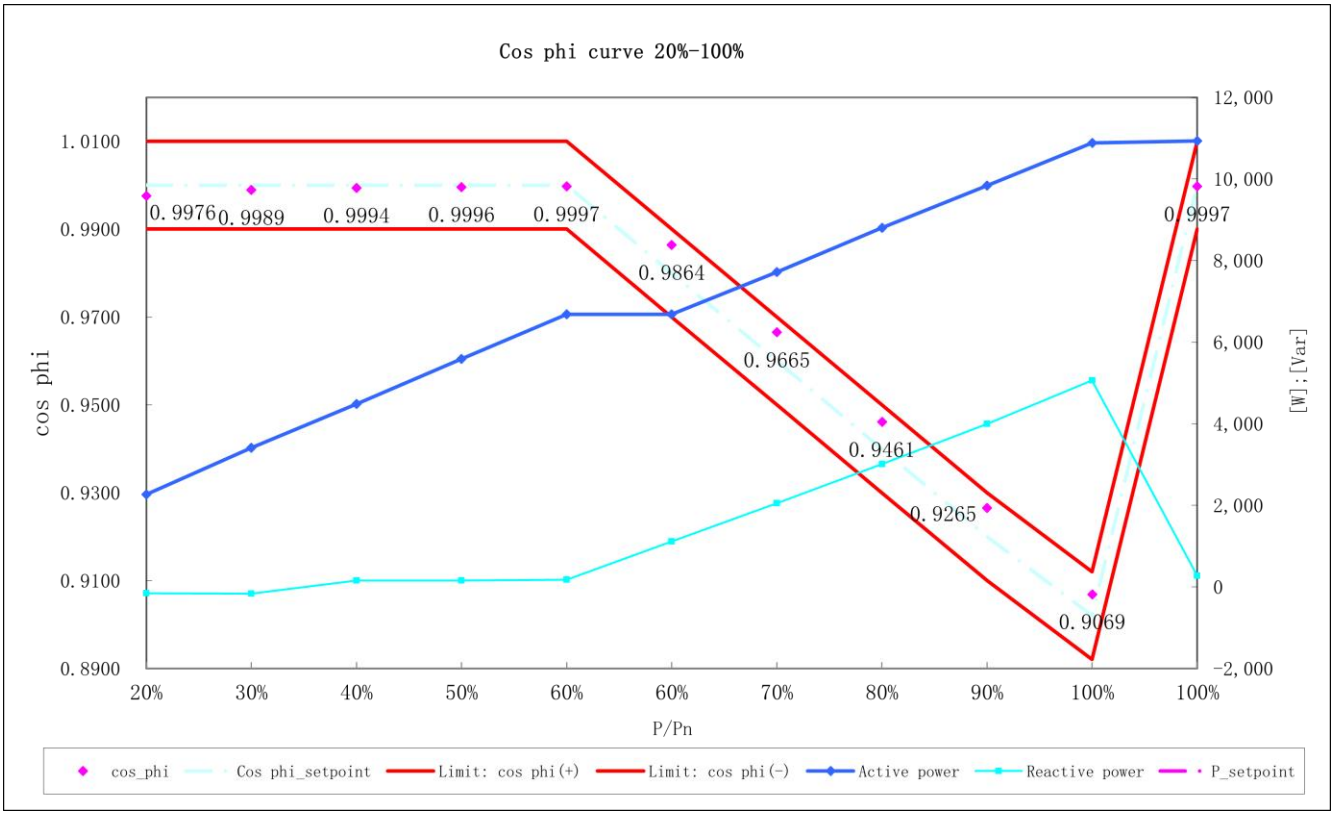
Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)				P
Test result					
DHN-LVEH3P12K-EU-G1 with Cmax battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	2287,4	185,7	0,9967	1,0000	-0,0033
30	3434,1	164,2	0,9989	1,0000	-0,0011
40	4515,1	163,8	0,9993	1,0000	-0,0007
50	5611,6	167,0	0,9996	1,0000	-0,0004
60	6700,8	172,1	0,9997	1,0000	-0,0003
60	6692,9	-1232,6	0,9835	0,9800	0,0035
70	7757,0	-2130,5	0,9643	0,9600	0,0043
80	8758,6	-2990,5	0,9464	0,9400	0,0064
90	9778,2	-3923,6	0,9281	0,9200	0,0081
100	10636,8	-4768,8	0,9125	0,9066	0,0059
100	10942,9	293,4	0,9996	1,0000	-0,0004
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	2271,5	-156,1	0,9976	1,0000	-0,0024
30	3413,5	-161,1	0,9989	1,0000	-0,0011
40	4485,1	156,9	0,9994	1,0000	-0,0006
50	5592,1	157,8	0,9996	1,0000	-0,0004
60	6686,0	174,3	0,9997	1,0000	-0,0003
60	6681,0	1112,1	0,9864	0,9800	0,0064
70	7714,5	2048,1	0,9665	0,9600	0,0065
80	8798,5	3010,8	0,9461	0,9400	0,0061
90	9839,2	3996,6	0,9265	0,9200	0,0065
100	10887,1	5057,8	0,9069	0,9021	0,0048
100	10936,0	272,5	0,9997	1,0000	-0,0003
Graph of cos φ(P)					

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Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)	P



Inductive



Capacitive

Note

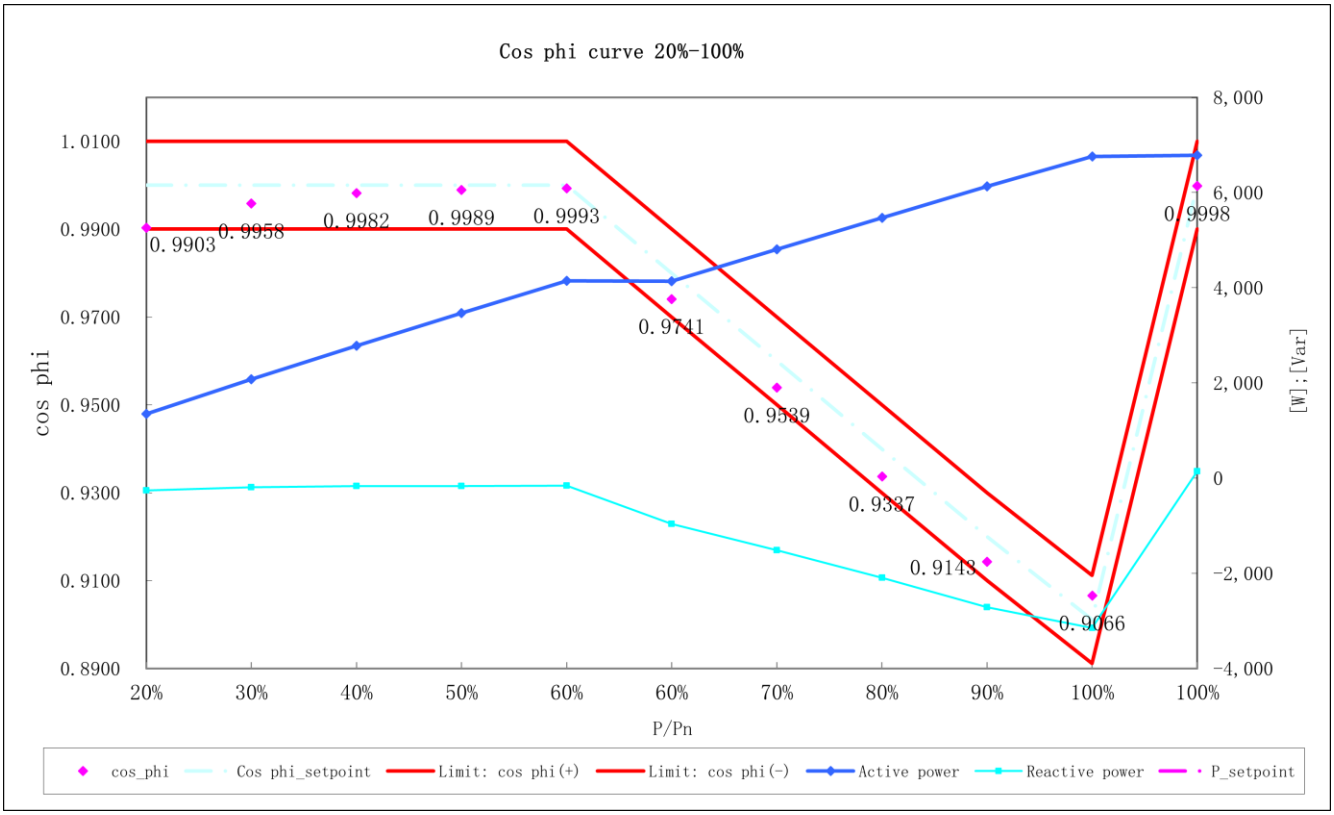
The lock-in value is adjustable between V_n and $1{,}1V_n$ and the lock-out value between V_n and $0{,}9V_n$ in 0,01V steps.

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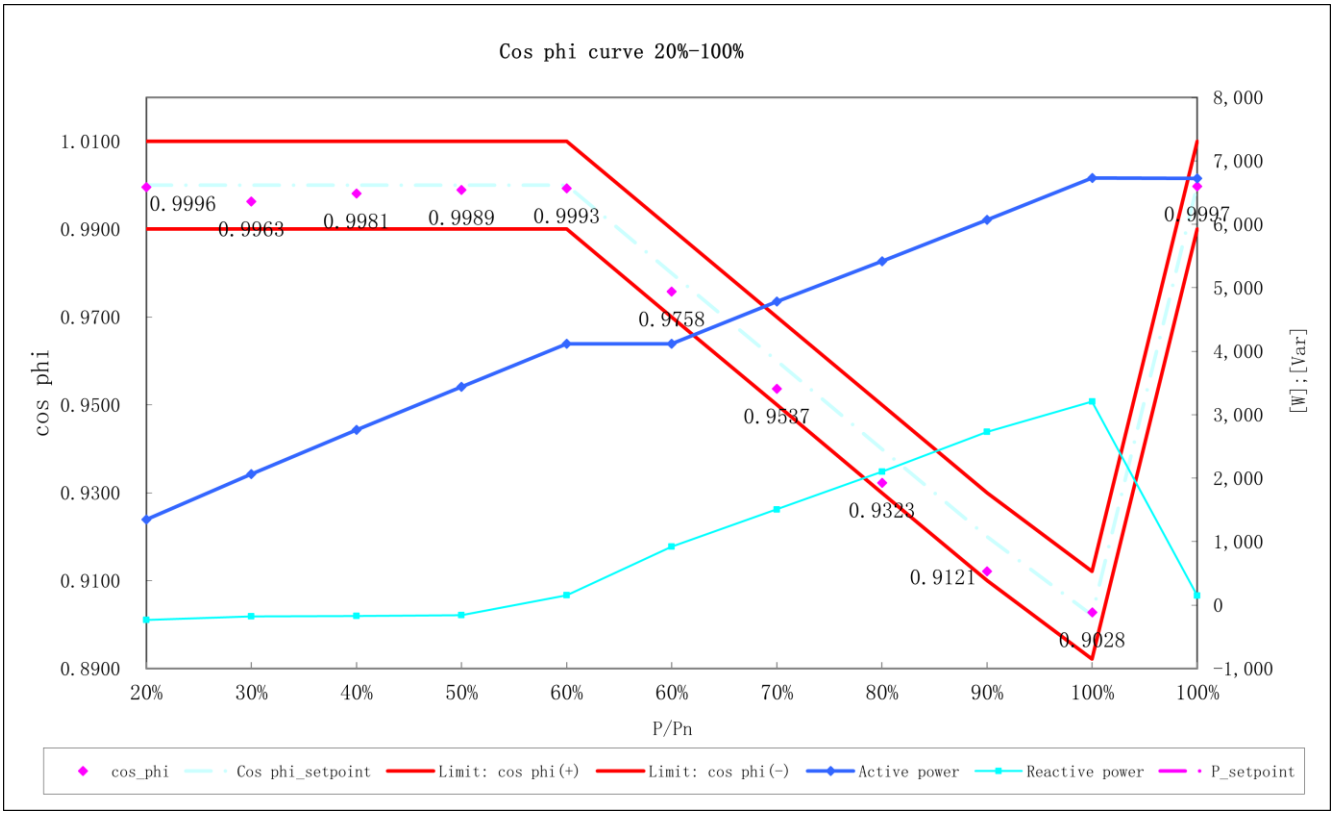
Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)				P
Test result					
DHN-LVEH3P12K-EU-G1 with Cmin battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	1351,9	-260,1	0,9903	1,0000	-0,0097
30	2076,9	-189,8	0,9958	1,0000	-0,0042
40	2777,7	-168,2	0,9982	1,0000	-0,0018
50	3467,2	-162,9	0,9989	1,0000	-0,0011
60	4141,6	-156,1	0,9993	1,0000	-0,0007
60	4139,8	-960,8	0,9741	0,9800	-0,0059
70	4806,6	-1513,0	0,9539	0,9600	-0,0061
80	5465,9	-2095,3	0,9337	0,9400	-0,0063
90	6129,9	-2714,7	0,9143	0,9200	-0,0057
100	6759,7	-3147,4	0,9066	0,9012	0,0054
100	6780,0	144,6	0,9998	1,0000	-0,0002
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	1345,5	-232,4	0,9996	1,0000	-0,0004
30	2064,5	-177,6	0,9963	1,0000	-0,0037
40	2758,9	-170,1	0,9981	1,0000	-0,0019
50	3441,0	-161,9	0,9989	1,0000	-0,0011
60	4117,9	155,5	0,9993	1,0000	-0,0007
60	4116,9	922,6	0,9758	0,9800	-0,0042
70	4781,4	1508,0	0,9537	0,9600	-0,0063
80	5419,6	2101,7	0,9323	0,9400	-0,0077
90	6071,1	2729,5	0,9121	0,9200	-0,0079
100	6727,5	3205,7	0,9028	0,9021	0,0007
100	6725,7	151,1	0,9997	1,0000	-0,0003
Graph of cos φ(P)					

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Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)	P



Inductive



Capacitive

Note

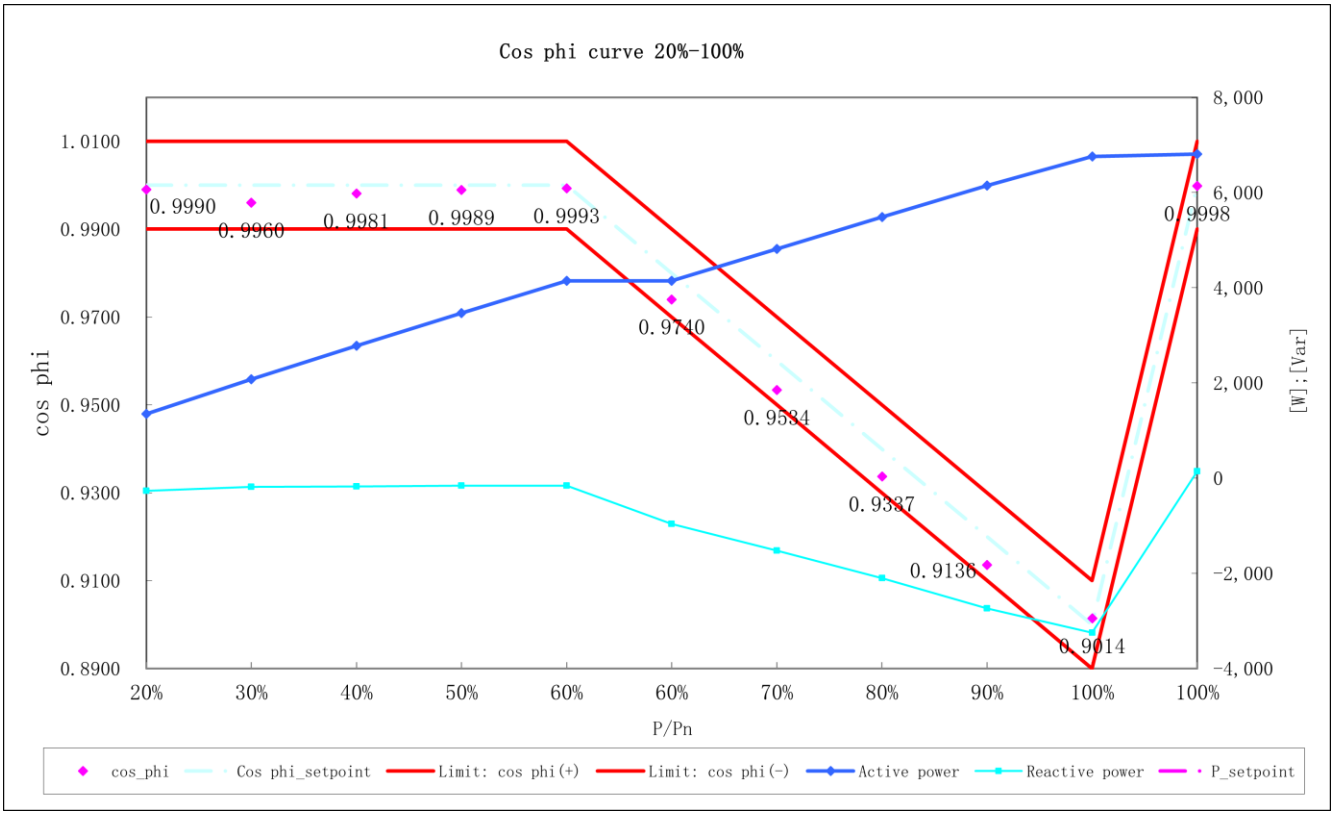
The lock-in value is adjustable between V_n and $1{,}1V_n$ and the lock-out value between V_n and $0{,}9V_n$ in 0,01V steps.

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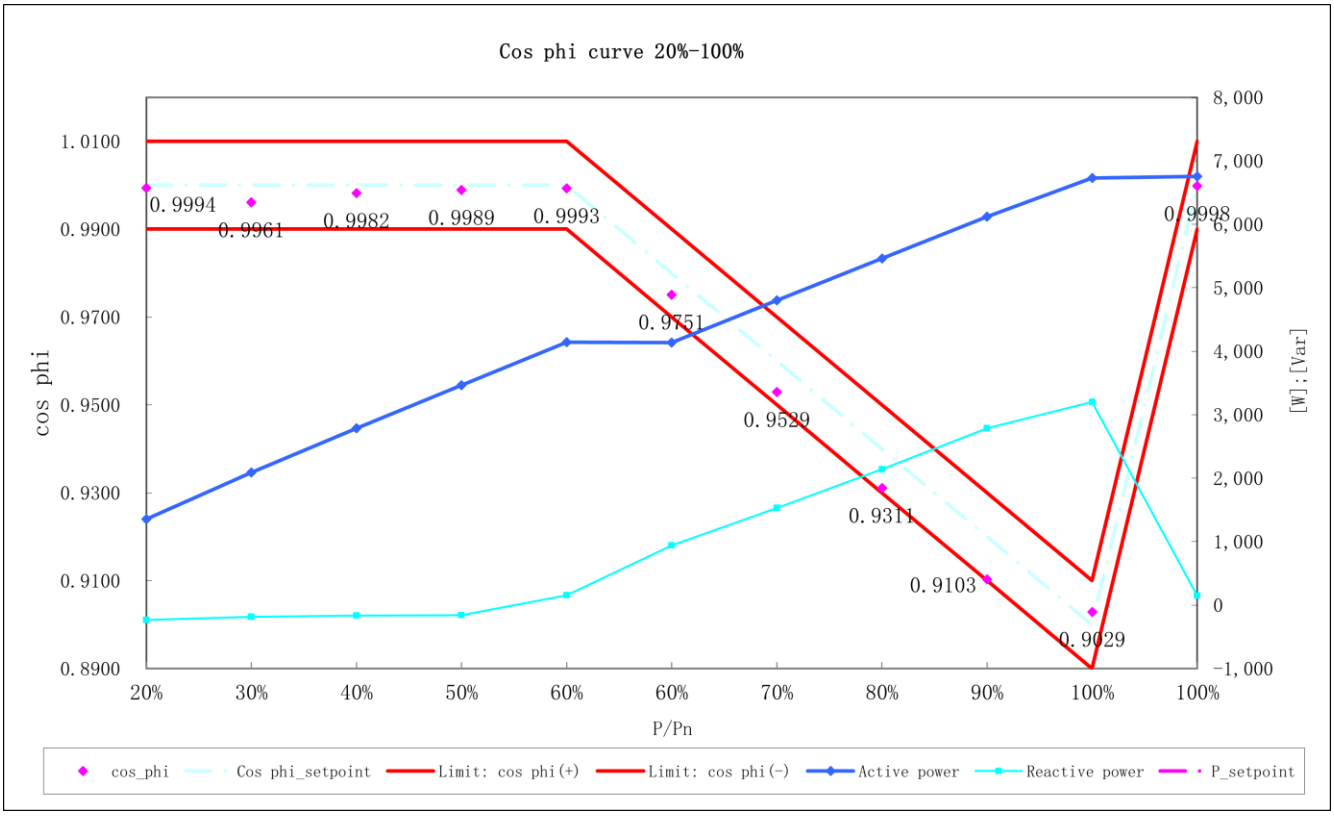
Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)				P
Test result					
DHN-LVEH3P8K-EU-G1 with Cmin battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	1349,5	-268,1	0,9990	1,0000	-0,0010
30	2077,2	-185,4	0,9960	1,0000	-0,0040
40	2780,4	-171,3	0,9981	1,0000	-0,0019
50	3471,3	-161,4	0,9989	1,0000	-0,0011
60	4146,3	-155,4	0,9993	1,0000	-0,0007
60	4144,9	-963,4	0,9740	0,9800	-0,0060
70	4819,3	-1525,0	0,9534	0,9600	-0,0066
80	5485,0	-2103,0	0,9337	0,9400	-0,0063
90	6147,0	-2735,9	0,9136	0,9200	-0,0064
100	6759,8	-3247,3	0,9014	0,9000	0,0014
100	6806,3	147,7	0,9998	1,0000	-0,0002
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	cos φ measured [1]	cos φ expected [1]	Δcos φ [1]
20	1351,8	-233,5	0,9994	1,0000	-0,0006
30	2088,1	-185,8	0,9961	1,0000	-0,0039
40	2783,2	-165,0	0,9982	1,0000	-0,0018
50	3466,6	-160,4	0,9989	1,0000	-0,0011
60	4144,1	154,4	0,9993	1,0000	-0,0007
60	4134,8	939,7	0,9751	0,9800	-0,0049
70	4802,9	1529,3	0,9529	0,9600	-0,0071
80	5459,7	2138,8	0,9311	0,9400	-0,0089
90	6119,7	2782,8	0,9103	0,9200	-0,0097
100	6727,4	3203,3	0,9029	0,9000	0,0029
100	6756,2	149,2	0,9998	1,0000	-0,0002
Graph of cos φ(P)					

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Bbis.6.7	Verification of compliance with the application of the standard delivery curve cos φ = f(P)	P



Inductive



Capacitive

Note

The lock-in value is adjustable between V_n and $1{,}1V_n$ and the lock-out value between V_n and $0{,}9V_n$ in 0,01V steps.

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Bbis.6.8	Automatic reactive power exchange according to a characteristic curve Q = f(V)	P

In accordance with 8.4.4.2, all storage systems in installations with a total capacity of more than 11,08 kW must be able to absorb or deliver reactive power automatically and autonomously (local control logic) according to the characteristic curves Q = f(V) shown as an example in Figure 51.

The purpose of the test is to verify that the storage system, through its converter, follows the automatic reactive power delivery mode according to the standard characteristic curves Q = f(V) given in E.2.

Since operation under this regulation criterion is assimilated to a network service provided by the Active User at the request of the DSO, the following applies.

Activation shall take place at the request of the DSO when the Operating Regulation is issued. The DSO shall also specify the values of the parameters that unambiguously characterise the curve, i.e.: V1i, V2i, V1s and V2s, k as well as the active power lock-in value in discharge (default value P = 20 %

* P_{SMAX} or, for integrated storage systems, P = 20 % * P_{NINV}) and, for storage systems connected to bidirectional inverters, the active power lock-in value in charge (P = 20 % * P_{CMAX}).

Parameters V1i, V2i, V1s and V2s must be able to be set in the range 0,9 ÷ 1,1 * V_n with step 0,01 * V_n, while parameters k must be able to be set in the range 0 ÷ 1, with step 0,01. In order to facilitate the execution of type tests, the parameters characterising the curve are conventionally set as follows:

V1s = 1,08 * V_n; V2s = 1,1 * V_n;

V1i = 0,92 * V_n; V2i = 0,9 * V_n;

k = 0,1;

It is as well as the lock-in value of active power in charge and discharge. s at the discretion of the test laboratory to use values of V1s and V1i other than the default values during the execution of the tests, as long as they are within the adjustment limits of the standard. The voltage settings and parameters used during the execution of the test protocol must be adjusted accordingly (see Bbis.6.9. The test report must state the characteristic parameters used.

The activation delay must be verified by repeating any of the tests in Section Bbis.6.9 with the activation delay different from 0 and verifying that the Q(V) actuation time differs by this delay.

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TEMP-0058-TG-EAW-ES-V01

Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)				P
Test 1: Discharge mode (P_{SMAX}) / k = 0,1					
Setting values	V1s in V_n [1]	1,08	V2s in V_n [1]	1,10	
	V1i in V_n [1]	0,92	V2i in V_n [1]	0,90	
	lock-in value [% P_{SMAX}]	20	lock-out value [% P_{SMAX}]	5	
	k-factor [1]	0,1			

-Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	1,07 V_n	15,62	246,3	605,1	≈k*Q_{max} (<±5%*S_n)	0,20
< 20%	1,09 V_n	15,58	250,5	619,8	≈k*Q_{max} (<±5%*S_n)	0,32
< 20%-30%	1,09 V_n	24,64	250,5	-2102,3	0,4* -Q_{max}	1,85
40%	1,09 V_n	40,69	250,6	-2242,8	0,4* -Q_{max}	0,68
50%	1,09 V_n	49,82	250,6	-2387,8	0,4* -Q_{max}	-0,53
60%	1,09 V_n	60,23	250,7	-2375,7	0,4* -Q_{max}	-0,43
70%	1,09 V_n	70,45	250,7	-2420,7	0,4* -Q_{max}	-0,80
80%	1,09 V_n	79,91	250,8	-2503,9	0,4* -Q_{max}	-1,49
90%	1,09 V_n	90,09	250,8	-2646,6	0,4* -Q_{max}	-2,68
100%	1,09 V_n	100,45	250,9	-2639,3	0,4* -Q_{max}	-2,62
100%	1,10 V_n	94,65	253,9	-5133,5	0,9* -Q_{max}	0,81
100%-10%	1,10 V_n	10,31	253,5	-5260,1	0,9* -Q_{max}	-0,25
10%→ ≤5%	1,10 V_n	4,05	253,5	593,2	≈k*Q_{max}(< ±5%*S_n)	0,10

Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	0,93 V_n	15,55	214,0	684,3	≈k*Q_{max} (<±5%*S_n)	0,86
< 20%	0,91 V_n	15,53	209,5	671,3	≈k*Q_{max}(<±5%*Sn)	0,75
< 20%-30%	0,91 V_n	24,35	209,5	3660,4	0,6* Q_{max}	1,45
40%	0,91 V_n	40,33	209,6	3528,6	0,6* Q_{max}	0,35
50%	0,91 V_n	49,90	209,7	3543,0	0,6* Q_{max}	0,47
60%	0,91 V_n	59,71	209,7	3457,2	0,6* Q_{max}	-0,25
70%	0,91 V_n	69,84	209,8	3452,8	0,6* Q_{max}	-0,28
80%	0,91 V_n	79,77	209,8	3463,2	0,6* Q_{max}	-0,20
90%	0,91 V_n	89,51	209,9	3363,1	0,6* Q_{max}	-1,03
100%	0,91 V_n	94,30	209,9	3257,9	0,6* Q_{max}	-1,91
100%	0,90 V_n	82,33	207,9	5582,0	1,0* Q_{max}	-1,91
100%-10%	0,90 V_n	10,18	207,5	5954,7	1,0* Q_{max}	1,19
10%→ ≤5%	0,90 V_n	4,03	207,4	660,2	≈k*Q_{max} (<±5%*S_n)	0,66

Note:

The lock-in value is adjustable between V_n and 1,1Vn and the lock-out value between V_n and 0,9 Vn in 0,01 V steps.

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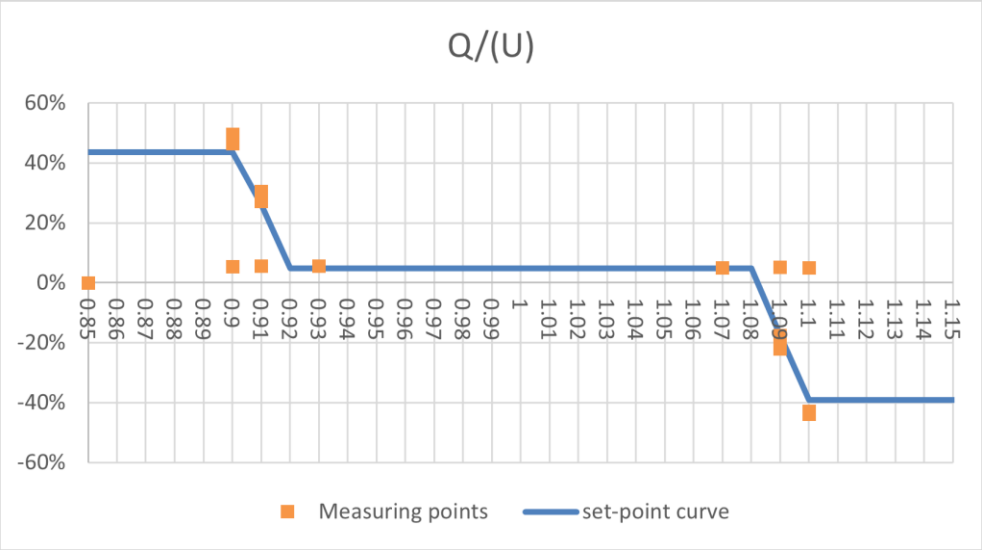
Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)	P

In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.

The under voltage measurement effects the active output power in reference to the reactive output power since the reactive output power has always priority. Therefore, the inverter must lower the active output power.

k varying between -1 and 1. For PV systems k = 0,1 for storage system k = 0 unless otherwise specified by the network operator. (For test, the setting value used is k = 0,1)

Graph



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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)				P
Test 2: Discharge mode (P_{SMAX}) / k = -0,1					
Setting values	V1s in V_n [1]	1,08	V2s in V_n [1]	1,10	
	V1i in V_n [1]	0,92	V2i in V_n [1]	0,90	
	lock-in value [% P_{SMAX}]	20	lock-out value [% P_{SMAX}]	5	
	k-factor [1]	-0,1			

-Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	1,07 V_n	15,65	246,3	-603,2	≈k*Q_{max}(<±5%*S_n)	-0,18
< 20%	1,09 V_n	15,65	250,4	-607,9	≈k*Q_{max}(<±5%*S_n)	-0,22
< 20%-30%	1,09 V_n	24,60	250,4	-3163,2	-0,6* Q_{max}	2,70
40%	1,09 V_n	40,92	250,5	-3169,9	-0,6* Q_{max}	2,64
50%	1,09 V_n	50,18	250,6	-3318,0	-0,6* Q_{max}	1,41
60%	1,09 V_n	60,72	250,6	-3465,5	-0,6* Q_{max}	0,18
70%	1,09 V_n	71,06	250,7	-3454,5	-0,6* Q_{max}	0,27
80%	1,09 V_n	80,29	250,7	-3452,5	-0,6* Q_{max}	0,29
90%	1,09 V_n	91,01	250,8	-3584,1	-0,6* Q_{max}	-0,81
100%	1,09 V_n	99,66	250,8	-3739,6	-0,6* Q_{max}	-2,11
100%	1,10 V_n	91,85	253,8	-5734,7	-1,0* Q_{max}	0,64
100%-10%	1,10 V_n	10,32	253,4	-5855,6	-1,0* Q_{max}	-0,37
10%→ ≤5%	1,10 V_n	4,03	253,4	-625,1	≈k*Q_{max}(<±5%*S_n)	-0,37

Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	0,93 V_n	15,62	213,9	-742,5	≈k*Q_{max} (<±5%*S_n)	-1,34
< 20%	0,91 V_n	15,72	209,4	-739,8	≈k*Q_{max} (<±5%*S_n)	-1,32
< 20%-30%	0,91 V_n	24,84	209,5	2661,2	0,4* Q_{max}	2,80
40%	0,91 V_n	41,08	209,6	2406,7	0,4* Q_{max}	0,68
50%	0,91 V_n	49,97	209,6	2418,6	0,4* Q_{max}	0,78
60%	0,91 V_n	60,82	209,7	2402,2	0,4* Q_{max}	0,65
70%	0,91 V_n	71,13	209,8	2307,1	0,4* Q_{max}	-0,15
80%	0,91 V_n	80,44	209,8	2254,6	0,4* Q_{max}	-0,58
90%	0,91 V_n	90,82	209,9	2058,3	0,4* Q_{max}	-2,22
100%	0,91 V_n	93,70	209,9	1953,0	0,4* Q_{max}	-3,10
100%	0,90 V_n	81,12	207,9	4989,8	0,9* Q_{max}	-2,01
100%-10%	0,90 V_n	10,50	207,5	5478,4	0,9* Q_{max}	2,07
10%→ ≤5%	0,90 V_n	1,68	207,4	-761,4	≈k*Q_{max} (<±5%*S_n)	-1,50

Note

The lock-in value is adjustable between V_n and 1,1V_n and the lock-out value between V_n and 0,9 V_n in 0,01 V steps.

In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.

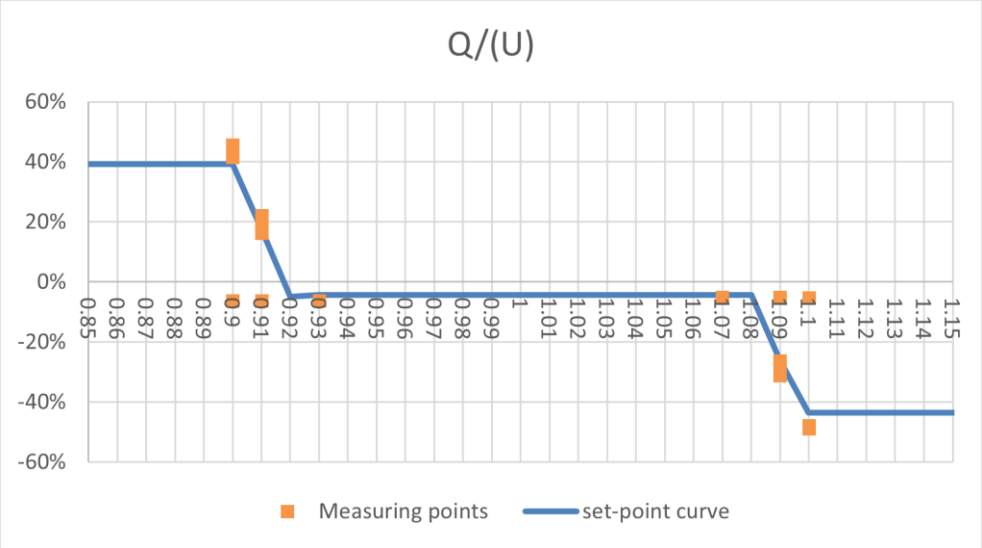
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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)	P

The under voltage measurement effects the active output power in reference to the reactive output power since the reactive output power has always priority. Therefore, the inverter must lower the active output power.

k varying between -1 and 1. For PV systems k = 0, for storage system k = 0 unless otherwise specified by the network operator. (For test, the setting value used is k = -0,1)

Graph



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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)				P
Test 3: Charge mode (P_{CMAX}) / k = 0,1					
Setting values	V1s in V_n [1]	1,08	V2s in V_n [1]	1,10	
	V1i in V_n [1]	0,92	V2i in V_n [1]	0,90	
	lock-in value [% P_{SMAX}]	20	lock-out value [% P_{SMAX}]	5	
	k-factor [1]	0,1			

-Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	1,07 V_n	-15,55	213,8	616,0	≈k*Q_{max} (<±5%*S_n)	0,29
< 20%	1,09 V_n	-15,55	209,3	615,4	≈k*Q_{max} (<±5%*S_n)	0,29
< 20%-30%	1,09 V_n	-28,39	209,2	3292,4	0,4* -Q_{max}	-1,62
40%	1,09 V_n	-43,90	209,1	3403,6	0,4* -Q_{max}	-0,69
50%	1,09 V_n	-54,92	209,1	3518,6	0,4* -Q_{max}	0,26
60%	1,09 V_n	-66,11	209,0	3506,3	0,4* -Q_{max}	0,16
70%	1,09 V_n	-77,03	208,9	3623,7	0,4* -Q_{max}	1,14
80%	1,09 V_n	-88,03	208,9	3755,7	0,4* -Q_{max}	2,24
90%	1,09 V_n	-95,33	208,8	3694,7	0,4* -Q_{max}	1,73
100%	1,09 V_n	-95,60	208,8	3627,3	0,4* -Q_{max}	1,17
100%	1,10 V_n	-83,40	206,9	5844,3	0,9* -Q_{max}	0,27
100%-10%	1,10 V_n	-11,38	207,3	5791,6	0,9* -Q_{max}	-0,17
10%→ ≤5%	1,10 V_n	-3,64	207,3	641,7	≈k*Q_{max}(< ±5%*S_n)	0,50

Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	0,93 V_n	-15,55	246,2	572,0	≈k*Q_{max} (<±5%*S_n)	-0,08
< 20%	0,91 V_n	-15,48	250,3	571,2	≈k*Q_{max}(<±5%*Sn)	-0,08
< 20%-30%	0,91 V_n	-28,34	250,3	-2583,0	0,6* Q_{max}	-2,15
40%	0,91 V_n	-43,81	250,2	-2480,9	0,6* Q_{max}	-1,30
50%	0,91 V_n	-54,81	250,1	-2495,8	0,6* Q_{max}	-1,43
60%	0,91 V_n	-66,03	250,1	-2508,0	0,6* Q_{max}	-1,53
70%	0,91 V_n	-76,95	250,0	-2408,5	0,6* Q_{max}	-0,70
80%	0,91 V_n	-87,95	250,0	-2323,9	0,6* Q_{max}	0,01
90%	0,91 V_n	-99,03	249,9	-2203,2	0,6* Q_{max}	1,01
100%	0,91 V_n	-107,98	249,9	-2096,5	0,6* Q_{max}	1,90
100%	0,90 V_n	-98,03	253,0	-5416,4	1,0* Q_{max}	-1,55
100%-10%	0,90 V_n	-11,38	253,4	-5293,6	1,0* Q_{max}	-0,53
10%→ ≤5%	0,90 V_n	-4,66	253,4	584,8	≈k*Q_{max} (<±5%*S_n)	0,03

Note:

The lock-in value is adjustable between V_n and 1,1Vn and the lock-out value between V_n and 0,9 Vn in 0,01 V steps.

In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.

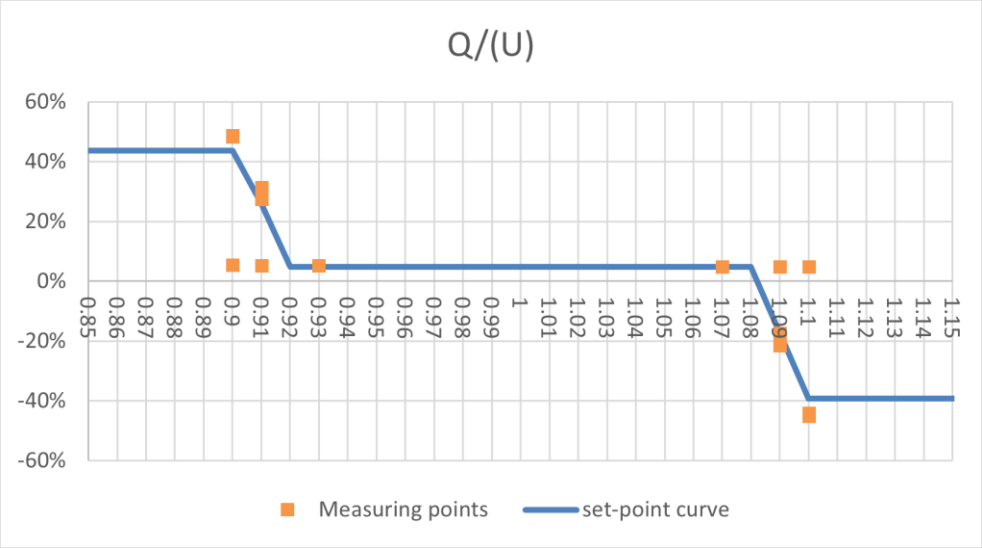
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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)	P

The under-voltage measurement effects the active output power in reference to the reactive output power since the reactive output power has always priority. Therefore, the inverter must lower the active output power.

k varying between -1 and 1. For PV systems k = 0, for storage system k = 0 unless otherwise specified by the network operator. (For test, the setting value used is k = 0,1)

Graph



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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)				P
Test 4: Charge mode (P_{CMAX}) / k = -0,1					
Setting values	V1s in V_n [1]	1,08	V2s in V_n [1]	1,10	
	V1i in V_n [1]	0,92	V2i in V_n [1]	0,90	
	lock-in value [% P_{SMAX}]	20	lock-out value [% P_{SMAX}]	5	
	k-factor [1]	-0,1			

-Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	1,07 V_n	-15,68	246,2	-744,3	≈k*Q_{max}(<±5%*S_n)	-1,36
< 20%	1,09 V_n	-15,70	250,3	-745,9	≈k*Q_{max}(<±5%*S_n)	-1,37
< 20%-30%	1,09 V_n	-28,66	250,2	-3618,0	-0,6* Q_{max}	-1,09
40%	1,09 V_n	-44,26	250,1	-3524,7	-0,6* Q_{max}	-0,31
50%	1,09 V_n	-55,26	250,1	-3534,6	-0,6* Q_{max}	-0,40
60%	1,09 V_n	-66,42	250,0	-3433,8	-0,6* Q_{max}	0,44
70%	1,09 V_n	-77,29	250,0	-3330,3	-0,6* Q_{max}	1,31
80%	1,09 V_n	-87,59	249,9	-3228,9	-0,6* Q_{max}	2,15
90%	1,09 V_n	-98,56	249,9	-3123,2	-0,6* Q_{max}	3,03
100%	1,09 V_n	-105,92	249,9	-3131,8	-0,6* Q_{max}	2,96
100%	1,10 V_n	-96,44	252,9	-5771,6	-1,0* Q_{max}	0,33
100%-10%	1,10 V_n	-11,52	253,3	-5643,5	-1,0* Q_{max}	1,40
10%→ ≤5%	1,10 V_n	-3,29	253,4	-731,7	≈k*Q_{max}(<±5%*S_n)	-1,25

Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)

P / P_{SMAX} [%] Set-point	Vac [V] Set-point	P / P_{SMAX} [%] measured	Vac [V] measured	Q [VAr] measured	Q [Var] expected	ΔQ (= ±5 % * S_n)
< 20%	0,93 V_n	-15,83	213,8	-15,83	≈k*Q_{max} (<±5%*S_n)	-1,05
< 20%	0,91 V_n	-15,81	209,6	-15,81	≈k*Q_{max} (<±5%*S_n)	-1,05
< 20%-30%	0,91 V_n	-28,59	209,5	-28,59	0,4* Q_{max}	-1,27
40%	0,91 V_n	-44,24	209,4	-44,24	0,4* Q_{max}	-1,28
50%	0,91 V_n	-55,36	209,4	-55,36	0,4* Q_{max}	-0,46
60%	0,91 V_n	-66,21	209,3	-66,21	0,4* Q_{max}	0,54
70%	0,91 V_n	-77,09	209,2	-77,09	0,4* Q_{max}	0,66
80%	0,91 V_n	-88,27	209,2	-88,27	0,4* Q_{max}	1,62
90%	0,91 V_n	-95,17	209,1	-95,17	0,4* Q_{max}	1,68
100%	0,91 V_n	-95,24	209,1	-95,24	0,4* Q_{max}	2,41
100%	0,90 V_n	-80,94	206,9	-80,94	0,9* Q_{max}	2,14
100%-10%	0,90 V_n	-11,40	207,3	-11,40	0,9* Q_{max}	-2,49
10%→ ≤5%	0,90 V_n	-3,28	207,3	-3,28	≈k*Q_{max} (<±5%*S_n)	-0,91

Note

The lock-in value is adjustable between V_n and 1,1V_n and the lock-out value between V_n and 0,9 V_n in 0,01 V steps.

In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.

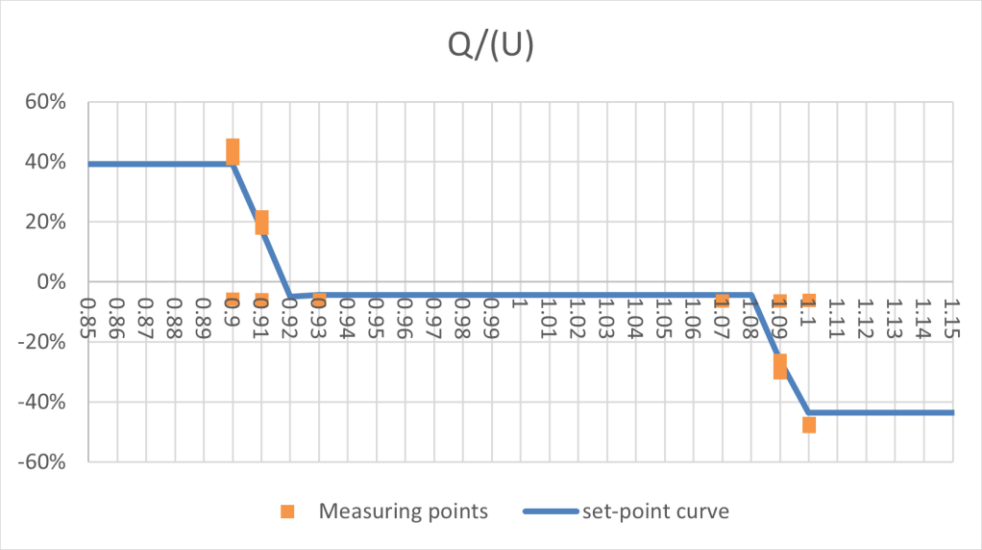
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Bbis.6.9	Verification of compliance with characteristic curve Q = f(V)	P

The under-voltage measurement effects the active output power in reference to the reactive output power since the reactive output power has always priority. Therefore, the inverter must lower the active output power.

k varying between -1 and 1. For PV systems k = 0, for storage system k = 0 unless otherwise specified by the network operator. (For test, the setting value used is k = -0,1)

Graph



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Bbis.7	Active Power Control	P
Storage systems must be equipped with functions to regulate the active power fed into the grid in four distinct ways • Automatic limitation in local logic, for voltage values close to 110 % of V_n, according to 8.5.3.1; • Automatic limitation for over-frequency transients originating on the network, according to 8.5.3.4; • Automatic increase for under-frequency transients originating in the network, as defined in 8.5.3.4; • On external command from the DSO, and/or in centralised logic (8.5.3.3).		

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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P

The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110 % of V_n.

Test result

DHN-LVEH3P12K-EU-G1 with Cmax battery

setpoint	Activation threshold -2 % of V_n	Activation threshold +2 % of V_n	Activation threshold -2 % of V_n
Voltage [V]	248,7	257,7	248,7
P_{E60} [% P_N]	98,8	-99,9	98,7
$\Delta P_{E60}/P_{Setpoint}$ [%]	-1,2	-19,9	-1,3
Settling time [s]	N/A	3,4	0,6
Limit settling time [s]	300		

Test:

1. the active power reduction function P(V) is enabled, according to the manufacturer's instructions (which must be stated in the test report):
2. adjust the voltage read at the converter's output terminals to -2 % of the manufacturer's declared activation threshold and the DC source so that the active power delivered at the output is equal to the maximum power available at the input;
3. adjust the voltage read at the output terminals of the converter to +2 % of the activation threshold stated by the manufacturer;
4. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
5. within 5 min from the instant of application of the voltage 2 % of the activation threshold declared by the manufacturer (compatible with the energy capacity of the storage system) it is verified that, in the case of storage systems connected to unidirectional converters the active power supplied by the inverter has been reduced to a value no greater than 20 % * P_{SMAX} (20 % * P_{NINV}, in the case of integrated EESS), while in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX} is also verified that the equipment signals the power reduction in progress (recording the modalities in the test report);
6. adjust the voltage read at the output terminals of the converter to -2 % of the activation threshold stated by the manufacturer;
7. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
8. check that the active power delivered by the inverter returns to the value congruent with the power
9. made available by the DC-side accumulators and, if used, of the primary or simulated source.

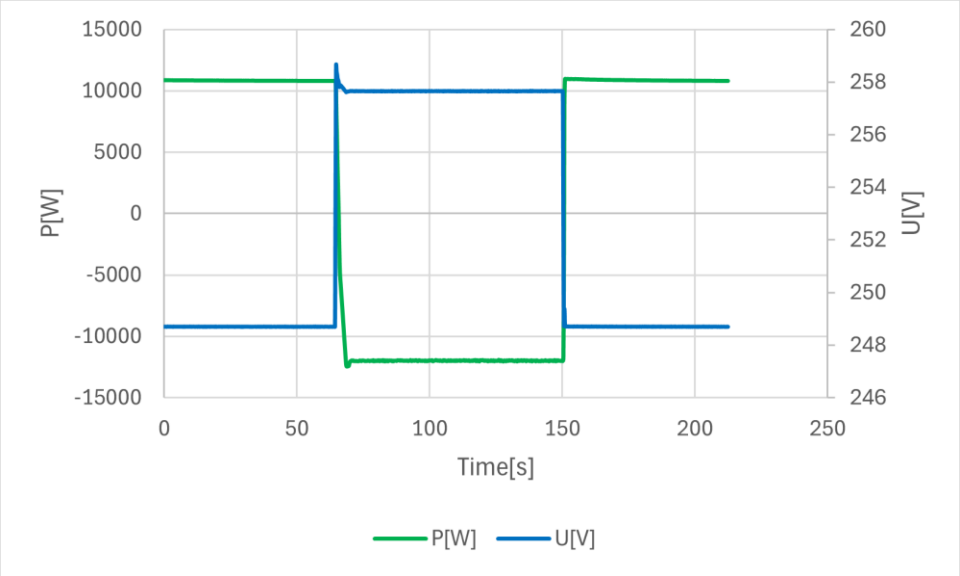
Assessment criterion

for adjustable PGUs:

- no network disconnection
- in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX}
- the setting time determined is equal or less than 300s
- the active power delivered by the inverter returns to the value congruent with the power made available by the DC-side accumulators

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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P
Graph		



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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P

The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110 % of V_n.

Test result

DHN-LVEH3P12K-EU-G1 with Cmin battery

setpoint	Activation threshold -2 % of V_n	Activation threshold +2 % of V_n	Activation threshold -2 % of V_n
Voltage [V]	248,5	257,5	248,7
P_{E60} [% P_N]	100,1	-100,1	100,6
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,1	-0,1	0,6
Settling time [s]	N/A	4,6	0,8
Limit settling time [s]	300		

Test:

10. the active power reduction function P(V) is enabled, according to the manufacturer's instructions (which must be stated in the test report):
11. adjust the voltage read at the converter's output terminals to -2 % of the manufacturer's declared activation threshold and the DC source so that the active power delivered at the output is equal to the maximum power available at the input;
12. adjust the voltage read at the output terminals of the converter to +2 % of the activation threshold stated by the manufacturer;
13. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
14. within 5 min from the instant of application of the voltage 2 % of the activation threshold declared by the manufacturer (compatible with the energy capacity of the storage system) it is verified that, in the case of storage systems connected to unidirectional converters the active power supplied by the inverter has been reduced to a value no greater than 20 % * P_{SMAX} (20 % * P_{NINV}, in the case of integrated EESS), while in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX} is also verified that the equipment signals the power reduction in progress (recording the modalities in the test report);
15. adjust the voltage read at the output terminals of the converter to -2 % of the activation threshold stated by the manufacturer;
16. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
17. check that the active power delivered by the inverter returns to the value congruent with the power
18. made available by the DC-side accumulators and, if used, of the primary or simulated source.

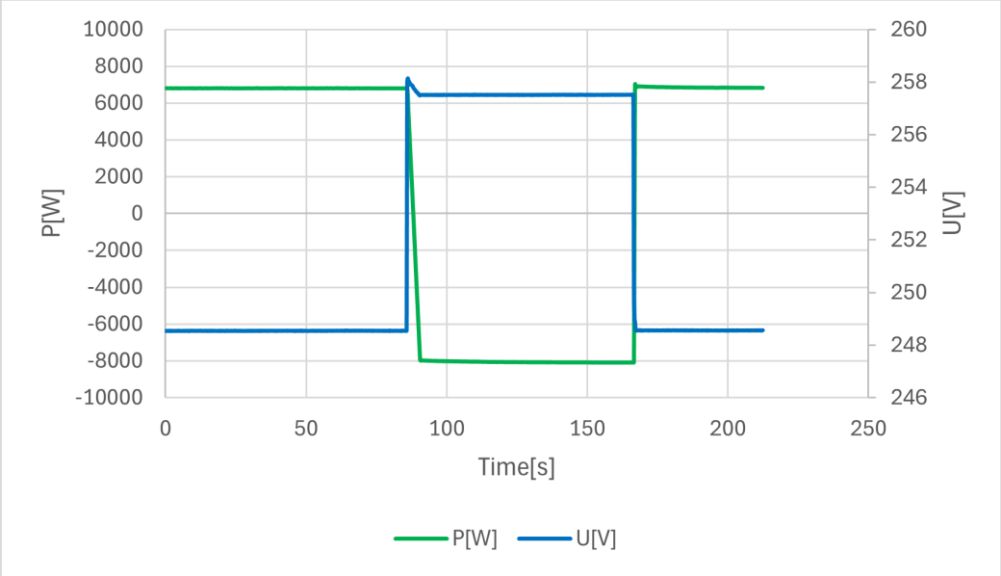
Assessment criterion

for adjustable PGUs:

- no network disconnection
- in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX}
- the setting time determined is equal or less than 300s
- the active power delivered by the inverter returns to the value congruent with the power made available by the DC-side accumulators

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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P
Graph		



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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P

The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110 % of V_n.

Test result

DHN-LVEH3P8K-EU-G1 with Cmin battery

setpoint	Activation threshold -2 % of V_n	Activation threshold +2 % of V_n	Activation threshold -2 % of V_n
Voltage [V]	248,5	257,5	248,5
P_{E60} [% P_N]	100,2	-100,4	100,6
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,2	-0,4	0,6
Settling time [s]	N/A	4,8	0,8
Limit settling time [s]	300		

Test:

19. the active power reduction function P(V) is enabled, according to the manufacturer's instructions (which must be stated in the test report):
20. adjust the voltage read at the converter's output terminals to -2 % of the manufacturer's declared activation threshold and the DC source so that the active power delivered at the output is equal to the maximum power available at the input;
21. adjust the voltage read at the output terminals of the converter to +2 % of the activation threshold stated by the manufacturer;
22. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
23. within 5 min from the instant of application of the voltage 2 % of the activation threshold declared by the manufacturer (compatible with the energy capacity of the storage system) it is verified that, in the case of storage systems connected to unidirectional converters the active power supplied by the inverter has been reduced to a value no greater than 20 % * P_{SMAX} (20 % * P_{NINV}, in the case of integrated EESS), while in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX} is also verified that the equipment signals the power reduction in progress (recording the modalities in the test report);
24. adjust the voltage read at the output terminals of the converter to -2 % of the activation threshold stated by the manufacturer;
25. measure the active power as 1 s averages and plot the values obtained in a time-dependent graph;
26. check that the active power delivered by the inverter returns to the value congruent with the power
27. made available by the DC-side accumulators and, if used, of the primary or simulated source.

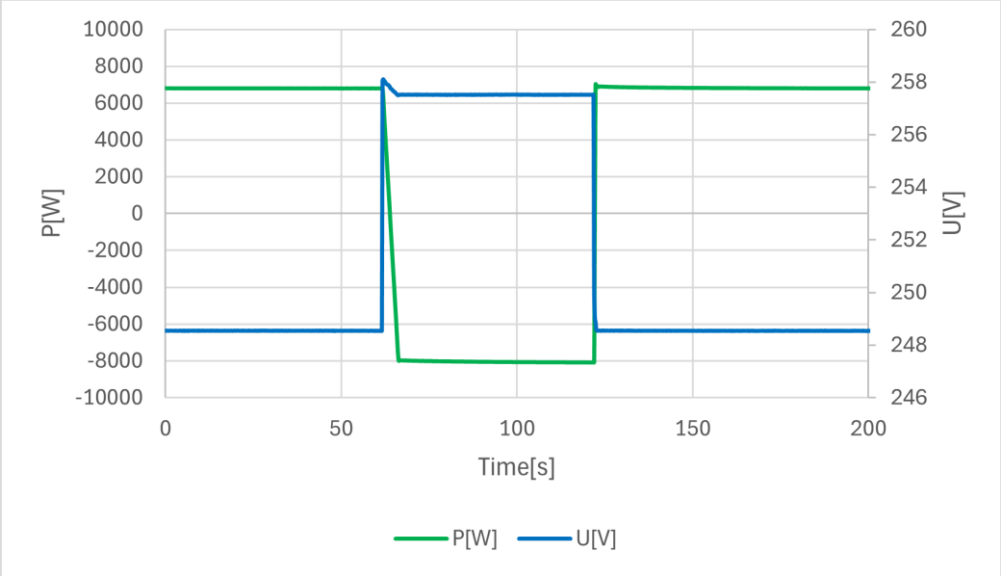
Assessment criterion

for adjustable PGUs:

- no network disconnection
- in the case of bi-directional converters, the EESS has switched to absorb, compatibly with the constraints given by its own capacity, an active power of at least 80 % * P_{CMAX}
- the setting time determined is equal or less than 300s
- the active power delivered by the inverter returns to the value congruent with the power made available by the DC-side accumulators

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Bbis.7.1	Automatic active power limitation for voltage values close to 110 % of nominal voltage	P
Graph		



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Bbis.7.2	Verification of automatic reduction of active power in presence of Over-frequency transitions on the network	P
Bbis.7.2.1	Performance of tests	

- Connect the test object following the manufacturer's instructions.
- Set all parameters of the simulated network to the respective normal operation values.
- Set all the parameters of the test object to the respective normal operation values, so that the output AC power of the inverter is equal to the maximum AC output for sequence A, and 50% in the case of sequence B.
- Take measurements at 7 points (the frequency value should have a maximum uncertainty of ± 10 mHz) consecutively over time:

1) f = 47,51 Hz (t1 for sequence A, t'1 for sequence B)

2) f =50 Hz + 0,15 Hz (t2 for sequence A, t'2 for sequence B)

3) f =50 Hz + 0,40 Hz (t3 for sequence A, t'3 for sequence B)

4) f =50 Hz + 0,60 Hz (t4 for sequence A, t'4 for sequence B)

5) f =50 Hz + 1,49 Hz (t5 for sequence A, t'5 for sequence B)

6) f =50 Hz + 0,11 Hz (t6 for sequence A, t'6 for sequence B)

At this point, perform step 7 bringing the frequency back to the nominal value in order to check the conditions for a gradual recovery of the maximum supply (sequence A), or 50% of the maximum power (sequence B):

7) f = 50 Hz (t7 for sequence A, t'7 for sequence B)

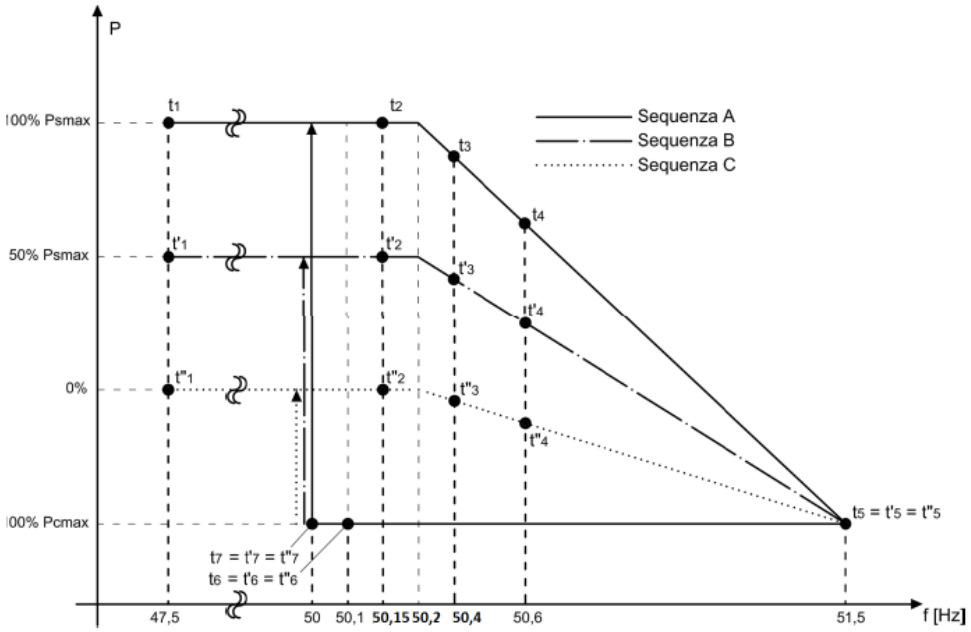


Figura 9Bbis – Curve di limitazione della potenza attiva per convertitori bidirezionali

Note:

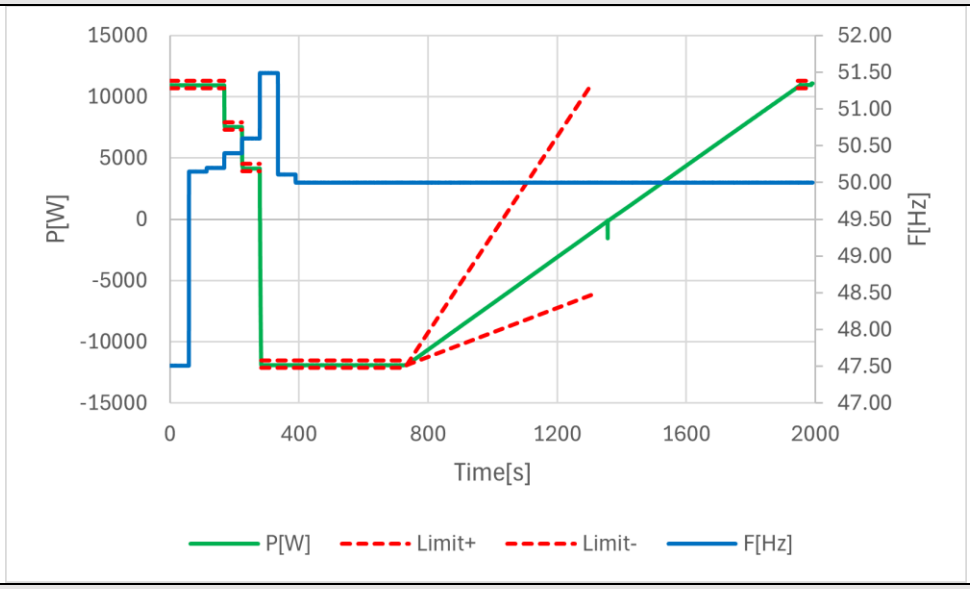
The inverter is able to set a delay for the activation of the curve from 0s - 1s.
(in 50ms steps / default setting: 0)

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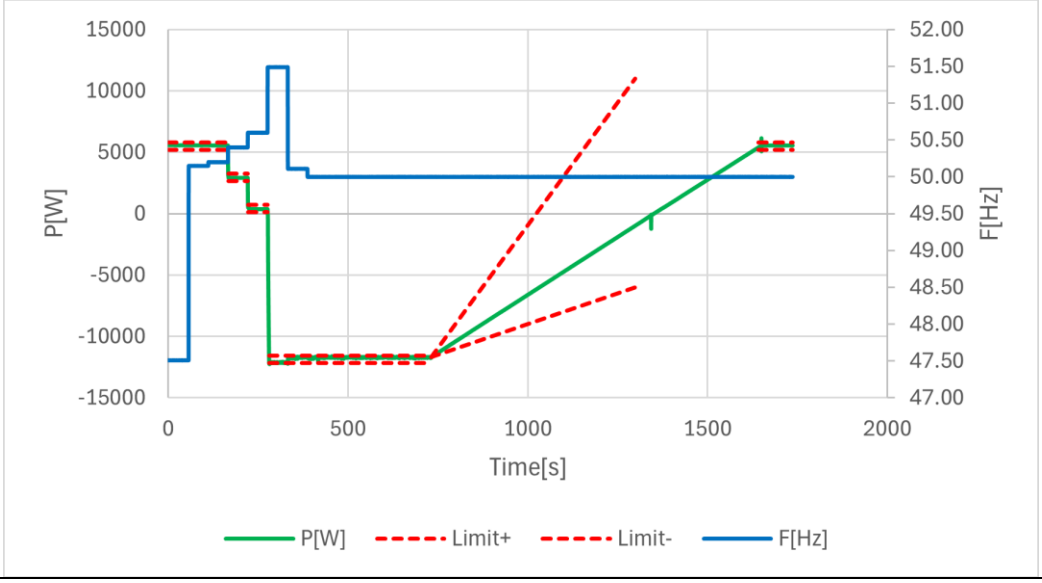
Bbis.7.2.2	Test results							P
Test result								
DHN-LVEH3P12K-EU-G1 with Cmax battery								
1-min mean value [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	11000,0	11000,0	11000,0	7615,3	4230,6	-11815,2	-11815,2	11000,0
P_{E60} [W]	10943,4	10937,6	10937,1	7534,5	4145,6	-11899,5	-11900,5	11087,6
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,47	-0,52	-0,52	-0,67	-0,71	-0,70	-0,71	0,73
2. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	5500,0	5500,0	5500,0	2961,2	423,5	-11862,0	-11862,0	5500,0
PE60 [W]	5587,5	5569,2	5556,1	2918,2	372,3	-12076,4	-11741,5	5553,5
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,73	0,58	0,47	-0,36	-0,43	-1,79	1,00	0,45
3. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	-1845,6	-3692,4	-11907,6	-11907,6	0,0
PE60 [W]	-73,4	-61,2	-58,4	-1843,1	-3713,6	-12075,7	-12080,3	-76,0
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,61	-0,51	-0,49	0,02	-0,18	-1,40	-1,44	-0,63
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							
Note								

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Graph of Measurement 1.: Active power output reduction 100%P_{Smax}

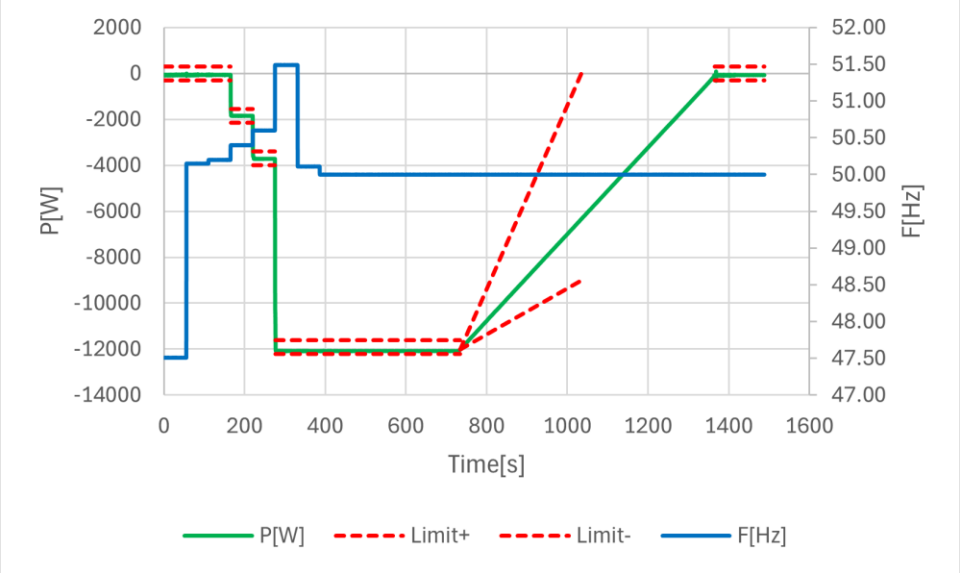


Graph of Measurement 2.: Active power output reduction 50%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 0%P_{Smax}

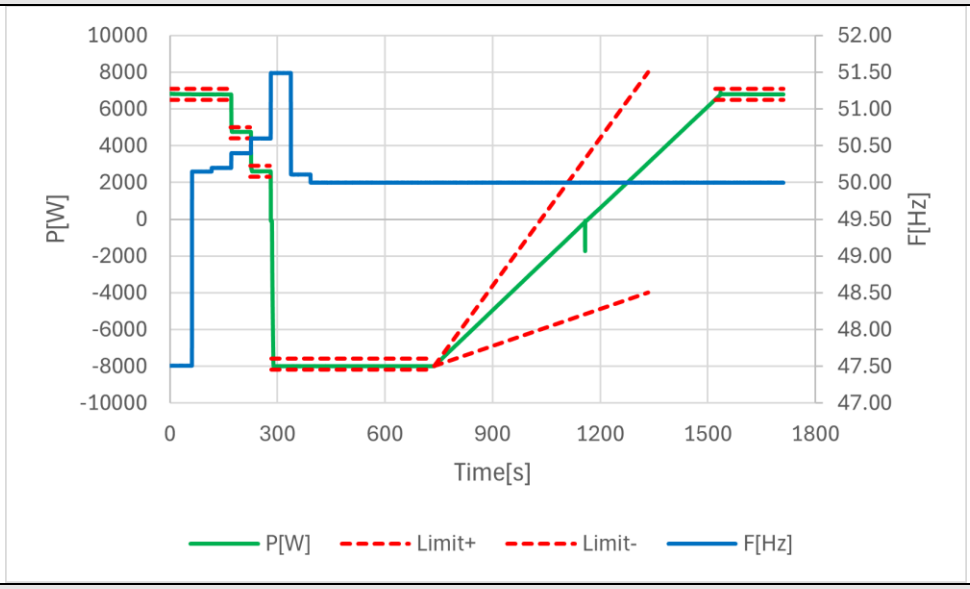


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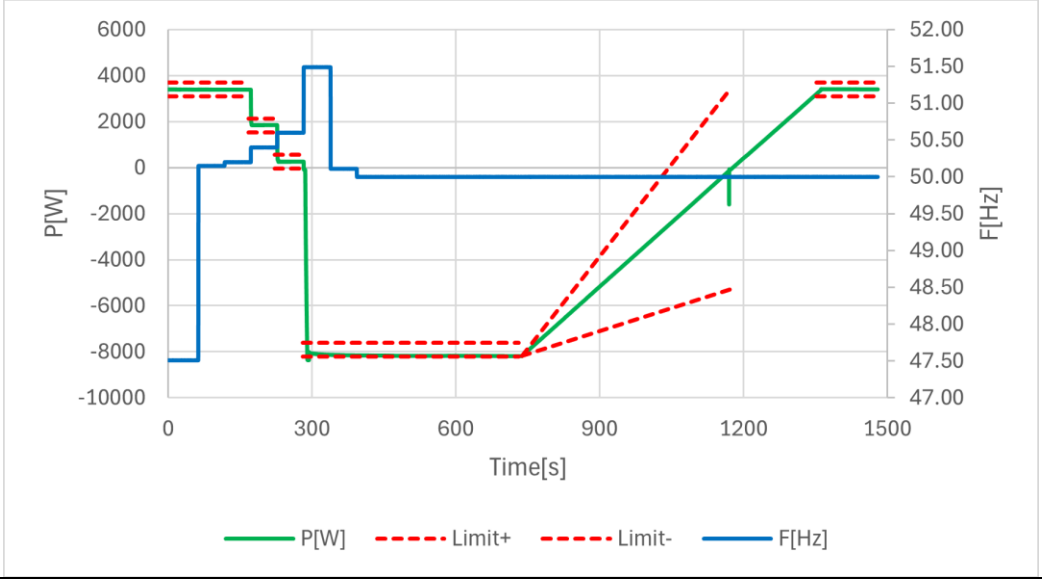
Bbis.7.2.2	Test results							P
Test result								
DHN-LVEH3P12K-EU-G1 with Cmin battery								
1-min mean value [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	6800,0	6800,0	6800,0	4707,6	2615,3	-7876,8	-7876,8	6800,0
P_{E60} [W]	6824,5	6798,8	6795,9	4758,5	2611,3	-7989,0	-7989,3	6808,5
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,20	-0,01	-0,03	0,42	-0,03	-0,93	-0,94	0,07
2. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	3400,0	3400,0	3400,0	1830,6	261,8	-7908,0	-7908,0	3400,0
PE60 [W]	3400,7	3388,6	3390,0	1851,0	261,9	-8087,6	-8150,3	3406,2
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,01	-0,10	-0,08	0,17	0,00	-1,50	-2,02	0,05
3. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	-1230,4	-2461,6	-7938,4	-7938,4	0,0
PE60 [W]	-14,5	-14,2	10,3	-1160,0	-2489,3	-8141,0	-8167,3	-11,6
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,12	-0,12	0,09	0,59	-0,23	-1,69	-1,91	-0,10
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							
Note								

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Graph of Measurement 1.: Active power output reduction 100%P_{Smax}

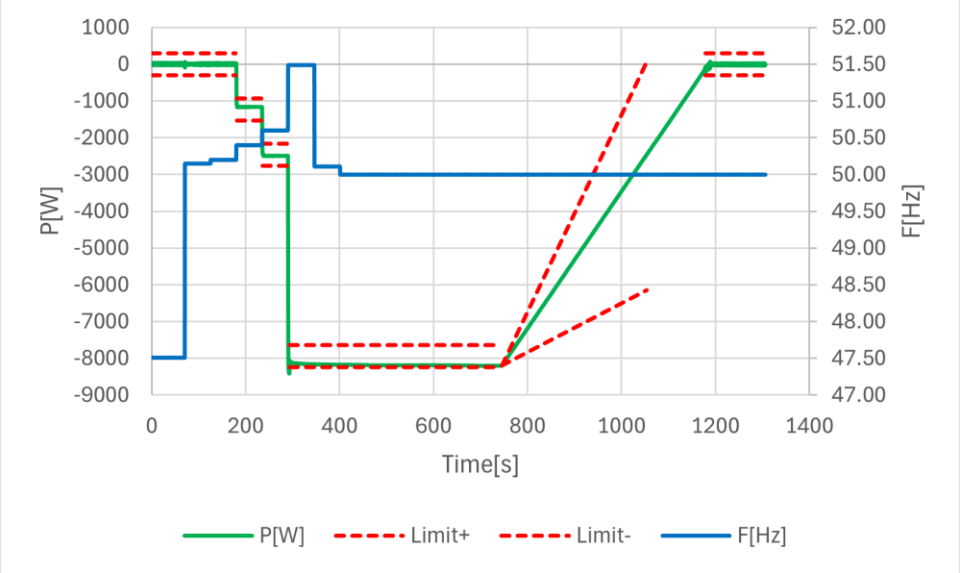


Graph of Measurement 2.: Active power output reduction 50%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 0%P_{Smax}

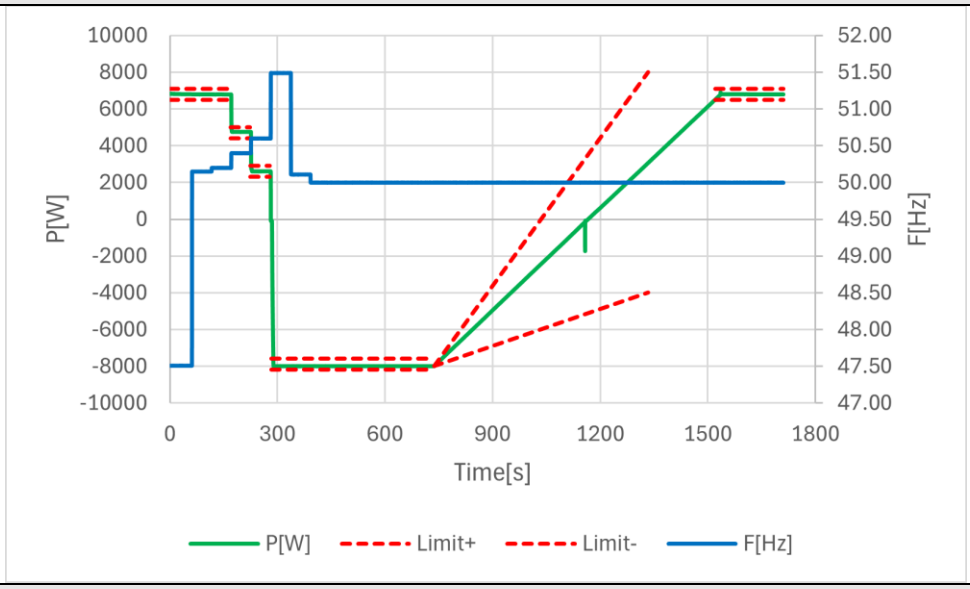


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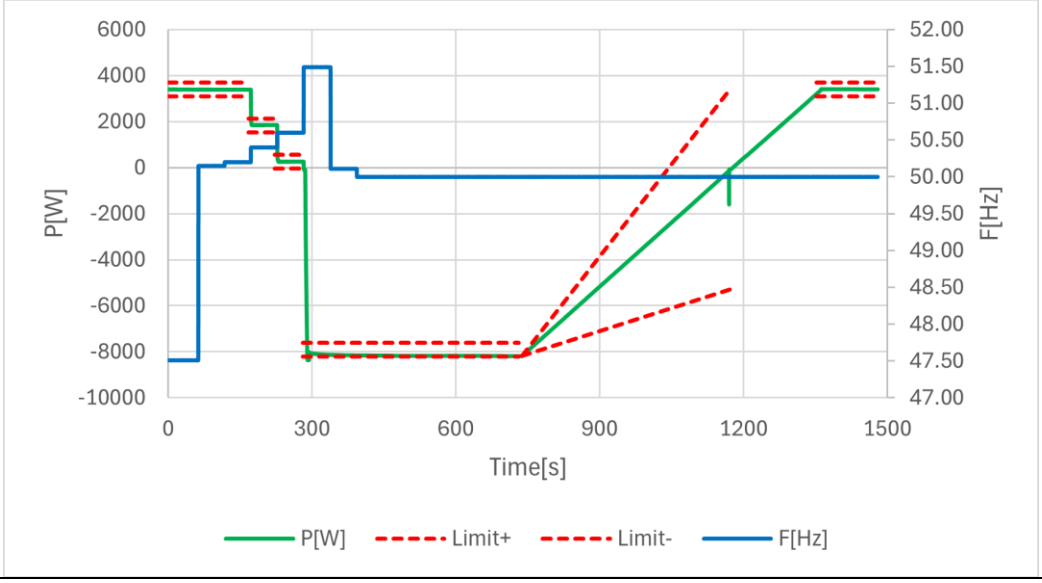
Bbis.7.2.2	Test results							P
Test result								
DHN-LVEH3P12K-EU-G1 with Cmin battery								
1-min mean value [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	6800,0	6800,0	6800,0	4707,6	2615,3	-7876,8	-7876,8	6800,0
P_{E60} [W]	6824,5	6798,8	6795,9	4758,5	2611,3	-7989,0	-7989,3	6808,5
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,20	-0,01	-0,03	0,42	-0,03	-0,93	-0,94	0,07
2. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	3400,0	3400,0	3400,0	1830,6	261,8	-7908,0	-7908,0	3400,0
PE60 [W]	3400,7	3388,6	3390,0	1851,0	261,9	-8087,6	-8150,3	3406,2
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,01	-0,10	-0,08	0,17	0,00	-1,50	-2,02	0,05
3. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	-1230,4	-2461,6	-7938,4	-7938,4	0,0
PE60 [W]	-14,5	-14,2	10,3	-1160,0	-2489,3	-8141,0	-8167,3	-11,6
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,12	-0,12	0,09	0,59	-0,23	-1,69	-1,91	-0,10
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							
Note								

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Graph of Measurement 1.: Active power output reduction 100%P_{Smax}

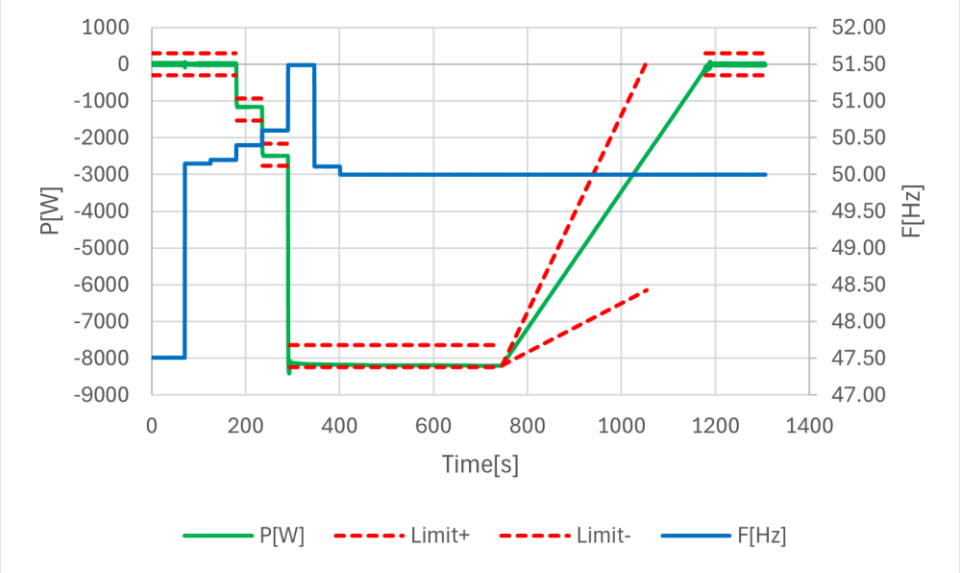


Graph of Measurement 2.: Active power output reduction 50%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 0%P_{Smax}



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Bbis.7.3	Verification of automatic active power increase in the presence of under-frequency transients on the grid	P
Bbis.7.3.1	Performance of tests	

- Connect the test object following the manufacturer's instructions.
- Set all parameters of the simulated network to the respective normal operation values.
- Set all the parameters of the test object to the respective normal operation values, so that the output AC power of the inverter is equal to the maximum AC output for sequence A, and 50% in the case of sequence B.
- Take measurements at 7 points (the frequency value should have a maximum uncertainty of ± 10 mHz) consecutively over time:

1) f = 51,49 Hz (t1 for sequence A, t'1 for sequence B)

2) f = 50,00 Hz - 0,15 Hz (t2 for sequence A, t'2 for sequence B)

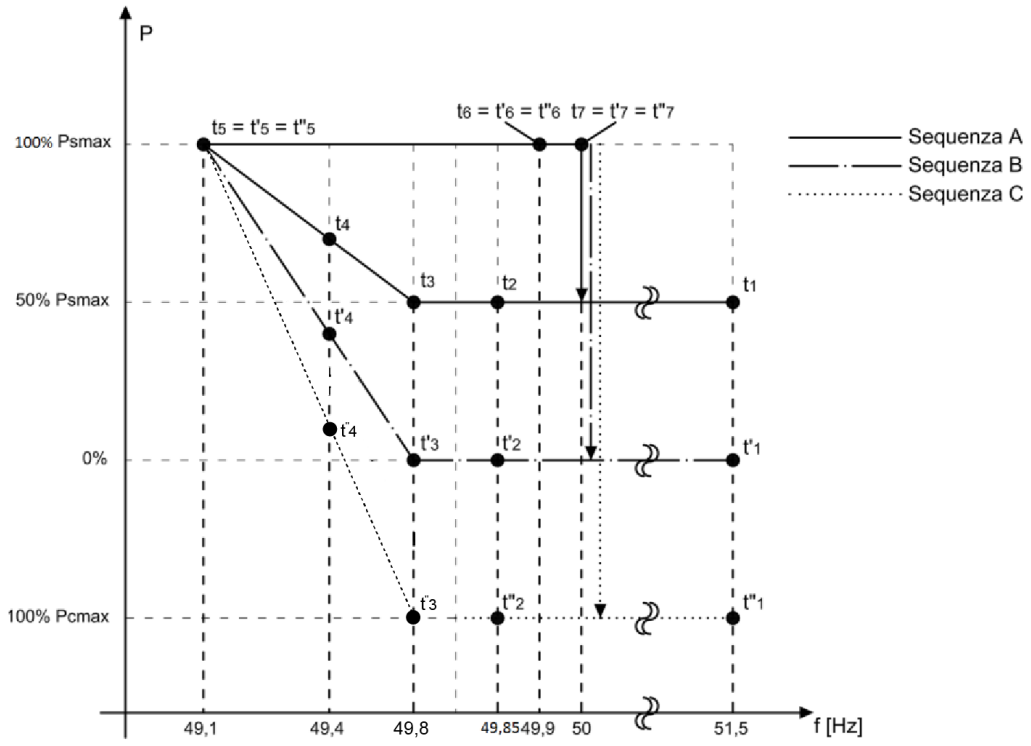
3) f = 50,00 Hz - 0,40 Hz (t3 for sequence A, t'3 for sequence B)

4) f = 50,00 Hz - 0,60 Hz (t4 for sequence A, t'4 for sequence B)

5) f = 50,00 Hz - 0,89 Hz (t5 for sequence A, t'5 for sequence B)

6) f = 50,00 Hz - 0,11 Hz (t6 for sequence A, t'6 for sequence B)

At this point, perform step 7 bringing the frequency back to the nominal value in order to check the conditions for a gradual recovery of the maximum supply (sequence A), or 50% of the maximum power (sequence B)



7) f = 50,00 Hz (t7 for sequence A, t'7 for sequence B)

Note

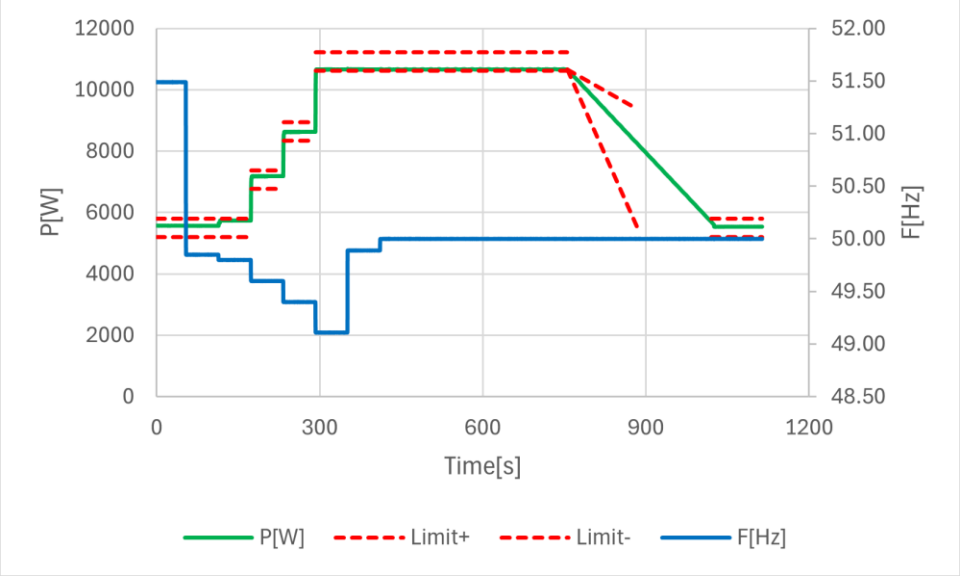
The inverter is able to set a delay for the activation of the curve from 0 s – 1 s.
(in 50 ms steps / default setting: 0 s)

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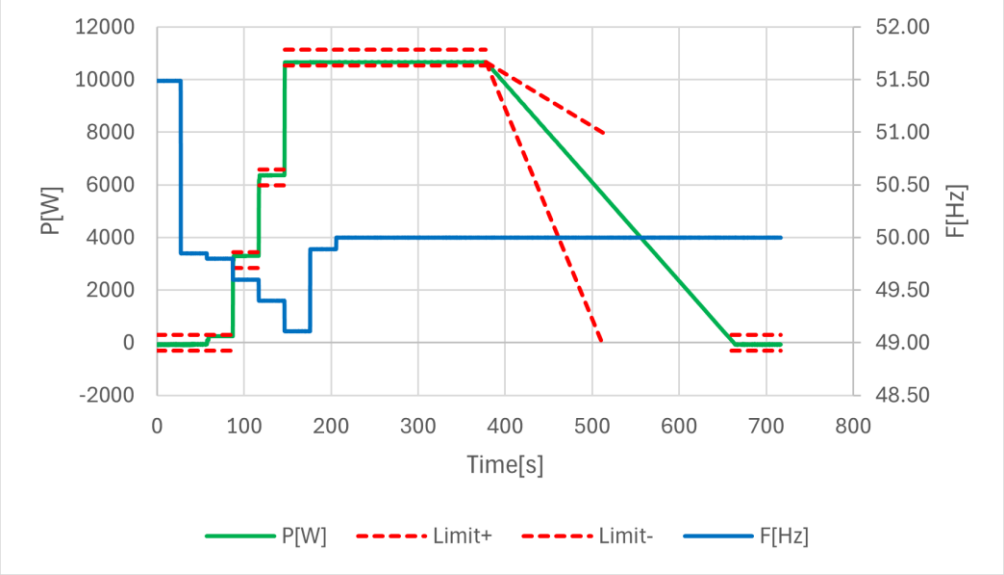
Bbis.7.3.2	Test results							P
Test result								
DHN-LVEH3P12K-EU-G1 with Cmax battery								
1-min mean value [Hz]	1) 51,49	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	5500,0	5500,0	5500,0	7071,9	8642,7	10921,9	10921,9	5500,0
P_{E60} [W]	5573,7	5568,2	5739,4	7186,5	8629,9	10662,9	10667,0	5538,5
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,67	0,62	2,18	1,04	-0,12	-2,35	-2,32	0,35
2. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	3142,7	6285,4	10842,7	10842,7	0,0
P_{E60} [W]	-87,3	-53,7	247,9	3303,0	6368,6	10663,8	10670,1	-65,5
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,73	-0,45	2,07	1,34	0,69	-1,49	-1,44	-0,55
3. Measurement 1) to 7): Active power output 100%P_{Cmax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	-12000,0	-12000,0	-12000,0	-5143,2	1571,9	10685,4	10685,4	-12000,0
P_{E60} [W]	-12067,6	-12071,9	-12063,6	-5029,9	1598,8	10791,7	10790,9	-11824,1
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,56	-0,60	-0,53	0,94	0,22	0,89	0,88	1,47
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							

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Graph of Measurement 1.: Active power output reduction 50%P_{Smax}

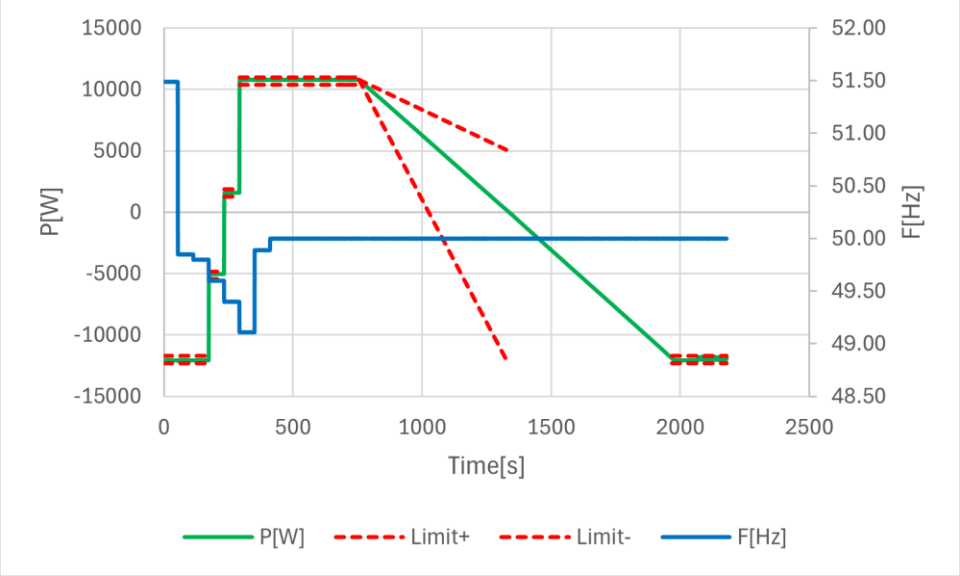


Graph of Measurement 2.: Active power output reduction 0%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 100%P_{Cmax}

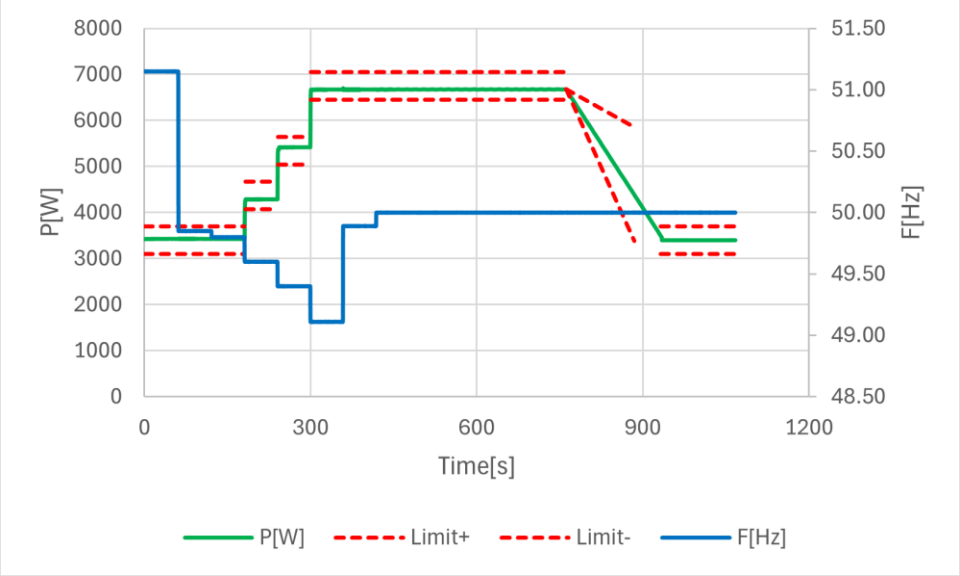


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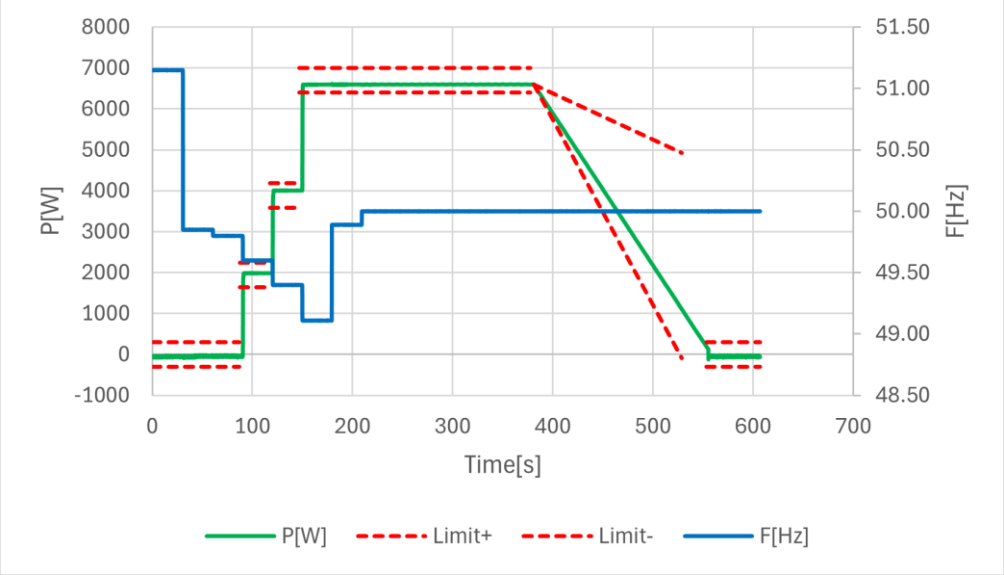
Bbis.7.3.2	Test results							P
Test result								
DHN-LVEH3P12K-EU-G1 with Cmin battery								
1-min mean value [Hz]	1) 51,49	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	3400,0	3400,0	3400,0	4371,7	5342,8	6751,7	6751,7	3400,0
P_{E60} [W]	3422,3	3427,6	3426,0	4286,7	5417,9	6672,3	6672,7	3398,7
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,33	0,41	0,38	-1,25	1,11	-1,17	-1,16	-0,02
2. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	1942,8	3885,5	6702,8	6702,8	0,0
P_{E60} [W]	-42,5	-40,4	-52,6	1986,9	4006,7	6598,5	6599,3	-30,7
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,35	-0,34	-0,44	0,37	1,01	-0,87	-0,86	-0,26
3. Measurement 1) to 7): Active power output 100%P_{Cmax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	-8000,0	-8000,0	-8000,0	-3428,8	971,7	6605,5	6605,5	-8000,0
P_{E60} [W]	-8127,7	-8137,2	-8139,1	-3636,6	858,7	6702,3	6702,2	-8140,0
$\Delta P_{E60}/P_{Setpoint}$ [%]	-1,06	-1,14	-1,16	-1,73	-0,94	0,81	0,81	-1,17
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							

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Graph of Measurement 1.: Active power output reduction 50%P_{Smax}

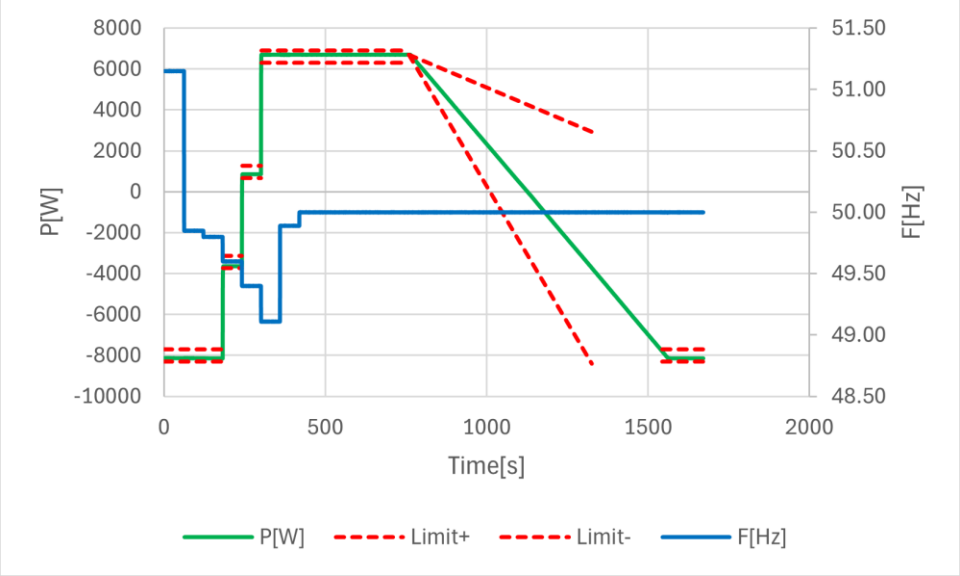


Graph of Measurement 2.: Active power output reduction 0%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 100%P_{Cmax}

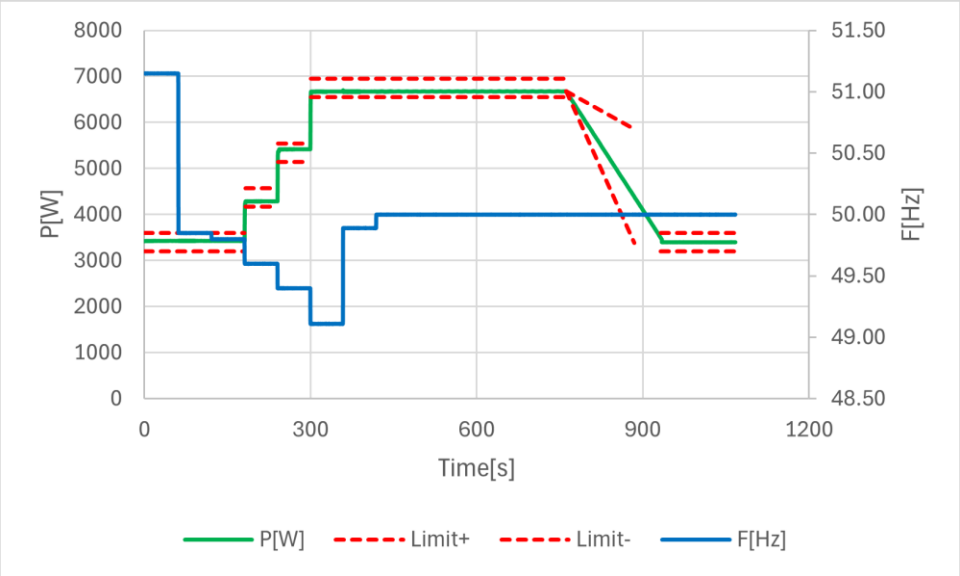


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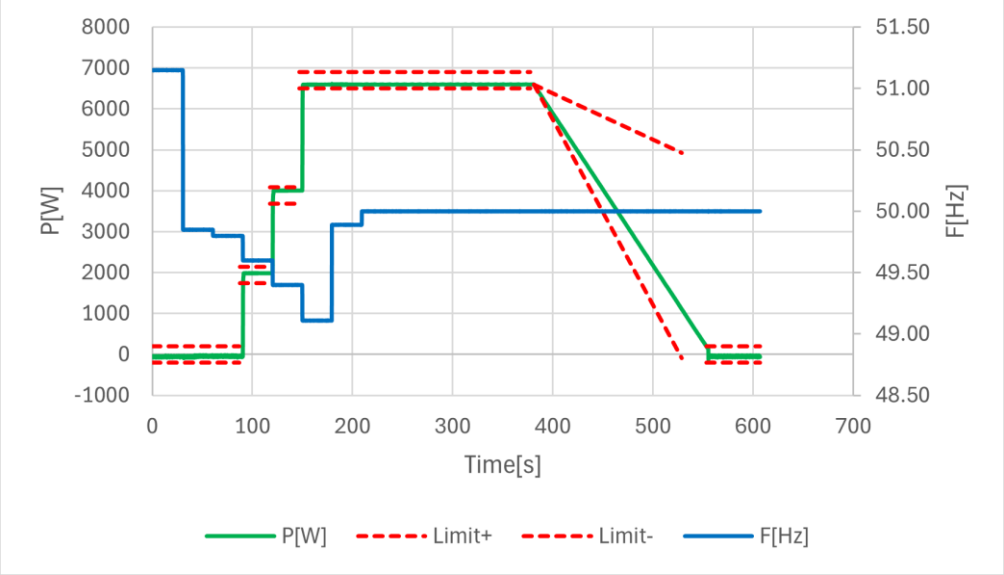
Bbis.7.3.2	Test results							P
Test result								
DHN-LVEH3P8K-EU-G1 with Cmin battery								
1-min mean value [Hz]	1) 51,49	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	3400,0	3400,0	3400,0	4371,7	5342,8	6751,7	6751,7	3400,0
P_{E60} [W]	3422,3	3427,6	3426,0	4286,7	5417,9	6672,3	6672,7	3398,7
$\Delta P_{E60}/P_{Setpoint}$ [%]	0,33	0,41	0,38	-1,25	1,11	-1,17	-1,16	-0,02
2. Measurement 1) to 7): Active power output 0%P_{Smax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	0,0	0,0	0,0	1942,8	3885,5	6702,8	6702,8	0,0
P_{E60} [W]	-42,5	-40,4	-52,6	1986,9	4006,7	6598,5	6599,3	-30,7
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,53	-0,51	-0,66	0,55	1,51	-1,30	-1,29	-0,38
3. Measurement 1) to 7): Active power output 100%P_{Cmax}								
Frequency [Hz]	51,49	49,85	49,80	49,60	49,40	49,11	49,89	50,00
$P_{setpoint}$ [W]	-8000,0	-8000,0	-8000,0	-3428,8	971,7	6605,5	6605,5	-8000,0
P_{E60} [W]	-8127,7	-8137,2	-8139,1	-3436,6	858,7	6702,3	6702,2	-8140,0
$\Delta P_{E60}/P_{Setpoint}$ [%]	-1,60	-1,71	-1,74	-0,10	-1,41	1,21	1,21	-1,75
Limit $\Delta P_{E60}/P_{Setpoint}$	± 2,5% % of S_n							

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Graph of Measurement 1.: Active power output reduction 50%P_{Smax}

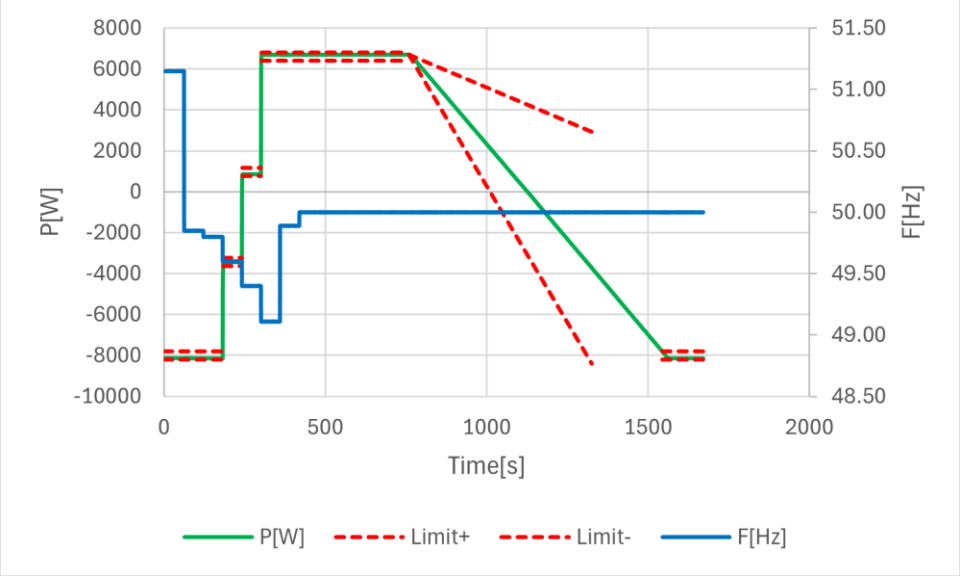


Graph of Measurement 2.: Active power output reduction 0%P_{Smax}



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Graph of Measurement 3.: Active power output reduction 100%P_{Cmax}



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Bbis.7.4	Verification of active power control on external control from DSO	P
Bidirectional converters		
DHN-LVEH3P12K-EU-G1 with Cmax battery		
1-min mean value	50% P_{SMAX} to 30% P_{CMAX}	
P_{E60} [%]	30,1	
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	
Settling time [s]	3,2	
Limit settling time [s]	30	

The ability to increase/decrease the active power input/output as a result of a remote signal must be tested by agreeing with the manufacturer of the storage system how the signal will be received and processed.

The test must be carried out according to the following steps:

- Bring the storage system up to 50 % of the available active feed-in power.
- Send the generator an active power set-point of 30 % of the P_{SMAX}.
- Maintain the set-point for a time of 60 s, consistent with the energy capacity of the storage system.
- Measure the active power delivered by the inverter, at least 30 s after the command for the new active power control set-point has been sent (this is to ensure that the system has reached a steady state).

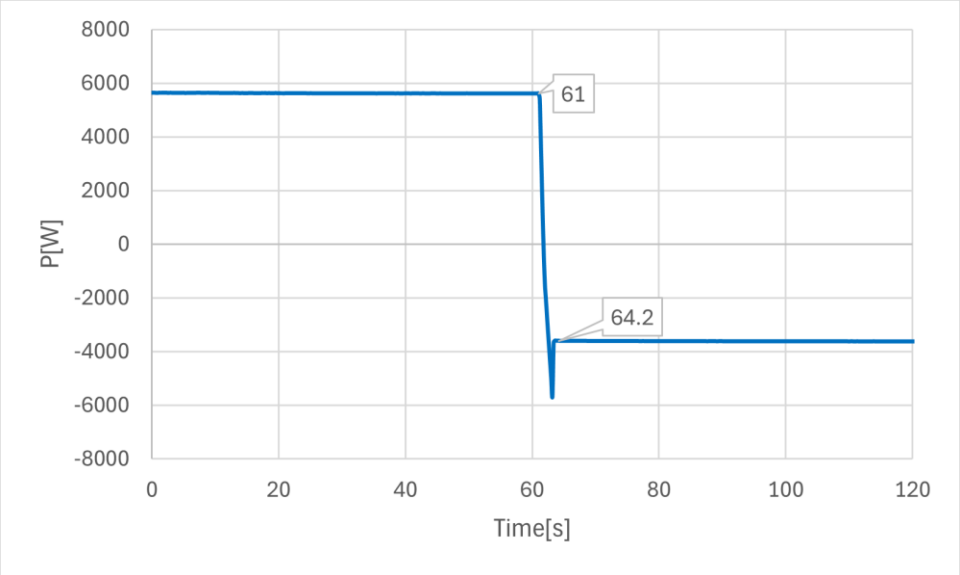
The test is considered successful if the maximum deviation between the assigned level and the actual measured value (average value with 1 min. window) for the active power is less than ± 2,5 % of them S_n.

In the case of storage systems connected to bidirectional converters, repeat the test at 30 % P_{CMAX}.

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Bbis.7.4	Verification of active power control on external control from DSO	P

Graph: 50% P_{SMAX} to 30% P_{CMAX}



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Bbis.7.4	Verification of active power control on external control from DSO	P
Bidirectional converters		
DHN-LVEH3P12K-EU-G1 with Cmin battery		
1-min mean value	50% P_{SMAX} to 30% P_{CMAX}	
P_{E60} [%]	29,6	
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	
Settling time [s]	4,6	
Limit settling time [s]	30	

The ability to increase/decrease the active power input/output as a result of a remote signal must be tested by agreeing with the manufacturer of the storage system how the signal will be received and processed.

The test must be carried out according to the following steps:

- Bring the storage system up to 50 % of the available active feed-in power.
- Send the generator an active power set-point of 30 % of the P_{SMAX}.
- Maintain the set-point for a time of 60 s, consistent with the energy capacity of the storage system.
- Measure the active power delivered by the inverter, at least 30 s after the command for the new active power control set-point has been sent (this is to ensure that the system has reached a steady state).

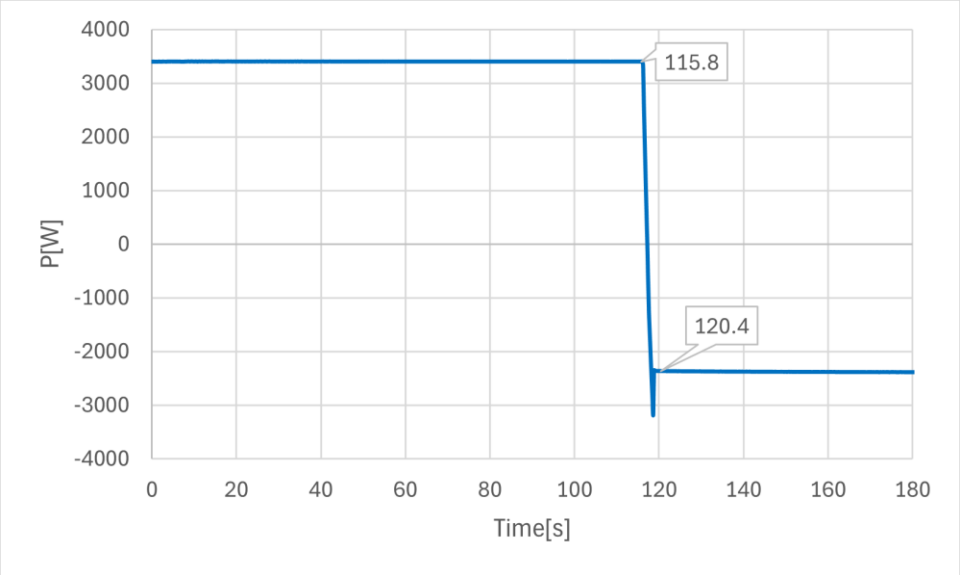
The test is considered successful if the maximum deviation between the assigned level and the actual measured value (average value with 1 min. window) for the active power is less than ± 2,5 % of them S_n.

In the case of storage systems connected to bidirectional converters, repeat the test at 30 % P_{CMAX}.

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Bbis.7.4	Verification of active power control on external control from DSO	P

Graph: 50% P_{SMAX} to 30% P_{CMAX}



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Bbis.7.4	Verification of active power control on external control from DSO	P
Bidirectional converters		
DHN-LVEH3P8K-EU-G1 with Cmin battery		
1-min mean value	50% P_{SMAX} to 30% P_{CMAX}	
P_{E60} [%]	29,7	
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	
Settling time [s]	3,6	
Limit settling time [s]	30	

The ability to increase/decrease the active power input/output as a result of a remote signal must be tested by agreeing with the manufacturer of the storage system how the signal will be received and processed.

The test must be carried out according to the following steps:

- Bring the storage system up to 50 % of the available active feed-in power.
- Send the generator an active power set-point of 30 % of the P_{SMAX}.
- Maintain the set-point for a time of 60 s, consistent with the energy capacity of the storage system.
- Measure the active power delivered by the inverter, at least 30 s after the command for the new active power control set-point has been sent (this is to ensure that the system has reached a steady state).

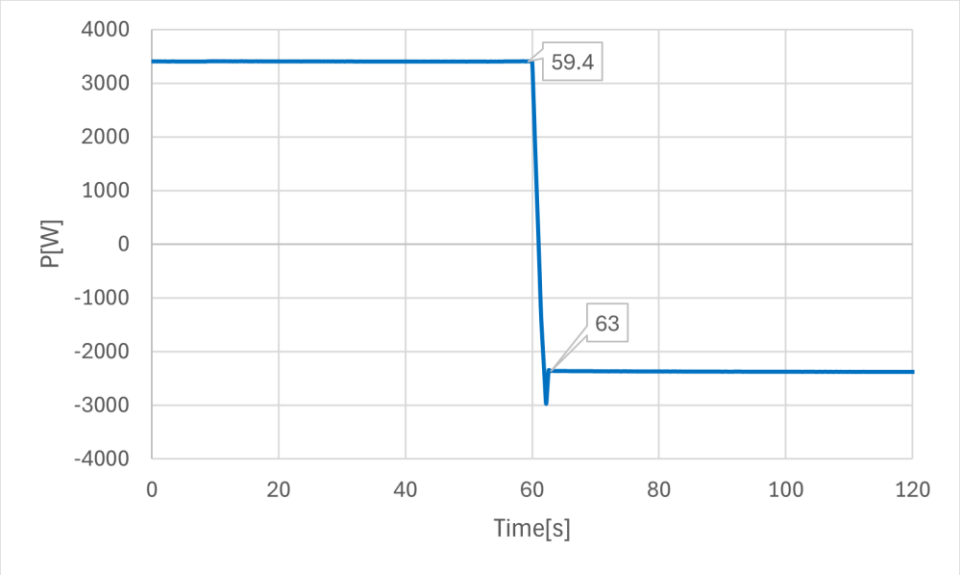
The test is considered successful if the maximum deviation between the assigned level and the actual measured value (average value with 1 min. window) for the active power is less than ± 2,5 % of them S_n.

In the case of storage systems connected to bidirectional converters, repeat the test at 30 % P_{CMAX}.

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Bbis.7.4	Verification of active power control on external control from DSO	P

Graph: 50% P_{SMAX} to 30% P_{CMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
Bidirectional converters		
DHN-LVEH3P12K-EU-G1 with Cmax battery		
1-min mean value	100% P_{SMAX} to 30% P_{CMAX}	100% P_{CMAX} to 50% P_{SMAX}
P_{E60} [%]	30,2	51,3
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	50% P_{SMAX} ± 2,5 % of S_n
Settling time [s]	4,2	1,6
Limit settling time [s]	50	50
1-min mean value	100% S_n to 15% S_n	
P_{E60} [%]	N/A	
Limit ΔP_{E60} [%]	S_n ± 2,5 % of S_n	
Settling time [s]	N/A	
Limit settling time [s]	60	

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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Test

For checking the settling time at a command to reduce the active power output, or increase the active power input, the test is carried out:

- for storage systems connected to bidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{CMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{SMAX} at time t0.

For testing the settling time to a command to increase active power, or reduce the active power absorbed, the test is carried out:

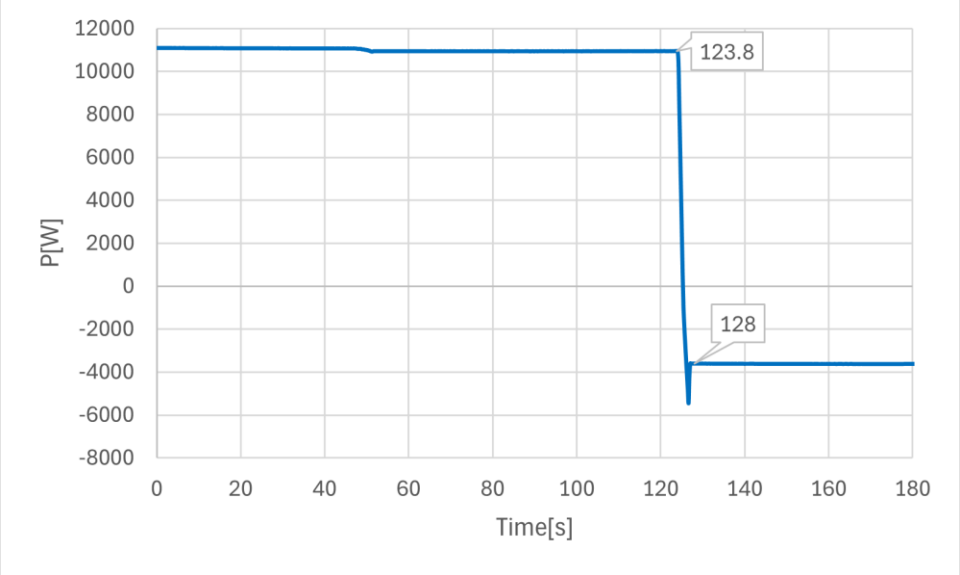
- for storage systems connected to bi-directional converters, adjusting the control parameter from 100 % * P_{CMAX} to 50 % * P_{SMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting parameter from 0 % * P_{SMAX} to 50 % * P_{SMAX} at time t0.

Assessment criterion

The settling time (or settling time) is the time interval from the instant t0 of application of the active power increment/limitation step (e.g. 100 % * P_{SMAX} 30 % * P_{SMAX}) to the instant in which the power falls stably within a tolerance band equal to ±2,5 % * Sn from new set value.

The maximum measured settling time must be less than 50 s, and in any case no more than 60 s in the case of the limitation command from 100 % * S_n to 15 % * S_n.

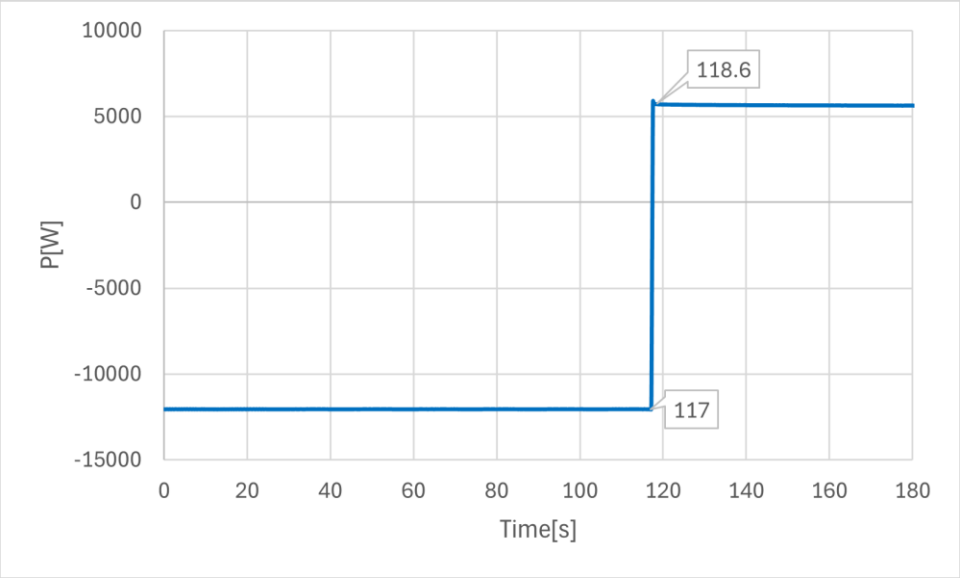
Graph: 100%P_{SMAX} to 30%P_{CMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Graph: 100% P_{CMAX} to 50% P_{SMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
Bidirectional converters		
DHN-LVEH3P12K-EU-G1 with Cmin battery		
1-min mean value	100% P_{SMAX} to 30% P_{CMAX}	100% P_{CMAX} to 50% P_{SMAX}
P_{E60} [%]	29,6	50,7
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	50% P_{SMAX} ± 2,5 % of S_n
Settling time [s]	6,2	2,0
Limit settling time [s]	50	50
1-min mean value	100% S_n to 15% S_n	
P_{E60} [%]	N/A	
Limit ΔP_{E60} [%]	S_n ± 2,5 % of S_n	
Settling time [s]	N/A	
Limit settling time [s]	60	

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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Test

For checking the settling time at a command to reduce the active power output, or increase the active power input, the test is carried out:

- for storage systems connected to bidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{CMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{SMAX} at time t0.

For testing the settling time to a command to increase active power, or reduce the active power absorbed, the test is carried out:

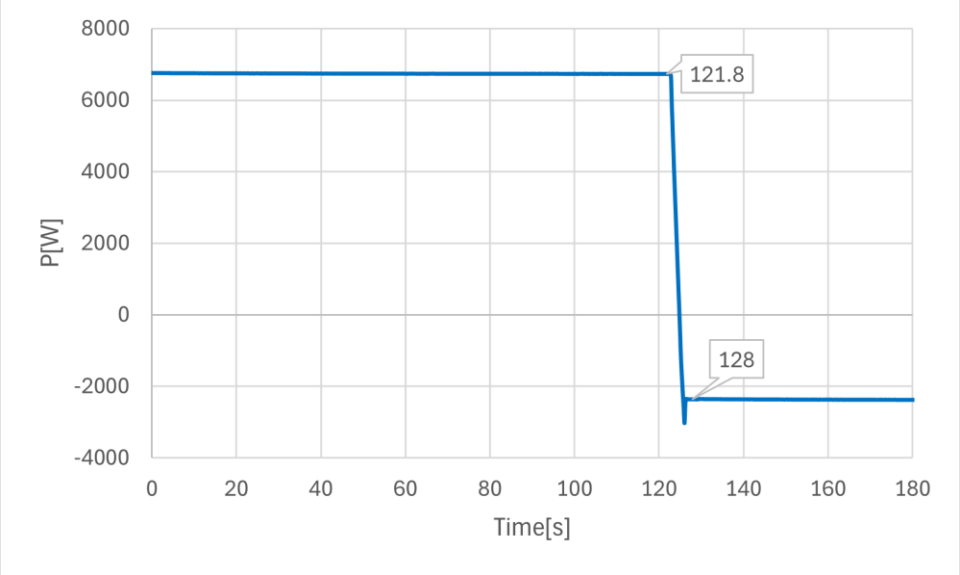
- for storage systems connected to bi-directional converters, adjusting the control parameter from 100 % * P_{CMAX} to 50 % * P_{SMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting parameter from 0 % * P_{SMAX} to 50 % * P_{SMAX} at time t0.

Assessment criterion

The settling time (or settling time) is the time interval from the instant t0 of application of the active power increment/limitation step (e.g. 100 % * P_{SMAX} 30 % * P_{SMAX}) to the instant in which the power falls stably within a tolerance band equal to ±2,5 % * Sn from new set value.

The maximum measured settling time must be less than 50 s, and in any case no more than 60 s in the case of the limitation command from 100 % * S_n to 15 % * S_n.

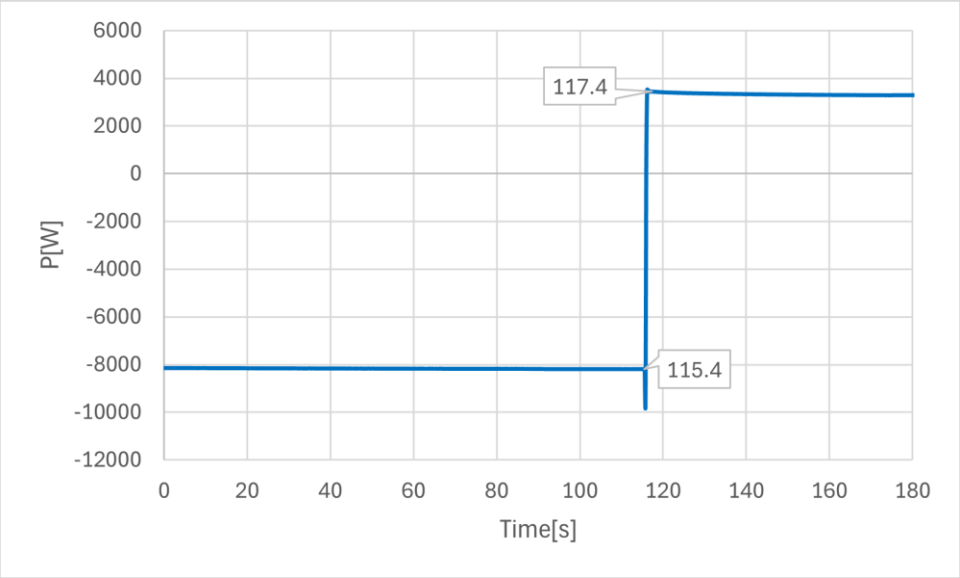
Graph: 100%P_{SMAX} to 30%P_{CMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Graph: 100% P_{CMAX} to 50% P_{SMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
Bidirectional converters		
DHN-LVEH3P8K-EU-G1 with Cmin battery		
1-min mean value	100% P_{SMAX} to 30% P_{CMAX}	100% P_{CMAX} to 50% P_{SMAX}
P_{E60} [%]	29,7	50,8
Limit ΔP_{E60} [%]	30% P_{CMAX} ± 2,5 % of S_n	50% P_{SMAX} ± 2,5 % of S_n
Settling time [s]	5,0	0,6
Limit settling time [s]	50	50
1-min mean value	100% S_n to 15% S_n	
P_{E60} [%]	N/A	
Limit ΔP_{E60} [%]	S_n ± 2,5 % of S_n	
Settling time [s]	N/A	
Limit settling time [s]	60	

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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Test

For checking the settling time at a command to reduce the active power output, or increase the active power input, the test is carried out:

- for storage systems connected to bidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{CMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting the control parameter from 100 % * P_{SMAX} to 30 % * P_{SMAX} at time t0.

For testing the settling time to a command to increase active power, or reduce the active power absorbed, the test is carried out:

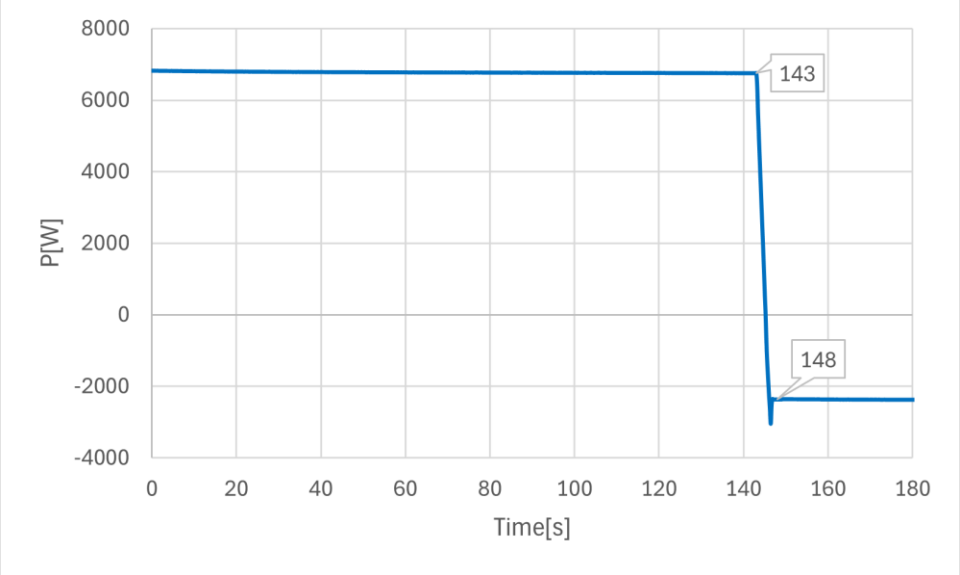
- for storage systems connected to bi-directional converters, adjusting the control parameter from 100 % * P_{CMAX} to 50 % * P_{SMAX} at time t0;
- for storage systems connected to unidirectional converters, adjusting parameter from 0 % * P_{SMAX} to 50 % * P_{SMAX} at time t0.

Assessment criterion

The settling time (or settling time) is the time interval from the instant t0 of application of the active power increment/limitation step (e.g. 100 % * P_{SMAX} 30 % * P_{SMAX}) to the instant in which the power falls stably within a tolerance band equal to ±2,5 % * Sn from new set value.

The maximum measured settling time must be less than 50 s, and in any case no more than 60 s in the case of the limitation command from 100 % * S_n to 15 % * S_n.

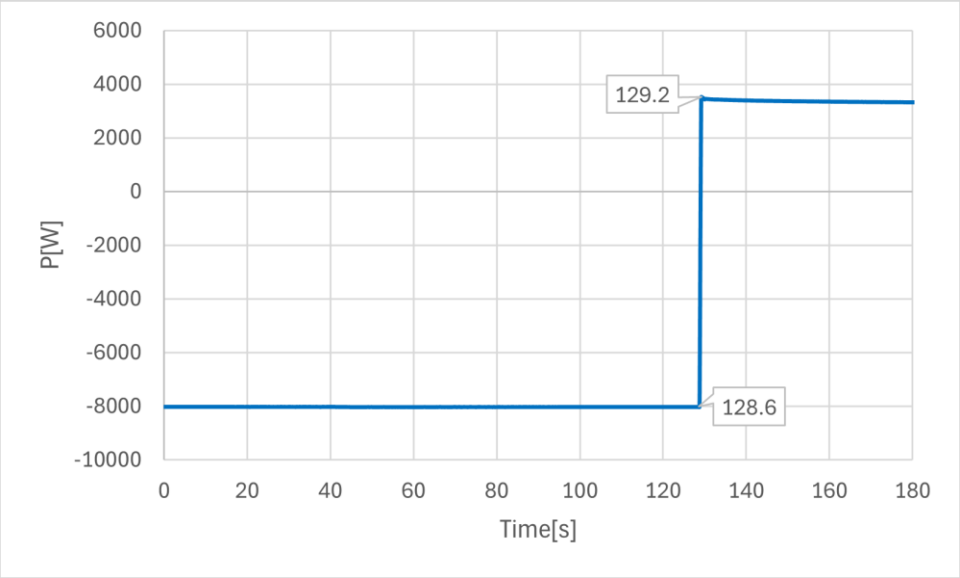
Graph: 100%P_{SMAX} to 30%P_{CMAX}



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Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P

Graph: 100% P_{CMAX} to 50% P_{SMAX}



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Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery (P_{SMAX})			
Phase 1 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1242,7	2487,8	3702,1
AC Voltage [V]	230,30	230,57	230,86
AC Current [A]	5,40	10,79	16,04
PF [1]	0,9991	0,9997	0,9998
Cosφ [1]	0,9991	0,9997	0,9998
DC Current in AC [mA]	41,0	26,2	0,6
DC Current in AC [% of I_n]	0,236	0,151	0,003
Phase 2 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1237,8	2481,3	3692,9
AC Voltage [V]	230,25	230,48	230,73
AC Current [A]	5,38	10,77	16,01
PF [1]	0,9991	0,9997	0,9997
Cosφ [1]	0,9991	0,9997	0,9997
DC Current in AC [mA]	5,0	3,4	0,9
DC Current in AC [% of I_n]	0,029	0,020	0,005
Phase 3 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1237,9	2480,2	3690,4
AC Voltage [V]	230,27	230,54	230,80
AC Current [A]	5,38	10,76	15,99
PF [1]	0,9989	0,9997	0,9998
Cosφ [1]	0,9989	0,9997	0,9998
DC Current in AC [mA]	43,3	29,2	4,4
DC Current in AC [% of I_n]	0,249	0,168	0,025

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery(P_{SMAX})			
Phase 1 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1244,8	2487,5	3700,2
AC Voltage [V]	230,30	230,57	230,85
AC Current [A]	5,41	10,79	16,03
PF [1]	0,9991	0,9997	0,9998
Cosφ [1]	0,9991	0,9997	0,9998
DC Current in AC [mA]	42,1	28,1	12,3
DC Current in AC [% of I_n]	0,242	0,161	0,071
Phase 2 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1240,1	2480,8	3691,2
AC Voltage [V]	230,25	230,48	230,71
AC Current [A]	5,39	10,77	16,00
PF [1]	0,9991	0,9997	0,9998
Cosφ [1]	0,9991	0,9997	0,9998
DC Current in AC [mA]	5,1	4,4	20,0
DC Current in AC [% of I_n]	0,029	0,025	0,115
Phase 3 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1240,3	2479,8	3688,9
AC Voltage [V]	230,27	230,54	230,80
AC Current [A]	5,39	10,76	15,99
PF [1]	0,9989	0,9997	0,9998
Cosφ [1]	0,9989	0,9997	0,9998
DC Current in AC [mA]	44,3	30,0	26,3
DC Current in AC [% of I_n]	0,255	0,173	0,151

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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TEMP-0058-TG-EAW-ES-V01

Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery(P_{SMAX})			
Phase 1 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1243,7	2471,9	3664,9
AC Voltage [V]	230,30	230,56	230,84
AC Current [A]	5,41	10,72	15,88
PF [1]	0,9991	0,9997	0,9998
Cosφ [1]	0,9991	0,9997	0,9998
DC Current in AC [mA]	42,1	28,0	12,6
DC Current in AC [% of I_n]	0,242	0,161	0,072
Phase 2 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1239,1	2465,6	3656,2
AC Voltage [V]	230,24	230,48	230,71
AC Current [A]	5,39	10,70	15,85
PF [1]	0,9990	0,9997	0,9997
Cosφ [1]	0,9990	0,9997	0,9997
DC Current in AC [mA]	1,2	4,1	5,3
DC Current in AC [% of I_n]	0,007	0,024	0,030
Phase 3 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	1239,2	2464,3	3653,9
AC Voltage [V]	230,27	230,54	230,80
AC Current [A]	5,39	10,69	15,84
PF [1]	0,9989	0,9997	0,9998
Cosφ [1]	0,9989	0,9997	0,9998
DC Current in AC [mA]	48,2	30,1	7,2
DC Current in AC [% of I_n]	0,277	0,173	0,042

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery (P_{CMAX})			
Phase 1 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1321,0	-2641,5	-4002,3
AC Voltage [V]	229,71	229,41	229,06
AC Current [A]	5,76	11,52	17,48
PF [1]	-0,9992	-0,9995	-0,9996
Cosφ [1]	-0,9992	-0,9995	-0,9996
DC Current in AC [mA]	6,0	36,4	51,7
DC Current in AC [% of I_n]	0,034	0,210	0,297
Phase 2 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1322,2	-2641,7	-4002,5
AC Voltage [V]	229,75	229,50	229,23
AC Current [A]	5,76	11,52	17,47
PF [1]	-0,9991	-0,9995	-0,9996
Cosφ [1]	-0,9991	-0,9995	-0,9996
DC Current in AC [mA]	5,9	3,3	20,0
DC Current in AC [% of I_n]	0,034	0,019	0,115
Phase 3 (Ambient)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1319,8	-2636,7	-3995,4
AC Voltage [V]	229,71	229,42	229,12
AC Current [A]	5,75	11,50	17,45
PF [1]	-0,9990	-0,9994	-0,9996
Cosφ [1]	-0,9990	-0,9994	-0,9996
DC Current in AC [mA]	19,5	38,7	26,3
DC Current in AC [% of I_n]	0,112	0,222	0,151

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery(P_{CMAX})			
Phase 1 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1323,2	-2641,9	-4012,0
AC Voltage [V]	229,71	229,41	229,08
AC Current [A]	5,77	11,52	17,52
PF [1]	-0,9992	-0,9995	-0,9996
Cosφ [1]	-0,9992	-0,9995	-0,9996
DC Current in AC [mA]	3,8	37,7	59,2
DC Current in AC [% of I_n]	0,022	0,217	0,341
Phase 2 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1324,1	-2642,0	-4012,0
AC Voltage [V]	229,75	229,49	229,22
AC Current [A]	5,77	11,52	17,51
PF [1]	-0,9991	-0,9995	-0,9996
Cosφ [1]	-0,9991	-0,9995	-0,9996
DC Current in AC [mA]	4,2	3,4	23,4
DC Current in AC [% of I_n]	0,024	0,019	0,135
Phase 3 (-10°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1321,9	-2637,4	-4004,4
AC Voltage [V]	229,71	229,42	229,11
AC Current [A]	5,76	11,50	17,48
PF [1]	-0,9990	-0,9994	-0,9996
Cosφ [1]	-0,9990	-0,9994	-0,9996
DC Current in AC [mA]	15,6	40,2	24,5
DC Current in AC [% of I_n]	0,090	0,231	0,141

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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Bbis.8.1	Verification of emission of continuous component		P
DHN-LVEH3P12K-EU-G1 with Cmax battery(P_{CMAX})			
Phase 1 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1320,7	-2641,8	-4014,0
AC Voltage [V]	229,71	229,41	229,08
AC Current [A]	5,75	11,52	17,53
PF [1]	-0,9992	-0,9995	-0,9996
Cosφ [1]	-0,9992	-0,9995	-0,9996
DC Current in AC [mA]	10,9	36,1	68,5
DC Current in AC [% of I_n]	0,063	0,207	0,394
Phase 2 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1321,6	-2641,8	-4013,4
AC Voltage [V]	229,75	229,49	229,22
AC Current [A]	5,76	11,52	17,52
PF [1]	-0,9991	-0,9995	-0,9996
Cosφ [1]	-0,9991	-0,9995	-0,9996
DC Current in AC [mA]	6,9	2,2	24,9
DC Current in AC [% of I_n]	0,040	0,013	0,143
Phase 3 (+55°C)			
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5
AC Power [W]	-1319,4	-2637,2	-4005,7
AC Voltage [V]	229,71	229,42	229,11
AC Current [A]	5,75	11,50	17,49
PF [1]	-0,9990	-0,9994	-0,9996
Cosφ [1]	-0,9990	-0,9994	-0,9996
DC Current in AC [mA]	25,2	39,7	24,9
DC Current in AC [% of I_n]	0,145	0,228	0,143

Note

Limits of clause 8.4.4.1

The measurement is be performed by averaging the measured quantity of a maximum time window of 1 sec., by recording the performance for a minimum period of 5 minutes and acquiring a minimum number of samples equal to the reciprocal of the time window in which the quantity was averaged (for 1 sec, at least 300 samples). The output rms current and rms voltage of the inverter are measured and recorded in the same manner.

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.

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Bbis.8.2	Verification of Protection against Continuous Component Input			P
Test result				
Actual Power	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [s]
I_{dc} = 0,5% of I_n (Positive)				
33%	0,5% I_n / 1 s	98	87	0,900
66%	0,5% I_n / 1 s	99	87	0,900
100%	0,5% I_n / 1 s	101	87	0,900
I_{dc} = 0,5% of I_n (Negative)				
33%	0,5% I_n / 1 s	105	87	0,900
66%	0,5% I_n / 1 s	107	87	0,900
100%	0,5% I_n / 1 s	113	87	0,900
I_{dc} = >1 A (Positive)				
33%	1 A / 0,2 s	1120	1000	0,150
66%	1 A / 0,2 s	1047	1000	0,150
100%	1 A / 0,2 s	1156	1000	0,150
I_{dc} = >1 A (Negative)				
33%	1 A / 0,2 s	1077	1000	0,150
66%	1 A / 0,2 s	1143	1000	0,150
100%	1 A / 0,2 s	1102	1000	0,150

Note

Checking the switch-off of the converter, if the first protection threshold Idc > (> 0,5 % In; in the case of systems with a power of less than 800 W: > 20 mA)

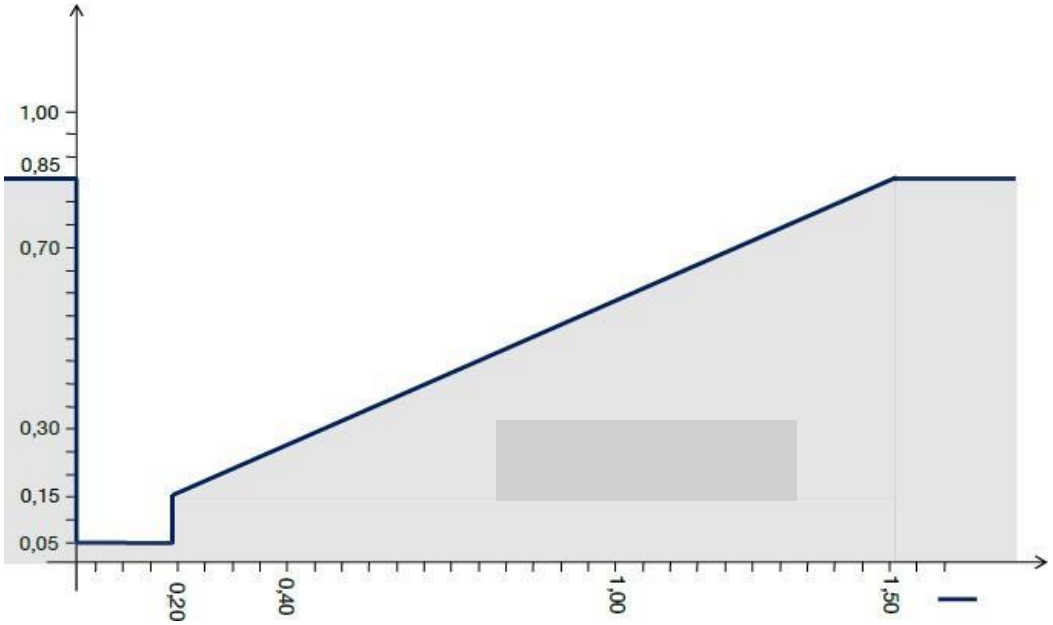
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Bbis.9	Verification of UVRT capability	P

General: discharge mode P_{SMAX}

The purpose of these tests is to verify that the storage system, when used in systems with a total output of more than 11,08 kW, is insensitive to voltage sags according to the voltage-time profile shown in Figure 71, according to 8.5.1. In particular, the tests must verify that the following functional requirements are met:

- in the cross-hatched area the generator must not disconnect from the network. Supply or absorption of active and reactive power prior to the occurrence of the fault can be temporarily interrupted in this area.
- in the area below (grey) the generator can disconnect from the network.
- within 400 ms from restoring network voltage to within the range of +10% and – 15% of nominal voltage, the generator must return to supplying active and reactive power to the network as before the fault, with a maximum tolerance of ± 10% of the nominal voltage of the generator. If voltage returns but remains in the range between 85% and 90%, power distribution may be reduced in relation to the generator / storage system limits of output power.



List of tests	Residual amplitude of phase-to-phase voltage V/V_n			Duration [s]	Form (*)
1s – three-phase symmetrical fault	0,10	± 0,05	(V1/Vn)	0,200 ± 0,020	
1a – asymmetrical fault phase	0,10	± 0,05	(V1/Vn)	0,200 ± 0,020	
2s – three-phase symmetrical fault	0,25	± 0,05	(V2/Vn)	0,400 ± 0,020	
2a – asymmetrical fault phase	0,25	± 0,05	(V2/Vn)	0,400 ± 0,020	
3s – three-phase symmetrical fault	0,50	± 0,05	(V3/Vn)	0,850 ± 0,020	
3a – asymmetrical fault phase	0,50	± 0,05	(V3/Vn)	0,850 ± 0,020	
4s – three-phase symmetrical fault	0,75	± 0,05	(V4/Vn)	1,300 ± 0,020	
4a – asymmetrical fault phase	0,75	± 0,05	(V4/Vn)	1,300 ± 0,020	
5 – LV two-phase asymmetrical fault	0,10	± 0,05	(V5/Vn)	0,200 ± 0,020	
6 – LV two-phase asymmetrical fault	0,50	± 0,05	(V6/Vn)	0,850 ± 0,020	

* Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms

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Overvoltage V-t Characteristic (OVRT) of Figure 30

1) the generator must not disconnect from the grid in the area below and along the points of the indicated characteristic (V-t), where V is the chained voltage at the point of connection. These values are expressed as a percentage of the nominal voltage
2) in the area above (in grey) the generator can disconnect from grid
3) The behaviour provided for by the curve in Figure 30 must be ensured in the event of a voltage rise of one or more voltages, i.e. the disconnection logic must be of the type 1 out of 3: it can be triggered for both symmetrical and dissymmetrical faults when one of the three voltage measurements exceeds in height and duration the permissible peak voltage.

The FRT characteristic required of generation plants over 11,08 kW is shown in Figure 30

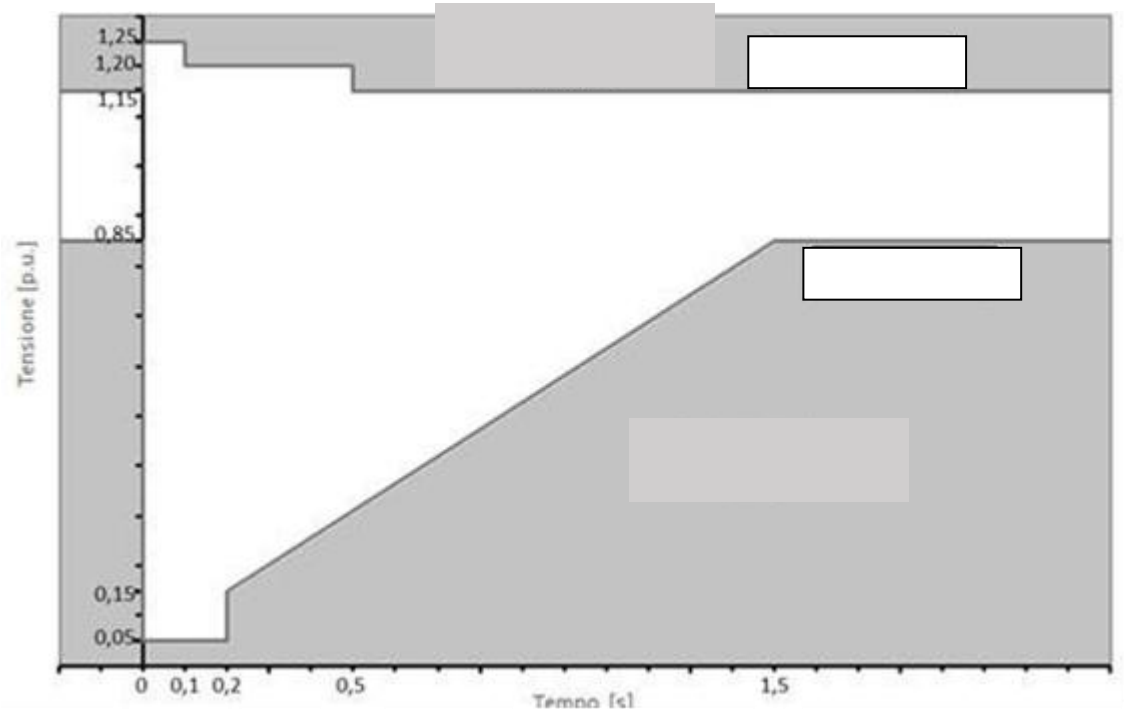


Figure 30 - Characteristic (V - t): UVRT and OVRT for generating parks over 11,08 kW

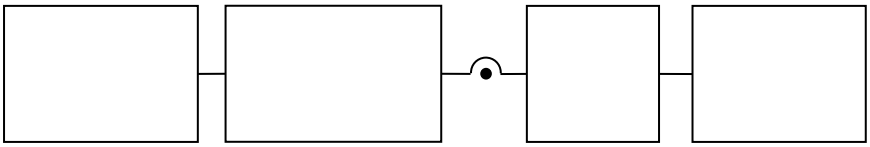
Verifications of the compliance of motor-drive converters with the requirements for immunity to voltage sags shall be carried out in accordance with Annex B, Article B.1.

List of tests	Residual amplitude of phase-to-phase voltage V/V_n	Duration [s]	Form (*)
OV1 – three-phase symmetrical fault	1,25 ± 0,05 (V1/Vn)	0,100 ± 0,020	
OV2 – three-phase symmetrical fault	1,20 ± 0,05 (V1/Vn)	0,500 ± 0,020	
* Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms			

Note

For large generators (> 100kW), it is permissible to carry out the tests at reduced power, as long as this exceeds 30% of the nominal power of the generator.

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Bbis.9.1	UVRT - how tests are carried out and recorded	P
Test setup		
Grid simulator (grid conditions varied)		☒
Test bench		☐
Identifier of test setup		See Annex 6 – Test equipment list
Schematic of test setup: 		Note on test setup: Instead of an LVRT test bench a low-voltage AC simulator was used.
Note: Evaluation of data measured at MP. Used sample rate: 10 kHz		
Grid parameters at MP1		
Nominal voltage PCC // U_G [V]		230 V (P-N) / 400 V (P-P)
Nominal apparent power of test setup // S_n [kVA]		75
Short-circuit power of the test setup // S_{sc} [kVA]		≥ 3x$S_{n,PGU}$
Grid reactance X_G [Ω]		5,56
Grid impedance R_G [Ω]		1,81
Test conditions Voltage simulator fall and rise time: < 10ms It will therefore be necessary to carry out at least 12 separate test sequences, corresponding to 2 residual voltage levels to be replicated to simulate the cases of three-phase symmetrical and two-phase asymmetrical MV and LV faults. Each sequence must then be repeated with the storage system operating at two initial power output levels (a: 10 % * P_{SMAX} ÷ 30 % * P_{SMAX}; b: > 90 % * P_{SMAX}).		

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Tests results

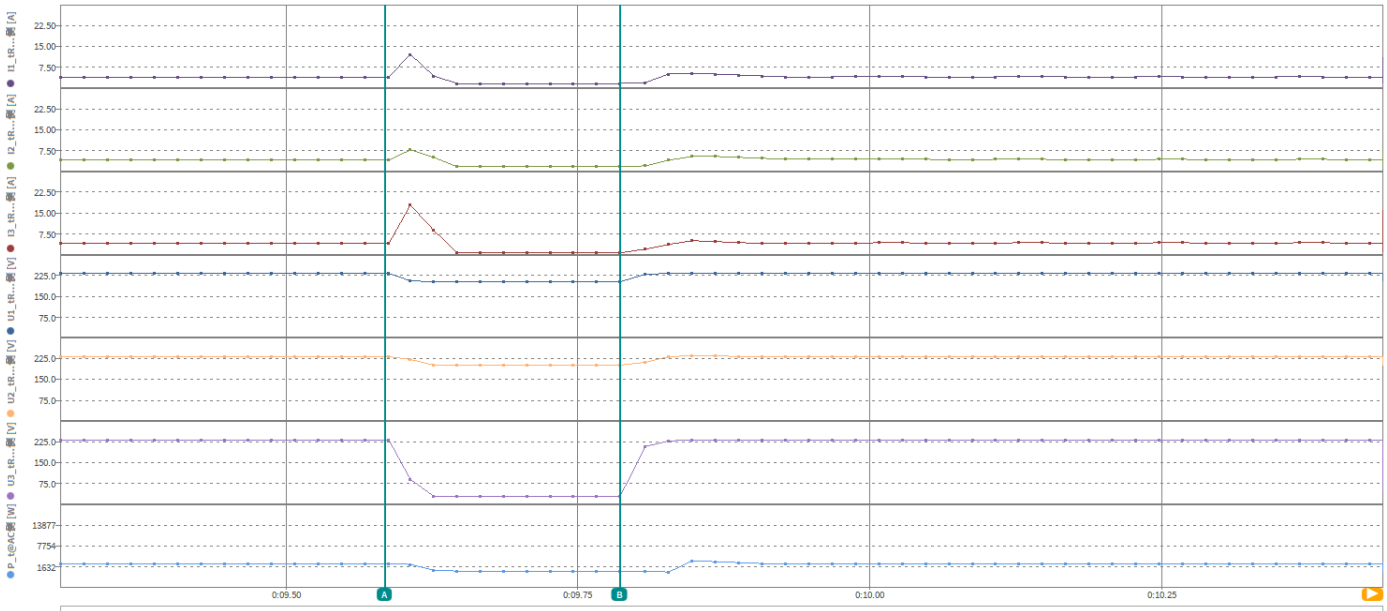
DHN-LVEH3P12K-EU-G1 with Cmax battery

List of tests	Residual amplitude of phase-to-phase voltage V/V_n	Dip Duration of Voltage dip [s]	Dip time measured [ms]	Recovery time measured [ms]	Verdict
1a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,10± 0,05	0,200 ± 0,020	0,201	0,138	P
1a – two-phase asymmetrical fault (P > 0,9)	0,10± 0,05	0,200 ± 0,020	0,202	0,383	P
1s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,10± 0,05	0,200 ± 0,020	0,201	0,132	P
1s – three-phase symmetrical fault (P > 0,9)	0,10± 0,05	0,200 ± 0,020	0,198	0,158	P
2a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,25± 0,05	0,400 ± 0,020	0,399	0,140	P
2a – two-phase asymmetrical fault (P > 0,9)	0,25± 0,05	0,400 ± 0,020	0,401	0,374	P
2s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,25± 0,05	0,400 ± 0,020	0,400	0,110	P
2s – three-phase symmetrical fault (P > 0,9)	0,25± 0,05	0,400 ± 0,020	0,405	0,107	P
3a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,50± 0,05	0,850 ± 0,020	0,843	0,400	P
3a – two-phase asymmetrical fault (P > 0,9)	0,50± 0,05	0,850 ± 0,020	0,851	0,374	P
3s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,50± 0,05	0,850 ± 0,020	0,861	0,158	P
3s – three-phase symmetrical fault (P > 0,9)	0,50± 0,05	0,850 ± 0,020	0,841	0,147	P
4a – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,75± 0,05	1,300 ± 0,020	1,303	0,214	P
4a – two-phase asymmetrical fault (P > 0,9)	0,75± 0,05	1,300 ± 0,020	1,306	0,131	P
4s – three-phase symmetrical fault (P = 0,1 - 0,3)	0,75± 0,05	1,300 ± 0,020	1,306	0,168	P
4s – three-phase symmetrical fault (P > 0,9)	0,75± 0,05	1,300 ± 0,020	1,300	0,157	P
5 – LV two-phase asymmetrical fault (P = 0,1 - 0,3)	0,10± 0,05	0,200 ± 0,020	0,199	0,143	P
5 – LV two-phase asymmetrical fault (P > 0,9)	0,10± 0,05	0,200 ± 0,020	0,204	0,119	P
6 – LV two-phase asymmetrical fault (P = 0,1 - 0,3)	0,50± 0,05	0,850 ± 0,020	0,855	0,140	P
6 – LV two-phase asymmetrical fault (P > 0,9)	0,50± 0,05	0,850 ± 0,020	0,844	0,128	P
OV1 – three-phase symmetrical fault (P > 0,9)	1,25± 0,05	0,100 ± 0,020	0,101	0,122	P
OV2 – three-phase symmetrical fault (P > 0,9)	1,20± 0,05	0,500 ± 0,020	0,503	0,089	P

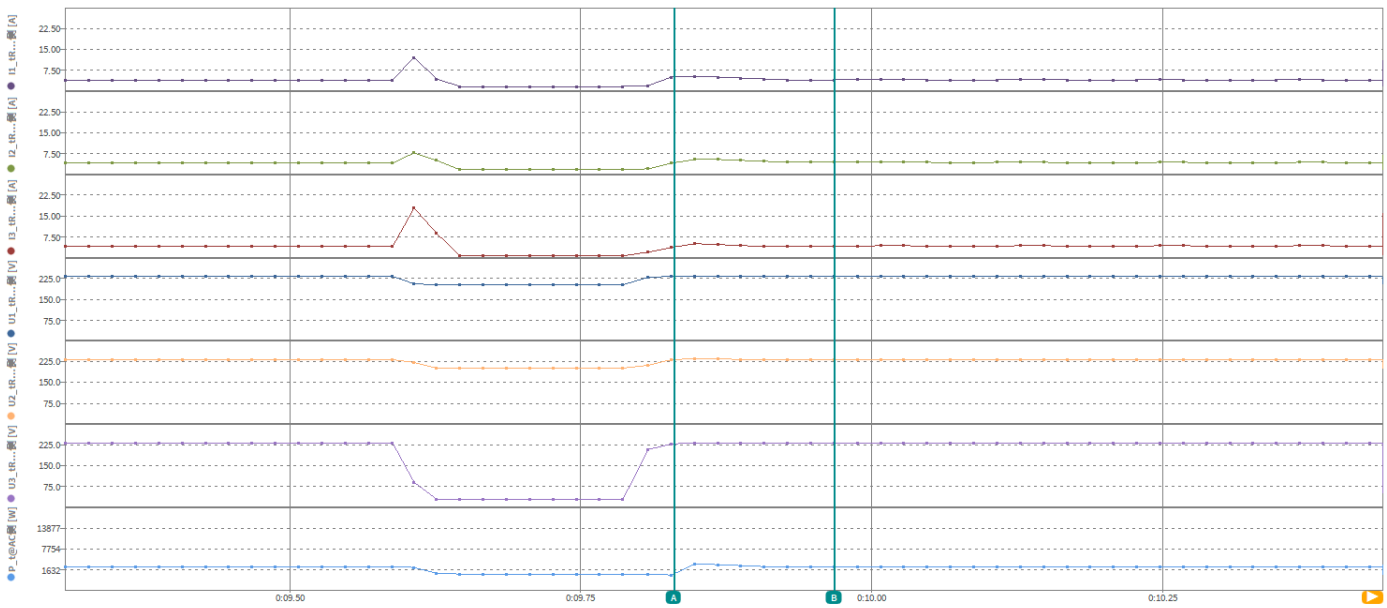
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Graph of LVRT

Test 1a – two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) a: 10 % * P_{SMAX} ÷ 30 %



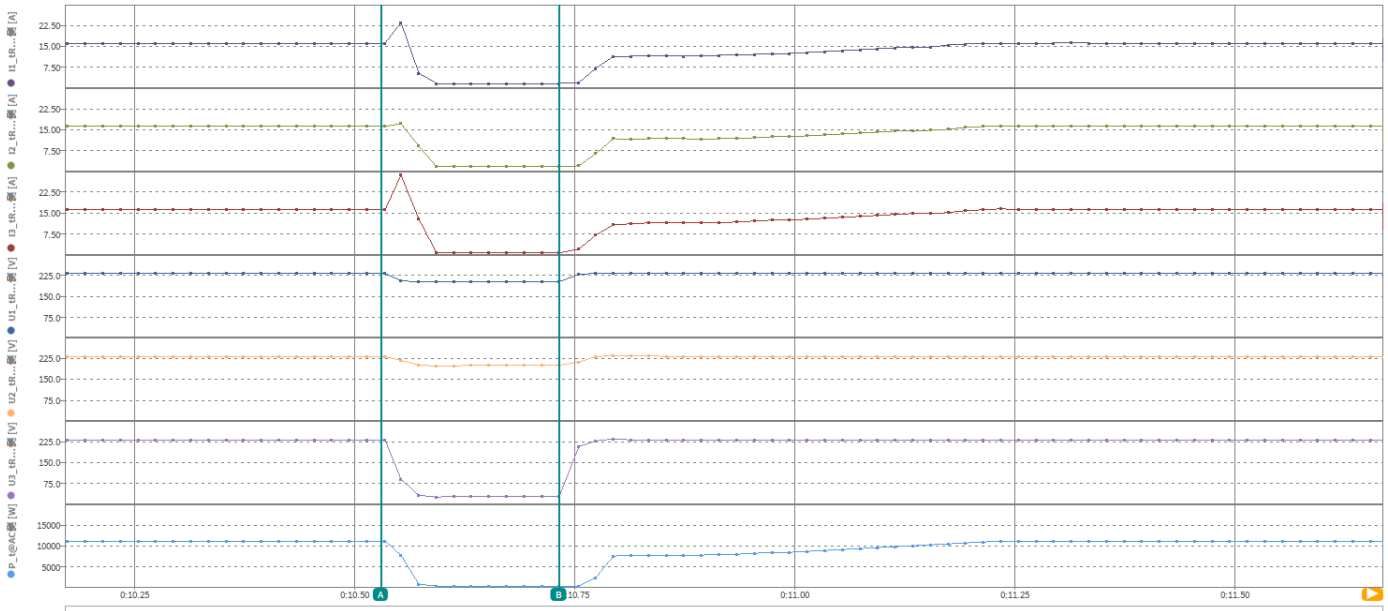
时间 [s]	A	B	间隔
	9.585108	9.786205	0.201097
I1_tRMS@AC侧 [A]	3.298504	1.021957	-2.276547
I2_tRMS@AC侧 [A]	3.292929	1.028992	-2.263937
I3_tRMS@AC侧 [A]	3.309010	0.132170	-3.176839
U1_tRMS@AC侧 [V]	230.2328	200.0749	-30.15790
U2_tRMS@AC侧 [V]	230.5561	200.4698	-30.08629
U3_tRMS@AC侧 [V]	230.7473	23.06281	-207.6844
P_t@AC侧 [W]	2276.783	-0.749639	-2277.533



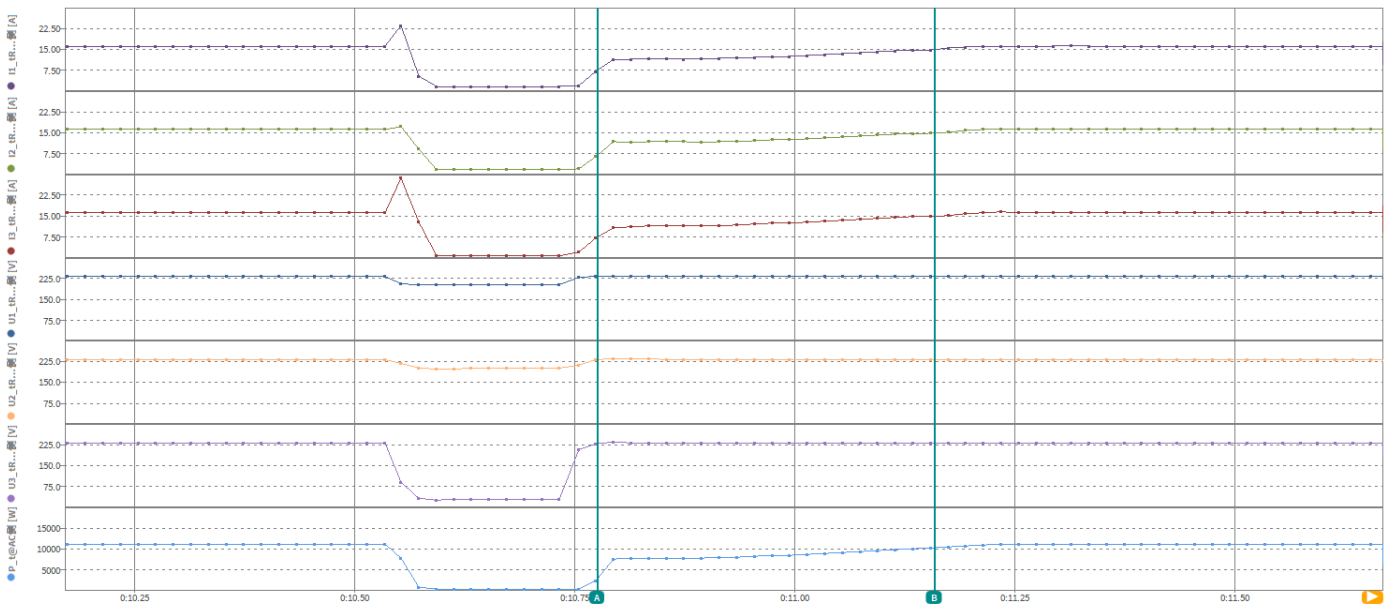
时间 [s]	A	B	间隔
	9.830294	9.968108	0.137814
I1_tRMS@AC侧 [A]	4.341339	3.460827	-0.880512
I2_tRMS@AC侧 [A]	3.431985	3.643034	0.211049
I3_tRMS@AC侧 [A]	3.180726	3.313954	0.133229
U1_tRMS@AC侧 [V]	229.6721	230.0441	0.372086
U2_tRMS@AC侧 [V]	229.4910	231.3106	1.819611
U3_tRMS@AC侧 [V]	227.6246	231.1699	3.545319
P_t@AC侧 [W]	-243.7084	2293.953	2537.662

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Test 1a – two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) b: > 90 % * P_{SMAX}



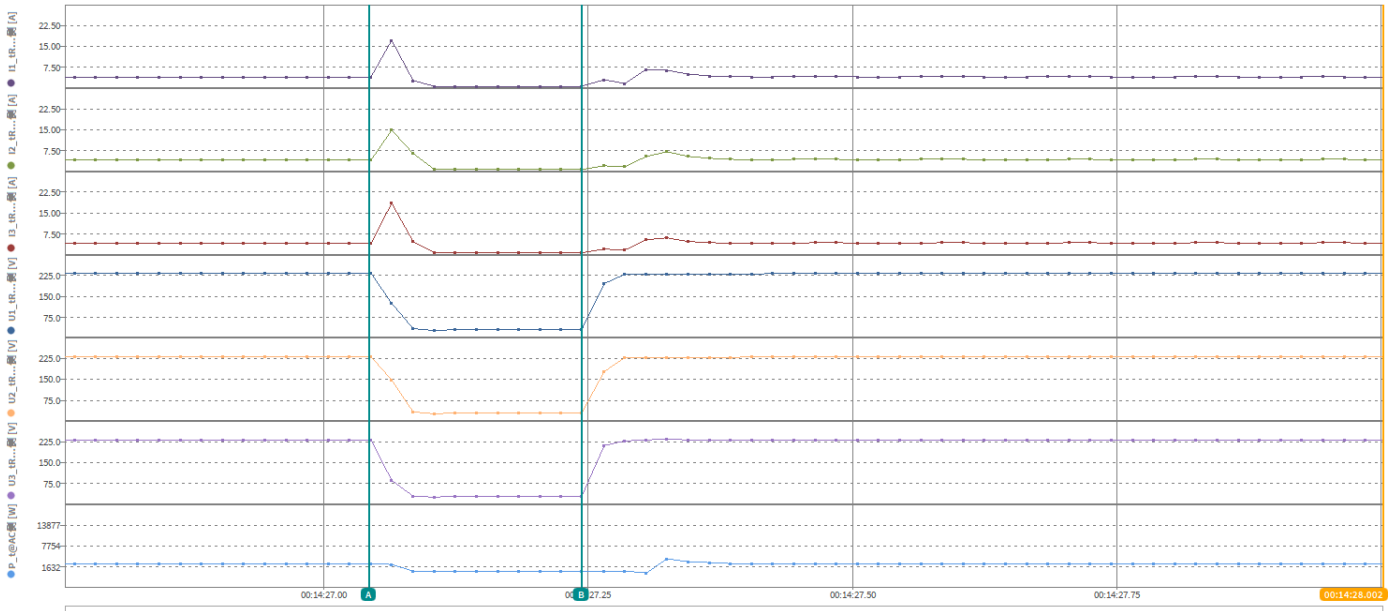
时间 [s]	A 0:10.530482	B 0:10.732635	间隔 0.202153
I1_tRMS@AC侧 [A]	15.81415	1.021509	-14.79265
I2_tRMS@AC侧 [A]	15.78768	1.027236	-14.76044
I3_tRMS@AC侧 [A]	15.83823	0.129759	-15.70847
U1_tRMS@AC侧 [V]	230.5810	199.8416	-30.73938
U2_tRMS@AC侧 [V]	230.8766	200.2888	-30.58775
U3_tRMS@AC侧 [V]	231.2299	23.08736	-208.1426
P_t@AC侧 [W]	10949.88	-0.768653	-10950.65



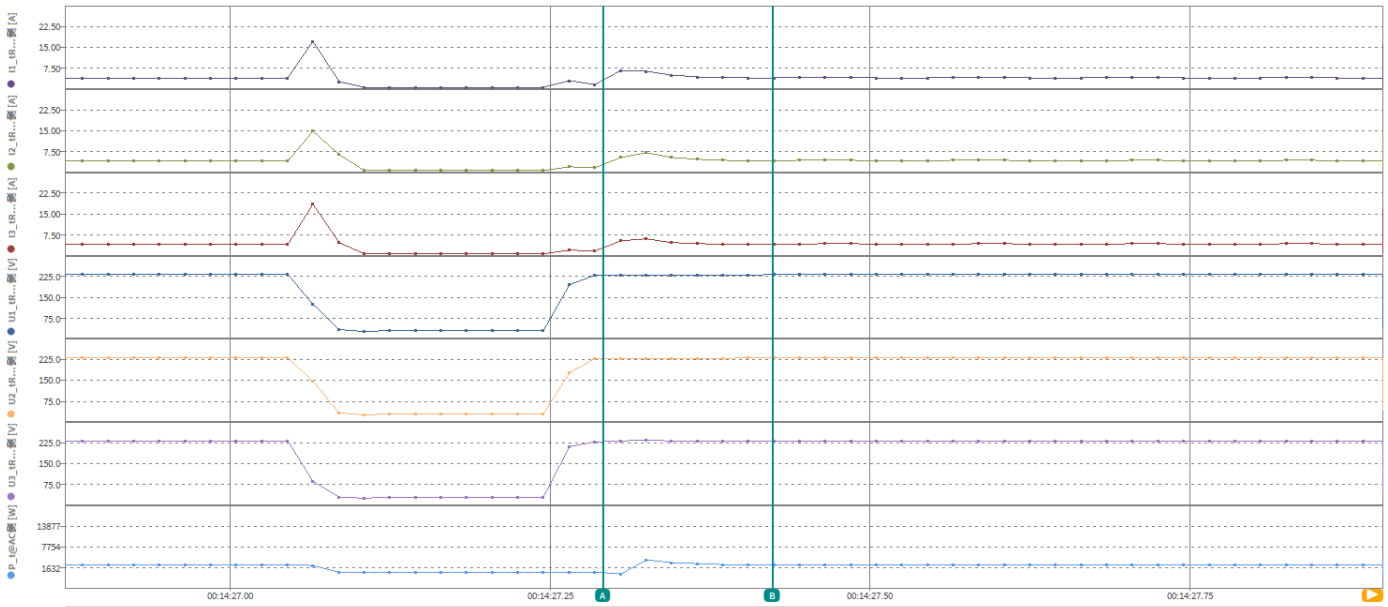
时间 [s]	A 0:10.776243	B 0:11.159142	间隔 0.382899
I1_tRMS@AC侧 [A]	6.669323	14.65046	7.981135
I2_tRMS@AC侧 [A]	5.881384	14.58350	8.702121
I3_tRMS@AC侧 [A]	6.474883	14.64692	8.172042
U1_tRMS@AC侧 [V]	230.3781	230.6554	0.277359
U2_tRMS@AC侧 [V]	229.9859	230.9669	0.981079
U3_tRMS@AC侧 [V]	228.4129	231.2971	2.884186
P_t@AC侧 [W]	2081.617	10110.95	8029.335

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Test 1s – three-phase symmetrical fault (V/V_n = 0,10; duration = 0,200 s) a: 10 % * P_{SMAX} ÷ 30 %



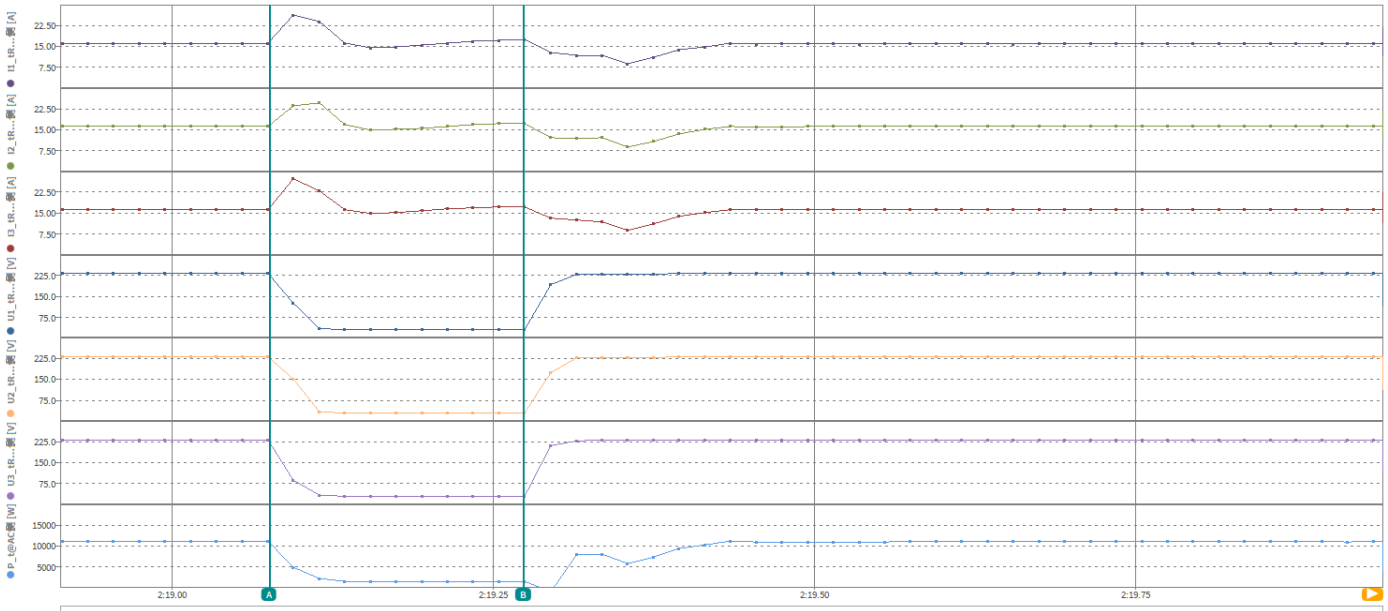
时间 [s]	A 00:14:27.0432588	B 00:14:27.2441348	间隔 0.2008760
I1_tRMS@AC侧 [A]	3.316487	0.140856	-3.175631
I2_tRMS@AC侧 [A]	3.309486	0.147887	-3.161599
I3_tRMS@AC侧 [A]	3.326126	0.135777	-3.190349
U1_tRMS@AC侧 [V]	230.1667	22.98307	-207.1836
U2_tRMS@AC侧 [V]	230.5421	23.19386	-207.3483
U3_tRMS@AC侧 [V]	230.7183	23.12153	-207.5968
P_t@AC侧 [W]	2288.870	0.092069	-2288.778



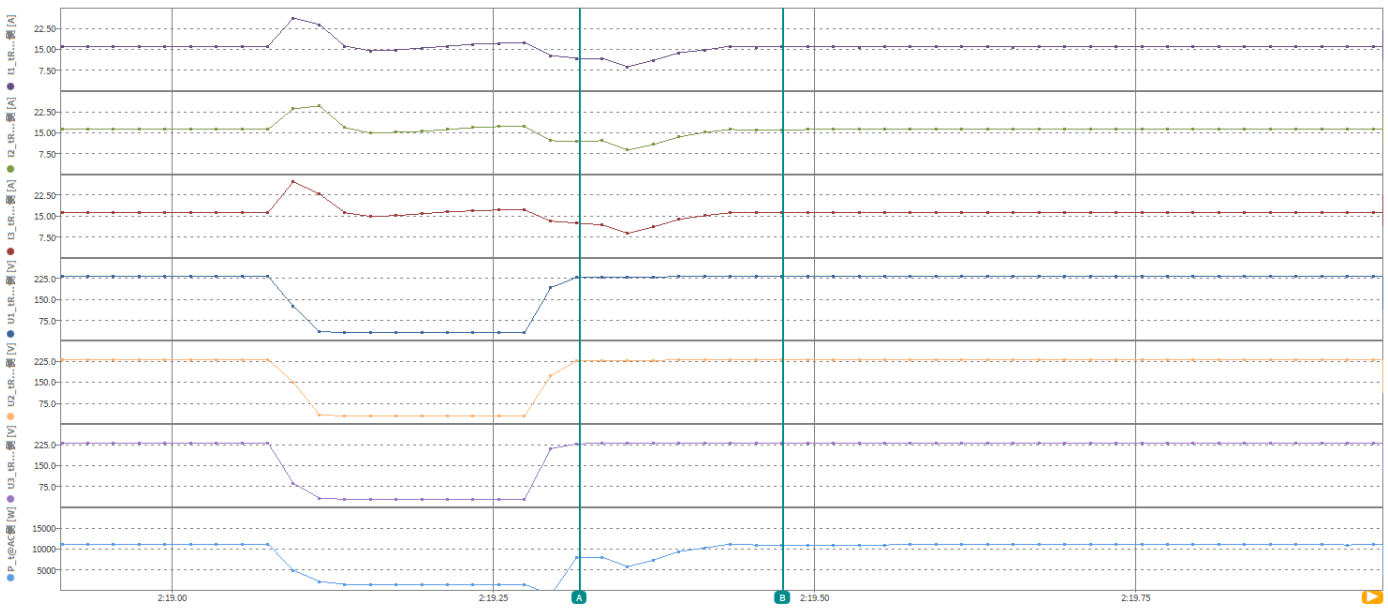
时间 [s]	A 00:14:27.2919203	B 00:14:27.4240799	间隔 0.1321597
I1_tRMS@AC侧 [A]	1.159418	3.531990	2.372573
I2_tRMS@AC侧 [A]	1.164401	3.575198	2.410797
I3_tRMS@AC侧 [A]	1.160361	3.405554	2.245193
U1_tRMS@AC侧 [V]	226.0220	229.2113	3.189270
U2_tRMS@AC侧 [V]	226.7713	229.4255	2.654251
U3_tRMS@AC侧 [V]	227.4999	231.2613	3.761444
P_t@AC侧 [W]	-2.465616	2287.119	2289.584

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Test 1s – three-phase symmetrical fault (V/V_n = 0,10; duration = 0,200 s) b: > 90 % * P_{SMAX}



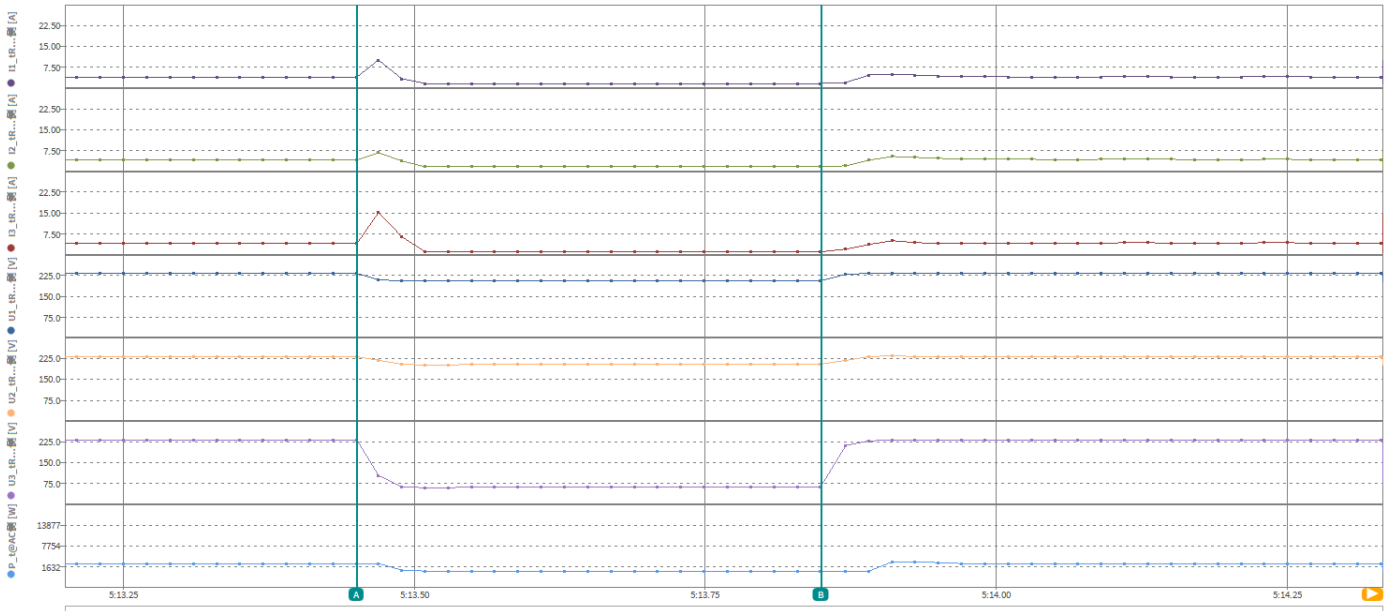
时间 [s]	A 2:19.0761326	B 2:19.2740816	间隔 0.1979490
I1_tRMS@AC侧 [A]	15.77787	16.89285	1.114985
I2_tRMS@AC侧 [A]	15.77221	16.77063	0.998424
I3_tRMS@AC侧 [A]	15.81003	16.86354	1.053508
U1_tRMS@AC侧 [V]	230.6665	24.00940	-206.6571
U2_tRMS@AC侧 [V]	230.8012	24.04601	-206.7552
U3_tRMS@AC侧 [V]	231.2131	24.14393	-207.0692
P_t@AC侧 [W]	10930.95	1211.280	-9719.665



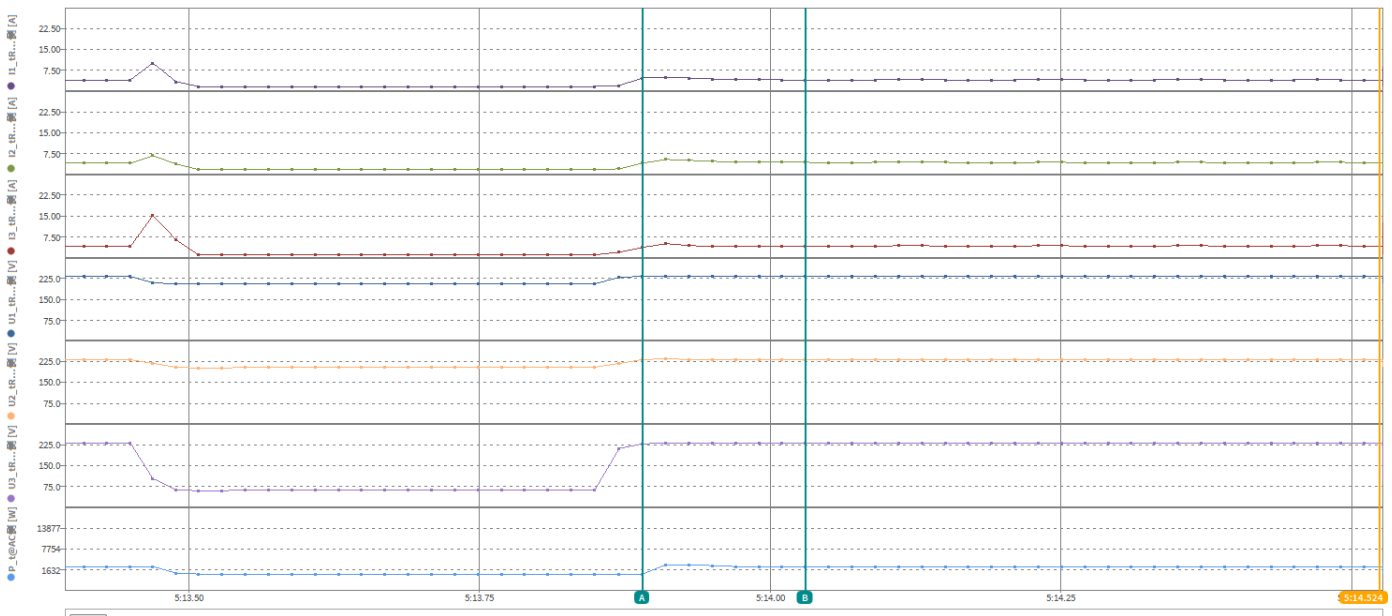
时间 [s]	A 2:19.3175036	B 2:19.4756005	间隔 0.1580969
I1_tRMS@AC侧 [A]	11.41188	15.68483	4.272949
I2_tRMS@AC侧 [A]	11.33015	15.65582	4.325672
I3_tRMS@AC侧 [A]	11.96932	15.69272	3.723395
U1_tRMS@AC侧 [V]	227.5266	230.2242	2.697540
U2_tRMS@AC侧 [V]	227.9297	230.3700	2.440216
U3_tRMS@AC侧 [V]	228.8944	231.7055	2.811081
P_t@AC侧 [W]	7800.644	10847.21	3046.564

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Test 2a – two-phase asymmetrical fault (V/V_n = 0,25; duration = 0,400 s) a: 10 % * P_{SMAX} ÷ 30 %



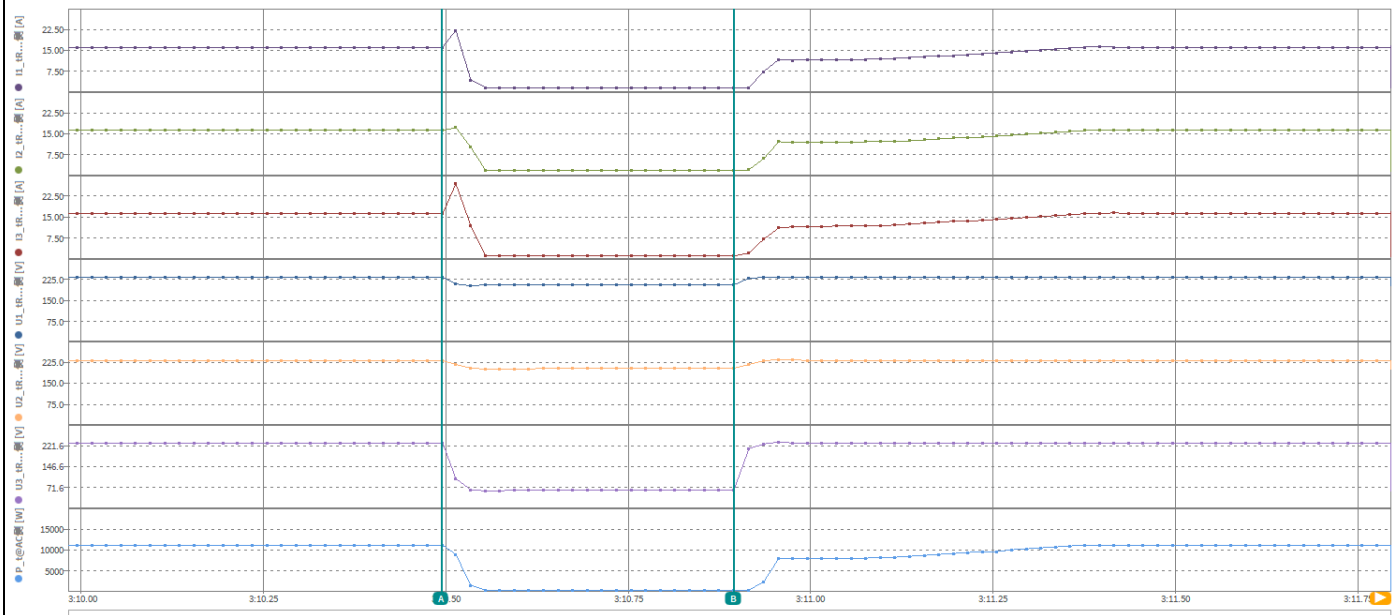
时间 [s]	A 5:13.4507950	B 5:13.8498117	间隔 0.3990167
I1_tRMS@AC侧 [A]	3.294419	1.033744	-2.260675
I2_tRMS@AC侧 [A]	3.296879	1.042022	-2.254857
I3_tRMS@AC侧 [A]	3.312560	0.299757	-3.012803
U1_tRMS@AC侧 [V]	230.2720	202.3024	-27.96959
U2_tRMS@AC侧 [V]	230.4749	203.2773	-27.19766
U3_tRMS@AC侧 [V]	230.8457	57.70207	-173.1436
P_t@AC侧 [W]	2277.919	-0.931607	-2278.851



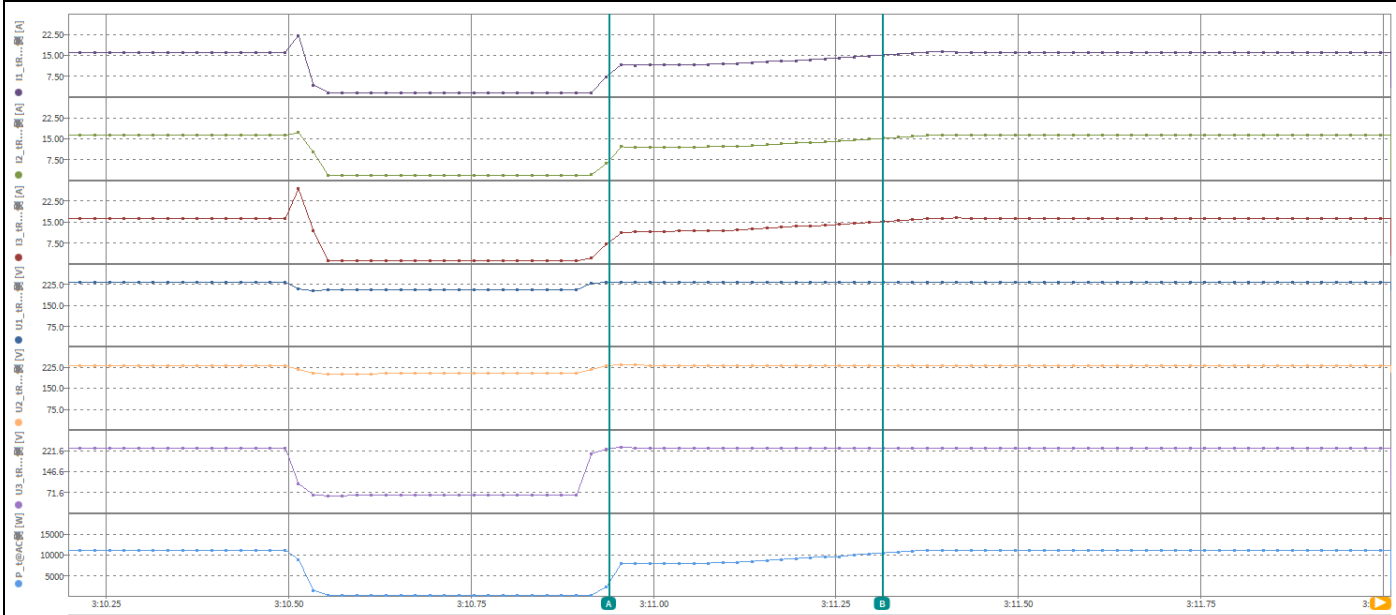
时间 [s]	A 5:13.8903656	B 5:14.0303432	间隔 0.1399776
I1_tRMS@AC侧 [A]	1.221549	3.600014	2.378465
I2_tRMS@AC侧 [A]	1.303712	3.794411	2.490699
I3_tRMS@AC侧 [A]	1.281150	3.572709	2.291559
U1_tRMS@AC侧 [V]	226.2703	230.1553	3.884995
U2_tRMS@AC侧 [V]	216.9795	231.1857	14.20627
U3_tRMS@AC侧 [V]	209.6163	231.3187	21.70241
P_t@AC侧 [W]	-119.7385	2270.730	2390.468

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Test 2a – two-phase asymmetrical fault (V/V_n = 0,25; duration = 0,400 s) b: > 90 % * P_{SMAX}



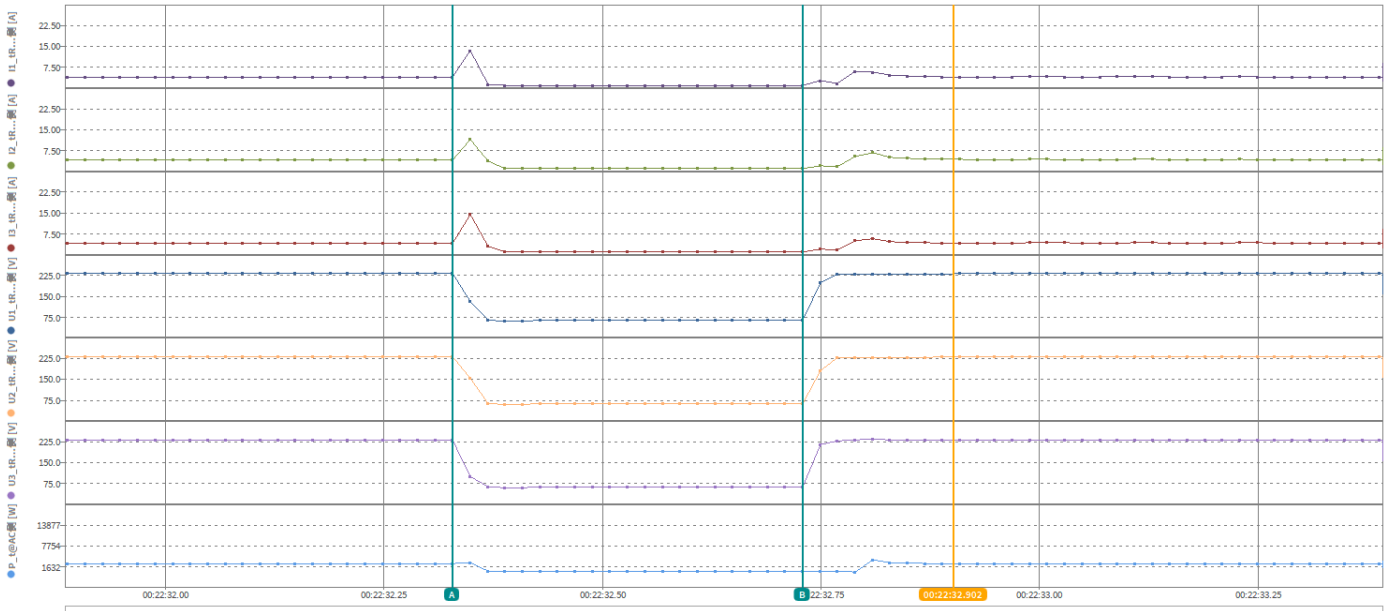
时间 [s]	A 3:10.494080	B 3:10.894792	间隔 0.400712
I1_tRMS@AC侧 [A]	15.77918	1.033056	-14.74612
I2_tRMS@AC侧 [A]	15.76396	1.041621	-14.72233
I3_tRMS@AC侧 [A]	15.80588	0.297781	-15.50810
U1_tRMS@AC侧 [V]	230.6045	202.1796	-28.42484
U2_tRMS@AC侧 [V]	230.8728	203.2397	-27.63310
U3_tRMS@AC侧 [V]	231.1736	57.64050	-173.5331
P_t@AC侧 [W]	10928.68	-0.785964	-10929.47



时间 [s]	A 3:10.939677	B 3:11.314141	间隔 0.374464
I1_tRMS@AC侧 [A]	6.807101	14.55096	7.743857
I2_tRMS@AC侧 [A]	5.659843	14.55239	8.892545
I3_tRMS@AC侧 [A]	6.631675	14.62322	7.991543
U1_tRMS@AC侧 [V]	230.4806	230.7835	0.302872
U2_tRMS@AC侧 [V]	230.8860	231.1205	0.234421
U3_tRMS@AC侧 [V]	229.1223	231.3246	2.202316
P_t@AC侧 [W]	2163.983	10006.57	7842.582

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Test 2s – three-phase symmetrical fault (V/V_n = 0,25; duration = 0,400 s) a: 10 % * P_{SMAX} ÷ 30 %



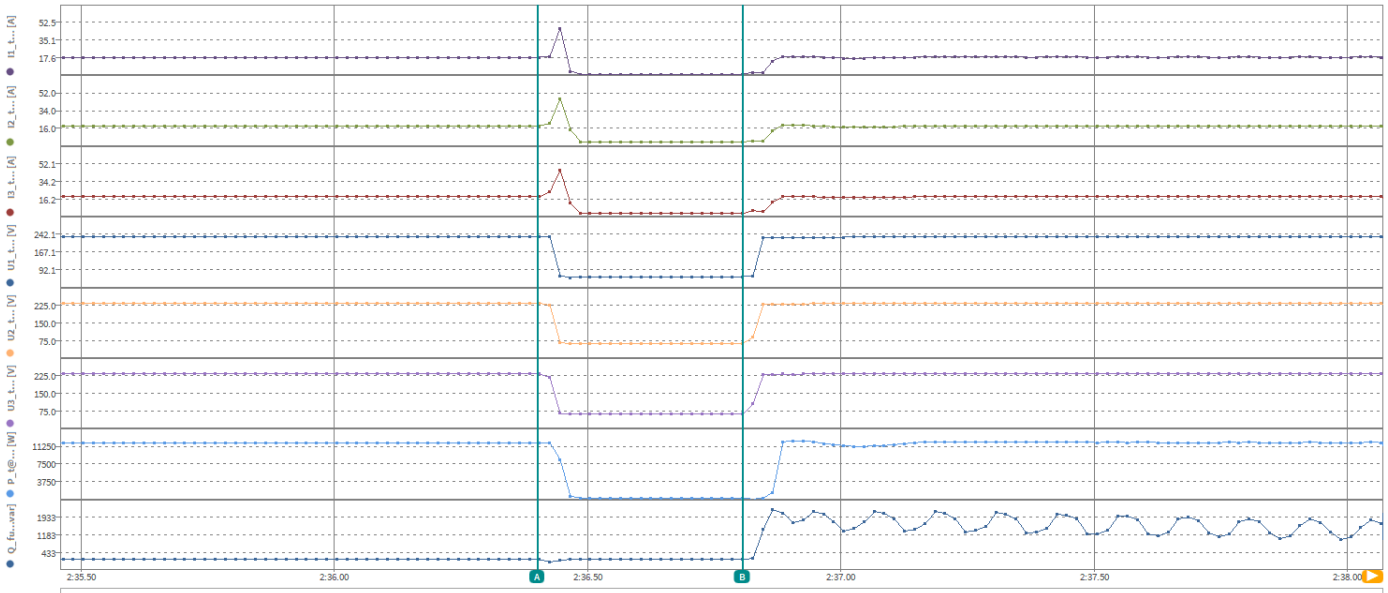
时间 [s]	A 00:22:32.328500	B 00:22:32.728960	间隔 0.400460
I1_tRMS@AC侧 [A]	3.308151	0.302196	-3.005955
I2_tRMS@AC侧 [A]	3.308494	0.307096	-3.001398
I3_tRMS@AC侧 [A]	3.322743	0.299562	-3.023181
U1_tRMS@AC侧 [V]	230.2010	57.55285	-172.6482
U2_tRMS@AC侧 [V]	230.5609	57.76920	-172.7917
U3_tRMS@AC侧 [V]	230.7527	57.65498	-173.0977
P_t@AC侧 [W]	2285.752	-0.026607	-2285.778



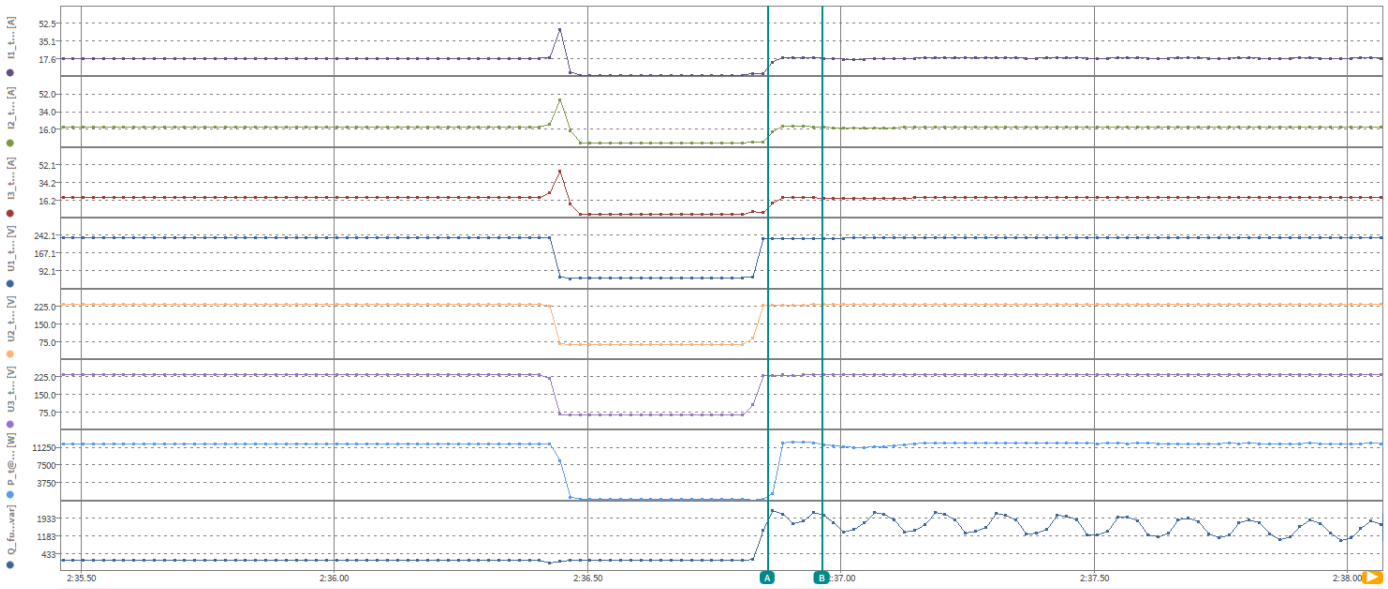
时间 [s]	A 00:22:32.787972	B 00:22:32.898206	间隔 0.110235
I1_tRMS@AC侧 [A]	1.184583	3.612078	2.427494
I2_tRMS@AC侧 [A]	1.189116	3.725361	2.536245
I3_tRMS@AC侧 [A]	1.184368	3.574302	2.389934
U1_tRMS@AC侧 [V]	227.4382	229.2032	1.764969
U2_tRMS@AC侧 [V]	227.6411	229.4422	1.801102
U3_tRMS@AC侧 [V]	228.2262	231.3733	3.147125
P_t@AC侧 [W]	-55.41264	2279.678	2335.091

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Test 2s – three-phase symmetrical fault (V/V_n = 0,25; duration = 0,400 s) b: > 90 % * P_{SMAX}



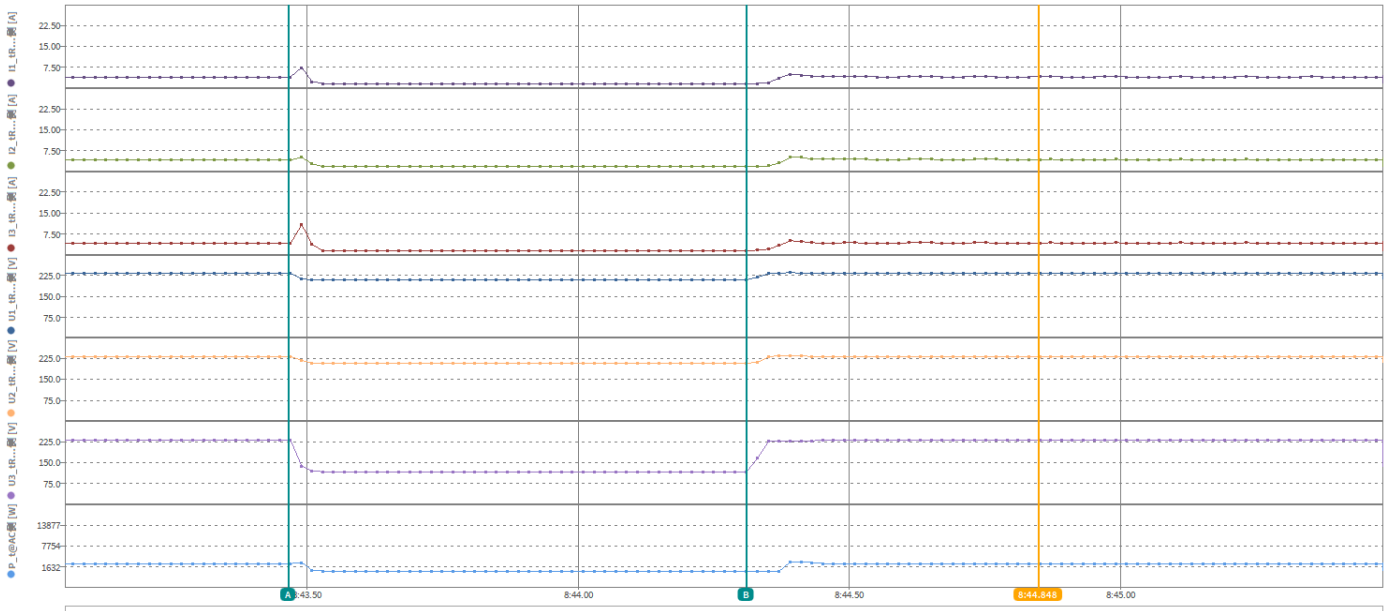
时间 [s]	A 2:36.401914	B 2:36.806465	间隔 0.404550
I1_tRMS@AC侧 [A]	17.39796	0.528082	-16.86988
I2_tRMS@AC侧 [A]	17.34242	0.532254	-16.81017
I3_tRMS@AC侧 [A]	17.39468	0.521082	-16.87359
U1_tRMS@AC侧 [V]	230.4373	57.12190	-173.3154
U2_tRMS@AC侧 [V]	230.6207	57.06956	-173.5511
U3_tRMS@AC侧 [V]	230.9425	57.16951	-173.7730
P_t@AC侧 [W]	12022.37	-0.289652	-12022.65
Q_fund@AC侧 [var]	87.97359	86.88966	-1.083931



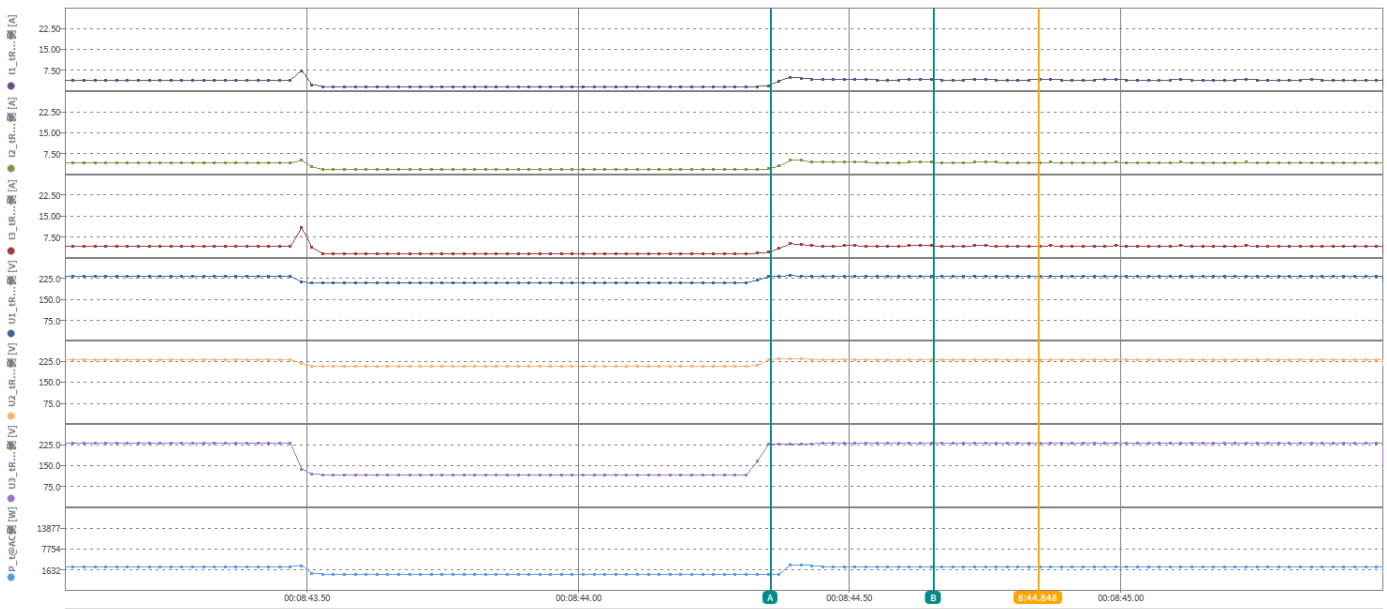
时间 [s]	A 2:36.856341	B 2:36.963482	间隔 0.107141
I1_tRMS@AC侧 [A]	2.067740	17.91769	15.84995
I2_tRMS@AC侧 [A]	2.078489	17.85779	15.77930
I3_tRMS@AC侧 [A]	2.013531	17.62784	15.61431
U1_tRMS@AC侧 [V]	227.8105	229.5192	1.708740
U2_tRMS@AC侧 [V]	227.0517	229.5576	2.505875
U3_tRMS@AC侧 [V]	227.9122	230.0407	2.128510
P_t@AC侧 [W]	-28.20419	12062.89	12091.10
Q_fund@AC侧 [var]	1387.990	2154.365	766.3743

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Test 3a – two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) a: 10 % * P_{SMAX} ÷ 30 %



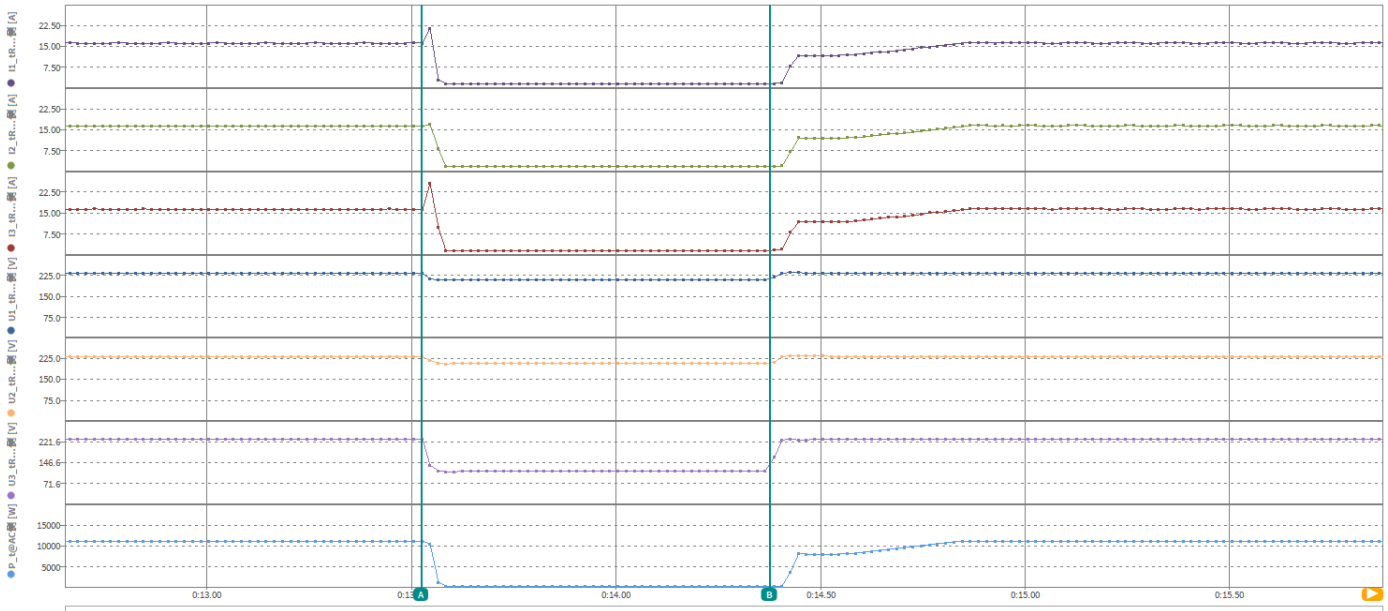
时间 [s]	A 8:43.466893	B 8:44.310150	间隔 0.843257
I1_tRMS@AC侧 [A]	3.292643	1.056888	-2.235754
I2_tRMS@AC侧 [A]	3.287735	1.065374	-2.222362
I3_tRMS@AC侧 [A]	3.308573	0.589777	-2.718795
U1_tRMS@AC侧 [V]	230.1888	206.8700	-23.31882
U2_tRMS@AC侧 [V]	230.4798	207.7734	-22.70634
U3_tRMS@AC侧 [V]	230.7962	115.2694	-115.5269
P_t@AC侧 [W]	2273.972	-1.070449	-2275.043



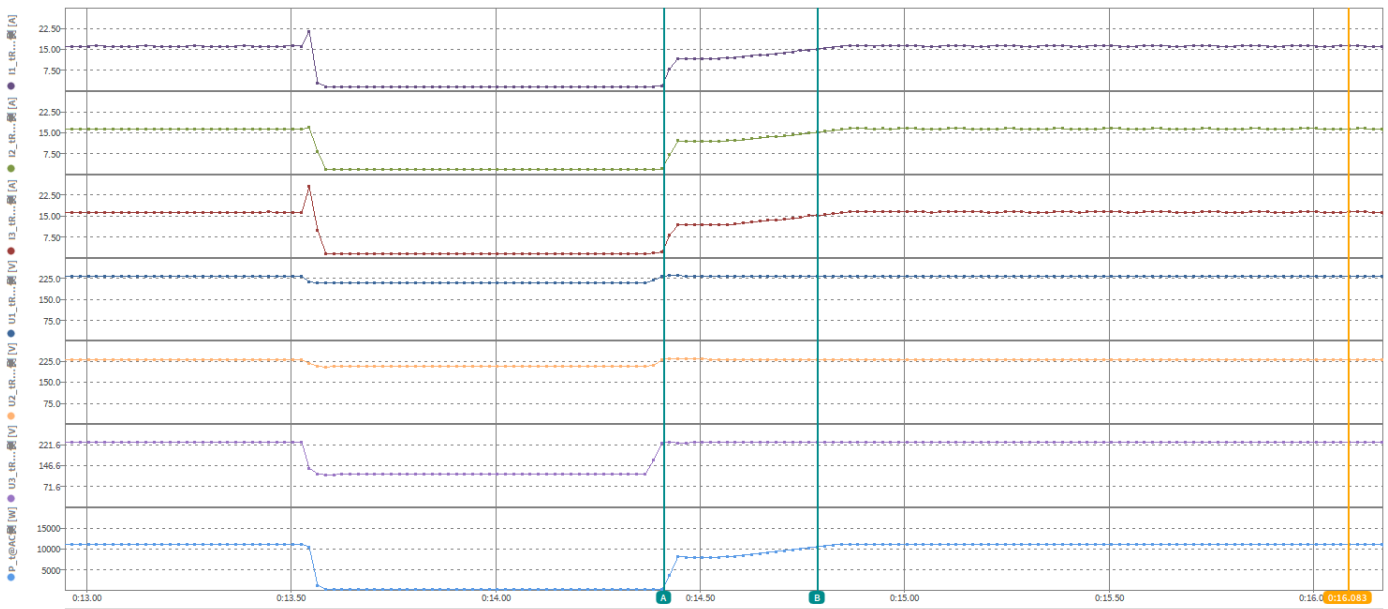
时间 [s]	A 8:44.354985	B 8:44.655040	间隔 0.300055
I1_tRMS@AC侧 [A]	1.233194	3.625244	2.392051
I2_tRMS@AC侧 [A]	1.232186	3.673812	2.441626
I3_tRMS@AC侧 [A]	1.225415	3.628875	2.403459
U1_tRMS@AC侧 [V]	229.6789	230.2604	0.581436
U2_tRMS@AC侧 [V]	230.0667	230.5910	0.524307
U3_tRMS@AC侧 [V]	228.9958	230.7209	1.725052
P_t@AC侧 [W]	-90.20517	2293.090	2383.295

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Test 3a – two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) b: > 90 % * P_{SMAX}



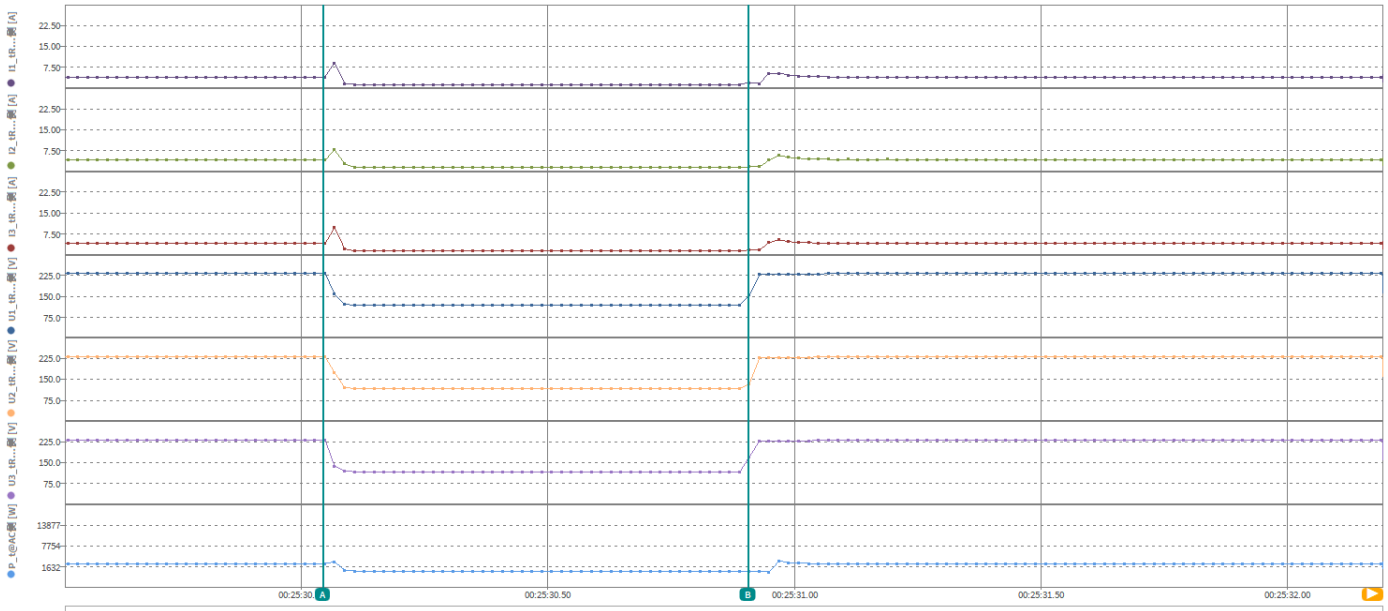
时间 [s]	A 0:13.525220	B 0:14.376228	间隔 0.851008
I1_tRMS@AC侧 [A]	16.07228	1.057343	-15.01494
I2_tRMS@AC侧 [A]	15.90955	1.065158	-14.84439
I3_tRMS@AC侧 [A]	15.94939	0.590273	-15.35912
U1_tRMS@AC侧 [V]	230.6618	206.9509	-23.71091
U2_tRMS@AC侧 [V]	230.9146	207.8505	-23.06413
U3_tRMS@AC侧 [V]	231.2020	115.2343	-115.9677
P_t@AC侧 [W]	11063.15	-1.171153	-11064.33



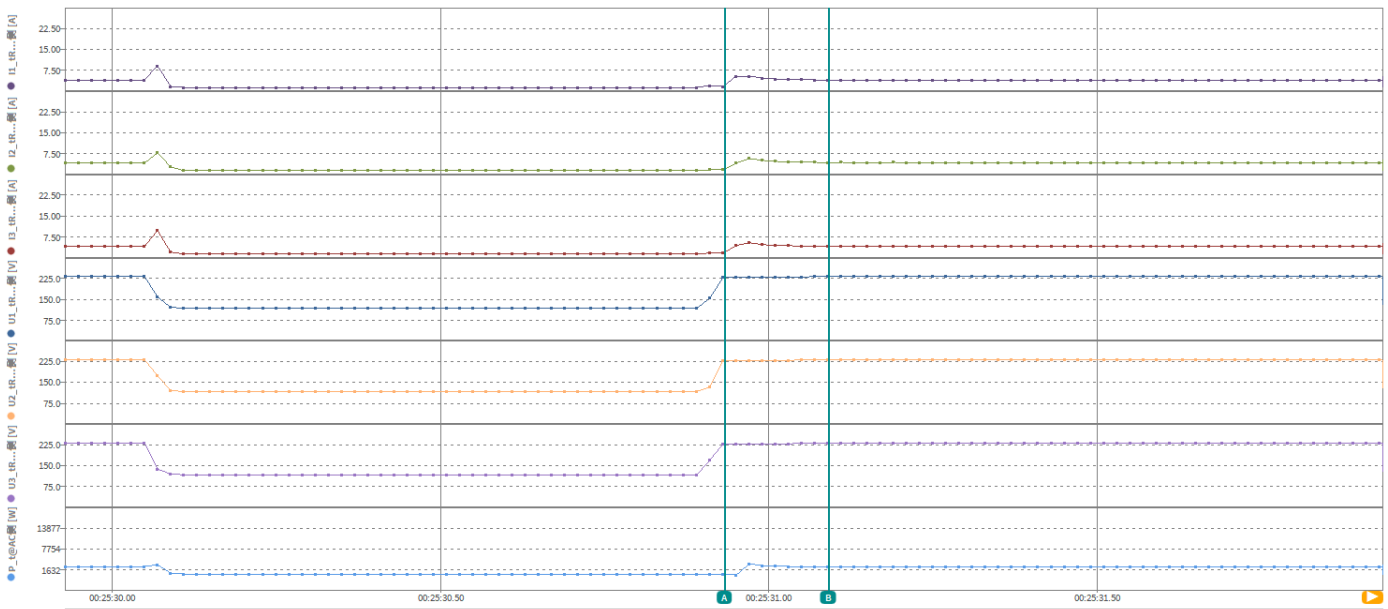
时间 [s]	A 0:14.412831	B 0:14.787132	间隔 0.374301
I1_tRMS@AC侧 [A]	1.257892	14.60772	13.34982
I2_tRMS@AC侧 [A]	1.258413	14.59460	13.33618
I3_tRMS@AC侧 [A]	1.247109	14.65694	13.40984
U1_tRMS@AC侧 [V]	229.6521	230.8505	1.198334
U2_tRMS@AC侧 [V]	230.0764	231.0722	0.995804
U3_tRMS@AC侧 [V]	228.9299	231.2769	2.347061
P_t@AC侧 [W]	-108.6093	10036.62	10145.23

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Test 3s – three-phase symmetrical fault (V/V_n = 0,50; duration = 0,850 s) a: 10 % * P_{SMAX} ÷ 30 %



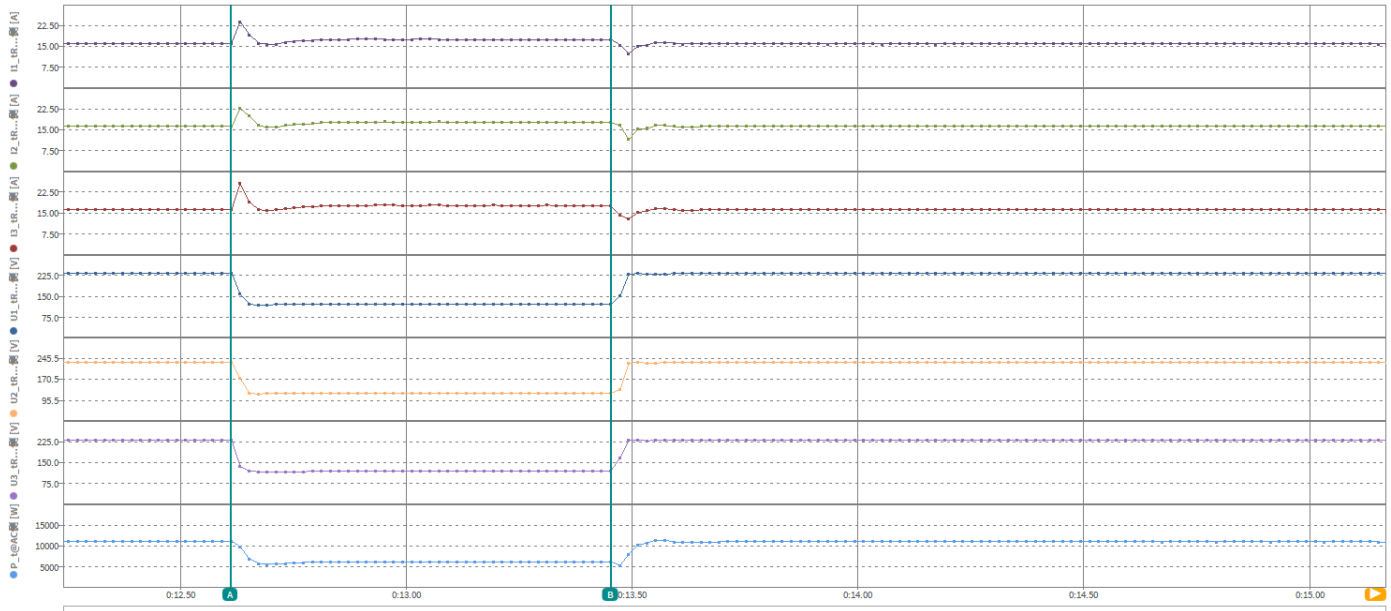
时间 [s]	A 00:25:30.045631	B 00:25:30.906822	间隔 0.861191
I1_tRMS@AC侧 [A]	3.305342	0.592389	-2.712953
I2_tRMS@AC侧 [A]	3.298685	0.595180	-2.703504
I3_tRMS@AC侧 [A]	3.320769	0.590040	-2.730729
U1_tRMS@AC侧 [V]	230.2230	115.1542	-115.0688
U2_tRMS@AC侧 [V]	230.5871	115.3414	-115.2457
U3_tRMS@AC侧 [V]	230.8109	115.3246	-115.4863
P_t@AC侧 [W]	2282.746	-0.400177	-2283.146



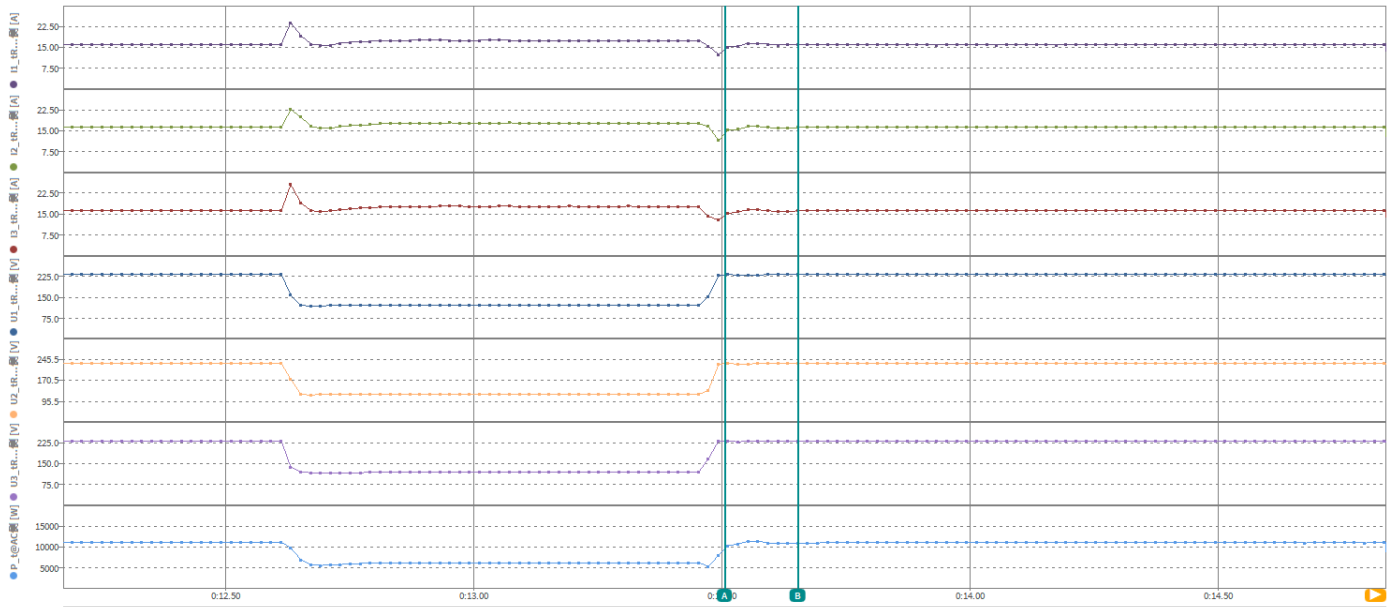
时间 [s]	A 00:25:30.933461	B 00:25:31.091407	间隔 0.157946
I1_tRMS@AC侧 [A]	1.201506	3.609650	2.408144
I2_tRMS@AC侧 [A]	1.204227	3.662425	2.458198
I3_tRMS@AC侧 [A]	1.198290	3.574879	2.376589
U1_tRMS@AC侧 [V]	228.0798	229.4761	1.396347
U2_tRMS@AC侧 [V]	228.5391	229.6805	1.141403
U3_tRMS@AC侧 [V]	228.9971	230.0296	1.032501
P_t@AC侧 [W]	-68.88940	2298.667	2367.556

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Test 3s – three-phase symmetrical fault (V/V_n = 0,50; duration = 0,850 s) b: > 90 % * P_{SMAX}



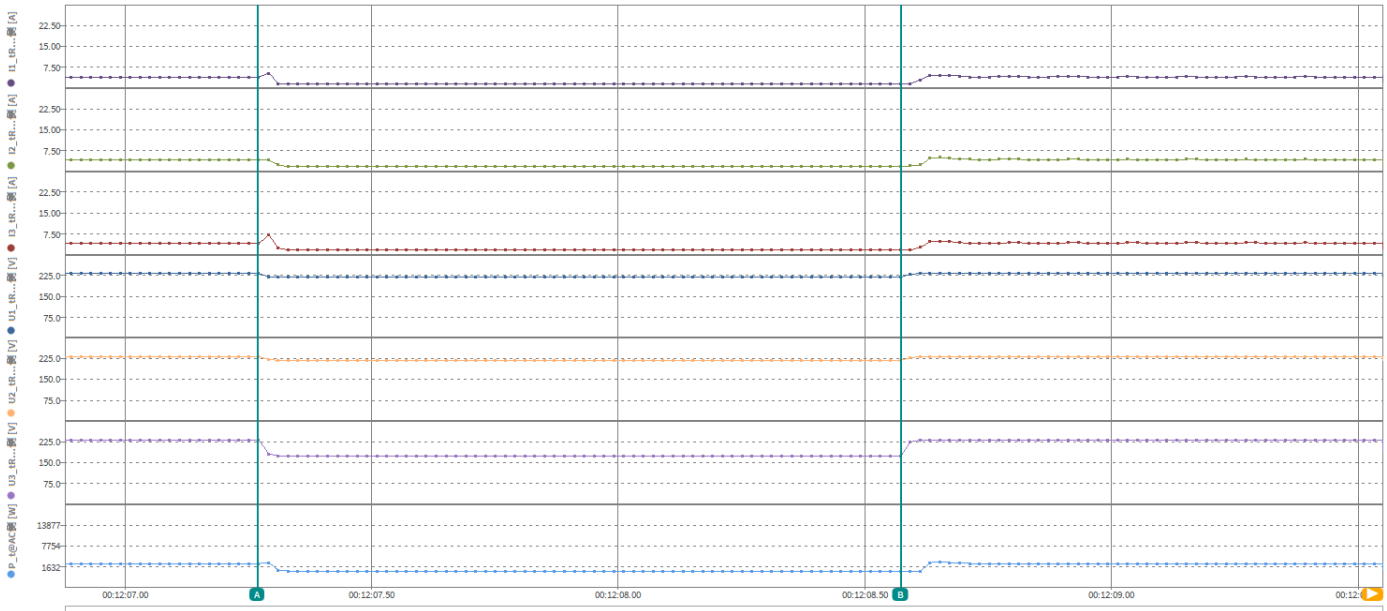
时间 [s]	A 0:12.611593	B 0:13.452958	间隔 0.841365
I1_tRMS@AC侧 [A]	15.78145	17.31456	1.533114
I2_tRMS@AC侧 [A]	15.77611	17.39381	1.617703
I3_tRMS@AC侧 [A]	15.81600	17.41326	1.597253
U1_tRMS@AC侧 [V]	230.6721	115.7908	-114.8813
U2_tRMS@AC侧 [V]	230.9066	115.9352	-114.9715
U3_tRMS@AC侧 [V]	231.2792	116.0284	-115.2509
P_t@AC侧 [W]	10937.10	6028.830	-4908.272



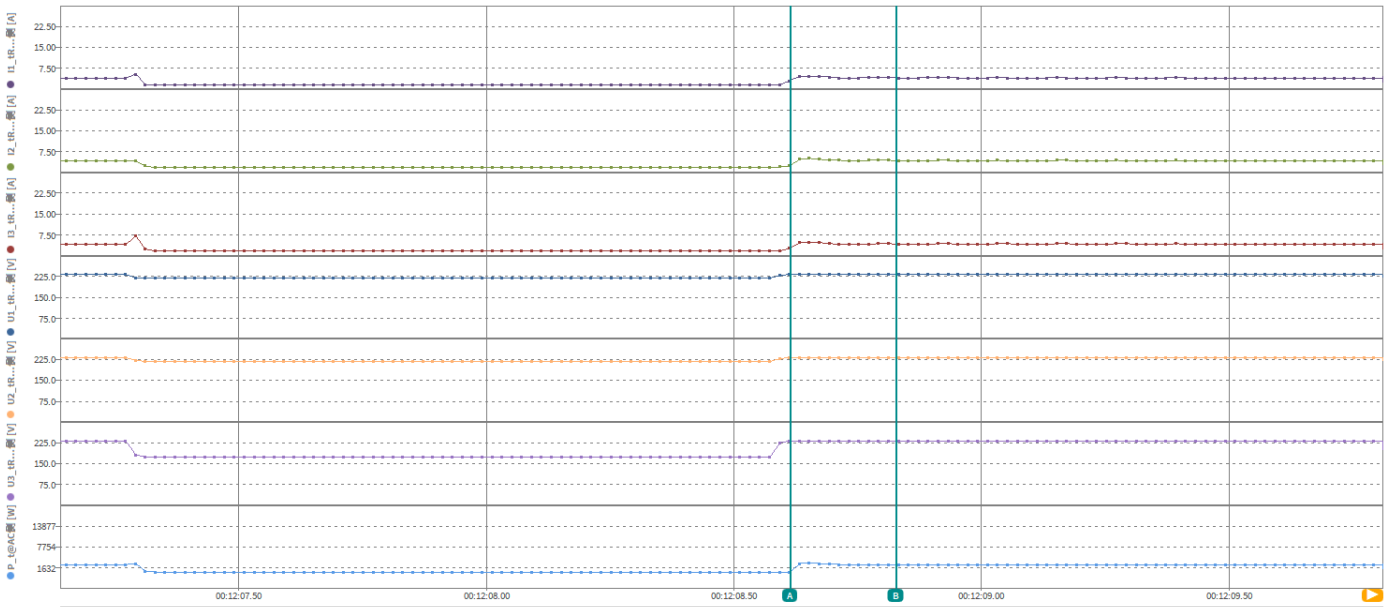
时间 [s]	A 0:13.506839	B 0:13.653974	间隔 0.147135
I1_tRMS@AC侧 [A]	12.06433	15.74658	3.682250
I2_tRMS@AC侧 [A]	11.00294	15.63147	4.628527
I3_tRMS@AC侧 [A]	12.45568	15.68756	3.231881
U1_tRMS@AC侧 [V]	228.1738	230.1967	2.022903
U2_tRMS@AC侧 [V]	228.3939	230.3629	1.968994
U3_tRMS@AC侧 [V]	229.3284	230.7910	1.462570
P_t@AC侧 [W]	7829.113	10818.65	2989.541

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Test 4a – two-phase asymmetrical fault (V/V_n = 0,75; duration = 1,300 s) a: 10 % * P_{SMAX} ÷ 30 %



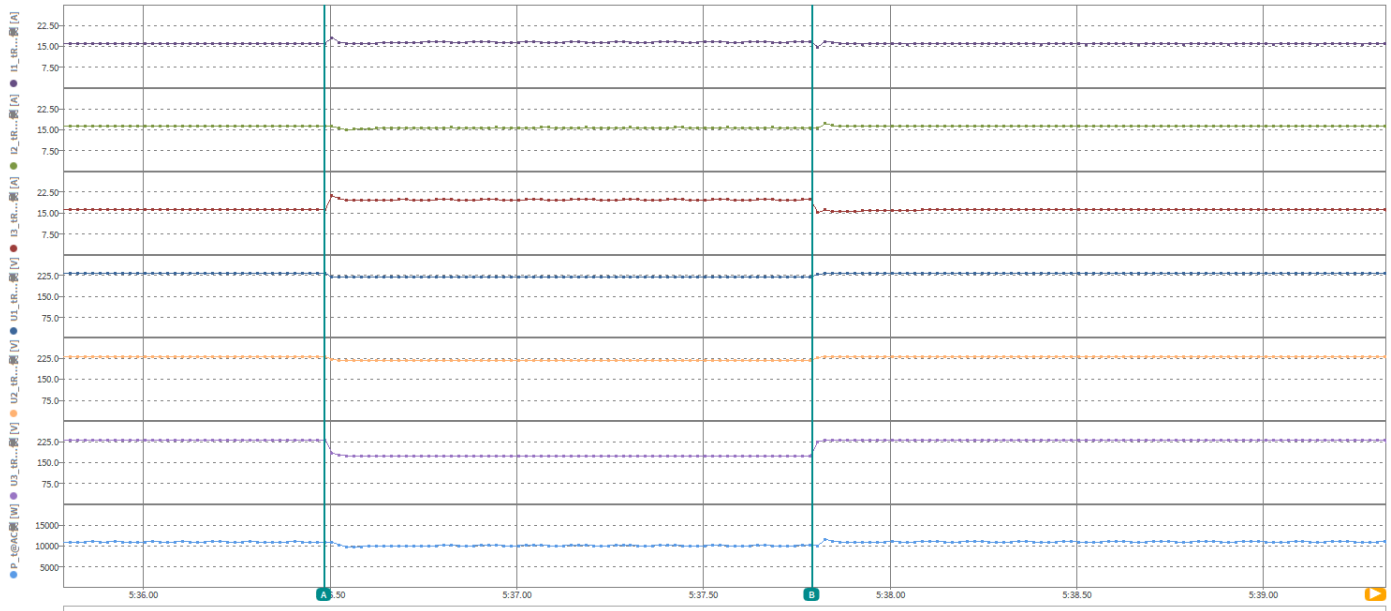
时间 [s]	A 00:12:07.269908	B 00:12:08.573076	间隔 1.303168
I1_tRMS@AC侧 [A]	3.303346	1.107451	-2.195895
I2_tRMS@AC侧 [A]	3.297634	1.113672	-2.183961
I3_tRMS@AC侧 [A]	3.310486	0.880101	-2.430385
U1_tRMS@AC侧 [V]	230.2258	216.2151	-14.01068
U2_tRMS@AC侧 [V]	230.5465	216.9133	-13.63324
U3_tRMS@AC侧 [V]	230.8337	173.0124	-57.82132
P_t@AC侧 [W]	2279.795	-1.696632	-2281.491



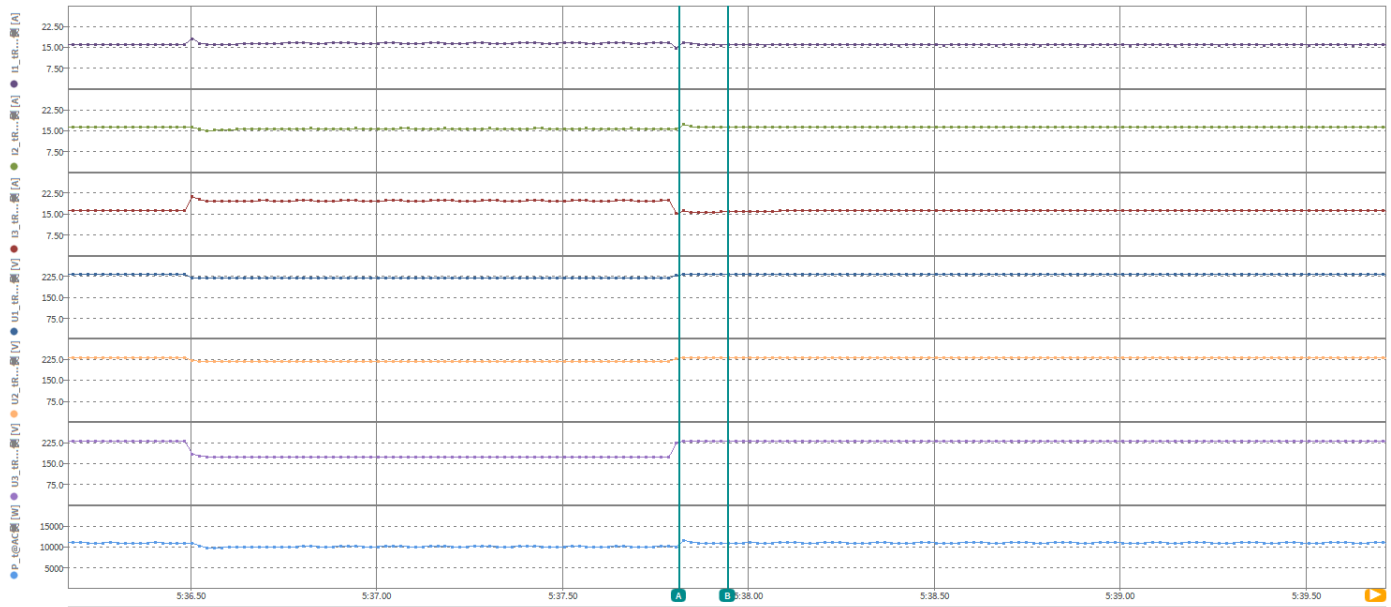
时间 [s]	A 00:12:08.614037	B 00:12:08.827628	间隔 0.213591
I1_tRMS@AC侧 [A]	1.194660	3.644544	2.449884
I2_tRMS@AC侧 [A]	1.283506	3.710128	2.426623
I3_tRMS@AC侧 [A]	1.163573	3.681785	2.518212
U1_tRMS@AC侧 [V]	227.8850	230.2216	2.336639
U2_tRMS@AC侧 [V]	226.5432	230.5300	3.986816
U3_tRMS@AC侧 [V]	223.6564	230.8955	7.239044
P_t@AC侧 [W]	-84.87287	2294.644	2379.517

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Test 4a – two-phase asymmetrical fault (V/V_n = 0,75; duration = 1,300 s) b: > 90 % * P_{SMAX}



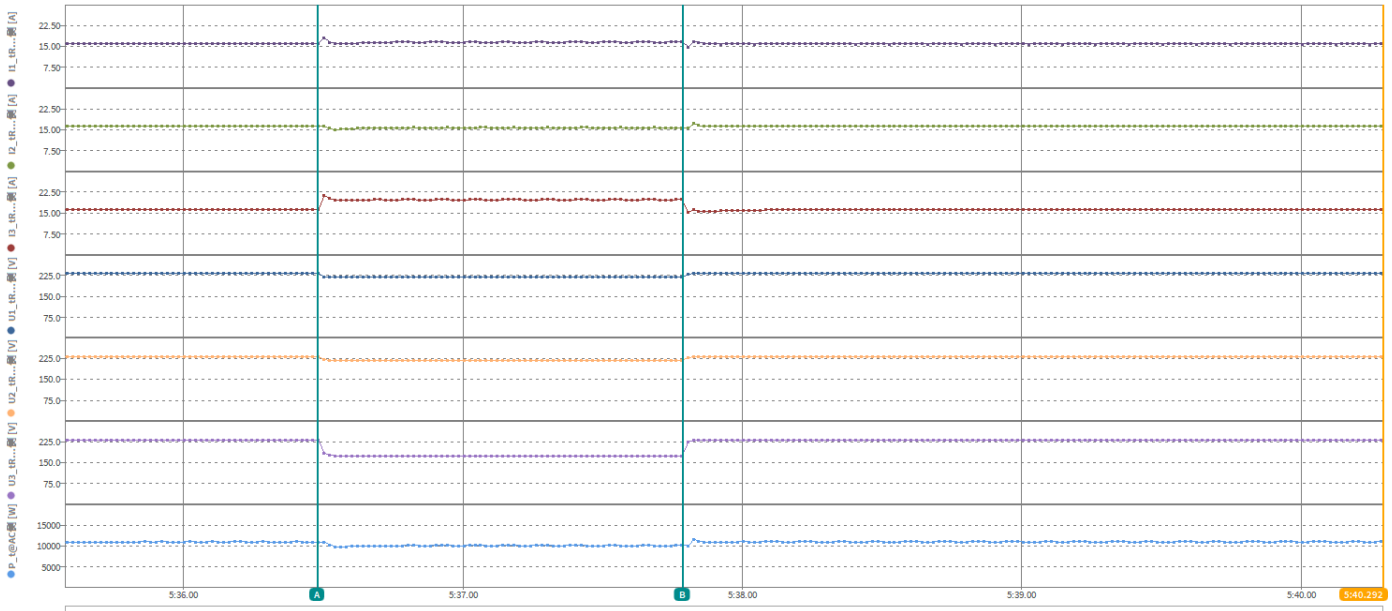
时间 [s]	A 5:36.485512	B 5:37.791535	间隔 1.306023
I1_tRMS@AC侧 [A]	15.75706	16.48276	0.725691
I2_tRMS@AC侧 [A]	15.74302	15.30705	-0.435962
I3_tRMS@AC侧 [A]	15.79059	19.54558	3.754993
U1_tRMS@AC侧 [V]	230.6180	216.8131	-13.80489
U2_tRMS@AC侧 [V]	230.8902	217.2984	-13.59181
U3_tRMS@AC侧 [V]	231.1779	173.7102	-57.46770
P_t@AC侧 [W]	10915.04	10028.28	-886.7637



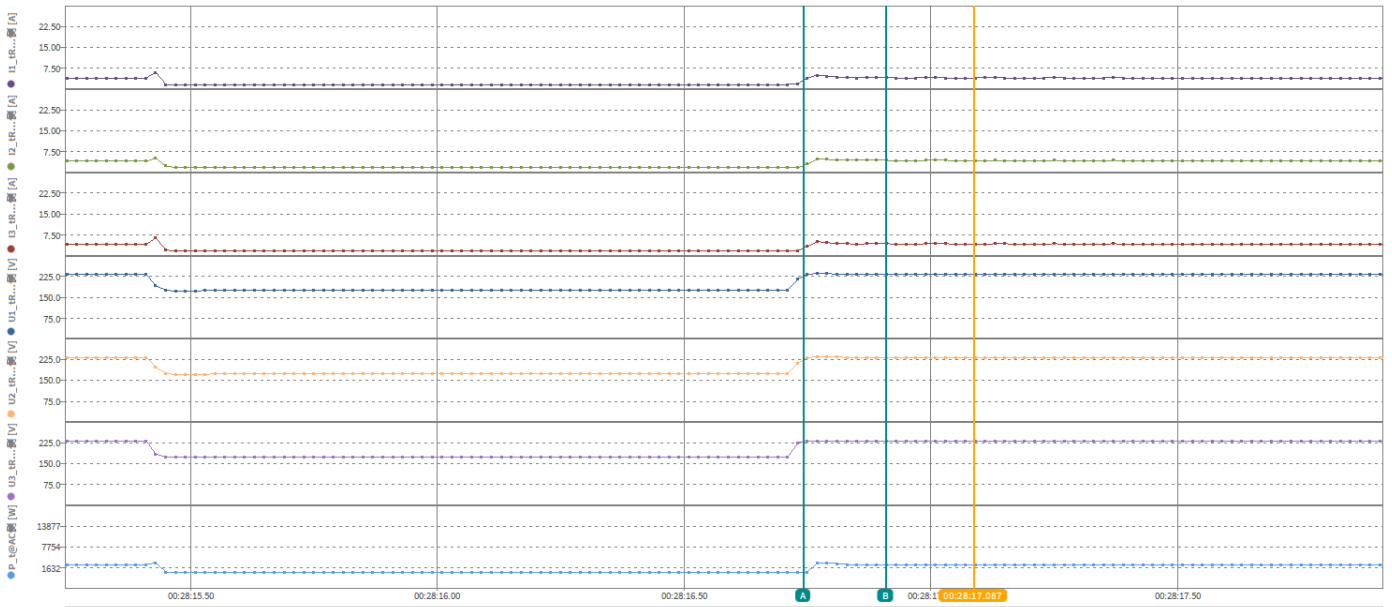
时间 [s]	A 5:37.814183	B 5:37.945037	间隔 0.130854
I1_tRMS@AC侧 [A]	14.37293	15.62066	1.247728
I2_tRMS@AC侧 [A]	15.09997	15.90816	0.808191
I3_tRMS@AC侧 [A]	14.78865	15.38499	0.596344
U1_tRMS@AC侧 [V]	228.0663	230.4399	2.373535
U2_tRMS@AC侧 [V]	227.0240	231.1848	4.160767
U3_tRMS@AC侧 [V]	223.6483	231.4156	7.767288
P_t@AC侧 [W]	9885.941	10830.96	945.0215

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Test 4s – three-phase symmetrical fault (V/V_n = 0,75; duration = 1,300 s) a: 10 % * P_{SMAX} ÷ 30 %



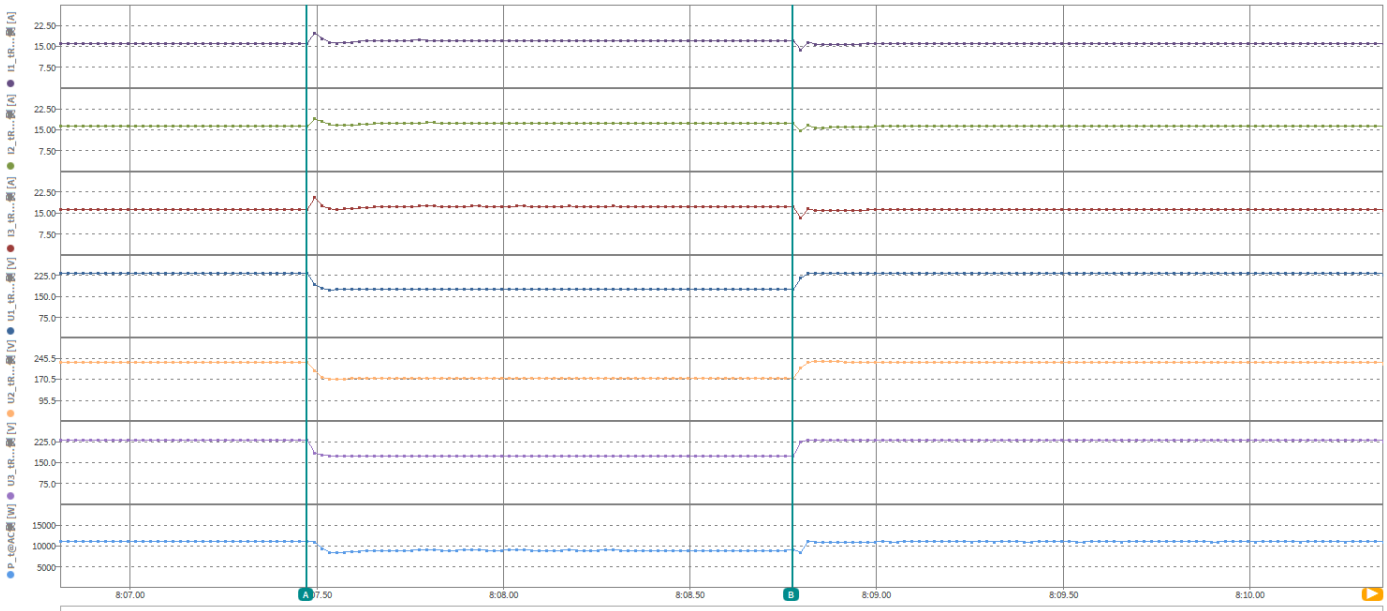
时间 [s]	A 5:36.480570	B 5:37.786820	间隔 1.306249
I1_tRMS@AC侧 [A]	15.75706	16.48629	0.729221
I2_tRMS@AC侧 [A]	15.74302	15.27732	-0.465692
I3_tRMS@AC侧 [A]	15.79059	19.53031	3.739721
U1_tRMS@AC侧 [V]	230.6180	216.8571	-13.76096
U2_tRMS@AC侧 [V]	230.8902	217.3940	-13.49619
U3_tRMS@AC侧 [V]	231.1779	173.7699	-57.40804
P_t@AC侧 [W]	10915.04	10020.41	-894.6299



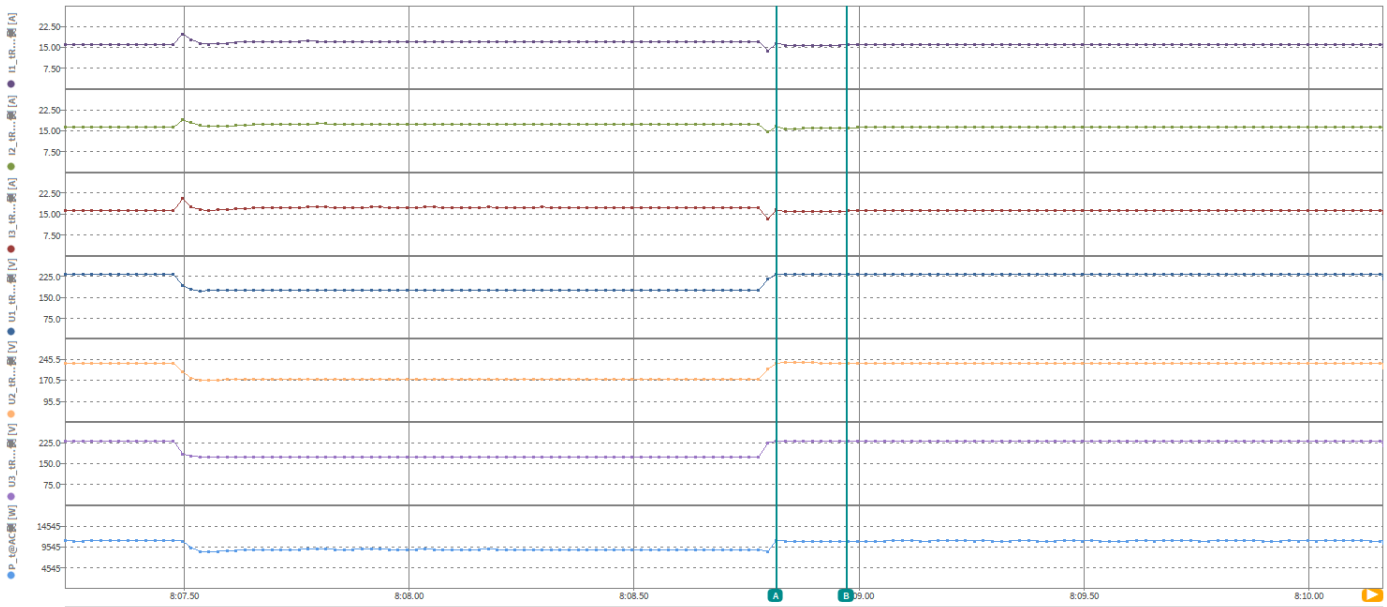
时间 [s]	A 00:28:16.742346	B 00:28:16.909273	间隔 0.166927
I1_tRMS@AC侧 [A]	1.245731	3.648812	2.403082
I2_tRMS@AC侧 [A]	1.188545	3.662986	2.474442
I3_tRMS@AC侧 [A]	1.174474	3.669142	2.494668
U1_tRMS@AC侧 [V]	215.4470	230.8569	15.40985
U2_tRMS@AC侧 [V]	209.0671	231.3387	22.27165
U3_tRMS@AC侧 [V]	223.5547	231.0088	7.454102
P_t@AC侧 [W]	-87.14560	2295.679	2382.825

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Test 4s – three-phase symmetrical fault (V/V_n = 0,75; duration = 1,300 s) b: > 90 % * P_{SMAX}



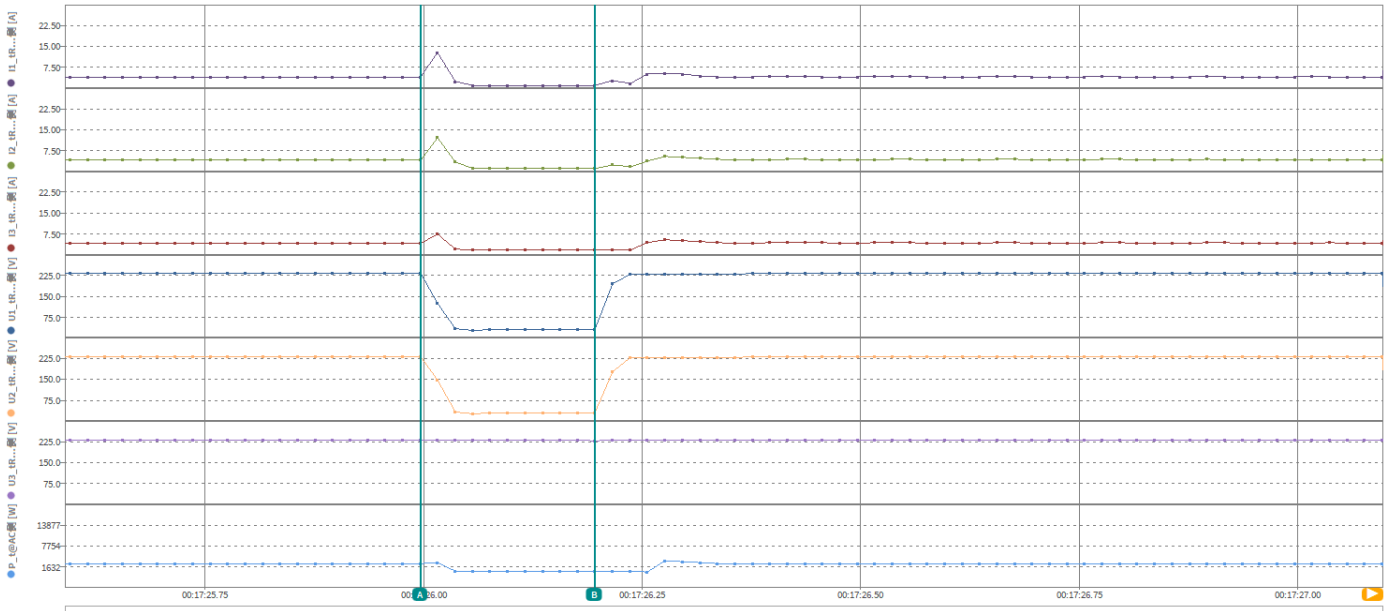
时间 [s]	A 8:07.473462	B 8:08.773424	间隔 1.299962
I1_tRMS@AC侧 [A]	15.77305	17.01372	1.240666
I2_tRMS@AC侧 [A]	15.75369	16.99874	1.245053
I3_tRMS@AC侧 [A]	15.80441	17.05334	1.248933
U1_tRMS@AC侧 [V]	230.6747	173.2929	-57.38184
U2_tRMS@AC侧 [V]	230.8578	173.4520	-57.40585
U3_tRMS@AC侧 [V]	231.2153	173.6407	-57.57468
P_t@AC侧 [W]	10925.55	8848.519	-2077.034



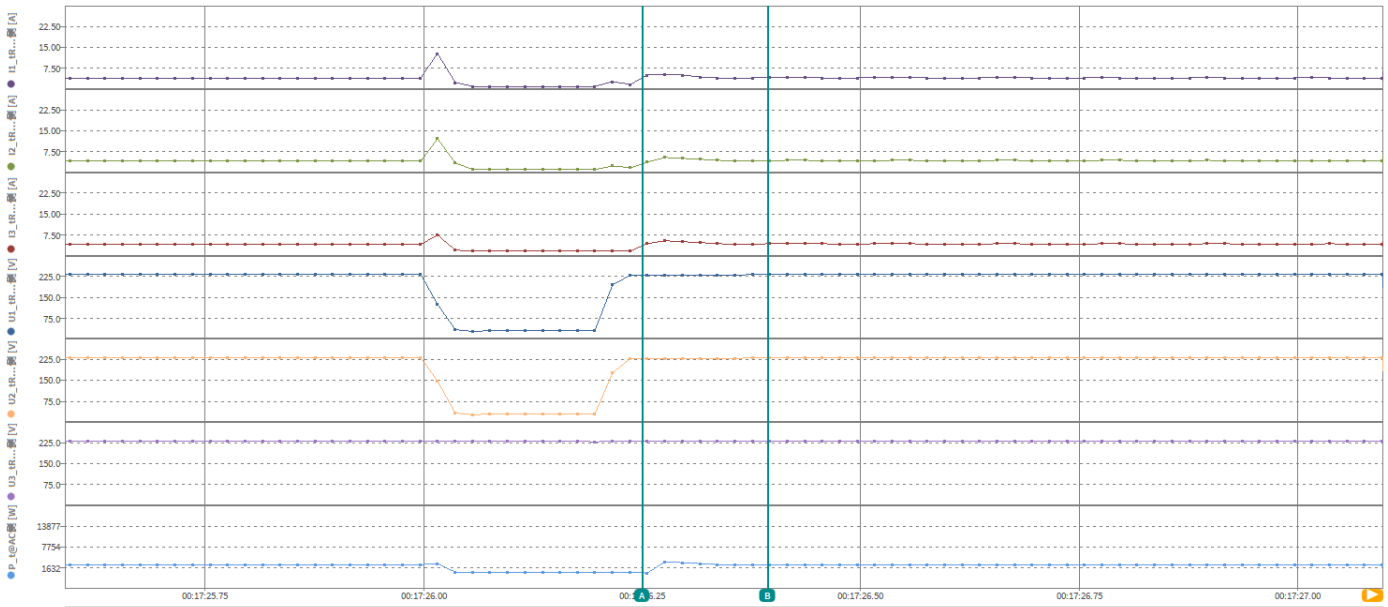
时间 [s]	A 8:08.815704	B 8:08.972642	间隔 0.156938
I1_tRMS@AC侧 [A]	13.38463	15.65464	2.270012
I2_tRMS@AC侧 [A]	14.28127	15.62661	1.345337
I3_tRMS@AC侧 [A]	12.77653	15.68814	2.911603
U1_tRMS@AC侧 [V]	215.2227	231.0999	15.87724
U2_tRMS@AC侧 [V]	209.0624	231.6596	22.59718
U3_tRMS@AC侧 [V]	223.4596	231.4075	7.947906
P_t@AC侧 [W]	8381.675	10865.13	2483.459

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Test 5 – LV two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) a: 10 % * P_{SMAX} ÷ 30 %



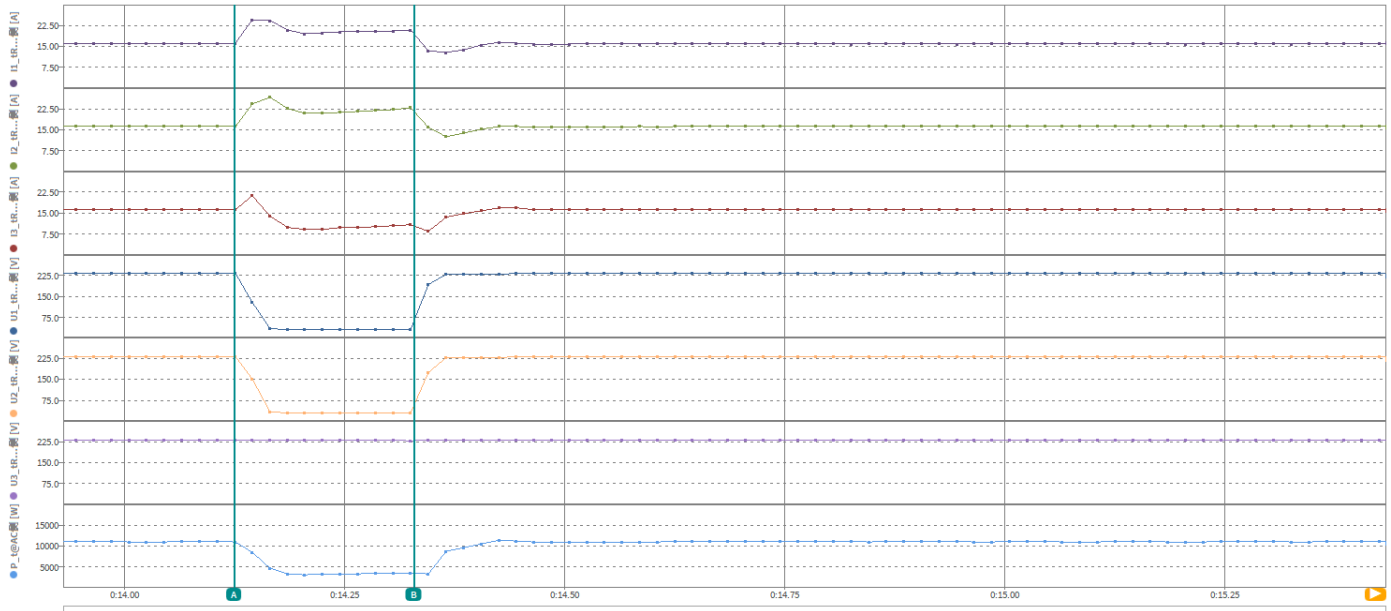
时间 [s]	A 00:17:25.996865	B 00:17:26.196024	间隔 0.199159
I1_tRMS@AC侧 [A]	3.294635	0.344976	-2.949659
I2_tRMS@AC侧 [A]	3.298857	0.342863	-2.955994
I3_tRMS@AC侧 [A]	3.306645	0.931130	-2.375515
U1_tRMS@AC侧 [V]	230.2219	23.26309	-206.9588
U2_tRMS@AC侧 [V]	230.5074	23.10338	-207.4041
U3_tRMS@AC侧 [V]	230.7731	229.9905	-0.782593
P_t@AC侧 [W]	2276.984	-0.341209	-2277.325



时间 [s]	A 00:17:26.250632	B 00:17:26.394113	间隔 0.143480
I1_tRMS@AC侧 [A]	1.191772	3.512093	2.320321
I2_tRMS@AC侧 [A]	1.204233	3.500483	2.296250
I3_tRMS@AC侧 [A]	1.203358	3.552514	2.349156
U1_tRMS@AC侧 [V]	226.0313	229.4216	3.390289
U2_tRMS@AC侧 [V]	226.6246	229.6017	2.977097
U3_tRMS@AC侧 [V]	230.3949	230.8618	0.466904
P_t@AC侧 [W]	-69.84544	2282.402	2352.248

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Test 5 – LV two-phase asymmetrical fault (V/V_n = 0,10; duration = 0,200 s) b: > 90 % * P_{SMAX}



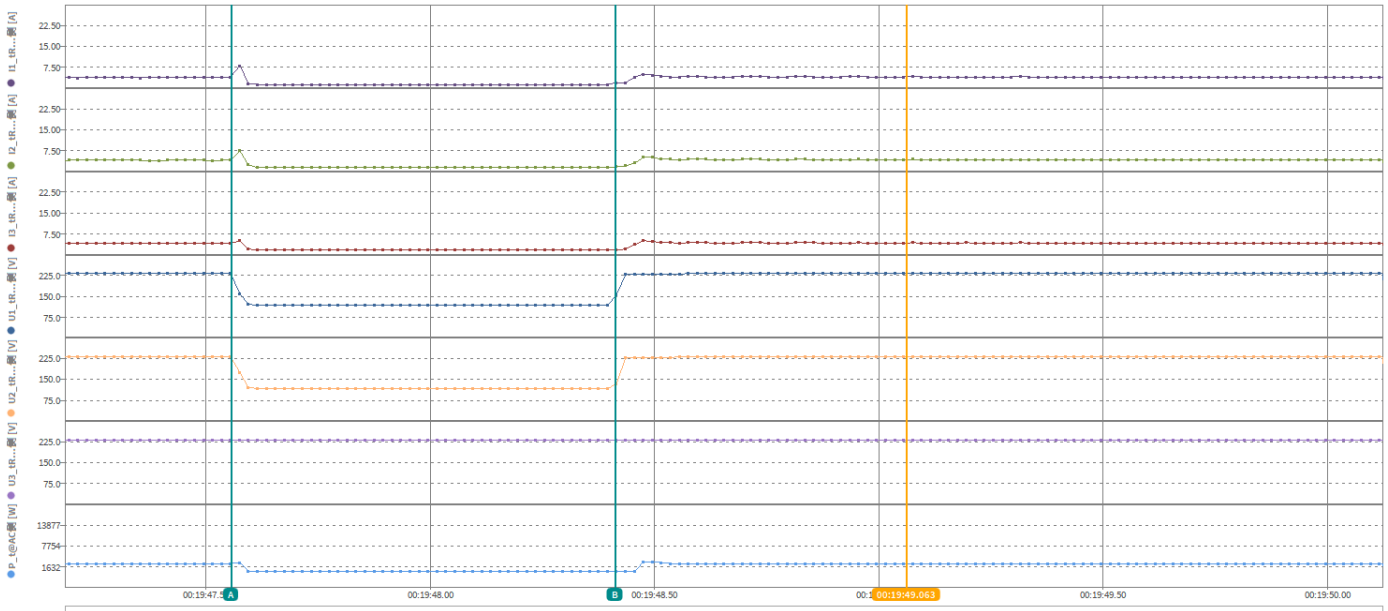
	A	B	间隔
时间 [s]	0:14.125620	0:14.329718	0.204099
I1_tRMS@AC侧 [A]	15.77021	20.70838	4.938165
I2_tRMS@AC侧 [A]	15.74500	22.58678	6.841781
I3_tRMS@AC侧 [A]	15.79083	10.20561	-5.585221
U1_tRMS@AC侧 [V]	230.6622	24.64318	-206.0190
U2_tRMS@AC侧 [V]	230.9124	24.26041	-206.6520
U3_tRMS@AC侧 [V]	231.2086	228.8793	-2.329346
P_t@AC侧 [W]	10920.26	3241.160	-7679.095



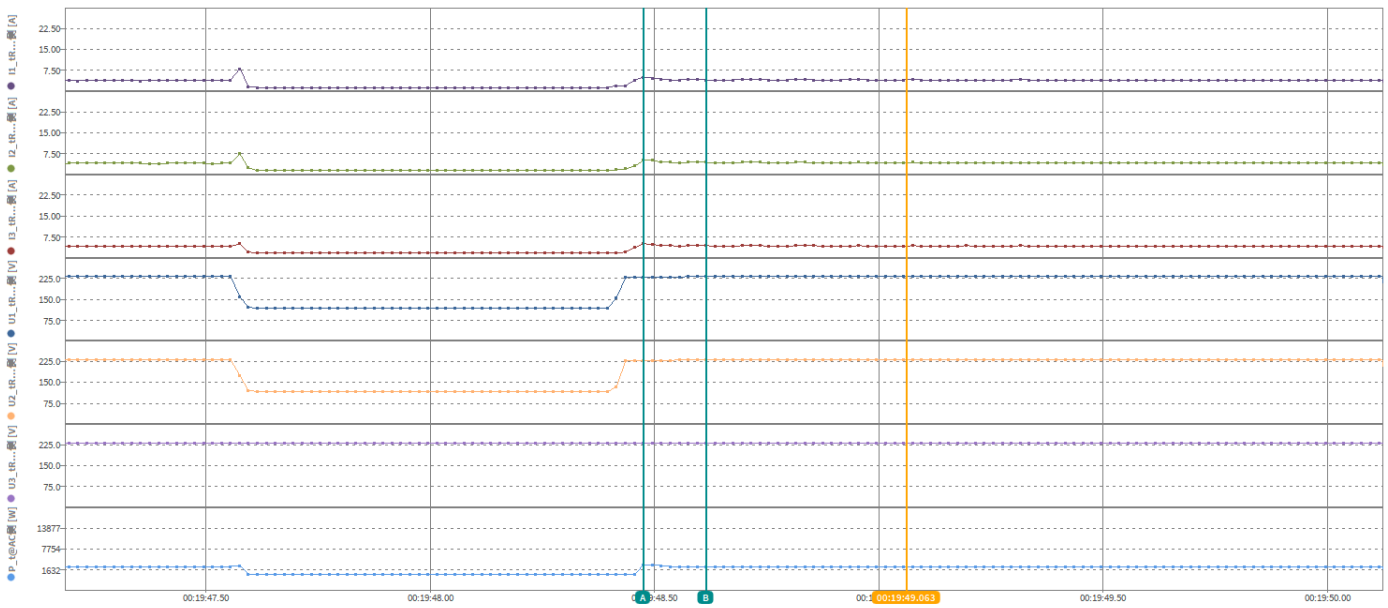
	A	B	间隔
时间 [s]	0:14.386080	0:14.505185	0.119104
I1_tRMS@AC侧 [A]	12.24312	15.58309	3.339966
I2_tRMS@AC侧 [A]	12.06860	15.39667	3.328073
I3_tRMS@AC侧 [A]	13.11101	15.89010	2.779092
U1_tRMS@AC侧 [V]	227.4351	229.8588	2.423752
U2_tRMS@AC侧 [V]	226.7768	229.9940	3.217209
U3_tRMS@AC侧 [V]	231.7065	231.3934	-0.313034
P_t@AC侧 [W]	8521.780	10792.22	2270.439

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Test 6 – LV two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) a: 10 % * P_{SMAX} ÷ 30 %



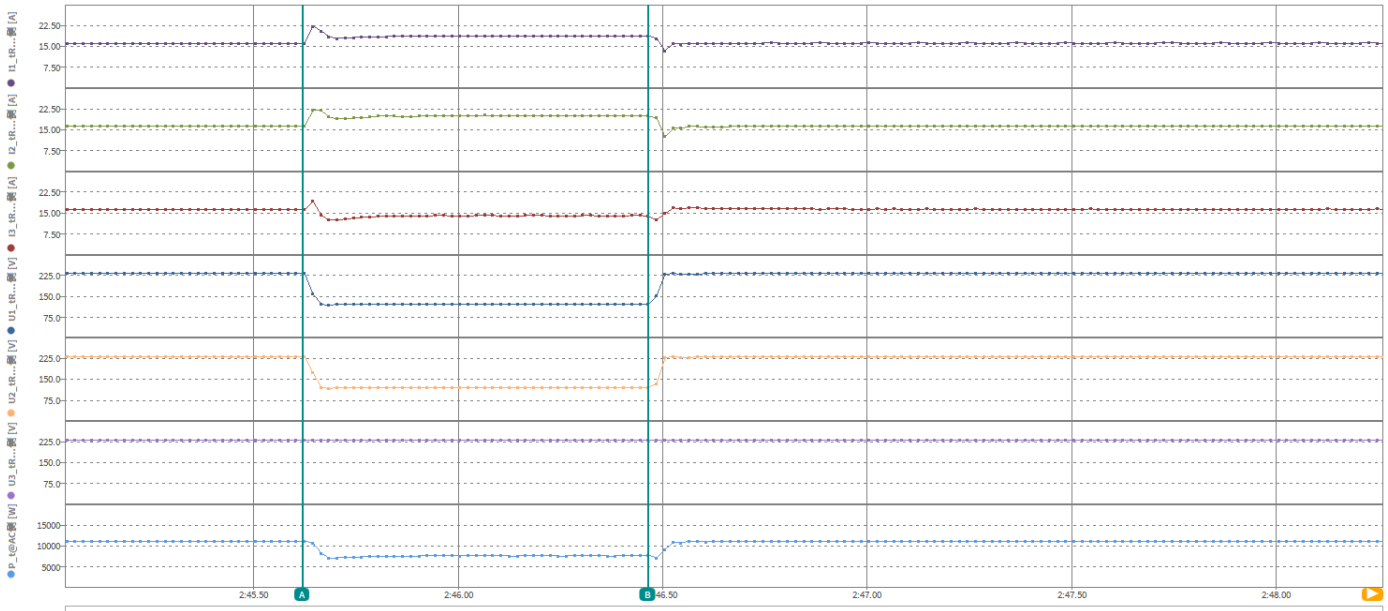
时间 [s]	A 00:19:47.557669	B 00:19:48.413169	间隔 0.855500
I1_tRMS@AC侧 [A]	3.285164	0.674197	-2.610968
I2_tRMS@AC侧 [A]	3.282457	0.674094	-2.608363
I3_tRMS@AC侧 [A]	3.294980	1.036461	-2.258519
U1_tRMS@AC侧 [V]	230.2621	115.3575	-114.9046
U2_tRMS@AC侧 [V]	230.5269	115.2476	-115.2793
U3_tRMS@AC侧 [V]	230.7837	230.3879	-0.395828
P_t@AC侧 [W]	2268.188	-0.874361	-2269.063



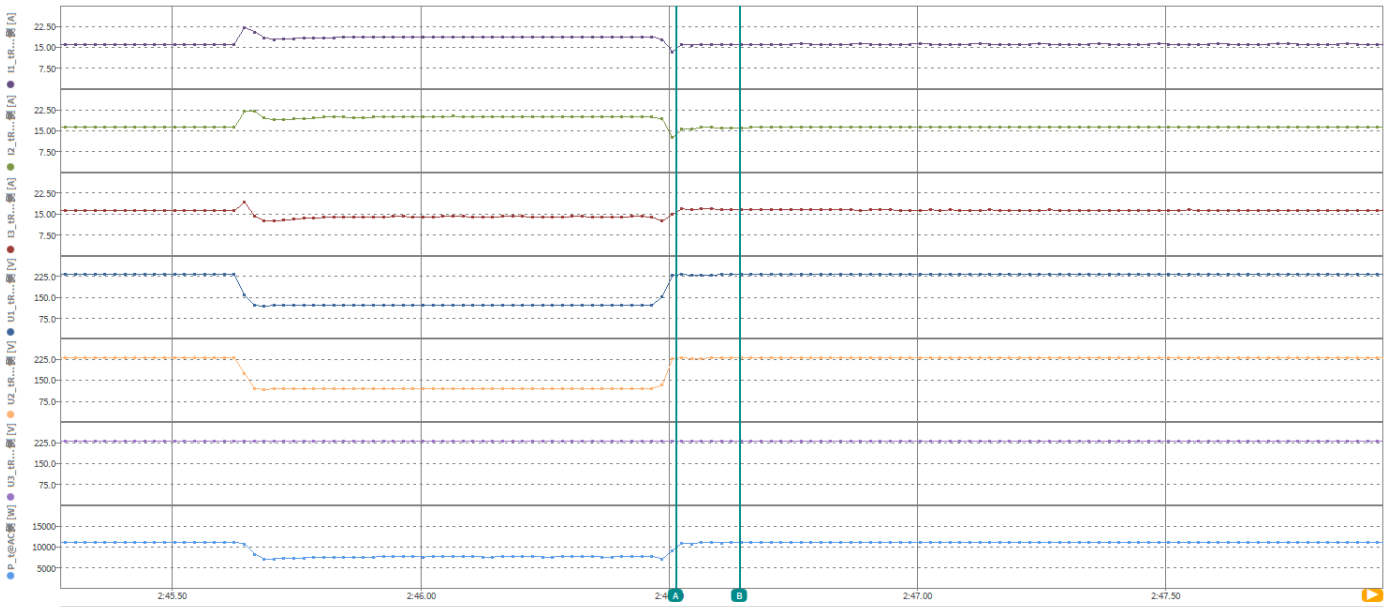
时间 [s]	A 00:19:48.475767	B 00:19:48.615568	间隔 0.139801
I1_tRMS@AC侧 [A]	3.564084	3.684040	0.119956
I2_tRMS@AC侧 [A]	2.465897	3.686689	1.220792
I3_tRMS@AC侧 [A]	3.123823	3.752684	0.628861
U1_tRMS@AC侧 [V]	227.3528	229.6456	2.292801
U2_tRMS@AC侧 [V]	227.4683	229.8031	2.334824
U3_tRMS@AC侧 [V]	230.8656	230.8191	-0.046478
P_t@AC侧 [W]	-25.18097	2285.854	2311.034

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Test 6 – LV two-phase asymmetrical fault (V/V_n = 0,50; duration = 0,850 s) b: > 90 % * P_{SMAX}



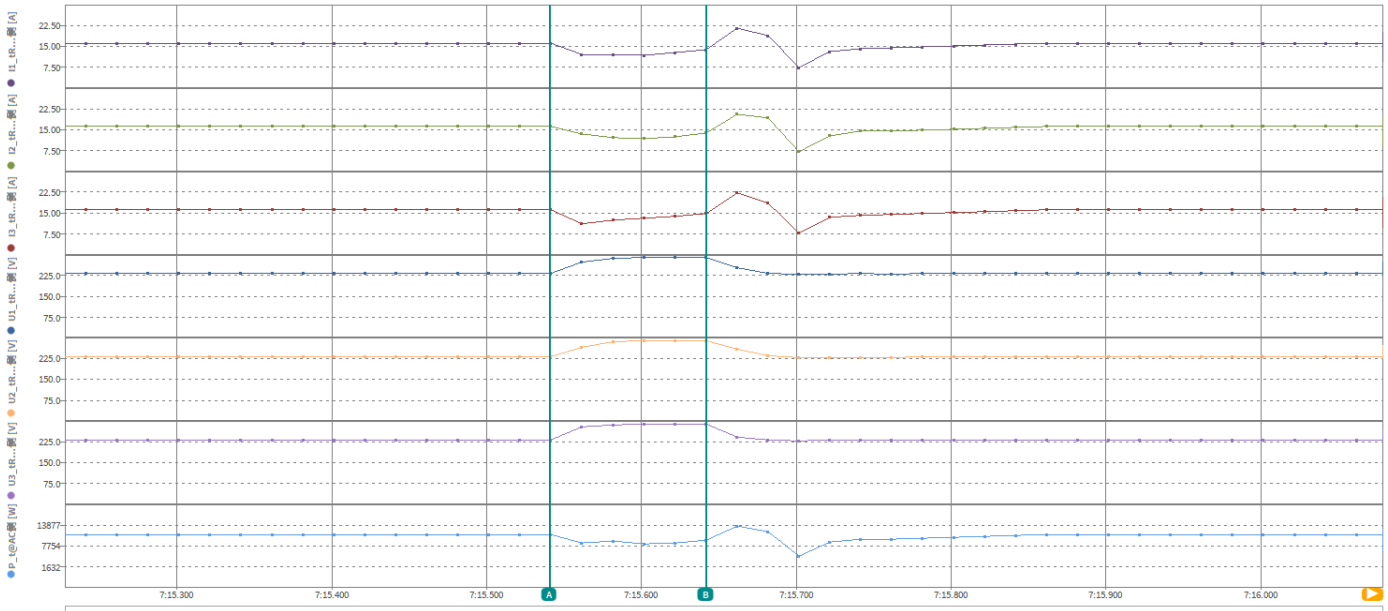
时间 [s]	A 2:45.620390	B 2:46.464535	间隔 0.844145
I1_tRMS@AC侧 [A]	15.96637	18.56337	2.597007
I2_tRMS@AC侧 [A]	15.95470	19.82438	3.869678
I3_tRMS@AC侧 [A]	15.99147	13.70741	-2.284065
U1_tRMS@AC侧 [V]	230.6564	115.9950	-114.6614
U2_tRMS@AC侧 [V]	230.9375	115.9401	-114.9974
U3_tRMS@AC侧 [V]	231.2689	230.8842	-0.384750
P_t@AC侧 [W]	11061.76	7517.894	-3543.865



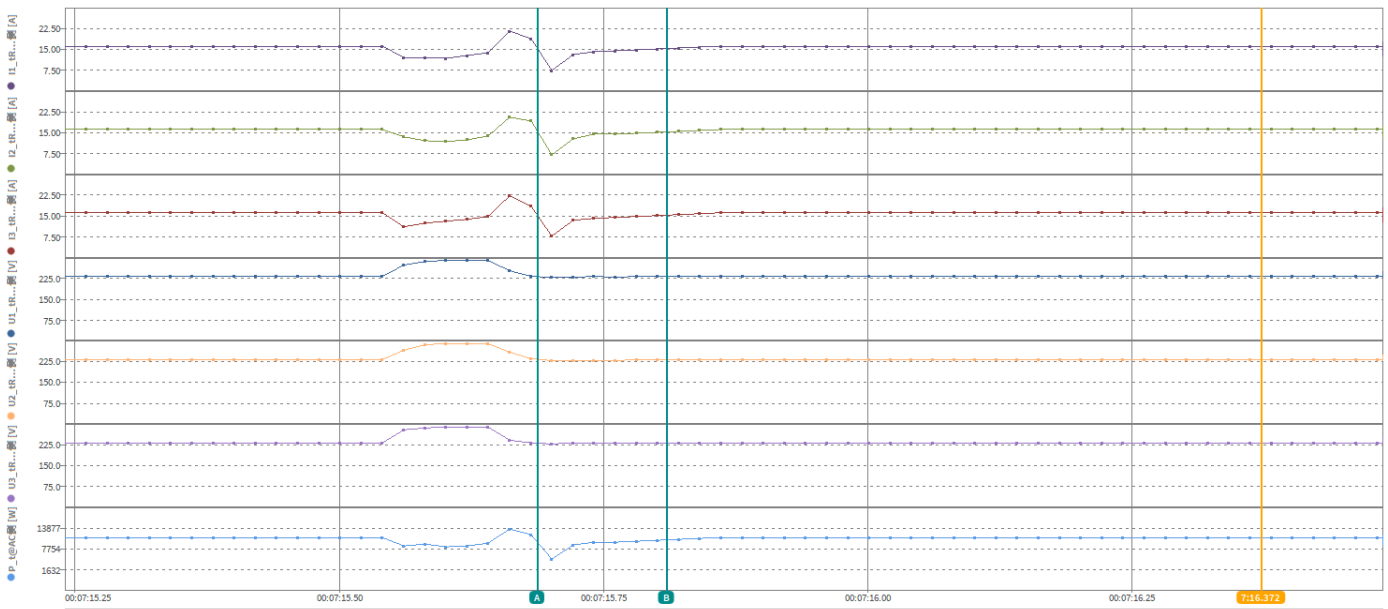
时间 [s]	A 2:46.514523	B 2:46.642630	间隔 0.128108
I1_tRMS@AC侧 [A]	13.03936	15.83290	2.793542
I2_tRMS@AC侧 [A]	12.12185	15.51661	3.394753
I3_tRMS@AC侧 [A]	14.37667	16.15837	1.781696
U1_tRMS@AC侧 [V]	228.5438	229.8580	1.314148
U2_tRMS@AC侧 [V]	228.0896	230.0459	1.956329
U3_tRMS@AC侧 [V]	231.4754	231.2953	-0.180069
P_t@AC侧 [W]	8926.394	10941.09	2014.692

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Test: OV1 – three-phase symmetrical fault (V/Vn = 1,25; duration = 0,100 s) >90% * P_{SMAX}



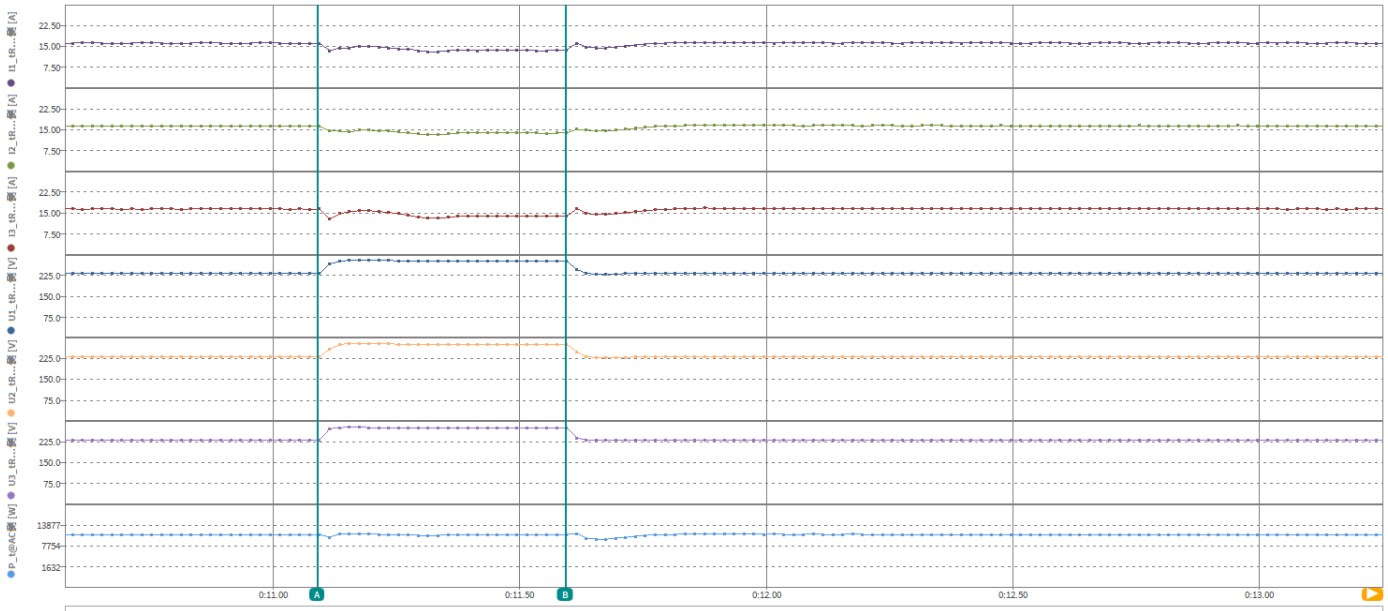
时间 [s]	A 7:15.5408038	B 7:15.6418708	间隔 0.1010670
I1_tRMS@AC侧 [A]	15.80933	12.45442	-3.354906
I2_tRMS@AC侧 [A]	15.79192	12.15357	-3.638352
I3_tRMS@AC侧 [A]	15.84886	13.34661	-2.502253
U1_tRMS@AC侧 [V]	230.6347	289.9262	59.29156
U2_tRMS@AC侧 [V]	230.8941	291.0160	60.12189
U3_tRMS@AC侧 [V]	231.2051	288.8402	57.63507
P_t@AC侧 [W]	10952.55	8510.289	-2442.262



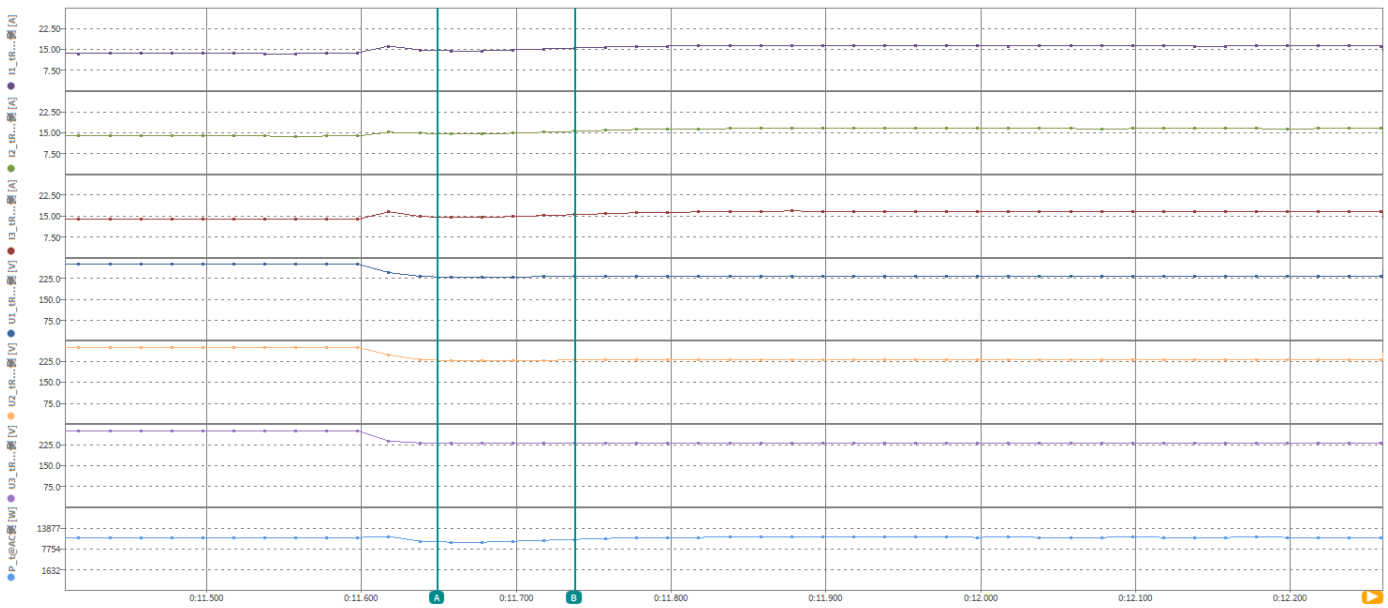
时间 [s]	A 7:15.6878227	B 7:15.8099411	间隔 0.1221184
I1_tRMS@AC侧 [A]	18.62369	14.73378	-3.889912
I2_tRMS@AC侧 [A]	19.00430	14.72279	-4.281507
I3_tRMS@AC侧 [A]	18.10752	14.77521	-3.332310
U1_tRMS@AC侧 [V]	232.6328	230.1004	-2.532349
U2_tRMS@AC侧 [V]	233.8413	230.0201	-3.821213
U3_tRMS@AC侧 [V]	232.0413	231.0939	-0.947327
P_t@AC侧 [W]	11973.43	10186.34	-1787.096

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Test: OV2 – three-phase symmetrical fault (V/V_n = 1,20; duration = 0,500 s) >90% * P_{SMAX}



时间 [s]	A 0:11.091558	B 0:11.594102	间隔 0.502544
I1_tRMS@AC侧 [A]	16.01376	13.28779	-2.725968
I2_tRMS@AC侧 [A]	15.98477	13.28588	-2.698897
I3_tRMS@AC侧 [A]	16.03227	13.33853	-2.693738
U1_tRMS@AC侧 [V]	230.5473	276.9277	46.38045
U2_tRMS@AC侧 [V]	230.8454	276.4355	45.59006
U3_tRMS@AC侧 [V]	231.1620	277.1320	45.97000
P_t@AC侧 [W]	11084.07	11044.24	-39.83008



时间 [s]	A 0:11.649273	B 0:11.737876	间隔 0.088603
I1_tRMS@AC侧 [A]	14.33436	14.88003	0.545666
I2_tRMS@AC侧 [A]	14.39496	14.85550	0.460543
I3_tRMS@AC侧 [A]	14.34735	14.86115	0.513799
U1_tRMS@AC侧 [V]	231.1729	229.4881	-1.684753
U2_tRMS@AC侧 [V]	230.8557	228.8587	-1.997070
U3_tRMS@AC侧 [V]	231.5481	230.7742	-0.773926
P_t@AC侧 [W]	9952.529	10240.56	288.0322

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Bbis.10	**Verification of insensitivity to automatic reclosure in phase discordance**	**P**
Bbis.10.1	**Simulated network test**	**P**

Referring to the diagram in Figure 75 - simulated network utilization:

- the grid simulator must be able to produce voltage phase jumps at the inverter output terminals of 90° and 180° respectively;
- storage system shall operate at a power level compatible with the characteristics of the test circuit and with unity power factor (cos φ = 1);

VR: simulated mains voltage.

- The storage system is to be brought into operation at full discharge power. Let the system operate under the set conditions for at least 5 min, consistent with the energy capacity of the EESS, or the time required for the temperature inside the converter to stabilize.

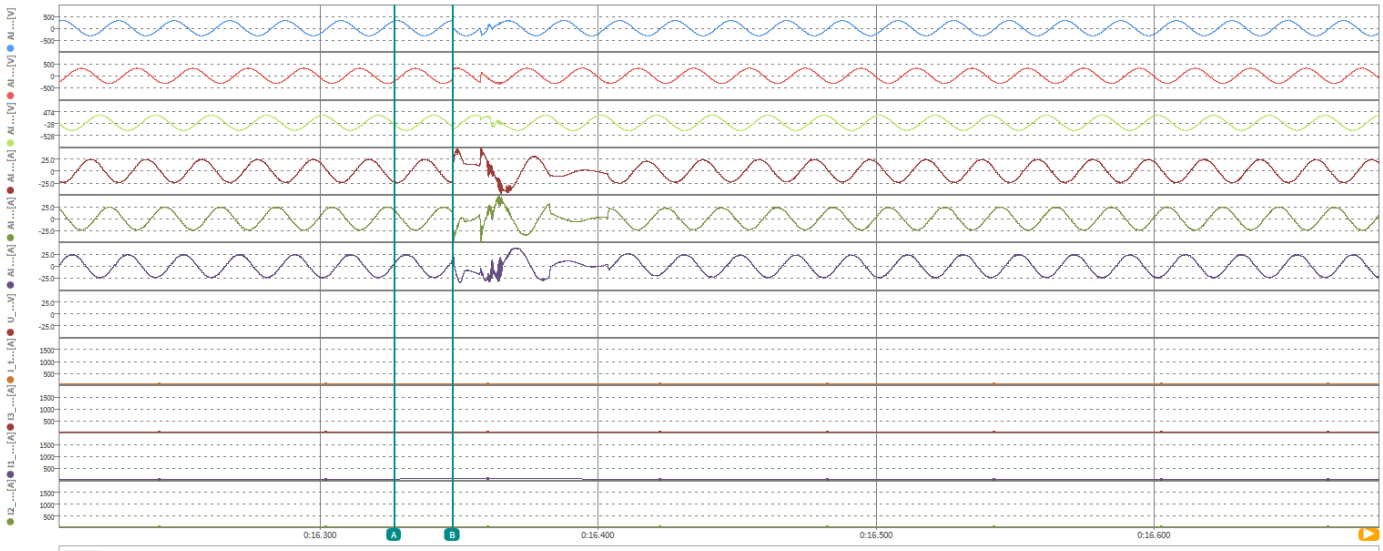
At the end of the stabilization period, two tests are to be carried out in sequence, inducing a transient that abruptly produces a phase-shift angle on the simulated VR mains voltage of 90° and 180°.

The test report should indicate for each of the two test sequences:

- the angle between the voltage before and after the phase jump, with an instrument having an error of 1°;
- the storage system current over a time window running from 20 ms before to at least 200 ms after the phase jump of the simulated mains voltage.

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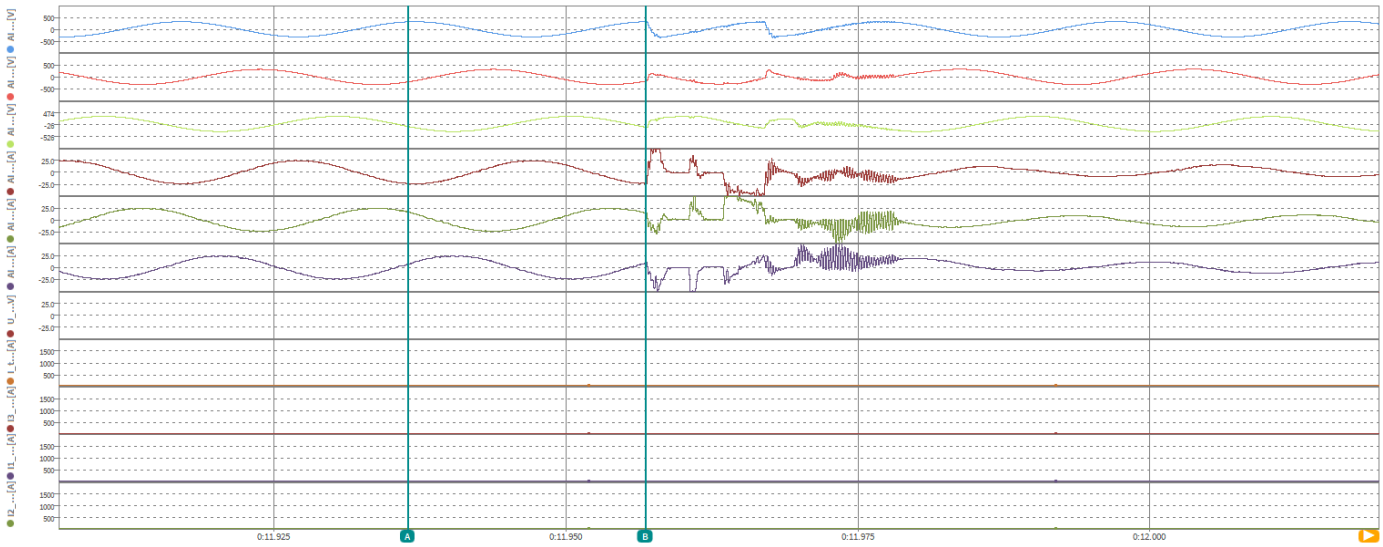
90° phase shift



	A	B	间隔
时间 [s]	0:16.3268863	0:16.3478117	0.0209254
AI 1/U1@TRIONet3_1338 [V]	308.7378	191.6642	-117.0735
AI 1/U2@TRIONet3_1338 [V]	-242.8222	-48.01250	194.8097
AI 1/U3@TRIONet3_1338 [V]	-65.52387	-209.9183	-144.3944
AI 1/I1@TRIONet3_1338 [A]	-22.67289	6.860972	29.53386
AI 1/I2@TRIONet3_1338 [A]	19.10544	-25.42997	-44.53540
AI 1/I3@TRIONet3_1338 [A]	3.408671	21.80410	18.39542
U_tRMS@DC侧 [V]	53.74992	53.74992	0.000000
I_tRMS@AC侧 [A]	17.45106	17.45106	0.000000
I3_tRMS@AC侧 [A]	17.44518	17.44518	0.000000
I1_tRMS@AC侧 [A]	17.46824	17.46824	0.000000
I2_tRMS@AC侧 [A]	17.43978	17.43978	0.000000

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180° phase shift



时间 [s]	A 0:11.9364872	B 0:11.9568293	间隔 0.0203421
AI 1/U1@TRIONet3_1338 [V]	318.4059	323.8752	5.469323
AI 1/U2@TRIONet3_1338 [V]	-213.1264	-185.7042	27.42219
AI 1/U3@TRIONet3_1338 [V]	-107.0561	-137.6538	-30.59769
AI 1/I1@TRIONet3_1338 [A]	-24.53303	-24.73068	-0.197649
AI 1/I2@TRIONet3_1338 [A]	16.83116	14.17804	-2.653122
AI 1/I3@TRIONet3_1338 [A]	7.683516	10.42271	2.739191
U_tRMS@DC网 [V]	53.81671	53.81671	0.000000
I_tRMS@AC网 [A]	17.44958	17.43587	-0.013704
I3_tRMS@AC网 [A]	17.44353	17.43990	-3.639e-3
I1_tRMS@AC网 [A]	17.47559	17.44788	-0.027708
I2_tRMS@AC网 [A]	17.42961	17.41985	-9.766e-3

This type of test can be performed in two ways:

with the inverter connected to a simulated network (Bbis.10.1)

with the inverter connected to the distribution network (Bbis.10.2 and alternatively Bbis.10.3).

The generator/storage must not be damaged as a result of the tests. Protective devices may be switched off or released.

With reference to the diagram in Figure 16B.bis – Using the simulated network:

- The network simulator should be able to produce phase shifts in of the output voltage at the inverter terminals of 90° and 180°, respectively.
- Generator: inverter operating at nominal power with unity power factor (cos φ = 1)
- VR: simulated network voltage
- The generator/storage system must start operating at nominal power. Let the system operate under the conditions set for at least 5 minutes or the time needed to stabilise the internal temperature of the converter.

After the stabilisation period two tests should be performed in sequence, by inducing the transient that produces a phase shift angle on the simulated network voltage VR of 180° and 90°.

In the test report the following data for each of the two test sequences shall be indicated:

- the angle between the voltage before and after the phase shift, with an instrument with a 1° error;

the generator current on a time window starting from 20 ms before until at least 200 ms after the phase shift of the simulated network voltage.

Note

The inverter was restarted after the test has been performed. There are no damages on the complete system.

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Annex No. 1
ISO 9001 certificate

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TEMP-0058-TG-EAW-ES-V01

CERTIFICATE OF CONFORMITY OF QUALITY MANAGEMENT SYSTEM CERTIFICATION

NO: 08923Q52345R0S

This Is To Certify That The Quality Management System Of

ANHUI DAHENG NEW ENERGY TECHNOLOGY CO., LTD.

4th Floor,Office Building,1yaoyuan Road,Luyang Industrial Park,Luyang District,Hefei City,Anhui Province
1yaoyuan Road, Luyang District, Hefei City, Anhui Province
Unified Social Credit Code: 91340100MA2WL7L582

Quality Management System Complies With:

GB/T19001-2016/ISO9001:2015 Standard

Scope:

The Development And Production Of Solarunit Smart PV Inverter

Date of issue: 2023-9-18 Expiry date: 2026-9-17

Holding this certificate organizations receive annual surveillance audits qualified, And administrative license valid state regulations scanning the QR code can verify the authenticity and dynamic management information of this certificate

北京中水卓越认证有限公司 证书专用章 (正本)

Representative of The Company

中国认可
国际互认
管理体系
MANAGEMENT SYSTEM
CNAS C089-M

The Certificate Information Can Be Inquired At http://www.cnca.gov.cn Or http://www.zsbc.net
Tel:010-58672798 Add: A-201,Fudun Center, No. 58, East Third Ring South Road, Chaoyang District, Beijing

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Annex No. 2
EMC Test Report

The complete EMC test report is stored at Bureau Veritas Consumer Products Services Germany GmbH in project CLVZ-ESH-P25112149.

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检测
TESTING
CNAS L19087

Report No.: SN250212

TEST REPORT

Product:	Three-phase Hybrid Inverter
Model No.:	DHN-LVEH3P8K-EU-G1 DHN-LVEH3P10K-EU-G1 DHN-LVEH3P12K-EU-G1
Applicant:	DAH New Energy Technology Co.,Ltd
Issued by:	Sainuotek (Jiaxing) Service Co., Ltd.
Lab Location:	Building 1, No. 1515, Shunze Road, Daqiao Town, Nanhu District, Jiaxing, Zhejiang, P.R. China

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TEMP-0058-TG-EAW-ES-V01

Report No.: SN250212

Test Report

Product	Three-phase Hybrid Inverter
Model No.	DHN-LVEH3P8K-EU-G1 DHN-LVEH3P10K-EU-G1 DHN-LVEH3P12K-EU-G1
Applicant	DAH New Energy Technology Co.,Ltd
Applicant Address	4th Floor, Office Building, 1 yao yuan Road, Luyang District, Hefei City, Anhui Province, China
Manufacturer	DAH New Energy Technology Co.,Ltd
Manufacturer Address	4th Floor, Office Building, 1 yao yuan Road, Luyang District, Hefei City, Anhui Province, China
Factory	DAH New Energy Technology Co.,Ltd
Factory Address	NO.1 yao yuan Road, Luyang Industrial Park, Luyang District, Hefei City, Anhui Province, China
Test Standards	IEC 61000-4-16:2015 IEC 61000-4-18:2019 IEC 61000-4-29:2000 ※CEI 0-21:2022 Clause A 4.6 8 Table 18
Test Result	PASS

Tested by	Yang Aojie	Nov. 26, 2025
	Signature, Date	
Reviewed by	Jiang Haibiao	Nov. 26, 2025
	Signature, Date	
Approved by	Lei-Tongzhou	Nov. 26, 2025
	Signature, Date	

SN-TRF-048-V1 Page 2 of 18

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Annex No. 3
Datasheet of the relay

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HF115F MINIATURE HIGH POWER RELAY

c UL us
File No.:E134517

File No.:116934

File No.:CQC08002028130



Features

- Low height: 15.7 mm
- 16A switching capability
- 5kV dielectric strength (between coil and contacts)
- Contact gap: ≥0.75mm, with optional specifications
- Creepage distance: 10mm
- Meeting VDE 0700, 0631 reinforce insulation
- Product in accordance to IEC 60335-1 available
- Sockets available
- Plastic sealed and flux proofed types available
- UL insulation system: Class F available

RoHS compliant

CONTACT DATA

Contact arrangement	1A, 1B, 1C	2A, 2B, 2C
Contact resistance[1]	100mΩ max.(at 1A 6VDC)	
Contact material	See ordering info.	
Contact rating (Res. load)	12A/16A 250VAC	8A 250VAC
Max. switching voltage[2]	440VAC / 300VDC	
Max. switching current	12A / 16A	8A
Max. switching power	3000VA / 4000VA	2000VA
Mechanical endurance	1 x 10^7OPS	
Electrical endurance	1H3B type: 1 x 10^5OPS (16A 250VAC, Resistive load, Room temp., 1s on 9s off) 2H4B type: 5 x 10^4OPS (8A 250VAC, Resistive load, Room temp., 1s on 9s off)	

Notes: 1) The data shown above are initial values,
2) see maximum switching power curve.

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	5000VAC 1min
	Between open contacts	1000VAC 1min
	Between contact sets	2500VAC 1min
Surge voltage (between coil & contacts)		10kV (1.2 / 50μs)
Operate time (at nomi. volt.)		15ms max.
Release time (at nomi. volt.)		8ms max.
Temperature rise (at nomi. volt.)		55K max.
Shock resistance *	Functional	98m/s²
	Destructive	980m/s²
Vibration resistance *		10Hz to 150Hz 10g/5g
Humidity		5% to 85% RH
Ambient temperature		-40°C to 85°C
Termination		PCB
Unit weight		Approx. 13.5g
Construction		Plastic sealed, Flux proofed

Notes: 1) The data shown above are initial values.
2) * Index is not in relay length direction.
3) UL insulation system: Class F, Class B.

COIL

Coil power	Approx. 400mW

COIL DATA at 23°C

Nominal Voltage VDC	Pick-up Voltage VDC max.[1]	Drop-out Voltage VDC min.[1]	Max. Voltage VDC [2]	Coil Resistance Ω
5	3.50	0.5	7.5	62 x (1±10%)
6	4.20	0.6	9.0	90 x (1±10%)
9	6.30	0.9	13.5	202 x (1±10%)
12	8.40	1.2	18	360 x (1±10%)
18	12.60	1.8	27	810 x (1±10%)
24	16.80	2.4	36	1440 x (1±10%)
48[3]	33.60	4.8	72	5760 x (1±15%)
60[3]	42.00	6.0	90	7500 x (1±15%)
110[3]	77.00	11.0	165	25200 x (1±15%)

Notes: 1) The data shown above are initial values.
2) Maximum voltage refers to the maximum voltage which relay coil could endure in a short period of time.
3) For products with rated voltage ≥ 48V, measures should be taken to prevent coil overvoltage in order to protect coil in test and application (eg. Connect diodes in parallel).

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Churod Electronics
东莞市中汇瑞德电子股份有限公司
Churod Electronics Co., Ltd.

F-RD36-1

东莞市中汇瑞德电子股份有限公司
电话：（86）-769-39006688
网址：www.churod.com

RELAY SPECIFICATION

继电器规格书

(File No.: 001000 / Version: 01 / Issued Date: Sep.7th, 2021 / Updated Date: July.16th, 2024)

Product Description（品名）:	**CHAR-112A90EA**
Manufacturer Address（制造商地址）	**广东省东莞市塘厦镇新贵路 20 号**
Part Number（编码）:	
Customer Name（客户）:	

Make（编制）	Check（审核）	Approved（批准）
Liangliang.Li	Wenjun.Wang	Andy.Tang
Date(日期)：2024.07.16	Date(日期)：2024.07.16	Date(日期)：2024.07.16

Customer Approval（客户批准）

STAMPING AREA（盖章处）
Especially claim: This specification should be checked in 2 weeks, if had not answered in the scheduled time, then regards as the agreement. 特别说明：此规格书请顾客在2周内确认，如未在规定时间内答复，则视为同意。

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Churod Electronics
东莞市中汇瑞德电子股份有限公司
Churod Electronics Co., Ltd.

F-RD36-1

1. HSF COMPLIANCE 环保符合性

HSF COMPLIANCE 环保符合性	It complies with the Hazardous Substance Management Standards， including RoHS and REACH. 本器件符合《有害物质管理标准》，包含 RoHS、REACH。

2.SAFETY STANDARD 安全标准

UL certificate **UL** 证书	E329801 85℃，600VAC,30A→90A→30A,30000cycle
TUV certificate **TUV** 证书	R50598204 85℃，600VAC,30A→90A→30A,30000cycle
CQC certificate **CQC** 证书	CQC23002402369 85℃，600VAC,30A→90A→30A,30000cycle

Standard 符合标准

According to 符合标准	GB/T 21711.1-2008 IEC61810-1-2015

3. CONTACT RATINGS 触点规格

Contact Arrangement 触点形式	1 Form X
Contact material 触点材料	Mov.-contact AgSnO2/ Stat.-contact AgCuO 动触点 AgSnO2 / 静触点 AgCuO
Initial voltage drop 初始接点压降	≤100mV at 90A ≤5mΩ at 6V/20A
Rated switching voltage (Normally Open) 额定切换电压（常开触点）	600VAC
Rated switching voltage (Normally Close) 额定切换电压（常闭触点）	—

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Rated current (Normally Open) 额定电流（常开触点）	90A
Rated current (Normally Close) 额定电流（常闭触点）	—
Rated switching power (Normally Open) 额定切换功率（常开触点）	54,000VA
Rated switching power (Normally Close) 额定切换功率（常闭触点）	—
Minimum applicable load (Normally Open) 最小使用负载（常开触点）	48VAC 100mA
Minimum applicable load (Normally Close) 最小使用负载（常闭触点）	—
Contact gap 触点间隙	≥4.0mm

4. AUXILIARY CONTACT RATINGS 辅助触点规格

Contact Arrangement 触点形式	1 Form A
Contact material 触点材料	AgNi（Ep.Au）
Initial Contact resistance 初始接触电阻	≤50mΩ at 6V/1A
Rated switching voltage (Normally Open) 额定切换电压（常开触点）	12VDC
Minimum applicable load (Normally Open) 最小使用负载（常开触点）	5mA

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Churod Electronics
东莞市中汇瑞德电子股份有限公司
Churod Electronics Co., Ltd.

File NO.: 00158720250306

东莞市中汇瑞德电子股份有限公司
电话：（86）-769-39006688
网址：www.churod.com

RELAY SPECIFICATION

继电器规格书

Version: A

共 9 页

Product Name（品名）：	**CHFN-V-112H1A2F(43A)**
Part Number（编码）：	
Customer Name（客户）：	

Make 编制	Check 审核	Approved 批准
Rick.Hu	Simon.Fu	Yang.Li
Date 日期：2025.3.6	Date 日期：2025.3.6	Date 日期：2025.3.6

Customer Approval （客户批准）

STAMPING AREA （盖章处）
Especially claim: This specification should be checked in 2 weeks, if had not answered in the scheduled time, then regards as the agreement. 特别说明：此规格书请顾客在2周内确认，如未在规定时间内答复，则视为同意。

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Churod Electronics
东莞市中汇瑞德电子股份有限公司
Churod Electronics Co., Ltd.

File NO.: 00158720250306

1. CERTIFIED COMPLIANCE 认证符合

TUV	IEC 61810-1	编号：R50220099
UL	UL 60947-1	编号：E341422
CQC	GB/T 21711.1	编号：CQC11002066606

2. HSF COMPLIANCE 环保符合性

HSF COMPLIANCE 环保符合性	Meet the latest regulations of RoHS and REACH 满足 RoHS 、REACH 最新法规要求

3. CONTACT RATINGS 触点规格

Contact Arrangement 触点形式	1 Form A (SPST) 1 组常开
Contact material 触点材料	Ag Alloy 银合金
Initial contact resistance 初始接触电阻	≤100mΩ at 6VDC/1A
Rated Load Current(Normally Open) 额定电流（常开触点）	43 A
Rated Switching Voltage(Normally Open) 额定切换电压（常开触点）	277 Va.c.
Rated Switching Power (Normally Open) 额定切换功率（常开触点）	11911VA
Min. Applicable Load(Normally Open) 最小使用负载（常开触点）	5 Vd.c.,100mA

4. COIL CHARACTERISTICS 线圈特性

Coil power 线圈功率 W	Max. Allowable Voltage 最大允许电压 Vd.c.	Nominal Voltage 额定电压 Vd.c.	Pick-up Voltage 吸合电压 Vd.c.	Drop-out Voltage 释放电压 Vd.c.	Coil Resistance 线圈电阻 Ω
1.6 (at 23℃)	130% of nominal coil voltage 130%额定线圈电压	12	≤9	≥0.6	90×(1±10%)
Note: All time parameters are measured at nominal voltage. 注： 所有的时间参数在常温,额定电压下测得。					

When the ambient temperature > 23°C,coil voltagerequires reduction to 5.4to <6.6V after applying rate voltage for 100ms~200ms.

当环境温度＞23℃时，线圈施加额定电压100ms~200ms 以后,电压需下降到5.4~6.6V。

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HF32F SUBMINIATURE INTERMEDIATE POWER RELAY

c UL us
File No.: E134517

File No.: 40012204

File No.: CQC12002076528



Features

- 1 Form A and 1 Form C configurations
- Subminiature, standard PCB layout
- Plastic sealed and flux proofed types available
- UL insulation system: Class F
- Product in accordance to IEC 60335-1 available

RoHS compliant

CONTACT DATA

Contact arrangement	1A, 1C		
Contact resistance[1)]	100mΩ max(at 1A 6VDC)		
Contact material	$AgSnO_2$, AgNi, AgCdO		
Contact rating (Res. load)	1A		1C
	H type: 5A 250VAC 5A 30VDC 10A 125VAC	HL type: 3A 250VAC 3A 30VDC	3A 250VAC 3A 30VDC
Max. switching current	10A		3A
Max. switching powert	1250VA/150W		750VA/90W
Max. switching voltage	250VAC/30VDC		
Mechanical endurance	5 x 10^6OPS		
Electrical endurance	H type:1 x 10^5OPS (5A 250VAC, Resistive load, Room temp., 1s on 1s off) HL type: 1x 10^5OPS (3A 250VAC, Resistive load, Room temp., 1s on 1s off) Z type:1x 10^5OPS (NO:3A/NC:3A, 250VAC, Resistive load, Room temp., 1.5s on 1.5s off)		

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

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	2500VAC 1min
	Between open contacts	1000VAC 1min
Operate time (at rated. volt.)		8ms max.
Release time (at rated. volt.)		5ms max.
Humidity		5% to 85% RH
Operation ambient temperature		-40˚C to 85˚C
Shock resistance	Functional	98m/s²
	Destructive	980m/s²
Vibration resistance		10Hz to 55Hz 1.5mm DA
Termination		PCB
Unit weight		Approx. 6g
Construction		Plastic sealed, Flux proofed

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

COIL

Coil power	Standard: Approx. 450mW; Sensitive: Approx.200mW

COIL DATA at 23˚C

Standard type

Nominal Voltage VDC	Pick-up Voltage VDC max.[1)]	Drop-out Voltage VDC min.[1)]	Max. Voltage VDC *2)	Coil Resistance Ω
3	2.25	0.15	3.9	20 x (1±10%)
5	3.75	0.25	6.5	55 x (1±10%)
6	4.50	0.30	7.8	80 x (1±10%)
9	6.75	0.45	11.7	180 x (1±10%)
12	9.00	0.60	15.6	320 x (1±10%)
18	13.5	0.90	23.4	720 x (1±10%)
24	18.0	1.20	31.2	1280 x (1±10%)
48	36.0	2.40	62.4	5120 x (1±10%)

Sensitive type (Only for 1 Form A)

Nominal Voltage VDC	Pick-up Voltage VDC max.[1)]	Drop-out Voltage VDC min.[1)]	Max. Voltage VDC *2)	Coil Resistance Ω
3	2.25	0.15	4.5	45 x (1±10%)
5	3.75	0.25	7.5	125 x (1±10%)
6	4.50	0.30	9.0	180 x (1±10%)
9	6.75	0.45	13.5	400 x (1±10%)
12	9.00	0.60	18.0	720 x (1±10%)
18	13.5	0.90	27.0	1600 x (1±10%)
24	18.0	1.20	36.0	2800 x (1±10%)
48	36.0	2.40	72.0	11520 x (1±10%)

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

HONGFA RELAY
ISO9001, IATF16949 , ISO14001, ISO45001, IECQ QC 080000, ISO/IEC 27001 CERTIFIED 2022 Rev. 1.00

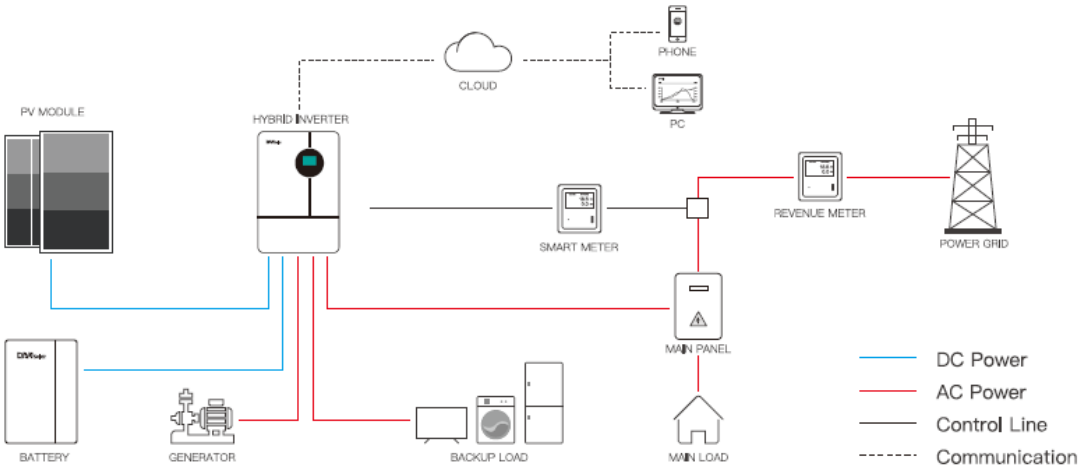
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Annex No. 4
Datasheet of the Batterie

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TECHNICAL PARAMETER

System Application



Technical Data

Model	DHN-LVWES15-G1
Main Parameter	
Battery Type	LiFePO4
Battery Rated Energy (kWh)	14.34
Battery Rated Capacity (Ah)	280
Scalability	Parallel connection of up to 16 units
Nominal Voltage (V)	51.2
Operating Voltage(V)	43.2~57.6
Charge/Discharge Current (A)-Recommend	140
Charge/Discharge Current (A)-Max.	200
Other Parameter	
Recommend Depth of Discharge(%)	≤90
System Dimension (W/H/D, mm)	520x680x232
System Weight (kg)	114
Master LED Indicator	6LED (SOC:16.6%~100%), 3LED (ON/OFF,RUN,ALARM)
IP Rating of Enclosure	IP20
Operating Temperature(℃)	Charge:0~+55/Discharge:-20~+55
Storage Temperature(℃)	-20~+35
Cycle Life (25±2℃,0.5C/0.5C,70%EOL)	≥8000
Installation	Wall-Mounted/Floor-Mounted (optional wheel)
Fire Prevention System	Prefabricated whole fluorine ketone fire extinguishing device (optional)
Communication Methods	CAN2.0/RS485
Warranty Period (years)	10
Certification	IEC62619-CB,CE,UN38.3
Compatible Inverters	SMA/VICTRON/SE/DEYE/SOLIS/GOODWE/GROWATT/ LUXPOWERTEK/SENERGY/SRD etc

E-mail: info@dahsolar.com
Add: No.1 Yaoyuan Road, Luyang District, Hefei City, Anhui Province, China
en.dahsolar.com

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Annex No. 5
Pictures of the unit

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Enclosure front


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Enclosure (connectors)


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Enclosure top side


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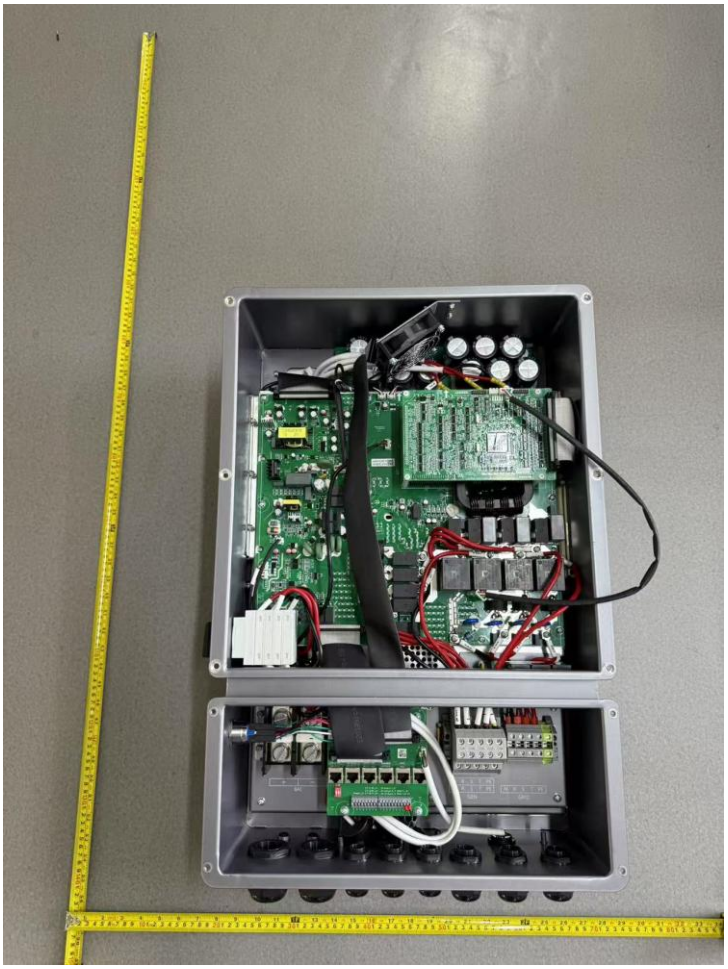
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Annex No. 6
Test Equipment list

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No.	Equipment	Internal No.	Type	Manufacturer	Last Calibration	Due Date
1	Oscilloscope	A4089036SH	DL850	YOKOGAWA	27/May/25	26/May/26
2	Voltage probe	A4089026SH	P5200A	Tektronix	17/Dec/24	16/Dec/25
3	Current probe	A4089037SH	960 30	YOKOGAWA	22/Aug/25	21/Aug/26
4	Current probe	A4089038SH	960 30	YOKOGAWA	22/Aug/25	21/Aug/26
5	Current probe	A4089039SH	960 30	YOKOGAWA	22/Aug/25	21/Aug/26
6	AC power supply	A7040071SH	61512	Chroma	Monitored by Power Analyzer	
7	AC power supply	A7040077SH	MX-30	AMETEK		
8	Programmable DC source	A7040058SH	62150H-1000S	Chroma		
9	Programmable DC source	A7040059SH	62150H-1000S	Chroma		
10	Programmable DC source	A7040069SH	62150H-1000S	Chroma		
11	Programmable DC source	A7040074SH	62150H-1000S	Chroma		
12	Programmable DC source	A7040075SH	62150H-1000S	Chroma		
13	Programmable DC source	A7040076SH	62150H-1000S	Chroma		
14	Programmable DC source	A7040070SH	62150H-1000S	Chroma		
15	Power Analyzer	A1240096SH	WT3000	YOKOGAWA	22/Aug/25	21/Aug/26
16	Power Analyzer	A1240097SH	WT3000	YOKOGAWA	27/May/25	26/May/26
17	Temperature & humidity meter	B4200046SH	polyma	W302M2A	16/Dec/24	15/Dec/25
18	Temperature & humidity meter	B4200078SH	314	center	02/Jun/25	01/Jun/26
19	Power Analyzer	A1240132SH	DEWE2-A4	DEWETRON	27/May/25	26/May/26

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End of Test Report

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