



**BUREAU
VERITAS**

TEST REPORT

CEI 0-21

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

Report No.: CVLZ-ESH-P25112150

Date of issue.....: 2025-12-24

Total number of pages.....: 261

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Accreditation.....:



Deutsche
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D-PL-12024-03-00

Applicant's name: DAH New Energy Technology Co. Ltd

Address: 4th Floor, Office Building, 1 yao yuan Road, Luyang Industrial Park, Luyang District, Hefei City, Anhui Province, China

Test specification

Standard: CEI 0-21:2022-03 + V1:2022-11 + V2:2024-01 + V2/EC:2024-03 + V2/EC2:2025-04

Note:

The device is for systems up to 11,08kW

Annex A Features and tests for the System Protection Interface (SPI)

Annex B Testing of generators connected to the grid via static converters

Annex Bbis Testing of storage systems

Certificate: Certificate of compliance

Template number standard: CEI 0-21_18

Master TRF originator.....: Bureau Veritas Consumer Products Services Germany GmbH

Test item description: Hybrid inverter

Trademark.....:



Model / Type.....: DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1, DHN-LVEH1P4.6K-EU-G1, DHN-LVEH1P5K-EU-G1, DHN-LVEH1P6K-EU-G1, DHN-LVEH1P7K-EU-G1, DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-EU-G1

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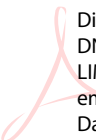
Characteristics of the static converter and storage system (SdA)					
Static converter model	DHN-LVEH1P3K-EU-G1	DHN-LVEH1P3.6K-EU-G1	DHN-LVEH1P4.6K-EU-G1	DHN-LVEH1P5K-EU-G1	DHN-LVEH1P6K-EU-G1
Input (PV DC)					
MPP voltage range [V]	120-425				
Max. input voltage [V]	500				
Max. input current per MPP tracker [A]	20		20+20		
Input (battery DC)					
DC voltage range [V]	40-60				
Max. DC voltage [V]	60				
Max. DC current per DC input [A]	70	80	102	112	135
AC connection					
Nominal AC voltage [V]	L/N/PE, 230V, 50/60Hz				
Rated output current [A]	13,0	15,7	20,0	21,8	26,1
Max. output current [A]	14,3	17,3	22,0	24,0	28,7
Nominal output power converter (P _{NINV}) [W]	3000	3600	4600	5000	6000
Rated apparent output power converter [VA]	3000	3600	4600	5000	6000
On-grid battery mode					
P _{sn} (nominal discharge power) [W].	3000	3400	4320	4670	5580
P _{cn} (nominal charging power) [W]	3000	3600	4600	5000	6000
P _{smax} (max. discharge power) [W]	3000	3400	4320	4670	5580
P _{cmax} (max. charging power) [W]	3000	3600	4600	5000	6000
Type	Bidirectional	Bidirectional	Bidirectional	Bidirectional	Bidirectional
Off-grid battery mode					
P _{sn} (nominal discharge power) [W]	3000	3400	4320	4670	5580
P _{smax} (max. discharge power) [W]	3000	3600	4600	5000	6000

Characteristics of the static converter and storage system (SdA)			
Static converter model	DHN-LVEH1P7K-EU-G1	DHN-LVEH1P7.5K-EU-G1	DHN-LVEH1P8K-EU-G1
Input (PV DC)			
MPP voltage range [V]	120-425		
Max. input voltage [V]	500		
Max. input current per MPP tracker [A]	20+20		
Input (battery DC)			
DC voltage range [V]	40-60		
Max. DC voltage [V]	60		
Max. DC current per DC input [A]	157	169	180
AC connection			
Nominal AC voltage [V]	L/N/PE, 230V, 50/60Hz		
Rated output current [A]	30,4	32,6	34,8
Max. output current [A]	33,5	35,9	38,3
Nominal output power converter (P _{NINV}) [W]	7000	7500	8000
Rated apparent output power converter [VA]	7000	7500	8000
On-grid battery mode			
P _{sn} (nominal discharge power) [W].	6480	6930	7300
P _{cn} (nominal charging power) [W]	7000	7500	8000
P _{smax} (max. discharge power) [W]	6480	6930	7300
P _{cmax} (max. charging power) [W]	7000	7500	8000
Type	Bidirectional	Bidirectional	Bidirectional
Off-grid battery mode			
P _{sn} (nominal discharge power) [W]	6480	6930	7300
P _{smax} (max. discharge power) [W]	7000	7500	8000



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-41495-1.03
No. of modules	1-16
Note	
Batteries are not integrated in the inverter and must be installed according to local regulations.	



Testing Location.....:	LCIE China Company Limited		
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Tested by (name, function and signature).....:	Joell Qin	 Joell Qin Test Engineer	 Digitally signed by Joell Qin DN: cn=Joell Qin, o=LCIE CHINA COMPANY LIMITED, ou=New energy, email=joell.qin@bureauveritas.com, c=CN Date: 2026.01.09 16:13:29 +08'00'
Approved by (name, function and signature).....:	Robin Wu	 Robin Wu Project Manager	 Digitally signed by Robin Wu DN: cn=Robin Wu, o=LCIE CHINA COMPANY LIMITED, ou=New Energy, email=robin.wu@bureauveritas.com, c=CN Date: 2026.01.12 14:44:40 +08'00'
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Manufacturer address.....:	4th Floor, Office Building, 1 yao yuan Road, Luyang Industrial Park, Luyang District, Hefei City, Anhui Province, China		
Factory's name	DAH New Energy Technology Co. Ltd		
Factory address.....:	No.1 yao yuan Road, Luyang Industrial Park, Luyang District, Hefei City, Anhui Province, China		

Document History			
Date	Internal reference	Modification / Change / Status	Revision
2025-12-24	Joell Qin	Initial report was written	0
Supplementary information:			



Test items particulars

Equipment mobility: Permanent connection
Operating condition: Continuous
Class of equipment.....: Class I
Protection against ingress of water.....: IP65 according to EN 60529
Mass of equipment [kg]: 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 2025-12-10

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.

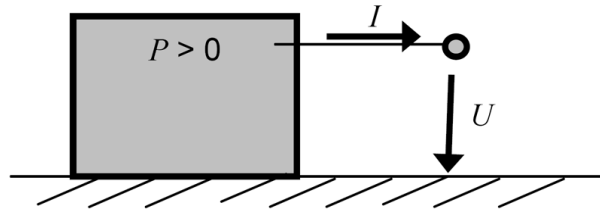
Throughout this report a comma is used as the decimal separator.

- "P_{rE}" for the rated active power:
- "P_{rE}" = $U_n \times I_r \times \cos \varphi$ (single-Phase); $P_{rE} = \sqrt{3} U_n \times I_r \times \cos \varphi$ (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
- "P_{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 [%] = $(Q_{expected} - Q_{E60}) / P_{Emax}$
- "E_{0,2}" 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

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.

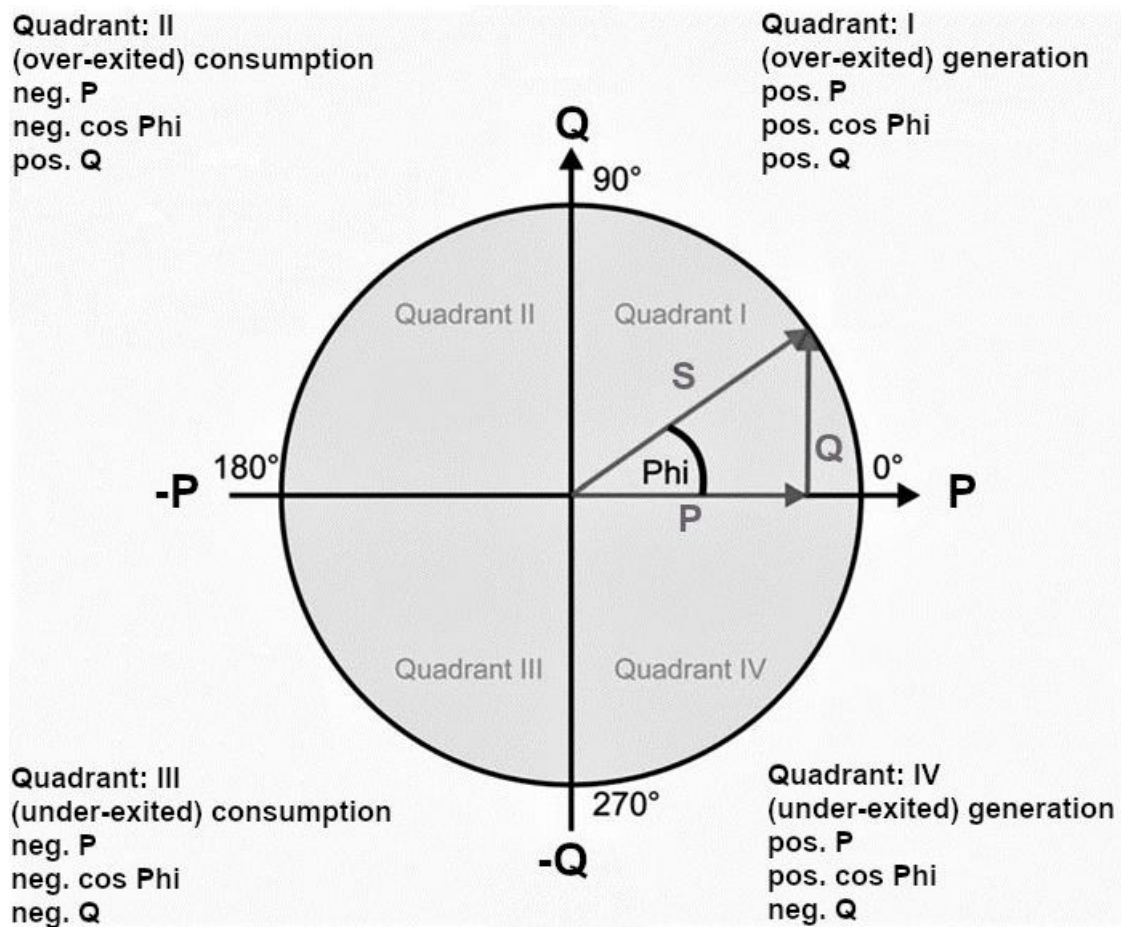


Figure 2

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



This Test Report consists of the following documents

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Copy of marking plate

DAH Solar Hybrid Inverter

Model : DHN-LVEH1P3K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A
Max. PV Input Power	4800W
Max. PV I_{sc}	23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	70A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	13.6/13A
Max. AC Input/Output Current	15/14.3A
AC Input/Output Rated Power	3000W
Max. Apparent Input/Output Power	3300VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	15/14.3A
Max. Apparent Output Power	3300VA
Peak Output Power	6000W,10s

Others

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



S/N : 7

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Made in China

DAH Solar Hybrid Inverter

Model : DHN-LVEH1P3.6K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A
Max. PV Input Power	5760W
Max. PV I_{sc}	23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	80A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	16.4/15.7A
Max. AC Input/Output Current	18/17.3A
AC Input/Output Rated Power	3600W
Max. Apparent Input/Output Power	3960VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	18/17.3A
Max. Apparent Output Power	3960VA
Peak Output Power	7200W,10s

Others

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



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DAH Solar Hybrid Inverter

Model : DHN-LVEH1P4.6K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	7360W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	102A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	20.9/20A
Max. AC Input/Output Current	23/22A
AC Input/Output Rated Power	4600W
Max. Apparent Input/Output Power	5060VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	23/22A
Max. Apparent Output Power	5060VA
Peak Output Power	9200W,10s

Others

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



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Made in China

DAH Solar Hybrid Inverter

Model : DHN-LVEH1P5K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	8000W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	112A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	22.8/21.8A
Max. AC Input/Output Current	25/24A
AC Input/Output Rated Power	5000W
Max. Apparent Input/Output Power	5500VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	25/24A
Max. Apparent Output Power	5500VA
Peak Output Power	10000W,10s

Others

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



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DAH Solar Hybrid Inverter

Model : DHN-LVEH1P6K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	9600W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	135A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	27.3/26.1A
Max. AC Input/Output Current	30/28.7A
AC Input/Output Rated Power	6000W
Max. Apparent Input/Output Power	6600VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	30/28.7A
Max. Apparent Output Power	6600VA
Peak Output Power	12000W,10s

Others

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


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DAH Solar Hybrid Inverter

Model : DHN-LVEH1P7K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	11200W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	157A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	31.8/30.4A
Max. AC Input/Output Current	35/33.5A
AC Input/Output Rated Power	7000W
Max. Apparent Input/Output Power	7700VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	35/33.5A
Max. Apparent Output Power	7700VA
Peak Output Power	14000W,10s

Others

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


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DAH Solar Hybrid Inverter

Model : DHN-LVEH1P7.5K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	12000W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	169A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	34.1/32.6A
Max. AC Input/Output Current	37.5/35.9A
AC Input/Output Rated Power	7500W
Max. Apparent Input/Output Power	8250VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	37.5/35.9A
Max. Apparent Output Power	8250VA
Peak Output Power	15000W,10s

Others

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



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DAH Solar Hybrid Inverter

Model : DHN-LVEH1P8K-EU-G1

PV Input

Max. PV Input Voltage	500V
MPPT Input Range	120V ~ 425V
Max. PV Input Current	20A+20A
Max. PV Input Power	12800W
Max. PV I_{sc}	23A+23A

Battery

Battery Type	Lead-acid or Lithium-ion
Battery Voltage	48V(40V ~ 60V)
Max. Charging /Discharging Current	180A

AC Input/Output

AC Input/Output Voltage	L/N/PE 220/230V
AC Input/Output Frequency	50/60Hz
AC Input/Output Rated Current	36.4/34.8A
Max. AC Input/Output Current	40/38.3A
AC Input/Output Rated Power	8000W
Max. Apparent Input/Output Power	8800VA
AC Power Factor Range	0.8 leading to 0.8 lagging

Load

AC Output Voltage	L/N/PE 220/230V
AC Output Frequency	50/60Hz
Max. AC Output Current	40/38.3A
Max. Apparent Output Power	8800VA
Peak Output Power	16000W,10s

Others

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



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Note:

Example of marking plate

General product information

DANsolar

Hybrid Inverter Series

USER MANUAL

DHN-LVEH1P3/3.6/5/6/7/7.5/8K-EU-G1



General product information

Model	DHN-LVEH1P3K-EU-G1 DHN-LVEH1P3K-BR-G1	DHN-LVEH1P3.6K-EU-G1 DHN-LVEH1P3.6K-BR-G1	DHN-LVEH1P4.6K-EU-G1 DHN-LVEH1P4.6K-BR-G1	DHN-LVEH1P5K-EU-G1 DHN-LVEH1P5K-BR-G1	DHN-LVEH1P6K-EU-G1 DHN-LVEH1P6K-BR-G1	DHN-LVEH1P7K-EU-G1 DHN-LVEH1P7K-BR-G1	DHN-LVEH1P7.5K-EU-G1 DHN-LVEH1P7.5K-BR-G1	DHN-LVEH1P8K-EU-G1 DHN-LVEH1P8K-BR-G1
Battery Input Data								
Battery Type	Lead-acid/Li-Ion							
Battery Voltage Range (V)	40~60V							
Max. Charging Current (A)	70	80	102	112	135	157	169	180
Max. Discharging Current (A)	70	80	102	112	135	157	169	180
Charging Strategy for Li-ion Battery	Self-adaption to BMS							
Number of Battery Input	1							
PV String Input Data								
Max. PV Input Power (W)	4800	5760	7360	8000	9600	11200	12000	12800
Max. PV Input Voltage (V)	500							
Start-up Voltage (V)	120							
MPPT Voltage Range (V)	120-425							
Rated PV input voltage (V)	370							
Max. Operating PV Input Current (A)	20		20+20					
Max. Input Short-Circuit Current (A)	23							
No. of MPP Trackers/ No. of Strings MPP Tracker	1/1		2/1+1					
AC Input/Output Data								
Rated AC Input/Output Active Power (W)	3000	3600	4600	5000	6000	7000	7500	8000
Max. AC Input/Output Apparent Power (VA)	3300	3960	5060	5500	6600	7700	8250	8800
Rated AC Input/Output Current (A)	13.6/13	16.4/15.7	20.9/20	22.8/21.8	27.3/26.1	31.8/30.4	34.1/32.6	36.4/34.8
Max. AC Input/Output Current (A)	15/14.3	18/17.3	23/22	25/24	30/28.7	35/33.5	37.5/35.9	40/38.3
Max. Continuous AC Passthrough (grid to load)(A)	27	33	42	46	54			
Peak Power (off-grid) (W)	2 times of rated power for 10s							
Power Factor Adjustment Range	0.8 leading to 0.8 lagging							
Rated Input/Output Voltage/Range (V)	220/230 0.85Un~1.1Un							
Rated Input/Output Grid Frequency/Range(Hz)	50/45-55, 60/55-65							
Grid Connection Form	L+N+PE							
Total Current Harmonic Distortion THDi	<2% (of nominal power)							
DC Injection Current	<0.5% In							
Efficiency								
Max. Efficiency	97.60%							
Euro Efficiency	96.50%							
MPPT Efficiency	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 level							
Surge Protection Level	TYPE II(DC), TYPE II(AC)							
Interface								
Communication Interface	RS485/CAN							
Monitor Mode	WiFi							
General Data								
Operating Temperature Range (°C)	-40 to +60							
Permissible Ambient Humidity	0-100%							
Permissible Altitude	3000m							
Ingress Protection(IP) Rating	IP65							
Inverter Topology	Non-Isolated							
Over Voltage Category	OVC II(DC), OVC III(AC)							
Cabinet Size (WxHxD mm)	330*563*223							
Weight (kg)	23.7				24.9			
Type of Cooling	Natural cooling				Intelligent Air Cooling			
Warranty	5 Years/10 Years the Warranty Period Depends the Final Installation Site of Inverter, More Info Please Refer to Warranty Policy							
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							

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 PV array or Grid through the inversion circuit, battery management unit is integrated in External Energy storage system.

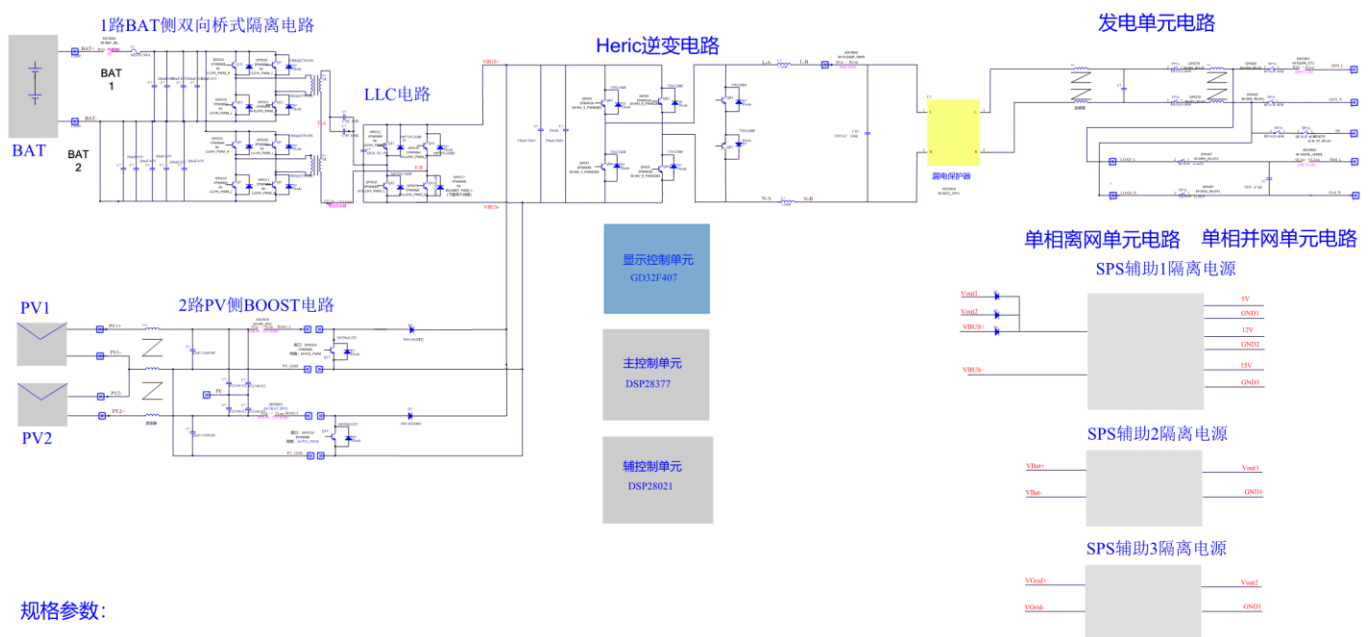
The Solar inverter is a three-phase type, the unit is providing EMC filtering at the output toward mains. The unit doesn't provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and two relays. This assures that the 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(U28) and slave DSP(U27).

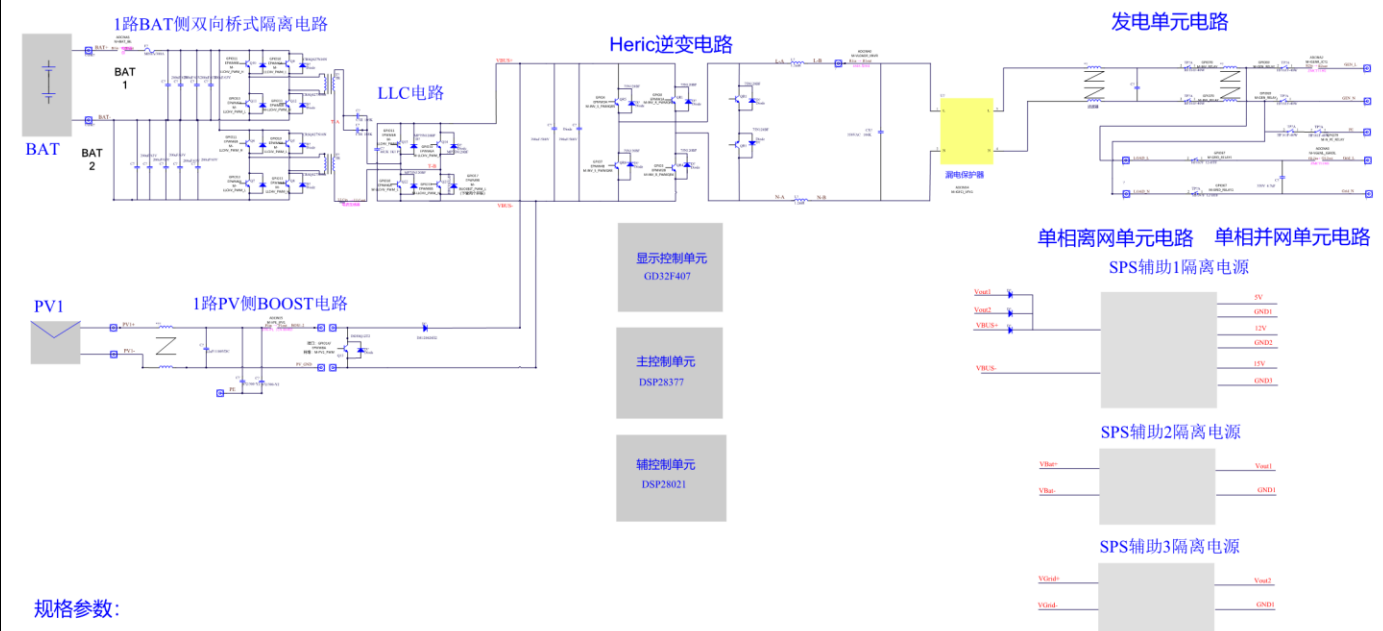
The main DSP(U28) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, in addition it tests RCMU circuit before each start up.

The slave DSP(U27) is used for controlling the relays, measuring the voltage, frequency, inject a dc AC current, the residual current, and communicating with the master DSP(U28). 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(U28), Slave DSP(U27) can open the relays.



Block diagram of DHN-LVEH1P7K-EU-G1, DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-EU-G1



Block diagram of DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1, DHN-LVEH1P5K-EU-G1, DHN-LVEH1P6K-EU-G1



Differences of the models in the series			
Inverter model	DHN-LVEH1P7K-EU-G1, DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-EU-G1	DHN-LVEH1P4.6K-EU-G1, DHN-LVEH1P5K-EU-G1, DHN-LVEH1P6K-EU-G1	DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1
Number of input	2		1
Number of String per MPPT	2/1+1		1+1
Number of External fan	2	None	None
Number of internal fan	1	1	None



The product was tested on

The products were tested on

Hardware: LVEH1P3/3,6/4,6/5/6/7/7,5/8K

Software: Master: 012D; Slave: 0106

All tests were performed on EUT DHN-LVEH1P8K-EU-G1 and are valid for the whole series.

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	

Test Results

CEI 0-21

Clause	Requirement – Test	Verdict
A.2	Features of the SPI	P
A.3	Setting ranges for the SPI	P
A.3.1	Minimum phase voltage protection [27]	P
A.3.2	Maximum phase voltage protection [59]	P
A.3.3	Minimum frequency protection [81<]	P
A.3.4	Maximum frequency protection [81>]	P
A.4.1	Features of the relay test box	N/A
A.4.2	LV Network Simulator Features	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	P

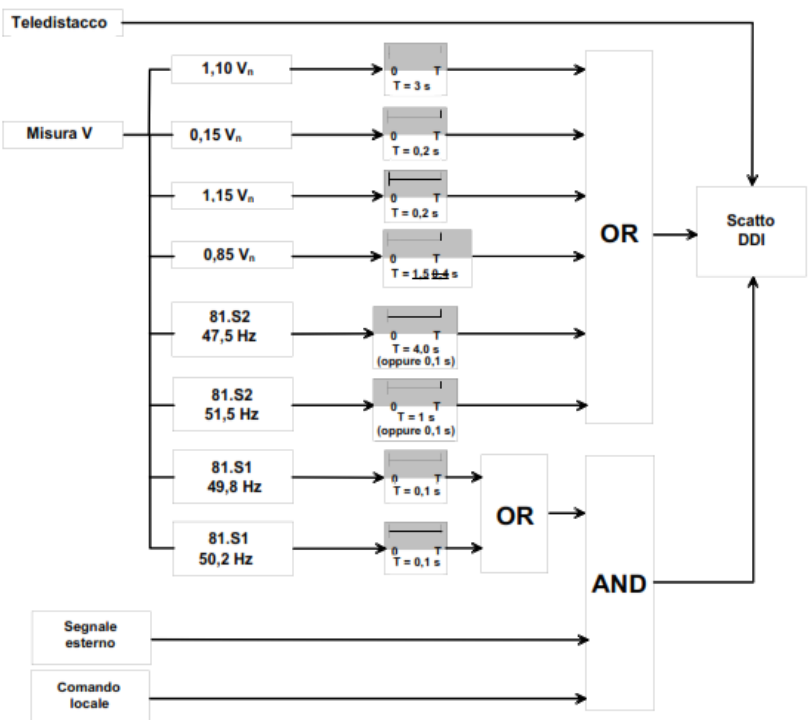
Note:

* Grid simulator according to A.4.2 used for testing.

A.2	Features of the SPI	P
The SPI provides		
- a minimum voltage protection function with two thresholds;		P
- a maximum voltage protection function with two thresholds;		P
- a minimum frequency protection function with two thresholds;		P
- a maximum frequency protection function with two thresholds;		P
- a signal processing function in the case of installation of a dedicated device (protective relay);		P
- a presence signal processing function;		P
- a self-diagnosis function;		P
- 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;		P
- an opening circuit of the interface device;		P
- 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.		N/A
The rated voltage and frequency for all protective functions are:		
Rated voltage: (230 / 400) V ⁽⁶⁴⁾		P
Nominal frequency: 50,0 Hz		P
SPI accuracies are:		
Voltage: $\pm 1\% V_n$		P
Frequency: ± 20 mHz		P
⁽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.		

A.3	Setting ranges for the SPI						P
It must be possible to change the intervention thresholds and times at the request of the DSO, so the SPI must be programmed 'by default' with the thresholds and times provided in Table 13 of the CEI, but it must always be possible to change thresholds and times with the steps and fields described in A.3.1, A.3.2, A.3.3 and A.3.4.							
The intervention thresholds and times are adjustable							P
A.3.1	Minimum phase voltage protection [27] Maximum phase voltage protection [59] Minimum frequency protection [81<] Maximum frequency protection [81>]						P
A.3.2							
A.3.3							
A.3.4							
Installations for unit output power ≥ 800 W							
Parameter	Threshold value			Tripping time			
	Default setting	Setting range	Step size	Default setting	Setting range	Step size	
Overvoltage (59.S1)	1,10 V _n	1 –1,20 V _n	0,01 V _n	3,0 s	≤ 3 s	--*	P
Overvoltage (59.S2)	1,15 V _n	1 –1,30 V _n	0,01 V _n	0,2 s	0,05 – 1,0 s	0,05 s	P
Undervoltage (27.S1)	0,85 V _n	0,2 – 1,0 V _n	0,05 V _n	1,5 s	0,05 – 5,0 s	0,05 s	P
Undervoltage (27.S2)	0,15 V _n	0,05 – 1,0 V _n	0,05 V _n	0,2 s	0,05 – 5,0 s	0,05 s	P
Overfrequency (81>.S1)	50,2 Hz	50,0 – 52,0 Hz	0,1 Hz	0,1 s	0,05 – 5,0 s	0,05 s	P
Underfrequency (81<.S1)	49,8 Hz	47,0 – 50,0 Hz	0,1 Hz	0,1 s	0,05 – 5,0 s	0,05 s	P
Overfrequency (81>.S2)	51,5 Hz	50,0 – 52,0 Hz	0,1 Hz	0,1 s	0,05 – 5,0 s	0,05 s	P
Underfrequency (81<.S2)	47,5 Hz	47,0 – 50,0 Hz	0,1 Hz	0,1 s	0,05 – 5,0 s	0,05 s	P
Note: (*) Maximum voltage protection (59.S1) must be realised as protection based on the calculation of the average value of 10 min in accordance with EN 61000-4-30. At the latest every 3,0 s, a new mean value of the previous 10 min must be created and compared with the setting value for protection 59.S1 in Table 13. The protection must be insensitive to frequency transients of 0,040 s or less.							

CEI 0-21		
Clause	Requirement – Test	Verdict
A.4.3	Functional tests on the interface protection system (SPI)	
A.4.3.1	Test procedure for maximum voltage and frequency functions	P
A.4.3.2	Test procedure for minimum voltage and frequency functions	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

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: - checking all functions; - measuring the accuracy of tripping thresholds; - measuring the accuracy of trip times; - 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); - 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).		
SPI Modes		
Transient mode: External signal: in transient mode (stand-alone operation, in the absence of an 'always on' communication system set up by the DSO), the status of this logic input must be permanently high (setting). Via the local command: - in the low state (value 0), permanent operation in permissive thresholds is achieved; - in the high state (value 1), permanent operation in restrictive thresholds is achieved (linked to possible DSO requirements). In this operating mode, the tripping time of the protections 81<.S2 and 81>.S2 must be 0,1 s. Final mode: External signal: the status of this logic input will be: - low (value 0) in the case of a correct operational communication network - high (value 1) in the case of a temporarily non-operational communication network - high (value 1) in the event of an external command sent by the DSO (e.g. in the event of a fault on the DSO's MV grid) The local control must be set permanently in the high state (value 1). In this operating mode, the tripping time will be 1 s for maximum frequency protection (81>.S2) and 4,0 s for minimum frequency protection (81<.S2).		
		

A.4.3.1 A.4.3.2	Test procedure for maximum voltage and frequency functions Test procedure for minimum voltage and frequency functions						P
	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			
Setup at SPI	Final mode of SPI (use of SPI based on local readings and external information/commands)						
Temperature [°C]	20°C ± 2°C						
Limit [Hz]	47,50			51,50			
Measurement of trip 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]	0,106	0,1077	0,107	0,108	0,107	0,102	
Temperature [°C]	-10°C ± 2°C						
Limit [Hz]	47,50 Hz			51,50 Hz			
Measurement of trip 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]	0,105	0,109	0,104	0,117	0,119	0,117	
Temperature [°C]	+55°C ± 2°C						
Limit [Hz]	47,50 Hz			51,50 Hz			
Measurement of trip 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]	0,113	0,111	0,111	0,113	0,112	0,110	
Assessment criterion:							
For frequencies between 49,8 Hz and 50,2 Hz (± 0,1% f _n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.							
Limit values:							
• ≤ 1% V_n for voltage tripping thresholds (≤ 5% V_n field verification tests) • ± 20 mHz for the frequency tripping thresholds • ≤ 3% ± 0,020 s for the tripping times • ≤ 1% V_n for the voltage reset thresholds • ± 20 mHz for the frequency reset thresholds • variation of the error during the repetition of the tests - ≤ 2% for voltages - ± 20 mHz for the frequency thresholds - ≤ 1% ± 0,020 s for the tripping times							

A.4.3.1 A4.3.2	Test procedure for maximum voltage and frequency functions Test procedure for minimum voltage and frequency functions						P
	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			
Setup at SPI	Transient mode of SPI (stand-alone, use of local information only)						
Temperature [°C]	20 ± 2°C						
Limit [Hz]	49,80			50,20			
Measurement of trip value [Hz]	49,80	49,80	49,80	50,20	50,20	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,114	0,117	0,116	0,113	0,112	0,110	
Temperature [°C]	-10 ± 2°C						
Limit [Hz]	49,80			50,20			
Measurement of trip value [Hz]	49,80	49,80	49,80	50,20	50,20	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,119	0,118	0,118	0,117	0,119	0,117	
Temperature [°C]	+55°C ± 2°C						
Limit [Hz]	49,80			50,20			
Measurement of trip value [Hz]	49,80	49,80	49,80	50,20	50,20	50,20	
Disconnection limit [s]	0,100			0,100			
Measurement the trip time [s]	0,108	0,106	0,110	0,108	0,102	0,102	
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 between 49,8 Hz and 50,2 Hz (± 0,1% f _n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.							
Limit values:							
• ≤ 1% V_n for voltage tripping thresholds (≤ 5% V_n field verification tests) • ± 20 mHz for the frequency tripping thresholds • ≤ 3% ± 0,020 s for the tripping times • ≤ 1% V_n for the voltage reset thresholds • ± 20 mHz for the frequency reset thresholds • variation of the error during the repetition of the tests - ≤ 2% for voltages - ± 20 mHz for the frequency thresholds - ≤ 1% ± 0,020 s for the tripping times							

A.4.3.1	Test procedure for maximum voltage and frequency functions			P
A.4.3.2	Test procedure for minimum voltage and frequency functions			
		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]		$V_n \rightarrow 0,15 V_n$		
Temperature [°C]		20 ± 2°C		
Limit [V]		34,5 V		
Measurement of trip value [V]		36,1	36,5	36,3
Disconnection limit [s]		0,200		
Measurement the trip time [s]		0,208	0,208	0,207
Temperature [°C]		-10 ± 2°C		
Limit [V]		34,5 V		
Measurement of trip value [V]		36,1	36,3	36,1
Disconnection limit [s]		0,200		
Measurement the trip time [s]		0,216	0,212	0,210
Temperature [°C]		+55 ± 2°C		
Limit [V]		34,5 V		
Measurement of trip value [V]		36,1	36,3	36,1
Disconnection limit [s]		0,200		
Measurement the trip time [s]		0,203	0,204	0,206
Assessment criterion:				
<u>Limit values:</u>				
• ≤ 1% V_n for voltage tripping thresholds (≤ 5% V_n field verification tests) • ± 20 mHz for the frequency tripping thresholds • ≤ 3% ± 0,020 s for the tripping times • ≤ 1% V_n for the voltage reset thresholds • ± 20 mHz for the frequency reset thresholds • variation of the error during the repetition of the tests - ≤ 2% for voltages - ± 20 mHz for the frequency thresholds - ≤ 1% ± 0,020 s for the tripping times				
Note:				
The indicated value for the tripping time must be adopted when the total power is greater than 11,08 kW, 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 V_n and t = 0,150 s.				

A.4.3.1 A.4.3.2	Test procedure for maximum voltage and frequency functions Test procedure for minimum voltage and frequency functions						P
		Under voltage (27.S1)			Over voltage (59.S2)		
A) STEPS for trip value [V to V]		1,1 threshold → decrease by max 5,0 V steps			0,9 threshold → increase by max 5,0 V steps		
D) STEP for trip time [V to V]		1,1 threshold → 0,9 threshold			0,9 threshold → 1,01 threshold		
Temperature [°C]		20 ± 2°C					
Limit [V]		195,5			264,5		
Measurement of trip value [V]		196,5	196,7	196,7	264,7	264,6	264,7
Disconnection limit [s]		1,500			0,200		
Measurement the trip time [s]		1,517	1,518	1,519	0,210	0,214	0,212
Temperature [°C]		-10 ± 2°C					
Limit [V]		195,5			264,5		
Measurement of trip value [V]		196,5	196,7	196,7	264,7	264,6	264,7
Disconnection limit [s]		1,500			0,200		
Measurement the trip time [s]		1,517	1,516	1,519	0,210	0,214	0,216
Temperature [°C]		+55 ± 2°C					
Limit [V]		195,5			264,5		
Measurement of trip value [V]		196,5	196,7	196,7	264,7	264,6	264,7
Disconnection limit [s]		1,500			0,200		
Measurement the trip time [s]		1,515	1,510	1,520	0,208	0,206	0,209
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:							
<u>Limit values:</u>							
• ≤ 1%V_n for voltage tripping thresholds (≤ 5% V_n field verification tests) • ± 20 mHz for the frequency tripping thresholds • ≤ 3% ± 0,020 s for the tripping times • ≤ 1% V_n for the voltage reset thresholds • ± 20 mHz for the frequency reset thresholds • variation of the error during the repetition of the tests - ≤ 2% for voltages - ± 20 mHz for the frequency thresholds - ≤ 1% ± 0,020 s for the tripping times							

A.4.3.1 A.4.3.2		Measuring the rise-in voltage protection as a running 10-minute mean value		P
(59.S1) moving average measurement over 10min according to EN 61000-4-30				
		Disconnection time [s]		Limit [s]
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	496,4		≤ 600
	Phase 2	N/A		
	Phase 3	N/A		
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	N/A		
	Phase 3	N/A		
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	323,4		The disconnection time should be about 50 % of the value measured in a). *
	Phase 2	N/A		
	Phase 3	N/A		
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.				

A.4.3.3.1		Insensitivity to harmonics of the frequency relay					P	
			Under frequency			Over frequency		
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		
			(81<.S2)			(81>.S2)		
Setup at SPI			Transient mode of SPI (stand-alone, use of local information only)					
Limit [Hz]			47,50			51,50		
Measurement of trip 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]			0,118	0,114	0,116	0,116	0,112	0,105
			(81<.S1)			(81>.S1)		
Setup at SPI			Transient mode of SPI (stand-alone, use of local information only)					
Limit [Hz]			49,80			50,20		
Measurement of trip value [Hz]			49,80	49,80	49,80	50,20	50,20	50,20
Disconnection limit [s]			0,100			0,100		
Measurement the trip time [s]			0,110	0,120	0,116	0,111	0,104	0,111
Test:								
The test setup for the harmonic distortion, was set with the following 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								
Assessment criterion:								
Limit values								
• ≤ 1% V_n for voltage tripping thresholds (≤ 5% V_n field verification tests) • ± 20 mHz for the frequency tripping thresholds • ≤ 3% ± 0,020 s for the tripping times • ≤ 1% V_n for the voltage reset thresholds • ± 20 mHz for the frequency reset thresholds • variation of the error during the repetition of the tests - ≤ 2% for voltages - ± 20 mHz for the frequency thresholds - ≤ 1% ± 0,020 s for the tripping times								

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]	0,028	

Note:

* Response time from receiving the remote tripping signal until the Interface Protection (PI) transmits the trip signal to the Interface Device (DDI).

The protection interface is allowed have a maximum delay of the remote tripping signal from receiving to transmitting to the DDI of 0.050 s.

Graph





A.4.3.3.3	Communication Signal		P
Frequency step	50,00 Hz → 0,99·threshold (81<.S2) hold at least 5,0 s	50,00 Hz → 1,01·threshold (81>.S2) hold at least 2,0 s	
Setup at SPI	Transient mode of SPI (stand-alone, use of local information only)		
	Underfrequency (81<.S2)	Overfrequency (81>.S2)	
Setting value of trip threshold [Hz]	47,50	51,50	
Setting value of trip time [s]	4,000	1,000	
Measured value of the trip time [s]	EUT trip at 81<.S1	EUT trip at 81>.S1	
	Underfrequency (81<.S1)	Overfrequency (81>.S1)	
Setting value of trip threshold [Hz]	49,80	50,20	
Setting value of trip time [s]	0,100	0,100	
Measured value of the trip time [s]	0,111	0,114	

A.4.3.4	Verification of insensitivity to the frequency derivative				P
		Start and End Frequency [Hz]	Change	Confirm	
Step 1	Positive Frequency drift	47,550 – 51,450	+2,5 Hz/s	No trip and inverter continue operation	
Step 2	Negative Frequency drift	51,450 – 47,550	-2,5 Hz/s	No trip and inverter continue operation	
Step 3	Positive Frequency drift	47,550 – 51,450	+2,5 Hz/s	No trip and inverter continue operation	
Step 4	Negative Frequency drift	51,450 – 47,550	-2,5 Hz/s	No trip and inverter continue operation	
Step 5	Positive Frequency drift	47,550 – 51,450	+2,5 Hz/s	No trip and inverter continue operation	
Step 6	Negative Frequency drift	51,450 – 47,550	-2,5 Hz/s	No trip and inverter continue operation	
Step 7	Positive Frequency drift	47,550 – 51,450	+2,5 Hz/s	No trip and inverter continue operation	
Step 8	Negative Frequency drift	51,450 – 47,550	-2,5 Hz/s	No trip and inverter continue operation	
Step 9	Positive Frequency drift	47,550 – 51,450	+2,5 Hz/s	No trip and inverter continue operation	
Step 10	Negative Frequency drift	51,450 – 47,550	-2,5 Hz/s	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 0,005 s, 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 0,005 s 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 $12,5 \text{ mHz} / 0,005 \text{ s} = 2,5 \text{ Hz/s}$.

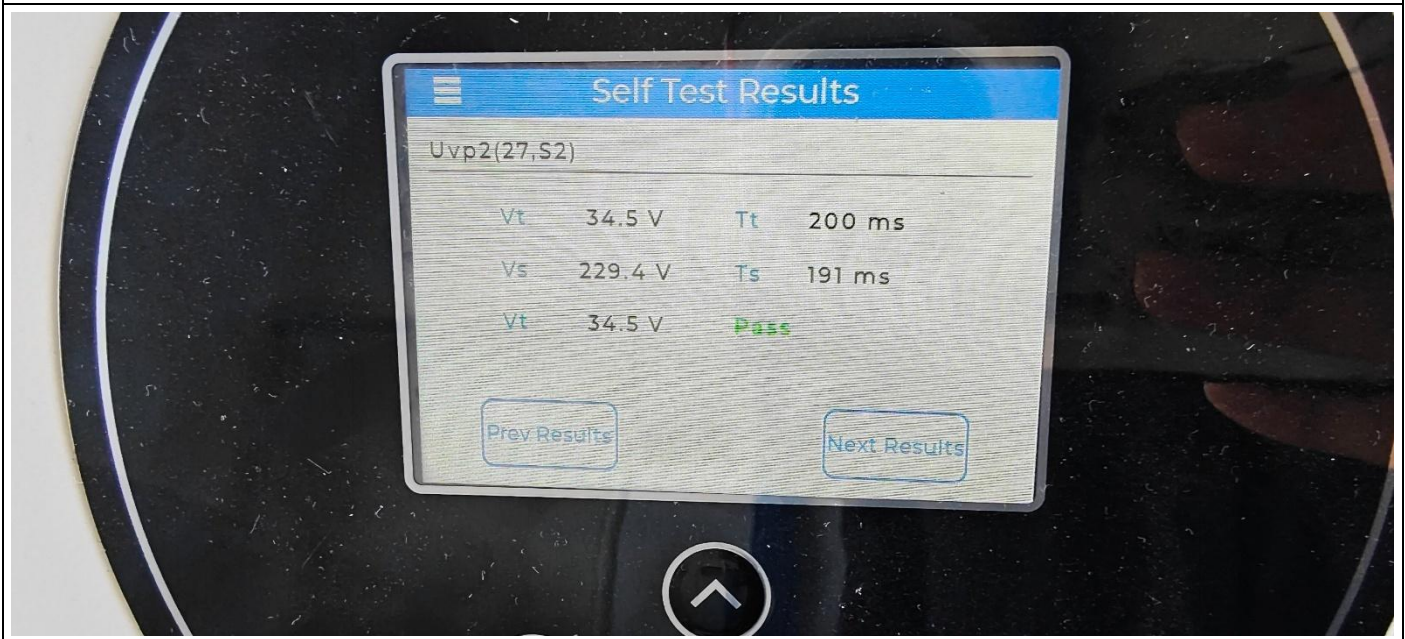
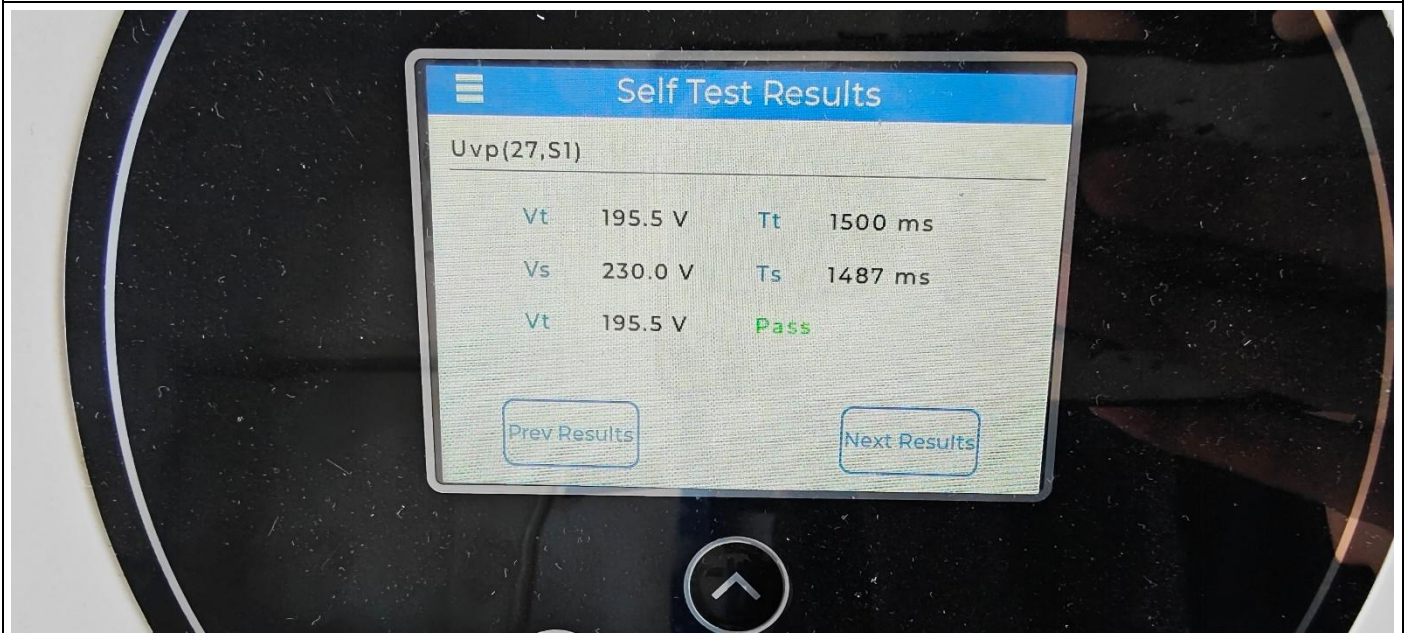
A.4.4	Self-test	P
Self-test function: If the interface protection functions are integrated in the inverter, at least one self-test system must be provided which checks the maximum/minimum frequency and maximum/minimum voltage functions provided in the interface protection system (SPI), as described below: • for each frequency and voltage protection function, the tripping threshold varies linearly upward or downward with a slope of $\leq 0,05 \text{ Hz/s}$ or $\leq 0,05 \text{ V}_n/\text{s}$ 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.		

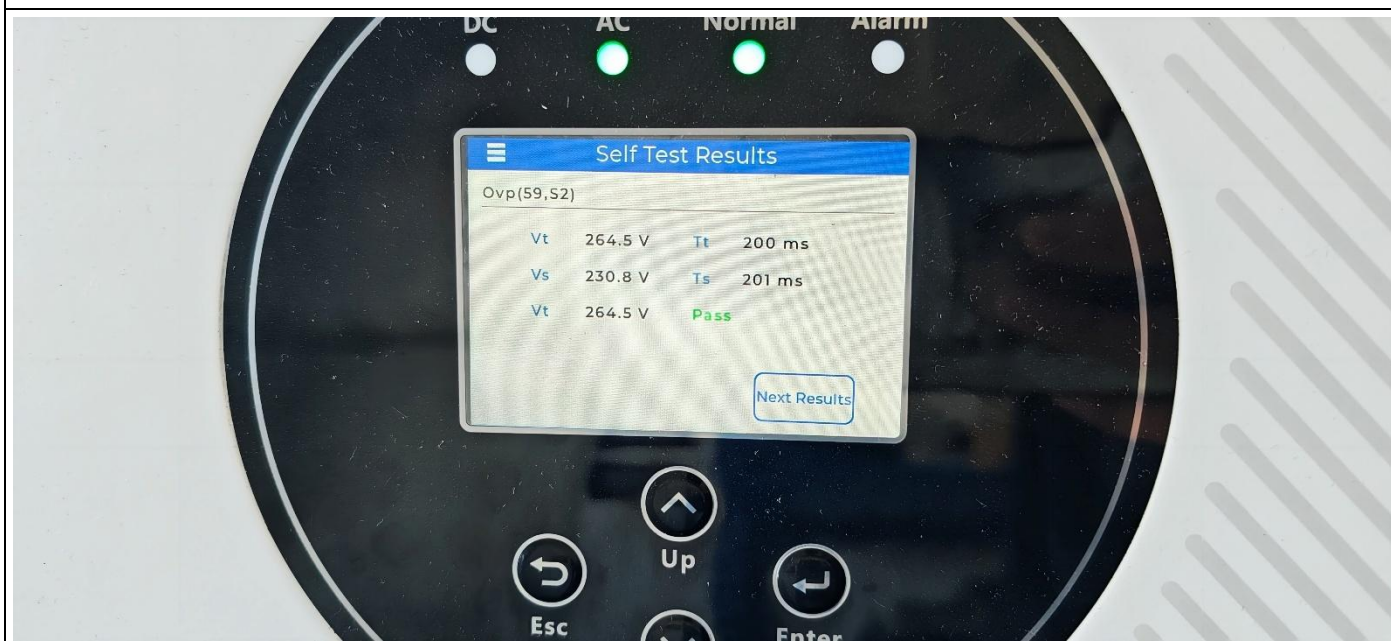
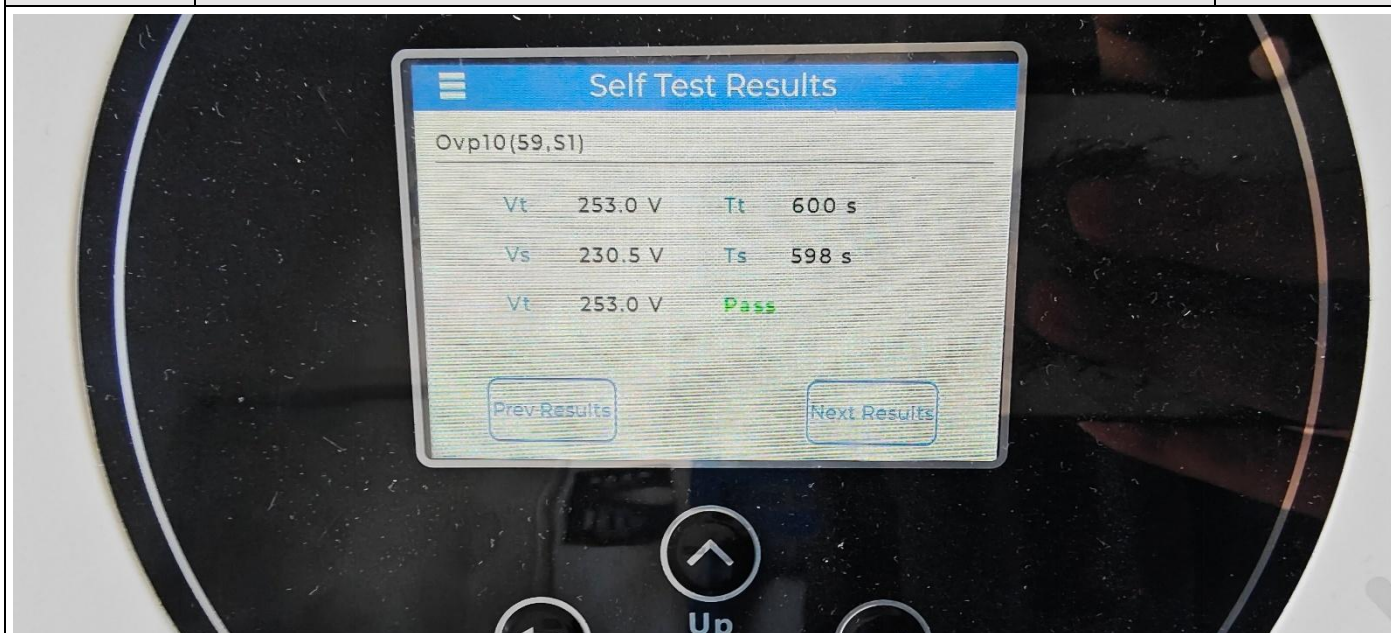
A.4.4

Self-test

P

Description of the Self-test

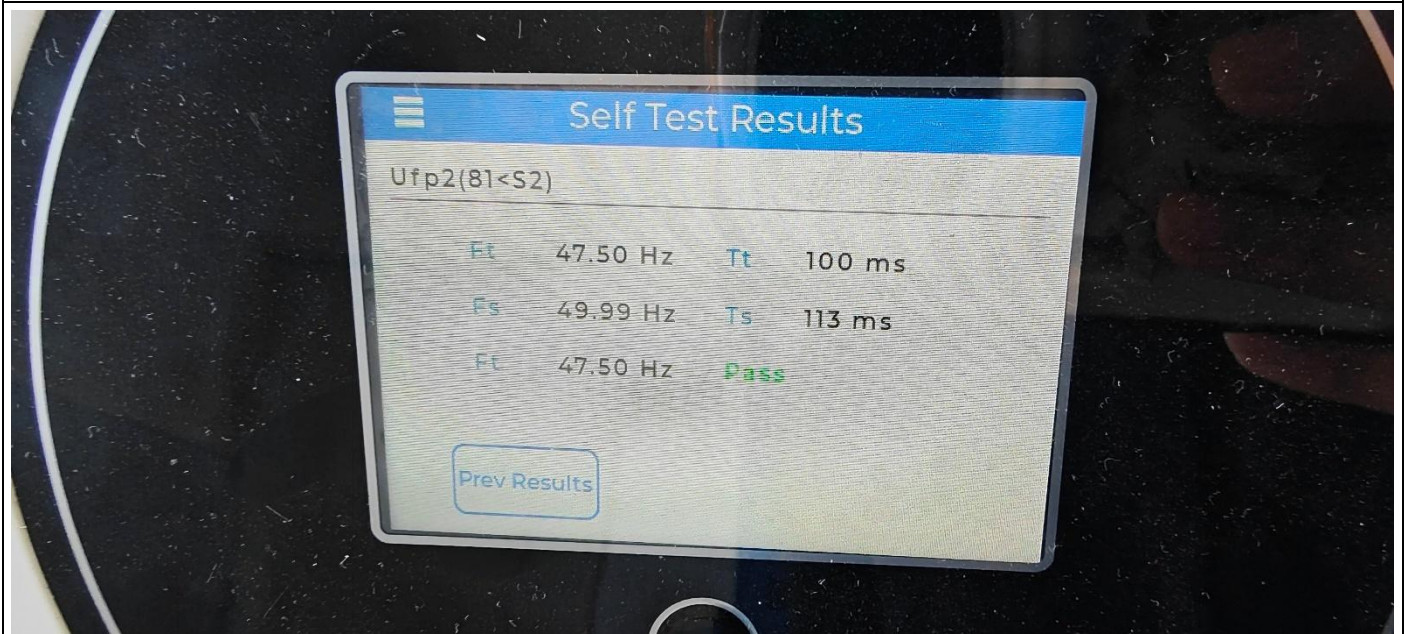
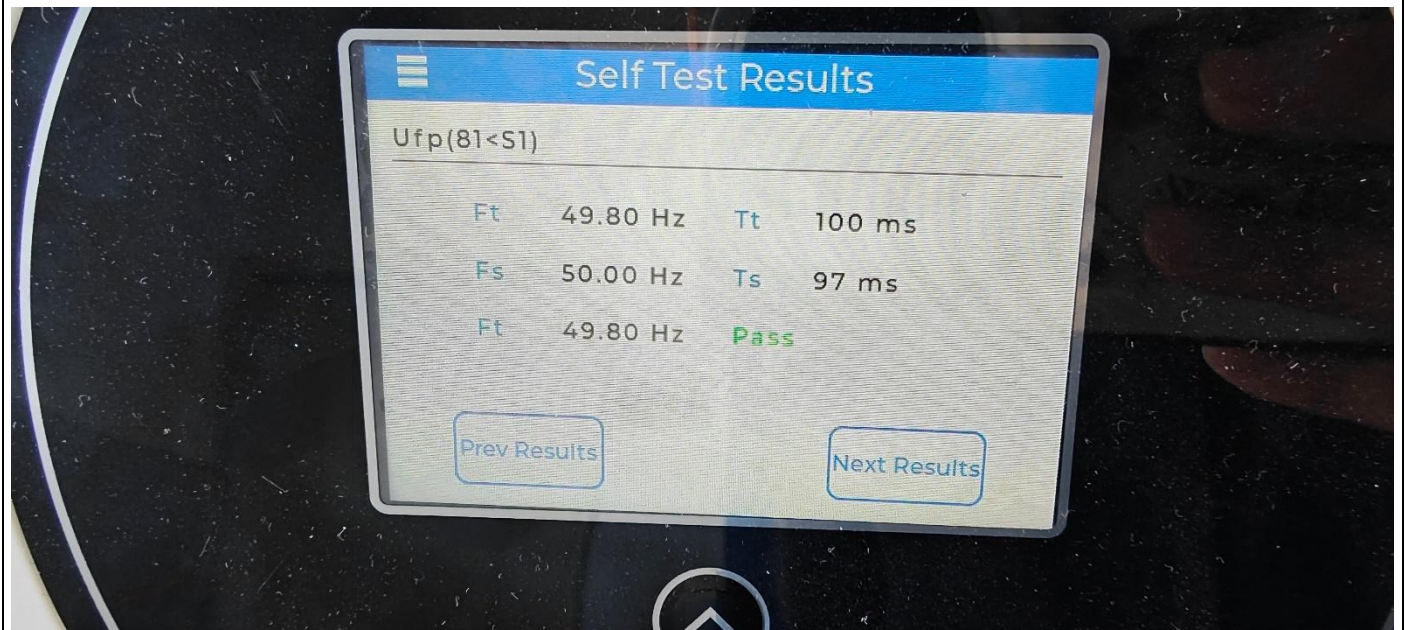


A.4.4**Self-test****P**

A.4.4

Self-test

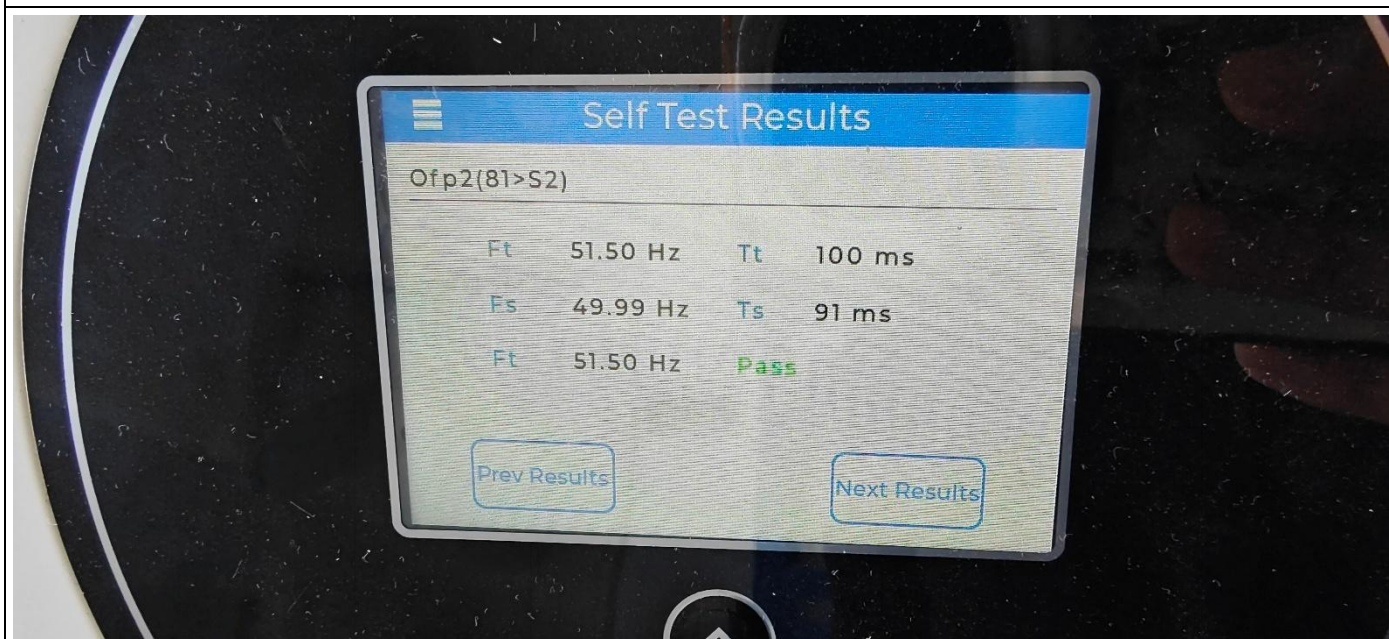
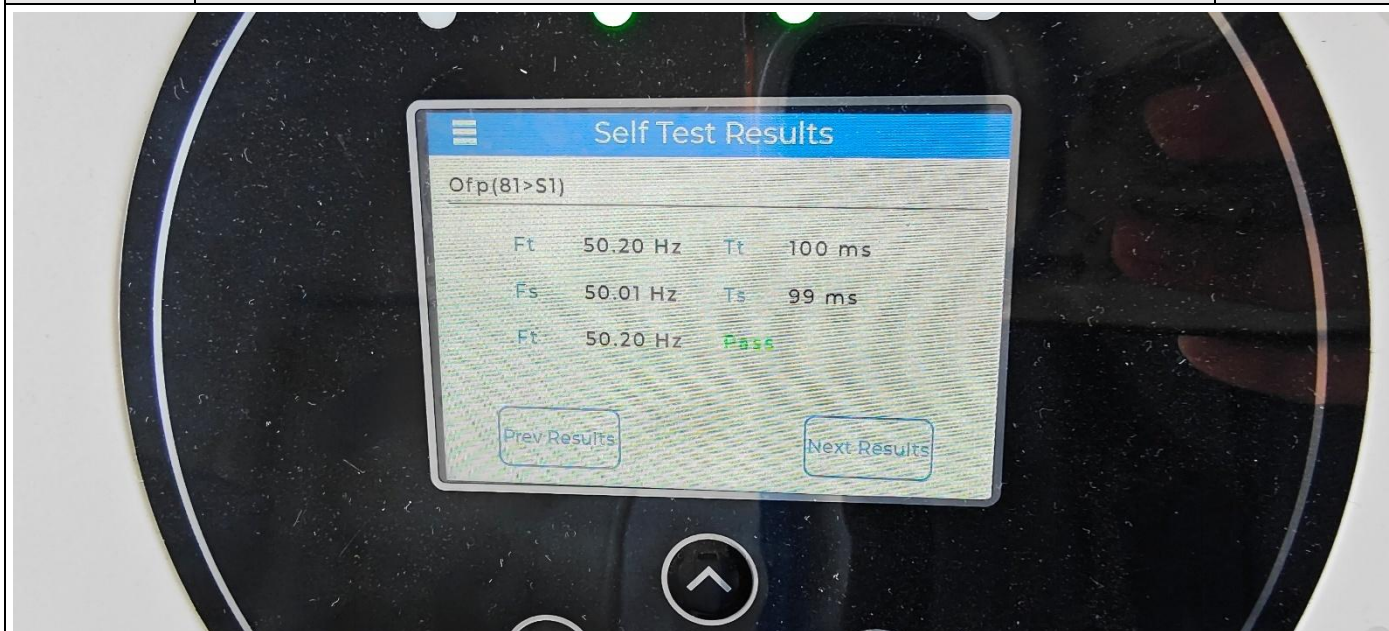
P



A.4.4

Self-test

P



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							
4.4		Testing in single fault condition					P
		ambient temperature (°C)			25		--
Component No.	Fault	Test Voltage (V)	Test Time	Fuse No.	Fuse Current (A)	Result	
R59	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
C234	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
R25	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
C12	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
C12	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
R125	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
R125	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, PV voltage sampling is 0 and no power out, BAT and grid normal operating, no hazard, no fire, no damage.	
R115	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
C264	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
C221	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
R94	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
C212	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.	
R196	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Leakage current" error, no hazard, no fire, no damage.	

A.4.5		Single fault tolerance					P
Q31, B-E	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Leakage current" error, no hazard, no fire, no damage.	
Q31, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Leakage current" error, no hazard, no fire, no damage.	
R195	Open before start up	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Leakage current" error, no hazard, no fire, no damage.	
Q13, G-E (PV)	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q13, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q15, G-E (INV)	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q15, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q16, G-E	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q16, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q6, G-E (LLC)	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q6, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q1, G-E (LLC)	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
Q1, E-C	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min			EUT shut down, "Fault" error, no hazard, no fire, no damage.	
RY1 pin3-pin4(INV)	Short before start up	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
RY2 Pin3-pin4(GRID)	Short before start up	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
RY6 Pin3-pin4(GEN)	Short before start up	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	

A.4.5		Single fault tolerance					P
RY1 (main) Pin3-pin4	Short before start up	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
C253	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U43 (MAIN) Pin1-pin2	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U37 (BAT) Pin1-pin2	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U2 (AC) Pin1-pin2	Open	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U43 Pin1-pin2	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U37 Pin1-pin2	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
U2 Pin1-pin2	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.	
T2 Pin7-8	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin18-19	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin33-34	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin23-24	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin4-5	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin2-3	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
T3 Pin1-2	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
L and N together	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down immediately, short-circuit current: rms: 42,5 A, no damage, no hazard, no fire	

A.4.5		Single fault tolerance					P
	L to ground	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.
	N to ground	Short	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.
	Grounding	Disconnected	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.
	DC side feedback current	AC short circuit	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	No Backfeed current.
	AC side feedback current	DC short circuit	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	No Backfeed current.
	AC output	Overload 41,7A	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	1 h	-	-	EUT Protect when short circuit time meets requirements if current is more than 42 A
	Internal fan	Stalling	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT report and power to grid dropped to 6,27 kW, no hazard, no fire, no damage.
	Internal fan	Disconnected	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT report and power to grid dropped to 6,27 kW, no hazard, no fire, no damage.
	External fan	Stalling	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT report and power to grid dropped to 6,27 kW, no hazard, no fire, no damage.
	External fan	Disconnected	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT report and power to grid dropped to 6,27 kW, no hazard, no fire, no damage.
	PV-/+	Reverse	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT shut down, "Fault" error, no hazard, no fire, no damage.
	L/N	Reverse	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.
	BAT	Reverse	PV: 360 Vdc Grid: 230 Vac BAT: 50 Vdc	10 min	-	-	EUT normal operating, no hazard, no fire, no damage.
supplementary information:							
Addendum – Shutdown device							
Each active phase can be switched, (L and N)							Yes/No
If no galvanic separation between AC and DC (PV): Two relays in series on each active phase are necessary to fulfil the basic insulation or simple separation based on the PV working voltage.							Two relays in series in each line and neutral



A.4.5	Single fault tolerance	P
Note: The errors in the control circuit simulate that the safety is even ensured during a single fault.		
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.		



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:



A.4.7		Climatic compatibility tests		P
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°C / +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.				
A: EUT not damaged and can be operated as expected during and after the test.				
B: EUT not damaged and can be operated as expected after the test.				
Note:				



A.4.8	Insulation tests		P
Rigidity of electricity			
Location	Test voltage	Result	
AC to PE	2,8 kV	No breakdown of insulation	
DC to PE	2 kV	No breakdown of insulation	
Impulse test			
AC and DC inputs	4 kV (1,2 / 50 μs)	No breakdown of insulation	
Measurement of the insulation resistance			
AC and DC inputs	> 100 MΩ at 500 Vdc	> 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	> 100 MΩ at 500 Vdc	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 2000 m.			



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		1,0 s	No breakdown
Note: No external protectors by the meaning of this clause present.			



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



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: The Inverter is a single-phase inverter and not intended for the use as multi-inverter application above 6 kW per phase.		

CEI 0-21		
Clause	Requirement – Test	Verdict
B.1	Tests on the inverter	P
a)	Harmonic emission	P
b)	Harmonic emission exceeding 75 A 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)	N/A
	Checking insensitivity to overvoltage dips (OVRT capability)	N/A
B.1.6	Checking the insensitivity to automatic reclosing during phase accordance	P



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (20°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2643,9		5287,3		7995,1		
AC Voltage [V]	229,92		230,84		231,97		
AC Current [A]	11,63		23,01		34,56		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	2,677		4,863		3,475		
PWHD [%]	0,606		0,833		0,617		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,521	--	22,900	--	34,441	--	-
2nd	0,089	0,256	0,356	1,025	0,487	1,400	8,00
3rd	0,898	2,580	1,631	4,690	1,094	3,146	N/A
4th	0,036	0,104	0,018	0,053	0,058	0,167	4,00
5th	0,175	0,503	0,163	0,469	0,124	0,357	10,70
6th	0,015	0,042	0,033	0,094	0,048	0,137	2,67
7th	0,122	0,351	0,184	0,528	0,017	0,049	7,20
8th	0,026	0,075	0,045	0,130	0,030	0,086	2,00
9th	0,040	0,115	0,054	0,156	0,005	0,014	N/A
10th	0,009	0,025	0,008	0,022	0,030	0,086	1,60
11th	0,037	0,105	0,006	0,017	0,011	0,033	3,10
12th	0,021	0,061	0,025	0,072	0,022	0,062	1,33
13th	0,028	0,080	0,049	0,141	0,011	0,033	2,00
14th	0,005	0,015	0,015	0,043	0,019	0,055	N/A
15th	0,013	0,037	0,029	0,083	0,013	0,036	N/A
16th	0,017	0,049	0,011	0,032	0,020	0,058	N/A
17th	0,010	0,030	0,002	0,006	0,006	0,018	N/A
18th	0,003	0,010	0,018	0,051	0,015	0,043	N/A
19th	0,012	0,035	0,020	0,057	0,006	0,017	N/A
20th	0,008	0,023	0,009	0,027	0,013	0,037	N/A
21th	0,010	0,029	0,022	0,062	0,007	0,021	N/A
22th	0,004	0,011	0,003	0,009	0,011	0,033	N/A
23th	0,009	0,026	0,006	0,016	0,008	0,023	N/A
24th	0,003	0,008	0,006	0,018	0,004	0,011	N/A
25th	0,010	0,028	0,017	0,049	0,005	0,015	N/A
26th	0,004	0,011	0,006	0,017	0,006	0,018	N/A
27th	0,011	0,030	0,012	0,033	0,004	0,013	N/A
28th	0,003	0,008	0,004	0,012	0,004	0,011	N/A
29th	0,007	0,021	0,010	0,028	0,008	0,024	N/A
30th	0,004	0,010	0,003	0,010	0,006	0,016	N/A



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (20°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
31th	0,011	0,032	0,013	0,036	0,008	0,022	N/A
32th	0,004	0,010	0,005	0,016	0,003	0,009	N/A
33th	0,010	0,028	0,011	0,032	0,003	0,009	N/A
34th	0,003	0,010	0,006	0,018	0,003	0,008	N/A
35th	0,008	0,024	0,010	0,029	0,009	0,027	N/A
36th	0,004	0,011	0,004	0,011	0,005	0,014	N/A
37th	0,010	0,030	0,008	0,024	0,008	0,024	N/A
38th	0,004	0,010	0,004	0,011	0,003	0,007	N/A
39th	0,008	0,024	0,010	0,030	0,007	0,021	N/A
40th	0,004	0,011	0,006	0,017	0,004	0,011	N/A
Note: The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (-10°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2643,4		5311,8		7995,8		
AC Voltage [V]	229,91		230,85		231,97		
AC Current [A]	11,59		23,01		34,56		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,300		4,856		3,480		
PWHD [%]	0,350		0,857		0,619		
Harmonic	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Harmonic Current Limits [%]
1st	11,519	--	22,899	--	34,444	--	-
2nd	0,070	0,200	0,374	1,076	0,487	1,399	8,00
3rd	0,436	1,254	1,624	4,670	1,096	3,152	N/A
4th	0,033	0,096	0,020	0,057	0,058	0,166	4,00
5th	0,054	0,156	0,164	0,471	0,123	0,354	10,70
6th	0,014	0,040	0,035	0,102	0,048	0,139	2,67
7th	0,044	0,125	0,185	0,531	0,018	0,051	7,20
8th	0,024	0,068	0,047	0,135	0,029	0,085	2,00
9th	0,031	0,089	0,054	0,156	0,005	0,014	N/A
10th	0,008	0,022	0,008	0,024	0,030	0,087	1,60
11th	0,020	0,058	0,005	0,016	0,012	0,033	3,10
12th	0,019	0,055	0,027	0,076	0,021	0,062	1,33
13th	0,014	0,039	0,050	0,142	0,012	0,033	2,00
14th	0,005	0,015	0,016	0,046	0,019	0,055	N/A
15th	0,011	0,033	0,029	0,083	0,013	0,037	N/A
16th	0,015	0,043	0,012	0,034	0,020	0,058	N/A
17th	0,003	0,010	0,002	0,006	0,006	0,018	N/A
18th	0,003	0,008	0,019	0,055	0,015	0,043	N/A
19th	0,003	0,010	0,020	0,058	0,006	0,017	N/A
20th	0,006	0,017	0,010	0,030	0,013	0,038	N/A
21th	0,004	0,011	0,022	0,063	0,007	0,020	N/A
22th	0,002	0,005	0,003	0,010	0,012	0,033	N/A
23th	0,002	0,006	0,006	0,017	0,008	0,023	N/A
24th	0,003	0,008	0,007	0,021	0,004	0,012	N/A
25th	0,004	0,010	0,017	0,050	0,005	0,015	N/A
26th	0,003	0,008	0,006	0,019	0,006	0,018	N/A
27th	0,004	0,013	0,012	0,035	0,004	0,013	N/A
28th	0,003	0,007	0,004	0,011	0,004	0,011	N/A
29th	0,004	0,010	0,010	0,029	0,009	0,025	N/A
30th	0,004	0,011	0,004	0,011	0,006	0,016	N/A



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (-10°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
31th	0,005	0,014	0,013	0,037	0,008	0,022	N/A
32th	0,003	0,009	0,006	0,016	0,003	0,009	N/A
33th	0,003	0,010	0,012	0,033	0,003	0,009	N/A
34th	0,003	0,008	0,006	0,017	0,003	0,008	N/A
35th	0,004	0,012	0,010	0,030	0,009	0,027	N/A
36th	0,004	0,012	0,004	0,012	0,005	0,014	N/A
37th	0,004	0,013	0,009	0,025	0,008	0,023	N/A
38th	0,003	0,010	0,004	0,010	0,002	0,007	N/A
39th	0,003	0,009	0,011	0,031	0,007	0,021	N/A
40th	0,003	0,009	0,006	0,016	0,004	0,010	N/A
Note: The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (55°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2643,7		5287,3		7995,1		
AC Voltage [V]	229,91		230,86		231,98		
AC Current [A]	11,59		23,00		34,56		
Frequency [Hz]	50,00		50,00		50,00		
THD40 [%]	1,300		4,780		3,475		
PWHD [%]	0,351		0,849		0,618		
Harmonic	Current Magnitude [A]	% of Fundamental	Current Magnitude [A]	% of Fundamental	Current Magnitude [A]	% of Fundamental	Harmonic Current Limits [%]
1st	11,520	--	22,898	--	34,441	--	-
2nd	0,070	0,201	0,370	1,065	0,485	1,396	8,00
3rd	0,436	1,254	1,598	4,596	1,095	3,149	N/A
4th	0,033	0,096	0,021	0,061	0,058	0,166	4,00
5th	0,054	0,155	0,156	0,449	0,124	0,356	10,70
6th	0,014	0,041	0,034	0,097	0,047	0,137	2,67
7th	0,043	0,124	0,182	0,523	0,017	0,050	7,20
8th	0,024	0,068	0,047	0,135	0,030	0,086	2,00
9th	0,031	0,089	0,054	0,156	0,005	0,014	N/A
10th	0,008	0,023	0,009	0,026	0,030	0,086	1,60
11th	0,020	0,058	0,006	0,016	0,012	0,033	3,10
12th	0,019	0,055	0,027	0,077	0,021	0,061	1,33
13th	0,014	0,040	0,049	0,142	0,012	0,034	2,00
14th	0,005	0,015	0,016	0,046	0,019	0,056	N/A
15th	0,011	0,032	0,029	0,084	0,012	0,036	N/A
16th	0,015	0,043	0,012	0,034	0,020	0,057	N/A
17th	0,003	0,010	0,002	0,007	0,006	0,019	N/A
18th	0,003	0,008	0,019	0,054	0,015	0,043	N/A
19th	0,004	0,010	0,019	0,056	0,006	0,017	N/A
20th	0,006	0,017	0,011	0,031	0,013	0,038	N/A
21th	0,004	0,011	0,021	0,061	0,007	0,020	N/A
22th	0,002	0,005	0,003	0,010	0,011	0,033	N/A
23th	0,002	0,006	0,006	0,018	0,008	0,023	N/A
24th	0,003	0,008	0,007	0,020	0,004	0,012	N/A
25th	0,004	0,010	0,017	0,049	0,005	0,015	N/A
26th	0,003	0,008	0,007	0,019	0,006	0,018	N/A
27th	0,004	0,013	0,012	0,034	0,005	0,013	N/A
28th	0,003	0,008	0,005	0,013	0,004	0,011	N/A
29th	0,004	0,010	0,010	0,028	0,009	0,025	N/A
30th	0,004	0,011	0,004	0,010	0,006	0,016	N/A



B.1 a) b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≥ 75 A per Phase) (55°C ± 2°C)					P
DHN-LVEH1P8K-EU-G1							
31th	0,005	0,013	0,013	0,037	0,008	0,022	N/A
32th	0,003	0,009	0,005	0,015	0,003	0,009	N/A
33th	0,003	0,010	0,011	0,032	0,003	0,009	N/A
34th	0,003	0,009	0,006	0,017	0,003	0,008	N/A
35th	0,004	0,012	0,010	0,030	0,009	0,027	N/A
36th	0,004	0,012	0,004	0,012	0,005	0,014	N/A
37th	0,004	0,013	0,009	0,025	0,008	0,023	N/A
38th	0,003	0,010	0,003	0,010	0,002	0,007	N/A
39th	0,003	0,009	0,011	0,030	0,007	0,021	N/A
40th	0,003	0,009	0,006	0,017	0,004	0,010	N/A
Note: The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



B.1 c)		Flicker emission			P
20°C ± 2°C					
Location	Test voltage	Result			
		P _{It}	P _{St}	d _c %	
33%	EN 61000-3-11	0,023	0,032	0,000	
66%	EN 61000-3-11	0,024	0,032	0,000	
100%*	EN 61000-3-11	0,024	0,032	0,000	
-10°C ± 2°C					
Location	Test voltage	Result			
		P _{It}	P _{St}	d _c %	
33%	EN 61000-3-11	0,033	0,065	0,000	
66%	EN 61000-3-11	0,031	0,061	0,000	
100%*	EN 61000-3-11	0,032	0,061	0,000	
55°C ± 2°C					
Location	Test voltage	Result			
		P _{It}	P _{St}	d _c %	
33%	EN 61000-3-11	0,055	0,122	0,000	
66%	EN 61000-3-11	0,033	0,064	0,000	
100%*	EN 61000-3-11	0,033	0,064	0,000	
Note:					
Mains Impedance according EN61000-3-3 / EN61000-3-11:					
R _{max} = 0,24 Ω; jX _{max} = 0,15 Ω @ 50,0 Hz (Z _{max} = 0,473 Ω)					
R _n = 0,16 Ω; jX _n = 0,1 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 16 A and on EN 61000-3-11 for more than 16 A.					



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

B.1.1.1.1 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 at least 30 s	111% V _n for at least 30 s	
Connection	No connection	No connection	
Limit	No connection allowed		
b) Start-up	V > 85% V _n	V < 110% V _n	
Reconnection time [s]	47,0	47,0	
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 with max +2,5% P _n (see below)		
c) Reconnection after tripping	V > 85% V _n	V < 110% V _n	
Reconnection time [s]	305,4	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 with max +2,5% P _n (see below)		
	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 with max +2,5% P _n (see below)		
e) Start-up	f > 49,90 Hz	f < 50,10 Hz	
Reconnection time [s]	47,0	47,0	
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 with max +2,5% P _n (see below)		
f) Reconnection after tripping	f > 49,90 Hz	f < 50,10 Hz	
Reconnection time [s]	306,2	304,8	
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 with max +2,5% P _n (see below)		
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			

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

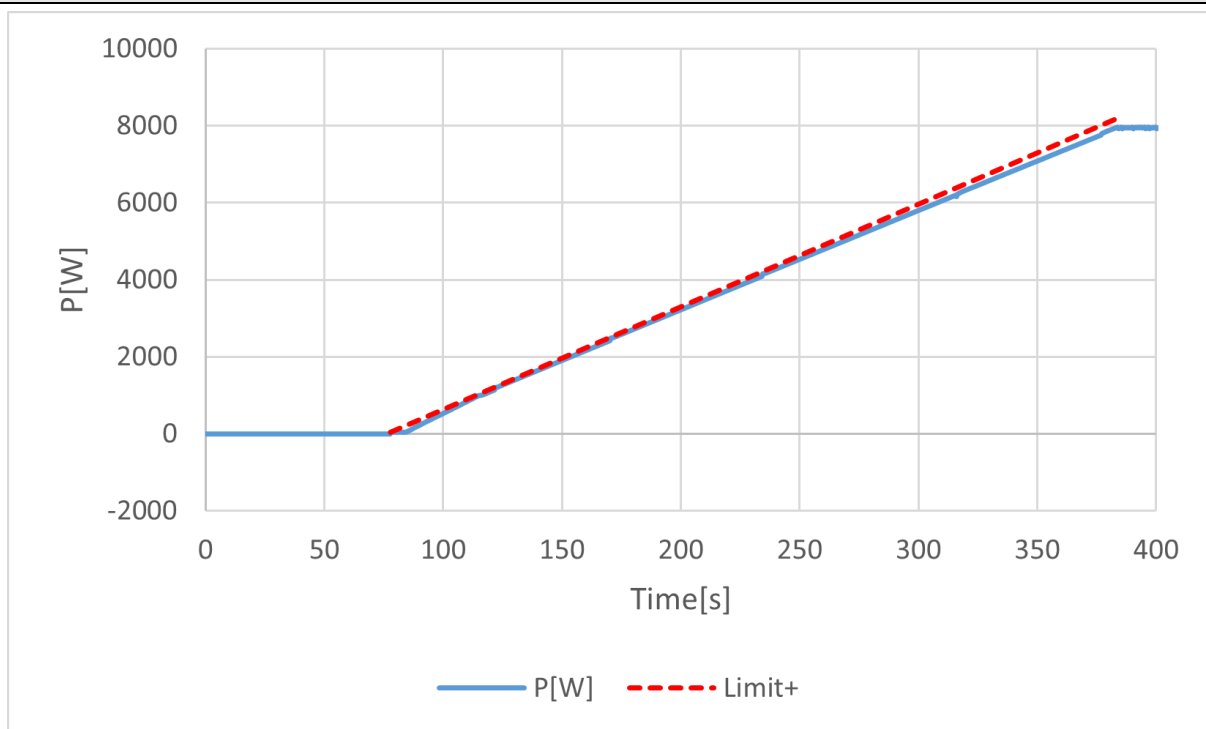
In addition, the power supply for indirectly connected production systems should be gradual, with a transition from the initial "no-load" conditions at the time of parallel, to the power value available with a maximum positive ramp of 20% of the maximum load per minute.

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.

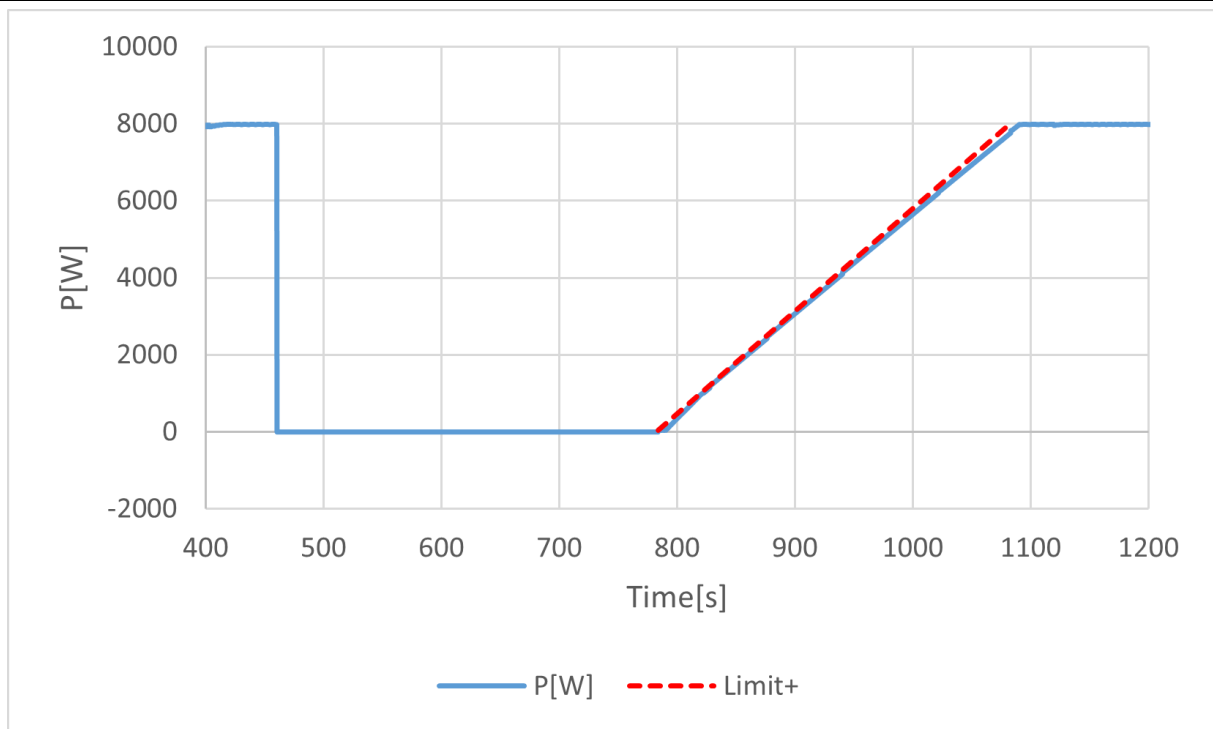
Note:

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 0,200 s (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 $+2,5\% * P_n$.

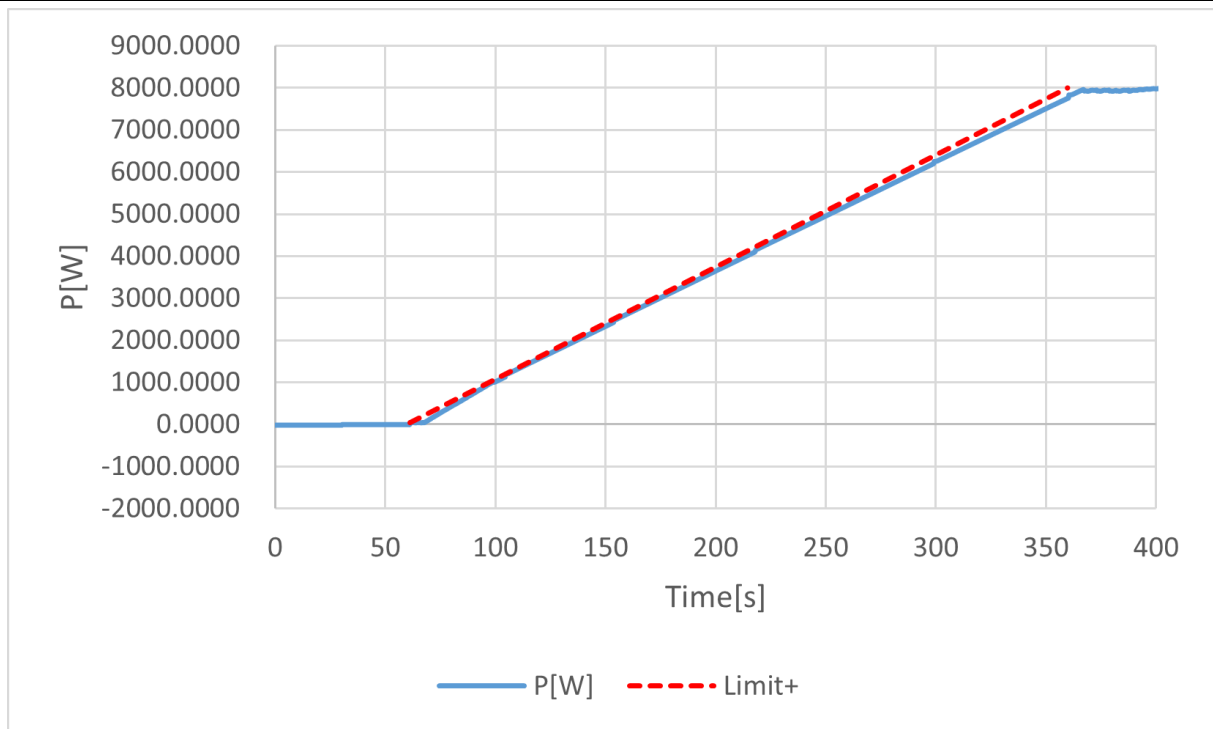
Graph of the gradual power supply test b)


B.1.1.1 B.1.1.2	Conditions of connection, reconnection and gradual power supply and gradual supply of active power	P
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Graph of the gradual power supply test c)

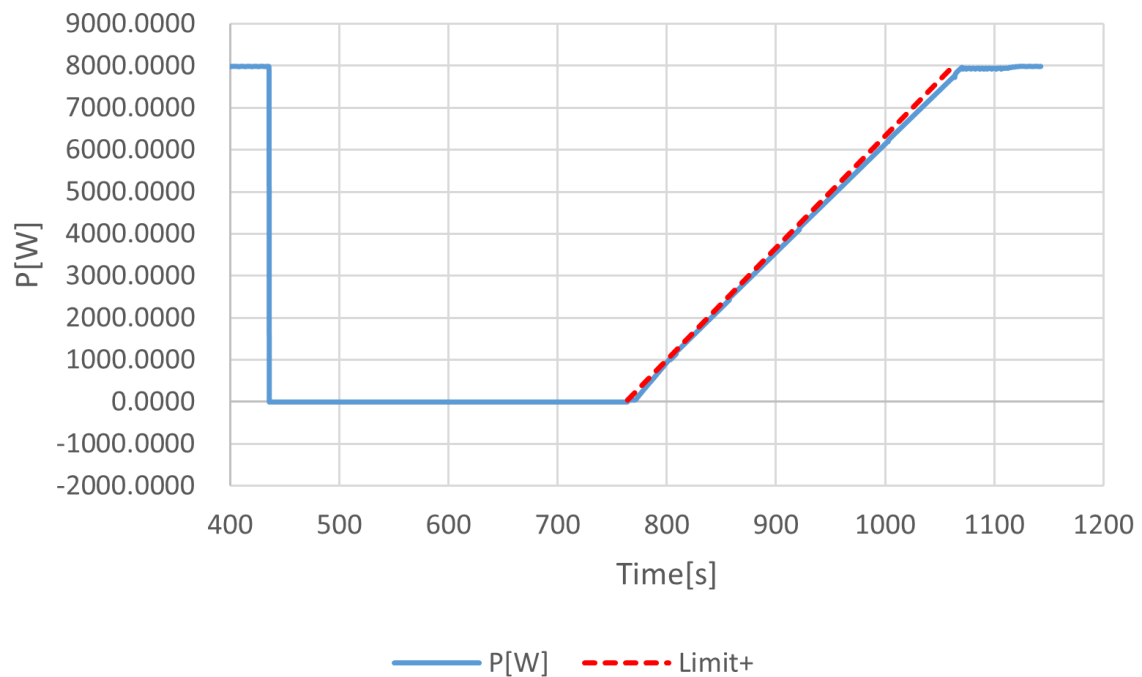


Graph of the gradual power supply test e)



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

Graph of the gradual power supply test f)





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	P
B.1.2.2.2	Inverters in systems with total capacity greater than 11,08 kW	N/A
B.1.2.3	Reactive power exchange at a given level	N/A
B.1.2.3.1	Procedures for performing tests and recording results	N/A
B.1.2.4	Response time to an assigned step level change	N/A
B.1.2.5	Automatic supply of reactive power according to a characteristic curve $\cos \varphi = f(P)$	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 $Q = f(V)$	N/A
B.1.2.6.1	Checking compliance with the rules for the implementing the characteristic curve $Q = f(V)$	N/A

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	$\cos \varphi \geq 0,95^{(*)}$	$\cos \varphi \geq 0,95^{(*)}$
synchronous	any	$\cos \varphi \geq 0,95^{(*)}$ adjustable	$\cos \varphi \geq 0,95^{(*)}$ adjustable
inverter	$\leq 11,08 \text{ kW}$	capability triangular in Fig. 13 $(*)$	
inverter	$> 11,08 \text{ kW}$	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.

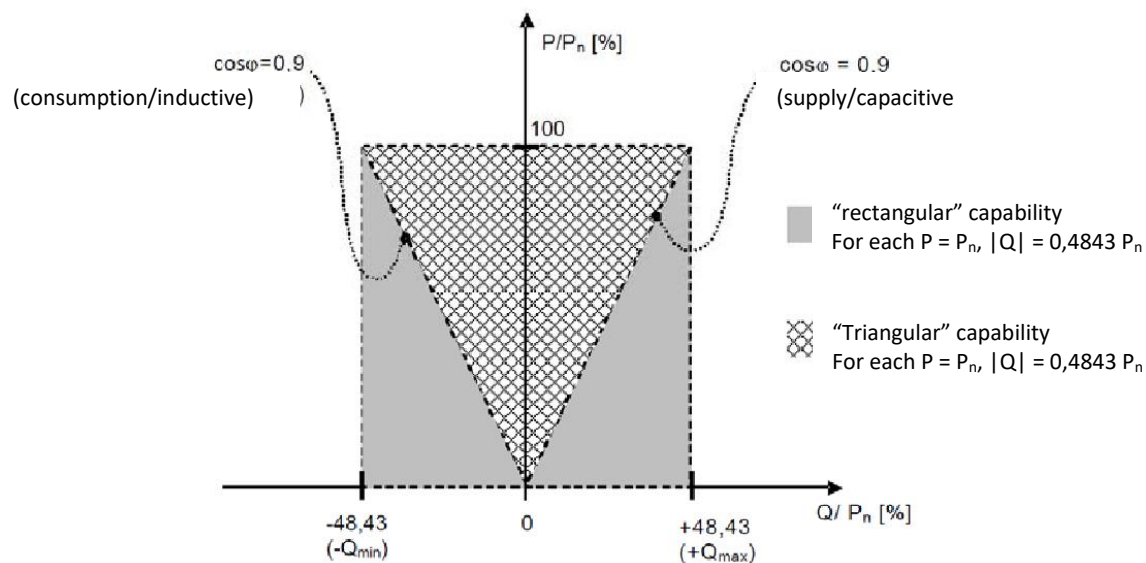


Figure 13 - “Triangular” and “rectangular” capability curves

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 0,200 s 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 0,200 s window. • In addition to measurements of reactive power limit values, the measured values should be recorded by setting the reactive power supplied to 0 ($\cos \varphi = 1$).

B.1.2.2.1 Test performance and recording mode up to 11,08 kW				P
Inductive reactive power absorption				
Power-BIN [%]	Active power $P_{ac E60}$ [W]	Reactive power Q_{E60} [Var]	Power factor $\cos \varphi_{E60}$ [1]	DC power $P_{dc E60}$ [W]
0 -10 (*)	411,3	-333,0	0,7772	470,6
10 -20 (**)	1200,5	-579,2	0,9007	1279,4
20 -30	2003,5	-966,5	0,9007	2105,6
30 -40	2802,1	-1345,1	0,9015	2930,4
40 -50	3603,5	-1727,2	0,9018	3761,7
50 -60	4404,3	-2119,3	0,9011	4568,2
60 -70	5203,5	-2485,0	0,9024	5403,2
70 -80	6024,0	-2901,6	0,9009	6258,4
80 -90	6803,0	-3221,3	0,9038	7087,0
90 -100 (***)	7353,4	-3393,2	0,9080	7702,8
Capacitive reactive power absorption				
Power-BIN [%]	Active power $P_{ac E60}$ [W]	Reactive power Q_{E60} [Var]	Power factor $\cos \varphi_{E60}$ [1]	DC power $P_{dc E60}$ [W]
0 -10 (*)	411,2	532,3	0,7725	470,6
10 -20 (**)	1203,2	583,5	0,8998	1279,4
20 -30	2006,6	971,6	0,9000	2105,2
30 -40	2806,2	1354,3	0,9006	2930,5
40 -50	3597,9	1736,7	0,9006	3752,1
50 -60	4406,2	2118,2	0,9013	4564,6
60 -70	5200,5	2426,4	0,9062	5391,6
70 -80	6010,9	2884,3	0,9016	6240,7
80 -90	6807,9	3233,7	0,9033	7082,1
90 -100 (***)	7466,1	3569,3	0,9022	7807,9
$\cos \varphi = 1$				
Power-BIN [%]	Active power $P_{ac E60}$ [W]	Reactive power Q_{E60} [Var]	Power factor $\cos \varphi_{E60}$ [1]	DC power $P_{dc E60}$ [W]
0 -10 (*)	412,2	247,6	0,7806	471,6
10 -20 (**)	1192,0	-219,4	0,9712	1268,6
20 -30	2008,3	-141,3	0,9903	2104,5
30 -40	2805,8	-72,5	0,9947	2926,5
40 -50	3607,3	-79,9	0,9961	3754,2
50 -60	4405,0	-360,4	0,9967	4554,0
60 -70	5207,2	-116,2	0,9960	5388,3
70 -80	6002,9	-486,2	0,9967	6217,7
80 -90	6872,3	-657,6	0,9955	7061,8
90 -100 (***)	7621,9	-158,9	0,9965	7923,9

B.1.2.2.1	Test performance and recording mode up to 11,08 kW	P
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Note:

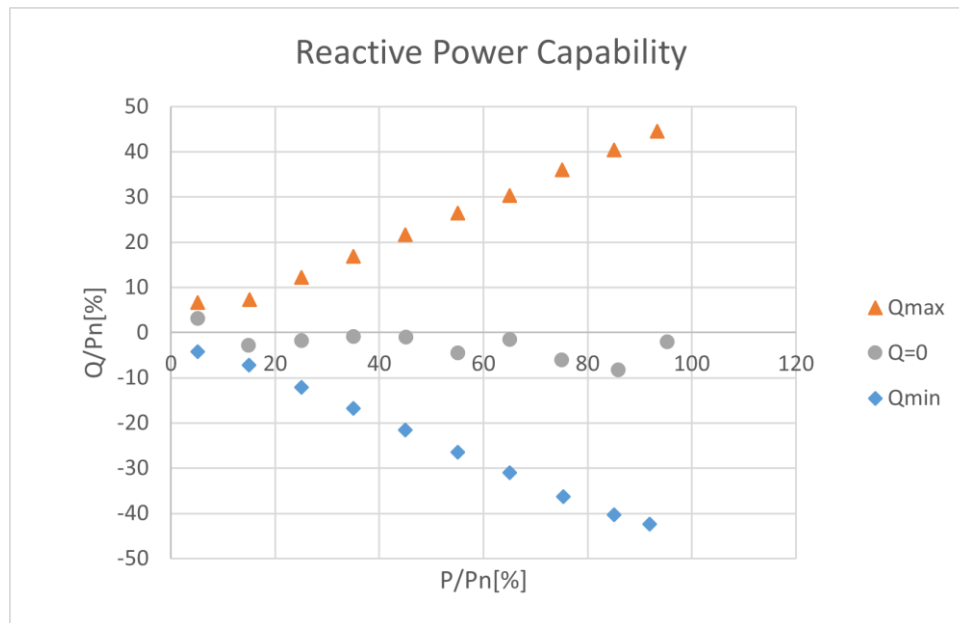
(*) For output powers of less than 10% of rated power the generator must not exchange a reactive power higher than 10% of the rated power.

(**) 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 $\cos \varphi$ steadily to reach a thermal balance.

The $\cos \varphi$ must be 0,9 or less at the 10 levels

Graph



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

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 $\cos \varphi = f(P)$ outlined in E.2, according to method a).

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

A: $P = 0,2 P_n$; $\cos \varphi = 1$

B: $P = 0,5 P_n$; $\cos \varphi = 1$

C: $P = P_n$; $\cos \varphi = \cos \varphi_{\max} = 0,9$ (inductive/capacitive)

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.

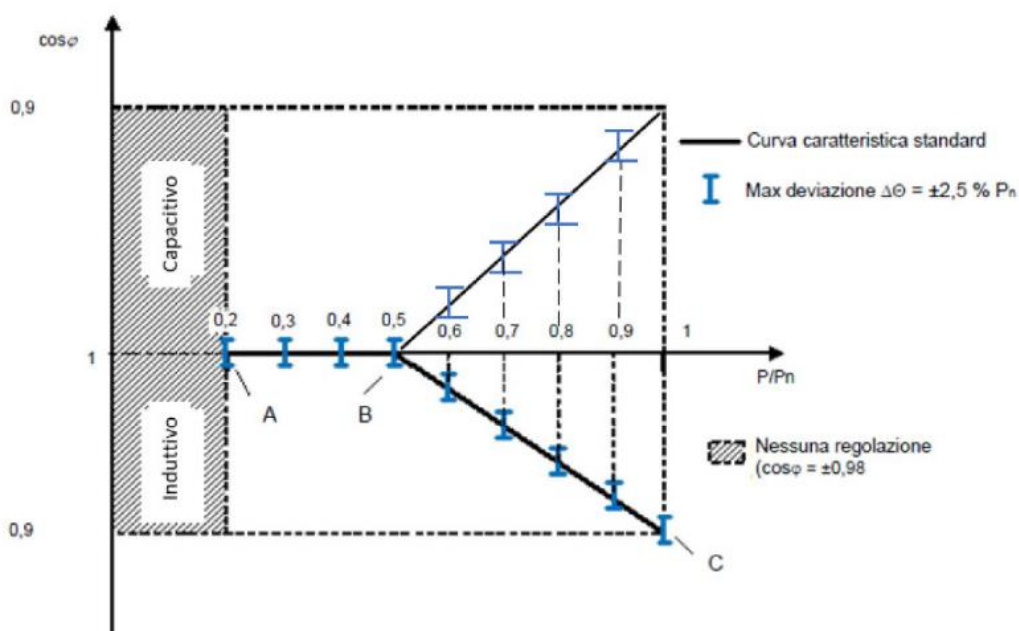


Figure 27 - Standard characteristic curve $\cos \varphi = f(P)$

Note:

Corrective Action from the ITALIAN ELECTRICAL ENGINEERING COMMITTEE

The changes introduced in V3 CEI 0-16 and V2 CEI 0-21 relating to the $\cos \varphi(P)$ function, which also requires the transfer of reactive power depending on the active power supplied, apply to all types of generation except asynchronous generators directly connected to the grid.

With regard to tests relating to new reactive power delivery functions, these must be performed in a manner similar to those already described in Annexes N, Nbis, Nter for CEI 0-16 and Annexes B, Bbis, Bter for CEI 0-21 with regard to reactive power absorption.

B.1.2.5.1 Checking compliance with the rules for implementing of the standard supply curve					P
Inductive reactive power absorption					
Power-BIN [%]	Active power $P_{E0,2}$ [W]	Reactive power $Q_{E0,2}$ [Var]	$\cos \varphi_{E0,2}$ [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1609,2	-227,6	0,9902	1,0000	-0,0098
30	2399,7	-149,1	0,9924	1,0000	-0,0076
40	3205,3	-234,2	0,9953	1,0000	-0,0047
50	3996,7	-86,9	0,9963	1,0000	-0,0037
60	4803,1	-196,2	0,9967	1,0000	-0,0033
60	4805,4	-952,2	0,9809	0,9800	0,0009
70	5606,2	-1623,1	0,9606	0,9600	0,0006
80	6424,4	-2301,2	0,9414	0,9400	0,0014
90	7200,0	-3052,5	0,9207	0,9200	0,0007
100	7574,9	-3647,6	0,9010	0,9106	-0,0096
100	7849,8	-148,8	0,9972	1,0000	-0,0028

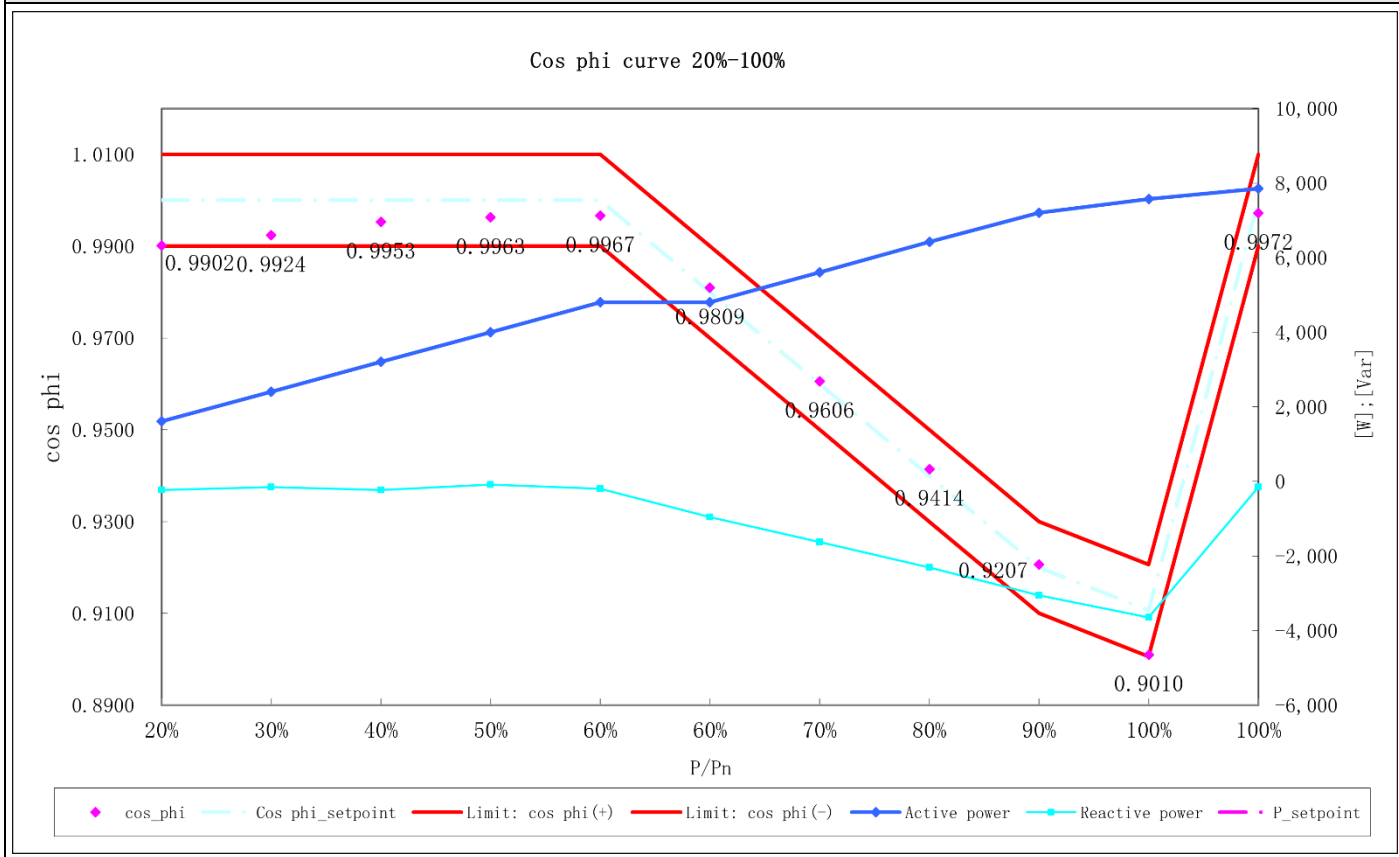
Note:

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

For each operating point, the maximum deviation of the reactive power from the target value must be less than $\Delta Q \leq \pm 2,5\% P_n$.

Settling time max 10 s.

Graph of $\cos \varphi(P)$ 20% to 100%



B.1.2.5.1 Checking compliance with the rules for implementing of the standard supply curve					P
Capacitive reactive power absorption					
Power-BIN [%]	Active power $P_{E0,2}$ [W]	Reactive power $Q_{E0,2}$ [Var]	$\cos \varphi_{E0,2}$ [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1611,5	226,8	0,9903	1,0000	-0,0097
30	2400,8	146,6	0,9926	1,0000	-0,0074
40	3207,2	233,7	0,9953	1,0000	-0,0047
50	4006,8	86,6	0,9963	1,0000	-0,0037
60	4806,6	97,1	0,9967	1,0000	-0,0033
60	4806,3	942,6	0,9813	0,9800	0,0013
70	5609,0	1625,6	0,9605	0,9600	0,0005
80	6422,8	2311,4	0,9409	0,9400	0,0009
90	7201,3	3059,6	0,9204	0,9200	0,0004
100	7599,4	3650,4	0,9014	0,9100	-0,0086
100	7856,3	581,2	0,9973	1,0000	-0,0027

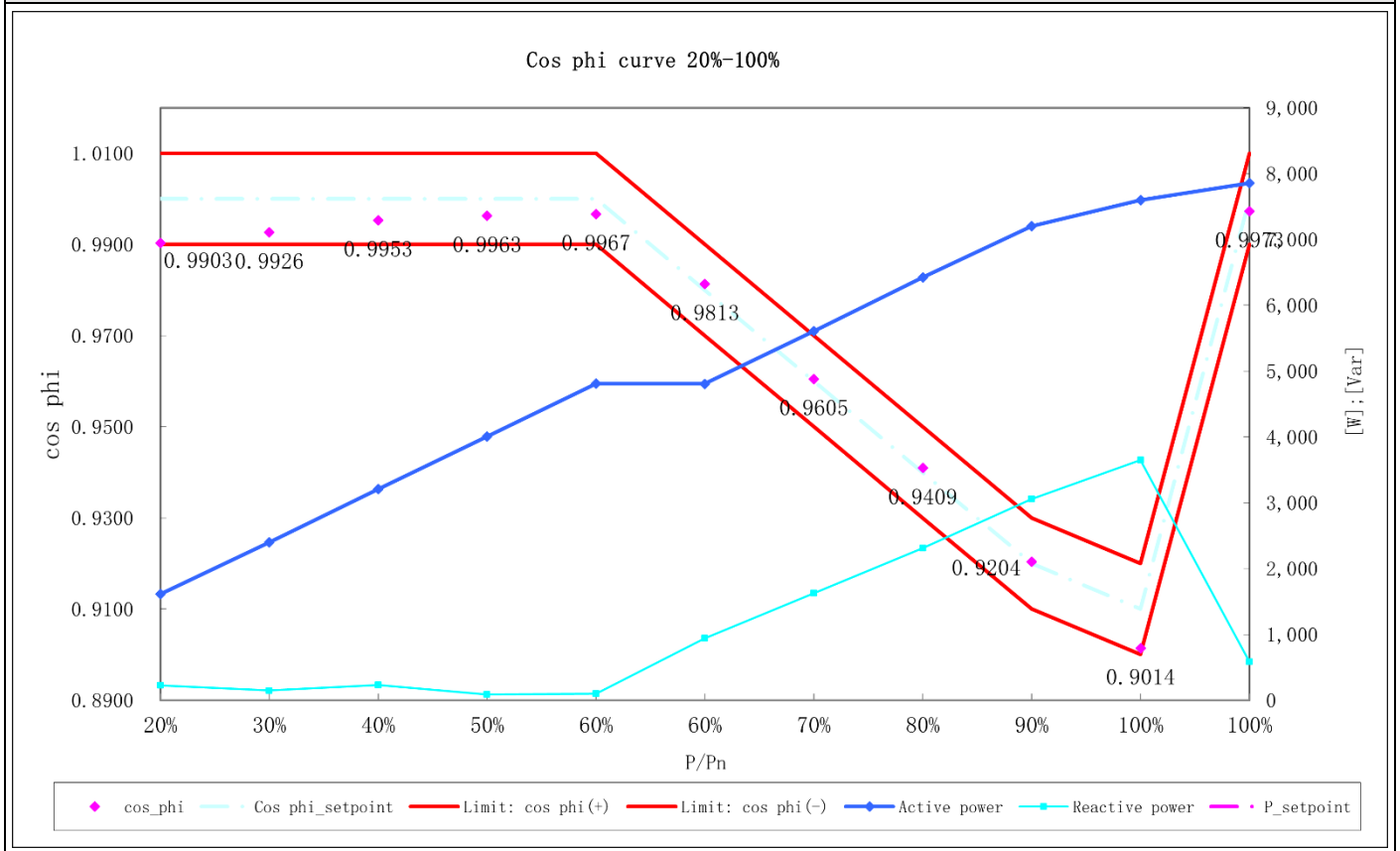
Note:

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

For each operating point, the maximum deviation of the reactive power from the target value must be less than $\Delta Q \leq \pm 2,5\% P_n$.

Settling time max 10 s.

Graph of $\cos \varphi(P)$ 20% to 100%



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 distributor	P

B.1.3.1 Automatic limitation of active power for voltage values close to 110% of the rated voltage		P	
Voltage step	V_{acE60} [% V_n]	P_{E60} [W]	P_{E60} [% P_n]
-2% V_n of activation threshold	108,02	8039,0	100,49
+2% V_n of activation threshold	111,90	1189,5	14,87
-2% V_n of activation threshold	108,01	8027,0	100,34
Settling time [s]	10,6		
Limit settling time [s]	300		
Measured decrease gradient power in % P_n/s	7,55		
Limit decrease gradient power settling in % P_n/s	less than 33		

Test:

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

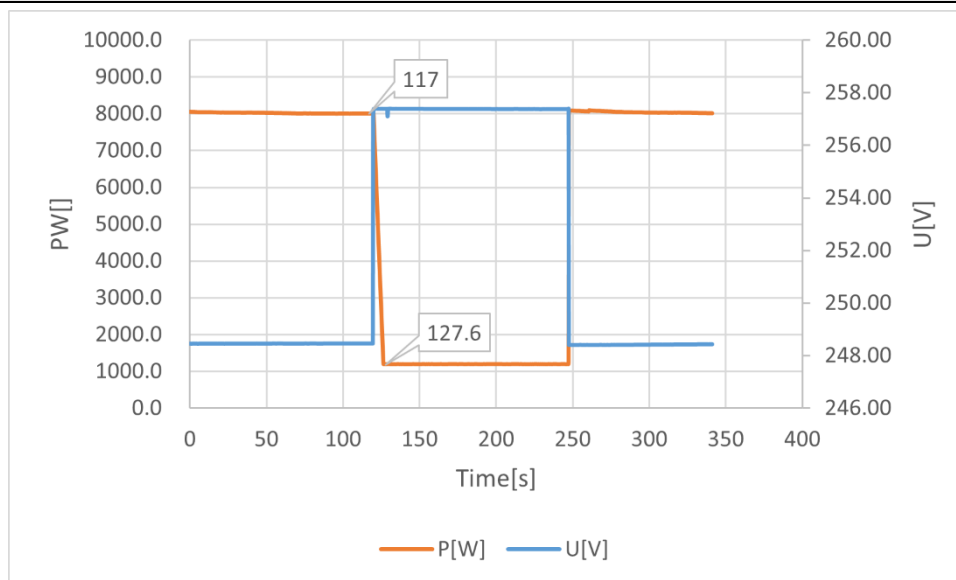
* The settling time is determined from the instant of application of the voltage (activation threshold +2% V_n) to the instant in which the active power reaches a value $\leq 20\%$ P_n .

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



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).	

B.1.3.2.1

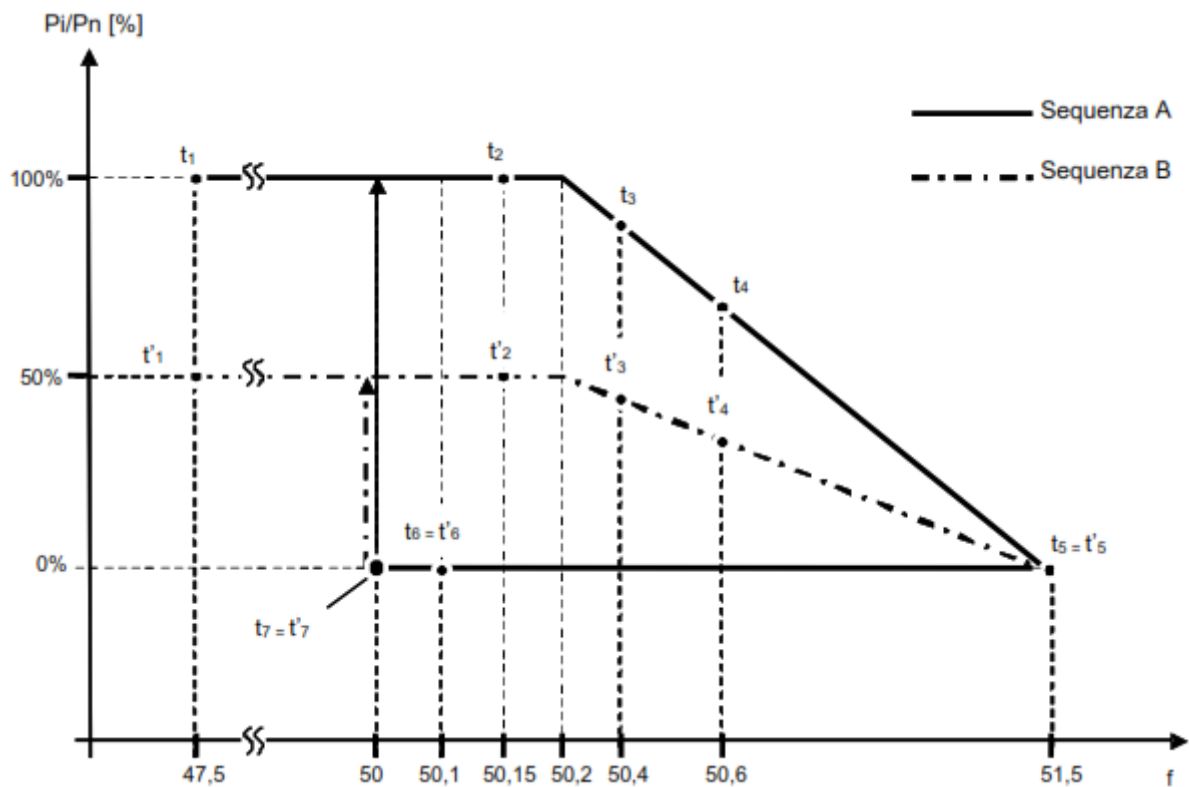
Testing procedure

- 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 (t_1 for sequence A, t'_1 for sequence B)
- 2) $f = 50,0$ Hz $\pm 0,15$ Hz (t_2 for sequence A, t'_2 for sequence B)
- 3) $f = 50,0$ Hz $\pm 0,40$ Hz (t_3 for sequence A, t'_3 for sequence B)
- 4) $f = 50,0$ Hz $\pm 0,60$ Hz (t_4 for sequence A, t'_4 for sequence B)
- 5) $f = 50,0$ Hz $\pm 1,49$ Hz (t_5 for sequence A, t'_5 for sequence B)
- 6) $f = 50,0$ Hz $\pm 0,11$ Hz (t_6 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 (t_7 for sequence A, t'_7 for sequence B)



Note:

The deviation between the expected active power value and the measured value is within a tolerance of $\pm 2,5\%$ P_n .

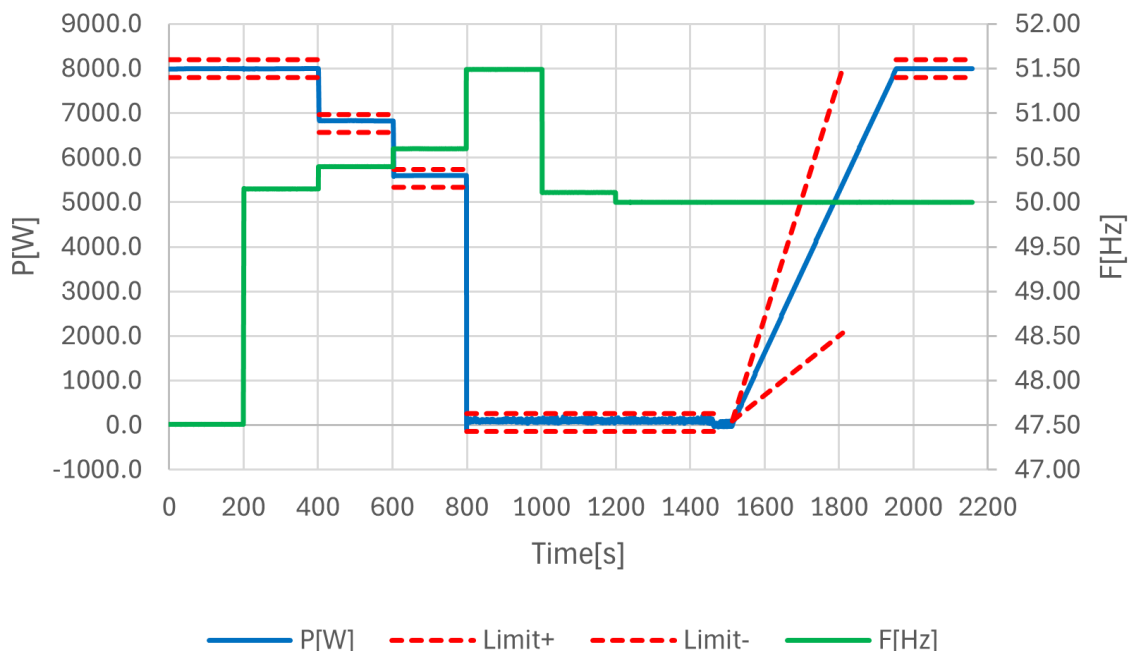
The inverter is able to set a delay for the activation of the curve from 0,0 s – 1,0 s (in 0,050 s steps / default setting: 0)

B.1.3.2.2		Adjusting active power in the presence of transients on the transmission network					P	
Setpoint [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 _n								
Frequency f _{E0,2} [Hz]		47,51	50,15	50,40	50,60	51,49	50,11	50,00
P _{setpoint} [W]		8000,0	8000,0	6768,8	5538,4	61,6	61,6	8000,0
P _{E0,2} [W]		7988,7	7994,9	6830,5	5600,6	100,1	91,4	7998,0
ΔP _{E0,2} /P _n [%]		-0,14	-0,06	0,77	0,78	0,48	0,37	-0,02
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]		4000,0	4000,0	3384,8	2769,6	30,4	30,4	4000,0
P _{E0,2} [W]		4007,1	4001,4	3379,8	2774,9	72,1	70,4	4003,8
ΔP _{E0,2} /P _n [%]		0,09	0,02	-0,06	0,07	0,52	0,50	0,05
Limit								
ΔP _{E0,2}		± 2,5% of P _n						
Determined power recovery delay [s]					313,6			
Determined power recovery gradient [% P _n /s]					0,23			

Note:

Power recovery delay (after the grid frequency returns to the nominal value): ≥ 5 minutes (300 s)

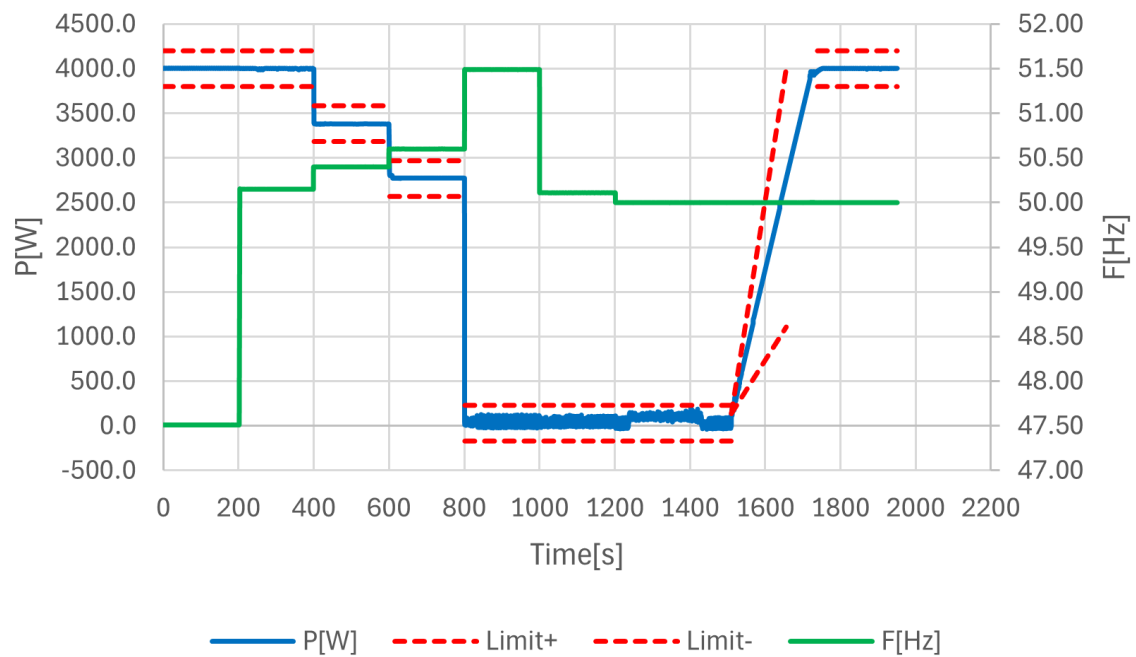
Gradual power recovery (after the grid frequency returns to the nominal value): ≤ 0,33% P_{max}/s but not less than 0,083% P_n/s, where P_{max} the active output power before exceeding 50,2 Hz (stored value).

Graph of Measurement 1.: Active power output reduction 100% P_n


B.1.3.2.2

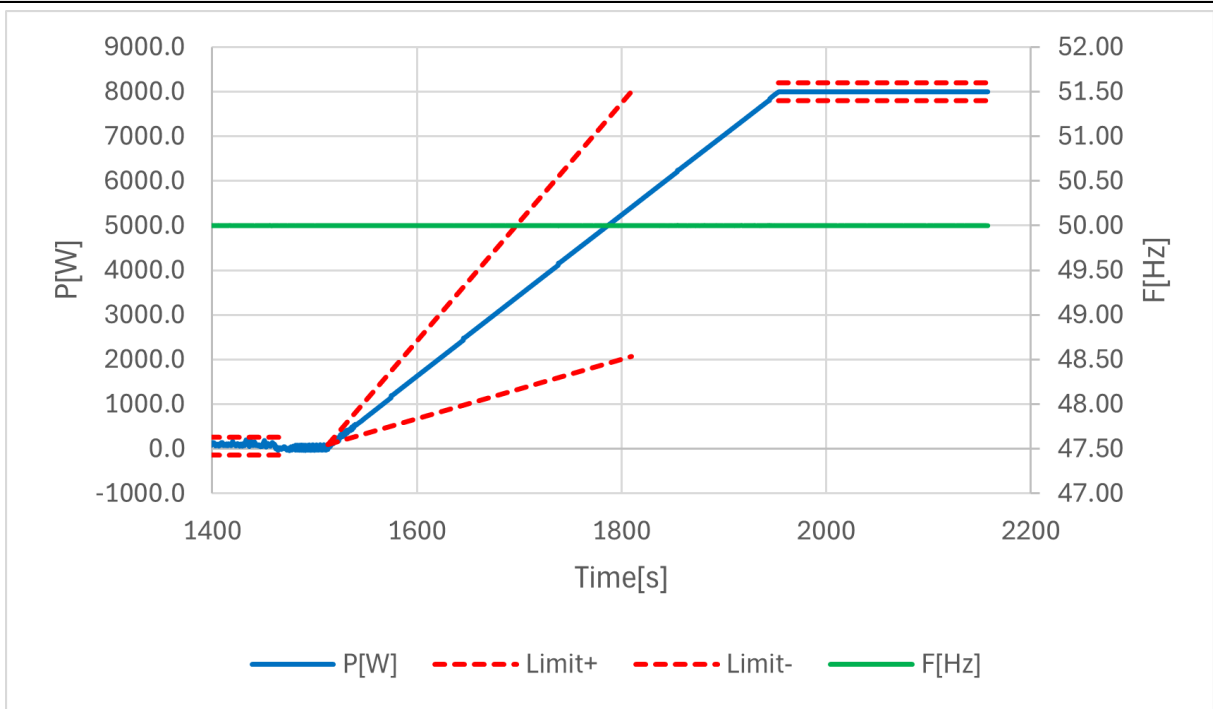
Adjusting active power in the presence of transients on the transmission network

P

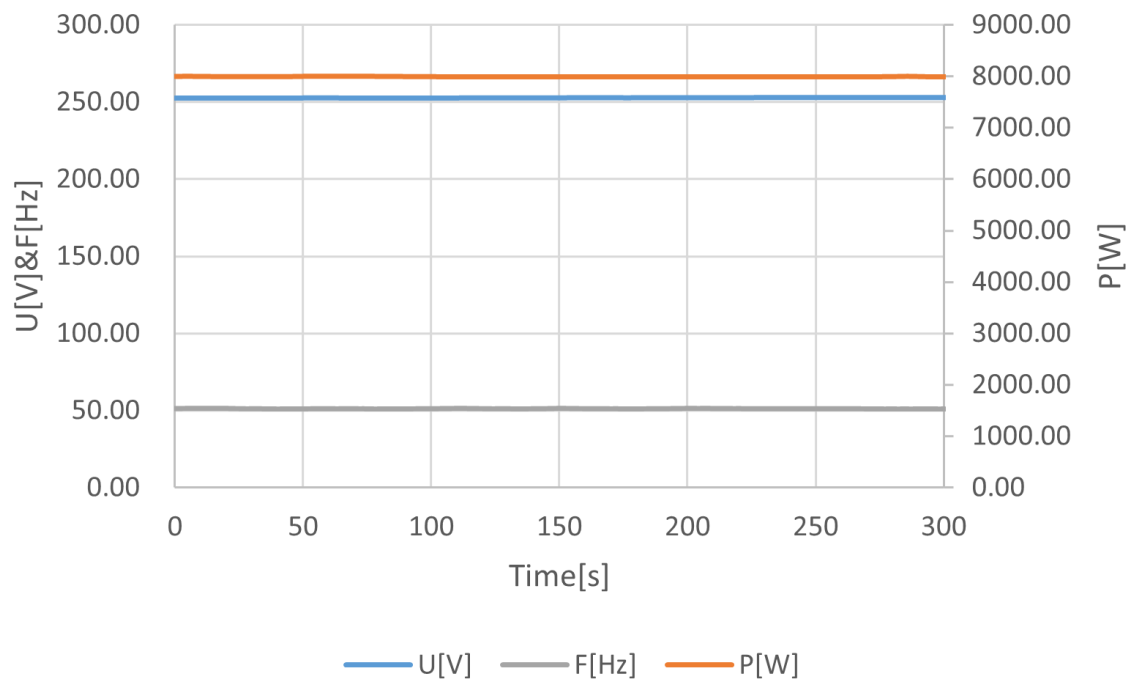
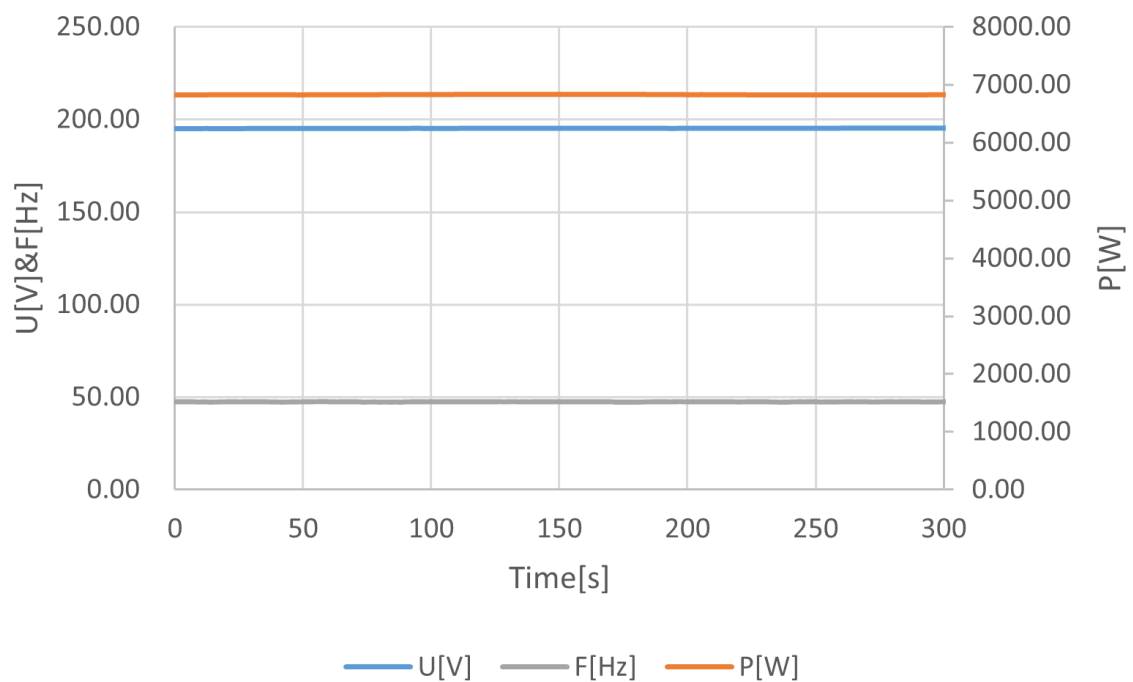
Graph of Measurement 2.: Active power output reduction 50% P_n 

B.1.3.2.2	Adjusting active power in the presence of transients on the transmission network	P
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Graph of Measurement 2.: Power gradient 100% P_{nom}



B.1.3.3		Checking the operating range in voltage and frequency			P
Test 1		V = 110% * V _n ; f = 51,5 Hz; P = 100% * P _n ; cos φ = 1 (duration: at least 5 minutes)			
Connection	Voltage V _{E300} [V]	Frequency f _{E300} [Hz]	Output power P _{E300} [W]	cos φ _{E300} [1]	
	253,15	51,50	8000,4	0,9971	
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 _{E300} [V]	Frequency f _{E300} [Hz]	Output power P _{E300} [W]	cos φ _{E300} [1]	
	195,51	47,50	6832,9	0,9970	
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% V _n = V = 90% V _n 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.					

B.1.3.3 Checking the operating range in voltage and frequency**P****Graph Test 1****Graph Test 2**

B.1.3.3.1	Reduction of the active power in the presence of transients under frequency on the transmission network					P
Setpoint [Hz]	a) 50,0 ± 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 P_{E60} [W]	8004,9	8051,0	8026,4	8044,8	8034,7	8038,6
$\Delta P_{E60}/P_n$ [%]	0,08	0,85	0,44	0,75	0,58	0,64

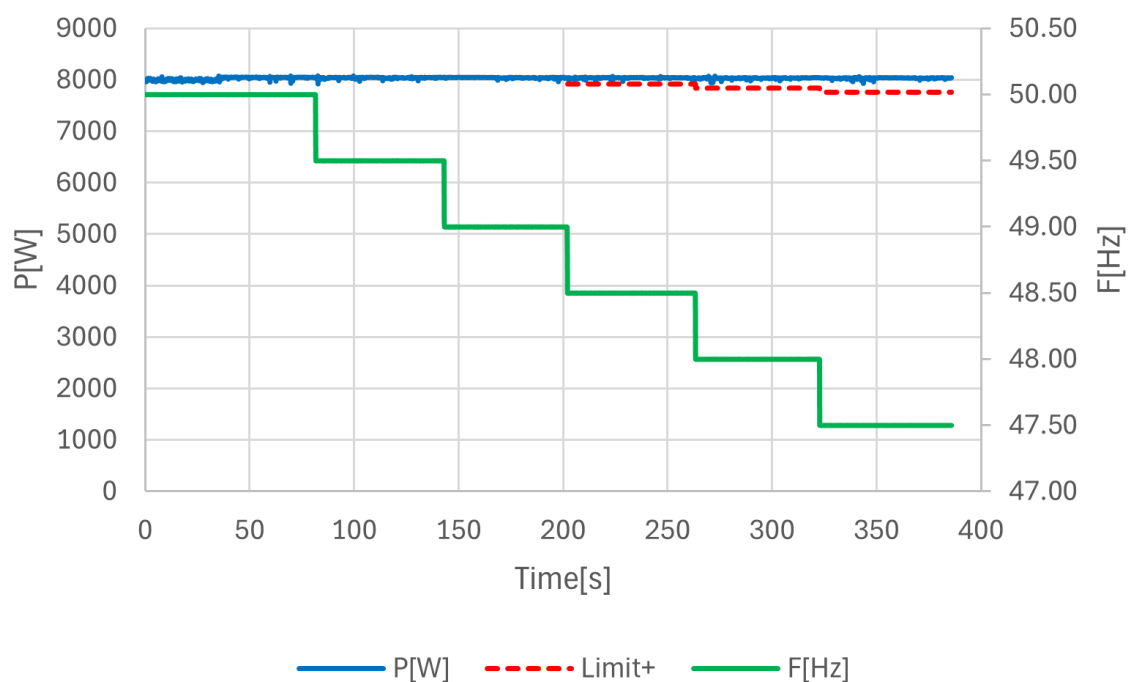
Test:

Measurements are 60 s mean values.

Note:

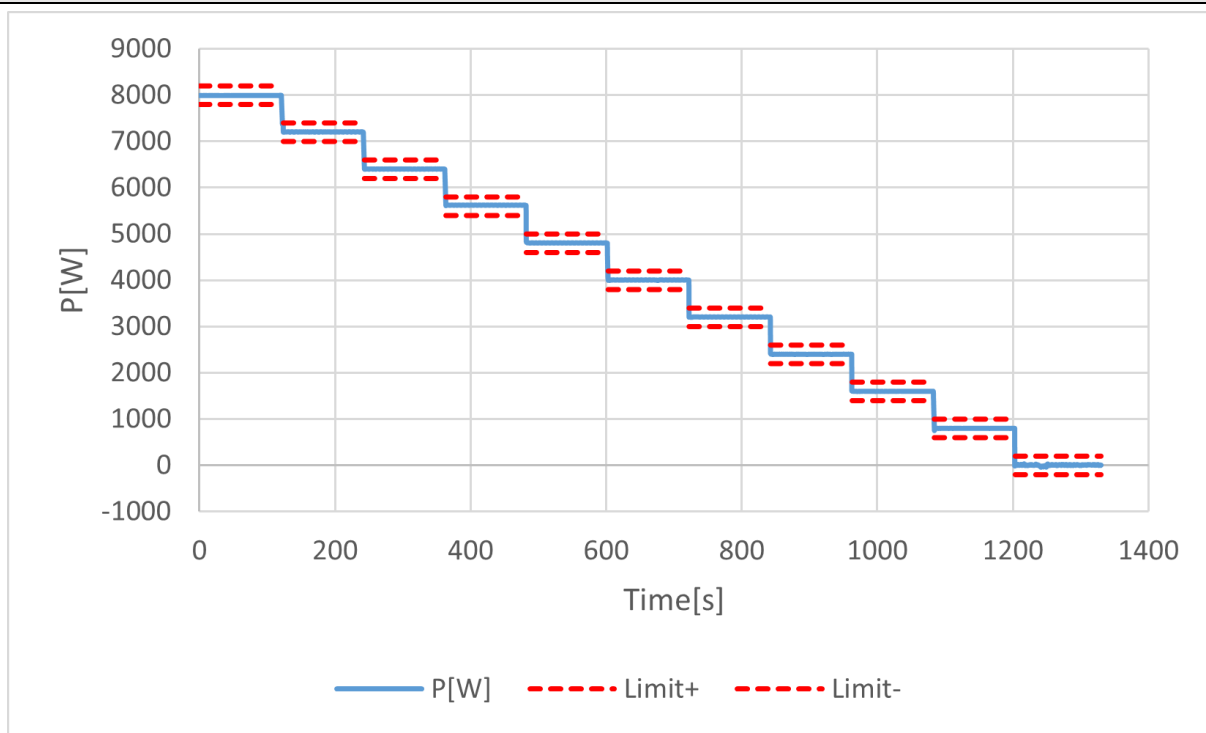
SPI deactivated for the test.

Graph



B.1.3.4	Limitation of the active power by an external control from the distributor									P	
Test result											
P _n /P [%]	100	90	80	70	60	50	40	30	20	10	0
P _{Setpoint} [W]	8000	7200	6400	5600	4800	4000	3200	2400	1600	800	0
P _{E60} [W]	7992,3	7207,8	6406,7	5624,3	4804,5	4006,9	3204,6	2400,9	1599,6	798,8	15,8
ΔP _{E60} [%]	-0,10	0,10	0,08	0,30	0,06	0,09	0,06	0,01	-0,01	-0,02	0,20
Limit											
ΔP [%]	± 2,5% of P _n										

Graph of the setting accuracy





B.1.3.4	Limitation of the active power by an external control from the distributor	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 $\leq 1\text{min}$ Note: The setting time is $\leq 1\text{min}$. See below "Graph of the setting accuracy". This paragraph did not apply for installations less 800 W.		



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

B.1.4.1		Checking the DC component output		P
Phase 1 (20°C ± 2°C)				
Power Level [% of VA _r]	33 ± 5	66 ± 5	100 ± 5	
AC Power P _{E60} [W]	2643,9	5287,3	7995,1	
AC Voltage V _{E60} [V]	229,92	230,84	231,97	
AC Current I _{E60} [A]	11,63	23,01	34,56	
PF _{E60} [1]	0,9918	0,9954	0,9973	
cosφ _{E60} [1]	0,9918	0,9954	0,9973	
DC Current in AC I _{E60} [mA]	41,4	136,0	154,9	
DC Current in AC I _{E60} [% of I _r]	0,119	0,391	0,445	
Phase 1 (-10°C ± 2°C)				
Power Level [% of VA _r]	33 ± 5	66 ± 5	100 ± 5	
AC Power P _{E60} [W]	2643,4	5311,8	7995,8	
AC Voltage V _{E60} [V]	229,91	230,85	231,97	
AC Current I _{E60} [A]	11,59	23,01	34,56	
PF _{E60} [1]	0,9918	0,9954	0,9973	
cosφ _{E60} [1]	0,9918	0,9954	0,9973	
DC Current in AC I _{E60} [mA]	49,4	156,6	155,5	
DC Current in AC I _{E60} [% of I _r]	0,142	0,450	0,447	
Phase 1 (+55°C ± 2°C)				
Power Level [% of VA _r]	33 ± 5	66 ± 5	100 ± 5	
AC Power P _{E60} [W]	2643,7	5287,3	7995,1	
AC Voltage V _{E60} [V]	229,91	230,86	231,98	
AC Current I _{E60} [A]	11,59	23,00	34,56	
PF _{E60} [1]	0,9919	0,9955	0,9973	
cosφ _{E60} [1]	0,9919	0,9955	0,9973	
DC Current in AC I _{E60} [mA]	48,2	151,8	153,3	
DC Current in AC I _{E60} [% of I _r]	0,139	0,436	0,441	
Note:				
Limits of clause 8.4.4.1				
The measurement is be performed by averaging the measured quantity of a maximum time window of 1,0 s, 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 1,0 s, 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.				

B.1.4.2 Checking the protection against DC injection				P
Actual Power	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [s]
$I_{dc} = 0,5\%$ of I_n (Positive, $20^\circ\text{C} \pm 2^\circ\text{C}$)				
33%	$0,5\% I_n / 1 \text{ s}$	176	174	0,75
66%	$0,5\% I_n / 1 \text{ s}$	176	174	0,75
100%	$0,5\% I_n / 1 \text{ s}$	188	174	0,75
$I_{dc} = 0,5\%$ of I_n (Negative, $20^\circ\text{C} \pm 2^\circ\text{C}$)				
33%	$0,5\% I_n / 1 \text{ s}$	176	174	0,75
66%	$0,5\% I_n / 1 \text{ s}$	188	174	0,75
100%	$0,5\% I_n / 1 \text{ s}$	186	174	0,75
$I_{dc} = >1 \text{ A}$ (Positive, $20^\circ\text{C} \pm 2^\circ\text{C}$)				
33%	$1 \text{ A} / 0,2 \text{ s}$	1051	1000	0,15
66%	$1 \text{ A} / 0,2 \text{ s}$	1162	1000	0,15
100%	$1 \text{ A} / 0,2 \text{ s}$	1162	1000	0,15
$I_{dc} = >1 \text{ A}$ (Negative, $20^\circ\text{C} \pm 2^\circ\text{C}$)				
33%	$1 \text{ A} / 0,2 \text{ s}$	1049	1000	0,15
66%	$1 \text{ A} / 0,2 \text{ s}$	1166	1000	0,15
100%	$1 \text{ A} / 0,2 \text{ s}$	1158	1000	0,15
Note:				
Checking the switch-off of the converter, if the first protection threshold $I_{dc} > (> 0,5\% I_n; \text{ in the case of systems with a power of less than } 800 \text{ W: } > 20 \text{ mA})$				



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)	N/A
B.1.5	Checking insensitivity to voltage dips (OVRT capability)	N/A



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

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 ($\cos \varphi = 1$)
- 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 0,020 s before until at least 0,200 s 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.

B.1.6.1	Test on the simulation network	P
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90° phase shift



180° phase shift





CEI 0-21		
Clause	Requirement – Test	Verdict
Annex L	Input Limitation System (SLI)	
L.4.1	Test Setups	--
L.4.2	Verification of SLI's ability to meet the maximum curve input described in L.3 following a load change	P
L.4.3	Verification of the SLI system's ability to comply with the maximum input curve described in L.3 following a power variation of the primary source	P
L.4.4	Verification of the SLI system's ability to comply with the limit of the power fed into the grid Under steady-state conditions	P
L.4.5	Verification of SLI system first fault tolerance	P

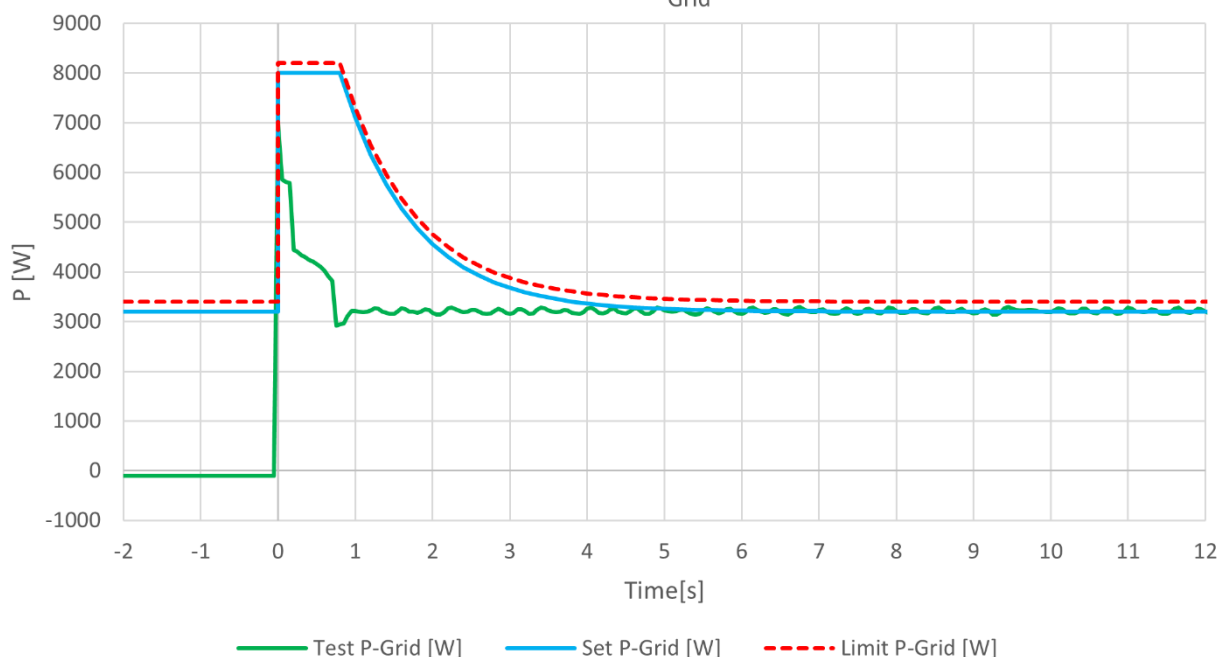
L.4.2 Verification of the ability of the SLI system to comply with the maximum input curve described in L.3 following a load change

P

Test1 (PIR=40%Pmax)

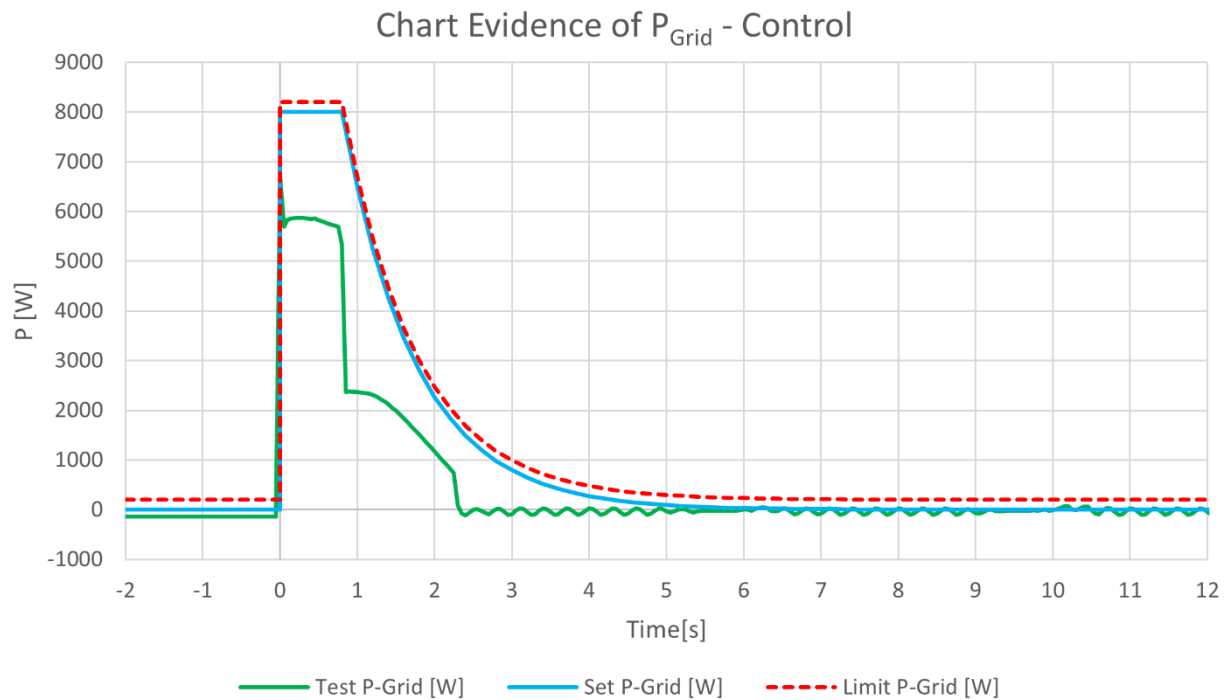
Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	100%	0%	100%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	100%	40%	0%		0,8	3

Chart Evidence of P_{Grid} - Control



Test2 (PIR=0%Pmax)

Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	100%	0%	100%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	100%	0%	0%		2,35	3



Note:

The measuring system shall record the active power for at least 5s before instant t_0 and up to 60s after instant t_0 .
SLI systems may only be installed on single-phase systems whose PIR does not exceed 6 kW and the total rated power of the installed generation systems does not exceed 11.08 kW.

Parametro	Prova 1	Prova 2
PIR	40%Pmax generatore	0%Pmax generatore
Limite di immissione	PIR – errore massimo ammesso come indicato in L.3	
Potenza generatore	100%Pmax generatore	
Potenza iniziale assorbita dal carico	100%Pmax generatore	
Potenza assorbita dal carico all'istante t_0	0%Pmax generatore	

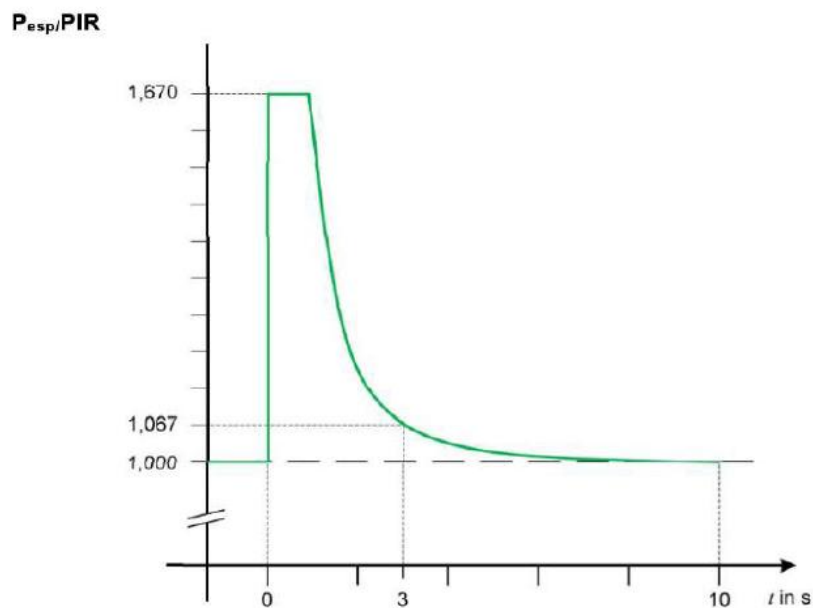


Figura 4- Curva limite di immissione

La curva segue l'equazione

$$\begin{cases} P_{esp}(t) = 1,67 \cdot PIR ; 0 \leq t < 0,8s \\ P_{esp}(t) = PIR(1 + 0,67e^{-1,05(t-0,8)}) ; t \geq 0,8s \end{cases}$$

$$PIR \leq 6kW^{(?)}$$

Dove $P_{esp}(t)$ è la potenza istantanea esportata in rete, mentre il tempo $t = 0$ definisce l'inizio dell'evento che ha innescato l'intervento del controllore SLI.

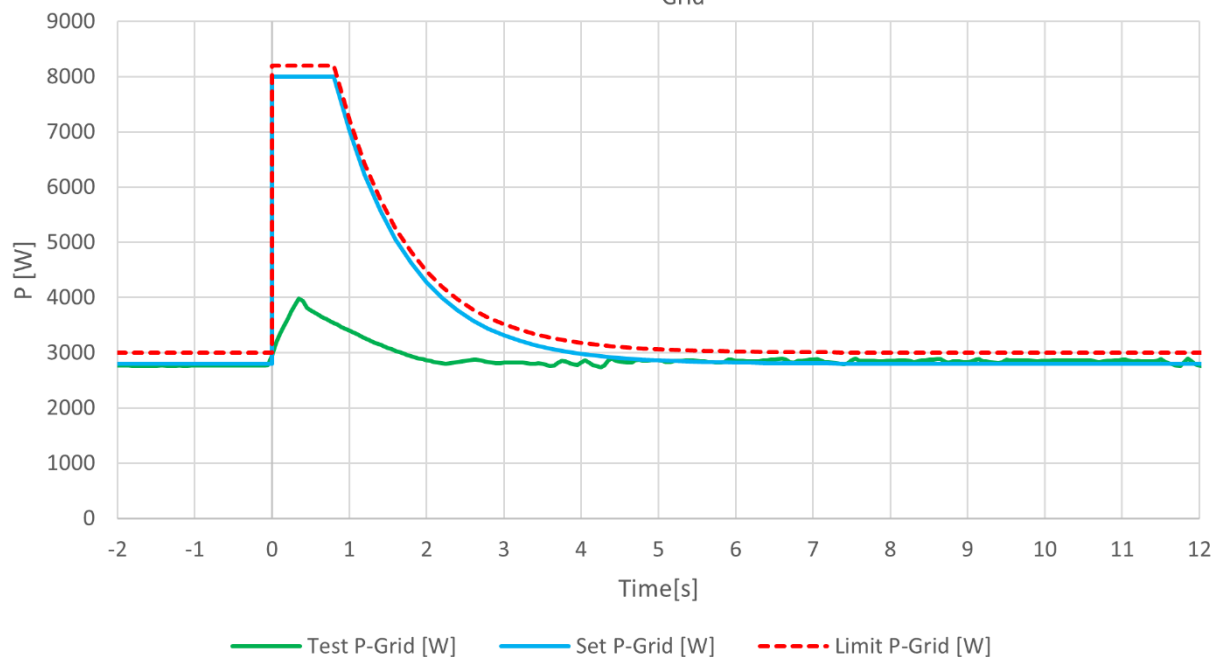
L.4.3 Verification of the ability of the SLI system to comply with the maximum input curve described in L.3 following a power variation of the primary source

P

Test1 (PIR=35%Pmax)

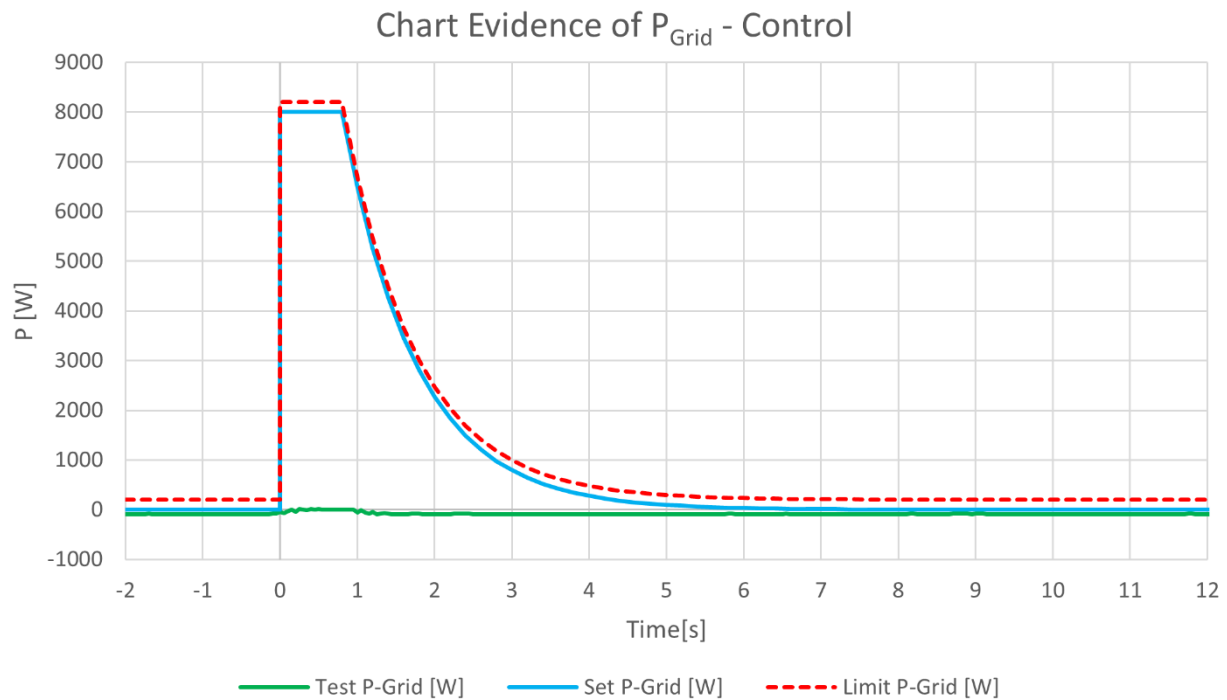
Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	40%	35%	5%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	110%	35%	5%		2,0	3

Chart Evidence of P_{Grid} - Control



Test2 (PIR=0%Pmax)

Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	40%	0%	5%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	110%	0%	5%		0,05	3



Note:

The measuring system shall record the active power for at least 5s before instant t_0 and up to 60s after instant t_0 .
SLI systems may only be installed on single-phase systems whose PIR does not exceed 6 kW and the total rated power of the installed generation systems does not exceed 11.08 kW.

Parametro	Prova 1	Prova 2
PIR	35%Pmax generatore	0%Pmax generatore
Limite di immissione	PIR – errore massimo ammesso come indicato in L.3	
Potenza iniziale del generatore	40%Pmax generatore	0%Pmax generatore
Potenza assorbita dal carico	5%Pmax generatore	
Potenza disponibile da sorgente primaria all'istante t_0	110%Pmax generatore	

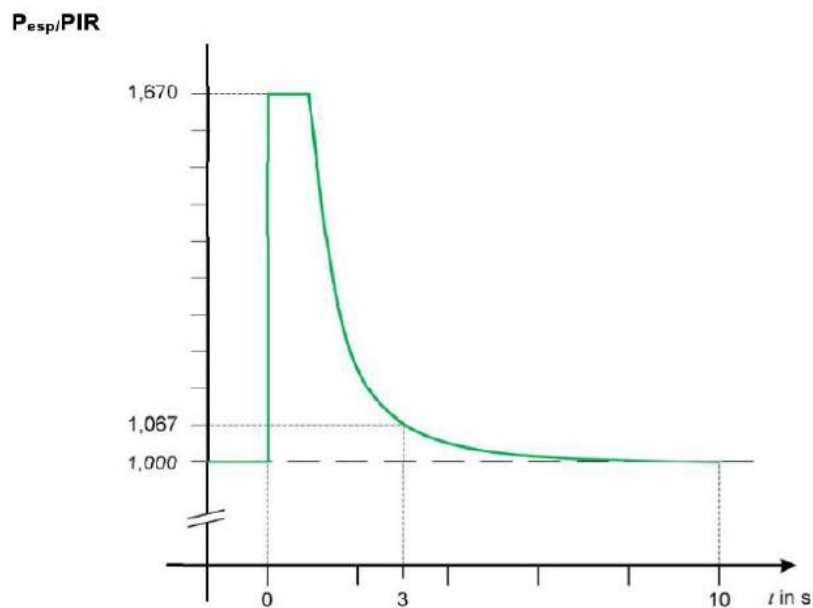


Figura 4- Curva limite di immissione

La curva segue l'equazione

$$\begin{cases} P_{esp}(t) = 1,67 \cdot PIR ; 0 \leq t < 0,8s \\ P_{esp}(t) = PIR(1 + 0,67e^{-1,05(t-0,8)}) ; t \geq 0,8s \end{cases}$$

$$PIR \leq 6kW^{(?)}$$

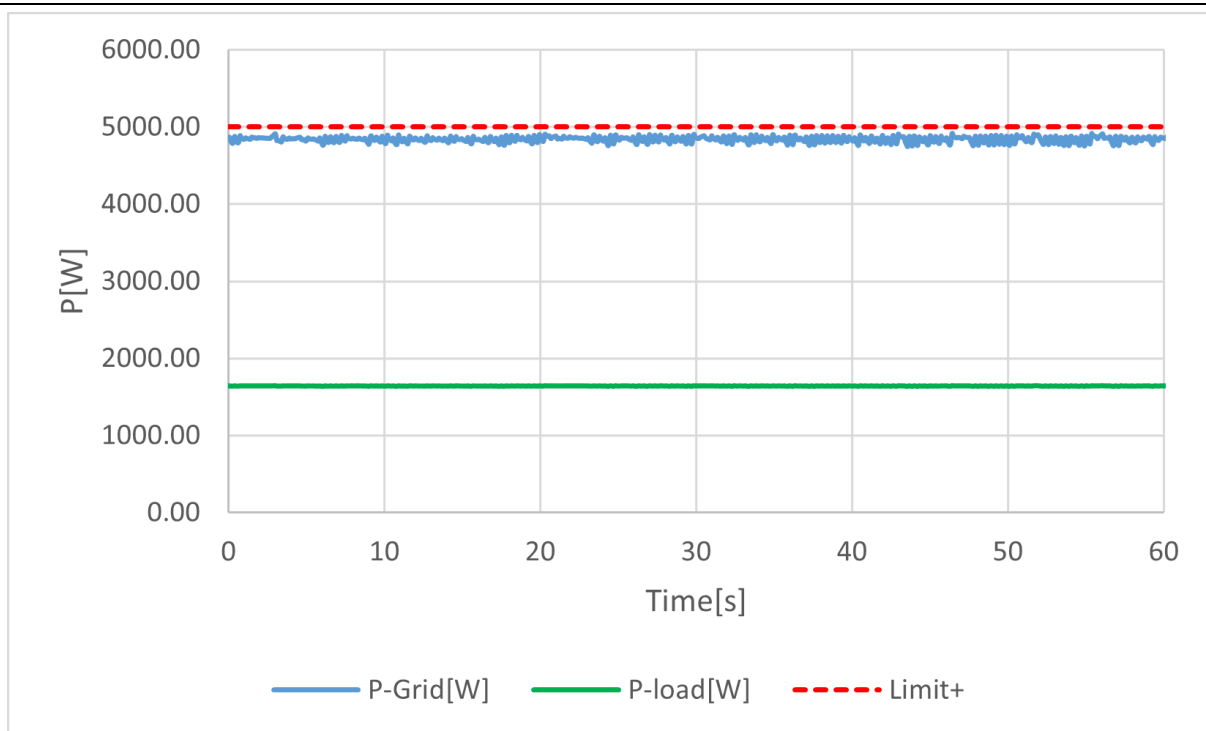
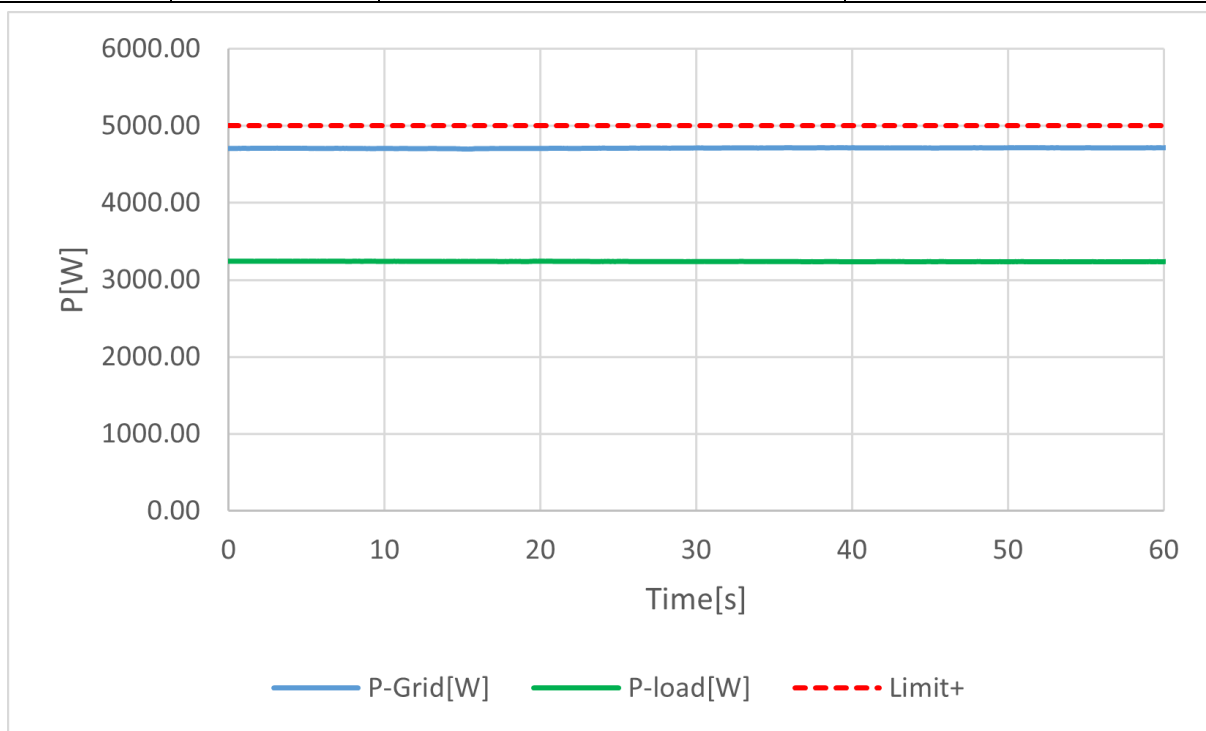
Dove $P_{esp}(t)$ è la potenza istantanea esportata in rete, mentre il tempo $t = 0$ definisce l'inizio dell'evento che ha innescato l'intervento del controllore SLI.

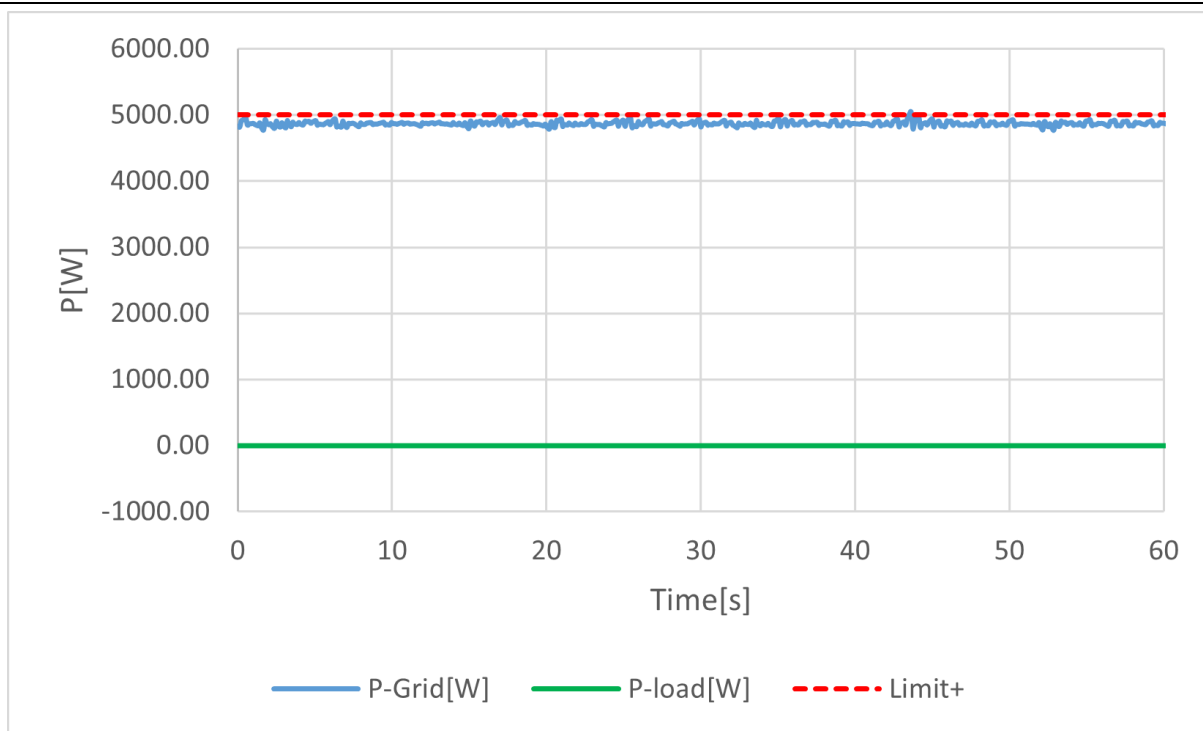
**L.4.4 Verification of the ability of the SLI system to comply with limit of the power fed into the grid
Under steady-state conditions**

P

Test1 (PIR=60%Pmax)

PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]
100%	60%	40%	P>1kw: 2,5%Pn P<=1kw: 25W
100%	60%	20%	P>1kw: 2,5%Pn P<=1kw: 25W
100%	60%	0%	P>1kw: 2,5%Pn P<=1kw: 25W





Note:

The measurement system must record the active power measurement for at least 15 minutes after the SLI control has limited the power input to a value below the PIR.

The measuring system shall record the active power for at least 5s before instant t_0 and up to 60s after instant t_0 .

SLI systems may only be installed on single-phase systems whose PIR does not exceed 6 kW and the total rated power of the installed generation systems does not exceed 11.08 kW.

Parametro	Prova
PIR	60%Pmax generatore
Limite di immissione	PIR - errore massimo ammesso come indicato in L.3
Potenza generata	100%Pmax generatore
Potenza assorbita dal carico	20%Pmax generatore

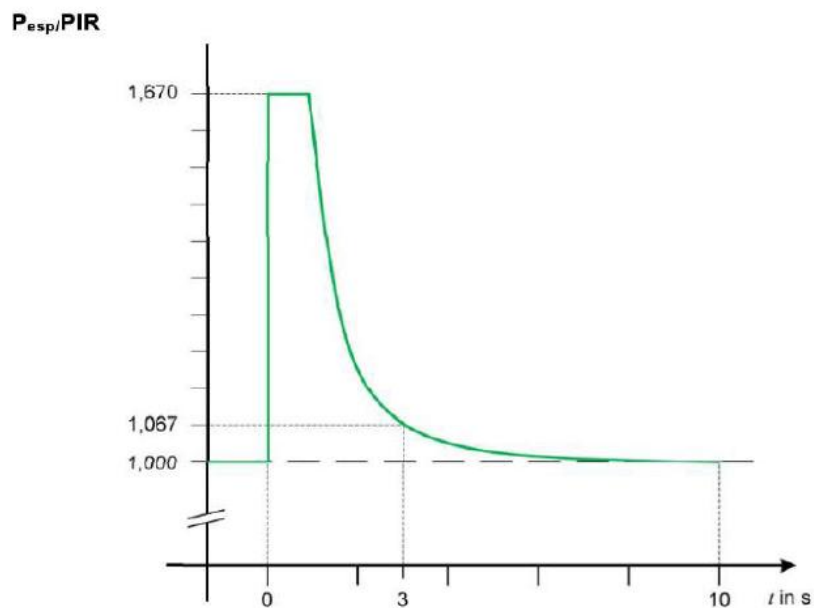


Figura 4- Curva limite di immissione

La curva segue l'equazione

$$\begin{cases} P_{esp}(t) = 1,67 \cdot PIR ; 0 \leq t < 0,8s \\ P_{esp}(t) = PIR(1 + 0,67e^{-1,05(t-0,8)}) ; t \geq 0,8s \end{cases}$$

$$PIR \leq 6kW^{(?)}$$

Dove $P_{esp}(t)$ è la potenza istantanea esportata in rete, mentre il tempo $t = 0$ definisce l'inizio dell'evento che ha innescato l'intervento del controllore SLI.

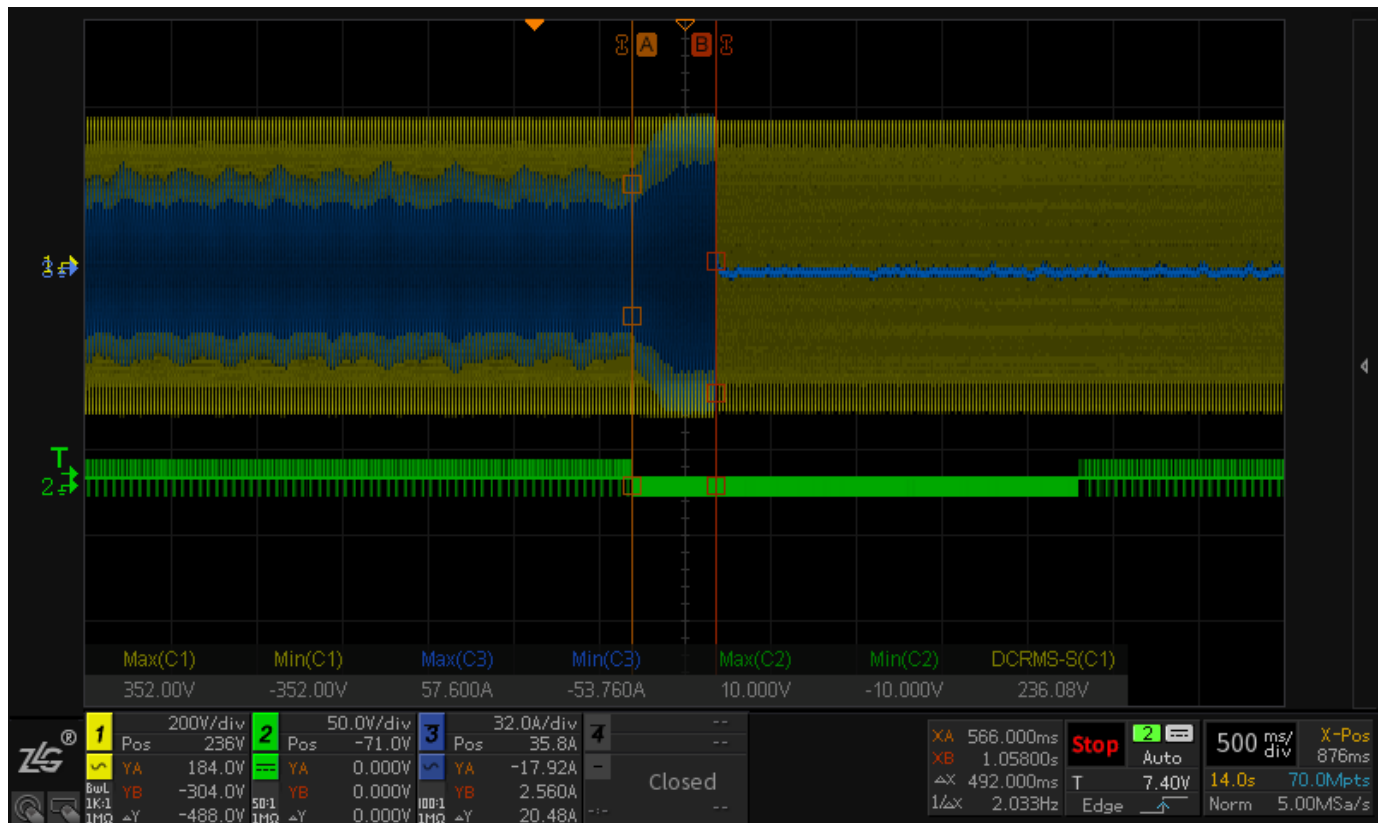
L.4.5 Verification of SLI system first fault tolerance

P

Test: (PIR=60%Pmax)

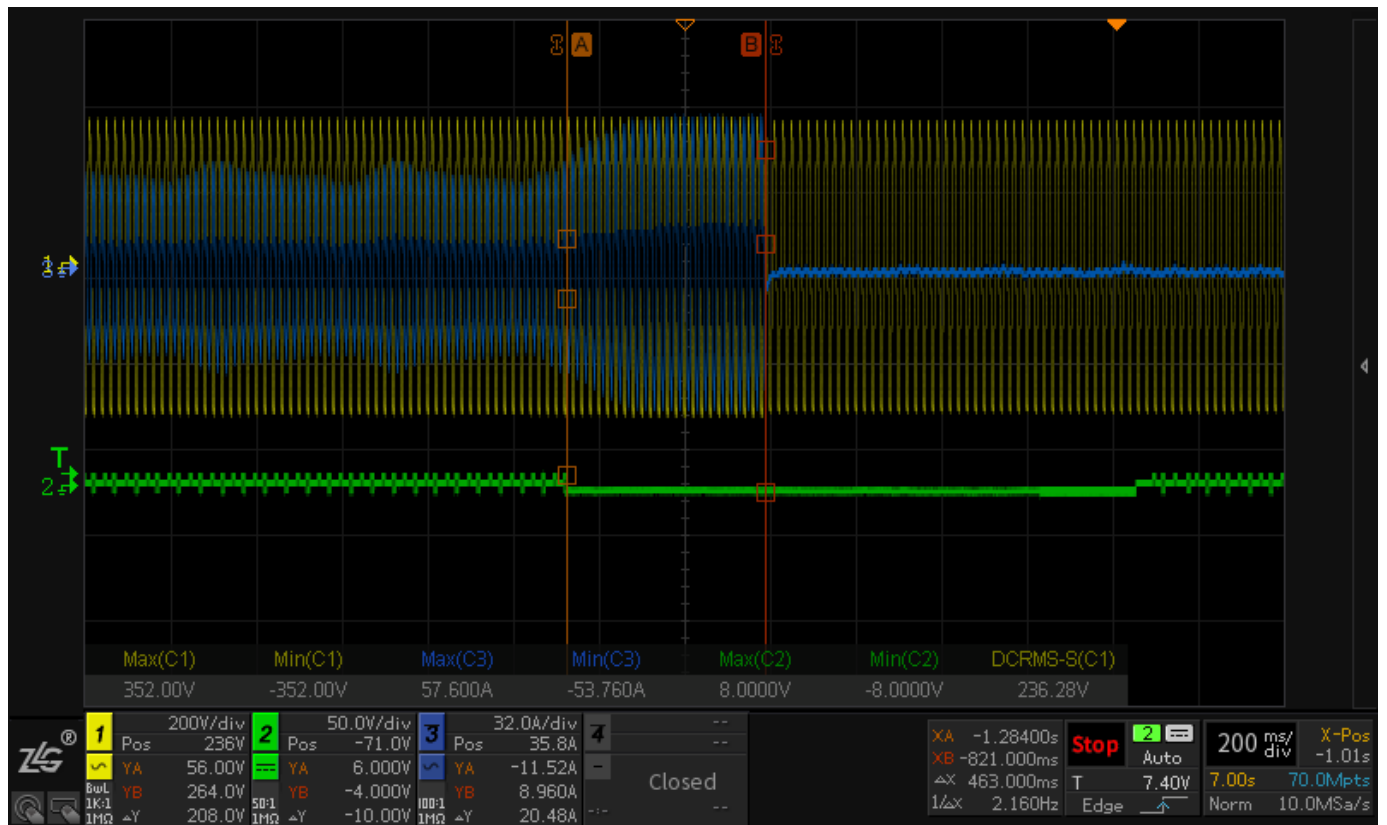
Test1 (Switching off the SLI control system)

Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	100%	60%	0%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	Switching off the SLI control system				--	--
3	100%	0%	0%		0,492	3



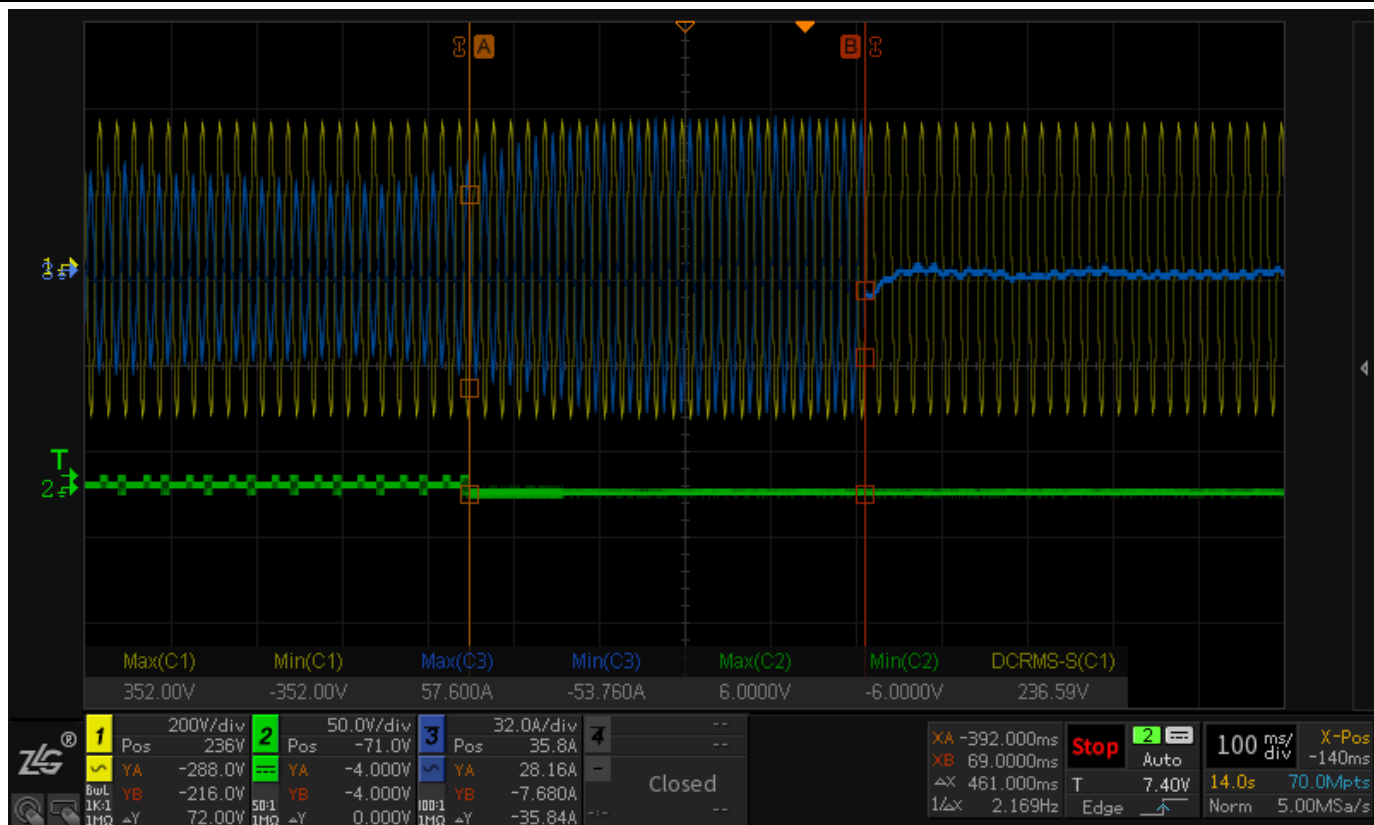
Test2 (Switching off the device measuring device for SLI purposes)

Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	100%	60%	0%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	Switching off the device measuring device for SLI purposes				--	--
3	100%	0%	0%		0,463	3



Test3 (Interruption of connection between transducer and measuring device)

Step	PPrimary source [W]	PGrid [W]	PLoad [W]	Limit [W]	Settling time [s]	Limit [s]
1	100%	60%	0%	P>1kw: 2,5%Pn P<=1kw: 25W	--	--
2	Interruption of connection between transducer and measuring device					
3	100%	0%	0%		0,461	3



Note:

The measuring system shall record the active power for at least 5s before instant t0 and up to 60s after instant t0.
SLI systems may only be installed on single-phase systems whose PIR does not exceed 6 kW and the total rated power of the installed generation systems does not exceed 11.08 kW.

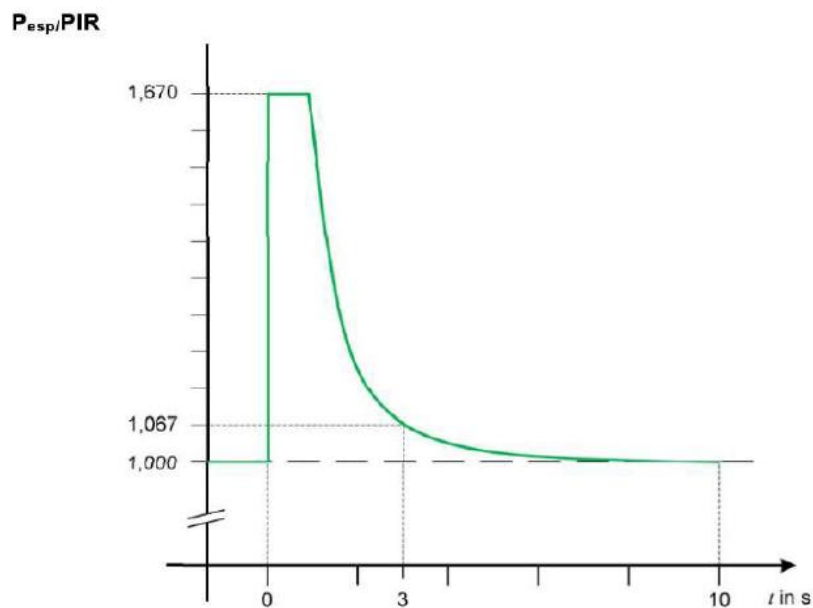


Figura 4- Curva limite di immissione

La curva segue l'equazione

$$\begin{cases} P_{esp}(t) = 1,67 \cdot PIR ; 0 \leq t < 0,8s \\ P_{esp}(t) = PIR(1 + 0,67e^{-1,05(t-0,8)}) ; t \geq 0,8s \end{cases}$$

$$PIR \leq 6kW^{(?)}$$

Dove $P_{esp}(t)$ è la potenza istantanea esportata in rete, mentre il tempo $t=0$ definisce l'inizio dell'evento che ha innescato l'intervento del controllore SLI.

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 75 A	P
	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	P
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total power output of more than 11,08 kW	N/A
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)	N/A
Bbis.6.5	Response time to a step change in the assigned level	N/A
Bbis.6.6	Automatic reactive power output according to a characteristic curve $\cos \varphi = f(P)$	
Bbis.6.7	Verification of compliance with the application of the standard delivery curve $\cos \varphi = f(P)$	P
Bbis.6.8	Automatic exchange of reactive power according to a characteristic curve $Q = f(V)$	N/A
Bbis.6.9	Verification of compliance with characteristic curve $Q = f(V)$ (greater 11,08 kW systems)	N/A
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	P
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	N/A
	Verification of OVRT capability	N/A
Bbis.10	Verification of insensitivity to automatic reclosure in phase discordance	P
Bbis.10.1	Simulated network test	P

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-LVEH1P8K-EU-G1 with Cmax battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2491,3		4884,3		7336,6		
AC Voltage [V]	230,93		229,88		230,19		
AC Current [A]	10,82		21,26		31,88		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,889		1,298		2,309		
PWHD [%]	0,835		1,283		1,679		
Harmonic	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Harmonic Current Limits [%]
1st	10,819	--	21,253	--	31,872	--	--
2nd	0,079	0,249	0,221	0,695	0,438	1,379	8,00
3rd	0,205	0,645	0,296	0,932	0,550	1,733	N/A
4th	0,062	0,194	0,069	0,219	0,091	0,287	4,00
5th	0,102	0,322	0,094	0,295	0,098	0,309	10,70
6th	0,036	0,114	0,051	0,160	0,044	0,138	2,67
7th	0,063	0,197	0,046	0,144	0,058	0,182	7,20
8th	0,053	0,168	0,036	0,113	0,051	0,160	2,00
9th	0,036	0,113	0,043	0,135	0,022	0,068	N/A
10th	0,023	0,073	0,045	0,141	0,039	0,122	1,60
11th	0,039	0,124	0,024	0,077	0,032	0,100	3,10
12th	0,038	0,119	0,026	0,082	0,034	0,106	1,33
13th	0,025	0,080	0,026	0,081	0,017	0,053	2,00
14th	0,028	0,090	0,030	0,096	0,038	0,121	N/A
15th	0,008	0,026	0,014	0,045	0,009	0,028	N/A
16th	0,025	0,078	0,033	0,104	0,022	0,069	N/A
17th	0,006	0,019	0,016	0,049	0,008	0,026	N/A
18th	0,011	0,034	0,016	0,050	0,033	0,103	N/A
19th	0,010	0,032	0,013	0,042	0,020	0,063	N/A
20th	0,007	0,022	0,008	0,027	0,017	0,053	N/A
21th	0,009	0,027	0,012	0,037	0,024	0,076	N/A
22th	0,008	0,025	0,008	0,025	0,013	0,040	N/A
23th	0,008	0,024	0,019	0,059	0,016	0,052	N/A
24th	0,003	0,009	0,003	0,011	0,005	0,017	N/A
25th	0,013	0,042	0,012	0,039	0,019	0,061	N/A
26th	0,001	0,005	0,003	0,008	0,012	0,037	N/A
27th	0,009	0,028	0,021	0,068	0,023	0,074	N/A
28th	0,002	0,006	0,002	0,006	0,009	0,029	N/A
29th	0,011	0,036	0,022	0,071	0,023	0,072	N/A

Bbis.3 a) / b)	Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)						P
Bidirectional converters (P _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
30th	0,003	0,011	0,005	0,017	0,003	0,009	N/A
31th	0,015	0,048	0,016	0,049	0,025	0,077	N/A
32th	0,004	0,012	0,002	0,006	0,004	0,012	N/A
33th	0,009	0,029	0,018	0,058	0,025	0,080	N/A
34th	0,005	0,014	0,005	0,017	0,005	0,017	N/A
35th	0,009	0,028	0,018	0,057	0,020	0,062	N/A
36th	0,005	0,015	0,005	0,016	0,005	0,015	N/A
37th	0,010	0,031	0,019	0,060	0,023	0,072	N/A
38th	0,007	0,022	0,004	0,013	0,008	0,026	N/A
39th	0,009	0,030	0,018	0,056	0,023	0,072	N/A
40th	0,009	0,030	0,020	0,062	0,037	0,116	N/A
41th	0,010	0,032	0,018	0,057	0,021	0,068	N/A
42th	0,006	0,019	0,008	0,025	0,009	0,029	N/A
43th	0,010	0,033	0,018	0,056	0,019	0,061	N/A
44th	0,006	0,019	0,007	0,023	0,005	0,017	N/A
45th	0,009	0,029	0,015	0,047	0,019	0,060	N/A
46th	0,006	0,020	0,006	0,017	0,005	0,016	N/A
47th	0,008	0,024	0,015	0,047	0,018	0,057	N/A
48th	0,006	0,018	0,006	0,017	0,006	0,018	N/A
49th	0,008	0,026	0,015	0,048	0,017	0,053	N/A
50th	0,005	0,017	0,006	0,019	0,005	0,016	N/A
Note: For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b). The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2782,1		-5146,1		-7963,3		
AC Voltage [V]	230,22		230,26		230,06		
AC Current [A]	12,19		22,44		34,71		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,113		2,000		3,674		
PWHD [%]	1,279		1,466		1,619		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	12,185	--	22,427	--	34,688	--	--
2nd	0,143	0,412	0,332	0,956	0,732	2,104	8,00
3rd	0,289	0,832	0,561	1,613	1,013	2,913	N/A
4th	0,073	0,209	0,083	0,238	0,075	0,215	4,00
5th	0,129	0,370	0,145	0,418	0,176	0,505	10,70
6th	0,059	0,170	0,068	0,196	0,074	0,213	2,67
7th	0,061	0,175	0,066	0,190	0,063	0,181	7,20
8th	0,053	0,152	0,059	0,169	0,068	0,195	2,00
9th	0,026	0,076	0,028	0,080	0,029	0,084	N/A
10th	0,044	0,128	0,052	0,148	0,055	0,159	1,60
11th	0,024	0,069	0,030	0,087	0,021	0,060	3,10
12th	0,036	0,103	0,041	0,119	0,046	0,133	1,33
13th	0,012	0,034	0,017	0,049	0,015	0,044	2,00
14th	0,027	0,078	0,034	0,098	0,038	0,109	N/A
15th	0,014	0,039	0,019	0,054	0,019	0,055	N/A
16th	0,021	0,060	0,026	0,076	0,028	0,079	N/A
17th	0,017	0,049	0,021	0,060	0,022	0,062	N/A
18th	0,016	0,045	0,021	0,059	0,024	0,069	N/A
19th	0,018	0,053	0,022	0,064	0,026	0,075	N/A
20th	0,012	0,036	0,017	0,048	0,019	0,054	N/A
21th	0,021	0,059	0,022	0,062	0,023	0,067	N/A
22th	0,009	0,025	0,012	0,035	0,014	0,040	N/A
23th	0,022	0,063	0,024	0,068	0,024	0,068	N/A
24th	0,007	0,021	0,010	0,029	0,012	0,034	N/A
25th	0,021	0,061	0,025	0,071	0,027	0,078	N/A
26th	0,009	0,027	0,009	0,027	0,010	0,029	N/A
27th	0,021	0,059	0,024	0,070	0,025	0,073	N/A
28th	0,010	0,027	0,009	0,025	0,009	0,025	N/A
29th	0,021	0,059	0,024	0,068	0,025	0,072	N/A
30th	0,009	0,026	0,007	0,021	0,008	0,024	N/A



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
31th	0,022	0,063	0,023	0,065	0,023	0,067	N/A
32th	0,011	0,030	0,006	0,018	0,007	0,020	N/A
33th	0,022	0,062	0,025	0,072	0,024	0,070	N/A
34th	0,011	0,030	0,005	0,016	0,006	0,017	N/A
35th	0,021	0,061	0,024	0,070	0,023	0,067	N/A
36th	0,010	0,029	0,006	0,016	0,006	0,016	N/A
37th	0,020	0,057	0,024	0,069	0,023	0,067	N/A
38th	0,010	0,029	0,005	0,015	0,008	0,022	N/A
39th	0,019	0,055	0,022	0,064	0,023	0,067	N/A
40th	0,011	0,032	0,018	0,052	0,034	0,097	N/A
41th	0,018	0,051	0,021	0,061	0,021	0,059	N/A
42th	0,009	0,025	0,007	0,019	0,010	0,027	N/A
43th	0,017	0,048	0,020	0,057	0,019	0,053	N/A
44th	0,008	0,022	0,004	0,012	0,005	0,013	N/A
45th	0,015	0,044	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,019	0,004	0,011	0,003	0,008	N/A
47th	0,014	0,041	0,017	0,047	0,013	0,038	N/A
48th	0,006	0,017	0,003	0,010	0,002	0,006	N/A
49th	0,013	0,036	0,015	0,042	0,011	0,032	N/A
50th	0,005	0,014	0,003	0,010	0,002	0,005	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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-LVEH1P8K-EU-G1 with Cmax battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2542,8		4951,4		7336,9		
AC Voltage [V]	230,16		229,12		230,19		
AC Current [A]	11,08		21,62		31,88		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,890		1,334		2,310		
PWHD [%]	0,838		1,284		1,678		
Harmonic	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Current Magnitude [A]	% of Funda-mental	Harmonic Current Limits [%]
1st	11,077	--	21,616	--	31,873	--	--
2nd	0,082	0,258	0,223	0,703	0,438	1,380	8,00
3rd	0,205	0,645	0,309	0,973	0,550	1,733	N/A
4th	0,061	0,191	0,074	0,232	0,091	0,287	4,00
5th	0,102	0,320	0,092	0,290	0,098	0,310	10,70
6th	0,037	0,115	0,049	0,155	0,044	0,139	2,67
7th	0,063	0,197	0,048	0,151	0,058	0,182	7,20
8th	0,050	0,159	0,035	0,110	0,051	0,160	2,00
9th	0,037	0,116	0,042	0,134	0,022	0,068	N/A
10th	0,026	0,081	0,046	0,146	0,039	0,122	1,60
11th	0,039	0,123	0,026	0,081	0,032	0,100	3,10
12th	0,038	0,119	0,027	0,085	0,034	0,106	1,33
13th	0,025	0,077	0,024	0,074	0,017	0,053	2,00
14th	0,027	0,086	0,031	0,098	0,038	0,121	N/A
15th	0,009	0,028	0,013	0,042	0,009	0,028	N/A
16th	0,025	0,079	0,031	0,099	0,022	0,069	N/A
17th	0,007	0,021	0,017	0,054	0,008	0,026	N/A
18th	0,010	0,031	0,014	0,044	0,033	0,103	N/A
19th	0,011	0,034	0,012	0,039	0,020	0,063	N/A
20th	0,007	0,023	0,009	0,029	0,017	0,053	N/A
21th	0,008	0,026	0,015	0,048	0,024	0,076	N/A
22th	0,008	0,025	0,008	0,026	0,013	0,040	N/A
23th	0,008	0,025	0,016	0,049	0,016	0,052	N/A
24th	0,002	0,007	0,003	0,010	0,005	0,017	N/A
25th	0,013	0,042	0,012	0,037	0,019	0,061	N/A
26th	0,001	0,004	0,003	0,009	0,012	0,037	N/A
27th	0,009	0,028	0,025	0,079	0,023	0,074	N/A
28th	0,002	0,007	0,003	0,011	0,009	0,029	N/A
29th	0,012	0,038	0,019	0,059	0,023	0,072	N/A
30th	0,004	0,012	0,006	0,018	0,003	0,009	N/A

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-LVEH1P8K-EU-G1 with Cmax battery							
31th	0,015	0,047	0,017	0,055	0,025	0,077	N/A
32th	0,004	0,013	0,002	0,006	0,004	0,012	N/A
33th	0,009	0,029	0,019	0,059	0,025	0,079	N/A
34th	0,004	0,013	0,005	0,017	0,005	0,017	N/A
35th	0,009	0,028	0,018	0,057	0,020	0,062	N/A
36th	0,005	0,017	0,004	0,013	0,005	0,015	N/A
37th	0,010	0,032	0,019	0,061	0,023	0,072	N/A
38th	0,007	0,022	0,004	0,011	0,008	0,026	N/A
39th	0,010	0,030	0,018	0,056	0,023	0,072	N/A
40th	0,009	0,029	0,020	0,063	0,037	0,116	N/A
41th	0,010	0,032	0,019	0,060	0,021	0,068	N/A
42th	0,006	0,019	0,009	0,029	0,009	0,029	N/A
43th	0,011	0,033	0,016	0,052	0,019	0,061	N/A
44th	0,007	0,020	0,006	0,020	0,005	0,017	N/A
45th	0,009	0,028	0,015	0,046	0,019	0,060	N/A
46th	0,006	0,020	0,005	0,016	0,005	0,017	N/A
47th	0,008	0,025	0,016	0,051	0,018	0,057	N/A
48th	0,005	0,017	0,006	0,020	0,006	0,018	N/A
49th	0,009	0,027	0,015	0,048	0,017	0,053	N/A
50th	0,006	0,017	0,006	0,018	0,005	0,014	N/A
Note:							
For test result (discharge mode P _{SMAX} , P _{NINV}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2663,3		-5312,9		-7963,6		
AC Voltage [V]	230,17		230,07		230,06		
AC Current [A]	11,68		23,18		34,70		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,084		2,086		3,674		
PWHD [%]	1,265		1,476		1,619		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,674	--	23,169	--	34,689	--	--
2nd	0,136	0,391	0,347	0,997	0,732	2,104	8,00
3rd	0,281	0,807	0,589	1,693	1,013	2,913	N/A
4th	0,072	0,207	0,084	0,242	0,075	0,215	4,00
5th	0,128	0,369	0,146	0,418	0,176	0,505	10,70
6th	0,059	0,169	0,068	0,196	0,074	0,213	2,67
7th	0,061	0,175	0,067	0,192	0,063	0,181	7,20
8th	0,053	0,152	0,060	0,173	0,068	0,195	2,00
9th	0,025	0,070	0,027	0,079	0,029	0,084	N/A
10th	0,044	0,126	0,051	0,147	0,055	0,159	1,60
11th	0,024	0,070	0,030	0,085	0,021	0,060	3,10
12th	0,035	0,100	0,043	0,122	0,046	0,133	1,33
13th	0,012	0,034	0,018	0,053	0,015	0,044	2,00
14th	0,027	0,076	0,034	0,099	0,038	0,109	N/A
15th	0,014	0,039	0,019	0,054	0,019	0,055	N/A
16th	0,021	0,060	0,027	0,077	0,028	0,079	N/A
17th	0,017	0,049	0,021	0,059	0,022	0,062	N/A
18th	0,015	0,043	0,022	0,062	0,024	0,069	N/A
19th	0,019	0,055	0,023	0,066	0,026	0,075	N/A
20th	0,011	0,033	0,017	0,049	0,019	0,054	N/A
21th	0,021	0,060	0,021	0,062	0,023	0,067	N/A
22th	0,008	0,024	0,012	0,036	0,014	0,040	N/A
23th	0,021	0,060	0,023	0,067	0,024	0,068	N/A
24th	0,008	0,024	0,011	0,031	0,012	0,034	N/A
25th	0,021	0,060	0,025	0,071	0,027	0,078	N/A
26th	0,009	0,026	0,010	0,029	0,010	0,029	N/A
27th	0,020	0,059	0,025	0,071	0,025	0,073	N/A
28th	0,009	0,026	0,009	0,026	0,009	0,025	N/A
29th	0,021	0,060	0,023	0,067	0,025	0,072	N/A
30th	0,010	0,030	0,007	0,022	0,008	0,024	N/A



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
31th	0,021	0,060	0,023	0,067	0,023	0,067	N/A
32th	0,011	0,031	0,007	0,020	0,007	0,020	N/A
33th	0,022	0,062	0,025	0,071	0,024	0,070	N/A
34th	0,011	0,030	0,006	0,016	0,006	0,017	N/A
35th	0,020	0,059	0,024	0,070	0,023	0,067	N/A
36th	0,010	0,030	0,005	0,016	0,006	0,016	N/A
37th	0,019	0,056	0,024	0,068	0,023	0,067	N/A
38th	0,010	0,028	0,005	0,015	0,008	0,022	N/A
39th	0,018	0,052	0,022	0,064	0,023	0,066	N/A
40th	0,011	0,032	0,018	0,053	0,034	0,097	N/A
41th	0,018	0,051	0,021	0,061	0,021	0,059	N/A
42th	0,009	0,025	0,007	0,019	0,010	0,027	N/A
43th	0,016	0,047	0,020	0,057	0,019	0,053	N/A
44th	0,008	0,022	0,004	0,012	0,005	0,013	N/A
45th	0,015	0,043	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,019	0,004	0,011	0,003	0,008	N/A
47th	0,014	0,040	0,016	0,047	0,013	0,038	N/A
48th	0,006	0,016	0,003	0,010	0,002	0,006	N/A
49th	0,012	0,035	0,014	0,041	0,011	0,032	N/A
50th	0,005	0,014	0,003	0,009	0,002	0,005	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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-LVEH1P8K-EU-G1 with Cmax battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2540,7		4943,5		7336,6		
AC Voltage [V]	230,16		229,12		230,19		
AC Current [A]	11,07		21,59		31,88		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,892		1,313		2,309		
PWHD [%]	0,837		1,287		1,679		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,067	--	21,581	--	31,872	--	--
2nd	0,083	0,261	0,219	0,690	0,438	1,379	8,00
3rd	0,206	0,648	0,303	0,955	0,550	1,733	N/A
4th	0,060	0,189	0,073	0,231	0,091	0,287	4,00
5th	0,101	0,317	0,091	0,288	0,098	0,309	10,70
6th	0,037	0,115	0,049	0,155	0,044	0,138	2,67
7th	0,062	0,196	0,046	0,145	0,058	0,182	7,20
8th	0,051	0,161	0,034	0,109	0,051	0,160	2,00
9th	0,038	0,119	0,043	0,136	0,022	0,068	N/A
10th	0,025	0,080	0,046	0,146	0,039	0,122	1,60
11th	0,040	0,125	0,026	0,081	0,032	0,100	3,10
12th	0,038	0,119	0,027	0,084	0,034	0,106	1,33
13th	0,024	0,076	0,023	0,074	0,017	0,053	2,00
14th	0,027	0,086	0,031	0,097	0,038	0,121	N/A
15th	0,009	0,028	0,013	0,042	0,009	0,028	N/A
16th	0,025	0,079	0,032	0,100	0,022	0,069	N/A
17th	0,007	0,022	0,017	0,053	0,008	0,026	N/A
18th	0,010	0,031	0,014	0,045	0,033	0,103	N/A
19th	0,011	0,033	0,013	0,040	0,020	0,063	N/A
20th	0,007	0,023	0,009	0,028	0,017	0,053	N/A
21th	0,009	0,028	0,014	0,044	0,024	0,076	N/A
22th	0,008	0,025	0,009	0,027	0,013	0,040	N/A
23th	0,008	0,024	0,017	0,053	0,016	0,052	N/A
24th	0,002	0,008	0,003	0,010	0,005	0,017	N/A
25th	0,014	0,043	0,012	0,037	0,019	0,061	N/A
26th	0,001	0,004	0,003	0,009	0,012	0,037	N/A
27th	0,009	0,029	0,025	0,077	0,023	0,074	N/A
28th	0,002	0,007	0,003	0,009	0,009	0,029	N/A
29th	0,012	0,036	0,020	0,062	0,023	0,072	N/A
30th	0,004	0,012	0,006	0,017	0,003	0,009	N/A



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 _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmax battery							
31th	0,015	0,046	0,017	0,053	0,025	0,077	N/A
32th	0,004	0,013	0,002	0,006	0,004	0,012	N/A
33th	0,010	0,030	0,019	0,060	0,025	0,080	N/A
34th	0,004	0,013	0,005	0,017	0,005	0,017	N/A
35th	0,009	0,028	0,018	0,057	0,020	0,062	N/A
36th	0,005	0,017	0,004	0,013	0,005	0,015	N/A
37th	0,010	0,032	0,019	0,061	0,023	0,072	N/A
38th	0,007	0,023	0,004	0,011	0,008	0,026	N/A
39th	0,009	0,030	0,018	0,057	0,023	0,072	N/A
40th	0,009	0,029	0,020	0,062	0,037	0,116	N/A
41th	0,010	0,032	0,019	0,060	0,021	0,068	N/A
42th	0,006	0,020	0,009	0,028	0,009	0,029	N/A
43th	0,011	0,033	0,017	0,054	0,019	0,061	N/A
44th	0,007	0,021	0,006	0,020	0,005	0,017	N/A
45th	0,009	0,028	0,015	0,046	0,019	0,060	N/A
46th	0,006	0,020	0,005	0,016	0,005	0,016	N/A
47th	0,008	0,025	0,016	0,050	0,018	0,057	N/A
48th	0,005	0,017	0,006	0,019	0,006	0,018	N/A
49th	0,008	0,026	0,015	0,049	0,017	0,053	N/A
50th	0,006	0,018	0,006	0,018	0,005	0,014	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _{C_{MAX}})							
DHN-LVEH1P8K-EU-G1 with C _{max} battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2664,5		-5329,0		-7963,3		
AC Voltage [V]	230,17		230,08		230,06		
AC Current [A]	11,69		23,25		34,71		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,083		2,096		3,674		
PWHD [%]	1,267		1,483		1,619		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,680	--	23,238	--	34,688	--	--
2nd	0,136	0,390	0,347	0,998	0,732	2,104	8,00
3rd	0,280	0,806	0,592	1,703	1,013	2,913	N/A
4th	0,072	0,206	0,085	0,243	0,075	0,215	4,00
5th	0,128	0,369	0,146	0,419	0,176	0,505	10,70
6th	0,059	0,170	0,069	0,197	0,074	0,213	2,67
7th	0,060	0,174	0,067	0,192	0,063	0,181	7,20
8th	0,053	0,153	0,060	0,174	0,068	0,195	2,00
9th	0,025	0,071	0,028	0,080	0,029	0,084	N/A
10th	0,044	0,125	0,052	0,148	0,055	0,159	1,60
11th	0,025	0,071	0,030	0,086	0,021	0,060	3,10
12th	0,035	0,100	0,043	0,124	0,046	0,133	1,33
13th	0,011	0,033	0,018	0,052	0,015	0,044	2,00
14th	0,027	0,077	0,034	0,099	0,038	0,109	N/A
15th	0,014	0,040	0,019	0,056	0,019	0,055	N/A
16th	0,020	0,059	0,027	0,078	0,028	0,079	N/A
17th	0,017	0,049	0,021	0,060	0,022	0,062	N/A
18th	0,015	0,044	0,022	0,063	0,024	0,069	N/A
19th	0,019	0,055	0,023	0,066	0,026	0,076	N/A
20th	0,012	0,034	0,017	0,049	0,019	0,054	N/A
21th	0,021	0,060	0,022	0,063	0,023	0,067	N/A
22th	0,008	0,023	0,012	0,036	0,014	0,040	N/A
23th	0,021	0,062	0,023	0,066	0,024	0,068	N/A
24th	0,008	0,024	0,011	0,031	0,012	0,034	N/A
25th	0,021	0,061	0,025	0,073	0,027	0,078	N/A
26th	0,009	0,027	0,010	0,029	0,010	0,029	N/A
27th	0,020	0,058	0,024	0,070	0,025	0,073	N/A
28th	0,009	0,026	0,009	0,025	0,009	0,025	N/A
29th	0,021	0,060	0,024	0,068	0,025	0,072	N/A
30th	0,010	0,029	0,008	0,022	0,008	0,024	N/A



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 _{C_{MAX}})							
DHN-LVEH1P8K-EU-G1 with C _{max} battery							
31th	0,021	0,061	0,024	0,068	0,023	0,068	N/A
32th	0,011	0,031	0,007	0,019	0,007	0,020	N/A
33th	0,021	0,060	0,025	0,071	0,024	0,070	N/A
34th	0,011	0,031	0,006	0,016	0,006	0,017	N/A
35th	0,021	0,060	0,025	0,071	0,023	0,067	N/A
36th	0,010	0,030	0,005	0,016	0,006	0,016	N/A
37th	0,019	0,056	0,024	0,068	0,023	0,067	N/A
38th	0,010	0,028	0,005	0,015	0,008	0,022	N/A
39th	0,018	0,052	0,022	0,064	0,023	0,067	N/A
40th	0,011	0,031	0,018	0,053	0,034	0,097	N/A
41th	0,018	0,051	0,021	0,061	0,021	0,059	N/A
42th	0,009	0,025	0,007	0,019	0,010	0,027	N/A
43th	0,016	0,047	0,020	0,057	0,019	0,053	N/A
44th	0,008	0,022	0,004	0,012	0,005	0,013	N/A
45th	0,015	0,044	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,019	0,004	0,010	0,003	0,008	N/A
47th	0,014	0,040	0,016	0,047	0,013	0,038	N/A
48th	0,006	0,016	0,003	0,010	0,002	0,006	N/A
49th	0,012	0,035	0,014	0,042	0,011	0,032	N/A
50th	0,005	0,013	0,003	0,009	0,002	0,005	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2255,5		4434,0		6779,1		
AC Voltage [V]	230,36		229,67		230,62		
AC Current [A]	9,83		19,32		29,40		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,946		1,271		2,175		
PWHD [%]	0,863		1,327		1,731		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	9,827	--	19,314	--	29,396	--	--
2nd	0,072	0,243	0,176	0,597	0,372	1,259	8,00
3rd	0,202	0,682	0,273	0,925	0,483	1,633	N/A
4th	0,056	0,189	0,077	0,259	0,082	0,278	4,00
5th	0,108	0,364	0,096	0,325	0,099	0,334	10,70
6th	0,042	0,142	0,044	0,147	0,049	0,165	2,67
7th	0,064	0,217	0,060	0,203	0,057	0,193	7,20
8th	0,051	0,172	0,043	0,145	0,050	0,168	2,00
9th	0,036	0,120	0,033	0,111	0,022	0,076	N/A
10th	0,022	0,075	0,038	0,129	0,033	0,113	1,60
11th	0,041	0,138	0,032	0,109	0,042	0,143	3,10
12th	0,041	0,138	0,029	0,098	0,043	0,145	1,33
13th	0,025	0,085	0,026	0,087	0,007	0,023	2,00
14th	0,026	0,089	0,032	0,107	0,026	0,088	N/A
15th	0,009	0,031	0,015	0,049	0,016	0,054	N/A
16th	0,025	0,086	0,035	0,117	0,030	0,100	N/A
17th	0,006	0,020	0,011	0,037	0,013	0,044	N/A
18th	0,012	0,040	0,016	0,053	0,030	0,103	N/A
19th	0,009	0,030	0,014	0,048	0,020	0,069	N/A
20th	0,006	0,020	0,008	0,028	0,013	0,044	N/A
21th	0,009	0,030	0,013	0,043	0,021	0,070	N/A
22th	0,009	0,029	0,005	0,016	0,013	0,044	N/A
23th	0,007	0,023	0,016	0,054	0,016	0,055	N/A
24th	0,002	0,008	0,007	0,022	0,003	0,010	N/A
25th	0,012	0,042	0,015	0,050	0,019	0,063	N/A
26th	0,001	0,004	0,003	0,011	0,006	0,022	N/A
27th	0,009	0,030	0,016	0,053	0,025	0,084	N/A
28th	0,003	0,009	0,002	0,006	0,008	0,026	N/A
29th	0,010	0,034	0,022	0,075	0,019	0,065	N/A
30th	0,003	0,011	0,005	0,017	0,004	0,013	N/A

Bbis.3 a) / b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)					P
Bidirectional converters (P _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,014	0,047	0,018	0,060	0,021	0,072	N/A
32th	0,004	0,013	0,004	0,013	0,007	0,022	N/A
33th	0,009	0,031	0,015	0,050	0,028	0,094	N/A
34th	0,005	0,015	0,004	0,012	0,004	0,012	N/A
35th	0,008	0,026	0,016	0,055	0,024	0,080	N/A
36th	0,005	0,018	0,004	0,013	0,004	0,013	N/A
37th	0,009	0,031	0,019	0,064	0,020	0,068	N/A
38th	0,007	0,025	0,006	0,021	0,006	0,022	N/A
39th	0,009	0,029	0,018	0,059	0,021	0,072	N/A
40th	0,009	0,032	0,018	0,061	0,035	0,120	N/A
41th	0,009	0,029	0,015	0,050	0,021	0,072	N/A
42th	0,006	0,021	0,006	0,021	0,009	0,031	N/A
43th	0,010	0,033	0,017	0,058	0,020	0,069	N/A
44th	0,006	0,021	0,007	0,023	0,006	0,022	N/A
45th	0,008	0,029	0,017	0,057	0,020	0,069	N/A
46th	0,007	0,023	0,007	0,023	0,006	0,020	N/A
47th	0,007	0,023	0,013	0,046	0,018	0,060	N/A
48th	0,006	0,019	0,006	0,019	0,005	0,018	N/A
49th	0,007	0,024	0,014	0,047	0,018	0,060	N/A
50th	0,005	0,018	0,006	0,019	0,007	0,023	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2676,9		-5253,4		-7969,6		
AC Voltage [V]	230,46		230,41		230,22		
AC Current [A]	11,72		22,89		34,72		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,097		2,083		3,733		
PWHD [%]	1,263		1,488		1,625		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,719	--	22,879	--	34,692	--	--
2nd	0,137	0,394	0,346	0,994	0,736	2,115	8,00
3rd	0,284	0,816	0,587	1,688	1,037	2,981	N/A
4th	0,074	0,212	0,088	0,253	0,075	0,216	4,00
5th	0,130	0,375	0,145	0,416	0,171	0,493	10,70
6th	0,061	0,175	0,069	0,200	0,077	0,220	2,67
7th	0,059	0,169	0,067	0,193	0,060	0,173	7,20
8th	0,054	0,155	0,062	0,178	0,070	0,201	2,00
9th	0,025	0,073	0,027	0,076	0,031	0,089	N/A
10th	0,045	0,130	0,052	0,150	0,055	0,158	1,60
11th	0,023	0,067	0,029	0,085	0,019	0,055	3,10
12th	0,035	0,102	0,044	0,125	0,048	0,137	1,33
13th	0,011	0,031	0,017	0,050	0,015	0,044	2,00
14th	0,027	0,078	0,035	0,100	0,038	0,110	N/A
15th	0,014	0,041	0,019	0,056	0,019	0,054	N/A
16th	0,021	0,059	0,027	0,077	0,028	0,080	N/A
17th	0,017	0,049	0,021	0,062	0,022	0,064	N/A
18th	0,015	0,044	0,021	0,062	0,025	0,071	N/A
19th	0,019	0,054	0,023	0,066	0,026	0,073	N/A
20th	0,012	0,033	0,017	0,049	0,018	0,053	N/A
21th	0,021	0,060	0,022	0,062	0,023	0,067	N/A
22th	0,008	0,023	0,012	0,035	0,014	0,040	N/A
23th	0,021	0,061	0,023	0,066	0,023	0,067	N/A
24th	0,008	0,023	0,011	0,031	0,012	0,034	N/A
25th	0,021	0,059	0,026	0,074	0,027	0,078	N/A
26th	0,009	0,025	0,010	0,029	0,010	0,028	N/A
27th	0,021	0,060	0,024	0,070	0,025	0,073	N/A
28th	0,009	0,025	0,009	0,025	0,009	0,025	N/A
29th	0,020	0,059	0,023	0,067	0,025	0,070	N/A
30th	0,010	0,028	0,008	0,022	0,008	0,022	N/A

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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,021	0,060	0,023	0,068	0,023	0,067	N/A
32th	0,011	0,031	0,007	0,019	0,007	0,020	N/A
33th	0,021	0,061	0,025	0,071	0,024	0,069	N/A
34th	0,010	0,030	0,006	0,016	0,006	0,016	N/A
35th	0,021	0,060	0,025	0,071	0,023	0,066	N/A
36th	0,010	0,030	0,005	0,015	0,006	0,016	N/A
37th	0,019	0,056	0,024	0,068	0,023	0,067	N/A
38th	0,010	0,029	0,005	0,015	0,008	0,022	N/A
39th	0,018	0,052	0,022	0,065	0,023	0,066	N/A
40th	0,011	0,032	0,020	0,056	0,036	0,103	N/A
41th	0,018	0,052	0,021	0,061	0,021	0,060	N/A
42th	0,009	0,026	0,007	0,019	0,009	0,027	N/A
43th	0,017	0,048	0,020	0,057	0,018	0,052	N/A
44th	0,008	0,022	0,004	0,012	0,005	0,014	N/A
45th	0,015	0,044	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,019	0,004	0,011	0,003	0,008	N/A
47th	0,014	0,041	0,017	0,048	0,013	0,038	N/A
48th	0,006	0,017	0,003	0,009	0,002	0,007	N/A
49th	0,013	0,036	0,014	0,041	0,011	0,032	N/A
50th	0,005	0,014	0,003	0,009	0,002	0,005	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _S CE = 33.							



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-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2498,0		4434,0		6778,8		
AC Voltage [V]	230,15		229,67		230,62		
AC Current [A]	10,89		19,32		29,40		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,958		1,540		2,175		
PWHD [%]	0,890		1,420		1,731		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	10,883	--	19,323	--	29,395	--	--
2nd	0,086	0,289	0,243	0,822	0,372	1,260	8,00
3rd	0,204	0,691	0,337	1,139	0,483	1,633	N/A
4th	0,058	0,195	0,071	0,241	0,082	0,278	4,00
5th	0,103	0,350	0,100	0,339	0,099	0,334	10,70
6th	0,040	0,135	0,050	0,170	0,049	0,165	2,67
7th	0,062	0,211	0,039	0,132	0,057	0,193	7,20
8th	0,049	0,166	0,034	0,114	0,050	0,168	2,00
9th	0,037	0,127	0,045	0,153	0,022	0,076	N/A
10th	0,027	0,090	0,043	0,146	0,033	0,113	1,60
11th	0,039	0,133	0,028	0,095	0,042	0,143	3,10
12th	0,037	0,126	0,031	0,105	0,043	0,145	1,33
13th	0,024	0,081	0,018	0,060	0,007	0,023	2,00
14th	0,027	0,093	0,024	0,082	0,026	0,088	N/A
15th	0,009	0,029	0,018	0,062	0,016	0,054	N/A
16th	0,025	0,085	0,034	0,114	0,030	0,100	N/A
17th	0,006	0,022	0,015	0,049	0,013	0,044	N/A
18th	0,009	0,032	0,018	0,061	0,031	0,103	N/A
19th	0,010	0,035	0,016	0,054	0,020	0,069	N/A
20th	0,008	0,027	0,008	0,027	0,013	0,044	N/A
21th	0,008	0,027	0,013	0,043	0,021	0,070	N/A
22th	0,007	0,025	0,009	0,030	0,013	0,044	N/A
23th	0,008	0,028	0,017	0,059	0,016	0,055	N/A
24th	0,002	0,008	0,004	0,015	0,003	0,010	N/A
25th	0,013	0,044	0,011	0,037	0,019	0,063	N/A
26th	0,001	0,005	0,003	0,012	0,006	0,022	N/A
27th	0,009	0,030	0,023	0,077	0,025	0,084	N/A
28th	0,003	0,008	0,003	0,009	0,008	0,026	N/A
29th	0,012	0,041	0,023	0,078	0,019	0,065	N/A
30th	0,004	0,013	0,006	0,020	0,004	0,013	N/A

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 _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,014	0,049	0,016	0,054	0,021	0,072	N/A
32th	0,004	0,014	0,002	0,007	0,007	0,022	N/A
33th	0,009	0,030	0,020	0,069	0,028	0,094	N/A
34th	0,004	0,014	0,006	0,020	0,004	0,012	N/A
35th	0,009	0,030	0,017	0,058	0,024	0,080	N/A
36th	0,006	0,019	0,004	0,012	0,004	0,013	N/A
37th	0,010	0,033	0,020	0,067	0,020	0,068	N/A
38th	0,007	0,024	0,004	0,013	0,006	0,022	N/A
39th	0,009	0,032	0,019	0,066	0,021	0,072	N/A
40th	0,009	0,031	0,022	0,074	0,035	0,120	N/A
41th	0,010	0,033	0,018	0,060	0,021	0,072	N/A
42th	0,006	0,021	0,008	0,027	0,009	0,031	N/A
43th	0,010	0,035	0,018	0,061	0,020	0,069	N/A
44th	0,007	0,023	0,007	0,025	0,006	0,022	N/A
45th	0,008	0,028	0,015	0,051	0,020	0,069	N/A
46th	0,006	0,021	0,005	0,017	0,006	0,020	N/A
47th	0,008	0,026	0,015	0,052	0,018	0,060	N/A
48th	0,005	0,019	0,006	0,020	0,005	0,018	N/A
49th	0,008	0,028	0,016	0,055	0,018	0,060	N/A
50th	0,006	0,020	0,006	0,022	0,007	0,023	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2695,2		-5272,2		-7969,8		
AC Voltage [V]	230,16		230,15		230,22		
AC Current [A]	11,82		23,00		34,72		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,119		2,111		3,674		
PWHD [%]	1,271		1,475		1,619		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,812	--	22,985	--	34,693	--	--
2nd	0,148	0,427	0,348	1,002	0,736	2,115	8,00
3rd	0,291	0,837	0,599	1,721	1,037	2,981	N/A
4th	0,071	0,204	0,085	0,244	0,075	0,216	4,00
5th	0,126	0,363	0,143	0,410	0,171	0,492	10,70
6th	0,060	0,173	0,070	0,201	0,077	0,220	2,67
7th	0,061	0,175	0,067	0,194	0,060	0,172	7,20
8th	0,052	0,151	0,061	0,175	0,070	0,201	2,00
9th	0,025	0,073	0,027	0,078	0,031	0,089	N/A
10th	0,045	0,129	0,052	0,149	0,055	0,158	1,60
11th	0,024	0,070	0,029	0,084	0,019	0,055	3,10
12th	0,035	0,101	0,043	0,124	0,048	0,137	1,33
13th	0,012	0,033	0,018	0,051	0,015	0,044	2,00
14th	0,026	0,076	0,034	0,099	0,038	0,110	N/A
15th	0,013	0,038	0,019	0,055	0,019	0,054	N/A
16th	0,021	0,059	0,026	0,076	0,028	0,080	N/A
17th	0,018	0,051	0,021	0,060	0,022	0,064	N/A
18th	0,015	0,043	0,022	0,062	0,025	0,071	N/A
19th	0,018	0,052	0,024	0,068	0,026	0,073	N/A
20th	0,011	0,033	0,016	0,047	0,018	0,053	N/A
21th	0,022	0,063	0,021	0,060	0,023	0,067	N/A
22th	0,009	0,025	0,012	0,035	0,014	0,040	N/A
23th	0,021	0,060	0,024	0,069	0,023	0,067	N/A
24th	0,008	0,023	0,011	0,030	0,012	0,034	N/A
25th	0,021	0,060	0,025	0,072	0,027	0,078	N/A
26th	0,009	0,027	0,010	0,028	0,010	0,028	N/A
27th	0,021	0,060	0,025	0,071	0,025	0,073	N/A
28th	0,009	0,027	0,009	0,025	0,009	0,025	N/A
29th	0,020	0,059	0,023	0,066	0,025	0,070	N/A
30th	0,010	0,028	0,007	0,021	0,008	0,022	N/A



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 _{C_{MAX}})							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,021	0,061	0,024	0,068	0,023	0,067	N/A
32th	0,011	0,031	0,007	0,019	0,007	0,020	N/A
33th	0,021	0,062	0,024	0,070	0,024	0,069	N/A
34th	0,011	0,032	0,005	0,016	0,006	0,016	N/A
35th	0,021	0,060	0,025	0,071	0,023	0,066	N/A
36th	0,010	0,030	0,005	0,015	0,006	0,016	N/A
37th	0,019	0,055	0,024	0,069	0,023	0,067	N/A
38th	0,010	0,029	0,005	0,015	0,008	0,022	N/A
39th	0,019	0,054	0,022	0,064	0,023	0,066	N/A
40th	0,011	0,032	0,018	0,052	0,036	0,103	N/A
41th	0,018	0,051	0,021	0,061	0,021	0,060	N/A
42th	0,009	0,025	0,006	0,017	0,009	0,027	N/A
43th	0,017	0,047	0,020	0,057	0,018	0,052	N/A
44th	0,008	0,023	0,004	0,012	0,005	0,014	N/A
45th	0,015	0,043	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,021	0,004	0,010	0,003	0,008	N/A
47th	0,014	0,040	0,016	0,047	0,013	0,038	N/A
48th	0,006	0,017	0,003	0,009	0,002	0,007	N/A
49th	0,012	0,035	0,014	0,042	0,011	0,032	N/A
50th	0,005	0,015	0,003	0,009	0,002	0,005	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _S MAX, or P _N INV for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	2489,6		4449,1		6778,8		
AC Voltage [V]	230,14		230,23		230,62		
AC Current [A]	10,85		19,32		29,40		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	0,961		1,527		2,175		
PWHD [%]	0,883		1,415		1,731		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	10,847	--	19,233	--	29,394	--	--
2nd	0,086	0,291	0,241	0,815	0,372	1,260	8,00
3rd	0,205	0,695	0,333	1,127	0,483	1,633	N/A
4th	0,059	0,198	0,070	0,236	0,082	0,278	4,00
5th	0,102	0,346	0,102	0,345	0,099	0,334	10,70
6th	0,038	0,127	0,050	0,170	0,049	0,165	2,67
7th	0,063	0,214	0,038	0,127	0,057	0,193	7,20
8th	0,050	0,170	0,033	0,112	0,050	0,168	2,00
9th	0,037	0,125	0,045	0,154	0,022	0,076	N/A
10th	0,025	0,086	0,042	0,142	0,033	0,113	1,60
11th	0,040	0,134	0,028	0,093	0,042	0,143	3,10
12th	0,038	0,128	0,032	0,107	0,043	0,145	1,33
13th	0,024	0,082	0,018	0,061	0,007	0,023	2,00
14th	0,027	0,092	0,024	0,081	0,026	0,088	N/A
15th	0,009	0,029	0,018	0,060	0,016	0,054	N/A
16th	0,025	0,084	0,033	0,112	0,030	0,100	N/A
17th	0,006	0,022	0,013	0,043	0,013	0,044	N/A
18th	0,010	0,034	0,019	0,064	0,031	0,103	N/A
19th	0,010	0,033	0,018	0,060	0,020	0,069	N/A
20th	0,007	0,025	0,008	0,026	0,013	0,043	N/A
21th	0,008	0,027	0,011	0,037	0,021	0,070	N/A
22th	0,008	0,026	0,009	0,030	0,013	0,044	N/A
23th	0,008	0,026	0,018	0,062	0,016	0,055	N/A
24th	0,002	0,008	0,005	0,015	0,003	0,010	N/A
25th	0,013	0,045	0,011	0,038	0,018	0,063	N/A
26th	0,001	0,005	0,003	0,011	0,006	0,022	N/A
27th	0,009	0,030	0,021	0,071	0,025	0,084	N/A
28th	0,003	0,009	0,002	0,007	0,008	0,026	N/A
29th	0,011	0,038	0,024	0,083	0,019	0,065	N/A
30th	0,004	0,013	0,006	0,021	0,004	0,013	N/A

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 _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,015	0,050	0,016	0,053	0,021	0,072	N/A
32th	0,004	0,014	0,002	0,008	0,007	0,022	N/A
33th	0,009	0,030	0,020	0,066	0,028	0,094	N/A
34th	0,004	0,014	0,005	0,018	0,004	0,012	N/A
35th	0,009	0,030	0,018	0,061	0,024	0,080	N/A
36th	0,006	0,019	0,004	0,015	0,004	0,013	N/A
37th	0,010	0,033	0,019	0,064	0,020	0,068	N/A
38th	0,007	0,025	0,004	0,013	0,006	0,022	N/A
39th	0,009	0,031	0,020	0,067	0,021	0,072	N/A
40th	0,009	0,031	0,022	0,074	0,035	0,120	N/A
41th	0,010	0,033	0,017	0,059	0,021	0,072	N/A
42th	0,006	0,021	0,008	0,026	0,009	0,031	N/A
43th	0,010	0,035	0,018	0,061	0,020	0,069	N/A
44th	0,007	0,023	0,008	0,026	0,006	0,022	N/A
45th	0,008	0,029	0,016	0,052	0,020	0,069	N/A
46th	0,006	0,022	0,005	0,018	0,006	0,020	N/A
47th	0,008	0,025	0,015	0,049	0,018	0,060	N/A
48th	0,006	0,019	0,005	0,018	0,005	0,018	N/A
49th	0,008	0,028	0,016	0,054	0,018	0,060	N/A
50th	0,006	0,019	0,007	0,022	0,007	0,023	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-2694,3		-5276,1		-7970,2		
AC Voltage [V]	230,17		230,16		230,22		
AC Current [A]	11,82		23,01		34,72		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,119		2,110		3,735		
PWHD [%]	1,275		1,476		1,625		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	11,809	--	23,001	--	34,694	--	--
2nd	0,148	0,425	0,347	0,999	0,736	2,115	8,00
3rd	0,292	0,839	0,599	1,721	1,038	2,984	N/A
4th	0,070	0,201	0,086	0,247	0,075	0,216	4,00
5th	0,126	0,363	0,143	0,411	0,171	0,491	10,70
6th	0,060	0,174	0,070	0,200	0,077	0,221	2,67
7th	0,061	0,175	0,068	0,195	0,060	0,172	7,20
8th	0,053	0,151	0,061	0,176	0,070	0,201	2,00
9th	0,025	0,073	0,028	0,079	0,031	0,089	N/A
10th	0,045	0,129	0,052	0,150	0,055	0,158	1,60
11th	0,024	0,070	0,029	0,085	0,019	0,055	3,10
12th	0,035	0,100	0,043	0,124	0,048	0,137	1,33
13th	0,011	0,032	0,018	0,051	0,015	0,044	2,00
14th	0,027	0,077	0,035	0,100	0,038	0,109	N/A
15th	0,014	0,039	0,019	0,055	0,019	0,055	N/A
16th	0,021	0,060	0,027	0,077	0,028	0,080	N/A
17th	0,018	0,051	0,021	0,060	0,022	0,064	N/A
18th	0,015	0,044	0,022	0,063	0,025	0,071	N/A
19th	0,018	0,052	0,024	0,068	0,025	0,073	N/A
20th	0,012	0,034	0,016	0,047	0,018	0,053	N/A
21th	0,022	0,062	0,021	0,060	0,023	0,067	N/A
22th	0,009	0,025	0,012	0,035	0,014	0,040	N/A
23th	0,021	0,061	0,024	0,069	0,023	0,067	N/A
24th	0,008	0,023	0,011	0,031	0,012	0,034	N/A
25th	0,021	0,061	0,025	0,071	0,027	0,078	N/A
26th	0,009	0,027	0,010	0,028	0,010	0,028	N/A
27th	0,021	0,060	0,025	0,071	0,025	0,073	N/A
28th	0,009	0,027	0,009	0,025	0,009	0,025	N/A
29th	0,020	0,059	0,023	0,066	0,024	0,070	N/A
30th	0,010	0,028	0,007	0,021	0,008	0,022	N/A



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 _C MAX)							
DHN-LVEH1P8K-EU-G1 with Cmin battery							
31th	0,021	0,061	0,023	0,067	0,023	0,067	N/A
32th	0,011	0,032	0,007	0,019	0,007	0,020	N/A
33th	0,021	0,062	0,025	0,071	0,024	0,069	N/A
34th	0,011	0,032	0,005	0,015	0,006	0,016	N/A
35th	0,021	0,061	0,025	0,071	0,023	0,066	N/A
36th	0,010	0,029	0,005	0,015	0,006	0,016	N/A
37th	0,019	0,056	0,024	0,069	0,023	0,067	N/A
38th	0,010	0,029	0,005	0,015	0,008	0,022	N/A
39th	0,018	0,053	0,022	0,064	0,023	0,066	N/A
40th	0,011	0,032	0,018	0,052	0,036	0,103	N/A
41th	0,018	0,051	0,021	0,062	0,021	0,060	N/A
42th	0,009	0,025	0,006	0,017	0,009	0,027	N/A
43th	0,017	0,048	0,020	0,057	0,018	0,052	N/A
44th	0,008	0,023	0,004	0,012	0,005	0,014	N/A
45th	0,015	0,042	0,018	0,052	0,016	0,045	N/A
46th	0,007	0,020	0,004	0,010	0,003	0,008	N/A
47th	0,014	0,040	0,017	0,048	0,013	0,038	N/A
48th	0,006	0,017	0,003	0,009	0,002	0,007	N/A
49th	0,012	0,036	0,014	0,041	0,011	0,032	N/A
50th	0,005	0,015	0,003	0,009	0,002	0,005	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	954,7		1968,1		2973,5		
AC Voltage [V]	229,86		230,25		230,63		
AC Current [A]	4,30		8,60		12,92		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	3,620		2,167		2,299		
PWHD [%]	2,083		1,884		2,246		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,278	--	8,592	--	12,914	--	--
2nd	0,158	1,213	0,061	0,467	0,106	0,815	8,00
3rd	0,390	2,987	0,206	1,582	0,214	1,641	N/A
4th	0,046	0,355	0,054	0,411	0,059	0,451	4,00
5th	0,169	1,298	0,112	0,858	0,105	0,808	10,70
6th	0,010	0,074	0,050	0,385	0,046	0,355	2,67
7th	0,079	0,608	0,066	0,509	0,063	0,479	7,20
8th	0,019	0,143	0,044	0,335	0,043	0,327	2,00
9th	0,026	0,202	0,035	0,266	0,032	0,245	N/A
10th	0,026	0,197	0,026	0,200	0,033	0,250	1,60
11th	0,035	0,265	0,045	0,344	0,044	0,334	3,10
12th	0,041	0,312	0,041	0,315	0,034	0,263	1,33
13th	0,016	0,123	0,023	0,174	0,027	0,204	2,00
14th	0,027	0,204	0,027	0,208	0,033	0,251	N/A
15th	0,010	0,074	0,010	0,077	0,005	0,037	N/A
16th	0,026	0,196	0,026	0,196	0,023	0,176	N/A
17th	0,007	0,053	0,005	0,041	0,010	0,073	N/A
18th	0,021	0,160	0,010	0,080	0,010	0,079	N/A
19th	0,009	0,066	0,008	0,063	0,009	0,068	N/A
20th	0,014	0,104	0,007	0,053	0,008	0,061	N/A
21th	0,004	0,027	0,008	0,058	0,009	0,071	N/A
22th	0,014	0,109	0,008	0,058	0,006	0,043	N/A
23th	0,004	0,029	0,008	0,058	0,014	0,108	N/A
24th	0,010	0,075	0,003	0,019	0,003	0,021	N/A
25th	0,009	0,069	0,011	0,083	0,010	0,078	N/A
26th	0,008	0,064	0,001	0,011	0,003	0,019	N/A
27th	0,007	0,054	0,009	0,066	0,011	0,087	N/A
28th	0,007	0,055	0,004	0,031	0,004	0,029	N/A
29th	0,008	0,058	0,010	0,075	0,017	0,127	N/A
30th	0,004	0,032	0,003	0,027	0,003	0,025	N/A

Bbis.3 a) / b)		Emission Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase) (Ambient)					P
Bidirectional converters (P _{S_{MAX}} , or P _{N_{INV}} for integrated EESS)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,011	0,083	0,013	0,097	0,013	0,098	N/A
32th	0,004	0,027	0,004	0,033	0,005	0,042	N/A
33th	0,009	0,071	0,007	0,057	0,011	0,088	N/A
34th	0,004	0,034	0,004	0,034	0,004	0,032	N/A
35th	0,009	0,069	0,007	0,055	0,011	0,084	N/A
36th	0,005	0,040	0,005	0,041	0,006	0,047	N/A
37th	0,009	0,072	0,009	0,067	0,011	0,081	N/A
38th	0,006	0,048	0,007	0,056	0,006	0,042	N/A
39th	0,010	0,080	0,008	0,062	0,013	0,102	N/A
40th	0,007	0,052	0,008	0,063	0,011	0,086	N/A
41th	0,009	0,068	0,008	0,061	0,013	0,097	N/A
42th	0,006	0,047	0,006	0,047	0,007	0,051	N/A
43th	0,010	0,074	0,009	0,067	0,010	0,079	N/A
44th	0,007	0,055	0,006	0,048	0,006	0,045	N/A
45th	0,010	0,074	0,007	0,051	0,011	0,081	N/A
46th	0,008	0,061	0,007	0,051	0,005	0,040	N/A
47th	0,009	0,066	0,006	0,046	0,011	0,084	N/A
48th	0,008	0,058	0,006	0,043	0,006	0,046	N/A
49th	0,008	0,065	0,006	0,049	0,009	0,072	N/A
50th	0,008	0,059	0,005	0,041	0,006	0,048	N/A
Note:							
For test result (discharge mode P _{S_{MAX}} , P _{N_{INV}}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-921,3		-1940,9		-2956,7		
AC Voltage [V]	231,16		230,76		230,36		
AC Current [A]	4,23		8,54		12,94		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	3,907		2,649		3,122		
PWHD [%]	2,428		2,767		3,498		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,195	--	8,536	--	12,934	--	--
2nd	0,220	1,684	0,116	0,890	0,154	1,181	8,00
3rd	0,443	3,397	0,261	1,997	0,308	2,359	N/A
4th	0,013	0,097	0,081	0,618	0,075	0,577	4,00
5th	0,047	0,359	0,115	0,884	0,129	0,989	10,70
6th	0,023	0,176	0,066	0,503	0,062	0,478	2,67
7th	0,020	0,152	0,051	0,387	0,063	0,482	7,20
8th	0,034	0,258	0,052	0,399	0,053	0,408	2,00
9th	0,038	0,293	0,018	0,136	0,026	0,196	N/A
10th	0,037	0,286	0,038	0,290	0,046	0,355	1,60
11th	0,039	0,301	0,015	0,117	0,022	0,166	3,10
12th	0,022	0,169	0,028	0,211	0,038	0,294	1,33
13th	0,024	0,185	0,007	0,056	0,011	0,084	2,00
14th	0,032	0,247	0,019	0,143	0,028	0,218	N/A
15th	0,026	0,199	0,008	0,062	0,016	0,120	N/A
16th	0,021	0,159	0,012	0,095	0,021	0,160	N/A
17th	0,022	0,166	0,017	0,129	0,017	0,134	N/A
18th	0,012	0,092	0,010	0,077	0,017	0,129	N/A
19th	0,026	0,199	0,015	0,116	0,019	0,145	N/A
20th	0,010	0,073	0,011	0,084	0,012	0,095	N/A
21th	0,017	0,132	0,017	0,128	0,021	0,163	N/A
22th	0,009	0,065	0,012	0,094	0,010	0,073	N/A
23th	0,015	0,116	0,014	0,108	0,022	0,166	N/A
24th	0,006	0,048	0,013	0,097	0,009	0,065	N/A
25th	0,016	0,123	0,015	0,112	0,022	0,165	N/A
26th	0,005	0,037	0,012	0,091	0,008	0,061	N/A
27th	0,014	0,108	0,015	0,114	0,022	0,165	N/A
28th	0,003	0,025	0,011	0,086	0,009	0,069	N/A
29th	0,011	0,087	0,016	0,122	0,021	0,163	N/A
30th	0,003	0,026	0,010	0,074	0,009	0,071	N/A

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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,010	0,078	0,018	0,138	0,022	0,171	N/A
32th	0,002	0,012	0,008	0,063	0,009	0,072	N/A
33th	0,010	0,073	0,018	0,141	0,022	0,172	N/A
34th	0,002	0,015	0,007	0,056	0,009	0,073	N/A
35th	0,008	0,059	0,018	0,136	0,022	0,170	N/A
36th	0,002	0,016	0,007	0,056	0,010	0,078	N/A
37th	0,007	0,054	0,017	0,129	0,021	0,158	N/A
38th	0,002	0,017	0,007	0,054	0,010	0,075	N/A
39th	0,006	0,047	0,015	0,118	0,020	0,152	N/A
40th	0,003	0,025	0,008	0,062	0,011	0,087	N/A
41th	0,006	0,044	0,014	0,109	0,019	0,147	N/A
42th	0,003	0,022	0,007	0,056	0,008	0,064	N/A
43th	0,005	0,037	0,013	0,103	0,018	0,136	N/A
44th	0,003	0,022	0,006	0,050	0,007	0,056	N/A
45th	0,006	0,043	0,012	0,096	0,016	0,125	N/A
46th	0,003	0,024	0,006	0,044	0,006	0,048	N/A
47th	0,006	0,043	0,012	0,089	0,015	0,115	N/A
48th	0,003	0,026	0,005	0,040	0,005	0,042	N/A
49th	0,006	0,046	0,011	0,083	0,013	0,099	N/A
50th	0,004	0,029	8,536	0,041	0,004	0,034	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _S CE = 33.							



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-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	979,4		1883,6		2839,2		
AC Voltage [V]	230,06		229,90		230,27		
AC Current [A]	4,40		8,25		12,36		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	3,282		2,118		2,220		
PWHD [%]	1,792		1,839		2,104		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,378	--	8,241	--	12,352	--	--
2nd	0,141	1,082	0,060	0,459	0,097	0,745	8,00
3rd	0,345	2,642	0,200	1,535	0,207	1,587	N/A
4th	0,057	0,437	0,058	0,446	0,062	0,477	4,00
5th	0,164	1,258	0,111	0,852	0,105	0,802	10,70
6th	0,017	0,132	0,040	0,307	0,037	0,282	2,67
7th	0,080	0,616	0,063	0,485	0,059	0,449	7,20
8th	0,017	0,130	0,048	0,369	0,047	0,359	2,00
9th	0,032	0,247	0,038	0,292	0,038	0,289	N/A
10th	0,018	0,139	0,023	0,175	0,028	0,217	1,60
11th	0,030	0,227	0,042	0,324	0,040	0,303	3,10
12th	0,039	0,300	0,039	0,300	0,036	0,277	1,33
13th	0,019	0,144	0,024	0,187	0,027	0,204	2,00
14th	0,029	0,223	0,028	0,217	0,028	0,213	N/A
15th	0,012	0,092	0,011	0,084	0,007	0,051	N/A
16th	0,020	0,155	0,022	0,165	0,024	0,187	N/A
17th	0,002	0,018	0,005	0,041	0,007	0,051	N/A
18th	0,021	0,158	0,015	0,114	0,011	0,085	N/A
19th	0,009	0,067	0,007	0,055	0,011	0,085	N/A
20th	0,013	0,096	0,005	0,041	0,006	0,048	N/A
21th	0,004	0,027	0,008	0,063	0,008	0,063	N/A
22th	0,010	0,078	0,008	0,065	0,007	0,052	N/A
23th	0,004	0,028	0,006	0,044	0,010	0,076	N/A
24th	0,008	0,058	0,003	0,022	0,003	0,025	N/A
25th	0,006	0,045	0,011	0,081	0,013	0,101	N/A
26th	0,007	0,054	0,001	0,009	0,001	0,010	N/A
27th	0,007	0,053	0,008	0,065	0,009	0,070	N/A
28th	0,005	0,042	0,004	0,028	0,002	0,017	N/A
29th	0,006	0,042	0,008	0,063	0,014	0,107	N/A
30th	0,003	0,022	0,004	0,030	0,004	0,029	N/A

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-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,007	0,057	0,012	0,088	0,015	0,115	N/A
32th	0,002	0,017	0,004	0,033	0,004	0,033	N/A
33th	0,009	0,068	0,009	0,068	0,010	0,073	N/A
34th	0,002	0,019	0,005	0,035	0,005	0,036	N/A
35th	0,007	0,051	0,007	0,052	0,011	0,081	N/A
36th	0,003	0,023	0,005	0,039	0,006	0,048	N/A
37th	0,007	0,052	0,007	0,055	0,010	0,079	N/A
38th	0,003	0,024	0,007	0,055	0,006	0,049	N/A
39th	0,008	0,060	0,008	0,060	0,011	0,081	N/A
40th	0,005	0,039	0,009	0,065	0,010	0,077	N/A
41th	0,007	0,057	0,007	0,052	0,012	0,089	N/A
42th	0,004	0,033	0,006	0,048	0,007	0,050	N/A
43th	0,008	0,058	0,008	0,059	0,011	0,084	N/A
44th	0,004	0,032	0,006	0,048	0,006	0,050	N/A
45th	0,008	0,058	0,007	0,057	0,009	0,071	N/A
46th	0,005	0,042	0,007	0,052	0,006	0,046	N/A
47th	0,007	0,051	0,005	0,041	0,009	0,071	N/A
48th	0,006	0,043	0,006	0,048	0,005	0,042	N/A
49th	0,007	0,050	0,005	0,041	0,010	0,073	N/A
50th	0,005	0,039	0,005	0,041	0,006	0,046	N/A
Note:							
For test result (discharge mode P _{SMAX} , P _{NINV}) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-1037,2		-1975,9		-3042,3		
AC Voltage [V]	230,81		230,45		230,04		
AC Current [A]	4,70		8,70		13,33		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	2,902		2,662		3,235		
PWHD [%]	2,057		2,777		3,493		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,684	--	8,697	--	13,322	--	--
2nd	0,214	1,638	0,117	0,898	0,164	1,258	8,00
3rd	0,295	2,258	0,263	2,018	0,324	2,481	N/A
4th	0,048	0,367	0,077	0,588	0,073	0,556	4,00
5th	0,021	0,160	0,116	0,893	0,127	0,970	10,70
6th	0,007	0,057	0,064	0,491	0,062	0,478	2,67
7th	0,022	0,167	0,051	0,393	0,063	0,481	7,20
8th	0,020	0,153	0,051	0,388	0,052	0,401	2,00
9th	0,015	0,115	0,020	0,152	0,028	0,213	N/A
10th	0,025	0,190	0,038	0,288	0,046	0,350	1,60
11th	0,038	0,291	0,018	0,135	0,022	0,172	3,10
12th	0,031	0,235	0,028	0,215	0,038	0,291	1,33
13th	0,021	0,161	0,007	0,056	0,011	0,082	2,00
14th	0,018	0,137	0,019	0,146	0,028	0,216	N/A
15th	0,019	0,147	0,009	0,071	0,015	0,118	N/A
16th	0,018	0,138	0,013	0,096	0,021	0,161	N/A
17th	0,014	0,108	0,017	0,130	0,017	0,130	N/A
18th	0,020	0,152	0,010	0,076	0,017	0,129	N/A
19th	0,016	0,124	0,015	0,119	0,019	0,143	N/A
20th	0,012	0,096	0,010	0,079	0,013	0,096	N/A
21th	0,011	0,081	0,018	0,137	0,021	0,164	N/A
22th	0,007	0,055	0,012	0,092	0,010	0,073	N/A
23th	0,013	0,102	0,015	0,113	0,021	0,165	N/A
24th	0,006	0,045	0,012	0,094	0,009	0,073	N/A
25th	0,012	0,093	0,015	0,113	0,021	0,164	N/A
26th	0,007	0,055	0,012	0,093	0,008	0,062	N/A
27th	0,011	0,087	0,014	0,111	0,022	0,165	N/A
28th	0,006	0,050	0,012	0,092	0,008	0,065	N/A
29th	0,009	0,066	0,016	0,121	0,021	0,164	N/A
30th	0,004	0,032	0,010	0,078	0,010	0,073	N/A

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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,010	0,074	0,018	0,134	0,022	0,169	N/A
32th	0,006	0,044	0,009	0,066	0,010	0,074	N/A
33th	0,011	0,082	0,018	0,138	0,023	0,174	N/A
34th	0,004	0,033	0,008	0,061	0,010	0,073	N/A
35th	0,010	0,074	0,018	0,135	0,022	0,167	N/A
36th	0,003	0,025	0,007	0,054	0,010	0,075	N/A
37th	0,008	0,058	0,017	0,129	0,021	0,160	N/A
38th	0,004	0,030	0,007	0,052	0,010	0,075	N/A
39th	0,007	0,057	0,015	0,117	0,020	0,151	N/A
40th	0,004	0,029	0,008	0,062	0,011	0,085	N/A
41th	0,007	0,054	0,014	0,111	0,019	0,147	N/A
42th	0,002	0,018	0,007	0,052	0,008	0,062	N/A
43th	0,006	0,050	0,013	0,103	0,018	0,136	N/A
44th	0,002	0,016	0,007	0,050	0,007	0,054	N/A
45th	0,006	0,043	0,012	0,091	0,016	0,124	N/A
46th	0,003	0,020	0,006	0,046	0,006	0,047	N/A
47th	0,006	0,042	0,011	0,086	0,015	0,113	N/A
48th	0,002	0,018	0,005	0,041	0,005	0,040	N/A
49th	0,004	0,032	0,010	0,076	0,013	0,101	N/A
50th	0,002	0,014	0,005	0,038	0,004	0,033	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	979,6		1883,9		2833,4		
AC Voltage [V]	230,06		229,90		230,26		
AC Current [A]	4,40		8,25		12,33		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	3,280		2,118		2,229		
PWHD [%]	1,804		1,834		2,109		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,379	--	8,242	--	12,327	--	--
2nd	0,143	1,098	0,060	0,462	0,095	0,728	8,00
3rd	0,344	2,634	0,200	1,532	0,209	1,604	N/A
4th	0,056	0,429	0,058	0,446	0,063	0,485	4,00
5th	0,164	1,260	0,111	0,853	0,105	0,803	10,70
6th	0,018	0,136	0,040	0,309	0,036	0,274	2,67
7th	0,081	0,618	0,064	0,490	0,058	0,448	7,20
8th	0,017	0,128	0,048	0,371	0,048	0,366	2,00
9th	0,032	0,245	0,038	0,290	0,038	0,291	N/A
10th	0,018	0,138	0,023	0,173	0,028	0,212	1,60
11th	0,029	0,222	0,042	0,321	0,040	0,305	3,10
12th	0,039	0,301	0,039	0,300	0,036	0,277	1,33
13th	0,019	0,145	0,025	0,189	0,026	0,202	2,00
14th	0,029	0,222	0,028	0,216	0,028	0,212	N/A
15th	0,012	0,092	0,011	0,085	0,008	0,060	N/A
16th	0,020	0,156	0,021	0,164	0,024	0,186	N/A
17th	0,002	0,019	0,005	0,038	0,007	0,055	N/A
18th	0,021	0,158	0,015	0,113	0,011	0,086	N/A
19th	0,009	0,069	0,007	0,056	0,011	0,085	N/A
20th	0,012	0,095	0,005	0,041	0,006	0,049	N/A
21th	0,004	0,027	0,008	0,060	0,008	0,065	N/A
22th	0,011	0,082	0,008	0,063	0,007	0,053	N/A
23th	0,004	0,029	0,006	0,047	0,009	0,071	N/A
24th	0,008	0,058	0,003	0,021	0,003	0,023	N/A
25th	0,006	0,045	0,011	0,083	0,014	0,105	N/A
26th	0,007	0,053	0,001	0,010	0,001	0,010	N/A
27th	0,007	0,053	0,008	0,061	0,009	0,068	N/A
28th	0,006	0,045	0,004	0,030	0,002	0,017	N/A
29th	0,006	0,042	0,008	0,063	0,014	0,104	N/A
30th	0,003	0,021	0,004	0,029	0,004	0,030	N/A



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-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,008	0,058	0,011	0,087	0,015	0,118	N/A
32th	0,002	0,016	0,004	0,032	0,004	0,034	N/A
33th	0,009	0,068	0,009	0,070	0,010	0,074	N/A
34th	0,002	0,019	0,005	0,038	0,005	0,038	N/A
35th	0,007	0,053	0,006	0,047	0,010	0,079	N/A
36th	0,003	0,023	0,005	0,037	0,006	0,046	N/A
37th	0,007	0,052	0,008	0,058	0,010	0,080	N/A
38th	0,003	0,024	0,007	0,053	0,007	0,051	N/A
39th	0,008	0,062	0,008	0,059	0,010	0,080	N/A
40th	0,005	0,039	0,009	0,067	0,010	0,077	N/A
41th	0,007	0,057	0,007	0,051	0,011	0,088	N/A
42th	0,004	0,034	0,007	0,050	0,007	0,051	N/A
43th	0,008	0,060	0,008	0,061	0,011	0,084	N/A
44th	0,004	0,032	0,006	0,045	0,007	0,051	N/A
45th	0,008	0,058	0,007	0,055	0,009	0,072	N/A
46th	0,006	0,042	0,007	0,056	0,006	0,047	N/A
47th	0,007	0,052	0,005	0,041	0,009	0,070	N/A
48th	0,006	0,044	0,006	0,047	0,006	0,042	N/A
49th	0,007	0,050	0,005	0,041	0,009	0,073	N/A
50th	0,005	0,040	0,005	0,038	0,006	0,046	N/A
Note: For test result (discharge mode P _{SMAX} , P _{NINV}) see B.1 a), b). The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
Phase 1							
Power Level	33%		66%		100%		
AC Power [W]	-1037,2		-1977,2		-3034,8		
AC Voltage [V]	230,81		230,45		230,04		
AC Current [A]	4,70		8,71		13,30		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	2,910		2,653		3,218		
PWHD [%]	2,065		2,771		3,487		
Harmonic	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Current Magnitude [A]	% of Funda- mental	Harmonic Current Limits [%]
1st	4,684	--	8,703	--	13,289	--	--
2nd	0,215	1,646	0,116	0,891	0,161	1,233	8,00
3rd	0,295	2,262	0,262	2,010	0,322	2,472	N/A
4th	0,048	0,364	0,077	0,589	0,072	0,556	4,00
5th	0,021	0,165	0,116	0,889	0,127	0,975	10,70
6th	0,007	0,055	0,064	0,490	0,062	0,474	2,67
7th	0,022	0,167	0,052	0,397	0,062	0,476	7,20
8th	0,020	0,152	0,051	0,388	0,052	0,400	2,00
9th	0,015	0,116	0,020	0,154	0,029	0,220	N/A
10th	0,025	0,193	0,038	0,288	0,045	0,349	1,60
11th	0,038	0,288	0,017	0,128	0,022	0,171	3,10
12th	0,031	0,235	0,028	0,214	0,038	0,288	1,33
13th	0,021	0,163	0,007	0,056	0,011	0,083	2,00
14th	0,018	0,137	0,019	0,144	0,028	0,215	N/A
15th	0,019	0,147	0,010	0,074	0,015	0,115	N/A
16th	0,018	0,140	0,012	0,094	0,021	0,161	N/A
17th	0,014	0,109	0,017	0,131	0,017	0,130	N/A
18th	0,020	0,152	0,010	0,075	0,017	0,128	N/A
19th	0,016	0,125	0,016	0,122	0,018	0,141	N/A
20th	0,012	0,095	0,010	0,079	0,013	0,098	N/A
21th	0,010	0,080	0,017	0,133	0,021	0,163	N/A
22th	0,007	0,057	0,012	0,090	0,009	0,072	N/A
23th	0,013	0,102	0,015	0,113	0,021	0,163	N/A
24th	0,006	0,044	0,013	0,097	0,009	0,072	N/A
25th	0,012	0,093	0,015	0,113	0,021	0,164	N/A
26th	0,007	0,055	0,012	0,094	0,008	0,063	N/A
27th	0,011	0,087	0,015	0,116	0,021	0,163	N/A
28th	0,007	0,051	0,011	0,086	0,009	0,065	N/A
29th	0,009	0,065	0,016	0,119	0,021	0,165	N/A
30th	0,004	0,031	0,010	0,078	0,010	0,073	N/A

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 _C MAX)							
DHN-LVEH1P3K-EU-G1 with Cmin battery							
31th	0,010	0,075	0,017	0,132	0,022	0,169	N/A
32th	0,006	0,047	0,009	0,070	0,010	0,074	N/A
33th	0,011	0,083	0,018	0,137	0,023	0,173	N/A
34th	0,004	0,032	0,008	0,059	0,010	0,073	N/A
35th	0,010	0,075	0,018	0,135	0,022	0,168	N/A
36th	0,003	0,026	0,007	0,057	0,010	0,076	N/A
37th	0,008	0,058	0,017	0,128	0,021	0,161	N/A
38th	0,004	0,031	0,007	0,053	0,010	0,075	N/A
39th	0,008	0,059	0,016	0,119	0,020	0,151	N/A
40th	0,004	0,029	0,008	0,058	0,011	0,086	N/A
41th	0,007	0,054	0,014	0,110	0,019	0,146	N/A
42th	0,002	0,019	0,007	0,054	0,008	0,062	N/A
43th	0,007	0,050	0,013	0,098	0,018	0,136	N/A
44th	0,002	0,017	0,006	0,048	0,007	0,054	N/A
45th	0,006	0,043	0,012	0,093	0,016	0,124	N/A
46th	0,003	0,020	0,006	0,047	0,006	0,048	N/A
47th	0,006	0,043	0,011	0,084	0,015	0,113	N/A
48th	0,002	0,019	0,005	0,042	0,005	0,041	N/A
49th	0,004	0,033	0,010	0,078	0,013	0,101	N/A
50th	0,002	0,014	0,005	0,037	0,004	0,034	N/A
Note:							
For test result (discharge mode P _S MAX, P _N INV) see B.1 a), b).							
The limits of symmetrical devices are fulfilled for R _{SCE} = 33.							



Bbis.3 c)	Flicker emission			P
DHN-LVEH1P8K-EU-G1 with Cmax battery				
Bidirectional converters (Discharge mode P_{SMAX} , or P_{NINV} for integrated EESS)				
Ambient				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,020	0,029	0,000
66%	EN 61000-3-11	0,028	0,043	0,000
100%*	EN 61000-3-11	0,026	0,034	0,000
-10°C				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,030	0,061	0,000
66%	EN 61000-3-11	0,030	0,061	0,000
100%*	EN 61000-3-11	0,024	0,033	0,000
+55°C				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,026	0,045	0,000
66%	EN 61000-3-11	0,029	0,044	0,000
100%*	EN 61000-3-11	0,024	0,033	0,000
Bidirectional converters (charge mode P_{CMAX})				
Ambient				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,020	0,023	0,000
66%	EN 61000-3-11	0,019	0,022	0,000
100%*	EN 61000-3-11	0,019	0,023	0,000
-10°C				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,043	0,095	0,000
66%	EN 61000-3-11	0,018	0,020	0,000
100%*	EN 61000-3-11	0,018	0,024	0,000
+55°C				
Location	Test voltage	Result		
		P_{It}	P_{St}	$d_{c\%}$
33%	EN 61000-3-11	0,048	0,050	0,000
66%	EN 61000-3-11	0,048	0,051	0,000
100%*	EN 61000-3-11	0,045	0,050	0,000



Bbis.3 c)	Flicker emission	P
Note: Mains Impedance according EN61000-3-3 / EN61000-3-11: $R_{\max} = 0,24 \, \Omega$; $jX_{\max} = 0,15 \, \Omega$ @ 50 Hz ($Z_{\max} = 0,473 \, \Omega$) $R_n = 0,16 \, \Omega$; $jX_n = 0,1 \, \Omega$ Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c: $Z_{\max} = Z_{\text{ref}} * 3,3\% / d_c(P_n)$ The tests are based on the limits of the EN61000-3-3 for less than 16 A and on EN 61000-3-11 for more than 16 A.		



Bbis.3 c)		Flicker emission			P
DHN-LVEH1P8K-EU-G1 with Cmin battery					
Bidirectional converters (Discharge mode P_{SMAX} , or P_{NINV} for integrated EESS)					
Ambient					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,047	0,051	0,000	
66%	EN 61000-3-11	0,041	0,044	0,000	
100%*	EN 61000-3-11	0,036	0,042	0,000	
-10°C					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,046	0,086	0,000	
66%	EN 61000-3-11	0,045	0,050	0,000	
100%*	EN 61000-3-11	0,044	0,048	0,000	
+55°C					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,046	0,086	0,000	
66%	EN 61000-3-11	0,019	0,017	0,000	
100%*	EN 61000-3-11	0,018	0,024	0,000	
Bidirectional converters (charge mode P_{CMAX})					
Ambient					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,033	0,066	0,000	
66%	EN 61000-3-11	0,056	0,060	0,000	
100%*	EN 61000-3-11	0,341	0,547	0,000	
-10°C					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,042	0,056	0,000	
66%	EN 61000-3-11	0,055	0,061	0,000	
100%*	EN 61000-3-11	0,019	0,025	0,000	
+55°C					
Location	Test voltage	Result			
		P_{It}	P_{St}	$d_{c\%}$	
33%	EN 61000-3-11	0,066	0,111	0,000	
66%	EN 61000-3-11	0,042	0,046	0,000	
100%*	EN 61000-3-11	0,041	0,044	0,000	



Bbis.3 c)	Flicker emission	P
DHN-LVEH1P8K-EU-G1 with Cmin battery		
Note: Mains Impedance according EN61000-3-3 / EN61000-3-11: $R_{\max} = 0,24 \Omega$; $jX_{\max} = 0,15 \Omega @ 50 \text{ Hz}$ ($Z_{\max} = 0,473 \Omega$) $R_n = 0,16 \Omega$; $jX_n = 0,1 \Omega$ Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c: $Z_{\max} = Z_{\text{ref}} * 3,3\% / d_c(P_n)$ The tests are based on the limits of the EN61000-3-3 for less than 16 A and on EN 61000-3-11 for more than 16 A.		



Bbis.3 c)	Flicker emission			P
DHN-LVEH1P3K-EU-G1 with Cmin battery				
Bidirectional converters (Discharge mode P _{SMAX} , or P _{NINV} for integrated EESS)				
Ambient				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,038	0,041	0,000
66%	EN 61000-3-11	0,038	0,042	0,000
100%*	EN 61000-3-11	0,039	0,045	0,000
-10°C				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,043	0,047	0,000
66%	EN 61000-3-11	0,053	0,096	0,000
100%*	EN 61000-3-11	0,316	0,580	0,000
+55°C				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,047	0,051	0,000
66%	EN 61000-3-11	0,045	0,053	0,000
100%*	EN 61000-3-11	0,242	0,495	0,000
Bidirectional converters (charge mode P _{CMAX})				
Ambient				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,017	0,019	0,000
66%	EN 61000-3-11	0,017	0,018	0,000
100%*	EN 61000-3-11	0,017	0,018	0,000
-10°C				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,033	0,042	0,000
66%	EN 61000-3-11	0,029	0,042	0,000
100%*	EN 61000-3-11	0,043	0,046	0,000
+55°C				
Location	Test voltage	Result		
		P _{It}	P _{St}	d _{c%}
33%	EN 61000-3-11	0,042	0,045	0,000
66%	EN 61000-3-11	0,043	0,045	0,000
100%*	EN 61000-3-11	0,025	0,042	0,000



Bbis.3 c)	Flicker emission	P
DHN-LVEH1P3K-EU-G1 with Cmin battery		
Note: Mains Impedance according EN61000-3-3 / EN61000-3-11: $R_{\max} = 0,24 \Omega$; $jX_{\max} = 0,15 \Omega @ 50 \text{ Hz}$ ($Z_{\max} = 0,473 \Omega$) $R_n = 0,16 \Omega$; $jX_n = 0,1 \Omega$ Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c: $Z_{\max} = Z_{\text{ref}} * 3,3\% / d_c(P_n)$ The tests are based on the limits of the EN61000-3-3 for less than 16 A and on EN 61000-3-11 for more than 16 A.		

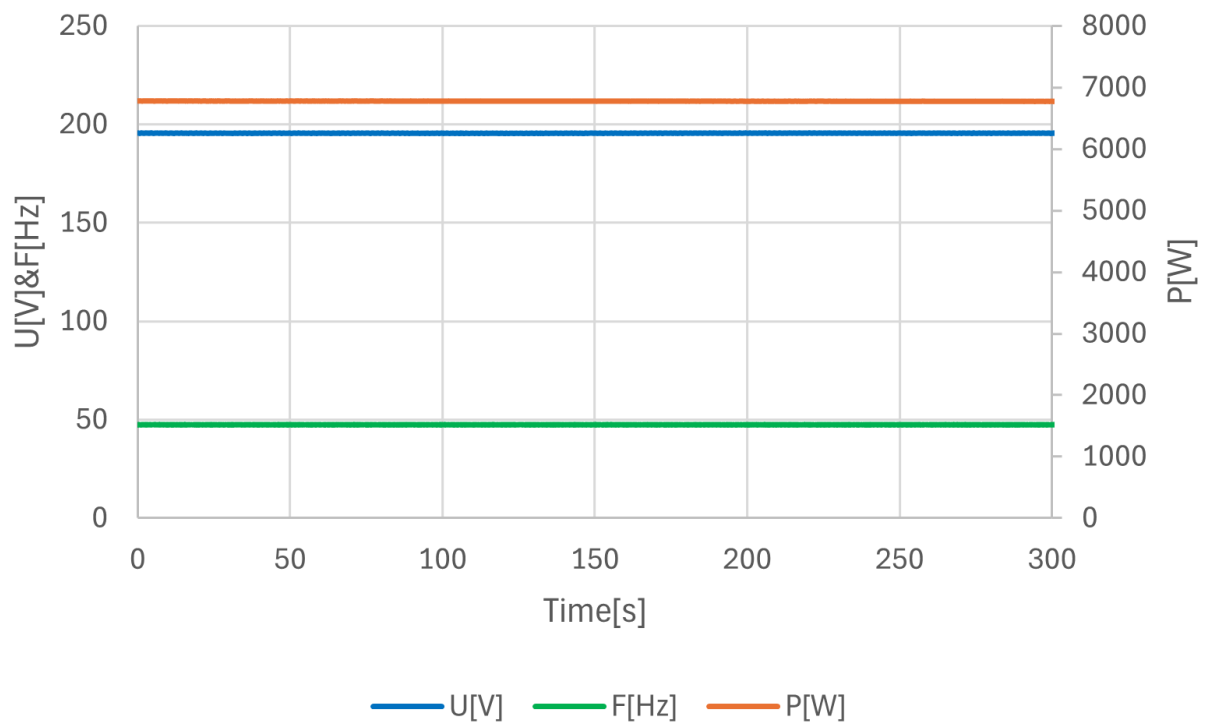
Bbis.4	Verification of the voltage and frequency operating range				P
Test results					
	Conditions				
Test 1(*)	V = 85% * V _n ; f = 47,5 Hz; P = 100% * P _S MAX (P _N INV for integrated EESS); cos φ = 1 for at least 300 s				
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]	
	195,55	47,50	6778,1	0,9992	
Limit	no disconnection allowed				
Test 2(**)	V = 110% * V _n ; f = 51,5 Hz; P = 100% * P _S MAX (P _N INV for integrated EESS); cos φ = 1 for at least 300 s				
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]	
	253,03	51,50	6853,3	0,9986	
Limit	no disconnection allowed				
Test 3	V = 85% * V _n ; f = 47,5 Hz; P = 100% * P _C MAX; cos φ = 1 for at least 300 s				
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]	
	195,02	47,50	-6739,9	-0,9961	
Limit	no disconnection allowed				
Test 4	V = 110% * V _n ; f = 51,5 Hz; P = 100% * P _C MAX; cos φ = 1 for at least 300 s				
Connection	Voltage [V]	Frequency [Hz]	Output power [W]	cos φ [1]	
	253,04	51,50	-8028,9	-0,9957	
Limit	no disconnection allowed				
Test:					
(*) Unit can operate at reduced power of P _S MAX ≥ 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).					

Bbis.4

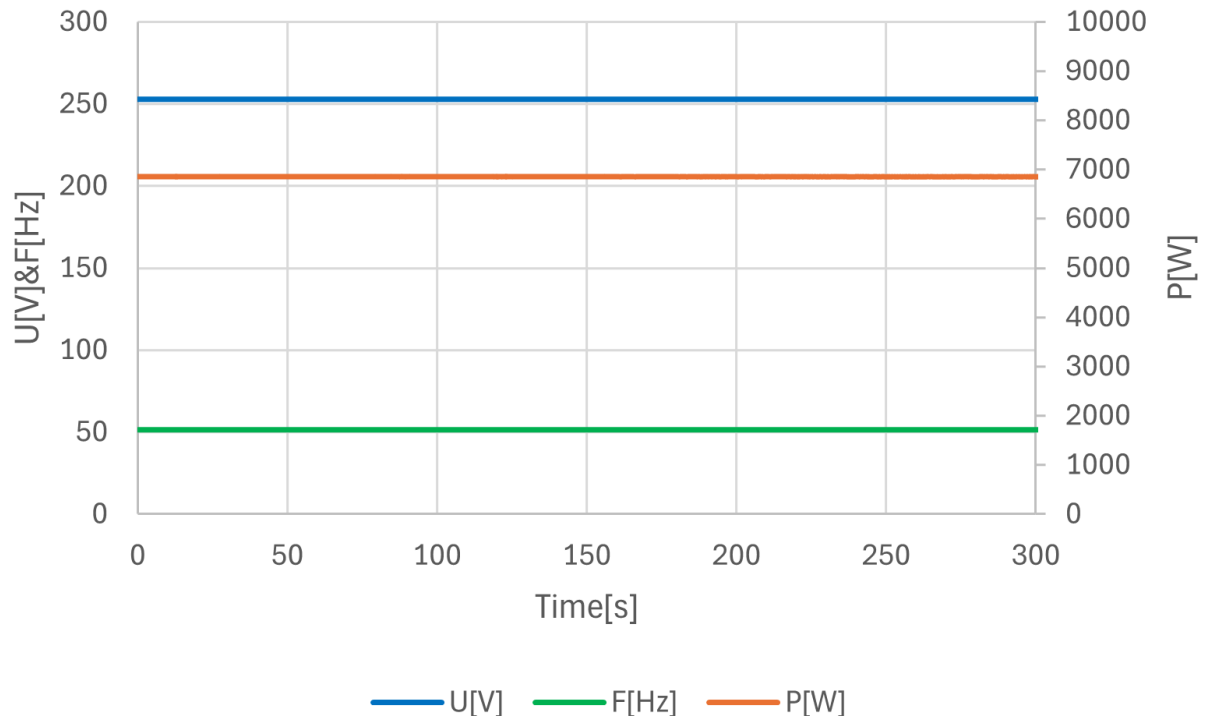
Verification of the voltage and frequency operating range

P

Graph of conditions of test 1

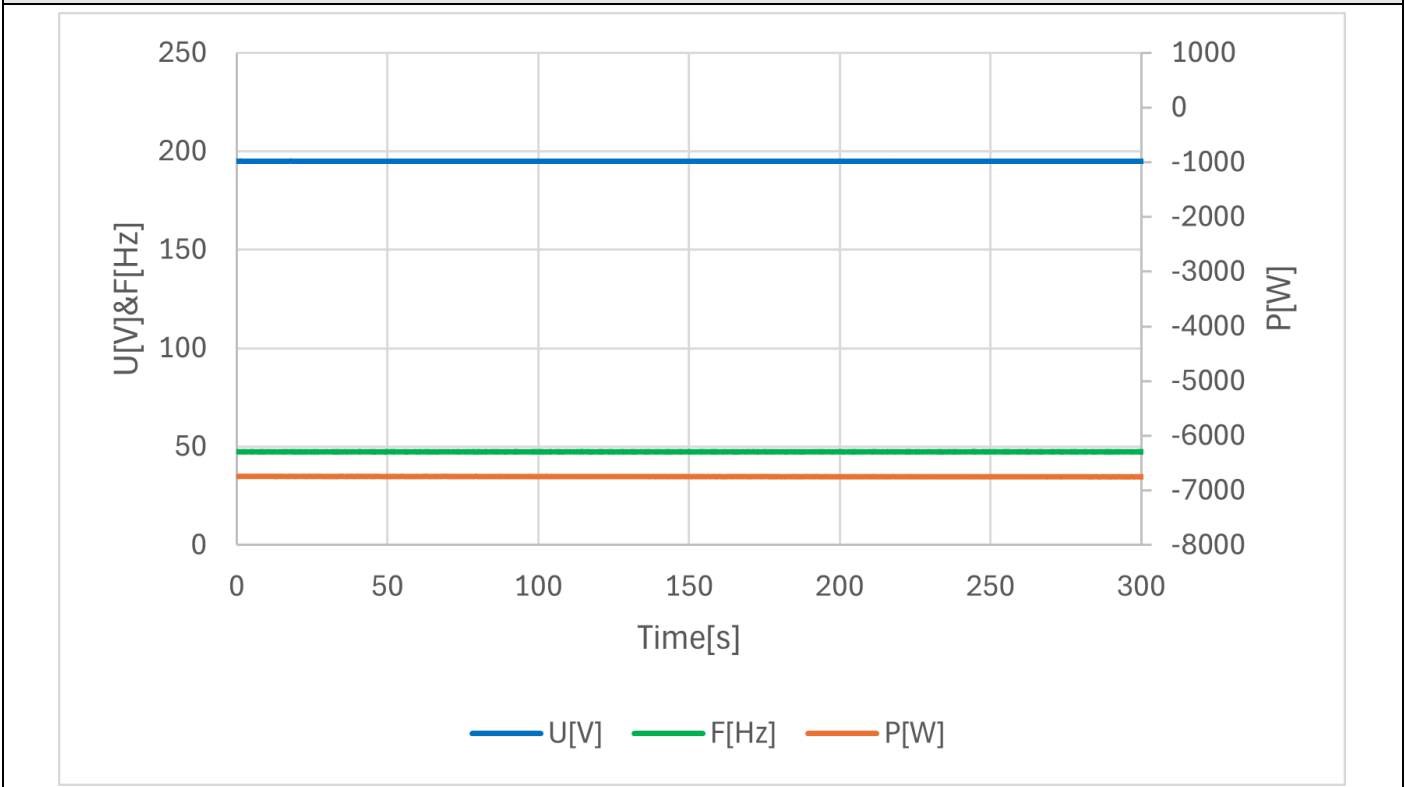


Graph of conditions of test 2

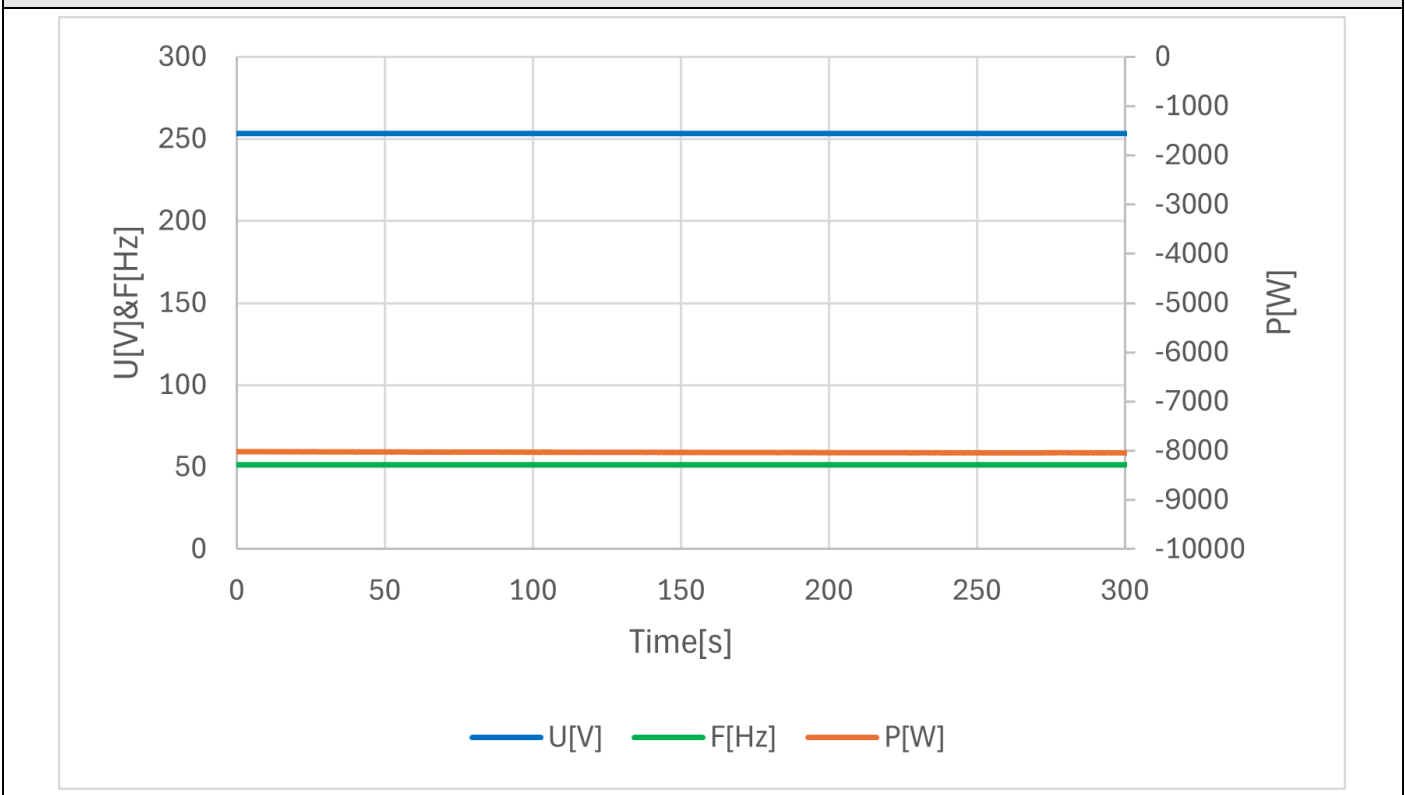


Bbis.4	Verification of the voltage and frequency operating range	P
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Graph of conditions of test 3



Graph of conditions of test 4



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		
Test: Bidirectional converters(Discharge mode P _{SMAx} , or P _{NINV} for integrated EESS)			
DHN-LVEH1P8K-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]	36,5	35,9	
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]	330,0	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]	36,4	36,8	
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]	330,2	331,3	
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			

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	

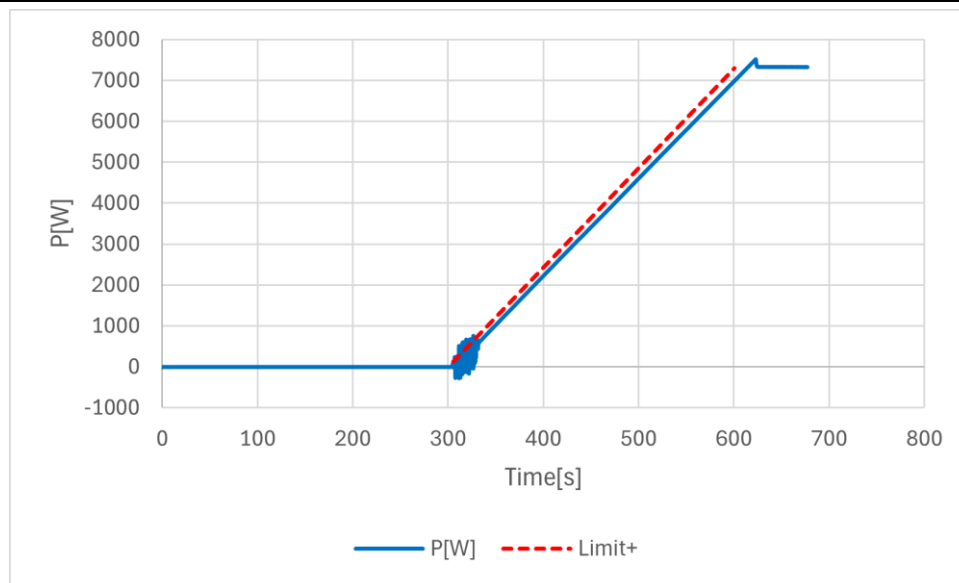
Assessment criterion:

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 49,00 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



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		
Test: Bidirectional converters (charge mode P _{CMAX})			
DHN-LVEH1P8K-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]	42,3	42,5	
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]	356,8	356,8	
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]	42,2	42,3	
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]	356,3	356,2	
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		

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	

Test:

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

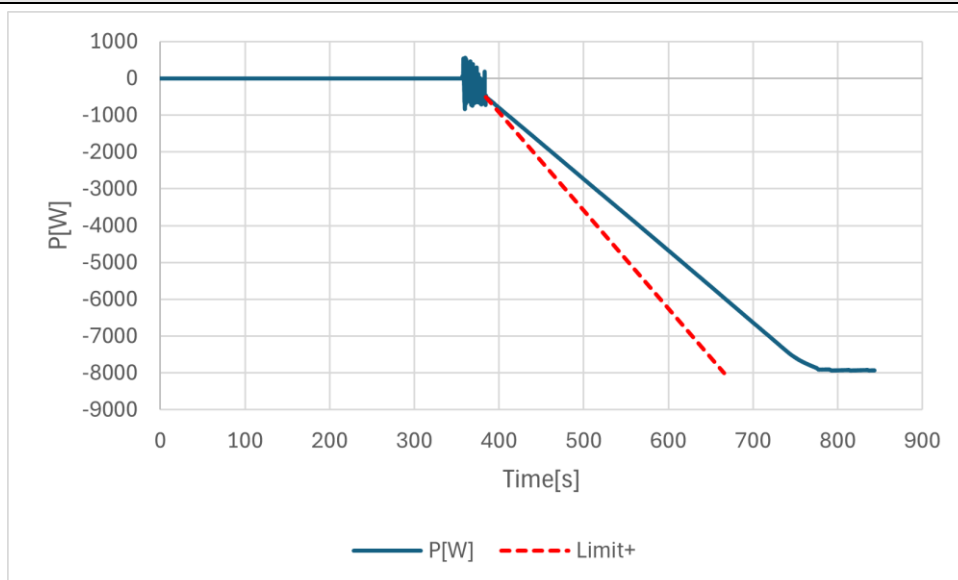
Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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):

- 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


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		
Test: Bidirectional converters(Discharge mode P _S MAX, or P _N INV for integrated EESS)			
DHN-LVEH1P8K-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]	30,8	30,9	
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]	325,9	324,7	
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]	31,4	33,8	
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]	312,2	315,3	
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			

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	

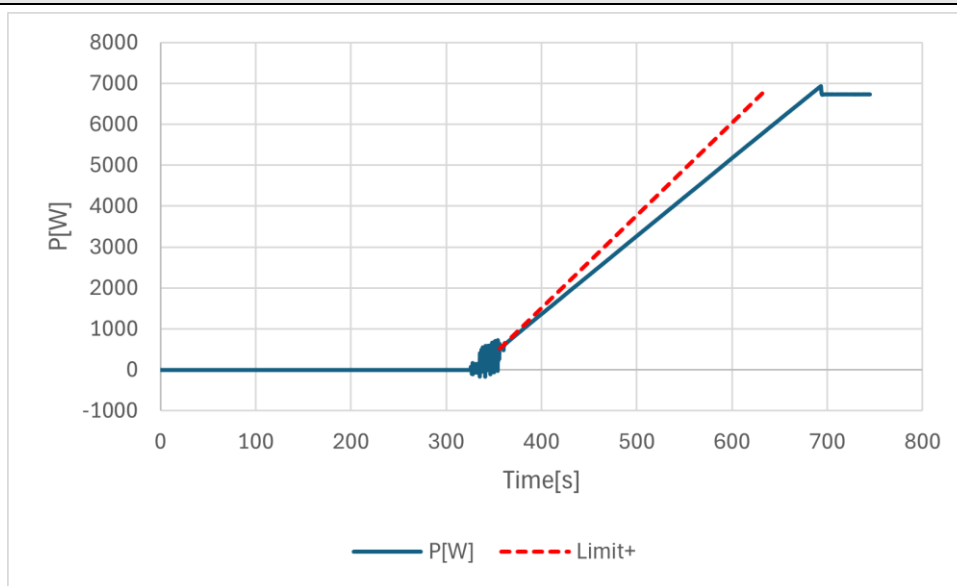
Assessment criterion:

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 49,00 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



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		
Test: Bidirectional converters (charge mode P _C MAX)			
DHN-LVEH1P8K-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]	42,3	42,66	
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]	354,8	358,0	
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]	42,5	42,7	
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]	358,9	352,4	
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		

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	

Test:

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

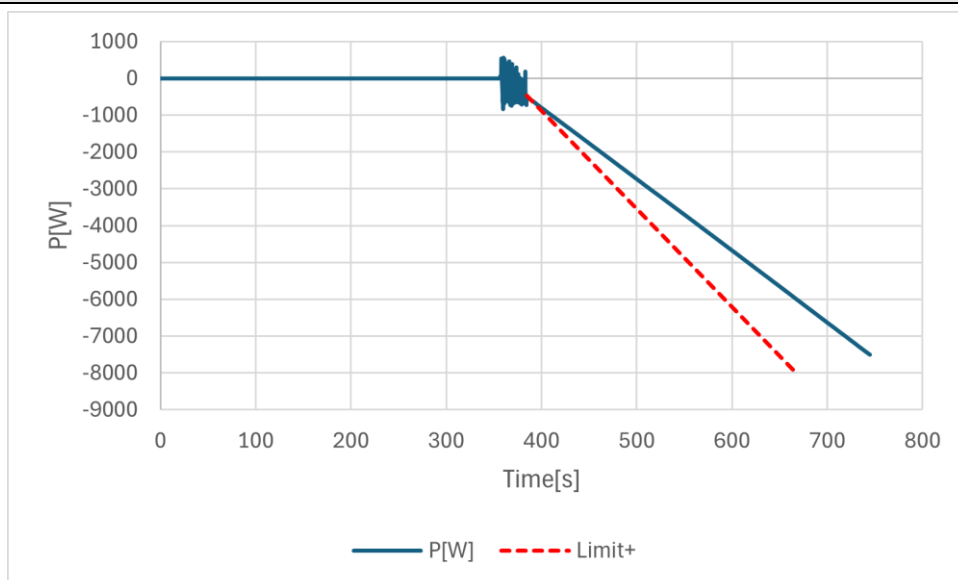
Test condition e) and f): frequency within the limits of 49,90 Hz to 50,10 Hz

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):

- 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


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		
Test: Bidirectional converters(Discharge mode P _S MAX, or P _N INV for integrated EESS)			
DHN-LVEH1P3K-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]	30,9	31,2	
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]	368,4	371,8	
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]	30,8	31,4	
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]	365,2	371,3	
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			

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	

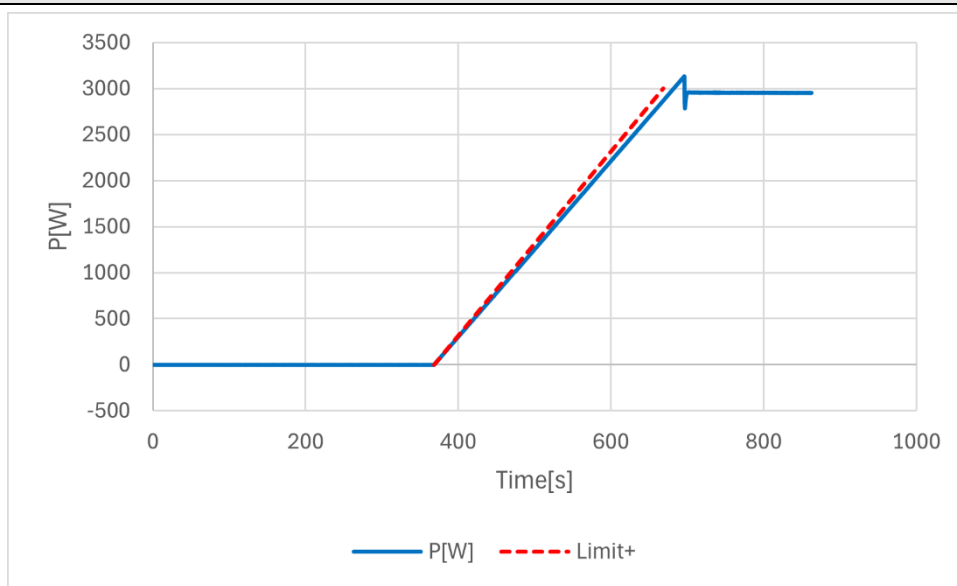
Assessment criterion:

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 49,00 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



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		
Test: Bidirectional converters (charge mode P _{C_{MAX}})			
DHN-LVEH1P3K-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]	32,8	32,5	
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]	351,5	351,8	
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]	32,2	32,3	
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]	352,3	352,2	
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		

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	

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

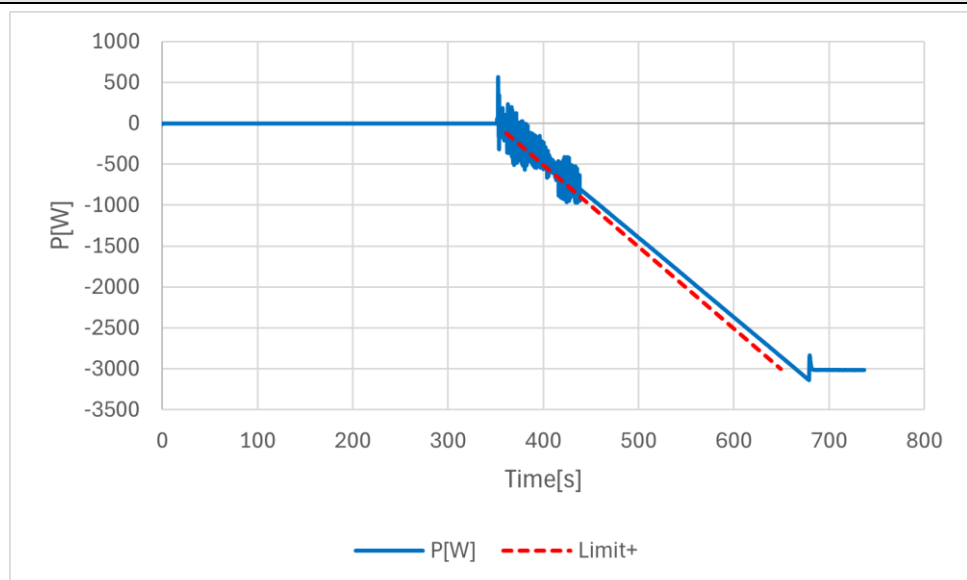
Assessment criterion:

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):

- 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



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

- 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,
- 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.

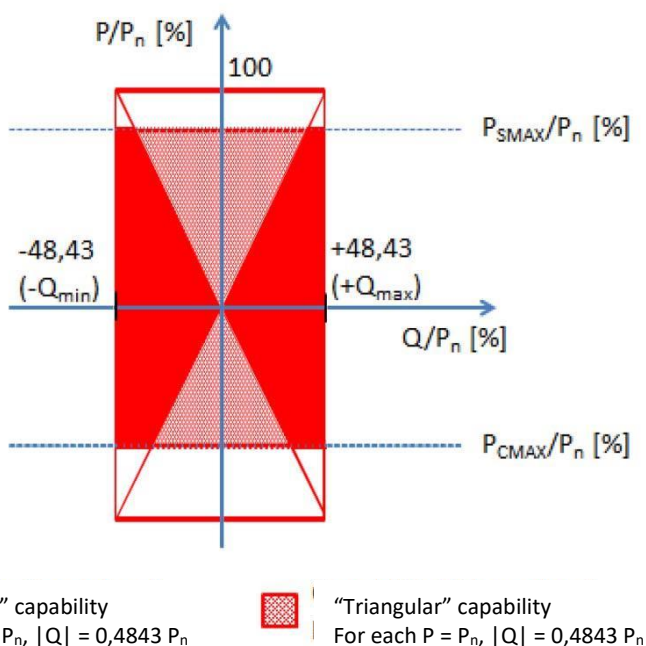


Figure 62 - Capability for a storage system with bidirectional inverter

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: $P_{S_{MAX}}$ (for accumulation of integrated systems, $P_{N_{INV}}$), or, in the case of systems of accumulation associated with bidirectional converters, $P_{C_{MAX}}$. • 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 $P_{S_{MAX}}$ (for integrated storage systems, $P_{N_{INV}}$) and, if the system is connected to a bidirectional converter, in 5 intervals the power take intervals [10-20]%; ...; [90-100]% of $P_{C_{MAX}}$. 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 $\cos \varphi$ 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 $\Delta Q = \pm 5\% \cdot S_n$.

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW				P
DHN-LVEH1P8K-EU-G1 with Cmax battery					
Test result: Bidirectional converters(Discharge mode P _S MAX, or P _N INV for integrated EESS)					
Inductive reactive power absorption					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	666,6	-3869,3	0,1696	808,2	
10 - 20	1362,6	-3857,7	0,3326	1519,1	
20 - 30	2070,8	-3889,7	0,4692	2253,5	
30 - 40	2769,1	-3871,2	0,5808	2984,5	
40 - 50	3457,5	-3872,8	0,6647	3712,8	
50 - 60	4166,3	-3873,0	0,7310	4488,9	
60 - 70	4828,9	-3841,8	0,7809	5207,3	
70 - 80	5527,3	-3865,0	0,8177	5975,9	
80 - 90	6256,4	-3831,2	0,8509	6788,4	
90 - 100	6896,0	-3856,6	0,8715	7509,3	
Limit	ΔQ ≤ ± 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	703,0	3867,4	0,1787	834,0	
10 - 20	1427,2	3863,8	0,3463	1575,4	
20 - 30	2133,7	3890,1	0,4806	2308,7	
30 - 40	2832,4	3878,4	0,5894	3041,8	
40 - 50	3525,2	3889,7	0,6710	3776,6	
50 - 60	4232,6	3883,9	0,7362	4552,5	
60 - 70	4945,4	3865,7	0,7872	5327,8	
70 - 80	5653,0	3859,5	0,8251	6105,6	
80 - 90	6335,2	3863,7	0,8529	6869,2	
90 - 100	7019,5	3851,4	0,8762	7640,5	
Limit	ΔQ ≤ ± 5% of S _n				

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW				P
DHN-LVEH1P8K-EU-G1 with Cmax battery					
Q = 0					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	746,9	263,7	0,9225	807,6	
10 - 20	1487,1	238,8	0,9863	1572,2	
20 - 30	2288,0	214,4	0,9949	2408,7	
30 - 40	3026,7	190,4	0,9973	3189,1	
40 - 50	3708,9	168,9	0,9982	3918,4	
50 - 60	4468,5	149,6	0,9985	4755,5	
60 - 70	5171,4	122,4	0,9987	5524,8	
70 - 80	5955,7	97,3	0,9986	6394,7	
80 - 90	6687,7	73,3	0,9986	7218,5	
90 - 100	7374,8	52,0	0,9985	8000,2	
Limit	ΔQ ≤ ± 5% of S _n				

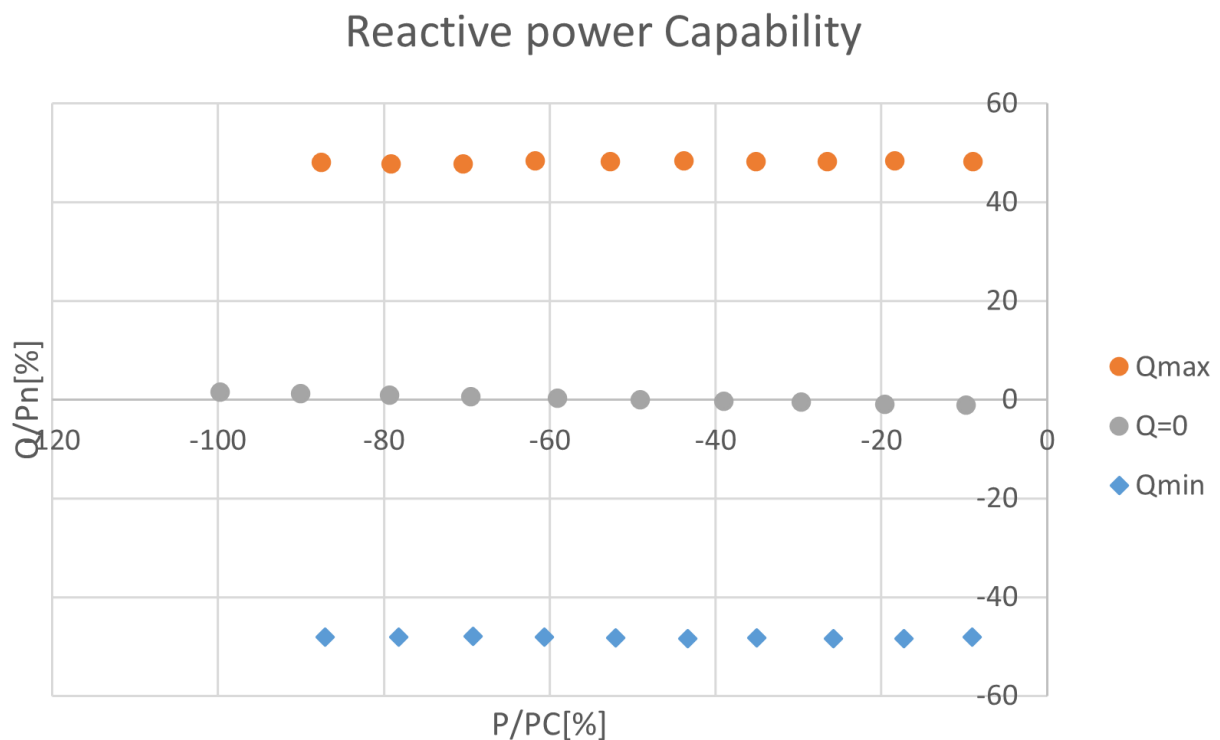
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW			P
DHN-LVEH1P8K-EU-G1 with Cmax battery				
Test result: Bidirectional converters (charge mode P _C MAX)				
Inductive reactive power absorption				
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-724,2	-3842,2	-0,1850	-581,0
10 - 20	-1385,6	-3877,4	-0,3361	-1226,0
20 - 30	-2064,5	-3872,5	-0,4698	-1881,8
30 - 40	-2799,8	-3865,1	-0,5857	-2586,1
40 - 50	-3466,3	-3869,5	-0,6660	-3216,0
50 - 60	-4165,2	-3853,4	-0,7327	-3874,3
60 - 70	-4852,3	-3846,8	-0,7820	-4497,5
70 - 80	-5537,9	-3829,3	-0,8208	-5129,4
80 - 90	-6258,9	-3848,8	-0,8497	-5788,5
90 - 100	-6967,0	-3852,4	-0,8739	-6430,6
Limit	ΔQ ≤ ± 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	-716,8	3860,8	-0,1824	-584,0
10 - 20	-1471,0	3873,8	-0,3547	-1319,7
20 - 30	-2118,8	3862,0	-0,4805	-1946,2
30 - 40	-2808,2	3855,0	-0,5881	-2606,1
40 - 50	-3503,1	3870,5	-0,6701	-3264,2
50 - 60	-4212,8	3857,5	-0,7364	-3930,4
60 - 70	-4943,0	3874,2	-0,7856	-4592,7
70 - 80	-5632,3	3827,0	-0,8255	-5228,6
80 - 90	-6327,5	3816,0	-0,8543	-5861,4
90 - 100	-7007,2	3841,3	-0,8749	-6474,8
Limit	ΔQ ≤ ± 5% of S _n			

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW				P
DHN-LVEH1P8K-EU-G1 with Cmax battery					
Q = 0					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	-782,3	-92,3	-0,9588	-717,5	
10 - 20	-1570,6	-69,8	-0,9958	-1479,9	
20 - 30	-2375,7	-43,3	-0,9981	-2250,2	
30 - 40	-3121,9	-21,9	-0,9982	-2957,0	
40 - 50	-3930,0	1,1	-0,9982	-3715,2	
50 - 60	-4727,4	23,1	-0,9981	-4439,3	
60 - 70	-5562,4	51,8	-0,9979	-5207,6	
70 - 80	-6346,6	77,3	-0,9978	-5920,3	
80 - 90	-7205,1	100,3	-0,9972	-6692,5	
90 - 100	-7980,0	122,6	-0,9979	-7381,9	
Limit	ΔQ ≤ ± 5% of S _n				
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 power storage system up to 11,08 kW is represented, which must be able to deliver with a cos φ = 0,95, i.e. Q _{min} /P _n = 0,3286%/P _n)					

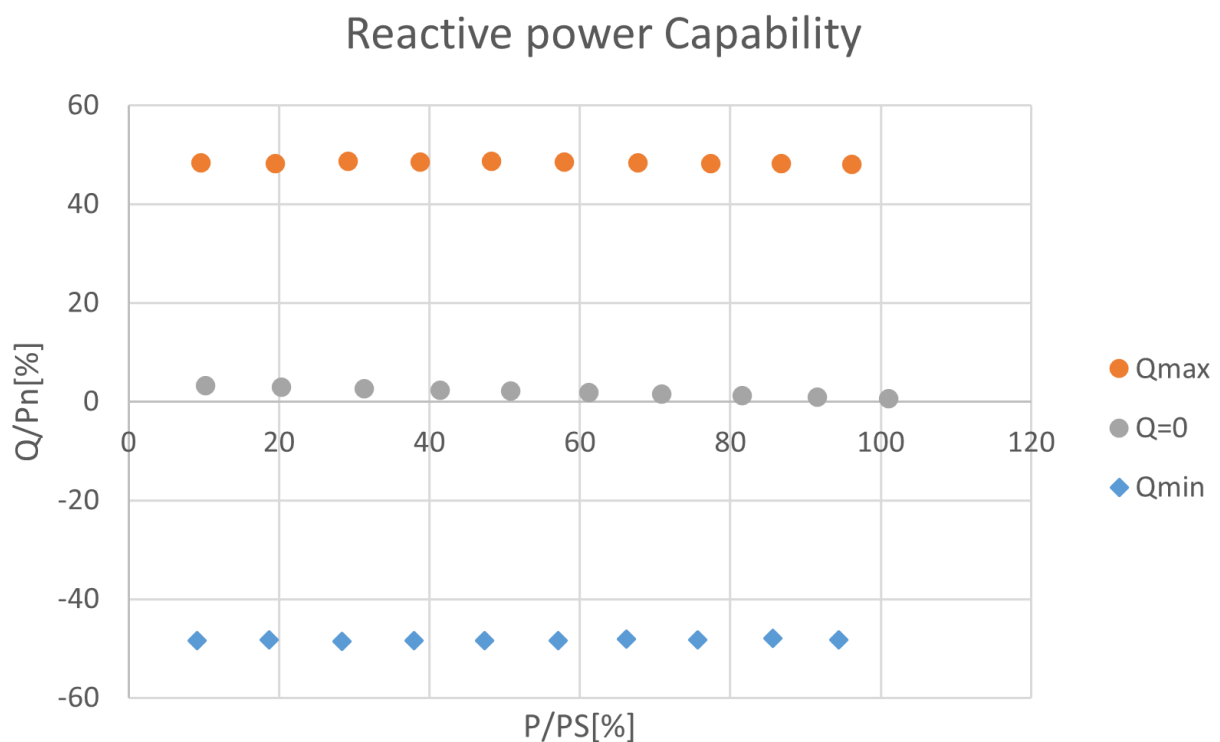
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	P
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DHN-LVEH1P8K-EU-G1 with Cmax battery

Graph of capability curves valid for inverter Charge mode $P_{C\text{MAX}}$



Graph of capability curves valid for inverter Discharge mode $P_{S\text{MAX}}$



Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW			P
DHN-LVEH1P8K-EU-G1 with Cmin battery				
Test result: Bidirectional converters (Discharge mode P _{SMAX} , or P _{NINV} for integrated EESS)				
Inductive reactive power absorption				
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	649,2	-3799,1	0,1683	773,8
10 - 20	1342,7	-3790,7	0,3334	1471,1
20 - 30	2017,0	-3776,1	0,4704	2154,0
30 - 40	2711,7	-3792,0	0,5805	2868,4
40 - 50	3380,8	-3794,3	0,6639	3562,5
50 - 60	4062,8	-3759,7	0,7324	4294,4
60 - 70	4729,5	-3780,4	0,7793	5003,0
70 - 80	5395,3	-3807,5	0,8151	5720,4
80 - 90	6072,9	-3766,7	0,8476	6457,9
90 - 100	6693,2	-3798,2	0,8675	7141,0
Limit	ΔQ ≤ ± 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	643,1	3988,6	0,1591	769,9
10 - 20	1356,7	3972,7	0,3229	1489,0
20 - 30	2055,8	3983,6	0,4583	2204,5
30 - 40	2743,9	3964,0	0,5687	2918,2
40 - 50	3425,1	3935,5	0,6560	3632,2
50 - 60	4089,4	3914,9	0,7218	4351,0
60 - 70	4746,9	3900,4	0,7720	5054,5
70 - 80	5394,9	3886,0	0,8106	5755,5
80 - 90	6034,2	3861,5	0,8415	6455,9
90 - 100	6701,1	3860,5	0,8656	7192,7
Limit	ΔQ ≤ ± 5% of S _n			

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW				P
DHN-LVEH1P8K-EU-G1 with Cmin battery					
Q = 0					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	686,1	245,4	0,9096	738,2	
10 - 20	1359,4	227,2	0,9853	1425,6	
20 - 30	2077,5	202,4	0,9946	2164,9	
30 - 40	2712,9	183,7	0,9970	2826,2	
40 - 50	3468,7	162,2	0,9981	3619,4	
50 - 60	4070,9	143,4	0,9985	4276,8	
60 - 70	4804,2	120,4	0,9987	5063,8	
70 - 80	4804,2	120,4	0,9987	5063,8	
80 - 90	6143,8	75,8	0,9986	6525,1	
90 - 100	6782,3	53,8	0,9985	7232,7	
Limit	ΔQ ≤ ± 5% of S _n				
Test result: Bidirectional converters (charge mode P _C MAX)					
Inductive reactive power absorption					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	-724,2	-3842,2	-0,1850	-581,0	
10 - 20	-1385,6	-3877,4	-0,3361	-1226,0	
20 - 30	-2064,5	-3872,5	-0,4698	-1881,8	
30 - 40	-2799,8	-3865,1	-0,5857	-2586,1	
40 - 50	-3466,3	-3869,5	-0,6660	-3216,0	
50 - 60	-4165,2	-3853,4	-0,7327	-3874,3	
60 - 70	-4852,3	-3846,8	-0,7820	-4497,5	
70 - 80	-5537,9	-3829,3	-0,8208	-5129,4	
80 - 90	-6258,9	-3848,8	-0,8497	-5788,5	
90 - 100	-6967,0	-3852,4	-0,8739	-6430,6	
Limit	ΔQ ≤ ± 5% of S _n				

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	P
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DHN-LVEH1P8K-EU-G1 with Cmin battery
Capacitive reactive power absorption

Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-716,8	3860,8	-0,1824	-584,0
10 - 20	-1471,0	3873,8	-0,3547	-1319,7
20 - 30	-2118,8	3862,0	-0,4805	-1946,2
30 - 40	-2808,2	3855,0	-0,5881	-2606,1
40 - 50	-3503,1	3870,5	-0,6701	-3264,2
50 - 60	-4212,8	3857,5	-0,7364	-3930,4
60 - 70	-4943,0	3874,2	-0,7856	-4592,7
70 - 80	-5632,3	3827,0	-0,8255	-5228,6
80 - 90	-6327,5	3816,0	-0,8543	-5861,4
90 - 100	-7007,2	3841,3	-0,8749	-6474,8

Limit	$\Delta Q \leq \pm 5\% \text{ of } S_n$
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Q = 0

Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-782,3	-92,3	-0,9588	-717,5
10 - 20	-1570,6	-69,8	-0,9958	-1479,9
20 - 30	-2375,7	-43,3	-0,9981	-2250,2
30 - 40	-3121,9	-21,9	-0,9982	-2957,0
40 - 50	-3930,0	1,1	-0,9982	-3715,2
50 - 60	-4727,4	23,1	-0,9981	-4439,3
60 - 70	-5562,4	51,8	-0,9979	-5207,6
70 - 80	-6346,6	77,3	-0,9978	-5920,3
80 - 90	-7205,1	100,3	-0,9972	-6692,5
90 - 100	-7980,0	122,6	-0,9979	-7381,9

Limit	$\Delta Q \leq \pm 5\% \text{ of } S_n$
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Note:

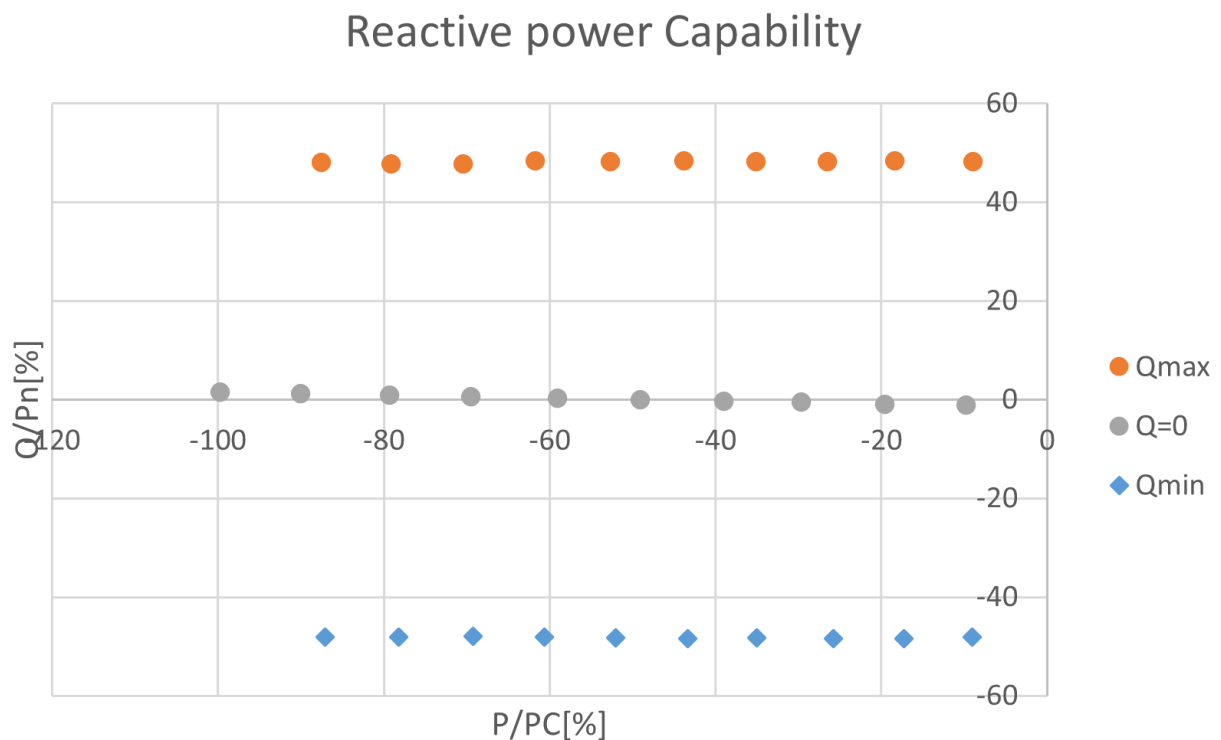
The inverter produces reactive power according to the circular characteristic. The priority is always given by the reactive power.

Maximum inductive and capacitive reactive power delivered as a function of active power (here the case of a power storage system up to 11,08 kW is represented, which must be able to deliver with a cos φ = 0,95, i.e. $Q_{\min}/P_n = 0,3286\%/P_n$)

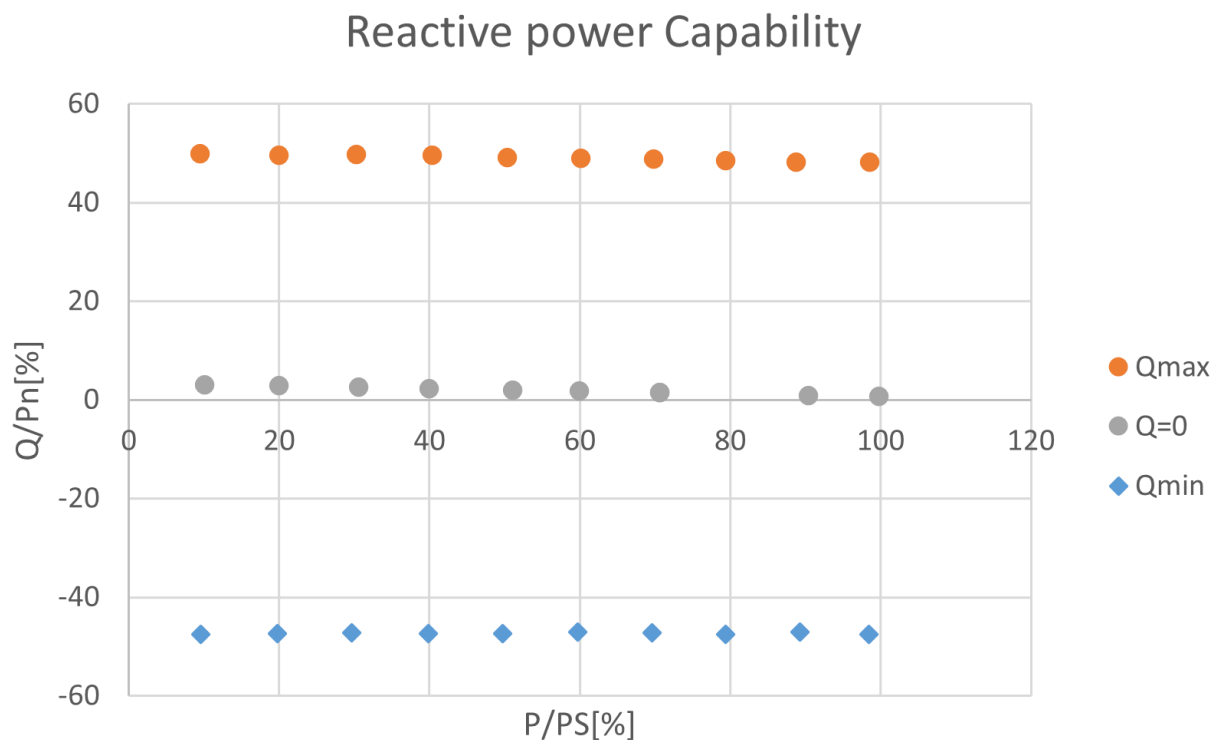
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	P
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DHN-LVEH1P8K-EU-G1 with Cmin battery

Graph of capability curves valid for inverter Charge mode $P_{C\text{MAX}}$



Graph of capability curves valid for inverter Discharge mode $P_{S\text{MAX}}$



Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW				P
DHN-LVEH1P3K-EU-G1 with Cmin battery					
Test result: Bidirectional converters / Unidirectional converters (Discharge mode P _{SMAX} , or P _{NINV} for integrated EESS)					
Inductive reactive power absorption					
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]	
0 - 10	276,8	-1446,5	0,1869	349,1	
10 - 20	551,6	-1437,3	0,3562	629,5	
20 - 30	813,6	-1446,2	0,4879	896,3	
30 - 40	1067,1	-1440,1	0,5925	1156,6	
40 - 50	1324,1	-1438,8	0,6744	1419,0	
50 - 60	1580,0	-1446,0	0,7349	1682,5	
60 - 70	1834,2	-1449,2	0,7822	1945,6	
70 - 80	2079,4	-1441,2	0,8194	2203,2	
80 - 90	2332,0	-1427,3	0,8505	2465,6	
90 - 100	2606,8	-1441,9	0,8729	2755,5	
Limit		ΔQ ≤ ± 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	277,1	1443,9	0,1853	341,9	
10 - 20	557,5	1445,2	0,3551	626,2	
20 - 30	797,2	1461,8	0,4743	870,4	
30 - 40	1042,7	1453,7	0,5791	1122,1	
40 - 50	1325,8	1468,7	0,6675	1415,2	
50 - 60	1559,2	1462,2	0,7275	1655,5	
60 - 70	1825,8	1461,3	0,7794	1932,5	
70 - 80	2080,2	1467,0	0,8161	2198,0	
80 - 90	2342,2	1457,0	0,8482	2472,2	
90 - 100	2604,0	1455,9	0,8721	2748,7	
Limit		ΔQ ≤ ± 5% of S _n			

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW			P
DHN-LVEH1P3K-EU-G1 with Cmin battery				
Q = 0				
Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	295,1	-95,9	0,6016	392,9
10 - 20	624,4	249,6	0,8946	682,4
20 - 30	916,9	128,6	0,9903	983,3
30 - 40	1206,5	132,4	0,9902	1281,9
40 - 50	1509,6	119,6	0,9956	1596,0
50 - 60	1817,3	111,8	0,9973	1916,5
60 - 70	2122,4	104,2	0,9981	2235,3
70 - 80	2397,3	96,5	0,9985	2524,7
80 - 90	2725,0	88,5	0,9988	2870,1
90 - 100	3000,6	78,8	0,9992	3162,8
Limit	ΔQ ≤ ± 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	-279,5	-1450,8	-0,1877	-200,6
10 - 20	-524,7	-1443,8	-0,3388	-439,1
20 - 30	-795,6	-1472,4	-0,4720	-702,3
30 - 40	-1022,3	-1462,6	-0,5692	-921,9
40 - 50	-1306,3	-1449,3	-0,6658	-1196,7
50 - 60	-1533,7	-1441,6	-0,7254	-1415,3
60 - 70	-1820,8	-1485,3	-0,7718	-1689,9
70 - 80	-2100,7	-1476,6	-0,8153	-1955,9
80 - 90	-2339,3	-1467,0	-0,8446	-2183,2
90 - 100	-2599,1	-1462,3	-0,8691	-2428,7
Limit	ΔQ ≤ ± 5% of S _n			

Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	P
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DHN-LVEH1P3K-EU-G1 with Cmin battery
Capacitive reactive power absorption

Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-264,0	1418,8	-0,1796	-193,8
10 - 20	-563,8	1428,1	-0,3626	-484,9
20 - 30	-785,0	1437,9	-0,4747	-701,9
30 - 40	-1039,4	1439,2	-0,5815	-948,2
40 - 50	-1297,1	1433,5	-0,6676	-1196,5
50 - 60	-1584,6	1430,6	-0,7394	-1472,0
60 - 70	-1815,3	1445,6	-0,7797	-1692,8
70 - 80	-2082,8	1429,9	-0,8221	-1946,5
80 - 90	-2339,8	1440,9	-0,8494	-2190,3
90 - 100	-2606,1	1437,3	-0,8735	-2443,3

Limit	$\Delta Q \leq \pm 5\% \text{ of } S_n$
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Q = 0

Power-BIN [% P _n]	Active power [W]	Reactive power [Var]	Power factor (cos φ) [1]	DC power [W]
0 - 10	-297,9	-584,0	-0,4107	-235,8
10 - 20	-659,2	-303,2	-0,7696	-592,2
20 - 30	-912,0	-43,6	-0,9904	-835,5
30 - 40	-1215,2	-35,0	-0,9913	-1126,3
40 - 50	-1500,2	-25,7	-0,9964	-1400,0
50 - 60	-1784,0	-13,4	-0,9979	-1670,9
60 - 70	-2072,9	-5,9	-0,9984	-1945,5
70 - 80	-2363,6	3,7	-0,9985	-2220,2
80 - 90	-2672,0	12,3	-0,9985	-2511,3
90 - 100	-2982,1	20,7	-0,9984	-2802,3

Limit	$\Delta Q \leq \pm 5\% \text{ of } S_n$
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Note:

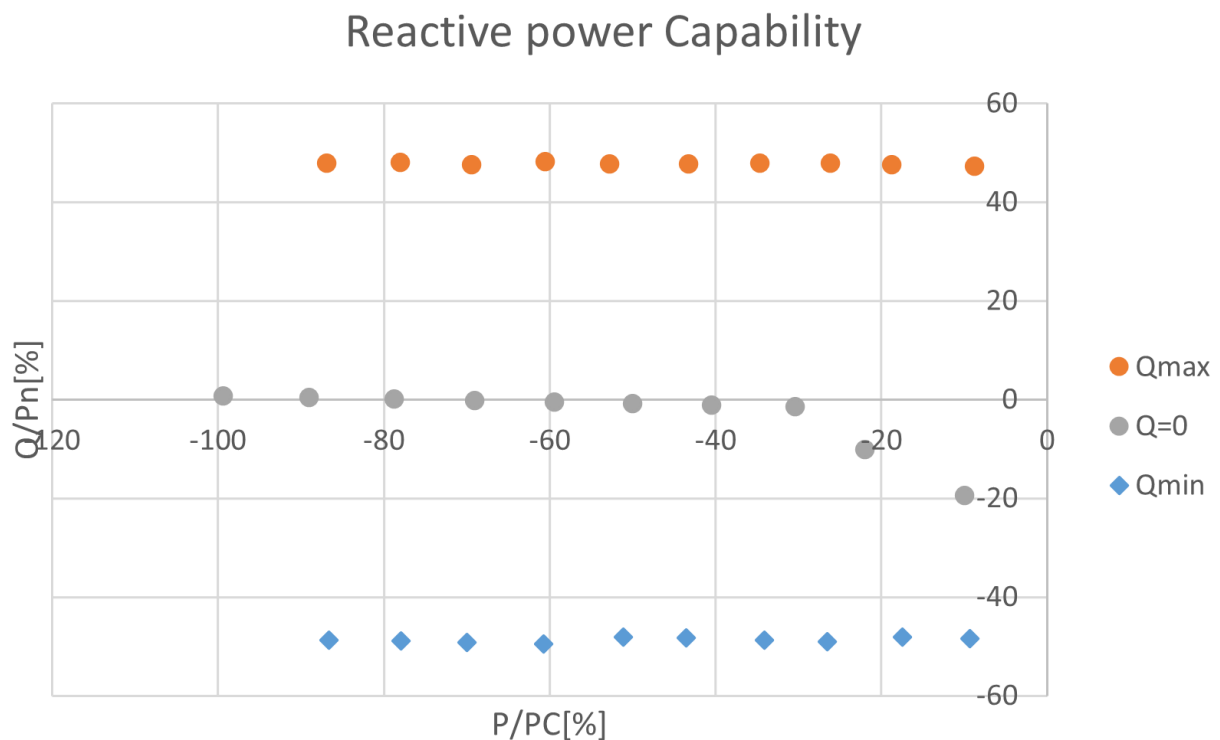
The inverter produces reactive power according to the circular characteristic. The priority is always given by the reactive power.

Maximum inductive and capacitive reactive power delivered as a function of active power (here the case of a power storage system up to 11,08 kW is represented, which must be able to deliver with a cos φ = 0,95, i.e. $Q_{\min}/P_n = 0,3286\%/P_n$)

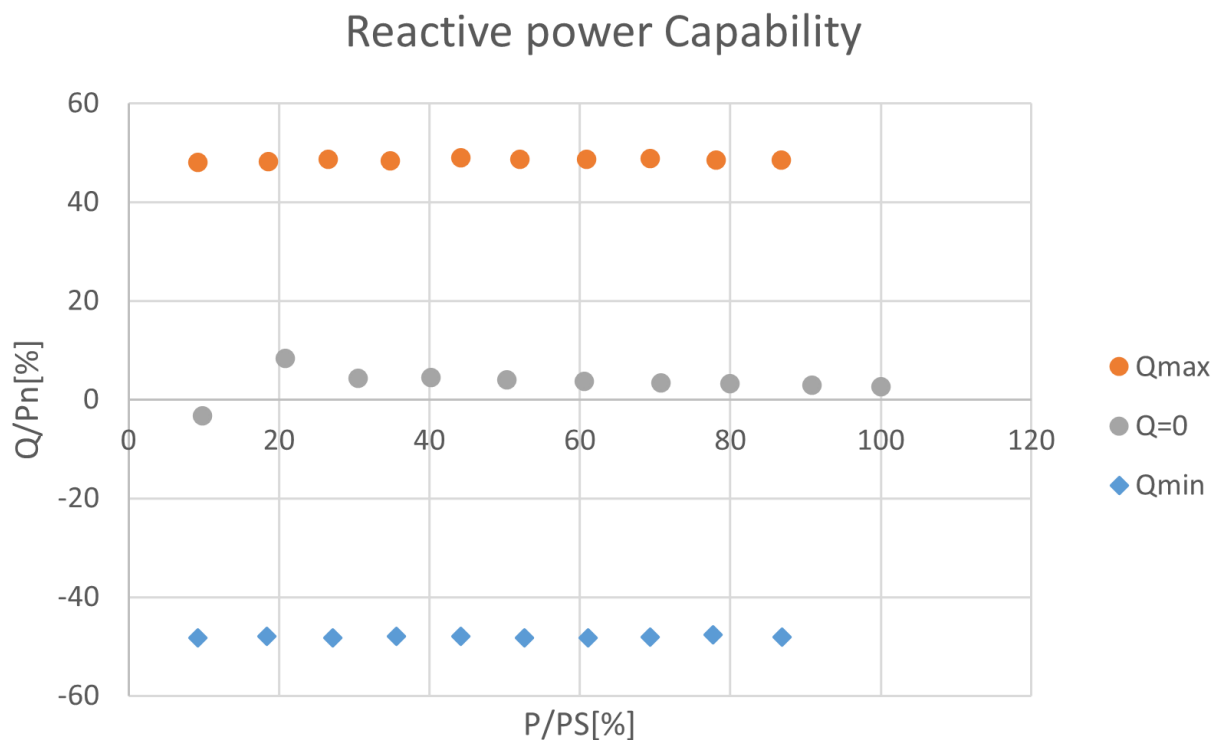
Bbis.6.2	Test performance and recording mode for Storage systems in installations with a total capacity of up to 11,08 kW	P
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DHN-LVEH1P3K-EU-G1 with Cmin battery

Graph of capability curves valid for inverter Charge mode $P_{C\text{MAX}}$



Graph of capability curves valid for inverter Discharge mode $P_{S\text{MAX}}$



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

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 $\cos \varphi = f(P)$ given in E.2, according to method a).

A: $P = 20\% \cdot P_{SMAX}$; $\cos \varphi = 1$

B: $P = 50\% \cdot P_{SMAX}$; $\cos \varphi = 1$

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

Where $\cos \varphi_{min}$ 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.

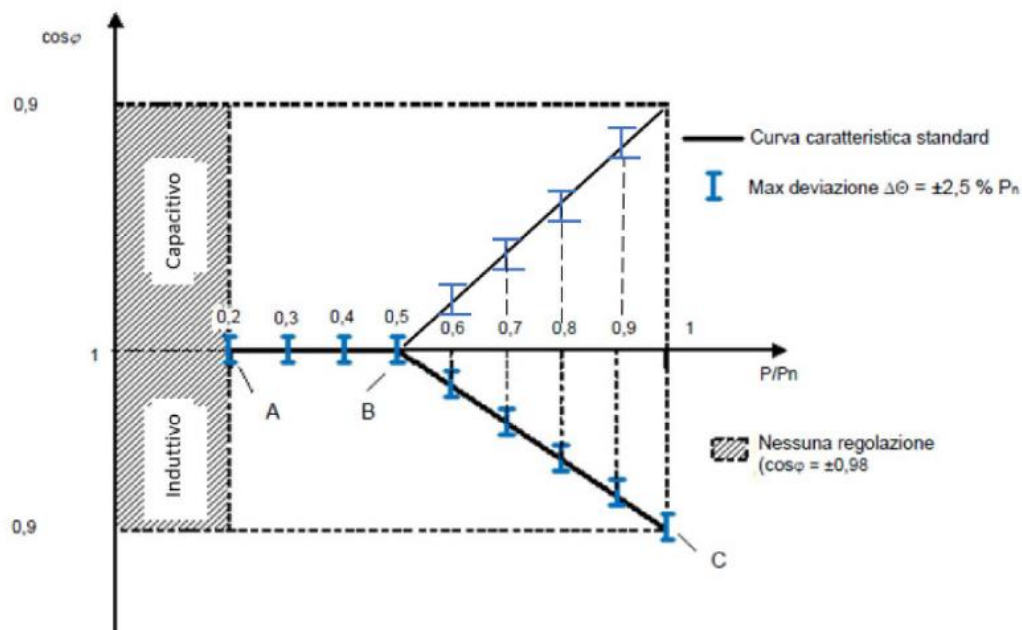
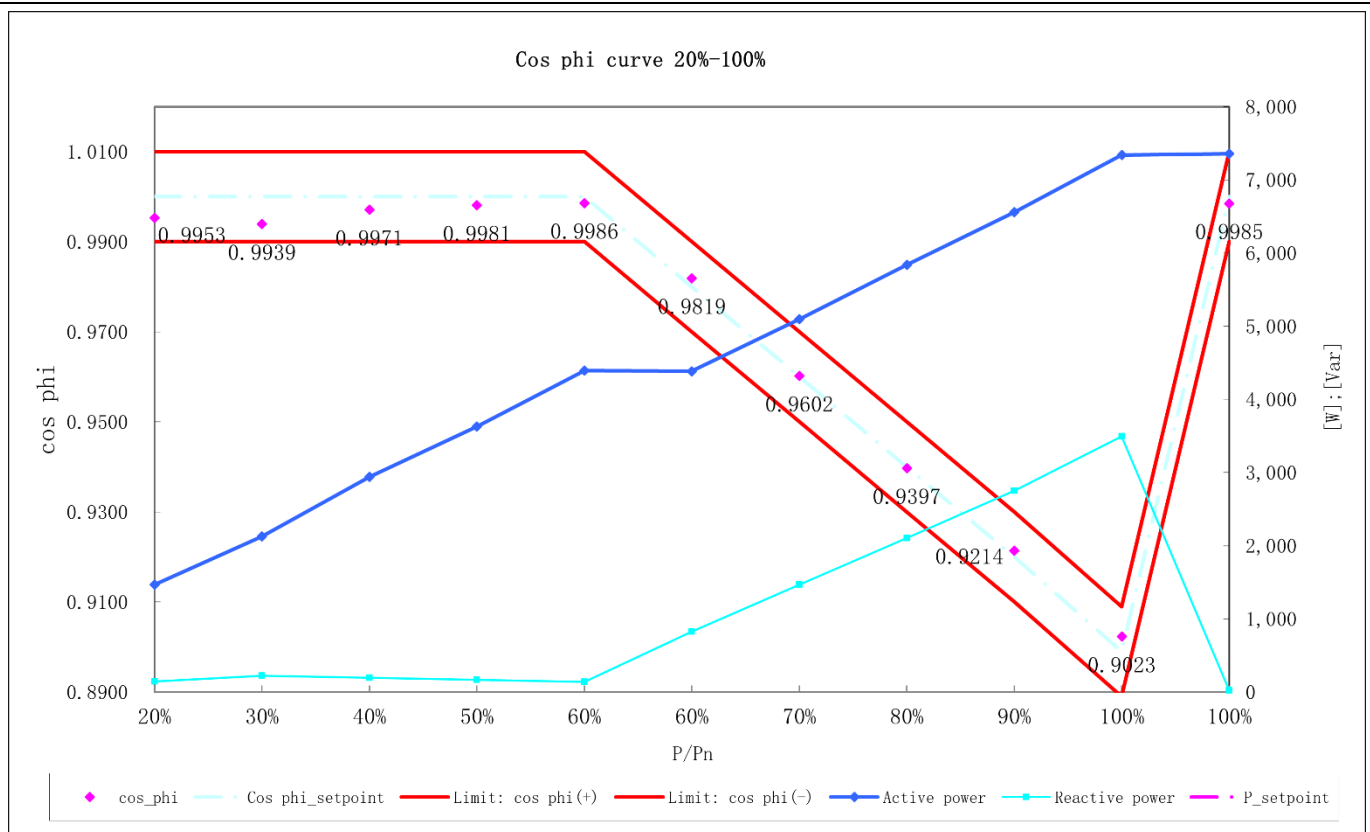
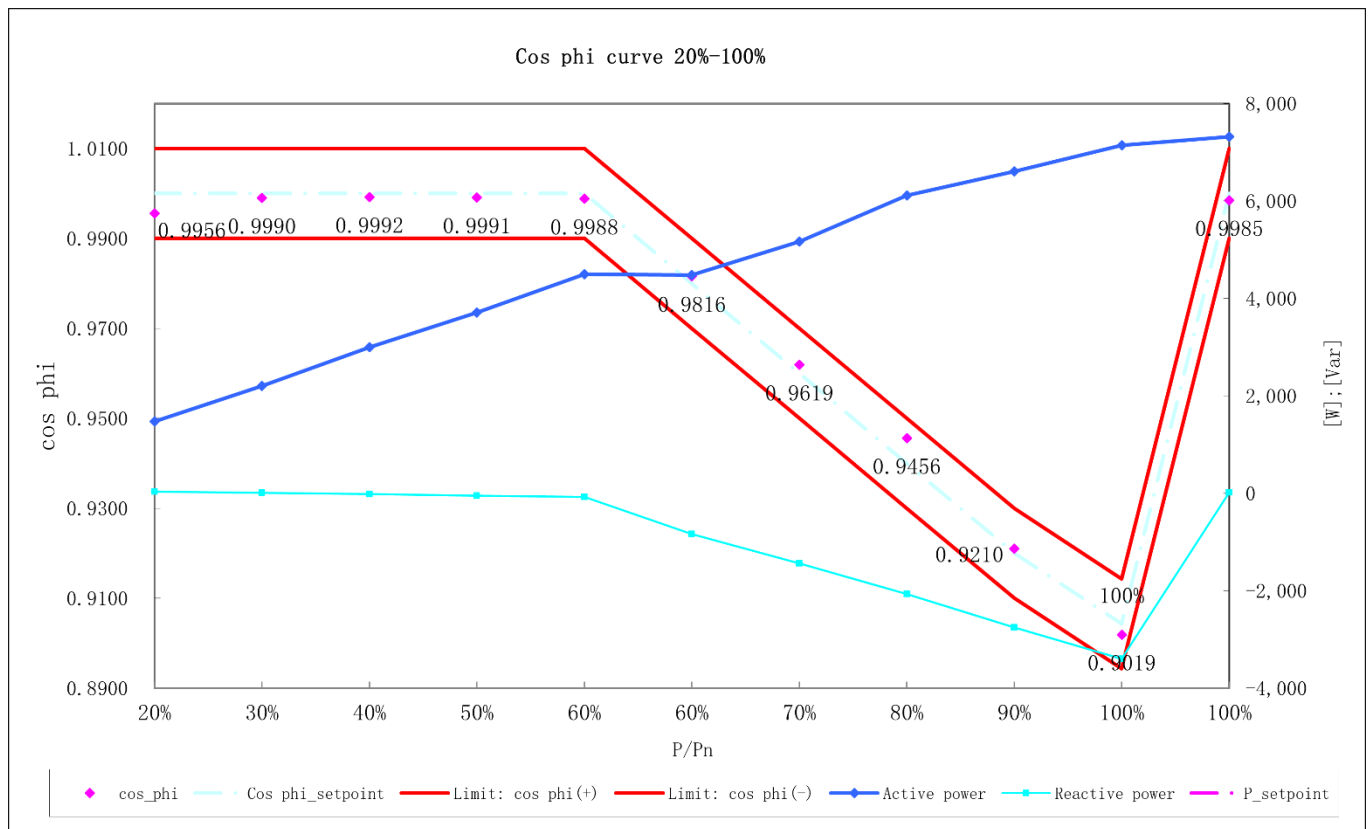


Figure 66 - Standard characteristic curve $\cos \varphi = f(P)$

Bbis.6.7	Verification of compliance with the application of the standard delivery curve $\cos \varphi = f(P)$				P
Test result					
DHN-LVEH1P8K-EU-G1 with Cmax battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1472,1	33,6	0,9956	1,0000	-0,0044
30	2205,5	6,4	0,9990	1,0000	-0,0010
40	2998,6	-19,4	0,9992	1,0000	-0,0008
50	3706,5	-46,5	0,9991	1,0000	-0,0009
60	4493,4	-75,4	0,9988	1,0000	-0,0012
60	4484,4	-837,7	0,9816	0,9800	0,0016
70	5169,4	-1436,7	0,9619	0,9600	0,0019
80	6115,8	-2064,0	0,9456	0,9400	0,0056
90	6604,9	-2752,9	0,9210	0,9200	0,0010
100	7141,8	-3394,2	0,9019	0,9043	-0,0024
100	7320,9	19,4	0,9985	1,0000	-0,0015
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1468,2	143,1	0,9953	1,0000	-0,0047
30	2126,3	220,0	0,9939	1,0000	-0,0061
40	2941,9	192,8	0,9971	1,0000	-0,0029
50	3625,6	168,3	0,9981	1,0000	-0,0019
60	4391,9	139,8	0,9986	1,0000	-0,0014
60	4383,7	826,5	0,9819	0,9800	0,0019
70	5096,3	1466,4	0,9602	0,9600	0,0002
80	5835,2	2105,7	0,9397	0,9400	-0,0003
90	6559,0	2748,6	0,9214	0,9200	0,0014
100	7337,0	3495,8	0,9023	0,9000	0,0023
100	7354,0	22,2	0,9985	1,0000	-0,0015
Graph of $\cos \varphi(P)$					

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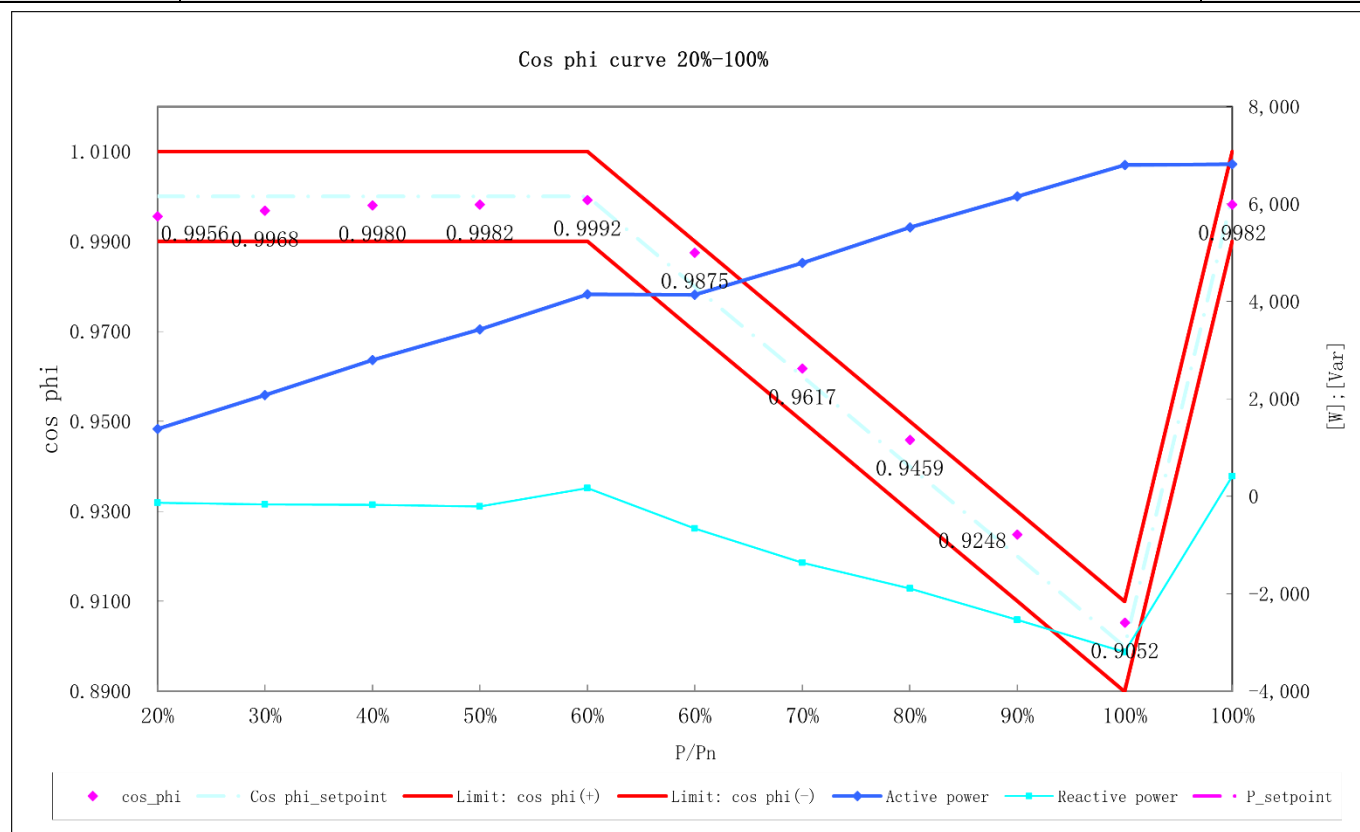


Note

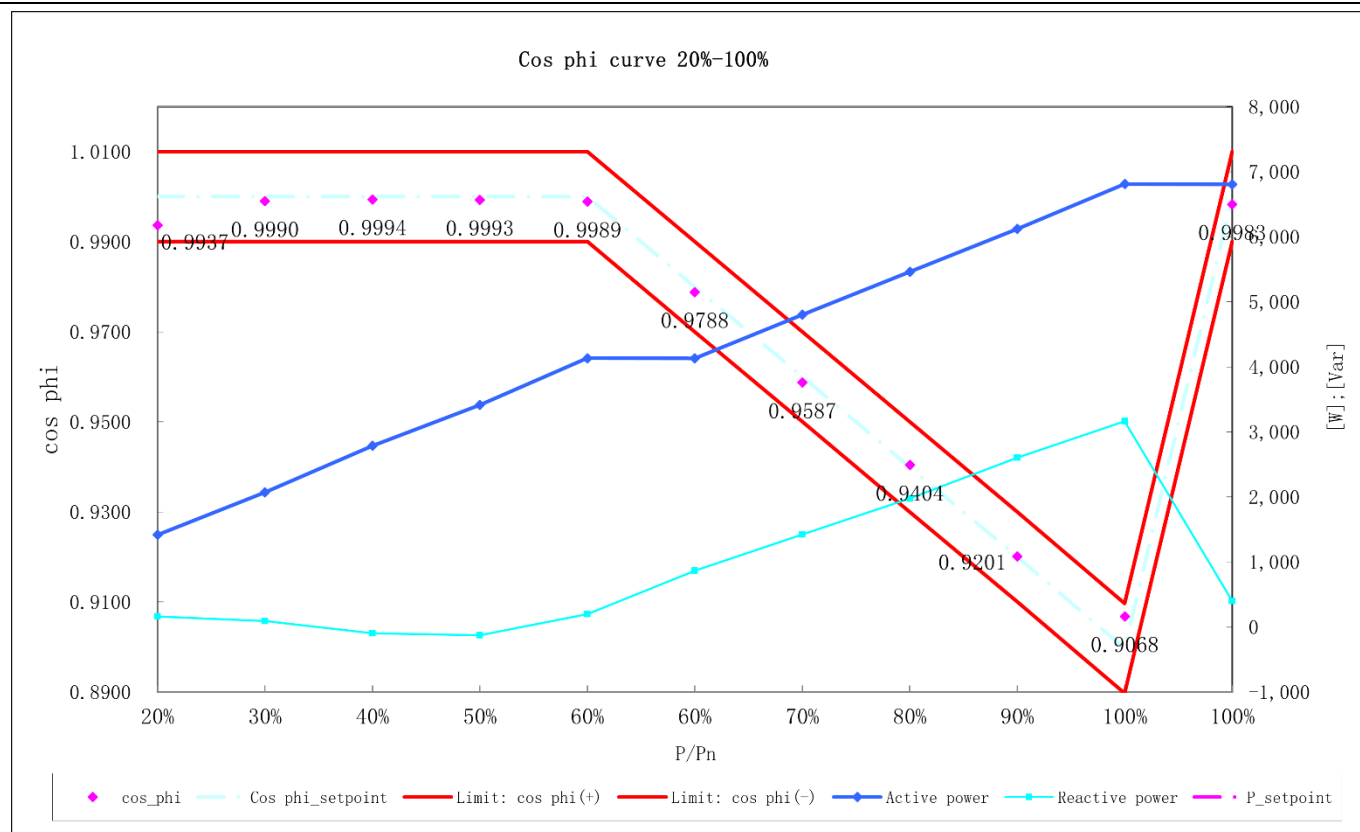
The lock-in value is adjustable between V_n and $1,1V_n$ and the lock-out value between V_n and $0,9V_n$ in $0,01V$ steps.

Bbis.6.7	Verification of compliance with the application of the standard delivery curve $\cos \varphi = f(P)$				P
Test result					
DHN-LVEH1P8K-EU-G1 with Cmin battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1380,9	-130,3	0,9956	1,0000	-0,0044
30	2076,4	-166,7	0,9968	1,0000	-0,0032
40	2796,3	-175,0	0,9980	1,0000	-0,0020
50	3427,4	-205,2	0,9982	1,0000	-0,0018
60	4144,3	169,3	0,9992	1,0000	-0,0008
60	4139,6	-660,0	0,9875	0,9800	0,0075
70	4792,8	-1366,8	0,9617	0,9600	0,0017
80	5518,5	-1892,3	0,9459	0,9400	0,0059
90	6156,7	-2532,4	0,9248	0,9200	0,0048
100	6803,3	-3193,3	0,9052	0,9000	0,0052
100	6820,7	409,2	0,9982	1,0000	-0,0018
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	1417,0	159,3	0,9937	1,0000	-0,0063
30	2067,3	93,6	0,9990	1,0000	-0,0010
40	2784,5	-96,2	0,9994	1,0000	-0,0006
50	3415,2	-128,9	0,9993	1,0000	-0,0007
60	4132,7	197,1	0,9989	1,0000	-0,0011
60	4129,6	863,4	0,9788	0,9800	-0,0012
70	4804,2	1425,8	0,9587	0,9600	-0,0013
80	5462,7	1975,3	0,9404	0,9400	0,0004
90	6121,6	2606,0	0,9201	0,9200	0,0001
100	6809,7	3165,5	0,9068	0,9000	0,0068
100	6805,9	401,6	0,9983	1,0000	-0,0017
Graph of $\cos \varphi(P)$					

Bbis.6.7	Verification of compliance with the application of the standard delivery curve $\cos \varphi = f(P)$	P
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Inductive



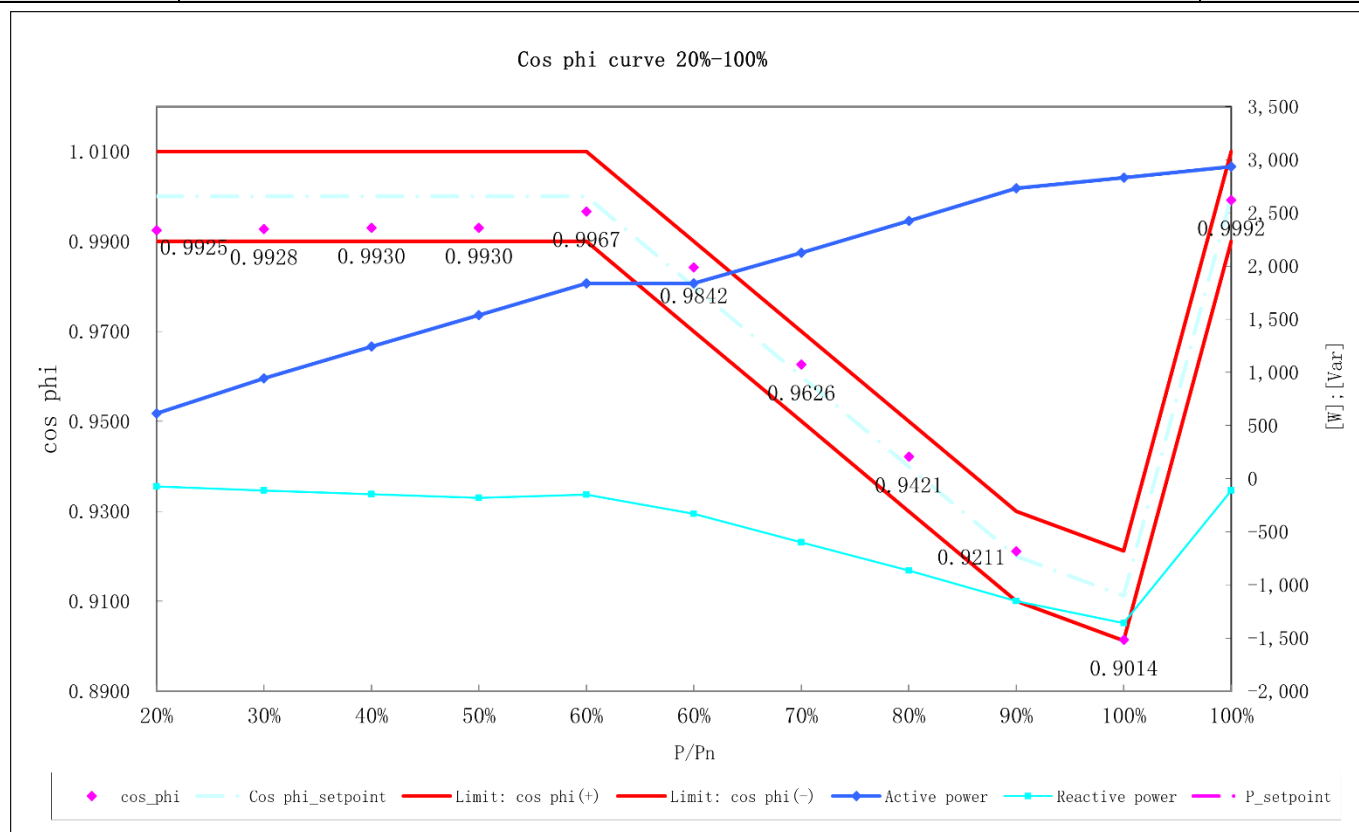
Capacitive

Note

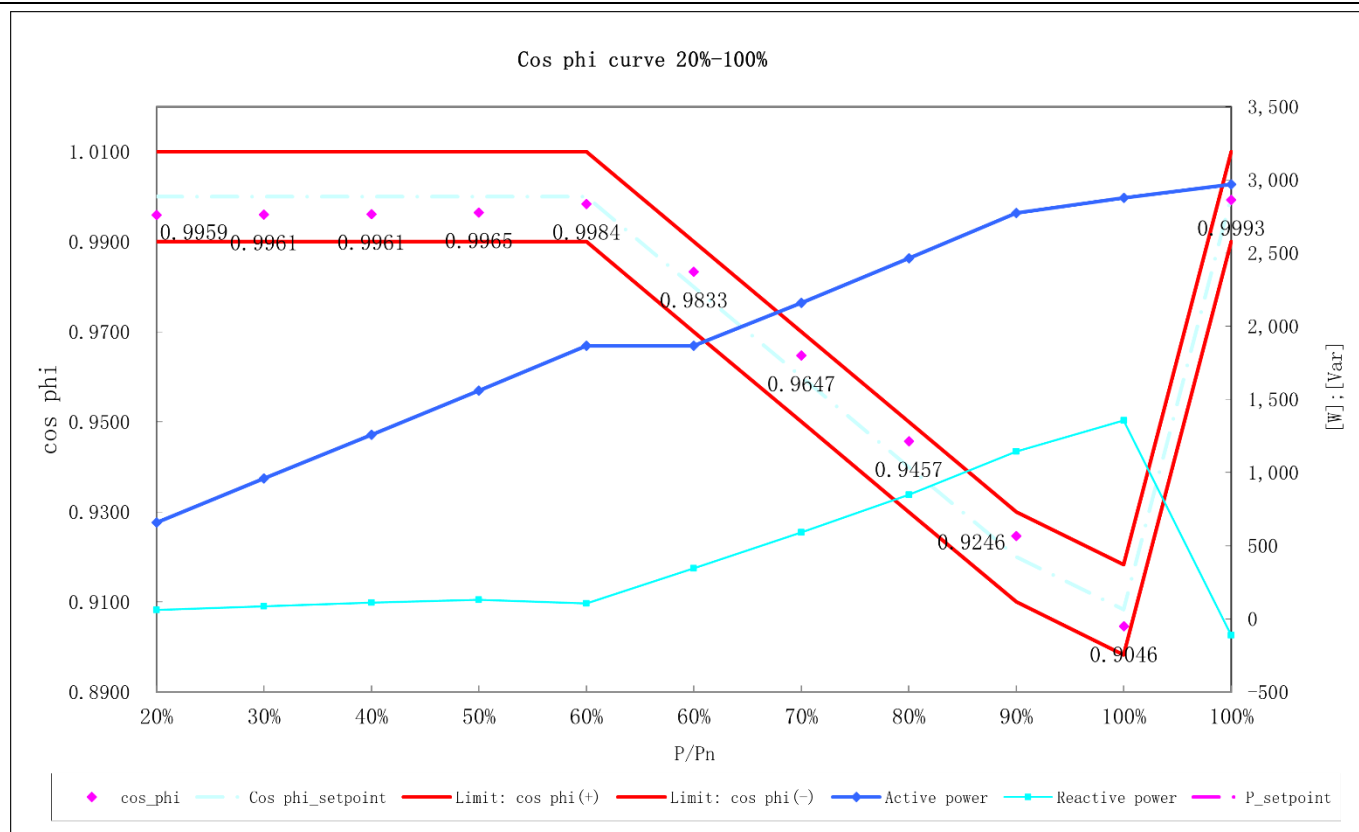
The lock-in value is adjustable between V_n and $1,1V_n$ and the lock-out value between V_n and $0,9V_n$ in $0,01V$ steps.

Bbis.6.7	Verification of compliance with the application of the standard delivery curve $\cos \varphi = f(P)$				P
Test result					
DHN-LVEH1P3K-EU-G1 with Cmin battery					
Inductive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	612,4	-75,4	0,9925	1,0000	-0,0075
30	942,9	-113,9	0,9928	1,0000	-0,0072
40	1241,1	-147,6	0,9930	1,0000	-0,0070
50	1535,9	-182,3	0,9930	1,0000	-0,0070
60	1836,4	-149,7	0,9967	1,0000	-0,0033
60	1835,2	-329,7	0,9842	0,9800	0,0042
70	2124,8	-598,0	0,9626	0,9600	0,0026
80	2425,3	-863,0	0,9421	0,9400	0,0021
90	2729,4	-1154,0	0,9211	0,9200	0,0011
100	2832,0	-1360,4	0,9014	0,9112	-0,0098
100	2933,6	-113,9	0,9992	1,0000	-0,0008
Capacitive reactive power absorption					
Power-BIN [%]	Active power P [W]	Reactive power Q [Var]	$\cos \varphi$ measured [1]	$\cos \varphi$ expected [1]	$\Delta \cos \varphi$ [1]
20	657,0	59,6	0,9959	1,0000	-0,0041
30	958,8	85,4	0,9961	1,0000	-0,0039
40	1258,9	111,0	0,9961	1,0000	-0,0039
50	1558,1	131,5	0,9965	1,0000	-0,0035
60	1865,8	104,4	0,9984	1,0000	-0,0016
60	1866,3	345,4	0,9833	0,9800	0,0033
70	2160,2	589,6	0,9647	0,9600	0,0047
80	2464,5	846,8	0,9457	0,9400	0,0057
90	2774,3	1142,9	0,9246	0,9200	0,0046
100	2875,8	1355,5	0,9046	0,9083	-0,0037
100	2970,0	-113,5	0,9993	1,0000	-0,0007
Graph of $\cos \varphi(P)$					

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

Bbis.6.8	Automatic reactive power exchange according to a characteristic curve $Q = f(V)$	N/A
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.: V_{1i}, V_{2i}, V_{1s} and V_{2s}, k as well as the active power lock-in value in discharge (default value $P = 20\%$ * $P_{S\text{MAX}}$ or, for integrated storage systems, $P = 20\% * P_{N\text{INV}}$ and, for storage systems connected to bidirectional inverters, the active power lock-in value in charge ($P = 20\% * P_{C\text{MAX}}$). Parameters V_{1i}, V_{2i}, V_{1s} and V_{2s} must be able to be set in the range $0,9 \div 1,1 * V_n$ with step $0,01 * V_n$, while parameters k must be able to be set in the range $0 \div 1$, with step $0,01$. In order to facilitate the execution of type tests, the parameters characterising the curve are conventionally set as follows: $V_{1s} = 1,08 * V_n$; $V_{2s} = 1,1 * V_n$; $V_{1i} = 0,92 * V_n$; $V_{2i} = 0,9 * V_n$; $k = 0,1$; 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 V_{1s} and V_{1i} 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.		



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).		

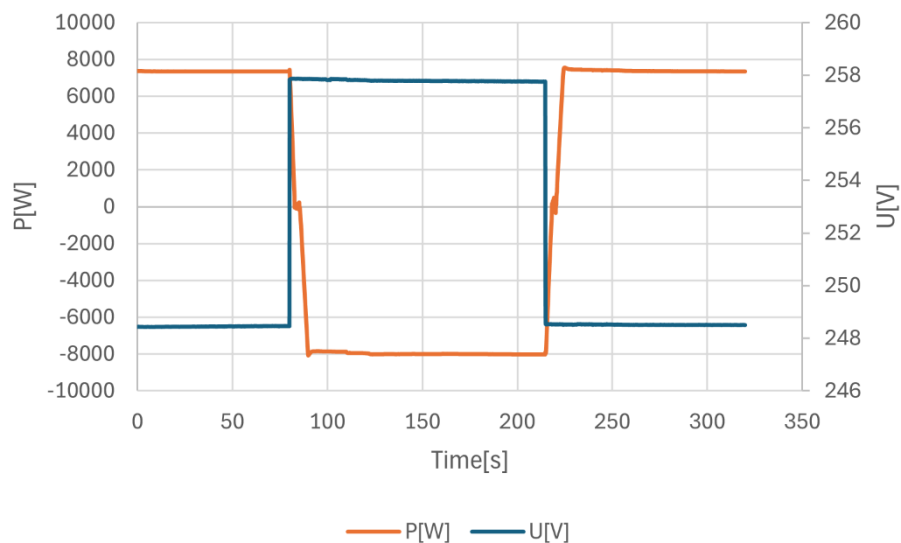
Bbis.7.1		Automatic active power limitation for voltage values close to 110% of nominal voltage		P
The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110% of V _n .				
DHN-LVEH1P8K-EU-G1 with Cmax battery				
Test result				
setpoint	Activation threshold -2% of V _n	Activation threshold +2% of V _n	Activation threshold -2% of V _n	
Voltage [V]	248,4	257,8	248,5	
P _{E60} [% P _n]	100,81	-100,16	101,00	
ΔP _{E60} /P _{Setpoint} [%]	0,81	-0,16	1,00	
Settling time [s]	--	9,6	9,8	
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:				
<				

Bbis.7.1

Automatic active power limitation for voltage values close to 110% of nominal voltage

P

Graph



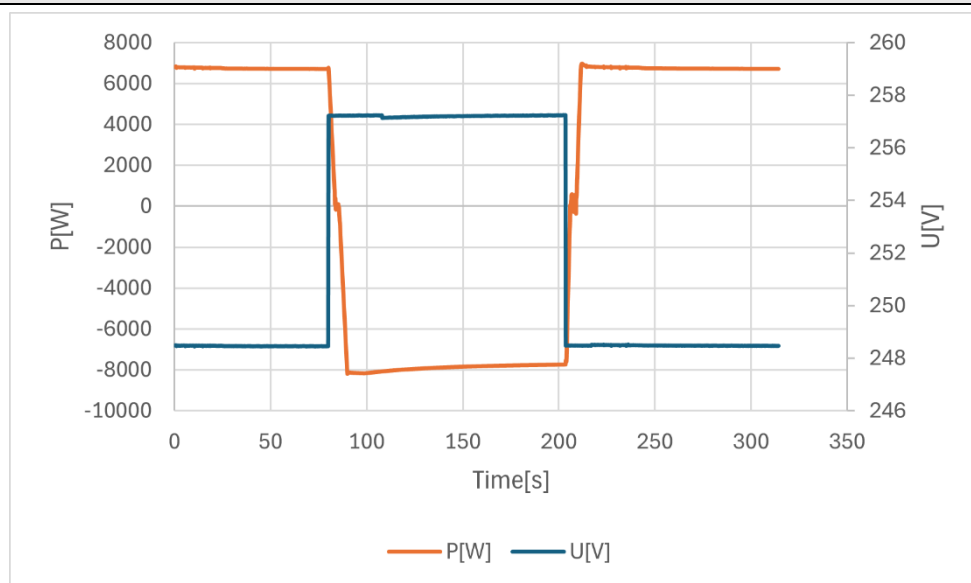
Bbis.7.1	Automatic active power limitation for voltage values close to 110% of nominal voltage			P
The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110% of V_n .				
DHN-LVEH1P8K-EU-G1 with Cmin battery				
Test result				
setpoint	Activation threshold -2% of V_n	Activation threshold +2% of V_n	Activation threshold -2% of V_n	
Voltage [V]	248,5	257,2	248,5	
P_{E60} [% P_n]	99,76	-98,84	98,91	
$\Delta P_{E60}/P_{Setpoint}$ [%]	-0,24	1,16	-1,09	
Settling time [s]	--	9,9	8,1	
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 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), - 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 300 s - the active power delivered by the inverter returns to the value congruent with the power made available by the DC-side accumulators				

Bbis.7.1

Automatic active power limitation for voltage values close to 110% of nominal voltage

P

Graph



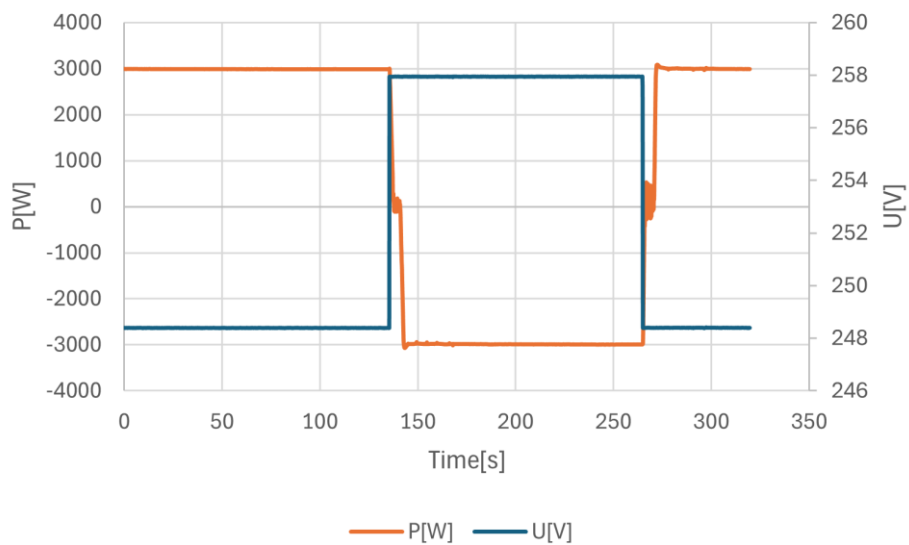
Bbis.7.1		Automatic active power limitation for voltage values close to 110% of nominal voltage		P
The purpose of the test is to verify the automatic reduction function of the active power output when the voltage read at the terminals of the storage system is close to 110% of V _n .				
DHN-LVEH1P3K-EU-G1 with Cmin battery				
Test result				
setpoint	Activation threshold -2% of V _n	Activation threshold +2% of V _n	Activation threshold -2% of V _n	
Voltage [V]	248,4	258,0	248,4	
P _{E60} [% P _n]	99,54	-99,75	99,58	
ΔP _{E60} /P _{Setpoint} [%]	-0,46	0,25	-0,42	
Settling time [s]	--	7,3	7,0	
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 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), • 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 300 s • the active power delivered by the inverter returns to the value congruent with the power made available by the DC-side accumulators				

Bbis.7.1

Automatic active power limitation for voltage values close to 110% of nominal voltage

P

Graph



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 (t_1 for sequence A, t'_1 for sequence B)

2) $f = 50,00$ Hz $\pm 0,15$ Hz (t_2 for sequence A, t'_2 for sequence B)

3) $f = 50,00$ Hz $\pm 0,40$ Hz (t_3 for sequence A, t'_3 for sequence B)

4) $f = 50,00$ Hz $\pm 0,60$ Hz (t_4 for sequence A, t'_4 for sequence B)

5) $f = 50,00$ Hz $\pm 1,49$ Hz (t_5 for sequence A, t'_5 for sequence B)

6) $f = 50,00$ Hz $\pm 0,11$ Hz (t_6 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 (t_7 for sequence A, t'_7 for sequence B)

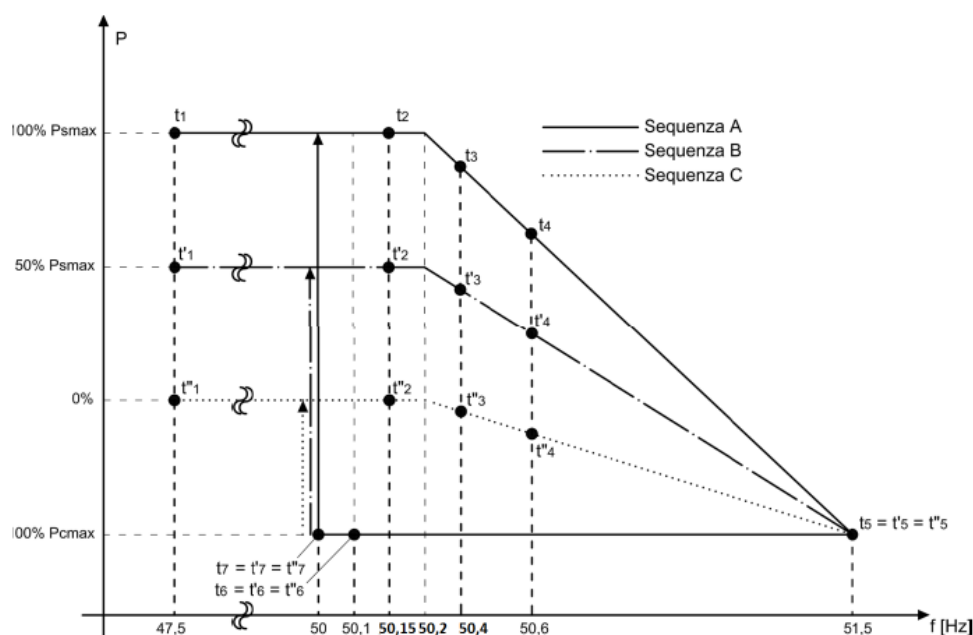


Figura 9Bbis – Curve di limitazione della potenza attiva per convertitori bidirezionali

Note:

The inverter is able to set a delay for the activation of the curve from 0,0 s – 1,0 s.
(in 0,050 s steps / default setting: 0)

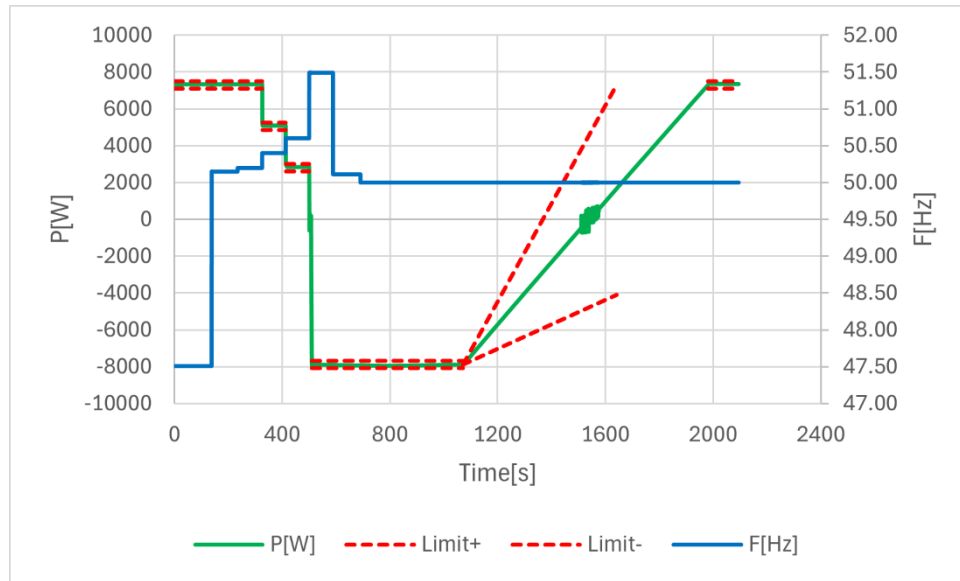


Bbis.7.2.2		Test results						P
DHN-LVEH1P8K-EU-G1 with Cmax battery								
Setvalue [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100% P _{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
P _{setpoint} [W]	7300,0	7300,0	7300,0	5053,8	2807,6	-7876,8	-7876,8	7300,0
P _{E60} [W]	7337,4	7340,6	7338,4	5095,8	2842,0	-7872,3	-7921,9	7361,2
ΔP _{E60} /P _{Setpoint} [%]	0,47	0,51	0,48	0,53	0,43	0,06	-0,56	0,76
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]	3650,0	3650,0	3650,0	1965,2	281,1	-7908,0	-7908,0	3650,0
P _{E60} [W]	3656,4	3651,6	3651,4	1981,6	279,5	-7911,4	-7910,9	3683,3
ΔP _{E60} /P _{Setpoint} [%]	0,08	0,02	0,02	0,21	-0,02	-0,04	-0,04	0,42
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	-1122,7	-2246,2	-7243,8	-7243,8	0,0
P _{E60} [W]	44,2	39,7	41,5	-1093,8	-2297,0	-7278,5	-7366,5	31,8
ΔP _{E60} /P _{Setpoint} [%]	0,55	0,50	0,52	0,36	-0,63	-0,43	-1,53	0,40
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
Test:								
Measurements are 60 s mean values								

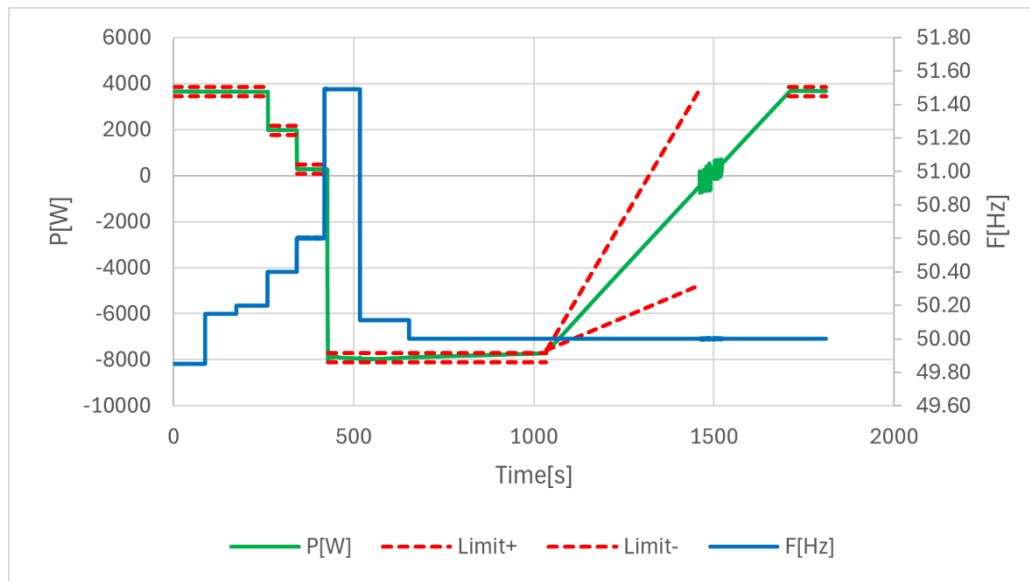
Bbis.7.2.2	Test results	P
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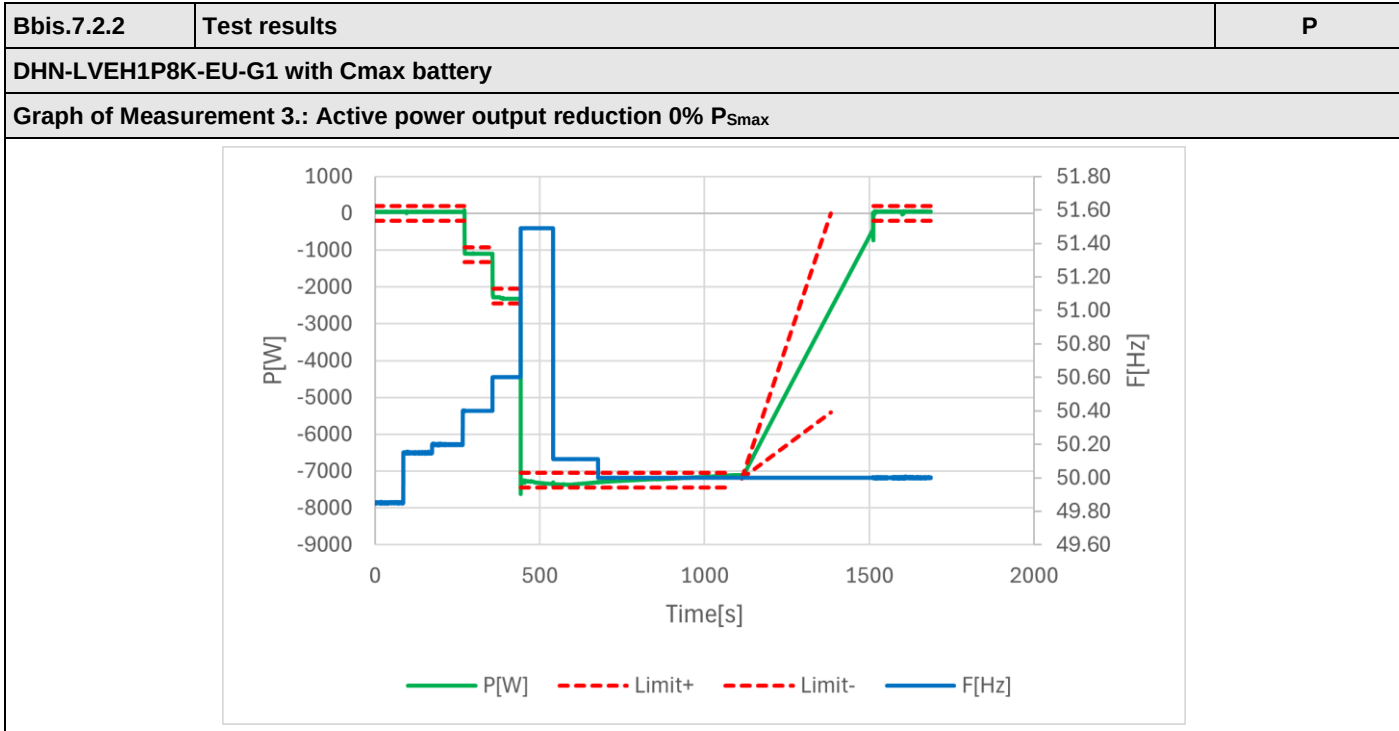
DHN-LVEH1P8K-EU-G1 with Cmax battery

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



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





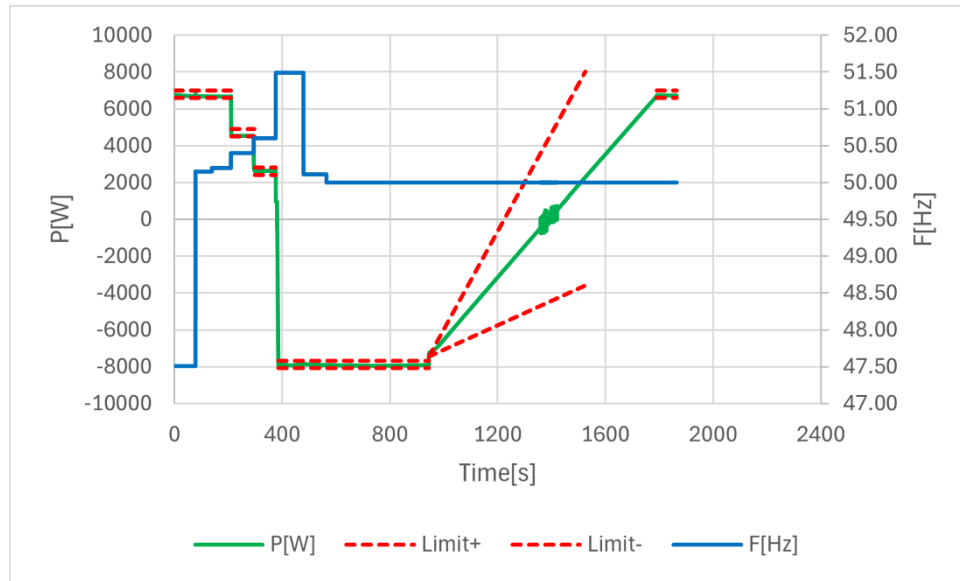


Bbis.7.2.2		Test results						P
DHN-LVEH1P8K-EU-G1 with Cmin battery								
Setvalue [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100% P _{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
P _{setpoint} [W]	6800,0	6800,0	6800,0	4707,6	2615,3	-7876,8	-7876,8	6800,0
P _{E60} [W]	6740,9	6685,3	6677,5	4534,8	2637,1	-7905,2	-7902,0	6729,9
ΔP _{E60} /P _{Setpoint} [%]	-0,74	-1,43	-1,53	-2,16	0,27	-0,35	-0,31	-0,88
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
P _{E60} [W]	3455.1	3456.1	3456.4	1981.6	279.5	-7847.4	-7849.9	3480.8
ΔP _{E60} /P _{Setpoint} [%]	0.69	0.70	0.71	1.89	0.22	0.76	0.73	1.01
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	-1045,8	-2092,4	-6747,6	-6747,6	0,0
P _{E60} [W]	39,9	39,6	39,8	-1095,5	-2218,8	-6813,1	-6864,1	46,4
ΔP _{E60} /P _{Setpoint} [%]	0,50	0,49	0,50	-0,62	-1,58	-0,82	-1,46	0,58
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
Test:								
Measurements are 60 s mean values								

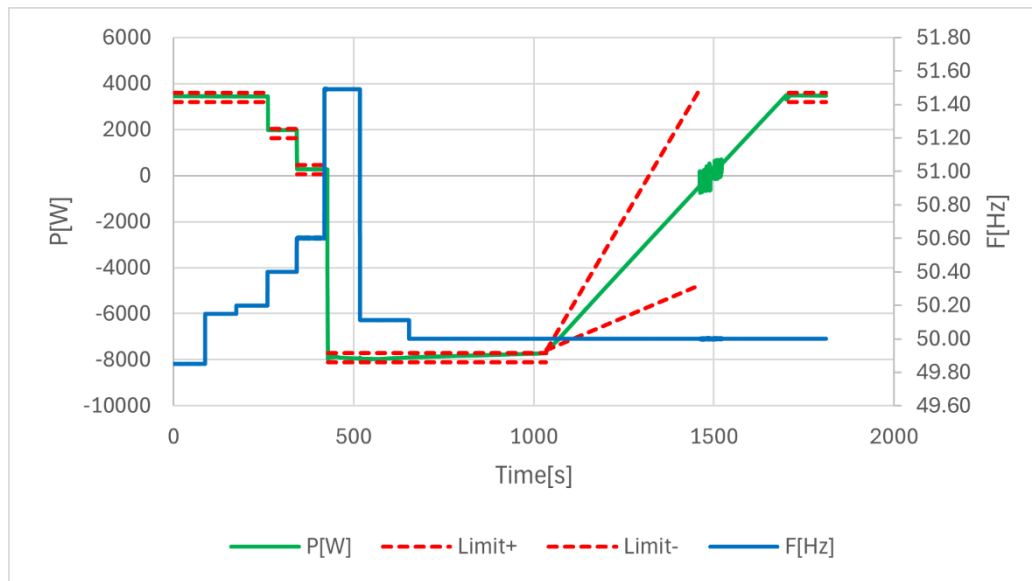
Bbis.7.2.2	Test results	P
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DHN-LVEH1P8K-EU-G1 with Cmin battery

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



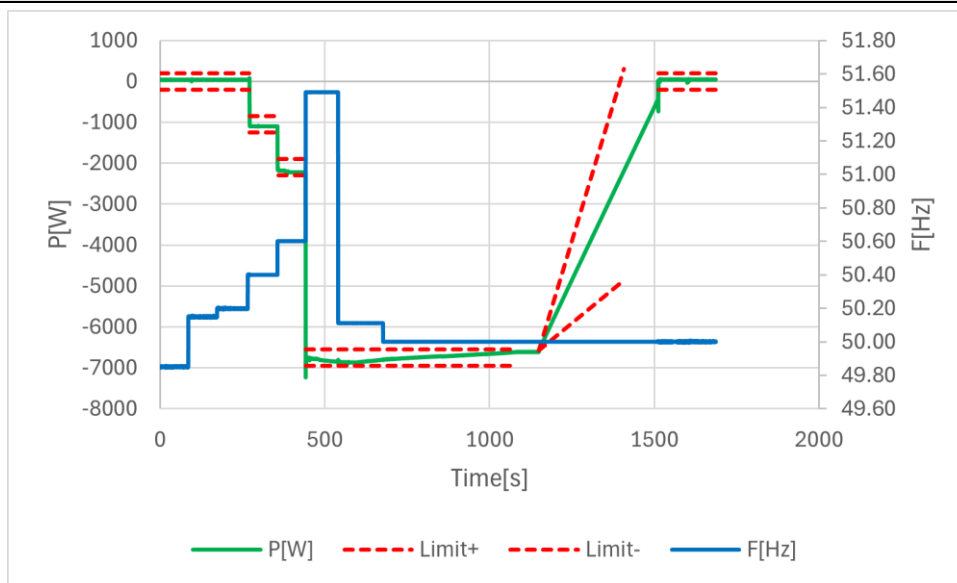
Graph of Measurement 2.: Active power output reduction 50% P_{Smax}



Bbis.7.2.2	Test results	P
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DHN-LVEH1P8K-EU-G1 with Cmin battery

Graph of Measurement 3.: Active power output reduction 0% P_{Smax}

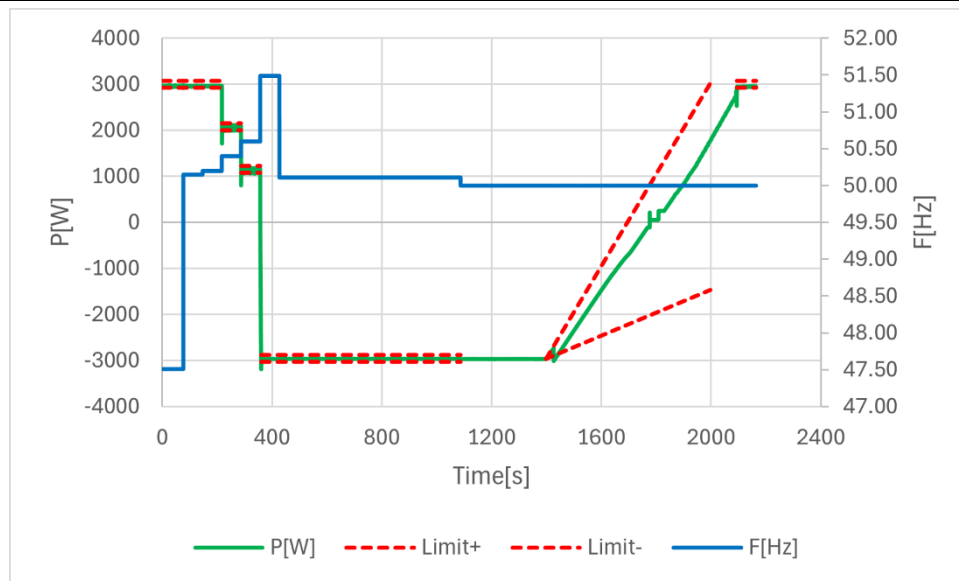


Bbis.7.2.2		Test results						P
DHN-LVEH1P3K-EU-G1 with Cmin battery								
Setvalue [Hz]	1) 47,51	2) 50,15	3) 50,20	4) 50,40	5) 50,60	6) 51,49	7) 50,11	8) 50,00
1. Measurement 1) to 7): Active power output 100% P _{Smax}								
Frequency [Hz]	47,51	50,15	50,20	50,40	50,60	51,49	50,11	50,00
P _{setpoint} [W]	3000,0	3000,0	3000,0	2076,9	1153,8	-2953,8	-2953,8	3000,0
P _{E60} [W]	2967,4	2959,5	2958,7	2026,4	1126,5	-2966,0	-2962,6	2944,2
ΔP _{E60} /P _{Setpoint} [%]	-1,09	-1,35	-1,38	-1,68	-0,91	-0,41	-0,29	-1,86
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]	1500,0	1500,0	1500,0	807,6	115,5	-2965,5	-2965,5	1500,0
P _{E60} [W]	1453,3	1452,5	1451,7	743,8	50,8	-2962,3	-2960,4	1451,5
ΔP _{E60} /P _{Setpoint} [%]	-1,56	-1,58	-1,61	-2,13	-2,16	0,11	0,17	-1,62
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	-461,4	-923,1	-2976,9	-2976,9	0,0
P _{E60} [W]	37,8	38,7	33,9	-507,5	-909,4	-2997,3	-2993,8	47,3
ΔP _{E60} /P _{Setpoint} [%]	1,26	1,29	1,13	-1,54	0,46	-0,68	-0,56	1,58
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
Test:								
Measurements are 60 s mean values								

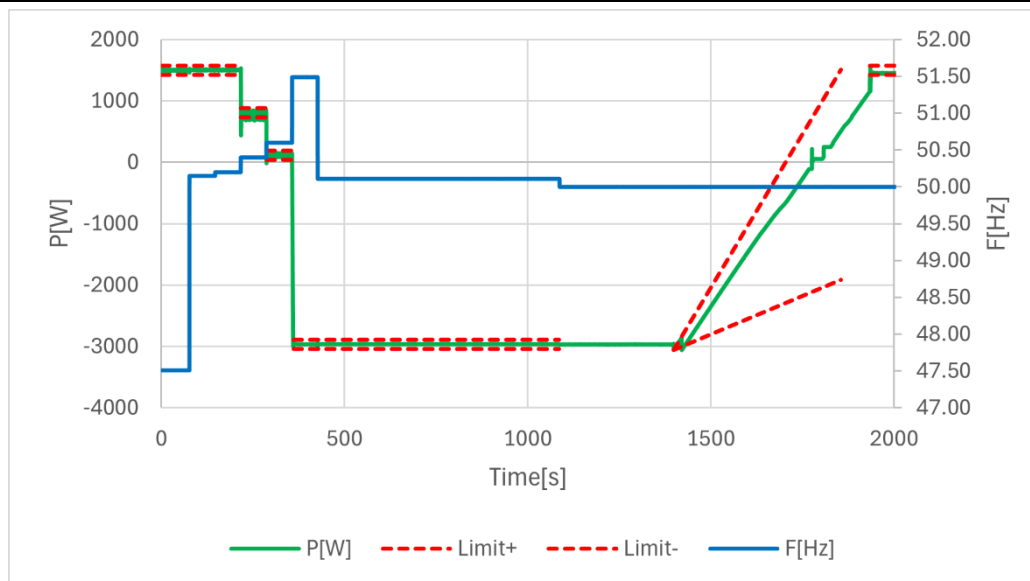
Bbis.7.2.2	Test results	P
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DHN-LVEH1P3K-EU-G1 with Cmin battery

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



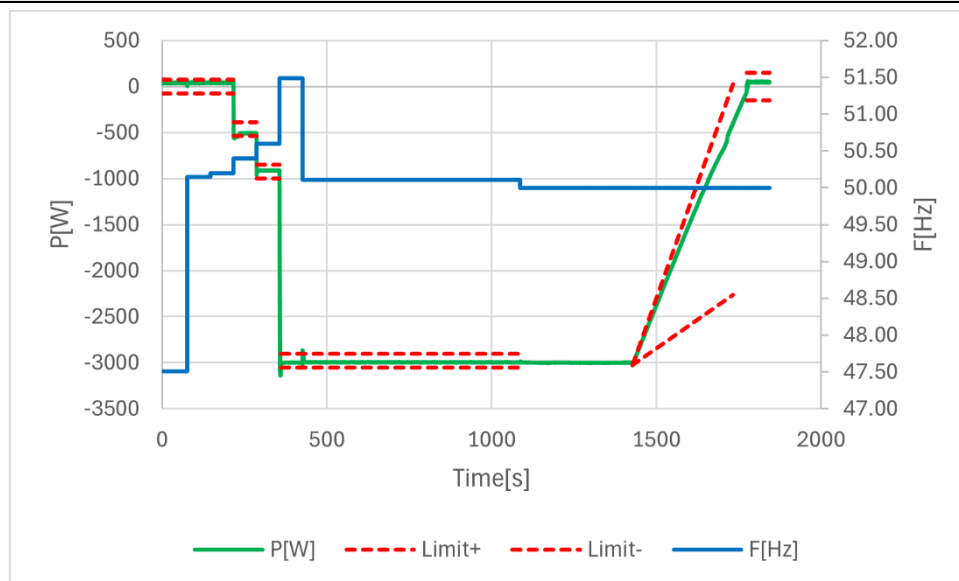
Graph of Measurement 2.: Active power output reduction 50% P_{Smax}



Bbis.7.2.2	Test results	P
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DHN-LVEH1P3K-EU-G1 with Cmin battery

Graph of Measurement 3.: Active power output reduction 0% P_{Smax}



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 (t_1 for sequence A, t'_1 for sequence B)

2) $f = 50,00$ Hz -0,15 Hz (t_2 for sequence A, t'_2 for sequence B)

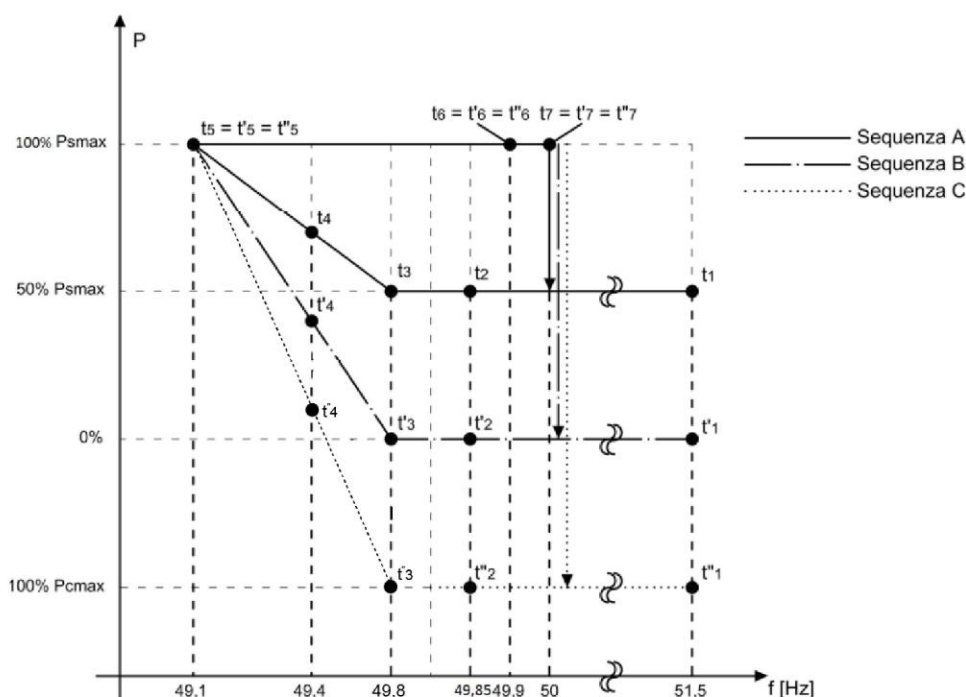
3) $f = 50,00$ Hz -0,40 Hz (t_3 for sequence A, t'_3 for sequence B)

4) $f = 50,00$ Hz -0,60 Hz (t_4 for sequence A, t'_4 for sequence B)

5) $f = 50,00$ Hz -0,89 Hz (t_5 for sequence A, t'_5 for sequence B)

6) $f = 50,00$ Hz -0,11 Hz (t_6 for sequence A, t'_6 for sequence B)

7) $f = 50,00$ Hz (t_7 for sequence A, t'_7 for sequence B, t''_7 for sequence C). The frequency is reset the frequency to the nominal value for the verification of the soft-reset conditions, for sequences A and B, respectively, of 50% and 0% of $P_{S\text{MAX}}$ (or of $P_{N\text{INV}}$ for integrated storage systems) and, for sequence C, of 100% of the $P_{C\text{MAX}}$.



Note:

The inverter is able to set a delay for the activation of the curve from 0,0 s – 1,0 s.
(in 0,050 s steps / default setting: 0,0 s)

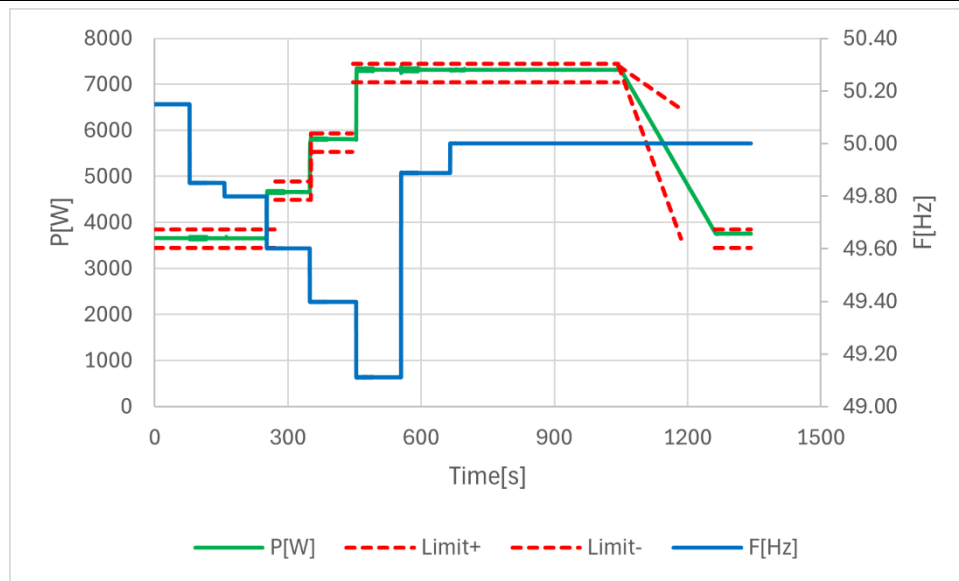


Bbis.7.3.2		Test results						P
DHN-LVEH1P8K-EU-G1 with Cmax battery								
Set value [Hz]	1) 51,15	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50% P _{Smax}								
Frequency [Hz]	51,15	49,85	49,80	49,60	49,40	49,11	49,89	50,00
P _{setpoint} [W]	3650,0	3650,0	3650,0	4693,2	5735,6	7248,2	7248,2	3650,0
P _{E60} [W]	3663,9	3660,0	3659,4	4662,7	5820,1	7321,9	7341,7	3759,2
ΔP _{E60} /P _{Setpoint} [%]	0,19	0,14	0,13	-0,42	1,16	1,01	1,28	1,50
2. Measurement 1) to 7): Active power output 0% P _{Smax}								
Frequency [Hz]	51,15	49,85	49,80	49,60	49,40	49,11	49,89	50,00
P _{setpoint} [W]	0,0	0,0	0,0	2085,6	4171,2	7195,6	7195,6	0,0
P _{E60} [W]	32,9	35,8	35,0	2036,0	4124,2	7181,3	7166,2	33,8
ΔP _{E60} /P _{Setpoint} [%]	0,41	0,45	0,44	-0,62	-0,59	-0,18	-0,37	0,42
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	1043,2	7091,2	7091,2	-8000,0
P _{E60} [W]	-7962,3	-7865,8	-7895,3	-3343,3	1228,6	7132,2	7121,1	-7968,9
ΔP _{E60} /P _{Setpoint} [%]	0,47	1,68	1,31	1,07	2,32	0,51	0,37	0,39
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
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.								
Measurements are 60 s mean values								
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% * S _n 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 .								

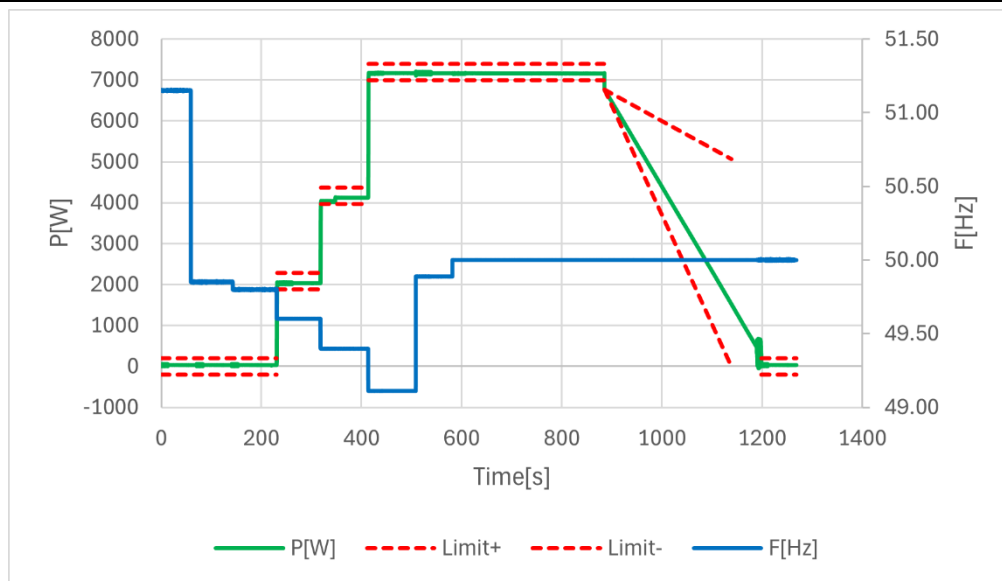
Bbis.7.3.2	Test results	P
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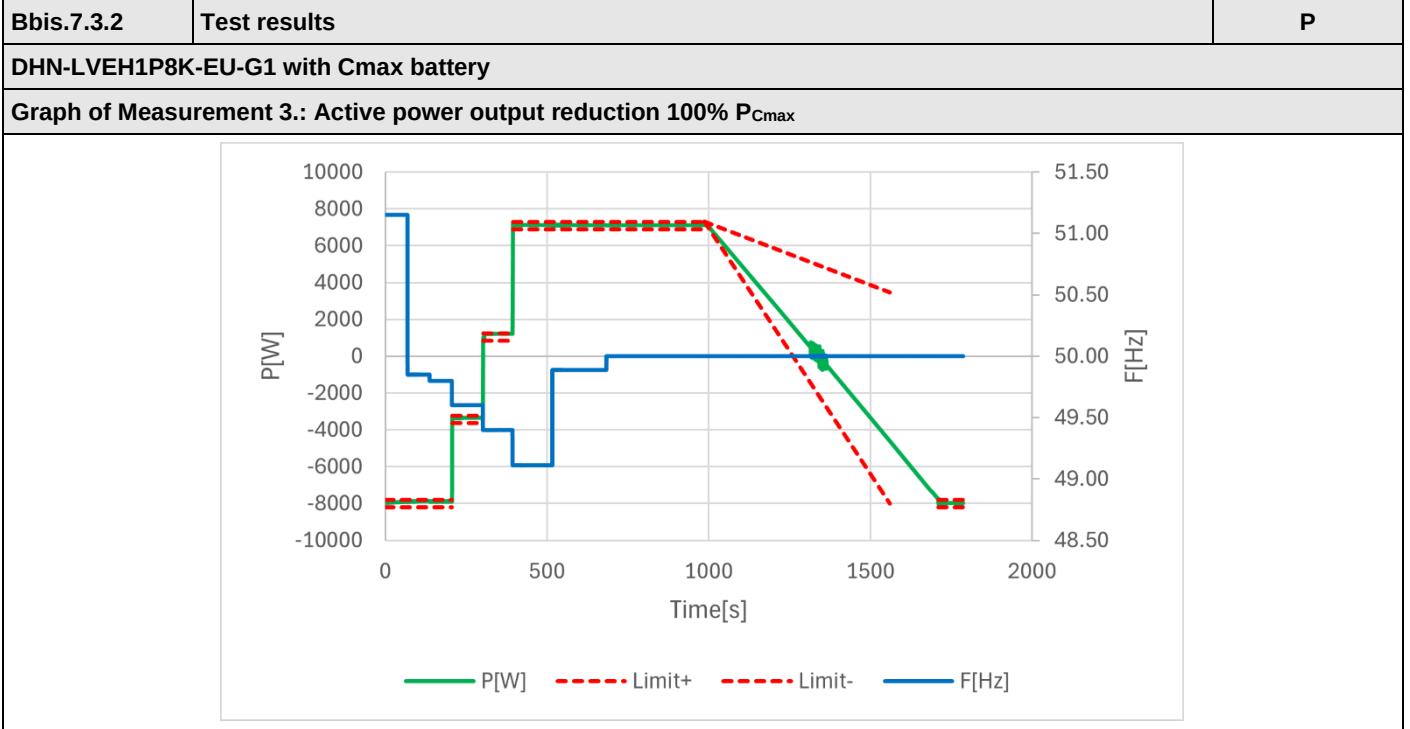
DHN-LVEH1P8K-EU-G1 with Cmax battery

Graph of Measurement 1.: Active power output reduction 50% P_{Smax}



Graph of Measurement 2.: Active power output reduction 0% P_{Smax}



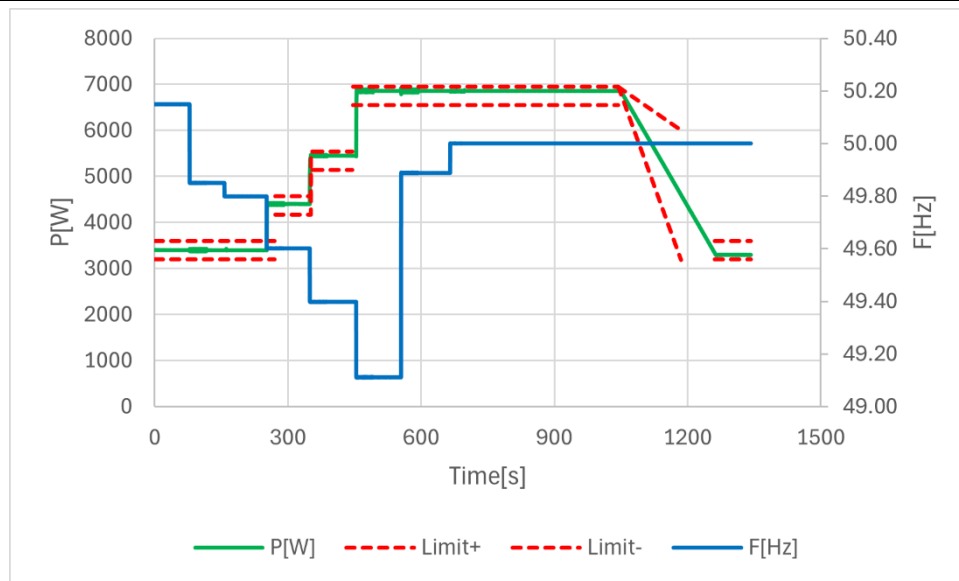


Bbis.7.3.2		Test results						P
DHN-LVEH1P8K-EU-G1 with Cmin battery								
Set value [Hz]	1) 51,15	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50% P _{Smax}								
Frequency [Hz]	51,15	49,85	49,80	49,60	49,40	49,11	49,89	50,00
P _{setpoint} [W]	3400,0	3400,0	3400,0	4371,7	5342,8	6751,7	6751,7	3400,0
P _{E60} [W]	3402,9	3390,6	3377,6	4420,4	5462,3	6832,5	6892,5	3298,7
ΔP _{E60} /P _{Setpoint} [%]	0,04	-0,14	-0,33	0,72	1,76	1,19	2,07	-1,49
2. Measurement 1) to 7): Active power output 0% P _{Smax}								
Frequency [Hz]	51,15	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]	32,9	35,8	35,0	2036,0	4036,5	6781,3	6766,2	33,8
ΔP _{E60} /P _{Setpoint} [%]	0,41	0,45	0,44	1,17	1,89	0,98	0,79	0,42
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]	-7958,8	-7896,8	-7870,7	-3423,3	895,3	6764,2	6764,1	-7977,2
ΔP _{E60} /P _{Setpoint} [%]	0,52	1,29	1,62	0,07	-0,96	1,98	1,98	0,28
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
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.								
Measurements are 60 s mean values								
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% * S _n 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 .								

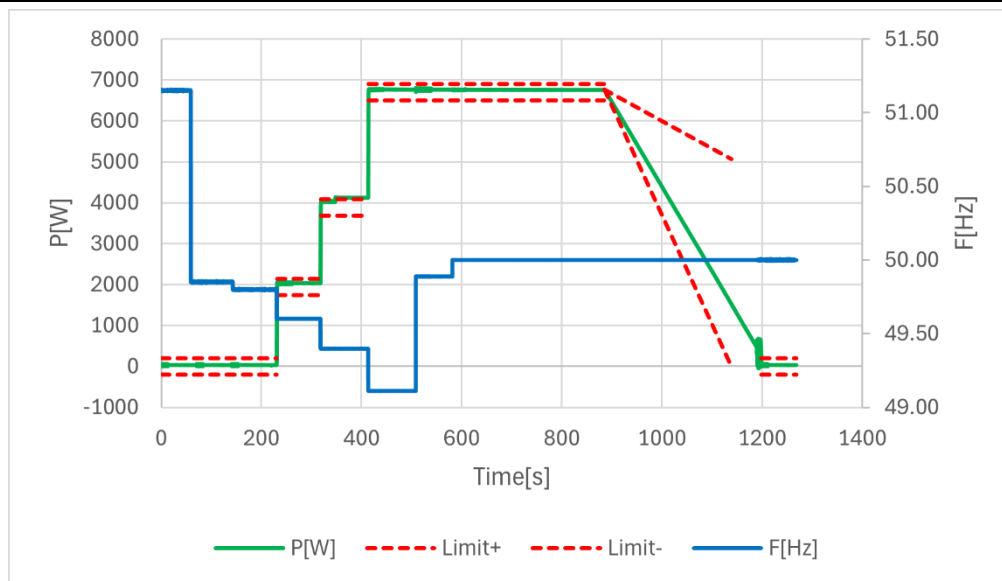
Bbis.7.3.2	Test results	P
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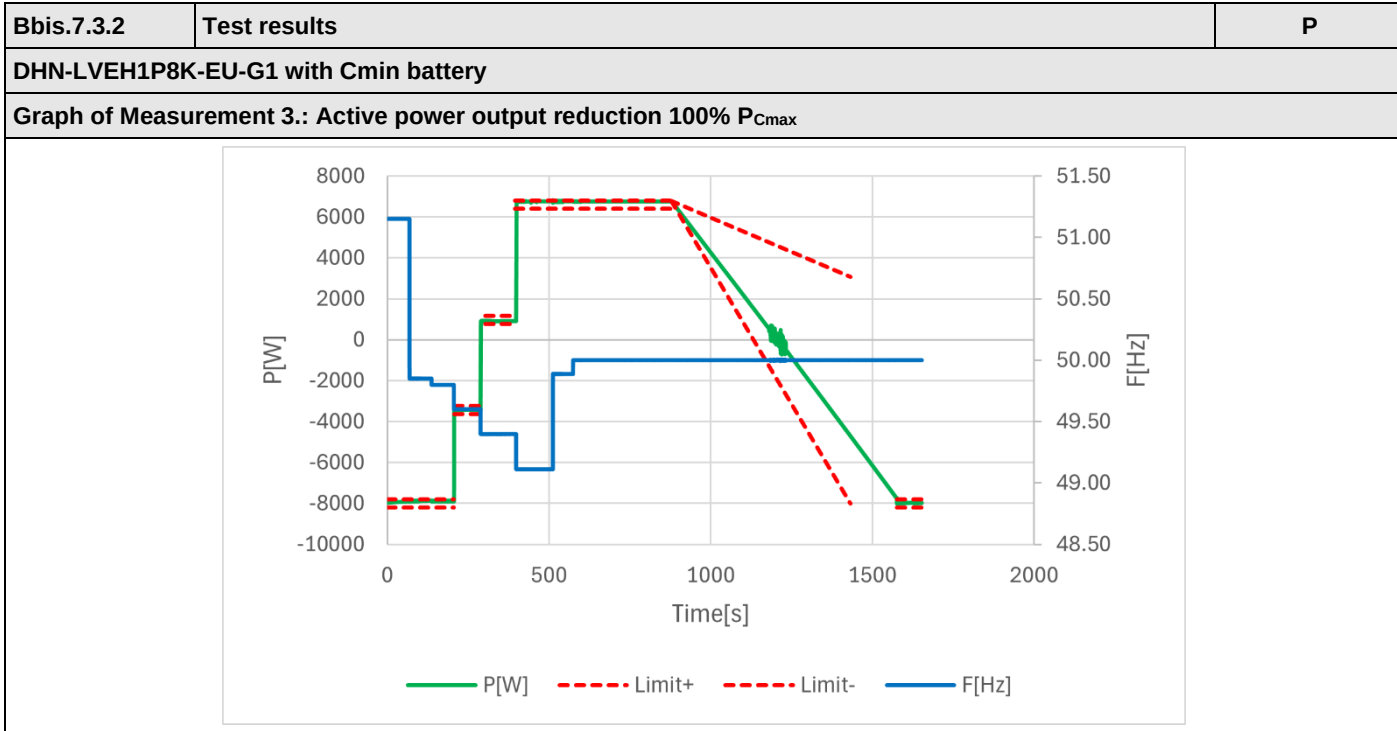
DHN-LVEH1P8K-EU-G1 with Cmin battery

Graph of Measurement 1.: Active power output reduction 50% P_{Smax}



Graph of Measurement 2.: Active power output reduction 0% P_{Smax}



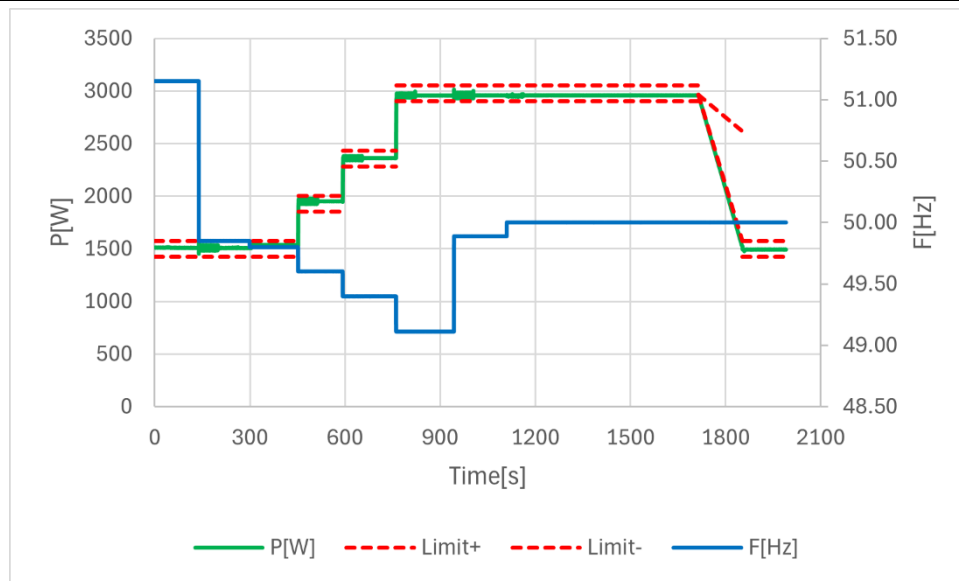


Bbis.7.3.2		Test results						P
DHN-LVEH1P3K-EU-G1 with Cmin battery								
Set value [Hz]	1) 51,15	3) 49,85	4) 49,80	4) 49,60	5) 49,40	5) 49,11	3) 49,89	8) 50,00
1. Measurement 1) to 7): Active power output 50% P _{Smax}								
Frequency [Hz]	51,15	49,85	49,80	49,60	49,40	49,11	49,89	50,00
P _{setpoint} [W]	1500,0	1500,0	1500,0	1928,7	2357,1	2978,7	2978,7	1500,0
P _{E60} [W]	1510,9	1510,4	1538,3	1954,5	2365,4	2956,9	2972,0	1493,9
ΔP _{E60} /P _{Setpoint} [%]	0,36	0,35	1,28	0,86	0,28	-0,73	-0,22	-0,20
2. Measurement 1) to 7): Active power output 0% P _{Smax}								
Frequency [Hz]	51,15	49,85	49,80	49,60	49,40	49,11	49,89	50,00
P _{setpoint} [W]	0,0	0,0	0,0	857,1	1714,2	2957,1	2957,1	0,0
P _{E60} [W]	17,4	19,6	20,3	865,9	1722,2	2948,6	2869,1	5,5
ΔP _{E60} /P _{Setpoint} [%]	0,58	0,65	0,68	0,29	0,27	-0,28	0,40	0,18
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]	-3000,0	-3000,0	-3000,0	-1285,8	428,7	2914,2	2914,2	-3000,0
P _{E60} [W]	-3007,5	-3028,7	-3024,1	-1303,3	443,1	2839,7	2839,1	-3023,5
ΔP _{E60} /P _{Setpoint} [%]	-0,25	-0,96	-0,80	-0,58	0,48	-2,48	-2,50	-0,78
Limit								
ΔP _{E60} /P _{Setpoint}	± 2,5% of S _n							
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.								
Measurements are 60 s mean values								
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% * S _n 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 .								

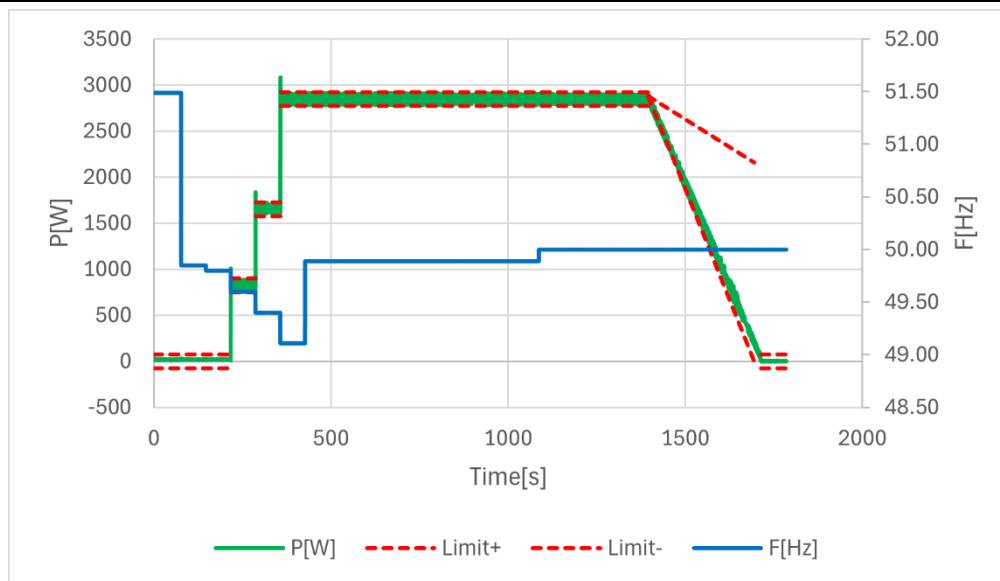
Bbis.7.3.2	Test results	P
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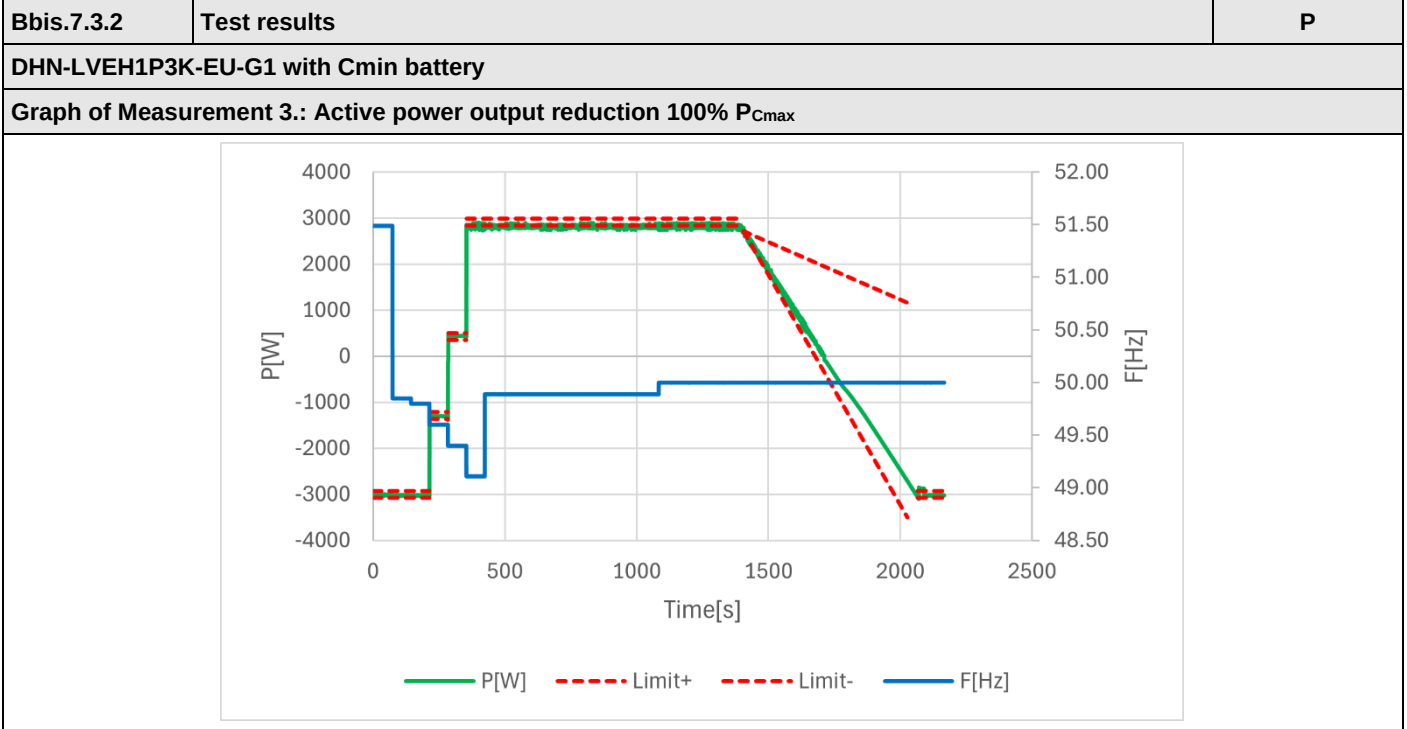
DHN-LVEH1P3K-EU-G1 with Cmin battery

Graph of Measurement 1.: Active power output reduction 50% P_{Smax}



Graph of Measurement 2.: Active power output reduction 0% P_{Smax}



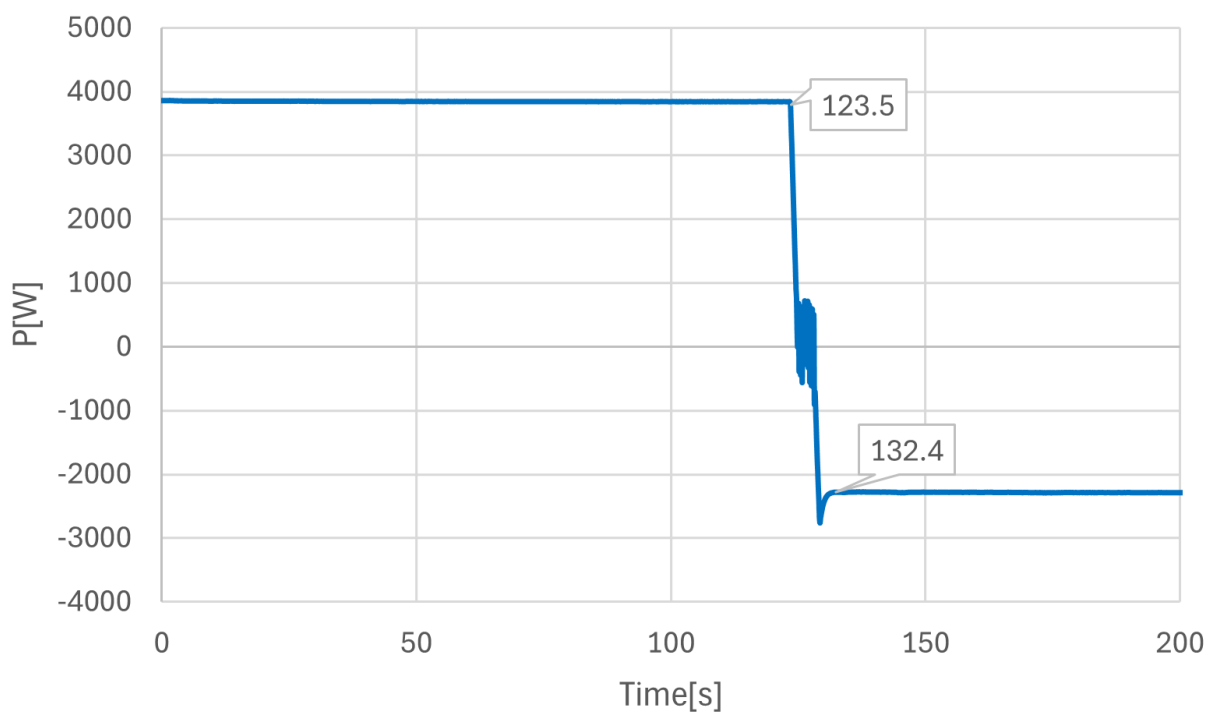


Bbis.7.4	Verification of active power control on external control from DSO	P
DHN-LVEH1P8K-EU-G1 with Cmax battery		
Set value	50% P _S MAX to 30% P _C MAX	
P _{E60} [%]	28,7	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	
Settling time [s]	8,5	
Limit settling time [s]	30	
Test:		
The ability to increase/decrease 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 _C MAX.		
Measurements are 60 s mean values		

Bbis.7.4

Verification of active power control on external control from DSO

P

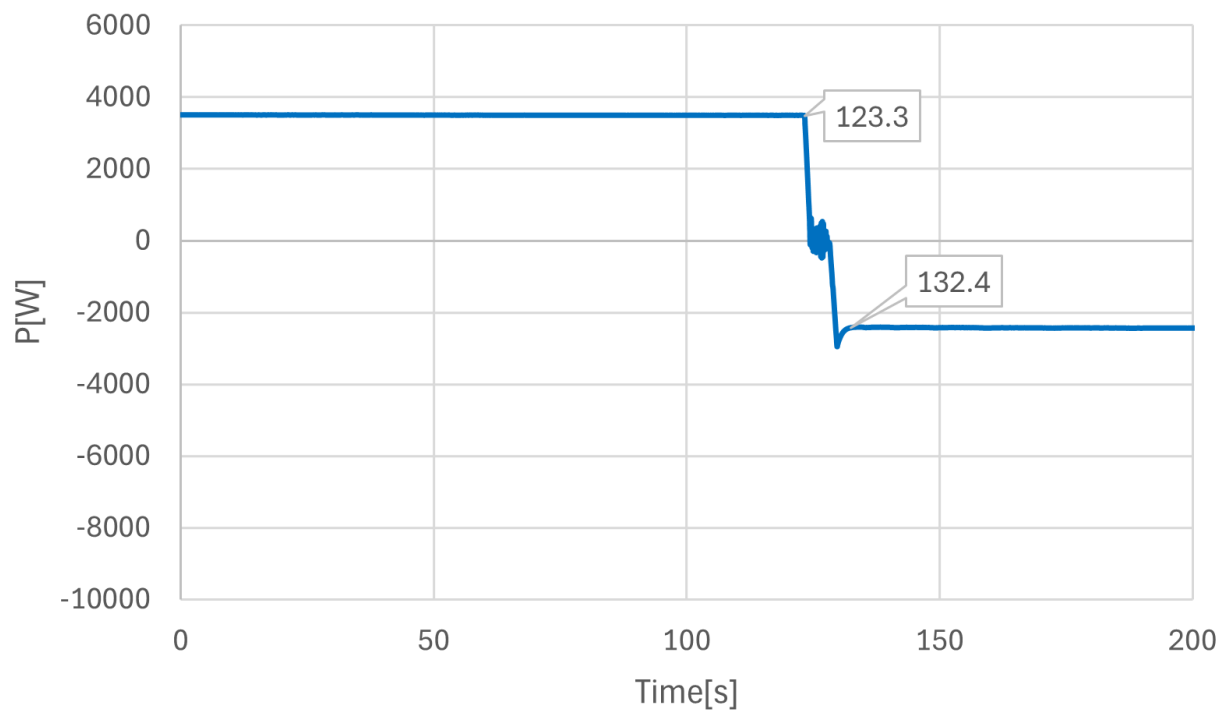
Graph: 50% $P_{S\text{MAX}}$ to 30% $P_{C\text{MAX}}$ 

Bbis.7.4	Verification of active power control on external control from DSO	P
DHN-LVEH1P8K-EU-G1 with Cmin battery		
Set value	50% P _S MAX to 30% P _C MAX	
P _{E60} [%]	30,2	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	
Settling time [s]	9,1	
Limit settling time [s]	30	
Test:		
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 _C MAX.		
Measurements are 60 s mean values		

Bbis.7.4

Verification of active power control on external control from DSO

P

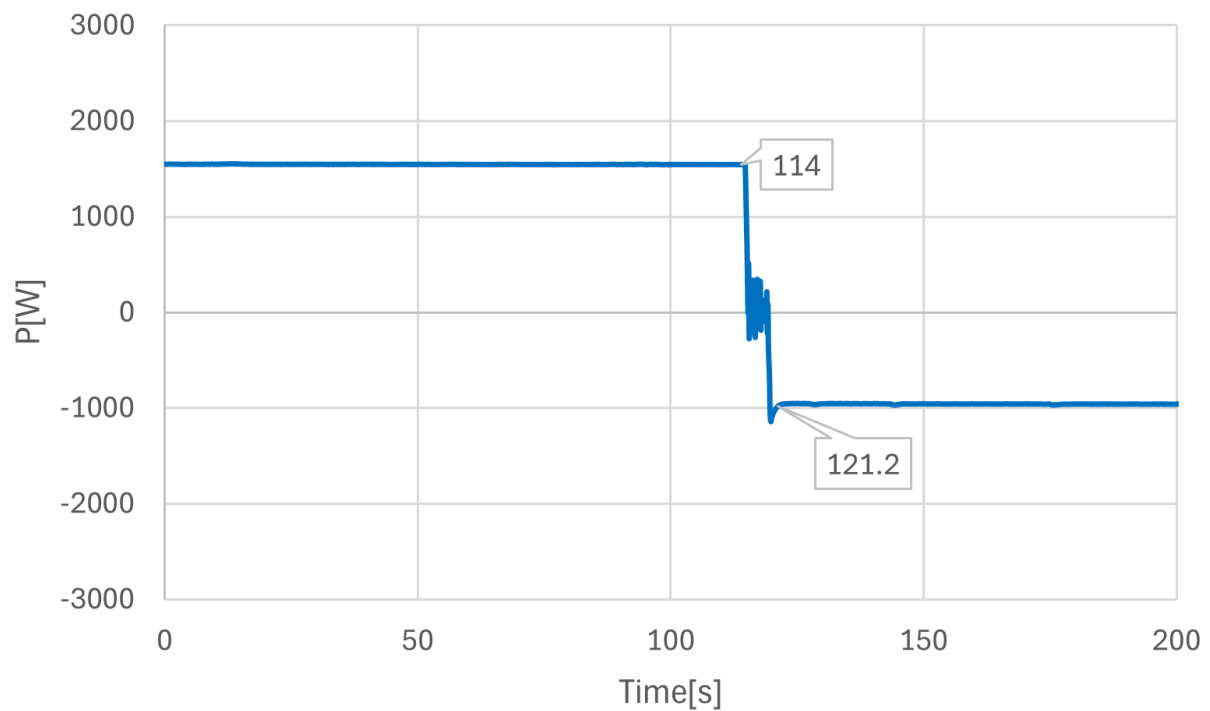
Graph: 50% $P_{S\text{MAX}}$ to 30% $P_{C\text{MAX}}$ 

Bbis.7.4	Verification of active power control on external control from DSO	P
DHN-LVEH1P3K-EU-G1 with Cmin battery		
Set value	50% P _S MAX to 30% P _C MAX	
P _{E60} [%]	32,0	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	
Settling time [s]	7,2	
Limit settling time [s]	30	
Test:		
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. Measurements are 60 s mean values		

Bbis.7.4

Verification of active power control on external control from DSO

P

Graph: 50% $P_{S\text{MAX}}$ to 30% $P_{C\text{MAX}}$ 



Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command		P
DHN-LVEH1P8K-EU-G1 with Cmax battery			
Set value	100% P _S MAX to 30% P _C MAX	100% P _C MAX to 50% P _S MAX	
P _{E60} [%]	28,7	48,5	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	50% P _S MAX ± 2,5% of S _n	
Settling time [s]	8,7	7,7	
Limit settling time [s]	50	50	
Set 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		

Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
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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 $100\% \cdot P_{S_{MAX}}$ to $30\% \cdot P_{C_{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting the control parameter from $100\% \cdot P_{S_{MAX}}$ to $30\% \cdot P_{S_{MAX}}$ at time t_0 .

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 $100\% \cdot P_{C_{MAX}}$ to $50\% \cdot P_{S_{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting parameter from $0\% \cdot P_{S_{MAX}}$ to $50\% \cdot P_{S_{MAX}}$ at time t_0 .

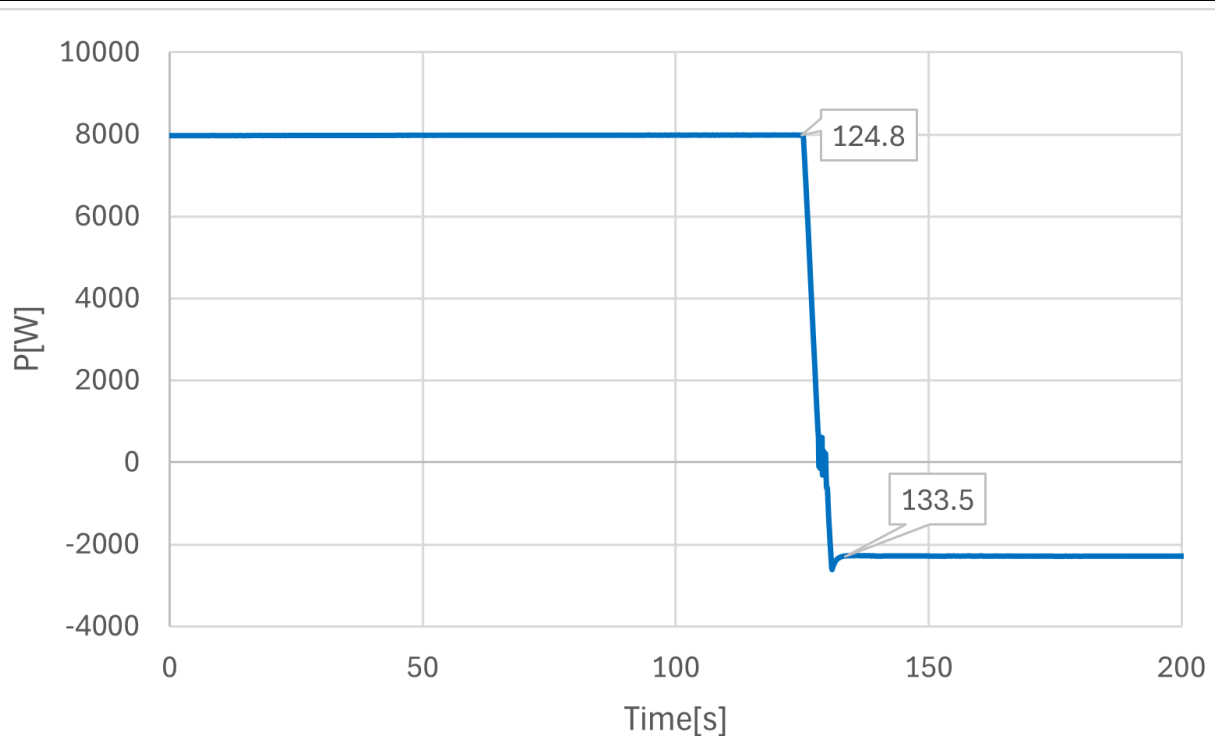
Measurements are 60 s mean values

Assessment criterion:

The settling time (or settling time) is the time interval from the instant t_0 of application of the active power increment/limitation step (e.g. $100\% \cdot P_{S_{MAX}}$ $30\% \cdot P_{S_{MAX}}$) to the instant in which the power falls stably within a tolerance band equal to $\pm 2,5\% \cdot S_n$ 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 $100\% \cdot S_n$ to $15\% \cdot S_n$.

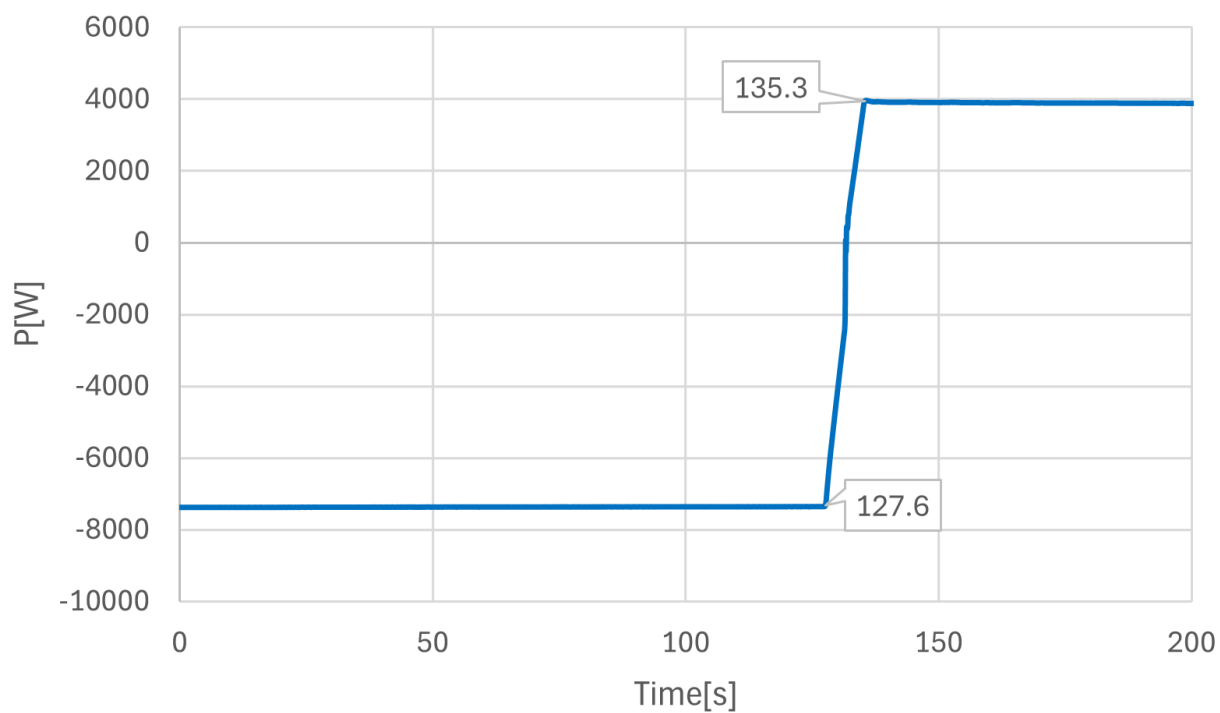
Graph: $100\% P_{S_{MAX}}$ to $30\% P_{C_{MAX}}$



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} 



Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command		P
DHN-LVEH1P8K-EU-G1 with Cmin battery			
Set value	100% P _S MAX to 30% P _C MAX	100% P _C MAX to 50% P _S MAX	
P _{E60} [%]	30,5	50,3	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	50% P _S MAX ± 2,5% of S _n	
Settling time [s]	8,5	8,4	
Limit settling time [s]	50	50	
Set 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		

Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
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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 $100\% \cdot P_{S_{MAX}}$ to $30\% \cdot P_{C_{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting the control parameter from $100\% \cdot P_{S_{MAX}}$ to $30\% \cdot P_{S_{MAX}}$ at time t_0 .

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 $100\% \cdot P_{C_{MAX}}$ to $50\% \cdot P_{S_{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting parameter from $0\% \cdot P_{S_{MAX}}$ to $50\% \cdot P_{S_{MAX}}$ at time t_0 .

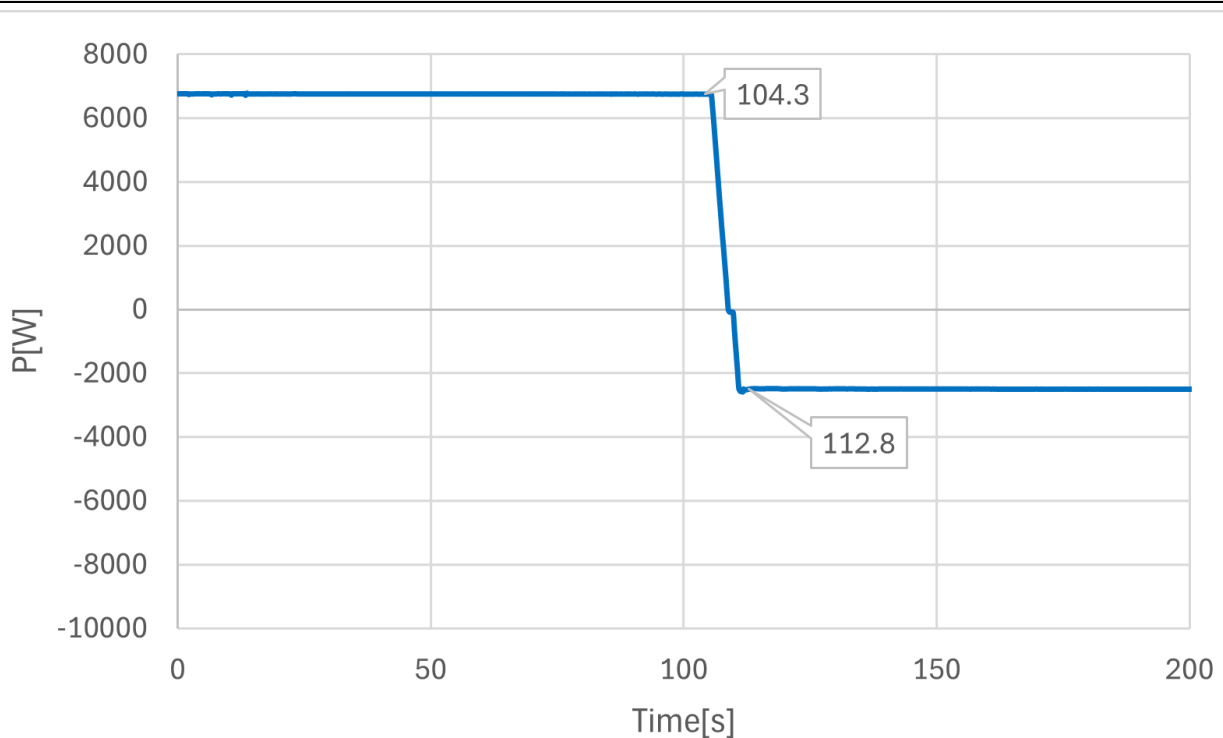
Measurements are 60 s mean values

Assessment criterion:

The settling time (or settling time) is the time interval from the instant t_0 of application of the active power increment/limitation step (e.g. $100\% \cdot P_{S_{MAX}}$ $30\% \cdot P_{S_{MAX}}$) to the instant in which the power falls stably within a tolerance band equal to $\pm 2,5\% \cdot S_n$ 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 $100\% \cdot S_n$ to $15\% \cdot S_n$.

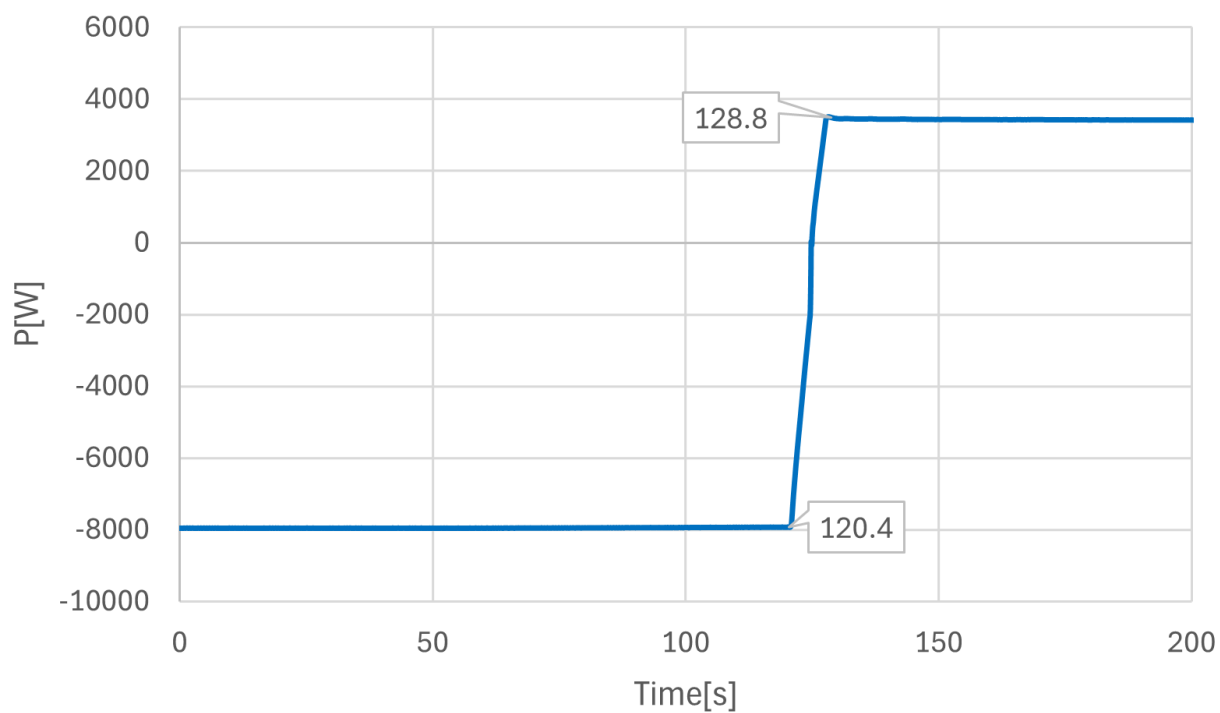
Graph: $100\% P_{S_{MAX}}$ to $30\% P_{C_{MAX}}$



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} 



Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command		P
DHN-LVEH1P3K-EU-G1 with Cmin battery			
Set value	100% P _S MAX to 30% P _C MAX	100% P _C MAX to 50% P _S MAX	
P _{E60} [%]	30,8	51,9	
Limit ΔP _{E60} [%]	30% P _C MAX ± 2,5% of S _n	50% P _S MAX ± 2,5% of S _n	
Settling time [s]	6,9	7,2	
Limit settling time [s]	50	50	
Set 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		

Bbis.7.4.1	Verification of the settling time to a power increase/reduction in command	P
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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 $100\% \cdot P_{S\text{MAX}}$ to $30\% \cdot P_{C\text{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting the control parameter from $100\% \cdot P_{S\text{MAX}}$ to $30\% \cdot P_{S\text{MAX}}$ at time t_0 .

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 $100\% \cdot P_{C\text{MAX}}$ to $50\% \cdot P_{S\text{MAX}}$ at time t_0 ;
- for storage systems connected to unidirectional converters, adjusting parameter from $0\% \cdot P_{S\text{MAX}}$ to $50\% \cdot P_{S\text{MAX}}$ at time t_0 .

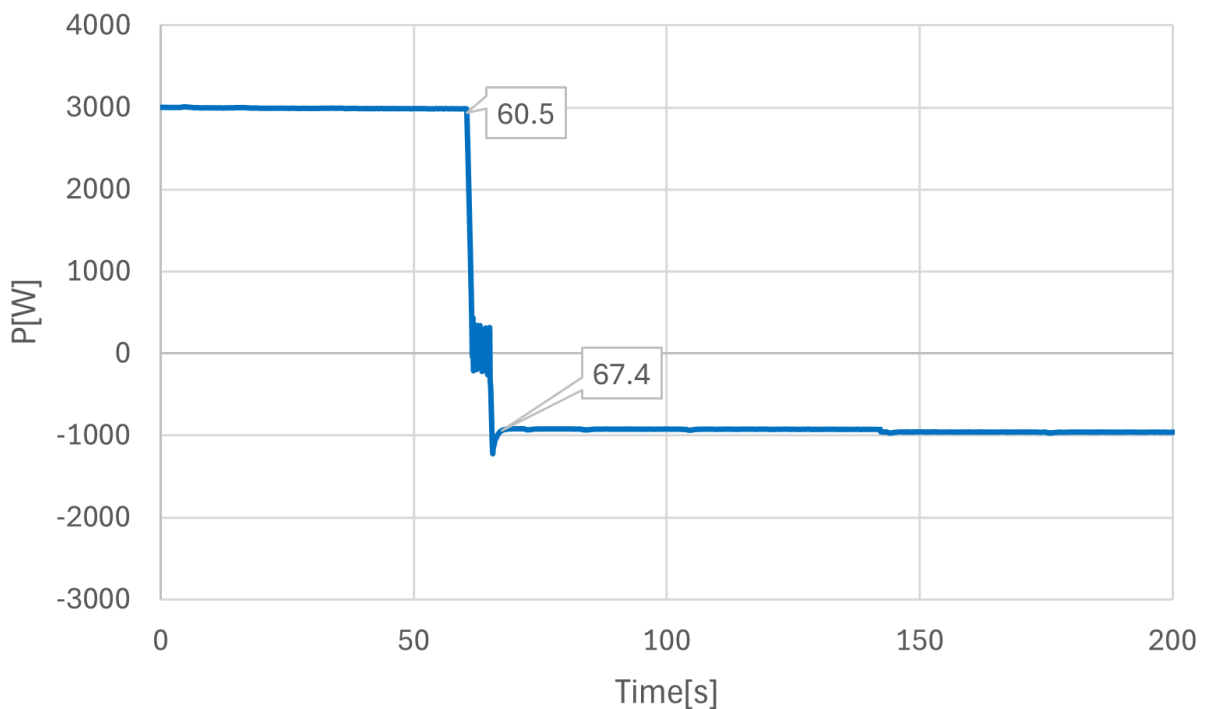
Measurements are 60 s mean values

Assessment criterion:

The settling time (or settling time) is the time interval from the instant t_0 of application of the active power increment/limitation step (e.g. $100\% \cdot P_{S\text{MAX}}$ $30\% \cdot P_{S\text{MAX}}$) to the instant in which the power falls stably within a tolerance band equal to $\pm 2,5\% \cdot S_n$ 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 $100\% \cdot S_n$ to $15\% \cdot S_n$.

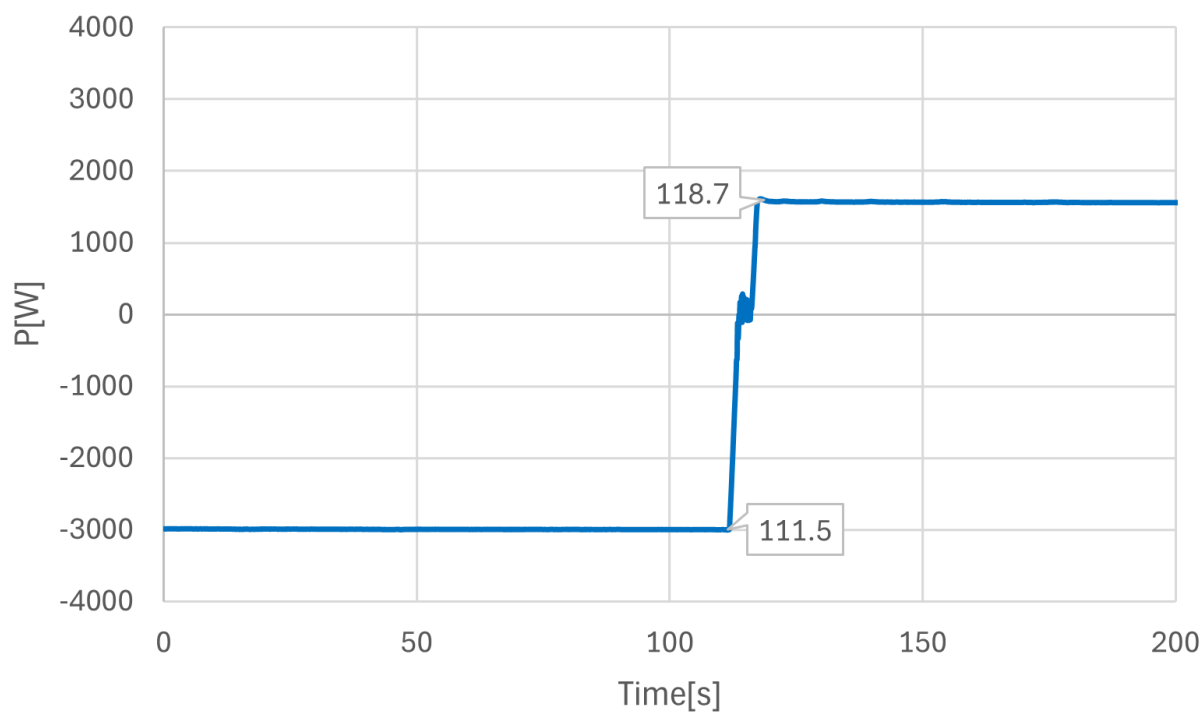
Graph: $100\% P_{S\text{MAX}}$ to $30\% P_{C\text{MAX}}$



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} 

Bbis.8.1	Verification of emission of continuous component			P
DHN-LVEH1P8K-EU-G1 with Cmax battery(P _S MAX)				
Phase 1 (Ambient)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	2491,3	4884,3	7336,6	
AC Voltage [V]	230,93	229,88	230,19	
AC Current [A]	10,82	21,26	31,88	
PF [1]	0,9968	0,9996	0,9997	
Cosφ [1]	0,9968	0,9996	0,9997	
DC Current in AC [mA]	19,1	6,2	22,8	
DC Current in AC [% of I _n]	0,060	0,020	0,072	
Phase 1 (-10°C ± 2°C)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	2542,8	4951,4	7336,9	
AC Voltage [V]	230,16	229,12	230,19	
AC Current [A]	11,08	21,62	31,88	
PF [1]	0,9971	0,9996	0,9997	
Cosφ [1]	0,9971	0,9996	0,9997	
DC Current in AC [mA]	8,0	3,2	22,9	
DC Current in AC [% of I _n]	0,025	0,010	0,072	
Phase 1 (+55°C ± 2°C)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	2540,7	4943,5	7336,6	
AC Voltage [V]	230,16	229,12	230,19	
AC Current [A]	11,07	21,59	31,88	
PF [1]	0,9971	0,9996	0,9997	
Cosφ [1]	0,9971	0,9996	0,9997	
DC Current in AC [mA]	5,8	2,8	22,8	
DC Current in AC [% of I _n]	0,018	0,009	0,072	
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 s, 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 s, 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.				

Bbis.8.1		Verification of emission of continuous component		P
DHN-LVEH1P8K-EU-G1 with Cmax battery(P _{C_{MAX}})				
Phase 1 (Ambient)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	-2782,1	-5146,1	-7963,3	
AC Voltage [V]	230,22	230,26	230,06	
AC Current [A]	12,19	22,44	34,71	
PF [1]	-0,9911	-0,9960	-0,9972	
Cosφ [1]	-0,9911	-0,9960	-0,9972	
DC Current in AC [mA]	15,9	23,9	24,6	
DC Current in AC [% of I _n]	0,046	0,069	0,071	
Phase 1 (-10°C ± 2°C)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	-2663,3	-5312,9	-7963,6	
AC Voltage [V]	230,17	230,07	230,06	
AC Current [A]	11,68	23,18	34,70	
PF [1]	-0,9906	-0,9962	-0,9972	
Cosφ [1]	-0,9906	-0,9962	-0,9972	
DC Current in AC [mA]	3,5	3,8	25,0	
DC Current in AC [% of I _n]	0,010	0,011	0,072	
Phase 1 (+55°C ± 2°C)				
Power Level [% of VA]	33 ± 5	66 ± 5	100 ± 5	
AC Power [W]	-2664,5	-5329,0	-7963,3	
AC Voltage [V]	230,17	230,08	230,06	
AC Current [A]	11,69	23,25	34,71	
PF [1]	-0,9906	-0,9962	-0,9972	
Cosφ [1]	-0,9906	-0,9962	-0,9972	
DC Current in AC [mA]	3,2	9,4	25,1	
DC Current in AC [% of I _n]	0,009	0,027	0,072	
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 s, 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 s, 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.				

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	208	174	0,75	
66%	0,5% I _n / 1 s	267	174	0,75	
100%	0,5% I _n / 1 s	206	174	0,75	
I _{dc} = 0,5% of I _n (Negative)					
33%	0,5% I _n / 1 s	205	174	0,75	
66%	0,5% I _n / 1 s	259	174	0,75	
100%	0,5% I _n / 1 s	212	174	0,75	
I _{dc} = > 1,0 A (Positive)					
33%	1,0 A / 0,2 s	1041	1000	0,15	
66%	1,0 A / 0,2 s	1142	1000	0,15	
100%	1,0 A / 0,2 s	1103	1000	0,15	
I _{dc} = > 1,0 A (Negative)					
33%	1,0 A / 0,2 s	1048	1000	0,15	
66%	1,0 A / 0,2 s	1148	1000	0,15	
100%	1,0 A / 0,2 s	1105	1000	0,15	
Note:					
Checking the switch-off of the converter, if the first protection threshold I _{dc} > (> 0,5 % I _n ; in the case of systems with a power of less than 800 W: > 20 mA)					

Bbis.10	Verification of insensitivity to automatic reclosure in phase discordance	P
Bbis.10.1	Simulated network test	P

Test:

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 ($\cos \varphi = 1$).

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 0,020 s before to at least 0,200 s after the phase jump of the simulated mains voltage.

Assessment Criterion:

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 ($\cos \varphi = 1$)
- 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.

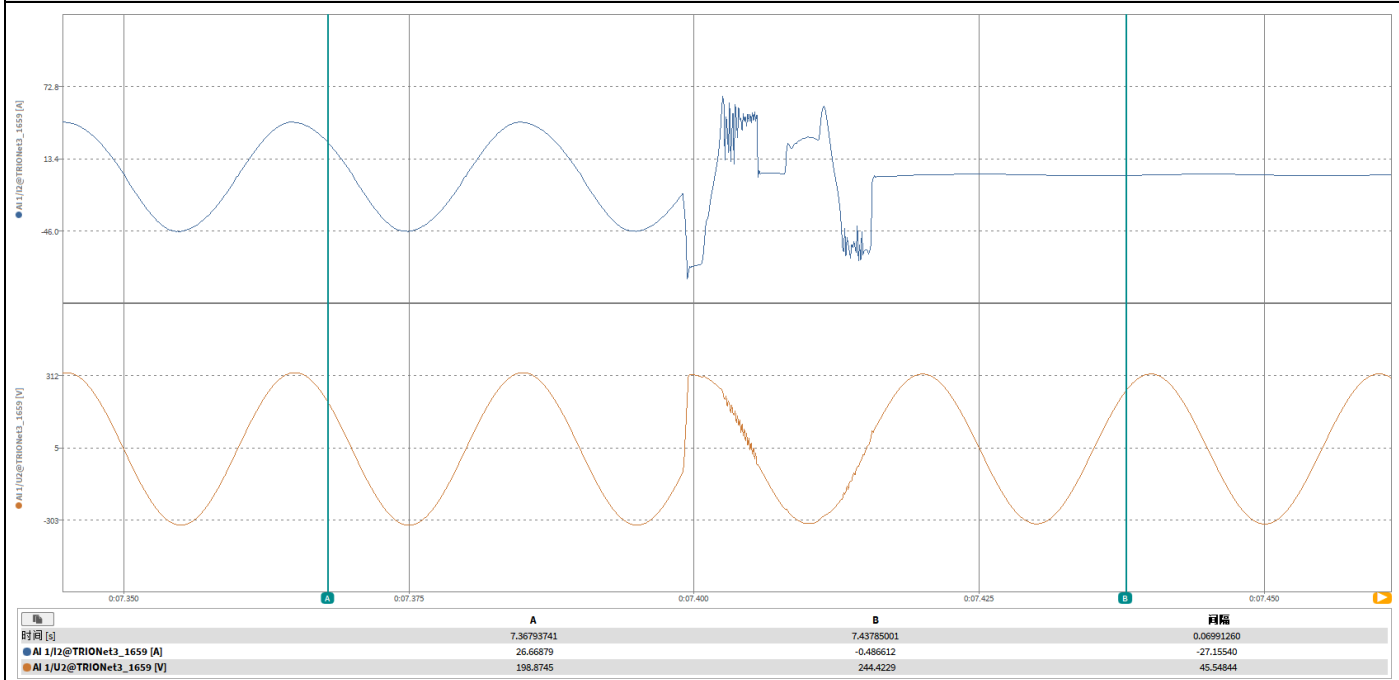
the generator current on a time window starting from 0,020 s before until at least 0,200 s after the phase shift of the simulated network voltage.

Note:

The inverter was restarted after the test has been performed. There are no damages on the complete system.

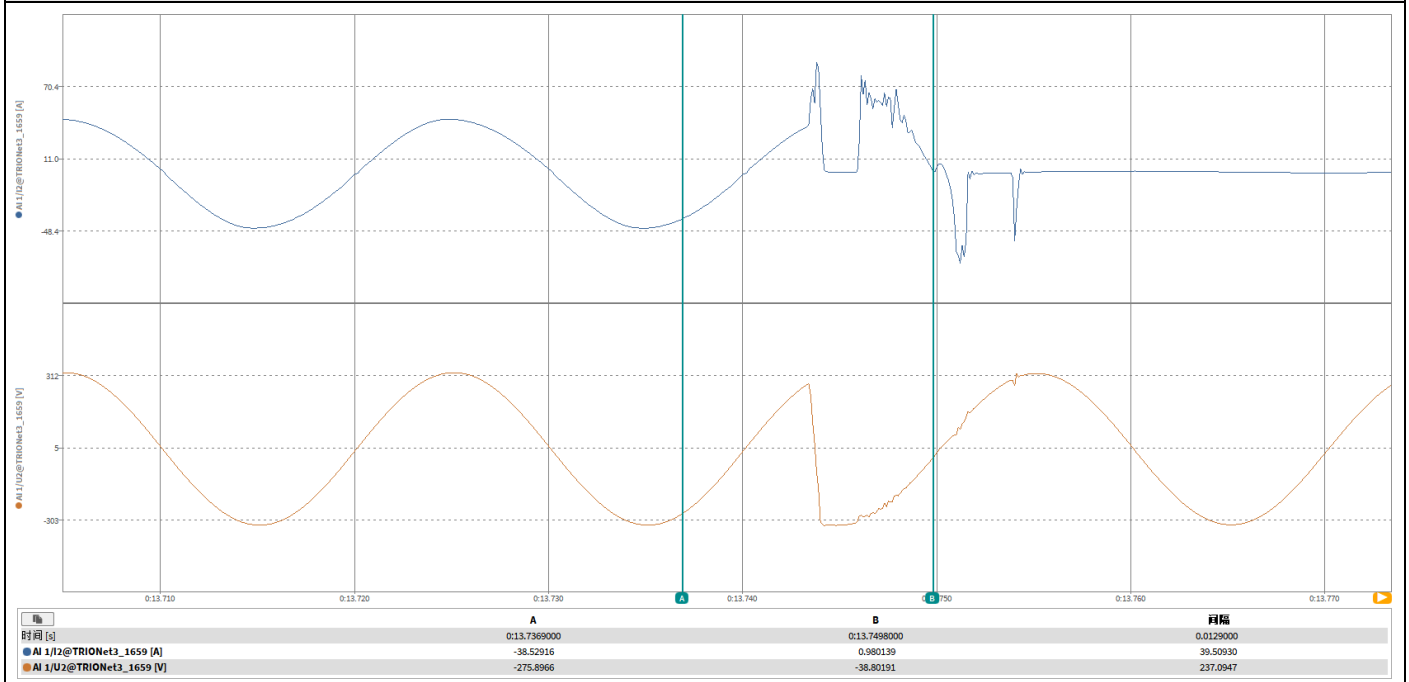
Bbis.10	Verification of insensitivity to automatic reclosure in phase discordance	P
Bbis.10.1	Simulated network test	P

90° phase shift



Bbis.10	Verification of insensitivity to automatic reclosure in phase discordance	P
Bbis.10.1	Simulated network test	P

180° phase shift



Annex No. 1

ISO 9001 certificate

ISO 9001 certificate

**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

中国认可
国际互认
管理体系**MANAGEMENT SYSTEM
CNAS C089-M**

Representative of The Company

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

Annex No. 2

EMC Test Report

The complete EMC test report is stored at Bureau Veritas Consumer Products Services Germany GmbH in project CVLZ-ESH-P25112150.

EMC Test Report

中国认可
国际互认
检测
TESTING
CNAS L19087

Report No.: SN250213

TEST REPORT

Product: Hybrid Inverter
DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1
Model No.: DHN-LVEH1P4.6K-EU-G1, DHN-LVEH1P5K-EU-G1
DHN-LVEH1P6K-EU-G1, DHN-LVEH1P7K-EU-G1
DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-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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Annex No. 3

Datasheet of the relay

Datasheet of the relay

HF186F

MINIATURE HIGH POWER RELAY



File No.: E133481



File No.: R 50476790



File No.: CQC20002260253



Features

- 55A 277VAC loading current capability
- 3.0 mm contact gap
- Low coil holding voltage contributes to saving energy of equipment.
- 10kV surge voltage(Between coil and contact)
- UL insulation system: Class F
- outline dimensions: (30×20×31) mm

RoHS compliant

CONTACT DATA

Contact arrangement	1A
Contact resistance	10mΩ max. (20 A 6VDC)
Contact material	AgSnO ₂
Contact rating (Res. load)	Making 20A Loading 55A, Breaking 20A 277VAC
Max.switching voltage	600VAC
Max.switching current	50A
Max.continuous current	66A at 85°C 55A at 105°C
Max.switching power	13850VAC
Mechanical endurance	1 x 10 ⁶ OPS
Electrical endurance	≥ 5 × 10 ⁴ OPS (105°C, 1s on 9s off, Making 20 A Loading 55 A breaking 20A, 277VAC, Resistive load) ≥ 1 × 10 ⁴ OPS (85°C, 1s on 9s off, 50A 277VAC, Resistive load)

Notes: The data shown above are initial values.

COIL

Coil power	Approx. 2.5W
Holding voltage	40% to 70%U _N (at 23°C) 45% to 55%U _N (at 105°C)

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

COIL DATA

Nominal Voltage VDC	Pick-up Voltage VDC max ⁽¹⁾	Drop-out Voltage VDC min ⁽¹⁾	Max. Voltage VDC ⁽²⁾	Coil Resistance Ω
6	4.2	0.3	6.6	14.4 x (1±10%)
9	6.3	0.45	9.9	32.4 x (1±10%)
12	8.4	0.6	13.2	57.6 x (1±10%)
24	16.8	1.2	26.4	230.4 x (1±10%)
48	33.6	2.4	52.8	921.6 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, IEC QC 080000, ISO/IEC 27001 CERTIFIED

2024 Rev. 1.01

CHARACTERISTICS

Insulation resistance	1000MΩ (500VDC)
Dielectric strength	Between open contacts 2500VAC 1min Between coil & contacts 5000VAC 1min
Surge voltage	Between coil & contacts 10kV(1.2 / 50μs)
Operate time (at rated. volt.)	20ms max
Release time (at rated. volt.)	10ms max
Coil temperature rise	50K max (Contact load current 55A, Applied voltage of coil 100% rated voltage for 100ms holding voltage of coil 50% rated voltage, at 105°C)
Shock resistance	Functional 196m/s ² Destructive 980m/s ²
Vibration resistance	10Hz to 55Hz 1.5mm DA
Humidity	5% to 85%RH(Coil applied holding voltage)
Ambient temperature	-40°C to 105°C
Termination	PCB
Unit weight	Approx. 55g
Construction	Flux proofed

Notes: The data shown above are initial values.

SAFETY APPROVAL RATINGS

CQC	Making 20A, loading 66 A breaking 20 A, 600 VAC, 85°C
UL/CUL	Making 20A, loading 55 A breaking 20 A, 277 VAC, 105°C
TUV	50 A, 277 VAC, 85°C Making 20A, loading 60 A breaking 20 A, 277 VAC, 85°C
TUV	40A 60VDC 85°C

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

Datasheet of the relay

ORDERING INFORMATION

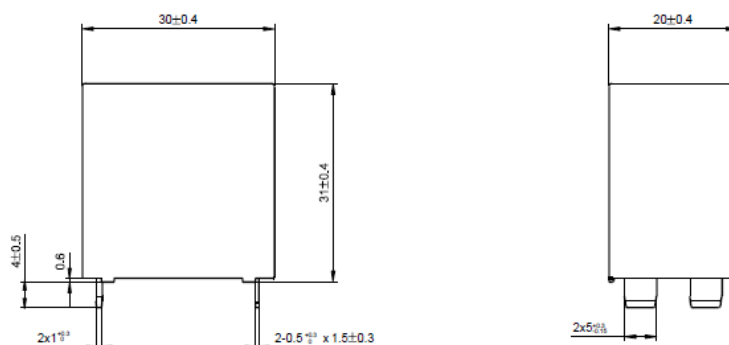
Type	HF186F/	12	-H	T	F	(XXX)
Coil voltage	6, 9, 12, 24,48 VDC					
Contact arrangement	1H: 1 Form A					
Contact material	T: AgSnO ₂					
Insulation standard	F: Class F					
Special code ³⁾	XXX: Customer special requirement			Nil: Standard		

Notes: 1) Please avoid using the relay in an environment containing organic silicon, otherwise the entry of organic silicon into the relay may acceleration contact failure. If there are harmful substances and elements such as water vapor, H₂S, SO₂, NO₂, Cl₂, P₂, dust, etc., as well as unknown harmful substances and elements, in the use of environmental gases, it may lead to increased contact resistance and poor contact during the use of relays. In the above situations, please control the materials that produce harmful substances and elements or use plastic sealed type, and arrange relevant tests to confirm that it meet the requirements for actual use.
2) Water cleaning or surface process is not suggested after the flux-proofed relays are assembled on PCB.
3) The customer special requirement express as special code after evaluating by Hongfa.

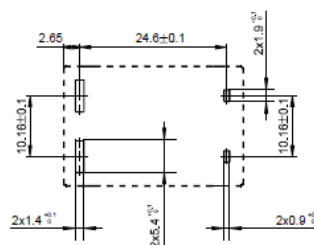
OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

Unit: mm

Outline Dimensions



PCB Layout (Bottom view)

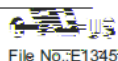


Datasheet of the relay

HF161F-W

SOLAR RELAY

Features



File No.: E134517

File No.: 40084430



File No.: CCC 0002050943
CCC 18002203498

- 31A switching capacity
- Applicable to inverter used for photovoltaic power generation systems
- Ideal for UPS
- 1.5mm contact gap (compliant to European Photovoltaic Standard VDE0126)
- 1.8mm contact gap (compliant to IEC 62109-2-2014)
- The clearance distance between contact and coil is bigger than 64mm, the creepage distance is bigger than 8mm (special code: 1A/5/5mm)
- Low coil holding voltage contributes to saving energy on equipment
- UL insulation system: Class-F

CONTACT DATA

Contact gap	1.5mm	1.8mm	2.0mm	2.3mm	2.5mm
Contact arrangement	1A				
Contact resistance ¹⁾	100mΩ max. (1A @VDC)				
Contact material	Ag30Ni				
Contact rating	Rated switching voltage: 250VAC Rated switching power: 7750VA (res. 240 Ω, 10ms)	Rated switching voltage: 250VAC Rated switching power: 8750VA (res. 240 Ω, 10ms)	Rated switching voltage: 250VAC Rated switching power: 7750VA (res. 240 Ω, 10ms)	Rated switching voltage: 250VAC Rated switching power: 7750VA (res. 240 Ω, 10ms)	Rated switching voltage: 250VAC Rated switching power: 7750VA (res. 240 Ω, 10ms)
Max. switching voltage	250VAC				
Max. switching current	31A	33A	31A	28A	28A
Max. switching power	7750VA	8750VA	7750VA	7750VA	7750VA
Max. dielectric use	1 x 40Amps	1 x 40Amps	1 x 40Amps	1 x 40Amps	1 x 40Amps
Physical endurance	10000 cycles (250VAC, 31A, 10ms) (250VAC, 31A, 10ms)	10000 cycles (250VAC, 33A, 10ms) (250VAC, 33A, 10ms)	10000 cycles (250VAC, 31A, 10ms) (250VAC, 31A, 10ms)	10000 cycles (250VAC, 28A, 10ms) (250VAC, 28A, 10ms)	10000 cycles (250VAC, 28A, 10ms) (250VAC, 28A, 10ms)

Notes: 1) Where not shown above are typical values.

CHARACTERISTICS

Insulation resistance	1000MΩ (at 500VDC)
Dielectric Withstand Voltage	4500VAC 1min
Strength Withstand Voltage	2500VAC 1min
Range voltage (at rated voltage)	10kV (1.2/50μs)
Operate time (at rated voltage)	20ms max.
Release time (at rated voltage)	10ms max.

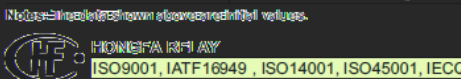
Temperature rise (at rated voltage)	65K max. (Contact load 31A, rated voltage 250VAC, at 85°C)
Shock resistance	70K max. (Contact load 31A, 60% of rated voltage, at 85°C)

Shock resistance	180ms ²
Vibration resistance	10Hz to 55Hz 2.5mm-10A
Anti-bomb temperature	400°C (at 10A)

Humidity	45% to 95% RH
Termination	PCB
Unit weight	Approx. 21g
Construction	Flux protected

Notes: 1) Where not shown above are typical values.

ISO9001, IATF16949, ISO14001, ISO45001, IECQ QC 080000, ISO/IEC 27001 CERTIFIED	2024
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370

COIL

Coil power	Approx. 1W
Coil voltage	36V to 480VDC
Coil resistance	45Ω to 400Ω

COIL DATA

Nominal Voltage VDC	Pick-up Voltage VDC max. 1)	Drop-out Voltage VDC min. 1)	Max. Voltage VDC 2)	Coil Resistance Ω
6	6.3	0.8	10.0	50-100
12	12.4	1.2	14.4	100-200
18	18.6	1.8	21.6	200-300
24	24.8	2.4	28.8	400-600

Notes: 1) Where not shown above are typical values.
2) Where not shown above are typical values.

Datasheet of the relay

SAFETY APPROVAL RATINGS

UL/CUL	AgSnO ₂	26A 277VAC at 75°C 22A 277VAC at 85°C 35A 400VAC at 85°C(A27)
VDE	AgSnO ₂	26A 277VAC at 75°C 22A 277VAC at 85°C 31A 250VAC COSφ=0.8 0.1s:10s 33A 250VAC COSφ=0.8 0.1s:10s (477)
TÜV	AgSnO ₂	35A 400VAC at 85°C(A27)

Notes: 1) All values unspecified are at room temperature.

2) Only typical loads are listed above. Other load specifications can be available upon request.

ORDERING INFORMATION

Type	HF161F-W / 12 -H T (XXX)
Coil voltage	9, 12, 18, 24VDC
Contact arrangement	H: 1 Form A
Contact material	T: AgSnO ₂
Special code ³⁾	XXX: Customer special requirement Nil: Standard

Notes: 1) Water cleaning or surface process is not suggested after the flux-proofed relays are assembled on PCB.

2) Please avoid using the relay in an environment containing organic silicon, otherwise the entry of organic silicon into the relay may acceleration contact failure. If there are harmful substances and elements such as water vapor, H₂S, SO₂, NO₂, Cl₂, etc. in the use of environmental gases, it may lead to increased contact resistance and poor contact during the use of relays. In the above situations, please control the materials or use plastic sealed type and arrange relevant tests to confirm.

3) The customer special requirement express as special code after evaluating by Hongfa. e.g. (414) stands for product with coil terminal of 1.4X0.4; e.g. (477) stands for Contact gap: 1.8mm, (456) stands for Contact gap: 2.0mm, (704) stands for Contact gap: 2.3mm, (A27) stands for Contact gap: 2.3mm, Contact rating 35A.

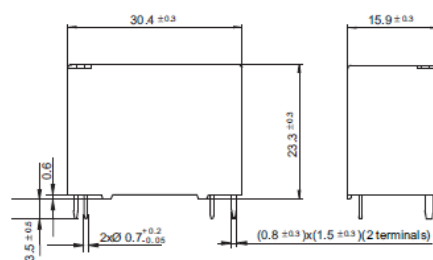
4) The product has two packaging options: suction tray packaging and tube packaging. Among them, the standard size of tube packaging is 592 mm. If you need special customization, please contact us.

OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

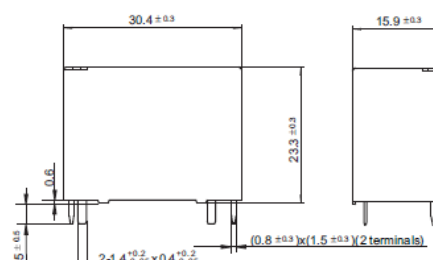
Unit: mm

Outline Dimensions

Standard type



(414) special code version



Datasheet of the relay

 **Churod Electronics**
Churod Electronics Co., Ltd.

File NO.: 00165520250623

1. CERTIFIED COMPLIANCE

TUV	IEC 61810-1	No: R50220099
UL	UL 60947-1	No: E341422
CQC	GB/T 21711.1	No: CQC11002066606

2. HSF COMPLIANCE

HSF COMPLIANCE	Meet the latest regulations of RoHS and REACH
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3. CONTACT RATINGS

Contact Arrangement	1 Form A (SPST)
Contact material	Ag Alloy
Initial contact resistance	≤10mΩ at 6VDC/20A
Rated Load Current(Normally Open)	43 A
Rated Switching Voltage(Normally Open)	277 V _{a.c.}
Rated Switching Power (Normally Open)	11911VA
Min. Applicable Load(Normally Open)	5 V _{d.c.} , 100mA

Note:

- ① Initial contact resistance test need to be tested under 6V DC/20A, contact loading 60s, if the test fails then retest to contact loading 300s after the contact impedance to determine
- ② Amount of product contact gap according to the inter-contact voltage resistance value of 100% test;
- ③ The minimum applicable load is a reference value, applicable under normal temperature, humidity, and pressure conditions. When used below zero degrees Celsius, it is recommended to operate in environments free from condensation and frost. The reference value may vary depending on the switching ratio, environmental conditions, mounting orientation, and expected lifespan. If the actual load is below 5VDC and 1A, it is advisable to conduct verification tests with the actual load before use.

Datasheet of the relay



File NO.: 00165520250623

4. COIL CHARACTERISTICS

Coil power W	Max. Allowable Voltage Vd.c.	Nominal Voltage Vd.c.	Pick-up Voltage Vd.c.	Drop-out Voltage Vd.c.	Coil Resistance Ω
1.6 (at 23°C)	130% of nominal coil voltage	12	≤ 9	≥ 0.6	$90 \times (1 \pm 10\%)$

Note: All time parameters are measured at nominal voltage.

When the ambient temperature $> 23^\circ\text{C}$, coil voltage requires reduction to 5.4 to $< 6.6\text{V}$ after applying rate voltage for 100ms~200ms.

5. TIME PARAMETER

Operate Time	$\leq 20\text{ms}$, excluding bounce time
Release Time	$\leq 10\text{ms}$, excluding bounce time

Note: All time parameters are measured at nominal voltage.

6. PERFORMANCE PARAMETER

Electrical Endurance	Resistive Load	Contact Rating		Times
		Contact Current: 43 A Contact Voltage: 277Va.c. on-off ratio: 1s: 9s Environment temperature: 85℃ Note: 1s ON (12Vd.c., 0.1s, drop 5.4Vd.c.~6.6Vd.c., 0.9s) , 9s OFF		30000
Temperature rise (at 85℃)	The maximum allowable temperature of the coil	The load terminal allows the maximum temperature	The housing allows the highest temperature	
	155℃	130℃	150℃	
Mechanical Endurance	300K cycles, 120 cycles/minute			
Weight	≈ 23 g			
Overall dimensions	30.1*15.7*23.3mm			
Note: Unless otherwise specified, the ambient temperature for electrical durability test is 23 ℃				

Note: Unless otherwise specified, the ambient temperature for electrical durability test is 23°C

7. INSULATION PERFORMANCE

Dielectric Strength	2800 V a.c. 1min, Leakage current $\leq 1\text{mA}$, between open contacts
	4500 V a.c. 1min, Leakage current $\leq 1\text{mA}$, between coil and contact
Impulse withstand voltage	10KV (1.2/50 μs), between coil to contacts
Insulation Resistance	1000 M Ω at 500 V d.c., between open contacts

Datasheet of the relay

 **Churod Electronics**
Churod Electronics Co., Ltd.

File NO.: 00165520250623

	1000 MΩ at 500 Vd.c. ,between coil and contact	
Insulation systems (UL)	155 (F)	
Insulation type	Basic insulation	
Insulation distance	Creepage distance	Spatial distance
	6.4mm, between coil to contacts	5.7mm, between coil to contacts

8. ENVIRONMENT PERFORMANCE

Category of protection		RT II (Flux tight)
Surround Ambient temperature		-40°C~85°C
Surround Ambient humidity		20% RH~85%RH
Storage temperature		-40~85°C
Storage humidity		20% RH~85%RH
Random Vibration	Stability	Capability to function during vibration No opening or closing of any closed or opened contact circuit respectively exceed 10μs when the relay is subjected to vibration of (10~55)Hz and 1.5mm dual amplitude in each of three mutually perpendicular axes for 10 minutes respectively, while it is in operate condition and in release condition.
	Intensity	Capability to function after vibration No trouble on structure and characteristics after the relay is subjected to vibration of (10~55)Hz and 1.5mm dual amplitude in each of three mutually perpendicular axes for 2 hours respectively.
Shock	Stability	Capability to function during shock No opening or closing of any closed or opened contact circuit respectively exceed 10μs when the relay is subjected to shock of 98.1m/s ² for 11ms in both directions of each of three mutually perpendicular axes for 3 times respectively, while it is in operate condition and in release condition.
	Intensity	Capability to function after shock No trouble on structure and characteristics after the relay is subjected to shock of 981m/s ² for 6ms in both directions of each of three mutually perpendicular axes for 3 times respectively.
Cold resistance		No trouble on structure and characteristics after placed at -40°C for 240 hours and 2 hours recovery in standard atmospheric conditions.
Thermal resistance		No trouble on structure and characteristics after placed at 85°C for 240 hours and 2 hours recovery in standard atmospheric conditions.
Humidity resistance		No trouble on structure and characteristics after placed at 40°C&95%RH for 240 hours and 2 hours recovery in standard atmospheric conditions.
Thermal shock resistance		No trouble on structure and characteristics after endure 100 cycles of cyclic temperature and 2 hours recovery in standard atmospheric conditions, which the temperature cycle consists of -40°C for 0.5 hour and 85°C for 0.5 hour.

Datasheet of the relay

 **Churod Electronics**
Churod Electronics Co., Ltd.

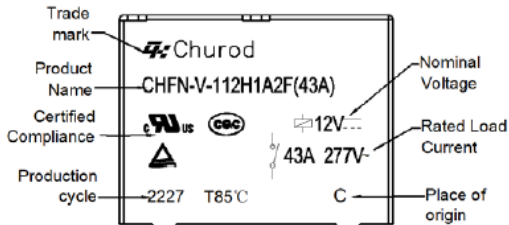
File NO.: 00165520250623

Terminal robustness	No trouble on structure and characteristics after endure axial pushing/pulling force of 10N for 10 seconds.
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9. LIST OF PLASTIC PARTS

No.	Name of parts	Material	Flame retardant rating	Tolerable temperature
1	Case	Engineering plastics	94-V0	150°C
2	Base	Engineering plastics	94-V0	150°C
3	Bobbin	Engineering plastics	94-V0	155°C
4	Coil	Magnet wire	3UEW	155 °C

10. MARKING

Marking Position	Side of relay cover
Cover color	Black
Marking Type	Laser Marking
Trade mark	
Marking Graphical representation	 Trade mark:  Churod Product Name: CHFN-V-112H1A2F(43A) Certified Compliance:  Production cycle: 2227 T85°C Nominal Voltage: 12V Rated Load Current: 43A 277V Place of origin: C

11. ORDERING INFORMATION

Datasheet of the relay

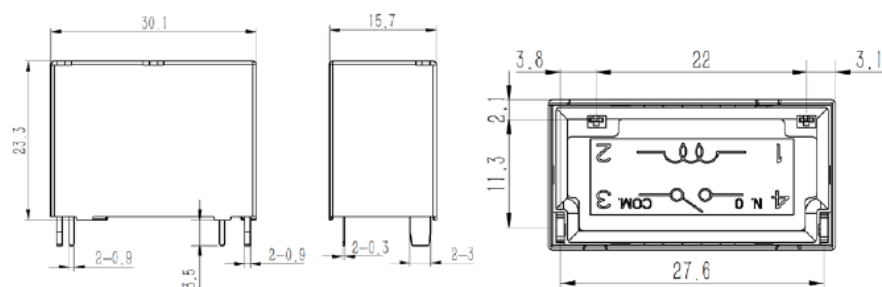
Churod Electronics
Churod Electronics Co., Ltd.

File NO.: 00165520250623

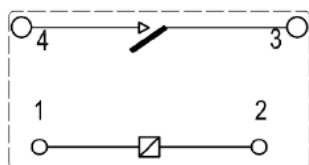
	CHFN	-V	-1	12	H1	A	2	F	(43A)
1.Product Name	CHFN								
2.Category of protection									
V = RT II (Flux tight)									
3.Contact Number									
1 = 1 set of contacts									
4.Nominal Voltage									
12 = 12VDC									
5.Coil power									
H1 = High-capacity type(1.6W)									
6.Contact Arrangement									
A = Normally open (SPST)									
7.Contact material									
2 = AgSnO ₂									
8.Insulation systems									
F&Blank=Class F (155°C)									
9.Rated Load Current									
(43A)=Rated Load Current 43A									

12. OUTLINE DIMENSIONS

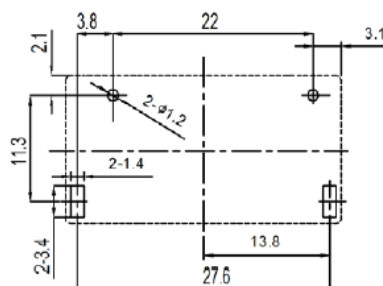
Outline dimension



Wiring diagram (Bottom View)



Mounting dimensions (Bottom View)



Datasheet of the relay



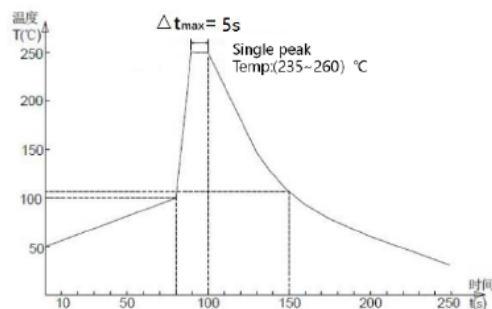
File NO.: 00165520250623

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

Outline dimensions hadn't specified tolerance		PC board dimensions hadn't specified tolerance
Outline dimensions	Tolerance	±0.1
≤0.3	±0.1	
≤1	±0.2	
≤5	±0.3	
> 5	±0.5	

13. INSTALLATION INFORMANTION

Solderability	260±5°C for 5±0.5 seconds
Resistance to soldering heat	260±5°C for 10±1 seconds
	350±10°C for 3.5±0.5 seconds
Standard direction	Relay PCB terminals downward
Terminals assignment and outline dimensions	Refer to APPENDIX
Wave soldering Condition	Refer the following Curve



14. ENGINEERING NOTES

- Unless otherwise explicitly stated, the standard environment conditions for measurement or testing are listed as followings:
 - Ambient temperature is 23°C±5°C.
 - Atmospheric pressure is 96× (1±10%) kPa.
 - Relative humidity is 25% RH ~ 75% RH.
 - Storage guarantee period is 36 months (For more than 1 year, the electrical parameters need to be fully checked and confirmed, and the test is OK before it can be used) ; The moisture-proof level is level 2;
 - Please avoid using the relay in the environment containing organic silicon, otherwise the organic silicon will enter the relay and accelerate the contact failure.
 - When used in polluted environment (H₂S、SO₂、NO₂、dust and other pollutants), it is recommend to select sealed products, and please conduct test confirmation in actual use.

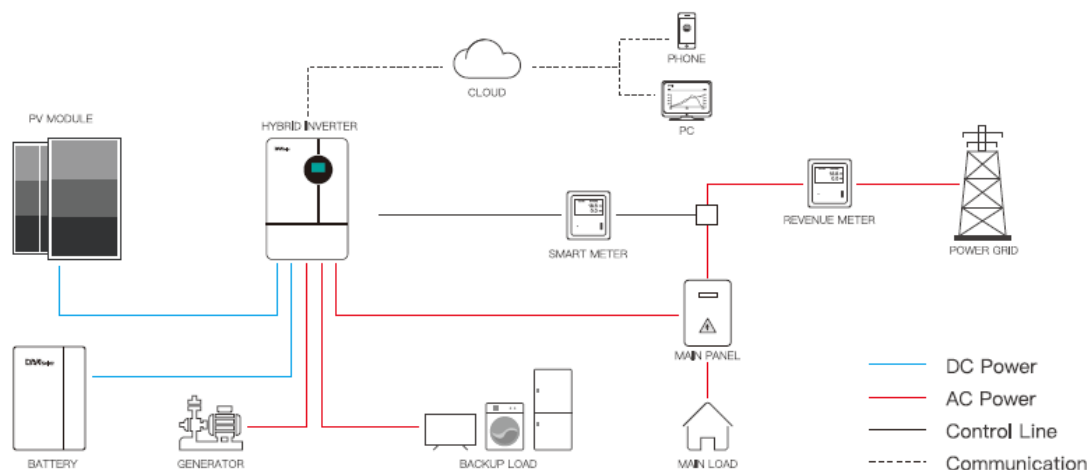
Annex No. 4

Datasheet of the Batterie

Datasheet of the Batterie

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(°C)	Charge:0~+55/Discharge:–20~+55
Storage Temperature(°C)	–20~+35
Cycle Life (25±2°C,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

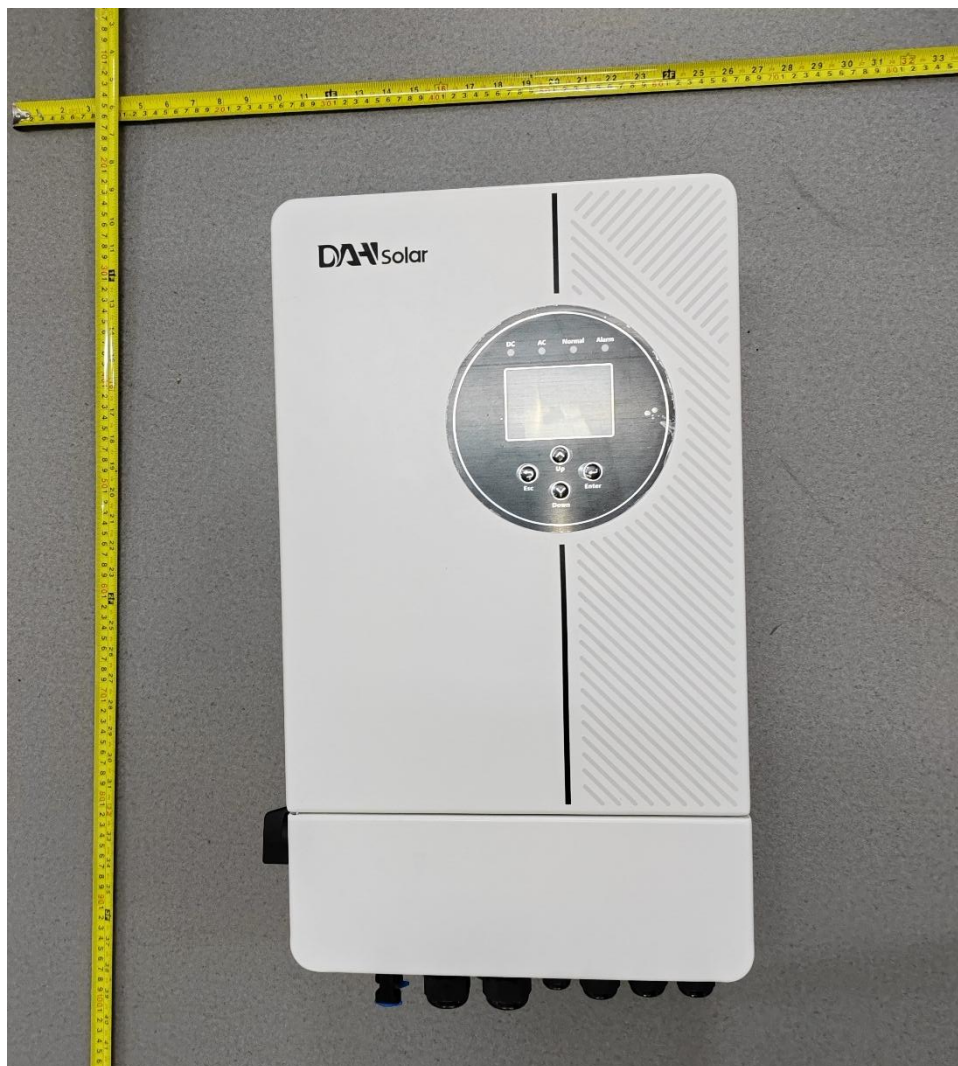
Add: No.1 Yaoyuan Road, Luyang District, Hefei City, Anhui Province, China

en.dahsolar.com

Annex No. 5

Pictures of the unit

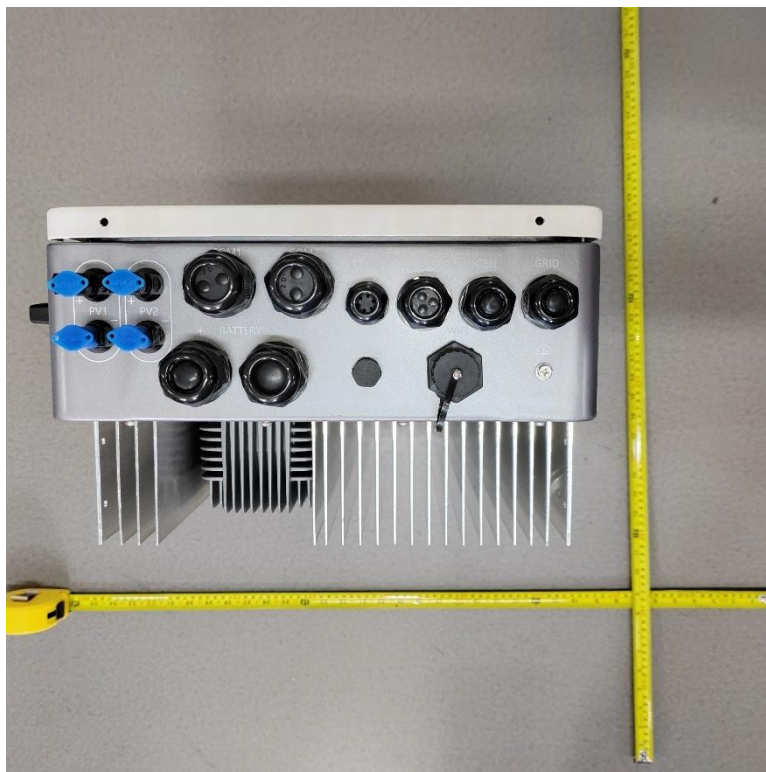
Enclosure front



Enclosure (connectors)



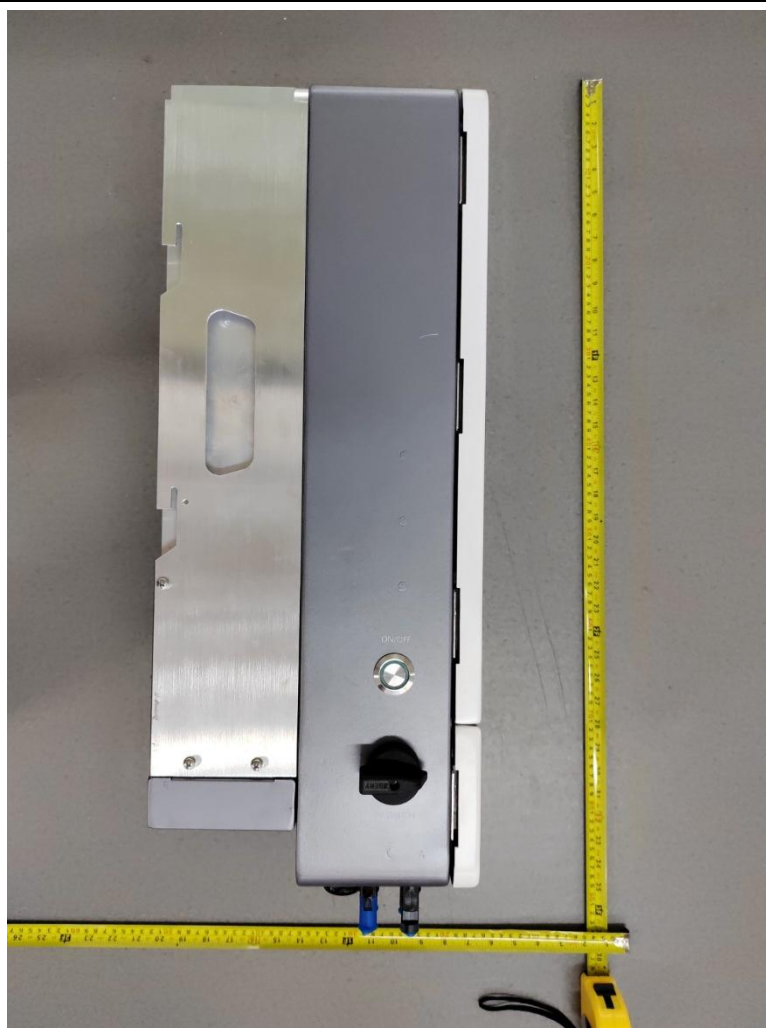
DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1



DHN-LVEH1P4.6K-EU-G1, DHN-LVEH1P5K-EU-G1, DHN-LVEH1P6K-EU-G1

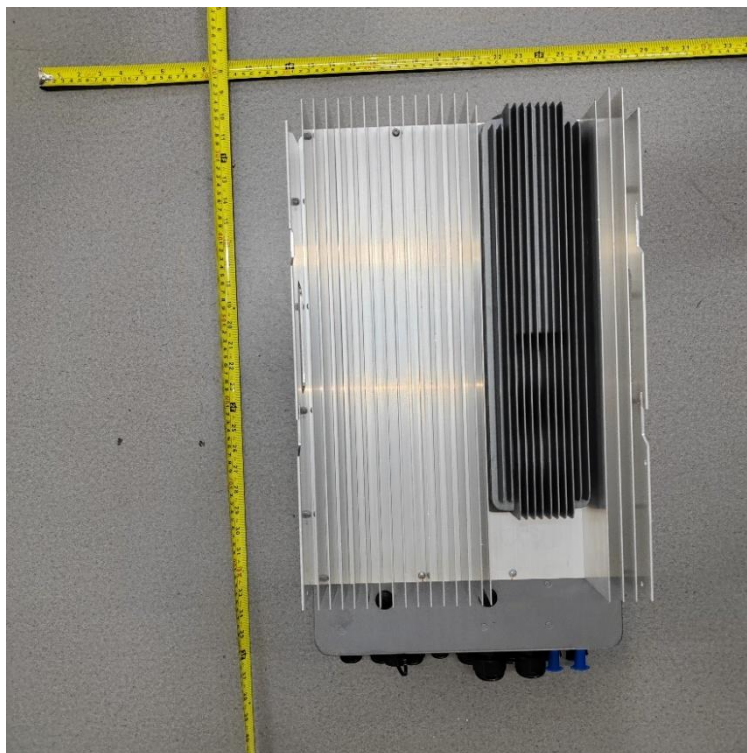


DHN-LVEH1P7K-EU-G1, DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-EU-G1

Enclosure top side**Enclosure left side**

Enclosure right side



Enclosure back

DHN-LVEH1P3K-EU-G1, DHN-LVEH1P3.6K-EU-G1, DHN-LVEH1P4.6K-EU-G1, DHN-LVEH1P5K-EU-G1, DHN-LVEH1P6K-EU-G1



DHN-LVEH1P7K-EU-G1, DHN-LVEH1P7.5K-EU-G1, DHN-LVEH1P8K-EU-G1

Annex No. 6

Test Equipment list



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

End of Test Report