Test Report issued under the responsibility of:

LYNS-TCi

TEST REPORT

TOR Erzeuger Typ A

Test Technical and organisational rules for operators and users of networks
TOR producers: connection and parallel operation of type A power generation sites and micro-generation plants
(Maximum capacity of 250 kW and rated voltage of 110 kV)

Report Number. ..... :	**HC24031903001-EG-AT-001**
Total pages ..... :	237
Tested by (name + signature) ..... :	Leslie He / Test engineer
Approved by (name + signature) ..... :	Lukes Lin / Project manager
Date of issue ..... :	2024-04-03

Applicant's name ..... :	Dream Maker Technologie GmbH
Address ..... :	Zimmerbachstr.37, 74676 Niedernhall
Manufacturer ..... :	Same as applicant
Address ..... :	Same as applicant

Testing laboratory name ..... :	Lyns-tci Technology Guangdong Co., Ltd.
Address ..... :	Room 1201, Unit 2, Building 18, No. 7, Science and Technology Boulevard, Houjie Town, Dongguan City, Guangdong, 523960 P.R.C
Testing Location ..... :	Guangdong HuaChuang Technology Service Co., Ltd.
Address ..... :	Room 815, No.122, Houjie Road (West), Houjie Town, Dongguan City, Guangdong, 523960 P.R.C

Test specification:	
Standard ..... :	TOR Erzeuger Typ A (Tested according to OVE-Richtlinie R 25:2020-03)
Test Report Form No. ..... :	TOR Erzeuger Typ A VER.1.1

Issued by: Lyns-tci Technology Guangdong Co., Ltd.
Address: Room 1201, Unit 2, Building 18, No. 7, Science and Technology Boulevard, Houjie Town, Dongguan City, Guangdong, 523960 P.R.C
Tel: +86 769 85598986 E-Mail: service-hc@lyns-tci.com Web: www. lyns-tci.com

Product name.....:	Hybrid Inverter
Trade Mark.....:	Dream Maker
Factory's name.....:	Dream Maker Technologie GmbH
Factory address .....:	Zimmerbachstr.37, 74676 Niedernhall

Model/Type reference .....:	**PCS-3-4KW-25A-1**	**PCS-3-5KW-25A-1**	**PCS-3-6KW-25A-1**	**PCS-3-8KW-25A-1**
Ratings:				
Max. DC Input voltage [V].....:	1000			
MPPT input voltage range [V].....:	120-950	120-950	120-950	200-950
Full load MPPT input voltage range [V].....:	140-850	175-850	210-850	275-850
Rated DC input voltage [V] .....:	620			
Max. input DC current [A].....:	15/15			
Short-circuit current [A] .....:	20/20			
Nominal output AC voltage [V].....:	3L+N+PE, 380/400Va.c, 50/60Hz			
Nominal output AC current [A] .....:	5,8	7,3	8,7	11,6
Max. output AC current [A].....:	6,7	8,3	10,0	13,3
Nominal active output power [W] ....:	4000	5000	6000	8000
Max. apparent output power [VA] ...:	4400	5500	6600	8800
Battery voltage range [V] .....:	135-750			
Max. charging / discharge current [A].....:	25/25			

Model/Type reference .....:	**PCS-3-10KW-25A-1**	**PCS-3-12KW-25A-1**
Ratings:		
Max. DC Input voltage [V] .....:	1000	
MPPT input voltage range [V] .....:	200-950	
Full load MPPT input voltage range [V] .....:	345-850	410-850
Rated DC input voltage [V] .....:	620	
Max. input DC current [A].....:	15/15	
Short-circuit current [A] .....:	20/20	
Nominal output AC voltage [V].....:	3L+N+PE, 380/400Va.c, 50/60Hz	
Nominal output AC current [A] .....:	14,5	17,4
Max. output AC current [A].....:	16,5	20,0
Nominal active output power [W] ....:	10000	12000
Max. apparent output power [VA] ...:	11000	13200
Battery voltage range [V] .....:	135-750	
Max. charging / discharge current [A] .....:	25/25	

Model/Type reference .....:	**PCS-3-10KW-40A-1**	**PCS-3-12KW-40A-1**	**PCS-3-15KW-40A-1**	**PCS-3-20KW-40A-1**
Ratings:				
Max. DC Input voltage [V] .....:	1000			
MPPT input voltage range [V] .....:	200-950			
Full load MPPT input voltage range [V] .....:	250-850	250-850	260-850	345-850
Rated DC input voltage [V] .....:	620	620	620	620
Max. input DC current [A].....:	30/30			
Short-circuit current [A] .....:	40/40			
Nominal output AC voltage [V].....:	3L+N+PE, 380/400Va.c, 50/60Hz			
Nominal output AC current [A] .....:	14,5	17,4	21,7	29,0
Max. output AC current [A].....:	16,5	20,0	25,0	33,5
Nominal active output power [W] ....:	10000	12000	15000	20000
Max. apparent output power [VA] ...:	11000	13200	16500	22000
Battery voltage range [V] .....:	135-750			
Max. charging / discharge current [A] .....:	40/40			
Software version .....:	V1.07			
Note: All tests are performed at 400V,50Hz.				

Contents

Revision history of test report

Issued Date	Description	Report No.
2024-04-03	Initial issue.	HC24031903001-EG-AT-001
Supplementary information: Test results documented in this report are taken from test report no. 220422BW002-EG-AT-002, issued by Guangdong HuaChuang Technology Service Co., Ltd. on 2023-04-14.		

Copy of marking plate

Dream Maker

Model: PCS-3-4KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	120-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	8kVA
On-grid Input Max. Current:	11.6Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	4kW
On-grid Output Max. Apparent Power:	4.4kVA
On-grid Output Max. Current:	6.7Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	4kW
Off-grid Output Max. Apparent Power:	4.4kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-5KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	120-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	10kVA
On-grid Input Max. Current:	14.5Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	5kW
On-grid Output Max. Apparent Power:	5.5kVA
On-grid Output Max. Current:	8.3Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	5kW
Off-grid Output Max. Apparent Power:	5.5kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-6KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	120-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	12kVA
On-grid Input Max. Current:	17.4Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	6kW
On-grid Output Max. Apparent Power:	6.6kVA
On-grid Output Max. Current:	10.0Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	6kW
Off-grid Output Max. Apparent Power:	6.6kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-8KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	16kVA
On-grid Input Max. Current:	23.2Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	8kW
On-grid Output Max. Apparent Power:	8.8kVA
On-grid Output Max. Current:	13.3Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	8kW
Off-grid Output Max. Apparent Power:	8.8kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-10KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-ion
On-grid Input Max. Apparent Power:	16.5kVA
On-grid Input Max. Current:	23.9Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	10kW
On-grid Output Max. Apparent Power:	11.0kVA
On-grid Output Max. Current:	16.5Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	10kW
Off-grid Output Max. Apparent Power:	11.0kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-12KW-25A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	15/15Ad.c.
Isc PV:	20/20Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	25/25Ad.c.
Battery Type:	Li-ion
On-grid Input Max. Apparent Power:	16.5kVA
On-grid Input Max. Current:	23.9Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	12kW
On-grid Output Max. Apparent Power:	13.2kVA
On-grid Output Max. Current:	20.0Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	12kW
Off-grid Output Max. Apparent Power:	13.2kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-10KW-40A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	30/30Ad.c.
Isc PV:	40/40Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	40/40Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	20kVA
On-grid Input Max. Current:	29.0Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	10kW
On-grid Output Max. Apparent Power:	11.0kVA
On-grid Output Max. Current:	16.5Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	10kW
Off-grid Output Max. Apparent Power:	11.0kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-12KW-40A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	30/30Ad.c.
Isc PV:	40/40Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	40/40Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	24kVA
On-grid Input Max. Current:	34.8Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	12kW
On-grid Output Max. Apparent Power:	13.2kVA
On-grid Output Max. Current:	20.0Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	12kW
Off-grid Output Max. Apparent Power:	13.2kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-15KW-40A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	30/30Ad.c.
Isc PV:	40/40Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	40/40Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	30kVA
On-grid Input Max. Current:	43.5Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	15kW
On-grid Output Max. Apparent Power:	16.5kVA[1]
On-grid Output Max. Current:	25.0Aa.c. [2]
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	15kW
Off-grid Output Max. Apparent Power:	16.5kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

1) AS 4777.2: 15.0kVA
2) AS 4777.2: 21.7A

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Dream Maker

Model: PCS-3-20KW-40A-1	Name: Hybrid Inverter
PV Max. Input Voltage:	1000Vd.c.
PV Max. Input Current:	30/30Ad.c.
Isc PV:	40/40Ad.c.
PV MPPT Voltage Range:	200-950Vd.c.
Battery Voltage Range:	135-750Vd.c.
Battery Max. Charge/Discharge Current:	40/40Ad.c.
Battery Type:	Li-Ion
On-grid Input Max. Apparent Power:	30kVA
On-grid Input Max. Current:	43.5Aa.c.
On-grid Input Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Input Nominal Frequency:	50/60Hz
On-grid Output Rated Power:	20kW
On-grid Output Max. Apparent Power:	22.0kVA
On-grid Output Max. Current:	33.5Aa.c.
On-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
On-grid Output Nominal Frequency:	50/60Hz
On-grid Power Factor:	0.8 leading ... 0.8 lagging
Off-grid Output Rated Power:	20kW
Off-grid Output Max. Apparent Power:	22.0kVA
Off-grid Output Nominal Voltage:	3/N/PE~380/400Va.c.
Off-grid Output Nominal Frequency:	50/60Hz
Operating Temperature Range:	-30...+60℃
Enclosure:	IP65
Protection Class:	I
Operating Altitude:	3000m
Communication:	CAN, RS485, WiFi/LAN (Optional)
Inverter Topology:	Non-isolated
Over Voltage Category:	II(PV), III(Main)

10 min

Manufacturer: Dream Maker Technologie GmbH
Address: Zimmerbachstr.37, 74676 Niedernhall

Vorsicht Hochspannung im Innern, nicht unter Last abtrennen. Um Stromschläge zu vermeiden, schalten Sie bitte zuerst den AC-Schalter, dann den Batterieschalter und zuletzt den DC-Schalter aus, bevor Sie irgendwelche Anschlussarbeiten am Wechselrichter vornehmen.

Während des Betriebs kann die Oberflächen-temperatur des Wechselrichters hohe Werte erreichen. Um Verbrennungen zu vermeiden, berühren Sie den Wechselrichter nicht, während er in Betrieb ist. Lassen Sie ihn abkühlen, bevor Sie ihn berühren.

General remarks - documentation

Possible test case verdicts

Test case does not apply to the test object ...: N/A

Test case is not rated .....: N/R

Test item does meet the requirement .....: P (Pass)

Test item does not meet the requirement ....: F (Fail)

Testing

Date of receipt of test items .....: 2022-04-22

Date(s) of performance of tests .....: 2022-05-12 to 2023-04-14

General remarks:

The test result presented in this report relate only to the object(s) tested. This report shall not be reproduced in part or in full without the written approval of the issuing testing laboratory.

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

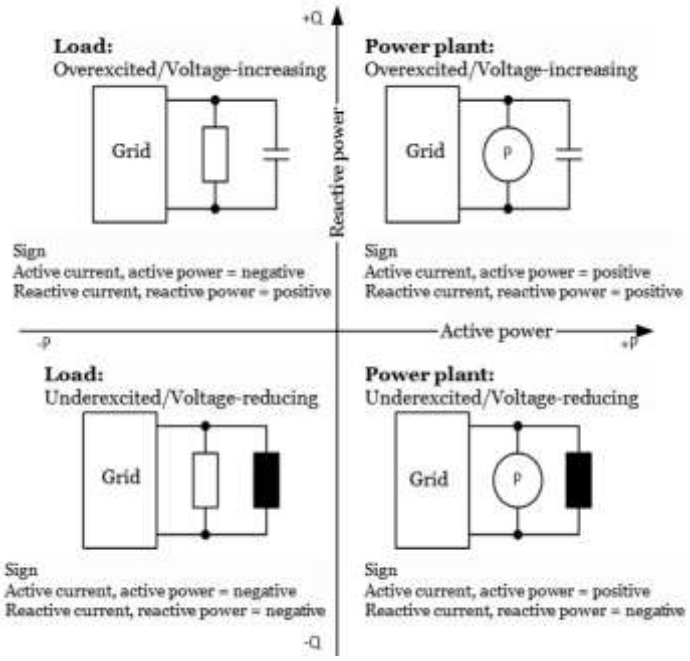
Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Conformity statements are decided in accordance with IEC GUIDE 115:2021 Procedure 2 (accuracy method), unless otherwise normatively specified or contractually agreed.

Direction definition of P and Q:

in this test report, the regarded system of the voltage and current vectors is the active sign convention system:

- If the inverter feeds to the grid the active power is measured with positive sign.
- If the inverter injects reactive power / current with leading power factor the reactive power / current is marked “leading” or “inductive” (under-excited) or has a negative sign.
- If the inverter injects reactive power / current with lagging power factor the reactive power / current is marked “lagging” or “capacitive” (over-excited) or has a positive sign.



General remarks for testing

Test setup:

For the testing two test setups were used.

- Test setup 1: Test configuration used for tests except islanding prevention testing.

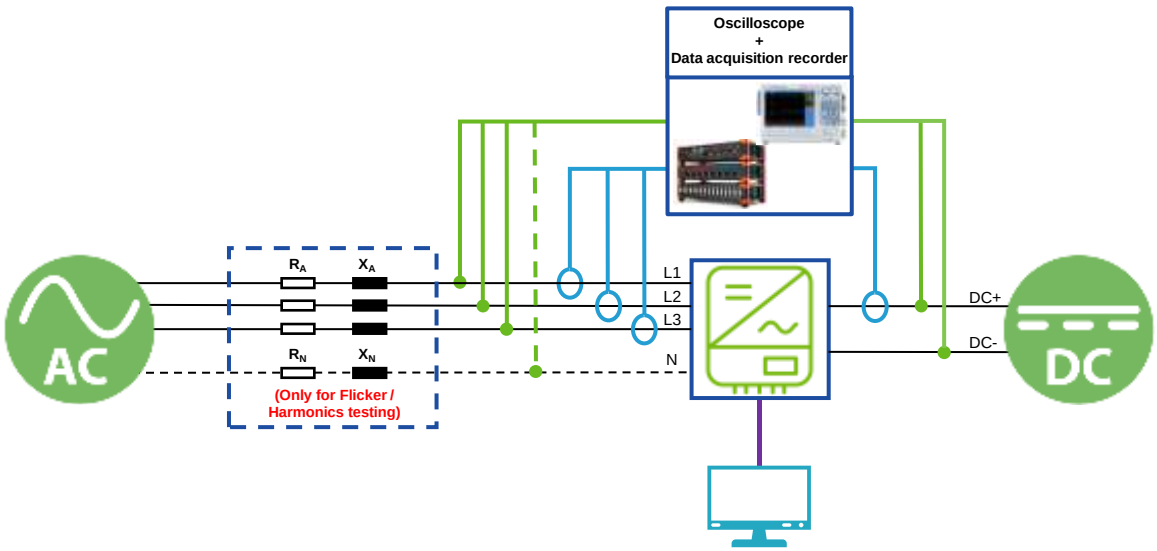


Figure 1 – Test setup 1 for Three phase

- Test setup 2 :Test configuration for islanding detection function.

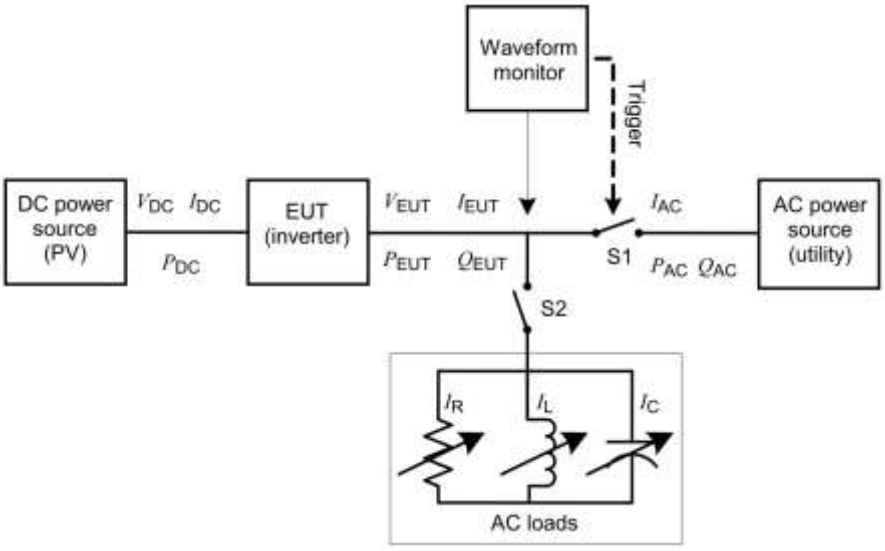


Figure 2 – Test circuit for islanding detection function in a power conditioner (inverter) from IEC 62116:2014

General remarks for testing

List of test requirement:

Annex A - Requirements for the test bench

Measurement equipment requirements according to:

Table A.1 – Minimum measurement accuracy of the measuring devices

Measure	Frequency range	Measurement accuracy related to the measuring range
Voltage up to 1000 V	50 Hz	±0,25 %
	DC bis < 1 kHz (except for 50 Hz)	±1,0 %
	1 kHz bis < 5 kHz	±1,5 %
	5 kHz bis < 20 kHz	±2,5 %
	≥ 20 kHz	±5,0 %
Current < 5 A	50 Hz	±0,5 %
	DC bis < 60 Hz (except for 50 Hz)	±1,0 %
	60 Hz bis < 5 kHz	±1,5 %
	5 kHz bis < 20 kHz	±2,5 %
	≥ 20 kHz (except for 50 Hz)	±5,0 %
Current > 5 A	50 Hz	±0,5 %
	DC bis < 5 kHz	±1,5 %
	5 kHz bis < 20 kHz	±3,5 %
	≥ 20 kHz	±5,0 %
Frequency	DC bis < 60 Hz	±0,01 Hz
	60 Hz bis 5 kHz	±0,2 %
	5 kHz bis < 20 kHz	±0,5 %
	≥ 20 kHz	±1 %
Measure	Measuring range	Measurement accuracy related to the measuring range
Displacement factor cosφ	Cosφ = 1 bis cosφ = 0,9	0,0025
Time	10 ms to < 200 ms	±5 % of the measured value
	200 ms to < 1 s	±10 ms
	≥ 1 s	±1 % of the measured value
Temperature	> −35 °C to 100 °C	±2 °C

General product information

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] ..... : Approximately 31kg

Product Description:

The hybrid solar system is usually composed of the PV array, hybrid inverter, lithium battery, loads and power grid. The Dreammaker PCS-3-20KW-40A-1 series inverter is also known as hybrid inverter or storage inverter, which is mainly used to combine the PV array, lithium battery, loads and power grid to realize intelligent power management and dispatching (See Figure 3)

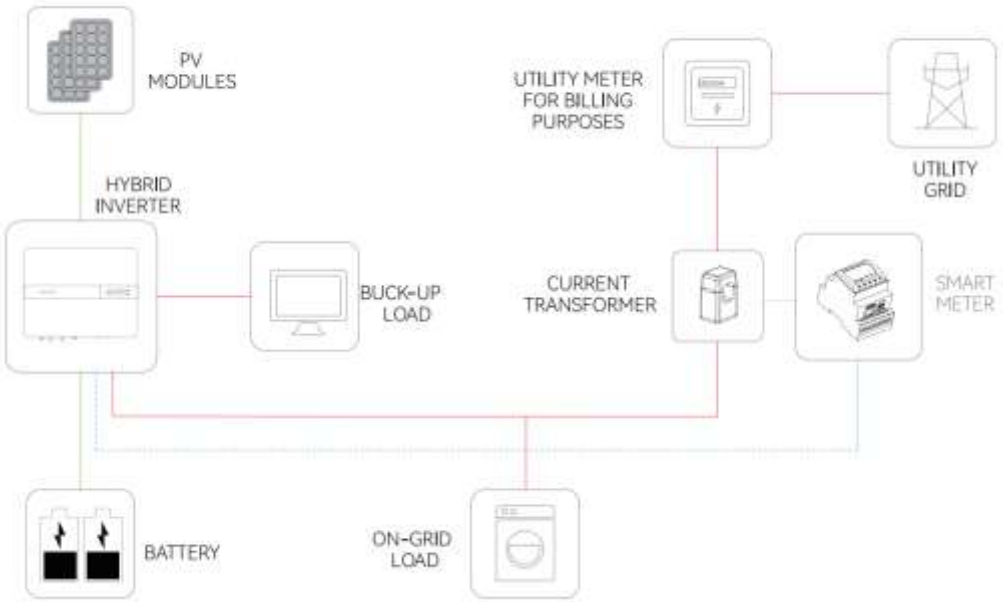


Figure 3 – Scheme of an installation

The product was tested on following revisions:

Hardware version: V1.00

Software version**:** V1.07

General product information

Description of the power circuit (Figure 4):

The input and output of the unit are protected by varistors to Earth. The unit is providing EMC filtering at the input and output toward mains. The unit does not provide galvanic separation from input to output (transformerless).

The output is switched off redundantly by the high-power switching bridge and two relays in series. 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 each start up.

The internal control is redundant built. It consists of Master DSP (U102) and slave DSP (U200).
The Master DSP (U102) control the relays by switching signals; measures the voltage, current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition, it tests the current sensors and the RCMU circuit before each start up.
The slave DSP (U200) is measuring the grid voltage, grid frequency and residual current, also can switch off the relays independently, and communicate with Master DSP (U102) each other.
The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Master DSP(U102). The Master DSP(U102) tests and calibrates before each start up all current sensors.
The unit provides two relays in series in all output conductors.

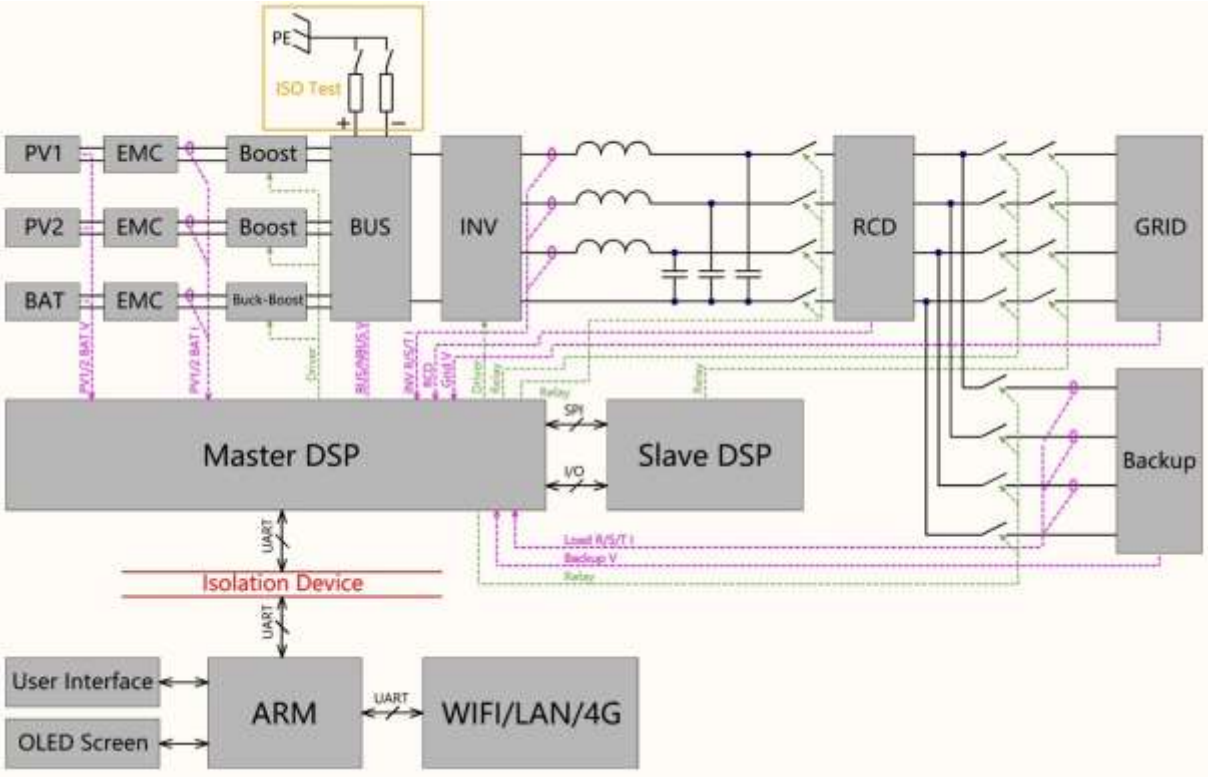


Figure 4 – Electrical Block Diagram

Differences of the model:

The electrical ratings' difference see datasheet for detail, and the difference on hareware see following table.

The module		**PCS-3-4KW-25A-1 PCS-3-5KW-25A-1 PCS-3-6KW-25A-1**	**PCS-3-8KW-25A-1 PCS-3-10KW-25A-1 PCS-3-12KW-25A-1**	**PCS-3-10KW-40A-1 PCS-3-12KW-40A-1**	**PCS-3-15KW-40A-1 PCS-3-20KW-40A-1**
PCB	-	Common PCB design, only power devices and relays differ			
PV common mode inductance	PV EMC	15A common-mode inductance 3mH		30A common-mode inductance 1mH	
BAT common mode inductance	BAT EMC	25A common-mode inductance 6mH		40A common-mode inductance 2,5mH	
INV common mode inductance	INV EMC	18A common-mode inductance 5mH			30A common-mode inductance 3,5mH
PV power tube	PV Boost	40A IGBT		40mR SiCMOS	
PV inductance		15A inductance 1220uH		30A inductance 590uH	
BAT power tube	BAT DC-DC	40A IGBT x2		40mR SiCMOS x2	
BAT inductance		25A inductance 1220uH		40A inductance 1100uH	
INV inductance	INV L	inductance 3244 uH	inductance 2218 uH		inductance 825 uH
Relay	Relay	33A relay			43A relay
fan	-	No fan		With the fan	
PV terminal	-	1+1		2+2	

Test & Assessment overview

OVE guideline R 25	
Clause & test item	**Verdict**
5.1 Testing of mains disturbances	P
5.1.1 General	P
5.1.2 Rapid voltage changes	P
5.1.3 Flickers	P
5.1.4 Harmonics and Interharmonics	P
5.1.4 a) Test Harmonics DIN EN 61000-3-2 (≤16 A per Phase)	P
5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)	P
5.2 Checking the symmetry behavior of three-phase converters	P
5.2.2 Calculation of asymmetry	P
5.3 Checking the behavior of the generating unit on the grid	P
5.3.1 General	P
5.3.2 Measurement of the active and reactive power working range (“PQ diagram”)	P
5.3.3 Termination of the active power feed after an OFF command via the telecontrol interface (input port)	P
5.3.4.1 Active power reduction in case of over frequency	P
5.3.5 Frequency-dependent active power reduction (active power at underfrequency)	P
5.3.6 Voltage-controlled active power derating P(U)	P
5.3.6.1.1 Test sequence for the quasi-stationary behaviour of the P(U) control	P
5.3.6.1.2 Test for the dynamic behaviour of the P(U) control	P
5.3.7 Reactive power setpoint control “fix cos φ”	P
5.3.8 Test of the displacement factor/active power characteristic curve cos φ (P)	P
5.3.9 Reactive power setpoint control “fix Q”	P
5.3.10 Voltage-controlled control functions “Q= f(V)”	P
5.3.10.1.1 Test Voltage-controlled control functions “Q= f(V)” - quasi-stationary behavior	P
5.3.10.1.2 Test Voltage-controlled control functions “Q= f(V)” - dynamic behavior	P
5.3.11 Protection of set values	P
5.4 Testing of NS protection	P
5.4.1.1.1 Voltage control (Inverters with automatic disconnection device)	P
5.4.1.2 Measuring the rise-in voltage protection as a running 10-minute mean value	P
5.4.2.1 Frequency measurement	P
5.4.3 Islanding protection testing	P
5.5 Testing of connecting conditions and synchronisation	P
5.6 Testing of the robustness and dynamic grid support	P
5.6.3 Verification for the dynamic grid support test for inverter (3-phase Inverters)	P

Annex 1 – Test Results

5.1 Testing of mains disturbances	P

5.1.1 General	P
The electrical installations of the customer system shall be planned, constructed and operated so that reactions to the network operator's network and to the systems of other customers are permanently reduced to a permissible minimum. Should interfering reactions on the network operator's network occur nonetheless, the customer shall apply measures to his system that are to be coordinated with the network operator. The network operator is entitled to disconnect the power generation system concerned from the network until the deficiencies are corrected. System perturbations are defined as: - Rapid voltage changes - Flicker - Harmonics, interharmonics and higher frequencies (up to 9 kHz)	

5.1.2 Rapid voltage changes	P

Test procedure and test conditions:

These tests serve to verify the requirements of TOR D2, Section 9.2.3.

The purpose of the test is to determine ki and kimax.

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

- Switch-on for any capacity
- Unfavourable case when switching the generator step
- Switch-on for nominal capacity
- Switch-off for nominal capacity (no emergency shutdown, but operative shutdown)

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

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rises of the PGU at 100 *Pn* %: ≤ 3 %

Assessment criteria:

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

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

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

Test results:

Switch-on for any capacity (10% Pn)

Phase	**L1**			**L2**			**L3**		
Single period effective values of the current [A]	0,829	1,261	1,082	1,708	1,383	1,249	2,113	1,124	1,461
Single period effective values of the voltage [V]	228,50	227,60	228,60	226,60	225,40	227,20	230,10	229,70	230,20
k_i value [1]	0,029	0,044	0,037	0,059	0,048	0,043	0,073	0,039	0,050
k_{imax} value [1]	0,044			0,059			0,073		

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

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

Switch-on for nominal capacity

Phase	**L1**			**L2**			**L3**		
Single period effective values of the current [A]	1,097	1,379	1,660	1,110	1,442	2,051	0,707	0,695	2,015

Single period effective values of the voltage [V]	228,50	228,50	228,1	226,70	226,60	227,40	230,20	229,80	229,90
k_i value [1]	0,038	0,048	0,057	0,038	0,050	0,071	0,024	0,024	0,070
k_{imax} value [1]	0,057			0,071			0,070		
Switch-off for nominal capacity									
Phase	**L1**			**L2**			**L3**		
Single period effective values of the current [A]	11,270	13,290	9,722	10,500	10,170	12,510	13,410	11,370	12,430
Single period effective values of the voltage [V]	227,80	227,00	227,90	225,90	226,10	226,10	229,60	228,70	229,30
k_i value [1]	0,389	0,459	0,335	0,362	0,351	0,432	0,463	0,392	0,429
k_{imax} value [1]	0,459			0,432			0,463		

Grid Frequency [Hz]	50,00
Grid voltage [V]	230,00
Rated current I_r [A]	28,986
Highest k_{imax} value for all switching operations [1]	0,463

Note:
The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.1.3 Flickers	P

Test procedure and test conditions:

These tests serve to verify the requirements of TOR D2, Section 9.2.4.

Voltage: 86% U_n to 109% U_n
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %

Voltage rises of the PGU at 100 *Pn* %: ≤ 3 %

Assessment criterion:

Long-term flicker strength: P_{lt}≤0,5

Determination of the flicker coefficient:

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

$$c_{\psi k} = P_{st} \times (S_k / P_n)$$

Output parameters of grid	**Voltage [V]:**	**230,01**	**Frequency [Hz]:**	**50**

EUT		**Selection of limits**	
☐ *1-phase*	☒ *3-phase*	☒ Equipment with rated current ≤16 A per phase *IEC EN 61000-3-3*	☐ Equipment with rated current ≤75 A per phase *IEC EN 61000-3-11*
PCS-3-4KW-25A-1			

Results: L1 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,39	0,16	0,00	0,33	0,28	0,00	0,16	0,13
Normalized to standard impedance	0,39	0,16	0,00	0,33	0,28	0,00	0,16	0,13
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω
Z_{ref}	☐ *1-phase*		R =	0,4	Ω	X =	0,25	Ω
	☒ *3-phase*		R =	0,24	Ω	X =	0,15	Ω

Results: L2 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,40	0,16	0,00	0,42	0,15	0,00	0,17	0,14
Normalized to standard impedance	0,40	0,16	0,00	0,42	0,15	0,00	0,17	0,14
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω

Z_{ref}	☐ *1-phase*	R = 0,4 Ω	X = 0,25 Ω
	☒ *3-phase*	R = 0,24 Ω	X = 0,15 Ω

Results: L3 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,25	0,24	0,00	0,38	0,16	0,00	0,16	0,13
Normalized to standard impedance	0,25	0,24	0,00	0,38	0,16	0,00	0,16	0,13
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R = 0,24 Ω			X = 0,15 Ω		
Z_{ref}	☐ *1-phase*		R = 0,4 Ω			X = 0,25 Ω		
	☒ *3-phase*		R = 0,24 Ω			X = 0,15 Ω		

Flicker for rated current ≤ 75A			**P**
Result: **PCS-3-4KW-25A-1**			
Grid impedance angle ψ_k	☒ 32° or ☐ 45°		
Phase	L1	L2	L3
☒ DIN EN 61000-3-3 (VDE 0838-3) ☐ DIN EN 61000-3-11 (VDE 0838-11)	3,2	3,4	3,2

Flicker for rated current ≥ 75A									**N/A**
☐ DIN EN 61000-3-3 (VDE 0838-3)			☐ DIN EN 61000-3-11 (VDE 0838-11)						
Result:									
Phase **P/Pn [%]**	**L1**			**L2**			**L3**		
	P_{lt}	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**
0%	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--
50%	--	--	--	--	--	--	--	--	--
60%	--	--	--	--	--	--	--	--	--
70%	--	--	--	--	--	--	--	--	--
80%	--	--	--	--	--	--	--	--	--
90%	--	--	--	--	--	--	--	--	--
100%	--	--	--	--	--	--	--	--	--

Flicker for rated currents >75A (at SCR = 20) (Calculation Flicker meter according to TG3)				**N/A**
Test conditions: Voltage: 86% Un to 109% Un Frequency: 50 Hz ± 0,5% THD of the voltage supply: ≤ 3 % Voltage rise of the PGU at 100% Pn: ≤ 3 %				
Assessment criterion: Long-term flicker strength: Plt≤0,5				
Rated Output voltage [V]				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	--	--	--	--
Short-term Flicker Pst [1]	--	--	--	--
Flicker step factor k(fψk) [1]	--	--	--	--
Voltage changes factor k(uψk) [1]	--	--	--	--

5.1.3 Flickers	P

Test procedure and test conditions:

These tests serve to verify the requirements of TOR D2, Section 9.2.4.

Voltage: 86% U_n to 109% U_n
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %

Voltage rises of the PGU at 100 *Pn* %: ≤ 3 %

Assessment criterion:

Long-term flicker strength: P_{lt}≤0,5

Determination of the flicker coefficient:

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

$$c_{\psi k} = P_{st} \times (S_k / P_n)$$

Output parameters of grid	**Voltage [V]:**	**230,01**	**Frequency [Hz]:**	**50**

EUT		**Selection of limits**	
☐ *1-phase*	☒ *3-phase*	☒ Equipment with rated current ≤16 A per phase *IEC EN 61000-3-3*	☐ Equipment with rated current ≤75 A per phase *IEC EN 61000-3-11*
PCS-3-10KW-40A-1			

Results: L1 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,33	0,33	0,00	0,31	0,30	0,00	0,10	0.09
Normalized to standard impedance	0,33	0,33	0,00	0,31	0,30	0,00	0,10	0.09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω
Z_{ref}	☐ *1-phase*		R =	0,4	Ω	X =	0,25	Ω
	☒ *3-phase*		R =	0,24	Ω	X =	0,15	Ω

Results: L2 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,34	0,08	0,00	0,32	0,07	0,00	0,09	0,09
Normalized to standard impedance	0,34	0,08	0,00	0,32	0,07	0,00	0,09	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω

5.1.3 Flickers	P

Z_{ref}	☐ *1-phase*	R =	0,4	Ω	X =	0,25	Ω	
	☒ *3-phase*	R =	0,24	Ω	X =	0,15	Ω	

Results: L3 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,31	0,29	0,00	0,33	0,29	0,00	0,10	0,09
Normalized to standard impedance	0,31	0,29	0,00	0,33	0,29	0,00	0,10	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R = 0,24 Ω			X = 0,15 Ω		
Z_{ref}	☐ *1-phase*		R = 0,4 Ω			X = 0,25 Ω		
	☒ *3-phase*		R = 0,24 Ω			X = 0,15 Ω		

Flicker for rated current ≤ 75A			**P**
Result: **PCS-3-10KW-40A-1**			
Grid impedance angle ψ_k	☒ 32° or ☐ 45°		
Phase	L1	L2	L3
☒ DIN EN 61000-3-3 (VDE 0838-3) ☐ DIN EN 61000-3-11 (VDE 0838-11)	2,0	1,8	2,0

Flicker for rated current ≥ 75A									**N/A**
☐ DIN EN 61000-3-3 (VDE 0838-3)				☐ DIN EN 61000-3-11 (VDE 0838-11)					
Result:									
Phase **P/Pn [%]**	**L1**			**L2**			**L3**		
	P_{lt}	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**
0%	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--
50%	--	--	--	--	--	--	--	--	--
60%	--	--	--	--	--	--	--	--	--
70%	--	--	--	--	--	--	--	--	--
80%	--	--	--	--	--	--	--	--	--
90%	--	--	--	--	--	--	--	--	--
100%	--	--	--	--	--	--	--	--	--

5.1.3 Flickers	P

Flicker for rated currents >75A (at SCR = 20) (Calculation Flicker meter according to TG3)				N/A
Test conditions: Voltage: 86% Un to 109% Un Frequency: 50 Hz ± 0,5% THD of the voltage supply: ≤ 3 % Voltage rise of the PGU at 100% Pn: ≤ 3 %				
Assessment criterion: Long-term flicker strength: Plt≤0,5				
Rated Output voltage [V]				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	--	--	--	--
Short-term Flicker Pst [1]	--	--	--	--
Flicker step factor k(fψk) [1]	--	--	--	--
Voltage changes factor k(uψk) [1]	--	--	--	--

5.1.3 Flickers	P

Test procedure and test conditions:

These tests serve to verify the requirements of TOR D2, Section 9.2.4.

Voltage: 86% U_n to 109% U_n
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %

Voltage rises of the PGU at 100 *Pn* %: ≤ 3 %

Assessment criterion:

Long-term flicker strength: P_{lt}≤0,5

Determination of the flicker coefficient:

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

$$c_{\psi k} = P_{st} \times (S_k / P_n)$$

Output parameters of grid	**Voltage [V]:**	**230,01**	**Frequency [Hz]:**	**50**

EUT		**Selection of limits**	
☐ *1-phase*	☒ *3-phase*	☐ Equipment with rated current ≤16 A per phase *IEC EN 61000-3-3*	☒ Equipment with rated current ≤75 A per phase *IEC EN 61000-3-11*
PCS-3-12KW-25A-1			

Results: L1 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,28	0,06	0,00	0,38	0,37	0,00	0,10	0,09
Normalized to standard impedance	0,28	0,06	0,00	0,38	0,37	0,00	0,10	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω
Z_{ref}	☐ *1-phase*		R =	0,4	Ω	X =	0,25	Ω
	☒ *3-phase*		R =	0,24	Ω	X =	0,15	Ω

Results: L2 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,41	0,13	0,00	0,33	0,09	0,00	0,10	0,09
Normalized to standard impedance	0,41	0,13	0,00	0,33	0,09	0,00	0,10	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,24	Ω	X =	0,15	Ω

5.1.3 Flickers	P

Z_{ref}	☐ *1-phase*	R =	0,4	Ω	X =	0,25	Ω	
	☒ *3-phase*	R =	0,24	Ω	X =	0,15	Ω	

Results: L3 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,34	0,12	0,00	0,34	0,33	0,00	0,09	0,09
Normalized to standard impedance	0,34	0,12	0,00	0,34	0,33	0,00	0,09	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R = 0,24 Ω			X = 0,15 Ω		
Z_{ref}	☐ *1-phase*		R = 0,4 Ω			X = 0,25 Ω		
	☒ *3-phase*		R = 0,24 Ω			X = 0,15 Ω		

Flicker for rated current ≤ 75A			**P**
Result: **PCS-3-12KW-25A-1**			
Grid impedance angle ψ_k	☒ 32° or ☐ 45°		
Phase	L1	L2	L3
☐ DIN EN 61000-3-3 (VDE 0838-3) ☒ DIN EN 61000-3-11 (VDE 0838-11)	2,0	2,0	1,8

Flicker for rated current ≥ 75A									**N/A**
☐ DIN EN 61000-3-3 (VDE 0838-3)				☐ DIN EN 61000-3-11 (VDE 0838-11)					
Result:									
Phase **P/Pn [%]**	**L1**			**L2**			**L3**		
	P_{lt}	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**
0%	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--
50%	--	--	--	--	--	--	--	--	--
60%	--	--	--	--	--	--	--	--	--
70%	--	--	--	--	--	--	--	--	--
80%	--	--	--	--	--	--	--	--	--
90%	--	--	--	--	--	--	--	--	--
100%	--	--	--	--	--	--	--	--	--

5.1.3 Flickers	P

Flicker for rated currents >75A (at SCR = 20) (Calculation Flickermeter according to TG3)				N/A
Test conditions: Voltage: 86% Un to 109% Un Frequency: 50 Hz ± 0,5% THD of the voltage supply: ≤ 3 % Voltage rise of the PGU at 100% Pn: ≤ 3 %				
Assessment criterion: Long-term flicker strength: Plt≤0,5				
Rated Output voltage [V]				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	--	--	--	--
Short-term Flicker Pst [1]	--	--	--	--
Flicker step factor k(fψk) [1]	--	--	--	--
Voltage changes factor k(uψk) [1]	--	--	--	--

5.1.3 Flickers	P

Test procedure and test conditions:

These tests serve to verify the requirements of TOR D2, Section 9.2.4.

Voltage: 86% U_n to 109% U_n
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %

Voltage rises of the PGU at 100 *Pn* %: ≤ 3 %

Assessment criterion:

Long-term flicker strength: P_{lt}≤0,5

Determination of the flicker coefficient:

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

$$c_{\psi k} = P_{st} \times (S_k / P_n)$$

Output parameters of grid	Voltage [V]:	230,06	Frequency [Hz]:	50

EUT		Selection of limits	
☐ *1-phase*	☒ *3-phase*	☐ Equipment with rated current ≤16 A per phase	☒ Equipment with rated current ≤75 A per phase
PCS-3-20KW-40A-1		*IEC EN 61000-3-3*	*IEC EN 61000-3-11*

Results: L1 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,40	0,20	0,00	0,35	0,32	0,00	0,12	0,10
Normalized to standard impedance	0,40	0,20	0,00	0,35	0,32	0,00	0,12	0,10
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,4	Ω	X =	0,25	Ω
Z_{ref}	☐ *1-phase*		R =	0,4	Ω	X =	0,25	Ω
	☒ *3-phase*		R =	0,24	Ω	X =	0,15	Ω

Results: L2 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,33	0,32	0,00	0,28	0,23	0,00	0,12	0,09
Normalized to standard impedance	0,33	0,32	0,00	0,28	0,23	0,00	0,12	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R =	0,4	Ω	X =	0,25	Ω
Z_{ref}	☐ *1-phase*		R =	0,4	Ω	X =	0,25	Ω

5.1.3 Flickers	P

	☒ *3-phase*	R = 0,24 Ω	X = 0,15 Ω

Results: L3 phase

	Starting			Stopping			Running	
	d_{max}	d_c	T_{max}	d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Measured Values at test impedance	0,29	0,06	0,00	0,36	0,26	0,00	0,12	0,09
Normalized to standard impedance	0,29	0,06	0,00	0,36	0,26	0,00	0,12	0,09
Limits according to 61000-3-3 & 61000-3-11	4%	3,3%	500 ms	4%	3,3%	500 ms	1,0	0,5
Z_{test}			R = 0,4 Ω			X = 0,25 Ω		
Z_{ref}	☐ *1-phase*		R = 0,4 Ω			X = 0,25 Ω		
	☒ *3-phase*		R = 0,24 Ω			X = 0,15 Ω		

Flicker for rated current ≤ 75A	P

Result: **PCS-3-20KW-40A-1**

Grid impedance angle ψ_k	☒ 32° or ☐ 45°		
Phase	L1	L2	L3
☐ DIN EN 61000-3-3 (VDE 0838-3) ☒ DIN EN 61000-3-11 (VDE 0838-11)	2,4	2,4	2,4

Flicker for rated current ≥ 75A	N/A

☐ DIN EN 61000-3-3 (VDE 0838-3)	☐ DIN EN 61000-3-11 (VDE 0838-11)

Result:

Phase **P/Pn [%]**	**L1**			**L2**			**L3**		
	P_{lt}	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**	**P_{lt}**	**P_{st}**	**dc%**
0%	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--
50%	--	--	--	--	--	--	--	--	--
60%	--	--	--	--	--	--	--	--	--
70%	--	--	--	--	--	--	--	--	--
80%	--	--	--	--	--	--	--	--	--
90%	--	--	--	--	--	--	--	--	--
100%	--	--	--	--	--	--	--	--	--

5.1.3 Flickers	P

Flicker for rated currents >75A (at SCR = 20) (Calculation Flickermeter according to TG3)				N/A
Test conditions: Voltage: 86% Un to 109% Un Frequency: 50 Hz ± 0,5% THD of the voltage supply: ≤ 3 % Voltage rise of the PGU at 100% Pn: ≤ 3 %				
Assessment criterion: Long-term flicker strength: Plt≤0,5				
Rated Output voltage [V]				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	--	--	--	--
Short-term Flicker Pst [1]	--	--	--	--
Flicker step factor k(fψk) [1]	--	--	--	--
Voltage changes factor k(uψk) [1]	--	--	--	--
Note: The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-40A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software. [1)] Refer to **Differences of the model**.				

5.1.4 Harmonics and Interharmonics	P

Test procedure and test conditions:

These tests serve to demonstrate the requirements of TOR D2, Section 9.2.5.

The harmonics, interharmonics and higher frequencies are each phase values of three phases.

The currents of the interharmonics to 2 kHz must be measured in accordance with DIN EN 61000-4-7 (VDE 0817-4-7), Annex A.

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

Voltage: 230Vac ± 1,0%

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3,0%

Voltage rises of the PGU at 100% Pn: ≤ 3,0%

5.1.4 a) Test Harmonics DIN EN 61000-3-2 (≤16 A per Phase)							P
PCS-3-4KW-25A-1							
Power Level	**33%**						
Phase	**L1**		**L2**		**L3**		
AC Power [W]	439		439		439		
AC Voltage [V]	230,02		230,00		230,05		
AC Current [A]	1,908		1,908		1,908		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	4,762		4,409		4,444		
PWHD [%]	15,744		14,965		15,049		
Harmonic	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Harmonic Current Limits (A)**
1st	1,907	--	1,955	--	1,927	--	--
2nd	0,035	1,817	0,028	1,443	0,035	1,833	1,080
3rd	0,018	0,956	0,011	0,539	0,027	1,408	2,300
4th	0,010	0,527	0,011	0,555	0,008	0,414	0,430
5th	0,026	1,345	0,011	0,549	0,012	0,604	1,140
6th	0,019	0,986	0,014	0,696	0,010	0,513	0,300
7th	0,016	0,856	0,018	0,930	0,017	0,876	0,770
8th	0,018	0,929	0,022	1,118	0,010	0,514	0,263
9th	0,011	0,565	0,014	0,740	0,022	1,119	0,400
10th	0,019	1,022	0,015	0,777	0,012	0,626	0,184
11th	0,015	0,802	0,014	0,697	0,017	0,883	0,330
12th	0,004	0,232	0,008	0,410	0,004	0,230	0,153
13th	0,019	1,021	0,028	1,420	0,015	0,798	0,210
14th	0,007	0,367	0,008	0,404	0,002	0,111	0,131
15th	0,005	0,285	0,008	0,395	0,008	0,397	0,150
16th	0,007	0,351	0,007	0,360	0,003	0,142	0,115
17th	0,034	1,760	0,037	1,890	0,030	1,583	0,132
18th	0,003	0,164	0,005	0,247	0,002	0,102	0,102
19th	0,028	1,465	0,026	1,321	0,024	1,230	0,188
20th	0,002	0,128	0,003	0,132	0,003	0,137	0,092
21th	0,002	0,084	0,004	0,195	0,003	0,143	0,107
22th	0,003	0,148	0,004	0,191	0,001	0,076	0,084
23th	0,014	0,749	0,015	0,764	0,018	0,938	0,098
24th	0,002	0,108	0,004	0,209	0,003	0,136	0,077
25th	0,019	0,987	0,015	0,765	0,019	0,978	0,090
26th	0,004	0,187	0,003	0,178	0,001	0,054	0,071
27th	0,001	0,076	0,004	0,183	0,002	0,102	0,080
28th	0,004	0,193	0,005	0,231	0,002	0,126	0,066
29th	0,015	0,804	0,015	0,792	0,016	0,828	0,078

30th	0,002	0,115	0,002	0,126	0,002	0,128	0,061
31th	0,027	1,412	0,024	1,209	0,024	1,243	0,073
32th	0,002	0,084	0,003	0,139	0,004	0,184	0,057
33th	0,002	0,113	0,004	0,200	0,011	0,566	0,068
34th	0,001	0,067	0,002	0,085	0,002	0,089	0,054
35th	0,013	0,674	0,012	0,633	0,011	0,587	0,064
36th	0,002	0,094	0,002	0,095	0,003	0,131	0,051
37th	0,010	0,516	0,009	0,443	0,011	0,579	0,061
38th	0,001	0,031	0,001	0,036	0,001	0,040	0,048
39th	0,001	0,070	0,001	0,049	0,002	0,098	0,058
40th	0,001	0,073	0,001	0,050	0,001	0,041	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	7
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,24 jX_A = 0,15 R_N = 0,16 jX_N = 0,10

Power Level	66%						
Phase	L1		L2		L3		
AC Power [W]	879		874		876		
AC Voltage [V]	230,35		230,28		230,44		
AC Current [A]	3,818		3,800		3,804		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,375		1,402		1,380		
PWHD [%]	3,730		3,673		3,740		
Harmonic	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Harmonic Current Limits (A)
1st	3,816	--	3,798	--	3,801	--	--
2nd	0,018	0,482	0,024	0,632	0,010	0,275	1,080
3rd	0,008	0,213	0,013	0,334	0,013	0,351	2,300
4th	0,020	0,517	0,019	0,511	0,025	0,650	0,430
5th	0,025	0,665	0,021	0,548	0,021	0,547	1,140
6th	0,002	0,060	0,004	0,114	0,005	0,120	0,300
7th	0,012	0,308	0,008	0,210	0,010	0,257	0,770
8th	0,006	0,149	0,007	0,197	0,007	0,193	0,263
9th	0,003	0,068	0,004	0,107	0,005	0,122	0,400
10th	0,013	0,335	0,013	0,332	0,015	0,393	0,184
11th	0,008	0,209	0,011	0,282	0,010	0,258	0,330
12th	0,002	0,061	0,003	0,086	0,003	0,081	0,153
13th	0,011	0,287	0,010	0,255	0,011	0,280	0,210
14th	0,003	0,088	0,003	0,085	0,004	0,115	0,131
15th	0,002	0,059	0,003	0,071	0,003	0,072	0,150
16th	0,003	0,066	0,003	0,066	0,003	0,073	0,115
17th	0,010	0,261	0,010	0,266	0,011	0,298	0,132
18th	0,002	0,061	0,002	0,061	0,002	0,061	0,102
19th	0,011	0,283	0,010	0,275	0,009	0,244	0,188
20th	0,002	0,060	0,003	0,067	0,003	0,072	0,092
21th	0,002	0,061	0,003	0,075	0,003	0,081	0,107
22th	0,002	0,063	0,002	0,060	0,003	0,071	0,084
23th	0,008	0,204	0,009	0,234	0,008	0,208	0,098
24th	0,002	0,062	0,003	0,066	0,002	0,064	0,077
25th	0,010	0,266	0,008	0,218	0,009	0,241	0,090
26th	0,002	0,059	0,003	0,072	0,003	0,077	0,071
27th	0,002	0,059	0,003	0,080	0,003	0,075	0,080
28th	0,004	0,100	0,003	0,084	0,004	0,108	0,066
29th	0,007	0,182	0,008	0,211	0,008	0,221	0,078
30th	0,002	0,059	0,002	0,066	0,003	0,068	0,061
31th	0,010	0,275	0,010	0,264	0,010	0,253	0,073
32th	0,003	0,084	0,003	0,085	0,004	0,102	0,057

33th	0,002	0,058	0,002	0,064	0,002	0,065	0,068
34th	0,003	0,068	0,003	0,070	0,002	0,063	0,054
35th	0,007	0,179	0,007	0,188	0,007	0,181	0,064
36th	0,002	0,060	0,002	0,063	0,002	0,062	0,051
37th	0,008	0,216	0,007	0,173	0,007	0,192	0,061
38th	0,002	0,062	0,003	0,070	0,002	0,065	0,048
39th	0,002	0,057	0,003	0,070	0,003	0,071	0,058
40th	0,003	0,082	0,003	0,072	0,003	0,082	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	7
FFU of PV curve [1]	1
Impedance [Ω]	
Line	$R_A = 0,24$ $jX_A = 0,15$
Neutral	$R_N = 0,16$ $jX_N = 0,10$

Power Level	100%						
Phase	L1		L2		L3		
AC Power [W]	1354		1362		1349		
AC Voltage [V]	230,14		230,16		230,23		
AC Current [A]	5,882		5,917		5,861		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	2,245		2,297		2,301		
PWHD [%]	6,419		6,392		6,554		
Harmonic	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Harmonic Current Limits (A)
1st	5,866	--	5,893	--	5,844	--	--
2nd	0,022	0,375	0,039	0,662	0,022	0,376	1,080
3rd	0,031	0,528	0,022	0,373	0,037	0,633	2,300
4th	0,023	0,392	0,026	0,441	0,028	0,479	0,430
5th	0,063	1,074	0,059	1,001	0,045	0,770	1,140
6th	0,014	0,239	0,011	0,187	0,016	0,274	0,300
7th	0,036	0,614	0,041	0,696	0,048	0,821	0,770
8th	0,047	0,801	0,051	0,865	0,055	0,941	0,263
9th	0,012	0,205	0,010	0,170	0,012	0,205	0,400
10th	0,038	0,648	0,038	0,645	0,038	0,650	0,184
11th	0,015	0,256	0,019	0,322	0,013	0,222	0,330
12th	0,012	0,205	0,010	0,170	0,012	0,205	0,153
13th	0,012	0,205	0,012	0,204	0,012	0,205	0,210
14th	0,015	0,256	0,013	0,221	0,013	0,222	0,131
15th	0,011	0,188	0,011	0,187	0,011	0,188	0,150
16th	0,015	0,256	0,014	0,238	0,013	0,222	0,115
17th	0,024	0,409	0,020	0,339	0,020	0,342	0,132
18th	0,011	0,188	0,011	0,187	0,011	0,188	0,102
19th	0,021	0,358	0,027	0,458	0,029	0,496	0,188
20th	0,010	0,170	0,012	0,204	0,011	0,188	0,092
21th	0,012	0,205	0,011	0,187	0,012	0,205	0,107
22th	0,011	0,188	0,011	0,187	0,011	0,188	0,084
23th	0,025	0,426	0,024	0,407	0,027	0,462	0,098
24th	0,011	0,188	0,011	0,187	0,012	0,205	0,077
25th	0,018	0,307	0,023	0,390	0,016	0,274	0,090
26th	0,013	0,222	0,012	0,204	0,013	0,222	0,071
27th	0,011	0,188	0,011	0,187	0,011	0,188	0,080
28th	0,014	0,239	0,013	0,221	0,013	0,222	0,066
29th	0,017	0,290	0,015	0,255	0,017	0,291	0,078
30th	0,011	0,188	0,010	0,170	0,011	0,188	0,061
31th	0,016	0,273	0,013	0,221	0,016	0,274	0,073
32th	0,011	0,188	0,012	0,204	0,011	0,188	0,057

33th	0,011	0,188	0,010	0,170	0,011	0,188	0,068
34th	0,011	0,188	0,011	0,187	0,011	0,188	0,054
35th	0,015	0,256	0,014	0,238	0,016	0,274	0,064
36th	0,011	0,188	0,011	0,187	0,011	0,188	0,051
37th	0,015	0,256	0,018	0,305	0,015	0,257	0,061
38th	0,011	0,188	0,010	0,170	0,011	0,188	0,048
39th	0,011	0,188	0,010	0,170	0,011	0,188	0,058
40th	0,011	0,188	0,011	0,187	0,011	0,188	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	7
FFU of PV curve [1]	1
Impedance [Ω]	
Line	$R_A = 0,24\ jX_A = 0,15$
Neutral	$R_N = 0,16\ jX_N = 0,10$

5.1.4 a) Test Harmonics DIN EN 61000-3-2 (≤16 A per Phase)							P
PCS-3-10KW-40A-1							
Power Level	**33%**						
Phase	**L1**		**L2**		**L3**		
AC Power [W]	1120		1120		1123		
AC Voltage [V]	230,01		229,99		230,06		
AC Current [A]	4,871		4,871		4,880		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	4,211		3,949		4,265		
PWHD [%]	5,970		5,869		5,873		
Harmonic	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Harmonic Current Limits (A)**
1st	4,895	--	4,869	--	4,909	--	--
2nd	0,038	0,770	0,030	0,620	0,037	0,753	1,080
3rd	0,058	1,185	0,019	0,381	0,039	0,792	2,300
4th	0,011	0,226	0,014	0,294	0,011	0,223	0,430
5th	0,109	2,236	0,103	2,123	0,117	2,381	1,140
6th	0,016	0,336	0,013	0,272	0,009	0,192	0,300
7th	0,125	2,555	0,125	2,563	0,134	2,731	0,770
8th	0,018	0,360	0,022	0,450	0,010	0,210	0,263
9th	0,008	0,167	0,014	0,291	0,018	0,376	0,400
10th	0,019	0,387	0,015	0,302	0,011	0,230	0,184
11th	0,066	1,358	0,057	1,162	0,061	1,236	0,330
12th	0,004	0,076	0,007	0,144	0,004	0,076	0,153
13th	0,034	0,692	0,040	0,830	0,040	0,816	0,210
14th	0,006	0,117	0,007	0,153	0,002	0,051	0,131
15th	0,005	0,100	0,007	0,138	0,005	0,112	0,150
16th	0,006	0,124	0,007	0,142	0,003	0,051	0,115
17th	0,021	0,426	0,025	0,509	0,020	0,411	0,132
18th	0,004	0,077	0,005	0,094	0,001	0,027	0,102
19th	0,023	0,465	0,020	0,413	0,020	0,403	0,188
20th	0,002	0,051	0,002	0,035	0,003	0,052	0,092
21th	0,002	0,049	0,003	0,058	0,003	0,061	0,107
22th	0,002	0,036	0,002	0,047	0,001	0,021	0,084
23th	0,021	0,432	0,019	0,393	0,023	0,460	0,098
24th	0,002	0,040	0,003	0,061	0,002	0,031	0,077
25th	0,021	0,433	0,020	0,412	0,023	0,462	0,090
26th	0,003	0,070	0,003	0,071	0,001	0,029	0,071
27th	0,002	0,032	0,003	0,063	0,004	0,076	0,080
28th	0,003	0,064	0,003	0,070	0,002	0,046	0,066
29th	0,022	0,451	0,021	0,429	0,020	0,399	0,078

30th	0,002	0,036	0,002	0,031	0,001	0,026	0,061
31th	0,018	0,360	0,018	0,360	0,018	0,376	0,073
32th	0,001	0,018	0,002	0,033	0,002	0,034	0,057
33th	0,002	0,048	0,003	0,066	0,010	0,207	0,068
34th	0,001	0,023	0,001	0,026	0,002	0,033	0,054
35th	0,022	0,447	0,021	0,437	0,020	0,411	0,064
36th	0,001	0,022	0,001	0,017	0,001	0,026	0,051
37th	0,009	0,176	0,008	0,161	0,009	0,176	0,061
38th	0,001	0,015	0,001	0,022	0,001	0,020	0,048
39th	0,002	0,040	0,001	0,022	0,001	0,030	0,058
40th	0,001	0,028	0,001	0,027	0,001	0,020	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	17
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,24 jX_A = 0,15 R_N = 0,16 jX_N = 0,10

Power Level	66%						
Phase	L1		L2		L3		
AC Power [W]	2207		2207		2206		
AC Voltage [V]	230,12		230,14		230,13		
AC Current [A]	9,589		9,588		9,588		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	3,624		3,639		3,703		
PWHD [%]	6,667		6,722		6,489		
Harmonic	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Current Magnitude (A)	% of Funda-mental	Harmonic Current Limits (A)
1st	9,554	--	9,601	--	9,543	--	--
2nd	0,049	0,513	0,047	0,490	0,039	0,409	1,080
3rd	0,059	0,618	0,040	0,417	0,021	0,220	2,300
4th	0,049	0,513	0,050	0,521	0,038	0,398	0,430
5th	0,235	2,460	0,244	2,541	0,252	2,641	1,140
6th	0,021	0,220	0,020	0,208	0,008	0,084	0,300
7th	0,153	1,601	0,156	1,625	0,168	1,760	0,770
8th	0,016	0,167	0,016	0,167	0,005	0,052	0,263
9th	0,011	0,115	0,014	0,146	0,015	0,157	0,400
10th	0,029	0,304	0,030	0,312	0,021	0,220	0,184
11th	0,107	1,120	0,091	0,948	0,093	0,975	0,330
12th	0,007	0,073	0,010	0,104	0,006	0,063	0,153
13th	0,066	0,691	0,078	0,812	0,076	0,796	0,210
14th	0,006	0,063	0,008	0,083	0,004	0,042	0,131
15th	0,005	0,052	0,008	0,083	0,004	0,042	0,150
16th	0,007	0,073	0,009	0,094	0,006	0,063	0,115
17th	0,056	0,586	0,053	0,552	0,050	0,524	0,132
18th	0,004	0,042	0,004	0,042	0,004	0,042	0,102
19th	0,054	0,565	0,056	0,583	0,056	0,587	0,188
20th	0,003	0,031	0,003	0,031	0,004	0,042	0,092
21th	0,003	0,031	0,004	0,042	0,008	0,084	0,107
22th	0,003	0,031	0,003	0,031	0,002	0,021	0,084
23th	0,046	0,481	0,041	0,427	0,041	0,430	0,098
24th	0,003	0,031	0,005	0,052	0,003	0,031	0,077
25th	0,022	0,230	0,026	0,271	0,028	0,293	0,090
26th	0,004	0,042	0,005	0,052	0,003	0,031	0,071
27th	0,003	0,031	0,006	0,062	0,005	0,052	0,080
28th	0,005	0,052	0,006	0,062	0,003	0,031	0,066
29th	0,023	0,241	0,021	0,219	0,017	0,178	0,078
30th	0,002	0,021	0,004	0,042	0,003	0,031	0,061
31th	0,032	0,335	0,035	0,365	0,031	0,325	0,073
32th	0,001	0,010	0,003	0,031	0,004	0,042	0,057

33th	0,002	0,021	0,004	0,042	0,004	0,042	0,068
34th	0,002	0,021	0,002	0,021	0,002	0,021	0,054
35th	0,030	0,314	0,033	0,344	0,028	0,293	0,064
36th	0,003	0,031	0,002	0,021	0,003	0,031	0,051
37th	0,063	0,659	0,063	0,656	0,063	0,660	0,061
38th	0,011	0,115	0,010	0,104	0,009	0,094	0,048
39th	0,005	0,052	0,011	0,115	0,005	0,052	0,058
40th	0,003	0,031	0,003	0,031	0,003	0,031	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	17
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Power Level	100%						
Phase	L1		L2		L3		
AC Power [W]	3346		3362		3334		
AC Voltage [V]	230,17		230,13		230,06		
AC Current [A]	14,537		14,610		14,491		
Frequency [Hz]	50,00		50,00		50,00		
THD [%]	1,850		1,949		1,949		
PWHD [%]	5,409		5,494		5,628		
Harmonic	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Harmonic Current Limits (A)**
1st	14,508	--	14,569	--	14,461	--	--
2nd	0,044	0,303	0,080	0,549	0,045	0,311	1,080
3rd	0,069	0,476	0,057	0,391	0,074	0,512	2,300
4th	0,051	0,352	0,049	0,336	0,063	0,436	0,430
5th	0,117	0,806	0,120	0,824	0,088	0,609	1,140
6th	0,029	0,200	0,022	0,151	0,038	0,263	0,300
7th	0,055	0,379	0,079	0,542	0,088	0,609	0,770
8th	0,101	0,696	0,104	0,714	0,117	0,809	0,263
9th	0,027	0,186	0,022	0,151	0,028	0,194	0,400
10th	0,086	0,593	0,083	0,570	0,087	0,602	0,184
11th	0,036	0,248	0,051	0,350	0,045	0,311	0,330
12th	0,024	0,165	0,022	0,151	0,024	0,166	0,153
13th	0,038	0,262	0,042	0,288	0,031	0,214	0,210
14th	0,031	0,214	0,026	0,178	0,026	0,180	0,131
15th	0,021	0,145	0,023	0,158	0,023	0,159	0,150
16th	0,031	0,214	0,030	0,206	0,029	0,201	0,115
17th	0,035	0,241	0,033	0,227	0,031	0,214	0,132
18th	0,022	0,152	0,021	0,144	0,022	0,152	0,102
19th	0,038	0,262	0,044	0,302	0,050	0,346	0,188
20th	0,025	0,172	0,025	0,172	0,024	0,166	0,092
21th	0,026	0,179	0,021	0,144	0,024	0,166	0,107
22th	0,022	0,152	0,021	0,144	0,023	0,159	0,084
23th	0,043	0,296	0,042	0,288	0,053	0,367	0,098
24th	0,023	0,159	0,022	0,151	0,023	0,159	0,077
25th	0,045	0,310	0,058	0,398	0,046	0,318	0,090
26th	0,022	0,152	0,023	0,158	0,026	0,180	0,071
27th	0,024	0,165	0,021	0,144	0,025	0,173	0,080
28th	0,027	0,186	0,029	0,199	0,029	0,201	0,066
29th	0,052	0,358	0,041	0,281	0,050	0,346	0,078
30th	0,021	0,145	0,022	0,151	0,022	0,152	0,061
31th	0,042	0,289	0,047	0,323	0,041	0,284	0,073
32th	0,026	0,179	0,025	0,172	0,026	0,180	0,057

33th	0,020	0,138	0,022	0,151	0,022	0,152	0,068
34th	0,022	0,152	0,024	0,165	0,025	0,173	0,054
35th	0,030	0,207	0,035	0,240	0,033	0,228	0,064
36th	0,021	0,145	0,021	0,144	0,021	0,145	0,051
37th	0,030	0,207	0,029	0,199	0,027	0,187	0,061
38th	0,021	0,145	0,021	0,144	0,023	0,159	0,048
39th	0,021	0,145	0,021	0,144	0,021	0,145	0,058
40th	0,022	0,152	0,021	0,144	0,022	0,152	0,046

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	17
FFU of PV curve [1]	1
Impedance [Ω]	
Line	$R_A = 0,24\ jX_A = 0,15$
Neutral	$R_N = 0,16\ jX_N = 0,10$

5.1.4 a) Test Harmonics DIN EN 61000-3-12 (>16 A per Phase)	P

Note:

THC and PWHC values calculated according to IEC 61000-3-12:2018+AMD1:2020 as follows:

total harmonic current

THC

total r.m.s. value of the harmonic current components of orders 2 to 40

$$THC = \sqrt{\sum_{h=2}^{40} I_h^2}$$

partial weighted harmonic current

PWHC

total r.m.s. value of a selected group of higher order harmonic current components (in this International Standard from order 14 to order 40), weighted with the harmonic order h

$$PWHC = \sqrt{\sum_{h=14}^{40} h \cdot I_h^2}$$

In this test report the following applies:

I_{ref} = I_n.

PCS-3-12KW-25A-1

Test condition:

Power Level	33%							
Phase	L1		L2		L3			
AC Power [W]	1301		1328		1312			
AC Voltage [V]	230,08		230,15		230,12		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	5,656		5,768		5,701			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	5,637	--	5,750	--	5,689	--	---	---
2nd	0,025	0,144	0,054	0,311	0,039	0,224	8	8
3rd	0,048	0,276	0,012	0,069	0,027	0,155	21,6	---
4th	0,031	0,178	0,028	0,161	0,029	0,167	4	4
5th	0,163	0,937	0,159	0,914	0,169	0,972	10,7	10,7
6th	0,013	0,075	0,008	0,046	0,007	0,040	2,67	2,67
7th	0,104	0,598	0,100	0,575	0,110	0,633	7,2	7,2
8th	0,022	0,127	0,022	0,127	0,010	0,058	2	2
9th	0,012	0,069	0,013	0,075	0,012	0,069	3,8	---
10th	0,022	0,127	0,019	0,109	0,014	0,081	1,6	1,6
11th	0,068	0,391	0,058	0,334	0,058	0,334	3,1	3,1
12th	0,005	0,029	0,009	0,052	0,005	0,029	1,33	1,33
13th	0,039	0,224	0,046	0,265	0,045	0,259	2	2
14th	0,011	0,063	0,013	0,075	0,005	0,029	---	---
15th	0,005	0,029	0,007	0,040	0,003	0,017	---	---

16th	0,006	0,035	0,006	0,035	0,003	0,017	---	---
17th	0,026	0,150	0,029	0,167	0,024	0,138	---	---
18th	0,004	0,023	0,004	0,023	0,002	0,012	---	---
19th	0,026	0,150	0,025	0,144	0,024	0,138	---	---
20th	0,003	0,017	0,002	0,012	0,003	0,017	---	---
21st	0,003	0,017	0,003	0,017	0,002	0,012	---	---
22nd	0,002	0,012	0,002	0,012	0,002	0,012	---	---
23rd	0,019	0,109	0,017	0,098	0,019	0,109	---	---
24th	0,002	0,012	0,003	0,017	0,002	0,012	---	---
25th	0,015	0,086	0,015	0,086	0,017	0,098	---	---
26th	0,004	0,023	0,004	0,023	0,002	0,012	---	---
27th	0,003	0,017	0,005	0,029	0,004	0,023	---	---
28th	0,003	0,017	0,003	0,017	0,003	0,017	---	---
29th	0,020	0,115	0,018	0,104	0,016	0,092	---	---
30th	0,003	0,017	0,003	0,017	0,003	0,017	---	---
31st	0,020	0,115	0,021	0,121	0,021	0,121	---	---
32nd	0,003	0,017	0,003	0,017	0,003	0,017	---	---
33rd	0,003	0,017	0,010	0,058	0,010	0,058	---	---
34th	0,003	0,017	0,003	0,017	0,002	0,012	---	---
35th	0,027	0,155	0,026	0,150	0,026	0,150	---	---
36th	0,003	0,017	0,003	0,017	0,003	0,017	---	---
37th	0,009	0,052	0,008	0,046	0,009	0,052	---	---
38th	0,001	0,006	0,001	0,006	0,001	0,006	---	---
39th	0,004	0,023	0,003	0,017	0,002	0,012	---	---
40th	0,002	0,012	0,002	0,012	0,001	0,006	---	---
THC / I_{ef} [%]	--	1,319	--	1,282	--	1,326	23	13
PWHC / I_{ref} [%]	--	1,795	--	1,804	--	1,730	23	22

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	20
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Test condition:								
Power Level	66%							
Phase	L1		L2		L3			
AC Power [W]	2631		2668		2655			
AC Voltage [V]	230,11		230,13		230,17		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	11,434		11,592		11,533			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	11,420	--	11,579	--	11,523	--	---	---
2nd	0,075	0,431	0,074	0,426	0,024	0,138	8	8
3rd	0,069	0,397	0,024	0,138	0,034	0,196	21,6	---
4th	0,043	0,247	0,036	0,207	0,034	0,196	4	4
5th	0,255	1,466	0,253	1,455	0,266	1,530	10,7	10,7
6th	0,017	0,098	0,014	0,081	0,006	0,035	2,67	2,67
7th	0,156	0,897	0,153	0,880	0,169	0,972	7,2	7,2
8th	0,019	0,109	0,018	0,104	0,004	0,023	2	2
9th	0,017	0,098	0,021	0,121	0,011	0,063	3,8	---
10th	0,026	0,150	0,026	0,150	0,014	0,081	1,6	1,6
11th	0,115	0,661	0,100	0,575	0,099	0,569	3,1	3,1
12th	0,007	0,040	0,013	0,075	0,007	0,040	1,33	1,33
13th	0,067	0,385	0,076	0,437	0,077	0,443	2	2
14th	0,014	0,081	0,013	0,075	0,004	0,023	---	---
15th	0,008	0,046	0,011	0,063	0,003	0,017	---	---
16th	0,005	0,029	0,008	0,046	0,005	0,029	---	---
17th	0,053	0,305	0,052	0,299	0,044	0,253	---	---
18th	0,003	0,017	0,004	0,023	0,003	0,017	---	---
19th	0,043	0,247	0,045	0,259	0,046	0,265	---	---
20th	0,002	0,012	0,003	0,017	0,002	0,012	---	---
21st	0,003	0,017	0,003	0,017	0,006	0,035	---	---
22nd	0,003	0,017	0,002	0,012	0,002	0,012	---	---
23rd	0,032	0,184	0,031	0,178	0,028	0,161	---	---
24th	0,002	0,012	0,003	0,017	0,002	0,012	---	---
25th	0,008	0,046	0,013	0,075	0,014	0,081	---	---
26th	0,002	0,012	0,003	0,017	0,002	0,012	---	---
27th	0,004	0,023	0,008	0,046	0,003	0,017	---	---
28th	0,003	0,017	0,004	0,023	0,002	0,012	---	---
29th	0,008	0,046	0,008	0,046	0,002	0,012	---	---
30th	0,003	0,017	0,006	0,035	0,003	0,017	---	---
31st	0,024	0,138	0,024	0,138	0,021	0,121	---	---
32nd	0,005	0,029	0,004	0,023	0,003	0,017	---	---

33rd	0,004	0,023	0,005	0,029	0,004	0,023	---	---
34th	0,005	0,029	0,007	0,040	0,008	0,046	---	---
35th	0,021	0,121	0,025	0,144	0,024	0,138	---	---
36th	0,003	0,017	0,004	0,023	0,002	0,012	---	---
37th	0,024	0,138	0,025	0,144	0,024	0,138	---	---
38th	0,006	0,035	0,007	0,040	0,005	0,029	---	---
39th	0,004	0,023	0,004	0,023	0,005	0,029	---	---
40th	0,003	0,017	0,002	0,012	0,003	0,017	---	---
THC / I_{ef} [%]	--	2,064	--	1,998	--	2,035	23	13
PWHC / I_{ref} [%]	--	2,407	--	2,515	--	2,296	23	22

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	20
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Test condition:								
Power Level	**100%**							
Phase	**L1**		**L2**		**L3**			
AC Power [W]	4025		4043		4011			
AC Voltage [V]	230,28		230,21		230,23		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	17,477		17,564		17,422			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	17,452	--	17,532	--	17,395	--	---	---
2nd	0,039	0,224	0,087	0,500	0,055	0,316	8	8
3rd	0,077	0,443	0,063	0,362	0,086	0,495	21,6	---
4th	0,062	0,357	0,047	0,270	0,072	0,414	4	4
5th	0,121	0,696	0,126	0,725	0,096	0,552	10,7	10,7
6th	0,033	0,190	0,022	0,127	0,035	0,201	2,67	2,67
7th	0,035	0,201	0,070	0,403	0,072	0,414	7,2	7,2
8th	0,108	0,621	0,104	0,598	0,120	0,690	2	2
9th	0,031	0,178	0,023	0,132	0,034	0,196	3,8	---
10th	0,096	0,552	0,087	0,500	0,093	0,535	1,6	1,6
11th	0,048	0,276	0,054	0,311	0,064	0,368	3,1	3,1
12th	0,025	0,144	0,022	0,127	0,026	0,150	1,33	1,33
13th	0,058	0,334	0,070	0,403	0,049	0,282	2	2
14th	0,034	0,196	0,029	0,167	0,027	0,155	---	---
15th	0,025	0,144	0,022	0,127	0,026	0,150	---	---
16th	0,032	0,184	0,030	0,173	0,028	0,161	---	---
17th	0,049	0,282	0,041	0,236	0,039	0,224	---	---
18th	0,022	0,127	0,022	0,127	0,021	0,121	---	---
19th	0,045	0,259	0,047	0,270	0,046	0,265	---	---
20th	0,026	0,150	0,025	0,144	0,026	0,150	---	---
21st	0,023	0,132	0,023	0,132	0,022	0,127	---	---
22nd	0,022	0,127	0,021	0,121	0,023	0,132	---	---
23rd	0,033	0,190	0,040	0,230	0,046	0,265	---	---
24th	0,022	0,127	0,022	0,127	0,022	0,127	---	---
25th	0,049	0,282	0,052	0,299	0,046	0,265	---	---
26th	0,023	0,132	0,024	0,138	0,026	0,150	---	---
27th	0,022	0,127	0,022	0,127	0,022	0,127	---	---
28th	0,026	0,150	0,028	0,161	0,026	0,150	---	---
29th	0,053	0,305	0,044	0,253	0,057	0,328	---	---
30th	0,021	0,121	0,022	0,127	0,022	0,127	---	---
31st	0,051	0,293	0,060	0,345	0,061	0,351	---	---
32nd	0,025	0,144	0,024	0,138	0,024	0,138	---	---

33rd	0,022	0,127	0,022	0,127	0,023	0,132	---	---
34th	0,022	0,127	0,022	0,127	0,024	0,138	---	---
35th	0,044	0,253	0,043	0,247	0,049	0,282	---	---
36th	0,021	0,121	0,021	0,121	0,021	0,121	---	---
37th	0,035	0,201	0,046	0,265	0,035	0,201	---	---
38th	0,022	0,127	0,023	0,132	0,024	0,138	---	---
39th	0,023	0,132	0,022	0,127	0,024	0,138	---	---
40th	0,023	0,132	0,025	0,144	0,023	0,132	---	---
THC / I_{ef} [%]	--	1,667	--	1,731	--	1,744	23	13
PWHC / I_{ref} [%]	--	4,894	--	5,039	--	5,128	23	22

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	20
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

PCS-3-20KW-40A-1								
Test condition:								
Power Level	33%							
Phase	L1		L2		L3			
AC Power [W]	2212		2212		2212			
AC Voltage [V]	230,13		230,14		230,14		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	9,612		9,611		9,612			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	9,616	--	9,722	--	9,672	--	---	---
2nd	0,071	0,245	0,056	0,193	0,050	0,173	8	8
3rd	0,061	0,210	0,051	0,176	0,014	0,048	21,6	---
4th	0,065	0,224	0,066	0,228	0,053	0,183	4	4
5th	0,246	0,849	0,259	0,894	0,263	0,907	10,7	10,7
6th	0,021	0,072	0,023	0,079	0,008	0,028	2,67	2,67
7th	0,154	0,531	0,155	0,535	0,169	0,583	7,2	7,2
8th	0,015	0,052	0,012	0,041	0,007	0,024	2	2
9th	0,011	0,038	0,012	0,041	0,015	0,052	3,8	---
10th	0,033	0,114	0,034	0,117	0,023	0,079	1,6	1,6
11th	0,113	0,390	0,097	0,335	0,098	0,338	3,1	3,1
12th	0,008	0,028	0,012	0,041	0,006	0,021	1,33	1,33
13th	0,062	0,214	0,075	0,259	0,073	0,252	2	2
14th	0,006	0,021	0,009	0,031	0,005	0,017	---	---
15th	0,006	0,021	0,009	0,031	0,005	0,017	---	---
16th	0,007	0,024	0,010	0,035	0,008	0,028	---	---
17th	0,056	0,193	0,054	0,186	0,051	0,176	---	---
18th	0,003	0,010	0,003	0,010	0,004	0,014	---	---
19th	0,056	0,193	0,058	0,200	0,058	0,200	---	---
20th	0,003	0,010	0,004	0,014	0,004	0,014	---	---
21st	0,004	0,014	0,005	0,017	0,010	0,035	---	---
22nd	0,004	0,014	0,005	0,017	0,002	0,007	---	---
23rd	0,050	0,173	0,044	0,152	0,046	0,159	---	---
24th	0,004	0,014	0,006	0,021	0,003	0,010	---	---
25th	0,022	0,076	0,026	0,090	0,029	0,100	---	---
26th	0,005	0,017	0,006	0,021	0,002	0,007	---	---
27th	0,003	0,010	0,008	0,028	0,005	0,017	---	---
28th	0,005	0,017	0,007	0,024	0,003	0,010	---	---
29th	0,024	0,083	0,021	0,072	0,018	0,062	---	---
30th	0,002	0,007	0,004	0,014	0,003	0,010	---	---
31st	0,033	0,114	0,036	0,124	0,032	0,110	---	---

32nd	0,002	0,007	0,004	0,014	0,003	0,010	---	---
33rd	0,003	0,010	0,003	0,010	0,005	0,017	---	---
34th	0,002	0,007	0,002	0,007	0,002	0,007	---	---
35th	0,029	0,100	0,029	0,100	0,026	0,090	---	---
36th	0,002	0,007	0,002	0,007	0,002	0,007	---	---
37th	0,028	0,097	0,028	0,097	0,030	0,104	---	---
38th	0,005	0,017	0,005	0,017	0,004	0,014	---	---
39th	0,004	0,014	0,005	0,017	0,005	0,017	---	---
40th	0,005	0,017	0,003	0,010	0,003	0,010	---	---
THC / I_{ef} [%]	--	1,237	--	1,250	--	1,250	23	13
PWHC / I_{ref} [%]	--	1,888	--	1,891	--	1,843	23	22

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	32,5
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Test condition:								
Power Level	66%							
Phase	L1		L2		L3			
AC Power [W]	4404		4404		4404			
AC Voltage [V]	230,13		230,18		230,15		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	19,138		19,134		19,136			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	19,140	--	19,307	--	19,135	--	---	---
2nd	0,079	0,273	0,064	0,221	0,057	0,197	8	8
3rd	0,062	0,214	0,051	0,176	0,013	0,045	21,6	---
4th	0,082	0,283	0,085	0,293	0,070	0,242	4	4
5th	0,263	0,907	0,280	0,966	0,283	0,976	10,7	10,7
6th	0,022	0,076	0,022	0,076	0,008	0,028	2,67	2,67
7th	0,158	0,545	0,157	0,542	0,173	0,597	7,2	7,2
8th	0,014	0,048	0,009	0,031	0,009	0,031	2	2
9th	0,012	0,041	0,012	0,041	0,015	0,052	3,8	---
10th	0,036	0,124	0,037	0,128	0,027	0,093	1,6	1,6
11th	0,122	0,421	0,105	0,362	0,107	0,369	3,1	3,1
12th	0,008	0,028	0,012	0,041	0,005	0,017	1,33	1,33
13th	0,061	0,210	0,074	0,255	0,073	0,252	2	2
14th	0,006	0,021	0,009	0,031	0,005	0,017	---	---
15th	0,007	0,024	0,009	0,031	0,004	0,014	---	---
16th	0,007	0,024	0,010	0,035	0,008	0,028	---	---
17th	0,057	0,197	0,056	0,193	0,053	0,183	---	---
18th	0,004	0,014	0,003	0,010	0,004	0,014	---	---
19th	0,058	0,200	0,060	0,207	0,061	0,210	---	---
20th	0,004	0,014	0,004	0,014	0,005	0,017	---	---
21st	0,004	0,014	0,006	0,021	0,009	0,031	---	---
22nd	0,004	0,014	0,005	0,017	0,002	0,007	---	---
23rd	0,052	0,179	0,047	0,162	0,049	0,169	---	---
24th	0,004	0,014	0,007	0,024	0,003	0,010	---	---
25th	0,022	0,076	0,027	0,093	0,030	0,104	---	---
26th	0,006	0,021	0,006	0,021	0,002	0,007	---	---
27th	0,004	0,014	0,008	0,028	0,005	0,017	---	---
28th	0,004	0,014	0,007	0,024	0,004	0,014	---	---
29th	0,024	0,083	0,021	0,072	0,019	0,066	---	---
30th	0,002	0,007	0,003	0,010	0,002	0,007	---	---
31st	0,033	0,114	0,037	0,128	0,033	0,114	---	---
32nd	0,002	0,007	0,004	0,014	0,003	0,010	---	---

33rd	0,003	0,010	0,003	0,010	0,005	0,017	---	---
34th	0,002	0,007	0,002	0,007	0,002	0,007	---	---
35th	0,028	0,097	0,028	0,097	0,026	0,090	---	---
36th	0,002	0,007	0,002	0,007	0,002	0,007	---	---
37th	0,021	0,072	0,021	0,072	0,023	0,079	---	---
38th	0,004	0,014	0,004	0,014	0,003	0,010	---	---
39th	0,003	0,010	0,004	0,014	0,003	0,010	---	---
40th	0,004	0,014	0,003	0,010	0,002	0,007	---	---
THC / I_{ef} [%]	--	1,313	--	1,332	--	1,332	23	13
PWHC / I_{ref} [%]	--	1,876	--	1,901	--	1,863	23	22

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	32,5
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Test condition:								
Power Level	**100%**							
Phase	**L1**		**L2**		**L3**			
AC Power [W]	6677		6710		6662			
AC Voltage [V]	230,27		230,29		230,27		Current emission limits (R_{sce} = 33) acc. IEC 61000-3-12 I_h / I_{ref} [%]	
AC Current [A]	28,995		29,139		28,933			
Frequency [Hz]	50,00		50,00		50,00			
Measurement results:								
Harmonic order	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	Measured Value [A]	I_h / I_{ref} [%]	1-phase	3-phases
1st	28,975	--	29,126	--	28,913	--	---	---
2nd	0,032	0,110	0,121	0,417	0,140	0,483	8	8
3rd	0,125	0,431	0,088	0,304	0,133	0,459	21,6	---
4th	0,150	0,518	0,122	0,421	0,130	0,449	4	4
5th	0,166	0,573	0,205	0,707	0,174	0,600	10,7	10,7
6th	0,040	0,138	0,023	0,079	0,043	0,148	2,67	2,67
7th	0,089	0,307	0,099	0,342	0,062	0,214	7,2	7,2
8th	0,087	0,300	0,084	0,290	0,100	0,345	2	2
9th	0,041	0,141	0,025	0,086	0,038	0,131	3,8	---
10th	0,112	0,386	0,102	0,352	0,104	0,359	1,6	1,6
11th	0,086	0,297	0,068	0,235	0,100	0,345	3,1	3,1
12th	0,028	0,097	0,022	0,076	0,027	0,093	1,33	1,33
13th	0,105	0,362	0,115	0,397	0,099	0,342	2	2
14th	0,042	0,145	0,031	0,107	0,030	0,104	---	---
15th	0,027	0,093	0,023	0,079	0,022	0,076	---	---
16th	0,022	0,076	0,025	0,086	0,022	0,076	---	---
17th	0,093	0,321	0,080	0,276	0,082	0,283	---	---
18th	0,023	0,079	0,021	0,072	0,022	0,076	---	---
19th	0,074	0,255	0,092	0,317	0,085	0,293	---	---
20th	0,024	0,083	0,024	0,083	0,025	0,086	---	---
21st	0,028	0,097	0,023	0,079	0,023	0,079	---	---
22nd	0,022	0,076	0,023	0,079	0,023	0,079	---	---
23rd	0,071	0,245	0,063	0,217	0,078	0,269	---	---
24th	0,023	0,079	0,021	0,072	0,024	0,083	---	---
25th	0,079	0,273	0,088	0,304	0,070	0,242	---	---
26th	0,025	0,086	0,023	0,079	0,027	0,093	---	---
27th	0,026	0,090	0,022	0,076	0,025	0,086	---	---
28th	0,034	0,117	0,034	0,117	0,030	0,104	---	---
29th	0,067	0,231	0,052	0,179	0,068	0,235	---	---
30th	0,022	0,076	0,021	0,072	0,022	0,076	---	---
31st	0,071	0,245	0,083	0,286	0,075	0,259	---	---
32nd	0,031	0,107	0,027	0,093	0,029	0,100	---	---

33rd	0,022	0,076	0,022	0,076	0,022	0,076	---	---
34th	0,023	0,079	0,025	0,086	0,025	0,086	---	---
35th	0,054	0,186	0,055	0,190	0,062	0,214	---	---
36th	0,019	0,066	0,019	0,066	0,020	0,069	---	---
37th	0,051	0,176	0,060	0,207	0,048	0,166	---	---
38th	0,019	0,066	0,019	0,066	0,021	0,072	---	---
39th	0,023	0,079	0,022	0,076	0,024	0,083	---	---
40th	0,021	0,072	0,021	0,072	0,020	0,069	---	---
THC / I_{ef} [%]	--	1,667	--	1,731	--	1,744	23	13
PWHC / I_{ref} [%]	--	4,894	--	5,039	--	5,128	23	22

PV-curve simulated according to	**--**
Voltage of defined MPP [V]	620
Current of defined MPP [A]	32,5
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10

Note:
The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-40A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-4KW-25A-1												
Phase L1												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,400	10,620	21,170	30,550	41,470	52,300	59,990	69,540	82,100	91,500	100,900	--
2	0,180	0,420	0,520	0,600	0,700	0,780	0,860	0,920	1,010	1,080	1,160	1,160
3	2,520	2,450	1,470	1,100	1,270	1,660	1,970	2,270	2,550	2,630	2,720	2,720
4	0,050	0,080	0,130	0,160	0,190	0,230	0,260	0,280	0,310	0,330	0,330	0,330
5	0,270	0,290	0,580	0,760	0,980	1,230	1,340	1,480	1,650	1,760	1,810	1,810
6	0,080	0,050	0,090	0,100	0,110	0,160	0,210	0,270	0,320	0,340	0,370	0,370
7	0,650	0,810	0,460	0,050	0,500	0,870	1,080	1,310	1,480	1,600	1,720	1,720
8	0,200	0,110	0,070	0,100	0,090	0,090	0,160	0,240	0,320	0,350	0,360	0,360
9	0,160	0,780	1,090	0,720	0,260	0,330	0,590	0,900	1,240	1,370	1,500	1,500
10	0,160	0,170	0,100	0,100	0,130	0,120	0,130	0,190	0,300	0,370	0,410	0,410
11	0,160	0,110	0,910	1,060	0,750	0,420	0,290	0,480	0,860	1,150	1,300	1,300
12	0,150	0,210	0,140	0,180	0,270	0,150	0,210	0,200	0,270	0,310	0,380	0,380
13	0,170	0,310	0,230	0,710	0,820	0,570	0,400	0,270	0,410	0,600	0,850	0,850
14	0,050	0,130	0,080	0,090	0,110	0,140	0,130	0,150	0,160	0,190	0,250	0,250
15	0,150	0,110	0,270	0,100	0,430	0,520	0,480	0,370	0,260	0,330	0,440	0,520
16	0,060	0,060	0,100	0,070	0,080	0,080	0,080	0,100	0,110	0,110	0,130	0,130
17	0,110	0,060	0,230	0,170	0,170	0,350	0,290	0,250	0,180	0,160	0,160	0,350
18	0,060	0,050	0,080	0,060	0,060	0,070	0,060	0,070	0,090	0,090	0,080	0,090
19	0,080	0,060	0,070	0,210	0,090	0,190	0,240	0,180	0,120	0,100	0,080	0,240
20	0,030	0,040	0,070	0,050	0,040	0,050	0,050	0,050	0,070	0,070	0,080	0,080
21	0,050	0,070	0,090	0,140	0,120	0,110	0,140	0,130	0,110	0,100	0,100	0,140
22	0,040	0,030	0,060	0,050	0,040	0,040	0,040	0,040	0,040	0,050	0,060	0,060
23	0,060	0,070	0,060	0,060	0,160	0,090	0,110	0,150	0,110	0,080	0,090	0,160
24	0,030	0,030	0,040	0,040	0,060	0,040	0,040	0,050	0,030	0,030	0,050	0,060
25	0,050	0,080	0,030	0,080	0,100	0,110	0,080	0,110	0,100	0,080	0,070	0,110
26	0,020	0,030	0,040	0,030	0,030	0,040	0,030	0,040	0,040	0,030	0,030	0,040
27	0,030	0,050	0,050	0,080	0,070	0,120	0,070	0,070	0,070	0,050	0,050	0,120
28	0,020	0,020	0,030	0,030	0,020	0,040	0,030	0,030	0,040	0,040	0,030	0,040
29	0,030	0,040	0,030	0,030	0,050	0,090	0,070	0,040	0,070	0,060	0,040	0,090
30	0,020	0,020	0,030	0,030	0,020	0,030	0,030	0,020	0,030	0,030	0,030	0,030
31	0,040	0,040	0,050	0,030	0,060	0,050	0,070	0,040	0,060	0,060	0,050	0,070

32	0,020	0,020	0,030	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040
33	0,030	0,030	0,050	0,040	0,050	0,040	0,070	0,060	0,050	0,070	0,050	0,070
34	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,030	0,040
35	0,040	0,040	0,030	0,020	0,020	0,040	0,030	0,050	0,030	0,050	0,050	0,050
36	0,040	0,050	0,030	0,060	0,060	0,030	0,050	0,050	0,050	0,040	0,070	0,070
37	0,030	0,020	0,040	0,030	0,020	0,050	0,030	0,050	0,020	0,030	0,030	0,050
38	0,020	0,020	0,020	0,020	0,020	0,030	0,020	0,030	0,030	0,030	0,030	0,030
39	0,040	0,040	0,060	0,050	0,030	0,050	0,040	0,050	0,030	0,040	0,040	0,060
40	0,020	0,020	0,030	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
41	0,030	0,020	0,030	0,020	0,020	0,030	0,030	0,040	0,020	0,020	0,020	0,040
42	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
43	0,040	0,040	0,040	0,040	0,020	0,030	0,050	0,040	0,040	0,030	0,030	0,050
44	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,010	0,020	0,020	0,020	0,020
45	0,030	0,030	0,040	0,050	0,030	0,030	0,040	0,040	0,040	0,030	0,030	0,050
46	0,010	0,010	0,020	0,020	0,020	0,010	0,020	0,010	0,020	0,020	0,020	0,020
47	0,030	0,020	0,020	0,030	0,020	0,020	0,030	0,030	0,030	0,020	0,030	0,030
48	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,010	0,020	0,020	0,020	0,020
49	0,030	0,030	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030
50	0,010	0,010	0,020	0,020	0,010	0,020	0,010	0,020	0,010	0,010	0,020	0,020
THC [A]	0,027	0,028	0,023	0,021	0,023	0,026	0,030	0,034	0,039	0,043	0,045	0,045
THDU [%]	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,050	0,060	0,060	0,060

Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,080	0,090	0,090	0,110	0,080	0,080	0,100	0,090	0,080	0,090	0,100	0,110
125	0,060	0,070	0,100	0,080	0,070	0,070	0,070	0,070	0,070	0,070	0,070	0,100
175	0,100	0,130	0,130	0,140	0,110	0,120	0,110	0,120	0,130	0,130	0,120	0,140
225	0,080	0,100	0,150	0,120	0,090	0,100	0,100	0,090	0,090	0,090	0,090	0,150
275	0,120	0,180	0,170	0,200	0,160	0,180	0,170	0,190	0,170	0,150	0,180	0,200
325	0,100	0,160	0,180	0,150	0,130	0,140	0,130	0,130	0,140	0,120	0,120	0,180
375	0,150	0,240	0,220	0,240	0,250	0,220	0,260	0,270	0,220	0,260	0,230	0,270
425	0,130	0,190	0,240	0,200	0,190	0,200	0,190	0,180	0,190	0,200	0,160	0,240
475	0,170	0,260	0,270	0,260	0,330	0,250	0,320	0,310	0,250	0,300	0,250	0,330
525	0,150	0,190	0,270	0,230	0,240	0,260	0,220	0,220	0,220	0,210	0,230	0,270
575	0,140	0,190	0,270	0,230	0,240	0,260	0,240	0,230	0,220	0,220	0,260	0,270
625	0,170	0,240	0,270	0,280	0,310	0,280	0,270	0,300	0,300	0,310	0,330	0,330
675	0,130	0,170	0,250	0,200	0,210	0,220	0,190	0,200	0,200	0,210	0,230	0,250
725	0,160	0,230	0,230	0,280	0,260	0,270	0,280	0,350	0,280	0,350	0,330	0,350
775	0,120	0,150	0,200	0,160	0,160	0,180	0,160	0,170	0,170	0,170	0,180	0,200
825	0,150	0,200	0,200	0,250	0,230	0,240	0,290	0,320	0,260	0,270	0,320	0,320
875	0,150	0,130	0,170	0,140	0,140	0,150	0,240	0,250	0,260	0,150	0,160	0,260
925	0,130	0,230	0,180	0,220	0,220	0,210	0,260	0,240	0,260	0,320	0,250	0,320
975	0,100	0,120	0,200	0,120	0,120	0,130	0,140	0,140	0,140	0,140	0,220	0,220
1025	0,120	0,170	0,150	0,230	0,200	0,170	0,190	0,180	0,210	0,240	0,250	0,250
1075	0,080	0,100	0,130	0,120	0,130	0,130	0,110	0,120	0,130	0,130	0,140	0,140
1125	0,100	0,140	0,130	0,150	0,190	0,140	0,140	0,170	0,140	0,170	0,190	0,190
1175	0,090	0,130	0,120	0,130	0,150	0,130	0,130	0,180	0,140	0,140	0,150	0,180
1225	0,070	0,090	0,110	0,090	0,100	0,130	0,100	0,100	0,100	0,110	0,110	0,130
1275	0,090	0,120	0,100	0,130	0,120	0,140	0,150	0,150	0,160	0,160	0,170	0,170
1325	0,070	0,080	0,100	0,080	0,080	0,110	0,080	0,080	0,090	0,090	0,090	0,110
1375	0,090	0,110	0,100	0,130	0,110	0,130	0,140	0,120	0,140	0,140	0,140	0,140
1425	0,060	0,070	0,090	0,070	0,070	0,090	0,070	0,070	0,070	0,080	0,080	0,090
1475	0,080	0,100	0,090	0,120	0,110	0,120	0,110	0,120	0,100	0,110	0,130	0,130
1525	0,060	0,070	0,080	0,070	0,070	0,080	0,060	0,070	0,070	0,070	0,070	0,080
1575	0,080	0,090	0,080	0,110	0,110	0,100	0,090	0,130	0,100	0,110	0,130	0,130
1625	0,060	0,060	0,080	0,070	0,060	0,070	0,060	0,070	0,070	0,070	0,070	0,080
1675	0,070	0,080	0,080	0,090	0,090	0,080	0,090	0,110	0,100	0,100	0,090	0,110
1725	0,060	0,060	0,070	0,060	0,060	0,070	0,070	0,060	0,070	0,070	0,070	0,070
1775	0,060	0,060	0,070	0,060	0,060	0,070	0,090	0,080	0,070	0,070	0,070	0,090
1825	0,090	0,080	0,070	0,080	0,070	0,070	0,090	0,080	0,100	0,080	0,090	0,100
1875	0,060	0,080	0,070	0,060	0,050	0,060	0,060	0,050	0,060	0,080	0,060	0,080
1925	0,060	0,080	0,070	0,080	0,070	0,080	0,070	0,080	0,080	0,090	0,080	0,090
1975	0,050	0,060	0,080	0,050	0,050	0,060	0,050	0,050	0,050	0,050	0,070	0,080

Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,120	0,130	0,150	0,160	0,130	0,130	0,140	0,150	0,140	0,130	0,150	0,160
2,3	0,110	0,120	0,120	0,140	0,130	0,110	0,130	0,120	0,120	0,120	0,130	0,140
2,5	0,110	0,110	0,110	0,130	0,110	0,120	0,110	0,130	0,120	0,120	0,120	0,130
2,7	0,100	0,100	0,100	0,110	0,110	0,110	0,110	0,110	0,110	0,110	0,110	0,110
2,9	0,110	0,110	0,100	0,110	0,110	0,110	0,110	0,120	0,120	0,130	0,130	0,130
3,1	0,100	0,090	0,090	0,090	0,100	0,100	0,100	0,100	0,110	0,120	0,120	0,120
3,3	0,090	0,090	0,080	0,090	0,100	0,100	0,100	0,110	0,110	0,120	0,120	0,120
3,5	0,090	0,080	0,070	0,080	0,090	0,100	0,100	0,110	0,130	0,130	0,130	0,130
3,7	0,090	0,080	0,070	0,080	0,090	0,110	0,110	0,120	0,130	0,130	0,150	0,150
3,9	0,080	0,070	0,060	0,070	0,080	0,100	0,140	0,140	0,140	0,150	0,160	0,160
4,1	0,080	0,070	0,070	0,070	0,090	0,100	0,130	0,160	0,150	0,160	0,170	0,170
4,3	0,080	0,070	0,070	0,080	0,090	0,100	0,110	0,130	0,150	0,160	0,170	0,170
4,5	0,070	0,070	0,060	0,070	0,090	0,100	0,110	0,120	0,160	0,150	0,150	0,160
4,7	0,060	0,050	0,050	0,050	0,060	0,060	0,080	0,080	0,100	0,110	0,100	0,110
4,9	0,050	0,040	0,040	0,050	0,050	0,060	0,070	0,070	0,080	0,090	0,080	0,090
5,1	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,060	0,060	0,060	0,070	0,070
5,3	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,050	0,050	0,050	0,050	0,050
5,5	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,050	0,050	0,050
5,7	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,050	0,050	0,050	0,050	0,050
5,9	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,040	0,040	0,040
6,1	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
6,3	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030
6,5	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
6,7	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,020	0,020	0,030
6,9	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030
7,1	0,030	0,030	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
7,3	0,040	0,030	0,030	0,020	0,030	0,030	0,030	0,030	0,030	0,020	0,020	0,040
7,5	0,020	0,020	0,020	0,020	0,020	0,030	0,020	0,020	0,020	0,020	0,020	0,030
7,7	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,9	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,1	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,3	0,030	0,020	0,020	0,030	0,030	0,030	0,030	0,020	0,020	0,020	0,020	0,030
8,5	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030
8,7	0,020	0,020	0,020	0,020	0,020	0,030	0,020	0,020	0,020	0,020	0,020	0,030
8,9	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,020	0,020	0,020	0,020	0,030

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	7
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01
Note: The normalization current is 5,797 A.	

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-4KW-25A-1												
Phase L2												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,680	10,830	21,180	30,380	41,180	51,950	59,540	68,980	81,420	90,760	100,100	--
2	0,720	0,430	0,400	0,430	0,490	0,570	0,620	0,710	0,800	0,880	0,950	0,950
3	2,620	2,340	1,360	0,930	1,070	1,480	1,740	2,020	2,270	2,380	2,460	2,620
4	0,230	0,280	0,330	0,330	0,300	0,250	0,210	0,180	0,130	0,130	0,140	0,330
5	0,270	0,300	0,630	0,850	1,070	1,300	1,360	1,500	1,640	1,720	1,770	1,770
6	0,270	0,230	0,080	0,210	0,290	0,310	0,280	0,240	0,170	0,140	0,110	0,310
7	0,610	0,710	0,350	0,120	0,570	0,940	1,170	1,380	1,570	1,690	1,790	1,790
8	0,190	0,440	0,340	0,140	0,140	0,240	0,300	0,300	0,270	0,210	0,180	0,440
9	0,150	0,730	0,970	0,630	0,270	0,440	0,700	1,010	1,330	1,480	1,610	1,610
10	0,120	0,220	0,460	0,390	0,220	0,160	0,180	0,250	0,260	0,250	0,190	0,460
11	0,210	0,150	0,860	0,970	0,730	0,470	0,450	0,650	1,010	1,250	1,400	1,400
12	0,140	0,230	0,240	0,360	0,410	0,220	0,270	0,230	0,270	0,250	0,310	0,410
13	0,130	0,230	0,250	0,650	0,740	0,570	0,420	0,360	0,510	0,720	0,950	0,950
14	0,170	0,180	0,100	0,150	0,260	0,250	0,190	0,140	0,130	0,140	0,180	0,260
15	0,090	0,050	0,200	0,150	0,410	0,480	0,430	0,360	0,320	0,390	0,510	0,510
16	0,100	0,110	0,140	0,070	0,110	0,160	0,160	0,130	0,100	0,090	0,090	0,160
17	0,080	0,100	0,150	0,120	0,170	0,290	0,290	0,260	0,190	0,170	0,180	0,290
18	0,040	0,060	0,080	0,090	0,050	0,100	0,090	0,100	0,080	0,070	0,060	0,100
19	0,060	0,080	0,080	0,180	0,110	0,220	0,210	0,150	0,100	0,100	0,080	0,220
20	0,030	0,080	0,060	0,070	0,040	0,060	0,070	0,060	0,070	0,060	0,060	0,080
21	0,070	0,070	0,060	0,120	0,100	0,120	0,130	0,130	0,110	0,090	0,080	0,130
22	0,030	0,050	0,050	0,050	0,060	0,040	0,060	0,050	0,040	0,040	0,060	0,060
23	0,070	0,070	0,040	0,060	0,120	0,070	0,110	0,130	0,090	0,070	0,100	0,130
24	0,030	0,050	0,060	0,040	0,050	0,040	0,030	0,050	0,040	0,040	0,040	0,060
25	0,070	0,070	0,040	0,070	0,100	0,080	0,080	0,090	0,100	0,090	0,070	0,100
26	0,030	0,040	0,050	0,040	0,040	0,060	0,030	0,050	0,040	0,030	0,030	0,060
27	0,030	0,040	0,050	0,050	0,050	0,080	0,050	0,070	0,080	0,060	0,040	0,080
28	0,030	0,020	0,030	0,040	0,030	0,040	0,030	0,030	0,040	0,030	0,030	0,040
29	0,030	0,030	0,030	0,030	0,040	0,070	0,060	0,050	0,080	0,070	0,040	0,080
30	0,020	0,020	0,040	0,040	0,030	0,050	0,040	0,030	0,040	0,030	0,020	0,050
31	0,050	0,050	0,050	0,030	0,040	0,050	0,060	0,040	0,060	0,060	0,040	0,060

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)											P	
32	0,020	0,020	0,050	0,030	0,030	0,040	0,040	0,030	0,030	0,040	0,030	0,050
33	0,050	0,040	0,040	0,030	0,030	0,040	0,070	0,060	0,080	0,070	0,050	0,080
34	0,030	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,030	0,040
35	0,030	0,030	0,040	0,020	0,030	0,050	0,070	0,070	0,070	0,070	0,050	0,070
36	0,040	0,060	0,030	0,060	0,070	0,030	0,060	0,060	0,050	0,050	0,070	0,070
37	0,020	0,030	0,040	0,040	0,050	0,070	0,070	0,090	0,070	0,080	0,060	0,090
38	0,030	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040
39	0,040	0,050	0,060	0,070	0,070	0,090	0,090	0,100	0,080	0,080	0,070	0,100
40	0,020	0,020	0,030	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030
41	0,030	0,030	0,050	0,050	0,060	0,080	0,080	0,090	0,080	0,080	0,070	0,090
42	0,020	0,020	0,040	0,030	0,030	0,030	0,020	0,020	0,030	0,020	0,030	0,040
43	0,030	0,030	0,050	0,060	0,070	0,080	0,080	0,090	0,080	0,070	0,060	0,090
44	0,020	0,020	0,030	0,050	0,060	0,040	0,020	0,020	0,040	0,030	0,030	0,060
45	0,040	0,050	0,060	0,070	0,060	0,060	0,070	0,060	0,050	0,040	0,030	0,070
46	0,030	0,040	0,050	0,030	0,050	0,030	0,020	0,020	0,020	0,030	0,020	0,050
47	0,040	0,050	0,050	0,050	0,040	0,030	0,040	0,040	0,030	0,030	0,040	0,050
48	0,030	0,040	0,060	0,040	0,030	0,030	0,040	0,030	0,030	0,040	0,030	0,060
49	0,050	0,050	0,040	0,040	0,020	0,030	0,050	0,050	0,040	0,040	0,040	0,050
50	0,030	0,040	0,050	0,040	0,040	0,040	0,040	0,020	0,020	0,030	0,030	0,050
THC [A]	0,029	0,027	0,022	0,020	0,022	0,026	0,029	0,033	0,038	0,041	0,044	0,044
THDU [%]	0,040	0,040	0,050	0,050	0,060	0,070	0,070	0,080	0,080	0,090	0,090	0,090

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,080	0,100	0,090	0,100	0,090	0,080	0,100	0,090	0,080	0,100	0,100	0,100
125	0,060	0,070	0,100	0,090	0,070	0,080	0,080	0,090	0,070	0,070	0,070	0,100
175	0,110	0,140	0,140	0,140	0,120	0,140	0,120	0,130	0,140	0,140	0,130	0,140
225	0,080	0,100	0,150	0,130	0,100	0,110	0,100	0,100	0,090	0,090	0,090	0,150
275	0,140	0,210	0,190	0,210	0,170	0,210	0,200	0,210	0,170	0,160	0,200	0,210
325	0,100	0,160	0,190	0,160	0,140	0,160	0,140	0,130	0,170	0,130	0,130	0,190
375	0,180	0,280	0,240	0,260	0,280	0,260	0,310	0,310	0,260	0,330	0,260	0,330
425	0,130	0,200	0,260	0,210	0,200	0,220	0,200	0,190	0,230	0,250	0,170	0,260
475	0,200	0,300	0,290	0,290	0,380	0,290	0,380	0,350	0,290	0,360	0,280	0,380
525	0,170	0,200	0,280	0,250	0,260	0,290	0,240	0,230	0,230	0,230	0,260	0,290
575	0,160	0,210	0,280	0,250	0,260	0,290	0,260	0,250	0,240	0,230	0,320	0,320
625	0,190	0,270	0,280	0,300	0,340	0,310	0,290	0,330	0,310	0,360	0,370	0,370
675	0,130	0,170	0,250	0,200	0,210	0,240	0,200	0,210	0,210	0,220	0,280	0,280
725	0,180	0,240	0,240	0,290	0,270	0,290	0,310	0,390	0,290	0,400	0,370	0,400
775	0,110	0,140	0,200	0,160	0,160	0,190	0,160	0,170	0,170	0,180	0,190	0,200
825	0,160	0,220	0,200	0,270	0,240	0,260	0,320	0,350	0,270	0,280	0,350	0,350
875	0,110	0,130	0,170	0,140	0,140	0,150	0,160	0,170	0,180	0,150	0,160	0,180
925	0,140	0,200	0,180	0,230	0,240	0,230	0,280	0,250	0,270	0,270	0,270	0,280
975	0,090	0,110	0,160	0,120	0,120	0,140	0,120	0,130	0,130	0,140	0,160	0,160
1025	0,130	0,180	0,150	0,200	0,220	0,180	0,200	0,180	0,220	0,260	0,260	0,260
1075	0,080	0,100	0,130	0,110	0,120	0,140	0,110	0,130	0,130	0,130	0,140	0,140
1125	0,100	0,150	0,130	0,150	0,180	0,140	0,140	0,190	0,150	0,180	0,200	0,200
1175	0,100	0,140	0,120	0,130	0,150	0,130	0,140	0,210	0,150	0,140	0,160	0,210
1225	0,070	0,090	0,110	0,090	0,100	0,110	0,100	0,110	0,100	0,110	0,110	0,110
1275	0,100	0,130	0,110	0,130	0,130	0,130	0,160	0,170	0,160	0,170	0,190	0,190
1325	0,070	0,080	0,100	0,080	0,080	0,100	0,080	0,090	0,090	0,100	0,090	0,100
1375	0,090	0,110	0,100	0,140	0,120	0,140	0,150	0,120	0,150	0,150	0,150	0,150
1425	0,060	0,070	0,090	0,070	0,070	0,090	0,070	0,070	0,070	0,080	0,080	0,090
1475	0,090	0,100	0,090	0,130	0,120	0,130	0,120	0,120	0,110	0,120	0,140	0,140
1525	0,060	0,060	0,080	0,070	0,070	0,080	0,060	0,070	0,070	0,070	0,070	0,080
1575	0,080	0,090	0,080	0,120	0,120	0,110	0,100	0,140	0,110	0,120	0,140	0,140
1625	0,060	0,060	0,080	0,070	0,070	0,070	0,060	0,070	0,070	0,070	0,070	0,080
1675	0,070	0,090	0,080	0,100	0,100	0,080	0,090	0,120	0,110	0,110	0,100	0,120
1725	0,060	0,060	0,070	0,060	0,070	0,070	0,070	0,060	0,070	0,070	0,080	0,080
1775	0,070	0,060	0,070	0,060	0,060	0,070	0,070	0,060	0,070	0,070	0,070	0,070
1825	0,100	0,090	0,070	0,080	0,080	0,080	0,090	0,080	0,080	0,090	0,090	0,100
1875	0,060	0,080	0,070	0,060	0,050	0,060	0,060	0,050	0,060	0,060	0,060	0,080
1925	0,060	0,090	0,070	0,080	0,080	0,090	0,080	0,090	0,080	0,090	0,080	0,090
1975	0,050	0,060	0,060	0,050	0,050	0,060	0,050	0,050	0,050	0,050	0,060	0,060

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,120	0,140	0,180	0,170	0,170	0,180	0,170	0,190	0,180	0,170	0,180	0,190
2,3	0,130	0,140	0,160	0,170	0,150	0,140	0,150	0,140	0,130	0,140	0,140	0,170
2,5	0,140	0,150	0,140	0,150	0,130	0,130	0,130	0,140	0,130	0,130	0,130	0,150
2,7	0,130	0,120	0,100	0,110	0,120	0,120	0,120	0,120	0,120	0,120	0,130	0,130
2,9	0,120	0,110	0,100	0,110	0,120	0,110	0,110	0,120	0,120	0,120	0,130	0,130
3,1	0,100	0,100	0,090	0,090	0,100	0,100	0,110	0,110	0,120	0,130	0,120	0,130
3,3	0,100	0,090	0,090	0,100	0,100	0,110	0,110	0,120	0,120	0,120	0,130	0,130
3,5	0,090	0,090	0,080	0,080	0,090	0,110	0,100	0,110	0,130	0,130	0,130	0,130
3,7	0,090	0,090	0,080	0,080	0,090	0,100	0,100	0,110	0,130	0,130	0,140	0,140
3,9	0,090	0,080	0,070	0,070	0,080	0,100	0,140	0,140	0,140	0,150	0,160	0,160
4,1	0,080	0,070	0,060	0,070	0,080	0,100	0,130	0,150	0,140	0,140	0,150	0,150
4,3	0,090	0,070	0,060	0,060	0,080	0,100	0,120	0,140	0,150	0,150	0,150	0,150
4,5	0,070	0,070	0,070	0,060	0,070	0,080	0,080	0,090	0,140	0,120	0,130	0,140
4,7	0,060	0,060	0,060	0,060	0,070	0,080	0,080	0,090	0,100	0,120	0,110	0,120
4,9	0,080	0,060	0,050	0,040	0,040	0,050	0,060	0,070	0,080	0,090	0,090	0,090
5,1	0,040	0,040	0,030	0,030	0,040	0,040	0,040	0,050	0,060	0,060	0,070	0,070
5,3	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,060	0,060	0,060
5,5	0,040	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,050	0,050	0,060	0,060
5,7	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,050	0,050	0,060	0,060	0,060
5,9	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,050	0,050	0,050
6,1	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,050	0,050	0,050
6,3	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040
6,5	0,040	0,040	0,030	0,040	0,040	0,040	0,040	0,050	0,050	0,050	0,050	0,050
6,7	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040
6,9	0,030	0,030	0,030	0,030	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030
7,1	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
7,3	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,020	0,020	0,020	0,020	0,030
7,5	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,7	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,9	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,1	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,3	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,5	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,7	0,010	0,020	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,9	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)		P
PV-curve simulated according to	--	
Voltage of defined MPP [V]	620	
Current of defined MPP [A]	7	
FFU of PV curve [1]	1	
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01	
Note: The normalization current is 5,797 A.		

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-4KW-25A-1												
Phase L3												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,780	11,060	21,560	30,820	41,660	52,450	60,010	69,460	81,880	91,210	100,500	--
2	0,150	0,360	0,440	0,520	0,600	0,670	0,740	0,810	0,890	0,950	1,010	1,010
3	2,570	2,320	1,350	0,920	1,050	1,510	1,800	2,090	2,340	2,450	2,510	2,570
4	0,060	0,120	0,140	0,140	0,160	0,190	0,220	0,250	0,280	0,300	0,310	0,310
5	0,200	0,300	0,590	0,800	1,040	1,280	1,380	1,520	1,670	1,770	1,830	1,830
6	0,140	0,070	0,120	0,100	0,090	0,110	0,150	0,200	0,250	0,280	0,290	0,290
7	0,700	0,830	0,400	0,110	0,580	0,970	1,180	1,370	1,530	1,640	1,730	1,730
8	0,240	0,150	0,080	0,080	0,070	0,070	0,100	0,150	0,230	0,260	0,290	0,290
9	0,140	0,880	1,000	0,640	0,240	0,380	0,670	0,970	1,310	1,480	1,620	1,620
10	0,170	0,190	0,120	0,090	0,110	0,130	0,100	0,120	0,210	0,270	0,290	0,290
11	0,150	0,180	0,930	1,040	0,770	0,480	0,440	0,630	0,960	1,210	1,370	1,370
12	0,120	0,180	0,130	0,270	0,230	0,130	0,190	0,160	0,270	0,240	0,340	0,340
13	0,130	0,310	0,240	0,660	0,770	0,620	0,490	0,430	0,560	0,750	0,950	0,950
14	0,060	0,110	0,090	0,120	0,110	0,120	0,130	0,120	0,140	0,150	0,210	0,210
15	0,170	0,080	0,270	0,140	0,440	0,520	0,440	0,360	0,320	0,370	0,480	0,520
16	0,070	0,050	0,090	0,070	0,080	0,080	0,080	0,090	0,100	0,090	0,110	0,110
17	0,140	0,090	0,240	0,150	0,190	0,320	0,300	0,260	0,200	0,180	0,200	0,320
18	0,050	0,050	0,070	0,050	0,050	0,070	0,080	0,090	0,080	0,070	0,070	0,090
19	0,110	0,070	0,080	0,200	0,090	0,220	0,220	0,170	0,120	0,100	0,080	0,220
20	0,040	0,040	0,050	0,050	0,050	0,060	0,050	0,050	0,060	0,060	0,060	0,060
21	0,060	0,080	0,060	0,110	0,110	0,110	0,150	0,160	0,120	0,080	0,070	0,160
22	0,040	0,040	0,050	0,040	0,050	0,050	0,050	0,050	0,040	0,040	0,050	0,050
23	0,050	0,060	0,060	0,070	0,140	0,080	0,130	0,140	0,090	0,080	0,090	0,140
24	0,030	0,030	0,040	0,040	0,050	0,050	0,050	0,050	0,040	0,040	0,050	0,050
25	0,050	0,070	0,040	0,060	0,110	0,090	0,080	0,110	0,080	0,080	0,080	0,110
26	0,020	0,030	0,040	0,030	0,040	0,040	0,030	0,040	0,030	0,030	0,040	0,040
27	0,040	0,070	0,060	0,060	0,060	0,110	0,060	0,080	0,080	0,060	0,040	0,110
28	0,020	0,030	0,030	0,040	0,030	0,040	0,030	0,030	0,030	0,030	0,030	0,040
29	0,030	0,040	0,030	0,030	0,040	0,100	0,070	0,050	0,080	0,060	0,040	0,100
30	0,020	0,030	0,030	0,030	0,030	0,040	0,030	0,030	0,030	0,030	0,030	0,040
31	0,040	0,040	0,040	0,030	0,060	0,070	0,080	0,050	0,070	0,060	0,040	0,080

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)											P	
32	0,020	0,030	0,030	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030
33	0,030	0,030	0,060	0,040	0,060	0,050	0,080	0,050	0,060	0,060	0,040	0,080
34	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,030	0,040	0,040	0,040	0,040
35	0,040	0,040	0,040	0,030	0,040	0,050	0,060	0,050	0,050	0,050	0,040	0,060
36	0,040	0,040	0,030	0,060	0,040	0,030	0,040	0,050	0,080	0,060	0,060	0,080
37	0,040	0,030	0,040	0,030	0,020	0,050	0,050	0,050	0,030	0,040	0,040	0,050
38	0,040	0,030	0,020	0,020	0,020	0,030	0,020	0,030	0,020	0,030	0,030	0,040
39	0,040	0,060	0,060	0,040	0,030	0,050	0,040	0,050	0,030	0,040	0,040	0,060
40	0,020	0,030	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030
41	0,030	0,030	0,030	0,030	0,020	0,030	0,030	0,040	0,030	0,030	0,040	0,040
42	0,020	0,020	0,050	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,050
43	0,040	0,040	0,040	0,030	0,020	0,030	0,050	0,050	0,040	0,030	0,030	0,050
44	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
45	0,040	0,030	0,040	0,040	0,030	0,030	0,050	0,040	0,040	0,030	0,030	0,050
46	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
47	0,030	0,020	0,020	0,040	0,030	0,030	0,030	0,030	0,040	0,030	0,030	0,040
48	0,020	0,020	0,020	0,040	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,040
49	0,030	0,030	0,030	0,040	0,040	0,030	0,030	0,040	0,040	0,030	0,030	0,040
50	0,020	0,020	0,020	0,020	0,010	0,020	0,010	0,020	0,020	0,020	0,010	0,020
THC [A]	0,027	0,027	0,022	0,020	0,021	0,026	0,029	0,034	0,039	0,042	0,045	0,045
THDU [%]	0,030	0,030	0,040	0,040	0,050	0,050	0,050	0,060	0,060	0,070	0,070	0,070

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,080	0,080	0,080	0,110	0,080	0,080	0,100	0,100	0,070	0,070	0,090	0,110
125	0,060	0,070	0,110	0,090	0,070	0,070	0,080	0,130	0,070	0,070	0,070	0,130
175	0,100	0,130	0,130	0,180	0,120	0,100	0,120	0,110	0,110	0,110	0,110	0,180
225	0,090	0,110	0,160	0,130	0,100	0,110	0,110	0,100	0,110	0,110	0,100	0,160
275	0,130	0,190	0,180	0,250	0,180	0,160	0,180	0,190	0,220	0,170	0,190	0,250
325	0,110	0,180	0,200	0,170	0,150	0,160	0,150	0,140	0,260	0,160	0,140	0,260
375	0,170	0,250	0,240	0,310	0,260	0,250	0,250	0,280	0,370	0,360	0,250	0,370
425	0,150	0,210	0,270	0,210	0,200	0,230	0,200	0,190	0,300	0,390	0,180	0,390
475	0,190	0,280	0,290	0,340	0,320	0,300	0,310	0,310	0,280	0,360	0,270	0,360
525	0,170	0,220	0,300	0,240	0,240	0,290	0,250	0,230	0,240	0,300	0,310	0,310
575	0,160	0,220	0,290	0,250	0,260	0,290	0,260	0,240	0,250	0,270	0,460	0,460
625	0,180	0,250	0,290	0,330	0,310	0,270	0,300	0,290	0,400	0,300	0,430	0,430
675	0,140	0,190	0,270	0,220	0,220	0,230	0,220	0,210	0,240	0,240	0,430	0,430
725	0,170	0,230	0,250	0,320	0,290	0,240	0,290	0,330	0,320	0,290	0,400	0,400
775	0,130	0,160	0,220	0,190	0,180	0,190	0,180	0,180	0,200	0,200	0,220	0,220
825	0,150	0,200	0,210	0,290	0,250	0,240	0,250	0,290	0,240	0,290	0,330	0,330
875	0,120	0,140	0,190	0,160	0,150	0,170	0,160	0,170	0,190	0,170	0,180	0,190
925	0,140	0,180	0,190	0,240	0,220	0,220	0,220	0,220	0,290	0,240	0,260	0,290
975	0,100	0,120	0,170	0,130	0,130	0,150	0,130	0,130	0,160	0,150	0,160	0,170
1025	0,120	0,150	0,160	0,210	0,180	0,180	0,200	0,170	0,260	0,180	0,240	0,260
1075	0,090	0,110	0,140	0,120	0,120	0,140	0,120	0,130	0,130	0,150	0,140	0,150
1125	0,100	0,130	0,140	0,160	0,150	0,140	0,160	0,160	0,170	0,180	0,190	0,190
1175	0,100	0,120	0,130	0,150	0,130	0,120	0,140	0,160	0,150	0,160	0,160	0,160
1225	0,080	0,100	0,120	0,100	0,100	0,110	0,110	0,110	0,110	0,130	0,120	0,130
1275	0,100	0,110	0,120	0,140	0,130	0,120	0,130	0,150	0,180	0,130	0,170	0,180
1325	0,070	0,090	0,110	0,090	0,090	0,100	0,090	0,090	0,100	0,110	0,100	0,110
1375	0,090	0,100	0,110	0,130	0,130	0,130	0,120	0,120	0,170	0,150	0,150	0,170
1425	0,070	0,080	0,100	0,090	0,080	0,090	0,080	0,080	0,080	0,090	0,090	0,100
1475	0,080	0,090	0,100	0,120	0,110	0,120	0,120	0,110	0,110	0,140	0,130	0,140
1525	0,060	0,070	0,090	0,080	0,070	0,080	0,070	0,070	0,080	0,080	0,080	0,090
1575	0,080	0,090	0,090	0,110	0,090	0,100	0,110	0,110	0,110	0,100	0,130	0,130
1625	0,060	0,070	0,080	0,070	0,070	0,080	0,070	0,070	0,080	0,080	0,070	0,080
1675	0,080	0,080	0,080	0,100	0,080	0,080	0,090	0,100	0,120	0,100	0,100	0,120
1725	0,080	0,070	0,080	0,070	0,070	0,070	0,070	0,070	0,070	0,080	0,080	0,080
1775	0,100	0,070	0,080	0,070	0,070	0,070	0,070	0,070	0,070	0,080	0,070	0,100
1825	0,150	0,090	0,080	0,080	0,080	0,080	0,070	0,070	0,080	0,080	0,090	0,150
1875	0,090	0,130	0,070	0,060	0,060	0,070	0,060	0,060	0,070	0,070	0,060	0,130
1925	0,070	0,130	0,070	0,080	0,080	0,080	0,080	0,070	0,090	0,080	0,080	0,130
1975	0,060	0,070	0,070	0,060	0,060	0,060	0,050	0,060	0,060	0,060	0,060	0,070

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,130	0,140	0,250	0,150	0,130	0,140	0,140	0,150	0,160	0,150	0,150	0,250
2,3	0,120	0,120	0,130	0,160	0,120	0,120	0,130	0,130	0,130	0,130	0,130	0,160
2,5	0,120	0,120	0,130	0,190	0,130	0,120	0,120	0,130	0,140	0,130	0,120	0,190
2,7	0,110	0,110	0,120	0,130	0,140	0,120	0,110	0,120	0,130	0,120	0,120	0,140
2,9	0,120	0,110	0,120	0,120	0,160	0,110	0,100	0,110	0,120	0,120	0,120	0,160
3,1	0,100	0,100	0,100	0,100	0,130	0,100	0,100	0,110	0,110	0,120	0,110	0,130
3,3	0,100	0,100	0,090	0,090	0,100	0,100	0,100	0,110	0,110	0,120	0,110	0,120
3,5	0,090	0,080	0,080	0,080	0,090	0,110	0,090	0,100	0,120	0,120	0,110	0,120
3,7	0,090	0,080	0,080	0,080	0,090	0,100	0,090	0,100	0,110	0,120	0,120	0,120
3,9	0,080	0,070	0,070	0,070	0,080	0,100	0,110	0,110	0,110	0,120	0,120	0,120
4,1	0,080	0,070	0,070	0,070	0,070	0,090	0,110	0,120	0,110	0,120	0,130	0,130
4,3	0,070	0,060	0,060	0,070	0,080	0,100	0,100	0,110	0,130	0,140	0,150	0,150
4,5	0,080	0,070	0,070	0,080	0,090	0,110	0,120	0,130	0,170	0,160	0,170	0,170
4,7	0,050	0,050	0,050	0,050	0,050	0,070	0,070	0,090	0,110	0,120	0,120	0,120
4,9	0,050	0,050	0,050	0,040	0,050	0,060	0,060	0,070	0,080	0,100	0,100	0,100
5,1	0,040	0,040	0,040	0,040	0,040	0,050	0,060	0,060	0,070	0,070	0,090	0,090
5,3	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,060	0,060	0,060
5,5	0,030	0,030	0,020	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,060	0,060
5,7	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,050	0,060	0,060
5,9	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,050	0,050	0,050	0,050
6,1	0,030	0,030	0,020	0,020	0,020	0,030	0,030	0,030	0,040	0,040	0,040	0,040
6,3	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,040	0,040	0,040
6,5	0,040	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040
6,7	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,040
6,9	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
7,1	0,030	0,030	0,030	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030
7,3	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030
7,5	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030
7,7	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030
7,9	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,040	0,050	0,050	0,050
8,1	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030
8,3	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,5	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,7	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
8,9	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	7
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01
Note: The normalization current is 5,797 A.	

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-20KW-40A-1												
Phase L1												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,750	11,390	21,180	30,900	40,560	50,500	60,640	70,710	80,780	90,820	100,900	--
2	0,220	0,330	0,420	0,500	0,580	0,650	0,730	0,810	0,890	0,960	1,040	1,040
3	1,170	0,550	0,740	1,030	1,130	1,140	1,130	1,070	1,020	0,980	0,950	1,170
4	0,030	0,080	0,110	0,140	0,150	0,160	0,170	0,180	0,190	0,200	0,210	0,210
5	0,240	0,320	0,460	0,590	0,670	0,710	0,710	0,730	0,730	0,750	0,790	0,790
6	0,040	0,040	0,070	0,120	0,140	0,140	0,150	0,150	0,160	0,160	0,170	0,170
7	0,170	0,050	0,360	0,530	0,630	0,670	0,720	0,740	0,740	0,750	0,770	0,770
8	0,060	0,030	0,050	0,110	0,140	0,150	0,150	0,150	0,170	0,170	0,180	0,180
9	0,160	0,250	0,170	0,440	0,560	0,670	0,710	0,740	0,770	0,800	0,800	0,800
10	0,050	0,040	0,040	0,100	0,160	0,170	0,170	0,180	0,190	0,190	0,200	0,200
11	0,110	0,390	0,130	0,300	0,510	0,630	0,690	0,750	0,770	0,790	0,820	0,820
12	0,050	0,150	0,150	0,220	0,260	0,270	0,320	0,310	0,280	0,250	0,260	0,320
13	0,070	0,250	0,200	0,140	0,350	0,450	0,580	0,630	0,670	0,720	0,750	0,750
14	0,040	0,050	0,050	0,070	0,100	0,140	0,170	0,180	0,190	0,210	0,220	0,220
15	0,050	0,060	0,150	0,090	0,170	0,320	0,420	0,490	0,560	0,590	0,630	0,630
16	0,030	0,030	0,040	0,040	0,050	0,080	0,120	0,150	0,160	0,180	0,200	0,200
17	0,050	0,060	0,140	0,070	0,050	0,160	0,220	0,300	0,350	0,400	0,450	0,450
18	0,020	0,020	0,020	0,030	0,030	0,040	0,060	0,080	0,100	0,110	0,150	0,150
19	0,030	0,070	0,090	0,060	0,030	0,060	0,120	0,160	0,200	0,250	0,270	0,270
20	0,020	0,020	0,020	0,020	0,030	0,030	0,050	0,070	0,080	0,090	0,100	0,100
21	0,020	0,040	0,030	0,060	0,050	0,080	0,120	0,110	0,160	0,150	0,160	0,160
22	0,020	0,020	0,020	0,020	0,030	0,030	0,040	0,040	0,070	0,070	0,090	0,090
23	0,020	0,020	0,040	0,060	0,050	0,060	0,090	0,080	0,120	0,140	0,170	0,170
24	0,010	0,020	0,010	0,030	0,020	0,030	0,030	0,040	0,060	0,060	0,120	0,120
25	0,020	0,020	0,030	0,040	0,030	0,040	0,050	0,060	0,060	0,100	0,110	0,110
26	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,020	0,030	0,040	0,070	0,070
27	0,010	0,030	0,020	0,030	0,020	0,020	0,040	0,050	0,070	0,090	0,110	0,110
28	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,050	0,050
29	0,020	0,010	0,030	0,030	0,010	0,010	0,030	0,030	0,040	0,040	0,080	0,080
30	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,030	0,040	0,040	0,040
31	0,010	0,010	0,020	0,020	0,010	0,010	0,020	0,020	0,030	0,040	0,040	0,040

32	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,040	0,040
33	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,020	0,040	0,040	0,040
34	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,050	0,050
35	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,030	0,030	0,040	0,040
36	0,010	0,010	0,040	0,040	0,070	0,060	0,080	0,090	0,080	0,040	0,100	0,100
37	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,030	0,030
38	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,040	0,040
39	0,010	0,020	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,040	0,040
40	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,030	0,030
41	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,030	0,030
42	0,010	0,010	0,010	0,010	0,010	0,020	0,010	0,010	0,010	0,010	0,020	0,020
43	0,010	0,020	0,010	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,030	0,030
44	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
45	0,010	0,020	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
46	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
47	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
48	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020
49	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
50	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,020
THC [A]	0,013	0,009	0,011	0,015	0,018	0,020	0,022	0,022	0,023	0,024	0,025	0,025
THDU [%]	0,040	0,040	0,030	0,050	0,060	0,070	0,080	0,080	0,080	0,080	0,080	0,080

Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,080	0,080	0,090	0,100	0,090	0,100	0,110	0,100	0,120	0,100	0,080	0,120
125	0,070	0,060	0,060	0,070	0,060	0,070	0,080	0,070	0,100	0,070	0,070	0,100
175	0,080	0,090	0,090	0,120	0,110	0,120	0,120	0,120	0,120	0,100	0,080	0,120
225	0,070	0,070	0,060	0,080	0,060	0,080	0,080	0,070	0,100	0,080	0,070	0,100
275	0,120	0,090	0,120	0,150	0,110	0,170	0,150	0,170	0,130	0,110	0,120	0,170
325	0,090	0,080	0,080	0,090	0,080	0,090	0,090	0,080	0,110	0,090	0,090	0,110
375	0,140	0,130	0,160	0,200	0,200	0,200	0,210	0,200	0,150	0,120	0,140	0,210
425	0,090	0,100	0,100	0,110	0,090	0,110	0,100	0,100	0,120	0,110	0,090	0,120
475	0,170	0,130	0,180	0,230	0,180	0,230	0,250	0,220	0,160	0,140	0,170	0,250
525	0,110	0,110	0,100	0,130	0,100	0,130	0,110	0,110	0,130	0,120	0,110	0,130
575	0,110	0,120	0,110	0,130	0,120	0,130	0,130	0,120	0,130	0,130	0,110	0,130
625	0,150	0,150	0,210	0,280	0,270	0,290	0,250	0,240	0,190	0,190	0,150	0,290
675	0,110	0,110	0,110	0,130	0,120	0,150	0,140	0,130	0,140	0,140	0,110	0,150
725	0,140	0,160	0,230	0,260	0,250	0,310	0,290	0,270	0,210	0,240	0,140	0,310
775	0,070	0,090	0,090	0,100	0,100	0,140	0,120	0,130	0,140	0,150	0,070	0,150
825	0,100	0,120	0,170	0,250	0,290	0,340	0,330	0,290	0,220	0,270	0,100	0,340
875	0,070	0,080	0,070	0,090	0,090	0,120	0,120	0,140	0,150	0,160	0,070	0,160
925	0,090	0,120	0,180	0,190	0,190	0,280	0,330	0,310	0,240	0,300	0,090	0,330
975	0,080	0,090	0,100	0,100	0,090	0,120	0,120	0,140	0,160	0,180	0,080	0,180
1025	0,070	0,100	0,130	0,190	0,240	0,240	0,290	0,320	0,270	0,340	0,070	0,340
1075	0,050	0,060	0,050	0,070	0,070	0,110	0,110	0,150	0,160	0,220	0,050	0,220
1125	0,060	0,080	0,130	0,120	0,140	0,220	0,190	0,250	0,210	0,290	0,060	0,290
1175	0,050	0,080	0,100	0,140	0,160	0,180	0,180	0,220	0,180	0,280	0,050	0,280
1225	0,040	0,050	0,040	0,050	0,060	0,080	0,080	0,110	0,140	0,220	0,040	0,220
1275	0,050	0,070	0,110	0,100	0,140	0,150	0,190	0,180	0,170	0,280	0,050	0,280
1325	0,030	0,040	0,040	0,040	0,050	0,060	0,070	0,080	0,110	0,180	0,030	0,180
1375	0,040	0,060	0,080	0,110	0,110	0,160	0,160	0,150	0,140	0,260	0,040	0,260
1425	0,030	0,040	0,030	0,040	0,040	0,050	0,060	0,070	0,090	0,140	0,030	0,140
1475	0,040	0,060	0,090	0,080	0,120	0,120	0,120	0,120	0,110	0,220	0,040	0,220
1525	0,030	0,030	0,030	0,030	0,030	0,050	0,050	0,060	0,080	0,110	0,030	0,110
1575	0,030	0,050	0,060	0,090	0,080	0,100	0,100	0,100	0,090	0,190	0,030	0,190
1625	0,030	0,030	0,030	0,030	0,040	0,050	0,040	0,050	0,060	0,090	0,030	0,090
1675	0,030	0,040	0,070	0,060	0,090	0,100	0,090	0,090	0,080	0,140	0,030	0,140
1725	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,060	0,080	0,020	0,080
1775	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,050	0,080	0,020	0,080
1825	0,030	0,040	0,060	0,050	0,070	0,070	0,080	0,080	0,060	0,100	0,030	0,100
1875	0,020	0,020	0,030	0,020	0,030	0,030	0,030	0,040	0,050	0,060	0,020	0,060
1925	0,020	0,040	0,040	0,060	0,060	0,080	0,060	0,080	0,050	0,100	0,020	0,100
1975	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,040	0,040	0,060	0,020	0,060

Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,050	0,050	0,070	0,080	0,080	0,090	0,100	0,100	0,120	0,100	0,160	0,160
2,3	0,050	0,040	0,050	0,070	0,070	0,070	0,090	0,090	0,090	0,080	0,130	0,130
2,5	0,050	0,050	0,050	0,060	0,060	0,060	0,070	0,070	0,080	0,070	0,120	0,120
2,7	0,040	0,060	0,060	0,060	0,050	0,060	0,060	0,080	0,090	0,100	0,110	0,110
2,9	0,040	0,040	0,060	0,080	0,070	0,080	0,080	0,080	0,080	0,070	0,100	0,100
3,1	0,040	0,030	0,050	0,060	0,050	0,060	0,060	0,060	0,070	0,070	0,090	0,090
3,3	0,030	0,030	0,050	0,050	0,050	0,060	0,050	0,060	0,060	0,070	0,090	0,090
3,5	0,030	0,030	0,050	0,060	0,050	0,060	0,060	0,070	0,070	0,080	0,110	0,110
3,7	0,030	0,030	0,050	0,060	0,060	0,070	0,070	0,080	0,080	0,080	0,120	0,120
3,9	0,030	0,030	0,050	0,060	0,070	0,080	0,080	0,090	0,100	0,110	0,150	0,150
4,1	0,030	0,030	0,050	0,070	0,070	0,090	0,100	0,100	0,120	0,120	0,170	0,170
4,3	0,030	0,030	0,050	0,060	0,070	0,090	0,100	0,110	0,120	0,140	0,180	0,180
4,5	0,030	0,030	0,040	0,050	0,060	0,070	0,080	0,090	0,100	0,110	0,150	0,150
4,7	0,020	0,020	0,030	0,040	0,040	0,050	0,060	0,060	0,070	0,080	0,100	0,100
4,9	0,020	0,020	0,030	0,030	0,040	0,040	0,040	0,050	0,050	0,050	0,070	0,070
5,1	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,050
5,3	0,020	0,010	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,040
5,5	0,020	0,010	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030
5,7	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030
5,9	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,1	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,3	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,010	0,020	0,020
6,5	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,7	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,010	0,020	0,020
6,9	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020
7,1	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,3	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,5	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,7	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,010	0,010	0,020
7,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,1	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,3	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,5	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,7	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	33
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01
Note: The normalization current is 28,986 A.	

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-20KW-40A-1												
Phase L2												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,770	11,050	20,470	29,820	39,120	48,710	58,510	68,320	78,160	87,990	97,870	--
2	0,130	0,080	0,150	0,220	0,290	0,370	0,450	0,530	0,610	0,680	0,760	0,760
3	1,130	0,470	0,630	0,880	0,990	1,020	1,000	0,970	0,930	0,890	0,840	1,130
4	0,080	0,130	0,110	0,080	0,090	0,100	0,110	0,130	0,140	0,150	0,170	0,170
5	0,220	0,350	0,480	0,580	0,640	0,670	0,690	0,700	0,710	0,740	0,770	0,770
6	0,070	0,070	0,100	0,070	0,040	0,030	0,050	0,050	0,070	0,080	0,090	0,100
7	0,160	0,060	0,380	0,560	0,660	0,710	0,740	0,780	0,790	0,810	0,830	0,830
8	0,080	0,060	0,100	0,100	0,070	0,050	0,060	0,070	0,080	0,090	0,110	0,110
9	0,140	0,210	0,210	0,460	0,590	0,680	0,720	0,740	0,780	0,790	0,800	0,800
10	0,060	0,120	0,050	0,090	0,080	0,060	0,080	0,090	0,090	0,090	0,110	0,120
11	0,090	0,350	0,130	0,330	0,540	0,660	0,720	0,770	0,790	0,820	0,830	0,830
12	0,040	0,200	0,170	0,260	0,280	0,280	0,340	0,310	0,270	0,170	0,160	0,340
13	0,070	0,240	0,190	0,170	0,370	0,510	0,620	0,690	0,720	0,760	0,790	0,790
14	0,040	0,060	0,070	0,070	0,090	0,080	0,100	0,100	0,090	0,090	0,120	0,120
15	0,040	0,090	0,120	0,090	0,190	0,340	0,460	0,530	0,610	0,630	0,670	0,670
16	0,050	0,030	0,060	0,040	0,050	0,050	0,060	0,070	0,080	0,080	0,100	0,100
17	0,030	0,040	0,120	0,080	0,070	0,160	0,250	0,310	0,370	0,430	0,480	0,480
18	0,020	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,060	0,060
19	0,030	0,070	0,100	0,030	0,040	0,060	0,130	0,200	0,240	0,300	0,340	0,340
20	0,020	0,020	0,020	0,030	0,020	0,030	0,040	0,040	0,040	0,040	0,050	0,050
21	0,020	0,030	0,040	0,050	0,040	0,060	0,100	0,130	0,150	0,150	0,170	0,170
22	0,020	0,020	0,010	0,020	0,030	0,030	0,040	0,030	0,040	0,040	0,070	0,070
23	0,020	0,020	0,040	0,060	0,060	0,060	0,100	0,100	0,130	0,140	0,160	0,160
24	0,020	0,020	0,010	0,030	0,020	0,030	0,040	0,040	0,060	0,040	0,110	0,110
25	0,020	0,020	0,040	0,040	0,040	0,040	0,050	0,070	0,090	0,130	0,140	0,140
26	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,020	0,030	0,030	0,060	0,060
27	0,010	0,020	0,020	0,020	0,020	0,020	0,040	0,050	0,060	0,080	0,090	0,090
28	0,010	0,020	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,040	0,040
29	0,020	0,010	0,030	0,030	0,010	0,020	0,020	0,020	0,040	0,060	0,090	0,090
30	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,030	0,030	0,030
31	0,010	0,010	0,030	0,020	0,010	0,010	0,020	0,020	0,040	0,050	0,070	0,070

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)											P	
32	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,030	0,030
33	0,010	0,010	0,020	0,010	0,010	0,010	0,020	0,020	0,030	0,030	0,040	0,040
34	0,010	0,010	0,010	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,050	0,050
35	0,010	0,010	0,020	0,010	0,010	0,010	0,020	0,030	0,030	0,050	0,060	0,060
36	0,010	0,020	0,040	0,050	0,080	0,060	0,090	0,110	0,090	0,050	0,100	0,110
37	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,020	0,030	0,040	0,040
38	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,030	0,020	0,040	0,040
39	0,020	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,030	0,030	0,050	0,050
40	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,030
41	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,010	0,020	0,020
42	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
43	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,030
44	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
45	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020
46	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
47	0,010	0,010	0,010	0,010	0,020	0,030	0,030	0,030	0,030	0,020	0,030	0,030
48	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020
49	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020
50	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
THC [A]	0,012	0,008	0,010	0,014	0,017	0,019	0,020	0,021	0,022	0,023	0,024	0,024
THDU [%]	0,030	0,050	0,060	0,070	0,090	0,090	0,100	0,100	0,110	0,110	0,110	0,110

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,080	0,090	0,060	0,100	0,110	0,080	0,110	0,120	0,100	0,120	0,100	0,120
125	0,070	0,070	0,050	0,060	0,080	0,060	0,080	0,080	0,060	0,100	0,070	0,100
175	0,060	0,090	0,080	0,100	0,130	0,120	0,140	0,140	0,140	0,120	0,090	0,140
225	0,070	0,070	0,060	0,070	0,080	0,060	0,080	0,090	0,070	0,100	0,080	0,100
275	0,070	0,130	0,070	0,140	0,180	0,120	0,200	0,180	0,190	0,130	0,100	0,200
325	0,070	0,090	0,080	0,080	0,090	0,070	0,090	0,090	0,080	0,100	0,090	0,100
375	0,080	0,160	0,130	0,190	0,230	0,230	0,230	0,240	0,240	0,160	0,120	0,240
425	0,090	0,090	0,090	0,100	0,120	0,100	0,120	0,120	0,110	0,120	0,110	0,120
475	0,100	0,180	0,110	0,200	0,260	0,200	0,260	0,280	0,250	0,160	0,140	0,280
525	0,090	0,110	0,110	0,100	0,130	0,110	0,140	0,120	0,120	0,130	0,120	0,140
575	0,100	0,100	0,100	0,120	0,130	0,120	0,140	0,140	0,130	0,130	0,140	0,140
625	0,070	0,160	0,130	0,230	0,320	0,300	0,330	0,300	0,280	0,210	0,210	0,330
675	0,090	0,100	0,100	0,110	0,130	0,120	0,150	0,140	0,130	0,130	0,140	0,150
725	0,060	0,150	0,160	0,260	0,290	0,280	0,340	0,350	0,310	0,230	0,260	0,350
775	0,070	0,070	0,070	0,090	0,110	0,110	0,140	0,130	0,140	0,140	0,160	0,160
825	0,070	0,110	0,110	0,190	0,280	0,320	0,390	0,390	0,340	0,240	0,290	0,390
875	0,060	0,060	0,070	0,070	0,090	0,090	0,130	0,120	0,140	0,150	0,160	0,160
925	0,060	0,090	0,120	0,200	0,210	0,210	0,320	0,380	0,360	0,240	0,300	0,380
975	0,050	0,050	0,060	0,080	0,080	0,090	0,120	0,130	0,150	0,160	0,180	0,180
1025	0,050	0,070	0,100	0,140	0,210	0,260	0,260	0,310	0,350	0,250	0,320	0,350
1075	0,040	0,040	0,060	0,060	0,070	0,080	0,110	0,130	0,160	0,170	0,220	0,220
1125	0,050	0,060	0,090	0,150	0,140	0,160	0,250	0,220	0,280	0,210	0,280	0,280
1175	0,040	0,050	0,080	0,110	0,160	0,190	0,200	0,230	0,250	0,200	0,300	0,300
1225	0,040	0,030	0,050	0,050	0,060	0,060	0,090	0,100	0,130	0,140	0,230	0,230
1275	0,030	0,040	0,070	0,130	0,110	0,150	0,170	0,230	0,200	0,180	0,320	0,320
1325	0,040	0,030	0,030	0,040	0,050	0,050	0,070	0,080	0,090	0,110	0,190	0,190
1375	0,030	0,040	0,060	0,090	0,130	0,130	0,180	0,200	0,170	0,150	0,300	0,300
1425	0,030	0,030	0,040	0,030	0,040	0,040	0,060	0,060	0,070	0,090	0,150	0,150
1475	0,030	0,040	0,060	0,110	0,090	0,140	0,140	0,140	0,140	0,120	0,250	0,250
1525	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,050	0,060	0,080	0,120	0,120
1575	0,030	0,030	0,050	0,070	0,110	0,090	0,110	0,120	0,130	0,100	0,200	0,200
1625	0,030	0,020	0,030	0,030	0,030	0,040	0,050	0,050	0,060	0,070	0,100	0,100
1675	0,030	0,030	0,050	0,080	0,070	0,110	0,120	0,120	0,110	0,080	0,150	0,150
1725	0,020	0,020	0,020	0,030	0,030	0,030	0,040	0,050	0,050	0,060	0,080	0,080
1775	0,030	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,060	0,090	0,090
1825	0,020	0,030	0,040	0,070	0,060	0,080	0,070	0,090	0,100	0,060	0,110	0,110
1875	0,030	0,020	0,020	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,070	0,070
1925	0,020	0,020	0,040	0,040	0,070	0,070	0,090	0,070	0,090	0,060	0,100	0,100
1975	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,040	0,040	0,060	0,060

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,050	0,050	0,060	0,080	0,090	0,100	0,110	0,110	0,120	0,100	0,160	0,160
2,3	0,050	0,040	0,050	0,070	0,070	0,080	0,100	0,100	0,100	0,090	0,130	0,130
2,5	0,050	0,040	0,050	0,060	0,060	0,070	0,070	0,080	0,080	0,070	0,120	0,120
2,7	0,040	0,060	0,050	0,060	0,060	0,060	0,070	0,080	0,090	0,100	0,110	0,110
2,9	0,040	0,040	0,060	0,080	0,080	0,080	0,090	0,080	0,080	0,060	0,100	0,100
3,1	0,040	0,040	0,050	0,060	0,060	0,060	0,070	0,070	0,060	0,060	0,090	0,090
3,3	0,040	0,030	0,050	0,060	0,060	0,060	0,070	0,070	0,070	0,070	0,090	0,090
3,5	0,030	0,030	0,040	0,060	0,060	0,070	0,070	0,070	0,080	0,080	0,110	0,110
3,7	0,040	0,030	0,050	0,070	0,070	0,080	0,080	0,090	0,090	0,100	0,130	0,130
3,9	0,030	0,020	0,040	0,060	0,060	0,080	0,080	0,090	0,100	0,110	0,150	0,150
4,1	0,030	0,030	0,040	0,060	0,070	0,090	0,100	0,110	0,130	0,150	0,200	0,200
4,3	0,030	0,030	0,040	0,060	0,070	0,090	0,100	0,110	0,120	0,140	0,180	0,180
4,5	0,030	0,020	0,030	0,050	0,060	0,070	0,080	0,090	0,100	0,110	0,140	0,140
4,7	0,020	0,020	0,030	0,040	0,040	0,050	0,060	0,070	0,080	0,080	0,100	0,100
4,9	0,020	0,020	0,030	0,040	0,040	0,050	0,050	0,050	0,060	0,060	0,080	0,080
5,1	0,020	0,010	0,020	0,030	0,030	0,030	0,040	0,040	0,040	0,040	0,050	0,050
5,3	0,020	0,010	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040
5,5	0,020	0,010	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040
5,7	0,020	0,010	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030	0,030
5,9	0,010	0,010	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030	0,030
6,1	0,020	0,010	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,030	0,030
6,3	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,5	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,7	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,9	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,010	0,020	0,020
7,1	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,3	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,5	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
7,7	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,010	0,020	0,020
7,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,1	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,3	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,5	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,7	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	33
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01
Note: The normalization current is 28,986 A.	

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
PCS-3-20KW-40A-1												
Phase L3												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	2,890	11,590	21,390	31,070	40,660	50,510	60,590	70,620	80,650	90,660	100,700	--
2	0,150	0,250	0,320	0,370	0,430	0,490	0,550	0,610	0,680	0,740	0,820	0,820
3	1,150	0,480	0,680	0,940	1,040	1,050	1,030	1,000	0,980	0,960	0,940	1,150
4	0,070	0,070	0,090	0,130	0,140	0,150	0,160	0,170	0,180	0,190	0,210	0,210
5	0,230	0,330	0,470	0,610	0,690	0,740	0,750	0,770	0,790	0,820	0,860	0,860
6	0,050	0,040	0,040	0,090	0,110	0,120	0,120	0,120	0,140	0,140	0,160	0,160
7	0,190	0,070	0,390	0,560	0,650	0,710	0,750	0,780	0,790	0,800	0,820	0,820
8	0,070	0,030	0,040	0,090	0,110	0,120	0,130	0,130	0,140	0,150	0,170	0,170
9	0,170	0,260	0,230	0,490	0,610	0,690	0,750	0,780	0,800	0,820	0,840	0,840
10	0,060	0,040	0,070	0,090	0,130	0,150	0,160	0,170	0,170	0,180	0,200	0,200
11	0,110	0,390	0,170	0,340	0,540	0,650	0,720	0,770	0,800	0,820	0,850	0,850
12	0,050	0,130	0,270	0,320	0,240	0,280	0,300	0,240	0,210	0,240	0,270	0,320
13	0,070	0,240	0,220	0,200	0,380	0,520	0,620	0,680	0,730	0,760	0,780	0,780
14	0,040	0,060	0,080	0,080	0,100	0,130	0,160	0,180	0,190	0,200	0,220	0,220
15	0,050	0,070	0,160	0,120	0,200	0,330	0,430	0,510	0,570	0,620	0,670	0,670
16	0,030	0,030	0,040	0,050	0,050	0,080	0,100	0,120	0,140	0,160	0,190	0,190
17	0,050	0,050	0,120	0,090	0,080	0,170	0,250	0,310	0,360	0,400	0,460	0,460
18	0,020	0,020	0,030	0,030	0,030	0,040	0,060	0,070	0,090	0,110	0,140	0,140
19	0,040	0,070	0,080	0,060	0,030	0,070	0,120	0,170	0,200	0,240	0,280	0,280
20	0,020	0,020	0,020	0,020	0,030	0,040	0,050	0,050	0,060	0,070	0,080	0,080
21	0,030	0,050	0,060	0,030	0,040	0,040	0,070	0,110	0,150	0,180	0,210	0,210
22	0,020	0,010	0,020	0,020	0,020	0,030	0,030	0,030	0,040	0,070	0,070	0,070
23	0,020	0,040	0,050	0,060	0,040	0,060	0,080	0,080	0,110	0,150	0,180	0,180
24	0,010	0,020	0,030	0,020	0,020	0,020	0,030	0,030	0,050	0,120	0,120	0,120
25	0,010	0,020	0,030	0,040	0,030	0,040	0,050	0,060	0,090	0,130	0,160	0,160
26	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,040	0,060	0,080	0,080
27	0,010	0,020	0,030	0,040	0,020	0,030	0,030	0,040	0,060	0,080	0,110	0,110
28	0,010	0,020	0,010	0,020	0,010	0,010	0,020	0,020	0,030	0,050	0,070	0,070
29	0,020	0,010	0,030	0,030	0,010	0,020	0,030	0,030	0,040	0,060	0,080	0,080
30	0,010	0,010	0,010	0,010	0,020	0,010	0,020	0,020	0,030	0,040	0,050	0,050
31	0,010	0,010	0,030	0,020	0,010	0,020	0,030	0,020	0,030	0,040	0,050	0,050

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)											P	
32	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,030	0,040	0,040
33	0,010	0,010	0,020	0,010	0,010	0,010	0,020	0,020	0,020	0,030	0,050	0,050
34	0,010	0,010	0,020	0,020	0,010	0,020	0,020	0,020	0,020	0,050	0,080	0,080
35	0,010	0,010	0,020	0,020	0,010	0,020	0,020	0,020	0,020	0,030	0,040	0,040
36	0,010	0,040	0,070	0,050	0,050	0,050	0,070	0,060	0,030	0,120	0,170	0,170
37	0,010	0,010	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,030	0,040	0,040
38	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,040	0,060	0,060
39	0,010	0,020	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,030	0,040	0,040
40	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,030	0,030	0,030
41	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020
42	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,010	0,010	0,020	0,020
43	0,010	0,010	0,010	0,020	0,010	0,010	0,020	0,020	0,010	0,010	0,020	0,020
44	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
45	0,010	0,020	0,010	0,020	0,010	0,010	0,020	0,020	0,010	0,010	0,020	0,020
46	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
47	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,040	0,040
48	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020
49	0,010	0,010	0,010	0,020	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020
50	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020
THC [A]	0,012	0,009	0,011	0,015	0,018	0,020	0,021	0,022	0,023	0,024	0,025	0,025
THDU [%]	0,030	0,040	0,050	0,060	0,070	0,080	0,080	0,090	0,090	0,090	0,090	0,090

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Interharmonics												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,090	0,060	0,080	0,110	0,100	0,080	0,100	0,090	0,090	0,130	0,080	0,130
125	0,080	0,060	0,060	0,070	0,070	0,050	0,070	0,070	0,060	0,110	0,070	0,110
175	0,070	0,070	0,120	0,140	0,120	0,130	0,120	0,090	0,100	0,120	0,120	0,140
225	0,070	0,080	0,070	0,070	0,080	0,060	0,080	0,080	0,070	0,120	0,080	0,120
275	0,070	0,110	0,150	0,180	0,160	0,130	0,170	0,120	0,120	0,130	0,150	0,180
325	0,070	0,080	0,080	0,090	0,090	0,070	0,100	0,080	0,080	0,130	0,090	0,130
375	0,080	0,110	0,220	0,250	0,200	0,230	0,170	0,180	0,130	0,160	0,190	0,250
425	0,090	0,120	0,120	0,110	0,110	0,090	0,110	0,100	0,090	0,150	0,110	0,150
475	0,090	0,180	0,250	0,250	0,230	0,210	0,200	0,210	0,140	0,170	0,210	0,250
525	0,090	0,100	0,120	0,120	0,120	0,110	0,130	0,110	0,110	0,170	0,130	0,170
575	0,100	0,120	0,130	0,130	0,130	0,110	0,130	0,120	0,110	0,170	0,130	0,170
625	0,080	0,190	0,260	0,270	0,260	0,290	0,250	0,180	0,150	0,230	0,270	0,290
675	0,090	0,100	0,110	0,120	0,130	0,120	0,140	0,130	0,120	0,180	0,150	0,180
725	0,070	0,150	0,250	0,310	0,230	0,260	0,240	0,210	0,170	0,270	0,340	0,340
775	0,070	0,090	0,090	0,080	0,100	0,100	0,130	0,120	0,130	0,200	0,160	0,200
825	0,070	0,140	0,220	0,200	0,210	0,300	0,300	0,250	0,190	0,290	0,390	0,390
875	0,060	0,070	0,070	0,080	0,090	0,090	0,130	0,130	0,140	0,210	0,180	0,210
925	0,060	0,130	0,170	0,220	0,160	0,190	0,240	0,260	0,220	0,320	0,450	0,450
975	0,050	0,070	0,070	0,060	0,070	0,070	0,110	0,120	0,140	0,220	0,210	0,220
1025	0,050	0,100	0,170	0,140	0,140	0,220	0,170	0,200	0,230	0,340	0,480	0,480
1075	0,040	0,050	0,060	0,060	0,060	0,070	0,100	0,100	0,140	0,230	0,270	0,270
1125	0,050	0,090	0,110	0,140	0,100	0,140	0,180	0,110	0,190	0,310	0,440	0,440
1175	0,040	0,080	0,130	0,100	0,100	0,150	0,150	0,110	0,180	0,310	0,420	0,420
1225	0,040	0,050	0,050	0,050	0,050	0,060	0,080	0,080	0,110	0,200	0,280	0,280
1275	0,030	0,090	0,100	0,120	0,080	0,130	0,100	0,130	0,160	0,290	0,410	0,410
1325	0,040	0,030	0,040	0,040	0,040	0,050	0,060	0,070	0,080	0,160	0,200	0,200
1375	0,030	0,070	0,110	0,080	0,080	0,100	0,130	0,120	0,130	0,250	0,370	0,370
1425	0,030	0,040	0,040	0,040	0,040	0,040	0,050	0,060	0,070	0,130	0,150	0,150
1475	0,030	0,070	0,080	0,100	0,060	0,110	0,110	0,080	0,100	0,210	0,320	0,320
1525	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,050	0,060	0,110	0,120	0,120
1575	0,030	0,050	0,100	0,070	0,070	0,070	0,070	0,050	0,070	0,180	0,280	0,280
1625	0,030	0,040	0,030	0,030	0,030	0,040	0,040	0,040	0,050	0,100	0,110	0,110
1675	0,030	0,060	0,060	0,080	0,050	0,090	0,080	0,060	0,060	0,150	0,220	0,220
1725	0,030	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,050	0,080	0,100	0,100
1775	0,030	0,030	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,080	0,100	0,100
1825	0,020	0,050	0,050	0,070	0,040	0,070	0,050	0,060	0,050	0,120	0,160	0,160
1875	0,030	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,040	0,070	0,070	0,070
1925	0,020	0,040	0,060	0,040	0,050	0,060	0,060	0,040	0,050	0,110	0,140	0,140
1975	0,020	0,030	0,020	0,020	0,020	0,020	0,030	0,030	0,040	0,060	0,060	0,060

5.1.4 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)												P
Higher Frequencies												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,050	0,070	0,080	0,080	0,070	0,080	0,090	0,070	0,090	0,160	0,180	0,180
2,3	0,050	0,060	0,070	0,070	0,060	0,070	0,080	0,070	0,080	0,130	0,150	0,150
2,5	0,060	0,060	0,060	0,060	0,050	0,060	0,060	0,050	0,070	0,110	0,150	0,150
2,7	0,040	0,070	0,060	0,060	0,050	0,050	0,060	0,060	0,080	0,120	0,120	0,120
2,9	0,040	0,050	0,060	0,070	0,060	0,070	0,080	0,070	0,060	0,100	0,100	0,100
3,1	0,040	0,050	0,050	0,050	0,040	0,050	0,050	0,050	0,060	0,090	0,100	0,100
3,3	0,040	0,040	0,050	0,040	0,040	0,050	0,050	0,050	0,060	0,080	0,090	0,090
3,5	0,030	0,040	0,050	0,040	0,040	0,050	0,050	0,050	0,060	0,090	0,100	0,100
3,7	0,030	0,040	0,050	0,050	0,050	0,060	0,060	0,070	0,070	0,100	0,120	0,120
3,9	0,030	0,040	0,040	0,050	0,050	0,060	0,060	0,070	0,080	0,110	0,130	0,130
4,1	0,030	0,030	0,040	0,050	0,050	0,070	0,080	0,090	0,100	0,130	0,150	0,150
4,3	0,030	0,030	0,040	0,050	0,060	0,080	0,090	0,090	0,120	0,150	0,190	0,190
4,5	0,030	0,030	0,050	0,060	0,070	0,080	0,090	0,110	0,120	0,150	0,190	0,190
4,7	0,020	0,020	0,030	0,050	0,050	0,070	0,070	0,080	0,090	0,110	0,140	0,140
4,9	0,030	0,020	0,030	0,040	0,040	0,050	0,060	0,060	0,070	0,080	0,100	0,100
5,1	0,020	0,020	0,030	0,030	0,030	0,040	0,040	0,050	0,050	0,060	0,080	0,080
5,3	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,040	0,040	0,060	0,060
5,5	0,020	0,010	0,020	0,020	0,020	0,030	0,030	0,030	0,030	0,040	0,060	0,060
5,7	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030	0,030	0,040	0,040	0,040
5,9	0,010	0,020	0,020	0,030	0,030	0,020	0,030	0,030	0,030	0,030	0,030	0,030
6,1	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
6,3	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,5	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,030	0,030
6,7	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
6,9	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,1	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020
7,3	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020
7,5	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
7,7	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020	0,030	0,020	0,030	0,030
7,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020	0,020	0,020
8,1	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,020	0,020
8,3	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,5	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,7	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010
8,9	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010	0,010

PV-curve simulated according to	--
Voltage of defined MPP [V]	620
Current of defined MPP [A]	33
FFU of PV curve [1]	1
Impedance [Ω] Line Neutral	 R_A = 0,15 jX_A= 0,15 R_N = 0,01 jX_N= 0,01

Note:

The normalization current is 28,986 A.

The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.2 Checking the symmetry behavior of three-phase converters	P

Test procedure and test conditions:

This section serves to prove the requirements according to TOR generator, section 6.1.1.

These tests are not applicable for direct connected rotating machines!

This test is necessary only for electronic inverters!

a) The failure of the inverter is to be stimulated the inverters sudden occur fault or communication loss with other inverters when it used on three phase system.
b) On the DC side of the inverter in one phase, the power must be abruptly reduced in such a way that the power value in one phase on the AC side drops by at least 3.68 kVA + 10%.

Assessment criteria:

The test is passed if the maximum value from the above measurements does not exceed 3680 VA

5.2.2 Calculation of asymmetry	P

Setting values	cos φ = 1	1,00				
	cos φ over-excited	0,90				
	cos φ under-excited	0,90				
Test: PCS-3-20KW-40A-1						
1-min mean value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
a) cos φ = 1 at 100 % P_{rE} ± 5 % P_n						
S_{E60} [VA]	6641	6584	6560	57	25	-82
	6642	6585	6559	57	26	-83
	6644	6587	6560	58	26	-84
	6643	6584	6561	59	24	-82
	6643	6585	6560	58	24	-83
cos φ_{E60}	0,999					
max. asymmetry [VA]	-84					
b) maximum under-excited (i) at 100 % P_{rE} ± 5 % P_n						
S_{E60} [VA]	7402	7320	7362	82	-42	-40
	7400	7317	7359	82	-42	-40
	7424	7341	7384	83	-43	-40
	7431	7349	7391	82	-42	-40
	7413	7331	7373	82	-42	-40
cos φ_{E60}	0,900					
max. asymmetry [VA]	83					
c) maximum over-excited (c) at 100 % P_{rE} ± 5 % Pn						
S_{E60} [VA]	7415	7369	7323	47	46	-92
	7432	7387	7341	45	46	-91
	7395	7350	7303	45	46	-92
	7400	7353	7308	47	45	-92
	7395	7349	7303	46	46	-92
cos φ_{E60}	0,899					
max. asymmetry [VA]	-92					
d) cos φ = 1 at 50 % P_{rE} ± 5 % Pn						
S_{E60} [VA]	3331	3291	3268	41	22	-63
	3332	3291	3268	41	23	-63
	3332	3291	3269	41	23	-64
	3332	3291	3269	41	23	-64

	3332	3291	3269	40	22	-63
cos φ_{E60}	0,998					
max. asymmetry [VA]	-64					
e) maximum under-excited (i) at 50 % P_{rE} ± 5 % Pn						
S_{E60} [VA]	3713	3654	3661	59	-7	-52
	3714	3654	3661	59	-7	-52
	3712	3652	3659	59	-7	-52
	3718	3659	3666	59	-7	-52
	3720	3661	3668	59	-7	-52
cos φ_{E60}	0,903					
max. asymmetry [VA]	59					
f) maximum over-excited (c) at 50 % P_{rE} ± 5 % Pn						
S_{E60} [VA]	3694	3668	3626	26	42	-69
	3695	3668	3626	26	43	-69
	3695	3668	3627	27	42	-68
	3695	3669	3627	27	42	-68
	3694	3668	3626	27	42	-68
cos φ_{E60}:	0,897					
max. asymmetry [VA]	-69					

Note:
The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3 Checking the behavior of the generating unit on the grid	P

5.3.1 General	P
Test procedure and test conditions: Section 5.3 serves as proof of the requirements according to TOR Erzeuger, Section 5 are met and to determine the values for S_n and P_n. The measurements were performed in the testing laboratory. at the grid-simulator: U_N = between 86 % Un and 109% Un until the test Frequency: 50 Hz +/- 0,5%	

5.3.2 Measurement of the active and reactive power working range ("PQ diagram")	P

Test procedure and test conditions:

The reactive power P(Q) was set by SW-Tool using RS485-interface.

For test d - I, the test voltage at which the highest active power was achieved is taken!

The EZE is operated in all possible of the following operating points, whereby each operating point must be kept for at least 1 minutes after the settling process has subsided. During the partial measurements a) to c) below, the primary energy source must not limit the output.

Measurement points a-c has to be performed at U_n, $0{,}86U_n$ and $1{,}09\ U_n$

a) With 0.86 Un, Un and 1.09 Un, the maximum possible active power must be set under the specification of a cos *(φ)* 1.

b) With 0.86 Un, Un and 1.09 Un, the maximum possible active power with maximum under-excited operation must be set (Q =43,6%/S_n.)

c) At 0.86 Un, Un and 1.09 Un, the maximum possible active power with maximum overexcited operation must be set (Q =43,6%/S_n.)

d) With 0.86 Un*, Un* and 1.09 Un*, the 20-30% active power which was determined values from a) with maximum under-excited operation must be set (Q =43,6%/S_n.)

e) At 0.86 Un*, Un* and 1.09 Un*, the 20-30% possible active power which was determined values from a) with maximum overexcited operation must be set(Q =43,6%/S_n.)

f) With 0.86 Un*, Un* and 1.09 Un*, the 10-20% active power which was determined values from a) with maximum under-excited operation must be set (Q =43,6%/S_n.)

g) At 0.86 Un*, Un* and 1.09 Un*, the 10-20% possible active power which was determined values from a) with maximum overexcited operation must be set(Q =43,6%/S_n.)

h) With 0.86 Un*, Un* and 1.09 Un*, the 0-10% active power which was determined values from a) with maximum under-excited operation must be set (Q =43,6%/S_n.)

i) At 0.86 Un*, Un* and 1.09 Un*, the 0-10% possible active power which was determined values from a) with maximum overexcited operation must be set(Q =43,6%/S_n.)

Assessment criteria:

Sn_{60} and Pn_{60} are determined by the highest value measured.

$S_{n\,60} = \max(Sn_{60\,a)}, Sn_{60\,b)}, Sn_{60\,c)})$

$Pn_{60} = \max(Pn_{60\,a)}, Pn_{60\,b)}, Pn_{60\,c)})$

Note:

Q=31,2 (φ 0,95)	(i) and (c):	PGU ≤ 3,68 kVA
Q=43,6 (φ 0,90)	(i) and (c):	PGU > 3,68 kVA

Results:			
Setting values	cos φ =:	1,00	
	Maximum over-excited:	43,6% Sn	
	Maximum under-excited:	-43,6% Sn	
PCS-3-20KW-40A-1			
60 s mean value	0,86 U_n	U_n	1,09U_n
a) cos φ 1 at 100% Pn			
U [V]:	198,14	230,29	250,99
$Pn_{60\ a)}$ [W]	19950	20071	20116
$Q_{60\ a)}$ [Var]	295	394	465
$Sn_{60\ a)}$ [VA]	19952	20075	20121
$\cos \varphi_{60}$	0,999	0,999	0,999
b) maximum under-excited (i) at 100% Pn			
U [V]:	198,10	230,18	250,93
$Pn_{60\ b)}$ [W]	17552	20000	20064
$Q_{60\ b)}$ [Var]	-9518	-9580	-9537
$Sn_{60\ b)}$ [VA]	19966	22176	22215
$\cos \varphi_{60}$	0,879	0,902	0,903
c) maximum over-excited (c) at 100% Pn			
U [V]:	198,11	230,27	250,99
$Pn_{60\ c)}$ [W]	17447	20016	20077
$Q_{60\ c)}$ [Var]	9539	9567	9588
$Sn_{60\ c)}$ [VA]	19884	22185	22249
$\cos \varphi_{60}$	0,877	0,902	0,902
d) maximum under-excited (i) at 20-30% Pn			
U [V]:	197,90	230,05	250,79
Pn_{60} [W]	6083	5946	5969
Q_{60} [Var]	-9528	-9594	-9540
Sn_{60} [VA]	11304	11287	11253
$\cos \varphi_{60}$	0,538	0,527	0,530
e) maximum over-excited (c) at 20-30% Pn			
U [V]:	197,88	230,15	250,83
Pn_{60} [W]	5991	5961	5983
Q_{60} [Var]	9554	9553	9548
Sn_{60} [VA]	11277	11260	11268
$\cos \varphi_{60}$	0,531	0,529	0,531
f) maximum under-excited (i) at 10-20% Pn			

U [V]:	197,82	230,02	250,78
Pn_{60} [W]	4031	3987	4007
Q_{60} [Var]	-9224	-9044	-9001
Sn_{60} [VA]	10067	9883	9852
$\cos \varphi_{60}$	0,400	0,403	0,407
g) maximum over-excited (c) at 10-20% Pn			
U [V]:	197,38	230,14	250,85
Pn_{60} [W]	4044	4001	4022
Q_{60} [Var]	9120	9063	9110
Sn_{60} [VA]	9976	9907	9959
$\cos \varphi_{60}$	0,405	0,404	0,404
h) maximum under-excited (i) at 0-10% Pn			
U [V]:	197,83	230,01	250,73
Pn_{60} [W]	2054	1977	1985
Q_{60} [Var]	-4701	-4505	-4552
Sn_{60} [VA]	5130	4920	4966
$\cos \varphi_{60}$	0,400	0,402	0,400
i) maximum over-excited (c) at 0-10% Pn			
U [V]:	197,88	230,11	250,79
Pn_{60} [W]	2060	1987	1995
Q_{60} [Var]	4732	4533	4578
Sn_{60} [VA]	5161	4949	4994
$\cos \varphi_{60}$	0,399	0,401	0,400
Sn_{60} and Pn_{60}			
Sn_{60}= max($Sn_{60\,a)}$, $Sn_{60\,b)}$, $Sn_{60\,c)}$) [VA]		22249	
Pn_{60}= max($Pn_{60\,a)}$, $Pn_{60\,b)}$, $Pn_{60\,c)}$)[W]		20116	

Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3.3 Termination of the active power feed after an OFF command via the telecontrol interface (input port)	P

Test procedure and test conditions:

These tests serve to prove the requirements according to TOR producer, section 5.4.1.

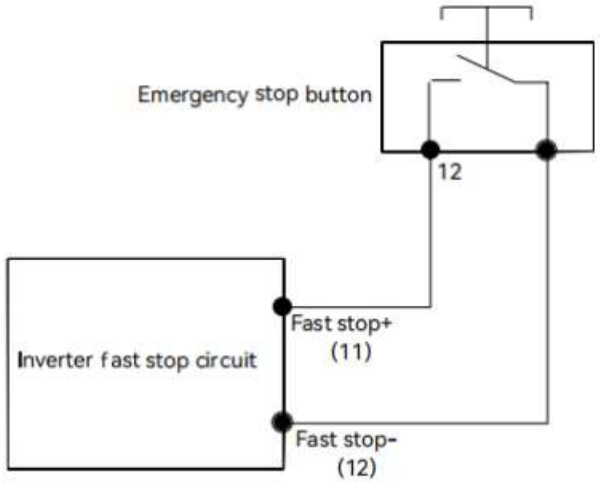
Assessment criteria:

The test is passed if the EZE ends the active power feed within 5 s. The criterion is an active power feed-in <5% Pn

A separation of the EZE from the network is permitted, but not mandatory.

Inverter interface**:**

The inverter comes standard with fast stop function, and you can use this function by connecting an external switch into the fast stop interface if it requires in the installation place.

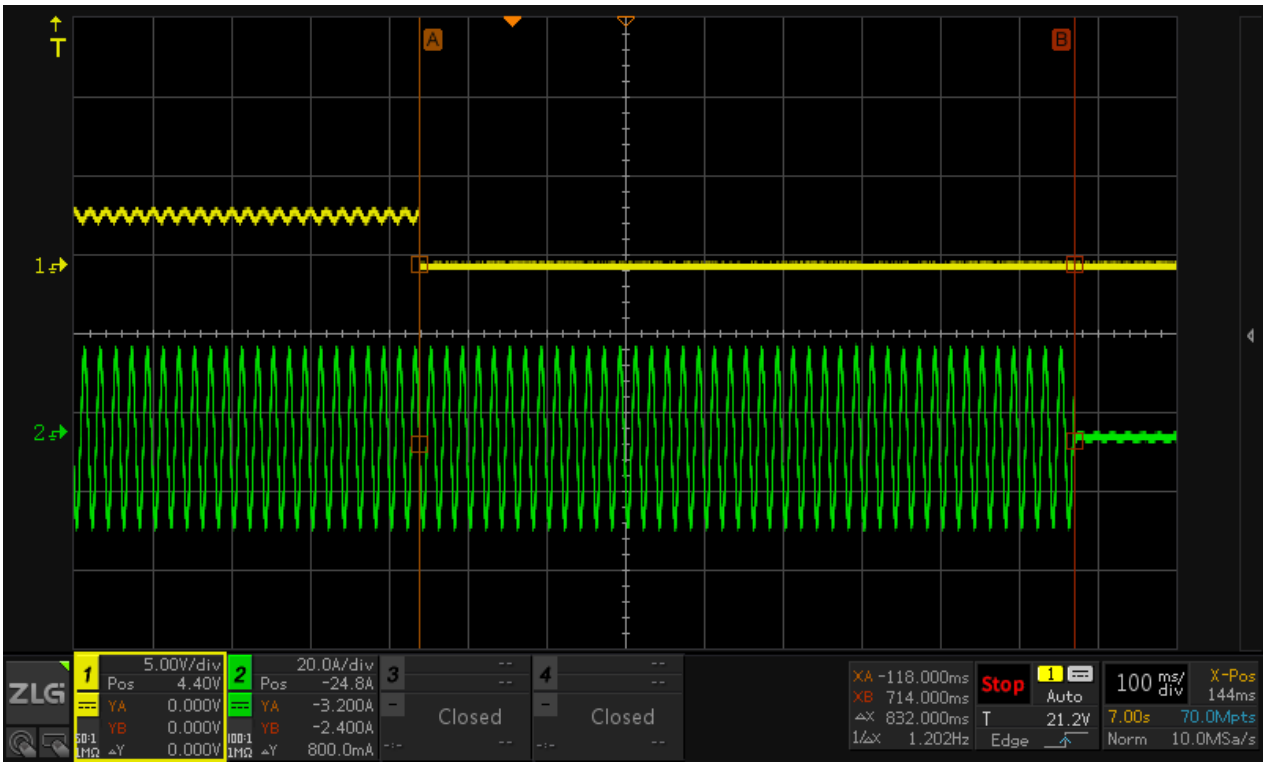


5.3.3 Termination of the active power feed after an OFF command via the telecontrol interface (input port)	P

Test result:

$P_{\_setting}$ point step	Measured value	Limit settling time [s]:
Setting times [s] P = 30%Pn to < 5%Pn	0,832	5

Tripping time:



Note:

The setpoint signal must be reduced from 30% to <5% Pn.

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3.4.1 Active power reduction in case of over frequency	P

Test procedure and test conditions:

The case of over frequency according to TOR Producer, Section 5.1.3. as well as proof of the active power gradient after reconnection according to TOR generator, Section 5.5.2.

The steps between points a) to j) may also be run with a frequency ramp of 1 Hz/s

In the case of non-synchronous power generation plants with converters and network connection point at the NIER voltage level, the following standard settings are recommended:

- Waiting time with automatic or operational activities: 60 s
- Waiting time in the event of a wiring after triggering the disclosure protection: 300 s

Assessment criteria:

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

a) For adjustable PGUs when:

1) the active power reduces between measuring points b) and f) given above with a gradient of 40% PM per Hz for a decreasing frequency (or rises for a frequency decreasing again).
2) the maximum active power gradient occurring in point g) is lower than 10% of maximum active power P_n every minute, and
3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_n by more than ± 10%.

b) For conditionally adjustable PGUs

1) when they behave as in a) within their adjustment range, and
2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

c) for non-regulated EZE, if

- a switch-off between 50.2 Hz and 51.5 Hz takes place within 1 s;
- The connection time in point j) corresponds to the manufacturer's information on the random generator

Result:

Test 1: Measurement: Active power output=100% Pn; DC Input power setting:>80%Pn; start frequency 50,20Hz; s=5% (40% P_{ref} / Hz);

Simulated grid frequency [Hz]	Measured frequency [Hz]:	$P_{setpoint}$ [%Pn]:	Measured P_{E60} [%Pn]:	Active power deviation ΔP [%Pn]	Limit deviation ΔP [%Pn]	Frequency response time of the grid [ms]
a) 50,00	50,00	100	100,02	0,02	+ 5%	--
b) 50,25	50,25	98	98,26	0,26		0,25
c) 50,70	50,70	80	79,82	-0,18		0,5
d) 51,15	51,15	62	61,92	-0,08		0,5
e) 50,70	50,70	80	80,21	0,21		0,5
f) 50,25	50,25	98	98,02	0,02		0,5
g) 50,00	50,00	100	100,00	0,00		0,25
h) 51,65	51,65	0	0,00	0,00		1,75
i) 50,15	50,15	0	0,01	0,01		1,75
j) 50,00	50,00	100	100,24	0,24		0,25

Simulated grid frequency [Hz]	Trip time [ms]	Limitation
g) 50 to h) 51,65	199	200ms

Simulated grid frequency [Hz]	Delay time [s]	Power Gradient	Delay time Limitation	Power Gradient Limitation
h) 51,65 to i) 50,15	No reconnection	--	No reconnection	--
i) 50,15 to j) 50	316	8,68% Pn /min	300s	≤ 10% Pn /min

Test 2: Measurement: Active power output 40% and 60%;
start frequency 50,20Hz; s=5% (40% P_{ref} / Hz);
after freezing, DC Input power setting > 80% Pn;

Simulated grid frequency [Hz]	Measured frequency [Hz]:	$P_{setpoint}$ [%Pn]:	Measured P_{E60} [%Pn]:	Active power deviation ΔP [%Pn]	Limit deviation ΔP [%Pn]	Frequency response time of the grid [ms]
a) 50,00	50,00	50	50,06	0,06	+ 5%	0,25
b) 50,25	50,25	49	49,18	0,17		0,5
c) 50,70	50,70	40	39,96	-0,05		0,5
d) 51,15	51,15	31	31,01	0,01		0,5
e) 50,70	50,70	40	40,15	0,15		0,5
f) 50,25	50,25	49	49,06	0,06		0,25
g) 50,00	50,00	100	100,68	0,68		1,75
h) 51,65	51,65	0	0,05	0,05		1,75
i) 50,15	50,15	0	0,05	0,05		0,25
j) 50,00	50,00	100	100,29	0,29		0,25

Simulated grid frequency [Hz]	Trip time [ms]	Limitation
g) 50 to h) 51,65	196	200ms

Simulated grid frequency [Hz]	Delay time [s]	Power Gradient	Delay time Limitation	Power Gradient Limitation
f) 50,25 to g) 50,00	--	8,64% Pn /min	--	≤ 10% Pn /min
h) 51,65 to i) 50,15	660	--	No reconnection	--
i) 50,15 to j) 50,00	315	8,67% Pn /min	300s	≤ 10% Pn /min

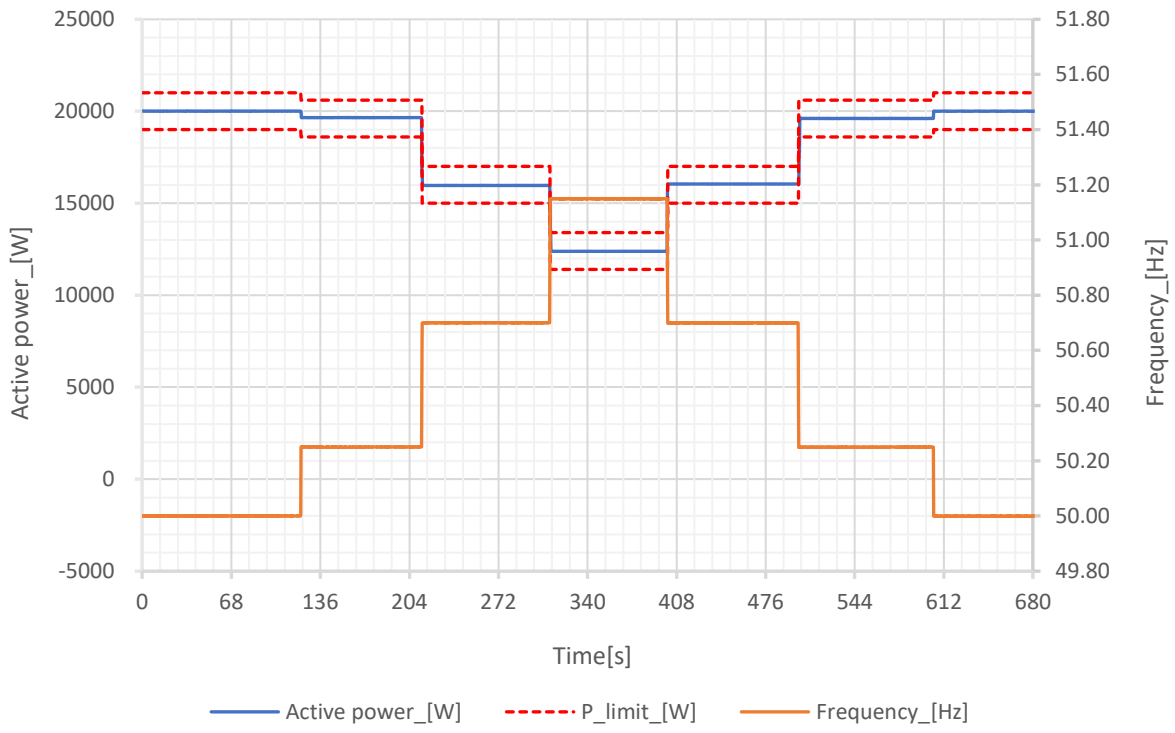
Note:

The equipment belongs to the type of non-synchronous generating types.

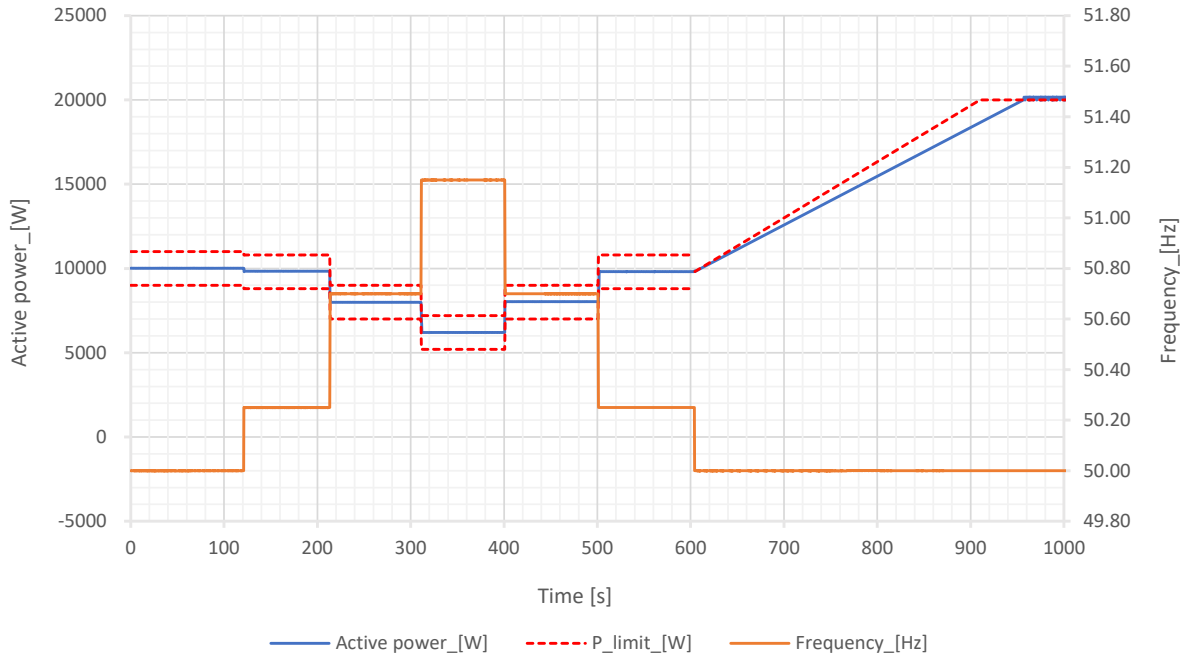
The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

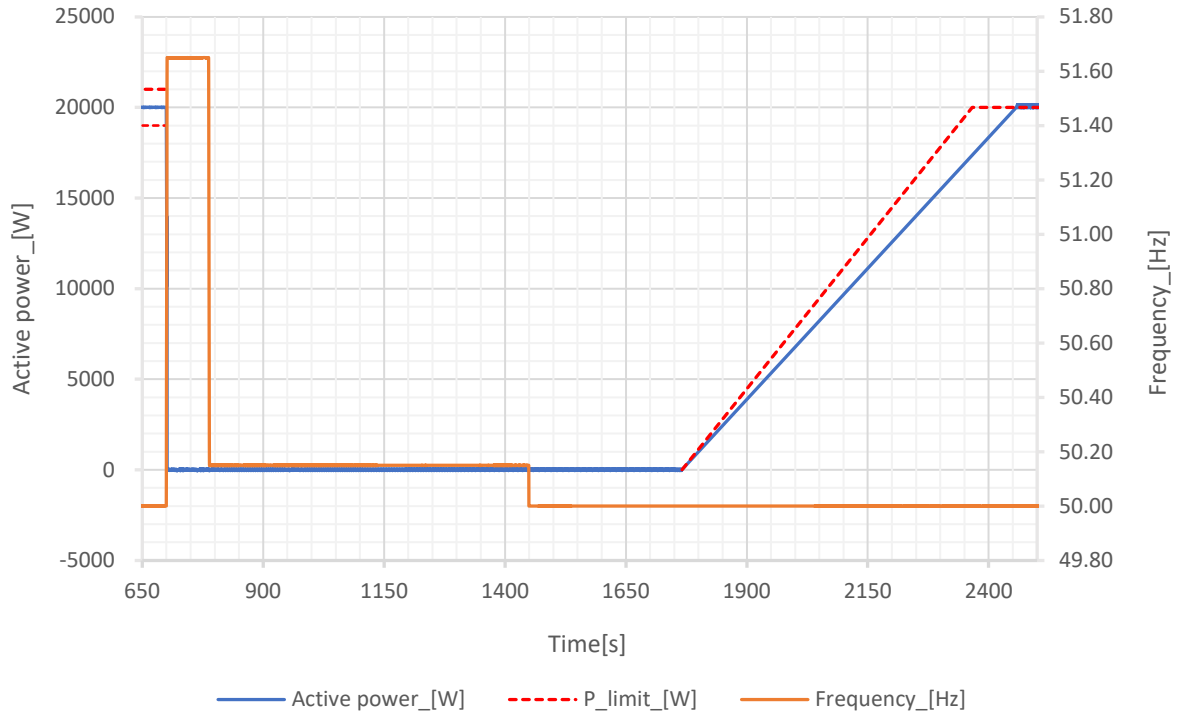
Graph Test 1@ 100% Pn



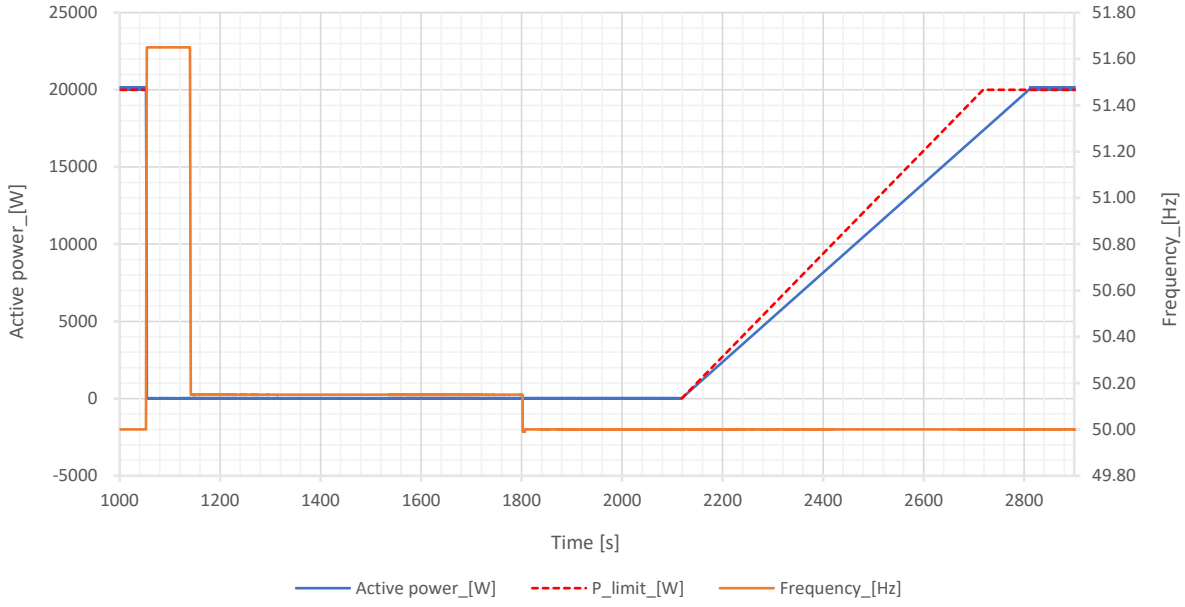
Graph Test2 @ 40-60% Pn



Gradient Test 1



Gradient Test 2



5.3.5	Frequency-dependent active power reduction (active power at underfrequency)	P

Test procedure and test conditions:

These tests serve to prove the behaviour of the GU at underfrequency according to TOR generator, section 5.1.5.

Operating point b) and c) must be kept for at least 1 minute.
The test must be carried out at 100% P_n.

With a programmable AC source, the PGU is operated at 100% n and 50 ± 0,01 Hz, thereafter the frequency is reduced to -1,0 Hz and after 1 minute reduce to - 2,4 to - 2,5 Hz. A 1-min mean value is recorded both before and after the frequency change.

The steps between points a) to c may also be run with a frequency ramp of 1 Hz/s

Assessment criteria:

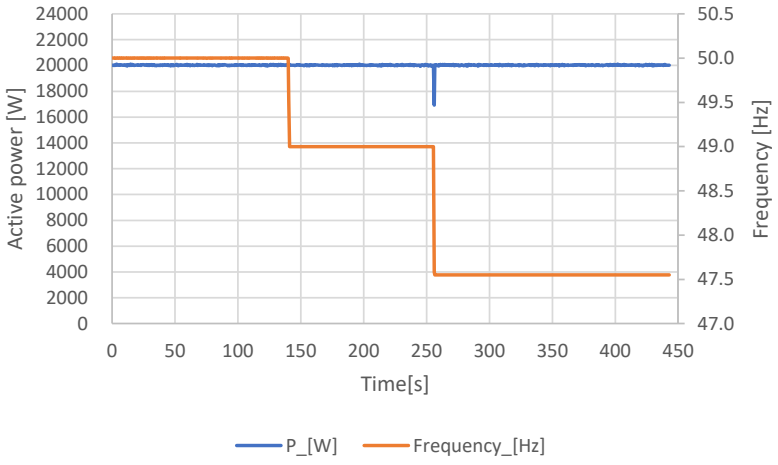
For synchronous EZE:
- The test is passed if the EZE does not reduce the power when the grid frequency changes from operating point a) to b) and the power drops by a maximum of 10% Pn per Hz from operating point b) to c).

For non-synchronous EZE:
- The test is passed if the EZE changes from operating point a) to b) when the network frequency changes does not reduce the power and from operating point b) to c) the power drops by a maximum of 2% Pn per Hz

Result:

Test sequent	Simulated grid frequency [Hz]	Measured frequency [Hz]:	$P_{setpoint}$ [%Pn]:	Measured P_{E60} [%Pn]:	Active power deviation ΔP [%Pn]	Limit deviation ΔP [%Pn]
a)	50,00 ± 0,01	50,00	100	100,14	0,14	2,0
b)	49,00 ± 0,01	49,00	100	100,13	0,13	
c)	47,55 ± 0,01	47,55	100	100,14	0,14	

Graphs



Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the**PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3.6 Voltage-controlled active power derating P(U)	P

5.3.6.1.1 Test sequence for the quasi-stationary behaviour of the P(U) control	P

PCS-3-4KW-25A-1

Test procedure and test conditions:

These checks from section 5.3.6. are used to prove the active power reduction in the event of overvoltage according to TOR generator, section 5.3.6.

The overvoltage protection Urms > may during the tests of the voltage-dependent control functions be deactivated.

Depending on the type of EZE (single or three-phase), the voltage changes must be carried out simultaneously or symmetrically on all phases.

Operate at 100% P / activation threshold: 110%U_n
Start at 100%U_n→jump to 109% than increase the voltage in 1% steps up 113% →decrease the voltage in 1% steps up to 109% →back to 100% U_n

Every voltage point must hold for 60 seconds.

Assessment criteria:

The quasi-steady-state behavior test has been passed, if the active power values measured according to 5.3.6.2.1 (30 s mean values) in stationary operation

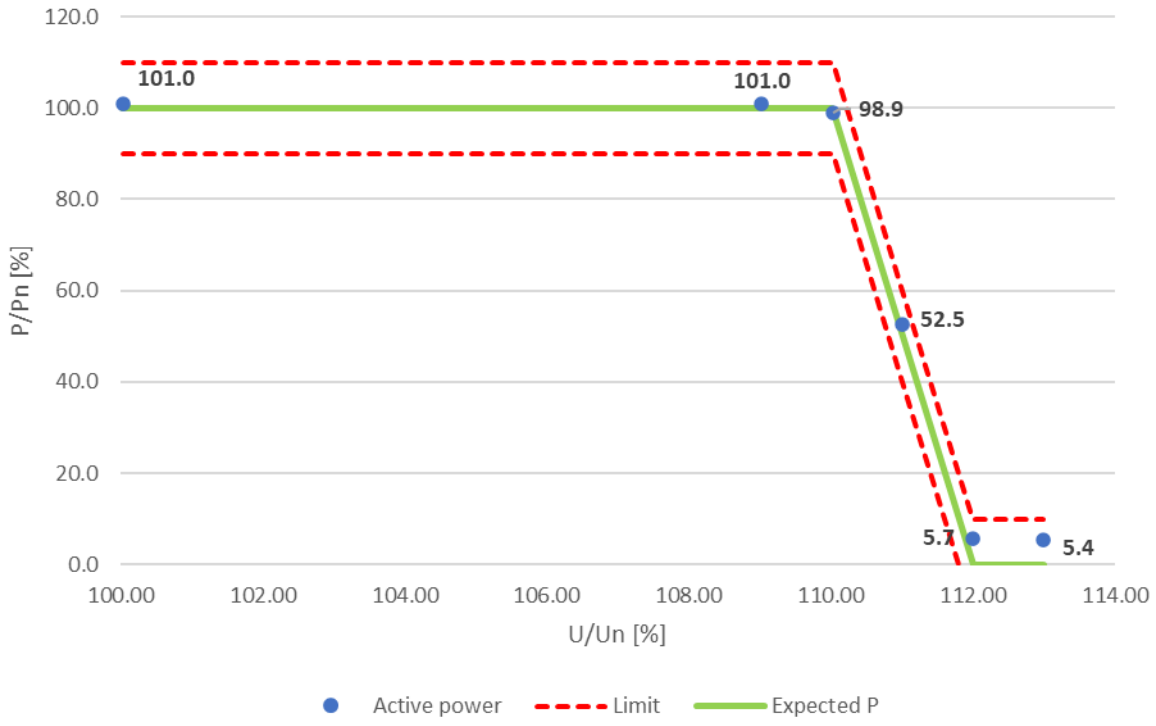
are within the tolerance band of ± 10% Pn and ± 1% Un of the specified P (U) characteristic

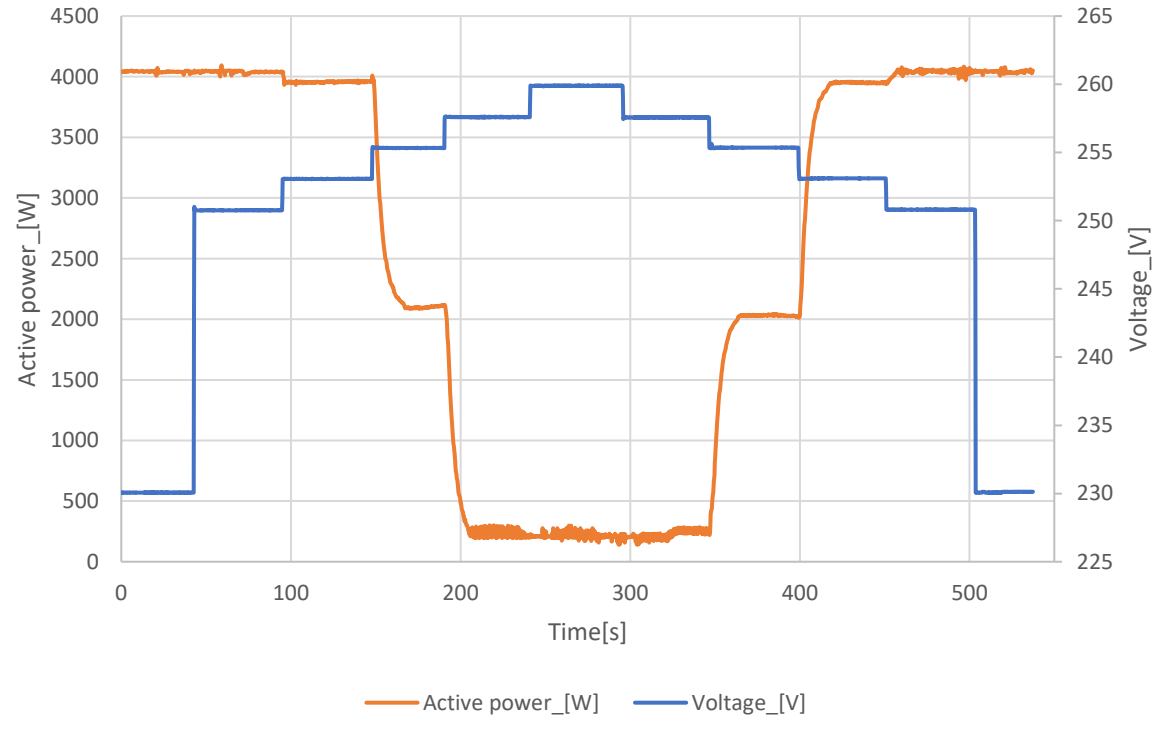
Setting value of the inverter:

Overvoltage Derating		
Overvoltage Derating Switch	ON	
P(U) Curve Start Voltage	253.0	V
Power of P(U) Curve Start Voltage	100.0	%
P(U) Curve End Voltage	257.6	v
Power of P(U) Curve End Voltage	0.0	%
P(U) Time constant	5.0	s

Test result:								
Test sequent	$Vac\_{setpoint}$ [%Un]	voltage measured [V]	current measured [A]	Expected P [%Pn]:	Measured P [%Pn]:	Measured Q [Var]:	ΔP [%Pn]	Limit deviation ΔP [%Pn]
a)	100	230,07	17,572	100,0	101,03	-115	1,03	
b)	109	250,76	16,120	100,0	101,01	175	1,01	
c)	110	253,06	15,646	100,0	98,93	212	1,07	
d)	111	255,33	8,230	50,0	52,47	189	2,47	
e)	112	257,60	0,955	0,0	5,74	95	5,74	
f)	113	259,89	0,902	0,0	5,36	90	5,36	± 10,0
g)	112	257,57	0,814	0,0	5,11	72	5,11	
h)	111	255,35	7,235	50,0	46,12	188	3,88	
i)	110	253,10	15,619	100,0	98,77	247	1,23	
j)	109	250,81	16,107	100,0	100,94	220	0,94	
k)	100	230,10	17,570	100,0	101,03	-93	1,03	

Graphs of P(U) function:





5.3.6.1.2 Test for the dynamic behavior of the P(U) control	P

Test procedure and test conditions:

Operate at 100% P / activation threshold: 110%Un / Tau= 5s

Start at 100%Un→jump to 109% →to 113% → to 109% →back to 100% Un

Every voltage point must hold for at 60 seconds.

* The test time must be minimum 10 times Tau in s but at least 60s

Assessment criteria:

The dynamic behavior test is passed if

- The determined time course of the active power during the measurement according to 5.3.6.2.2 within the entire measurement period is within the tolerance bands that result from the behavior of an equivalent PT1 element (1st order filter). Permissible tolerances for the active power values are ± 10% Pn as well as for the time +3 seconds.

The tolerance bands are calculated according to Table 2.

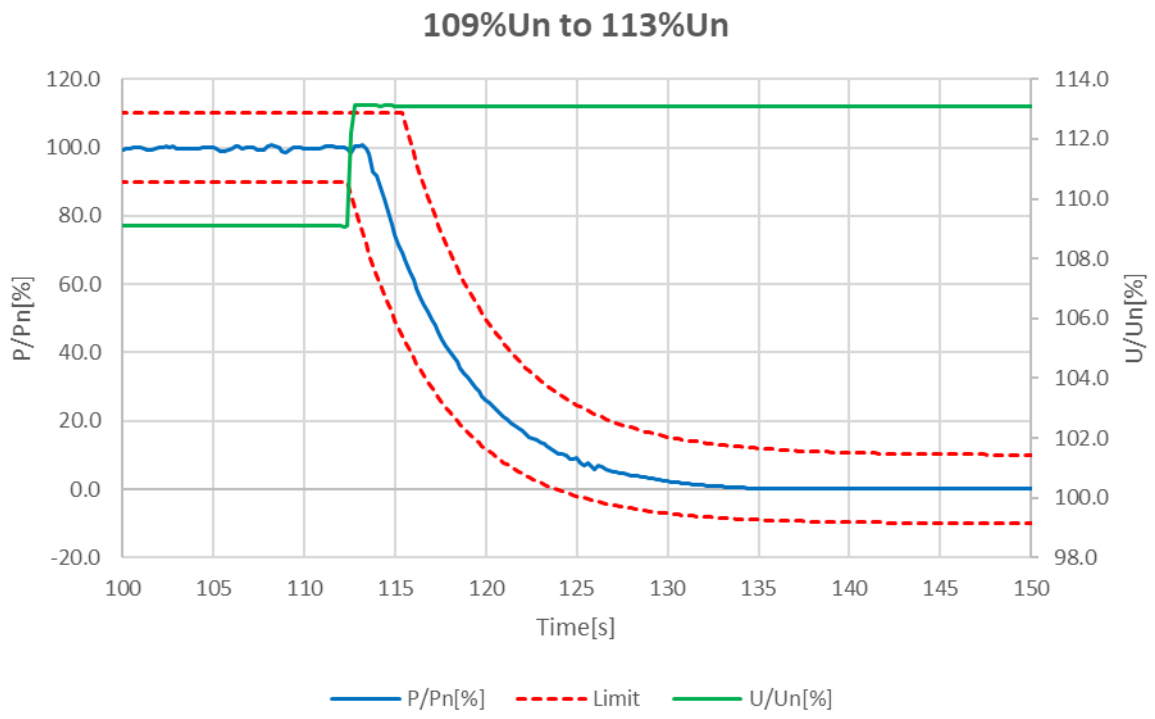
- There are no discontinuities in the characteristic curve, power fluctuations or a shutdown of the EZE;
- A reduction of the active power down to a power of <10% Pn or to that of the manufacturer specified minimum performance is possible

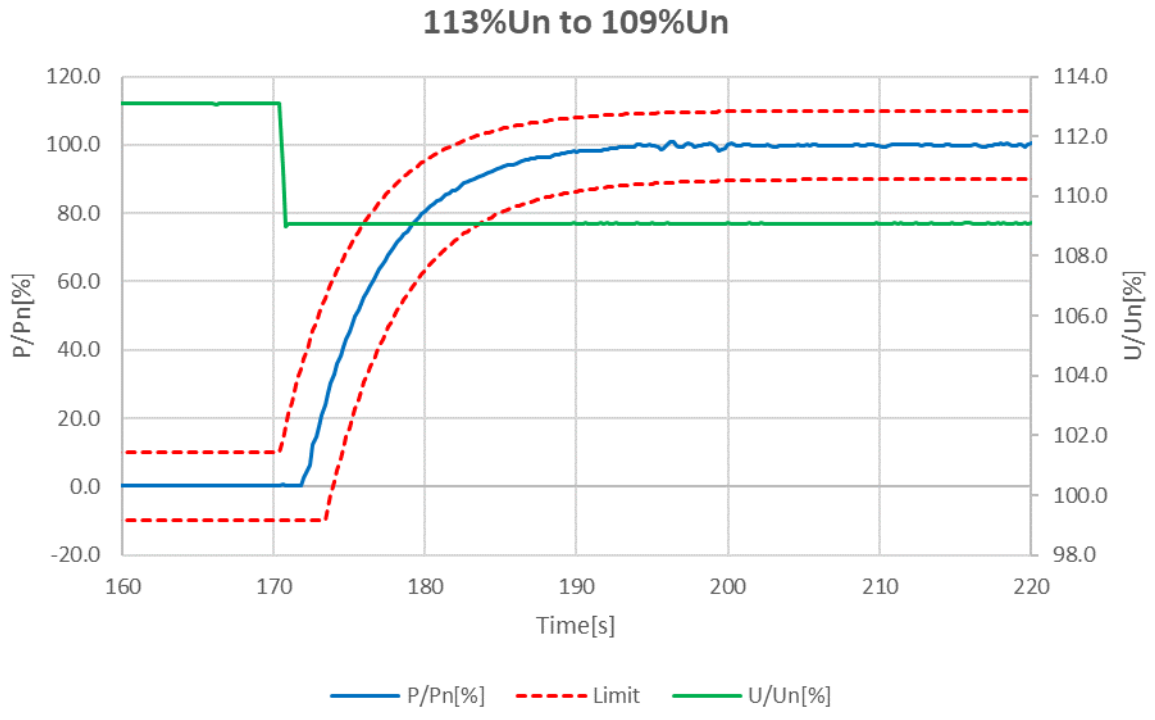
increase in active power $P_2 > P_1$	Upper Tolerance band:	for all *t*: $P_2 - (P_2 - P_1)\, e^{(-t / Tau)} + 0{,}10\, P_n$
	lower Tolerance band:	for *t* < 3 Second: $P_1 - 0{,}10\, P_n$ für t ≥ 3 Second: P2 − (P2 − P1) e([−t+3 Seconds] / Tau) - 0,10 Pn
drop in active power $P_2 < P_1$	Upper Tolerance band:	for *t* < 3 Second: $P_1 + 0{,}10\, P_n$ for t ≥ 3 Second: P2 − (P2 − P1) e([−t+3 Seconds] / Tau) + 0,10 Pn
	lower Tolerance band:	for all *t*: $P_2 - (P_2 - P_1)\, e^{(-t / Tau)} - 0{,}10\, P_n$

Result: PCS-3-4KW-25A-1

Test sequent	$Vac_{\_setpoint}$ [%Un]	voltage measured [V]	current measured [A]	Expected P [%Pn]:	Measured P [%Pn]:	Measured Q [Var]:	ΔP [%Pn]	Limit deviation ΔP [%Pn]
a)	100	230,07	5,81	100	100,2	-121	0,23	± 10,0
b)	109	250,90	5,31	100	99,8	208	0,16	
c)	113	260,10	0,09	0	0,3	50	0,31	
d)	109	250,91	5,32	100	100,0	179	0,02	
e)	100	230,20	5,78	100	99,7	-81	0,29	

Graphs


109%Un to 113%Un
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
P/Pn[%]
114.0
112.0
110.0
108.0
106.0
104.0
102.0
100.0
98.0
U/Un[%]
100 105 110 115 120 125 130 135 140 145 150
Time[s]
P/Pn[%]
Limit
U/Un[%]


113%Un to 109%Un
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
P/Pn[%]
114.0
112.0
110.0
108.0
106.0
104.0
102.0
100.0
98.0
U/Un[%]
160 170 180 190 200 210 220
Time[s]
P/Pn[%]
Limit
U/Un[%]

5.3.6 Voltage-controlled active power derating P(U)	P

5.3.6.1.1 Test sequence for the quasi-stationary behaviour of the P(U) control	P

PCS-3-20KW-40A-1

Test procedure and test conditions:

These checks from section 5.3.6. are used to prove the active power reduction in the event of overvoltage according to TOR generator, section 5.3.6.

The overvoltage protection Urms > may during the tests of the voltage-dependent control functions be deactivated.

Depending on the type of EZE (single or three-phase), the voltage changes must be carried out simultaneously or symmetrically on all phases.

Operate at 100% P / activation threshold: 110%U_n
Start at 100%U_n→jump to 109% than increase the voltage in 1% steps up 113% →decrease the voltage in 1% steps up to 109% →back to 100% U_n

Every voltage point must hold for 60 seconds.

Assessment criteria:

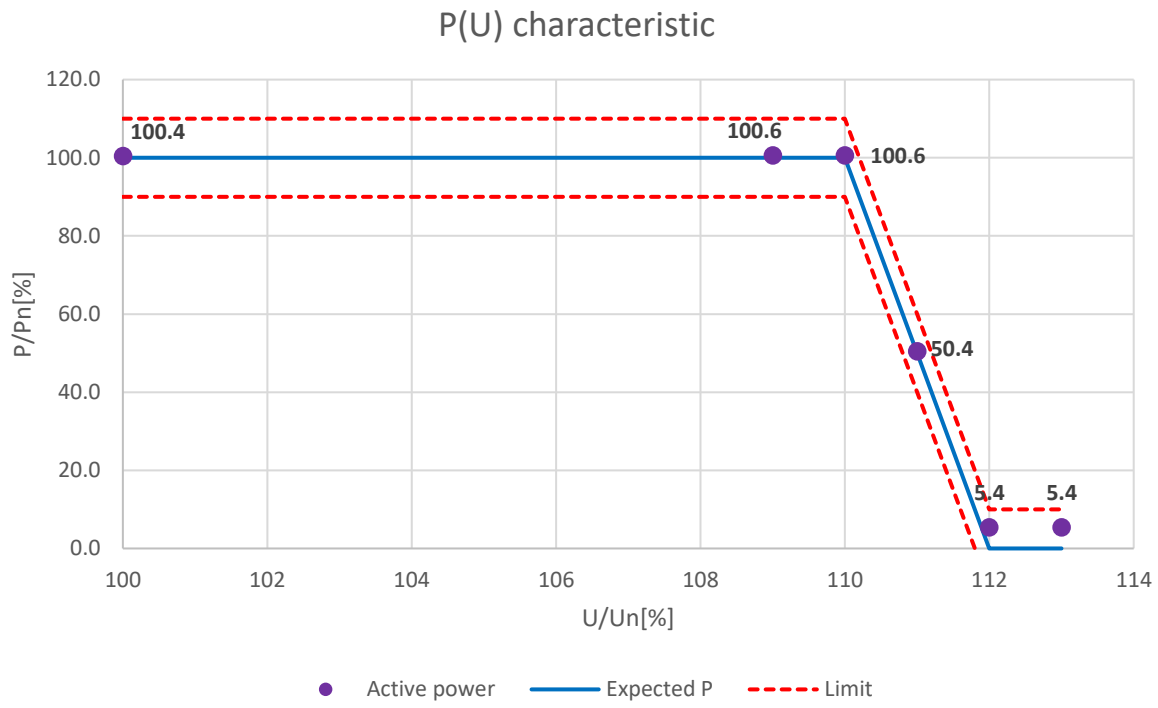
The quasi-steady-state behavior test has been passed, if the active power values measured according to 5.3.6.2.1 (30 s mean values) in stationary operation

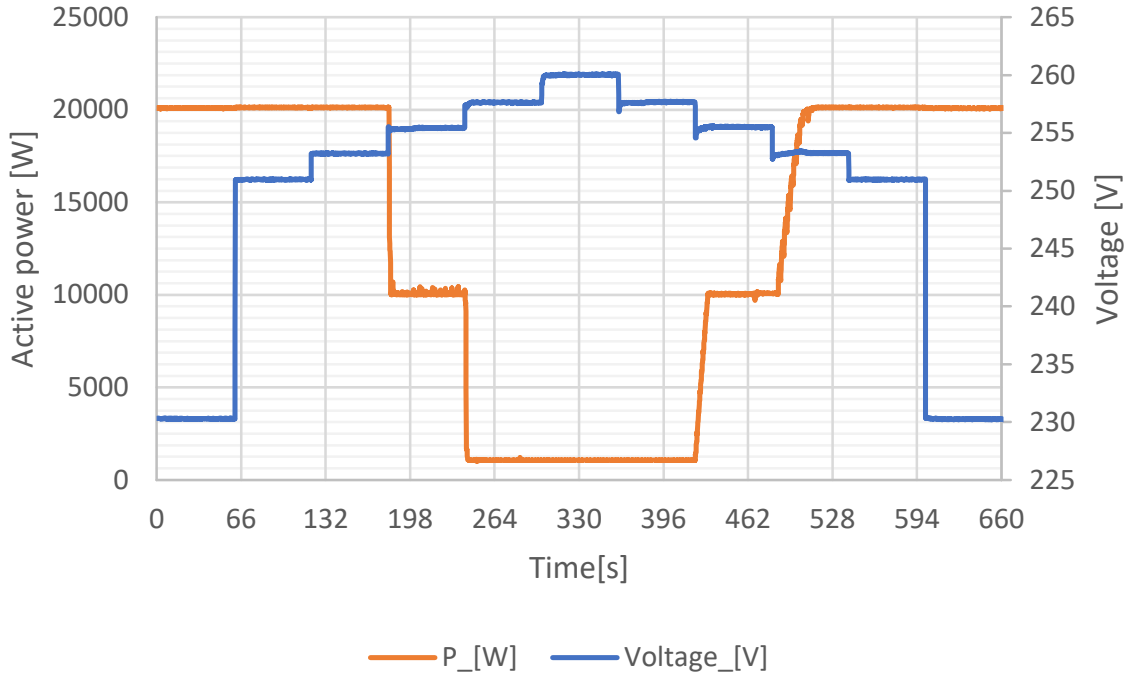
are within the tolerance band of ± 10% Pn and ± 1% Un of the specified P (U) characteristic

Test result:

Test sequent	Vac setpoint [%Un]	voltage measured [V]	current measured [A]	Expected P [%Pn]:	Measured P [%Pn]:	Measured Q Var]:	ΔP [%Pn]	Limit deviation ΔP [%Pn]
a)	100	230,29	29,083	100,0	100,40	774	0,405	
b)	109	250,97	26,741	100,0	100,61	816	0,606	
c)	110	253,22	26,506	100,0	100,62	826	0,616	
d)	111	255,40	13,169	50,0	50,42	217	0,421	
e)	112	257,62	1,389	0,0	5,36	181	5,364	
f)	113	260,01	1,376	0,0	5,36	186	5,363	± 10,0
g)	112	257,64	1,389	0,0	5,36	195	5,364	
h)	111	255,52	13,121	50,0	50,26	217	0,259	
i)	110	253,27	26,452	100,0	100,43	826	0,433	
j)	109	250,97	26,740	100,0	100,60	814	0,604	
k)	100	230,27	29,079	100,0	100,38	772	0,380	

Graphs


P(U) characteristic
120.0
100.0
80.0
60.0
40.0
20.0
0.0
P/Pn[%]
100.4
100.6
100.6
50.4
5.4
5.4
100
102
104
106
108
110
112
114
U/Un[%]
Active power
Expected P
Limit


25000
20000
15000
10000
5000
0
Active power [W]
265
260
255
250
245
240
235
230
225
Voltage [V]
0
66
132
198
264
330
396
462
528
594
660
Time[s]
P_[W]
Voltage_[V]

5.3.6.1.2 Test for the dynamic behaviour of the P(U) control	P

Test procedure and test conditions:

Operate at 100% P / activation threshold: 110%Un / Tau= 5s

Start at 100%Un→jump to 109% →to 113% → to 109% →back to 100% Un

Every voltage point must hold for at 60 seconds.

* The test time must be minimum 10 times Tau in s but at least 60s

Assessment criteria:

The dynamic behavior test is passed if

- The determined time course of the active power during the measurement according to 5.3.6.2.2 within the entire measurement period is within the tolerance bands that result from the behavior of an equivalent PT1 element (1st order filter). Permissible tolerances for the active power values are ± 10% Pn as well as for the time +3 seconds.

The tolerance bands are calculated according to Table 2.

- There are no discontinuities in the characteristic curve, power fluctuations or a shutdown of the EZE;
- A reduction of the active power down to a power of <10% Pn or to that of the manufacturer specified minimum performance is possible

increase in active power $P_2 > P_1$	Upper Tolerance band:	for all *t*: $P_2 - (P_2 - P_1)\, e^{(-t / Tau)} + 0{,}10\, P_n$
	lower Tolerance band:	for *t* < 3 Second: $P_1 - 0{,}10\, P_n$ für t ≥ 3 Second: P2 − (P2 − P1) e([−t+3 Seconds] / Tau) - 0,10 Pn
drop in active power $P_2 < P_1$	Upper Tolerance band::	for *t* < 3 Second: $P_1 + 0{,}10\, P_n$ for t ≥ 3 Second: P2 − (P2 − P1) e([−t+3 Seconds] / Tau) + 0,10 Pn
	lower Tolerance band:	for all *t*: $P_2 - (P_2 - P_1)\, e^{(-t / Tau)} - 0{,}10\, P_n$

Result: PCS-3-20KW-40A-1

Test sequent	Vac_setpoint [%Un]	voltage measured [V]	current measured [A]	Expected P [%Pn]:	Measured P [%Pn]:	Measured Q [Var]:	ΔP [%Pn]	Limit deviation ΔP [%Pn]
a)	100	230,35	85,877	100	98,8	51	1,15	± 10,0
b)	109	250,32	79,142	100	99,0	114	1,02	
c)	113	259,70	1,618	0	-0,2	-198	0,22	
d)	109	250,33	79,172	100	99,0	115	0,97	
e)	100	230,36	85,835	100	98,8	52	1,20	

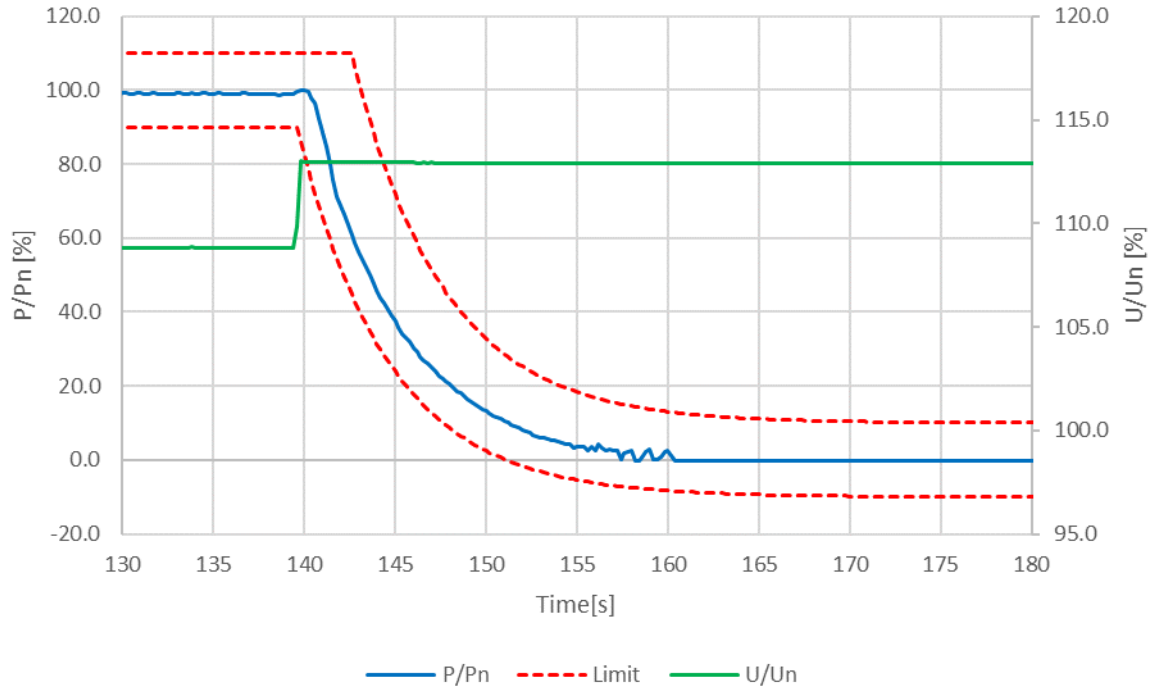
Note:

The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

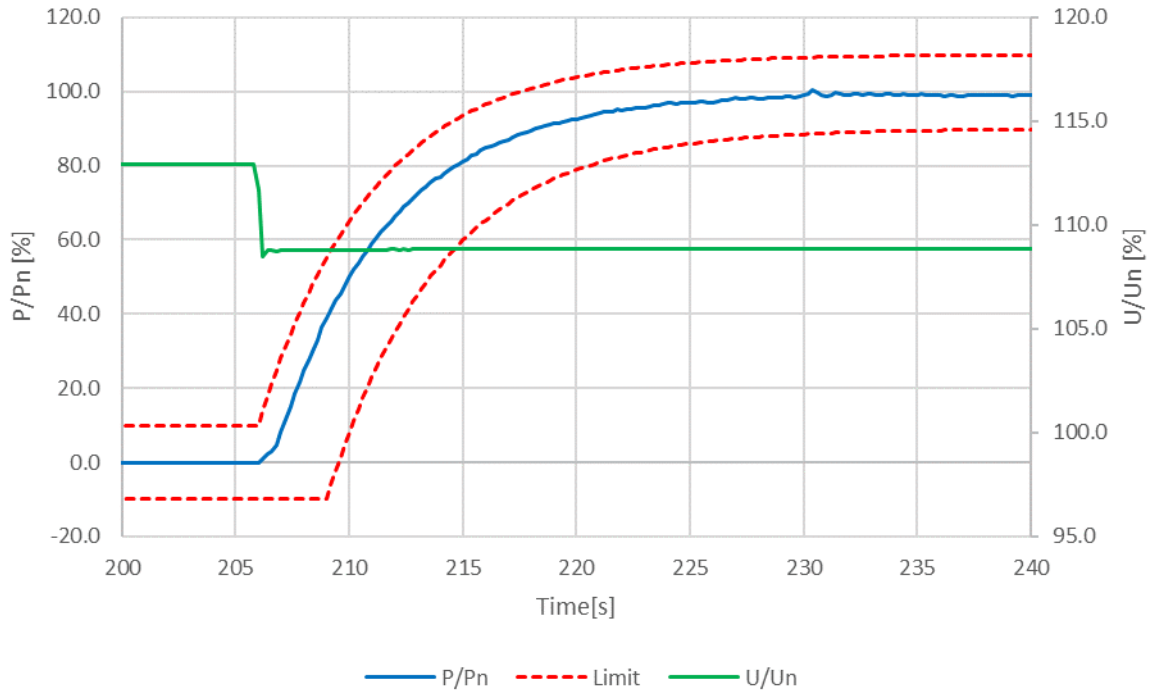
[1)] Refer to **Differences of the model**.

Graphs

109%Un-113%Un



113%Un-109%Un



5.3.7 Reactive power setpoint control “fix cos φ”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.

**applies for Units $\Sigma S_n \leq 3.68$ kVA

For cos φ 0,95 over-excited and φ 0,95 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

*Applies for Units $\Sigma S_n \geq 3.68$ kVA

For cos φ 0,90 over-excited and φ 0,90 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

Assessment criteria:

The test is passed if all cos φ values (30 s mean) do not deviate from the specification by more than ± 0,01.

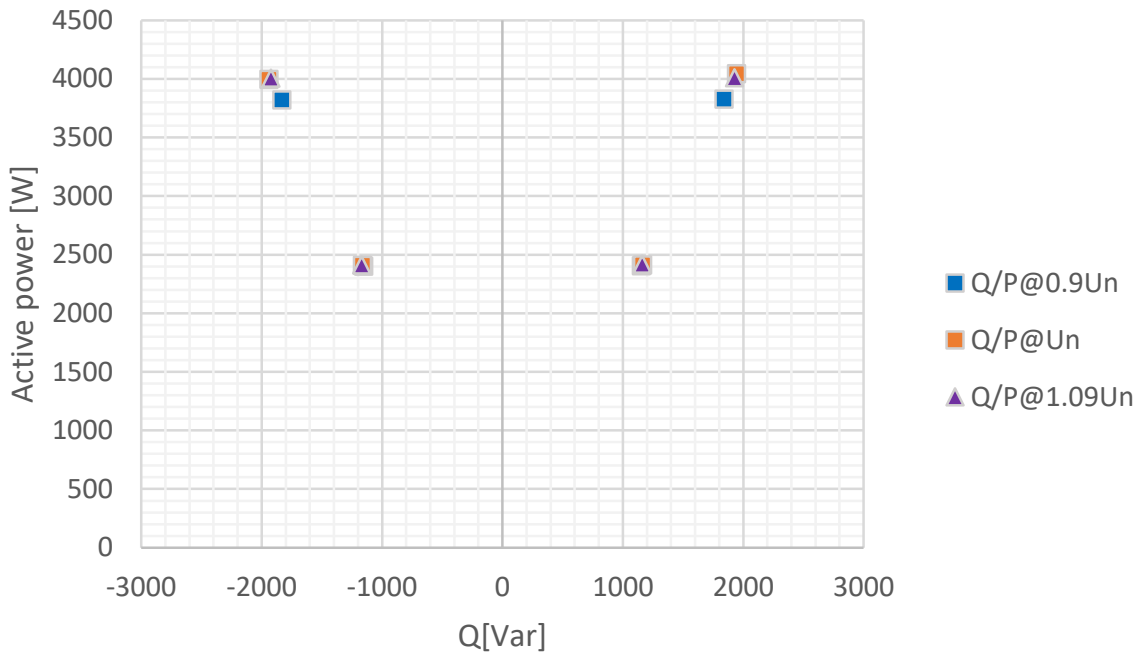
For EZE with generators directly connected to the grid, which cannot regulate reactive power due to the principle, such as asynchronous generators, and therefore use non-controllable fixed capacities, the tolerance band increases from 0,01 to 0,02. This device type is only evaluated at Un.

Result: PCS-3-4KW-25A-1

Setting values	cos φ under-excited:	0,90
	cos φ over-excited:	0,90

30 s mean value	0,91U_n		U_n		1,09 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}
a) cos φ 0,9 over-excited						
U [V]:	209,39	209,83	229,99	230,11	250,78	250,76
P_{E30} [W]:	2405	3826	2413	4044	2418	4010
Q_{E30} [Var]:	1154	1841	1166	1945	1162	1928
S_{E30} [VA]:	2668	4246	2680	4487	2683	4450
cos $\varphi_{E30\text{-over-excited}}$	0,902	0,901	0,900	0,901	0,901	0,901
b) cos φ 0,9 under-excited						
U [V]:	209,33	209,75	230,19	230,01	250,71	250,70
P_{E30} [W]:	2401	3820	2408	3996	2414	4005
Q_{E30} [Var]:	-1152	-1832	-1164	-1941	-1171	-1922
S_{E30} [VA]:	2663	4237	2675	4442	2683	4442
cos $\varphi_{E30\text{-under-excited}}$:	0,902	0,902	0,900	0,900	0,900	0,902
Limit cos φ:	cos φ= 0,89 to 0,91 (c) and cos φ= 0,89 to 0,91 (i)					

Graph:


4500
4000
3500
3000
2500
2000
1500
1000
500
0
Active power [W]
-3000
-2000
-1000
0
1000
2000
3000
Q[Var]
Q/P@0.9Un
Q/P@Un
Q/P@1.09Un

5.3.7 Reactive power setpoint control “fix cos φ”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.

**applies for Units $\Sigma S_n \leq 3.68$ kVA

For cos φ 0,95 over-excited and φ 0,95 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

*Applies for Units $\Sigma S_n \geq 3.68$ kVA

For cos φ 0,90 over-excited and φ 0,90 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

Assessment criteria:

The test is passed if all cos φ values (30 s mean) do not deviate from the specification by more than ± 0.01.

For EZE with generators directly connected to the grid, which cannot regulate reactive power due to the principle, such as asynchronous generators, and therefore use non-controllable fixed capacities, the tolerance band increases from 0.01 to 0.02. This device type is only evaluated at Un.

Result:PCS-3-20KW-40A-1

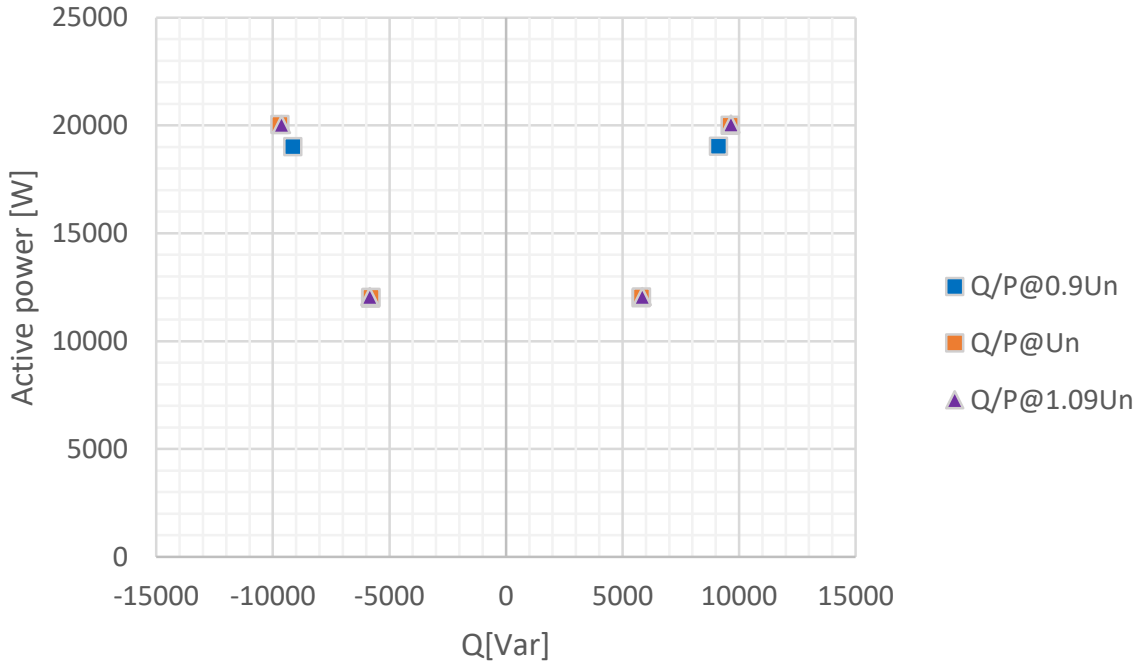
Setting values	cos φ under-excited:	0,90
	cos φ over-excited:	0,90

30 s mean value	0,91U_n		U_n		1,09 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}
a) cos φ 0,9 over-excited						
U [V]:	209,49	209,50	230,20	230,29	250,92	250,97
P_{E30} [W]:	12004	19027	12042	20011	12071	20070
Q_{E30} [Var]:	5797	9111	5816	9615	5857	9662
S_{E30} [VA]:	13331	21096	13373	22201	13417	22275
cos $\varphi_{E30\text{-over-excited}}$	0,900	0,901	0,900	0,901	0,899	0,901
b) cos φ 0,9 under-excited						
U [V]:	209,46	209,48	230,12	230,16	250,90	250,94
P_{E30} [W]:	11995	19010	12032	20034	12058	20049
Q_{E30} [Var]:	-5803	-9139	-5785	-9703	-5846	-9634
S_{E30} [VA]:	13325	21093	13350	22260	13401	22244
cos $\varphi_{E30\text{-under-excited}}$:	0,900	0,901	0,901	0,899	0,899	0,901
Limit cos φ:	cos φ= 0,89 to 0,91 (c) and cos φ= 0,89 to 0,91 (i)					

Note:
The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

Graph:



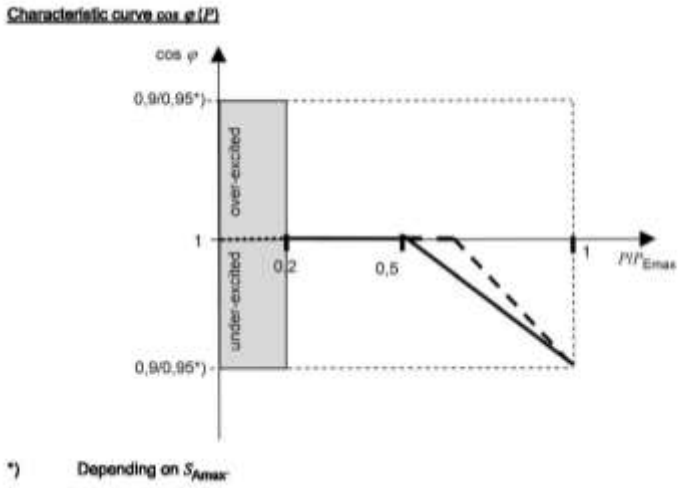
5.3.8	Test of the displacement factor/active power characteristic curve cos φ (P)	P

Test procedure and test conditions:

The test serves as verification of the standard cos φ (P) curve according to TOR Erzeuger, 5.3.4.1.

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

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



* Every test step point must hold for 60 seconds.

Assessment criteria:

Test 1: cos φ accuracy cos φ (±0,01)
Test 2: cos φ accuracy cos φ (±0,02)

The active power steps must be approached with an accuracy of ± 5% P_n.

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

Result:PCS-3-4KW-25A-1

Test a): 20% to 100% to 20% Pn

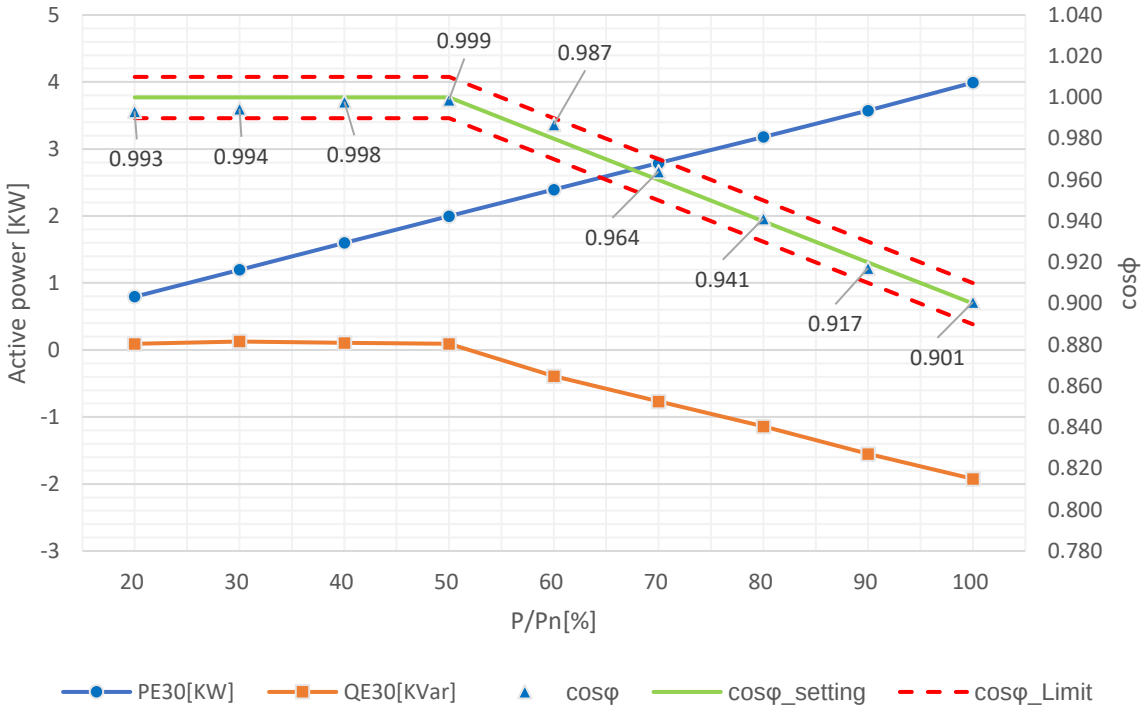
Power-BIN [%]	U [V]:	P_{E30} [kW]:	P_{E30} of P_n [%]:	Q_{E30} [kVar]:	cos φ_{E30}:	cos $\varphi_{setpoint}$ of P_{E30}:	Δ cos φ
20	230,07	0,797	19,91	0,093	0,993	1,000	-0,007
30	230,11	1,198	29,95	0,126	0,994	1,000	-0,006
40	230,15	1,599	39,97	0,105	0,998	1,000	-0,002
50	230,19	1,998	49,94	0,093	0,999	1,000	-0,001
60	230,05	2,394	59,85	-0,392	0,987	0,980	0,007
70	230,09	2,789	69,73	-0,768	0,964	0,960	0,004
80	230,07	3,178	79,45	-1,140	0,941	0,940	0,001
90	230,06	3,573	89,32	-1,552	0,917	0,920	-0,003
100	230,12	3,990	99,75	-1,923	0,901	0,900	0,001
90	230,24	3,570	89,25	-1,560	0,916	0,920	-0,004

80	230,19	3,177	79,43	-1,149	0,940	0,940	0,000
70	230,24	2,787	69,67	-0,772	0,964	0,960	0,004
60	230,18	2,390	59,76	-0,390	0,987	0,980	0,007
50	230,21	1,996	49,91	0,095	0,999	1,000	-0,001
40	230,15	1,597	39,91	0,112	0,998	1,000	-0,002
30	230,11	1,199	29,96	0,131	0,994	1,000	-0,006
20	230,08	0,796	19,90	0,097	0,993	1,000	-0,007

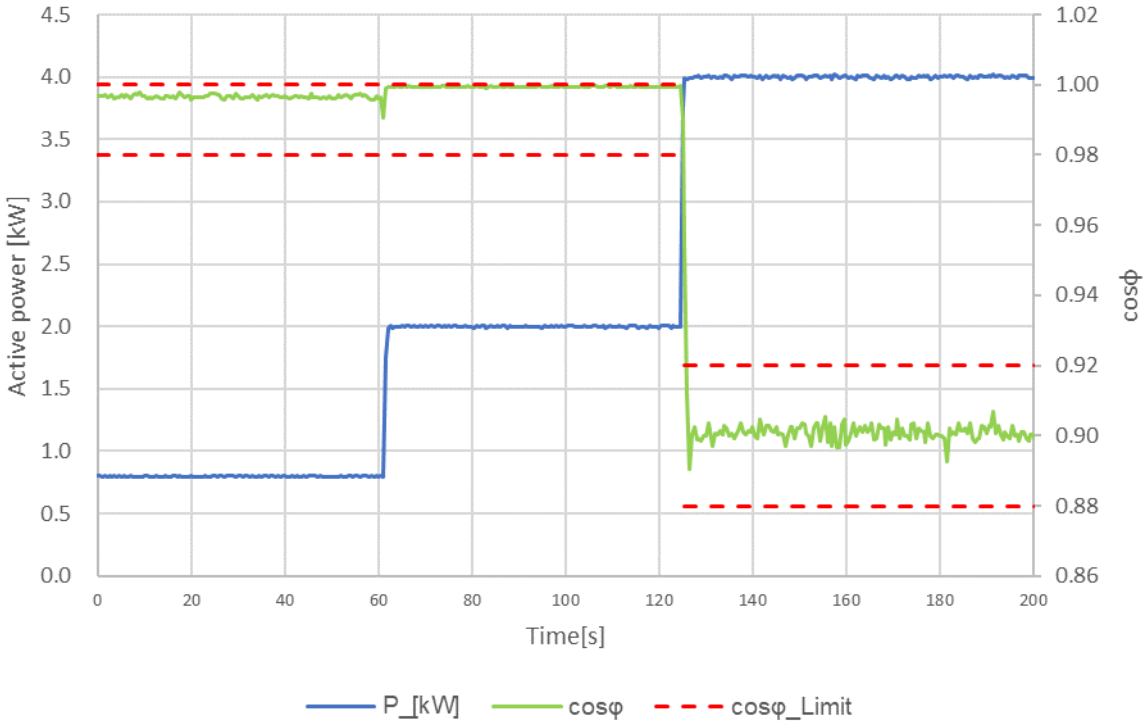
Test b): 20% to 50% to 100% P_n

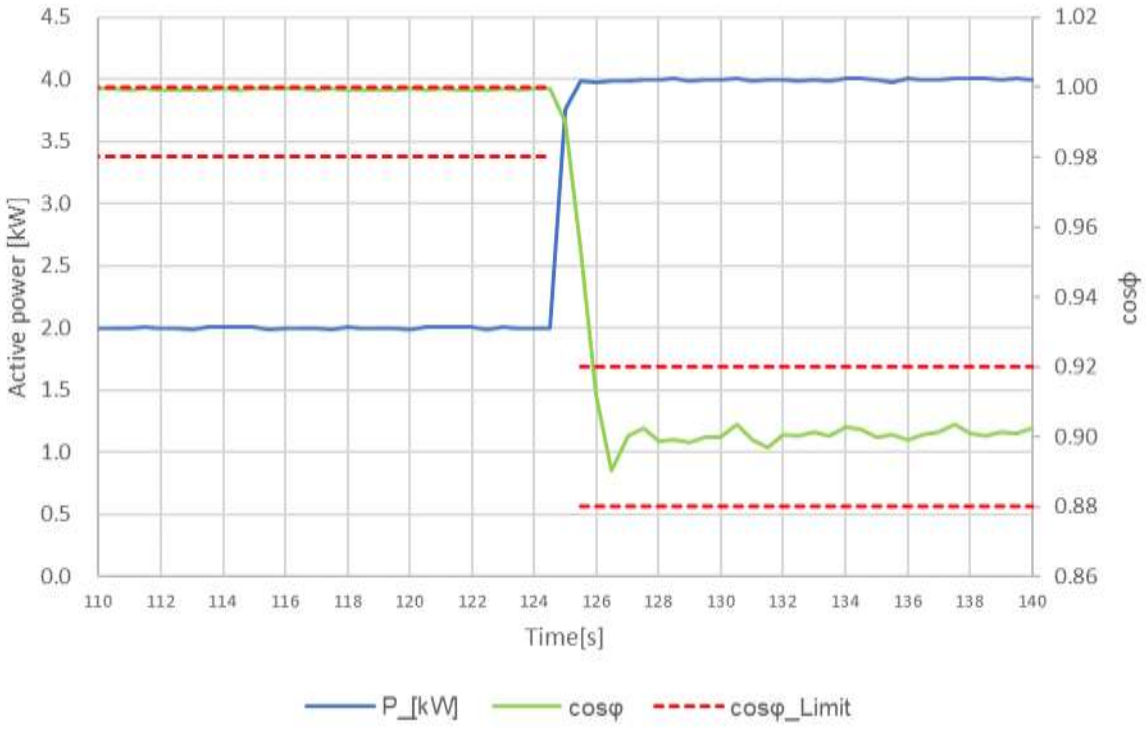
Power-BIN [%]	U [V]:	PE30 [kW]:	PE30 of Pn [%]:	QE30 [kVar]:	cos φE30:	cos φsetpoint of PE30:	Δ cos φ
20	230,08	0,799	19,97	0,096	0,993	1,000	-0,007
Settling time Tr [s] 20% to 50% Pn	0				Limit setting time ≤ 10s		
50	230,19	2,003	50,07	0,096	0,999	1,000	-0,001
Settling time Tr [s] 50% to 100% Pn	1,0				Limit setting time ≤ 10s		
100	230,12	4,000	99,99	-1,926	0,901	0,900	0,001
100	230,12	3,999	99,96	-1,931	0,900	0,900	0,001
Settling time Tr [s] 100% to 50% Pn	0,5				Limit setting time ≤ 10s		
50	230,19	2,002	50,05	0,095	0,999	1,000	-0,001
Settling time Tr [s] 50% to 20% Pn	0				Limit setting time ≤ 10s		
20	230,03	0,795	19,89	0,092	0,993	1,000	-0,007

Graph of cos φ(P): Test a)

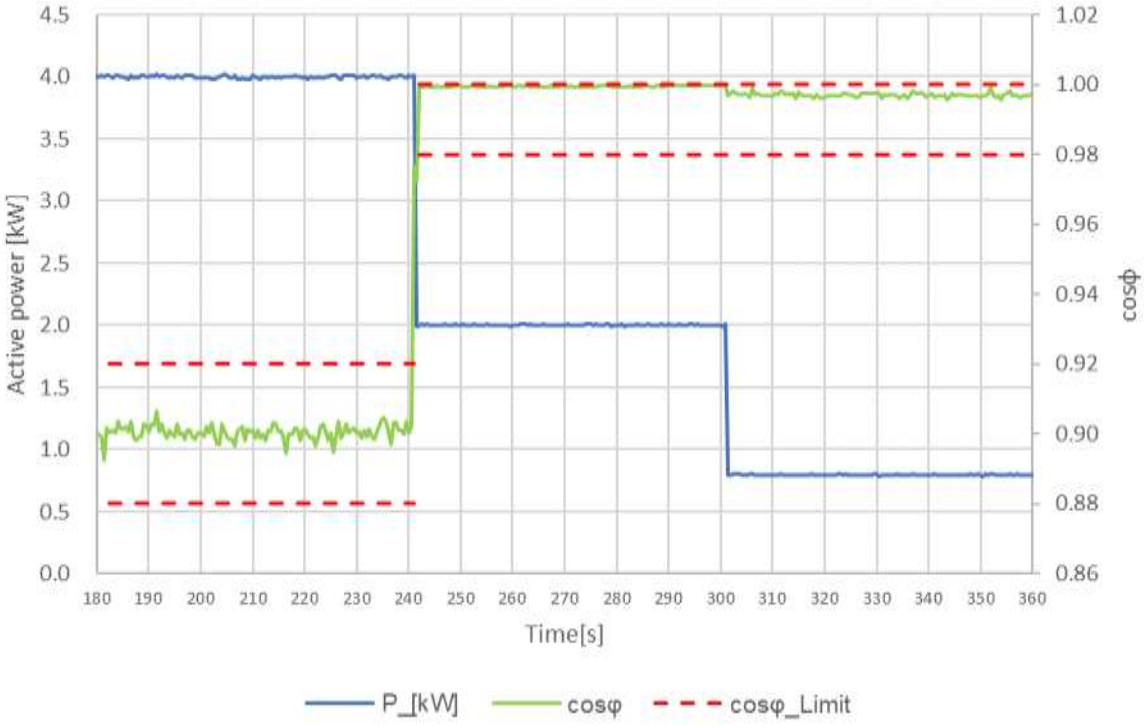


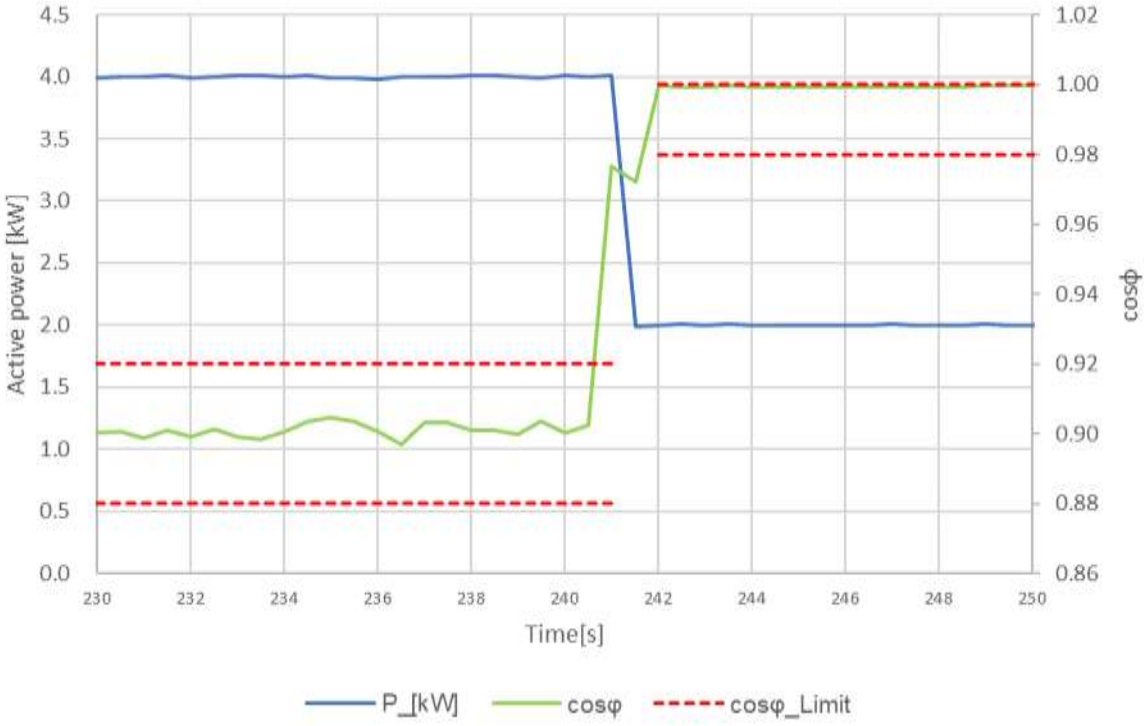
Graph of setting (T_0) time: Test b) 20% to 50% to 100%





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





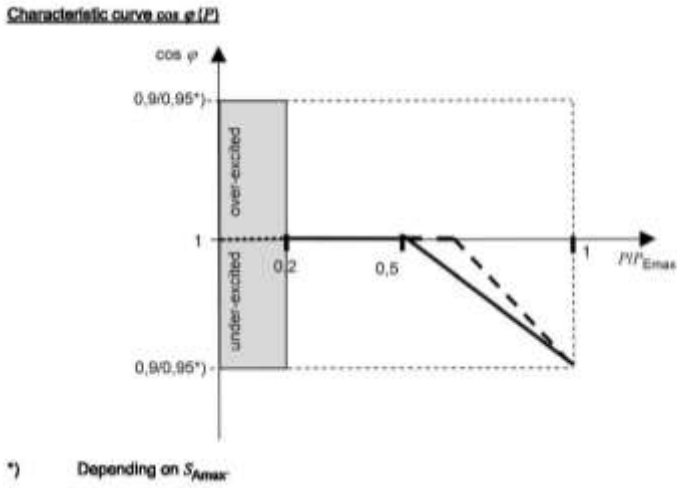
5.3.8	Test of the displacement factor/active power characteristic curve cos φ (P)	P

Test procedure and test conditions:

The test serves as verification of the standard cos φ (P) curve according to TOR Erzeuger, 5.3.4.1.

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

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



* Every test step point must hold for 60 seconds.

Assessment criteria:

Test 1: cos φ accuracy cos φ (±0,01)
Test 2: cos φ accuracy cos φ (±0,02)

The active power steps must be approached with an accuracy of ± 5% P_n.

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

Result:PCS-3-20KW-40A-1

Test a): 20% to 100% to 20% Pn

Power-BIN [%]	U [V]:	P_{E30} [kW]:	P_{E30} of P_n [%]:	Q_{E30} [kVar]:	cos φ_{E30}:	cos $\varphi_{setpoint}$ of P_{E30}:	Δ cos φ
20	230,13	4,073	20,37	0,319	0,997	1,00	-0,003
30	230,17	6,117	30,58	0,319	0,999	1,00	-0,001
40	230,22	8,152	40,76	0,320	0,999	1,00	-0,001
50	230,13	10,187	50,93	-0,313	1,000	1,00	0,000
60	230,13	12,200	61,00	-2,371	0,982	0,98	0,002
70	230,15	14,210	71,05	-3,975	0,963	0,96	0,003
80	230,19	16,279	81,40	-5,743	0,943	0,94	0,003
90	230,13	18,184	90,92	-7,551	0,924	0,92	0,004
100	230,16	19,994	99,97	-9,593	0,902	0,90	0,002
100	230,16	19,990	99,95	-9,593	0,902	0,90	0,002

90	230,20	18,160	90,80	-7,554	0,925	0,92	0,005
80	230,30	16,195	80,98	-5,735	0,943	0,94	0,003
70	230,32	14,204	71,02	-3,997	0,963	0,96	0,003
60	230,26	12,198	60,99	-2,384	0,981	0,98	0,001
50	230,31	10,186	50,93	-0,342	0,999	1,00	-0,001
40	230,22	8,150	40,75	0,297	0,999	1,00	-0,001
30	230,10	6,119	30,60	0,319	0,999	1,00	-0,001
20	230,06	4,073	20,37	0,318	0,997	1,00	-0,003

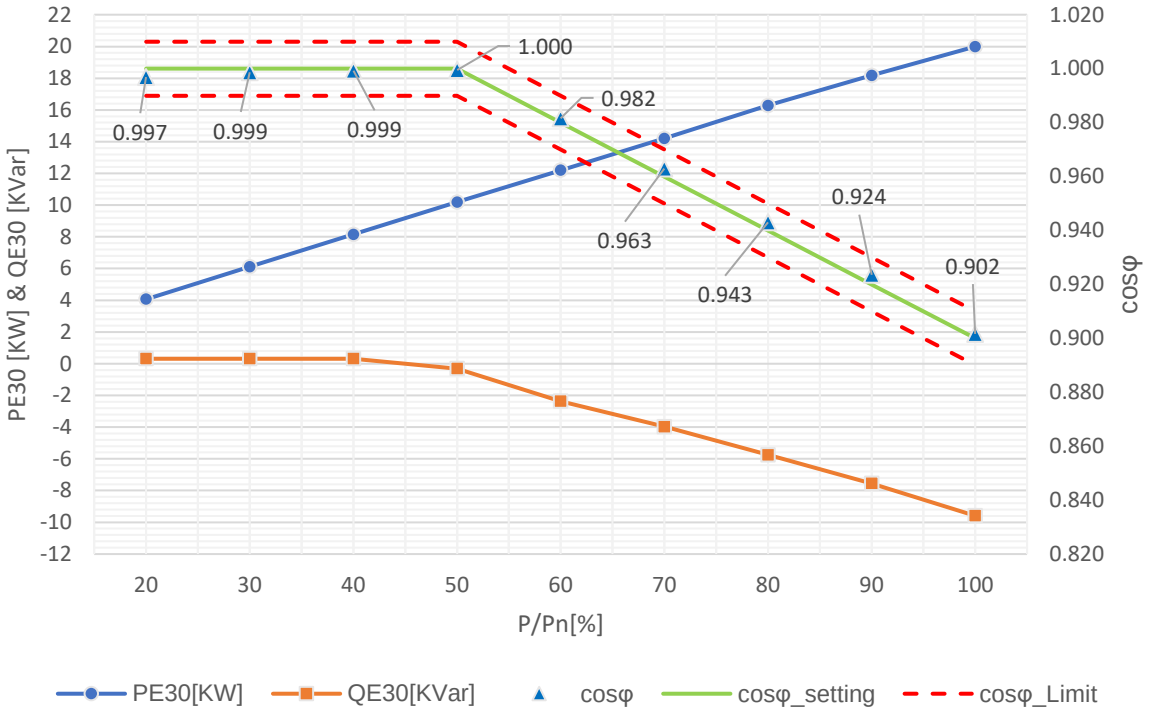
Test b): 20% to 50% to 100% P_n

Power-BIN [%]	U [V]:	PE30 [kW]:	PE30 of Pn [%]:	QE30 [kVar]:	cos φE30:	cos φsetpoint of PE30:	Δ cos φ
20	230,06	4,073	20,36	0,319	0,997	1,00	-0,003
Settling time Tr [s] 20% to 50% Pn	0				Limit setting time ≤ 10s		
50	230,13	10,189	50,94	-0,316	1,000	1,00	-0,001
Settling time Tr [s] 50% to 100% Pn	7,5				Limit setting time ≤ 10s		
100	230,23	20,034	100,17	-9,555	0,903	0,90	0,003
100	230,25	20,030	100,15	-9,554	0,903	0,90	0,003
Settling time Tr [s] 100% to 50% Pn	2,0				Limit setting time ≤ 10s		
50	230,18	10,183	50,91	-0,305	0,999	1,00	-0,001
Settling time Tr [s] 50% to 20% Pn	0				Limit setting time ≤ 10s		
20	230,17	4,073	20,37	0,291	0,997	1,00	-0,003

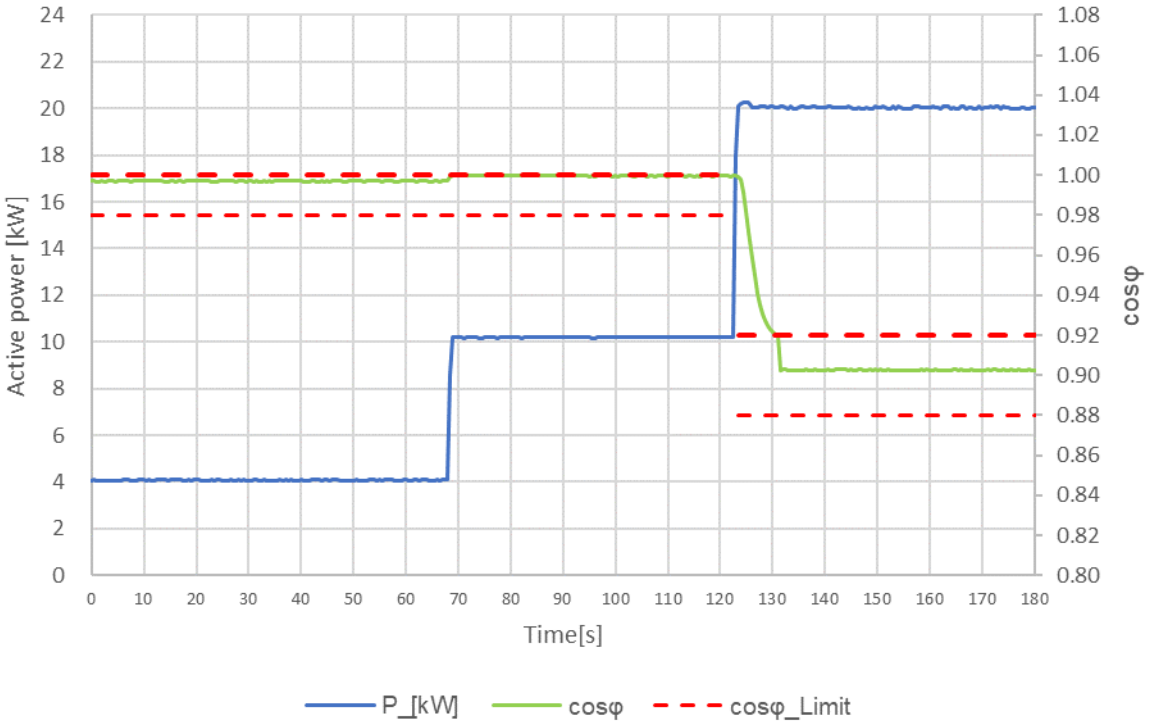
Note:
The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

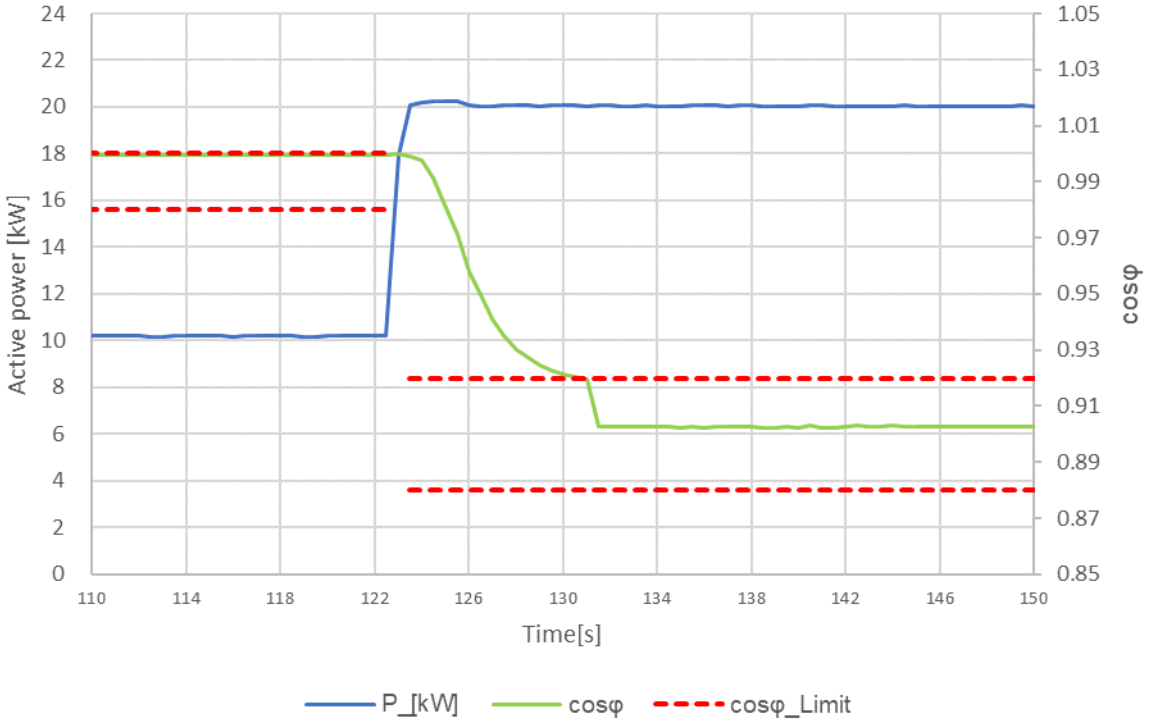
[1)] Refer to **Differences of the model**.

Graph of cos φ(P): Test a)

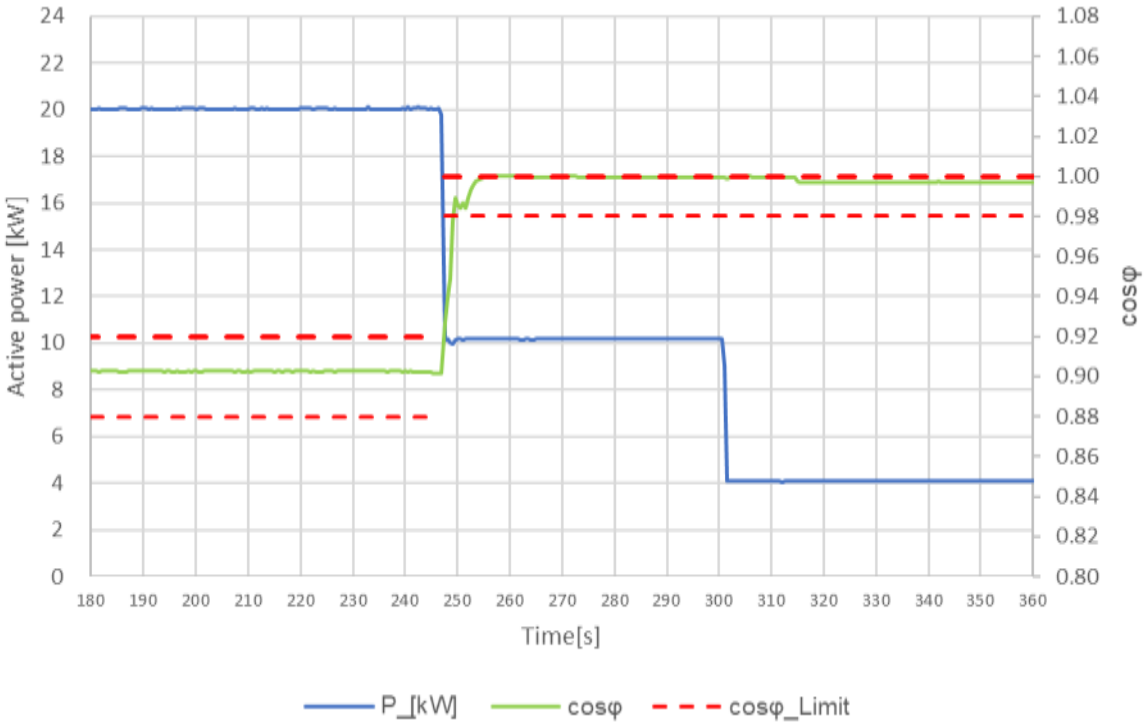


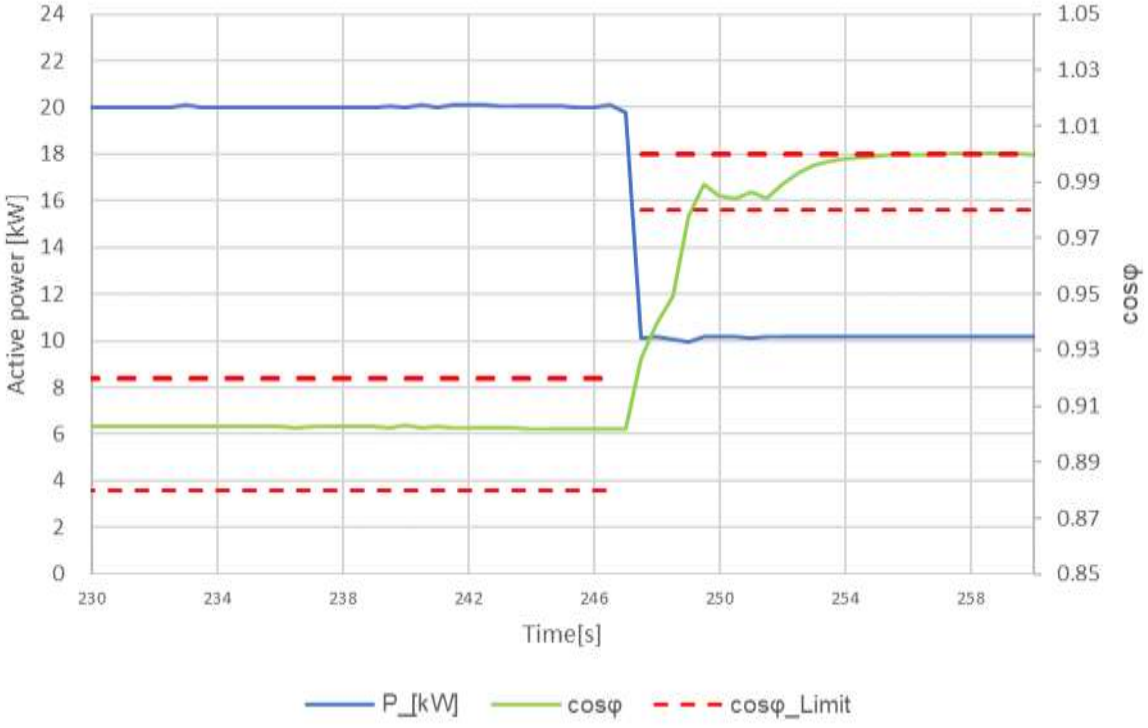
Graph of setting (T_0) time: Test b) 20% to 50% to 100%





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





5.3.9 Reactive power setpoint control “fix Q”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.

**applies for inverter $\Sigma S_n \leq 3.68$ kVA
For Q=31,2 over-excited and Q=31,2 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

*Applies for inverter $\Sigma S_n \geq 3.68$ kVA
For Q=43,6 over-excited and Q=43,6 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

**Q=31,2 (φ 0,95) (i) and (c): PGU ≤ 3,68 kVA

*Q=43,6 (φ 0,90) (i) and (c): PGU > 3,68 kVA

* Every test step point must hold for 60 seconds.

Assessment criteria:

The test is passed if all Q values (30 s mean) are not more than ± 4% S_n from the specification differ.

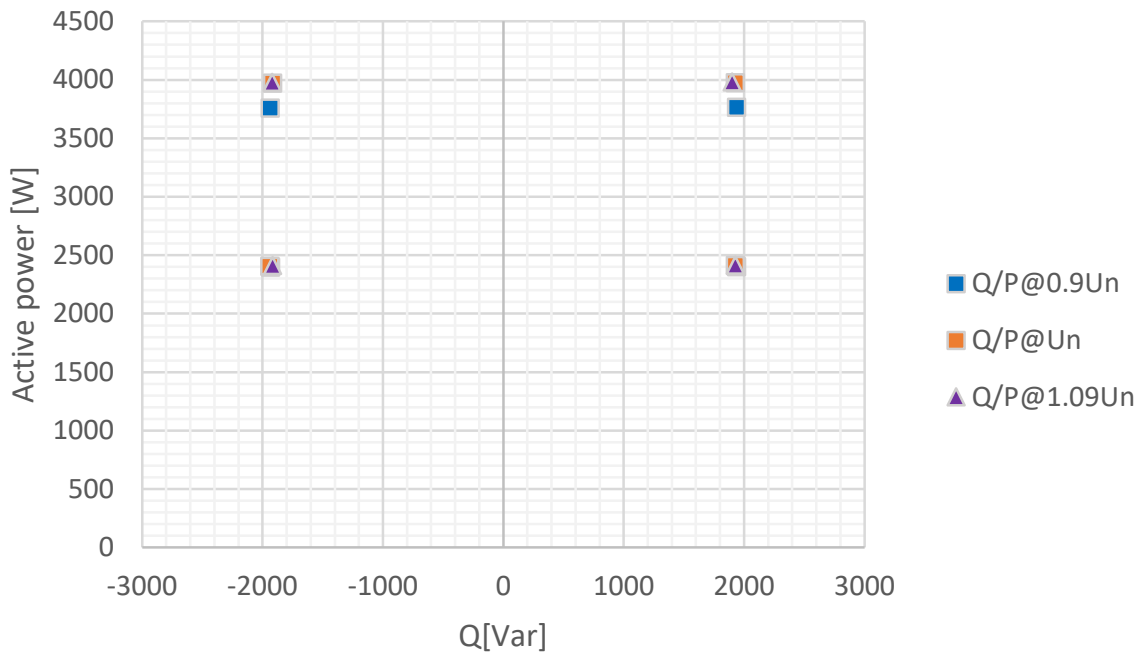
In the case of EZE with generators directly connected to the grid, which cannot regulate reactive power due to the principle, such as asynchronous generators, and therefore use non-controllable fixed capacities, the tolerance band extends from ± 4% P_n to ± 10% P_n. This device type is only used at U_n rated.

Result: PCS-3-4KW-25A-1

Setting values	$Q_{max\text{-}overexcited}$	+43,6%Sn
	$Q_{max\text{-}underexcited}$	-43,6%Sn

30 s mean value	0,91U_n		U_n		1,09 U_n	
Active power	40 – 60% P_n	S_n	40 – 60% Pn	S_n	40 – 60% P_n	S_n
a) Qmax at +43,6%Sn						
U [V]:	209,45	209,43	230,09	230,14	250,81	250,78
P_{E30} [W]:	2401	3763	2410	3974	2416	3983
Q_{E30} [Var]:	1937	1938	1927	1927	1925	1900
S_{E30} [VA]:	3085	4233	3086	4416	3089	4413
cos $\varphi_{E30\text{-}over\text{-}excited}$	0,778	0,889	0,781	0,900	0,782	0,903
b) Qmin at -43,6%Sn						
U [V]:	209,30	209,37	229,99	230,02	250,74	250,82
P_{E30} [W]:	2396	3758	2404	3970	2411	3977
Q_{E30} [Var]:	-1935	-1937	-1942	-1918	-1919	-1920
S_{E30} [VA]:	3080	4227	3090	4409	3082	4416
cos $\varphi_{E30\text{-}over\text{-}excited}$	0,778	0,889	0,778	0,900	0,782	0,901
Limit cos φ:	± 4% Sn					

Graph:


4500
4000
3500
3000
2500
2000
1500
1000
500
0
Active power [W]
-3000
-2000
-1000
0
1000
2000
3000
Q[Var]
Q/P@0.9Un
Q/P@Un
Q/P@1.09Un

5.3.9 Reactive power setpoint control “fix Q”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.

**applies for inverter $\Sigma S_n \leq 3.68$ kVA
For Q=31,2 over-excited and Q=31,2 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

*Applies for inverter $\Sigma S_n \geq 3.68$ kVA
For Q=43,6 over-excited and Q=43,6 under-excited, the active power will be measured at value between 40% P_n and 60% and S_n

**Q=31,2 (φ 0,95) (i) and (c): PGU ≤ 3,68 kVA

*Q=43,6 (φ 0,90) (i) and (c): PGU > 3,68 kVA

* Every test step point must hold for 60 seconds.

Assessment criteria:

The test is passed if all Q values (30 s mean) are not more than ± 4% S_n from the specification differ.

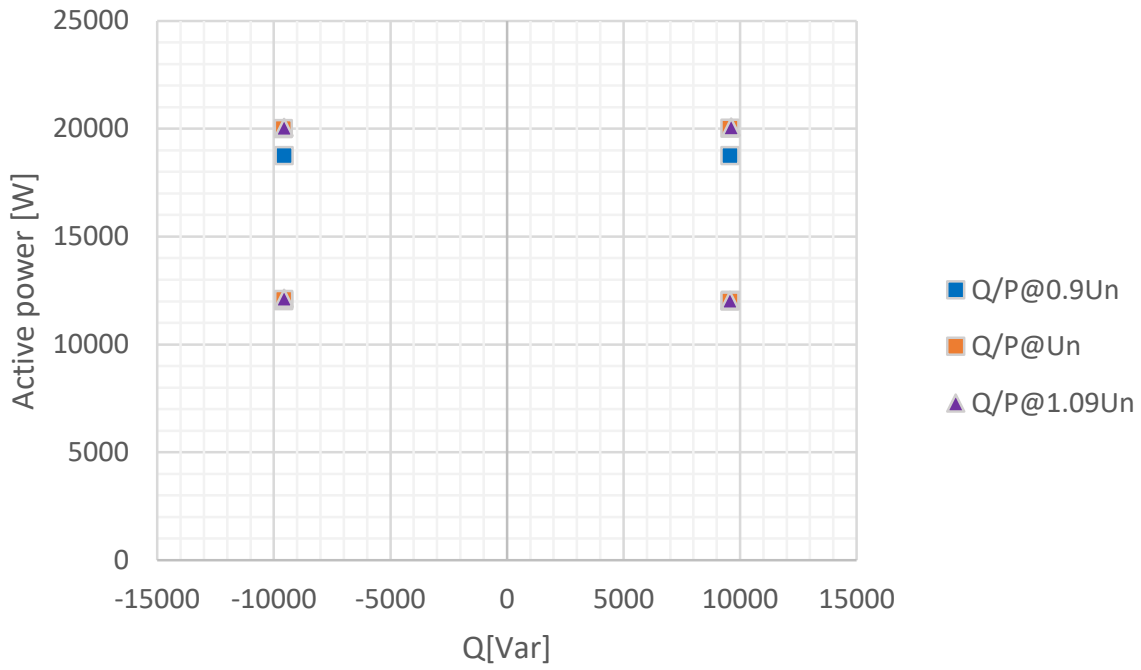
In the case of EZE with generators directly connected to the grid, which cannot regulate reactive power due to the principle, such as asynchronous generators, and therefore use non-controllable fixed capacities, the tolerance band extends from ± 4% P_n to ± 10% P_n. This device type is only used at U_n rated.

Result: PCS-3-20KW-40A-1

Setting values	Qmax	+43,6%Sn
	Qmin	-43,6%Sn

30 s mean value	0,91U_n		U_n		1,09 U_n	
Active power	40 – 60% Pn	Sn	40 – 60% Pn	Sn	40 – 60% Pn	Sn
a) Qmax at +43,6%Sn						
U [V]:	209,58	209,59	230,24	230,29	250,90	250
P_{E30} [W]:	12044	18762	12010	20030	12047	20086
Q_{E30} [Var]:	9580	9567	9565	9570	9565	9614
S_{E30} [VA]:	15390	21060	15354	22199	15383	22268
cos $\varphi_{E30\text{-over-excited}}$	0,782	0,890	0,782	0,902	0,783	0,902
b) Qmin at -43,6%Sn						
U [V]:	209,41	209,50	230,16	230,24	250,86	250,91
P_{E30} [W]:	12028	18754	12092	19999	12131	20060
Q_{E30} [Var]:	-9574	-9566	-9583	-9599	-9563	-9561
S_{E30} [VA]:	15373	21053	15429	22184	15447	22222
cos $\varphi_{E30\text{-over-excited}}$	0,782	0,890	0,784	0,902	0,785	0,903
Limit cos φ:	± 4% Sn					

Graph:



Note:

The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3.10 Voltage-controlled control functions “Q= f(V)”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.2

Setting values for the Q(U) characteristic test:			
Required voltage points according table 3	Voltage (U/U_n)	Reactive power (Q/S_n)	Time constant Tau
a	0,92	43,6% (over exited)	3 s
b	0,96	0,0	
c	1,05	0,0	
d	1,08	43,6% (under exited)	

Note:

1. Check the behavior of the Q(U) control, the time constant or the response time of the Q(U) control must be defined according to a first-order filter with a time constant Tau of 3 s.
2. Also, the P(U) functions default setting will be enabled (Tau=5s).
3. The overvoltage protection U_{eff} > may be deactivated when testing the voltage-dependent control functions

Assessment criteria:

The examination of inpatient behavior is passed if

- The 30 s mean values of the reactive power values measured in stationary operation measured according to 5.3.10.1.1 are within the tolerance band of ± 4% Sn and ± 1% Un of the set Q (U) characteristic.

- in the power range Pmin up to 20% Pn the time course of the reactive power is constant and when P = 0, the reactive power goes towards 0. Compliance with the tolerance band of ± 4% Sn is in this Active power range not required.

Setting value of the inverter:

Overvoltage Derating		
Overvoltage Derating Switch	ON	
P(U) Curve Start Voltage	253.0	V
Power of P(U) Curve Start Voltage	100.0	%
P(U) Curve End Voltage	257.6	v
Power of P(U) Curve End Voltage	0.0	%
P(U) Time constant	5.0	s

Reactive Power/Voltage Feature		
Q(U) Curve Switch	ON	
Q(U) Point1 Voltage	211.6	V
Q(U) Curve Point1 Reactive Power Percent	43.6	%
Q(U) Point2 Voltage	220.8	V
Q(U) Curve Point2 Reactive Power Percent	0.0	%
Q(U) Point3 Voltage	241.5	V
Q(U) Curve Point3 Reactive Power Percent	0.000	%
Q(U) Point4 Voltage	248.4	V
Q(U) Curve Point4 Reactive Power Percent	-43.6	%
Time constant for Q(U)	3.0	s
Minimum cos(phi)	0.400	

5.3.10.1.1 Test Voltage-controlled control functions “Q= f(V)” - quasi-stationary behavior	P

Result:PCS-3-4KW-25A-1

a) to n) 100% Pn

Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	100	230,14	100,06	4003	-176	68	176	-4,00	1,56	4,00
2	101	232,32	101,01	4002	-176	70	176	-4,00	1,59	4,00
3	102	234,60	102,00	4004	-176	71	176	-4,00	1,62	4,00
4	103	236,94	103,02	4006	-176	73	176	-4,00	1,65	4,00
5	104	239,22	104,01	4007	-176	74	176	-4,00	1,68	4,00
6	105	241,49	105,00	4009	-176	75	176	-4,00	1,72	4,00
7	106	243,83	106,01	4008	-815	-618	-463	-18,53	-14,04	-10,53
8	107	246,12	107,01	4005	-1455	-1293	-1103	-33,07	-29,38	-25,07
9	108	248,43	108,01	4002	-2094	-1953	-1742	-47,60	-44,40	-39,60
10	109	250,73	109,02	4002	-2094	-1943	-1742	-47,60	-44,16	-39,60
11	110	253,01	110,00	4002	-2094	-1942	-1742	-47,60	-44,13	-39,60
12	111	255,23	110,97	2020	-2094	-1928	-1742	-47,60	-43,83	-39,60
13	112	257,77	112,07	54	-176	120	-1742	-4,00	2,72	4,00
14	113	259,91	113,00	55	-176	120	-1742	-4,00	2,72	4,00
15	112	257,59	112,00	55	-176	120	-1742	-4,00	2,72	4,00
16	111	255,35	111,02	2003	-2094	-1927	-1742	-47,60	-43,79	-39,60
17	110	253,07	110,03	4000	-2094	-1940	-1742	-47,60	-44,09	-39,60
18	109	250,75	109,02	4001	-2094	-1946	-1742	-47,60	-44,22	-39,60
19	108	248,44	108,02	4001	-2094	-1945	-1742	-47,60	-44,21	-39,60
20	107	246,20	107,05	4005	-1455	-1272	-1103	-33,07	-28,90	-25,07
21	106	243,85	106,02	4007	-815	-603	-463	-18,53	-13,71	-10,53
22	105	241,65	105,06	4008	-176	67	176	-4,00	1,53	4,00
23	104	239,25	104,02	4007	-176	75	176	-4,00	1,70	4,00
24	103	236,89	103,00	4006	-176	74	176	-4,00	1,67	4,00
25	102	234,65	102,02	4005	-176	72	176	-4,00	1,64	4,00
26	101	232,38	101,04	4003	-176	71	176	-4,00	1,61	4,00
27	100	230,03	100,01	4001	-176	69	176	-4,00	1,58	4,00
28	99	227,73	99,01	4002	-176	68	176	-4,00	1,54	4,00
29	98	225,42	98,01	4000	-176	67	176	-4,00	1,52	4,00
30	97	223,12	97,01	3999	-176	65	176	-4,00	1,48	4,00
31	96	220,79	96,00	3998	-176	35	176	-4,00	0,80	4,00

32	95	218,62	95,05	3996	304	491	656	6,90	11,17	14,90
33	94	216,32	94,05	3994	783	1122	1135	17,80	25,49	25,80
34	93	214,06	93,07	3990	1263	1583	1615	28,70	35,98	36,70
35	92	211,75	92,07	3841	1742	1964	2094	39,60	44,65	47,60
36	91	209,45	91,07	3808	1742	1962	2094	39,60	44,60	47,60
37	90	207,18	90,08	3764	1742	1959	2094	39,60	44,52	47,60
38	89	204,88	89,08	3727	1742	1954	2094	39,60	44,41	47,60
39	88	202,56	88,07	3685	1742	1951	2094	39,60	44,34	47,60
40	87	200,26	87,07	3644	1742	1947	2094	39,60	44,25	47,60
41	86	197,92	86,05	3604	1742	1942	2094	39,60	44,13	47,60
42	85	195,65	85,06	3563	1742	1940	2094	39,60	44,09	47,60
43	86	197,95	86,07	3603	1742	1945	2094	39,60	44,21	47,60
44	87	200,31	87,09	3645	1742	1948	2094	39,60	44,28	47,60
45	88	202,56	88,07	3684	1742	1952	2094	39,60	44,37	47,60
46	89	204,86	89,07	3726	1742	1956	2094	39,60	44,44	47,60
47	90	207,14	90,06	3766	1742	1959	2094	39,60	44,52	47,60
48	91	209,46	91,07	3806	1742	1965	2094	39,60	44,67	47,60
49	92	211,74	92,06	3845	1742	1969	2094	39,60	44,75	47,60
50	93	213,99	93,04	3991	1263	1390	1615	28,70	31,59	36,70
51	94	216,21	94,01	3994	783	928	1135	17,80	21,10	25,80
52	95	218,50	95,00	3996	304	471	656	6,90	10,71	14,90
53	96	220,79	96,00	3997	-176	33	176	-4,00	0,74	4,00
54	97	223,15	97,02	3998	-176	66	176	-4,00	1,50	4,00
55	98	225,42	98,01	4000	-176	80	176	-4,00	1,83	4,00
56	99	227,73	99,01	4000	-176	87	176	-4,00	1,98	4,00
57	100	230,06	100,03	4002	-176	95	176	-4,00	2,15	4,00
a) to n) < 20% Pn										
Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	100	230,13	100,06	800	-176	42	176	-4,00	0,95	4,00
2	101	232,37	101,03	799	-176	43	176	-4,00	0,97	4,00
3	102	234,66	102,03	800	-176	43	176	-4,00	0,99	4,00
4	103	236,88	102,99	800	-176	44	176	-4,00	1,00	4,00
5	104	239,23	104,01	801	-176	45	176	-4,00	1,02	4,00
6	105	241,50	105,00	801	-176	46	176	-4,00	1,05	4,00
7	106	243,86	106,03	801	-815	-564	-463	-18,53	-12,82	-10,53

8	107	246,11	107,01	800	-1455	-1224	-1103	-33,07	-27,81	-25,07
9	108	248,44	108,02	799	-2094	-1842	-1742	-47,60	-41,87	-39,60
10	109	250,66	108,98	798	-2094	-1834	-1742	-47,60	-41,69	-39,60
11	110	253,01	110,00	798	-2094	-1830	-1742	-47,60	-41,60	-39,60
12	111	255,26	110,98	799	-2094	-1823	-1742	-47,60	-41,44	-39,60
13	112	257,78	112,08	22	-176	107	-1742	-4,00	2,43	4,00
14	113	259,89	112,99	22	-176	113	-1742	-4,00	2,56	4,00
15	112	257,54	111,98	21	-176	112	-1742	-4,00	2,56	4,00
16	111	255,34	111,02	789	-2094	-1825	-1742	-47,60	-41,49	-39,60
17	110	253,00	110,00	798	-2094	-1831	-1742	-47,60	-41,62	-39,60
18	109	250,71	109,00	798	-2094	-1836	-1742	-47,60	-41,72	-39,60
19	108	248,41	108,00	798	-2094	-1814	-1742	-47,60	-41,22	-39,60
20	107	246,20	107,04	799	-1455	-1171	-1103	-33,07	-26,61	-25,07
21	106	243,90	106,04	801	-815	-571	-463	-18,53	-12,99	-10,53
22	105	241,62	105,05	801	-176	42	176	-4,00	0,94	4,00
23	104	239,18	103,99	801	-176	46	176	-4,00	1,05	4,00
24	103	236,93	103,01	800	-176	45	176	-4,00	1,02	4,00
25	102	234,59	101,99	801	-176	44	176	-4,00	1,00	4,00
26	101	232,29	100,99	800	-176	43	176	-4,00	0,99	4,00
27	100	229,95	99,98	800	-176	42	176	-4,00	0,97	4,00
28	99	227,67	98,99	800	-176	42	176	-4,00	0,95	4,00
29	98	225,39	97,99	800	-176	41	176	-4,00	0,93	4,00
30	97	223,09	97,00	798	-176	40	176	-4,00	0,92	4,00
31	96	220,81	96,00	799	-176	23	176	-4,00	0,52	4,00
32	95	218,60	95,04	798	304	484	656	6,90	11,01	14,90
33	94	216,14	93,97	798	783	933	1135	17,80	21,21	25,80
34	93	213,99	93,04	797	1263	1359	1615	28,70	30,88	36,70
35	92	211,64	92,02	795	1742	1842	2094	39,60	41,87	47,60
36	91	209,23	90,97	794	1742	1856	2094	39,60	42,19	47,60
37	90	207,16	90,07	795	1742	1851	2094	39,60	42,08	47,60
38	89	204,85	89,06	794	1742	1848	2094	39,60	41,99	47,60
39	88	202,56	88,07	793	1742	1846	2094	39,60	41,95	47,60
40	87	200,24	87,06	794	1742	1841	2094	39,60	41,83	47,60
41	86	197,93	86,05	793	1742	1838	2094	39,60	41,76	47,60
42	85	195,63	85,06	793	1742	1832	2094	39,60	41,64	47,60
43	86	197,91	86,05	793	1742	1838	2094	39,60	41,77	47,60

44	87	200,19	87,04	793	1742	1842	2094	39,60	41,86	47,60
45	88	202,50	88,05	794	1742	1846	2094	39,60	41,95	47,60
46	89	204,83	89,06	794	1742	1849	2094	39,60	42,02	47,60
47	90	207,12	90,05	795	1742	1852	2094	39,60	42,09	47,60
48	91	209,43	91,06	795	1742	1856	2094	39,60	42,19	47,60
49	92	211,74	92,06	795	1742	1859	2094	39,60	42,26	47,60
50	93	213,97	93,03	797	1263	1330	1615	28,70	30,22	36,70
51	94	216,21	94,01	798	783	901	1135	17,80	20,49	25,80
52	95	218,53	95,01	798	304	464	656	6,90	10,55	14,90
53	96	220,81	96,01	799	-176	19	176	-4,00	0,43	4,00
54	97	223,04	96,97	799	-176	36	176	-4,00	0,82	4,00
55	98	225,50	98,04	799	-176	43	176	-4,00	0,97	4,00
56	99	227,68	98,99	800	-176	44	176	-4,00	0,99	4,00
57	100	230,02	100,01	799	-176	44	176	-4,00	1,01	4,00

o) to z) Test@91%Un

Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	91	209,24	90,97	40	-176	92	176	-4,00	2,10	4,00
2	91	209,25	90,98	203	304	465	656	6,90	10,57	14,90
3	91	209,27	90,99	414	783	949	1135	17,80	21,57	25,80
4	91	209,30	91,00	623	1263	1429	1615	28,70	32,48	36,70
5	91	209,32	91,01	811	1742	1901	2094	39,60	43,20	47,60
6	91	209,31	91,00	623	1263	1430	1615	28,70	32,50	36,70
7	91	209,30	91,00	414	783	949	1135	17,80	21,58	25,80
8	91	209,29	90,99	204	304	468	656	6,90	10,64	14,90
9	91	209,27	90,99	40	-176	92	176	-4,00	2,10	4,00

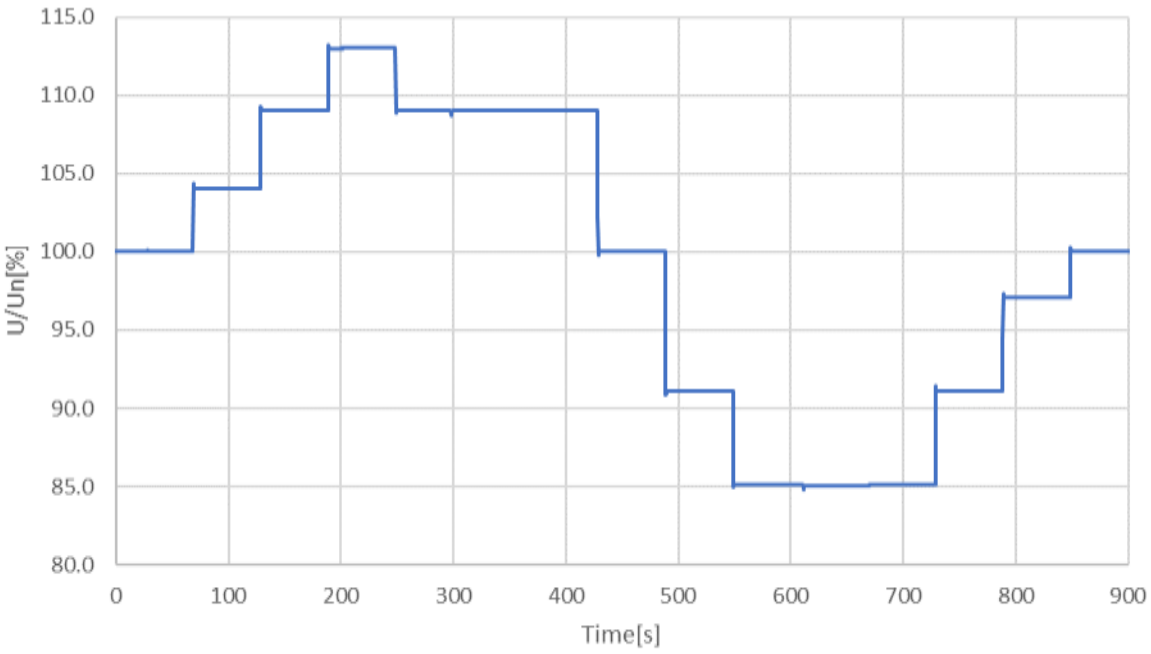
o) to z) Test@109%Un

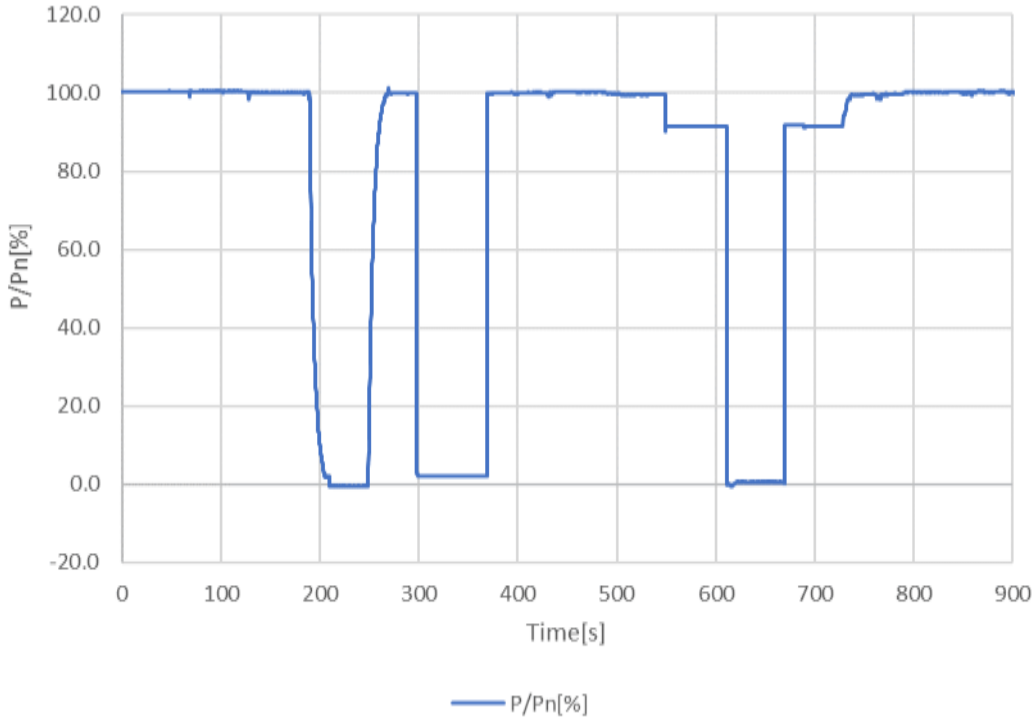
Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	109	250,71	109,00	40	-176	-92	176	-4,00	-2,10	4,00
2	109	250,73	109,01	213	-656	-488	-304	-14,90	-11,10	-6,90
3	109	250,74	109,02	425	-1135	-977	-783	-25,80	-22,20	-17,80
4	109	250,75	109,02	634	-1615	-1455	-1263	-36,70	-33,08	-28,70
5	109	250,76	109,02	819	-2094	-1920	-1742	-47,60	-43,63	-39,60
6	109	250,75	109,02	634	-1615	-1456	-1263	-36,70	-33,10	-28,70
7	109	250,73	109,02	416	-1135	-954	-783	-25,80	-21,69	-17,80

8	109	250,73	109,02	216	-656	-495	-304	-14,90	-11,26	-6,90
9	109	250,73	109,01	40	-176	-92	176	-4,00	-2,10	4,00

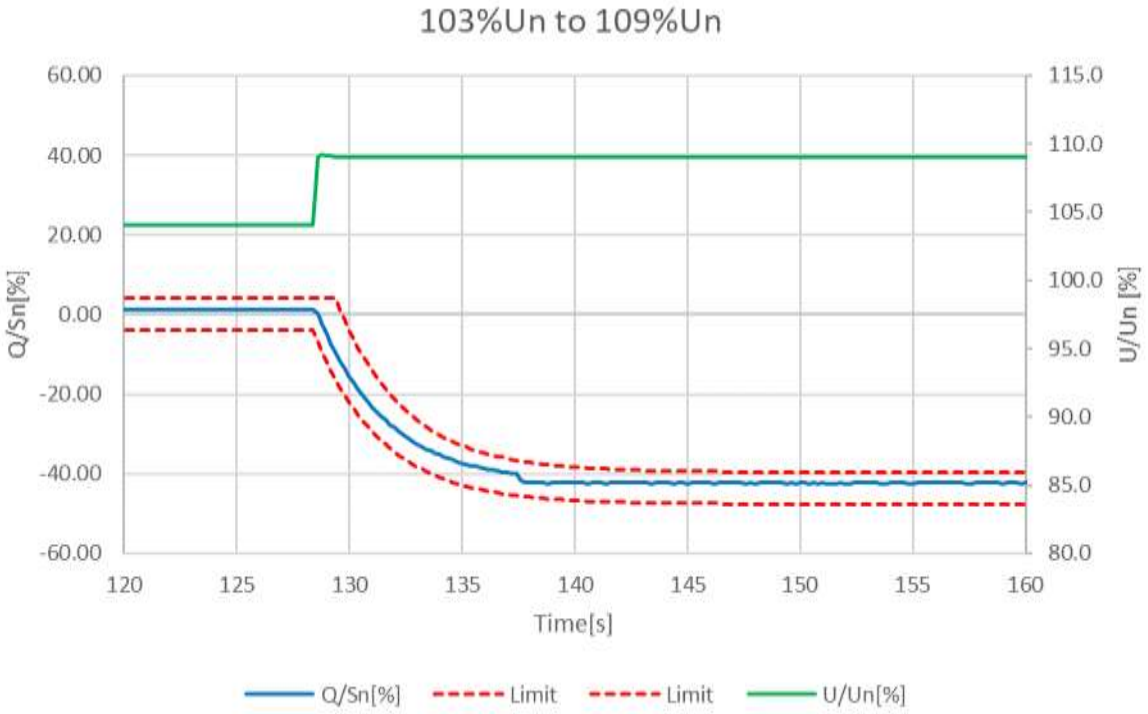
5.3.10.1.2 Test Voltage-controlled control functions “Q= f(V)” - dynamic behavior											P
$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{tol_under} [W]	P_{30s} [W]	P_{tol_upper} [W]	P_{30s} [%]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q,set [%Sn]	Q_{30s} [%Sn]
100	230,15	100,1	3600	4014	4400	100,34	-176	33	176	0	0,8
104	239,33	104,1	3600	4016	4400	100,41	-176	45	176	0	1,1
109	250,73	109,0	3600	4005	4400	100,12	-1920	-1693	-1568	-43,6	-42,3
113	259,96	113,0	0	-17	400	-0,41	-176	-91	176	0	-2,3
109	250,73	109,0	3600	3964	4400	99,11	-1920	-1690	-1568	-43,6	-42,3
109	250,77	109,0	0	82	400	2,05	-356	-226	-4	-4,5	-5,6
109	250,73	109,0	3600	4003	4400	100,07	-1920	-1694	-1568	-43,6	-42,3
100	230,15	100,1	3600	4008	4400	100,21	-176	32	176	0	0,8
91	209,59	91,1	3600	3986	4400	99,66	1568	1755	1920	43,6	43,9
85	195,80	85,1	3600	3658	4400	91,46	1568	1742	1920	43,6	43,6
85	195,64	85,1	0	23	400	0,59	-176	71	176	0	1,8
85	195,80	85,1	3600	3658	4400	91,46	1568	1742	1920	43,6	43,6
91	209,59	91,1	3600	3982	4400	99,56	1568	1755	1920	43,6	43,9
97	223,26	97,1	3600	4009	4400	100,23	-176	26	176	0	0,7
100	230,15	100,1	3600	4010	4400	100,26	-176	34	176	0	0,8

Graph:

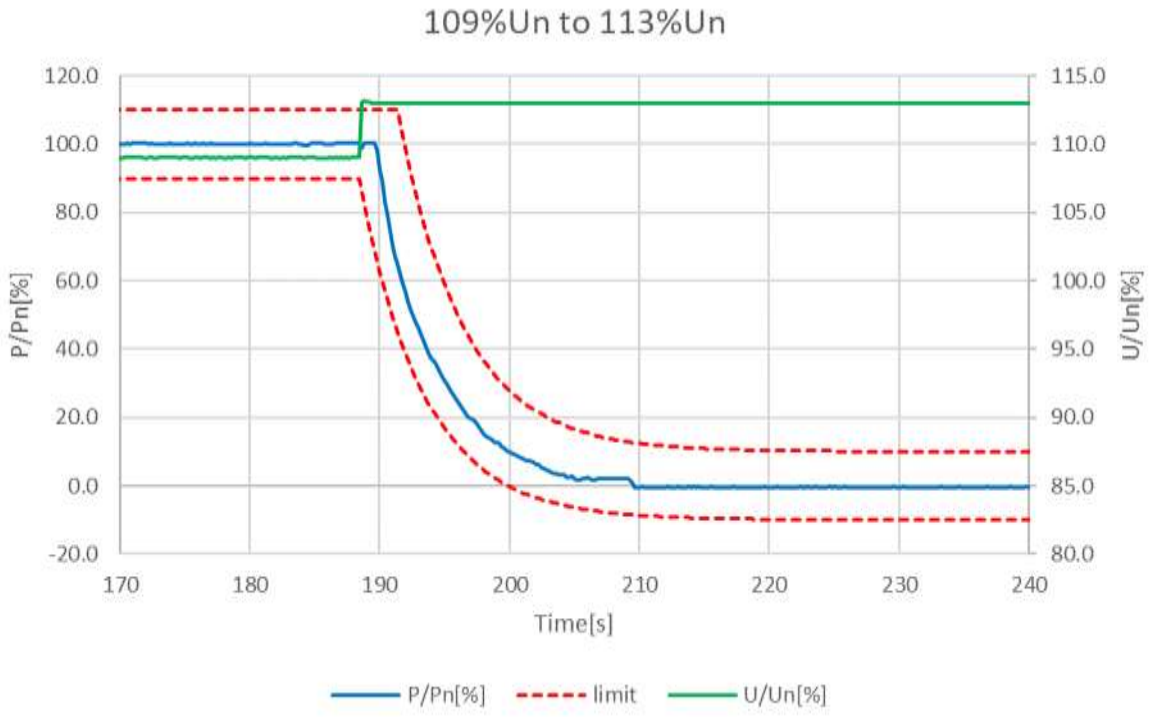

115.0
110.0
105.0
100.0
95.0
90.0
85.0
80.0
U/Un[%]
0
100
200
300
400
500
600
700
800
900
Time[s]
U/Un[%]

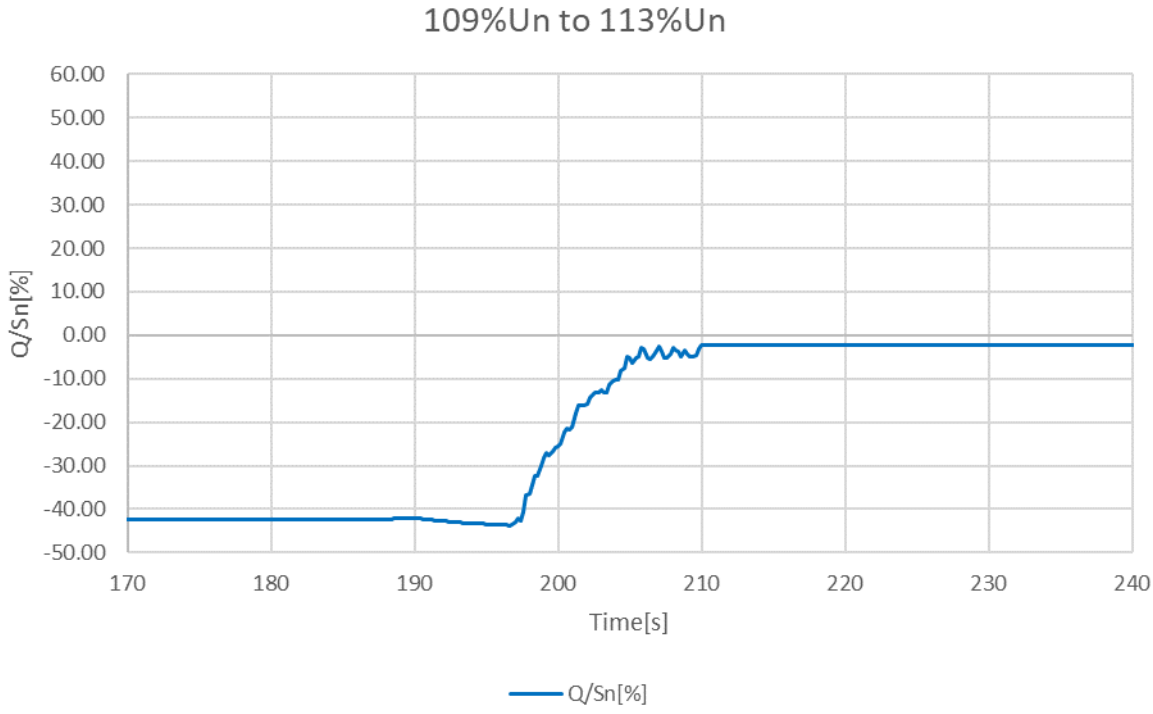

120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
P/Pn[%]
0
100
200
300
400
500
600
700
800
900
Time[s]
P/Pn[%]

Graph of Q(U): Test steps from 2 to 3→1,04Un to 1,09Un

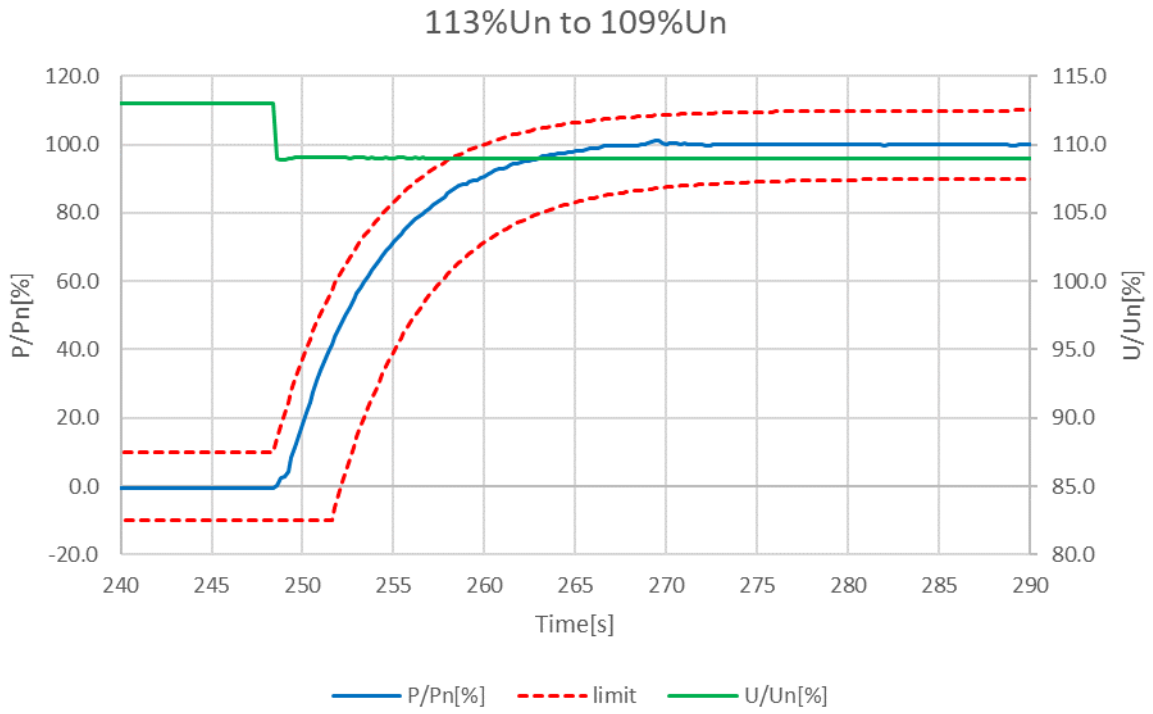


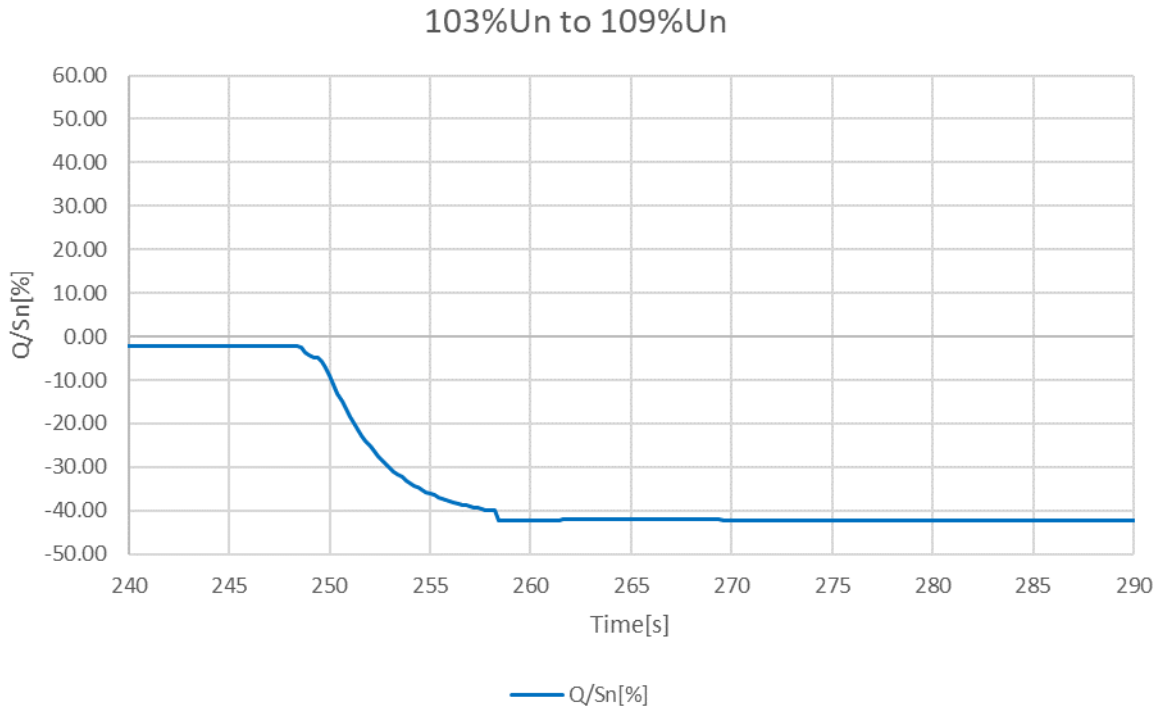
Graph of Q(U): Test steps from 3 to 4→1,09Un to 1,13Un



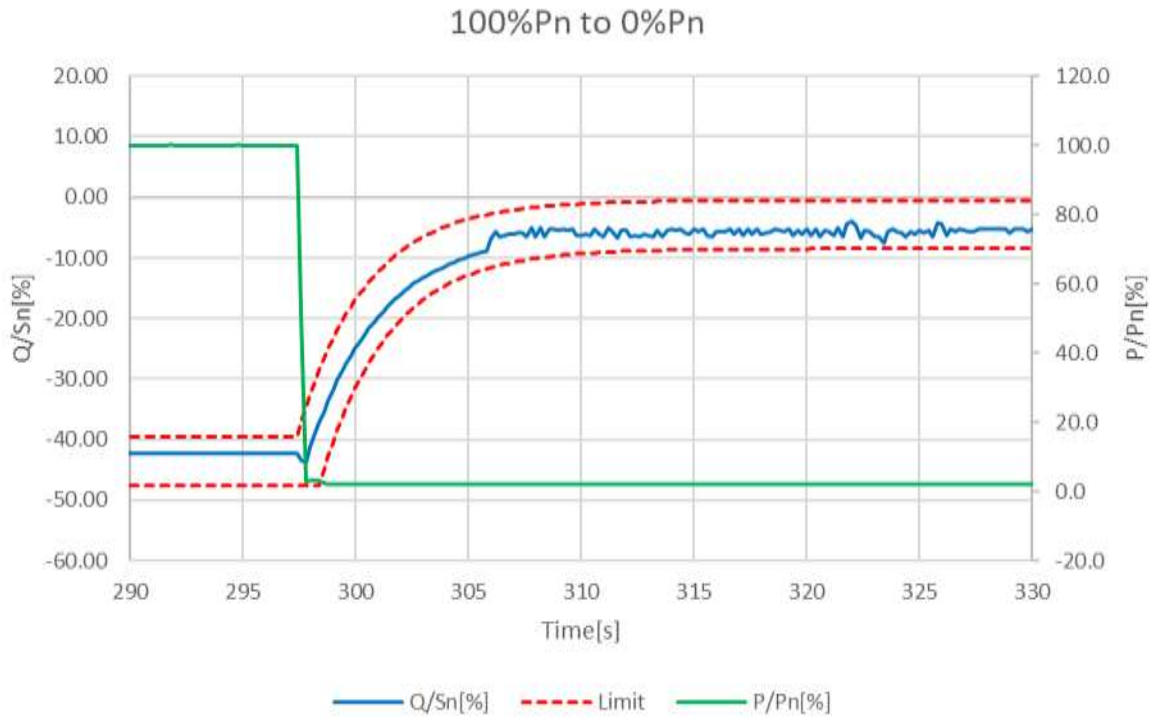


Graph of Q(U): Test steps from 4 to 5→1,13Un to 1,09Un

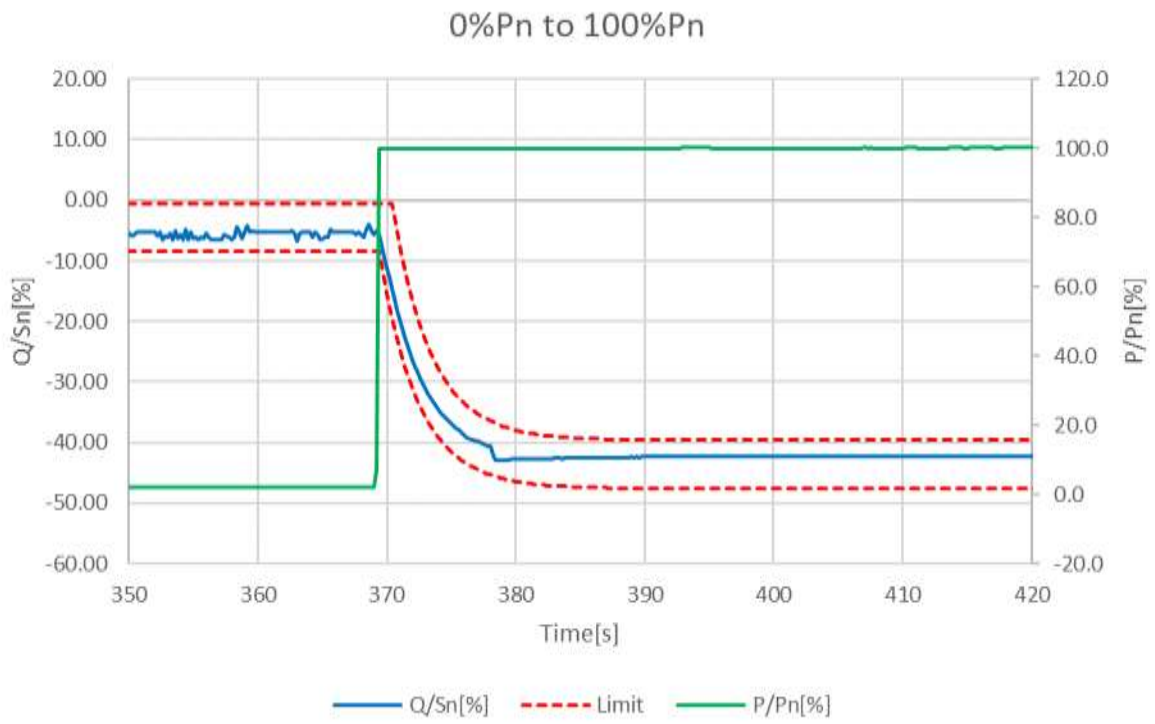




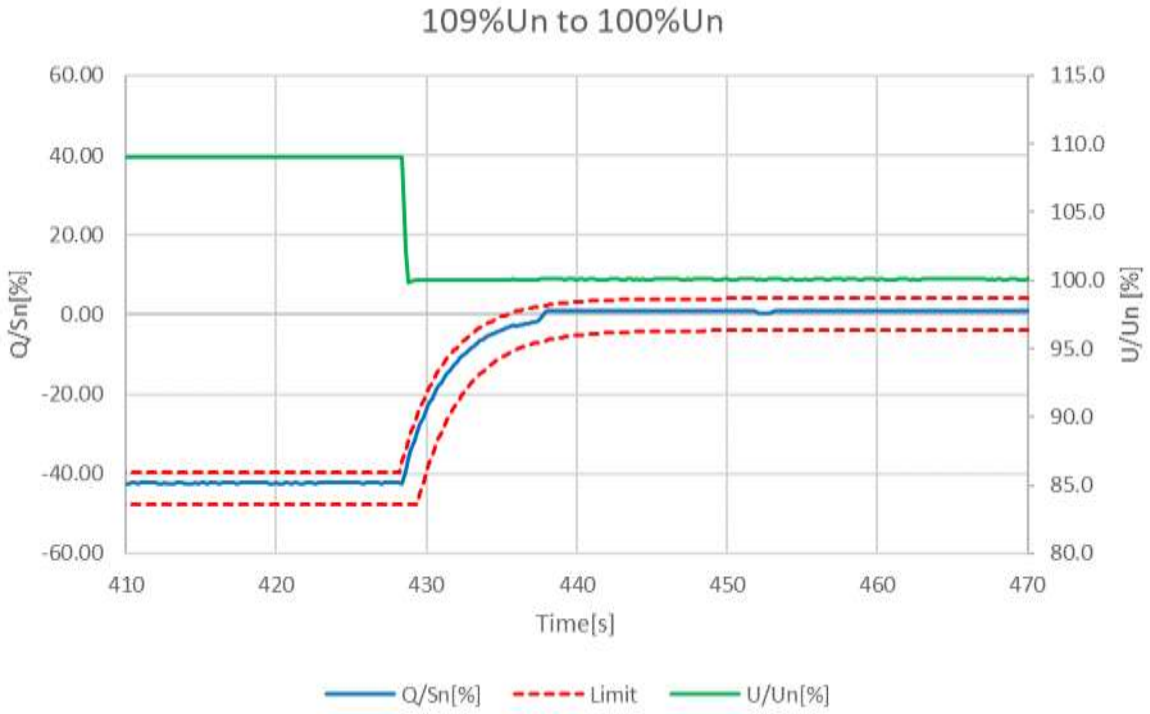
Graph of Q(U): Test steps from 5 to 6→100%Pn to 0%Pn



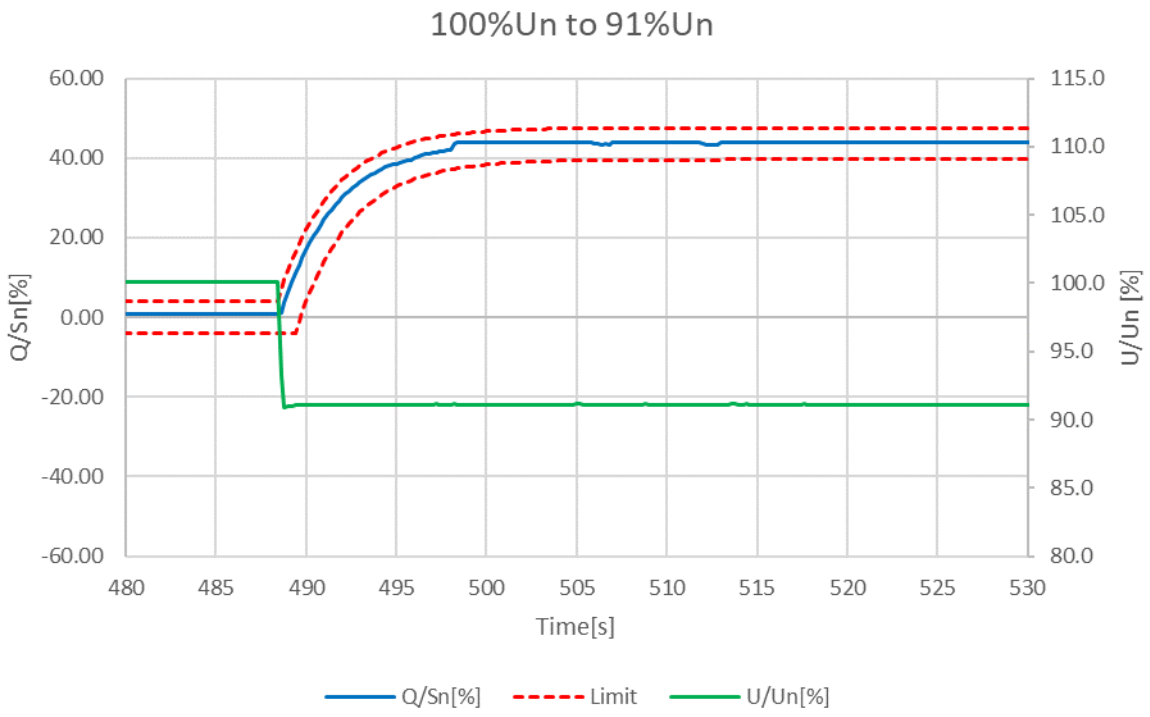
Graph of Q(U): Test steps from 6 to 7→0%Pn to 100%Pn



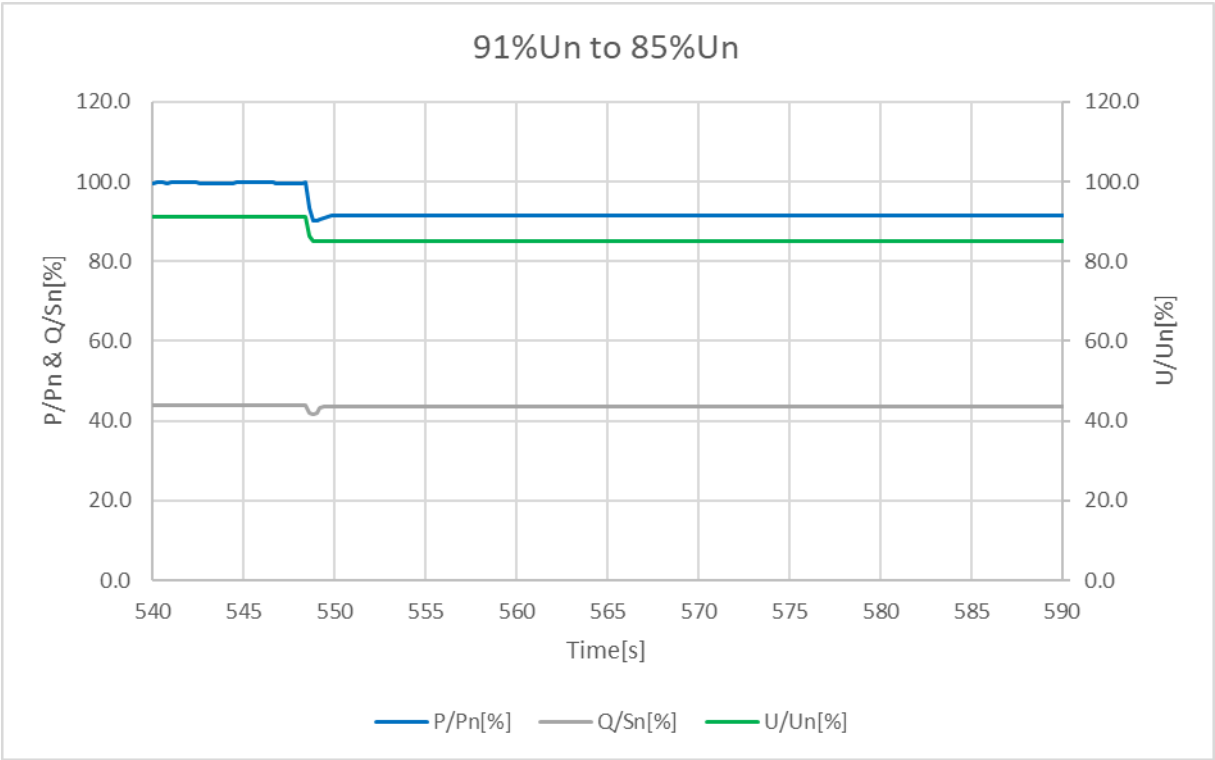
Graph of Q(U): Test steps from 7 to 8→1,09Un to 1,00Un



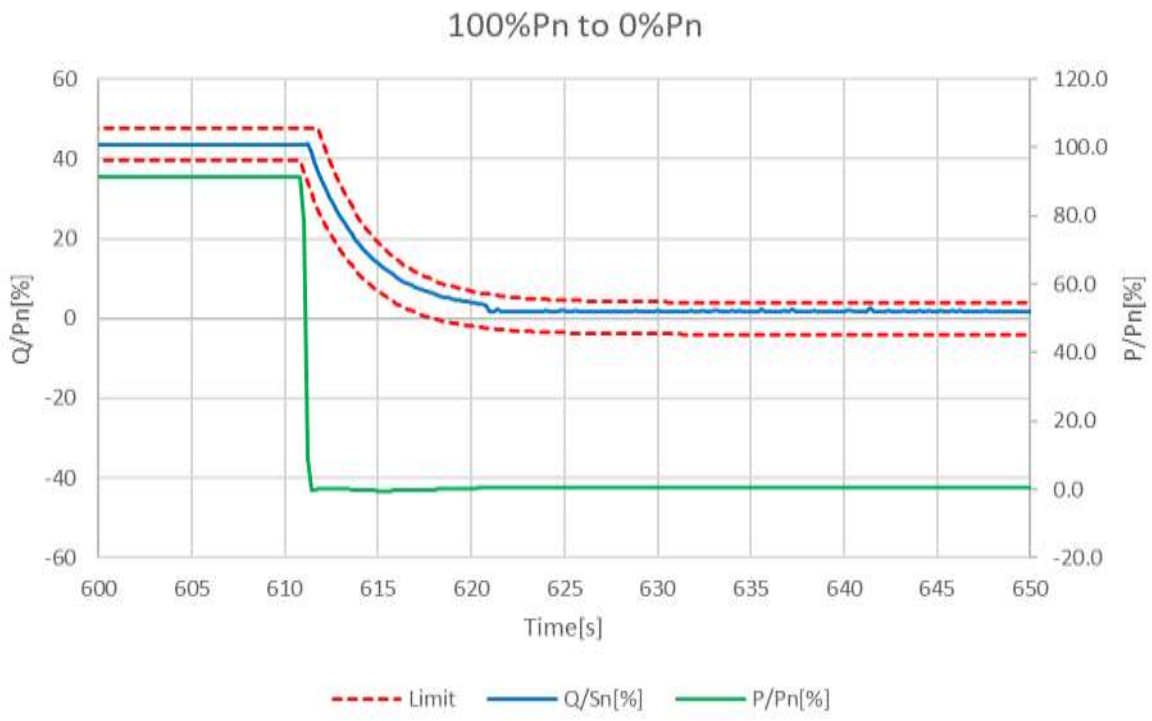
Graph of Q(U): Test steps from 8 to 9 →1,00Un to 0,91Un



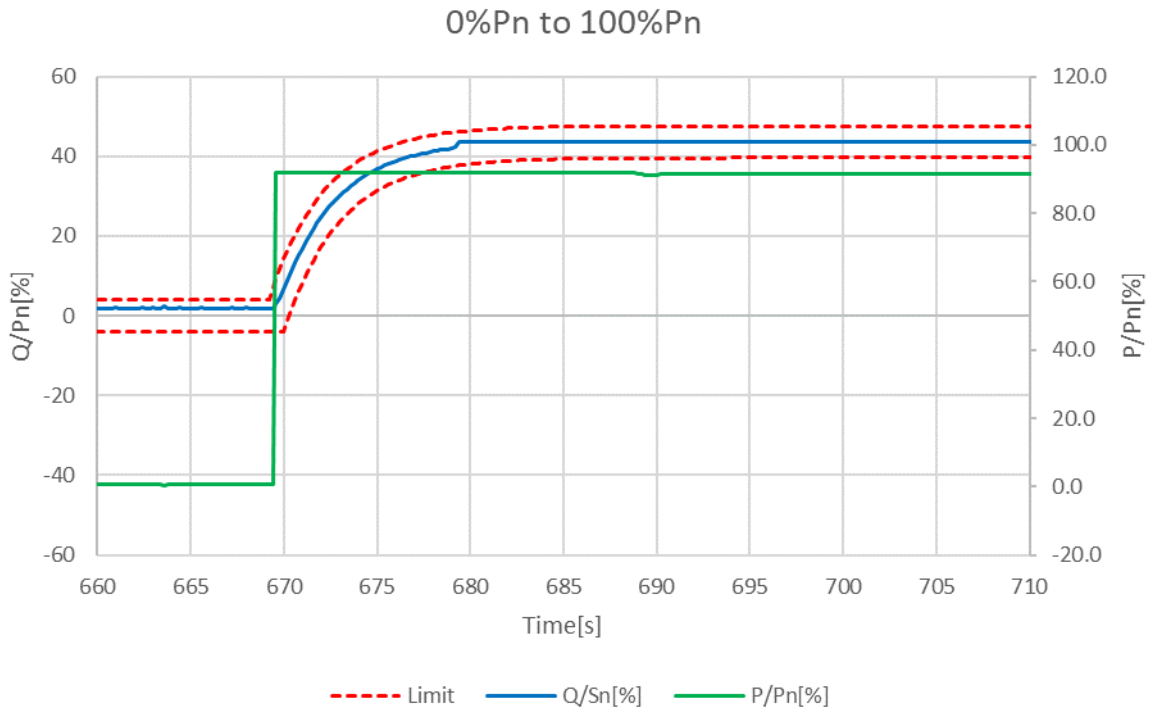
Graph of Q(U): Test steps from 9 to 10→0,91Un to 0,85Un



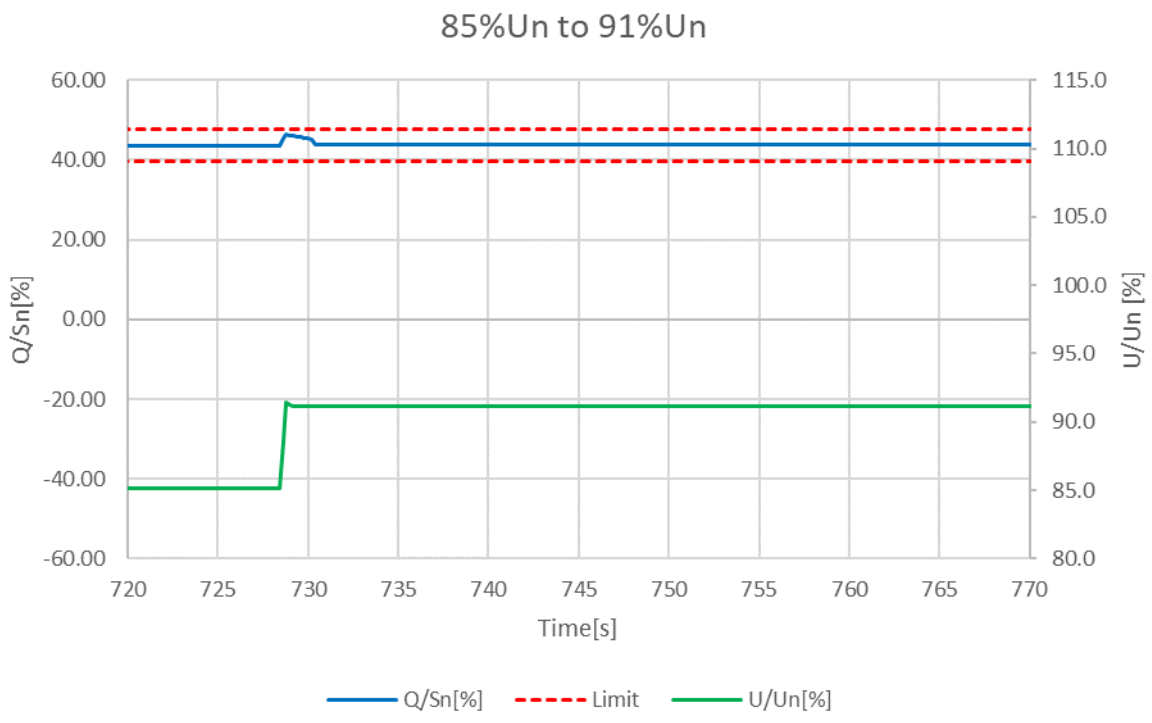
Graph of Q(U): Test steps from 10 to 11→100%Pn to 0%Pn



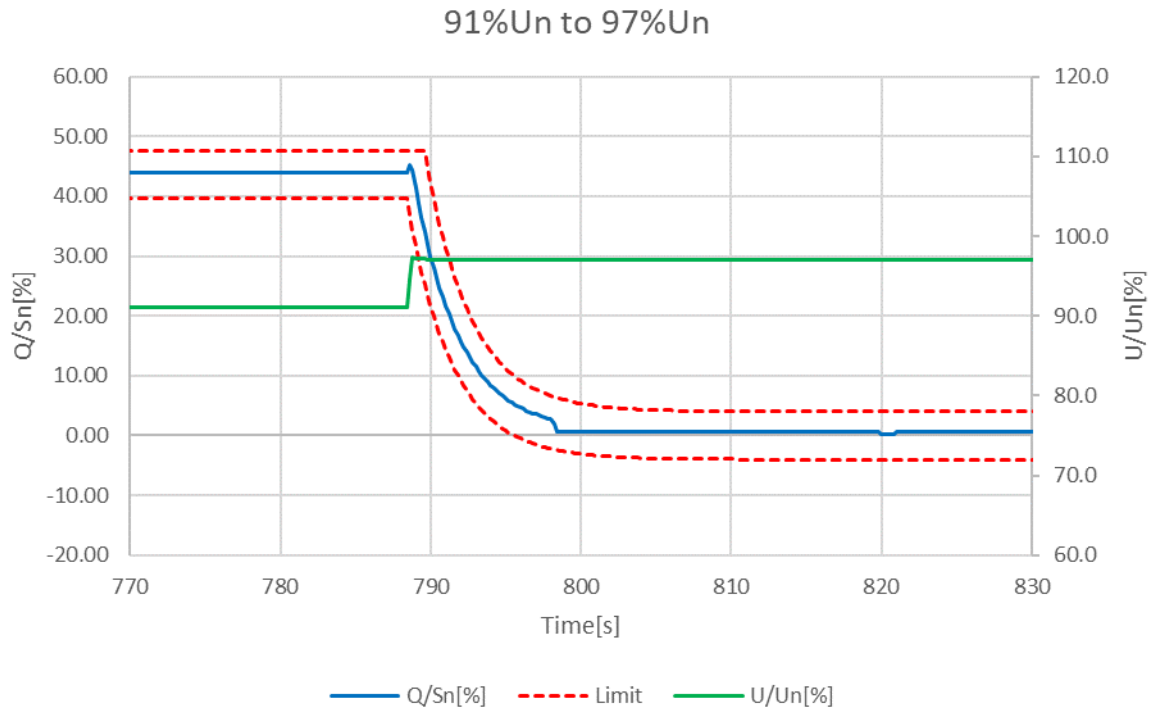
Graph of Q(U): Test steps from 11 to 12→0%Pn to 100%Pn



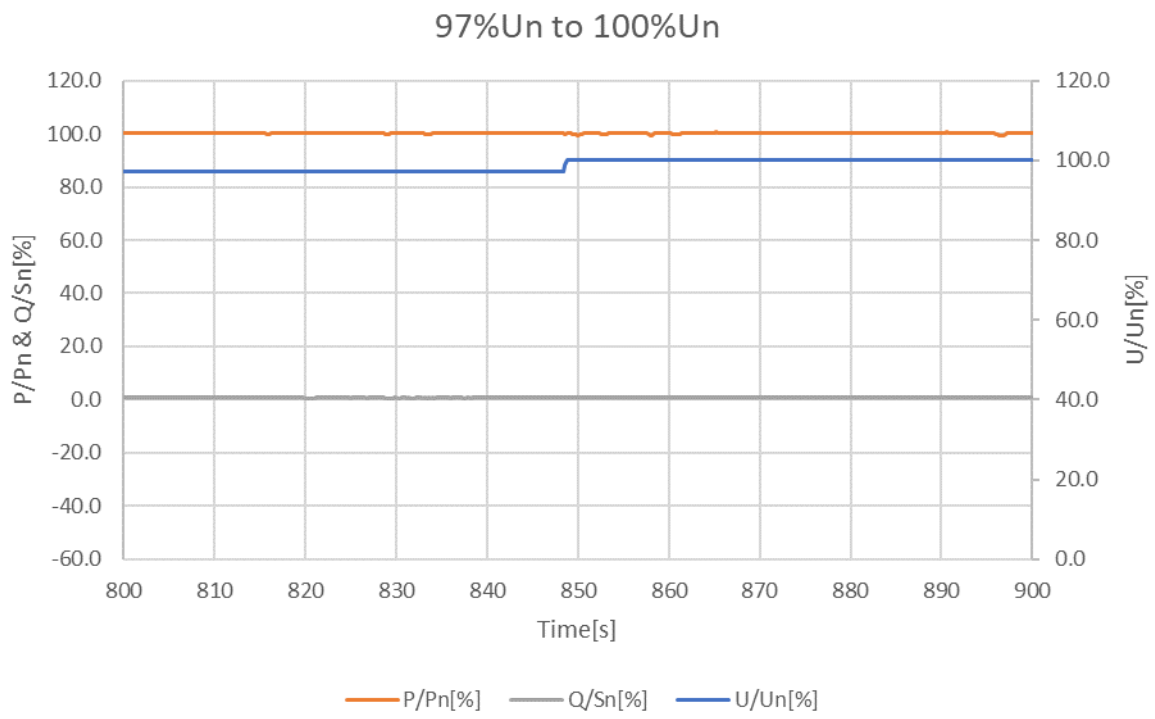
Graph of Q(U): Test steps from 12 to 13→0,85Un to 0,91Pn



Graph of Q(U): Test steps from 13 to 14→0,91Un to 0,97Un



Graph of Q(U): Test steps from 14 to 15→0,97Un to 1,00Un



5.3.10 Voltage-controlled control functions “Q= f(V)”	P

Test procedure and test conditions:

The test serves as verification of the reactive power mode according to TOR Erzeuger, 5.3.4.2

Setting values for the Q(U) characteristic test:			
Required voltage points according table 3	Voltage (U/U_n)	Reactive power (Q/S_n)	Time constant Tau
a	0,92	43,6% (over exited)	3 s
b	0,96	0,0	
c	1,05	0,0	
d	1,08	43,6% (under exited)	

Note:

4. Check the behavior of the Q(U) control, the time constant or the response time of the Q(U) control must be defined according to a first-order filter with a time constant Tau of 3 s.
5. Also, the P(U) functions default setting will be enabled (Tau=5s).
6. The overvoltage protection U_{eff} > may be deactivated when testing the voltage-dependent control functions

Assessment criteria:

The examination of inpatient behaviour is passed if

- The 30 s mean values of the reactive power values measured in stationary operation measured according to 5.3.10.1.1 are within the tolerance band of ± 4% Sn and ± 1% Un of the set Q (U) characteristic.

- in the power range Pmin up to 20% Pn the time course of the reactive power is constant and when P = 0, the reactive power goes towards 0. Compliance with the tolerance band of ± 4% Sn is in this Active power range not required.

Note:

The test had been performed on the model **PCS-3-4KW-25A-1**, **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

5.3.10.1.1 Test Voltage-controlled control functions “Q= f(V)” - quasi-stationary behavior	P

Result:PCS-3-20KW-40A-1

a) to n) 100% Pn

Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	100	230,14	100,06	20015	-880	336	880	-4,00	1,53	4,00
2	101	232,32	101,01	20012	-880	343	880	-4,00	1,56	4,00
3	102	234,59	102,00	20020	-880	350	880	-4,00	1,59	4,00
4	103	236,93	103,01	20031	-880	357	880	-4,00	1,62	4,00
5	104	239,21	104,00	20037	-880	364	880	-4,00	1,65	4,00
6	105	241,49	104,99	20047	-880	371	880	-4,00	1,68	4,00
7	106	243,83	106,01	20039	-4077	-3033	-2317	-18,53	-13,79	-10,53
8	107	246,11	107,00	20023	-7275	-6347	-5515	-33,07	-28,85	-25,07
9	108	248,43	108,01	20010	-10472	-9592	-8712	-47,60	-43,60	-39,60
10	109	250,73	109,01	20009	-10472	-9540	-8712	-47,60	-43,36	-39,60
11	110	253,01	110,00	20011	-10472	-9534	-8712	-47,60	-43,34	-39,60
12	111	255,22	110,97	10100	-10472	-9468	-8712	-47,60	-43,04	-39,60
13	112	257,76	112,07	272	-880	587	880	-4,00	2,67	4,00
14	113	259,90	113,00	273	-880	587	880	-4,00	2,67	4,00
15	112	257,59	111,99	273	-880	587	880	-4,00	2,67	4,00
16	111	255,35	111,02	10013	-10472	-9460	-8712	-47,60	-43,00	-39,60
17	110	253,06	110,03	20002	-10472	-9525	-8712	-47,60	-43,30	-39,60
18	109	250,74	109,02	20005	-10472	-9553	-8712	-47,60	-43,42	-39,60
19	108	248,44	108,02	20006	-10472	-9551	-8712	-47,60	-43,41	-39,60
20	107	246,20	107,04	20026	-7275	-6244	-5515	-33,07	-28,38	-25,07
21	106	243,85	106,02	20036	-4077	-2963	-2317	-18,53	-13,47	-10,53
22	105	241,64	105,06	20039	-880	331	880	-4,00	1,51	4,00
23	104	239,25	104,02	20034	-880	368	880	-4,00	1,67	4,00
24	103	236,88	102,99	20028	-880	361	880	-4,00	1,64	4,00
25	102	234,65	102,02	20026	-880	354	880	-4,00	1,61	4,00
26	101	232,38	101,03	20013	-880	347	880	-4,00	1,58	4,00
27	100	230,03	100,01	20006	-880	340	880	-4,00	1,55	4,00
28	99	227,72	99,01	20010	-880	334	880	-4,00	1,52	4,00
29	98	225,42	98,01	20002	-880	328	880	-4,00	1,49	4,00
30	97	223,12	97,01	19994	-880	320	880	-4,00	1,45	4,00
31	96	220,79	95,99	19990	-880	174	880	-4,00	0,79	4,00

32	95	218,61	95,05	19982	1518	2413	3278	6,90	10,97	14,90
33	94	216,32	94,05	19969	3916	5508	5676	17,80	25,03	25,80
34	93	214,05	93,07	19952	6314	7772	8074	28,70	35,33	36,70
35	92	211,75	92,06	19204	8712	9646	10472	39,60	43,84	47,60
36	91	209,45	91,06	19040	8712	9635	10472	39,60	43,79	47,60
37	90	207,17	90,08	18820	8712	9618	10472	39,60	43,72	47,60
38	89	204,87	89,08	18634	8712	9594	10472	39,60	43,61	47,60
39	88	202,55	88,06	18423	8712	9579	10472	39,60	43,54	47,60
40	87	200,26	87,07	18222	8712	9559	10472	39,60	43,45	47,60
41	86	197,91	86,05	18018	8712	9535	10472	39,60	43,34	47,60
42	85	195,64	85,06	17815	8712	9525	10472	39,60	43,30	47,60
43	86	197,94	86,06	18016	8712	9551	10472	39,60	43,41	47,60
44	87	200,30	87,09	18224	8712	9566	10472	39,60	43,48	47,60
45	88	202,56	88,07	18422	8712	9585	10472	39,60	43,57	47,60
46	89	204,86	89,07	18630	8712	9602	10472	39,60	43,64	47,60
47	90	207,14	90,06	18832	8712	9618	10472	39,60	43,72	47,60
48	91	209,45	91,07	19030	8712	9649	10472	39,60	43,86	47,60
49	92	211,73	92,06	19227	8712	9669	10472	39,60	43,95	47,60
50	93	213,98	93,03	19953	6314	6825	8074	28,70	31,02	36,70
51	94	216,21	94,00	19968	3916	4558	5676	17,80	20,72	25,80
52	95	218,50	95,00	19980	1518	2313	3278	6,90	10,51	14,90
53	96	220,78	95,99	19985	-880	160	880	-4,00	0,73	4,00
54	97	223,15	97,02	19990	-880	323	880	-4,00	1,47	4,00
55	98	225,41	98,01	19999	-880	395	880	-4,00	1,79	4,00
56	99	227,73	99,01	19998	-880	428	880	-4,00	1,94	4,00
57	100	230,05	100,02	20011	-880	465	880	-4,00	2,11	4,00
a) to n) 20% Pn										
Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	100	230,12	100,05	4000	-880	209	880	-4,00	0,95	4,00
2	101	232,36	101,03	3997	-880	213	880	-4,00	0,97	4,00
3	102	234,66	102,02	4000	-880	217	880	-4,00	0,99	4,00
4	103	236,87	102,99	4000	-880	221	880	-4,00	1,00	4,00
5	104	239,22	104,01	4003	-880	226	880	-4,00	1,03	4,00
6	105	241,49	105,00	4007	-880	230	880	-4,00	1,05	4,00
7	106	243,86	106,03	4004	-4077	-2825	-2317	-18,53	-12,84	-10,53

8	107	246,11	107,00	3999	-7275	-6125	-5515	-33,07	-27,84	-25,07
9	108	248,43	108,01	3993	-10472	-9223	-8712	-47,60	-41,92	-39,60
10	109	250,66	108,98	3988	-10472	-9183	-8712	-47,60	-41,74	-39,60
11	110	253,00	110,00	3991	-10472	-9163	-8712	-47,60	-41,65	-39,60
12	111	255,26	110,98	3993	-10472	-9127	-8712	-47,60	-41,49	-39,60
13	112	257,78	112,08	108	-880	234	880	-4,00	1,06	4,00
14	113	259,88	112,99	108	-880	248	880	-4,00	1,13	4,00
15	112	257,54	111,97	105	-880	242	880	-4,00	1,10	4,00
16	111	255,33	111,01	3949	-10472	-9138	-8712	-47,60	-41,54	-39,60
17	110	253,00	110,00	3988	-10472	-9168	-8712	-47,60	-41,67	-39,60
18	109	250,70	109,00	3991	-10472	-9190	-8712	-47,60	-41,77	-39,60
19	108	248,40	108,00	3992	-10472	-9080	-8712	-47,60	-41,27	-39,60
20	107	246,19	107,04	3997	-7275	-5865	-5515	-33,07	-26,66	-25,07
21	106	243,90	106,04	4003	-4077	-2860	-2317	-18,53	-13,00	-10,53
22	105	241,62	105,05	4004	-880	208	880	-4,00	0,95	4,00
23	104	239,17	103,99	4004	-880	230	880	-4,00	1,05	4,00
24	103	236,92	103,01	4002	-880	225	880	-4,00	1,02	4,00
25	102	234,58	101,99	4005	-880	221	880	-4,00	1,01	4,00
26	101	232,28	100,99	3998	-880	217	880	-4,00	0,99	4,00
27	100	229,95	99,98	3998	-880	213	880	-4,00	0,97	4,00
28	99	227,67	98,99	3997	-880	209	880	-4,00	0,95	4,00
29	98	225,38	97,99	3997	-880	204	880	-4,00	0,93	4,00
30	97	223,09	96,99	3991	-880	202	880	-4,00	0,92	4,00
31	96	220,80	96,00	3994	-880	114	880	-4,00	0,52	4,00
32	95	218,60	95,04	3990	1518	2424	3278	6,90	11,02	14,90
33	94	216,14	93,97	3989	3916	4672	5676	17,80	21,24	25,80
34	93	213,99	93,04	3985	6314	6802	8074	28,70	30,92	36,70
35	92	211,63	92,01	3974	8712	9223	10472	39,60	41,92	47,60
36	91	209,22	90,97	3970	8712	9293	10472	39,60	42,24	47,60
37	90	207,15	90,07	3973	8712	9268	10472	39,60	42,13	47,60
38	89	204,84	89,06	3970	8712	9250	10472	39,60	42,04	47,60
39	88	202,55	88,07	3967	8712	9240	10472	39,60	42,00	47,60
40	87	200,24	87,06	3968	8712	9214	10472	39,60	41,88	47,60
41	86	197,92	86,05	3963	8712	9199	10472	39,60	41,81	47,60
42	85	195,63	85,06	3964	8712	9173	10472	39,60	41,69	47,60
43	86	197,91	86,05	3964	8712	9200	10472	39,60	41,82	47,60

44	87	200,18	87,04	3967	8712	9219	10472	39,60	41,91	47,60
45	88	202,50	88,04	3969	8712	9239	10472	39,60	42,00	47,60
46	89	204,83	89,06	3969	8712	9255	10472	39,60	42,07	47,60
47	90	207,12	90,05	3973	8712	9271	10472	39,60	42,14	47,60
48	91	209,42	91,05	3975	8712	9293	10472	39,60	42,24	47,60
49	92	211,74	92,06	3977	8712	9307	10472	39,60	42,31	47,60
50	93	213,96	93,03	3984	6314	6656	8074	28,70	30,25	36,70
51	94	216,21	94,00	3989	3916	4513	5676	17,80	20,51	25,80
52	95	218,53	95,01	3991	1518	2324	3278	6,90	10,56	14,90
53	96	220,81	96,00	3993	-880	94	880	-4,00	0,43	4,00
54	97	223,03	96,97	3997	-880	182	880	-4,00	0,83	4,00
55	98	225,49	98,04	3997	-880	215	880	-4,00	0,98	4,00
56	99	227,68	98,99	3999	-880	218	880	-4,00	0,99	4,00
57	100	230,01	100,00	3997	-880	223	880	-4,00	1,01	4,00

o) to z) Test@91%Un

Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	91	209,23	90,97	202	-880	462	880	-4,00	2,10	4,00
2	91	209,24	90,98	1014	1518	2326	3278	6,90	10,57	14,90
3	91	209,26	90,98	2068	3916	4746	5676	17,80	21,57	25,80
4	91	209,29	91,00	3115	6314	7146	8074	28,70	32,48	36,70
5	91	209,32	91,01	4054	8712	9503	10472	39,60	43,20	47,60
6	91	209,31	91,00	3116	6314	7150	8074	28,70	32,50	36,70
7	91	209,30	91,00	2068	3916	4747	5676	17,80	21,58	25,80
8	91	209,28	90,99	1020	1518	2340	3278	6,90	10,64	14,90
9	91	209,27	90,99	201	-880	462	880	-4,00	2,10	4,00

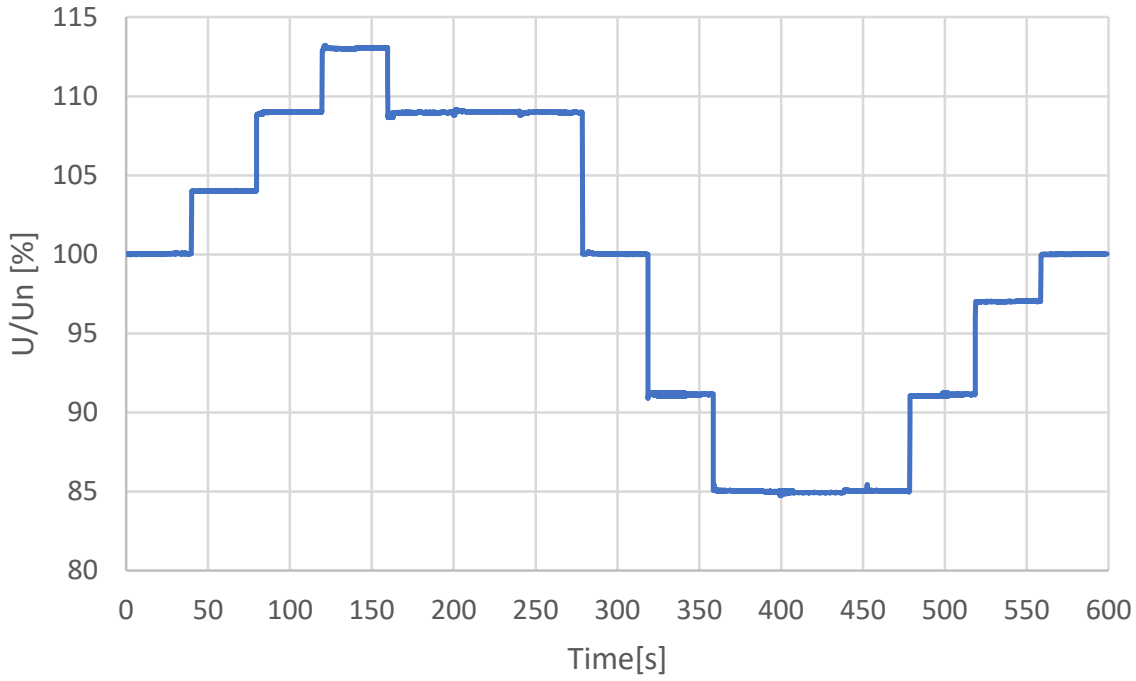
o) to z) Test@109%Un

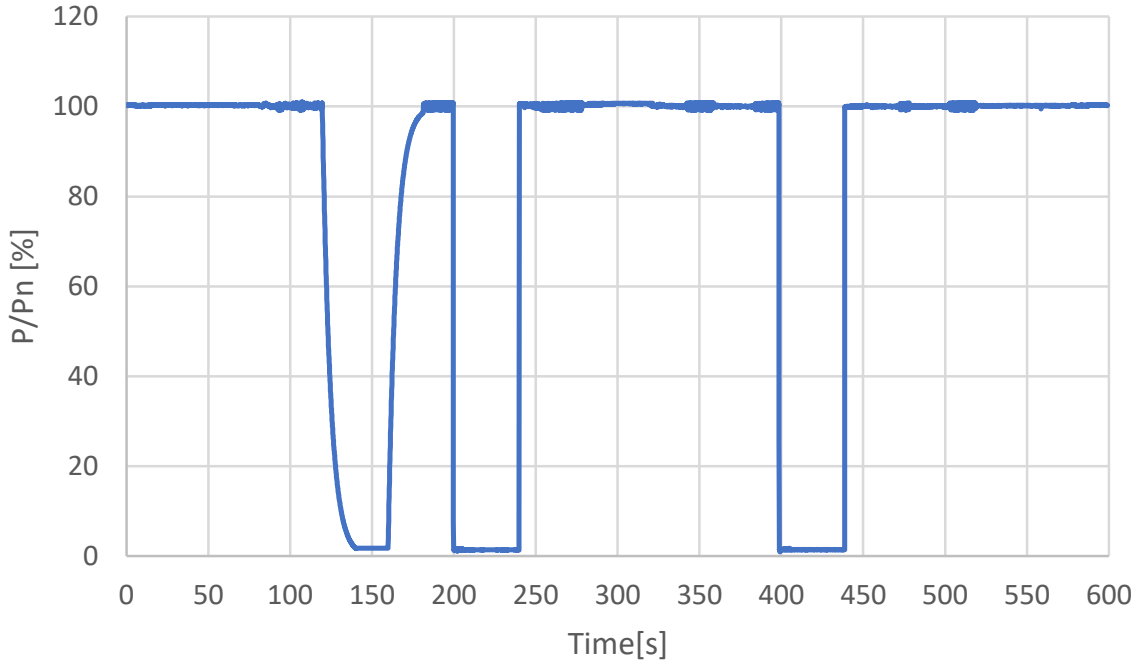
Voltage steps	$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{30s} [W]	Q_{tol_under} [Var]	Q_{30s} [Var]	Q_{tol_upper} [Var]	Q_{tol_under} [%Sn]	Q_{30s} [%Sn]	Q_{tol_upper} [%Sn]
1	109	250,71	109,00	201	-880	-462	880	-4,00	-2,10	4,00
2	109	250,72	109,01	1065	-3278	-2442	-1518	-14,90	-11,10	-6,90
3	109	250,73	109,01	2127	-5676	-4884	-3916	-25,80	-22,20	-17,80
4	109	250,74	109,02	3172	-8074	-7277	-6314	-36,70	-33,08	-28,70
5	109	250,75	109,02	4095	-10472	-9599	-8712	-47,60	-43,63	-39,60
6	109	250,74	109,02	3172	-8074	-7281	-6314	-36,70	-33,10	-28,70
7	109	250,73	109,01	2080	-5676	-4772	-3916	-25,80	-21,69	-17,80

8	109	250,73	109,01	1079	-3278	-2477	-1518	-14,90	-11,26	-6,90
9	109	250,72	109,01	201	-880	-462	880	-4,00	-2,10	4,00

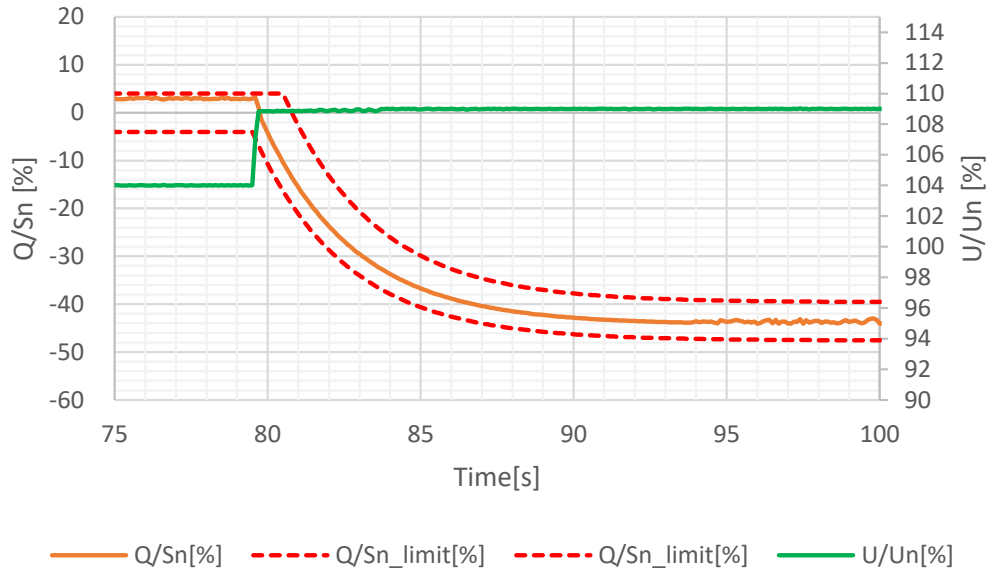
5.3.10.1.2 Test Voltage-controlled control functions "Q= f(V)" - dynamic behavior											P
$U_{\_step}$ [%Un]	$U_{\_meas}$ [V]	$U_{\_meas}$ [%Un]	P_{tol_under} [kW]	P_{30s} [kW]	P_{tol_upper} [kW]	P_{30s} [%Pn]	Q_{tol_under} [kVar]	Q_{30s} [kVar]	Q_{tol_upper} [kVar]	Q,set [%Sn]	Q_{30s} [%Sn]
100	230,06	100,03	18,0	20,057	22,0	100,28	-0,88	0,640	0,88	0	2,9
104	239,23	104,01	18,0	20,061	22,0	100,31	-0,88	0,645	0,88	0	2,9
109	250,71	109,00	18,0	20,021	22,0	100,11	-10,47	-9,597	-8,71	-43,6	-43,6
113	260,03	113,06	0,0	0,341	2,0	1,70	-0,88	-0,617	0,88	0	-2,8
109	250,63	108,97	18,0	19,925	22,0	99,63	-10,47	-9,607	-8,71	-43,6	-43,7
109	250,75	109,02	0,0	0,267	2,0	1,33	-0,88	-0,683	0,88	0	-3,1
109	250,67	108,99	18,0	20,022	22,0	100,11	-10,47	-9,608	-8,71	-43,6	-43,7
100	230,05	100,02	18,0	20,132	22,0	100,66	-0,88	0,626	0,88	0	2,8
91	209,62	91,14	18,0	20,038	22,0	100,19	8,71	9,598	10,47	43,6	43,6
85	195,58	85,03	18,0	20,016	22,0	100,08	8,71	9,586	10,47	43,6	43,6
85	195,35	84,94	0,0	0,279	2,0	1,40	-0,88	0,715	0,88	0	3,2
85	195,61	85,05	18,0	20,011	22,0	100,06	8,71	9,583	10,47	43,6	43,6
91	209,51	91,09	18,0	20,027	22,0	100,14	8,71	9,592	10,47	43,6	43,6
97	223,17	97,03	18,0	20,038	22,0	100,19	-0,88	0,641	0,88	0	2,9
100	230,03	100,01	18,0	20,049	22,0	100,24	-0,88	0,640	0,88	0	2,9

Graph:

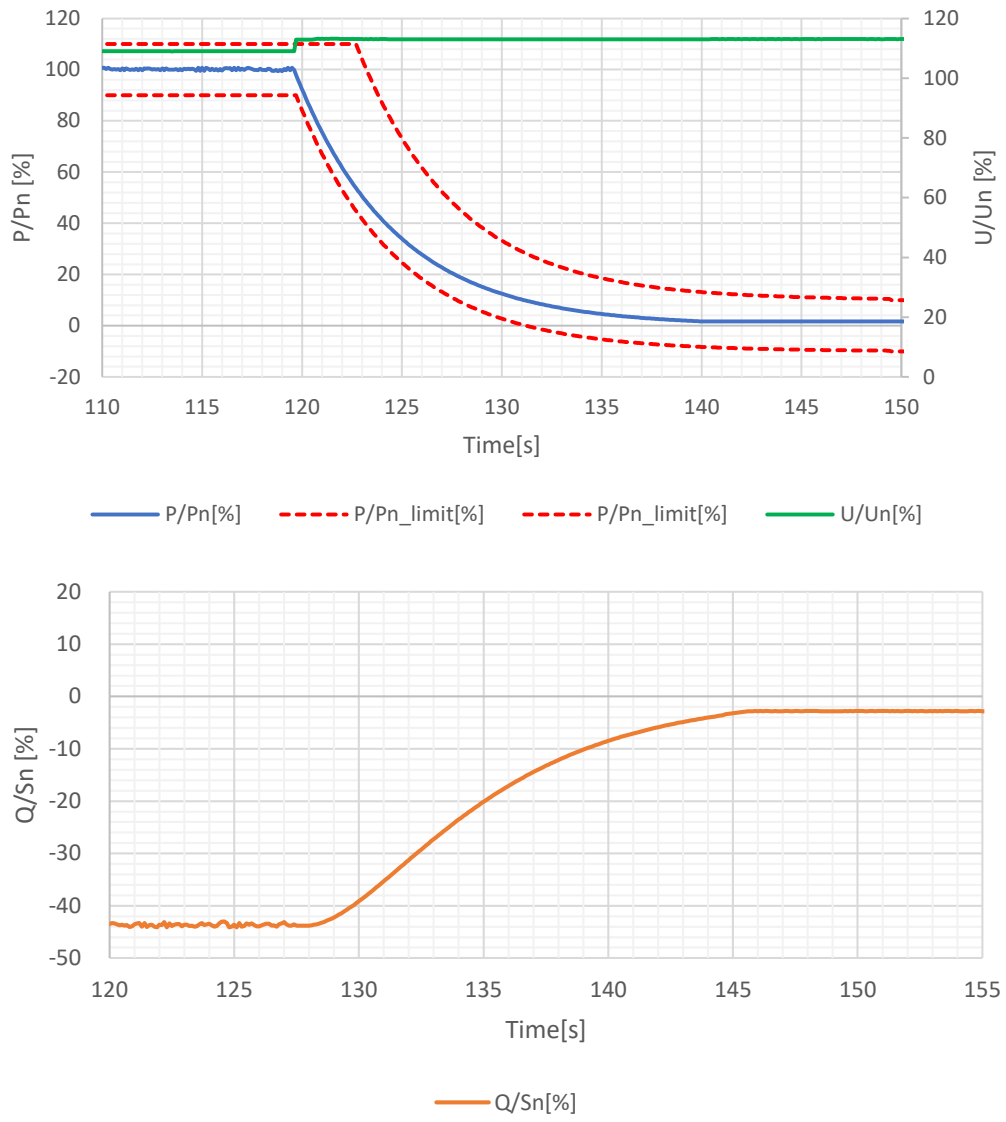

115
110
105
100
95
90
85
80
U/Un [%]
0
50
100
150
200
250
300
350
400
450
500
550
600
Time[s]


120
100
80
60
40
20
0
P/Pn [%]
0
50
100
150
200
250
300
350
400
450
500
550
600
Time[s]

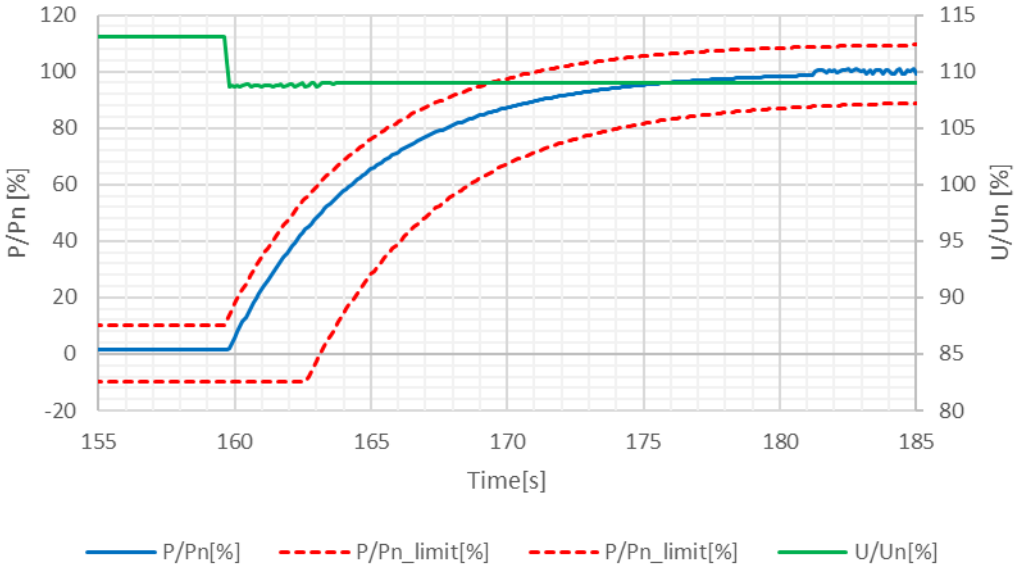
Graph of Q(U): Test steps from 2 to 3→1,04Un to 1,09Un

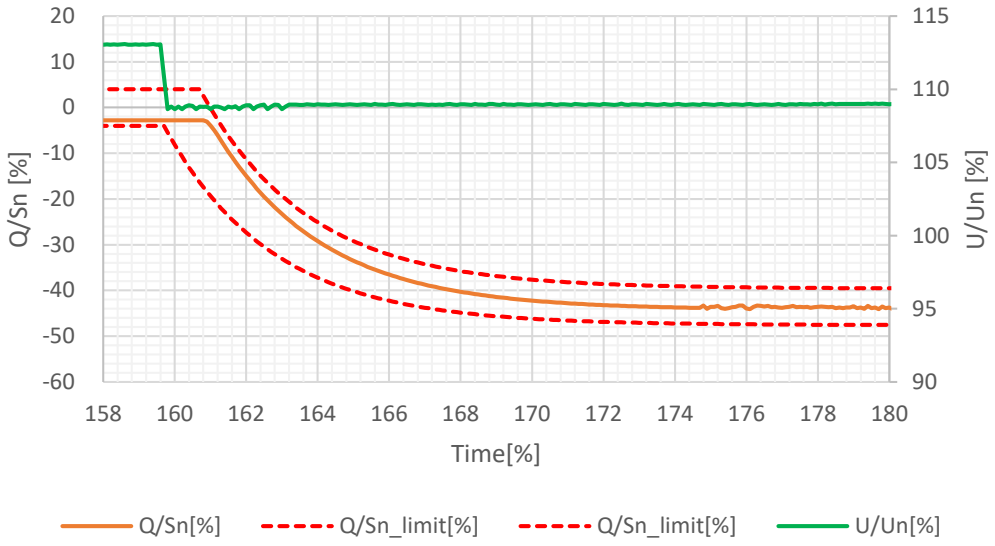


Graph of Q(U): Test steps from 3 to 4→1,09Un to 1,13Un

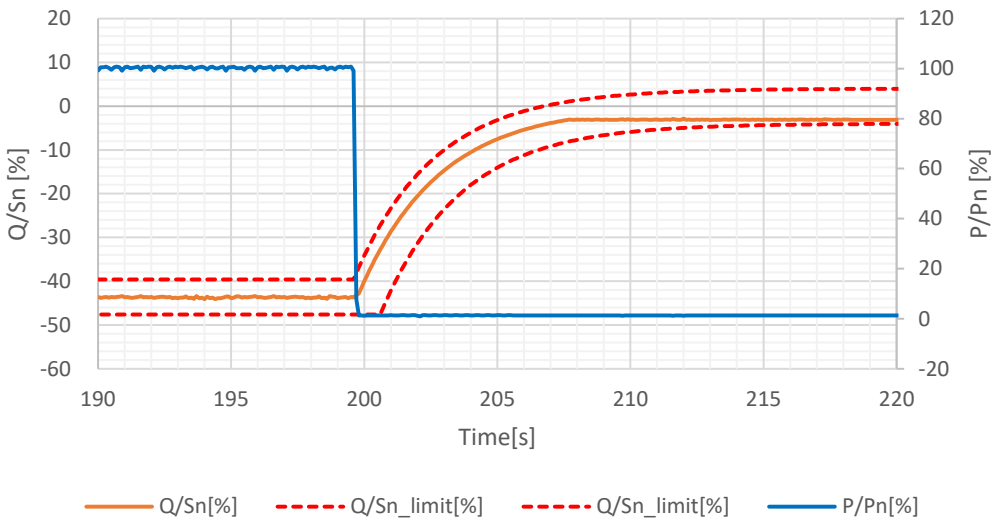


Graph of Q(U): Test steps from 4 to 5→1,13Un to 1,09Un

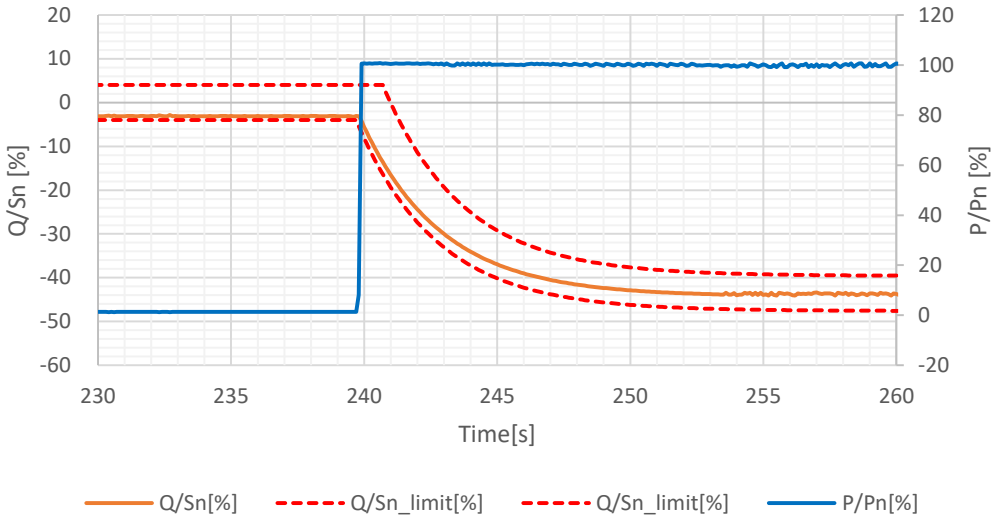




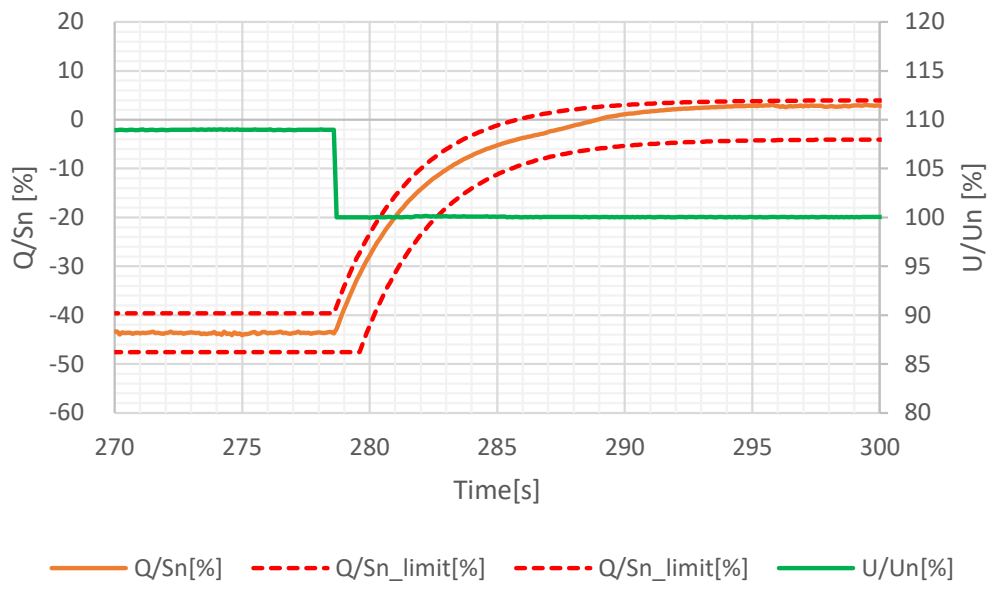
Graph of Q(U): Test steps from 5 to 6→100%Pn to 0%Pn



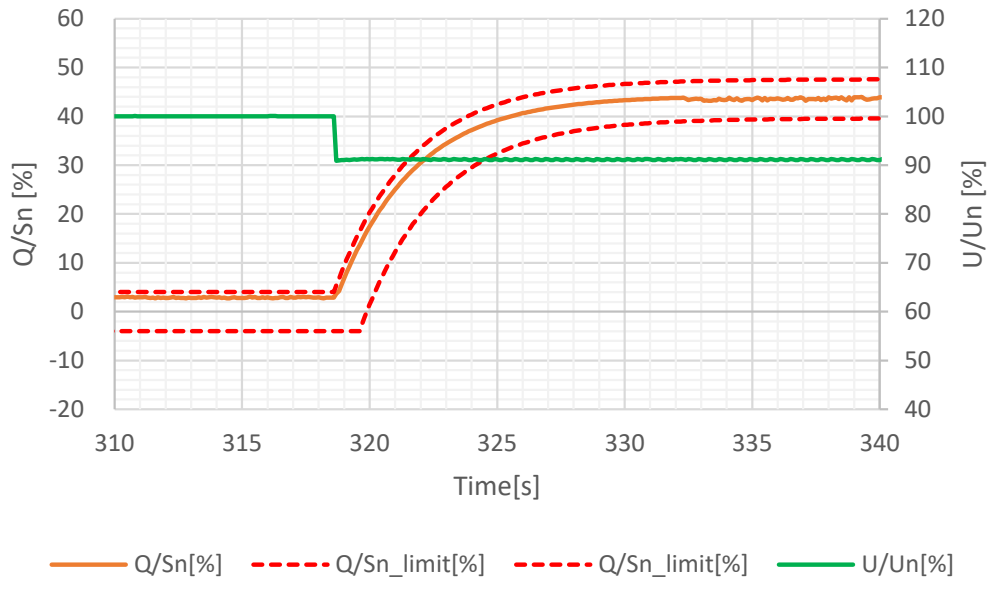
Graph of Q(U): Test steps from 6 to 7→0%Pn to 100%Pn



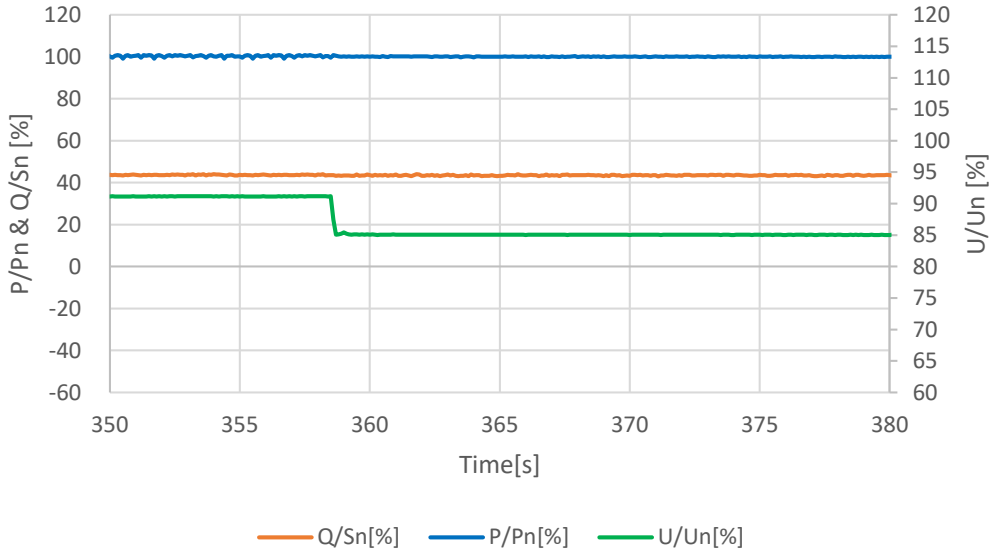
Graph of Q(U): Test steps from 7 to 8→1,09Un to 1,00Un



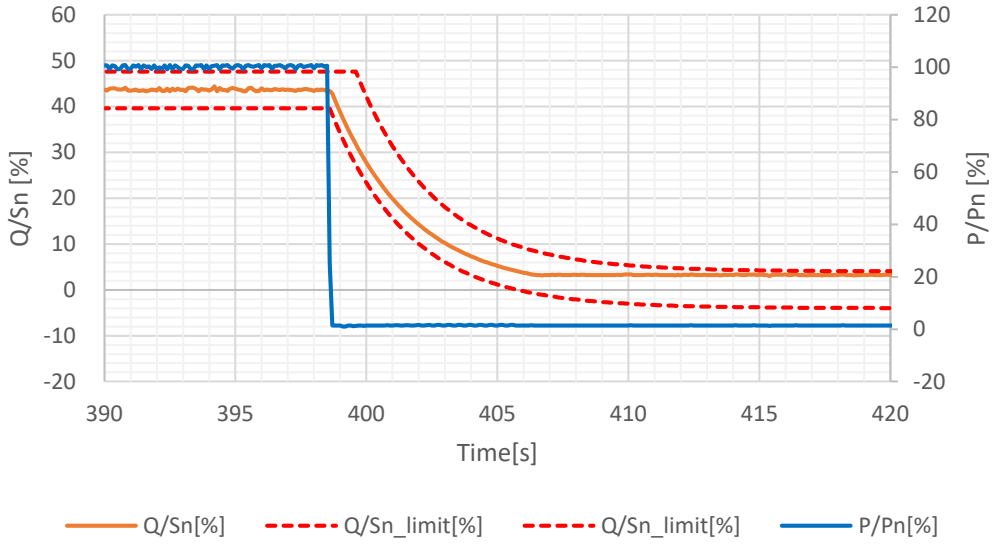
Graph of Q(U): Test steps from 8 to 9 →1,00Un to 0,91Un



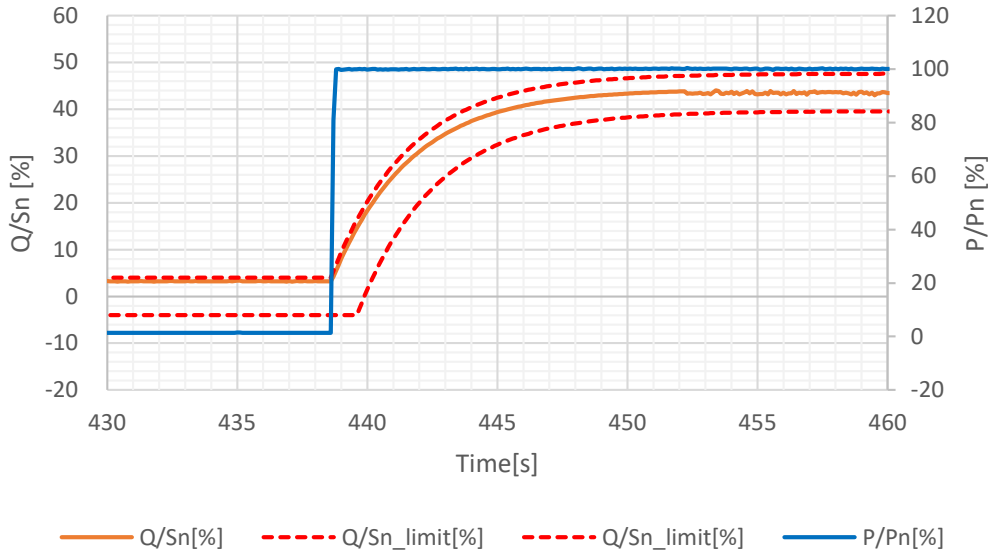
Graph of Q(U): Test steps from 9 to 10→0,91Un to 0,85Un



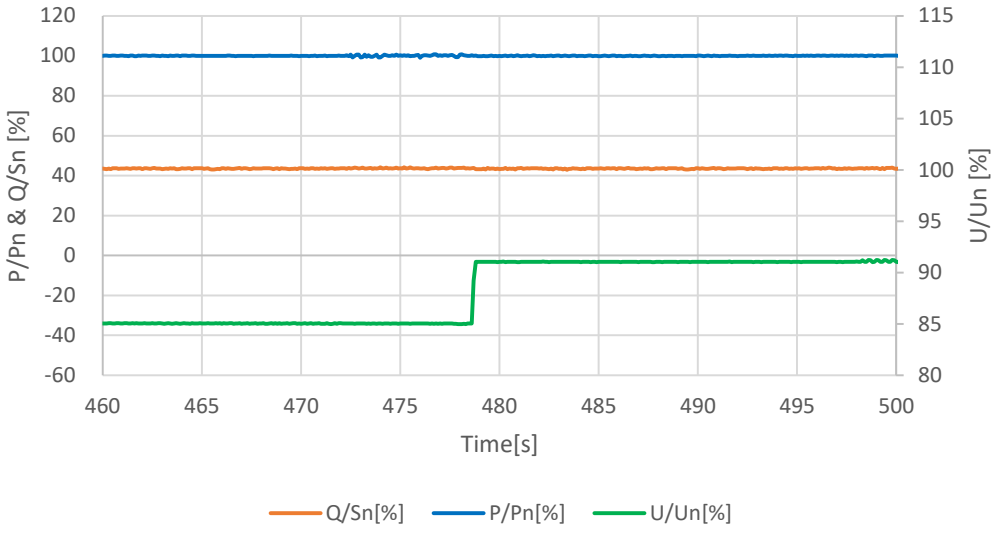
Graph of Q(U): Test steps from 10 to 11→100%Pn to 0%Pn



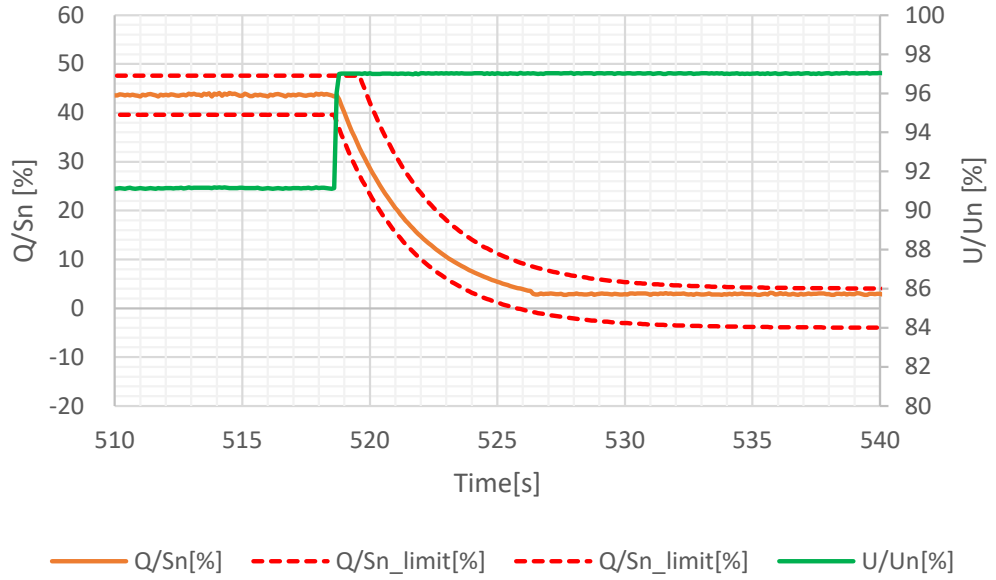
Graph of Q(U): Test steps from 11 to 12→0%Pn to 100%Pn



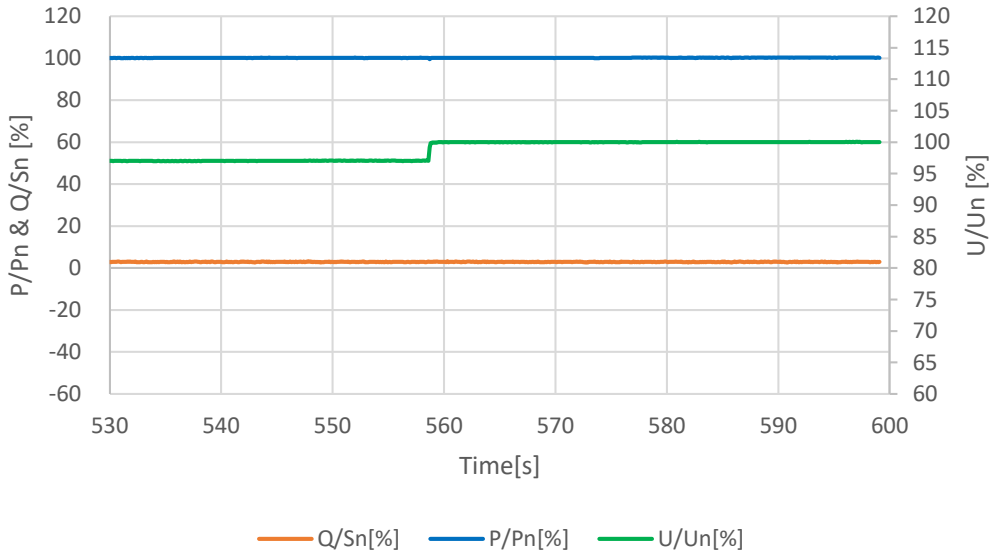
Graph of Q(U): Test steps from 12 to 13→0,85Un to 0,91Pn



Graph of Q(U): Test steps from 13 to 14→0,91Un to 0,97Un



Graph of Q(U): Test steps from 14 to 15→0,97Un to 1,00Un



5.3.11 Protection of set values

Test procedure and test conditions:

The test serves as evidence of the requirements according to TOR Erzeuger, 6.2.3

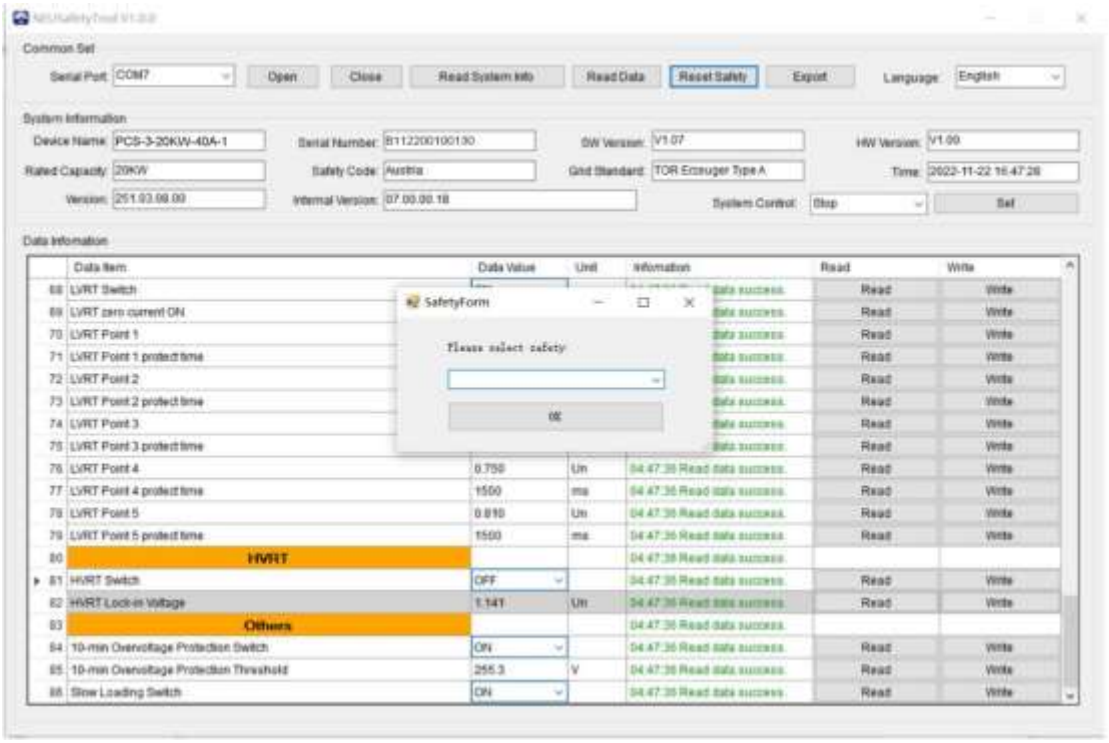
The corresponding parameter was set by SW-Tool using RS485-interface.

Assessment criteria:

- All parameters are password protected.
- The customer cannot change any values.
- The parameter no change when update the software version.

Result:

All parameters are password protected.	☒ **yes**	☐ **no**
The customer cannot change any values	☒ **yes**	☐ **no**
The parameter no change when update the software version	☒ **yes**	☐ **no**



5.4 Testing of NS protection

Test procedure and test conditions:

This section serves to prove the requirements according to TOR Generator, Section 6.1.2.

The corresponding parameter was set by SW-Tool using RS485-interface.

Table 8: Setting values for the protection of inverters with automatically acting free- switch point

Function	Setting range of the Protection relays	Recommended protection relaxation setting value	
Overvoltage protection Ueff>>	1,00 – 1,30 Un	≤ 1,15 Un	≤ 0,1 s
Overvoltage protection Ueff> or	1,00 – 1,30 Un	≤ 1,11 Un*	≤ 60 s
Overvoltage protection Ueff> with monitoring of the 10 min moving average		≤ 1,11 Un*	≤ 0,1 s
Undervoltage protection Ueff <	0,10 – 1,00 Un	0,8 Un	1,5 s
Undervoltage protection Ueff <<	0,10 – 1,00 Un	0,25 Un	≤ 0,5 s
Overfrequency protection f>	50 – 55 Hz	51,5 Hz	≤ 0,1 s
Underfrequency protection f <	45 – 50Hz	47,5 Hz	≤ 0,1 s
	Setting range of the disconnection time		Step length
Disconnection time	0-180s		0,02s

Note:

*** N/A if 5.4.1.1.2 Measuring the rise-in voltage protection as a running 10-minute mean value is used**

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

The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, limit is given with ±100ms according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2018.

5.4.1.1.1 Voltage control (Inverters with automatic disconnection device)						**P**
Integrated NS protection multi-phase ≤30kVA (phase to neutral)						
Setting values of the NS protection:	Setting	Value [V]	Times [s]	Setting	Value [V]	Times [s]
	U<	184,0	1,50	U<	57,5	0,5
	U>	264,5	0,1	U>>	--	--

Operating time of the monitoring device:						
L1 to N:						
	Under voltage 1:			**Over voltage 1:**		
Step [V to V]:	230,0 to 177,1			230,0 to 271,4		
Setpoint [V]:	184,0			264,5		
Deviation limit [V]:	≤2,3			≤2,3		
Measurement [V]:	184,9	184,9	185,0	263,6	263,4	263,3
Voltage deviation [V]:	0,9	0,9	1,0	-0,9	-1,1	-1,2
Limit [ms]:	≤ 1500+100(delay)			≤ 100+100(delay)		
Disconnection time [ms]:	1502	1506	1502	156	161	149
	Under voltage 2:					
Step [V to V]:	230,0 to 50,6					
Setpoint [V]:	57,5					
Deviation limit [V]:	≤2,3					
Measurement [V:]	57,5	57,3	57,4			
Voltage deviation [V]:	0,0	-0,2	-0,1			
Limit [ms]:	≤ 500+100(delay)					
Disconnection time [ms]:	546	529	532			
L2 to N:						
	Under voltage 1:			**Over voltage 1:**		
Step [V to V]:	230,0 to 177,1			230,0 to 271,4		
Setpoint [V]:	184,0			264,5		
Deviation limit [V]:	≤2,3			≤2,3		
Measurement [V]:	184,9	184,9	185,0	263,3	263,5	263,4
Voltage deviation [V]:	0,9	0,9	1,0	-1,2	-1,0	-1,1
Limit [ms]:	≤ 1500+100(delay)			≤ 100+100(delay)		
Disconnection time [ms]:	1514	1513	1506	154	152	155
	Under voltage 2:					

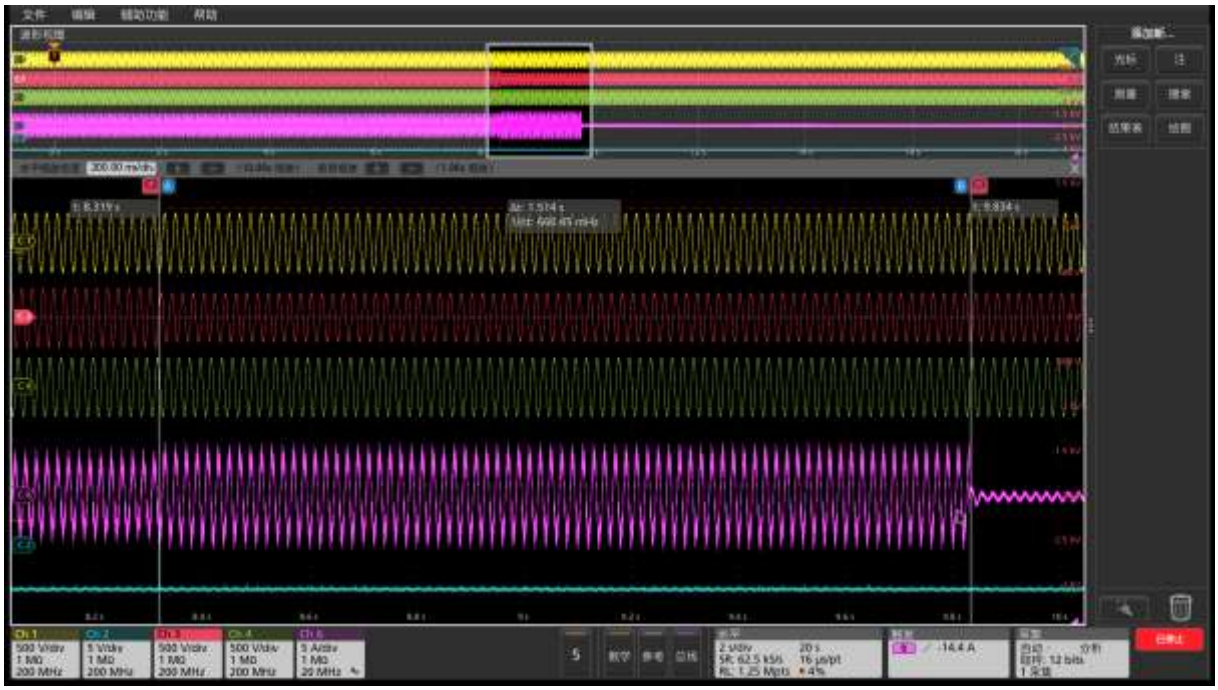
Step [V to V]:	230,0 to 50,6					
Setpoint [V]:	57,5					
Deviation limit [V]:	≤2,3					
Measurement [V:]	57,7	57,3	57,4			
Voltage deviation [V]:	0,2	-0,2	-0,1			
Limit [ms]:	≤ 500+100(delay)					
Disconnection time [ms]:	551	545	501			
L3 to N:						
	Under voltage 1:			**Over voltage 1:**		
Step [V to V]:	230,0 to 177,1			230,0 to 271,4		
Setpoint [V]:	184,0			264,5		
Deviation limit [V]:	≤2,3			≤2,3		
Measurement [V:]	184,9	185,0	185,0	263,5	263,5	263,6
Voltage deviation [V]:	0,9	1,0	1,0	-1,0	-1,0	-0,9
Limit [ms]:	≤ 1500+100(delay)			≤ 100+100(delay)		
Disconnection time [ms]:	1500	1511	1508	184	193	168
	Under voltage 2:					
Step [V to V]:	230,0 to 50,6					
Setpoint [V]:	57,5					
Deviation limit [V]:	≤2,3					
Measurement [V:]	56,3	55,8	55,8			
Voltage deviation [V]:	-1,2	-1,7	-1,7			
Limit [ms]:	≤ 500+100(delay)					
Disconnection time [ms]:	521	529	543			

Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

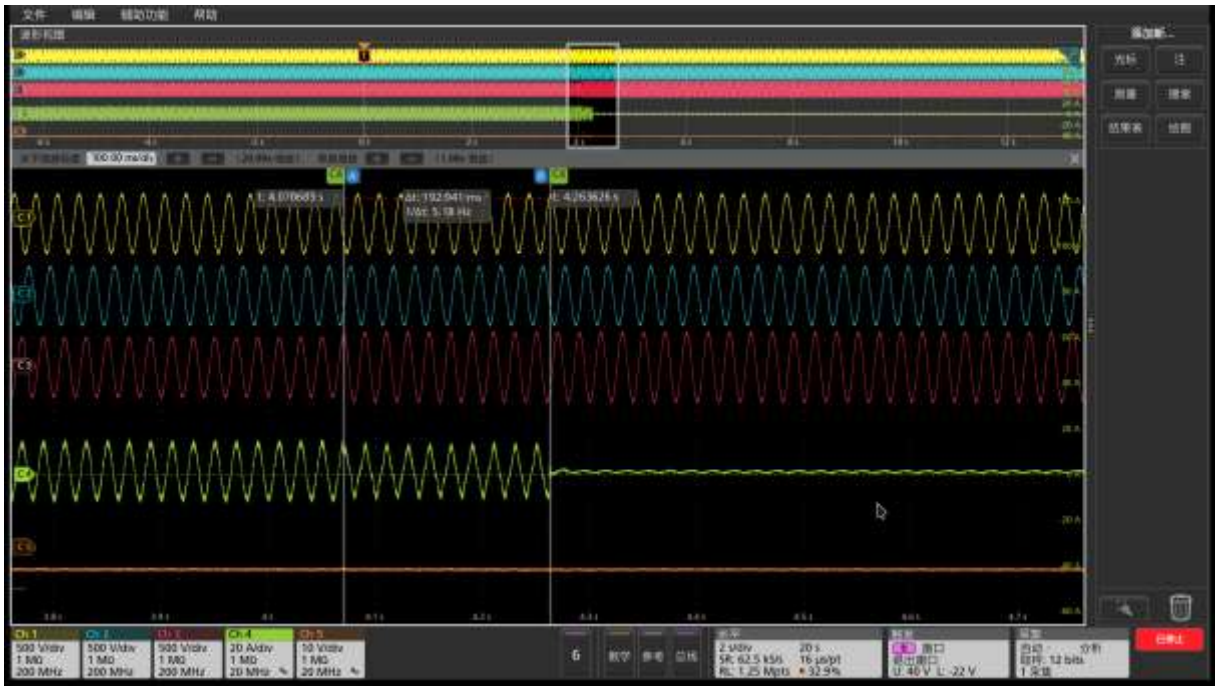
[1)] Refer to **Differences of the model**.

Under voltage 1 L2 to N:



Under voltage 2 L2 to LN:

Over voltage 1 L3 to N:



5.4.1.2 Measuring the rise-in voltage protection as a running 10-minute mean value	P

Test procedure and test conditions:
To avoid triggering the overvoltage protection U_{eff} >> it must be deactivated when carrying out the tests.

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. default threshold: 111% Un. If the threshold is not adjustable than set to 110%Un

Setting values of the NS protection:	Setting U> [V]	255,3
	Setting $T_{disconnection\ U>}$ [s]	600

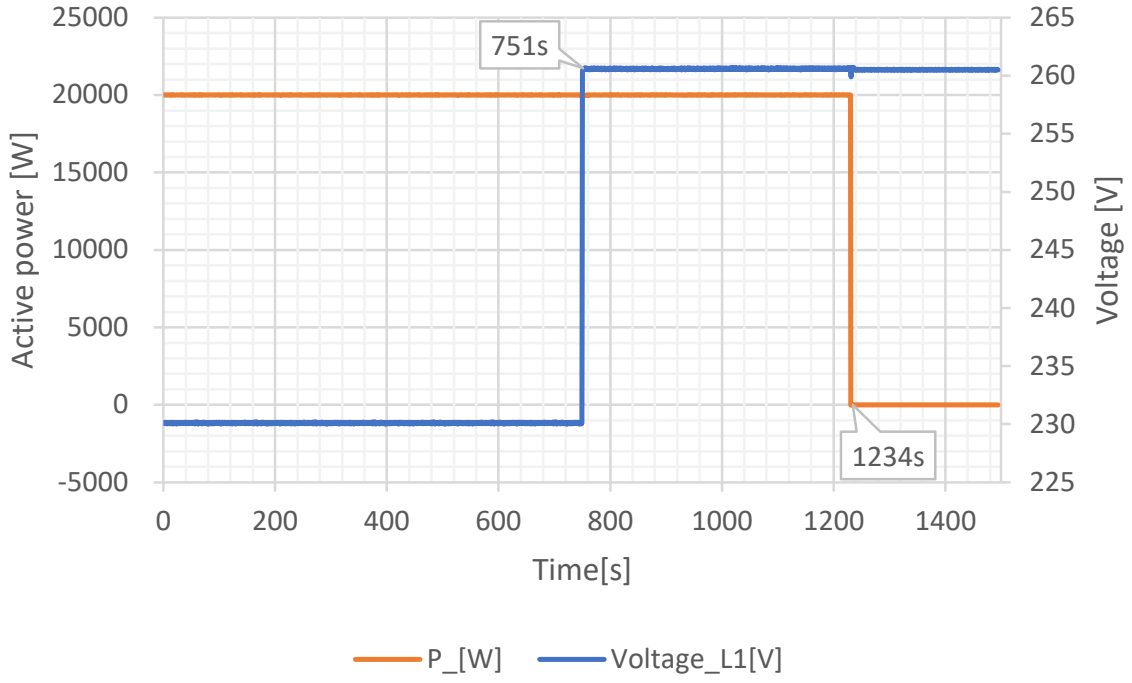
Test:

		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 113% U_n. Disconnection must take place within 600 s.		
	Phase 1:	483	≤ 600 s
	Phase 2:	473	
	Phase 3:	464	
b)	The voltage is set to U_n for 600 s and then to 109% U_n for 600 s. No disconnection should take place.		
	Phase 1:	No disconnection	Disconnection should not take place.
	Phase 2:	No disconnection	
	Phase 3:	No disconnection	
c)	The voltage is set to 107 % U_n and held for 600 s. Thereafter the voltage is set to 115 % U_n. Disconnection must take place within 300 s or about 50 % of the disconnection time measured in point a). *		
	Phase 1:	275	The disconnection time should be about 50 % of the value measured in a). *
	Phase 2:	280	
	Phase 3:	282	

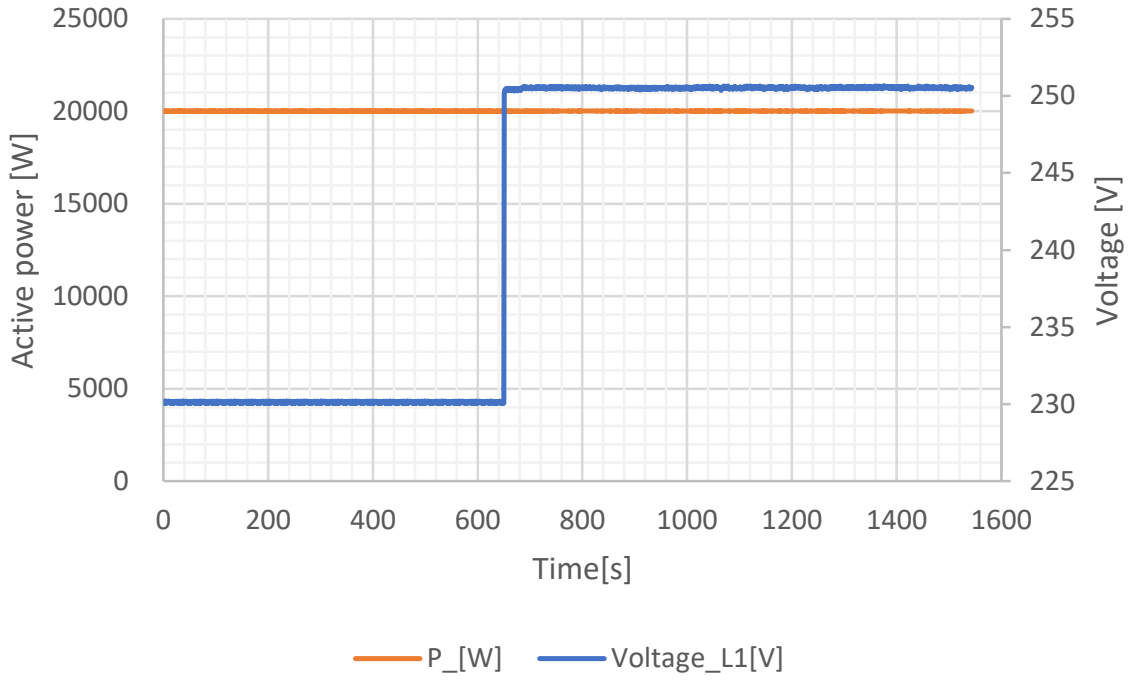
Note:
The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

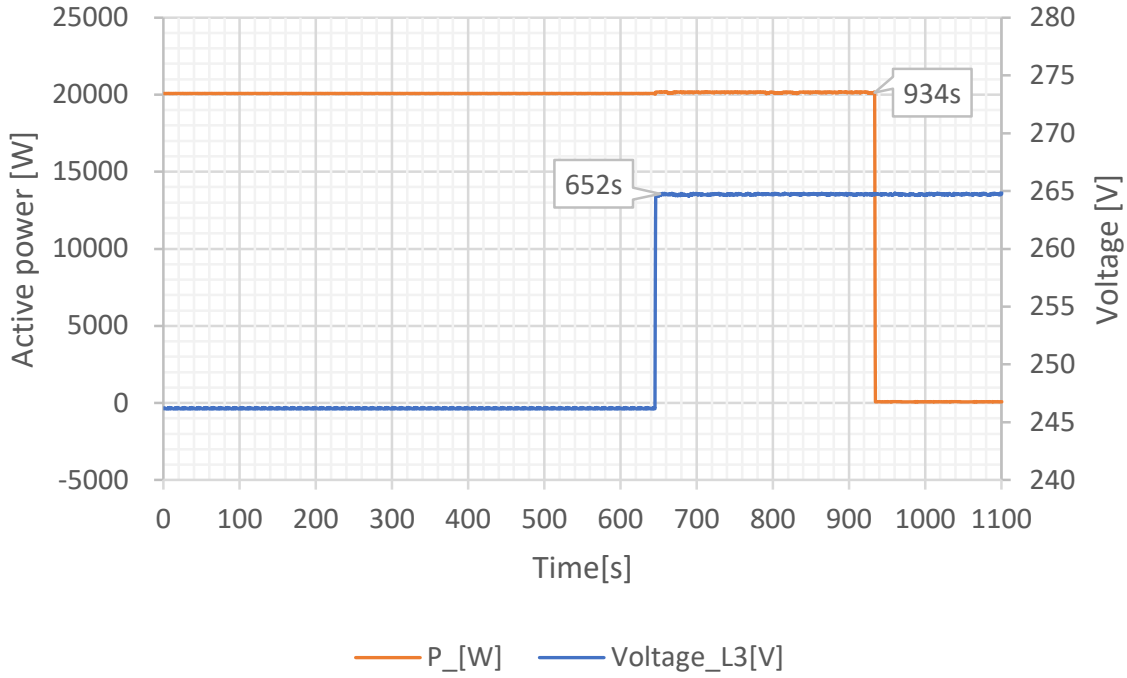
a) Voltage set to 113 % U_n:



b) Voltage set to 109% U_n:



c) Voltage set to 107 % U_n, thereafter 115% U_n:



5.4.2.1 Frequency measurement	P

Test procedure and test conditions:

Testing of the frequency over protection f> and of the under-frequency protection f <.

To determine the switch-off time, a ramp must be run at 1 Hz / s

Note:

The setting value and the trip value of the frequency may not vary by more than ±0,1% f_n.

Result:

Setting values of the NS protection:	Setting f< [Hz]:	47,50
	Setting f>[Hz]:	51,50
	Setting $T_{disconnection}$ [s]	0,1

Operating time of the monitoring device:

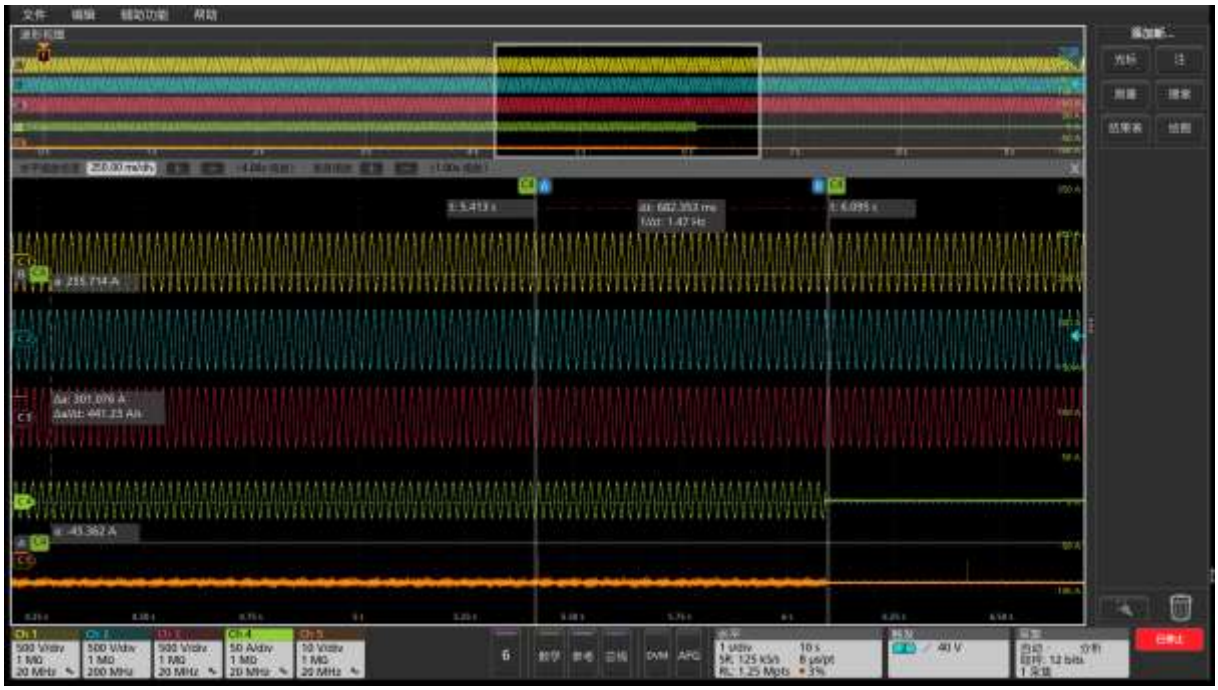
	Under frequency:			**Over frequency:**		
Ramp [Hz to Hz]:	47,0 -> 48,0			51,0 -> 52,0		
Setpoint [Hz]:	47,50			51,50		
Deviation limit [Hz]:	≤0,05			≤0,05		
Measurement [Hz]:	47,51	47,51	47,51	51,49	51,49	51,49
Frequency deviation [Hz]:	0,01	0,01	0,01	0,01	0,01	0,01
Limit [ms]:	≤ 100+100(delay)			≤ 100+100(delay)		
Disconnection time [ms]:	153	172	171	173	178	173

Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

Under frequency:



Over frequency:

5.4.3 Islanding protection testing	P

Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (EUT output = 100%)	P

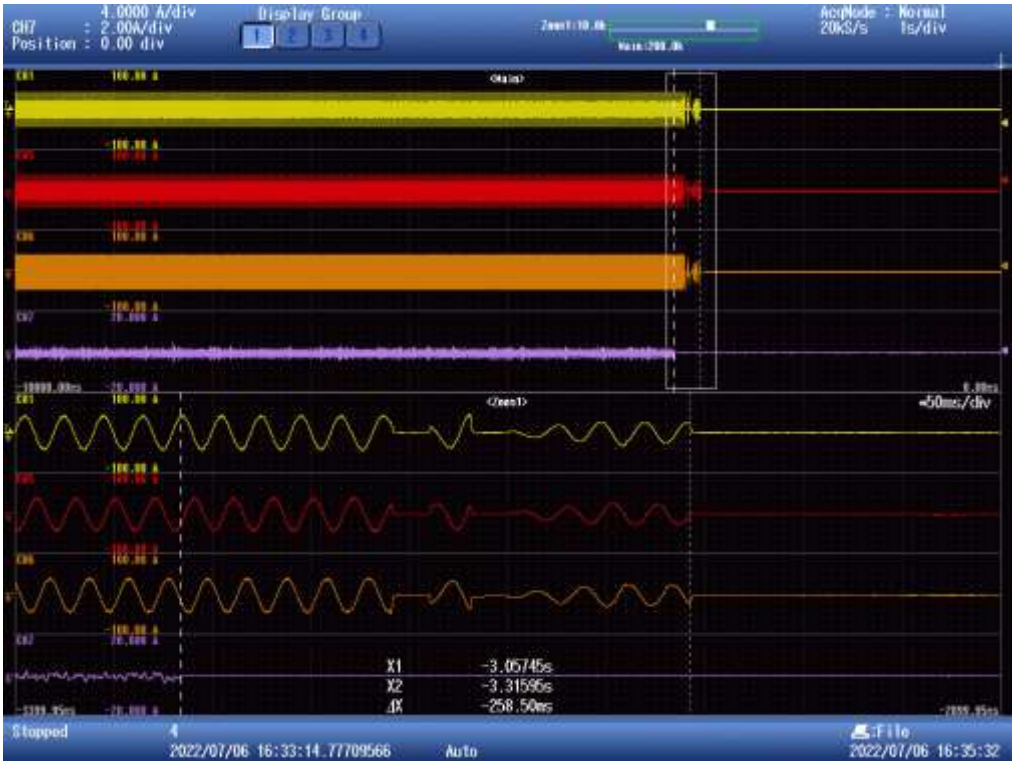
Test conditions	Frequency: 50+/-0,2Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (kW per phase)	Actual Q_f	V_{DC}	Remarks4)
1	100	100	0	0	259	6,720	0,977	679	Test A at BL
2	100	100	-5	-5	232	6,700	1,002	680	Test A at IB
3	100	100	-5	0	202	6,720	1,028	679	Test A at IB
4	100	100	-5	+5	214	6,680	1,053	680	Test A at IB
5	100	100	0	-5	215	6,720	0,952	679	Test A at IB
6	100	100	0	+5	230	6,740	1,001	679	Test A at IB
7	100	100	+5	-5	194	6,730	0,907	681	Test A at IB
8	100	100	+5	0	190	6,720	0,930	679	Test A at IB
9	100	100	+5	+5	201	6,720	0,953	680	Test A at IB

Parameter at 0% per phase	L= 25,07 mH	R= 7,87 Ω	C= 385,88 µF
Iac fundamental current at balance condition	L1: 273mA	L2: 165mA	L3: 54mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = >75% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 75 % of range =X + 0,75 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at Pac 0% and Qac 0% reactive load and 100% nominal power


Islanding protection according Table 7 – Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

Test conditions	Frequency: 50+/-0,2Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (kW per phase)	Actual Q_f	V_{DC}	Remarks4)
1	66	66	0	-5	185	4,530	0,963	570	Test B at IB
2	66	66	0	-4	215	4,500	0,968	570	Test B at IB
3	66	66	0	-3	242	4,480	0,973	569	Test B at IB
4	66	66	0	-2	259	4,530	0,978	570	Test B at IB
5	66	66	0	-1	240	4,530	0,983	570	Test B at IB
6	66	66	0	0	291	4,530	0,988	559	Test B at BL
7	66	66	0	1	247	4,480	0,993	570	Test B at IB
8	66	66	0	2	245	4,530	0,998	570	Test B at IB
9	66	66	0	3	251	4,530	1,003	569	Test B at IB
10	66	66	0	4	209	4,520	1,008	570	Test B at IB
11	66	66	0	5	193	4,530	1,013	570	Test B at IB

Parameter at 0% per phase	L= 36,82 mH	R= 11,68 Ω	C= 263,73 µF
Iac fundamental current at balance condition	L1: 80mA	L2: 284mA	L3: 281mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage 5) = 50 % of rated input voltage range, ±10 %
5) Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at Pac 0% and Qac 0% reactive load and 66% nominal power


Islanding protection according Table 7 – Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

Test conditions	Frequency: 50+/-0,2Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (kW per phase)	Actual Q_f	V_{DC}	Remarks4)
1	33	33	0	-5	128	2,327	0,929	429	Test C at IB
2	33	33	0	-4	244	2,317	0,934	430	Test C at IB
3	33	33	0	-3	123	2,327	0,939	429	Test C at IB
4	33	33	0	-2	261	2,327	0,944	429	Test C at IB
5	33	33	0	-1	151	2,320	0,948	429	Test C at IB
6	33	33	0	0	297	2,327	0,953	430	Test C at BL
7	33	33	0	1	272	2,250	0,958	429	Test C at IB
8	33	33	0	2	170	2,327	0,963	429	Test C at IB
9	33	33	0	3	189	2,327	0,967	428	Test C at IB
10	33	33	0	4	311	2,283	0,972	429	Test C at IB
11	33	33	0	5	137	2,327	0,977	429	Test C at IB

Parameter at 0% per phase	L= 74,84 mH	R= 22,73 Ω	C= 131,60 µF
Iac fundamental current at balance condition	L1: 217mA	L2: 199mA	L3: 201mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition C:
EUT output power PEUT = 25 % – 33 % 5) of maximum
EUT input voltage 6) = <20 % of rated input voltage range
5) Or minimum allowable EUT output level if greater than 33 %.
6) Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 20 % of range =X + 0,2 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

Disconnection at Pac 0% and Qac 0% reactive load and 33% nominal power

5.5 Testing of connecting conditions and synchronisation	P

Setting value:	Min. voltage for connected to grid:	195,5
	Max. voltage for connected to grid:	250,7
	Min. frequency for connected to grid:	47,5
	Max. frequency for connected to grid:	50,1
	Observation time (≥300s):	300

Test procedure and test conditions:

The connection and synchronization are carried out or monitored by at least one suitable device. This device can be implemented in the control of the EZE or in the automatic activation point (integrated or external) and is according to the TOR generator, section 5.5.2. set and check as follows:

a) The manufacturer must provide the testing laboratory with documentation on the functions implemented in the component.
b) If the EZE is not switched on, the test is carried out by changing the set nominal frequency and nominal voltage in the control.

Note:

The test is passed if the EZE or the automatic disconnection point can only be switched on within the tolerance bands according to the TOR producer, Section 5.5.2 and after the voltage and frequency have remained within the tolerance bands after 300 s at the earliest.

≥ 60 s ≙ restart and if no error was produced

≥300s ≙ if an error was produced

Result:

Test a): Out start-up voltage range				
Test condition:	84% Un For 120 s		111%Un For 120 s	
Assessment criterion:	Connection after observation time (≥ 120 s), power gradient ≤ 10%Pn/min			
Connection after 120s?	☐ yes	☒ no	☐ yes	☒ no
Power gradient:	Power gradient ≤ 10%Pn/min			

Test b): In start-up voltage range		
Test condition:	86% Un	108% Un
Assessment criterion:	Connection after observation time (≥ 60s), power gradient ≤ 10%Pn/min	
Connection time [s]	65	82
Connection Voltage [V]	198,1	248,4
Power gradient:	Power gradient ≤ 10%Pn/min	

Test c): Reconnection after tripping of interface protections		
Test condition:	Voltage retuned within 86% Un after tripping of interface protections	Voltage retuned within 108% Un after tripping of interface protections

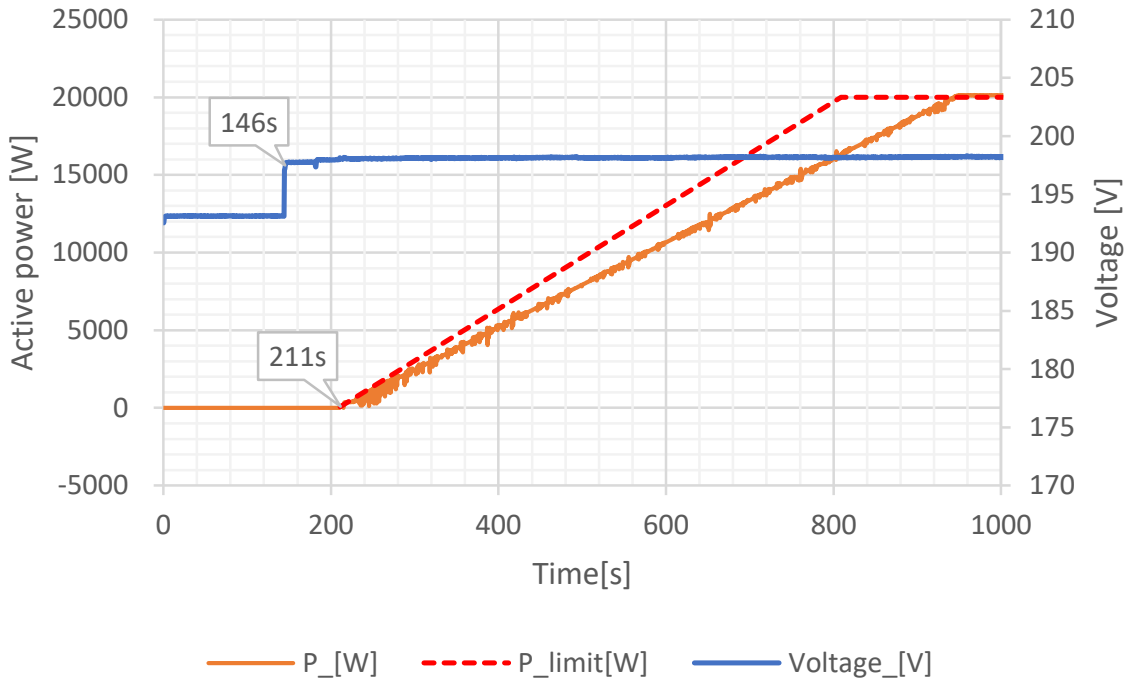
Assessment criterion:	Connection after observation time (≥ 300s), power gradient ≤ 10%Pn/min			
Connection time [s]	322		312	
Reconnection Voltage [V]	198,0		248,4	
Power gradient:	Power gradient ≤ 10%Pn/min			
Test d): Out start-up frequency range				
Test condition:	47,45 Hz		50,15 Hz	
Assessment criterion:	Connection after observation time (≥ 60s), power gradient ≤ 10%Pn/min			
Connection after 120s?	☐ yes	☒ no	☐ yes	☒ no
Power gradient:	Power gradient ≤ 10%Pn/min			
Test e): In start-up frequency range				
Test condition:	47,55 Hz		50,05 Hz	
Assessment criterion:	Connection after observation time (≥ 60s), power gradient ≤ 10%Pn/min			
Connection time [s]	65		78	
Connection frequency [V]	47,55		50,05	
Power gradient:	Power gradient ≤ 10%Pn/min			
Test f): Reconnection after tripping of interface protections				
Test condition:	Voltage retuned within 47,55 Hz after tripping of interface protections		Voltage retuned within 50,05 Hz after tripping of interface protections	
Assessment criterion:	Connection after observation time (≥ 300s), power gradient ≤ 10%Pn/min			
Connection time [s]	320		328	
Reconnection frequency [V]	47,55		50,05	
Power gradient:	Power gradient ≤ 10%Pn/min			

Note:

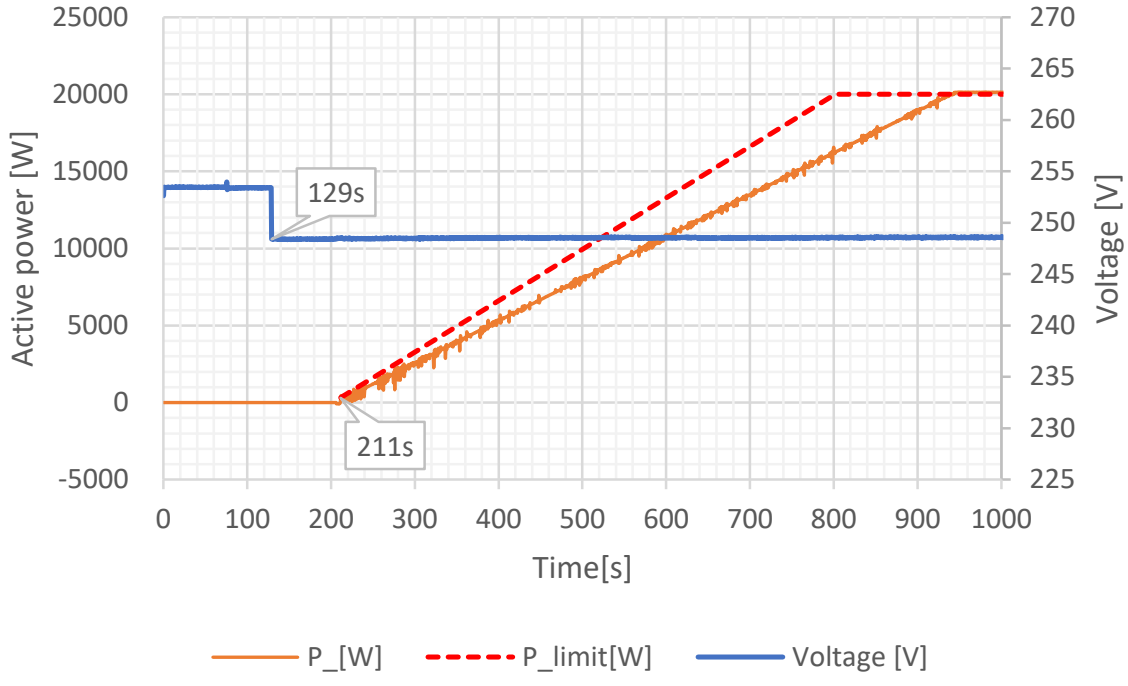
The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

[1)] Refer to **Differences of the model**.

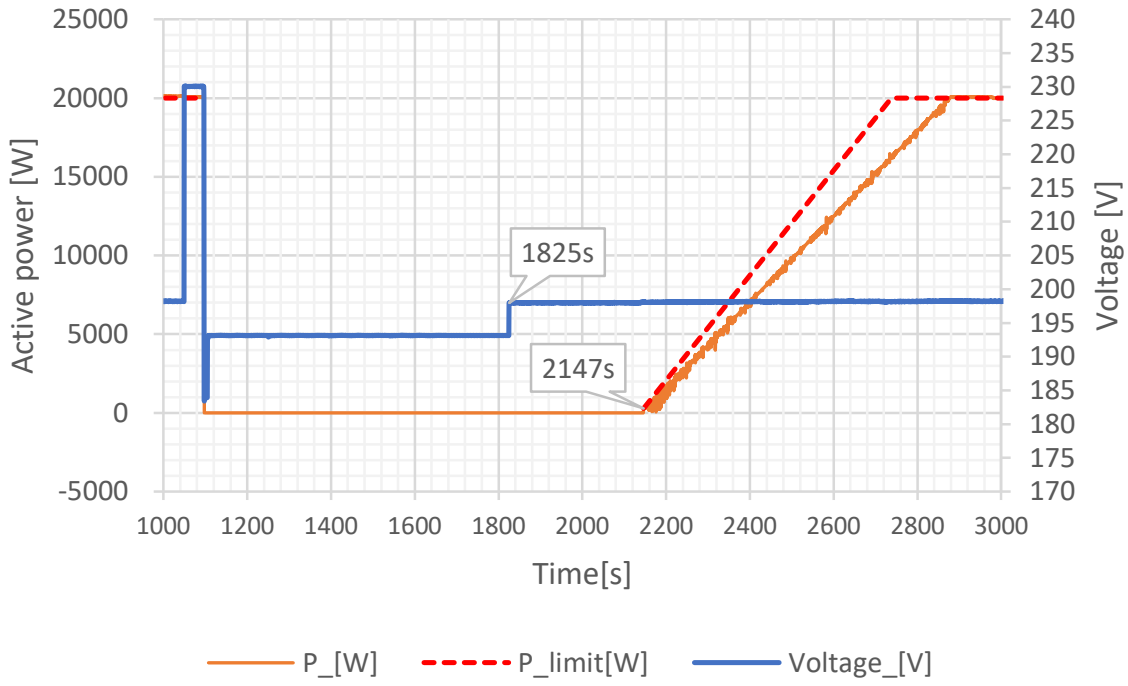
a) 84% Un to b) 86% Un



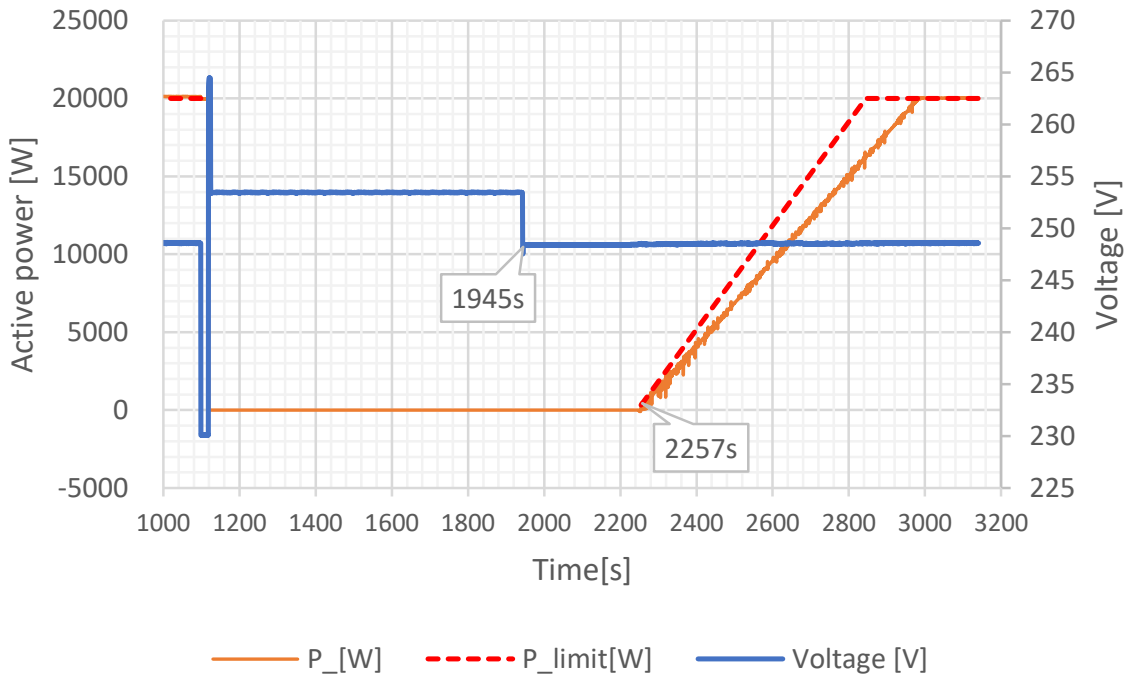
a) 111% Un to b) 109% Un



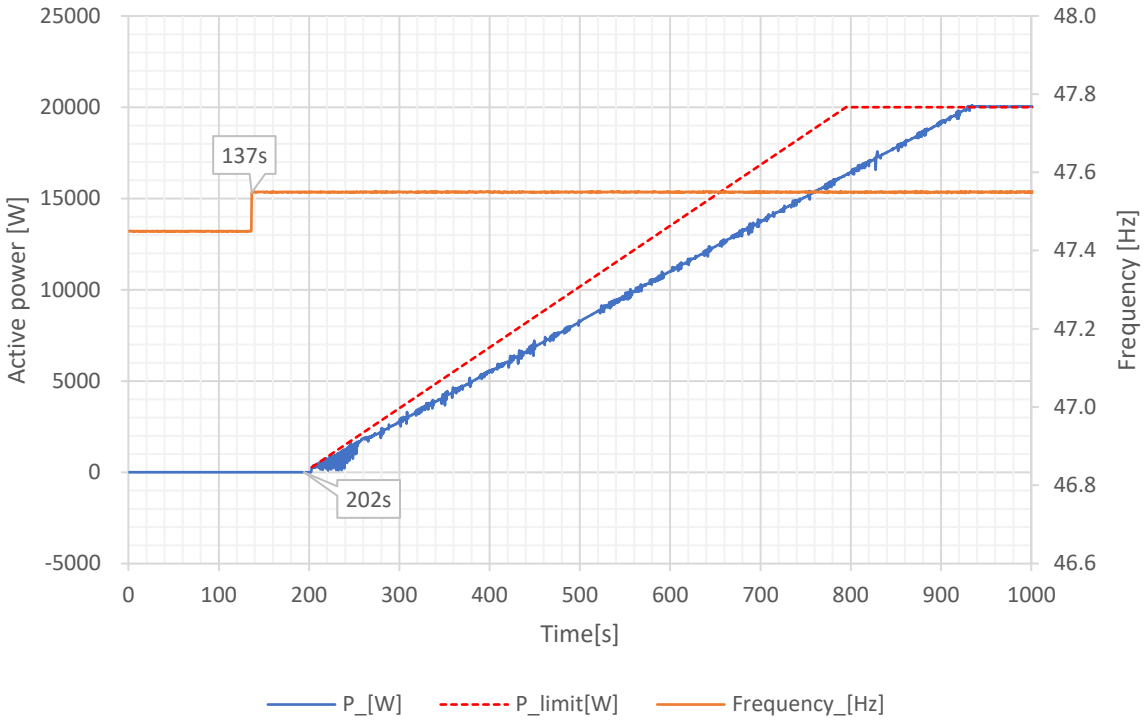
c) 86% Un after tripping of interface protections



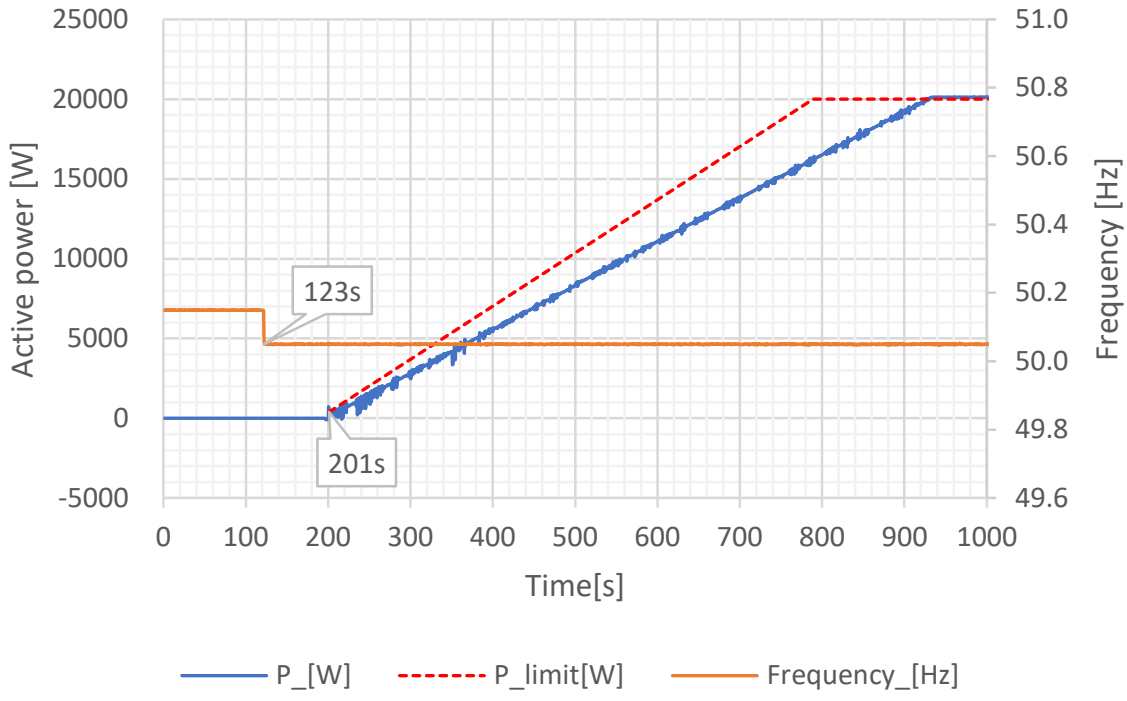
c) 109% Un after tripping of interface protections



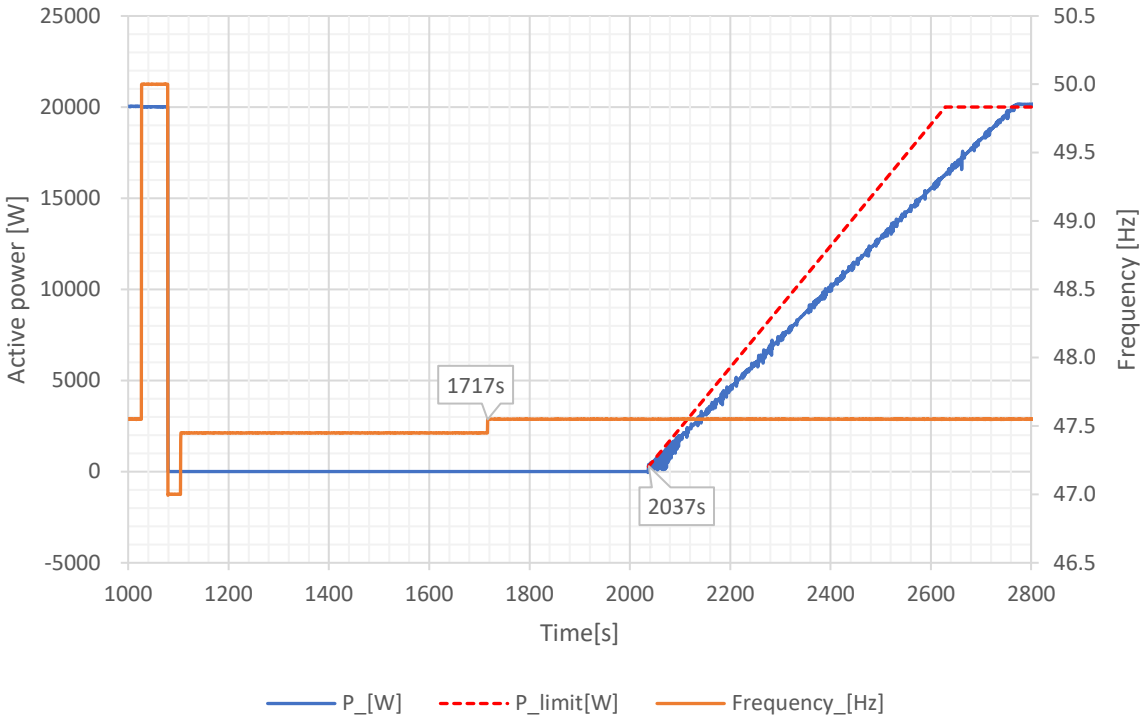
d) 47,45 Hz to to e) 47,55Hz



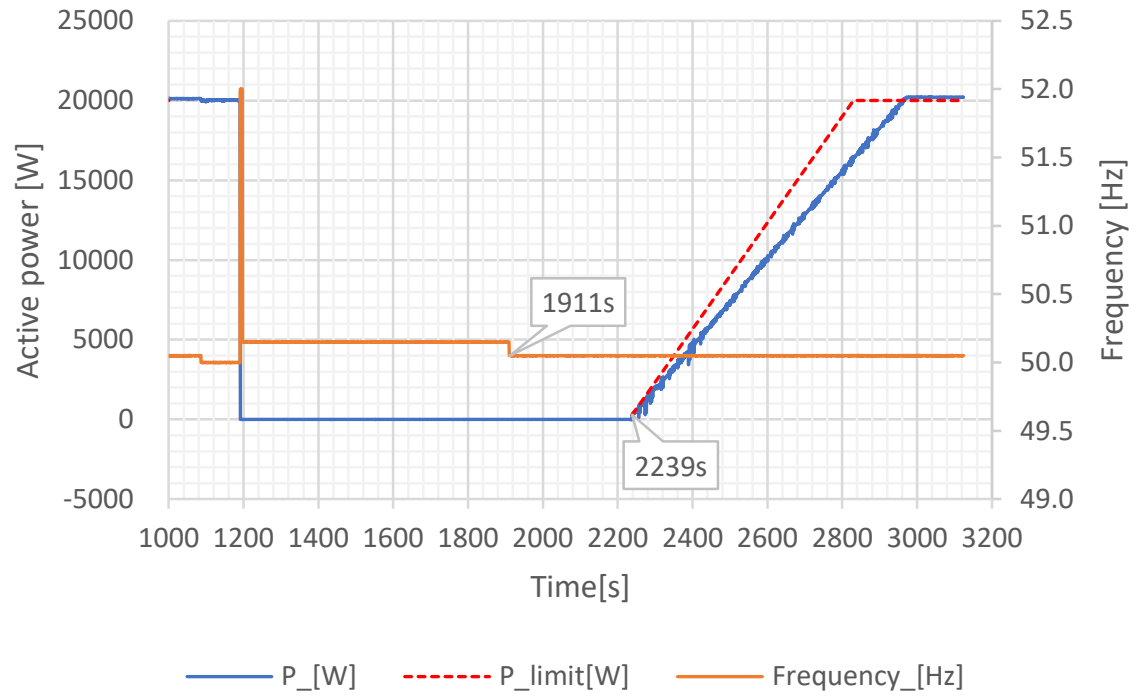
d) 50,10 Hz to to e) 50,05Hz



f) 47,55 Hz after tripping of interface protections



f) 50,05 Hz after tripping of interface protections



5.6 Testing of the robustness and dynamic grid support	P

Test procedure and test conditions:

These tests serve to prove the requirements of the requirements regarding robustness and dynamic grid support according to TOR Generator, Section 5.2.

At lease the recording must begin at least 10 s before the error occurs. After a faulty declaration (Voltage in the range 0,85 $U_n \leq U \leq 1,1\ U_n$), the recording must continue for at least another 60 s.

Behavior during the network fault

- No separation of the EZE from the grid during the break-in. If the EZE disconnects from the network, the time of the disconnection must be documented.

- Non-synchronous units and memories must not feed in either an active or a reactive current during a network fault and a voltage at the terminals of the EZE below 0.8 Un. This the requirement is met if, in the event of a voltage dip or the current fed in by the generating unit and / or the memory 60 ms after the occurrence of this voltage dip / increase in no phase conductor does not exceed 20% of the rated current Ir and after 100 ms no more than 10% Ir.

The generated voltage dips and voltage increases should meet the following requirements:

a) The effective grid impedance from the PGU point of view must meet the following criteria:
   - Short-circuit power at the EZE before and after the fault must be between 10 Sn and 30 Sn;
   - R/X 0.3 – 3 (for the impedances used in the test facility)

b) The test facility and if necessary. the mains simulator must be able to carry the maximum current of the test object in both the generator and motor areas. The energy consumption must be designed for the occurring shock short-circuit current iP (according to OVE EN 60909-0). iP of the DUT types is very different. Guideline values are:
   - For inverter-coupled systems approx. 2.2 Ir
   - For directly coupled asynchronous or synchronous machines approx. 7 Ir.

c) The generator simulates symmetrical and asymmetric voltage dips and voltage increases, the error form A and D according to Figure A.1 with the phase shit of the voltage according to Table A.2 must be adhered to, taking into account the old group effect. The illustrations show conductor-neutral conductor voltages.

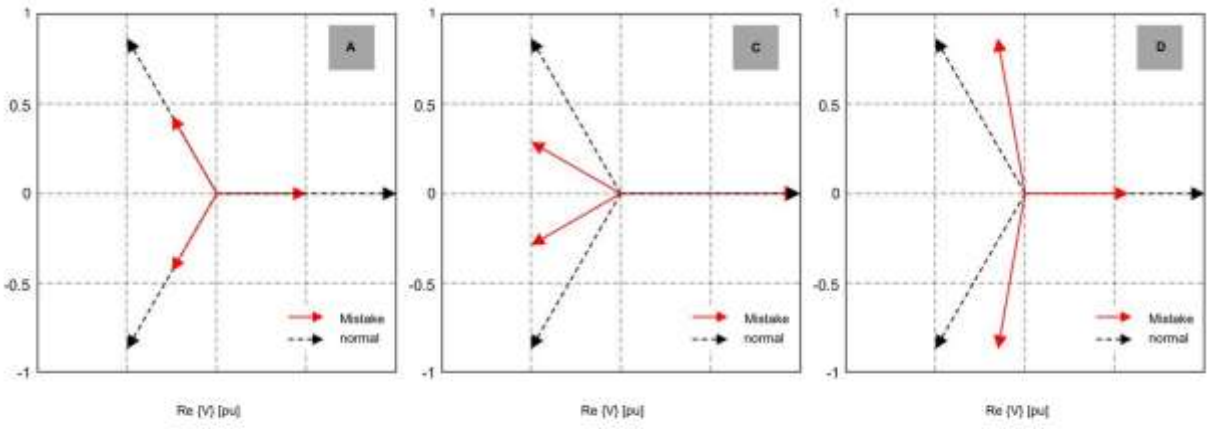


Figure A.1 - Error types "A", "C" and "D"
according to [MHJ Bollen "Understanding Power Quality Problems"]

Table A.2 - Fault patterns for FRT tests on type 2 PGU and storage when carried out on electronic network simulators

test no.	L1	L2	L3	Type	remark
–	1.00 > -150.0 °	1.00 > 90.0 °	1.00 > -30.0 °	A	initial state
1.3, 1.4	0.62 > -173.3 °	0.15 > 90.0 °	0.62 > -6.9 °	D 1	LV FRT
2.3, 2.4	0.76 > -161.1 °	0.50 > 90.0 °	0.76 > -19.1 °	D 1	
3.3, 3.4	0.93 > -152.8 °	0.85 > 89.9 °	0.93 > -27.4 °	D 1	

Test requirements:

The measurements were performed in the testing laboratory.

at the grid-simulator:

U_N = between 86 % Un and 109% Un until the test

Frequency: 50 Hz +/- 0,5%

Voltage harmonic: ≤ 3% THD

Voltage various: ≤ 3% Un

Assessment criteria:

- No disconnection of the EZE from the grid during the testing.
- Non-synchronous units and storage devices output active current and reactive current not exceed 10% of In during the grid fault and the fault voltage is below 0,8Un.
- No separation of the EZE within 60 s after the end of the fault;
- Synchronous units: Start-up time of the active power maximum 6 s
- Non-synchronous units and memory: Rise time of the active power maximum 1 s

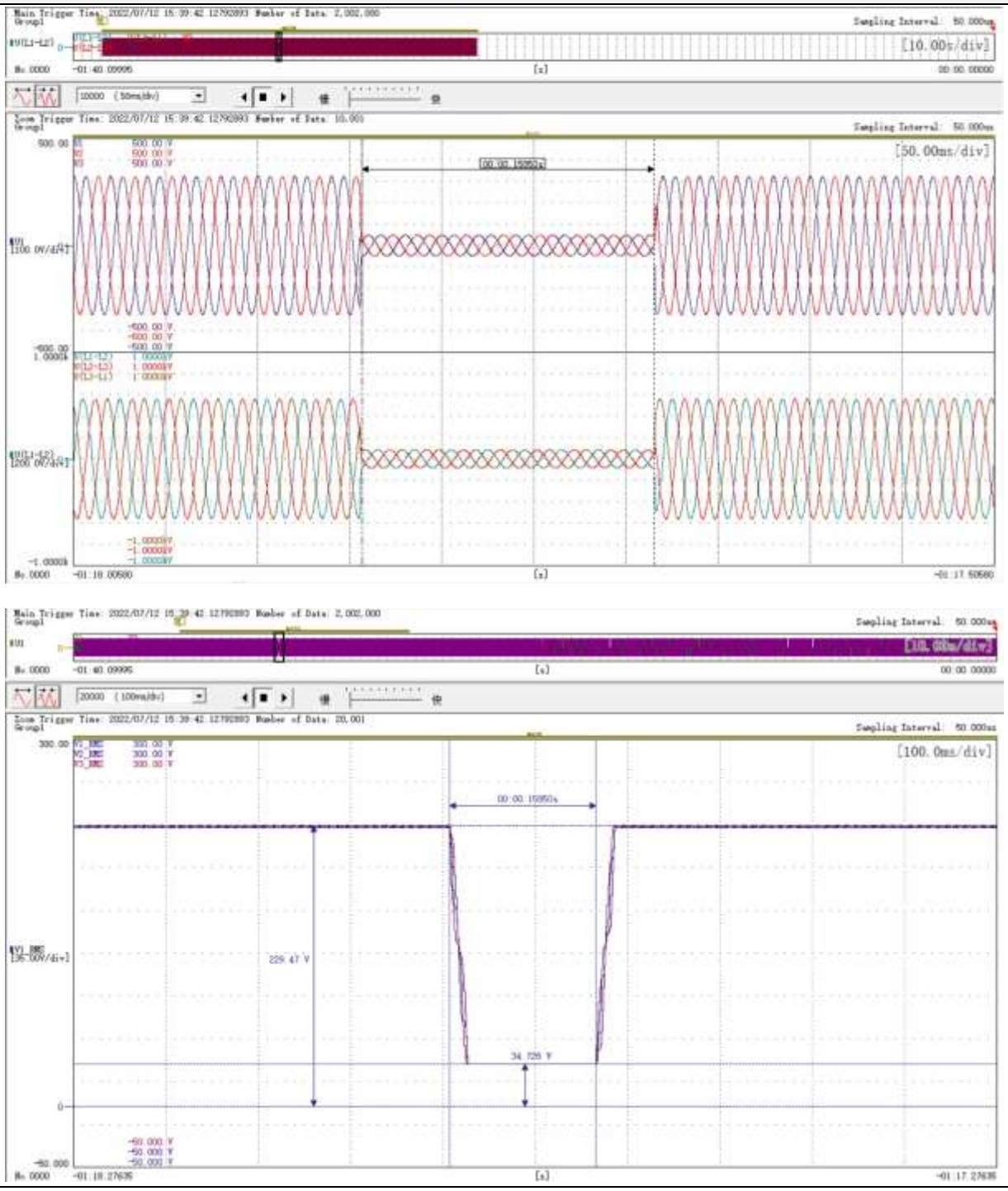
Note:

The test had been performed on the model **PCS-3-20KW-40A-1** the test results are valid for the **PCS-3-4KW-25A-1**, **PCS-3-5KW-25A-1**, **PCS-3-6KW-25A-1**, **PCS-3-8KW-25A-1**, **PCS-3-10KW-25A-1**, **PCS-3-12KW-25A-1**, **PCS-3-10KW-40A-1**, **PCS-3-12KW-40A-1**, **PCS-3-15KW-40A-1** since it is pretty much the same in hardware[1)] and just power derated by software.

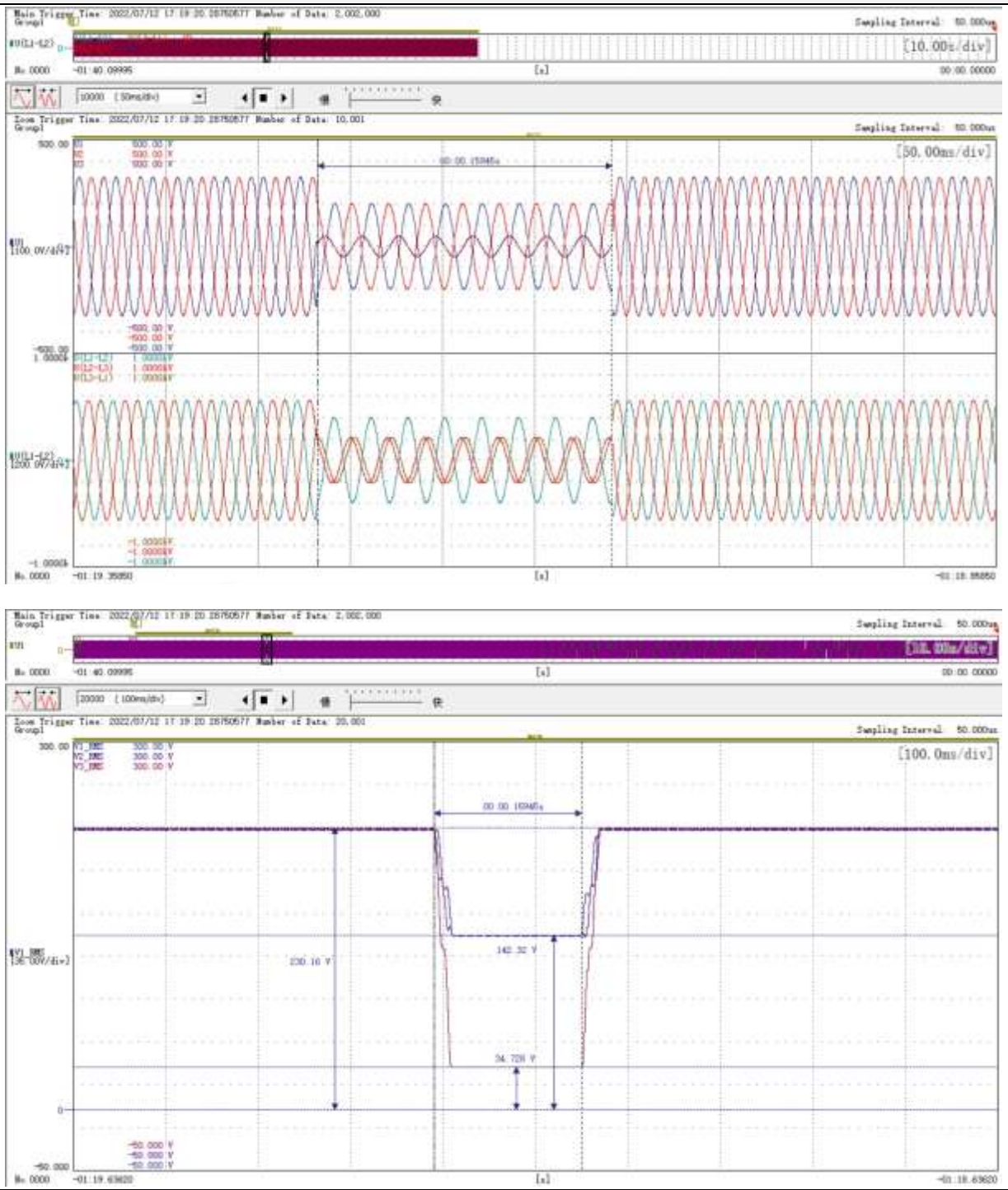
[1)] Refer to **Differences of the model**.

5.6.3 Verification for the dynamic grid support test for inverter (3-phase Inverters)									P
Load definition									
			requirement			**Used for testing**			
Full load			P_n ±2%P_n			100%P_n			
Partial load			0,2·P_n ~ 0,6·P_n			0,3P_n			
Test	**Voltage Fault depth [p.u. U_n]**	**Fault type**	**Fault duration [ms]**	**Load / P-setpoint**	**Q-setpoint [%P_{rE}]**	**Test condition**			
						No.	**Test 1**	**Test 2**	
1	0,15 … 0,25 typical: 0,15	3-phase (type A)	≥ 150 (at U=0,15) ≥ 250 (at U=0,25)	full load	(0 - ±10%) 0	1.1	☒	☒	
				partial load		1.2	☒	☒	
		2-phase (type D1)		full load		1.3	☒	☒	
		2-phase (type D2)		full load		1.3.a	☒	☒	
		2-phase (type D1)		partial load		1.4	☒	☒	
2	0,50 … 0,60 typical: 0,50	3-phase (type A)	≥ 840 (at U=0,50) ≥ 1020 (at U=0,60)	full load	(0 - ±10%) 0	2.1	☒	☒	
				partial load		2.2	☒	☒	
		2-phase (type D1)		full load		2.3	☒	☒	
				partial load		2.4	☒	☒	
3	0,85 … 0,90 typical: 0,85	3-phase (type A)	≥ 60000	full load	(0 - ±10%) 0	3.1	☒	☒	
				partial load		3.2	☒	☒	
		2-phase (type D1)		full load		3.3	☒	☒	
				partial load		3.4	☒	☒	
No load test									
0	0,15 … 0,25 typical: 0,15	3-phase (type A)	≥ 150 (at U=0,15) ≥ 250 (at U=0,25)	No load	0	Test 0.1.1	☒	☒	
		2-phase (type D1)				Test 0.1.2	☒	☒	
		2-phase (type D2)				Test 0.1.3	☒	☒	
	0,50 … 0,60 typical: 0,50	3-phase (type A)	≥ 840 (at U=0,50) ≥ 1020 (at U=0,60)			Test 0.2.1	☒	☒	
		2-phase (type D1)				Test 0.2.2	☒	☒	
	0,85 … 0,90 typical: 0,85	3-phase (type A)	≥ 60000			Test 0.3.1	☒	☒	
		2-phase (type D1)				Test 0.3.2	☒	☒	
Note: Each case two consecutive tests must be completed successfully; Test results show only Test 1.									

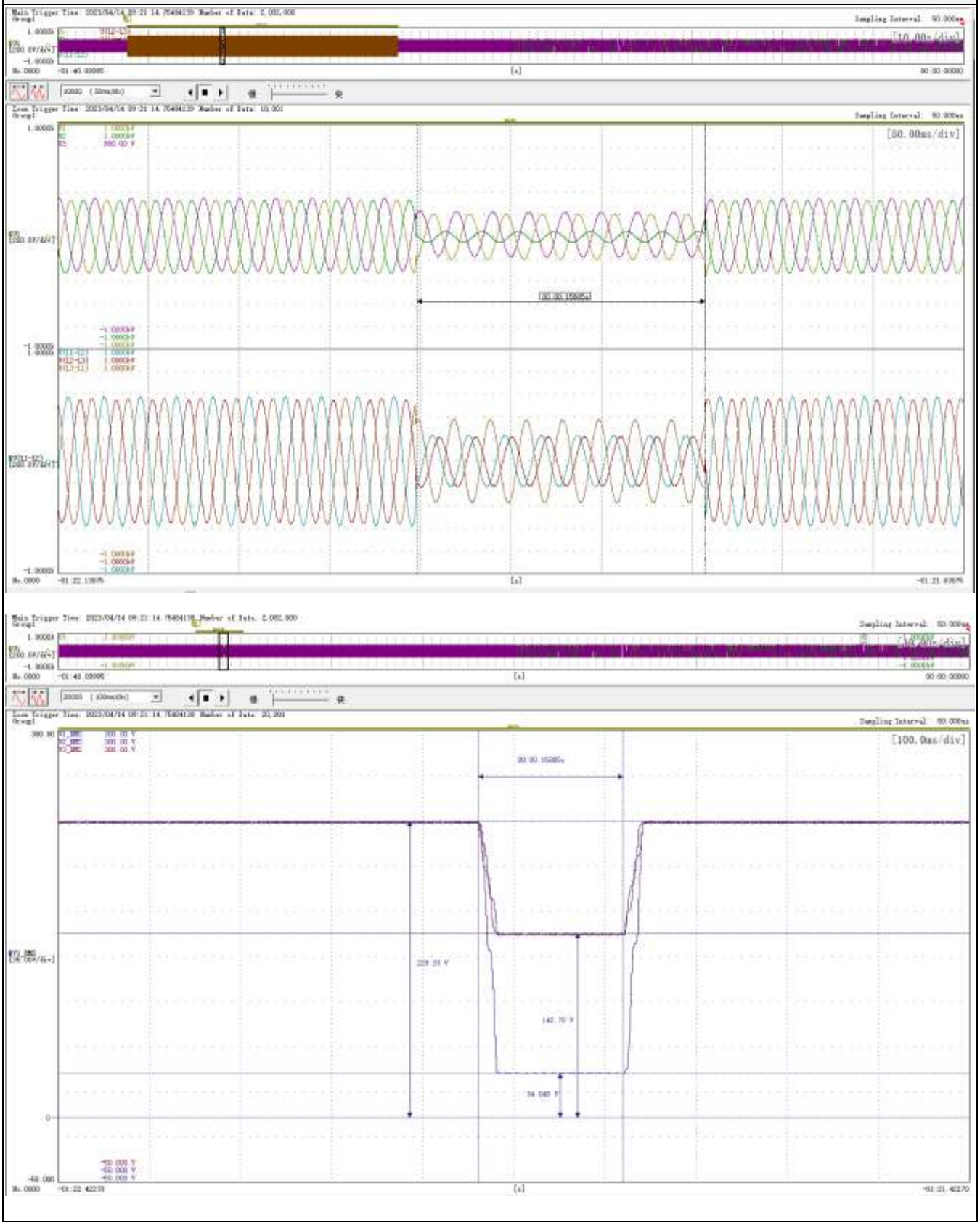
No load Test 0.1.1



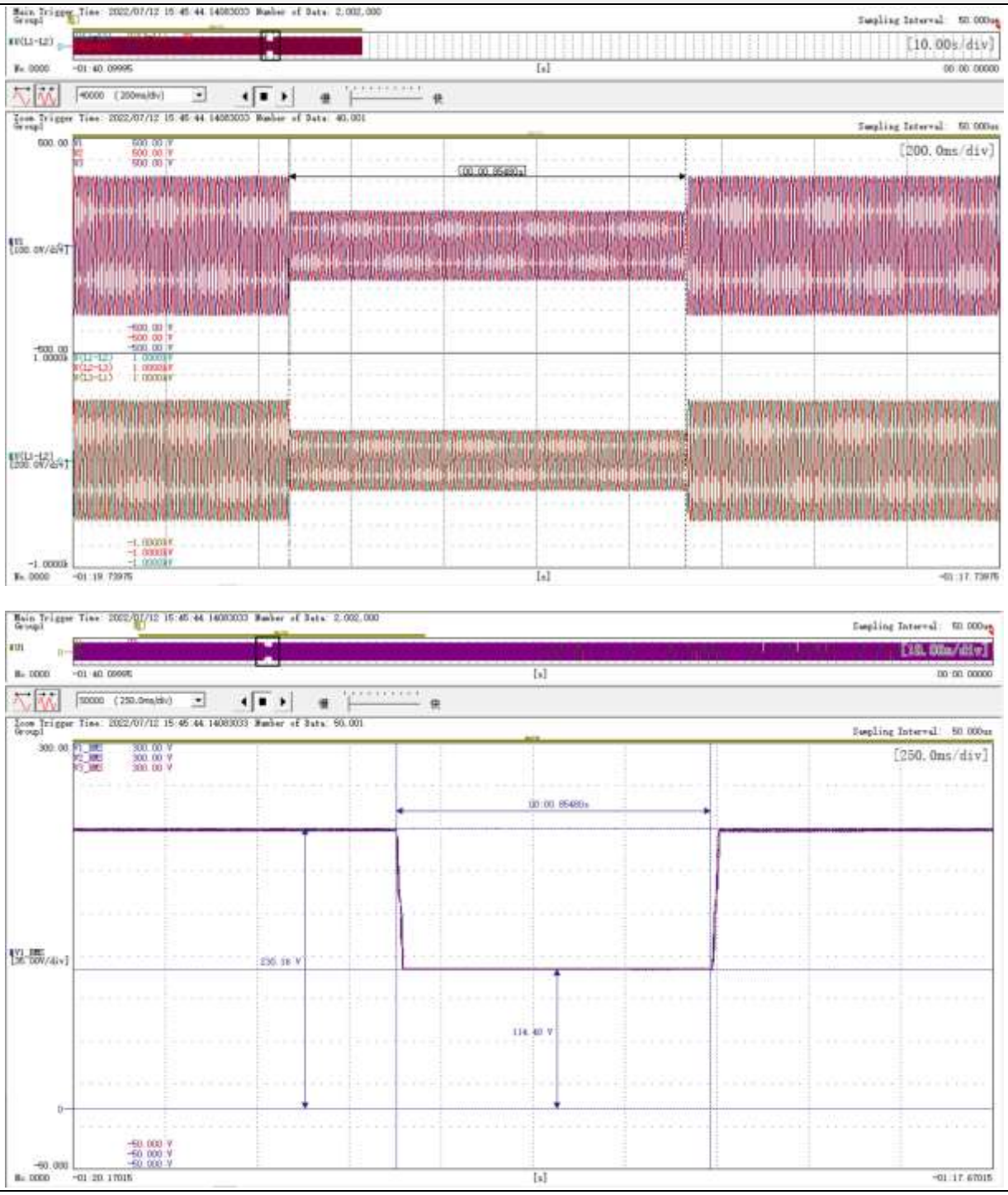
No load Test 0.1.2



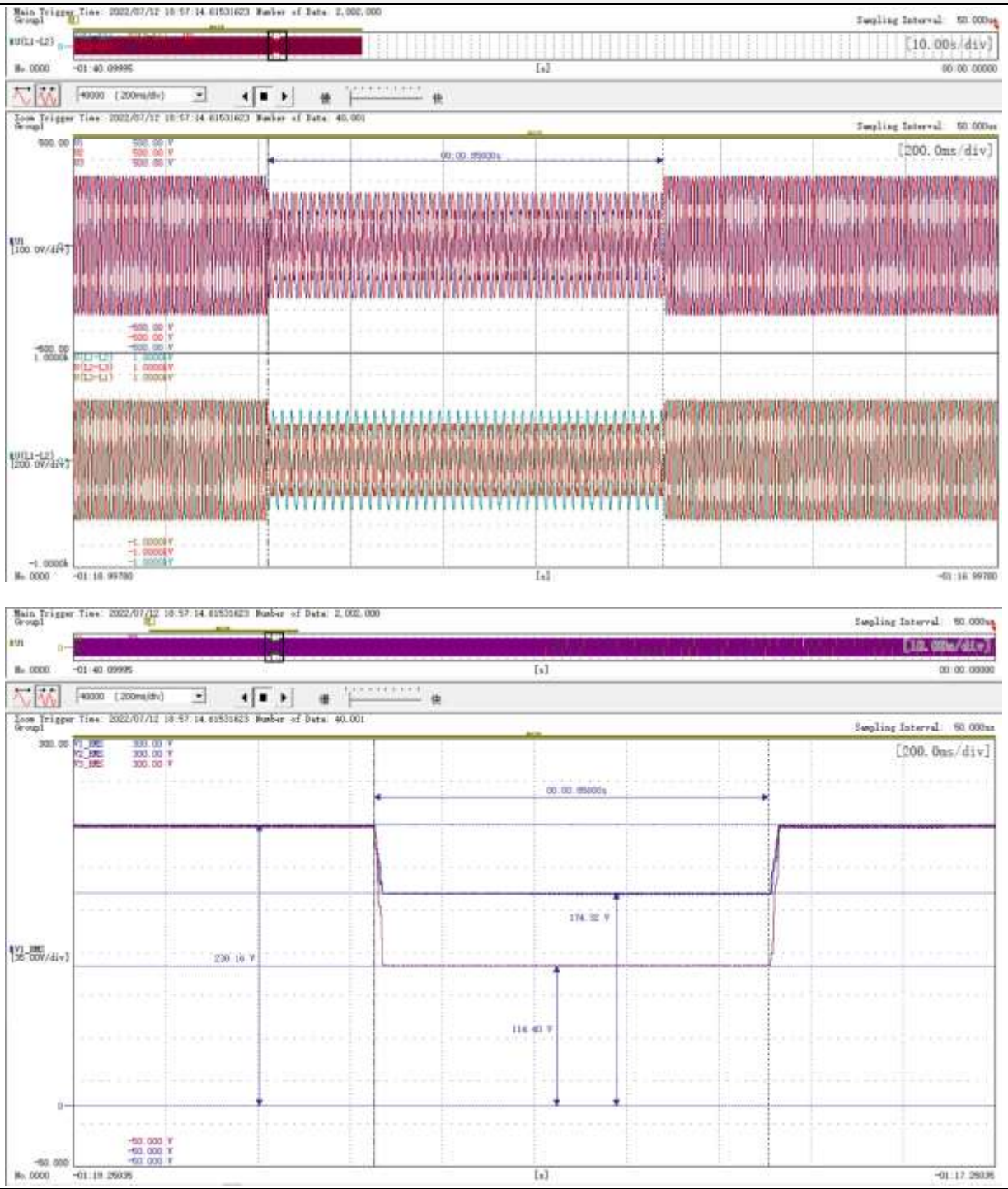
No load Test 0.1.3

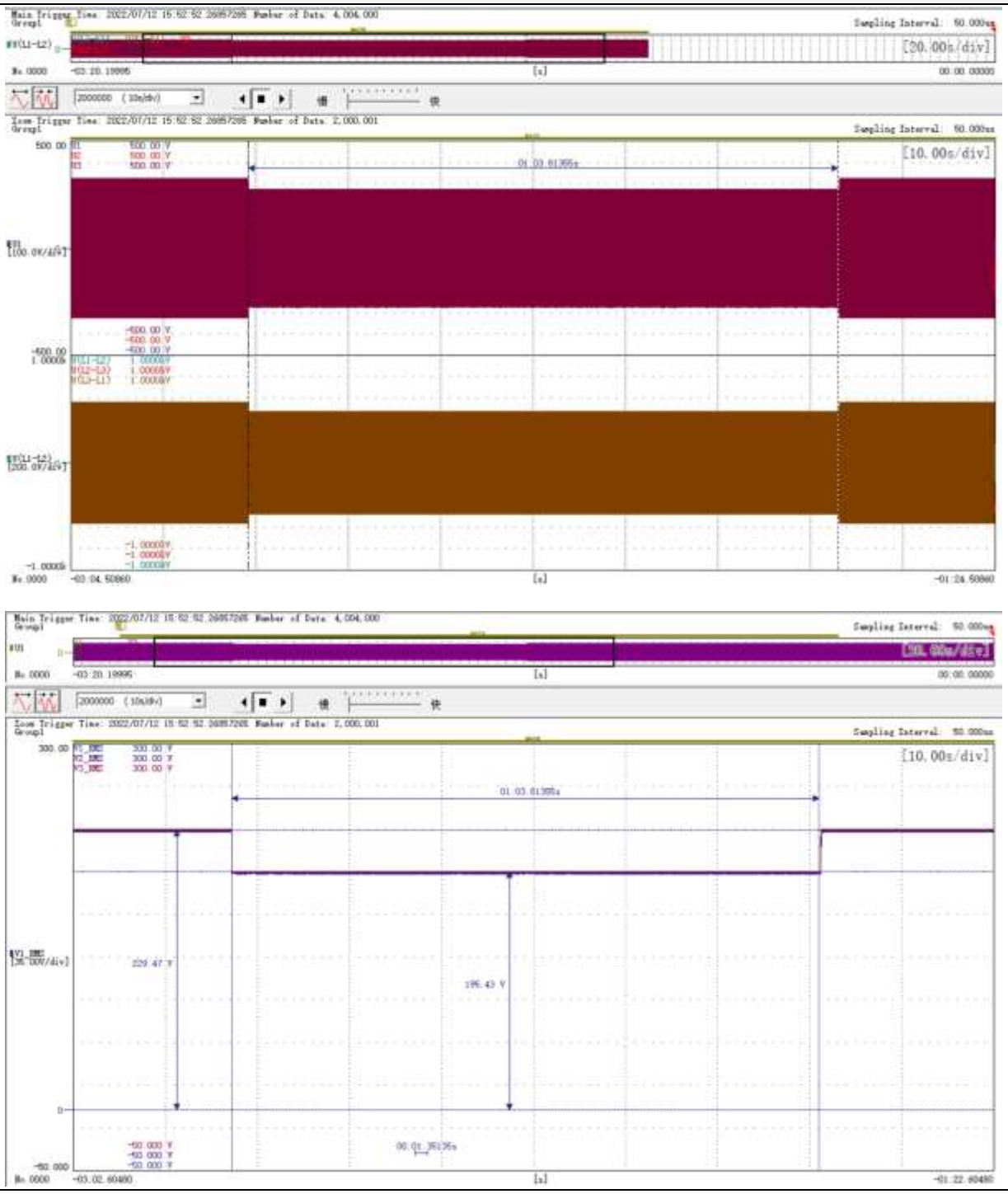


No load Test 0.2.1

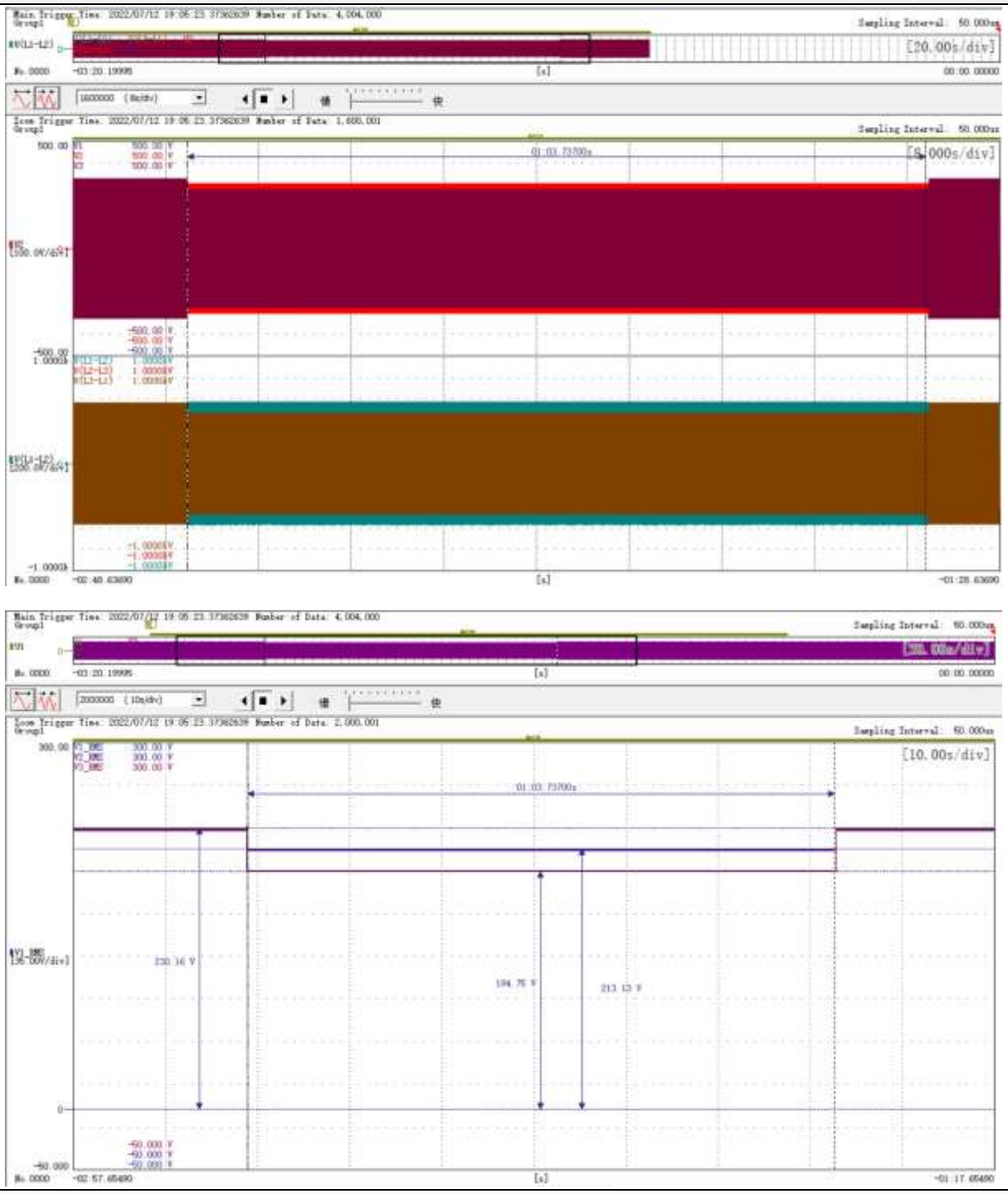


No load Test 0.2.2



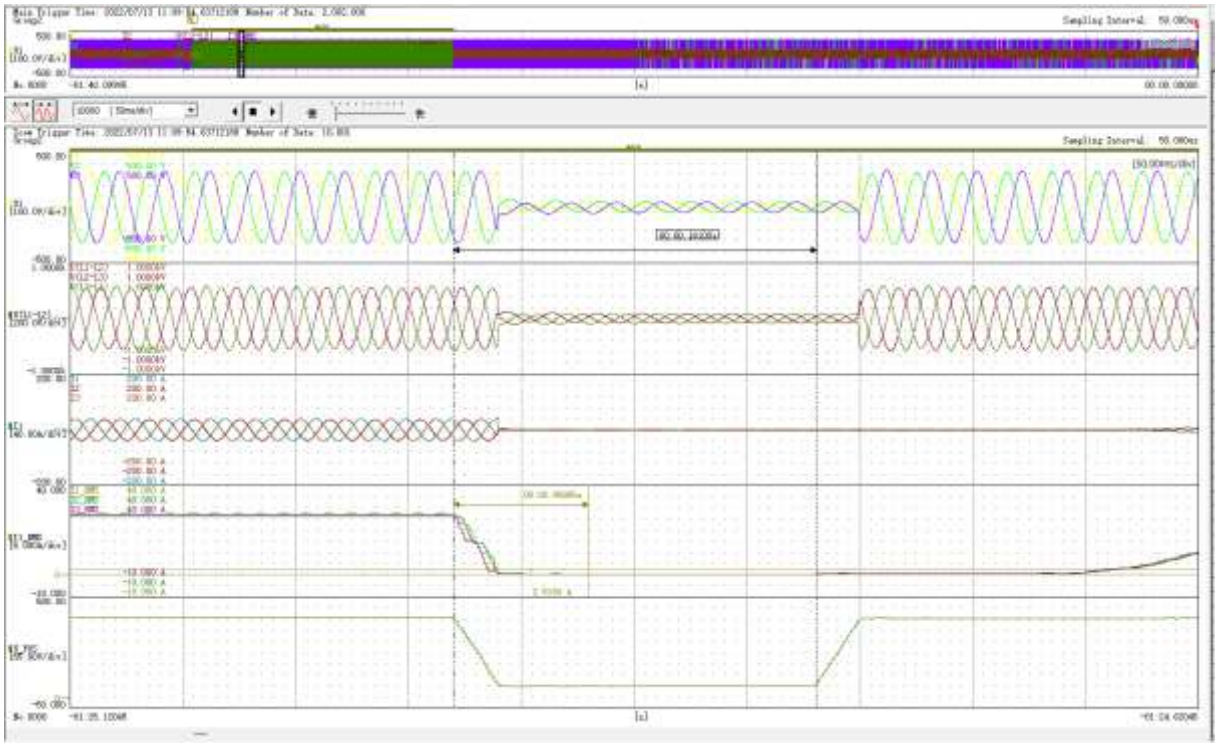
No load Test 0.3.1


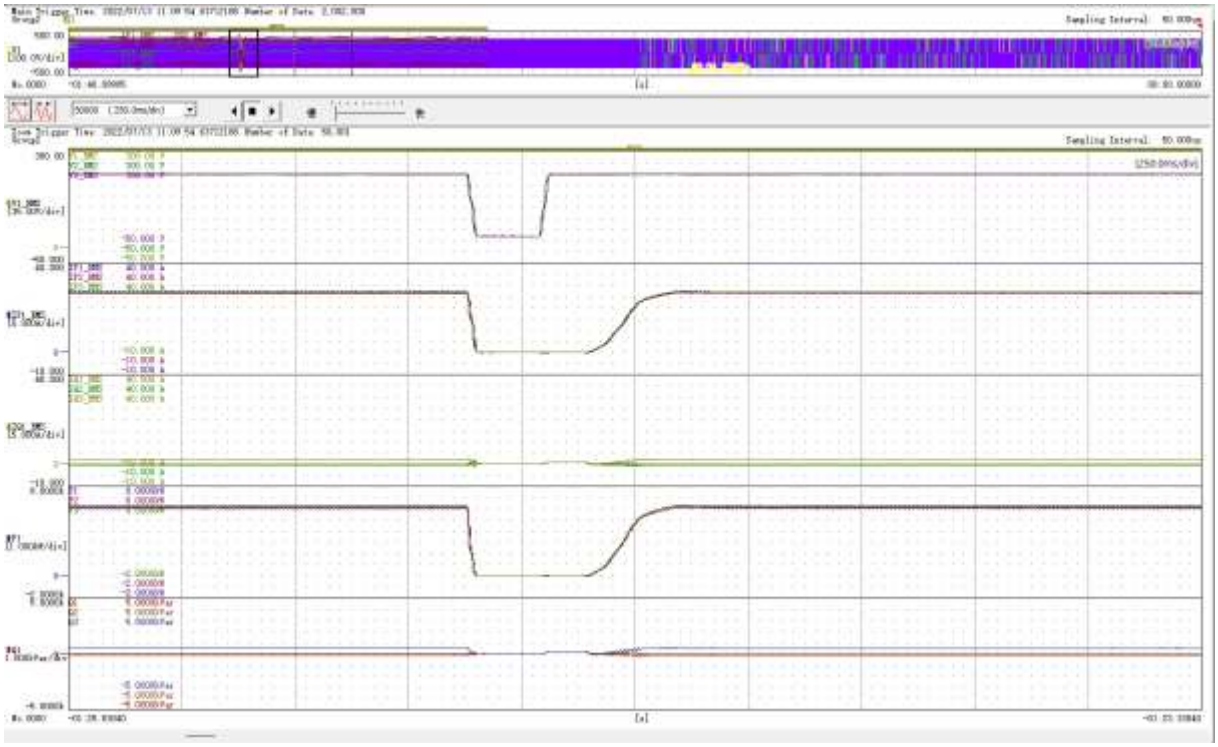
No load Test 0.3.2



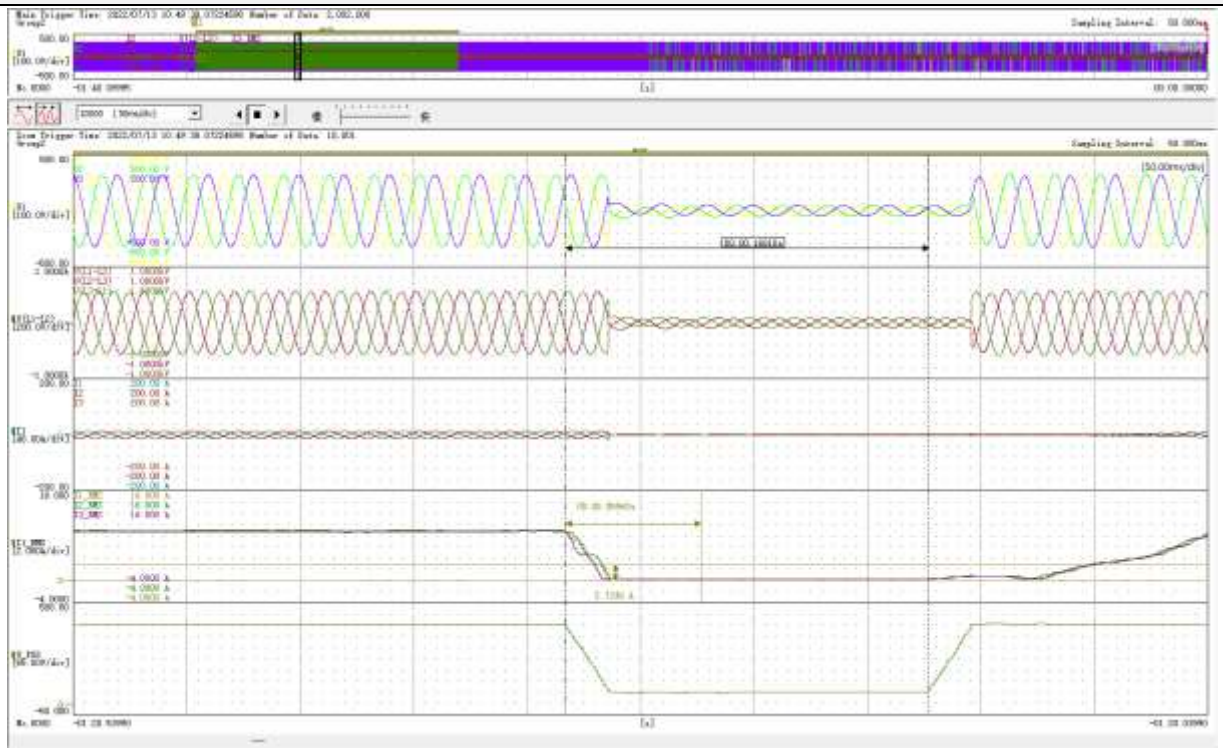
Graph of FRT test one								
Test result:								
List of tests	Residual voltage [p.u. U_n]	Duration limit [ms]	P set pre-fault [%Pn]	Q set pre-fault [%Pn]	Recover time [ms]		Disconnection occurred?	Test No.
					P	Q		
P_{Emax} in %	**30% ±5%**							
1.A.1- Symmetrical	0,15	160 ± 20	30	0	105	0	☐ yes ☒ no	1.2
1.D.1- Asymmetrical	0,15	160 ± 20	30	0	106	0	☐ yes ☒ no	1.4
2.A.1- Symmetrical	0,50	850 ± 20	30	0	112	0	☐ yes ☒ no	2.2
2.D.1- Asymmetrical	0,50	850 ± 20	30	0	105	0	☐ yes ☒ no	2.4
3.A.1- Symmetrical	0,85	60000 ± 20	30	0	171	0	☐ yes ☒ no	3.2
3.D.1- Asymmetrical	0,85	60000 ± 20	30	0	270	0	☐ yes ☒ no	3.4
P_{Emax} in %	**100% ±5%**							
1.A.1- Symmetrical	0,15	160 ± 20	100	0	247	0	☐ yes ☒ no	1.1
1.D.1- Asymmetrical	0,15	160 ± 20	100	0	261	0	☐ yes ☒ no	1.3
1.D.2- Asymmetrical	0,15	160 ± 20	100	0	101	0	☐ yes ☒ no	1.3.a
2.A.1- Symmetrical	0,50	850 ± 20	100	0	159	0	☐ yes ☒ no	2.1
2.D.1- Asymmetrical	0,50	850 ± 20	100	0	159	0	☐ yes ☒ no	2.3
3.A.1- Symmetrical	0,85	60000 ± 20	100	0	297	0	☐ yes ☒ no	3.1
3.D.1- Asymmetrical	0,85	60000 ± 20	100	0	284	0	☐ yes ☒ no	3.3

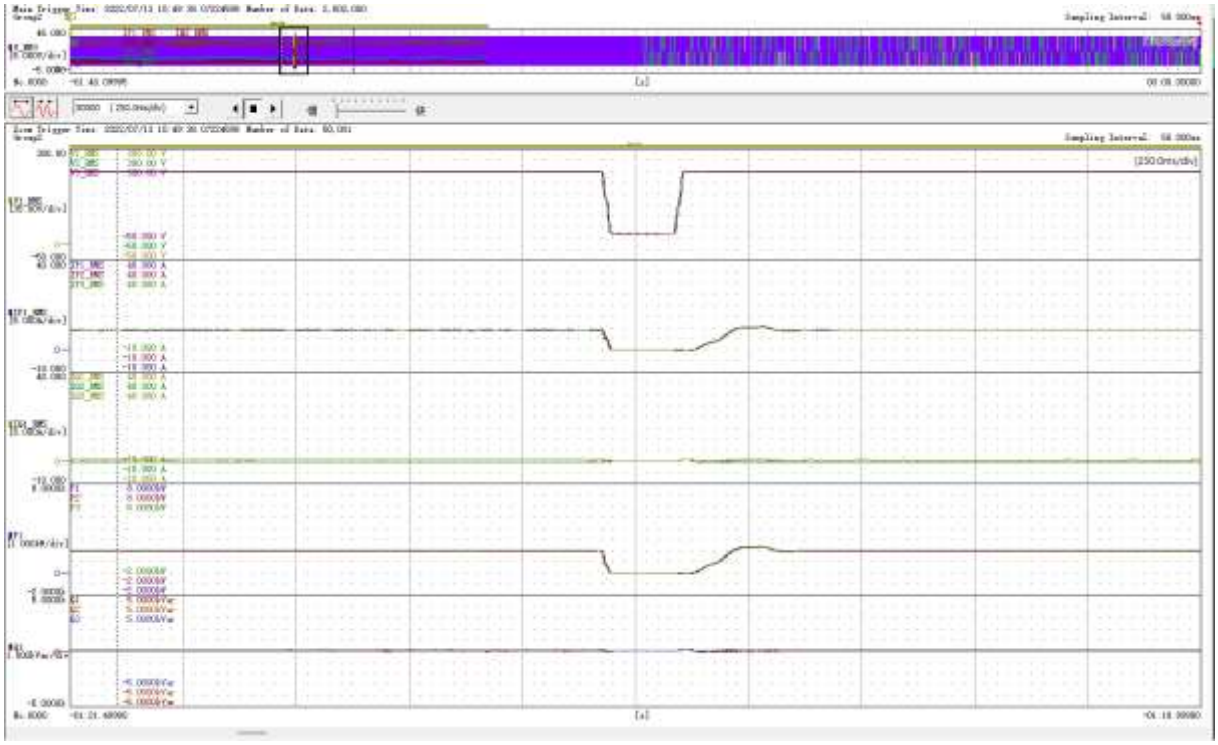
1.1



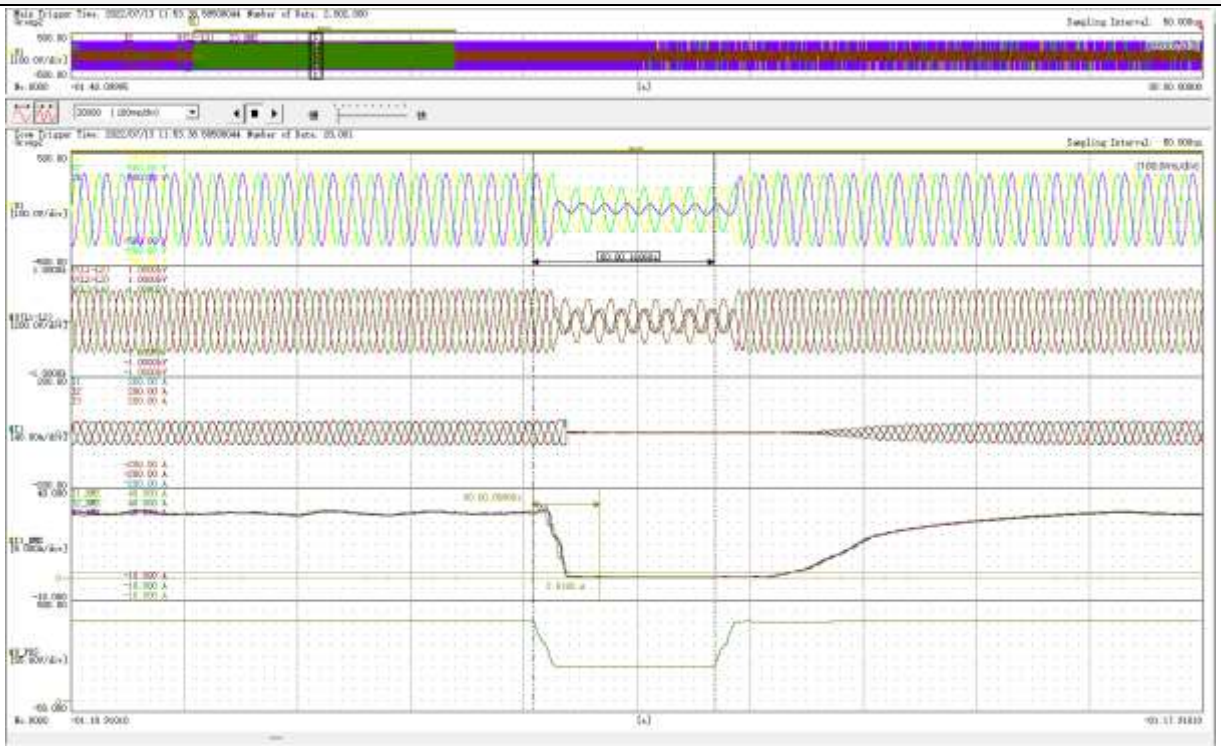


1.2

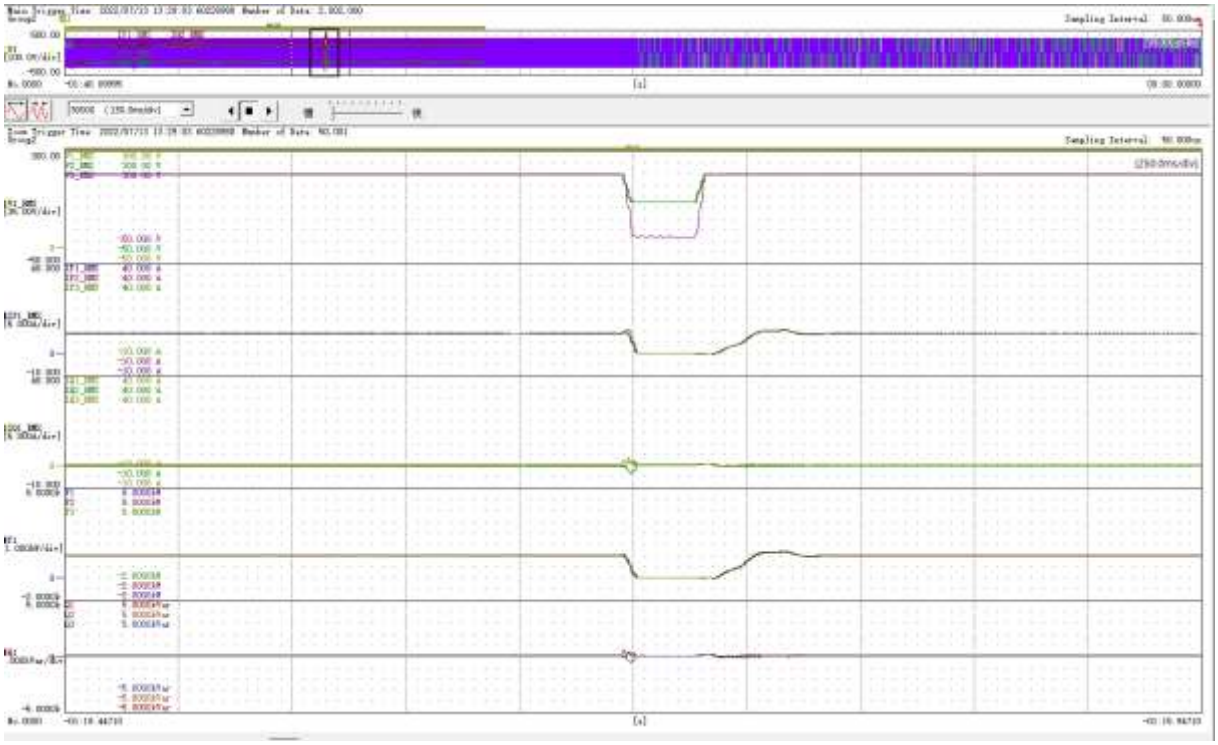




Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1,1	1,2
	1	Date	--	--	yyyy.mm.dd	2022,07,13	2022,07,13
	2	Time (start of test)	--	--	hh:mm:ss.f	11:12:30	10:49:38
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0,15	0,15
	5	Setting dip duration		--	--	150	150
	6	Point of fault entry	Total	--	ms	24280	19777
	7	Point of fault clearance	Total	--	ms	24437	19935
	8	Fault duration in empty load test	Total	--	ms	159	158,5
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,149	0,149
	10		Phase 2			0,149	0,149
	11		Phase 3			0,149	0,149
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,996	0,994
	14		Phase 2			0,992	0,990
	15		Phase 3			0,995	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,998	0,302
	17	Active power	Total	t1-10s to t1	p.u.	0,993	0,300
	18		Pos.			0,992	0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,039	0,012
	20		Pos.			0,022	0,003
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,149	0,149
	23		Phase 2			0,149	0,149
	24		Phase 3			0,148	0,149
	25	Line current	Phase 1	t1+60ms	p.u.	0,004	0,004
	26		Phase 2			0,003	0,004
	27		Phase 3			0,004	0,004
	28	Line current	Phase 1	t1+100ms	p.u.	0,004	0,004
	29		Phase 2			0,003	0,004
	30		Phase 3			0,004	0,004
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000	0,000
	32		Pos.			0,000	0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,996	0,994
	34		Phase 2			0,992	0,990
	35		Phase 3			0,995	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,986	0,300
	37		Pos.			0,984	0,300
	38	Active power rising time	Pos.	--	s	0,247	0,105
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,037	0,012
	40		Pos.			0,020	0,003
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

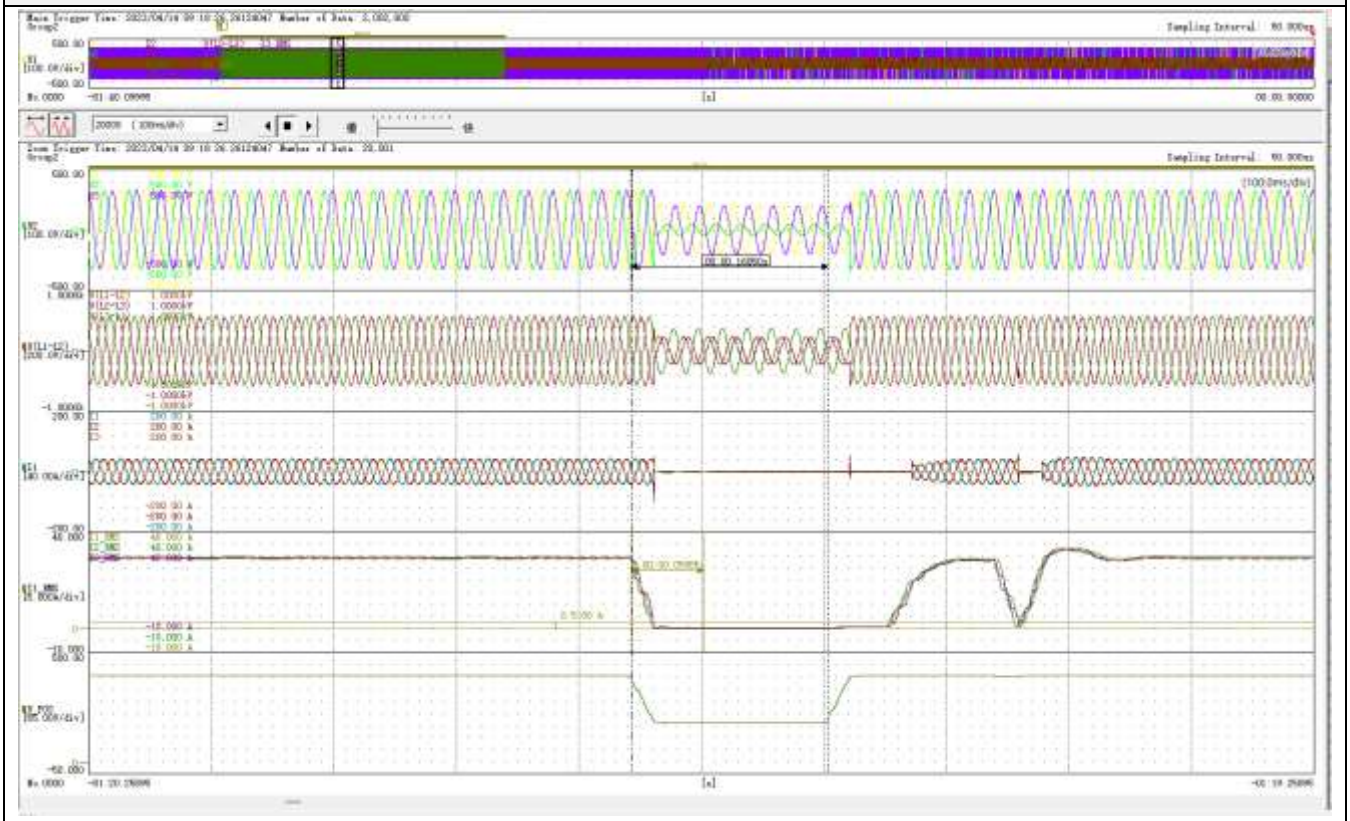
1.3


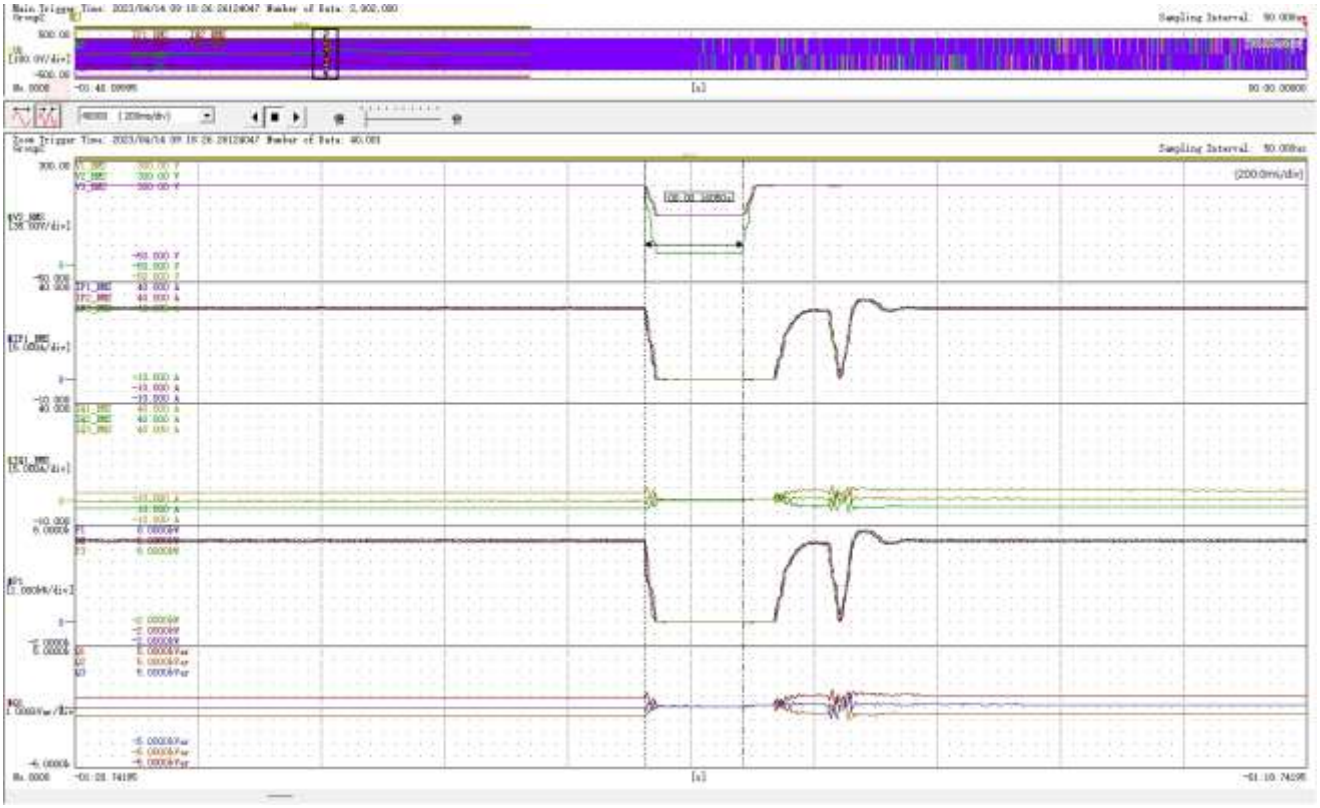

1.4



Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1,3	1,4
	1	Date	--	--	yyyy.mm.dd	2022,07,13	2022,07,13
	2	Time (start of test)	--	--	hh:mm:ss.f	11:53:38	13:29:03
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,15	0,15
	5	Setting dip duration		--	--	150	150
	6	Point of fault entry	Total	--	ms	21597	22881
	7	Point of fault clearance	Total	--	ms	21757	23038
	8	Fault duration in empty load test	Total	--	ms	159,45	159,45
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,616	0,616
	10		Phase 2			0,616	0,616
	11		Phase 3			0,149	0,149
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,996	0,995
	14		Phase 2			0,992	0,990
	15		Phase 3			0,995	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,999	0,303
	17	Active power	Total	t1-10s to t1	p.u.	0,994	0,301
	18		Pos.			0,993	0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,038	0,012
	20		Pos.			0,021	0,003
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,616	0,616
	23		Phase 2			0,613	0,613
	24		Phase 3			0,148	0,149
	25	Line current	Phase 1	t1+60ms	p.u.	0,017	0,017
	26		Phase 2			0,023	0,017
	27		Phase 3			0,004	0,004
	28	Line current	Phase 1	t1+100ms	p.u.	0,017	0,017
	29		Phase 2			0,019	0,017
	30		Phase 3			0,004	0,004
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000	0,000
	32		Pos.			0,000	0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,996	0,995
	34		Phase 2			0,992	0,989
	35		Phase 3			0,995	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,982	0,300
	37		Pos.			0,981	0,300
	38	Active power rising time	Pos.	--	s	0,221	0,106
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,035	0,012
	40		Pos.			0,021	0,003
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

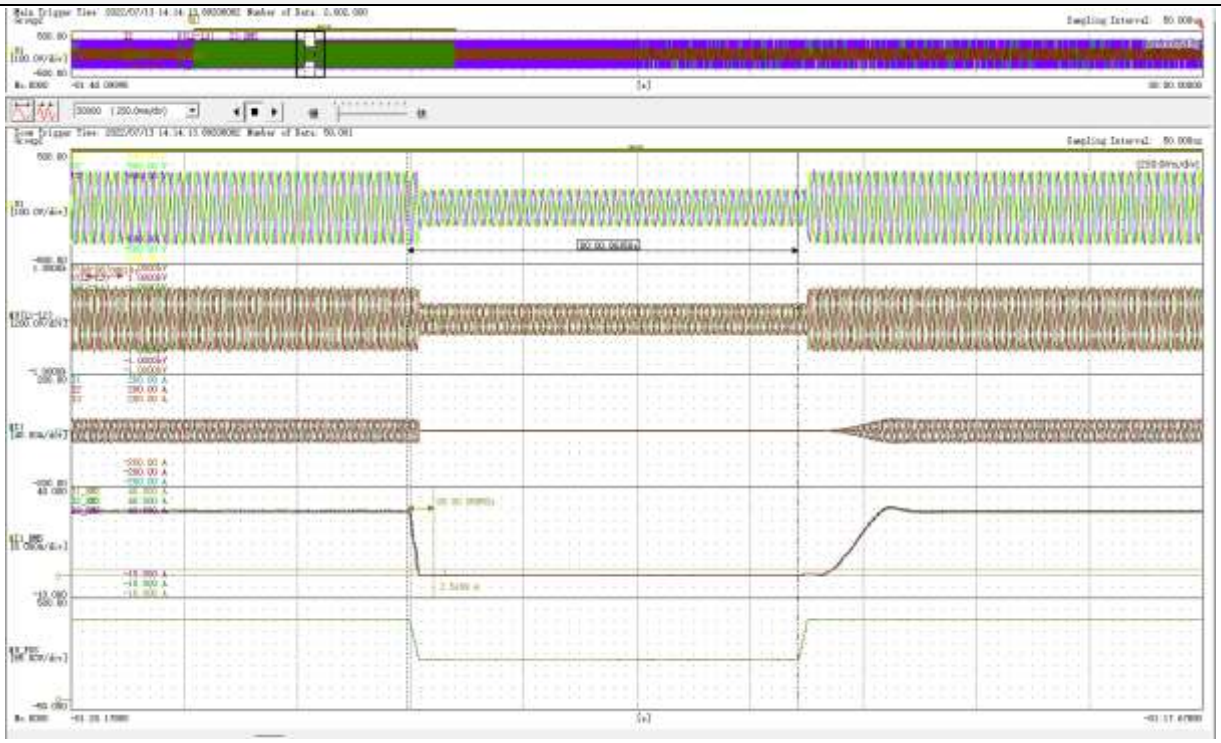
1.3.a

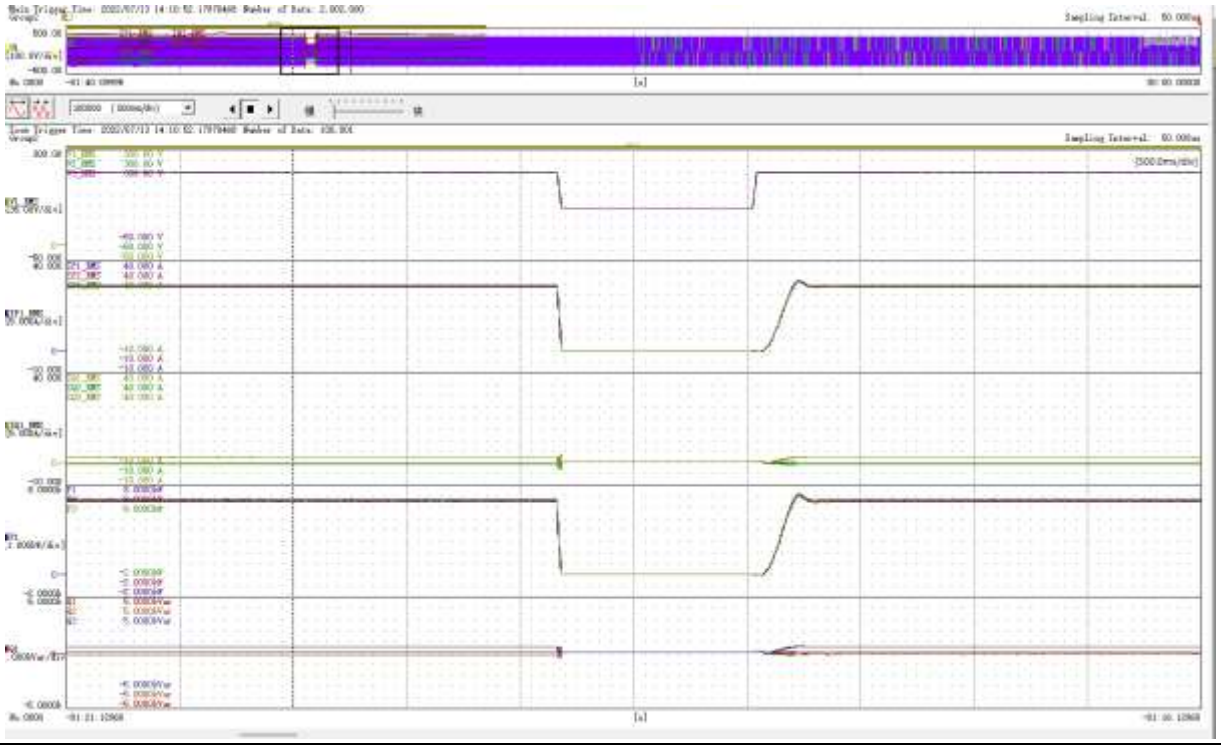




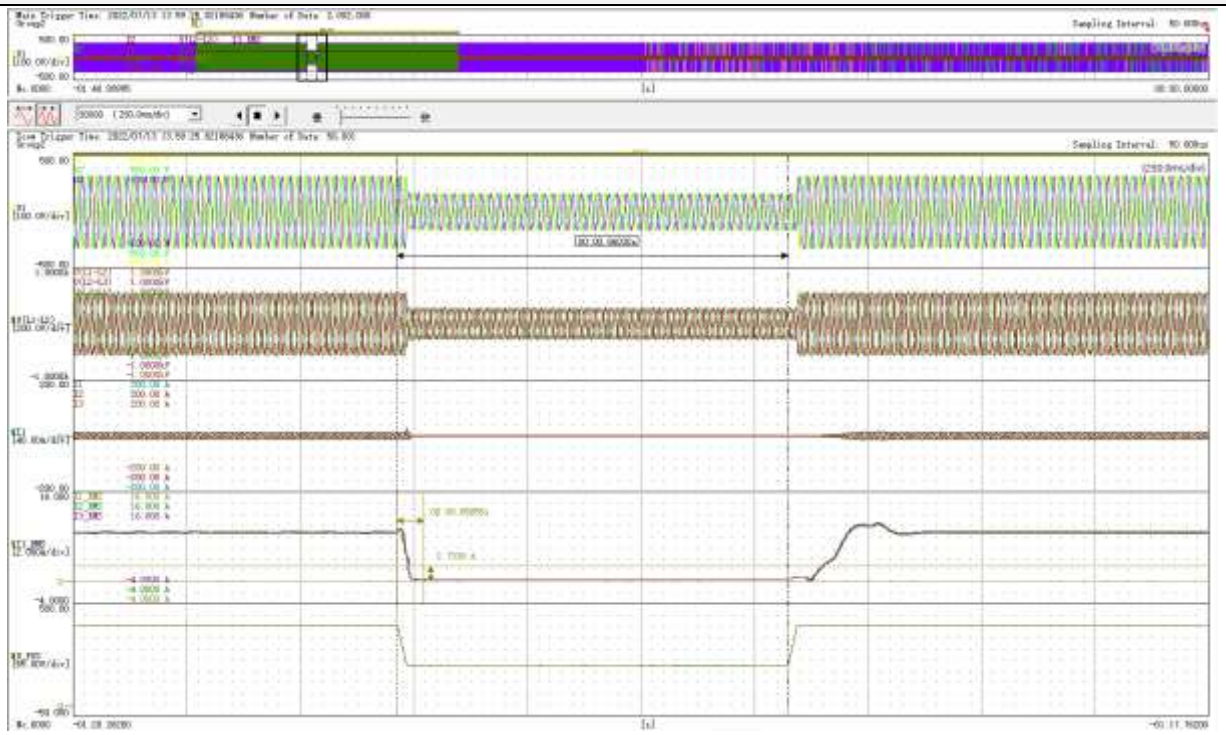
Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1,3	--
	1	Date	--	--	yyyy.mm.dd	2023,4,14	--
	2	Time (start of test)	--	--	hh:mm:ss.f	9:18:26	--
	3	Fault type (phase)	--	--	--	D2	--
	4	Setting voltage depth	Line to line	--	p.u.	0,15	--
	5	Setting dip duration		--	--	150	--
	6	Point of fault entry	Total	--	ms	18159,40	--
	7	Point of fault clearance	Total	--	ms	18318,25	--
	8	Fault duration in empty load test	Total	--	ms	158,85	--
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,615	--
	10		Phase 2			0,150	--
	11		Phase 3			0,612	--
	12		Pos.	t1-10s to t1		0,994	--
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,996	--
	14		Phase 2			0,997	--
	15		Phase 3			0,996	--
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,002	--
	17	Active power	Total	t1-10s to t1	p.u.	1,004	--
	18		Pos.			1,005	--
	19	Reactive power	Total	t1-10s to t1	p.u.	0,077	--
	20		Pos.			0,001	--
	21	Cosφ	--	t1-10s to t1	--	1,000	--
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,615	--
	23		Phase 2			0,150	--
	24		Phase 3			0,612	--
	25	Line current	Phase 1	t1+60ms	p.u.	0,014	--
	26		Phase 2			0,022	--
	27		Phase 3			0,021	--
	28	Line current	Phase 1	t1+100ms	p.u.	0,035	--
	29		Phase 2			0,005	--
	30		Phase 3			0,013	--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000	--
	32		Pos.			0,000	--
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,996	--
	34		Phase 2			0,997	--
	35		Phase 3			0,996	--
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,003	--
	37		Pos.			1,005	--
	38	Active power rising time	Pos.	--	s	0,241	--
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,077	--
	40		Pos.			0,007	--
	41	Reactive power rising time	Pos.	--	s	0,000	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	--

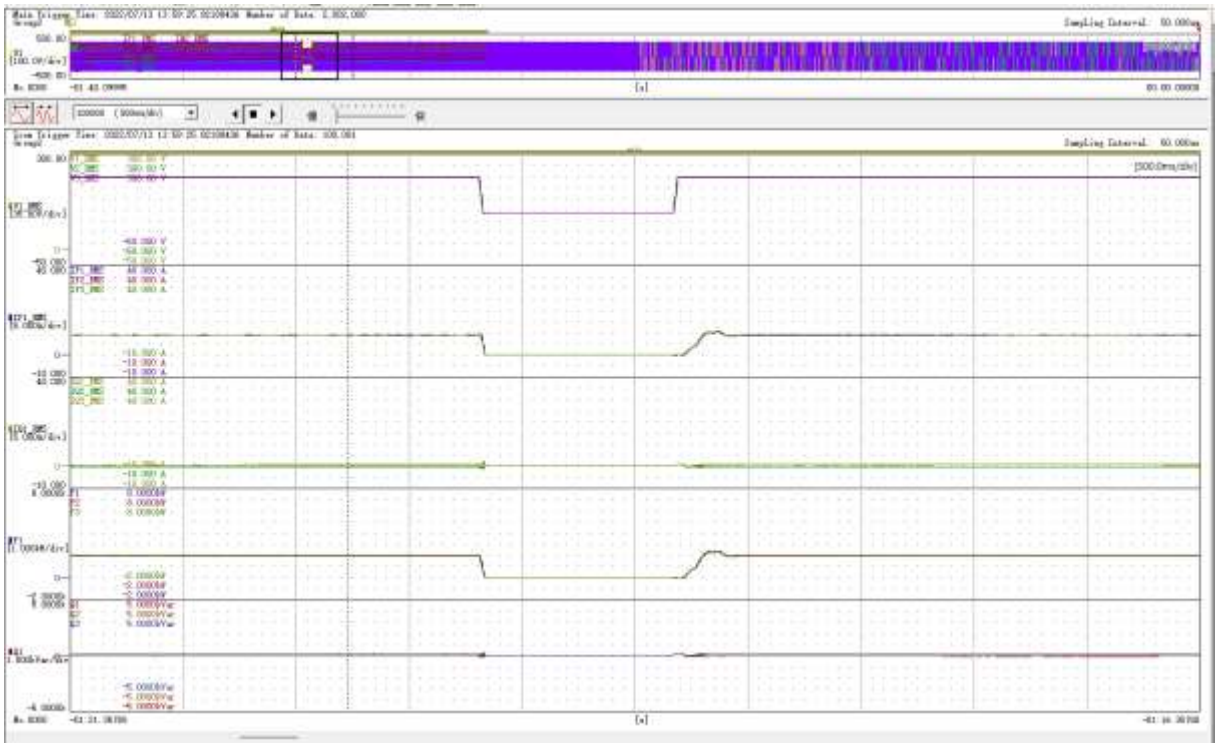
2.1



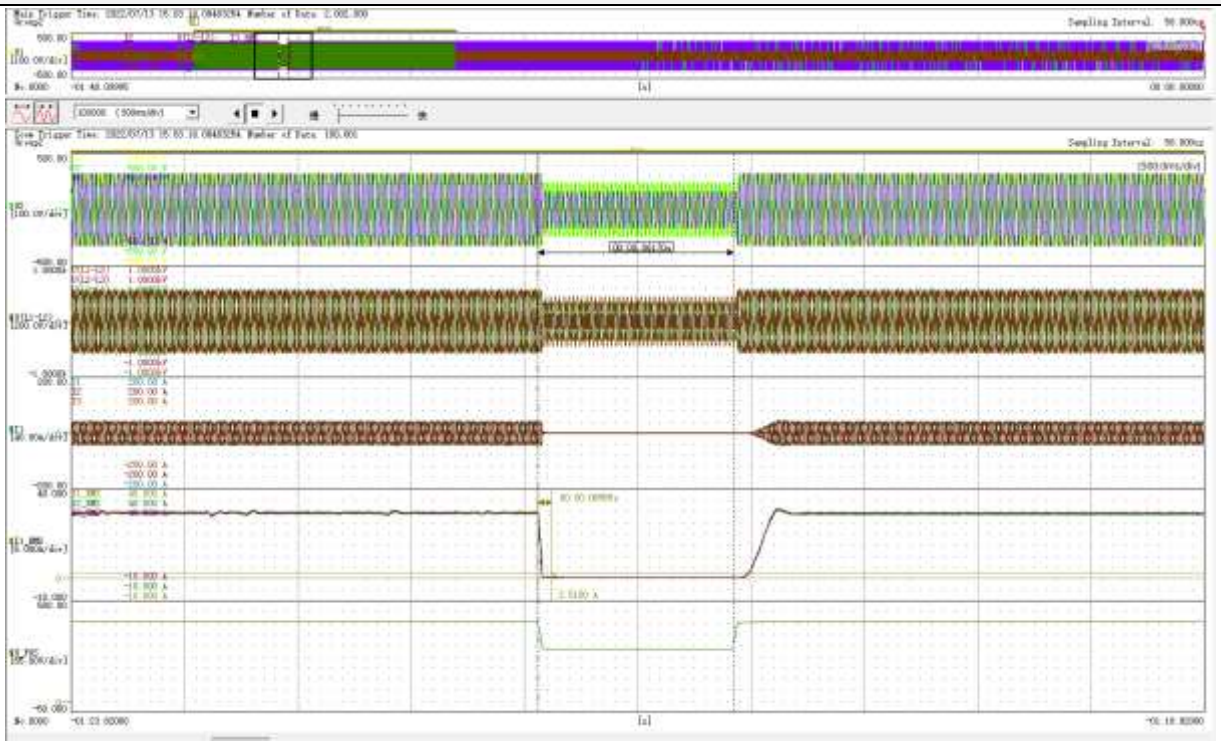
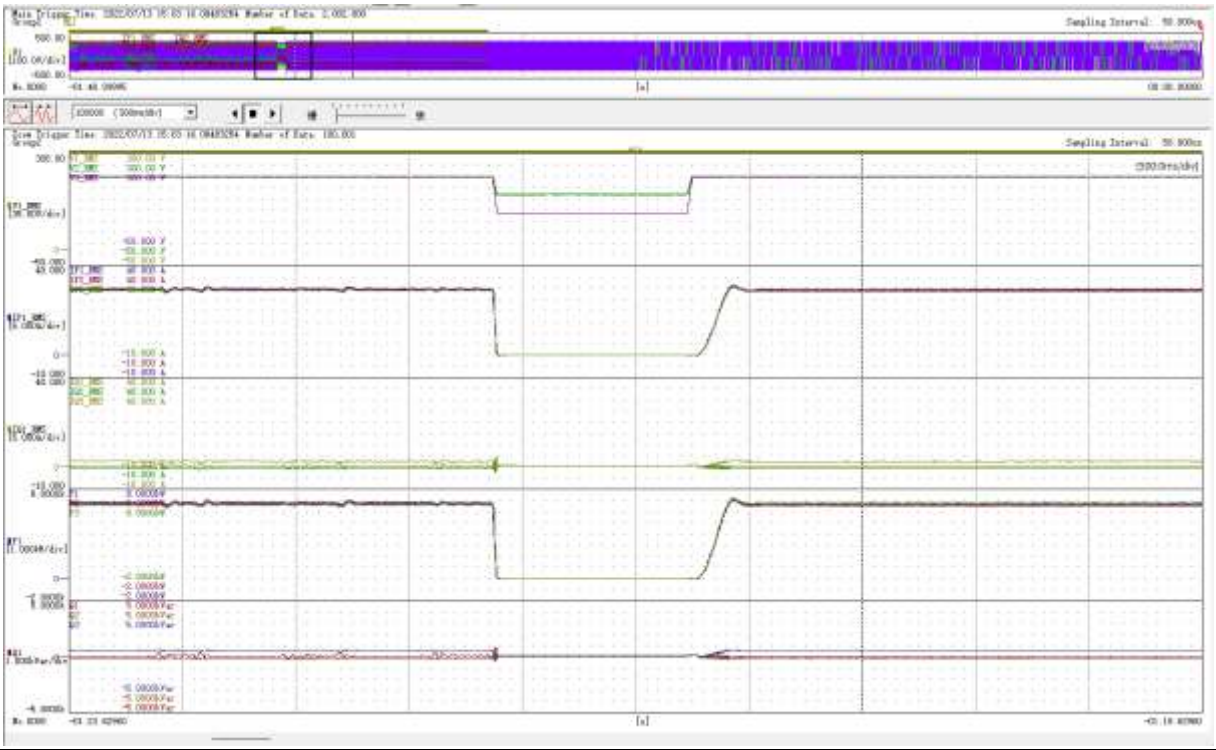


2.2

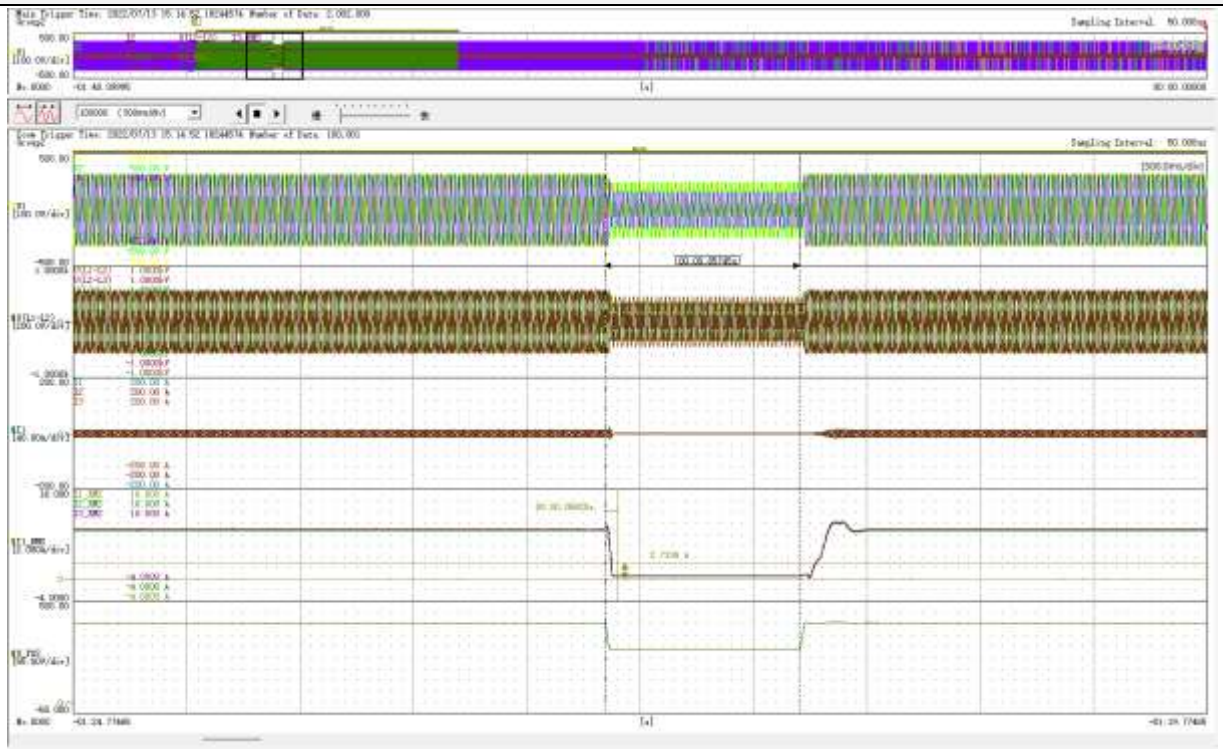


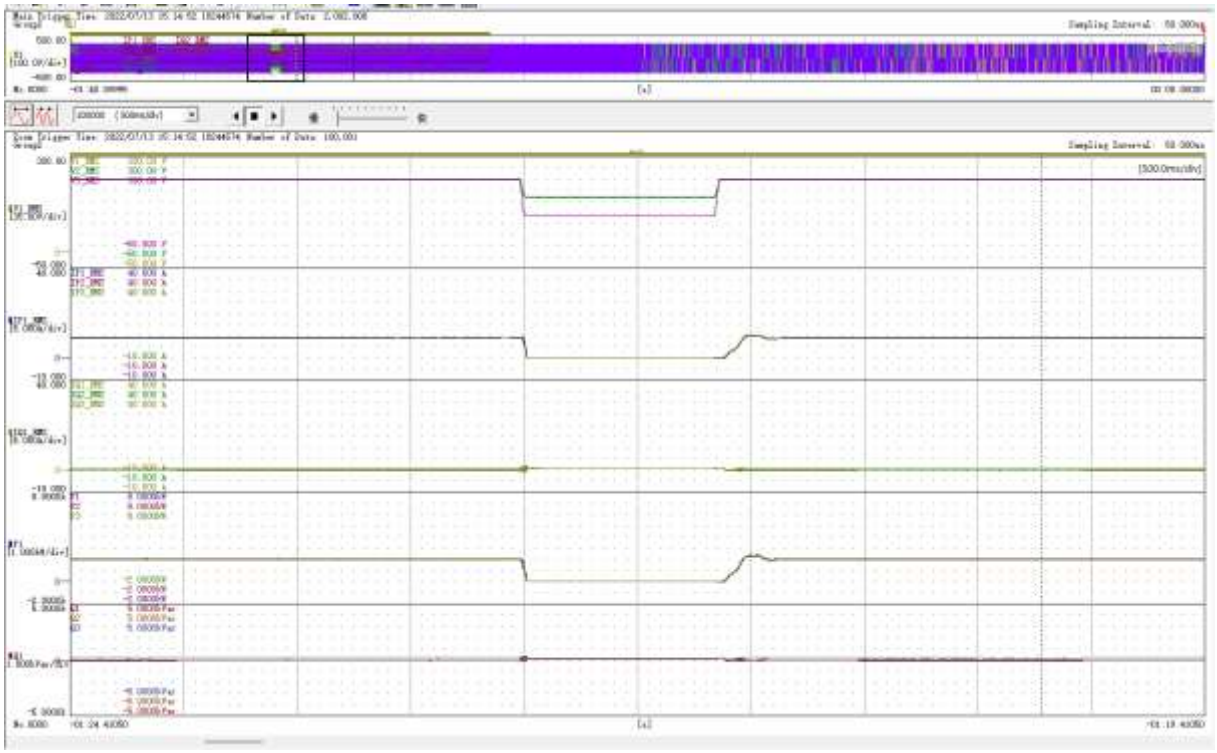


Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2,1	2,2
	1	Date	--	--	yyyy.mm.dd	2022,07,13	2022,07,13
	2	Time (start of test)	--	--	hh:mm:ss.f	14:10:52	13:59:25
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0,5	0,5
	5	Setting dip duration		--	--	840	840
	6	Point of fault entry	Total	--	ms	21134	20553
	7	Point of fault clearance	Total	--	ms	21983	21412
	8	Fault duration in empty load test	Total	--	ms	854,8	854,8
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,497	0,497
	10		Phase 2			0,496	0,496
	11		Phase 3			0,498	0,498
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,996	0,994
	14		Phase 2			0,992	0,989
	15		Phase 3			0,995	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997	0,303
	17	Active power	Total	t1-10s to t1	p.u.	0,991	0,300
	18		Pos.			0,990	0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,036	0,012
	20		Pos.			0,021	0,003
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,497	0,497
	23		Phase 2			0,495	0,494
	24		Phase 3			0,496	0,496
	25	Line current	Phase 1	t1+60ms	p.u.	0,014	0,014
	26		Phase 2			0,015	0,013
	27		Phase 3			0,014	0,014
	28	Line current	Phase 1	t1+100ms	p.u.	0,014	0,014
	29		Phase 2			0,014	0,013
	30		Phase 3			0,014	0,014
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000	0,000
	32		Pos.			0,000	0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,996	0,994
	34		Phase 2			0,992	0,989
	35		Phase 3			0,995	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,991	0,300
	37		Pos.			0,990	0,300
	38	Active power rising time	Pos.	--	s	0,159	0,118
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,036	0,012
	40		Pos.			0,020	0,003
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

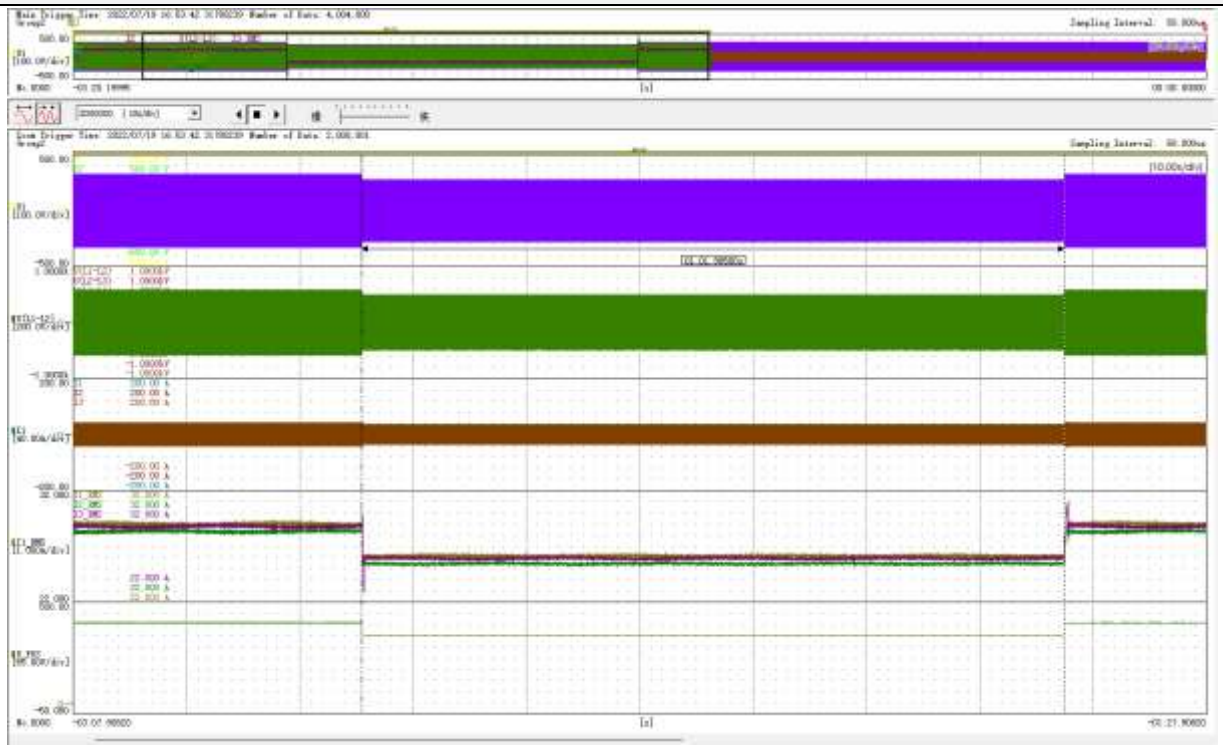
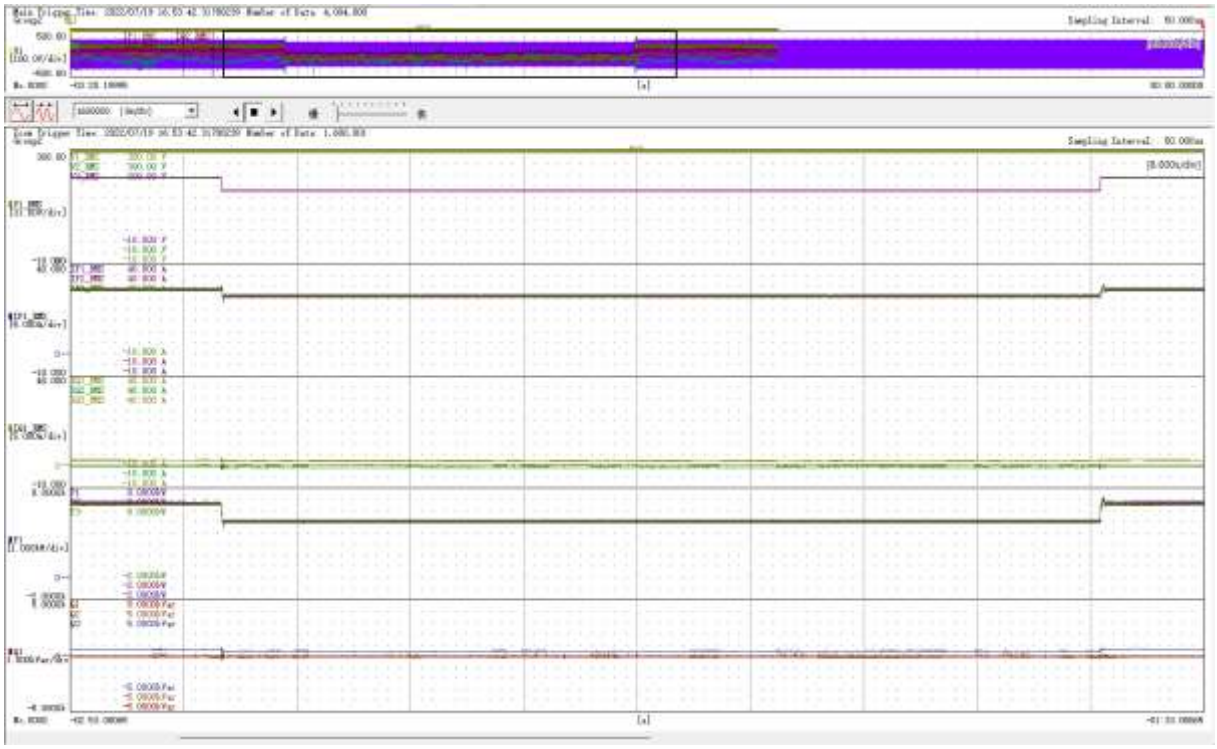
2.3



2.4

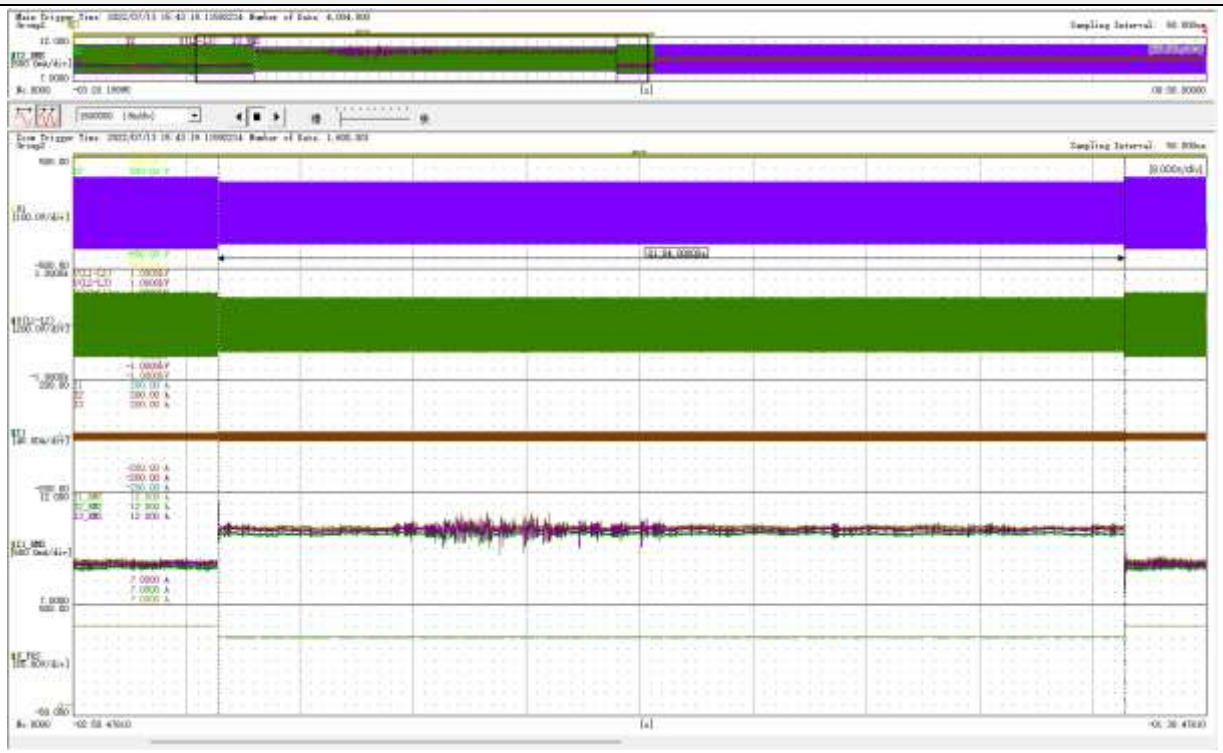


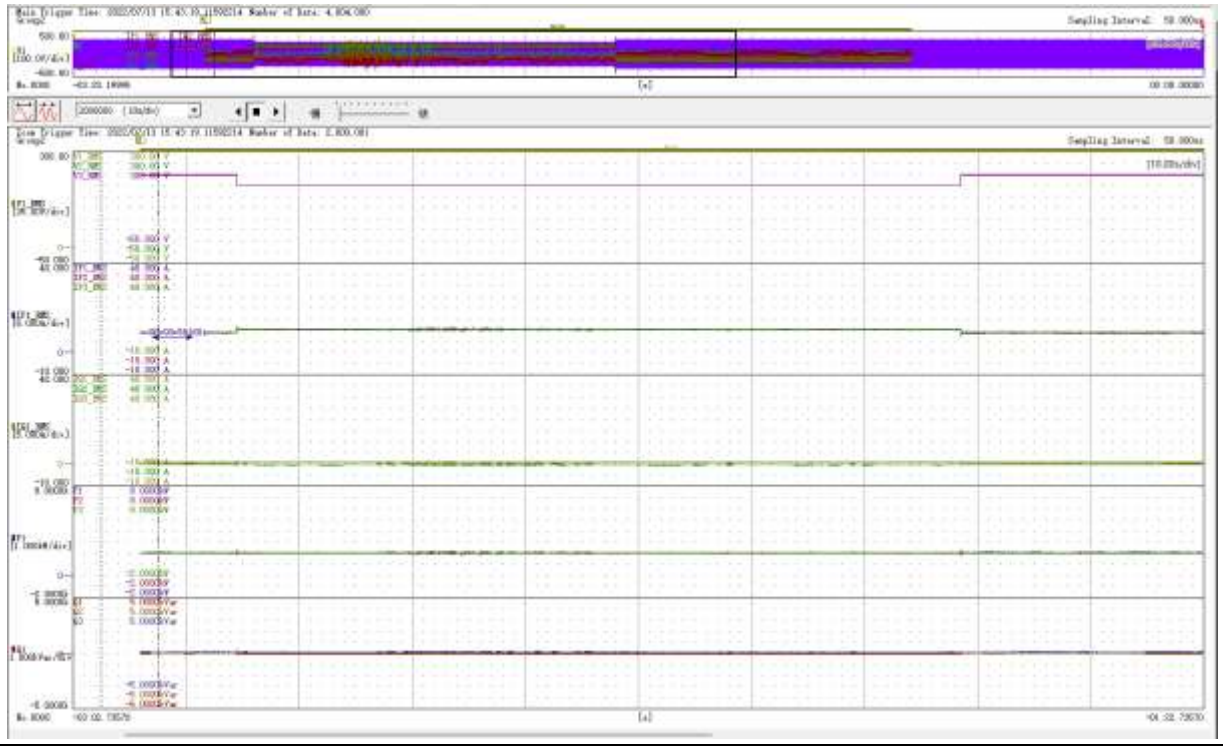


Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2,3	2,4
	1	Date	--	--	yyyy.mm.dd	2022,07,13	2022,07,13
	2	Time (start of test)	--	--	hh:mm:ss.f	15:03:16	15:14:52
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,5	0,5
	5	Setting dip duration		--	--	840	840
	6	Point of fault entry	Total	--	ms	18341	17673
	7	Point of fault clearance	Total	--	ms	19192	18524
	8	Fault duration in empty load test	Total	--	ms	856	856
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,755	0,755
	10		Phase 2			0,754	0,754
	11		Phase 3			0,498	0,498
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,996	0,994
	14		Phase 2			0,992	0,990
	15		Phase 3			0,995	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,010	0,302
	17	Active power	Total	t1-10s to t1	p.u.	1,005	0,300
	18		Pos.			1,004	0,300
	19	Reactive power	Total	t1-10s to t1	p.u.	0,040	0,012
	20		Pos.			0,022	0,004
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,755	0,755
	23		Phase 2			0,751	0,751
	24		Phase 3			0,496	0,496
	25	Line current	Phase 1	t1+60ms	p.u.	0,021	0,021
	26		Phase 2			0,022	0,021
	27		Phase 3			0,014	0,014
	28	Line current	Phase 1	t1+100ms	p.u.	0,021	0,021
	29		Phase 2			0,021	0,021
	30		Phase 3			0,014	0,014
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000	0,000
	32		Pos.			0,000	0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,996	0,994
	34		Phase 2			0,992	0,990
	35		Phase 3			0,995	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,997	0,301
	37		Pos.			0,996	0,300
	38	Active power rising time	Pos.	--	s	0,159	0,105
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,037	0,011
	40		Pos.			0,021	0,003
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

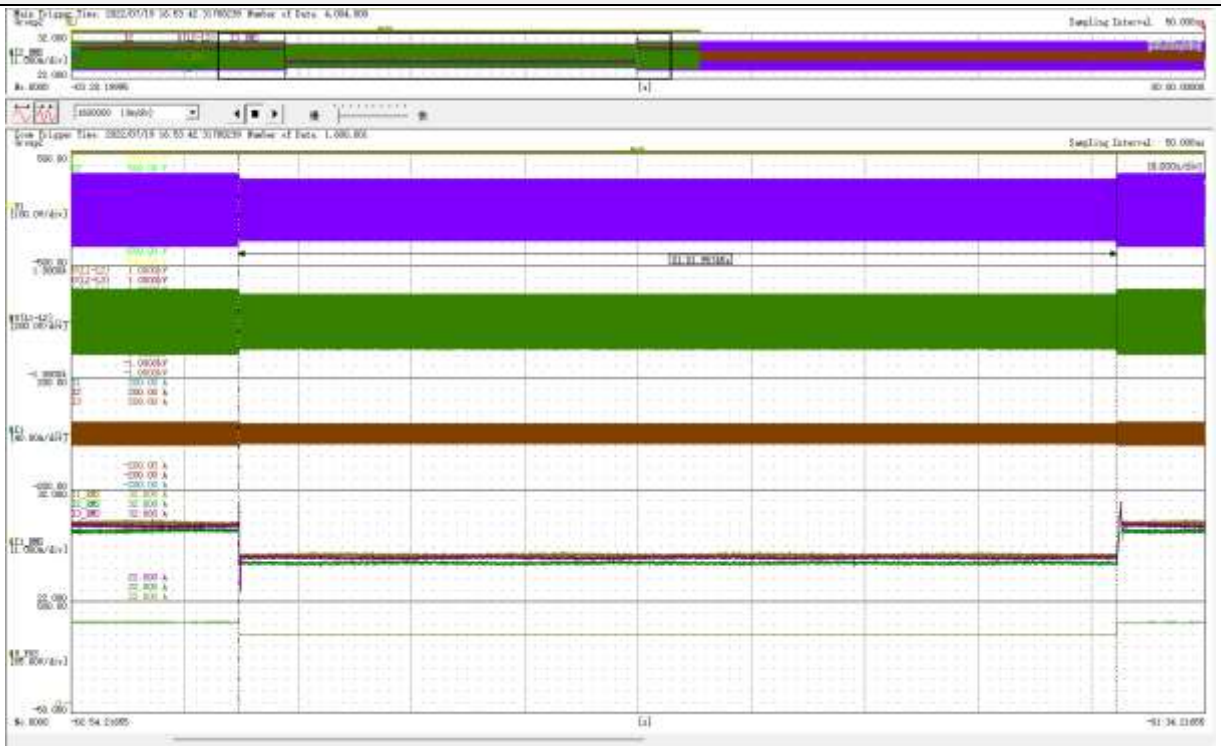
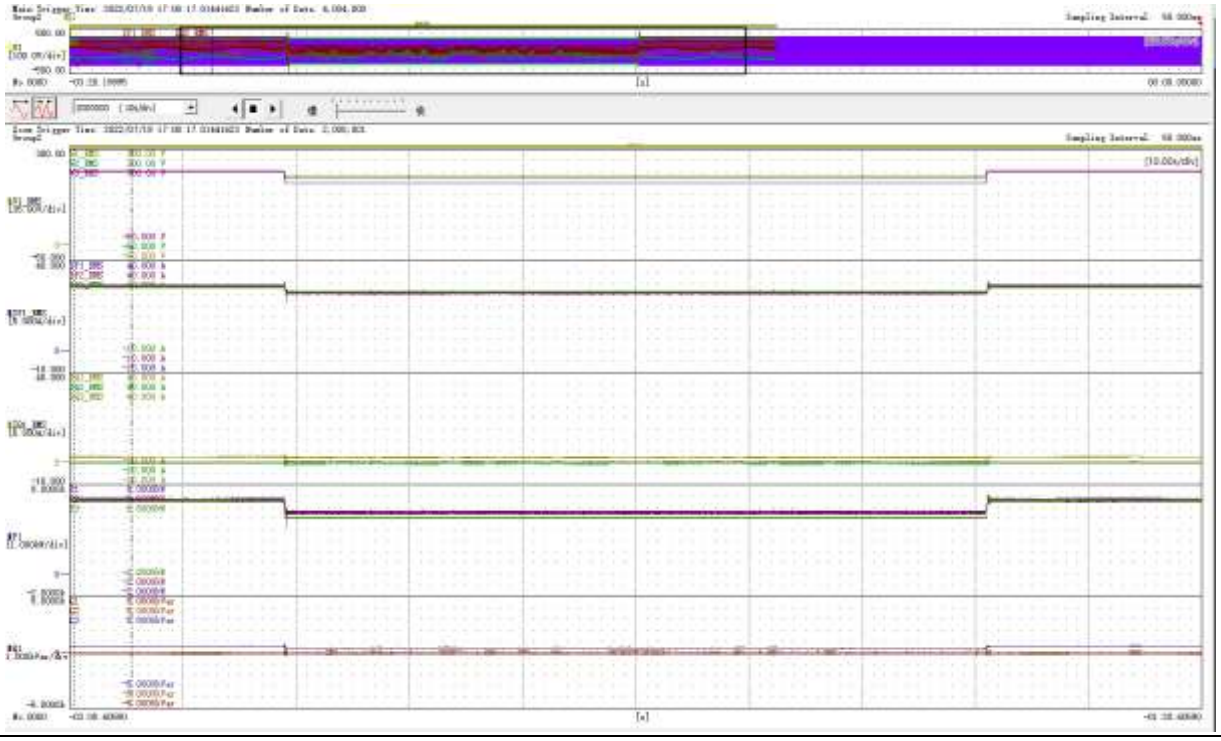
3.1



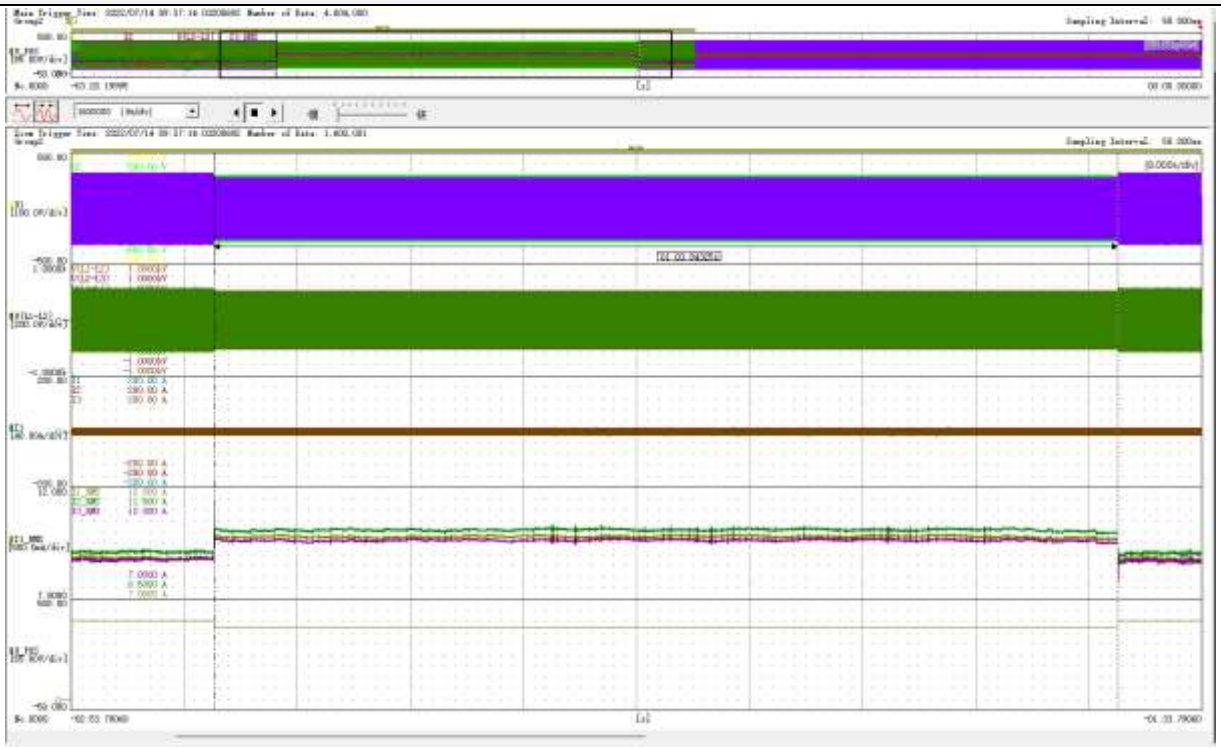
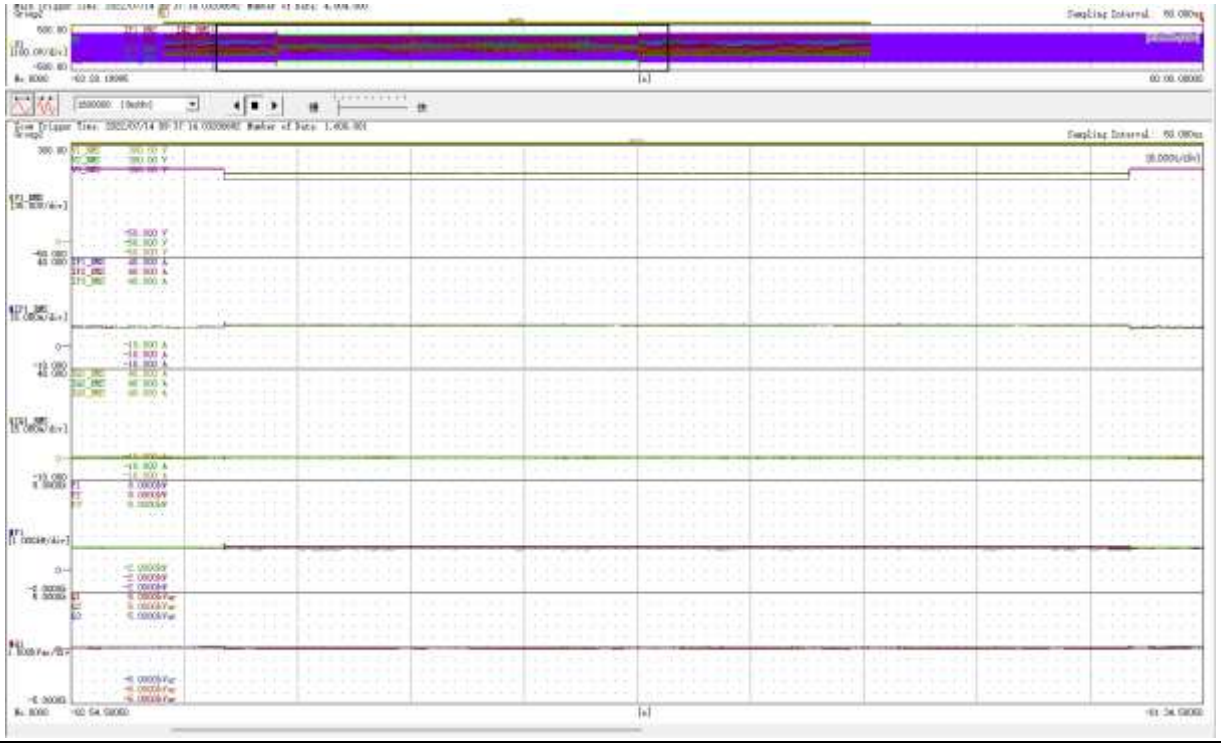
3.2





Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3,1	3,2
	1	Date	--	--	yyyy.mm.dd	2022,07,19	2022,07,13
	2	Time (start of test)	--	--	hh:mm:ss.f	16:53:42	15:43:19
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0,85	0,85
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry	Total	--	ms	37797	31972
	7	Point of fault clearance	Total	--	ms	99538	95780
	8	Fault duration in empty load test	Total	--	ms	63814	63814
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,845	0,845
	10		Phase 2			0,843	0,843
	11		Phase 3			0,847	0,847
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,004	0,994
	14		Phase 2			1,000	0,990
	15		Phase 3			1,003	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,989	0,303
	17	Active power	Total	t1-10s to t1	p.u.	0,992	0,300
	18		Pos.			0,990	0,300
	19	Reactive power	Total	t1-10s to t1	p.u.	0,037	0,012
	20		Pos.			0,022	0,003
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,847	0,845
	23		Phase 2			0,843	0,842
	24		Phase 3			0,846	0,844
	25	Line current	Phase 1	t1+60ms	p.u.	0,937	0,380
	26		Phase 2			0,912	0,365
	27		Phase 3			0,933	0,372
	28	Line current	Phase 1	t1+100ms	p.u.	0,899	0,348
	29		Phase 2			0,876	0,341
	30		Phase 3			0,896	0,345
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,752	0,300
	32		Pos.			0,751	0,299
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,004	0,994
	34		Phase 2			1,000	0,990
	35		Phase 3			1,003	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,992	0,301
	37		Pos.			0,990	0,300
	38	Active power rising time	Pos.	--	s	0,297	0,171
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,038	0,011
	40		Pos.			0,022	0,004
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

3.3



3.4



Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3,3	3,4
	1	Date	--	--	yyyy.mm.dd	2022,07,19	2022,07,14
	2	Time (start of test)	--	--	hh:mm:ss.f	17:08:17	9:37:14
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,85	0,85
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry	Total	--	ms	38583	36493
	7	Point of fault clearance	Total	--	ms	100387	100288
	8	Fault duration in empty load test	Total	--	ms	63737	63737
	9	Voltage depth/height in empty load test	Phase 1	t1+100ms to t2	p.u.	0,924	0,924
	10		Phase 2			0,923	0,923
	11		Phase 3			0,847	0,847
	12		Pos.	t1-10s to t1		0,994	0,994
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,004	0,994
	14		Phase 2			1,001	0,989
	15		Phase 3			1,003	0,993
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,988	0,301
	17	Active power	Total	t1-10s to t1	p.u.	0,992	0,299
	18		Pos.			0,991	0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,036	0,012
	20		Pos.			0,021	0,004
	21	Cosφ	--	t1-10s to t1	--	1,000	1,000
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,926	0,924
	23		Phase 2			0,923	0,920
	24		Phase 3			0,846	0,844
	25	Line current	Phase 1	t1+60ms	p.u.	0,976	0,347
	26		Phase 2			0,972	0,338
	27		Phase 3			0,950	0,344
	28	Line current	Phase 1	t1+100ms	p.u.	0,909	0,332
	29		Phase 2			0,881	0,328
	30		Phase 3			0,892	0,329
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,801	0,299
	32		Pos.			0,801	0,299
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,004	0,994
	34		Phase 2			1,001	0,989
	35		Phase 3			1,004	0,993
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,992	0,297
	37		Pos.			0,991	0,296
	38	Active power rising time	Pos.	--	s	0,284	0,270
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,036	0,011
	40		Pos.			0,021	0,003
	41	Reactive power rising time	Pos.	--	s	0,000	0,000
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

Annex 2 – Default parameter settings

System Information	
Time:	2022-12-01 19:17:30
Device Name:	PCS-3-20KW-40A-1
Serial Number:	B112200100130
SW Version:	V1.07
Version:	251.03.08.00
Internal Version:	07.00.00.18
HW Version:	V1.00
Rated Capacity:	20KW
Safety Code:	Austria
Grid Standard:	TOR Erzeuger Type A

Grid and System Protection		
Level-1 Undervoltage Protection Threshold	184.0	V
Level-1 Undervoltage Protection Duration	75	Prd
Level-1 Overvoltage Protection Threshold	264.5	V
Level-1 Overvoltage Protection Duration	5	Prd
Level-2 Undervoltage Protection Threshold	57.5	V
Level-2 Undervoltage Protection Duration	25	Prd
Level-2 Overvoltage Protection Threshold	264.5	V
Level-2 Overvoltage Protection Duration	5	Prd
Level-1 Underfrequency Protection Threshold	47.50	Hz
Level-1 Underfrequency Protection Duration	5	Prd
Level-1 Overfrequency Protection Threshold	51.50	Hz
Level-1 Overfrequency Protection Duration	5	Prd
Level-2 Underfrequency Protection Threshold	47.50	Hz
Level-2 Underfrequency Protection Duration	5	Prd
Level-2 Overfrequency Protection Threshold	51.50	Hz
Level-2 Overfrequency Protection Duration	5	Prd

Note:

Default setting of the integrated Network and System (NS) protection may deviate to the recommended setting according to Annex A.3, chapter 5 or table 8, chapter 6.3.3.1, TOR Erzeuger Typ A Version 1.2. If needed the protection setting should be modified according to requirements of the network operator.

Reactive Power/Voltage Feature		
Q(U) Curve Switch	ON	
Q(U) Point1 Voltage	211.6	V
Q(U) Curve Point1 Reactive Power Percent	43.6	%
Q(U) Point2 Voltage	220.8	V
Q(U) Curve Point2 Reactive Power Percent	0.0	%
Q(U) Point3 Voltage	241.5	V
Q(U) Curve Point3 Reactive Power Percent	0.000	%
Q(U) Point4 Voltage	248.4	V
Q(U) Curve Point4 Reactive Power Percent	-43.6	%
Time constant for Q(U)	5.0	s
Minimum cos(phi)	0.400	

Cosφ(P) Curve		
Cosφ(P) Curve Switch	ON	
Cosφ(P) Curve PointA Power	0.0	%
Cosφ(P) Curve PointB Power	50.0	%
Cosφ(P) Curve PointC Power	100.0	%
Cosφ(P) Curve PointA PF	1.000	
Cosφ(P) Curve PointB PF	1.000	
Cosφ(P) Curve PointC PF	0.900	

Fix Q Parameter		
Q fix	ON	
Q/Smax	0.0	%

Fixed cos phi Parameter		
Cos phi fix Enable	ON	
Cos phi fix Value	1.000	

Grid Connected Restrictions		
Start Delay Time	60	s
Grid Connected Recovery Time from Grid Faults	300	s
Undervoltage Recovery Limit	195.5	V
Overvoltage Recovery Limit	250.7	V
Underfrequency Recovery Limit	47.50	Hz
Overfrequency Recovery Limit	50.10	Hz
Active power gradient after reconnection	8.0	%/min

Overvoltage Derating		
Overvoltage Derating Switch	ON	
P(U) Curve Start Voltage	253.0	V
Power of P(U) Curve Start Voltage	100.0	%
P(U) Curve End Voltage	257.6	v
Power of P(U) Curve End Voltage	0.0	%
P(U) Time constant	5.0	s

Overfrequency Derating		
FP Overfrequency Derating Switch	ON	
Start Threshold of FP Overfrequency Derating	50.20	Hz
Droop for P(f)	5.0	%
FPFrequency Threshold of Recovery Power from FP Overfrequency Derating	50.10	Hz
Allow Time of Recovery Power from FP Overfrequency Derating	1	s
Slow Loading Switch of Recovery Power from FP Overfrequency Derating	1	
Slow Loading Rate of Recovery Power from FP Overfrequency Derating	10.0	%

LVRT		
LVRT Switch	ON	
LVRT zero current ON	0.800	Un
LVRT Point 1	0.150	Un
LVRT Point 1 protect time	200	ms
LVRT Point 2	0.300	Un
LVRT Point 2 protect time	650	ms
LVRT Point 3	0.500	Un
LVRT Point 3 protect time	900	ms
LVRT Point 4	0.750	Un
LVRT Point 4 protect time	1500	ms
LVRT Point 5	0.810	Un
LVRT Point 5 protect time	1500	ms

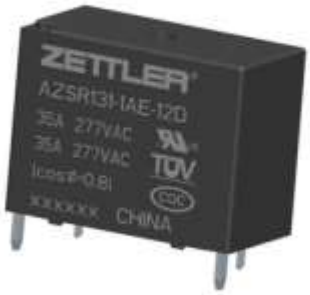
HVRT		
HVRT Switch	OFF	
HVRT Lock-in Voltage	1.141	Un

Others		
10-min Overvoltage Protection Switch	ON	
10-min Overvoltage Protection Threshold	255.3	V
Slow Loading Switch	ON	

Annex 3 – Datasheet of the interface System (Relay)

AZSR131

35 AMP MINIATURE POWER RELAY



FEATURES:

- Dielectric strength 4500Vrms, 10KV surge
- 35 Amp switching capability
- Contact gap : 1.8mm/2.3 mm available
- UL class F insulation system
- GWT(IEC60335-1) version available
- UL： E365652
- TUV： B 088793 005
- CQC： 17002168255

CONTACTS

Arrangement	SPST (1 Form A)
Ratings	Resistive load: Max. switched power: 9695VA Max. switched current: 35A Max. switched voltage: 277VAC Max. continuous current: 35 A
Rated Load UL	26A at 277 VAC, resistive, 85° C, 50k cycles 35A at 277 VAC, resistive, 85° C, 30k cycles
TUV/CQC	22A at 277 VAC, resistive, 70° C, 100k cycles 26A at 277 VAC, resistive, 85° C, 50k cycles 33A at 277 VAC, cos phi 0.8, 85° C, 50k cycles 35A at 277 VAC, cos phi 0.8, 85° C, 30k cycles
Material	AgSnO2(Silver tin oxide)
Resistance	＜100 mΩ initially (at 6V, 1A, voltage drop method)

COIL

Power At pickup Voltage Max. Continuous Dissipation Temperature Rise	790 mw (typical) 2.0 W at 20℃(68℉) ambient 70℃ Max. at Rated voltage,35A,85℃
Temperature	Max. 155℃(311℉) class F

NOTES

1.All values at 20℃(68℉)
2.Relay may pull in with less than "Must Operate" value
3.Specifications subject to change without notice

GENERAL DATA

Life Expectancy Mechanical Electrical	Minimum operations 100,000 cycles Min. (2.3mm gap) 300,000 cycles Min. (1.8mm gap) See UL/TUV/CQC ratings
Operate Time(typical)	20 ms Max. at nominal coil voltage
Release Time(typical)	10 ms Max. at nominal coil voltage (with no coil suppression)
Dielectric Strength (Initial.)	4500 Vrms(coil to contacts) 2500 Vrms(between open contacts)
Surge Voltage	10KV @1.2/50μs (coil to contacts)
Insulation Resistance	1,000MΩ min. at 20℃ 500VDC 50% RH
Holding voltage	Greater than 35% of nominal coil voltage
Dropout	Greater than 5% of nominal coil voltage
Ambient Temperature Operating Storage	At rated coil voltage -40℃(-40F)to 85℃(185℉) -40℃(-40F)to 105℃(221℉)
Vibration	1.5mm DA at 10-55 Hz
Shock	20g
Enclosure	P.B.T, Polyester
Terminals	Tinned copper alloy, P.C.
Max. Solder Temp.	270℃(518℉)
Max. solder time	5 seconds
Weight	25g
Packing unit in pcs	50per tray/500per carton box

ZETTLER RELAY (XIAMEN) CO., LTD. *www.zettlercn.com*
5F,No.6 , Xinjin Road , Xinyang Industrial Zone, Haicang District, Xiamen, China. Tel:(0592)2631523 Fax: (0592)2631599

7/25/17

AZSR131

RELAY ORDERING DATA

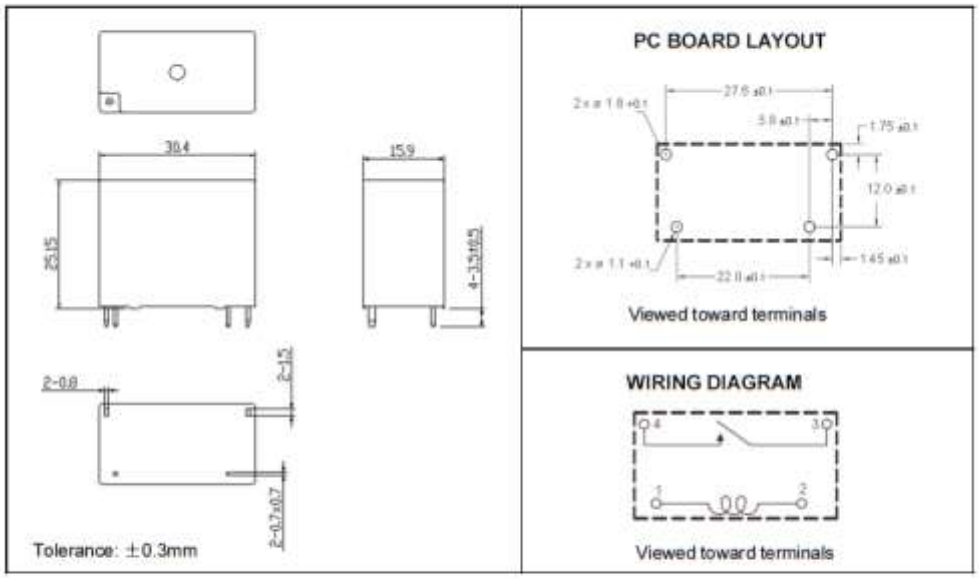
COIL SPECIFICATIONS @20℃					ORDER NUMBER
Nominal Coil VDC	Must Operate VDC	Min. holding VDC	Max. Continuous VDC	Coil Resistance Ω± 10%	
5	3.75	1.75	6	18	AZSR131-1AE-5D
9	6.75	3.20	10.8	58	AZSR131-1AE-9D
12	9	4.2	14.4	103	AZSR131-1AE-12D
18	13.5	6.3	21.6	230	AZSR131-1AE-18D
24	18	8.4	28.8	410	AZSR131-1AE-24D
48	36	16.8	57.6	1650	AZSR131-1AE-48D

NOMENCLATURE

AZSR131 - 1A E - 12D GW (200) (XXX)
I II III IV V VI VII

I. Basic Series	AZSR131
II. Contact Form	1A: 1 form A
III. Contact Material	E: AgSnO2
IV. Coil Voltage	5, 9, 12, 18, 24, 48 VDC.
V. Glow wire degree	Blank: without glow wire GW: with glow wire
VI. Contact Gap	Blank: 1.8 mm (200): 2.3 mm
VII. Special code	Additional numbers or letters, which does not designate construction features or ratings

MECHANICAL DATA



ZETTLER RELAY (XIAMEN) CO., LTD. *www.zettlercn.com*
5F,No.6 , Xinjin Road , Xinyang Industrial Zone, Haicang District, Xiamen, China. Tel:(0592)2631523 Fax: (0592)2631599

7/25/17

AZSR143

50 AMP MINIATURE POWER RELAY

FEATURES

- 50 Amp switching capability
- Contact gap: 1.8mm standard / 2.0mm available
- Dielectric strength 4.5 kV_{RMS}
- 10kV Surge
- UL class F insulation
- UL / CUR E365652
- TÜV B0887930015
- CQC 19002227975

CONTACTS

Arrangement	SPST-N.O. (1 Form A)
Ratings (max.) switched power switched current continuous current switched voltage	(resistive load) 1385.0 VA 50 A 50 A 277 VAC
Rated Loads **UL/CUR/TÜV/CQC**	43 A at 277 VAC, resistive, 85 °C, 30k cycles 33 A at 277 VAC, resistive, 105°C, 30k cycles 50 A at 277 VAC, resistive, 85 °C, 6k cycles 20 A at 277 VAC on, carry 50A, 20A 277VAC off, resistive, 85 °C, 50k cycles
Contact material	$AgSnO_2$ (silver tin oxide)
Contact gap standard version option (103) version	 1.8 mm 2.0 mm
Contact resistance initial typical	(load contact) ≤ 100 mΩ < 3 mΩ

COIL

Nominal coil DC voltages	5, 9, 12, 18, 24, 48
Dropout voltage	> 5% of nominal coil voltage
Holding voltage	> 35% of nominal coil voltage
Coil power nominal holding power at pickup voltage	(at 23 °C) 1.6 W 196 mW 900 mW
Temperature Rise	70 K (126°F) at nom. coil voltage, 85°C
Max. temperature	Class F insulation - 155°C (311°F)

GENERAL DATA

Life Expectancy mechanical electrical	(minimum operations) 1 x 10^5 see UL/CUR/TÜV/CQC ratings
Operate Time	20 ms (max.) at nominal coil voltage
Release Time	10 ms (max.) at nominal coil voltage, without coil suppression
Dielectric Strength coil to load contacts open load contacts	(at sea level for 1 min.) 4500 V_{RMS} 2500 V_{RMS}
Surge Voltage	10kV @1.2/50µs (coil to contacts)
Insulation Resistance	1000 MΩ (min.) at 23°C, 500 VDC, 50% RH
Temperature Range operating	(at nominal coil voltage) -40°C (-40°F) to 85°C (185°F)
Vibration resistance	0.062" (1.5 mm) DA at 10–55 Hz
Shock	20 g
Enclosure protection category material group flammability	P.B.T. polyester RT II, flux proof IIIa UL94 V-0
Terminals	Tinned copper alloy, P. C.
Soldering max. temperature max. time	 270 °C 5 s
Dimensions length width height	 35.0 mm (1.38") 16.0 mm (0.63") 27.9 mm (1.10")
Weight	25 grams (approx.)
Compliance	UL 508, IEC 61810-1, RoHS, REACH
Packing unit in pcs	50 per plastic tray / 500 per carton box

ZETTLER

www.ZETTLER-group.com page 1 of 3 2020-06-26

AZSR143

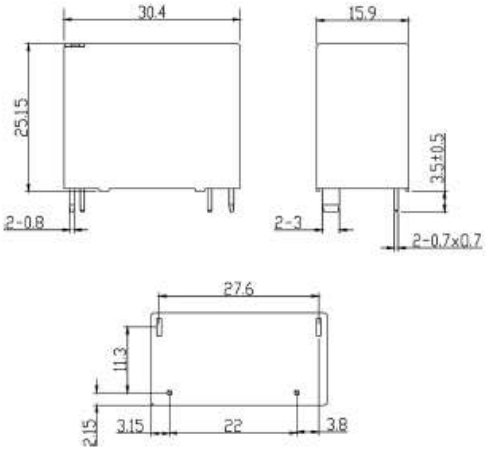
COIL VOLTAGE SPECIFICATIONS

Nominal Coil VDC	Must Operate VDC	Min. Holding VDC	Max. Cont. VDC	Resistance Ohm ± 10%
5	3.75	1.75	6.0	15.5
9	6.75	3.15	10.8	50.5
12	9.0	4.2	14.4	90.0
18	13.5	6.3	21.6	202.5
24	18.0	8.4	28.8	360.0
48	36.0	16.8	57.6	1440

Note: All values at 23°C (73°F), upright position, terminals downward.

MECHANICAL DATA

Dimensions in mm. Tolerance: ±0.3mm



ORDERING DATA

AZSR143-1AE-□□D□□□

Options
nil: standard version
(103): 2.0 mm contact gap version

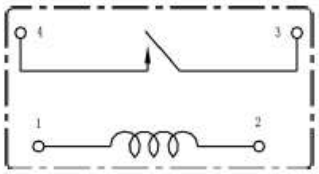
Nominal coil voltage
see coil voltage specifications table

Example ordering data

AZSR143-1AE-24D	24 VDC nominal coil voltage, 1.8 mm contact gap
AZSR143-1AE-24D(103)	24 VDC nominal coil voltage, 2.0 mm contact gap

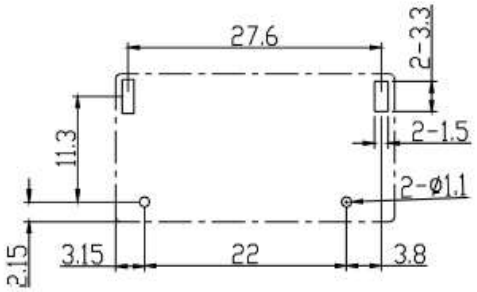
WIRING DIAGRAMS

Viewed towards terminals



PC BOARD LAYOUT

Viewed towards terminals. Dimensions in mm.



NOTES

1. All values at 23°C (73°F).
2. Relay may pull in with less than "Must Operate" value.
3. Provide sufficient PCB cross section as heat spreader on terminals.
4. Specifications subject to change without notice.

HF161F-W SOLAR RELAY

c UL us
File No.:E134517

File No.:40031410

File No.:CQC10002050943
CQC18002203499

Features

- 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 62109-2-2011)
- The clearance distance between contact and coil is bigger than 6.4mm, the creepage distance is bigger than 8mm. (special code 477: 7.5mm)
- Low coil holding voltage contributes to saving energy of equipment.
- UL insulation system: Class F

RoHS compliant

CONTACT DATA

Contact gap	1.5mm	1.8mm	2.0mm	2.3mm
Contact arrangement	1A			
Contact resistance[1]	≤100mΩ (1A 6VDC)			
Contact material	$AgSnO_2$			
Contact rating	Resistive: 26A 250VAC Inductive: 31A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC Inductive: 33A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC Inductive: 31A 250VAC (cosø=0.8) 0.1s:10s	Resistive: 26A 250VAC
Max. switching voltage	277VAC			
Max. switching current	31A	33A	31A	26A
Max. switching power	7750VA	8250VA	7750VA	7202VA
Mechanical endurance	1×10^6 OPS	1×10^5 OPS	1×10^5 OPS	1×10^5 OPS
Electrical endurance	HT type: 3×10^4 OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3×10^4 OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3×10^4 OPS (26A 250VAC Resistive 75°C 1.5s on 1.5s off)	HT type: 3×10^4 OPS (26A 250VAC Resistive Room temp. 1.5s on 1.5s off)

Notes: 1)The data shown above are initial values.

COIL

Coil power	Approx. 1.4W
Holding voltage	35% to 120%U_N (at 23°C) 45% to 80%U_N (at 85°C)

Notes: 1)The coil holding voltage is the voltage of coil after being applied rated voltage for 100ms
2)The relay coil does not allow applied more than maximum of holding voltage values for a long time (Eg: 120% Un at 23°C; 80% Un at 85°C), prevent overheating burned.

COIL DATA at 23°C

Nominal Voltage VDC	Pick-up Voltage VDC max.[1]	Drop-out Voltage VDC min.[1]	Max. Voltage VDC*[2]	Coil Resistance Ω
9	6.3	0.9	10.8	58 x (1±10%)
12	8.4	1.2	14.4	103 x (1±10%)
18	12.6	1.8	21.6	230 x (1±10%)
24	16.8	2.4	28.8	410 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.

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	4500VAC 1min
	Between open contacts	2500VAC 1min
Surge voltage (between coil & contacts)		10kV (1.2/50μs)
Operate time (at rated. volt.)		20ms max.
Release time (at rated. volt.)		10ms max.
Temperature rise (at rated. volt.)		95K max. (Contact load current 31A, rated voltage excitation, at 60°C)
		70K max. (Contact load current 31A, 80% of rated voltage excitation, at 85°C)
Shock resistance	Functional	196m/s²
	Destructive	980m/s²
Vibration resistance		10Hz to 55Hz 1.5mm DA
Ambient temperature		-40°C to 85°C (Apply holding voltage to coil, which is 45% to 80% that of rated voltage)
Humidity		5% to 85% RH
Termination		PCB
Unit weight		Approx. 21g
Construction		Flux proofed

Notes: The data shown above are initial values.

SAFETY APPROVAL RATINGS

UL/CUL	$AgSnO_2$	26A 277VAC at 75°C 22A 277VAC at 85°C
VDE	$AgSnO_2$	26A 277VAC at 75°C 22A 277VAC at 85°C 31A 250VAC cosø=0.8 0.1s:10s 33A 250VAC cosø=0.8 0.1s:10s (477)

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

HONGFA RELAY
ISO9001、ISO/TS16949、ISO14001、OHSAS18001、IECQ QC 080000 CERTIFIED 2019 Rev. 1.00

ORDERING INFORMATION

	HF161F-W /	12	-H	T	(XXX)
Type					
Coil voltage	9, 12, 18, 24VDC				
Contact arrangement	H: 1 Form A				
Contact matcrial	T: $AgSnO_2$				
Special code[3]	XXX: Customer special requirement		Nil: Standard		

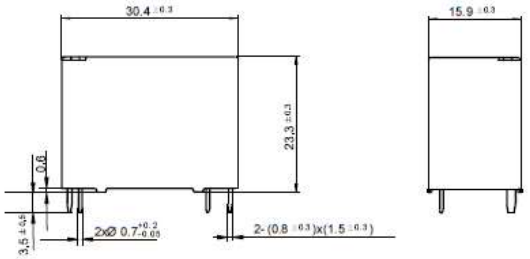
Notes: 1) Water cleaning or surface process is not suggested after the flux-proofed relays are assembled on PCB.
2) Flux-proofed relays can not be used in the environment with pollutants like H_2S, SO_2, NO_2, dust, etc.
3) The customer special requirement express as special code after evaluating by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

OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

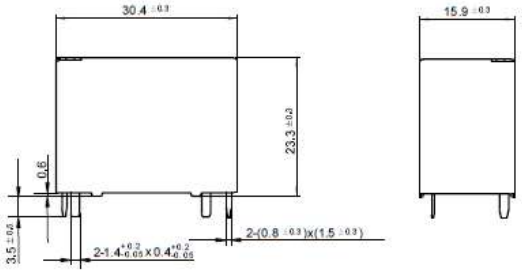
Unit mm

Outline Dimensions

Standard type



(414) special code version

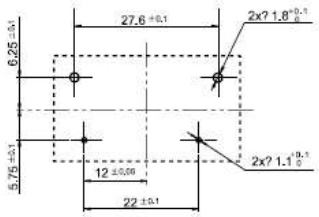


OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

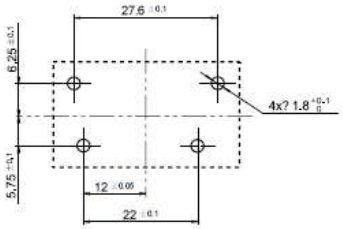
Unit: mm

PCB Layout (Bottom view)

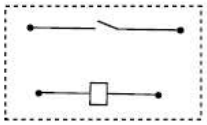
Standard type



(414) special code version



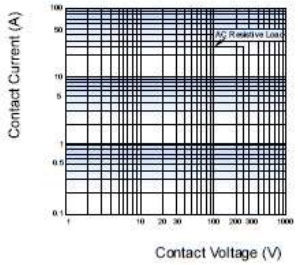
Wiring Diagram



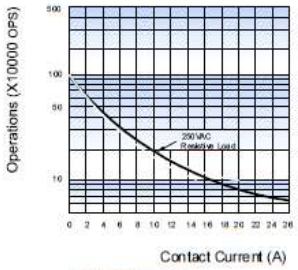
Remark: 1) In case of no tolerance shown in outline dimension: outline dimension ≤1mm, tolerance should be ±0.2mm; outline dimension >1mm and ≤5mm, tolerance should be ±0.3mm; outline dimension >5mm, tolerance should be ±0.4mm.
2) The tolerance without indicating for PCB layout is always ±0.1mm.

CHARACTERISTIC CURVES

MAXIMUM SWITCHING POWER



ENDURANCE CURVE



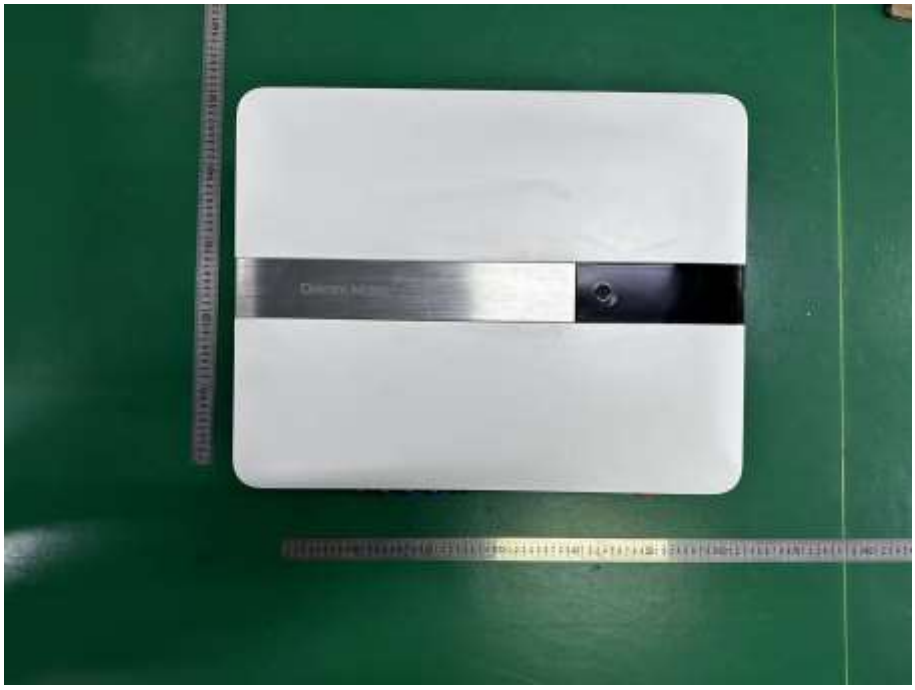
Test conditions:
at 75°C, 1.5s on 1.5s off.

Disclaimer

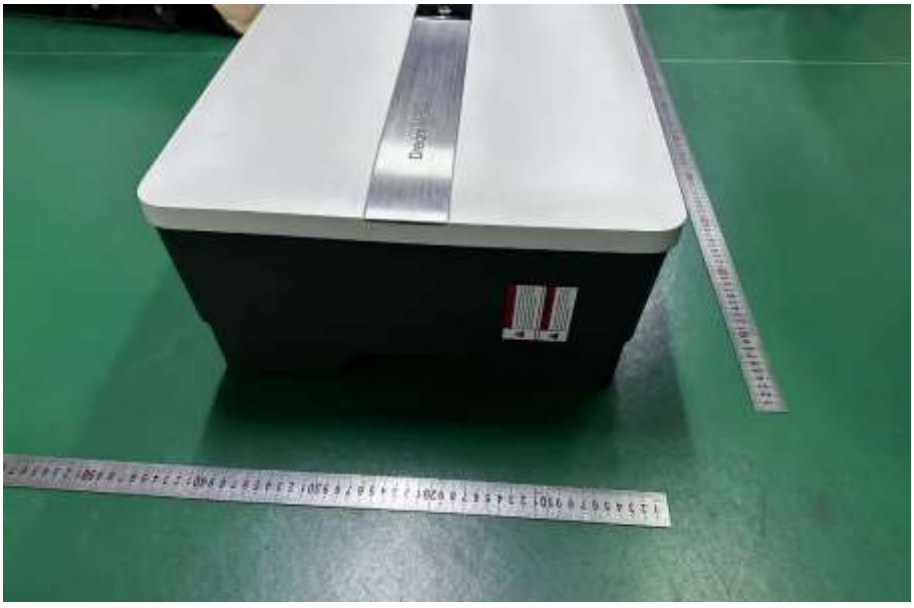
The specification is for reference only. See to "Terminology and Guidelines" for more information. Specifications subject to change without notice. We could not evaluate all the performance and all the parameters for every possible application. Thus the user should be in a right position to choose the suitable product for their own application. If there is any query, please contact Hongfa for the technical service. However, it is the user's responsibility to determine which product should be used only.

Annex 4 – Pictures of the unit

Enclosure front view



Enclosure side view



Enclosure side view

Enclosure TOP view:

Enclosure bottom view:

PCS-3-4KW-25A-1, PCS-3-5KW-25A-1, PCS-3-6KW-25A-1, PCS-3-8KW-25A-1, PCS-3-10KW-25A-1, PCS-3-12KW-25A-1

Enclosure bottom view:

PCS-3-10KW-40A-1, PCS-3-12KW-40A-1, PCS-3-15KW-40A-1, PCS-3-20KW-40A-1

Enclosure rear view:

PCS-3-4KW-25A-1, PCS-3-5KW-25A-1, PCS-3-6KW-25A-1, PCS-3-8KW-25A-1, PCS-3-10KW-25A-1, PCS-3-12KW-25A-1

Enclosure rear view:

PCS-3-10KW-40A-1, PCS-3-12KW-40A-1, PCS-3-15KW-40A-1, PCS-3-20KW-40A-1

Annex 5 – Test equipment list

Date(s) of performance of tests: 2022-05-12 to 2023-04-14

Equipment	Internal No.	Manufacturer	Type	Serial No.	Due date Calibration
DC source	HC-ENG-011	Chroma	62150H-1000S	62150EF00314	Monitored by Power Analyzer
	HC-ENG-010	Chroma	62150H-1000S	62150EF01653	
AC source	HC-ENG-012	Chroma	61830	//	
Load	HC-ENG-005	Qunling	ACLT-3803H	93H006289	
Data acquisition instrument	HC-ENG-003	DEWESOFT	SIRIUSi-HS-4xHV-4xLV	DB20123915	2023-09-05
Digital Oscilloscopes	HC-ENG-009	YOKOGAWA	DL850	91P215763	2023-08-14
	//	Tektronix	MSO56 5-BW-500	//	2023-03-10
Current sensor	HC-ENG-019	LEM	IT 400-S	82021060080	2023-09-05
	HC-ENG-020	LEM	IT 400-S	82021060081	2023-09-05
	HC-ENG-021	LEM	IT 400-S	82021060082	2023-09-05
	HC-ENG-022	LEM	IT 400-S	82021060084	2023-09-05

---End of Test Report---