TOR Erzeuger Typ A Version 1.1:12.12.2019
Connection and parallel operation of power generation plants of type A and of small generation plants (maximum capacity <250 kW and nominal voltage <110 kV)
In junction with OVE-Richtlinie R 25:2020-03-01

Report Reference No..... ...: 210727058GZU-001
Date of issue .....: 09 Sep 2021
Total number of pages.....: 96 pages

Testing Laboratory	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Address.....	Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China
Testing location/ address.....	Same as above
Tested by (name + signature).....:	Gaison Engineer
Approved by (+ signature).....	Jason Fu Supervisor

Applicant's name	Zucchetti Centro Sistemi SpA
Address.....	Via Lungarno 305/A 52028 Terranuova Bracciolini (AR) Italy

Test specification:

Standard	TOR Erzeuger Typ A Version 1.1: 12.12.2019 OVE-Richtlinie R 25:2020-03-01
Test procedure.....	Type test
Non-standard test method.....:	N/A

Test Report Form No.	TOR Erzeuger Typ A Version 1.1b
Test Report Form(s) Originator	Intertek Guangzhou
Master TRF	Dated 2020-06

Test item description	Hybrid inverter
Trade Mark.....	ZCS
Manufacturer.....	Same as Applicant
Model/Type reference :	AZZURRO 3PH HYD5000 ZSS, AZZURRO 3PH HYD6000 ZSS, AZZURRO 3PH HYD8000 ZSS, AZZURRO 3PH HYD10000 ZSS, AZZURRO 3PH HYD15000 ZSS, AZZURRO 3PH HYD20000 ZSS
Ratings.....	See ratings in page 7-8

Summary of testing:

Tests performed (name of test and test clause):

TOR Erzeuger Typ A Version 1.1 (OVE-Richtlinie R 25)	Test Description
4 (5.1.2)	Rapid voltage changes
4 (5.1.3)	Flicker
4 (5.1.4)	Harmonics and inter-harmonics
6.1.1 (5.2)	Testing the symmetry behavior of three-phase inverters
5.3.3 (5.3.2)	Measuring the active and reactive power working range ("PQ diagram")
5.4.1 (5.3.3)	Termination of active power supply after off command via telecontrol interface (input port)
5.1.3 (5.3.4)	Active power reduction at overfrequency
5.1.5 (5.3.5)	Frequency-dependent active power reduction (active power at underfrequency)
5.3.6 (5.3.6)	Voltage controlled active power control P (U)
5.3.4 (5.3.7)	Reactive power control according to setpoint specification "cos φ fixed"
5.3.4.1 (5.3.8)	Reactive power control "cos φ (P)"
5.3.4 (5.3.9)	Reactive power control according to setpoint specification "Q fix"
5.3.4.2 & 5.3.6 (5.3.10)	Voltage-controlled control functions (reactive power control Q (U) and active power control P (U))
6.2.3 (5.3.11)	Protection of the settings as requested by the TOR producers
6.1.2 (5.4.1)	Voltage protection
6.1.2 (5.4.2)	Frequency protection
6.1.2 (5.4.3)	Detection of unwanted island operation
5.5.2 (5.5)	Checking the connection conditions and synchronization
5.2 (5.6)	Dynamic network support

Remark:

Other than special notice, the model AZZURRO 3PH HYD20000 ZSS is type tested.

Testing location:

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch

Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China

Copy of marking plate

ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD5000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	12.5/12.5A
Max.PV Isc	15/15A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	8A
Max. Power Output to Grid	5500VA
Max. Current from Grid	15A
Max. Power from Grid	10000VA
Back-up Max. Output Current	8A
Back-up Max. Output Power	5500VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60°C
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III, DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
Manufactured in PRC

CEI0-21,CEI0-16,VDE-AR-N4105,UNE206007-1,
EN50549-1,UTE C15-712-1,VDE0126-1-1

ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD6000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	12.5/12.5A
Max.PV Isc	15/15A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	10A
Max. Power Output to Grid	6600VA
Max. Current from Grid	17A
Max. Power from Grid	12000VA
Back-up Max. Output Current	10A
Back-up Max. Output Power	6600VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60°C
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III, DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
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EN50549-1,UTE C15-712-1,VDE0126-1-1

ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD8000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	12.5/12.5A
Max.PV Isc	15/15A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	13A
Max. Power Output to Grid	8800VA
Max. Current from Grid	24A
Max. Power from Grid	16000VA
Back-up Max. Output Current	13A
Back-up Max. Output Power	8800VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60°C
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III, DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
Manufactured in PRC

CEI0-21,CEI0-16,VDE-AR-N4105,UNE206007-1,
EN50549-1,UTE C15-712-1,VDE0126-1-1

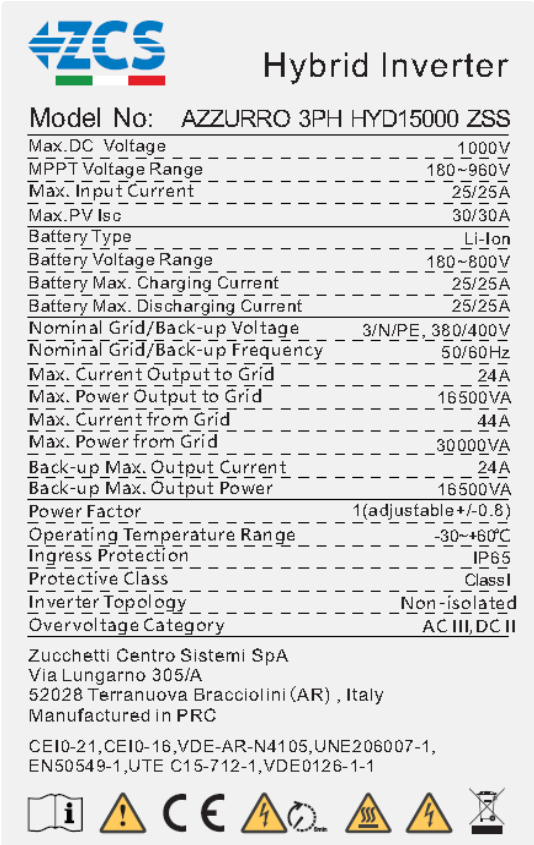
ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD10000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	25/25A
Max.PV Isc	30/30A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back up Voltage	3/N/PE, 380/400V
Nominal Grid/Back up Frequency	50/60Hz
Max. Current Output to Grid	16A
Max. Power Output to Grid	11000VA
Max. Current from Grid	29A
Max. Power from Grid	20000VA
Back up Max. Output Current	16A
Back up Max. Output Power	11000VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60°C
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non isolated
Overvoltage Category	AC III, DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
Manufactured in PRC

CEI0-21,CEI0-16,VDE-AR-N4105,UNE206007-1,
EN50549-1,UTE C15-712-1,VDE0126-1-1



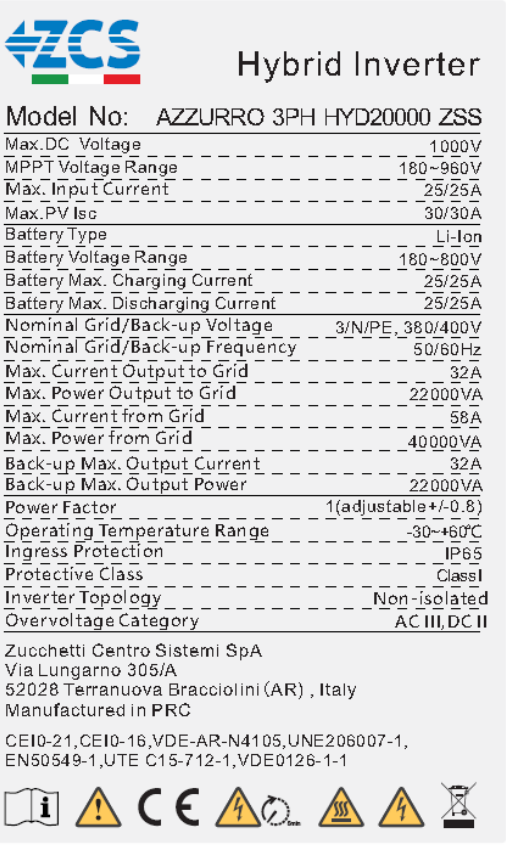
ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD15000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	25/25A
Max.PV Isc	30/30A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	24A
Max. Power Output to Grid	16500VA
Max. Current from Grid	44A
Max. Power from Grid	30000VA
Back-up Max. Output Current	24A
Back-up Max. Output Power	16500VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
Manufactured in PRC

CEI0-21,CEI0-16,VDE-AR-N4105,UNE206007-1,
EN50549-1,UTE C15-712-1,VDE0126-1-1



ZCS Hybrid Inverter

Model No: AZZURRO 3PH HYD20000 ZSS

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	25/25A
Max.PV Isc	30/30A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	32A
Max. Power Output to Grid	22000VA
Max. Current from Grid	58A
Max. Power from Grid	40000VA
Back-up Max. Output Current	32A
Back-up Max. Output Power	22000VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Zucchetti Centro Sistemi SpA
Via Lungarno 305/A
52028 Terranuova Bracciolini (AR) , Italy
Manufactured in PRC

CEI0-21,CEI0-16,VDE-AR-N4105,UNE206007-1,
EN50549-1,UTE C15-712-1,VDE0126-1-1

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation.

Test item particulars.....:		
Temperature range .....:	-30℃ - +60℃	
AC Overvoltage category.....:	☐ OVC I	☐ OVC II ☒ OVC III ☐ OVC IV
DC Overvoltage category .....:	☐ OVC I	☒ OVC II ☐ OVC III ☐ OVC IV
IP protection class .....:	IP 65	
Possible test case verdicts:		
- test case does not apply to the test object.....:	N/A (Not applicable)	
- test object does meet the requirement .....:	P (Pass)	
- test object does not meet the requirement .....:	F (Fail)	
Testing.....:		
Date of receipt of test item.....:	20 May 2021	
Date (s) of performance of tests.....:	20 May 2021–08 Jun 2021	

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

When determining for test conclusion, measurement uncertainty of tests has been considered.
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The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.

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

This is a copy report, the test records are based on original report No.210526211GZU-003, dated on 10 June 2021, issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

General product information:

The inverter converts DC voltage, generated by photovoltaic modules, into AC voltage.

The units are three-phases inverter. The input and output 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 redundant by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of one error.

The topology diagram as following:

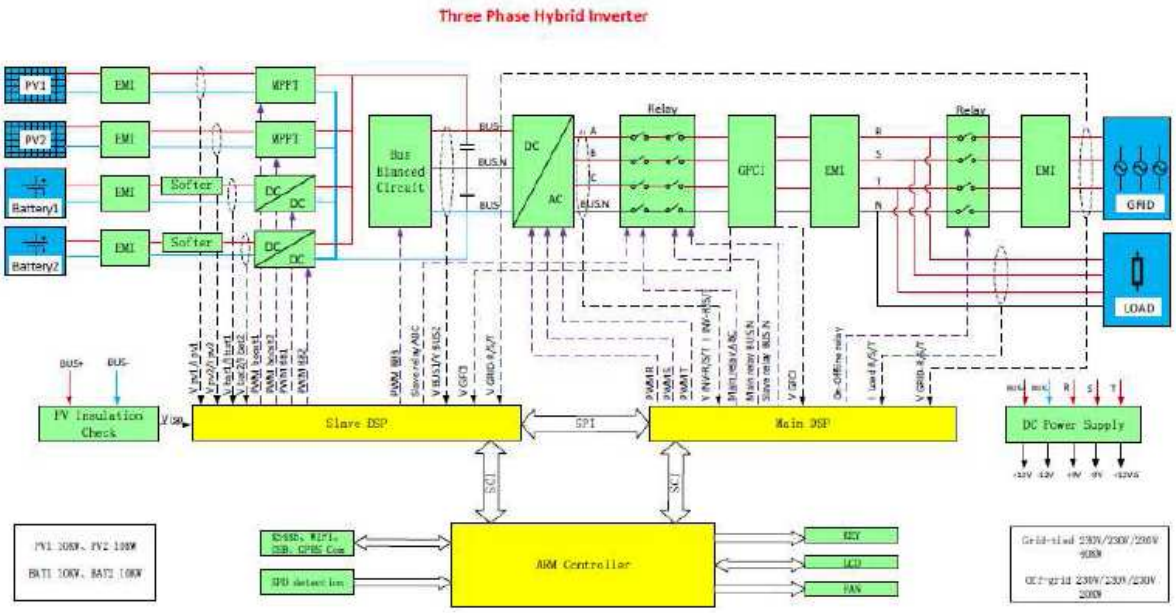


Figure 1 – Block diagram

The internal control is redundant built. It consists of master DSP(U37) and slave DSP(U39).

The master DSP (U37) control the relays by switch signals, measures PV voltage, PV current,Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground, in addition it tests the array insulation resistance and the RMCU circuit before each start up.

The slave DSP (U39) is measures the grid voltage, grid frequency and residual current , also can switch off the relays independently, and communicate with master DSP (U39).

The current is measured by a current sensor. The AC current signal and the injectied DC current signal are sent to the Main DSP(U37). The Mian DSP(U37) tests and calibrates before each start upp all current sensors.

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

Models difference:

Model AZZURRO 3PH HYD5000 ZSS, AZZURRO 3PH HYD6000 ZSS, AZZURRO 3PH HYD8000 ZSS, AZZURRO 3PH HYD10000 ZSS, AZZURRO 3PH HYD15000 ZSS, AZZURRO 3PH HYD20000 ZSS are completely identical and output power derated by software, except for the following table

Models	AZZURRO 3PH HYD5000 ZSS	AZZURRO 3PH HYD6000 ZSS	AZZURRO 3PH HYD8000 ZSS	AZZURRO 3PH HYD10000 ZSS	AZZURRO 3PH HYD15000 ZSS	AZZURRO 3PH HYD20000 ZSS
Inverter induction	0.876mH		1.12mH		1.5mH	

BOOST induction	0.915mH	1.8mH
Cooling system	Without external fans	With external fans

The product was tested on:
The Software Version: V1.0
The Hardware Version: V2.00

Ratings:

Model / Specifications	AZZURRO 3PH HYD5000 ZSS	AZZURRO 3PH HYD6000 ZSS	AZZURRO 3PH HYD8000 ZSS	AZZURRO 3PH HYD10000 ZSS	AZZURRO 3PH HYD15000 ZSS	AZZURRO 3PH HYD20000 ZSS
Input data (PV)						
Max. DC voltage	1000V					
MPP voltage range	180~960V					
No. of MPP trackers	2					
Max. input current per MPP trackers	12.5/12.5A			25/25A		
Max. short-circuit current per MPP trackers	15A/15A			30A/30A		
Output data(/Input data (AC)						
Max. AC apparent power	5500VA /10000VA	6600VA/ 12000VA	8800VA/ 16000VA	11000VA/ 20000VA	16500VA/ 30000VA	22000VA/ 40000VA
Nominal AC voltage	3W+N+PE, 230V/400V;					
AC grid frequency	50Hz					
Max. current	8A/15A	10A/17A	13A/24A	16A/29A	24A/44A	32A/58A
Power factor	1(adjustable +/-0.8)					
Stand alone(AC power)						
Max. AC apparent power	5500VA	6600VA	8800VA	11000VA	16500VA	22000 VA
Nominal AC voltage	3W+N+PE , 220/380, 230V/400V;					
Nominal AC frequency	50/60Hz					
Max. output current	8.0A	10A	13A	16A	24A	32A
Battery data（DC）						
Battery voltage range	180~800V					

Max. charging / discharging current	25A	25A/25A
Type of battery	lithium battery	
Others		
Technology	Transformerless	
Protection degree	IP 65	
Operating temperature range	–25 °C ~ +60 °C With derating above 45 °C	
Pollution degree	II	
Protective Class	Class I	

Factory information:

Dongguan SOFAR SOLAR Co., Ltd.

1F-6F, Building E, No.1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City,China

TOR Erzeuger Typ A Version 1.1			
Clause	Requirement - Test	Result - Remark	Verdict
4	Network connection procedure and relevant documents	(See appended table) Tests are performed according to clause 5.1.2 Rapid voltage changes 5.1.3 Flicker 5.1.4 Harmonics and inter-harmonics of OVE-Richtlinie R 25:2020-03-01	P
5.1.3	Active power reduction at over frequency (LFSM-O)	(See appended table) Tests are performed according to clause 5.3.4 Active power reduction at overfrequency of OVE-Richtlinie R 25:2020-03-01	P
5.1.5	Reduction of the maximum active power output with decreasing frequency	(See appended table) Tests are performed according to clause 5.3.5 Frequency-dependent active power reduction (active power at underfrequency) of OVE-Richtlinie R 25:2020-03-01	P
5.2	Requirements for dynamic grid support	(See appended table) Tests are performed according to clause 5.6 Dynamic network support of OVE-Richtlinie R 25:2020-03-01	P
5.3.3	Reactive power capacity	(See appended table) Tests are performed according to clause 5.3.2 Measuring the active and reactive power working range ("PQ diagram") of OVE-Richtlinie R 25:2020-03-01	P

TOR Erzeuger Typ A Version 1.1			
Clause	Requirement - Test	Result - Remark	Verdict
5.3.4	Method for provision of reactive power	(See appended table) Tests are performed according to clause 5.3.7 Reactive power control according to setpoint specification "cos φ fixed" 5.3.9 Reactive power control according to setpoint specification "Q fix" of OVE-Richtlinie R 25:2020-03-01	P
5.3.4.1	Standard characteristic curve for the reactive power supply method cos φ (P) in the low-voltage grid	(See appended table) Tests are performed according to clause 5.3.8 Reactive power control "cos φ (P)" of OVE-Richtlinie R 25:2020-03-01	P
5.3.4.2	Standard characteristic curve for the reactive power supply method Q (U) in the low voltage grid	(See appended table) Tests are performed according to clause 5.3.10 Voltage-controlled control functions (reactive power control Q (U) and active power control P (U)) of OVE-Richtlinie R 25:2020-03-01	P
5.3.6	Voltage-controlled active power control	Same as clause 5.3.10 as required by OVE-Richtlinie R 25:2020-03-01	P
5.4.1	Active power specification by the network operator	(See appended table) Tests are performed according to clause 5.3.3 Termination of active power supply after off command via telecontrol interface (input port) of OVE-Richtlinie R 25:2020-03-01	P

TOR Erzeuger Typ A Version 1.1			
Clause	Requirement - Test	Result - Remark	Verdict
5.5.2	Connection conditions	(See appended table) Tests are performed according to clause 5.5 Checking the connection conditions and synchronization of OVE-Richtlinie R 25:2020-03-01	P
6	Execution of the system and protection	(See appended table) Tests are performed according to clause 5.4.1 Voltage protection 5.4.2 Frequency protection 5.4.3 Detection of unwanted island operation of OVE-Richtlinie R 25:2020-03-01	P
6.1.1	Connection system and symmetry	(See appended table) Tests are performed according to clause 5.2 Testing the symmetry behavior of three-phase inverters of OVE-Richtlinie R 25:2020-03-01	P
6.2.3	Control systems and settings	(See appended table) Tests are performed according to clause 5.3.11 Protection of the settings as requested by the TOR producers of OVE-Richtlinie R 25:2020-03-01	P

Appended Table - Testing Result

5.1.2	TABLE: Rapid voltage change								P
switching on at power <10% Pn, or minimum possible power									
Phase	L1			L2			L3		
Voltage [V]	1.038	1.816	1.486	0.628	0.878	0.943	0.907	1.067	0.996
Current [A]	229.9	230.1	230.1	229.9	230.1	230.1	229.9	229.9	229.9
Ki	0.032	0.057	0.046	0.020	0.027	0.029	0.028	0.033	0.031
Kimax value	0.057								
Operation type: start-up at Pn (reference condition) with circuit breaker reclosing									
Phase	L1			L2			L3		
Voltage [V]	1.160	1.556	1.057	0.942	0.940	0.976	1.363	1.488	1.459
Current [A]	230.0	230.0	229.9	229.8	229.9	229.9	229.9	229.9	229.9
Ki	0.036	0.049	0.033	0.029	0.029	0.031	0.043	0.047	0.046
Kimax value	0.049								
Operation type: shut-down (breaking operation at nominal power)									
Phase	L1			L2			L3		
Voltage [V]	0.900	0.929	1.172	0.955	1.015	0.799	1.081	0.783	0.936
Current [A]	230.07	230.66	229.96	229.81	230.15	230.76	230.29	230.77	229.91
Ki	0.016	0.016	0.020	0.016	0.018	0.014	0.019	0.014	0.016
Kimax value	0.020								
Note: 1) Sk,fic/Sn = 20 2) ki is the ratio of the highest current occurring during a switching operation to the normal generator current, the current is to be considered as an r.m.s. value over a period									

5.1.3	TABLE: Flick	P

Flicker für Bemessungsströme >75A (bei SCR = 20)

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

Rated Output voltage [V]	230			
AZZURRO 3PH HYD5000 ZSS				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	5.331	3.479	2.836	2.675
Short-term Flicker Pst [1]	0.157	0.102	0.083	0.079
AZZURRO 3PH HYD20000 ZSS				
Grid impedance angle ψk [°]	30	50	70	85
Flicker coefficient c(ψk) [1]	4.149	2.327	1.907	1.794
Short-term Flicker Pst [1]	0.127	0.083	0.068	0.064

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD5000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.181	0.276	0.253	0.231	0.219	0.168	0.154	0.180	0.177	0.137	0.155
3	0.102	0.199	0.258	0.201	0.148	0.146	0.188	0.196	0.234	0.234	0.221
4	0.113	0.294	0.255	0.215	0.187	0.129	0.113	0.127	0.124	0.101	0.116
5	0.567	1.248	1.233	0.663	0.512	0.627	0.765	0.840	0.833	0.848	0.840
6	0.082	0.187	0.163	0.150	0.141	0.113	0.121	0.135	0.132	0.110	0.125
7	0.794	0.896	1.245	0.829	0.434	0.209	0.225	0.370	0.384	0.265	0.340
8	0.190	0.240	0.184	0.158	0.126	0.089	0.099	0.107	0.119	0.103	0.109
9	0.098	0.160	0.202	0.240	0.230	0.192	0.216	0.257	0.235	0.238	0.214
10	0.136	0.217	0.143	0.152	0.122	0.097	0.104	0.103	0.100	0.086	0.095
11	0.596	0.884	0.831	1.518	1.216	0.550	0.318	0.463	0.608	0.719	0.755
12	0.085	0.145	0.125	0.122	0.109	0.079	0.080	0.083	0.074	0.076	0.075
13	0.398	0.584	0.845	0.848	0.534	0.428	0.542	0.693	0.707	0.664	0.577
14	0.327	0.307	0.140	0.116	0.107	0.085	0.081	0.086	0.076	0.068	0.072
15	0.097	0.113	0.189	0.123	0.103	0.129	0.126	0.136	0.186	0.206	0.186
16	0.239	0.200	0.202	0.098	0.094	0.080	0.075	0.074	0.074	0.074	0.068
17	0.304	0.284	0.826	0.613	0.917	0.967	0.652	0.521	0.292	0.136	0.294
18	0.062	0.126	0.118	0.090	0.083	0.057	0.060	0.056	0.053	0.052	0.048
19	0.564	0.512	0.835	0.825	1.080	0.588	0.298	0.460	0.707	0.913	0.988
20	0.258	0.352	0.125	0.079	0.082	0.073	0.058	0.060	0.055	0.049	0.054
21	0.068	0.086	0.105	0.111	0.085	0.102	0.131	0.112	0.109	0.120	0.133
22	0.115	0.162	0.104	0.119	0.061	0.068	0.073	0.063	0.057	0.051	0.053
23	0.451	0.202	0.394	0.583	0.773	0.522	0.405	0.349	0.252	0.243	0.289
24	0.050	0.097	0.083	0.071	0.059	0.050	0.045	0.044	0.040	0.041	0.037
25	0.326	0.258	0.225	0.665	0.704	0.742	0.505	0.377	0.320	0.466	0.592
26	0.252	0.228	0.072	0.130	0.083	0.063	0.044	0.049	0.051	0.043	0.039
27	0.055	0.087	0.069	0.076	0.075	0.064	0.049	0.067	0.069	0.070	0.076
28	0.149	0.195	0.134	0.106	0.059	0.039	0.037	0.043	0.044	0.040	0.042
29	0.331	0.256	0.559	0.500	0.173	0.679	0.578	0.236	0.142	0.156	0.178
30	0.060	0.100	0.093	0.062	0.050	0.037	0.037	0.039	0.034	0.035	0.037
31	0.234	0.157	0.356	0.395	0.167	0.528	0.387	0.236	0.214	0.220	0.159
32	0.323	0.162	0.147	0.135	0.093	0.097	0.075	0.058	0.051	0.046	0.036
33	0.058	0.093	0.088	0.101	0.082	0.089	0.077	0.083	0.095	0.110	0.090
34	0.251	0.205	0.161	0.122	0.061	0.051	0.052	0.051	0.040	0.046	0.042
35	0.126	0.191	0.175	0.233	0.230	0.203	0.203	0.410	0.392	0.296	0.189
36	0.065	0.111	0.097	0.055	0.056	0.040	0.048	0.045	0.037	0.037	0.041
37	0.164	0.164	0.120	0.290	0.166	0.207	0.235	0.372	0.242	0.096	0.196
38	0.143	0.289	0.132	0.067	0.055	0.051	0.054	0.045	0.039	0.040	0.036
39	0.067	0.068	0.048	0.043	0.075	0.109	0.105	0.077	0.089	0.108	0.125
40	0.340	0.315	0.261	0.142	0.104	0.067	0.065	0.046	0.038	0.040	0.036

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD5000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.055	0.352	0.319	0.311	0.322	0.203	0.195	0.296	0.309	0.193	0.256
125	0.061	0.163	0.135	0.136	0.138	0.099	0.099	0.111	0.121	0.093	0.112
175	0.065	0.163	0.140	0.142	0.141	0.111	0.111	0.124	0.129	0.113	0.128
225	0.070	0.338	0.284	0.243	0.187	0.130	0.132	0.147	0.148	0.132	0.147
275	0.079	0.369	0.301	0.259	0.199	0.139	0.139	0.152	0.157	0.145	0.155
325	0.074	0.325	0.271	0.244	0.212	0.145	0.145	0.161	0.162	0.143	0.154
375	0.077	0.360	0.299	0.231	0.179	0.126	0.131	0.160	0.173	0.145	0.157
425	0.068	0.169	0.138	0.140	0.132	0.111	0.115	0.119	0.121	0.116	0.117
475	0.060	0.142	0.117	0.124	0.119	0.099	0.104	0.107	0.103	0.099	0.101
525	0.059	0.275	0.233	0.177	0.150	0.103	0.096	0.101	0.093	0.087	0.089
575	0.062	0.289	0.235	0.194	0.171	0.103	0.088	0.095	0.083	0.078	0.083
625	0.052	0.211	0.212	0.157	0.140	0.093	0.082	0.089	0.080	0.072	0.077
675	0.053	0.215	0.230	0.162	0.153	0.097	0.078	0.082	0.074	0.064	0.070
725	0.045	0.112	0.103	0.088	0.088	0.073	0.065	0.065	0.064	0.060	0.061
775	0.042	0.096	0.090	0.082	0.081	0.067	0.059	0.061	0.062	0.059	0.058
825	0.041	0.176	0.170	0.135	0.115	0.069	0.056	0.063	0.066	0.058	0.059
875	0.042	0.160	0.183	0.130	0.109	0.072	0.059	0.065	0.059	0.056	0.053
925	0.042	0.142	0.150	0.131	0.104	0.067	0.056	0.060	0.057	0.053	0.053
975	0.039	0.137	0.154	0.121	0.096	0.063	0.055	0.057	0.051	0.045	0.048
1025	0.040	0.077	0.077	0.071	0.073	0.055	0.053	0.053	0.048	0.044	0.050
1075	0.034	0.074	0.061	0.064	0.058	0.060	0.051	0.048	0.044	0.049	0.050
1125	0.035	0.112	0.113	0.100	0.089	0.060	0.058	0.056	0.055	0.043	0.048
1175	0.035	0.101	0.115	0.106	0.083	0.055	0.050	0.053	0.049	0.042	0.043
1225	0.047	0.101	0.118	0.115	0.100	0.075	0.068	0.062	0.057	0.046	0.041
1275	0.035	0.089	0.108	0.097	0.077	0.053	0.041	0.043	0.042	0.040	0.043
1325	0.040	0.062	0.063	0.058	0.052	0.046	0.042	0.044	0.044	0.042	0.041
1375	0.032	0.057	0.053	0.052	0.046	0.040	0.036	0.038	0.039	0.037	0.036
1425	0.039	0.086	0.096	0.085	0.069	0.051	0.045	0.047	0.046	0.042	0.043
1475	0.032	0.078	0.096	0.081	0.067	0.044	0.039	0.045	0.044	0.037	0.038
1525	0.031	0.076	0.088	0.075	0.062	0.043	0.040	0.042	0.043	0.038	0.040
1575	0.032	0.073	0.089	0.071	0.057	0.042	0.042	0.046	0.042	0.036	0.039
1625	0.031	0.058	0.050	0.043	0.039	0.037	0.038	0.038	0.037	0.036	0.035
1675	0.031	0.056	0.045	0.040	0.038	0.036	0.038	0.038	0.038	0.036	0.036
1725	0.032	0.074	0.058	0.050	0.044	0.038	0.040	0.040	0.039	0.036	0.036
1775	0.033	0.069	0.056	0.050	0.046	0.037	0.038	0.041	0.040	0.035	0.036
1825	0.033	0.065	0.055	0.053	0.045	0.039	0.039	0.038	0.039	0.036	0.036
1875	0.034	0.066	0.057	0.052	0.046	0.036	0.039	0.040	0.039	0.034	0.034
1925	0.037	0.060	0.042	0.039	0.038	0.036	0.037	0.037	0.037	0.035	0.035
1975	0.036	0.059	0.043	0.040	0.038	0.035	0.037	0.037	0.036	0.035	0.035

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD5000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.433	0.320	0.373	0.389	0.444	0.432	0.485	0.650	0.608	0.466	0.369
2.3	0.358	0.358	0.400	0.403	0.442	0.331	0.335	0.280	0.386	0.359	0.326
2.5	0.485	0.383	0.417	0.365	0.342	0.346	0.316	0.414	0.360	0.265	0.280
2.7	0.347	0.341	0.389	0.420	0.427	0.462	0.382	0.313	0.396	0.297	0.273
2.9	0.298	0.320	0.298	0.248	0.368	0.220	0.323	0.254	0.334	0.351	0.254
3.1	0.360	0.280	0.334	0.317	0.297	0.257	0.262	0.236	0.331	0.335	0.246
3.3	0.283	0.283	0.305	0.336	0.288	0.318	0.402	0.329	0.327	0.402	0.327
3.5	0.169	0.217	0.248	0.239	0.238	0.270	0.234	0.286	0.245	0.268	0.281
3.7	0.149	0.171	0.194	0.197	0.195	0.198	0.227	0.209	0.215	0.211	0.207
3.9	0.103	0.114	0.123	0.124	0.127	0.135	0.136	0.149	0.142	0.141	0.142
4.1	0.077	0.090	0.096	0.096	0.100	0.098	0.100	0.103	0.106	0.103	0.104
4.3	0.067	0.076	0.081	0.082	0.083	0.081	0.083	0.086	0.084	0.087	0.087
4.5	0.059	0.064	0.068	0.069	0.070	0.070	0.072	0.071	0.074	0.073	0.074
4.7	0.107	0.113	0.117	0.119	0.120	0.121	0.121	0.122	0.122	0.122	0.123
4.9	0.049	0.052	0.054	0.054	0.055	0.055	0.054	0.056	0.056	0.057	0.057
5.1	0.047	0.049	0.050	0.051	0.051	0.051	0.052	0.052	0.053	0.053	0.053
5.3	0.042	0.044	0.045	0.045	0.045	0.046	0.046	0.046	0.047	0.047	0.047
5.5	0.040	0.042	0.042	0.042	0.042	0.042	0.043	0.043	0.043	0.044	0.044
5.7	0.041	0.042	0.042	0.042	0.043	0.043	0.043	0.043	0.044	0.044	0.044
5.9	0.036	0.038	0.038	0.037	0.038	0.037	0.038	0.038	0.039	0.039	0.039
6.1	0.047	0.048	0.048	0.048	0.048	0.048	0.048	0.049	0.049	0.049	0.049
6.3	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.036	0.036	0.036	0.037
6.5	0.033	0.034	0.034	0.033	0.034	0.034	0.034	0.034	0.035	0.035	0.035
6.7	0.033	0.034	0.033	0.033	0.033	0.033	0.033	0.034	0.035	0.034	0.035
6.9	0.031	0.033	0.033	0.032	0.033	0.033	0.034	0.034	0.034	0.033	0.035
7.1	0.054	0.055	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.055
7.3	0.031	0.032	0.031	0.032	0.032	0.032	0.032	0.032	0.033	0.033	0.033
7.5	0.030	0.031	0.030	0.030	0.031	0.031	0.031	0.031	0.031	0.033	0.032
7.7	0.029	0.030	0.029	0.029	0.029	0.030	0.029	0.029	0.029	0.031	0.030
7.9	0.028	0.030	0.029	0.029	0.029	0.030	0.029	0.029	0.029	0.030	0.030
8.1	0.028	0.030	0.029	0.029	0.029	0.030	0.030	0.030	0.030	0.032	0.030
8.3	0.036	0.038	0.037	0.038	0.038	0.037	0.038	0.038	0.038	0.038	0.039
8.5	0.036	0.039	0.038	0.037	0.037	0.037	0.037	0.038	0.037	0.038	0.038
8.7	0.025	0.027	0.026	0.026	0.026	0.027	0.027	0.027	0.027	0.028	0.028
8.9	0.025	0.027	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.027	0.027

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD6000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.118	0.195	0.204	0.174	0.151	0.115	0.112	0.114	0.113	0.144	0.113
3	0.079	0.161	0.190	0.124	0.118	0.140	0.150	0.195	0.178	0.178	0.164
4	0.084	0.216	0.191	0.152	0.114	0.092	0.089	0.087	0.085	0.102	0.082
5	0.497	1.011	0.850	0.461	0.476	0.617	0.688	0.697	0.709	0.708	0.690
6	0.050	0.162	0.138	0.127	0.099	0.097	0.094	0.095	0.091	0.111	0.089
7	0.772	0.823	0.890	0.498	0.208	0.203	0.234	0.215	0.216	0.321	0.260
8	0.101	0.169	0.134	0.110	0.082	0.079	0.089	0.092	0.086	0.093	0.078
9	0.068	0.142	0.165	0.176	0.161	0.170	0.206	0.197	0.185	0.164	0.157
10	0.092	0.158	0.128	0.106	0.088	0.085	0.080	0.076	0.071	0.078	0.070
11	0.475	0.702	1.032	1.163	0.575	0.251	0.401	0.548	0.617	0.647	0.617
12	0.055	0.140	0.121	0.086	0.064	0.061	0.063	0.061	0.059	0.061	0.054
13	0.537	0.580	0.788	0.578	0.375	0.428	0.580	0.590	0.520	0.450	0.413
14	0.161	0.263	0.094	0.101	0.078	0.067	0.068	0.061	0.058	0.059	0.053
15	0.081	0.109	0.161	0.063	0.105	0.099	0.117	0.168	0.164	0.138	0.132
16	0.199	0.164	0.119	0.069	0.070	0.065	0.059	0.063	0.058	0.055	0.050
17	0.388	0.385	0.471	0.697	0.870	0.603	0.405	0.149	0.186	0.326	0.338
18	0.050	0.120	0.083	0.079	0.054	0.045	0.044	0.042	0.040	0.042	0.038
19	0.554	0.328	0.362	0.923	0.609	0.203	0.421	0.661	0.823	0.784	0.705
20	0.272	0.330	0.090	0.069	0.071	0.048	0.044	0.044	0.040	0.043	0.040
21	0.071	0.094	0.061	0.104	0.071	0.115	0.089	0.096	0.099	0.110	0.108
22	0.212	0.148	0.073	0.072	0.064	0.062	0.049	0.046	0.036	0.042	0.034
23	0.468	0.389	0.697	0.419	0.458	0.401	0.268	0.164	0.260	0.189	0.194
24	0.062	0.119	0.080	0.071	0.063	0.052	0.049	0.047	0.044	0.053	0.059
25	0.355	0.237	0.501	0.303	0.665	0.460	0.303	0.297	0.445	0.543	0.508
26	0.206	0.249	0.094	0.079	0.051	0.034	0.038	0.039	0.034	0.031	0.032
27	0.037	0.075	0.059	0.068	0.065	0.044	0.054	0.054	0.059	0.070	0.063
28	0.210	0.188	0.104	0.080	0.037	0.030	0.034	0.034	0.032	0.037	0.027
29	0.145	0.233	0.322	0.365	0.487	0.445	0.146	0.103	0.149	0.143	0.213
30	0.035	0.088	0.057	0.041	0.032	0.033	0.031	0.030	0.028	0.032	0.028
31	0.238	0.249	0.257	0.348	0.398	0.355	0.166	0.181	0.185	0.175	0.154
32	0.124	0.192	0.125	0.084	0.080	0.064	0.046	0.043	0.036	0.028	0.030
33	0.046	0.061	0.056	0.045	0.074	0.060	0.071	0.090	0.085	0.072	0.090
34	0.207	0.201	0.108	0.078	0.053	0.049	0.041	0.037	0.036	0.035	0.033
35	0.107	0.137	0.118	0.154	0.213	0.171	0.365	0.301	0.194	0.114	0.177
36	0.037	0.072	0.057	0.048	0.033	0.042	0.035	0.033	0.030	0.033	0.028
37	0.070	0.166	0.249	0.175	0.196	0.207	0.313	0.129	0.108	0.243	0.328
38	0.303	0.315	0.082	0.064	0.044	0.051	0.037	0.028	0.032	0.033	0.027
39	0.049	0.044	0.050	0.069	0.076	0.093	0.066	0.079	0.096	0.106	0.112
40	0.313	0.314	0.165	0.110	0.056	0.051	0.035	0.032	0.032	0.030	0.028

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD6000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.036	0.253	0.253	0.272	0.197	0.161	0.157	0.172	0.166	0.257	0.171
125	0.045	0.099	0.099	0.107	0.091	0.081	0.080	0.086	0.083	0.107	0.081
175	0.049	0.110	0.110	0.115	0.099	0.093	0.098	0.098	0.098	0.114	0.097
225	0.047	0.224	0.224	0.184	0.115	0.104	0.114	0.114	0.116	0.133	0.117
275	0.047	0.233	0.233	0.188	0.122	0.114	0.123	0.126	0.127	0.140	0.124
325	0.050	0.221	0.221	0.208	0.134	0.116	0.121	0.126	0.125	0.137	0.118
375	0.050	0.231	0.231	0.175	0.118	0.111	0.116	0.124	0.122	0.139	0.118
425	0.050	0.103	0.103	0.105	0.097	0.094	0.095	0.098	0.098	0.100	0.092
475	0.046	0.092	0.092	0.089	0.086	0.084	0.083	0.085	0.085	0.090	0.084
525	0.043	0.175	0.175	0.134	0.097	0.077	0.074	0.074	0.073	0.075	0.074
575	0.040	0.187	0.187	0.147	0.099	0.074	0.071	0.070	0.069	0.071	0.067
625	0.037	0.168	0.168	0.117	0.088	0.068	0.064	0.063	0.062	0.067	0.062
675	0.035	0.166	0.166	0.134	0.097	0.065	0.058	0.056	0.055	0.067	0.060
725	0.033	0.077	0.077	0.069	0.064	0.053	0.052	0.052	0.051	0.054	0.052
775	0.031	0.072	0.072	0.064	0.059	0.048	0.048	0.051	0.050	0.050	0.049
825	0.030	0.132	0.132	0.106	0.066	0.047	0.047	0.051	0.049	0.050	0.049
875	0.029	0.132	0.132	0.100	0.071	0.049	0.047	0.048	0.046	0.048	0.045
925	0.031	0.119	0.119	0.099	0.063	0.046	0.047	0.047	0.045	0.046	0.044
975	0.027	0.109	0.109	0.093	0.058	0.044	0.041	0.040	0.038	0.041	0.040
1025	0.030	0.056	0.056	0.056	0.046	0.044	0.041	0.038	0.038	0.040	0.039
1075	0.025	0.050	0.050	0.050	0.043	0.041	0.037	0.034	0.034	0.037	0.037
1125	0.025	0.090	0.090	0.085	0.056	0.041	0.037	0.035	0.035	0.042	0.038
1175	0.026	0.087	0.087	0.086	0.052	0.041	0.038	0.038	0.037	0.038	0.036
1225	0.029	0.088	0.088	0.080	0.057	0.051	0.054	0.054	0.055	0.049	0.035
1275	0.025	0.084	0.084	0.074	0.049	0.034	0.033	0.034	0.032	0.034	0.033
1325	0.030	0.050	0.050	0.047	0.039	0.035	0.035	0.036	0.035	0.035	0.034
1375	0.025	0.047	0.047	0.041	0.035	0.030	0.032	0.032	0.031	0.032	0.030
1425	0.030	0.080	0.080	0.066	0.047	0.039	0.036	0.036	0.035	0.038	0.037
1475	0.025	0.078	0.078	0.060	0.042	0.034	0.034	0.034	0.032	0.034	0.032
1525	0.025	0.075	0.075	0.057	0.041	0.035	0.032	0.033	0.033	0.037	0.034
1575	0.025	0.069	0.069	0.053	0.039	0.036	0.033	0.032	0.032	0.036	0.035
1625	0.026	0.041	0.041	0.034	0.032	0.032	0.030	0.031	0.031	0.031	0.031
1675	0.026	0.038	0.038	0.033	0.030	0.031	0.031	0.031	0.031	0.032	0.031
1725	0.026	0.046	0.046	0.040	0.032	0.032	0.031	0.031	0.030	0.032	0.031
1775	0.026	0.043	0.043	0.038	0.033	0.032	0.031	0.032	0.030	0.032	0.030
1825	0.026	0.047	0.047	0.040	0.034	0.033	0.030	0.031	0.030	0.032	0.030
1875	0.026	0.044	0.044	0.038	0.033	0.032	0.030	0.030	0.029	0.030	0.030
1925	0.029	0.034	0.034	0.032	0.031	0.030	0.030	0.030	0.030	0.031	0.030
1975	0.028	0.034	0.034	0.031	0.029	0.029	0.029	0.030	0.029	0.030	0.030

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD6000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.339	0.262	0.403	0.271	0.410	0.404	0.575	0.476	0.339	0.335	0.465
2.3	0.372	0.333	0.293	0.392	0.259	0.293	0.241	0.322	0.273	0.240	0.258
2.5	0.341	0.302	0.289	0.399	0.298	0.261	0.361	0.270	0.218	0.268	0.325
2.7	0.413	0.260	0.325	0.284	0.320	0.328	0.277	0.305	0.204	0.255	0.320
2.9	0.152	0.229	0.239	0.223	0.238	0.231	0.205	0.316	0.242	0.213	0.241
3.1	0.232	0.227	0.256	0.229	0.231	0.235	0.194	0.276	0.249	0.179	0.204
3.3	0.263	0.223	0.248	0.228	0.286	0.326	0.248	0.314	0.317	0.229	0.237
3.5	0.131	0.183	0.209	0.194	0.211	0.191	0.241	0.203	0.235	0.216	0.208
3.7	0.108	0.146	0.161	0.172	0.168	0.184	0.172	0.182	0.170	0.172	0.179
3.9	0.077	0.097	0.105	0.114	0.106	0.115	0.126	0.117	0.117	0.117	0.116
4.1	0.063	0.075	0.080	0.083	0.083	0.086	0.087	0.086	0.087	0.088	0.088
4.3	0.055	0.063	0.066	0.068	0.068	0.068	0.072	0.070	0.073	0.071	0.072
4.5	0.048	0.054	0.056	0.057	0.058	0.060	0.060	0.060	0.062	0.062	0.062
4.7	0.089	0.095	0.098	0.100	0.101	0.101	0.101	0.102	0.102	0.103	0.103
4.9	0.040	0.043	0.044	0.045	0.045	0.046	0.046	0.047	0.047	0.048	0.049
5.1	0.039	0.041	0.042	0.042	0.043	0.043	0.043	0.044	0.044	0.045	0.045
5.3	0.035	0.037	0.037	0.038	0.038	0.038	0.039	0.039	0.039	0.040	0.040
5.5	0.033	0.034	0.035	0.035	0.035	0.036	0.036	0.036	0.037	0.037	0.037
5.7	0.034	0.035	0.035	0.036	0.036	0.036	0.036	0.037	0.037	0.037	0.037
5.9	0.030	0.031	0.031	0.031	0.032	0.032	0.032	0.032	0.033	0.033	0.033
6.1	0.039	0.040	0.040	0.040	0.040	0.040	0.041	0.041	0.041	0.041	0.041
6.3	0.028	0.029	0.029	0.029	0.029	0.030	0.030	0.030	0.031	0.030	0.031
6.5	0.027	0.028	0.028	0.028	0.028	0.028	0.029	0.029	0.029	0.029	0.029
6.7	0.027	0.028	0.027	0.027	0.028	0.028	0.028	0.028	0.029	0.028	0.029
6.9	0.027	0.027	0.027	0.027	0.027	0.028	0.028	0.029	0.028	0.028	0.028
7.1	0.044	0.046	0.045	0.045	0.045	0.045	0.045	0.046	0.046	0.046	0.046
7.3	0.025	0.026	0.026	0.027	0.027	0.027	0.027	0.028	0.027	0.028	0.027
7.5	0.025	0.026	0.025	0.025	0.026	0.026	0.026	0.027	0.026	0.027	0.026
7.7	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.025
7.9	0.023	0.024	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.025	0.025
8.1	0.023	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.026	0.025	0.025
8.3	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032	0.032	0.032
8.5	0.031	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032	0.031
8.7	0.021	0.022	0.022	0.022	0.022	0.022	0.022	0.023	0.024	0.023	0.023
8.9	0.020	0.022	0.021	0.022	0.022	0.022	0.022	0.022	0.023	0.022	0.023

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD8000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.089	0.173	0.138	0.124	0.090	0.086	0.084	0.081	0.099	0.082	0.077
3	0.060	0.163	0.117	0.093	0.114	0.132	0.133	0.132	0.115	0.112	0.110
4	0.064	0.185	0.128	0.098	0.070	0.064	0.062	0.061	0.069	0.059	0.057
5	0.368	0.836	0.400	0.365	0.488	0.509	0.531	0.535	0.507	0.498	0.498
6	0.039	0.123	0.097	0.084	0.075	0.069	0.071	0.069	0.072	0.064	0.061
7	0.572	0.799	0.479	0.177	0.153	0.160	0.165	0.183	0.241	0.205	0.196
8	0.078	0.115	0.090	0.064	0.060	0.067	0.064	0.064	0.062	0.055	0.056
9	0.053	0.138	0.141	0.119	0.137	0.146	0.139	0.126	0.108	0.098	0.094
10	0.072	0.089	0.087	0.067	0.064	0.058	0.053	0.055	0.055	0.049	0.046
11	0.359	0.446	0.945	0.468	0.209	0.367	0.462	0.484	0.446	0.402	0.398
12	0.042	0.080	0.071	0.055	0.048	0.046	0.046	0.044	0.041	0.038	0.038
13	0.394	0.448	0.517	0.314	0.355	0.445	0.392	0.340	0.285	0.246	0.244
14	0.125	0.176	0.075	0.063	0.052	0.048	0.043	0.041	0.041	0.038	0.042
15	0.060	0.081	0.064	0.080	0.074	0.115	0.122	0.109	0.093	0.084	0.084
16	0.150	0.135	0.055	0.054	0.046	0.045	0.046	0.042	0.037	0.034	0.030
17	0.287	0.527	0.394	0.660	0.395	0.193	0.127	0.240	0.283	0.265	0.253
18	0.038	0.071	0.054	0.041	0.035	0.031	0.031	0.031	0.029	0.026	0.025
19	0.415	0.314	0.558	0.480	0.194	0.429	0.610	0.593	0.480	0.424	0.433
20	0.206	0.165	0.054	0.055	0.037	0.034	0.031	0.028	0.030	0.028	0.031
21	0.056	0.060	0.077	0.051	0.085	0.065	0.074	0.082	0.082	0.069	0.069
22	0.159	0.078	0.071	0.050	0.044	0.035	0.027	0.029	0.027	0.022	0.020
23	0.351	0.407	0.274	0.357	0.269	0.143	0.183	0.160	0.138	0.143	0.130
24	0.036	0.054	0.051	0.038	0.029	0.029	0.025	0.026	0.035	0.021	0.022
25	0.261	0.240	0.324	0.504	0.299	0.193	0.327	0.397	0.401	0.369	0.362
26	0.146	0.071	0.074	0.042	0.026	0.028	0.028	0.023	0.023	0.023	0.027
27	0.027	0.036	0.046	0.051	0.030	0.043	0.046	0.046	0.054	0.038	0.042
28	0.153	0.099	0.070	0.030	0.021	0.024	0.024	0.023	0.023	0.018	0.017
29	0.117	0.181	0.340	0.344	0.282	0.060	0.109	0.126	0.176	0.223	0.211
30	0.025	0.050	0.034	0.024	0.024	0.025	0.021	0.022	0.023	0.020	0.020
31	0.180	0.122	0.310	0.281	0.220	0.114	0.132	0.100	0.188	0.200	0.184
32	0.112	0.095	0.079	0.057	0.046	0.034	0.029	0.023	0.021	0.020	0.024
33	0.033	0.050	0.050	0.055	0.045	0.061	0.065	0.063	0.064	0.058	0.054
34	0.162	0.139	0.079	0.041	0.036	0.026	0.027	0.026	0.024	0.020	0.018
35	0.080	0.135	0.172	0.164	0.174	0.264	0.157	0.096	0.170	0.243	0.253
36	0.029	0.059	0.031	0.026	0.033	0.026	0.024	0.021	0.022	0.021	0.020
37	0.056	0.121	0.215	0.161	0.186	0.158	0.073	0.196	0.281	0.324	0.316
38	0.231	0.208	0.048	0.036	0.036	0.023	0.021	0.023	0.023	0.019	0.021
39	0.037	0.027	0.033	0.050	0.063	0.055	0.071	0.085	0.079	0.088	0.100
40	0.247	0.231	0.095	0.044	0.036	0.023	0.024	0.021	0.022	0.022	0.022

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD8000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.028	0.212	0.194	0.180	0.122	0.115	0.113	0.112	0.162	0.120	0.115
125	0.035	0.082	0.079	0.077	0.062	0.057	0.057	0.062	0.067	0.056	0.055
175	0.038	0.084	0.083	0.081	0.071	0.070	0.071	0.075	0.074	0.070	0.070
225	0.037	0.187	0.151	0.097	0.082	0.084	0.085	0.089	0.091	0.084	0.084
275	0.038	0.199	0.160	0.104	0.085	0.090	0.093	0.100	0.097	0.093	0.093
325	0.039	0.175	0.155	0.113	0.088	0.090	0.091	0.092	0.094	0.088	0.088
375	0.039	0.200	0.137	0.092	0.081	0.087	0.089	0.088	0.094	0.085	0.086
425	0.042	0.086	0.079	0.074	0.070	0.071	0.071	0.073	0.072	0.070	0.071
475	0.040	0.077	0.070	0.068	0.064	0.061	0.062	0.064	0.063	0.063	0.065
525	0.036	0.160	0.105	0.081	0.059	0.054	0.054	0.054	0.054	0.055	0.056
575	0.033	0.162	0.116	0.085	0.056	0.049	0.048	0.051	0.050	0.049	0.051
625	0.030	0.138	0.093	0.075	0.052	0.045	0.044	0.046	0.048	0.046	0.046
675	0.028	0.154	0.101	0.085	0.048	0.042	0.041	0.042	0.048	0.045	0.044
725	0.026	0.065	0.053	0.052	0.040	0.039	0.037	0.039	0.039	0.038	0.040
775	0.025	0.056	0.047	0.048	0.036	0.037	0.036	0.037	0.036	0.037	0.039
825	0.024	0.103	0.080	0.054	0.034	0.036	0.036	0.035	0.035	0.036	0.037
875	0.023	0.109	0.077	0.058	0.036	0.034	0.034	0.033	0.034	0.034	0.035
925	0.025	0.089	0.075	0.050	0.034	0.034	0.033	0.033	0.032	0.032	0.033
975	0.021	0.099	0.072	0.048	0.034	0.029	0.028	0.029	0.029	0.028	0.029
1025	0.024	0.048	0.045	0.036	0.033	0.029	0.028	0.029	0.029	0.028	0.029
1075	0.020	0.043	0.039	0.034	0.031	0.026	0.025	0.028	0.028	0.026	0.028
1125	0.020	0.072	0.060	0.047	0.030	0.026	0.026	0.028	0.029	0.026	0.027
1175	0.020	0.075	0.067	0.045	0.030	0.027	0.026	0.027	0.027	0.026	0.027
1225	0.038	0.076	0.065	0.059	0.048	0.046	0.046	0.047	0.040	0.048	0.045
1275	0.019	0.066	0.060	0.040	0.031	0.024	0.024	0.023	0.025	0.024	0.024
1325	0.024	0.037	0.036	0.031	0.026	0.028	0.027	0.026	0.026	0.025	0.026
1375	0.019	0.033	0.030	0.027	0.022	0.028	0.023	0.023	0.023	0.022	0.022
1425	0.024	0.055	0.050	0.037	0.027	0.027	0.031	0.028	0.028	0.026	0.026
1475	0.019	0.055	0.048	0.034	0.024	0.025	0.024	0.029	0.025	0.023	0.024
1525	0.021	0.049	0.044	0.032	0.024	0.024	0.024	0.025	0.027	0.024	0.025
1575	0.019	0.051	0.042	0.030	0.026	0.023	0.023	0.024	0.027	0.025	0.026
1625	0.019	0.030	0.025	0.024	0.023	0.022	0.023	0.024	0.023	0.024	0.024
1675	0.020	0.030	0.023	0.023	0.024	0.023	0.023	0.023	0.023	0.024	0.024
1725	0.020	0.037	0.031	0.026	0.025	0.023	0.022	0.023	0.023	0.023	0.024
1775	0.020	0.033	0.030	0.027	0.025	0.023	0.022	0.023	0.023	0.023	0.024
1825	0.021	0.033	0.032	0.027	0.024	0.023	0.022	0.022	0.023	0.022	0.024
1875	0.021	0.032	0.031	0.026	0.024	0.023	0.021	0.022	0.023	0.022	0.023
1925	0.023	0.028	0.024	0.023	0.023	0.022	0.022	0.022	0.023	0.022	0.023
1975	0.022	0.028	0.024	0.023	0.023	0.022	0.021	0.022	0.022	0.022	0.023

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD8000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.252	0.229	0.262	0.309	0.360	0.413	0.261	0.297	0.361	0.430	0.426
2.3	0.274	0.264	0.215	0.187	0.193	0.235	0.213	0.175	0.216	0.253	0.281
2.5	0.257	0.266	0.206	0.217	0.233	0.247	0.163	0.223	0.231	0.237	0.216
2.7	0.317	0.262	0.293	0.233	0.193	0.245	0.164	0.183	0.242	0.266	0.268
2.9	0.114	0.187	0.182	0.199	0.152	0.212	0.190	0.131	0.175	0.201	0.207
3.1	0.172	0.202	0.172	0.188	0.166	0.194	0.193	0.130	0.182	0.208	0.233
3.3	0.194	0.187	0.194	0.211	0.261	0.198	0.240	0.168	0.188	0.236	0.266
3.5	0.099	0.144	0.145	0.152	0.159	0.154	0.174	0.163	0.158	0.181	0.206
3.7	0.080	0.116	0.125	0.126	0.131	0.135	0.127	0.127	0.134	0.139	0.142
3.9	0.057	0.077	0.079	0.080	0.085	0.089	0.088	0.086	0.087	0.093	0.096
4.1	0.047	0.058	0.061	0.062	0.063	0.065	0.064	0.065	0.066	0.068	0.069
4.3	0.041	0.049	0.051	0.051	0.052	0.052	0.055	0.053	0.055	0.058	0.059
4.5	0.036	0.042	0.043	0.044	0.044	0.046	0.046	0.046	0.047	0.048	0.050
4.7	0.067	0.072	0.074	0.075	0.076	0.076	0.077	0.077	0.077	0.078	0.078
4.9	0.030	0.033	0.034	0.034	0.035	0.035	0.035	0.036	0.037	0.038	0.038
5.1	0.029	0.031	0.031	0.032	0.033	0.033	0.033	0.034	0.034	0.035	0.036
5.3	0.026	0.028	0.028	0.028	0.029	0.029	0.030	0.030	0.030	0.031	0.032
5.5	0.025	0.026	0.026	0.026	0.027	0.027	0.028	0.028	0.028	0.029	0.029
5.7	0.025	0.026	0.026	0.027	0.027	0.027	0.028	0.028	0.028	0.029	0.029
5.9	0.022	0.023	0.023	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.026
6.1	0.029	0.030	0.030	0.030	0.030	0.031	0.031	0.031	0.031	0.031	0.031
6.3	0.021	0.022	0.022	0.022	0.022	0.023	0.023	0.023	0.023	0.023	0.024
6.5	0.020	0.021	0.021	0.021	0.021	0.022	0.022	0.022	0.022	0.022	0.023
6.7	0.020	0.021	0.021	0.021	0.021	0.022	0.022	0.021	0.022	0.022	0.022
6.9	0.020	0.021	0.020	0.020	0.021	0.021	0.021	0.021	0.021	0.021	0.022
7.1	0.033	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.035
7.3	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.021
7.5	0.018	0.019	0.019	0.019	0.020	0.019	0.020	0.020	0.020	0.020	0.021
7.7	0.018	0.018	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.019
7.9	0.017	0.018	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.019
8.1	0.018	0.018	0.018	0.019	0.018	0.019	0.019	0.019	0.019	0.019	0.019
8.3	0.023	0.023	0.023	0.024	0.024	0.023	0.024	0.024	0.024	0.024	0.024
8.5	0.023	0.023	0.023	0.023	0.023	0.023	0.024	0.024	0.023	0.024	0.024
8.7	0.016	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.017	0.018	0.018
8.9	0.015	0.016	0.016	0.016	0.016	0.016	0.017	0.017	0.017	0.017	0.017

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD10000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.089	0.173	0.138	0.124	0.090	0.086	0.084	0.081	0.099	0.082	0.077
3	0.060	0.163	0.117	0.093	0.114	0.132	0.133	0.132	0.115	0.112	0.110
4	0.064	0.185	0.128	0.098	0.070	0.064	0.062	0.061	0.069	0.059	0.057
5	0.368	0.836	0.400	0.365	0.488	0.509	0.531	0.535	0.507	0.498	0.498
6	0.039	0.123	0.097	0.084	0.075	0.069	0.071	0.069	0.072	0.064	0.061
7	0.572	0.799	0.479	0.177	0.153	0.160	0.165	0.183	0.241	0.205	0.196
8	0.078	0.115	0.090	0.064	0.060	0.067	0.064	0.064	0.062	0.055	0.056
9	0.053	0.138	0.141	0.119	0.137	0.146	0.139	0.126	0.108	0.098	0.094
10	0.072	0.089	0.087	0.067	0.064	0.058	0.053	0.055	0.055	0.049	0.046
11	0.359	0.446	0.945	0.468	0.209	0.367	0.462	0.484	0.446	0.402	0.398
12	0.042	0.080	0.071	0.055	0.048	0.046	0.046	0.044	0.041	0.038	0.038
13	0.394	0.448	0.517	0.314	0.355	0.445	0.392	0.340	0.285	0.246	0.244
14	0.125	0.176	0.075	0.063	0.052	0.048	0.043	0.041	0.041	0.038	0.042
15	0.060	0.081	0.064	0.080	0.074	0.115	0.122	0.109	0.093	0.084	0.084
16	0.150	0.135	0.055	0.054	0.046	0.045	0.046	0.042	0.037	0.034	0.030
17	0.287	0.527	0.394	0.660	0.395	0.193	0.127	0.240	0.283	0.265	0.253
18	0.038	0.071	0.054	0.041	0.035	0.031	0.031	0.031	0.029	0.026	0.025
19	0.415	0.314	0.558	0.480	0.194	0.429	0.610	0.593	0.480	0.424	0.433
20	0.206	0.165	0.054	0.055	0.037	0.034	0.031	0.028	0.030	0.028	0.031
21	0.056	0.060	0.077	0.051	0.085	0.065	0.074	0.082	0.082	0.069	0.069
22	0.159	0.078	0.071	0.050	0.044	0.035	0.027	0.029	0.027	0.022	0.020
23	0.351	0.407	0.274	0.357	0.269	0.143	0.183	0.160	0.138	0.143	0.130
24	0.036	0.054	0.051	0.038	0.029	0.029	0.025	0.026	0.035	0.021	0.022
25	0.261	0.240	0.324	0.504	0.299	0.193	0.327	0.397	0.401	0.369	0.362
26	0.146	0.071	0.074	0.042	0.026	0.028	0.028	0.023	0.023	0.023	0.027
27	0.027	0.036	0.046	0.051	0.030	0.043	0.046	0.046	0.054	0.038	0.042
28	0.153	0.099	0.070	0.030	0.021	0.024	0.024	0.023	0.023	0.018	0.017
29	0.117	0.181	0.340	0.344	0.282	0.060	0.109	0.126	0.176	0.223	0.211
30	0.025	0.050	0.034	0.024	0.024	0.025	0.021	0.022	0.023	0.020	0.020
31	0.180	0.122	0.310	0.281	0.220	0.114	0.132	0.100	0.188	0.200	0.184
32	0.112	0.095	0.079	0.057	0.046	0.034	0.029	0.023	0.021	0.020	0.024
33	0.033	0.050	0.050	0.055	0.045	0.061	0.065	0.063	0.064	0.058	0.054
34	0.162	0.139	0.079	0.041	0.036	0.026	0.027	0.026	0.024	0.020	0.018
35	0.080	0.135	0.172	0.164	0.174	0.264	0.157	0.096	0.170	0.243	0.253
36	0.029	0.059	0.031	0.026	0.033	0.026	0.024	0.021	0.022	0.021	0.020
37	0.056	0.121	0.215	0.161	0.186	0.158	0.073	0.196	0.281	0.324	0.316
38	0.231	0.208	0.048	0.036	0.036	0.023	0.021	0.023	0.023	0.019	0.021
39	0.037	0.027	0.033	0.050	0.063	0.055	0.071	0.085	0.079	0.088	0.100
40	0.247	0.231	0.095	0.044	0.036	0.023	0.024	0.021	0.022	0.022	0.022

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD10000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.028	0.212	0.194	0.180	0.122	0.115	0.113	0.112	0.162	0.120	0.115
125	0.035	0.082	0.079	0.077	0.062	0.057	0.057	0.062	0.067	0.056	0.055
175	0.038	0.084	0.083	0.081	0.071	0.070	0.071	0.075	0.074	0.070	0.070
225	0.037	0.187	0.151	0.097	0.082	0.084	0.085	0.089	0.091	0.084	0.084
275	0.038	0.199	0.160	0.104	0.085	0.090	0.093	0.100	0.097	0.093	0.093
325	0.039	0.175	0.155	0.113	0.088	0.090	0.091	0.092	0.094	0.088	0.088
375	0.039	0.200	0.137	0.092	0.081	0.087	0.089	0.088	0.094	0.085	0.086
425	0.042	0.086	0.079	0.074	0.070	0.071	0.071	0.073	0.072	0.070	0.071
475	0.040	0.077	0.070	0.068	0.064	0.061	0.062	0.064	0.063	0.063	0.065
525	0.036	0.160	0.105	0.081	0.059	0.054	0.054	0.054	0.054	0.055	0.056
575	0.033	0.162	0.116	0.085	0.056	0.049	0.048	0.051	0.050	0.049	0.051
625	0.030	0.138	0.093	0.075	0.052	0.045	0.044	0.046	0.048	0.046	0.046
675	0.028	0.154	0.101	0.085	0.048	0.042	0.041	0.042	0.048	0.045	0.044
725	0.026	0.065	0.053	0.052	0.040	0.039	0.037	0.039	0.039	0.038	0.040
775	0.025	0.056	0.047	0.048	0.036	0.037	0.036	0.037	0.036	0.037	0.039
825	0.024	0.103	0.080	0.054	0.034	0.036	0.036	0.035	0.035	0.036	0.037
875	0.023	0.109	0.077	0.058	0.036	0.034	0.034	0.033	0.034	0.034	0.035
925	0.025	0.089	0.075	0.050	0.034	0.034	0.033	0.033	0.032	0.032	0.033
975	0.021	0.099	0.072	0.048	0.034	0.029	0.028	0.029	0.029	0.028	0.029
1025	0.024	0.048	0.045	0.036	0.033	0.029	0.028	0.029	0.029	0.028	0.029
1075	0.020	0.043	0.039	0.034	0.031	0.026	0.025	0.028	0.028	0.026	0.028
1125	0.020	0.072	0.060	0.047	0.030	0.026	0.026	0.028	0.029	0.026	0.027
1175	0.020	0.075	0.067	0.045	0.030	0.027	0.026	0.027	0.027	0.026	0.027
1225	0.038	0.076	0.065	0.059	0.048	0.046	0.046	0.047	0.040	0.048	0.045
1275	0.019	0.066	0.060	0.040	0.031	0.024	0.024	0.023	0.025	0.024	0.024
1325	0.024	0.037	0.036	0.031	0.026	0.028	0.027	0.026	0.026	0.025	0.026
1375	0.019	0.033	0.030	0.027	0.022	0.028	0.023	0.023	0.023	0.022	0.022
1425	0.024	0.055	0.050	0.037	0.027	0.027	0.031	0.028	0.028	0.026	0.026
1475	0.019	0.055	0.048	0.034	0.024	0.025	0.024	0.029	0.025	0.023	0.024
1525	0.021	0.049	0.044	0.032	0.024	0.024	0.024	0.025	0.027	0.024	0.025
1575	0.019	0.051	0.042	0.030	0.026	0.023	0.023	0.024	0.027	0.025	0.026
1625	0.019	0.030	0.025	0.024	0.023	0.022	0.023	0.024	0.023	0.024	0.024
1675	0.020	0.030	0.023	0.023	0.024	0.023	0.023	0.023	0.023	0.024	0.024
1725	0.020	0.037	0.031	0.026	0.025	0.023	0.022	0.023	0.023	0.023	0.024
1775	0.020	0.033	0.030	0.027	0.025	0.023	0.022	0.023	0.023	0.023	0.024
1825	0.021	0.033	0.032	0.027	0.024	0.023	0.022	0.022	0.023	0.022	0.024
1875	0.021	0.032	0.031	0.026	0.024	0.023	0.021	0.022	0.023	0.022	0.023
1925	0.023	0.028	0.024	0.023	0.023	0.022	0.022	0.022	0.023	0.022	0.023
1975	0.022	0.028	0.024	0.023	0.023	0.022	0.021	0.022	0.022	0.022	0.023

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD10000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.252	0.229	0.262	0.309	0.360	0.413	0.261	0.297	0.361	0.430	0.426
2.3	0.274	0.264	0.215	0.187	0.193	0.235	0.213	0.175	0.216	0.253	0.281
2.5	0.257	0.266	0.206	0.217	0.233	0.247	0.163	0.223	0.231	0.237	0.216
2.7	0.317	0.262	0.293	0.233	0.193	0.245	0.164	0.183	0.242	0.266	0.268
2.9	0.114	0.187	0.182	0.199	0.152	0.212	0.190	0.131	0.175	0.201	0.207
3.1	0.172	0.202	0.172	0.188	0.166	0.194	0.193	0.130	0.182	0.208	0.233
3.3	0.194	0.187	0.194	0.211	0.261	0.198	0.240	0.168	0.188	0.236	0.266
3.5	0.099	0.144	0.145	0.152	0.159	0.154	0.174	0.163	0.158	0.181	0.206
3.7	0.080	0.116	0.125	0.126	0.131	0.135	0.127	0.127	0.134	0.139	0.142
3.9	0.057	0.077	0.079	0.080	0.085	0.089	0.088	0.086	0.087	0.093	0.096
4.1	0.047	0.058	0.061	0.062	0.063	0.065	0.064	0.065	0.066	0.068	0.069
4.3	0.041	0.049	0.051	0.051	0.052	0.052	0.055	0.053	0.055	0.058	0.059
4.5	0.036	0.042	0.043	0.044	0.044	0.046	0.046	0.046	0.047	0.048	0.050
4.7	0.067	0.072	0.074	0.075	0.076	0.076	0.077	0.077	0.077	0.078	0.078
4.9	0.030	0.033	0.034	0.034	0.035	0.035	0.035	0.036	0.037	0.038	0.038
5.1	0.029	0.031	0.031	0.032	0.033	0.033	0.033	0.034	0.034	0.035	0.036
5.3	0.026	0.028	0.028	0.028	0.029	0.029	0.030	0.030	0.030	0.031	0.032
5.5	0.025	0.026	0.026	0.026	0.027	0.027	0.028	0.028	0.028	0.029	0.029
5.7	0.025	0.026	0.026	0.027	0.027	0.027	0.028	0.028	0.028	0.029	0.029
5.9	0.022	0.023	0.023	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.026
6.1	0.029	0.030	0.030	0.030	0.030	0.031	0.031	0.031	0.031	0.031	0.031
6.3	0.021	0.022	0.022	0.022	0.022	0.023	0.023	0.023	0.023	0.023	0.024
6.5	0.020	0.021	0.021	0.021	0.021	0.022	0.022	0.022	0.022	0.022	0.023
6.7	0.020	0.021	0.021	0.021	0.021	0.022	0.022	0.021	0.022	0.022	0.022
6.9	0.020	0.021	0.020	0.020	0.021	0.021	0.021	0.021	0.021	0.021	0.022
7.1	0.033	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.035
7.3	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.021
7.5	0.018	0.019	0.019	0.019	0.020	0.019	0.020	0.020	0.020	0.020	0.021
7.7	0.018	0.018	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.019
7.9	0.017	0.018	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.019
8.1	0.018	0.018	0.018	0.019	0.018	0.019	0.019	0.019	0.019	0.019	0.019
8.3	0.023	0.023	0.023	0.024	0.024	0.023	0.024	0.024	0.024	0.024	0.024
8.5	0.023	0.023	0.023	0.023	0.023	0.023	0.024	0.024	0.023	0.024	0.024
8.7	0.016	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.017	0.018	0.018
8.9	0.015	0.016	0.016	0.016	0.016	0.016	0.017	0.017	0.017	0.017	0.017

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD15000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.263	0.261	0.236	0.243	0.261	0.265	0.270	0.282	0.293	0.310	0.318
3	0.198	0.197	0.195	0.195	0.209	0.208	0.211	0.215	0.215	0.217	0.221
4	0.169	0.184	0.169	0.166	0.173	0.168	0.169	0.170	0.170	0.174	0.173
5	0.493	0.545	0.691	0.668	0.671	0.671	0.671	0.688	0.686	0.704	0.721
6	0.169	0.147	0.141	0.140	0.140	0.143	0.141	0.144	0.145	0.144	0.146
7	0.499	0.313	0.462	0.468	0.462	0.446	0.443	0.415	0.403	0.388	0.375
8	0.125	0.075	0.079	0.077	0.081	0.084	0.083	0.083	0.085	0.085	0.087
9	0.079	0.033	0.027	0.027	0.029	0.030	0.031	0.039	0.035	0.034	0.033
10	0.115	0.051	0.054	0.049	0.050	0.047	0.052	0.048	0.049	0.047	0.049
11	0.265	0.283	0.305	0.330	0.269	0.224	0.202	0.166	0.133	0.119	0.097
12	0.108	0.072	0.023	0.027	0.031	0.036	0.034	0.040	0.039	0.038	0.036
13	0.087	0.394	0.169	0.261	0.245	0.227	0.223	0.196	0.182	0.157	0.158
14	0.117	0.065	0.017	0.014	0.016	0.021	0.024	0.029	0.030	0.029	0.027
15	0.123	0.043	0.030	0.032	0.030	0.029	0.024	0.030	0.027	0.031	0.030
16	0.119	0.081	0.015	0.013	0.017	0.014	0.015	0.019	0.018	0.015	0.015
17	0.250	0.389	0.156	0.199	0.137	0.171	0.162	0.134	0.111	0.098	0.090
18	0.092	0.070	0.019	0.022	0.018	0.020	0.023	0.027	0.026	0.023	0.020
19	0.231	0.331	0.102	0.164	0.095	0.135	0.122	0.087	0.066	0.056	0.049
20	0.055	0.058	0.015	0.016	0.013	0.018	0.018	0.023	0.023	0.021	0.020
21	0.064	0.044	0.024	0.029	0.029	0.028	0.023	0.026	0.023	0.023	0.022
22	0.060	0.056	0.016	0.017	0.011	0.011	0.013	0.017	0.017	0.016	0.015
23	0.153	0.201	0.091	0.150	0.035	0.105	0.084	0.059	0.046	0.050	0.077
24	0.055	0.039	0.017	0.021	0.009	0.016	0.018	0.021	0.021	0.019	0.017
25	0.091	0.153	0.101	0.110	0.041	0.142	0.149	0.128	0.118	0.105	0.094
26	0.046	0.034	0.013	0.015	0.010	0.014	0.015	0.020	0.020	0.018	0.017
27	0.037	0.035	0.022	0.022	0.026	0.031	0.029	0.034	0.027	0.024	0.023
28	0.019	0.016	0.012	0.014	0.009	0.012	0.012	0.015	0.014	0.014	0.013
29	0.061	0.118	0.156	0.084	0.086	0.149	0.149	0.138	0.120	0.111	0.113
30	0.029	0.030	0.011	0.012	0.010	0.015	0.016	0.021	0.021	0.018	0.015
31	0.039	0.124	0.158	0.067	0.179	0.214	0.146	0.057	0.045	0.079	0.096
32	0.036	0.022	0.012	0.009	0.011	0.017	0.014	0.018	0.020	0.019	0.016
33	0.053	0.037	0.017	0.099	0.086	0.065	0.042	0.041	0.046	0.046	0.041
34	0.034	0.011	0.013	0.010	0.009	0.011	0.012	0.015	0.019	0.020	0.018
35	0.101	0.131	0.154	0.112	0.197	0.212	0.160	0.085	0.048	0.080	0.109
36	0.015	0.013	0.012	0.008	0.012	0.015	0.012	0.016	0.020	0.020	0.021
37	0.127	0.116	0.133	0.053	0.100	0.082	0.045	0.042	0.097	0.192	0.332
38	0.018	0.017	0.012	0.008	0.011	0.011	0.010	0.015	0.017	0.017	0.019
39	0.018	0.025	0.024	0.018	0.020	0.024	0.026	0.030	0.028	0.045	0.061
40	0.023	0.025	0.013	0.010	0.008	0.009	0.009	0.011	0.010	0.014	0.018

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD15000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.118	0.135	0.080	0.082	0.109	0.084	0.082	0.081	0.084	0.082	0.074
125	0.067	0.083	0.060	0.062	0.080	0.066	0.062	0.063	0.062	0.062	0.057
175	0.044	0.058	0.041	0.043	0.053	0.049	0.049	0.051	0.051	0.052	0.050
225	0.074	0.065	0.030	0.031	0.036	0.034	0.034	0.036	0.037	0.040	0.039
275	0.054	0.045	0.026	0.026	0.029	0.026	0.026	0.027	0.028	0.031	0.031
325	0.048	0.043	0.022	0.021	0.024	0.022	0.021	0.023	0.023	0.024	0.025
375	0.040	0.036	0.019	0.018	0.020	0.018	0.017	0.018	0.019	0.020	0.020
425	0.032	0.025	0.016	0.015	0.017	0.015	0.015	0.016	0.016	0.017	0.018
475	0.027	0.023	0.014	0.012	0.014	0.013	0.013	0.013	0.014	0.015	0.015
525	0.029	0.030	0.013	0.012	0.013	0.012	0.012	0.013	0.013	0.014	0.014
575	0.030	0.030	0.012	0.011	0.012	0.011	0.011	0.012	0.012	0.012	0.013
625	0.027	0.029	0.012	0.010	0.011	0.010	0.010	0.011	0.011	0.011	0.012
675	0.028	0.029	0.011	0.011	0.011	0.009	0.009	0.010	0.010	0.011	0.011
725	0.022	0.019	0.009	0.010	0.010	0.009	0.009	0.009	0.009	0.010	0.010
775	0.020	0.016	0.010	0.009	0.010	0.008	0.008	0.009	0.009	0.009	0.009
825	0.021	0.024	0.010	0.008	0.009	0.008	0.008	0.009	0.009	0.009	0.009
875	0.021	0.022	0.009	0.008	0.009	0.008	0.009	0.008	0.008	0.009	0.009
925	0.019	0.023	0.010	0.009	0.010	0.010	0.009	0.009	0.009	0.010	0.010
975	0.018	0.020	0.008	0.007	0.008	0.007	0.007	0.008	0.008	0.008	0.008
1025	0.016	0.016	0.009	0.009	0.009	0.009	0.008	0.009	0.009	0.009	0.009
1075	0.014	0.015	0.007	0.007	0.008	0.007	0.007	0.008	0.007	0.008	0.008
1125	0.015	0.015	0.008	0.007	0.007	0.007	0.007	0.008	0.007	0.008	0.008
1175	0.015	0.016	0.008	0.007	0.008	0.007	0.007	0.008	0.008	0.008	0.008
1225	0.013	0.014	0.008	0.007	0.008	0.007	0.007	0.008	0.008	0.008	0.008
1275	0.014	0.014	0.008	0.007	0.008	0.007	0.007	0.008	0.008	0.008	0.008
1325	0.014	0.012	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010
1375	0.012	0.009	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008
1425	0.014	0.012	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010
1475	0.012	0.010	0.008	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008
1525	0.012	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009
1575	0.012	0.010	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009
1625	0.012	0.011	0.010	0.008	0.008	0.009	0.010	0.012	0.011	0.012	0.011
1675	0.011	0.009	0.008	0.008	0.009	0.008	0.008	0.009	0.010	0.010	0.010
1725	0.011	0.008	0.008	0.008	0.008	0.009	0.008	0.009	0.010	0.011	0.011
1775	0.011	0.009	0.008	0.008	0.008	0.008	0.009	0.009	0.010	0.010	0.011
1825	0.012	0.009	0.008	0.008	0.008	0.008	0.009	0.010	0.010	0.010	0.012
1875	0.011	0.010	0.008	0.008	0.008	0.008	0.008	0.009	0.010	0.010	0.011
1925	0.012	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.011	0.011
1975	0.011	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.012

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD15000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.069	0.111	0.129	0.053	0.124	0.095	0.077	0.088	0.133	0.221	0.376
2.3	0.105	0.103	0.110	0.087	0.117	0.098	0.089	0.090	0.103	0.108	0.118
2.5	0.108	0.106	0.119	0.086	0.124	0.110	0.099	0.086	0.081	0.089	0.086
2.7	0.075	0.089	0.143	0.065	0.121	0.107	0.083	0.064	0.073	0.086	0.102
2.9	0.075	0.077	0.089	0.068	0.068	0.090	0.080	0.072	0.080	0.086	0.092
3.1	0.076	0.079	0.081	0.071	0.073	0.106	0.097	0.088	0.086	0.094	0.105
3.3	0.077	0.082	0.082	0.083	0.085	0.112	0.107	0.106	0.108	0.118	0.128
3.5	0.063	0.068	0.072	0.074	0.075	0.085	0.093	0.103	0.111	0.116	0.124
3.7	0.055	0.061	0.065	0.064	0.066	0.071	0.073	0.077	0.079	0.080	0.082
3.9	0.036	0.039	0.043	0.042	0.043	0.045	0.047	0.047	0.047	0.048	0.049
4.1	0.029	0.030	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.038	0.038
4.3	0.025	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.031	0.031	0.032
4.5	0.021	0.022	0.023	0.024	0.025	0.025	0.026	0.026	0.026	0.026	0.026
4.7	0.038	0.039	0.040	0.041	0.041	0.041	0.042	0.042	0.042	0.042	0.042
4.9	0.017	0.018	0.018	0.019	0.020	0.020	0.020	0.021	0.021	0.021	0.022
5.1	0.016	0.017	0.017	0.017	0.018	0.019	0.019	0.019	0.020	0.020	0.020
5.3	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.017	0.017	0.018	0.018
5.5	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.017
5.7	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.017
5.9	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.014	0.014	0.015
6.1	0.016	0.016	0.016	0.016	0.017	0.017	0.017	0.017	0.017	0.018	0.018
6.3	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013	0.013	0.013	0.014
6.5	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012	0.013	0.013
6.7	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012	0.012	0.013
6.9	0.011	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012
7.1	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.019	0.019	0.019
7.3	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.012
7.5	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
7.7	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011
7.9	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011
8.1	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011
8.3	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.014	0.014	0.014	0.014
8.5	0.012	0.013	0.013	0.013	0.013	0.013	0.013	0.014	0.014	0.014	0.014
8.7	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.011	0.010
8.9	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.011	0.011

5.1.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: AZZURRO 3PH HYD20000 ZSS	P

Active power P/P_n [%]	5	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.198	0.178	0.162	0.158	0.163	0.154	0.155	0.155	0.159	0.171	0.310
3	0.191	0.156	0.150	0.158	0.164	0.166	0.168	0.171	0.178	0.189	0.334
4	0.121	0.129	0.129	0.132	0.225	0.134	0.132	0.131	0.129	0.122	0.258
5	0.248	0.469	0.512	0.506	0.505	0.505	0.505	0.516	0.538	0.557	0.714
6	0.138	0.102	0.101	0.100	0.101	0.104	0.105	0.106	0.106	0.113	0.239
7	0.267	0.271	0.368	0.353	0.332	0.314	0.296	0.282	0.264	0.249	0.334
8	0.098	0.062	0.063	0.059	0.063	0.062	0.063	0.064	0.068	0.079	0.152
9	0.024	0.024	0.025	0.026	0.027	0.033	0.036	0.035	0.041	0.057	0.074
10	0.109	0.041	0.037	0.032	0.034	0.031	0.031	0.031	0.026	0.020	0.080
11	0.294	0.266	0.254	0.199	0.162	0.119	0.083	0.065	0.066	0.077	0.105
12	0.078	0.033	0.013	0.015	0.016	0.017	0.019	0.020	0.024	0.034	0.082
13	0.222	0.259	0.188	0.180	0.167	0.149	0.124	0.105	0.105	0.116	0.232
14	0.065	0.020	0.016	0.012	0.014	0.012	0.011	0.012	0.013	0.019	0.027
15	0.069	0.026	0.023	0.024	0.020	0.021	0.023	0.025	0.025	0.022	0.096
16	0.102	0.024	0.012	0.009	0.011	0.008	0.009	0.008	0.009	0.012	0.018
17	0.060	0.283	0.147	0.098	0.130	0.108	0.084	0.070	0.073	0.088	0.204
18	0.088	0.026	0.009	0.008	0.007	0.008	0.009	0.009	0.012	0.015	0.019
19	0.059	0.227	0.129	0.068	0.099	0.072	0.050	0.044	0.054	0.072	0.061
20	0.069	0.021	0.009	0.009	0.009	0.007	0.008	0.007	0.008	0.010	0.017
21	0.061	0.025	0.022	0.022	0.019	0.020	0.019	0.019	0.020	0.020	0.077
22	0.081	0.018	0.008	0.007	0.008	0.006	0.006	0.006	0.007	0.009	0.011
23	0.061	0.112	0.137	0.024	0.078	0.048	0.035	0.047	0.077	0.092	0.068
24	0.060	0.017	0.008	0.006	0.005	0.006	0.007	0.007	0.008	0.009	0.016
25	0.064	0.067	0.121	0.030	0.114	0.102	0.088	0.075	0.076	0.087	0.339
26	0.038	0.017	0.011	0.007	0.007	0.005	0.006	0.006	0.006	0.006	0.011
27	0.038	0.017	0.016	0.019	0.022	0.025	0.022	0.019	0.018	0.016	0.213
28	0.036	0.015	0.009	0.006	0.007	0.006	0.006	0.006	0.006	0.007	0.021
29	0.039	0.013	0.105	0.066	0.116	0.108	0.090	0.083	0.092	0.097	0.418
30	0.019	0.014	0.009	0.007	0.006	0.006	0.007	0.006	0.007	0.007	0.025
31	0.046	0.043	0.065	0.136	0.148	0.070	0.036	0.066	0.084	0.100	0.387
32	0.017	0.016	0.010	0.006	0.009	0.008	0.009	0.007	0.007	0.007	0.032
33	0.033	0.073	0.061	0.065	0.042	0.030	0.035	0.034	0.030	0.027	0.215
34	0.014	0.011	0.009	0.007	0.008	0.008	0.010	0.009	0.009	0.008	0.024
35	0.096	0.060	0.075	0.149	0.149	0.085	0.038	0.069	0.099	0.111	0.253
36	0.009	0.010	0.006	0.005	0.008	0.009	0.009	0.011	0.012	0.011	0.014
37	0.095	0.032	0.043	0.076	0.053	0.024	0.073	0.177	0.305	0.265	0.021
38	0.011	0.013	0.007	0.005	0.005	0.006	0.009	0.009	0.010	0.011	0.014
39	0.018	0.012	0.014	0.016	0.018	0.020	0.021	0.038	0.047	0.043	0.056
40	0.020	0.012	0.008	0.006	0.006	0.006	0.007	0.011	0.014	0.015	0.011

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD20000 ZSS											
Active power P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	0.090	0.102	0.065	0.067	0.067	0.067	0.066	0.065	0.066	0.068	0.110
125	0.054	0.071	0.052	0.055	0.057	0.053	0.053	0.052	0.053	0.054	0.099
175	0.042	0.040	0.033	0.036	0.048	0.037	0.039	0.039	0.042	0.044	0.085
225	0.054	0.036	0.023	0.025	0.044	0.027	0.028	0.029	0.031	0.033	0.060
275	0.041	0.031	0.020	0.020	0.022	0.020	0.022	0.023	0.024	0.026	0.045
325	0.036	0.028	0.016	0.015	0.016	0.016	0.017	0.018	0.019	0.021	0.038
375	0.033	0.025	0.013	0.013	0.013	0.013	0.014	0.015	0.016	0.017	0.026
425	0.021	0.016	0.011	0.011	0.012	0.011	0.012	0.012	0.013	0.015	0.022
475	0.019	0.015	0.010	0.009	0.010	0.009	0.010	0.011	0.012	0.013	0.019
525	0.027	0.021	0.009	0.009	0.009	0.009	0.009	0.010	0.011	0.012	0.017
575	0.028	0.019	0.009	0.009	0.008	0.008	0.009	0.009	0.010	0.010	0.020
625	0.021	0.020	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.010	0.036
675	0.023	0.016	0.008	0.008	0.008	0.007	0.008	0.008	0.008	0.009	0.014
725	0.015	0.011	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.013
775	0.013	0.011	0.006	0.006	0.007	0.006	0.007	0.007	0.007	0.008	0.012
825	0.016	0.016	0.007	0.006	0.006	0.006	0.006	0.007	0.007	0.008	0.012
875	0.016	0.014	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.012
925	0.014	0.015	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.015
975	0.014	0.012	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.011
1025	0.012	0.010	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.013
1075	0.010	0.008	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.011
1125	0.012	0.011	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.011
1175	0.012	0.010	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.011
1225	0.011	0.009	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.014
1275	0.011	0.009	0.006	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.012
1325	0.011	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.017
1375	0.009	0.007	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.015
1425	0.011	0.009	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.023
1475	0.008	0.008	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.018
1525	0.008	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.021
1575	0.008	0.008	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.019
1625	0.009	0.009	0.007	0.007	0.007	0.008	0.008	0.009	0.009	0.009	0.022
1675	0.007	0.007	0.006	0.006	0.006	0.006	0.007	0.008	0.007	0.008	0.017
1725	0.007	0.007	0.006	0.006	0.006	0.006	0.007	0.008	0.008	0.008	0.016
1775	0.007	0.007	0.006	0.006	0.006	0.007	0.007	0.008	0.009	0.008	0.017
1825	0.008	0.007	0.006	0.006	0.006	0.007	0.007	0.008	0.010	0.009	0.021
1875	0.008	0.007	0.006	0.006	0.006	0.006	0.007	0.008	0.009	0.010	0.020
1925	0.009	0.008	0.007	0.007	0.007	0.007	0.007	0.008	0.009	0.010	0.017
1975	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.009	0.010	0.014

5.1.4	**TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)**										
Model: AZZURRO 3PH HYD20000 ZSS											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	0.079	0.051	0.031	0.095	0.066	0.059	0.099	0.200	0.346	0.317	0.103
2.3	0.073	0.090	0.073	0.089	0.071	0.066	0.075	0.080	0.104	0.138	0.150
2.5	0.077	0.103	0.080	0.095	0.081	0.066	0.061	0.065	0.071	0.087	0.130
2.7	0.074	0.109	0.091	0.094	0.077	0.053	0.052	0.066	0.079	0.093	0.107
2.9	0.058	0.062	0.058	0.052	0.069	0.055	0.059	0.065	0.070	0.072	0.129
3.1	0.054	0.059	0.059	0.055	0.078	0.071	0.064	0.073	0.085	0.102	0.149
3.3	0.057	0.060	0.069	0.063	0.083	0.080	0.081	0.091	0.103	0.118	0.194
3.5	0.049	0.053	0.058	0.058	0.066	0.075	0.083	0.092	0.103	0.101	0.159
3.7	0.043	0.046	0.048	0.049	0.053	0.056	0.059	0.060	0.063	0.067	0.116
3.9	0.028	0.031	0.031	0.032	0.034	0.035	0.035	0.036	0.037	0.040	0.072
4.1	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.028	0.029	0.029	0.056
4.3	0.019	0.020	0.021	0.021	0.022	0.023	0.023	0.023	0.024	0.024	0.047
4.5	0.016	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.020	0.020	0.040
4.7	0.029	0.030	0.030	0.031	0.031	0.031	0.032	0.032	0.032	0.032	0.064
4.9	0.013	0.013	0.014	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.031
5.1	0.012	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.015	0.029
5.3	0.011	0.011	0.012	0.012	0.013	0.013	0.013	0.013	0.014	0.014	0.026
5.5	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013	0.024
5.7	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013	0.024
5.9	0.009	0.009	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.021
6.1	0.012	0.012	0.012	0.012	0.013	0.013	0.013	0.013	0.014	0.014	0.026
6.3	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.019
6.5	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.011	0.019
6.7	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.018
6.9	0.008	0.008	0.008	0.008	0.008	0.009	0.099	0.009	0.009	0.010	0.018
7.1	0.014	0.014	0.014	0.014	0.014	0.014	0.075	0.014	0.014	0.015	0.029
7.3	0.008	0.008	0.008	0.008	0.008	0.008	0.061	0.009	0.009	0.009	0.017
7.5	0.007	0.007	0.008	0.008	0.008	0.008	0.052	0.008	0.008	0.009	0.017
7.7	0.007	0.007	0.007	0.008	0.008	0.008	0.059	0.008	0.008	0.009	0.016
7.9	0.007	0.007	0.007	0.007	0.008	0.008	0.064	0.008	0.008	0.009	0.016
8.1	0.007	0.007	0.007	0.008	0.008	0.008	0.081	0.008	0.008	0.008	0.017
8.3	0.010	0.010	0.010	0.010	0.010	0.010	0.083	0.010	0.011	0.011	0.021
8.5	0.009	0.010	0.010	0.010	0.010	0.010	0.059	0.011	0.011	0.011	0.022
8.7	0.007	0.007	0.007	0.007	0.007	0.007	0.035	0.008	0.008	0.008	0.015
8.9	0.006	0.007	0.007	0.007	0.007	0.007	0.028	0.008	0.008	0.008	0.015

5.2	TABLE: Asymmetry calculation for three-phase inverter	P

☒ Three-phase inverter

Test voltage: 230 V, 50 Hz

No.	Test condition		Power asymmetry [KVA]				
	cos φ	P/P_n	I	II	III	IV	VI
1	1.00	100%	0.015	0.013	0.013	0.013	0.012
2	1.00	50%	0.010	0.009	0.009	0.009	0.009
3	max. under-excited	100%	0.007	0.009	0.009	0.007	0.010
4		50%	0.007	0.007	0.007	0.005	0.006
5	max. over-excited	100%	0.009	0.009	0.009	0.008	0.008
6		50%	0.008	0.007	0.007	0.007	0.007

Max. Power Asymmetry [KVA]	0.015	Limitation [KVA]	3.680

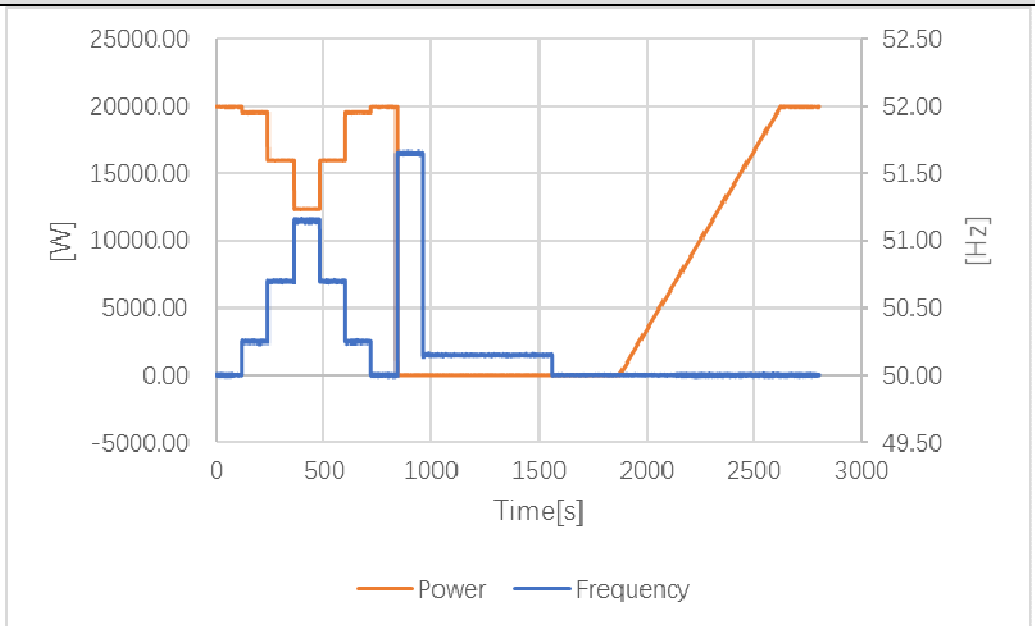
5.3.2	TABLE: Measurement of active- and reactive power ranges								P
No.	Test condition		Measurement						
	Cos_φ	U / Un	U [V]	I [A]	P_{Emax} [W]	S_{Emax} [VA]	Q [Var]	Cos_φ	Set Cos_φ
a1	1.00	86%	197.95	32.10	19052.78	19060.85	470.20	0.9996	1.0
a2		100%	230.78	28.92	20013.99	20021.73	419.78	0.9996	1.0
a3		109%	250.84	26.69	20075.89	20082.91	428.50	0.9997	1.0
b1	Q = 43.6%Sn under-excited	86%	197.87	32.02	17051.65	19004.59	-8391.36	0.8972	0.9
b2		100%	230.75	31.82	19772.39	22030.30	-9715.23	0.8975	0.9
b3		109%	250.83	29.57	20016.70	22252.30	-9720.89	0.8995	0.9
c1	Q = 43.6%Sn over-excited	86%	197.81	32.93	17276.34	19539.83	9128.66	0.8942	0.9
c2		100%	230.80	32.05	19949.43	22188.63	9713.64	0.8991	0.9
c3		109%	250.87	29.54	19999.94	22229.85	9704.05	0.8997	0.9
d	Q = 43.6%Sn under-excite	100%	230.21	15.79	4945.16	10908.21	-9722.86	0.4533	<0.9
e	Q = 43.6%Sn over-excited	100%	230.26	15.81	4976.26	10923.83	9724.53	0.4555	<0.9
f	Q = 43.6%Sn under-excite	100%	230.12	14.63	2849.53	10102.73	-9692.52	0.2821	<0.9
g	Q = 43.6%Sn over-excited	100%	230.21	14.68	2924.64	10138.34	9707.33	0.2885	<0.9
h	Q = 43.6%Sn under-excite	100%	230.10	14.28	1844.02	9859.98	-9685.99	0.1870	<0.9
i	Q = 43.6%Sn over-excited	100%	230.17	14.26	1871.71	9849.18	9669.68	0.1900	<0.9

5.3.3	TABLE: Termination of active power supply after off command via telecontrol interface (input port)	P

Activation of Logic interface Power from 100%Pn to <5%Pn	Time
	1.2s
Limitation	5s
The interface used	Terminal is used for logic interface input port, which specified in manual

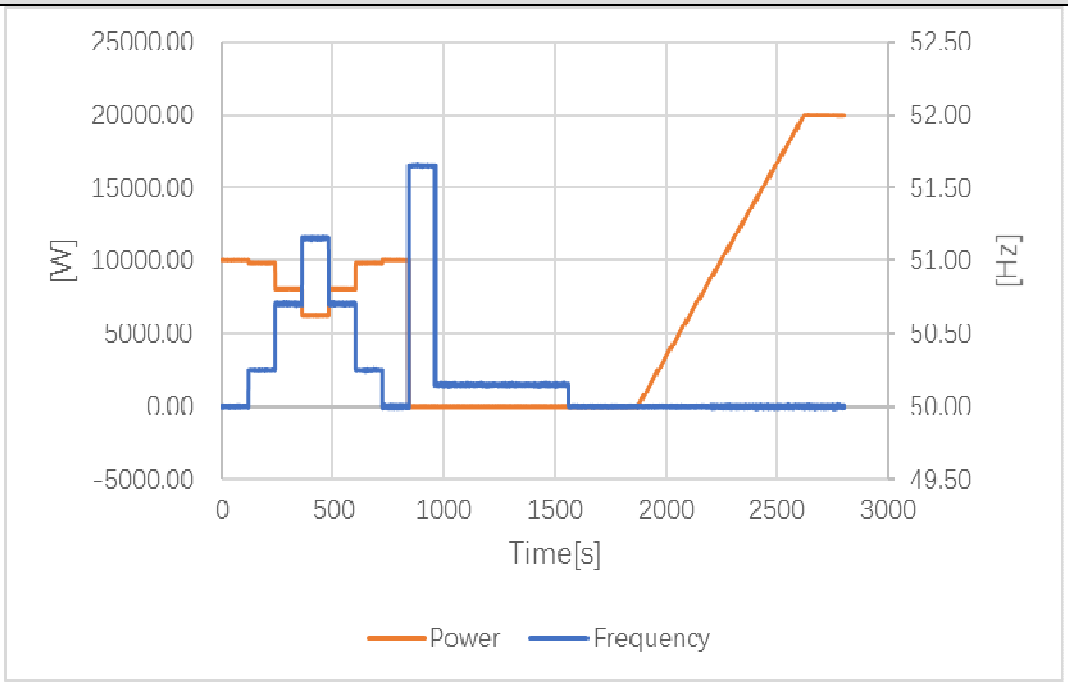
5.3.4	TABLE: Active power reduction at overfrequency							P
Test 1 Setting parameters of the EZE: P = 100% PEmax Start of power reduction at 50.2 Hz .s = 5% (40% Pref / Hz)	40%P_{ref}(W)		8000		5%P_{Emax} (W)	1000		
	f (Hz)	Expected Active power output [P/ PEmax]	Measured output Power (W)	Tolerance between measured P and Expected [△P/ PEmax]	Tolerance Limit [%]	Time		
						The initial time delay TV <2s	The response time T_{90} <2s	The settling time <20s
a) 50Hz ± 0.01Hz	50.00	100%	19967.29	-0.16%	< ± 5%	--	--	--
b)50.25Hz ± 0.05Hz	50.25	98%	19539.18	-0.30%	< ± 5%	0.6s	1.0s	1.4s
c)50.70Hz ± 0.10Hz	50.70	80%	15967.73	-0.16%	< ± 5%	--	0.8s	1.2s
d)51.15Hz ± 0.05Hz	51.15	62%	12380.28	-0.10%	< ± 5%	--	0.6s	1.2s
e)50.70Hz ± 0.01Hz	50.70	80%	15968.43	-0.16%	< ± 5%	--	0.8s	1.2s
f)50.25Hz ± 0.01Hz	50.25	98%	19539.51	-0.30%	< ± 5%	--	0.8s	1.2s
g)50Hz ± 0.01Hz	50.00	100%	19964.14	-0.18%	< ± 5%	--	0.6s	2.2s
h)51.65Hz± 0.01Hz	Disconnection Time[ms]: _175.0___, Limitation[ms]: _200__							
i)50.15Hz± 0.01Hz	Reconnection : ☐ Yes/ ☒ No, Limitation: No reconnection is allowed.							
j)50.00Hz± 0.01Hz	Maximal Rising Gradient [%W/min]: _8.01__, Limitation [%W/min]: 10%							

Test curve



Test 2 Setting parameters of the EZE: P = 50% PEmax Start of power reduction at 50.2 Hz .s = 5% (40% Pref / Hz)	40%P_{ref}(W)		4000		5%P_{Emax} (W)	1000		
	f (Hz)	Expected Active power output [P/ PEmax]	Measured output Power (W)	Tolerance between measured P and Expected [△P/ PEmax]	Tolerance Limit [%]	Time		
						The initial time delay TV <2s	The response time T_{90} <2s	The settling time <20s
a) 50Hz ± 0.01Hz	50.00	50%	10017.08	0.09%	< ± 5%	--	--	--
b)50.25Hz ± 0.05Hz	50.25	49%	9831.66	0.16%	< ± 5%	0.4s	1.0s	2.0s
c)50.70Hz ± 0.10Hz	50.70	40%	8051.47	0.26%	< ± 5%	--	0.6s	1.4s
d)51.15Hz ± 0.05Hz	51.15	31%	6263.39	0.32%	< ± 5%	--	0.6s	1.2s
e)50.70Hz ± 0.01Hz	50.70	40%	8050.94	0.25%	< ± 5%	--	0.6s	1.2s
f)50.25Hz ± 0.01Hz	50.25	49%	9831.84	0.16%	< ± 5%	--	0.6s	1.2s
g)50Hz ± 0.01Hz	50.00	50%	10021.33	0.11%	< ± 5%	--	0.4s	0.8s
h)51.65Hz± 0.01Hz	Disconnection Time[ms]: _100.0_, Limitation[ms]: _200_							
i)50.15Hz± 0.01Hz	Reconnection : ☐ Yes/ ☒ No, Limitation: No reconnection is allowed.							
j)50.00Hz± 0.01Hz	Maximal Rising Gradient [%W/min]: _8.03_, Limitation [%W/min]: 10%							

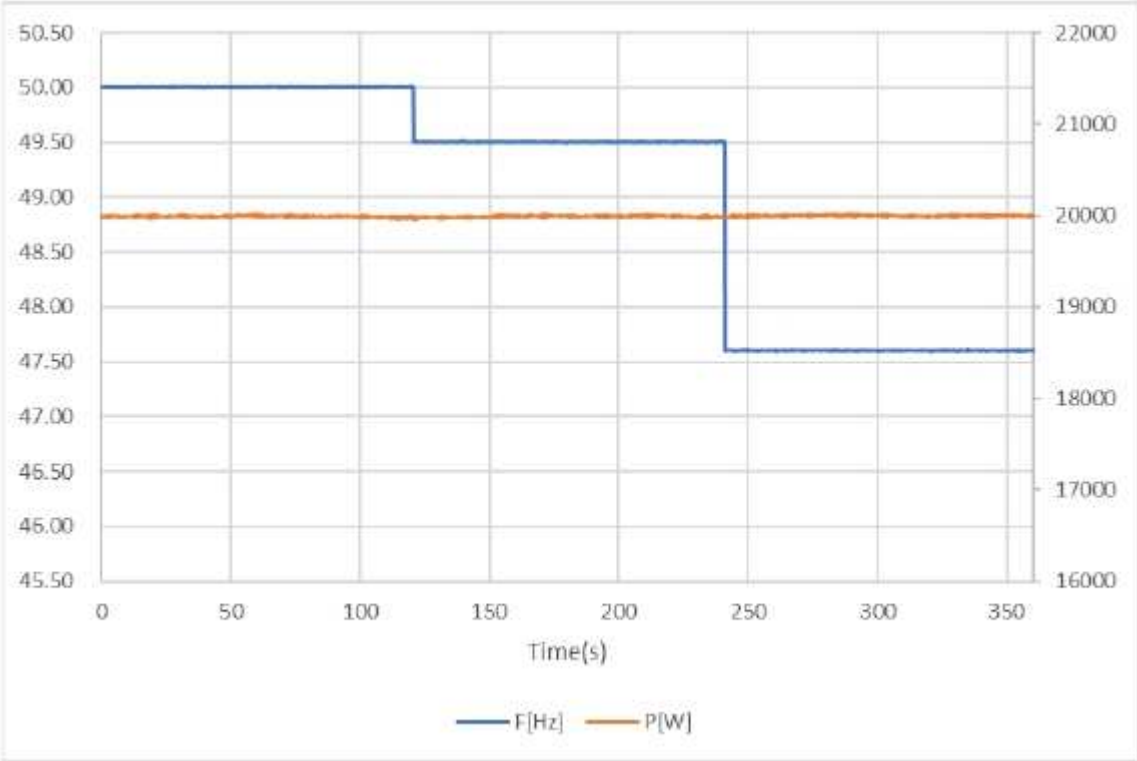
Test curve



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

	f (Hz)	Power (KW)
50.00 ± 0.01Hz	50.00	19.988
49.0 Hz	49.00	19.986
47.50 ~ 47.60Hz	47.55	19.995

Test curve

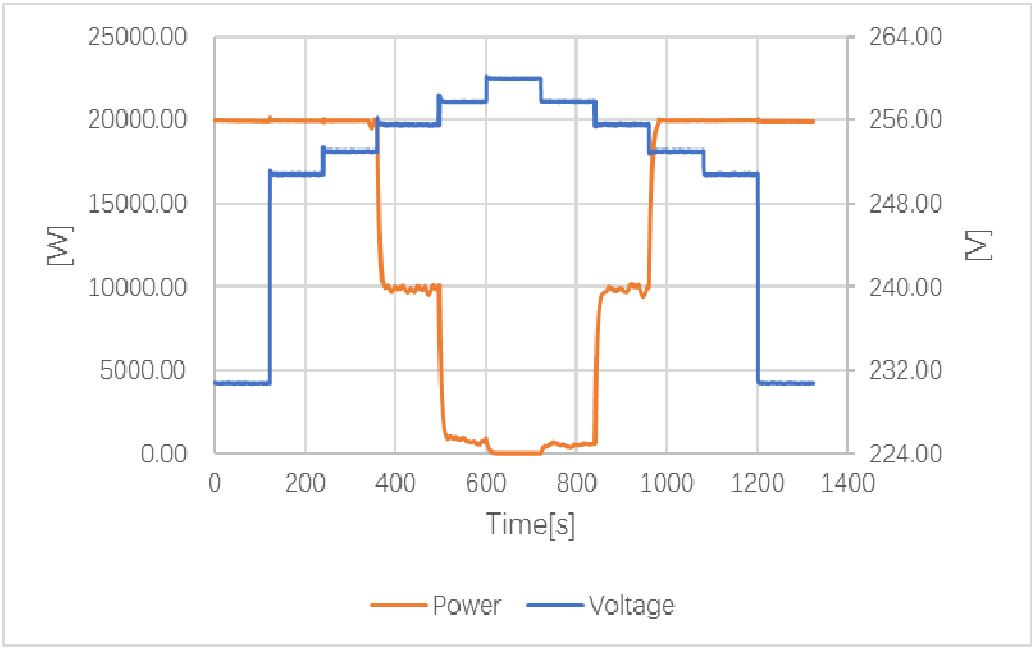


5.3.6	TABLE: Voltage controlled active power control P (U)						P
a) Test procedure for the quasi-stationary behavior of the P (U) control							
U/Un	U [V]	I[A]	P[W]	Q[Var]	Pdesired	△P/Pn	Limitation
109%	250.82	26.56	19978.73	356.06	100%	-0.11%	± 10%
110%	253.02	26.28	19947.58	356.80	100%	-0.26%	± 10%
111%	255.58	12.92	9901.90	250.89	50%	-0.49%	± 10%
112%	257.79	1.15	860.00	-229.57	0%	4.30%	± 10%
113%	260.01	0.31	50.26	-67.25	0%	0.25%	± 10%
112%	257.81	0.76	540.45	-216.11	0%	2.70%	± 10%
111%	255.59	12.82	9830.25	248.05	50%	-0.85%	± 10%
110%	253.02	26.27	19934.35	353.32	100%	-0.33%	± 10%
109%	250.81	26.57	19991.26	354.32	100%	-0.04%	± 10%
100%	230.76	28.80	19934.27	349.65	100%	-0.33%	± 10%
b) Test procedure for dynamic							
U/Un	U [V]	I[A]	P[W]	Q[Var]	Remark		
100%	230.76	28.83	19958.29	348.33	EZE in operation; Start of recording		
109%	250.93	26.62	20036.83	345.882	P (U) rule may not yet respond		
113%	260.08	0.33	258.27	108.19	P (U) control regulates power to 0 or minimum possible power.		
109%	250.94	26.60	20025.74	330.72	P (U) rule canceled		
100%	230.77	28.92	20025.00	331.52	EZE in operation		
100%	230.77	28.93	20025.11	336.05	End of the recording		

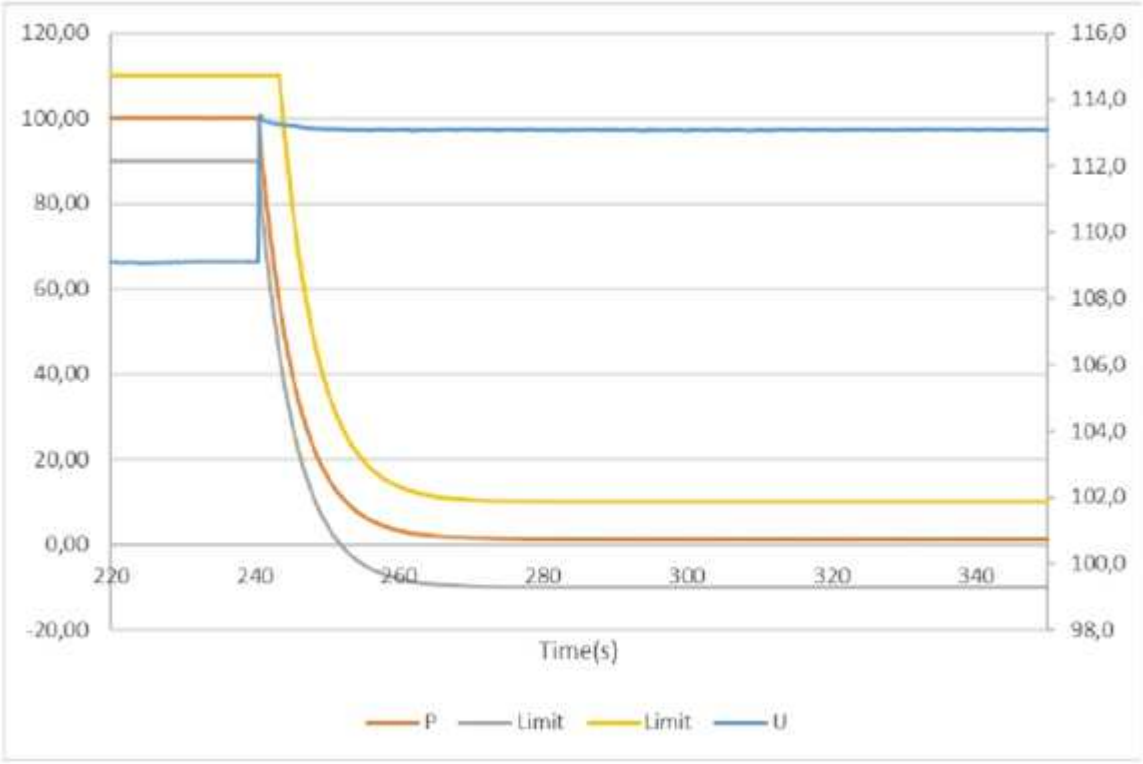
Remark:

Increase in active power P2> P1	Upper tolerance band:	for all t: $P2 - (P2 - P1) \cdot e^{(-t / Tau)} + 0{,}10 \cdot Pn$
	Lower tolerance band:	for t <3 seconds: $P1 - 0{,}10 \cdot Pn$ for t ≥ 3 seconds: $P2 - (P2 - P1) \cdot e^{([-t + 3\ seconds] / Tau)} - 0.10 \cdot Pn$
Drop in active power P2 <P1	Upper tolerance band:	for t <3 seconds: $P1 + 0{,}10 \cdot Pn$ for t ≥ 3 seconds: $P2 - (P2 - P1) \cdot e^{([-t + 3\ seconds] / Tau)} + 0{,}10 \cdot Pn$
	Lower tolerance band:	for all t: $P2 - (P2 - P1) \cdot e^{(-t / tau)} - 0{,}10 \cdot Pn$

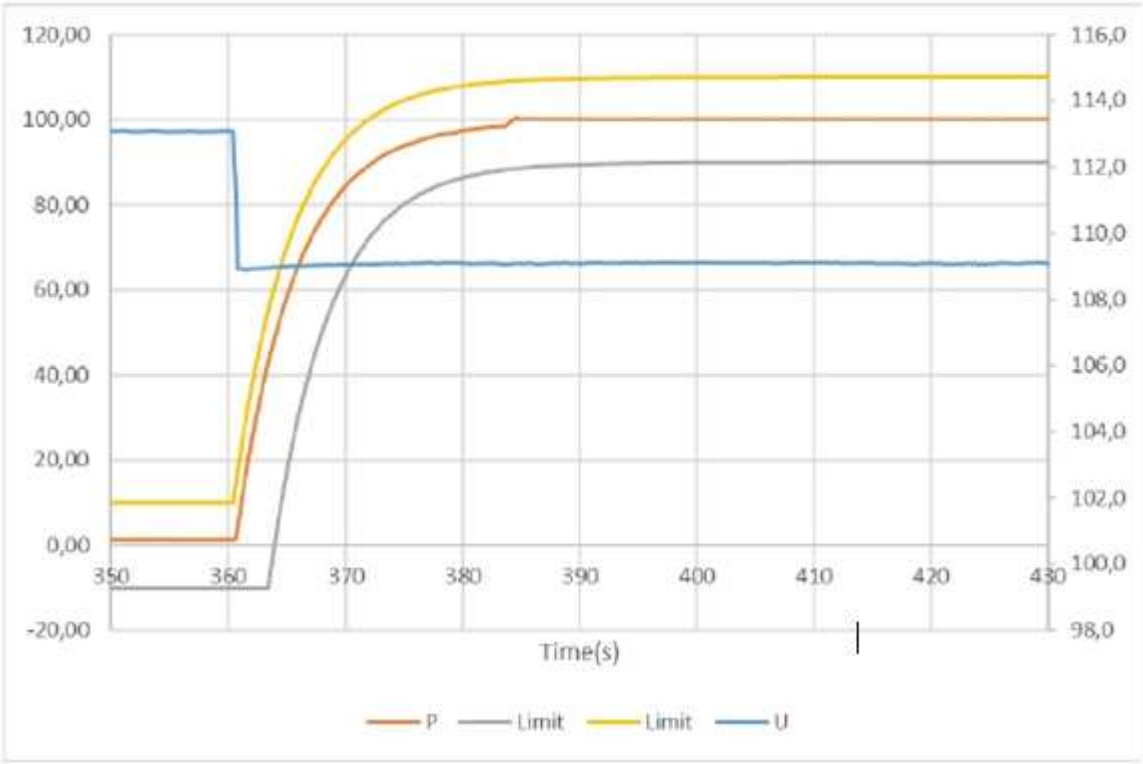
P(U) for test procedure (a), Curve



Graph of Voltage-controlled active power limitation P(V), form 109%Un to 113%Un

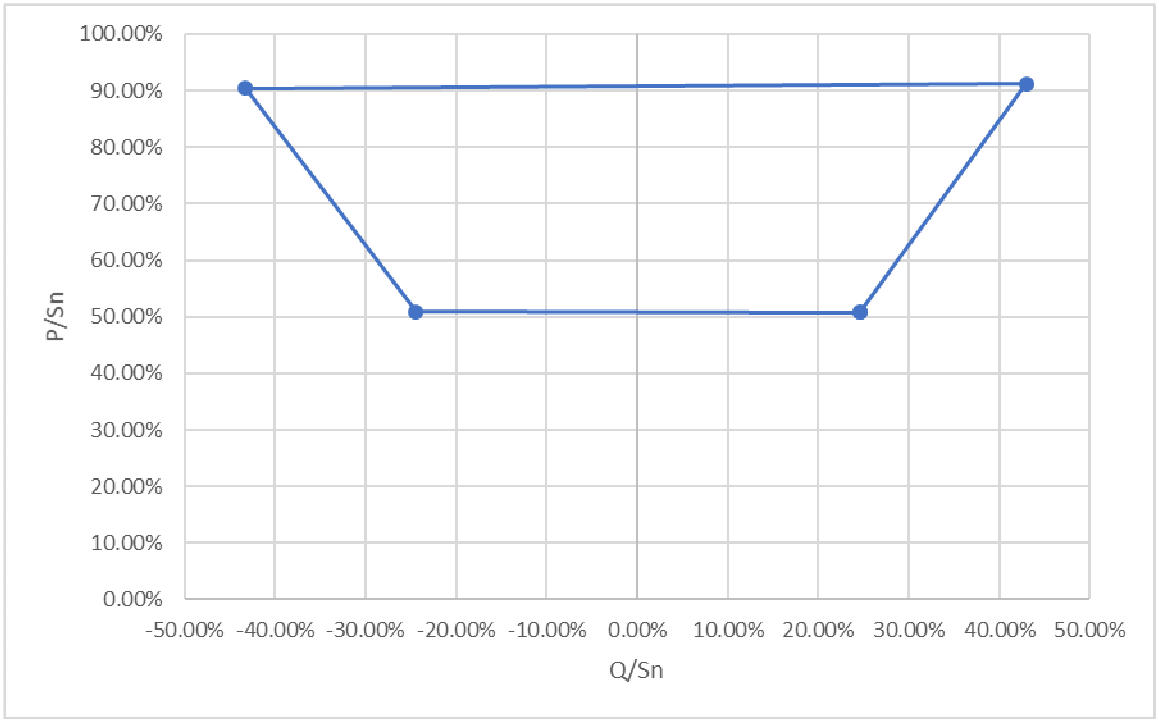


Graph of Voltage-controlled active power limitation P(V), form 113%Un to 109%Un



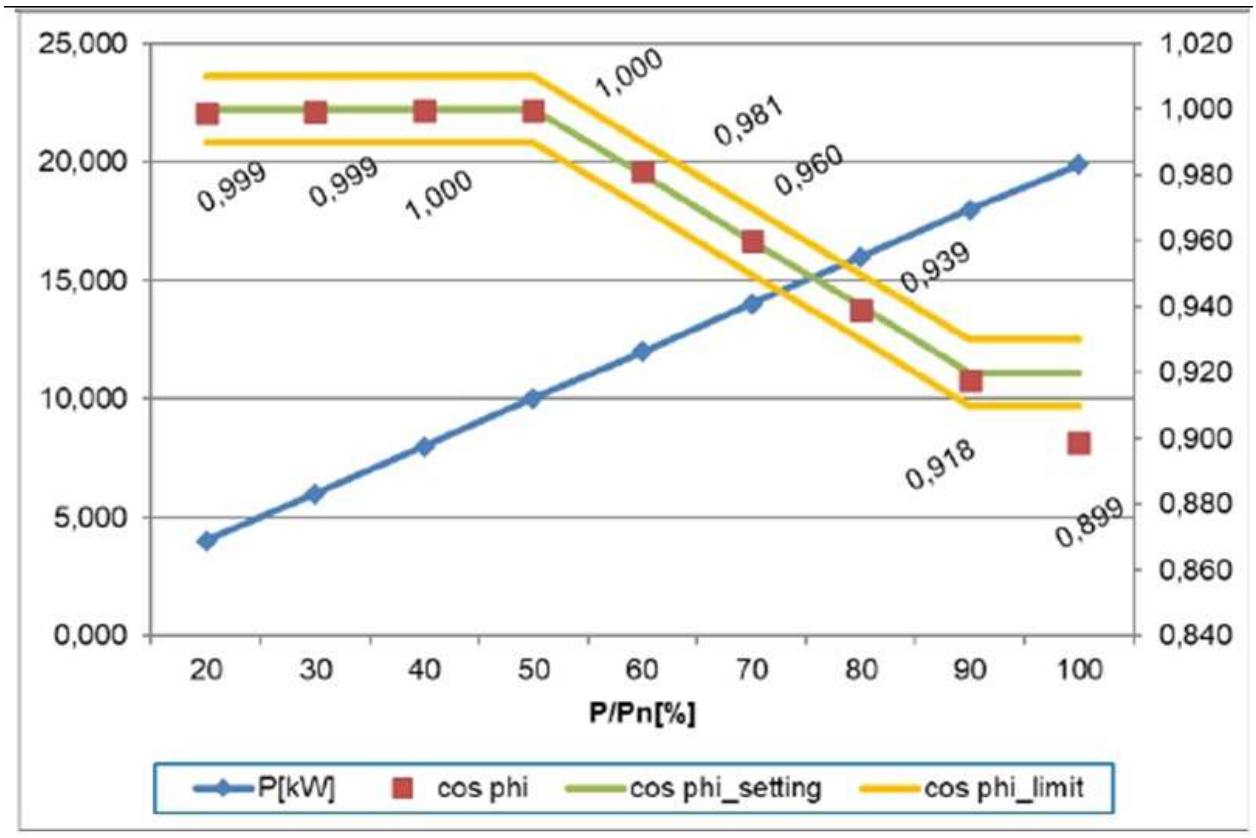
5.3.7	TABLE: Reactive power control according to setpoint specification "cos φ fixed"							P
No.	Test condition		Measurement					
	Cos_{φ}	Power	U/Un [%]	P [KW]	Q [KVar]	cos φ	Δ cos φ	Limit
☒ ∑ SEmax > 3.68kVA								
a)	minimum cos ϕ under-excited	50%P_{Emax}	0.91	9.951	-4.827	0.900	0	≤ ±0.01
			1.00	9.992	-4.846	0.900	0	≤ ±0.01
			1.09	10.021	-4.868	0.899	-0.001	≤ ±0.01
		S_{Emax}	0.91	18.045	-8.764	0.900	0	≤ ±0.01
			1.00	19.768	-9.720	0.897	-0.003	≤ ±0.01
			1.09	19.890	-9.727	0.898	-0.002	≤ ±0.01
b)	minimum cos ϕ over-excited	50%P_{Emax}	0.91	9.967	4.859	0.899	-0.001	≤ ±0.01
			1.00	10.014	4.853	0.900	0	≤ ±0.01
			1.09	10.046	4.868	0.900	0	≤ ±0.01
		S_{Emax}	0.91	18.095	8.844	0.898	-0.002	≤ ±0.01
			1.00	19.848	9.714	0.898	-0.002	≤ ±0.01
			1.09	19.842	9.696	0.898	-0.002	≤ ±0.01

P-Q Diagram



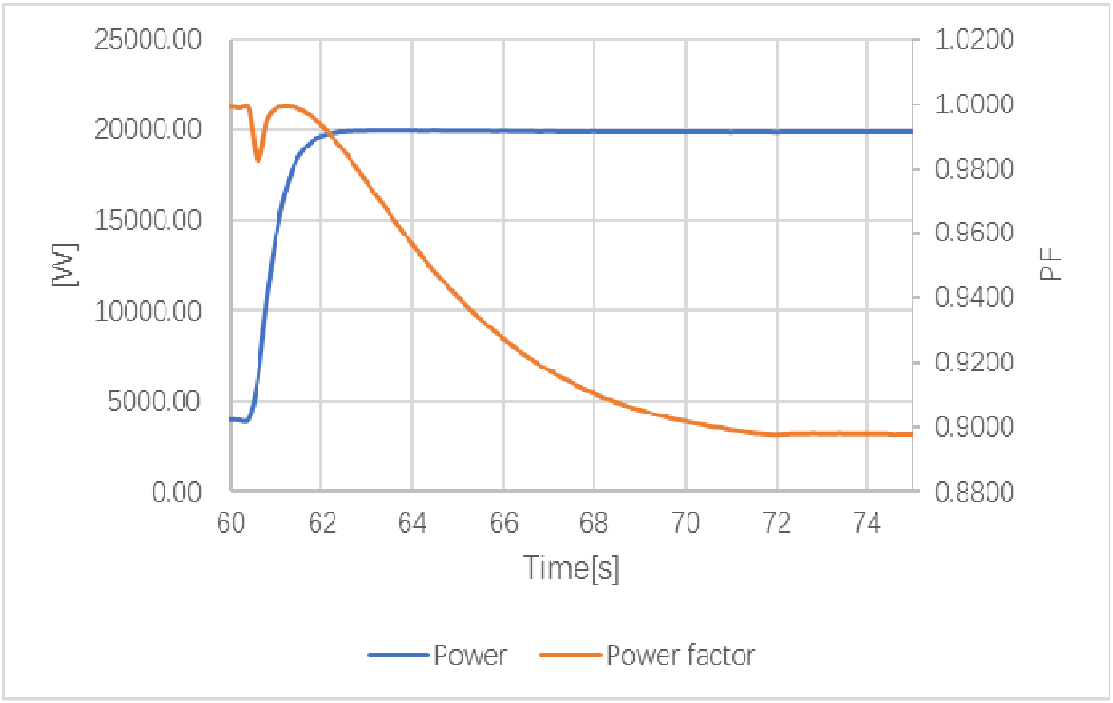
5.3.8	Reactive power control "cos φ (P)"						P
Set point P/PEmax [%]	Set point [W]	Measured Active Power [KW]	Measured Reactive Power [KVAR]	Measured $\cos\varphi$	Expected $\cos\varphi$	$\Delta\cos\varphi$	limit $\Delta\cos\varphi$
20	2000	4.010	0.118	0.999	1.00	-0.001	0.0100
30	3000	5.998	0.193	0.999	1.00	-0.001	0.0100
40	4000	8.008	0.203	1.000	1.00	0	0.0100
50	5000	10.056	0.214	1.000	1.00	0	0.0100
60	6000	12.009	-2.365	0.981	0.98	0.001	0.0100
70	7000	14.033	-4.093	0.960	0.96	0	0.0100
80	8000	15.996	-5.849	0.939	0.94	-0.001	0.0100
90	9000	17.993	-7.782	0.918	0.92	-0.002	0.0100
100	10000	19.899	-9.719	0.899	0.90	-0.001	0.0100

cos φ (P) curve



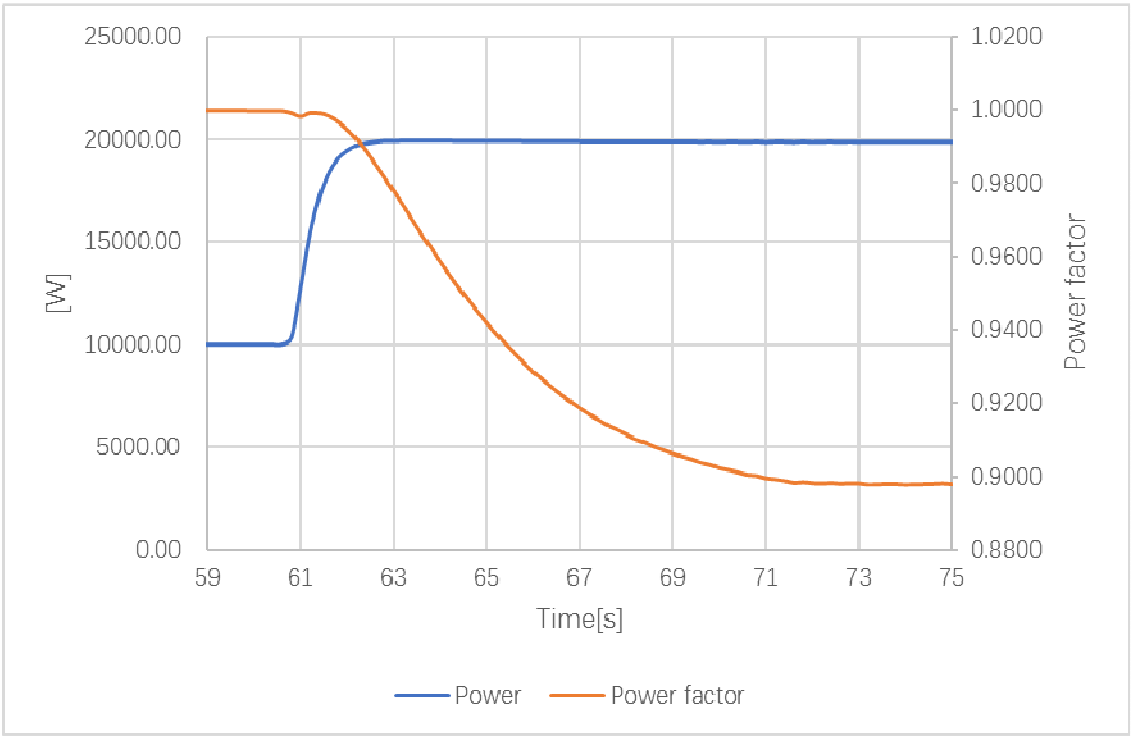
Time response for cosφ setting

Active power step: 20%PEmax - 90%PEmax (9.6s)



Time response for cosφ setting

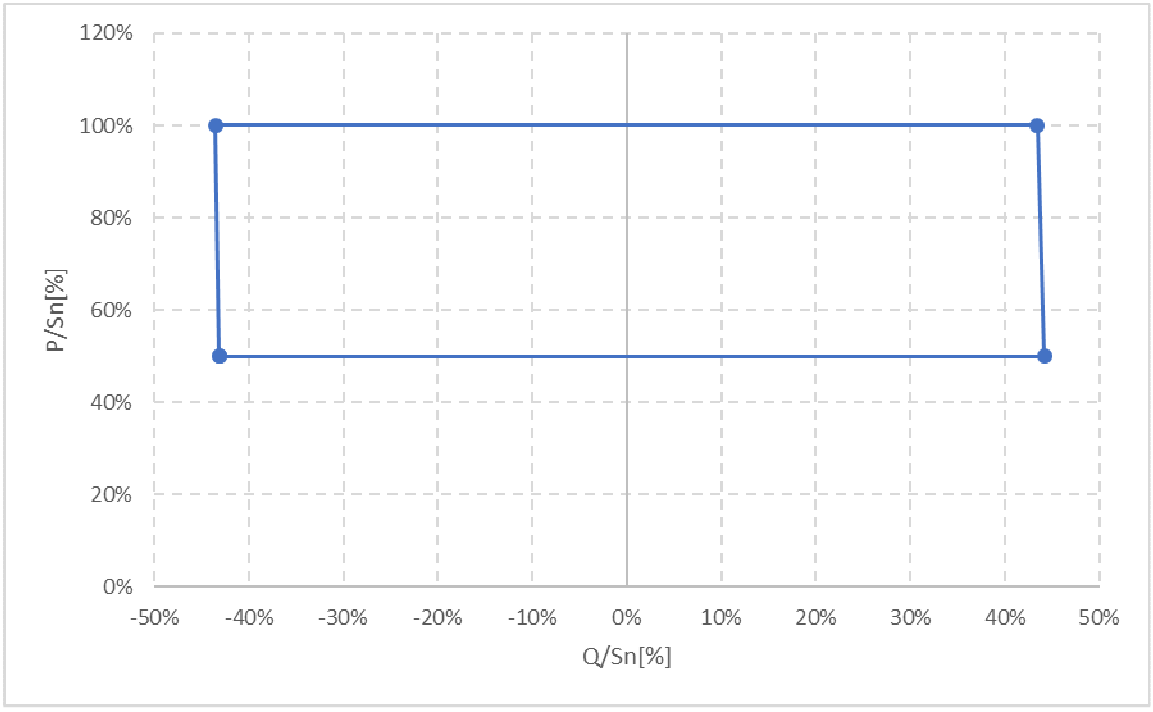
Active power step: 50%PEmax - 90%PEmax (9.6s)



5.3.9	TABLE: Reactive power control according to setpoint specification "Q fix"	P

No.	Test condition		Measurement					
	Cos_{φ}	Power	U/Un [%]	P [KW]	Q [KVar]	Expect Q [KVar]	Δ Q/Sn	Limit
☒ ∑ SEmax > 3.68kVA								
a)	Maximum Q under-excited	50%P_{Emax}	0.91	9.862	-9.707	-9.592	-0.52%	≤ ±4%
			1.00	9.909	-9.707	-9.592	-0.52%	≤ ±4%
			1.09	9.935	-9.709	-9.592	-0.53%	≤ ±4%
		S_{Emax}	0.91	18.180	-8.785	-9.592	3.67%	≤ ±4%
			1.00	19.898	-9.700	-9.592	-0.49%	≤ ±4%
			1.09	19.989	-9.702	-9.592	-0.50%	≤ ±4%
b)	Maximum Q over-excited	50%P_{Emax}	0.91	9.894	9.715	9.592	0.56%	≤ ±4%
			1.00	9.935	9.707	9.592	0.52%	≤ ±4%
			1.09	9.965	9.697	9.592	0.48%	≤ ±4%
		S_{Emax}	0.91	18.697	9.026	9.592	-2.57%	≤ ±4%
			1.00	19.930	9.707	9.592	0.52%	≤ ±4%
			1.09	20.012	9.706	9.592	0.52%	≤ ±4%

P-Q Diagram



5.3.10	TABLE: Voltage-controlled control functions (reactive power control Q (U) and active power control P (U))	P

a) Test procedure for quasi-stationary behavior

Test at 100%Pn

Voltage Setting U_{PGU}	U [V]	I [A]	P [KW]	Q [KVar]	Expect Q [KVar]	ΔQ/Sn
100%Un	230.22	28.97	20.010	0.364	0.00	1.82%
101%Un	232.40	28.71	20.019	0.344	0.00	1.72%
102%Un	234.78	28.43	20.023	0.344	0.00	1.72%
103%Un	237.08	28.15	20.021	0.349	0.00	1.75%
104%Un	238.22	28.02	20.028	0.354	0.00	1.77%
105%Un	241.76	27.63	20.036	-0.363	0.00	-1.82%
106%Un	244.06	27.36	20.029	-3.313	-2.907	-2.03%
107%Un	246.24	27.10	20.017	-6.594	-5.813	-3.91%
108%Un	248.52	26.79	19.977	-8.701	-8.720	0.10%
109%Un	250.84	26.55	19.979	-8.698	-8.720	0.11%
110%Un	253.23	26.33	19.999	-8.732	-8.720	-0.06%
111%Un	255.46	12.77	9.784	-8.821	-8.720	-0.50%
112%Un	257.82	0.41	0.315	-0.659	0	-3.30%
113%Un	260.02	0.06	0.046	-0.060	0	-0.30%
112%Un	257.78	0.46	0.357	-0.745	0	-3.73%
111%Un	255.47	12.64	9.691	-8.822	-8.720	-0.51%
110%Un	253.25	26.32	19.999	-8.732	-8.720	-0.06%
109%Un	250.79	26.51	19.945	-8.675	-8.720	0.23%
108%Un	248.54	26.74	19.940	-8.677	-8.720	0.22%
107%Un	246.26	27.05	19.982	-6.484	-5.813	-3.36%
106%Un	244.09	27.34	20.021	-3.402	-2.907	-2.48%
105%Un	241.81	27.64	20.054	-0.398	0.00	-1.99%
104%Un	239.30	27.92	20.047	0.350	0.00	1.75%
103%Un	237.11	28.16	20.031	0.349	0.00	1.75%
102%Un	234.79	28.43	20.027	0.341	0.00	1.71%
101%Un	232.41	28.71	20.018	0.353	0.00	1.77%
100%Un	230.43	28.95	20.011	0.343	0.00	1.72%
99%Un	227.81	29.28	20.008	0.337	0.00	1.69%
98%Un	225.53	29.56	19.998	0.351	0.00	1.76%
97%Un	223.15	29.85	19.983	0.342	0.00	1.71%
96%Un	220.93	30.14	19.979	0.613	0.00	3.07%

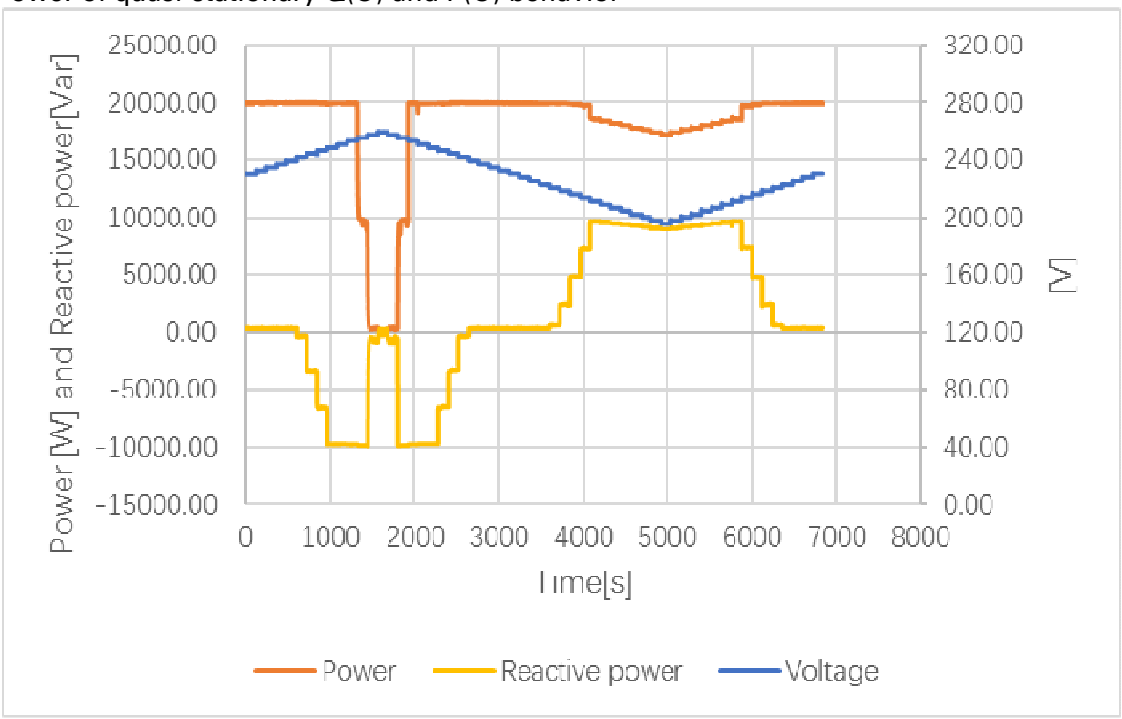
95%Un	218.65	30.44	19.969	2.509	2.180	1.65%
94%Un	216.26	30.70	19.920	4.879	4.360	2.60%
93%Un	213.97	30.80	19.774	7.264	6.540	3.62%
92%Un	211.64	29.34	18.629	8.669	8.720	-0.26%
91%Un	209.34	29.36	18.437	8.618	8.720	-0.51%
90%Un	207.04	29.36	18.239	8.507	8.720	-1.07%
89%Un	204.83	29.38	18.052	8.393	8.720	-1.64%
88%Un	202.35	29.37	17.828	8.294	8.720	-2.13%
87%Un	200.36	29.39	17.666	8.179	8.720	-2.71%
86%Un	197.84	29.39	17.446	9.060	8.720	1.70%
85%Un	195.65	29.40	17.255	8.958	8.720	1.19%
86%Un	197.83	29.38	17.436	8.080	8.720	-3.20%
87%Un	200.14	29.38	17.643	8.175	8.720	-2.73%
88%Un	202.33	29.38	17.832	8.281	8.720	-2.20%
89%Un	204.85	29.38	18.053	8.394	8.720	-1.63%
90%Un	207.04	29.36	18.239	8.507	8.720	-1.07%
91%Un	209.32	29.31	18.406	8.611	8.720	-0.55%
92%Un	211.62	29.36	18.639	8.696	8.720	-0.12%
93%Un	213.96	28.72	18.435	6.620	6.540	0.40%
94%Un	216.28	30.69	19.911	4.814	4.360	2.27%
95%Un	218.65	30.44	19.969	2.487	2.180	1.54%
96%Un	220.95	30.12	19.968	0.624	0	3.12%
97%Un	223.14	29.86	19.991	0.337	0	1.69%
98%Un	225.53	29.56	19.999	0.351	0	1.76%
99%Un	227.83	29.27	20.003	0.343	0	1.72%
100%Un	230.31	28.96	20.010	0.355	0	1.78%
Limitation	± 4%Sn					
Test at 20%Pn						
Voltage Setting U_{PGU}	U [V]	I [A]	P [KW]	Q [KVar]	Expect Q [KVar]	ΔQ/Sn
100%Un	230.40	6.09	4.207	0.024	0.00	0.12%
101%Un	232.71	6.03	4.208	0.023	0.00	0.12%
102%Un	234.71	5.97	4.204	0.022	0.00	0.11%
103%Un	237.00	5.92	4.208	0.021	0.00	0.11%
104%Un	239.21	5.87	4.214	0.020	0.00	0.10%
105%Un	241.54	6.21	4.502	-0.338	0.00	-1.69%

106%Un	243.89	6.12	4.478	-3.317	-2.907	-2.05%
107%Un	246.19	6.01	4.441	-6.160	-5.813	-1.74%
108%Un	248.51	5.90	4.398	-8.764	-8.720	-0.22%
109%Un	250.94	5.84	4.400	-8.765	-8.720	-0.23%
110%Un	253.03	5.75	4.368	-8.766	-8.720	-0.23%
111%Un	255.44	5.69	4.363	-8.766	-8.720	-0.23%
112%Un	257.62	0.09	0.071	-0.043	0	-0.22%
113%Un	259.92	0.08	0.065	-0.043	0	-0.22%
112%Un	257.63	0.09	0.066	-0.042	0	-0.21%
111%Un	255.38	5.71	4.376	-8.766	-8.720	-0.23%
110%Un	253.03	5.76	4.373	-8.766	-8.720	-0.23%
109%Un	250.83	5.81	4.370	-8.765	-8.720	-0.23%
108%Un	248.43	5.86	4.367	-8.765	-8.720	-0.23%
107%Un	246.13	5.97	4.406	-6.040	-5.813	-1.14%
106%Un	243.74	6.07	4.442	-3.069	-2.907	-0.81%
105%Un	241.54	6.15	4.456	-0.385	0.00	-1.93%
104%Un	239.22	6.22	4.461	0.025	0.00	0.13%
103%Un	236.91	6.27	4.455	0.026	0.00	0.13%
102%Un	234.62	6.33	4.455	0.027	0.00	0.14%
101%Un	232.42	6.39	4.454	0.028	0.00	0.14%
100%Un	230.42	6.44	4.454	0.029	0.00	0.15%
99%Un	227.81	6.51	4.452	0.030	0.00	0.15%
98%Un	225.42	6.58	4.449	0.031	0.00	0.16%
97%Un	223.21	6.64	4.447	0.032	0.00	0.16%
96%Un	220.91	6.71	4.444	0.033	0.00	0.17%
95%Un	218.53	6.79	4.451	1.956	2.180	-1.12%
94%Un	216.33	6.83	4.430	4.088	4.360	-1.36%
93%Un	214.03	6.84	4.393	6.291	6.540	-1.25%
92%Un	211.63	6.86	4.355	8.594	8.720	-0.63%
91%Un	209.29	6.93	4.351	8.849	8.720	0.64%
90%Un	206.89	7.00	4.342	8.849	8.720	0.64%
89%Un	204.79	7.07	4.346	8.850	8.720	0.65%
88%Un	202.39	7.15	4.343	8.851	8.720	0.66%
87%Un	200.11	7.23	4.338	8.851	8.720	0.66%
86%Un	197.89	7.30	4.332	8.852	8.720	0.66%
85%Un	195.58	7.37	4.325	8.853	8.720	0.66%

86%Un	196.92	7.42	4.383	8.961	8.720	1.21%
87%Un	200.09	7.18	4.312	8.851	8.720	0.66%
88%Un	202.39	7.11	4.316	8.850	8.720	0.65%
89%Un	204.80	7.03	4.317	8.849	8.720	0.64%
90%Un	207.00	6.95	4.317	8.849	8.720	0.64%
91%Un	209.39	6.88	4.321	8.848	8.720	0.64%
92%Un	211.69	6.81	4.324	8.558	8.720	-0.81%
93%Un	214.00	6.81	4.374	6.373	6.540	-0.83%
94%Un	216.29	6.79	4.405	4.190	4.360	-0.85%
95%Un	218.69	6.75	4.430	1.890	2.180	-1.45%
96%Un	220.89	6.68	4.424	0.032	0	0.16%
97%Un	223.21	6.62	4.433	0.031	0	0.16%
98%Un	225.52	6.56	4.435	0.030	0	0.15%
99%Un	227.82	6.50	4.442	0.029	0	0.15%
100%Un	230.42	6.41	4.432	0.028	0	0.14%
Limitation	± 4%Sn					
Test at ESS with a minimum active power <20% Pn						
Voltage setting: 91%Un						
Power Setting	U [V]	I [A]	P [KW]	Q [KVar]	Expect Q [KVar]	ΔQ/Sn
1%Pn	209.33	0.30	0.190	0.326	0.458	-0.66%
5%Pn	209.40	1.61	1.011	2.140	2.291	-0.75%
10%Pn	209.45	3.18	1.998	4.401	4.583	-0.91%
15%Pn	209.49	4.77	3.000	6.730	6.874	-0.72%
20%Pn	209.53	6.30	3.957	8.957	9.165	-1.04%
15%Pn	209.46	4.78	3.001	6.731	6.874	-0.71%
10%Pn	209.40	3.16	1.986	4.372	4.583	-1.06%
5%Pn	209.36	1.59	1.001	2.116	2.291	-0.87%
1%Pn	209.32	0.29	0.179	0.303	0.458	-0.78%
Voltage setting: 109%Un						
1%Pn	250.79	0.22	0.163	-0.349	-0.458	0.55%
5%Pn	250.76	1.34	1.011	-2.190	-2.291	0.51%
10%Pn	250.79	2.66	2.002	-4.424	-4.583	0.79%
15%Pn	250.83	4.01	3.019	-6.723	-6.874	0.75%
20%Pn	250.86	5.30	3.992	-8.929	-9.165	1.18%
15%Pn	250.87	4.00	3.009	-6.703	-6.874	0.85%

10%Pn	250.86	2.64	1.990	-4.398	-4.583	0.93%
5%Pn	250.82	1.33	0.998	-2.160	-2.291	0.65%
1%Pn	250.78	0.19	0.146	-0.323	-0.458	0.68%
Limitation	Continuity of minimal cosφ =0.4 and ± 4%Sn					

100% Power of quasi-stationary Q(U) and P(U) behavior

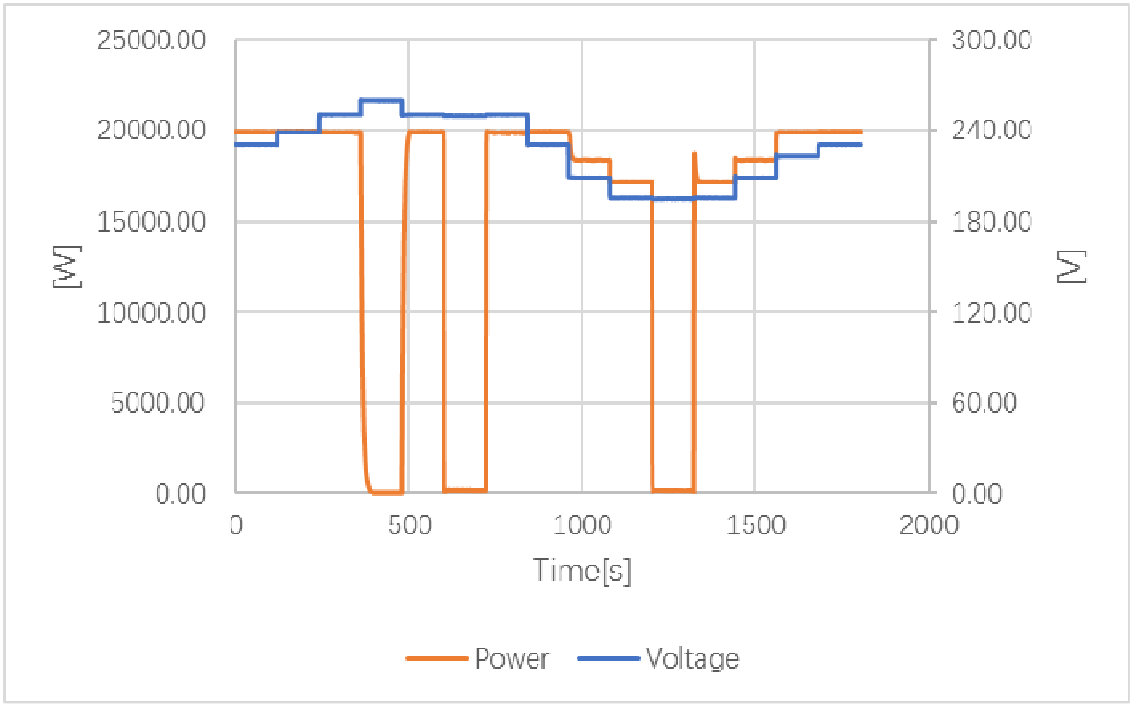


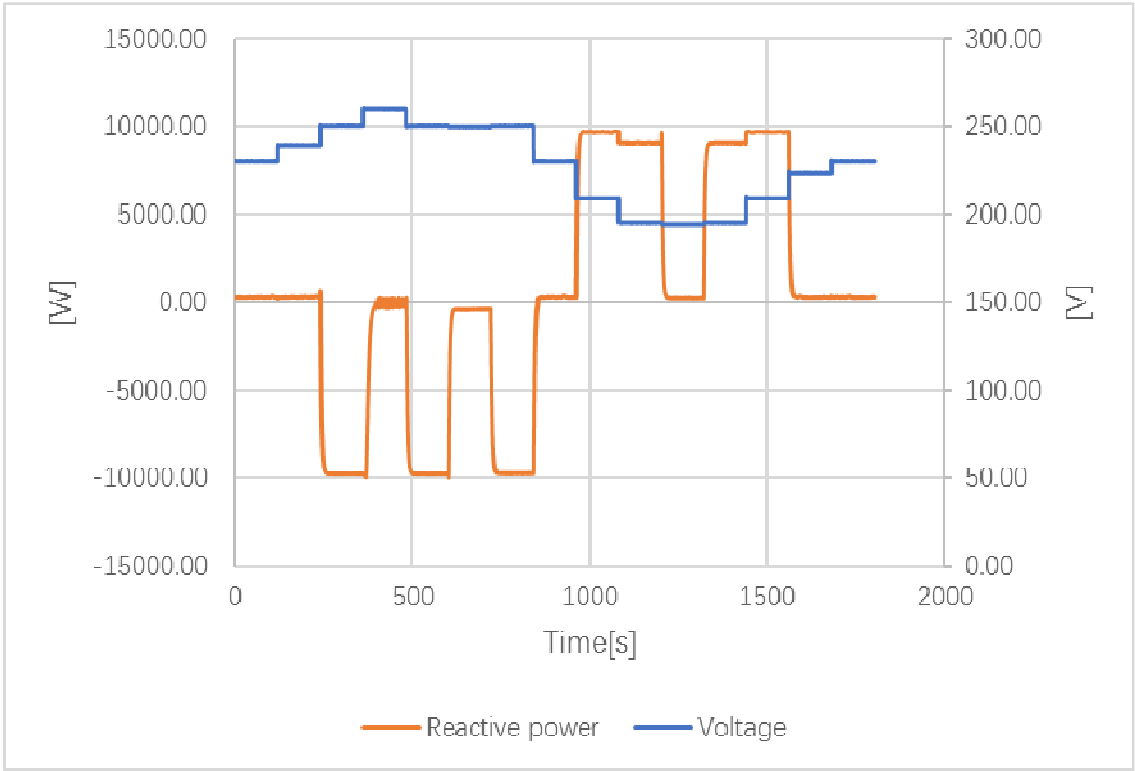
b) Test procedure for Dynamic						
Step	Voltage Setting U_{PGU}	U [V]	I [A]	P [KW]	Q [KVar]	Remark
1	100%Un	230.78	28.85	19.973	0.343	EZE in operation; Start of recording
2	104%Un	239.26	27.85	19.991	0.360	--
3	109%Un	250.78	26.51	19.946	-9.748	Examination of Q (U) behavior
4	113%Un	260.01	0.06	0.047	-0.071	Testing the correct interaction of Q (U) and P (U)
5	109%Un	250.80	26.54	19.965	-9.751	
6	109%Un	250.20	0.25	0.189	-0.397	Checking the Q (U) behavior when changing the active power
7	109%Un	250.79	26.49	19.930	-9.727	
8	100%Un	230.77	28.86	19.983	0.346	Examination of Q (U) behavior
9	91%Un	209.41	29.28	18.395	9.707	Examination of Q (U) behavior
10	85%Un	195.62	29.32	17.206	9.055	Testing the Q (U) behavior at voltages below 90% Un
11	85%Un	194.85	0.30	0.175	0.293	Checking the Q (U) behavior when changing the active power
12	85%Un	195.60	29.31	17.200	9.065	
13	91%Un	209.38	29.28	18.394	9.718	--
14	97%Un	223.40	29.77	19.949	0.350	Examination of Q (U) behavior
15	100%Un	230.78	28.86	19.978	0.347	End of the recording

Remark:

Increase in reactive powerQ2> Q 1	Upper tolerance band:	for all t: $Q2 - (Q2 - Q1) \cdot e^{(-t / Tau)} + 0.04 \cdot Sn$
	Lower tolerance band:	for t <1 second: $Q1 - 0.04 \cdot Sn$ for t ≥ 1 second: $Q2 - (Q2 - Q1) \cdot e^{([-t + 1\ second] / Tau)} - 0.04 \cdot Sn$
Waste of reactive powerQ 2 <Q 1	Upper tolerance band:	for t <1 second: $Q1 + 0.04 \cdot Sn$ for t ≥ 1 second: $Q2 - (Q2 - Q1) \cdot e^{([-t + 1\ second] / Tau)} + 0.04 \cdot Sn$
	Lower tolerance band:	for all t: $Q2 - (Q2 - Q1) \cdot e^{(-t / tau)} - 0.04 \cdot Sn$

Q(U) Dynamic


25000.00
20000.00
15000.00
10000.00
5000.00
0.00
[W]
300.00
240.00
180.00
120.00
60.00
0.00
[V]
0
500
1000
1500
2000
Time[s]
Power
Voltage


15000.00
10000.00
5000.00
0.00
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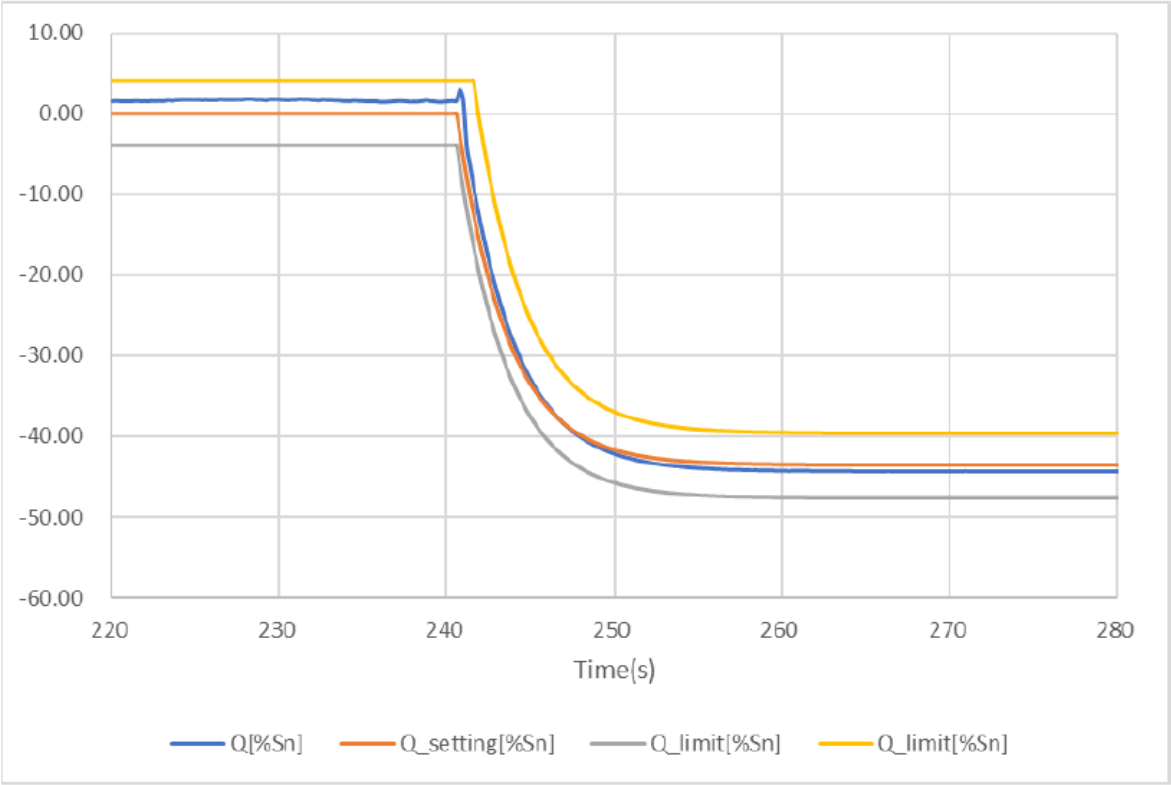
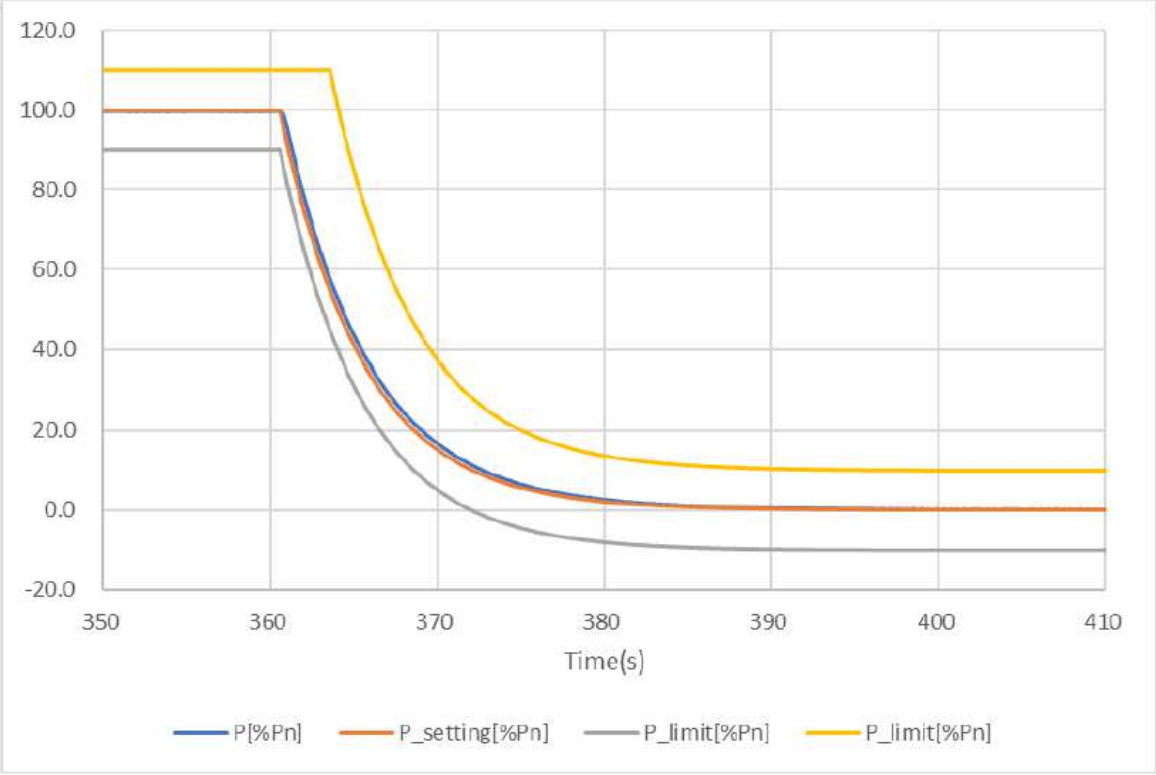
-10000.00
-15000.00
[W]
300.00
250.00
200.00
150.00
100.00
50.00
0.00
[V]
0
500
1000
1500
2000
Time[s]
Reactive power
Voltage

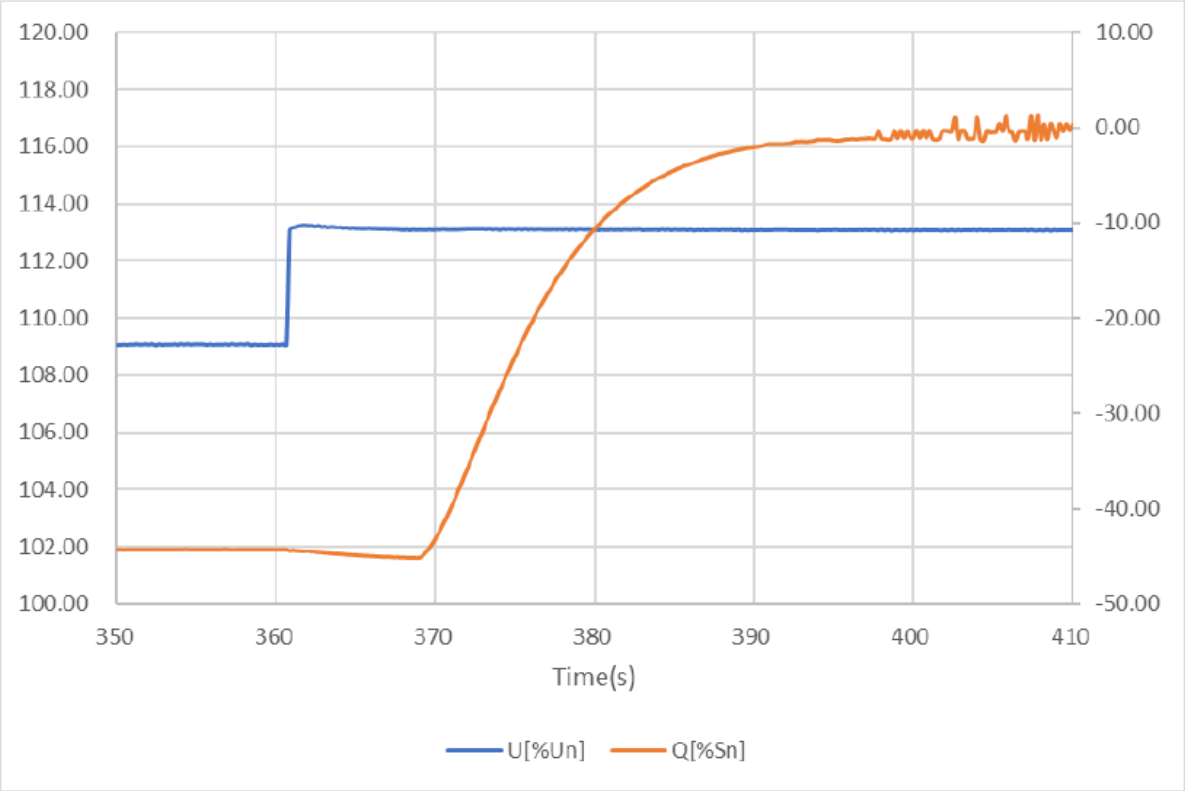
Evaluation of transient response with step 2-3



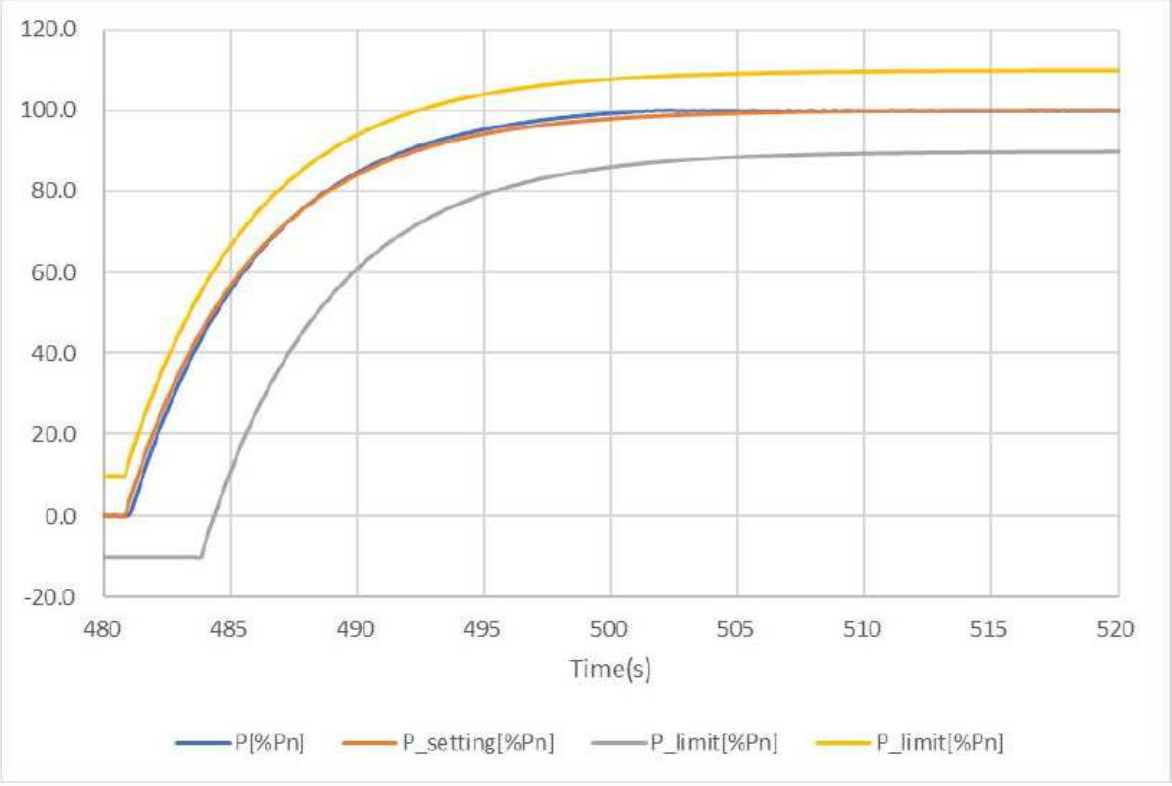
Evaluation of transient response with step 3-4



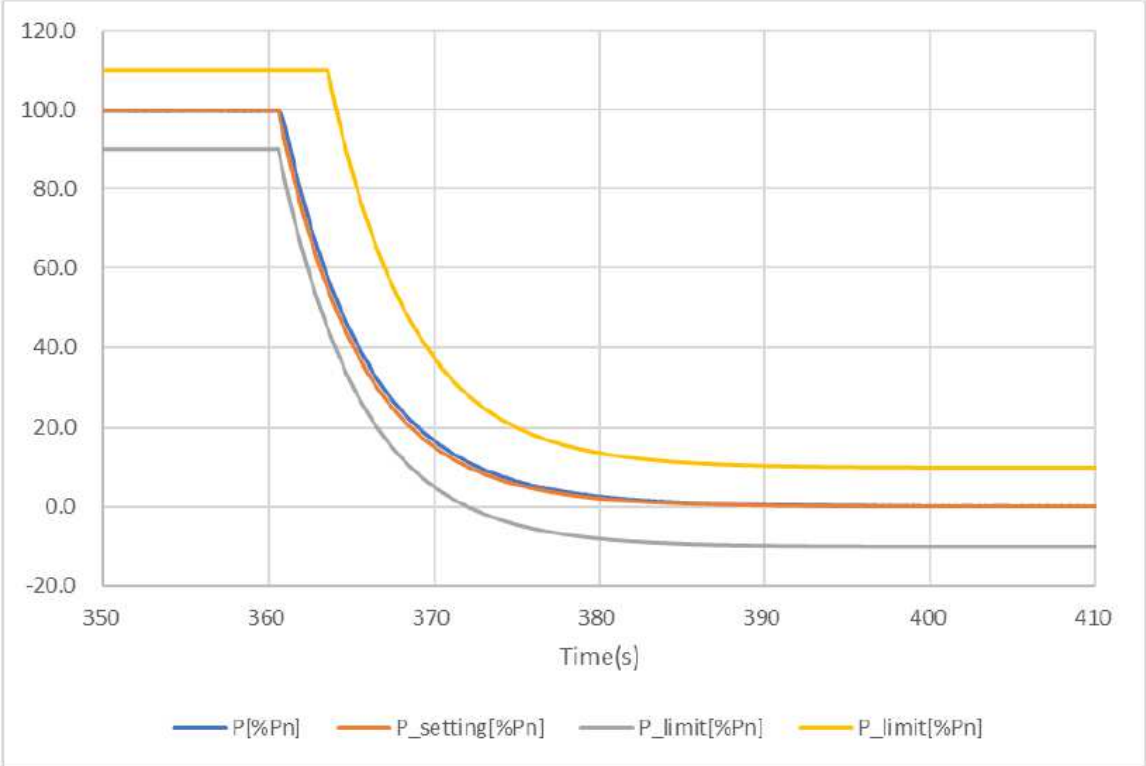
Evaluation of transient response with step 3-4 with minimum Cosφ =0.4



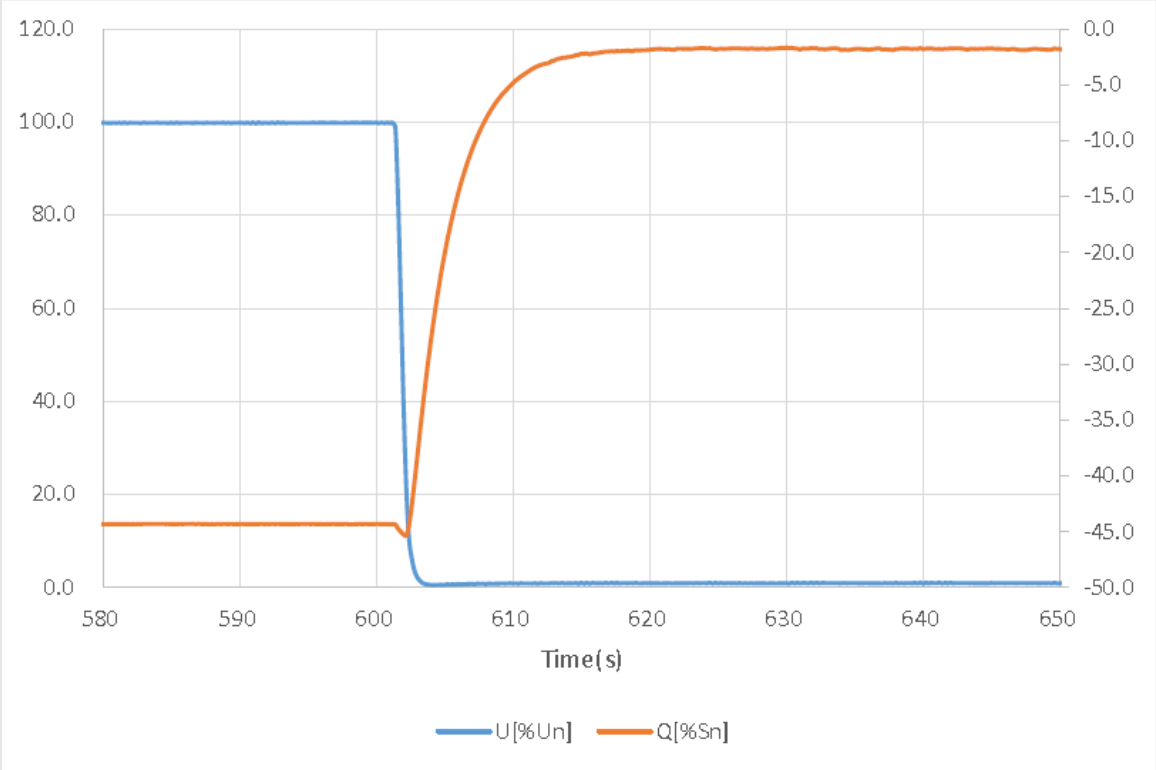
Evaluation of transient response with step 4-5 P(U)



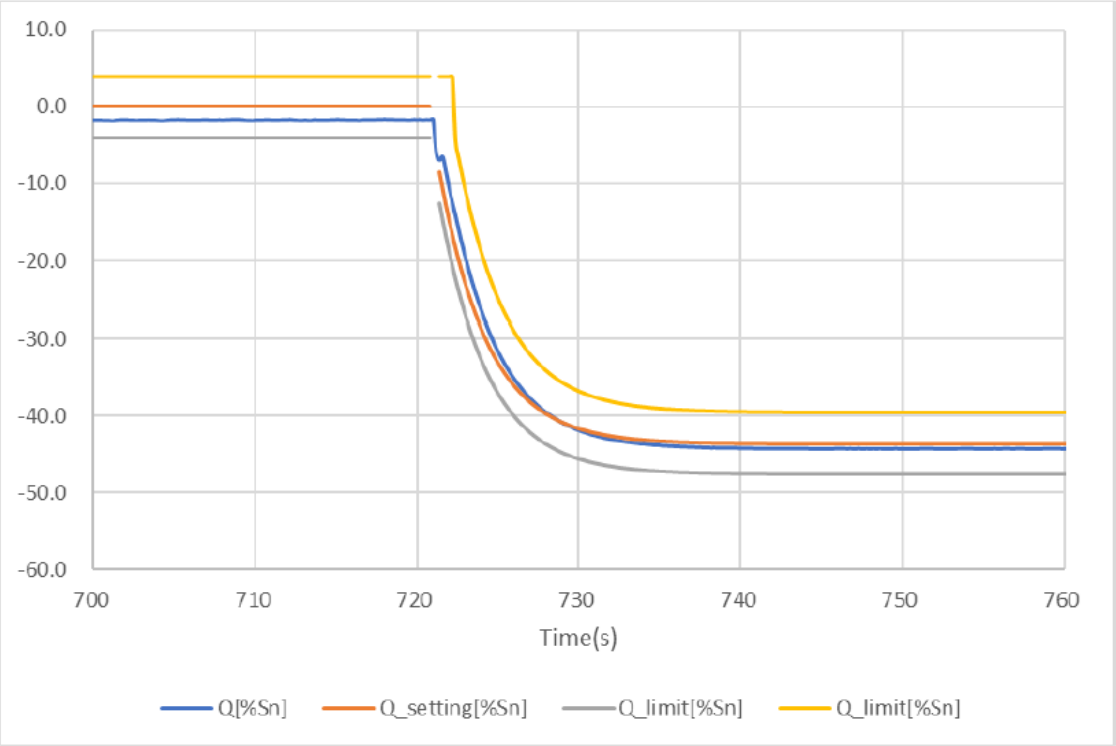
Evaluation of transient response with step 4-5 Q(U)



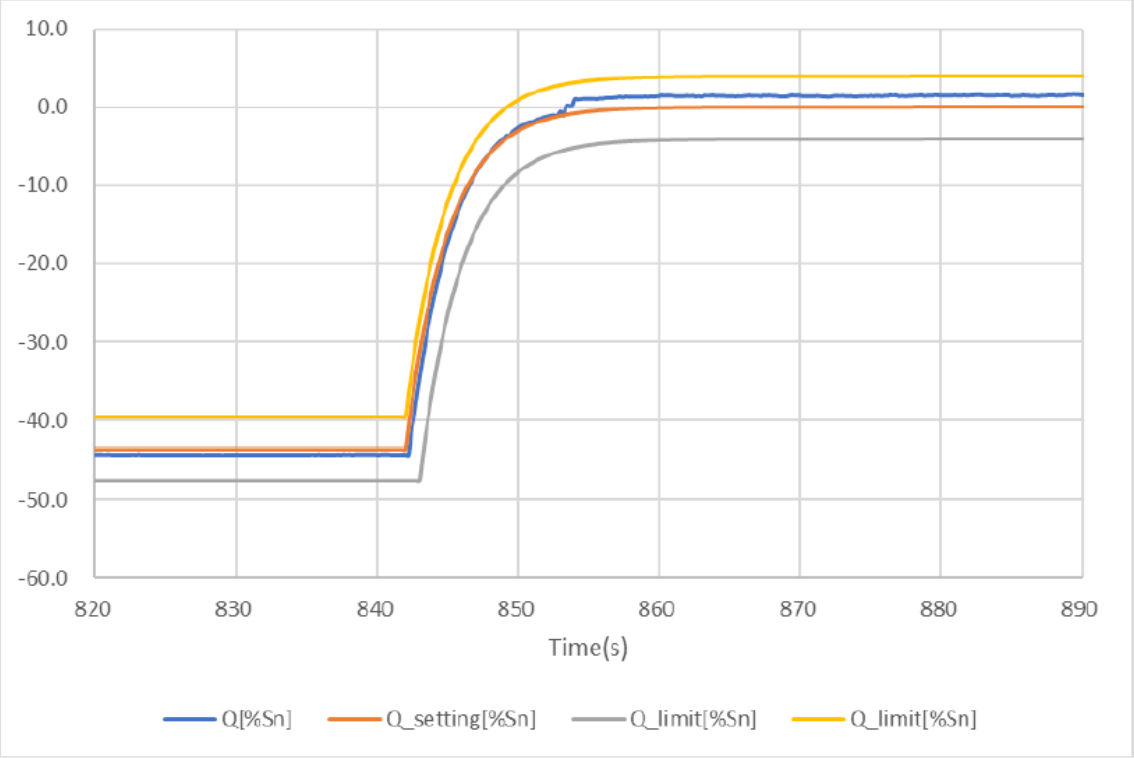
Evaluation of transient response with step 5-6 with minimum Cosφ =0.4



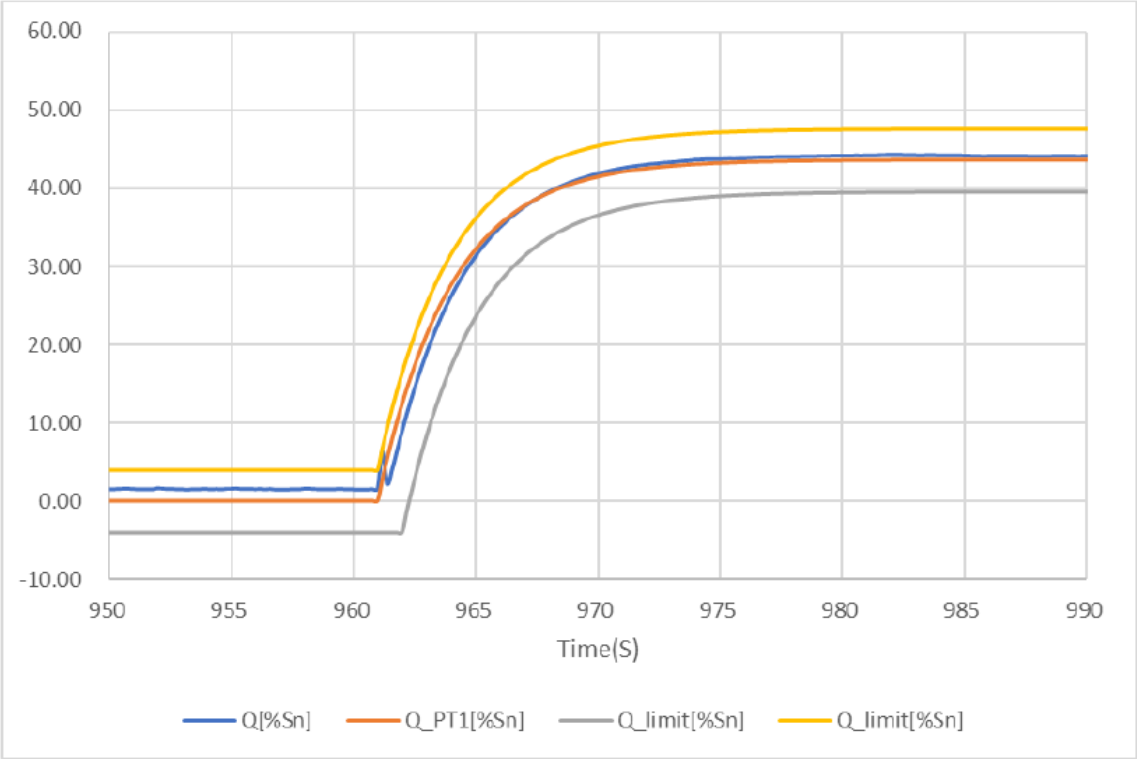
Evaluation of transient response with step 6-7



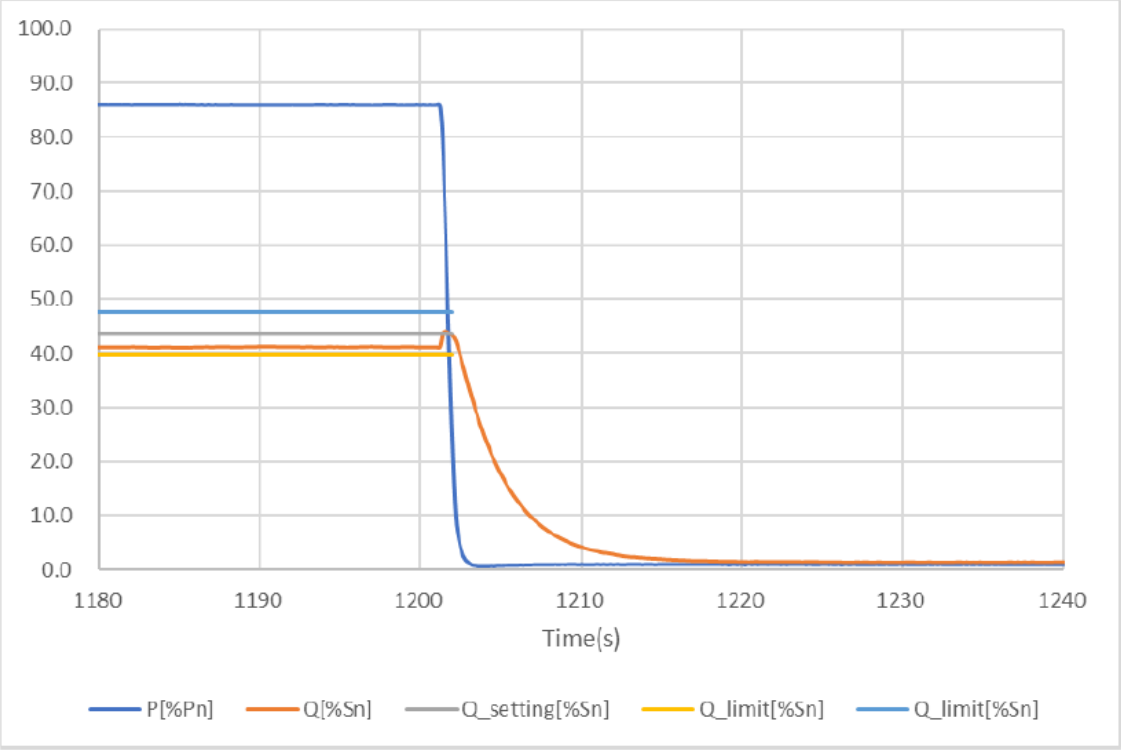
Evaluation of transient response with step 7-8



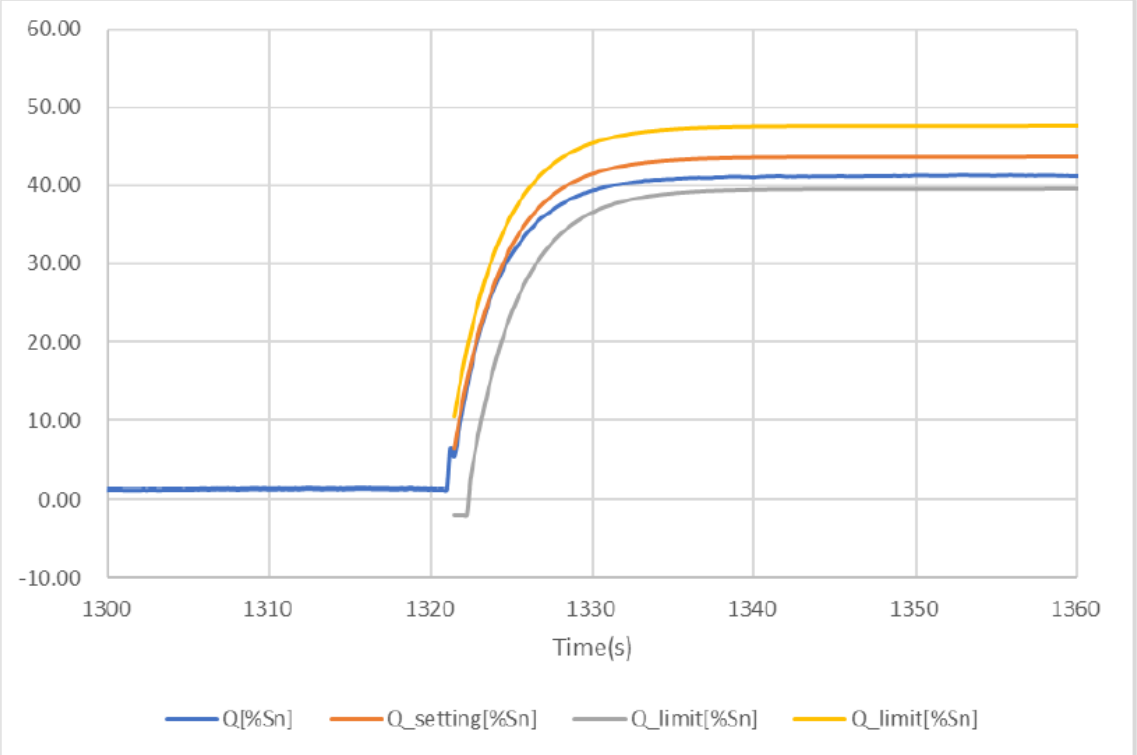
Evaluation of transient response with step 8-9



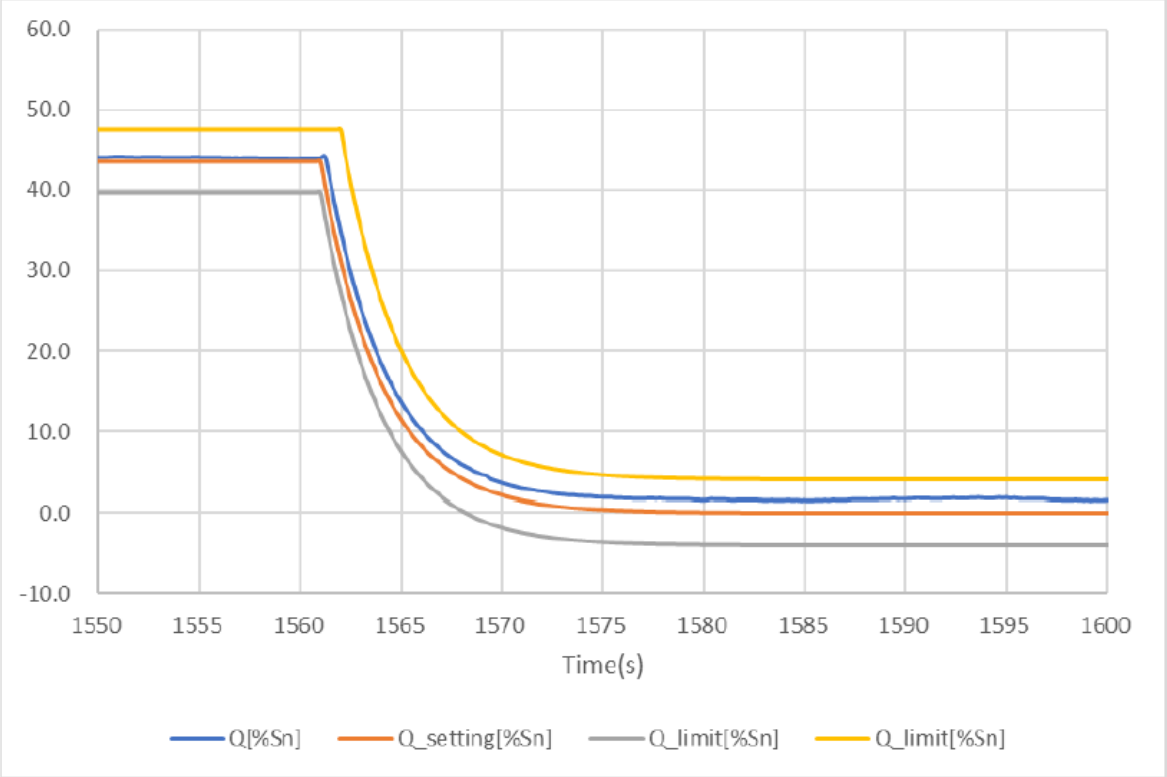
Evaluation of transient response with step 10-11 with minimum Cosφ =0.4



Evaluation of transient response with step 11-12 with minimum Cosφ =0.4



Evaluation of transient response with step 13-14



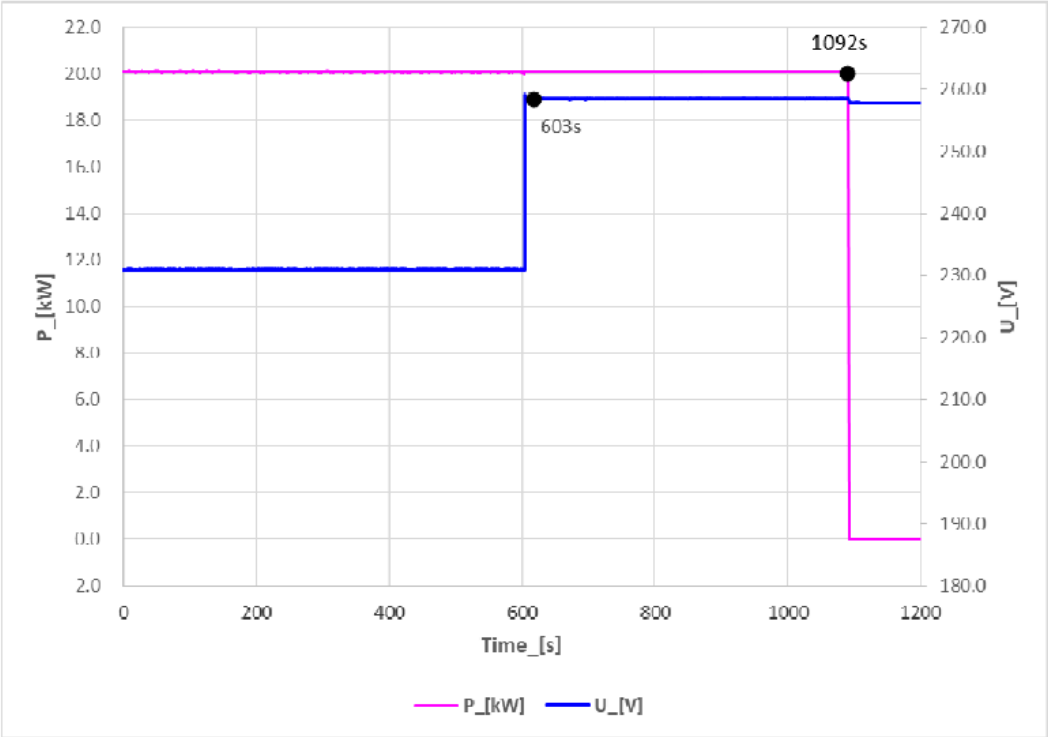
5.4.1		Voltage protection	P

OV Stage 2 No.	Set value	Measured L1-N	Measured L2-N	Measured L3-N	Limitation	Test condition
1	1.15Un [V]	264.6	263.9	265.2	1.15Un+/-1%U	Testing of trip value: By slowly increasing the line voltage up to the 116%Un Testing of trip time: Mains voltage is jumped from Un to 118%Un. Remark: 1, Checked the settings are password-protected, and can not change and access to user 2, Checked the parameters or settings are not changed when software updates
	100ms	124.0ms	130ms	126ms	<200ms	
2	1.15Un [V]	264.5	263.8	265.2	1.15Un+/-1%U	
	100ms	128ms	124ms	122ms	<200ms	
3	1.15Un [V]	264.6	263.8	265.2	1.15Un+/-1%U	
	100ms	130ms	130ms	126ms	<200ms	

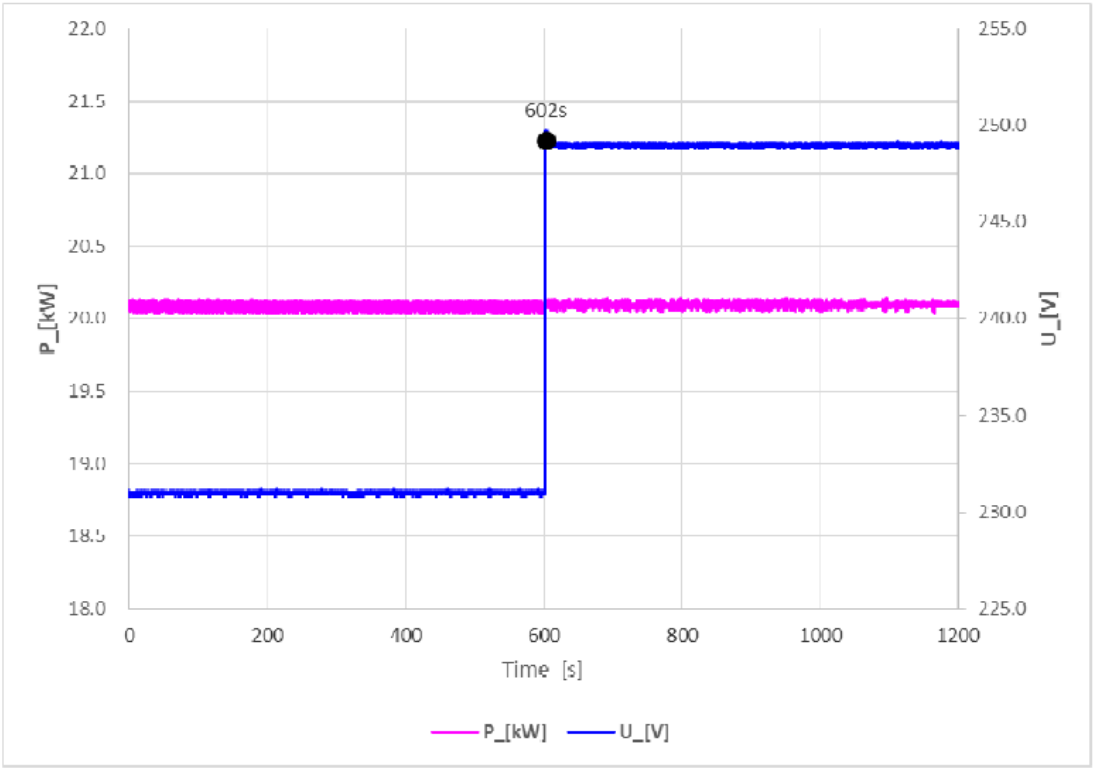
OV Stage 1 No.	Set value	Trip time [s]	Limitation [s]	Test condition
1	Set value 1.10Un 100ms	496	≤ 600	Operation under nominal voltage for 10min, then jumped from Un to 1.12Un.
2		No disconnect	No disconnect	Operation under nominal voltage for 10min, then jumped from Un to 1.08Un.
3		302	225 - 375	Operation under 1.06 voltage for 10min, then jumped from 1.06Un to 1.14Un.

Remark:
1, Checked the settings are password-protected, and can not change and access to user
2, Checked the parameters or settings are not changed when software updates

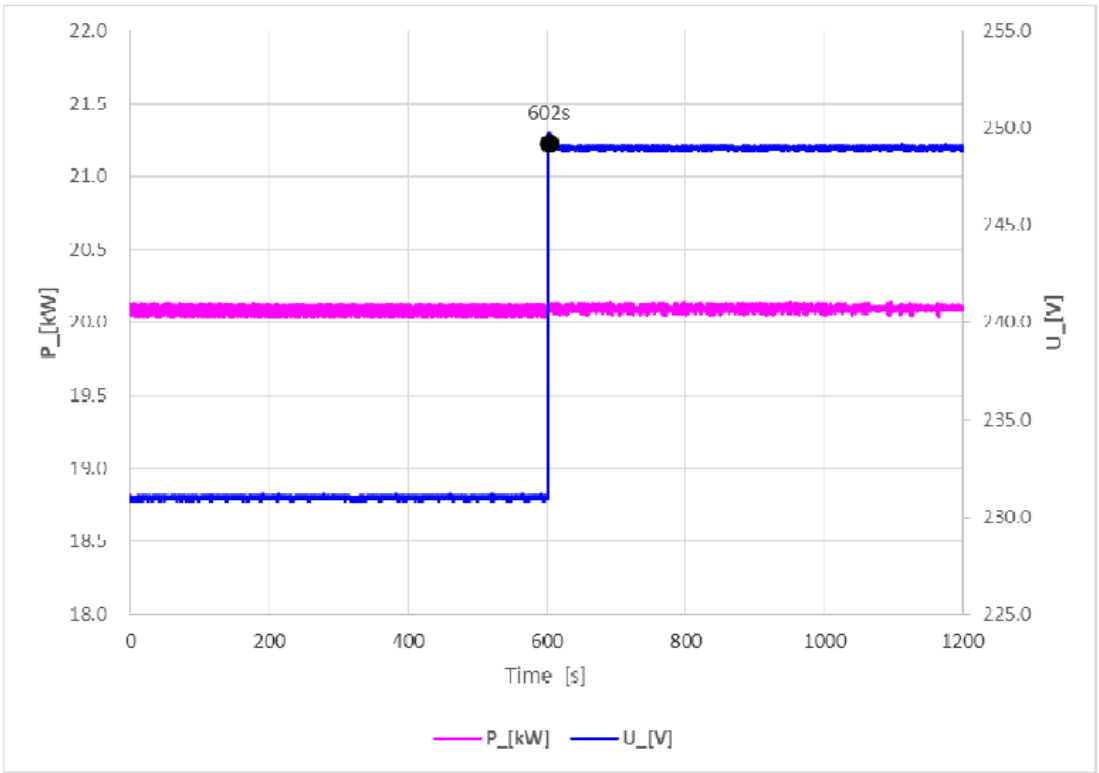
OV Stage 2 Protection time Max.130ms



OV Stage 1: Un to 112Un



OV Stage 1: Un to 108Un



OV Stage 1:1.06 Un to 1.14Un

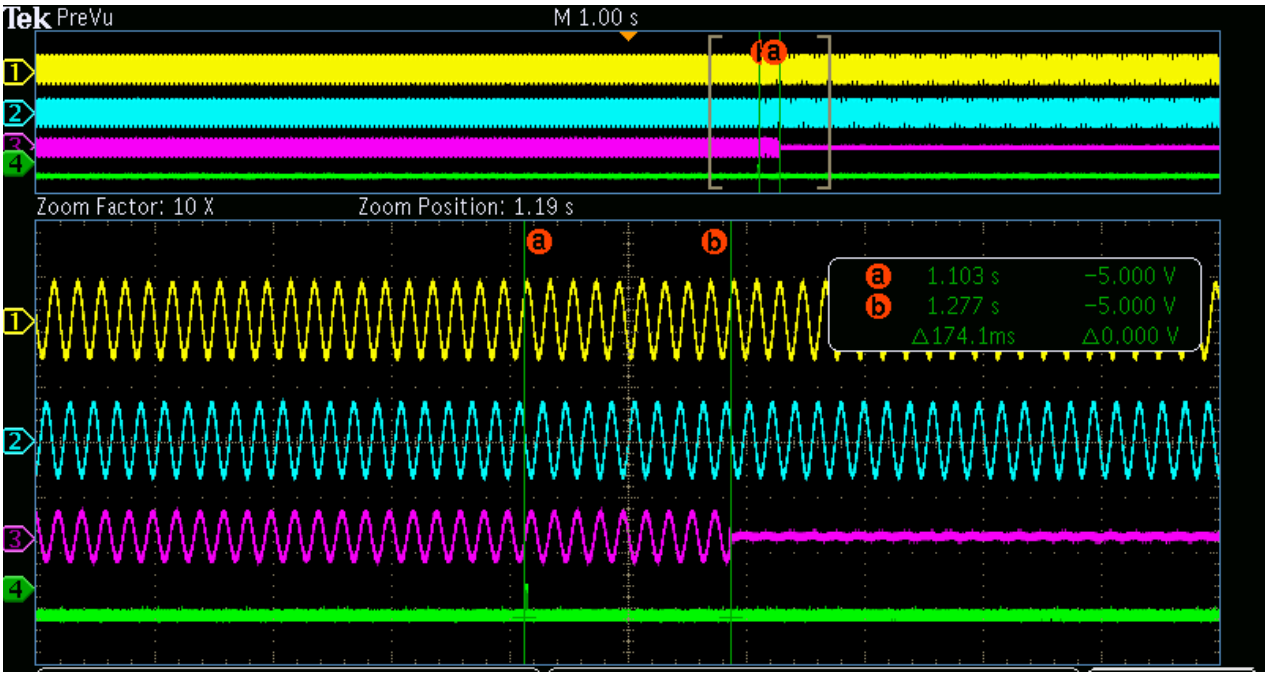
UV Stage 1	Set value	Measured			Limitation [ms]	Test condition
No.		L1-N	L2-N	L3-N		
1	0.8Un [V]	183.7	183.2	184.3	0.8Un +/- 1%Un	Testing of trip value: By slowly reducing the line voltage up to the 79%Un Testing of trip time: Mains voltage is jumped from Un to 77%Un. Remark: 1, Checked the settings are password-protected, and can not change and access to user 2, Checked the parameters or settings are not changed when software updates
	1.5s	1.532s	1.540s	1.550s	<1.6s	
2	0.8Un [V]	183.8	183.2	184.3	0.8Un +/- 1%Un	
	1.5s	1.526s	1.535s	1.550s	<1.6s	
3	0.8Un [V]	183.7	183.2	184,3	0.8Un +/- 1%Un	
	1.5s	1.524s	1.530s	1.540s	<1.6s	

UV Stage 2	Set value	Measured			Limitation	Test condition
No.		L1-N	L2-N	L3-N		
1	0.25Un [V]	57.2	57.3	57.2	0.25Un+/- 1%Un	UV Stage 1 deactivated Testing of trip value: By slowly reducing the line voltage up to the 24%Un Testing of trip time: Mains voltage is jumped from Un to 22%Un. Remark: 1, Checked the settings are password-protected, and can not change and access to user 2, Checked the parameters or settings are not changed when software updates
	500ms	520ms	530ms	530ms	<600ms	
2	0.25Un [V]	57.2	57.3	57.2	0.25Un+/- 1%U	
	500ms	525ms	533ms	535ms	<600ms	
3	0.25Un [V]	57.2	57.3	57.2	0.25Un+/- 1%U	
	500ms	520ms	528ms	530ms	<600ms	

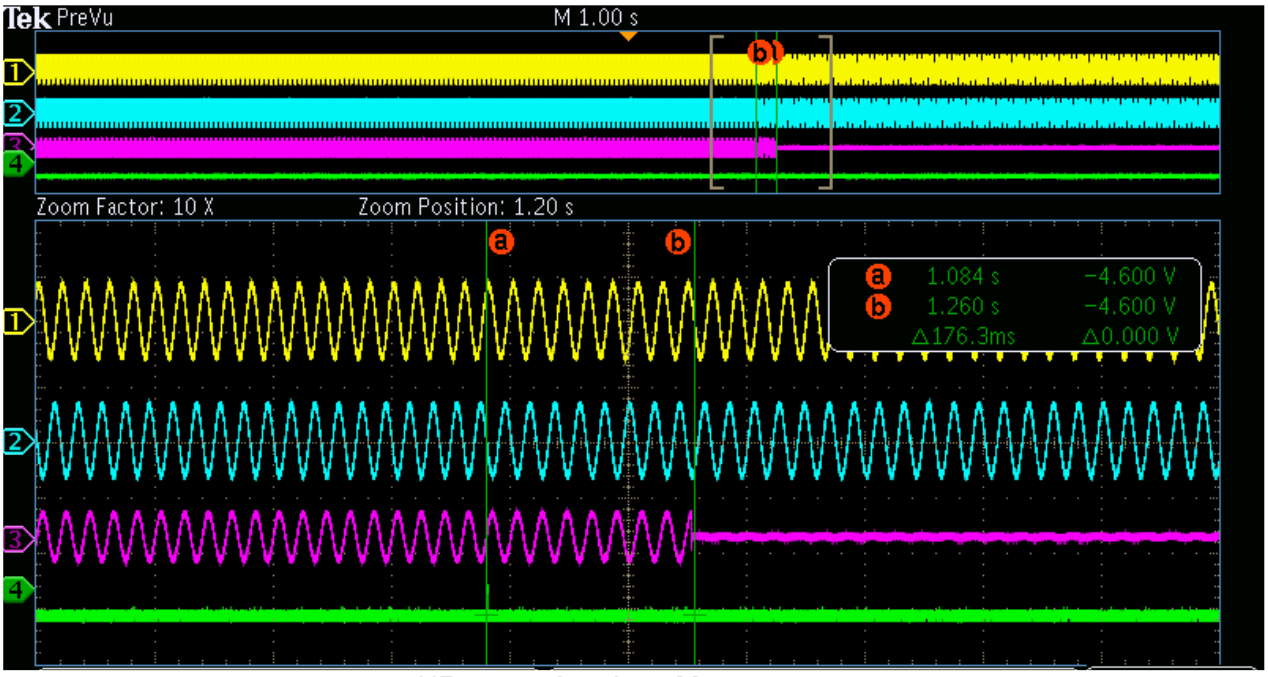
UV Stage 1: Protection time: Max. 1.550s

UV Stage 2: Protection time: Max. 535.0ms

5.4.2	Frequency protection					P
OF No.	Set value	Measured Trip value			Limitation	Remark
1	51.5Hz	51.49Hz	51.49Hz	51.49Hz	51.5+/- 0.05Hz	By increasing the line frequency with a rate of change of 1 Hz/s up to 51.55Hz Remark: 1, Checked the settings are password-protected, and can not change and access to user 2, Checked the parameters or settings are not changed when software updates
2	100ms	172.5ms	174.1ms	172.7ms	<200ms	
UF No.	Set value	Measured Trip value			Limitation [ms]	Remark
1	47.5Hz	47.50Hz	47.52Hz	47.51Hz	47.5+/- 0.05Hz	By reducing the line frequency with a rate of change of 1 Hz/s up to 47.45Hz Remark: 1, Checked the settings are password-protected, and can not change and access to user 2, Checked the parameters or settings are not changed when software updates
2	100ms	176.3ms	172.9ms	160.5ms	<200ms	



OF: protection time:Max. 174.1ms



UF: protection time: Max. 176.3ms

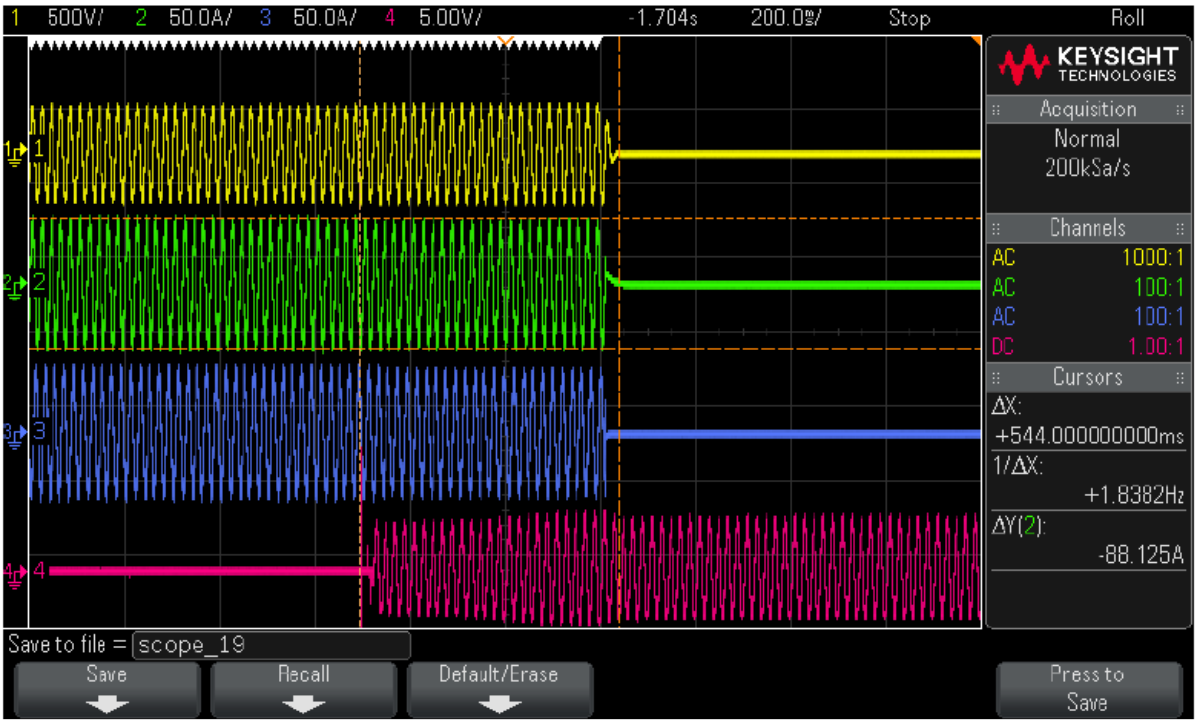
5.4.3	Detection of unwanted island operation	P

No.	PEUT[1] (% of EUT rating)	Reactive load (% of QL in 6.1.d)1)	PAC[2] (% of nominal)	QAC[3] (% of nominal)	Run on time (ms)	PEUT (KW)	Actual Qf	VDC	Remarks[4]
1	100	100	0	0	544	19.8	1.000	738	Test A at BL
2	66	66	0	0	496	13.16	0.999	490	Test B at BL
3	33	33	0	0	518	6.62	0.999	242	Test C at BL
4	100	100	-5	-5	404	19.8	1.026	738	Test A at IB
5	100	100	-5	0	436	19.8	1.053	738	Test A at IB
6	100	100	-5	5	410	19.8	1.079	738	Test A at IB
7	100	100	0	-5	482	19.8	0.975	738	Test A at IB
8	100	100	0	5	510	19.8	1.025	738	Test A at IB
9	100	100	5	-5	412	19.8	0.929	738	Test A at IB
10	100	100	5	0	442	19.8	0.954	738	Test A at IB
11	100	100	5	5	414	19.8	0.976	738	Test A at IB
12	66	66	0	-5	418	13.16	0.974	490	Test B at IB
13	66	66	0	-4	430	13.16	0.979	490	Test B at IB
14	66	66	0	-3	444	13.16	0.984	490	Test B at IB
15	66	66	0	-2	446	13.16	0.989	490	Test B at IB
16	66	66	0	-1	462	13.16	0.994	490	Test B at IB
17	66	66	0	1	490	13.16	1.004	490	Test B at IB
18	66	66	0	2	468	13.16	1.009	490	Test B at IB
19	66	66	0	3	458	13.16	1.014	490	Test B at IB
20	66	66	0	4	452	13.16	1.019	490	Test B at IB
21	66	66	0	5	404	13.16	1.024	490	Test B at IB
22	33	33	0	-5	380	6.62	0.974	242	Test C at IB
23	33	33	0	-4	442	6.62	0.979	242	Test C at IB
24	33	33	0	-3	448	6.62	0.984	242	Test C at IB
25	33	33	0	-2	466	6.62	0.989	242	Test C at IB
26	33	33	0	-1	482	6.62	0.994	242	Test C at IB
27	33	33	0	1	508	6.62	1.004	242	Test C at IB
28	33	33	0	2	444	6.62	1.009	242	Test C at IB
29	33	33	0	3	424	6.62	1.014	242	Test C at IB
30	33	33	0	4	422	6.62	1.019	242	Test C at IB
31	33	33	0	5	396	6.62	1.024	242	Test C at IB

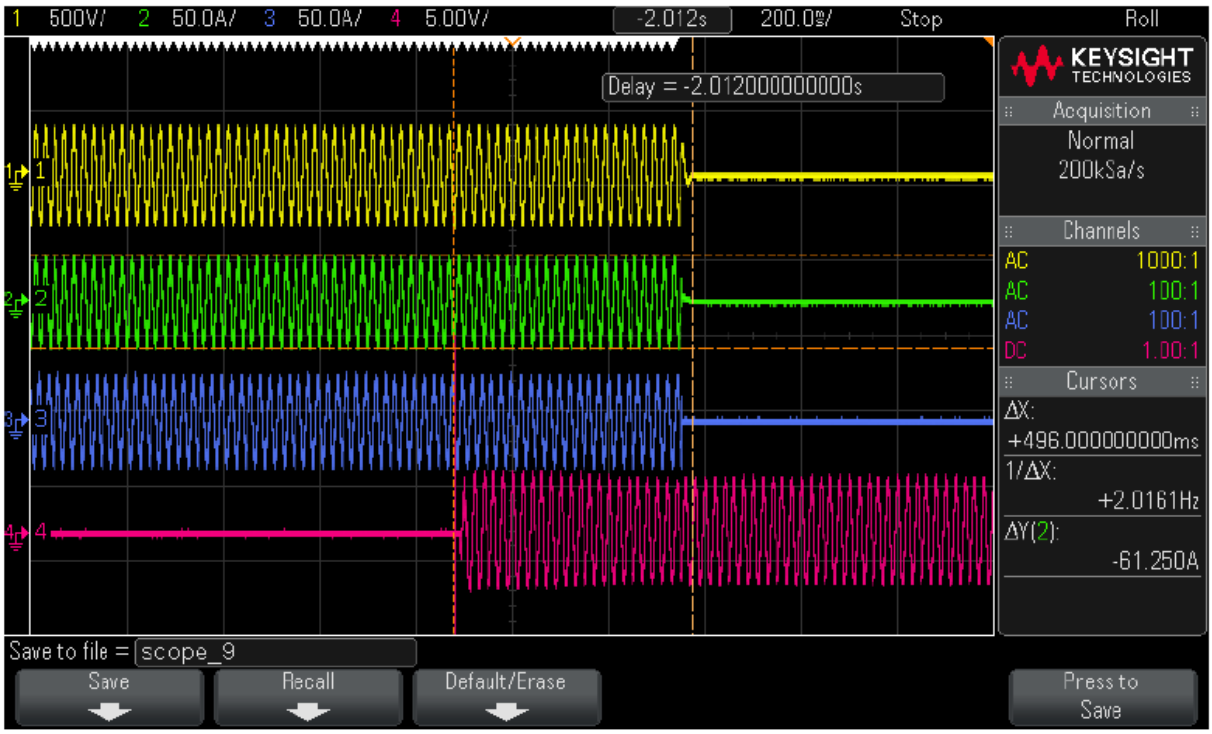
Remark:

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.
5) *Note: test condition A (100%): If any of the recorded run-on times are longer than the one recorded for the rated balance condition, i.e. test procedure 6.1 f), then the non-shaded parameter

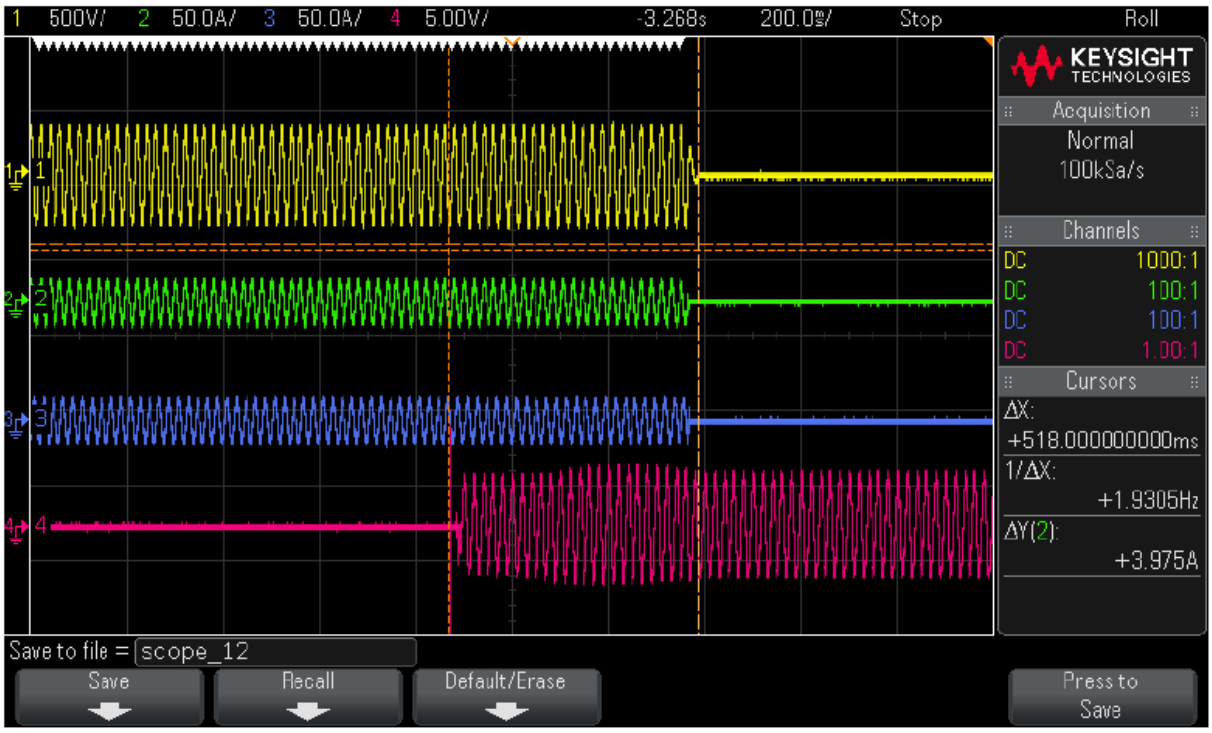
combinations (no.32~47) also require testing.



PEUT 100%, PAC 0%, QAC 0%, = 544ms



PEUT 66%, PAC 0%, QAC 0%, = 496ms



PEUT 33%, PAC 0%, QAC 0%, = 518ms

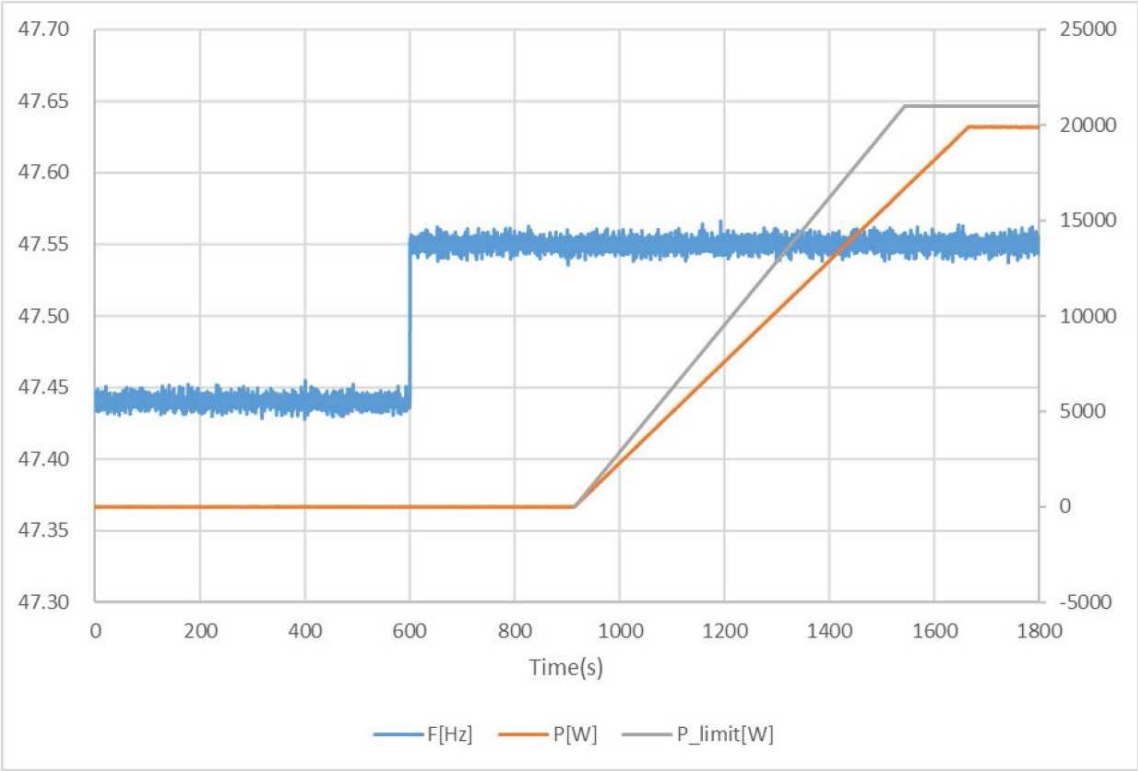
5.5	Checking the connection conditions and synchronization	P

1, **checking for automatic or operational activation**

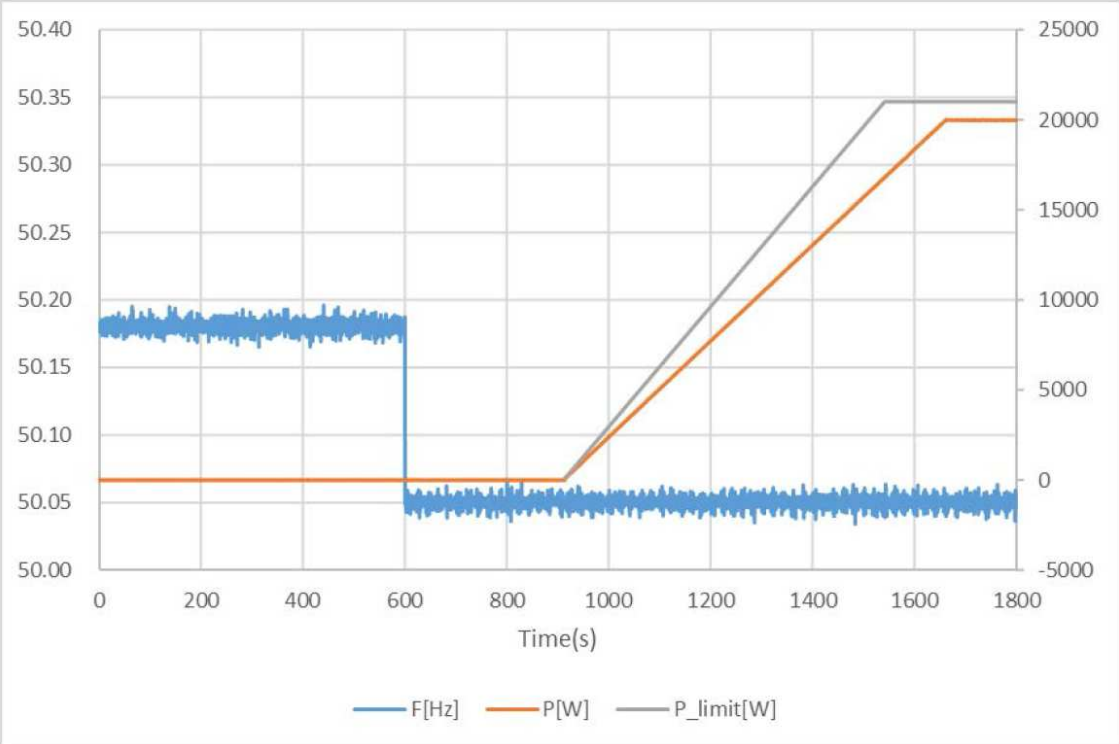
Measure Item	Reconnection?		Measured threshold value	Connection Time (60s)	Gradient
f_{ist} = 47.45Hz	☐ Yes	☒ No	47.45Hz	--	--
f_{ist} ≥ 47.55Hz	☒ Yes	☐ No	47.55Hz	64.0s	8.50%/min
f_{ist} > 50.15Hz	☐ Yes	☒ No	50.15Hz	--	--
f_{ist} ≤ 50.05Hz	☒ Yes	☐ No	50.05Hz	127s	8.56%/min
U_{ist} < 84% U_n	☐ Yes	☒ No	193.29V	--	--
U_{ist} ≥ 86% U_n	☒ Yes	☐ No	197.89V	64.0s	8.93%/min
U_{ist} > 110% U_n	☐ Yes	☒ No	253.17V	--	--
U_{ist} ≤ 108% U_n	☒ Yes	☐ No	248.41V	63.0s	8.97%/min

1, **checking for connection after tripping of the disconnection protection**

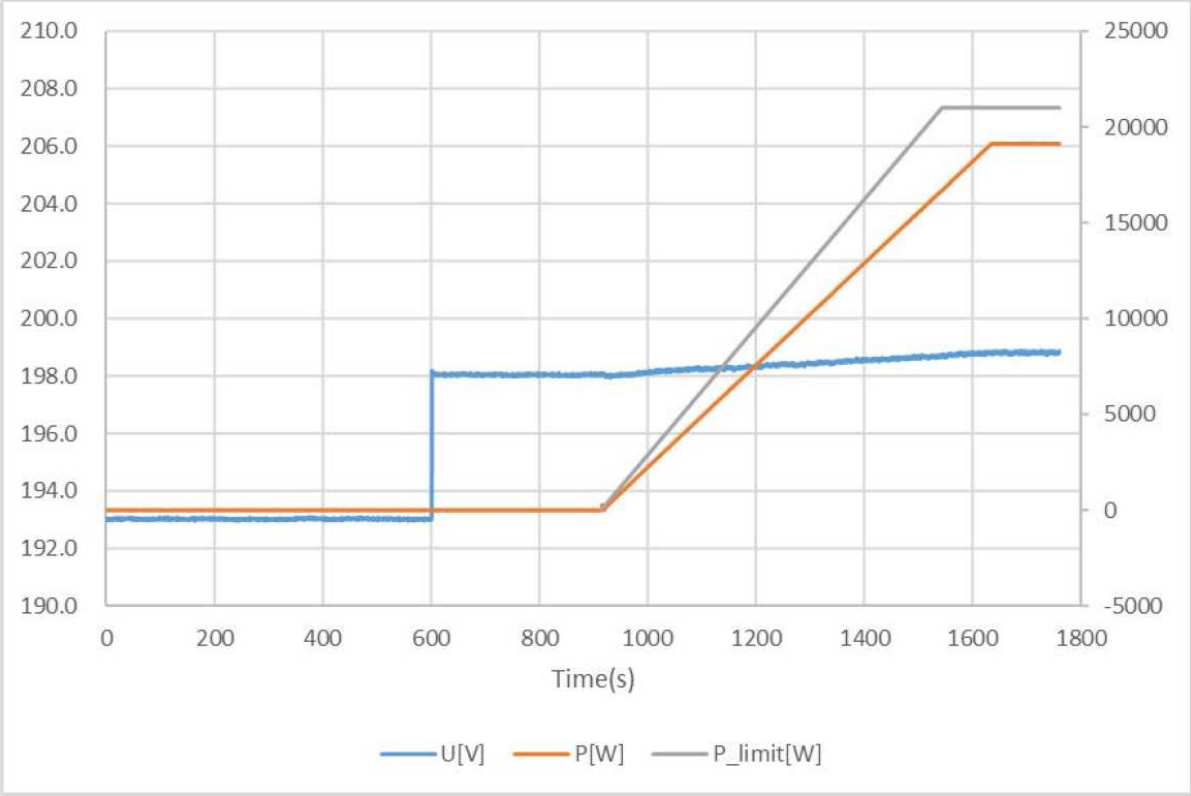
Measure Item	Reconnection?		Measured threshold value	Connection Time (300s)	Gradient
f_{ist} = 47.45Hz	☐ Yes	☒ No	47.00Hz	--	--
f_{ist} ≥ 47.55Hz	☒ Yes	☐ No	47.55Hz	315s	8.87%/min
f_{ist} > 50.15Hz	☐ Yes	☒ No	51.60Hz	--	--
f_{ist} ≤ 50.05Hz	☒ Yes	☐ No	50.05Hz	314s	8.89%/min
U_{ist} < 84% U_n	☐ Yes	☒ No	193.29V	--	--
U_{ist} ≥ 86% U_n	☒ Yes	☐ No	197.85V	315s	8.98%/min
U_{ist} > 110% U_n	☐ Yes	☒ No	253.17V	--	--
U_{ist} ≤ 108% U_n	☒ Yes	☐ No	248.41V	314s	9.04%/min



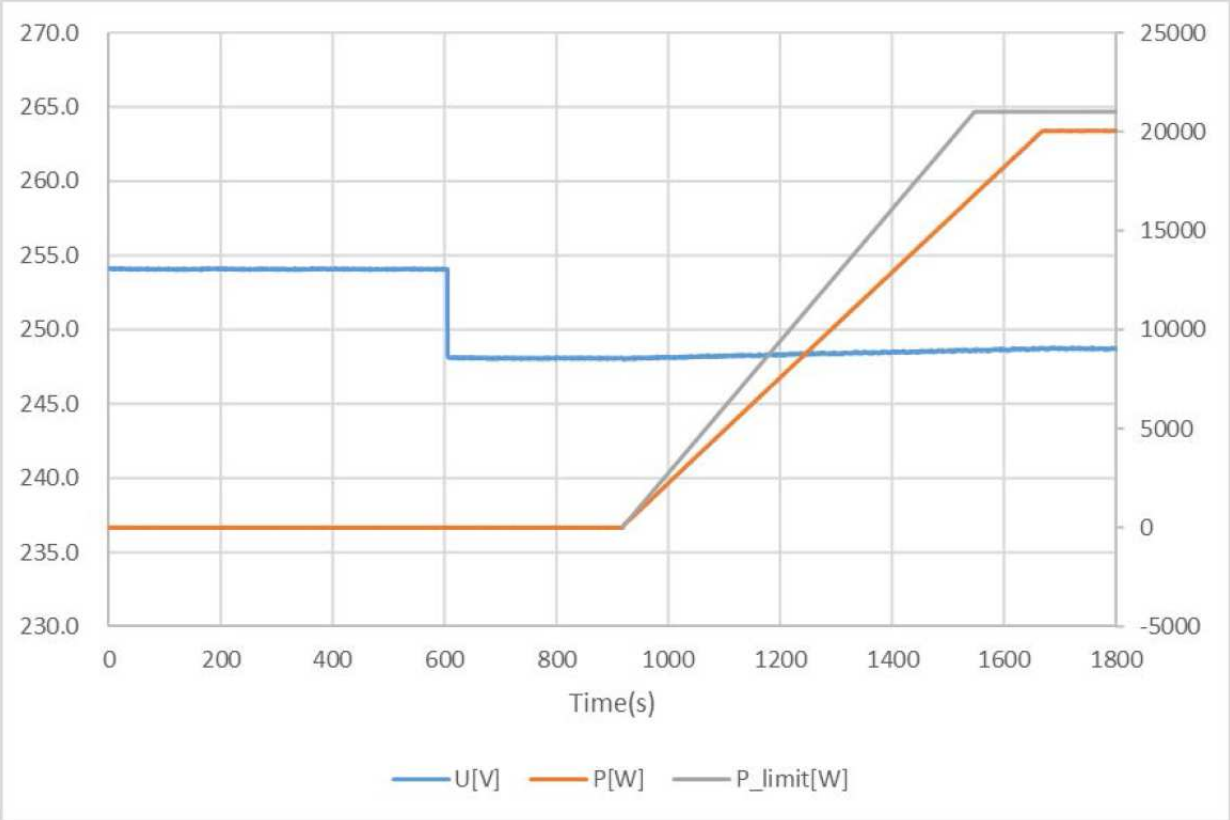
Graph of the gradual power supply and reconnection: for 47.55Hz



Graph of the gradual power supply and reconnection: for 50.05Hz



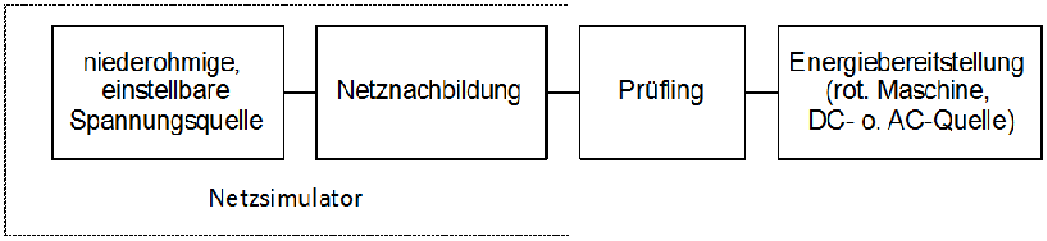
Graph of the gradual power supply and reconnection: for 86%Un



Graph of the gradual power supply and reconnection: for 108%Un

5.6	Dynamic Network support	P

Test equipment:

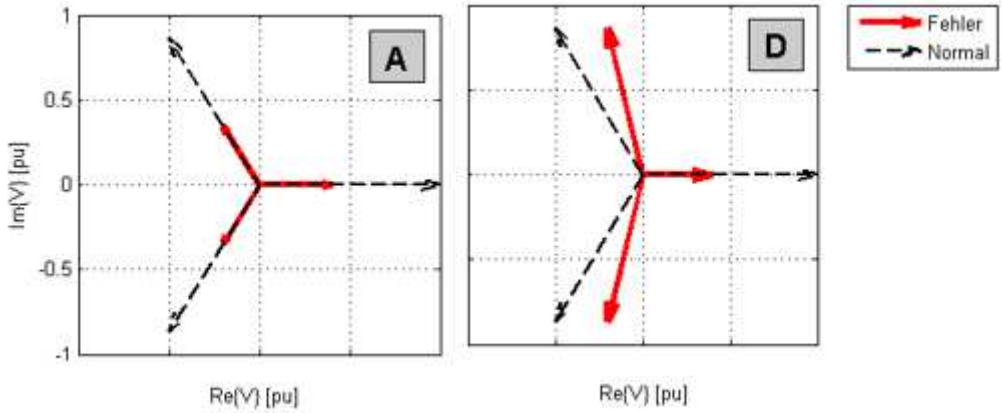


The effective network impedance from view of PGU must fulfill following criterion:
- short-circuited power at PGU before and after fault must be between 10xSn and 30xSn
- R/X 0.3-3 (for applied impedance in test equipment)

The test equipment and network simulator must be able to take the max. occurring PGU current, both in generating and motoring area. The energy absorb shall be designed for sudden short circuited current Ip (per IEC 60909). Ip is obvious different by the type of test sample, the correct value shall be:

- for inverter coupled system about 2.2In,
- for direct coupled Asynchronous or Synchronous machines about 7In.

Grid simulator settings for asymmetry grid fault:



D1	Test Equipment	Test Sample
Connection terminal	U	L1
	V	L2
	W	L3 (L for single phase)
D2	Test Equipment	Test Sample
Connection terminal	U	L3
	V	L1 (L for single phase)
	W	L2

Test Nr	L1	L2	L3	Typ	Comments
--	1,00 > – 150,0°	1,00 > 90,0°	1,00 > – 30,0°	A	initial state
1.3,1.4	0,62 > –	0,15 > 90,0°	0,62 > – 6,9°	D1	LV FRT

	173,3°				
2.3,2.4	0,76 > – 161,1°	0,50 > 90,0°	0,76 > – 19,1°	D1	
3.3,3.4	0,93 > – 152,8°	0,85 > 89,9°	0,93 > – 27,4°	D1	

Diagram:

For each test the following diagrams shall be figured since t1-1s (one second before fault entry) till t2+6s (six seconds after fault clear), zoomed if needed:

Empty load tests:

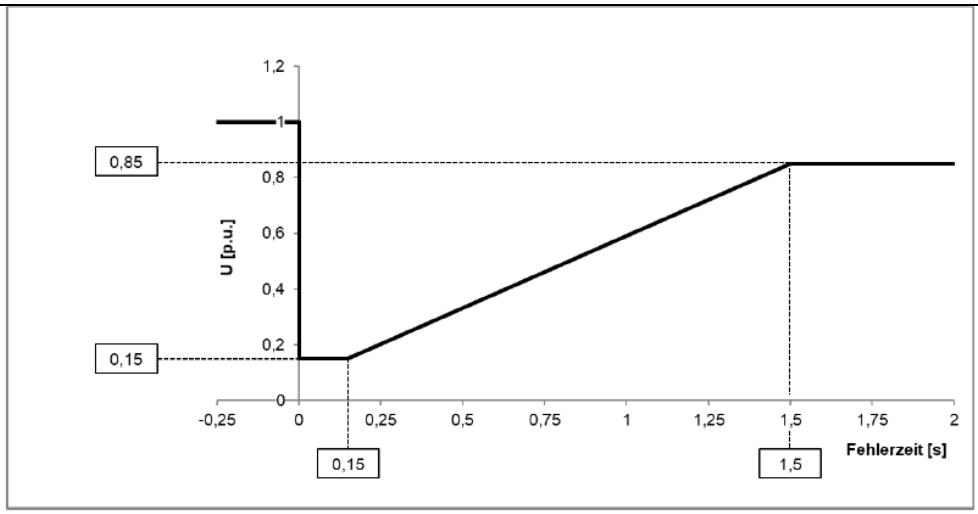
- line to line voltages and line to neutral voltages (signal)
- full period-RMS value of line to neutral voltages with updated rate of 1/ms.

Tests with sample:

- line to line voltage and line to neutral voltage (signal)
- line currents (signal)
- full period-RMS value of line to neutral voltage with updated rate of 1/ms
- full period-RMS value of line currents with updated rate of 1/ms (active and reactive part additionally)
- active power and reactive power in pos. sequence with updated rate of 1/ms
- voltage and current in pos. sequence with updated rate of 1/ms

Test condition:

Test	Burglary depth P.U.	Fault pattern	Fault duration ms	load	Reactive power before the test in Q / Pn	Test number
1	0,15 … 0,25	3-phase (type A)	At 0.15 pu ≥ 150 At 0.25 pu ≥ 250	full load	0 to ± 10%	1.1
				partial load		1.2
		2-phase (type D)		full load		1.3
				partial load		1.4
2	0,50 … 0,60	3-phase (type A)	At 0.5 pu ≥ 840 At 0.6 pu ≥ 1 020	full load	0 to ± 10%	2.1
				partial load		2.2
		2-phase (type D)		full load		2.3
				partial load		2.4
3	0,85 … 0,90	3-phase (type A)	≥ 60 000	full load	0 to ± 10%	3.1
				partial load		3.2
		2-phase (type D)		full load		3.3
				partial load		3.4



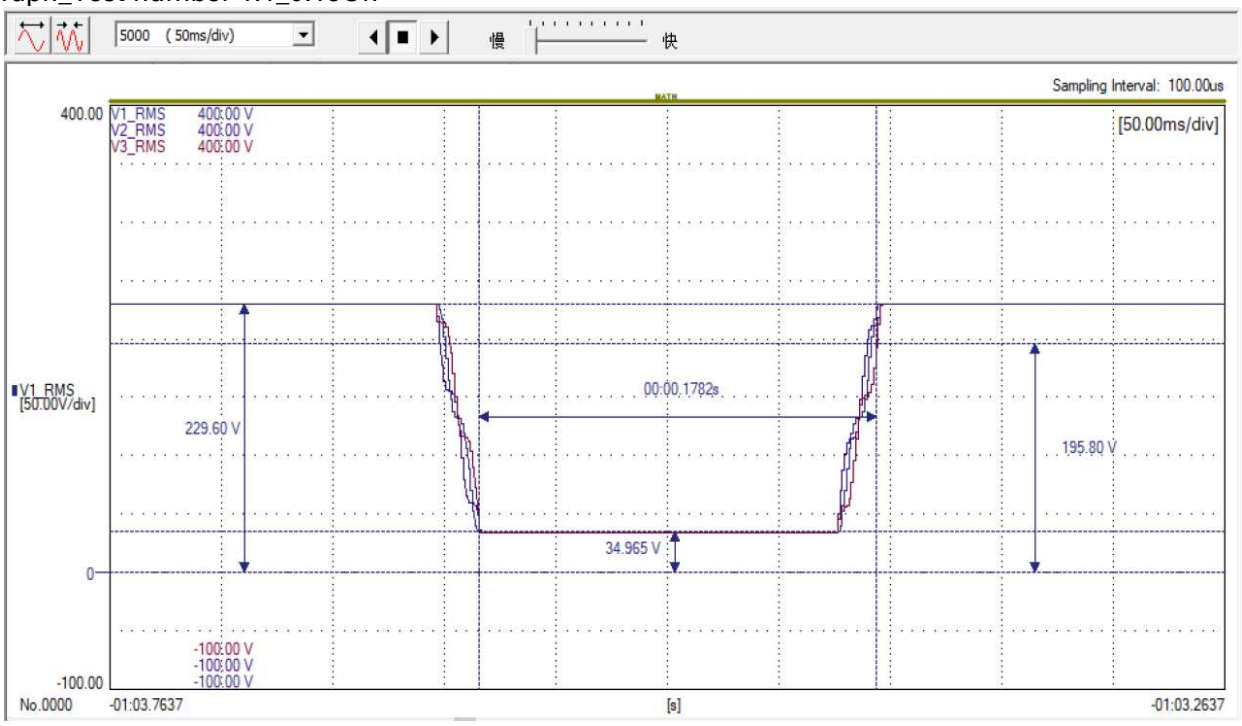
Method of calculations:

Notes on calculations:	Used formula	Remarks
General remarks: The average grid frequency over the measured interval is calculated from zero-crossings of the sine function. Only 10 cycles before the dip are used for this calculation. RMS-Calculations are performed with a moving window, which is determined by T = 1/f and must remain constant. The number of samples N per calculation window is determined by the sampling rate f_s. N has to be even and an integer number nearest to the product $T*f_s$.	$\underline{U}_1 = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} u(n) \cdot e^{-j(\frac{2\pi n}{N})}$ $\underline{I}_1 = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} i(n) \cdot e^{-j(\frac{2\pi n}{N})}$	- Calculated for each phase A,B,C - N: Amount of samples per window - n: number of sample
Performed Calculation	$\underline{U}^+ = \frac{1}{3} \cdot (\underline{U}_{1A} + \underline{U}_{1B} \cdot e^{+j\frac{2\pi}{3}} + \underline{U}_{1C} \cdot e^{-j\frac{2\pi}{3}})$ $\underline{I}^+ = \frac{1}{3} \cdot (\underline{I}_{1A} + \underline{I}_{1B} \cdot e^{+j\frac{2\pi}{3}} + \underline{I}_{1C} \cdot e^{-j\frac{2\pi}{3}})$	
Complex values for the fundamental harmonic	$P = 3 \cdot U^+ \cdot I^+ \cdot \cos(\varphi)$ $Q = 3 \cdot U^+ \cdot I^+ \cdot \sin(\varphi)$	Phase-angle : Angular difference between current and voltage $\varphi = (\varphi_U - \varphi_I)$
Positive sequence component of the voltage and current	$I_r = I^+ \cdot \sin(\varphi)$ $I_{tot} = I^+$	
Power:	$U_{rms} = \sqrt{\frac{1}{N} \cdot \sum_{n=0}^{N} (u(n) - \overline{u})^2}$ $\overline{u} = \frac{1}{N} \cdot \sum_{n=0}^{N} u(n)$	- Calculated for each phase A,B,C or L1, L2, L3

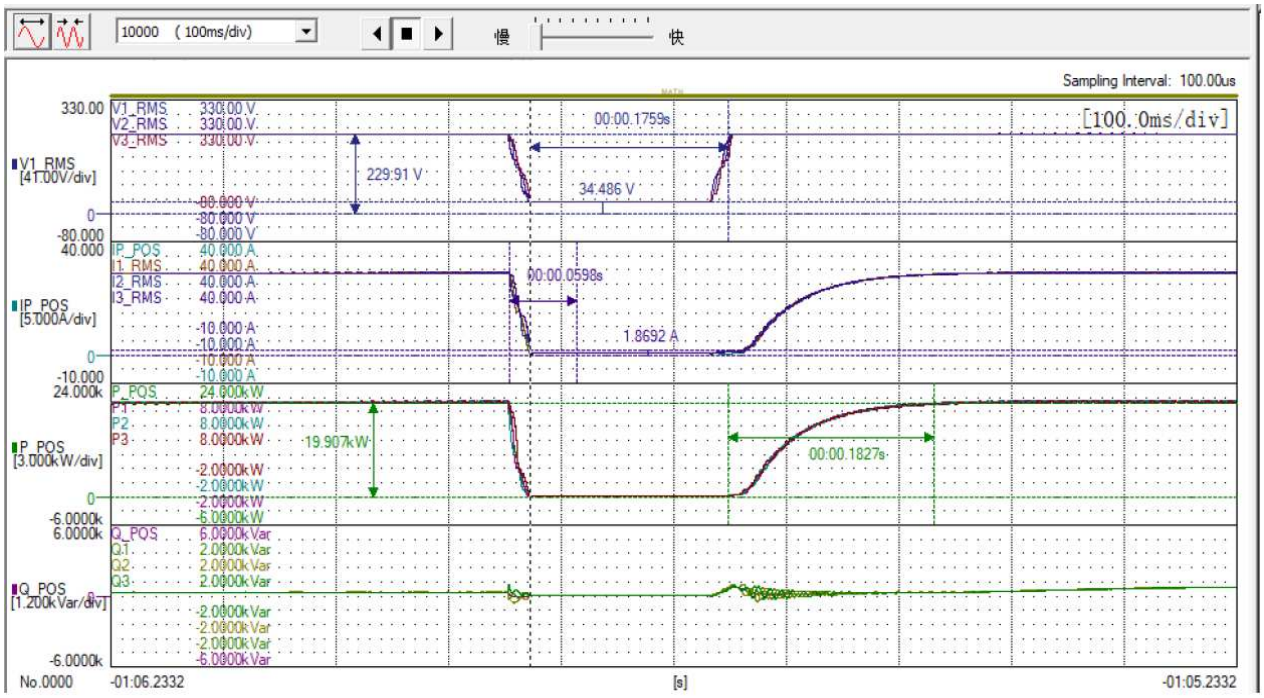
Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]			60K						
NS protection settings			See table 5.4 for detail.						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	1.1		2.1	
	1	Date	--	--	dd.mm.yyyy	06 Jun -2021 to 08-Jun-2021			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		A	A	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.15		0.50	
	5	Setting dip duration		--	ms	150		840	
	6	Point of fault entry	Total	--	ms	20ms			
	7	Point of fault clearance	Total	--	ms	20ms			
	8	Fault duration in empty load test	Total	--	ms	150		1500	
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15		0.50	
	10		Positive sequence		p.u.	0.15		0.50	
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.001		1.001	
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.993		1.001	
	13	Active power	Total	t1-10s to t1	p.u.	0.996		0.996	
	14		Positive sequence			0.996		0.996	
	15	Reactive power	Total	t1-10s to t1	p.u.	0.033		0.031	
	16		Positive sequence			0.033		0.032	
	17	Cos_{φ}	--	t1-10s to t1	--	1.000		1.000	

During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.148	0.500
	19	Line current	Phase 1	t1+60ms	p.u.	0.029	0.036
	20		Phase 2			0.027	0.034
	21		Phase 3			0.026	0.036
	22	Line current	Phase 1	t1+100ms	p.u.	0.027	0.034
	23		Phase 2			0.025	0.033
	24		Phase 3			0.027	0.032
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.004	0.009
	26		Positive sequence			0.004	0.009
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.001	1.002
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.997	0.998
	29		Total			0.997	0.998
	39	Active power rising time	Positive sequence	--	s	0.183	0.247
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.044	0.044
	32		Total			0.044	0.044
	33	Reactive power rising time	Positive sequence	--	s	0.183	0.247
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	

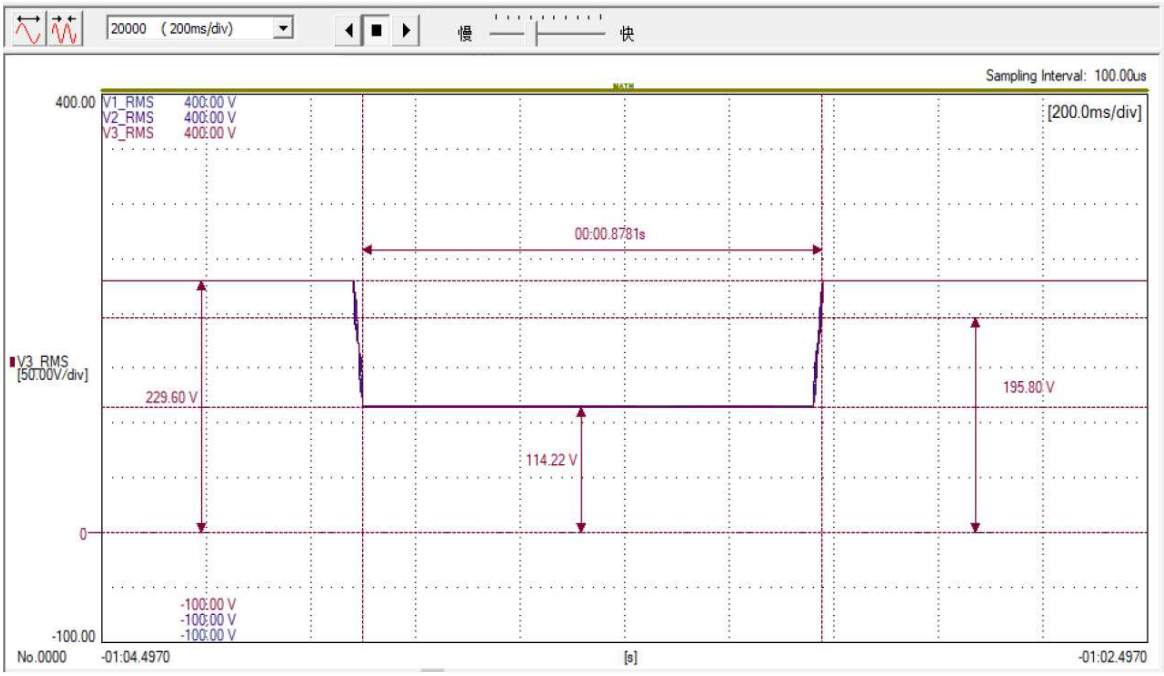
Graph_Test number 1.1_0.15Un



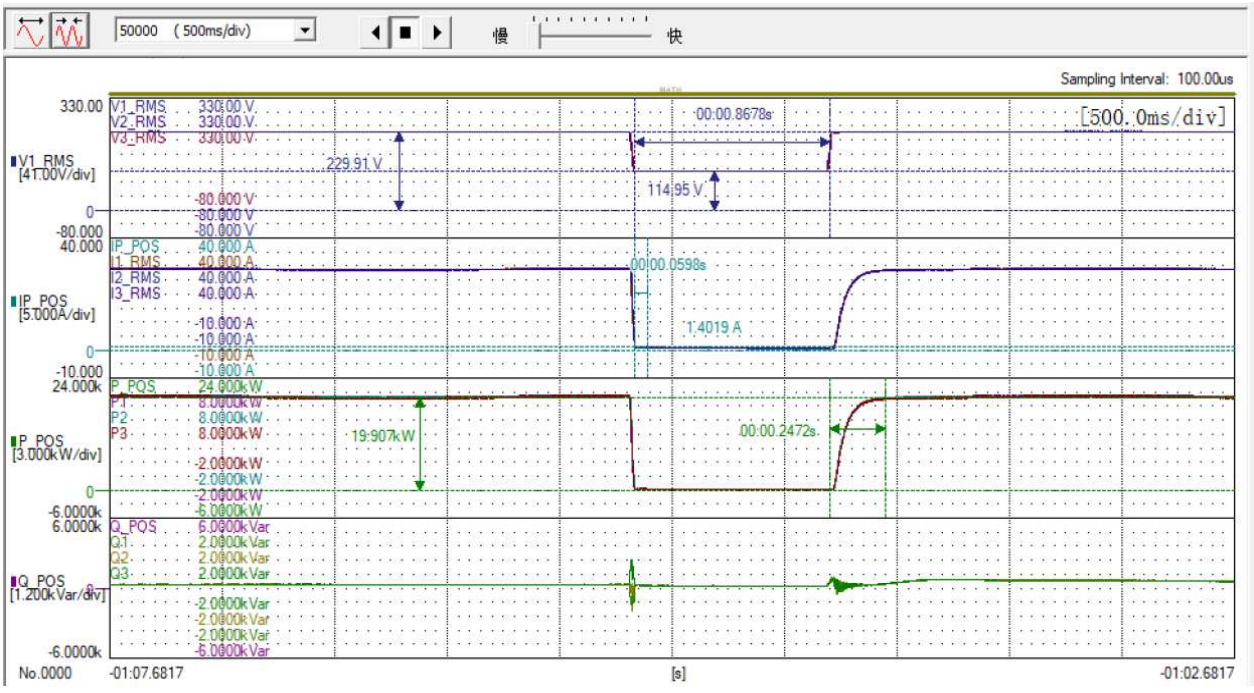
Empty load



Graph_Test number 2.1_0.50Un



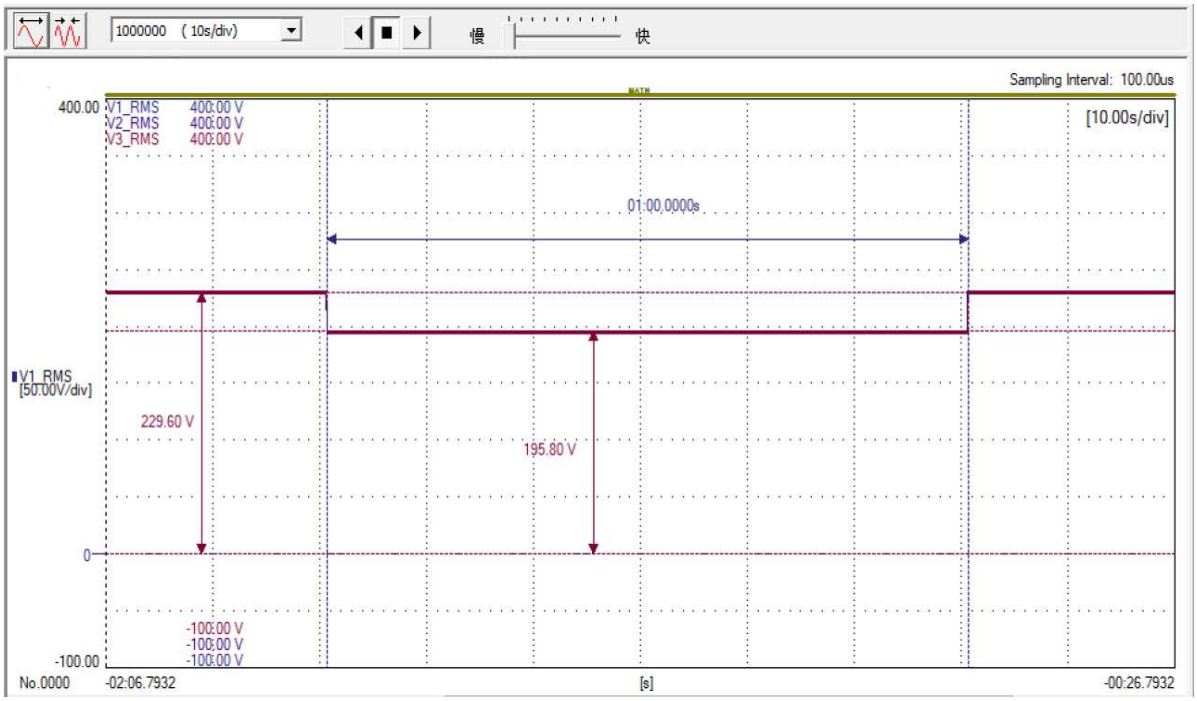
Empty load



Verification of dynamic network support (Continued)									P
Short-circuited power at generator terminal [VA]			60 K						
NS protection settings			See table 5.4 for detail.						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	3.1	1.3	2.3	3.3
	1	Date	--	--	dd.mm.yyyy	06 Jun -2021 to 08-Jun-2021			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		A	D1	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.85	0.15	0.50	0.85
	5	Setting dip duration		--	ms	60000	150	840	60000
	6	Point of fault entry	Total	--	ms	20ms			
	7	Point of fault clearance	Total	--	ms	20ms			
	8	Fault duration in empty load test	Total	--	ms	60000	150	1500	60000
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 / t1-10s to t1	p.u.	0.85	0.62/ 0.15/ 0.62	0.76/ 0.50/ 0.76	0.93/ 0.85 0.93
	10		Positive sequence		p.u.	0.85	0.463	0.673	0.903
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.001	1.001	1.001	1.001
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	1.002	1.004	1.005	0.999
	13	Active power	Total	t1-10s to t1	p.u.	0.997	0.999	1.000	0.997
	14		Positive sequence			0.997	0.999	1.000	0.997
	15	Reactive power	Total	t1-10s to t1	p.u.	0.031	0.031	0.031	0.031
	16		Positive sequence			0.032	0.032	0.032	0.032
	17	Cos_{φ}	--	t1-10s to t1	--	1.000	1.000	1.000	1.000
During	18	Voltage	Line to	t1+100ms	p.u.	0.847	0.621/	0.762/	0.933/

dip t1 to t2			neutral	to t2-20ms			0.150/ 0.620	0.501/ 0.762	0.853/ 0.932
	19	Line current	Phase 1	t1+60ms	p.u.	0.043	0.041	0.036	0.046
	20		Phase 2			0.045	0.034	0.031	0.045
	21		Phase 3			0.040	0.034	0.037	0.046
	22	Line current	Phase 1	t1+100ms	p.u.	0.041	0.039	0.032	0.041
	23		Phase 2			0.042	0.032	0.029	0.042
	24		Phase 3			0.041	0.030	0.033	0.046
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.014	0.012	0.007	0.014
	26		Positive sequence			0.013	0.012	0.007	0.014
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.001	1.002	1.002	1.002
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.998	1.000	1.000	1.000
	29		Total			0.998	1.000	1.000	1.000
	39	Active power rising time	Positive sequence	--	s	0.460	0.195	0.227	0.575
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.032	0.037	0.040	0.031
	32		Total			0.032	0.037	0.040	0.031
	33	Reactive power rising time	Positive sequence	--	s	0.460	0.195	0.227	0.575
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph_Test number 3.1



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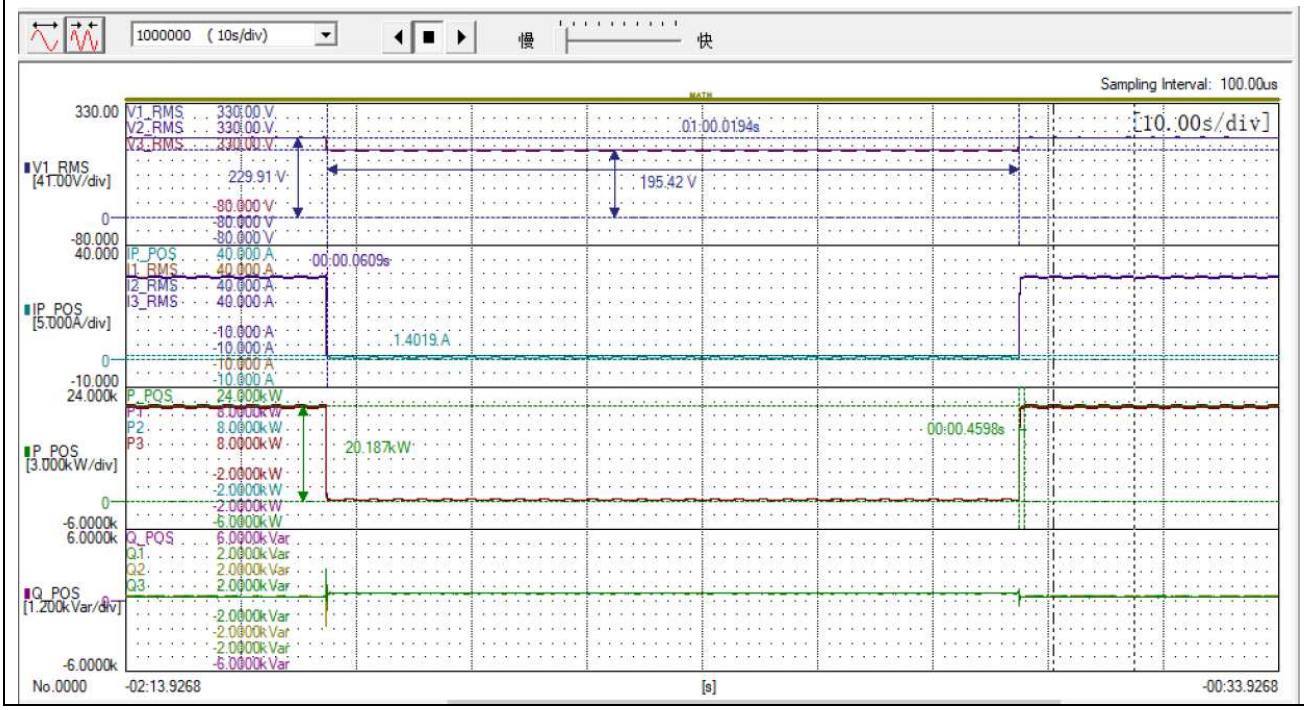
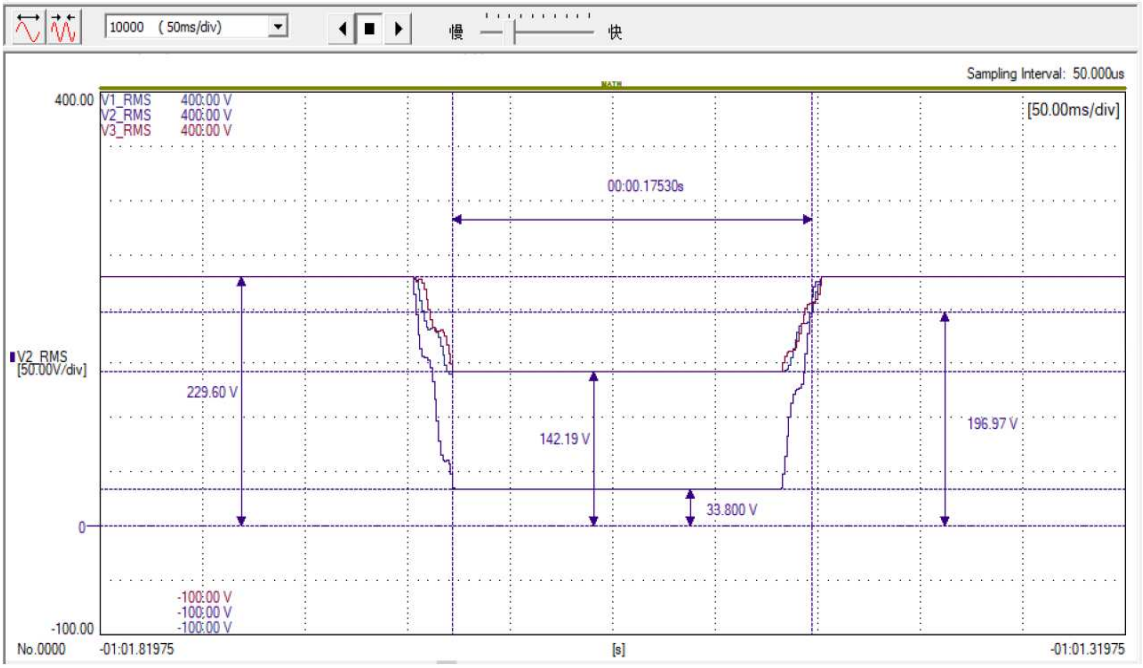


Graph_Test number 1.3



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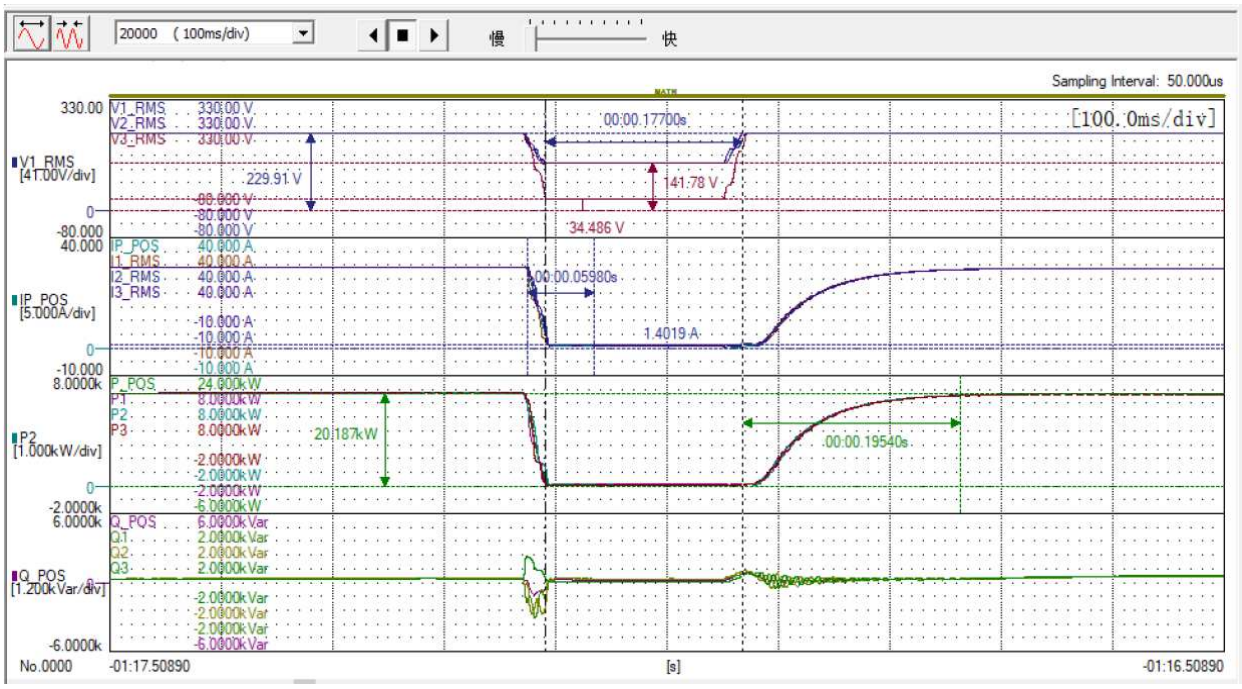
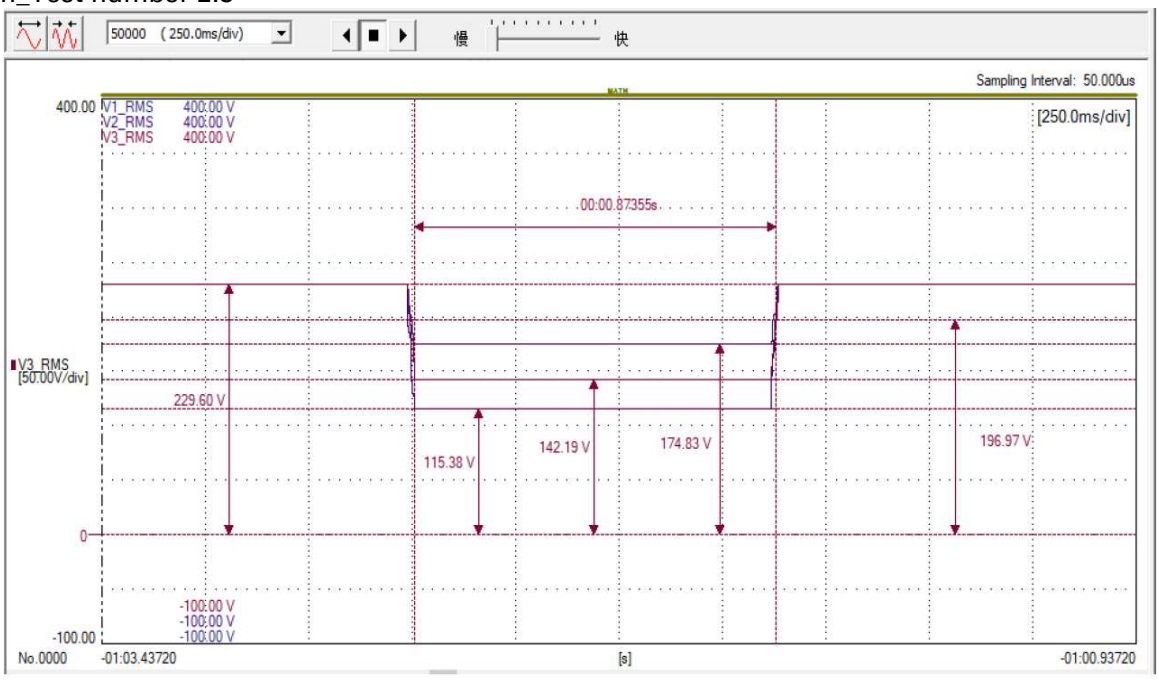
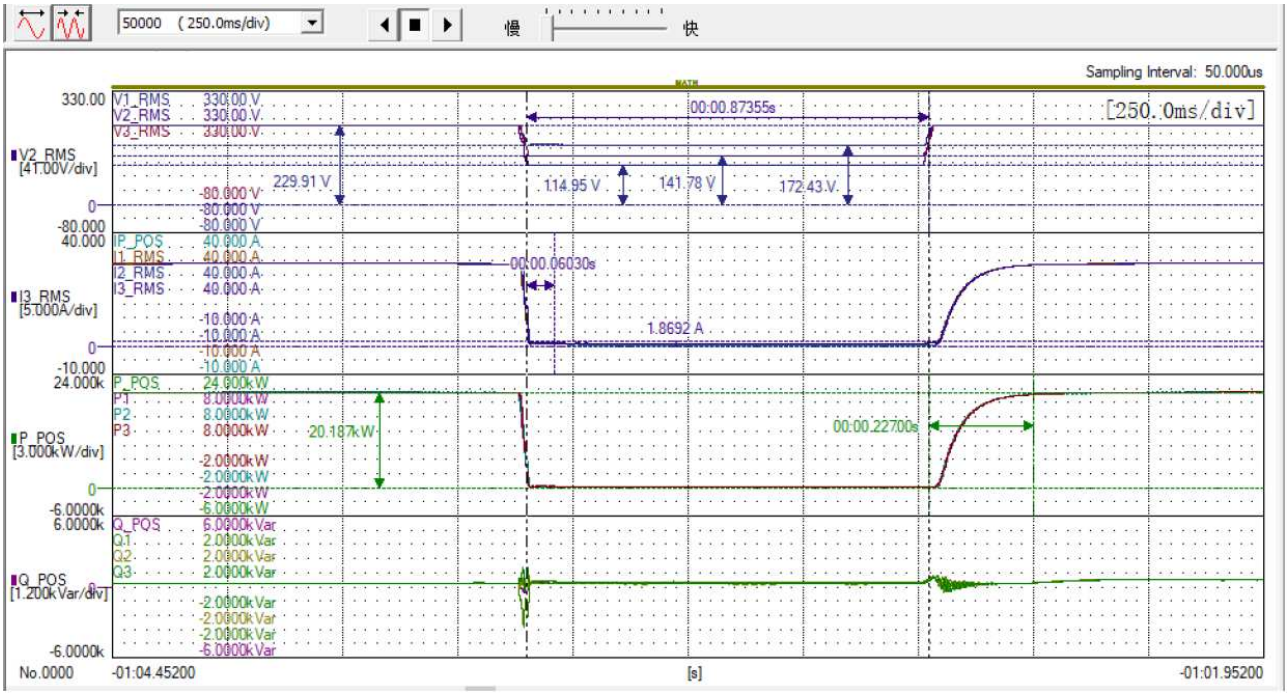


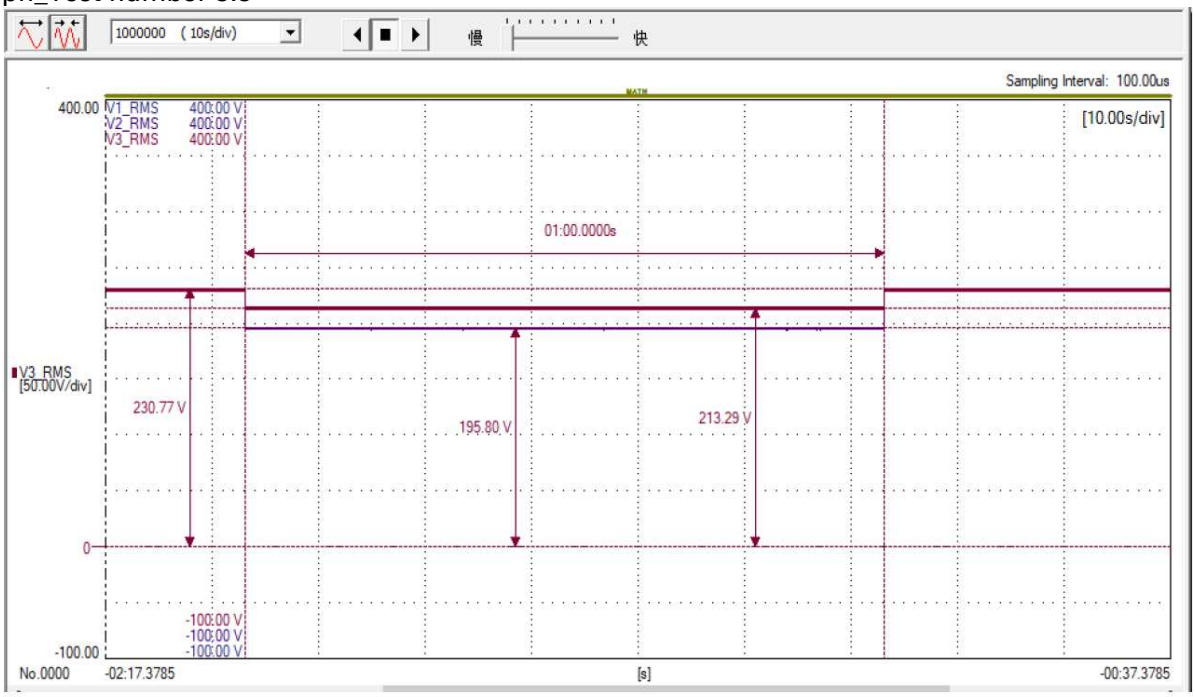
Graph_Test number 2.3



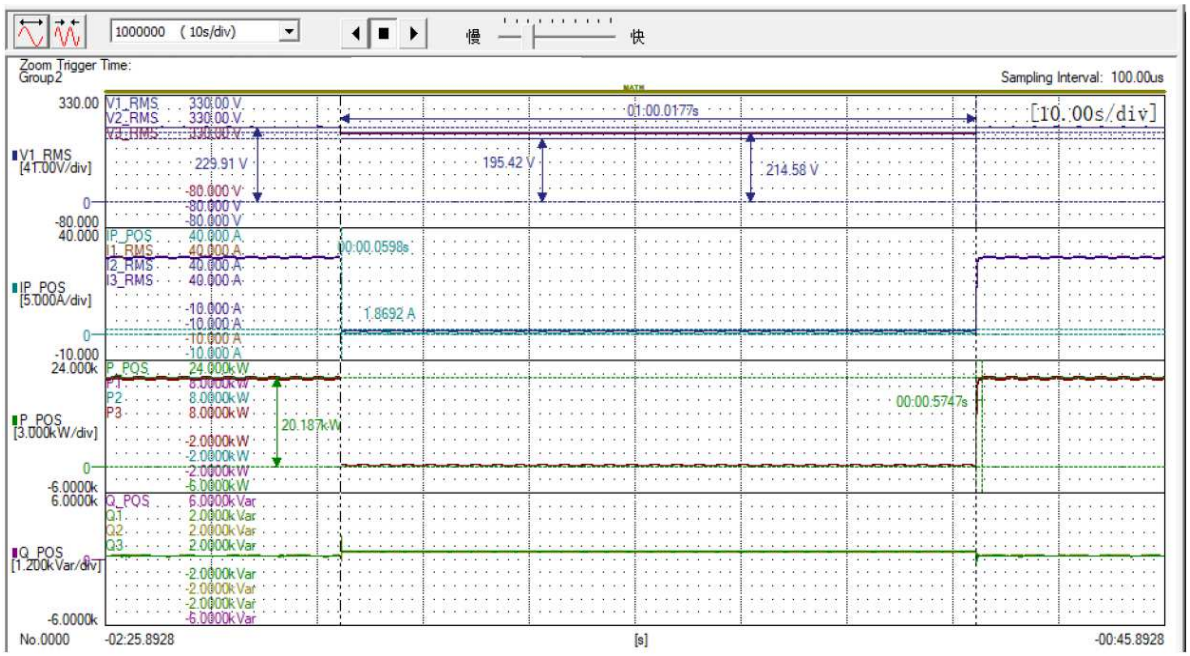
Empty load



Graph_Test number 3.3



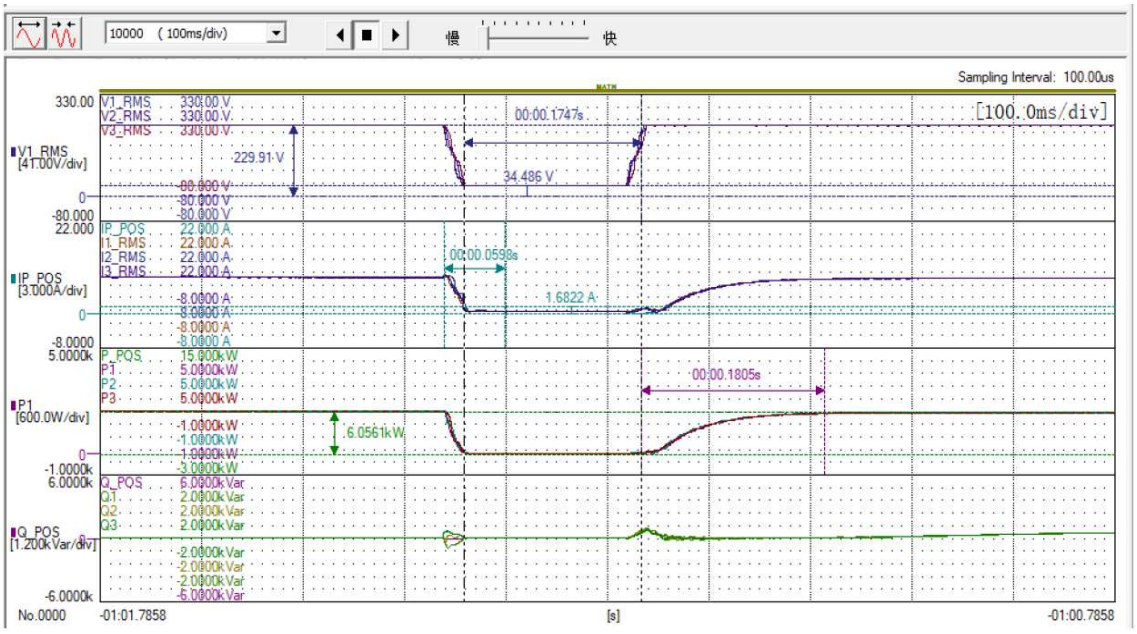
Empty load



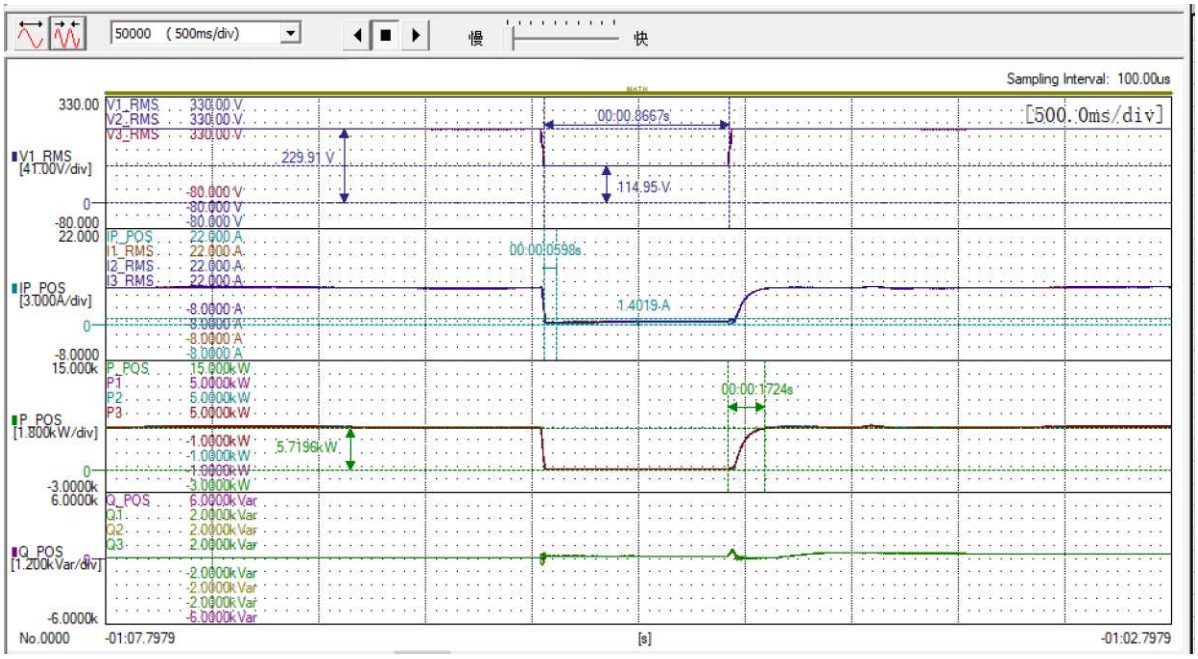
Verification of dynamic network support (Continued)							P
Short-circuited power at generator terminal [VA]			60 K				
NS protection settings			See table 5.4 for detail.				
	No.	Parameter	Phase ref.	Time ref.	unit	Result	
General Info.	0	Test number	--	--	--	1.2	2.2
	1	Date	--	--	dd.mm.yyyy	06 Jun -2021 to 08-Jun-2021	
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph	
	3	Fault type (phase)	--	--		A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.15	0.50
	5	Setting dip duration		--	ms	150	840
	6	Point of fault entry	Total	--	ms	20ms	
	7	Point of fault clearance	Total	--	ms	20ms	
	8	Fault duration in empty load test	Total	--	ms	150	840
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15	0.50
	10		Positive sequence		p.u.	0.15	0.50
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	0.999	1.000
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.302	0.291
	13	Active power	Total	t1-10s to t1	p.u.	0.299	0.296
	14		Positive sequence			0.299	0.296
	15	Reactive power	Total	t1-10s to t1	p.u.	0.006	0.006
	16		Positive sequence			0.007	0.007
	17	Cos_{φ}	--	t1-10s to t1	--	1.000	1.000
During dip t1 to	18	Voltage	Line to neutral	t1+100ms to t2-	p.u.	0.148	0.501

t2				20ms			
	19	Line current	Phase 1	t1+60ms	p.u.	0.029	0.025
	20		Phase 2			0.027	0.025
	21		Phase 3			0.026	0.028
	22	Line current	Phase 1	t1+100ms	p.u.	0.027	0.029
	23		Phase 2			0.025	0.026
	24		Phase 3			0.027	0.027
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.003	0.011
	26		Positive sequence			0.003	0.011
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	0.999	0.999
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.299	0.296
	29		Total			0.299	0.296
	39	Active power rising time	Positive sequence	--	s	0.181	0.172
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.020	0.020
	32		Total			0.020	0.020
	33	Reactive power rising time	Positive sequence	--	s	0.181	0.172
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	

Graph_Test number 1.2_0.15Un



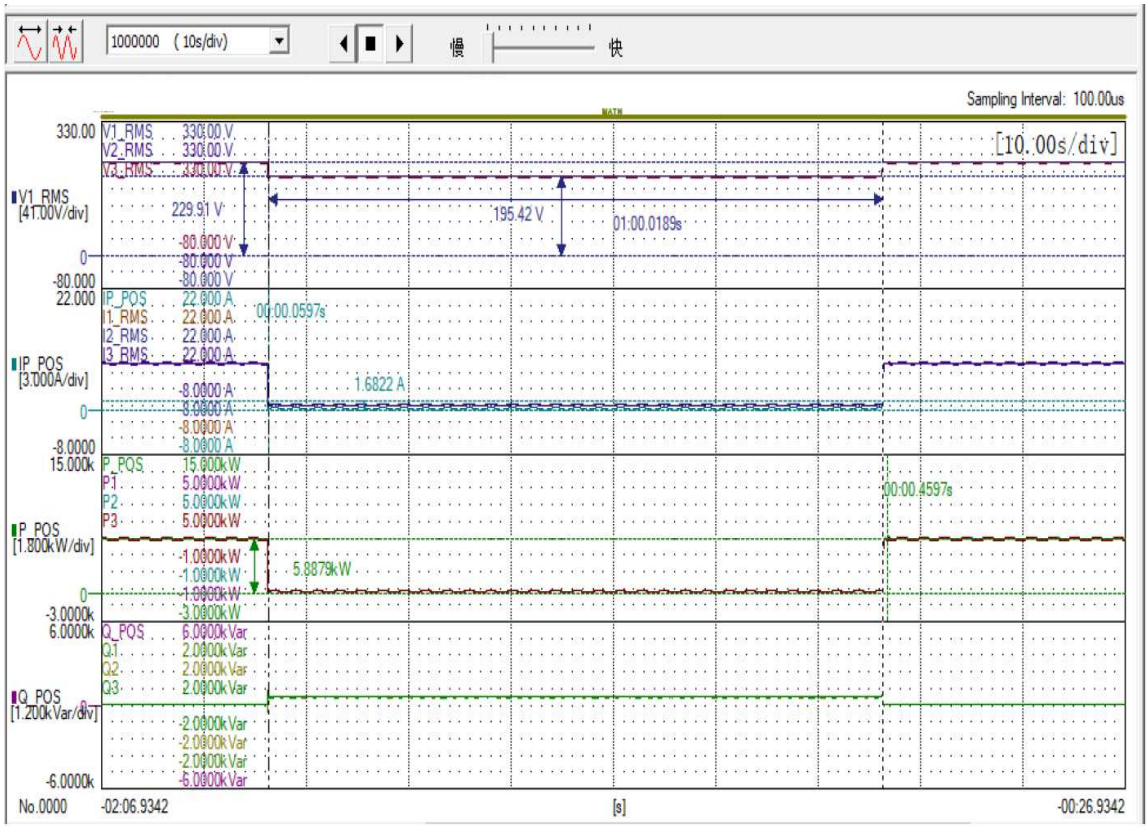
Graph_Test number 2.2_0.50Un



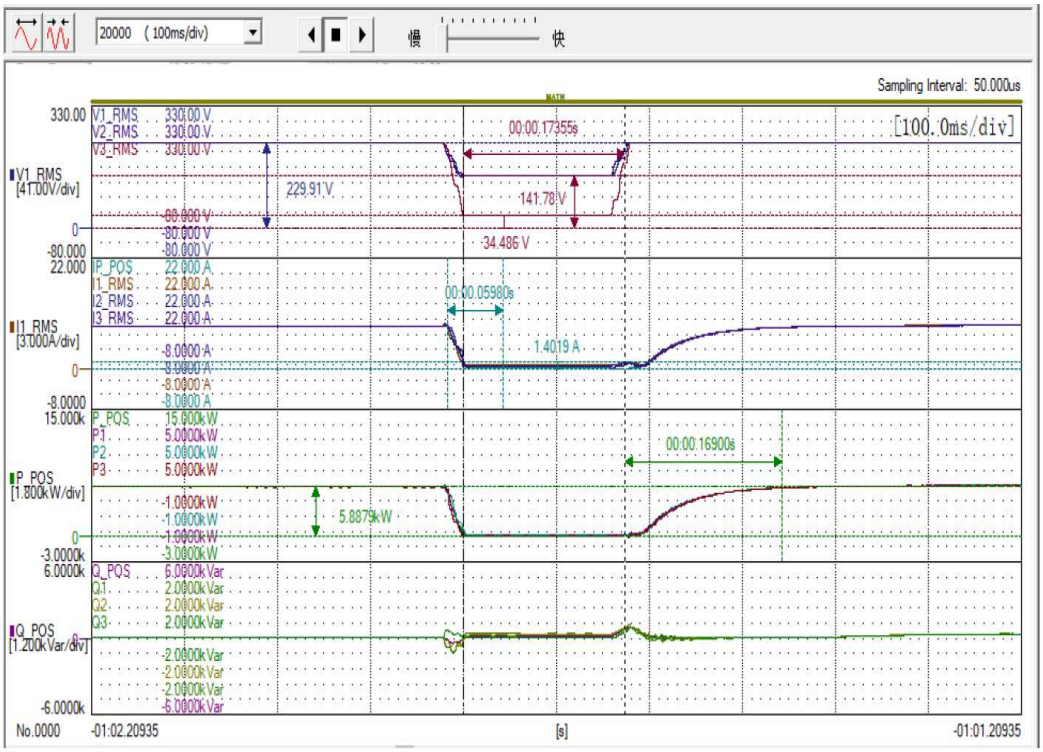
Verification of dynamic network support (Continued)									P
Short-circuited power at generator terminal [VA]			60 K						
NS protection settings			See table 5.4 for detail.						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	3.2	1.4	2.4	3.4
	1	Date	--	--	dd.mm.yyyy	06 Jun -2021 to 08-Jun-2021			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		A	D1	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.85	0.15	0.50	0.85
	5	Setting dip duration		--	ms	60000	150	840	60000
	6	Point of fault entry	Total	--	ms	20ms			
	7	Point of fault clearance	Total	--	ms	20ms			
	8	Fault duration in empty load test	Total	--	ms	60000	150	1500	60000
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 / t1-10s to t1	p.u.	0.85	0.62/ 0.15/ 0.62	0.761/ 0.500/ 0.761	0.932/ 0.852/ 0.932
	10		Positive sequence		p.u.	0.85	0.46	0.674	0.905
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.291	0.295	0.300	0.303
	13	Active power	Total	t1-10s to t1	p.u.	0.296	0.299	0.299	0.298
	14		Positive sequence			0.296	0.299	0.299	0.298
	15	Reactive power	Total	t1-10s to t1	p.u.	0.006	0.006	0.006	0.006
	16		Positive sequence			0.006	0.007	0.007	0.006
	17	Cos_{φ}	--	t1-10s to t1	--	0.9893	0.9919	0.9917	0.9918

During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85	0.620/ 0.150/ 0.621	0.761/ 0.501/ 0.761	0.932/ 0.852/ 0.931
	19	Line current	Phase 1	t1+60ms	p.u.	0.039	0.030	0.029	0.040
	20		Phase 2			0.037	0.022	0.025	0.042
	21		Phase 3			0.038	0.022	0.032	0.047
	22	Line current	Phase 1	t1+100ms	p.u.	0.039	0.031	0.029	0.039
	23		Phase 2			0.036	0.022	0.024	0.038
	24		Phase 3			0.036	0.021	0.030	0.043
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.014	0.006	0.007	0.014
	26		Positive sequence			0.014	0.006	0.007	0.014
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.000	1.000	1.000	1.000
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.296	0.299	0.298	0.298
	29		Total			0.296	0.299	0.298	0.299
	39	Active power rising time	Positive sequence	--	s	0.460	0.169	0.168	0.575
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.007	0.014	0.016	0.006
	32		Total			0.007	0.014	0.016	0.006
	33	Reactive power rising time	Positive sequence	--	s	0.460	0.169	0.168	0.575
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

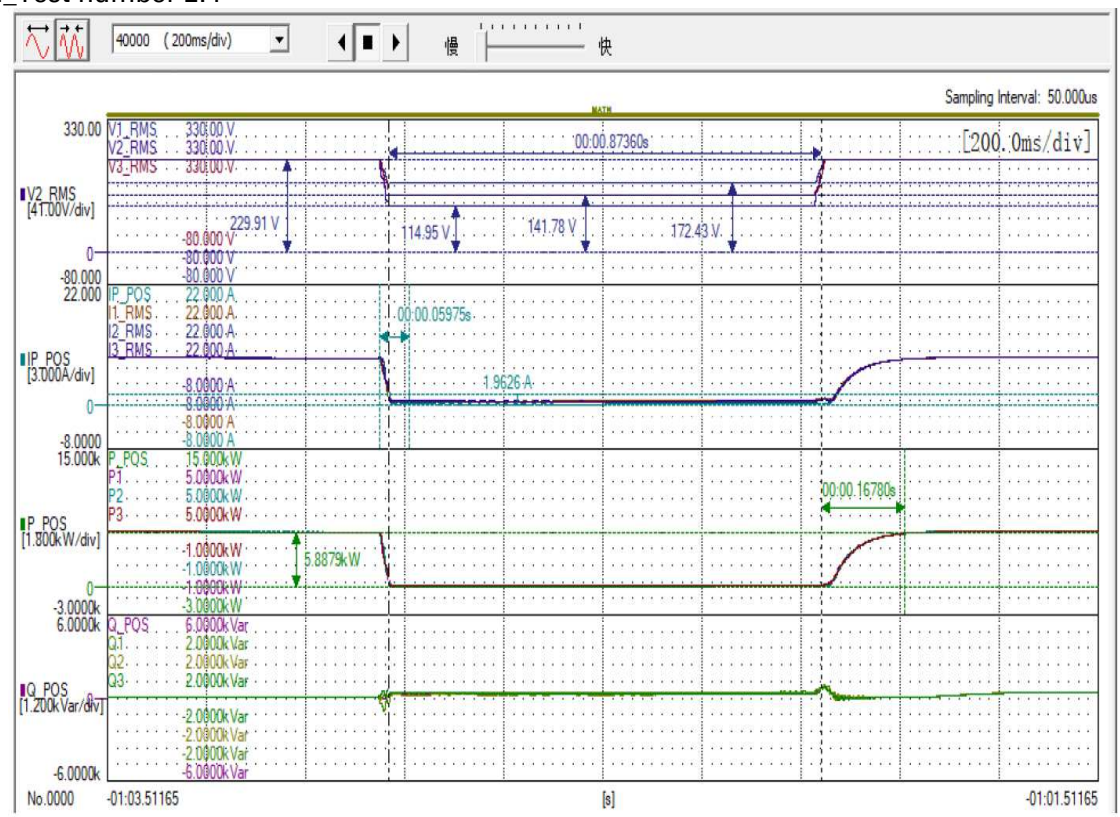
Graph_Test number 3.2



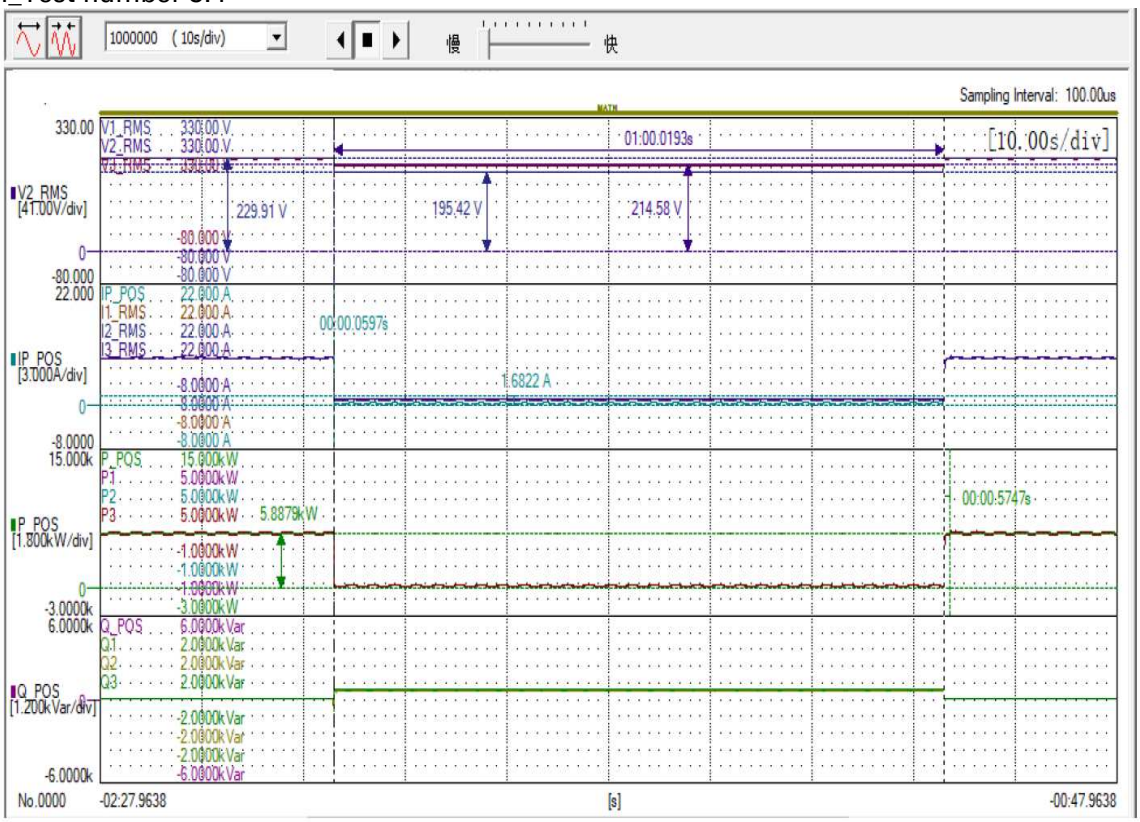
Graph_Test number 1.4



Graph_Test number 2.4



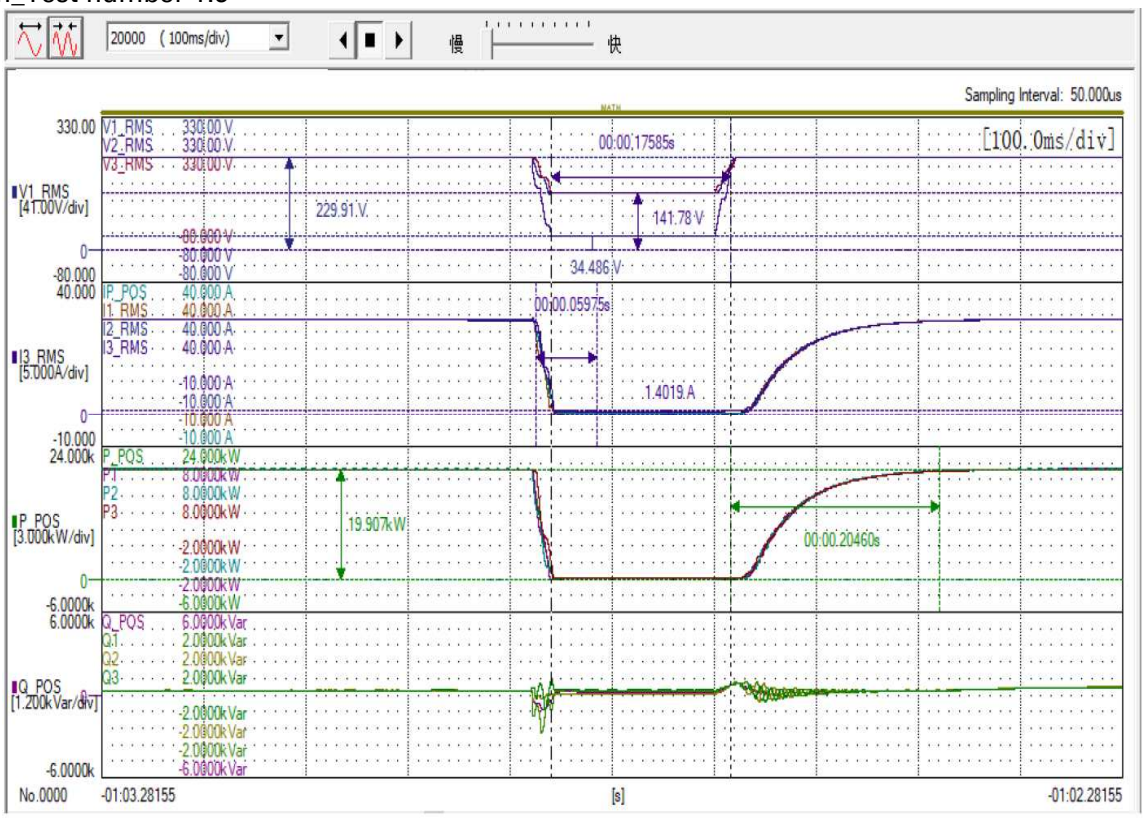
Graph_Test number 3.4



Verification of dynamic network support (Continued)						P
Short-circuited power at generator terminal [VA]			60 K			
NS protection settings			See table 5.4 for detail.			
	No.	Parameter	Phase ref.	Time ref.	unit	Result
General Info.	0	Test number	--	--	--	1.5
	1	Date	--	--	dd.mm.yyyy	26-May -2020 to 10-June-2020
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph
	3	Fault type (phase)	--	--		D2
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--	ms	150
	6	Point of fault entry	Total	--	ms	20ms
	7	Point of fault clearance	Total	--	ms	20ms
	8	Fault duration in empty load test	Total	--	ms	150
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 / t1-10s to t1	p.u.	0.15/ 0.62/ 0.62
	10		Positive sequence		p.u.	0.46
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.993
	13	Active power	Total	t1-10s to t1	p.u.	0.999
	14		Positive sequence			0.999
	15	Reactive power	Total	t1-10s to t1	p.u.	0.032
	16		Positive sequence			0.032
	17	Cos_{φ}	--	t1-10s to t1	--	0.9991

During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15/ 0.62/ 0.62
	19	Line current	Phase 1	t1+60ms	p.u.	0.024
	20		Phase 2			0.022
	21		Phase 3			0.033
	22	Line current	Phase 1	t1+100ms	p.u.	0.021
	23		Phase 2			0.019
	24		Phase 3			0.029
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.004
	26		Positive sequence			0.005
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.999
	29		Total			0.999
	39	Active power rising time	Positive sequence	--	s	0.205
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.038
	32		Total			0.038
	33	Reactive power rising time	Positive sequence	--	s	0.205
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

Graph_Test number 1.5



Appended photos

Overview

Interface view

Rear view

Side view

(End of Report)