TL-395

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REPORT
VDE-AR-N 4105:2018-11
Generators connected to the low-voltage distribution network – Technical requirements for the connection to and parallel operation with low-voltage distribution networks in junction with
DIN VDE V 0124-100 :2020-06

Report Reference No…………….....:	220602098GZU-001
Date of issue ………………………….:	26 Dec 2022
Total number of pages………………..:	192 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 Li Engineer
Approved by (+ signature)............	Jason Fu Supervisor
Applicant's name	INVT Solar Technology (Shenzhen) Co., Ltd.
Address..	6th Floor, Block A, INVT Guangming Technology Building, Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen, PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard	VDE-AR-N 4105:2018-11 DIN VDE V 0124-100 :2020-06
Test procedure..............................	Type approval
Non-standard test method…………..:	N/A
Test Report Form No.	VDE-AR-N 4105d
Test Report Form(s) Originator	Intertek Guangzhou
Master TRF	Dated 2019-06

Test item description	Grid-tied Solar inverter
Trade Mark....................................	invt
Manufacturer.................................	Same as Applicant

Model/Type reference............:	iMars XG100KTR, iMars XG100KTR-F, iMars XG110KTR, iMars XG110KTR-F		
Ratings...............................:	Model	iMars XG100KTR	iMars XG100KTR-F
	Max.PV voltage	1100Vdc	
	MPPT voltage range	180V – 1000Vdc	
	Max.input current	26A*9	30A*9
	PV Isc	40A*9	
	Nominal output voltage	3/N/PE, 230/400Vac	
	Nominal output Frequency	50Hz	
	Max.output current	158.8A	
	Rated output power	100KW	
	Max.apparent power	110KVA	
	Power factor range	0.8Leading – 0.8 lagging	
	Safety level	Class I	
	Ingress Protection	IP 66	
	Operation Ambient Temperature	-30℃ - +60℃	
	Software version	V1.1	
	Model	iMars XG110KTR	iMars XG110KTR-F
	Max.PV voltage	1100Vdc	
	MPPT voltage range	180V – 1000Vdc	
	Max.input current	26A*10	30A*10
	PV Isc	40A*10	
	Nominal output voltage	3/N/PE, 230/400Vac	
	Nominal output Frequency	50Hz	
	Max.output current	174.6A	
	Rated output power	110KW	
	Max.apparent power	121KVA	
	Power factor range	0.8Leading – 0.8 lagging	
	Safety level	Class I	
	Ingress Protection	IP 66	
	Operation Ambient Temperature	-30℃ - +60℃	
	Software version	V1.1	

Summary of testing:

Tests performed (name of test and test clause):

VDE4105 (VDE0124)	Test Description
5.4.4.1 (5.2.2)	Rapid voltage changes
5.4.4.2 (5.2.3)	Flicker
5.4.4.3 (5.2.4)	Harmonics and inter-harmonics
5.4.4.8 (5.2.6)	DC current feeding to network
5.6 (5.3)	Asymmetry calculation for three-phase inverter
5.7.2.2.2 (5.4.2)	Measurement of active- and reactive power ranges
5.7.2.3 (5.4.8.1)	Reactive power provision below PEmax
5.7.2.4 (5.4.8.2, 5.4.8.3 & 5.4.8.4)	Method of reactive power provision
5.7.3 (5.8)	Dynamic Network support
5.7.4.2 (5.4.3)	Network security management
5.7.4.3 (5.4.4 & 5.4.5 & 5.4.6 & 5.4.7)	Active power adjustment when over- and under frequency
8.3 (5.6)	Connection conditions and synchronisation

Remark:

Other than special notice, the model iMars XG110KTR is type tested.

For clause 5.7.2.2.2 and 5.4.4.3, all models are tested to check with the specification within 2%.

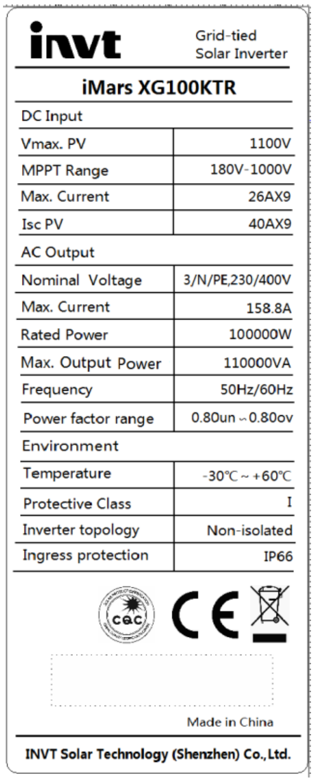
For clause 5.4.4.2 and 5.4.4.8, models iMars XG100KTR and iMars XG110KTR are tested to ensure all the series models are complied.

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



invt Grid-tied Solar Inverter

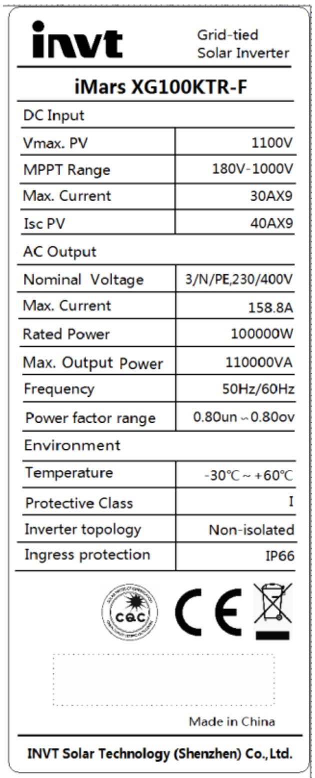
iMars XG100KTR

DC Input	
Vmax. PV	1100V
MPPT Range	180V-1000V
Max. Current	26AX9
Isc PV	40AX9
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Current	158.8A
Rated Power	100000W
Max. Output Power	110000VA
Frequency	50Hz/60Hz
Power factor range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

CQC CE

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.



invt Grid-tied Solar Inverter

iMars XG100KTR-F

DC Input	
Vmax. PV	1100V
MPPT Range	180V-1000V
Max. Current	30AX9
Isc PV	40AX9
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Current	158.8A
Rated Power	100000W
Max. Output Power	110000VA
Frequency	50Hz/60Hz
Power factor range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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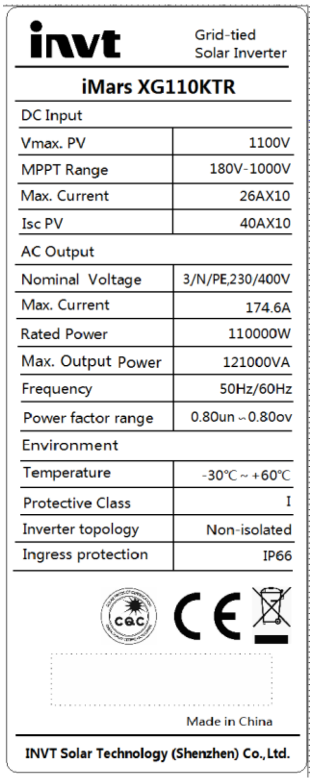

invt Grid-tied Solar Inverter

iMars XG110KTR

DC Input	
Vmax. PV	1100V
MPPT Range	180V-1000V
Max. Current	26AX10
Isc PV	40AX10
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Current	174.6A
Rated Power	110000W
Max. Output Power	121000VA
Frequency	50Hz/60Hz
Power factor range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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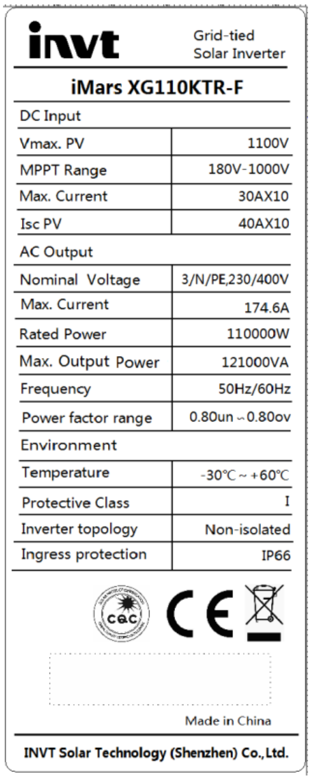

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iMars XG110KTR-F

DC Input	
Vmax. PV	1100V
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Inverter topology	Non-isolated
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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 ....:	
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...:	12 Sep 2022
Date (s) of performance of tests..................................:	12 Sep 2022– 23 Dec 2022

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.

General product information:

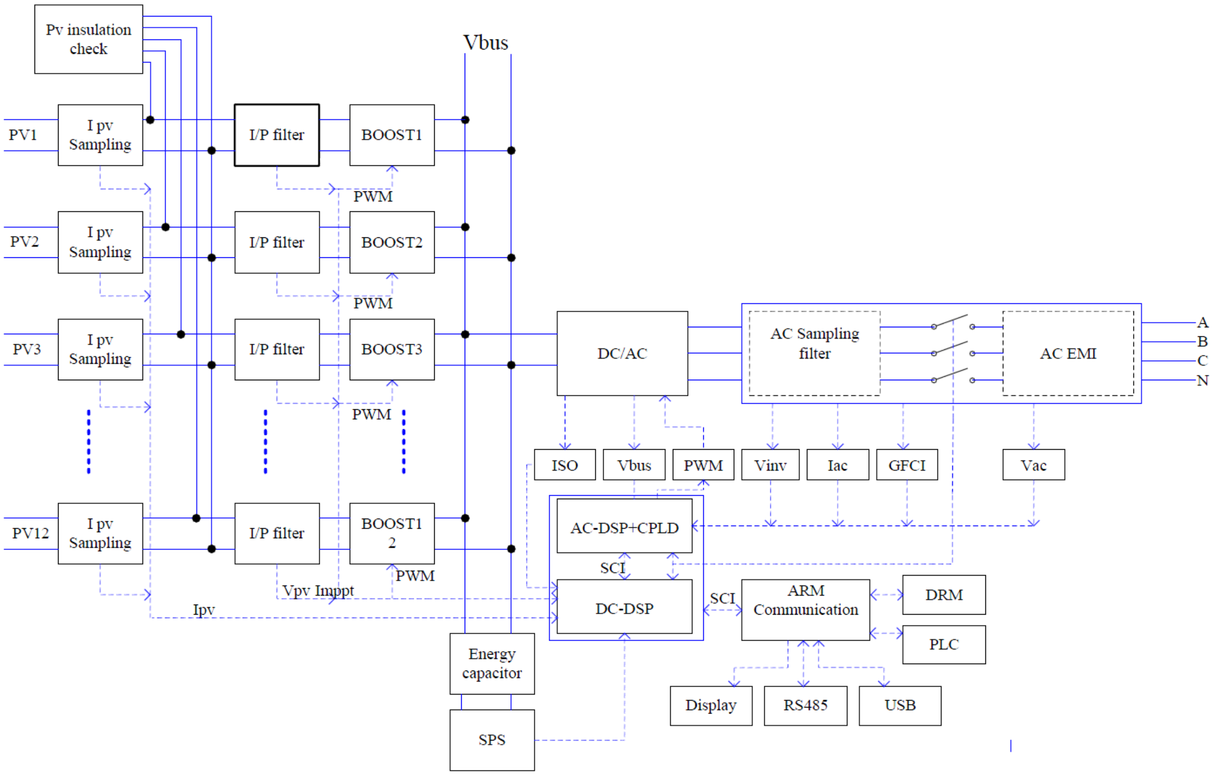
The control system is divided into DC and AC control. AC-DSP and CPLD on the AC side mainly monitors the voltage, current, frequency and GFCI on the grid side, and participates in the inverter control.

The DC-DSP monitors the voltage, current, and ISO on the PV input side, and participates in the BOOS booster circuit and maximum power MPPT point tracking.

There is an internal communication circuit between the two DSP to coordinate with each other to complete the software function of the whole machine.
The ARM monitoring board does not participate in the control of the whole system. It communicates with the DC-SPS to collect the data of the whole system.

The relays (K3, K4, K5, K6) are designed on redundant structure where K4, K6 are controlled by DC-DSP and K5, K6 are controlled by AC-DSP.

The AC-DSP and DC-DSP are used together to control relay open or close, if the single fault on one controller, the other controller can be capable of opening the relay, so that still providing safety means.



Model difference:

All models are identical, except the output power derating in software.

The product was tested on:

The Software version: V1.1

Factory information:

Shenzhen INVT Electric Co., Ltd. (Baoan Factory)

4th to 1st floors of Emerson Industrial Park, No. 3, Fengtang Avenue, Tangwei Community, Fuhai Street, Baoan District, Shenzhen, CHINA.

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict

4	**General framework conditions**		N/A
4.1	**Provisions and regulations**	This report is only evaluated and tested for PGU; The PGS incorporated with the PGU shall further consider this clause and sub-clause.	N/A
4.2	**Application procedure and relevant document for connection**	Shall consider in final PGS	N/A
4.3	**Commissioning of the power generation system and/or the storage unit**	Shall consider in final PGS	N/A

5	**Network connection**		**P**
5.1	**Principles for determination of the network connection point** Power generation systems and storage units shall be connected at a suitable point of the network, i. e. the network connection point. Based on the documents listed in 4.2, the network operator determines the suitable network connection point which will ensure safe network operation while also taking into account the power generation system and the storage unit and at which the requested power can be drawn and transmitted. The essential aspect for a network connection evaluation is always the behaviour of the power generation system and the storage unit at the network connection point or at the PCC. This is intended to ensure that the power generation system or storage unit is operated without adverse interactions and impairment of the supply of other customers. Annex D shows an example of the connection evaluation of power generation systems..	Shall consider in final PGS	N/A
5.2	**Rating of the network equipment** Due to their operating mode, power generation systems and storage units may cause higher loading of lines, transformers and other network equipment. Therefore, the network operator verifies the transmission capacity of the network equipment with regard to the connected power generation systems and storage units in accordance with the relevant rating regulations. For calculation purposes, the maximum apparent power of the sum of all power generation systems and storage units ΣS_{Amax} and usually the load factor m = 1 shall be used. This does not apply to buried cables for the connection of photovoltaic systems where a load factor m = 0,7 shall be used.	Shall consider in final PGS	N/A

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.3	Permissible voltage change For undisturbed operation of the network, the amount of the voltage change caused by all power generation systems with a network connection point in a low-voltage network shall at none of the PCCs in this network may a value of 3 % as compared with the voltage without power generation systems. Deviations from the value of $\Delta u_a \leq 3$ % are permissible as specified by the network operator (e. g. when using a controllable local network transformer). When calculating the voltage change, the displacement factor shall be taken into account which is provided by the network operator for the maximum apparent connection power of the power generation system S_{Amax}.	Shall consider in final PGS	N/A
5.4	**Network interactions** For power generation systems and storage units, the permissible limits for network interactions are also described in VDE-AR-N 4100, 5.4. For the connection evaluation of power generation systems and storage units, the connection owner provides the completed forms E.2 to E.5 to the network operator.	The related clause 5.2.2 to 5.2.4 have been tested and verified in accordance with VDE-1R-N 4100, 5.4, E.5 is provided separately.	P
5.5	**Connection criteria**		P
5.5.1	**General** When connecting a power generation system or a storage unit, the technical connection conditions of the network operator shall be observed.	Shall be considered full feed-in that in accordance with VDE-AR-N 4100 in the power system	P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.5.2	**$P_{AV, E}$ monitoring (feed-in limitation)** $P_{AV, E}$ monitoring allows a connection power $P_{AV, E}$ deviating from the installed power to be agreed with the network operator and to be set. The feed-in limit described in this sub-clause shall be measured at the central meter panel in accordance with VDE-AR-N 4100, 7.2. $P_{AV, E}$ monitoring can be an independent equipment mounted at the central meter panel in accordance with VDE-AR-N 4100 or in a suitable circuit distributor or may also be part of a power generation unit or a storage unit or a charging unit for electric vehicles. When $P_{AV, E}$ is exceeded, the power of the power generation system and/or the storage unit causing the event shall be reduced. $P_{AV, E}$ monitoring is to be used for monitoring the agreed active connection power $P_{AV, E}$ of power generation systems and/or storage units if thefeed-in power at the network connection point $P_{AV, E}$ agreed with the network operator is smaller than the sum of the installed maximum active connection power of all power generation systems and/or storage units at that network connection point.		N/A
5.5.3	**Power generation systems ready for connection** In addition to the requirements specified in this VDE application guide, DIN VDE V 0100-551-1 (VDE V 0100-551-1) applies to power generation systems ready for connection. Provided a connection-ready power generation system is connected via an existing specific energy socket (e. g. complying with VDE V 0628-1 (VDE V 0628-1)) and a bidirectional meter is mounted at the central meter panel, the signature and the details of the system installer on the commissioning protocol E.8 may be omitted. A site map is not required in this case. This only applies up to a value $S_{Amax} \leq 600$ VA per network user installation..		N/A
5.6	**Three-phase inverter systems** For three-phase power generation systems feeding into the network via inverters, the power feed-in into the three line conductors shall be three-phase balanced. The inverter circuit shall preferably be set up as a three phase current unit. The positive sequence system of the terminal voltages, even if they are unbalanced, is to be used as the reference quantity for the currents.	The unit is a three-phase inverter that feed into three current balanced	P
5.7	**Behaviour of the power generation system at the network**		P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.1	**General** For frequencies between 47,5 Hz and 51,5 Hz, automatic disconnection from the network due to a frequency deviation is not permitted. The actual operating principle and the associated exceptions are detailed in 5.7.4.3. Frequency-dependent active power control is implemented in the open-loop control of the power generation units.. In the frequency range of 47,5 Hz to 51,5 Hz, power generation systems shall be capable of network parallel operation in compliance with the time-related minimum requirements given in Table 1. Power generation units shall be able to ride through rapid frequency changes without disconnection from the network. This requirement applies provided the following averaged rates of change of frequency (RoCoF) are not exceeded: – ± 2,0 Hz/s for a moving time slot of 0,5 s; or – ± 1,5 Hz/s for a moving time slot of 1 s; or – ± 1,25 Hz/s for a moving time slot of 2 s. In case of rapid frequency changes, frequency measurements shall not take more than 200 ms. The minimum accuracy of frequency measurements is ± 50 mHz.	(See appended table) Manufacture declaration ROCOF (2.0Hz/s) without disconnection.	P
5.7.2	**Steady-state voltage stability/reactive power supply**		P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.2.1	**General boundary conditions** Steady-state voltage stability means the reactive power supply provided by a power generation system and/or a storage unit when energy is supplied for the purpose of voltage stability in the distribution network. The steady-state voltage stability is intended to keep slow (steady-state) voltage changes in the distribution network within acceptable limits. In case of three-phase feed-in, the reactive power supply associated with all three methods described in 5.7.2.4 a) to c) refers to the positive sequence system components of the current and voltage fundamental component. In a passive sign convention system (see A.8), this means the operation of the power generation system in Quadrant II (under-excited) or Quadrant III (over-excited). If a storage unit consumes energy from the network, the reactive power exchange at the network connection point shall comply with the contractual agreements regarding the network connection for customer installations for consumption (see VDE-AR-N 4100). It shall be possible to approach each set-point resulting from the applied control method according to the required reactive power range given in 5.7.2.2 and to operate the power generation unit therein for any duration. Changes of the reactive power supply within the agreed reactive power range shall be possible at any time. Upon agreement with the network operator, the reactive power control range may be extended..		P
5.7.2.2	**Reactive power supply at ΣS_{Emax}**		P
5.7.2.2.1	**General** It is permissible in certain cases described in 5.7.2.2.2 and 5.7.3 to reduce the active power supply to the benefit of the reactive power supply. This is not considered a reduction of the active power supply in thecontext of network security management. Power generation systems shall comply with the reactive power supply irrespective of the number of feed-inphases under normal operating conditions in the voltage tolerance band U_n ± 10 %.		P
5.7.2.2.2	**Type 2 systems – inverters only** At the generator terminals, each power generation unit to be connected shall meet the requirements according to Figure 2 and Figure 3.		P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict

5.7.2.2.3	**Type 2 systems – Asynchronous generators (directly connected to the network and principally not able to control any reactive power)** For power generation units with generators that are directly connected to the network and principally not able to control any reactive power and therefore use constant capacities, a constant displacement factor cos ϕ = 0,95under-excited with an accuracy of ± 0,02 at nominal voltage and rated power shall be observed.	Inverter	N/A
5.7.2.2.4	**Type 1 systems and type 2 systems – stirling generators and fuel cells** For power generation systems with a rated apparent power ofΣSEmax ≤ 4,6 kVA , the network operator does not give any specifications. The value of cos ϕ lies within a range of cos ϕ = 0,95under-excited to 0,95over-excited. At its generator terminals, each power generation unit to be connected in systems ΣSEmax > 4,6 kVA shall meet the requirements according to Figure 4.		N/A
5.7.2.3	**Reactive power supply smaller than *P*Emax** In addition to the requirements for reactive power supply at the operating point *P*Emax of the power generation unit (*P*mom = *P*Emax), requirements also apply to operation with an instantaneous active power *P*mom smaller than *P*Emax. The minimum requirement for the reactive power supply in partial load operating mode at the generator terminals is indicated as a red triangle on the *P/Q* diagram. Within the ranges given in Figure 5 or Figure 6, the maximum residual deviation between the set-point and the actual value of the reactive power at the generator terminals shall not exceed ± 4,0 % in relation to *P*Emax. Within the range of 0 ≤ *P*mom/*P*Emax < 0,2 (or 0,1, respectively), the power generation unit shall not exceed the reactive power value at the generator terminals of 10 % of the active power value *P*Emax (reactive power supply and consumption respectively). Where a minimum technical power for a power generation unit has been agreed, the same conditions apply as for the range 0 ≤ *P*mom/*P*Emax < 0,2 (or 0,1, respectively) between 0 and the minimum technical power.	(See appended table)	P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.2.4	**Methods for reactive power supply** The reactive power supply for steady-state voltage stability shall not impair the dynamic network stability. The reactive power to be provided by the power generation system is limited to the range given in Figure 5 or Figure 6, respectively. In the context of network connection planning, the network operator prescribes to the connection owner one of the following methods for reactive power supply at the generator terminals of the power generation unit: a) reactive power voltage characteristic curve *Q*(*U*); or b) displacement factor/active power characteristic curve cos ϕ (*P*); or c) fixed displacement factor cos ϕ. The *Q*(*U*) rule applies only to three-phase power generation units connected to the three-phase current system. Here, too, the reactive power requirements are implemented at the generator terminals of the power generation units.	Method a, b and c are used for reactive power supply PGU S_{Emax} ≥4.6 kVA characteristic curve provided by the network operator within cosφ= 0.90under-excited to 0.90 over-excited.	P
	Re: a) reactive power voltage characteristic curve *Q*(*U*) The objective of this method is the reactive power exchange between power generation unit and network depending on the actual voltage at the generator terminals of the power generation unit (*Q*= *f* (*U*)). The reference voltage U_{Q0} is 400 V / 3. The arithmetic mean of the r.m.s. values (optionally of the positive sequence system) of the three measured line-to-neutral voltages at the generator terminals of the power generation unit is the target value for the reactive power to be fed in on all line conductors. Voltage measurement shall not exceed a maximum measurement error of 1 % in relation to the nominal value.	(See appended table)	P
	Re: b) Displacement factor/active power characteristic curve cos ϕ (*P*) The objective of this method is the reactive power supply by the power generation unit depending on the actual active power output ($Q = f(P_{mom})$).	(See appended table)	P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
	Re: c) Displacement factor cos ϕ The objective of displacement factor control is the power feed-in by the power generation unit at a constant active power/apparent power ratio (cos ϕ = const). Thereby, the use of the reactive power control range given in Figure 5 and Figure 6 is restricted. For this purpose, the target value is defined with a minimum increment of Δ cos ϕ = 0,01. The maximum permissible error tolerance of the reactive power feed-in is calculated using the error tolerance given in 5.7.2.3 of ± 4 % in relation to P_{Emax}. The network operator predefines a displacement factor set-point.	(See appended table)	P
5.7.2.5	**Requirements for reactive power methods of type 2 systems (inverters only) and type 1 systems** In the delivery state, none of the three reactive power methods specified in 5.7.2.4 is set as default. During the commissioning of power generation units, the method specified by the network operator shall be set by the system installer. Without the setting of the method specified by the network operator, power generation units shall not feed in any power.		P
	The control behaviour of the reactive power (methods a), b) and c)) with respect to set-point offsets corresponds to the PT-1 behaviour shown in Figure 10. Method a) deals with a closed control circuit under consideration of the network impedance. Each reactive power value resulting from the control behavior predefined by the network operator shall be adjustable within a range of 6 s to 60 s (from 10 s to 60 s for type 1) when being provided by the power generation unit. The time specified by the network operator corresponds to 3 Tau of a PT-1 behaviour or to the time until reaching 95 % of the set-point. If no actual value is predefined by the network operator for this purpose, the applicable value is 10 s for 3 Tau or 95 % of the set-point, respectively. The envelop delay time includes the determination of the network voltage or the active and reactive powers.		P
5.7.2.6	**Special aspects regarding the extension of power generation systems** The requirements specified in 5.7.2.4 shall also be met by the newly added power generation units at their generator terminals. The reactive power supply by the added power generation units in accordance with 5.7.2.2 shall be determined based on the sum of the rated apparent powers of the existing power generation system and the newly added power generation units.		P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict

5.7.3	**Dynamic network stability**		P
5.7.3.1	**General**	(See appended table)	P
5.7.3.2	**Dynamic network stability for type 1 units** **Transient stability – Reaction to network faults** Regarding the power generation unit remaining connected to the network, the following applies to type 1 units: Throughout the operating range of the power generation unit, voltage drops caused by single-phase, two phase or three-phase network faults and the subsequent voltage transient phenomena shall not cause the power generation unit to become unstable or to disconnect from the network if the voltage assumes values within the limit curves shown in Figure 11 (red for the under-voltage limit curve, blue for the over-voltage limit curve).		N/A
5.7.3.3	**Dynamic network stability for type 2 units and storage units** The following conditions apply to all type 2 power generation units and storage units: As long as the line-neutral-voltages at the generator terminals of the power generation unit or storage unit do not exceed the limit curves shown in Figure 12 (red for the under-voltage limit curve, blue for the over-voltage limit curve), both the power generation unit and the storage unit shall neither become unstable nor disconnect from the network throughout the operating range.		P
	For evaluating the curves, the smallest respective value of the line-neutral-voltages at the power generation unit or the storage unit shall be used in case of a voltage drop, and the highest respective value of the line-neutral- voltages at the power generation unit or the storage unit shall be used in case of a voltage rise. As far as the set values for the NS protection given in Table 2 (column "Inverter(s)") anticipate the requirements given in Figure 12 in certain working points, merely the checking of the set values for NS protection is required for the verification procedure.		P
	If the voltage at the generator terminals falls below < 0,8 *U*n or exceeds > 1,15 *U*n (onset of fault), type 2 power generation units and storage units shall ride through voltage drops without feeding current into the network of the network operator (limited dynamic network stability).		P

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Clause	Requirement - Test	Result - Remark	Verdict
	This requirement is deemed to be met, if the current fed in by the power generation unit(s) and/or the storage unit in any line conductor does not exceed 20 % of the rated current I_r within 60 ms and 10 % of I_r within 100 ms upon a voltage drop below 0,8 U_n or a voltage rise above 1,15 U_n.		P
	Behaviour after the end of a fault If, after the end of a fault, the network voltage resumes a value within the voltage band from –15 % U_n to +10 % U_n and the active current of the power generation unit and/or the storage unit has been reduced during the network fault, it shall, immediately after the end of the fault, be increased to its pre-fault value as quickly as possible. The transient period shall not exceed a maximum of 1 s. The reactive power supply follows 5.7.2.5 in its time-related behaviour. In case of rotating machinery, the transient period shall not exceed a maximum of 6 s. At voltages of 1,15 U_n, the power generation units and storage units shall not disconnect from the network for a period of up to 60 s after the onset of the fault. If the tripping of the self-protection of the power generation units and/or the storage unit is imminent, these units can adjust their reactive power behaviour such as to prevent self-protection tripping.		P
5.7.4	**Active power output**		P
5.7.4.1	**General** In cases where set-points are specified by a third party (e. g. direct marketing) and of network security management in accordance with 5.7.4.2, the new set-point shall be approached with the customer installation's power gradients listed below in relation to the network connection point. Implementation of those power gradients directly at the power generation units or storage units is sufficient for meeting the requirement. The following power gradients shall be observed for increasing/reducing the active power output of power generation systems (minimum technical power or 5 % P_{Amax} ↔ 100 % P_{Amax}) as well as the energy supply and consumption by storage units (5 % P_{Amax} ↔ 100 % P_{Amax}): – at a maximum rate of 0,66 % P_{Amax} per s; – at a minimum rate of 0,33 % P_{Amax} per s. Power generation systems may react more slowly in case of set-points specified by third parties and of power increases. For this purpose, a minimum rate of 4 % P_{Amax} per minute should be observed.	The active power can be remote-controlled on the communication interface	P

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Clause	Requirement - Test	Result - Remark	Verdict
	Other technically induced power gradients (e. g. for hydro power generation systems with level control depending on network demands) are permissible upon approval by the network operator. The power increase or reduction of the customer installation shall be realised in a uniform process, i. e. with a behaviour as linear as possible. The specification of set-points by third parties shall be realised on the level of the individual customer installation or by the sum of all systems accessed by a third party (e. g. by uniform distribution of the active powers to be connected or disconnected over a total period of ≥ 2,5 min).		N/A
	The power generation system or storage unit shall be provided with a logical interface (inlet port) which, irrespective of the power gradients listed above, allows to terminate the active power output within 5 s upon reception of a corresponding signal from the network operator. Additionally, the interface may be used for network security management.		P
5.7.4.2	**Network security management**		P

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Clause	Requirement - Test	Result - Remark	Verdict
5.7.4.2.1	**Types of power generation systems and storage units** If not specified otherwise by legislation, the requirements described below apply. **Photovoltaic systems** PV systems shall contribute to the avoidance of network overload. For this purpose, PV system power is divided into three power groups: – For PV systems up to and including 30 kWp, the system operator may chose between two options: a) by means of a corresponding inverter design or a certified technical control, the active power feed-in of the PV system shall be permanently limited to a maximum value of 70 % of the installed module power at the network connection point with the power gradients given in 5.7.4.1; or b) the PV system shall be provided with a technical means for remote-controlled reduction of the feedin power by the network operator. – PV systems > 30 kWp up to and including 100 kWp shall be provided with a technical means enabling the remote-controlled reduction of the feed-in power by the network operator. – PV systems > 100 kWp shall be provided with a technical means enabling the remote-controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power. If the installed total power increases to > 100 kWp due to the installation of a further PV system on the same plot or building within a period of 12 months, legal provisions require implementation of the feed-in management for systems > 100 kWp while providing the actual feed-in power for the total power..	The active power can be remote-controlled on the communication interface	P
	Cogeneration of power and heat (CHP) systems, wind, biogas, hydroelectric power as well as landfill and sewage gas systems Those PV systems with P_{Amax} > 100 kW shall be provided with a technical means enabling the remote-controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power.		N/A

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
	Storage units buffering EEG or KWKG systems Those storage units with *P*Amax > 100 kW shall be provided with a technical means enabling the remote controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power. These requirements do not apply if the feeding into the network of the network operator by a storage unit is prevented by technical control means. This shall be demonstrated by means of a manufacturer's declaration.		N/A
	Any EEG and KWKG systems with an intelligent measurement system If an intelligent measurement system is present, the network operator may demand the metering point operator to transmit network state data (i. e. also the actual feed-in power).		N/A
	Any power generation systems and storage units other than those indicated above All power generation systems and storage units shall be provided with technical means enabling the remote-controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power.		P
5.7.4.2.2	**Implementation of network security management** Power generation systems and storage units shall be able to reduce their active power to a power value predetermined by the network operator at the network connection point without disconnecting from the network. The following values have proved effective: 100 %/60 %/30 %/0 % in relation to the installed active feed-in power *P*Amax. Instead of reducing the generated active power, the consumed power of the customer installation can be increased, too. The sum of the reduced generated active power and/or the increased consumed active power at the network connection point shall not deviate by more than ± 5 % from the setpoint of active power limitation. Power reduction shall be possible for any operating state and from any operating point. In case of a redispatch, the power generation systems shall be technically capable of increasing the power to a maximum of *P*Amax upon the network operator's request.	(See appended table)	P

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Clause	Requirement - Test	Result - Remark	Verdict
5.7.4.2.3	**Active power adjustment at over-frequency and under-frequency** A network frequency outside the tolerance band of ± 200 mHz around the nominal network frequency of 50,0 Hz indicates the presence of a critical system state in the integrated network where any power generation units and storage units shall contribute to the network frequency support. The accuracy of the frequency measurement in the steady state shall be ≤ ± 10 mHz. The requirements given in 5.7.4.3 do not apply to storage units in standby mode. Additionally, DC coupled storage units shall behave as type 2 units. In case of **over-frequency**, an excess of generated power is opposed by a deficit of consumed power. Therefore, all power generation units and storage units shall be able to adjust the active power working point at an over-frequency up to a maximum of 51,5 Hz (see Figure 14 and Figure 15). Power generation units shall enable the frequency for starting this frequency-dependent active power feed-in to be set to a value between 50,2 Hz and 50,5 Hz. Unless specified otherwise by the network operator, this start frequency shall be set to 50,2 Hz. The static value of the frequency-dependent active power feed-in shall be adjustable within a range of 2 % to 12 %. This corresponds to a power gradient within a range of 16,67 % of Pref per Hertz (s = 12 %) to 100 % of Pref per Hertz (s = 2 %). Unless specified otherwise by the network operator, a gradient of 40 % of Pref per Hertz (s = 5 %) shall be set (see Figure 14). For storage units, the generated active power with a gradient of 40 % of PEmax per Hertz (s = 5 %) shall be reduced or increased (see Figure 15). Consequently, the power generation unit or the storage unit will constantly move up and down along the frequency characteristic within the frequency range of 50,2 Hz (unless specified otherwise for power generation units by the network operator) to 51,5 Hz with regard to its maximum possible active power feed-in ("operation along the characteristic").	(See appended table) The starting frequency can be set from 50.2 to 50.5Hz, And, power gradient 2%-12% adjustable Default 50.2 and power gradient 5% setting.	P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
	At frequencies below 49,8 Hz, all power generation units shall increase the instantaneous generated active power *P*mom with a gradient of 40 % *P*Emax per Hertz (*s* = 5 %) to its technically possible maximum value. For storage units, a gradient of 100 % *P*Emax per Hertz (*s* = 2 %) applies. The maximum value is determined by the actual primary energy supply as well as the actually usable storage power. Power reductions for the protection of operating equipment are permitted even at under-frequency. For CHP systems, power reductions resulting from a heat-lead operating mode or a power drop due to the rotational speed are also permitted. Storage units dedicated to other purposes (e. g. gas storage units in biogas systems, DC buffer storage elements for self-consumption etc.) should be activated for this purpose. System-integrated storage units with an energy level below *P*n × 30 s (e. g. smoothing chokes, indirect capacitors etc.) may be neglected for this application. Consequently, power generation units and storage units will constantly move up and down along the frequency characteristic also within the frequency range of 49,8 Hz to 47,5 Hz or 47,8 Hz with regard to their maximum possible active power feed-in (“operation along the characteristic”). At an under-frequency within the range of 49,8 Hz to 47,5 Hz, all storage units in charging mode shall reduce their instantaneous charging power according to the characteristic curve shown in Figure 15 to its technically possible minimum value (“operation along the characteristic”). In addition, storage units, as far as their charging state permits, shall change into the operating mode “energy supply” and increase their power according to the characteristic curve shown in Figure 15. In this case, system stability is of higher priority than a potential restraint for feeding storage energy into the network of the network operator based on technical/financial requirements. At network frequencies *f* < 47,5 Hz, power generation units and storage units shall disconnect from the network (see Figure 14 and Figure 15).	PV Inverter, a gradient of 40 % *P*Emax per Hertz (*s* = 5 %) applies (See appended table)	P

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Clause	Requirement - Test	Result - Remark	Verdict
	Requirements for the control times for power generation units and storage units The initial time delay *T*V of the frequency-dependent adjustment of the active power output at over-frequency and under-frequency is part of the transient period and shall preferably be ≤ 2 s. In case of a time delay > 2 s, the operator of the power generation system shall justify that delay by submitting technical proof to the transmission network operator. For type 2 power generation units and storage units, the necessary initial time delays *T*V for reaching the required transient periods are significantly shorter than 2 s. For the time curve of the frequency-dependent active power adjustment, the following conditions regarding the initial time delay *T*V and the transient period *T*an_90 % shall be observed: – After *T*V + 0,1 × (*T*an_90 % – *T*V) has elapsed, a value of at least 9 % of the required power adjustment Δ*P* has been reached. – After the transient period *T*an_90 % has elapsed, a value of 90 % of the power adjustment Δ*P* has been reached.		P
	During the control process ("operation along the characteristic"), the power generation unit and the storage unit shall respond as quickly as possible to sudden network frequency changes within a frequency range of 50,2 Hz to 51,5 Hz (subject to capability as declared by the manufacturer) with a transient period of 8 s for Δ*P* ≤ 45 % of *P*Emax and Δ*P* for power changes beyond that in case of type 1 units and type 2 units with rotating machinery and 2 s in case of all other type 2 power generation units and 1 s in case of storage units. The settling period shall not exceed 30 s for type 1 units and type 2 units with rotating machinery or 20 s for all other type 2 power generation units and for storage units. After settling, the supplied active power should deviate by ≤ ± 10 % *P*Emax from the set-point. The same requirements shall be applied to the active power increase at an under-frequency between 49,8 Hz and 47,5 Hz.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Conditional requirements based on technical restrictions As an alternative to active power reduction at over-frequency, non-controllable power generation units may disconnect from the network within the frequency range of 50,2 Hz to 51,5 Hz; in that case, uniform distribution of the disconnection frequency in maximum increments of 0,1 Hz shall be ensured for each system type by the manufacturer. Power generation units of limited variability, e. g. only within the range of 70 % to 100 % *P*Emax, can be curtailed within that range in accordance with the characteristic curve. Outside the controllable range, disconnection is then carried out according to the uniformly distributed shut-down limit curve. For power generation units with combustion engines or gas turbines, active power reduction occurs with a power gradient of at least 66 % *P*Emax per minute (equals 1,11 % *P*Emax per second). Thus, the transient period of 8 s can be observed up to a power reduction of 8,88 % *P*Emax. In case of a greater change of frequency, the transient period is accordingly higher. Linear generators, such as stirling machines up to a maximum apparent power of *S*Amax ≤ 4,6 kVA, are exempt from the active power feed-in at over/under-frequency. They may remain connected to the network within a frequency range between 50,2 Hz and their maximum upper frequency limit and may disconnect from the network if this value is exceeded or, at the latest, when a frequency of 51,5 Hz is reached or exceeded. At an under-frequency between 49,8 Hz and their maximum lower frequency limit, linear generators should remain connected to the network but shall disconnect from it at the latest when a frequency of 47,5 Hz is reached or exceeded.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	End of critical network state and return to normal operation Even if the network frequency has resumed a value within the tolerance band of 50,0 Hz ± 200 mHz after a frequency deviation, a critical network state has still to be assumed initially. The time for transition from the critical network state to normal operation is limited by a maximum change of the active power set-point based on *P*mom. This change of the active power set-point (except for providing the operating reserve) shall be limited to a maximum gradient of 10 % of the active power *P*Emax per minute (under consideration of 5.7.1). Only after the network frequency has been within the tolerance band of 50,0 Hz ± 200 mHz for 10 min continuously, the normal operation of the network is deemed to be restored whereupon this requirement does no longer apply.		P
5.7.4.4	**Voltage-dependent active power reduction** In order to avoid disconnection of the power generation system due to over-voltage protection *U* >, it is permissible to reduce the active power feed-in as a function of the voltage of (a) power generation unit(s). Implementation is then chosen by the system manufacturer. This is not considered an active power reduction in the context of feed-in management in compliance with EEG. Surges or oscillations of the active power feed-in are not permitted for that purpose.		N/A
5.7.5	**Short-circuit contribution** Due to the operation of a power generation system, the short-circuit current of the low-voltage network is increased by the short-circuit current of the power generation system. Therefore, the short-circuit current of the power generation system to be expected at the network connection point shall be indicated in accordance with 4.2. For the determination of the initial short-circuit AC current contribution *I*kA of a power generation system, the following roughly estimated values can be assumed: – for synchronous generators: 8 times the rated current; – for asynchronous generators: 6 times the rated current; – for generators and storage units with inverters: the rated current. If the power generation system causes a short-circuit current increase in the network operator's network in excess of the rated value, then connection owner and network operator shall agree upon appropriate measures limiting the short-circuit current from the power generation system accordingly.		P

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
6	**Construction of the power generation system/network and system protection (NS protection)**		N/A
6.1	**General requirements** The network and system protection (NS protection) is a type-tested protective device with a NS protection certificate (see Form E.6) wherein all protective functions specified in 6.5 are installed. The NS protection acts on the interface switch in accordance with 6.4. Depending on the sum of the maximum apparent powers of all power generation systems and storage units connected to the same network connection pointΣS_{Amax} , the following conditions apply to the NS protection:	Shall install outside	N/A
6.2	**Central NS protection** The central NS protection shall be accommodated, installed and connected as an independent equipment at the central meter panel in a suitable circuit distributor in accordance with VDE-AR-N 4100, Clause 8, Paragraph 1, and not in the upper connection compartment according to VDE-AR-N 4100, 7.2, Paragraph 11. Examples of the arrangement of the central NS protection and hence the connection of power generation systems to meter panels are shown in Annex C. For central NS protection, it is additionally required to carry out a trigger test for checking the tripping circuit “NS protection – interface switch”. For this purpose, the central NS protection is provided with a means for tripping the interface switch (e. g. by means of a test button) for testing purposes. Activation shall be visualised at the interface switch.	Shall install outside	N/A
6.3	**Integrated NS protection** In the case of integrated NS protection, the NS protection can be integrated in the programmable system control of the power generation units (e. g. in the inverter control). In this case, the means for testing the tripping circuit “NS protection – interface switch” by the system installer is not required. The integrated NS protection acts on an integrated interface switch (see 6.4.3).		N/A
6.4	**Interface switch**		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
6.4.1	**General** For the connection of the power generation system to the network operator's low-voltage network or to the remaining customer installation, an interface switch shall be used. The interface switch is controlled by the NS protection and automatically triggers if at least one protective function responds. As interface switches, the switching devices of the individual power generation units (integrated interface switch) can be used. The integrated interface switches can also be used in combination with the central NS protection. In any case, central NS protection from Σ*S*Amax>30 kVA (sum of the maximum apparent powers of all power generation systems and storage units connected to the same network connection point; for exceptions, see 6.1) shall be directly connected to the central meter panel. Where a signal is routed to a spatially separate switching device, it shall be ensured that the required disconnection periods given in Table 2 are observed and lead to the disconnection of the power generation system. During commissioning of the power generation system, a tripping test of the interface switch shall be conducted. The interface switch shall be designed for the rated conditional short-circuit current and under consideration of the protective devices required according to 6.5 and it shall enable instantaneous tripping. The switching capacity of the interface switch shall be rated according to the rated current of the upstream fuse or the maximum initial short-circuit AC current contribution of the power generation system, whichever is the higher. The functional check of the interface switch shall be carried out according to a) or b) or c): a) by using an interface switch which, in its active state, requires a control voltage to be applied continuously and which disconnects automatically when this voltage is no longer applied. The operational connection and disconnection processes shall be monitored; b) by connection and disconnection of the interface switch via the NS protection and monitoring its proper functioning (e. g. break contact of a monitoring contact) at least once daily; c) by using the integrated interface switch and the integrated NS protection for PV and battery inverters in compliance with DIN EN 62109 (VDE 0126-14). When a defect of the interface switch is detected, the power generation system shall neither feed in nor reconnect.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict

6.4.2	**Central interface switch** The central interface switch shall be a galvanic break device (e. g. mechanical contactor, protective motor switch, mechanical circuit breaker). For a power generation system required to contribute to the dynamic network stability, an interface switch enabling compliance with the requirements specified in 5.7.3 (no malfunction at under-voltage in the context of the FRT requirements) shall be used. The interface switch shall be installed in the distribution field of or directly at the central meter panel in a circuit distributor. Examples of the arrangement of interface switches and hence the connection of power generation systems to meter panels are shown in Annex C.		N/A
6.4.3	**Integrated interface switch** For the construction of the interface switch, the requirements specified in 6.1 shall be considered. The interface switch (e. g. power relay, mechanical contactor, mechanical circuit-breaker, etc.) ensures galvanic breaking. For power generation systems with inverters, the interface switch shall be provided on the inverter’s network side.		N/A
6.5	**Protective devices and protection settings**		N/A
6.5.1	**General** The purpose of NS protection is to disconnect the power generation system from the network in the event of inadmissible voltage and frequency values (also refer to DIN VDE 0100-551 (VDE 0100-551)). This is meant to prevent inadvertent feed-in from the power generation system into a partial network separated from the main distribution network.		N/A
6.5.2	**Protective functions** The NS protection shall be provided with a means for preventing unauthorised access (z. B. sealable, password protection). The rise-in-voltage protection $U >$ shall be designed such as to be adjustable in the NS protection (see Table 2, Footnote b). Additionally, the time delay of the voltage drop protection $U <$ and $U <<$ for directly coupled synchronous and asynchronous generators with Pn > 50 kW shall also be designed such as to be adjustable in the NS protection (see Table 2, Footnote d). Any other protective functions listed in 6.5.1 are either to be installed permanently, i. e. not adjustable, in the NS protection or to be provided with an additional separate protection against unauthorised access (e. g. password protection) for preventing modifications.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
6.5.3	**Islanding detection**		N/A
6.6	**Further requirements for power generation systems**	Shall be considered in PGS	N/A
7	**Metering for billing purposes**		N/A
8	**Operation of the system**		P
8.1	**General**		P
8.2	**Special aspects of the management of the network operator's network**		N/A
8.3	**Connection conditions and synchronisation**		P
8.3.1	**General** Power generation systems and storage units shall be connected to the network operator's network only if a suitable device determines that both the mains voltage and the mains frequency are within the tolerance range of 85 % U_n to 110 % U_n or 47,5 Hz to 50,1 Hz, respectively, for a period of at least 60 seconds. Additionally, the delay times for the reconnection of a generator and the staggered times applicable when connecting several generators shall be sufficient for safely finishing any control and adjustment processes within the power generation system and/or the storage unit caused by the connection. In case of power generation systems and storage units being reconnected to the network operator's network at the tripping of the NS protective device or the $P_{AV, E}$ monitoring, the active power of controllable power generation systems and storage units supplied to the network operator's network shall not exceed the gradient of 10 % of the active power P_{Amax} per minute. Non-controllable power generation systems and storage units can connect after 1 min to 10 min (random generator) or later.	(See appended table)	P
8.3.2	**Connection of synchronous generators**		N/A
8.3.3	**Connection of asynchronous generators**		N/A
8.3.4	**Connection of power generation units and storage units with inverters** Power generation units with inverters (such as photovoltaic systems) and storage units with inverters shall only be connected with $k_{imax} \leq 1,2$.		P
8.4	**Special aspects regarding the planning, installation and operation of power generation systems and storage units each with PAmax ≥ 135 kW**		N/A
9	**Verification of electrical properties**		P

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Clause	Requirement - Test	Result - Remark	Verdict

	Annex A: Explanations (informative)	

	Annex B: Connection examples and measurement strategies (informative)	

	Annex C: Examples of meter panel configurations (informative)	

	Annex D: Examples for the connection evaluation of power generation systems - Connection of a 20 kW PV system (informative)	

	Annex E: Forms (mandatory)	**P**
E.1	Application procedure	N/A
E.2	Data sheet for power generation systems	N/A
E.3	Data sheet for storage units	N/A
E.4	Unit certificate	P
E.5	Test report “Network interactions” for power generation units with an input current > 75 A	P
E.6	Certificate of the network and system protection	N/A
E.7	Requirements for the test report for the NS protection	N/A
E.8	Commissioning protocol for power generation systems and/or storage units	N/A
E.9	Type approval procedure	N/A

Appended Table - Testing Result

5.2.2	TABLE: Rapid voltage change				**P**
Starting at 10% of rate power					
Condition	Operating tests				
	Frequency [Hz]	Voltage [V]	Current [A]	Ki	
Test 1: cosφ=1	50	229.4	7.37	0.056	
Test 2: cosφ=Max over-excited	50	229.1	8.48	0.053	
Test 3: cosφ=Max under-excited	50	229.4	9.34	0.058	
Maximum inrush current factor k_{imax}	0.058				
Starting at 100% of rate power					
Condition	Operating tests				
	Frequency [Hz]	Voltage [V]	Current [A]	Ki	
Test 1: cosφ=1	50	229.0	9.54	0.060	
Test 2: cosφ=Max over-excited	50	228.6	8.04	0.050	
Test 3: cosφ=Max under-excited	50	228.2	8.65	0.054	
Maximum inrush current factor k_{imax}	0.060				
Service disconnection at rated power					
Condition	Operating tests				
	Frequency [Hz]	Voltage [V]	Current [A]	Ki	
Test 1: cosφ=1	50	145.9	90.59	0.568	
Test 2: cosφ=Max over-excited	50	149.1	92.85	0.582	
Test 3: cosφ=Max under-excited	50	135.3	84.27	0.529	
Maximum inrush current factor k_{imax}	0.582				
Worst-case over-all switching operations, k_{imax}	0.582				
Note: 1) 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.					

Switching actions	Ki
Marking operation without default (to primary energy carrier)	0.058
Worst case at switch over of generator sections	0.582
Marking operation at reference conditions (of primary energy carrier)	0.060
Breaking operation at nominal power	0.582
Worst case value of all switching operations Ki max	0.582

5.2.3	TABLE: Flicker			P
Model: iMars XG100KTR				
Grid impedance angle, ψ_K	30	50	70	85
Power level [%P_n]	Flicker coefficient, c(ψ_K)			
0 – 5	5.26	5.42	4.74	4.94
10	5.42	5.68	5.62	5.70
20	5.58	5.44	5.28	5.06
30	4.96	4.90	5.12	4.34
40	5.08	5.06	4.98	5.26
50	5.60	5.52	5.86	5.16
60	4.26	4.14	3.84	4.82
70	4.48	4.76	4.36	4.58
80	4.38	4.64	4.44	5.26
90	5.32	5.14	5.20	5.62
100	5.54	5.60	5.38	5.48
Max. flicker coefficient, c(ψ_K)	5.60	5.68	5.86	5.70
Max. Short-term flicker, P_{st}	0.280	0.284	0.293	0.285
Max. long-term flicker, P_{lt}	0.272	0.279	0.271	0.281
Reactive power setpoint during testing [Kvar]	0			
Ratio $S_{k.fic}$/Sn in the fictitious grid used for analysis	20			

5.2.3	TABLE: Flicker			P
Model: iMars XG110KTR				
Grid impedance angle, ψ_K	30	50	70	85
Power level [% P_n]	Flicker coefficient, $c(\psi_K)$			
0 – 5	5.22	4.28	6.30	5.56
10	6.16	5.82	6.64	6.34
20	4.46	4.98	5.58	5.06
30	6.74	6.64	6.56	5.62
40	5.48	5.52	7.38	6.54
50	3.86	4.26	5.86	6.82
60	5.96	6.68	6.82	6.74
70	6.64	6.18	6.28	7.22
80	5.60	4.86	7.56	7.42
90	4.18	4.36	7.50	7.84
100	6.02	5.52	7.36	7.10
Max. flicker coefficient, $c(\psi_K)$	6.74	6.68	7.56	7.84
Max. Short-term flicker, P_{st}	0.337	0.334	0.378	0.392
Max. long-term flicker, P_{lt}	0.274	0.283	0.261	0.286
Reactive power setpoint during testing [Kvar]	0			
Ratio $S_{k.fic}/Sn$ in the fictitious grid used for analysis	20			

5.2.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: iMars XG100KTR	P

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.0771	0.0575	0.0305	0.1244	0.0454	0.0354	0.0985	0.0751	0.0756	0.0874	0.0794
3	0.4797	0.6522	0.6792	0.6172	0.6075	0.3512	0.4066	0.4084	0.4523	0.4741	0.4814
4	0.0290	0.0474	0.0322	0.0350	0.0484	0.1044	0.1334	0.1521	0.1405	0.1486	0.1961
5	0.3584	0.2686	0.3256	0.3004	0.3004	0.3525	0.3505	0.3290	0.3044	0.3284	0.3281
6	0.0307	0.0382	0.0320	0.0322	0.0542	0.0776	0.0603	0.0655	0.0515	0.0534	0.0836
7	0.2483	0.2257	0.2084	0.1893	0.1174	0.2123	0.2166	0.2132	0.2162	0.2143	0.2042
8	0.0169	0.0674	0.0483	0.0606	0.0411	0.0321	0.0306	0.0363	0.0376	0.0401	0.0550
9	0.0884	0.3082	0.3113	0.2855	0.3522	0.2370	0.2293	0.2292	0.2276	0.2182	0.2096
10	0.0084	0.0335	0.0325	0.0385	0.0855	0.0482	0.0482	0.0566	0.0640	0.0721	0.0831
11	0.0149	0.0773	0.0473	0.3011	0.2471	0.1505	0.3241	0.4123	0.4414	0.4421	0.4641
12	0.0077	0.0902	0.1005	0.0955	0.0916	0.0991	0.0986	0.0984	0.1004	0.0970	0.0981
13	0.0201	0.1976	0.3273	0.0723	0.1476	0.0656	0.2005	0.2835	0.3323	0.3585	0.3844
14	0.0063	0.0633	0.0385	0.0412	0.0543	0.0326	0.0513	0.0792	0.0833	0.0864	0.0853
15	0.0184	0.1225	0.1021	0.1015	0.2543	0.1156	0.0766	0.0456	0.0431	0.0432	0.0613
16	0.0050	0.0562	0.0370	0.0526	0.0546	0.0365	0.0321	0.0453	0.0606	0.0656	0.0691
17	0.0075	0.1393	0.0621	0.3205	0.0626	0.0532	0.1734	0.3146	0.3775	0.3931	0.3956
18	0.0043	0.0521	0.0603	0.0630	0.0463	0.0631	0.0516	0.0611	0.0792	0.0834	0.0912
19	0.0043	0.2184	0.2180	0.2703	0.0995	0.0432	0.1474	0.2294	0.2942	0.3174	0.3321
20	0.0036	0.0555	0.0801	0.0992	0.1103	0.0694	0.0775	0.0556	0.0541	0.0672	0.0820
21	0.0105	0.2993	0.1995	0.2962	0.1844	0.0850	0.0973	0.1366	0.1754	0.2072	0.2483
22	0.0017	0.0932	0.0906	0.1060	0.0904	0.0604	0.0651	0.0585	0.0710	0.1004	0.1320
23	0.0067	0.1563	0.1783	0.2021	0.2723	0.1421	0.1266	0.2102	0.3594	0.4776	0.5535
24	0.0020	0.0896	0.1195	0.1391	0.1244	0.0892	0.0844	0.0894	0.1085	0.1170	0.1296
25	0.0025	0.1675	0.3795	0.2301	0.3852	0.1840	0.1584	0.1801	0.2541	0.3401	0.4186
26	0.0018	0.0797	0.1006	0.1182	0.1273	0.1231	0.1261	0.1274	0.1345	0.1342	0.1346
27	0.0035	0.1033	0.2066	0.1834	0.2941	0.0944	0.0970	0.1092	0.1146	0.1425	0.1673
28	0.0021	0.0618	0.0655	0.0923	0.0893	0.0881	0.0921	0.1351	0.1334	0.1344	0.1271
29	0.0037	0.1494	0.2452	0.1254	0.2106	0.3630	0.2426	0.2450	0.2901	0.3985	0.4623
30	0.0008	0.0673	0.0715	0.0834	0.0784	0.0771	0.0926	0.1066	0.1090	0.1393	0.1425
31	0.0008	0.0792	0.0841	0.1731	0.0992	0.2566	0.1572	0.1633	0.2464	0.3060	0.3571
32	0.0006	0.0636	0.0631	0.0596	0.0612	0.0611	0.0584	0.0543	0.0726	0.0776	0.0840
33	0.0015	0.1133	0.0493	0.2193	0.0851	0.1073	0.0623	0.0655	0.0884	0.0986	0.1075
34	0.0007	0.0362	0.0333	0.0392	0.0420	0.0463	0.0495	0.0504	0.0535	0.0716	0.0756
35	0.0020	0.0566	0.0390	0.1165	0.0655	0.2433	0.1463	0.1221	0.1821	0.1871	0.1911
36	0.0005	0.0472	0.0505	0.0445	0.0542	0.0540	0.0492	0.0480	0.0524	0.0616	0.0646
37	0.0007	0.0553	0.0683	0.0806	0.0653	0.1161	0.1116	0.0565	0.0905	0.0986	0.0976
38	0.0003	0.0272	0.0276	0.0230	0.0273	0.0280	0.0353	0.0283	0.0301	0.0345	0.0326
39	0.0005	0.0314	0.0356	0.0244	0.0296	0.0240	0.0321	0.0355	0.0283	0.0361	0.0426
40	0.0003	0.0214	0.0223	0.0222	0.0296	0.0261	0.0251	0.0281	0.0282	0.0302	0.0251

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)									
Model: iMars XG100KTR										
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	0.0845	0.0738	0.1035	0.1022	0.1007	0.1076	0.1044	0.1051	0.1139	0.1082	0.0087
125	0.0317	0.0268	0.0322	0.0330	0.0348	0.0362	0.0352	0.0355	0.0396	0.0369	0.0071
175	0.0245	0.0215	0.0270	0.0268	0.0288	0.0303	0.0294	0.0308	0.0329	0.0323	0.0074
225	0.0238	0.0294	0.0287	0.0277	0.0277	0.0291	0.0291	0.0303	0.0313	0.0318	0.0096
275	0.0214	0.0303	0.0270	0.0266	0.0277	0.0293	0.0287	0.0299	0.0316	0.0306	0.0160
325	0.0146	0.0186	0.0238	0.0243	0.0254	0.0265	0.0264	0.0271	0.0288	0.0289	0.0091
375	0.0121	0.0190	0.0232	0.0242	0.0243	0.0255	0.0260	0.0264	0.0283	0.0288	0.0095
425	0.0093	0.0207	0.0229	0.0234	0.0235	0.0246	0.0248	0.0258	0.0273	0.0282	0.0085
475	0.0079	0.0212	0.0232	0.0237	0.0241	0.0252	0.0259	0.0262	0.0282	0.0288	0.0090
525	0.0088	0.0244	0.0316	0.0299	0.0313	0.0330	0.0340	0.0349	0.0371	0.0376	0.0105
575	0.0089	0.0291	0.0370	0.0371	0.0358	0.0383	0.0388	0.0410	0.0421	0.0425	0.0151
625	0.0077	0.0282	0.0339	0.0332	0.0340	0.0356	0.0367	0.0381	0.0398	0.0409	0.0108
675	0.0058	0.0247	0.0316	0.0306	0.0312	0.0329	0.0344	0.0357	0.0366	0.0374	0.0098
725	0.0038	0.0214	0.0244	0.0252	0.0255	0.0273	0.0280	0.0298	0.0310	0.0310	0.0086
775	0.0033	0.0202	0.0249	0.0253	0.0260	0.0271	0.0284	0.0297	0.0304	0.0314	0.0074
825	0.0030	0.0224	0.0255	0.0261	0.0270	0.0286	0.0299	0.0307	0.0320	0.0334	0.0098
875	0.0028	0.0230	0.0258	0.0267	0.0275	0.0293	0.0305	0.0315	0.0329	0.0341	0.0116
925	0.0026	0.0229	0.0267	0.0288	0.0305	0.0312	0.0316	0.0327	0.0342	0.0355	0.0090
975	0.0023	0.0241	0.0274	0.0292	0.0309	0.0314	0.0322	0.0341	0.0361	0.0373	0.0120
1025	0.0022	0.0229	0.0268	0.0290	0.0303	0.0313	0.0335	0.0356	0.0380	0.0403	0.0100
1075	0.0021	0.0233	0.0289	0.0315	0.0333	0.0339	0.0359	0.0384	0.0421	0.0445	0.0090
1125	0.0031	0.0351	0.0448	0.0479	0.0503	0.0506	0.0533	0.0577	0.0611	0.0647	0.0140
1175	0.0032	0.0393	0.0511	0.0558	0.0570	0.0585	0.0604	0.0661	0.0722	0.0768	0.0198
1225	0.0030	0.0409	0.0472	0.0515	0.0544	0.0573	0.0618	0.0668	0.0737	0.0800	0.0144
1275	0.0022	0.0340	0.0386	0.0431	0.0459	0.0480	0.0509	0.0550	0.0611	0.0693	0.0156
1325	0.0014	0.0241	0.0257	0.0297	0.0315	0.0330	0.0363	0.0401	0.0455	0.0514	0.0112
1375	0.0012	0.0226	0.0236	0.0269	0.0295	0.0300	0.0320	0.0354	0.0398	0.0453	0.0093
1425	0.0010	0.0226	0.0226	0.0259	0.0279	0.0286	0.0304	0.0331	0.0360	0.0402	0.0126
1475	0.0009	0.0222	0.0213	0.0242	0.0266	0.0269	0.0283	0.0301	0.0326	0.0363	0.0185
1525	0.0008	0.0214	0.0202	0.0232	0.0249	0.0258	0.0265	0.0281	0.0300	0.0332	0.0124
1575	0.0008	0.0205	0.0187	0.0213	0.0223	0.0229	0.0237	0.0255	0.0269	0.0298	0.0187
1625	0.0007	0.0187	0.0168	0.0192	0.0205	0.0202	0.0213	0.0229	0.0245	0.0268	0.0147
1675	0.0006	0.0182	0.0166	0.0178	0.0192	0.0195	0.0200	0.0208	0.0222	0.0245	0.0104
1725	0.0007	0.0206	0.0205	0.0213	0.0228	0.0228	0.0233	0.0234	0.0243	0.0258	0.0229
1775	0.0007	0.0235	0.0221	0.0234	0.0253	0.0250	0.0251	0.0257	0.0266	0.0281	0.0169
1825	0.0006	0.0226	0.0216	0.0226	0.0241	0.0242	0.0241	0.0254	0.0259	0.0274	0.0122
1875	0.0005	0.0177	0.0165	0.0173	0.0190	0.0192	0.0195	0.0201	0.0212	0.0224	0.0123
1925	0.0004	0.0131	0.0115	0.0121	0.0131	0.0132	0.0136	0.0140	0.0149	0.0158	0.0089
1975	0.0003	0.0123	0.0103	0.0108	0.0116	0.0118	0.0124	0.0126	0.0132	0.0141	0.0079

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG100KTR											
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	0.0008	0.0626	0.0434	0.0462	0.0531	0.0573	0.0592	0.0564	0.0575	0.0648	0.0785
2.3	0.0006	0.0280	0.0480	0.0371	0.0452	0.0474	0.0441	0.0433	0.0421	0.0448	0.0490
2.5	0.0005	0.0341	0.0322	0.0354	0.0410	0.0377	0.0365	0.0388	0.0420	0.0503	0.0638
2.7	0.0005	0.0491	0.0392	0.0289	0.0281	0.0282	0.0312	0.0325	0.0374	0.0424	0.0523
2.9	0.0004	0.0188	0.0310	0.0239	0.0188	0.0210	0.0235	0.0241	0.0261	0.0293	0.0350
3.1	0.0004	0.0287	0.0330	0.0473	0.0405	0.0346	0.0385	0.0378	0.0403	0.0426	0.0451
3.3	0.0004	0.0280	0.0265	0.0314	0.0390	0.0307	0.0305	0.0307	0.0308	0.0295	0.0301
3.5	0.0003	0.0202	0.0255	0.0243	0.0280	0.0297	0.0272	0.0252	0.0276	0.0287	0.0277
3.7	0.0003	0.0232	0.0244	0.0241	0.0319	0.0388	0.0335	0.0295	0.0315	0.0329	0.0330
3.9	0.0003	0.0262	0.0255	0.0316	0.0275	0.0333	0.0323	0.0323	0.0334	0.0369	0.0372
4.1	0.0003	0.0167	0.0160	0.0164	0.0222	0.0179	0.0194	0.0205	0.0207	0.0236	0.0261
4.3	0.0003	0.0215	0.0292	0.0209	0.0318	0.0287	0.0308	0.0325	0.0322	0.0363	0.0379
4.5	0.0003	0.0199	0.0172	0.0215	0.0241	0.0257	0.0272	0.0281	0.0273	0.0287	0.0311
4.7	0.0002	0.0184	0.0207	0.0225	0.0202	0.0218	0.0216	0.0222	0.0238	0.0257	0.0269
4.9	0.0002	0.0215	0.0283	0.0222	0.0258	0.0278	0.0295	0.0309	0.0333	0.0350	0.0367
5.1	0.0002	0.0210	0.0205	0.0239	0.0233	0.0237	0.0252	0.0270	0.0284	0.0298	0.0296
5.3	0.0002	0.0225	0.0192	0.0248	0.0232	0.0224	0.0264	0.0258	0.0271	0.0283	0.0323
5.5	0.0002	0.0184	0.0236	0.0210	0.0238	0.0245	0.0279	0.0282	0.0315	0.0361	0.0402
5.7	0.0002	0.0239	0.0248	0.0274	0.0295	0.0310	0.0317	0.0331	0.0355	0.0374	0.0396
5.9	0.0002	0.0431	0.0455	0.0464	0.0472	0.0472	0.0484	0.0511	0.0511	0.0519	0.0550
6.1	0.0002	0.0283	0.0313	0.0302	0.0400	0.0384	0.0425	0.0470	0.0485	0.0488	0.0526
6.3	0.0002	0.0352	0.0350	0.0399	0.0423	0.0444	0.0471	0.0474	0.0454	0.0457	0.0482
6.5	0.0002	0.0334	0.0290	0.0353	0.0433	0.0419	0.0430	0.0447	0.0466	0.0482	0.0510
6.7	0.0002	0.0257	0.0256	0.0281	0.0406	0.0412	0.0450	0.0491	0.0504	0.0504	0.0547
6.9	0.0002	0.0323	0.0283	0.0352	0.0480	0.0569	0.0596	0.0623	0.0646	0.0618	0.0655
7.1	0.0002	0.0254	0.0321	0.0321	0.0442	0.0533	0.0635	0.0665	0.0664	0.0633	0.0636
7.3	0.0002	0.0171	0.0191	0.0233	0.0282	0.0376	0.0472	0.0604	0.0753	0.0808	0.0781
7.5	0.0002	0.0165	0.0174	0.0195	0.0239	0.0308	0.0385	0.0495	0.0767	0.1311	0.1537
7.7	0.0002	0.0155	0.0162	0.0176	0.0230	0.0283	0.0346	0.0423	0.0676	0.1199	0.1450
7.9	0.0001	0.0130	0.0125	0.0125	0.0173	0.0202	0.0252	0.0299	0.0382	0.0444	0.0513
8.1	0.0001	0.0135	0.0149	0.0149	0.0190	0.0218	0.0223	0.0242	0.0263	0.0294	0.0343
8.3	0.0001	0.0123	0.0139	0.0131	0.0162	0.0154	0.0175	0.0185	0.0198	0.0229	0.0290
8.5	0.0001	0.0088	0.0084	0.0091	0.0107	0.0112	0.0119	0.0125	0.0134	0.0146	0.0174
8.7	0.0001	0.0098	0.0103	0.0099	0.0112	0.0106	0.0112	0.0116	0.0129	0.0148	0.0187
8.9	0.0001	0.0088	0.0084	0.0091	0.0107	0.0106	0.0112	0.0125	0.0129	0.0148	0.0174

Note:
The reference current I_n is 144.9 A.
The stated harmonics are maximum values of all 3 phases.
The unit complies with DIN EN 61000-3-12 (VDE 0838-12). Measurement results given above in consideration of customer installation with multiple units with rated current >75A.

5.2.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: iMars XG100KTR-F	P

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.0492	0.0812	0.0231	0.1349	0.0448	0.0283	0.1150	0.0912	0.0433	0.0579	0.0538
3	0.4149	0.4590	0.8623	0.5376	0.4076	0.3894	0.4950	0.4070	0.5861	0.5947	0.5992
4	0.0334	0.0696	0.0206	0.0314	0.0572	0.0660	0.1602	0.2000	0.1259	0.0949	0.1948
5	0.2759	0.2734	0.3227	0.2833	0.4353	0.4022	0.2339	0.4771	0.2687	0.2793	0.2726
6	0.0196	0.0265	0.0171	0.0406	0.0791	0.0951	0.0424	0.0565	0.0715	0.0686	0.1133
7	0.1962	0.2908	0.2302	0.1683	0.1101	0.1599	0.2300	0.1295	0.2497	0.2074	0.2697
8	0.0093	0.0887	0.0667	0.0831	0.0355	0.0373	0.0349	0.0523	0.0260	0.0469	0.0325
9	0.0545	0.2442	0.3650	0.3369	0.2199	0.2287	0.2313	0.1613	0.1504	0.2324	0.3133
10	0.0111	0.0297	0.0436	0.0517	0.1063	0.0460	0.0440	0.0827	0.0483	0.0865	0.0792
11	0.0110	0.0537	0.0251	0.3985	0.3309	0.2184	0.4796	0.3111	0.3488	0.3998	0.3705
12	0.0050	0.1328	0.0615	0.1339	0.1112	0.0875	0.0958	0.1162	0.0962	0.0911	0.1014
13	0.0134	0.2157	0.2827	0.0611	0.1181	0.0643	0.1396	0.2657	0.2654	0.4751	0.2271
14	0.0057	0.0698	0.0364	0.0479	0.0749	0.0245	0.0663	0.0592	0.0862	0.0632	0.1092
15	0.0175	0.1441	0.1086	0.0553	0.2266	0.1342	0.0441	0.0513	0.0393	0.0388	0.0900
16	0.0027	0.0448	0.0241	0.0439	0.0431	0.0346	0.0453	0.0354	0.0312	0.0771	0.0805
17	0.0043	0.0952	0.0444	0.4500	0.0386	0.0534	0.1938	0.4434	0.2362	0.2195	0.5109
18	0.0053	0.0718	0.0893	0.0912	0.0435	0.0944	0.0329	0.0679	0.1160	0.1043	0.1098
19	0.0037	0.2332	0.1133	0.3979	0.1134	0.0445	0.0863	0.1256	0.2736	0.4092	0.2208
20	0.0041	0.0751	0.0548	0.0646	0.1369	0.0753	0.0617	0.0466	0.0678	0.0576	0.0913
21	0.0077	0.3433	0.2960	0.2916	0.1952	0.0786	0.1456	0.2037	0.1976	0.1326	0.1555
22	0.0012	0.1050	0.1086	0.1046	0.0670	0.0694	0.0542	0.0463	0.0538	0.0570	0.1697
23	0.0061	0.1401	0.2108	0.1136	0.1557	0.1097	0.1880	0.1752	0.2722	0.2682	0.6232
24	0.0015	0.1004	0.0894	0.0839	0.0743	0.1151	0.1108	0.1165	0.1386	0.1272	0.1850
25	0.0021	0.1658	0.4309	0.1755	0.1947	0.1588	0.1391	0.2662	0.2289	0.3365	0.5275
26	0.0020	0.0710	0.0550	0.0915	0.1512	0.0989	0.1615	0.0910	0.1325	0.0779	0.1335
27	0.0045	0.0769	0.1396	0.1229	0.2620	0.0857	0.1421	0.1097	0.0719	0.1995	0.2325
28	0.0025	0.0767	0.0651	0.1064	0.0721	0.1254	0.0692	0.0918	0.1303	0.1073	0.0814
29	0.0022	0.1790	0.2050	0.1628	0.2518	0.4703	0.1972	0.2345	0.2841	0.4442	0.3588
30	0.0010	0.0661	0.0384	0.1042	0.0732	0.0606	0.0507	0.1237	0.1359	0.0857	0.0930
31	0.0008	0.0661	0.1230	0.0976	0.1060	0.1611	0.1723	0.1121	0.3541	0.1626	0.1866
32	0.0005	0.0571	0.0400	0.0883	0.0904	0.0744	0.0313	0.0661	0.0967	0.0705	0.0621
33	0.0020	0.0969	0.0624	0.1346	0.0994	0.0590	0.0646	0.0833	0.1068	0.1320	0.1240
34	0.0008	0.0348	0.0451	0.0261	0.0419	0.0261	0.0493	0.0719	0.0744	0.0430	0.0887
35	0.0020	0.0334	0.0248	0.1230	0.0644	0.3351	0.1756	0.1399	0.2134	0.2258	0.1271
36	0.0006	0.0523	0.0723	0.0633	0.0579	0.0792	0.0544	0.0291	0.0489	0.0430	0.0918
37	0.0007	0.0489	0.0795	0.0545	0.0535	0.1239	0.0994	0.0565	0.0682	0.1419	0.0941
38	0.0002	0.0281	0.0353	0.0325	0.0336	0.0180	0.0455	0.0422	0.0159	0.0252	0.0421
39	0.0004	0.0284	0.0510	0.0246	0.0411	0.0159	0.0243	0.0361	0.0159	0.0489	0.0369
40	0.0004	0.0274	0.0112	0.0137	0.0169	0.0304	0.0340	0.0321	0.0173	0.0382	0.0298

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG100KTR-F											
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	0.1039	0.0633	0.1290	0.0691	0.0520	0.0738	0.1448	0.0530	0.0832	0.0799	0.0058
125	0.0467	0.0231	0.0250	0.0466	0.0212	0.0348	0.0269	0.0300	0.0511	0.0388	0.0051
175	0.0138	0.0264	0.0312	0.0310	0.0216	0.0174	0.0201	0.0186	0.0458	0.0383	0.0054
225	0.0125	0.0316	0.0280	0.0331	0.0326	0.0279	0.0208	0.0267	0.0244	0.0451	0.0134
275	0.0118	0.0447	0.0274	0.0219	0.0387	0.0215	0.0156	0.0232	0.0383	0.0202	0.0196
325	0.0157	0.0163	0.0230	0.0165	0.0179	0.0369	0.0168	0.0235	0.0227	0.0170	0.0099
375	0.0151	0.0111	0.0202	0.0190	0.0255	0.0140	0.0272	0.0228	0.0209	0.0402	0.0140
425	0.0053	0.0292	0.0127	0.0237	0.0187	0.0223	0.0212	0.0266	0.0205	0.0409	0.0055
475	0.0057	0.0234	0.0245	0.0221	0.0323	0.0244	0.0147	0.0337	0.0322	0.0307	0.0107
525	0.0065	0.0289	0.0282	0.0235	0.0162	0.0474	0.0419	0.0249	0.0340	0.0456	0.0115
575	0.0107	0.0304	0.0455	0.0187	0.0231	0.0388	0.0371	0.0367	0.0618	0.0392	0.0219
625	0.0044	0.0147	0.0503	0.0428	0.0273	0.0441	0.0400	0.0320	0.0205	0.0594	0.0066
675	0.0078	0.0292	0.0416	0.0375	0.0311	0.0381	0.0252	0.0399	0.0463	0.0203	0.0106
725	0.0027	0.0135	0.0249	0.0216	0.0200	0.0146	0.0193	0.0283	0.0323	0.0265	0.0094
775	0.0048	0.0261	0.0154	0.0159	0.0175	0.0314	0.0294	0.0310	0.0217	0.0175	0.0045
825	0.0040	0.0114	0.0362	0.0182	0.0244	0.0345	0.0230	0.0213	0.0232	0.0168	0.0089
875	0.0017	0.0315	0.0348	0.0341	0.0167	0.0366	0.0288	0.0438	0.0364	0.0391	0.0098
925	0.0036	0.0222	0.0138	0.0161	0.0255	0.0369	0.0310	0.0233	0.0253	0.0381	0.0129
975	0.0020	0.0143	0.0345	0.0148	0.0213	0.0436	0.0236	0.0487	0.0447	0.0199	0.0101
1025	0.0029	0.0260	0.0379	0.0301	0.0177	0.0166	0.0236	0.0503	0.0479	0.0545	0.0073
1075	0.0031	0.0200	0.0271	0.0277	0.0239	0.0268	0.0452	0.0354	0.0329	0.0630	0.0086
1125	0.0040	0.0300	0.0344	0.0525	0.0547	0.0613	0.0464	0.0319	0.0789	0.0325	0.0145
1175	0.0020	0.0287	0.0267	0.0764	0.0432	0.0470	0.0768	0.0614	0.0636	0.0613	0.0226
1225	0.0015	0.0539	0.0289	0.0649	0.0320	0.0692	0.0604	0.0976	0.0425	0.0830	0.0091
1275	0.0018	0.0400	0.0467	0.0313	0.0683	0.0682	0.0313	0.0825	0.0641	0.0709	0.0081
1325	0.0007	0.0302	0.0298	0.0435	0.0171	0.0343	0.0528	0.0409	0.0516	0.0352	0.0139
1375	0.0009	0.0233	0.0130	0.0366	0.0385	0.0376	0.0279	0.0183	0.0448	0.0571	0.0064
1425	0.0011	0.0207	0.0161	0.0135	0.0194	0.0148	0.0410	0.0172	0.0494	0.0206	0.0101
1475	0.0009	0.0204	0.0192	0.0162	0.0215	0.0259	0.0217	0.0252	0.0430	0.0398	0.0178
1525	0.0008	0.0108	0.0279	0.0337	0.0209	0.0246	0.0197	0.0244	0.0402	0.0183	0.0079
1575	0.0005	0.0255	0.0113	0.0260	0.0332	0.0332	0.0220	0.0363	0.0170	0.0304	0.0264
1625	0.0006	0.0217	0.0188	0.0146	0.0147	0.0183	0.0253	0.0257	0.0315	0.0320	0.0188
1675	0.0005	0.0139	0.0182	0.0119	0.0261	0.0229	0.0206	0.0247	0.0308	0.0147	0.0055
1725	0.0010	0.0184	0.0141	0.0116	0.0146	0.0307	0.0263	0.0283	0.0264	0.0166	0.0159
1775	0.0005	0.0123	0.0164	0.0293	0.0270	0.0139	0.0147	0.0146	0.0227	0.0153	0.0123
1825	0.0007	0.0187	0.0307	0.0290	0.0253	0.0179	0.0192	0.0218	0.0360	0.0329	0.0131
1875	0.0005	0.0139	0.0197	0.0117	0.0185	0.0133	0.0144	0.0223	0.0233	0.0228	0.0098
1925	0.0003	0.0171	0.0130	0.0146	0.0147	0.0067	0.0204	0.0192	0.0189	0.0181	0.0125
1975	0.0004	0.0099	0.0127	0.0072	0.0167	0.0157	0.0143	0.0147	0.0085	0.0144	0.0105

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG100KTR-F											
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	0.0012	0.0379	0.0638	0.0486	0.0493	0.0822	0.0577	0.0694	0.0538	0.0609	0.0509
2.3	0.0008	0.0358	0.0551	0.0405	0.0641	0.0627	0.0403	0.0567	0.0494	0.0249	0.0251
2.5	0.0003	0.0376	0.0271	0.0278	0.0351	0.0373	0.0216	0.0578	0.0556	0.0588	0.0913
2.7	0.0005	0.0485	0.0337	0.0413	0.0313	0.0297	0.0164	0.0422	0.0215	0.0634	0.0741
2.9	0.0004	0.0278	0.0294	0.0206	0.0118	0.0291	0.0347	0.0174	0.0273	0.0351	0.0522
3.1	0.0006	0.0201	0.0233	0.0416	0.0207	0.0477	0.0346	0.0226	0.0601	0.0631	0.0398
3.3	0.0004	0.0170	0.0191	0.0259	0.0558	0.0212	0.0212	0.0384	0.0214	0.0284	0.0386
3.5	0.0004	0.0167	0.0204	0.0267	0.0164	0.0374	0.0342	0.0255	0.0393	0.0179	0.0172
3.7	0.0003	0.0217	0.0172	0.0332	0.0233	0.0535	0.0263	0.0380	0.0323	0.0277	0.0273
3.9	0.0003	0.0175	0.0137	0.0257	0.0281	0.0406	0.0339	0.0358	0.0468	0.0293	0.0193
4.1	0.0003	0.0197	0.0223	0.0164	0.0294	0.0230	0.0238	0.0302	0.0185	0.0262	0.0373
4.3	0.0004	0.0262	0.0411	0.0280	0.0188	0.0242	0.0376	0.0471	0.0299	0.0476	0.0276
4.5	0.0003	0.0226	0.0154	0.0320	0.0269	0.0363	0.0348	0.0248	0.0405	0.0234	0.0249
4.7	0.0002	0.0260	0.0180	0.0264	0.0172	0.0232	0.0145	0.0286	0.0171	0.0306	0.0303
4.9	0.0001	0.0203	0.0184	0.0264	0.0209	0.0399	0.0230	0.0311	0.0324	0.0399	0.0527
5.1	0.0002	0.0130	0.0146	0.0269	0.0331	0.0341	0.0155	0.0246	0.0189	0.0258	0.0302
5.3	0.0001	0.0214	0.0149	0.0278	0.0159	0.0297	0.0283	0.0368	0.0173	0.0380	0.0428
5.5	0.0002	0.0099	0.0333	0.0122	0.0226	0.0265	0.0326	0.0408	0.0194	0.0503	0.0295
5.7	0.0002	0.0330	0.0253	0.0247	0.0386	0.0190	0.0218	0.0172	0.0381	0.0421	0.0337
5.9	0.0002	0.0381	0.0384	0.0682	0.0659	0.0555	0.0597	0.0482	0.0713	0.0558	0.0531
6.1	0.0003	0.0269	0.0459	0.0163	0.0279	0.0410	0.0446	0.0280	0.0398	0.0539	0.0502
6.3	0.0002	0.0190	0.0238	0.0554	0.0361	0.0353	0.0670	0.0442	0.0351	0.0438	0.0603
6.5	0.0002	0.0444	0.0230	0.0374	0.0472	0.0586	0.0400	0.0391	0.0335	0.0603	0.0704
6.7	0.0002	0.0216	0.0263	0.0298	0.0346	0.0572	0.0548	0.0323	0.0362	0.0506	0.0670
6.9	0.0002	0.0310	0.0199	0.0190	0.0286	0.0602	0.0308	0.0451	0.0877	0.0700	0.0669
7.1	0.0001	0.0300	0.0267	0.0453	0.0634	0.0450	0.0357	0.0956	0.0505	0.0621	0.0796
7.3	0.0002	0.0245	0.0198	0.0283	0.0169	0.0417	0.0401	0.0669	0.0978	0.1130	0.0392
7.5	0.0002	0.0220	0.0162	0.0109	0.0289	0.0399	0.0481	0.0563	0.0839	0.1110	0.2270
7.7	0.0002	0.0086	0.0152	0.0213	0.0148	0.0364	0.0353	0.0398	0.0612	0.1589	0.1469
7.9	0.0001	0.0071	0.0078	0.0108	0.0240	0.0155	0.0295	0.0330	0.0532	0.0650	0.0758
8.1	0.0001	0.0106	0.0178	0.0128	0.0159	0.0180	0.0204	0.0244	0.0362	0.0431	0.0191
8.3	0.0001	0.0131	0.0108	0.0158	0.0179	0.0188	0.0153	0.0101	0.0134	0.0186	0.0218
8.5	0.0001	0.0064	0.0115	0.0134	0.0145	0.0146	0.0177	0.0140	0.0092	0.0174	0.0192
8.7	0.0001	0.0051	0.0101	0.0101	0.0072	0.0154	0.0153	0.0162	0.0129	0.0195	0.0152
8.9	0.0001	0.0129	0.0097	0.0108	0.0159	0.0112	0.0101	0.0125	0.0151	0.0135	0.0198

Note:
The reference current I_n is 144.9A.
The stated harmonics are maximum values of all 3 phases.
The unit complies with DIN EN 61000-3-12 (VDE 0838-12). Measurement results given above in consideration of customer installation with multiple units with rated current >75A.

5.2.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: iMars XG110KTR	P

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.0462	0.0652	0.0288	0.1341	0.0598	0.0184	0.1146	0.1325	0.0523	0.0449	0.0696
3	0.5360	0.2651	1.2652	0.5742	0.2471	0.3994	0.3024	0.5534	0.3901	0.5659	0.5250
4	0.0465	0.0847	0.0189	0.0306	0.0290	0.0401	0.2170	0.1779	0.1498	0.1144	0.1575
5	0.3139	0.2458	0.3873	0.2978	0.5411	0.4585	0.1501	0.5411	0.1943	0.2359	0.1580
6	0.0143	0.0349	0.0222	0.0210	0.1124	0.1168	0.0332	0.0520	0.0574	0.0598	0.0756
7	0.2524	0.2357	0.2103	0.2518	0.1540	0.1164	0.1784	0.1822	0.2966	0.2057	0.2793
8	0.0075	0.1029	0.0363	0.0579	0.0464	0.0288	0.0446	0.0629	0.0261	0.0463	0.0303
9	0.0608	0.1383	0.2115	0.2365	0.1150	0.2284	0.3369	0.1944	0.1313	0.1968	0.4397
10	0.0092	0.0204	0.0456	0.0363	0.0833	0.0459	0.0307	0.0944	0.0639	0.0682	0.1163
11	0.0085	0.0757	0.0323	0.5874	0.2013	0.1969	0.4506	0.3879	0.2306	0.3180	0.3941
12	0.0053	0.0871	0.0556	0.0756	0.0805	0.0869	0.1287	0.1689	0.0839	0.0670	0.0613
13	0.0160	0.1917	0.2101	0.0508	0.1748	0.0870	0.0880	0.2780	0.3962	0.4144	0.1338
14	0.0062	0.1000	0.0439	0.0485	0.0493	0.0360	0.0654	0.0835	0.0733	0.0368	0.1632
15	0.0244	0.1146	0.0597	0.0772	0.2251	0.0738	0.0520	0.0281	0.0573	0.0411	0.1346
16	0.0032	0.0331	0.0250	0.0619	0.0587	0.0359	0.0490	0.0383	0.0343	0.0459	0.1174
17	0.0027	0.0902	0.0480	0.5543	0.0450	0.0331	0.0999	0.2351	0.3263	0.2787	0.4821
18	0.0046	0.1015	0.0713	0.0978	0.0492	0.0784	0.0389	0.0481	0.1084	0.1038	0.0682
19	0.0022	0.2023	0.1406	0.3069	0.1093	0.0370	0.0468	0.0679	0.3538	0.2708	0.2484
20	0.0027	0.0814	0.0634	0.0402	0.1631	0.1054	0.0316	0.0257	0.0749	0.0506	0.1347
21	0.0060	0.1947	0.3373	0.3382	0.2410	0.0758	0.1704	0.2547	0.1739	0.1037	0.1425
22	0.0016	0.0978	0.0830	0.1232	0.0337	0.0450	0.0640	0.0330	0.0797	0.0587	0.2289
23	0.0076	0.2085	0.1823	0.0596	0.0797	0.1063	0.2619	0.1718	0.3864	0.2016	0.7993
24	0.0022	0.1429	0.0512	0.0557	0.0387	0.0958	0.0734	0.1516	0.1504	0.1243	0.1966
25	0.0020	0.0911	0.4568	0.1776	0.1411	0.1862	0.2060	0.2035	0.2204	0.4010	0.6771
26	0.0022	0.0757	0.0745	0.0464	0.1829	0.0585	0.2334	0.0620	0.1468	0.0779	0.1145
27	0.0047	0.0930	0.1353	0.1049	0.2209	0.1076	0.1713	0.1560	0.0985	0.1902	0.2603
28	0.0034	0.0474	0.0585	0.0916	0.0886	0.0787	0.0456	0.1201	0.1398	0.0770	0.0550
29	0.0022	0.2167	0.2125	0.1872	0.2900	0.2417	0.1577	0.1819	0.2593	0.4096	0.2547
30	0.0013	0.0458	0.0331	0.1192	0.0555	0.0344	0.0663	0.1213	0.0975	0.0739	0.1259
31	0.0006	0.0548	0.1156	0.1031	0.1292	0.1919	0.2414	0.0771	0.2827	0.2418	0.1491
32	0.0005	0.0332	0.0302	0.1190	0.0788	0.0650	0.0395	0.0844	0.1391	0.0562	0.0410
33	0.0025	0.1336	0.0838	0.0733	0.0717	0.0789	0.0687	0.0841	0.1392	0.1185	0.1074
34	0.0005	0.0301	0.0409	0.0226	0.0483	0.0222	0.0522	0.0505	0.1113	0.0369	0.0625
35	0.0017	0.0261	0.0167	0.0685	0.0451	0.4672	0.1420	0.1352	0.1970	0.2143	0.1760
36	0.0005	0.0291	0.1071	0.0566	0.0688	0.0780	0.0701	0.0374	0.0470	0.0386	0.0812
37	0.0005	0.0606	0.0826	0.0670	0.0456	0.1750	0.0830	0.0673	0.0836	0.0790	0.0603
38	0.0002	0.0238	0.0326	0.0423	0.0477	0.0112	0.0324	0.0453	0.0145	0.0191	0.0331
39	0.0004	0.0379	0.0554	0.0252	0.0335	0.0178	0.0300	0.0385	0.0107	0.0340	0.0547
40	0.0005	0.0182	0.0092	0.0074	0.0095	0.0353	0.0466	0.0236	0.0171	0.0519	0.0333

5.2.4 TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)

Model: iMars XG110KTR

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	0.0883	0.0630	0.0844	0.0629	0.0354	0.0383	0.2046	0.0545	0.1031	0.0513	0.0058
125	0.0340	0.0204	0.0191	0.0635	0.0313	0.0305	0.0280	0.0414	0.0350	0.0471	0.0066
175	0.0076	0.0374	0.0284	0.0227	0.0204	0.0112	0.0135	0.0264	0.0454	0.0502	0.0037
225	0.0165	0.0398	0.0178	0.0443	0.0227	0.0225	0.0167	0.0234	0.0141	0.0309	0.0108
275	0.0125	0.0484	0.0327	0.0210	0.0289	0.0134	0.0083	0.0344	0.0228	0.0297	0.0104
325	0.0185	0.0241	0.0121	0.0104	0.0222	0.0324	0.0096	0.0261	0.0317	0.0253	0.0050
375	0.0135	0.0093	0.0125	0.0105	0.0300	0.0156	0.0317	0.0155	0.0261	0.0247	0.0180
425	0.0074	0.0202	0.0079	0.0201	0.0261	0.0223	0.0181	0.0217	0.0271	0.0397	0.0036
475	0.0031	0.0127	0.0192	0.0112	0.0271	0.0268	0.0127	0.0270	0.0213	0.0376	0.0059
525	0.0088	0.0251	0.0371	0.0132	0.0120	0.0518	0.0457	0.0174	0.0347	0.0496	0.0112
575	0.0097	0.0163	0.0535	0.0114	0.0238	0.0320	0.0270	0.0359	0.0821	0.0208	0.0122
625	0.0031	0.0143	0.0276	0.0272	0.0366	0.0659	0.0443	0.0445	0.0121	0.0878	0.0095
675	0.0113	0.0361	0.0473	0.0293	0.0230	0.0215	0.0205	0.0271	0.0686	0.0119	0.0115
725	0.0038	0.0156	0.0178	0.0203	0.0253	0.0104	0.0171	0.0155	0.0390	0.0165	0.0075
775	0.0043	0.0340	0.0140	0.0211	0.0155	0.0392	0.0292	0.0196	0.0149	0.0237	0.0038
825	0.0047	0.0071	0.0542	0.0095	0.0141	0.0497	0.0265	0.0307	0.0298	0.0171	0.0072
875	0.0019	0.0236	0.0498	0.0274	0.0238	0.0269	0.0425	0.0542	0.0240	0.0209	0.0096
925	0.0027	0.0147	0.0182	0.0167	0.0378	0.0202	0.0266	0.0137	0.0262	0.0235	0.0124
975	0.0029	0.0207	0.0484	0.0099	0.0194	0.0505	0.0204	0.0297	0.0477	0.0162	0.0075
1025	0.0023	0.0200	0.0503	0.0352	0.0126	0.0247	0.0288	0.0493	0.0669	0.0649	0.0068
1075	0.0028	0.0252	0.0218	0.0389	0.0154	0.0308	0.0252	0.0335	0.0267	0.0926	0.0056
1125	0.0035	0.0290	0.0456	0.0390	0.0460	0.0769	0.0466	0.0200	0.0667	0.0251	0.0193
1175	0.0010	0.0381	0.0285	0.0891	0.0408	0.0663	0.0963	0.0797	0.0394	0.0494	0.0243
1225	0.0008	0.0431	0.0251	0.0555	0.0346	0.0543	0.0731	0.1358	0.0342	0.0545	0.0081
1275	0.0017	0.0326	0.0406	0.0352	0.0818	0.0506	0.0436	0.1117	0.0385	0.0899	0.0041
1325	0.0006	0.0384	0.0283	0.0351	0.0174	0.0295	0.0451	0.0607	0.0261	0.0300	0.0123
1375	0.0008	0.0296	0.0184	0.0345	0.0384	0.0469	0.0156	0.0097	0.0521	0.0802	0.0092
1425	0.0015	0.0110	0.0159	0.0132	0.0138	0.0190	0.0440	0.0217	0.0697	0.0189	0.0151
1475	0.0008	0.0215	0.0147	0.0222	0.0282	0.0339	0.0242	0.0308	0.0588	0.0278	0.0138
1525	0.0006	0.0095	0.0371	0.0346	0.0280	0.0344	0.0234	0.0192	0.0339	0.0221	0.0085
1575	0.0004	0.0141	0.0093	0.0251	0.0465	0.0465	0.0195	0.0494	0.0204	0.0252	0.0384
1625	0.0007	0.0221	0.0098	0.0189	0.0186	0.0102	0.0282	0.0215	0.0253	0.0451	0.0272
1675	0.0004	0.0176	0.0209	0.0141	0.0317	0.0283	0.0216	0.0363	0.0356	0.0075	0.0068
1725	0.0006	0.0200	0.0104	0.0148	0.0077	0.0377	0.0229	0.0177	0.0268	0.0148	0.0204
1775	0.0005	0.0132	0.0108	0.0257	0.0360	0.0149	0.0110	0.0217	0.0221	0.0175	0.0146
1825	0.0008	0.0195	0.0394	0.0222	0.0330	0.0251	0.0134	0.0306	0.0423	0.0260	0.0116
1875	0.0005	0.0152	0.0255	0.0119	0.0223	0.0167	0.0117	0.0309	0.0153	0.0191	0.0114
1925	0.0004	0.0107	0.0098	0.0121	0.0075	0.0061	0.0188	0.0180	0.0197	0.0209	0.0145
1975	0.0003	0.0147	0.0147	0.0084	0.0127	0.0175	0.0123	0.0159	0.0071	0.0132	0.0084

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG110KTR											
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	0.0011	0.0495	0.0592	0.0380	0.0327	0.0724	0.0887	0.0724	0.0618	0.0410	0.0726
2.3	0.0008	0.0263	0.0598	0.0461	0.0294	0.0697	0.0326	0.0354	0.0573	0.0633	0.0724
2.5	0.0005	0.0404	0.0165	0.0528	0.0234	0.0227	0.0328	0.0198	0.0330	0.0378	0.0878
2.7	0.0006	0.0633	0.0267	0.0192	0.0279	0.0410	0.0316	0.0344	0.0452	0.0468	0.0605
2.9	0.0004	0.0244	0.0237	0.0344	0.0271	0.0293	0.0309	0.0185	0.0197	0.0369	0.0502
3.1	0.0004	0.0236	0.0441	0.0468	0.0598	0.0317	0.0237	0.0319	0.0515	0.0453	0.0627
3.3	0.0003	0.0362	0.0359	0.0268	0.0379	0.0315	0.0229	0.0304	0.0165	0.0324	0.0166
3.5	0.0004	0.0161	0.0320	0.0211	0.0168	0.0171	0.0191	0.0363	0.0273	0.0423	0.0151
3.7	0.0002	0.0253	0.0236	0.0171	0.0396	0.0555	0.0233	0.0205	0.0448	0.0378	0.0336
3.9	0.0003	0.0304	0.0340	0.0392	0.0185	0.0300	0.0257	0.0281	0.0220	0.0479	0.0338
4.1	0.0003	0.0191	0.0214	0.0097	0.0327	0.0218	0.0282	0.0248	0.0227	0.0292	0.0220
4.3	0.0004	0.0270	0.0222	0.0234	0.0193	0.0314	0.0334	0.0224	0.0189	0.0490	0.0292
4.5	0.0002	0.0111	0.0166	0.0207	0.0330	0.0338	0.0223	0.0216	0.0137	0.0289	0.0270
4.7	0.0002	0.0161	0.0134	0.0269	0.0225	0.0253	0.0289	0.0158	0.0232	0.0227	0.0243
4.9	0.0003	0.0261	0.0357	0.0223	0.0307	0.0279	0.0411	0.0397	0.0313	0.0400	0.0242
5.1	0.0003	0.0283	0.0134	0.0293	0.0297	0.0283	0.0217	0.0217	0.0294	0.0328	0.0156
5.3	0.0003	0.0242	0.0169	0.0300	0.0288	0.0287	0.0313	0.0167	0.0212	0.0150	0.0269
5.5	0.0002	0.0185	0.0350	0.0106	0.0356	0.0337	0.0160	0.0165	0.0460	0.0414	0.0584
5.7	0.0002	0.0122	0.0171	0.0157	0.0303	0.0175	0.0361	0.0434	0.0286	0.0354	0.0466
5.9	0.0003	0.0285	0.0602	0.0288	0.0325	0.0573	0.0417	0.0501	0.0685	0.0571	0.0438
6.1	0.0001	0.0347	0.0186	0.0268	0.0241	0.0371	0.0234	0.0643	0.0571	0.0426	0.0349
6.3	0.0002	0.0299	0.0180	0.0295	0.0468	0.0476	0.0659	0.0448	0.0315	0.0373	0.0718
6.5	0.0001	0.0235	0.0239	0.0306	0.0605	0.0274	0.0556	0.0570	0.0383	0.0346	0.0432
6.7	0.0002	0.0229	0.0179	0.0205	0.0268	0.0561	0.0622	0.0370	0.0708	0.0622	0.0462
6.9	0.0003	0.0400	0.0292	0.0439	0.0590	0.0569	0.0571	0.0782	0.0887	0.0694	0.0793
7.1	0.0001	0.0238	0.0330	0.0375	0.0508	0.0394	0.0802	0.0794	0.0679	0.0563	0.0801
7.3	0.0002	0.0176	0.0172	0.0204	0.0304	0.0457	0.0686	0.0513	0.1085	0.0963	0.0430
7.5	0.0001	0.0112	0.0250	0.0152	0.0133	0.0237	0.0366	0.0578	0.0499	0.1260	0.1794
7.7	0.0003	0.0120	0.0100	0.0225	0.0303	0.0321	0.0223	0.0281	0.0504	0.1175	0.1718
7.9	0.0001	0.0087	0.0172	0.0130	0.0228	0.0201	0.0139	0.0163	0.0305	0.0539	0.0500
8.1	0.0001	0.0134	0.0201	0.0130	0.0187	0.0147	0.0248	0.0313	0.0144	0.0220	0.0312
8.3	0.0001	0.0174	0.0156	0.0144	0.0228	0.0125	0.0170	0.0186	0.0272	0.0170	0.0169
8.5	0.0001	0.0051	0.0090	0.0056	0.0143	0.0060	0.0124	0.0135	0.0089	0.0098	0.0208
8.7	0.0001	0.0064	0.0084	0.0050	0.0088	0.0137	0.0147	0.0061	0.0070	0.0142	0.0206
8.9	0.0001	0.0059	0.0103	0.0069	0.0081	0.0115	0.0140	0.0184	0.0125	0.0179	0.0121

Note:
The reference current I_n is 159.4 A.
The stated harmonics are maximum values of all 3 phases.
The unit complies with DIN EN 61000-3-12 (VDE 0838-12). Measurement results given above in consideration of customer installation with multiple units with rated current >75A.

5.2.4	TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-4-7) Model: iMars XG110KTR-F	P

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	0.0559	0.0420	0.0183	0.0764	0.0315	0.0183	0.1553	0.0726	0.0275	0.0741	0.0328
3	0.6100	0.3789	0.5485	0.6550	0.2374	0.2187	0.5387	0.2204	0.4168	0.7068	0.4715
4	0.0242	0.0661	0.0142	0.0326	0.0340	0.0878	0.0829	0.1191	0.1373	0.0577	0.1417
5	0.2545	0.1443	0.3716	0.1817	0.4936	0.2102	0.2508	0.4306	0.1573	0.2433	0.2170
6	0.0243	0.0234	0.0218	0.0362	0.0912	0.1069	0.0469	0.0637	0.0911	0.0549	0.0775
7	0.1386	0.2118	0.1908	0.1033	0.0684	0.2305	0.1331	0.1767	0.3601	0.2416	0.3752
8	0.0071	0.1219	0.0866	0.0954	0.0363	0.0265	0.0214	0.0405	0.0154	0.0334	0.0242
9	0.0705	0.2327	0.1891	0.4971	0.2868	0.2623	0.2150	0.1356	0.2048	0.3402	0.3398
10	0.0056	0.0330	0.0273	0.0284	0.1418	0.0231	0.0254	0.1222	0.0467	0.0746	0.0817
11	0.0059	0.0310	0.0244	0.2937	0.4949	0.1532	0.5657	0.3230	0.4689	0.5484	0.2121
12	0.0053	0.1336	0.0448	0.2002	0.0631	0.1134	0.1039	0.1589	0.0909	0.1268	0.0678
13	0.0112	0.1569	0.2180	0.0904	0.1442	0.0637	0.1236	0.3544	0.1827	0.5680	0.3155
14	0.0078	0.0450	0.0211	0.0361	0.0527	0.0135	0.0975	0.0503	0.0630	0.0521	0.0579
15	0.0182	0.1873	0.1013	0.0811	0.2481	0.0973	0.0659	0.0351	0.0472	0.0440	0.0975
16	0.0016	0.0415	0.0193	0.0390	0.0433	0.0489	0.0626	0.0178	0.0445	0.1042	0.1091
17	0.0057	0.1059	0.0561	0.2768	0.0363	0.0671	0.1410	0.5235	0.1472	0.1479	0.4793
18	0.0058	0.0635	0.1026	0.0930	0.0640	0.0697	0.0231	0.0854	0.0718	0.1505	0.0859
19	0.0032	0.3219	0.0756	0.3181	0.1077	0.0486	0.0765	0.1198	0.3215	0.5306	0.1591
20	0.0029	0.0803	0.0576	0.0527	0.1415	0.1007	0.0510	0.0316	0.0681	0.0543	0.0919
21	0.0092	0.5022	0.2888	0.3613	0.2903	0.0538	0.1957	0.2646	0.1372	0.1850	0.1842
22	0.0007	0.1574	0.0732	0.0987	0.0606	0.0450	0.0674	0.0255	0.0532	0.0764	0.1476
23	0.0073	0.0719	0.1370	0.0724	0.1364	0.0715	0.1147	0.1240	0.2736	0.3636	0.9289
24	0.0016	0.0728	0.1275	0.0636	0.0495	0.1171	0.0976	0.0831	0.1387	0.0681	0.2551
25	0.0027	0.1149	0.3867	0.1867	0.2263	0.1549	0.1996	0.2285	0.1817	0.1855	0.6397
26	0.0011	0.0765	0.0811	0.1167	0.1976	0.1186	0.1172	0.0697	0.1461	0.0591	0.0979
27	0.0033	0.0981	0.1704	0.1481	0.2588	0.0441	0.2069	0.1183	0.0851	0.2151	0.3369
28	0.0020	0.0540	0.0684	0.0641	0.0475	0.1467	0.0742	0.0582	0.1930	0.0801	0.1025
29	0.0020	0.0984	0.2290	0.0966	0.3611	0.6597	0.1710	0.1257	0.1648	0.6079	0.4250
30	0.0010	0.0899	0.0420	0.0841	0.0419	0.0627	0.0310	0.1283	0.0984	0.0444	0.1205
31	0.0004	0.0510	0.0693	0.0868	0.1182	0.1452	0.2303	0.0884	0.1787	0.2210	0.0949
32	0.0005	0.0391	0.0385	0.0749	0.0659	0.0951	0.0214	0.0397	0.0943	0.0627	0.0758
33	0.0013	0.0755	0.0428	0.1790	0.0569	0.0447	0.0761	0.0947	0.1431	0.1515	0.1695
34	0.0011	0.0208	0.0382	0.0263	0.0560	0.0259	0.0634	0.0492	0.0683	0.0251	0.1269
35	0.0021	0.0298	0.0218	0.1389	0.0476	0.3710	0.2049	0.0847	0.1468	0.1496	0.1827
36	0.0004	0.0532	0.0727	0.0438	0.0338	0.0854	0.0483	0.0297	0.0687	0.0631	0.0928
37	0.0004	0.0344	0.0828	0.0744	0.0542	0.1331	0.0929	0.0813	0.0484	0.1266	0.0925
38	0.0002	0.0168	0.0401	0.0250	0.0369	0.0134	0.0571	0.0476	0.0157	0.0353	0.0259
39	0.0003	0.0359	0.0405	0.0229	0.0222	0.0119	0.0343	0.0337	0.0155	0.0438	0.0544
40	0.0004	0.0170	0.0097	0.0166	0.0170	0.0208	0.0399	0.0278	0.0135	0.0531	0.0287

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG110KTR-F											
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	0.0737	0.0402	0.1708	0.0856	0.0720	0.0608	0.2153	0.0579	0.0528	0.1183	0.0081
125	0.0279	0.0119	0.0254	0.0544	0.0198	0.0384	0.0342	0.0415	0.0362	0.0415	0.0030
175	0.0169	0.0351	0.0462	0.0227	0.0154	0.0169	0.0194	0.0243	0.0625	0.0386	0.0079
225	0.0083	0.0208	0.0262	0.0308	0.0372	0.0251	0.0241	0.0183	0.0222	0.0346	0.0183
275	0.0126	0.0489	0.0267	0.0265	0.0309	0.0223	0.0132	0.0317	0.0360	0.0116	0.0285
325	0.0097	0.0153	0.0213	0.0134	0.0102	0.0394	0.0105	0.0136	0.0261	0.0241	0.0066
375	0.0218	0.0110	0.0159	0.0138	0.0328	0.0113	0.0364	0.0250	0.0310	0.0572	0.0154
425	0.0031	0.0197	0.0068	0.0127	0.0197	0.0122	0.0203	0.0322	0.0253	0.0551	0.0077
475	0.0058	0.0197	0.0133	0.0128	0.0311	0.0365	0.0203	0.0185	0.0451	0.0336	0.0073
525	0.0046	0.0184	0.0412	0.0323	0.0225	0.0246	0.0234	0.0162	0.0364	0.0557	0.0086
575	0.0112	0.0432	0.0547	0.0139	0.0340	0.0319	0.0514	0.0254	0.0717	0.0540	0.0298
625	0.0056	0.0095	0.0398	0.0488	0.0212	0.0279	0.0212	0.0328	0.0117	0.0390	0.0065
675	0.0103	0.0412	0.0476	0.0203	0.0165	0.0419	0.0180	0.0486	0.0421	0.0291	0.0142
725	0.0032	0.0196	0.0222	0.0119	0.0283	0.0211	0.0128	0.0351	0.0409	0.0236	0.0075
775	0.0029	0.0384	0.0197	0.0223	0.0149	0.0168	0.0231	0.0187	0.0190	0.0115	0.0059
825	0.0050	0.0118	0.0482	0.0193	0.0193	0.0515	0.0151	0.0143	0.0258	0.0202	0.0064
875	0.0012	0.0292	0.0419	0.0378	0.0128	0.0408	0.0210	0.0401	0.0379	0.0252	0.0097
925	0.0038	0.0113	0.0202	0.0170	0.0305	0.0387	0.0203	0.0283	0.0353	0.0406	0.0108
975	0.0029	0.0196	0.0409	0.0136	0.0250	0.0513	0.0153	0.0726	0.0560	0.0247	0.0085
1025	0.0028	0.0375	0.0423	0.0412	0.0134	0.0165	0.0194	0.0271	0.0276	0.0736	0.0093
1075	0.0044	0.0193	0.0296	0.0144	0.0182	0.0299	0.0561	0.0454	0.0447	0.0347	0.0051
1125	0.0030	0.0156	0.0362	0.0327	0.0772	0.0853	0.0566	0.0205	0.1008	0.0241	0.0122
1175	0.0012	0.0387	0.0327	0.0492	0.0635	0.0317	0.0960	0.0528	0.0707	0.0751	0.0272
1225	0.0019	0.0531	0.0359	0.0660	0.0476	0.0578	0.0795	0.1416	0.0281	0.0675	0.0124
1275	0.0012	0.0330	0.0507	0.0254	0.0920	0.0410	0.0326	0.1216	0.0923	0.0886	0.0071
1325	0.0010	0.0400	0.0160	0.0556	0.0147	0.0327	0.0704	0.0313	0.0637	0.0221	0.0141
1375	0.0009	0.0290	0.0122	0.0481	0.0315	0.0541	0.0380	0.0156	0.0277	0.0390	0.0058
1425	0.0008	0.0118	0.0109	0.0123	0.0161	0.0137	0.0315	0.0168	0.0474	0.0225	0.0133
1475	0.0009	0.0185	0.0137	0.0133	0.0182	0.0325	0.0301	0.0261	0.0628	0.0220	0.0230
1525	0.0005	0.0120	0.0292	0.0217	0.0107	0.0329	0.0250	0.0166	0.0284	0.0137	0.0066
1575	0.0007	0.0376	0.0138	0.0279	0.0281	0.0381	0.0137	0.0186	0.0172	0.0342	0.0283
1625	0.0008	0.0203	0.0203	0.0112	0.0134	0.0130	0.0220	0.0322	0.0393	0.0372	0.0124
1675	0.0003	0.0101	0.0151	0.0106	0.0316	0.0143	0.0283	0.0125	0.0245	0.0085	0.0077
1725	0.0007	0.0162	0.0208	0.0129	0.0205	0.0406	0.0362	0.0242	0.0265	0.0087	0.0115
1775	0.0003	0.0143	0.0095	0.0288	0.0159	0.0085	0.0095	0.0205	0.0190	0.0172	0.0173
1825	0.0008	0.0111	0.0349	0.0210	0.0329	0.0108	0.0258	0.0185	0.0304	0.0327	0.0175
1875	0.0006	0.0168	0.0258	0.0145	0.0145	0.0137	0.0188	0.0234	0.0223	0.0254	0.0082
1925	0.0004	0.0252	0.0193	0.0100	0.0199	0.0096	0.0172	0.0249	0.0125	0.0243	0.0072
1975	0.0006	0.0148	0.0188	0.0064	0.0103	0.0192	0.0089	0.0138	0.0049	0.0169	0.0085

5.2.4	TABLE: Harmonics and inter-harmonics (According to DIN EN 61000-4-7)										
Model: iMars XG110KTR-F											
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	0.0007	0.0740	0.0397	0.0246	0.0628	0.0520	0.0870	0.0771	0.0558	0.0819	0.0907
2.3	0.0003	0.0335	0.0293	0.0240	0.0611	0.0568	0.0586	0.0253	0.0395	0.0388	0.0385
2.5	0.0003	0.0320	0.0240	0.0408	0.0583	0.0265	0.0364	0.0429	0.0605	0.0749	0.0676
2.7	0.0003	0.0466	0.0372	0.0257	0.0351	0.0222	0.0185	0.0344	0.0243	0.0316	0.0339
2.9	0.0002	0.0159	0.0282	0.0133	0.0205	0.0198	0.0218	0.0343	0.0358	0.0414	0.0360
3.1	0.0006	0.0288	0.0398	0.0317	0.0562	0.0384	0.0507	0.0264	0.0226	0.0424	0.0543
3.3	0.0003	0.0318	0.0253	0.0280	0.0563	0.0256	0.0397	0.0450	0.0326	0.0148	0.0451
3.5	0.0004	0.0136	0.0240	0.0321	0.0391	0.0369	0.0389	0.0189	0.0355	0.0160	0.0178
3.7	0.0004	0.0123	0.0262	0.0253	0.0254	0.0511	0.0453	0.0311	0.0264	0.0332	0.0236
3.9	0.0002	0.0177	0.0339	0.0299	0.0151	0.0385	0.0305	0.0387	0.0389	0.0385	0.0339
4.1	0.0003	0.0095	0.0130	0.0170	0.0319	0.0192	0.0289	0.0296	0.0255	0.0210	0.0173
4.3	0.0002	0.0305	0.0281	0.0180	0.0253	0.0412	0.0398	0.0471	0.0189	0.0542	0.0375
4.5	0.0002	0.0208	0.0192	0.0144	0.0161	0.0266	0.0295	0.0168	0.0205	0.0162	0.0363
4.7	0.0002	0.0197	0.0288	0.0197	0.0123	0.0184	0.0202	0.0169	0.0194	0.0139	0.0222
4.9	0.0001	0.0139	0.0355	0.0176	0.0333	0.0406	0.0202	0.0182	0.0252	0.0320	0.0355
5.1	0.0002	0.0272	0.0307	0.0301	0.0256	0.0171	0.0374	0.0324	0.0190	0.0333	0.0278
5.3	0.0002	0.0142	0.0188	0.0324	0.0231	0.0228	0.0316	0.0149	0.0354	0.0387	0.0173
5.5	0.0003	0.0113	0.0154	0.0172	0.0337	0.0177	0.0212	0.0422	0.0230	0.0225	0.0415
5.7	0.0001	0.0299	0.0366	0.0274	0.0409	0.0393	0.0211	0.0438	0.0308	0.0328	0.0362
5.9	0.0002	0.0346	0.0606	0.0313	0.0667	0.0240	0.0680	0.0490	0.0520	0.0453	0.0292
6.1	0.0002	0.0271	0.0447	0.0424	0.0309	0.0377	0.0282	0.0354	0.0331	0.0444	0.0753
6.3	0.0001	0.0490	0.0402	0.0571	0.0589	0.0370	0.0660	0.0369	0.0482	0.0493	0.0704
6.5	0.0002	0.0197	0.0320	0.0300	0.0565	0.0241	0.0490	0.0297	0.0558	0.0639	0.0454
6.7	0.0003	0.0240	0.0285	0.0186	0.0534	0.0585	0.0523	0.0576	0.0320	0.0573	0.0632
6.9	0.0002	0.0371	0.0409	0.0389	0.0325	0.0753	0.0772	0.0624	0.0369	0.0359	0.0385
7.1	0.0001	0.0200	0.0318	0.0436	0.0539	0.0596	0.0623	0.0609	0.0818	0.0669	0.0866
7.3	0.0003	0.0185	0.0125	0.0186	0.0275	0.0278	0.0448	0.0611	0.0951	0.0956	0.0575
7.5	0.0001	0.0185	0.0094	0.0238	0.0215	0.0325	0.0392	0.0573	0.0845	0.1176	0.1816
7.7	0.0003	0.0099	0.0153	0.0182	0.0281	0.0393	0.0336	0.0270	0.0381	0.0841	0.2109
7.9	0.0001	0.0117	0.0095	0.0087	0.0168	0.0140	0.0373	0.0317	0.0210	0.0275	0.0489
8.1	0.0001	0.0096	0.0196	0.0076	0.0108	0.0227	0.0256	0.0361	0.0161	0.0226	0.0447
8.3	0.0001	0.0162	0.0084	0.0093	0.0220	0.0135	0.0140	0.0100	0.0143	0.0271	0.0271
8.5	0.0001	0.0105	0.0124	0.0070	0.0062	0.0060	0.0163	0.0110	0.0119	0.0174	0.0175
8.7	0.0001	0.0059	0.0116	0.0072	0.0092	0.0060	0.0116	0.0145	0.0107	0.0182	0.0214
8.9	0.0001	0.0094	0.0072	0.0072	0.0132	0.0138	0.0083	0.0089	0.0111	0.0172	0.0151

Note:
The reference current I_n is 159.4 A.
The stated harmonics are maximum values of all 3 phases.
The unit complies with DIN EN 61000-3-12 (VDE 0838-12). Measurement results given above in consideration of customer installation with multiple units with rated current >75A.

5.2.6	TABLE: DC Injection					P
Model: iMars XG100KTR						
Mains voltage: 230V						
Power P/Pn		100%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.051A	0.04%	0.141A	0.10%	0.175A	0.12%	0.5%
Power P/Pn [%]		66%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.043A	0.03%	0.087A	0.6%	0.070A	0.05%	0.5%
Power P/Pn [%]		33%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.033A	0.02%	0.069A	0.05%	0.055A	0.04%	0.5%
Model: iMars XG110KTR						
Power P/Pn		100%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.051A	0.03%	0.092A	0.06%	0.101A	0.06%	0.5%
Power P/Pn [%]		66%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.050A	0.03%	0.098A	0.06%	0.065A	0.04%	0.5%
Power P/Pn [%]		33%				
Measurement						Limitation
Phase L1		Phase L2		Phase L3		
0.040A	0.03%	0.042A	0.03%	0.045A	0.03%	0.5%

5.3.2	TABLE: Asymmetry calculation for three-phase inverter						P
☒ Three-phase inverter							
Test voltage: 230 V, 50 Hz							
No.	Test condition		Power asymmetry [VA]				
	cosφ	P/P_{Emax}	I	II	III	IV	VI
1	1.00	100%	64.83	61.56	65.53	67.38	63.86
2	1.00	50%	30.78	31.39	35.52	36.28	35.80
3	max. under-excited	100%	94.75	96.45	93.18	91.48	94.93
4		50%	60.48	60.24	62.58	64.28	68.18
5	max. over-excited	100%	66.38	67.44	68.05	65.17	67.30
6		50%	77.02	77.00	74.86	76.88	77.29
Max. Power Asymmetry [VA]			96.45		Limitation [VA]	6050	

5.4.2	TABLE: Measurement of active- and reactive power ranges	P

Model: iMars XG100KTR

No.	Test condition		Measurement					
	Cosφ	U / Un	U [V]	I [A]	PEmax600 *) [W]	Semax600 *) [VA]	Q [Var]	Cosφ
a1	1.00	90%	207.80	160.59	100077.2	100110.4	-2569.5	0.9997
a3		100%	230.74	146.34	101261.6	101296.2	-2637.2	0.9997
a5		109%	251.37	133.12	100351.9	100391.8	-2821.6	0.9996
b1	max. under-excited	95%	219.19	159.88	94683.4	105138.7	-45707.1	0.9006
b3		100%	230.71	158.9	99044.6	109973.4	-47793.8	0.9006
B5		109%	251.33	144.3	98118.6	108863.9	-47159.8	0.9013
c1	max. over-excited	90%	207.73	159.6	89652.2	99483.1	43119.9	0.9012
c3		100%	230.78	159.4	99433.4	110390.9	47948.4	0.9007
c4		105%	242.23	151.1	98862.4	109865.1	47921.6	0.8999

PEmax600 [W]	101261.6
SEmax600 [VA]	110390.9

Model: iMars XG100KTR-F

No.	Test condition		Measurement					
	Cosφ	U / Un	U [V]	I [A]	PEmax600 *) [W]	Semax600 *) [VA]	Q [Var]	Cosφ
a1	1.00	90%	207.8	160.6	100094.4	100127.7	-2575.5	0.9997
a3		100%	230.7	146.3	101257.3	101291.9	-2638.3	0.9997
a5		109%	251.4	133.1	100359.7	100399.6	-2808.4	0.9996
b1	max. under-excited	95%	219.2	159.9	94709.7	105167.6	-45719.0	0.9006
b3		100%	230.7	158.9	99050.8	109980.2	-47796.6	0.9006
B5		109%	251.3	144.4	98113.9	108859.2	-47158.5	0.9013
c1	max. over-excited	90%	207.7	159.7	89683.0	99512.5	43123.5	0.9012
c3		100%	230.8	159.5	99436.0	110392.7	47947.4	0.9007
c4		105%	242.2	151.2	98869.6	109873.2	47925.5	0.8999

PEmax600 [W]	101257.3
SEmax600 [VA]	110392.7

Model: iMars XG110KTR

No.	Test condition		Measurement					
	Cosφ	U / Un	U [V]	I [A]	$P_{Emax600}$ *) [W]	$S_{emax600}$ *) [VA]	Q [Var]	Cosφ
a1	1.00	90%	207.87	176.2	109824.8	109862.0	-2840.0	0.9997
a3		100%	230.80	159.7	110548.4	110583.7	-2786.0	0.9997
a5		109%	251.44	146.7	110646.9	110685.6	-2897.2	0.9997
b1	max. under-excited	95%	219.18	175.8	103935.3	115602.8	-50609.1	0.8991
b3		100%	230.68	175.3	109121.8	121306.7	-52986.7	0.8996
B5		109%	251.30	160.4	108846.4	120904.1	-52632.0	0.9003
c1	max. over-excited	90%	207.77	176.5	98939.0	110011.5	48097.8	0.8994
c3		100%	230.77	176.0	109759.3	121864.5	52949.5	0.9007
c4		105%	242.22	166.9	109146.7	121300.1	52920.1	0.8998

$P_{Emax600}$ [W]	110646.9
$S_{Emax600}$ [VA]	121864.5

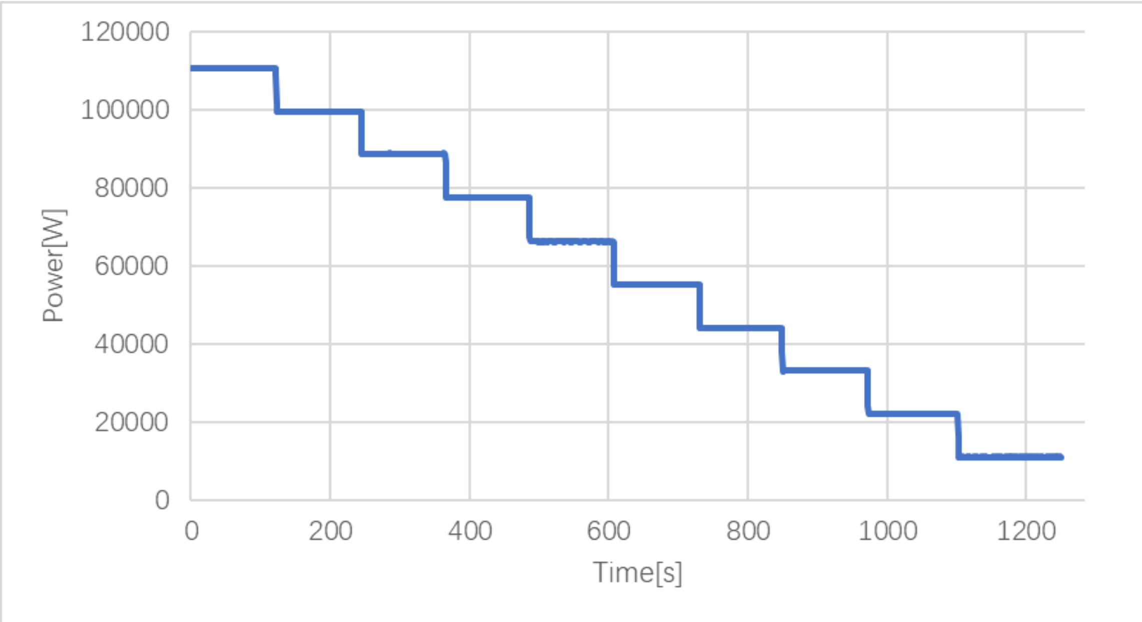
Model: iMars XG110KTR-F

No.	Test condition		Measurement					
	Cosφ	U / Un	U [V]	I [A]	$P_{Emax600}$ *) [W]	$S_{emax600}$ *) [VA]	Q [Var]	Cosφ
a1	1.00	90%	207.87	176.2	109823.0	109860.2	-2844.3	0.9997
a3		100%	230.80	159.7	110546.1	110580.7	-2747.4	0.9997
a5		109%	251.42	146.8	110667.5	110706.3	-2900.5	0.9997
b1	max. under-excited	95%	219.17	175.8	103937.5	115606.8	-50613.5	0.8991
b3		100%	230.68	175.3	109124.1	121311.9	-52994.3	0.8995
B5		109%	251.30	160.4	108836.7	120893.2	-52627.0	0.9003
c1	max. over-excited	90%	207.77	176.5	98945.4	110018.2	48099.8	0.8994
c3		100%	230.76	176.0	109765.0	121869.6	52949.3	0.9007
c4		105%	242.23	166.9	109148.1	121302.5	52922.6	0.8998

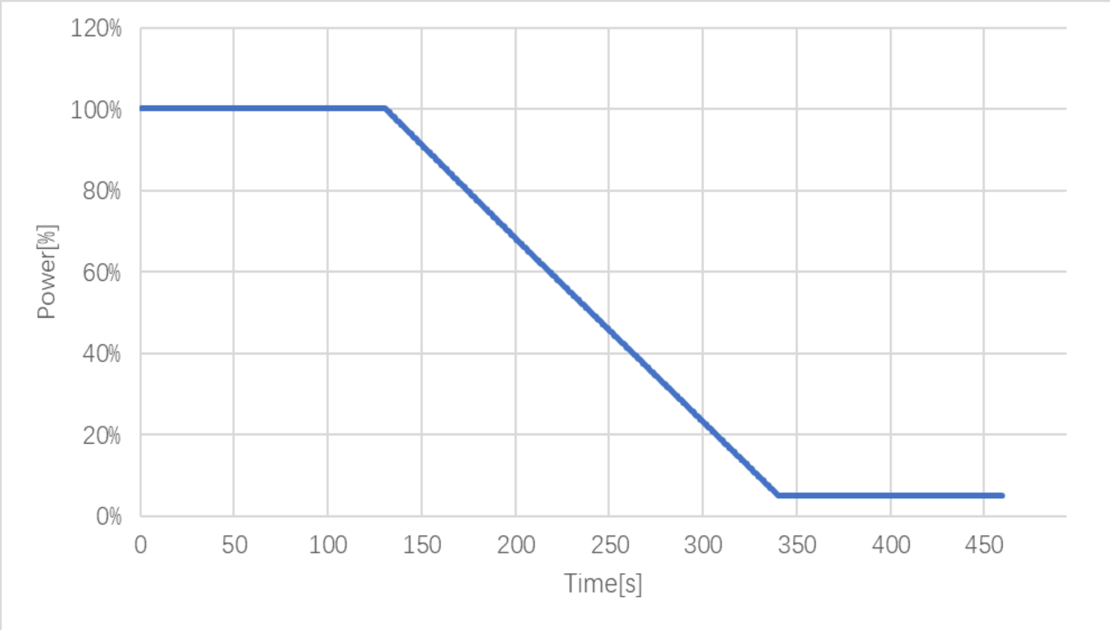
$P_{Emax600}$ [W]	110667.5
$S_{Emax600}$ [VA]	121869.6

Remark:
*) The 10-minutes mean value are recorded.

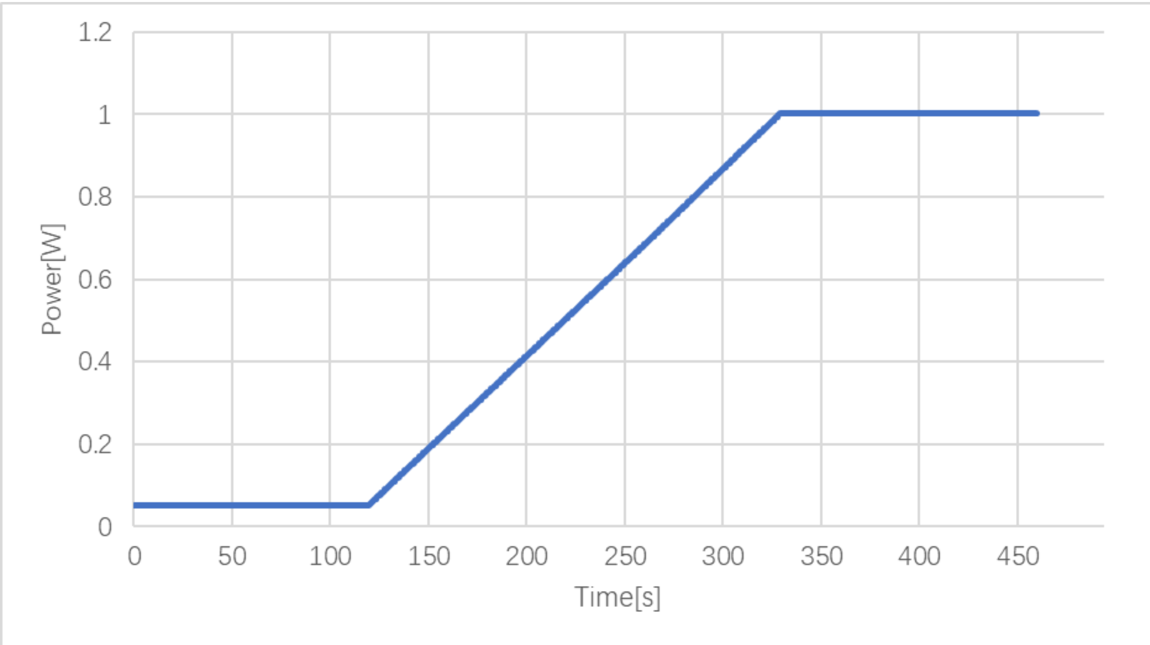
5.4.3	Active power reduction through setpoint specification			P
Measurement Item	Power Setting [W]	Actual Power [W]	Tolerance of power [W]	Δ P/ Pn [%]
100%	110000.0	110466.8	466.8	0.42
90%	99000.0	99605.8	605.8	0.55
80%	88000.0	88803.2	803.2	0.73
70%	77000.0	77483.8	483.8	0.44
60%	66000.0	66210.3	210.3	0.19
50%	55000.0	55106.6	106.6	0.10
40%	44000.0	44224.9	224.9	0.20
30%	33000.0	33227.5	227.5	0.21
20%	22000.0	22177.9	177.9	0.16
10%	11000.0	11152.3	152.3	0.14
Limitation of Δ P/ Pn	± 5%			



Power gradient (100%Pn ->5%Pn) [W/s]:	509.7W/s (0.463%)
Power gradient (5%Pn ->100%Pn) [W/s]:	517.3W/s (0.470%)
Limitation of gradient [%Pn]	0.33%Pn – 0.66%Pn



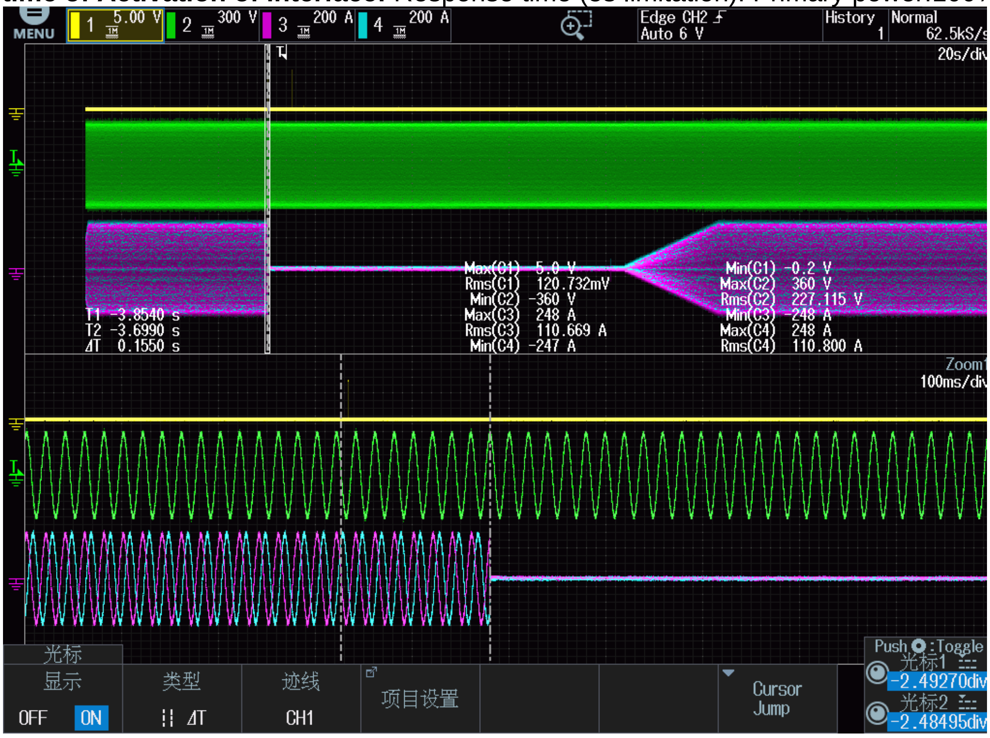
Power gradient from 100% to 5%



Power gradient from 5% to 100%

5.4.3.5	TABLE: Testing of logical interface (input port)		P
Activation of Logic interface Power from 100%Pn to 0		Time	
		0.155s	
Limitation		completely terminated within a maximum of 5 s after the change of state of the logical signal.	

Response time of Activation of interface: Response time (5s limitation): Primary power:100% to 0%

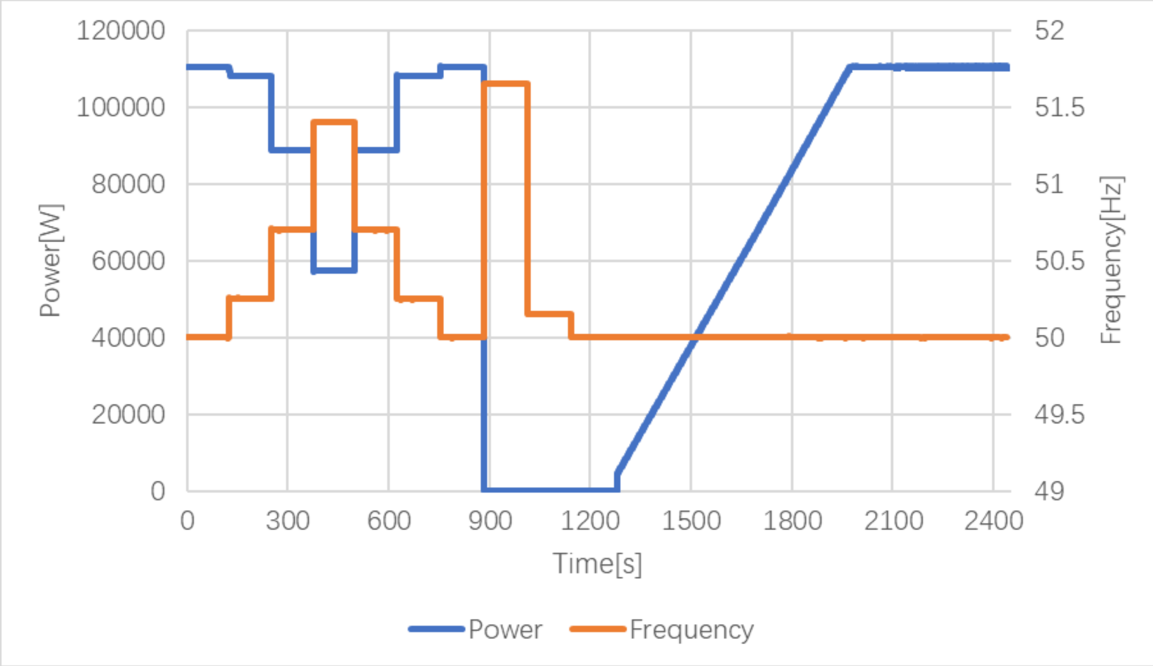


Response time: 0.155s

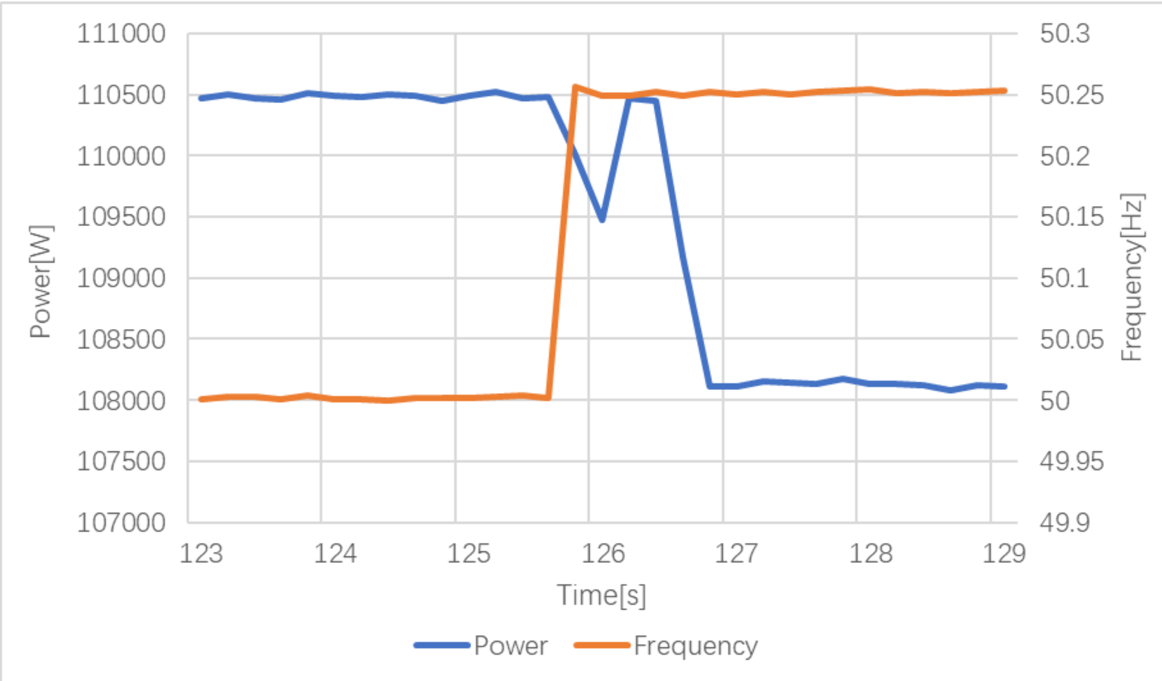
5.4.3.5	TABLE: Measurement priority interfaces / energy management system	N/A
The active power reduction can be requested by only one interface.		

5.4.4	Active power supply 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_{Emax} (W)		44000		10%P_{Emax} (W)			11000	
	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 times *T*an_90 % <2s	The settling times <20s	
a) 50Hz ± 0.01Hz	50.00	100	110502.3	0.46	< ± 5%	--	--	--	
b)50.25Hz ± 0.01Hz	50.25	98	108116.3	0.29	< ± 10%	0.3	0.6	1.2	
c)50.70Hz ± 0.01Hz	50.70	80	88694.5	0.63	< ± 10%	--	0.6	1.3	
d)51.40Hz ± 0.01Hz	51.40	52	57430.1	0.21	< ± 10%	--	0.8	1.4	
e)50.70Hz ± 0.01Hz	50.70	80	88667.8	0.61	< ± 10%	--	0.7	1.3	
f)50.25Hz ± 0.01Hz	50.25	98	108161.9	0.33	< ± 10%	--	0.6	1.2	
g)50Hz ± 0.01Hz	50.00	100	110547.6	0.50	< ± 10%	--	0.7	1.3	
h)51.65Hz± 0.01Hz	Disconnection Time[ms]:100, Limitation[ms]: 200								
i)50.15Hz± 0.01Hz	Reconnection: ☐ Yes/ ☒ No, Limitation: No reconnection is allowed.								
j)50.00Hz± 0.01Hz	Reconnection time: 133.2s Maximal Rising Gradient [%/min]:8.64%, Limitation [%/min]: 10%								

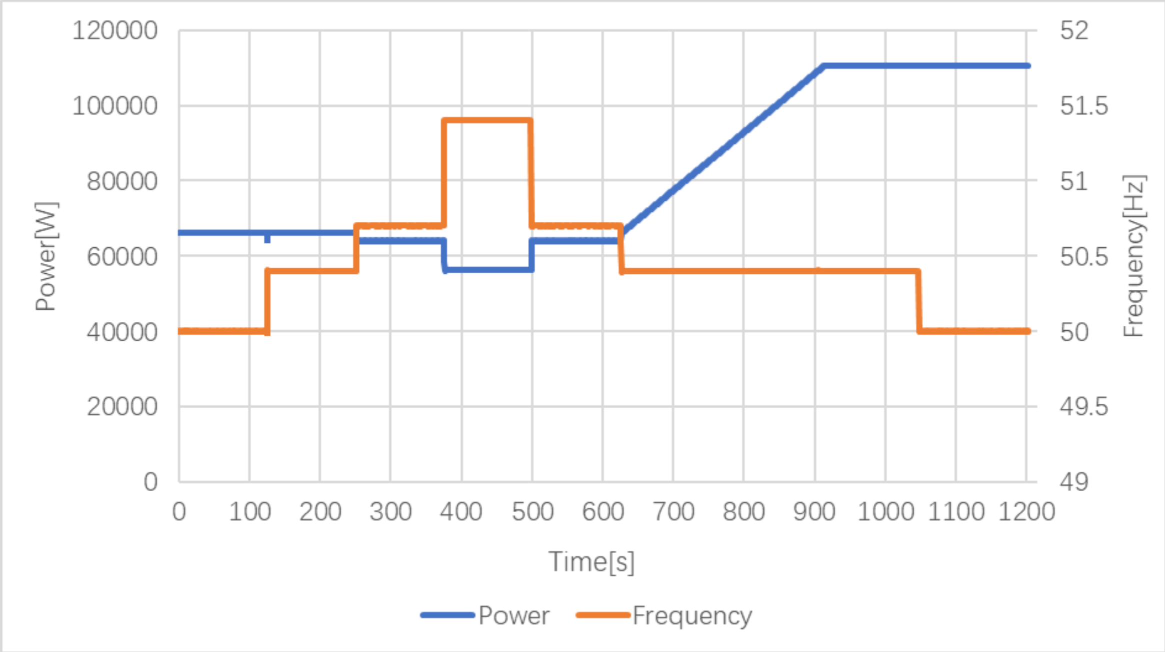
Test 2	16.67%P_{Emax} (W)		18337		10%P_{Emax} (W)		11000	
Setting parameters of the EZE: P = 60% PEmax (The reduction of the primary energy supply to limit the active power output, or the limiting setting of the active power output must be removed from measuring point c) Start of power reduction at 50.5 Hz s= 12% (16.67% P / Hz)	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 times $T_{an\_90\,\%}$ <2s	The settling times <20s
a)50Hz ± 0.01Hz	50.00	60	66273.9	0.25	< ± 5%	--	--	--
b)50.40Hz ± 0.01Hz	50,40	60	66264.6	0.24	< ± 10%	--	--	--
c)50.70Hz ± 0.01Hz	50.70	58	64044.2	0.22	< ± 10%	0.3	0.7	1.6
d)51.40Hz ± 0.01Hz	51.40	51	56259.5	0.15	< ± 10%	--	0.7	1.5
e)50.70Hz ± 0.01Hz	50.70	58	64042.9	0.22	< ± 10%	--	0.6	1.5
f)50.10Hz ± 0.01Hz	50.10	60-100	Maximal Rising Gradient [%/min]: 8.36, Limitation [%/min]: 10%					
g)50Hz ± 0.01Hz	50.00	100	--					



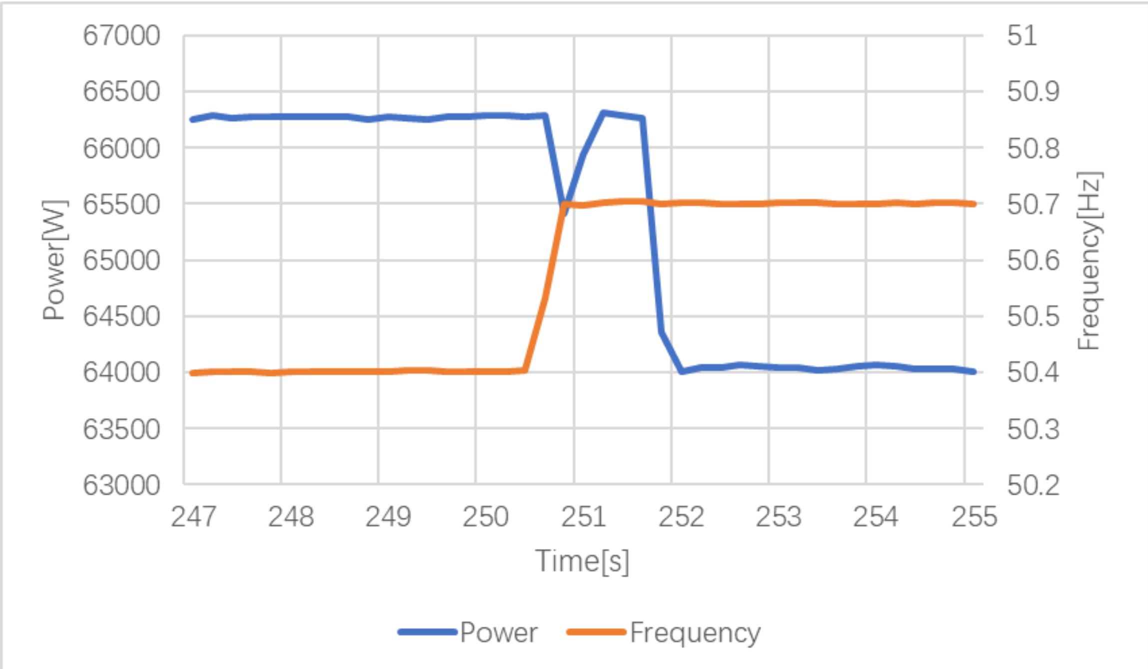
Test 1 P&F curve



Response time



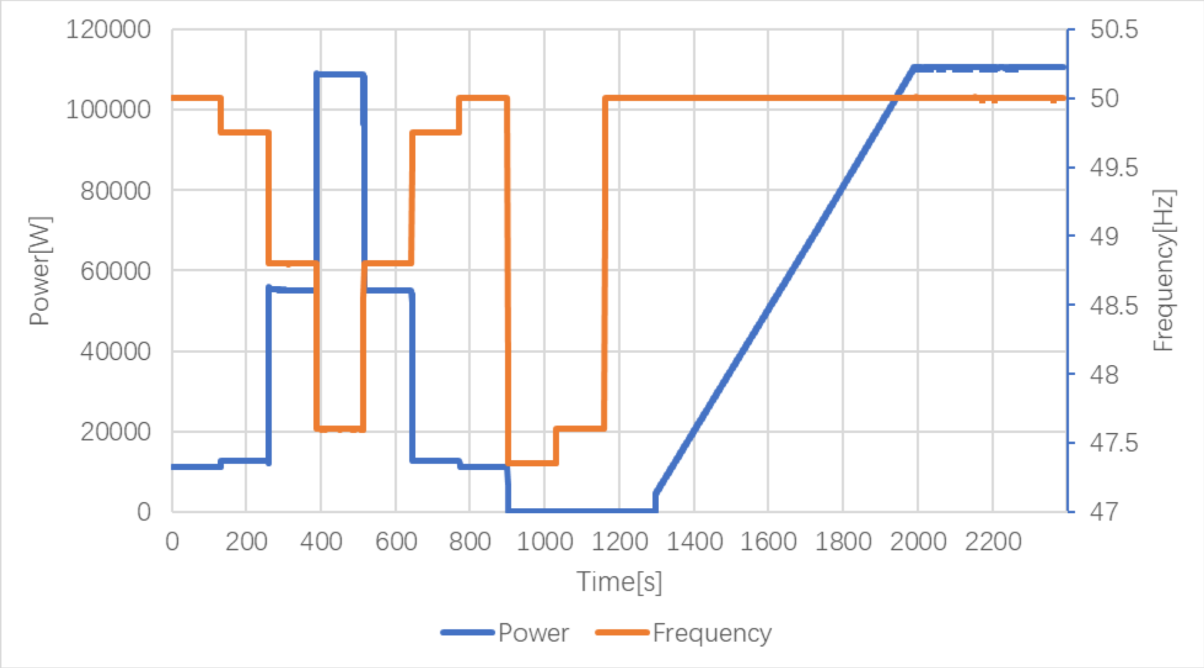
Test 2 P&F curve



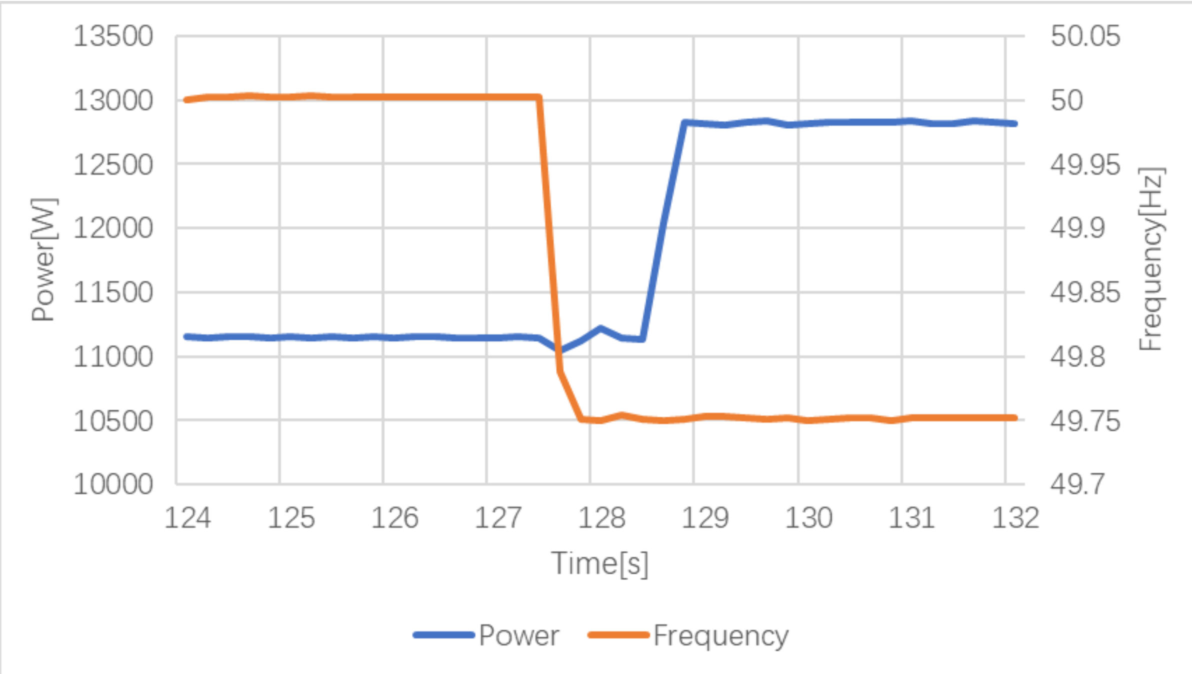
Response time

5.4.6	Active power supply at underfrequency							P
Test 1 Setting parameters of the EZE:P=10% Start of power reduction at 49.8 Hz	40%P_{Emax} (W)		44000		10%P_{Emax} (W)		11000	
	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 times Tan_90 % <2s	The settling times <20s
a) 50Hz ± 0.01Hz	50.00	10	11146.8	0.13	< ± 5%	--	--	--
b)49.75Hz ± 0.01Hz	49.75	12	12819.1	-0.35	< ± 10%	0.3	0.6	1.4
c)48.80Hz ± 0.01Hz	48.80	50	55162.7	0.15	< ± 10%	--	0.5	1.3
d)47.60Hz ± 0.01Hz	47.60	98	108771.9	0.88	< ± 10%	--	0.4	1.4
e)48.80Hz ± 0.01Hz	48.80	50	55113.0	0.10	< ± 10%	--	0.5	1.3
f)49.75Hz ± 0.01Hz	49.85	12	12817.3	-0.35	< ± 10%	--	0.4	1.1
g)50Hz ± 0.01Hz	50.00	10	11148.4	0.13	< ± 10%	--	--	--
h)47.35Hz± 0.01Hz	Disconnection Time[ms]: 100, Limitation[ms]: _200__							
i)47.60Hz± 0.01Hz	Reconnection: ☐ Yes/ ☒ No, Limitation: No reconnection is allowed.							
j)50.00Hz± 0.01Hz	Reconnection time: 133.4s Maximal Rising Gradient [%/min]: 8.62%, Limitation [%/min]: 10%							

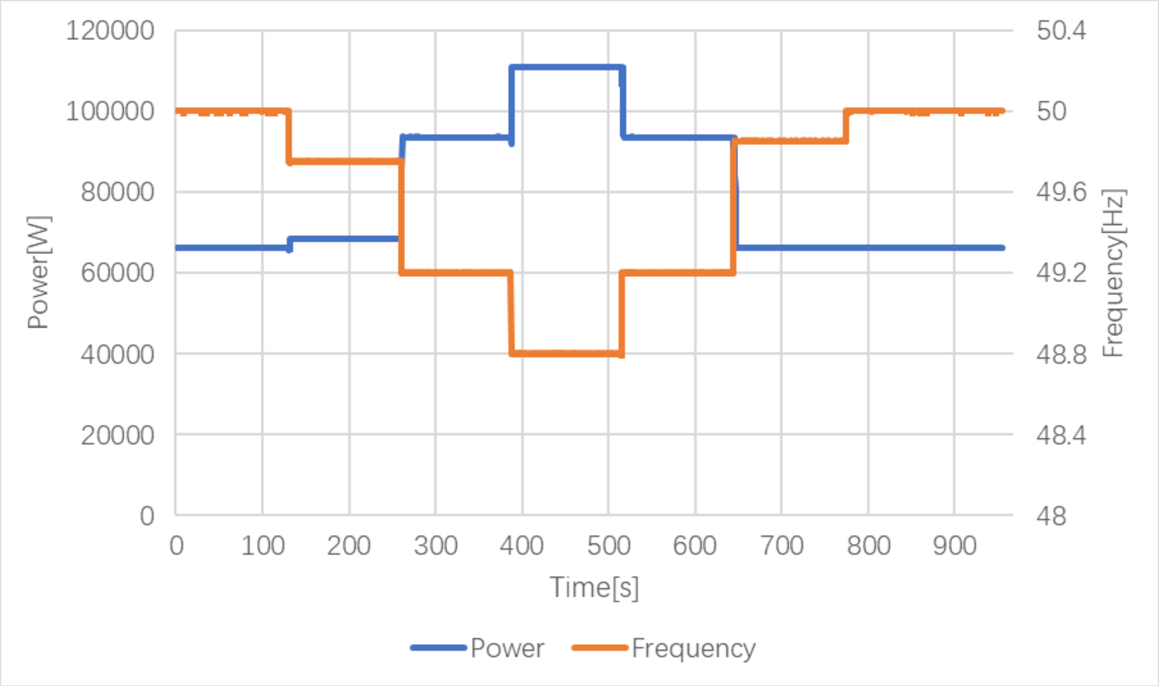
Test 2 Setting parameters of the EZE: P = 60% PEmax (The reduction of the primary energy supply to limit the active power output, or the limiting setting of the active power output must be removed from measuring point c) Start of power reduction at 49.8 Hz	40%P_{Emax} (W)		53200			10%P_{Emax} (W)		13300
	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 times $T_{an\_90\ \%}$ <2s	The settling times <20s
a)50Hz ± 0.01Hz	50.00	60	66238.5	0.22	< ± 5%	--	--	--
b)49.75Hz ± 0.01Hz	49.75	62	68485.1	0.26	< ± 10%	0.3	0.6	1.4
c)49.20Hz ± 0.01Hz	49.20	84	93604.4	1.09	< ± 10%	--	0.5	1.1
d)48.80Hz ± 0.01Hz	48.80	100	110871.2	0.79	< ± 10%	--	0.6	1.2
e)49.20Hz ± 0.01Hz	49.20	84	93605.4	1.10	< ± 10%	--	--	--
f)49.85Hz ± 0.01Hz	49.85	60	66234.4	0.21	< ± 10%	--	0.7	1.1
g)50Hz ± 0.01Hz	50.00	60	66232.6	0.21	< ± 10%	---	--	--



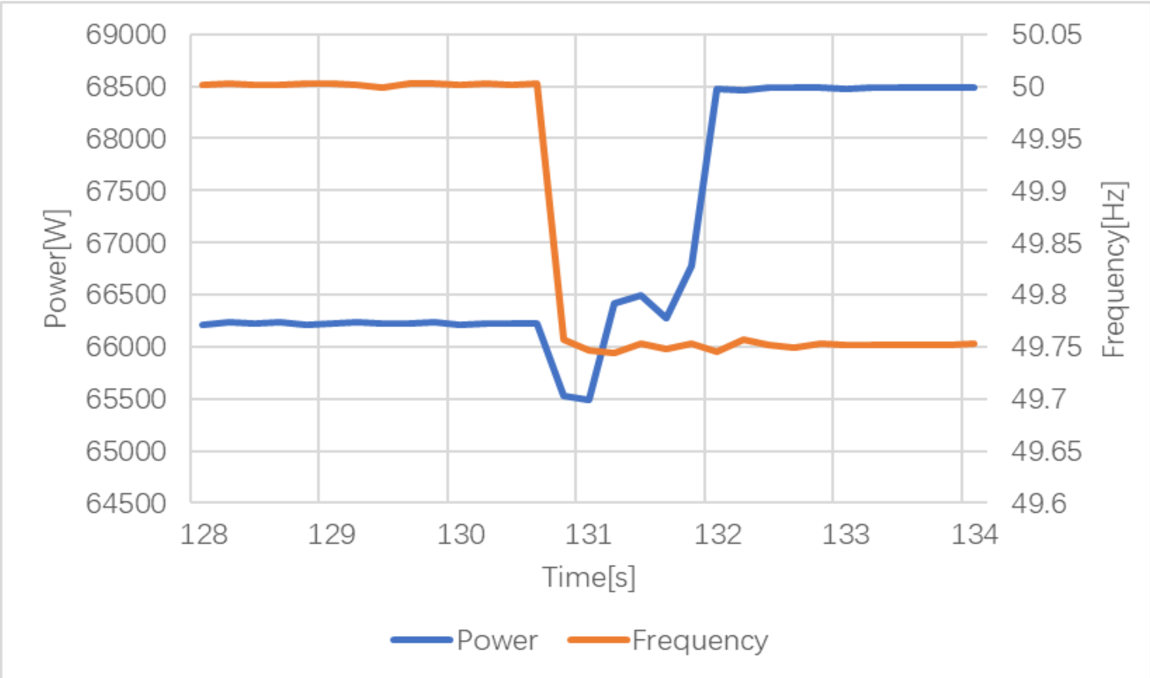
Test 1 P&F curve



Response time



Test 2 P&F curve

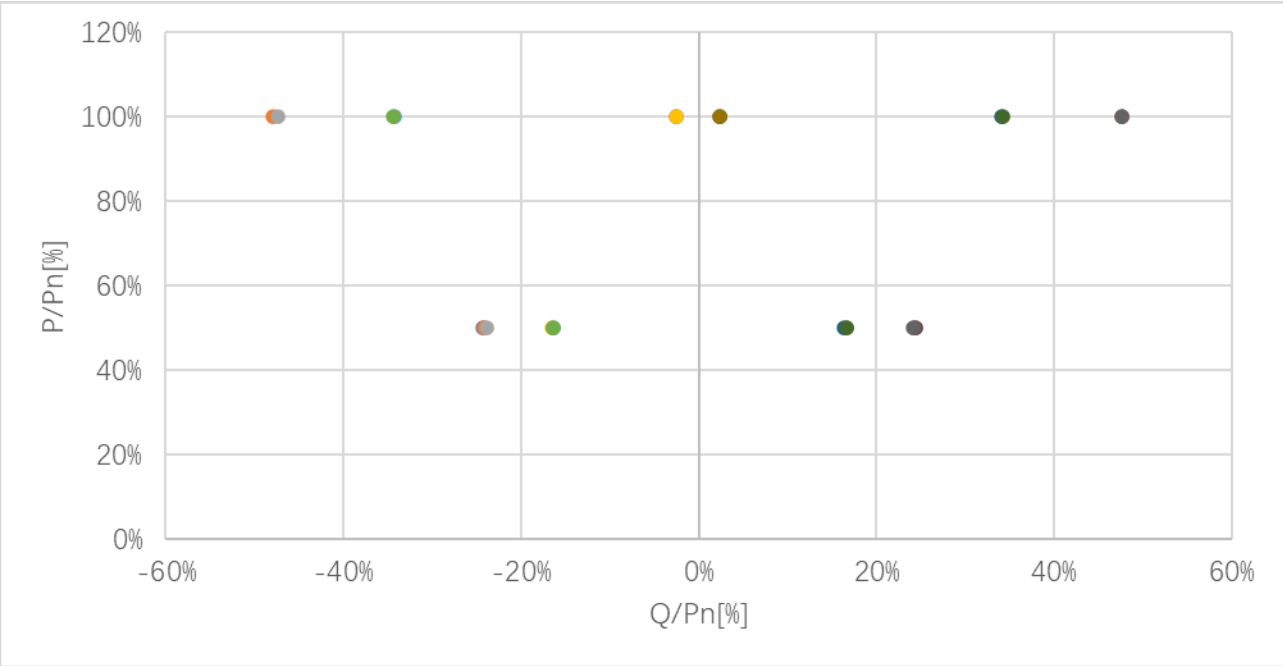


Response time

5.4.8.2	TABLE: Reactive power / displacement factor setting accuracy								P
	Cos$_φ$	Power	U [V]	P [W]	Q [Var]	S [VA]	cos ϕ	Δ Q / P_{Emax}	Limit Δ Q / P_{Emax}
☒ ∑ SEmax > 4.6kVA									
c)	0.90 under-excited	50%P_{Emax}	207.41	55459.49	-26679.26	61543.01	0.9012	-0.04	≤ ±4%
			230.36	54980.98	-26492.34	61030.79	0.9009	0.13	≤ ±4%
			253.34	55034.84	-26201.92	60953.89	0.9029	0.40	≤ ±4%
		S_{Emax}	207.68	109823.06	-2844.32	109860.27	0.9997	-2.59*	≤ ±4%
			230.69	109052.70	-52676.30	121108.70	0.9004	0.54	≤ ±4%
			253.62	108319.40	-52042.80	120173.10	0.9013	1.12	≤ ±4%
	0.95 under-excited	50%P_{Emax}	207.43	55448.66	-18147.22	58342.76	0.9504	0.85	≤ ±4%
			230.38	55352.68	-17963.76	58194.65	0.9512	1.02	≤ ±4%
			253.34	55126.97	-18061.08	58010.23	0.9503	0.93	≤ ±4%
		S_{Emax}	207.74	110023.06	-2754.32	110030.27	0.9997	-2.50*	≤ ±4%
			230.74	115431.50	-37691.72	121429.51	0.9506	0.43	≤ ±4%
			253.68	115514.04	-37843.25	121555.04	0.9503	0.29	≤ ±4%
d)	0.90 over-excited	50%P_{Emax}	207.47	55915.08	26851.84	62028.37	0.9014	0.19	≤ ±4%
			230.42	55393.36	26745.32	61512.11	0.9005	0.10	≤ ±4%
			253.38	55178.89	26582.28	61248.10	0.9008	-0.05	≤ ±4%
		S_{Emax}	207.77	110107.06	2654.32	110123.27	0.9997	2.41*	≤ ±4%
			230.77	109049.90	52290.95	120938.96	0.9017	-0.89	≤ ±4%
			253.69	107852.85	52297.02	119863.35	0.8998	-0.89	≤ ±4%
	0.95 over-excited	50% P_{Emax}	207.47	55744.83	18220.07	58646.90	0.9505	-0.78	≤ ±4%
			230.42	55300.05	17889.30	58121.64	0.9515	-1.08	≤ ±4%
			253.38	55095.02	18246.24	58037.82	0.9493	-0.76	≤ ±4%
		S_{Emax}	207.81	100907.05	2627.31	100923.21	0.9997	2.39*	≤ ±4%
			230.81	115501.53	37460.25	121424.37	0.9512	-0.64	≤ ±4%
			253.74	114527.20	37685.80	120568.25	0.9499	-0.43	≤ ±4%

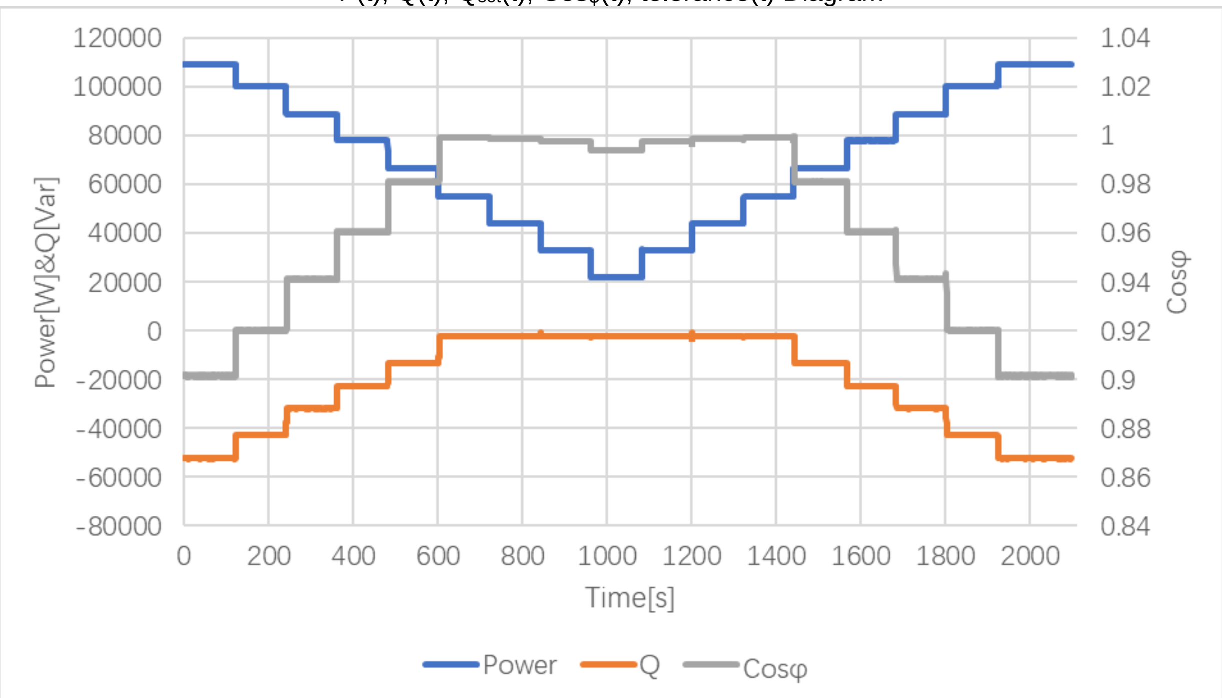
Remark:
* Pass for voltage-reactive restriction.

P-Q Diagram

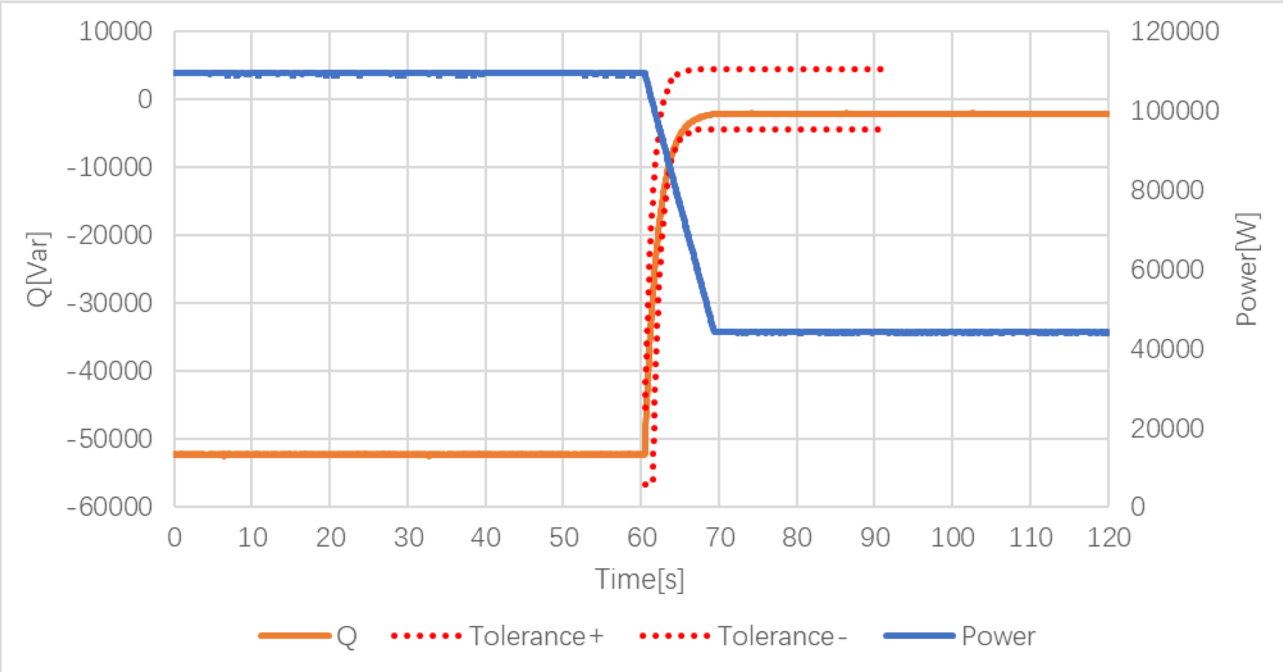


5.4.8.3	TABLE: Testing the displacement factor / active power characteristic curve Cos$_{\varphi}$(P)						P
3) Test steps for supply-dependent EZE accuracy (characteristic curve)							
Step	Pdc[W]	P[W]	Q[Var]	Cosϕ	Qdesired	∆ Q / P_{Emax}	Limitation
100%	112784.3	109016.0	-52268.6	0.9017	-53273.0	0.91	± 4%
90%	103356.2	100087.9	-42553.8	0.9203	-42173.8	-0.35	± 4%
80%	91594.4	88786.7	-31878.8	0.9412	-31939.7	0.06	± 4%
70%	80283.0	77901.1	-22586.9	0.9604	-22458.3	-0.12	± 4%
60%	68261.4	66404.8	-13130.3	0.9810	-13401.9	0.25	± 4%
50%	56679.5	55128.6	-2176.4	0.9992	0	-1.98	± 4%
40%	45279.8	44122.2	-2165.3	0.9988	0	-1.97	± 4%
30%	33988.8	33116.8	-2246.6	0.9977	0	-2.04	± 4%
20%	22497.5	21868.8	-2403.9	0.9940	0	-2.19	± 4%
30%	33973.5	33115.7	-2249.2	0.9977	0	-2.04	± 4%
40%	45222.4	44123.9	-2165.5	0.9988	0	-1.97	± 4%
50%	56521.4	55132.7	-2178.6	0.9992	0	-1.98	± 4%
60%	68107.9	66408.2	-13126.8	0.9810	-13401.9	0.25	± 4%
70%	79987.6	77875.5	-22569.4	0.9605	-22458.3	-0.10	± 4%
80%	91419.3	88791.9	-31876.8	0.9412	-31939.7	0.06	± 4%
90%	103306.8	100090.2	-42554.8	0.9203	-42173.8	-0.35	± 4%
100%	112806.5	109022.1	-52271.5	0.9017	-53273.0	0.91	± 4%

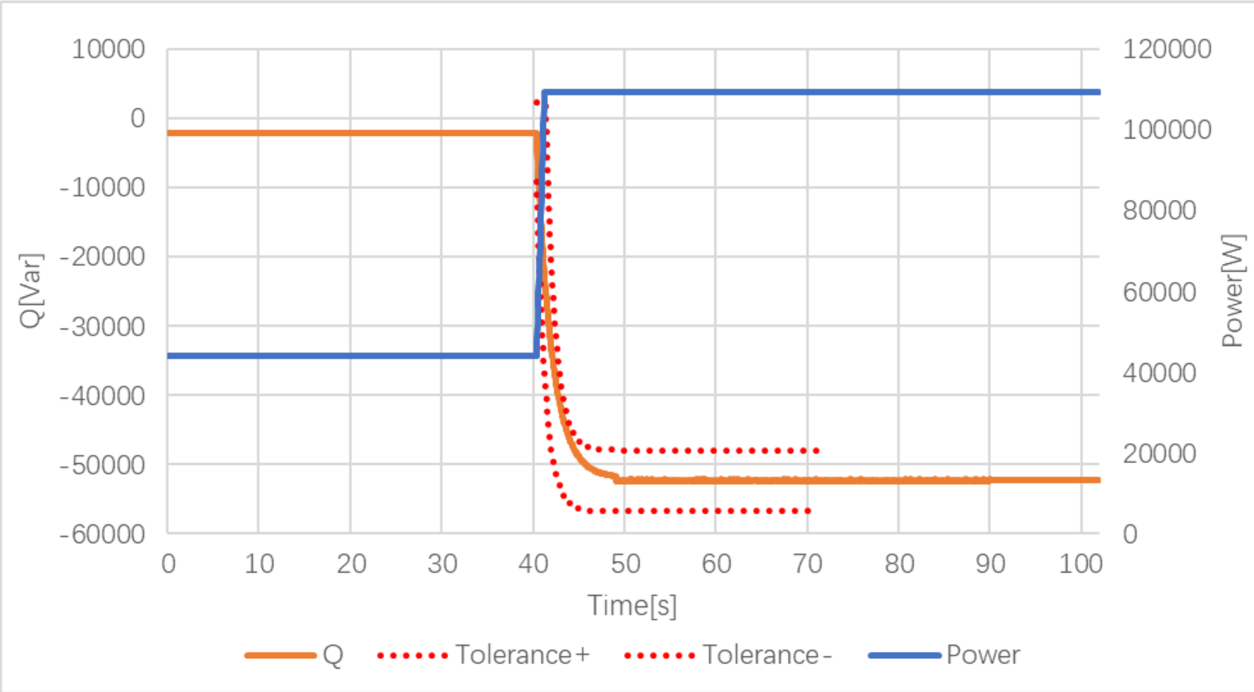
P(t), Q(t), Q_{set}(t), Cos$_{\varphi}$(t), tolerance(t) Diagram



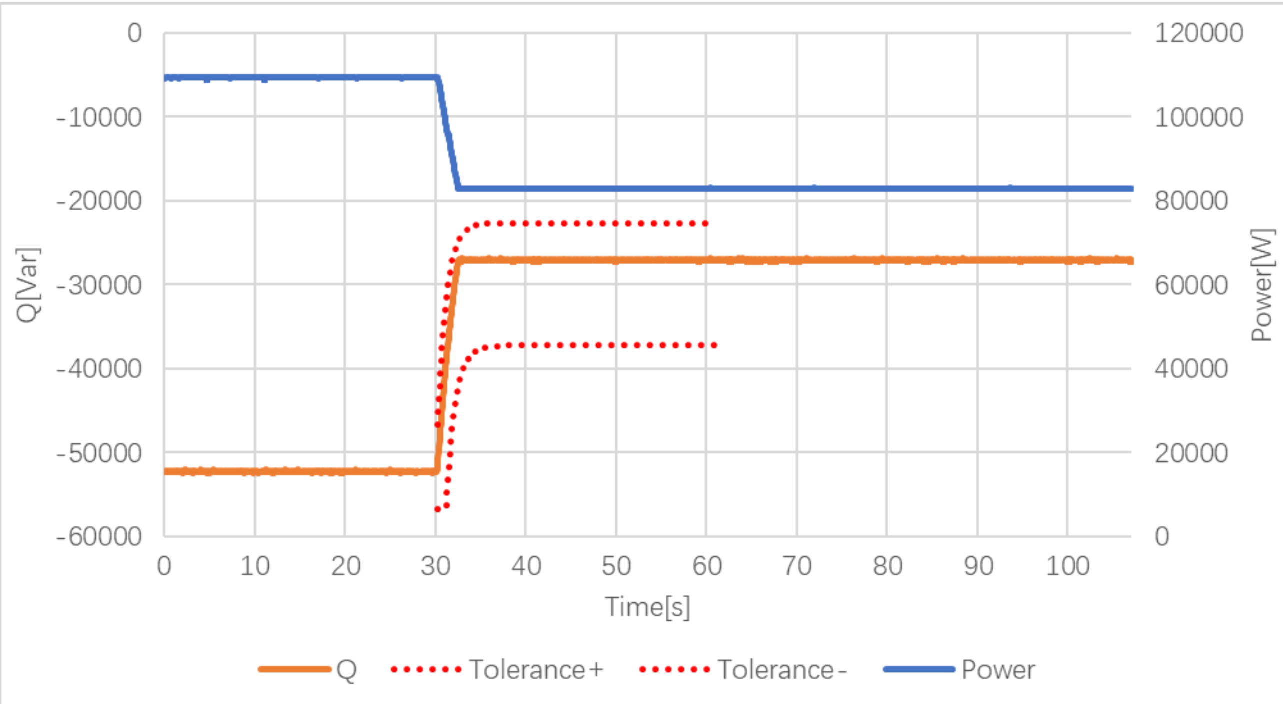
4) Test steps for supply-dependent EZE-dynamics		
P/ Pn [%]	Duration [s]	Dynamic as PT1 character ?
100	60	--
40	60	☒ Pass ☐ Failed
100	60	☒ Pass ☐ Failed
75	60	☒ Pass ☐ Failed



Power from 100% to 40% with PT1 character



Power from 40% to 100% with PT1 character

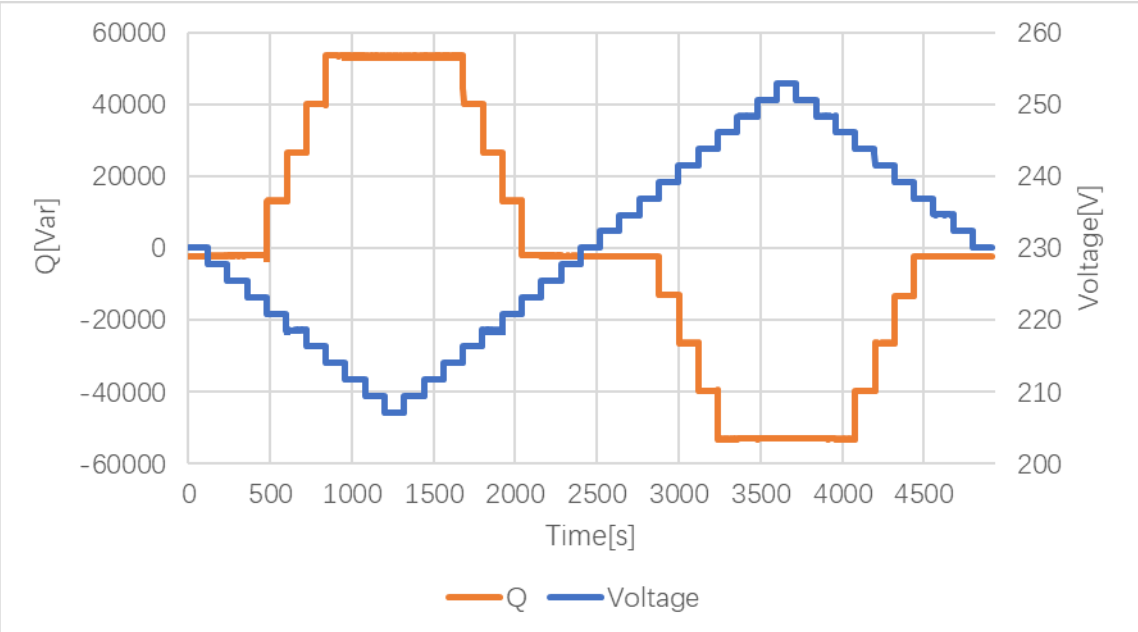


Power from 100% to 75% with PT1 character

5.4.8.4	TABLE: Checking the reactive power voltage characteristic Q(U)				P
5.4.8.4.1 Checking the accuracy of the Q (U) control					
Qmax = 53273 Var					
Voltage Setting U_{PGU}	Target Q_{PGU} [Var]	Measurement Q_{PGU} [Var]	Measurement U_{PGU} [V]	Δ Q_{PGU} [Var]	Limitation Δ Q [Var]
100%Un	0.00	-2178.5	230.10	-2178.5	±4400
99%Un	0.00	-2147.4	227.75	-2147.4	±4400
98%Un	0.00	-2112.5	225.40	-2112.5	±4400
97%Un	0.00	-2077.2	223.10	-2077.2	±4400
96%Un	13318.3	13186.8	220.82	-131.5	±4400
95%Un	26636.5	26423.1	218.55	-213.4	±4400
94%Un	39954.7	40063.1	216.27	108.4	±4400
93%Un	53273	53565.2	214.10	292.2	±4400
92%Un	53273	53547.3	211.59	274.3	±4400
91%Un	53273	53561.7	209.55	288.7	±4400
90%Un	53273	53538.6	207.19	265.6	±4400
91%Un	53273	53557.3	209.47	284.3	±4400
92%Un	53273	53548.9	211.63	275.9	±4400
93%Un	53273	53497.4	213.98	224.4	±4400
94%Un	39954.7	40107.4	216.28	152.7	±4400
95%Un	26636.5	26632.5	218.53	-4	±4400
96%Un	13318.3	13195.2	220.83	-123.1	±4400
97%Un	0.00	-2086.3	223.08	-2086.3	±4400
98%Un	0.00	-2123.4	225.40	-2123.4	±4400
99%Un	0.00	-2097.2	227.69	-2097.2	±4400
100%Un	0.00	-2108.3	230.47	-2108.3	±4400
101%Un	0.00	-2088.3	232.37	-2088.3	±4400
102%Un	0.00	-2115.6	234.71	-2115.6	±4400
103%Un	0.00	-2096.3	236.88	-2096.3	±4400
104%Un	-13318.3	-13140.2	239.30	178.1	±4400
105%Un	-26636.5	-26441.3	241.62	195.2	±4400
106%Un	-39954.7	-39656.7	243.88	298	±4400
107%Un	-53273	-53156.9	246.38	116.1	±4400
108%Un	-53273	-53313.7	248.54	-40.7	±4400
109%Un	-53273	-53265.8	250.87	7.2	±4400
110%Un	-53273	-53307.3	253.15	-34.3	±4400

109%Un	-53273	-53315.7	250.87	-42.7	±4400
108%Un	-53273	-53298.5	248.59	-25.5	±4400
107%Un	-53273	-53324.5	246.37	-51.5	±4400
106%Un	-39954.7	-39661.9	243.91	292.8	±4400
105%Un	-26636.5	-26446.0	241.61	190.5	±4400
104%Un	-13318.3	-13255.9	239.38	62.4	±4400
103%Un	0.00	-2240.3	236.88	-2240.3	±4400
102%Un	0.00	-2158.5	234.78	-2158.5	±4400
101%Un	0.00	-2184.2	232.45	-2184.2	±4400
100%Un	0.00	-2237.8	230.51	-2237.8	±4400

Q(U) Diagram



5.4.8.4.2 Checking the dynamics of the Q (U) control

X_{net} value: 0.0764

K_{RR} value: 4.9235

Voltage Setting U_{PGU}	Target Q	Measurement Q_{SOll} [Var]	Measurement Q_{Start} [Var]	Response time T_{MESS} [s]	Parameterized response time T (s)	Dynamic as PT1
Reach to initial status, Q_{EZE} = 0						
Un + $\Delta U_{ind,Y}$	Inductive, 0.95Qmax	-52427.8	-2140.9	7.7	10	☒ Pass ☐ Failed
Return to initial status, stationary operation for 1min, Q_{EZE} = 0						
Un + $\Delta U_{ind,Y}$	Inductive, 0.95Qmax	-52386.4	-2037.7	7.8	10	☒ Pass ☐ Failed
Return to initial status, stationary operation for 1min, Q_{EZE} = 0						
Un + $\Delta U_{ind,Y}$	Inductive,	-52486.4	-2085.4	7.8	10	☒ Pass

	0.95Qmax					☐ Failed
Return to initial status, stationary operation for 1min, Q_{EZE} = 0						
Un +$\Delta U_{Cap,Y}$	Capacitive, 0.95Qmax	52853.7	-2127.8	7.9	10	☒ Pass ☐ Failed
Return to initial status, stationary operation for 1min, Q_{EZE} = 0						
Un+ $\Delta U_{Cap,Y}$	Capacitive, 0.95Qmax	53005.7	-2017.4	7.9	10	☒ Pass ☐ Failed
Return to initial status, stationary operation for 1min, Q_{EZE} = 0						
Un +$\Delta U_{Cap,Y}$	Capacitive, 0.95Qmax	52975.7	-2157.8	8.0	10	☒ Pass ☐ Failed

Remark:

Xnet = 0.0218*3*U_{NY}^2 / (0.85*|Q_{max}|)

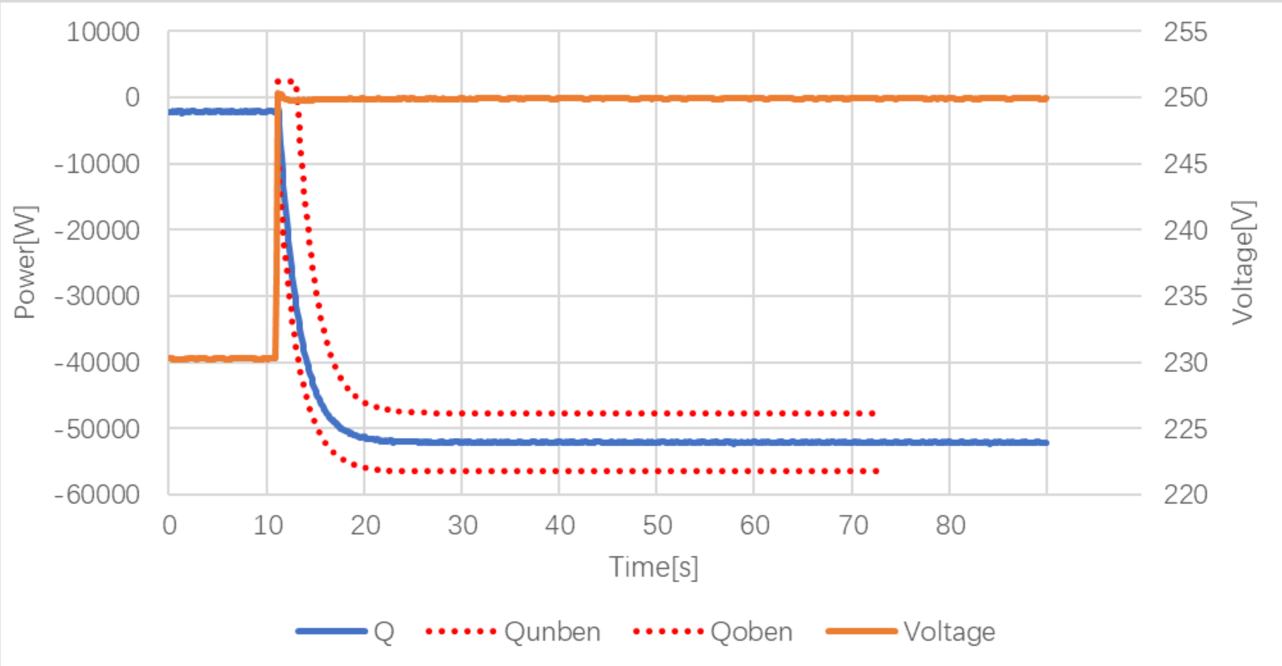
$\Delta U_{ind,Y}$ = 1.03*U_{NY} - U_{PGU} + (Xnet / (3*$U_{N,Y}$) + 1 / k_{QU}) * 0.85 * |Q_{max}|

$\Delta U_{Cap,Y}$ = 0.97*U_{NY} - U_{PGU} - (Xnet / (3*$U_{N,Y}$) + 1 / k_{QU}) * 0.85 * |Q_{max}|

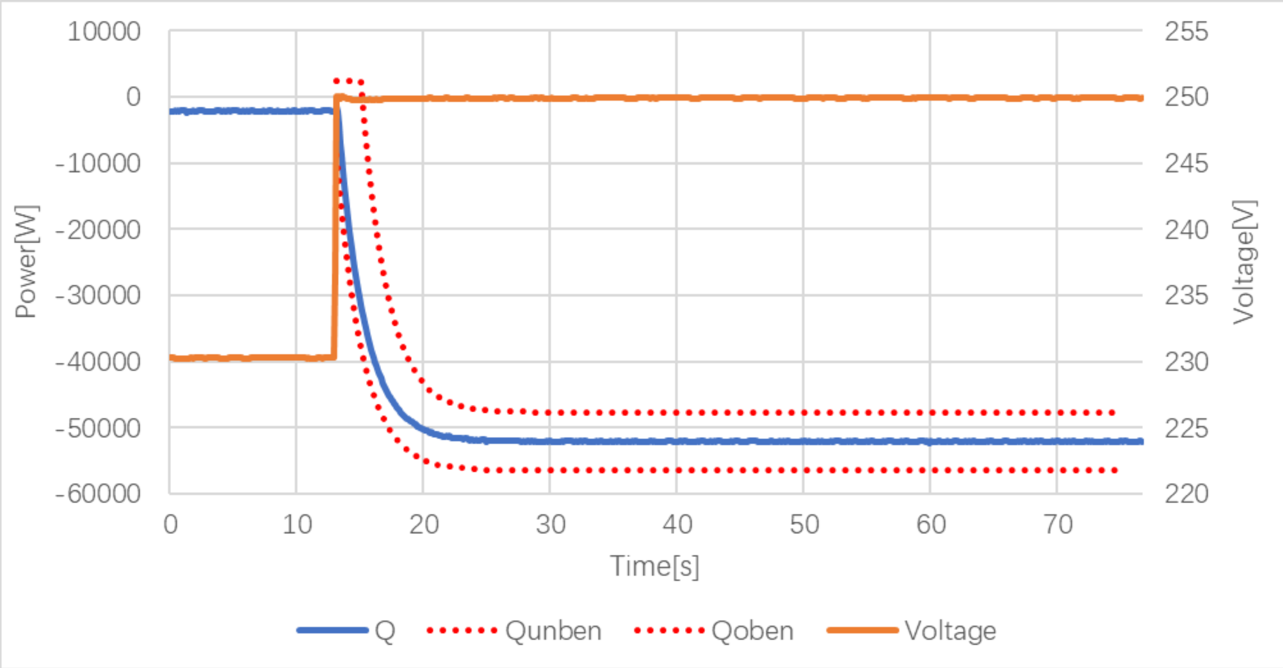
k_{QU} = |Q_{max}| / (0.04*U_{NY})

K_{RR} =3 + |Q_{max}| * Xnet / 0.04* U_{NY}^2

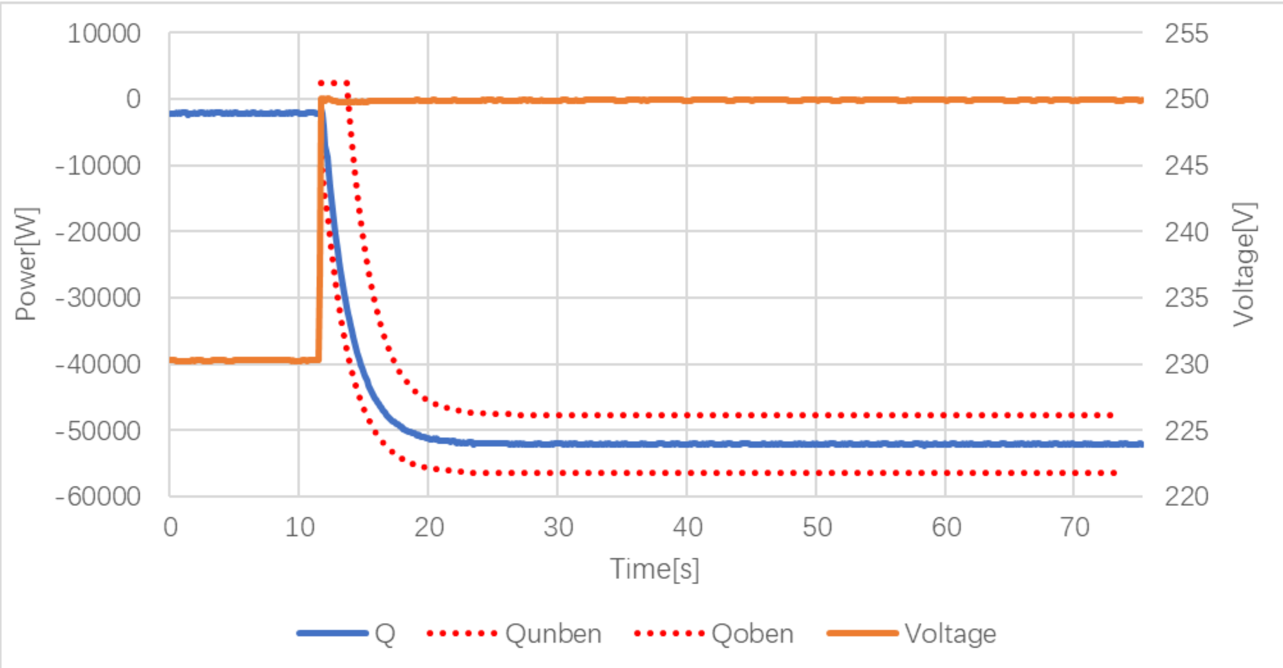
Q(t), Q_{set}(t),tolerance(t) Diagram



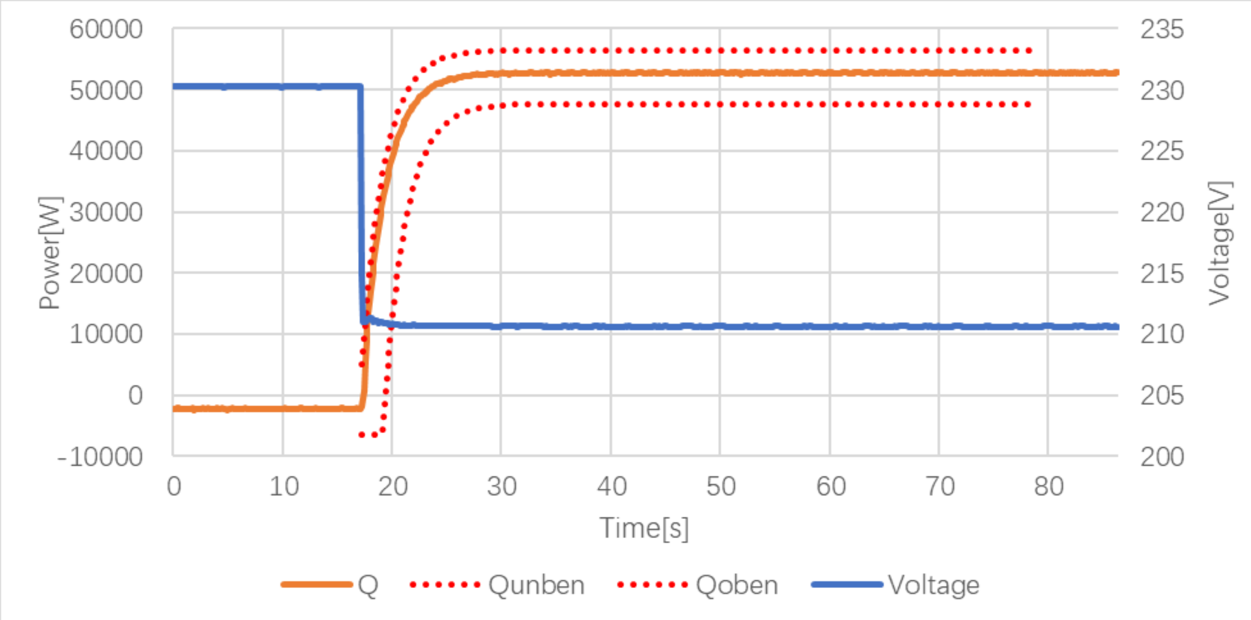
First time



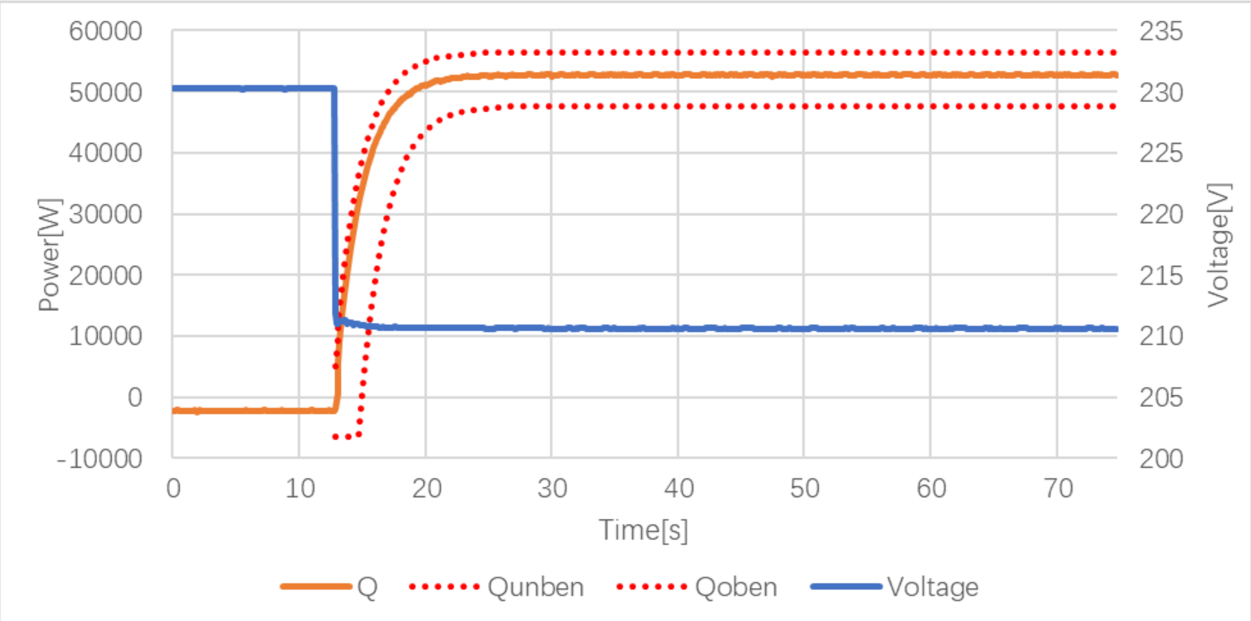
Second time



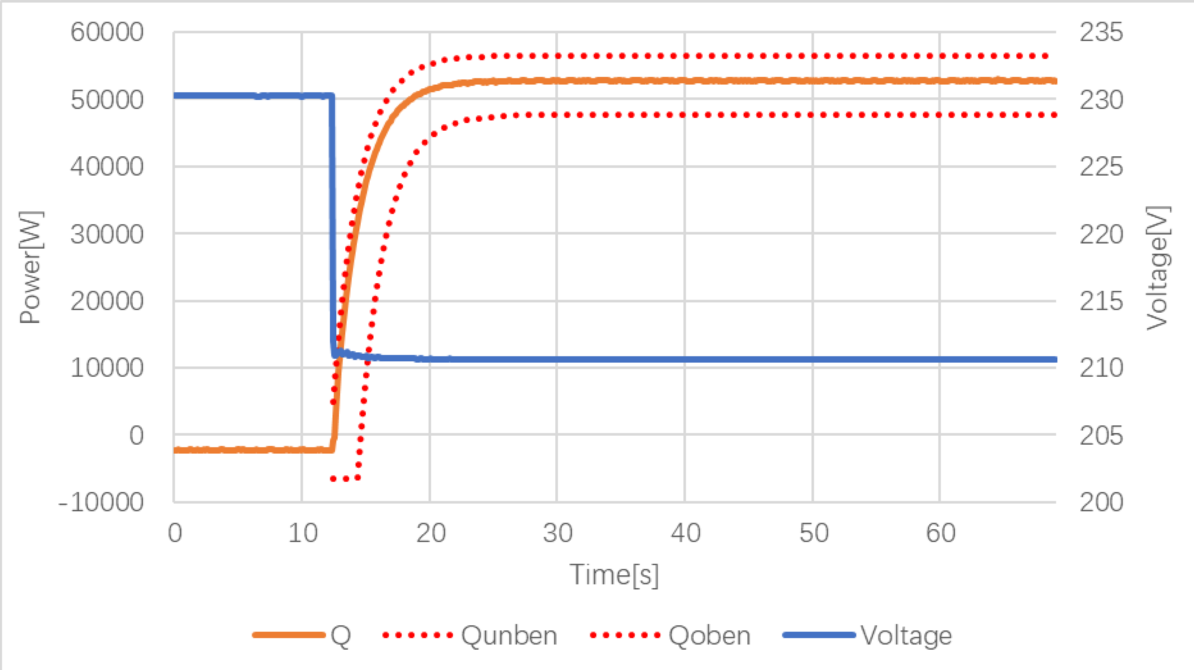
Third time



First time



Second time

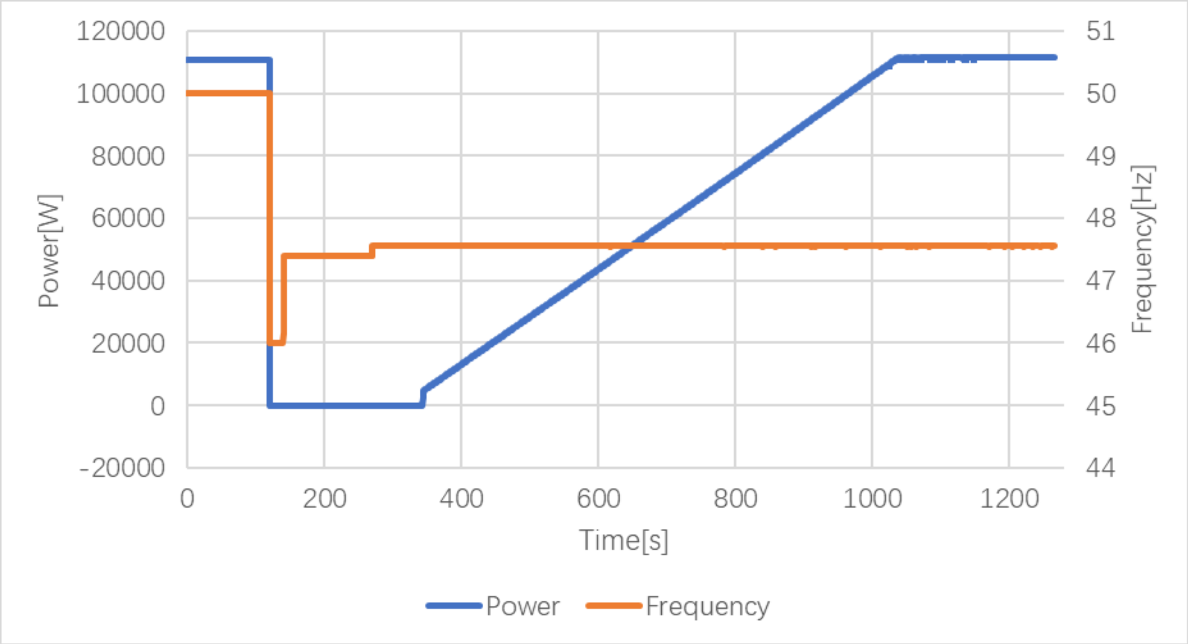


60000
50000
40000
30000
20000
10000
0
-10000
Power[W]
235
230
225
220
215
210
205
200
Voltage[V]
0
10
20
30
40
50
60
Time[s]
Q
Qunben
Qoben
Voltage

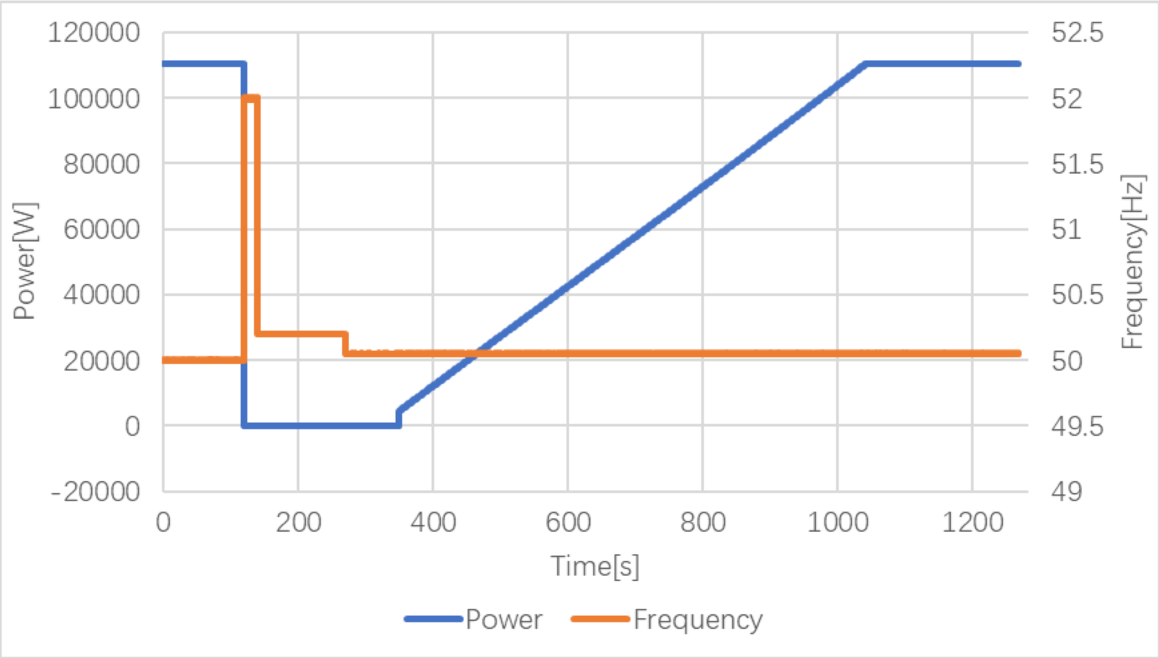
Third time

5.6	Connection conditions and synchronization		P
DC input:	AC output:	Rated Output Power	
755Vdc	230Vac; 50Hz	110.0kW	
Measure Item	Reconnection?	Reconnection Time (>60s)	
f_{ist} <47.45Hz	☐ Yes ☒ No	Cannot reconnection	
f_{ist} ≥ 47.55Hz	☒ Yes ☐ No	70.4s	
f_{ist} > 50.15Hz	☐ Yes ☒ No	Cannot reconnection	
f_{ist} ≤ 50.05Hz	☒ Yes ☐ No	76.6s	
U_{ist} < 84% U_n	☐ Yes ☒ No	Cannot reconnection	
U_{ist} ≥ 86% U_n	☒ Yes ☐ No	76.8s	
U_{ist} > 111% U_n	☐ Yes ☒ No	Cannot reconnection	
U_{ist} ≤ 109% U_n	☒ Yes ☐ No	70.6s	

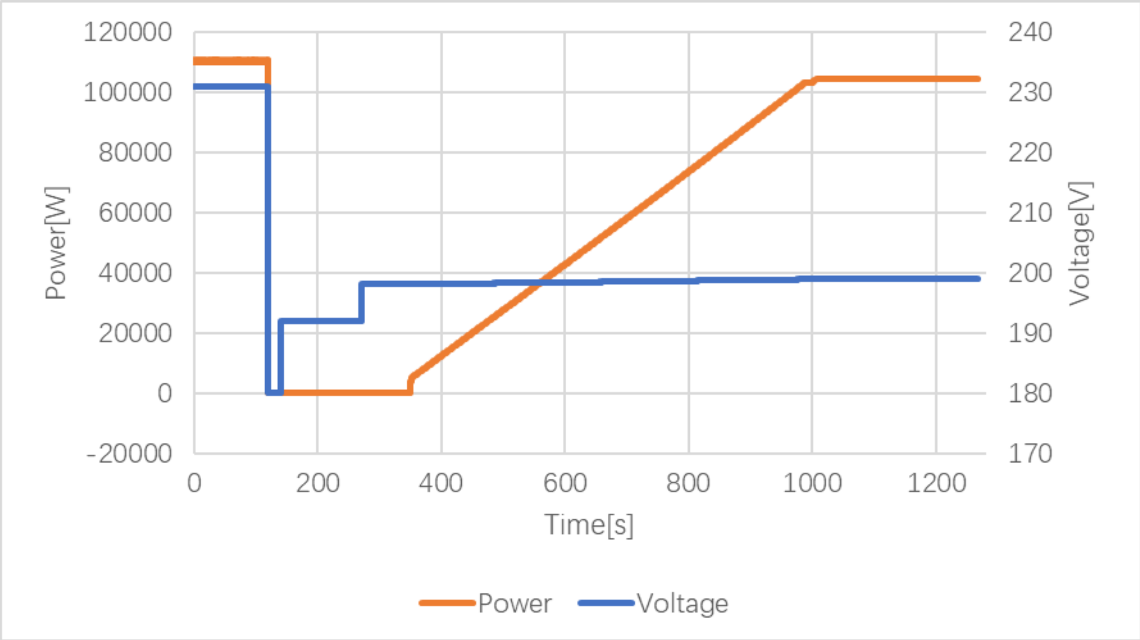
Graph of the gradual power supply and reconnection: for 47.55Hz



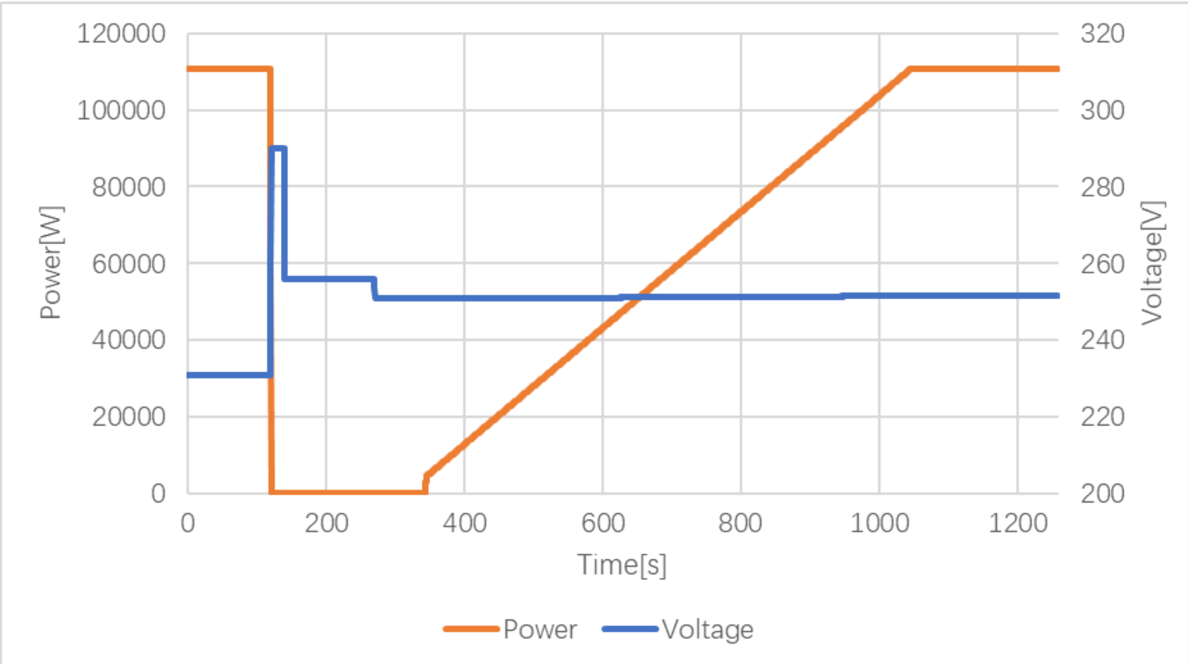
Graph of the gradual power supply and reconnection: for 50.05Hz



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

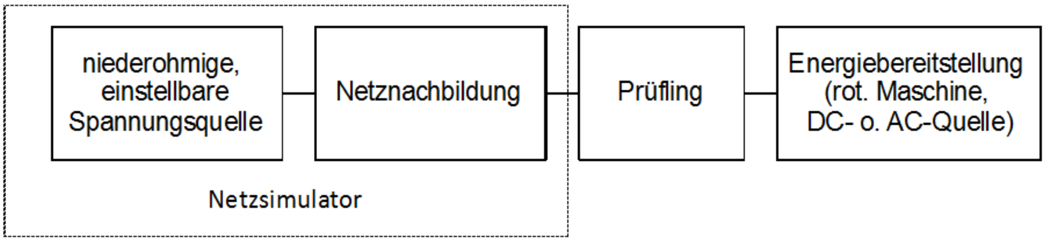


Graph of the gradual power supply and reconnection: for 109%Un



5.8	Dynamic Network support	P

Test equipment:

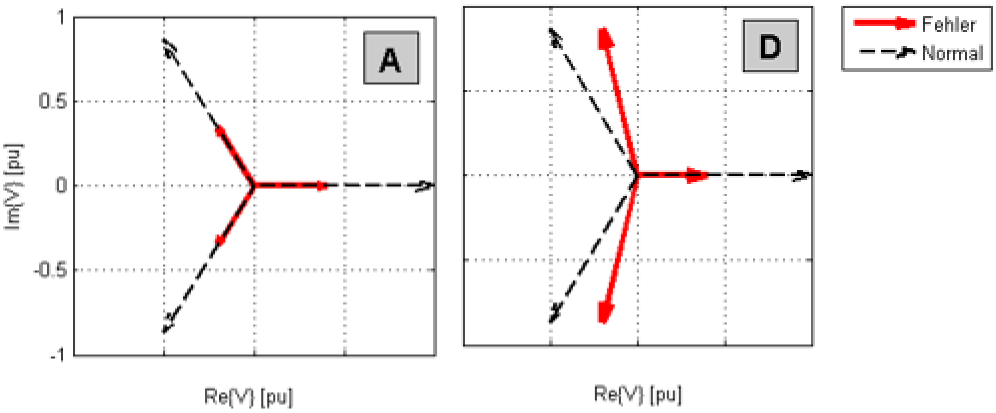


The effective network impedance from view of PGU must fulfill following criterion:
- short-circuited power at PGU before and after fault must be between 10xSn and 30xSn
- R/X 0.3-3 (for applied impedance in test equipment)

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

VDE No.	U	V	W	Type	Remark
--	1.00, -150°	1.00, 90°	1.00, -30°	A	Initial status

1.3, 1.4	0.62, -173.3°	0.15, 90°	0.62, -6.9°	D	UVRT
2.3, 2.4, 3.3, 3.4	0.76, -161.1°	0.50, 90°	0.76, -19.1°	D	
4.3, 4.4	0.93, -152.8°	0.85, 89.9°	0.93, -27.4°	D	
5.3, 5.4	1.08, -144.5°	1.25, 89.1°	1.06, -36.3°	D	OVRT
6.3, 6.4	1.06, -145.5°	1.20, 89.3°	1.05, -35.1°	D	
7.3, 7.4	1.04, -146.6°	1.15, 89.4°	1.04, -33.9°	D	

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:

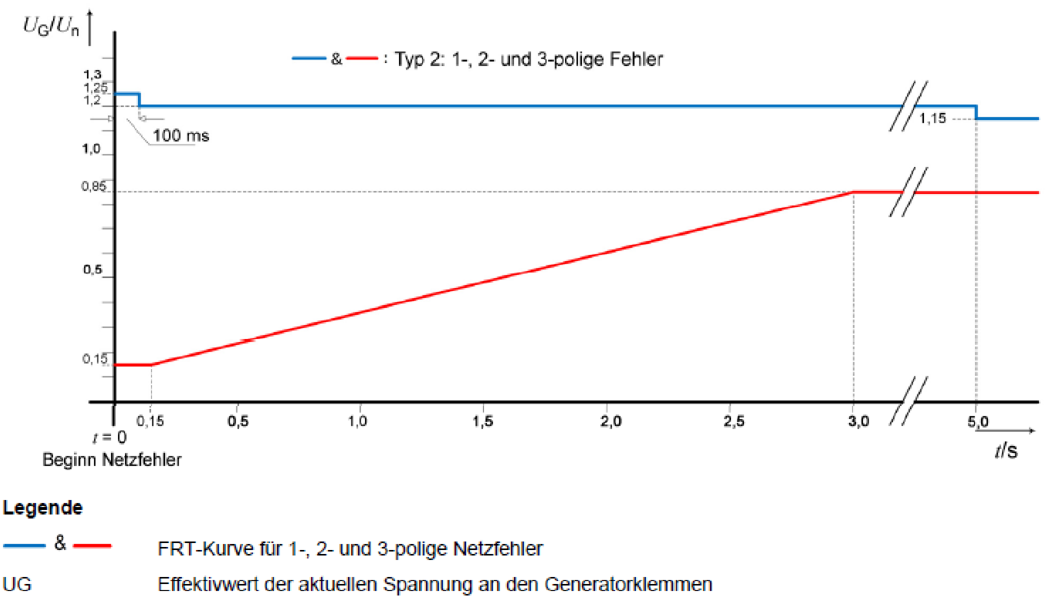
Empty load tests:

- 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:



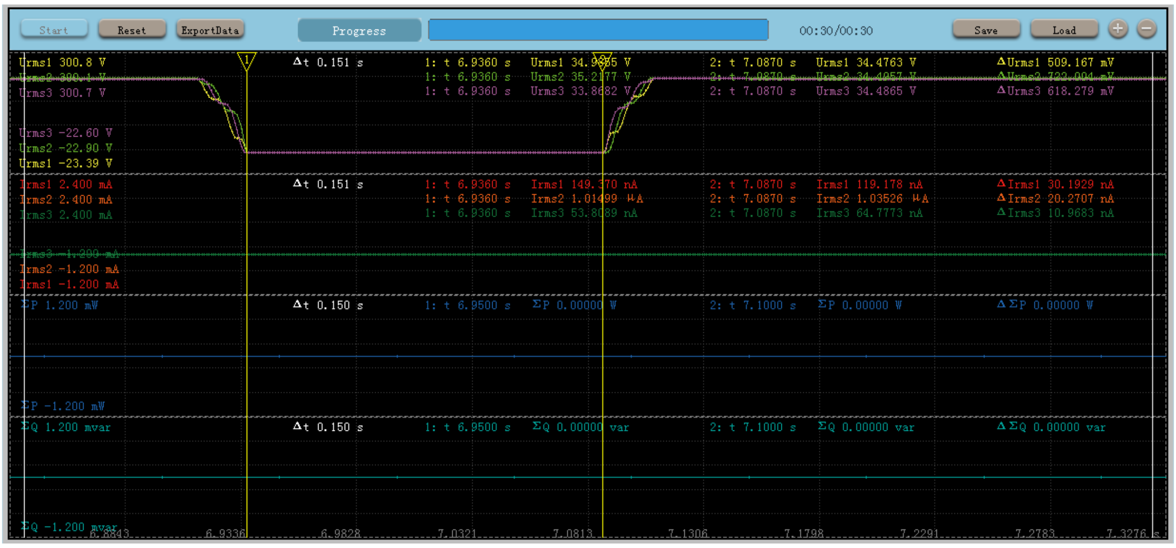
Method of calculations:

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 $T*f_S$.	$\underline{U}_1 = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} u(n) \cdot e^{-j(\frac{2 \cdot \pi \cdot n}{N})}$ $\underline{I}_1 = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} i(n) \cdot e^{-j(\frac{2 \cdot \pi \cdot n}{N})}$	- 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]					300K			
NS protection settings					See table 2 in VDE-AR-N 4105:2018			
	No.	Parameter	Phase ref.	Time ref.	unit	Result		
General Info.	0	Test number	--	--	--	1.1	2.1	3.1
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022		
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph		
	3	Fault type (phase)	--	--		A	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.15	0.5	0.5
	5	Setting dip duration		--	ms	150	1500	1500
	6	Point of fault entry	Total	--	ms	See graph		
	7	Point of fault clearance	Total	--	ms	See graph		
	8	Fault duration in empty load test	Total	--	ms	151.0	1501.0	1501.0
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15	0.5	0.5
	10		Positive sequence		p.u.	0.15	0.5	0.5
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.01	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	1.001	1.106	1.109
	13	Active power	Total	t1-10s to t1	p.u.	1.009	1.003	1.001
	14		Positive sequence			1.009	1.003	1.001
	15	Reactive power	Total	t1-10s to t1	p.u.	0.027	0.469	-0.482
	16		Positive sequence			0.027	0.469	-0.482
	17	Cos_{φ}	--	t1-10s to t1	--	1.0000	0.9027	0.9012
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15	0.50	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.005	0.015	0.017
	20		Phase 2			0.005	0.015	0.017

	21		Phase 3			0.005	0.015	0.017
	22	Line current	Phase 1	t1+100ms	p.u.	0.005	0.015	0.017
	23		Phase 2			0.005	0.015	0.017
	24		Phase 3			0.005	0.015	0.017
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.001	0.001
	26		Positive sequence			0.001	0.001	0.001
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	1.009	0.995	1.001
	29		Total			1.009	0.995	1.001
	39	Active power rising time	Positive sequence	--	s	0.467	0.483	0.467
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	-0.025	0.455	-0.467
	32		Total			-0.025	0.455	-0.467
	33	Reactive power rising time	Positive sequence	--	s	0.078	9.910	9.518
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes		

Graph of Test number 1.1

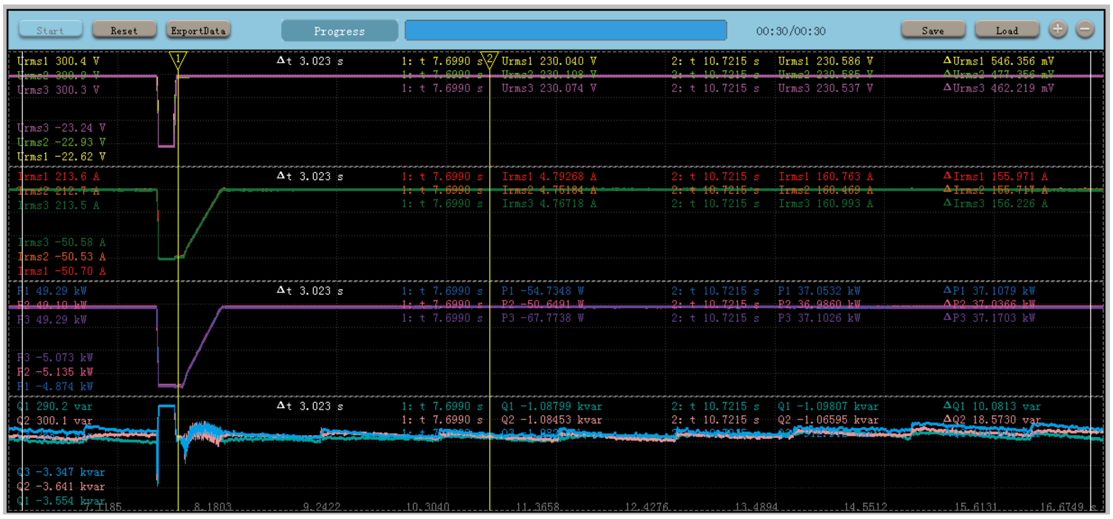


Empty load

Before dip (t1-100ms)

During dip (t1+60ms)

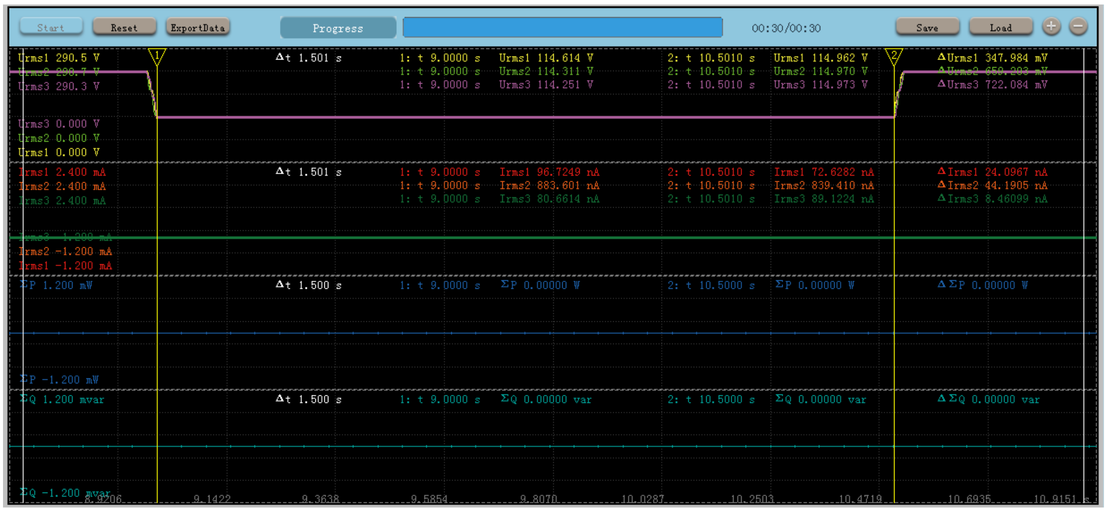
During dip (t1+100ms)



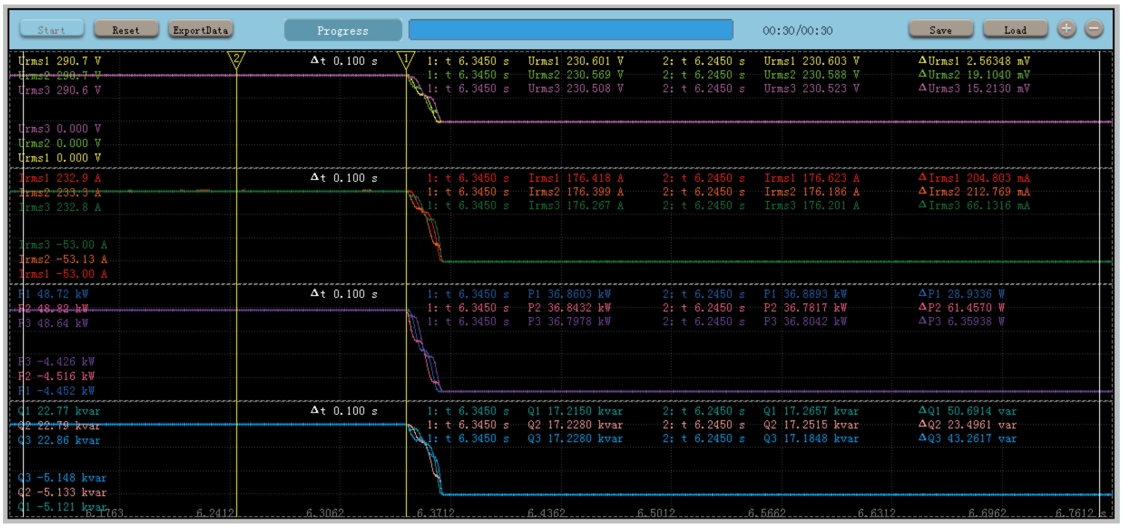
After dip (t2+3s)

Active power recovery time

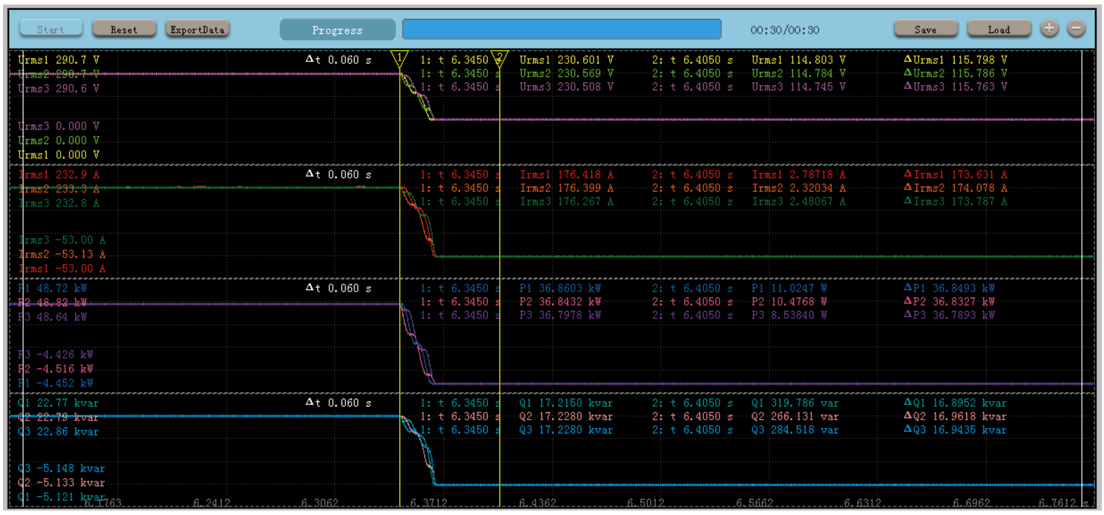
Graph of Test number 2.1



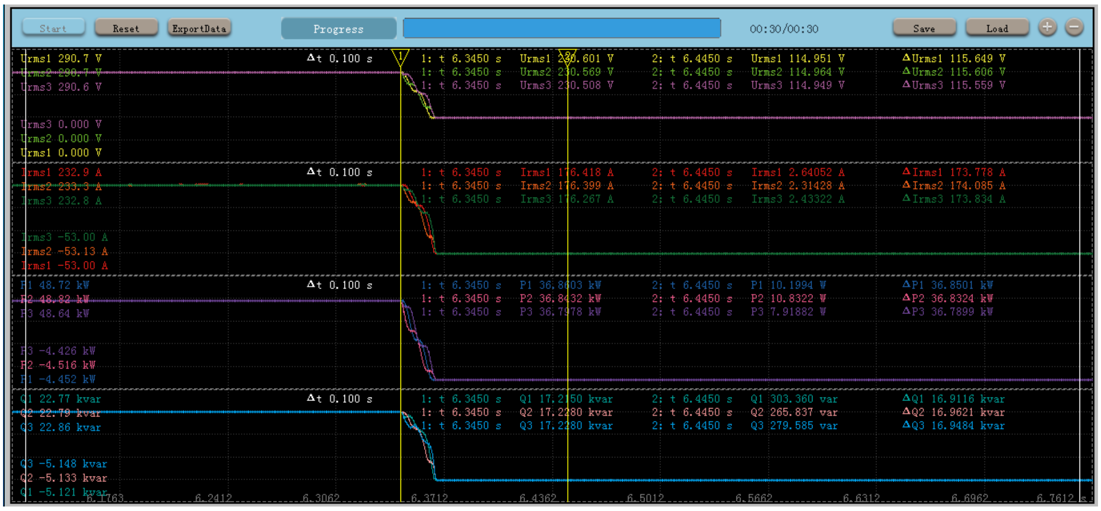
Empty load



Before dip (t1-100ms)

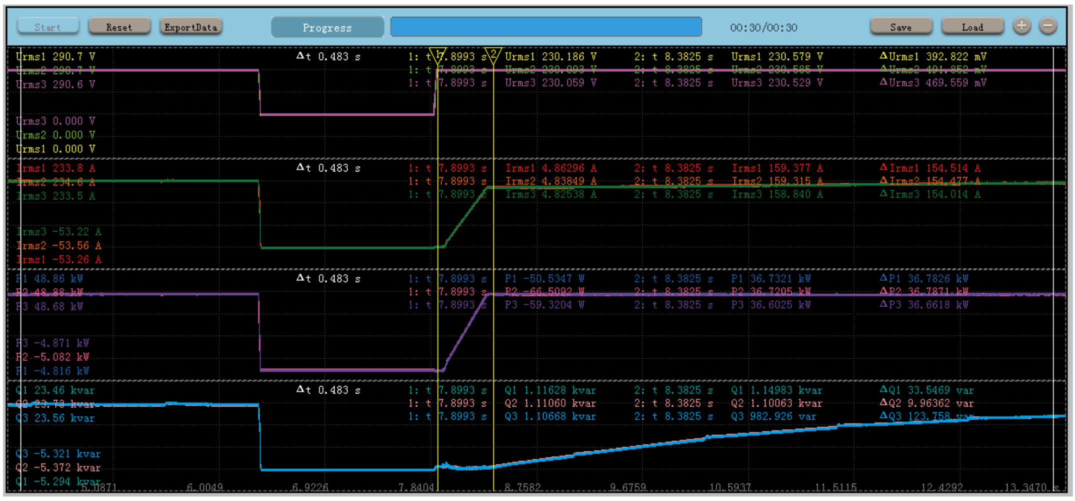


During dip (t1+60ms)

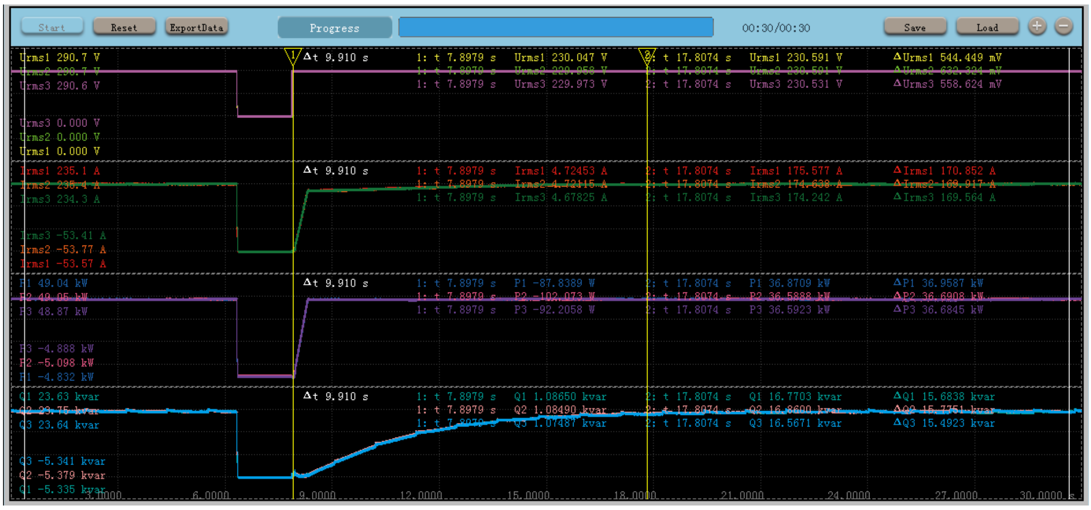


During dip (t1+100ms)

After dip (t2+3s)

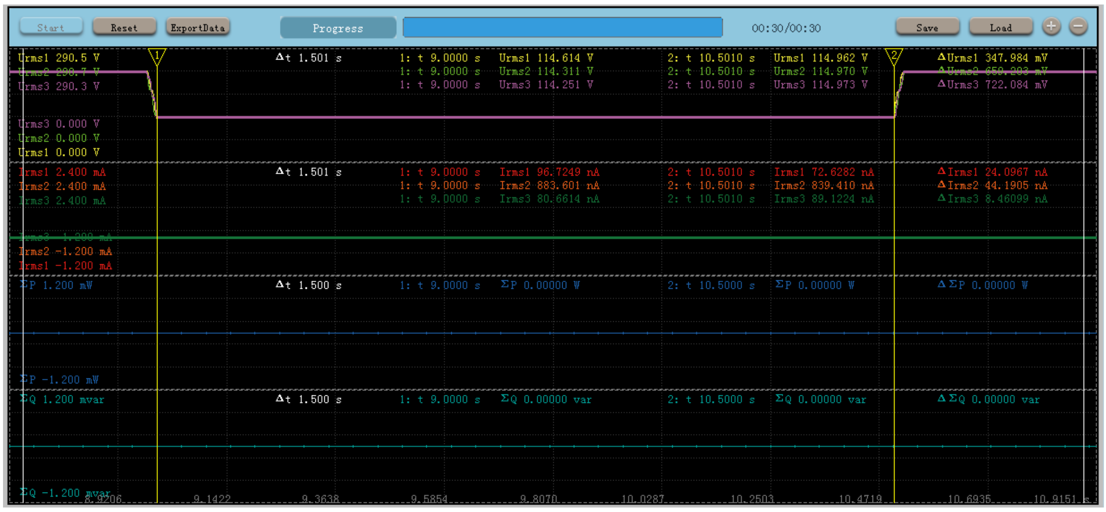


Active power recovery time



Reactive power recovery time

Graph of Test number 3.1



Empty load

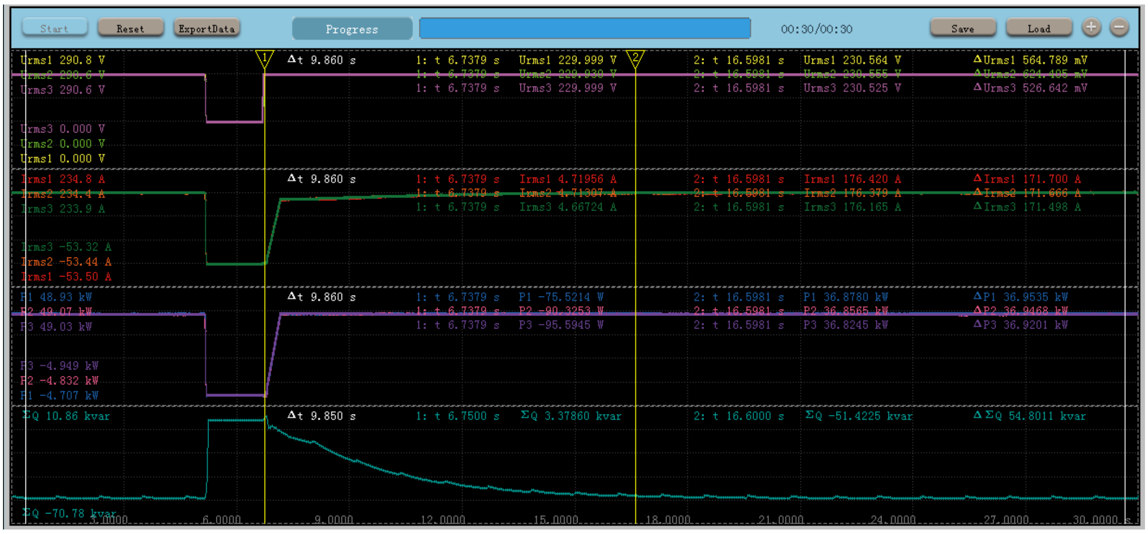
Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)

After dip (t2+3s)

Active power recovery time

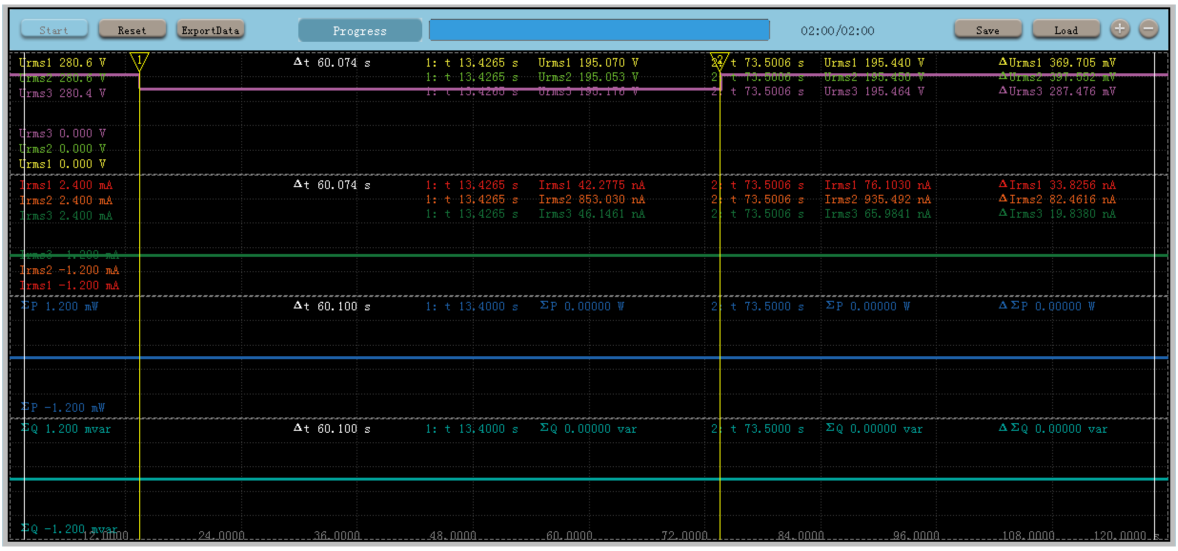


reactive power recovery time

Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]			300K						
NS protection settings			See table 2 in VDE-AR-N 4105:2018						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	4.1	5.1	6.1	7.1
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	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.	0.85	1.25	1.20	1.15
	5	Setting dip duration		--	ms	60000	100	5000	60000
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	60074	100.56	5000.1	60021
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85	1.25	1.20	1.15
	10		Positive sequence		p.u.	0.85	1.25	1.20	1.15
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	1.00	1.00	1.00	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.000	0.998	0.999	0.999
	14		Positive sequence			1.000	0.998	0.999	0.999
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.009	-0.012	-0.012	-0.012
	16		Positive sequence			-0.009	-0.012	-0.012	-0.012
	17	Cos$_{\varphi}$	--	t1-10s to t1	--	1.0000	1.0000	1.0000	1.0000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85	1.25	1.20	1.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.756	0.037	0.035	0.041
	20		Phase 2			0.783	0.037	0.035	0.041

	21		Phase 3			0.767	0.037	0.035	0.041
	22	Line current	Phase 1	t1+100ms	p.u.	0.902	0.036	0.036	0.863
	23		Phase 2			0.914	0.036	0.036	0.863
	24		Phase 3			0.907	0.036	0.036	0.863
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.777	0.001	0.001	0.998
	26		Positive sequence			0.777	0.001	0.001	0.998
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	1.002	1.004	1.004	0.998
	29		Total			1.002	1.004	1.004	0.998
	39	Active power rising time	Positive sequence	--	s	0.055	0.441	0.827	0.073
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	-0.020	-0.019	-0.007	-0.011
	32		Total			-0.020	-0.019	-0.007	-0.011
	33	Reactive power rising time	Positive sequence	--	s	0.046	0.086	0.142	0.067
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph of Test number 4.1



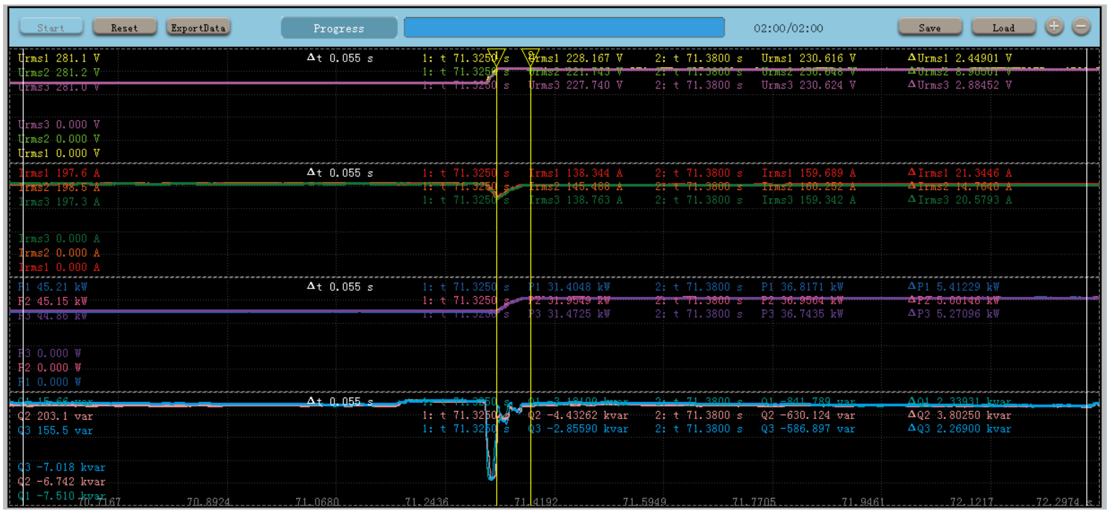
Empty load

Before dip (t1-100ms)

During dip (t1+60ms)

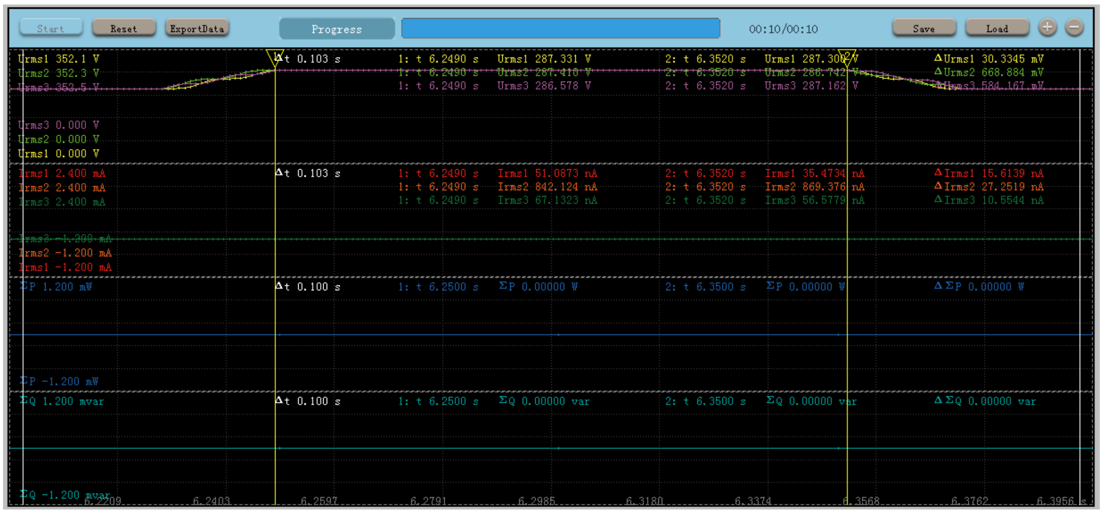
During dip (t1+100ms)

After dip (t2+3s)



Active power recovery time

Graph of Test number 5.1

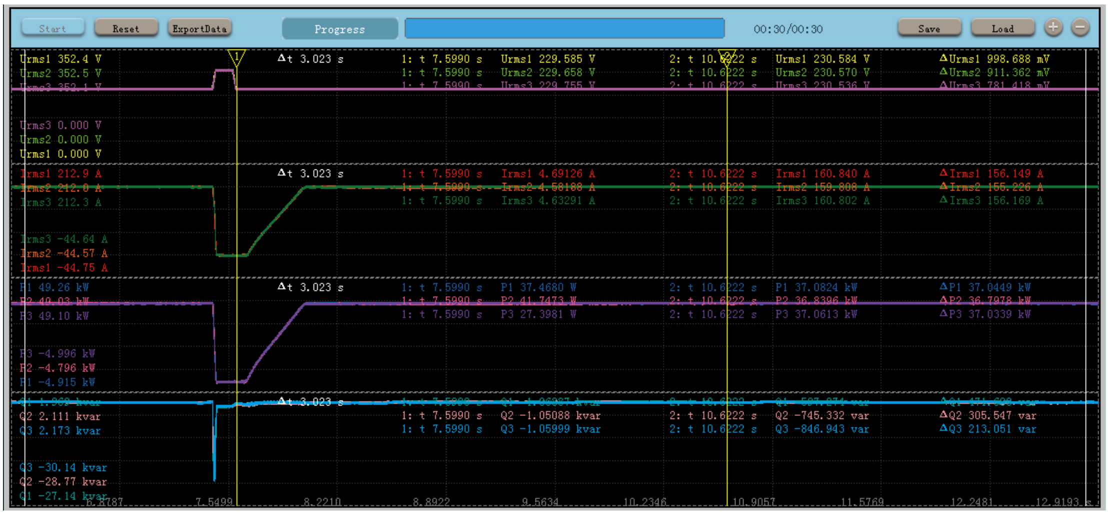


Empty load

Before dip (t1-100ms)


During dip (t1+60ms)

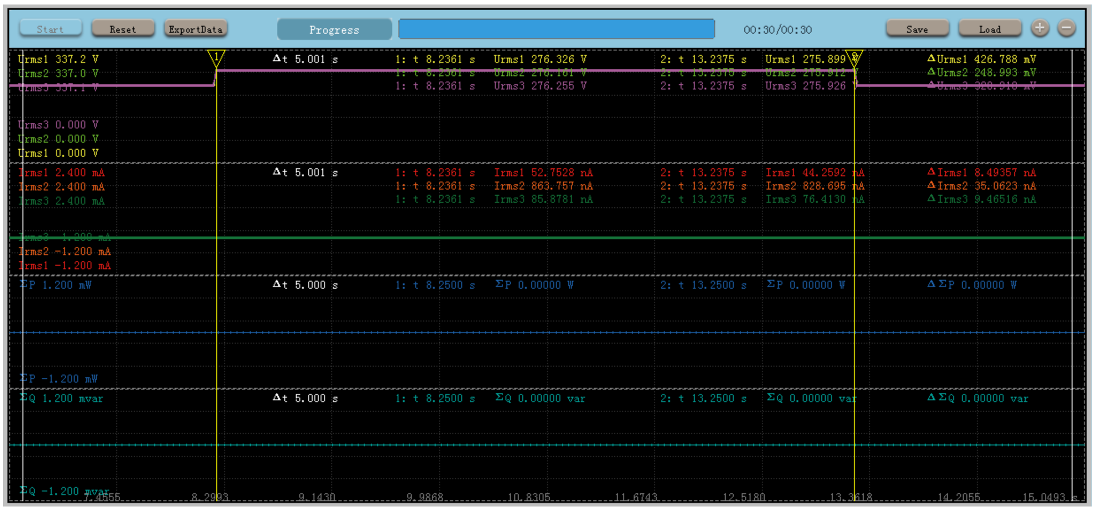

During dip (t1+100ms)



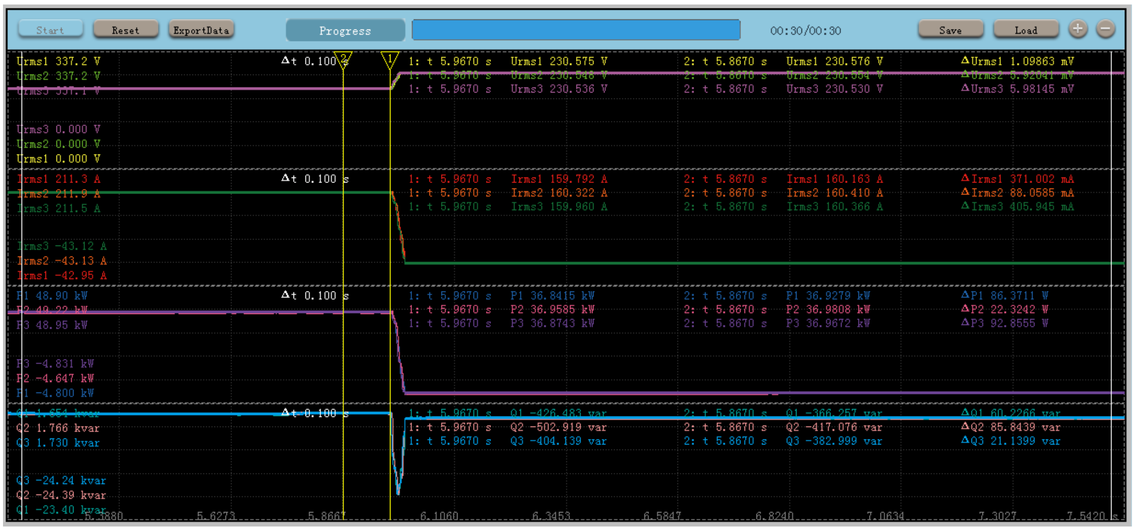
After dip (t2+3s)

Active power recovery time

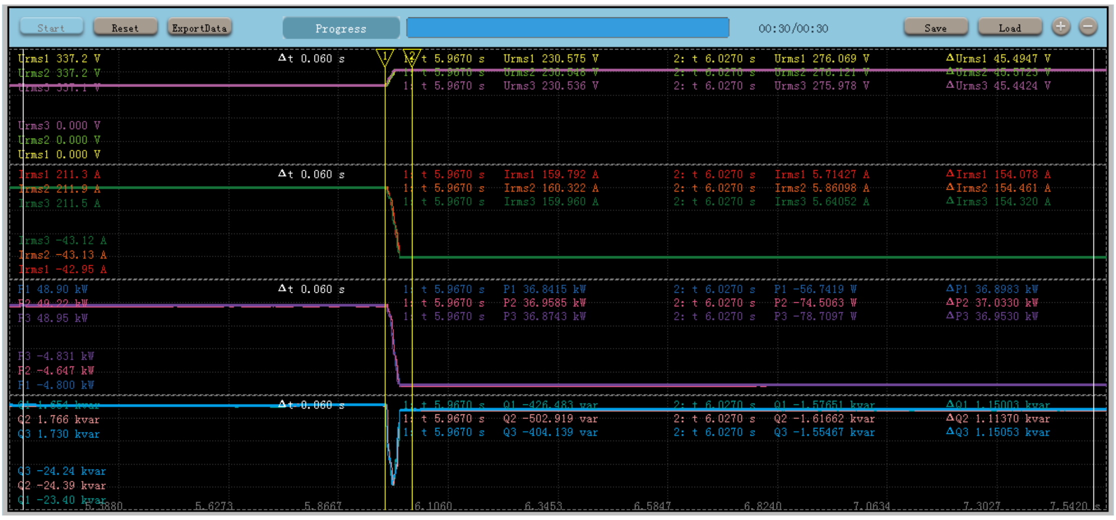
Graph of Test number 6.1



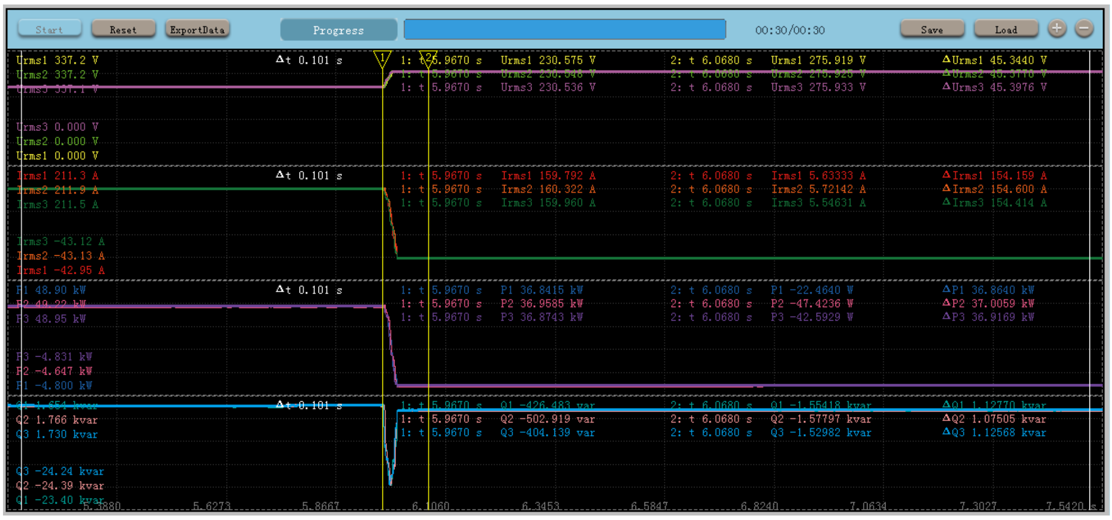
Empty load



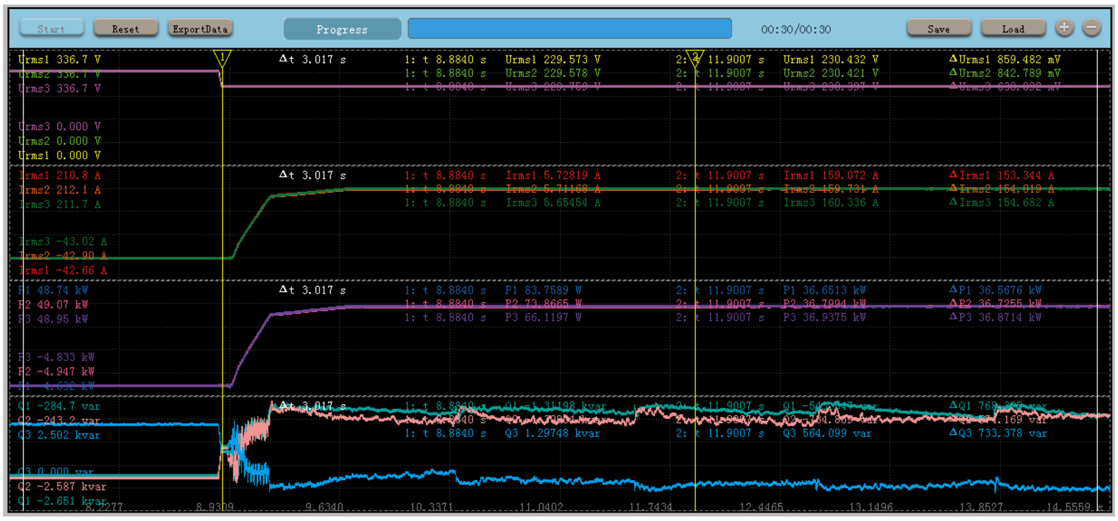
Before dip (t1-100ms)



During dip (t1+60ms)



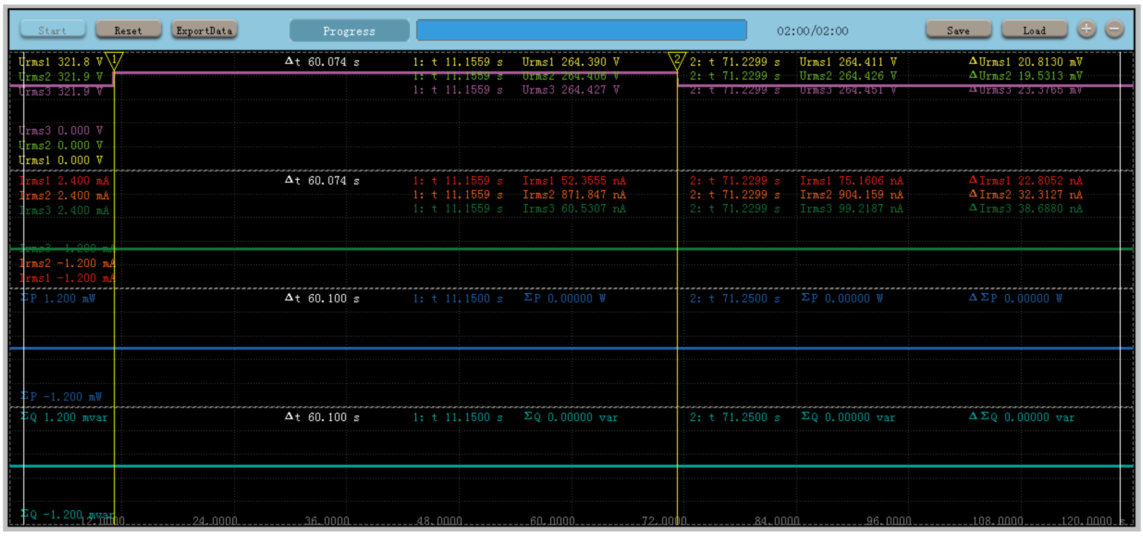
During dip (t1+100ms)



After dip (t2+3s)

Active power recovery time

Graph of Test number 7.1



Empty load

Before dip (t1-100ms)


During dip (t1+60ms)

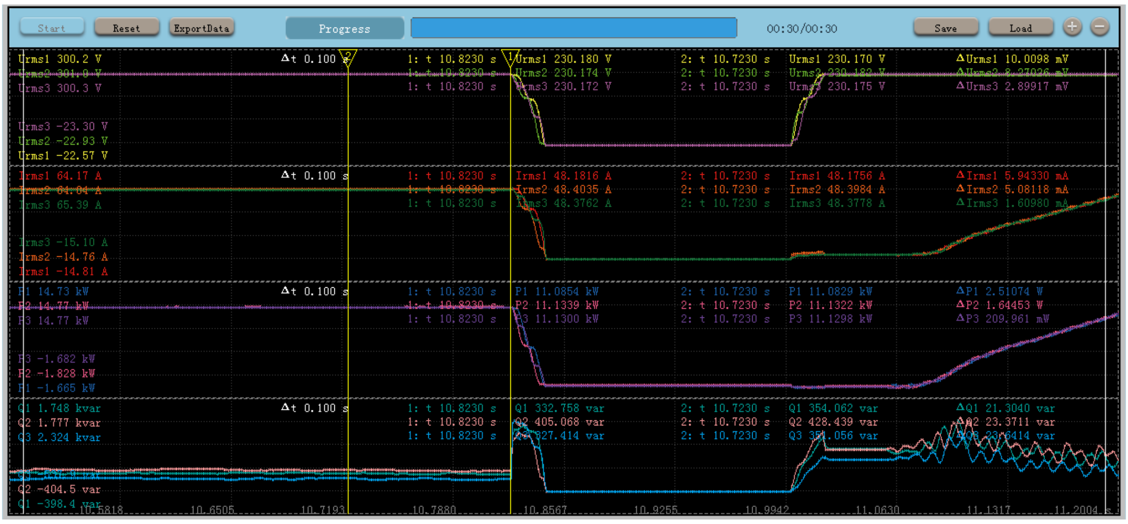

During dip (t1+100ms)

After dip (t2+3s)

Verification of dynamic network support								P
Short-circuited power at generator terminal [VA]			300K					
NS protection settings			See table 2 in VDE-AR-N 4105:2018					
	No.	Parameter	Phase ref.	Time ref.	unit	Result		
General Info.	0	Test number	--	--	--	1.2	2.2	3.2
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022		
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph		
	3	Fault type (phase)	--	--		A	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.15	0.5	0.5
	5	Setting dip duration		--	ms	150	1500	1500
	6	Point of fault entry	Total	--	ms	See graph		
	7	Point of fault clearance	Total	--	ms	See graph		
	8	Fault duration in empty load test	Total	--	ms	151.805	1505.7	1502.7
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15	0.5	0.5
	10		Positive sequence		p.u.	0.15	0.5	0.5
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.30	0.56	0.56
	13	Active power	Total	t1-10s to t1	p.u.	0.303	0.309	0.310
	14		Positive sequence			0.303	0.309	0.310
	15	Reactive power	Total	t1-10s to t1	p.u.	0.014	0.469	-0.481
	16		Positive sequence			0.014	0.469	-0.481
	17	Cos$_{\varphi}$	--	t1-10s to t1	--	0.9989	0.5178	0.5409
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15	0.50	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.002	0.012	0.010
	20		Phase 2			0.003	0.012	0.010

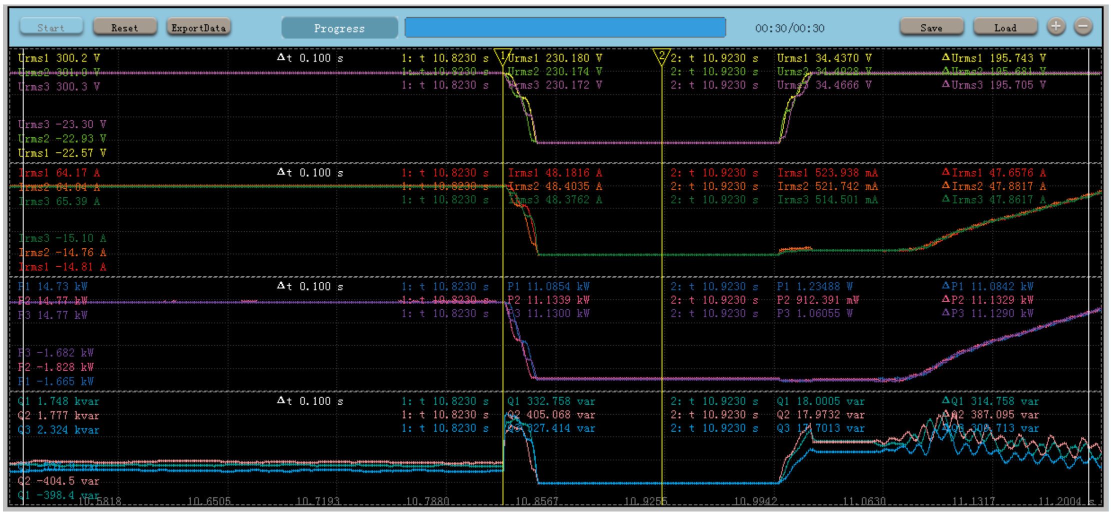
	21		Phase 3			0.003	0.012	0.010
	22	Line current	Phase 1	t1+100ms	p.u.	0.002	0.012	0.011
	23		Phase 2			0.003	0.012	0.011
	24		Phase 3			0.003	0.012	0.011
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.001	0.002
	26		Positive sequence			0.001	0.001	0.002
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.304	0.312	0.311
	29		Total			0.304	0.312	0.311
	39	Active power rising time	Positive sequence	--	s	0.220	0.916	0.249
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	-0.014	0.464	-0.464
	32		Total			-0.014	0.464	-0.464
	33	Reactive power rising time	Positive sequence	--	s	0.169	9.821	9.687
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes		

Graph of Test number 1.2

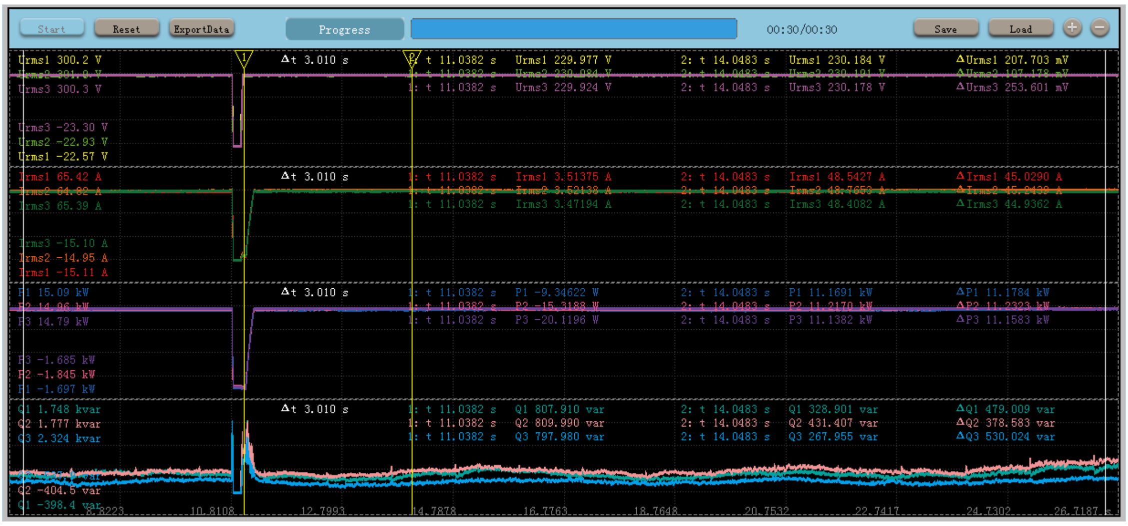


Before dip (t1-100ms)

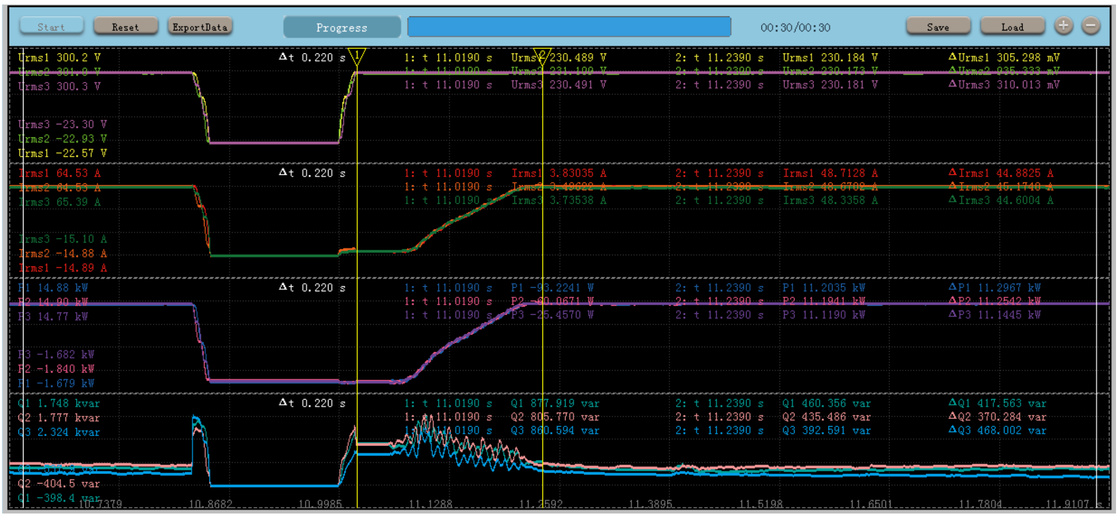
During dip (t1+60ms)



During dip (t1+100ms)

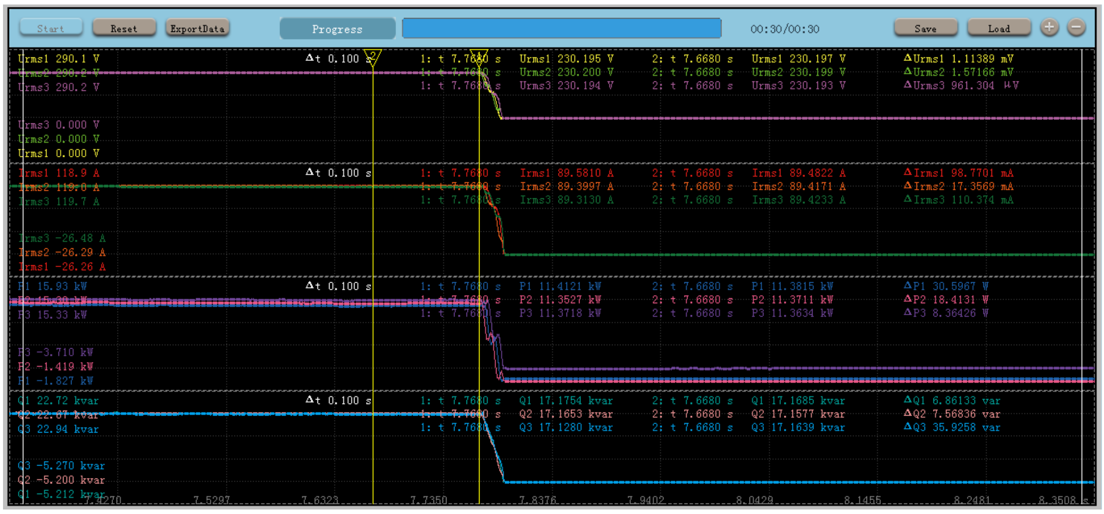


After dip (t2+3s)

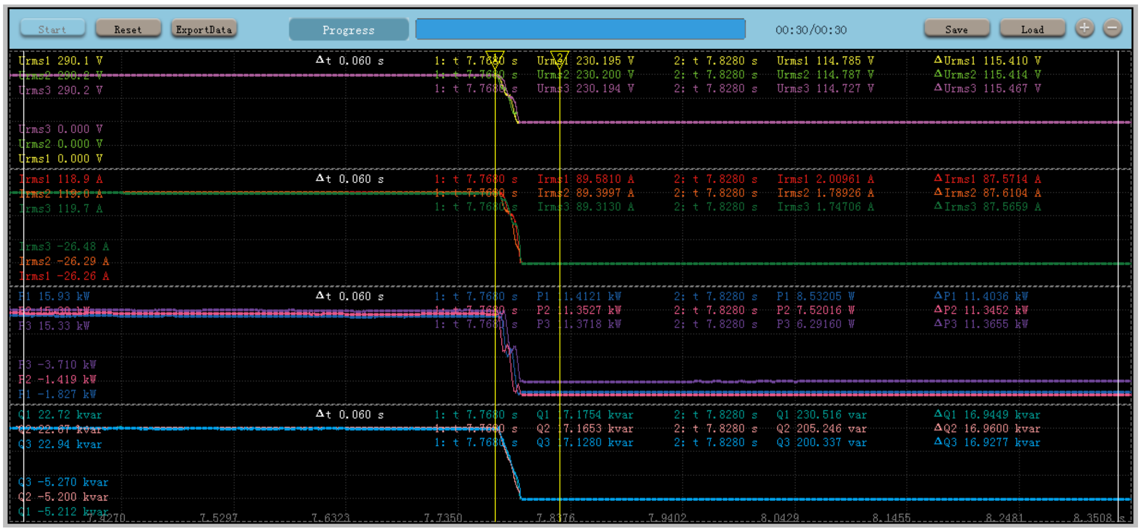


Active power recovery time

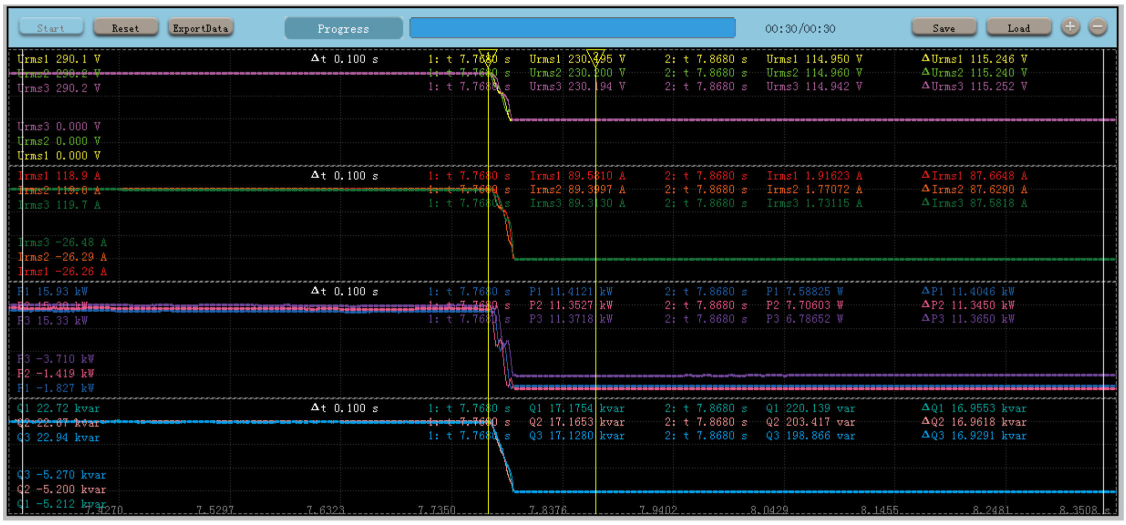
Graph of Test number 2.2



Before dip (t1-100ms)

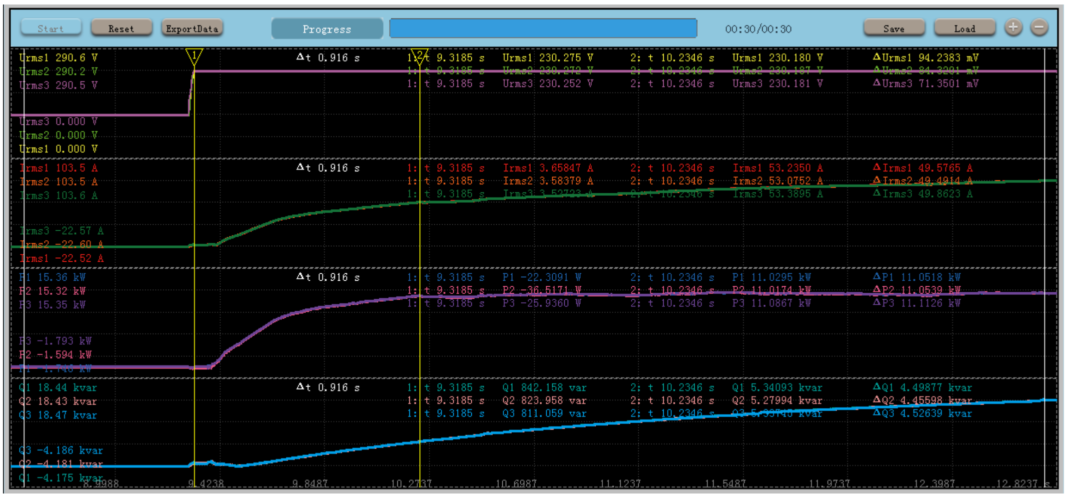


During dip (t1+60ms)

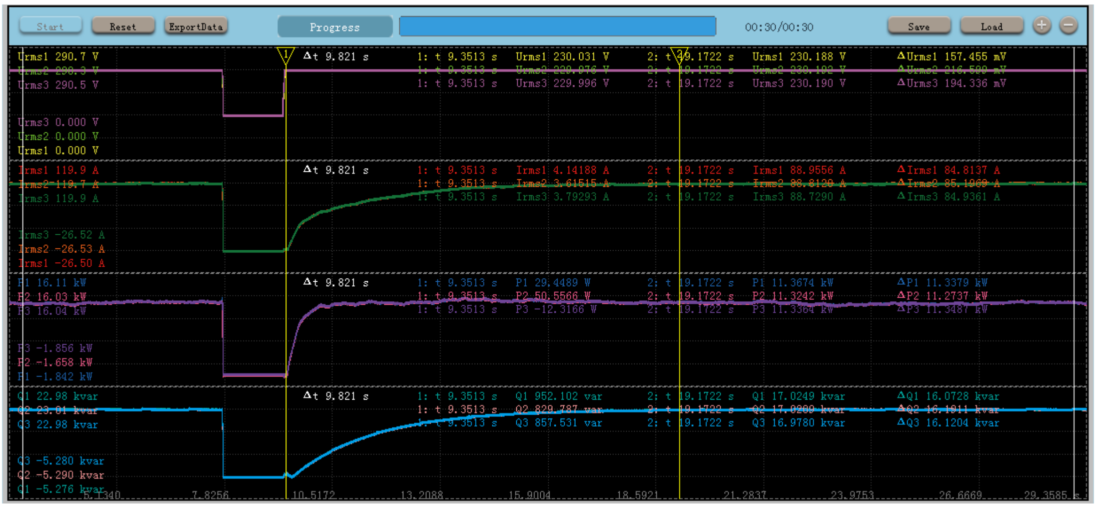


During dip (t1+100ms)

After dip (t2+3s)

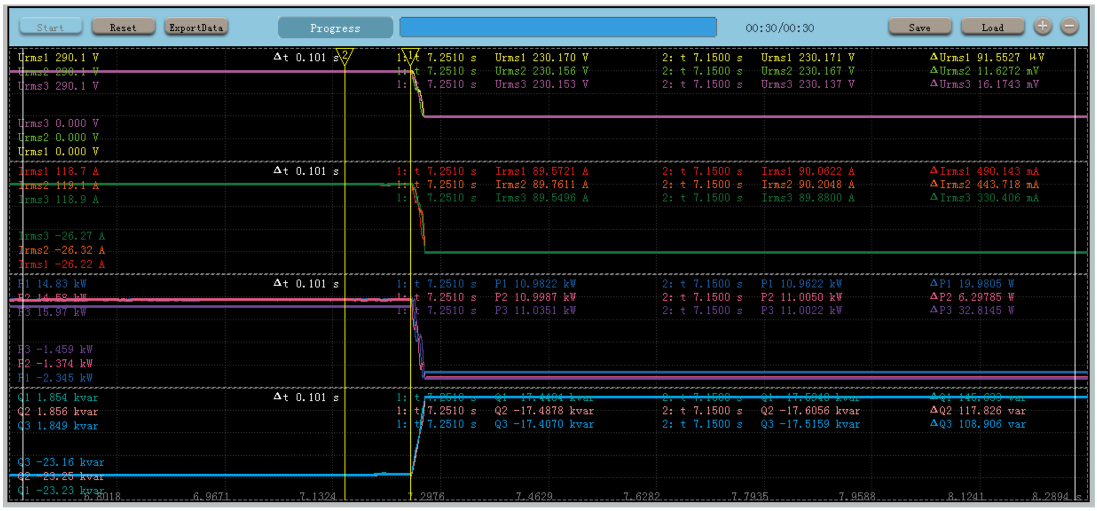


Active power recovery time

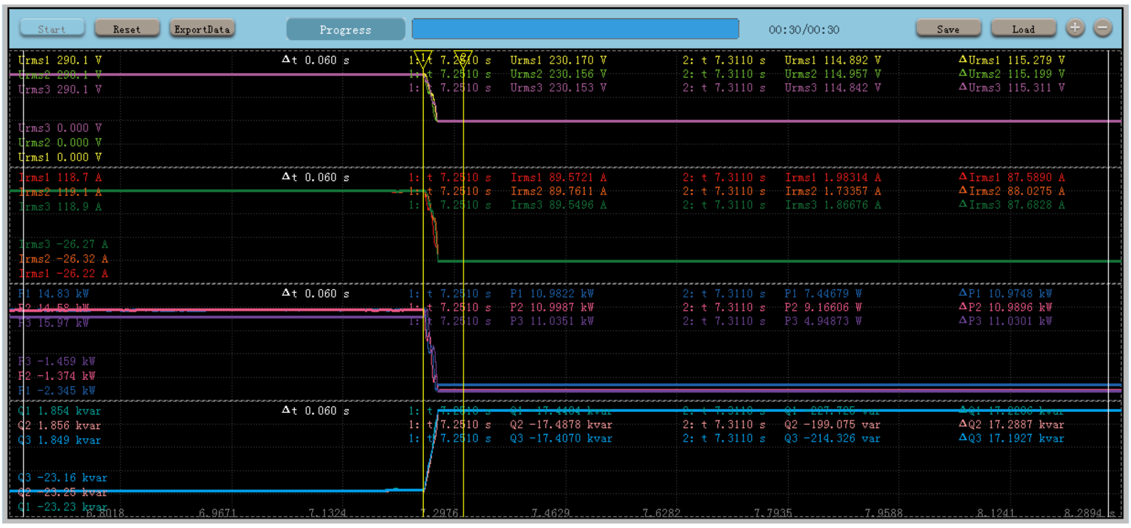


Reactive power recovery time

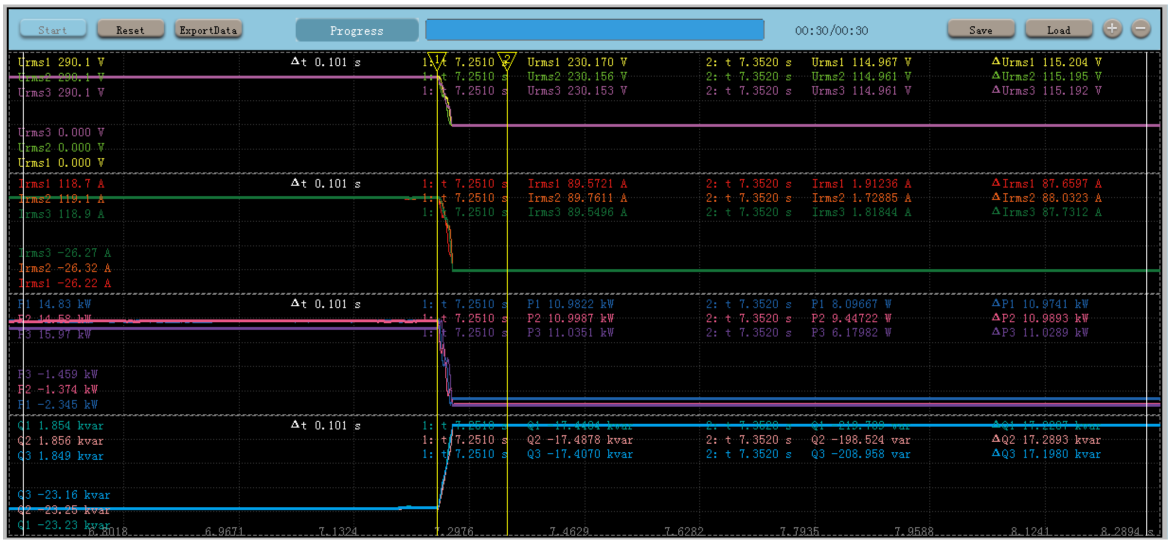
Graph of Test number 3.2



Before dip (t1-100ms)



During dip (t1+60ms)



During dip (t1+100ms)

After dip (t2+3s)

Active power recovery time

Reactive power recovery time

Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]		300K							
NS protection settings		See table 2 in VDE-AR-N 4105:2018							
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	4.2	5.2	6.2	7.2
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	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.	0.85	1.25	1.20	1.15
	5	Setting dip duration		--	ms	60000	100	5000	60000
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	60074	100.56	5007.1	60021
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85	1.25	1.20	1.15
	10		Positive sequence		p.u.	0.85	1.25	1.20	1.15
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.31	0.31	0.31	0.31
	13	Active power	Total	t1-10s to t1	p.u.	0.304	0.306	0.299	0.306
	14		Positive sequence			0.304	0.306	0.299	0.306
	15	Reactive power	Total	t1-10s to t1	p.u.	0.022	0.014	0.013	0.015
	16		Positive sequence			0.022	0.014	0.013	0.015
	17	Cos_{φ}	--	t1-10s to t1	--	0.9972	0.9989	0.9988	0.9999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85	1.25	1.20	1.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.357	0.025	0.050	0.238
	20		Phase 2			0.357	0.025	0.033	0.226

	21		Phase 3			0.357	0.025	0.034	0.231
	22	Line current	Phase 1	t1+100ms	p.u.	0.356	0.025	0.027	0.263
	23		Phase 2			0.356	0.025	0.027	0.263
	24		Phase 3			0.356	0.025	0.027	0.263
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.306	0.001	0.000	0.307
	26		Positive sequence			0.306	0.001	0.000	0.307
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.303	0.304	0.301	0.302
	29		Total			0.303	0.304	0.301	0.302
	39	Active power rising time	Positive sequence	--	s	0.043	0.217	0.216	0.047
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.006	0.015	0.015	0.010
	32		Total			0.006	0.015	0.015	0.010
	33	Reactive power rising time	Positive sequence	--	s	0.037	0.073	0.253	0.073
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph of Test number 4.2

Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)

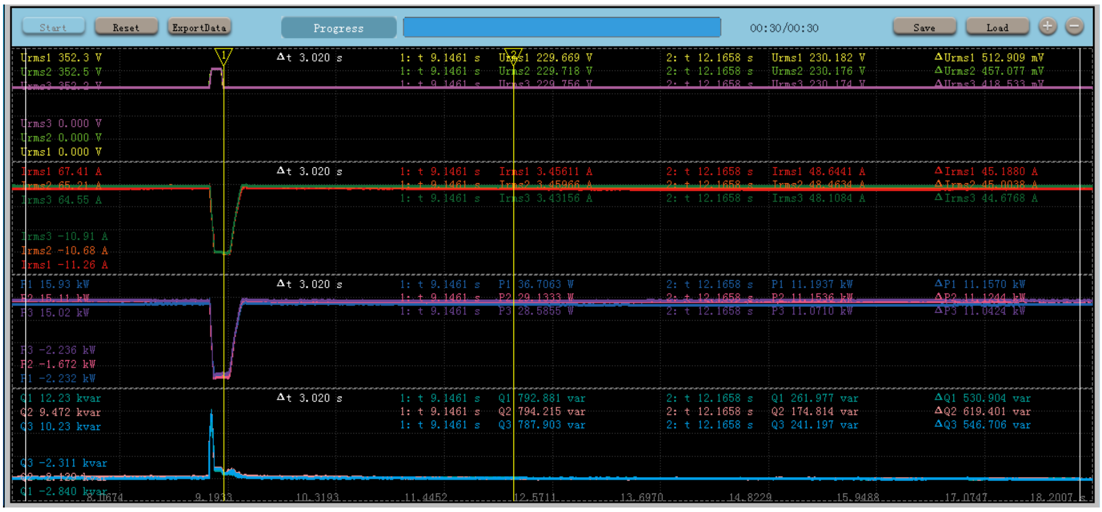
After dip (t2+3s)

Graph of Test number 5.2

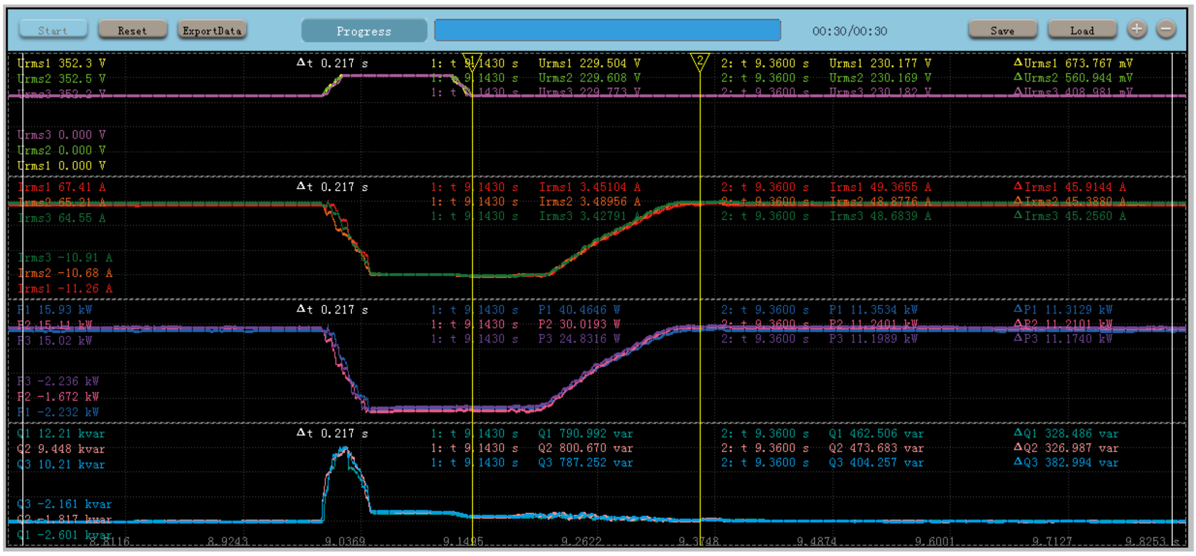
Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)

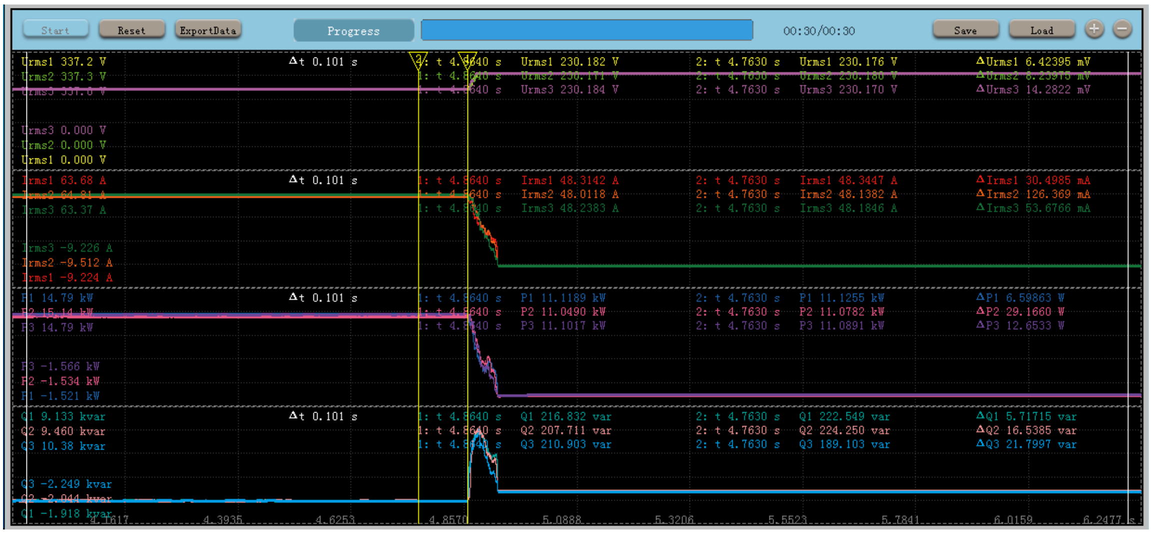


After dip (t2+3s)

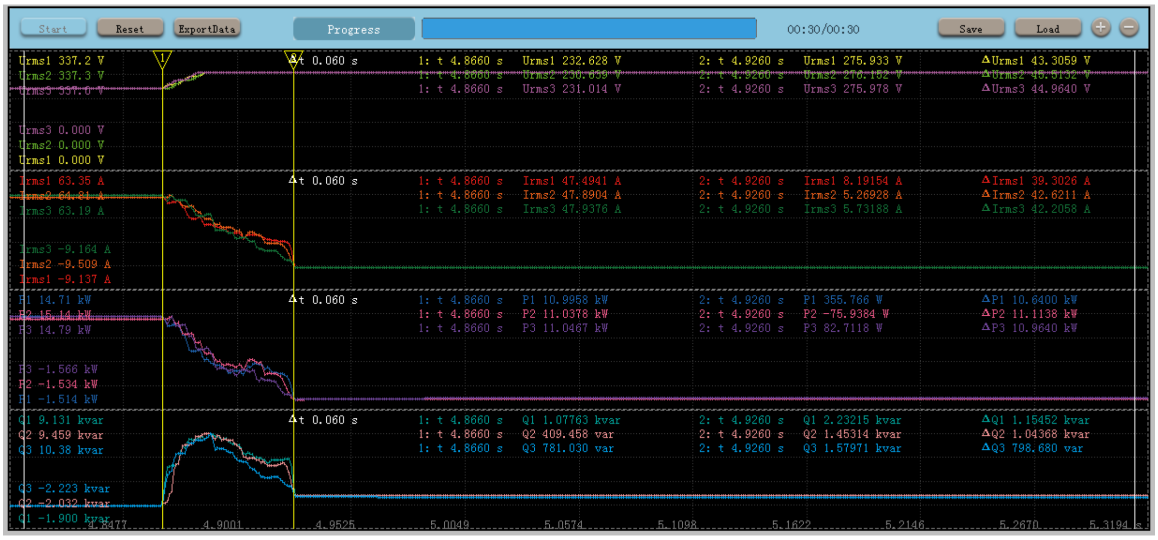


Active power recovery time

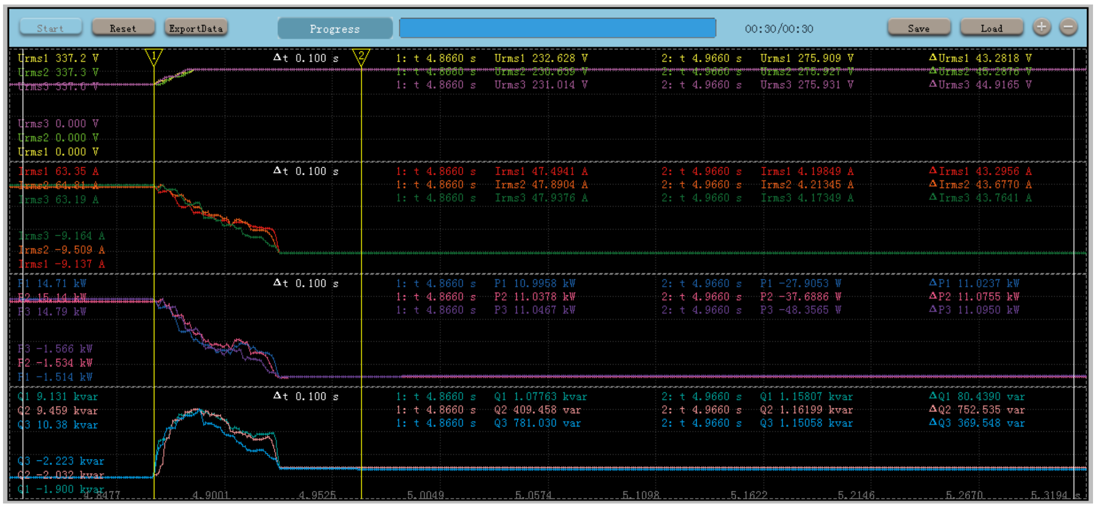
Graph of Test number 6.2



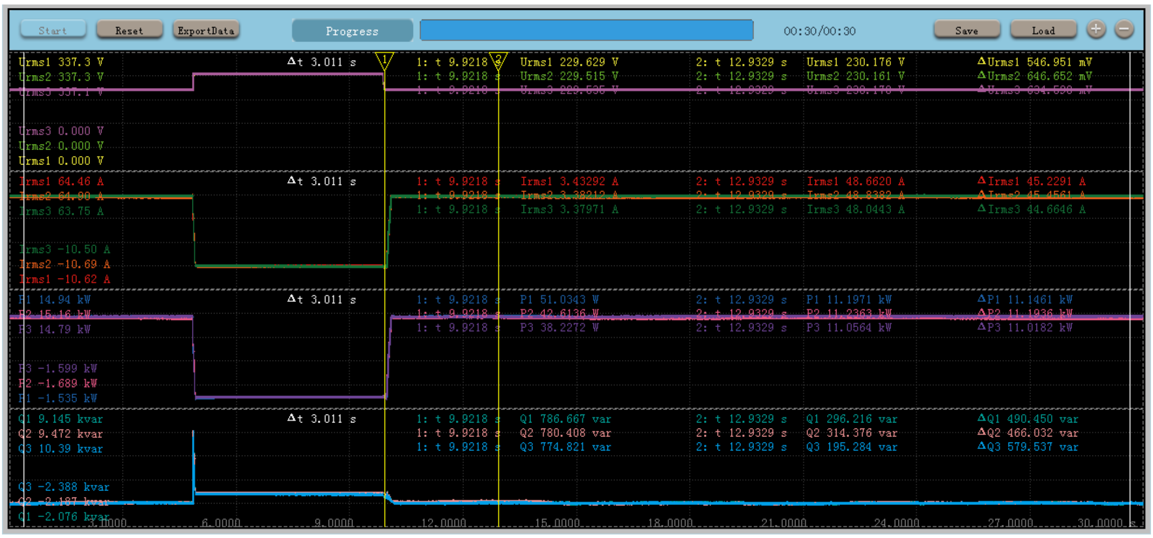
Before dip (t1-100ms)



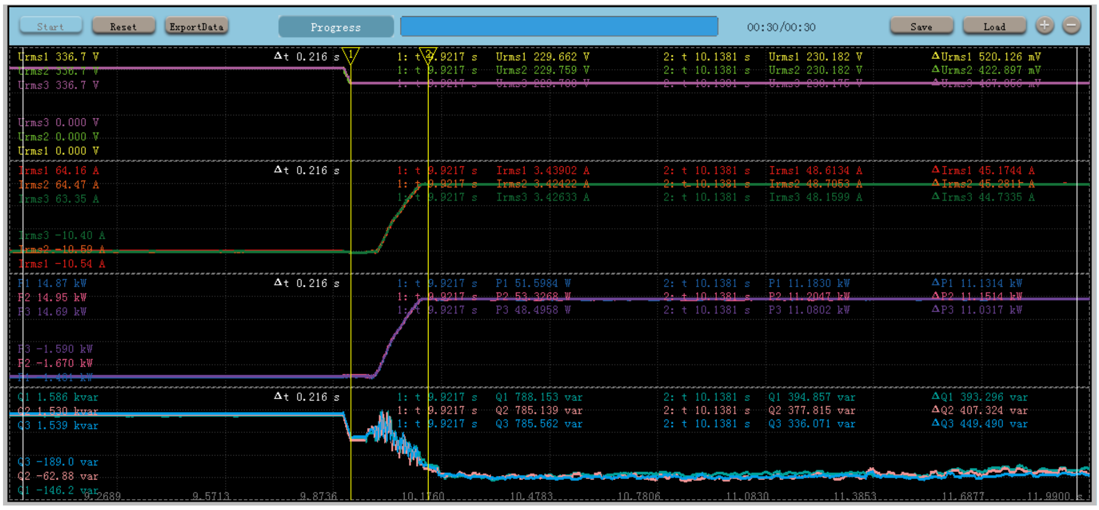
During dip (t1+60ms)



During dip (t1+100ms)

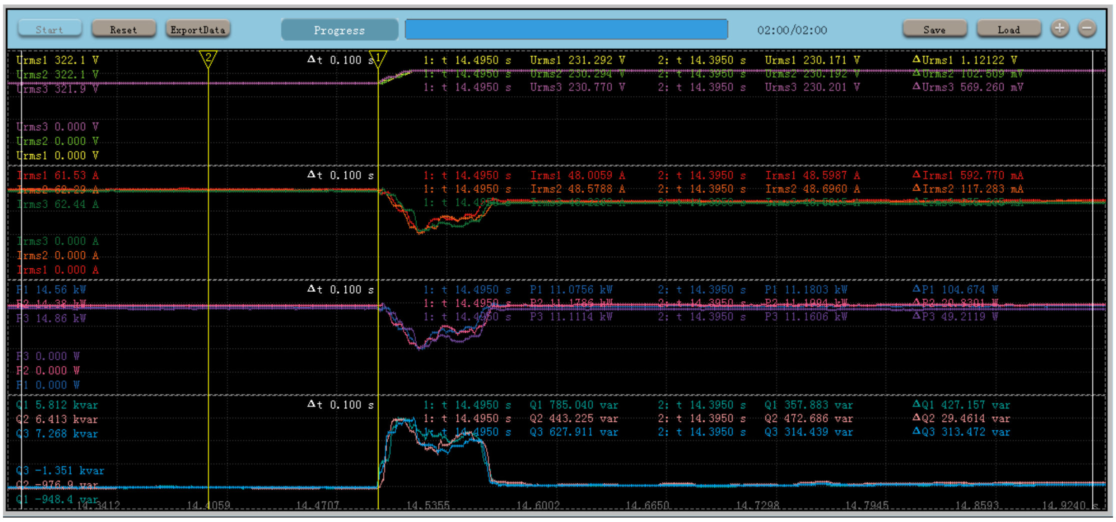


After dip (t2+3s)

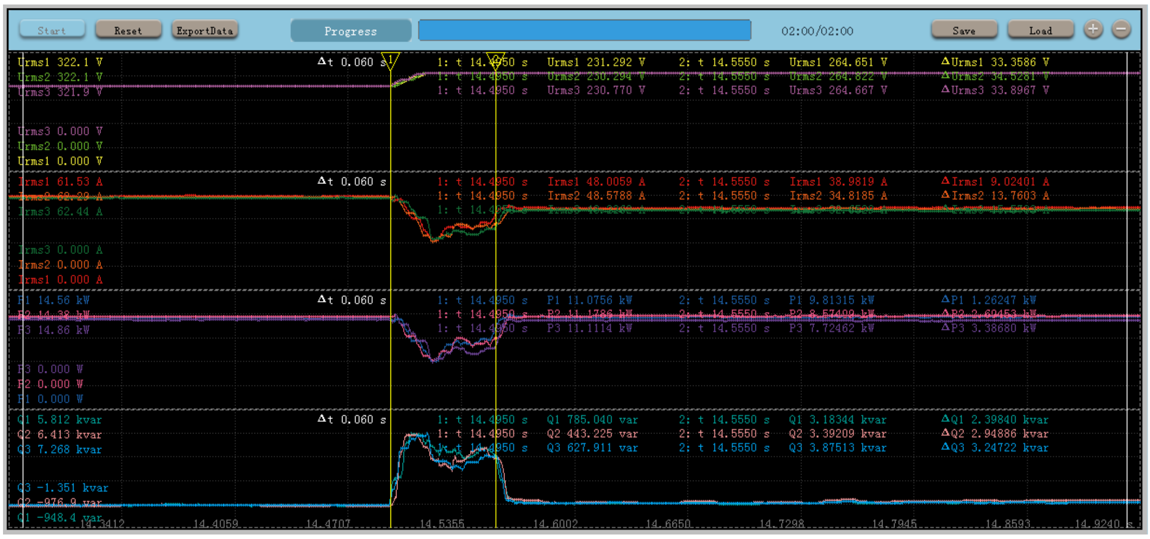


Active power recovery time

Graph of Test number 7.2



Before dip (t1-100ms)



During dip (t1+60ms)

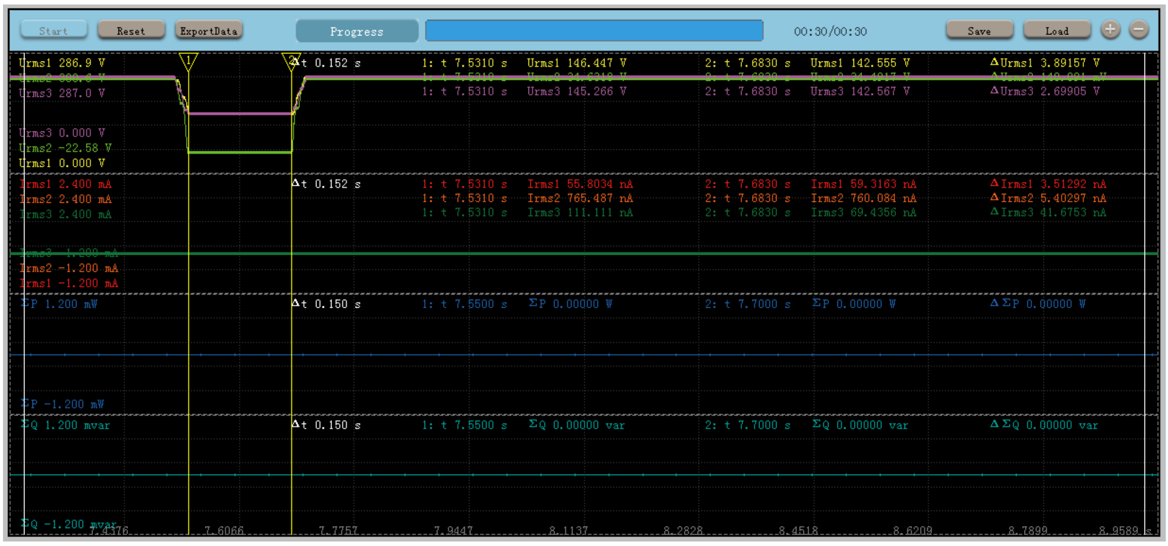
During dip (t1+100ms)

After dip (t2+3s)

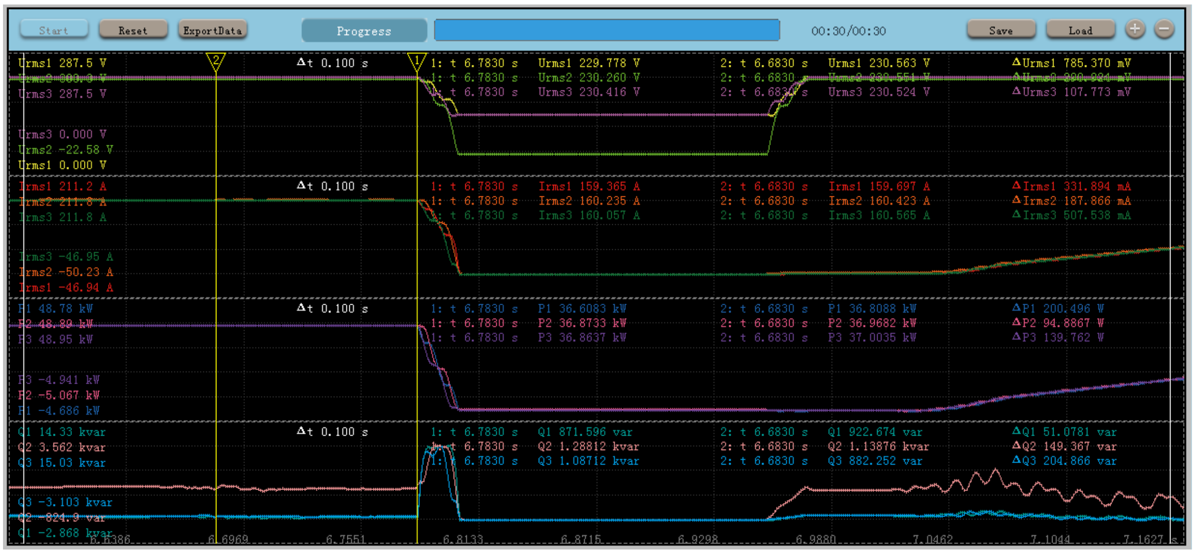
Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]			300K						
NS protection settings			See table 2 in VDE-AR-N 4105:2018						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	1.3	2.3	3.3	4.3
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		D1	D1	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.15	0.50	0.50	0.85
	5	Setting dip duration		--	ms	150	1500	1500	60000
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	151.09	1503.5	1504.6	60021
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.617	0.761	0.761	0.932
						0.151	0.501	0.501	0.856
						0.617	0.762	0.761	0.932
	10		Positive sequence		p.u.	0.431	0.665	0.665	0.904
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.01	0.99	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	1.000	1.110	1.101	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.000	0.988	0.986	0.997
	14		Positive sequence			1.000	0.988	0.986	0.997
	15	Reactive power	Total	t1-10s to t1	p.u.	0.027	0.468	-0.484	0.023
	16		Positive sequence			0.027	0.468	-0.484	0.023
	17	Cosφ	--	t1-10s to t1	--	0.9999	0.9029	0.8977	0.9999
During dip t1 to	18	Voltage	Phase 1	t1+100ms to t2-	p.u.	0.617	0.760	0.762	0.932
			Phase 2			0.151	0.502	0.500	0.851

t2			Phase 3	20ms		0.617	0.762	0.763	0.933
	19	Line current	Phase 1	t1+60ms	p.u.	0.019	0.019	0.021	1.004
	20		Phase 2			0.006	0.017	0.020	1.013
	21		Phase 3			0.019	0.019	0.019	1.002
	22	Line current	Phase 1	t1+100ms	p.u.	0.019	0.019	0.021	1.004
	23		Phase 2			0.006	0.017	0.020	1.013
	24		Phase 3			0.019	0.019	0.019	1.002
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.001	0.001	0.922
	26		Positive sequence			0.001	0.001	0.001	0.922
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	1.001	1.022	1.031	1.000
	29		Total			1.001	1.022	1.031	1.000
	39	Active power rising time	Positive sequence	--	s	0.467	0.480	0.483	0.060
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.007	0.458	-0.483	0.022
	32		Total			0.007	0.458	-0.483	0.022
	33	Reactive power rising time	Positive sequence	--	s	0.094	9.894	9.954	0.056
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph of Test number 1.3



Empty load

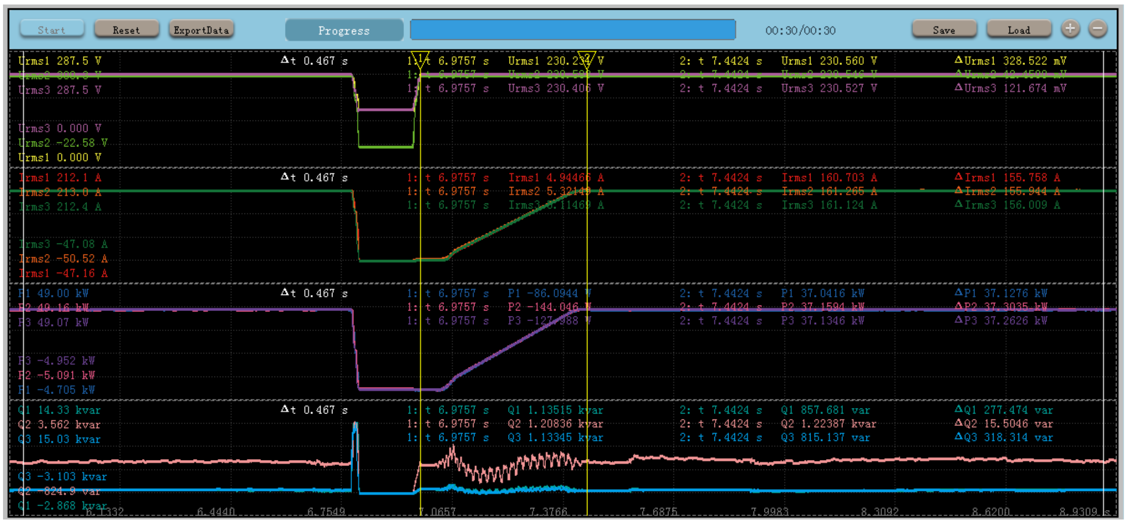


Before dip (t1-100ms)

During dip (t1+60ms)

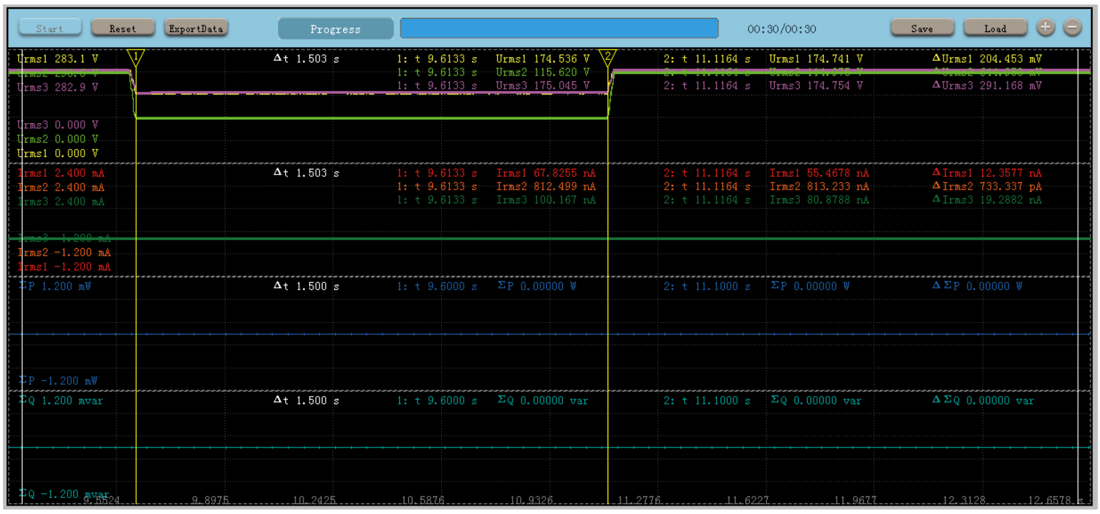
During dip (t1+100ms)

After dip (t2+3s)

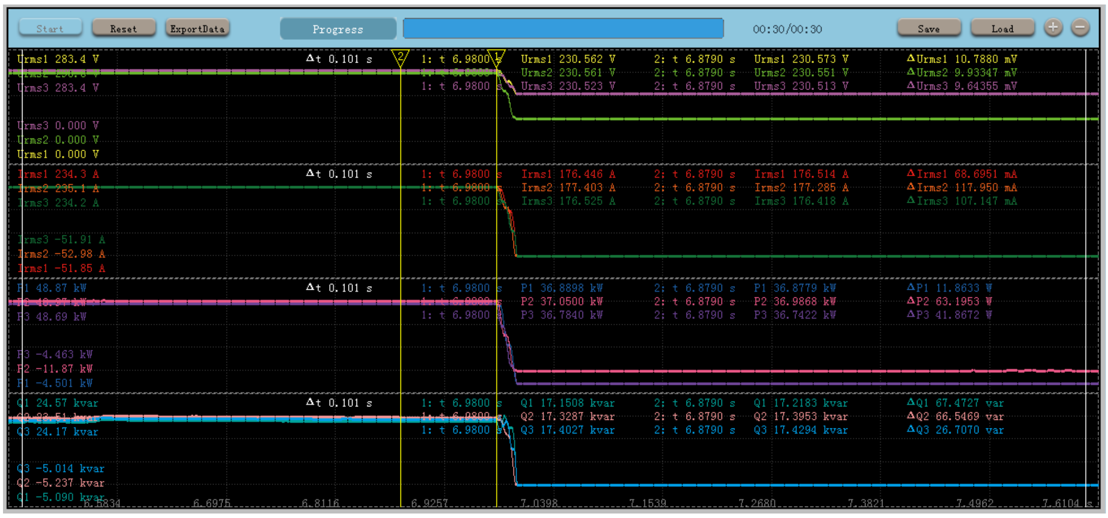


Active power recovery time

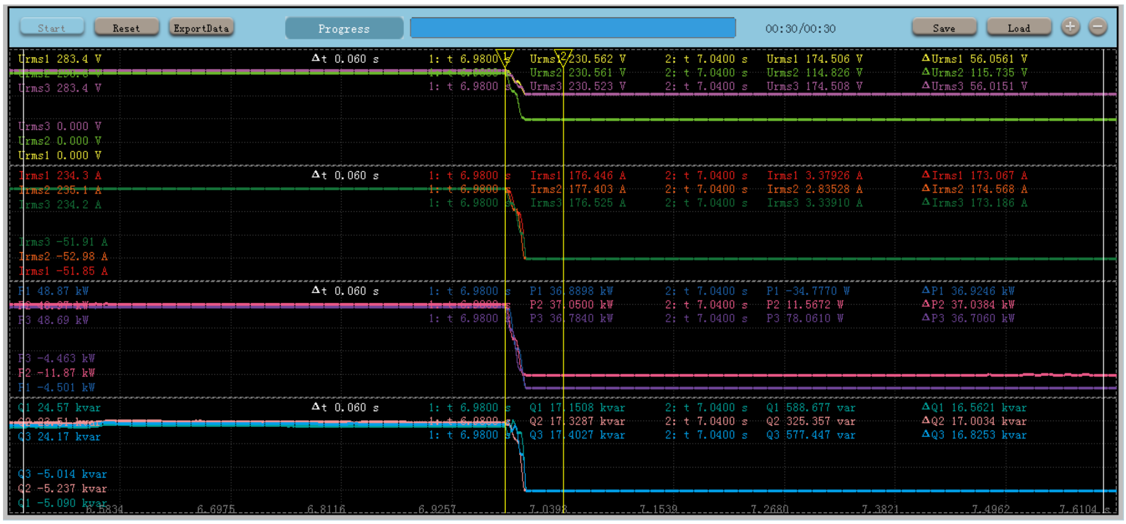
Graph of Test number 2.3



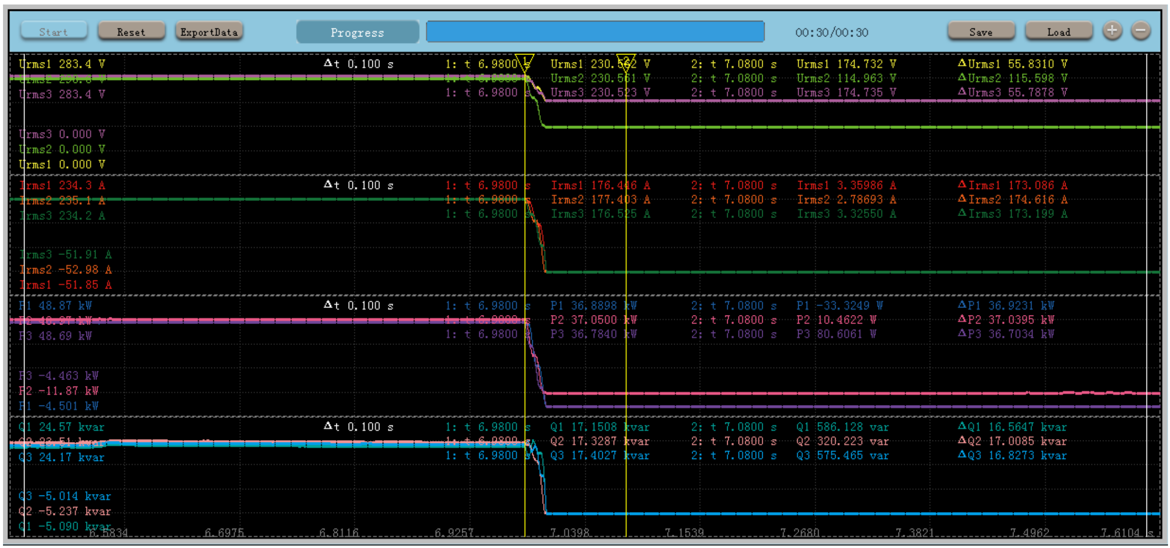
Empty load



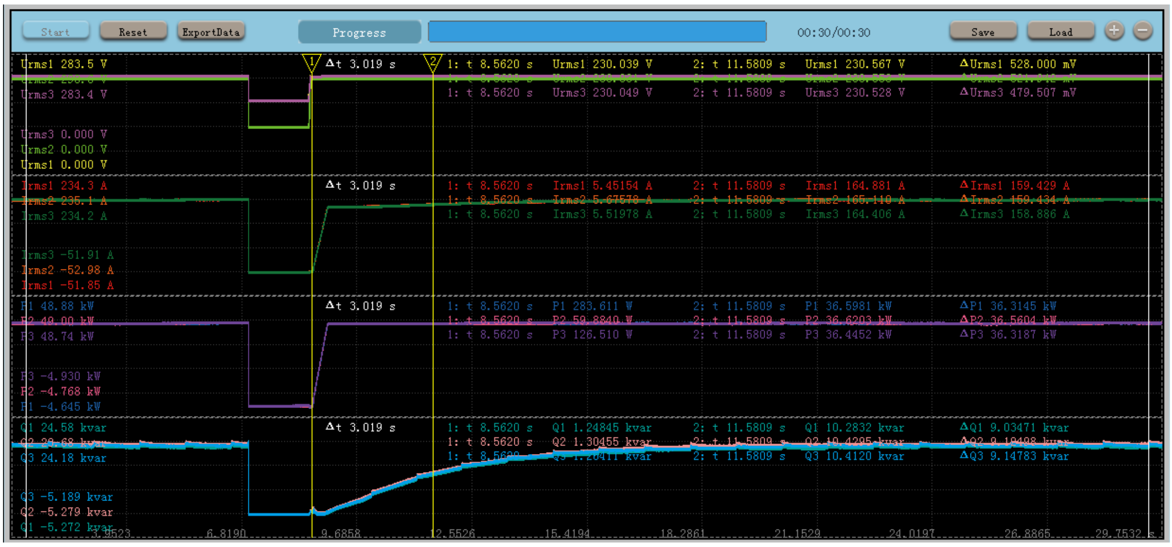
Before dip (t1-100ms)



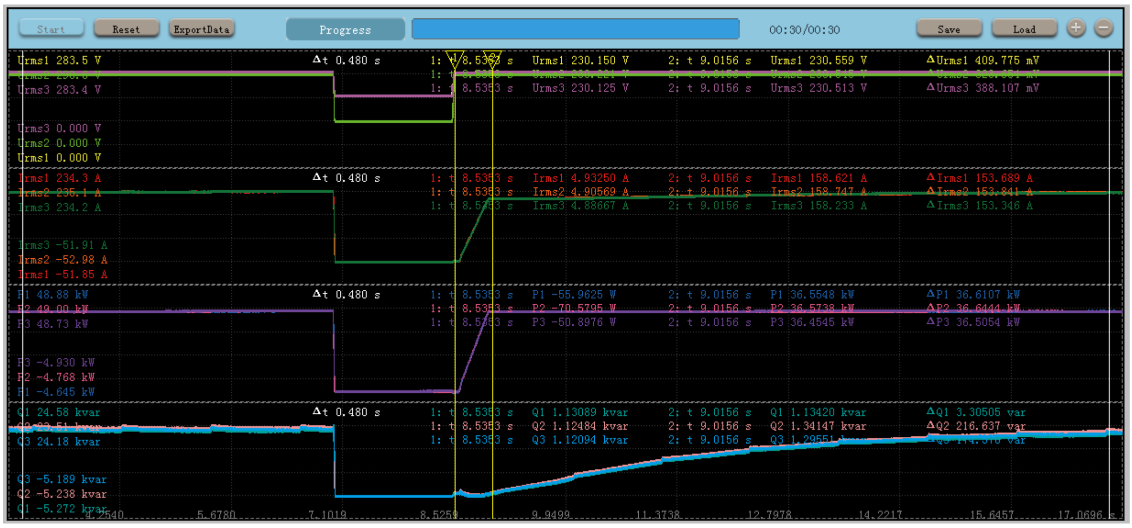
During dip (t1+60ms)



During dip (t1+100ms)



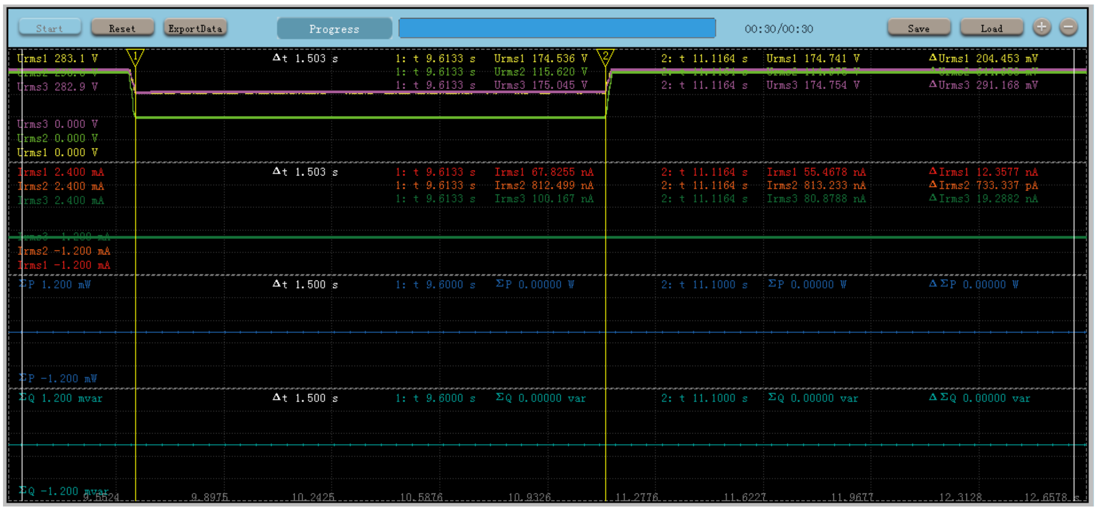
After dip (t2+3s)



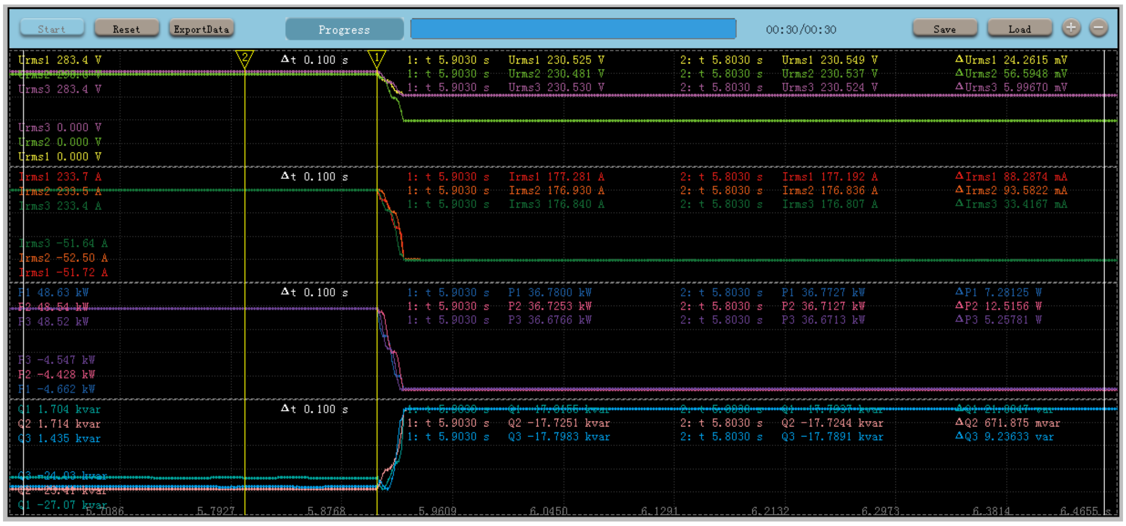
Active power recovery time

reactive power recovery time

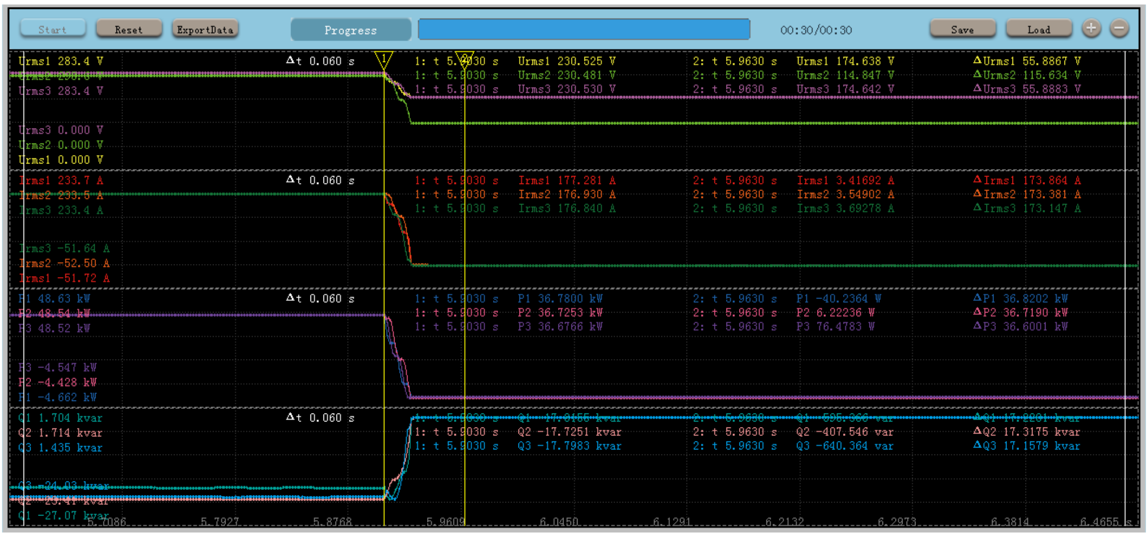
Graph of Test number 3.3



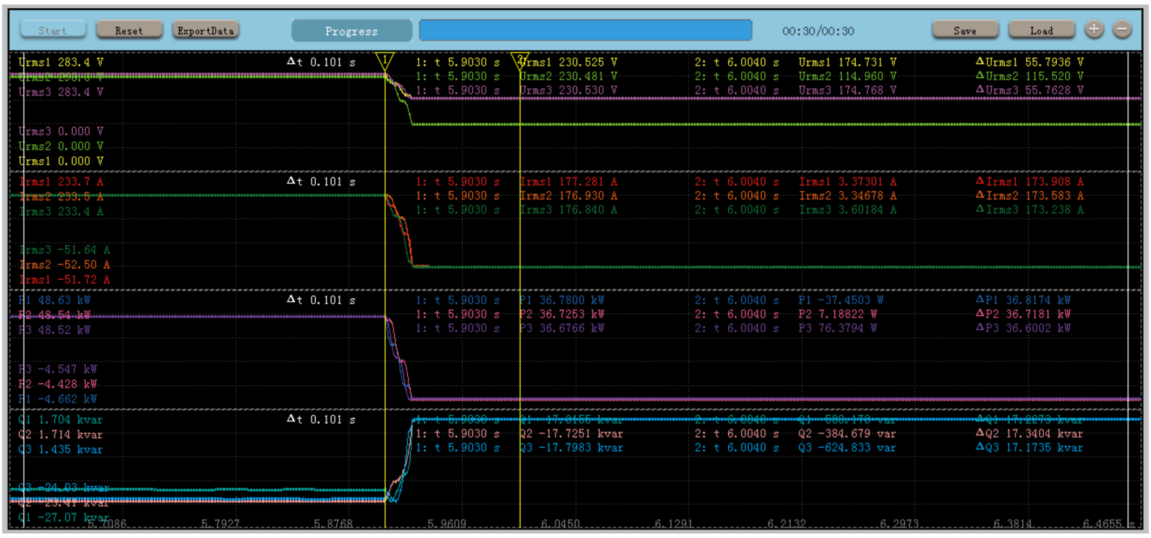
Empty load



Before dip (t1-100ms)



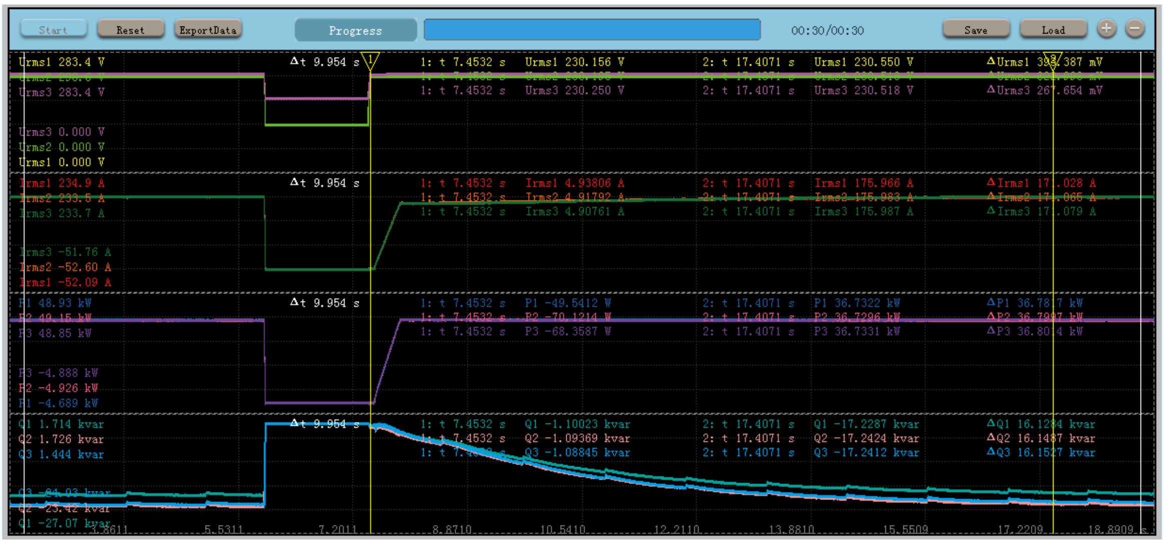
During dip (t1+60ms)



During dip (t1+100ms)

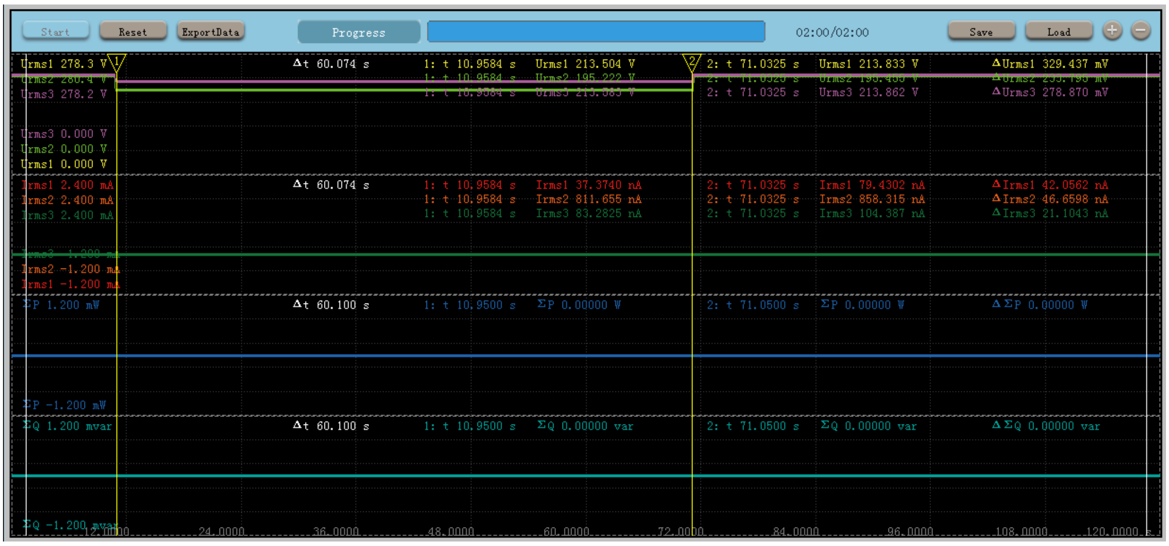
After dip (t2+3s)

Active power recovery time



Reactive power recovery time

Graph of Test number 4.3



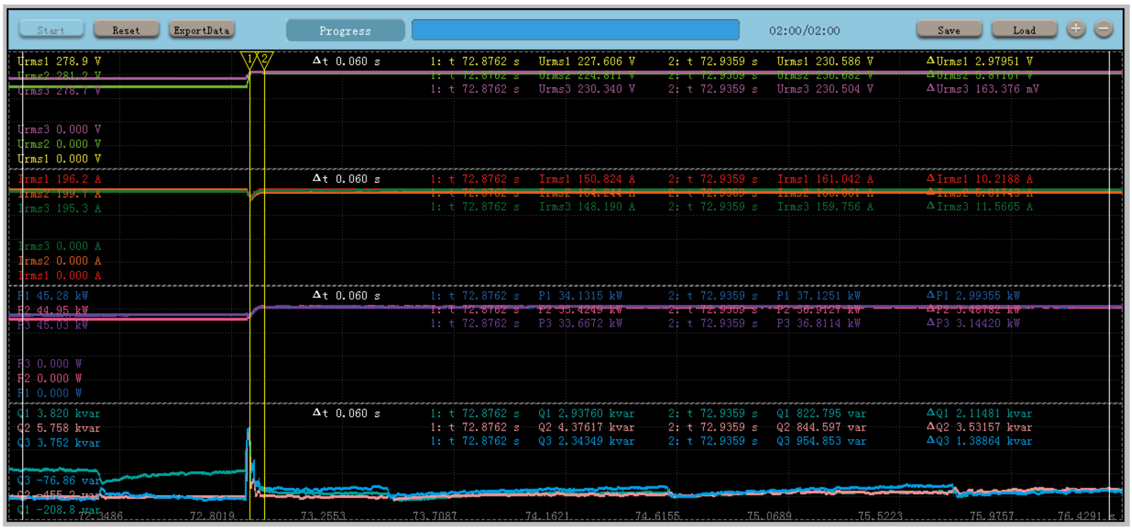
Empty load

Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)

After dip (t2+3s)

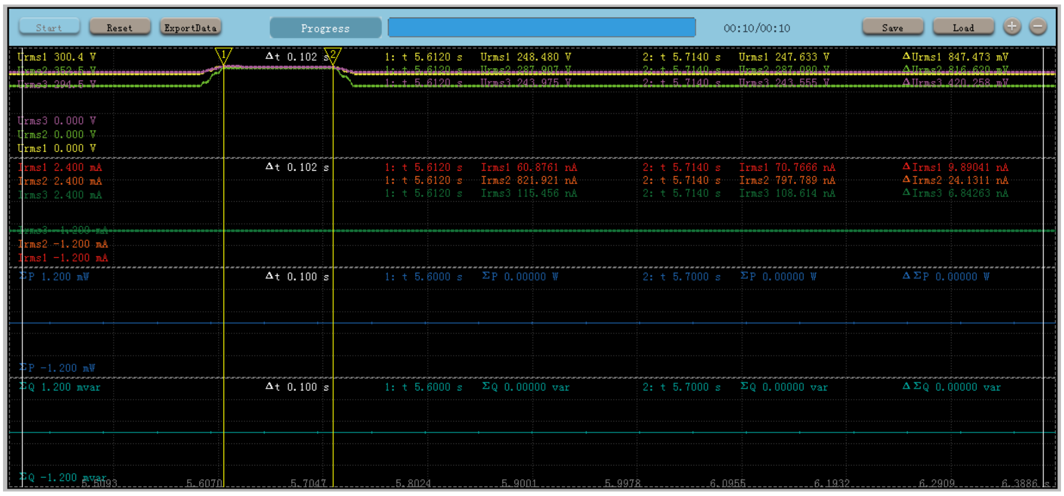


Active power recovery time

Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]				300K					
NS protection settings				See table 2 in VDE-AR-N 4105:2018					
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	5.3	6.3	7.3	1.4
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		D1	D1	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	1.25	1.20	1.15	0.15
	5	Setting dip duration		--	ms	100	5000	60000	150
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	100.94	5008.3	60209	161.09
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.082	1.062	1.042	0.621
						1.252	1.202	1.152	0.151
						1.062	1.053	1.042	0.621
	10		Positive sequence		p.u.	1.128	1.103	1.077	0.431
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.01	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	1.02	1.00	1.00	0.303
	13	Active power	Total	t1-10s to t1	p.u.	1.001	1.000	0.999	0.303
	14		Positive sequence			1.001	1.000	0.999	0.303
	15	Reactive power	Total	t1-10s to t1	p.u.	0.012	0.012	-0.012	0.014
	16		Positive sequence			0.012	0.012	-0.012	0.014
	17	$\cos_{\varphi}$	--	t1-10s to t1	--	1.0000	0.9999	1.0000	0.9989
During dip t1 to	18	Voltage	Phase 1	t1+100ms to t2-	p.u.	1.080	1.062	1.042	0.619
			Phase 2			1.251	1.200	1.150	0.151

t2			Phase 3	20ms		1.061	1.052	1.042	0.622
	19	Line current	Phase 1	t1+60ms	p.u.	0.034	0.042	0.941	0.008
	20		Phase 2			0.034	0.042	0.934	0.003
	21		Phase 3			0.034	0.041	0.939	0.008
	22	Line current	Phase 1	t1+100ms	p.u.	0.033	0.041	0.941	0.008
	23		Phase 2			0.034	0.042	0.929	0.003
	24		Phase 3			0.033	0.041	0.939	0.008
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.001	0.999	0.001
	26		Positive sequence			0.001	0.001	0.999	0.001
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	1.003	0.990	0.999	0.316
	29		Total			1.003	0.990	0.999	0.316
	39	Active power rising time	Positive sequence	--	s	0.442	0.890	0.068	0.214
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.016	0.007	-0.011	0.016
	32		Total			0.016	0.007	-0.011	0.016
	33	Reactive power rising time	Positive sequence	--	s	0.038	0.054	0.038	0.056
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph of Test number 5.3

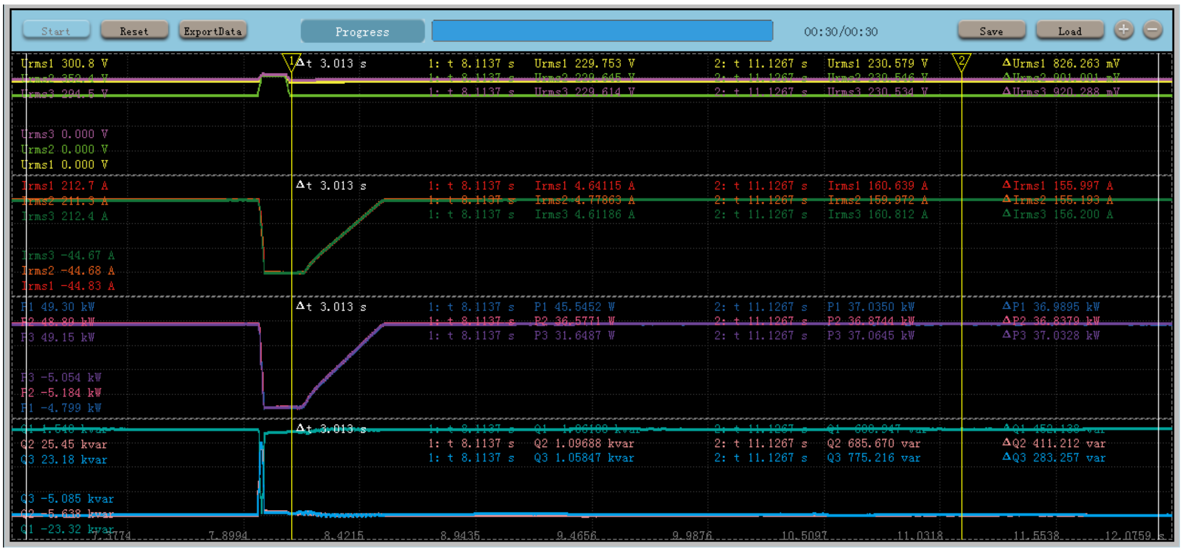


Empty load

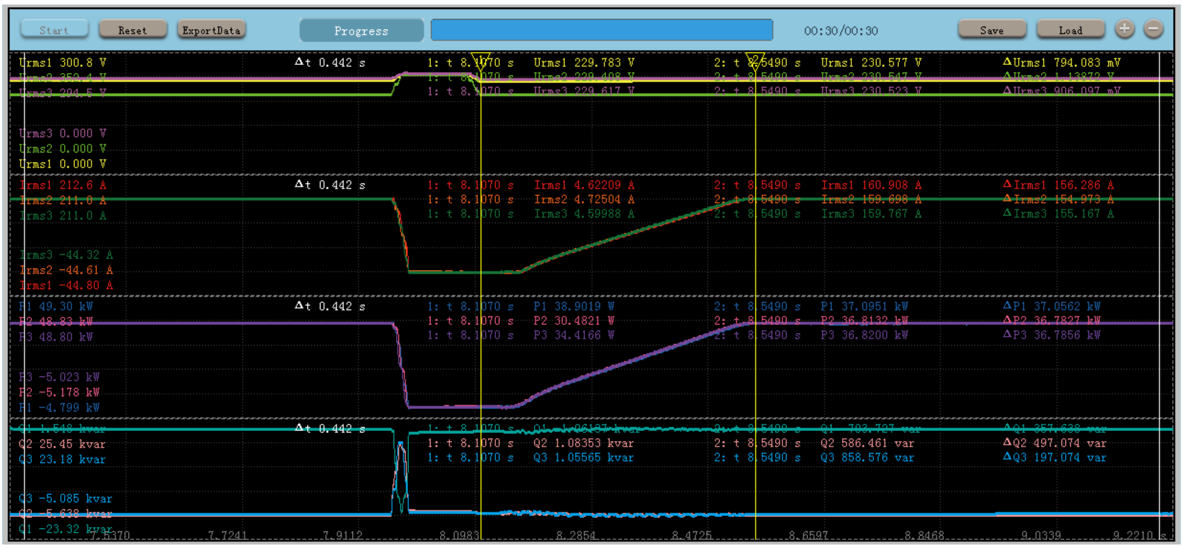
Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)

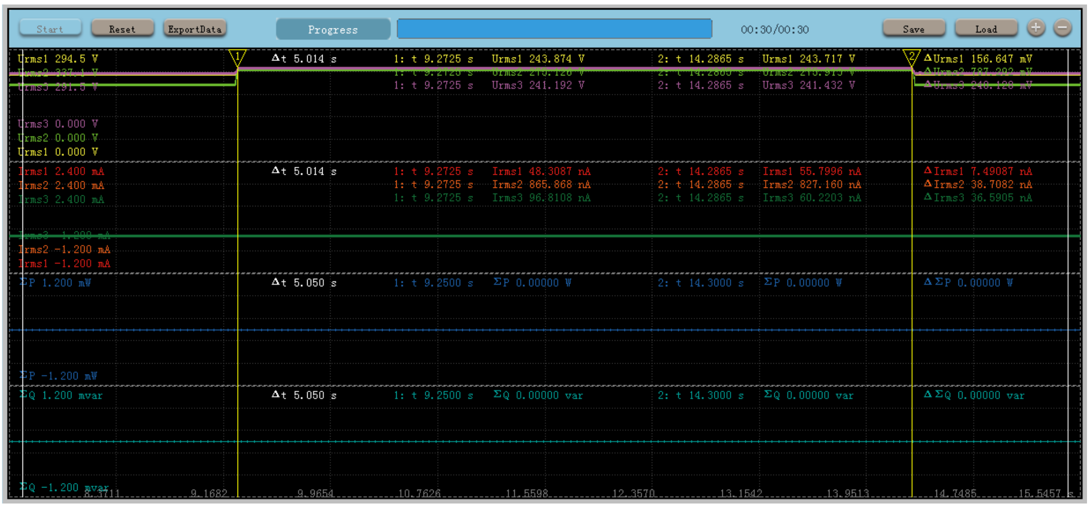


After dip (t2+3s)

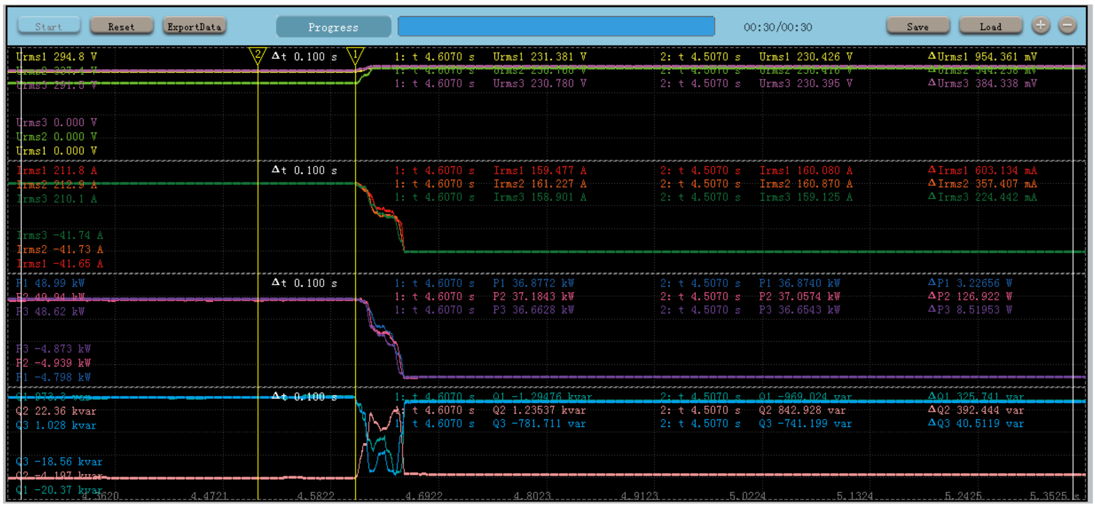


Active power recovery time

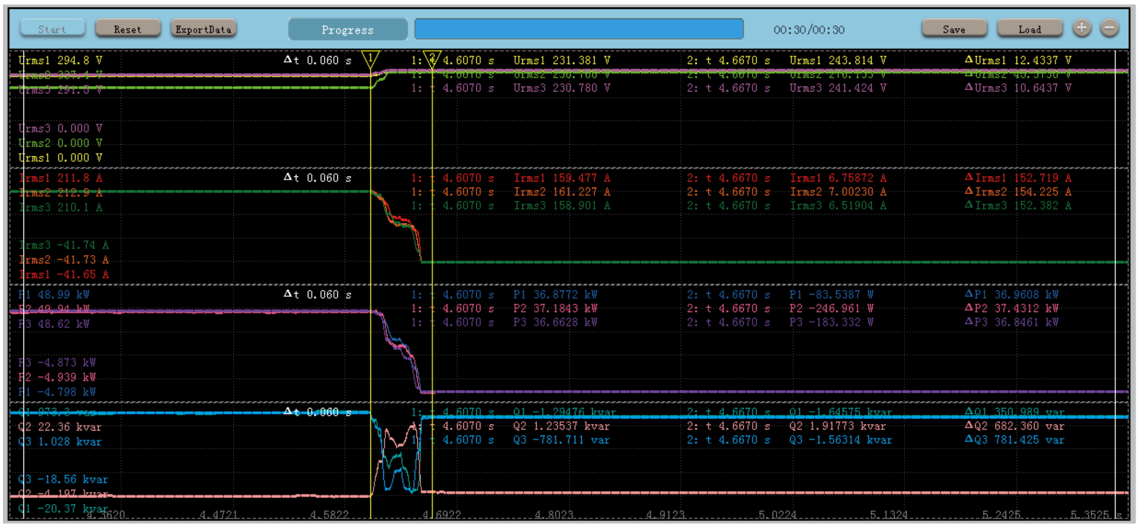
Graph of Test number 6.3



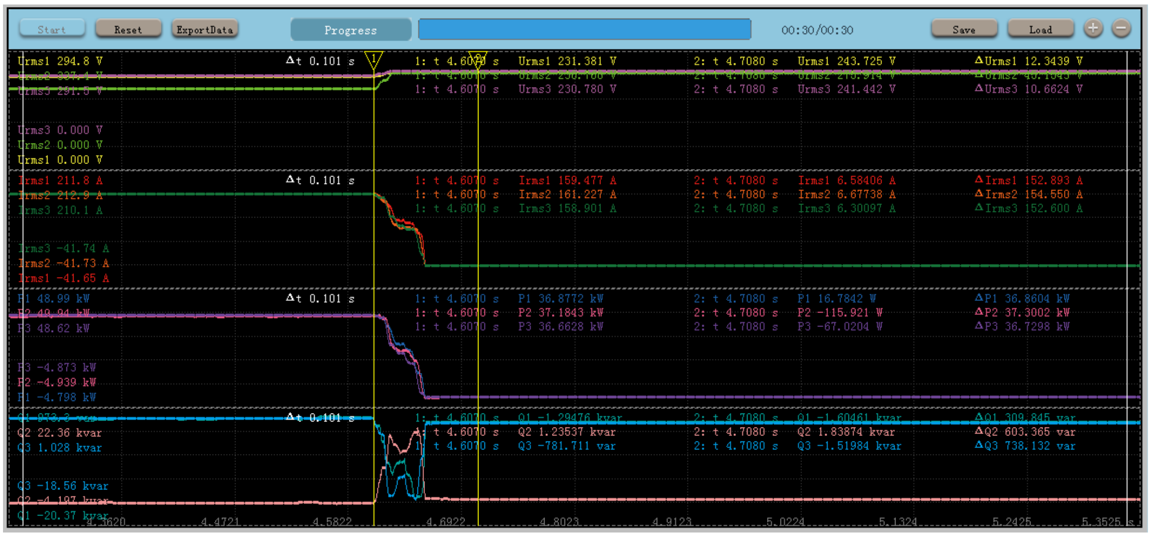
Empty load



Before dip (t1-100ms)

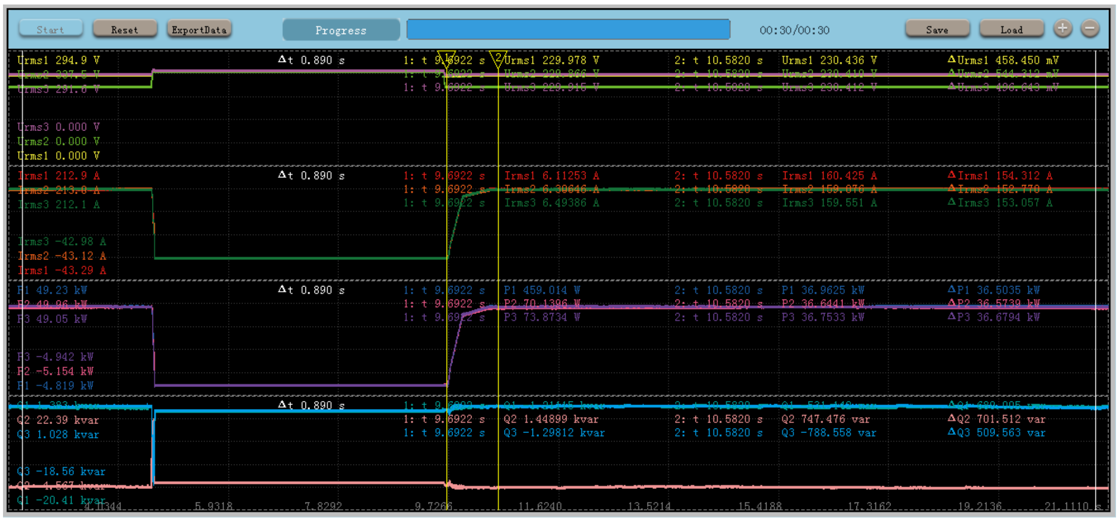


During dip (t1+60ms)



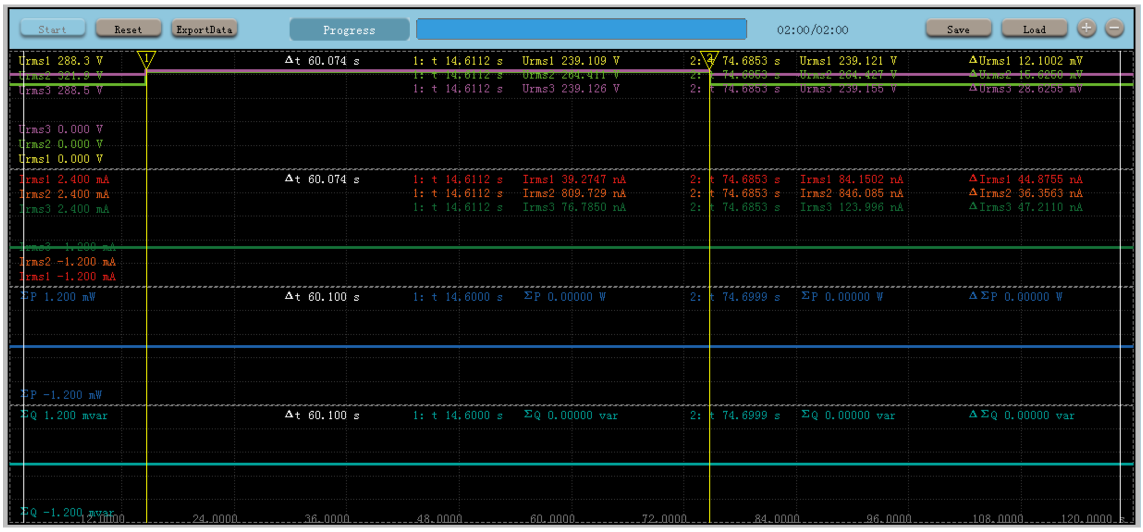
During dip (t1+100ms)

After dip (t2+3s)

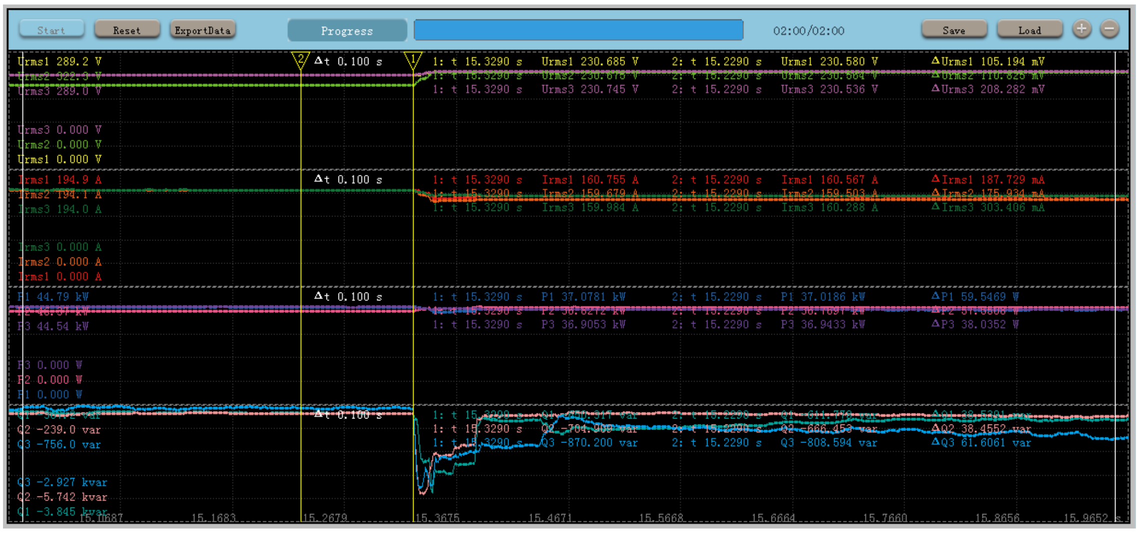


Active power recovery time

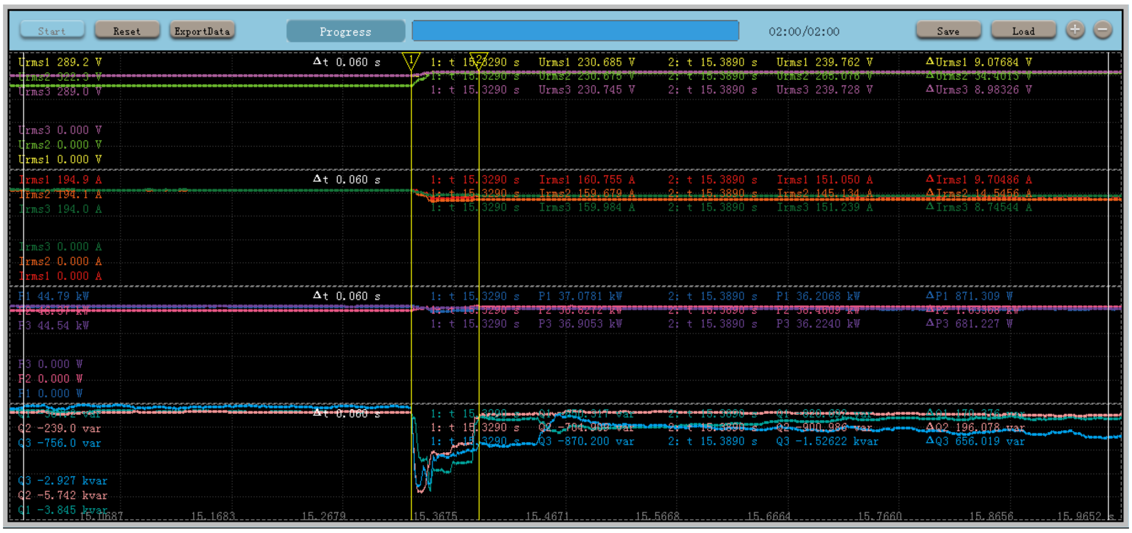
Graph of Test number 7.3



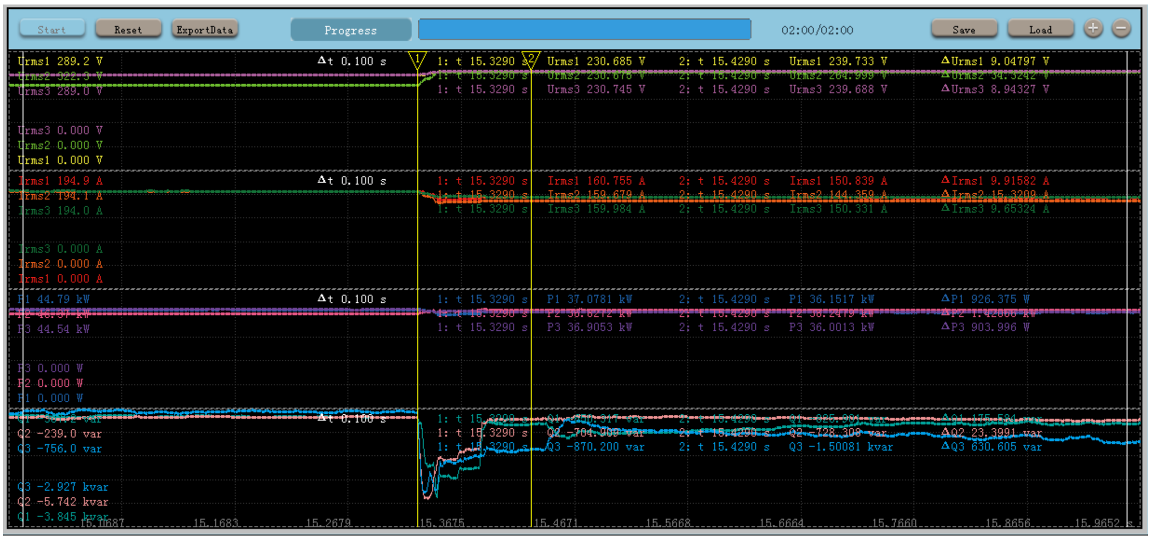
Empty load



Before dip (t1-100ms)



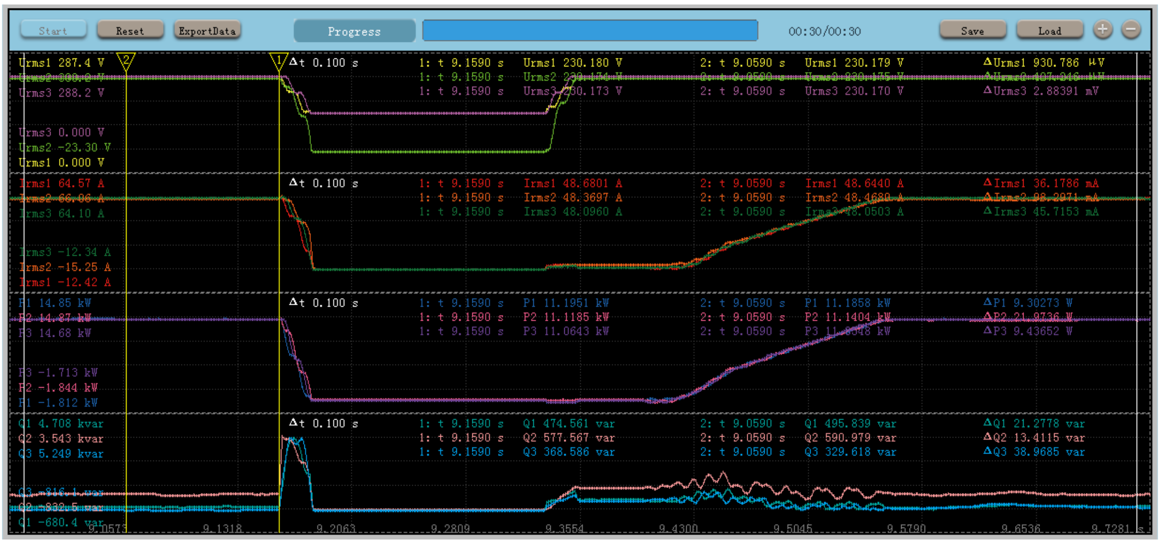
During dip (t1+60ms)



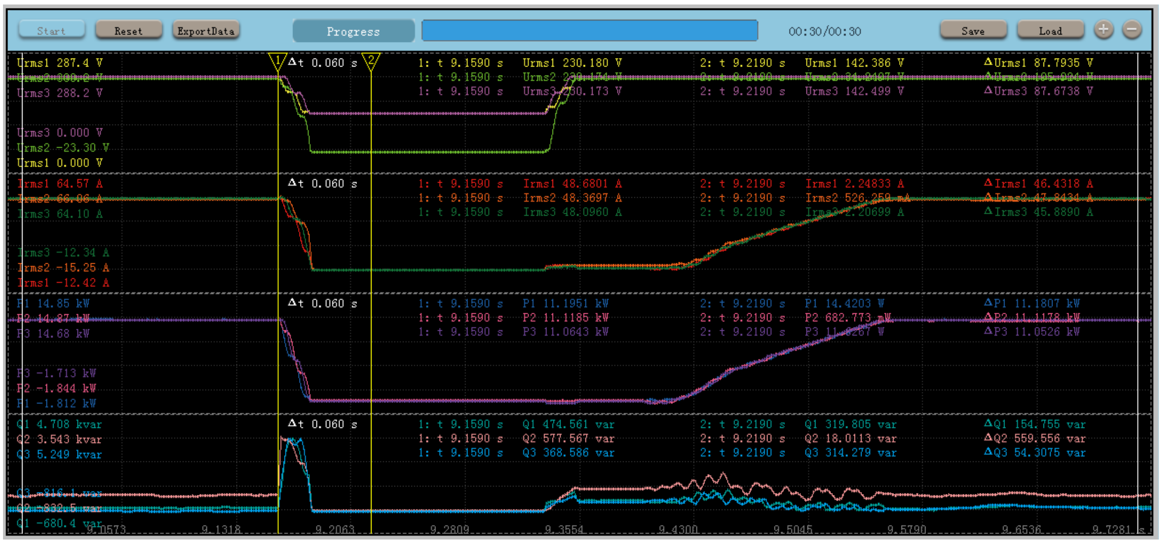
During dip (t1+100ms)

After dip (t2+3s)

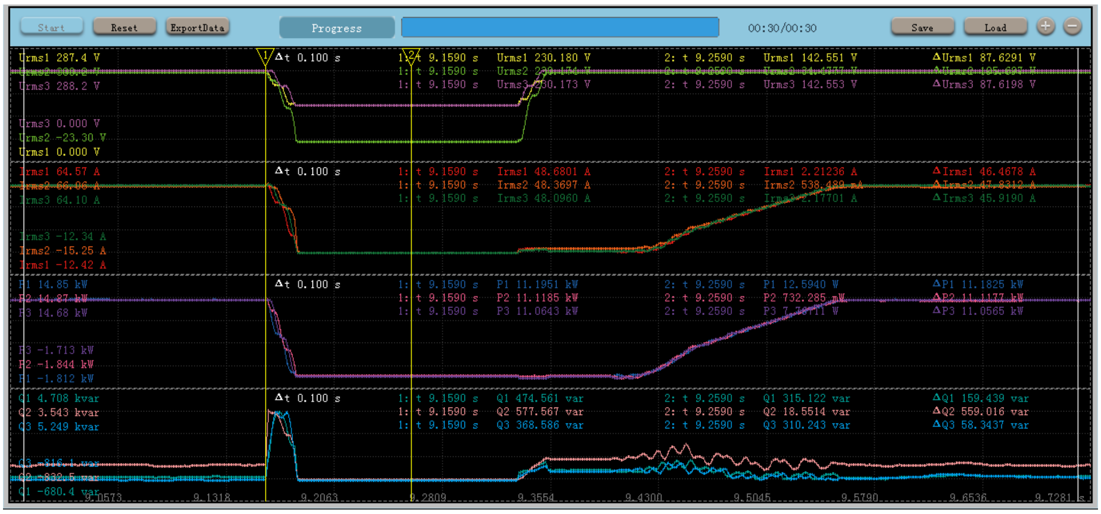
Graph of Test number 1.4



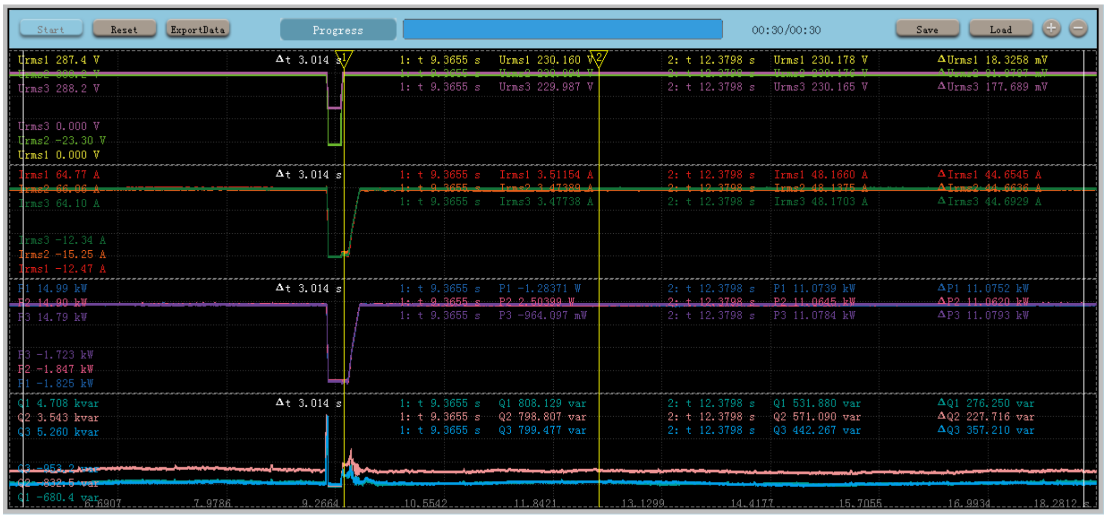
Before dip (t1-100ms)



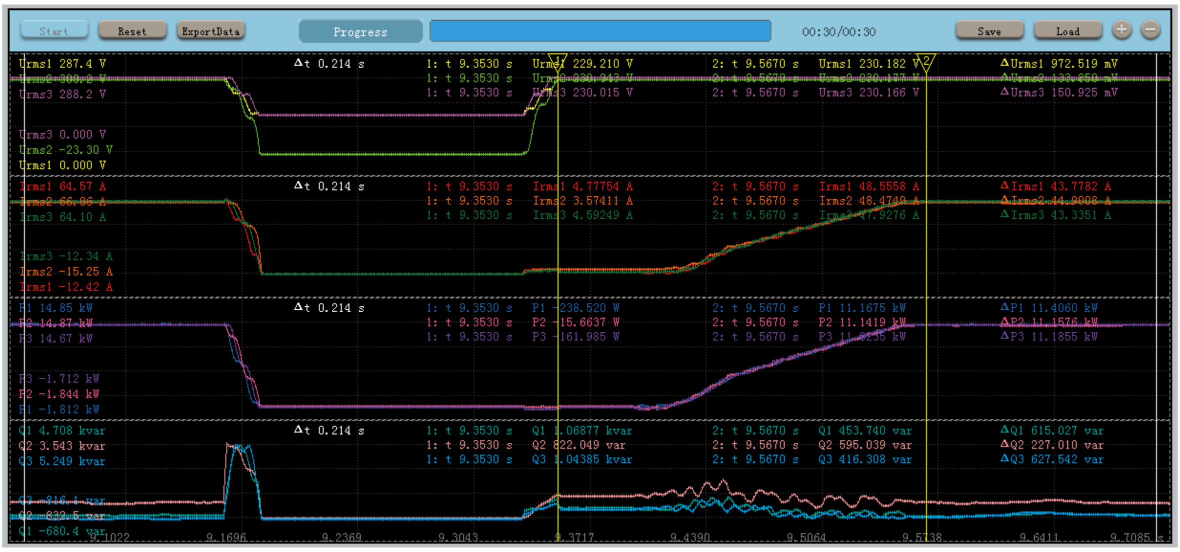
During dip (t1+60ms)



During dip (t1+100ms)



After dip (t2+3s)

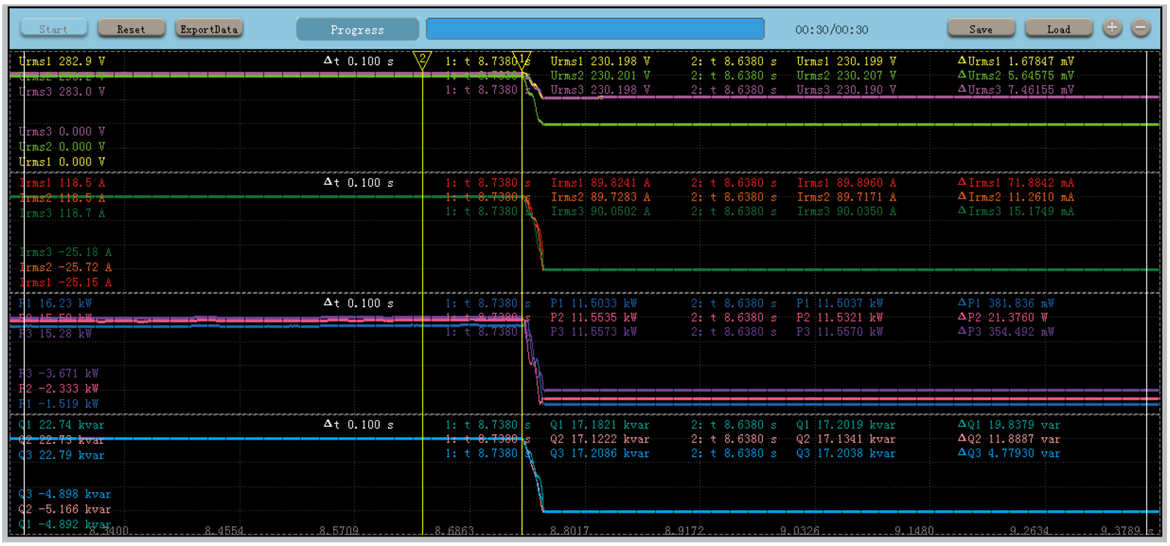


Active power recovery time

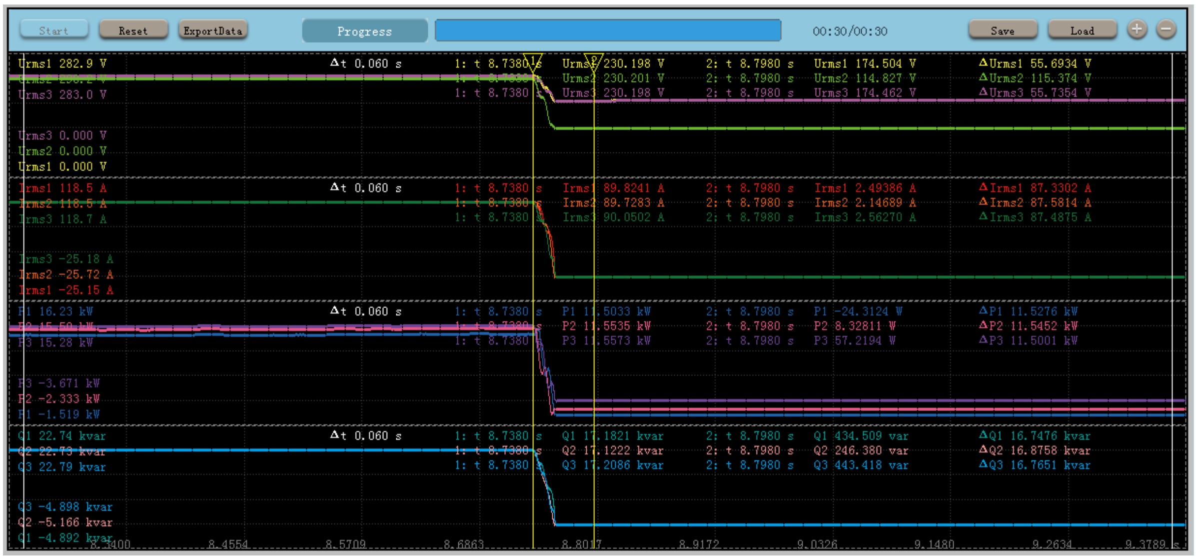
Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]			300K						
NS protection settings			See table 2 in VDE-AR-N 4105:2018						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	2.4	3.4	4.4	5.4
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		D1	D1	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.50	0.50	0.85	1.25
	5	Setting dip duration		--	ms	1500	1500	60000	100
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	1503.5	1504.6	60021	100.94
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.763	0.761	0.932	1.082
						0.501	0.501	0.856	1.252
						0.762	0.761	0.932	1.062
	10		Positive sequence		p.u.	0.665	0.665	0.904	1.128
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.558	0.586	0.304	0.303
	13	Active power	Total	t1-10s to t1	p.u.	0.301	0.281	0.303	0.303
	14		Positive sequence			0.301	0.281	0.303	0.303
	15	Reactive power	Total	t1-10s to t1	p.u.	0.471	-0.481	0.013	0.007
	16		Positive sequence			0.471	-0.481	0.013	0.007
	17	Cos φ	--	t1-10s to t1	--	0.5114	0.5484	0.9990	0.9989
During dip t1 to	18	Voltage	Phase 1	t1+100ms to t2-	p.u.	0.762	0.762	0.932	1.082
			Phase 2			0.500	0.501	0.852	1.250

t2			Phase 3	20ms		0.762	0.762	0.932	1.062
	19	Line current	Phase 1	t1+60ms	p.u.	0.009	0.006	0.333	0.024
	20		Phase 2			0.006	0.008	0.328	0.025
	21		Phase 3			0.008	0.007	0.328	0.025
	22	Line current	Phase 1	t1+100ms	p.u.	0.009	0.006	0.328	0.023
	23		Phase 2			0.006	0.008	0.328	0.024
	24		Phase 3			0.008	0.007	0.333	0.024
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.001	0.299	0.001
	26		Positive sequence			0.001	0.001	0.299	0.001
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.001	1.000	1.000	1.000
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u	0.302	0.301	0.302	0.301
	29		Total			0.302	0.301	0.302	0.301
	39	Active power rising time	Positive sequence	--	s	0.932	0.230	0.073	0.215
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	0.470	-0.464	0.013	0.08
	32		Total			0.470	-0.464	0.013	0.08
	33	Reactive power rising time	Positive sequence	--	s	9.910	9.911	0.023	0.035
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

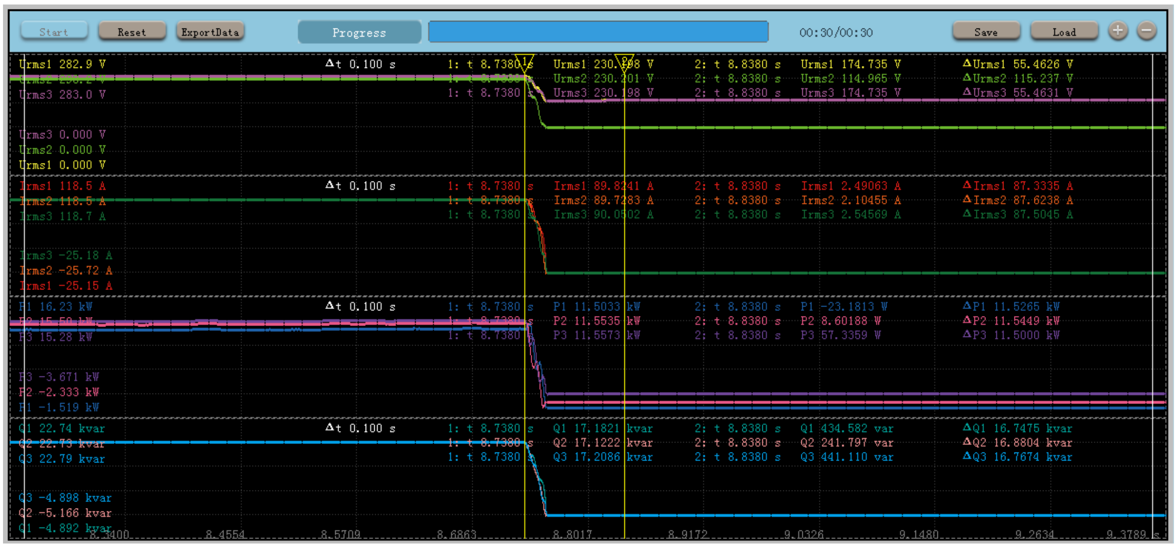
Graph of Test number 2.4



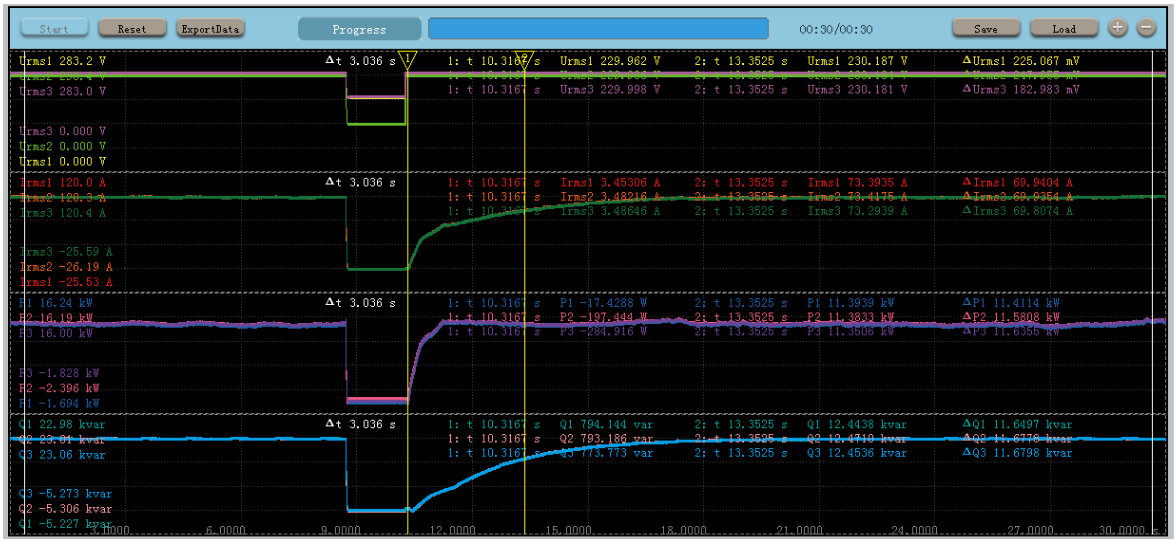
Before dip (t1-100ms)



During dip (t1+60ms)



During dip (t1+100ms)

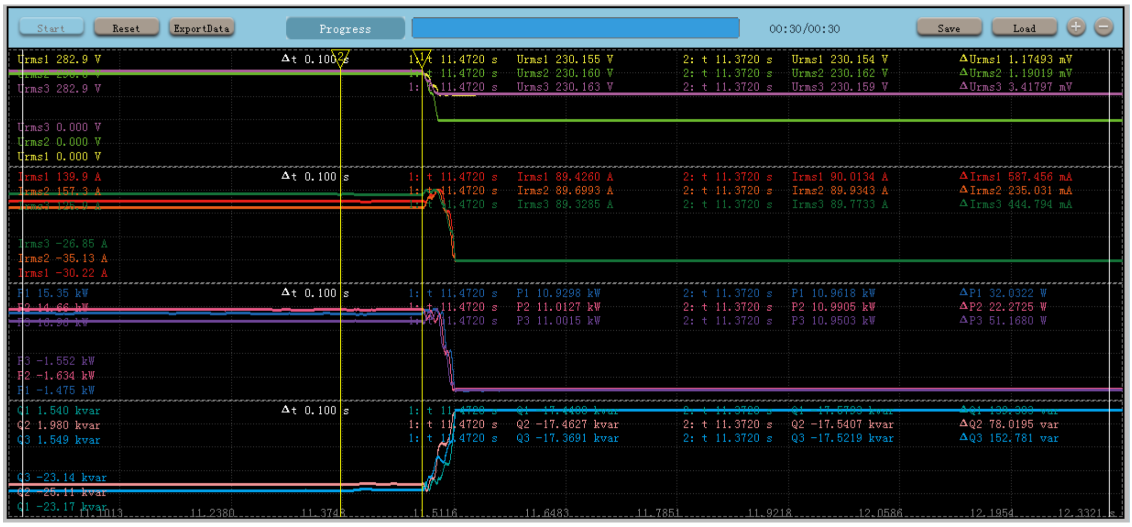


After dip (t2+3s)

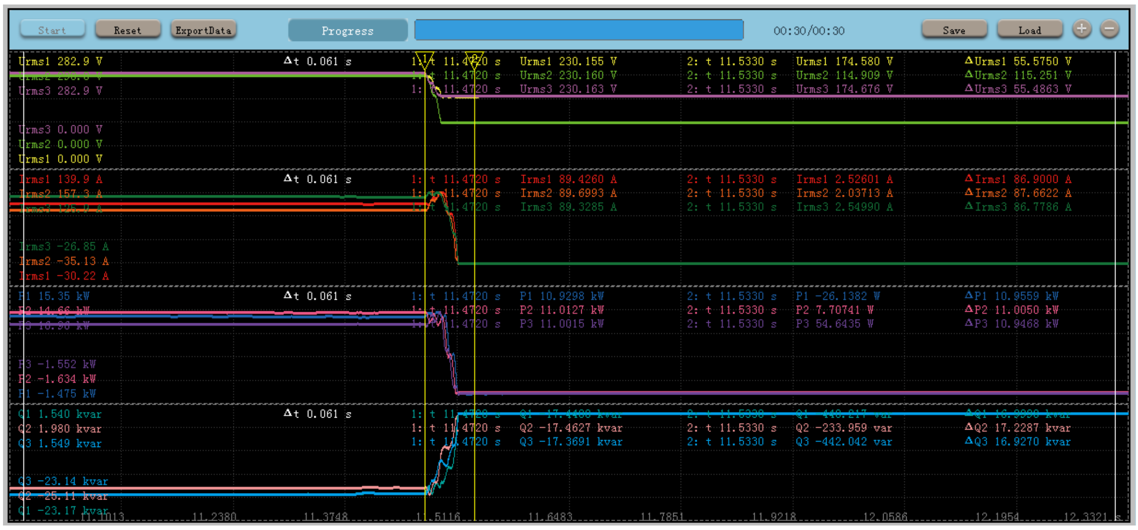
Active power Recovery time

Reactive power Recovery time

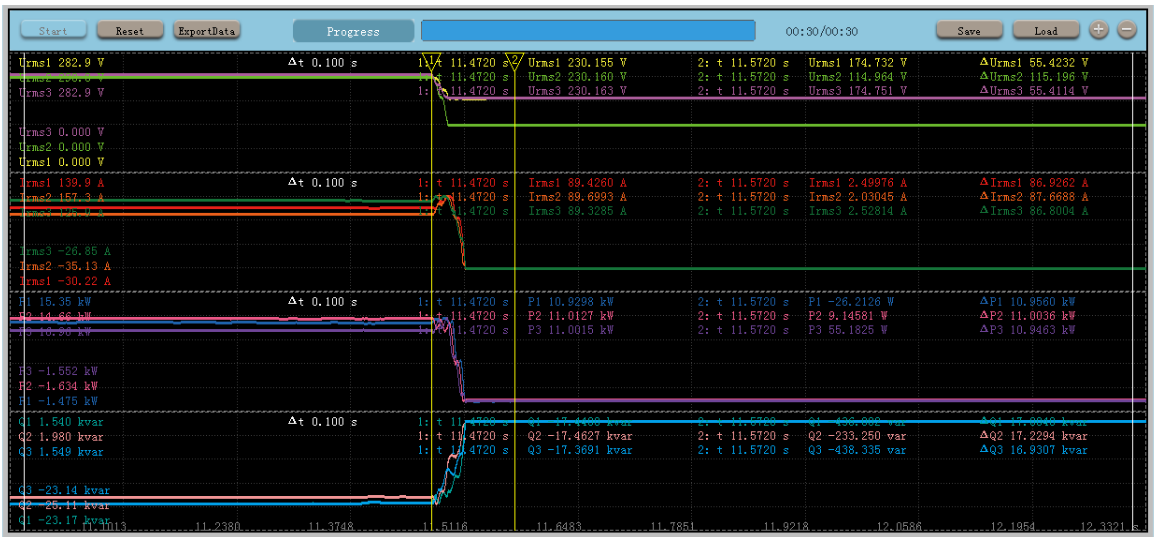
Graph of Test number 3.4



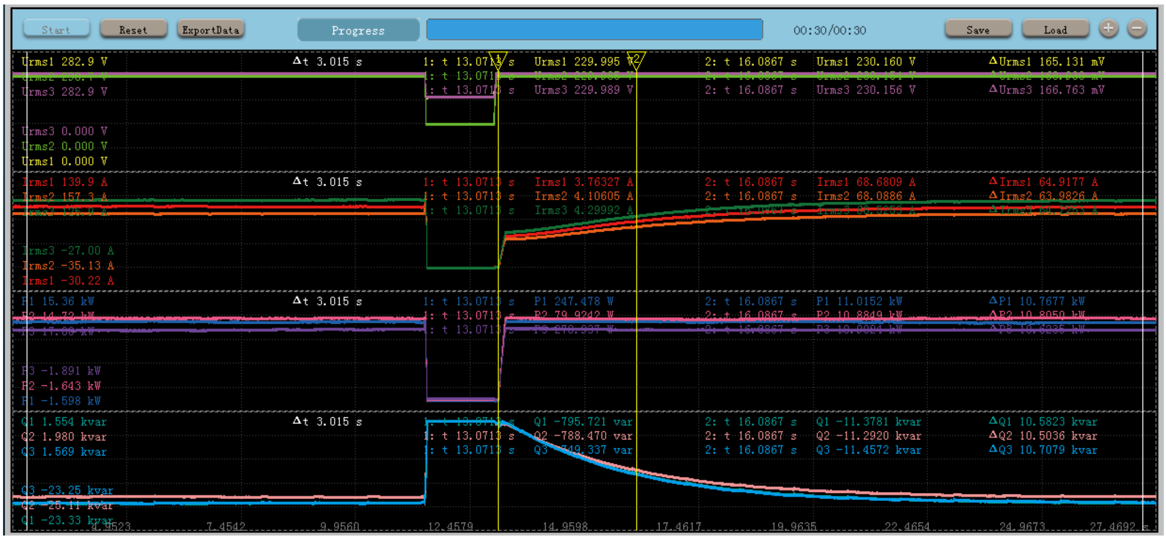
Before dip (t1-100ms)



During dip (t1+60ms)

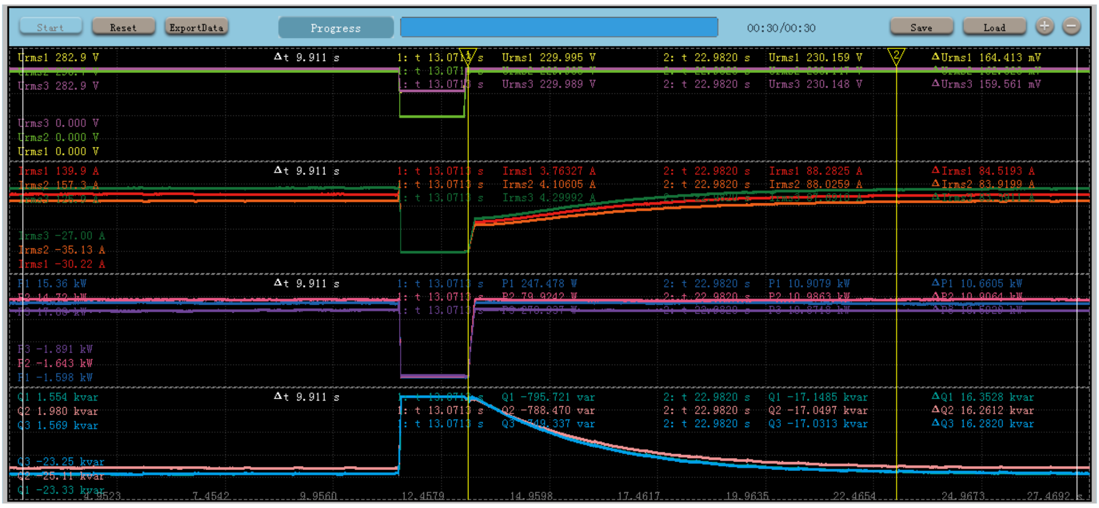


During dip (t1+100ms)



After dip (t2+3s)

Active power recovery time

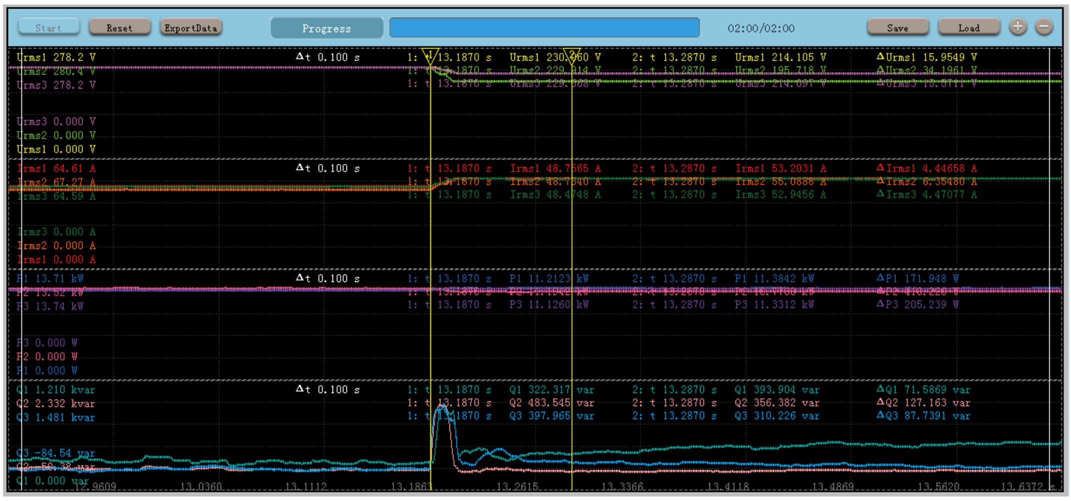


Reactive power recovery time

Graph of Test number 4.4

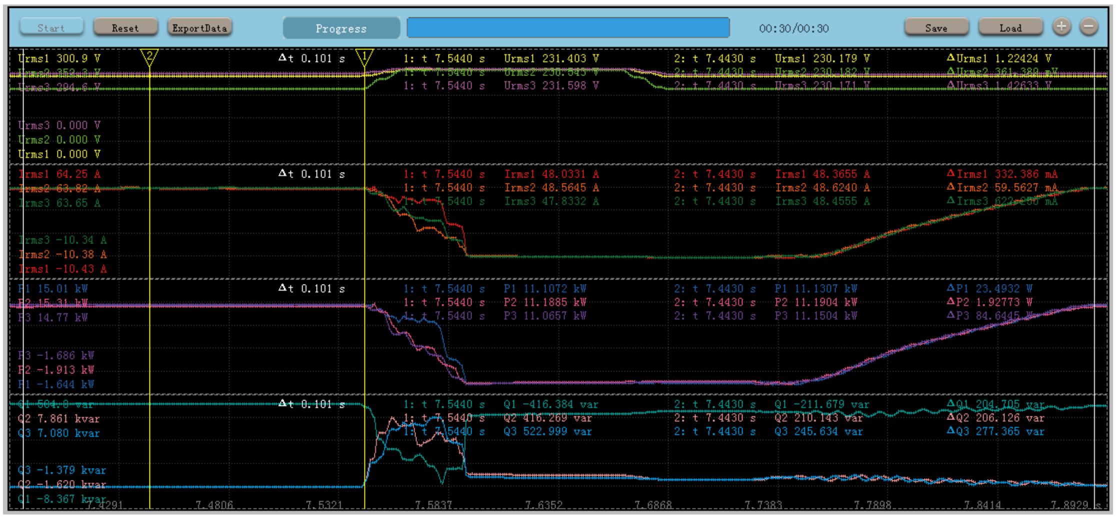
Before dip (t1-100ms)

During dip (t1+60ms)

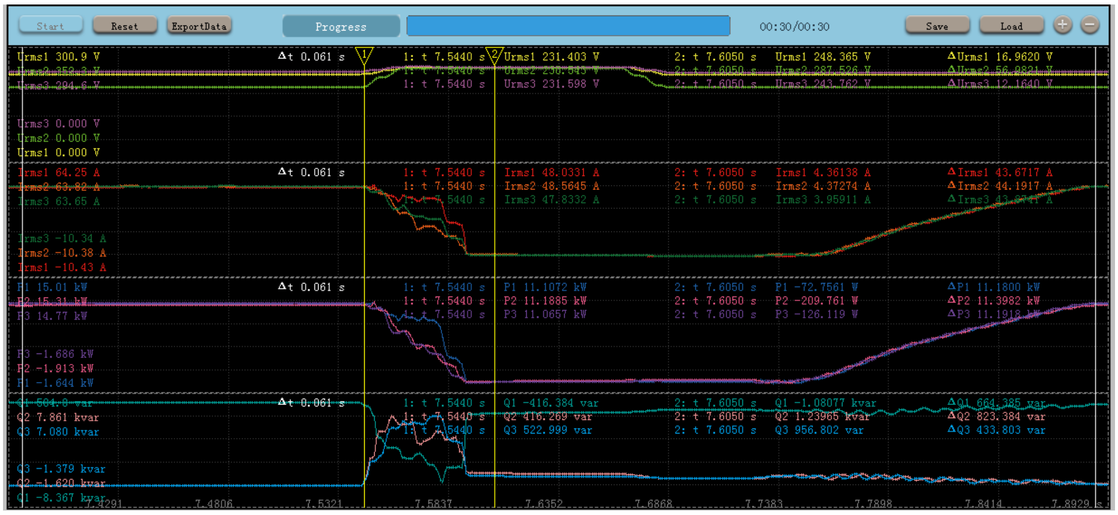

During dip (t1+100ms)


After dip (t2+3s)

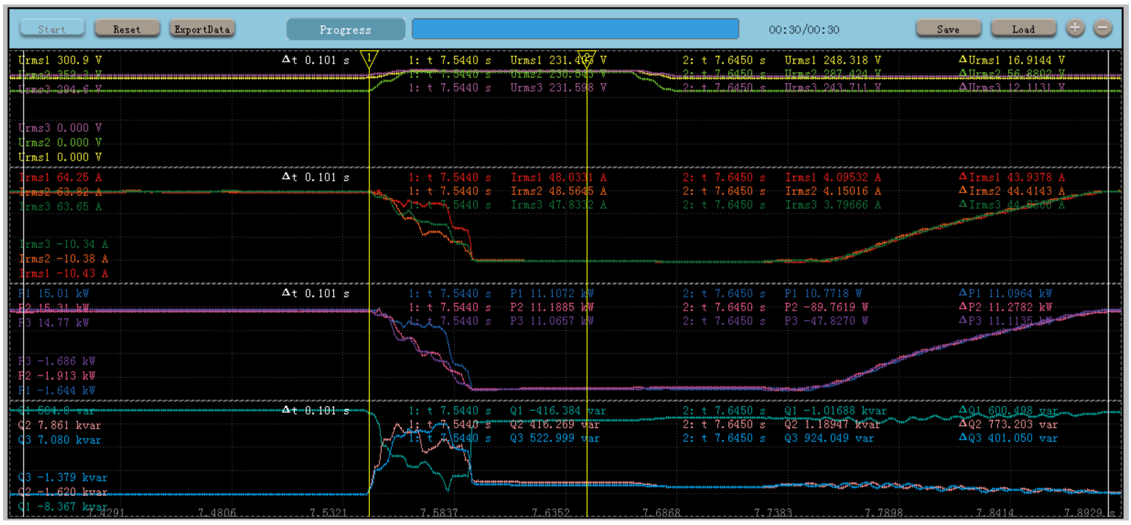
Graph of Test number 5.4



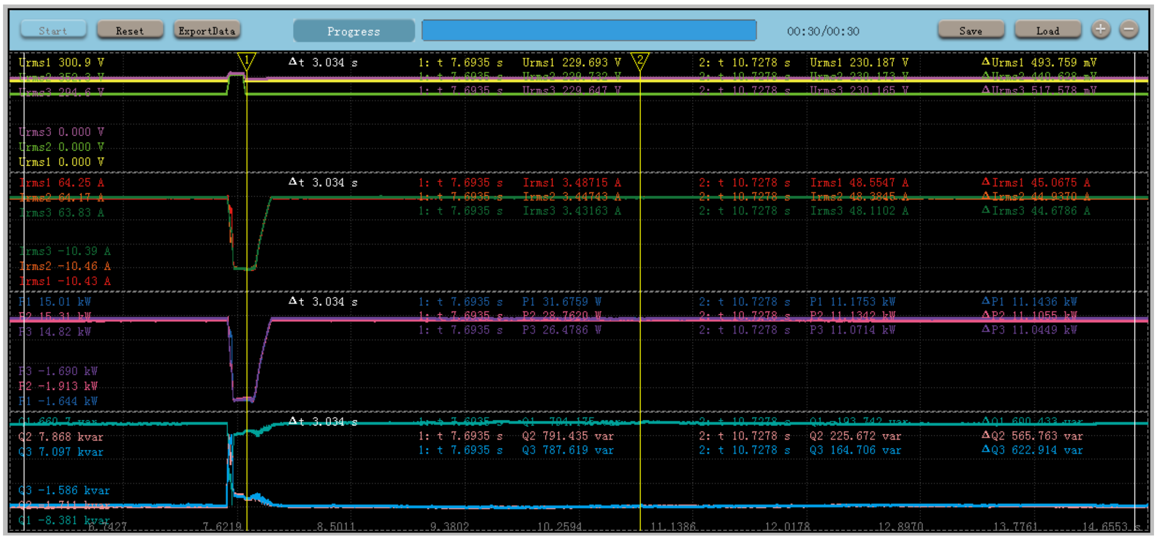
Before dip (t1-100ms)



During dip (t1+60ms)



During dip (t1+100ms)



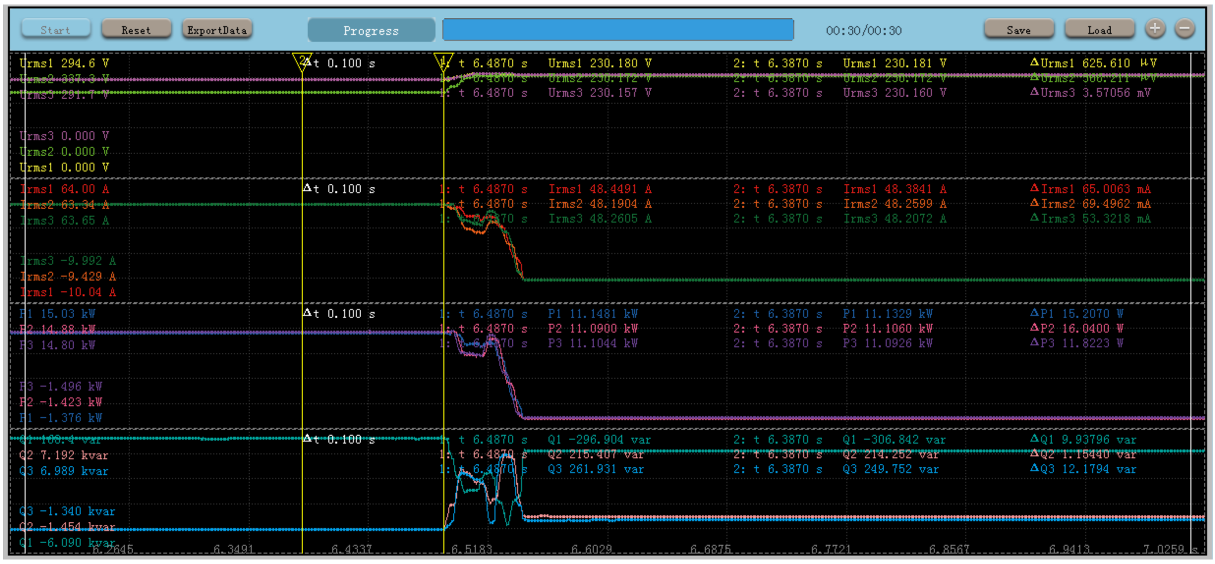
After dip (t2+3s)

Active power recovery time

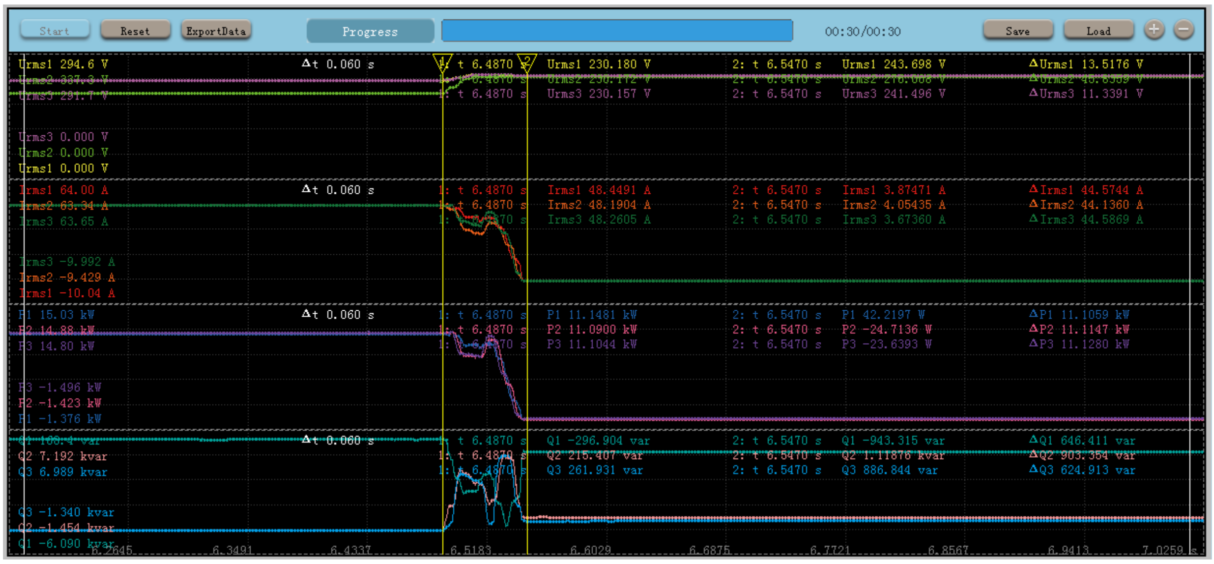
Verification of dynamic network support									P
Short-circuited power at generator terminal [VA]			300K						
NS protection settings			See table 2 in VDE-AR-N 4105:2018						
	No.	Parameter	Phase ref.	Time ref.	unit	Result			
General Info.	0	Test number	--	--	--	6.4	7.4	1.5	5.5
	1	Date	--	--	dd.mm.yyyy	15-Nov-2022 to 22-Nov-2022			
	2	Time (start of test)	--	--	hh:mm:ss.f	See graph			
	3	Fault type (phase)	--	--		D1	D1	D2	D2
	4	Setting voltage depth	Line to line	--	p.u.	1.20	1.15	0.15	1.25
	5	Setting dip duration		--	ms	5000	60000	150	100
	6	Point of fault entry	Total	--	ms	See graph			
	7	Point of fault clearance	Total	--	ms	See graph			
	8	Fault duration in empty load test	Total	--	ms	5008.3	60209	159.51	100.51
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.062	1.042	0.151	1.252
						1.202	1.152	0.623	1.064
						1.053	1.042	0.622	1.082
	10		Positive sequence		p.u.	1.103	1.077	0.429	1.124
Before dip <t1	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1-100ms	p.u.	0.302	0.305	1.00	1.00
	13	Active power	Total	t1-10s to t1	p.u.	0.302	0.304	1.000	1.001
	14		Positive sequence			0.302	0.304	1.000	1.001
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.009	-0.009	0.012	-0.010
	16		Positive sequence			-0.009	-0.009	0.012	-0.010
	17	$\cos_\varphi$	--	t1-10s to t1	--	0.9995	0.9988	1.0000	0.9999
During dip t1 to t2	18	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1.059	1.040	0.151	1.252
			Phase 2			1.199	1.149	0.618	1.064
			Phase 3			1.052	1.041	0.622	1.082

	19	Line current	Phase 1	t1+60ms	p.u.	0.012	0.288	0.008	0.031
	20		Phase 2			0.014	0.286	0.009	0.031
	21		Phase 3			0.011	0.289	0.009	0.031
	22	Line current	Phase 1	t1+100ms	p.u.	0.011	0.290	0.008	0.031
	23		Phase 2			0.013	0.287	0.009	0.032
	24		Phase 3			0.011	0.289	0.009	0.032
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.001	0.301	0.001	0.001
	26		Positive sequence			0.001	0.301	0.001	0.001
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	0.303	0.302	1.001	0.994
	29		Total			0.303	0.302	1.001	0.994
	39	Active power rising time	Positive sequence	--	s	0.208	0.037	0.447	0.432
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.	-0.007	-0.013	0.018	-0.007
	32		Total			-0.007	-0.013	0.018	-0.007
	33	Reactive power rising time	Positive sequence	--	s	0.075	0.049	0.045	0.080
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes			

Graph of Test number 6.4



Before dip (t1-100ms)



During dip (t1+60ms)

During dip (t1+100ms)

After dip (t2+3s)

Active power recovery time

Graph of Test number 7.4

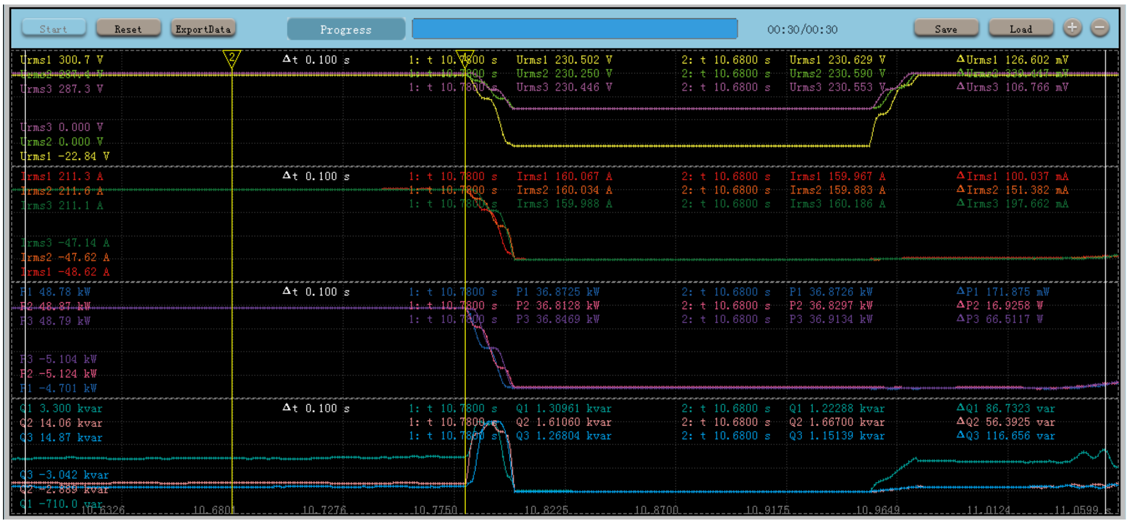
Before dip (t1-100ms)

During dip (t1+60ms)

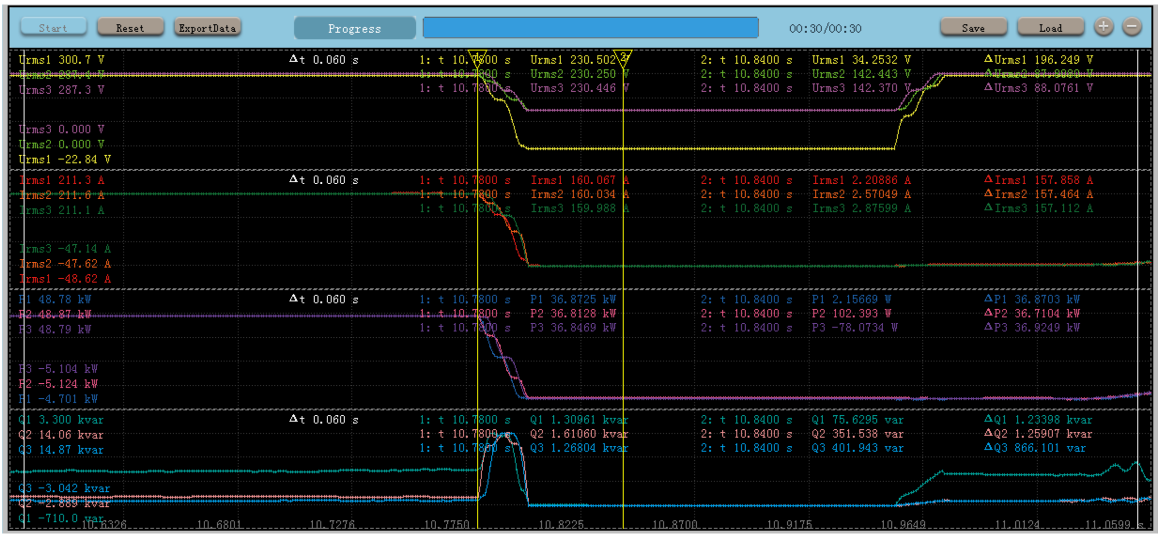
During dip (t1+100ms)

After dip (t2+3s)

Graph of Test number 1.5

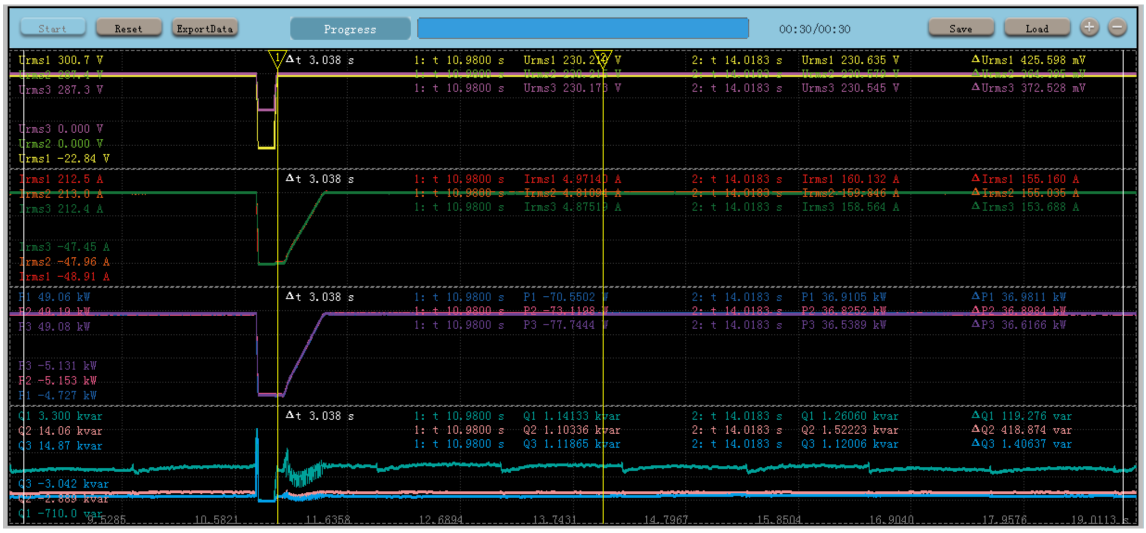


Before dip (t1-100ms)

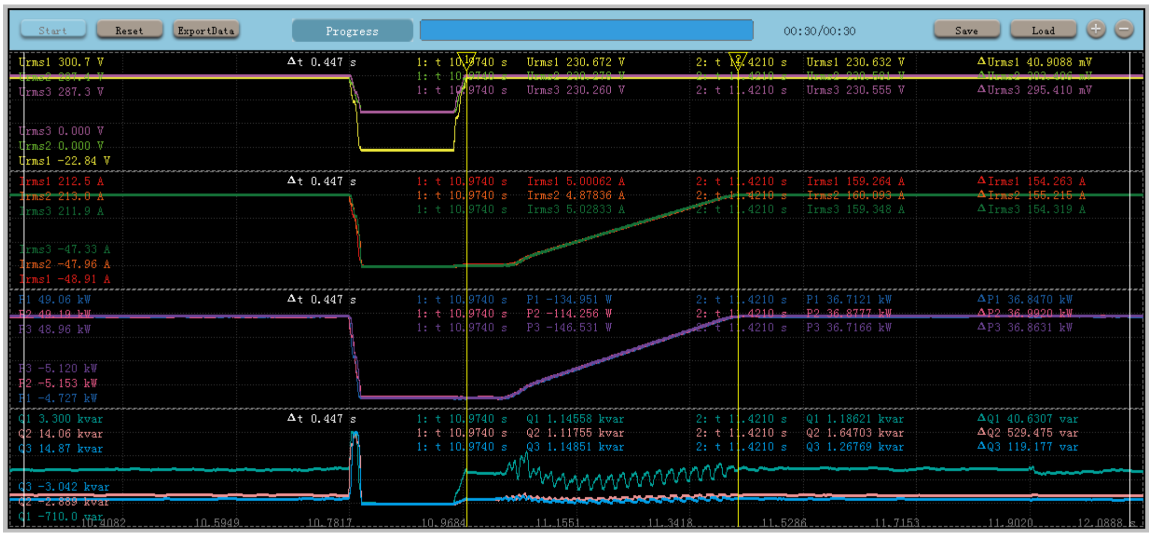


During dip (t1+60ms)

During dip (t1+100ms)



After dip (t2+3s)



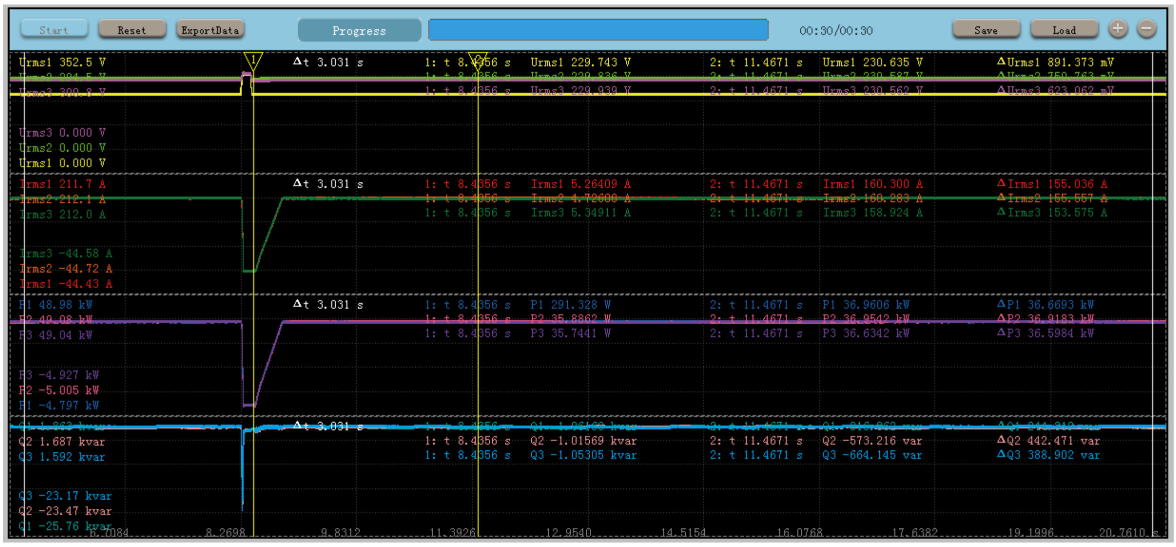
Active power recovery time

Graph of Test number 5.5

Before dip (t1-100ms)

During dip (t1+60ms)

During dip (t1+100ms)



After dip (t2+3s)

Active power recovery time

E.5 Test report “Network interactions” for power generation units with an input current > 75 A

<table>
<tr><td rowspan="6">Manufacturer indications:
(Herstellerangaben)</td><td colspan="2">System type (Anlagenart) (BHKW, PV-WR, …)</td><td colspan="4">PV</td></tr>
<tr><td colspan="2" rowspan="4">Max. active power PEmax
(maximale Wirkleistung PEmax)</td><td>iMars XG100KTR</td><td colspan="2">iMars XG100KTR-F</td><td>iMars XG110KTR</td></tr>
<tr><td>101.26KW</td><td colspan="2">101.26KW</td><td>110.65KW</td></tr>
<tr><td>iMars XG110KTR-F</td><td colspan="2"></td><td rowspan="2"></td></tr>
<tr><td>110.67KW</td><td colspan="2"></td></tr>
<tr><td colspan="2">Rated voltage (Bemessungsspannung)</td><td colspan="4">3/N/PE, 230/400Vac</td></tr>
<tr><td>Measurement period (Messzeitraum)</td><td colspan="2">From (vom) YYYY-MM-DD to (bis) YYYY-MM-DD</td><td colspan="4">12 Sep 2022– 23 Dec 2022</td></tr>
<tr><td colspan="3">Rapid voltage changes (Schnelle Spannungsänderungen)</td><td colspan="4">ki = 0.582</td></tr>
<tr><td colspan="3">Connection without provisions (regarding the primary energy carrier)
(Einschalten ohne Vorgabe (zum Primärenergieträger))</td><td colspan="4">ki = 0.058</td></tr>
<tr><td colspan="3">Most adverse case when switching between generator levels
(Ungünstigster Fall beim Umschalten der Generatorstufen)</td><td colspan="4">ki = 0.582</td></tr>
<tr><td colspan="3">Connection at nominal conditions (of the primary energy carrier)
(Einschalten bei Nennbedingungen (des Primärenergieträgers))</td><td colspan="4">ki = 0.060</td></tr>
<tr><td colspan="3">Disconnection at rated power (Ausschalten bei Bemessungsleistung)</td><td colspan="4">ki = 0.582</td></tr>
<tr><td colspan="3">Worst value of all switching operations (Schlechtester Wert aller Schaltvorgänge)</td><td colspan="4">kimax = 0.582</td></tr>
<tr><td rowspan="2">Flicker</td><td colspan="2">Network impedance angle Ψ_k
(Netzimpedanzwinkel Ψ_k)</td><td>30°</td><td>50°</td><td>70°</td><td>85°</td></tr>
<tr><td colspan="2">Initial flicker factor c_Ψ
(Anlagenflickerbeiwert c_Ψ)</td><td>5.60</td><td>5.68</td><td>5.86</td><td>5.70</td></tr>
</table>

Model: iMARS XG100KTR											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Ordinal number (Ordnungszahl)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.0771	0.0575	0.0305	0.1244	0.0454	0.0354	0.0985	0.0751	0.0756	0.0874	0.0794
3	0.4797	0.6522	0.6792	0.6172	0.6075	0.3512	0.4066	0.4084	0.4523	0.4741	0.4814
4	0.0290	0.0474	0.0322	0.0350	0.0484	0.1044	0.1334	0.1521	0.1405	0.1486	0.1961
5	0.3584	0.2686	0.3256	0.3004	0.3004	0.3525	0.3505	0.3290	0.3044	0.3284	0.3281
6	0.0307	0.0382	0.0320	0.0322	0.0542	0.0776	0.0603	0.0655	0.0515	0.0534	0.0836
7	0.2483	0.2257	0.2084	0.1893	0.1174	0.2123	0.2166	0.2132	0.2162	0.2143	0.2042
8	0.0169	0.0674	0.0483	0.0606	0.0411	0.0321	0.0306	0.0363	0.0376	0.0401	0.0550
9	0.0884	0.3082	0.3113	0.2855	0.3522	0.2370	0.2293	0.2292	0.2276	0.2182	0.2096
10	0.0084	0.0335	0.0325	0.0385	0.0855	0.0482	0.0482	0.0566	0.0640	0.0721	0.0831
11	0.0149	0.0773	0.0473	0.3011	0.2471	0.1505	0.3241	0.4123	0.4414	0.4421	0.4641
12	0.0077	0.0902	0.1005	0.0955	0.0916	0.0991	0.0986	0.0984	0.1004	0.0970	0.0981
13	0.0201	0.1976	0.3273	0.0723	0.1476	0.0656	0.2005	0.2835	0.3323	0.3585	0.3844
14	0.0063	0.0633	0.0385	0.0412	0.0543	0.0326	0.0513	0.0792	0.0833	0.0864	0.0853
15	0.0184	0.1225	0.1021	0.1015	0.2543	0.1156	0.0766	0.0456	0.0431	0.0432	0.0613
16	0.0050	0.0562	0.0370	0.0526	0.0546	0.0365	0.0321	0.0453	0.0606	0.0656	0.0691
17	0.0075	0.1393	0.0621	0.3205	0.0626	0.0532	0.1734	0.3146	0.3775	0.3931	0.3956
18	0.0043	0.0521	0.0603	0.0630	0.0463	0.0631	0.0516	0.0611	0.0792	0.0834	0.0912
19	0.0043	0.2184	0.2180	0.2703	0.0995	0.0432	0.1474	0.2294	0.2942	0.3174	0.3321
20	0.0036	0.0555	0.0801	0.0992	0.1103	0.0694	0.0775	0.0556	0.0541	0.0672	0.0820
21	0.0105	0.2993	0.1995	0.2962	0.1844	0.0850	0.0973	0.1366	0.1754	0.2072	0.2483
22	0.0017	0.0932	0.0906	0.1060	0.0904	0.0604	0.0651	0.0585	0.0710	0.1004	0.1320
23	0.0067	0.1563	0.1783	0.2021	0.2723	0.1421	0.1266	0.2102	0.3594	0.4776	0.5535
24	0.0020	0.0896	0.1195	0.1391	0.1244	0.0892	0.0844	0.0894	0.1085	0.1170	0.1296
25	0.0025	0.1675	0.3795	0.2301	0.3852	0.1840	0.1584	0.1801	0.2541	0.3401	0.4186
26	0.0018	0.0797	0.1006	0.1182	0.1273	0.1231	0.1261	0.1274	0.1345	0.1342	0.1346
27	0.0035	0.1033	0.2066	0.1834	0.2941	0.0944	0.0970	0.1092	0.1146	0.1425	0.1673
28	0.0021	0.0618	0.0655	0.0923	0.0893	0.0881	0.0921	0.1351	0.1334	0.1344	0.1271
29	0.0037	0.1494	0.2452	0.1254	0.2106	0.3630	0.2426	0.2450	0.2901	0.3985	0.4623
30	0.0008	0.0673	0.0715	0.0834	0.0784	0.0771	0.0926	0.1066	0.1090	0.1393	0.1425
31	0.0008	0.0792	0.0841	0.1731	0.0992	0.2566	0.1572	0.1633	0.2464	0.3060	0.3571
32	0.0006	0.0636	0.0631	0.0596	0.0612	0.0611	0.0584	0.0543	0.0726	0.0776	0.0840
33	0.0015	0.1133	0.0493	0.2193	0.0851	0.1073	0.0623	0.0655	0.0884	0.0986	0.1075
34	0.0007	0.0362	0.0333	0.0392	0.0420	0.0463	0.0495	0.0504	0.0535	0.0716	0.0756
35	0.0020	0.0566	0.0390	0.1165	0.0655	0.2433	0.1463	0.1221	0.1821	0.1871	0.1911
36	0.0005	0.0472	0.0505	0.0445	0.0542	0.0540	0.0492	0.0480	0.0524	0.0616	0.0646
37	0.0007	0.0553	0.0683	0.0806	0.0653	0.1161	0.1116	0.0565	0.0905	0.0986	0.0976
38	0.0003	0.0272	0.0276	0.0230	0.0273	0.0280	0.0353	0.0283	0.0301	0.0345	0.0326
39	0.0005	0.0314	0.0356	0.0244	0.0296	0.0240	0.0321	0.0355	0.0283	0.0361	0.0426
40	0.0003	0.0214	0.0223	0.0222	0.0296	0.0261	0.0251	0.0281	0.0282	0.0302	0.0251

Inter-harmonics (Zwischenharmonische)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.0845	0.0738	0.1035	0.1022	0.1007	0.1076	0.1044	0.1051	0.1139	0.1082	0.0087
125	0.0317	0.0268	0.0322	0.0330	0.0348	0.0362	0.0352	0.0355	0.0396	0.0369	0.0071
175	0.0245	0.0215	0.0270	0.0268	0.0288	0.0303	0.0294	0.0308	0.0329	0.0323	0.0074
225	0.0238	0.0294	0.0287	0.0277	0.0277	0.0291	0.0291	0.0303	0.0313	0.0318	0.0096
275	0.0214	0.0303	0.0270	0.0266	0.0277	0.0293	0.0287	0.0299	0.0316	0.0306	0.0160
325	0.0146	0.0186	0.0238	0.0243	0.0254	0.0265	0.0264	0.0271	0.0288	0.0289	0.0091
375	0.0121	0.0190	0.0232	0.0242	0.0243	0.0255	0.0260	0.0264	0.0283	0.0288	0.0095
425	0.0093	0.0207	0.0229	0.0234	0.0235	0.0246	0.0248	0.0258	0.0273	0.0282	0.0085
475	0.0079	0.0212	0.0232	0.0237	0.0241	0.0252	0.0259	0.0262	0.0282	0.0288	0.0090
525	0.0088	0.0244	0.0316	0.0299	0.0313	0.0330	0.0340	0.0349	0.0371	0.0376	0.0105
575	0.0089	0.0291	0.0370	0.0371	0.0358	0.0383	0.0388	0.0410	0.0421	0.0425	0.0151
625	0.0077	0.0282	0.0339	0.0332	0.0340	0.0356	0.0367	0.0381	0.0398	0.0409	0.0108
675	0.0058	0.0247	0.0316	0.0306	0.0312	0.0329	0.0344	0.0357	0.0366	0.0374	0.0098
725	0.0038	0.0214	0.0244	0.0252	0.0255	0.0273	0.0280	0.0298	0.0310	0.0310	0.0086
775	0.0033	0.0202	0.0249	0.0253	0.0260	0.0271	0.0284	0.0297	0.0304	0.0314	0.0074
825	0.0030	0.0224	0.0255	0.0261	0.0270	0.0286	0.0299	0.0307	0.0320	0.0334	0.0098
875	0.0028	0.0230	0.0258	0.0267	0.0275	0.0293	0.0305	0.0315	0.0329	0.0341	0.0116
925	0.0026	0.0229	0.0267	0.0288	0.0305	0.0312	0.0316	0.0327	0.0342	0.0355	0.0090
975	0.0023	0.0241	0.0274	0.0292	0.0309	0.0314	0.0322	0.0341	0.0361	0.0373	0.0120
1025	0.0022	0.0229	0.0268	0.0290	0.0303	0.0313	0.0335	0.0356	0.0380	0.0403	0.0100
1075	0.0021	0.0233	0.0289	0.0315	0.0333	0.0339	0.0359	0.0384	0.0421	0.0445	0.0090
1125	0.0031	0.0351	0.0448	0.0479	0.0503	0.0506	0.0533	0.0577	0.0611	0.0647	0.0140
1175	0.0032	0.0393	0.0511	0.0558	0.0570	0.0585	0.0604	0.0661	0.0722	0.0768	0.0198
1225	0.0030	0.0409	0.0472	0.0515	0.0544	0.0573	0.0618	0.0668	0.0737	0.0800	0.0144
1275	0.0022	0.0340	0.0386	0.0431	0.0459	0.0480	0.0509	0.0550	0.0611	0.0693	0.0156
1325	0.0014	0.0241	0.0257	0.0297	0.0315	0.0330	0.0363	0.0401	0.0455	0.0514	0.0112
1375	0.0012	0.0226	0.0236	0.0269	0.0295	0.0300	0.0320	0.0354	0.0398	0.0453	0.0093
1425	0.0010	0.0226	0.0226	0.0259	0.0279	0.0286	0.0304	0.0331	0.0360	0.0402	0.0126
1475	0.0009	0.0222	0.0213	0.0242	0.0266	0.0269	0.0283	0.0301	0.0326	0.0363	0.0185
1525	0.0008	0.0214	0.0202	0.0232	0.0249	0.0258	0.0265	0.0281	0.0300	0.0332	0.0124
1575	0.0008	0.0205	0.0187	0.0213	0.0223	0.0229	0.0237	0.0255	0.0269	0.0298	0.0187
1625	0.0007	0.0187	0.0168	0.0192	0.0205	0.0202	0.0213	0.0229	0.0245	0.0268	0.0147
1675	0.0006	0.0182	0.0166	0.0178	0.0192	0.0195	0.0200	0.0208	0.0222	0.0245	0.0104
1725	0.0007	0.0206	0.0205	0.0213	0.0228	0.0228	0.0233	0.0234	0.0243	0.0258	0.0229
1775	0.0007	0.0235	0.0221	0.0234	0.0253	0.0250	0.0251	0.0257	0.0266	0.0281	0.0169
1825	0.0006	0.0226	0.0216	0.0226	0.0241	0.0242	0.0241	0.0254	0.0259	0.0274	0.0122
1875	0.0005	0.0177	0.0165	0.0173	0.0190	0.0192	0.0195	0.0201	0.0212	0.0224	0.0123
1925	0.0004	0.0131	0.0115	0.0121	0.0131	0.0132	0.0136	0.0140	0.0149	0.0158	0.0089
1975	0.0003	0.0123	0.0103	0.0108	0.0116	0.0118	0.0124	0.0126	0.0132	0.0141	0.0079

Higher frequencies (Höhere Frequenzen)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.0008	0.0626	0.0434	0.0462	0.0531	0.0573	0.0592	0.0564	0.0575	0.0648	0.0785
2.3	0.0006	0.0280	0.0480	0.0371	0.0452	0.0474	0.0441	0.0433	0.0421	0.0448	0.0490
2.5	0.0005	0.0341	0.0322	0.0354	0.0410	0.0377	0.0365	0.0388	0.0420	0.0503	0.0638
2.7	0.0005	0.0491	0.0392	0.0289	0.0281	0.0282	0.0312	0.0325	0.0374	0.0424	0.0523
2.9	0.0004	0.0188	0.0310	0.0239	0.0188	0.0210	0.0235	0.0241	0.0261	0.0293	0.0350
3.1	0.0004	0.0287	0.0330	0.0473	0.0405	0.0346	0.0385	0.0378	0.0403	0.0426	0.0451
3.3	0.0004	0.0280	0.0265	0.0314	0.0390	0.0307	0.0305	0.0307	0.0308	0.0295	0.0301
3.5	0.0003	0.0202	0.0255	0.0243	0.0280	0.0297	0.0272	0.0252	0.0276	0.0287	0.0277
3.7	0.0003	0.0232	0.0244	0.0241	0.0319	0.0388	0.0335	0.0295	0.0315	0.0329	0.0330
3.9	0.0003	0.0262	0.0255	0.0316	0.0275	0.0333	0.0323	0.0323	0.0334	0.0369	0.0372
4.1	0.0003	0.0167	0.0160	0.0164	0.0222	0.0179	0.0194	0.0205	0.0207	0.0236	0.0261
4.3	0.0003	0.0215	0.0292	0.0209	0.0318	0.0287	0.0308	0.0325	0.0322	0.0363	0.0379
4.5	0.0003	0.0199	0.0172	0.0215	0.0241	0.0257	0.0272	0.0281	0.0273	0.0287	0.0311
4.7	0.0002	0.0184	0.0207	0.0225	0.0202	0.0218	0.0216	0.0222	0.0238	0.0257	0.0269
4.9	0.0002	0.0215	0.0283	0.0222	0.0258	0.0278	0.0295	0.0309	0.0333	0.0350	0.0367
5.1	0.0002	0.0210	0.0205	0.0239	0.0233	0.0237	0.0252	0.0270	0.0284	0.0298	0.0296
5.3	0.0002	0.0225	0.0192	0.0248	0.0232	0.0224	0.0264	0.0258	0.0271	0.0283	0.0323
5.5	0.0002	0.0184	0.0236	0.0210	0.0238	0.0245	0.0279	0.0282	0.0315	0.0361	0.0402
5.7	0.0002	0.0239	0.0248	0.0274	0.0295	0.0310	0.0317	0.0331	0.0355	0.0374	0.0396
5.9	0.0002	0.0431	0.0455	0.0464	0.0472	0.0472	0.0484	0.0511	0.0511	0.0519	0.0550
6.1	0.0002	0.0283	0.0313	0.0302	0.0400	0.0384	0.0425	0.0470	0.0485	0.0488	0.0526
6.3	0.0002	0.0352	0.0350	0.0399	0.0423	0.0444	0.0471	0.0474	0.0454	0.0457	0.0482
6.5	0.0002	0.0334	0.0290	0.0353	0.0433	0.0419	0.0430	0.0447	0.0466	0.0482	0.0510
6.7	0.0002	0.0257	0.0256	0.0281	0.0406	0.0412	0.0450	0.0491	0.0504	0.0504	0.0547
6.9	0.0002	0.0323	0.0283	0.0352	0.0480	0.0569	0.0596	0.0623	0.0646	0.0618	0.0655
7.1	0.0002	0.0254	0.0321	0.0321	0.0442	0.0533	0.0635	0.0665	0.0664	0.0633	0.0636
7.3	0.0002	0.0171	0.0191	0.0233	0.0282	0.0376	0.0472	0.0604	0.0753	0.0808	0.0781
7.5	0.0002	0.0165	0.0174	0.0195	0.0239	0.0308	0.0385	0.0495	0.0767	0.1311	0.1537
7.7	0.0002	0.0155	0.0162	0.0176	0.0230	0.0283	0.0346	0.0423	0.0676	0.1199	0.1450
7.9	0.0001	0.0130	0.0125	0.0125	0.0173	0.0202	0.0252	0.0299	0.0382	0.0444	0.0513
8.1	0.0001	0.0135	0.0149	0.0149	0.0190	0.0218	0.0223	0.0242	0.0263	0.0294	0.0343
8.3	0.0001	0.0123	0.0139	0.0131	0.0162	0.0154	0.0175	0.0185	0.0198	0.0229	0.0290
8.5	0.0001	0.0088	0.0084	0.0091	0.0107	0.0112	0.0119	0.0125	0.0134	0.0146	0.0174
8.7	0.0001	0.0098	0.0103	0.0099	0.0112	0.0106	0.0112	0.0116	0.0129	0.0148	0.0187
8.9	0.0001	0.0088	0.0084	0.0091	0.0107	0.0106	0.0112	0.0125	0.0129	0.0148	0.0174

Model: iMars XG100KTR-F											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Ordinal number (Ordnungszahl)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.0492	0.0812	0.0231	0.1349	0.0448	0.0283	0.1150	0.0912	0.0433	0.0579	0.0538
3	0.4149	0.4590	0.8623	0.5376	0.4076	0.3894	0.4950	0.4070	0.5861	0.5947	0.5992
4	0.0334	0.0696	0.0206	0.0314	0.0572	0.0660	0.1602	0.2000	0.1259	0.0949	0.1948
5	0.2759	0.2734	0.3227	0.2833	0.4353	0.4022	0.2339	0.4771	0.2687	0.2793	0.2726
6	0.0196	0.0265	0.0171	0.0406	0.0791	0.0951	0.0424	0.0565	0.0715	0.0686	0.1133
7	0.1962	0.2908	0.2302	0.1683	0.1101	0.1599	0.2300	0.1295	0.2497	0.2074	0.2697
8	0.0093	0.0887	0.0667	0.0831	0.0355	0.0373	0.0349	0.0523	0.0260	0.0469	0.0325
9	0.0545	0.2442	0.3650	0.3369	0.2199	0.2287	0.2313	0.1613	0.1504	0.2324	0.3133
10	0.0111	0.0297	0.0436	0.0517	0.1063	0.0460	0.0440	0.0827	0.0483	0.0865	0.0792
11	0.0110	0.0537	0.0251	0.3985	0.3309	0.2184	0.4796	0.3111	0.3488	0.3998	0.3705
12	0.0050	0.1328	0.0615	0.1339	0.1112	0.0875	0.0958	0.1162	0.0962	0.0911	0.1014
13	0.0134	0.2157	0.2827	0.0611	0.1181	0.0643	0.1396	0.2657	0.2654	0.4751	0.2271
14	0.0057	0.0698	0.0364	0.0479	0.0749	0.0245	0.0663	0.0592	0.0862	0.0632	0.1092
15	0.0175	0.1441	0.1086	0.0553	0.2266	0.1342	0.0441	0.0513	0.0393	0.0388	0.0900
16	0.0027	0.0448	0.0241	0.0439	0.0431	0.0346	0.0453	0.0354	0.0312	0.0771	0.0805
17	0.0043	0.0952	0.0444	0.4500	0.0386	0.0534	0.1938	0.4434	0.2362	0.2195	0.5109
18	0.0053	0.0718	0.0893	0.0912	0.0435	0.0944	0.0329	0.0679	0.1160	0.1043	0.1098
19	0.0037	0.2332	0.1133	0.3979	0.1134	0.0445	0.0863	0.1256	0.2736	0.4092	0.2208
20	0.0041	0.0751	0.0548	0.0646	0.1369	0.0753	0.0617	0.0466	0.0678	0.0576	0.0913
21	0.0077	0.3433	0.2960	0.2916	0.1952	0.0786	0.1456	0.2037	0.1976	0.1326	0.1555
22	0.0012	0.1050	0.1086	0.1046	0.0670	0.0694	0.0542	0.0463	0.0538	0.0570	0.1697
23	0.0061	0.1401	0.2108	0.1136	0.1557	0.1097	0.1880	0.1752	0.2722	0.2682	0.6232
24	0.0015	0.1004	0.0894	0.0839	0.0743	0.1151	0.1108	0.1165	0.1386	0.1272	0.1850
25	0.0021	0.1658	0.4309	0.1755	0.1947	0.1588	0.1391	0.2662	0.2289	0.3365	0.5275
26	0.0020	0.0710	0.0550	0.0915	0.1512	0.0989	0.1615	0.0910	0.1325	0.0779	0.1335
27	0.0045	0.0769	0.1396	0.1229	0.2620	0.0857	0.1421	0.1097	0.0719	0.1995	0.2325
28	0.0025	0.0767	0.0651	0.1064	0.0721	0.1254	0.0692	0.0918	0.1303	0.1073	0.0814
29	0.0022	0.1790	0.2050	0.1628	0.2518	0.4703	0.1972	0.2345	0.2841	0.4442	0.3588
30	0.0010	0.0661	0.0384	0.1042	0.0732	0.0606	0.0507	0.1237	0.1359	0.0857	0.0930
31	0.0008	0.0661	0.1230	0.0976	0.1060	0.1611	0.1723	0.1121	0.3541	0.1626	0.1866
32	0.0005	0.0571	0.0400	0.0883	0.0904	0.0744	0.0313	0.0661	0.0967	0.0705	0.0621
33	0.0020	0.0969	0.0624	0.1346	0.0994	0.0590	0.0646	0.0833	0.1068	0.1320	0.1240
34	0.0008	0.0348	0.0451	0.0261	0.0419	0.0261	0.0493	0.0719	0.0744	0.0430	0.0887
35	0.0020	0.0334	0.0248	0.1230	0.0644	0.3351	0.1756	0.1399	0.2134	0.2258	0.1271
36	0.0006	0.0523	0.0723	0.0633	0.0579	0.0792	0.0544	0.0291	0.0489	0.0430	0.0918
37	0.0007	0.0489	0.0795	0.0545	0.0535	0.1239	0.0994	0.0565	0.0682	0.1419	0.0941
38	0.0002	0.0281	0.0353	0.0325	0.0336	0.0180	0.0455	0.0422	0.0159	0.0252	0.0421
39	0.0004	0.0284	0.0510	0.0246	0.0411	0.0159	0.0243	0.0361	0.0159	0.0489	0.0369
40	0.0004	0.0274	0.0112	0.0137	0.0169	0.0304	0.0340	0.0321	0.0173	0.0382	0.0298

Inter-harmonics (Zwischenharmonische)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.1039	0.0633	0.1290	0.0691	0.0520	0.0738	0.1448	0.0530	0.0832	0.0799	0.0058
125	0.0467	0.0231	0.0250	0.0466	0.0212	0.0348	0.0269	0.0300	0.0511	0.0388	0.0051
175	0.0138	0.0264	0.0312	0.0310	0.0216	0.0174	0.0201	0.0186	0.0458	0.0383	0.0054
225	0.0125	0.0316	0.0280	0.0331	0.0326	0.0279	0.0208	0.0267	0.0244	0.0451	0.0134
275	0.0118	0.0447	0.0274	0.0219	0.0387	0.0215	0.0156	0.0232	0.0383	0.0202	0.0196
325	0.0157	0.0163	0.0230	0.0165	0.0179	0.0369	0.0168	0.0235	0.0227	0.0170	0.0099
375	0.0151	0.0111	0.0202	0.0190	0.0255	0.0140	0.0272	0.0228	0.0209	0.0402	0.0140
425	0.0053	0.0292	0.0127	0.0237	0.0187	0.0223	0.0212	0.0266	0.0205	0.0409	0.0055
475	0.0057	0.0234	0.0245	0.0221	0.0323	0.0244	0.0147	0.0337	0.0322	0.0307	0.0107
525	0.0065	0.0289	0.0282	0.0235	0.0162	0.0474	0.0419	0.0249	0.0340	0.0456	0.0115
575	0.0107	0.0304	0.0455	0.0187	0.0231	0.0388	0.0371	0.0367	0.0618	0.0392	0.0219
625	0.0044	0.0147	0.0503	0.0428	0.0273	0.0441	0.0400	0.0320	0.0205	0.0594	0.0066
675	0.0078	0.0292	0.0416	0.0375	0.0311	0.0381	0.0252	0.0399	0.0463	0.0203	0.0106
725	0.0027	0.0135	0.0249	0.0216	0.0200	0.0146	0.0193	0.0283	0.0323	0.0265	0.0094
775	0.0048	0.0261	0.0154	0.0159	0.0175	0.0314	0.0294	0.0310	0.0217	0.0175	0.0045
825	0.0040	0.0114	0.0362	0.0182	0.0244	0.0345	0.0230	0.0213	0.0232	0.0168	0.0089
875	0.0017	0.0315	0.0348	0.0341	0.0167	0.0366	0.0288	0.0438	0.0364	0.0391	0.0098
925	0.0036	0.0222	0.0138	0.0161	0.0255	0.0369	0.0310	0.0233	0.0253	0.0381	0.0129
975	0.0020	0.0143	0.0345	0.0148	0.0213	0.0436	0.0236	0.0487	0.0447	0.0199	0.0101
1025	0.0029	0.0260	0.0379	0.0301	0.0177	0.0166	0.0236	0.0503	0.0479	0.0545	0.0073
1075	0.0031	0.0200	0.0271	0.0277	0.0239	0.0268	0.0452	0.0354	0.0329	0.0630	0.0086
1125	0.0040	0.0300	0.0344	0.0525	0.0547	0.0613	0.0464	0.0319	0.0789	0.0325	0.0145
1175	0.0020	0.0287	0.0267	0.0764	0.0432	0.0470	0.0768	0.0614	0.0636	0.0613	0.0226
1225	0.0015	0.0539	0.0289	0.0649	0.0320	0.0692	0.0604	0.0976	0.0425	0.0830	0.0091
1275	0.0018	0.0400	0.0467	0.0313	0.0683	0.0682	0.0313	0.0825	0.0641	0.0709	0.0081
1325	0.0007	0.0302	0.0298	0.0435	0.0171	0.0343	0.0528	0.0409	0.0516	0.0352	0.0139
1375	0.0009	0.0233	0.0130	0.0366	0.0385	0.0376	0.0279	0.0183	0.0448	0.0571	0.0064
1425	0.0011	0.0207	0.0161	0.0135	0.0194	0.0148	0.0410	0.0172	0.0494	0.0206	0.0101
1475	0.0009	0.0204	0.0192	0.0162	0.0215	0.0259	0.0217	0.0252	0.0430	0.0398	0.0178
1525	0.0008	0.0108	0.0279	0.0337	0.0209	0.0246	0.0197	0.0244	0.0402	0.0183	0.0079
1575	0.0005	0.0255	0.0113	0.0260	0.0332	0.0332	0.0220	0.0363	0.0170	0.0304	0.0264
1625	0.0006	0.0217	0.0188	0.0146	0.0147	0.0183	0.0253	0.0257	0.0315	0.0320	0.0188
1675	0.0005	0.0139	0.0182	0.0119	0.0261	0.0229	0.0206	0.0247	0.0308	0.0147	0.0055
1725	0.0010	0.0184	0.0141	0.0116	0.0146	0.0307	0.0263	0.0283	0.0264	0.0166	0.0159
1775	0.0005	0.0123	0.0164	0.0293	0.0270	0.0139	0.0147	0.0146	0.0227	0.0153	0.0123
1825	0.0007	0.0187	0.0307	0.0290	0.0253	0.0179	0.0192	0.0218	0.0360	0.0329	0.0131
1875	0.0005	0.0139	0.0197	0.0117	0.0185	0.0133	0.0144	0.0223	0.0233	0.0228	0.0098
1925	0.0003	0.0171	0.0130	0.0146	0.0147	0.0067	0.0204	0.0192	0.0189	0.0181	0.0125
1975	0.0004	0.0099	0.0127	0.0072	0.0167	0.0157	0.0143	0.0147	0.0085	0.0144	0.0105

Higher frequencies (Höhere Frequenzen)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.0012	0.0379	0.0638	0.0486	0.0493	0.0822	0.0577	0.0694	0.0538	0.0609	0.0509
2.3	0.0008	0.0358	0.0551	0.0405	0.0641	0.0627	0.0403	0.0567	0.0494	0.0249	0.0251
2.5	0.0003	0.0376	0.0271	0.0278	0.0351	0.0373	0.0216	0.0578	0.0556	0.0588	0.0913
2.7	0.0005	0.0485	0.0337	0.0413	0.0313	0.0297	0.0164	0.0422	0.0215	0.0634	0.0741
2.9	0.0004	0.0278	0.0294	0.0206	0.0118	0.0291	0.0347	0.0174	0.0273	0.0351	0.0522
3.1	0.0006	0.0201	0.0233	0.0416	0.0207	0.0477	0.0346	0.0226	0.0601	0.0631	0.0398
3.3	0.0004	0.0170	0.0191	0.0259	0.0558	0.0212	0.0212	0.0384	0.0214	0.0284	0.0386
3.5	0.0004	0.0167	0.0204	0.0267	0.0164	0.0374	0.0342	0.0255	0.0393	0.0179	0.0172
3.7	0.0003	0.0217	0.0172	0.0332	0.0233	0.0535	0.0263	0.0380	0.0323	0.0277	0.0273
3.9	0.0003	0.0175	0.0137	0.0257	0.0281	0.0406	0.0339	0.0358	0.0468	0.0293	0.0193
4.1	0.0003	0.0197	0.0223	0.0164	0.0294	0.0230	0.0238	0.0302	0.0185	0.0262	0.0373
4.3	0.0004	0.0262	0.0411	0.0280	0.0188	0.0242	0.0376	0.0471	0.0299	0.0476	0.0276
4.5	0.0003	0.0226	0.0154	0.0320	0.0269	0.0363	0.0348	0.0248	0.0405	0.0234	0.0249
4.7	0.0002	0.0260	0.0180	0.0264	0.0172	0.0232	0.0145	0.0286	0.0171	0.0306	0.0303
4.9	0.0001	0.0203	0.0184	0.0264	0.0209	0.0399	0.0230	0.0311	0.0324	0.0399	0.0527
5.1	0.0002	0.0130	0.0146	0.0269	0.0331	0.0341	0.0155	0.0246	0.0189	0.0258	0.0302
5.3	0.0001	0.0214	0.0149	0.0278	0.0159	0.0297	0.0283	0.0368	0.0173	0.0380	0.0428
5.5	0.0002	0.0099	0.0333	0.0122	0.0226	0.0265	0.0326	0.0408	0.0194	0.0503	0.0295
5.7	0.0002	0.0330	0.0253	0.0247	0.0386	0.0190	0.0218	0.0172	0.0381	0.0421	0.0337
5.9	0.0002	0.0381	0.0384	0.0682	0.0659	0.0555	0.0597	0.0482	0.0713	0.0558	0.0531
6.1	0.0003	0.0269	0.0459	0.0163	0.0279	0.0410	0.0446	0.0280	0.0398	0.0539	0.0502
6.3	0.0002	0.0190	0.0238	0.0554	0.0361	0.0353	0.0670	0.0442	0.0351	0.0438	0.0603
6.5	0.0002	0.0444	0.0230	0.0374	0.0472	0.0586	0.0400	0.0391	0.0335	0.0603	0.0704
6.7	0.0002	0.0216	0.0263	0.0298	0.0346	0.0572	0.0548	0.0323	0.0362	0.0506	0.0670
6.9	0.0002	0.0310	0.0199	0.0190	0.0286	0.0602	0.0308	0.0451	0.0877	0.0700	0.0669
7.1	0.0001	0.0300	0.0267	0.0453	0.0634	0.0450	0.0357	0.0956	0.0505	0.0621	0.0796
7.3	0.0002	0.0245	0.0198	0.0283	0.0169	0.0417	0.0401	0.0669	0.0978	0.1130	0.0392
7.5	0.0002	0.0220	0.0162	0.0109	0.0289	0.0399	0.0481	0.0563	0.0839	0.1110	0.2270
7.7	0.0002	0.0086	0.0152	0.0213	0.0148	0.0364	0.0353	0.0398	0.0612	0.1589	0.1469
7.9	0.0001	0.0071	0.0078	0.0108	0.0240	0.0155	0.0295	0.0330	0.0532	0.0650	0.0758
8.1	0.0001	0.0106	0.0178	0.0128	0.0159	0.0180	0.0204	0.0244	0.0362	0.0431	0.0191
8.3	0.0001	0.0131	0.0108	0.0158	0.0179	0.0188	0.0153	0.0101	0.0134	0.0186	0.0218
8.5	0.0001	0.0064	0.0115	0.0134	0.0145	0.0146	0.0177	0.0140	0.0092	0.0174	0.0192
8.7	0.0001	0.0051	0.0101	0.0101	0.0072	0.0154	0.0153	0.0162	0.0129	0.0195	0.0152
8.9	0.0001	0.0129	0.0097	0.0108	0.0159	0.0112	0.0101	0.0125	0.0151	0.0135	0.0198

Model: iMars XG110KTR											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Ordinal number (Ordnungszahl)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.0462	0.0652	0.0288	0.1341	0.0598	0.0184	0.1146	0.1325	0.0523	0.0449	0.0696
3	0.5360	0.2651	1.2652	0.5742	0.2471	0.3994	0.3024	0.5534	0.3901	0.5659	0.5250
4	0.0465	0.0847	0.0189	0.0306	0.0290	0.0401	0.2170	0.1779	0.1498	0.1144	0.1575
5	0.3139	0.2458	0.3873	0.2978	0.5411	0.4585	0.1501	0.5411	0.1943	0.2359	0.1580
6	0.0143	0.0349	0.0222	0.0210	0.1124	0.1168	0.0332	0.0520	0.0574	0.0598	0.0756
7	0.2524	0.2357	0.2103	0.2518	0.1540	0.1164	0.1784	0.1822	0.2966	0.2057	0.2793
8	0.0075	0.1029	0.0363	0.0579	0.0464	0.0288	0.0446	0.0629	0.0261	0.0463	0.0303
9	0.0608	0.1383	0.2115	0.2365	0.1150	0.2284	0.3369	0.1944	0.1313	0.1968	0.4397
10	0.0092	0.0204	0.0456	0.0363	0.0833	0.0459	0.0307	0.0944	0.0639	0.0682	0.1163
11	0.0085	0.0757	0.0323	0.5874	0.2013	0.1969	0.4506	0.3879	0.2306	0.3180	0.3941
12	0.0053	0.0871	0.0556	0.0756	0.0805	0.0869	0.1287	0.1689	0.0839	0.0670	0.0613
13	0.0160	0.1917	0.2101	0.0508	0.1748	0.0870	0.0880	0.2780	0.3962	0.4144	0.1338
14	0.0062	0.1000	0.0439	0.0485	0.0493	0.0360	0.0654	0.0835	0.0733	0.0368	0.1632
15	0.0244	0.1146	0.0597	0.0772	0.2251	0.0738	0.0520	0.0281	0.0573	0.0411	0.1346
16	0.0032	0.0331	0.0250	0.0619	0.0587	0.0359	0.0490	0.0383	0.0343	0.0459	0.1174
17	0.0027	0.0902	0.0480	0.5543	0.0450	0.0331	0.0999	0.2351	0.3263	0.2787	0.4821
18	0.0046	0.1015	0.0713	0.0978	0.0492	0.0784	0.0389	0.0481	0.1084	0.1038	0.0682
19	0.0022	0.2023	0.1406	0.3069	0.1093	0.0370	0.0468	0.0679	0.3538	0.2708	0.2484
20	0.0027	0.0814	0.0634	0.0402	0.1631	0.1054	0.0316	0.0257	0.0749	0.0506	0.1347
21	0.0060	0.1947	0.3373	0.3382	0.2410	0.0758	0.1704	0.2547	0.1739	0.1037	0.1425
22	0.0016	0.0978	0.0830	0.1232	0.0337	0.0450	0.0640	0.0330	0.0797	0.0587	0.2289
23	0.0076	0.2085	0.1823	0.0596	0.0797	0.1063	0.2619	0.1718	0.3864	0.2016	0.7993
24	0.0022	0.1429	0.0512	0.0557	0.0387	0.0958	0.0734	0.1516	0.1504	0.1243	0.1966
25	0.0020	0.0911	0.4568	0.1776	0.1411	0.1862	0.2060	0.2035	0.2204	0.4010	0.6771
26	0.0022	0.0757	0.0745	0.0464	0.1829	0.0585	0.2334	0.0620	0.1468	0.0779	0.1145
27	0.0047	0.0930	0.1353	0.1049	0.2209	0.1076	0.1713	0.1560	0.0985	0.1902	0.2603
28	0.0034	0.0474	0.0585	0.0916	0.0886	0.0787	0.0456	0.1201	0.1398	0.0770	0.0550
29	0.0022	0.2167	0.2125	0.1872	0.2900	0.2417	0.1577	0.1819	0.2593	0.4096	0.2547
30	0.0013	0.0458	0.0331	0.1192	0.0555	0.0344	0.0663	0.1213	0.0975	0.0739	0.1259
31	0.0006	0.0548	0.1156	0.1031	0.1292	0.1919	0.2414	0.0771	0.2827	0.2418	0.1491
32	0.0005	0.0332	0.0302	0.1190	0.0788	0.0650	0.0395	0.0844	0.1391	0.0562	0.0410
33	0.0025	0.1336	0.0838	0.0733	0.0717	0.0789	0.0687	0.0841	0.1392	0.1185	0.1074
34	0.0005	0.0301	0.0409	0.0226	0.0483	0.0222	0.0522	0.0505	0.1113	0.0369	0.0625
35	0.0017	0.0261	0.0167	0.0685	0.0451	0.4672	0.1420	0.1352	0.1970	0.2143	0.1760
36	0.0005	0.0291	0.1071	0.0566	0.0688	0.0780	0.0701	0.0374	0.0470	0.0386	0.0812
37	0.0005	0.0606	0.0826	0.0670	0.0456	0.1750	0.0830	0.0673	0.0836	0.0790	0.0603
38	0.0002	0.0238	0.0326	0.0423	0.0477	0.0112	0.0324	0.0453	0.0145	0.0191	0.0331
39	0.0004	0.0379	0.0554	0.0252	0.0335	0.0178	0.0300	0.0385	0.0107	0.0340	0.0547
40	0.0005	0.0182	0.0092	0.0074	0.0095	0.0353	0.0466	0.0236	0.0171	0.0519	0.0333

Inter-harmonics (Zwischenharmonische)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.0883	0.0630	0.0844	0.0629	0.0354	0.0383	0.2046	0.0545	0.1031	0.0513	0.0058
125	0.0340	0.0204	0.0191	0.0635	0.0313	0.0305	0.0280	0.0414	0.0350	0.0471	0.0066
175	0.0076	0.0374	0.0284	0.0227	0.0204	0.0112	0.0135	0.0264	0.0454	0.0502	0.0037
225	0.0165	0.0398	0.0178	0.0443	0.0227	0.0225	0.0167	0.0234	0.0141	0.0309	0.0108
275	0.0125	0.0484	0.0327	0.0210	0.0289	0.0134	0.0083	0.0344	0.0228	0.0297	0.0104
325	0.0185	0.0241	0.0121	0.0104	0.0222	0.0324	0.0096	0.0261	0.0317	0.0253	0.0050
375	0.0135	0.0093	0.0125	0.0105	0.0300	0.0156	0.0317	0.0155	0.0261	0.0247	0.0180
425	0.0074	0.0202	0.0079	0.0201	0.0261	0.0223	0.0181	0.0217	0.0271	0.0397	0.0036
475	0.0031	0.0127	0.0192	0.0112	0.0271	0.0268	0.0127	0.0270	0.0213	0.0376	0.0059
525	0.0088	0.0251	0.0371	0.0132	0.0120	0.0518	0.0457	0.0174	0.0347	0.0496	0.0112
575	0.0097	0.0163	0.0535	0.0114	0.0238	0.0320	0.0270	0.0359	0.0821	0.0208	0.0122
625	0.0031	0.0143	0.0276	0.0272	0.0366	0.0659	0.0443	0.0445	0.0121	0.0878	0.0095
675	0.0113	0.0361	0.0473	0.0293	0.0230	0.0215	0.0205	0.0271	0.0686	0.0119	0.0115
725	0.0038	0.0156	0.0178	0.0203	0.0253	0.0104	0.0171	0.0155	0.0390	0.0165	0.0075
775	0.0043	0.0340	0.0140	0.0211	0.0155	0.0392	0.0292	0.0196	0.0149	0.0237	0.0038
825	0.0047	0.0071	0.0542	0.0095	0.0141	0.0497	0.0265	0.0307	0.0298	0.0171	0.0072
875	0.0019	0.0236	0.0498	0.0274	0.0238	0.0269	0.0425	0.0542	0.0240	0.0209	0.0096
925	0.0027	0.0147	0.0182	0.0167	0.0378	0.0202	0.0266	0.0137	0.0262	0.0235	0.0124
975	0.0029	0.0207	0.0484	0.0099	0.0194	0.0505	0.0204	0.0297	0.0477	0.0162	0.0075
1025	0.0023	0.0200	0.0503	0.0352	0.0126	0.0247	0.0288	0.0493	0.0669	0.0649	0.0068
1075	0.0028	0.0252	0.0218	0.0389	0.0154	0.0308	0.0252	0.0335	0.0267	0.0926	0.0056
1125	0.0035	0.0290	0.0456	0.0390	0.0460	0.0769	0.0466	0.0200	0.0667	0.0251	0.0193
1175	0.0010	0.0381	0.0285	0.0891	0.0408	0.0663	0.0963	0.0797	0.0394	0.0494	0.0243
1225	0.0008	0.0431	0.0251	0.0555	0.0346	0.0543	0.0731	0.1358	0.0342	0.0545	0.0081
1275	0.0017	0.0326	0.0406	0.0352	0.0818	0.0506	0.0436	0.1117	0.0385	0.0899	0.0041
1325	0.0006	0.0384	0.0283	0.0351	0.0174	0.0295	0.0451	0.0607	0.0261	0.0300	0.0123
1375	0.0008	0.0296	0.0184	0.0345	0.0384	0.0469	0.0156	0.0097	0.0521	0.0802	0.0092
1425	0.0015	0.0110	0.0159	0.0132	0.0138	0.0190	0.0440	0.0217	0.0697	0.0189	0.0151
1475	0.0008	0.0215	0.0147	0.0222	0.0282	0.0339	0.0242	0.0308	0.0588	0.0278	0.0138
1525	0.0006	0.0095	0.0371	0.0346	0.0280	0.0344	0.0234	0.0192	0.0339	0.0221	0.0085
1575	0.0004	0.0141	0.0093	0.0251	0.0465	0.0465	0.0195	0.0494	0.0204	0.0252	0.0384
1625	0.0007	0.0221	0.0098	0.0189	0.0186	0.0102	0.0282	0.0215	0.0253	0.0451	0.0272
1675	0.0004	0.0176	0.0209	0.0141	0.0317	0.0283	0.0216	0.0363	0.0356	0.0075	0.0068
1725	0.0006	0.0200	0.0104	0.0148	0.0077	0.0377	0.0229	0.0177	0.0268	0.0148	0.0204
1775	0.0005	0.0132	0.0108	0.0257	0.0360	0.0149	0.0110	0.0217	0.0221	0.0175	0.0146
1825	0.0008	0.0195	0.0394	0.0222	0.0330	0.0251	0.0134	0.0306	0.0423	0.0260	0.0116
1875	0.0005	0.0152	0.0255	0.0119	0.0223	0.0167	0.0117	0.0309	0.0153	0.0191	0.0114
1925	0.0004	0.0107	0.0098	0.0121	0.0075	0.0061	0.0188	0.0180	0.0197	0.0209	0.0145
1975	0.0003	0.0147	0.0147	0.0084	0.0127	0.0175	0.0123	0.0159	0.0071	0.0132	0.0084

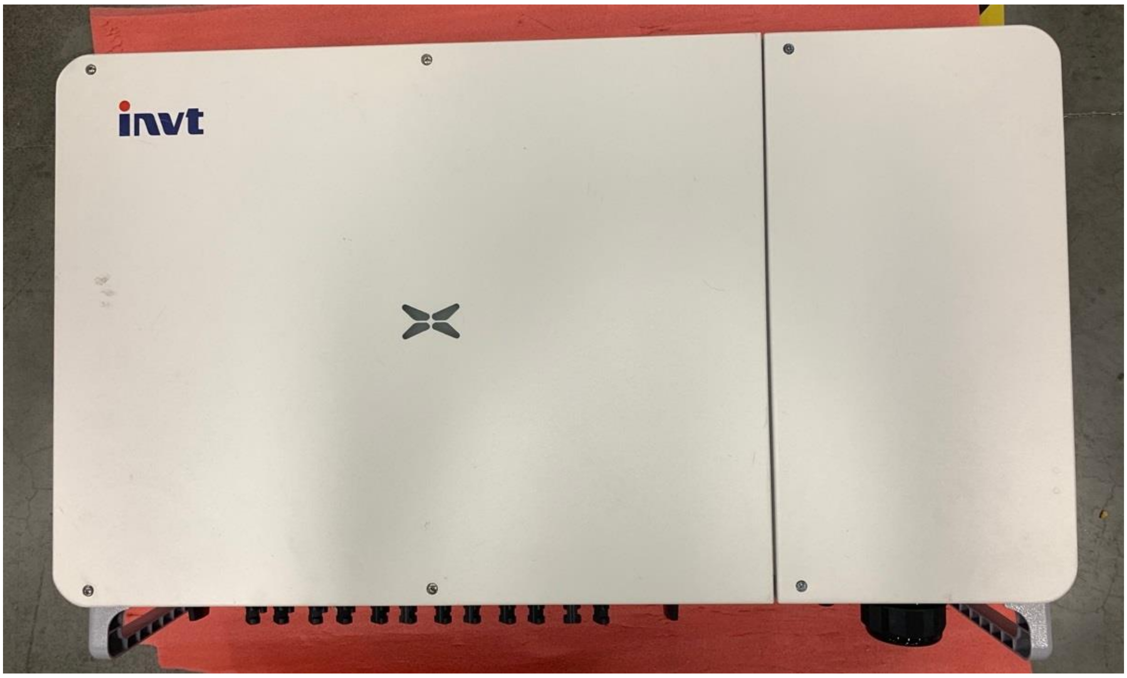
Higher frequencies (Höhere Frequenzen)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.0011	0.0495	0.0592	0.0380	0.0327	0.0724	0.0887	0.0724	0.0618	0.0410	0.0726
2.3	0.0008	0.0263	0.0598	0.0461	0.0294	0.0697	0.0326	0.0354	0.0573	0.0633	0.0724
2.5	0.0005	0.0404	0.0165	0.0528	0.0234	0.0227	0.0328	0.0198	0.0330	0.0378	0.0878
2.7	0.0006	0.0633	0.0267	0.0192	0.0279	0.0410	0.0316	0.0344	0.0452	0.0468	0.0605
2.9	0.0004	0.0244	0.0237	0.0344	0.0271	0.0293	0.0309	0.0185	0.0197	0.0369	0.0502
3.1	0.0004	0.0236	0.0441	0.0468	0.0598	0.0317	0.0237	0.0319	0.0515	0.0453	0.0627
3.3	0.0003	0.0362	0.0359	0.0268	0.0379	0.0315	0.0229	0.0304	0.0165	0.0324	0.0166
3.5	0.0004	0.0161	0.0320	0.0211	0.0168	0.0171	0.0191	0.0363	0.0273	0.0423	0.0151
3.7	0.0002	0.0253	0.0236	0.0171	0.0396	0.0555	0.0233	0.0205	0.0448	0.0378	0.0336
3.9	0.0003	0.0304	0.0340	0.0392	0.0185	0.0300	0.0257	0.0281	0.0220	0.0479	0.0338
4.1	0.0003	0.0191	0.0214	0.0097	0.0327	0.0218	0.0282	0.0248	0.0227	0.0292	0.0220
4.3	0.0004	0.0270	0.0222	0.0234	0.0193	0.0314	0.0334	0.0224	0.0189	0.0490	0.0292
4.5	0.0002	0.0111	0.0166	0.0207	0.0330	0.0338	0.0223	0.0216	0.0137	0.0289	0.0270
4.7	0.0002	0.0161	0.0134	0.0269	0.0225	0.0253	0.0289	0.0158	0.0232	0.0227	0.0243
4.9	0.0003	0.0261	0.0357	0.0223	0.0307	0.0279	0.0411	0.0397	0.0313	0.0400	0.0242
5.1	0.0003	0.0283	0.0134	0.0293	0.0297	0.0283	0.0217	0.0217	0.0294	0.0328	0.0156
5.3	0.0003	0.0242	0.0169	0.0300	0.0288	0.0287	0.0313	0.0167	0.0212	0.0150	0.0269
5.5	0.0002	0.0185	0.0350	0.0106	0.0356	0.0337	0.0160	0.0165	0.0460	0.0414	0.0584
5.7	0.0002	0.0122	0.0171	0.0157	0.0303	0.0175	0.0361	0.0434	0.0286	0.0354	0.0466
5.9	0.0003	0.0285	0.0602	0.0288	0.0325	0.0573	0.0417	0.0501	0.0685	0.0571	0.0438
6.1	0.0001	0.0347	0.0186	0.0268	0.0241	0.0371	0.0234	0.0643	0.0571	0.0426	0.0349
6.3	0.0002	0.0299	0.0180	0.0295	0.0468	0.0476	0.0659	0.0448	0.0315	0.0373	0.0718
6.5	0.0001	0.0235	0.0239	0.0306	0.0605	0.0274	0.0556	0.0570	0.0383	0.0346	0.0432
6.7	0.0002	0.0229	0.0179	0.0205	0.0268	0.0561	0.0622	0.0370	0.0708	0.0622	0.0462
6.9	0.0003	0.0400	0.0292	0.0439	0.0590	0.0569	0.0571	0.0782	0.0887	0.0694	0.0793
7.1	0.0001	0.0238	0.0330	0.0375	0.0508	0.0394	0.0802	0.0794	0.0679	0.0563	0.0801
7.3	0.0002	0.0176	0.0172	0.0204	0.0304	0.0457	0.0686	0.0513	0.1085	0.0963	0.0430
7.5	0.0001	0.0112	0.0250	0.0152	0.0133	0.0237	0.0366	0.0578	0.0499	0.1260	0.1794
7.7	0.0003	0.0120	0.0100	0.0225	0.0303	0.0321	0.0223	0.0281	0.0504	0.1175	0.1718
7.9	0.0001	0.0087	0.0172	0.0130	0.0228	0.0201	0.0139	0.0163	0.0305	0.0539	0.0500
8.1	0.0001	0.0134	0.0201	0.0130	0.0187	0.0147	0.0248	0.0313	0.0144	0.0220	0.0312
8.3	0.0001	0.0174	0.0156	0.0144	0.0228	0.0125	0.0170	0.0186	0.0272	0.0170	0.0169
8.5	0.0001	0.0051	0.0090	0.0056	0.0143	0.0060	0.0124	0.0135	0.0089	0.0098	0.0208
8.7	0.0001	0.0064	0.0084	0.0050	0.0088	0.0137	0.0147	0.0061	0.0070	0.0142	0.0206
8.9	0.0001	0.0059	0.0103	0.0069	0.0081	0.0115	0.0140	0.0184	0.0125	0.0179	0.0121

Model: iMars XG110KTR-F											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Ordinal number (Ordnungszahl)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.0559	0.0420	0.0183	0.0764	0.0315	0.0183	0.1553	0.0726	0.0275	0.0741	0.0328
3	0.6100	0.3789	0.5485	0.6550	0.2374	0.2187	0.5387	0.2204	0.4168	0.7068	0.4715
4	0.0242	0.0661	0.0142	0.0326	0.0340	0.0878	0.0829	0.1191	0.1373	0.0577	0.1417
5	0.2545	0.1443	0.3716	0.1817	0.4936	0.2102	0.2508	0.4306	0.1573	0.2433	0.2170
6	0.0243	0.0234	0.0218	0.0362	0.0912	0.1069	0.0469	0.0637	0.0911	0.0549	0.0775
7	0.1386	0.2118	0.1908	0.1033	0.0684	0.2305	0.1331	0.1767	0.3601	0.2416	0.3752
8	0.0071	0.1219	0.0866	0.0954	0.0363	0.0265	0.0214	0.0405	0.0154	0.0334	0.0242
9	0.0705	0.2327	0.1891	0.4971	0.2868	0.2623	0.2150	0.1356	0.2048	0.3402	0.3398
10	0.0056	0.0330	0.0273	0.0284	0.1418	0.0231	0.0254	0.1222	0.0467	0.0746	0.0817
11	0.0059	0.0310	0.0244	0.2937	0.4949	0.1532	0.5657	0.3230	0.4689	0.5484	0.2121
12	0.0053	0.1336	0.0448	0.2002	0.0631	0.1134	0.1039	0.1589	0.0909	0.1268	0.0678
13	0.0112	0.1569	0.2180	0.0904	0.1442	0.0637	0.1236	0.3544	0.1827	0.5680	0.3155
14	0.0078	0.0450	0.0211	0.0361	0.0527	0.0135	0.0975	0.0503	0.0630	0.0521	0.0579
15	0.0182	0.1873	0.1013	0.0811	0.2481	0.0973	0.0659	0.0351	0.0472	0.0440	0.0975
16	0.0016	0.0415	0.0193	0.0390	0.0433	0.0489	0.0626	0.0178	0.0445	0.1042	0.1091
17	0.0057	0.1059	0.0561	0.2768	0.0363	0.0671	0.1410	0.5235	0.1472	0.1479	0.4793
18	0.0058	0.0635	0.1026	0.0930	0.0640	0.0697	0.0231	0.0854	0.0718	0.1505	0.0859
19	0.0032	0.3219	0.0756	0.3181	0.1077	0.0486	0.0765	0.1198	0.3215	0.5306	0.1591
20	0.0029	0.0803	0.0576	0.0527	0.1415	0.1007	0.0510	0.0316	0.0681	0.0543	0.0919
21	0.0092	0.5022	0.2888	0.3613	0.2903	0.0538	0.1957	0.2646	0.1372	0.1850	0.1842
22	0.0007	0.1574	0.0732	0.0987	0.0606	0.0450	0.0674	0.0255	0.0532	0.0764	0.1476
23	0.0073	0.0719	0.1370	0.0724	0.1364	0.0715	0.1147	0.1240	0.2736	0.3636	0.9289
24	0.0016	0.0728	0.1275	0.0636	0.0495	0.1171	0.0976	0.0831	0.1387	0.0681	0.2551
25	0.0027	0.1149	0.3867	0.1867	0.2263	0.1549	0.1996	0.2285	0.1817	0.1855	0.6397
26	0.0011	0.0765	0.0811	0.1167	0.1976	0.1186	0.1172	0.0697	0.1461	0.0591	0.0979
27	0.0033	0.0981	0.1704	0.1481	0.2588	0.0441	0.2069	0.1183	0.0851	0.2151	0.3369
28	0.0020	0.0540	0.0684	0.0641	0.0475	0.1467	0.0742	0.0582	0.1930	0.0801	0.1025
29	0.0020	0.0984	0.2290	0.0966	0.3611	0.6597	0.1710	0.1257	0.1648	0.6079	0.4250
30	0.0010	0.0899	0.0420	0.0841	0.0419	0.0627	0.0310	0.1283	0.0984	0.0444	0.1205
31	0.0004	0.0510	0.0693	0.0868	0.1182	0.1452	0.2303	0.0884	0.1787	0.2210	0.0949
32	0.0005	0.0391	0.0385	0.0749	0.0659	0.0951	0.0214	0.0397	0.0943	0.0627	0.0758
33	0.0013	0.0755	0.0428	0.1790	0.0569	0.0447	0.0761	0.0947	0.1431	0.1515	0.1695
34	0.0011	0.0208	0.0382	0.0263	0.0560	0.0259	0.0634	0.0492	0.0683	0.0251	0.1269
35	0.0021	0.0298	0.0218	0.1389	0.0476	0.3710	0.2049	0.0847	0.1468	0.1496	0.1827
36	0.0004	0.0532	0.0727	0.0438	0.0338	0.0854	0.0483	0.0297	0.0687	0.0631	0.0928
37	0.0004	0.0344	0.0828	0.0744	0.0542	0.1331	0.0929	0.0813	0.0484	0.1266	0.0925
38	0.0002	0.0168	0.0401	0.0250	0.0369	0.0134	0.0571	0.0476	0.0157	0.0353	0.0259
39	0.0003	0.0359	0.0405	0.0229	0.0222	0.0119	0.0343	0.0337	0.0155	0.0438	0.0544
40	0.0004	0.0170	0.0097	0.0166	0.0170	0.0208	0.0399	0.0278	0.0135	0.0531	0.0287

Inter-harmonics (Zwischenharmonische)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.0737	0.0402	0.1708	0.0856	0.0720	0.0608	0.2153	0.0579	0.0528	0.1183	0.0081
125	0.0279	0.0119	0.0254	0.0544	0.0198	0.0384	0.0342	0.0415	0.0362	0.0415	0.0030
175	0.0169	0.0351	0.0462	0.0227	0.0154	0.0169	0.0194	0.0243	0.0625	0.0386	0.0079
225	0.0083	0.0208	0.0262	0.0308	0.0372	0.0251	0.0241	0.0183	0.0222	0.0346	0.0183
275	0.0126	0.0489	0.0267	0.0265	0.0309	0.0223	0.0132	0.0317	0.0360	0.0116	0.0285
325	0.0097	0.0153	0.0213	0.0134	0.0102	0.0394	0.0105	0.0136	0.0261	0.0241	0.0066
375	0.0218	0.0110	0.0159	0.0138	0.0328	0.0113	0.0364	0.0250	0.0310	0.0572	0.0154
425	0.0031	0.0197	0.0068	0.0127	0.0197	0.0122	0.0203	0.0322	0.0253	0.0551	0.0077
475	0.0058	0.0197	0.0133	0.0128	0.0311	0.0365	0.0203	0.0185	0.0451	0.0336	0.0073
525	0.0046	0.0184	0.0412	0.0323	0.0225	0.0246	0.0234	0.0162	0.0364	0.0557	0.0086
575	0.0112	0.0432	0.0547	0.0139	0.0340	0.0319	0.0514	0.0254	0.0717	0.0540	0.0298
625	0.0056	0.0095	0.0398	0.0488	0.0212	0.0279	0.0212	0.0328	0.0117	0.0390	0.0065
675	0.0103	0.0412	0.0476	0.0203	0.0165	0.0419	0.0180	0.0486	0.0421	0.0291	0.0142
725	0.0032	0.0196	0.0222	0.0119	0.0283	0.0211	0.0128	0.0351	0.0409	0.0236	0.0075
775	0.0029	0.0384	0.0197	0.0223	0.0149	0.0168	0.0231	0.0187	0.0190	0.0115	0.0059
825	0.0050	0.0118	0.0482	0.0193	0.0193	0.0515	0.0151	0.0143	0.0258	0.0202	0.0064
875	0.0012	0.0292	0.0419	0.0378	0.0128	0.0408	0.0210	0.0401	0.0379	0.0252	0.0097
925	0.0038	0.0113	0.0202	0.0170	0.0305	0.0387	0.0203	0.0283	0.0353	0.0406	0.0108
975	0.0029	0.0196	0.0409	0.0136	0.0250	0.0513	0.0153	0.0726	0.0560	0.0247	0.0085
1025	0.0028	0.0375	0.0423	0.0412	0.0134	0.0165	0.0194	0.0271	0.0276	0.0736	0.0093
1075	0.0044	0.0193	0.0296	0.0144	0.0182	0.0299	0.0561	0.0454	0.0447	0.0347	0.0051
1125	0.0030	0.0156	0.0362	0.0327	0.0772	0.0853	0.0566	0.0205	0.1008	0.0241	0.0122
1175	0.0012	0.0387	0.0327	0.0492	0.0635	0.0317	0.0960	0.0528	0.0707	0.0751	0.0272
1225	0.0019	0.0531	0.0359	0.0660	0.0476	0.0578	0.0795	0.1416	0.0281	0.0675	0.0124
1275	0.0012	0.0330	0.0507	0.0254	0.0920	0.0410	0.0326	0.1216	0.0923	0.0886	0.0071
1325	0.0010	0.0400	0.0160	0.0556	0.0147	0.0327	0.0704	0.0313	0.0637	0.0221	0.0141
1375	0.0009	0.0290	0.0122	0.0481	0.0315	0.0541	0.0380	0.0156	0.0277	0.0390	0.0058
1425	0.0008	0.0118	0.0109	0.0123	0.0161	0.0137	0.0315	0.0168	0.0474	0.0225	0.0133
1475	0.0009	0.0185	0.0137	0.0133	0.0182	0.0325	0.0301	0.0261	0.0628	0.0220	0.0230
1525	0.0005	0.0120	0.0292	0.0217	0.0107	0.0329	0.0250	0.0166	0.0284	0.0137	0.0066
1575	0.0007	0.0376	0.0138	0.0279	0.0281	0.0381	0.0137	0.0186	0.0172	0.0342	0.0283
1625	0.0008	0.0203	0.0203	0.0112	0.0134	0.0130	0.0220	0.0322	0.0393	0.0372	0.0124
1675	0.0003	0.0101	0.0151	0.0106	0.0316	0.0143	0.0283	0.0125	0.0245	0.0085	0.0077
1725	0.0007	0.0162	0.0208	0.0129	0.0205	0.0406	0.0362	0.0242	0.0265	0.0087	0.0115
1775	0.0003	0.0143	0.0095	0.0288	0.0159	0.0085	0.0095	0.0205	0.0190	0.0172	0.0173
1825	0.0008	0.0111	0.0349	0.0210	0.0329	0.0108	0.0258	0.0185	0.0304	0.0327	0.0175
1875	0.0006	0.0168	0.0258	0.0145	0.0145	0.0137	0.0188	0.0234	0.0223	0.0254	0.0082
1925	0.0004	0.0252	0.0193	0.0100	0.0199	0.0096	0.0172	0.0249	0.0125	0.0243	0.0072
1975	0.0006	0.0148	0.0188	0.0064	0.0103	0.0192	0.0089	0.0138	0.0049	0.0169	0.0085

Higher frequencies (Höhere Frequenzen)											
Active power (Wirkleistung) P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency (Frequenz) [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.0007	0.0740	0.0397	0.0246	0.0628	0.0520	0.0870	0.0771	0.0558	0.0819	0.0907
2.3	0.0003	0.0335	0.0293	0.0240	0.0611	0.0568	0.0586	0.0253	0.0395	0.0388	0.0385
2.5	0.0003	0.0320	0.0240	0.0408	0.0583	0.0265	0.0364	0.0429	0.0605	0.0749	0.0676
2.7	0.0003	0.0466	0.0372	0.0257	0.0351	0.0222	0.0185	0.0344	0.0243	0.0316	0.0339
2.9	0.0002	0.0159	0.0282	0.0133	0.0205	0.0198	0.0218	0.0343	0.0358	0.0414	0.0360
3.1	0.0006	0.0288	0.0398	0.0317	0.0562	0.0384	0.0507	0.0264	0.0226	0.0424	0.0543
3.3	0.0003	0.0318	0.0253	0.0280	0.0563	0.0256	0.0397	0.0450	0.0326	0.0148	0.0451
3.5	0.0004	0.0136	0.0240	0.0321	0.0391	0.0369	0.0389	0.0189	0.0355	0.0160	0.0178
3.7	0.0004	0.0123	0.0262	0.0253	0.0254	0.0511	0.0453	0.0311	0.0264	0.0332	0.0236
3.9	0.0002	0.0177	0.0339	0.0299	0.0151	0.0385	0.0305	0.0387	0.0389	0.0385	0.0339
4.1	0.0003	0.0095	0.0130	0.0170	0.0319	0.0192	0.0289	0.0296	0.0255	0.0210	0.0173
4.3	0.0002	0.0305	0.0281	0.0180	0.0253	0.0412	0.0398	0.0471	0.0189	0.0542	0.0375
4.5	0.0002	0.0208	0.0192	0.0144	0.0161	0.0266	0.0295	0.0168	0.0205	0.0162	0.0363
4.7	0.0002	0.0197	0.0288	0.0197	0.0123	0.0184	0.0202	0.0169	0.0194	0.0139	0.0222
4.9	0.0001	0.0139	0.0355	0.0176	0.0333	0.0406	0.0202	0.0182	0.0252	0.0320	0.0355
5.1	0.0002	0.0272	0.0307	0.0301	0.0256	0.0171	0.0374	0.0324	0.0190	0.0333	0.0278
5.3	0.0002	0.0142	0.0188	0.0324	0.0231	0.0228	0.0316	0.0149	0.0354	0.0387	0.0173
5.5	0.0003	0.0113	0.0154	0.0172	0.0337	0.0177	0.0212	0.0422	0.0230	0.0225	0.0415
5.7	0.0001	0.0299	0.0366	0.0274	0.0409	0.0393	0.0211	0.0438	0.0308	0.0328	0.0362
5.9	0.0002	0.0346	0.0606	0.0313	0.0667	0.0240	0.0680	0.0490	0.0520	0.0453	0.0292
6.1	0.0002	0.0271	0.0447	0.0424	0.0309	0.0377	0.0282	0.0354	0.0331	0.0444	0.0753
6.3	0.0001	0.0490	0.0402	0.0571	0.0589	0.0370	0.0660	0.0369	0.0482	0.0493	0.0704
6.5	0.0002	0.0197	0.0320	0.0300	0.0565	0.0241	0.0490	0.0297	0.0558	0.0639	0.0454
6.7	0.0003	0.0240	0.0285	0.0186	0.0534	0.0585	0.0523	0.0576	0.0320	0.0573	0.0632
6.9	0.0002	0.0371	0.0409	0.0389	0.0325	0.0753	0.0772	0.0624	0.0369	0.0359	0.0385
7.1	0.0001	0.0200	0.0318	0.0436	0.0539	0.0596	0.0623	0.0609	0.0818	0.0669	0.0866
7.3	0.0003	0.0185	0.0125	0.0186	0.0275	0.0278	0.0448	0.0611	0.0951	0.0956	0.0575
7.5	0.0001	0.0185	0.0094	0.0238	0.0215	0.0325	0.0392	0.0573	0.0845	0.1176	0.1816
7.7	0.0003	0.0099	0.0153	0.0182	0.0281	0.0393	0.0336	0.0270	0.0381	0.0841	0.2109
7.9	0.0001	0.0117	0.0095	0.0087	0.0168	0.0140	0.0373	0.0317	0.0210	0.0275	0.0489
8.1	0.0001	0.0096	0.0196	0.0076	0.0108	0.0227	0.0256	0.0361	0.0161	0.0226	0.0447
8.3	0.0001	0.0162	0.0084	0.0093	0.0220	0.0135	0.0140	0.0100	0.0143	0.0271	0.0271
8.5	0.0001	0.0105	0.0124	0.0070	0.0062	0.0060	0.0163	0.0110	0.0119	0.0174	0.0175
8.7	0.0001	0.0059	0.0116	0.0072	0.0092	0.0060	0.0116	0.0145	0.0107	0.0182	0.0214
8.9	0.0001	0.0094	0.0072	0.0072	0.0132	0.0138	0.0083	0.0089	0.0111	0.0172	0.0151

Appended photos



Front view

Front view

Front view

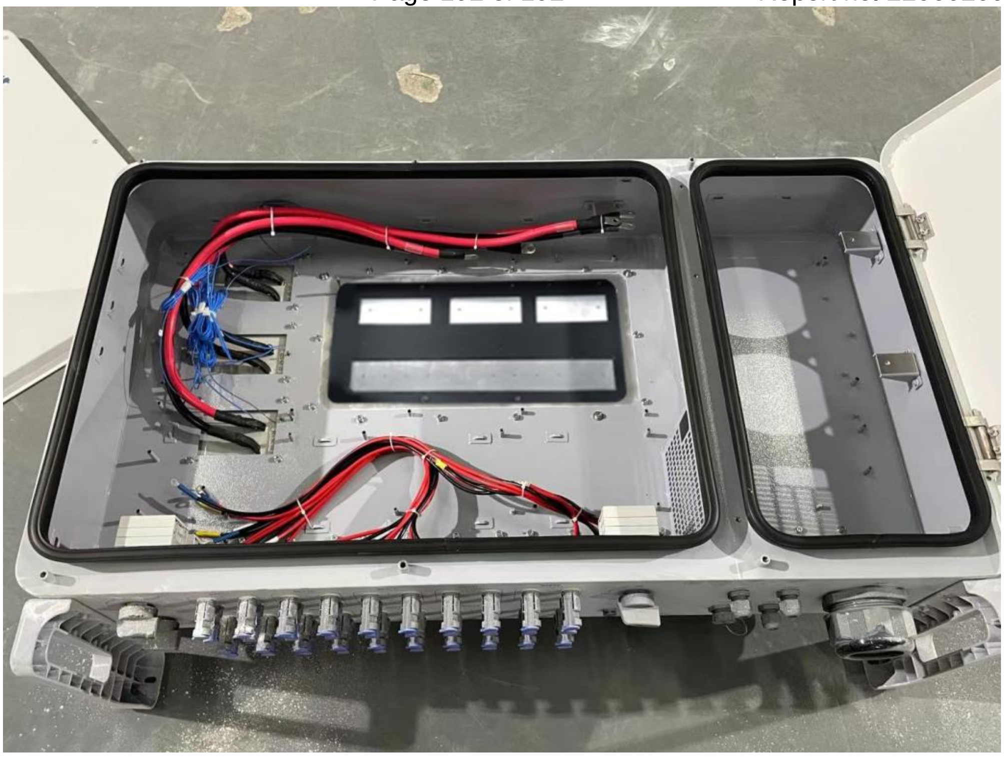
Side view

Connection view (for 9 strings)

Connection view (for 10 strings)

Grounded view

Internal view



Internal view (removed PCB board)

(End of Report)