TEST REPORT

DIN VDE V 0124-100

Test requirements for generation units to be connected and operated parallel with the low voltage distribution networks

Report reference number............. :	**PVDE181008N021**
Date of issue .... ……...:	2019-04-16
Total number of pages.......... ……...:	104
Testing laboratory name .... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address .... :	No. 34, Chenwulu Section, Guantai Rd., Houjie Town, Dongguan City, Guangdong 523942, China
Applicant's name .... :	**JIANGSU GOODWE POWER SUPPLY TECHNOLOGY CO.,LTD.**
Address .... :	NO.189 Kun Lun Shan Road， Suzhou New District.jiangsu,China
Test specification	
Standard .... :	DIN VDE V 0124-100:2012-07
Zertifikate .... :	**Certificate of compliance**
Test report form number. .... :	DIN VDE V 0124-100
Master TRF .... :	Bureau Veritas Consumer Products Services Germany GmbH
Test item description..................... :	**Grid-Connected PV inverter**
Trademark....................................... :	GOODWE your solar engine
Model / Type .... :	GW36K-MT, GW30K-MT, GW25K-MT

Ratings .... :	GW25K-MT	GW30K-MT	GW36K-MT
MPP DC voltage range [V]............... :	200~950		
Input DC voltage range [V] .... :	Max. 1100		
Input DC current [A] .... :	25/25/25		
Output AC voltage [V] .... :	3/N/PE~400 or 3/PE~400, 50Hz		
Output AC current [A]....................... :	40	48	53.3
Nominal Output power [kW]............. :	25	30	36/33*
Max. Output power [kVA]................. :	27.5	33/30**	36
*: 33kW for Italy, 36kW for other country; **: 30kVA for Australia, 33kVA for other country.			

Testing Location .... :	**Shenzhen Academy of Metrology & Quality Inspection**
Address .... :	No. 4 Tongfa Rd.,Nanshan, Shenzhen, China
Tested by (name and signature)....................... :	Dora Zhang
Approved by (name and signature)....................... :	James Huang
Manufacturer's name..................... :	**JIANGSU GOODWE POWER SUPPLY TECHNOLOGY CO.,LTD.**
Factory address .... :	NO.189 Kun Lun Shan Road， Suzhou New District.jiangsu,China

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2019-04-16	Dora Zhang	Initial report was written	0
Supplementary information:			

Test items particulars

Equipment mobility .... :	Permanent connection
Operating condition .... :	Continuous
Class of equipment .... :	Class I
Protection against ingress of water.. :	IP65 according to EN 60529
Mass of equipment [kg].................... :	Approx. 39

Test case verdicts

Test case does not apply to the test object............................... :	N/A
Test item does meet the requirement................................ :	P(ass)
Test item does not meet the requirement................................ :	F(ail)

Testing

Date of receipt of test item .... :	2018-10-08
Date(s) of performance of test .... :	2018-10-08 to 2019-04-15

General remarks:

The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the requirements of DIN VDE V 0124-100. This report shall not be reproduced, except in full, without the written approval of the applicant.

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

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

This Test Report consists of the following documents:

1. Test Report
   - 5.1. Verification of permissible system perturbations
   - 5.2. Verification of the symmetry characteristics of three-phase inverter modules
   - 5.3. Verification of the characteristics of the power generation unit on the network
   - 5.4. Testing of NS protection
   - 5.5. Testing of connecting conditions and synchronisation
2. Pictures of the unit – Annex No. 1
3. Test equipment list – Annex No. 2

Copy of marking plate

GOODWE
your solar engine

Name:Grid-Tied PV Inverter
Type :GW36K-MT

Max. PV-generator power	42900W
Vmax PV	1100Vd.c.
Isc PV	31.3/31.3/31.3Ad.c.
Rated DC voltage	600Vd.c.
MPPT voltage range	200...950Vd.c.
Max. DC current	25/25/25Ad.c.
Rated grid voltage	3N/PE~400V or 3/PE~400V
Max. output current	53.3Aa.c.
AC-grid frequency	50/60Hz
Rated power	36/33kW*
Max. apparent power	36kVA
Inverter topology	Non-isolated
Power factor range	Default >0.99 0.8cap...0.8ind
Operating temperature range	-30...60°C
AC overvoltage-category	Category III
DC overvoltage-category	Category II
IP degree	IP65
Protective class	Class I

Grid-connected standard: RD1699+RD413+UNE;
VDE-AR-N 4105; VDE0126-1-1; AS/NZS 4777.2:2015;EN 50438
IEC61727;IEC62116;CEI 0-21;G99;G100;NRS 097-2-1;
*:33kW for Italy,36kW for other country

5min

CE

S/N:

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S/N

GOODWE
your solar engine

Name:Grid-Tied PV Inverter
Type :GW30K-MT

Max. PV-generator power	39000W
Vmax PV	1100Vd.c.
Isc PV	31.3/31.3/31.3Ad.c.
Rated DC voltage	600Vd.c.
MPPT voltage range	200...950Vd.c.
Max. DC current	25/25/25Ad.c.
Rated grid voltage	3N/PE~400V or 3/PE~400V
Max. output current	48Aa.c.
AC-grid frequency	50/60Hz
Rated power	30kW
Max. apparent power	33/30kVA*
Inverter topology	Non-isolated
Power factor range	Default >0.99 0.8cap...0.8ind
Operating temperature range	-30...60°C
AC overvoltage-category	Category III
DC overvoltage-category	Category II
IP degree	IP65
Protective class	Class I

Grid-connected standard: RD1699+RD413+UNE;
VDE-AR-N 4105; VDE0126-1-1; AS/NZS 4777.2:2015;EN 50438
IEC61727;IEC62116;CEI 0-21;G99;G100;NRS 097-2-1;
*:30kVA for Australia,33kVA for other country

5min

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S/N

GOODWE
your solar engine

Name:Grid-Tied PV Inverter
Type :GW25K-MT

Max. PV-generator power	32500W
Vmax PV	1100Vd.c.
Isc PV	31.3/31.3/31.3Ad.c.
Rated DC voltage	600Vd.c.
MPPT voltage range	200...950Vd.c.
Max. DC current	25/25/25Ad.c.
Rated grid voltage	3N/PE~400V or 3/PE~400V
Max. output current	40Aa.c.
AC-grid frequency	50/60Hz
Rated power	25kW
Max. apparent power	27.5kVA
Inverter topology	Non-isolated
Power factor range	Default >0.99 0.8cap...0.8ind
Operating temperature range	-30...60°C
AC overvoltage-category	Category III
DC overvoltage-category	Category II
IP degree	IP65
Protective class	Class I

Grid-connected standard: RD1699+RD413+UNE;
VDE-AR-N 4105; VDE0126-1-1; AS/NZS 4777.2:2015;EN 50438
IEC61727;IEC62116;CEI 0-21;G99;G100;NRS 097-2-1;

5min

CE

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S/N

General product information:

The Solar converter converts DC voltage into AC voltage.
The DC input of Solar converter can be supplied from PV array and Batteries.
The charging current to batteries from PV array, battery management unit is integrated in External Energy storage.

Rate of change of frequency (RoCoF) detection was used for LOM protection.

Description of the power circuit (Figure 1):

The input and output are protected by Varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

The internal control is redundant built. It consists of Microcontroller DSP (U401) and MCU (U503).

The DSP (U401) control the relays by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The MCU (U503) is measures the grid voltage, grid frequency, DCI and residual current, also can switch off the relays independently, and communicate with the DSP (U401) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the DSP (U401). The DSP (U401) tests and calibrates before each start up all current sensors.

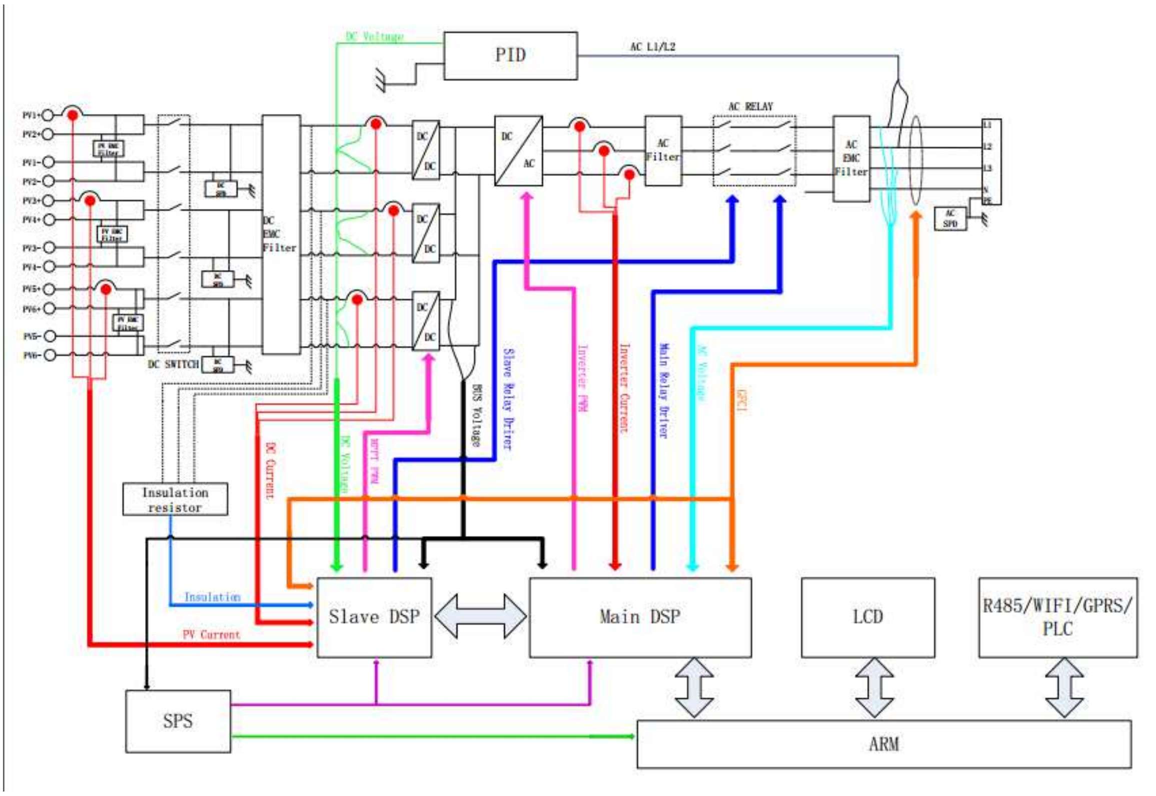


Figure 1 – Block diagram

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

Differences of the models:

The models GW25K-MT, GW30K-MT and GW36K-MT are almost identical in hardware except current sampling circuit and the output power derated by software.

The product was tested on:

Hardware: 290-10066
Software: V1.01.01.01

Description of the remote control in a typical installation:

Inverter operation data can be transferred by RS485, or WIFI Modular to a PC with monitoring software or to data logger device such as Ezlogger Pro. USB just used for service debug; RS485 is the standard communication choice for inverter, and WIFI modular can be used optionally for communication.

RS485 Communication:
The RS485 port of inverter is used to connect the EzLogger Pro, and the total length of connecting cable should not exceed 1000m. Communication lines must be separated from other power lines to prevent the communication from being interfered.

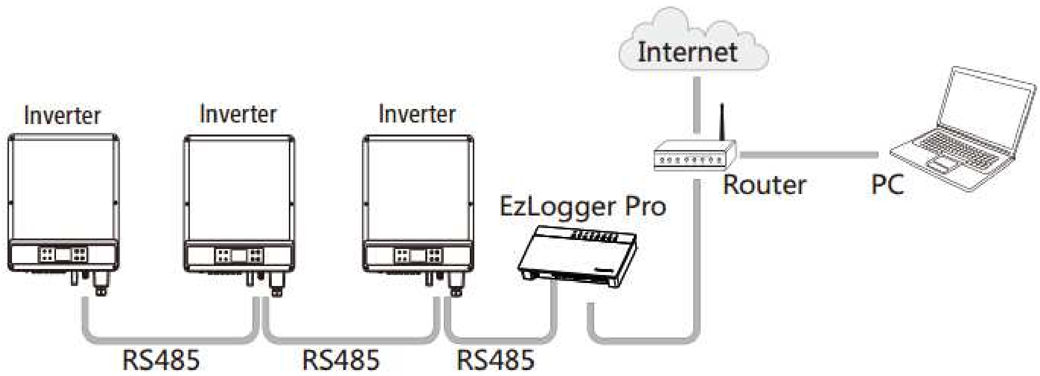
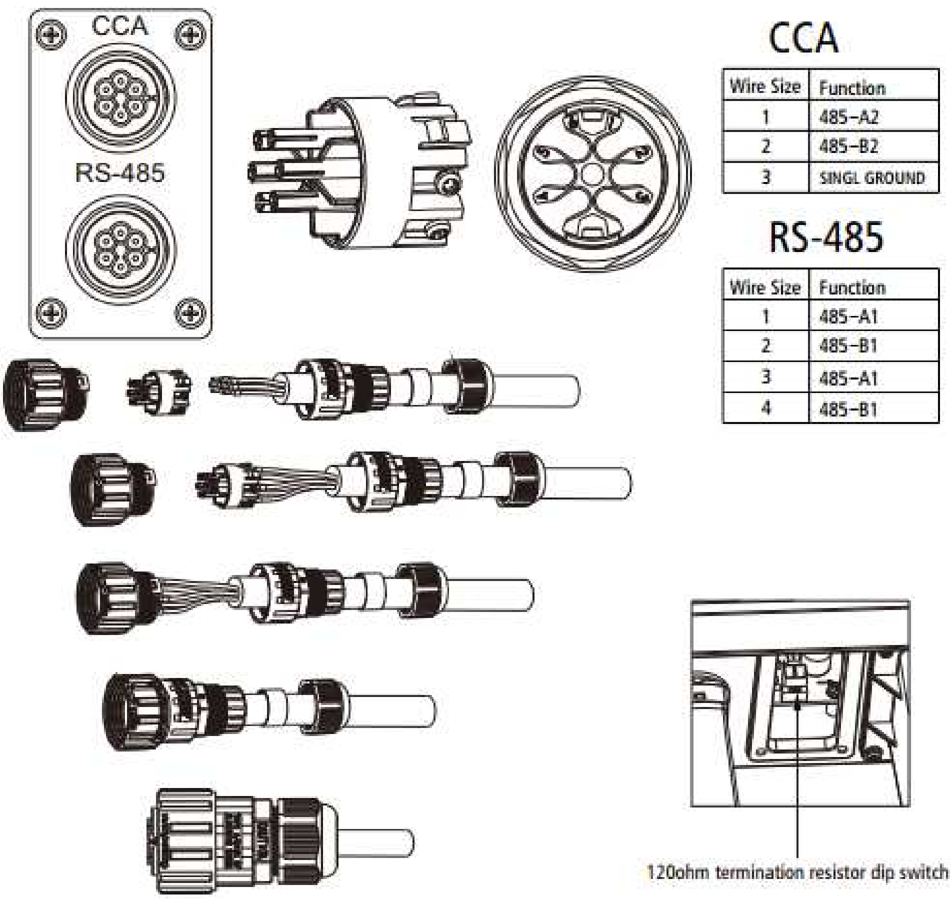


Figure 2 –RS485 connection



CCA

Wire Size	Function
1	485-A2
2	485-B2
3	SINGL GROUND

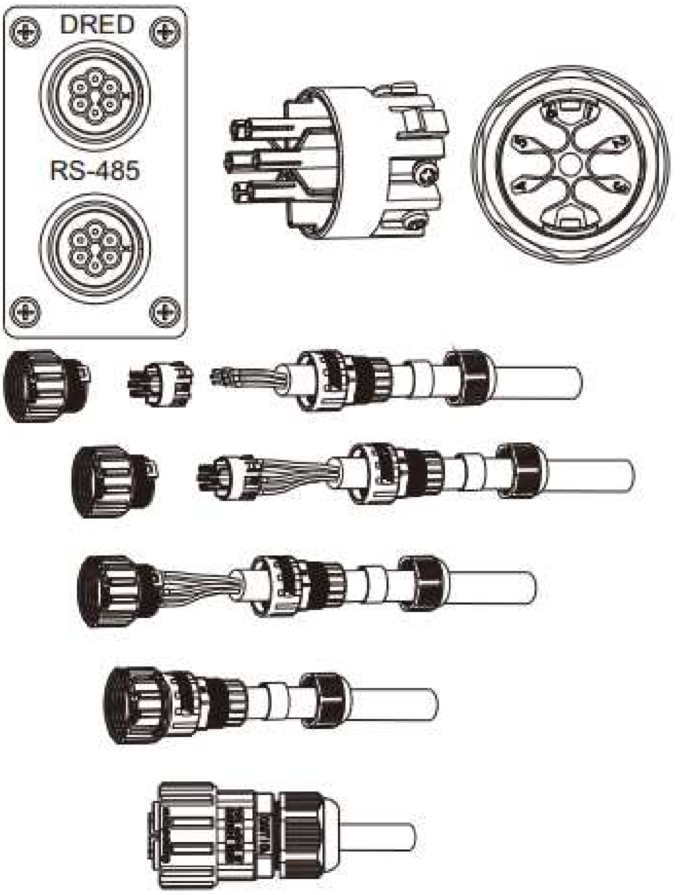
RS-485

Wire Size	Function
1	485-A1
2	485-B1
3	485-A1
4	485-B1

Figure 3 –Fasten the cable of RS485

DRED function:

DRM function is achieved by Ezlogger Pro, and please connect the Ezlogger Pro through RS485 port. Detailed DRED connection refer to Ezlogger Pro manual



DRED

Wire Size	Function
1	DRED1
2	DRED2
3	DRED3
4	DRED4
5	REF1
6	REF2

RS-485

Wire Size	Function
1	485-A1
2	485-B1
3	485-A1
4	485-B1
5	485-A2
6	485-B2

Figure 4 –Fasten the cable of DRED

WiFi Communication:

This function is only applicable for WiFi model, for specific configuration.

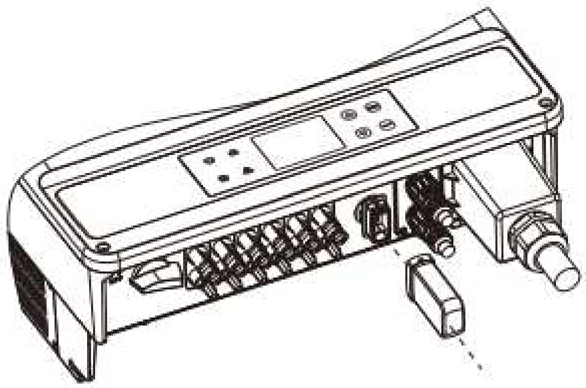


Figure 5 –The WiFi module installation of SMT series

Description of the connection to the ripple control receiver:

DI terminal interface of Ezlogger Pro is as follow:

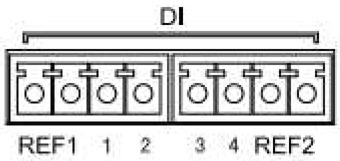


Figure 6 – Schematic diagram of Ezlogger Pro DI Port

The port defined as follow:

DI Port	Description
REF1	Active power derating
1	D_IN1
2	D_IN2
3	D_IN3
4	D_IN4
REF2	Reactive power compensation

Ezlogger Pro is connected to the ripple control receiver as follows:

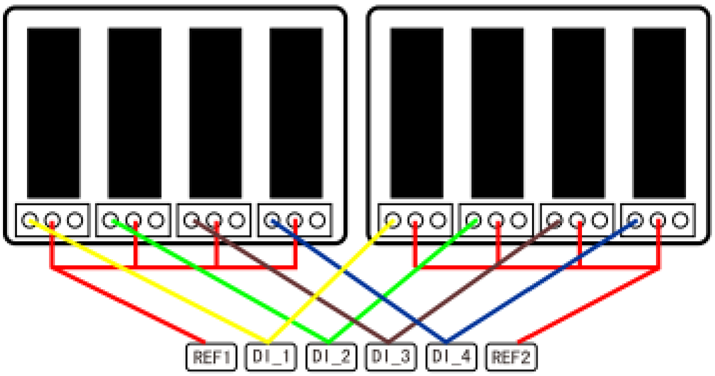


Figure 7 – Diagram of connection of Ezlogger Pro DI Port to RCR

Steps:

1. Select a cable of appropriate length, and connect one end of the cable with the ripple control reciver.
2. Connect the other end of the cable with the corresponding DI port of Ezlogger Pro, and refer to the RS485 communication connection method for detailed connection.

General remarks:

The test results presented in this report relate only to the object(s) tested.
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"(see appended table)" refers to a table appended to the report.

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

The following suffixes are used for variables in tables and figures:

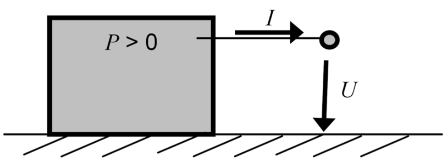
- "P_N" for the nominal active power:
  $P_n = U_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3}\, U_n \times I_n \times \cos \varphi_n$ (three-Phase)
- "_E0,2" for gliding average values over 200 milliseconds
- "_E60" for gliding average values over 60 seconds.
- "_E600" for gliding average values over 10 minutes.
- "(c)" for over-excited
- "(i)" for under-excited

Acronyms:

PGU: power generating unit
PGS: power generating system

The regarded system of the voltage and current vectors is the load view (Figure 8):

- If the inverter feeds to the grid the active power is measured with negative sign. For the sake of reading the document the measured active infeed power has a positive sign



- If the inverter consumes inductive reactive power the reactive power is marked "inductive" or has a positive sign.
- If the inverter consumes capacitive reactive power the reactive power is marked "capacitive" or has a negative sign.

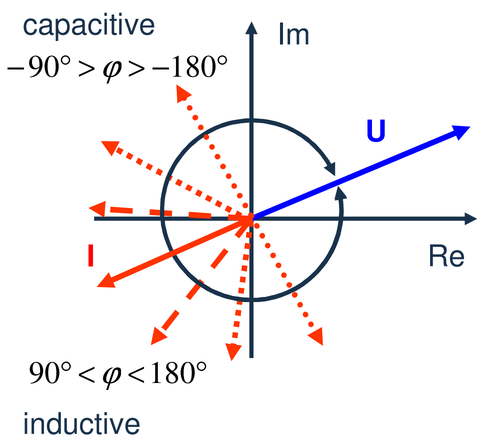


Figure 8

5 Prüfungen DIN VDE V 0124-100:2012-07		
Clause	**Test**	**Result**
5.1	Verification of permissible system perturbations	**P**
5.2	Verification of the symmetry characteristics of three-phase inverter modules	**P**
5.3	Verification of the characteristics of the power generation unit on the network	**P**
5.4	Testing of NS protection	**P**
5.5	Testing of connecting conditions and synchronisation	**P**

5.1	Verification of permissible system perturbations DIN VDE V 0124-100:2012-07		
Clause	**Test**		**Result**
5.1.1	General		**P**
5.1.2	Rapid voltage changes		**P**
	5.1.2.1	Tests	**P**
	5.1.2.2	Documentation of tests	**P**
5.1.3	Flicker		**P**
	5.1.3.1	Tests	**P**
	5.1.3.2	Documentation of tests	**P**
5.1.4	Harmonics and interharmonics		**P**
	5.1.4.1	Tests	**P**
	5.1.4.2	Additional tests	**P**
	5.1.4.3	Documentation of tests	**P**

5.1.1 **General** These tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.4 are met.	**P**

The electrical equipment of the customer system has been planned and built, and will be operated, such that system perturbations affecting the network of the network operator and the installations of other customers are limited to a permissible level on a permanent basis.

System perturbations are defined as:
- Rapid voltage changes
- Flicker
- Harmonics, interharmonics and higher frequencies (up to 9 kHz)

Note:

5.1.2 Rapid voltage changes These tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.4.2 are met.	**P**

The purpose of the test is to determine k_i and k_{imax}.

The following three cases must be tested to VDE-AR-N 4105, Annex F.3 (where applicable).

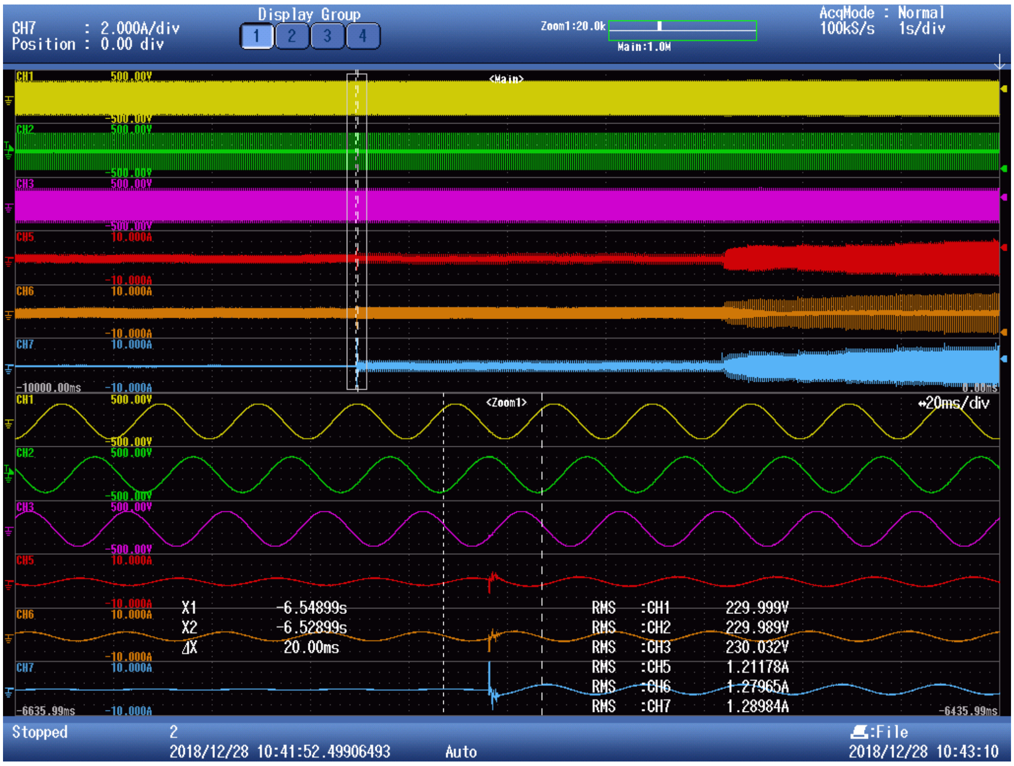
- Switch-on for any capacity
- Unfavourable case when switching the generator step
- Switch-on for nominal capacity

Test conditions:
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %
Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

L1 phase			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	1,212	1,163	1,155
Single period effective values of the voltage [V]	230,00	230,04	230,07
k_i value	0,023	0,022	0,022
k_{imax} value	0,023		
Unfavourable case when switching the generator step			
Single period effective values of the current [A]	N/A	N/A	N/A
Single period effective values of the voltage [V]	N/A	N/A	N/A
k_i value	N/A	N/A	N/A
k_{imax} value	N/A		
Switch-on for nominal capacity			
Single period effective values of the current [A]	1,195	1,185	1,207
Single period effective values of the voltage [V]	230,07	230,11	230,21
k_i value	0,023	0,023	0,023
k_{imax} value	0,023		
L2 phase			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	1,280	1,308	1,269
Single period effective values of the voltage [V]	229,99	229,23	229,94
k_i value	0,025	0,025	0,024
k_{imax} value	0,025		
Unfavourable case when switching the generator step			

Single period effective values of the current [A]	N/A	N/A	N/A
Single period effective values of the voltage [V]	N/A	N/A	N/A
k_i value	N/A	N/A	N/A
k_{imax} value	N/A		
Switch-on for nominal capacity			
Single period effective values of the current [A]	1,300	1,365	1,298
Single period effective values of the voltage [V]	229,94	229,97	229,85
k_i value	0,025	0,026	0,025
k_{imax} value	0,026		
L3 phase			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	1,290	1,236	1,191
Single period effective values of the voltage [V]	230,03	230,06	230,08
k_i value	0,025	0,024	0,023
k_{imax} value	0,025		
Unfavourable case when switching the generator step			
Single period effective values of the current [A]	N/A	N/A	N/A
Single period effective values of the voltage [V]	N/A	N/A	N/A
k_i value	N/A	N/A	N/A
k_{imax} value	N/A		
Switch-on for nominal capacity			
Single period effective values of the current [A]	1,331	1,392	1,438
Single period effective values of the voltage [V]	230,08	230,05	230,03
k_i value	0,026	0,027	0,028
k_{imax} value	0,028		
Highest k_{imax} value for all switching operations			
0,028			
Note: The tests had been performed on the GW36K-MT is valid for the GW30K-MT and GW25K-MT, since it is identical in control board, with same hardware and software construction.			

Switch-on for any capacity (10% P_{Emax})



Switch-on for nominal capacity

5.1.3 Flicker

These tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.4.3 are met.

The purpose of the test is to determine long-term flicker strength P_{lt}.

For power generation systems with rated currents ≤ 75 A, system perturbations are deemed sufficiently limited when the generation units adhere to the thresholds in norms DIN EN 61000-3-3 (VDE 0838-3) and DIN EN 61000-3-11 (VDE 0838-11).

Test conditions:
Voltage: 86% U_n to 109% U_n
Frequency: 50 Hz ± 0,5%
THD of the voltage supply: ≤ 3 %
Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

Flicker to DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 (VDE 0838-11) for generator units ≤ 75 A

Flicker to:	Result:		
	P_{lt}	P_{st}	dc%
DIN EN 61000-3-11 (GW36K-MT)	0,23	0,23	0,00
DIN EN 61000-3-11 (GW30K-MT)	0,23	0,23	0,00
DIN EN 61000-3-11 (GW25K-MT)	0,22	0,22	0,00

Assessment criterion:

Long-term flicker strength P_{lt} to DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 must be ≤ 0,5.

Determination of the flicker coefficient:

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

where S_k is the short-circuit power of the network standby element (during the determination of the appropriate Pst values)

The following applies according to DIN EN 61000-3-3 (≤ 16 A) for the network standby element: S_k = 339199
The value for the network standby element must be determined separately with measurements for rated currents > 75 A.

Flicker to DIN EN 61400-21 (VDE 0127-21) (or FGW TR3)	
GW36K-MT	
Grid impedance angle ψ_k	32°
Flicker coefficient $c(\psi_k)$	3,58
Short-term flicker P_{st}	0,23
GW30K-MT	
Grid impedance angle ψ_k	32°
Flicker coefficient $c(\psi_k)$	4,30
Short-term flicker P_{st}	0,23
GW25K-MT	
Grid impedance angle ψ_k	32°
Flicker coefficient $c(\psi_k)$	4,93
Short-term flicker P_{st}	0,22
Assessment criterion: Long-term flicker strength**:** $P_{lt} \leq 0,5$	
Note:	

5.1.4 Harmonics and interharmonics These tests are designed to provide evidence that the requirements of VDE-AR-N 4015, 5.4.4 are met.	**P**

Adherence to the thresholds for harmonic currents must be verified as followed:

- For nominal currents ≤ 16 A per conductor to DIN EN 61000-3-2 (VDE 0838-2)
- For nominal currents > 16 A and ≤ 75 A per conductor to DIN EN 61000-3-12 (VDE 0838-12)
- For PGUs intended for PGSs with nominal currents > 75 A, the measurements must be conducted as in 5.1.4.2.

Test conditions:

Voltage: 86% U_n to 109% U_n

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

5.1.4.1 Tests	P

Note:
The tests should be based on the limits of the EN61000-3-2 for less than 16A.
Covered by EMC Report 13.7.6.8

Maximum permissible harmonic current as per EN 61000-3-12

Harmonic	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Limit [%] 3phasig	8,00	N/A	4,00	10,70	2,67	7,20	2,00	N/A	1,60	3,10	1,33	2,00
Test value [%]	See below											

	THD	PWHD
Limit [%] 3-phase	13	22
Test value [%]	See below	

Order	Measure[%]	Limit[%]	Margin[%]
2	0.8610	12.0000	92.8
3	0.2796	32.9700	99.2
4	0.2109	6.0000	96.5
5	0.3144	16.9800	98.1
6	0.1856	4.0000	95.4
7	0.3722	10.9875	96.6
8	0.1587	3.0000	94.7
9	0.2246	5.7375	96.1
10	0.1485	2.4000	93.8
11	0.8213	4.7400	82.7
12	0.1757	2.0000	91.2
13	0.7960	3.0900	74.2
THD	2.5880	35.2125	92.7
PWHD	9.9333	35.2125	71.8

GW25K-MT L1 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	1.0294	12.0000	91.4
3	0.4976	32.9700	98.5
4	0.2350	6.0000	96.1
5	0.3388	16.9800	98.0
6	0.1414	4.0000	96.5
7	0.5922	10.9875	94.6
8	0.1753	3.0000	94.2
9	0.1581	5.7375	97.2
10	0.1029	2.4000	95.7
11	0.7013	4.7400	85.2
12	0.0817	2.0000	95.9
13	0.8944	3.0900	71.1
THD	2.6813	35.2125	92.4
PWHD	9.7858	35.2125	72.2

GW25K-MT L2 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.7063	12.0000	94.1
3	0.5422	32.9700	98.4
4	0.3833	6.0000	93.6
5	0.5168	16.9800	97.0
6	0.2573	4.0000	93.6
7	0.5765	10.9875	94.8
8	0.1472	3.0000	95.1
9	0.3088	5.7375	94.6
10	0.1319	2.4000	94.5
11	0.7998	4.7400	83.1
12	0.1798	2.0000	91.0
13	0.8693	3.0900	71.9
THD	2.6520	35.2125	92.5
PWHD	9.7036	35.2125	72.4

GW25K-MT L3 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.7214	12.0000	94.0
3	0.2609	32.9700	99.2
4	0.1813	6.0000	97.0
5	0.2134	16.9800	98.7
6	0.1533	4.0000	96.2
7	0.3329	10.9875	97.0
8	0.1224	3.0000	95.9
9	0.1956	5.7375	96.6
10	0.1334	2.4000	94.4
11	0.7241	4.7400	84.7
12	0.1416	2.0000	92.9
13	0.6761	3.0900	78.1
THD	2.3465	35.2125	93.3
PWHD	9.4092	35.2125	73.3

GW30K-MT L1 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.8469	12.0000	92.9
3	0.4296	32.9700	98.7
4	0.2069	6.0000	96.6
5	0.4134	16.9800	97.6
6	0.1270	4.0000	96.8
7	0.4759	10.9875	95.7
8	0.1484	3.0000	95.1
9	0.1355	5.7375	97.6
10	0.0868	2.4000	96.4
11	0.6060	4.7400	87.2
12	0.0725	2.0000	96.4
13	0.7897	3.0900	74.4
THD	2.4229	35.2125	93.1
PWHD	9.1759	35.2125	73.9

GW30K-MT L2 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.5634	12.0000	95.3
3	0.5153	32.9700	98.4
4	0.3382	6.0000	94.4
5	0.5079	16.9800	97.0
6	0.2312	4.0000	94.2
7	0.5163	10.9875	95.3
8	0.1368	3.0000	95.4
9	0.2751	5.7375	95.2
10	0.1246	2.4000	94.8
11	0.7252	4.7400	84.7
12	0.1576	2.0000	92.1
13	0.7653	3.0900	75.2
THD	2.4070	35.2125	93.2
PWHD	8.9047	35.2125	74.7

GW30K-MT L3 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.5039	12.0000	95.8
3	0.2273	32.9700	99.3
4	0.1600	6.0000	97.3
5	0.2131	16.9800	98.7
6	0.1183	4.0000	97.0
7	0.3648	10.9875	96.7
8	0.1065	3.0000	96.4
9	0.1648	5.7375	97.1
10	0.1108	2.4000	95.4
11	0.5948	4.7400	87.5
12	0.1096	2.0000	94.5
13	0.5809	3.0900	81.2
THD	2.0878	35.2125	94.1
PWHD	8.7882	35.2125	75.0

GW36K-MT L1 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.6005	12.0000	95.0
3	0.4071	32.9700	98.8
4	0.1717	6.0000	97.1
5	0.4833	16.9800	97.2
6	0.1055	4.0000	97.4
7	0.4258	10.9875	96.1
8	0.1235	3.0000	95.9
9	0.1116	5.7375	98.1
10	0.0775	2.4000	96.8
11	0.5118	4.7400	89.2
12	0.0708	2.0000	96.5
13	0.6740	3.0900	78.2
THD	2.1902	35.2125	93.8
PWHD	8.7689	35.2125	75.1

GW36K-MT L2 phase

Order	Measure[%]	Limit[%]	Margin[%]
2	0.3876	12.0000	96.8
3	0.4981	32.9700	98.5
4	0.2939	6.0000	95.1
5	0.4891	16.9800	97.1
6	0.1922	4.0000	95.2
7	0.5136	10.9875	95.3
8	0.1092	3.0000	96.4
9	0.2294	5.7375	96.0
10	0.1022	2.4000	95.7
11	0.6155	4.7400	87.0
12	0.1239	2.0000	93.8
13	0.6514	3.0900	78.9
THD	2.1769	35.2125	93.8
PWHD	8.3745	35.2125	76.2

GW36K-MT L3 phase

Note:

The tests should be based on the limits of the EN 61000-3-12 for more than 16A.

5.1.4.2 Additional measurements for PGUs intended for PGSs with nominal currents > 75 A	P

The currents of the interharmonics to 2 kHz must be measured in accordance with DIN EN 61000-4-7 (VDE 0817-4-7), Annex A. The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with DIN EN 61000-4-7 (VDE 0847-4-7), Annex B.

Test: GW36K-MT

P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	3,036	13,180	21,183	29,820	38,340	48,893	58,242	69,259	76,627	89,566	97,708
2	0,122	0,173	0,203	0,245	0,286	0,312	0,339	0,362	0,383	0,407	0,405
3	0,069	0,088	0,094	0,116	0,132	0,152	0,179	0,206	0,235	0,275	0,291
4	0,044	0,054	0,069	0,082	0,098	0,109	0,119	0,129	0,138	0,155	0,166
5	0,196	0,182	0,130	0,103	0,093	0,104	0,117	0,134	0,143	0,157	0,165
6	0,028	0,065	0,067	0,075	0,082	0,086	0,097	0,104	0,108	0,130	0,141
7	0,134	0,150	0,130	0,115	0,111	0,111	0,115	0,116	0,129	0,144	0,156
8	0,061	0,062	0,045	0,041	0,045	0,049	0,052	0,053	0,057	0,062	0,063
9	0,107	0,115	0,122	0,123	0,128	0,131	0,135	0,141	0,141	0,150	0,149
10	0,064	0,061	0,045	0,044	0,045	0,040	0,041	0,045	0,047	0,049	0,053
11	0,077	0,072	0,073	0,070	0,070	0,060	0,049	0,051	0,055	0,068	0,072
12	0,024	0,023	0,032	0,029	0,031	0,034	0,035	0,037	0,038	0,046	0,047
13	0,077	0,073	0,070	0,069	0,078	0,077	0,065	0,057	0,057	0,068	0,073
14	0,028	0,027	0,037	0,031	0,030	0,029	0,025	0,027	0,031	0,034	0,037
15	0,035	0,044	0,048	0,052	0,049	0,053	0,056	0,057	0,056	0,062	0,066
16	0,024	0,023	0,030	0,026	0,027	0,027	0,026	0,026	0,029	0,035	0,040
17	0,100	0,099	0,082	0,084	0,099	0,089	0,081	0,075	0,069	0,062	0,059
18	0,036	0,039	0,024	0,026	0,031	0,030	0,029	0,030	0,033	0,039	0,039
19	0,070	0,081	0,073	0,074	0,085	0,078	0,071	0,071	0,070	0,065	0,055
20	0,029	0,025	0,021	0,020	0,022	0,025	0,026	0,023	0,024	0,033	0,032
21	0,033	0,044	0,046	0,049	0,049	0,050	0,053	0,053	0,056	0,061	0,065
22	0,019	0,023	0,025	0,025	0,026	0,032	0,031	0,029	0,027	0,039	0,037
23	0,087	0,093	0,093	0,092	0,098	0,098	0,092	0,085	0,081	0,079	0,076
24	0,026	0,025	0,023	0,025	0,029	0,028	0,029	0,027	0,030	0,039	0,035
25	0,069	0,082	0,086	0,083	0,093	0,089	0,084	0,077	0,073	0,073	0,066
26	0,021	0,019	0,019	0,020	0,023	0,023	0,030	0,027	0,025	0,035	0,029
27	0,017	0,022	0,023	0,023	0,025	0,025	0,026	0,028	0,027	0,036	0,034
28	0,023	0,023	0,022	0,022	0,025	0,025	0,030	0,031	0,029	0,036	0,031
29	0,076	0,086	0,090	0,091	0,094	0,089	0,087	0,081	0,080	0,076	0,074
30	0,020	0,021	0,020	0,023	0,023	0,023	0,029	0,026	0,023	0,033	0,028
31	0,051	0,074	0,080	0,086	0,091	0,095	0,097	0,096	0,095	0,095	0,090
32	0,017	0,017	0,015	0,017	0,020	0,022	0,029	0,027	0,025	0,032	0,026
33	0,019	0,021	0,023	0,023	0,023	0,023	0,023	0,025	0,025	0,033	0,026
34	0,018	0,017	0,018	0,022	0,026	0,028	0,032	0,034	0,033	0,036	0,036
35	0,051	0,067	0,078	0,075	0,078	0,085	0,089	0,092	0,092	0,093	0,092
36	0,014	0,017	0,020	0,022	0,023	0,022	0,022	0,026	0,023	0,027	0,024
37	0,043	0,062	0,073	0,077	0,083	0,086	0,089	0,094	0,090	0,089	0,077
38	0,013	0,014	0,015	0,017	0,021	0,023	0,027	0,029	0,028	0,030	0,026

39	0,015	0,016	0,016	0,017	0,017	0,017	0,017	0,021	0,021	0,029	0,021
40	0,014	0,015	0,017	0,018	0,023	0,026	0,029	0,032	0,033	0,034	0,032

Interharmonics : GW36K-MT											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
F [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,050	0,300	0,202	0,606	0,188	0,127	0,514	0,445	0,115	0,135	0,131
125	0,039	0,063	0,058	0,085	0,061	0,058	0,084	0,081	0,062	0,069	0,070
175	0,036	0,048	0,047	0,060	0,052	0,052	0,060	0,060	0,054	0,062	0,068
225	0,031	0,040	0,039	0,047	0,043	0,042	0,048	0,046	0,042	0,053	0,057
275	0,028	0,036	0,036	0,041	0,038	0,038	0,043	0,044	0,040	0,048	0,052
325	0,027	0,035	0,034	0,037	0,036	0,036	0,040	0,039	0,036	0,046	0,047
375	0,027	0,034	0,033	0,036	0,034	0,035	0,037	0,038	0,036	0,044	0,045
425	0,026	0,031	0,035	0,040	0,035	0,033	0,034	0,034	0,033	0,042	0,042
475	0,045	0,050	0,053	0,054	0,055	0,055	0,053	0,052	0,051	0,053	0,056
525	0,024	0,032	0,034	0,043	0,040	0,032	0,031	0,032	0,029	0,037	0,038
575	0,025	0,037	0,041	0,041	0,042	0,034	0,032	0,032	0,031	0,036	0,038
625	0,023	0,033	0,044	0,040	0,037	0,035	0,030	0,030	0,028	0,034	0,038
675	0,021	0,028	0,039	0,038	0,039	0,036	0,029	0,029	0,028	0,032	0,039
725	0,021	0,025	0,041	0,036	0,039	0,036	0,028	0,027	0,027	0,032	0,039
775	0,020	0,024	0,038	0,035	0,035	0,034	0,028	0,027	0,027	0,031	0,040
825	0,024	0,025	0,029	0,030	0,033	0,031	0,028	0,026	0,026	0,032	0,039
875	0,032	0,034	0,023	0,024	0,035	0,033	0,028	0,026	0,026	0,033	0,038
925	0,032	0,035	0,020	0,023	0,032	0,032	0,030	0,025	0,025	0,035	0,037
975	0,036	0,027	0,020	0,022	0,027	0,028	0,030	0,025	0,025	0,038	0,037
1025	0,027	0,030	0,019	0,020	0,022	0,027	0,029	0,024	0,024	0,039	0,036
1075	0,018	0,025	0,019	0,020	0,021	0,030	0,029	0,024	0,025	0,042	0,036
1125	0,015	0,018	0,018	0,020	0,020	0,029	0,027	0,024	0,024	0,042	0,035
1175	0,016	0,018	0,018	0,020	0,021	0,028	0,028	0,024	0,024	0,043	0,033
1225	0,015	0,017	0,017	0,019	0,019	0,024	0,030	0,025	0,024	0,044	0,031
1275	0,015	0,018	0,017	0,019	0,019	0,022	0,031	0,026	0,024	0,042	0,029
1325	0,016	0,017	0,017	0,019	0,019	0,021	0,029	0,028	0,024	0,041	0,028
1375	0,017	0,018	0,019	0,020	0,020	0,022	0,029	0,029	0,025	0,039	0,028
1425	0,016	0,018	0,018	0,021	0,021	0,022	0,030	0,032	0,025	0,040	0,028
1475	0,015	0,018	0,018	0,021	0,021	0,022	0,034	0,034	0,027	0,042	0,029
1525	0,016	0,019	0,019	0,022	0,022	0,023	0,035	0,034	0,027	0,042	0,030
1575	0,015	0,017	0,017	0,020	0,020	0,021	0,034	0,034	0,026	0,042	0,029
1625	0,015	0,017	0,018	0,019	0,020	0,022	0,032	0,032	0,028	0,042	0,032
1675	0,014	0,016	0,017	0,018	0,020	0,021	0,030	0,032	0,029	0,043	0,031
1725	0,015	0,018	0,018	0,021	0,021	0,022	0,029	0,034	0,030	0,041	0,032
1775	0,015	0,017	0,017	0,020	0,020	0,021	0,027	0,033	0,030	0,037	0,031
1825	0,017	0,020	0,021	0,023	0,023	0,024	0,028	0,036	0,032	0,040	0,034
1875	0,015	0,017	0,017	0,020	0,021	0,023	0,026	0,034	0,030	0,041	0,030
1925	0,018	0,021	0,022	0,023	0,024	0,025	0,026	0,034	0,032	0,043	0,031
1975	0,015	0,016	0,017	0,019	0,020	0,021	0,023	0,031	0,030	0,042	0,029

Higher Frequencies : GW36K-MT											
P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,054	0,069	0,084	0,100	0,117	0,129	0,143	0,158	0,164	0,176	0,156
2,3	0,063	0,056	0,058	0,073	0,090	0,106	0,124	0,142	0,152	0,171	0,155
2,5	0,065	0,061	0,058	0,069	0,079	0,092	0,113	0,129	0,154	0,163	0,125
2,7	0,085	0,080	0,072	0,080	0,087	0,098	0,117	0,130	0,153	0,215	0,238
2,9	0,063	0,062	0,059	0,065	0,068	0,067	0,059	0,061	0,092	0,245	0,273
3,1	0,063	0,067	0,069	0,077	0,088	0,095	0,107	0,120	0,132	0,122	0,110
3,3	0,053	0,070	0,065	0,069	0,077	0,086	0,098	0,120	0,150	0,147	0,150
3,5	0,047	0,059	0,063	0,068	0,072	0,078	0,085	0,104	0,121	0,153	0,163
3,7	0,024	0,029	0,030	0,033	0,035	0,038	0,042	0,052	0,052	0,065	0,071
3,9	0,015	0,018	0,019	0,019	0,019	0,019	0,020	0,025	0,023	0,030	0,032
4,1	0,010	0,011	0,012	0,013	0,012	0,013	0,015	0,015	0,014	0,016	0,017
4,3	0,009	0,009	0,010	0,010	0,010	0,010	0,011	0,012	0,011	0,012	0,013
4,5	0,007	0,007	0,008	0,008	0,008	0,008	0,009	0,009	0,009	0,010	0,010
4,7	0,010	0,010	0,011	0,011	0,011	0,011	0,011	0,011	0,011	0,012	0,012
4,9	0,006	0,006	0,006	0,007	0,007	0,007	0,007	0,007	0,007	0,008	0,008
5,1	0,005	0,006	0,006	0,007	0,006	0,006	0,007	0,007	0,007	0,007	0,007
5,3	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007
5,5	0,005	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007
5,7	0,005	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007
5,9	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006	0,006	0,006
6,1	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007
6,3	0,005	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007
6,5	0,004	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007
6,7	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006
6,9	0,004	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,006	0,006
7,1	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,007	0,007	0,007	0,007
7,3	0,004	0,004	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
7,5	0,004	0,004	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
7,7	0,004	0,004	0,004	0,005	0,004	0,004	0,004	0,004	0,004	0,005	0,005
7,9	0,004	0,004	0,004	0,004	0,005	0,005	0,005	0,004	0,004	0,005	0,005
8,1	0,004	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005
8,3	0,005	0,005	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006
8,5	0,005	0,005	0,005	0,006	0,005	0,006	0,005	0,005	0,005	0,005	0,006
8,7	0,004	0,004	0,004	0,004	0,004	0,004	0,004	0,004	0,004	0,005	0,005
8,9	0,003	0,004	0,004	0,004	0,004	0,004	0,004	0,004	0,004	0,005	0,005

Note:
The normalization current is 52,17A for GW36K-MT
The stated harmonics are maximum values of all 3 phases.

Test: GW30K-MT											
P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	4,198	10,089	19,988	30,722	40,775	51,534	59,311	69,319	79,054	88,776	98,425
2	0,256	0,268	0,324	0,396	0,471	0,563	0,619	0,667	0,717	0,760	0,772
3	0,114	0,087	0,093	0,096	0,107	0,121	0,130	0,163	0,179	0,211	0,255
4	0,060	0,058	0,076	0,092	0,107	0,122	0,133	0,159	0,170	0,178	0,204
5	0,226	0,254	0,242	0,242	0,271	0,255	0,234	0,222	0,203	0,205	0,214
6	0,108	0,125	0,132	0,134	0,130	0,157	0,167	0,165	0,169	0,171	0,180
7	0,197	0,237	0,239	0,230	0,235	0,238	0,219	0,215	0,220	0,218	0,222
8	0,087	0,091	0,089	0,084	0,077	0,071	0,070	0,071	0,072	0,075	0,076
9	0,126	0,125	0,131	0,138	0,135	0,140	0,143	0,146	0,157	0,165	0,167
10	0,066	0,075	0,075	0,076	0,078	0,077	0,075	0,070	0,069	0,071	0,071
11	0,084	0,100	0,117	0,135	0,150	0,173	0,178	0,178	0,172	0,175	0,175
12	0,038	0,036	0,034	0,033	0,038	0,041	0,041	0,047	0,047	0,050	0,053
13	0,096	0,094	0,103	0,117	0,135	0,154	0,155	0,157	0,164	0,164	0,171
14	0,030	0,031	0,033	0,038	0,041	0,042	0,040	0,039	0,038	0,039	0,041
15	0,050	0,048	0,050	0,052	0,049	0,055	0,054	0,057	0,059	0,068	0,062
16	0,030	0,035	0,041	0,044	0,045	0,045	0,044	0,043	0,043	0,043	0,046
17	0,098	0,110	0,116	0,107	0,111	0,124	0,135	0,145	0,161	0,174	0,172
18	0,035	0,035	0,041	0,042	0,038	0,032	0,030	0,031	0,042	0,038	0,035
19	0,090	0,106	0,114	0,109	0,098	0,100	0,096	0,104	0,120	0,126	0,126
20	0,028	0,042	0,033	0,034	0,037	0,034	0,030	0,033	0,035	0,041	0,037
21	0,049	0,057	0,059	0,060	0,058	0,060	0,064	0,068	0,072	0,069	0,070
22	0,028	0,038	0,039	0,031	0,032	0,036	0,036	0,036	0,038	0,039	0,041
23	0,097	0,108	0,103	0,105	0,100	0,103	0,097	0,102	0,111	0,108	0,117
24	0,032	0,039	0,046	0,033	0,037	0,036	0,038	0,039	0,037	0,044	0,038
25	0,076	0,081	0,081	0,082	0,080	0,085	0,089	0,099	0,099	0,099	0,106
26	0,026	0,039	0,037	0,030	0,032	0,034	0,033	0,033	0,035	0,042	0,039
27	0,038	0,048	0,043	0,040	0,039	0,040	0,044	0,050	0,052	0,054	0,059
28	0,027	0,036	0,040	0,037	0,031	0,034	0,035	0,037	0,039	0,042	0,038
29	0,085	0,088	0,082	0,084	0,079	0,082	0,087	0,104	0,107	0,102	0,098
30	0,030	0,031	0,044	0,040	0,034	0,036	0,038	0,040	0,053	0,046	0,043
31	0,057	0,068	0,069	0,076	0,080	0,063	0,070	0,083	0,079	0,084	0,074
32	0,022	0,024	0,034	0,039	0,043	0,033	0,034	0,035	0,036	0,043	0,038
33	0,032	0,031	0,031	0,039	0,044	0,038	0,038	0,038	0,043	0,041	0,038
34	0,023	0,024	0,028	0,040	0,036	0,041	0,042	0,043	0,040	0,038	0,038
35	0,036	0,056	0,069	0,086	0,107	0,090	0,091	0,097	0,093	0,097	0,097
36	0,022	0,025	0,027	0,030	0,040	0,040	0,041	0,042	0,039	0,039	0,037
37	0,034	0,070	0,073	0,091	0,111	0,104	0,118	0,120	0,118	0,120	0,122
38	0,022	0,025	0,026	0,025	0,035	0,034	0,036	0,036	0,035	0,037	0,039
39	0,037	0,044	0,043	0,046	0,046	0,050	0,046	0,043	0,042	0,045	0,051
40	0,042	0,023	0,023	0,023	0,024	0,031	0,033	0,032	0,031	0,034	0,042

Interharmonics : GW30K-MT											
P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,056	0,101	0,160	0,193	0,238	0,290	0,327	0,383	0,433	0,545	0,692
125	0,048	0,057	0,063	0,076	0,088	0,107	0,112	0,136	0,145	0,173	0,243
175	0,050	0,053	0,055	0,061	0,065	0,079	0,081	0,091	0,099	0,121	0,146
225	0,051	0,045	0,049	0,052	0,056	0,067	0,066	0,078	0,074	0,088	0,115
275	0,052	0,043	0,046	0,051	0,057	0,062	0,063	0,070	0,074	0,084	0,097
325	0,057	0,042	0,044	0,046	0,048	0,054	0,054	0,061	0,061	0,070	0,081
375	0,041	0,042	0,043	0,046	0,049	0,053	0,052	0,056	0,058	0,061	0,073
425	0,037	0,041	0,041	0,043	0,046	0,047	0,051	0,055	0,052	0,057	0,066
475	0,038	0,041	0,041	0,042	0,044	0,057	0,057	0,053	0,051	0,052	0,061
525	0,036	0,041	0,042	0,042	0,054	0,054	0,057	0,049	0,048	0,050	0,061
575	0,038	0,041	0,042	0,042	0,053	0,055	0,055	0,054	0,052	0,051	0,056
625	0,036	0,039	0,041	0,040	0,047	0,052	0,053	0,056	0,048	0,048	0,054
675	0,036	0,040	0,039	0,049	0,049	0,053	0,056	0,057	0,046	0,050	0,054
725	0,034	0,038	0,037	0,049	0,049	0,052	0,051	0,048	0,042	0,046	0,049
775	0,034	0,038	0,038	0,044	0,047	0,045	0,043	0,043	0,043	0,045	0,047
825	0,034	0,037	0,041	0,045	0,050	0,041	0,042	0,043	0,047	0,048	0,051
875	0,033	0,037	0,047	0,049	0,051	0,039	0,040	0,040	0,057	0,051	0,050
925	0,033	0,038	0,045	0,045	0,040	0,039	0,039	0,040	0,057	0,050	0,046
975	0,033	0,052	0,045	0,049	0,038	0,038	0,040	0,041	0,049	0,055	0,050
1025	0,032	0,053	0,046	0,042	0,038	0,039	0,040	0,041	0,045	0,051	0,045
1075	0,032	0,048	0,049	0,037	0,037	0,039	0,041	0,040	0,041	0,049	0,045
1125	0,033	0,052	0,050	0,038	0,039	0,039	0,040	0,040	0,043	0,049	0,046
1175	0,031	0,057	0,058	0,037	0,038	0,041	0,042	0,042	0,041	0,053	0,049
1225	0,032	0,049	0,060	0,037	0,038	0,040	0,041	0,043	0,042	0,052	0,047
1275	0,032	0,051	0,050	0,039	0,039	0,040	0,042	0,042	0,044	0,056	0,048
1325	0,031	0,054	0,056	0,038	0,038	0,039	0,039	0,041	0,044	0,059	0,047
1375	0,033	0,052	0,057	0,040	0,037	0,039	0,039	0,040	0,047	0,063	0,047
1425	0,031	0,056	0,047	0,049	0,039	0,039	0,040	0,040	0,056	0,061	0,048
1475	0,037	0,047	0,052	0,051	0,041	0,038	0,040	0,041	0,065	0,056	0,048
1525	0,033	0,036	0,056	0,055	0,049	0,038	0,039	0,041	0,052	0,061	0,049
1575	0,033	0,037	0,052	0,059	0,064	0,040	0,041	0,042	0,050	0,061	0,048
1625	0,033	0,036	0,039	0,052	0,060	0,046	0,049	0,046	0,055	0,058	0,052
1675	0,032	0,035	0,035	0,055	0,051	0,054	0,054	0,056	0,062	0,052	0,054
1725	0,034	0,037	0,036	0,059	0,056	0,063	0,061	0,060	0,052	0,048	0,052
1775	0,032	0,035	0,036	0,051	0,054	0,055	0,059	0,058	0,052	0,047	0,053
1825	0,031	0,033	0,034	0,037	0,049	0,057	0,058	0,055	0,045	0,046	0,052
1875	0,031	0,033	0,032	0,033	0,054	0,056	0,054	0,053	0,049	0,046	0,051
1925	0,034	0,032	0,032	0,032	0,049	0,049	0,054	0,048	0,042	0,044	0,053
1975	0,041	0,033	0,031	0,032	0,035	0,054	0,050	0,044	0,043	0,043	0,055

Higher Frequencies : GW30K-MT											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,087	0,094	0,122	0,136	0,147	0,150	0,152	0,156	0,163	0,186	0,220
2,3	0,114	0,091	0,078	0,078	0,090	0,089	0,094	0,110	0,121	0,137	0,168
2,5	0,074	0,082	0,074	0,076	0,088	0,093	0,105	0,133	0,157	0,174	0,188
2,7	0,108	0,081	0,076	0,082	0,087	0,090	0,106	0,132	0,154	0,167	0,186
2,9	0,050	0,040	0,045	0,049	0,048	0,049	0,047	0,046	0,043	0,046	0,078
3,1	0,054	0,040	0,040	0,048	0,047	0,051	0,055	0,057	0,057	0,057	0,061
3,3	0,080	0,080	0,087	0,093	0,094	0,104	0,107	0,109	0,111	0,114	0,113
3,5	0,063	0,067	0,073	0,079	0,083	0,088	0,090	0,097	0,100	0,105	0,108
3,7	0,058	0,059	0,061	0,065	0,068	0,074	0,076	0,078	0,082	0,088	0,094
3,9	0,066	0,068	0,072	0,076	0,083	0,091	0,097	0,100	0,103	0,102	0,105
4,1	0,056	0,056	0,059	0,062	0,064	0,070	0,073	0,078	0,082	0,085	0,086
4,3	0,058	0,051	0,049	0,052	0,056	0,061	0,062	0,064	0,070	0,070	0,072
4,5	0,061	0,060	0,061	0,061	0,061	0,075	0,074	0,074	0,074	0,072	0,066
4,7	0,073	0,069	0,059	0,056	0,067	0,073	0,073	0,070	0,068	0,068	0,067
4,9	0,054	0,056	0,059	0,072	0,071	0,077	0,085	0,075	0,073	0,069	0,068
5,1	0,059	0,066	0,073	0,065	0,070	0,055	0,058	0,057	0,068	0,062	0,061
5,3	0,038	0,057	0,056	0,041	0,044	0,043	0,043	0,044	0,049	0,053	0,052
5,5	0,028	0,045	0,035	0,033	0,037	0,035	0,038	0,039	0,041	0,050	0,049
5,7	0,022	0,025	0,025	0,026	0,030	0,029	0,029	0,032	0,033	0,044	0,039
5,9	0,017	0,019	0,018	0,017	0,020	0,019	0,020	0,021	0,023	0,031	0,029
6,1	0,014	0,015	0,015	0,017	0,019	0,019	0,019	0,019	0,019	0,023	0,026
6,3	0,013	0,012	0,012	0,012	0,014	0,015	0,015	0,015	0,016	0,017	0,023
6,5	0,011	0,009	0,009	0,010	0,011	0,011	0,011	0,011	0,012	0,013	0,018
6,7	0,009	0,009	0,009	0,010	0,011	0,011	0,011	0,011	0,013	0,014	0,016
6,9	0,008	0,007	0,008	0,008	0,009	0,009	0,009	0,010	0,010	0,011	0,014
7,1	0,007	0,006	0,007	0,007	0,007	0,008	0,008	0,008	0,008	0,010	0,011
7,3	0,005	0,006	0,006	0,007	0,007	0,008	0,008	0,009	0,008	0,009	0,010
7,5	0,005	0,005	0,006	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,009
7,7	0,005	0,005	0,006	0,006	0,006	0,007	0,007	0,007	0,007	0,007	0,008
7,9	0,005	0,005	0,005	0,006	0,006	0,006	0,007	0,006	0,007	0,007	0,007
8,1	0,006	0,006	0,006	0,006	0,007	0,007	0,006	0,007	0,007	0,007	0,007
8,3	0,005	0,006	0,006	0,007	0,007	0,007	0,007	0,007	0,007	0,006	0,007
8,5	0,007	0,008	0,007	0,007	0,008	0,007	0,007	0,006	0,006	0,006	0,007
8,7	0,008	0,007	0,008	0,007	0,007	0,007	0,006	0,006	0,006	0,006	0,006
8,9	0,005	0,005	0,006	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005

Note:
The normalization current is 43,48A for GW30K-MT
The stated harmonics are maximum values of all 3 phases.

Test: GW25K-MT										
P/P$_n$ [%]	0	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1	3,568	10,367	24,642	34,171	44,647	49,728	59,717	69,513	83,288	88,812	98,477
2	0,345	0,345	0,391	0,445	0,526	0,575	0,654	0,707	0,808	0,857	0,940
3	0,162	0,147	0,107	0,114	0,131	0,143	0,150	0,172	0,189	0,209	0,232
4	0,079	0,076	0,090	0,103	0,117	0,132	0,147	0,168	0,181	0,196	0,209
5	0,248	0,286	0,304	0,322	0,330	0,342	0,318	0,306	0,273	0,240	0,228
6	0,123	0,148	0,150	0,118	0,122	0,137	0,188	0,191	0,207	0,201	0,208
7	0,224	0,271	0,284	0,272	0,278	0,297	0,292	0,280	0,265	0,267	0,269
8	0,096	0,114	0,108	0,110	0,102	0,091	0,086	0,088	0,089	0,091	0,088
9	0,151	0,152	0,158	0,161	0,164	0,162	0,169	0,171	0,176	0,182	0,191
10	0,086	0,086	0,092	0,099	0,098	0,097	0,093	0,091	0,084	0,081	0,082
11	0,100	0,122	0,139	0,145	0,167	0,184	0,204	0,206	0,210	0,215	0,207
12	0,045	0,042	0,041	0,040	0,043	0,045	0,047	0,053	0,058	0,059	0,057
13	0,116	0,115	0,128	0,133	0,151	0,162	0,182	0,182	0,187	0,189	0,198
14	0,039	0,038	0,047	0,045	0,046	0,043	0,046	0,044	0,041	0,046	0,047
15	0,058	0,055	0,062	0,059	0,056	0,057	0,065	0,063	0,066	0,068	0,071
16	0,032	0,042	0,049	0,057	0,058	0,056	0,054	0,055	0,052	0,053	0,054
17	0,108	0,134	0,140	0,131	0,126	0,134	0,149	0,156	0,174	0,186	0,197
18	0,043	0,047	0,048	0,043	0,041	0,039	0,038	0,037	0,038	0,044	0,043
19	0,104	0,129	0,129	0,121	0,110	0,114	0,118	0,116	0,129	0,135	0,149
20	0,031	0,040	0,049	0,042	0,042	0,042	0,042	0,041	0,040	0,045	0,046
21	0,060	0,068	0,068	0,060	0,061	0,066	0,072	0,074	0,081	0,084	0,087
22	0,031	0,036	0,037	0,039	0,039	0,038	0,043	0,043	0,040	0,044	0,050
23	0,112	0,120	0,115	0,107	0,112	0,116	0,124	0,117	0,125	0,132	0,136
24	0,041	0,040	0,043	0,043	0,042	0,045	0,043	0,043	0,044	0,044	0,050
25	0,083	0,091	0,089	0,081	0,090	0,093	0,104	0,103	0,117	0,120	0,118
26	0,028	0,039	0,044	0,035	0,037	0,037	0,040	0,042	0,040	0,041	0,046
27	0,043	0,050	0,048	0,041	0,041	0,042	0,048	0,055	0,058	0,062	0,066
28	0,033	0,045	0,039	0,037	0,035	0,034	0,036	0,040	0,044	0,046	0,048
29	0,092	0,101	0,092	0,099	0,101	0,098	0,099	0,100	0,122	0,126	0,122
30	0,035	0,069	0,048	0,038	0,038	0,039	0,043	0,042	0,048	0,050	0,056
31	0,060	0,076	0,078	0,098	0,104	0,104	0,085	0,091	0,097	0,100	0,096
32	0,026	0,030	0,042	0,032	0,034	0,034	0,039	0,039	0,041	0,050	0,046
33	0,041	0,039	0,040	0,051	0,052	0,047	0,040	0,042	0,040	0,048	0,046
34	0,026	0,030	0,034	0,035	0,035	0,037	0,043	0,042	0,045	0,050	0,045
35	0,042	0,046	0,091	0,136	0,142	0,137	0,114	0,118	0,109	0,113	0,112
36	0,025	0,029	0,031	0,031	0,033	0,032	0,037	0,038	0,041	0,044	0,050
37	0,044	0,070	0,093	0,132	0,146	0,146	0,129	0,139	0,143	0,144	0,143
38	0,025	0,028	0,036	0,038	0,032	0,032	0,034	0,035	0,047	0,048	0,044
39	0,046	0,047	0,056	0,061	0,062	0,056	0,053	0,052	0,046	0,047	0,049
40	0,030	0,027	0,029	0,049	0,029	0,027	0,036	0,035	0,043	0,039	0,039

Interharmonics : GW25K-MT											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,069	0,090	0,198	0,230	0,293	0,314	0,350	0,403	0,457	0,494	0,584
125	0,068	0,066	0,084	0,096	0,122	0,123	0,140	0,140	0,149	0,163	0,191
175	0,067	0,063	0,071	0,076	0,098	0,096	0,107	0,109	0,111	0,117	0,133
225	0,057	0,056	0,059	0,065	0,075	0,073	0,094	0,087	0,085	0,091	0,107
275	0,062	0,064	0,056	0,060	0,061	0,068	0,077	0,086	0,086	0,091	0,090
325	0,048	0,060	0,054	0,075	0,060	0,062	0,067	0,076	0,076	0,074	0,077
375	0,046	0,051	0,053	0,079	0,056	0,058	0,065	0,069	0,075	0,078	0,073
425	0,043	0,050	0,059	0,070	0,056	0,057	0,058	0,060	0,069	0,070	0,064
475	0,044	0,049	0,058	0,052	0,053	0,055	0,055	0,057	0,065	0,065	0,062
525	0,044	0,048	0,052	0,050	0,053	0,055	0,054	0,055	0,062	0,065	0,063
575	0,044	0,048	0,048	0,049	0,053	0,054	0,054	0,054	0,060	0,063	0,060
625	0,041	0,045	0,047	0,047	0,049	0,049	0,050	0,050	0,056	0,062	0,059
675	0,043	0,046	0,050	0,047	0,049	0,049	0,051	0,051	0,053	0,059	0,061
725	0,039	0,044	0,059	0,045	0,046	0,046	0,047	0,049	0,051	0,058	0,056
775	0,040	0,045	0,057	0,045	0,046	0,045	0,047	0,048	0,050	0,057	0,055
825	0,040	0,062	0,062	0,044	0,045	0,045	0,048	0,049	0,050	0,057	0,057
875	0,038	0,052	0,057	0,043	0,044	0,043	0,045	0,046	0,048	0,057	0,059
925	0,037	0,052	0,055	0,044	0,043	0,043	0,044	0,046	0,047	0,058	0,059
975	0,039	0,054	0,058	0,046	0,043	0,043	0,046	0,045	0,048	0,058	0,060
1025	0,037	0,049	0,058	0,044	0,043	0,043	0,044	0,045	0,047	0,054	0,057
1075	0,038	0,042	0,055	0,042	0,044	0,043	0,044	0,045	0,046	0,053	0,059
1125	0,039	0,042	0,042	0,044	0,047	0,046	0,046	0,046	0,046	0,052	0,063
1175	0,036	0,040	0,041	0,042	0,042	0,047	0,048	0,046	0,046	0,050	0,065
1225	0,038	0,043	0,049	0,042	0,045	0,045	0,049	0,045	0,046	0,048	0,065
1275	0,039	0,050	0,058	0,043	0,044	0,043	0,046	0,045	0,047	0,050	0,063
1325	0,039	0,060	0,059	0,042	0,043	0,043	0,045	0,047	0,047	0,058	0,063
1375	0,039	0,059	0,059	0,046	0,043	0,043	0,045	0,047	0,048	0,063	0,065
1425	0,037	0,061	0,058	0,048	0,043	0,042	0,045	0,046	0,049	0,068	0,067
1475	0,037	0,070	0,065	0,044	0,043	0,043	0,045	0,046	0,049	0,066	0,068
1525	0,038	0,055	0,061	0,042	0,043	0,043	0,045	0,049	0,049	0,059	0,064
1575	0,038	0,042	0,058	0,042	0,044	0,044	0,047	0,048	0,050	0,065	0,066
1625	0,039	0,041	0,059	0,042	0,043	0,042	0,049	0,047	0,050	0,070	0,068
1675	0,037	0,040	0,043	0,043	0,048	0,044	0,048	0,048	0,049	0,068	0,069
1725	0,040	0,042	0,042	0,044	0,047	0,049	0,049	0,048	0,048	0,064	0,065
1775	0,038	0,041	0,042	0,042	0,043	0,047	0,047	0,048	0,048	0,061	0,062
1825	0,037	0,038	0,043	0,040	0,041	0,045	0,046	0,045	0,050	0,066	0,060
1875	0,036	0,037	0,051	0,041	0,043	0,042	0,045	0,043	0,057	0,066	0,053
1925	0,037	0,037	0,043	0,068	0,041	0,040	0,041	0,042	0,062	0,062	0,049
1975	0,037	0,037	0,038	0,059	0,039	0,040	0,041	0,042	0,060	0,054	0,048

Higher Frequencies : GW25K-MT											
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,094	0,098	0,154	0,186	0,182	0,183	0,190	0,211	0,204	0,194	0,203
2,3	0,160	0,123	0,095	0,125	0,138	0,138	0,129	0,144	0,133	0,139	0,154
2,5	0,106	0,102	0,090	0,101	0,115	0,119	0,123	0,132	0,159	0,175	0,199
2,7	0,134	0,116	0,091	0,095	0,102	0,104	0,108	0,127	0,159	0,170	0,189
2,9	0,066	0,055	0,052	0,055	0,059	0,059	0,060	0,059	0,055	0,052	0,049
3,1	0,069	0,058	0,048	0,048	0,053	0,055	0,061	0,065	0,069	0,071	0,074
3,3	0,099	0,098	0,105	0,106	0,110	0,113	0,122	0,125	0,130	0,133	0,137
3,5	0,071	0,077	0,088	0,091	0,096	0,100	0,107	0,108	0,111	0,111	0,111
3,7	0,069	0,071	0,073	0,075	0,080	0,082	0,088	0,091	0,092	0,093	0,098
3,9	0,084	0,084	0,086	0,093	0,099	0,102	0,109	0,111	0,120	0,121	0,124
4,1	0,074	0,069	0,070	0,075	0,076	0,078	0,083	0,088	0,094	0,097	0,103
4,3	0,064	0,063	0,059	0,066	0,067	0,067	0,073	0,073	0,079	0,082	0,085
4,5	0,067	0,075	0,070	0,067	0,066	0,069	0,090	0,087	0,091	0,091	0,087
4,7	0,084	0,082	0,069	0,074	0,073	0,074	0,083	0,080	0,081	0,077	0,077
4,9	0,064	0,065	0,066	0,071	0,069	0,067	0,078	0,081	0,084	0,082	0,082
5,1	0,072	0,085	0,068	0,069	0,073	0,074	0,067	0,067	0,068	0,066	0,071
5,3	0,048	0,072	0,050	0,047	0,050	0,052	0,049	0,052	0,050	0,053	0,059
5,5	0,033	0,037	0,041	0,038	0,042	0,044	0,041	0,048	0,045	0,047	0,060
5,7	0,026	0,029	0,040	0,027	0,030	0,034	0,033	0,038	0,038	0,048	0,050
5,9	0,020	0,022	0,027	0,021	0,022	0,024	0,023	0,025	0,026	0,033	0,038
6,1	0,018	0,018	0,020	0,019	0,020	0,023	0,022	0,023	0,025	0,028	0,026
6,3	0,014	0,015	0,015	0,020	0,016	0,016	0,019	0,020	0,023	0,024	0,020
6,5	0,013	0,012	0,011	0,014	0,017	0,016	0,017	0,017	0,017	0,015	0,016
6,7	0,011	0,012	0,011	0,012	0,014	0,016	0,015	0,014	0,014	0,014	0,015
6,9	0,009	0,008	0,009	0,010	0,011	0,011	0,011	0,011	0,012	0,012	0,013
7,1	0,009	0,008	0,008	0,008	0,009	0,009	0,009	0,009	0,010	0,011	0,011
7,3	0,006	0,007	0,008	0,008	0,008	0,009	0,009	0,009	0,010	0,011	0,011
7,5	0,006	0,006	0,007	0,008	0,008	0,008	0,008	0,008	0,009	0,009	0,009
7,7	0,006	0,006	0,007	0,008	0,007	0,007	0,007	0,008	0,008	0,008	0,008
7,9	0,006	0,006	0,007	0,007	0,007	0,007	0,007	0,008	0,008	0,008	0,008
8,1	0,007	0,007	0,008	0,007	0,008	0,008	0,008	0,008	0,008	0,008	0,008
8,3	0,006	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008
8,5	0,009	0,009	0,010	0,008	0,008	0,009	0,008	0,008	0,008	0,008	0,008
8,7	0,010	0,009	0,009	0,008	0,008	0,008	0,008	0,008	0,007	0,007	0,007
8,9	0,006	0,006	0,007	0,006	0,006	0,006	0,006	0,006	0,006	0,006	0,006

Note:
The normalization current is 36,23A for GW25K-MT
The stated harmonics are maximum values of all 3 phases.

5.2 Verification of the symmetry characteristics of three-phase inverter modules DIN VDE V 0124-100:2012-07			
Clause	**Test**		**Result**
5.2.1	General		**P**
5.2.2	Test in the test laboratory:		**P**
	5.2.2.1	Calculation of asymmetry	**P**
	5.2.2	Additional tests for communicatively coupled inverter modules	**N/A**
	5.2.2.1	Failure of individual inverter modules	**N/A**
	5.2.2.2	Power drop of individual inverter modules	**N/A**
5.2.3	Tests in the field		**N/A**

5.2.1 General These tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.5 and 5.6 are met.	**P**
The phase angles are specified by the distribution network and so only the power symmetry is discussed.	
Note:	

5.2.2 Test in the test laboratory		**P**
Test Condition:	The measurements were performed in the testing laboratory. at the grid-simulator: U_N = between 86 % Un and 109% Un until the test Frequency: 50 Hz +/- 0,5%	
Note: If an examination is required for any other requirements, these apply to this test.		

5.2.2.1 Calculation of asymmetry						P
Setting values	cos φ = 1:		1,00			
	cos φ over-excited:		0,80			
	cos φ under-excited:		0,80			
Test:						
1-min mean value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
a) cos φ = 1 at 100 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	11,990	11,999	12,040	-0,009	-0,041	0,050
	11,990	12,001	12,040	-0,011	-0,039	0,050
	11,989	12,000	12,040	-0,011	-0,040	0,051
	11,989	12,000	12,039	-0,010	-0,040	0,050
	11,989	11,999	12,038	-0,010	-0,039	0,050
cos $φ_{E60}$:	0,999					
max. asymmetry [kVA]:	0,051					
b) maximum under-excited (i) at 100 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	9,217	9,201	9,209	0,016	-0,008	-0,008
	9,173	9,158	9,165	0,015	-0,007	-0,008
	9,195	9,176	9,185	0,020	-0,009	-0,010
	9,198	9,183	9,192	0,016	-0,009	-0,006
	9,073	9,055	9,064	0,018	-0,008	-0,010
cos $φ_{E60}$:	0,792					
max. asymmetry [kVA]:	0,020					
c) maximum over-excited (c) at 100 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	9,192	9,213	9,261	-0,022	-0,047	0,069
	9,203	9,226	9,271	-0,024	-0,045	0,069
	9,201	9,224	9,269	-0,023	-0,045	0,068
	9,013	9,034	9,079	-0,021	-0,045	0,066
	9,238	9,260	9,305	-0,022	-0,046	0,068
cos $φ_{E60}$:	0,799					
max. asymmetry [kVA]:	0,069					
d) cos φ = 1 at 50 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	6,008	6,017	6,040	-0,009	-0,022	0,032
	6,008	6,017	6,040	-0,009	-0,023	0,033
	6,007	6,017	6,039	-0,010	-0,022	0,032
	6,008	6,018	6,041	-0,010	-0,023	0,033
	6,008	6,018	6,041	-0,010	-0,023	0,033
cos $φ_{E60}$:	0,999					
max. asymmetry [kVA]:	0,033					

e) maximum under-excited (i) at 50 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	6,012	6,011	6,021	0,001	-0,010	0,009
	6,012	6,011	6,020	0,001	-0,009	0,008
	6,014	6,011	6,021	0,003	-0,010	0,007
	6,012	6,012	6,022	0,000	-0,010	0,010
	6,013	6,011	6,021	0,001	-0,010	0,008
cos φ_{E60}:	0,792					
max. asymmetry [kVA]:	0,010					
f) maximum over-excited (c) at 50 % P_n ± 5 % P_{Emax}						
S_{E60} [kVA]:	6,003	6,022	6,056	-0,020	-0,034	0,054
	6,003	6,024	6,058	-0,020	-0,035	0,055
	6,004	6,023	6,058	-0,018	-0,035	0,054
	6,003	6,022	6,056	-0,019	-0,034	0,054
	6,004	6,022	6,057	-0,018	-0,035	0,053
cos φ_{E60}:	0,802					
max. asymmetry [kVA]:	0,055					
Limit [kVA]:	≤ 5 % S_{Emax} and 4,6 kVA					

Test:
The maximum absolute difference between the apparent powers of the three phases is determined for each of the five measurements (1-min means) in the respective operating point. The maximum of these five values is again determined.

Assessment criterion:
The test is passed if the maximum value from the above measurements does not exceed 5 % S_{Emax} and 4,6 kVA.

Note:
The maximum inductive and capacitive values are specified by the manufacturer.

The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3 Verification of the characteristics of the power generation unit on the network DIN VDE V 0124-100:2012-07			
Clause	**Test**		**Result**
5.3.1	General		**P**
5.3.2	Measurement of the active reactive power range		**P**
5.3.3	Active power reduction by specifying setpoints		**P**
	5.3.3.1	Setpoint control	**P**
	5.3.3.2	Measurement of setting accuracy	**P**
	5.3.3.3	Measurement of setting time	**P**
5.3.4	Active power feed-in for overfrequency		**P**
	5.3.4.1.1	Test cycle for adjustable/conditionally adjustable PGUs	**P**
	5.3.4.1.2	Test cycle for all PGUs (adjustable, conditionally adjustable and non-adjustable PGUs)	**P**
5.3.5	Active power feed-in for underfrequency		**P**
5.3.6	Reactive power output		**P**
	5.3.6.1	Tests of the cos φ setting accuracy	**P**
	5.3.6.4	Test for a displacement factor/ active power characteristic curve cos φ (P)	**P**

5.3.1 General (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.7 are met)		**P**
Test Condition:	The measurements were performed in the testing laboratory. at the grid-simulator: U_N = between 86 % Un and 109% Un until the test Frequency: 50 Hz +/- 0,5%	
Note: If an examination is required for any other requirements, these apply to this test.		

5.3.2 Measurement of the active power and reactive power range (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.7.5 are met)			**P**
Setting values	cos φ = 1:	1,00	
	cos φ max. over-excited:	0,80	
	cos φ max. under-excited:	0,80	
Test: GW36K-MT			
600 s mean value	U_n	$1{,}09\ U_n$	
a) cos φ 1 at 100% P_{Emax}			
U [V]:	230,13	250,83	
$P_{Emax600\ a)}$ [kW]	36,234	36,077	
$S_{Emax600\ a)}$ [kVa]	36,239	36,082	
cos $\varphi_{Emax600}$	0,999	0,999	
b) maximum under-excited (i) at 100% P_{Emax}			
U [V]:	230,06	250,74	
$P_{Emax600\ b)}$ [kW]	27,646	28,570	
$S_{Emax600\ b)}$ [kVa]	34,427	35,503	
cos $\varphi_{Emax600\text{-under-excited}}$	0,803	0,805	
c) maximum over-excited (c) at 100% P_{Emax}			
U [V]:	230,13	250,78	
$P_{Emax600\ c)}$ [kW]	26,809	28,224	
$S_{Emax600\ c)}$ [kVa]	33,894	35,325	
cos $\varphi_{Emax600\text{-over-excited}}$	0,791	0,799	
d) maximum under-excited (i) at 20-30% P_{Emax}			
U [V]:	230,02	250,74	
$P_{Emax60\ d)}$ [kW]	8,982	8,973	
$S_{Emax60\ d)}$ [kVa]	11,179	11,129	
cos $\varphi_{Emax60\text{-over-excited}}$	0,803	0,806	
e) maximum over-excited (c) at 20-30% P_{Emax}			
U [V]:	230,04	250,74	
$P_{Emax60\ e)}$ [kW]	8,991	9,014	
$S_{Emax60\ e)}$ [kVa]	11,223	11,257	
cos $\varphi_{Emax60\text{-over-excited}}$	0,801	0,801	
$S_{Emax600}$ and $P_{Emax\ 600}$			
$S_{Emax600} = \max(S_{Emax600\ a)}, S_{Emax600\ b)}, S_{Emax600\ c)})$ [kVa]	36,239		
$P_{Emax\ 600} = \max(P_{Emax600\ a)}, P_{Emax600\ b)}, P_{Emax600\ c)})$ [kW]	36,234		

Test: GW30K-MT		
600 s mean value	U_n	1,09 U_n
a) cos φ 1 at 100% P_{Emax}		
U [V]:	230,25	251,01
$P_{Emax600\ a)}$ [kW]	30,311	30,301
$S_{Emax600\ a)}$ [kVa]	30,350	30,333
cos $\varphi_{Emax600}$	0,999	0,999
b) maximum under-excited (i) at 100% P_{Emax}		
U [V]:	230,18	250,78
$P_{Emax600\ b)}$ [kW]	29,288	29,984
$S_{Emax600\ b)}$ [kVa]	37,040	37,946
cos $\varphi_{Emax600-under-excited}$	0,791	0,790
c) maximum over-excited (c) at 100% P_{Emax}		
U [V]:	230,07	250,77
$P_{Emax600\ c)}$ [kW]	28,970	29,797
$S_{Emax600\ c)}$ [kVa]	36,268	37,287
cos $\varphi_{Emax600-over-excited}$	0,799	0,799
d) maximum under-excited (i) at 20-30% P_{Emax}		
U [V]:	230,09	250,73
$P_{Emax60\ d)}$ [kW]	7,548	7,546
$S_{Emax60\ d)}$ [kVa]	9,536	9,536
cos $\varphi_{Emax60-over-excited}$	0,791	0,791
e) maximum over-excited (c) at 20-30% P_{Emax}		
U [V]:	230,08	250,77
$P_{Emax60\ e)}$ [kW]	7,529	7,524
$S_{Emax60\ e)}$ [kVa]	9,405	9,379
cos $\varphi_{Emax60-over-excited}$	0,801	0,802
$S_{Emax600}$ and $P_{Emax\ 600}$		
$S_{Emax600}$= max($S_{Emax600\ a)}$, $S_{Emax600\ b)}$, $S_{Emax600\ c)}$) [kVa]	37,946	
$P_{Emax\ 600}$= max($P_{Emax600\ a)}$, $P_{Emax600\ b)}$, $P_{Emax600\ c)}$) [kW]	30,311	

Test: GW25K-MT		
600 s mean value	U_n	1,09 U_n
a) cos φ 1 at 100% P_{Emax}		
U [V]:	230,24	250,96
$P_{Emax600\ a)}$ [kW]	25,450	25,433
$S_{Emax600\ a)}$ [kVa]	25,485	25,463
$\cos φ_{Emax600}$	0,999	0,999
b) maximum under-excited (i) at 100% P_{Emax}		
U [V]:	230,14	250,84
$P_{Emax600\ b)}$ [kW]	22,393	23,098
$S_{Emax600\ b)}$ [kVa]	28,330	29,224
$\cos φ_{Emax600\text{-under-excited}}$	0,790	0,790
c) maximum over-excited (c) at 100% P_{Emax}		
U [V]:	230,06	250,74
$P_{Emax600\ c)}$ [kW]	21,949	22,551
$S_{Emax600\ c)}$ [kVa]	27,445	28,172
$\cos φ_{Emax600\text{-over-excited}}$	0,800	0,800
d) maximum under-excited (i) at 20-30% P_{Emax}		
U [V]:	230,05	251,02
$P_{Emax60\ d)}$ [kW]	6,221	6,246
$S_{Emax60\ d)}$ [kVa]	7,836	7,895
$\cos φ_{Emax60\text{-over-excited}}$	0,794	0,791
e) maximum over-excited (c) at 20-30% P_{Emax}		
U [V]:	230,04	250,70
$P_{Emax60\ e)}$ [kW]	6,228	6,228
$S_{Emax60\ e)}$ [kVa]	7,749	7,749
$\cos φ_{Emax60\text{-over-excited}}$	0,804	0,804
$S_{Emax600}$ and $P_{Emax\ 600}$		
$S_{Emax600}$= max($S_{Emax600\ a)}$, $S_{Emax600\ b)}$, $S_{Emax600\ c)}$) [kVa]	29,224	
$P_{Emax\ 600}$= max($P_{Emax600\ a)}$, $P_{Emax600\ b)}$, $P_{Emax600\ c)}$) [kW]	25,450	

Test: The PGU is operated in all of the following, possible operating points. Every operating point must be retained for at least 600s after the transient effect has faded. During the measurements, there may be no power limitation by the primary energy source. a) For cos φ, the maximum active power possible in this range is set. b) For maximum under-excited operation, the maximum active power possible in this operating point is set c) For maximum over-excited operation, the maximum active power possible in this operating point is set. d) For maximum under-excited operation, the power set to 20-30% P_{Emax}. e) For maximum over-excited operation, the power set to 20-30% P_{Emax}. The operating points d) and e) must be retained for at least 60 s.
Assessment criterion: $S_{Emax600}$ and $P_{Emax\ 600}$ are determined by the highest value measured. $S_{Emax600} = \max(S_{Emax600a)}, S_{Emax600b)}, S_{Emax600c)})$ $P_{Emax600} = \max(P_{Emax600a)}, P_{Emax600b)}, P_{Emax600c)})$
Note: The maximum settable cos φ must be set. No specification: PGU ≤ 3,68 kVA not in PGS > 3,68 kVA φ 0,95 (i) and (c): PGU > 3,68 kVA and ≤ 13,8 kVA not in PGS > 13,8 kVA and for PGU ≤ 3,68 kVA also in PGS ≤ 13,8 kVA φ 0,90 (i) and (c): PGU > 13,8 kVA and for PGU ≤ 13,8 kVA also in PGS > 13,8 kVA

5.3.3 Active power reduction by specifying setpoints	P
The following tests apply for PGUs >100 kW and PGSs that, according to the manufacturers, can participate in feed-in management / network security management.	
Note: The EEC also stipulates this test for PGUs with lower power ratings.	

5.3.3.1 Setpoint control	P
The following procedure must be used for the setpoint control test for the active power: a) The test must be conducted with a chronologically coherent test procedure; b) The available active power output must be at least 90% P_{Emax} during the entire duration of the test c) The active power must be measured at the three-phase/AC current connector of the PGU d) If the PGU has several different interfaces for setpoint specification, the interface returning the most unfavourable results must be tested.	

Inverter operation data can be transferred by RS485, or WIFI Modular to a PC with monitoring software or to data logger device such as Ezlogger Pro. USB just used for service debug; RS485 is the standard communication choice for inverter, and WIFI modular can be used optionally for communication.

RS485 Communication:

The RS485 port of inverter is used to connect the EzLogger Pro, and the total length of connecting cable should not exceed 1000m. Communication lines must be separated from other power lines to prevent the communication from being interfered.

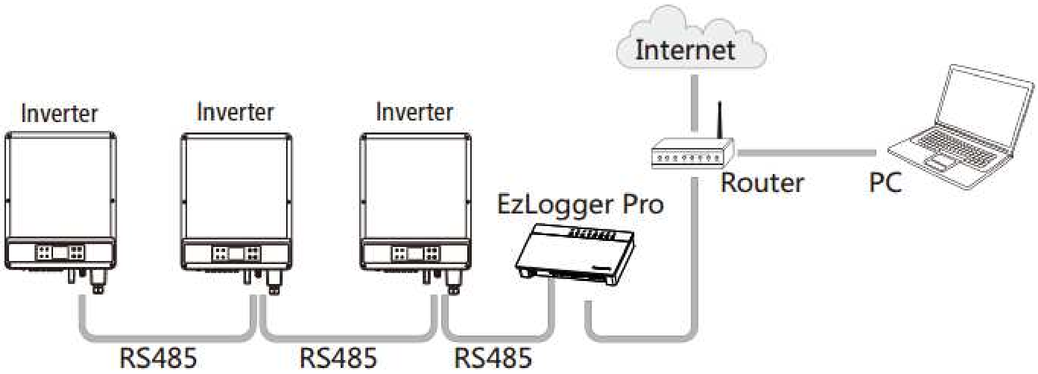


Figure 9 –RS485 connection

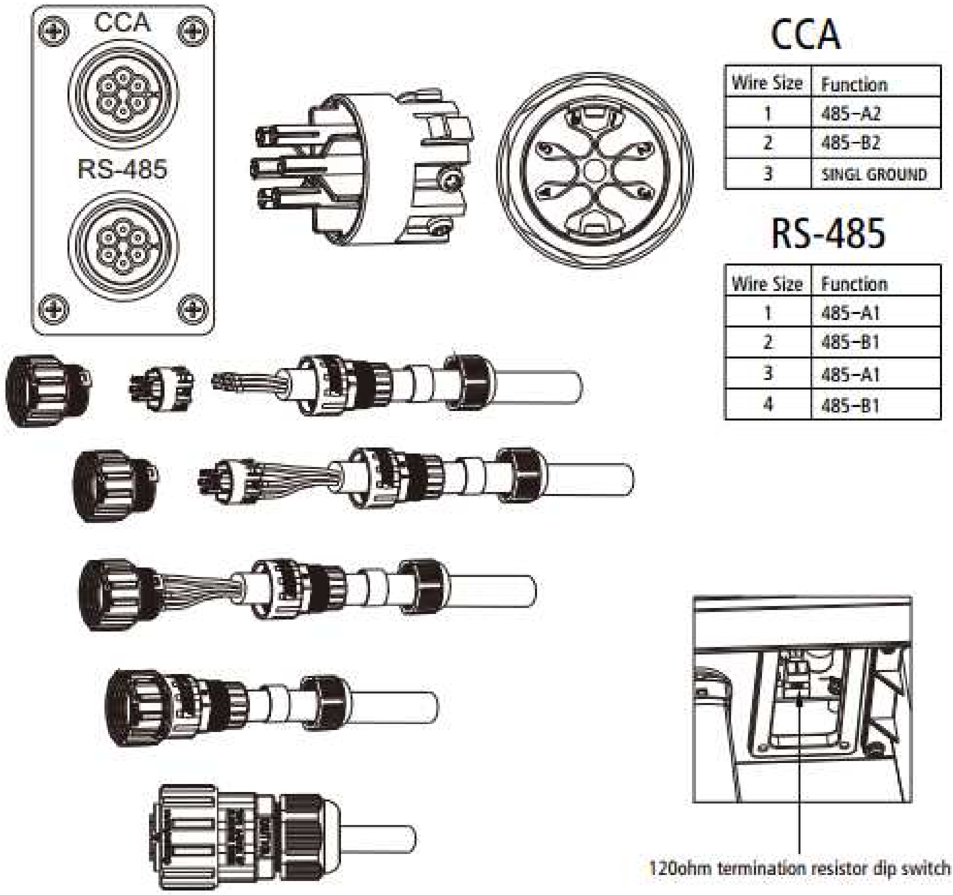
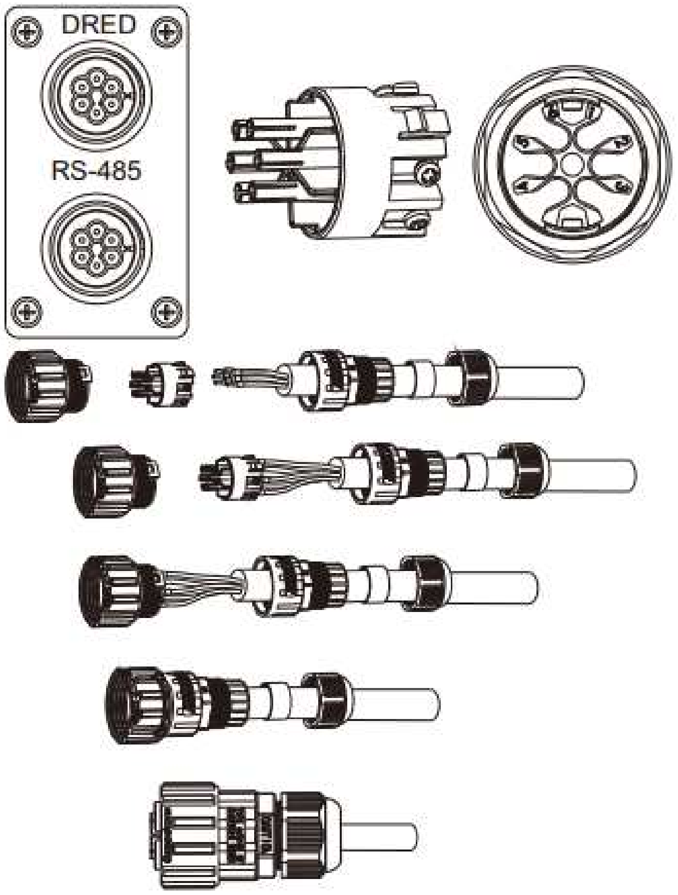


Figure 10 –Fasten the cable of RS485

DRED function:

DRM function is achieved by Ezlogger Pro, and please connect the Ezlogger Pro through RS485 port. Detailed DRED connection refer to Ezlogger Pro manual



DRED

Wire Size	Function
1	DRED1
2	DRED2
3	DRED3
4	DRED4
5	REF1
6	REF2

RS-485

Wire Size	Function
1	485-A1
2	485-B1
3	485-A1
4	485-B1
5	485-A2
6	485-B2

Figure 11 –Fasten the cable of DRED

WiFi Communication:

This function is only applicable for WiFi model, for specific configuration.

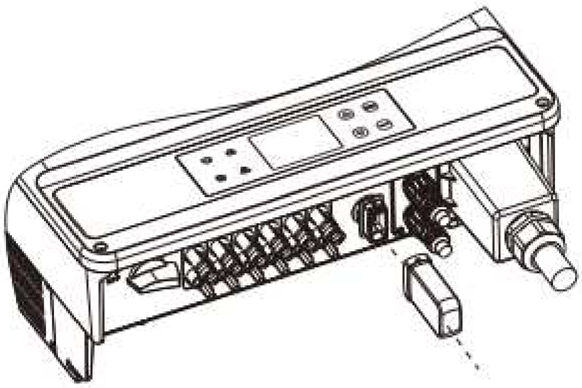


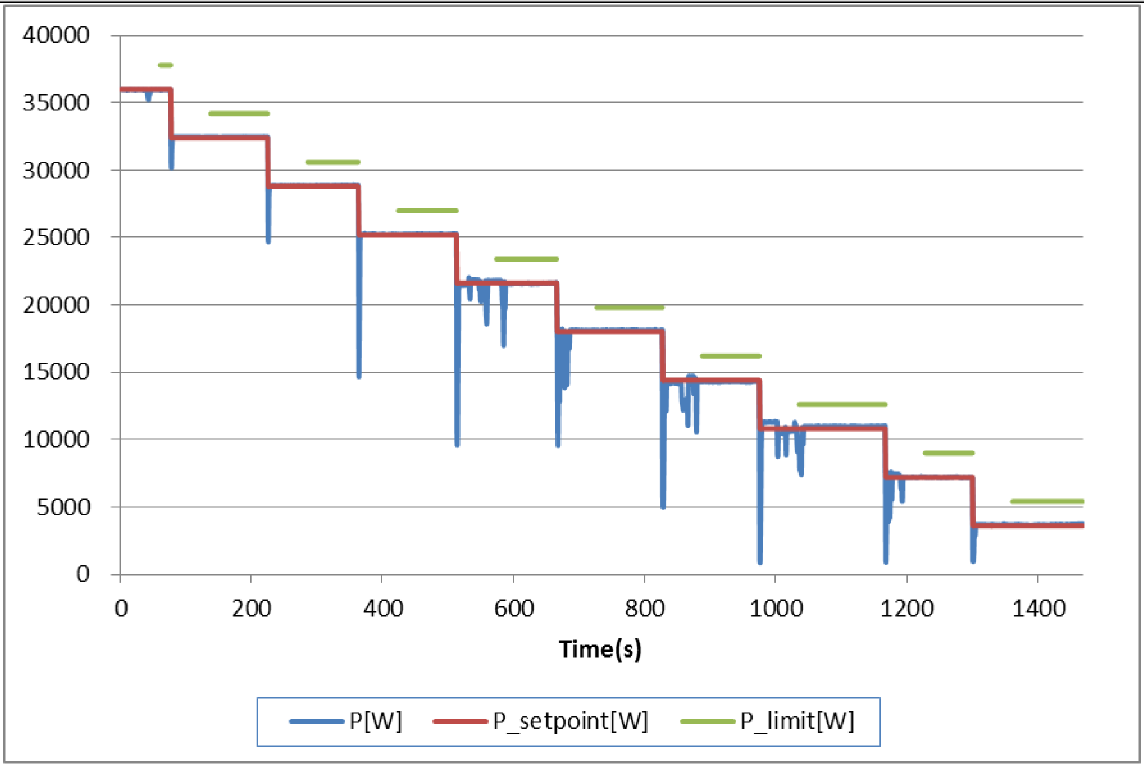
Figure 12 –The WiFi module installation of SMT series

Note:

See 5.3.3.2 for measurements.

5.3.3.2 Measurement of setting accuracy	P

Graph of the setting accuracy:



Test:

1-min mean value / P_n/P [%]	100	90	80	70	60	50	40	30	20	10
$P_{Setpoint}$[kW]:	36,000	32,400	28,800	25,200	21,600	18,000	14,400	10,800	7,200	3,600
P_{E60} [kW]:	35,982	32,470	28,879	25,273	21,421	18,133	14,279	10,763	7,211	3,674
$\Delta P_{E60}/P_{Setpoint}$ [%]:	-0,051	0,195	0,220	0,203	-0,496	0,371	-0,335	-0,103	0,031	0,205
Limit $\Delta P_{E60}/P_{Setpoint}$:	+ 5 % of P_{Emax}									

Test:

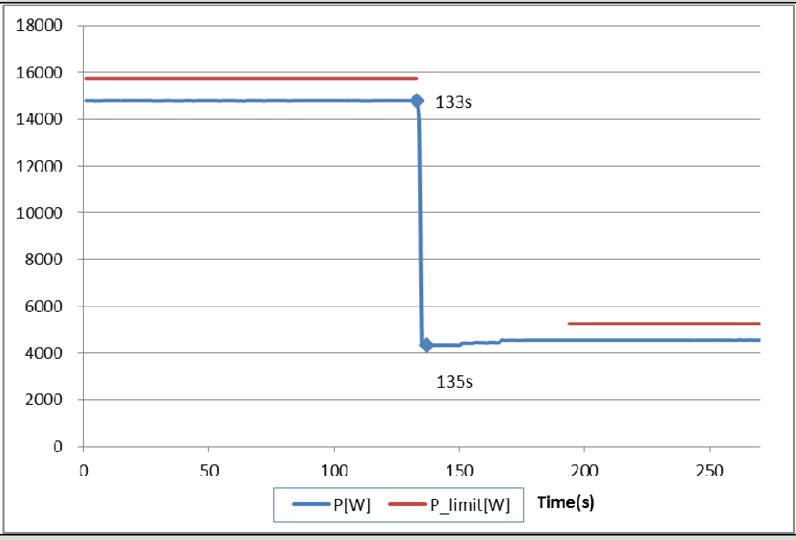
The setpoint signal must be reduced from 100% to 10% P_{Emax}:

a) for adjustable PGUs in increments of 10% P_{Emax}. 1 minute must elapse after every change to the setpoint setting so that the PGU can settle at the new setpoint. Then the active power of the PGU must be measured as a 1-min mean value.

b) For all other PGUs, in line with their adjustable steps. 5 minutes must elapse after the setpoint setting is changed so that the PGU can settle at the new setpoint. Then the active power of the PGU must be measured as a 1-min mean value.

Assessment criterion: a) for adjustable PGUs: - no network disconnection - the active power value does not exceed the setpoint by more than 5% P_{Emax} - the setting time determined this way is ≤ 1min b) For all other PGUs: - the active power value does not exceed the setpoint by more than 5% PEmax or - the setpoint is fallen below within 5 minutes or the PGU has switched off
Note: The setting time is ≤ 1min. See below “Graph of the setting accuracy”. The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3.3.3 Measurement of setting time		P
Graph of the adjustment time:		



Test:		
1-min mean value	100% of P_{Emax}	30% of P_{Emax}
$P_{Setpoint}$[kW]:	36,000	10,800
P_{E60} [kW]:	36,063	10,828
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0,176	0,078
Limit $\Delta P_{E60}/P_{Setpoint}$:	+ 5 % of P_{Emax}	
T_0[s]:	9s	
Limit T_0:	≤ 60 s	

Test:
The setting time is measured with a setpoint change from 100% to 30% of nominal active power P_{Emax} at time t_0.
The setting time of the PGU must be determined in this test.

Assessment criterion:
a) for adjustable PGUs:
- no network disconnection
- the active power value does not exceed the setpoint by more than 5% P_{Emax}
- the setting time determined this way is ≤ 1min

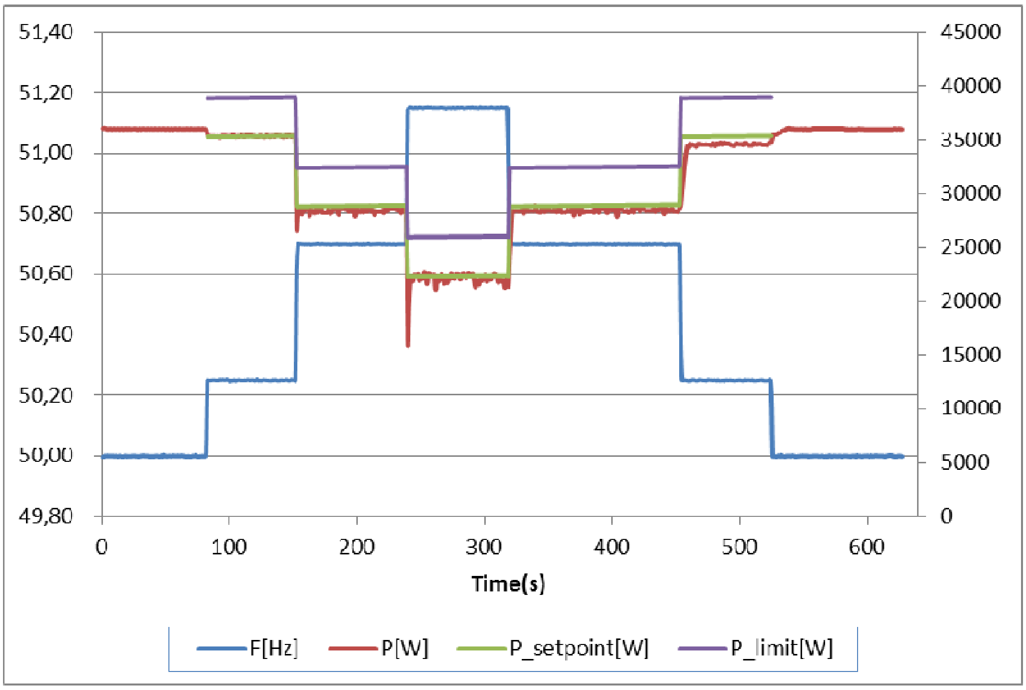
b) For all other PGUs:
- the active power value does not exceed the setpoint by more than 5% P_{Emax} or
- the setpoint is fallen below within 5 minutes or the PGU has switched off

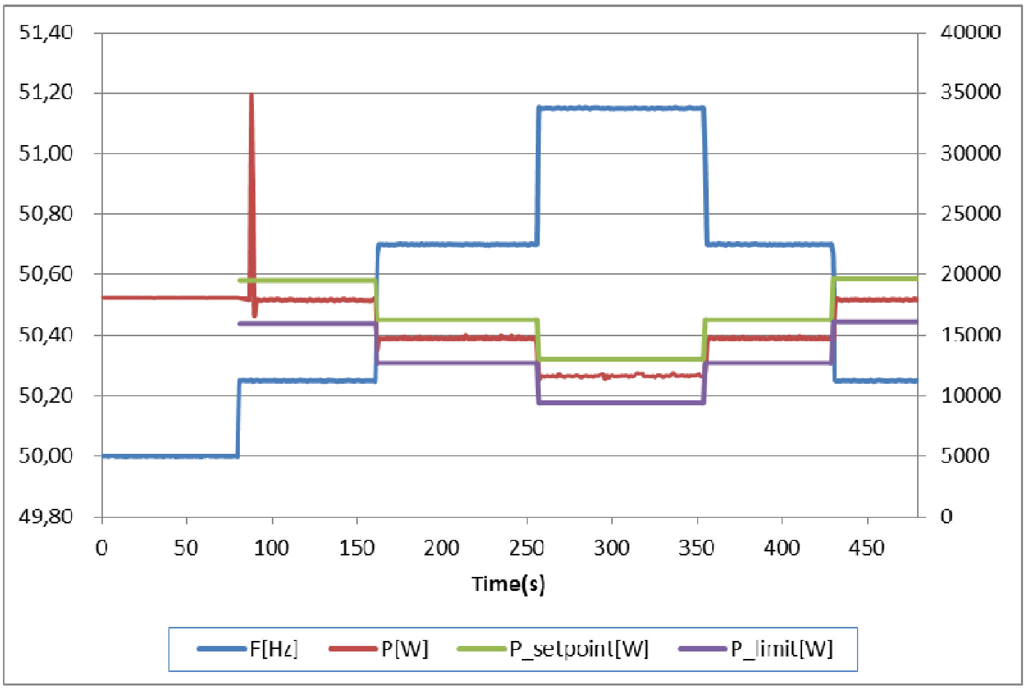
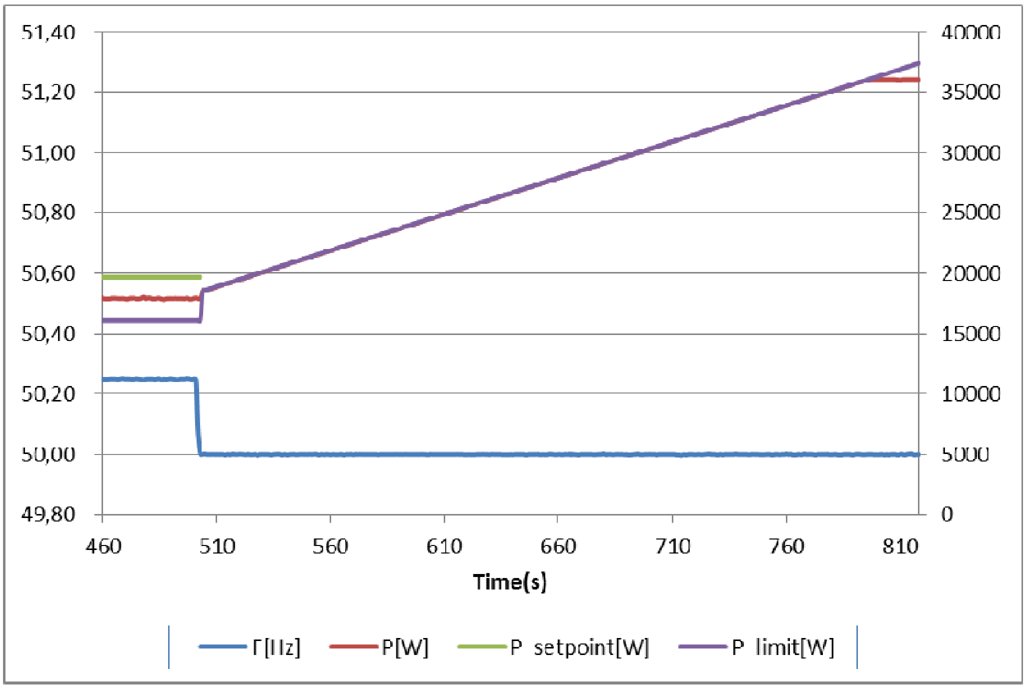
Note:
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3.4	**Active power feed-in for overfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.7.3.3 are met)

5.3.4.1.1 Test cycle for adjustable/conditionally adjustable PGUs	**P**

Test:							
1-min mean value	a) 50,00 Hz	b) 50,25 Hz	c) 50,70 Hz	d) 51,15 Hz	e) 50,70 Hz	f) 50,25 Hz	g) 50,00 Hz
1. Measurement a) to g): Active power output > 80% P_{Emax}							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
$P_{setpoint}$ [kW]:	N/A	35,288	28,806	22,325	28,806	35,288	N/A
P_{E60} [kW]:	36,008	35,362	28,439	22,184	28,435	34,594	36,002
$\Delta P_{E60}/P_{Setpoint}$ [%]:	N/A	0,49	-2,45	-0,94	-2,47	-4,63	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_{Emax}							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	N/A
$P_{setpoint}$ [kW]:	N/A	17,754	14,493	11,232	14,493	17,754	N/A
P_{E60} [kW]:	18,116	17,898	14,766	11,657	14,773	17,897	N/A
$\Delta P_{E60}/P_{Setpoint}$ [%]:	N/A	0,96	1,82	2,83	1,87	0,95	N/A
Limit $\Delta P_{E60}/P_{Setpoint}$:	+ 10 % of P_{Emax}						
Graph of Measurement 1.: Active power output > 80% P_{Emax}							

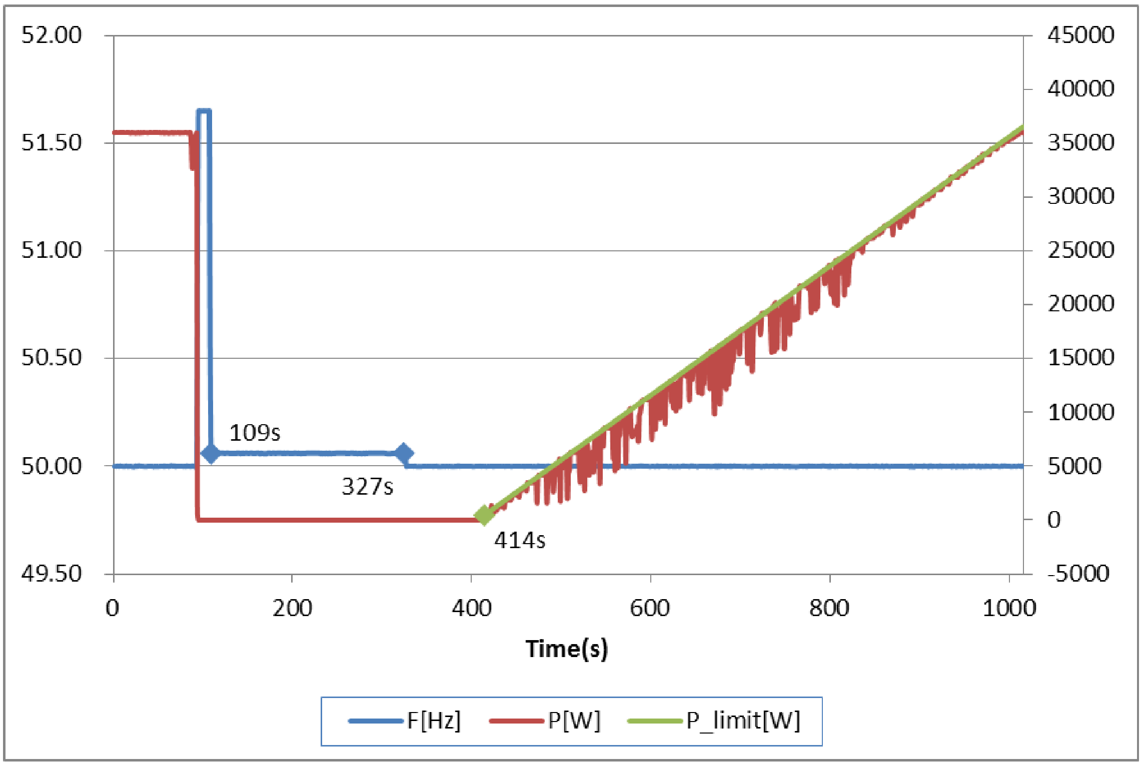


Graph of Measurement 2.:Active power output 40% and 60% after freezing > 80% P_{Emax}

Graph of power gradient:


Test: The test is conducted for two powers. First, the test must start at a power > 80% P_{Emax} ("Measurement 1"), and in a second test, for a power between 40% to 60% P_{Emax} ("Measurement 2"). In the second test, after freezing of the PM, the available active power output must be increased to a value > 80% P_{Emax}, and after the network frequency of 50,2 Hz is fallen below, the rise of the active power gradient must be recorded. Point g) must be held until the PGU is again feeding in with the active power output available.
Assessment criterion: For f=50,2 Hz, the value of the PM active power currently being generated is "frozen". a) For adjustable PGUs when: 1) the active power reduces between measuring points b) and f) given above with a gradient of 40% PM per Hz for a decreasing frequency (or rises for a frequency decreasing again). 2) the maximum active power gradient occurring in point g) is lower than 10% of maximum active power P_{Emax} every minute, and 3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_{Emax} by more than ± 10%. b) For conditionally adjustable PGUs 1) when they behave as in a) within their adjustment range, and 2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz. The PGU must have disconnected from the network no later than 200ms after frequency h) is reached.
Note: The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3.4.1.2 Test cycle for all PGUs (adjustable, conditionally adjustable and non-adjustable)	P

Graph of frequency g) to j):



Test:

1-min mean value	g) 50,00 ± 0,01 Hz	h) 51,65 ± 0,05 Hz	i) 50,06 Hz ± 0,01 Hz	j) 50,00 Hz ± 0,01 Hz

1) g) 50,00 ± 0,01 Hz to h) 51,65 ± 0,05 Hz

Disconnection time [ms]:	192	Limit [ms]:	200

Test:
Following tests a) to g), frequency h) 51,65 Hz ± 0,05 Hz must be set for at least 200ms. Afterwards, frequency i) 50,06 Hz ± 0,01 Hz is enabled and kept for at least 3 minutes.
Afterwards, frequency j) 50,00 Hz ± 0,01 Hz is enabled and kept until transient oscillation of the active power at the earliest.

Assessment criterion:
The PGU must have disconnected from the network no later than 200ms after frequency h) is reached.

Thereafter, also whilst frequency i) is being held, there may be no resynchronisation or active power feed-in, i.e. not on the characteristic curve as tested before in a) to g).

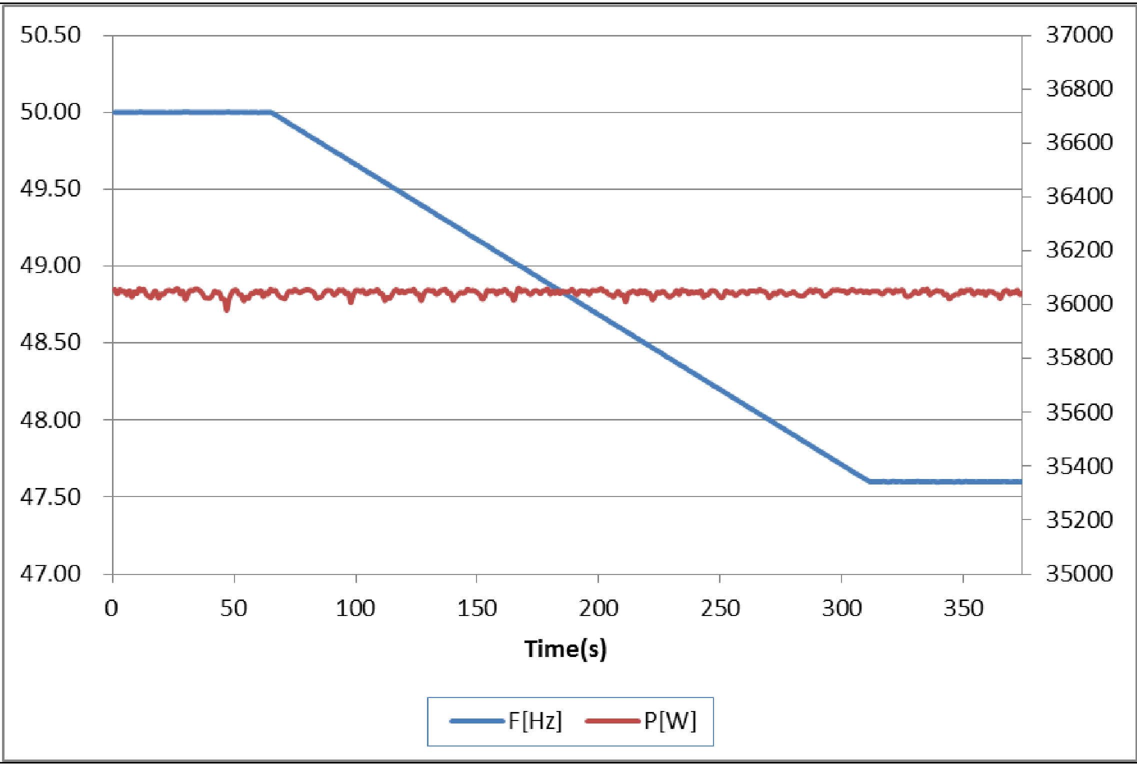
a) For adjustable PGUs when:
- ab) the maximum active power gradient occurring in point j) is lower than 10% of maximum active power P_{Emax} every minute, and
- ac) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_{Emax} by more than ± 10%.

b) For conditionally adjustable PGUs
- ba) when they behave as in a) within their adjustment range, and
- bb) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

Note:
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3.5 Active power feed-in for underfrequency — P

Graph of frequency a) to b):



Test:

	Switch to:	
1-min mean value	a) 50 ± 0,01 [Hz]	b) - 2,4 to - 2,5 [Hz]
Frequency [Hz]:	50,00	47,60
P_{E60} [kW]:	36,046	36,044
$\Delta P_{a)}/P_{b)}$ [%]:	0,005	

Test:
Operating point b) must be kept for at least 1 minute.
The test must be carried out at 100% P_{Emax}.

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

Assessment criterion:
The test is passed when the PGU does not disconnect from the network on a network frequency change and continues to feed in 100% P_{Emax} .

Note:
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.3.6 Reactive power output

(these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 5.7.5 are met)

The PGU has:
- passed for use for the adjustable cos φ range
- not passed for use for the adjustable cos φ range
- limitations for use in PGSs > **3,68 kVA** or **≤ 13,8 kVA**

5.3.6.1 Tests of the cos φ setting accuracy	**P**

Setting values	cos φ over-excited:	0,80
	cos φ under-excited:	0,80

d) and e) PGUs used in PGSs > 13,8 kVA

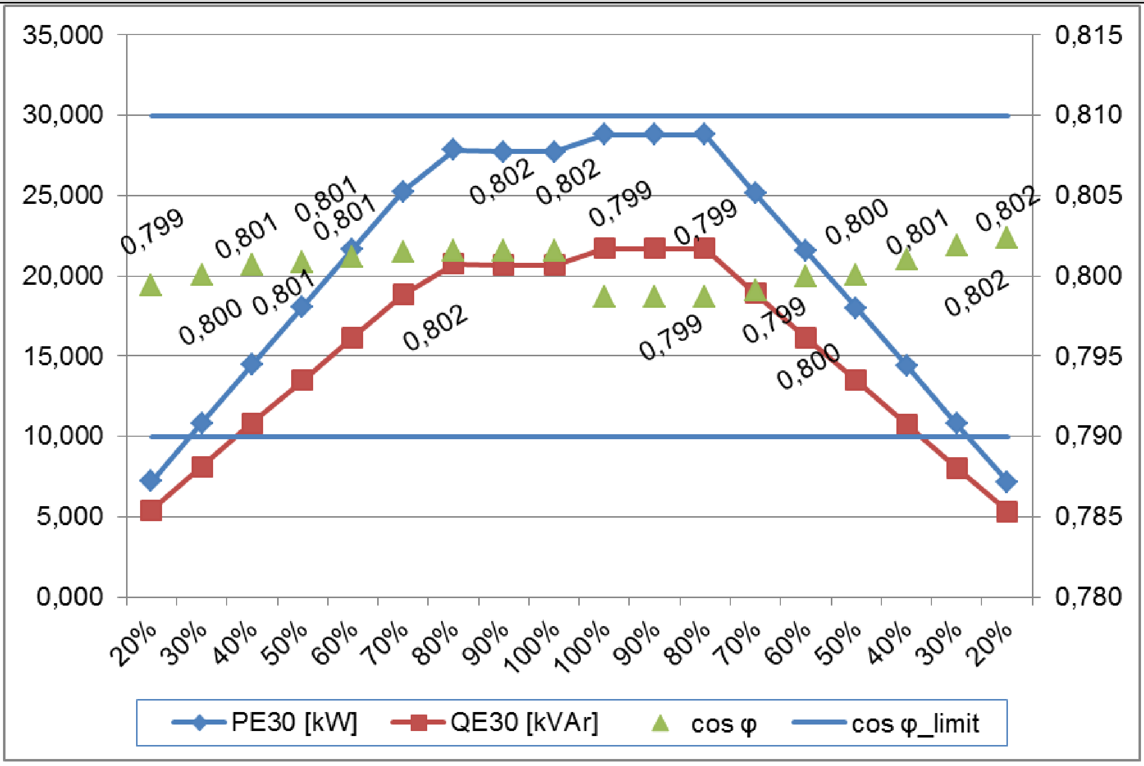
Test: GW36K-MT

30 s mean value	U_n		1,09 U_n	
Active power	S_{Emax}	40 – 60 %P_{Emax}	S_{Emax}	40 – 60 %P_{Emax}
d) cos φ 0,8 over-excited				
U [V]:	230,17	230,07	250,83	250,76
P_{E30} [kW]:	27,733	18,076	28,267	18,101
Q_{E30} [kVAr]:	20,688	13,519	21,077	13,514
cos $\varphi_{E30\text{-over-excited}}$:	0,802	0,801	0,802	0,801
e) cos φ 0,8 under-excited				
U [V]:	230,09	230,06	250,73	250,73
P_{n30} [kW]:	28,814	17,998	27,344	18,012
Q_{E30} [kVAr].	-21,708	-13,497	-21,145	-13,841
cos $\varphi_{E30\text{-under-excited}}$:	0,799	0,800	0,791	0,793
Limit cos φ_{E30}:	cos φ= 0,79 to 0,81 (c) and cos φ= 0,79 to 0,81 (i)			

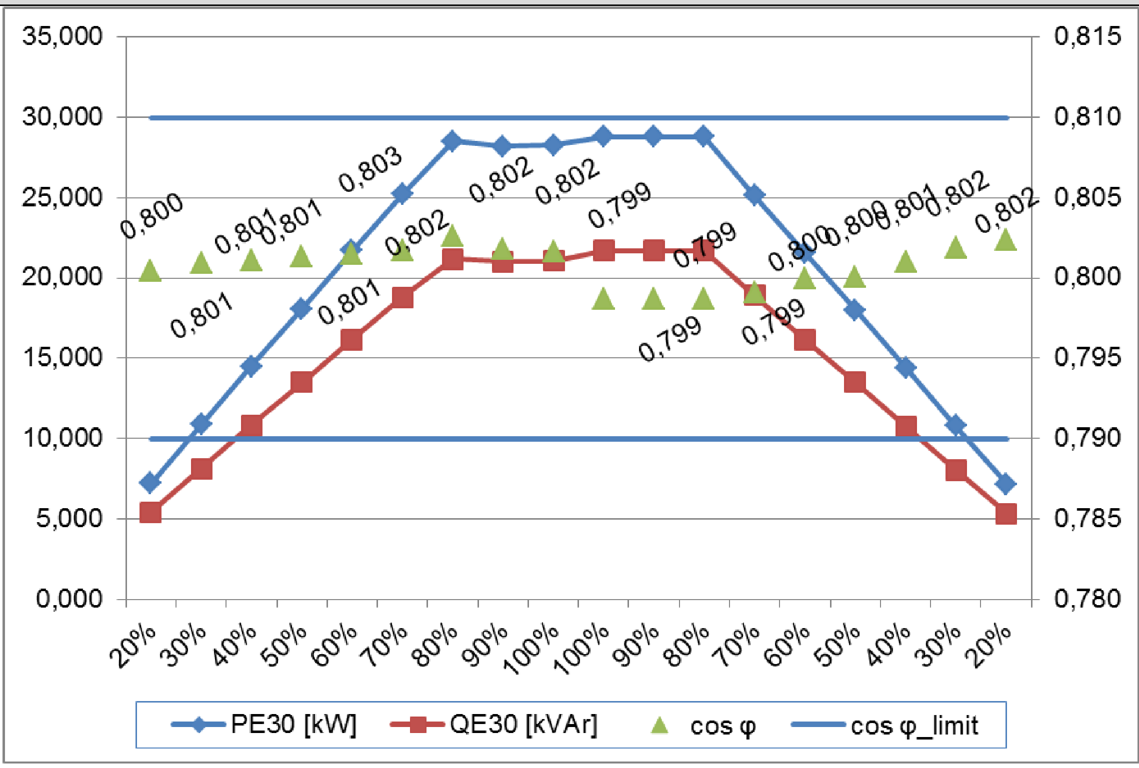
P_n/P [%]	10	20	30	40	50	60	70	80	80	80
30 s mean value	cos φ over-excited (c) @ U_n									
U [V]:	N/A	229,98	230,06	230,08	230,07	230,08	230,08	230,14	230,17	230,17
P_{E30} [kW]:	N/A	7,204	10,854	14,458	18,076	21,665	25,252	27,834	27,733	27,733
Q_{E30} [kVAr]:	N/A	5,414	8,138	10,817	13,519	16,184	18,843	20,760	20,687	20,688
cos $\varphi_{E30\text{-over-excited}}$:	N/A	0,799	0,800	0,801	0,801	0,801	0,801	0,802	0,802	0,802
	cos φ over-excited (c) @ $U_{1,09}$									
U [V]:	N/A	250,72	250,74	250,74	250,76	250,78	250,78	250,85	250,80	250,83
P_{n30} [kW]:	N/A	7,210	10,866	14,488	18,101	21,690	25,233	28,503	28,220	28,267
Q_{E30} [kVAr]:	N/A	5,398	8,123	10,825	13,514	16,183	18,809	21,184	21,033	21,077

cos $\varphi_{E30\text{-over-excited}}$:	N/A	0,800	0,801	0,801	0,801	0,801	0,802	0,803	0,802	0,802
30 s mean value	cos φ under-excited (i) @ U_n									
U [V]:	N/A	229,83	230,04	230,04	230,06	229,96	230,07	230,08	230,08	230,09
P_{E30} [kW]:	N/A	7,187	10,804	14,406	17,998	21,572	25,145	28,808	28,808	28,814
Q_{E30} [kVAr]:	N/A	-5,344	-8,049	-10,765	-13,497	-16,178	-18,919	-21,706	-21,706	-21,708
cos $\varphi_{E30\text{-under-excited}}$:	N/A	0,802	0,802	0,801	0,800	0,800	0,799	0,799	0,799	0,799
	cos φ under-excited (i) @ $U_{1,09}$									
U [V]:	N/A	250,72	250,69	250,70	250,73	250,74	250,69	250,78	250,75	250,73
P_{E30} [kW]:	N/A	7,186	10,803	14,414	18,012	21,596	25,169	27,900	27,471	27,344
Q_{E30} [kVAr]:	N/A	-5,327	-8,291	-11,064	-13,841	-16,632	-19,427	-21,560	-21,237	-21,145
cos $\varphi_{E30\text{-under-excited}}$:	N/A	0,803	0,793	0,793	0,793	0,792	0,792	0,791	0,791	0,791
Limit cos φ_{E30}:	cos φ= 0,79 to 0,81 (c) and cos φ= 0,79 to 0,81 (i)									

Graph of cos φ over-excited (c) and under-excited (i) @ U_n: GW36K-MT



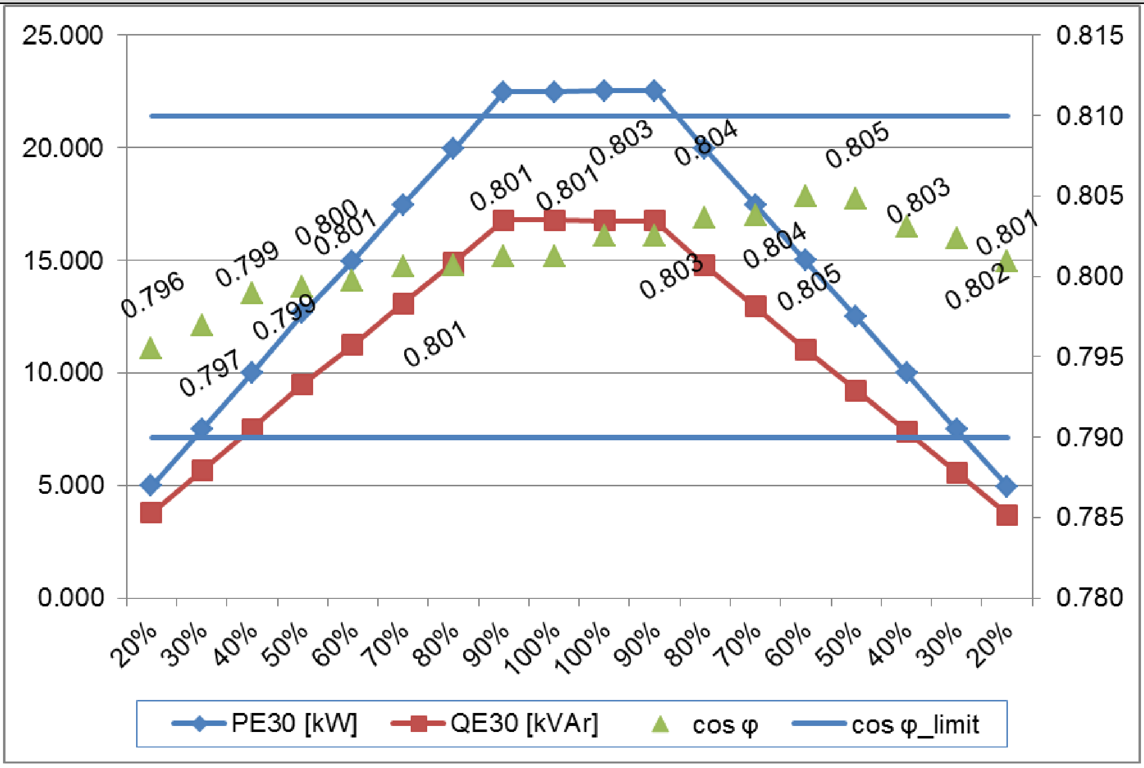
Graph of cos φ over-excited (c) and under-excited (i) @ $U_{1,09}$: GW36K-MT



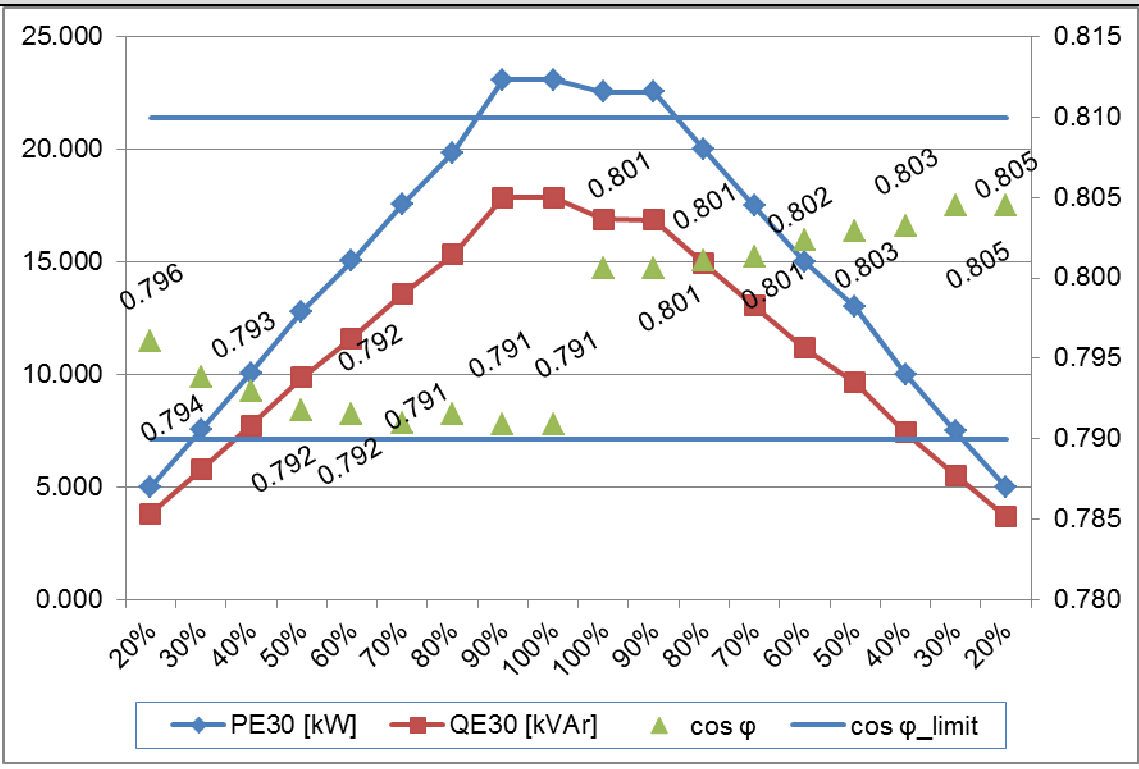
Test: GW25K-MT				
30 s mean value	U_n		1,09 U_n	
Active power	S_{Emax}	40 – 60 %P_{Emax}	S_{Emax}	40 – 60 %P_{Emax}
d) cos φ 0,8 over-excited				
U [V]:	230,17	230,13	250,80	250,82
P_{E30} [kW]:	22,491	12,657	23,093	12,816
Q_{E30} [kVAr]:	16,794	9,513	17,867	9,887
cos $\varphi_{E30\text{-over-excited}}$:	0,801	0,799	0,791	0,792
e) cos φ 0,8 under-excited				
U [V]:	230,18	230,11	250,78	250,72
P_{n30} [kW]:	22,525	12,489	22,564	12,991
Q_{E30} [kVAr].	-16,745	-3,005	-16,888	-9,645
cos $\varphi_{E30\text{-under-excited}}$:	0,803	0,805	0,801	0,803
Limit cos φ_{E30}:	cos φ= 0,79 to 0,81 (c) and cos φ= 0,79 to 0,81 (i)			

P_n/P [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	cos φ over-excited (c) @ U_n									
U [V]:	N/A	230,05	230,13	230,21	230,13	230,15	230,18	230,14	230,17	230,17
P_{E30} [kW]:	N/A	4,967	7,477	9,981	12,657	14,980	17,472	19,940	22,489	22,491
Q_{E30} [kVAr]:	N/A	3,783	5,668	7,512	9,513	11,245	13,077	14,921	16,793	16,794
cos $\varphi_{E30\text{-over-excited}}$:	N/A	0,796	0,797	0,799	0,799	0,800	0,801	0,801	0,801	0,801
	cos φ over-excited (c) @ $U_{1,09}$									
U [V]:	N/A	250,79	250,77	250,83	250,82	250,86	250,81	250,84	250,80	250,80
P_{n30} [kW]:	N/A	5,007	7,536	10,066	12,816	15,044	17,542	19,858	23,094	23,093
Q_{E30} [kVAr]:	N/A	3,807	5,772	7,734	9,887	11,614	13,569	15,334	17,867	17,867
cos $\varphi_{E30\text{-over-excited}}$:	N/A	0,796	0,794	0,793	0,792	0,792	0,791	0,792	0,791	0,791
30 s mean value	cos φ under-excited (i) @ U_n									
U [V]:	N/A	230,12	230,07	230,10	230,11	230,13	230,09	230,06	230,18	230,18
P_{E30} [kW]:	N/A	4,964	7,484	9,988	12,489	14,983	17,476	19,955	22,525	22,525
Q_{E30} [kVAr]:	N/A	-1,166	-1,790	-2,403	-3,005	-11,042	-12,934	-14,776	-16,745	-16,745
cos $\varphi_{E30\text{-under-excited}}$:	N/A	0,801	0,802	0,803	0,805	0,805	0,804	0,804	0,803	0,803
	cos φ under-excited (i) @ $U_{1,09}$									
U [V]:	N/A	250,71	250,70	250,65	250,72	250,72	250,72	250,75	250,78	250,78
P_{E30} [kW]:	N/A	4,966	7,490	10,007	12,991	15,023	17,509	20,009	22,562	22,564
Q_{E30} [kVAr]:	N/A	-3,665	-5,529	-7,420	-9,645	-11,174	-13,071	-14,949	-16,886	-16,888
cos $\varphi_{E30\text{-under-excited}}$:	N/A	0,805	0,805	0,803	0,803	0,802	0,801	0,801	0,801	0,801
Limit cos φ_{E30}:	cos φ= 0,79 to 0,81 (c) and cos φ= 0,79 to 0,81 (i)									

Graph of cos φ over-excited (c) and under-excited (i) @ U_n: GW25K-MT



Graph of cos φ over-excited (c) and under-excited (i) @ $U_{1,09}$: GW25K-MT

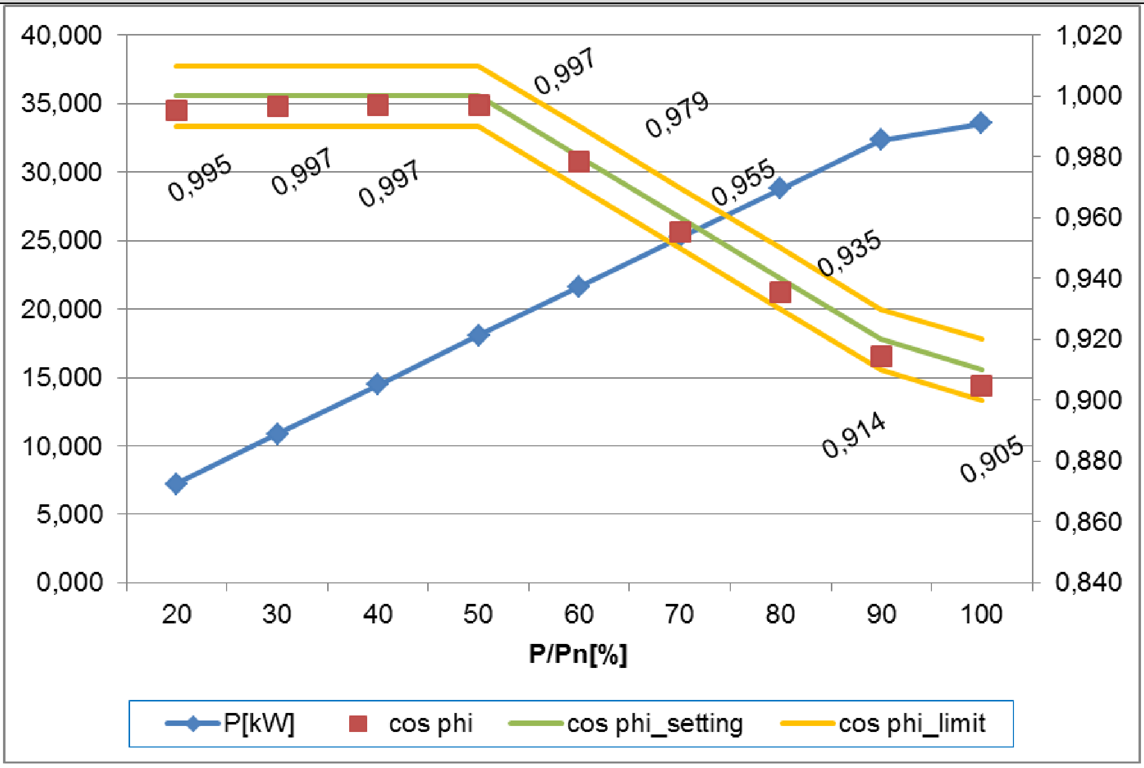


Test: a) With no specification of cos φ, the active power must be adjust between 40 % P_{Emax} and 60 % P_{Emax} and to S_{Emax} b) & c) For cos φ 0,95 over-excited and φ 0,95 under-excited, the active power must be adjust between 40 % P_{Emax} and 60 % P_{Emax} and to S_{Emax} d) & e) For cos φ 0,90 over-excited and φ 0,90 under-excited, the active power must be adjust between 40 % P_{Emax} and 60 % P_{Emax} and to S_{Emax} For measurements a) to c), there may be no power limitation by the primary energy source.
Assessment criterion: a) Applicable for PGUs ≤ 3,68 kVA that cannot be used in PGSs > 3,68 kVA: The test is passed when all operating points of a) of the PGU lie in range cos φ= 0,95 over-excited to cos φ= 0,95 under-excited. b) and c) For PSUs > 3,68 kVA and ≤ 13,8 kVA that cannot be used in PGSs > 13,8 kVA, and for PGUs ≤ 3,68 kVA that can be used in PGSs ≤ 13,8 kVA, the following applies: The test is passed when all measurement points of b) lie within range cos φ= 0,94 to 0,96 over-excited and of c) in range cos φ= 0,94 to 0,96. d) and e) For PGUs > 13,8 kVA and for PGUs ≤ 13,8kVA also in PGSs > 13,8 kVA The test is passed when all measurement points of d) lie within range cos φ= 0,89 to 0,91 over-excited and of e) in range cos φ= 0,89 to 0,91.
Note: The tests had been performed on the GW36K-MT and GW25K-MT are valid for the GW30K-MT, since it is identical in control board, with same hardware and software construction.

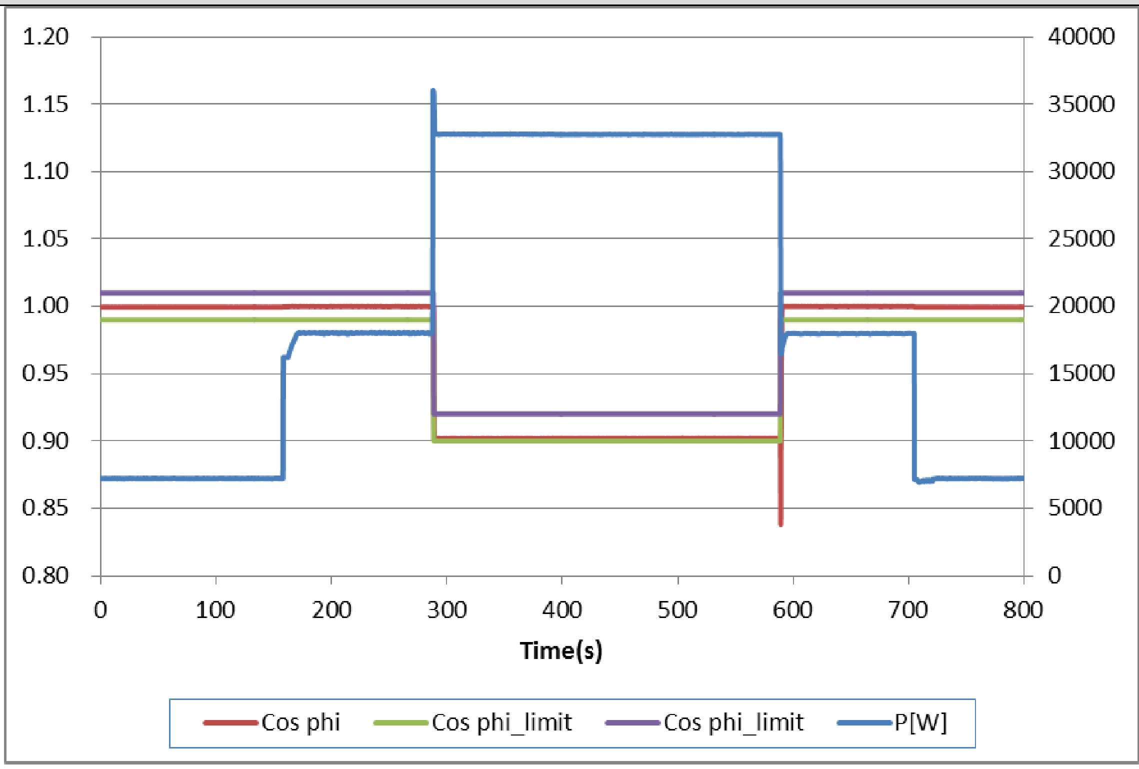
5.3.6.4 Test for a displacement factor/active power characteristic curve cos φ (P)										**P**
Test a):										
P_{Emax}/P [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	20% to 100% P_{Emax}									
U [V]:	N/A	230,07	230,09	230,09	230,10	230,09	230,09	230,12	230,11	230,13
P_{E30} [kW]:	N/A	7,215	10,857	14,490	18,061	21,639	25,215	28,773	32,364	33,544
P_{E30} of P_{Emax} [%]:	N/A	20,042	30,158	40,249	50,169	60,109	70,042	79,925	89,901	93,178
Q_{E30} [kVAr]:	N/A	0,685	0,889	1,119	1,376	-4,557	-7,805	-10,871	-14,333	-15,804
cos $φ_{E30}$:	N/A	0,995	0,997	0,997	0,997	0,979	0,955	0,935	0,914	0,905
cos $φ_{setpoint}$ of P_{E30}:	N/A	1,0	1,0	1,0	1,0	0,98	0,96	0,94	0,92	0,91
Limit cos φ $_{E30}$:	cos $φ_{setpoint}$ ± 0,01									

Test b):			
P_{Emax}/P_n [%]	20	50	90
30 s mean value	20% to 50% to 100% P_{Emax}		
U [V]:	230,10	230,18	230,09
P_{E30} [kW]:	7,223	17,134	32,791
P_{E30} of P_{Emax} [%]:	20,06	47,60	91,09
Q_{E30} [kVAr]:	-0,224	-0,320	-15,699
cos φ $_{E30}$:	0,999	0,999	0,902
cos $φ_{setpoint}$ of P_{E30}:	1,0	1,0	0,91
T_0[s]:	< 1 s	1,2s	
30 s mean value	100% to 50% to 20% P_{Emax}		
U [V]:	230,09	230,14	230,07
P_{E30} [kW]:	32,770	17,977	7,221
P_{E30} [%]:	91,03	49,94	20,06
Q_{E30} [kVAr]:	-15,686	-0,329	-0,223
cos φ $_{E30}$:	0,902	0,999	0,999
cos $φ_{setpoint}$ of P_{E30}:	0,91	1,0	1,0
T_0 [s]:	< 1 s	1,6s	
Limit T_0 [s]:	10 s		
Limit cos φ $_{E30}$:	cos $φ_{setpoint}$ ± 0,01		

Graph of cos φ(P): Test a)



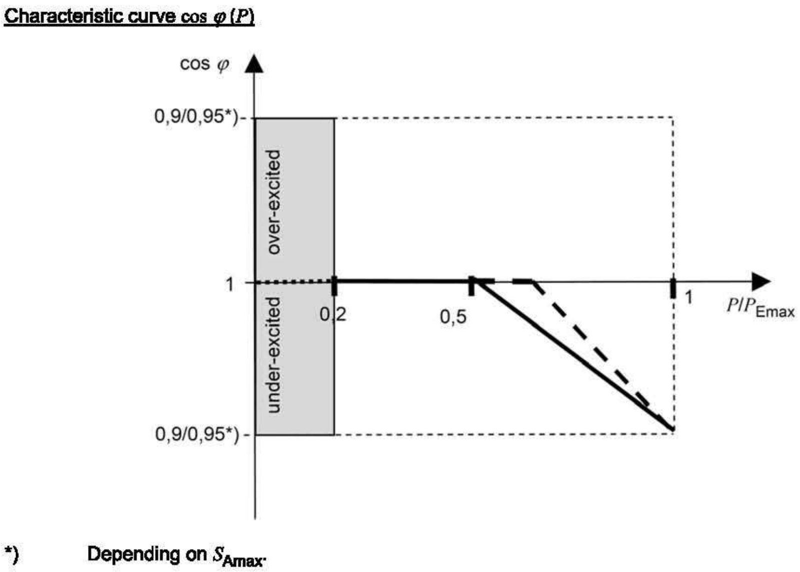
Graph of setting (T_0) time: Test b)



Test:

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

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



Assessment criterion:

Test 1: cos φ accuracy cos φ (±0,01)

Test 2: cos φ accuracy cos φ (±0,01)

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

Note:

The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.4 Testing of NS protection
5.5 Testing of connecting conditions and synchronisation
DIN VDE V 0124-100:2012-07

Clause	Test		Result
5.4.1	General These tests are designed to provide evidence that the requirements of VDE-AR-N 4105 are met		**P**
5.4.2	Central NS protection		**N/A**
5.4.3	Integrated NS protection		**P**
5.4.4	Interface switch		
	5.4.4.1 General		**P**
	5.4.4.2 Integrated interface switch		**P**
5.4.5	Protection devices for the interface switch		
	5.4.5.1	General	**P**
	5.4.5.2	Functional safety	**P**
	5.4.5.3	Voltage control	**P**
	5.4.5.3.3	Measurement of the rise-in voltage protection as a running 10-min mean value	**P**
	5.4.5.4	Frequency measurement	**P**
	5.4.5.5	Reporting NS protection	**P**
5.4.6	Islanding detection		**P**
5.5	Connecting conditions and synchronisation		**P**
	5.5.2	Short interruption	**P**

5.4.2 Central NS protection (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.2 are met)	**N/A**
NS protection provides the possibility for sealing or Password protection is given for protection functions. The interface switch is triggered when the switch in the "NS protection interface switch" circuit is actuated (only relevant for external NS protection). Actuation of the interface switch is displayed on the power generation unit. Display is provided by warning light or display text .	

5.4.3 Integrated NS protection (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.3 are met)	**P**
Password protection is given for protection function U >.	

5.4.4 Interface switch	
5.4.4.1 General (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.4.1 are met)	**P**

The interface switch consists of two electrical break devices connected in series and is therefore designed with redundancy.

See 5.4.5.2 Functional safety for the test for single-fault tolerance and fault finding with subsequent disconnection for the entire functional chain.

An all-pole galvanic break device is provided.

Note:
For synchronous machines, the break device for synchronisation is designed three pole instead of four pole.

5.4.4.2 **Integrated interface switch** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.4.3 are met)	**P**

The inverter that is not galvanically separated has two independent galvanically separating breaking devices

See 5.4.5.2 Functional safety for the test for single-fault tolerance of the interface switch

The interface switch is short-circuit proof for the maximum short-circuit current of the power generation unit.

max. short-circuit current of the power generation unit= 53,3A, 250 Vac
max. switching current relay= 65 A, 277 Vac

Datasheet of the relay:

HF176/12-H3F

Note:

5.4.5 Protection devices for the interface switch	
5.4.5.1 General (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.5.1 are met)	**P**

Test condition:	The measurements were performed in the testing laboratory. at the grid-simulator: U_N = between 86 % Un and 109% Un until the test Frequency: 50 Hz +/- 0,5%

Note:
If an examination is required for any other requirements, these apply to this test.

5.4.5.2 Functional safety	**P**

Component No.	Fault	Test condition: AC	Test condition: DC	Test time	Fuse no.	Fault condition AC	Fault condition DC	Result
Relay defect RY800 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Relay defect RY802 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Relay defect RY804 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Relay defect RY805 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Relay defect RY809 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Relay defect RY811 pin1-pin2	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Relay Check Failure” No damage.No hazard.
Grid voltage monitoring R754	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:” Vac Failure.”. After the fault condition was cleared, inverter operated normally.

Grid voltage monitoring R761	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R784	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R787	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R788	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R791	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect R804	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect R810	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect R819	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect R821	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect R825	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.
RCMU detect defect U701 Pin 9 – pin 10	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" GFCI Failure.". After the fault condition was cleared, inverter operated normally.

DSP lost control DSP U503 Pin 41	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" CPU Failure.". After the fault condition was cleared, inverter operated normally.
DSP U503 Pin 42	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" CPU Failure.". After the fault condition was cleared, inverter operated normally.
DSP U503 Pin 46	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" CPU Failure.". After the fault condition was cleared, inverter operated normally.
DSP U503 Pin 55	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" CPU Failure.". After the fault condition was cleared, inverter operated normally.
Crystal Oscillator X500 Pin 1 – pin 3	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" CPU Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R116	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R119	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure.". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring R121	Open	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring U104 Pin 2 – pin 3	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure". After the fault condition was cleared, inverter operated normally.
Grid voltage monitoring U103 Pin 4 – pin 5	Short	230V 52,1 A	860V 42,8 A	10min.	--	230V 0,1A	850V 0,1A	Inverter disconnected from grid immediately. Error message:" Vac Failure". After the fault condition was cleared, inverter operated normally.
ISO detect defect R1	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:" Isolation Fail" No damage.No hazard.

ISO detect defect R15	Short before start up	230V 0,1A	850V 0,1A	10min.	--	230V 0,1A	850V 0,1A	Inverter did not start-up. Error message:” Isolation Fail” No damage.No hazard.

Note:

The errors in the control circuit simulate that the safety is even ensured during a single fault.

The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

5.4.5.3 Voltage control						**P**
Integrated NS protection three phase ≤ 30kVA (phase to neutral)						
Setting values of the NS protection:	Setting U< [V]:		184,0			
	Setting U>> [V]:		264,5			
	Setting $T_{disconnection}$ [ms]		150			
Operating time of the monitoring device:						
	Under voltage:			**Over voltage:**		
L1 to N:						
Step [V to V]:	230,0 V to 177,1 V			230,0 V to 271,4 V		
Limit [V]:	184,0 V			264,5 V		
Measurement [V:]	183,2	183,2	183,2	263,8	263,8	263,8
Limit [ms]:	200 ms			200 ms		
Disconnection time [ms]:	177	189	161	171	176	176
L2 to N:						
Step [V to V]:	230,0 V to 177,1 V			230,0 V to 271,4 V		
Limit [V]:	184,0 V			264,5 V		
Measurement [V:]	183,5	183,5	183,5	264,2	264,2	264,2
Limit [ms]:	200 ms			200 ms		
Disconnection time [ms]:	167	165	177	182	186	191
L3 to N:						
Step [V to V]:	230,0 V to 177,1 V			230,0 V to 271,4 V		
Limit [V]:	184,0 V			264,5 V		
Measurement [V:]	184,7	184,7	184,7	264,9	264,8	264,9
Limit [ms]:	200 ms			200 ms		
Disconnection time [ms]:	174	192	194	169	170	184

Test:

The voltages per phase conductor are measured, into which current is fed between the line conductor and the neutral conductor.

To measure the disconnection time a surge of 77%$_n$ is taken from the nominal voltage and of 118%$_n$ from the nominal voltage for undervoltage and undervoltage.

Assessment criterion:

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

Limit values:

Voltage drop protection	U<	0,8 U_n	200 ms
Rise-in voltage protection	U>>	1,15 U_n	200 ms

Note:

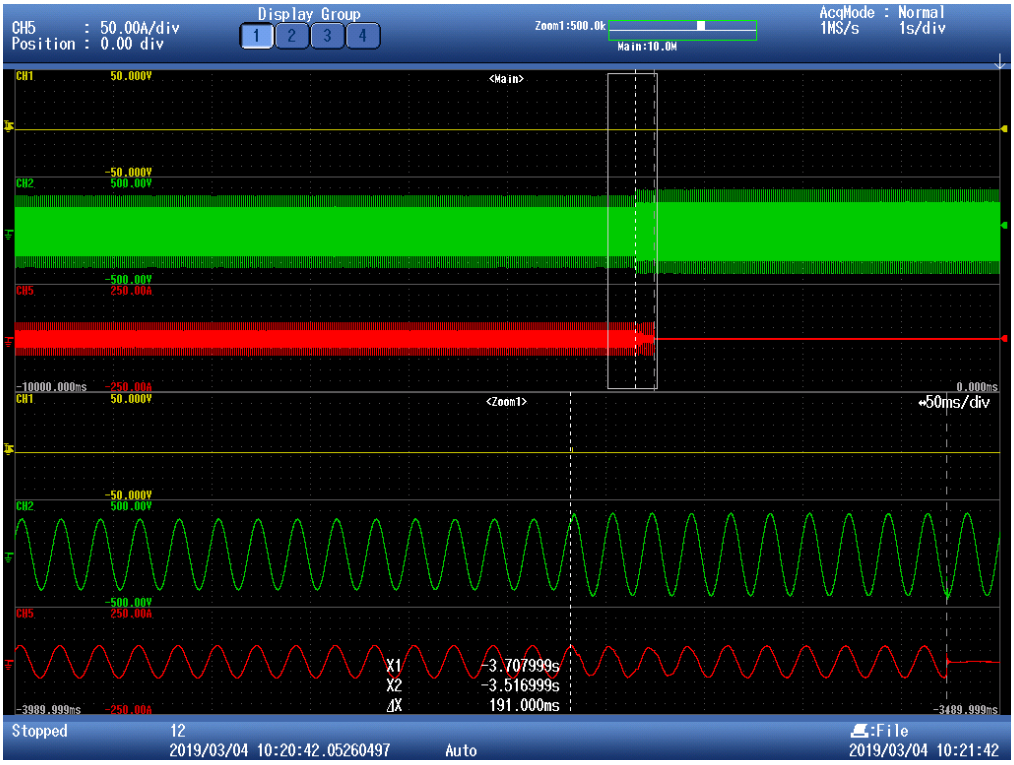
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

Graph of under voltage : L1 to N

Graph of over voltage : L1 to N

Graph of under voltage : L2 to N

Graph of over voltage : L2 to N



Graph of under voltage : L3 to N

Graph of over voltage : L3 to N

5.4.5.3.3 Measuring the rise-in voltage protection as a running 10-minute mean value			P
Test:			
		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n. Disconnection must take place within 600 s.		
	Phase 1:	447 s	600 s
	Phase 2:	447 s	
	Phase 3:	432 s	
b)	The voltage is set to U_n for 600 s and then to 108% U_n for 600 s. No disconnection should take place.		
	Phase 1:	No disconnected	Disconnection should not take place.
	Phase 2:	No disconnected	
	Phase 3:	No disconnected	
c)	The voltage is set to 106 % U_n and held for 600 s. Thereafter the voltage is set to 114 % U_n. *The disconnection should last for half the period as in Point a)		
	Phase 1:	256 s	*
	Phase 2:	276 s	
	Phase 3:	244 s	

Test:
a) This test serves as proof of the measurement accuracy and the maximum set time.
b) This test serves as proof of the measurement accuracy.
c) This test serves as proof of the correct formation of the 10 minute running mean value.

Assessment criterion:
The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1 % of Un.

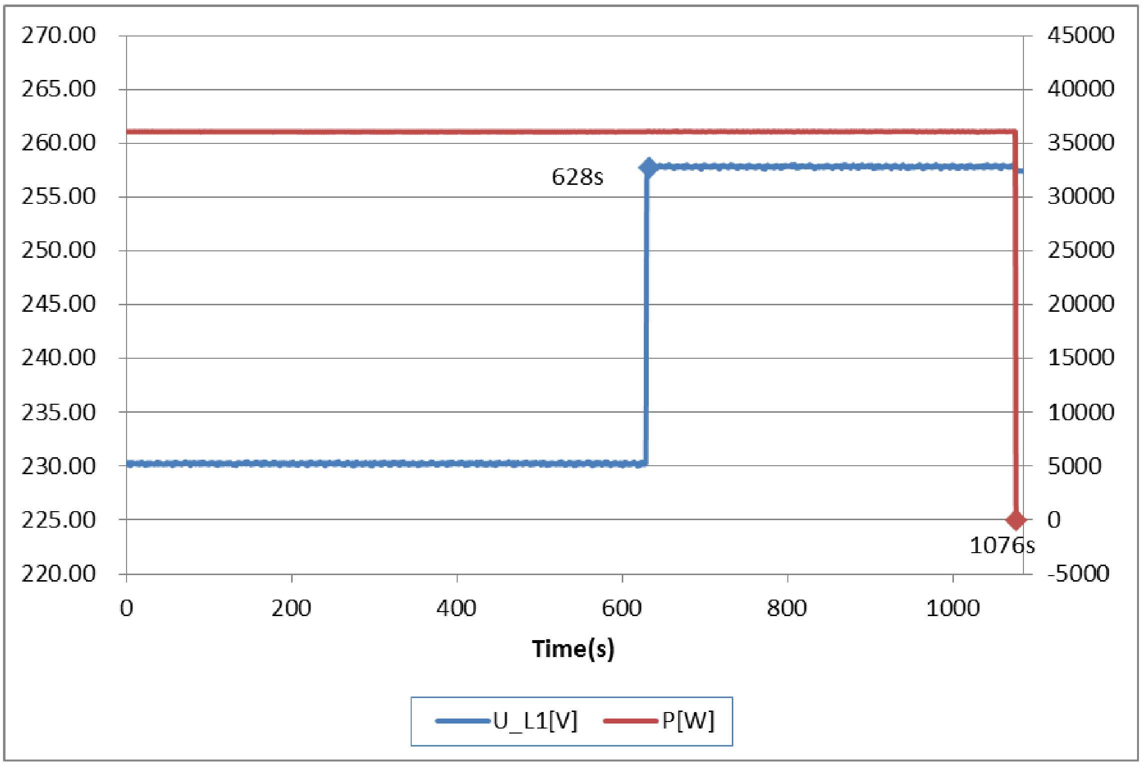
Limit values:
Rise-in voltage protection U> 1,1 U_n after a max. 600 s, the switch off after 200 ms.

Note:
If only one integrated NS protection is used for the power generation systems ≤30kVA, the value of the rise-in voltage protection U> of 1,1 U_n may not be changed.

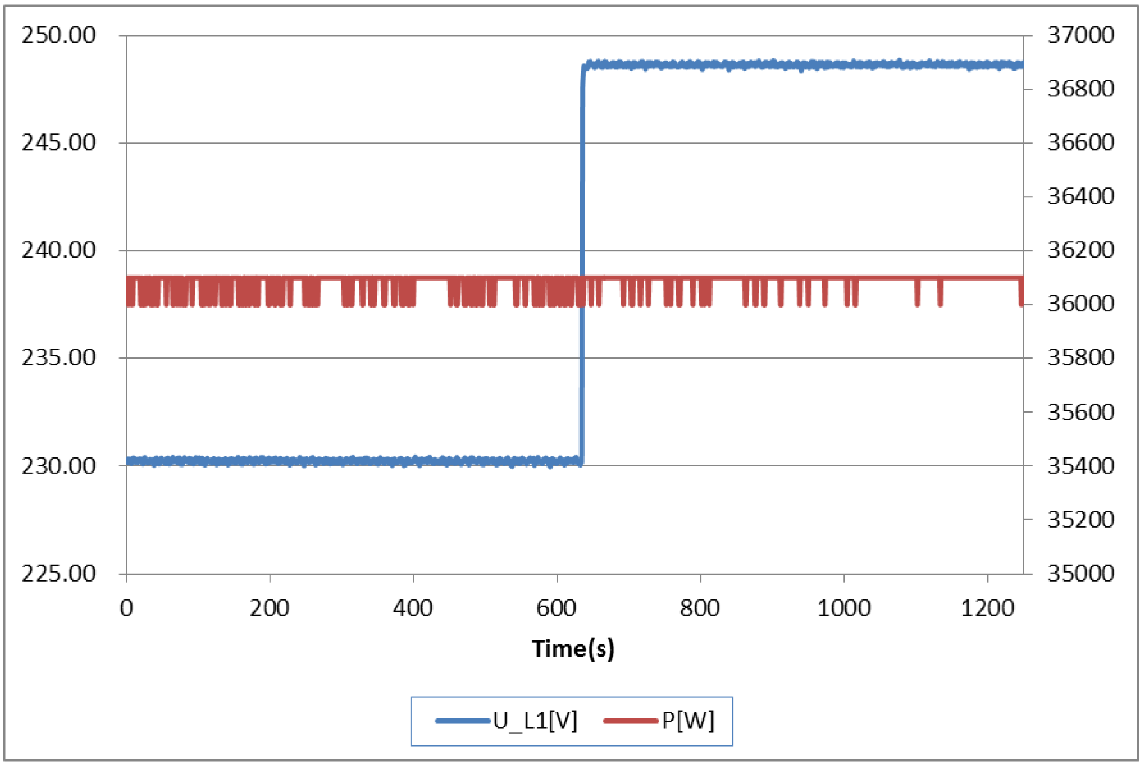
* The disconnection time for test c) may vary due to tolerances of the measurement accuracy of the voltage of the NS protection. For a setting value 600 s a range from 225 s to 375 s is within the permissable tolerance.

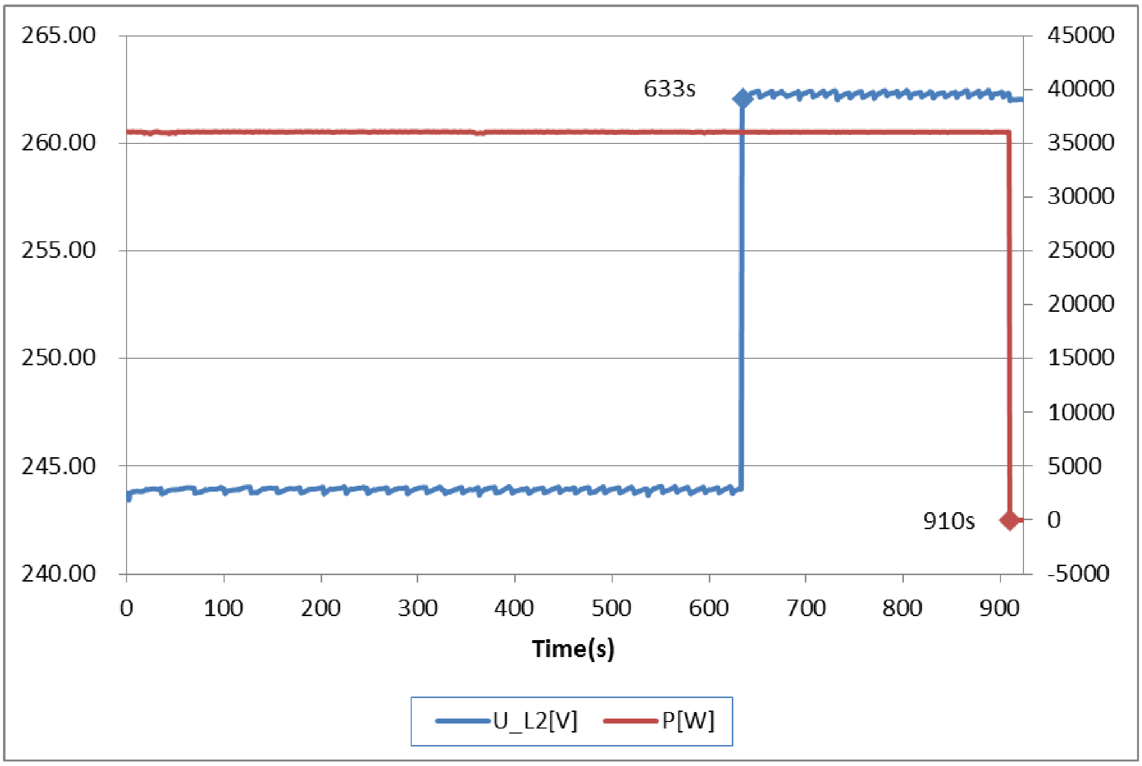
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

Graph of test a) Voltage set to 112 % U_n:



Graph of test b) Voltage set to 108% U_n:



Graph of test c) Voltage set to 106 % U_n, thereafter 114% U_n:


5.4.5.4 Frequency measurement						P
Setting values of the NS protection:	Setting f< [Hz]:		47,50			
	Setting f>[Hz]:		51,50			
	Setting $T_{disconnection}$ [ms]		150			
Operating time of the monitoring device						
	Under frequency			**Over frequency**		
Ramp [Hz to Hz]:	48,00 Hz -> 47,00 Hz			51,00 Hz -> 52,00 Hz		
Limit [Hz]:	47,50 Hz			51,50 Hz		
Measurement [Hz]:	47,48	47,48	47,48	51,51	51,51	51,51
Limit [ms]:	200 ms			200 ms		
Disconnection time [ms]:	194	171	159	192	189	164

Test:
The measuring is performed at a continuous change of frequency of 1 Hz/s. The trip value was determined manually by reducing the frequency in 10 mHz steps. When the trip value is known (e.g. 47,50 Hz), the grid simulator is programmed to run from e.g. 48,00 Hz to 47,00 Hz with 1 Hz/s. The disconnection time is calculated by the measured time minus the 500 ms from 48,00 Hz to 47,50 Hz.

Assessment criterion:
The setting value and the trip value of the frequency may not vary by more than ±0.1 % f_n .

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

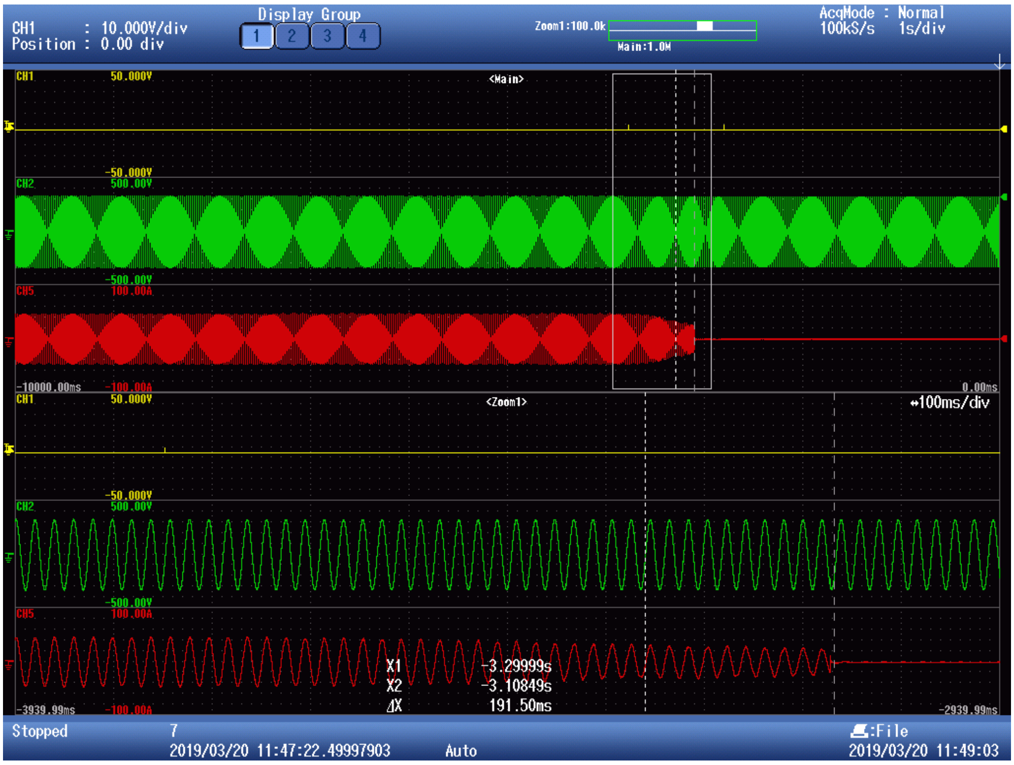
Limit values:

Frequency decrease protection	f<	47,5 Hz	200 ms
Frequency increase protection	f<	51,5 Hz	200 ms

Note:
The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

Graph of under frequency:

Graph of over frequency:



5.4.5.5 Reporting NS protection	P
The last 5 dated failure reports on the NS protection can be read. An interruption in the supply voltage of ≤ 3s does not result in any loss of failure reports. Central NS protection: It is possible to read the setting values and the failure reports of the NS protection independently of the operational state and without any additional aids. Integrated NS protection: It is possible to read out the values of the NS protection via the data interface, if the values are not directly readable.	
Note:	

5.4.6 Islanding detection
(these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 6.5.3 are met)

For power generation systems, islanding detection must be carried out using one of the following processes:

a) active method, e.g. by means of frequency – shift process (oscillating circuit)

b) passive method with the help of the three-phase voltage control (only possible for power generation systems without converters or for single-phase generation units with converters).

(see 5.4.5.3 3-phase voltage control)

With the passive process, it is important to provide evidence that the power generation unit can be set not equal to 120°.

5.4.6.1 Active method (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, D.1 are met)			**P**
Test condition:	Frequency: 50+/-0,01 Hz U_N = 230+/-1% V_{ac} RLC consumes inverter real power within +/-3% Distortion factor of chokes <3% Quality Q>2		
Disconnection limit:	5 s		
L1 phase			
Output power: / Osc. parameter	25%	50%	100%
- 5%	500ms	380ms	76ms
- 4%	546ms	124ms	82ms
- 3%	488ms	396ms	58ms
- 2%	360ms	344ms	42ms
- 1%	500ms	350ms	78ms
0%	500ms	344ms	200ms
+1%	380ms	440ms	378ms
+2%	444ms	102ms	230ms
+3%	464ms	406ms	166ms
+4%	280ms	334ms	138ms
+5%			
Parameter at 0%	L= 36,45 mH R= 25,31 Ω C= 271,38µF	L= 17,95 mH R= 12,69 Ω C= 565,02 µF	L= 8,79 mH R= 6,34 Ω C= 1088,51 µF
L2 phase			
Output power: / Osc. parameter	25%	50%	100%
- 5%	396ms	306ms	50ms
- 4%	482ms	444ms	54ms
- 3%	526ms	352ms	84ms
- 2%	494ms	432ms	352ms
- 1%	432ms	410ms	99ms
0%	179ms	70ms	290ms
+1%	404ms	404ms	160ms
+2%	412ms	412ms	192ms
+3%	460ms	460ms	112ms
+4%	250ms	250ms	138ms
+5%	302ms	302ms	108ms
Parameter at 0%	L= 36,45 mH R= 25,31 Ω C= 271,38µF	L= 17,95 mH R= 12,69 Ω C= 565,02 µF	L= 8,79 mH R= 6,34 Ω C= 1088,51 µF

L3 phase			
Output power: Osc. parameter	25%	50%	100%
- 5%	356ms	124ms	62ms
- 4%	476ms	380ms	92ms
- 3%	448ms	360ms	94ms
- 2%	278ms	258ms	414ms
- 1%	336ms	428ms	233ms
0%	210ms	334ms	166ms
+1%	498ms	260ms	90ms
+2%	464ms	354ms	60ms
+3%	424ms	504ms	92ms
+4%	516ms	362ms	116ms
+5%	418ms	384ms	248ms
Parameter at 0%	L= 36,45 mH R= 25,31 Ω C= 271,38μF	L= 17,95 mH R= 12,69 Ω C= 565,02 μF	L= 8,79 mH R= 6,34 Ω C= 1088,51 μF

Test:

The capacitors and the chokes of the resonant circuit were adjusted in order to reach a quality of >2. $P_{QC}+P_{QL}=-P_{Q,WR}$. The resistors of the resonant circuit consumed the real power of the inverter (P_{WR}) within +/-3%.

$$L = \frac{U^2}{2 \cdot \pi \cdot 50Hz \cdot P \cdot Q} \qquad C = \frac{P \cdot Q}{2 \cdot \pi \cdot 50Hz \cdot U^2}$$

Assessment criterion:

Limit values:

Quality factor Q > 2

Disconnection t ≤ 5 s

Note:

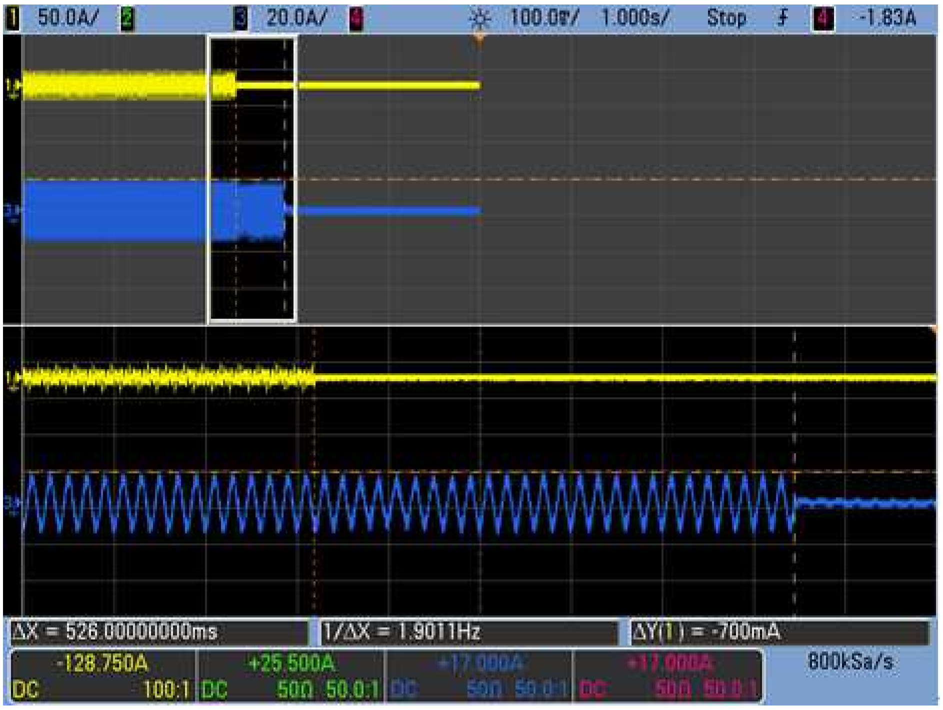
The tests had been performed on the GW36K-MT are valid for the GW25K-MT and GW30K-MT, since it is same as in hardware and just power derated by software.

Oscillating circuit test: 25% output power, Phase L1

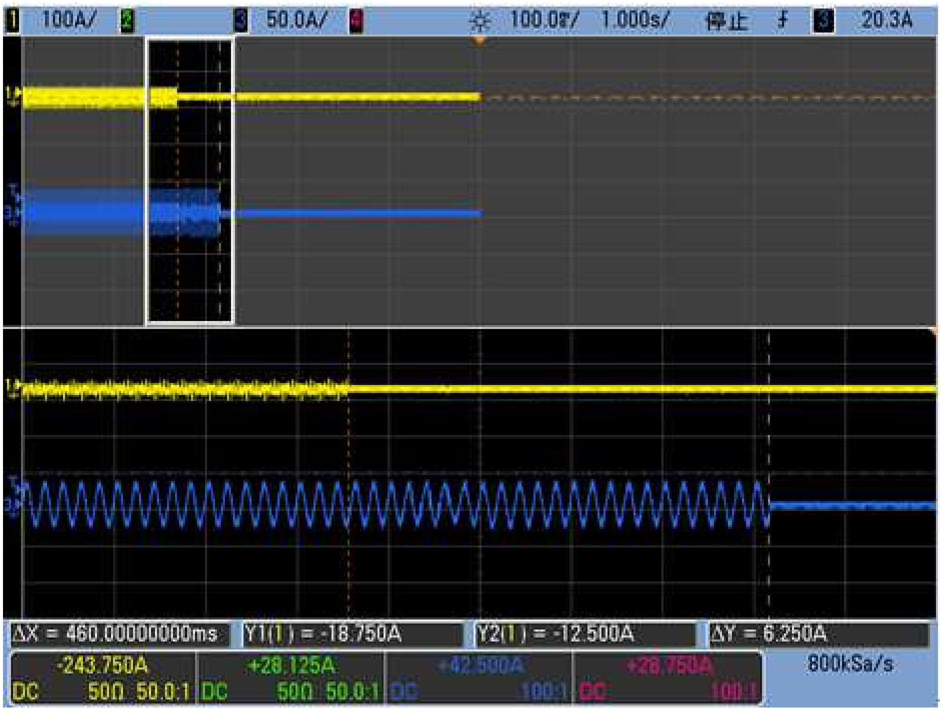
Oscillating circuit test: 50% output power, Phase L1

Oscillating circuit test: 100% output power, Phase L1

Oscillating circuit test: 25% output power, Phase L2



Oscillating circuit test: 50% output power, Phase L2



Oscillating circuit test: 100% output power, Phase 2

Oscillating circuit test: 25% output power, Phase L3

Oscillating circuit test: 50% output power, Phase L3

Oscillating circuit test: 100% output power, Phase L3

5.4.6.1 Passive method	N/A
Three-phase voltage control is permitted for islanding detection, as the currents of the power generation unit are controlled independently, so that arbitrary phase relationships can develop.	
Test: The test is performed according to the voltage disconnection testing clause 5.4.5.3.1 a). The test is passed, if the current follows without phase displacement of the voltage on the displaced phase. For test results, see clause 5.4.5.3.1 a) above.	
Note:	

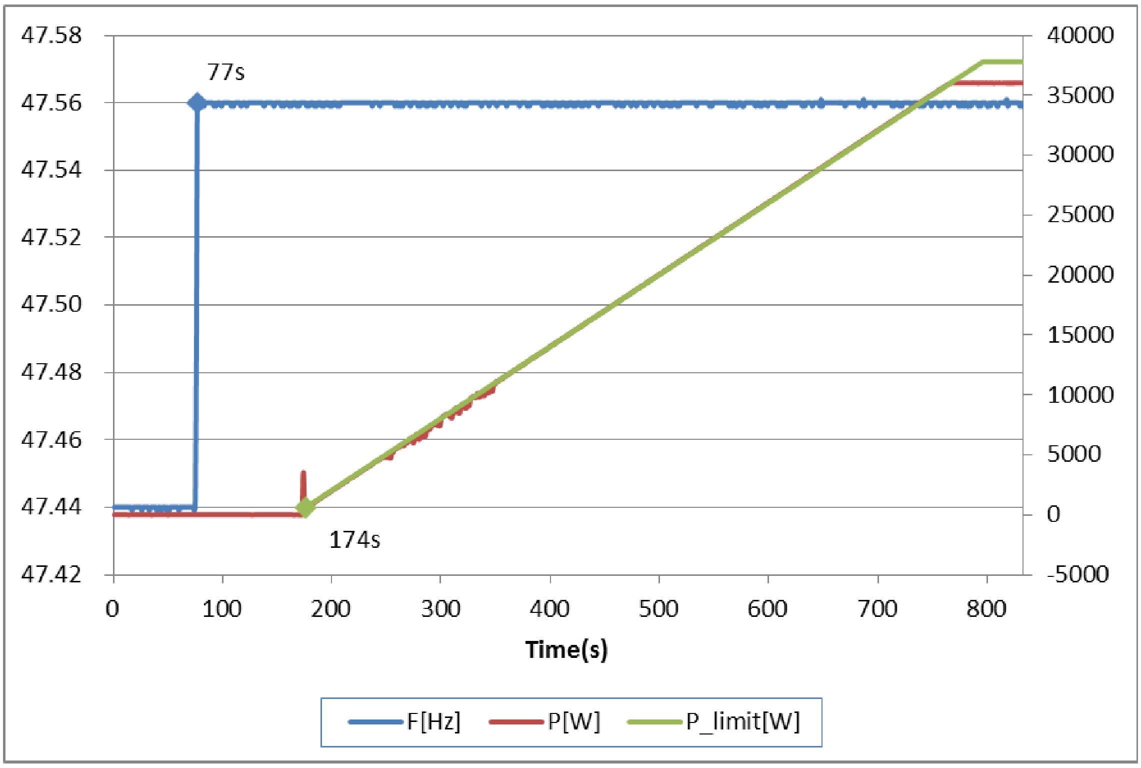
5.5 Testing of connecting conditions and synchronisation DIN VDE V 0124-100:2012-07		
Clause	**Test**	**Result**
5.5	Connecting conditions and synchronisation	**P**
	5.5.2 Short interruption	**P**

5.5	**Connecting conditions and synchronisation** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105, 8.3.1 are met)		**P**
Setting values of the NS protection:	Setting $T_{reconnection\ 60s}$ [s]:	70	
	Setting f< [Hz]:	47,5	
	Setting f> [Hz]:	51,5	
	Setting V< [V]:	184,0	
	Setting V>> [V]:	264,5	

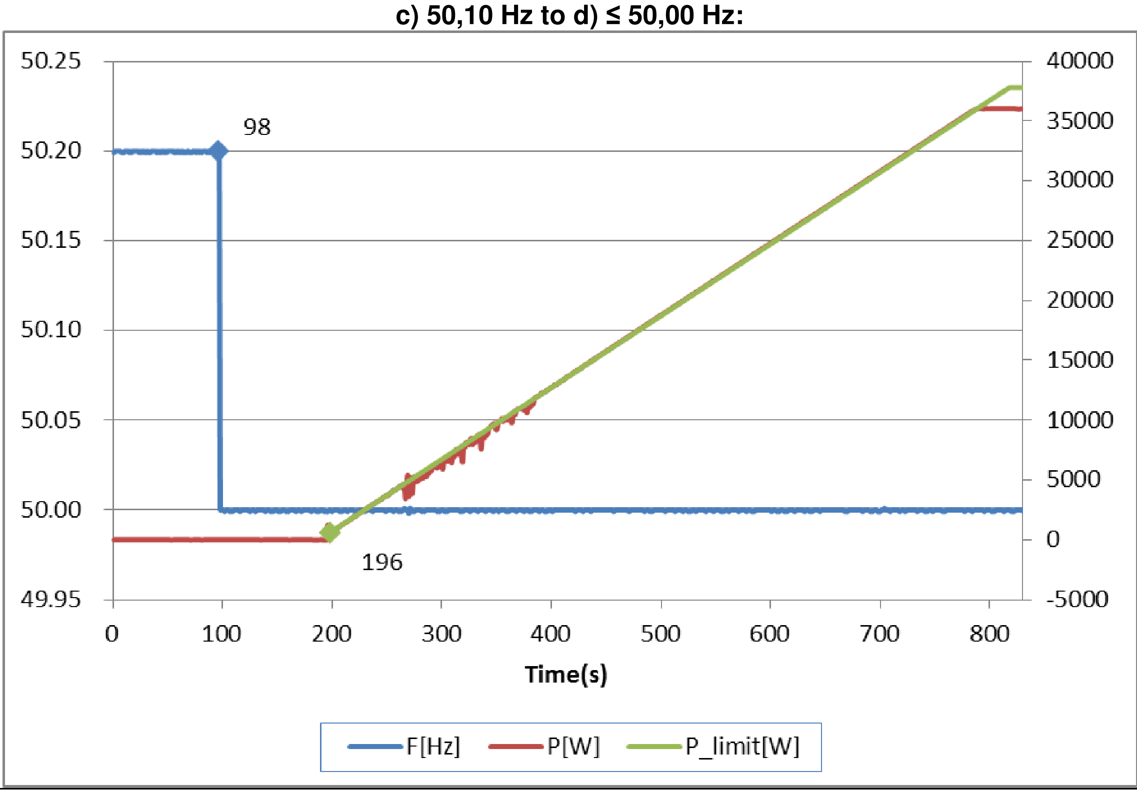
Test:			
	f_{ist}	**Reset time:**	**Limit:**
Connecting conditions for frequencies:			
a)	47,45 Hz	No reconnected.	No resetting allowed
	Switch to:		
b)	≥ 47,55 Hz	97 s	≥ 60 s
c)	50,06 Hz	No reconnected.	No resetting allowed
	Switch to:		
d)	≥ 50,0 Hz	98 s	≥ 60 s
Connecting conditions for voltages: L1 phase			
e)	84%	No reconnected.	No resetting allowed
	Switch to:		
f)	≥ 86%	97 s	≥ 60 s
g)	111 %	No reconnected.	No resetting allowed
	Switch to:		
h)	≤ 109%	98 s	≥ 60 s
Connecting conditions for voltages: L2 phase			
e)	84%	No reconnected.	No resetting allowed
	Switch to:		
f)	≥ 86%	99 s	≥ 60 s
g)	111 %	No reconnected.	No resetting allowed
	Switch to:		
h)	≤ 109%	98 s	≥ 60 s
Connecting conditions for voltages: L3 phase			
e)	84%	No reconnected.	No resetting allowed
	Switch to:		
f)	≥ 86%	98 s	≥ 60 s
g)	111 %	No reconnected.	No resetting allowed
	Switch to:		
h)	≤ 109%	98 s	≥ 60 s

Test: see points a) to h) for the test process. The measurement was carried out with a programmable AC source. e.g. connecting conditions for frequencies: Point a) and b). The AC source was programmed in such a way that the first step of 230 V / 50 Hz to 200 V / 47,0 Hz resulted in a faulty disconnection. Thereafter the voltage and frequency for 100 s is set to 215 V / 47,45 Hz. Switching on again is not permitted. After a lapse of 100 s the voltage is set to 230 V / 47,55 Hz. Setting again after 60 s is permitted.
Assessment criterion: After actuating the NS protection it should be checked that the system can only be switched within the tolerance ranges (($85\% \ U_n \leq U \leq 110\% \ U_n$) and ($47,5 \ Hz \leq f \leq 50,05Hz$)) at the earliest after 60 s after voltage and frequency has remained within the tolerance ranges.
Note: The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

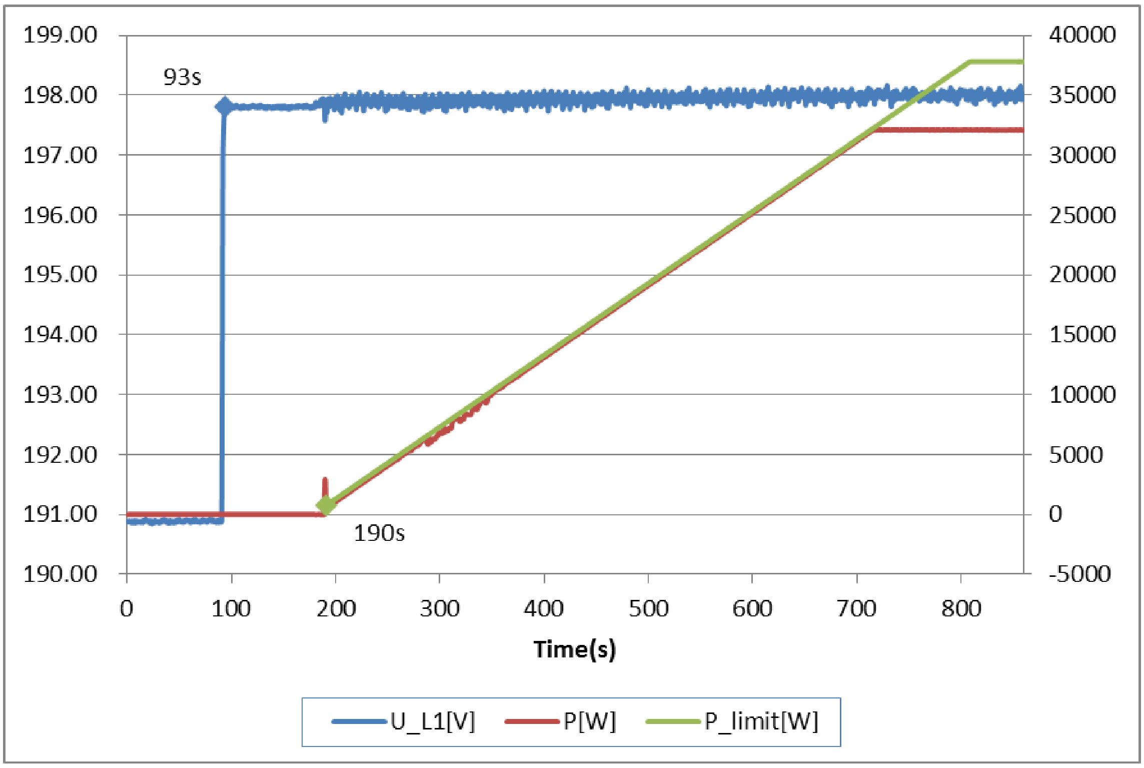
a) 47,50 Hz to b) ≥ 47,55 Hz:



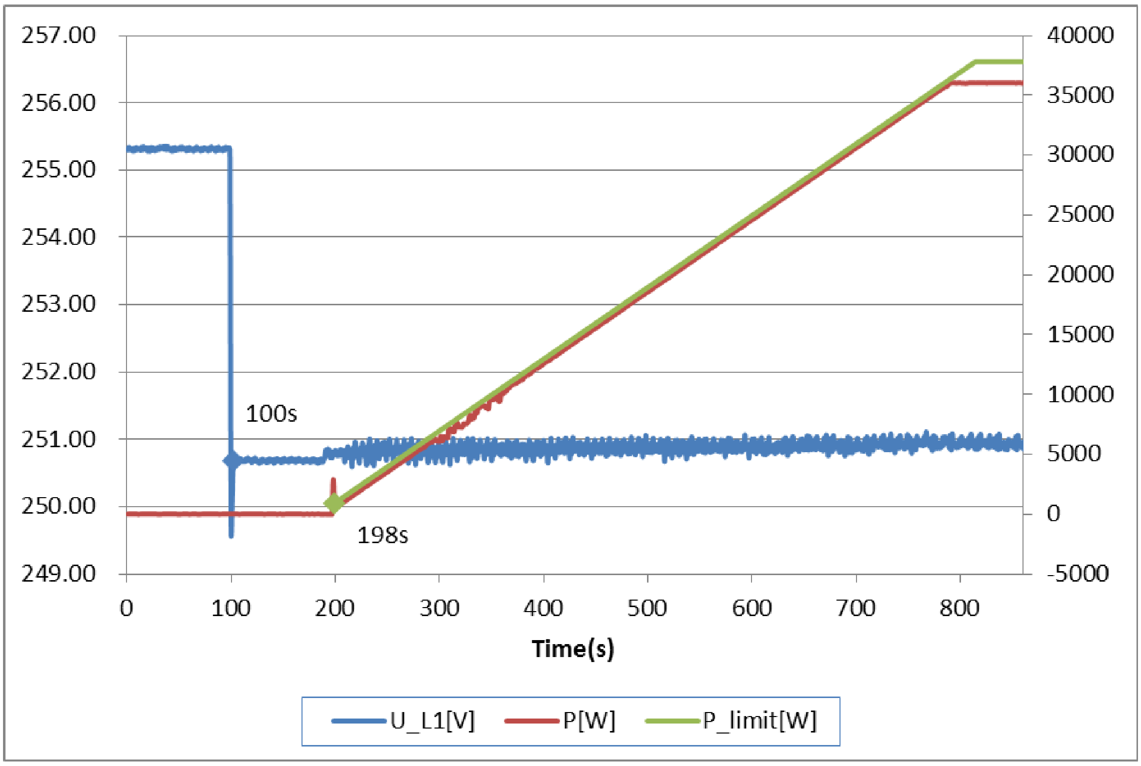
c) 50,10 Hz to d) ≤ 50,00 Hz:



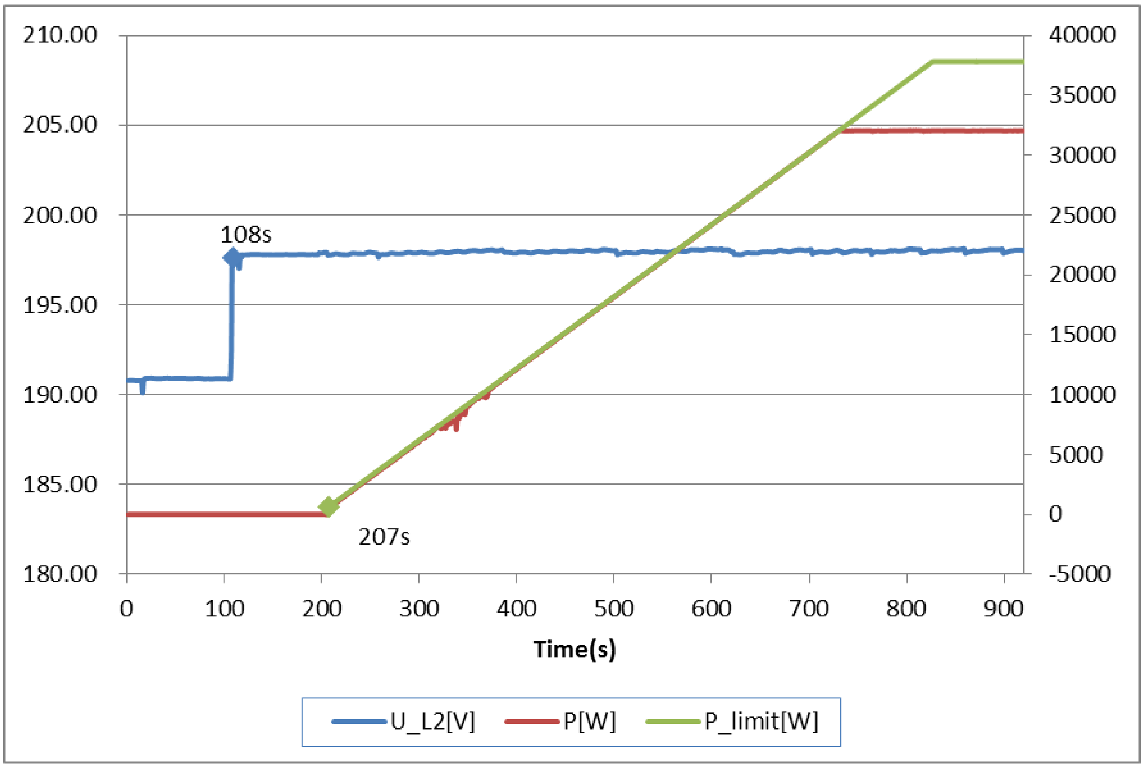
e) 84 % U_n to f) ≥ 86 % U_n: L1 phase



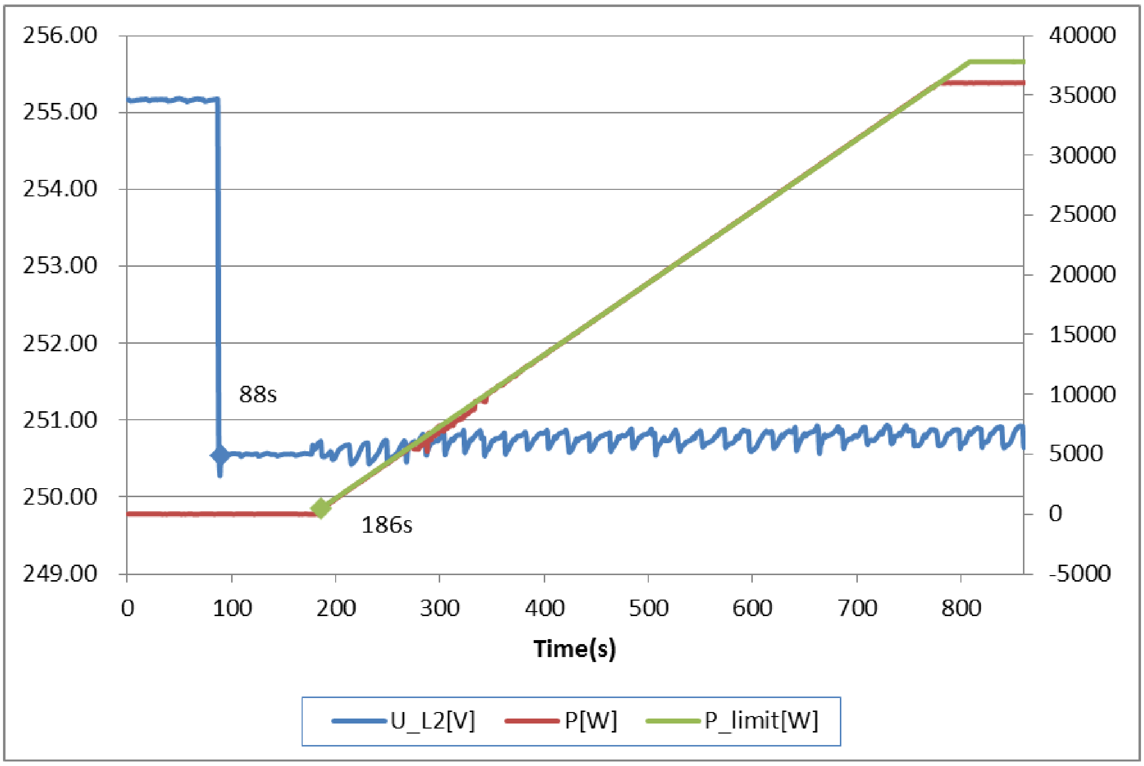
g) 111 % U_n to h) ≤ 109 % U_n: L1 phase



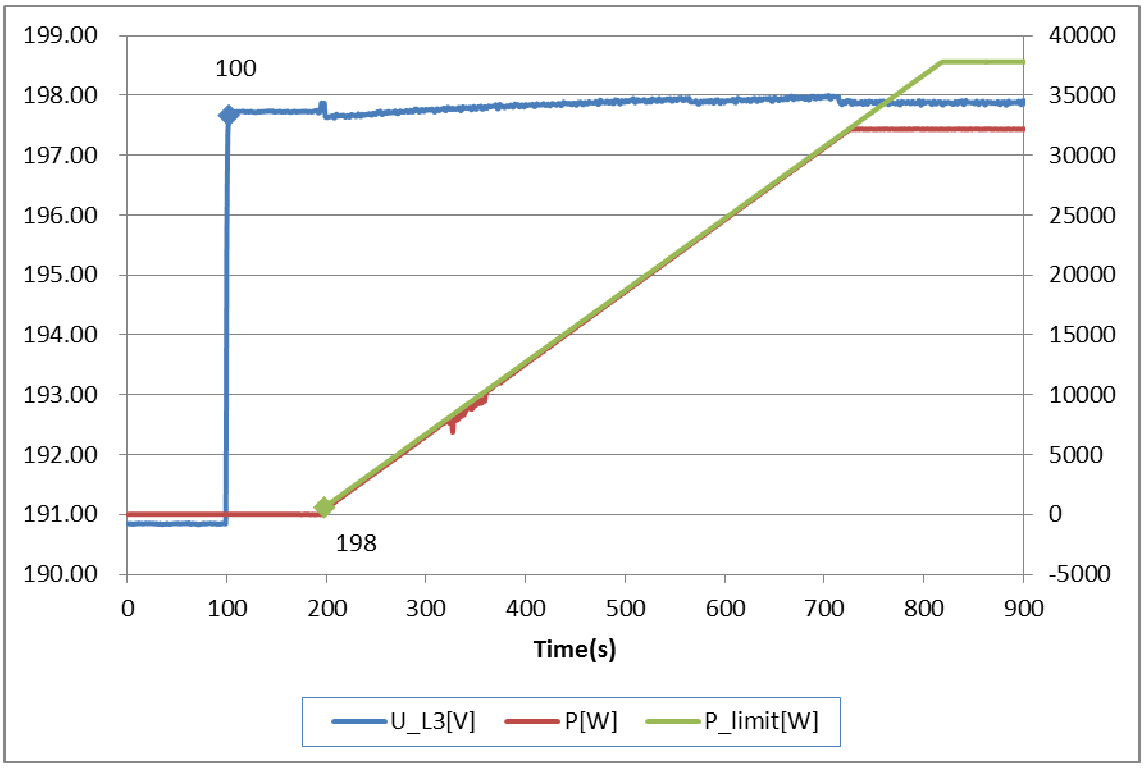
e) 84 % U_n to f) ≥ 86 % U_n: L2 phase



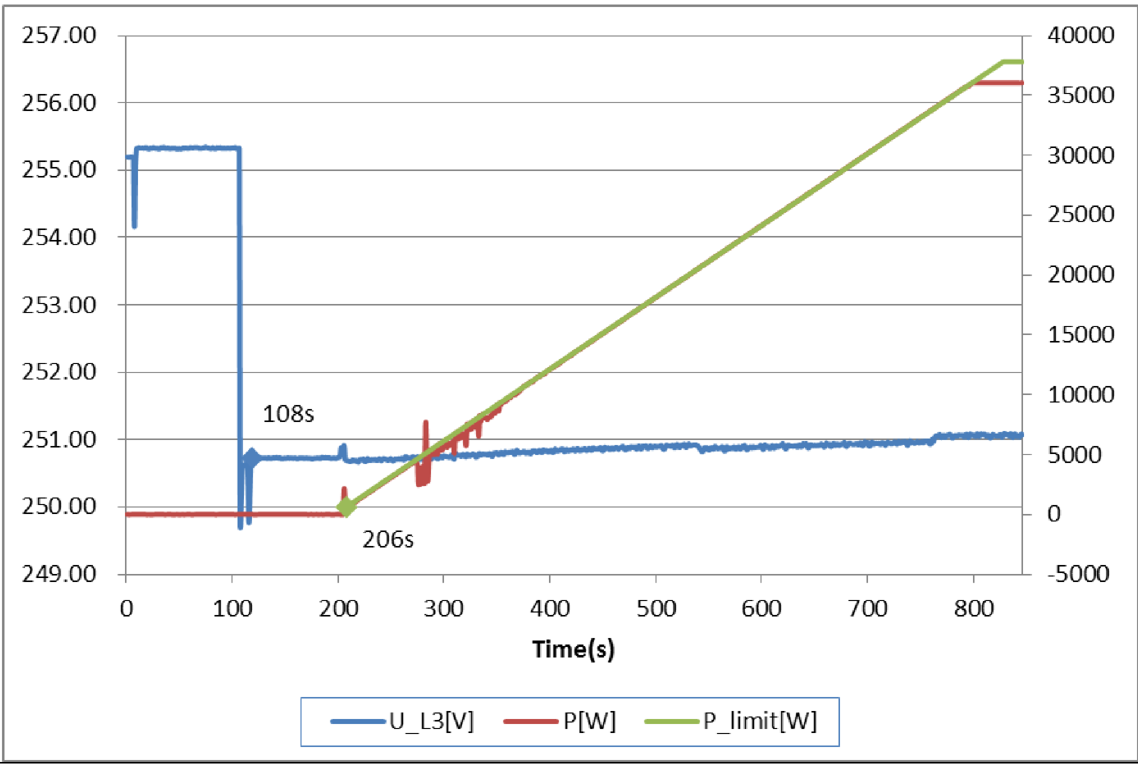
g) 111 % U_n to h) ≤ 109 % U_n: L2 phase



e) 84 % U_n to f) ≥ 86 % U_n: L3 phase



g) 111 % U_n to h) ≤ 109 % U_n: L3 phase



5.5.2 Short interruption				P
Setting values of the NS protection:	Setting $T_{disconnection\ 5s}$ [s]:	70		
	Setting $T_{reconnection\ 60s}$ [s]:	70		
	Setting V< [V]:	184,0		
	Step 1:	**Step 2:**		
Step [V to V]	230 V to 177,1 V	230 V to 177,1 V		
Jump Duration [s]:	2 s	4 s		
Limit [s]:	≥ 5 s	≥ 60 s		
Reconnection Time [s]:	87	118		

Test:
After providing evidence of a short interruption the network voltage is reduced from the nominal voltage with a surge of 77% U_n. A surge to the nominal voltage takes place after 2 s.
After providing evidence of a short interruption the network voltage is reduced from the nominal voltage with a surge of 77% U_n. A surge to the nominal voltage takes place after 4 s.

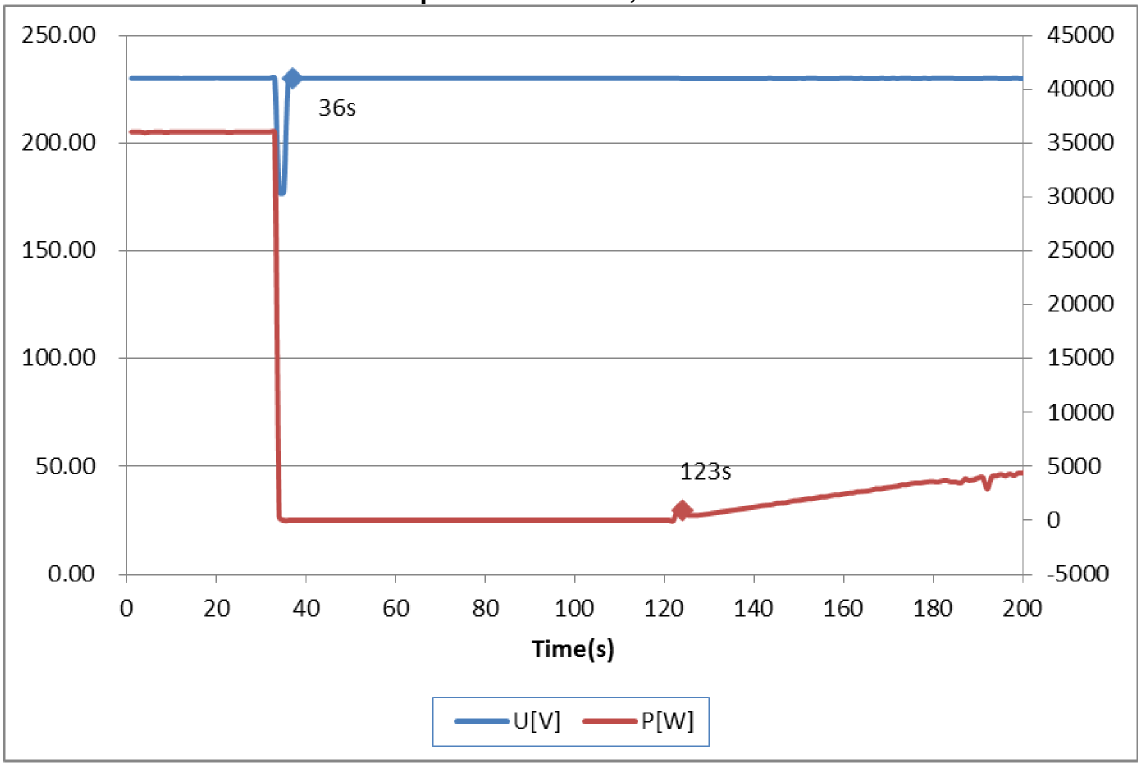
Assessment criterion:
Limit values:
Short interruption ≤ 2 s Reset time ≥ 5 s
Short interruption ≥ 3 s Reset time ≥ 60 s

Note:
A short interruption is characterised by exceeding or not reaching the NS protection settings for the network frequency and/or network voltage for a maximum period of 3 seconds.

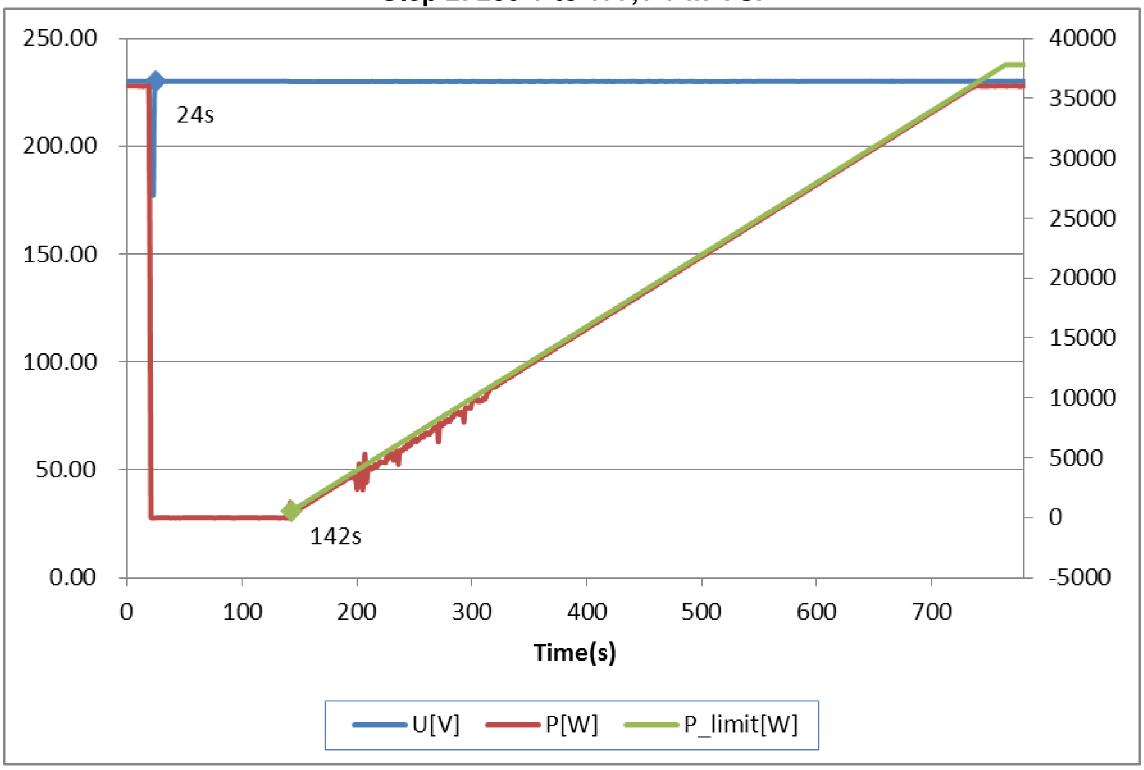
A ramp of 10% P_n is not necessary after short interruptions.

The tests had been performed on the GW36K-MT are valid for the GW30K-MT and GW25K-MT since it is same as in hardware and just power derated by software.

Step 1: 230 V to 177,1 V in 2 s:



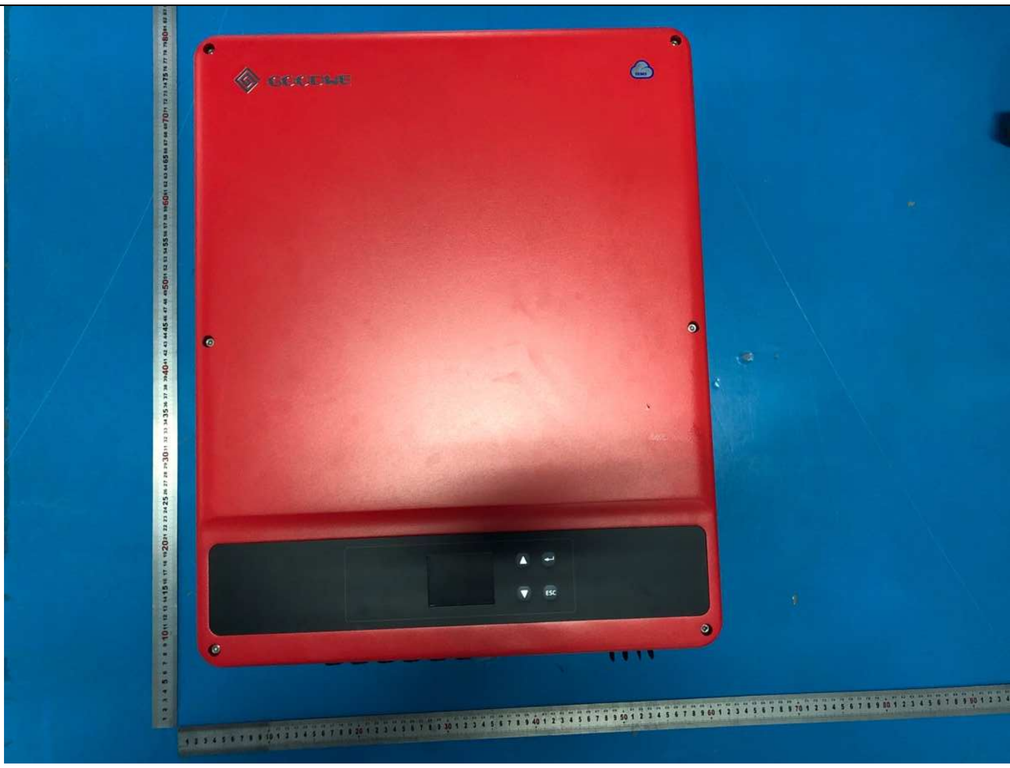
Step 2: 230 V to 177,1 V in 4 s:



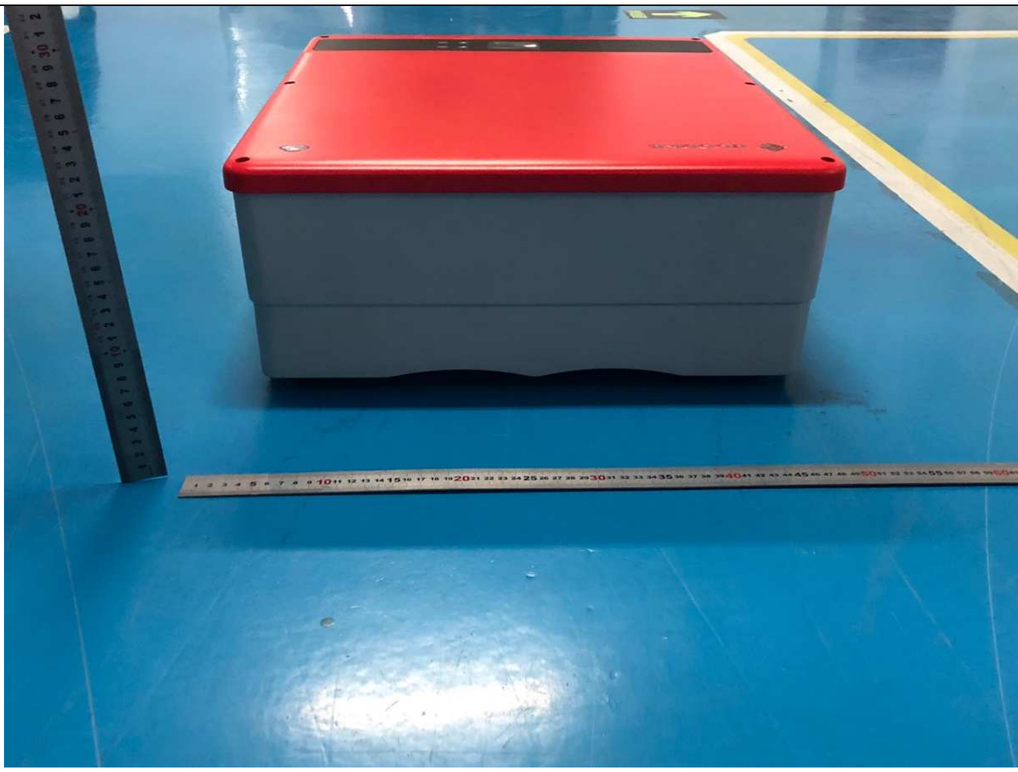
Annex No. 1

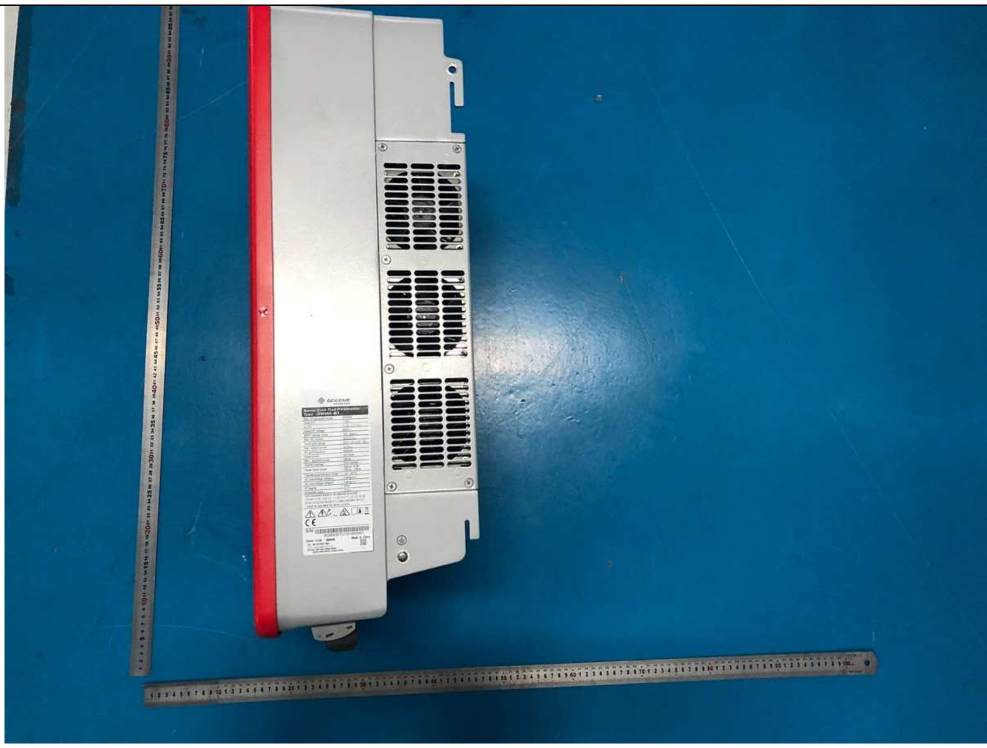
Pictures of the unit

The full pictures refer to PHOTO DOCUMENT
Project No.: 181008N021
Date: 20190123

Front view

Rear view


Bottom Side and Terminal view

Top Side view


Left Side view

Right Side view


Annex No. 2

Test Equipment list

Test location: Shenzhen Academy of Metrology & Quality Inspection
Dates of performance test: 2018-10-08 to 2019-04-15

Equipment	Internal no.:	Manufacturer:	Type:	Serial no.:	Last calibration Will be valid until
Power Analyzer	SB11178	YOKOGAWA	WT3000	91P215776	2019/03/25
AC Source	SB14325	Chroma	61860	618603800236	Monitored by Power Analyzer
DC Simulation Power Supply	SB14324	Chroma	62150H-1000S	6215EF01653	
	SB14324	Chroma	62150H-1000S	6215EF01653	
	SB14324	Chroma	62150H-1000S	6215EF01653	
	SB14324	Chroma	62150H-1000S	6215EF01653	
	SB14324	Chroma	62150H-1000S	6215EF01653	
	SB14324	Chroma	62150H-1000S	6215EF01653	
RLC Load	SB9605	Qunling	ACLT-3830H	--	
Eight Channel Digital Phosphor Oscilloscope	SB11177	YOKOGAWA	DL850	91P215763	2019/2/26
Oscilloscope probel	SB9149	TEKTRONIX	P5100A	--	2019/3/27
Oscilloscope probel	SB9155	TEKTRONIX	P5100A	--	2019/12/27
Oscilloscope probel	SB9159	TEKTRONIX	P5100A	--	2019/12/27
Current transducer	SB14641	YOKOGAWA	CT200	8173420022	2019/09/26
Current transducer	SB14642	YOKOGAWA	CT200	8173420030	2019/09/26
Current transducer	SB14643	YOKOGAWA	CT200	8173420024	2019/09/26