Prüfbericht-Nr.: *Test report no.:*	**CN2283DK 003**	**Auftrags-Nr.:** *Order no.:*	244469877	Seite 1 von 23 *Page 1 of **23***
Kunden-Referenz-Nr.: *Client reference no.:*	2480431	**Auftragsdatum:** *Order date:*	2022-12-16	
Auftraggeber: *Client:*	**Apex Solar Energy Technology GmbH** Reisholzer Werftstr. 76 Düsseldorf 40589 Germany			
Prüfgegenstand: *Test item:*	Grid-connected PV Inverter			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	APEX-P3-xx(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K), APEX-P3-xx-G(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K)			
Auftrags-Inhalt: *Order content:*	A3 Certificate			
Prüfgrundlage: *Test specification:*	VDE-AR-N 4105/11.18 *Erzeugungsanlagen am Niederspannungsnetz – Technische Mindestanforderungen für Anschluss und Parallelbetrieb von Erzeugungsanlagen am Niederspannungsnetz* *Generators connected to the low-voltage distribution network – Technical requirements for the connection to and parallel operation with low-voltage distribution networks*			

Wareneingangsdatum: *Date of sample receipt:*	2023-01-12
Prüfmuster-Nr.: *Test sample no:*	A003402982-001
Prüfzeitraum: *Testing period:*	2023-01-12 - 2023-01-13
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass

geprüft von: *tested by:Jiayu Hu*	Jiayu Hu	**genehmigt von:** *authorized by:Jingge Pan*	Jingge Pan
Datum: *Date:* 2023-01-13		**Ausstellungsdatum:** *Issue date:* 2023-01-13	
Stellung / *Position:*	**Project Engineer**	**Stellung** / *Position:*	**Reviewer**

Sonstiges / *Other:*

- Test procedure complied with E DIN VDE V 0124-100/06.20, see report CN2283DK 003 attachment 1 for detail.
- The mentioned models listed on above are identical to the original models in the previous section report report CN2283DK 001 except for model name, trademark and license holder etc. See following pages for details.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

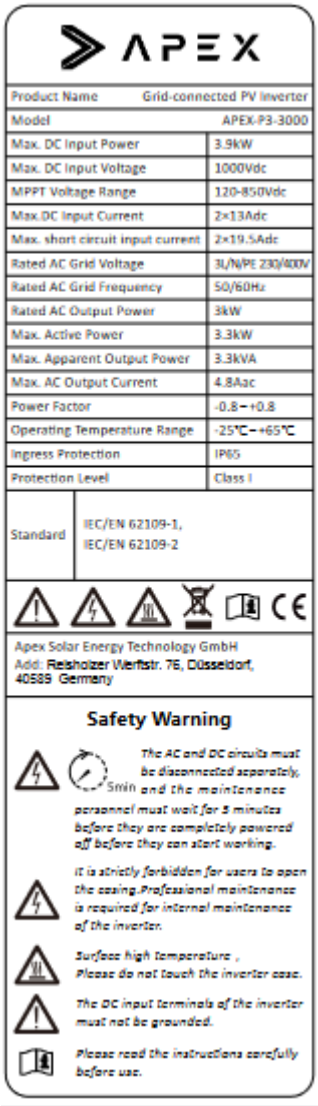
Liste der verwendeten Prüfmittel
List of used test equipment

Equip.	Description	Model	Manufacturer
9017073	Power Analyser(DEWETRON)	DEWE2-PA7	Austria, DEWETRON
9017078	Programmable AC Source(61860)	61860	Chroma ATE INC.
G1819268	Anti-islanding test detection devices	ACLT-4830H	QUNLING Energy Resources
G1819272	Leakage Current Testing Network	IEC 60990, Figure 4	Shanghai Anbiao Co., Ltd.
G1819277	PV array simulator	62150H-1000S	Chroma Co.
G1819278	PV array simulator	62150H-1000S	Chroma Co.
G1819279	PV array simulator	62150H-1000S	Chroma Co.
G1819280	PV array simulator	62150H-1000S	Chroma Co.

Produktbeschreibung
Product description

1	**Produktdetails** *Product details*	See below.

Copy of marking plate:



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-3000
Max. DC Input Power	3.9kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	3kW
Max. Active Power	3.3kW
Max. Apparent Output Power	3.3kVA
Max. AC Output Current	4.8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

Apex Solar Energy Technology GmbH
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Safety Warning

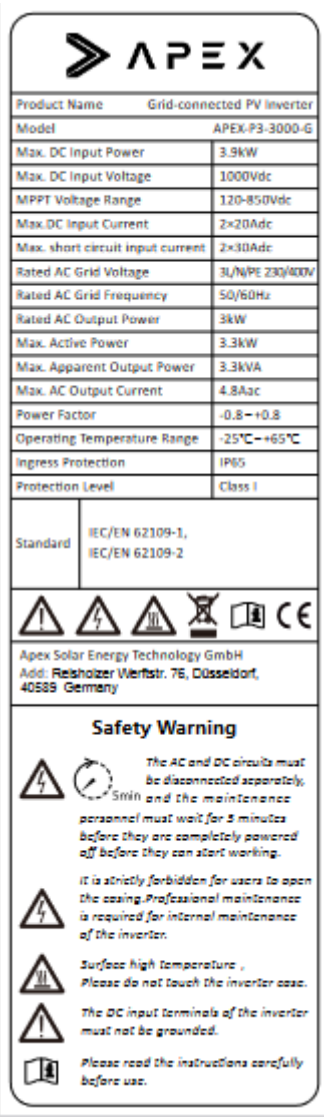
The AC and DC circuits must be disconnected separately, and the maintenance personnel must wait for 5 minutes before they are completely powered off before they can start working.

It is strictly forbidden for users to open the casing.Professional maintenance is required for internal maintenance of the inverter.

Surface high temperature , Please do not touch the inverter case.

The DC input terminals of the inverter must not be grounded.

Please read the instructions carefully before use.



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-3000-G
Max. DC Input Power	3.9kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	3kW
Max. Active Power	3.3kW
Max. Apparent Output Power	3.3kVA
Max. AC Output Current	4.8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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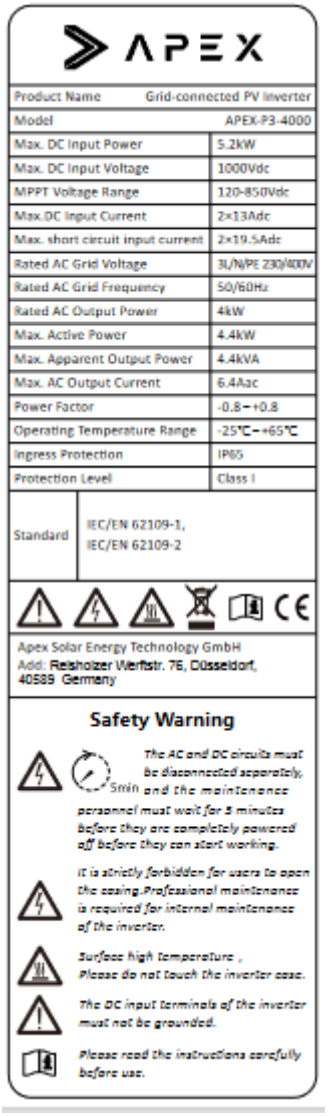
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-4000
Max. DC Input Power	5.2kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	4kW
Max. Active Power	4.4kW
Max. Apparent Output Power	4.4kVA
Max. AC Output Current	6.4Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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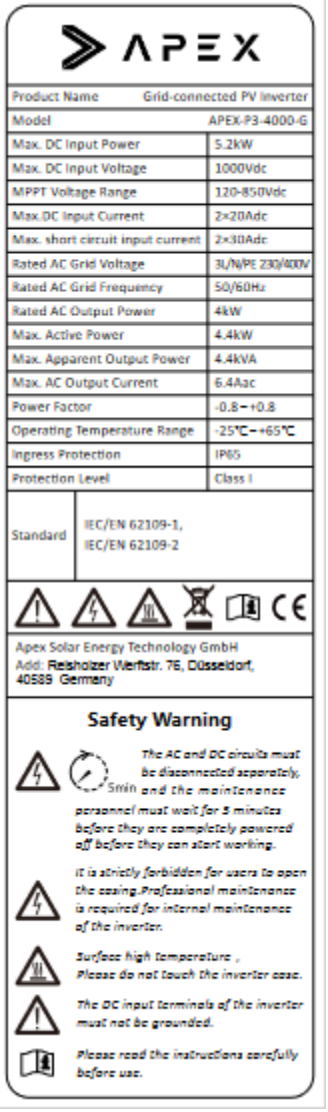

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-4000-G
Max. DC Input Power	5.2kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	4kW
Max. Active Power	4.4kW
Max. Apparent Output Power	4.4kVA
Max. AC Output Current	6.4Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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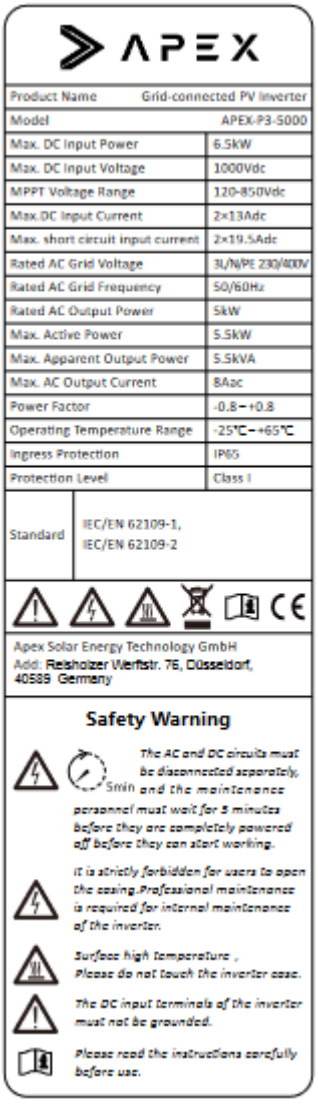
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-5000
Max. DC Input Power	6.5kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	5kW
Max. Active Power	5.5kW
Max. Apparent Output Power	5.5kVA
Max. AC Output Current	8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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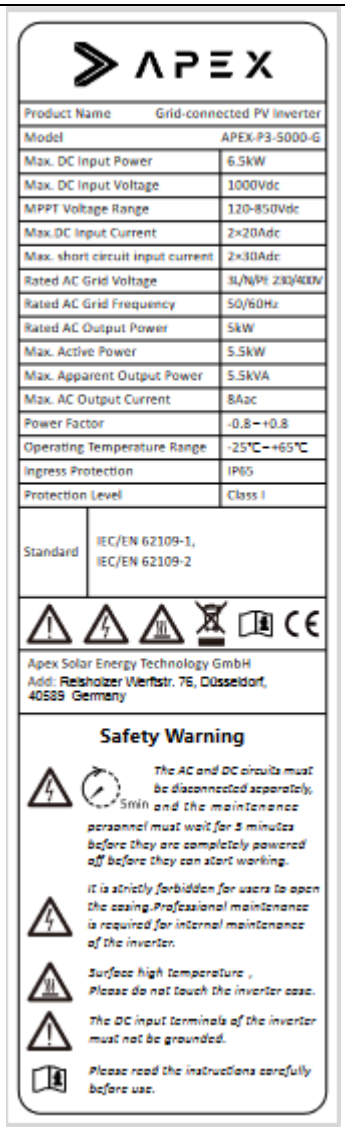

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-5000-G
Max. DC Input Power	6.5kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	5kW
Max. Active Power	5.5kW
Max. Apparent Output Power	5.5kVA
Max. AC Output Current	8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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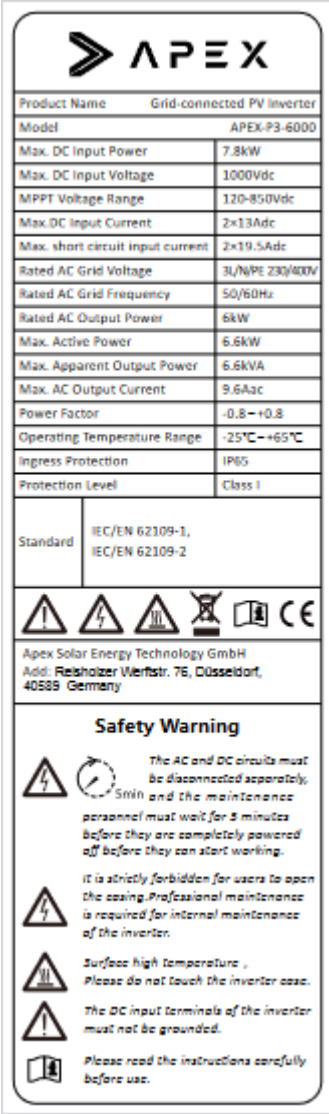
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-6000
Max. DC Input Power	7.8kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	6kW
Max. Active Power	6.6kW
Max. Apparent Output Power	6.6kVA
Max. AC Output Current	9.6Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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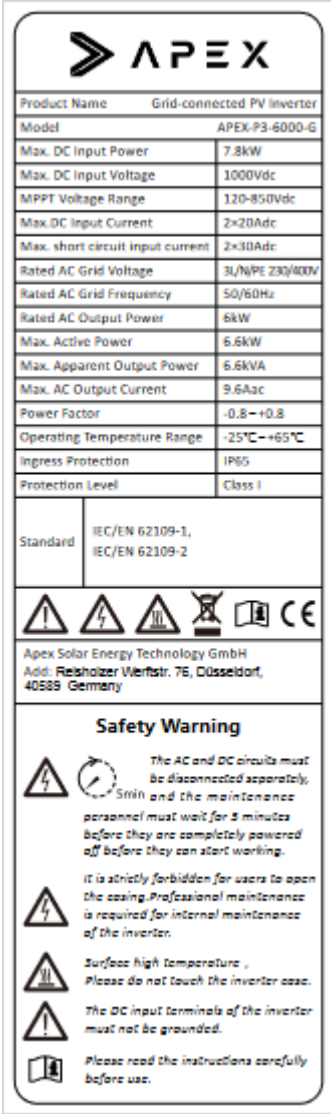

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-6000-G
Max. DC Input Power	7.8kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	6kW
Max. Active Power	6.6kW
Max. Apparent Output Power	6.6kVA
Max. AC Output Current	9.6Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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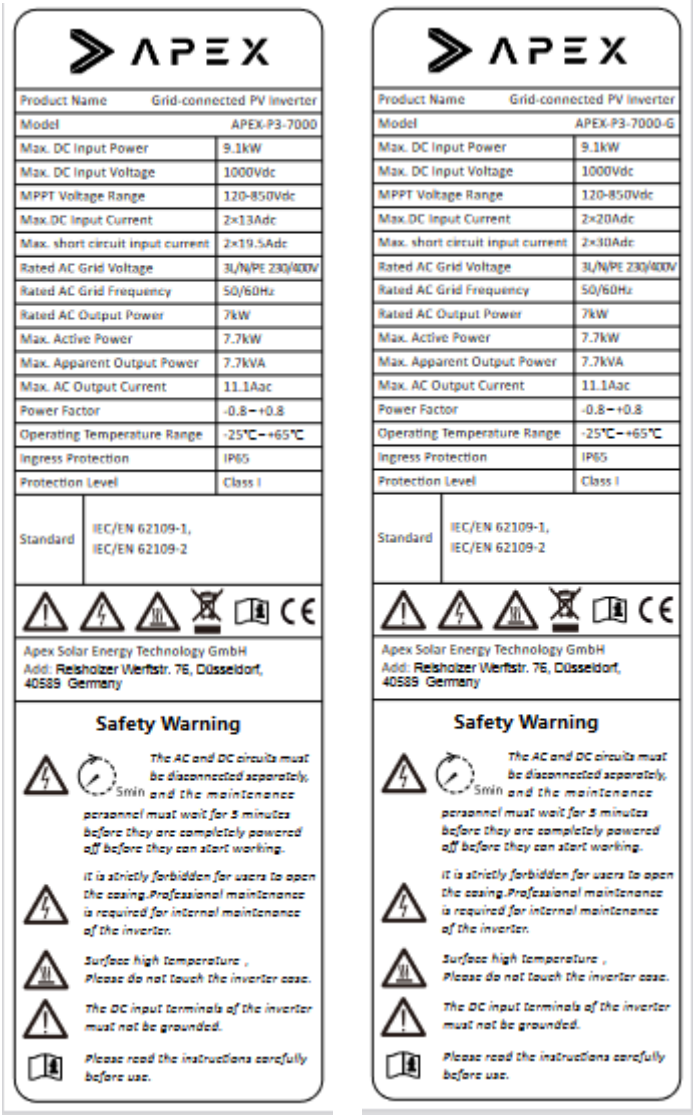
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-7000
Max. DC Input Power	9.1kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	7kW
Max. Active Power	7.7kW
Max. Apparent Output Power	7.7kVA
Max. AC Output Current	11.1Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-7000-G
Max. DC Input Power	9.1kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	7kW
Max. Active Power	7.7kW
Max. Apparent Output Power	7.7kVA
Max. AC Output Current	11.1Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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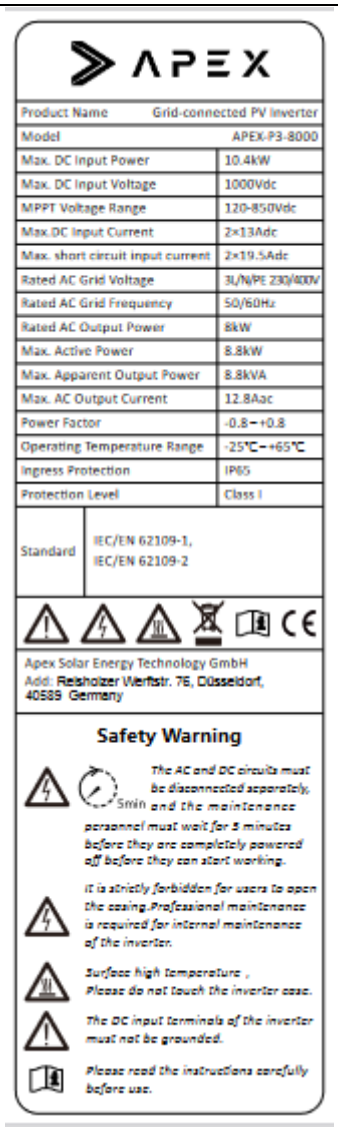
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-8000
Max. DC Input Power	10.4kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	8kW
Max. Active Power	8.8kW
Max. Apparent Output Power	8.8kVA
Max. AC Output Current	12.8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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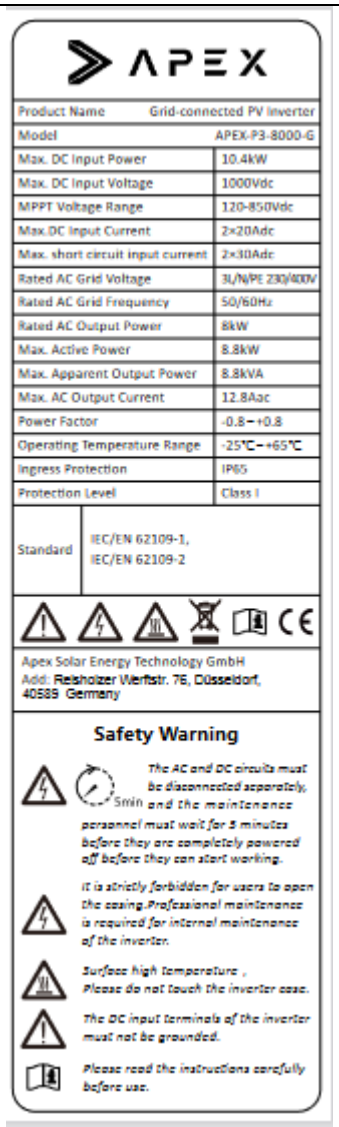

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-8000-G
Max. DC Input Power	10.4kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	8kW
Max. Active Power	8.8kW
Max. Apparent Output Power	8.8kVA
Max. AC Output Current	12.8Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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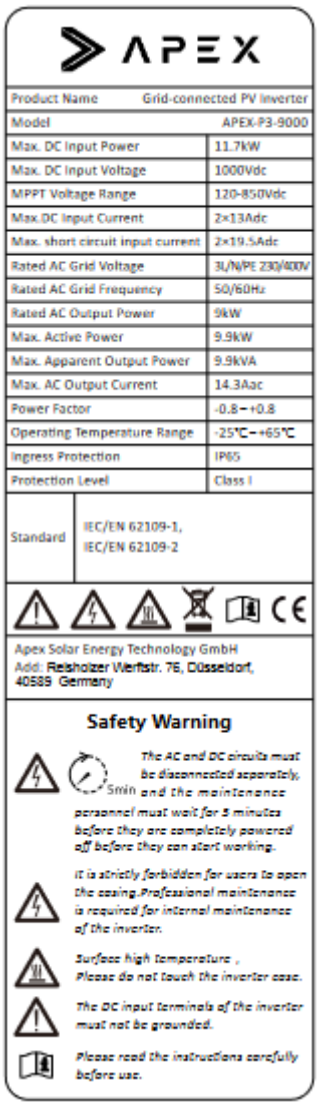
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-9000
Max. DC Input Power	11.7kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	9kW
Max. Active Power	9.9kW
Max. Apparent Output Power	9.9kVA
Max. AC Output Current	14.3Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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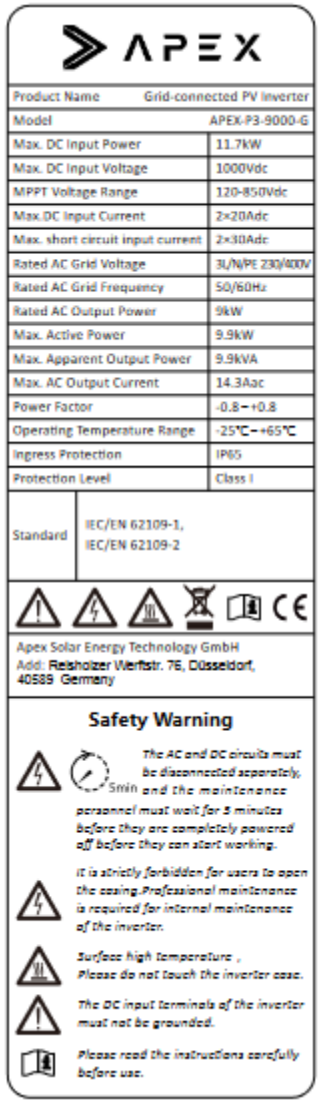


APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-9000-G
Max. DC Input Power	11.7kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	9kW
Max. Active Power	9.9kW
Max. Apparent Output Power	9.9kVA
Max. AC Output Current	14.3Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

Apex Solar Energy Technology GmbH
Add: Reisholzer Werftstr. 76, Düsseldorf, 40589 Germany

Safety Warning

5min *The AC and DC circuits must be disconnected separately, and the maintenance personnel must wait for 5 minutes before they are completely powered off before they can start working.*

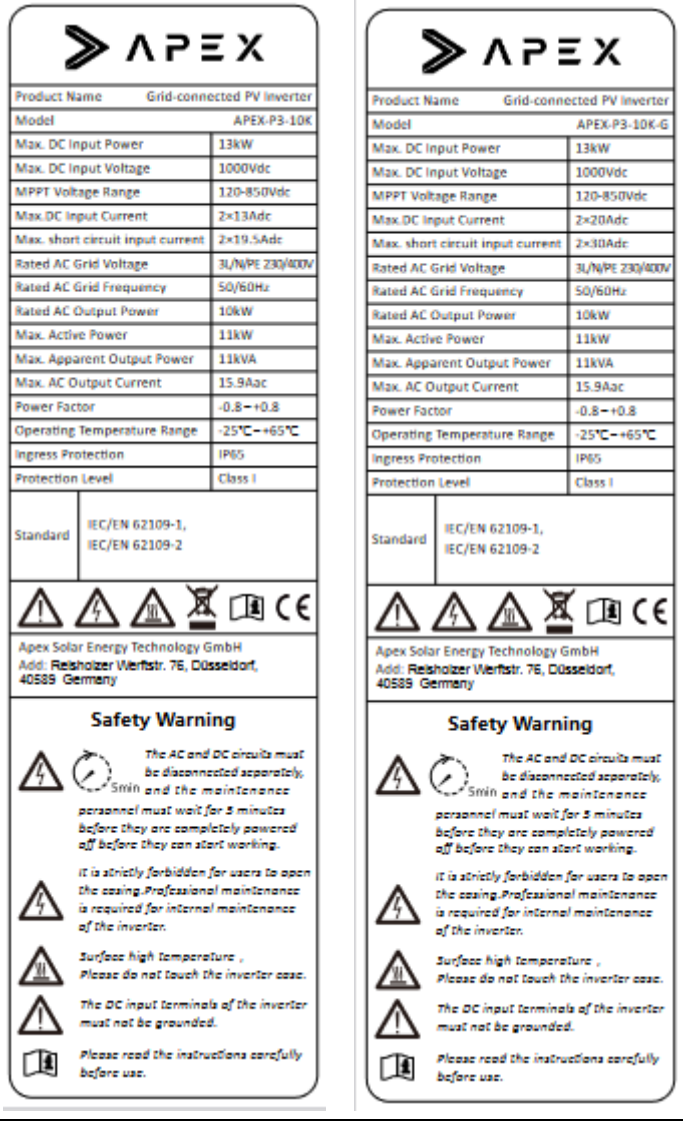
It is strictly forbidden for users to open the casing.Professional maintenance is required for internal maintenance of the inverter.

Surface high temperature , Please do not touch the inverter case.

The DC input terminals of the inverter must not be grounded.

Please read the instructions carefully before use.

Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-10K
Max. DC Input Power	13kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	10kW
Max. Active Power	11kW
Max. Apparent Output Power	11kVA
Max. AC Output Current	15.9Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-10K-G
Max. DC Input Power	13kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	120-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	10kW
Max. Active Power	11kW
Max. Apparent Output Power	11kVA
Max. AC Output Current	15.9Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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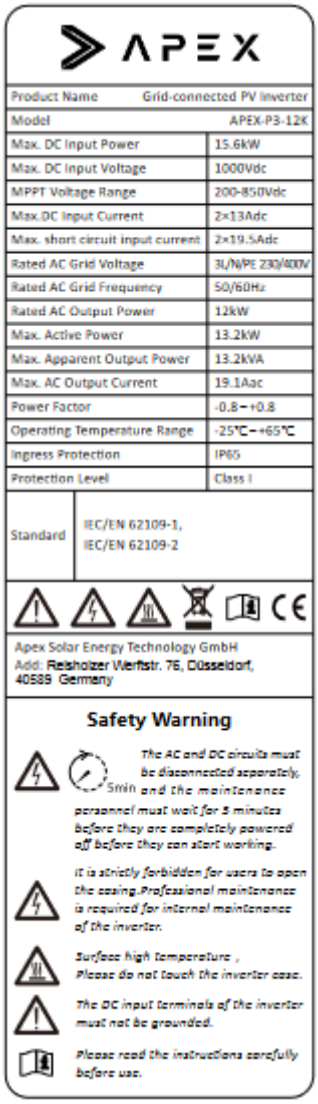
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-12K
Max. DC Input Power	15.6kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	200-850Vdc
Max.DC Input Current	2×13Adc
Max. short circuit input current	2×19.5Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	12kW
Max. Active Power	13.2kW
Max. Apparent Output Power	13.2kVA
Max. AC Output Current	19.1Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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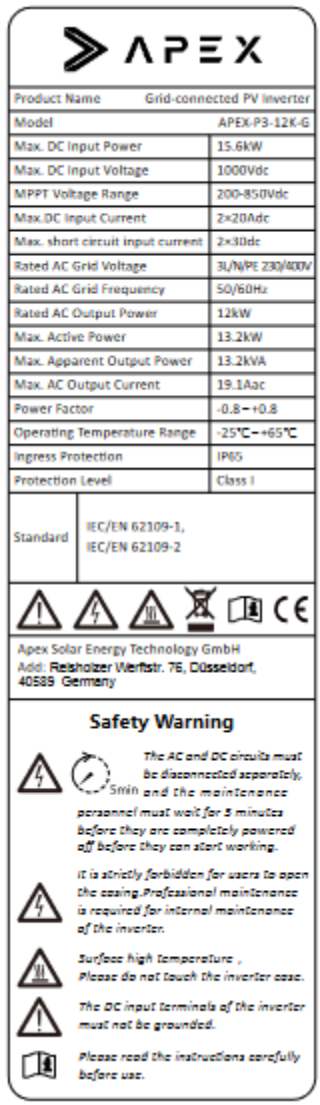

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-12K-G
Max. DC Input Power	15.6kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	200-850Vdc
Max.DC Input Current	2×20Adc
Max. short circuit input current	2×30dc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	12kW
Max. Active Power	13.2kW
Max. Apparent Output Power	13.2kVA
Max. AC Output Current	19.1Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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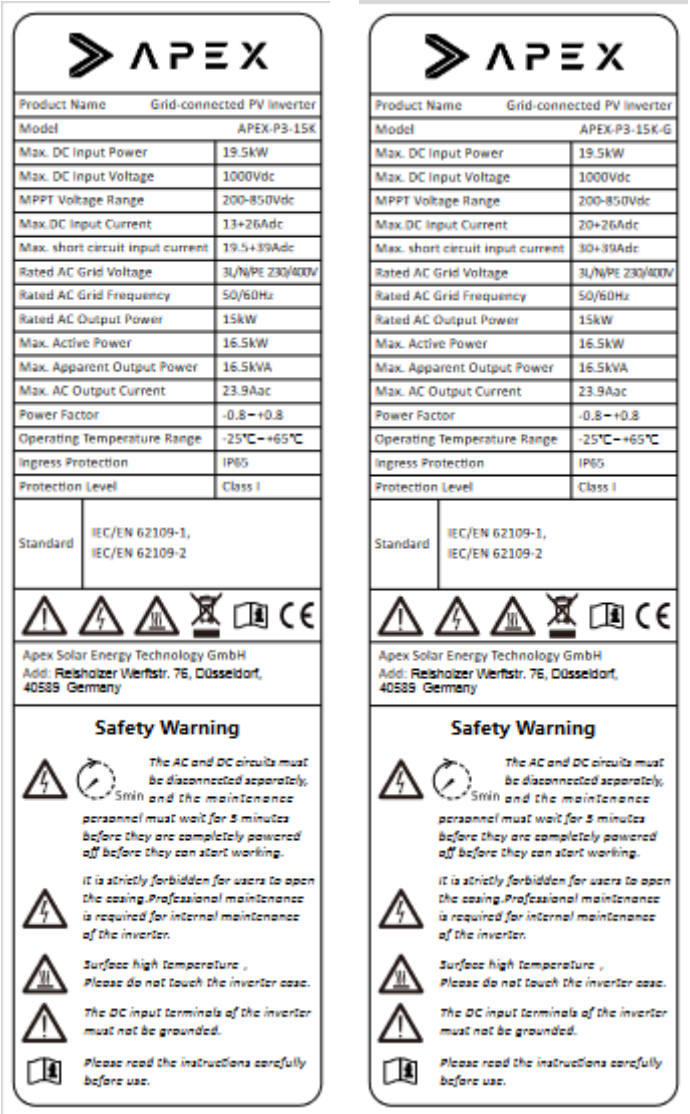
Produktbeschreibung
Product description



APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-15K
Max. DC Input Power	19.5kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	200-850Vdc
Max.DC Input Current	13+26Adc
Max. short circuit input current	19.5+39Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	15kW
Max. Active Power	16.5kW
Max. Apparent Output Power	16.5kVA
Max. AC Output Current	23.9Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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Please read the instructions carefully before use.

APEX

Product Name	Grid-connected PV Inverter
Model	APEX-P3-15K-G
Max. DC Input Power	19.5kW
Max. DC Input Voltage	1000Vdc
MPPT Voltage Range	200-850Vdc
Max.DC Input Current	20+26Adc
Max. short circuit input current	30+39Adc
Rated AC Grid Voltage	3L/N/PE 230/400V
Rated AC Grid Frequency	50/60Hz
Rated AC Output Power	15kW
Max. Active Power	16.5kW
Max. Apparent Output Power	16.5kVA
Max. AC Output Current	23.9Aac
Power Factor	-0.8~+0.8
Operating Temperature Range	-25℃~+65℃
Ingress Protection	IP65
Protection Level	Class I
Standard	IEC/EN 62109-1, IEC/EN 62109-2

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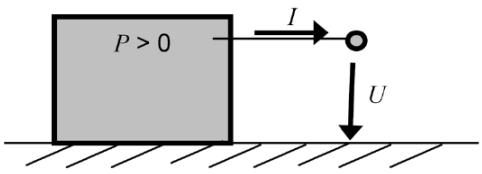
Produktbeschreibung
Product description

Possible test case verdicts:	
- test case does not apply to the test object..... :	**N/A**
- test object was not evaluated for the requirement.... :	N/E
- test object does meet the requirement ..... :	Pass (P)
- test object does not meet the requirement..... :	Fail (F)
Testing:	
Date of receipt of test items..... :	See cover page
Date(s) of performance of tests..... :	See cover page

General remarks:

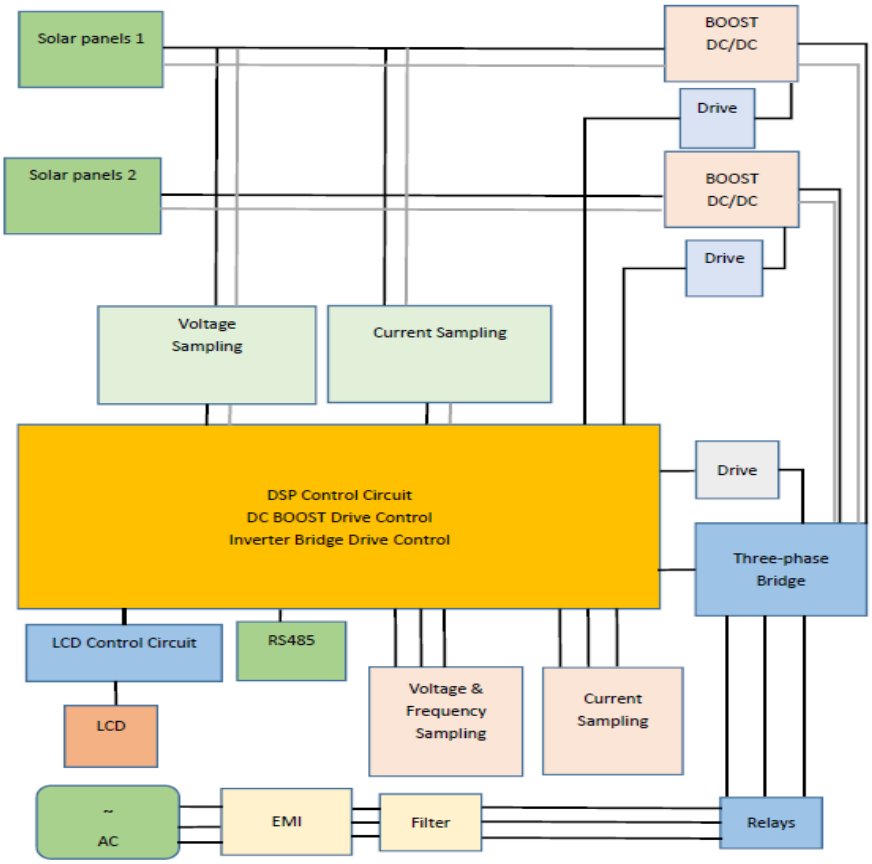
"(see Attachment #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.
The tests results presented in this report relate only to the object tested.
This report shall not be reproduced except in full without the written approval of the testing laboratory.
List of test equipment must be kept on file and available for review.
Additional test data and/or information provided in the attachments to this report.
Throughout this report a ☐ comma / ☒ point is used as the decimal separator.
Generator reference system:



General product information:

Breif description:
The on-grid inverter is designed according to the wall mounted type installation , can convert solar panel DC power into AC power which can directly input to the grid. The block diagram below shows the toplogic structure of it.

Produktbeschreibung
Product description



Block Diagram

Model Difference:

The inverters: APEX-P3-xx(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K), APEX-P3-xx-G(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K) are identical, they used the same PCB Layout, the difference between them are showed in the table below.

Produktbeschreibung
Product description

Reference Position	APEX-P3-xx(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K)	APEX-P3-12K	APEX-P3-15K	**Comments**
L1,L2,LR,LS,LT	10KW-(L1+L2+LR+LS+LT)	12KW-(L1+L2+LR+LS+LT)	15KW-(L1+L2+LR+LS+LT)	Inverter Choke
C141,C142	500V/390uF	NC	NC	Inverter Bus Capacitor
C1,C2,C3,C4	NC	600V/50uF	600V/50uF	
D1	1200V/60A	1200V/60A	1200V/60A	Freewheeling Diode
D23	1200V/60A	1200V/60A	1200V/20A-SIC	
R109, R25, R110, R42	2.2K	2.2K	3.3K	Inverter current sampling resistor
FAN1	12V/0.31A/60mm	12V/0.31A/60mm	12V/0.31A/60mm	Internal fan
FAN2	NC	NC	12V/0.3A/80mm	External fan
PV input connector in parallel	2/1+1	2/1+1	2/1+2	Number of input connectors

Throughout the test report following abbreviations may be used:

- cl clearance
- dcr creepage distance
- dti distance through insulation
- BI basic insulation
- DI double insulation
- s-c short-circuit
- o-c open-circuit
- o-l overload
- SI supplementary insulation
- RI reinforced insulation

Remote control:
Remote shutdown and power control function is realized by Meter or Wifi interface.

The product was tested on:
Software version: 5172

Test condition:
Temperature: 25°C Relative humidity: 65%

Produktbeschreibung
Product description

Model list:

MODELS LIST		APEX-P3-3000	APEX-P3-4000	APEX-P3-5000
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000		
	$I_{SC\ PV}$ [A]	19.5/19.5	19.5/19.5	19.5/19.5
	MPP Voltage Range V_{MPP} [Vdc]	120-850	120-850	120-850
	Max. Input Current I_{MAX} [A]	13.0/13.0	13.0/13.0	13.0/13.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400		
	Rated Output Frequency Fn [Hz]	50		
	Rated Active Power Pn [W]	3000	4000	5000
	Max. Active Power P_{Emax} [W]	3300	4400	5500
	Max. Apparent power S_{Emax} [VA]	3300	4400	5500
	Max. Output Current I_{max} [A]	4.8	6.4	8.0
	Power Factor Range cosφ [λ]	0.8un…0.8ov		
ROTECTION SETTINGS	Firmware version	5172		
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25		
	The accuracy of voltage measurement[U/Un]	±0.01		
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)		
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5		
	The accuracy of frequency measurement [f/fn]	±0.001		
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)		
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)		
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10		
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)		
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)		
Note*:				

Produktbeschreibung
Product description

MODELS LIST		APEX-P3-6000	APEX-P3-7000	APEX-P3-8000	APEX-P3-9000
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000			
	$I_{SC\ PV}$ [A]	19.5/19.5	19.5/19.5	19.5/19.5	19.5/19.5
	MPP Voltage Range V_{MPP} [Vdc]	120-850	120-850	120-850	120-850
	Max. Input Current I_{MAX} [A]	13.0/13.0	13.0/13.0	13.0/13.0	13.0/13.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400			
	Rated Output Frequency Fn [Hz]	50			
	Rated Active Power Pn [W]	6000	7000	8000	9000
	Max. Active Power P_{Emax} [W]	6600	7700	8800	9900
	Max. Apparent power S_{Emax} [VA]	6600	7700	8800	9900
	Max. Output Current I_{max} [A]	9.6	11.1	12.8	14.3
	Power Factor Range cosφ [λ]	0.8un…0.8ov			
ROTECTION SETTINGS	Firmware version	5172			
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25			
	The accuracy of voltage measurement[U/Un]	±0.01			
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)			
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5			
	The accuracy of frequency measurement [f/fn]	±0.001			
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)			
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)			
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10			
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)			
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)			
Note*:					

Produktbeschreibung
Product description

MODELS LIST		APEX-P3-10K	APEX-P3-12K	APEX-P3-15K
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000		
	$I_{SC\ PV}$ [A]	19.5/19.5	19.5/19.5	19.5/39.0
	MPP Voltage Range V_{MPP} [Vdc]	120-850	200-850	200-850
	Max. Input Current I_{MAX} [A]	13.0/13.0	13.0/13.0	13.0/26.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400		
	Rated Output Frequency Fn [Hz]	50		
	Rated Active Power Pn [W]	10000	12000	15000
	Max. Active Power P_{Emax} [W]	11000	13200	16500
	Max. Apparent power S_{Emax} [VA]	11000	13200	16500
	Max. Output Current I_{max} [A]	15.9	19.1	23.9
	Power Factor Range cosφ [λ]	0.8un…0.8ov		
ROTECTION SETTINGS	Firmware version	5172		
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25		
	The accuracy of voltage measurement[U/Un]	±0.01		
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)		
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5		
	The accuracy of frequency measurement [f/fn]	±0.001		
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)		
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)		
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10		
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)		
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)		
Note*:				

Produktbeschreibung
Product description

MODELS LIST		APEX-P3-3000-G	APEX-P3-4000-G	APEX-P3-5000-G
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000		
	$I_{SC\ PV}$ [A]	30.0/30.0	30.0/30.0	30.0/30.0
	MPP Voltage Range V_{MPP} [Vdc]	120-850	120-850	120-850
	Max. Input Current I_{MAX} [A]	20.0/20.0	20.0/20.0	20.0/20.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400		
	Rated Output Frequency Fn [Hz]	50		
	Rated Active Power Pn [W]	3000	4000	5000
	Max. Active Power P_{Emax} [W]	3300	4400	5500
	Max. Apparent power S_{Emax} [VA]	3300	4400	5500
	Max. Output Current I_{max} [A]	4.8	6.4	8.0
	Power Factor Range cosφ [λ]	0.8un…0.8ov		
ROTECTION SETTINGS	Firmware version	5172		
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25		
	The accuracy of voltage measurement[U/Un]	±0.01		
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)		
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5		
	The accuracy of frequency measurement [f/fn]	±0.001		
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)		
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)		
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10		
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)		
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)		
Note*:				

Produktbeschreibung
Product description

MODELS LIST		APEX-P3-6000-G	APEX-P3-7000-G	APEX-P3-8000-G	APEX-P3-9000-G
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000			
	$I_{SC\ PV}$ [A]	30.0/30.0	30.0/30.0	30.0/30.0	30.0/30.0
	MPP Voltage Range V_{MPP} [Vdc]	120-850	120-850	120-850	120-850
	Max. Input Current I_{MAX} [A]	20.0/20.0	20.0/20.0	20.0/20.0	20.0/20.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400			
	Rated Output Frequency Fn [Hz]	50			
	Rated Active Power Pn [W]	6000	7000	8000	9000
	Max. Active Power P_{Emax} [W]	6600	7700	8800	9900
	Max. Apparent power S_{Emax} [VA]	6600	7700	8800	9900
	Max. Output Current I_{max} [A]	9.6	11.1	12.8	14.3
	Power Factor Range cosφ [λ]	0.8un…0.8ov			
ROTECTION SETTINGS	Firmware version	5172			
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25			
	The accuracy of voltage measurement[U/Un]	±0.01			
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)			
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5			
	The accuracy of frequency measurement [f/fn]	±0.001			
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)			
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)			
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10			
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)			
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)			
Note*:					

Produktbeschreibung
Product description

MODELS LIST		APEX-P3-10K-G	APEX-P3-12K-G	APEX-P3-15K-G
PV INPUT	$V_{MAX\ PV}$ [Vdc]	1000		
	$I_{SC\ PV}$ [A]	30.0/30.0	30.0/30.0	30.0/39.0
	MPP Voltage Range V_{MPP} [Vdc]	120-850	200-850	200-850
	Max. Input Current I_{MAX} [A]	20.0/20.0	20.0/20.0	20.0/26.0
AC OUTPUT	Rated Output Voltage per phase Un [Vac]	3L/N/PE 400		
	Rated Output Frequency Fn [Hz]	50		
	Rated Active Power Pn [W]	10000	12000	15000
	Max. Active Power P_{Emax} [W]	11000	13200	16500
	Max. Apparent power S_{Emax} [VA]	11000	13200	16500
	Max. Output Current I_{max} [A]	15.9	19.1	23.9
	Power Factor Range cosφ [λ]	0.8un…0.8ov		
ROTECTION SETTINGS	Firmware version	5172		
	Voltage threshold value [U/Un]	$U_{MIN\ stage\ 1}$: 0.80, $U_{MIN\ stage\ 2}$: 0.45 $U_{MAX\ stage\ 1}$: 1.10, $U_{MAX\ stage\ 2}$: 1.25		
	The accuracy of voltage measurement[U/Un]	±0.01		
	Voltage trip time [ms]	$U_{MIN\ stage\ 1}$: <3100 (T_{LIMIT}: <3100), $U_{MIN\ stage\ 2}$: <400 (T_{LIMIT}: <400), $U_{MAX\ stage\ 1}$: <200 (T_{LIMIT}: <200), $U_{MAX\ stage\ 2}$: <200 (T_{LIMIT}: <200)		
	Frequency threshold value [Hz]	F_{MIN}: 47.5, F_{MAX}: 51.5		
	The accuracy of frequency measurement [f/fn]	±0.001		
	Frequency trip time [ms]	F_{MIN}: <200 (T_{LIMIT}: 200), F_{MAX}: <200 (T_{LIMIT}: 200)		
	Active anti-islanding trip time [s]	<9.0 (T_{LIMIT}: 9)		
	Reconnection Voltage [U/Un]	U_{MIN}: 0.85 , U_{MAX}: 1.10		
	Reconnection Frequency [Hz]	F_{MIN}: 47.5 (F_{LIMITU}: 47.5), F_{MAX}: 50.10 (F_{LIMITO}: 50.10)		
	Reconnection Time [s]	60 (T_{LIMIT} ≥ 60)		
Note*:				

Produktbeschreibung
Product description

2	**Maße / Gewicht** *Dimensions / Weight*	Please refer to the user manual.
3	**Bedienelemente** *Operating elements*	N/A
4	**Ausstattung / Zubehör** *Equipment / Accessories*	N/A
5	**Verwendete Materialien** *Used materials*	N/A
6	**Sonstiges** *Other*	N/A

1	**Anwendungsbereich** ***Scope*** Details zur Ausgestaltung der messtechnischen Nachweise und zur Dokumentation der Messergebnisse sind in DIN VDE-V 0124-100 (VDE V 0124-100):2020-06 beschrieben. ***Details on the design of the measuring certificates and the documentation of the measurement results are described in DIN VDE-V 0124-100 (VDE V 0124-100):2020-06.***

ANLAGE zum Prüfbericht-Nr.: CN2283DK 003
APPENDIX to Test Report No.:

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

See CN2283DK 003 attachment 1 for test report of VDE V 0124-100: 2020.
See CN2283DK 003 attachment 2 for Photo documentations

Prüfbericht-Nr.: *Test report no.:*	See test report CN2283DK 003	**Auftrags-Nr.:** *Order no.*:	See test report CN2283DK 003	
Kunden-Referenz-Nr.: *Client reference no.:*	See test report CN2283DK 003	**Auftragsdatum:** *Order date:*	See test report CN2283DK 003	
Auftraggeber: *Client:*	See test report CN2283DK 003			
Prüfgegenstand: *Test item:*	See test report CN2283DK 003			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	See test report CN2283DK 003			
Auftrags-Inhalt: *Order content*:	A3 Certificate			
Prüfgrundlage: *Test specification:*	DIN VDE V 0124-100/06.20 *Netzintegration von Erzeugungsanlagen –Niederspannung –Prüfanforderungen an Erzeugungseinheiten vorgesehen zum Anschluss und Parallelbetrieb am Niederspannungsnetz* *Grid integration of generator plants – Low-voltage – Test requirements for generator units to be connected to and operated in parallel with low-voltage distribution networks*			

Wareneingangsdatum: *Date of sample receipt:*	See test report CN2283DK 003
Prüfmuster-Nr.: *Test sample no:*	See test report CN2283DK 003
Prüfzeitraum: *Testing period:*	See test report CN2283DK 003
Ort der Prüfung: *Place of testing:*	See test report CN2283DK 003
Prüflaboratorium: *Testing laboratory:*	See test report CN2283DK 003
Prüfergebnis*: *Test result*:*	Pass

geprüft von: *tested by:See test report CN2283DK 003*		**genehmigt von:** *authorized by:See test report CN2283DK 003*	
Datum: *Date:* See test report CN2283DK 003		**Ausstellungsdatum:** *Issue date:* See test report CN2283DK 003	
Stellung / *Position:*	See test report CN2283DK 003	**Stellung** / *Position:*	See test report CN2283DK 003
Sonstiges / *Other:*	N/A		
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*	Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*		

* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Prüfbericht-Nr.: CN2283DK 003 attachment 1
Test Report No.:

Liste der verwendeten Prüfmittel
List of used test equipment

See test report CN2283DK 003 for detail.

Prüfbericht-Nr.: CN2283DK 003 attachment 1
Test Report No.:

Produktbeschreibung
Product description

See test report CN2283DK 003

Prüfbericht-Nr.: CN2283DK 003 attachment 1
Test Report No.:

Absatz	Anforderungen-Prüfungen	Messergebnisse-Bemerkungen	Bewertung
Clause	*Requirements-Tests*	*Measuring results-Remarks*	*Evaluation*
1	**Anwendungsbereich** ***Scope***		
	Diese DIN-VDE-Vornorm dient dem Nachweis der elektrischen Eigenschaften von Erzeugungseinheiten (EZE) nach der VDE-AR N 4105:2018-11 und gegebenenfalls anderen Netzanschlussbedingungen. *This DIN VDE preliminary standard serves to verify the electrical properties of power generation units (PGU) in accordance with VDE-AR N 4105:2018-11 and, if applicable, other grid connection conditions.*		
5	**Prüfungen** ***Tests***		
5.1	**Allgemeines** ***General information***		P
5.2	**Nachweis zulässger Netzrückwirkungen** ***Verification of permitted network reaction***		P
5.3	**Nachweis des Symmetrieverhaltens von Umrichtern** ***Verification of symmetry behaviour of inverter***		P
5.4	**Nachweis des Verhaltens der Erzeugungseinheit am Netz** ***Verification of behaviours of PGU on grid***		P
5.5	**Nachweis des NA-Schutzes** ***Verification of NS-protections***		N/A
5.6	**Zuschaltbedingungen und Synchronisierung** ***Connection conditions and synchrouzation***		P
5.7	**Nachweis der PAV,E-überwachung** ***Verification of PAV,E-monitoring***		P
5.8	**Nachweis der dynamischen Netzstützung** ***Verifiation of dynamic network supporting***		P

Prüfbericht-Nr.: CN2283DK 003 attachment 1
Test Report No.:

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

See following data for details.

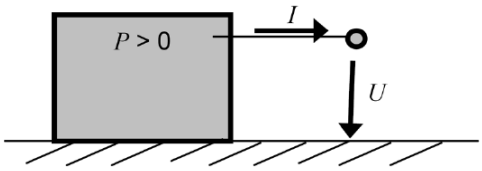
Prüfbericht-Nr.: *Test report no.:*	**CN2283DK 003**	Seite 1 von 199 *Page 1 of 199*

Test Engineer:	Jiayu Hu	Reviewer:	Jingge Pan
Signature:	Jiayu Hu	Signature:	Jingge Pan

Testing Location:	
Name:	TÜV Rheinland (Shanghai) Co., Ltd.
Address:	No. 177, Lane 777, Guangzhong West Road, Jing'an District, Shanghai, China

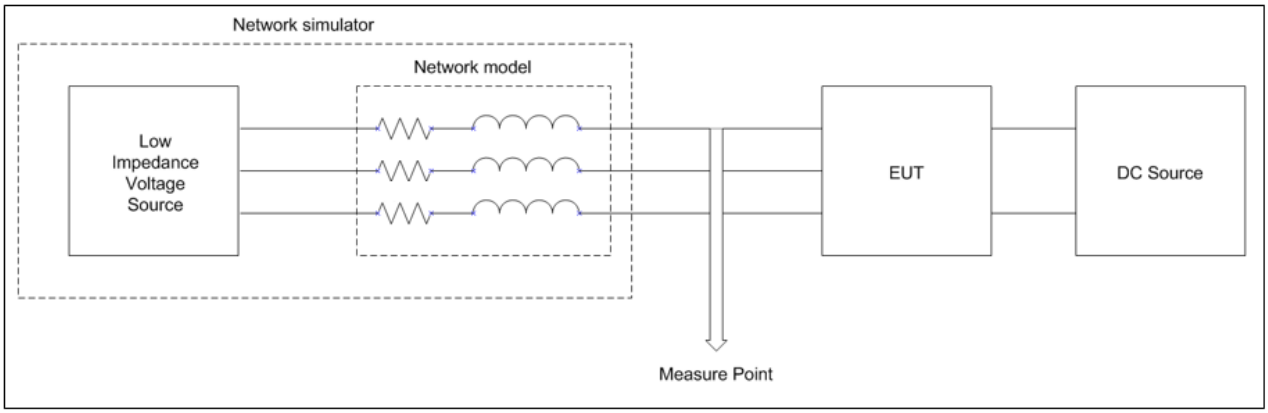
Test Sample No.:	A003402982-001

Test Condition:	Generator reference system applied in test:



Test Date:	12.01.2023-13.01.2023

Test bench diagram:



A network model (grid impedance simulator) only connected in test bench in flicker test (<75A condition), in the other tests the network model is bypassed.

Test items			Remark
5.2	Verification of permitted network reaction		Pass
5.2.2	Rapid voltage change (Kimax)		Pass
5.2.3	Flicker		Pass
5.2.4	Harmonics and Inter-harmonics (I inter, I higher)		Pass
5.2.5	Commutation notches		Pass
5.2.6	DC current feeding to network (Idc)		Pass
5.3	Verification of symmetry behaviours of inverter		Pass
5.3.2	Tests of three-phase inverter (Imbalance)		Pass
5.3.3	Symmetry operation with a symmetry device		Pass
5.4	Verification of behaviours of PGU on network		Pass
5.4.2	Measurement of active- and reactive power ranges (P&Q range)		Pass
5.4.3	Active power reduction through setting provision (P control)		Pass
5.4.4	Active power output of PGU by over-frequency (LFSM-O)		Pass
5.4.5	Active power output of ESS by over-frequency (LFSM-O)		N/A
5.4.6	Active power output of PGU by under-frequency (LFSM-U)		Pass
5.4.7	Active power output of ESS by under-frequency (LFSM-U)		N/A
5.4.8.2	Tests of reactive power / displacement factor setting accuracy (Fixed cosφ)		Pass
5.4.8.3	Tests of displacement factor- / active power character curve (cosφ(P))		Pass
5.4.8.4	Tests of reactive power-voltage character curve (Q(U))		Pass
5.5	Verification of NS-protection		Pass
5.5.2	NS-protection		Pass
5.5.3	Central NS-protecton		N/A
5.5.4	Integrated NS-protection		Pass
5.5.6	Interface switch (Functional safety)		Pass
5.5.7	Protection devices and protection settings (OV/UV, OF/UF)		Pass
5.5.9	Constructional features of NS protection		Pass
5.5.10	Islanding detection		Pass
5.6	Connection conditions and synchronization (Reconnection)		Pass
5.7	Verification of $P_{AV,E}$ monitoring		Pass
5.8	Verification of dynamic network supporting (FVRT)		Pass

5.2.2	TABLE: Rapid voltage change (Kimax)			P
Test Conditions	Measurements			Limit
	U [V]	I [A]	Ki	Ki
Starting to 50%Pn	230.3	5.9	0.51	≤ 1.2
Starting to 100% Pn	230.4	11.5	0.99	≤ 1.2
Stopping at 100% Pn	230.4	11.6	1.00	≤ 1.2
Note(s):				

5.2.3	TABLE: Flicker				P
L1					
Measurement	Plt	0.10			
	Limit	0.65			
	Pst	dc[%]	dmax[%]	d(t)[ms]	$C_{\Psi k}$
	1.0	3.3	4.0	500	--
1	0.10	0.13	0.37	0	0.60
2	0.10	0.13	0.37	0	0.60
3	0.10	0.15	0.35	0	0.60
4	0.10	0.15	0.37	0	0.60
5	0.10	0.14	0.37	0	0.60
6	0.10	0.13	0.36	0	0.60
7	0.10	0.15	0.36	0	0.60
8	0.10	0.12	0.35	0	0.60
9	0.10	0.11	0.37	0	0.60
10	0.10	0.13	0.37	0	0.60
11	0.10	0.13	0.36	0	0.60
12	0.10	0.12	0.36	0	0.60
L2					
Measurement	Plt	0.16			
	Limit	0.65			
	Pst	dc[%]	dmax[%]	d(t)[ms]	$C_{\Psi k}$
	1.0	3.3	4.0	500	--
1	0.16	0.08	0.31	0	0.96
2	0.16	0.09	0.29	0	0.96
3	0.16	0.10	0.31	0	0.96
4	0.16	0.11	0.31	0	0.96
5	0.16	0.08	0.31	0	0.96
6	0.16	0.10	0.31	0	0.96
7	0.16	0.08	0.31	0	0.96
8	0.16	0.11	0.30	0	0.96
9	0.16	0.12	0.31	0	0.96
10	0.16	0.12	0.31	0	0.96
11	0.16	0.12	0.31	0	0.96
12	0.16	0.08	0.31	0	0.96
L3					
Measurement	Plt	0.06			
	Limit	0.65			
	Pst	dc[%]	dmax[%]	d(t)[ms]	$C_{\Psi k}$
	1.0	3.3	4.0	500	--
1	0.06	0.04	0.26	0	0.36
2	0.06	0.04	0.26	0	0.36

3	0.06	0.03	0.26	0	0.36
4	0.06	0.04	0.26	0	0.36
5	0.06	0.03	0.26	0	0.36
6	0.06	0.04	0.26	0	0.36
7	0.06	0.03	0.26	0	0.36
8	0.06	0.03	0.26	0	0.36
9	0.06	0.03	0.26	0	0.36
10	0.06	0.04	0.26	0	0.36
11	0.06	0.04	0.26	0	0.36
12	0.06	0.04	0.26	0	0.36
Note(s): PGU and ESS with nominal current ≤75A (Per DIN EN 61000-3-3 / DIN EN 61000-3-11) Zref=0.24+0.15j					

5.2.4	TABLE: Iinter & Ihigher											P
Harmonics												
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100	Limit
Order No.	I/In [%]											
2	0.12	0.62	0.61	0.62	0.56	0.70	0.54	0.66	0.41	0.43	0.58	9.31
3	0.01	0.06	0.09	0.17	0.26	0.16	0.51	0.24	0.22	0.22	0.25	19.83
4	0.02	0.22	0.34	0.32	0.29	0.31	0.25	0.34	0.46	0.49	0.57	3.71
5	0.03	0.25	0.08	0.95	1.31	0.51	1.87	0.68	0.73	0.76	0.81	9.83
6	0.01	0.04	0.11	0.26	0.20	0.10	0.17	0.13	0.09	0.09	0.11	2.59
7	0.08	0.45	0.53	0.87	1.09	0.34	1.17	0.85	0.47	0.53	0.59	6.64
8	0.02	0.27	0.18	0.29	0.28	0.09	0.23	0.08	0.08	0.09	0.10	1.81
9	0.00	0.03	0.08	0.12	0.11	0.09	0.19	0.13	0.12	0.12	0.14	3.45
10	0.01	0.23	0.25	0.37	0.33	0.06	0.23	0.14	0.15	0.18	0.18	1.45
11	0.02	0.61	0.66	0.18	0.28	0.29	0.21	0.25	0.57	0.75	0.95	2.84
12	0.01	0.04	0.09	0.14	0.14	0.07	0.15	0.13	0.10	0.11	0.12	1.21
13	0.01	0.10	0.83	0.57	0.37	0.37	0.22	0.18	0.35	0.53	0.71	1.81
14	0.01	0.07	0.04	0.10	0.12	0.05	0.14	0.08	0.11	0.12	0.13	1.03
15	0.00	0.07	0.08	0.09	0.07	0.09	0.12	0.11	0.08	0.08	0.09	1.29
16	0.00	0.04	0.08	0.14	0.07	0.05	0.13	0.09	0.10	0.10	0.10	0.91
17	0.01	0.35	0.22	0.57	0.48	0.36	0.22	0.17	0.10	0.18	0.30	1.14
18	0.00	0.04	0.12	0.05	0.06	0.08	0.06	0.10	0.07	0.08	0.10	0.80
19	0.01	0.26	0.03	0.37	0.47	0.26	0.21	0.20	0.11	0.08	0.13	1.02
20	0.00	0.06	0.14	0.07	0.10	0.10	0.08	0.12	0.09	0.08	0.08	0.72
21	0.00	0.04	0.07	0.09	0.07	0.08	0.07	0.09	0.07	0.08	0.09	0.92
22	0.01	0.10	0.07	0.10	0.05	0.08	0.07	0.12	0.07	0.06	0.07	0.66
23	0.02	0.13	0.16	0.11	0.19	0.14	0.27	0.30	0.25	0.22	0.16	0.84
24	0.01	0.03	0.06	0.04	0.04	0.11	0.03	0.12	0.06	0.08	0.08	0.60
25	0.01	0.21	0.25	0.14	0.09	0.09	0.24	0.28	0.25	0.22	0.16	0.78
26	0.01	0.05	0.10	0.07	0.04	0.08	0.05	0.09	0.07	0.07	0.07	0.56
27	0.00	0.04	0.04	0.04	0.03	0.08	0.03	0.06	0.08	0.09	0.08	0.72
28	0.01	0.05	0.08	0.03	0.08	0.06	0.05	0.07	0.06	0.07	0.08	0.52
29	0.01	0.11	0.16	0.21	0.13	0.08	0.18	0.24	0.19	0.17	0.10	0.67
30	0.01	0.07	0.06	0.03	0.03	0.07	0.03	0.05	0.09	0.09	0.09	0.48
31	0.01	0.04	0.04	0.22	0.18	0.09	0.13	0.17	0.17	0.15	0.10	0.63
32	0.01	0.05	0.08	0.06	0.04	0.08	0.05	0.03	0.07	0.09	0.08	0.46
33	0.00	0.05	0.07	0.03	0.04	0.08	0.03	0.06	0.07	0.08	0.07	0.59
34	0.01	0.02	0.07	0.04	0.03	0.06	0.03	0.04	0.07	0.08	0.07	0.42
35	0.00	0.06	0.05	0.07	0.14	0.08	0.07	0.06	0.11	0.11	0.11	0.55
36	0.01	0.03	0.03	0.02	0.02	0.08	0.02	0.05	0.07	0.06	0.06	0.41
37	0.00	0.03	0.02	0.09	0.14	0.08	0.08	0.05	0.08	0.09	0.11	0.53
38	0.01	0.05	0.05	0.03	0.03	0.08	0.06	0.07	0.05	0.06	0.06	0.38
39	0.00	0.05	0.07	0.03	0.02	0.08	0.02	0.07	0.06	0.05	0.06	0.50
40	0.00	0.06	0.07	0.04	0.03	0.07	0.04	0.07	0.05	0.06	0.06	0.36

Inter-harmonics												
P/Pn [%]	0	10	20	30	40	50	60	70	80	90	100	Limit
f [Hz]	I/In [%]											
75	0.01	0.11	0.12	0.14	0.13	0.12	0.14	0.13	0.36	0.39	0.43	--
125	0.01	0.10	0.10	0.17	0.12	0.10	0.12	0.10	0.25	0.28	0.31	--
175	0.01	0.09	0.13	0.20	0.17	0.09	0.17	0.09	0.17	0.18	0.20	--
225	0.01	0.09	0.11	0.21	0.18	0.09	0.16	0.08	0.12	0.13	0.14	--
275	0.01	0.10	0.12	0.23	0.19	0.10	0.16	0.08	0.11	0.12	0.13	--
325	0.01	0.09	0.11	0.21	0.18	0.09	0.15	0.08	0.14	0.16	0.18	--
375	0.00	0.08	0.08	0.19	0.15	0.07	0.13	0.07	0.13	0.14	0.15	--
425	0.00	0.08	0.08	0.17	0.13	0.07	0.12	0.06	0.12	0.13	0.14	--
475	0.00	0.09	0.09	0.16	0.14	0.07	0.11	0.06	0.11	0.12	0.13	--
525	0.00	0.08	0.10	0.15	0.14	0.07	0.11	0.06	0.12	0.13	0.15	--
575	0.00	0.07	0.08	0.14	0.13	0.07	0.11	0.06	0.10	0.12	0.13	--
625	0.00	0.08	0.08	0.13	0.12	0.07	0.11	0.06	0.11	0.12	0.13	--
675	0.00	0.07	0.07	0.11	0.10	0.06	0.09	0.05	0.09	0.09	0.10	--
725	0.00	0.08	0.07	0.10	0.09	0.06	0.09	0.05	0.08	0.08	0.09	--
775	0.00	0.06	0.07	0.10	0.09	0.06	0.09	0.05	0.07	0.07	0.08	--
825	0.00	0.06	0.07	0.09	0.08	0.05	0.09	0.05	0.06	0.07	0.08	--
875	0.00	0.05	0.05	0.08	0.08	0.05	0.08	0.04	0.06	0.06	0.07	--
925	0.00	0.05	0.05	0.07	0.07	0.05	0.08	0.04	0.06	0.06	0.06	--
975	0.00	0.04	0.04	0.22	0.21	0.04	0.21	0.04	0.05	0.05	0.05	--
1025	0.00	0.04	0.04	0.06	0.06	0.04	0.06	0.04	0.05	0.05	0.04	--
1075	0.00	0.04	0.06	0.06	0.06	0.04	0.06	0.03	0.05	0.05	0.05	--
1125	0.00	0.04	0.06	0.06	0.05	0.03	0.05	0.03	0.05	0.05	0.04	--
1175	0.00	0.03	0.04	0.06	0.05	0.03	0.05	0.03	0.05	0.05	0.04	--
1225	0.00	0.03	0.04	0.06	0.05	0.03	0.05	0.03	0.05	0.04	0.04	--
1275	0.00	0.03	0.03	0.06	0.05	0.03	0.05	0.03	0.04	0.04	0.04	--
1325	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.03	0.04	0.04	0.04	--
1375	0.00	0.03	0.05	0.05	0.05	0.03	0.05	0.03	0.05	0.06	0.05	--
1425	0.00	0.03	0.05	0.05	0.05	0.03	0.05	0.03	0.05	0.04	0.04	--
1475	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.03	0.05	0.05	0.05	--
1525	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.03	0.04	0.04	0.04	--
1575	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.03	0.04	0.04	0.04	--
1625	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.03	0.04	0.04	0.03	--
1675	0.00	0.03	0.04	0.05	0.05	0.03	0.05	0.03	0.05	0.05	0.05	--
1725	0.00	0.03	0.04	0.05	0.05	0.03	0.04	0.03	0.03	0.04	0.04	--
1775	0.00	0.03	0.03	0.05	0.05	0.03	0.04	0.03	0.04	0.04	0.04	--
1825	0.00	0.03	0.03	0.04	0.05	0.03	0.04	0.03	0.03	0.04	0.04	--
1875	0.00	0.03	0.03	0.05	0.05	0.03	0.04	0.03	0.03	0.03	0.03	--
1925	0.00	0.03	0.03	0.05	0.04	0.03	0.04	0.02	0.03	0.03	0.03	--
1975	0.00	0.03	0.03	0.05	0.05	0.03	0.05	0.02	0.03	0.03	0.03	--

Higher frequency Harmonics												
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100	Limit
f [kHz]	I/In [%]											
2.1	0.01	0.23	0.15	0.20	0.14	0.17	0.18	0.21	0.20	0.19	0.23	--
2.3	0.01	0.14	0.15	0.13	0.13	0.11	0.14	0.16	0.13	0.12	0.14	--
2.5	0.01	0.11	0.17	0.12	0.15	0.11	0.14	0.18	0.16	0.13	0.11	--
2.7	0.01	0.24	0.19	0.13	0.13	0.18	0.14	0.20	0.25	0.26	0.24	--
2.9	0.01	0.20	0.08	0.12	0.11	0.14	0.10	0.15	0.21	0.21	0.20	--
3.1	0.01	0.26	0.09	0.11	0.13	0.08	0.11	0.15	0.31	0.29	0.26	--
3.3	0.01	0.27	0.10	0.10	0.11	0.06	0.11	0.15	0.27	0.25	0.27	--
3.5	0.00	0.16	0.07	0.08	0.08	0.07	0.09	0.08	0.07	0.08	0.16	--
3.7	0.00	0.06	0.11	0.06	0.07	0.09	0.08	0.07	0.07	0.06	0.06	--
3.9	0.01	0.07	0.11	0.09	0.09	0.09	0.09	0.08	0.07	0.07	0.07	--
4.1	0.00	0.05	0.09	0.07	0.08	0.06	0.08	0.07	0.07	0.06	0.05	--
4.3	0.00	0.06	0.10	0.06	0.06	0.10	0.05	0.10	0.08	0.07	0.06	--
4.5	0.00	0.07	0.08	0.06	0.06	0.10	0.05	0.07	0.07	0.07	0.07	--
4.7	0.00	0.08	0.08	0.13	0.12	0.08	0.12	0.09	0.08	0.08	0.08	--
4.9	0.00	0.05	0.04	0.09	0.09	0.04	0.10	0.04	0.04	0.04	0.05	--
5.1	0.00	0.04	0.03	0.06	0.06	0.03	0.06	0.03	0.04	0.04	0.04	--
5.3	0.00	0.04	0.04	0.06	0.06	0.04	0.05	0.04	0.04	0.04	0.04	--
5.5	0.00	0.03	0.02	0.05	0.06	0.02	0.05	0.02	0.03	0.03	0.03	--
5.7	0.00	0.02	0.02	0.05	0.05	0.02	0.04	0.02	0.02	0.02	0.02	--
5.9	0.00	0.02	0.02	0.04	0.04	0.02	0.04	0.02	0.02	0.02	0.02	--
6.1	0.00	0.02	0.02	0.04	0.03	0.02	0.03	0.02	0.02	0.02	0.02	--
6.3	0.00	0.01	0.01	0.03	0.03	0.01	0.03	0.01	0.01	0.01	0.01	--
6.5	0.00	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	--
6.7	0.00	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	--
6.9	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	--
7.1	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	--
7.3	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	--
7.5	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	--
7.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
7.9	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	--
8.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
8.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
8.5	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	--
8.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
8.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
Note(s): The max. value of three phases were chosen.												

5.2.5	TABLE: Commutation notches			P
Test Conditions P/ P_{Emax}	Measurements			
	I_{com} [A]			
	L1	L2	L3	
25% - 35%	1.4	2.0	3.2	
65% - 75%	1.9	3.1	3.3	
> 90%	2.2	3.2	3.7	
Note(s):				

5.2.6	TABLE: DC current feeding to network (Idc)			P
Test Conditions P/ P_{Emax}	Measurements			Limit
	Idc / In [%]			Idc/In
	L1	L2	L3	
30% - 40%	0.09	0.33	0.29	0.5%
60% - 70%	0.34	0.24	0.30	0.5%
> 95%	0.08	0.16	0.20	0.5%
Note(s):				

5.3.2	TABLE: Tests of three-phase inverter (Imbalance)						P
Test Conditions		Measurements					Limit
cosφ	S/S_{Emax} [%]	S_{asy}/S_{Emax} [%]					S_{asy}/S_{Emax} [%]
1.0	100	0.06	0.06	0.06	0.06	0.05	≤ ±5
1.0	50	0.08	0.08	0.09	0.09	0.08	
Max. un	100	0.05	0.05	0.05	0.05	0.05	
Max. un	50	0.05	0.05	0.05	0.05	0.05	
Max. ov	100	0.06	0.06	0.07	0.07	0.06	
Max. ov	50	0.07	0.07	0.07	0.07	0.07	
Note(s): S_{asy}: Max. Asymmetry power among three phases.							

5.4.2	TABLE: Measurement of active- and reactive power ranges (P&Q range)							P
Test Conditions		Measurements				Δ Limit		
U/Un	cosφ	U [V]	P_{max} [W]	cosφ	S_{max} [VA]	cosφ	P_{max}/ P_{Emax}	S_{max}/ S_{Emax}
0.9	1.0	207.3	8758.7	1.000	8759.0	--	≤102%	≤102%
1.0		230.3	8792.2	1.000	8792.7			
1.09		250.7	8790.0	0.999	8790.7			
0.9	Max.un	207.0	7889.8	0.901	8751.5	≤0.9		
1.0		230.1	7900.9	0.899	8784.1			
1.09		250.8	7903.4	0.900	8775.1			
0.9	Max.ov	207.2	7899.4	0.899	8782.7			
1.0		230.2	7906.6	0.899	8790.9			
1.09		250.8	7911.0	0.900	8785.1			
Note(s):								

5.4.3(a)	TABLE: Active power reduction through setting provision (P control)		P
Test Conditions	Measurements		Limit
P/Pn [%]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	Δ P/Pn [%]
100	100.1	0.1	≤ 5%
90	90.1	0.1	
80	77.5	-2.6	
70	70.1	0.1	
60	60.0	0.0	
50	50.0	0.0	
40	39.7	-0.3	
30	29.8	-0.2	
20	19.9	-0.1	
10	10.0	0.0	
No disconnection occur			N

5.4.3(b)	TABLE: Active power reduction through setting provision (P control)	P
Test Conditions	Measurements	Limit
P/Pn [%]	ΔP/Δt [%Pn/s]	ΔP/Δt [%Pn/s]
100->5	0.49	0.33-0.66
5->100	0.49	

5.4.3(c)	TABLE: Active power reduction through setting provision (P control)		P
Test Conditions		Measurements	Limit
P/Pn [%]		P/Pn [%]	P/Pn [%]
Interface port 1	Interface port 2	Interface port 3	
70	90	50	
Meter	N/A	Wifi	49.5 ≤ 50
P/Pn [%]		P/Pn [%]	P/Pn [%]
Interface port 1	Interface port 2	Interface port 3	
60	100	80	
Meter	Wifi	N/A	59.8 ≤ 60
P/Pn [%]		P/Pn [%]	P/Pn [%]
Interface port 1	Interface port 2	Interface port 3	
90	50	70	
Meter	Wifi	N/A	49.7 ≤ 50

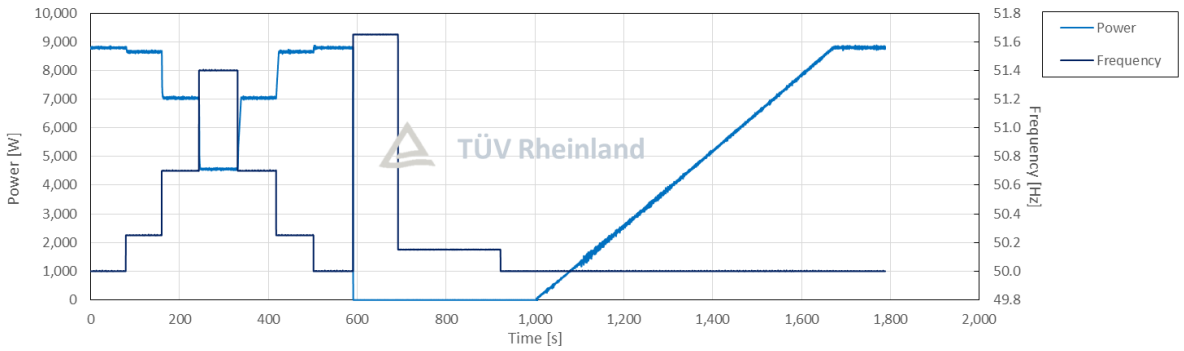
5.4.3(d)	TABLE: Active power reduction through setting provision (P control)	P
Test Conditions	Measurements	Limit
P/Pn [%]	$T_{response}$ [s]	$T_{response}$ [s]
100->0	2.5	≤ 5
Note(s):		

5.4.4(a)	TABLE: Active power output of PGU by over-frequency (LFSM-O)										P
LFSM-O settings	f_{active}		f_{stop}		$f_{deactive}$		Droop				
	50.2		N/A		50.2		5%(40%P_M/Hz)				
Test Conditions	Measurements						Target	Tolerance	Limit		
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	T_{rise} [s]	T_{set} [s]	T_v [s]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	T_{rise} [s]	T_{set} [s]
50.00	100	99.9%	50.00	--	--	--	100	-0.1%	≤±10	≤2	≤20
50.25	100	98.3%	50.25	1.70	1.70	0.00	98	0.3%			
50.70	100	80.0%	50.70	1.80	1.80	0.00	80	0.0%			
51.40	100	51.8%	51.40	1.80	1.80	0.20	52	-0.2%			
50.70	100	80.0%	50.70	1.00	1.00	0.00	80	0.0%			
50.25	100	98.3%	50.25	1.50	1.50	0.00	98	0.3%			
50.00	100	99.9%	50.00	0.70	0.70	0.00	100	-0.1%			
51.65	100	Disconnection					0	--			
50.15	100	No Reconnection					0	--			

Test Conditions		Measurements			Target	Tolerance	Limit	
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	$\Delta P/\Delta t$ [%/min]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	$\Delta P/\Delta t$ [%/min]
50.00	100	99.9%	50.00	9.07	100	-0.1%	≤±10	≤10

Note(s):

Plotting diagram:

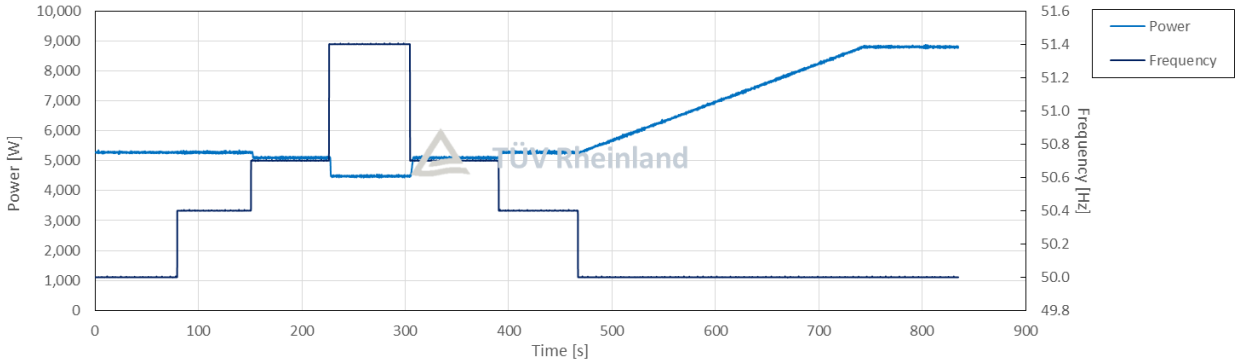


5.4.4(b)	TABLE: Active power output of PGU by over-frequency (LFSM-O)										P
LFSM-O settings	f_{active}		f_{stop}		$f_{deactive}$			Droop			
	50.5		N/A		50.2			12%(16.67%P_M/Hz)			
Test Conditions	Measurements						Target	Tolerance	Limit		
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	T_{rise} [s]	T_{set} [s]	T_v [s]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	T_{rise} [s]	T_{set} [s]
50.00	60	60.0%	50.00	--	--	--	60	-0.02%	≤±10	≤2	≤20
50.40	60	60.0%	50.40	--	--	--	60	-0.03%			
50.70	60->100	57.9%	50.70	1.80	1.80	0.0	58	-0.06%			
51.40	100	50.9%	51.40	1.80	1.80	0.3	51	-0.06%			
50.70	100	58.0%	50.70	1.00	1.00	0.2	58	-0.05%			
50.40	100	60.0%	50.40	1.70	1.70	0.0	60	-0.01%			

Test Conditions	Measurements			Target	Tolerance	Limit	
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	$\Delta P/\Delta t$ [%/min]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	$\Delta P/\Delta t$ [%/min]
50.00	100	100.0%	50.00	9.08	100	0.0%	≤±10	≤10

Note(s):

Plotting diagram:

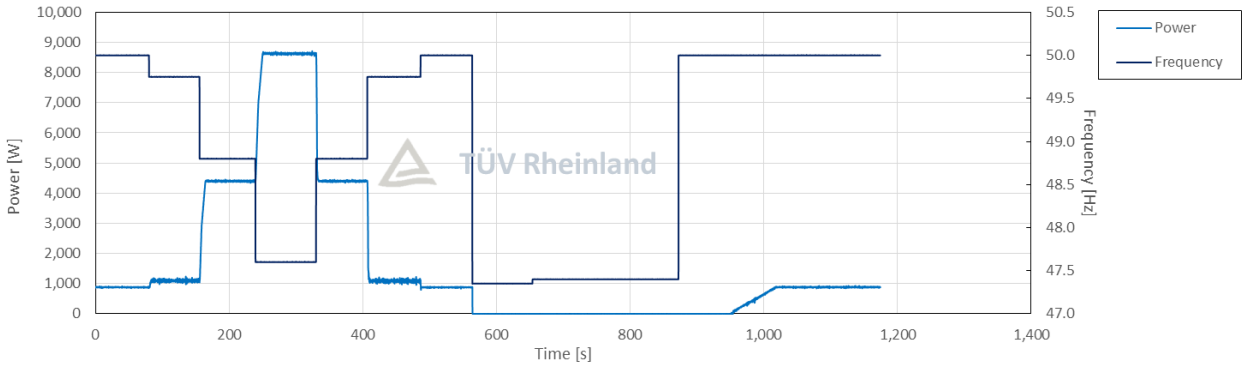


5.4.6(a)	TABLE: Active power output of PGU by under-frequency (LFSM-U)										P
LFSM-U settings	f_{active}		f_{stop}		$f_{deactive}$			Droop			
	49.8		N/A		49.8			5%(40%P_{Emax}/Hz)			
Test Conditions	Measurements						Target	Tolerance	Limit		
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	T_{rise} [s]	T_{set} [s]	T_v [s]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	T_{rise} [s]	T_{set} [s]
50.00	100	10.0%	50.00	--	--	--	10	0.01%	≤±10	≤2	≤20
49.75	100	12.4%	49.75	1.60	1.80	0.1	12	0.45%			
48.80	100	50.0%	48.80	1.50	1.50	0.1	50	0.02%			
47.60	100	98.1%	47.60	1.20	1.20	0.0	98	0.06%			
48.80	100	50.0%	48.80	1.70	1.70	0.0	50	-0.01%			
49.75	100	12.4%	49.75	1.90	1.90	0.2	12	0.37%			
50.00	100	10.0%	50.00	0.50	0.50	0.1	10	-0.02%			
47.35	100	Disconnection					0	--			
47.40	100	No Reconnection					0	--			

Test Conditions	Measurements			Target	Tolerance	Limit	
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	$\Delta P/\Delta t$ [%/min]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	$\Delta P/\Delta t$ [%/min]
50.00	100	9.9%	50.00	9.10	10	-0.1%	≤±10	≤10

Note(s):
Product power was limited to 10% at the beginning of test by a lower priority command from user.

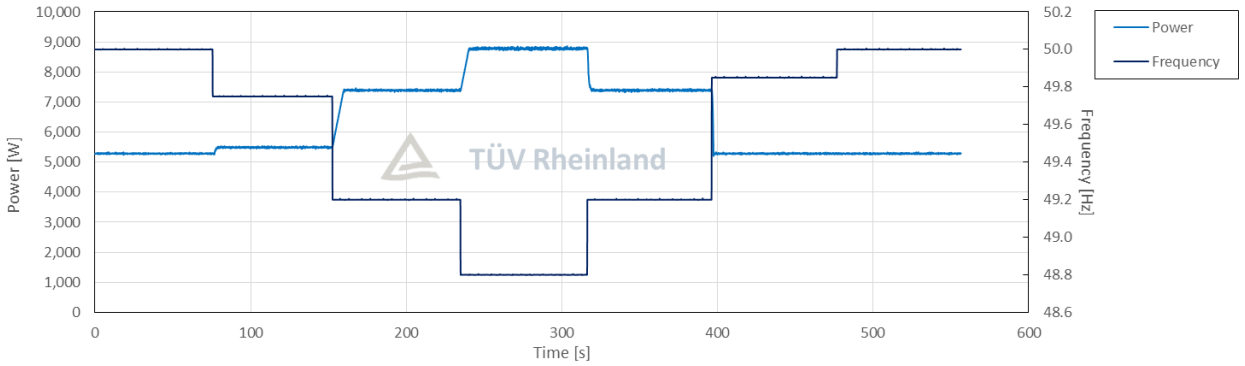
Plotting diagram:



5.4.6(b)	TABLE: Active power output of PGU by under-frequency (LFSM-U)								P		
LFSM-U settings	f_{active}		f_{stop}		$f_{deactive}$				Droop		
	49.8		N/A		49.8				5%(40%P_{Emax}/Hz)		
Test Conditions	Measurements						Target	Tolerance	Limit		
f [Hz]	P_{rim} [%]	P/P_{Emax} [%]	f [Hz]	T_{rise} [s]	T_{set} [s]	T_v [s]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	ΔP [%]	T_{rise} [s]	T_{set} [s]
50.00	100	60.1%	50.00	--	--	--	60	0.07%	≤±10	≤2	≤20
49.75	100	62.4%	49.75	1.40	1.40	0.7	62	0.43%			
49.20	100	84.0%	49.20	1.70	1.70	0.0	84	0.02%			
48.80	100	99.8%	48.80	1.90	1.90	0.1	100	-0.21%			
49.20	100	84.0%	49.20	1.80	1.80	0.0	84	-0.01%			
49.85	100	60.1%	49.85	1.20	1.20	0.0	60	0.07%			
50.00	100	60.1%	50.00	--	--	--	60	0.07%			

Note(s):
Product power was limited to 60% at the beginning of test by a lower priority command from user.

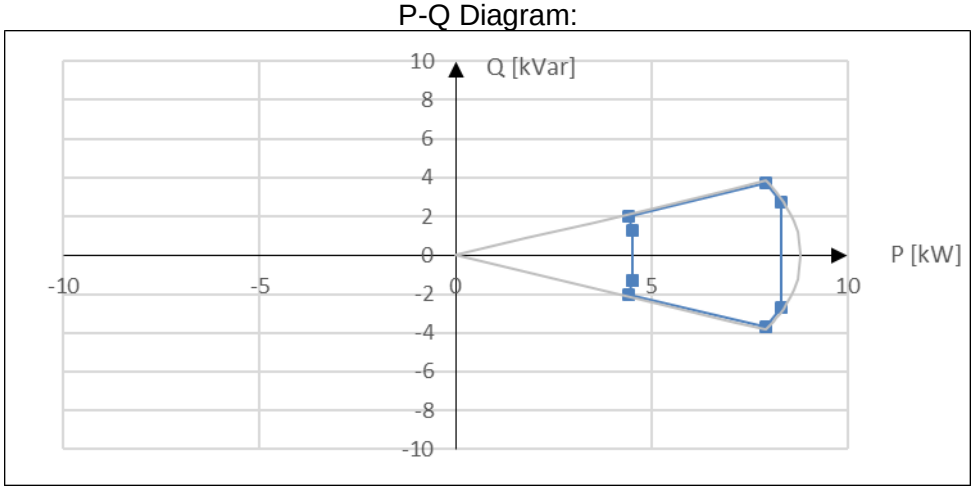
Plotting diagram:



5.4.8.2	TABLE: Tests of reactive power / displacement factor setting accuracy (Fixed cosφ)									P
Test Conditions			Measurements					Target	Tolerance	Limit
U/Un [%]	P/P_{Emax} [%]	cosφ	P [W]	Q [Var]	S [VA]	U [V]	cosφ	Q [Var]	ΔQ/P_{Emax} [%]	ΔQ/P_{Emax} [%]
90	50	0.90 under-excited	4398	-2127	4886	207	0.900	-2416	-0.28	≤± 4
90	S_{Emax}		7127	-3414	7904	207	0.901	-4169	0.49	≤± 4
100	50		4404	-2055	5569	230	0.899	-2424	-0.22	≤± 4
100	S_{Emax}		7911	-3770	8782	230	0.900	-4341	0.61	≤± 4
110	50		4407	-2126	4895	253	0.900	-2419	-0.20	≤± 4
110	S_{Emax}		7911	-3816	8784	253	0.900	-4346	0.63	≤± 4
90	50	0.95 under-excited	4396	-1436	4626	207	0.950	-1642	-0.44	≤± 4
90	S_{Emax}		7537	-2456	7928	207	0.950	-2990	0.39	≤± 4
100	50		4585	-1433	4616	230	0.949	-1647	0.00	≤± 4
100	S_{Emax}		8359	-2726	8795	231	0.950	-3127	0.48	≤± 4
110	50		4404	-1444	4639	253	0.949	-1643	-0.35	≤± 4
110	S_{Emax}		8343	-2730	8781	253	0.950	-3130	0.50	≤± 4
90	50	0.90 over-excited	4404	2120	4890	207	0.900	2422	0.16	≤± 4
90	S_{Emax}		7128	3452	7922	207	0.899	4161	-0.16	≤± 4
100	50		4404	2063	5569	230	0.900	2429	-0.17	≤± 4
100	S_{Emax}		7904	3817	8779	230	0.900	4348	-0.67	≤± 4
110	50		4399	2126	4887	253	0.900	2424	-0.15	≤± 4
110	S_{Emax}		7912	3818	8787	253	0.900	4379	-0.64	≤± 4
90	50	0.95 over-excited	4404	1440	4636	207	0.950	1645	-0.22	≤± 4
90	S_{Emax}		7521	2466	7919	207	0.950	2983	-0.27	≤± 4
100	50		4399	1438	4630	230	0.950	1651	-0.17	≤± 4
100	S_{Emax}		8348	2728	8784	230	0.950	3115	-0.20	≤± 4
110	50		4408	1444	4641	253	0.949	1647	-0.14	≤± 4
110	S_{Emax}		8307	2714	8741	253	0.950	3130	0.56	≤± 4

Note(s):

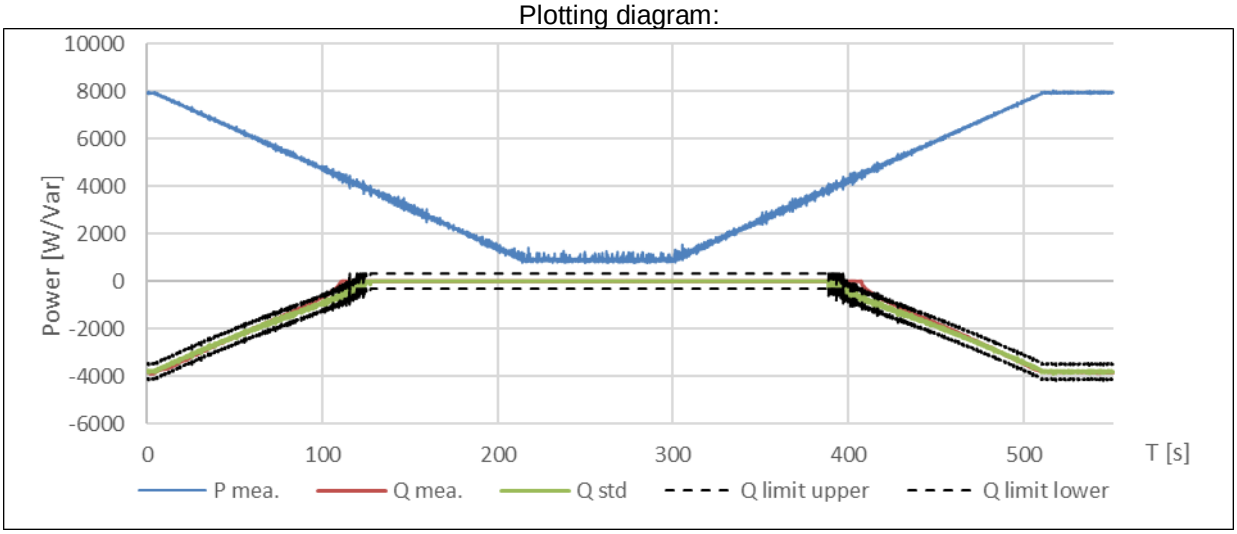
P-Q Diagram:

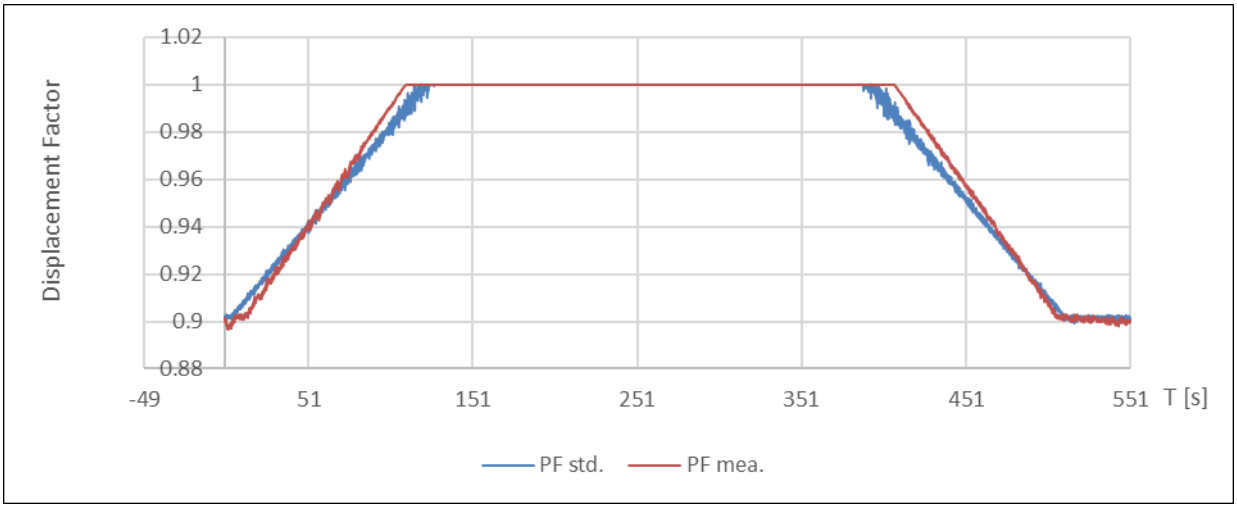


5.4.8.3(a)	TABLE: Tests of displacement factor- / active power character curve (cosφ(P))			P
cosφ (P) curve settings:	P/P_{Emax} [%]	10	50	100
	cosφ	1.0	1.0	0.9
	3Tau [s]	10		

Test Conditions	Limit
$P_{dc}/P_{dc,r}$ [%]	$\Delta Q/P_{Emax}$ [%]
100->10->100 with ramp ≤30%$P_{dc,r}$/min	≤±4.0

Plotting diagram:



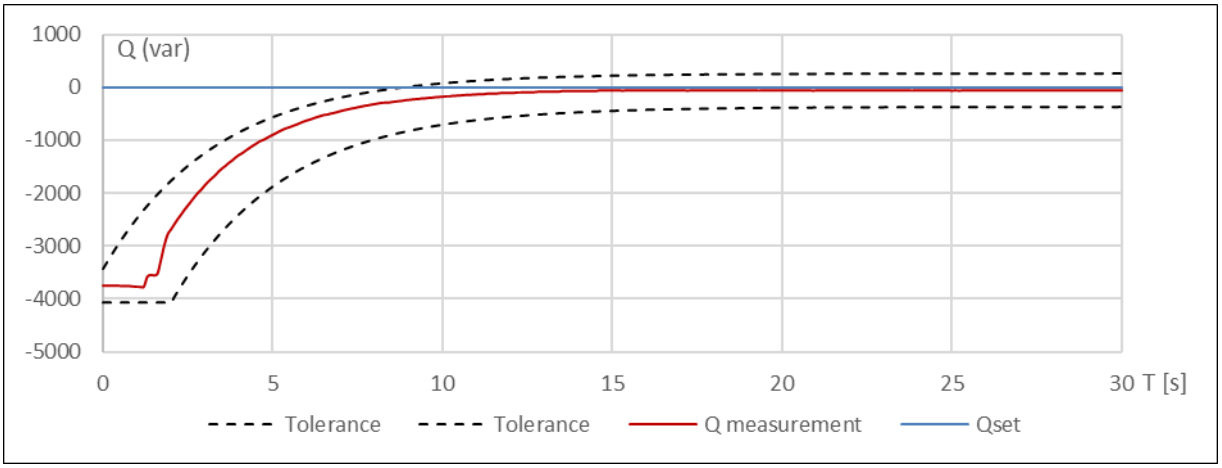


5.4.8.3(b)	TABLE: Tests of displacement factor- / active power character curve (cosφ(P))	P

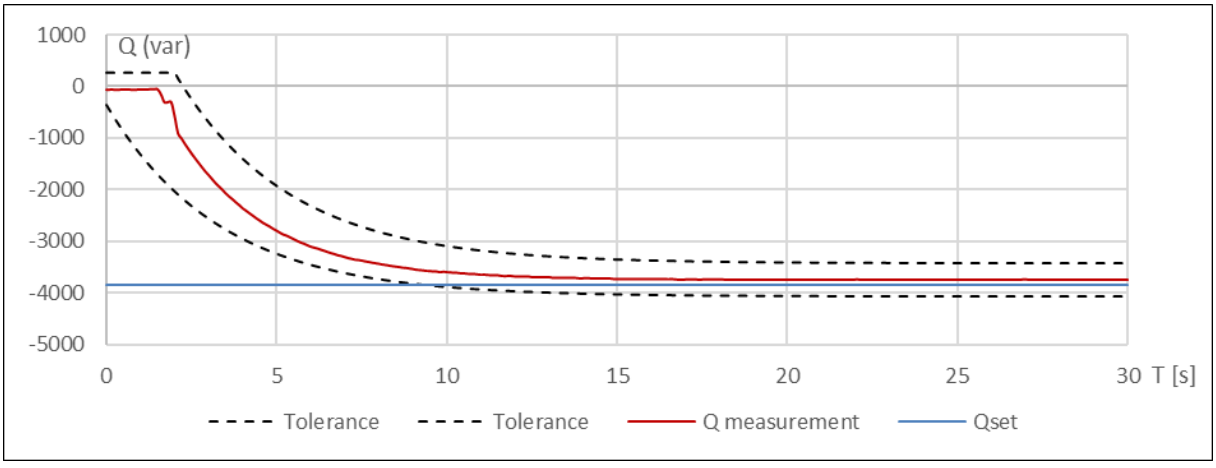
Test Conditions	Measurements	Limit
$P_{rim}/P_{dc,r}$ [%]	Response time T [s]	Response time T [s]
100->40	9.5	Complied with PT-1 curve
40->100	9.5	
100->75	9.6	

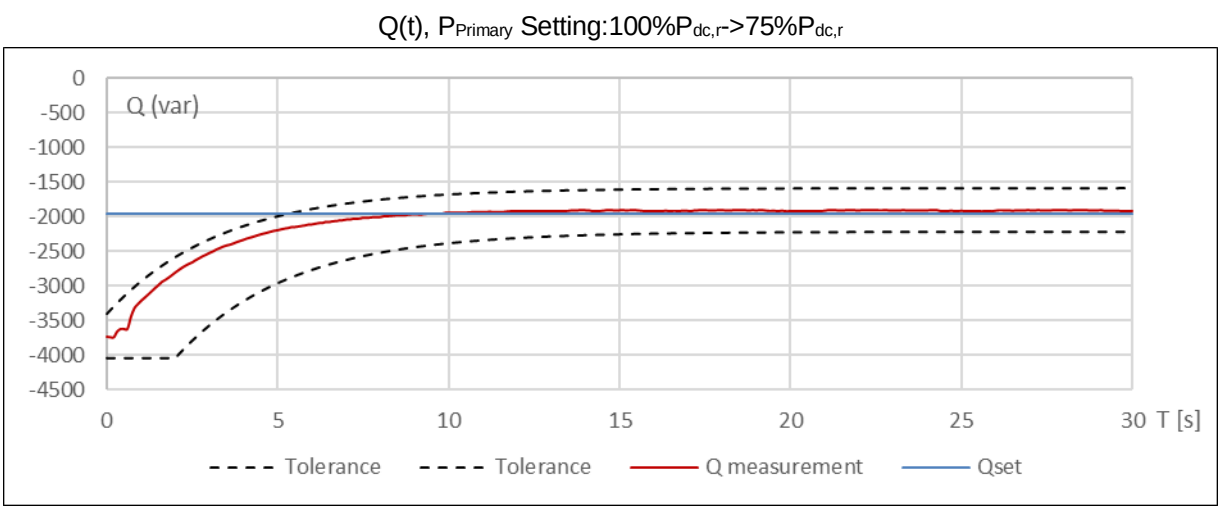
Plotting diagram:

Q(t), $P_{Primary}$ Setting:100%$P_{dc,r}$->40%$P_{dc,r}$



Q(t), $P_{Primary}$ Setting:40%$P_{dc,r}$->100%$P_{dc,r}$

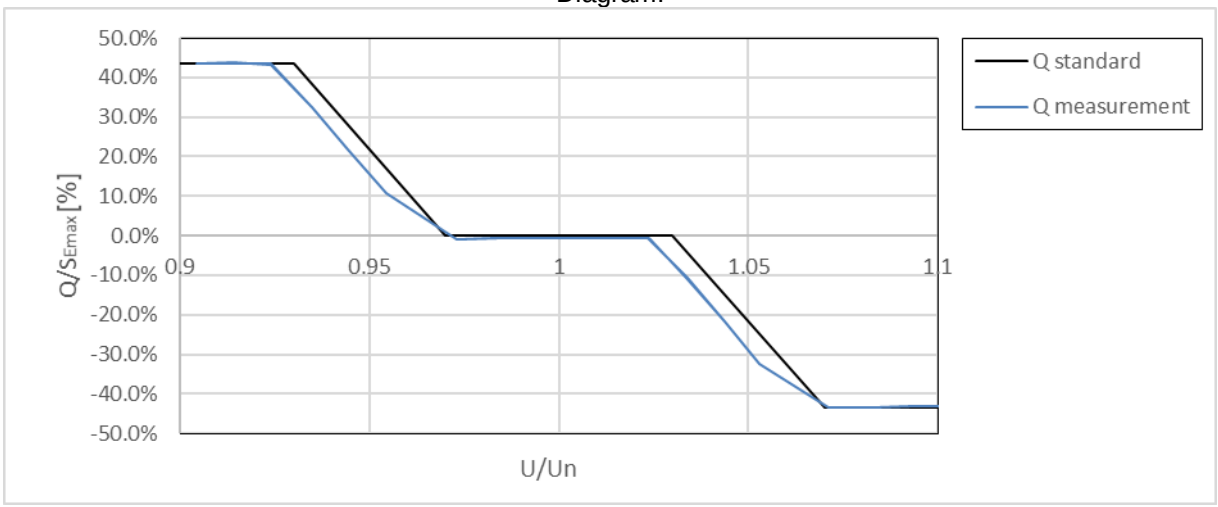



Q(t), PPrimary Setting:100%Pdc,r->75%Pdc,r
Q (var)
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
-4500
0
5
10
15
20
25
30 T [s]
Tolerance
Tolerance
Q measurement
Qset

5.4.8.4(a)	TABLE: Tests of reactive power-voltage character curve (Q(U))				P
Q (U) curve settings:	U/Un	0.93	0.97	1.03	1.07
	Q/S_{Emax}	+0.436	0	0	-0.436
	3Tau [s]	6			

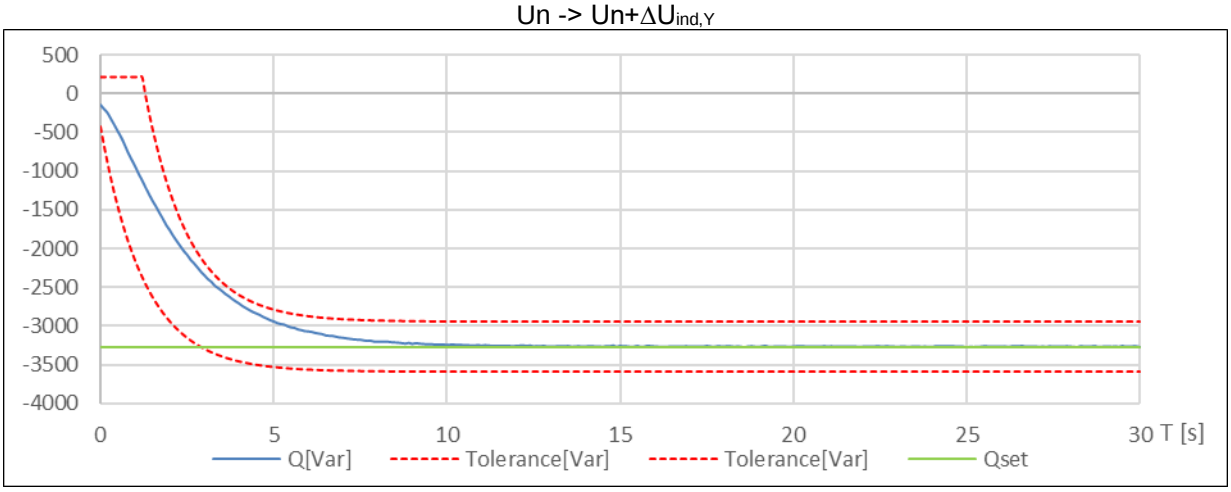
Test Conditions	Measurements		Target	Tolerance	Limit
U/Un[%]	Q[Var]	U [V]	Q[Var]	$\Delta Q/P_{Emax}$[%]	$\Delta Q/P_{Emax}$[%]
100	-63.6	230.1	0	-0.72	≤±4
99	-66.2	227.5	0	-0.75	≤±4
98	-68.3	225.2	0	-0.78	≤±4
97	-70.3	223.2	0	-0.80	≤±4
96	948.6	220.9	959	-0.12	≤±4
95	1905.2	218.7	1918	-0.15	≤±4
94	2849.6	216.4	2878	-0.32	≤±4
93	3802.0	213.5	3837	-0.40	≤±4
92	3808.3	211.9	3837	-0.33	≤±4
91	3846.7	209.6	3837	0.11	≤±4
90	3836.1	207.2	3837	-0.01	≤±4
91	3838.1	209.6	3837	0.01	≤±4
92	3840.9	211.9	3837	0.04	≤±4
93	3842.6	213.5	3837	0.06	≤±4
94	2854.9	216.5	2878	-0.26	≤±4
95	1907.3	218.7	1918	-0.12	≤±4
96	949.5	221.0	959	-0.11	≤±4
97	-70.8	223.3	0	-0.80	≤±4
98	-68.5	225.5	0	-0.78	≤±4
99	-66.2	227.8	0	-0.75	≤±4
100	-63.7	230.3	0	-0.72	≤±4
101	-61.8	232.3	0	-0.70	≤±4
102	-58.0	234.6	0	-0.66	≤±4
103	-57.5	236.9	0	-0.65	≤±4
104	-936.0	239.1	-959	0.26	≤±4
105	-1898.7	241.4	-1918	0.22	≤±4
106	-2856.8	243.6	-2878	0.24	≤±4
107	-3814.6	245.9	-3837	0.25	≤±4
108	-3812.3	248.2	-3837	0.28	≤±4
109	-3807.9	250.5	-3837	0.33	≤±4
110	-3806.9	253.0	-3837	0.34	≤±4
109	-3806.9	250.7	-3837	0.34	≤±4
108	-3812.9	248.2	-3837	0.27	≤±4
107	-3815.8	245.9	-3837	0.24	≤±4
106	-2857.3	243.7	-2878	0.24	≤±4
105	-1901.2	241.4	-1918	0.19	≤±4
104	-936.0	239.1	-959	0.26	≤±4
103	-57.4	236.9	0	-0.65	≤±4
102	-59.9	234.6	0	-0.68	≤±4
101	-61.7	232.3	0	-0.70	≤±4
100	-61.6	230.3	0	-0.70	≤±4

Diagram:

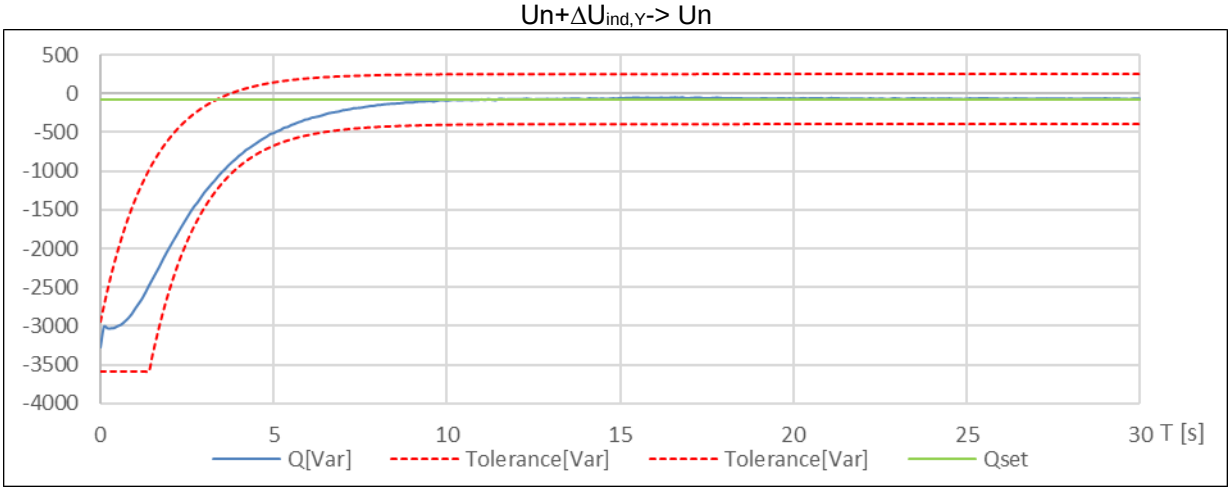

50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
-10.0%
-20.0%
-30.0%
-40.0%
-50.0%
Q/SEmax [%]
0.9
0.95
1
1.05
1.1
U/Un
Q standard
Q measurement

5.4.8.4(b)	TABLE: Tests of reactive power-voltage character curve (Q(U))					P
Test Conditions	Measurement			Target	Limit	
	Settling time T [s]	Q_{Start} [Var]	Q_{end} [Var]	Q_{end}/S_{Emax} [%]	Settling time T [s]	$\Delta Q_{end}/P_{Emax}$ [%]
Un -> Un+$\Delta U_{ind,Y}$	5.5	-139	-3268	0.37	Refer to PT-1 curve	--
Un+$\Delta U_{ind,Y}$-> Un	5.7	-3271	-77	0		≤±4
Un -> Un+$\Delta U_{ind,Y}$	5.6	-124	-3268	0.37		--
Un+$\Delta U_{ind,Y}$-> Un	5.6	-3760	-85	0		≤±4
Un -> Un+$\Delta U_{ind,Y}$	5.4	-130	-3262	0.37		--
Un+$\Delta U_{ind,Y}$-> Un	5.6	-3770	-88	0		≤±4
Un -> Un+$\Delta U_{cap,Y}$	5.3	45	3272	0.37		--
Un+$\Delta U_{cap,Y}$-> Un	5.3	3220	-55	0		≤±4
Un -> Un+$\Delta U_{cap,Y}$	5.8	37	3277	0.37		--
Un+$\Delta U_{cap,Y}$-> Un	5.6	3269	-14	0		≤±4
Un -> Un+$\Delta U_{cap,Y}$	5.5	40	3275	0.37		--
Un+$\Delta U_{cap,Y}$-> Un	5.5	3275	30	0		≤±4

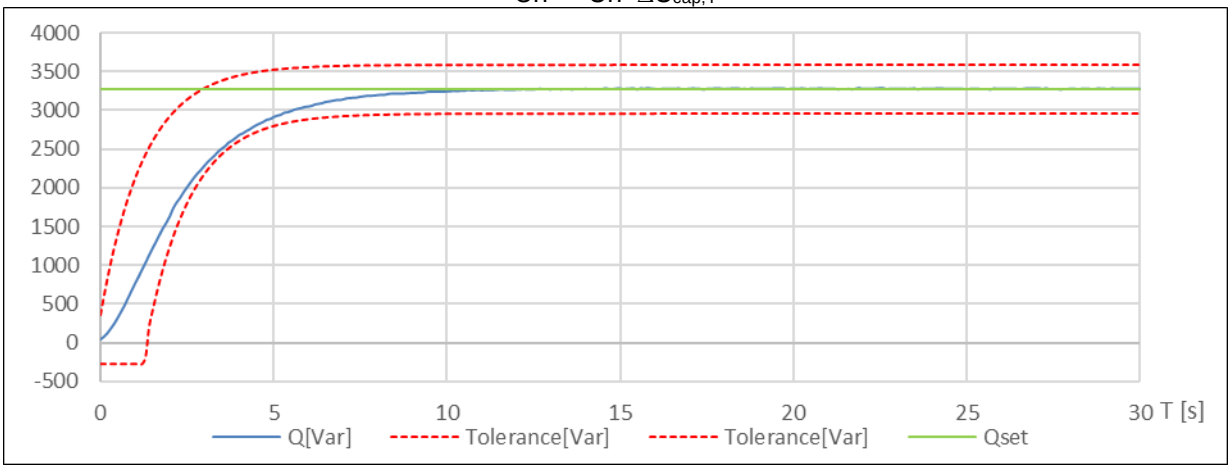
Plotting Diagram
Un -> Un+$\Delta U_{ind,Y}$



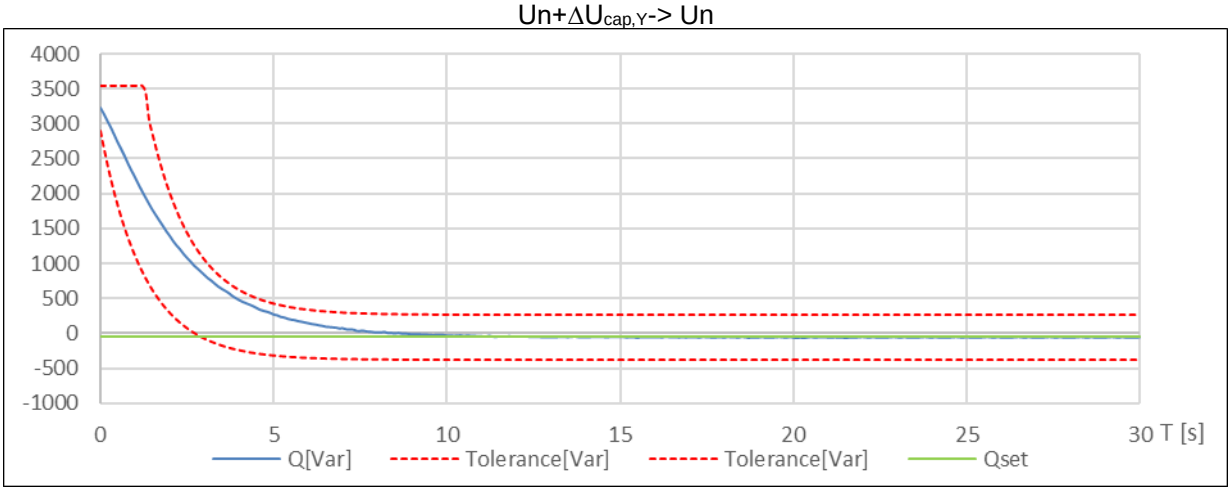
Un+$\Delta U_{ind,Y}$-> Un



Un -> Un+$\Delta U_{cap,Y}$



Un+$\Delta U_{cap,Y}$-> Un



Note(s): Xnet=1.06Ohm

5.5.2, 5.5.4, 5.5.6	TABLE: NS-protection, Integrated interface switch (Functional safety)	P

No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1.	PCE input	Reversed	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter does not work. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
2.	PCE input	s-c	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter does not work. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
3.	PCE input	Over-voltage	DC 480/850	30min			DC Input: 1050Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F55' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

4.	PCE input (only for multi-string)	Different input MPP1: low input MPP2: high input	DC 480/850	30min			DC Input: mpp1：480Vdc / 10.42A / 5kW mpp2：850Vdc / 5.88A / 5kW AC Output: 230Vac / 14.06A / 9.7kW FID: The inverter works normally. MT: n.a. SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
5.	PCE input (only for multi-string)	Same input (MPP1 & MPP2 from same power source)	DC 480/850	30min			DC Input:mpp1： 850Vdc / 5.88A / 5kW mpp2：850Vdc /5.88A / 5kW AC Output: 230Vac / 14.06A / 9.7kW FID: The inverter works normally. MT: n.a. SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
6.	PCE output	Power over-feed (OCP & OTP function controlled by DSP / software is disable)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that ‘F18’ was faulty. MT: SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

7.	PCE output	Over-voltage (OVP function controlled by DSP / software is disable)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 300Vac / 0A / 0kW FID: When output phase voltage rised from 230V to 300V,The inverter stopped working immediately, and the LCD showed that 'F26' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
8.	PCE output (A to B)	s-c	DC 480/850	30min			DC Input:850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F18' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
9.	PCE output (A to C)	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F18' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

10.	PCE output (B to C)	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F18' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
11.	PCE output	Phase sequence or polarity incorrect	DC 480/850	30min			DC Input: 850Vdc / 11.76A / 10kW AC Output: 230Vac / 14.06A / 9.7kW FID: The inverter works normally. MT: n.a. SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
12.	PCE output	A-Phase mis-wiring grid connection	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F42' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

13.	PCE output	B-Phase mis-wiring grid connection	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F42' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
14.	PCE output	C-Phase mis-wiring grid connection	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F42' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
15.	PCE Cooling system failure	Fan locked (MF1)	DC 480/850	30min			DC Input: 480Vdc / 10.83A / 5.2kW AC Output: 207Vac / 7.27A / 5kW FID: The inverter works normally. MT: Ambient=65℃, enclosure=68.61℃ SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

16.	PCE Cooling system failure	opening blocked	DC 480/850	30min			DC Input: 480Vdc / 10.83A / 5.2kW AC Output: 207Vac / 7.27A / 5kW FID: The inverter works normally. MT: n/a SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
17.	PCE output overload	o-l	DC 480/850	30min			DC Input: 480Vdc / 10.83A / 5.2kW AC Output: 207Vac / 7.27A / 5kW FID: The inverter works normally. MT: Ambient=65℃, enclosure=68.36℃ SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
18.	PCE Cooling system failure	blanket test	DC 480/850	30min			DC Input: 480Vdc / 10.83A / 5.2kW AC Output: 207Vac / 7.27A / 5kW FID: The inverter works normally. MT: Ambient=65℃, enclosure=68.8℃ SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes / ☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
MCU or DPS processer failure							

19.	DSP failure	+1.8V power supply disable	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'comm error' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
20.	DSP failure	+3.3V power supply disable	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'comm error' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
21.	DSP failure	+5V power supply disable	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'comm error' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
Loss of control & Function check fault							

22.	IGBT PMW	Loss / failure (no power)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F26' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
23.	IGBT PMW	Loss / failure (one bridge on always)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, the IGBT QR2 damaged, and the LCD showed that 'F26' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
24.	IGBT PMW	Loss / failure (No driver)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F26' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

25.	PV/DC Voltage detector C30 S-C	Loss / failure	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, the LCD showed that 'F41' was faulty, and the DC indicator on the LCD is off . MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
26.	PV/DC current detector R110 O-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, the LCD showed that 'F41' was faulty, and the DC indicator on the LCD is off . MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
27.	BUS Voltage detector C24 S-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F56' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

28.	Inverter current detector U3 3 to 4 S-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F26' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
29.	Inverter voltage detector R127 S-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 260Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F41' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
30.	Grid/AC voltage detector R331 S-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 260Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F41' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

31.	PV isolation device function check R39 S-C	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 260Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F24' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
32.	Relay / Contactor function check (RY1 o-c)	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F30' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
33.	Relay / Contactor function check (RY3 o-c)	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F30' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

34.	Relay / Contactor function check (RY5 o-c)	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F30' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
35.	RCD/RCM function check	Loss / failure	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F23' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
36.	Heat-sink temperature detector C38S-C	Loss / failure (s-c)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F64' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

37.	Heat-sink temperature detector R51O-C	Loss / failure(o-c)	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F64' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
Components single fault condition and Functional insulation on PWB short circuit test							
38.	IGBT (IGBT D-S) Q8 D-S S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the IGBT Q8,Q9 are damaged. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☐ Yes /☒ No, NCD: ☐ Yes /☒ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
39.	DC input Bus capacitor (820µF) C141 S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the Bus capacitor C142,C30,C39,C50 are damaged. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☐ Yes /☒ No, NCD: ☐ Yes /☒ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

40.	DC input filter capacitor C153 S-C	s-c	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter does not work. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
41.	LC filter capacitor C28 S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F18' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
42.	Power supply transformer (T1) 1 to 3 S-C	s-c	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD turns off. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
43.	Power supply transformer (T1) 4 to 5 S-C	s-c	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD turns off. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

44.	Power supply transformer (T1) 6 to 7 S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F41' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
45.	Power supply transformer (T1) 9 to 10 S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 11.76A / 10kW AC Output: 230Vac / 14.06A / 9.7kW FID: The inverter works properly, but wifi does not work properly. MT: n.a. SD: ☐ Yes /☒ No, GD: ☐ Yes /☒ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
46.	Power supply transformer (T1) 12 to 13 S-C	s-c	DC 480/850	30min			DC Input:850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F41' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

47.	Power supply transformer (T1) 14 to 15 S-C	s-c	DC 480/850	30min			DC Input: 850Vdc / 0A / 0W AC Output: 230Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD showed that 'F23' was faulty. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.
48.	Power supply transformer (T1) 15 to 16 S-C	s-c	DC 480/850	30min			DC Input: 0Vdc / 0A / 0W AC Output: 0Vac / 0A / 0kW FID: The inverter stopped working immediately, and the LCD turns off. MT: n.a. SD: ☒ Yes /☐ No, GD: ☒ Yes /☐ No RO: ☒ Yes /☐ No, NCD: ☒ Yes /☐ No NH: ☒ Pass / ☐ Fail. DST: ☒ Pass / ☐ Fail.

Legend (Special evaluation for PV Inverter abnormal test)

FID	Fault Indication	MT	Max. Temperature
SD	PCE Shut Down:	DG	Disconnection To Grid
RO	Recovered to Operate after removing the single fault setting	NCD	No comp. or parts damaged
NH	No hazards occurred	DST	Dielectric strength test
s-c	short-circuited	o-c	open-circuited
o-l	Over-load.		

Note(s):

5.5.7(a)	TABLE: Protection devices and protection settings (OV/UV)					P
Condition	Setting U/Un [%]	Measurement Trip value [V]				Limitation ΔU/Un [%]
		L123	L1	L2	L3	
U>>	125	288.1	288.6	288.5	288.8	≤±1.0
U<	80	183.6	183.1	182.8	183.3	
U<<	45	103.2	103.1	102.8	102.7	
Condition	Setting U/Un [%]	Measurement Trip value [V]				Limitation ΔU/Un [%]
		L123	L1-L2	L2-L3	L3-L1	
U>>	125	--	--	--	--	≤±1.0
U<	80	--	--	--	--	
U<<	45	--	--	--	--	
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1	L2	L3	
U>>	100	112	123	126	130	≤200
U<	3000	3035	3038	3032	3046	3000-3100
U<<	300	353	348	352	314	300-400
Condition	Setting	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-L2	L2-L3	L3-L1	
U>>	100	--	--	--	--	≤200
U<	3000	--	--	--	--	3000-3100
U<<	300	--	--	--	--	300-400
Condition	Setting [s]	Measurement Trip time [s]				Limitation [s]
		L123	L1	L2	L3	
U> 230->257.6	500	500.0	--	--	--	450-550
U> 230->248.4	No disconnect	No disconnect	--	--	--	No disconnect
U> 244->262.2	300	--	305.0	--	--	225-375
Note(s): Tests on L-L voltages are applicable to product over 30kVA.						

5.5.7(b)	TABLE: Protection devices and protection settings (OF/UF)		P
Condition	Setting f [Hz]	Measurement Trip value [Hz]	Limitation Δf/fn [%]
f>	51.5	51.5	≤±0.1
f<	47.5	47.5	
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
f>	100	110	≤200
f<	100	98	≤200
Note(s):			

5.5.7(c)	TABLE: Protection devices and protection settings		P
1.	The last 5 fault indication can be read	Pass	
	Fault 1:	Code"F48",AC lower frequency	
	Fault 2:	Code"F55",DC busbar voltage is too high	
	Fault 3:	Code"F45",AC Line U,V over voltage	
	Fault 4:	Code"F45",AC Line U,V over voltage	
	Fault 5:	Code"F35",No AC grid	
2.	Fault indication can be read after a supply interruption ≤3s	Pass	
	Fault 1:	Code"F35",No AC grid	
	Fault 2:	Code"F35",No AC grid	
	Fault 3:	Code"F55",DC busbar voltage is too high	
	Fault 4:	Code"F55",DC busbar voltage is too high	
	Fault 5:	Code"F55",DC busbar voltage is too high	

5.5.9	TABLE: Constructional features of NS protection		P
1.	The protection settings can be read on PGU or data interface equipment	Pass	
		Interface equipment:	
2.	The NS protection settings shall be protected.	Pass	
		Protection type:	
3.	If all protection settings are fixed	Pass	

5.5.10	TABLE: Islanding detection (per IEC 62116: 2014)					P
Power 100%						
Conditions	P_R [kW]	Q_L [kVar]	Q_C [kVar]	Q_f	Trip time [ms]	Limitation [ms]
P_R: -10% Q_C: +10%	L1: 2.40	L1: 3.11	L1: 2.94	1.061	257.8	
	L2: 2.39	L2: 3.07	L2: 2.94	1.095		9000
	L3: 2.40	L3: 3.03	L3: 2.94	1.097		
P_R: -10% Q_C: +5%	L1: 2.40	L1: 3.11	L1: 2.80	1.046	277.1	
	L2: 2.39	L2: 3.07	L2: 2.80	1.079		9000
	L3: 2.40	L3: 3.03	L3: 2.80	1.082		
P_R: -10% Q_C: 0%	L1: 2.40	L1: 3.11	L1: 2.67	1.031	267.2	
	L2: 2.39	L2: 3.07	L2: 2.67	1.064		9000
	L3: 2.40	L3: 3.03	L3: 2.67	1.066		
P_R: -10% Q_C: -5%	L1: 2.40	L1: 3.11	L1: 2.54	1.015	259.5	
	L2: 2.39	L2: 3.07	L2: 2.54	1.045		9000
	L3: 2.40	L3: 3.03	L3: 2.54	1.046		
P_R: -10% Q_C: -10%	L1: 2.40	L1: 3.11	L1: 2.40	1.000	163.9	
	L2: 2.39	L2: 3.07	L2: 2.40	1.032		9000
	L3: 2.40	L3: 3.03	L3: 2.40	1.033		
P_R: -5% Q_C: +10%	L1: 2.54	L1: 3.11	L1: 2.94	1.061	429.2	
	L2: 2.53	L2: 3.07	L2: 2.94	1.061		9000
	L3: 2.54	L3: 3.03	L3: 2.94	1.063		
P_R: -5% Q_C: -10%	L1: 2.54	L1: 3.11	L1: 2.40	1.000	170.5	
	L2: 2.53	L2: 3.07	L2: 2.40	1.001		9000
	L3: 2.54	L3: 3.03	L3: 2.40	1.001		
P_R: 0% Q_C: +10%	L1: 2.67	L1: 3.11	L1: 2.94	1.029	476.3	
	L2: 2.66	L2: 3.07	L2: 2.94	1.030		9000
	L3: 2.67	L3: 3.03	L3: 2.94	1.031		
P_R: -5% Q_C: +5%	L1: 2.54	L1: 3.11	L1: 2.80	1.046	479.8	
	L2: 2.53	L2: 3.07	L2: 2.80	1.047		9000
	L3: 2.54	L3: 3.03	L3: 2.80	1.048		
P_R: -5% Q_C: 0%	L1: 2.54	L1: 3.11	L1: 2.67	1.031	530.5	
	L2: 2.53	L2: 3.07	L2: 2.67	1.032		9000
	L3: 2.54	L3: 3.03	L3: 2.67	1.033		
P_R: -5% Q_C: -5%	L1: 2.54	L1: 3.11	L1: 2.54	1.015	173.5	
	L2: 2.53	L2: 3.07	L2: 2.54	1.017		9000
	L3: 2.54	L3: 3.03	L3: 2.54	1.017		
P_R: 0% Q_C: +5%	L1: 2.67	L1: 3.11	L1: 2.80	1.015	1043.0	
	L2: 2.66	L2: 3.07	L2: 2.80	1.016		9000

	L3: 2.67	L3: 3.03	L3: 2.80	1.016		
P_R: 0% Q_C: 0%	L1: 2.67	L1: 3.11	L1: 2.67	0.999		
	L2: 2.66	L2: 3.07	L2: 2.67	1.001	842.0	9000
	L3: 2.67	L3: 3.03	L3: 2.67	1.001		
P_R: 0% Q_C: -5%	L1: 2.67	L1: 3.11	L1: 2.54	0.985		
	L2: 2.66	L2: 3.07	L2: 2.54	0.987	494.6	9000
	L3: 2.67	L3: 3.03	L3: 2.54	0.986		
P_R: +5% Q_C: +5%	L1: 2.80	L1: 3.11	L1: 2.80	0.985		
	L2: 2.79	L2: 3.07	L2: 2.80	0.987	415.1	9000
	L3: 2.80	L3: 3.03	L3: 2.80	0.987		
P_R: +5% Q_C: 0%	L1: 2.80	L1: 3.11	L1: 2.67	0.971		
	L2: 2.79	L2: 3.07	L2: 2.67	0.973	808.9	9000
	L3: 2.80	L3: 3.03	L3: 2.67	0.972		
P_R: +5% Q_C: -5%	L1: 2.80	L1: 3.11	L1: 2.54	0.957		
	L2: 2.79	L2: 3.07	L2: 2.54	0.959	418.0	9000
	L3: 2.80	L3: 3.03	L3: 2.54	0.958		
P_R: 0% Q_C: -10%	L1: 2.67	L1: 3.11	L1: 2.40	0.970		
	L2: 2.66	L2: 3.07	L2: 2.40	0.972	154.7	9000
	L3: 2.67	L3: 3.03	L3: 2.40	0.971		
P_R: +5% Q_C: +10%	L1: 2.80	L1: 3.11	L1: 2.94	0.999		
	L2: 2.79	L2: 3.07	L2: 2.94	1.001	633.5	9000
	L3: 2.80	L3: 3.03	L3: 2.94	1.001		
P_R: +5% Q_C: -10%	L1: 2.80	L1: 3.11	L1: 2.40	1.000		
	L2: 2.79	L2: 3.07	L2: 2.40	1.001	158.5	9000
	L3: 2.80	L3: 3.03	L3: 2.40	1.001		
P_R: +10% Q_C: +10%	L1: 2.94	L1: 3.11	L1: 2.94	0.971		
	L2: 2.93	L2: 3.07	L2: 2.94	0.973	556.4	9000
	L3: 2.94	L3: 3.03	L3: 2.94	0.973		
P_R: +10% Q_C: +5%	L1: 2.94	L1: 3.11	L1: 2.80	0.958		
	L2: 2.93	L2: 3.07	L2: 2.80	0.960	818.5	9000
	L3: 2.94	L3: 3.03	L3: 2.80	0.959		
P_R: +10% Q_C: 0%	L1: 2.94	L1: 3.11	L1: 2.67	0.952		
	L2: 2.93	L2: 3.07	L2: 2.67	0.954	574.0	9000
	L3: 2.94	L3: 3.03	L3: 2.67	0.953		
P_R: +10% Q_C: -5%	L1: 2.94	L1: 3.11	L1: 2.54	0.958		
	L2: 2.93	L2: 3.07	L2: 2.54	0.960	701.9	9000
	L3: 2.94	L3: 3.03	L3: 2.54	0.959		
P_R: +10% Q_C: -10%	L1: 2.94	L1: 3.11	L1: 2.40	0.972		
	L2: 2.93	L2: 3.07	L2: 2.40	0.973	179.2	9000

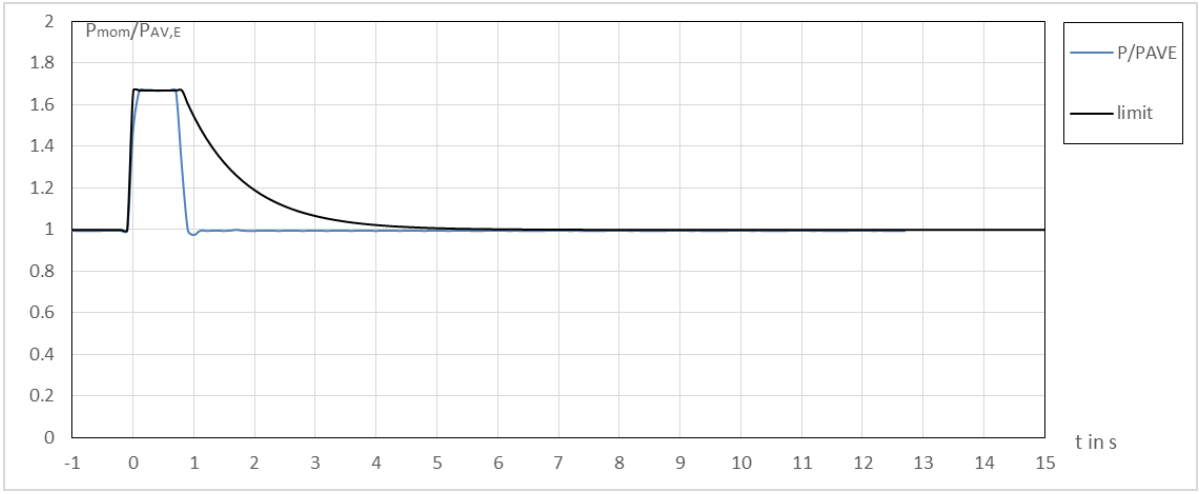
	L3: 2.94	L3: 3.03	L3: 2.40	0.973		
Power 66%						
Conditions	P_R [kW]	Q_L [kVar]	Q_C [kVar]	Q_f	Trip time [ms]	Limitation [ms]
P_R: 0% Q_C: -5%	L1: 1.76	L1: 2.07	L1: 1.68	0.963	175.9	
	L2: 1.76	L2: 2.04	L2: 1.67	0.964		9000
	L3: 1.76	L3: 2.09	L3: 1.67	0.963		
P_R: 0% Q_C: -4%	L1: 1.76	L1: 2.07	L1: 1.70	0.970	276.0	
	L2: 1.76	L2: 2.04	L2: 1.69	0.972		9000
	L3: 1.76	L3: 2.09	L3: 1.69	0.970		
P_R: 0% Q_C: -3%	L1: 1.76	L1: 2.07	L1: 1.72	0.978	300.8	
	L2: 1.76	L2: 2.04	L2: 1.71	0.980		9000
	L3: 1.76	L3: 2.09	L3: 1.71	0.978		
P_R: 0% Q_C: -2%	L1: 1.76	L1: 2.07	L1: 1.73	0.985	461.5	
	L2: 1.76	L2: 2.04	L2: 1.72	0.987		9000
	L3: 1.76	L3: 2.09	L3: 1.72	0.985		
P_R: 0% Q_C: -1%	L1: 1.76	L1: 2.07	L1: 1.75	0.993	579.3	
	L2: 1.76	L2: 2.04	L2: 1.74	0.995		9000
	L3: 1.76	L3: 2.09	L3: 1.74	0.993		
P_R: 0% Q_C: 0%	L1: 1.76	L1: 2.07	L1: 1.77	1.000	780.0	
	L2: 1.76	L2: 2.04	L2: 1.76	1.002		9000
	L3: 1.76	L3: 2.09	L3: 1.76	1.000		
P_R: 0% Q_C: +1%	L1: 1.76	L1: 2.07	L1: 1.79	1.007	682.8	
	L2: 1.76	L2: 2.04	L2: 1.78	1.010		9000
	L3: 1.76	L3: 2.09	L3: 1.78	1.007		
P_R: 0% Q_C: +2%	L1: 1.76	L1: 2.07	L1: 1.81	1.014	515.1	
	L2: 1.76	L2: 2.04	L2: 1.80	1.017		9000
	L3: 1.76	L3: 2.09	L3: 1.80	1.015		
P_R: 0% Q_C: +3%	L1: 1.76	L1: 2.07	L1: 1.82	1.022	392.7	
	L2: 1.76	L2: 2.04	L2: 1.81	1.024		9000
	L3: 1.76	L3: 2.09	L3: 1.81	1.022		
P_R: 0% Q_C: +4%	L1: 1.76	L1: 2.07	L1: 1.84	1.029	288.6	
	L2: 1.76	L2: 2.04	L2: 1.83	1.032		9000
	L3: 1.76	L3: 2.09	L3: 1.83	1.029		
P_R: 0% Q_C: +5%	L1: 1.76	L1: 2.07	L1: 1.86	1.036	176.6	
	L2: 1.76	L2: 2.04	L2: 1.85	1.039		9000
	L3: 1.76	L3: 2.09	L3: 1.85	1.036		
Power 33%						

Conditions	P_R [kW]	Q_L [kVar]	Q_C [kVar]	Q_f	Trip time [ms]	Limitation [ms]
P_R: 0% Q_c: -5%	L1: 0.88	L1: 0.99	L1: 0.84	0.976	177.7	
	L2: 0.88	L2: 0.99	L2: 0.84	0.979		9000
	L3: 0.88	L3: 1.00	L3: 0.84	0.976		
P_R: 0% Q_c: -4%	L1: 0.88	L1: 0.99	L1: 0.84	0.981	353.1	
	L2: 0.88	L2: 0.99	L2: 0.84	0.984		9000
	L3: 0.88	L3: 1.00	L3: 0.84	0.981		
P_R: 0% Q_c: -3%	L1: 0.88	L1: 0.99	L1: 0.85	0.986	516.3	
	L2: 0.88	L2: 0.99	L2: 0.85	0.989		9000
	L3: 0.88	L3: 1.00	L3: 0.85	0.986		
P_R: 0% Q_c: -2%	L1: 0.88	L1: 0.99	L1: 0.86	0.990	579.7	
	L2: 0.88	L2: 0.99	L2: 0.86	0.994		9000
	L3: 0.88	L3: 1.00	L3: 0.86	0.990		
P_R: 0% Q_c: -1%	L1: 0.88	L1: 0.99	L1: 0.87	0.995	693.9	
	L2: 0.88	L2: 0.99	L2: 0.87	0.999		9000
	L3: 0.88	L3: 1.00	L3: 0.87	0.995		
P_R: 0% Q_c: 0%	L1: 0.88	L1: 0.99	L1: 0.88	1.000	891.3	
	L2: 0.88	L2: 0.99	L2: 0.88	1.004		9000
	L3: 0.88	L3: 1.00	L3: 0.88	1.000		
P_R: 0% Q_c: +1%	L1: 0.88	L1: 0.99	L1: 0.89	1.005	790.4	
	L2: 0.88	L2: 0.99	L2: 0.89	1.009		9000
	L3: 0.88	L3: 1.00	L3: 0.89	1.005		
P_R: 0% Q_c: +2%	L1: 0.88	L1: 0.99	L1: 0.90	1.009	528.0	
	L2: 0.88	L2: 0.99	L2: 0.90	1.014		9000
	L3: 0.88	L3: 1.00	L3: 0.90	1.009		
P_R: 0% Q_c: +3%	L1: 0.88	L1: 0.99	L1: 0.91	1.014	485.1	
	L2: 0.88	L2: 0.99	L2: 0.91	1.019		9000
	L3: 0.88	L3: 1.00	L3: 0.91	1.014		
P_R: 0% Q_c: +4%	L1: 0.88	L1: 0.99	L1: 0.92	1.019	324.3	
	L2: 0.88	L2: 0.99	L2: 0.92	1.024		9000
	L3: 0.88	L3: 1.00	L3: 0.92	1.019		
P_R: 0% Q_c: +5%	L1: 0.88	L1: 0.99	L1: 0.92	1.023	168.3	
	L2: 0.88	L2: 0.99	L2: 0.92	1.029		9000
	L3: 0.88	L3: 1.00	L3: 0.92	1.024		

5.6	TABLE: Connection conditions and synchronization (Reconnection)			P
Condition	Measurement		Limitation	
	Reconnection	Delay time [s]	Reconnection	Delay time [s]
f<47.45Hz	No	--	No	≥60
f≥47.55Hz	Yes	112	Yes	≥60
f>50.15Hz	No	--	No	≥60
f≤50.05Hz	Yes	111	Yes	≥60
U<0.84Un	No	--	No	≥60
U≥0.86Un	Yes	118	Yes	≥60
U>1.11Un	No	--	No	≥60
U≤1.09Un	Yes	115	Yes	≥60
Note(s):				

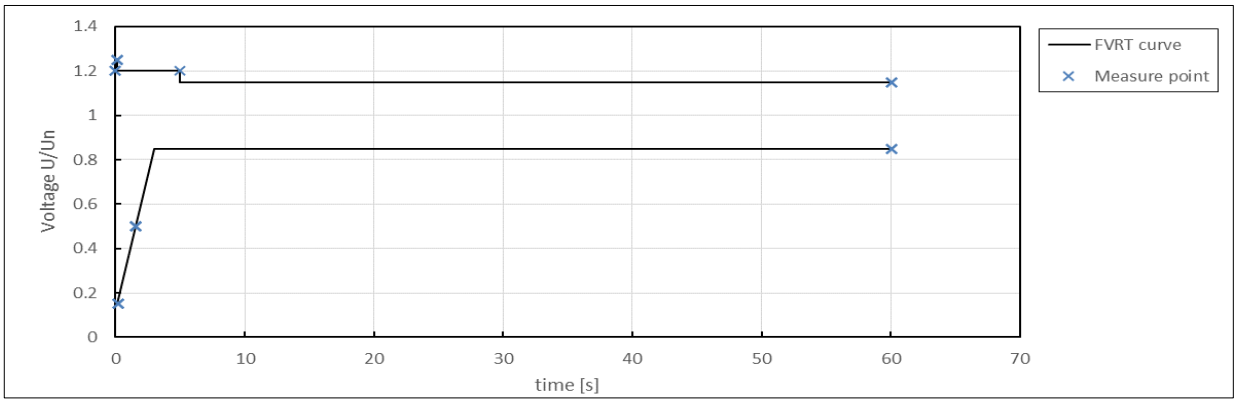
5.7	TABLE: $P_{AV,E}$ monitoring	P
$P_{AV,E}$ value setting: 60% Pn		
Power limit method		
Test method	Condition	
Cut of load	P_{load}/Pn: 40%->0%	

Power curve:



5.8	TABLE: Verification of dynamic network supporting (FVRT)	P

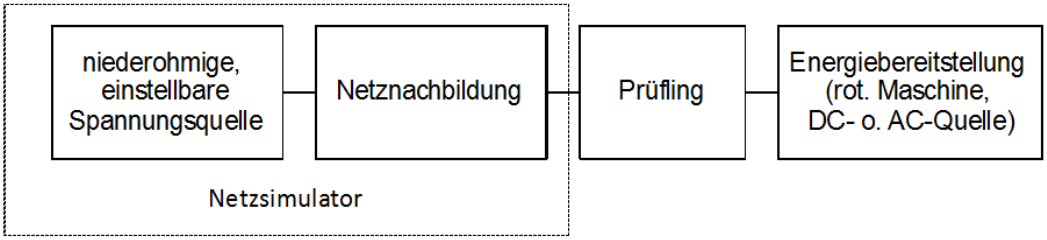
FRT curve settings:



Fault Type	3-phase fault and 2-phase fault
Transformer Type	Dy5
NS protection settings	See table 5.5.7 for detail.
Any auxilliary power supply in fault ride through?	Yes/No
Terminal sequence	For D1: U-L1, V-L2, W-L3 For D2: U-L3, V-L1, W-L2

Test Procedure:

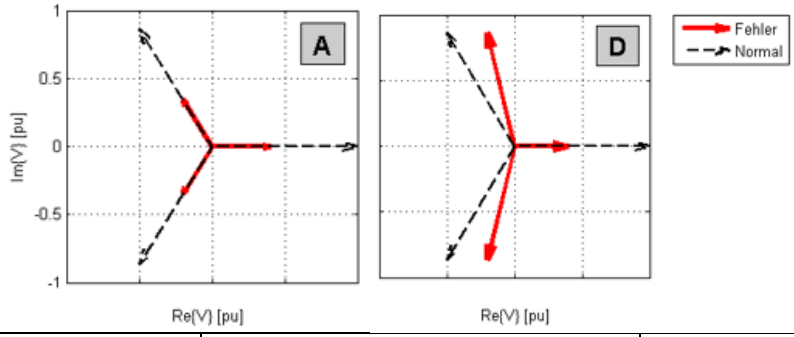
Test Equipment:



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

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

Grid simulator settings for asymmetry grid fault:



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

VDE No.	U	V	W	Type	Remark
--	1.00, -150°	1.00, 90°	1.00, -30°	A	Initial status
1.3, 1.4	0.62, -173.3°	0.15, 90°	0.62, -6.9°	D	UVRT
2.3, 2.4, 3.3, 3.4	0.76, -161.1°	0.50, 90°	0.76, -19.1°	D	
4.3, 4.4	0.93, -152.8°	0.85, 89.9°	0.93, -27.4°	D	
5.3, 5.4	1.08, -144.5°	1.25, 89.1°	1.06, -36.3°	D	OVRT
6.3, 6.4	1.06, -145.5°	1.20, 89.3°	1.05, -35.1°	D	
7.3, 7.4	1.04, -146.6°	1.15, 89.4°	1.04, -33.9°	D	

Diagram:

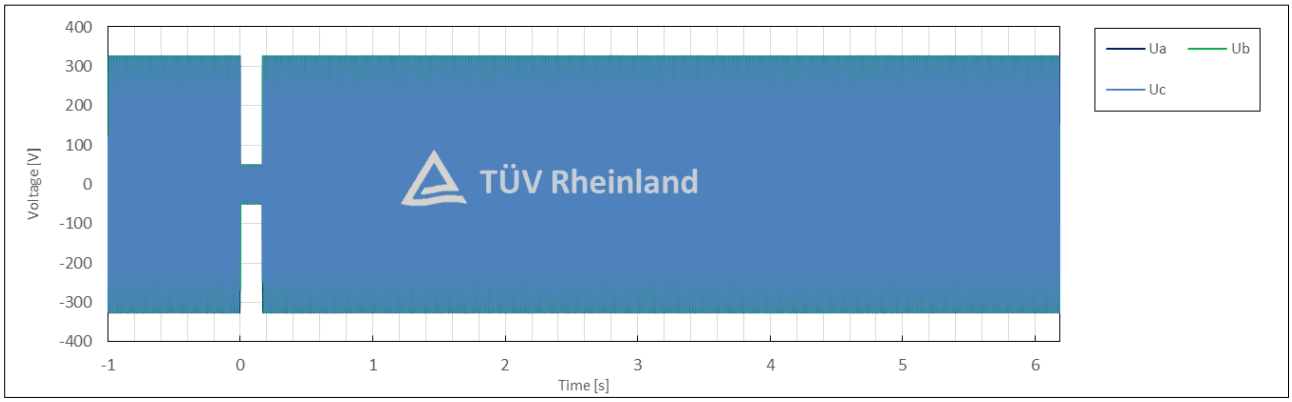
For each test the following diagrams shall be figured since t1-1s (one second before fault entry) till t2+6s (six seconds after fault clear), zoomed if needed:
Empty load tests:
- line to line voltages and line to neutral voltages (signal)
- full period-RMS value of line to neutral voltages with updated rate of 1/ms.

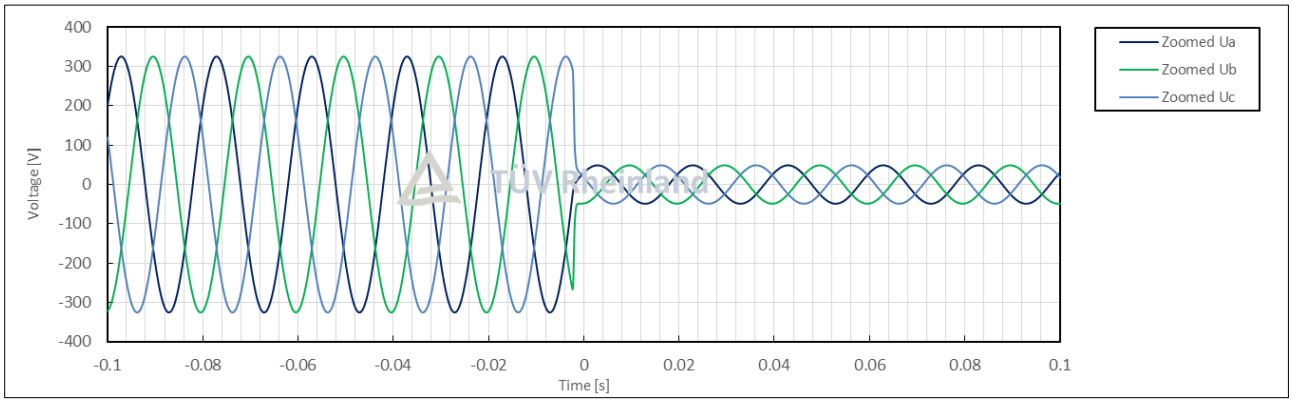
Tests with sample:
- line to line voltage and line to neutral voltage (signal)
- line currents (signal)
- full period-RMS value of line to neutral voltage with updated rate of 1/ms
- full period-RMS value of line currents with updated rate of 1/ms (active and reactive part additionally)
- active power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

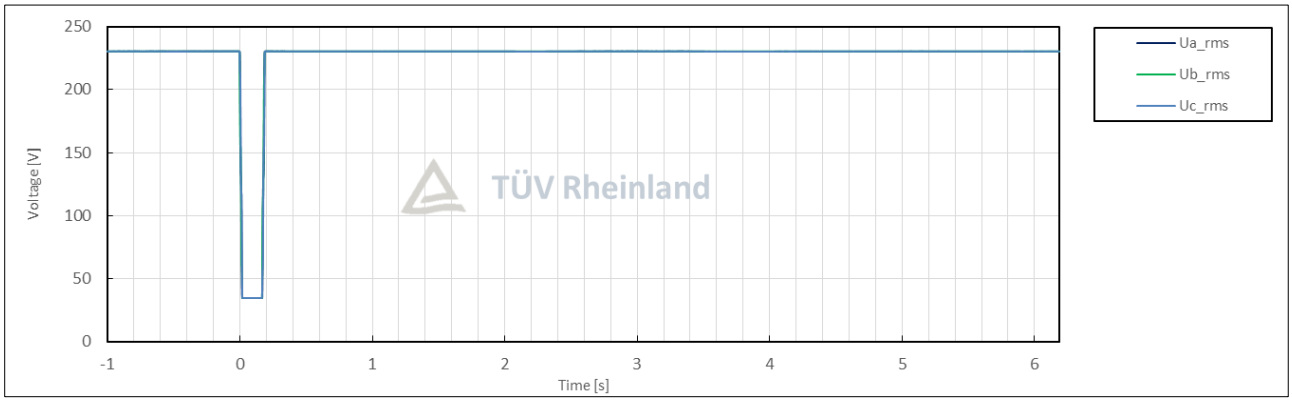
Test	U/Un [p.u.]	Fault type	Fault duration [ms]	P/Pn [p.u.]	Q/Pn [p.u.]	Test No.
1	0.15…..0.25	A	For 0.15pu ≥150 For 0.25pu ≥500	1.0	0…±0.1	1.1
				0.2…0.6		1.2
		D1		1.0		1.3
				0.2…0.6		1.4
		D2		1.0		1.3 (D2)
2	0.50….0.60	A	For 0.5pu ≥1500 For 0.60pu ≥ 2000	1.0	Max. over-excited	2.1
				0.2…0.6		2.2
		D1		1.0		2.3
				0.2…0.6		2.4
3	0.50….0.60	A	For 0.5pu ≥1500 For 0.60pu ≥ 2000	1.0	Max. under-excited	3.1
				0.2…0.6		3.2
		D1		1.0		3.3
				0.2…0.6		3.4
4	0.85….0.90	A	≥ 60000	1.0	0…±0.1	4.1
				0.2…0.6		4.2
		D1		1.0		4.3
				0.2…0.6		4.4
5	1.2….1.25	A	≥ 100	1.0	0…±0.1	5.1
				0.2…0.6		5.2
		D1		1.0		5.3
				0.2…0.6		5.4
		D2		1.0		5.3 (D2)
6	1.15…1.20	A	≥ 5000	1.0	0…±0.1	6.1
				0.2…0.6		6.2
		D1		1.0		6.3
				0.2…0.6		6.4
7	1.10…1.15	A	≥ 60000	1.0	0…±0.1	7.1
				0.2…0.6		7.2
		D1		1.0		7.3

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.1
	1	Date	--	--	dd.mm.yyyy	06.13.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	23:36:53
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--		186
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	186
	8	Fault duration in empty load test	Total	--	ms	186
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15
	10		Pos.		p.u.	0.15
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.02
	16		Pos.			-0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.00
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.143
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.02
	32		Pos.			-0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

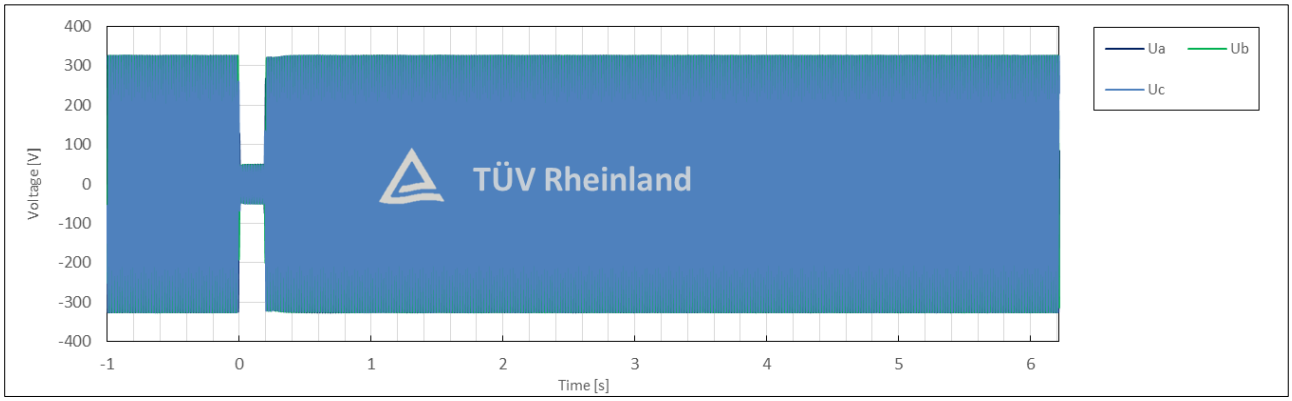
Test No. 1.1 idle test

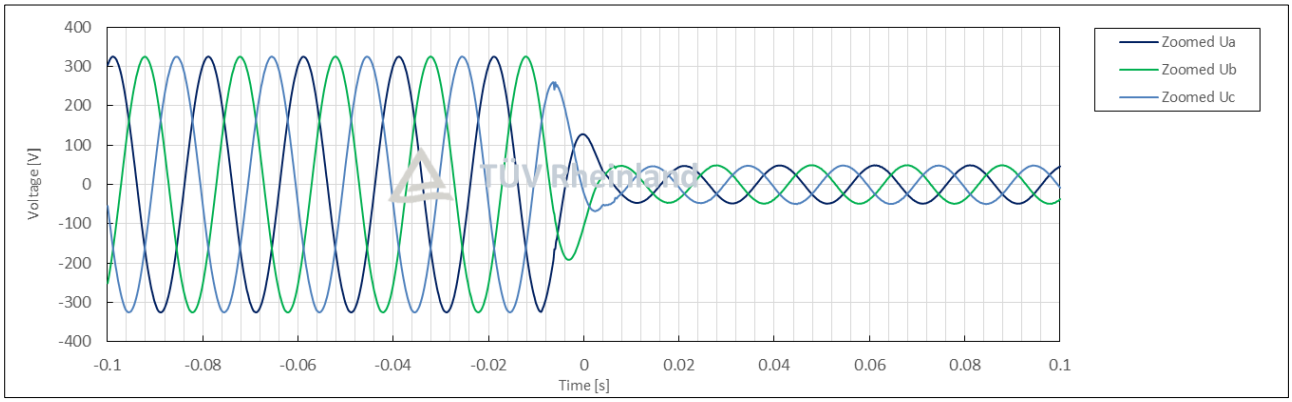


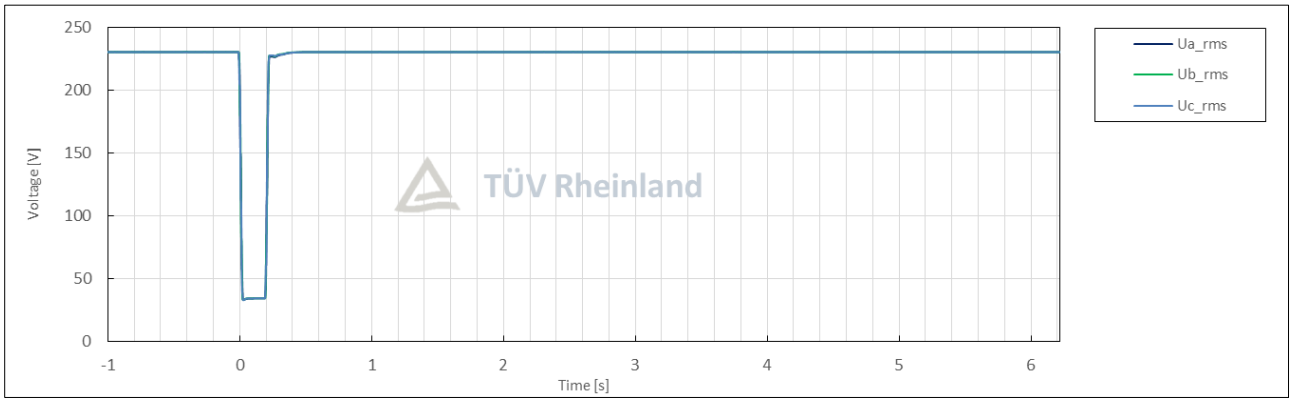


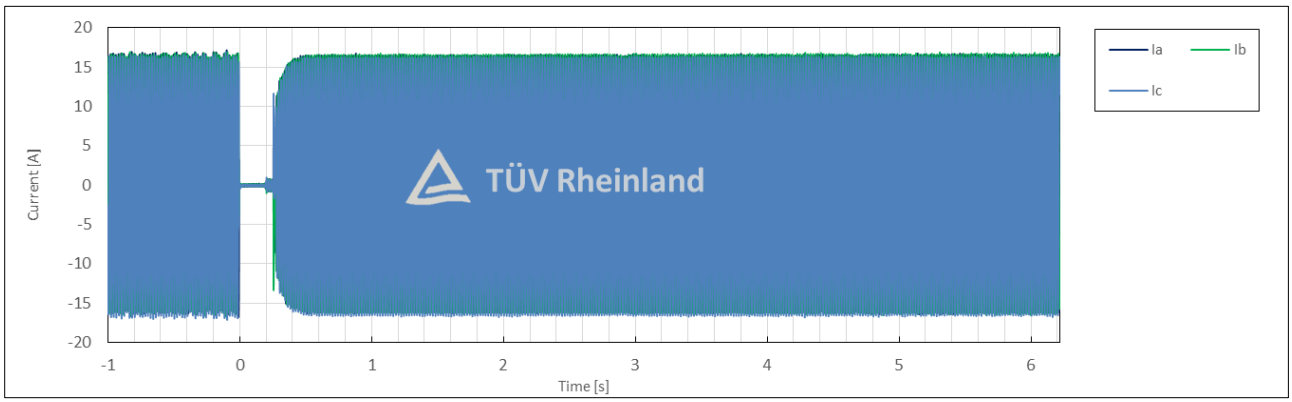


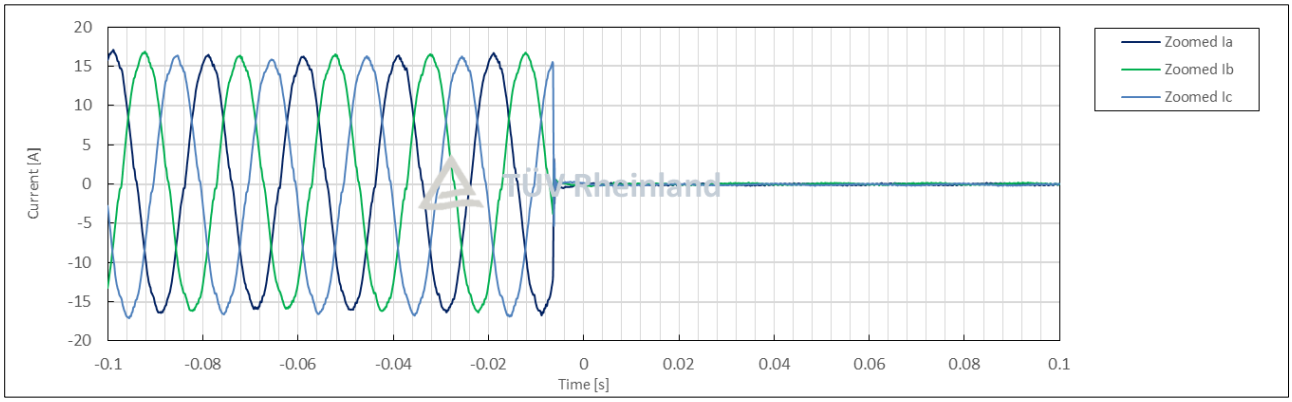
Test No. 1.1 with PGU

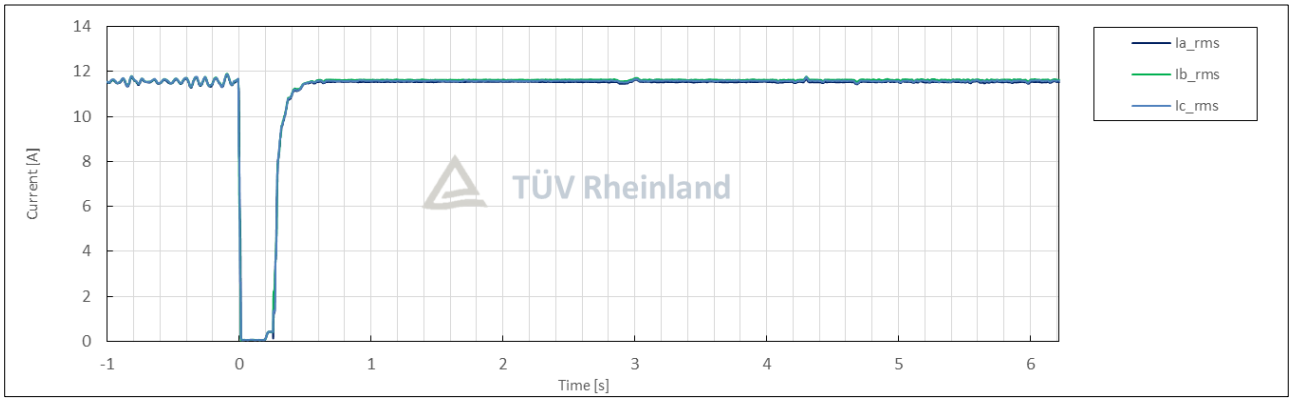


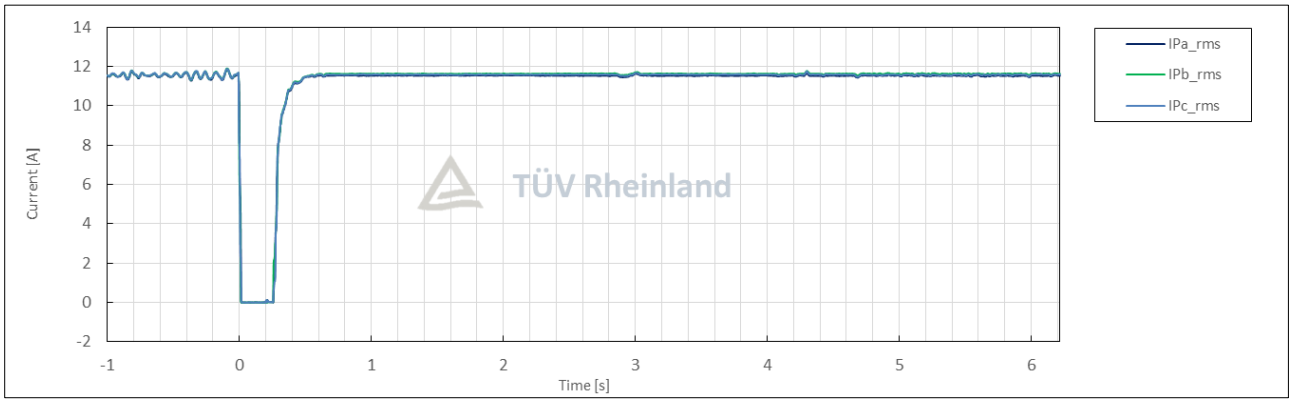


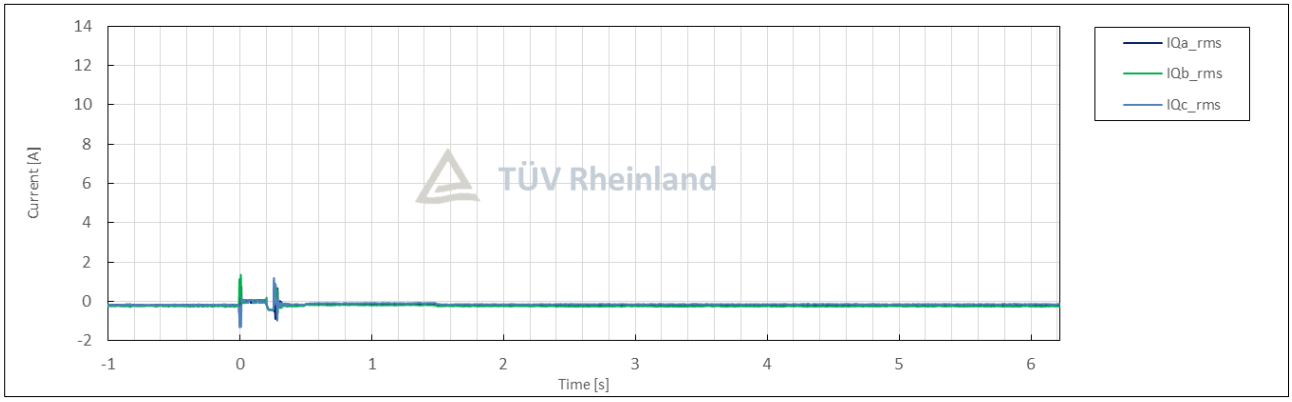


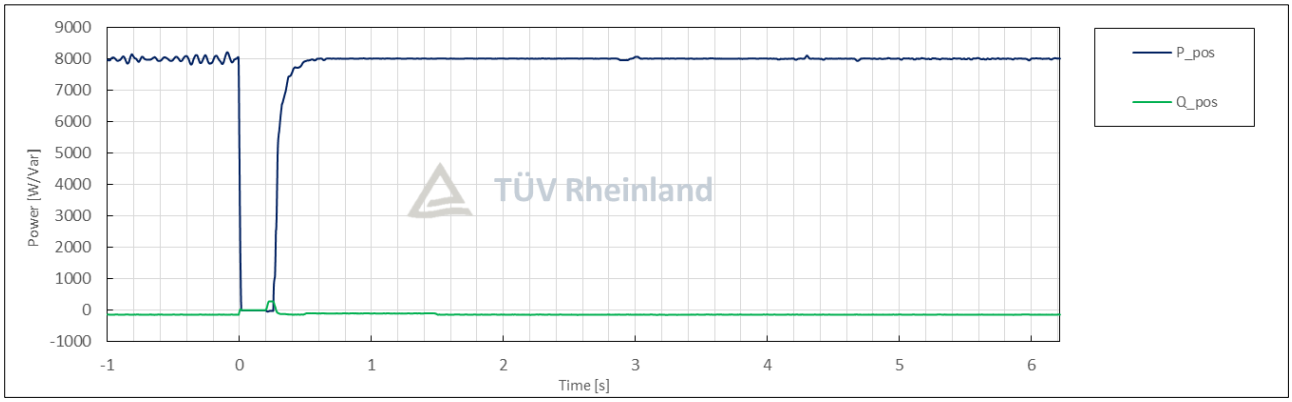


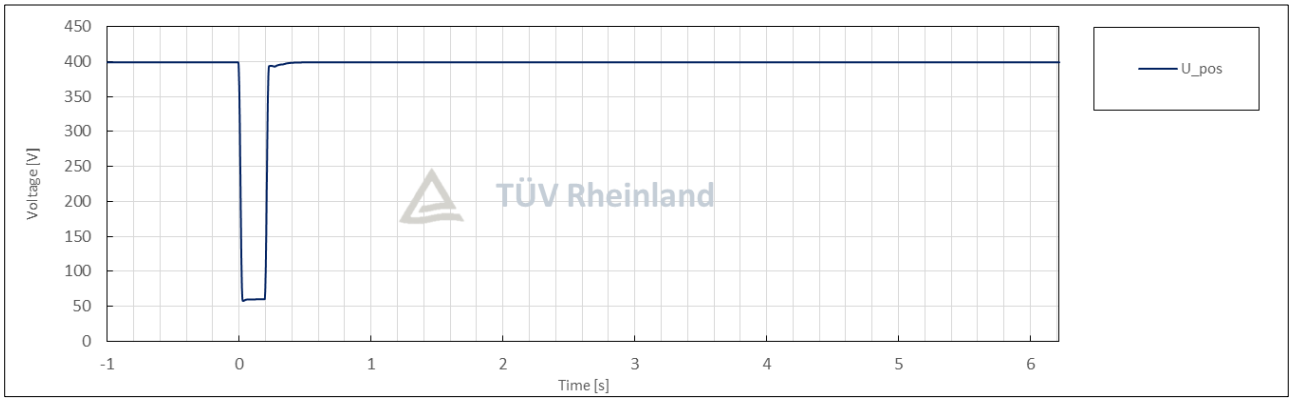

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

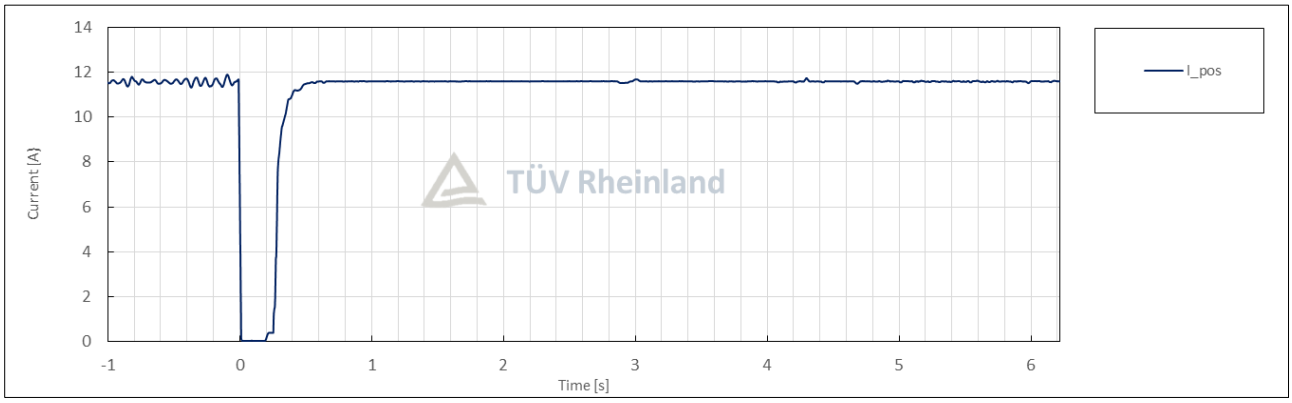

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

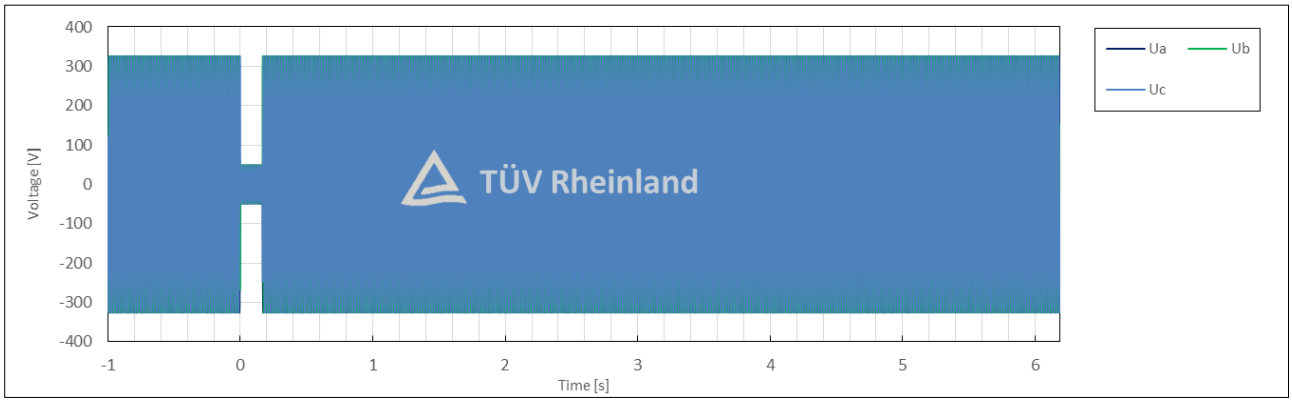

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

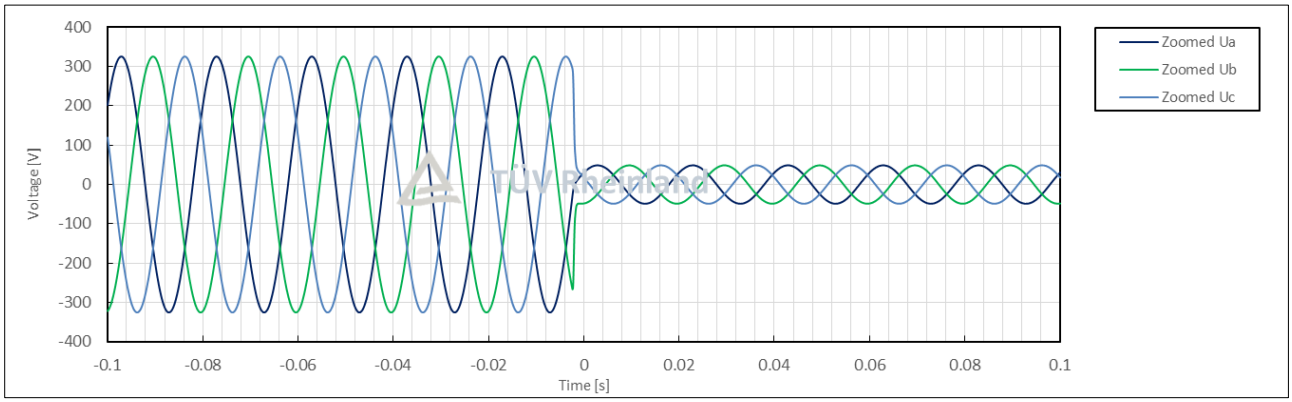

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

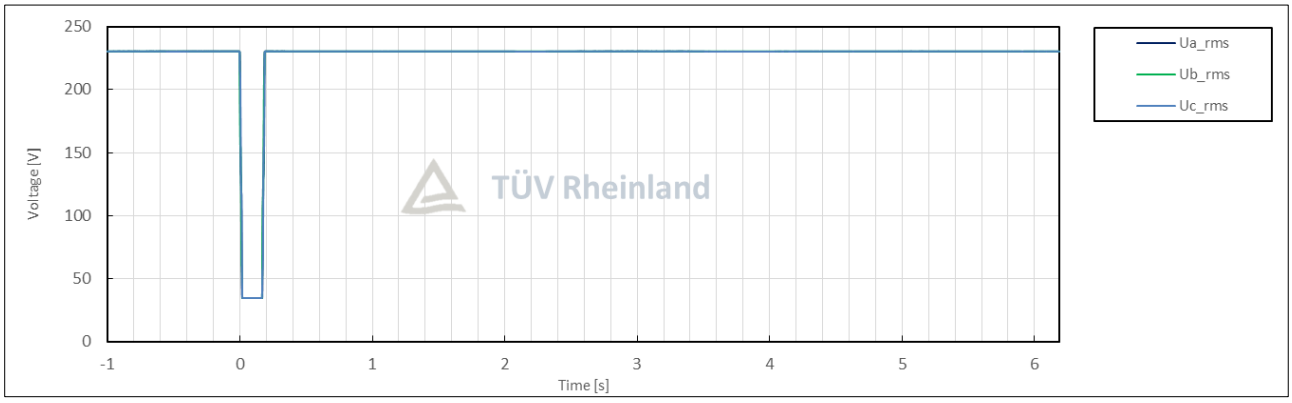

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.2
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:58:32
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--		186
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	186
	8	Fault duration in empty load test	Total	--	ms	186
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15
	10		Pos.		p.u.	0.15
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			-0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.03
	20		Phase 2			0.03
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.293
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			-0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

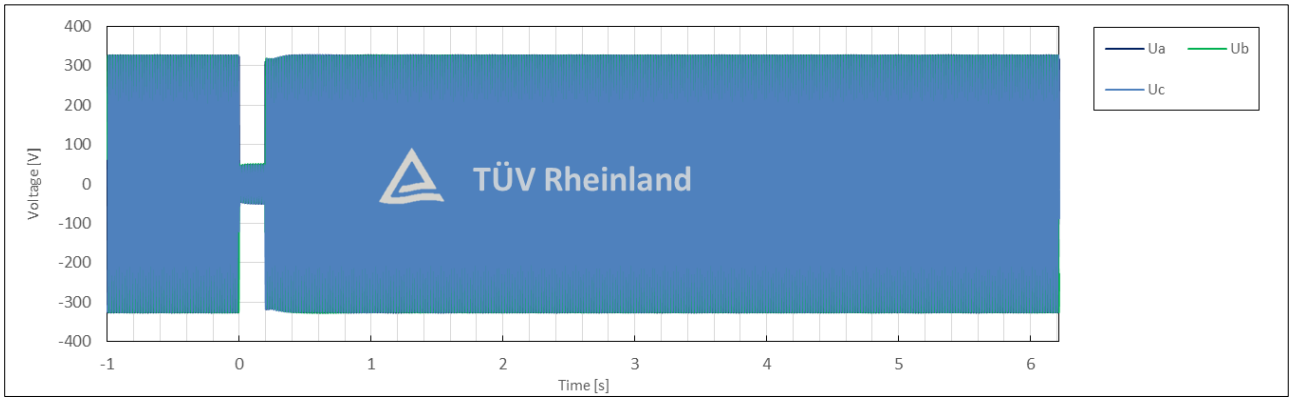
Test No. 1.2 idle test

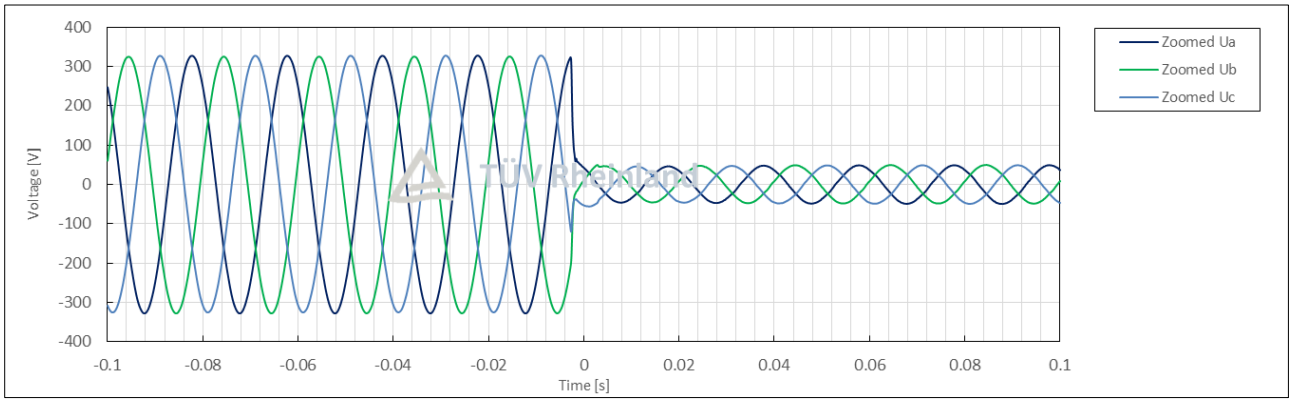


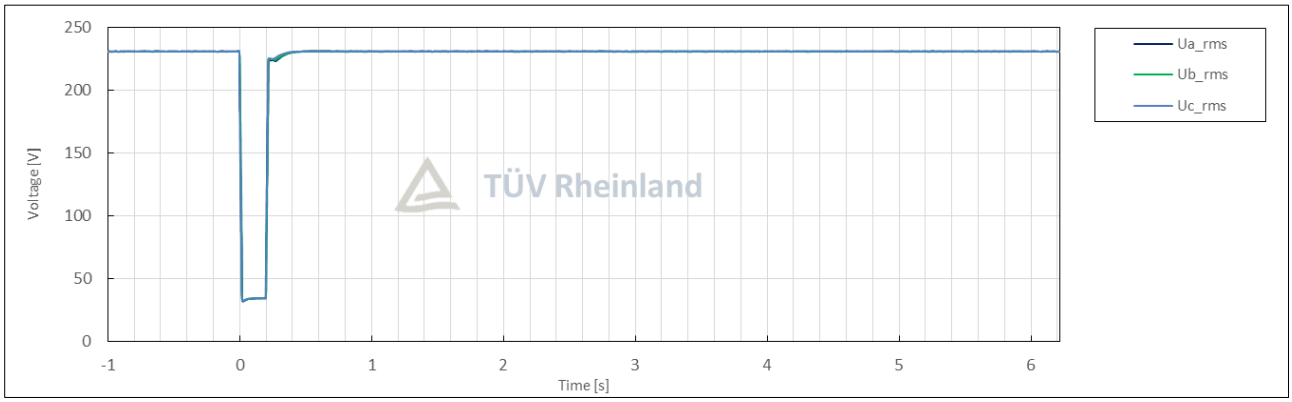


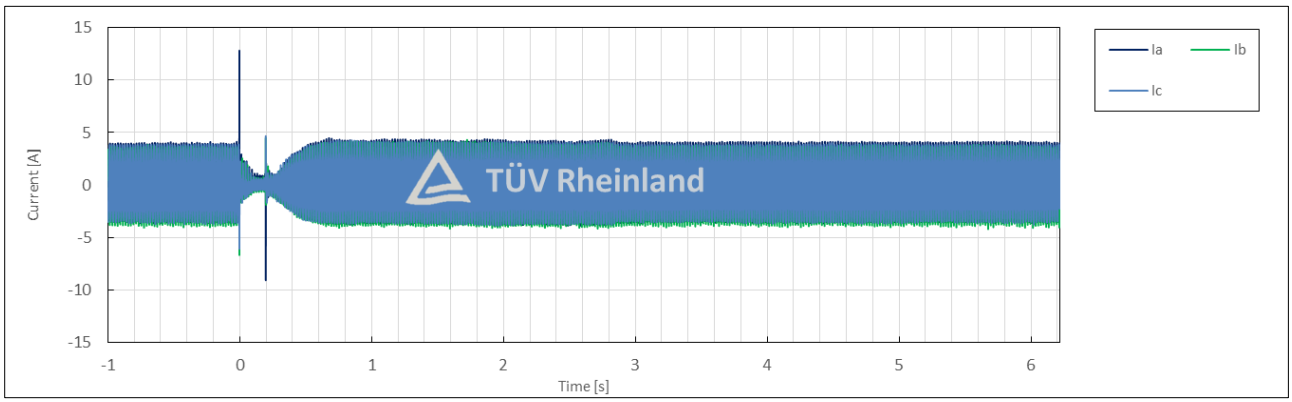


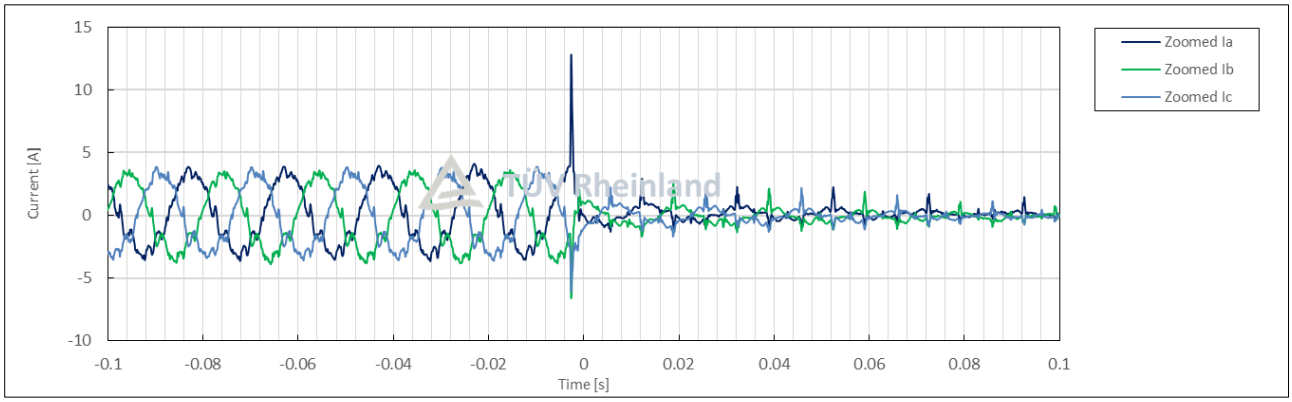
Test No. 1.2 with PGU

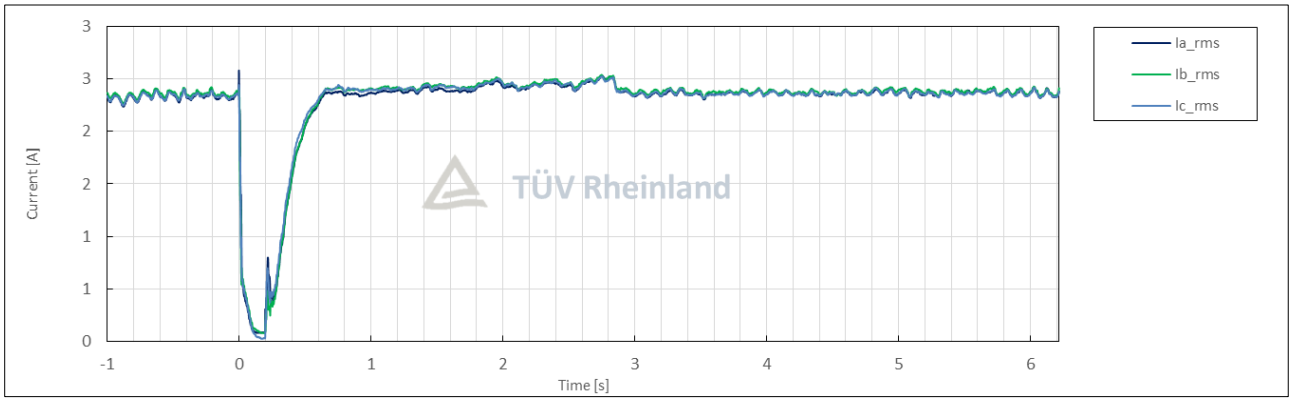


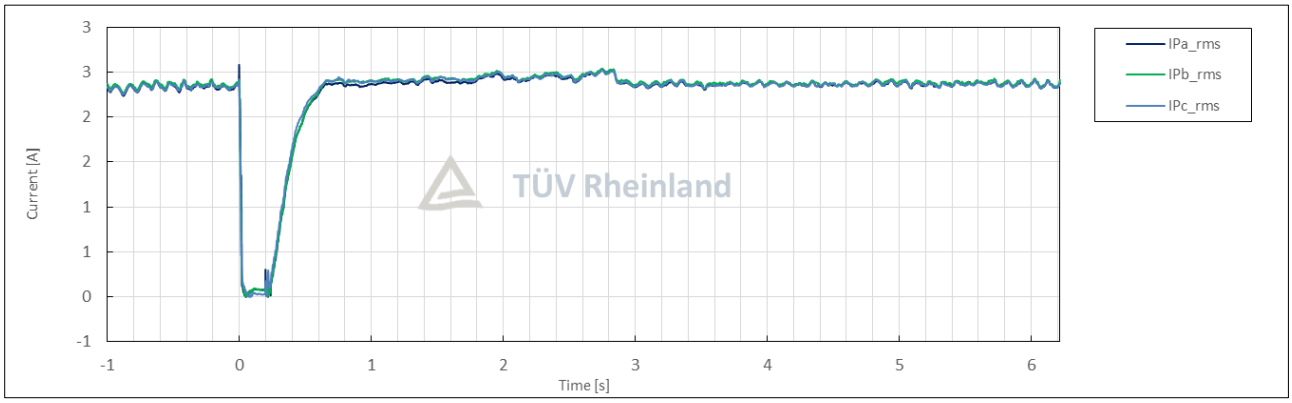


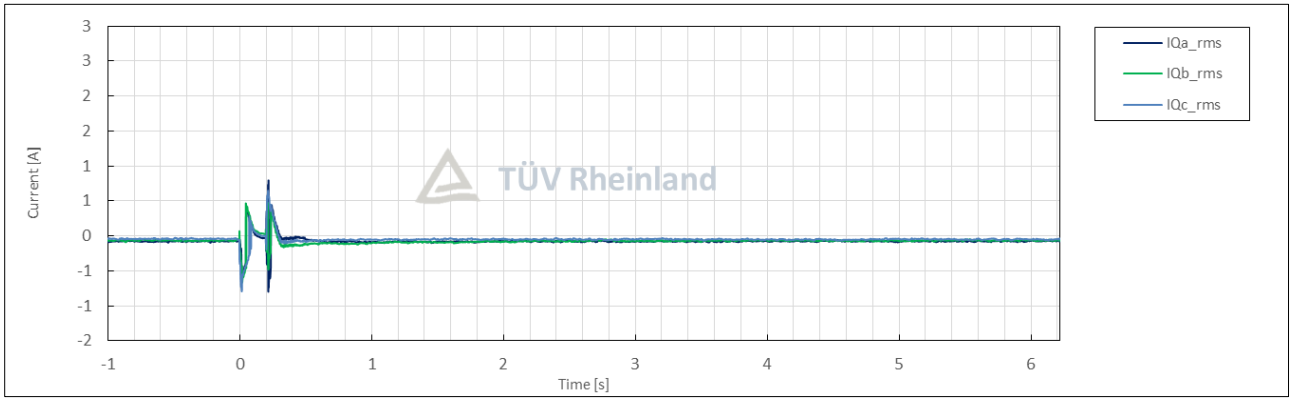


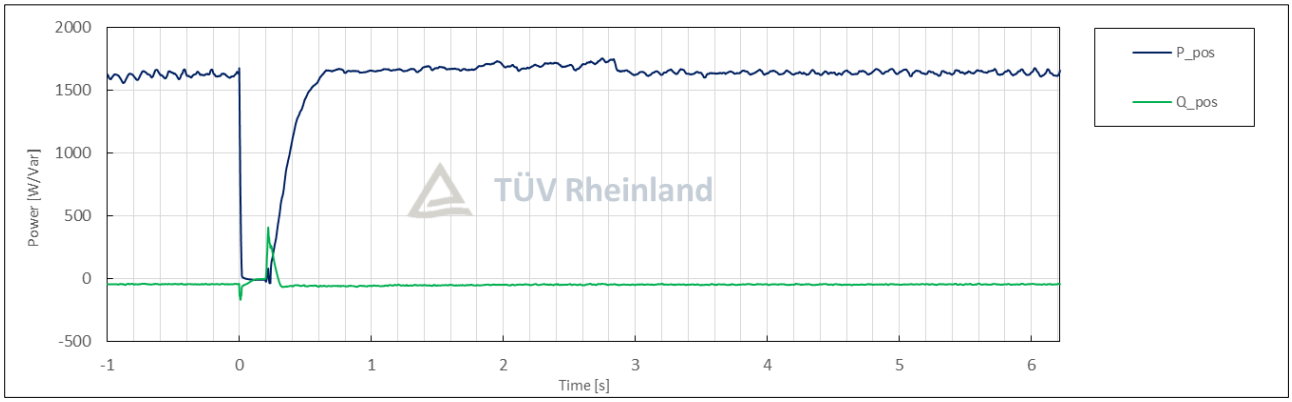


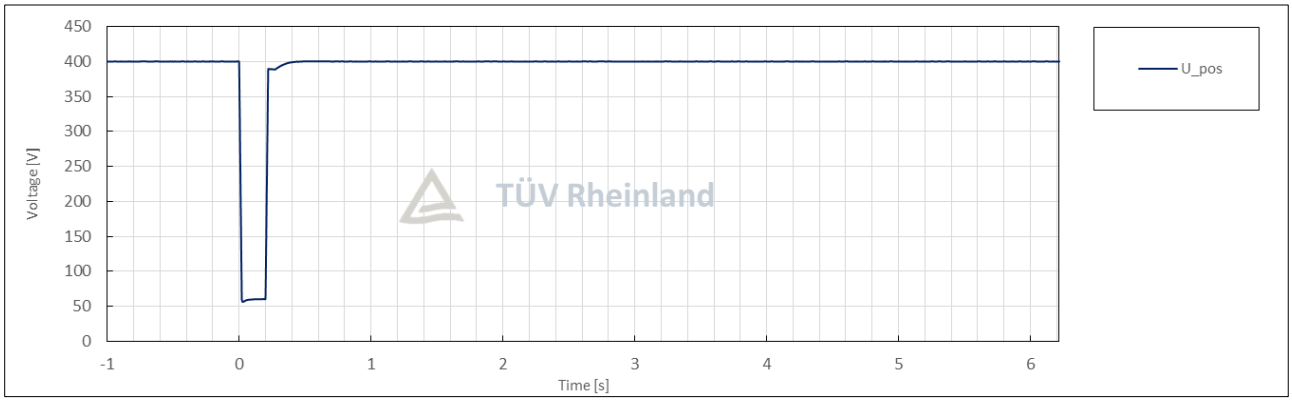

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

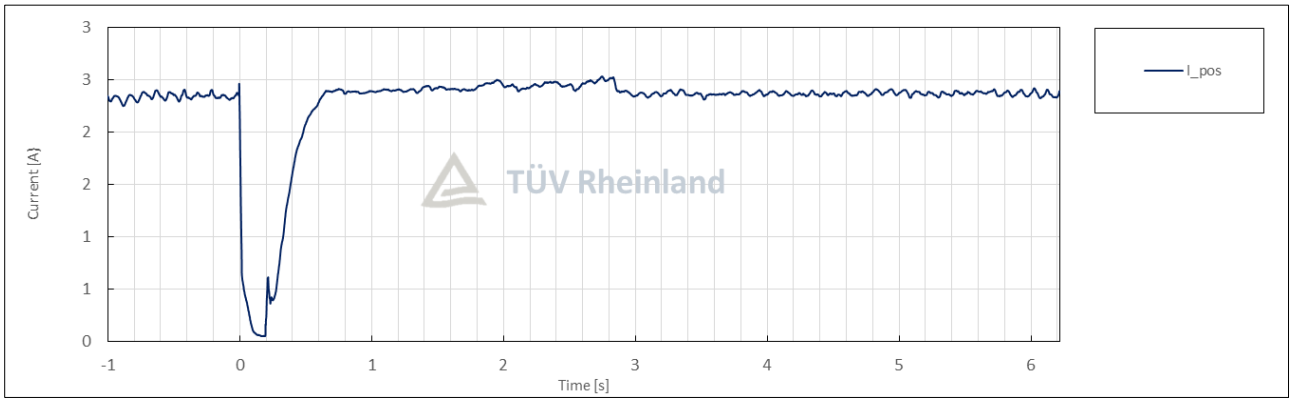

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

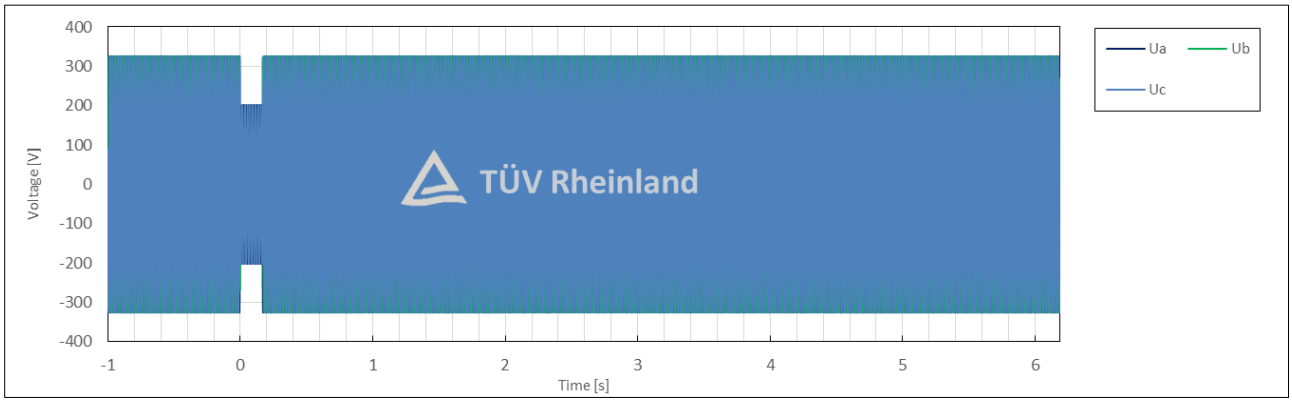

2000
1500
1000
500
0
-500
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

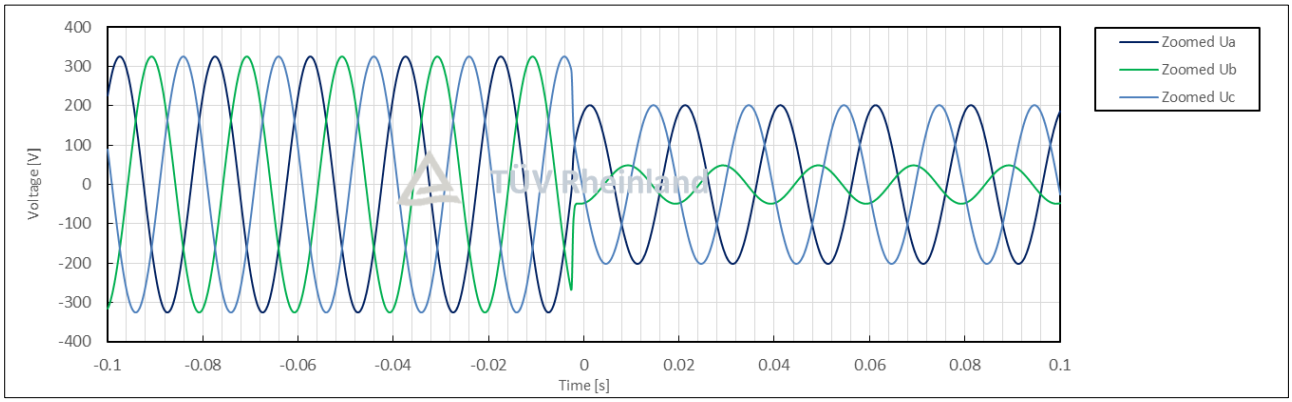

450
400
350
300
250
200
150
100
50
0
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

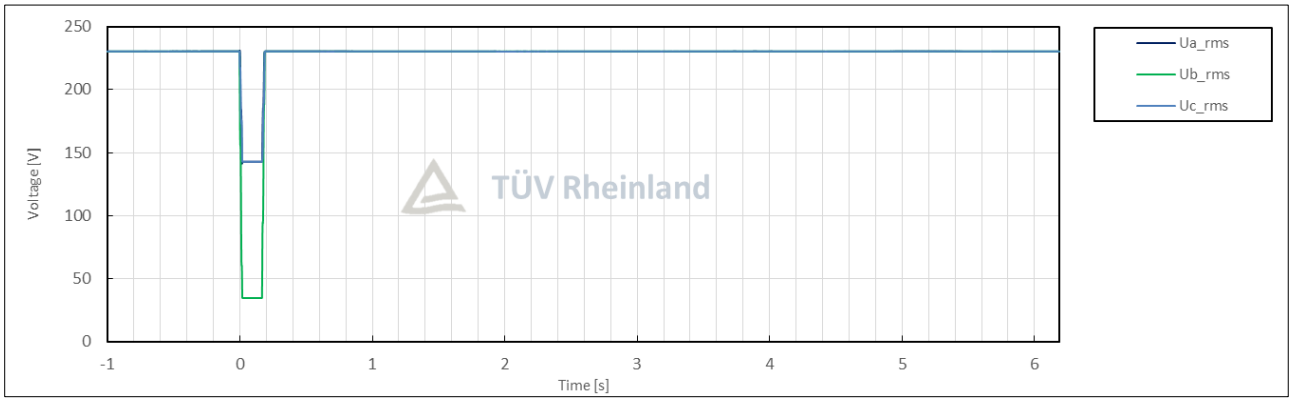

3
3
2
2
1
1
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.3
	1	Date	--	--	dd.mm.yyyy	06.13.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	23:40:54
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--		186
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	186
	8	Fault duration in empty load test	Total	--	ms	186
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15
	10		Pos.		p.u.	0.46
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.99
	13	Active power	Total	t1-10s to t1	p.u.	0.99
	14		Pos.			0.99
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.04
	20		Phase 2			0.05
	21		Phase 3			0.07
	22	Line current	Phase 1	t1+100ms	p.u.	0.04
	23		Phase 2			0.04
	24		Phase 3			0.06
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.02
	26		Pos.			0.02
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.94
	29		Pos.			0.94
	39	Active power rising time	Pos.	--	s	0.743
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

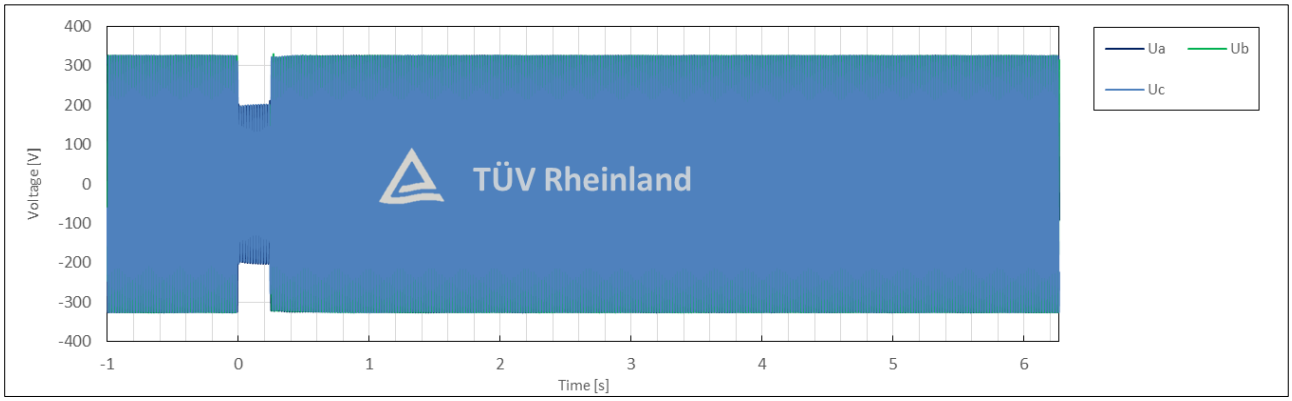
Test No. 1.3 idle test

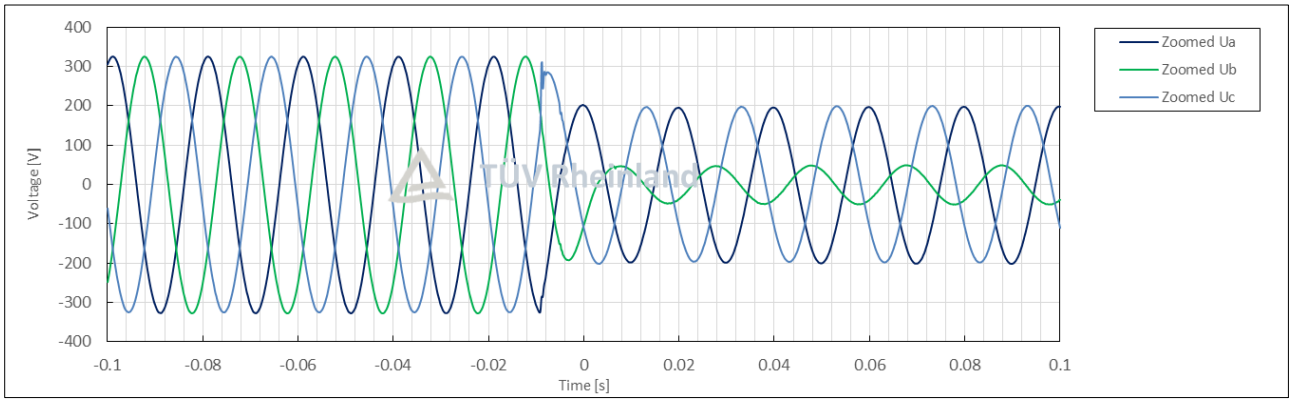


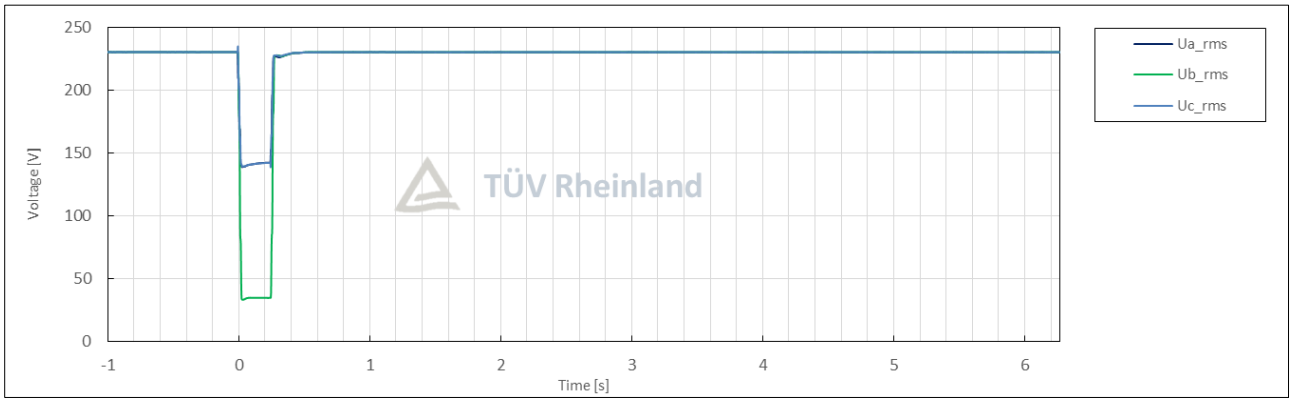


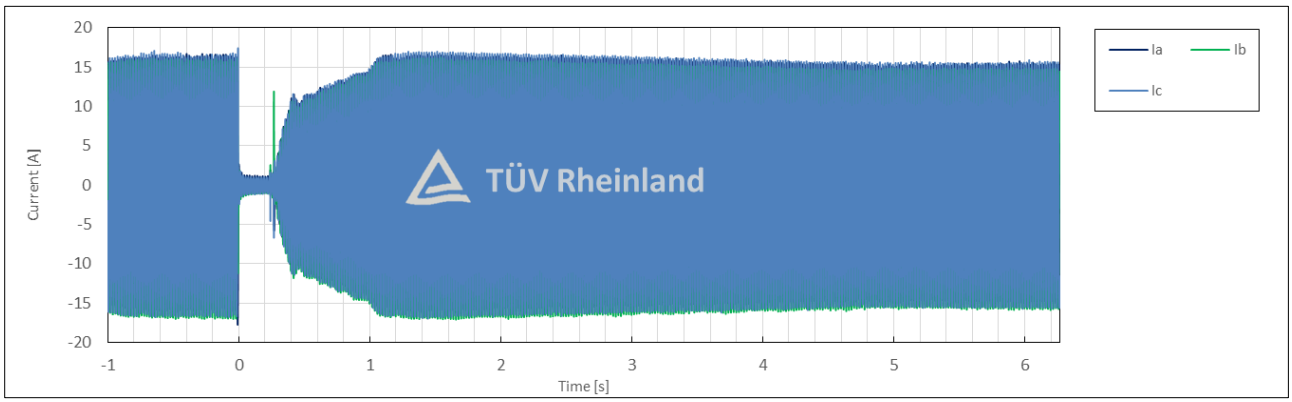


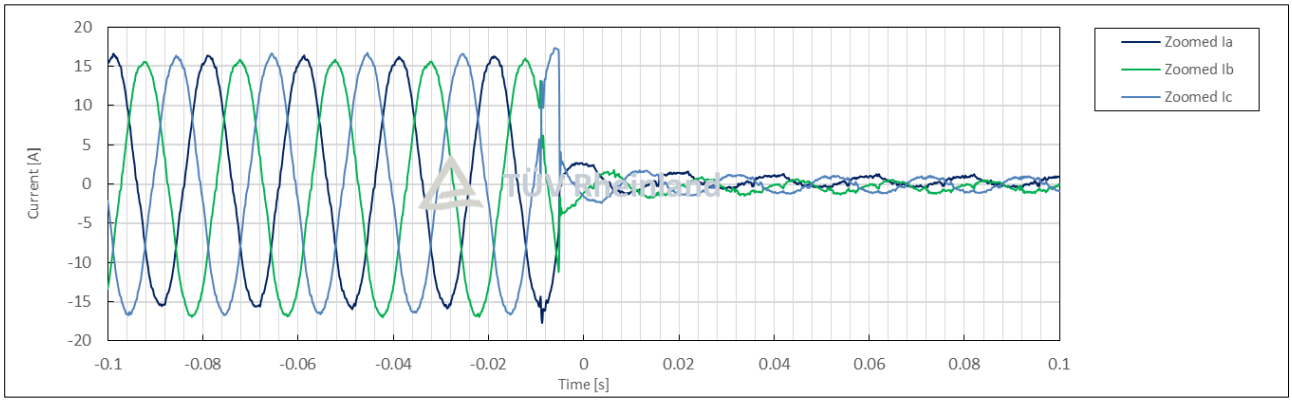
Test No. 1.3 with PGU

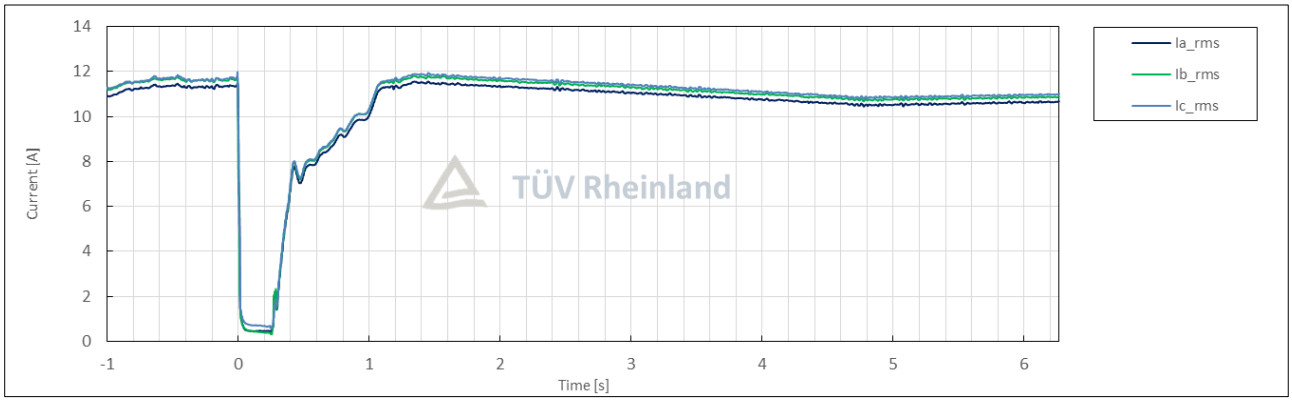


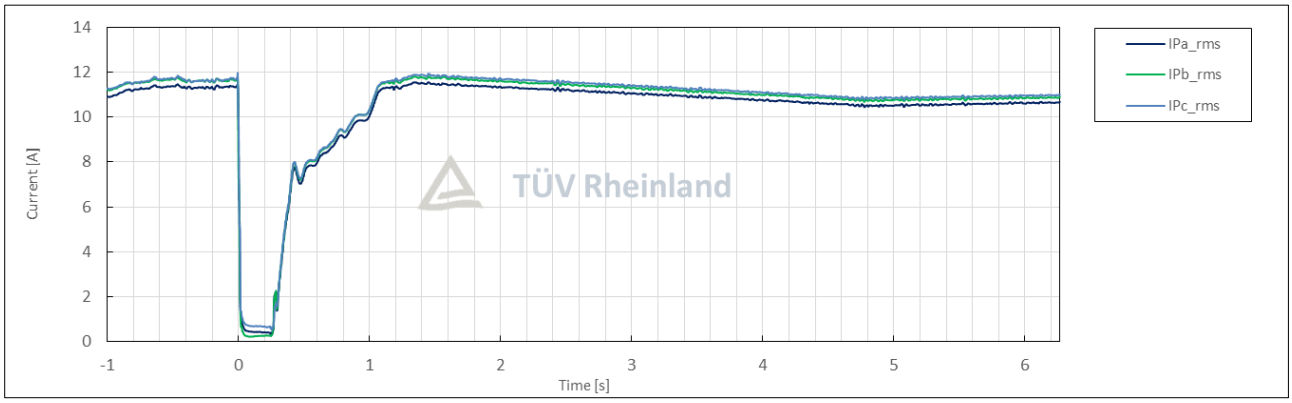


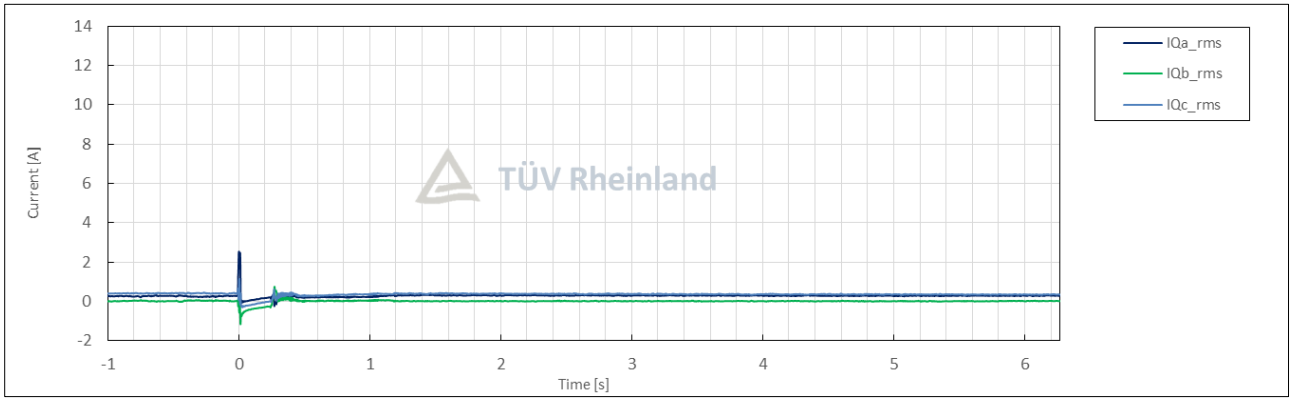


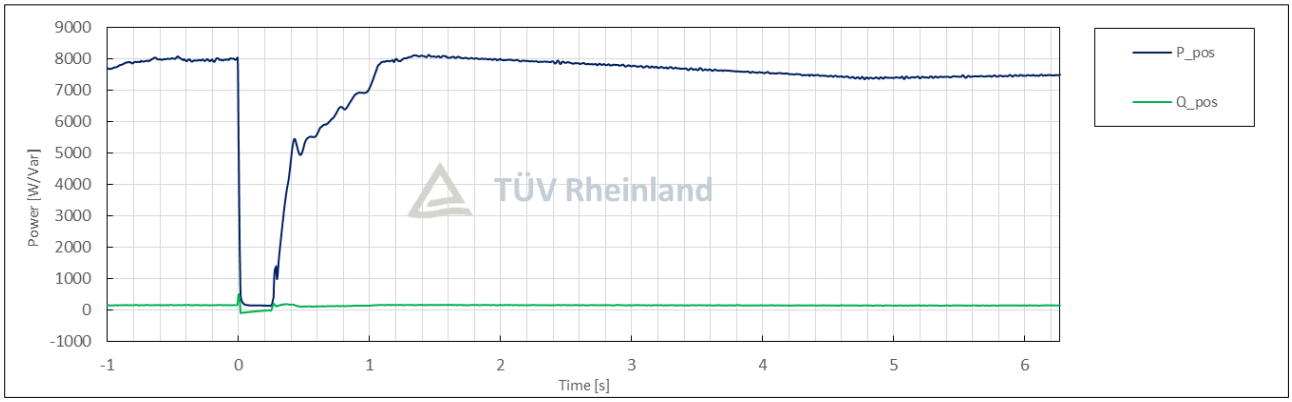


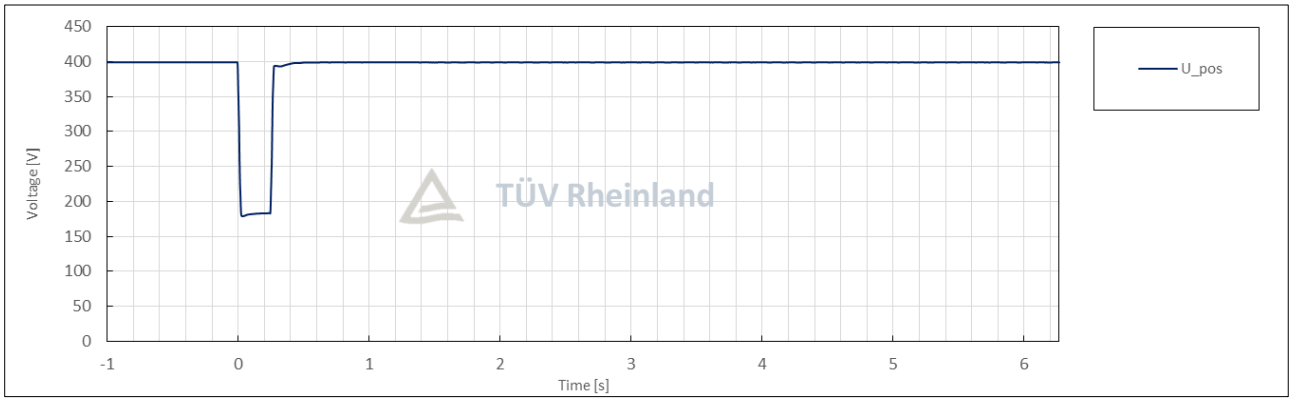

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

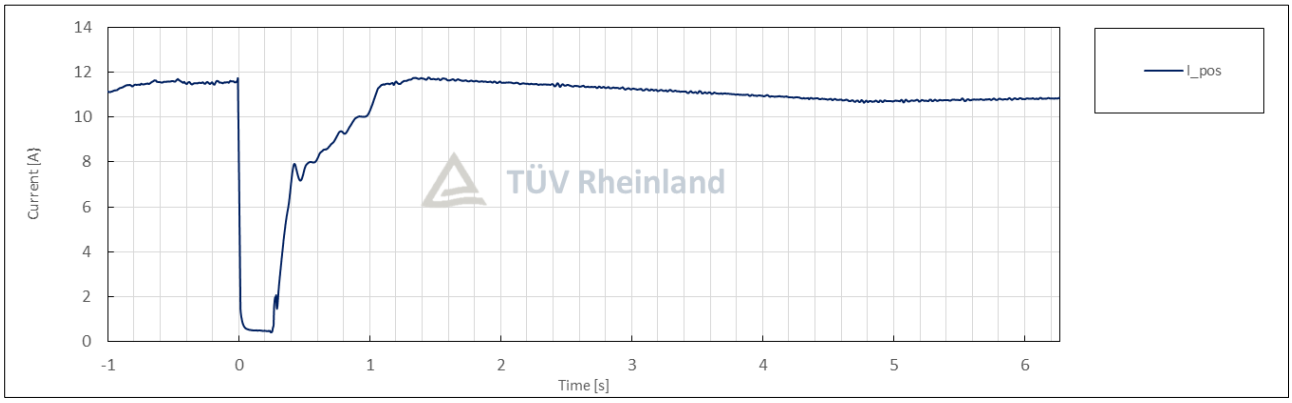

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

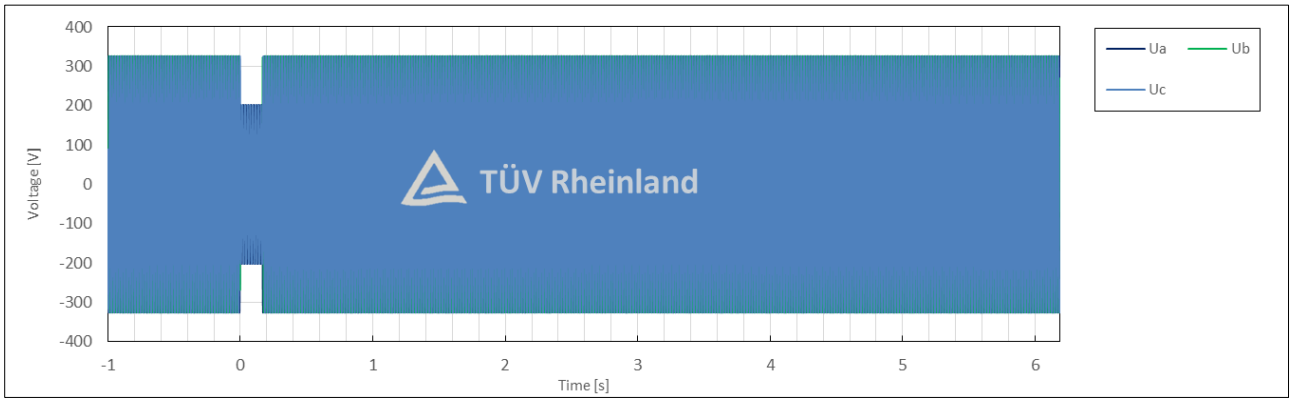

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

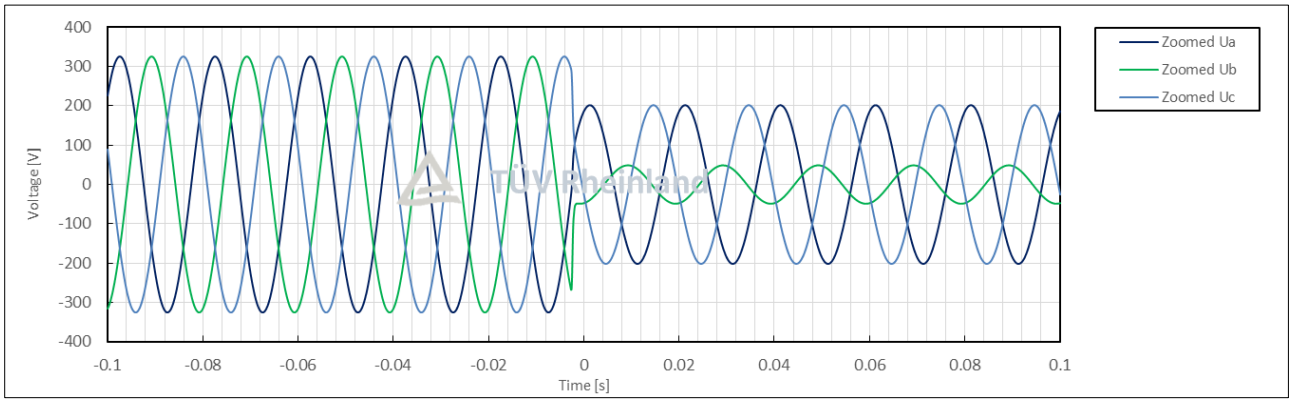

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

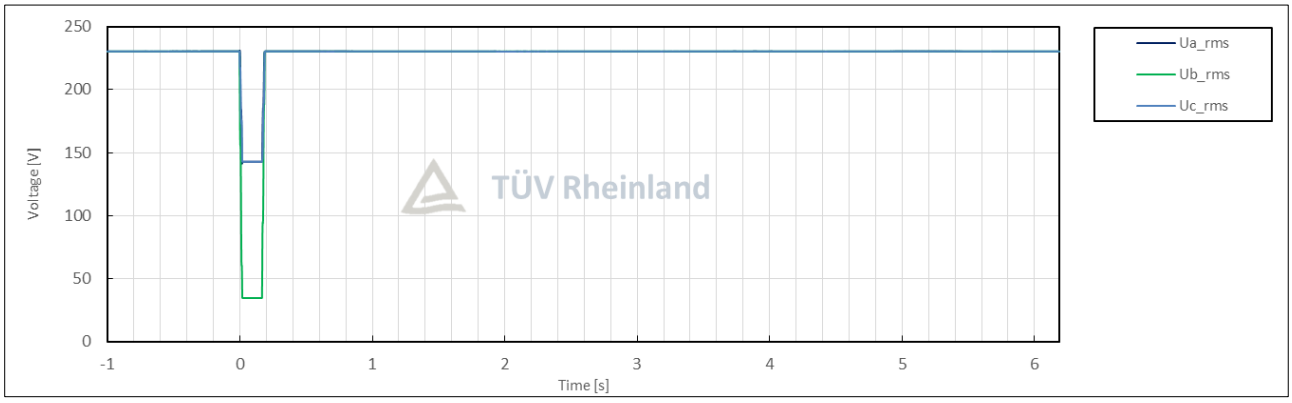

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.3(D2)
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:56:39
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--		186
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	186
	8	Fault duration in empty load test	Total	--	ms	186
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15
	10		Pos.		p.u.	0.46
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.01
	16		Pos.			0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.05
	20		Phase 2			0.06
	21		Phase 3			0.04
	22	Line current	Phase 1	t1+100ms	p.u.	0.04
	23		Phase 2			0.06
	24		Phase 3			0.04
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.261
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.01
	32		Pos.			0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

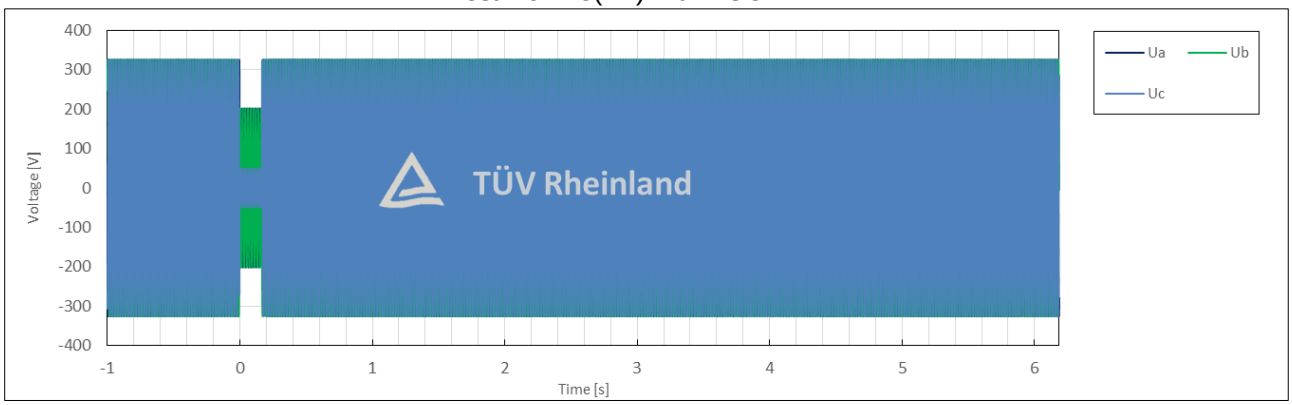
Test No. 1.3(D2) idle test

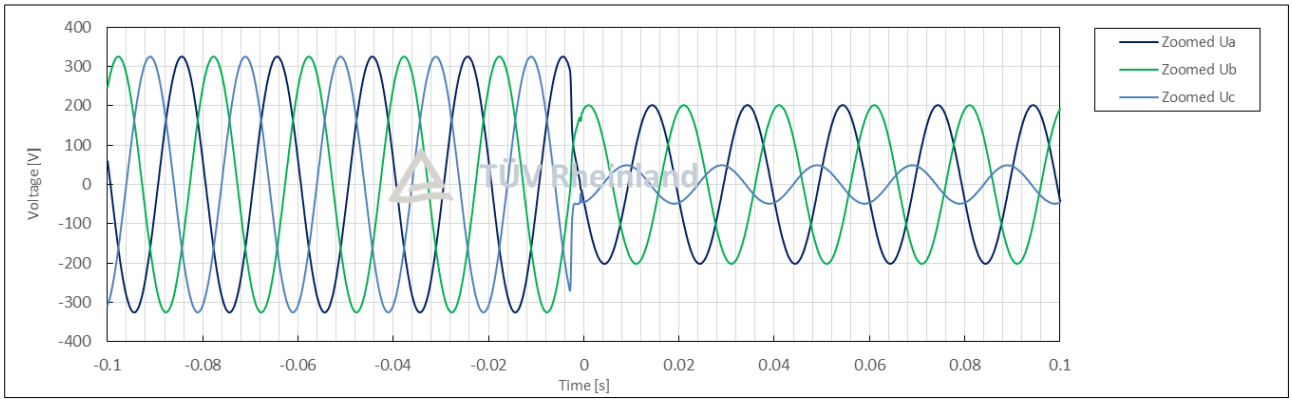


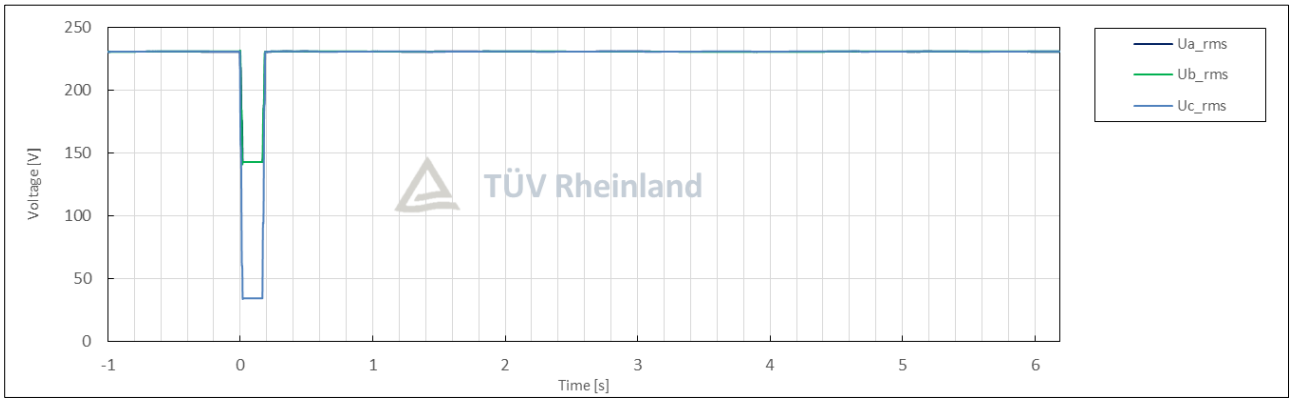


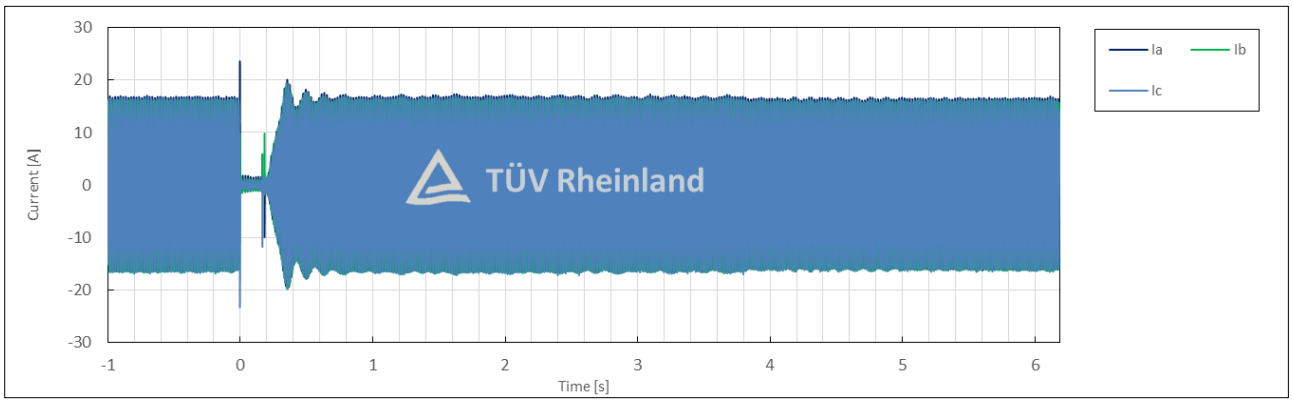


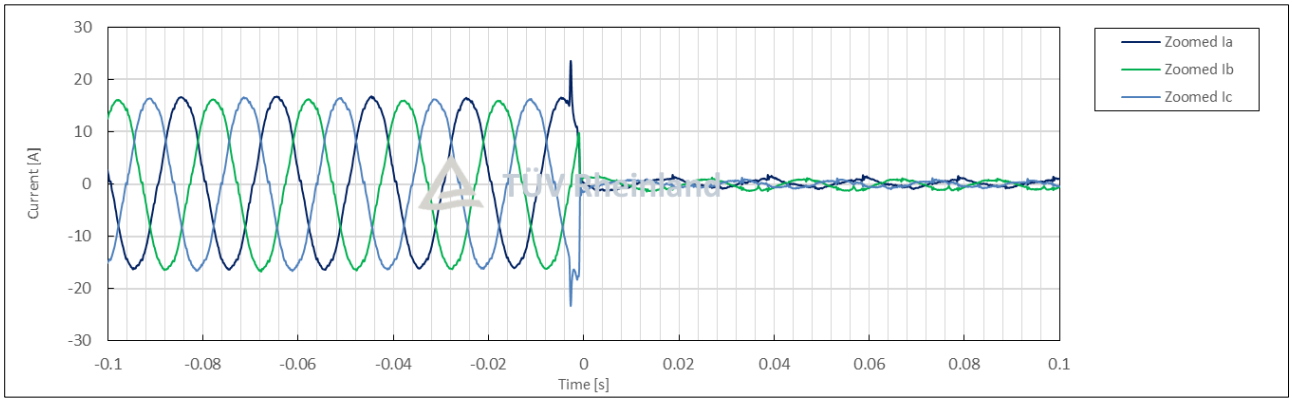
Test No. 1.3(D2) with PGU

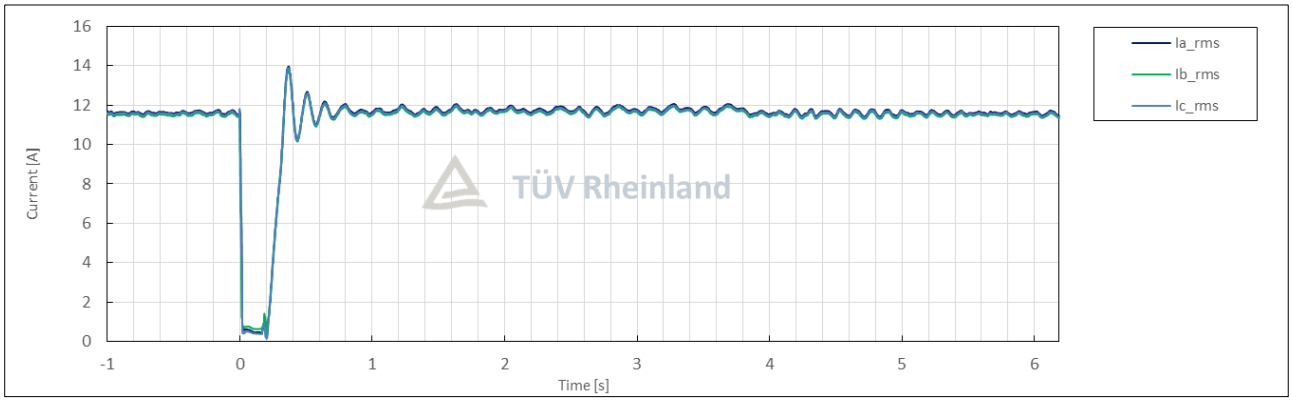


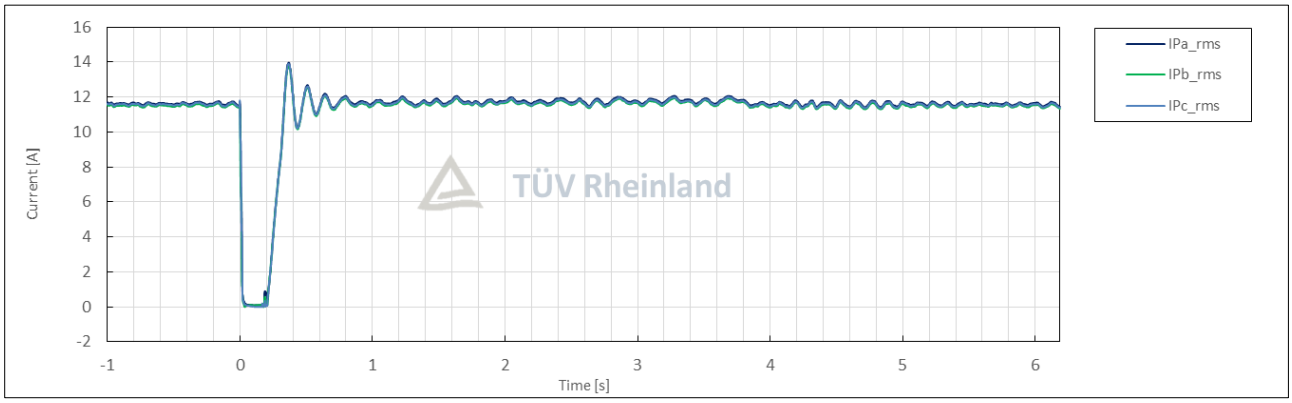


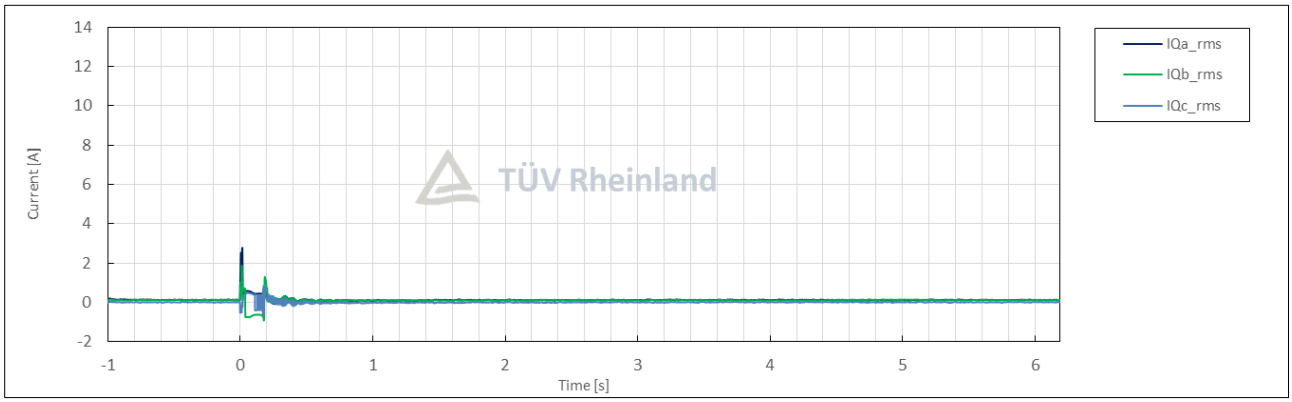


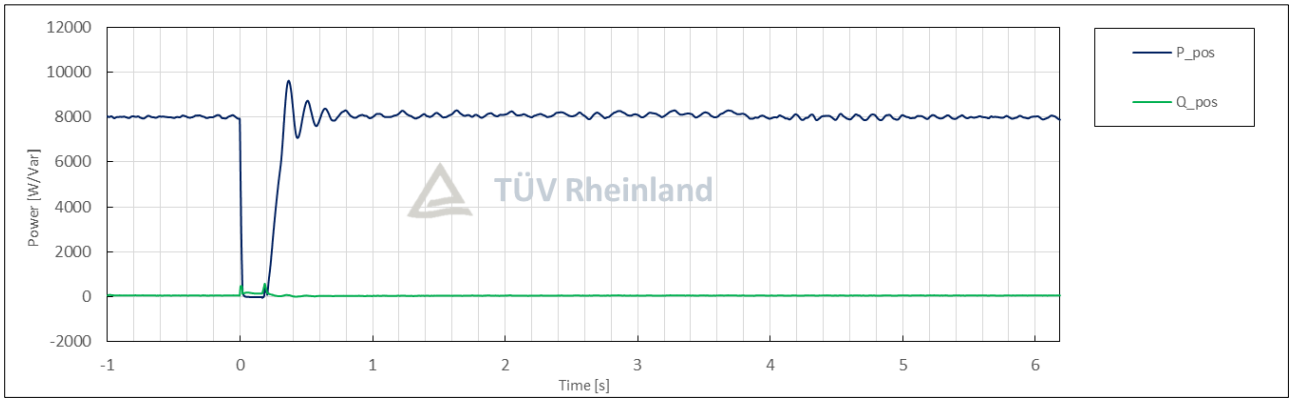


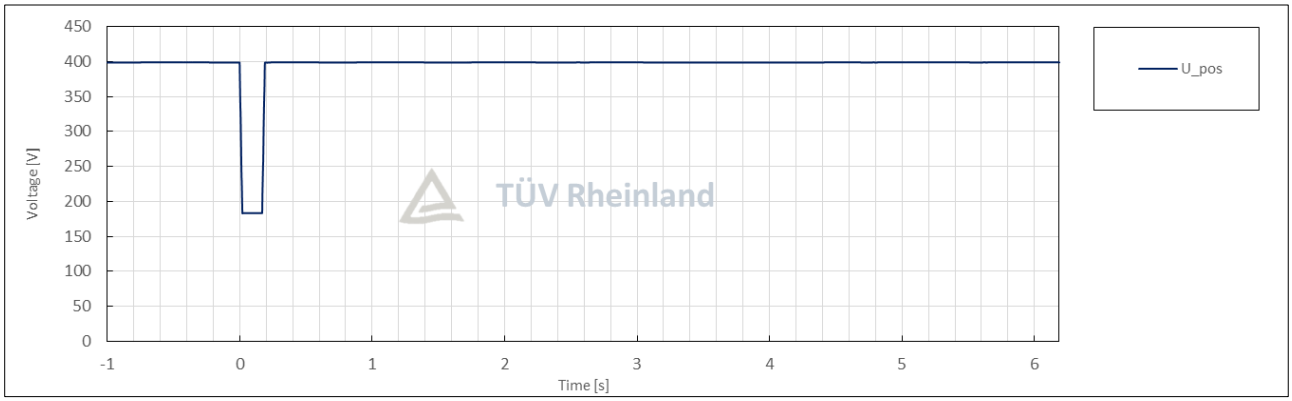

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

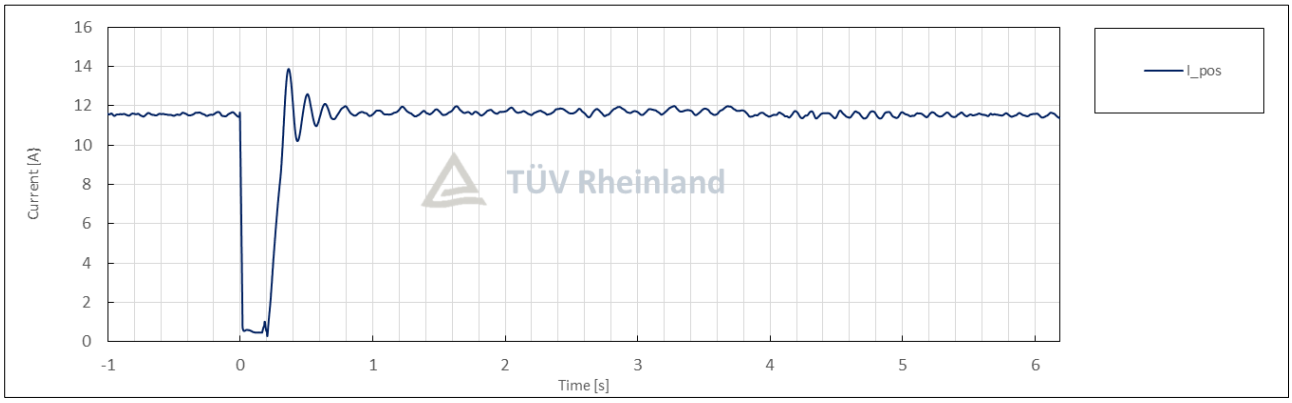

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

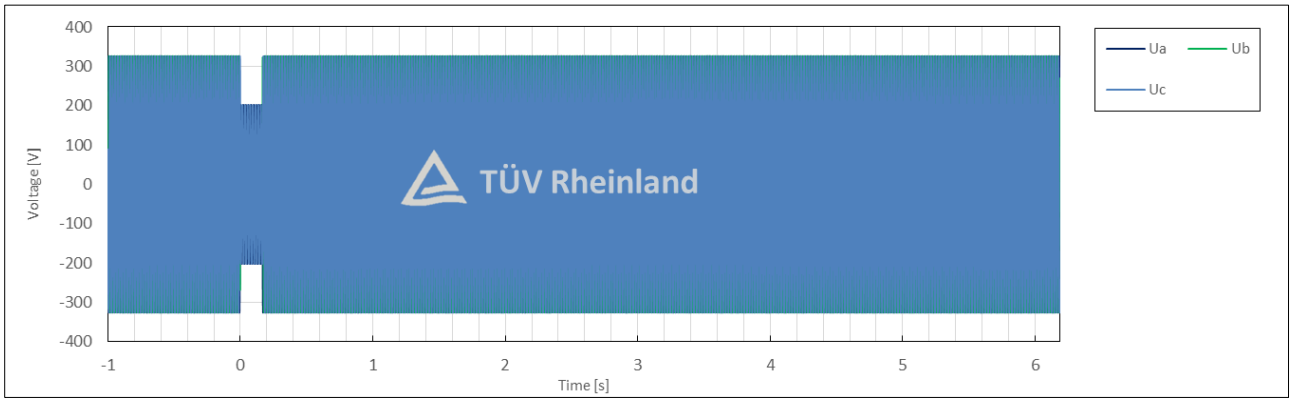

12000
10000
8000
6000
4000
2000
0
-2000
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

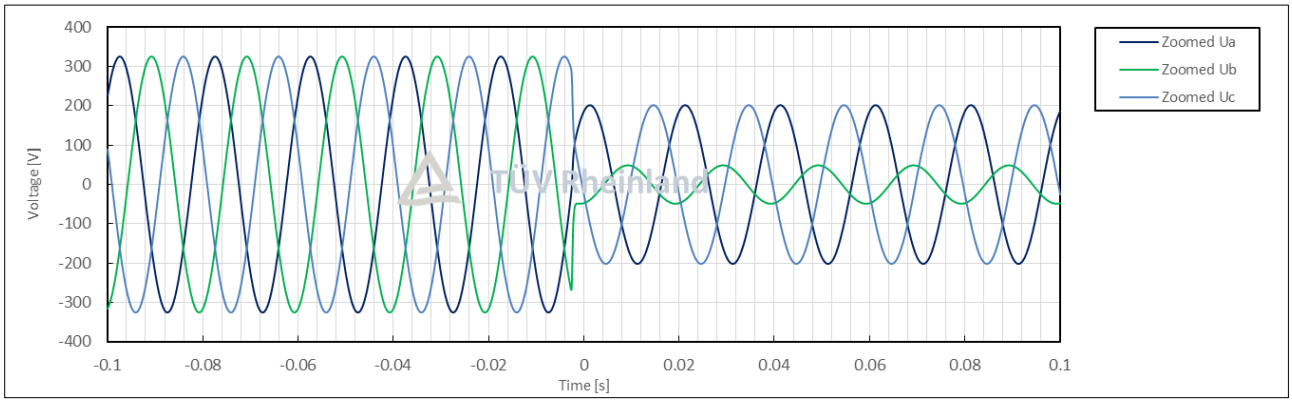

450
400
350
300
250
200
150
100
50
0
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

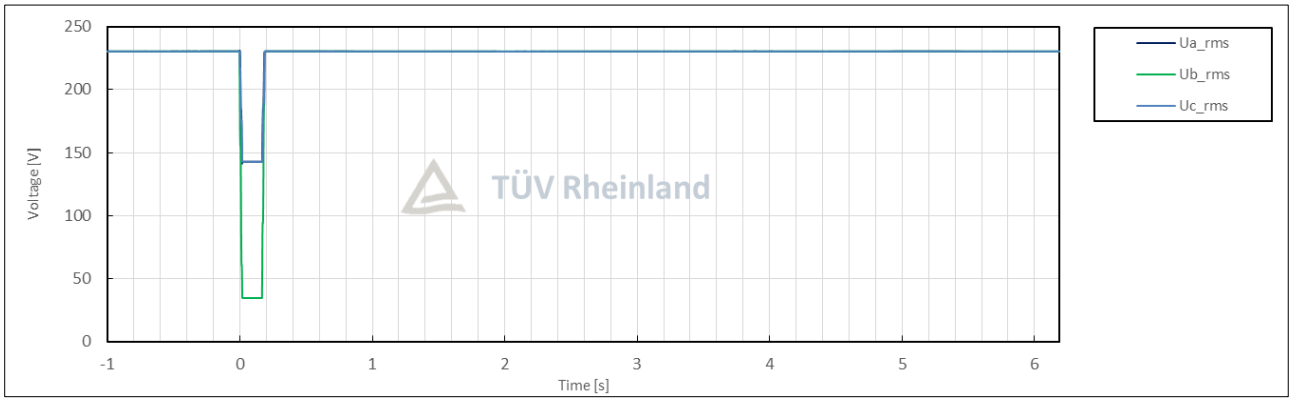

16
14
12
10
8
6
4
2
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.4
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:59:21
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.15
	5	Setting dip duration		--		186
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	186
	8	Fault duration in empty load test	Total	--	ms	186
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.15
	10		Pos.		p.u.	0.46
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			-0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.04
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.02
	23		Phase 2			0.03
	24		Phase 3			0.02
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.299
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			-0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

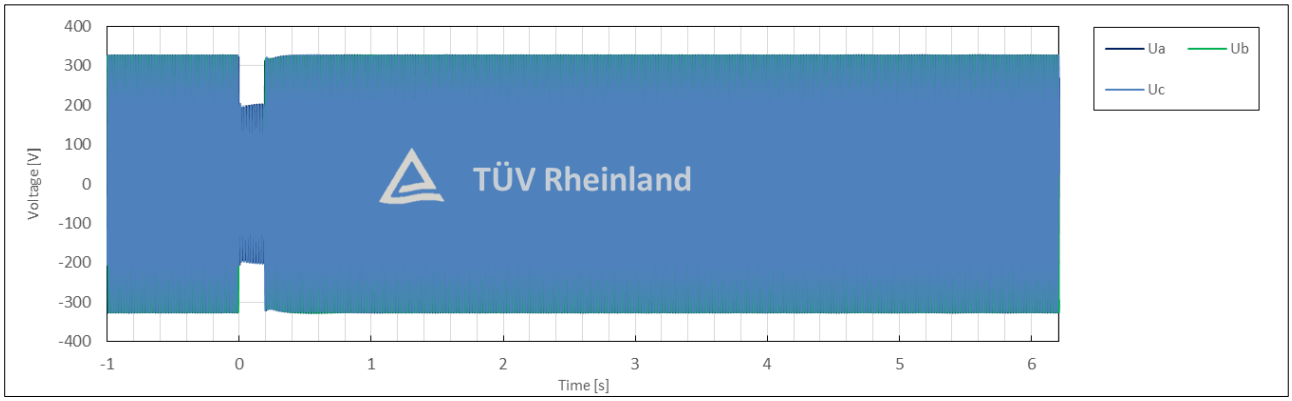
Test No. 1.4 idle test

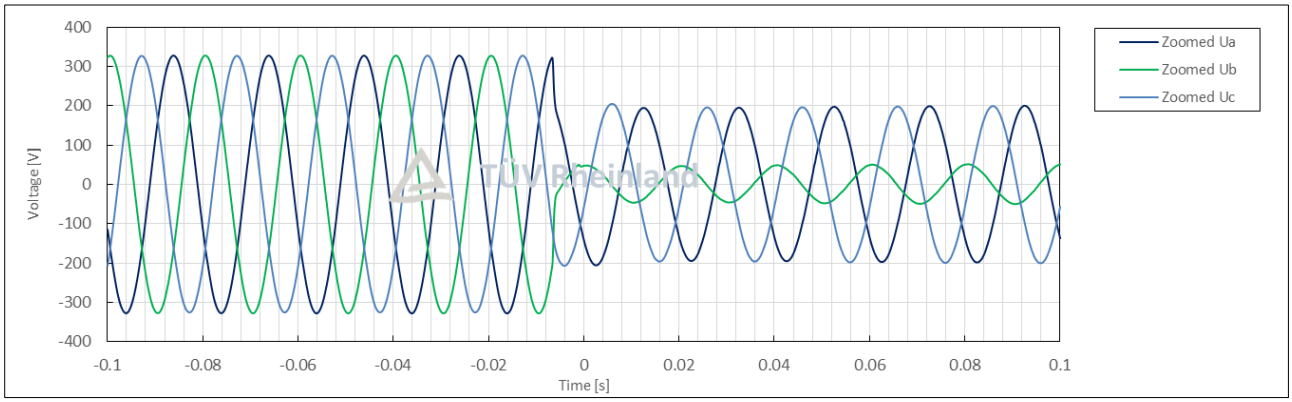


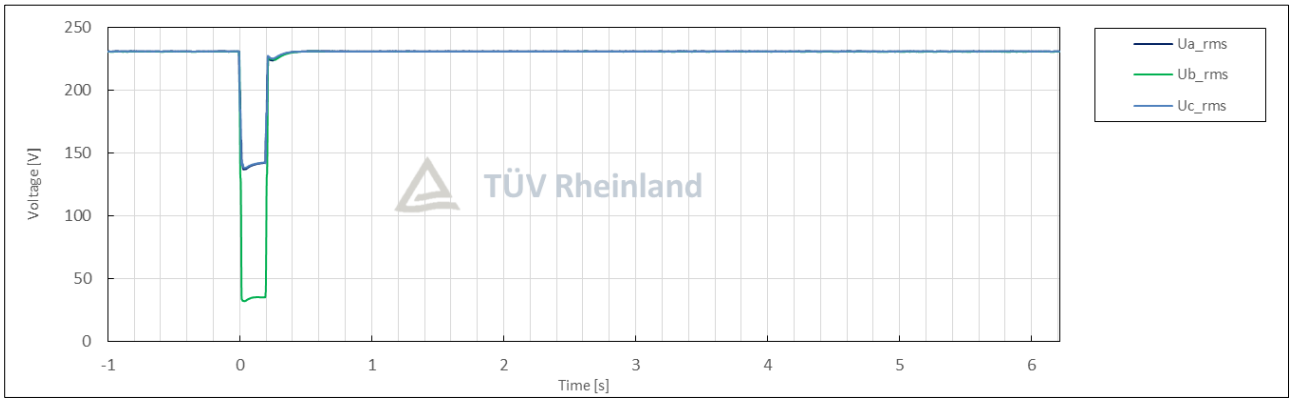


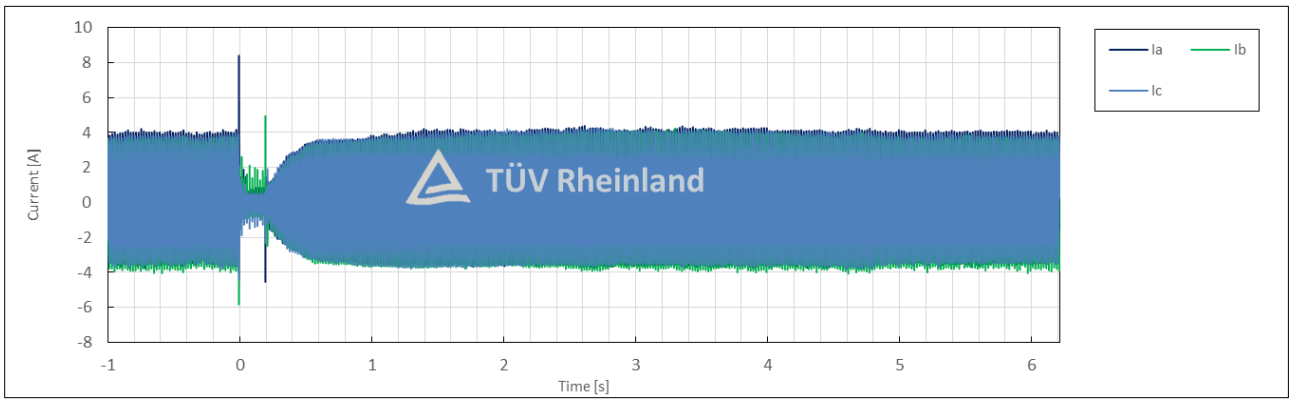


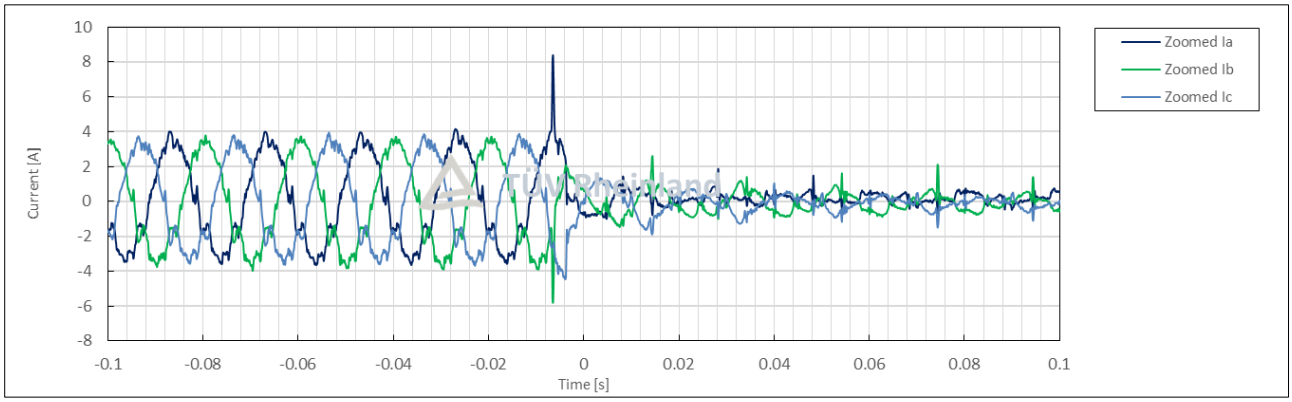
Test No. 1.4 with PGU

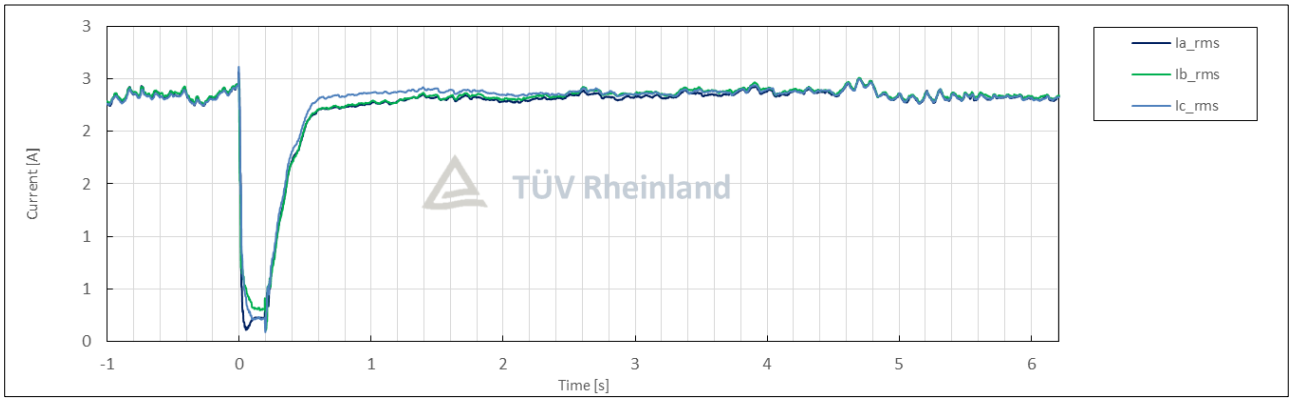


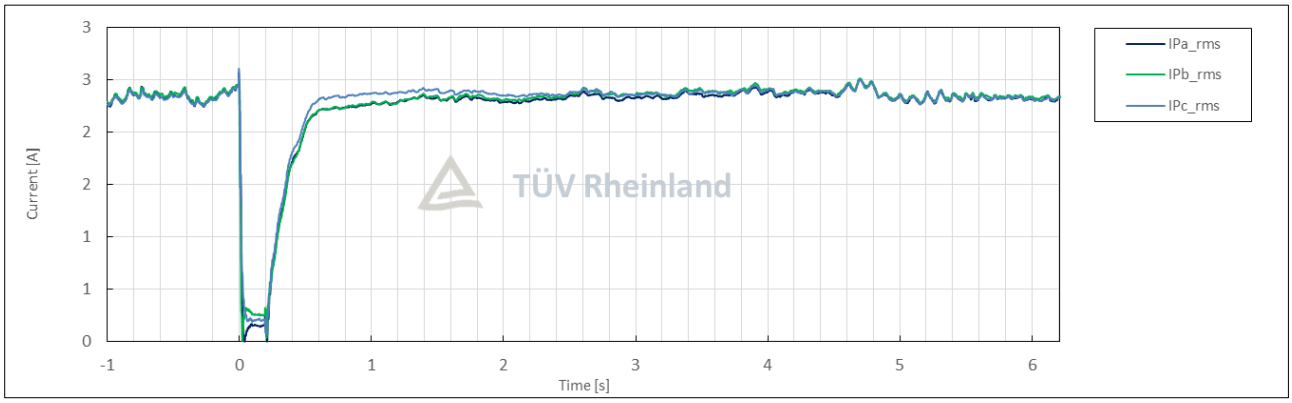


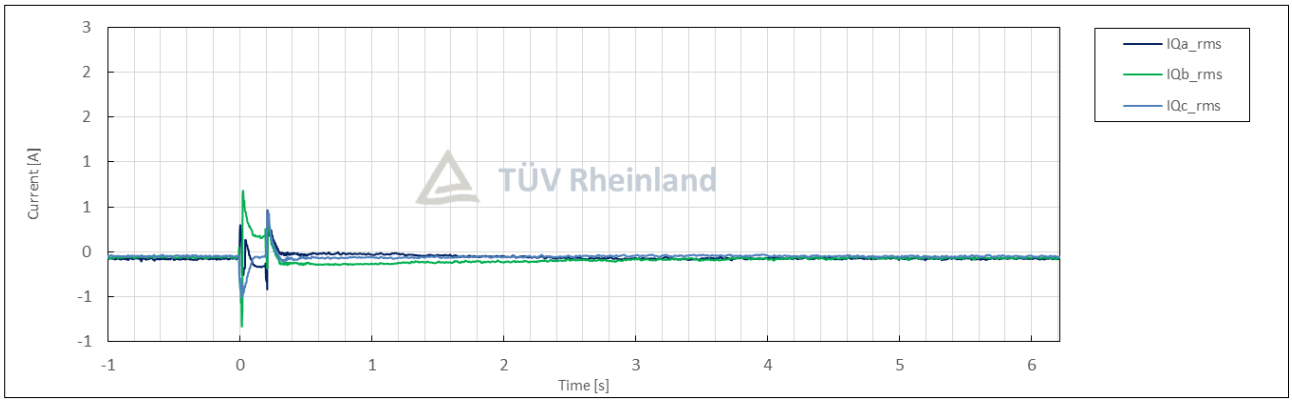


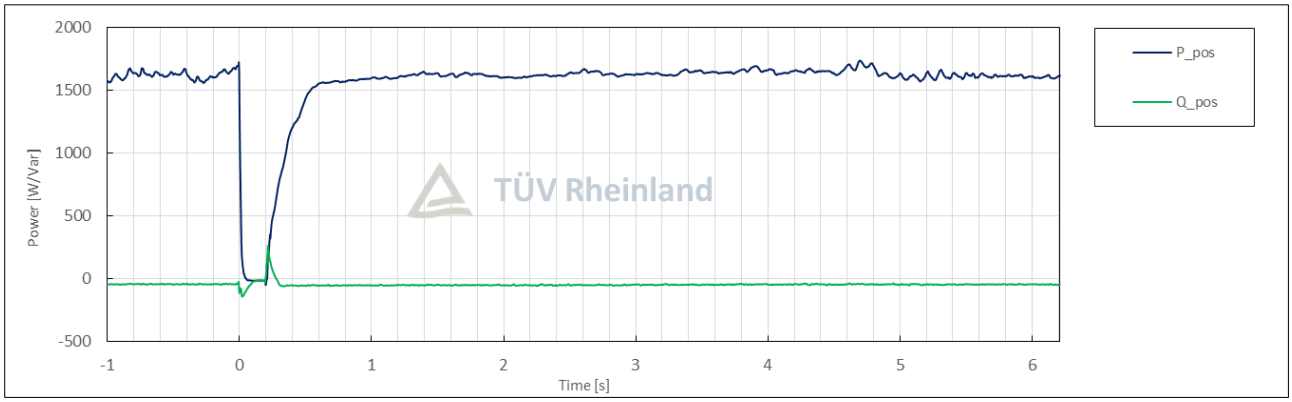


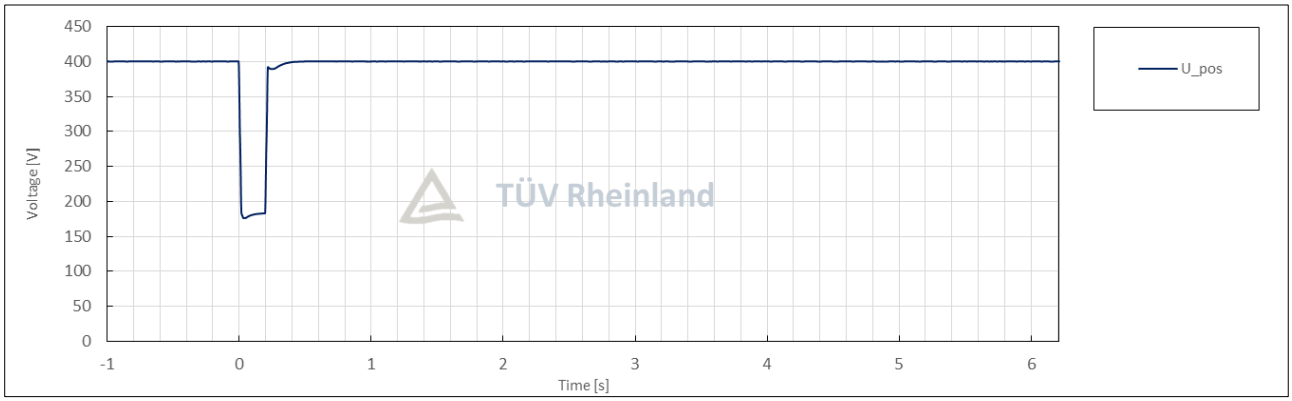

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

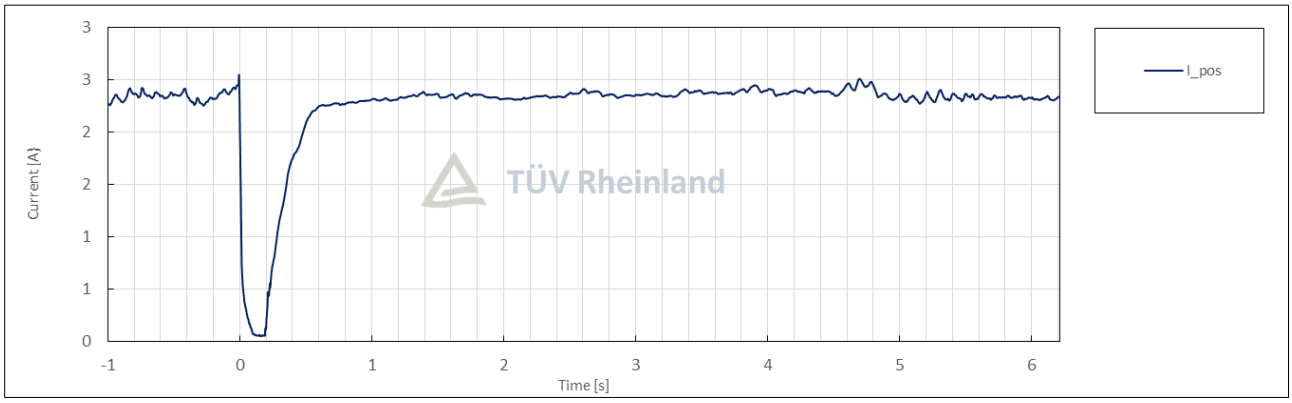

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

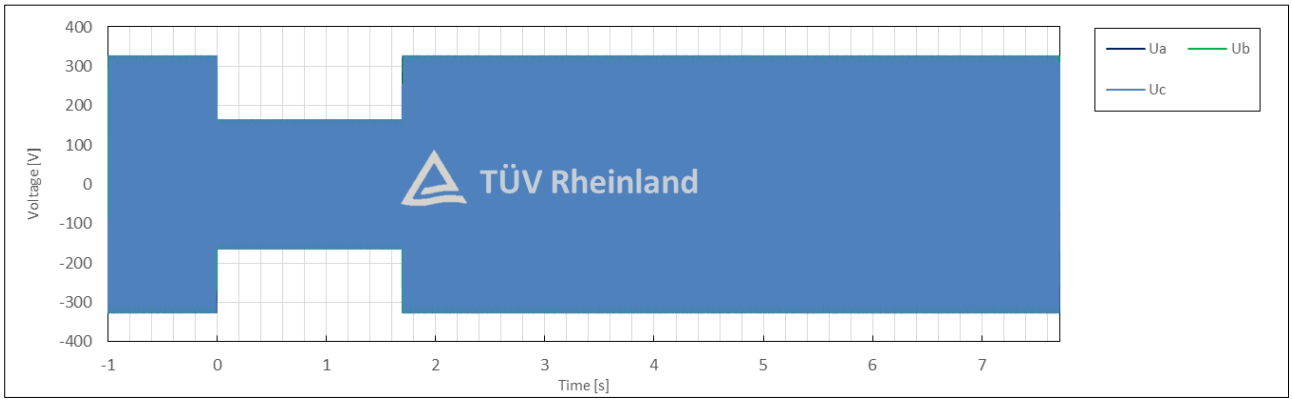

2000
1500
1000
500
0
-500
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

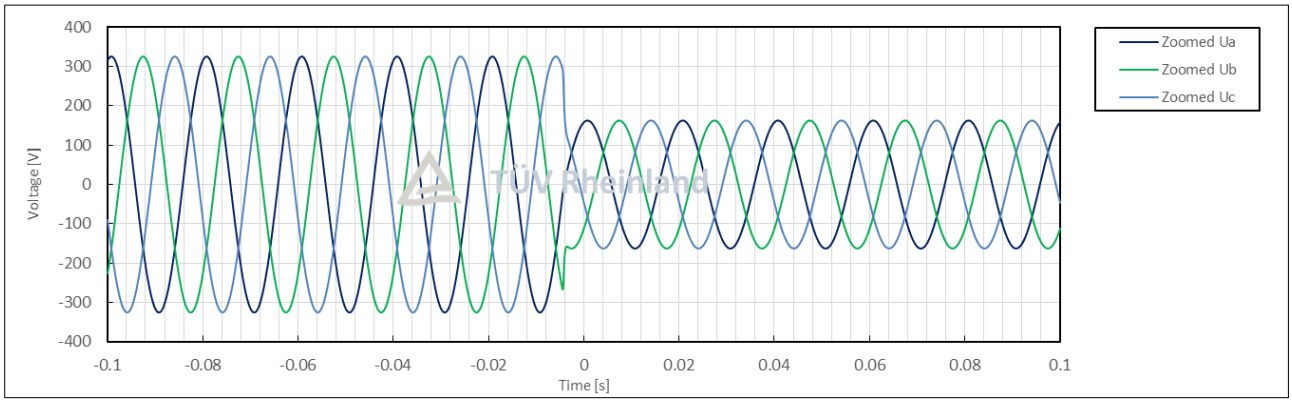

450
400
350
300
250
200
150
100
50
0
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

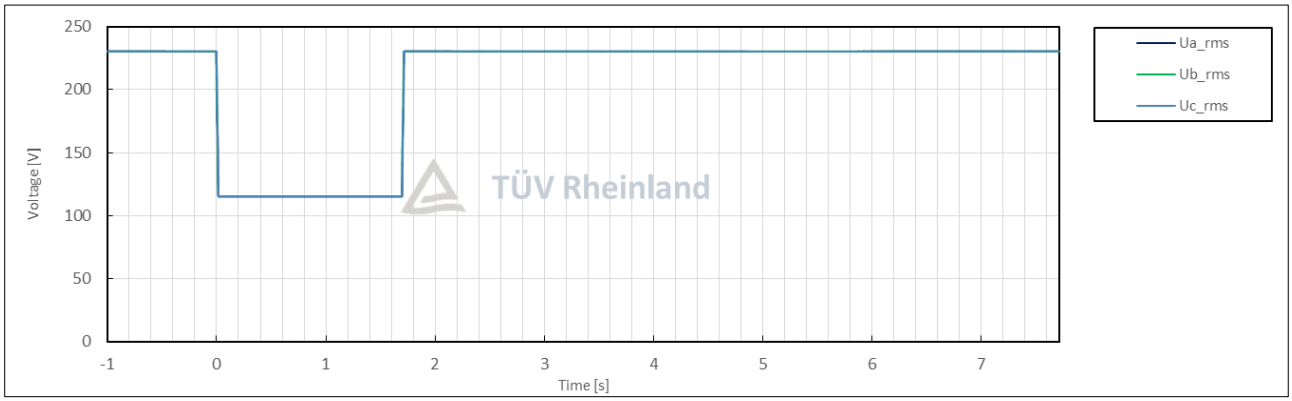

3
3
2
2
1
1
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.1
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:48:39
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1713
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1713
	8	Fault duration in empty load test	Total	--	ms	1713
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.50
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.01
	13	Active power	Total	t1-10s to t1	p.u.	0.91
	14		Pos.			0.91
	15	Reactive power	Total	t1-10s to t1	p.u.	0.44
	16		Pos.			0.44
	17	Cos_{φ}	--	t1-10s to t1	--	0.902
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.02
	20		Phase 2			0.02
	21		Phase 3			0.02
	22	Line current	Phase 1	t1+100ms	p.u.	0.02
	23		Phase 2			0.02
	24		Phase 3			0.02
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.91
	29		Pos.			0.91
	39	Active power rising time	Pos.	--	s	0.781
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.37
	32		Pos.			0.37
	33	Reactive power rising time	Pos.	--	s	9.308
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

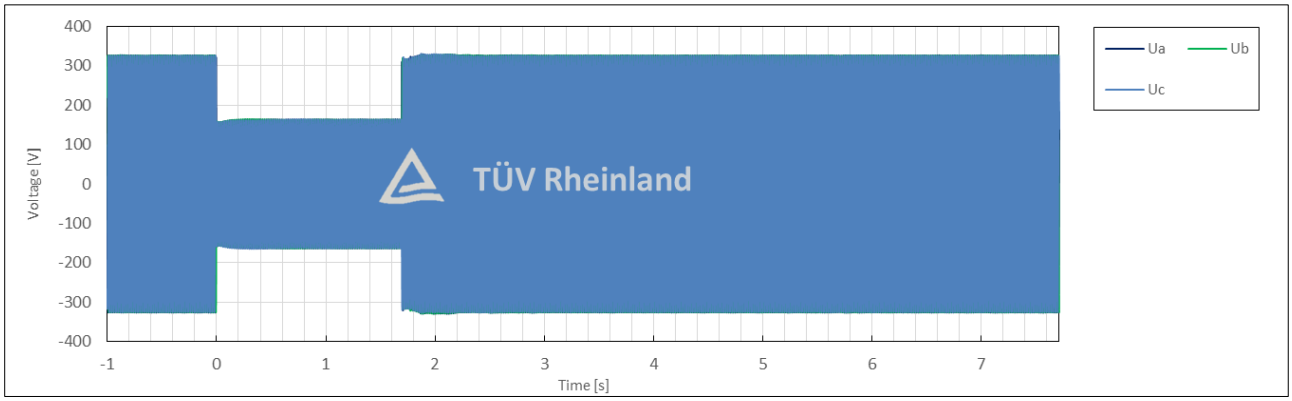
Test No. 2.1 idle test

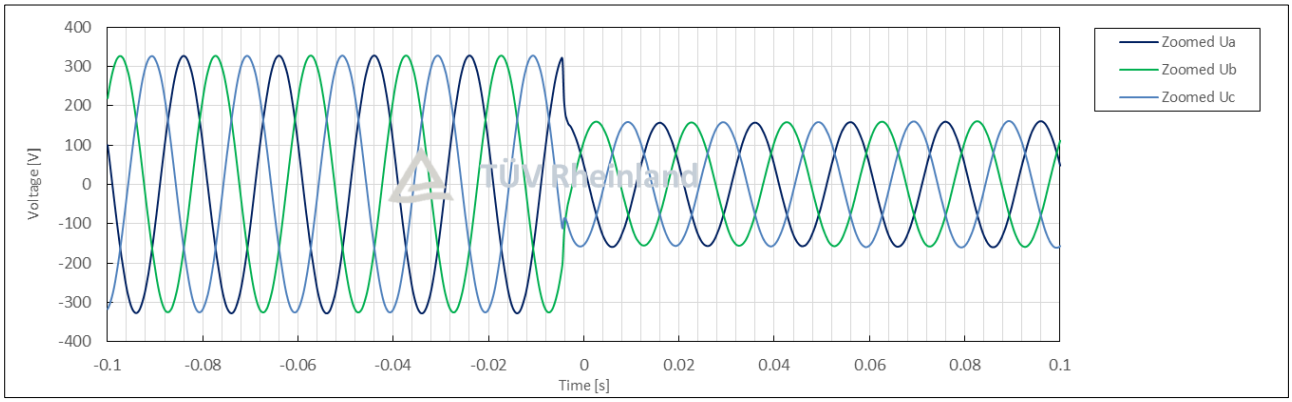


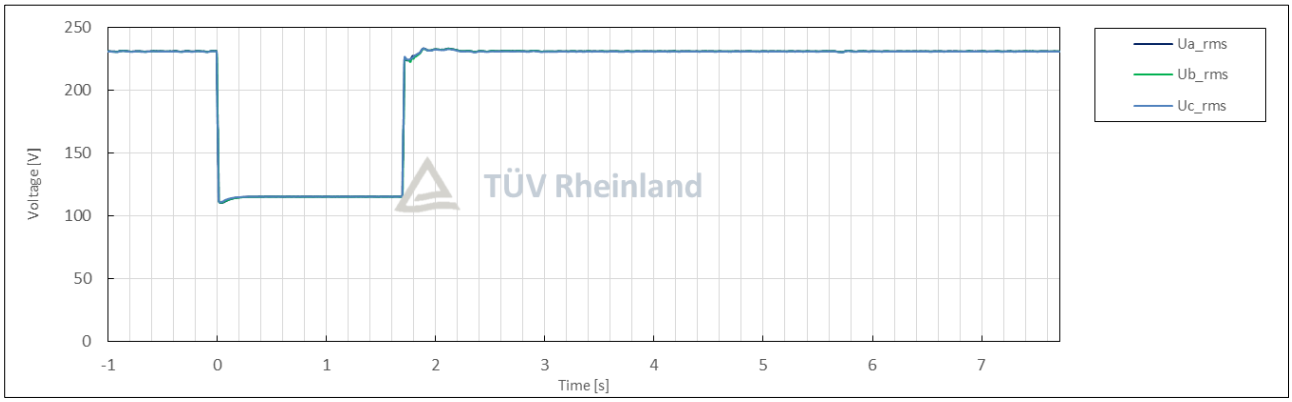


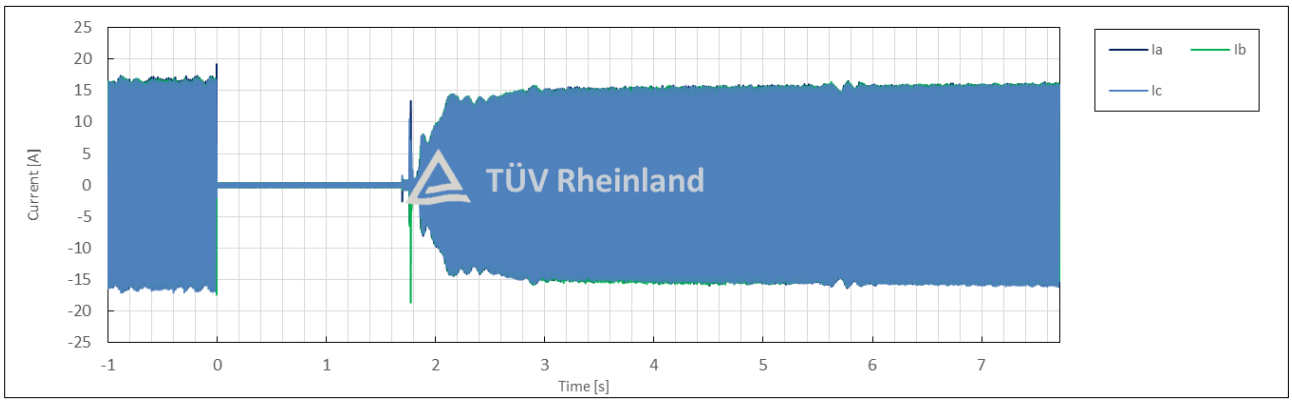


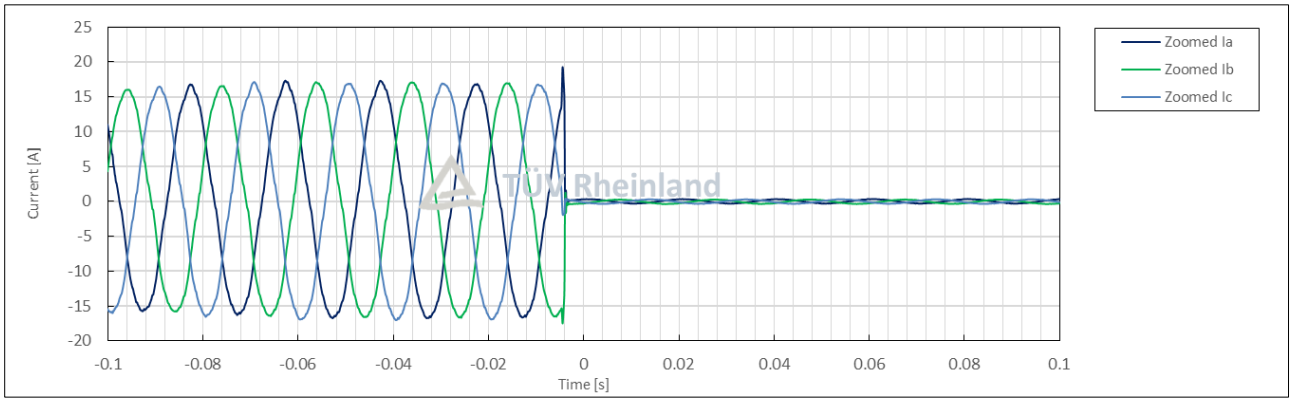
Test No. 2.1 with PGU

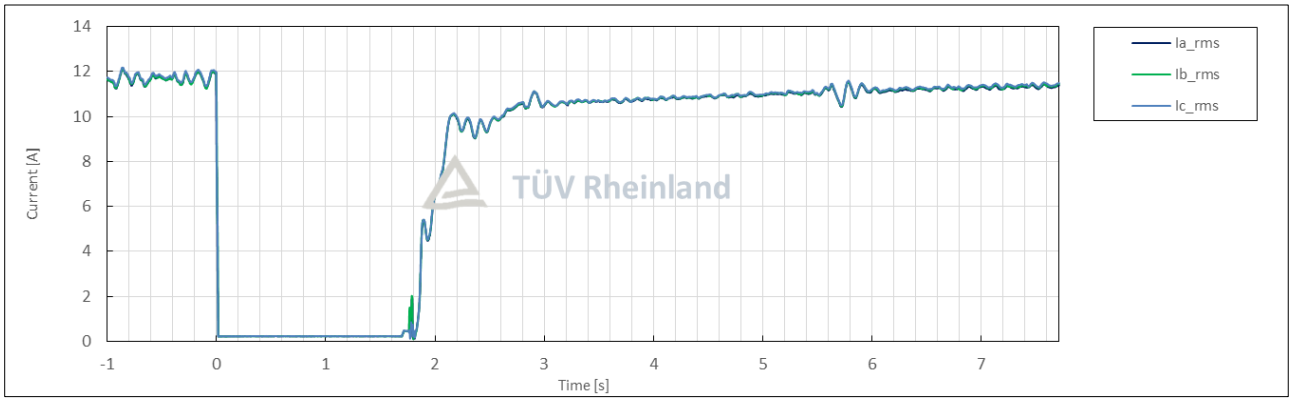


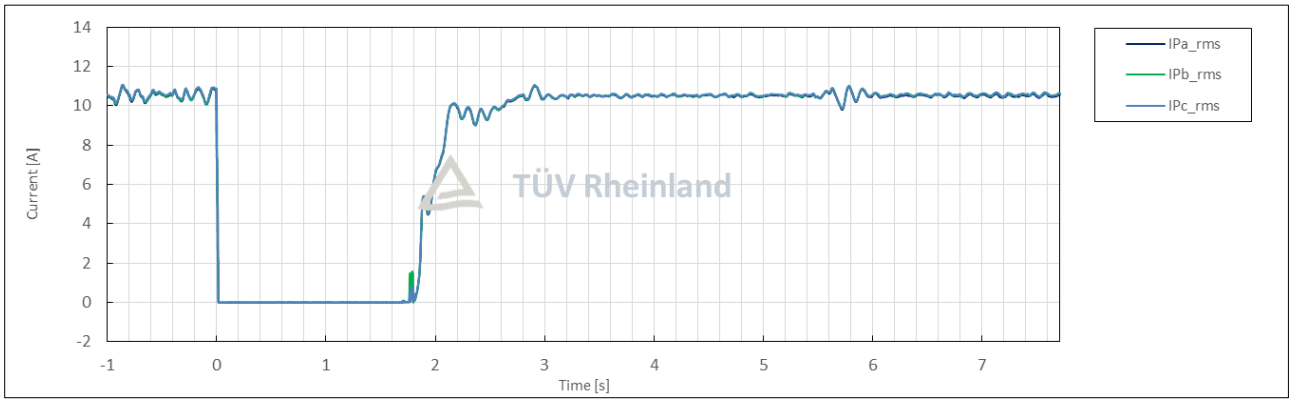


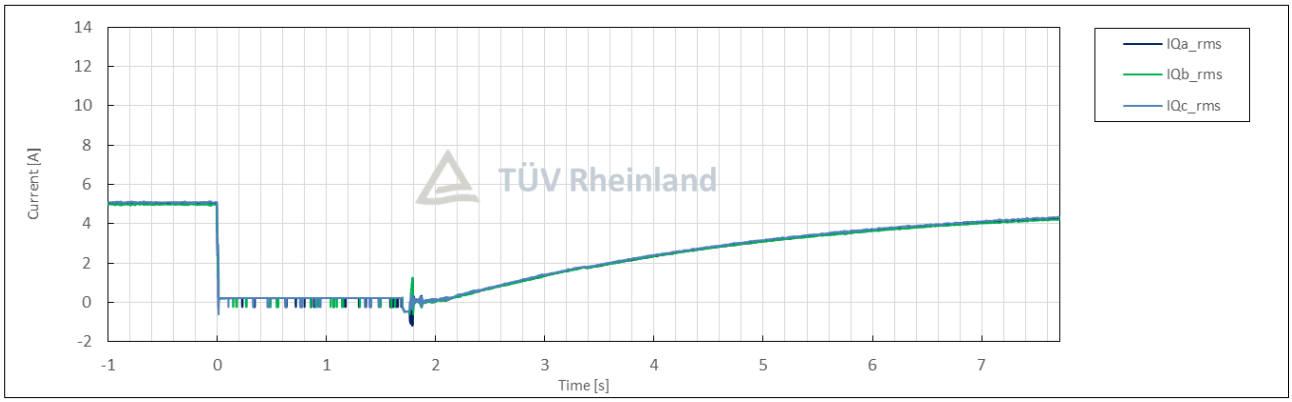


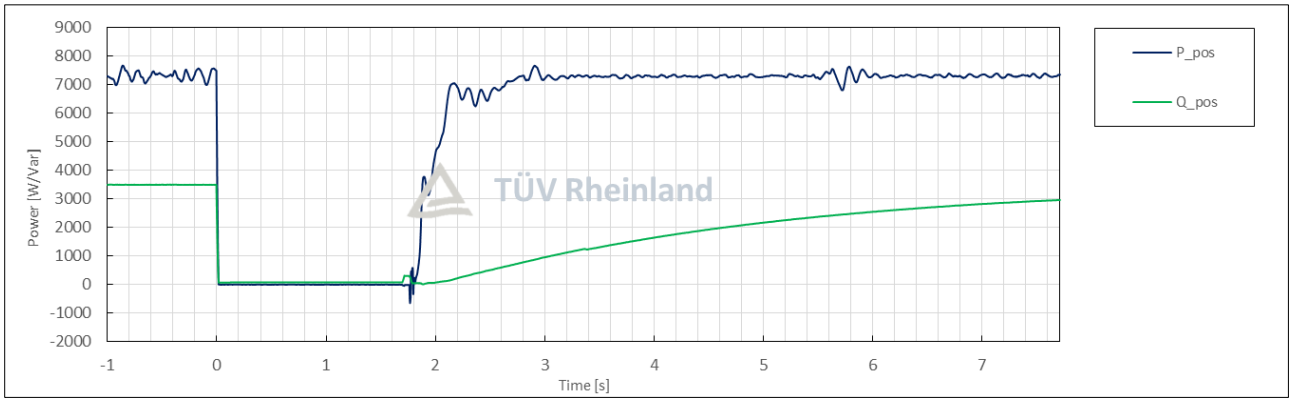


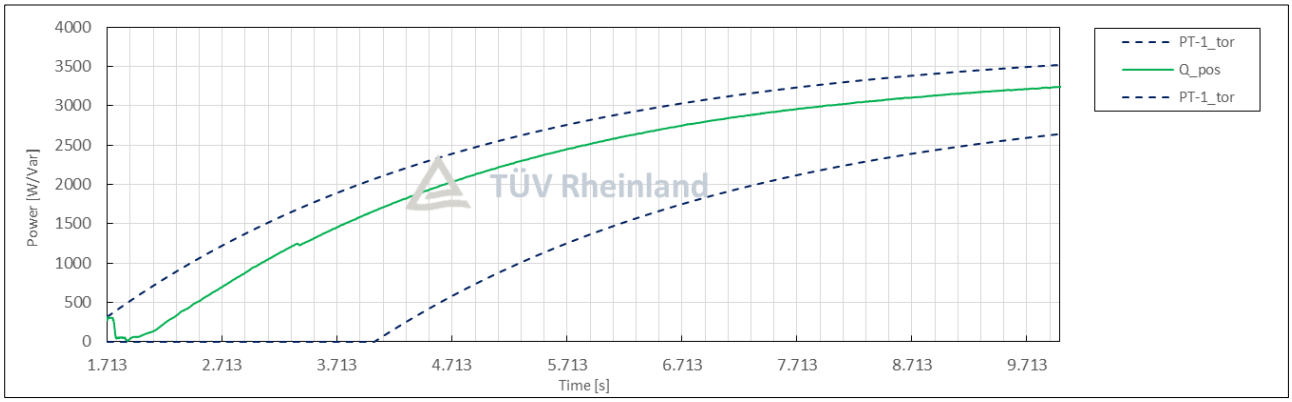

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

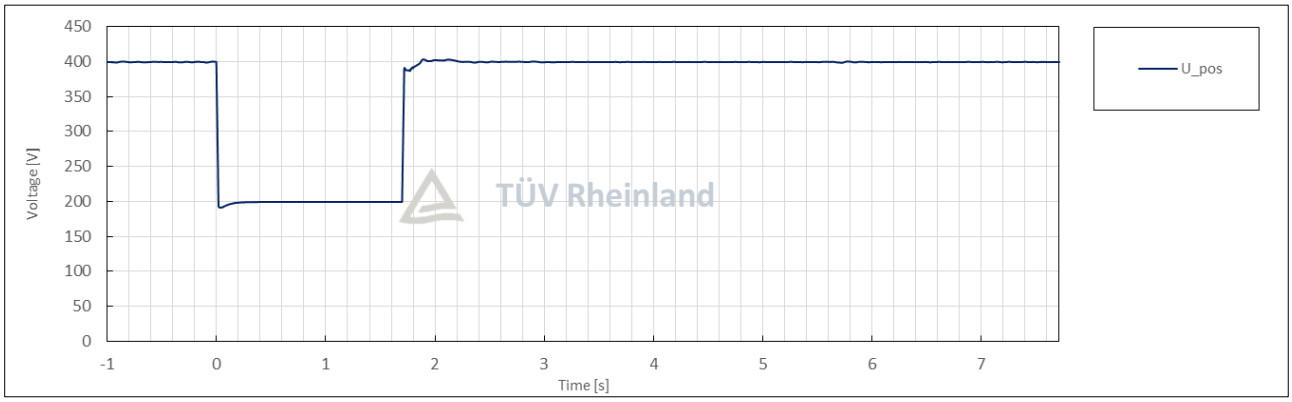

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland

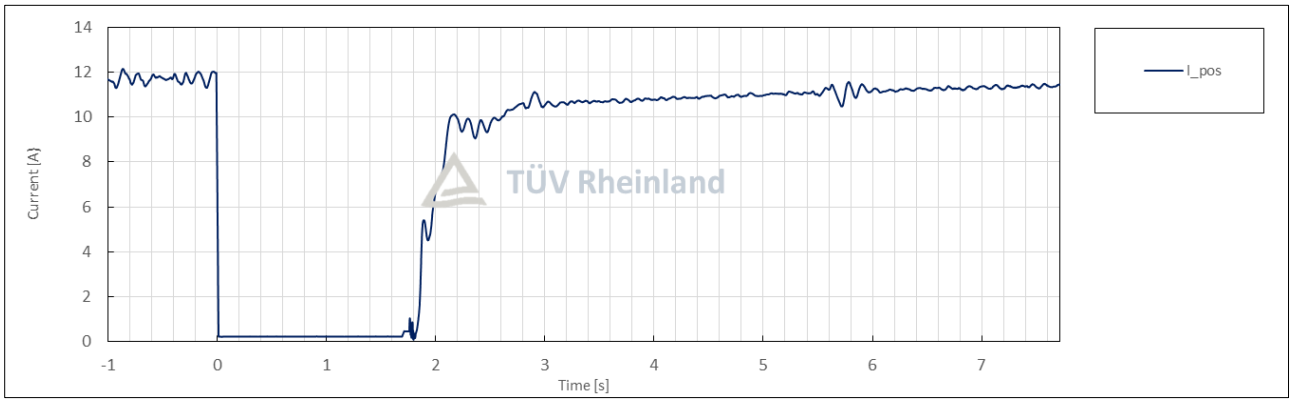

IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland


Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

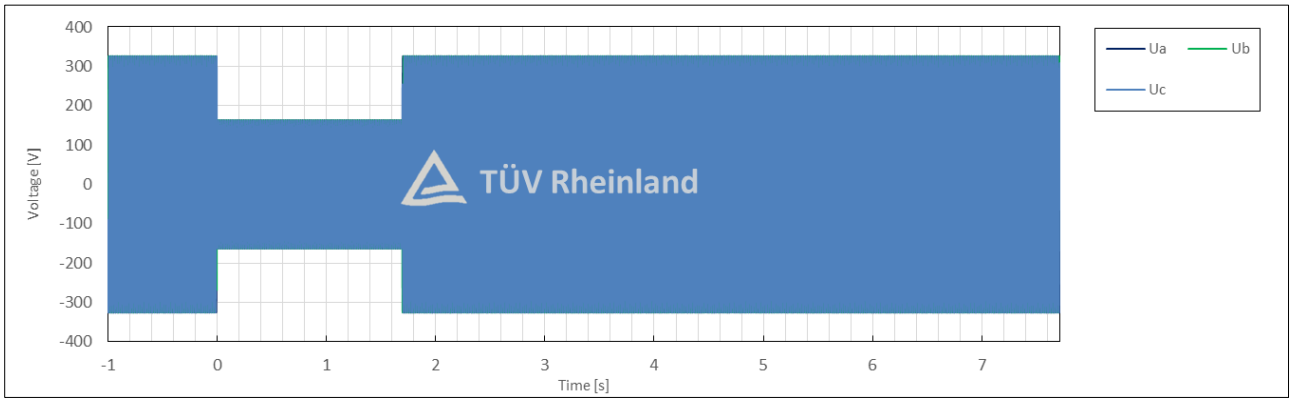

Power [W/Var]
Time [s]
PT-1_tor
Q_pos
PT-1_tor
TÜV Rheinland

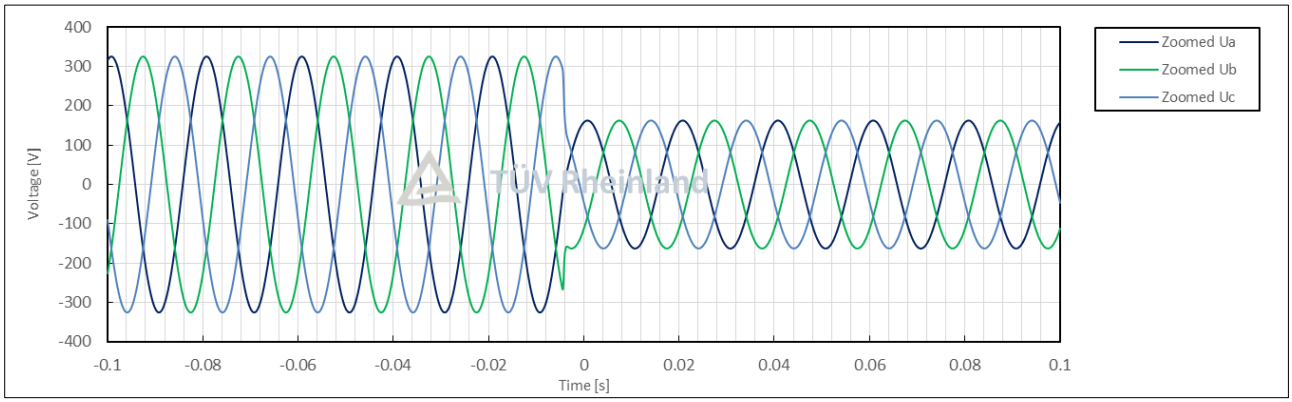

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

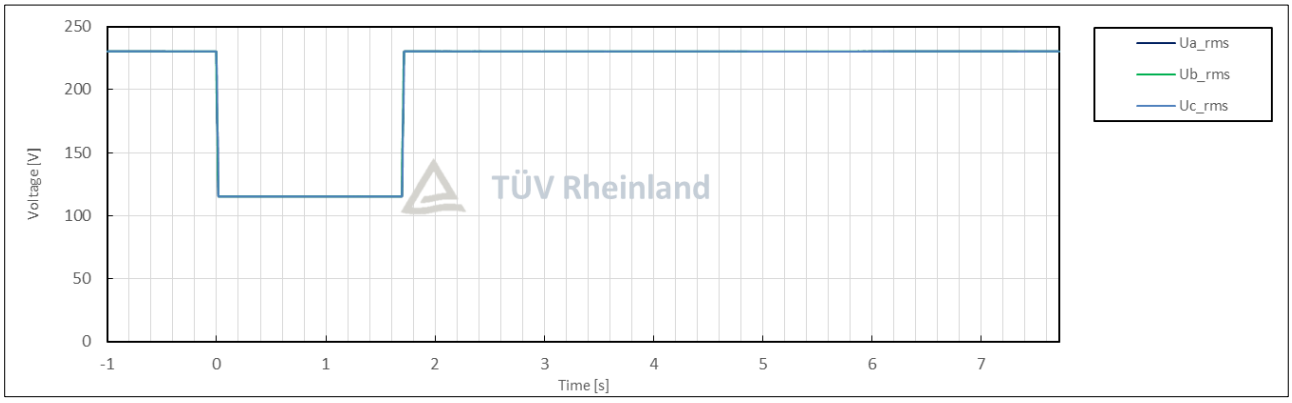

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.2
	1	Date	--	--	dd.mm.yyyy	06.18.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	11:20:31
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1713
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1713
	8	Fault duration in empty load test	Total	--	ms	1713
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.50
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.22
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	0.10
	16		Pos.			0.10
	17	Cos_{φ}	--	t1-10s to t1	--	0.901
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.718
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.08
	32		Pos.			0.08
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

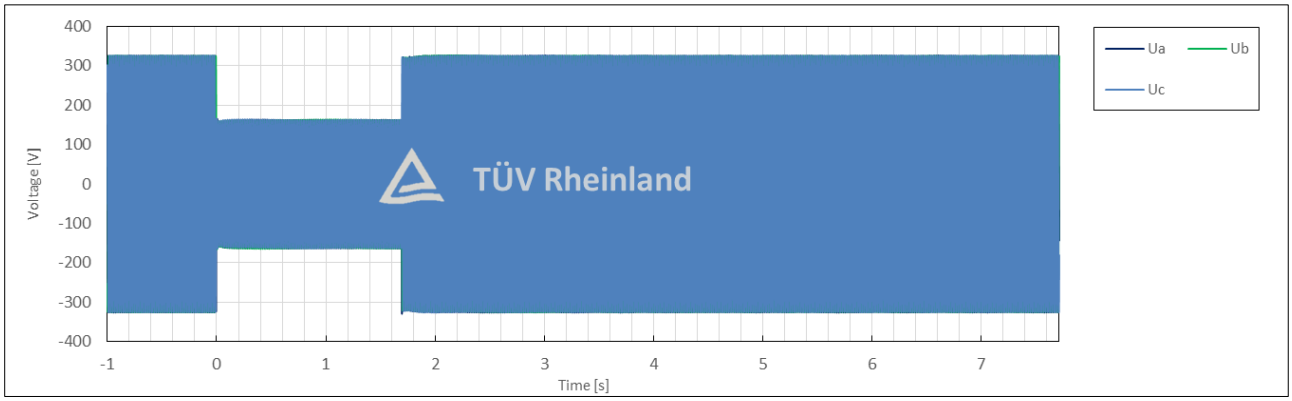
Test No. 2.2 idle test

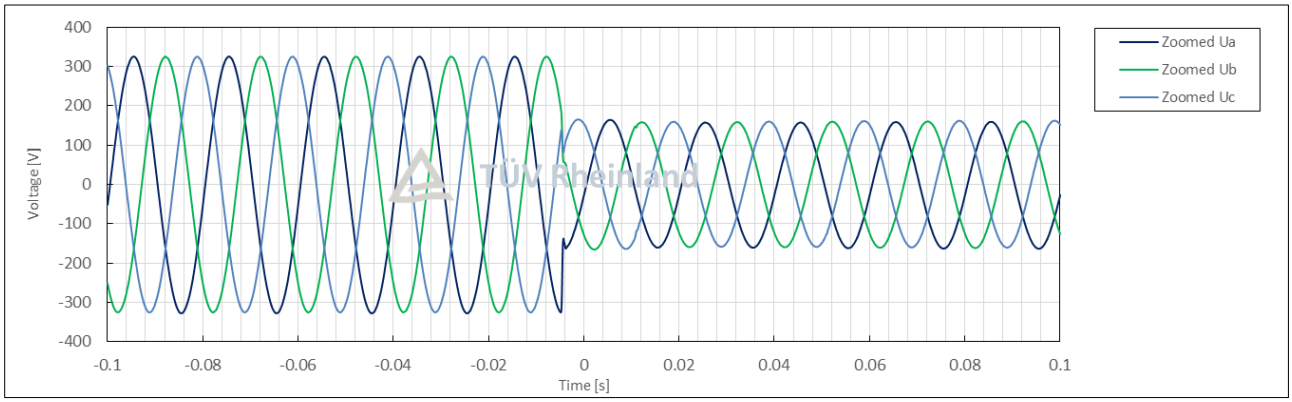


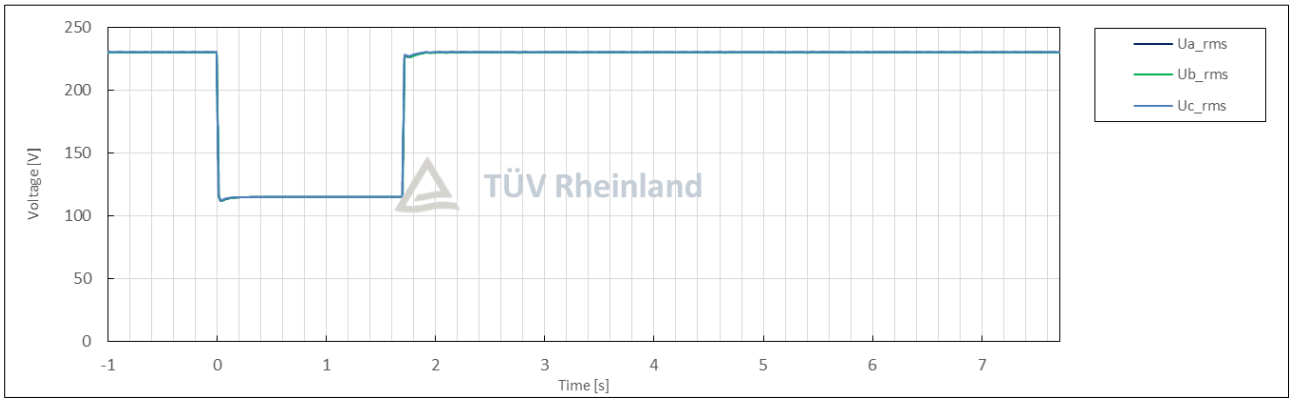


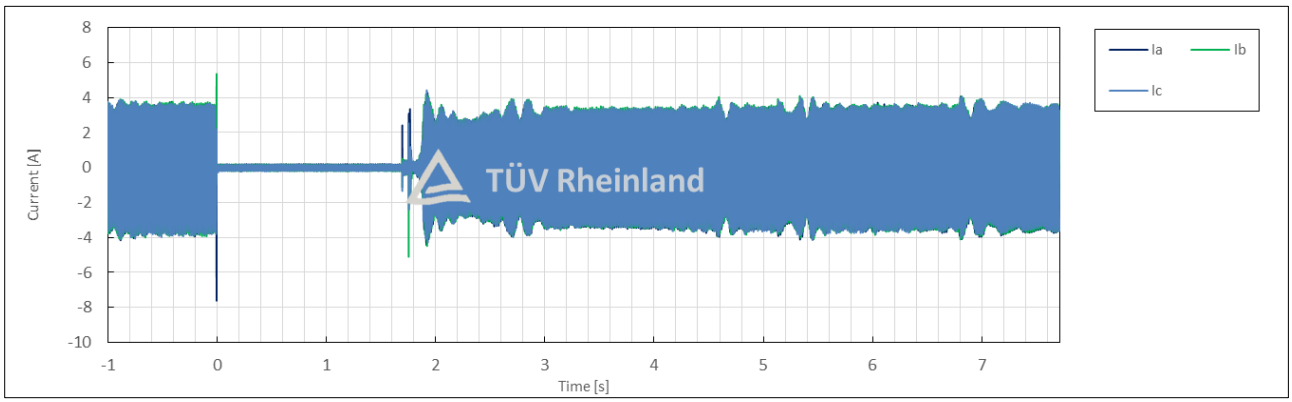


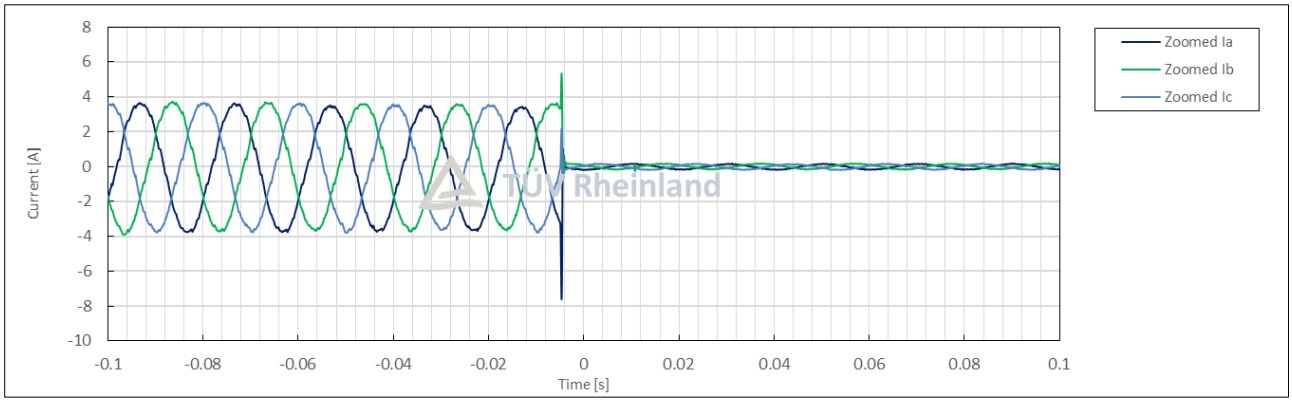
Test No. 2.2 with PGU

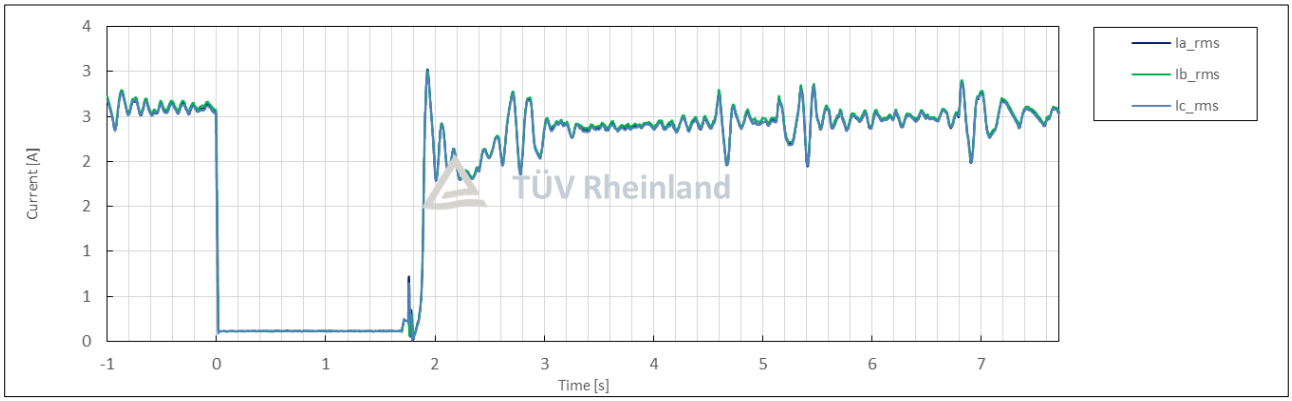


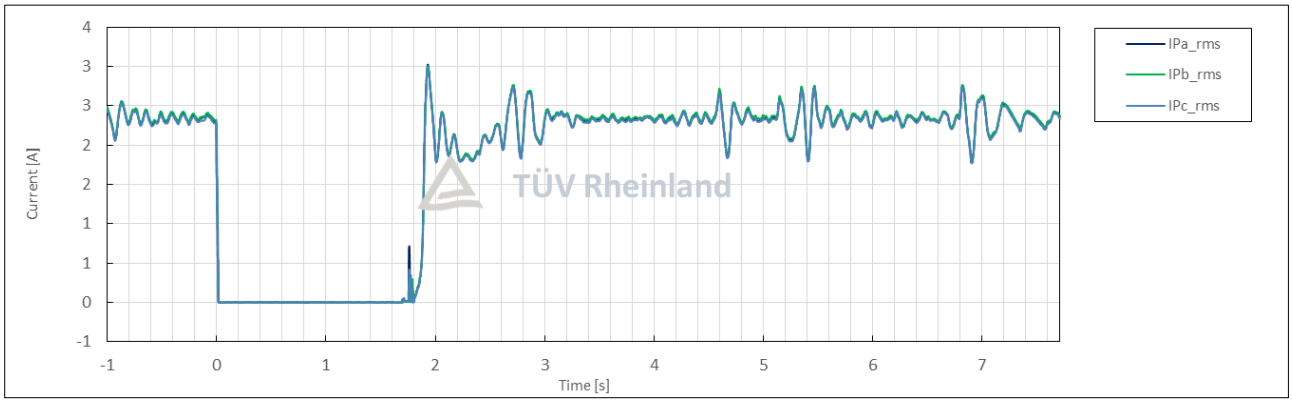


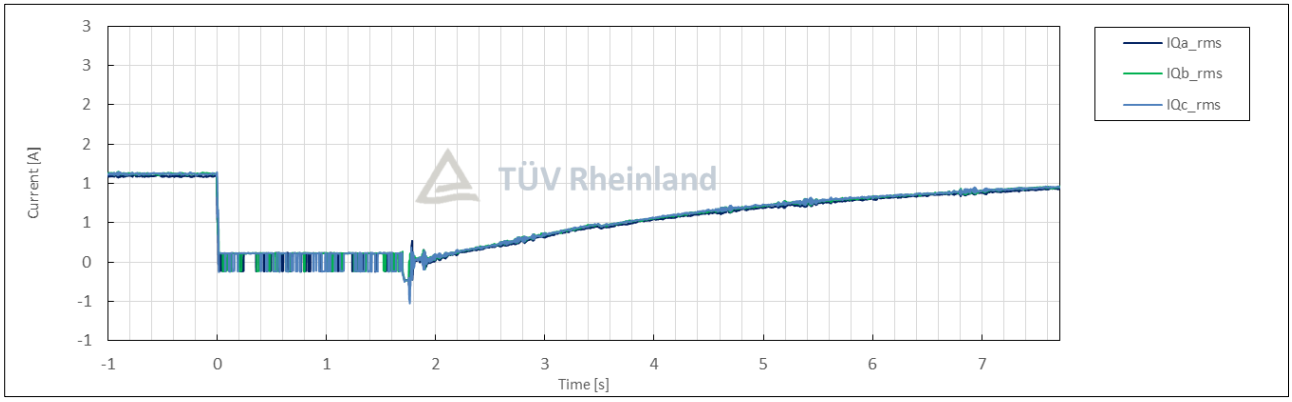


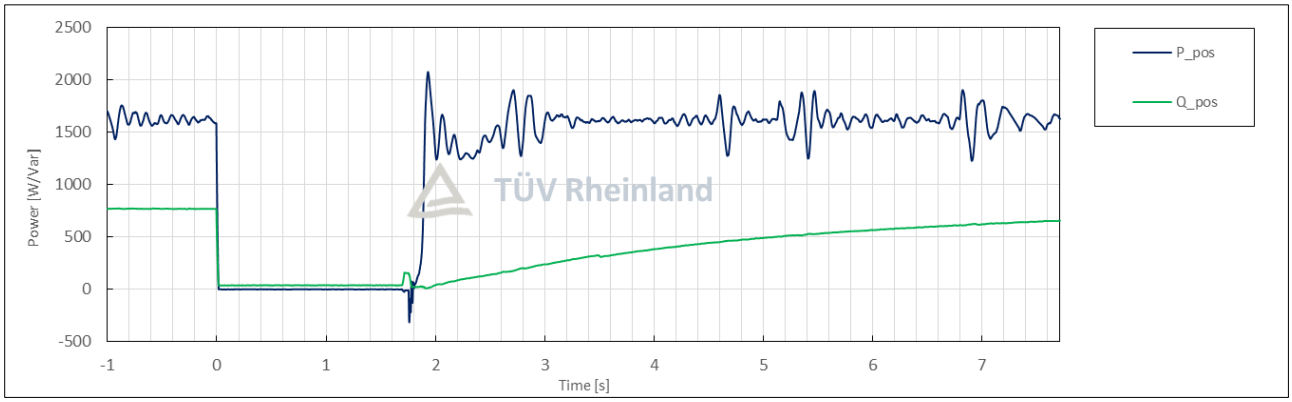


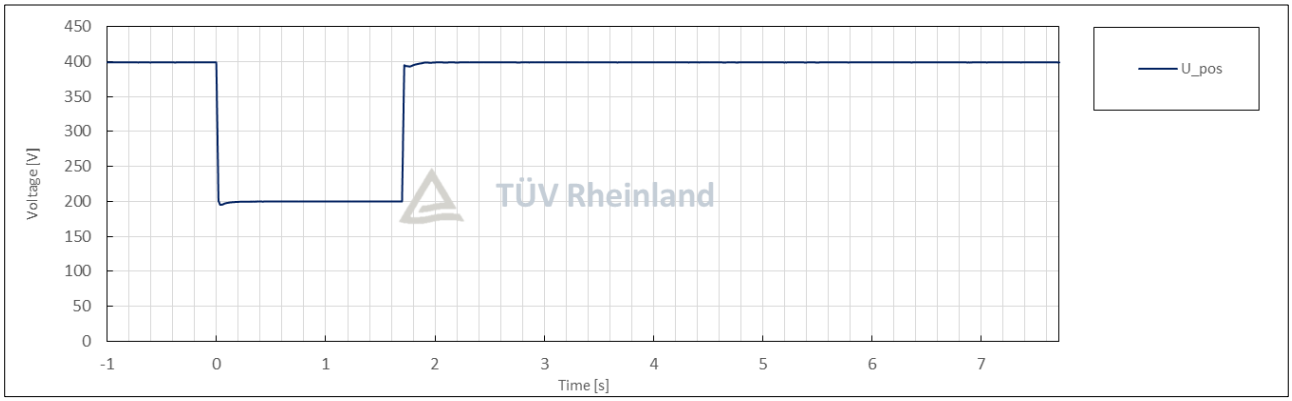

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

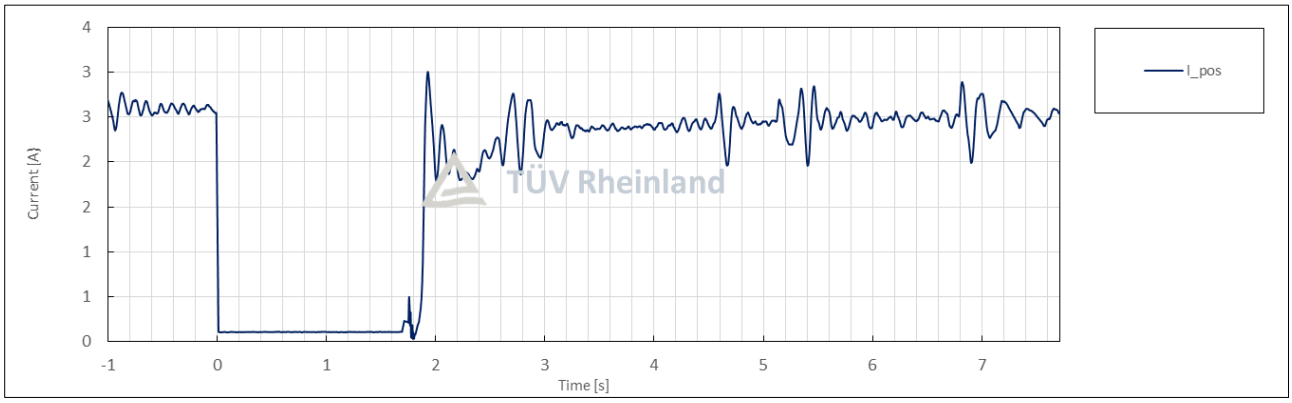

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

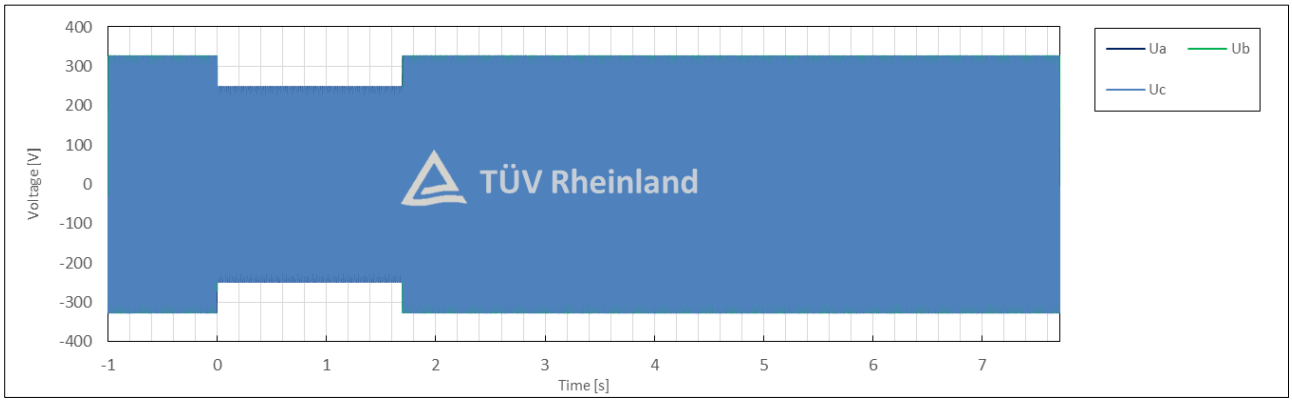

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

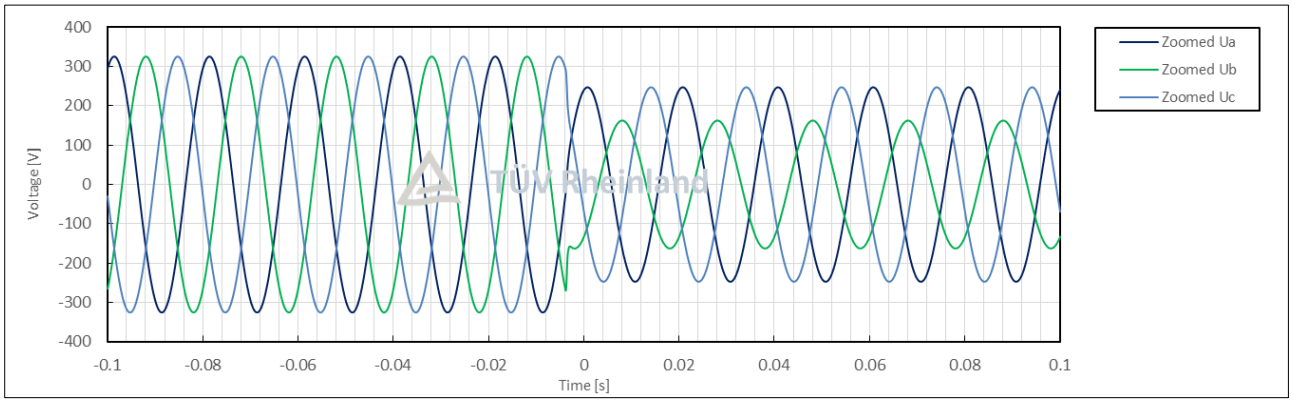

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

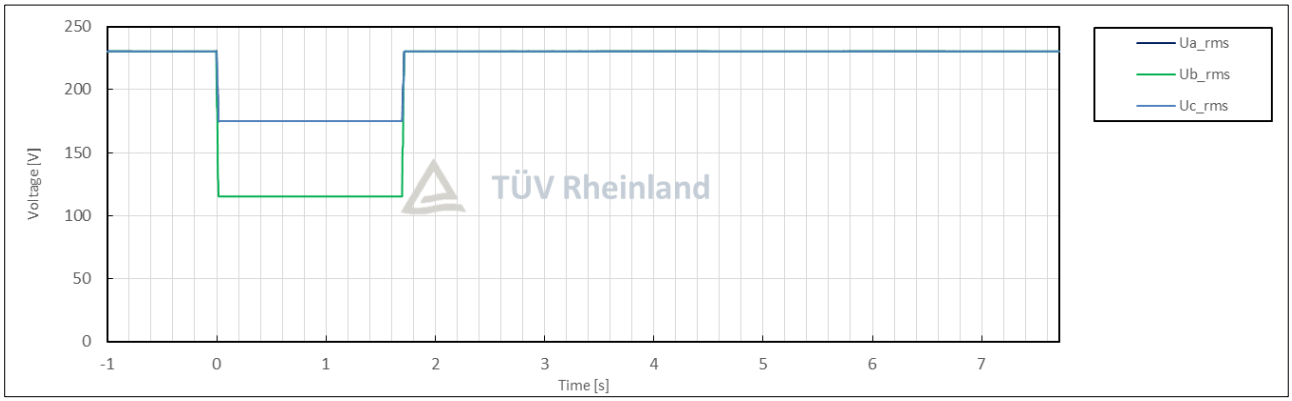

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.3
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:50:26
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1709
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1709
	8	Fault duration in empty load test	Total	--	ms	1709
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.67
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.01
	13	Active power	Total	t1-10s to t1	p.u.	0.91
	14		Pos.			0.91
	15	Reactive power	Total	t1-10s to t1	p.u.	0.43
	16		Pos.			0.43
	17	Cos_{φ}	--	t1-10s to t1	--	0.903
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.03
	20		Phase 2			0.02
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.03
	23		Phase 2			0.02
	24		Phase 3			0.03
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.91
	29		Pos.			0.91
	39	Active power rising time	Pos.	--	s	0.434
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.36
	32		Pos.			0.36
	33	Reactive power rising time	Pos.	--	s	9.496
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

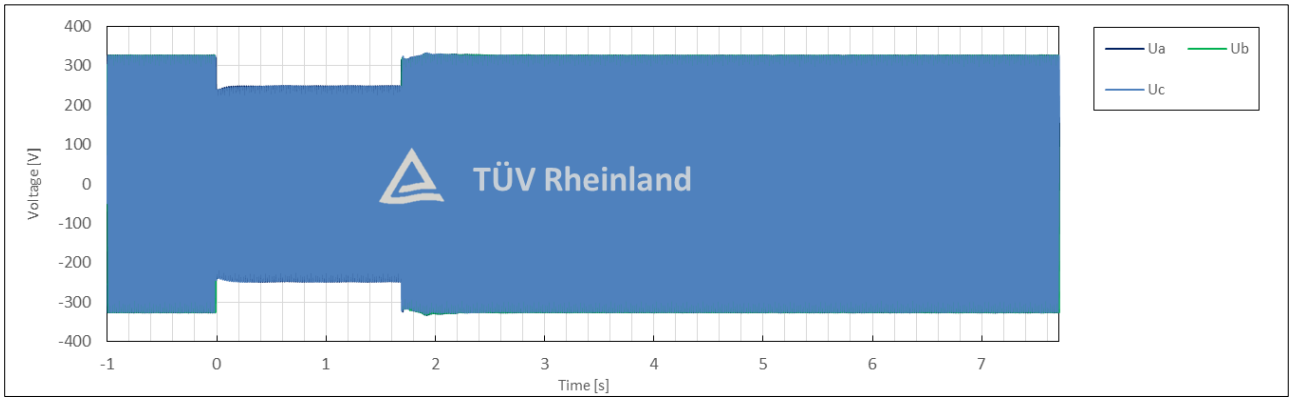
Test No. 2.3 idle test

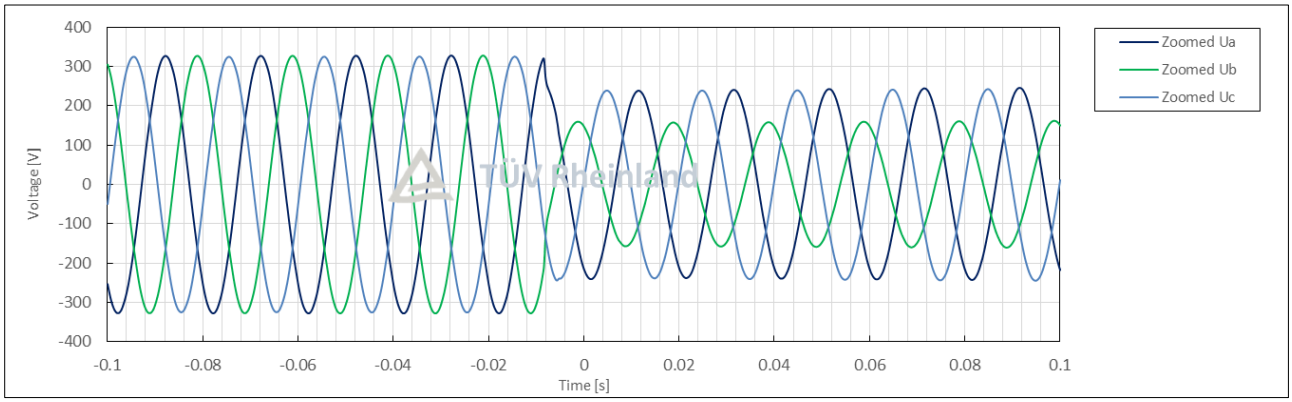


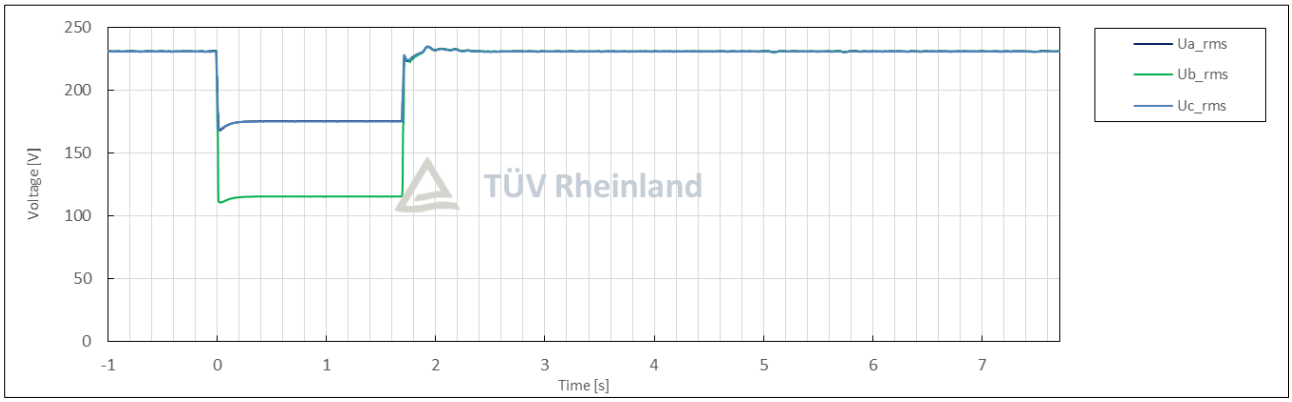


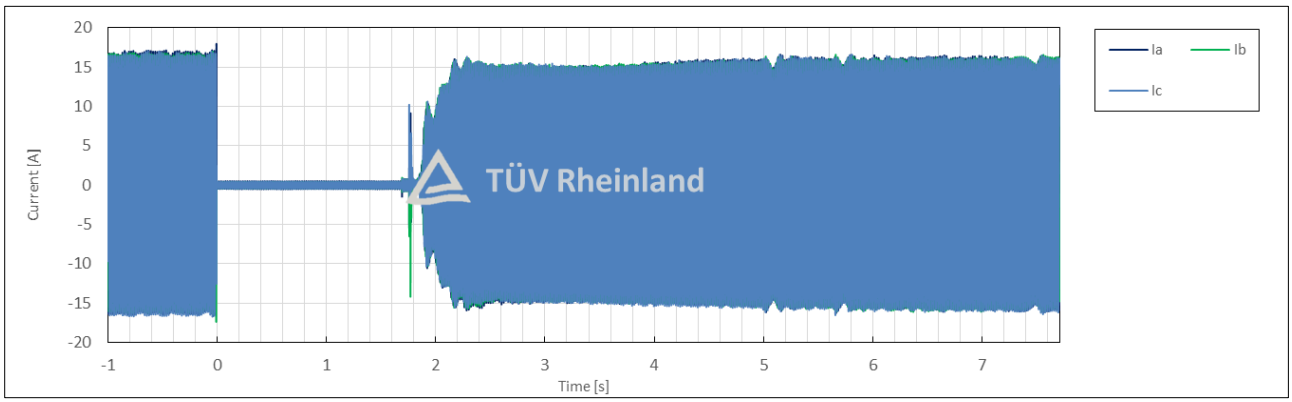


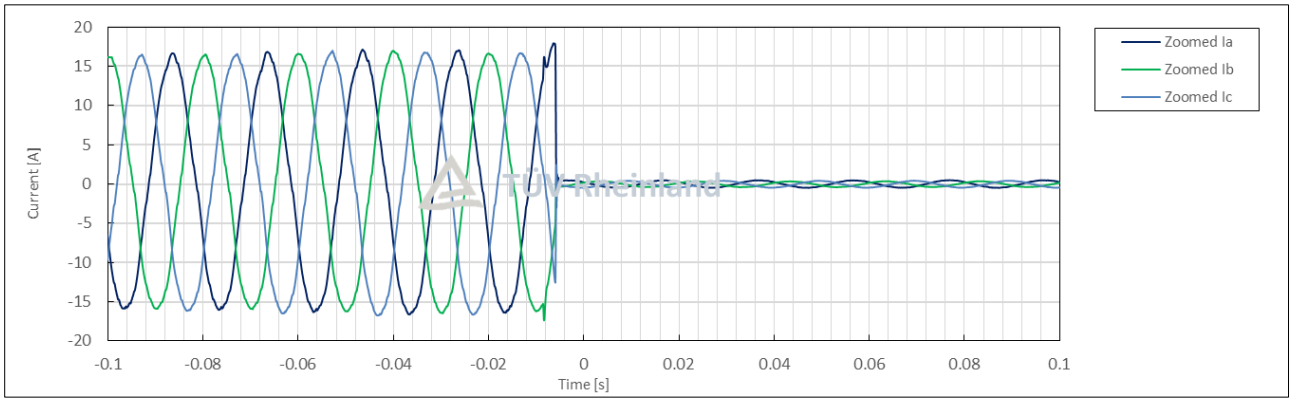
Test No. 2.3 with PGU

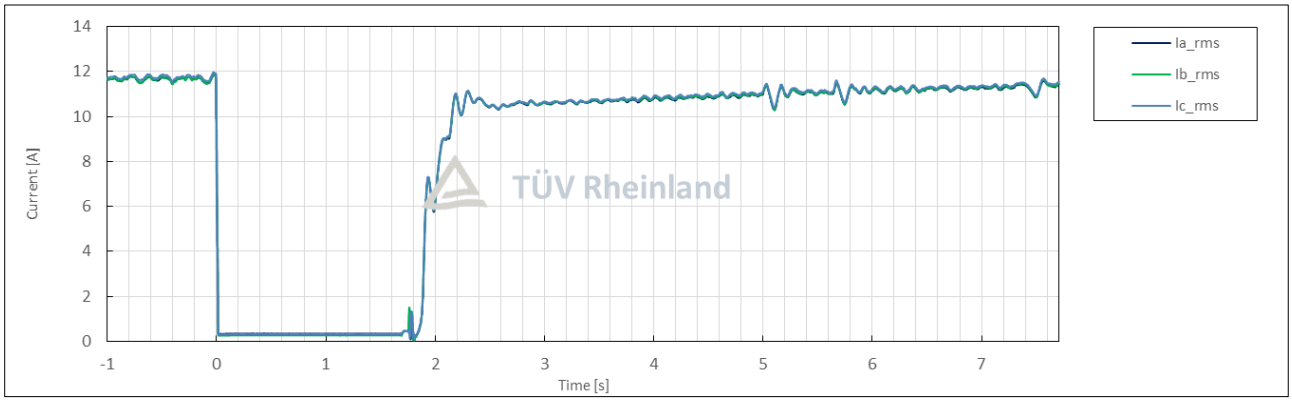


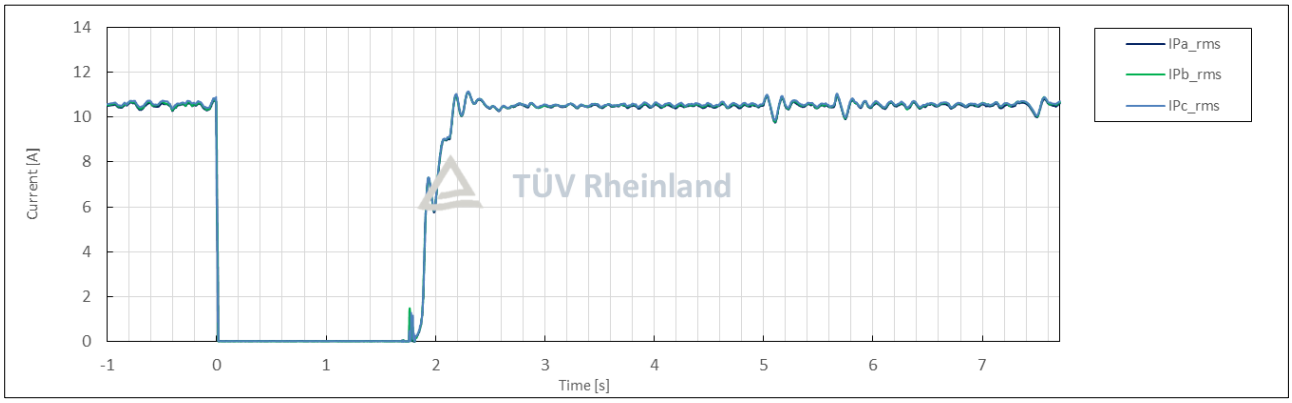


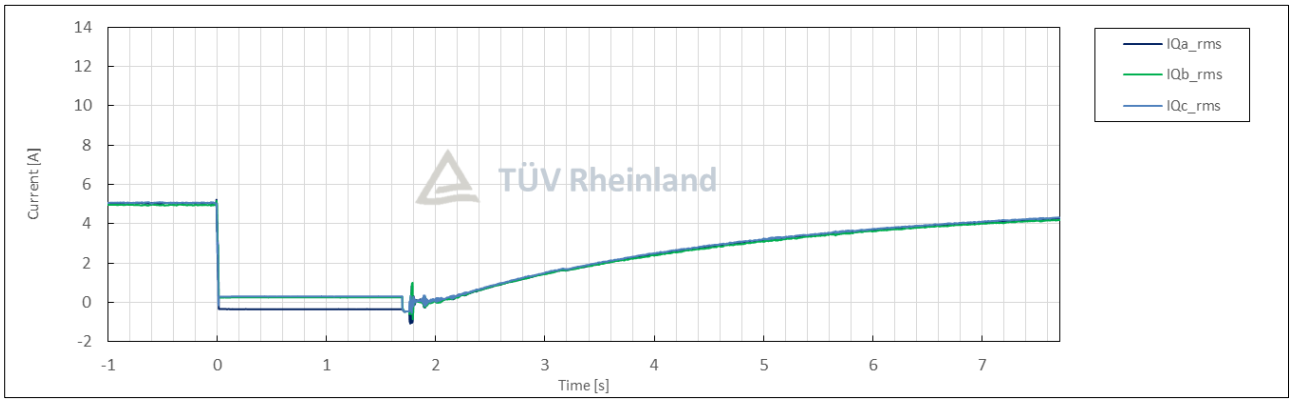


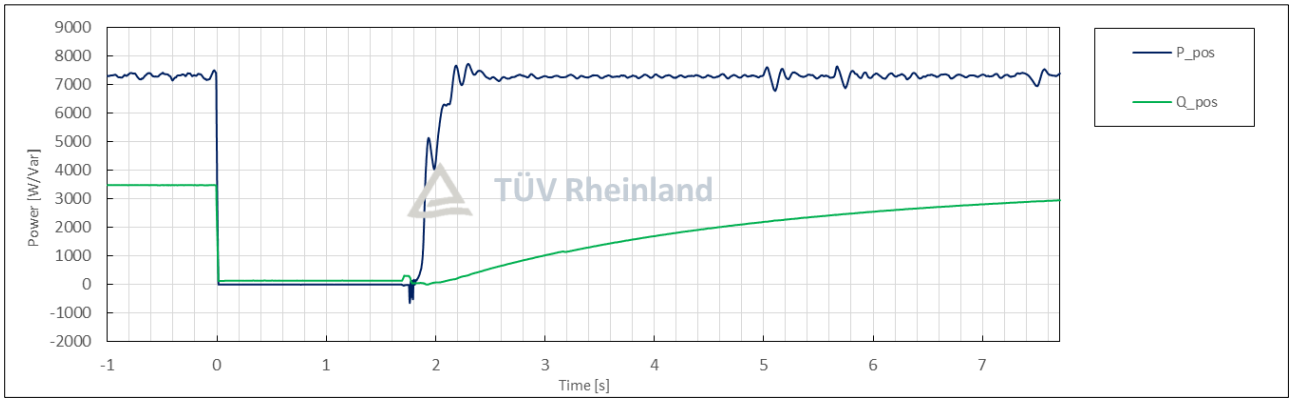


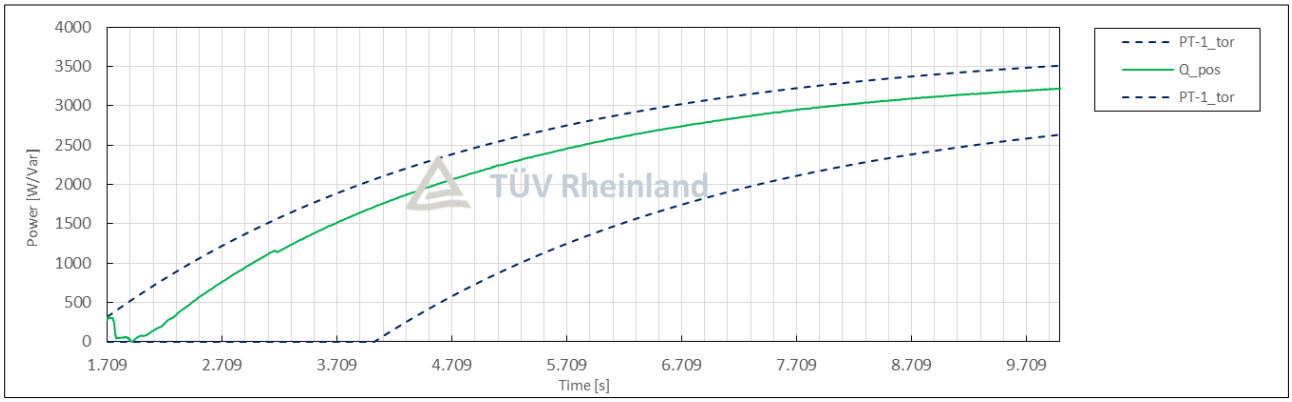

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

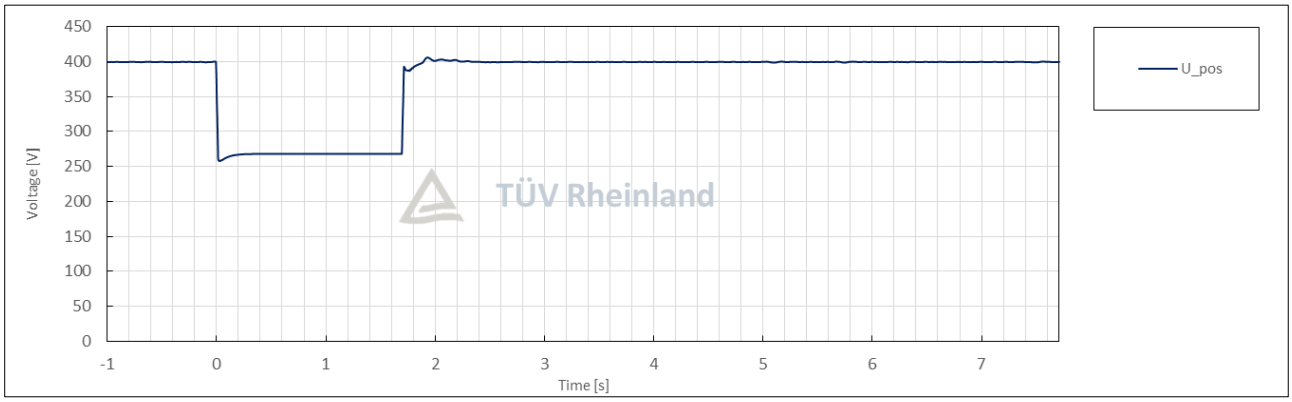

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland

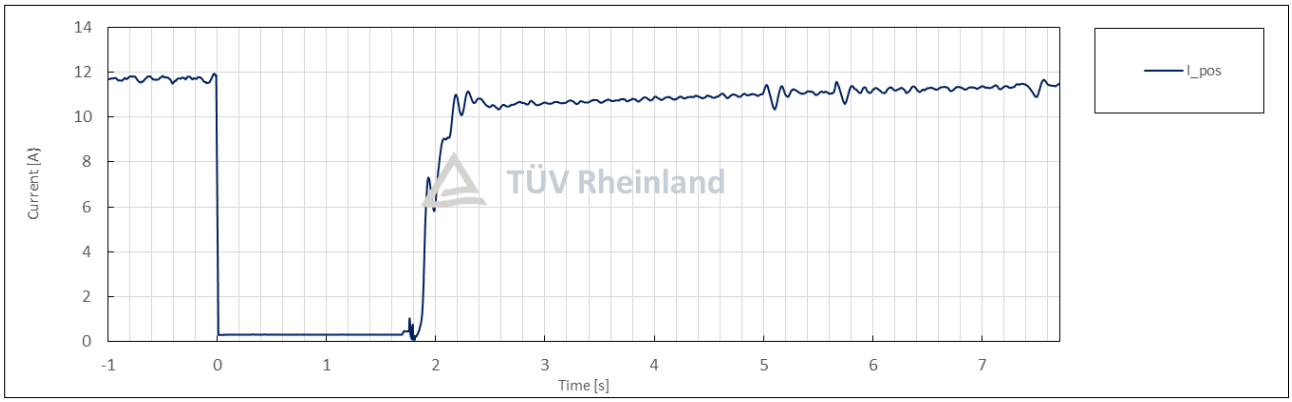

IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland


Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

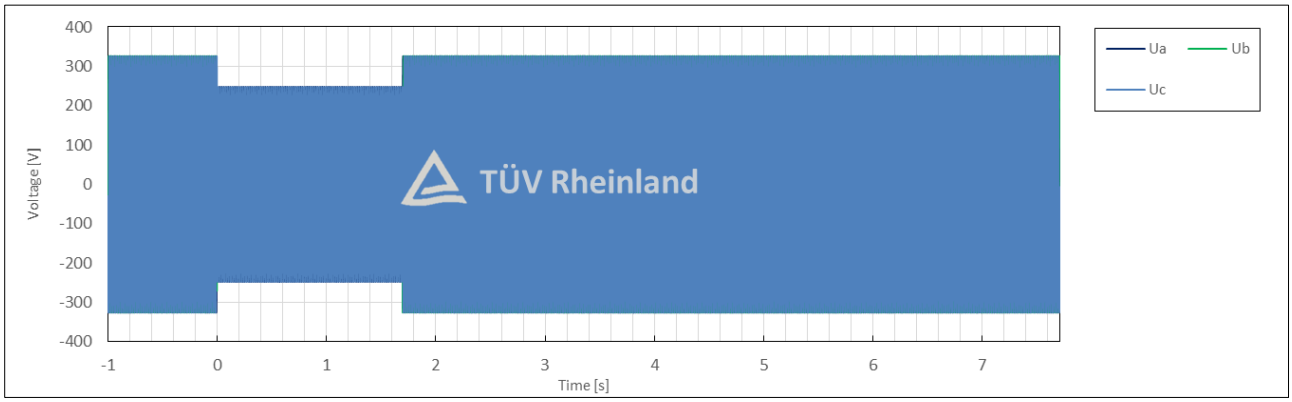

Power [W/Var]
Time [s]
PT-1_tor
Q_pos
PT-1_tor
TÜV Rheinland

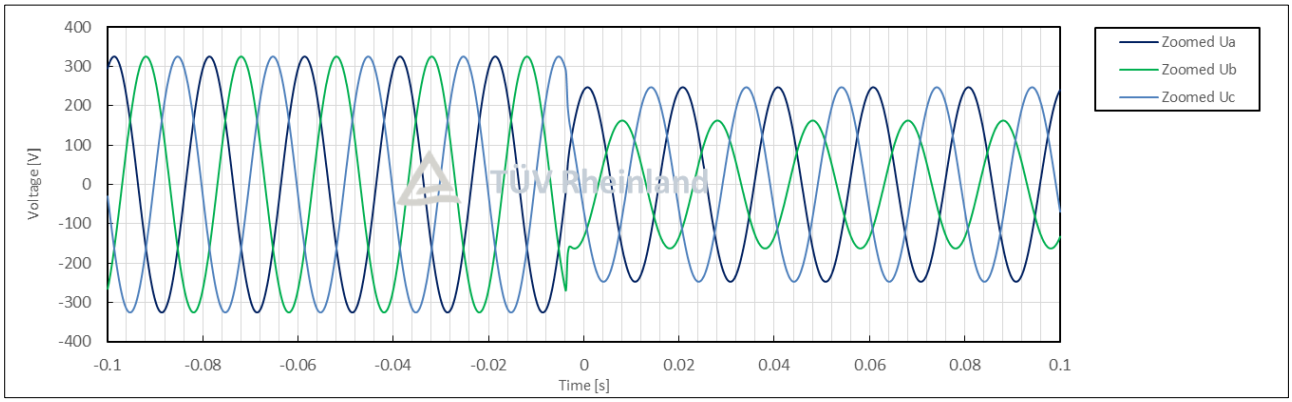

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

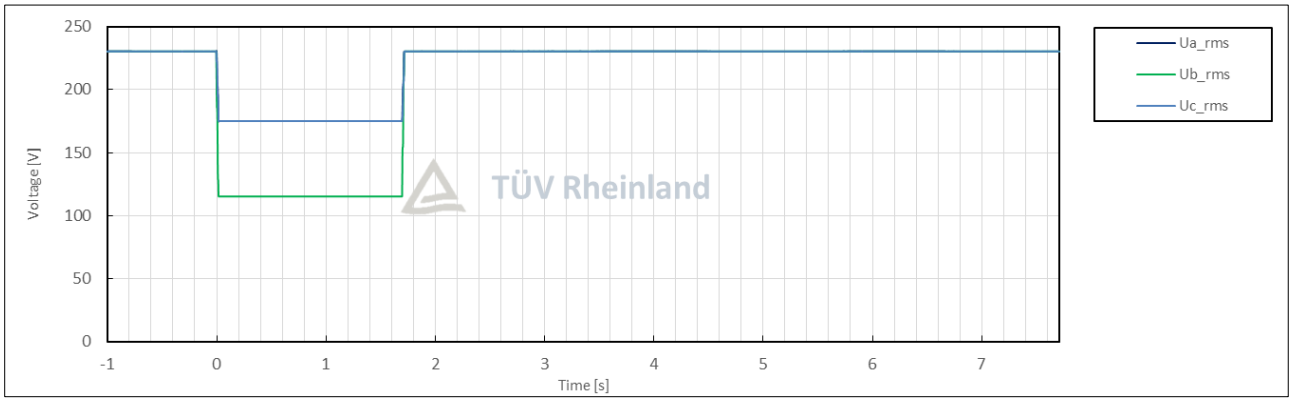

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.4
	1	Date	--	--	dd.mm.yyyy	06.18.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	11:21:22
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1709
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1709
	8	Fault duration in empty load test	Total	--	ms	1709
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.67
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.22
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	0.09
	16		Pos.			0.09
	17	Cos_{φ}	--	t1-10s to t1	--	0.904
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.944
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.08
	32		Pos.			0.08
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

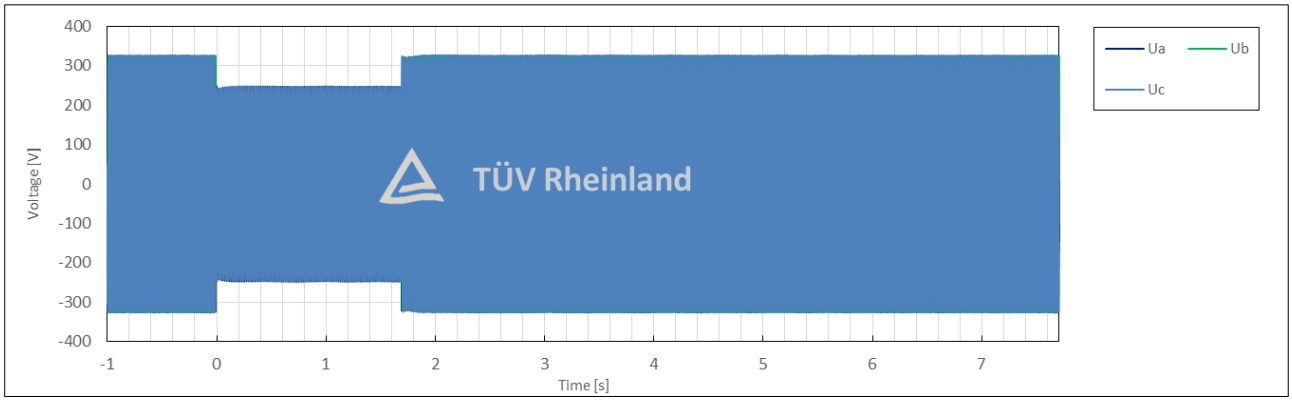
Test No. 2.4 idle test

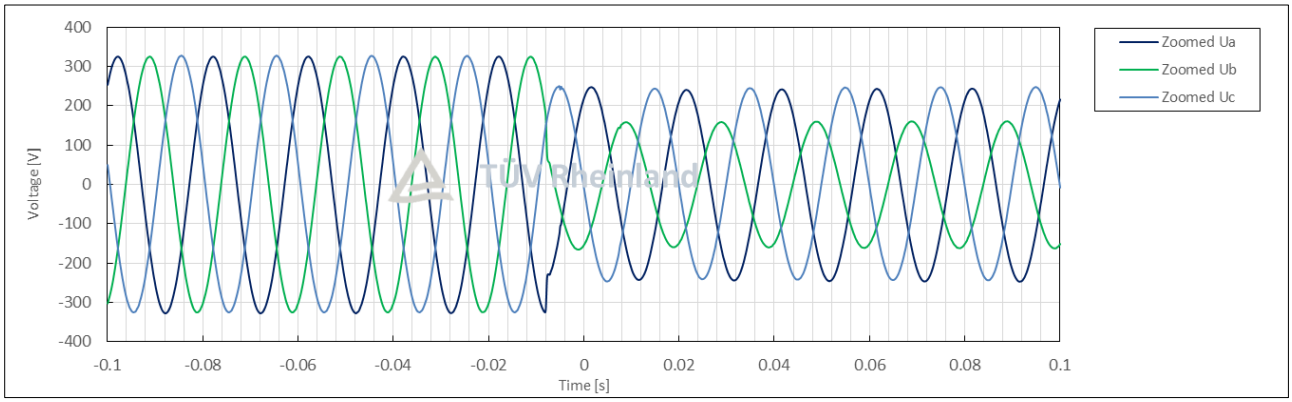


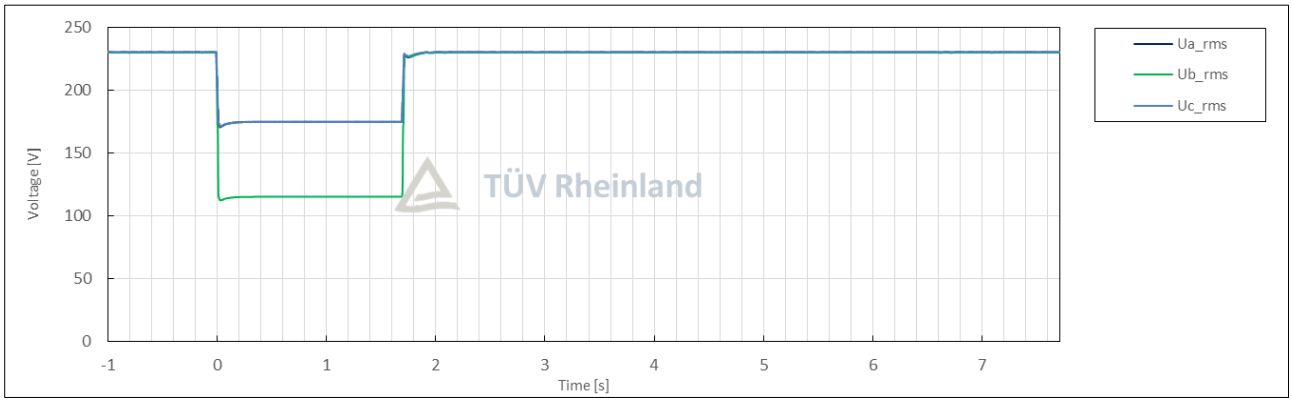


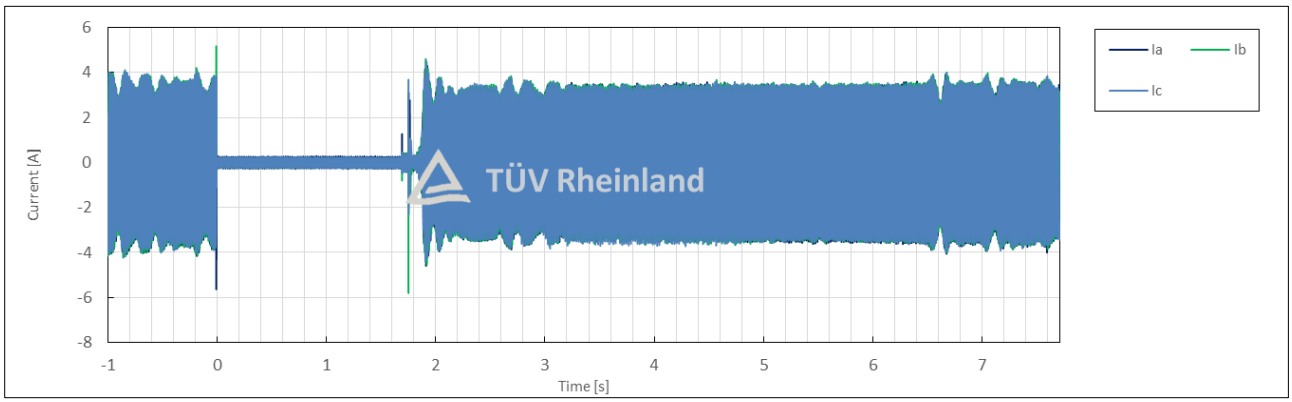


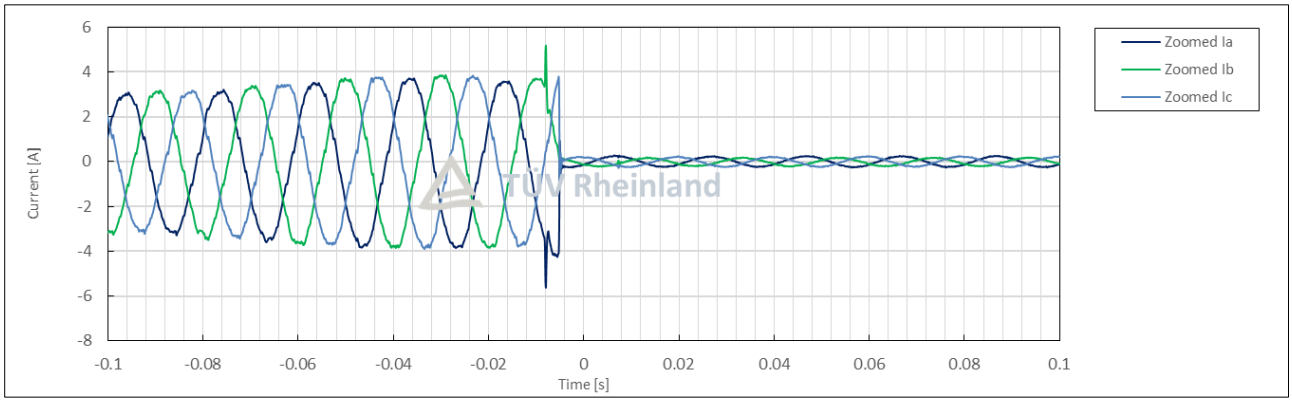
Test No. 2.4 with PGU

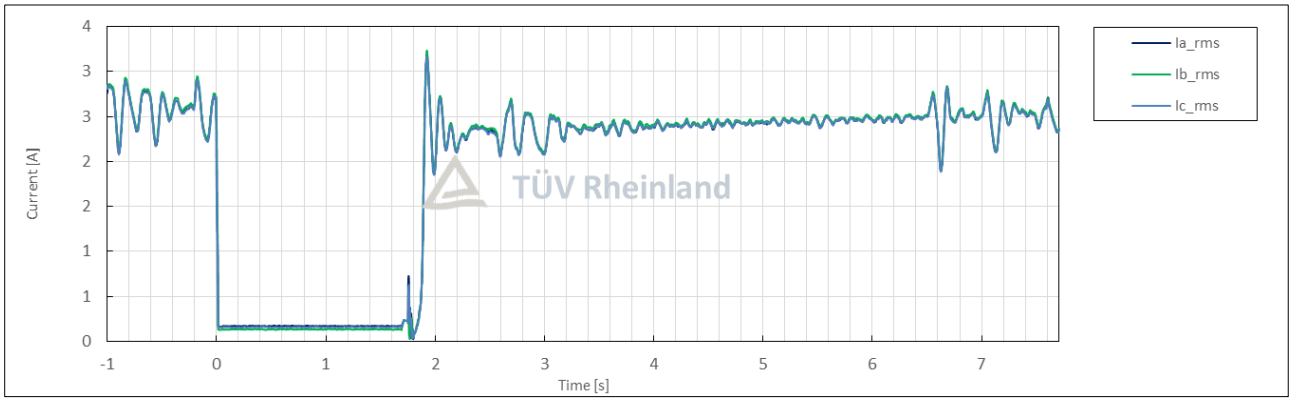


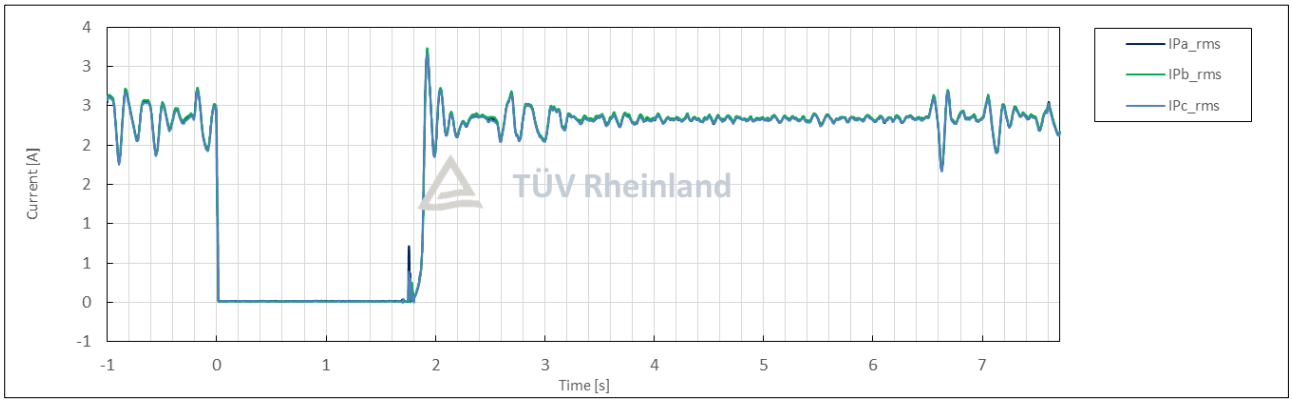


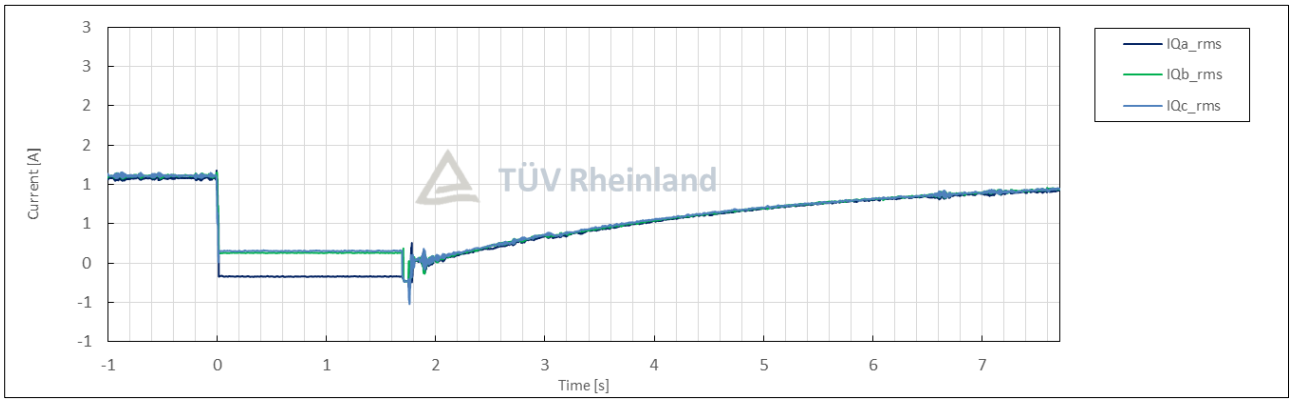


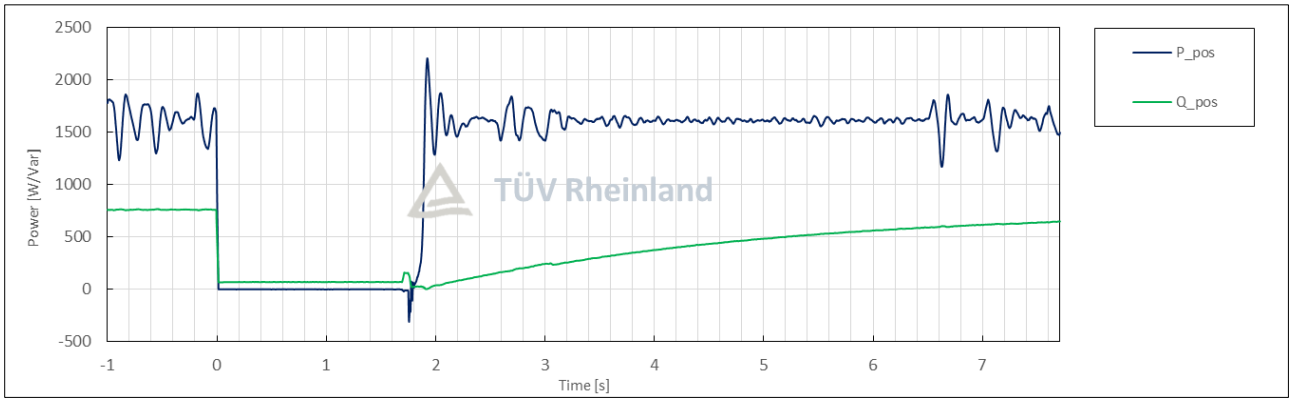


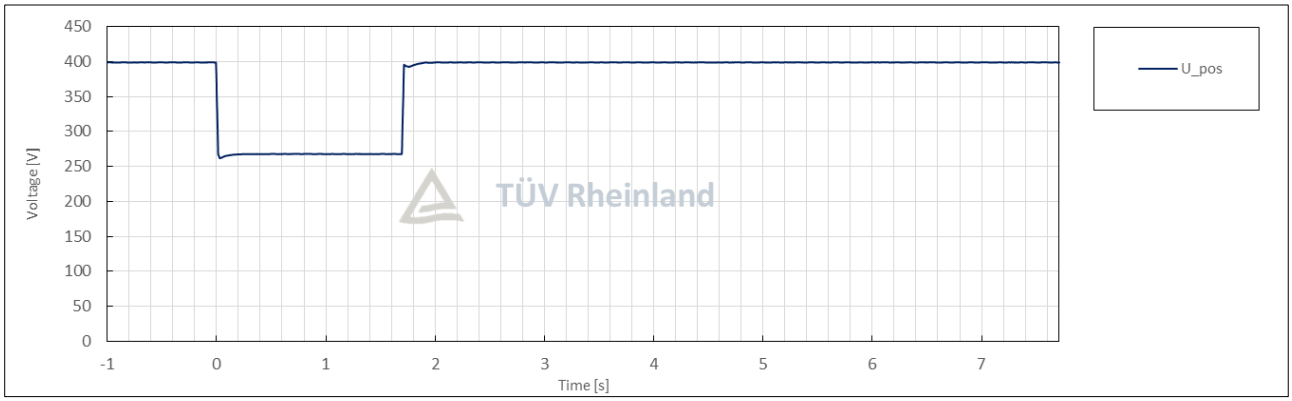

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

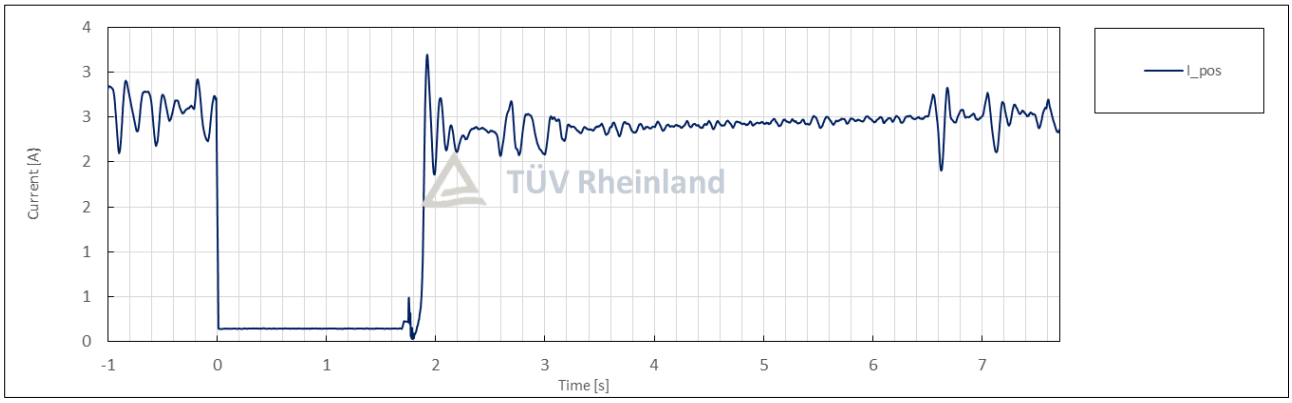

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

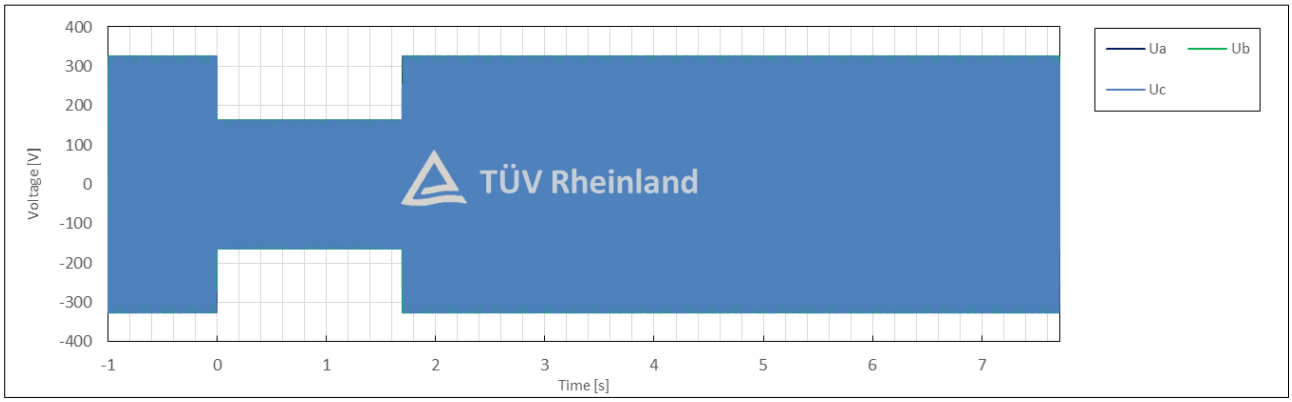

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

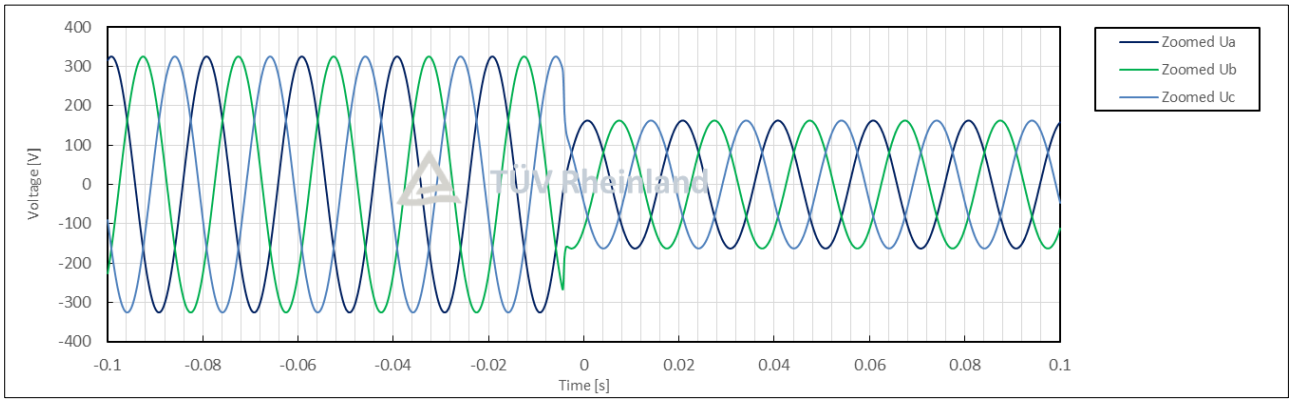

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

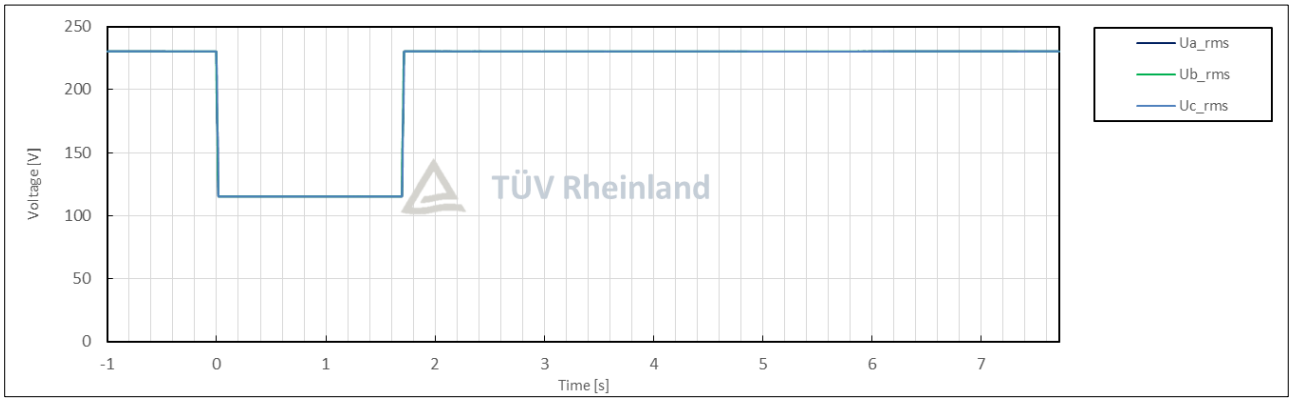

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.1
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:52:31
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1713
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1713
	8	Fault duration in empty load test	Total	--	ms	1713
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.50
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	0.90
	14		Pos.			0.90
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.44
	16		Pos.			-0.44
	17	Cos_{φ}	--	t1-10s to t1	--	0.900
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.02
	20		Phase 2			0.02
	21		Phase 3			0.02
	22	Line current	Phase 1	t1+100ms	p.u.	0.02
	23		Phase 2			0.02
	24		Phase 3			0.02
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.90
	29		Pos.			0.90
	39	Active power rising time	Pos.	--	s	0.754
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.37
	32		Pos.			-0.37
	33	Reactive power rising time	Pos.	--	s	9.159
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

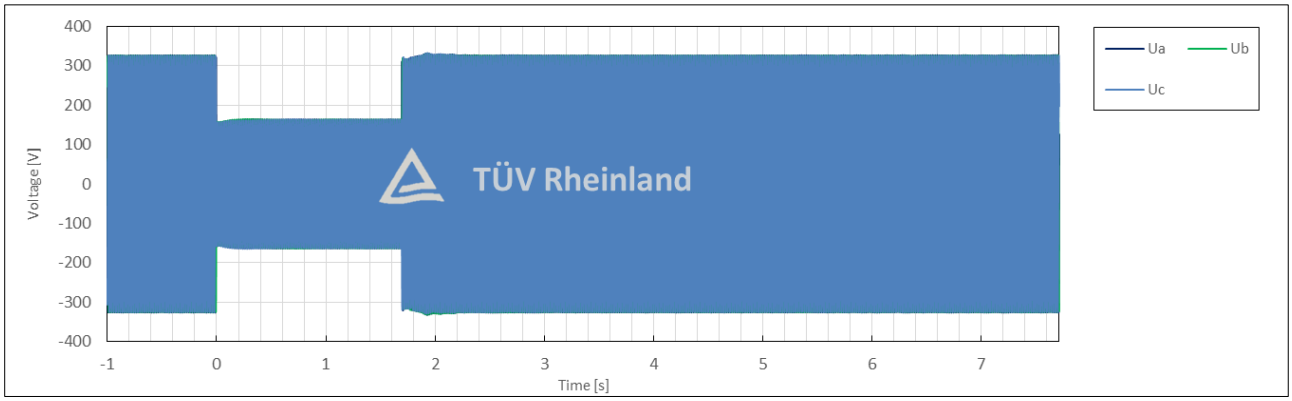
Test No. 3.1 idle test

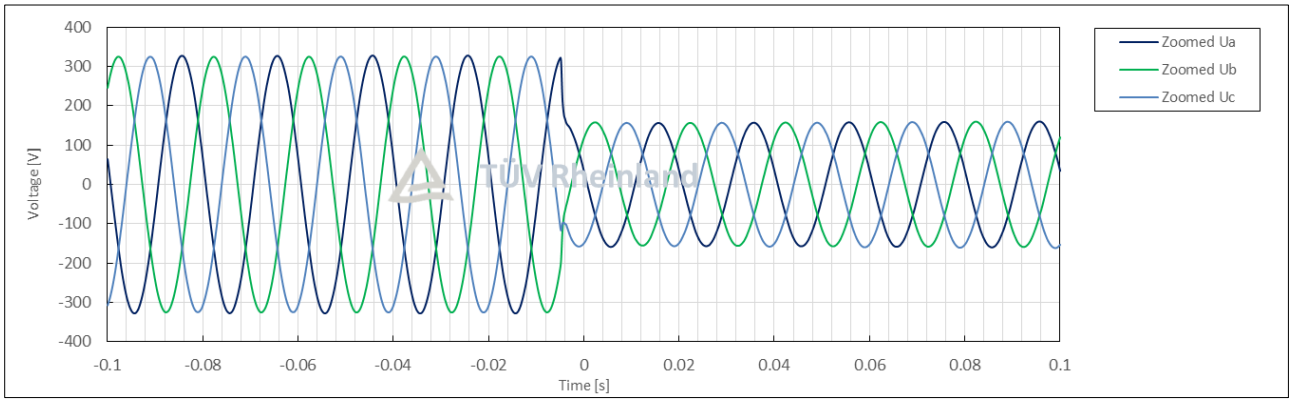


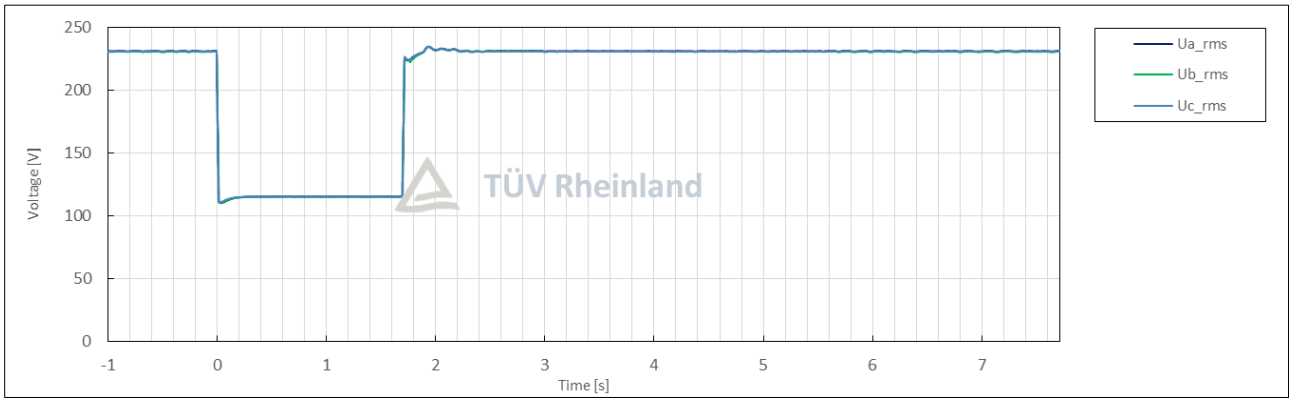


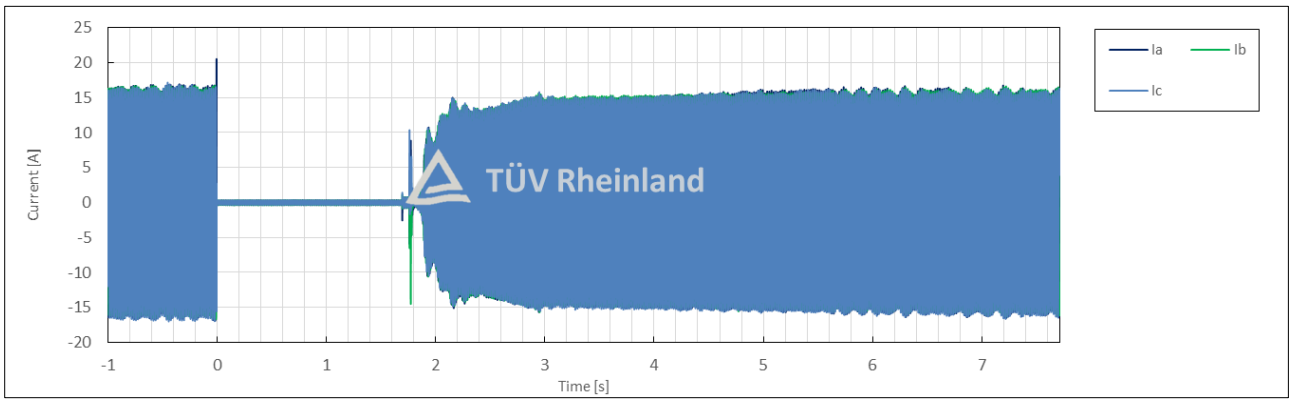


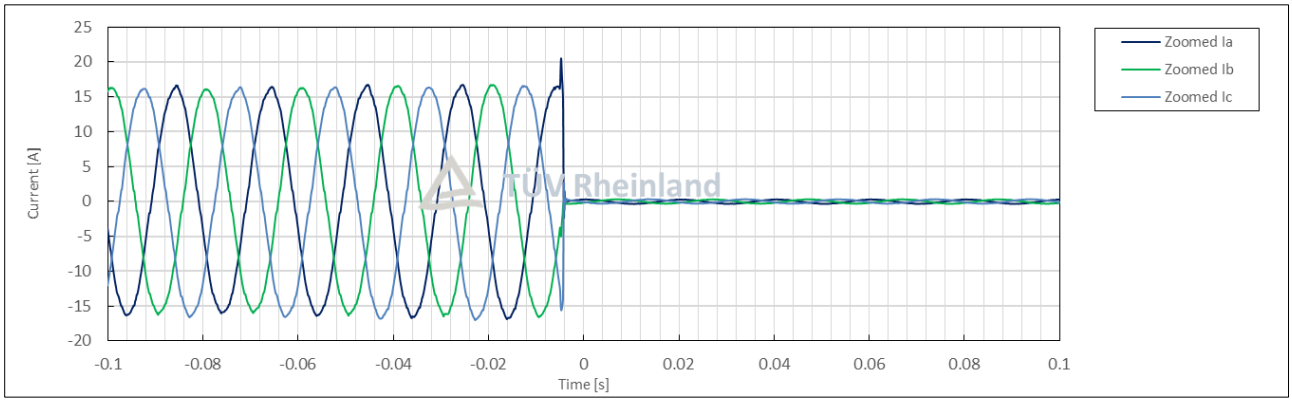
Test No. 3.1 with PGU

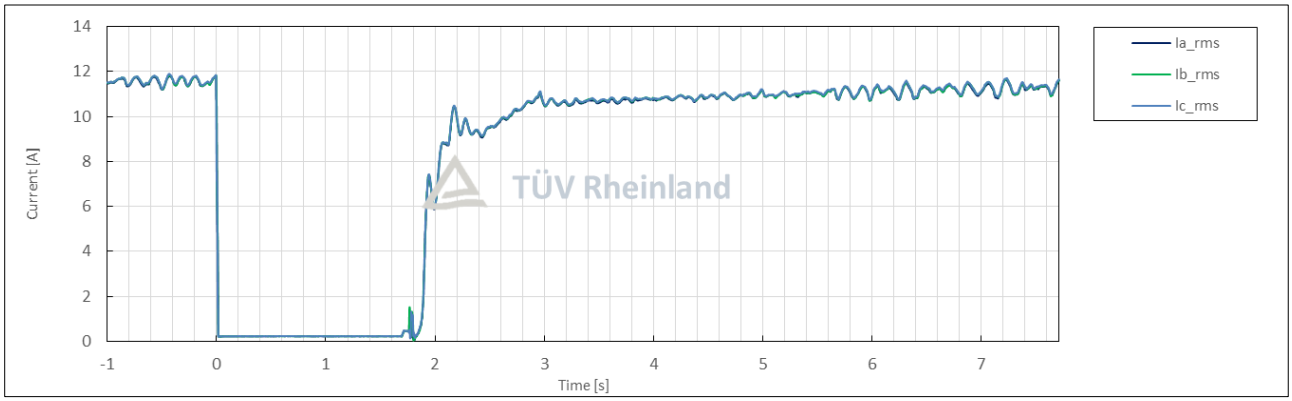


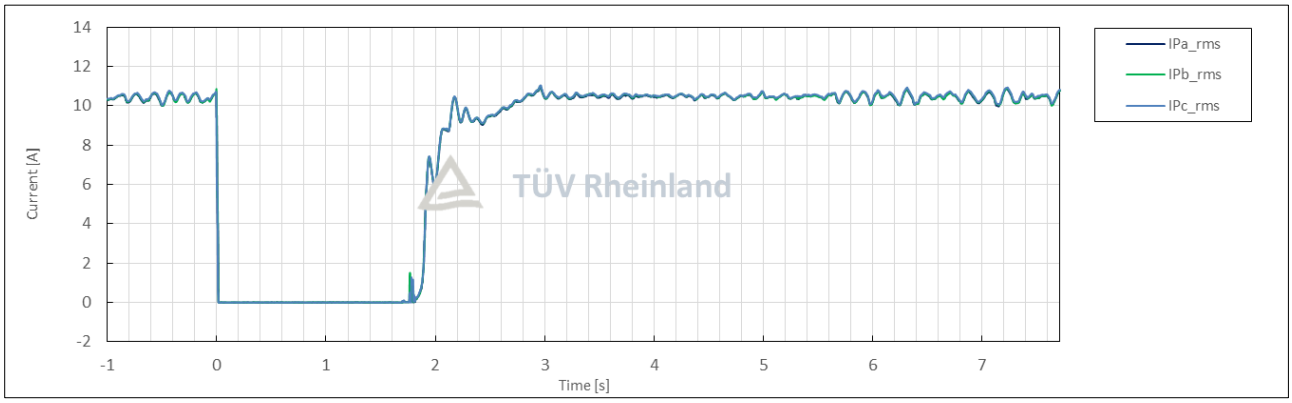


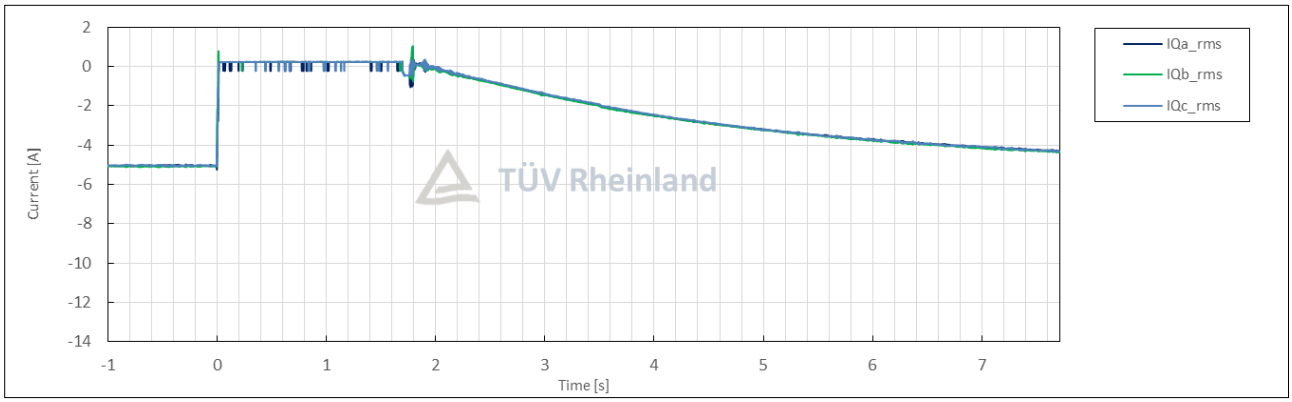


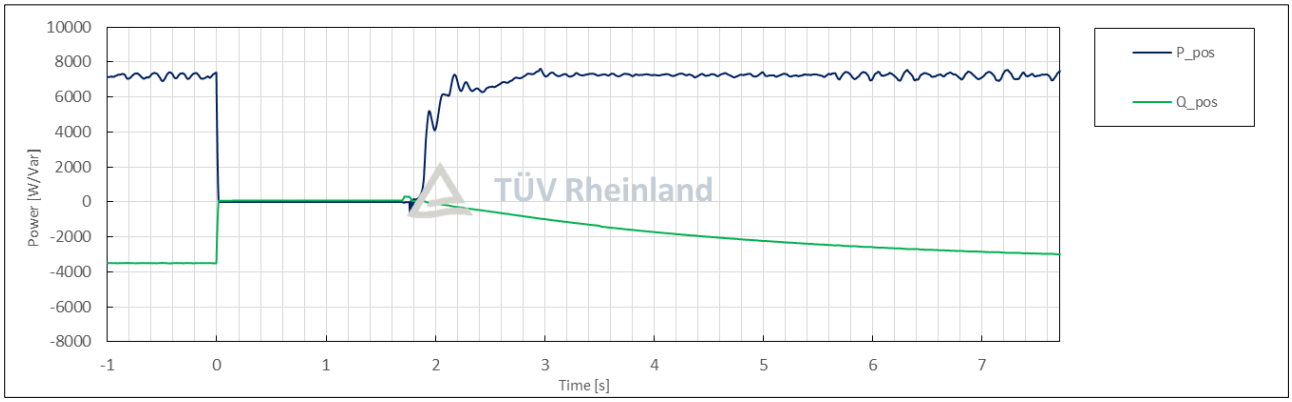


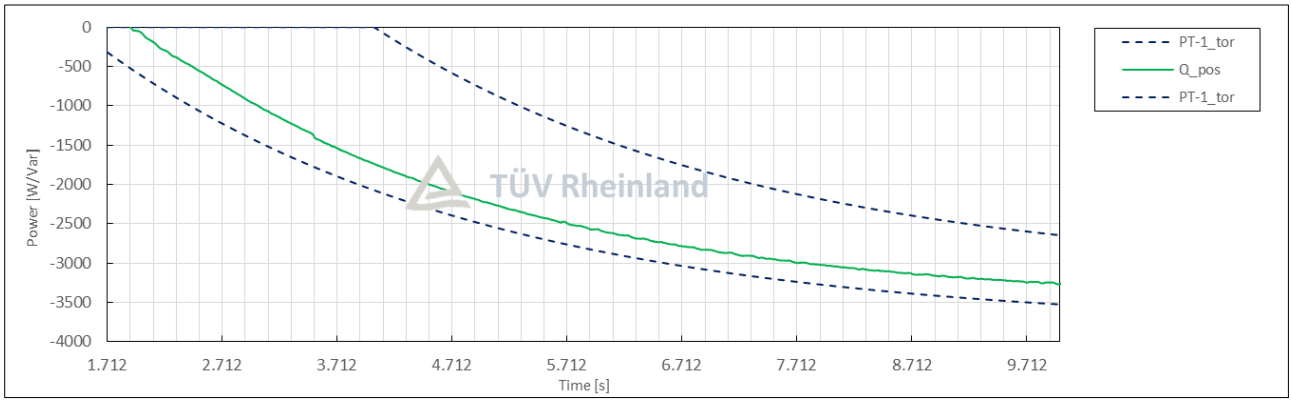

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

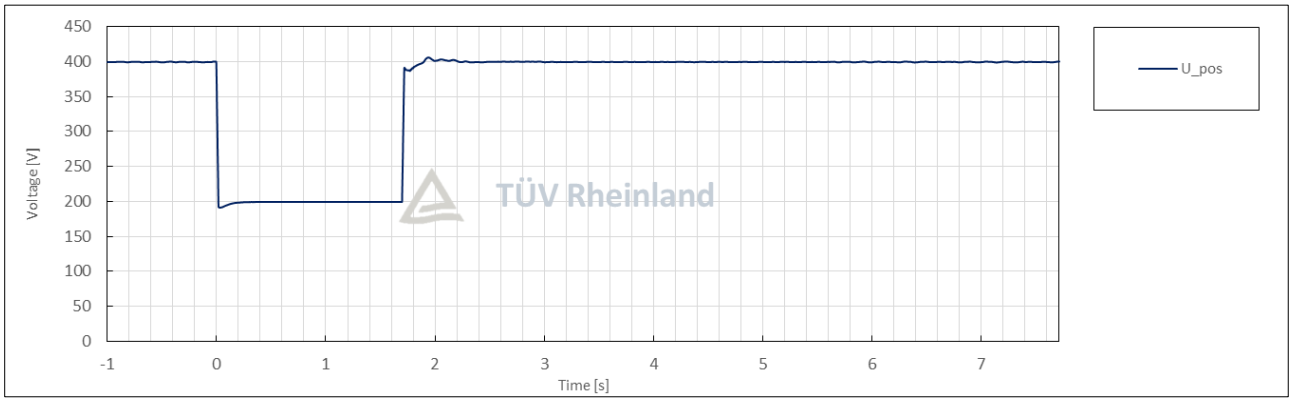

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland

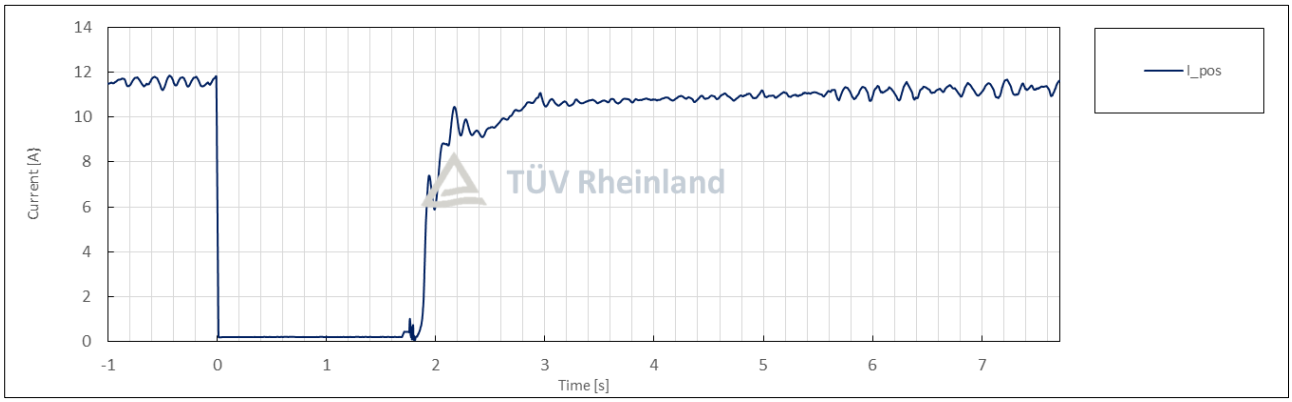

IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland


Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

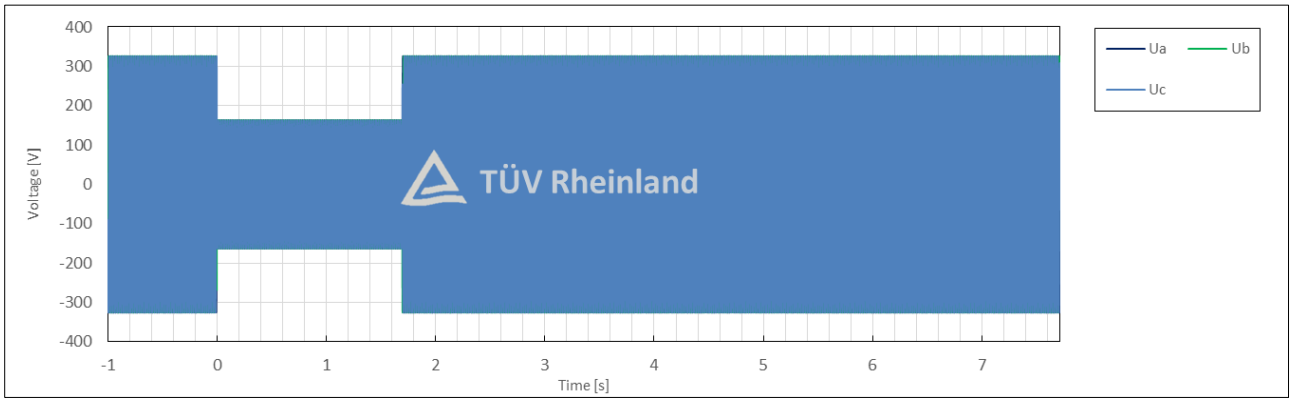

Power [W/Var]
Time [s]
PT-1_tor
Q_pos
PT-1_tor
TÜV Rheinland

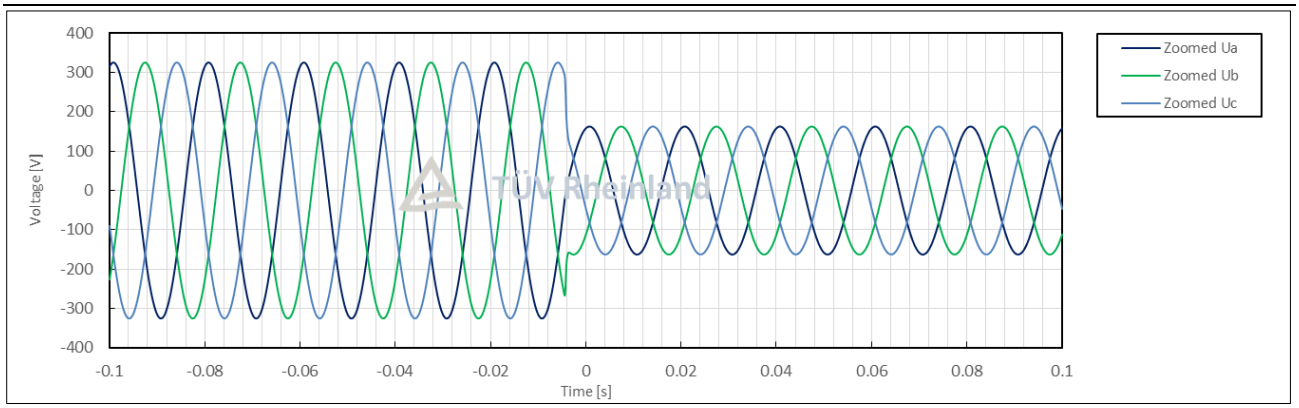

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

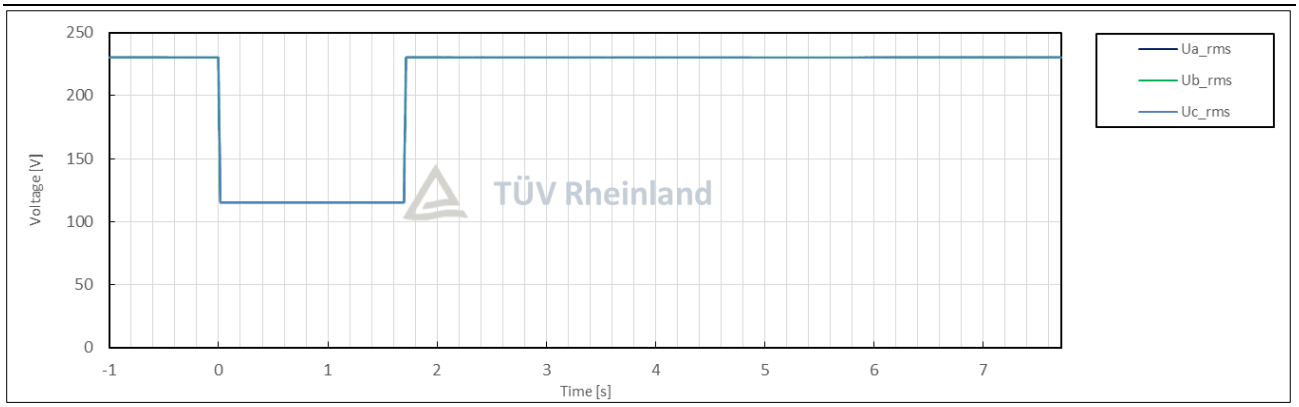

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.2
	1	Date	--	--	dd.mm.yyyy	06.18.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	11:22:14
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1713
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1713
	8	Fault duration in empty load test	Total	--	ms	1713
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.50
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.22
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.10
	16		Pos.			-0.10
	17	Cos_{φ}	--	t1-10s to t1	--	0.900
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.818
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.08
	32		Pos.			-0.08
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

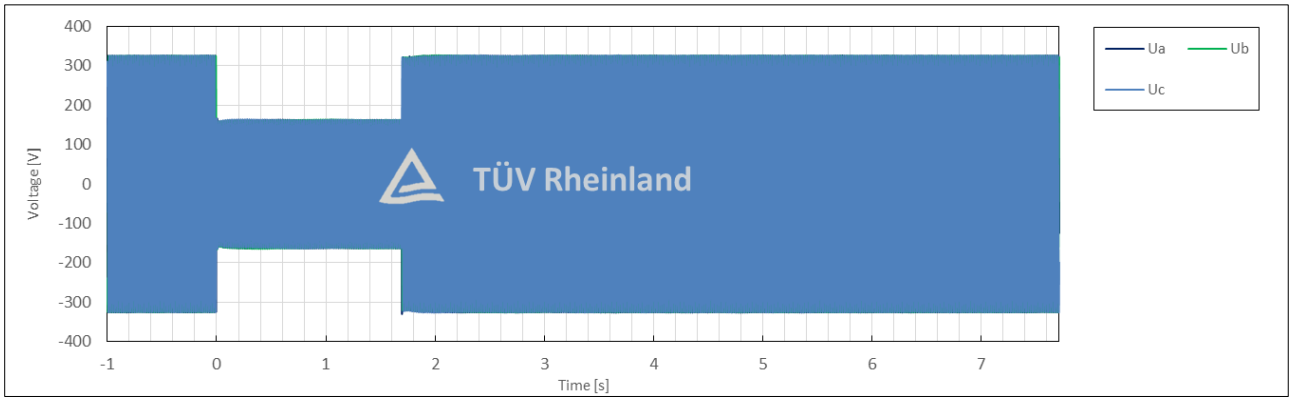
Test No. 3.2 idle test

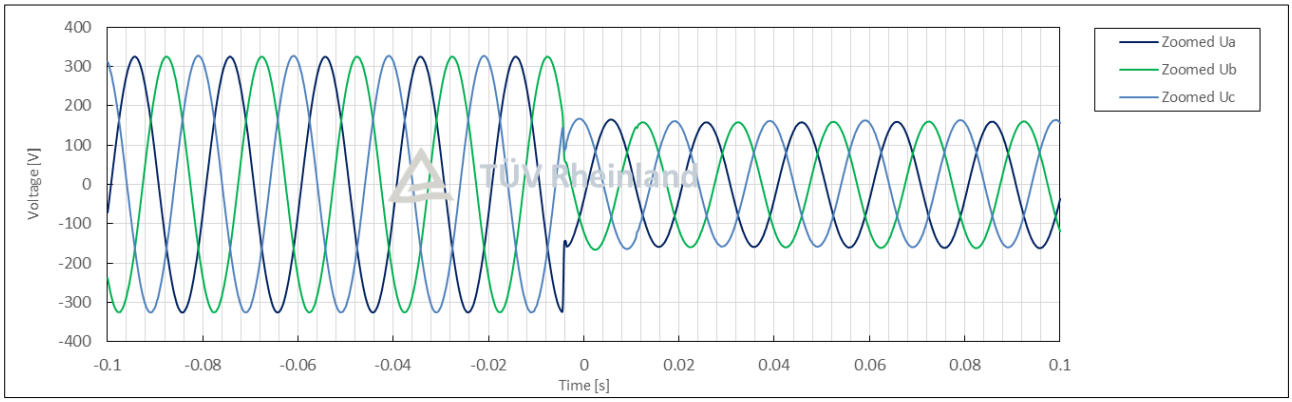


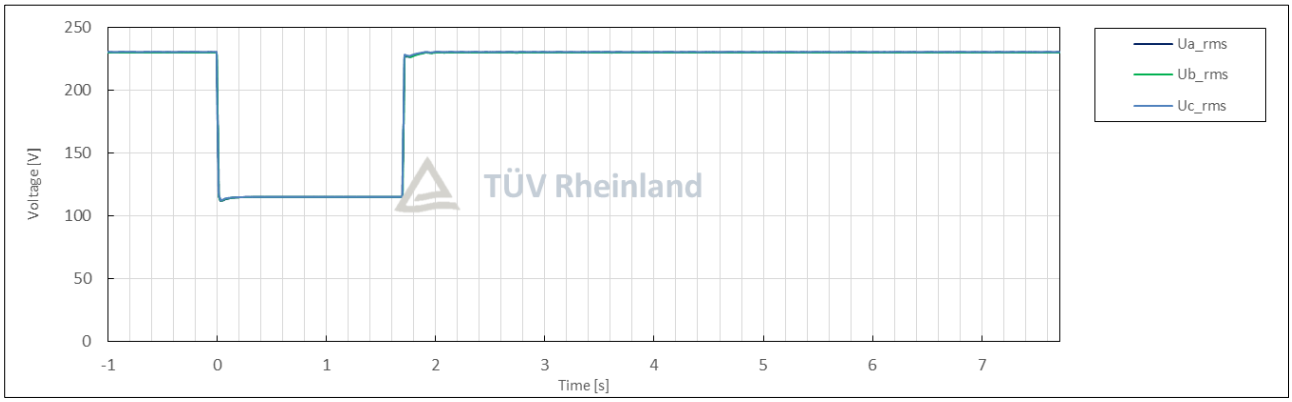


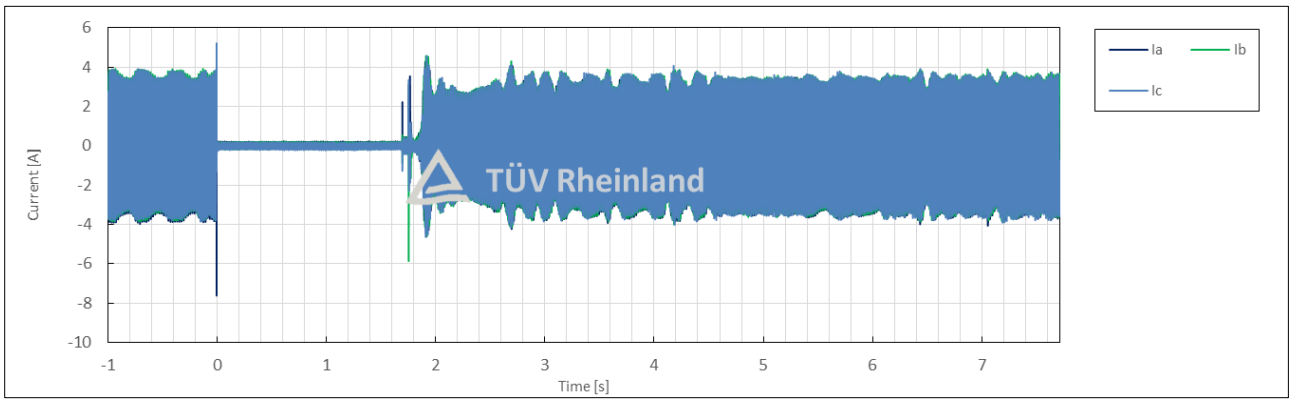


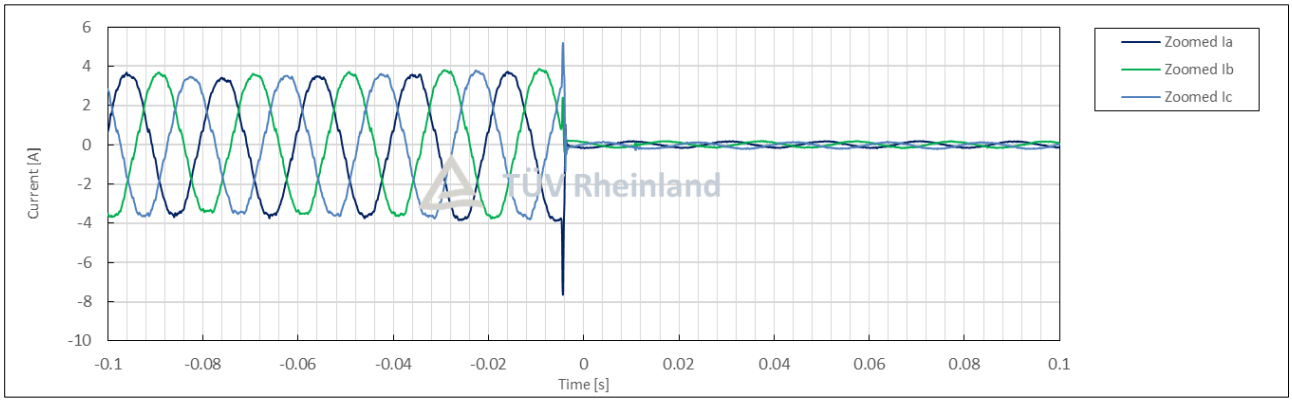
Test No. 3.2 with PGU

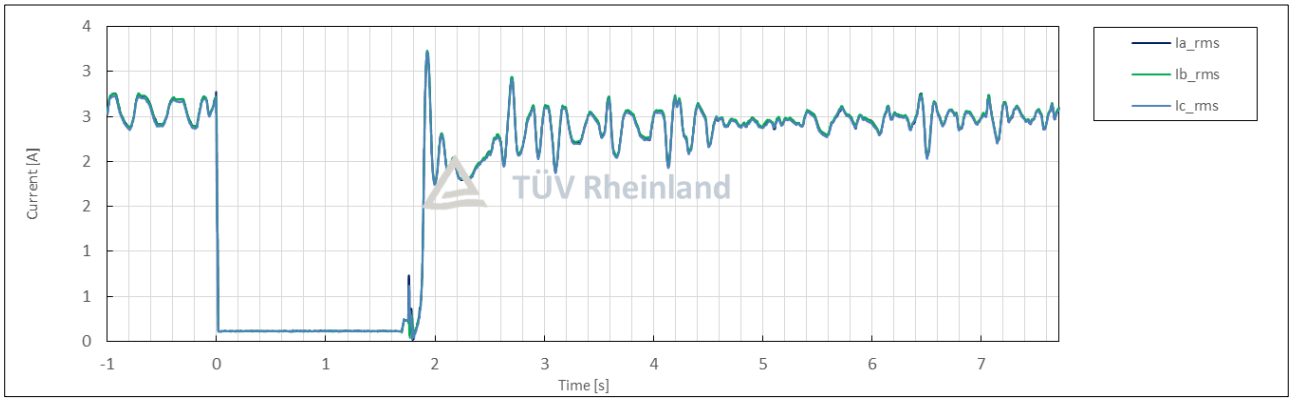


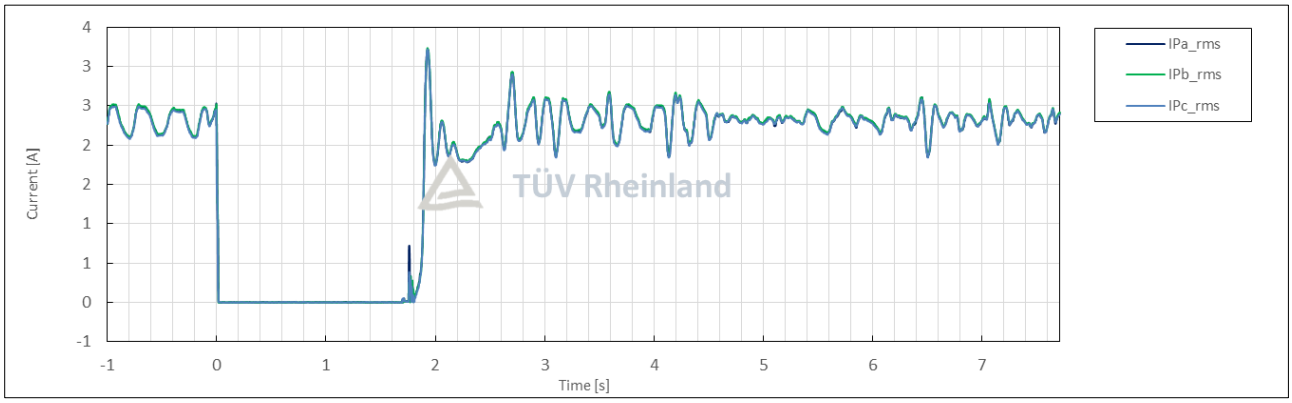


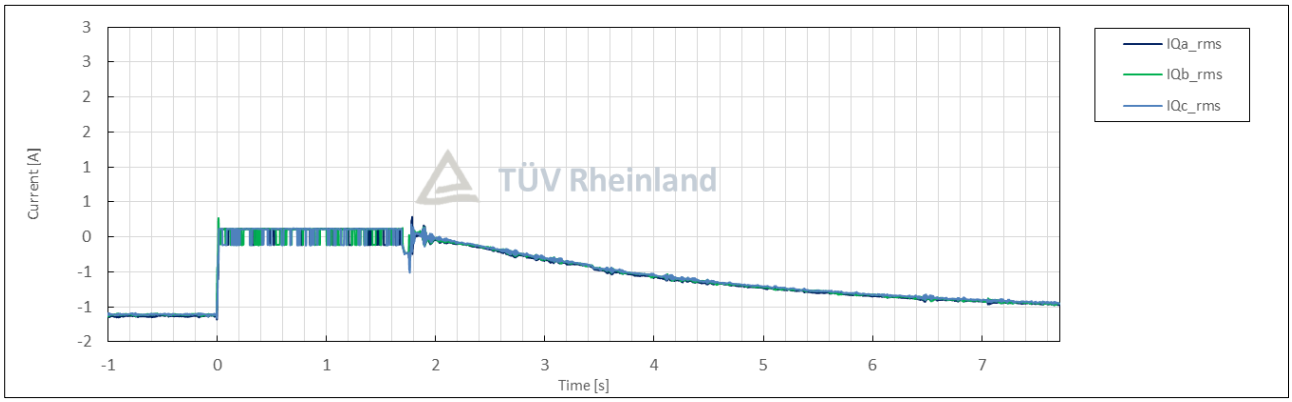


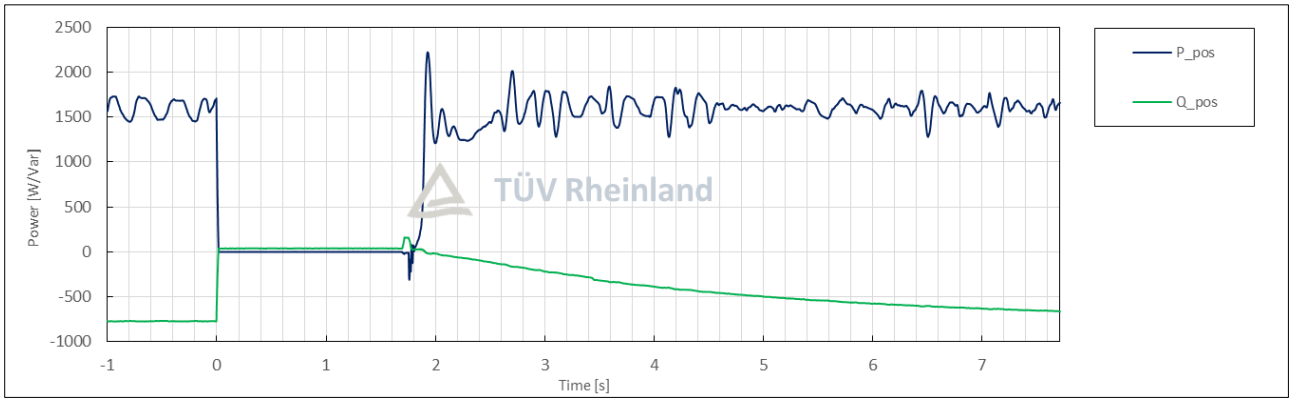


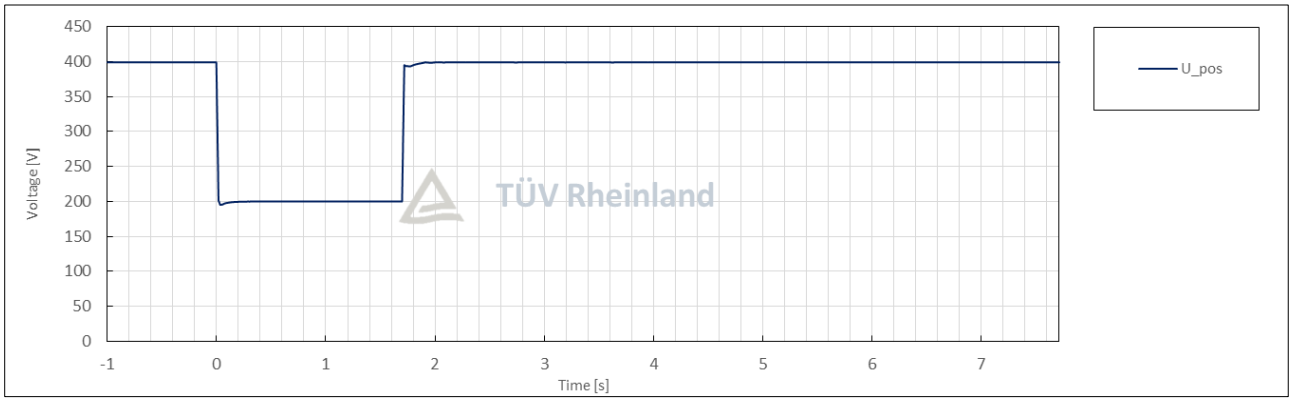

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

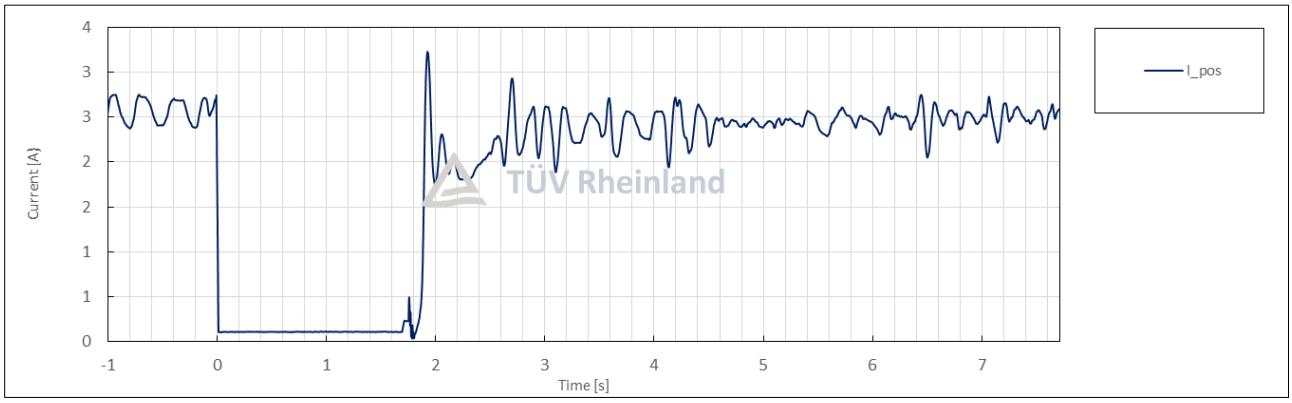

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

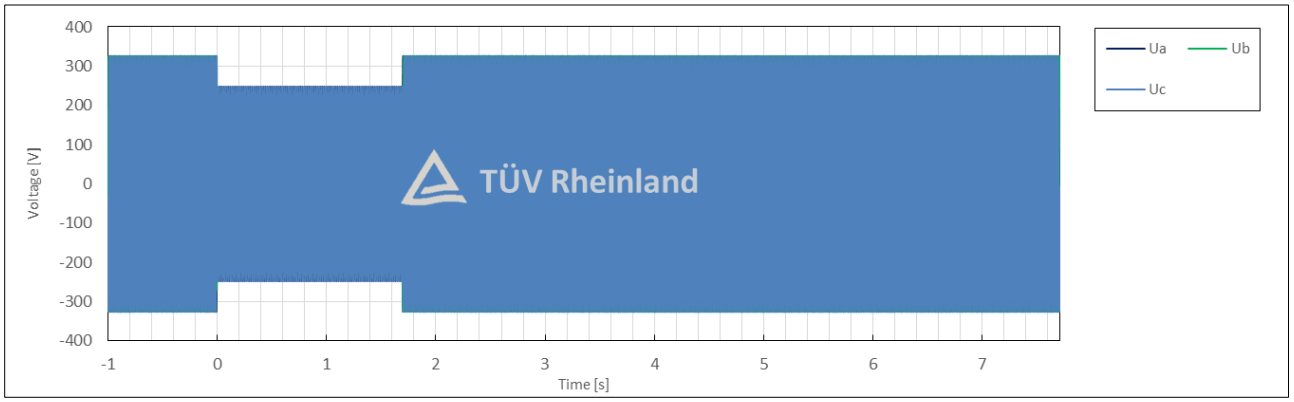

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

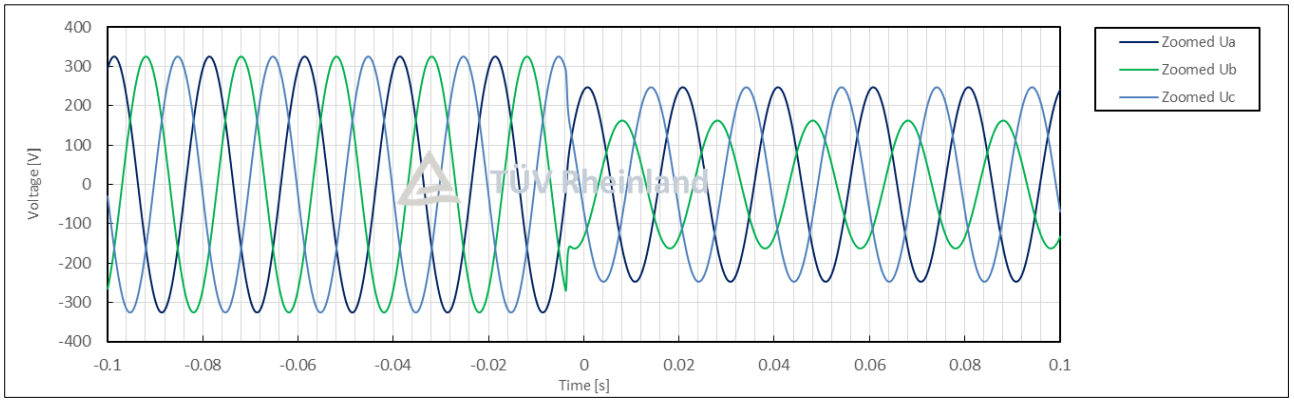

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

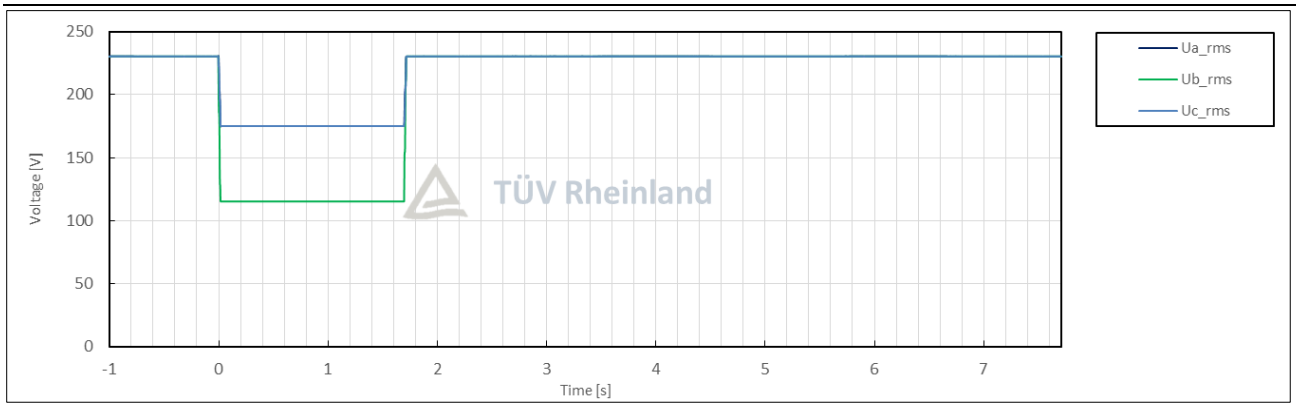

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.3
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:54:50
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1709
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1709
	8	Fault duration in empty load test	Total	--	ms	1709
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.67
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	0.90
	14		Pos.			0.90
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.44
	16		Pos.			-0.44
	17	Cos_{φ}	--	t1-10s to t1	--	0.898
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.03
	20		Phase 2			0.02
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.03
	23		Phase 2			0.02
	24		Phase 3			0.03
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.90
	29		Pos.			0.90
	39	Active power rising time	Pos.	--	s	0.421
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.37
	32		Pos.			-0.37
	33	Reactive power rising time	Pos.	--	s	9.312
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

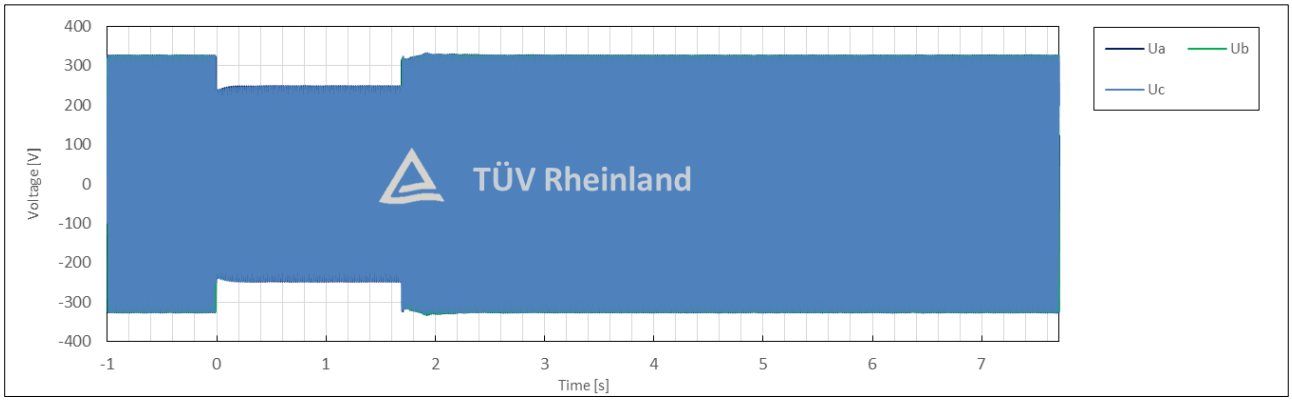
Test No. 3.3 idle test

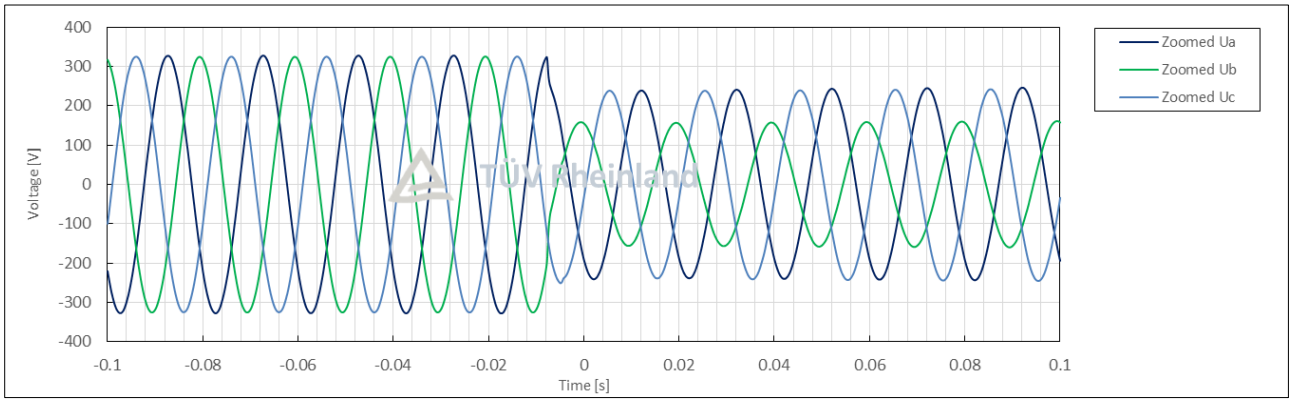


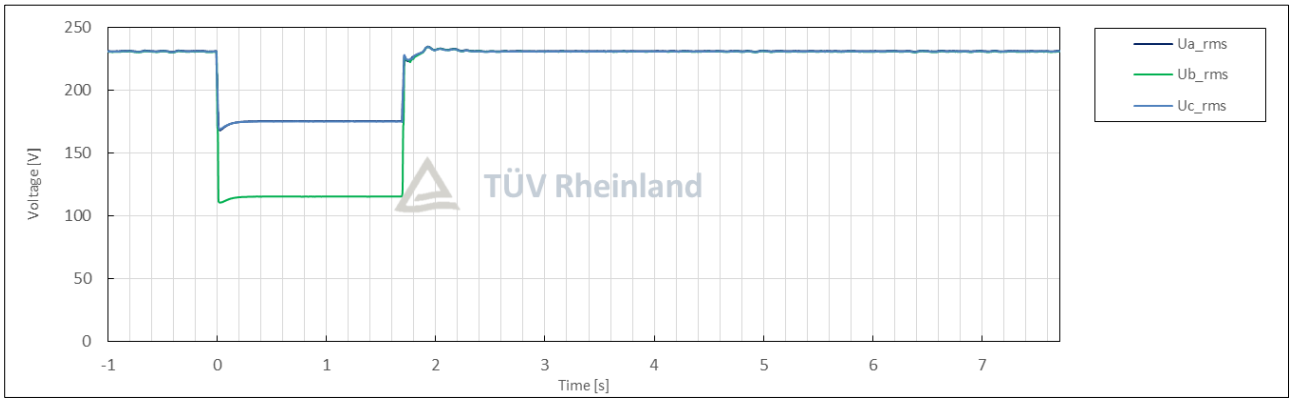


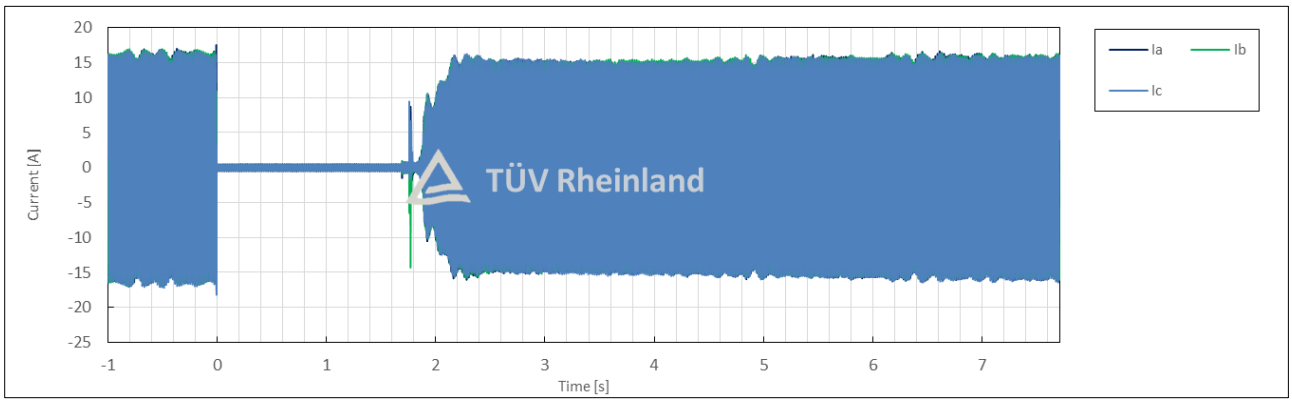


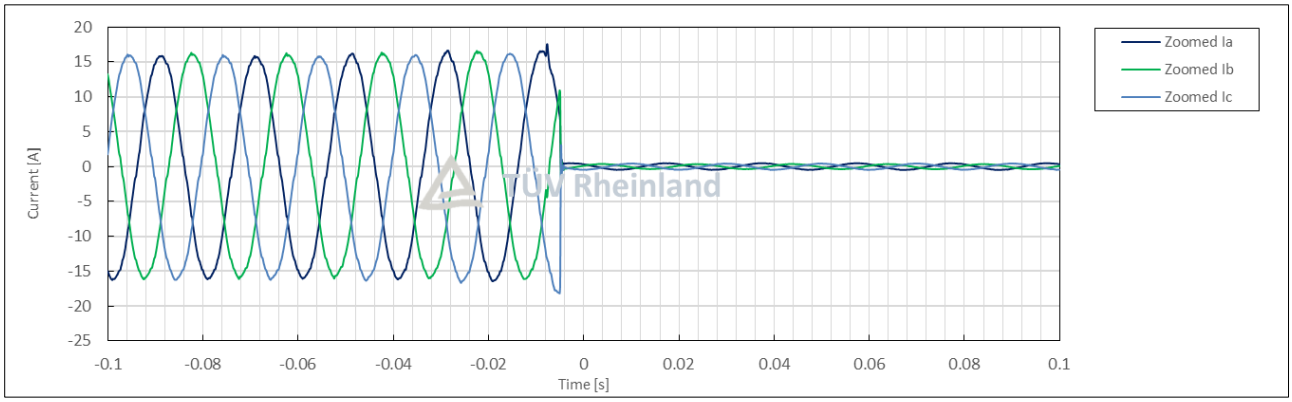
Test No. 3.3 with PGU

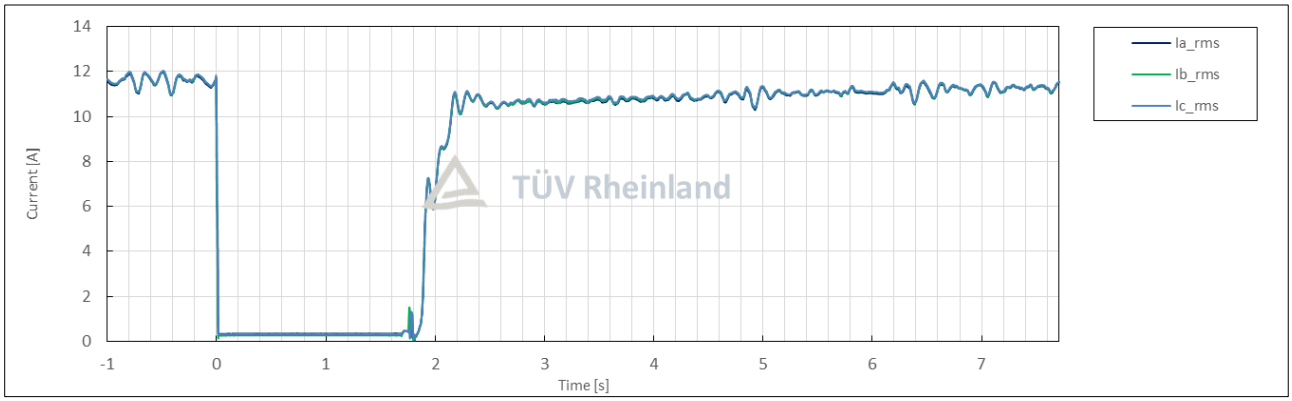


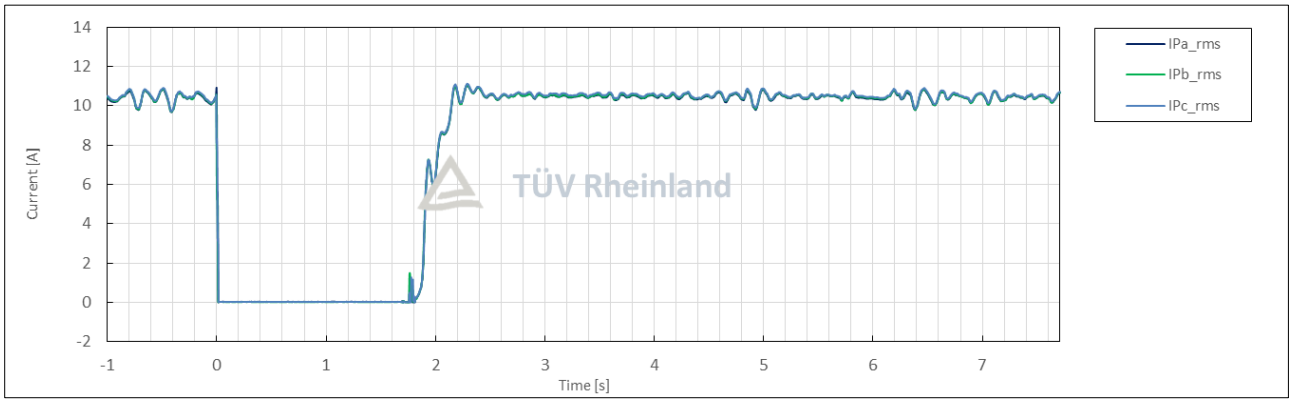


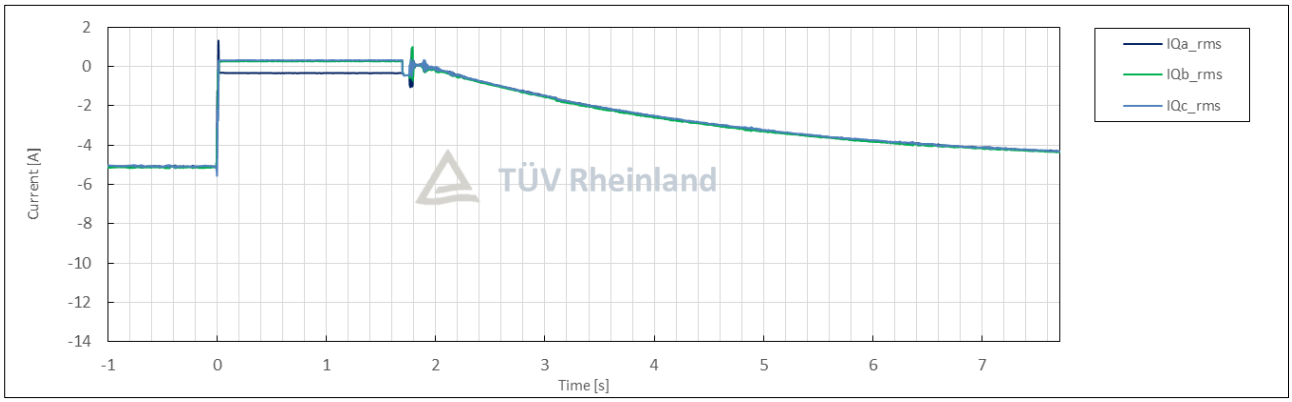


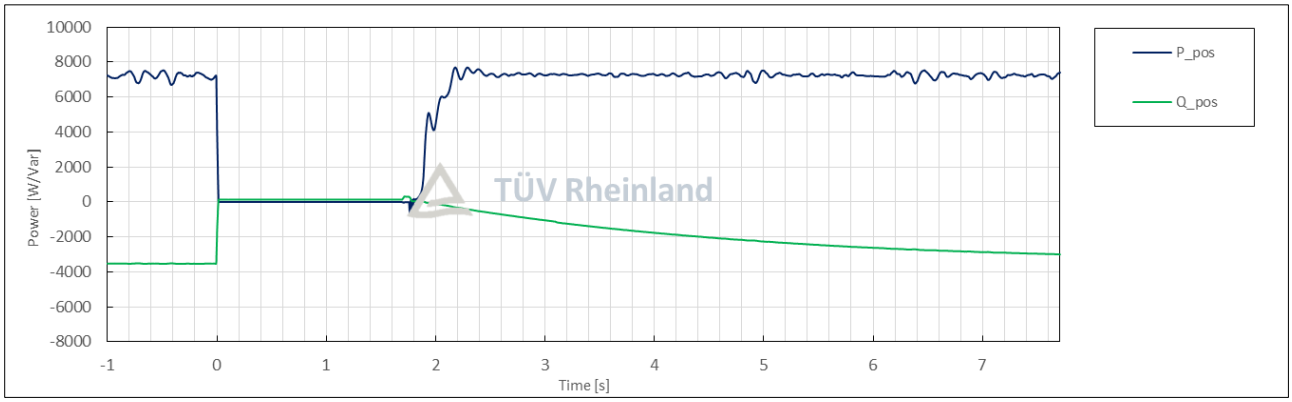


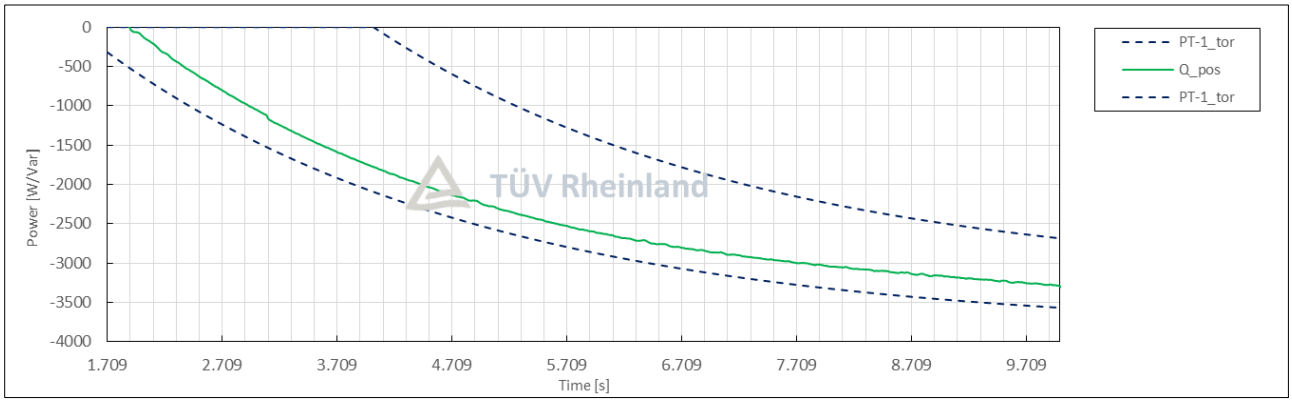

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

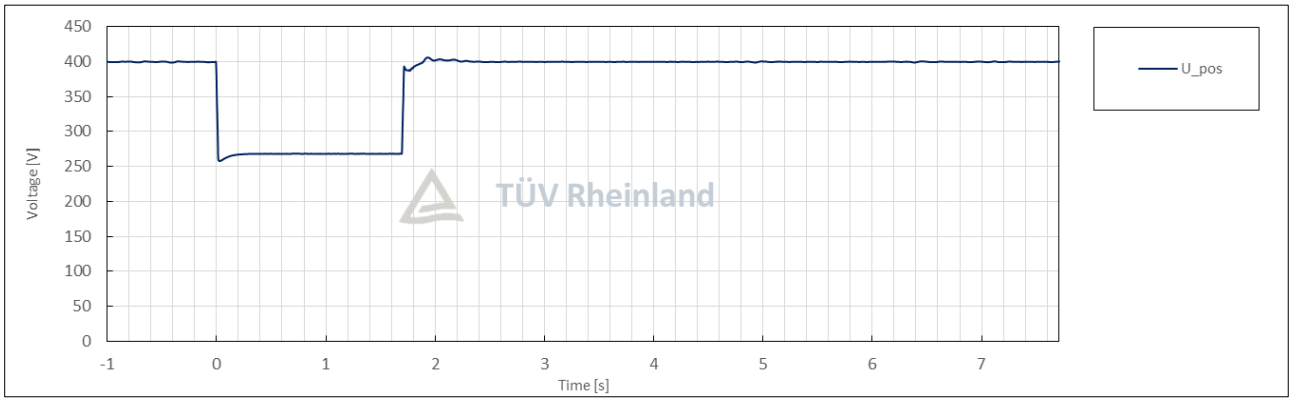

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland

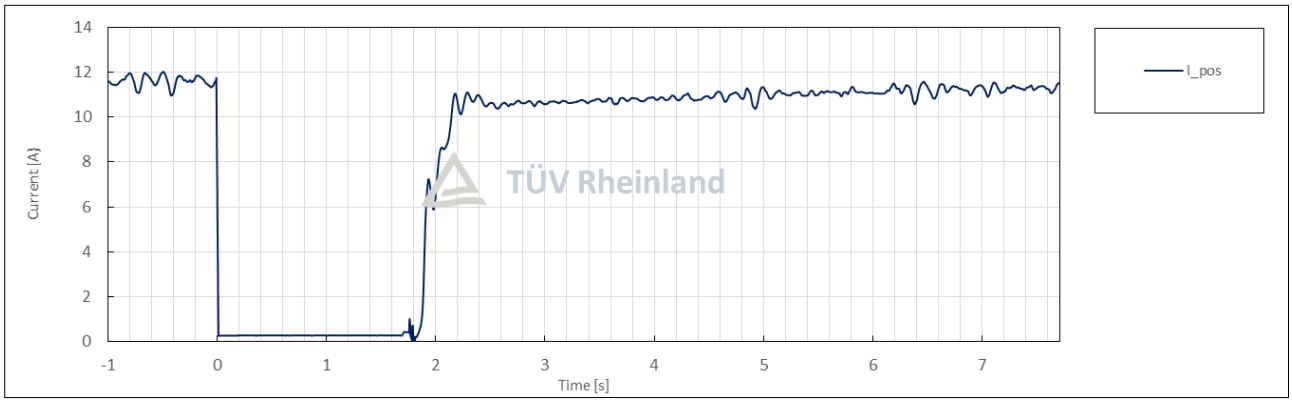

IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland


Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

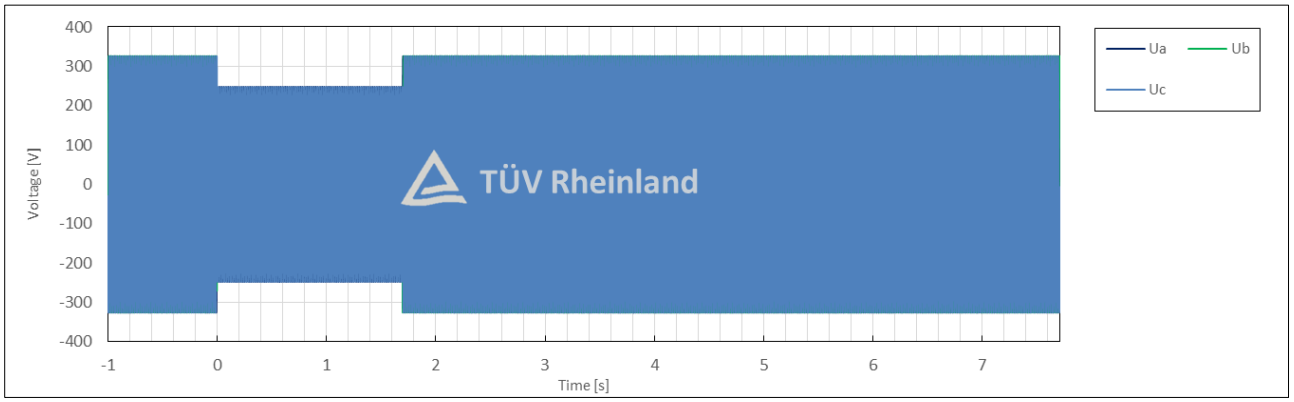

Power [W/Var]
Time [s]
PT-1_tor
Q_pos
PT-1_tor
TÜV Rheinland

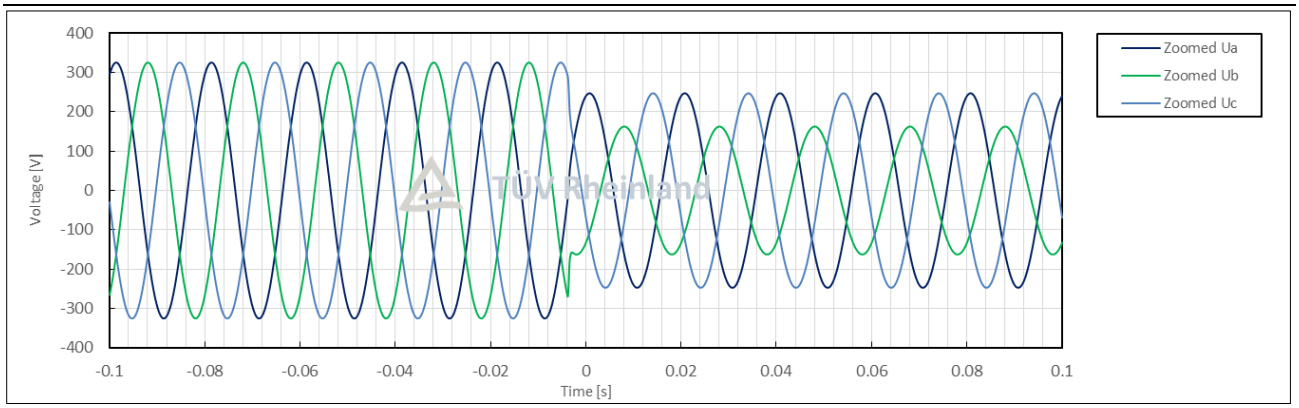

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

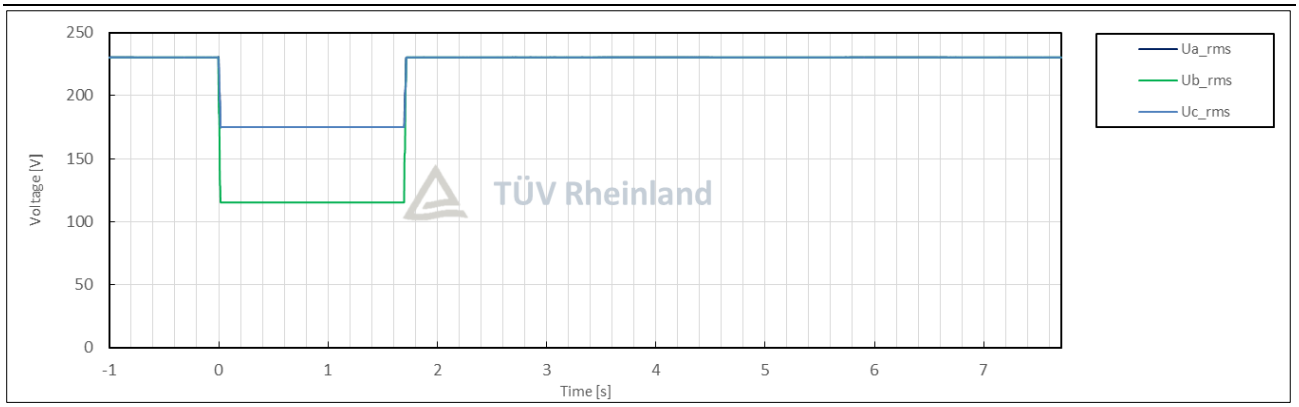

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.4
	1	Date	--	--	dd.mm.yyyy	06.18.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	11:23:54
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.50
	5	Setting dip duration		--		1709
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	1709
	8	Fault duration in empty load test	Total	--	ms	1709
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.50
	10		Pos.		p.u.	0.67
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.22
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.10
	16		Pos.			-0.10
	17	Cos_{φ}	--	t1-10s to t1	--	0.901
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.50
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.00
	26		Pos.			0.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.987
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.08
	32		Pos.			-0.08
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

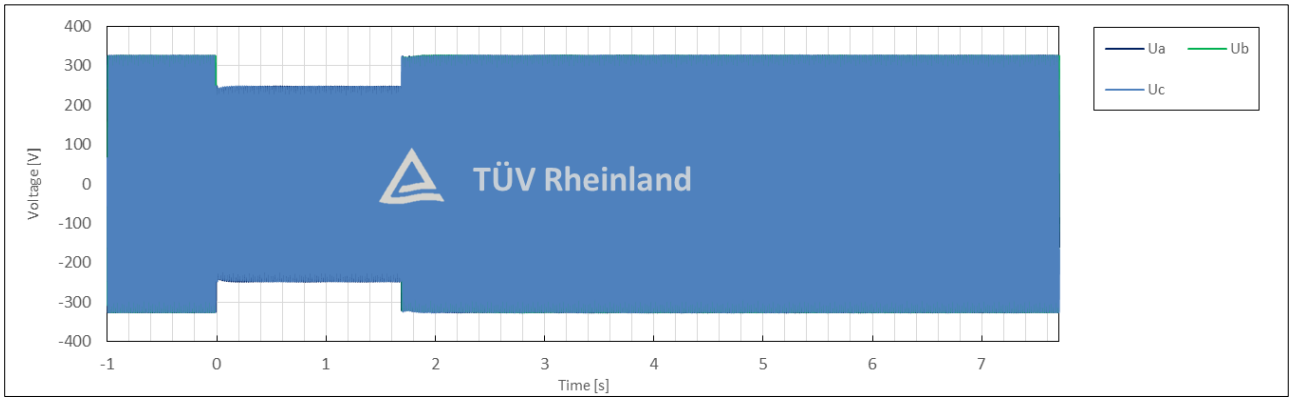
Test No. 3.4 idle test

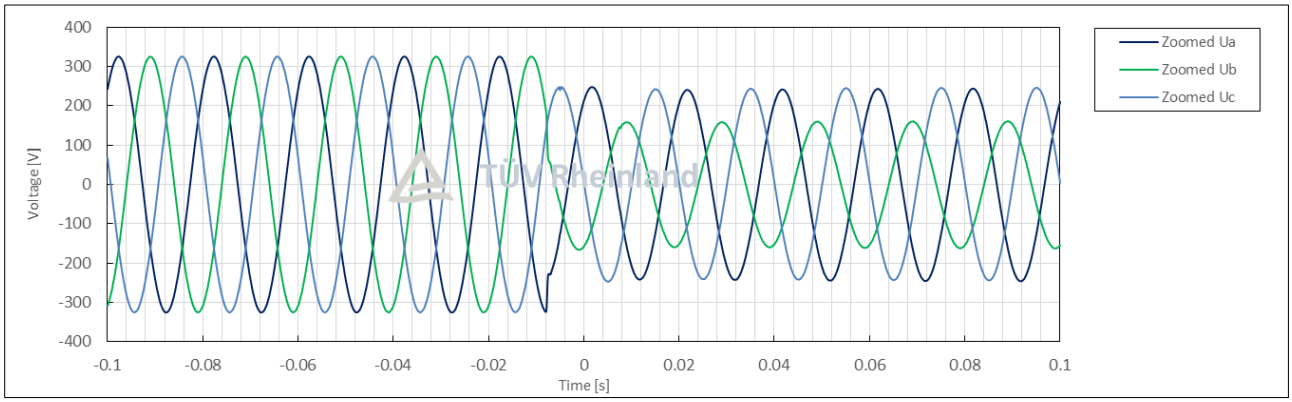


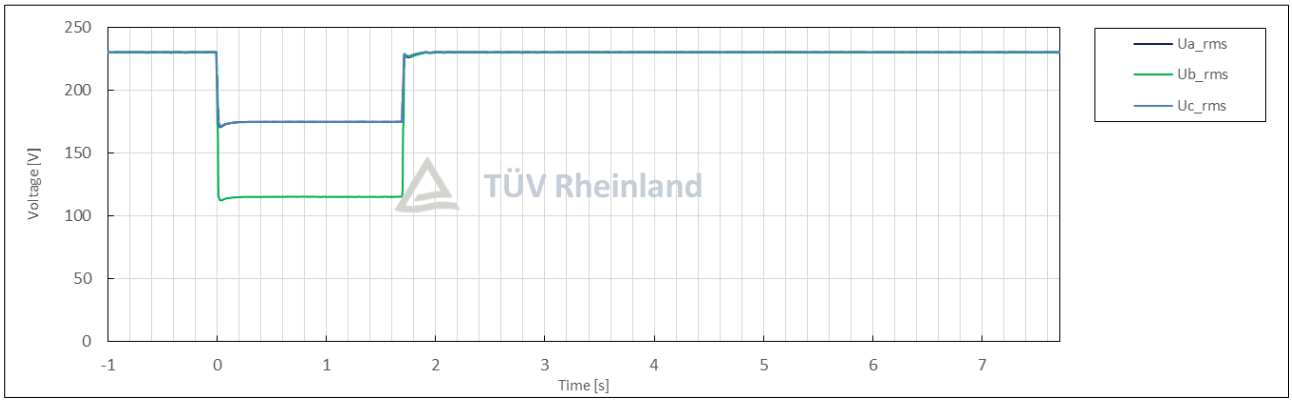


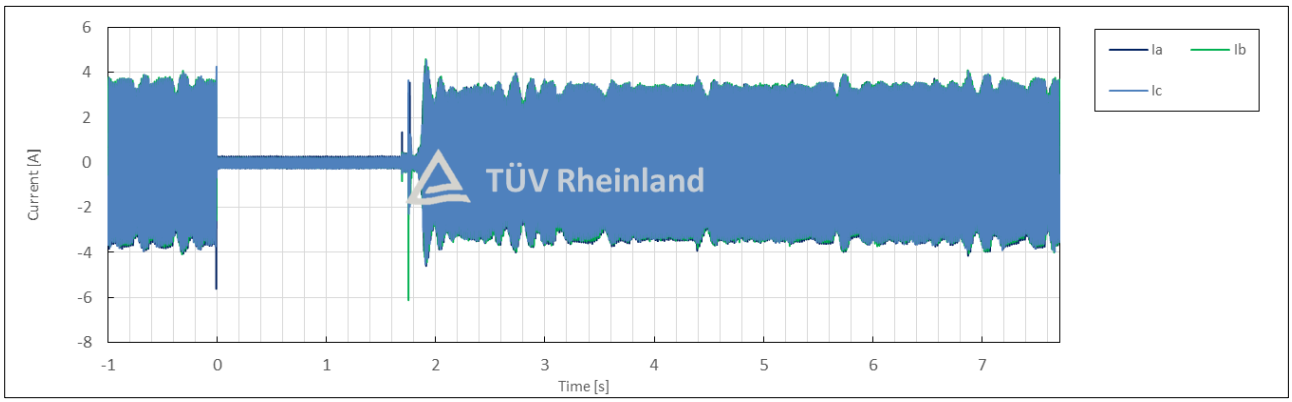


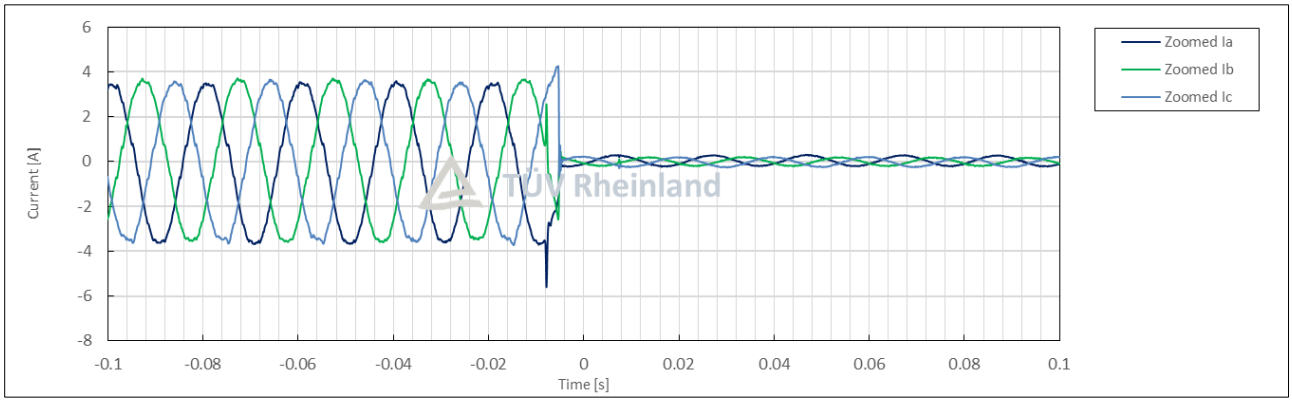
Test No. 3.4 with PGU

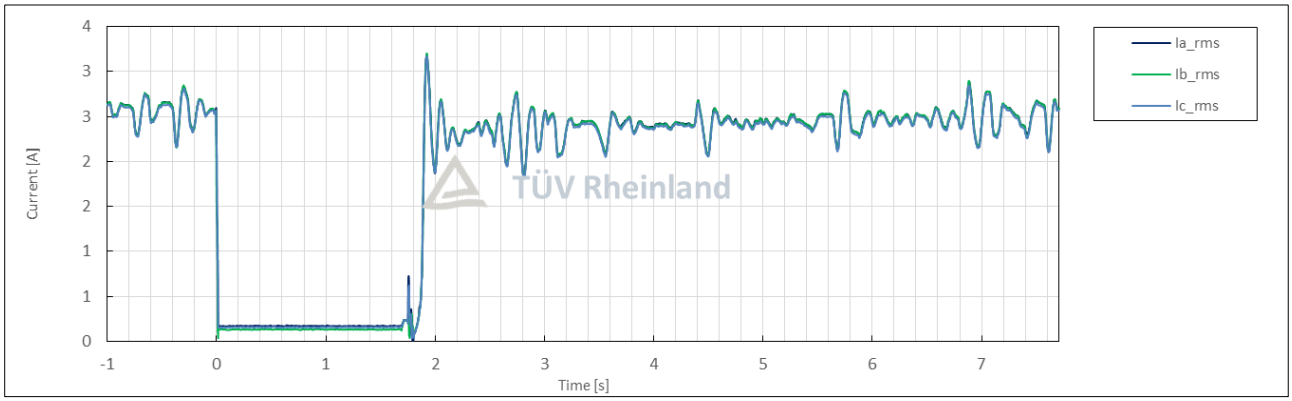


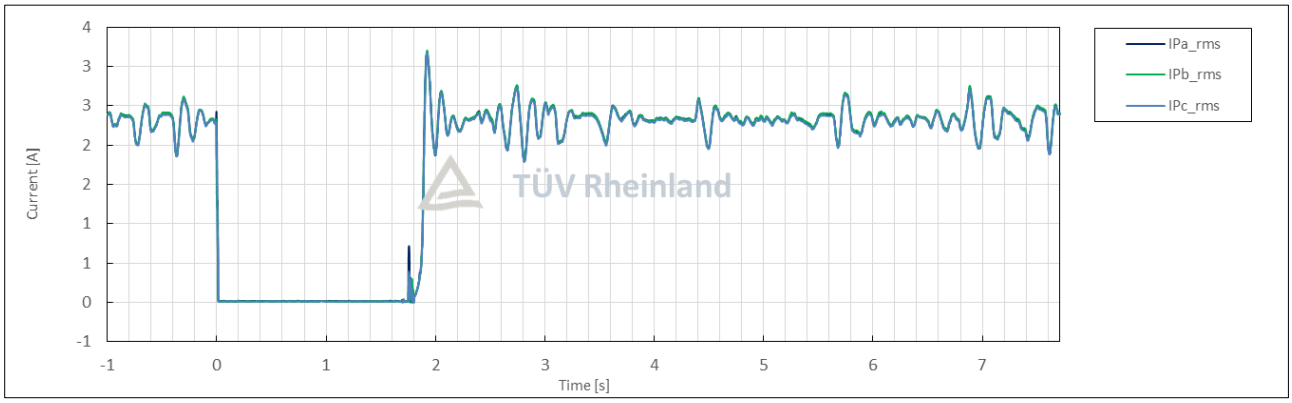


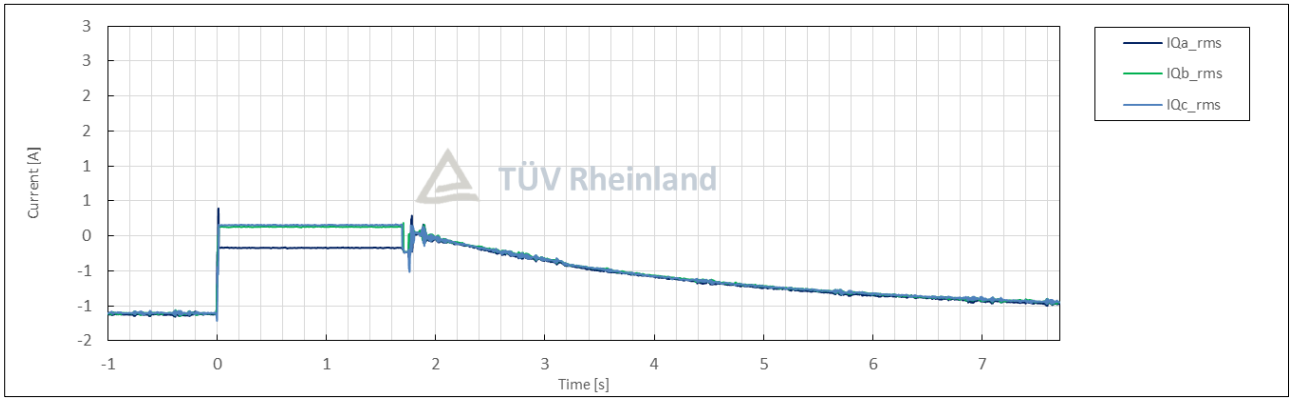


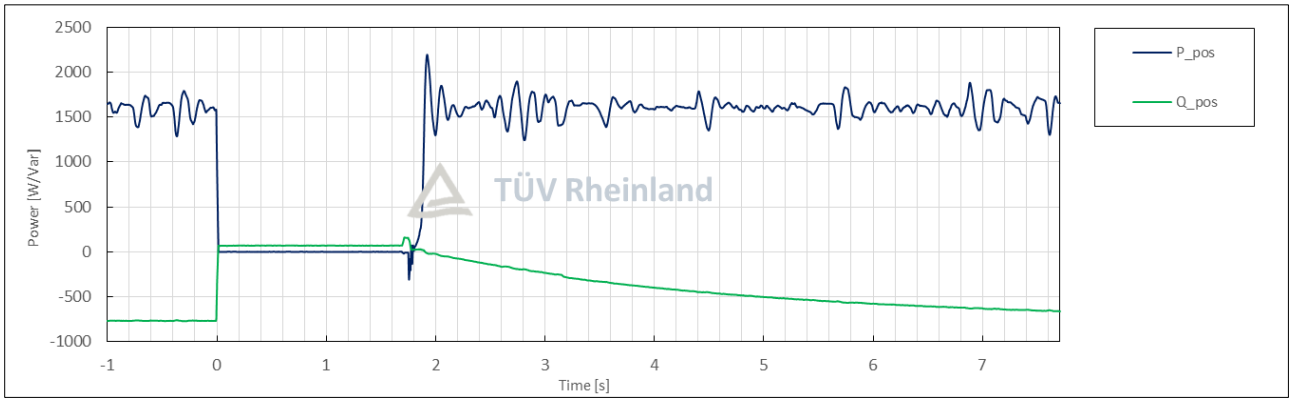


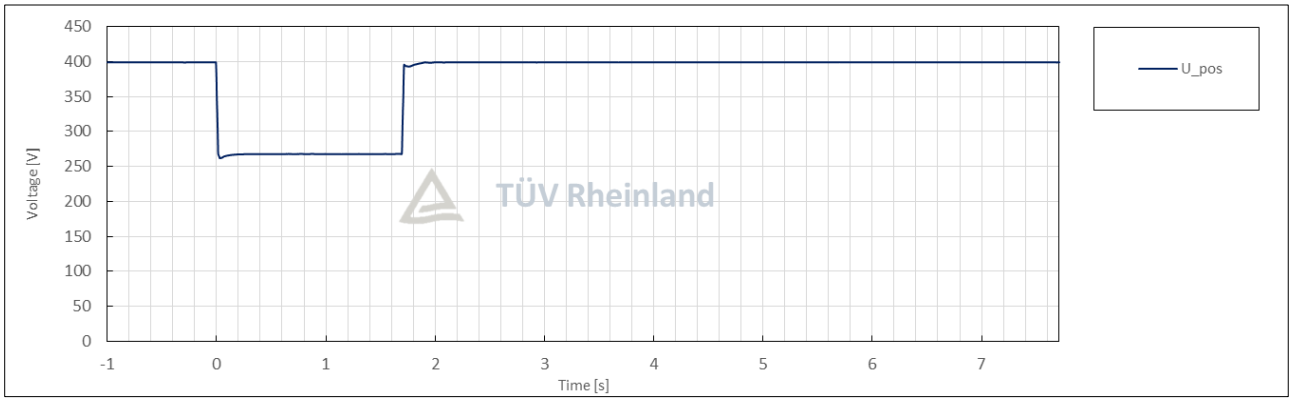

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

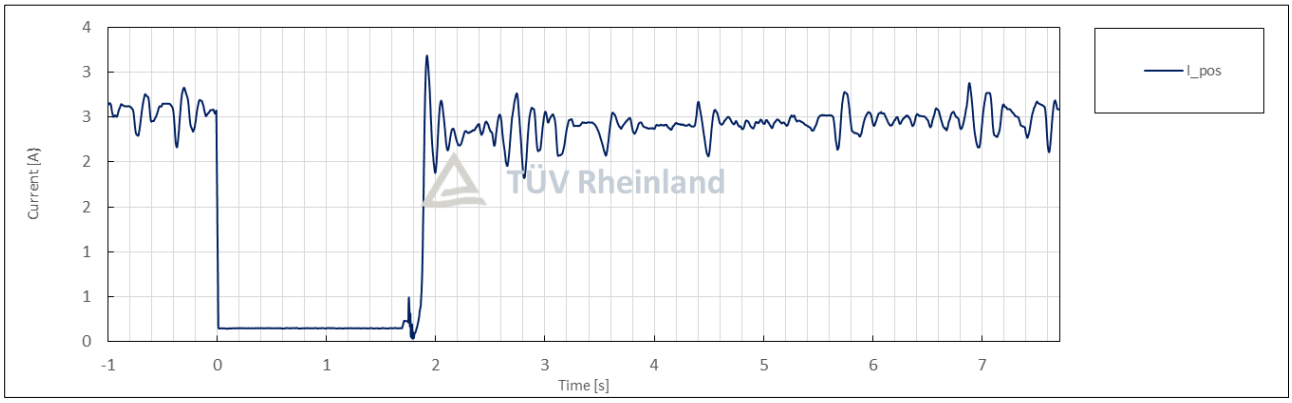

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

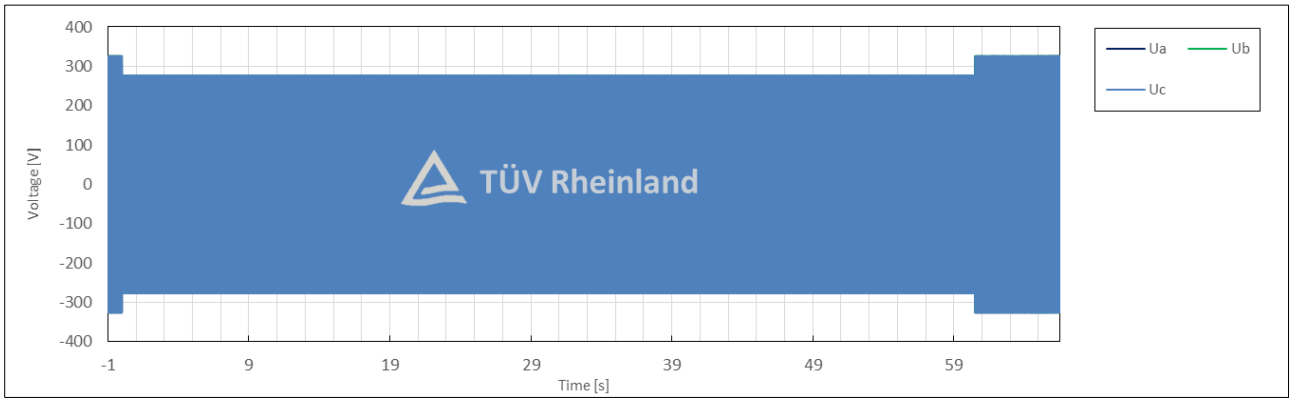

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

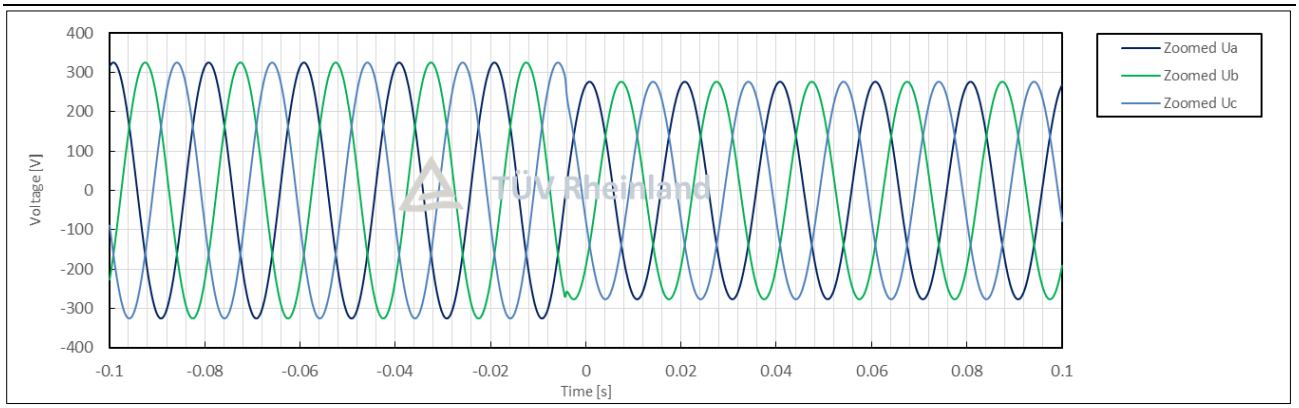

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

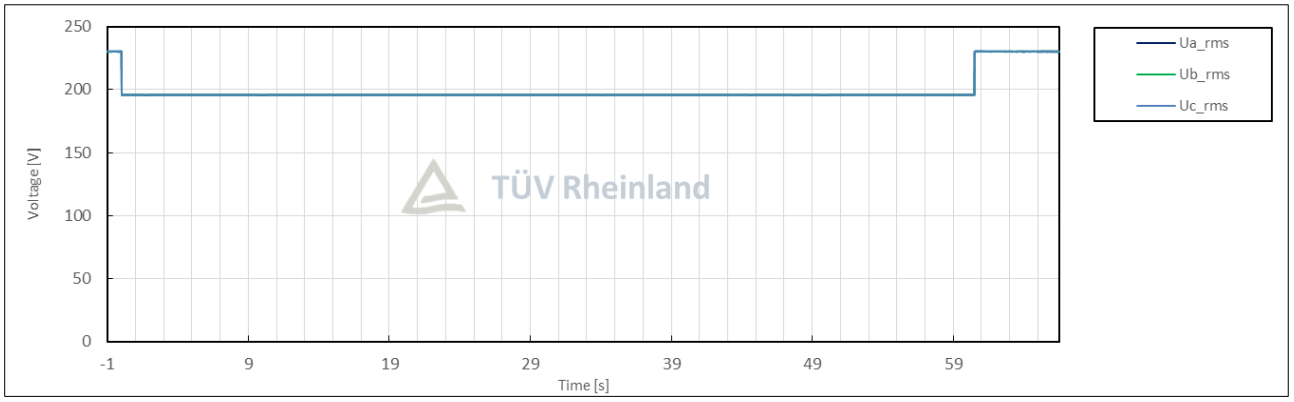

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.1
	1	Date	--	--	dd.mm.yyyy	0
	2	Time (start of test)	--	--	hh:mm:ss.f	0:00:00
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.85
	5	Setting dip duration		--		60512
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60512
	8	Fault duration in empty load test	Total	--	ms	60512
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85
	10		Pos.		p.u.	0.85
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.03
	16		Pos.			-0.03
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85
	19	Line current	Phase 1	t1+60ms	p.u.	1.21
	20		Phase 2			1.22
	21		Phase 3			1.22
	22	Line current	Phase 1	t1+100ms	p.u.	1.17
	23		Phase 2			1.17
	24		Phase 3			1.18
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.83
	26		Pos.			0.83
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.492
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.03
	32		Pos.			-0.03
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

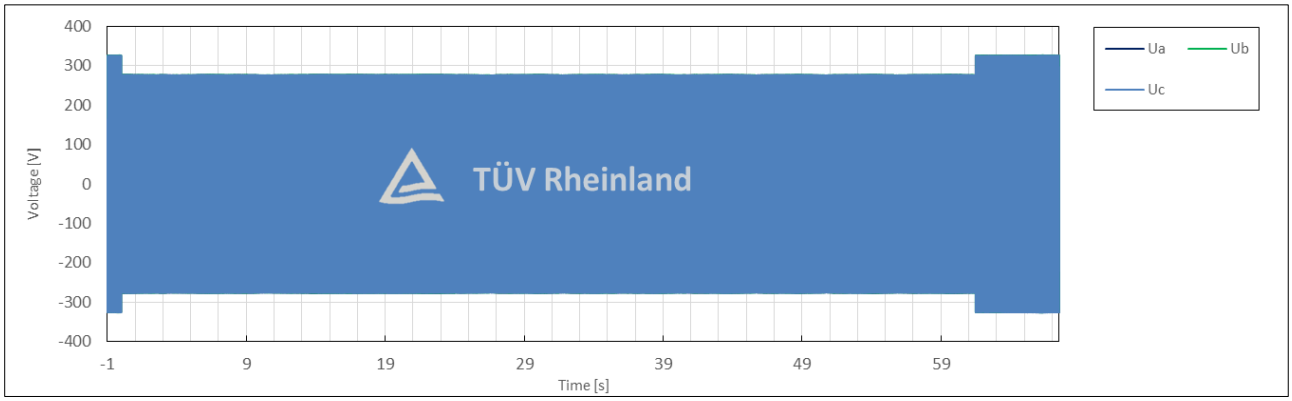
Test No. 4.1 idle test

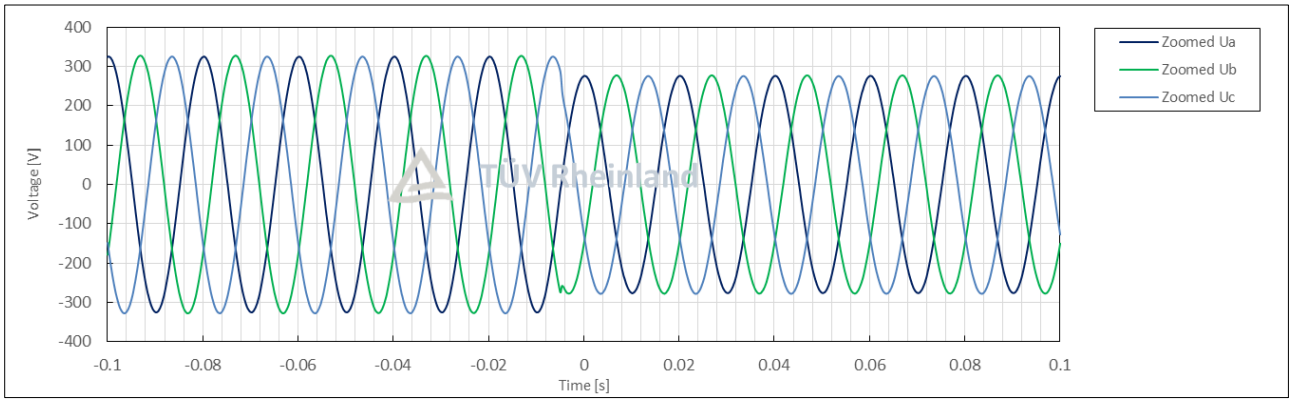


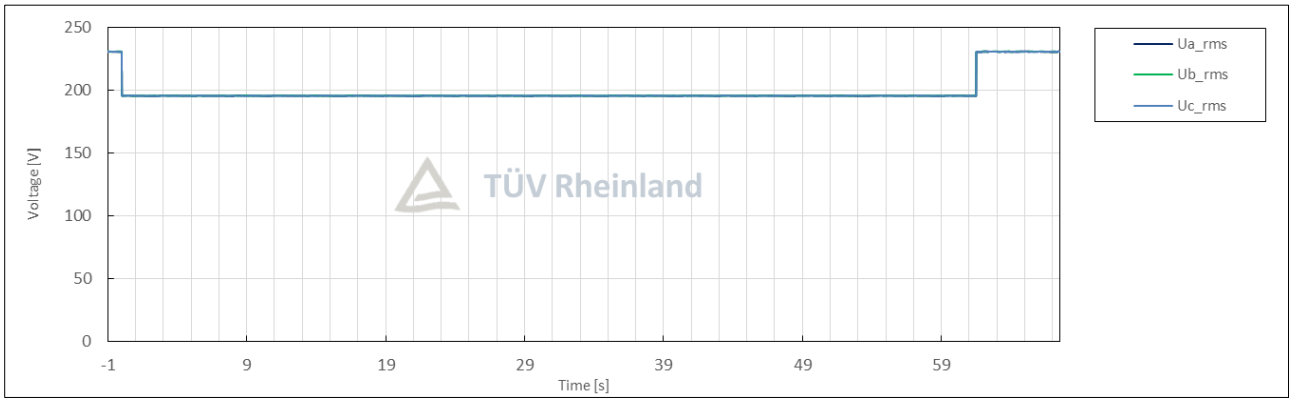


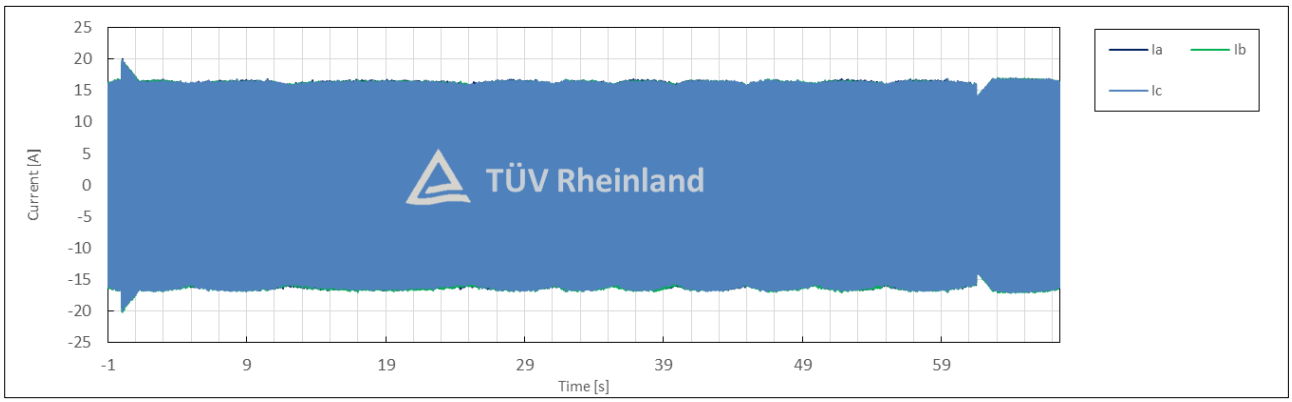


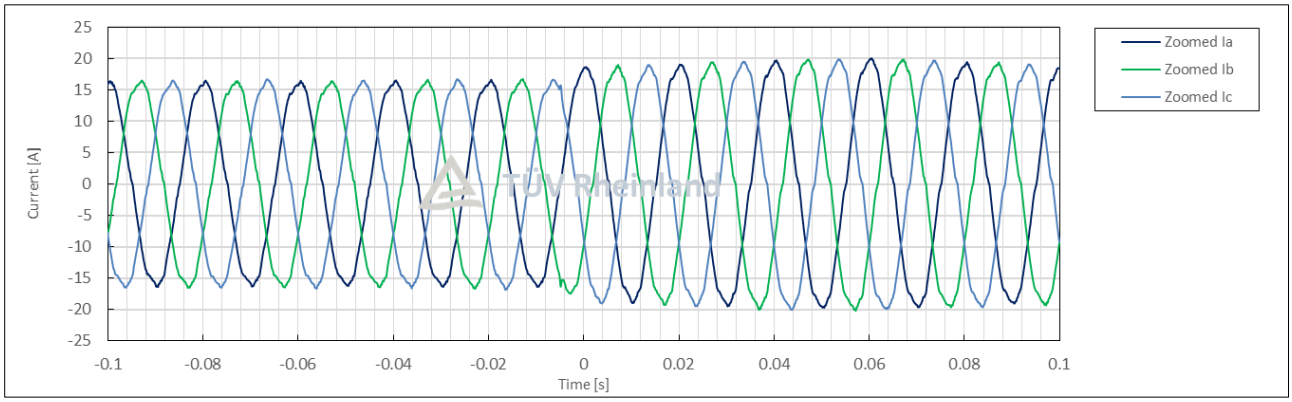
Test No. 4.1 with PGU

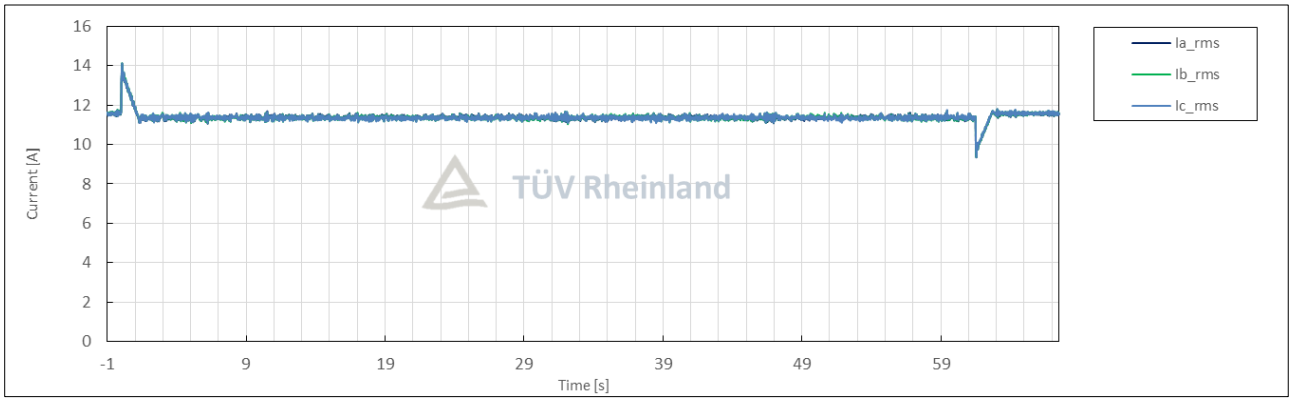


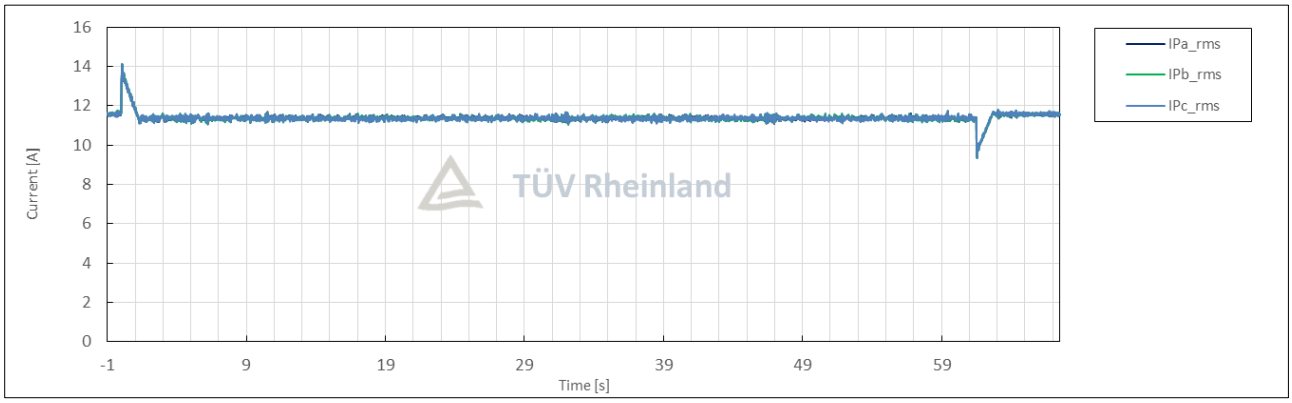


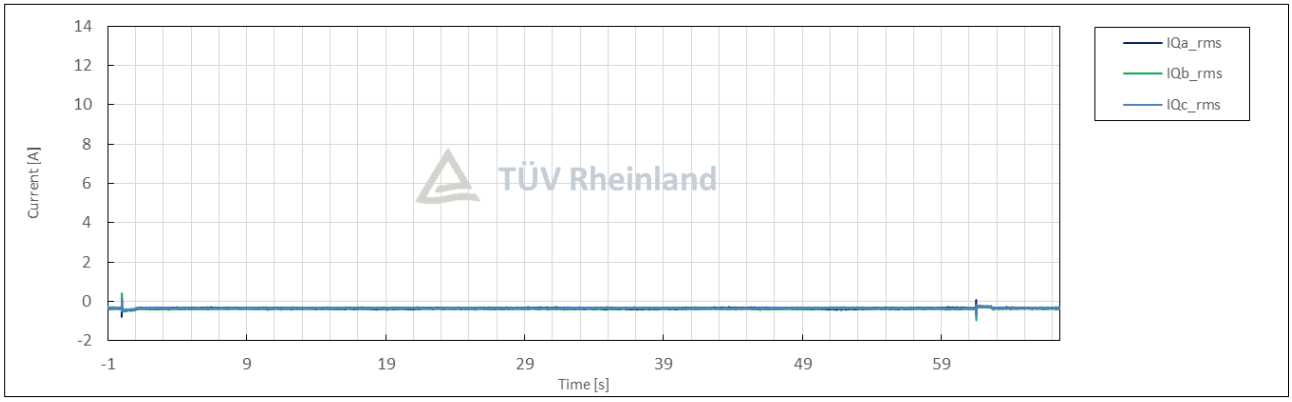


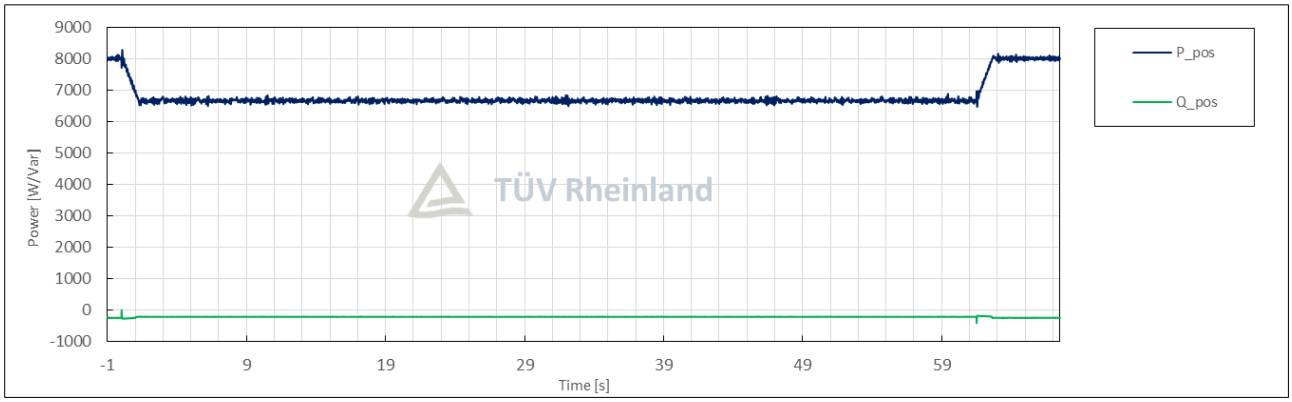


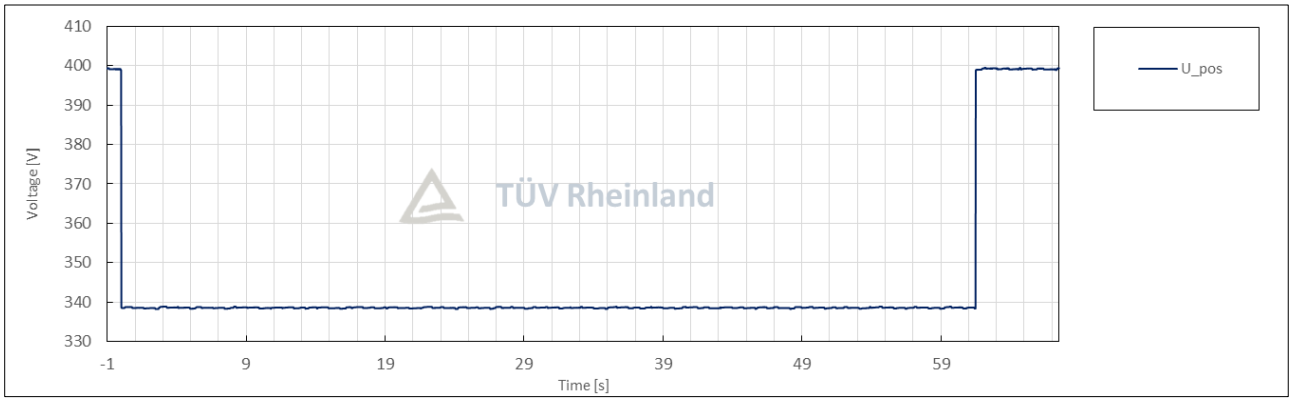

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

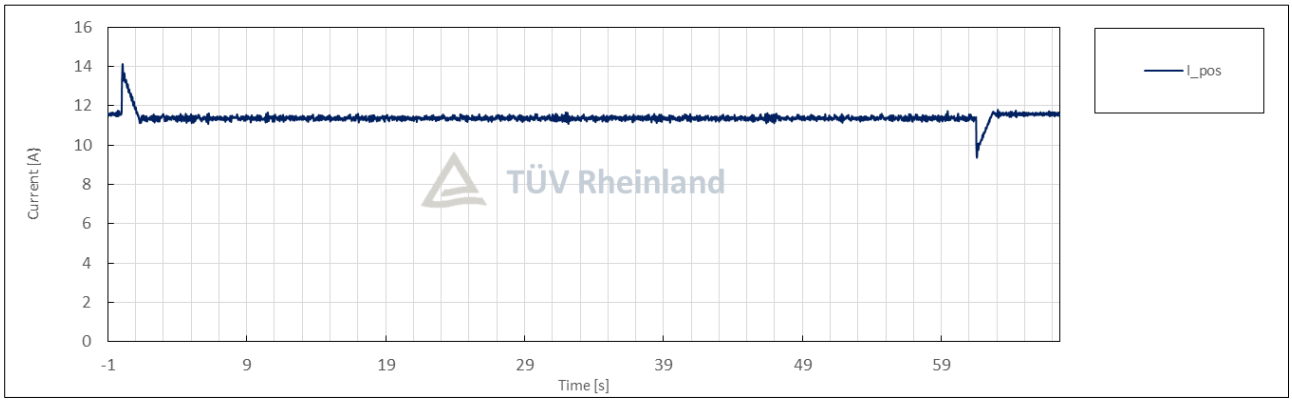

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

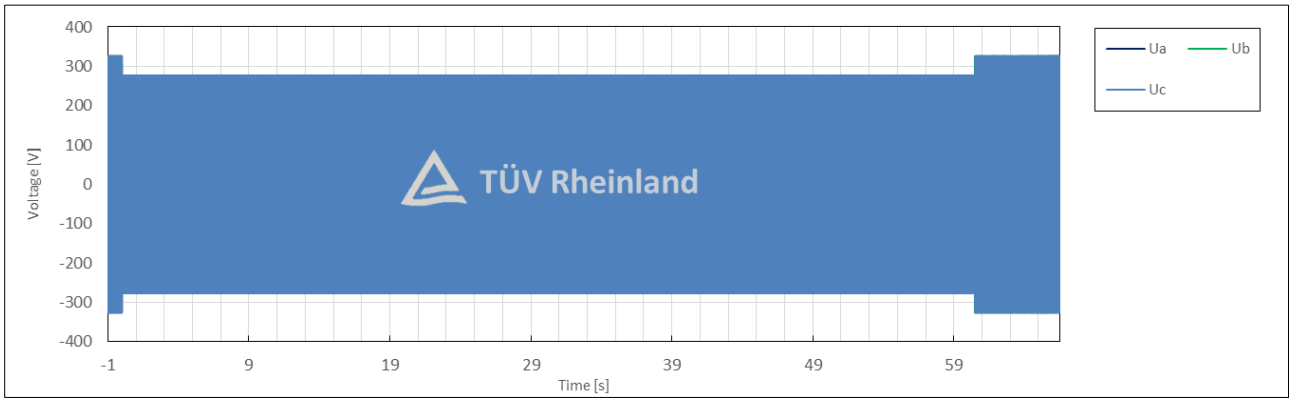

9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

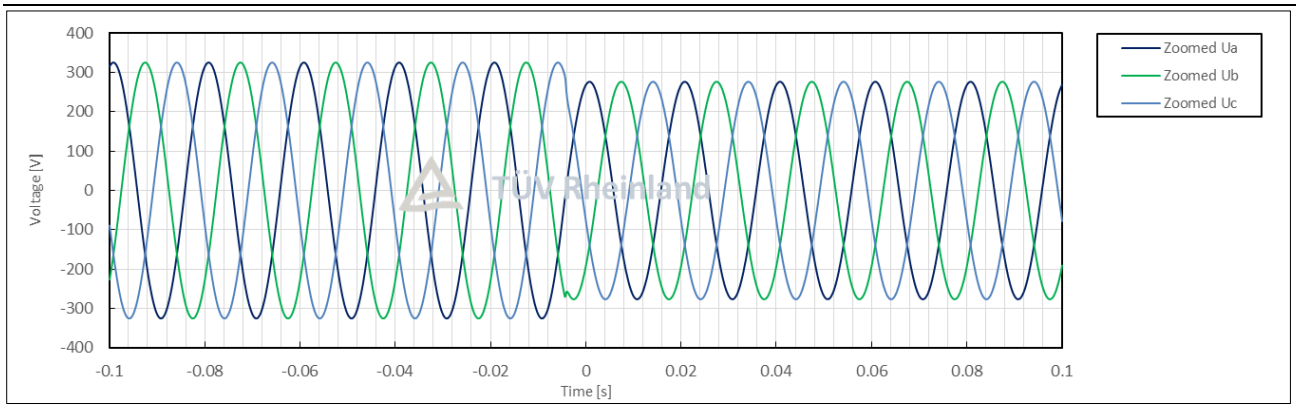

410
400
390
380
370
360
350
340
330
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

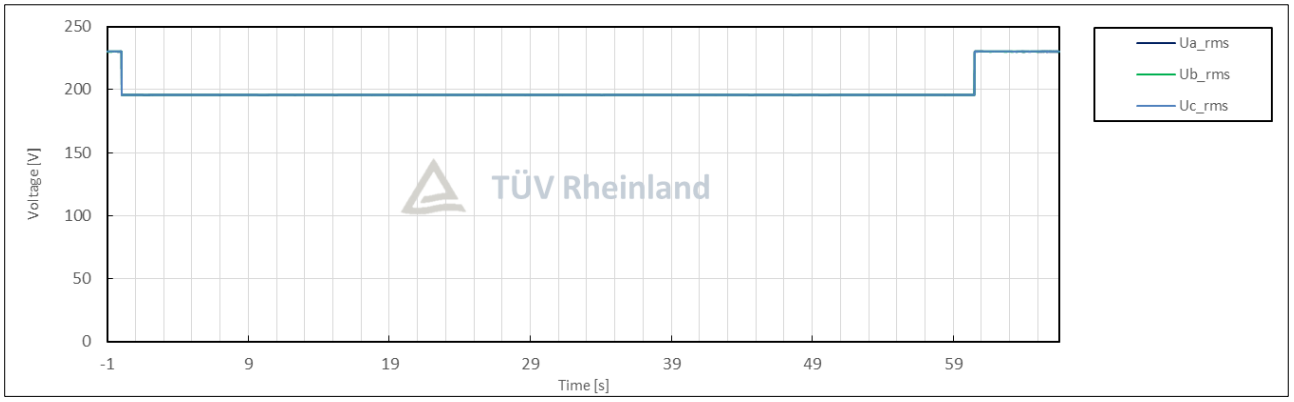

16
14
12
10
8
6
4
2
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.2
	1	Date	--	--	dd.mm.yyyy	0
	2	Time (start of test)	--	--	hh:mm:ss.f	0:00:00
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.85
	5	Setting dip duration		--		60512
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60512
	8	Fault duration in empty load test	Total	--	ms	60512
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85
	10		Pos.		p.u.	0.85
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	0.20
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			-0.01
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			0.997
	17	Cos_{φ}	--	t1-10s to t1	--	0.85
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.25
	19	Line current	Phase 1	t1+60ms	p.u.	0.24
	20		Phase 2			0.24
	21		Phase 3			0.24
	22	Line current	Phase 1	t1+100ms	p.u.	0.23
	23		Phase 2			0.23
	24		Phase 3			0.20
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.20
	26		Pos.			1.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	0.20
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			N/A
	39	Active power rising time	Pos.	--	s	-0.01
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			N/A
	33	Reactive power rising time	Pos.	--	s	No
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	0.20

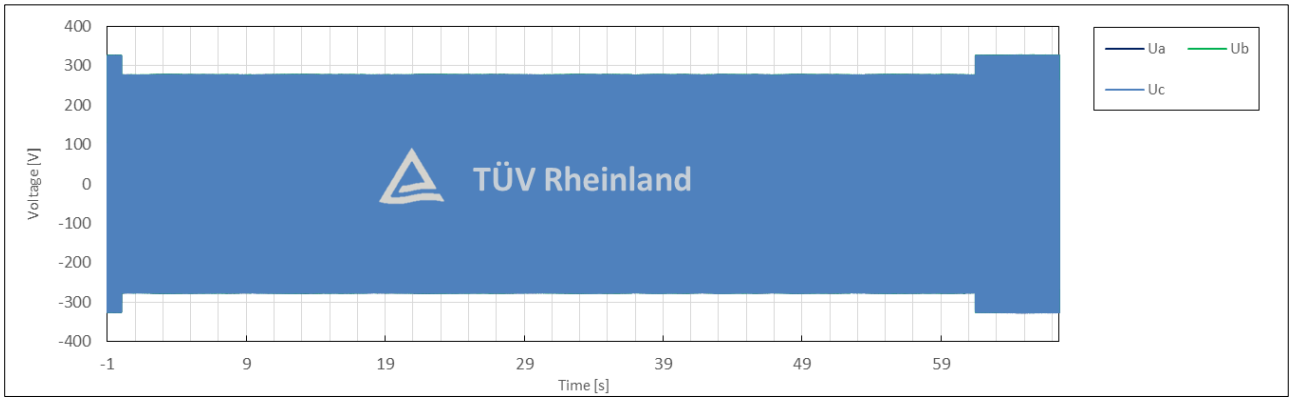
Test No. 4.2 idle test

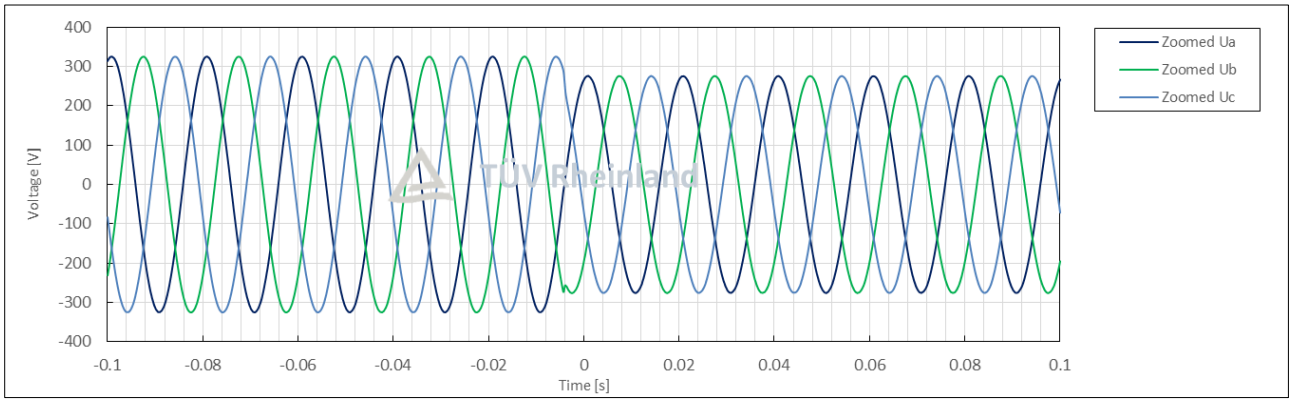


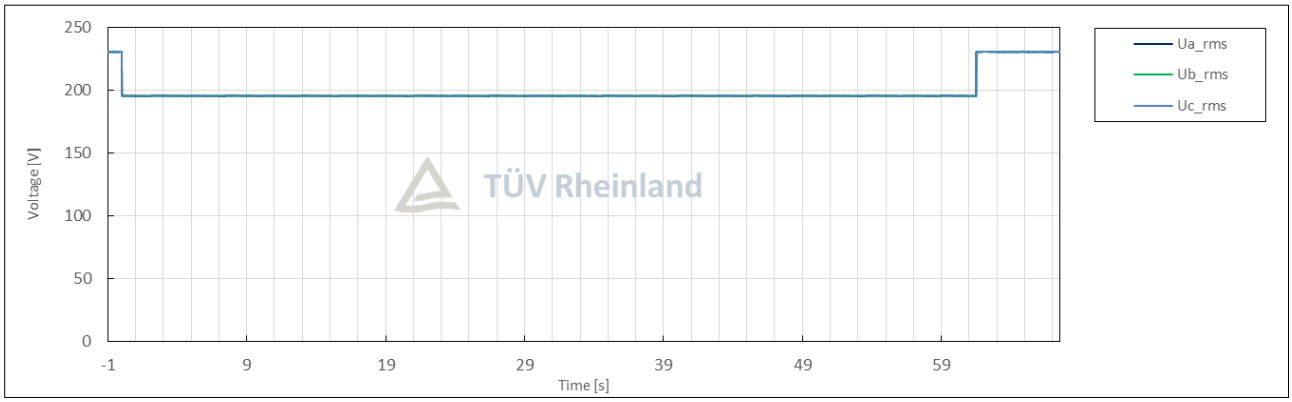


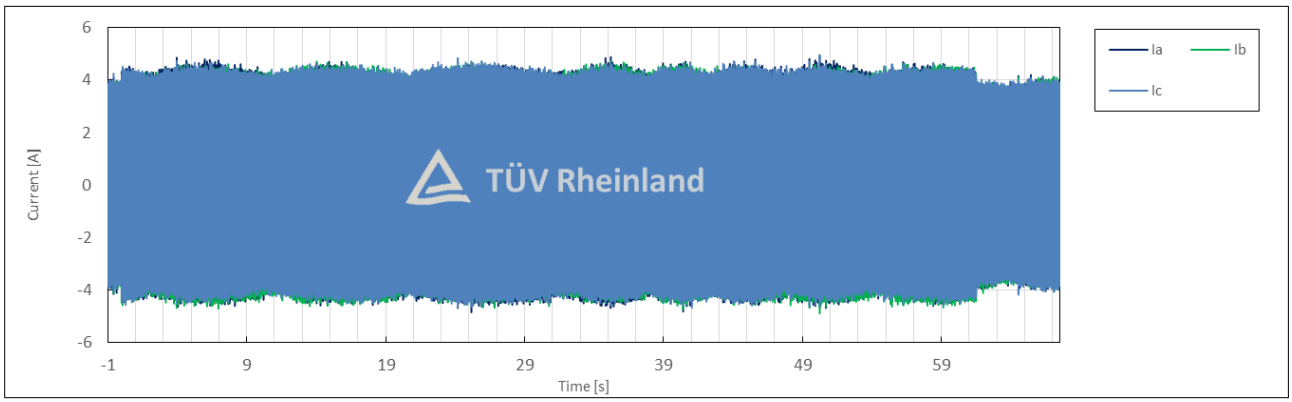


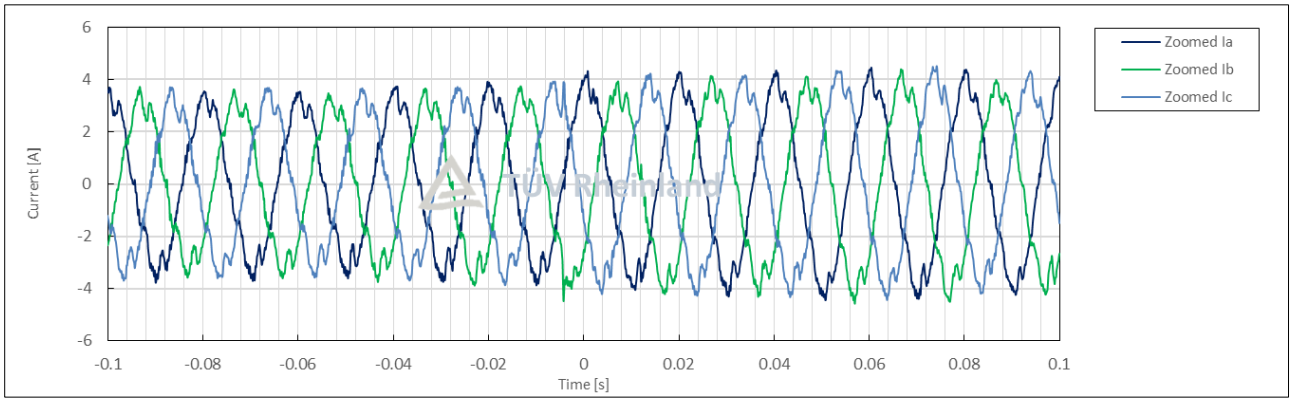
Test No. 4.2 with PGU

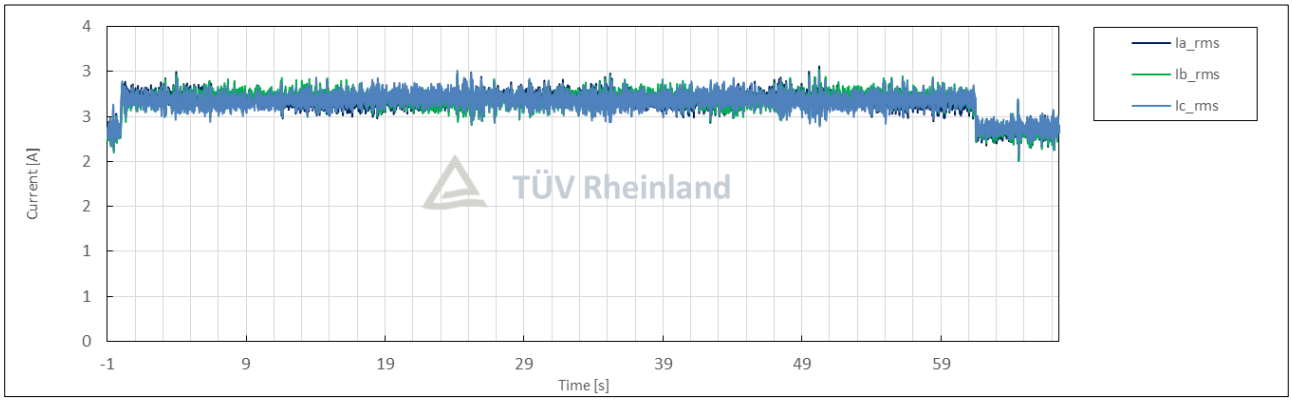


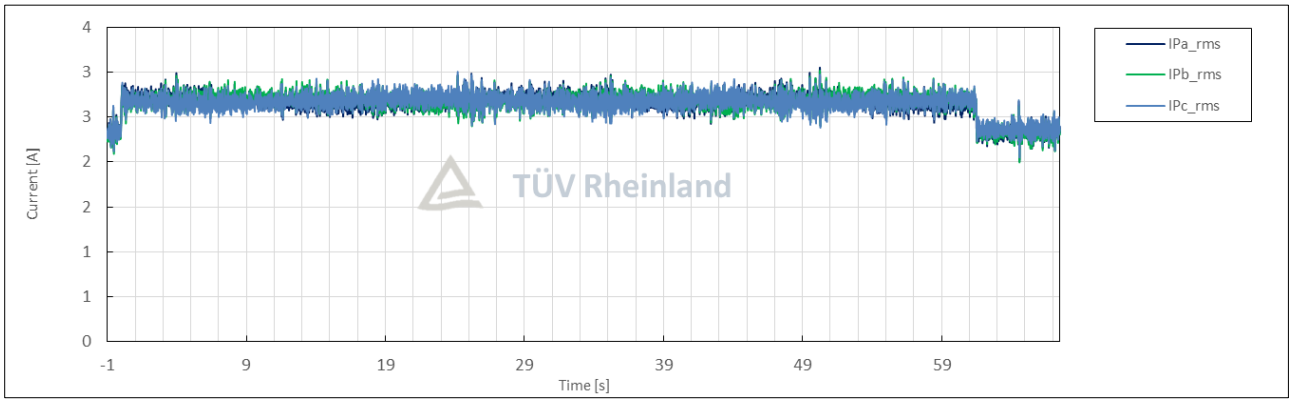


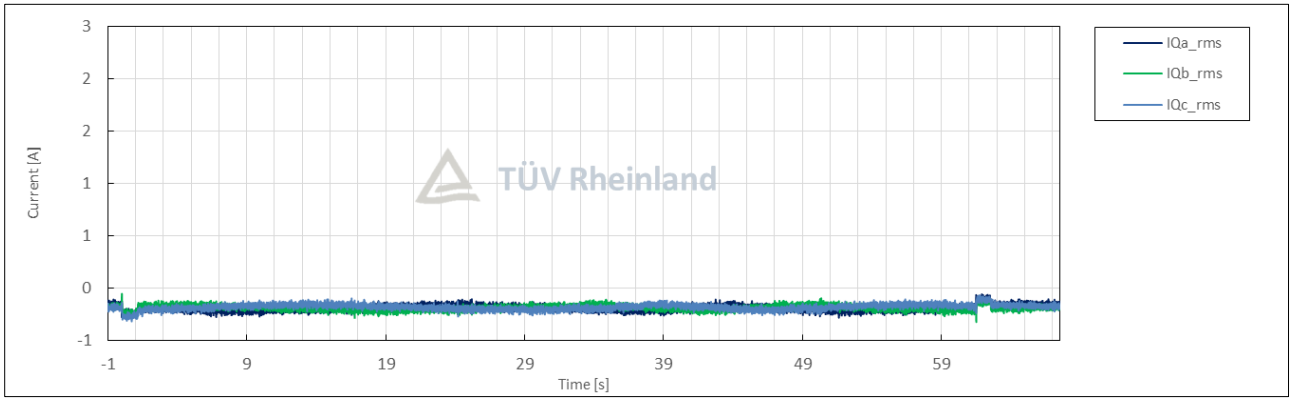


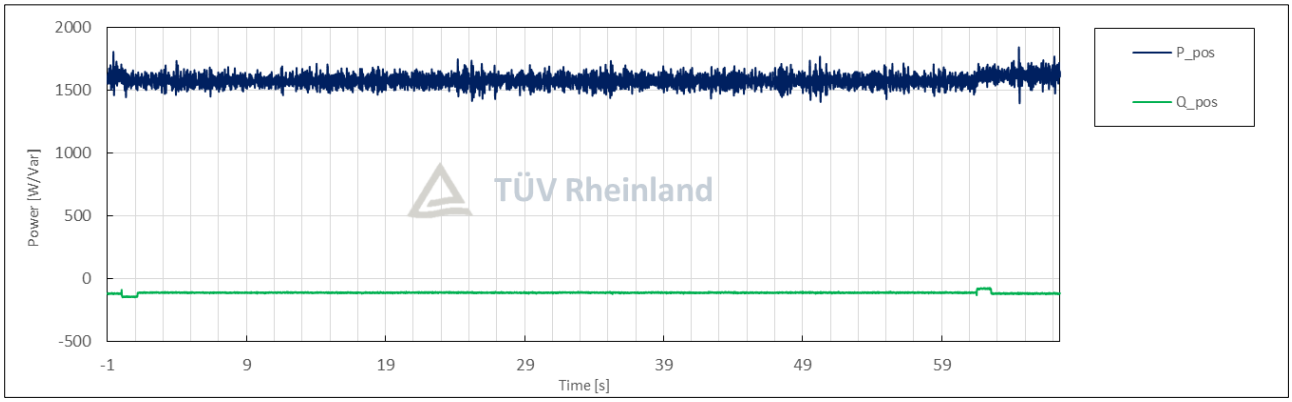


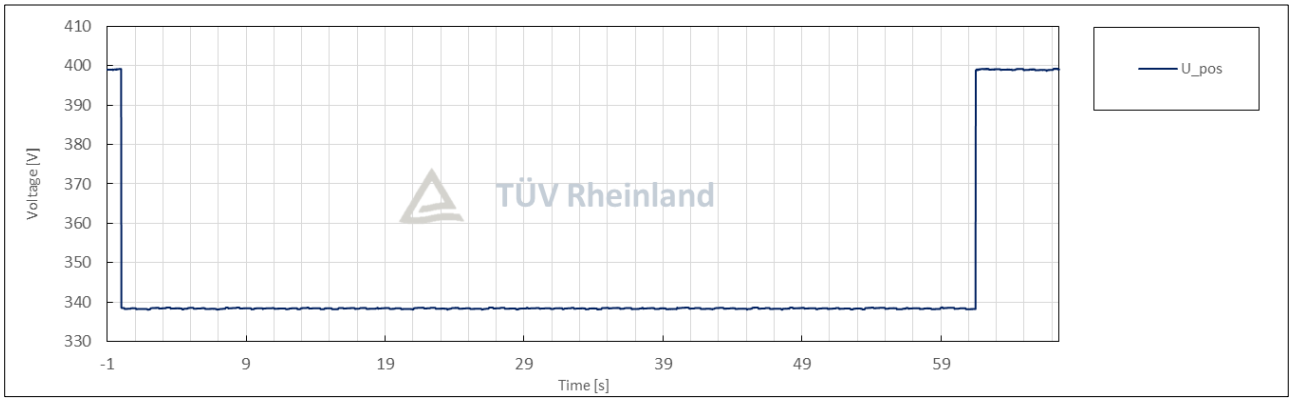

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

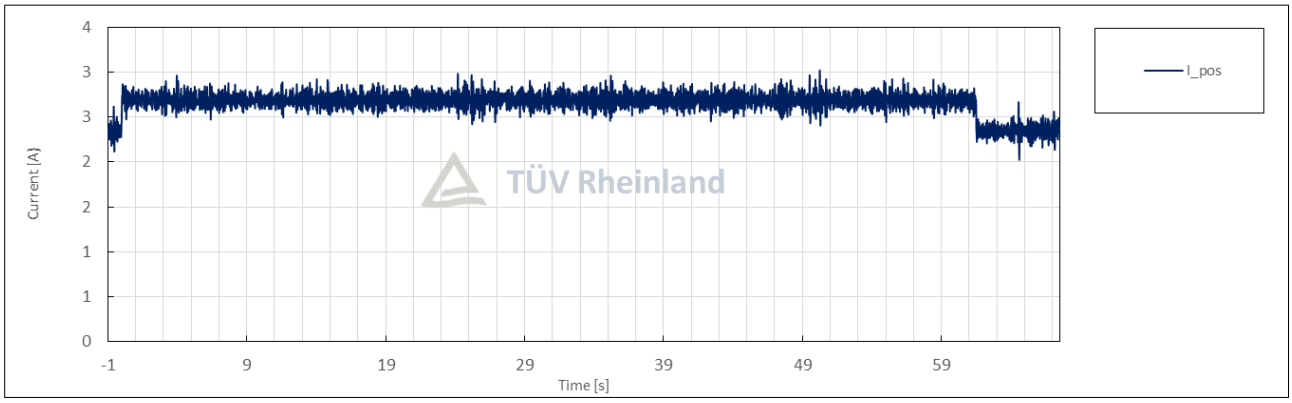

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

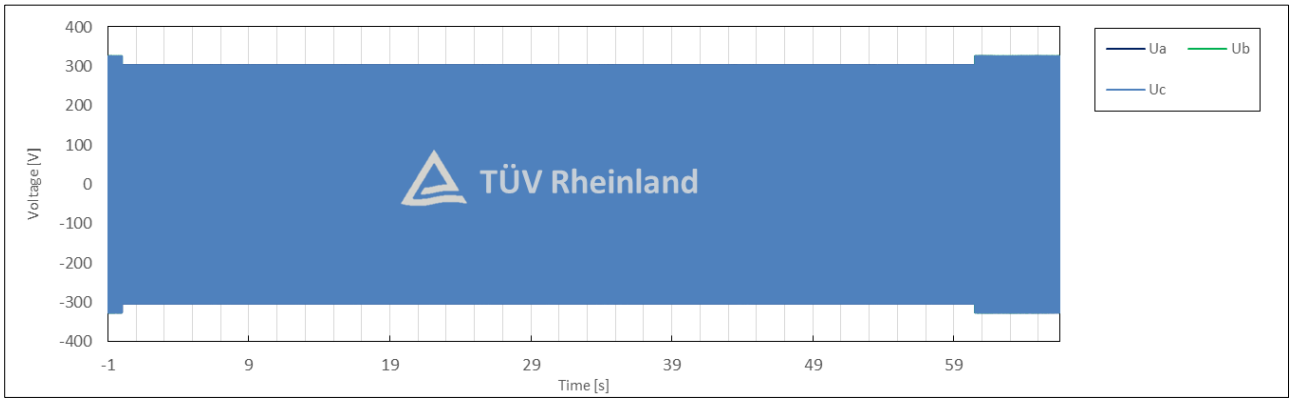

2000
1500
1000
500
0
-500
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

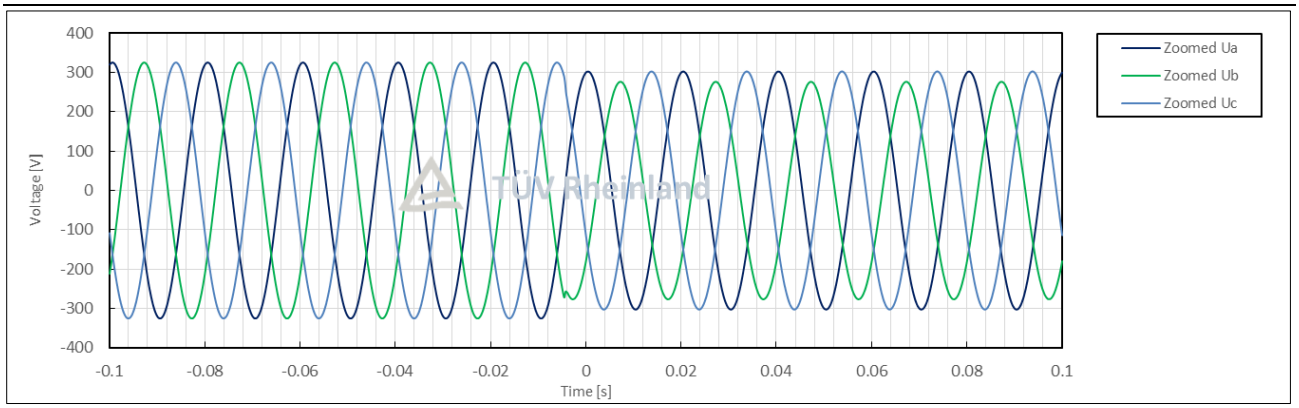

410
400
390
380
370
360
350
340
330
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

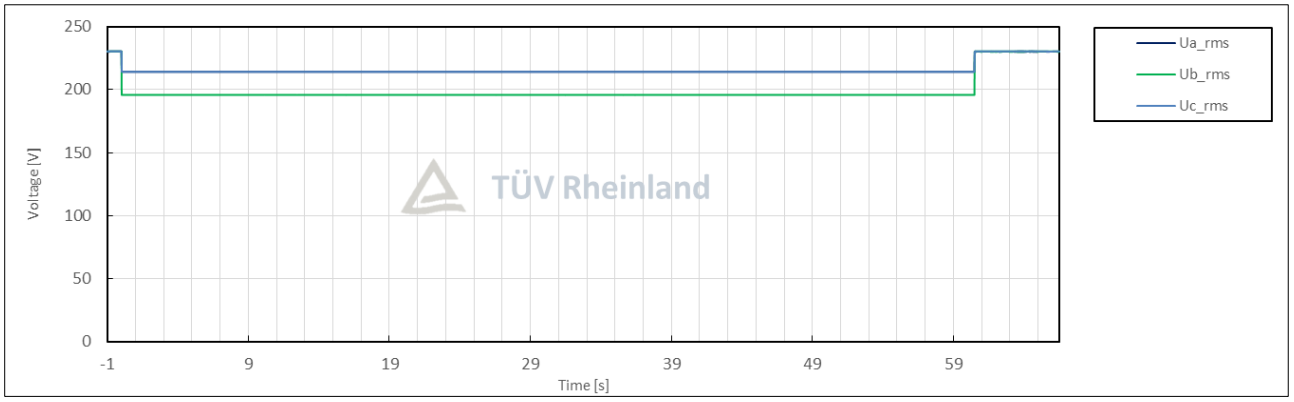

4
3
3
2
2
1
1
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.3
	1	Date	--	--	dd.mm.yyyy	0
	2	Time (start of test)	--	--	hh:mm:ss.f	0:00:00
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.85
	5	Setting dip duration		--		60508
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60508
	8	Fault duration in empty load test	Total	--	ms	60508
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85
	10		Pos.		p.u.	0.90
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.03
	16		Pos.			-0.03
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85
	19	Line current	Phase 1	t1+60ms	p.u.	1.12
	20		Phase 2			1.13
	21		Phase 3			1.10
	22	Line current	Phase 1	t1+100ms	p.u.	1.11
	23		Phase 2			1.13
	24		Phase 3			1.09
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.90
	26		Pos.			0.90
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.315
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.03
	32		Pos.			-0.03
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

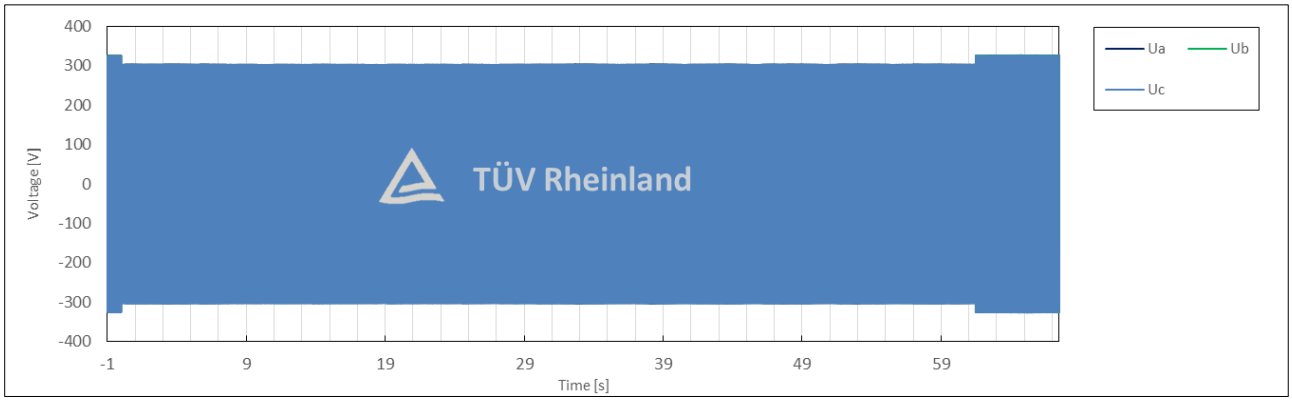
Test No. 4.3 idle test

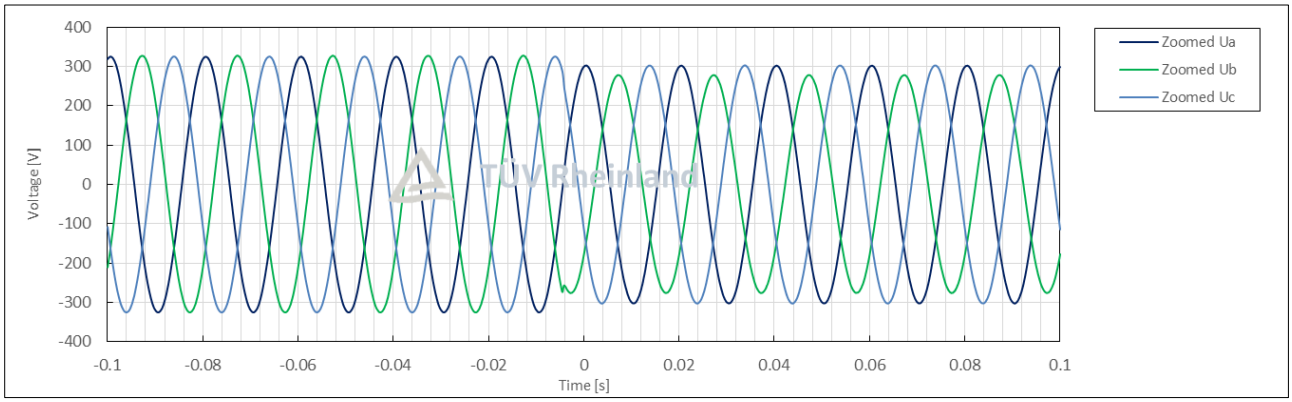


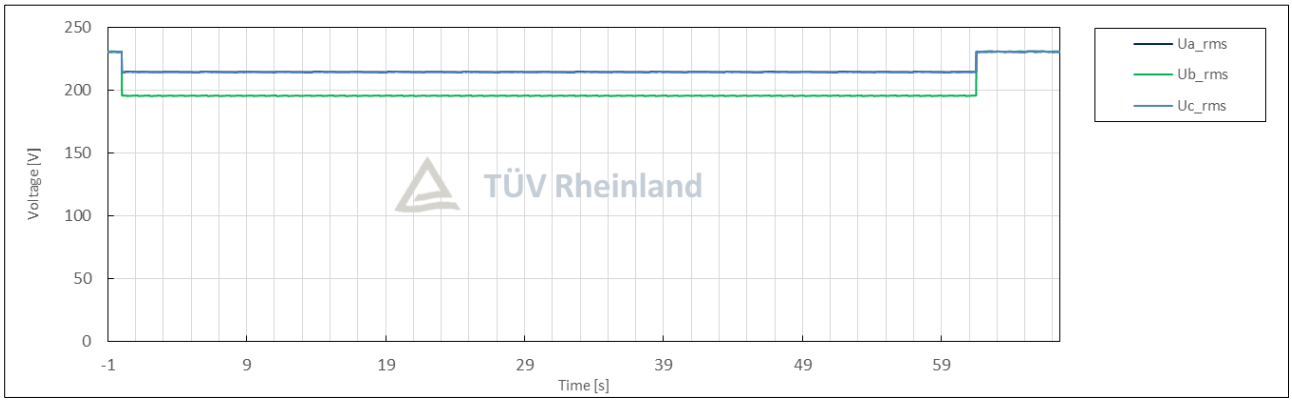


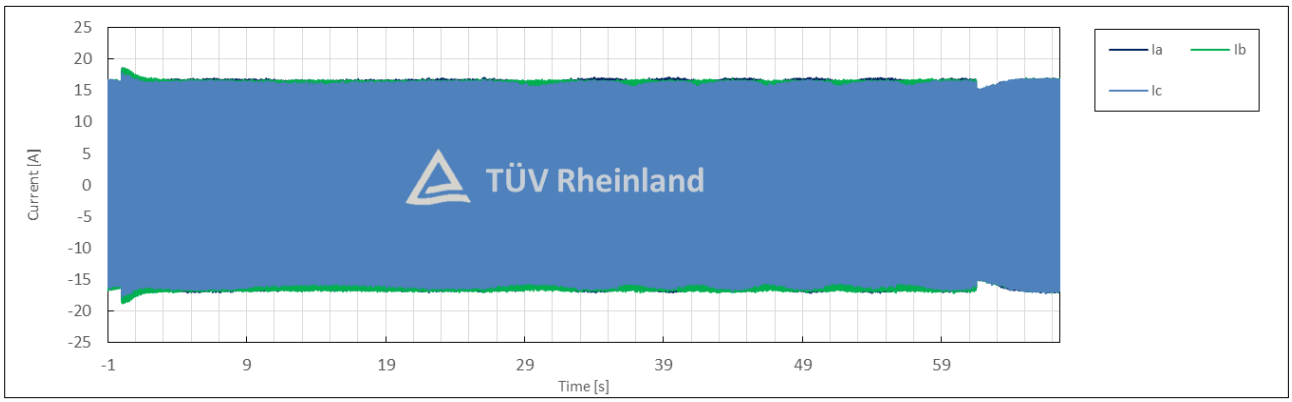


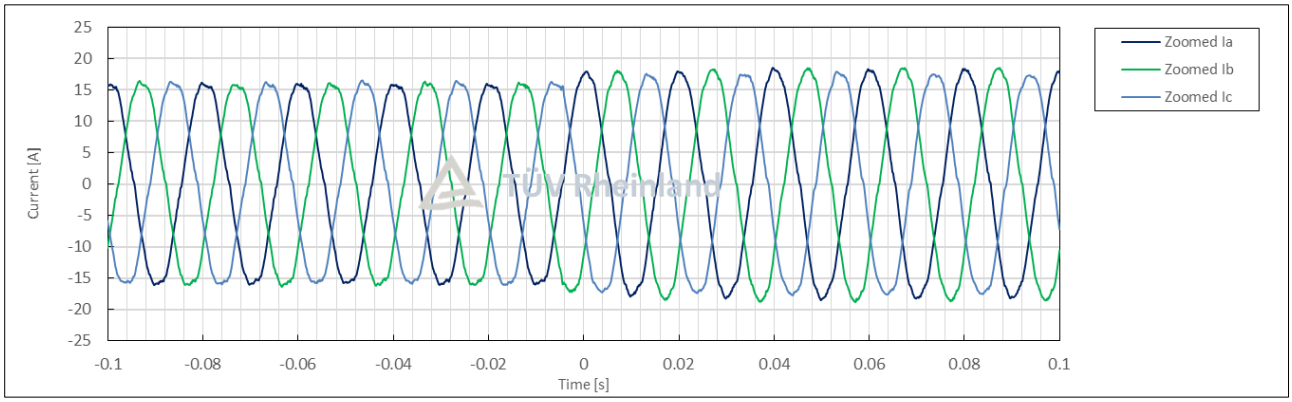
Test No. 4.3 with PGU

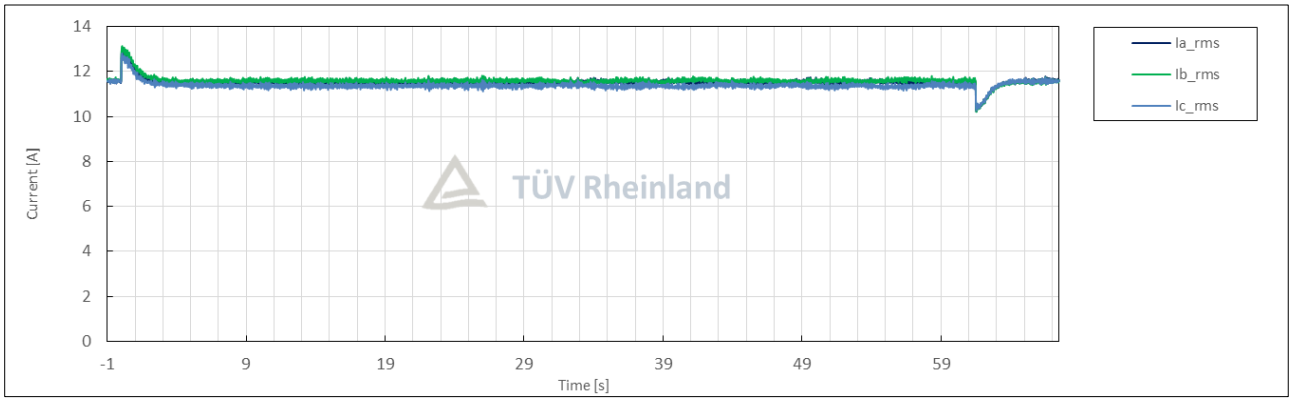


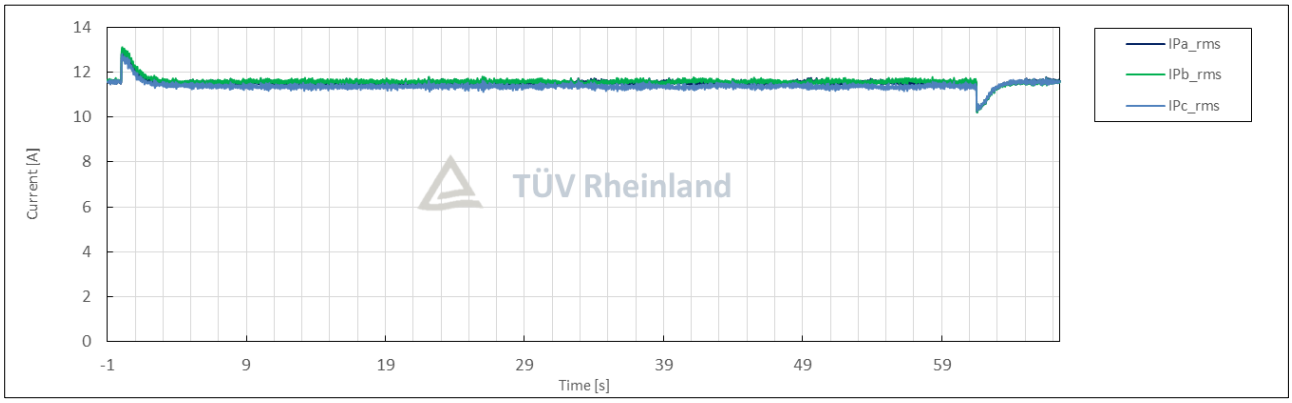


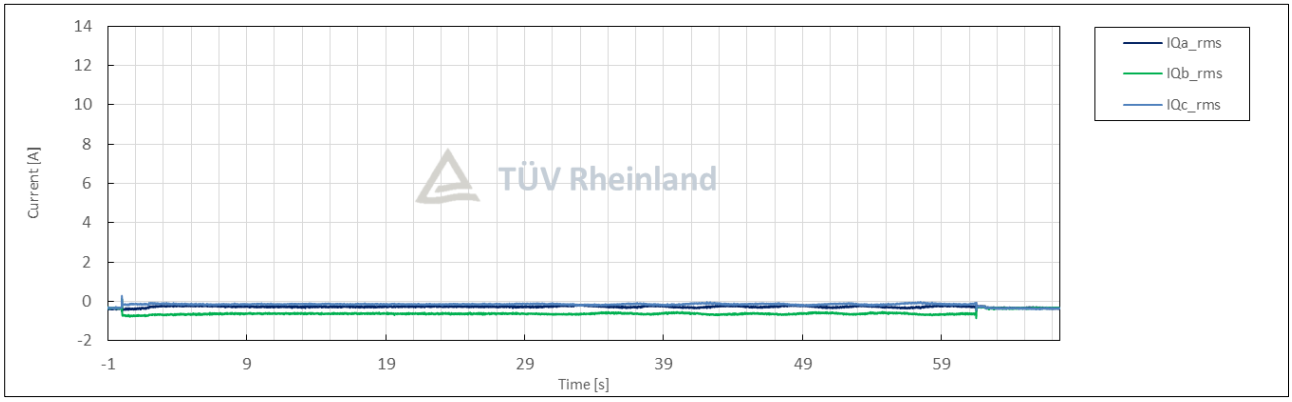


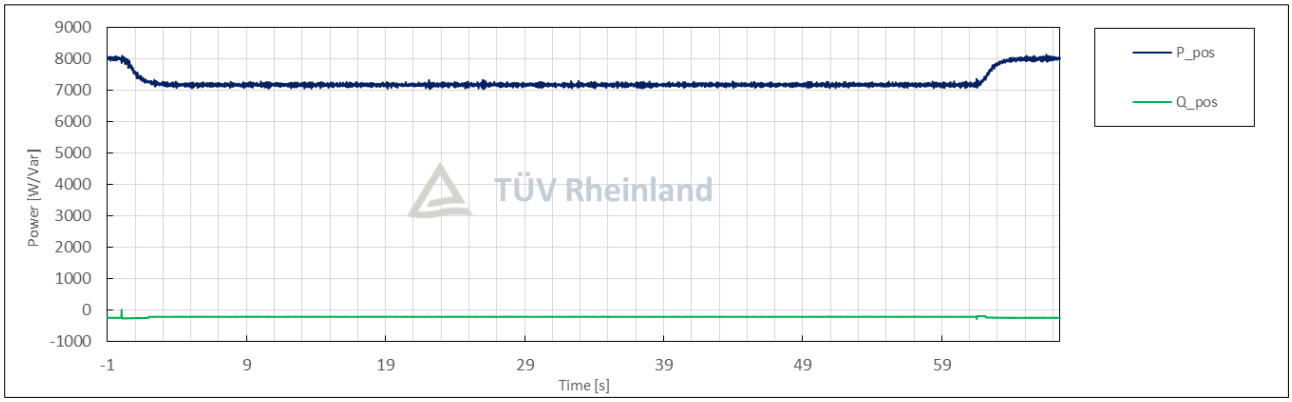


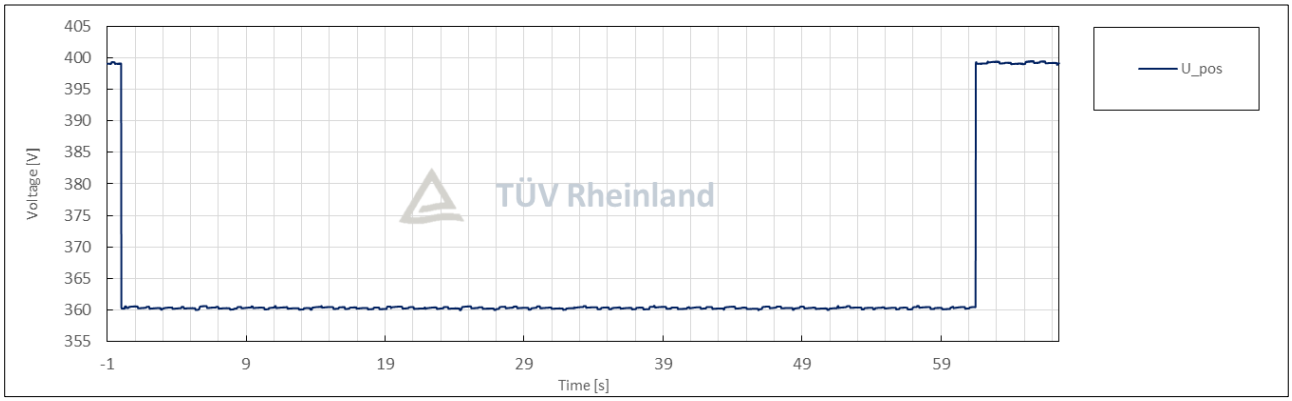

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

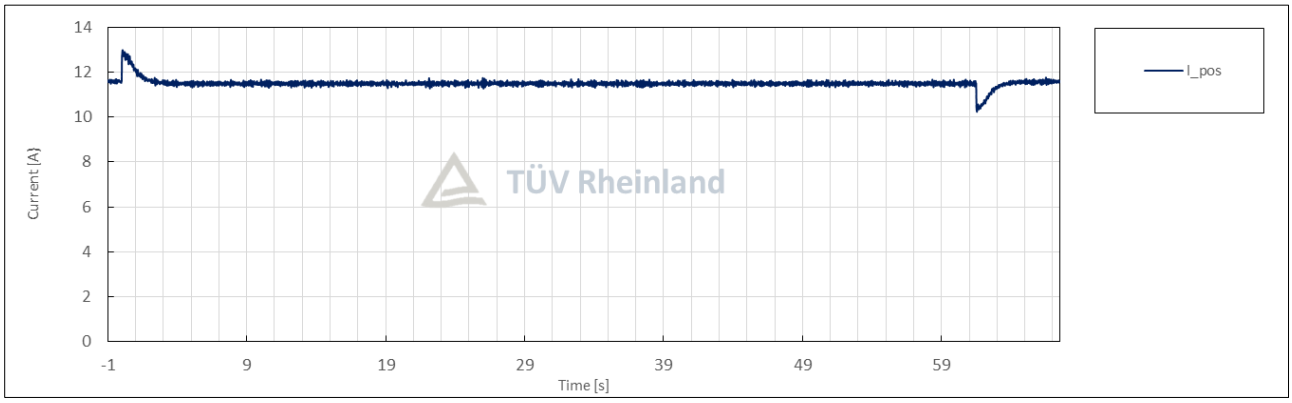

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

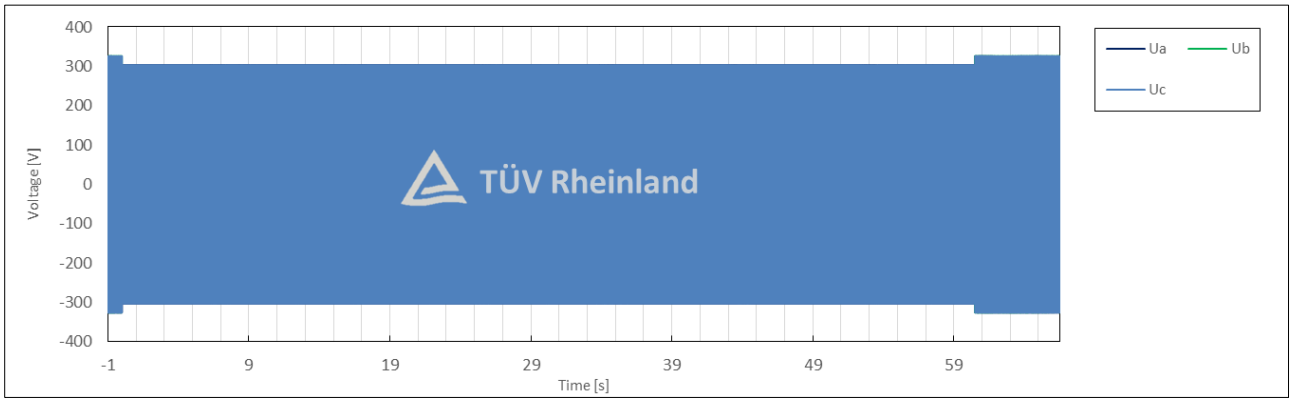

9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

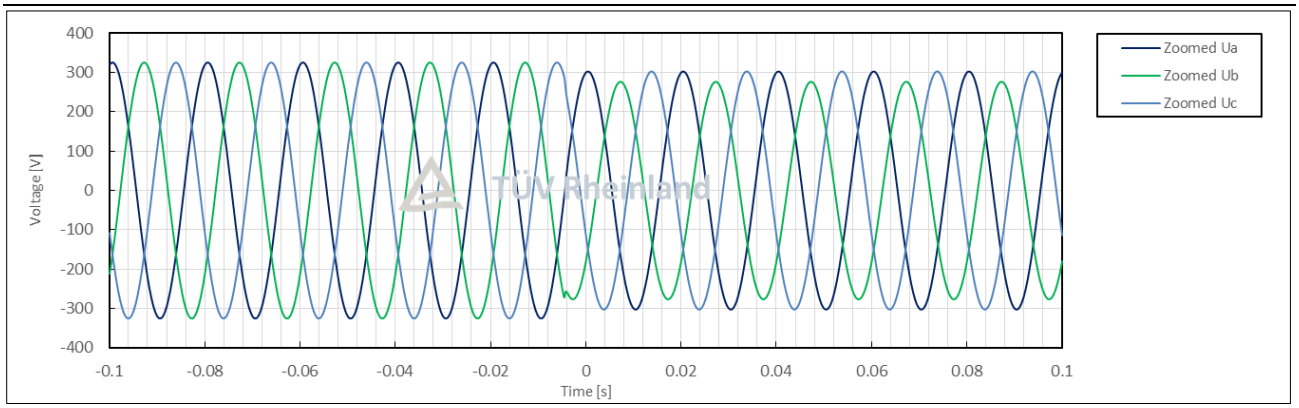

405
400
395
390
385
380
375
370
365
360
355
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

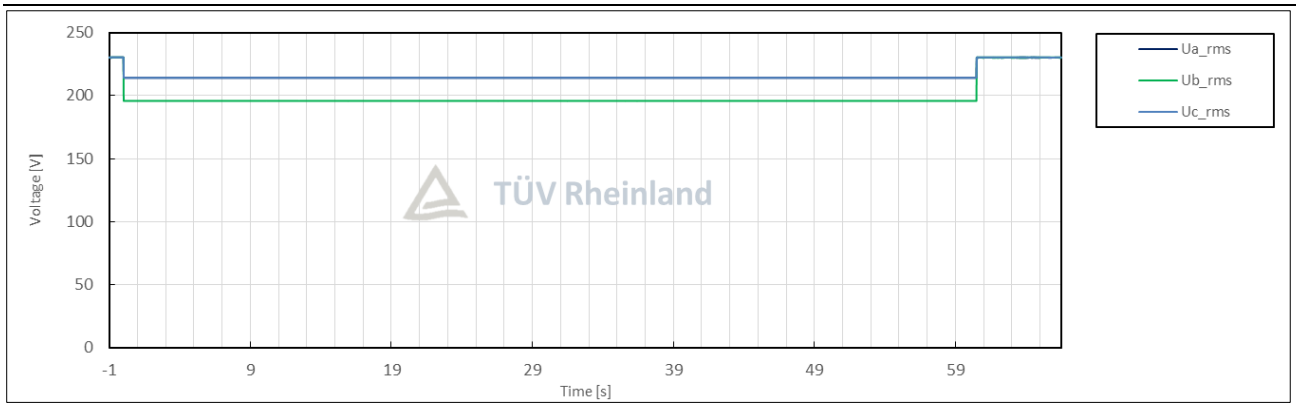

14
12
10
8
6
4
2
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.4
	1	Date	--	--	dd.mm.yyyy	0
	2	Time (start of test)	--	--	hh:mm:ss.f	0:00:00
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	0.85
	5	Setting dip duration		--		60508
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60508
	8	Fault duration in empty load test	Total	--	ms	60508
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.85
	10		Pos.		p.u.	0.90
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			-0.01
	17	Cos_{φ}	--	t1-10s to t1	--	0.997
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.85
	19	Line current	Phase 1	t1+60ms	p.u.	0.22
	20		Phase 2			0.23
	21		Phase 3			0.22
	22	Line current	Phase 1	t1+100ms	p.u.	0.21
	23		Phase 2			0.22
	24		Phase 3			0.22
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.20
	26		Pos.			0.20
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	N/A
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			-0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

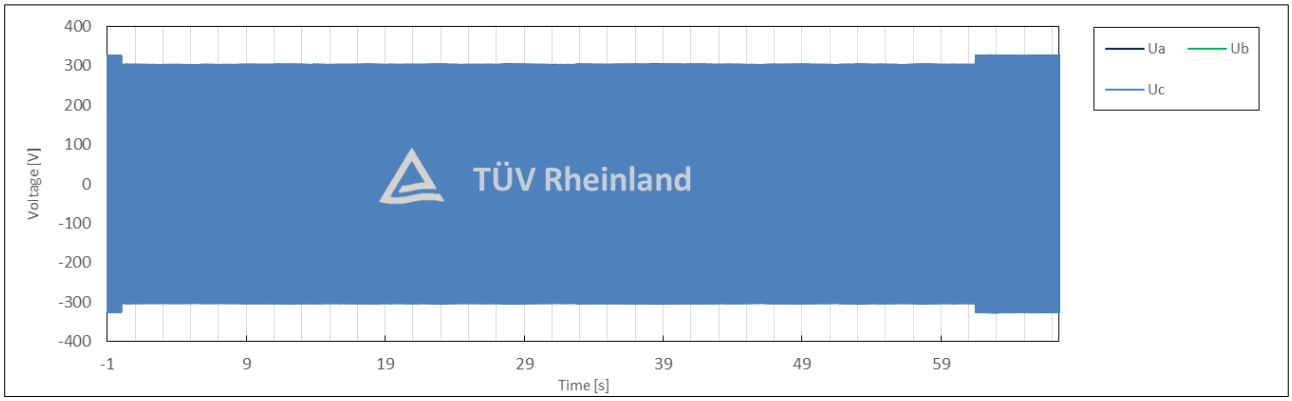
Test No. 4.4 idle test

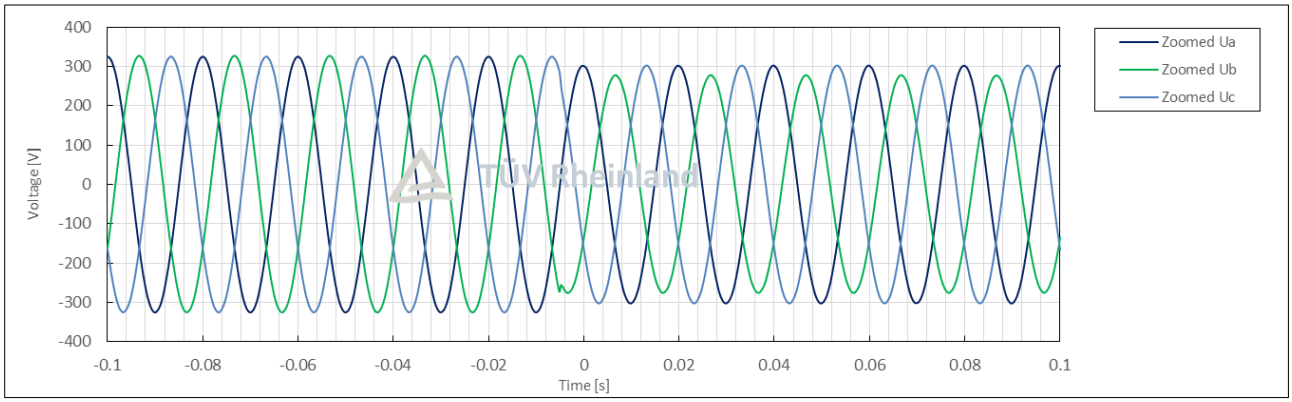


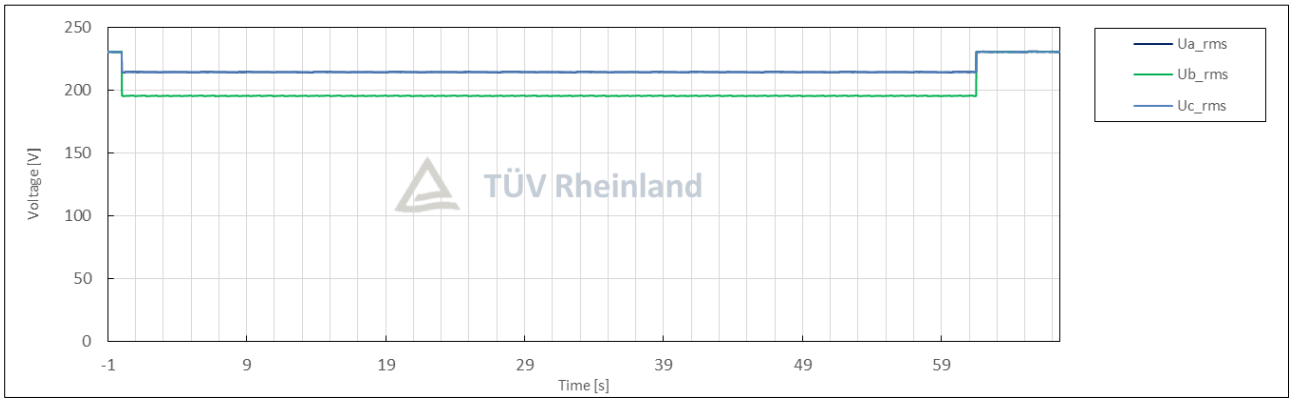


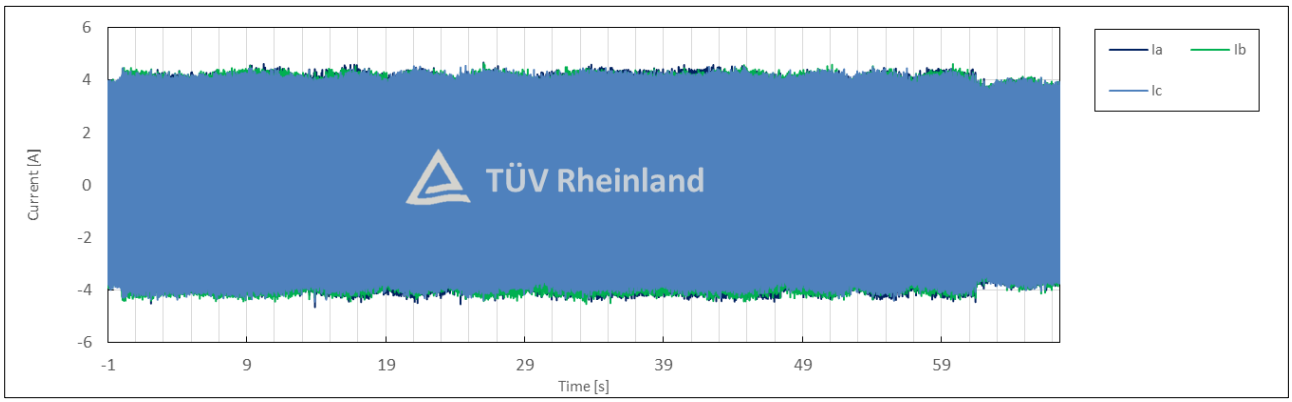


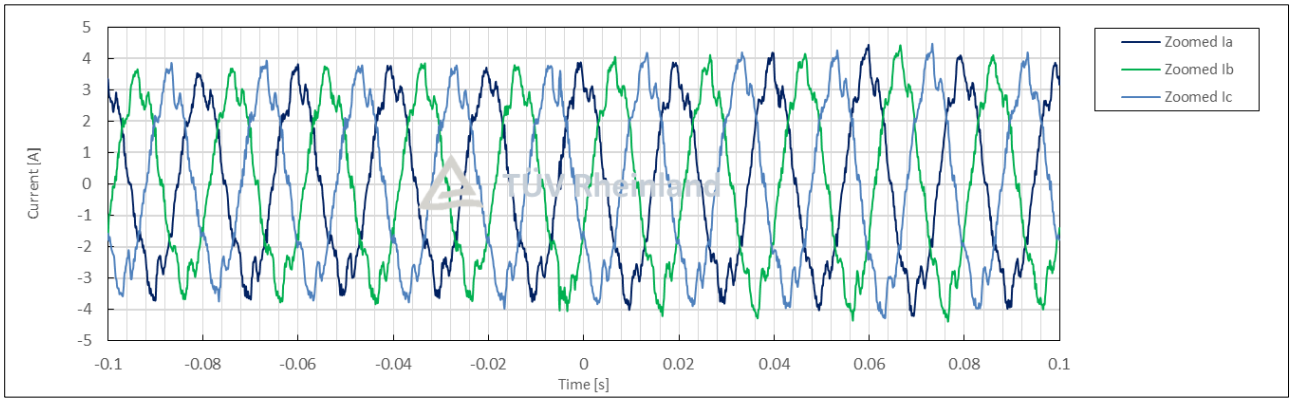
Test No. 4.4 with PGU

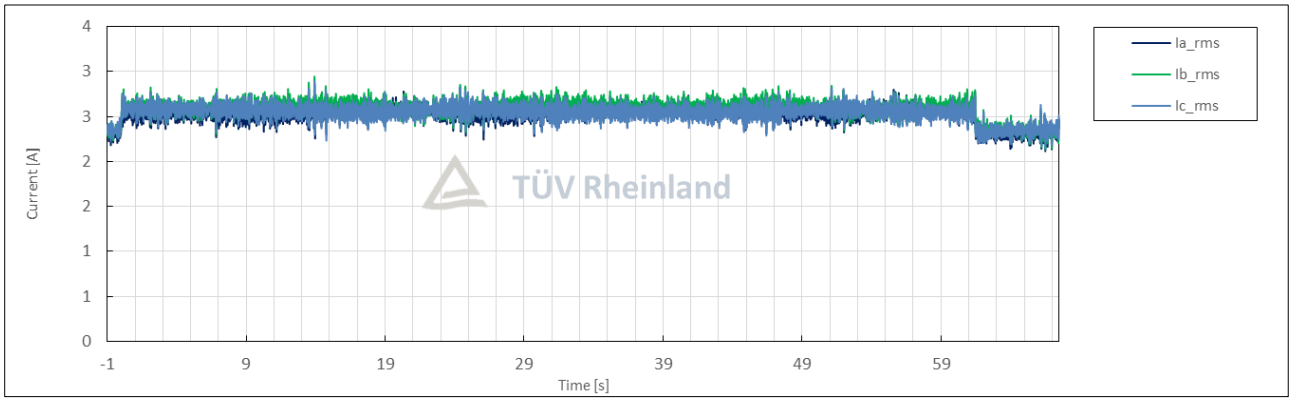


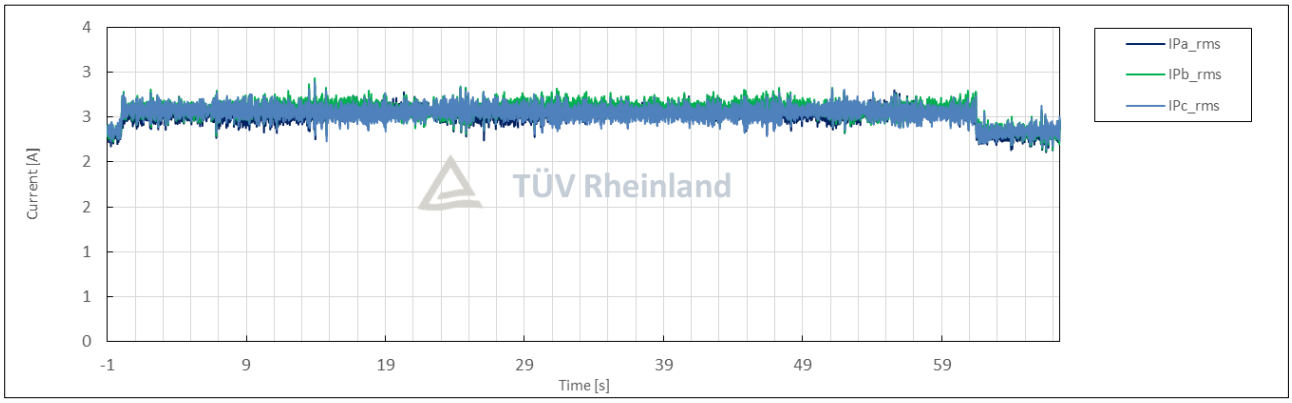


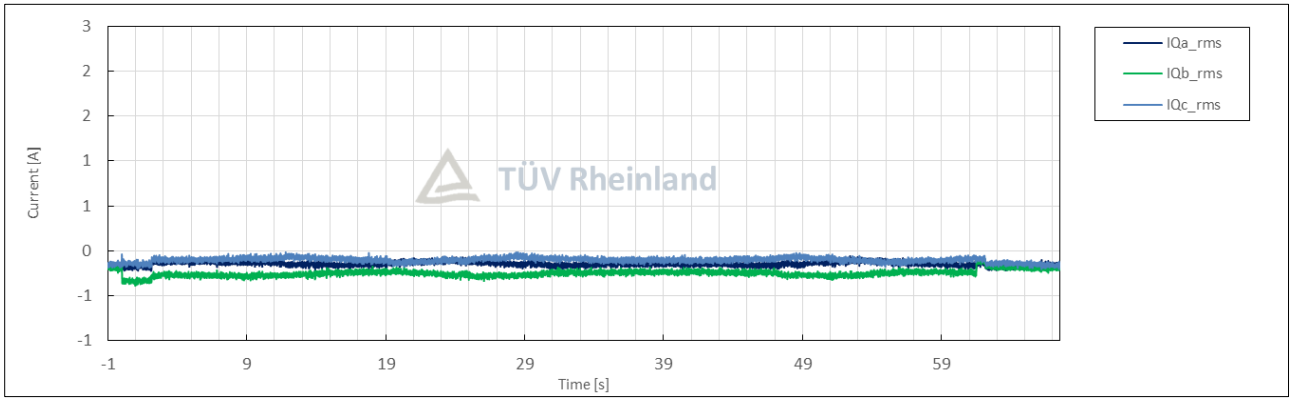


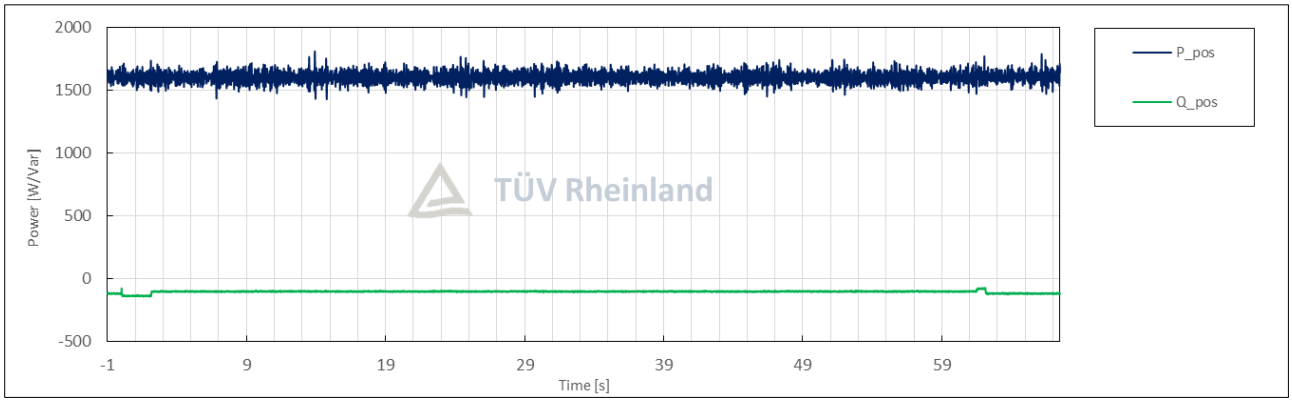


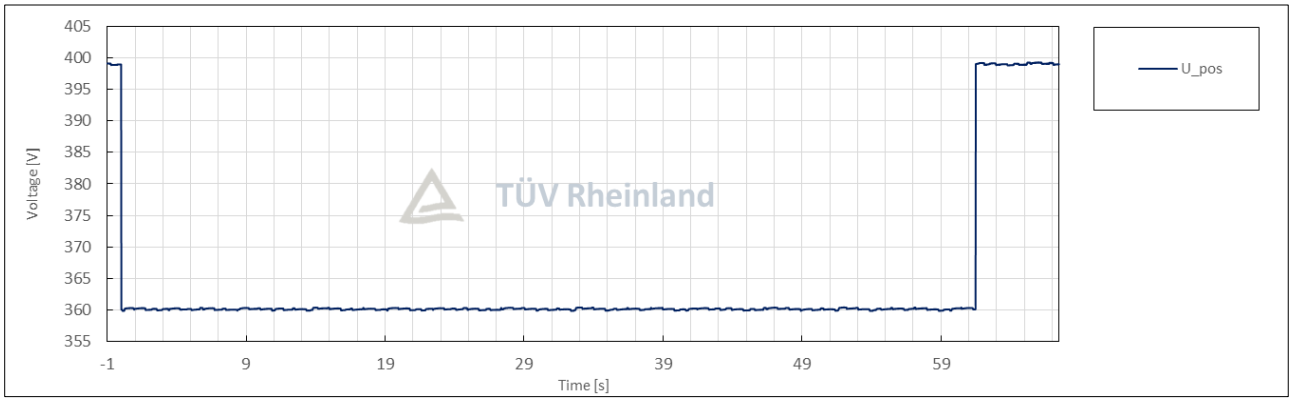

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

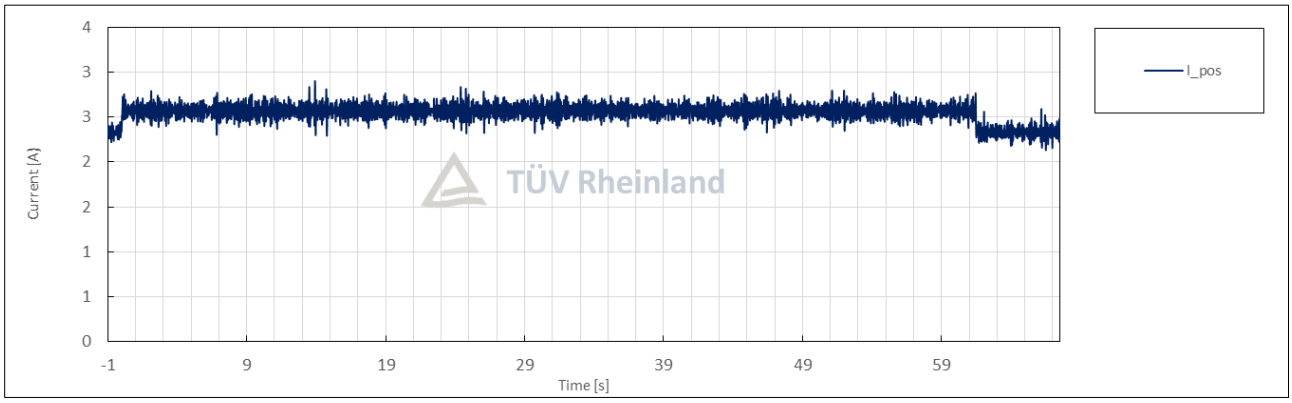

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

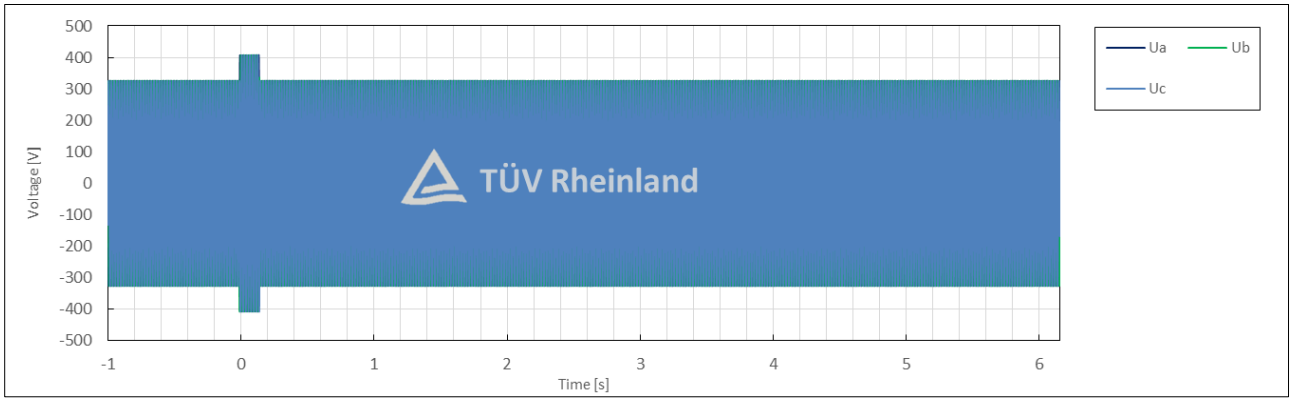

2000
1500
1000
500
0
-500
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

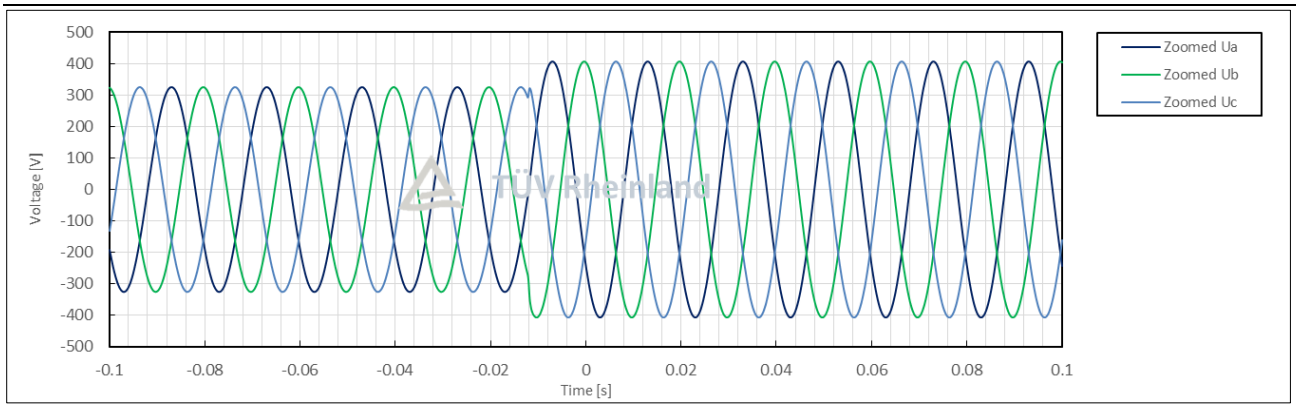

405
400
395
390
385
380
375
370
365
360
355
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

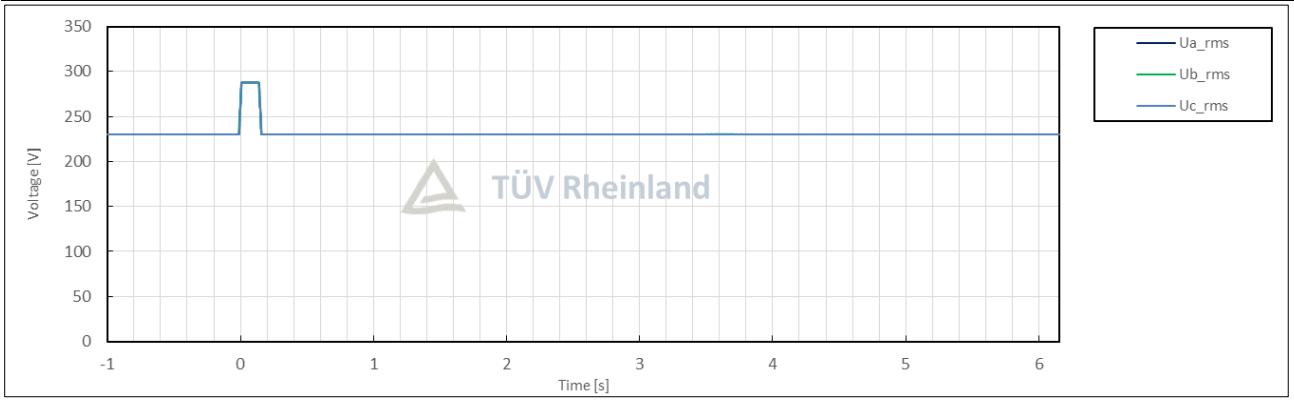

4
3
3
2
2
1
1
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.1
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:02:43
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.25
	5	Setting dip duration		--		153
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	153
	8	Fault duration in empty load test	Total	--	ms	153
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.25
	10		Pos.		p.u.	1.25
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.99
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.25
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.00
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.02
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.99
	29		Pos.			0.99
	39	Active power rising time	Pos.	--	s	0.516
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

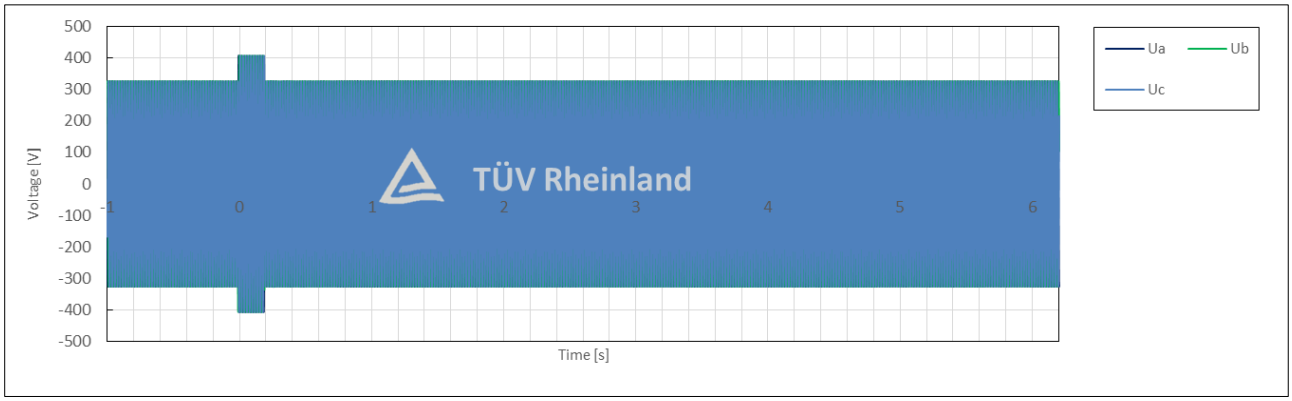
Test No. 5.1 idle test

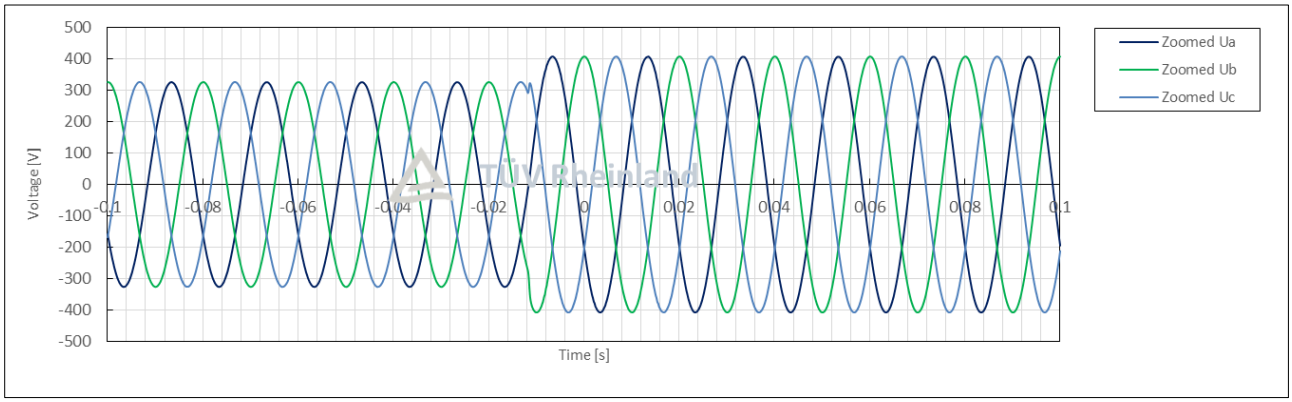


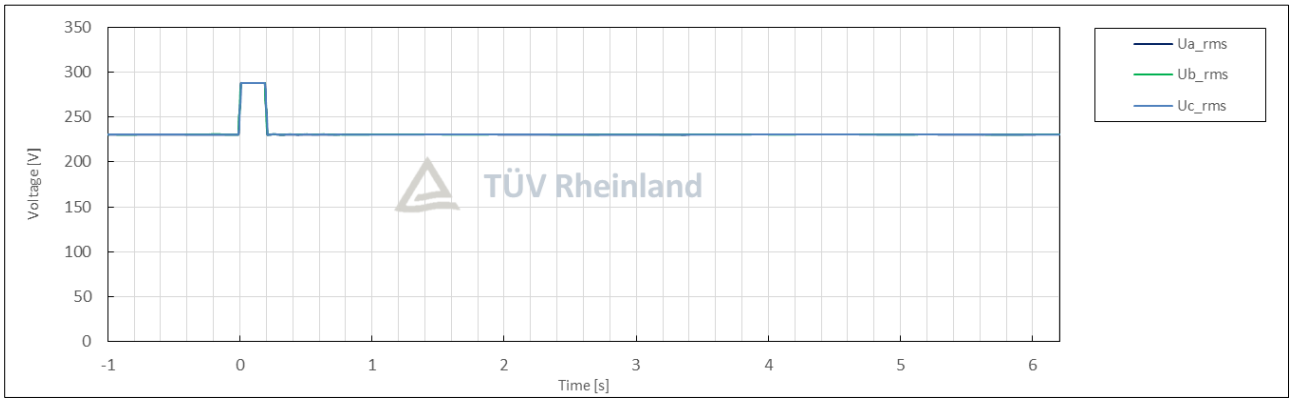


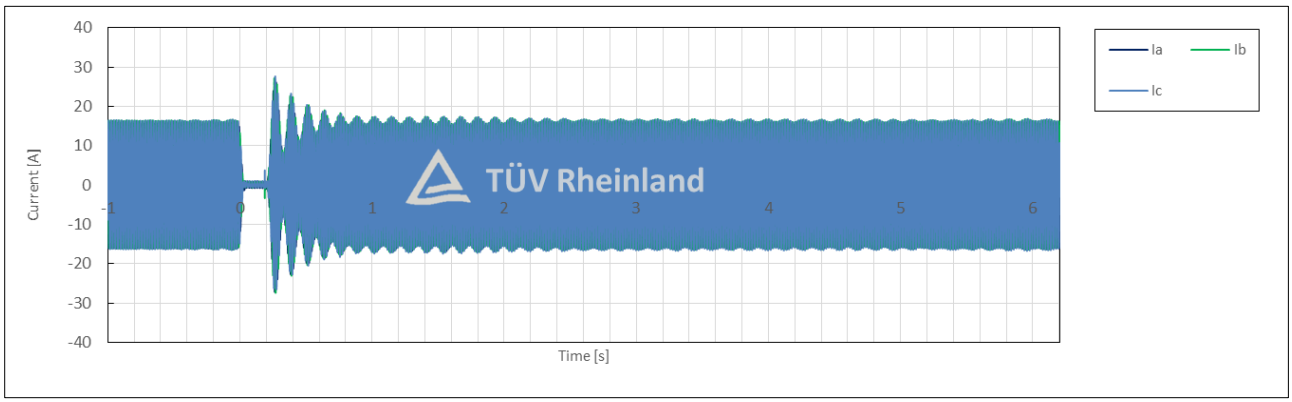


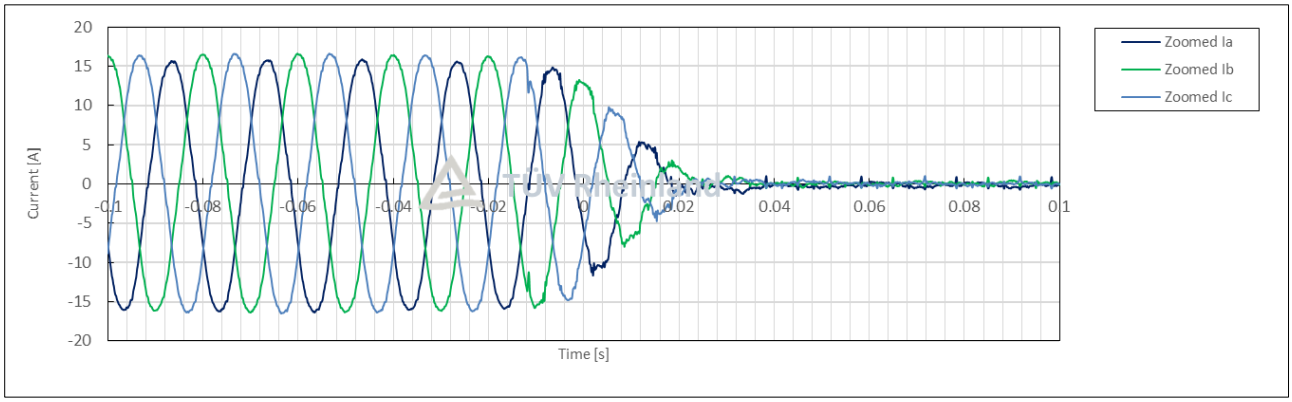
Test No. 5.1 with PGU

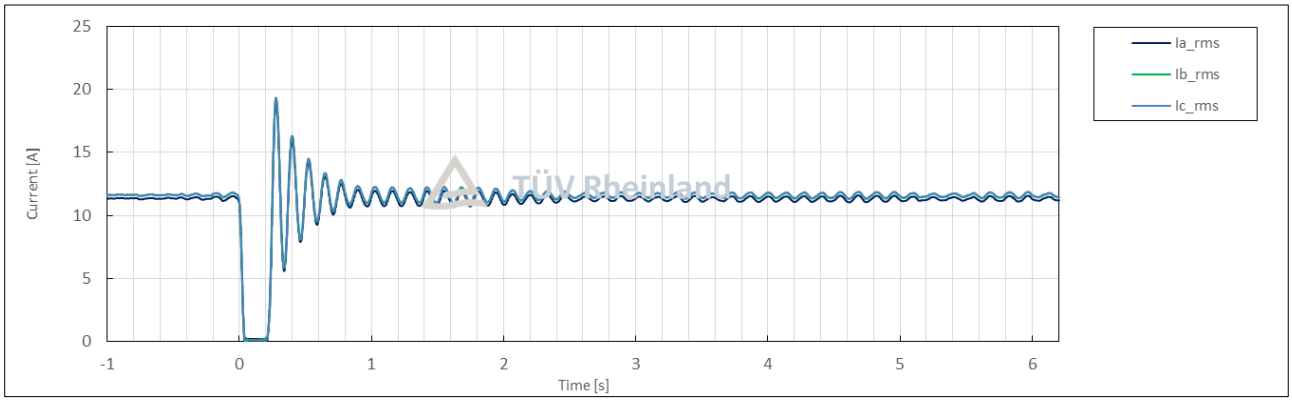


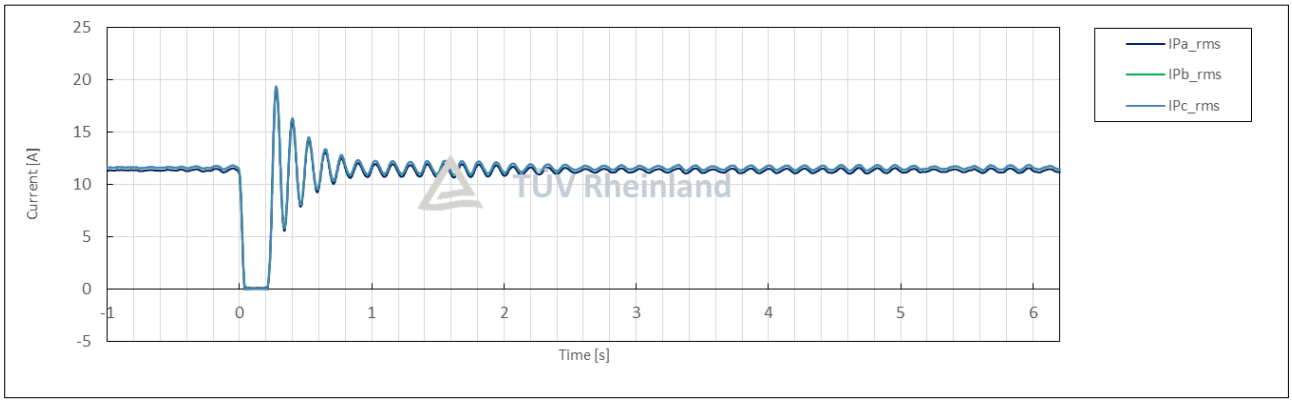


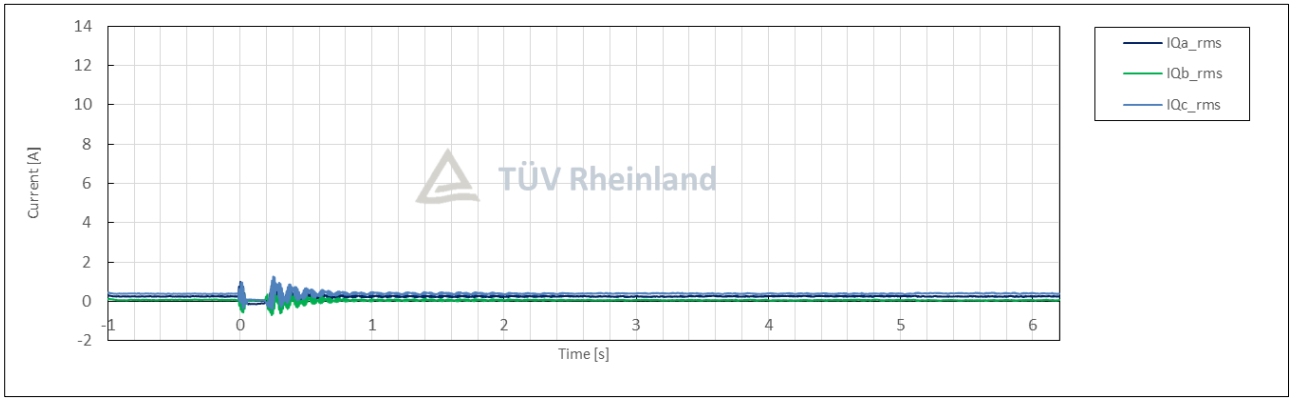


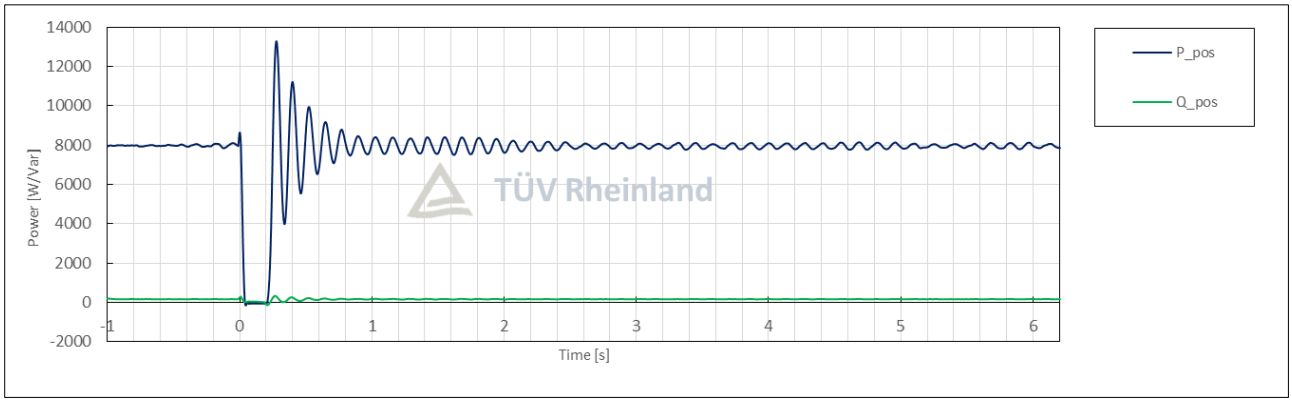


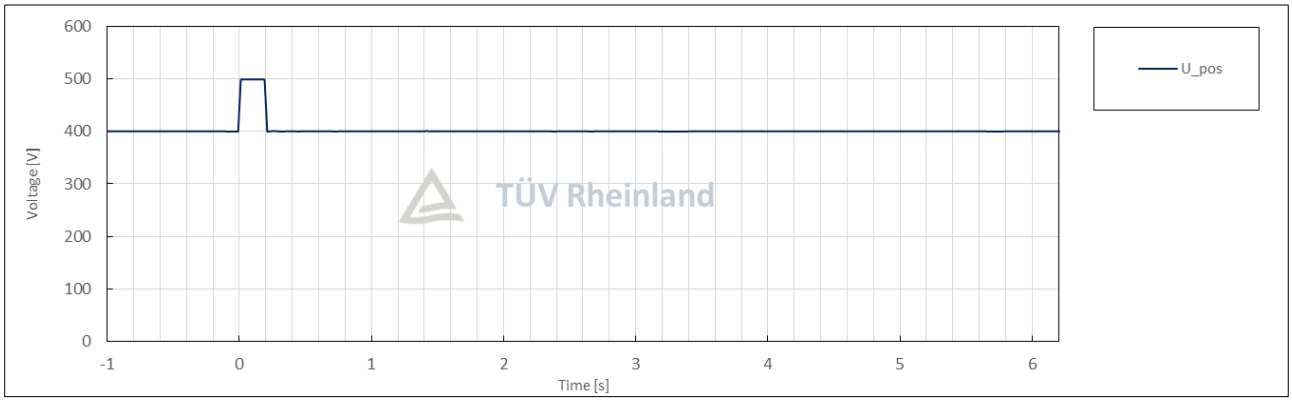

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

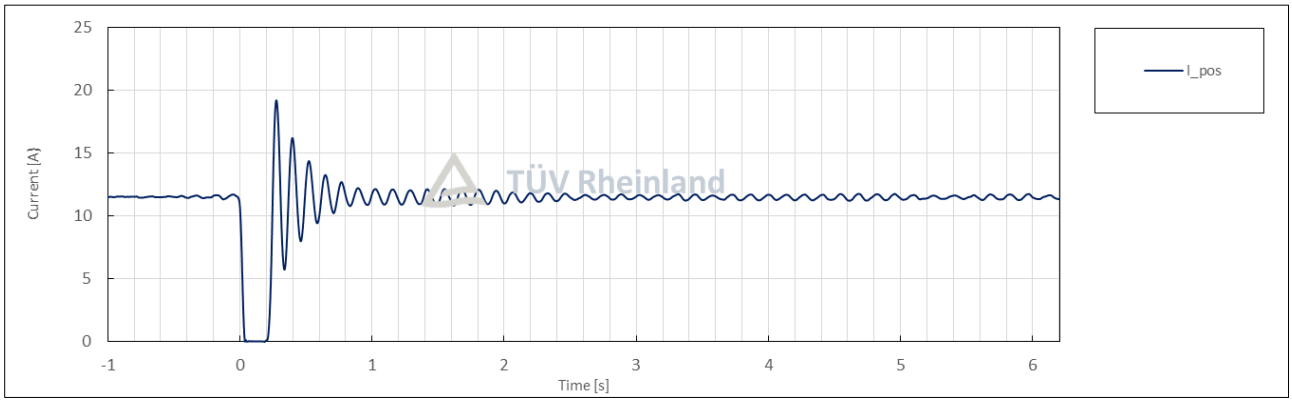

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

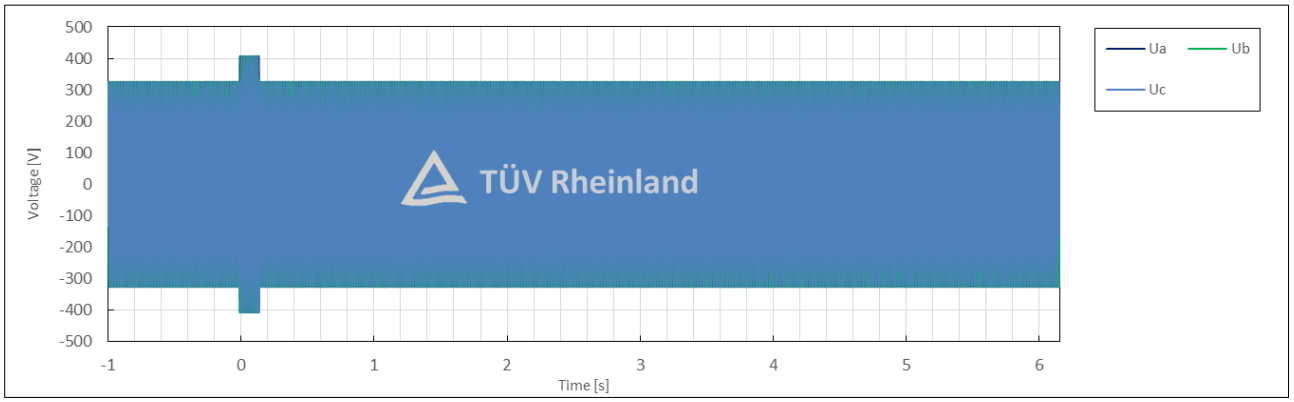

14000
12000
10000
8000
6000
4000
2000
0
-2000
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

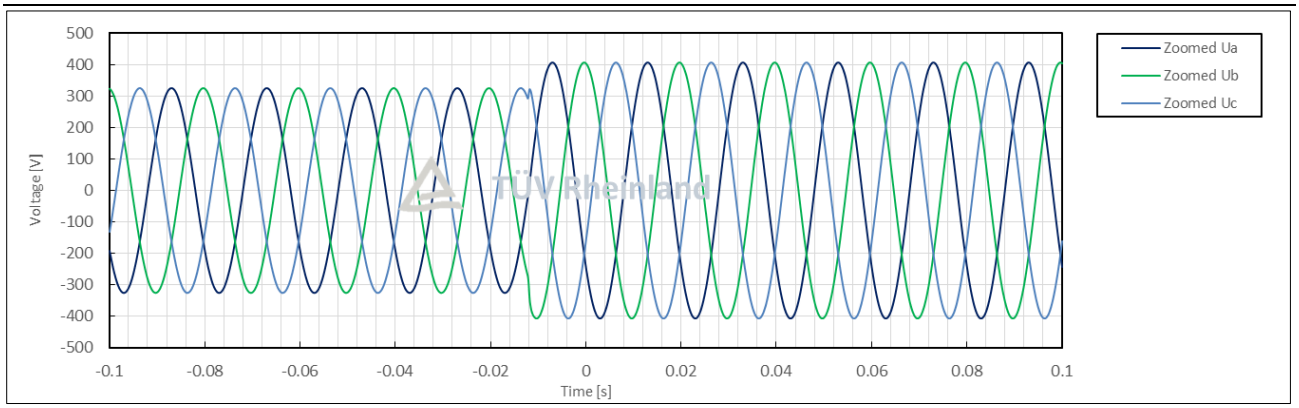

600
500
400
300
200
100
0
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

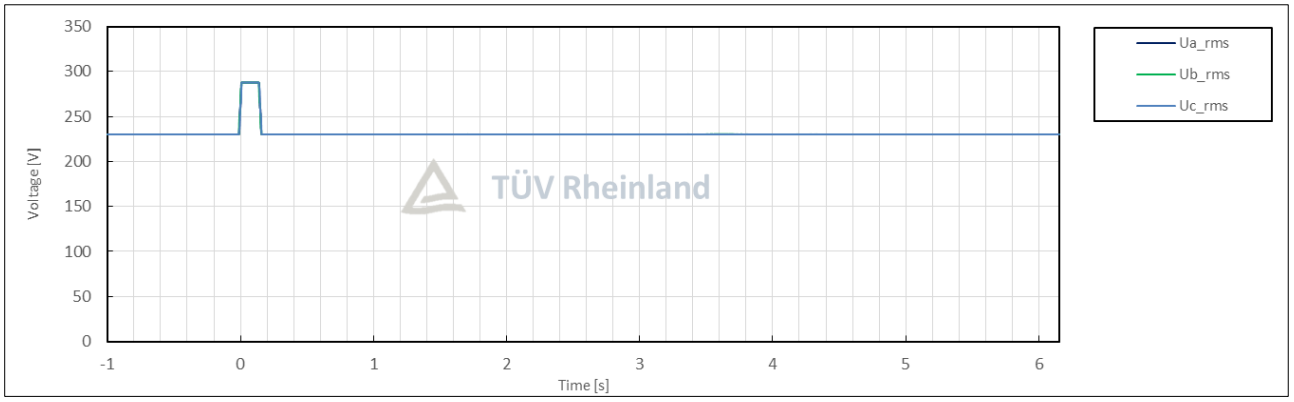

25
20
15
10
5
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.2
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	23:00:55
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.25
	5	Setting dip duration		--		153
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	153
	8	Fault duration in empty load test	Total	--	ms	153
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.25
	10		Pos.		p.u.	1.25
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			-0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.24
	19	Line current	Phase 1	t1+60ms	p.u.	0.03
	20		Phase 2			0.03
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.02
	23		Phase 2			0.02
	24		Phase 3			0.03
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.02
	26		Pos.			0.02
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.343
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			-0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

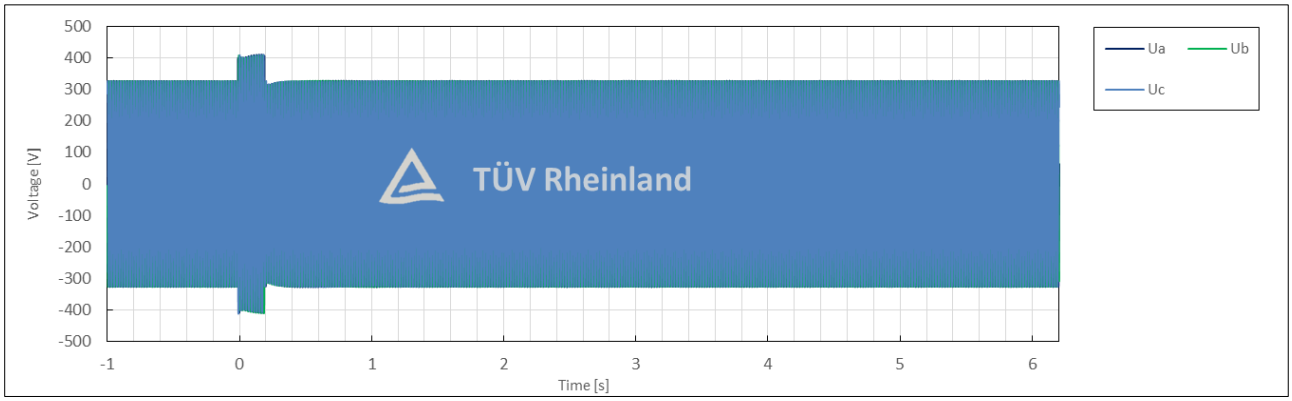
Test No. 5.2 idle test

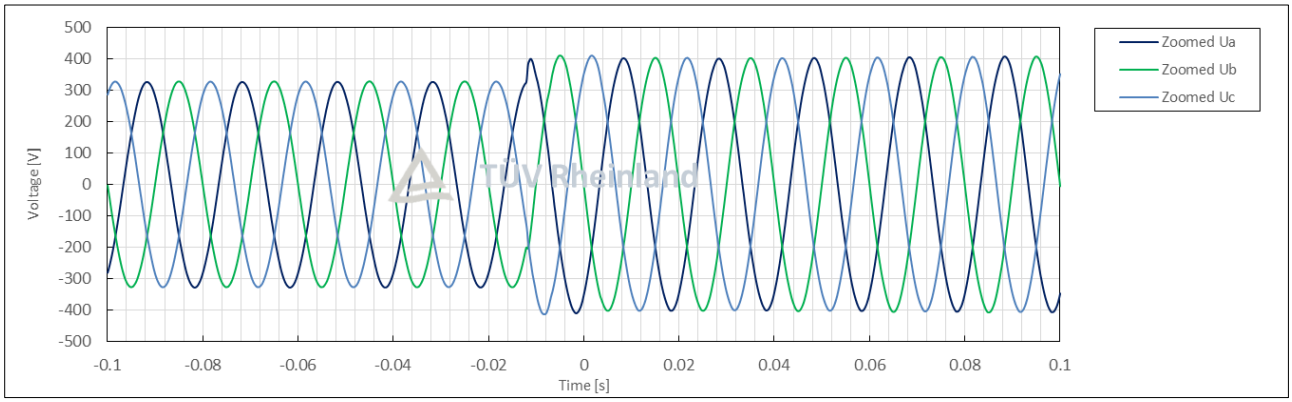


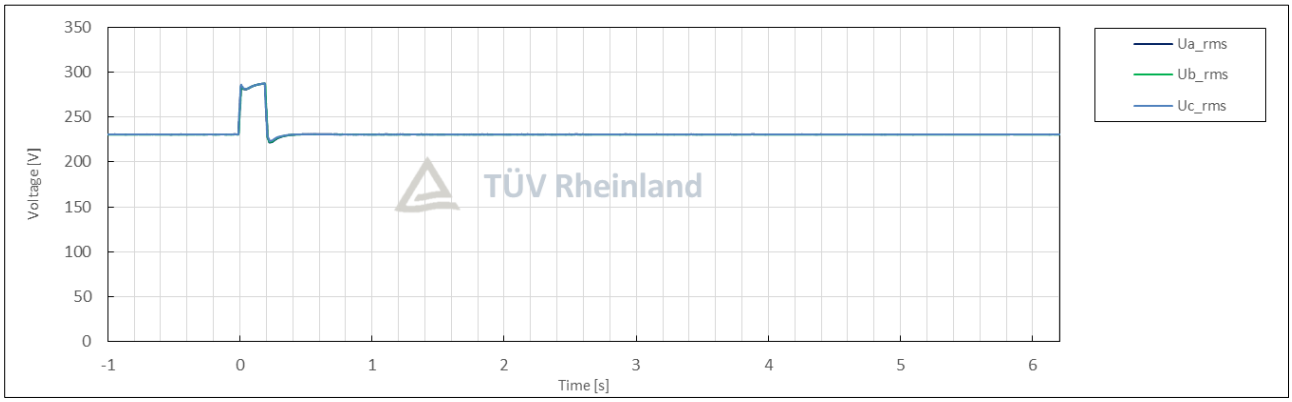


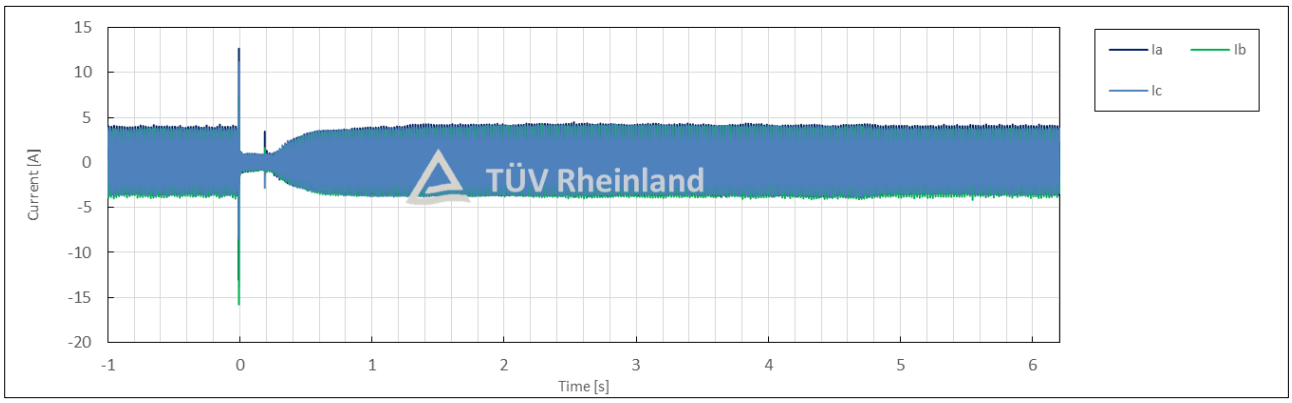


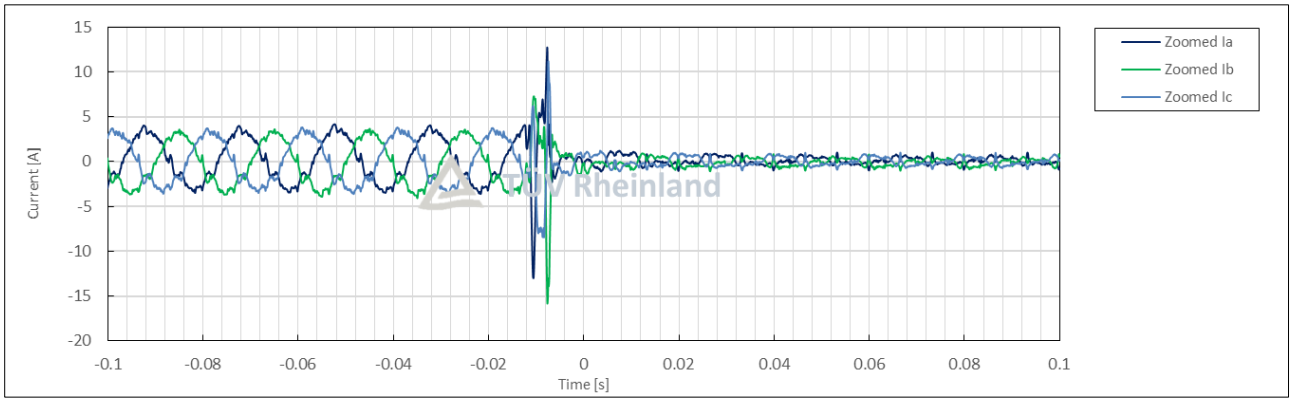
Test No. 5.2 with PGU

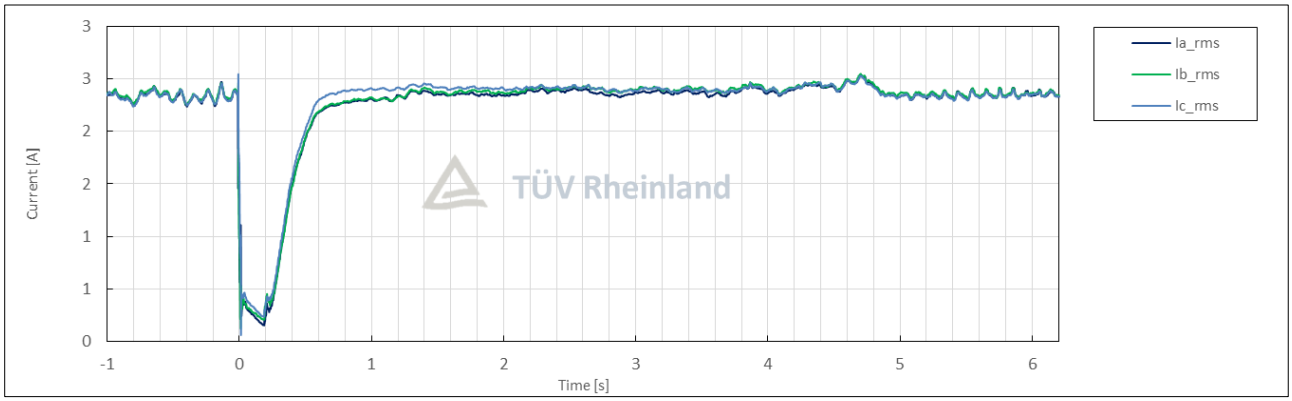


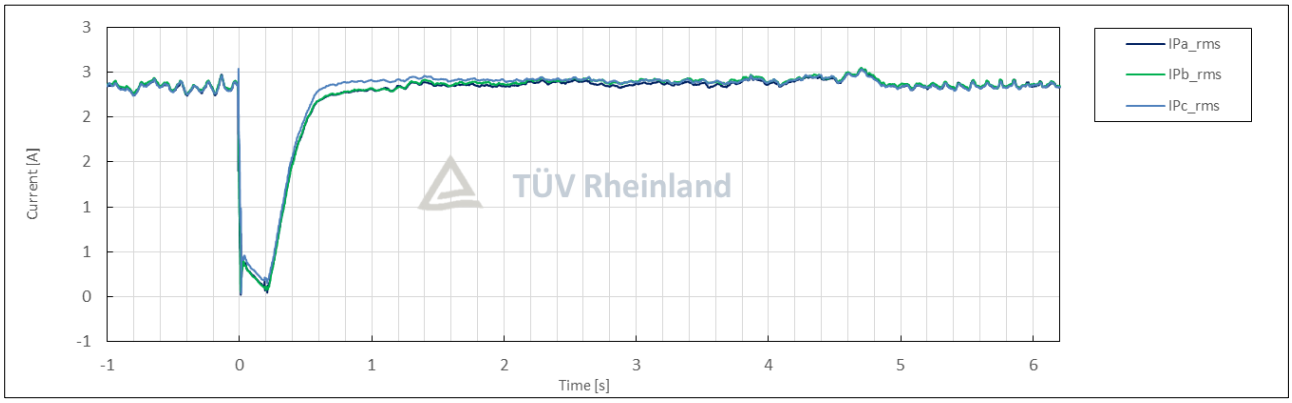


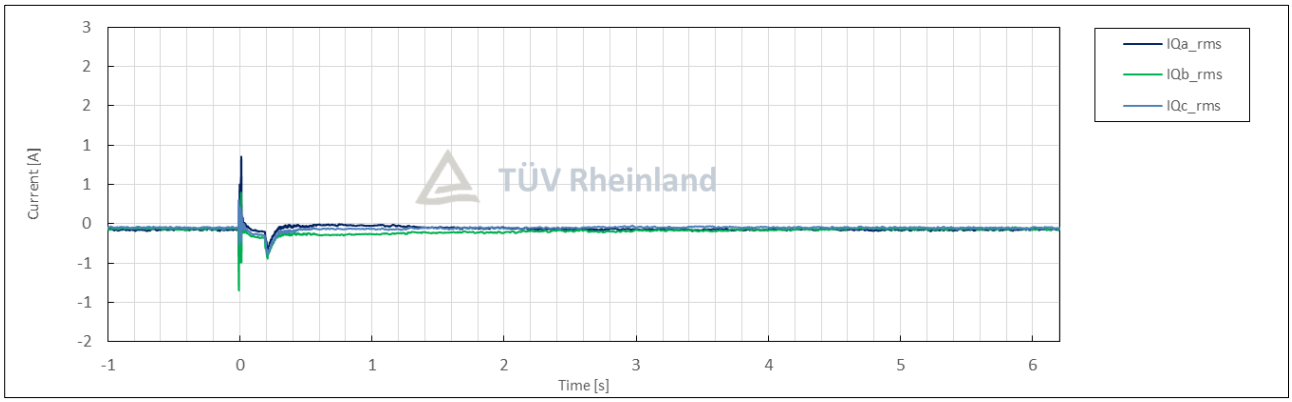


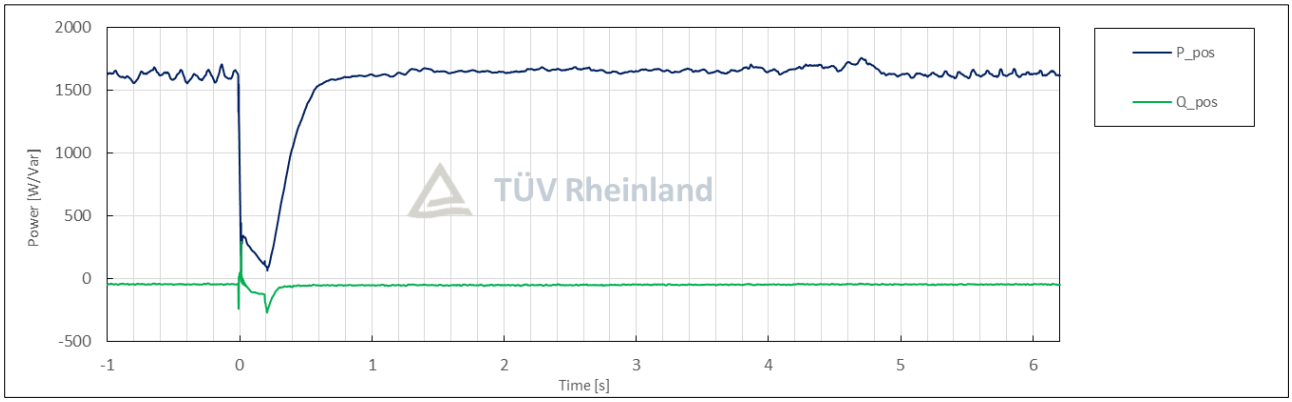


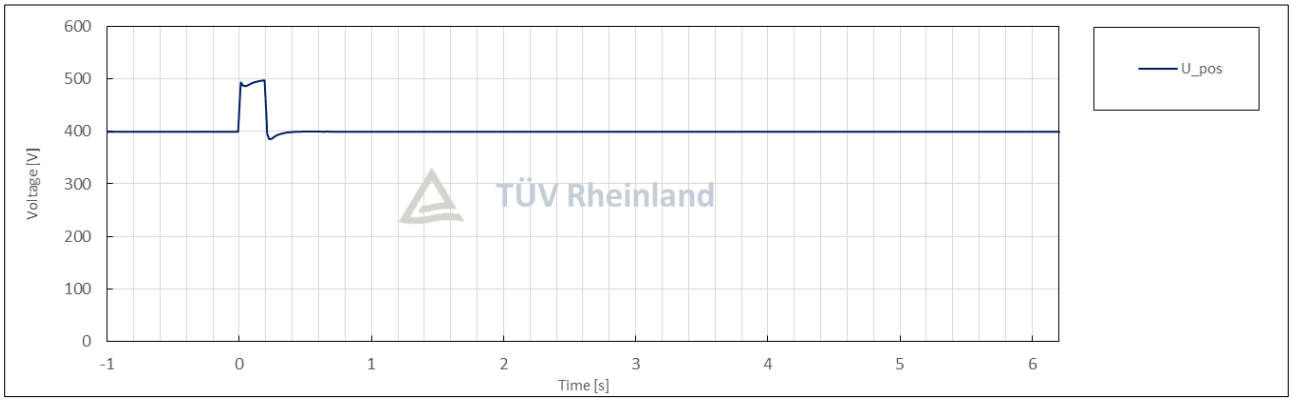

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

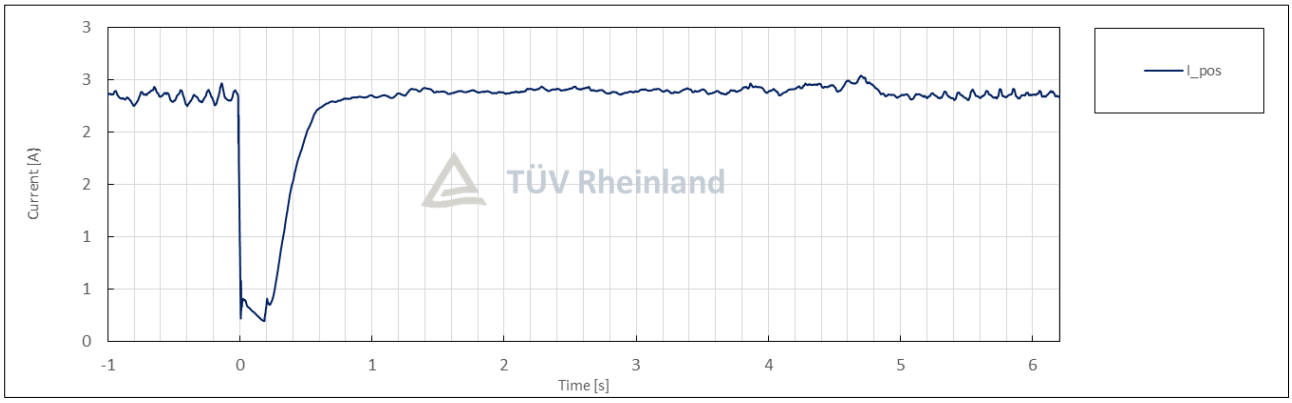

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

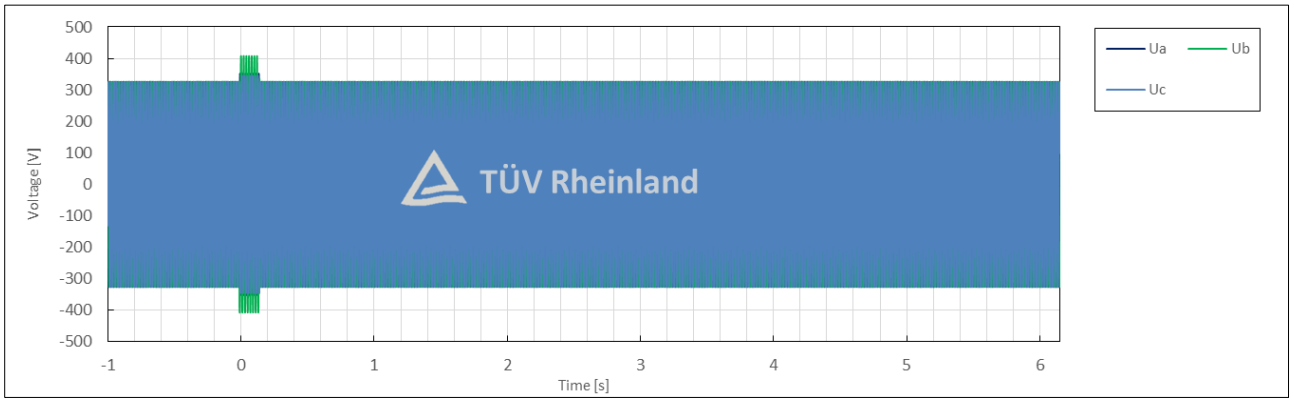

2000
1500
1000
500
0
-500
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

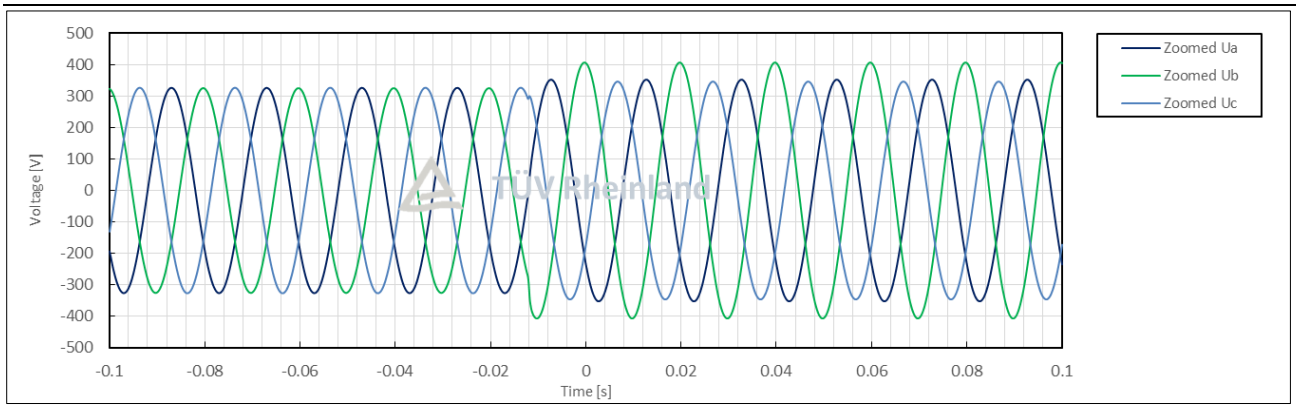

600
500
400
300
200
100
0
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

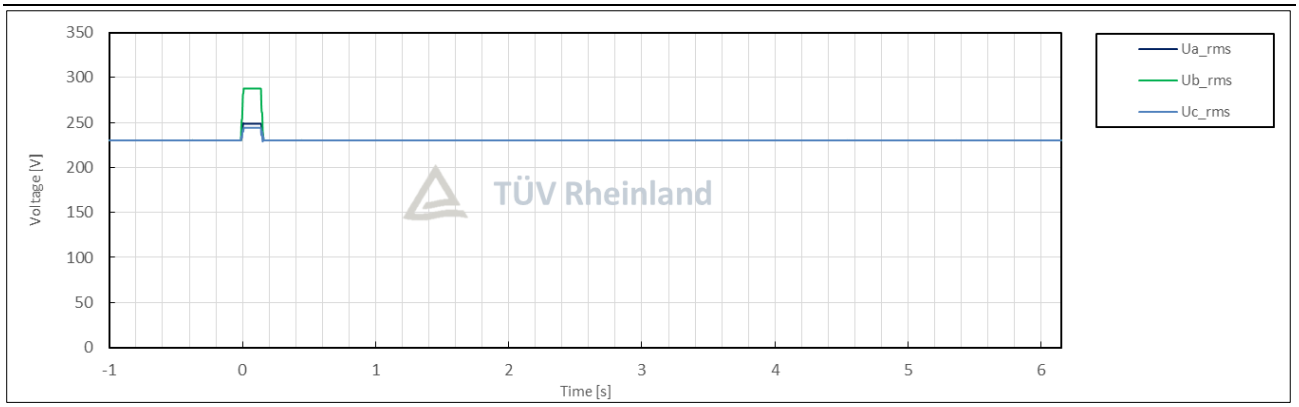

3
3
2
2
1
1
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.3
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:06:41
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.25
	5	Setting dip duration		--		150
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	150
	8	Fault duration in empty load test	Total	--	ms	150
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.25
	10		Pos.		p.u.	1.13
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.99
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.25
	19	Line current	Phase 1	t1+60ms	p.u.	0.00
	20		Phase 2			0.00
	21		Phase 3			0.00
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.00
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.51
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

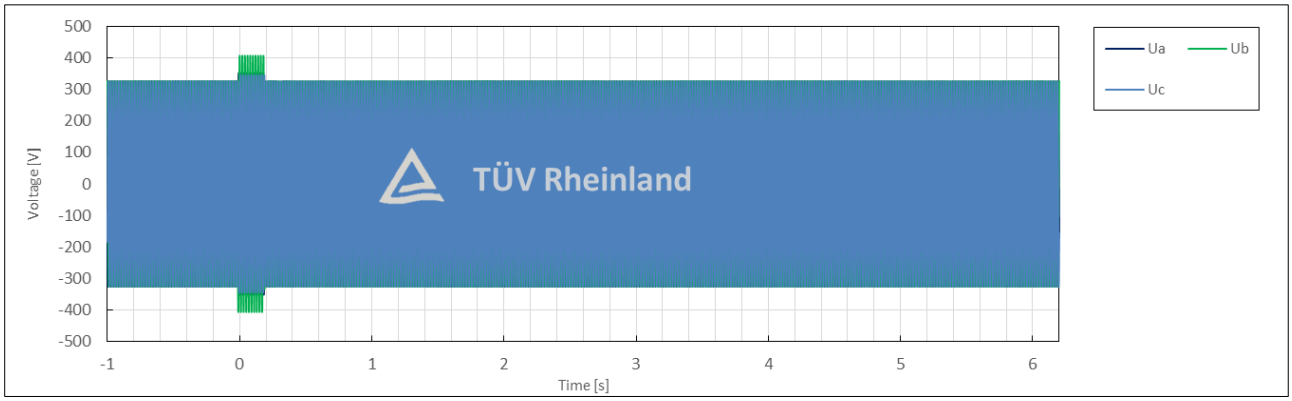
Test No. 5.3 idle test

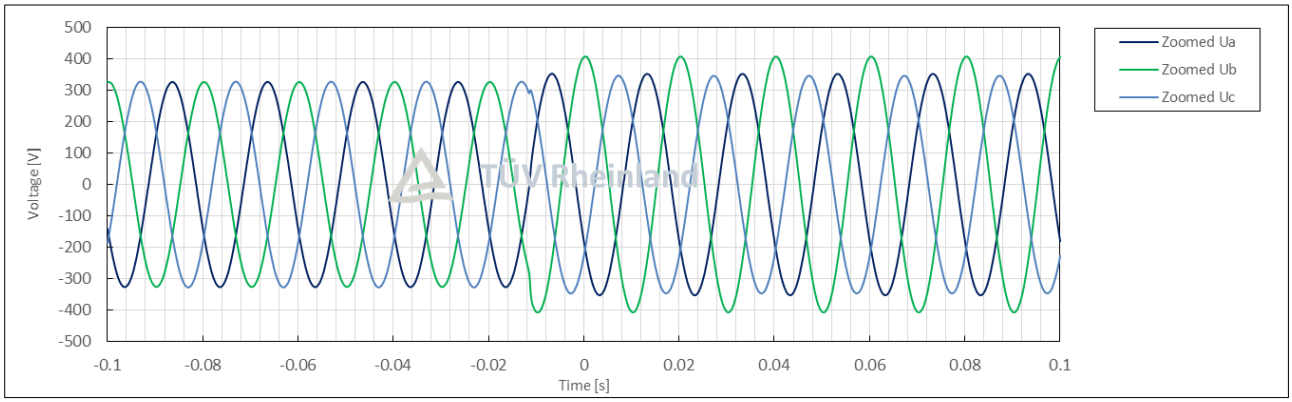


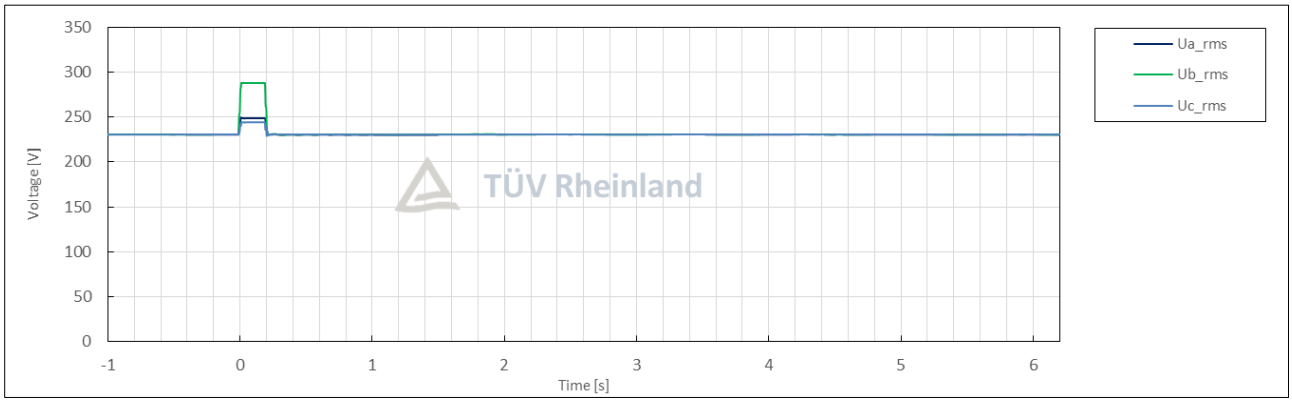


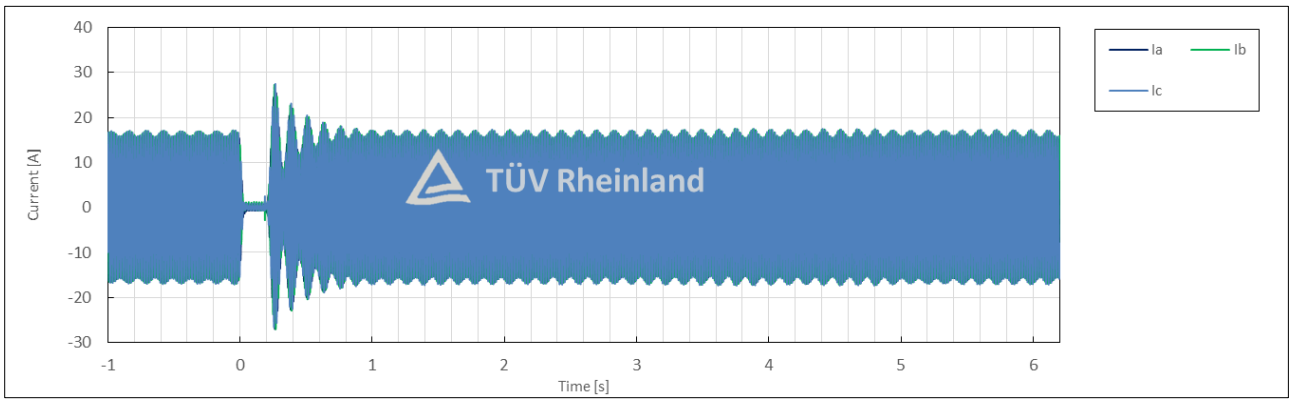


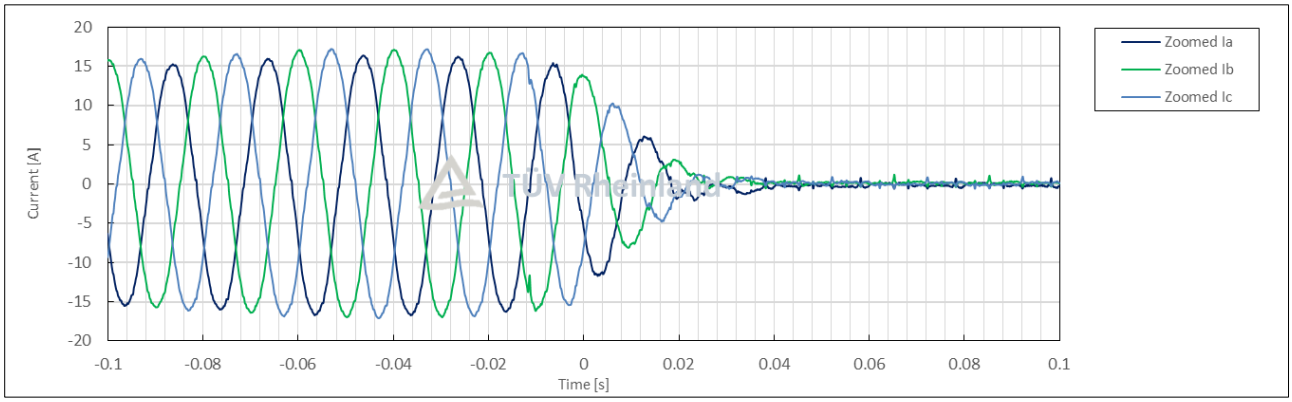
Test No. 5.3 with PGU

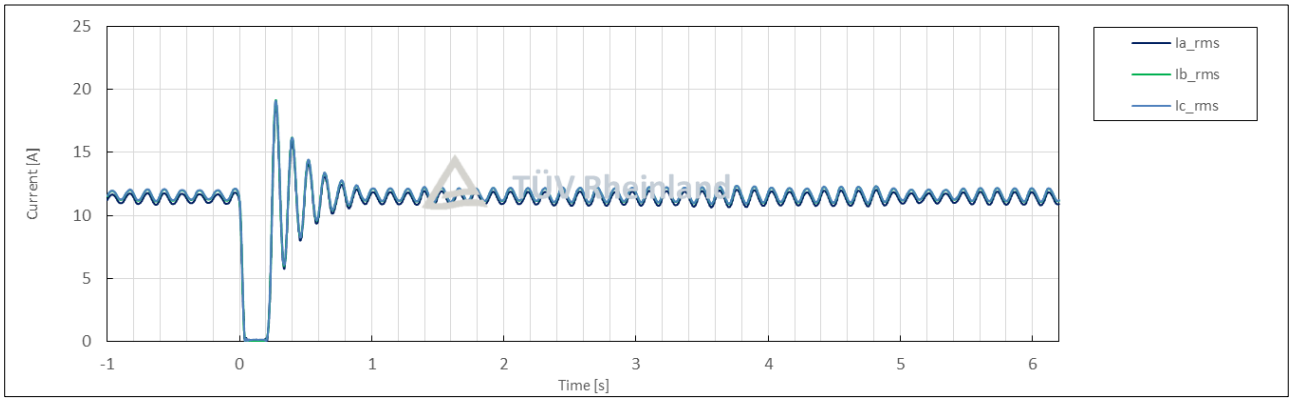


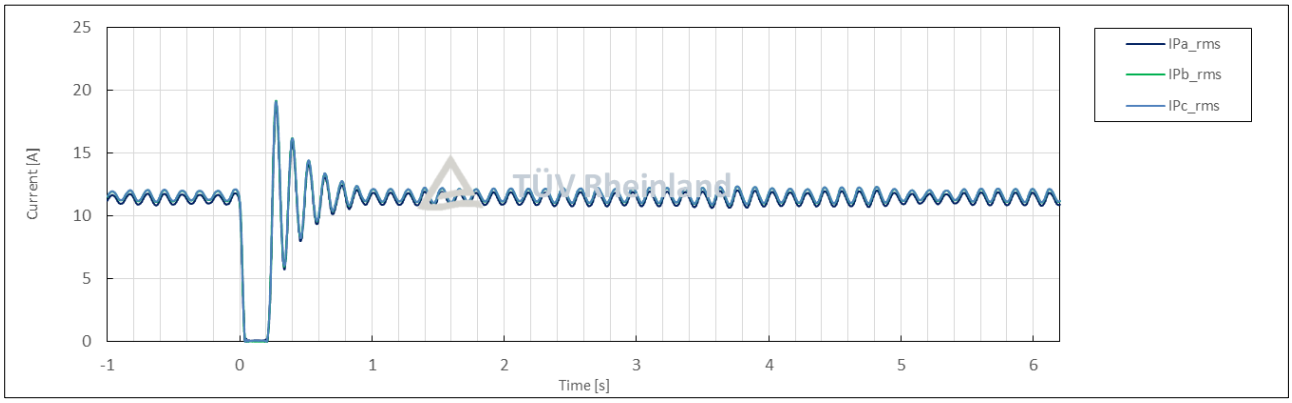


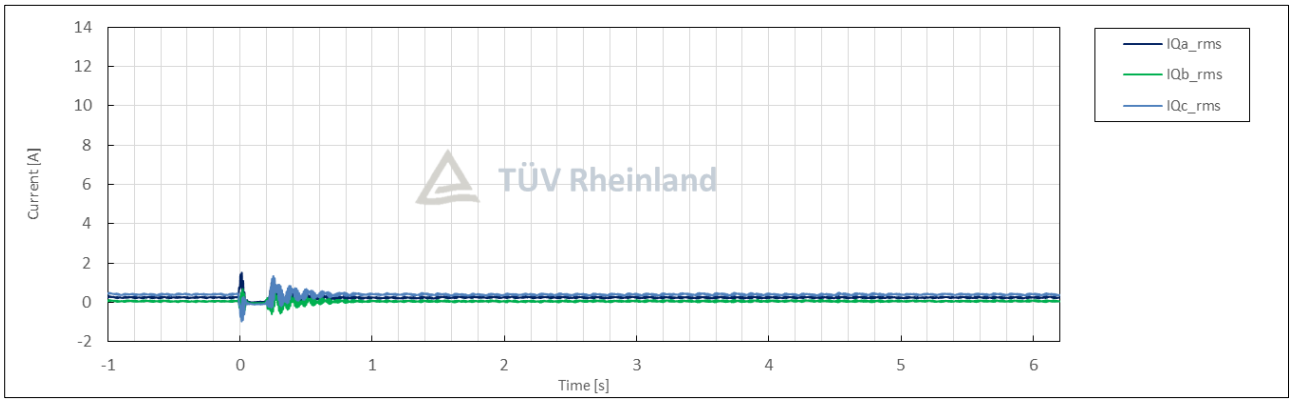


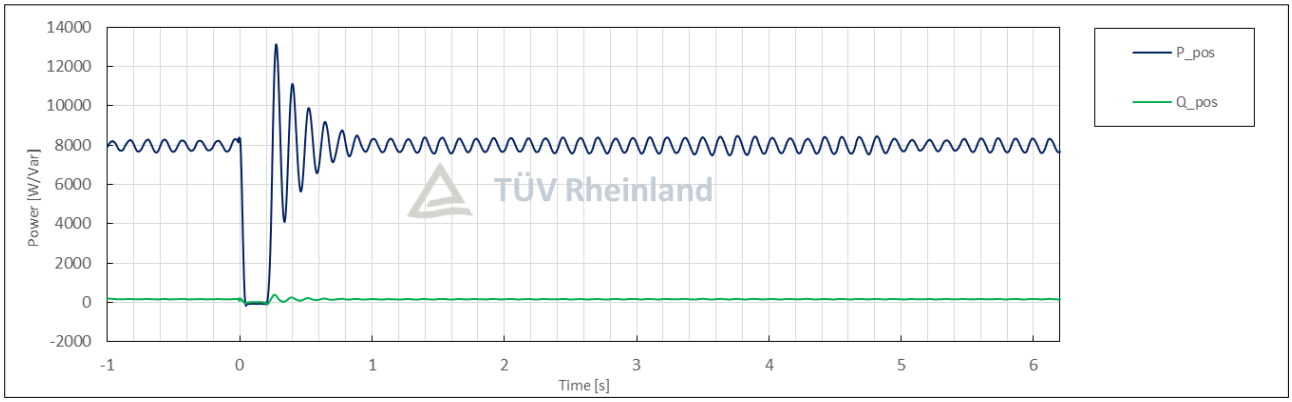


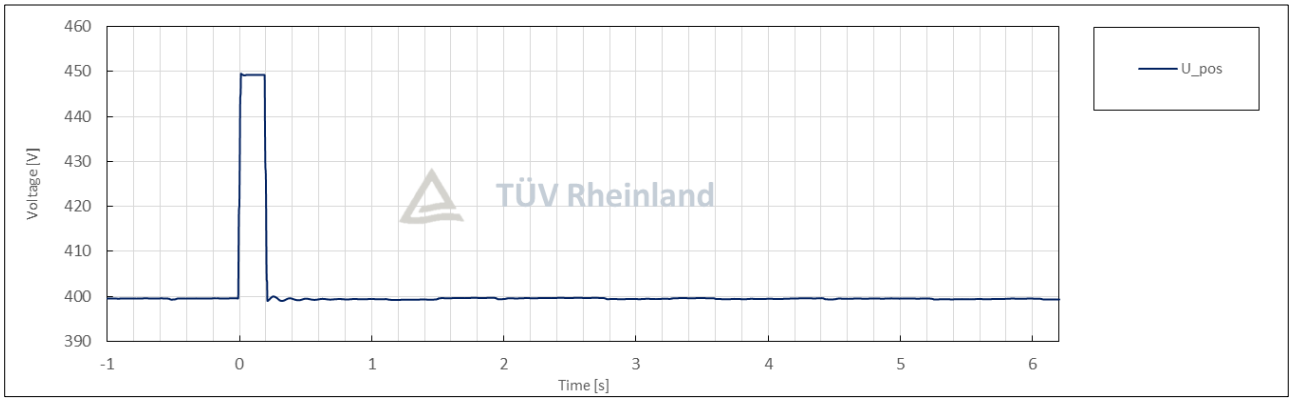

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

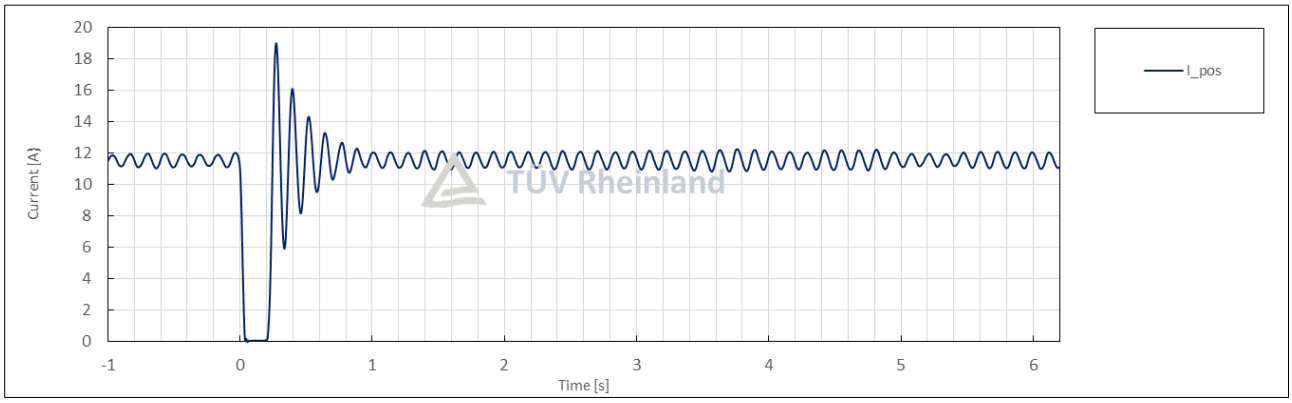

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

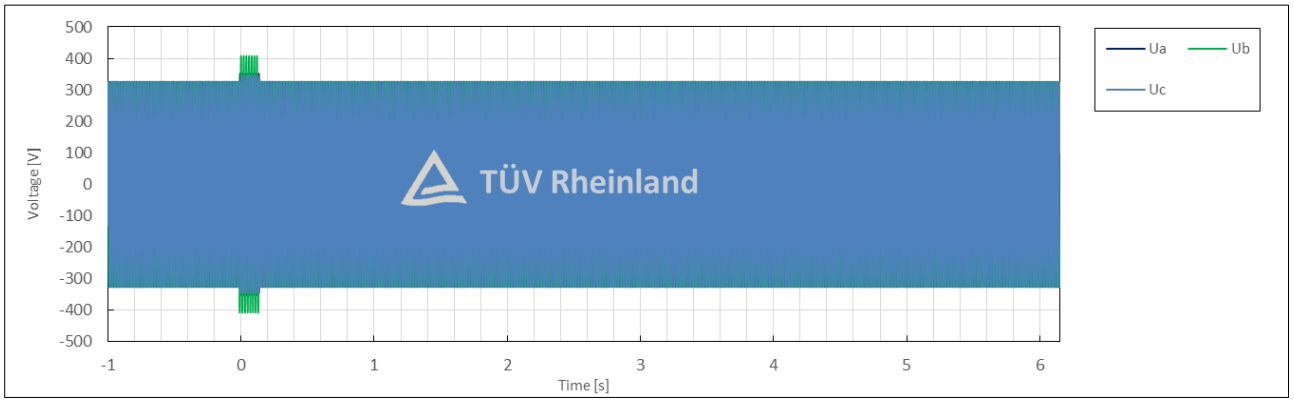

Power [W/Var]
Time [s]
P_pos
Q_pos
TÜV Rheinland

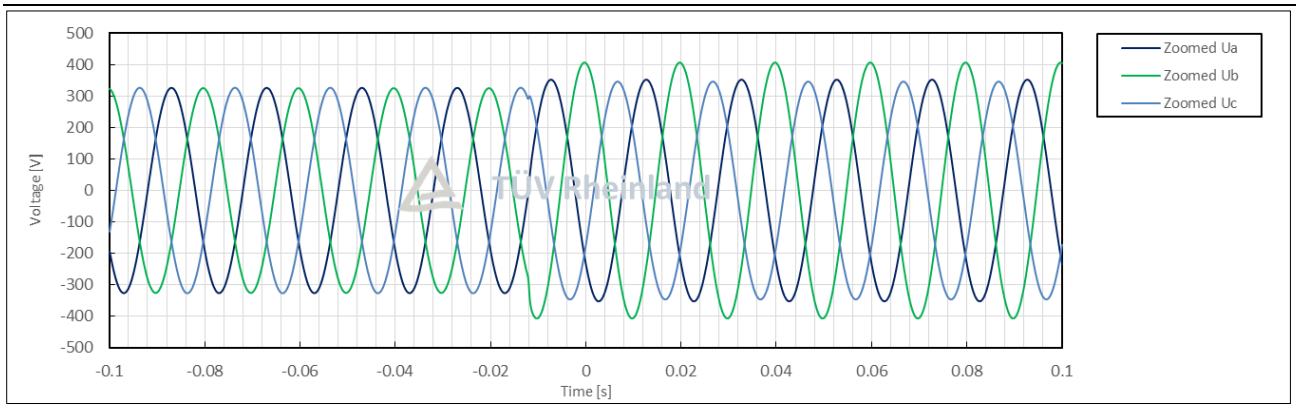

Voltage [V]
Time [s]
U_pos
TÜV Rheinland

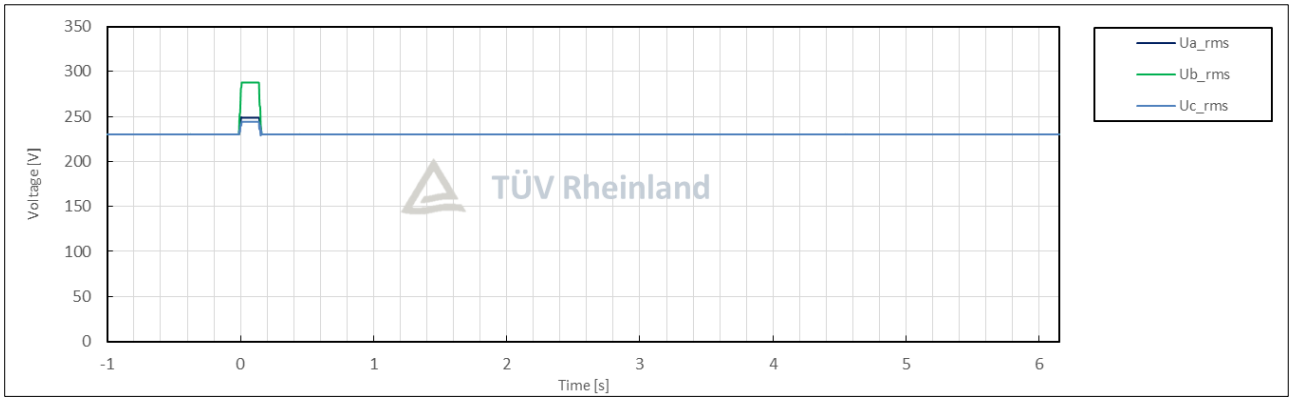

Current [A]
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.3(D2)
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	22:57:30
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.25
	5	Setting dip duration		--		150
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	150
	8	Fault duration in empty load test	Total	--	ms	150
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.25
	10		Pos.		p.u.	1.13
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.01
	16		Pos.			0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.25
	19	Line current	Phase 1	t1+60ms	p.u.	0.06
	20		Phase 2			0.06
	21		Phase 3			0.07
	22	Line current	Phase 1	t1+100ms	p.u.	0.06
	23		Phase 2			0.06
	24		Phase 3			0.07
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.03
	26		Pos.			0.03
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.01
	29		Pos.			1.01
	39	Active power rising time	Pos.	--	s	0.162
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.01
	32		Pos.			0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

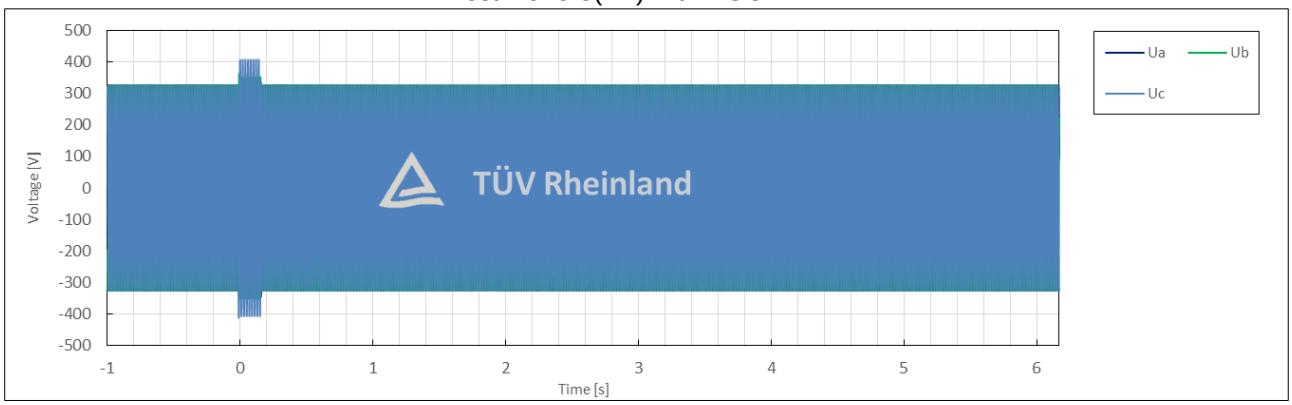
Test No. 5.3(D2) idle test

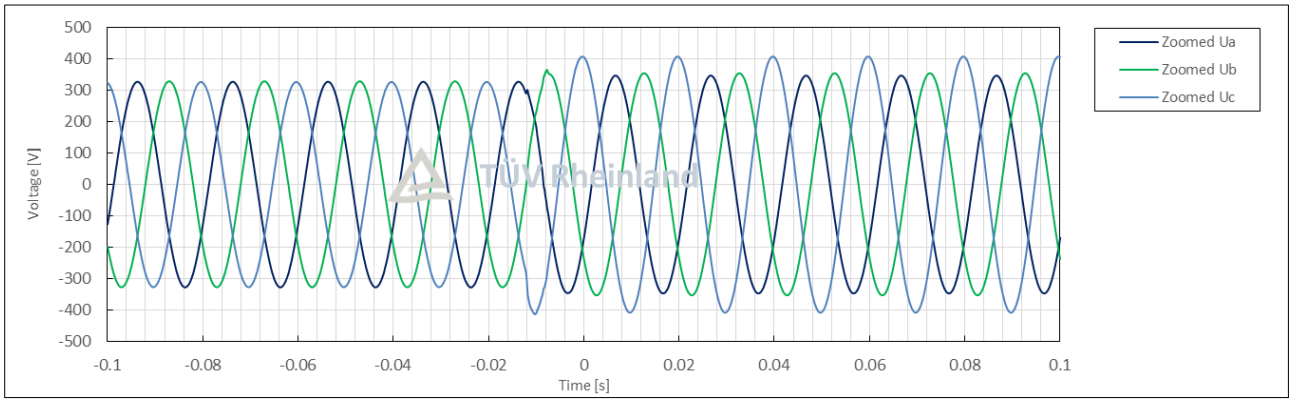


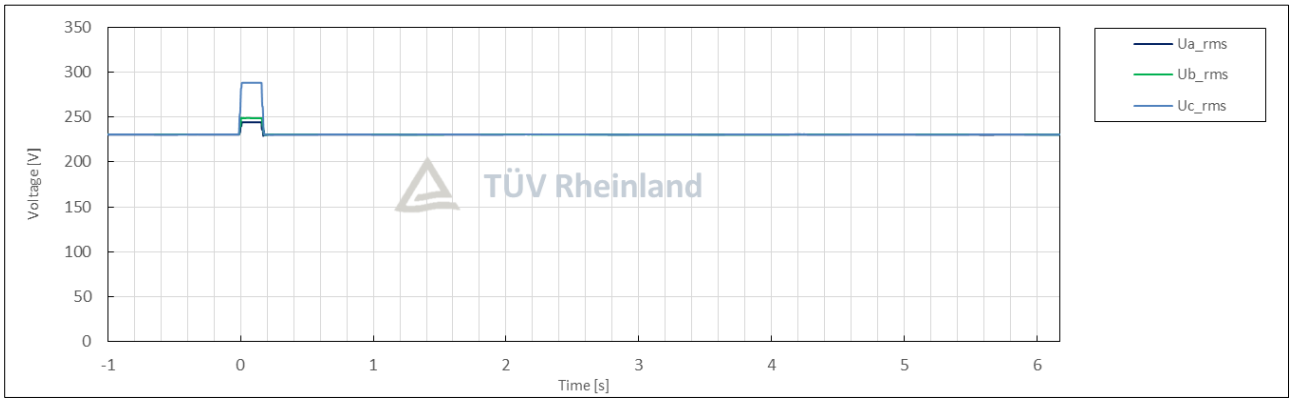


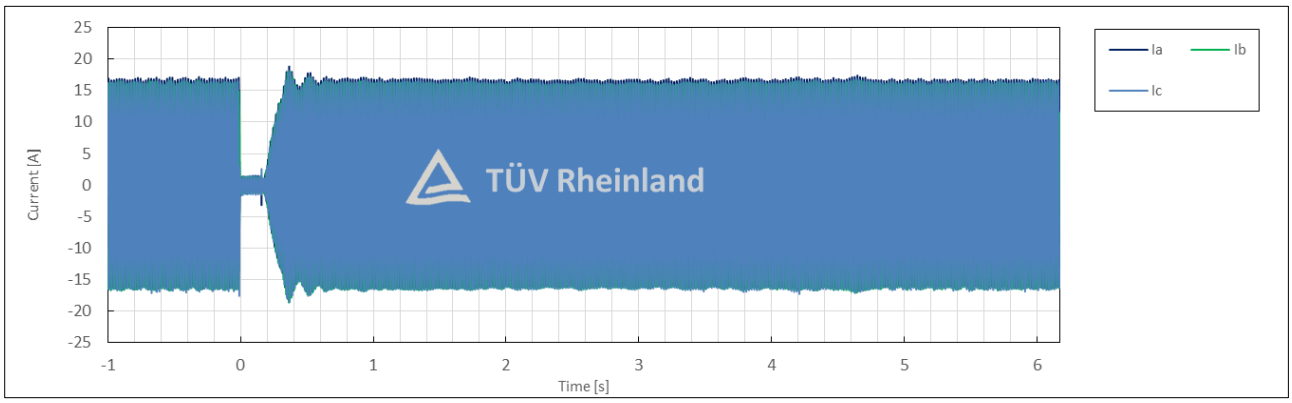


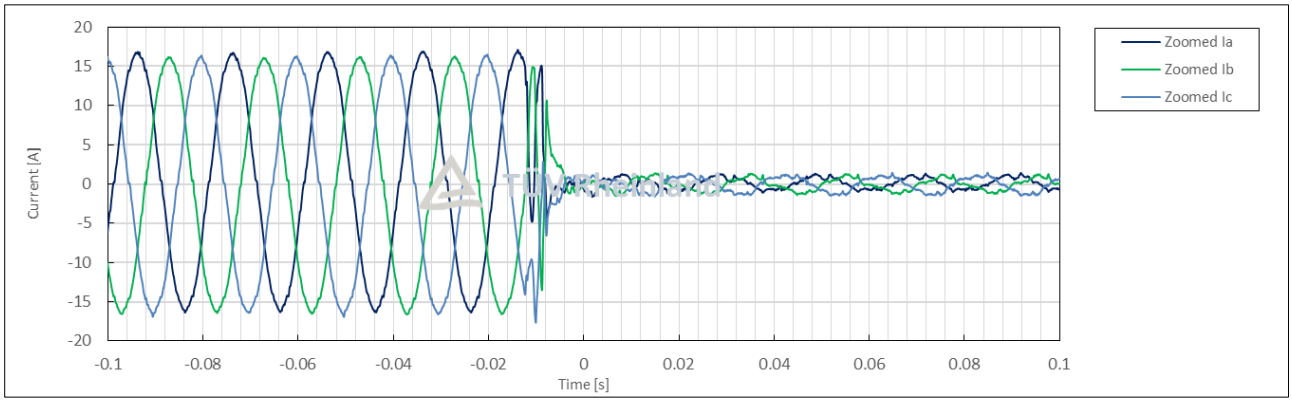
Test No. 5.3(D2) with PGU

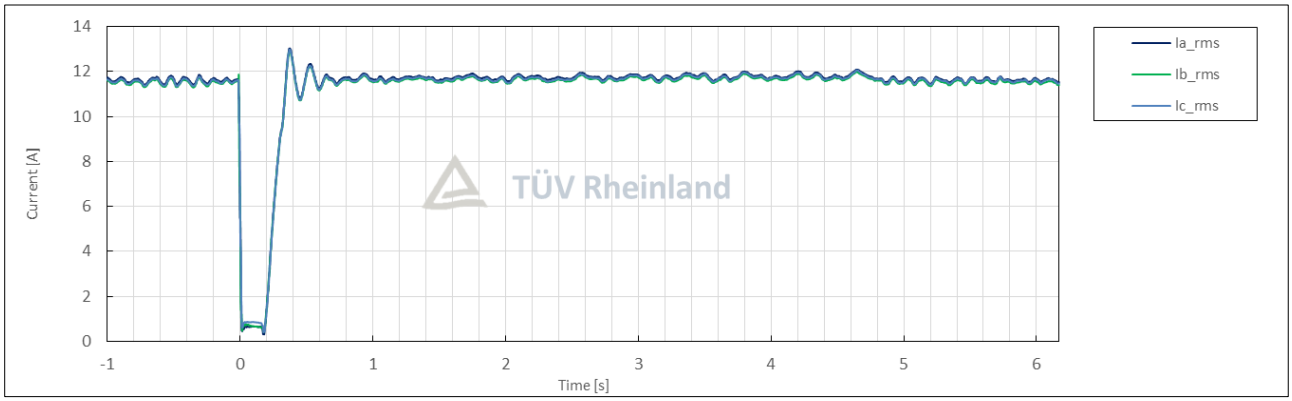


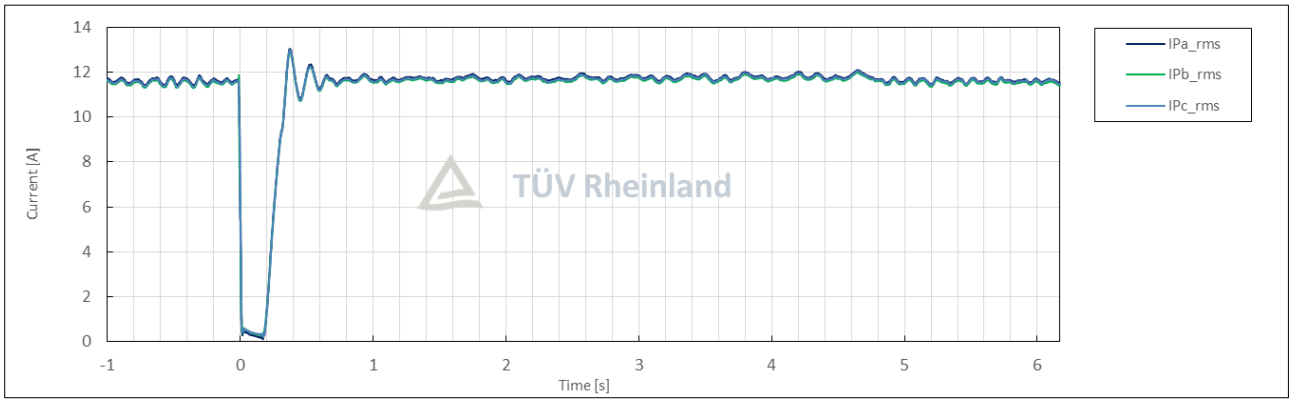


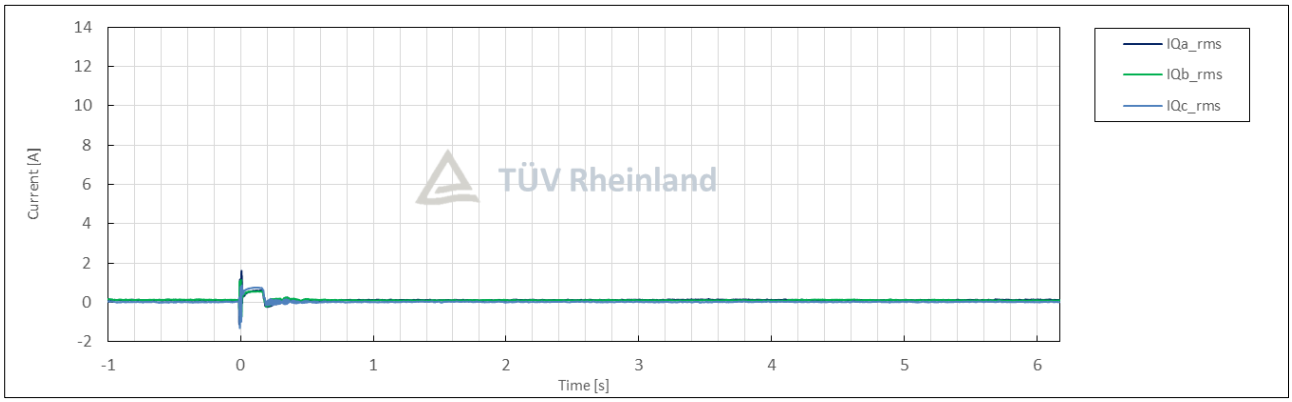


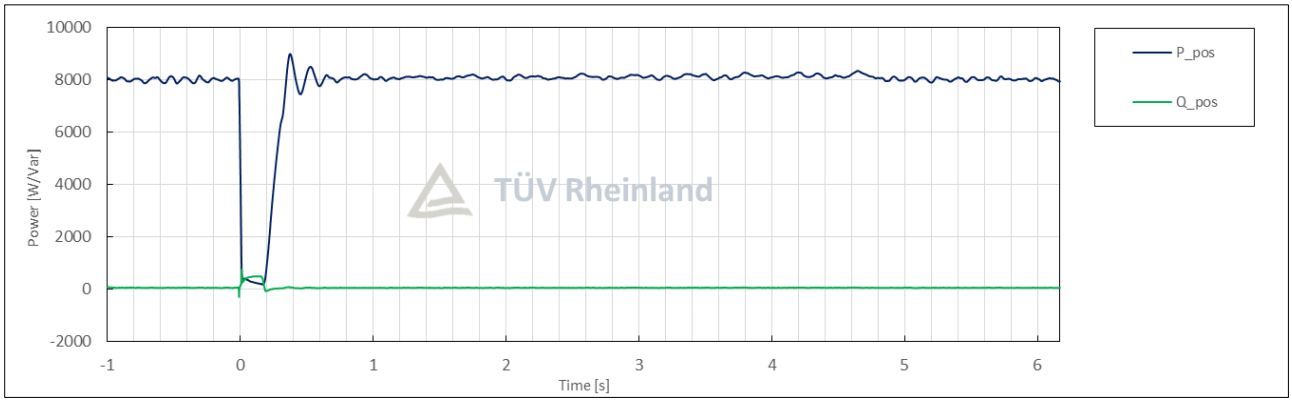


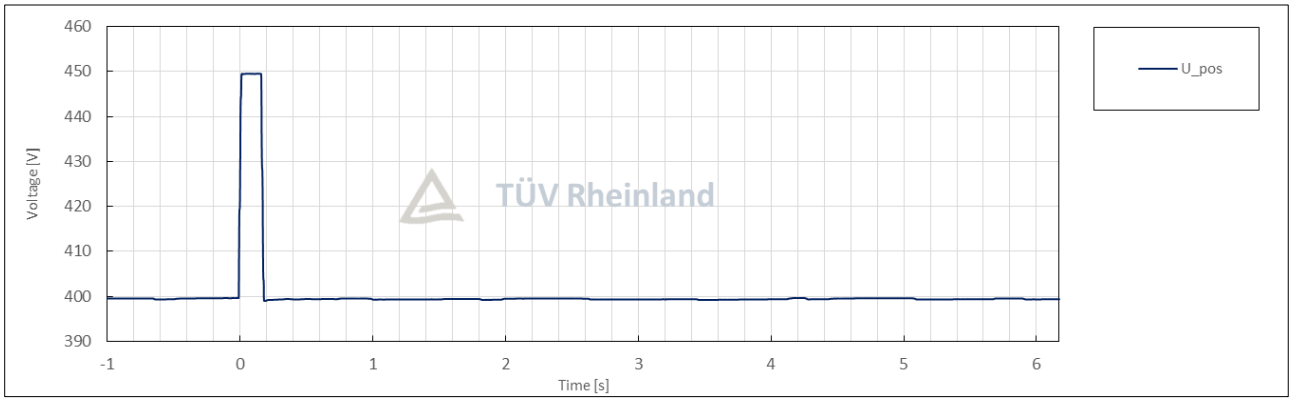

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

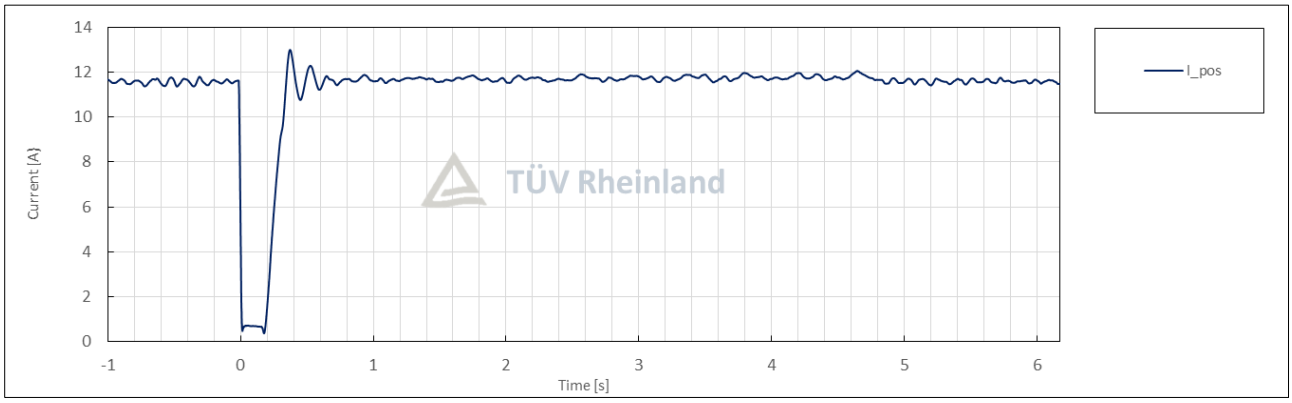

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

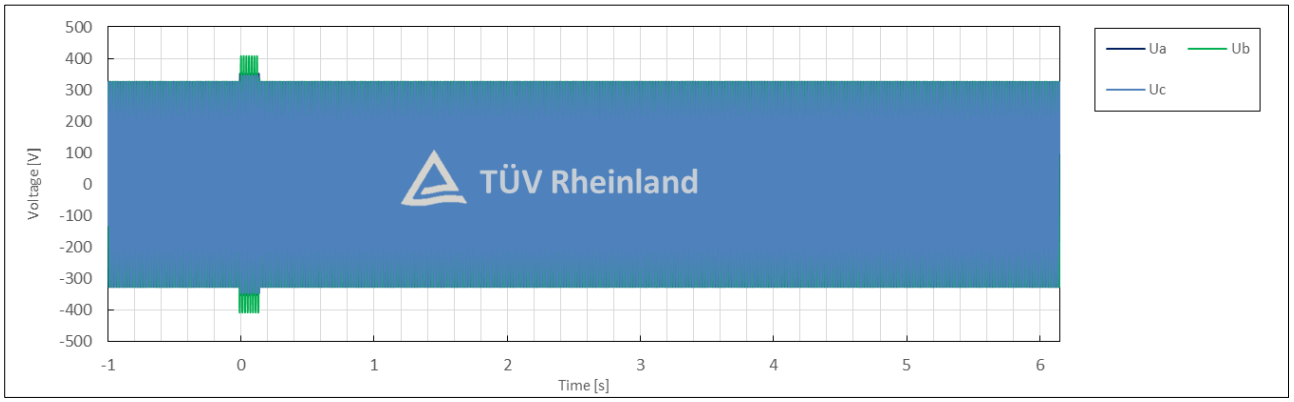

10000
8000
6000
4000
2000
0
-2000
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

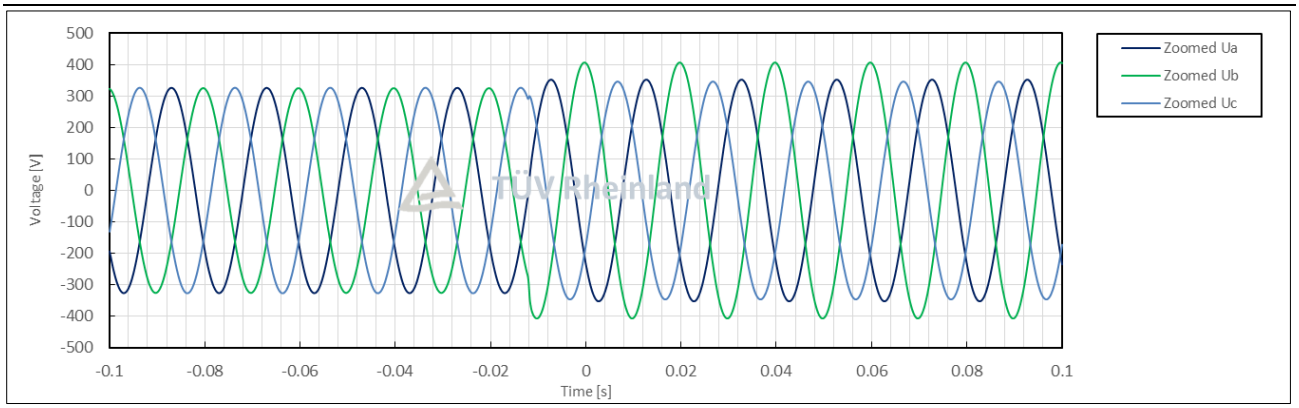

460
450
440
430
420
410
400
390
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

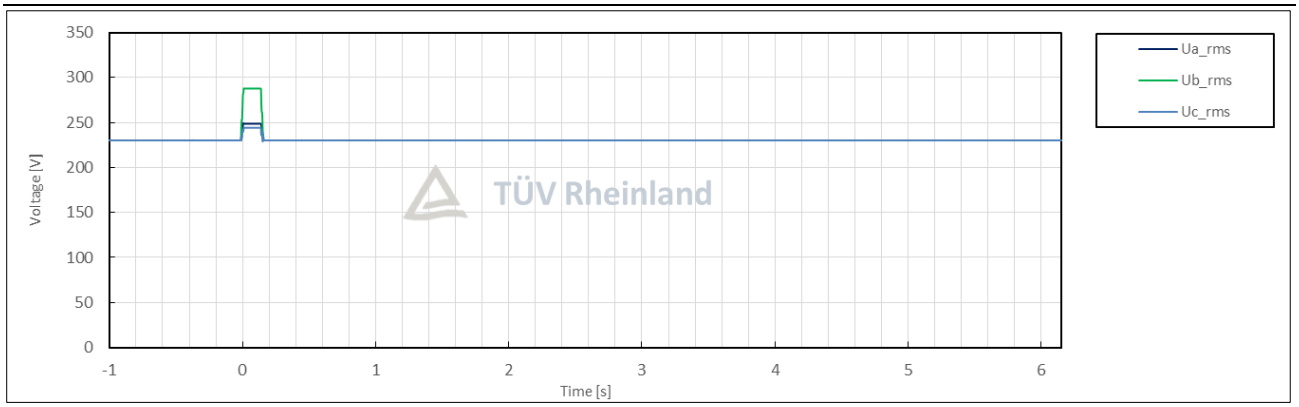

14
12
10
8
6
4
2
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.4
	1	Date	--	--	dd.mm.yyyy	06.16.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	23:01:41
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.25
	5	Setting dip duration		--		150
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	150
	8	Fault duration in empty load test	Total	--	ms	150
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.25
	10		Pos.		p.u.	1.13
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	-0.01
	16		Pos.			-0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.24
	19	Line current	Phase 1	t1+60ms	p.u.	0.04
	20		Phase 2			0.03
	21		Phase 3			0.03
	22	Line current	Phase 1	t1+100ms	p.u.	0.03
	23		Phase 2			0.02
	24		Phase 3			0.02
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.02
	26		Pos.			0.02
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.348
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.01
	32		Pos.			-0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

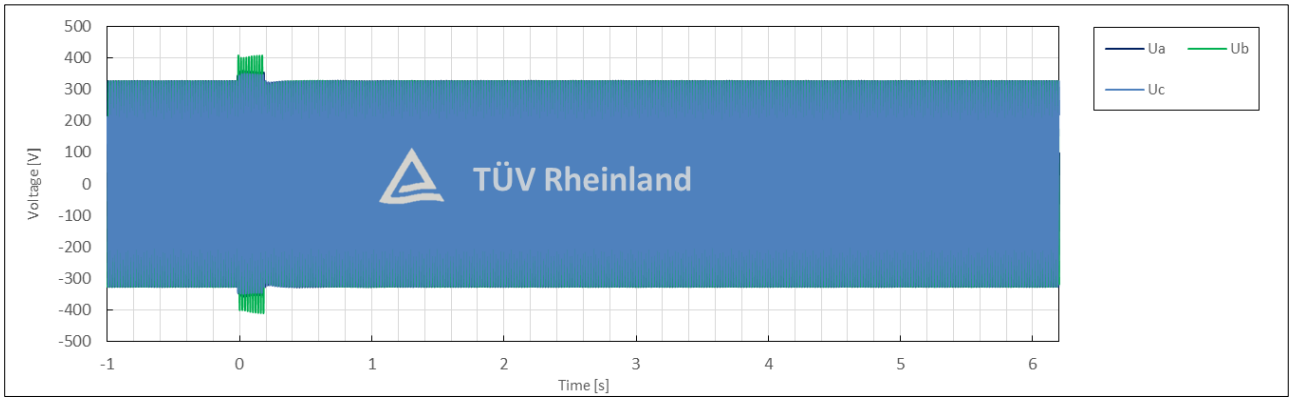
Test No. 5.4 idle test

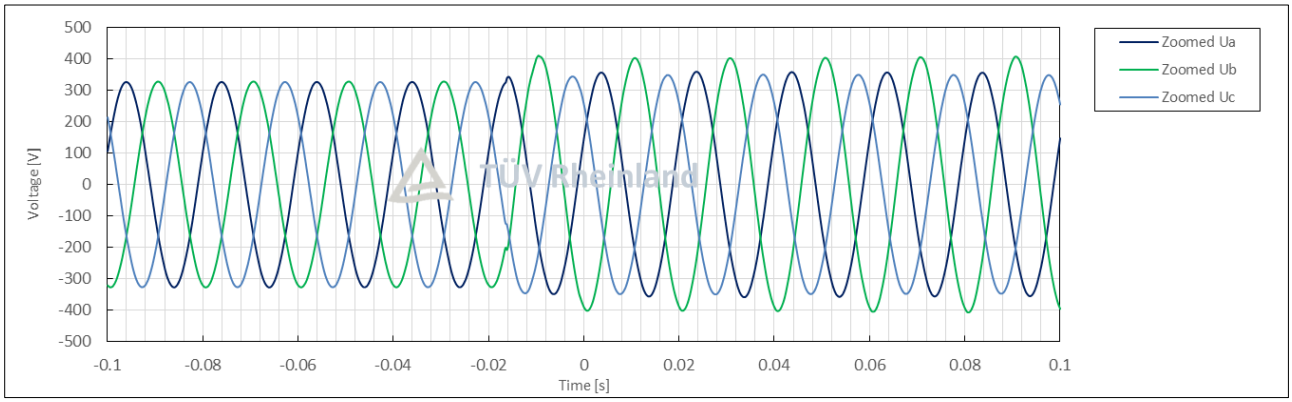


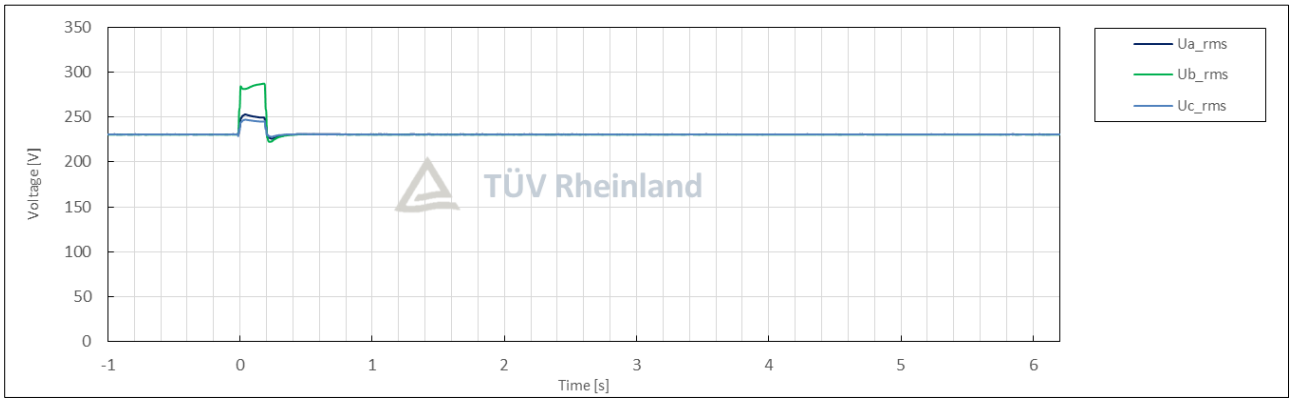


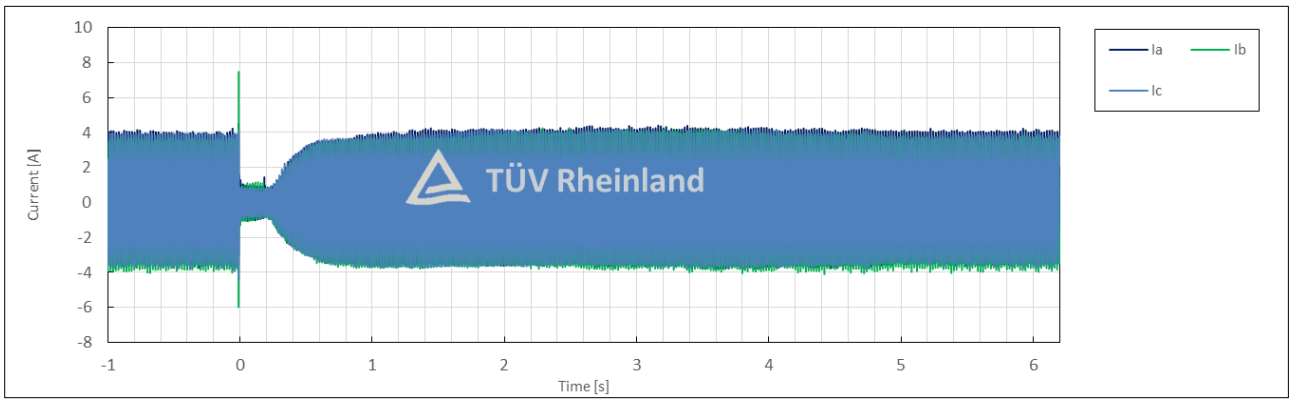


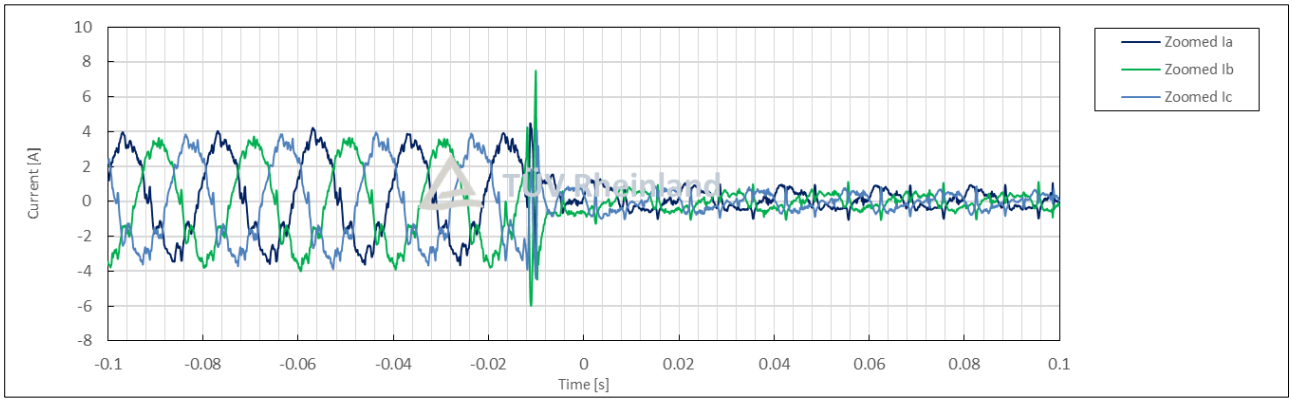
Test No. 5.4 with PGU

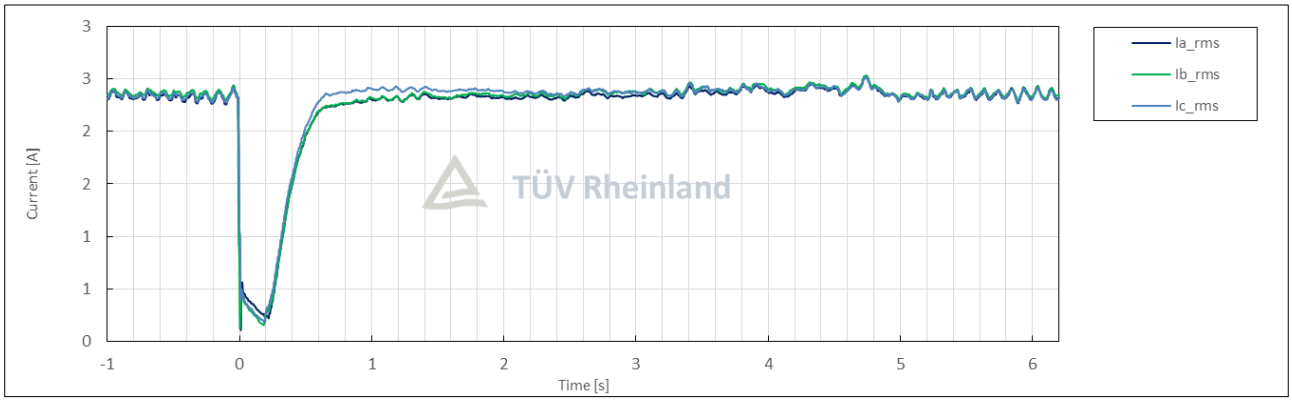


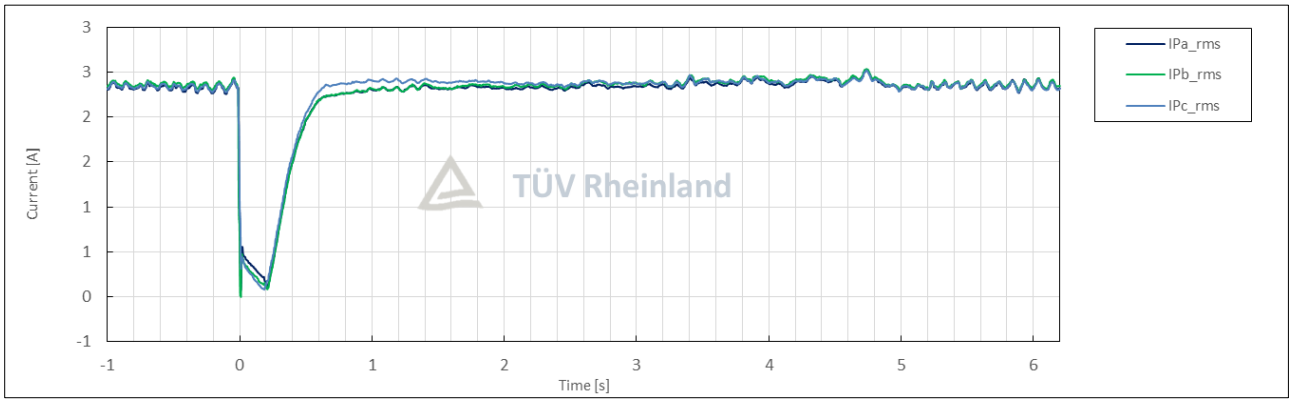


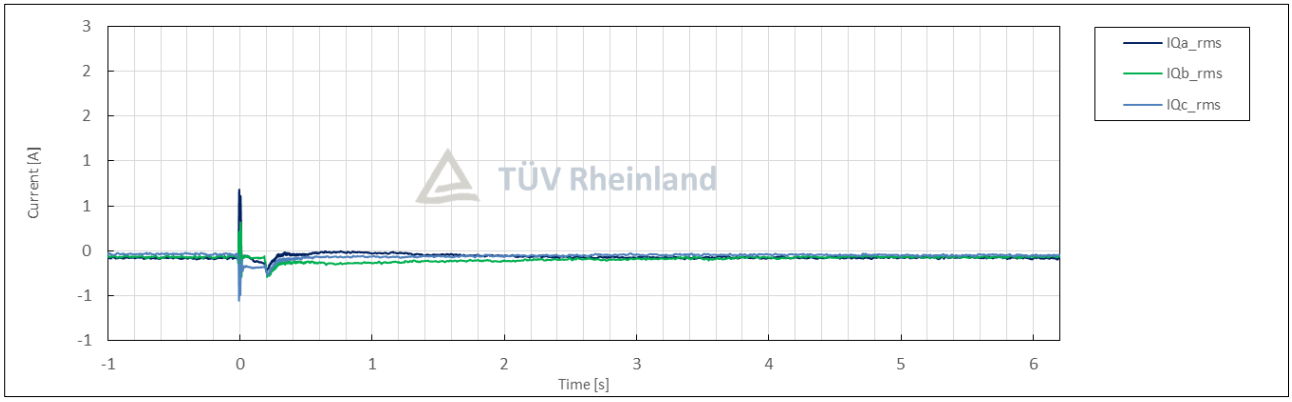


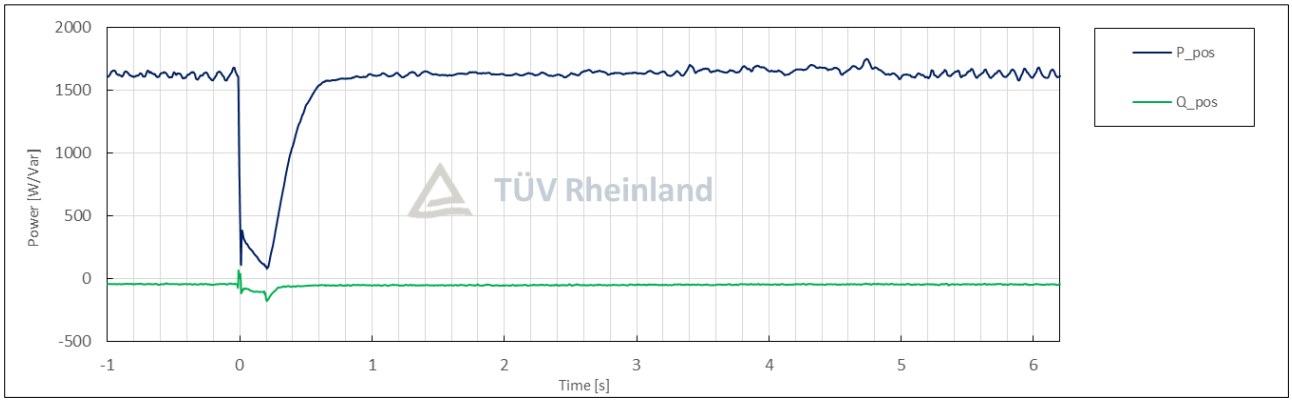


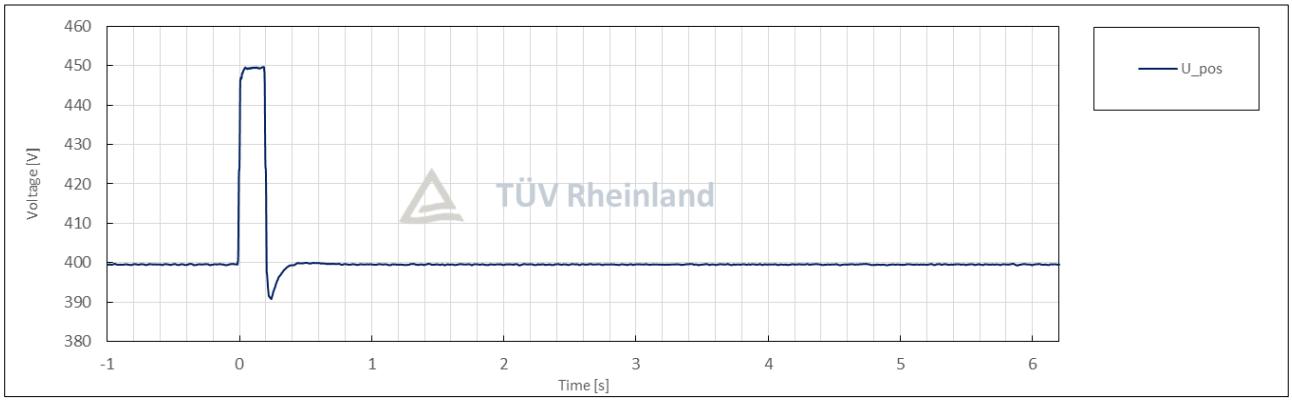

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

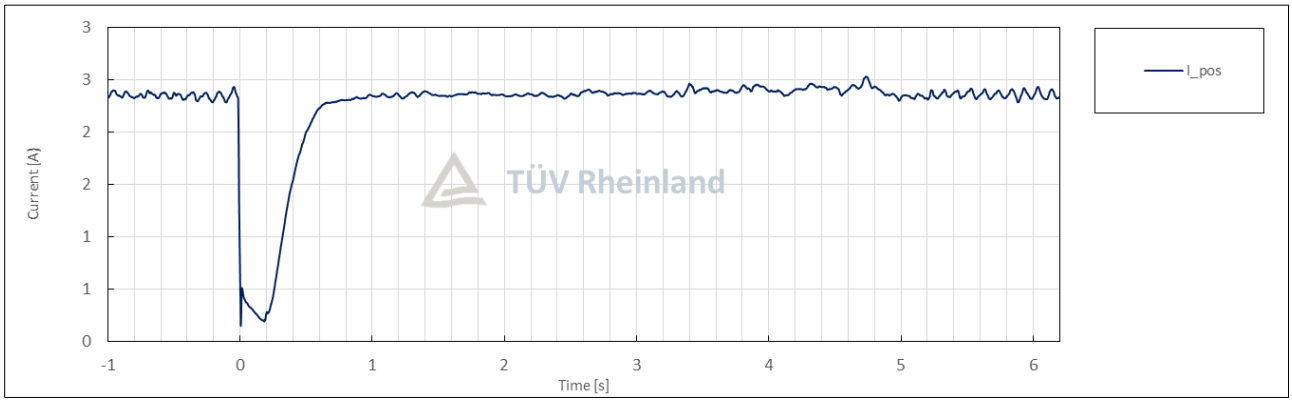

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

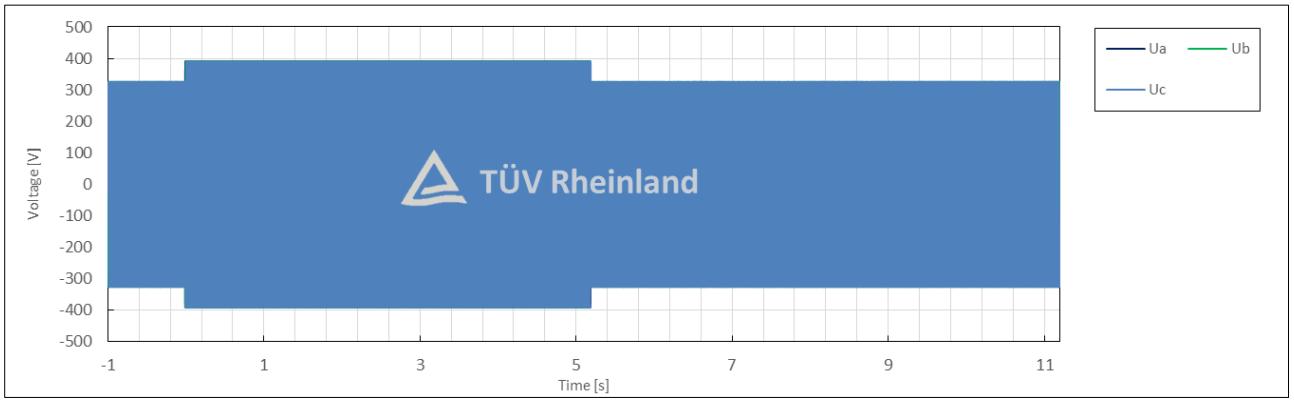

2000
1500
1000
500
0
-500
Power [W/Var]
-1
0
1
2
3
4
5
6
Time [s]
P_pos
Q_pos
TÜV Rheinland

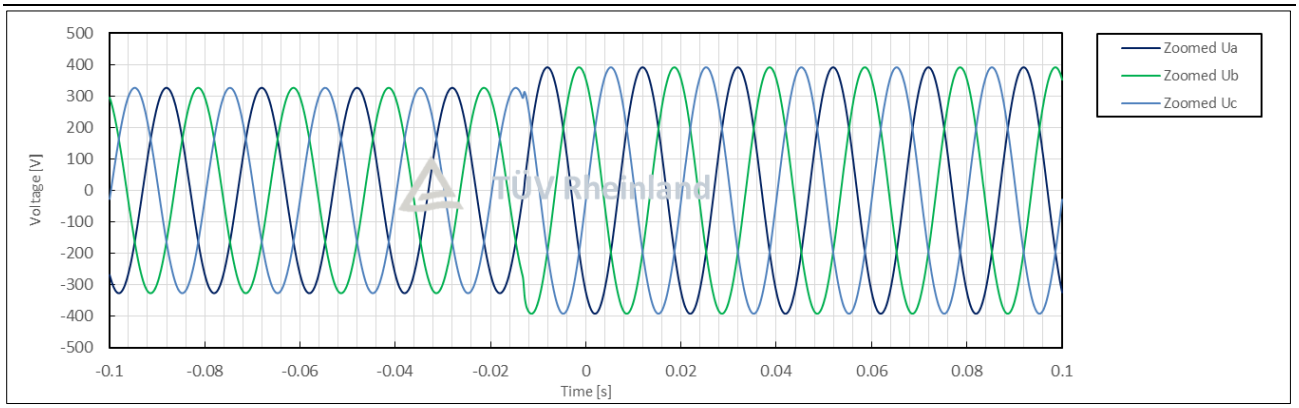

460
450
440
430
420
410
400
390
380
Voltage [V]
-1
0
1
2
3
4
5
6
Time [s]
U_pos
TÜV Rheinland

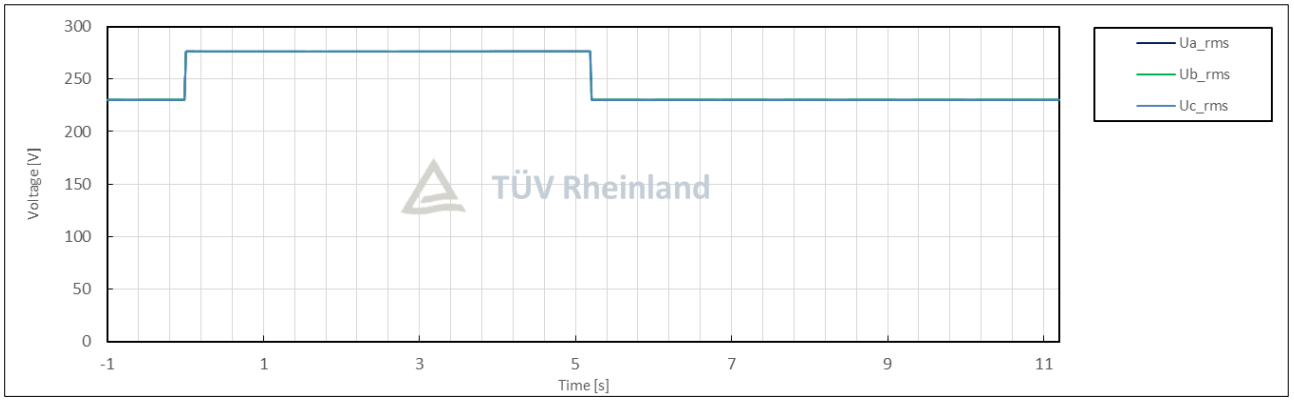

3
3
2
2
1
1
0
Current [A]
-1
0
1
2
3
4
5
6
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.1
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:08:47
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.20
	5	Setting dip duration		--		5199
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	5199
	8	Fault duration in empty load test	Total	--	ms	5199
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.20
	10		Pos.		p.u.	1.20
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.20
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.01
	21		Phase 3			0.02
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.291
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

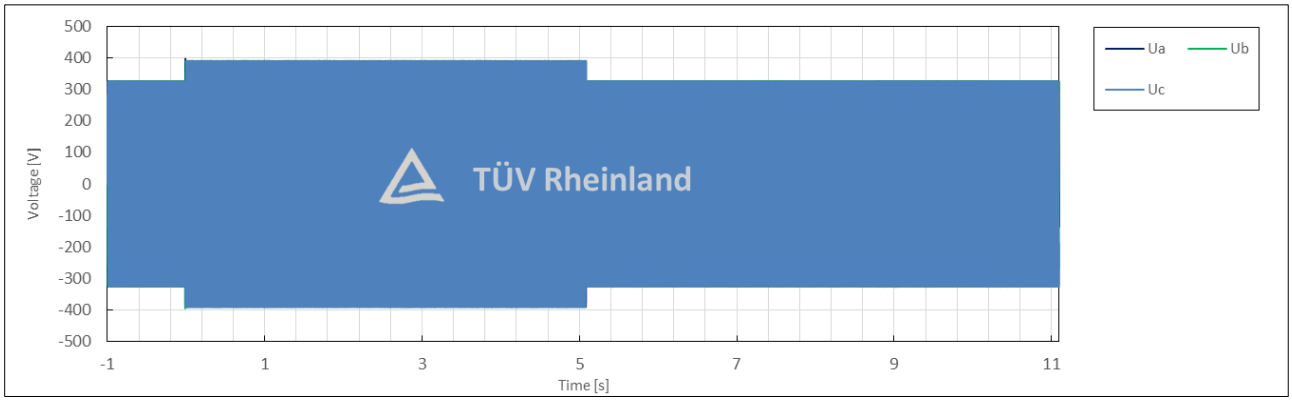
Test No. 6.1 idle test

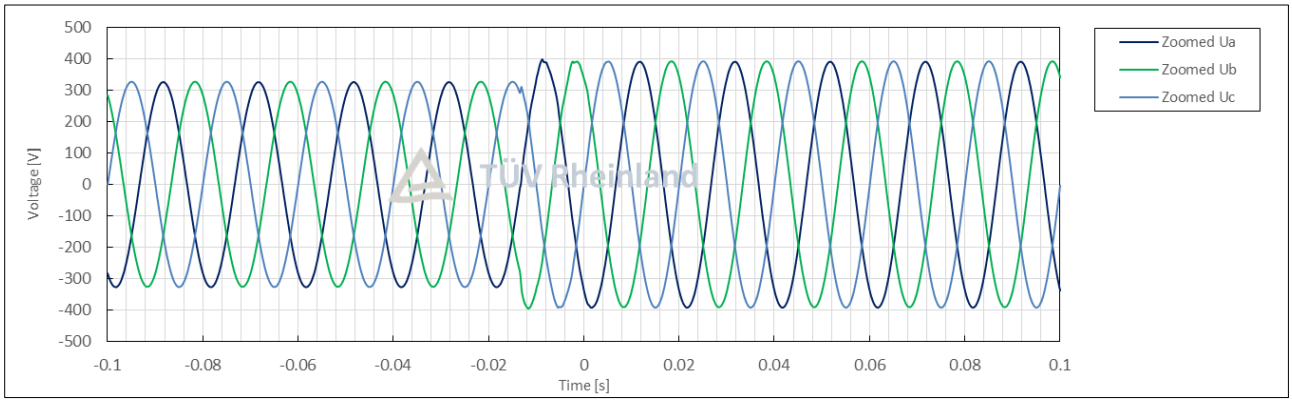


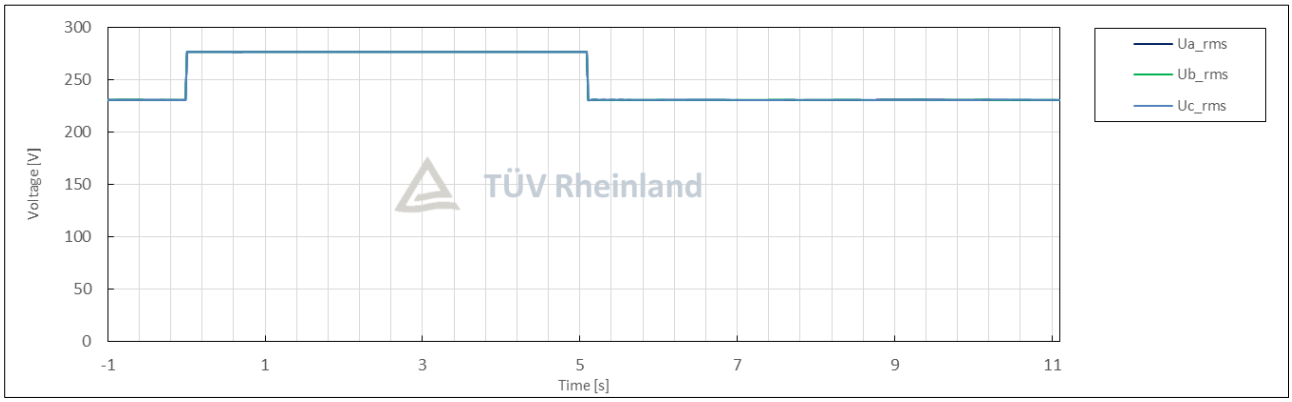


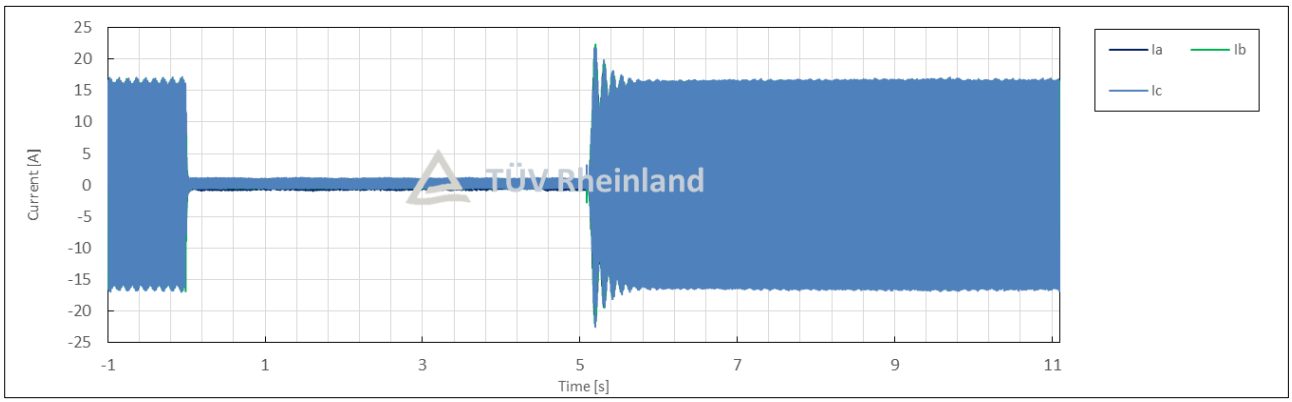


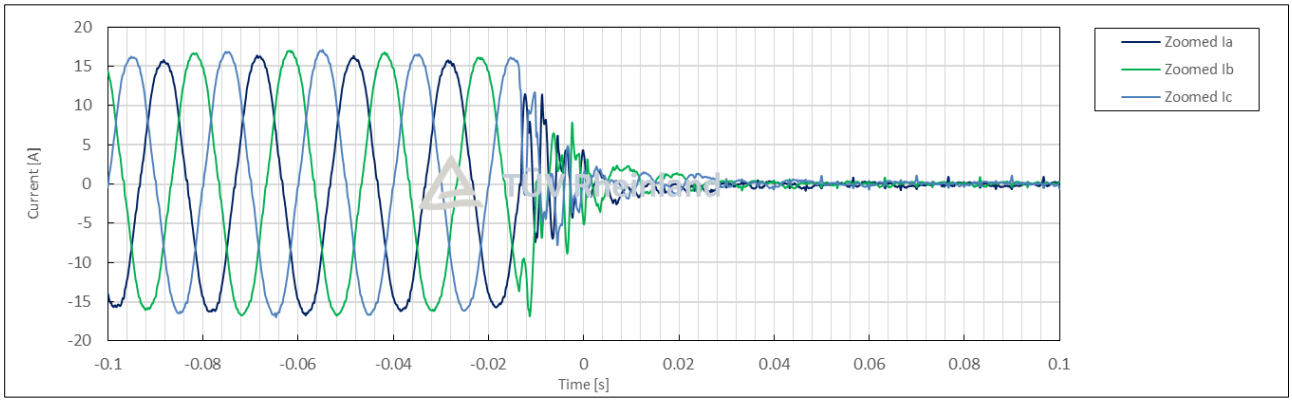
Test No. 6.1 with PGU

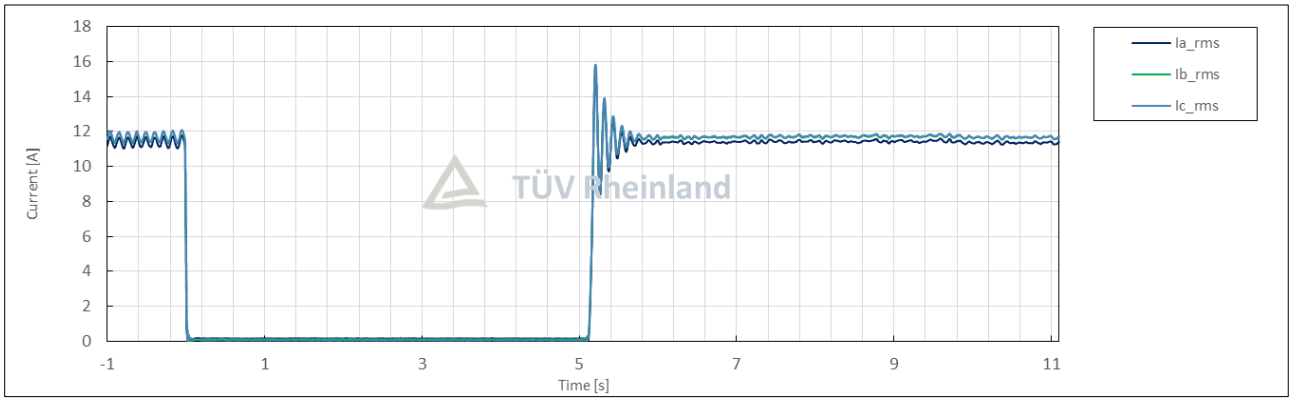


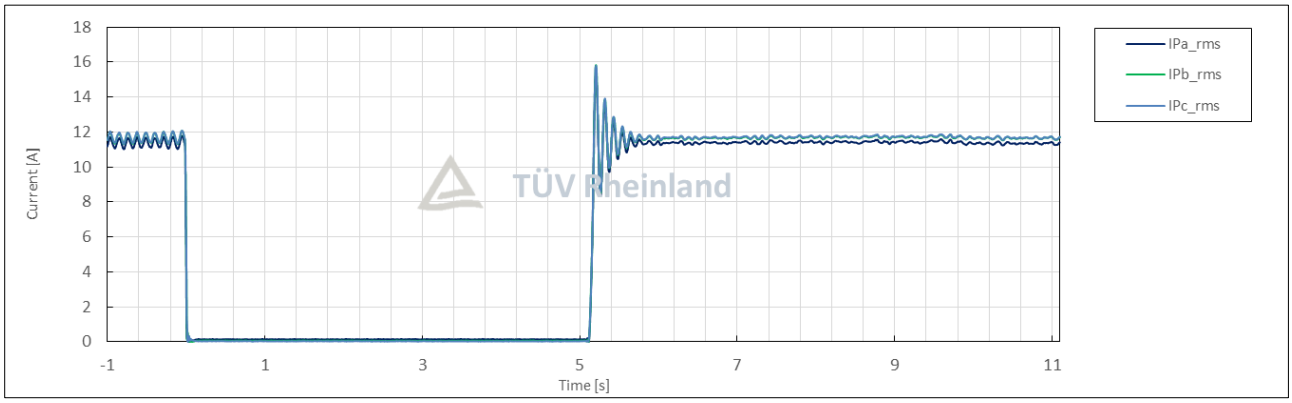


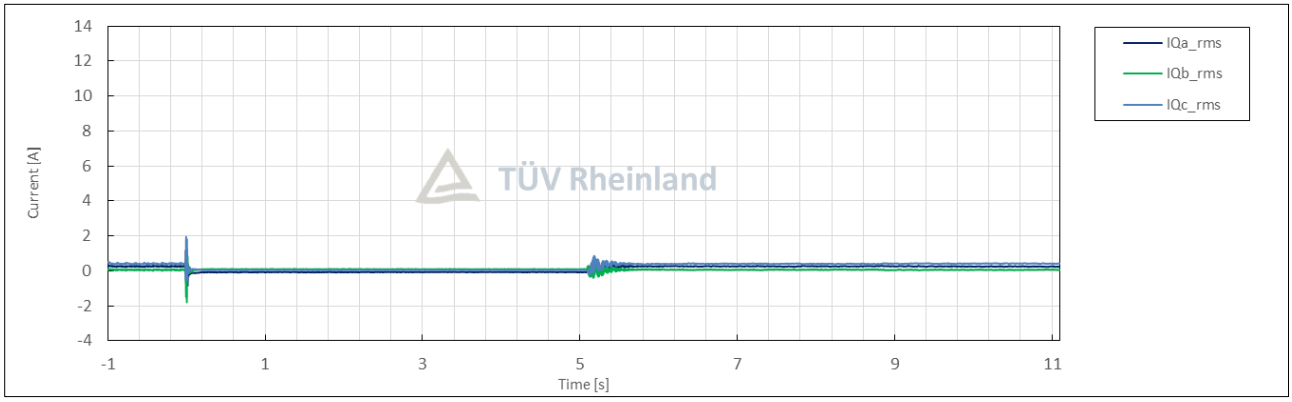


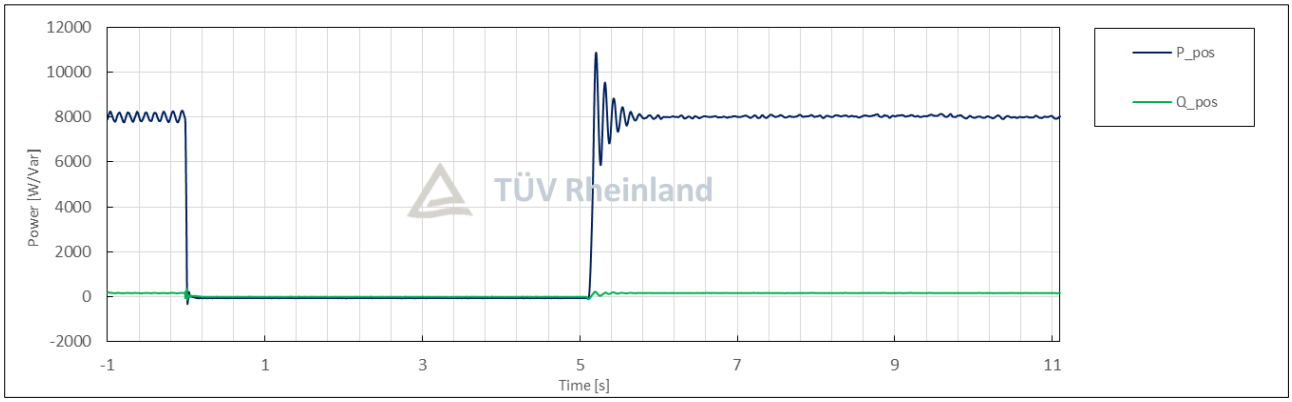


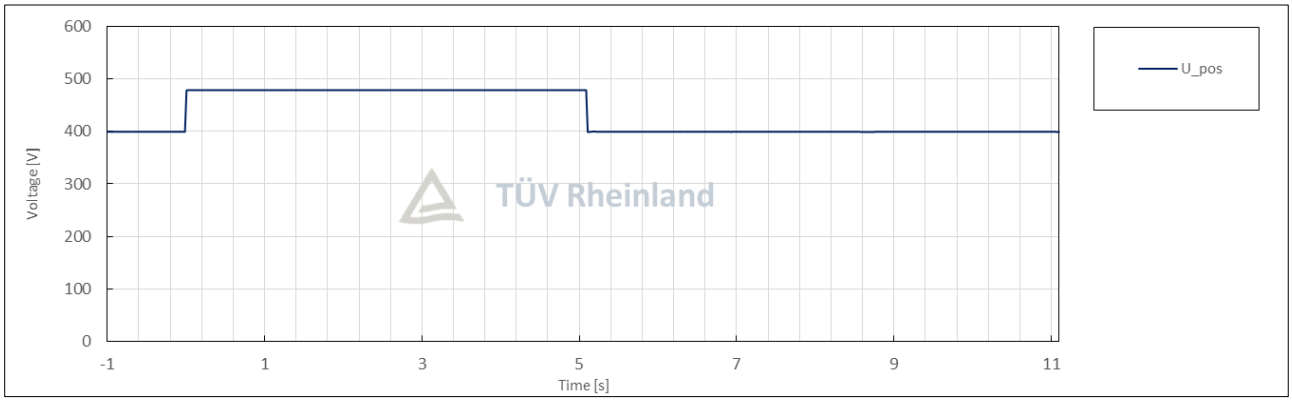

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

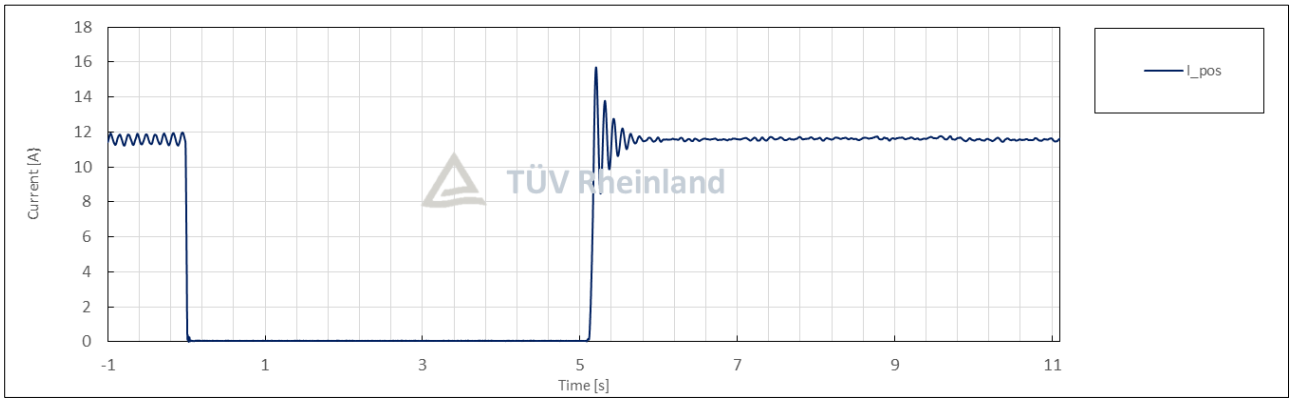

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

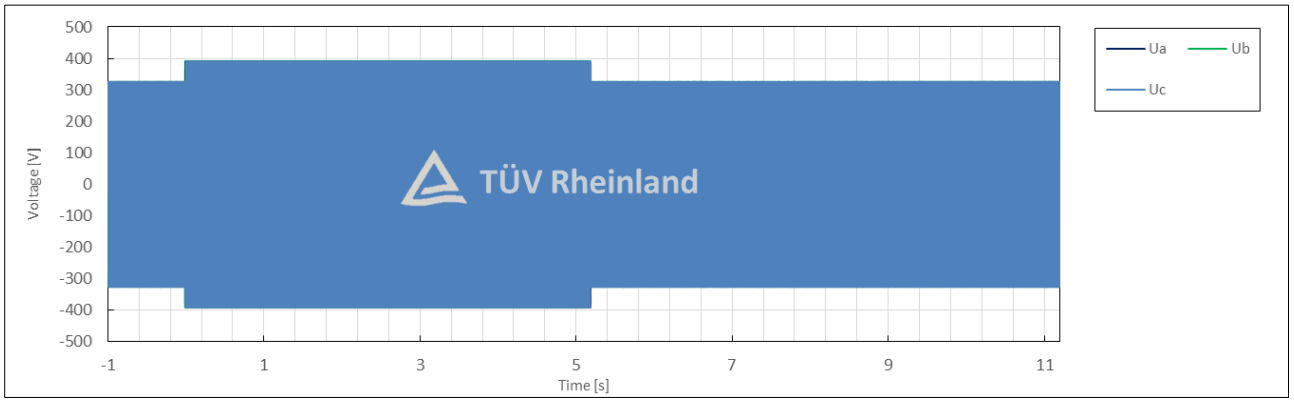

12000
10000
8000
6000
4000
2000
0
-2000
Power [W/Var]
-1
1
3
5
7
9
11
Time [s]
P_pos
Q_pos
TÜV Rheinland

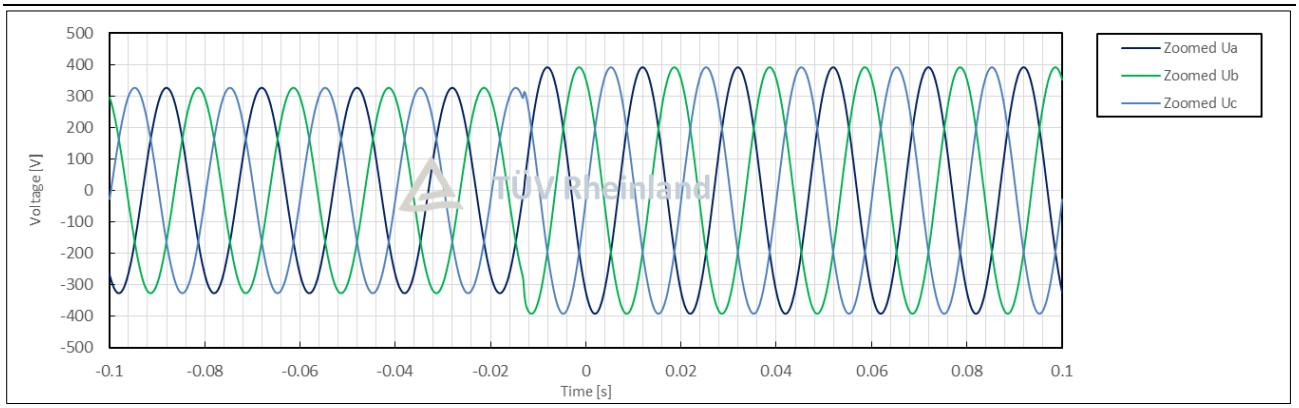

600
500
400
300
200
100
0
Voltage [V]
-1
1
3
5
7
9
11
Time [s]
U_pos
TÜV Rheinland

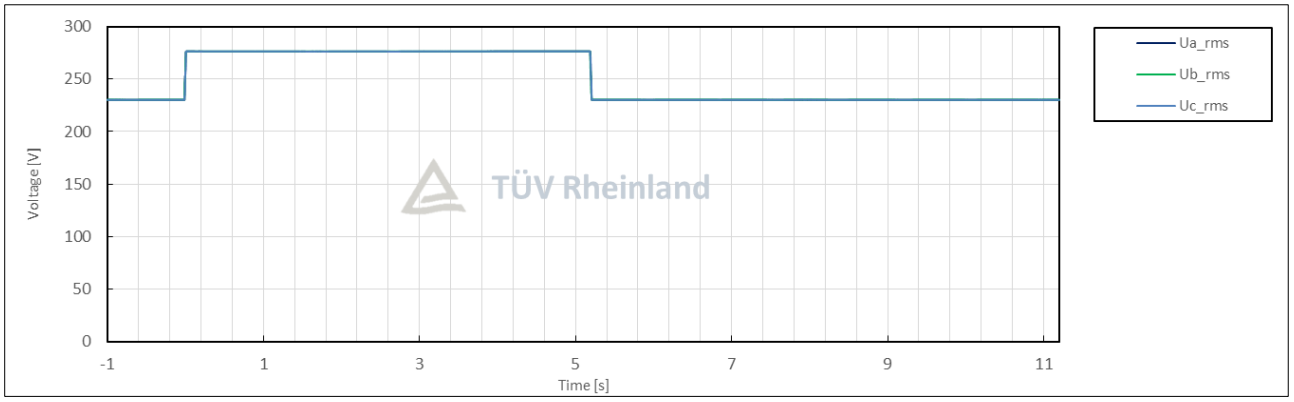

18
16
14
12
10
8
6
4
2
0
Current [A]
-1
1
3
5
7
9
11
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.2
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:09:40
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.20
	5	Setting dip duration		--		5199
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	5199
	8	Fault duration in empty load test	Total	--	ms	5199
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.20
	10		Pos.		p.u.	1.20
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	0.01
	16		Pos.			0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.20
	19	Line current	Phase 1	t1+60ms	p.u.	0.01
	20		Phase 2			0.00
	21		Phase 3			0.02
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.01
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.24
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.01
	32		Pos.			0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

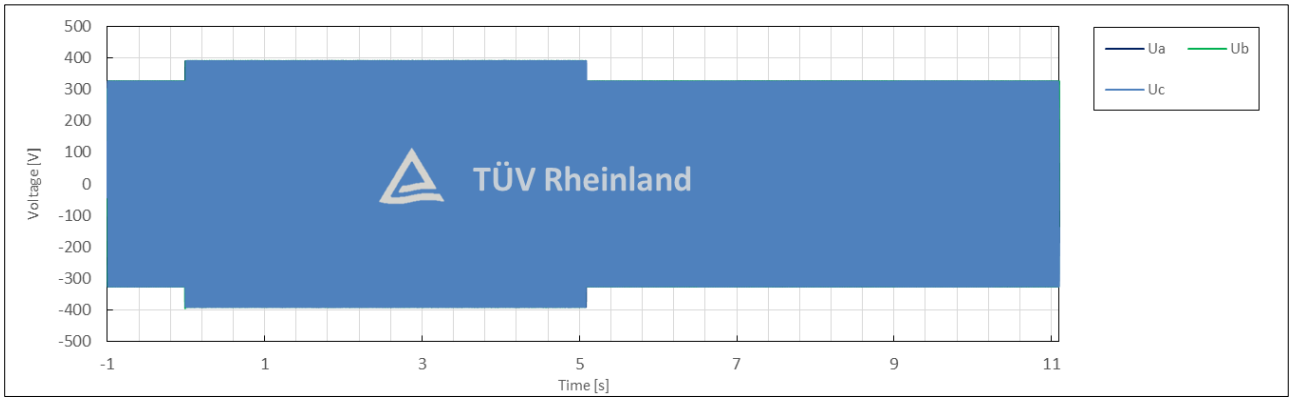
Test No. 6.2 idle test

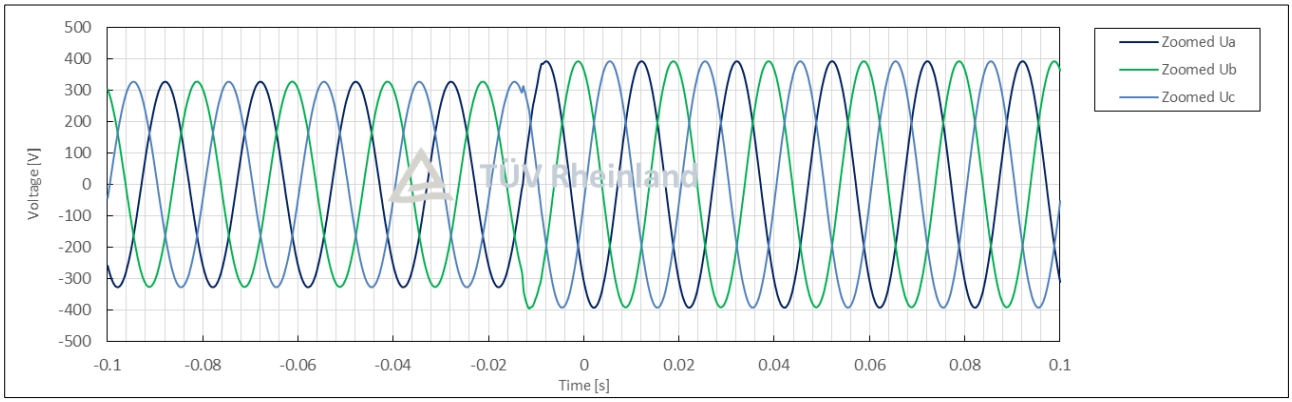


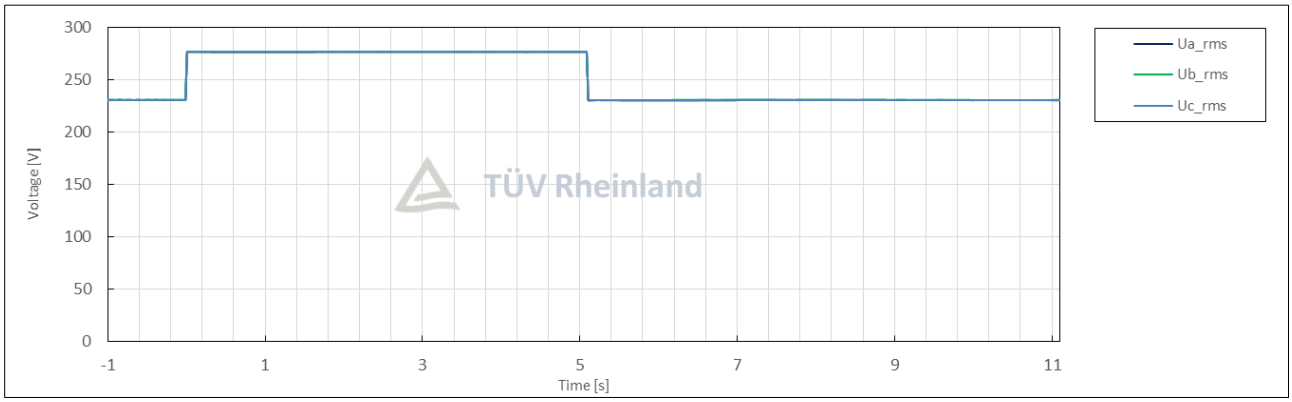


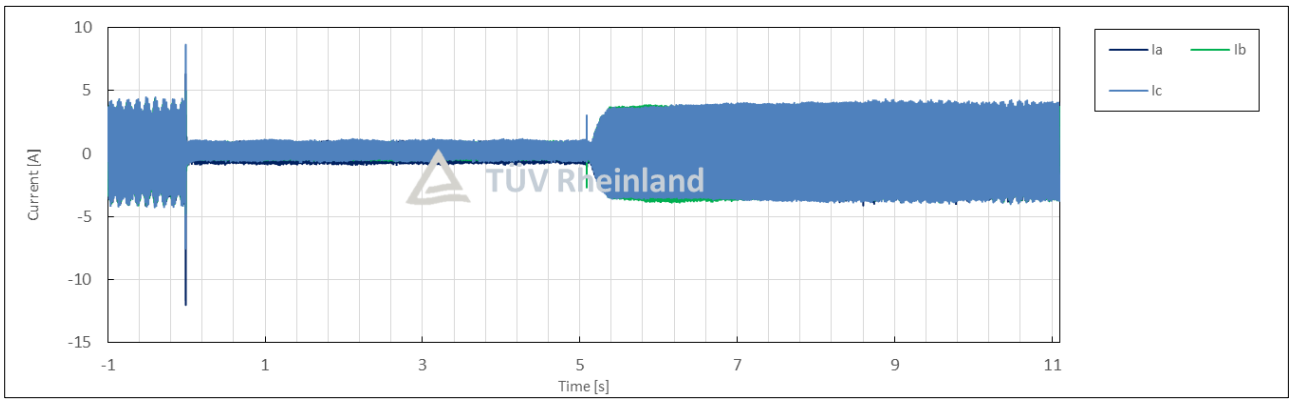


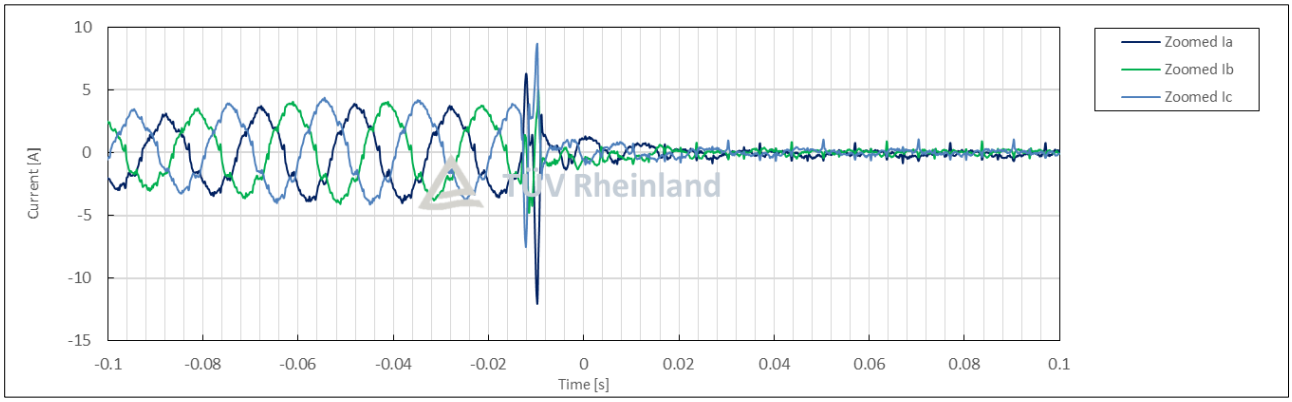
Test No. 6.2 with PGU

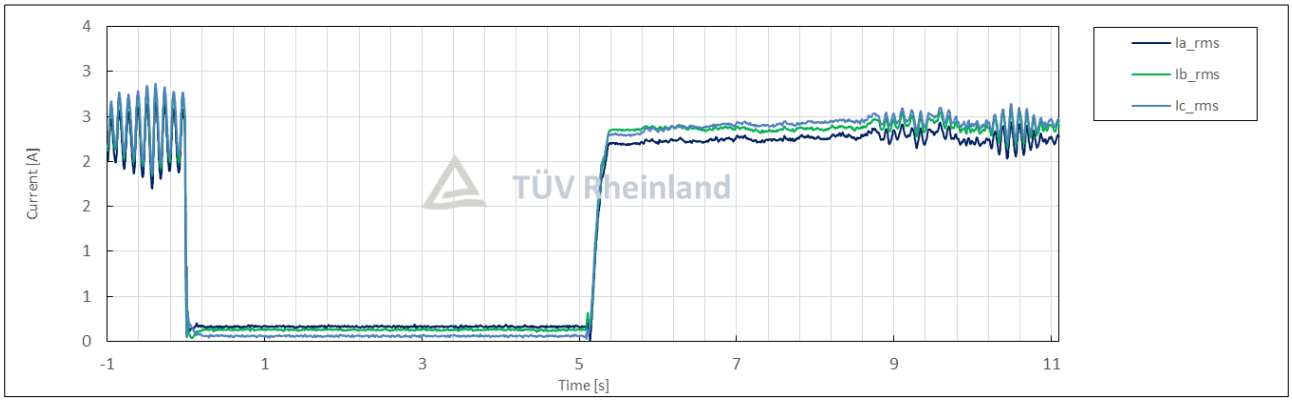


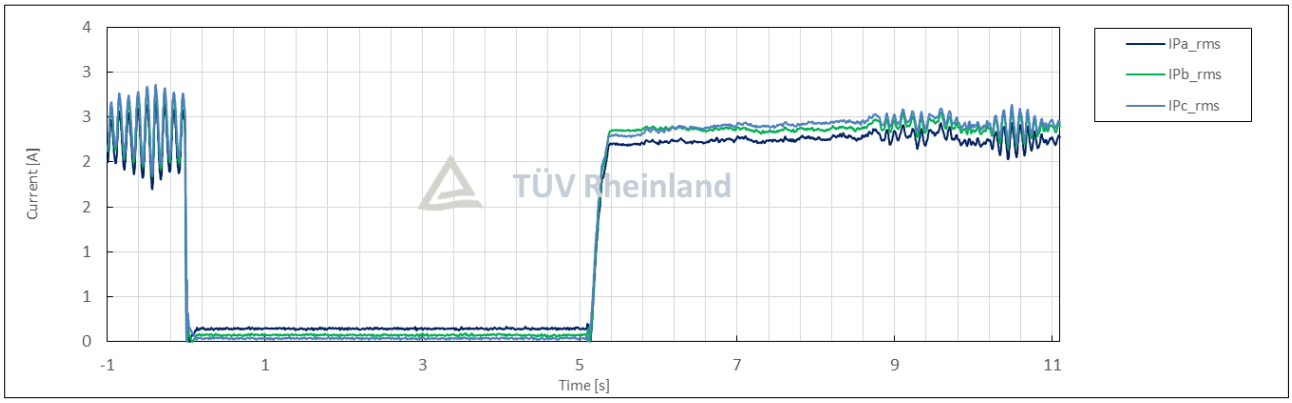


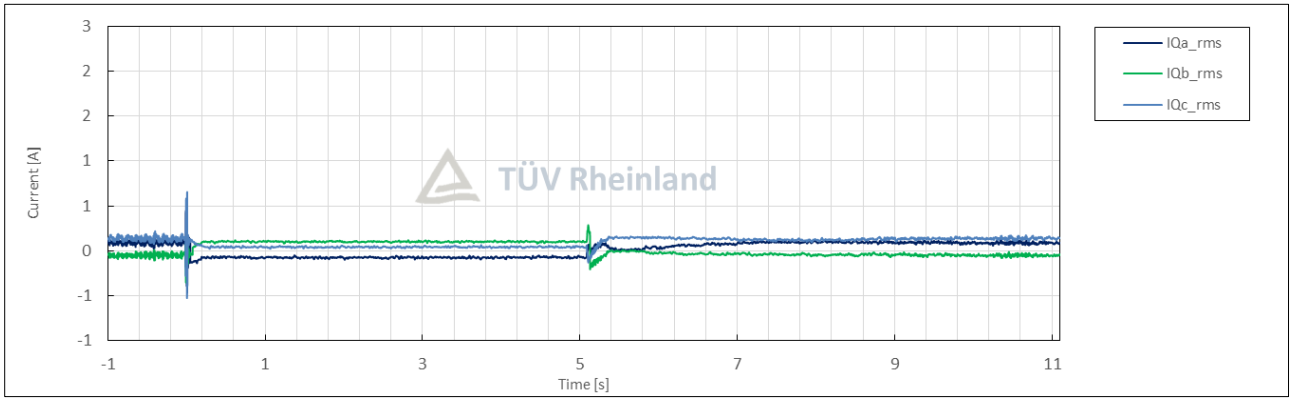


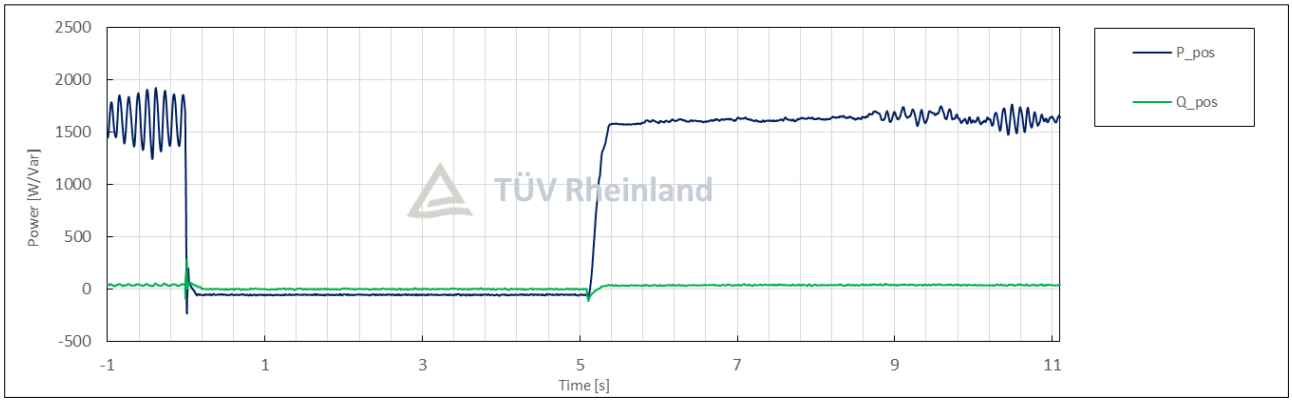


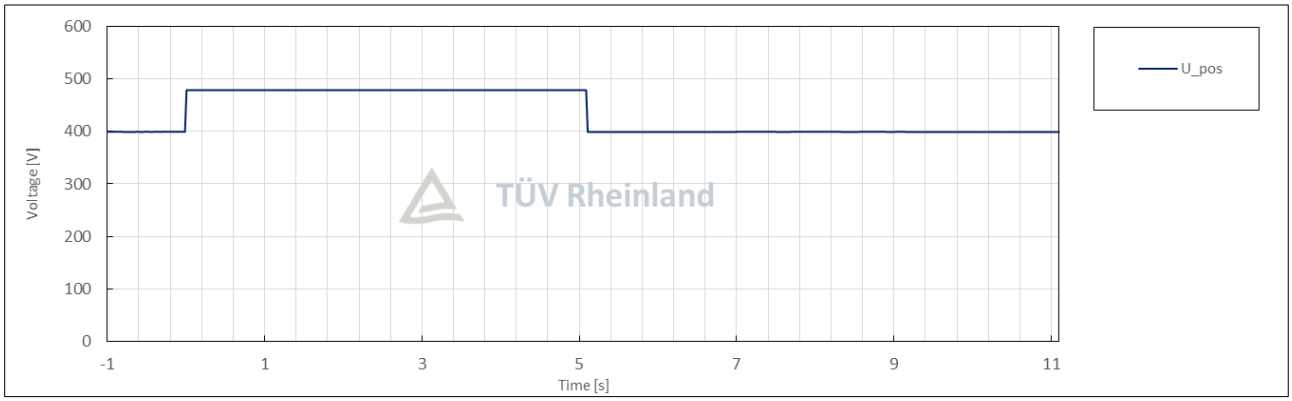

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

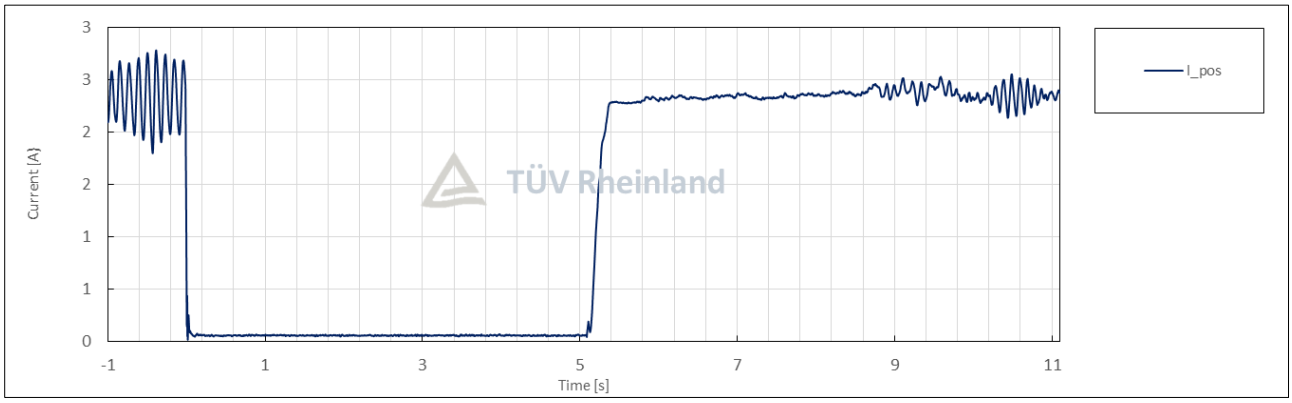

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

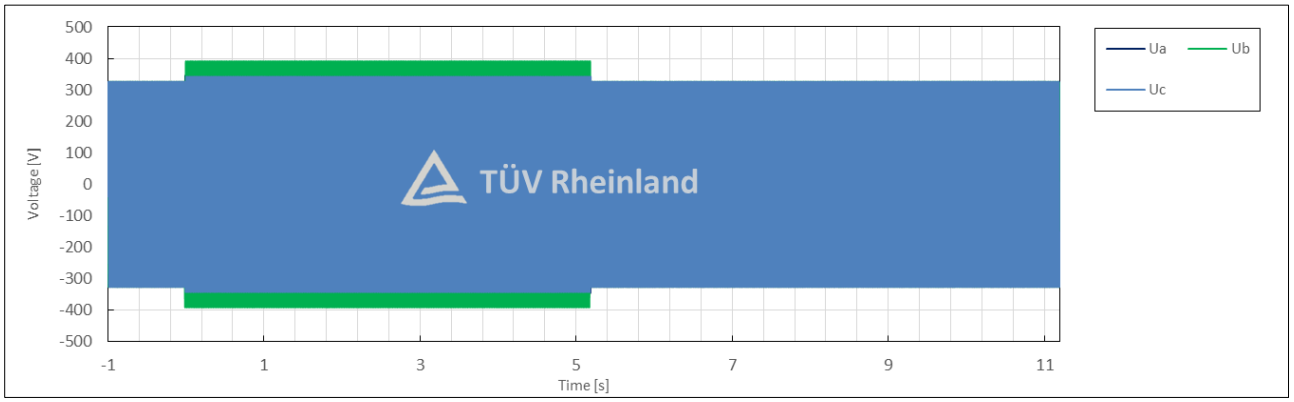

2500
2000
1500
1000
500
0
-500
Power [W/Var]
-1
1
3
5
7
9
11
Time [s]
P_pos
Q_pos
TÜV Rheinland

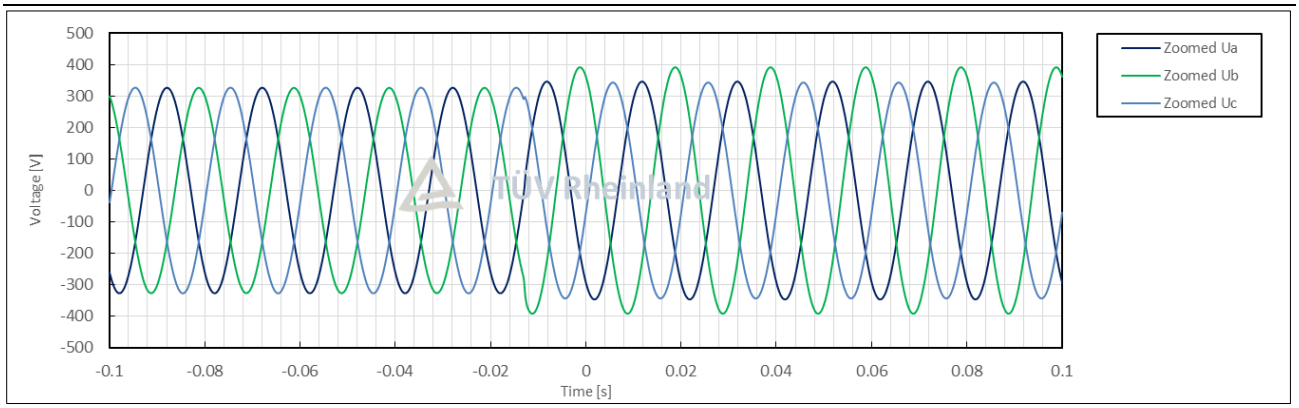

600
500
400
300
200
100
0
Voltage [V]
-1
1
3
5
7
9
11
Time [s]
U_pos
TÜV Rheinland

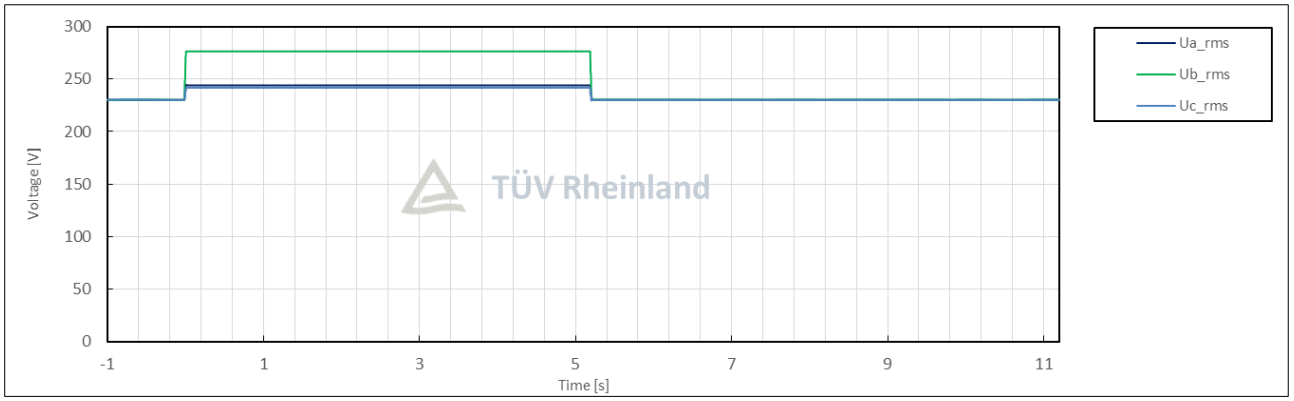

3
3
2
2
1
1
0
Current [A]
-1
1
3
5
7
9
11
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.3
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:10:29
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.20
	5	Setting dip duration		--		5198
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	5198
	8	Fault duration in empty load test	Total	--	ms	5198
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.20
	10		Pos.		p.u.	1.10
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.20
	19	Line current	Phase 1	t1+60ms	p.u.	0.00
	20		Phase 2			0.00
	21		Phase 3			0.00
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.00
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	0.288
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

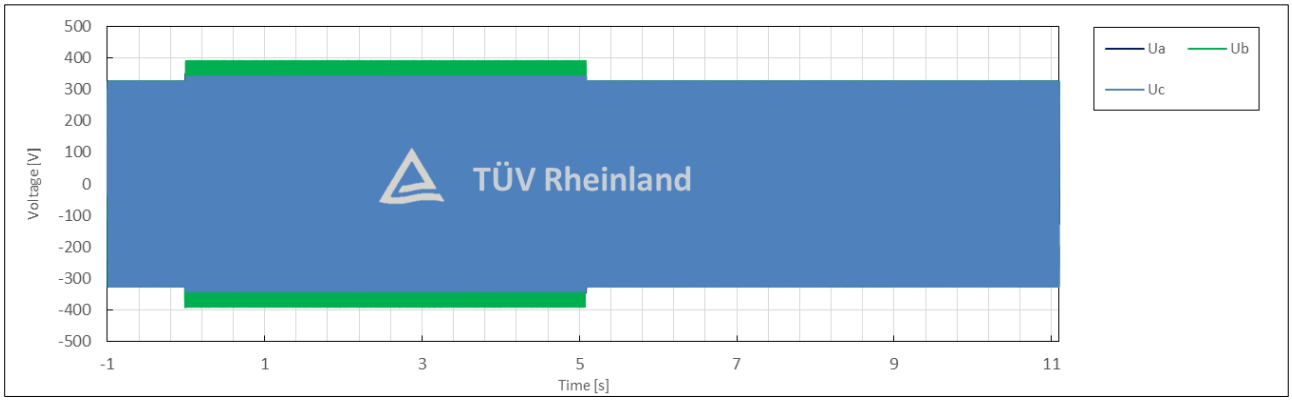
Test No. 6.3 idle test

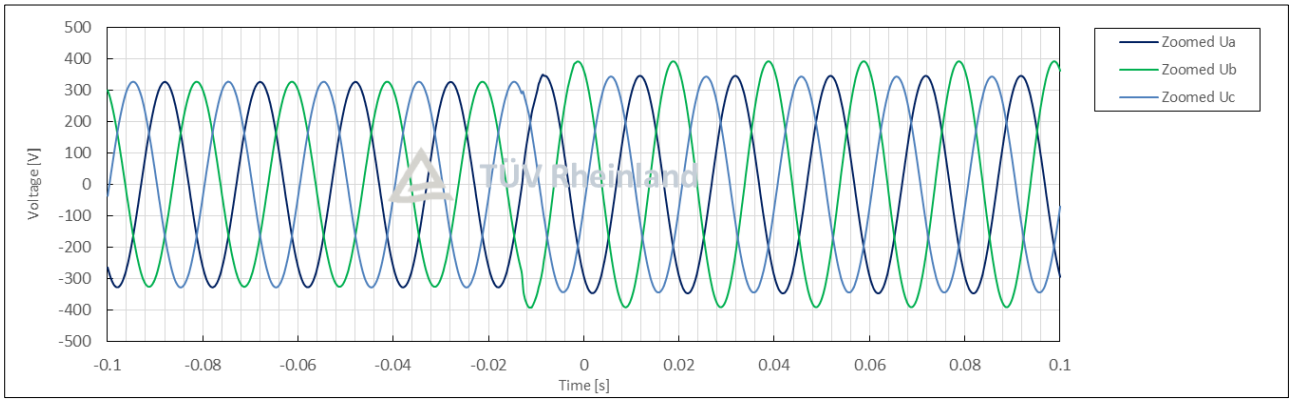


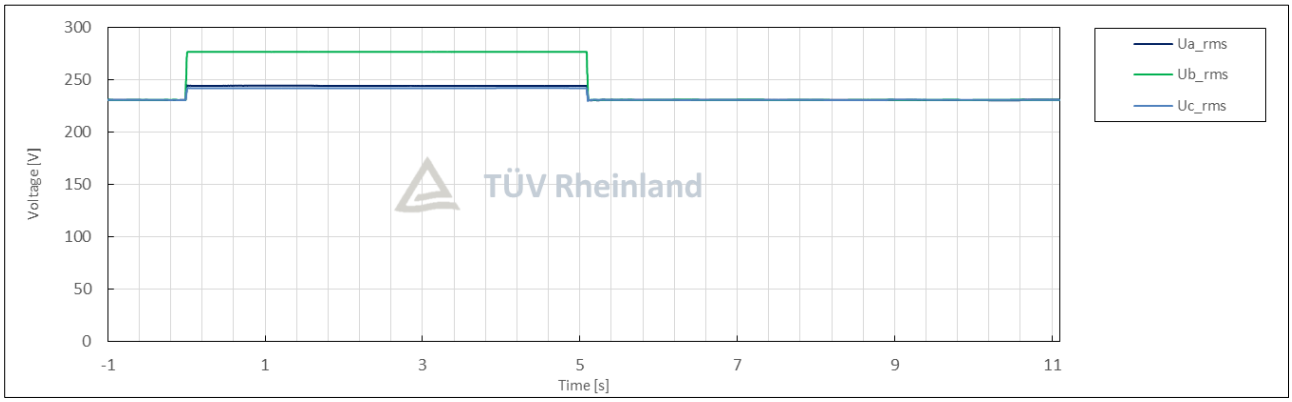


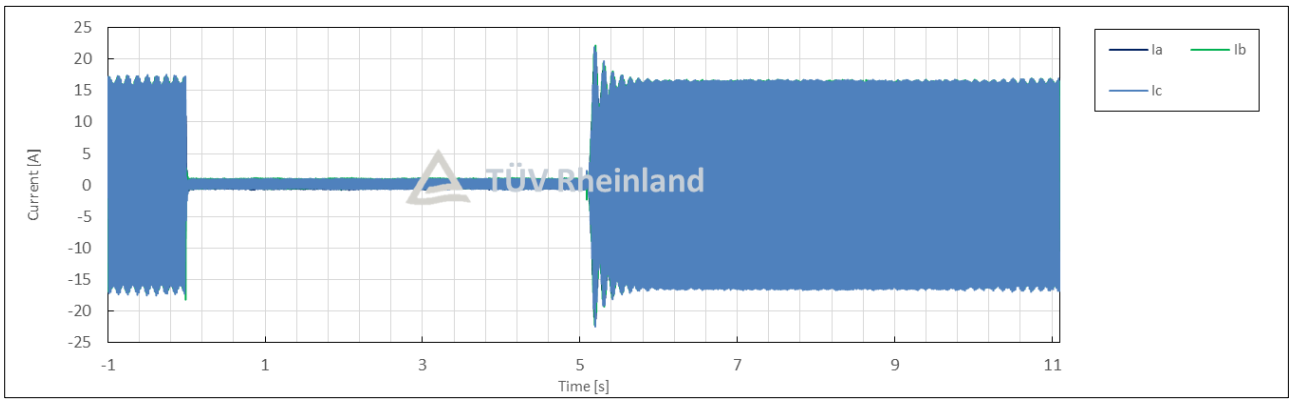


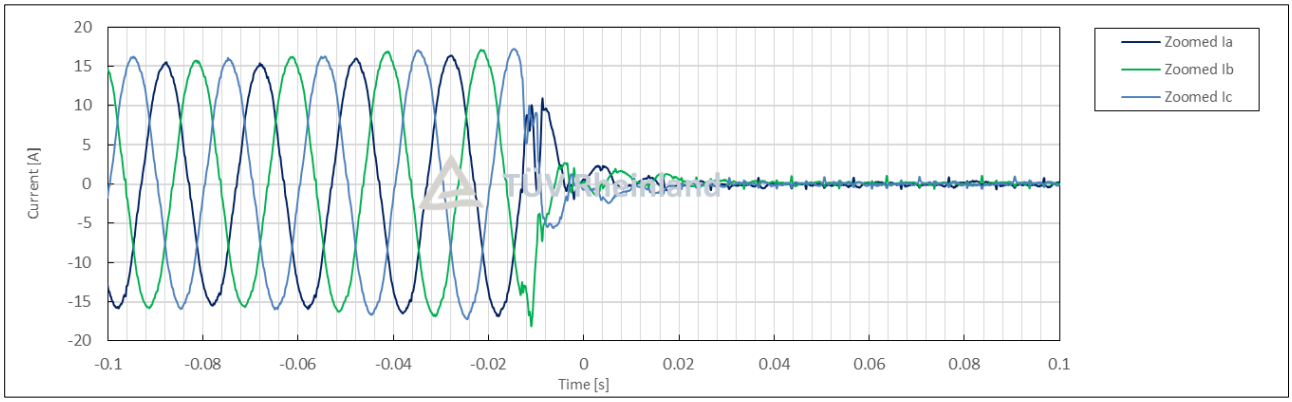
Test No. 6.3 with PGU

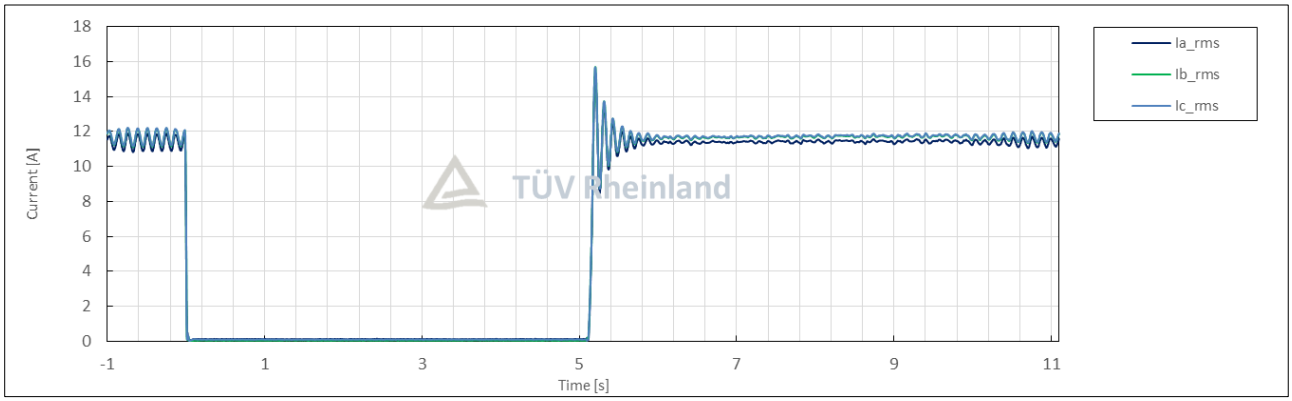


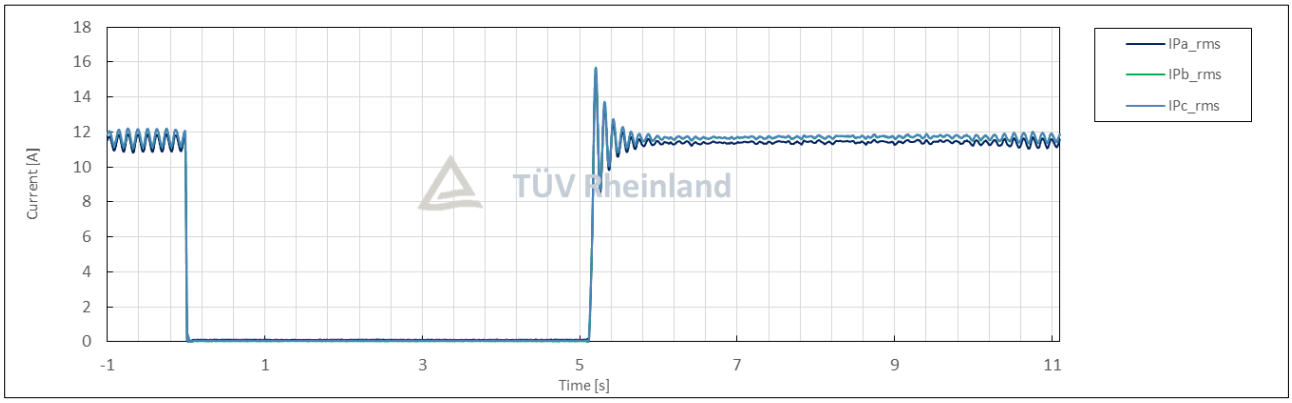


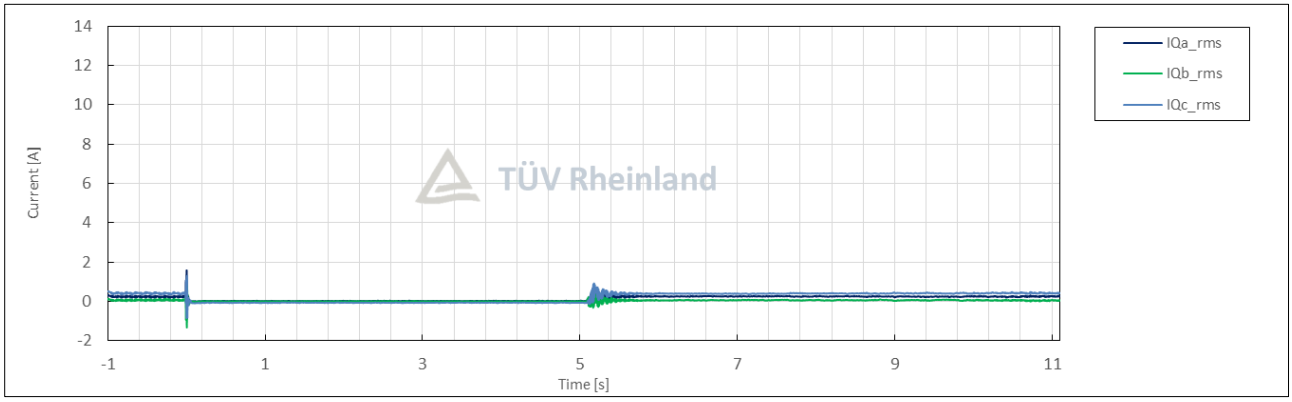


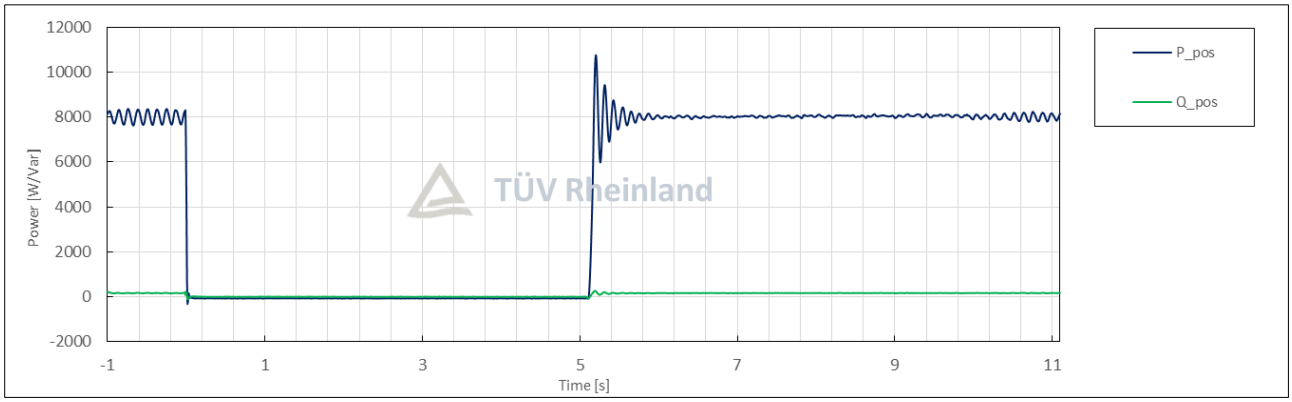


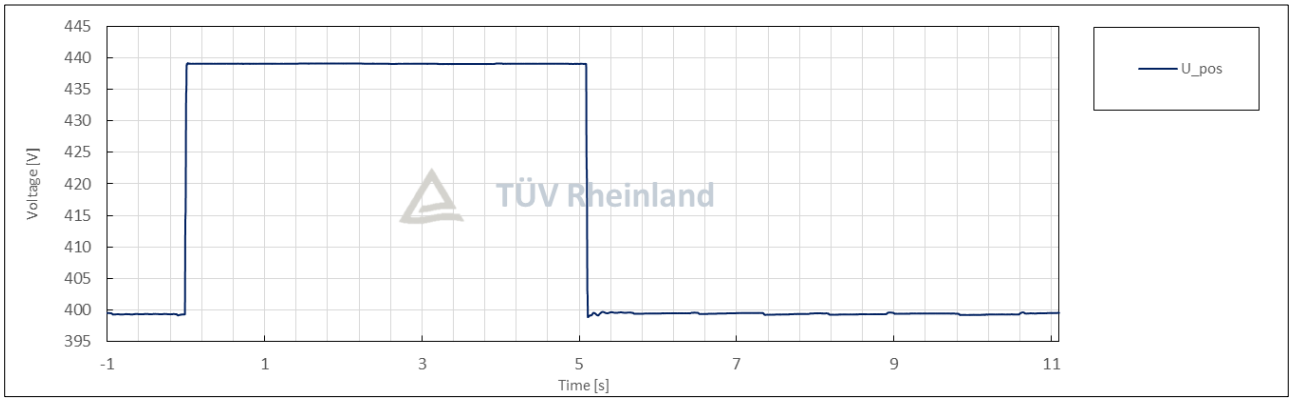

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

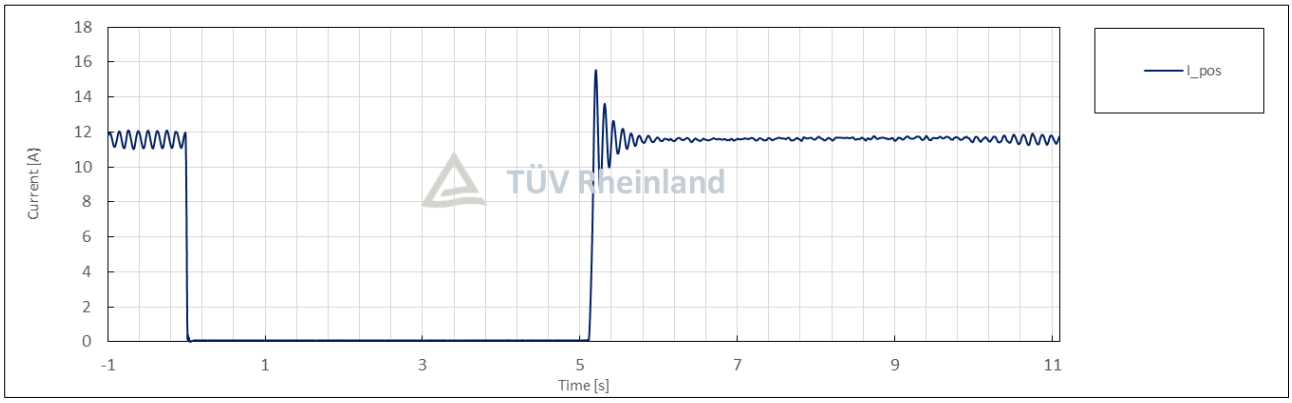

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

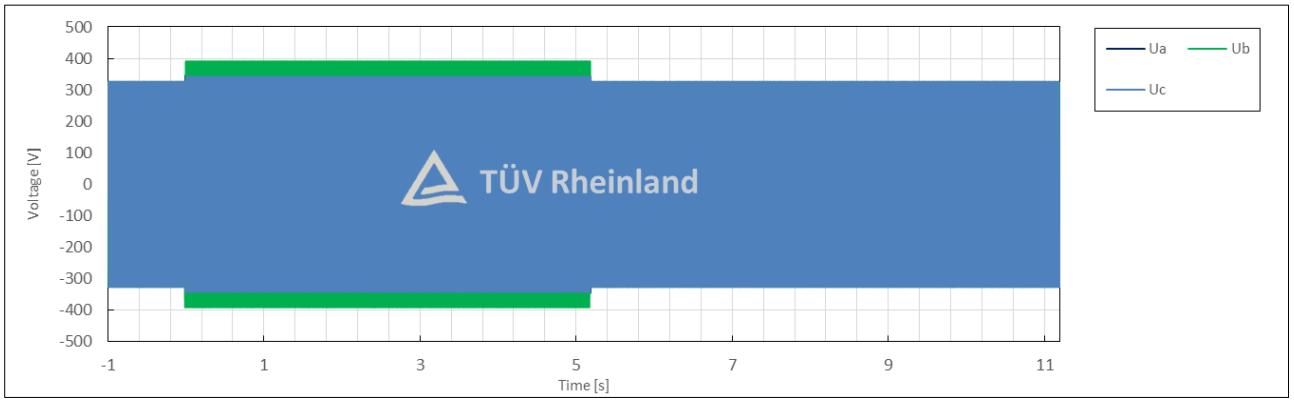

12000
10000
8000
6000
4000
2000
0
-2000
Power [W/Var]
-1
1
3
5
7
9
11
Time [s]
P_pos
Q_pos
TÜV Rheinland

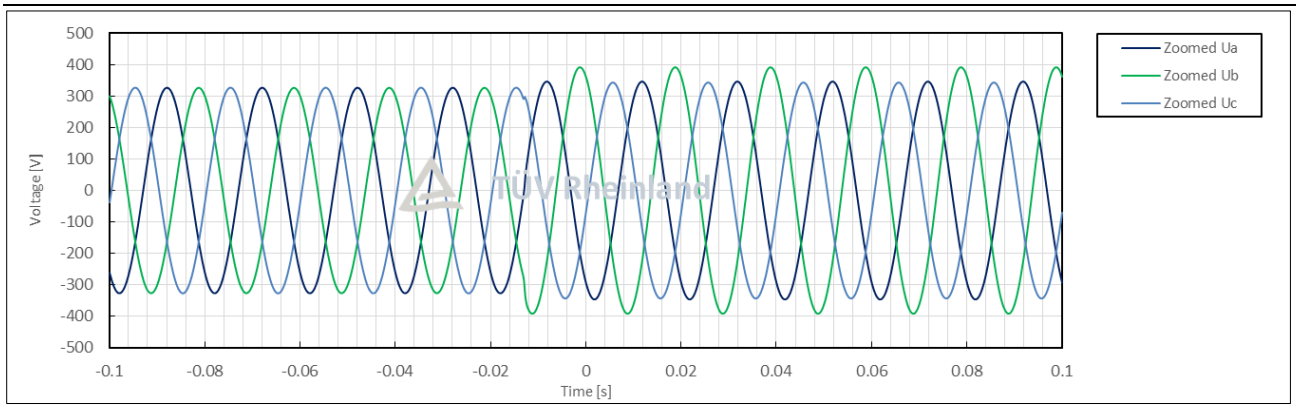

445
440
435
430
425
420
415
410
405
400
395
Voltage [V]
-1
1
3
5
7
9
11
Time [s]
U_pos
TÜV Rheinland

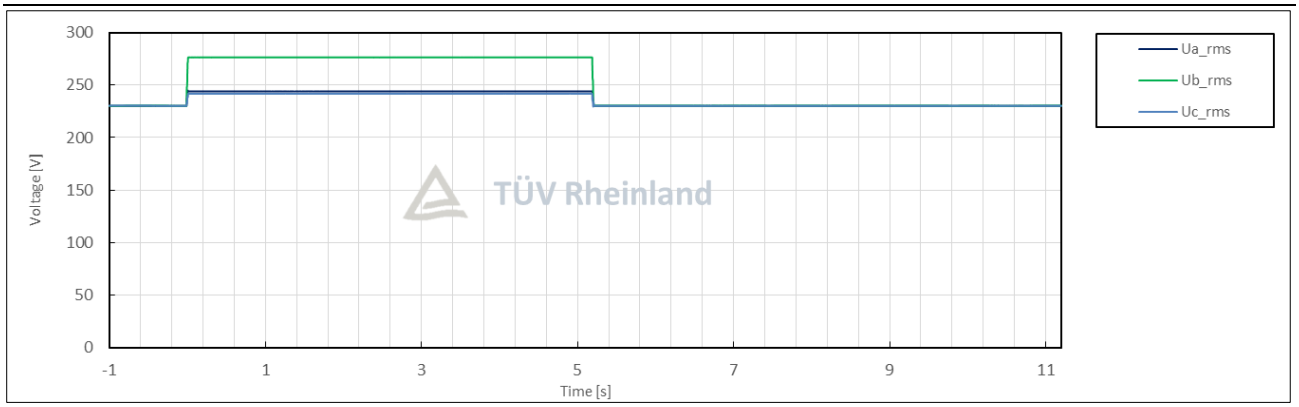

18
16
14
12
10
8
6
4
2
0
Current [A]
-1
1
3
5
7
9
11
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.4
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:11:29
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.20
	5	Setting dip duration		--		5198
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	5198
	8	Fault duration in empty load test	Total	--	ms	5198
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.20
	10		Pos.		p.u.	1.10
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	0.01
	16		Pos.			0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.20
	19	Line current	Phase 1	t1+60ms	p.u.	0.00
	20		Phase 2			0.01
	21		Phase 3			0.01
	22	Line current	Phase 1	t1+100ms	p.u.	0.01
	23		Phase 2			0.00
	24		Phase 3			0.01
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.01
	26		Pos.			-0.01
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	0.24
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.01
	32		Pos.			0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

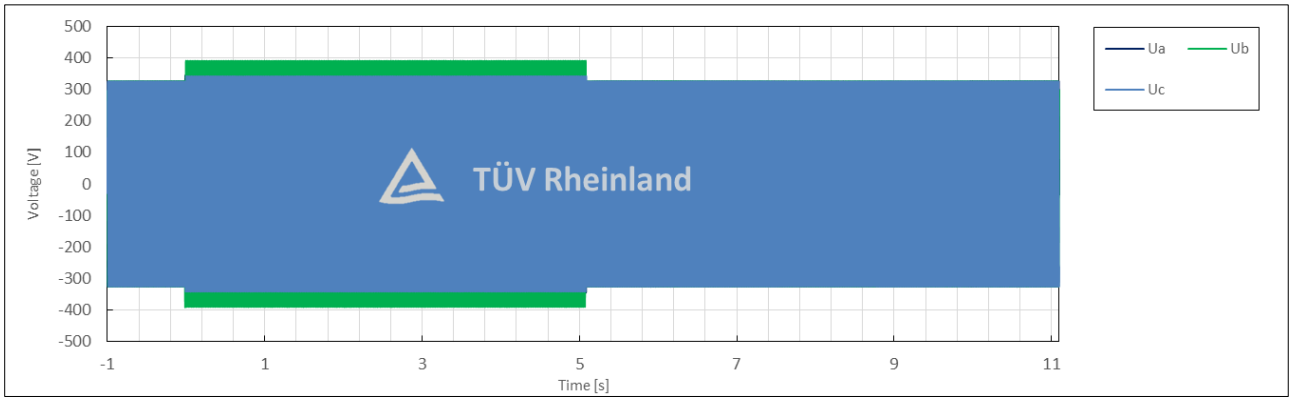
Test No. 6.4 idle test

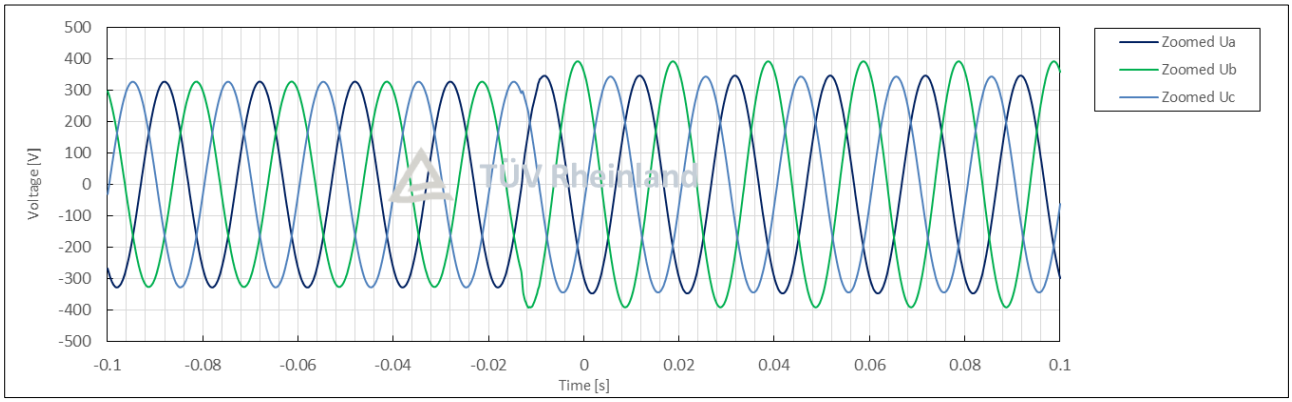


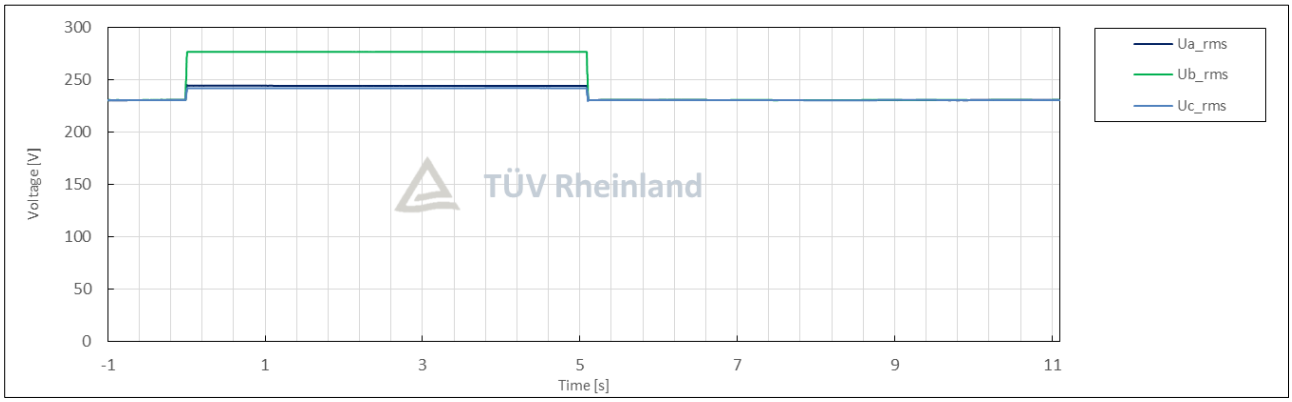


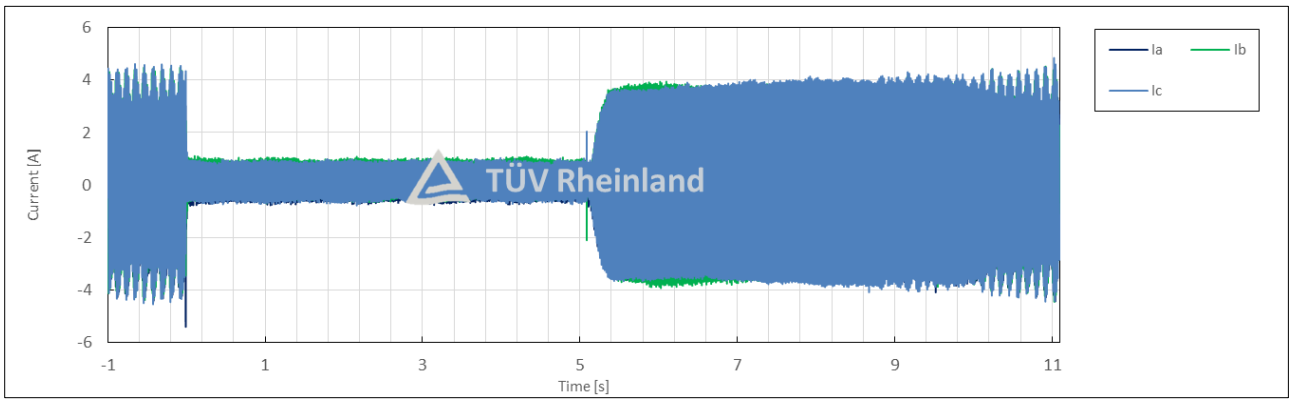


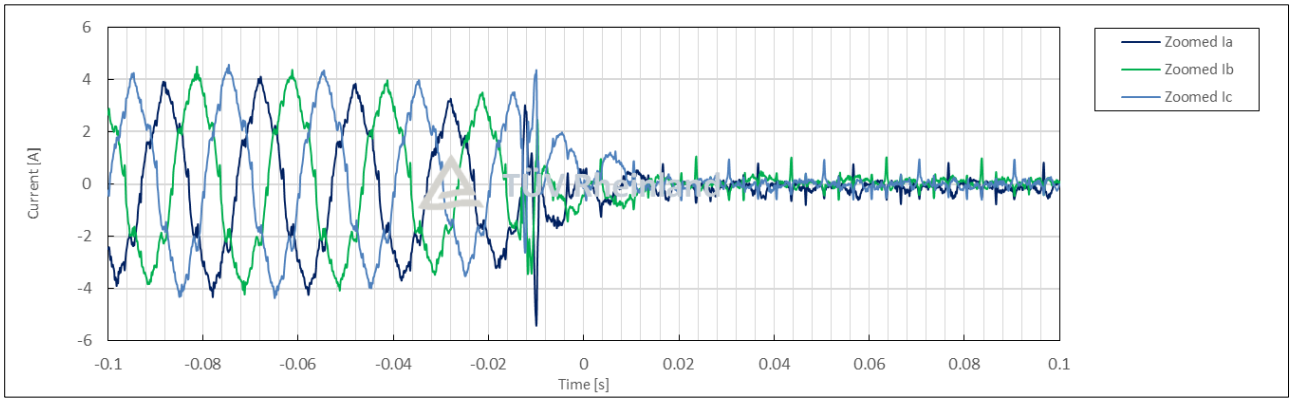
Test No. 6.4 with PGU

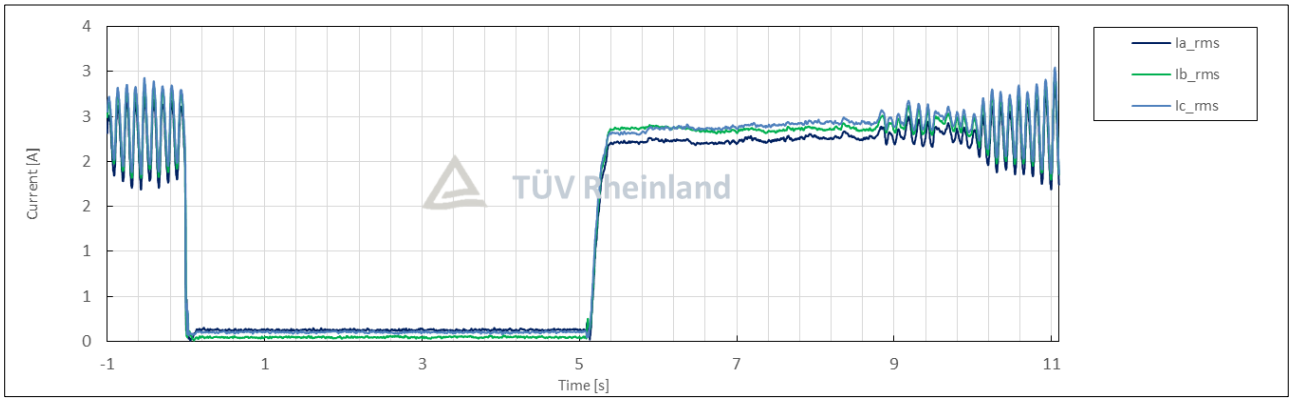


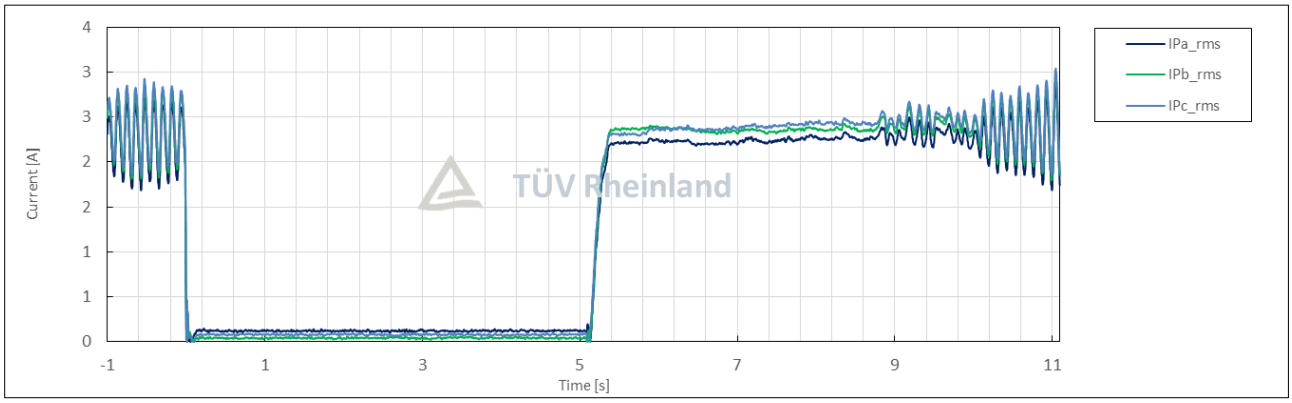


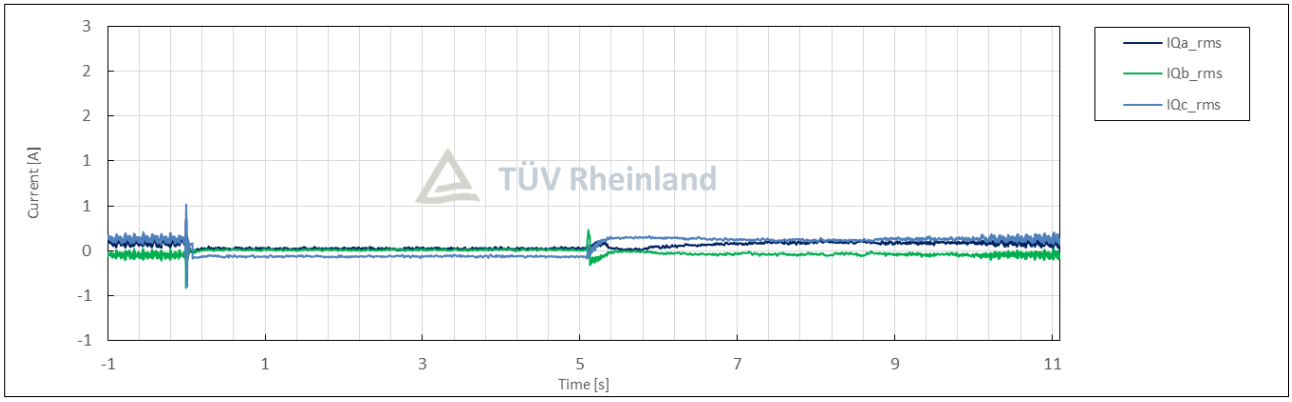


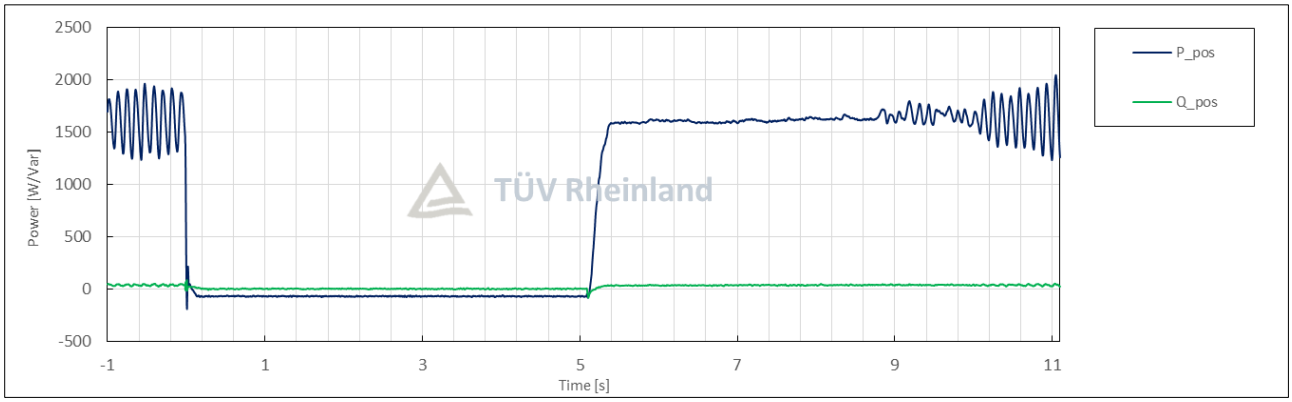


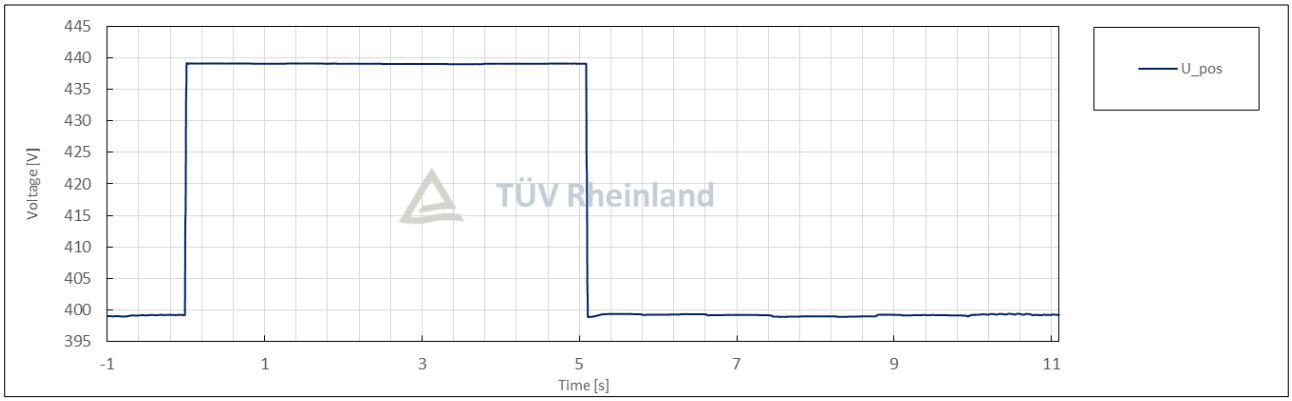

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]

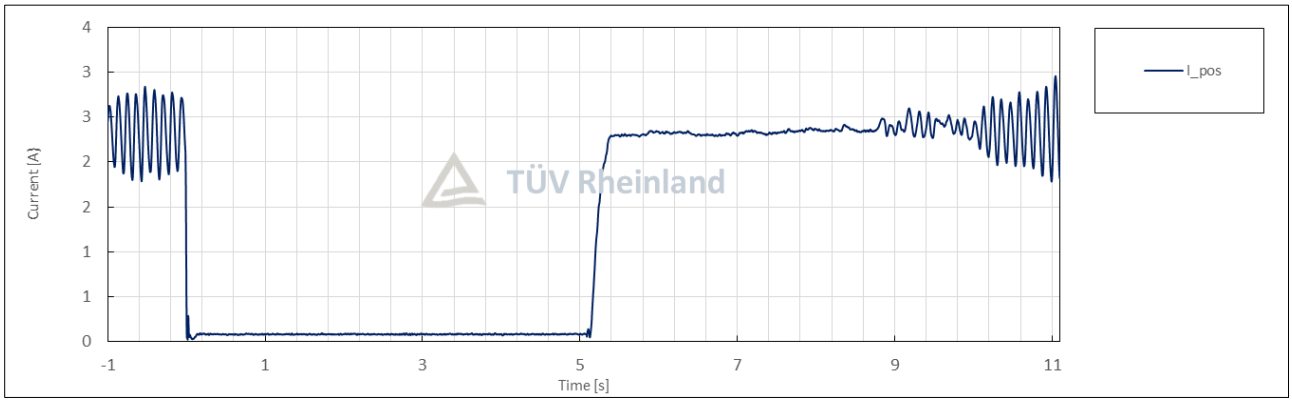

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]

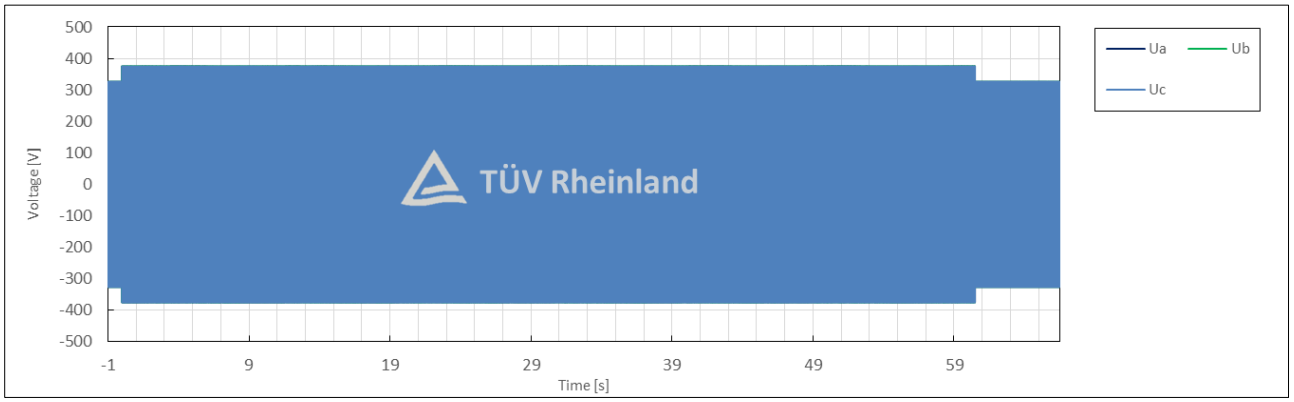

2500
2000
1500
1000
500
0
-500
Power [W/Var]
-1
1
3
5
7
9
11
Time [s]
P_pos
Q_pos
TÜV Rheinland

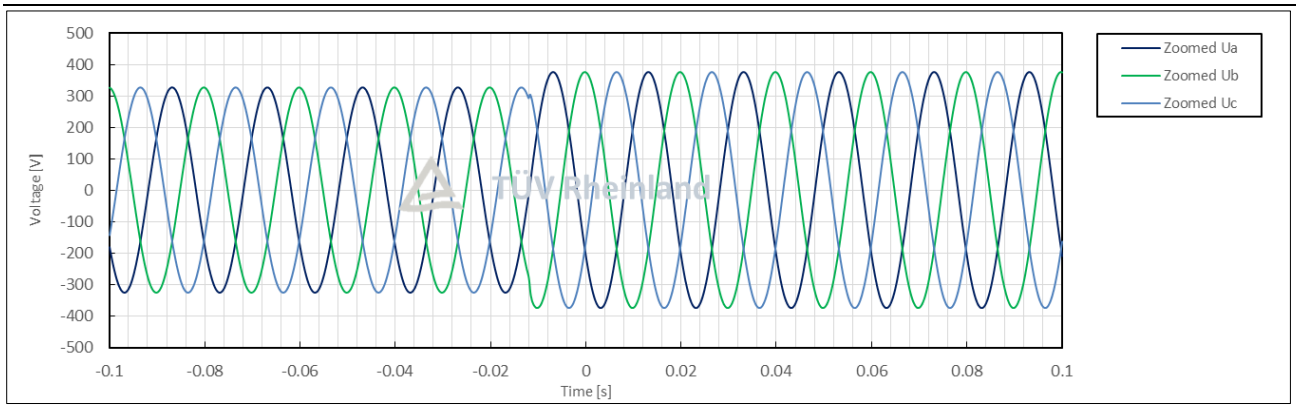

445
440
435
430
425
420
415
410
405
400
395
Voltage [V]
-1
1
3
5
7
9
11
Time [s]
U_pos
TÜV Rheinland

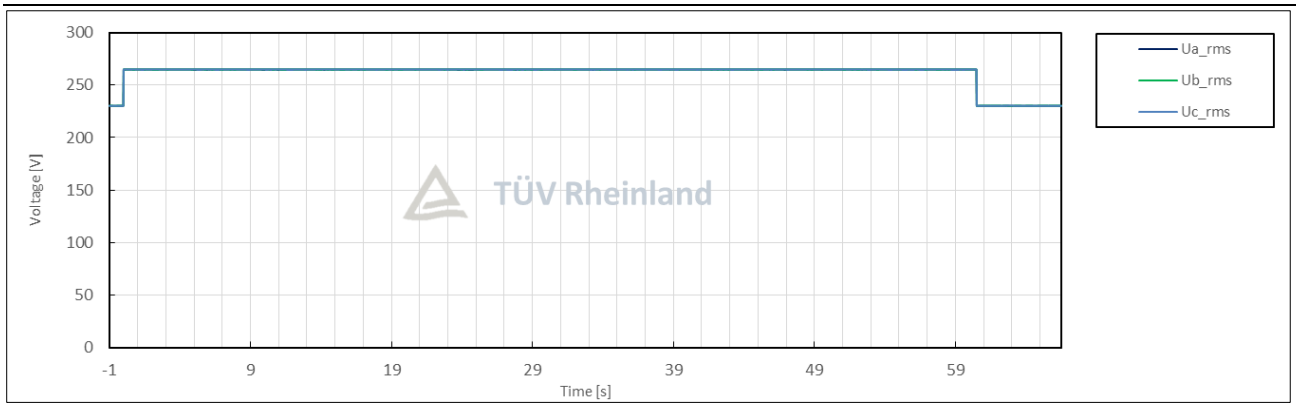

4
3
3
2
2
1
1
0
Current [A]
-1
1
3
5
7
9
11
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.1
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:14:22
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.15
	5	Setting dip duration		--		60498
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60498
	8	Fault duration in empty load test	Total	--	ms	60498
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.15
	10		Pos.		p.u.	1.15
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.99
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.81
	20		Phase 2			0.81
	21		Phase 3			0.83
	22	Line current	Phase 1	t1+100ms	p.u.	0.84
	23		Phase 2			0.83
	24		Phase 3			0.84
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	1.00
	26		Pos.			1.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	N/A
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

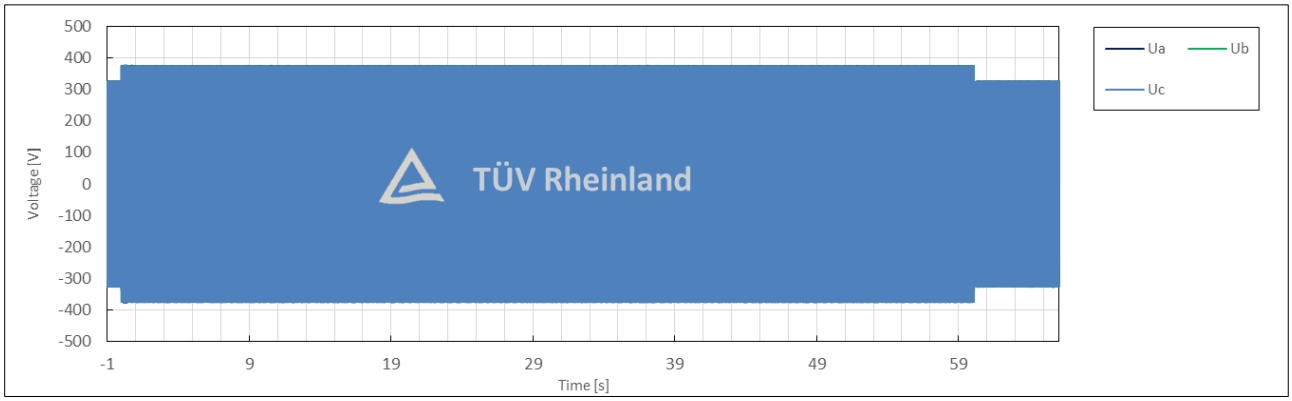
Test No. 7.1 idle test

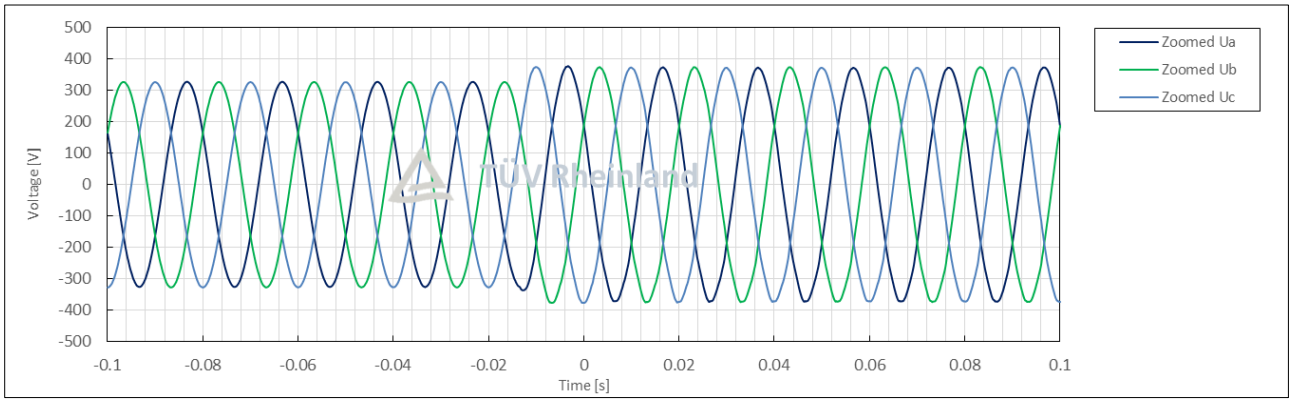


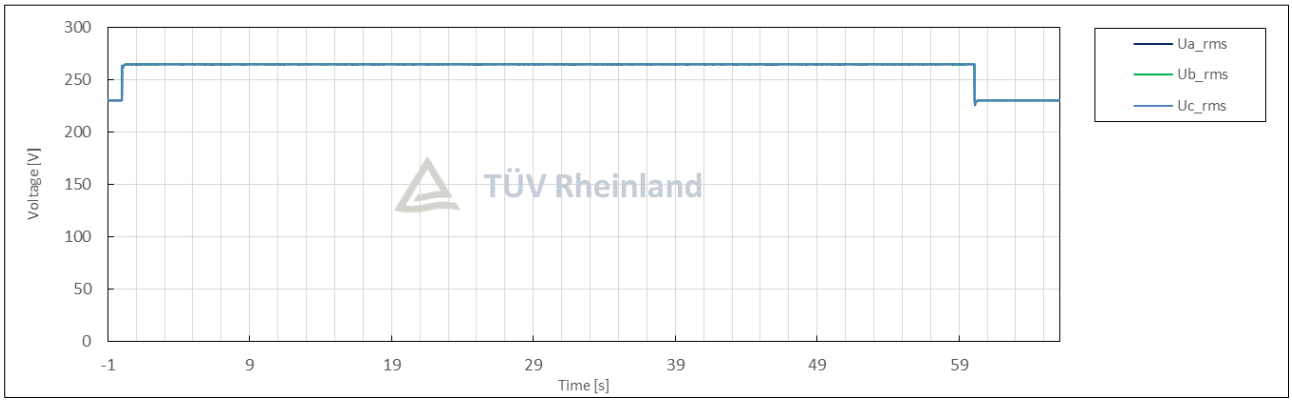


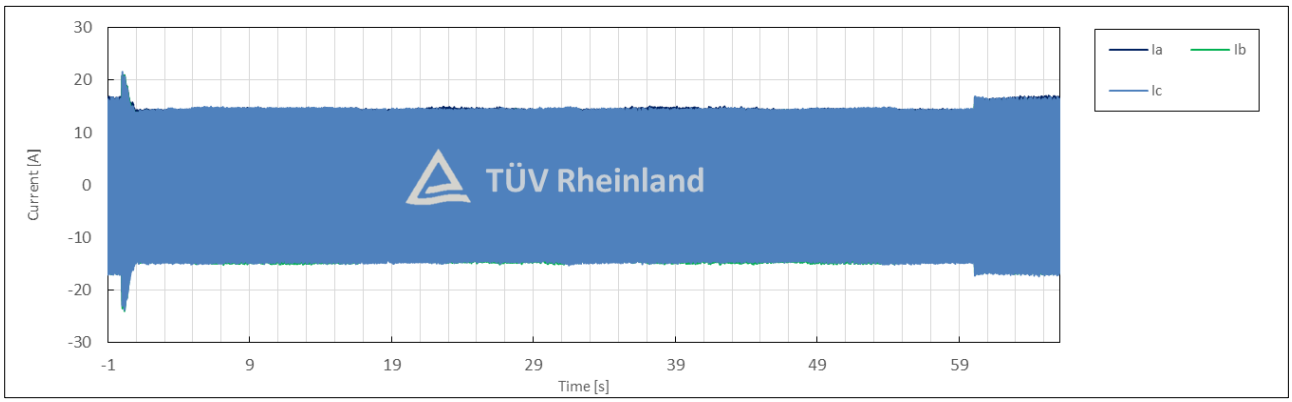


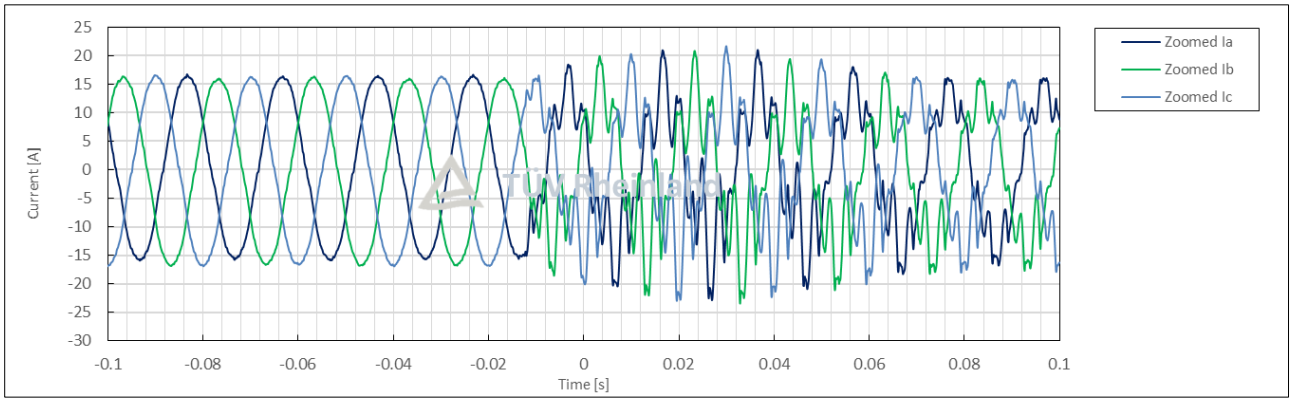
Test No. 7.1 with PGU

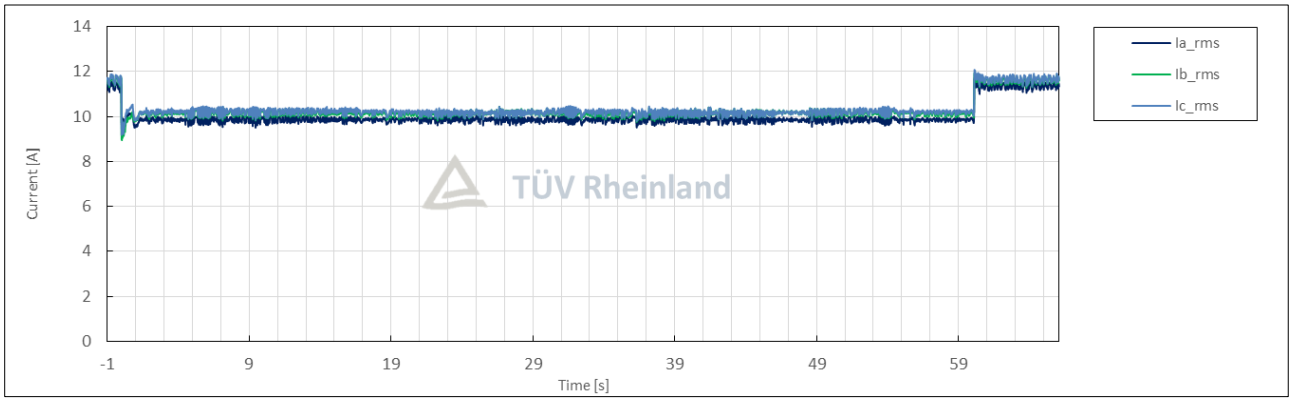


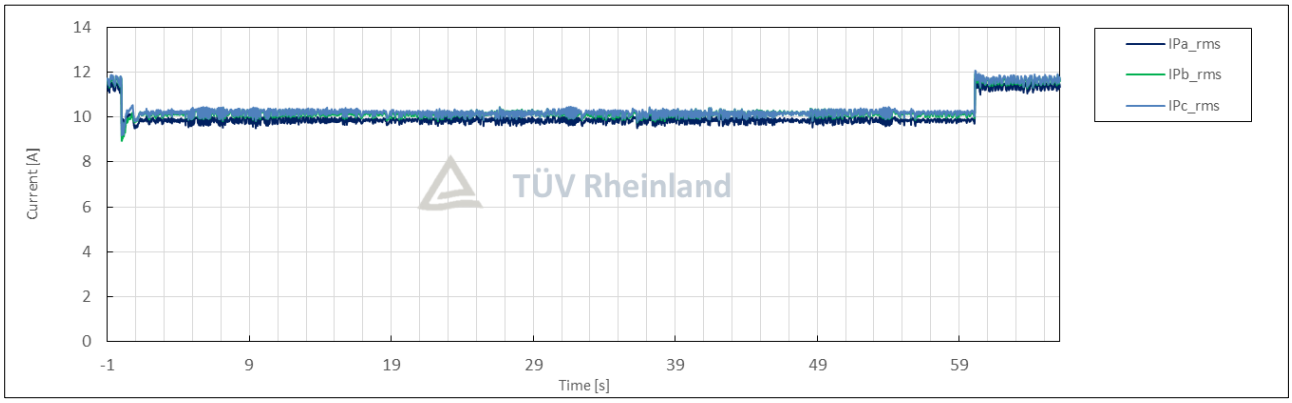


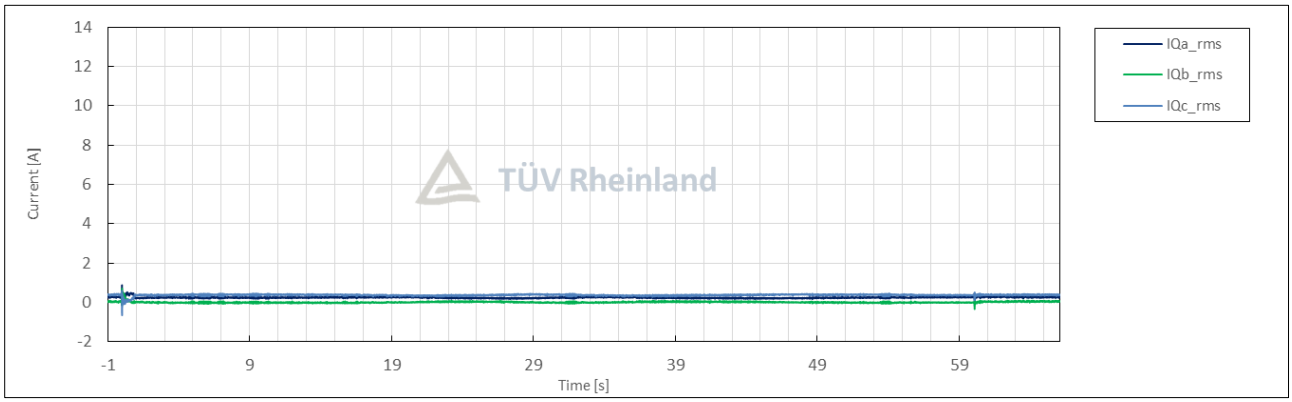


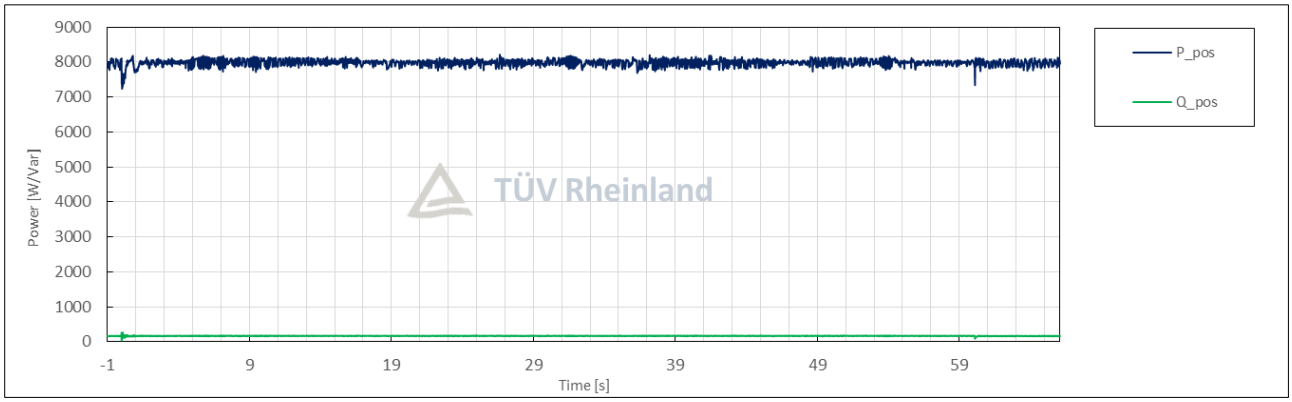


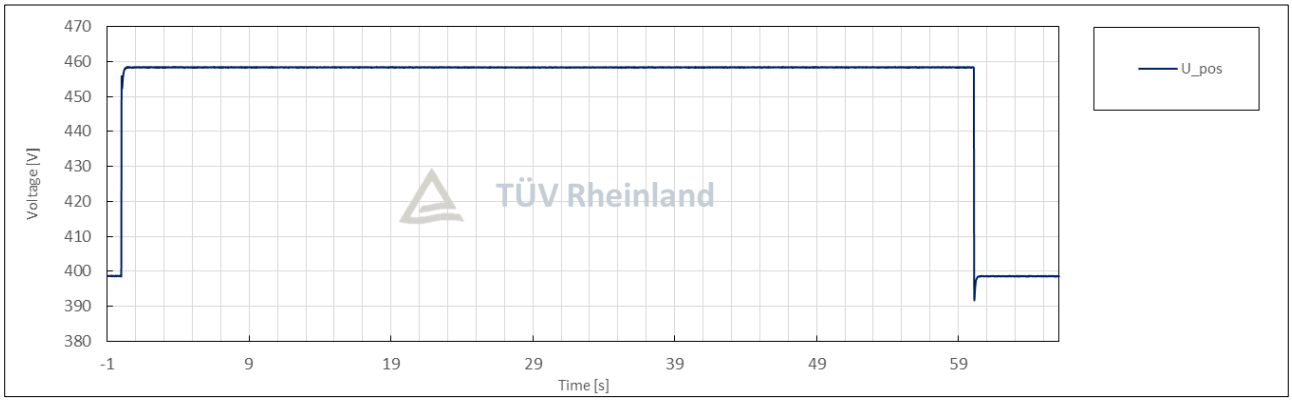

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

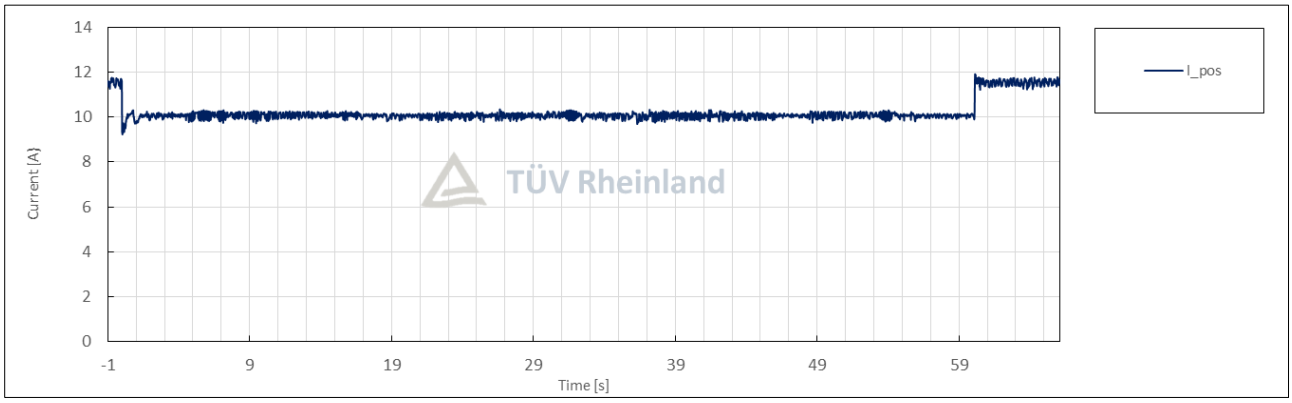

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

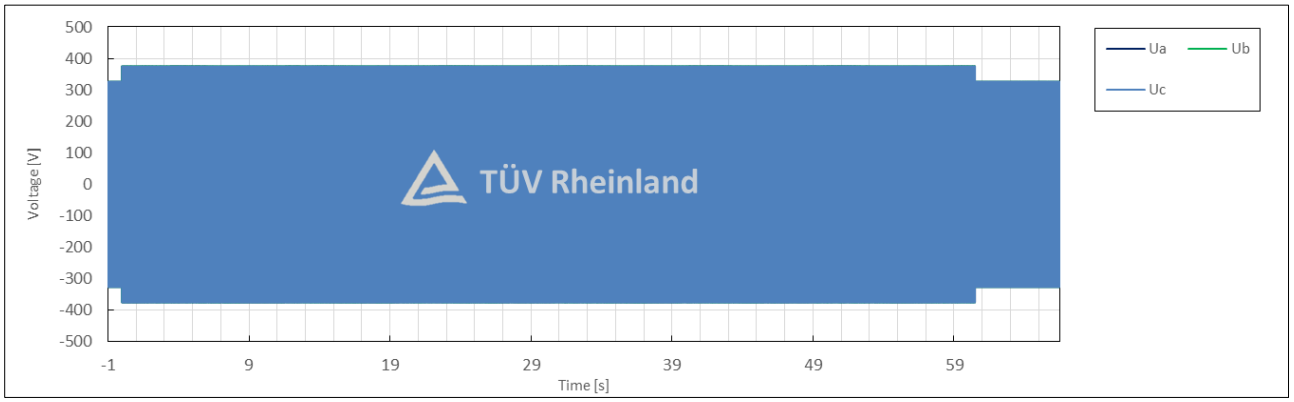

9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

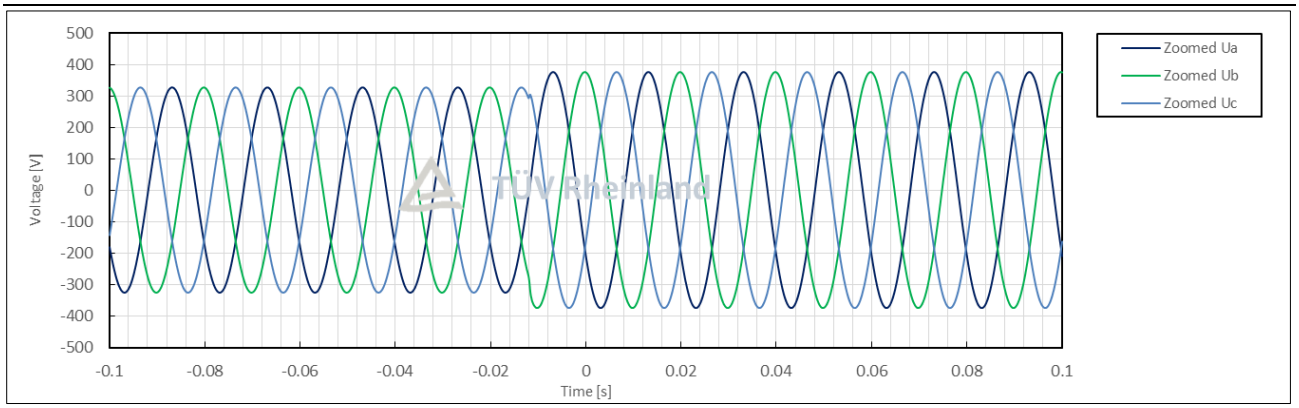

470
460
450
440
430
420
410
400
390
380
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

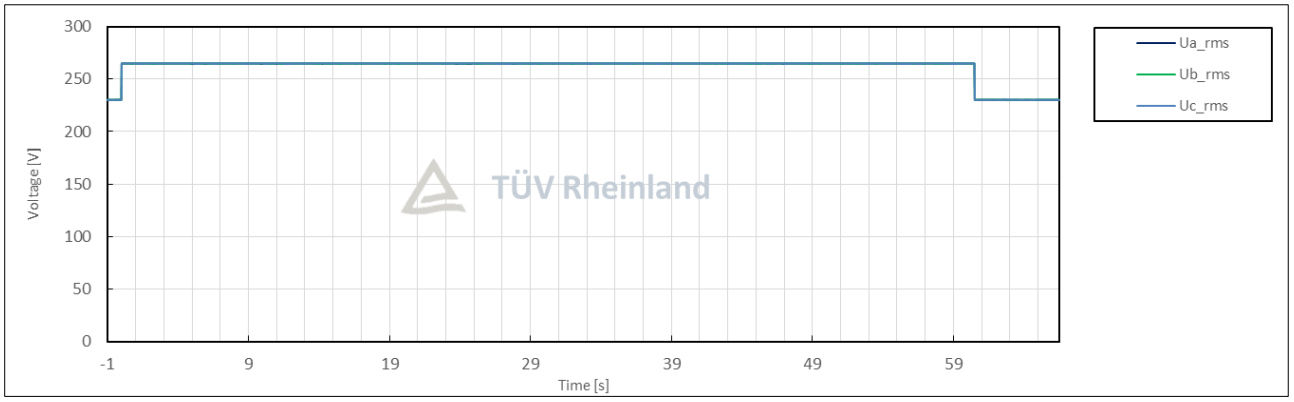

14
12
10
8
6
4
2
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.2
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:16:19
	3	Fault type (phase)	--	--		3-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.15
	5	Setting dip duration		--		60498
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60498
	8	Fault duration in empty load test	Total	--	ms	60498
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.15
	10		Pos.		p.u.	1.15
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.20
	13	Active power	Total	t1-10s to t1	p.u.	0.20
	14		Pos.			0.20
	15	Reactive power	Total	t1-10s to t1	p.u.	0.01
	16		Pos.			0.01
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.16
	20		Phase 2			0.17
	21		Phase 3			0.17
	22	Line current	Phase 1	t1+100ms	p.u.	0.15
	23		Phase 2			0.16
	24		Phase 3			0.16
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.20
	26		Pos.			0.20
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.20
	29		Pos.			0.20
	39	Active power rising time	Pos.	--	s	N/A
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.01
	32		Pos.			0.01
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

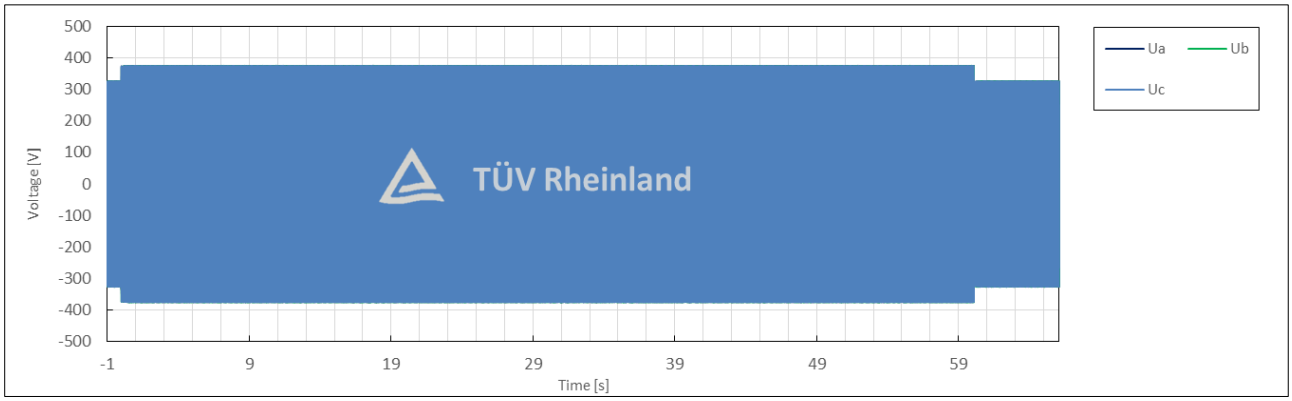
Test No. 7.2 idle test

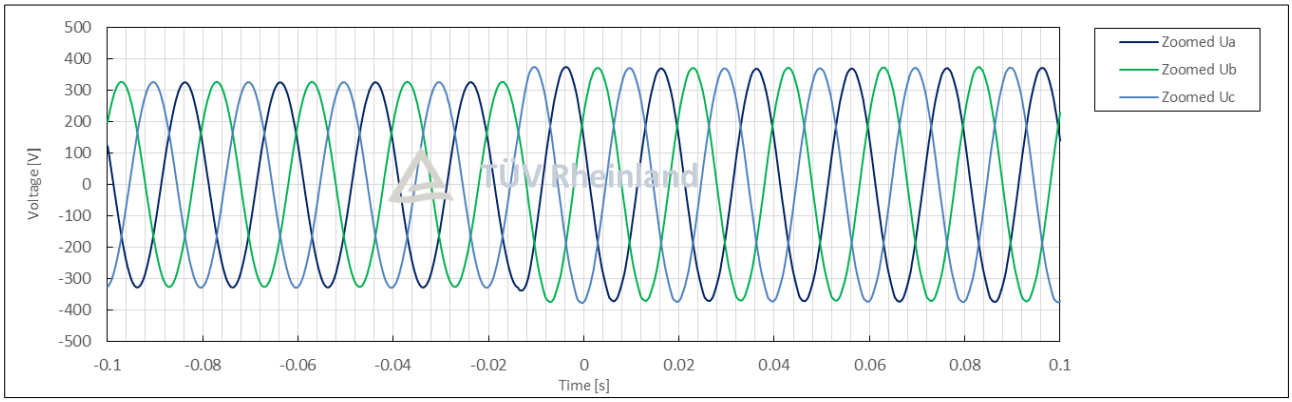


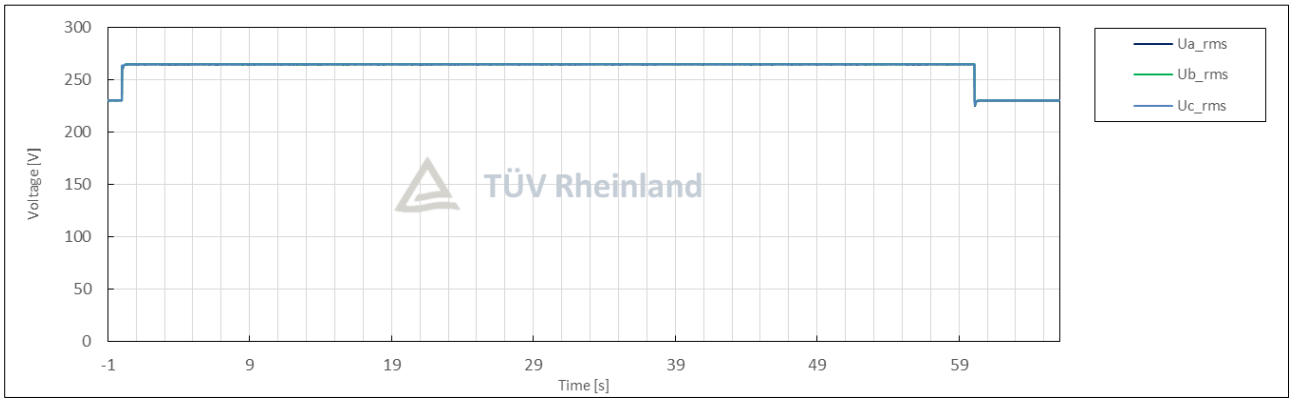


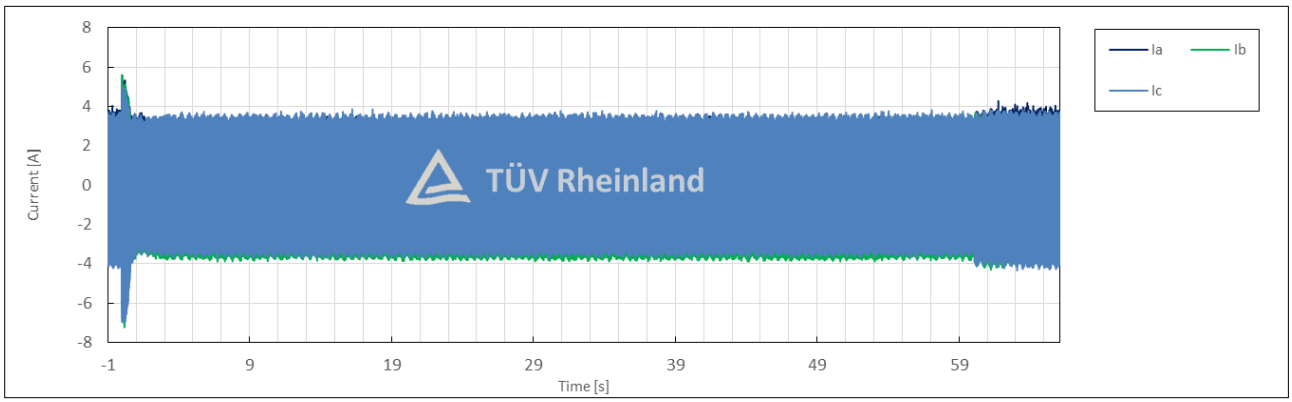


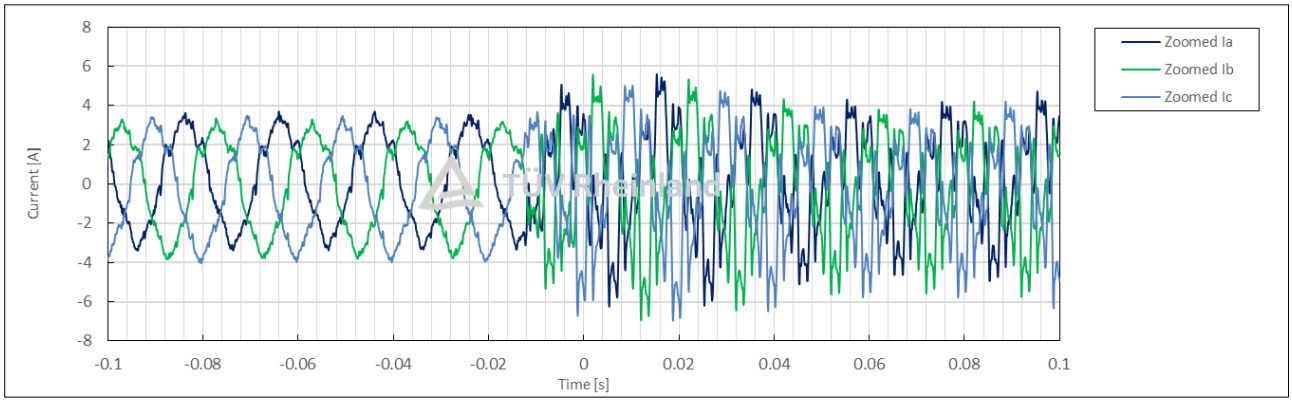
Test No. 7.2 with PGU

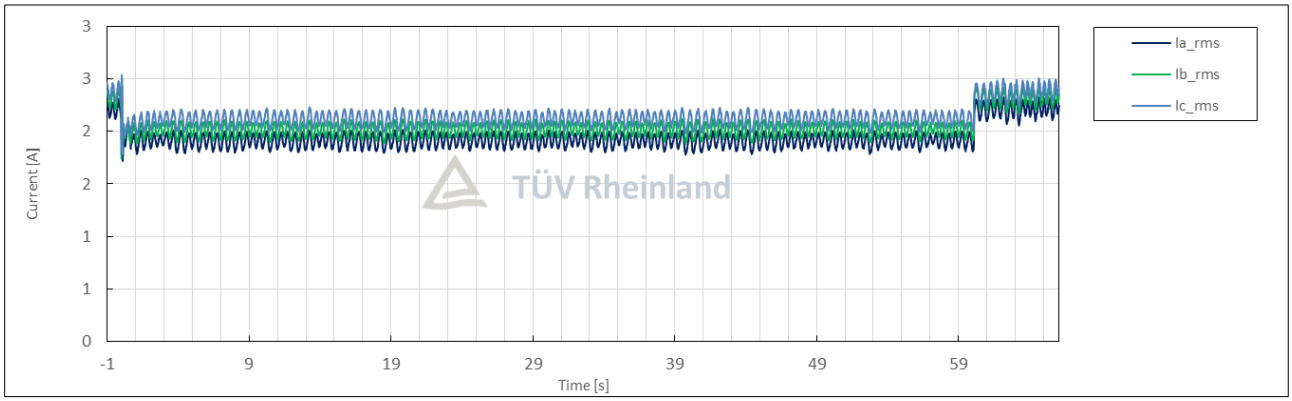


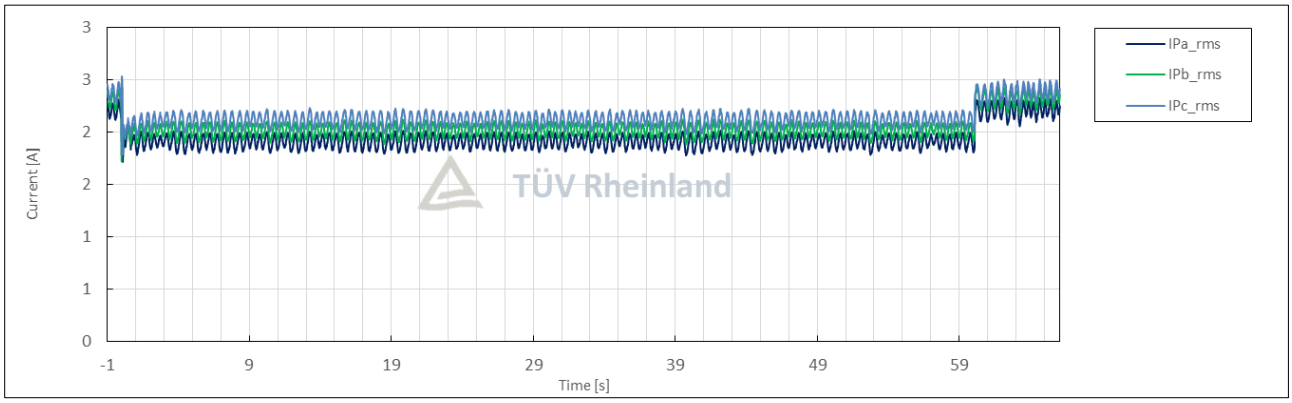


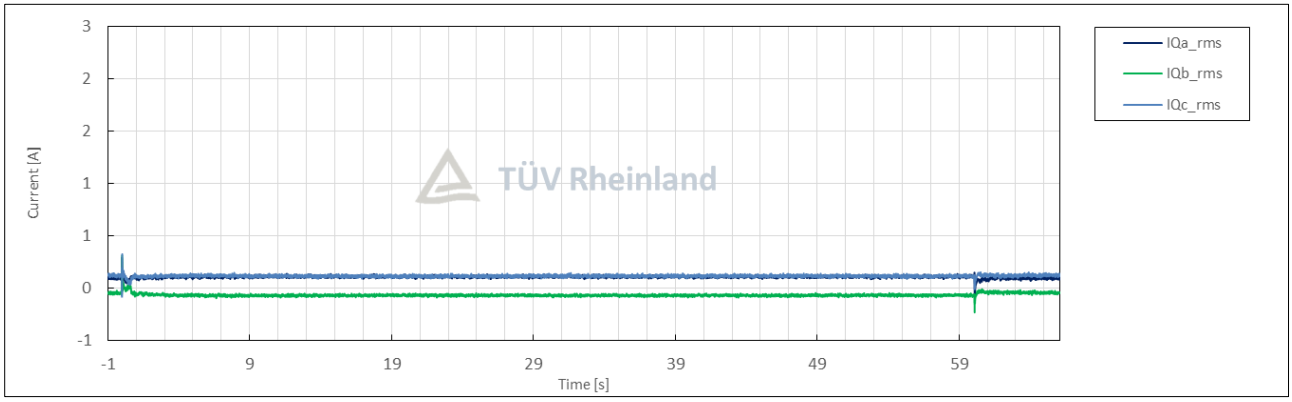


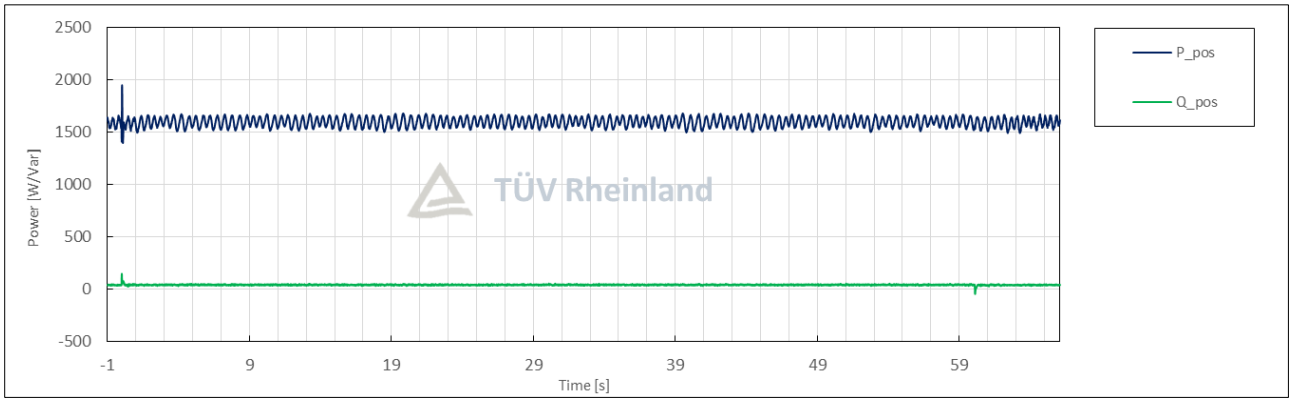


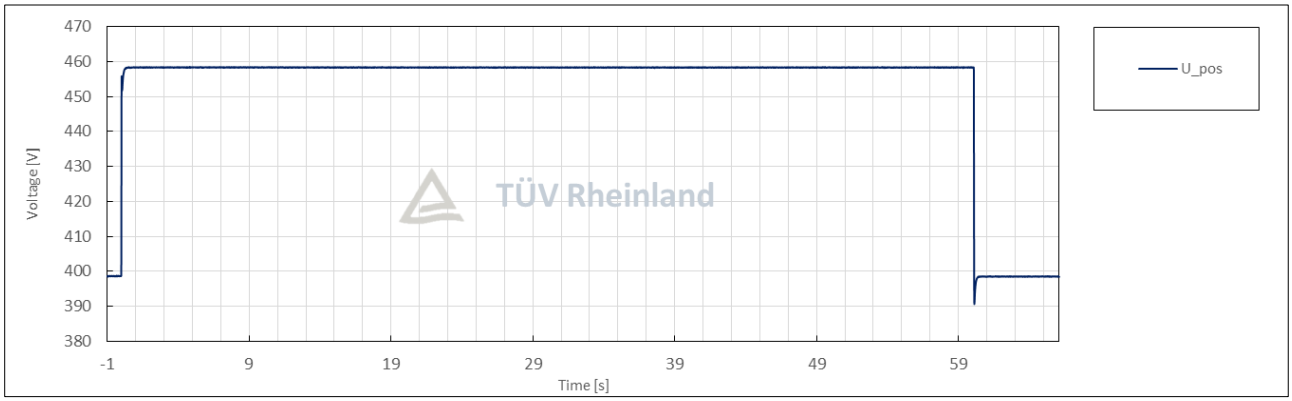

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

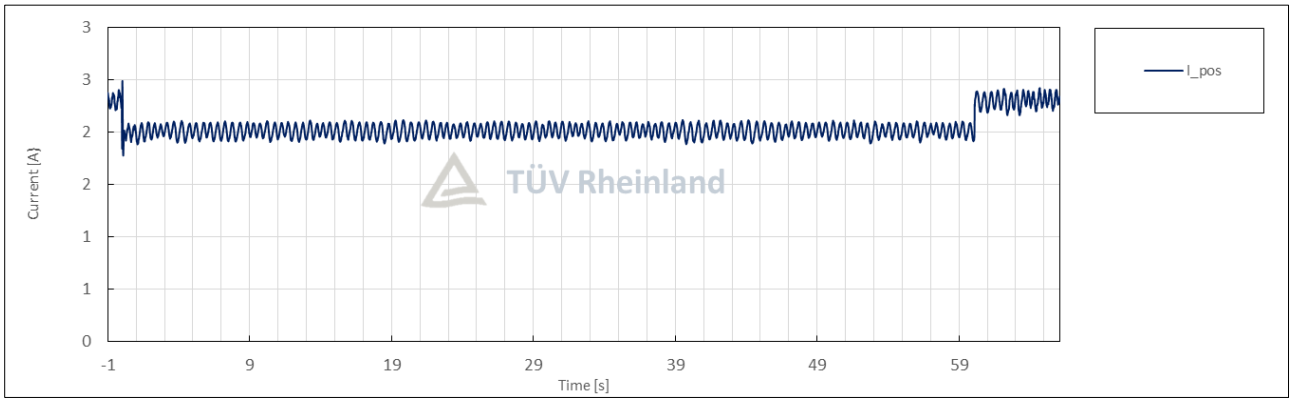

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland

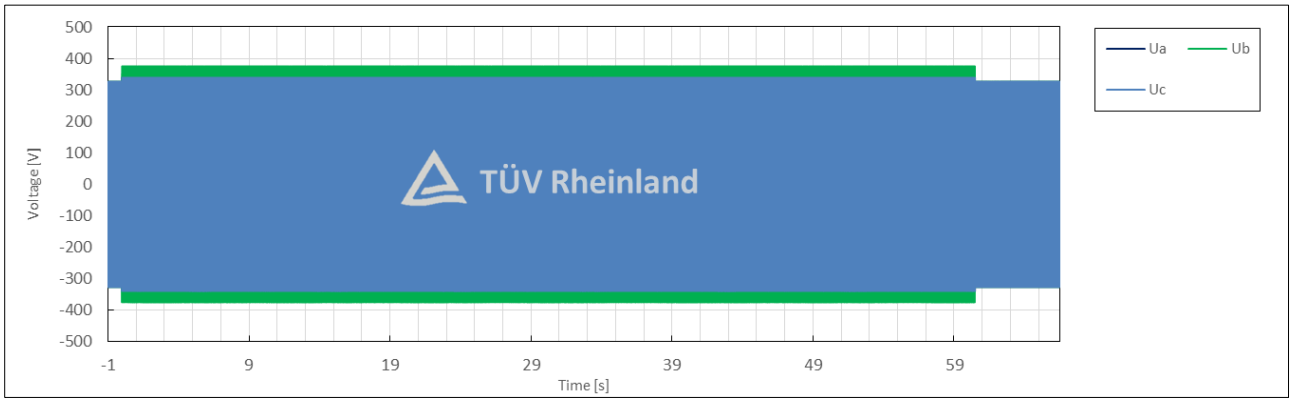

2500
2000
1500
1000
500
0
-500
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland

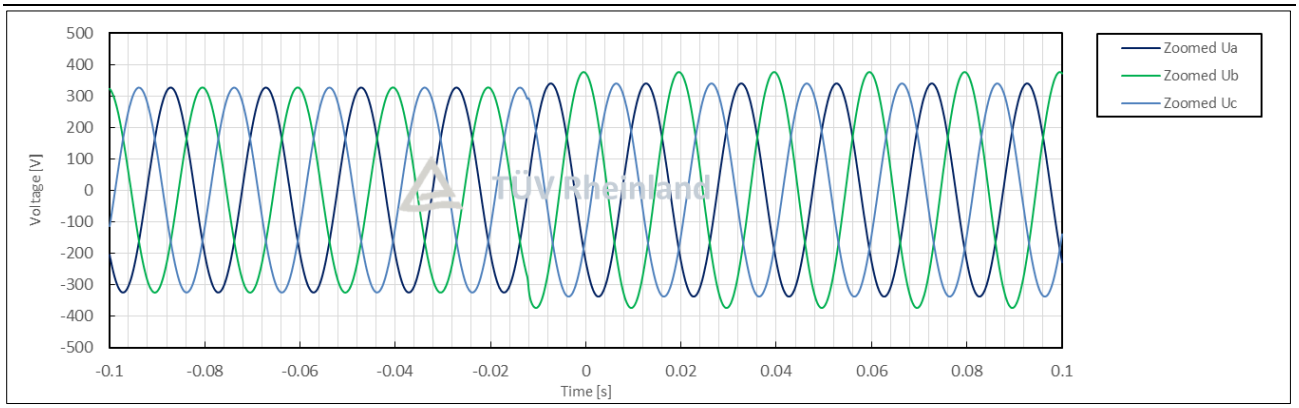

470
460
450
440
430
420
410
400
390
380
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland

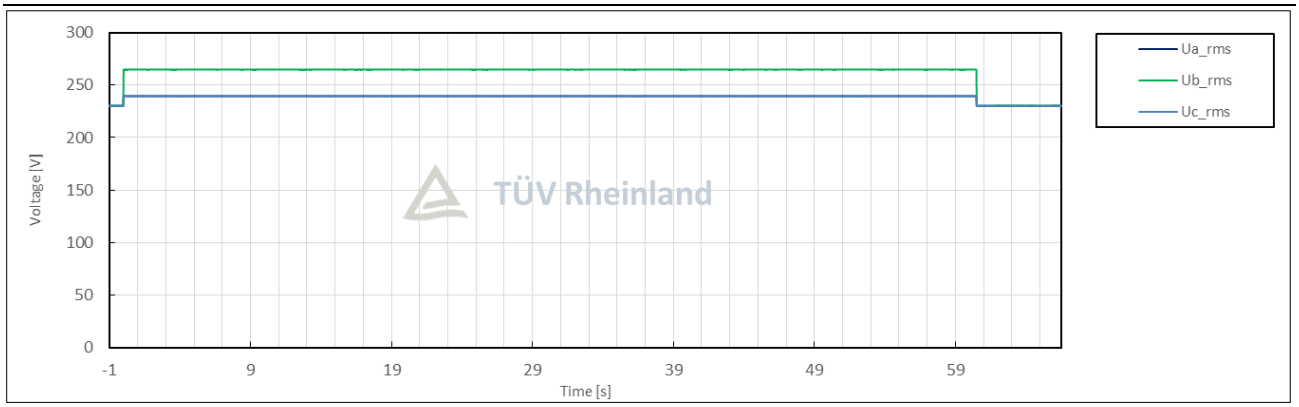

3
3
2
2
1
1
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.3
	1	Date	--	--	dd.mm.yyyy	06.14.2022
	2	Time (start of test)	--	--	hh:mm:ss.f	0:18:05
	3	Fault type (phase)	--	--		2-phase fault
	4	Setting voltage depth	Line to line	--	p.u.	1.15
	5	Setting dip duration		--		60498
	6	Point of fault entry	Total	--	ms	0
	7	Point of fault clearance	Total	--	ms	60498
	8	Fault duration in empty load test	Total	--	ms	60498
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.15
	10		Pos.		p.u.	1.08
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.00
	12	Current	Pos.	t1-500ms to t1-100ms	p.u.	1.00
	13	Active power	Total	t1-10s to t1	p.u.	1.00
	14		Pos.			1.00
	15	Reactive power	Total	t1-10s to t1	p.u.	0.02
	16		Pos.			0.02
	17	Cos_{φ}	--	t1-10s to t1	--	1.000
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.15
	19	Line current	Phase 1	t1+60ms	p.u.	0.85
	20		Phase 2			0.88
	21		Phase 3			0.87
	22	Line current	Phase 1	t1+100ms	p.u.	0.92
	23		Phase 2			0.96
	24		Phase 3			0.94
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	1.00
	26		Pos.			1.00
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00
	28	Active power	Total	t2+3s to t2+10s	p.u.	1.00
	29		Pos.			1.00
	39	Active power rising time	Pos.	--	s	N/A
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.02
	32		Pos.			0.02
	33	Reactive power rising time	Pos.	--	s	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	No

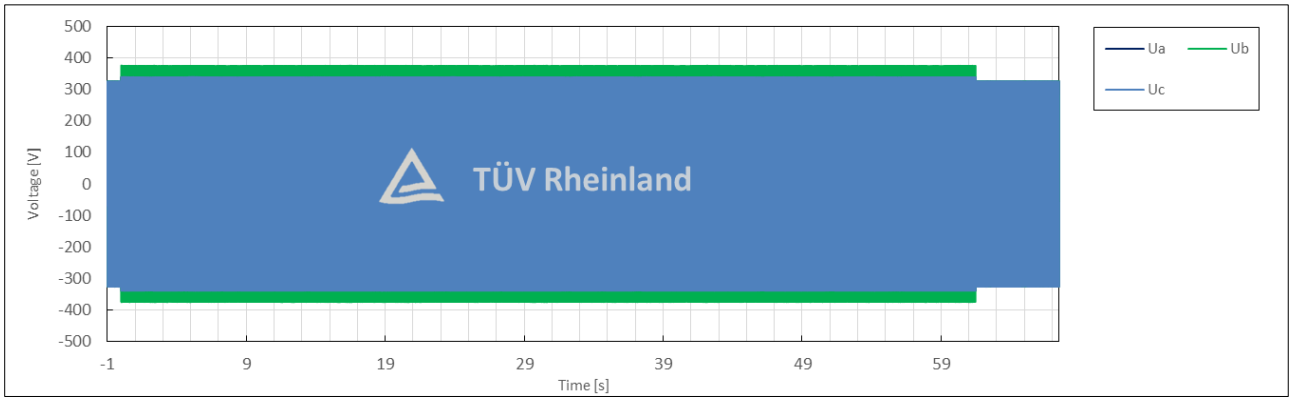
Test No. 7.3 idle test

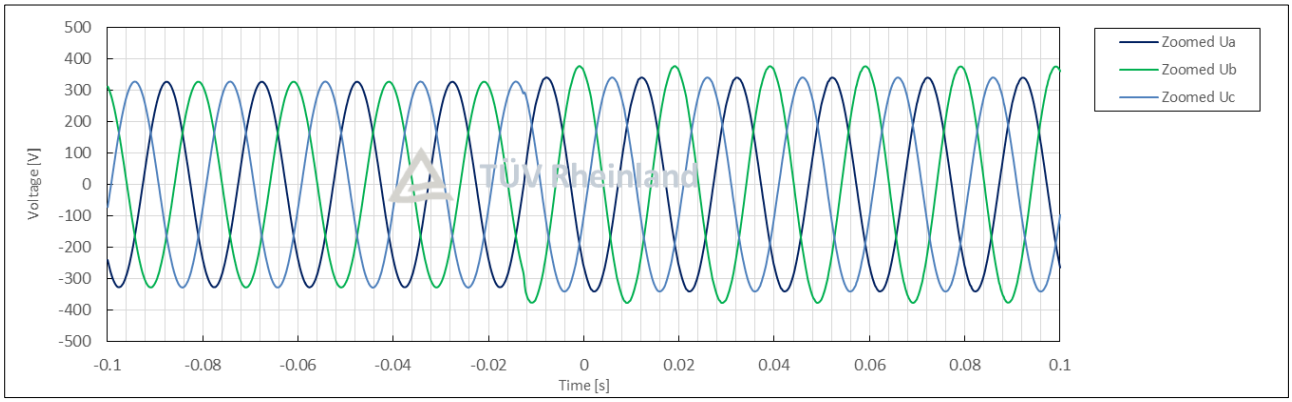


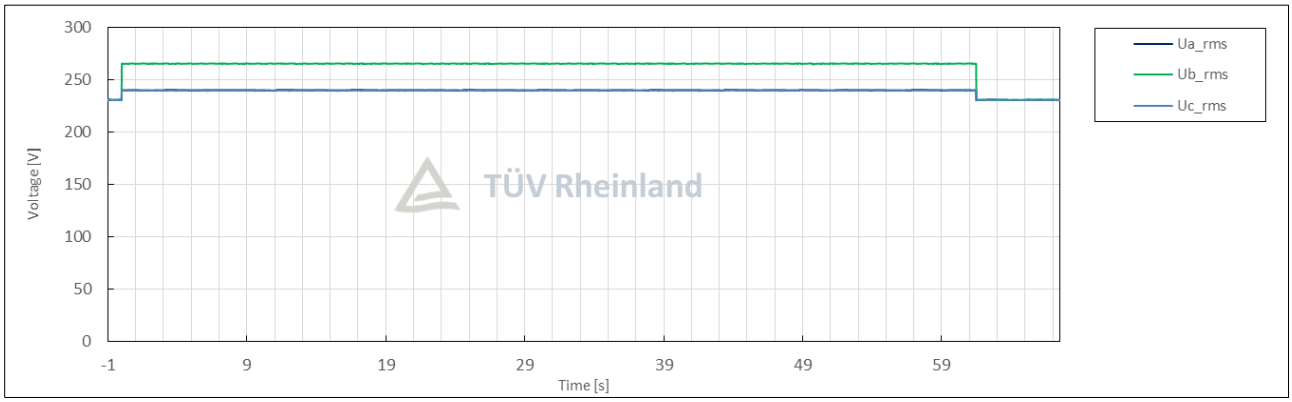


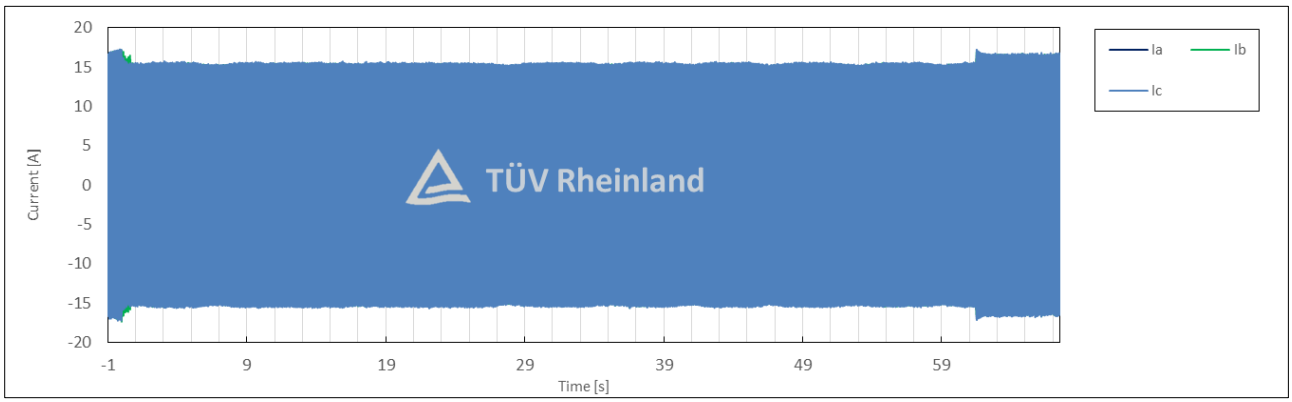


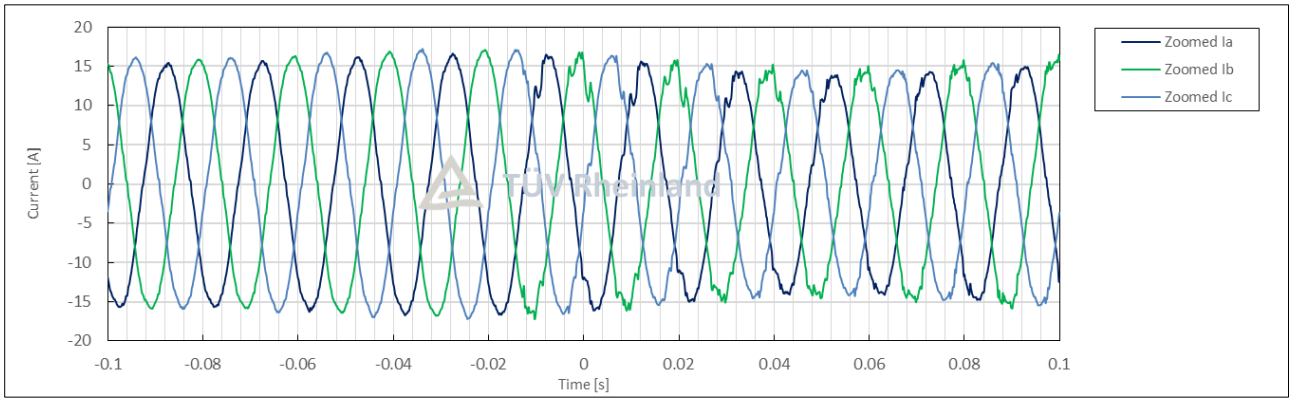
Test No. 7.3 with PGU

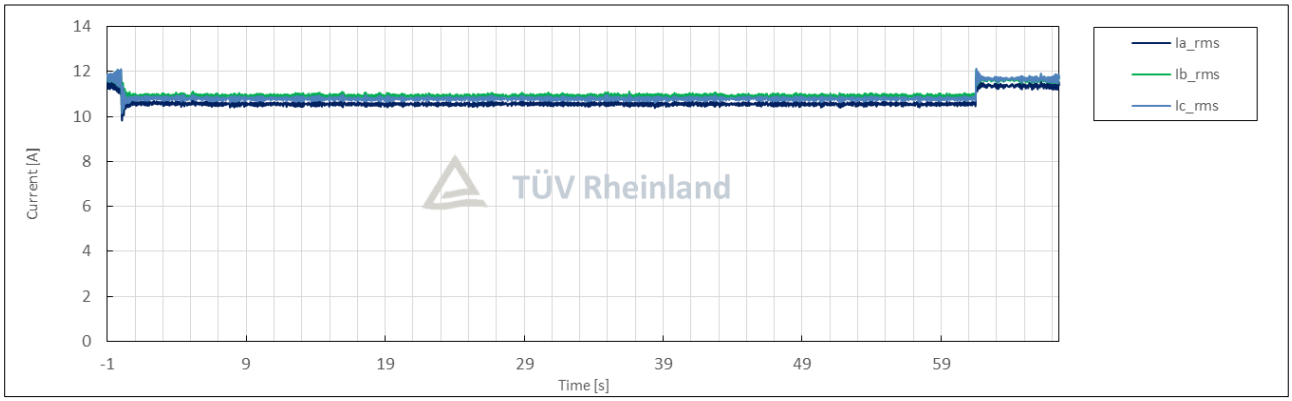


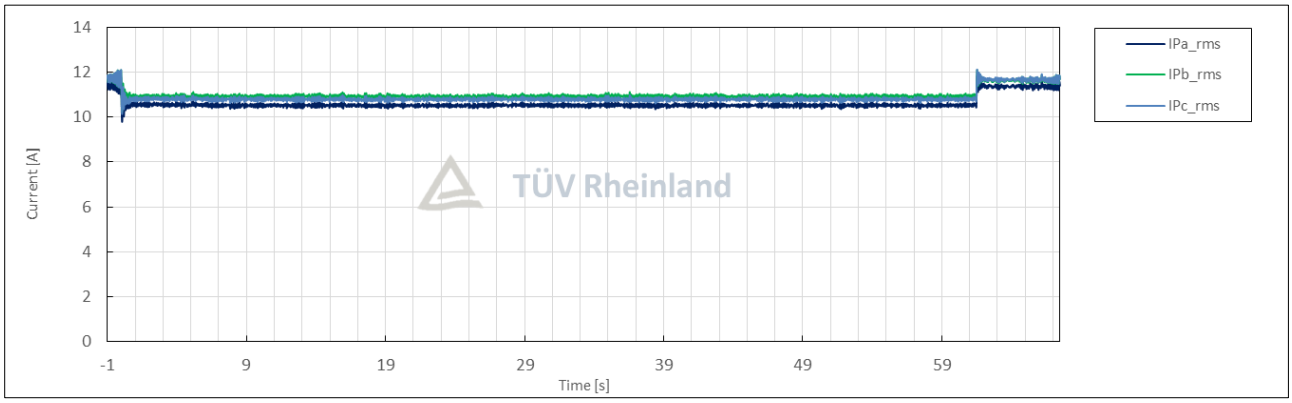


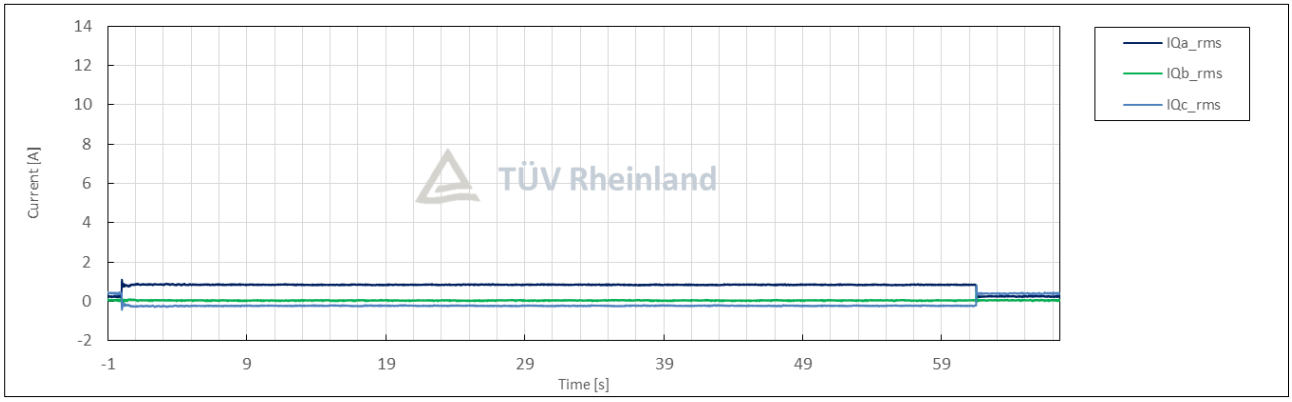


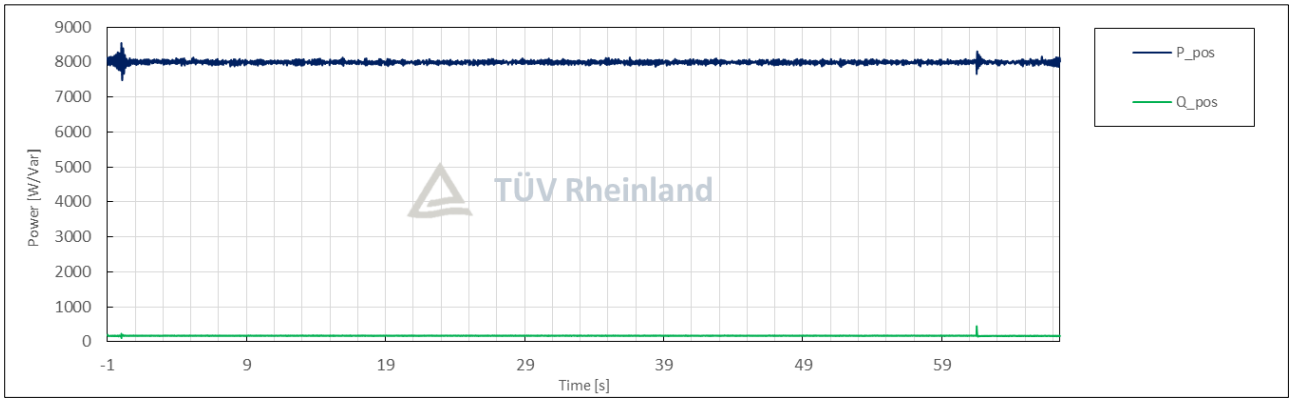


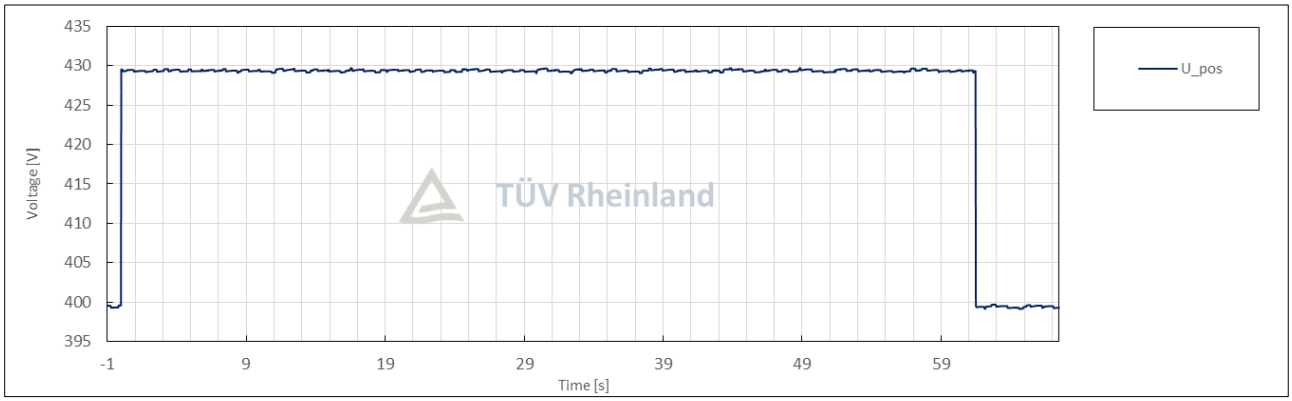

Zoomed Ia
Zoomed Ib
Zoomed Ic
Current [A]
Time [s]
TÜV Rheinland

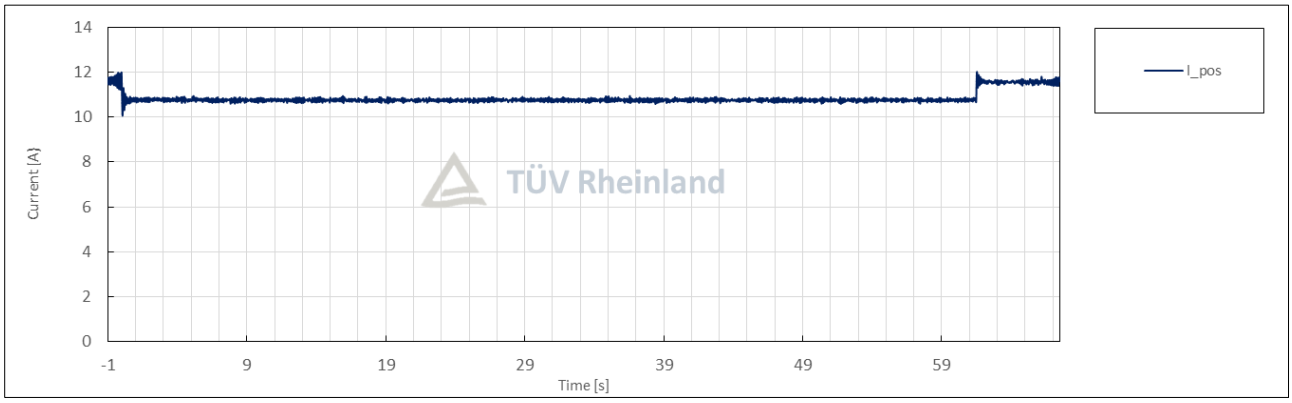

Ia_rms
Ib_rms
Ic_rms
Current [A]
Time [s]
TÜV Rheinland


IPa_rms
IPb_rms
IPc_rms
Current [A]
Time [s]
TÜV Rheinland


IQa_rms
IQb_rms
IQc_rms
Current [A]
Time [s]
TÜV Rheinland


9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Power [W/Var]
-1
9
19
29
39
49
59
Time [s]
P_pos
Q_pos
TÜV Rheinland


435
430
425
420
415
410
405
400
395
Voltage [V]
-1
9
19
29
39
49
59
Time [s]
U_pos
TÜV Rheinland


14
12
10
8
6
4
2
0
Current [A]
-1
9
19
29
39
49
59
Time [s]
I_pos
TÜV Rheinland

Revision History:

Date YYYY-MM-DD	Contents of modification (latest on top)	Prepared by	Approved by
2020-07-08	Originated and released into QM system	Tobias Yang	Weichun Li

TÜVRheinland®

PHOTO DOCUMENTATION

CN2283DK 003

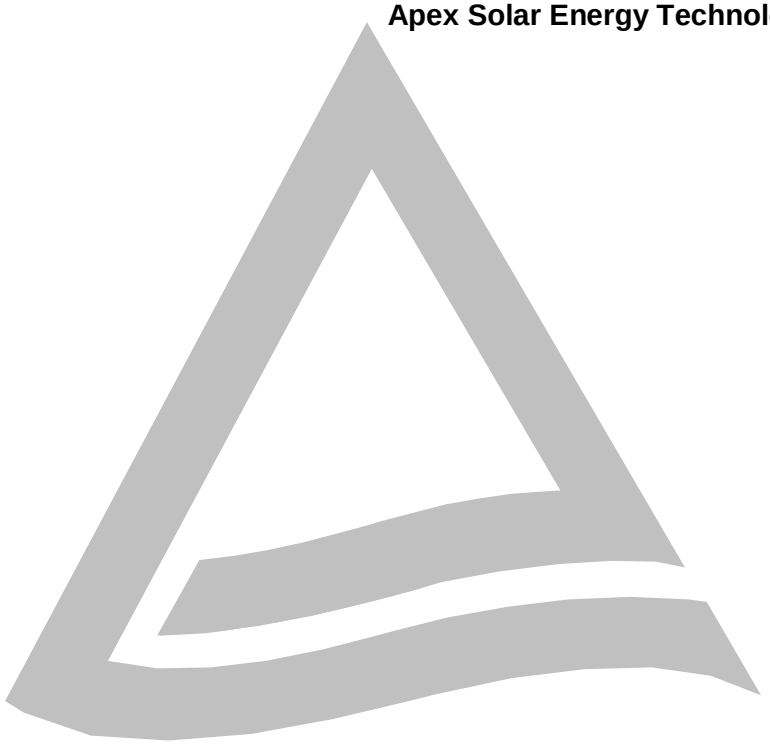
for

Grid-connected PV Inverter

APEX-P3-xx(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K),

APEX-P3-xx-G(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K)

Apex Solar Energy Technology GmbH

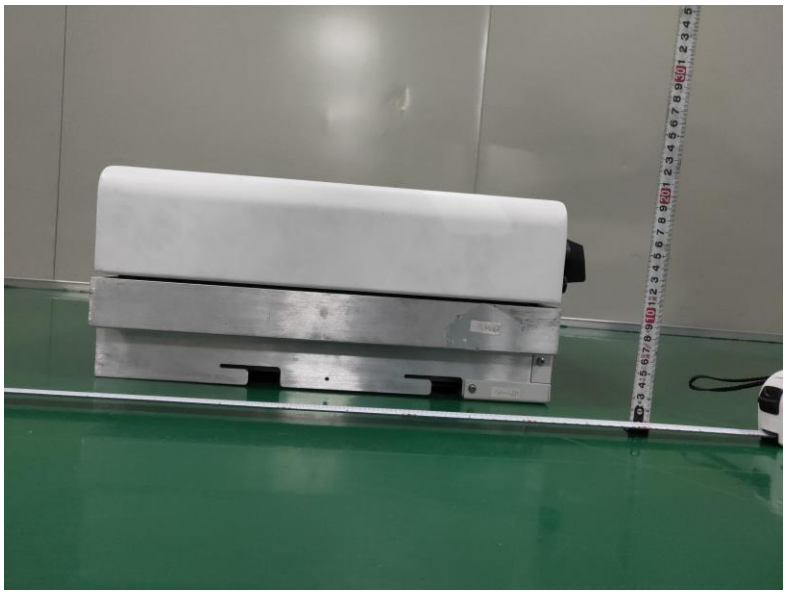


This documentation consists of 3 pages (excluding this cover page)

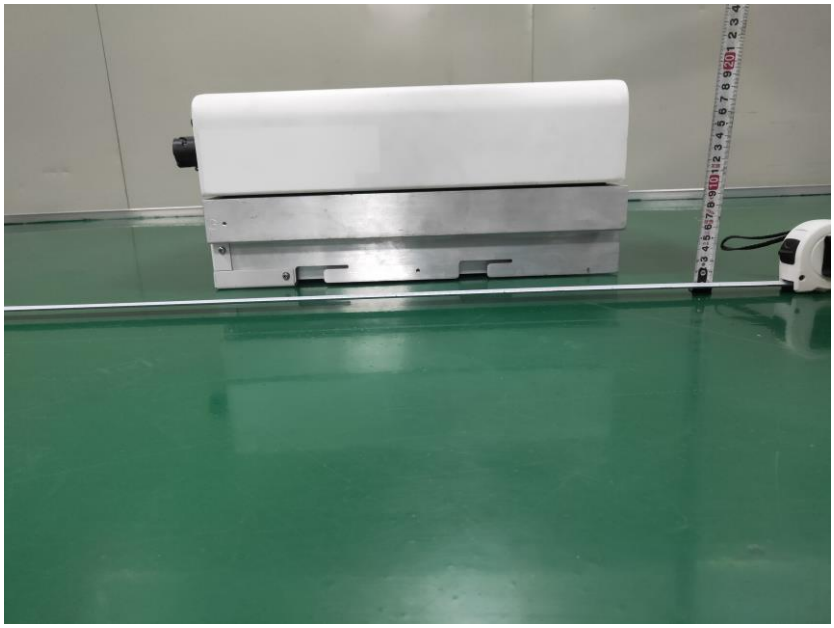
Report Number: CN2283DK 003

Model: APEX-P3-xx(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K), APEX-P3-xx-G(xx=3000, 4000, 5000, 6000, 7000, 8000, 9000, 10K, 12K, 15K)

Overall view

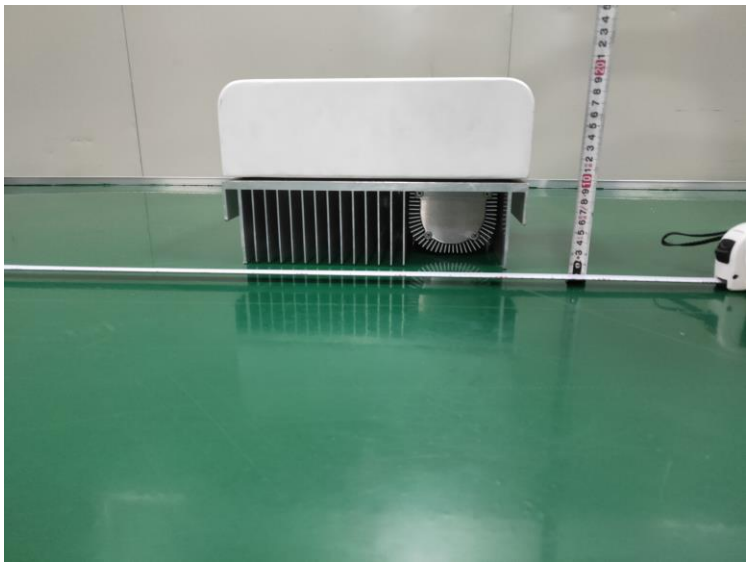


Side view 1



Side view 2

Bottom view



Top view

Back view