Prüfbericht - Produkte
Test Report - Products

Prüfbericht-Nr.: *Test report no.*:	CN24N4VE 001	**Auftrags-Nr.:** *Order no.*:	2505983	Seite 1 von 42 *Page 1 of 42*
Kunden-Referenz-Nr.: *Client reference no.*:	2542484	**Auftragsdatum:** *Order date:*	2023.08.14	
Auftraggeber: *Client*:	Langfang IN-Power Electric Co., Ltd. No.68 Lotus Rd, Economic&Technical Development Zone, Langfang, Hebei, 065001, P.R.China			
Prüfgegenstand: *Test item*:	Power Conversion System			
Bezeichnung / Typ-Nr.: *Identification / Type no.*:	INPPCS-100/0.4-W-14-C1-OS, INPPCS-100/0.4-W-24-C1-OS			
Auftrags-Inhalt: *Order content*:	AZ Certification			
Prüfgrundlage: *Test specification*:	AS/NZS 4777.2:2020 +A1:2021 *Grid connection of energy systems via inverters* *Part 2: Inverter requirements*			

Wareneingangsdatum: *Date of sample receipt*:	2023.08.16
Prüfmuster-Nr.: *Test sample no:*	A003653835-001
Prüfzeitraum: *Testing period*:	2023.12.21- 2024.01.20
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: Qi Liang*	X Qi Liang	**genehmigt von:** *authorized by:Chu Sun*	X Chu Sun
Datum: *Date:* 2024.02.24		**Ausstellungsdatum:** *Issue date:* 2024.02.24	
Stellung / Position:	Project Engineer	**Stellung** / Position:	Authorizer

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.: CN24N4VE 001
Test report no.:

Anmerkungen
Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. *The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.*
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3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. *Test clauses with remark of * are subcontracted to qualified subcontractors and descripted under the respective test clause in the report.* *Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.*
4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnisen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezueglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. *The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.*

Produktbeschreibung

Product description

List of test equipment

Equip.	Description	Model	Manufacturer
9017073	Power Analyser(DEWETRON)	DEWE2-PA7	Austria. DEWETRON
9017076	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
G1819279	PV array simulator	62150H-1000S	Chroma Co.
G1819278	PV array simulator	62150H-1000S	Chroma Co.
G1819280	PV array simulator	62150H-1000S	Chroma Co.

Rating Label :

Name: Power Conversion System	
Model: INPPCS-100/0.4-W-24-C1-OS	
Max. DC voltage	900V
DC voltage range	630-900V
Rated DC power	100kW
Max.DC power	110kW
Max. DC current	175A
Nominal AC voltage	3L/N/PE,400V/230V
AC voltage tolerance	-15%-+15%
Nominal frequency	50Hz
Rated AC power	100kW
Max. AC current	160A
Power factor	-0.99-+0.99
Protection Class	Class I
Degree of protection	IP20
Temperature range	-25-60°C (>45°C derating)
DRM	0

Name: Power Conversion System	
Model: INPPCS-100/0.4-W-14-C1-OS	
Max. DC voltage	900V
DC voltage range	630-900V
Rate DC power	100kW
Max. DC power	110kW
Max. DC current	175A
Nominal AC voltage	3L/N/PE,400V/230V
AC voltage tolerance	-15%- +15%
Nominal frequency	50Hz
Rated AC power	100kW
Max. AC current	160A
Power factor	-0.99-+0.99
Protection Class	Class I
Degree of protection	IP20
Temperature range	-25-60°C (>45°C derating)
DRM	0

Produktbeschreibung

Product description

General product information:

Product Description:

The main function of INPPCS-100/0.4-W-14-C1-OS and INPPCS-100/0.4-W-24-C1-OS is to charge and discharge battery components.The DC voltage range is 630V-900V, the AC voltage range is 340-460Va.c.

They can work at Grid-connected model to charge or discharge the battery, or work at Grid-disconnected model to supply the AC load with battery discharging, or work at standby model to wait for receiving operation instructions after grid-connected INPPCS is turned on.

See model list below for more information.

Differences of the models:

The two models: INPPCS-100/0.4-W-14-C1-OS and INPPCS-100/0.4-W-24-C1-OS have the same hard ware, the only difference is that the model INPPCS-100/0.4-W-14-C1-OS has a AC circuit breaker at AC side and INPPCS-100/0.4-W-24-C1-OS has no AC circuit breaker.

Table 2: Mode difference list

Reference Position	INPPCS-100/0.4-W-14-C1-OS	INPPCS-100/0.4-W-24-C1-OS	Comments
AC breaker	CM3-250C	NC	
Terminal block	NC	RD150-01-V-RT/DW80-02-02-C/DSTB150	

Unless otherwise specified, all tests were conducted on basic model of INPPCS-100/0.4-W-14-C1-OS to represent the other models.

The system diagram block is shown as below:

Produktbeschreibung
Product description

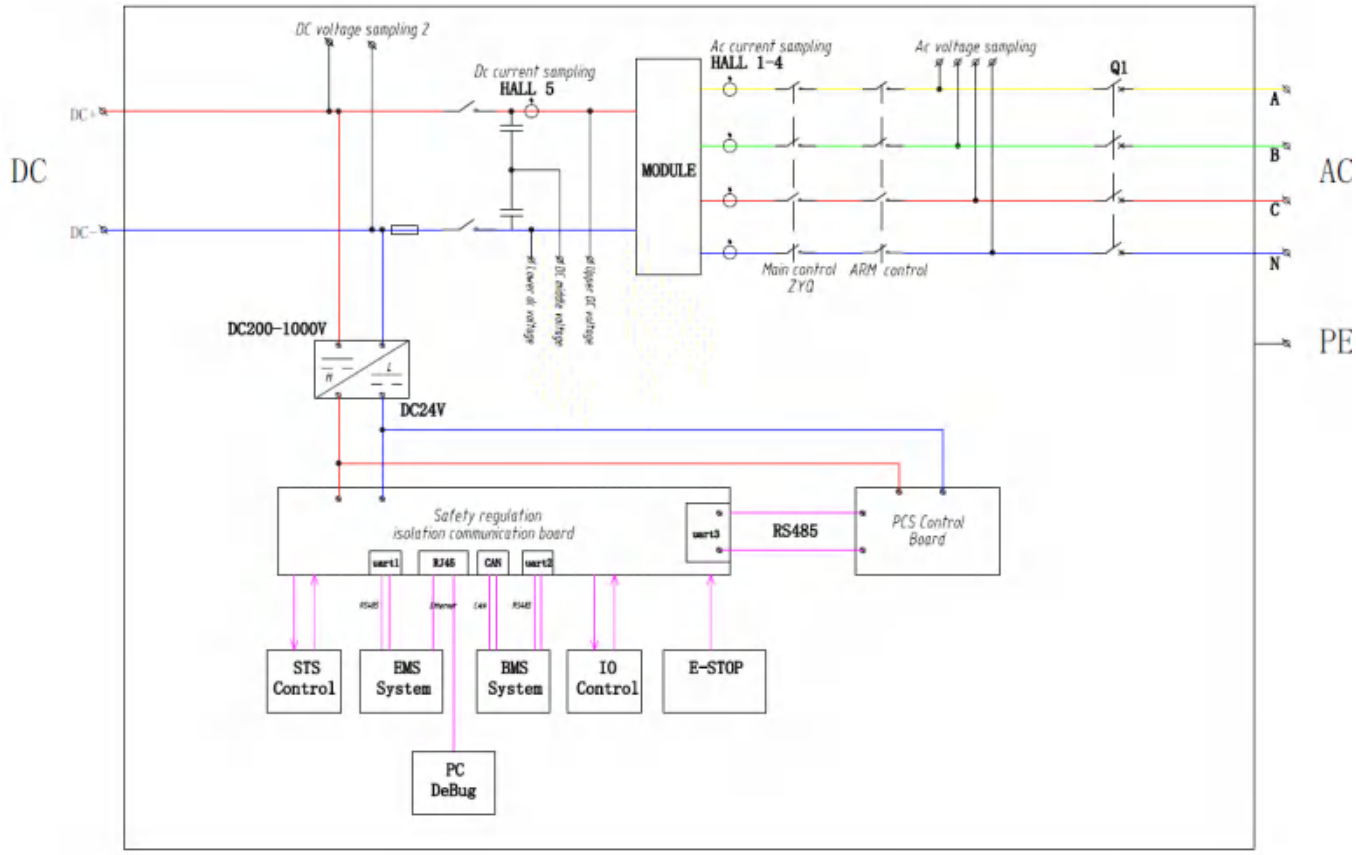


Figure 1 system block diagram of INPPCS-100/0.4-W-14-C1-OS

Produktbeschreibung
Product description

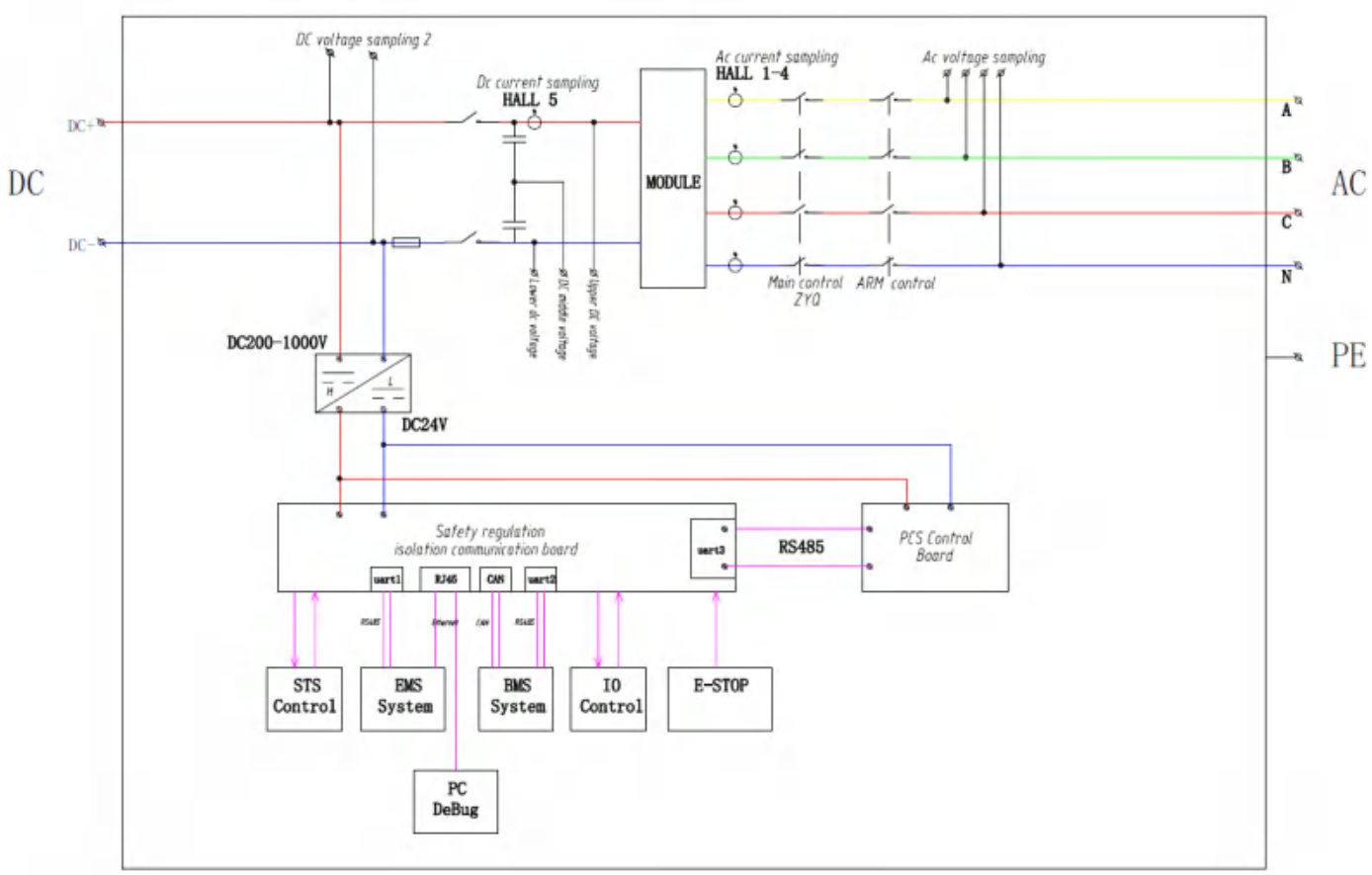


Figure 2 system block diagram of INPPCS-100/0.4-W-24-C1-OS

1) Definition of circuits inside of the Grid-connected PV Inverter.

I. PV input circuits

PV input circuits are directly connected to the PV array and the voltage can be up to 1100Vdc. Decisive voltage C considered for the PV voltage side.

II. AC output to the AC mains

AC output will be 230Vac.

Decisive voltage C considered for the AC voltage side.

III.Communication

The communication terminal (RS485/USB/DRM) can be communicated to COM-port.

Decisive voltage A considered for the communication side.

2) Isolation used in the product

Protective separation applied between decisive voltage A and decisive voltage C with corresponding overvoltage category.

3) Cooling method

Physical cooling by metal heat sink and internal fans as well as external fans.

4) Isolation between decisive voltage A and decisive voltage C

Reinforced insulation provided in the product to separate those two part

Produktbeschreibung
Product description

The product was tested on:
Software version: ARM 679.0 FPGA 78.0 ARM 2.11
Test condition:
Temperature: 25°C Relative humidity: 65%

Remote control:
INPPCS can be reserved with one RS485, one Ethernet interface and one CAN for communication between INPPCS and battery components, user local station or remote upper computer, and has Ethernet interface with Power station monitoring system.

Model list:

Model		INPPCS-100/0.4-W-14-C1-OS	INPPCS-100/0.4-W-24-C1-OS
DC Side	Max. DC voltage [Vd.c.]	900	900
	Min. DC voltage [Vd.c.]	630	630
	DC voltage range [Vd.c.]	630-900	630-900
	Max. DC current [Ad.c.]	175	175
	Rated DC power [kW]	100	100
	Max. DC power [kW]	110	110
	Rated conditional short-circuit current [Ad.c.]	30k	30k
	Overvoltage Category (OVC)	II	II
AC Side (Grid)	AC rated Input /Output active Power P_E [kW]	100	100
	AC rated Input /Output apparent Power P_E [kVA]	100	100
	Max. AC Input/Output current [Aa.c.]	160	160
	Nominal AC voltage Ur [Va.c.]	3L/N/PE, 400 /230	3L/N/PE, 400 /230
	AC voltage tolerance	-15%-+15%	-15%-+15%
	Nominal frequency/Frequency F_{NETZ} [Hz]	50 /60	50 /60
	Harmonic (THDi)	≤5% (at nominal Power), Linear load	≤5% (at nominal Power), Linear load
	Power factor	-0.99-+0.99, At nominal Power	-0.99-+0.99, At nominal Power
	Adjustable reactive Power	-100%–100%	-100%–100%

	range		
	Overvoltage Category (OVC)	III	III
AC Side (Off-Grid)	Nominal AC voltage Ur [Va.c.]	3L/N/PE, 400 /230	3L/N/PE, 400 /230
	AC voltage tolerance	AC 400 V ± 3%	AC 400 V ± 3%
	AC rated Input /Output apparent Power P_E [kVA]	100	100
	Max. AC Input/Output current [Aa.c.]	160	160
	Harmonic THDu	≤3%, Linear load	≤3%, Linear load
	DC voltage component	<0.5%, Linear load	<0.5%, Linear load
	Unbalance load capacity	100%	100%
	Nominal frequency/Frequency F_{NETZ} [Hz]	50 /60	50 /60
System Parameters	Type of Inverter	Non-isolated	Non-isolated
	Battery Type	Li-ion or lead-acid Battery	Li-ion or lead-acid Battery
	Max. efficiency	>98%	>98%
	Communication	RS485, CAN, Ethernet	RS485, CAN, Ethernet
	Enclosure Dimensions (W * H * D)	480 mm × 260 mm × 620 mm (Cabinet size), 480 mm × 260 mm × 720 mm (added circuit breaker size)	480 mm × 260 mm × 620 mm, Cabinet size
	Weight	70 kg	70 kg
	Degree of protection	IP20	IP20
	Operating ambient temperature [°C]	-25-60 (>45 derating)	-25-60 (>45 derating)
	Allowable relative humidity	RH ≤95%	RH ≤95%
	Cooling method	Forced air cooling	Forced air cooling
	Max. operating altitude	4,000 m (>2,000 m derating)	4,000 m (>2,000 m derating)
	Pollution degree	2	2

Produktbeschreibung

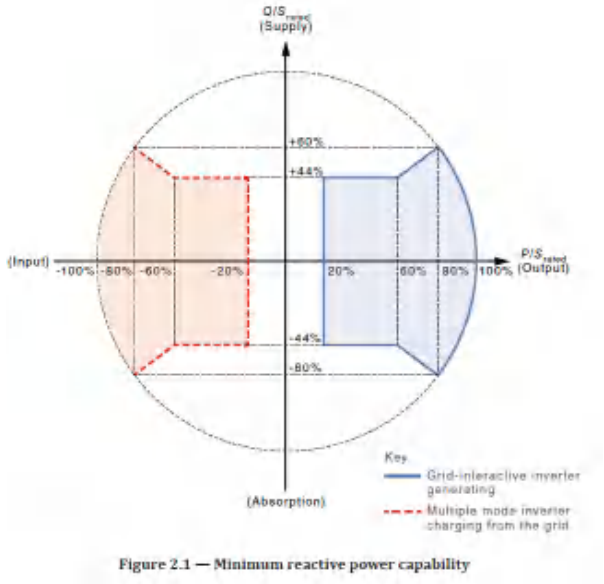
Product description

	Software version	ARM 679.0 FPGA 78.0 ARM 2.11	ARM 679.0 FPGA 78.0 ARM 2.11

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
2.1	General		P
	This Standard does not prevent the use of materials, methods of assembly, procedures, or additional functions and the like that are not specifically included in the requirements of this Standard, or are not mentioned in it, provided the minimum safety, functional and performance requirements specified herein are met.		P
2.2	Electrical safety		P
	Inverters for use in inverter energy systems with photovoltaic (PV) arrays and/or batteries shall conform to IEC 62109-1 and IEC 62109-2, and the requirements within this Standard.	IEC 62109-1/-2 complied. See IEC 62109-1/2 test report： CN24636U 001	P
	Throughout IEC 62109-1 and IEC 62109-2, the term “power conditioning equipment (PCE)” is used. For the purposes of this Standard, “PCE” shall be replaced with the term “inverter”.		P
	Inverters for use in inverter energy systems that have energy storage (batteries) as the only possible energy source shall conform to the electrical safety requirements of IEC 62477-1, and the requirements within this Standard.		P
	Inverters for use in inverter energy systems that incorporate energy sources other than photovoltaic (PV) arrays or batteries shall conform to IEC 62477-1, and the requirements within this Standard.		P
	Throughout IEC 62477-1, the term “power electronic converter system (PECS)” is used. For the purposes of this Standard, “PECS” shall be replaced with the term “inverter”.		P
2.3	Provision for external connections		P
2.3.1	General		P
	Inverters shall be used and installed as fixed equipment only. Inverters shall not be used as portable equipment.		P
	The inverter shall be connected in accordance with Clause 2.3.3.2. Inverter provisions for external connection —		P
	(a) shall be for fixed equipment only; and	Fixed equipment.	P
	(b) shall provide for safe and reliable connection to any d.c. source or load or any a.c. source or load.	Certified DC and AC connector.Tool.	P
	All inverter ports (except communications ports) shall incorporate connection types for either —		P
	(i) permanently connected equipment (see Clause 2.3.2); or	Permanently connected.	P
	(ii) pluggable type B equipment (see Clause 2.3.3). Inverter source or load connections shall not incorporate connection types for pluggable type A equipment.		N/A
2.3.2	Permanently connected equipment		P

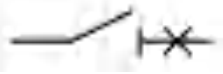
Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Permanently connected inverters shall have terminals for connection to fixed installation wiring.	Certified DC and AC connector. Tool.	P
2.3.3	Pluggable type B equipment		N/A
2.3.3.1	General		N/A
	Pluggable type B equipment shall have one of the following means of connection:		N/A
	(a) A non-detachable cord for connection to the electrical installation by means of a connector.		N/A
	(b) An appliance inlet that can be connected to a matching connector.		N/A
	Pluggable type B equipment shall not incorporate —		N/A
	(i) a connection by a connector or inlet conforming to any of the dimensional sheets of AS/NZS 60320.1;		N/A
	(ii) a connection by a plug conforming to AS/NZS 3112; or		N/A
	(iii) a connection by a connector or inlet where hazardous voltages are accessible by the standard test finger. NOTE The standard test finger is the same as that used in IEC 62109-1.		N/A
2.3.3.2	Electric vehicle connections		N/A
	Pluggable type B equipment for an electric vehicle used in an inverter energy system connected via flexible lead with a plug shall —		N/A
	(a) be Mode 3 or Mode 4 in accordance with IEC 61851-1;		N/A
	(b) utilize a Case C connection as per IEC 61851-1 between the fixed electric vehicle supply equipment and the electric vehicle; and		N/A
	(c) utilize connectors that comply with AS IEC 62196.2 in the case of Mode 3 or IEC 62196-3 in the case of Mode 4.		N/A
2.4	Earth fault/earth leakage detection		P
2.4.1	Photovoltaic (PV) array earth fault/earth leakage detection		P
	For inverter energy systems used with PV array systems that require earth fault detection and residual current detection, either internal or external to the inverter, the type of detection used shall be declared in accordance with IEC 62109-1 and IEC 62109-2.		P
	If an external residual current device (RCD) is required, the manufacturer's installation instructions shall state the need for an RCD and shall specify its rating, type and required circuit location in accordance with Section 7.		N/A
	Compliance shall be checked by inspection of the inverter's markings and manufacturer's documentation, and testing in accordance with IEC 62109-2.	See IEC 62109-2 report CN24636U 001	P
	Where the additional detection for functionally earthed PV arrays, as required by AS/NZS 5033, is present in the inverter, this additional detection shall, before start-up of the system —		N/A
	(a) open circuit the functional earth connection to the PV array;		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(b) measure the resistance to earth of each conductor of the PV array;		N/A
	(c) if the earth resistance is above the resistance limit (Riso limit) threshold specified in Table 2.1, the system shall reconnect the functional earth and shall be allowed to start; and		N/A
	(d) if the earth resistance is equal to or less than the resistance limit (Riso limit) threshold specified in Table 2.1, the inverter shall shut down and initiate an earth fault alarm in accordance with the requirements of IEC 62109-2. NOTE 1 Direct functional earthing of systems is not recommended. Functional earthing via a resistor is a safer option wherever it is possible.		N/A
2.4.2	Battery Energy Storage System (BESS) earth fault/earth leakage detection		P
	For inverters used with battery systems, the requirements for earth fault alarm monitoring of AS/NZS 5139 may apply. Where an inverter has a port for connecting a battery system installation that requires an alarm for monitoring of earth faults in conformance to AS/NZS 5139, the inverter should provide an alarm. Where no alarm is provided in the inverter, the inverter documentation shall require the addition of an external alarm and monitoring device. The inverter documentation should refer to the battery system manufacturer's instructions for earth fault monitoring and earth leakage levels that indicate a fault.		P
2.5	Compatibility with electrical installation		P
	The inverter shall be compatible with wiring practices for LV electrical installations of AS/NZS 3000 and variations as required in AS/NZS 4777.1. The inverter a.c. voltage and frequency operation shall conform to the limits specified in AS 60038.		P
	NOTE The inverter needs to have a.c. voltage and frequency ratings compatible with Australian and New Zealand electrical supply regulations as a minimum requirement. In Australia, the voltage ranges present on electrical distribution networks may be in accordance with AS 61000.3.100. In New Zealand, the voltage range is specified in Electricity (Safety) Regulations 2010 (NZ) and is less than the limit specified in AS 60038.		P
2.6	Reactive power capability	Complied.	P
	The inverter shall be capable of absorbing or supplying at least the specified reactive power of Clause 3.3 down to a power factor of 0.8 for all active power output or input levels above 60 % of rated apparent power. Where the active power output or input level is between 20 % and 60 % of rated apparent power, the inverter shall be capable of absorbing or supplying reactive power of at least 44 % of rated apparent power. Where the active power output or input level is below 20 % of rated apparent power, reactive		P

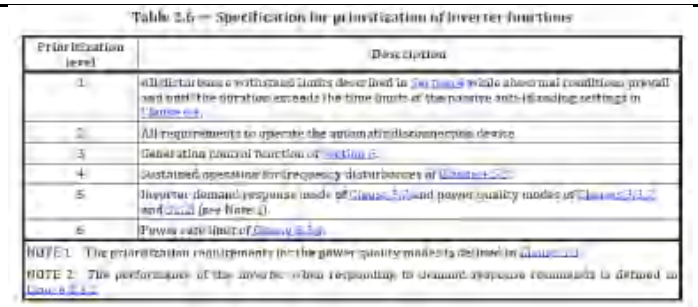
Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	power being absorbed or supplied may be reduced due to limitation of inverter power factor capabilities. The minimum reactive power capability requirement is shown in Figure 2.1.		
	NOTE For inverter active power output or input below 20 % of rated apparent power, the reactive power may be controlled such that the vars supplied or absorbed are less than the amount of vars supplied or absorbed at 20% of rated apparent power output or input.		P
	 Figure 2.1 — Minimum reactive power capability		P
2.7	Harmonic currents	Complied	P
	The harmonic currents of the inverter shall not exceed the limits specified in Tables 2.2 and 2.3 and the total harmonic current distortion (ITHD) to the 50th harmonic shall be less than 5 %.		P
	Compliance shall be determined by type testing in accordance with the harmonic current limit test specified in Appendix B.	See appendix B.	P
	NOTE The inverter should not significantly radiate or sink frequencies used for ripple control by the local electrical distributor. The distributor should be consulted to determine which frequencies are used. Fitting of additional filtering components may be required in some grid areas.	To be determined in final installation.	N/A
2.8	Voltage fluctuations and flicker	Complied	P
	The inverter shall conform to the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 for equipment with rated current less than or equal to 16 A per phase (a.c.). For equipment with rated current greater than 16 A per phase (a.c.), if the inverter cannot meet the requirements of AS/NZS 61000.3.3, the maximum permissible connection point impedance (*Z*max) shall be determined such that the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 can be met. The impedance shall be determined in accordance with the methods given in AS/NZS 61000.3.11.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	The values of *P*st and *P*lt, when tested using *Z*ref, and the network impedance value (*Z*max or *Z*ref) required for compliance shall be included in the inverter documentation. NOTE Definitions of Pst and Plt and the value of Zref are given in AS/NZS 61000.3.3.		
	Compliance shall be determined by testing in accordance with the relevant Standard. The inverter shall remain connected throughout the test and the automatic disconnection device shall not operate.	See Appendix.	P
2.9	Transient voltage limits	Complied.	P
	To prevent damage to electrical equipment connected to the same circuit as the inverter, disconnection of the inverter from the grid shall not result in transient overvoltages beyond the limits specified in Table 2.4.		P
	Compliance shall be determined by type testing in accordance with the transient voltage limit test specified in Appendix C. The voltage-duration curve is derived from the measurements taken at the grid-interactive port of the inverter. The transient voltage limits listed in Table 2.4 are graphically illustrated in Figure 2.2.	See appendix C for detail.	P
2.10	DC current injection	Complied.	P
	In the case of a single-phase inverter, the d.c. current output of the inverter at any a.c. port including the grid-interactive and/or stand-alone port shall not exceed 0.5 % of the inverter's rated current or 5 mA, whichever is the greater. In the case of a three-phase inverter, the d.c. current output of the inverter at any a.c. port, including the grid-interactive and/or stand-alone port, measured in each of the phases, shall not exceed 0.5 % of the inverter's per-phase rated current or 5 mA, whichever is the greater. If the inverter does not incorporate a mains frequency isolating transformer or is not used with a dedicated external isolation transformer, it shall be type tested to ensure the d.c. current output at any a.c. port of the inverter is below the limits specified above at all current output levels.		P
	Compliance shall be determined by type testing in accordance with the d.c. current injection test specified in Appendix D.	See appendix D for detail.	P
	NOTE For any inverter capable of injecting d.c. fault current into the electrical installation the selection of an RCD, where required, needs to be such that the RCD operates correctly with the level of d.c. fault current being injected.	To be determined in final installation.	N/A
2.11	Current balance for three-phase inverters		P
	In the case of a three-phase inverter the a.c. current output shall be generated and injected into the three-phase electrical installation as a three-phase balanced current.		P
	Compliance shall be determined by type testing in accordance with the following requirement. The a.c.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	current output for each phase for three-phase balanced current shall be within 5 % of the measured value of the other phases at rated current when injected into a balanced three-phase voltage.		
	Inverters which can be used in a voltage balance mode, as defined in Clause 3.3.2.4, are allowed to generate unbalanced currents.		P
2.12	Isolation of energy sources		P
2.12.1	General		P
	Where an energy source port has a load break switching device that is part of and within the inverter and is part of the method for isolating the energy source, the load break switching device/s shall —	the energy input ports has installed load breaking switch device.	P
	(a) have a voltage rating equal to or greater than the inverter's maximum voltage rating for that port;		P
	(b) interrupt all live conductors simultaneously;		P
	(c) be able to be secured in the open position and only secured when the main contacts are in the open position;		P
	(d) be either a switch disconnector that conforms to Clause 2.12.2 or a circuit breaker that conforms to Clause 2.12.3;	Complied.	P
	(e) conform to additional requirements of Clause 2.12.4 for PV array energy source;		P
	(f) conform to additional requirements of Clause 2.12.5 for battery system energy sources; and		N/A
	(g) for all energy sources other than those listed in Items (e) and (f) be rated for a.c. or d.c. operation per the port type, and if d.c. rated be a non-polarized type.		P
	Where a load break switching device is part of and within the inverter, and forms part of the method for isolating the energy source/s, there shall be a warning label to isolate energy source/s prior to removal of any cover for maintenance or repair.		P
	Documentation of permitted and safe access (including isolation) to inverters for maintenance and repair shall be included in manuals.		P
	Combination fused switch disconnectors or fused circuit breakers shall not be used as the load break switching device as part of or within the inverter. Where any load break switching device is part of and within the inverter and does not meet the requirements of this Clause (2.12.1) a warning label shall be used to indicate that an additional external load break switching device is required. Documentation for an inverter that requires an external load break switching device shall include the requirement of an additional external load break switching device that conforms to the requirements AS/NZS 4777.1.		N/A
2.12.2	Switch-disconnector		N/A
	Where a load break switching device that is part of or within the inverter is a switch disconnector, it shall —		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(a) be rated for independent manual operation;		N/A
	(b) be classified as suitable for disconnection and be marked with the following symbol:		N/A
	(c) have a utilization category of at least DC-21B where the port is suitable for a d.c. energy source;		N/A
	(d) have a utilization category at least AC-21B where the port is suitable for an a.c. energy source;		N/A
	(e) conform to relevant switch-disconnector standards as specified for the port and rating criteria in Clauses 2.12.4 or 2.12.5;		N/A
	(f) have a current rating where rated operational current (*Ie)* and *I(make),* and *Ic(break)* rated current are rated such that the disconnector is capable of interrupting the maximum rated normal and fault current for that port as specified in the inverter documentation; and		N/A
	(g) have a current rating for the thermal current (*I*the and *I*the solar) rated for the installation environment specified by the manufacturer.		N/A
2.12.3	Circuit breaker		N/A
	Where a load break switching device that is part of or within the inverter is a circuit breaker, it shall —		N/A
	(a) conform to AS/NZS IEC 60947.2; and		N/A
	(b) be classified as suitable for isolation and be marked with the following symbol: 		N/A
2.12.4	PV array ports		N/A
	For inverters with an apparent power rating of less than 30 kVA the isolating devices for PV array ports that are part of or within the inverter shall conform to the requirements of AS 60947.3 for switch disconnectors for photovoltaic (PV) d.c. applications.		N/A
	For inverters with an apparent power rating of 30 kVA or more the isolating devices for PV array ports		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	as a part of or within the inverter shall conform to AS 60947.3 for switch-disconnectors for photovoltaic (PV) d.c. applications with the following modifications:		
	(a) have a minimum utilization category of DC-PV1;		N/A
	(b) for inverters with IP6x or greater, have at least pollution degree 2; and		N/A
	(c) where the utilization category is DC-PV1, have a continuous backfeed current as tested by IEC 62109-1 of less than 0.3 A.		N/A
2.12.5	Battery system ports		N/A
	Isolating devices for battery system ports that are part of or within the inverter shall meet the following additional requirements:		N/A
	(a) Shall conform to AS 60947.3.		N/A
	(b) Shall be of the non-polarized type.		N/A
	(c) Shall have a current rating equal to or greater than the maximum rated d.c. current for the battery system port.		N/A
	(d) Shall have a utilization category of at least DC-21B. NOTE Other d.c. energy ports may be treated the same as a battery system port.		N/A
2.13	Measurement accuracy	Complied	P
	To ensure the stable and reliable operation of the inverter protective functions and all modes of operation, the inverter shall conform to or exceed the measurement and calculation accuracy requirements specified in Table 2.5. Where the inverter utilizes an external measurement device, the measurement and calculation accuracy of the system (including the combination of the inverter and external measurement device) shall conform to the measurement and calculation accuracy requirements specified in Table 2.5. Table 2.5 – Specification for measurement and calculation accuracy 		P
2.14	Prioritization of protection and operational modes	Complied.	P
	Inverters responding to abnormal voltage or frequency conditions shall meet the prioritization levels of Table 2.6.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
			
2.15	Firmware	See model list	P
	The inverter firmware determines the functioning of an inverter as well as responses required by this Standard. The functions may be spread over multiple programmable devices. The inverter firmware may change over the life of a specific inverter model.		P
	The inverter firmware version shall be reported in testing. The inverter firmware version identifier shall be accessible for inspection. Inverter firmware version information may be displayed via a panel/screen, external device or software interface.		P
	Inverter firmware changes and updates shall conform to the requirements of this Standard. Where an inverter firmware update affects any of the provisions specified in Sections 2, 3, 4 and 5 conformance with this Standard shall be determined.	To be determined in updating.	N/A
3.1	General		P
	Unless otherwise stated, the modes in the following Clauses are for the grid-interactive port of the inverter.		P
3.2	Inverter demand response modes (DRMs)	See appendix E.	P
3.2.1	General		P
	The inverter shall support the demand response mode DRM 0 of Table 3.1. The inverter should support the other demand response modes of Table 3.1. NOTE 1 The only mandatory demand response mode is DRM 0. Support for other demand response modes is optional.	Only DRM0 supported. See appendix E for detail.	P
	The inverter shall detect and initiate a response to all supported demand response commands within 2 s. The inverter shall continue to respond while the mode remains asserted.		P
	The inverter shall conform to the relevant requirements of Section 2 and this Section (3), and with all of the requirements of Section 4, while any demand response mode is asserted and following the cessation of a demand response command.		P
	The inverter shall be capable of responding to demand response commands via a demand response enabling device (DRED) as defined in Clause 3.2.2.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Compliance shall be determined by testing as specified in Appendix E.		P
	NOTE 2 The demand response modes may be provided via an integrated device or an external device, where DRM 0 meets the requirements of Clause 4.1. Only integrated devices and external devices providing DRM 0 are applicable for testing in this Standard.	Integrated.	P
3.2.2	Interaction with demand response enabling device (DRED)		P
	The inverter shall have a means of connecting to a DRED. This means of connection shall include a terminal block or RJ45 socket. The terminal block or RJ45 socket shall conform to the minimum electrical specifications in Table 3.2. The terminal block or RJ45 socket may be physically mounted in the inverter or in a separate device that remotely communicates with the inverter.	RJ45	P
	NOTE 1 In the absence of a DRED, the inverter may be fitted with a DRED bypass device.		P
	NOTE 2 RJ45 is the common name for the 8P8C modular connector specified in ISO/IEC 8877, which is generally used to terminate communications cables.		P
	NOTE 3 Where a separate device that remotely communicates with the inverter is used then other methods are possible using a range of different communications systems and protocols in the inverter or external. Provided that this still allows the inverter to interact with the DRED.		P
	(a) The inverter shall not inject more than 30 mA (d.c. or a.c.) into — (i) terminals “DRM1/5”, “DRM2/6”, “DRM3/7” or “DRM4/8”, where a terminal block is used; or (ii) pins 1, 2, 3 or 4, where an RJ45 socket is used.		P
	(b) The inverter shall allow for a drop of up to 1.6 V across the DRED and associated wiring when nominally shorted.		P
	(c) The inverter shall not supply more than 34.5 V (d.c. or a.c.) to any terminal of the terminal block or RJ45 socket.		P
	(d) If the impedance between pins 5 and 6 is detected to be above 20 kΩ, the inverter shall failsafe to DRM 0 asserted.		P
	The DRED may assert more than one DRM at a time, in which case the requirements of every active DRM that is supported by the inverter shall be simultaneously satisfied.		P
	The inverter shall detect the assertion of any combination of DRMs which result in terminal 5 and 6 being shorted simultaneously as assertion of DRM 0.		P
	Where DRM 3 or DRM 7 are supported, the reactive power set-point shall be set by default to operate at unity power factor. The reactive power set-point should be adjustable up to a minimum of 60 % of the inverter’s kVA rating.		N/A
	The inverter may provide a power supply for use by the DRED. If included this shall be d.c. and of a voltage less than 34.5 V.		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Where an RJ45 socket is used, pins 7 and 8 may be utilized as positive and negative DRED power supply pins respectively. The power supply shall be capable of delivering at least 0.5 A at a minimum of 6 V d.c., otherwise the inverter shall short pins 7 and 8 together.		P
	Where a terminal block is used, only those terminals needed for the supported DRMs are required.		N/A
3.3	Inverter power quality response modes		P
3.3.1	General		P
	The inverter shall have the following power quality response modes:		P
	(a) Volt-var response mode (Clause 3.3.2).		P
	(b) Volt-watt response mode (Clause 3.3.2).		P
	(c) Fixed power factor (Clause 3.3.3).		P
	(d) Reactive power mode (Clause 3.3.3).		P
	(e) Power rate limit (Clause 3.3.4).		P
	The inverter may have the Voltage balance mode (Clause 3.3.2.4).		N/A
	For each of the power quality response modes available in the inverter, the inverter shall conform to the relevant requirements of this Section (3) and Section 2, and all of the requirements of Sections 4 and 5, when these modes are enabled or disabled.		P
	Compliance shall be determined by type testing as specified in Appendix F, Appendix G and Appendix J.		P
	If these power quality response modes of operation are controlled by an external device, the external device shall not interfere with the inverter conforming to the relevant requirements of this Section (3) and Section 2, and all of the requirements of Section 4 and 5, when the external device is controlling these modes.		P
	The required characteristics of the power quality response modes are specified below in Clauses 3.3.2, 3.3.3 and 3.3.4.		
	NOTE Additional requirements in Clause 3.4.3 are for multiple mode inverters with energy storage and when operating in charging modes.	Hybrid inverter.	P
3.3.2	Volt response modes		P
3.3.2.1	General		P
	The volt–watt and volt–var response modes specified in Clause 3.3.2.2 and Clause 3.3.2.3 shall be able to operate concurrently when both modes are active.		P
	For three-phase inverters, the inverter shall use the average of the three single-phase voltages as the reference voltage to determine the corresponding volt response action.		P
	The volt-watt mode (Clause 3.3.2.2) may be used with the volt-var mode (Clause 3.3.2.3), fixed power factor mode (Clause 3.3.3), or fixed reactive power mode (Clause 3.3.3).		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	The volt-var mode may be used with the volt-watt mode (Clause 3.3.2.2).		P
	Where a power quality response mode is enabled the inverter shall commence and complete the required response according to the defined characteristics of Clause 3.3.2 within the relevant times specified in Table 3.5, starting from the time the voltage is measured as deviating by 1 V from the 10 s average. Response times faster than the maximum times in Table 3.5 are permitted, and commencement and completion of the inverter response should not be unnecessarily delayed or slowed. Table 3.5 — Power quality response mode — Maximum response times Region | Response commencement time | Response completion time All | 1 s | 10 s		P
	Compliance shall be determined by type testing in accordance with the power quality (voltage) response mode tests specified in Appendix G.	See appendix G for detail.	P
3.3.2.2	Volt–watt response mode		P
	The volt–watt response mode varies the maximum active power output level of the inverter in response to the voltage at its grid-interactive port. The volt–watt response mode shall be enabled by default.		P
	The response curve required for the volt–watt response mode is defined by two volt response reference values and corresponding maximum active power output levels, the default values are listed in Table 3.6. Above *V*W2, the maximum active power output shall not tpT2icSm exceed the limit specified at *V*W2. An example volt-watt response mode is shown in Figure 3.1.		P
3.3.2.3	Volt–var response mode		P
	The volt–var response mode varies the reactive power absorbed or supplied by the inverter in response to the voltage at its grid-interactive port. The volt–var response mode shall be enabled by default. The response curve required for the volt–var response is defined by four volt response reference values and corresponding reactive power levels, the default values are listed in Table 3.7. Below *V*V1, reactive power shall be maintained at the level specified for *VV1*. Above *VV4*, reactive power shall be maintained at the level specified for *VV4*. An example volt-var response mode is shown in Figure 3.2.		P
	Where the inverter apparent power rating is reached, active power level shall be reduced to stay within the inverter apparent power rating while meeting the volt-var mode reactive power requirements of this Clause (3.3.2.3). This behaviour is intended to provide reactive power priority.		P
3.3.2.4	Voltage balance modes		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	A voltage imbalance between phases may occur in an electrical installation that presents a load that is not balanced across the phases. Three-phase inverters, or single-phase inverters used in a three-phase combination may be used for voltage balancing between phases by injecting unbalanced three-phase currents into the electrical installation.		N/A
	If the voltage balance mode is available, the following requirements apply:		N/A
	(a) The voltage balance mode shall be disabled by default.		N/A
	(b) For single-phase inverters used in a three-phase combination, the requirements of Clause 5.2 apply.		N/A
	(c) The voltage balance mode shall be able to — (i) operate correctly with a single fault applied to the voltage balance control system; (ii) detect the fault or loss of operability and cause the inverter to revert to injecting current into the three-phase electrical installation as a three-phase balanced current; or (iii) detect the fault or loss of operability and disconnect the inverter from the electrical installation.		N/A
3.3.3	Fixed power factor mode and reactive power mode		P
	The fixed power factor mode or the reactive power mode may be enabled in some situations by the electrical distributor to meet local grid requirements, one of these modes shall be enabled if the voltvar mode is disabled. These modes shall be disabled by default.		P
	For the fixed power factor mode, the minimum range of settings shall be 0.8 to 1.0 supplying reactive power, and 1.0 to 0.8 absorbing reactive power, the default power factor setting shall be 1.0. The fixed power factor mode is for control of the displacement power factor over the range of inverter power output.		P
	The volt–watt mode and fixed power factor mode shall be able to operate concurrently.		P
	For the fixed power factor mode, the measurement of power factor shall be the displacement power factor of the inverter treated as a load from the perspective of the grid.		P
	For the fixed power factor mode, the measurement of power factor shall be the displacement power factor of the inverter treated as a load from the perspective of the grid.		P
	The volt–watt mode and reactive power mode shall be able to operate concurrently.		P
	Where the inverter apparent power rating is reached, active power output level shall be reduced to meet the inverter apparent power rating while meeting the fixed power factor mode or reactive power requirements of this Clause (3.3.3). This behaviour is intended to provide reactive power priority.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Compliance shall be determined by type testing in accordance with the fixed power factor mode and reactive power mode test specified in Appendix F.	See appendix F for detail.	P
3.3.4	Power rate limit		P
3.3.4.1	General		P
	The power rate limit for an inverter is a power quality response mode. The inverter shall have the capability to rate limit changes in power generation through the grid-interactive port. Inverters capable of multiple mode operation shall have the capability to rate limit changes in power level (for example increasing/decreasing of charging rates of connected energy storage).		P
	The power rate limit only applies to the changes in power level specified in Clause 3.3.4.3.		P
	NOTE The power rate limit causes the inverter power level to either ramp up or ramp down smoothly as it transitions from one power level to another. Changes in power level may be constrained by several factors such as the type of energy source connected, energy storage and operating state of the inverter. For example, an inverter without energy storage may not be able to ramp down when required if the energy source ceases suddenly or conversely may not be able to ramp up if the energy source is not able to deliver more power. Likewise, when the inverter is generating maximum power, it can ramp down but cannot ramp up, while a multiple mode inverter with a completely charged storage system may ramp up (discharge power) but cannot ramp up consumption of power (charge power).		P
	Compliance shall be determined by type testing in accordance with the reconnection test specified in Appendix I and the sustained operation for frequency disturbance test in Appendix J.	See appendix I and J for detail.	P
3.3.4.2	Gradient of power rate limit		P
	The power rate limit (*W*Gra) is the ramp rate of active power output in response to changes in power and is defined as a percentage of rated power per minute. The nominal ramp time (*T*n) is the nominal time for a 100 % change in power output with a power rate limit of *W*Gra. An inverter shall have an adjustable power rate limit (*W*Gra) which limits the change in power output to the set power rate limit. The default setting for the power rate limit (*W*Gra) for increase and decrease shall be 16.67 % of rated power per minute which is a nominal ramp time of 6 min.		P
	The power rate limit (*W*Gra) shall be adjustable within the range 5 % to 100 % of rated power per minute. It is permitted to have two separate power rate limits for increase and decrease in power level, as follows: (a) to rate limit an increase in power (*W*Gra+); and (b) to rate limit a decrease in power (*W*Gra−).		P
	The default setting of *W*Gra+ and *W*Gra− shall be the same as *W*Gra.		P
3.3.4.3	Power rate limit modes		P
3.3.4.3.1	General		P
	The inverter power rate limit (*W*Gra) is applicable to operate in the following modes:		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(a) Soft ramp up after connect, reconnect or soft ramp up/down following a response to frequency disturbance.		P
	(b) Changes in a.c. operation and control.		P
	(c) Changes in energy source operation.	Power Conversion System	P
	The following clauses provide operation information for each mode.		P
3.3.4.4	Nonlinearity of power rate limit changes		P
	The nonlinearity (*NL*) of the power rate limit (*W*Gra) in response to a change of the inverter power level, as defined by the characteristic curve depicted in Figure 3.3, shall be less than 10 %.		P
3.4	Multiple mode inverter operation		P
3.4.1	General		P
	The requirements in this Clause for multiple mode inverters are in addition to the requirements for inverters.		P
	Multiple mode inverters operating in charging mode through the grid-interactive port shall conform to the requirements of Clause 3.3.2.3.		P
	When the multiple mode inverter is operating in stand-alone mode and disconnected from the grid all active conductors of the stand-alone port shall be isolated from the grid.		P
	Multiple mode inverters in stand-alone mode may utilize the grid-interactive port as the stand-alone port or may utilize a separate stand-alone port.		P
	Multiple mode inverters shall be arranged to ensure that the continuity of the neutral conductor to the load from the electrical installation is not interrupted when the inverter is operating in stand-alone mode, disconnected from the grid and supplies a load via the stand-alone port.		P
	NOTE The requirements for the automatic disconnection device in Clause 4.2 are intended to ensure that at least basic insulation or simple separation is maintained between the energy source port, the grid-interactive port and stand-alone ports when the inverter ceases to operate.		P
	Multiple mode inverters shall be arranged such that only the allowed installation methods of AS/NZS 3000 and AS/NZS 4777.1 can be used.		P
	When the multiple mode inverter is operating in stand-alone mode and is disconnected from the grid, the stand-alone port shall conform to the requirements for d.c. current injection (refer to Clause 2.10) into the connected load circuits. The type of RCD compatible with and for use on the stand-alone mode outputs shall be declared.		P
3.4.2	Sinusoidal output in stand-alone mode		P
	The a.c. output voltage waveform of a stand-alone port of a multiple mode inverter operating in standalone		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	mode, shall conform to the requirements of this Clause (3.4.2). The a.c. output voltage waveform of a stand-alone mode shall have a voltage total harmonic distortion (THD) not exceeding of 5 % and no individual harmonic at a level exceeding 5 %.		
	Compliance shall be checked by measuring the THD and the individual harmonic voltages with the inverter delivering 5 % power or the lowest continuous available power output greater than 5 %, and 50 % and 100 % of its continuous rated power, into a resistive load, with the inverter supplied with nominal d.c. input voltage. The THD measuring instrument shall measure the sum of the harmonics from $n = 2$ to $n = 50$ as a percentage of the fundamental ($n = 1$) component at each load level.		P
3.4.3	Volt–watt response mode for inverters with energy storage when charging		P
	The volt–watt response mode for charging of energy storage varies the maximum active power input of the inverter from the grid in response to the voltage at its grid-interactive port. An inverter with energy storage that can be charged through the grid-interactive port shall have this volt–watt response mode. This volt–watt response mode is only active when energy storage charges through the grid-interactive port. The volt–watt response mode for charging of energy storage shall be enabled by default.		P
	The response curve required for the volt–watt response is defined by two volt response reference values and corresponding maximum power input levels through the grid-interactive port, the default values are listed in Table 3.8. Example response modes are shown in Figure 3.4.		P
	The inverter shall commence and complete any required volt-watt response for charging according to the defined characteristics of this Clause 3.4.3 within the relevant times specified in Table 3.5.		P
3.4.4	Stand-alone inverters		P
	There are a variety of stand-alone inverters, which are intended for supply of 230 V a.c. power to loads within the electrical installation only, with energy provided from batteries, solar arrays and/or other d.c. sources. These inverters have a stand-alone port for supplying the loads within the electrical installation separate to the a.c. input port. These inverters also have an a.c. input port that can be directly connected to either a grid or an independent a.c. energy source such as a diesel generating set. A stand-alone inverter is a type of multiple mode inverter.		P
	Any inverter that is not a grid-interactive inverter but is an uninterruptible power system (UPS) that is		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	in accordance with AS 62040.1, AS IEC 62040.2, AS IEC 62040.3 and IEC 62040 series is not considered a stand-alone inverter for the purposes of this Standard.		
	Any inverter that is not a grid-interactive inverter but is an uninterruptible power system (UPS) that is in accordance with AS 62040.1, AS IEC 62040.2, AS IEC 62040.3 and IEC 62040 series is not considered a stand-alone inverter for the purposes of this Standard.		P
	(a) charging the system batteries when other energy sources are unavailable;		P
	(b) providing direct supply to site loads, bypassing the inverter completely, when local generation such as from solar and batteries is insufficient; or		P
	(c) providing supplementary supply to site loads (in parallel with the inverter output) when local generation is insufficient to supply the entire load.		P
	Stand-alone inverters shall not output power from the a.c. input port during normal operation or fault conditions.		P
	The stand-alone port of a stand-alone inverter shall be separate to the a.c. input port.		P
	Where the a.c. input port can be connected to the grid the inverter shall have settings to conform to this Standard for connection to the grid.		P
	A stand-alone inverter with an a.c. input port that is connected to a grid, shall conform to the requirements of this Standard with modifications as described in Appendix M.		P
	NOTE The arrangement covered by this Clause is for where the a.c. input will use the grid as an alternative/back up energy source for the stand-alone system to supply energy to the installation.		P
3.5	Security of operational settings		P
	The settings of the demand response or power quality response modes of the inverter shall be secured against inadvertent or unauthorized change. Changes to the settings shall require the use of a tool and special instructions not provided to unauthorized personnel.		P
	NOTE Special interface devices and passwords are regarded as tools.	Password	P
	The settings shall be capable of only being adjusted within the values specified in this Section (3).		P
	Compliance shall be determined by inspection.		P
	The inverter settings shall be able to be viewed in read-only mode for verification. A set of operational instructions for viewing inverter regional setting shall be available. Inverter operational settings information may be displayed via a panel/screen, external device or software interface.		P
4	Protective functions for connection to electrical installations and the grid		P
4.1	General		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	There shall be an automatic disconnection device to prevent injection of energy into the point of supply and prevent the formation of an unintentional island with the grid or part thereof when supply from the grid is disrupted.		P
	NOTE This includes preventing the formation of an island within any part of the electrical installation, which is normally connected to the grid.		P
	The automatic disconnection device shall operate — (a) if supply from the grid is disrupted;		P
	(b) when the grid goes outside preset limits (e.g. undervoltage/overvoltage, under-frequency/overfrequency); or		P
	(c) when the demand response mode DRM 0 (see Clause 3.2) is asserted.		P
	For inverter energy systems connected to multiple phases the automatic disconnection device shall operate if any of the above conditions is met on any phase.		P
	The automatic disconnection device may be within the inverter or a separate device.	Integrated	P
	Compliance shall be determined by type testing the automatic disconnection device within the inverter or combined with the inverter. Where the automatic disconnection device is separate to the inverter (or inverters), the inverter (or inverters) and the automatic disconnection device shall be tested together as though they are one inverter. Compliance of one combination of inverter and automatic disconnection device does not ensure compliance of either device as part of a different combination. Specific requirements are specified in Clauses 4.2 to 4.8.		P
4.2	Automatic disconnection device		P
	The automatic disconnection device shall prevent power (both a.c. and d.c.) from entering the grid when the automatic disconnection device operates.		P
	The automatic disconnection device shall provide isolation in all live conductors.		P
	NOTE 1 The automatic disconnection device need not disconnect sensing and control circuits.		P
	Automatic disconnection devices for isolation shall conform to the following requirements:		P
	(a) They shall be capable of withstanding an impulse voltage for at least over voltage category III, and have an adequate contact gap.		P
	(b) They shall not be able to falsely indicate that the contacts are open.		P
	(c) They shall be designed and installed so as to prevent unintentional closure, such as might be caused by impact, vibration or the like.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(d) They shall be devices that disconnect all live conductors (active and neutral) of the inverter from the grid-interactive port.		P
	Exception: For multiple mode inverters with stand-alone mode, which conform to IEC 62477.1 , the automatic disconnection device for isolation shall be a device that disconnects active conductors of the multiple mode inverter from the grid-interactive port.		N/A
	(e) They shall be such that with a single fault applied to the automatic disconnection device or to any other location in the inverter, at least basic insulation or simple separation is maintained between the energy source port and the grid-interactive port when the means of disconnection is intended to be in the open state.		P
	(f) They shall be such that with a single fault applied to the automatic disconnection device or to any other location in the inverter, power is prevented from entering the grid.		P
	NOTE 2 In the case of a non-isolated inverter, the prevention of power entering the grid can be achieved by two mechanical automatic disconnection devices in series in each live conductor. In the case of an isolated inverter, the prevention of power entering the grid can be achieved by a single mechanical automatic disconnection device and a semiconductor device (or semiconductor devices) in each live conductor. The control of the two automatic disconnection devices can be achieved by two independent control circuits to satisfy the single fault requirements in Items (e) and (f) consistent with principals of IEC 62109-2.	Two relays in series.	P
	The automatic disconnection device shall be capable of interrupting at least the rated current.		P
	A semiconductor (solid-state) device shall not be used for isolation purposes.		P
4.3	Active anti-islanding protection		P
	The combination of the inverter and the automatic disconnection device shall incorporate at least one method of active anti-islanding protection.		P
	NOTE 1 Examples of such methods include —		P
	(a) shifting the frequency of the inverter away from nominal conditions in the absence of a reference frequency (frequency shift);		P
	(b) allowing the frequency of the inverter to be inherently unstable in the absence of a reference frequency (frequency instability);		N/A
	(c) periodically varying the power output of the inverter (power variation); and		N/A
	(d) monitoring for sudden changes in the impedance of the grid by periodically injecting a current pulse		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(current injection).		
	The method used to provide active anti-islanding protection shall be declared in documentation.		P
	NOTE 2 Active anti-islanding protection is required in addition to the passive anti-islanding protection specified in Clause 4.4 to prevent a situation where islanding may occur because multiple inverters and/or other generators are providing a frequency and voltage reference for one another and/or because load and generation is balanced.		P
	To prevent islanding, the active anti-islanding protection system shall operate the automatic disconnection device (see Clause 4.2) within 2 s of disruption to the power supply from the grid.		P
	Compliance shall be determined by type testing in accordance with the active anti-islanding test specified in Appendix H.	See appendix H for detail.	P
4.4	Voltage and frequency limits (passive anti-islanding protection)	See appendix I for detail	P
	The combination of the inverter and the automatic disconnection device shall incorporate the following forms of passive anti-islanding protection:		P
	(a) Undervoltage and overvoltage protection.		P
	(b) Under-frequency and over-frequency protection.		P
	For sustained variation of the voltage and frequency beyond each limit specified in Table 4.1 and Table 4.2, the automatic disconnection device (see Clause 4.2) shall operate no sooner than the required trip delay time and before the maximum disconnection time.		P
	The inverter shall remain in continuous operation for voltage and frequency variations with a duration shorter than the trip delay time specified in Table 4.1 and Table 4.2. The inverter shall remain in continuous operation and operate, as required by Clauses 4.5.4, 4.5.5 and 4.5.6, for voltage and frequency variations with a duration shorter than the trip delay time specified in Table 4.1 and Table 4.2.		P
	Each protective function limit shall be preset and secured against change on selection of the specific region.		P
	For a multiple mode inverter meeting the performance classification for output requirements of AS IEC 62040.3 that provides an operational mode to supply load continuously during grid disruption, the inverter may disconnect the grid-interactive port within the trip delay time, provided that when the grid voltage recovers within the voltage requirements of the AS IEC 62040.3 performance classification within the trip delay time the inverter shall reconnect within 400 ms.		N/A
	Compliance shall be determined by type testing in accordance with the voltage and frequency limits	See appendix I for detail	P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	tests specified in Appendix I.		
4.5	Limits for sustained operation		P
4.5.1	General		P
	The inverter or inverter energy system shall remain in continuous operation over the range of voltages and frequencies that it is required to be compatible with. Refer to Clause 2.5.		P
4.5.2	Sustained operation for voltage variations		P
	The inverter shall operate the automatic disconnection device (see Clause 4.2) within 3 s when the average voltage for a 10 min period exceeds the *V*nom-max specified in Table 4.3.		P
	The sustained operation for voltage variations shall not interfere with the active and passive antiislanding requirements of Clauses 4.3 and 4.4.		P
	The 10 min average value shall be compared against the limit *V*nom-max at least every 3 s to determine when to disconnect.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for voltage variations test specified in Appendix J.	See appendix J for detail.	P
4.5.3	Sustained operation for frequency variations		P
4.5.3.1	General		P
	The inverter shall be capable of supplying rated power between 45 Hz and 52 Hz.		P
	Where the inverter is a multiple mode inverter connecting an energy storage system it shall be capable of charging the energy storage from the grid-interactive port between 49.5 Hz and 55 Hz.		P
	Where a frequency variation results in frequency to be outside the continuous operation range, the inverter shall respond according to the defined characteristics of Clause 4.5.3.2 and Clause 4.5.3.3.		P
	The inverter shall commence its response within the specified time of Table 4.6, starting from the time the frequency is measured as crossing the continuous operation threshold (either fLLCO or fULCO). The inverter shall complete its response within the specified time of Table 4.6, starting from the time the frequency reaches its maximum deviation. Response time faster than the maximum times in Table 4.6 are permitted, and commencement and completion of the inverter response should not be unnecessarily delayed or slowed.		P
	Where a frequency variation results in a change of power level of an inverter, the inverter power shall remain at the required level, until the frequency is maintained within the continuous operating region (less the hysteresis margin) for a period of 20 s. Table 4.7 provides values for hysteresis margin (*f*hyst) for each region.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	When the conditions for returning to continuous operation defined in Clause 4.5.3.2 and 4.5.3.3 have been met, any change in power level shall be at a rate no greater than the power rate limit (*W*Gra) of Clause 3.3.4.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for frequency variations test specified in Appendix J.	See appendix J for detail	P
4.5.3.2	Response to a decrease in frequency		P
4.5.3.2.1	General response to a decrease in frequency		P
4.5.3.2.2	Response to a decrease in frequency for multiple mode inverters with energy storage		P
4.5.3.3	Response to an increase in frequency		P
4.5.3.3.1	General response to an increase in frequency		P
4.5.3.3.2	Response to an increase in frequency for multiple mode inverters with energy storage		P
4.5.4	Voltage disturbance withstand		P
	A voltage disturbance is any variation of voltages outside of the voltage limits continuous operation of Table 4.8. The inverter or inverter energy system shall respond as specified in Table 4.8 for voltage disturbances.		P
	The inverter shall cease power generation within 200 ms after the measured voltage falls below or exceeds the continuous operation limits. For voltage disturbances lasting less than the trip delay times in Table 4.1, the inverter shall restore active power output to the pre-disturbance level within 400 ms after the measured voltage has returned to within the continuous operation limits of Table 4.8.		P
	For a three-phase inverter, the inverter shall respond in the event of a voltage disturbance on any of the phases.		P
	For a multiple mode inverter meeting the performance classification for output requirements of AS IEC 62040.3 that provides an operational mode to supply load continuously during grid disruption, the inverter may disconnect the grid-interactive port in place of the cease power generation requirement, provided that when the grid voltage recovers within the voltage requirements of the AS IEC 62040.3 performance classification relevant to the inverter, the inverter shall restore active power output through the grid-interactive port to the pre-disturbance level within 400 ms.		N/A
	Compliance shall be determined by type testing in accordance with the voltage disturbance withstand test specified in Appendix I.	See appendix I for detail.	P
4.5.4.2	Multiple voltage disturbances		P
	A multiple voltage disturbance event is any number of voltage disturbances as defined in Clause 4.5.4.1 where the cumulative time that the voltage is less than the trip delay time as specified in Table 4.1,		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	provided that each voltage disturbance occurs no more than 15 s since the previous disturbance. After a period of 15 s without a disturbance, any further disturbances shall be treated as a new multiple voltage disturbance event. Refer to Figure 4.5 for example of a multiple voltage disturbance event.		
	The inverter shall respond in accordance with the requirements of Clause 4.5.4.1 in the event of multiple voltage disturbances. The inverter shall not disconnect for at least two multiple voltage disturbance events. The inverter may disconnect in the event of any further voltage disturbance within the following 20 minute period.		P
	Compliance shall be determined by type testing in accordance with the multiple voltage disturbance withstand test specified in Appendix I.		P
4.5.5	Voltage phase angle shift withstand		P
	The inverter shall remain in continuous operation for a single-phase voltage angle shift within a voltage cycle of at least 60 electrical degrees. In addition, three-phase inverters shall remain in continuous operation for a voltage phase angle shift within a voltage cycle, in the positive-sequence, of at least 20 electrical degrees. Refer to Table 4.9.		P
	Compliance shall be determined by type testing in accordance with the voltage phase angle shift withstand test specified in Appendix I.		P
4.5.6	Rate of change of frequency		P
	The inverter shall maintain continuous operation for frequency excursions with a rate of change of frequency (ROCOF) that do not exceed ± 4.0 Hz/s for a duration of 0.25 s.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for frequency variations test specified in Appendix J.	See appendix J for detail.	P
4.6	Disconnection on external signal		P
	The automatic disconnection device shall incorporate the ability to disconnect on an external signal.		P
	If an external signal or demand response “DRM 0” condition is asserted, the automatic disconnection device shall operate within 2 s.		P
	Compliance shall be determined by type testing as specified in Appendix E.	See appendix E for detail.	P
4.7	Connection and reconnection procedure		P
	Only after all of the following conditions have been met shall the automatic disconnection device operate to connect or reconnect the inverter to the grid —		P
	(a) the voltage has been maintained within the utilization limits of AS 60038 (for Australia) or the utilization limits (for New Zealand) for at least 60 s;		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(b) the frequency has been maintained within the range 47.5 Hz to 50.15 Hz for at least 60 s;		P
	(c) the inverter and the grid are synchronized and in-phase with each other; and		P
	(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.		P
	After the automatic disconnection device operates to connect or reconnect the inverter the output shall rate limit increase in power generation to the set power rate limit (*W*Gra) for increase in power of Clause 3.3.4. Unconstrained power operation may recommence after the automatic disconnection device operates to connect or reconnect the inverter, when either the rated power output is reached or the required power output level of the inverter exceeds the available energy source.		P
	Compliance shall be determined by type testing in accordance with the tests as specified in Appendix H and Appendix I.	See appendix I and H for detail.	P
4.8	Security of protection settings		P
	The settings of the automatic disconnection device shall be secured against inadvertent or unauthorized changes. Changes to the settings shall require the use of a tool and special instructions not provided to unauthorized personnel.		P
	The settings, specified in Clause 4.5, shall only be capable of being adjusted within the limits specified in Clause 4.5.		P
	The limit values of the automatic disconnection device, specified in Clause 4.4, shall be secured against changes.		P
	The specific regional settings selected for Australia or New Zealand, once applied or confirmed for each inverter, shall be secured against unauthorized changes. NOTE Special interface devices and passwords are regarded as tools.	Password	P
	Compliance shall be determined by inspection.		P
4.9	Activation of protection settings		P
	The inverter shall not operate the automatic disconnection device to connect until a regional setting has been selected and activated by an authorized person.		P
	Variations to default regional configuration settings of this Section (4) shall be within the ranges specified within this Section (4).		P
	Where the inverter does not connect due to no selection or activation of a regional configuration, the inverter shall provide a visible alert.		P
	The inverter settings shall be able to be viewed in read-only mode for verification. A set of operational		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	instructions for viewing inverter regional setting shall be available. Inverter regional settings may be displayed via a panel/screen, external device or software interface.		
5.0	Multiple inverter combinations	Product cannot communicative coupled to a three phase system.	N/A
5.1	General		N/A
	There are installations where multiple inverter energy systems are used and the electrical installation connects at a single point of supply to the grid. Inverter energy systems are often comprised of multiple inverters used in combination to provide the desired inverter energy system capacity or to ensure that voltage balance is maintained in multiple-phase connections to the grid.		N/A
	This Section (5) specifies the requirements and tests for inverter energy systems used in such combinations. If a combination is not tested, it should not be used or external devices should be used in accordance with the requirements of AS/NZS 4777.1.	External current monitoring devices should be used if such multiple combination installed.	N/A
	Possible combinations are single-phase inverters used in parallel, single-phase inverters used in multiple-phase installations and three-phase inverters used in parallel.		N/A
5.2	Inverter current balance across multiple phases		N/A
	In a multiple-phase inverter energy system comprised of individual single-phase inverters, the a.c. current output should be generated and injected into the multiple-phase electrical installation to minimize current imbalance. The maximum current imbalance in a multiple-phase inverter energy system comprised of either individual single-phase inverters connected on separate phases or a combination of single-phase inverters and multiple-phase inverters shall not exceed 21.7 A for more than 15 s. NOTE 1 This maximum current imbalance also applies to multiple mode inverters used in a inverter energy system that may have a charging mode. NOTE 2 Provisions for current balance of three-phase inverters are given in Clause 2.11.		N/A
5.3	Grid disconnection		N/A
	When any inverter (single-phase or multiple-phase) within a multiple-phase inverter energy system disconnects as required by Section 4, all inverters within the multiple-phase inverter energy system shall disconnect within 2 s of the first inverter disconnecting. This applies to all inverters used in combination for multiple phases.		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
			N/A
5.4	Grid connection and reconnection		N/A
	When multiple inverters are used together in a multiple-phase combination, only after all the conditions of Clause 4.7 have been met on all connected phases shall the automatic disconnection device operate to connect or reconnect any inverter of the multiple-phase combination to the grid.		N/A
	Where any inverter used in a multiple-phase combination has a rated current exceeding 21.7 A per phase, the requirement of Clause 5.2 shall be met when connecting or reconnecting.		N/A
5.5	Testing combinations		N/A
5.5.1	Single-phase combinations		N/A
5.5.2	Single-phase combinations		N/A
5.5.3	Required tests for multiple inverter combinations		N/A
5.5.4	Multiple inverters with one automatic disconnection device		N/A
6.0	Generation control function		N/A
6.1	General		N/A
	The generation control function is used to control the active or apparent power output levels of an inverter or multiple inverter combination such that it meets a predetermined generation output level that may be less than the total rated apparent power of the inverter or multiple inverter combination. Two generation control functions should be provided as inverter functions, these are — (a) generation limit control; and (b) export limit control.		N/A
	This Section (6) applies to an inverter or multiple inverter combinations that have either or both generation control functions. Where included in the inverter, these generation control functions shall be disabled by default.		N/A
	The generation control function for an inverter or multiple inverter combination should operate with the following limits:		N/A
	(i) Soft limit: A limit that will cause the inverter or multiple inverter combination to reduce its output, preventing generation greater than the limit.		N/A
	(ii) Hard limit: A limit that when activated will cause the inverter or multiple inverter combination to disconnect (e.g. when the soft limit has not been met).		N/A
	The soft limit may be utilized with the hard limit to minimize the number of disconnections due to exceeding the hard limit. Where both hard and soft limits are used the requirements for hard limit shall take precedence over the soft limit requirements.		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	The generation control function shall monitor the response of the inverter or multiple inverter combination to the soft limit and hard limit. Where a fault or loss of operability is detected the generation control function shall respond such that on failure of —		N/A
	(A) the soft limit function, reduce the output of the inverter or multiple inverter combination to zero within 15 s; and		N/A
	(B) the hard limit function, operate the automatic disconnection device within 5 s.		N/A
	For multiple-phase systems, the generation control functions shall monitor and control the generation on each phase.		N/A
	The generation control may use inverter internal measurements or external sensors for measurements. All measurement for generation control functions shall conform to Table 2.5 specifications. The generation control function may be integrated into the inverter or use an external controller. NOTE The external controller may be another inverter in the multiple inverter combination.		N/A
	Where an external measurement device or controller is used, any loss of signal or failure of the device shall cause the inverter or multiple inverter combination to operate the automatic disconnection device and disconnect within 5 s, unless the only generation limit control activated is a soft export limit, in which case the inverter or multiple inverter combination shall reduce active power output to the soft export limit setting as a maximum within 15 s.		N/A
	The connection to external devices shall be re-established and achieve stable operation for at least 15 s before the inverter or multiple inverter combination reconnects in accordance with Clause 4.7.		N/A
	Compliance shall be determined by type testing in accordance with the generation control function test specified in Appendix L.		N/A
6.2	Generation limit control		N/A
6.2.1	General		N/A
	The generation limit control function provides control of the apparent power output level of an inverter or multiple inverter combination within an electrical installation. The generation limit control function may be integrated into the inverter or an external device.		N/A
	The generation limit control for an inverter or multiple inverter combination shall limit the apparent power output level, specified as an apparent power value (VA). The generation limit control function shall have a hard limit and a soft limit specified, where the soft limit coordinates with the hard limit.		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Where a generation limit has been applied the generation limit shall be substituted for the inverter or multiple inverter combination rated apparent power for determining the corresponding level of response for the power quality response modes of the inverter or multiple inverter combination. For multiple inverter combinations, including multiple-phase systems, the generation limit shall apply to the net apparent power output at the point of generation.		N/A
	In multiple-phase systems the apparent power level shall be balanced across the phases.		N/A
6.2.2	Soft limit		N/A
	For the generation limit control function a soft limit shall be utilized to control the apparent power output level such that the hard limit is not exceeded.		N/A
	Where the soft limit is exceeded, the generation limit control function shall operate to reduce the apparent power output of the inverter or multiple inverter combination to less than the soft limit within 15 s.		N/A
6.2.3	Hard limit		N/A
	Where the hard limit is exceeded for 15 s the generation limit control function shall operate to disconnect the inverter or each inverter within the multiple inverter combination within 5 s.		N/A
			P
6.3	Export limit control		N/A
6.3.1	General		N/A
	The export limit control function for an inverter is used to control the generation from an inverter or multiple inverter combination to manage the export power level from an electrical installation to the grid. The export limit control function may be integrated into the inverter or an external device.		N/A
	The export limit control for an inverter or multiple inverter combination shall limit the active power export level, specified as an active power value (*W*). The export limit may be set to allow export to the grid or to provide a minimum import load from the grid.		N/A
	For inverter or multiple inverter combinations, including multiple-phase systems, the export limit shall apply to the net active power level at the point of supply across all phases.		N/A
6.3.2	Soft limit		N/A
	For the export limit control function, where the soft limit is exceeded the export limit control function shall operate to reduce the power output of the inverter or multiple inverter combination such that the export limit of the electrical installation is met within 15 s.		N/A
6.3.3	Hard limit		N/A
	For inverter or multiple inverter combination the hard limit may be applied. For the export limit control		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	function, where the hard limit is exceeded the export limit control function shall operate to disconnect the inverter or each inverter within the multiple inverter combination within 5 s.		
7.0	Inverter marking and documentation		P
7.1	General		P
	The inverter shall conform to the marking and documentation requirements of IEC 62109-1 and IEC 62109-2, as varied by this Section (7). All markings and documentation shall be in the English language. NOTE The marking and documentation may be written in other languages in addition to English.		P
7.2	Marking		P
	The following variations apply to the marking requirements of IEC 62109-1 and IEC 62109-2:		P
	(a) Inverters that are designated for use in inverter energy systems incorporating energy sources other than PV arrays or batteries shall bear additional or alternative markings applicable to the energy source.	No energy sources other than PV arrays or batteries.	N/A
	(b) Inverters that are designated for use in closed electrical operating areas shall be marked with a warning stating that they are not suitable for installation in households or areas of a similar type or use (i.e. domestic).		P
	NOTE This requirement is derived from the Cooling system failure—Blanketing test of IEC 62109-2. It is intended to ensure that inverters for closed electrical operating areas are not installed in areas where the intended ventilation may be blocked after installation due to shared access and use. For example, an inverter may be installed with correct ventilation in a storage area, but over time the area may become cluttered with material that blocks required ventilation and rests against the heat sink, preventing adequate cooling of the device.		P
7.2.2	Equipment ratings		P
	The inverter shall be marked with its ratings and the ratings of each port, as specified in Table 7.1. Only those ratings that are applicable to the type of inverter are required. The ratings shall be plainly and permanently marked on the inverter, in a location that is clearly visible after installation.		P
7.2.3	Port		P
	Each port shall be marked with its classification and indicate whether a.c. or d.c. voltage as applicable. Typical classifications for input, output and communication ports include the following: (a) PV (photovoltaic). (b) Wind turbine. (c) Energy storage. (d) Battery. (e) Generator. (f) Grid-interactive. (g) Stand-alone.		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(h) a.c. input. (i) Load. (j) Communications (type). (k) DRM.		
7.2.4	External and ancillary equipment		N/A
	If the inverter requires external or ancillary equipment for compliance with this Standard, the requirement for any such equipment shall be marked on the inverter along with the following or an equivalent statement: Refer to the installation instructions for type and ratings or symbol. NOTE External or ancillary equipment includes external automatic disconnection devices, external isolation transformers and external RCDs. Any external or ancillary equipment shall be marked in accordance with this Section (7).		N/A
7.2.5	Residual current devices (RCDs)		P
	Inverter energy systems used with PV array systems require residual current detection in accordance with IEC 62109-1 and IEC 62109-2. The requirements can be met by the installation of a suitably rated RCD external to the inverter or by an RCMU integral to the inverter. Where an external RCD is required, the inverter shall be marked with a warning along with the rating and type of RCD required. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following or an equivalent statement:	Integrated RCMU	P
	WARNING — AN RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER If the inverter energy system requires a type B RCD, the inverter shall be marked with a warning. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following:		N/A
	WARNING — A TYPE B RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER		N/A
7.2.6	Demand response modes		P
	The demand response modes supported by the inverter should be permanently marked on the name plate or on a durable sticker to indicate the demand response modes of which the unit is capable. Where the inverter utilizes a demand response interface port an alternative location for the marking where not on nameplate should be on or near that port. Figure 7.1 illustrates a permitted form of marking. If this form of marking is used, each box shall contain a tick or a cross (if the inverter has that capability) or remain blank (if it does not have that capability). Alternatively, only the modes supported may be marked.		P
	If the physical interface is a terminal block, then —		P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	(a) the terminals shall be engraved or otherwise durably marked; or (b) a permanent label with “DRM Port” shall be affixed near the terminal block.		
	The marking shall indicate which terminal corresponds to which demand response mode. The range of markings is indicated against Pins 1 to 6 in Table 3.4.		P
	The marking shall indicate which terminal corresponds to which demand response mode. The range of markings is indicated against Pins 1 to 6 in Table 3.4.		P
7.3	Documentation		P
7.3.1	General		P
	The documentation supplied with the inverter shall provide all information necessary for the correct and safe installation, operation, maintenance and use of the system and any required external devices including information specified in Clause 7.2. All inverters, including those intended for use in systems incorporating energy sources other than PV arrays or batteries, shall conform to the documentation requirements of IEC 62109-1 and IEC 62109-2. Inverter documentation shall include a description of the type of inverter as either a grid-interactive or stand-alone inverter, in accordance with the requirements of this Standard. There may be additional descriptions related to the energy source/s or whether it also is a multiple mode inverter with various other modes of operation. Inverter documentation shall include specification of environmental condition that it is intended for and the rated maximum operating ambient temperature that shall not be less than — (a) 40 °C for indoor conditioned; (b) 50 °C for indoor unconditioned; (c) 50 °C for outdoor unconditioned without solar effects; or (d) 60 °C for outdoor unconditioned with solar effects. NOTE Without solar effects means that the inverter is installed in a location not subject to solar radiation as per AS 60947.3.		P
7.3.2	Equipment ratings		P
	The documentation supplied with the inverter shall state the ratings of the inverter and the ratings for each port and parameter listed in Table 7.2. Only those ratings that are applicable to the type of inverter are required. For equipment with rated current greater than 16 A per phase, additional documentation requirements apply. See Clause 2.8.		P
7.3.3	Ports		P
7.3.4	External and ancillary equipment		N/A

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
	Where an inverter or multiple inverter combinations requires external or ancillary equipment to achieve functional requirements of this Standard, the documentation shall — (a) state the requirement for any such equipment; (b) provide sufficient information to identify the external or ancillary equipment, either by manufacturer and part number or by type and rating; and (c) specify assembly, location, mounting and connection requirements.	N/A	N/A
7.3.5	Residual current devices (RCDs)		N/A
7.3.6	Multiple mode inverters		P
	Where the inverter is capable of multiple mode operation, the documentation shall include the following: (a) Ratings and means of connection to each source of supply to the inverter or output from the inverter. (b) Any requirements related to wiring and external controls, including the method of maintaining neutral continuity within the electrical installation to any stand-alone ports as required. (c) Disconnection means and isolation means. (d) Overcurrent protection needed.		P
7.3.7	Multiple inverter combinations		N/A
	Where an inverter has been tested for use in a multiple inverter combination as per Section 5, the documentation shall include the following: (a) Valid combinations of inverters. (b) Installation instructions for correct operation as a multiple inverter combination.		N/A
7.3.8	Firmware		P
	The documentation shall provide instructions for viewing of the inverter firmware version and the selected regional settings and any variations to the default inverter settings in read-only mode. This is to prevent unauthorized modification of inverter settings. Documentation on the initial configuration and selection of regional settings and other settings at commissioning shall be provided to authorized persons. Restricted information on accessing and changing the regional settings, other settings and firmware after initial configuration shall be provided to authorized persons only.		P
Appendix B	Harmonic current limit test	See table appendix B	P
Appendix C	Transient voltage limit test	See table appendix C	P
Appendix D	DC injection test	See table appendix D	P
Appendix E	Demand response mode testing including disconnection on external signal	See table appendix E	P
Appendix	Fixed power factor mode and reactive power mode test	See table appendix F	P

Absatz *Clause*	Anforderungen - Prüfungen *Requirements - Tests*	Messergebnisse - Bemerkungen *Measuring results - Remarks*	Bewertung *Evaluation*
F			
Appendix G	Power quality (voltage) response mode testing	See table appendix G	P
Appendix H	Active anti-islanding test	See table appendix H	P
Appendix I	Voltage and frequency limits tests	See table appendix I	P
Appendix J	Sustained operation test procedures	See table appendix J	P
Appendix K	Multiple inverter testing	-	N/A
Appendix L	Generation control function testing	-	N/A
Appendix M	Stand-alone inverters	-	N/A

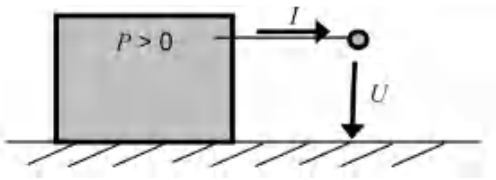
ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

See following pages for test data.

Prüfbericht-Nr.:
Test report no.: CN24N4VE 001

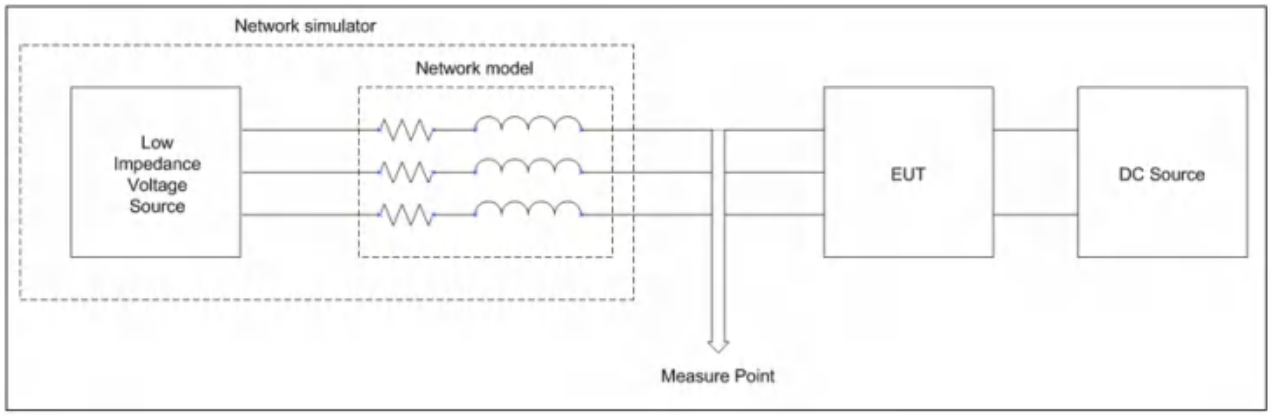
Project Engineer:	Qi Liang	Reviewer:	Chu Sun
Signature:	Qi Liang	Signature:	Chu Sun

Test Sample No.:	A003653835-001

Test Condition:	Generator reference system applied in test: 

Test Date:	2023.12.21- 2024.01.20

Test bench diagram:



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

Clause	Test items	Remark
Appendix B	Harmonic current limit test	INPPCS-100/0.4-W-14-C1-OS
Appendix C	Transient voltage limit test	INPPCS-100/0.4-W-14-C1-OS
Appendix D	DC injection test	INPPCS-100/0.4-W-14-C1-OS
Appendix E	Demand response mode testing including disconnection on external signal	INPPCS-100/0.4-W-14-C1-OS
Appendix F	Fixed power factor mode and reactive power mode test	INPPCS-100/0.4-W-14-C1-OS
Appendix G	Power quality (voltage) response mode testing	INPPCS-100/0.4-W-14-C1-OS
Appendix H	Active anti-islanding test	INPPCS-100/0.4-W-14-C1-OS
Appendix I	Voltage and frequency limit tests	INPPCS-100/0.4-W-14-C1-OS
Appendix J	Sustained operation test procedures	INPPCS-100/0.4-W-14-C1-OS
Appendix K	Multiple inverter testing	N/A
Appendix L	Generation control function testing	N/A
Appendix M	Stand-alone inverters	N/A

Appendix B	TABLE: Harmonic current limit test												P
Impedance in test: 0.15 Ω + j0.15 Ω, 0.1 Ω + j0.1 Ω													
Current [A]	144.93						72.46						
Current I/In[%]	100%						50%						Limit
Order number	Measurement												
	L1		L2		L3		L1		L2		L3		[%]
	A	[%]	A	[%]	A	[%]	A	[%]	A	[%]	A	[%]	
1	143.50	99.01%	144.86	99.95%	144.09	99.42%	72.04	100.00%	72.69	100.90%	72.30	100.35%	100
2	0.20	0.14%	0.23	0.16%	0.36	0.25%	0.18	0.26%	0.27	0.37%	0.40	0.56%	1.0
3	2.89	2.00%	2.57	1.78%	2.82	1.95%	2.71	3.77%	2.39	3.32%	2.58	3.58%	4.0
4	0.62	0.43%	0.60	0.41%	0.65	0.45%	0.60	0.83%	0.58	0.81%	0.60	0.83%	1.0
5	0.24	0.16%	0.23	0.16%	0.18	0.13%	0.37	0.52%	0.36	0.50%	0.37	0.52%	4.0
6	0.09	0.06%	0.08	0.05%	0.12	0.08%	0.14	0.19%	0.12	0.17%	0.15	0.20%	1.0
7	1.14	0.79%	1.17	0.81%	1.24	0.86%	0.93	1.29%	0.98	1.37%	1.04	1.44%	4.0
8	0.14	0.09%	0.16	0.11%	0.14	0.10%	0.15	0.21%	0.16	0.22%	0.16	0.22%	1.0
9	0.17	0.12%	0.17	0.11%	0.16	0.11%	0.32	0.45%	0.30	0.42%	0.29	0.40%	2.0
10	0.10	0.07%	0.09	0.06%	0.11	0.08%	0.09	0.13%	0.09	0.12%	0.10	0.14%	0.5
11	0.26	0.18%	0.23	0.16%	0.22	0.15%	0.33	0.46%	0.35	0.48%	0.32	0.45%	2.0
12	0.19	0.13%	0.18	0.13%	0.20	0.14%	0.22	0.30%	0.21	0.29%	0.21	0.30%	0.5

13	0.29	0.20 %	0.33	0.23 %	0.31	0.22 %	0.15	0.21 %	0.19	0.26 %	0.17	0.23 %	2.0
14	0.06	0.04 %	0.05	0.04 %	0.05	0.04 %	0.05	0.07 %	0.05	0.07 %	0.04	0.06 %	0.5
15	0.30	0.21 %	0.30	0.21 %	0.29	0.20 %	0.34	0.47 %	0.33	0.46 %	0.33	0.45 %	1.0
16	0.06	0.04 %	0.06	0.04 %	0.06	0.04 %	0.06	0.08 %	0.06	0.09 %	0.06	0.08 %	0.5
17	0.10	0.07 %	0.10	0.07 %	0.10	0.07 %	0.08	0.11 %	0.07	0.10 %	0.07	0.10 %	1.0
18	0.12	0.08 %	0.11	0.08 %	0.11	0.07 %	0.11	0.15 %	0.11	0.16 %	0.10	0.14 %	0.5
19	0.08	0.06 %	0.09	0.07 %	0.08	0.05 %	0.03	0.05 %	0.03	0.04 %	0.04	0.05 %	1.0
20	0.05	0.03 %	0.05	0.04 %	0.05	0.03 %	0.04	0.06 %	0.05	0.07 %	0.04	0.06 %	0.5
21	0.12	0.08 %	0.12	0.09 %	0.11	0.07 %	0.09	0.13 %	0.09	0.13 %	0.09	0.12 %	0.6
22	0.03	0.02 %	0.04	0.02 %	0.03	0.02 %	0.03	0.04 %	0.03	0.05 %	0.03	0.04 %	0.5
23	0.26	0.18 %	0.26	0.18 %	0.28	0.19 %	0.25	0.34 %	0.24	0.34 %	0.23	0.32 %	0.6
24	0.05	0.03 %	0.04	0.03 %	0.05	0.03 %	0.03	0.05 %	0.03	0.04 %	0.03	0.05 %	0.5
25	0.06	0.04 %	0.07	0.05 %	0.07	0.05 %	0.04	0.06 %	0.04	0.05 %	0.05	0.06 %	0.6
26	0.03	0.02 %	0.04	0.03 %	0.02	0.02 %	0.03	0.04 %	0.03	0.04 %	0.03	0.04 %	0.5
27	0.18	0.12 %	0.18	0.12 %	0.19	0.13 %	0.20	0.28 %	0.19	0.27 %	0.21	0.29 %	0.6
28	0.03	0.02 %	0.05	0.03 %	0.03	0.02 %	0.03	0.05 %	0.04	0.05 %	0.03	0.04 %	0.5

29	0.19	0.13 %	0.18	0.13 %	0.19	0.13 %	0.11	0.16 %	0.12	0.17 %	0.12	0.16 %	0.6
30	0.02	0.02 %	0.04	0.03 %	0.04	0.03 %	0.02	0.03 %	0.03	0.04 %	0.03	0.04 %	0.5
31	0.03	0.02 %	0.06	0.04 %	0.05	0.04 %	0.04	0.06 %	0.05	0.07 %	0.05	0.07 %	0.6
32	0.02	0.02 %	0.02	0.02 %	0.02	0.02 %	0.03	0.04 %	0.02	0.03 %	0.02	0.03 %	0.5
33	0.10	0.07 %	0.09	0.06 %	0.11	0.07 %	0.14	0.19 %	0.12	0.17 %	0.14	0.20 %	0.6
THD 50	2.30		2.10		2.29		4.29		3.90		4.19		5

Voltage harmonic of test grid-100%In

Order number	Measurement value			Limit
	L1 [%]	L2 [%]	L3 [%]	[%]
2	0.02%	0.02%	0.02%	0.2
3	0.59%	0.60%	0.58%	0.9
4	0.02%	0.02%	0.02%	0.2
5	0.16%	0.16%	0.15%	0.4
6	0.01%	0.01%	0.01%	0.2
7	0.10%	0.10%	0.10%	0.3
8	0.03%	0.02%	0.02%	0.2
9	0.01%	0.02%	0.01%	0.2
10	0.02%	0.02%	0.02%	0.2
11	0.07%	0.08%	0.08%	0.1
12	0.03%	0.02%	0.02%	0.1
13	0.05%	0.04%	0.04%	0.1
14	0.02%	0.02%	0.02%	0.1

15	0.07%	0.07%	0.06%	0.1
16	0.02%	0.02%	0.02%	0.1
17	0.04%	0.04%	0.04%	0.1
18	0.02%	0.02%	0.01%	0.1
19	0.02%	0.03%	0.01%	0.1
20	0.02%	0.02%	0.02%	0.1
21	0.03%	0.03%	0.02%	0.1
22	0.02%	0.01%	0.02%	0.1
23	0.08%	0.09%	0.09%	0.1
24	0.02%	0.01%	0.02%	0.1
25	0.03%	0.03%	0.03%	0.1
26	0.02%	0.03%	0.02%	0.1
27	0.05%	0.04%	0.05%	0.1
28	0.02%	0.01%	0.02%	0.1
29	0.10%	0.06%	0.07%	0.1
30	0.01%	0.01%	0.01%	0.1
31	0.04%	0.02%	0.04%	0.1
32	0.01%	0.01%	0.01%	0.1
33	0.05%	0.03%	0.04%	0.1
THD 50	0.68	0.67	0.65	5

Voltage harmonic of test grid-50%In				
Order number	Measurement value			Limit
	L1 [%]	L2 [%]	L3 [%]	[%]
2	0.02%	0.02%	0.02%	0.2
3	0.39%	0.40%	0.39%	0.9
4	0.02%	0.02%	0.02%	0.2

5	0.05%	0.06%	0.05%	0.4
6	0.01%	0.01%	0.01%	0.2
7	0.07%	0.05%	0.05%	0.3
8	0.02%	0.02%	0.02%	0.2
9	0.09%	0.09%	0.09%	0.2
10	0.02%	0.02%	0.01%	0.2
11	0.09%	0.09%	0.09%	0.1
12	0.02%	0.02%	0.02%	0.1
13	0.04%	0.03%	0.04%	0.1
14	0.02%	0.02%	0.02%	0.1
15	0.06%	0.06%	0.05%	0.1
16	0.02%	0.01%	0.02%	0.1
17	0.03%	0.03%	0.03%	0.1
18	0.01%	0.02%	0.01%	0.1
19	0.01%	0.01%	0.01%	0.1
20	0.01%	0.01%	0.02%	0.1
21	0.01%	0.01%	0.01%	0.1
22	0.01%	0.01%	0.01%	0.1
23	0.09%	0.09%	0.09%	0.1
24	0.01%	0.01%	0.01%	0.1
25	0.03%	0.03%	0.04%	0.1
26	0.01%	0.01%	0.01%	0.1
27	0.04%	0.04%	0.05%	0.1
28	0.02%	0.01%	0.02%	0.1
29	0.09%	0.04%	0.04%	0.1
30	0.02%	0.01%	0.02%	0.1
31	0.03%	0.03%	0.03%	0.1
32	0.01%	0.01%	0.01%	0.1
33	0.04%	0.03%	0.03%	0.1
THD 50	0.49	0.47	0.45	5

Additional	TABLE: Sinusoidal output in stand-alone mode						P
Power P/Pn[%]	50%			100%			Limit
Order number	Measurement						
	L1	L2	L3	L1	L2	L3	
	[%]	[%]	[%]	[%]	[%]	[%]	[%]
1	100.00%	100.00 %	100.00%	100.00%	100.00%	100.00%	--
2	0.34%	0.25%	0.28%	0.30%	0.25%	0.25%	5.0
3	0.53%	0.25%	0.59%	0.31%	0.28%	0.33%	5.0
4	0.11%	0.14%	0.14%	0.13%	0.12%	0.11%	5.0
5	0.85%	1.21%	0.93%	1.16%	1.17%	1.12%	5.0
6	0.07%	0.10%	0.12%	0.10%	0.04%	0.13%	5.0
7	0.55%	0.45%	0.61%	0.74%	0.67%	0.79%	5.0
8	0.17%	0.06%	0.15%	0.13%	0.07%	0.09%	5.0
9	0.19%	0.16%	0.23%	0.10%	0.07%	0.11%	5.0
10	0.11%	0.07%	0.16%	0.09%	0.09%	0.05%	5.0
11	0.08%	0.30%	0.29%	0.35%	0.43%	0.34%	5.0
12	0.07%	0.03%	0.08%	0.11%	0.03%	0.12%	5.0
13	0.18%	0.18%	0.15%	0.28%	0.25%	0.31%	5.0
14	0.03%	0.09%	0.09%	0.11%	0.06%	0.07%	5.0
15	0.06%	0.06%	0.03%	0.05%	0.05%	0.07%	5.0
16	0.03%	0.05%	0.07%	0.07%	0.07%	0.03%	5.0
17	0.14%	0.11%	0.15%	0.14%	0.21%	0.16%	5.0
18	0.06%	0.05%	0.06%	0.08%	0.03%	0.09%	5.0
19	0.12%	0.11%	0.12%	0.12%	0.11%	0.13%	5.0
20	0.07%	0.03%	0.09%	0.09%	0.05%	0.06%	5.0
21	0.02%	0.03%	0.03%	0.03%	0.04%	0.04%	5.0
22	0.09%	0.03%	0.07%	0.05%	0.06%	0.03%	5.0
23	0.11%	0.09%	0.10%	0.05%	0.09%	0.08%	5.0
24	0.06%	0.05%	0.05%	0.06%	0.03%	0.06%	5.0
25	0.06%	0.11%	0.11%	0.05%	0.05%	0.05%	5.0
26	0.05%	0.04%	0.02%	0.07%	0.04%	0.04%	5.0

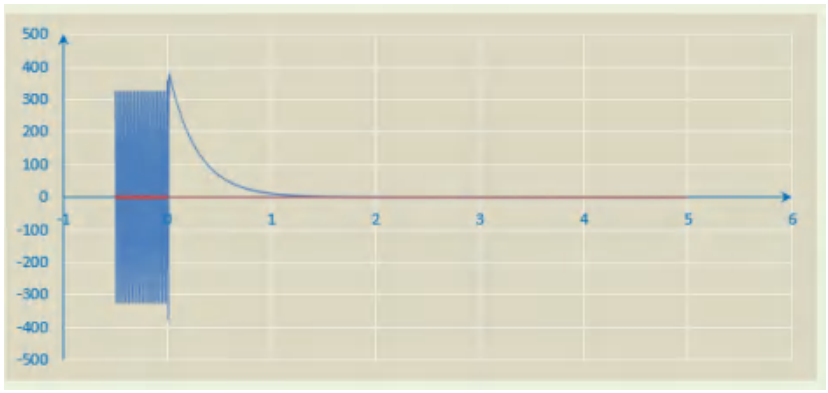
27	0.04%	0.03%	0.04%	0.01%	0.02%	0.02%	5.0
28	0.08%	0.05%	0.04%	0.04%	0.04%	0.02%	5.0
29	0.09%	0.08%	0.11%	0.02%	0.03%	0.04%	5.0
30	0.07%	0.02%	0.05%	0.04%	0.03%	0.04%	5.0
31	0.09%	0.11%	0.08%	0.03%	0.02%	0.03%	5.0
32	0.05%	0.03%	0.02%	0.05%	0.03%	0.03%	5.0
33	0.03%	0.02%	0.01%	0.01%	0.02%	0.02%	5.0
34	0.04%	0.03%	0.02%	0.02%	0.03%	0.02%	5.0
35	0.07%	0.07%	0.08%	0.02%	0.02%	0.03%	5.0
36	0.03%	0.01%	0.03%	0.02%	0.03%	0.03%	5.0
37	0.06%	0.07%	0.05%	0.02%	0.01%	0.03%	5.0
38	0.02%	0.01%	0.02%	0.04%	0.02%	0.02%	5.0
39	0.03%	0.02%	0.02%	0.02%	0.02%	0.02%	5.0
40	0.02%	0.01%	0.02%	0.01%	0.02%	0.02%	5.0
41	0.04%	0.02%	0.05%	0.02%	0.02%	0.02%	5.0
42	0.02%	0.01%	0.02%	0.02%	0.01%	0.02%	5.0
43	0.03%	0.04%	0.01%	0.01%	0.02%	0.02%	5.0
44	0.02%	0.02%	0.01%	0.02%	0.01%	0.01%	5.0
45	0.04%	0.02%	0.03%	0.01%	0.01%	0.01%	5.0
46	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	5.0
47	0.06%	0.02%	0.04%	0.01%	0.01%	0.01%	5.0
48	0.03%	0.01%	0.03%	0.01%	0.01%	0.01%	5.0
49	0.03%	0.03%	0.02%	0.01%	0.02%	0.01%	5.0
50	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	5.0
THD 50	1.30	1.44	1.43	1.57	1.53	1.56	5.0

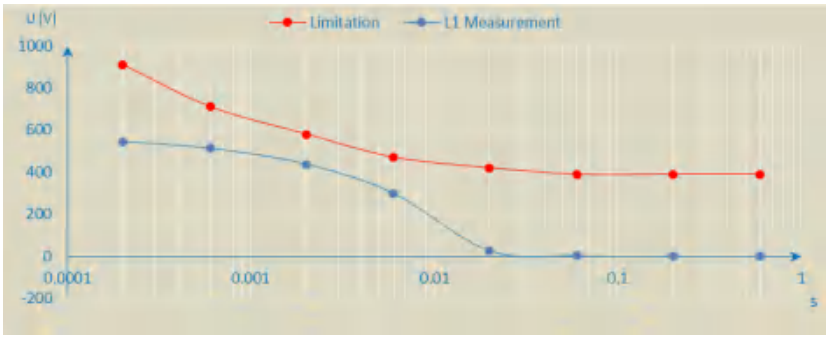
Appendix C	TABLE : Transient Voltage limit test			P
Phase A				
Duration [s]	Transient Voltage Limits [V]	Test output apparent power [VA]		
		10% output	50% output	100% output
		10000	50000	100000
		Measurements of Instantaneous Voltage (Line to Neutral) [V]		
0.0002	910	545	517	276
0.0006	710	513	505	230
0.002	580	438	459	174
0.006	470	299	321	91
0.02	420	28	10	16
0.06	390	4	1	1
0.2	390	1	1	1
0.6	390	1	1	1

Note(s):

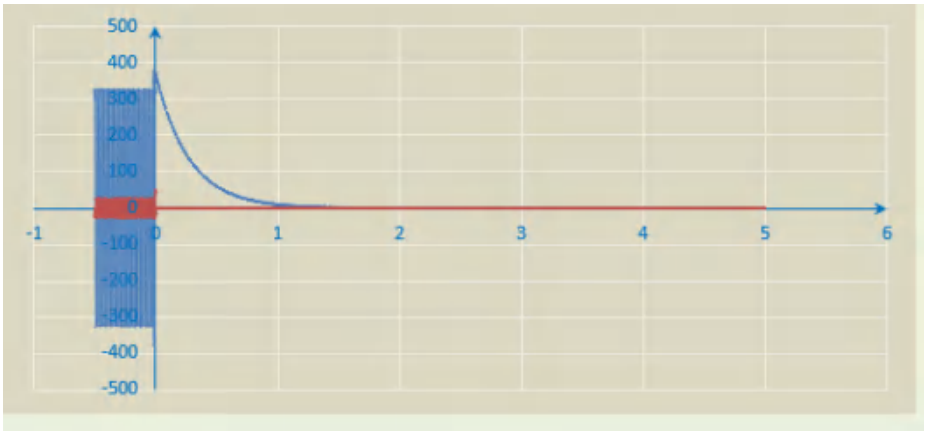
Diagram

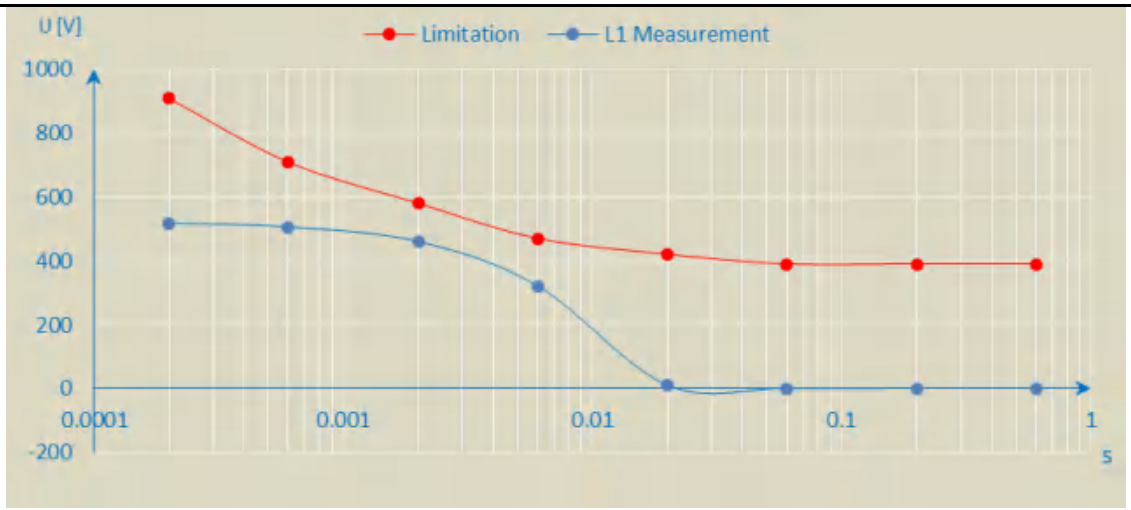
10%Pn output



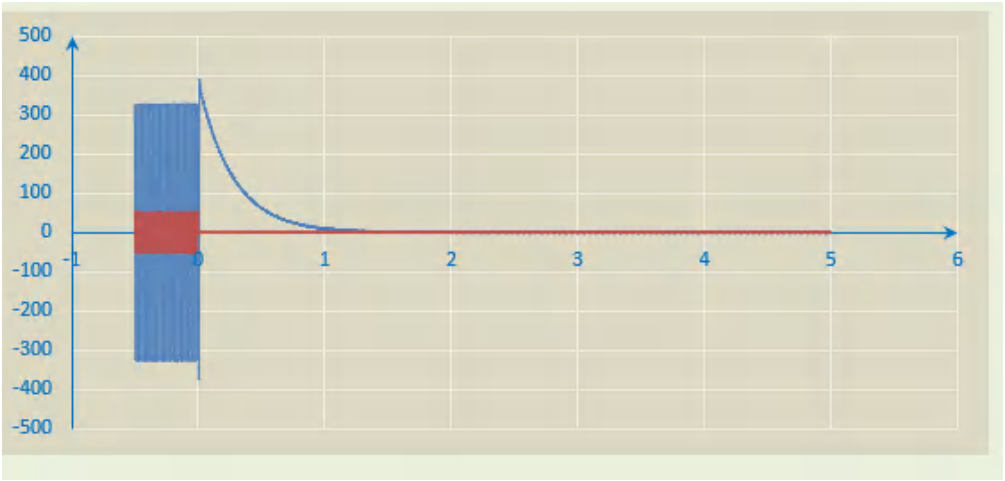


50%Pn output





100%Pn output

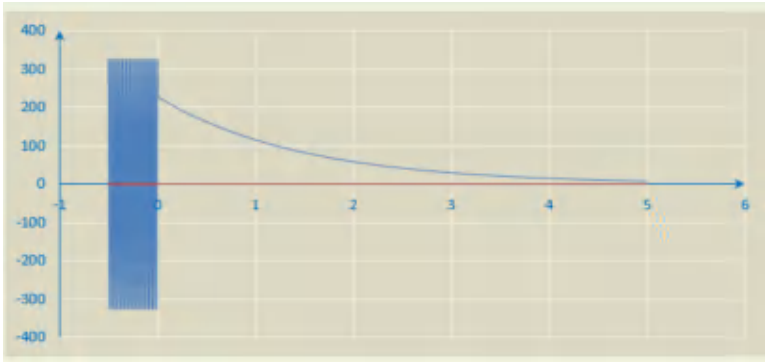


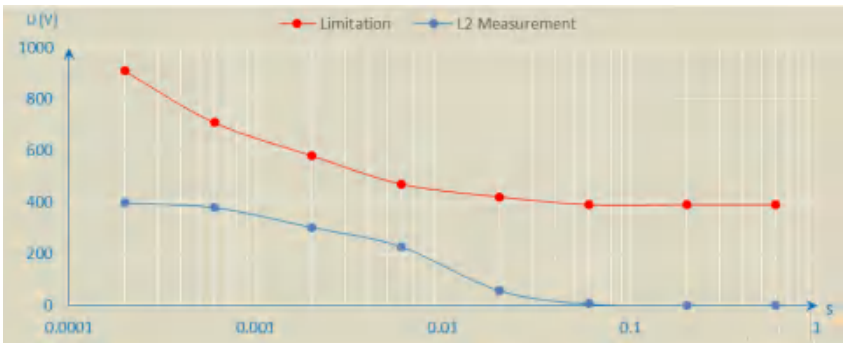
Phase B		
Duration [s]	Transient	Test output apparent power [VA]

	Voltage Limits [V]	10% output	50% output	100% output
		10000	50000	100000
		Measurements of Instantaneous Voltage (Line to Neutral) [V]		
0.0002	910	397	330	382
0.0006	710	380	270	373
0.002	580	303	211	347
0.006	470	228	142	242
0.02	420	59	19	19
0.06	390	7	1	1
0.2	390	1	1	1
0.6	390	1	1	1

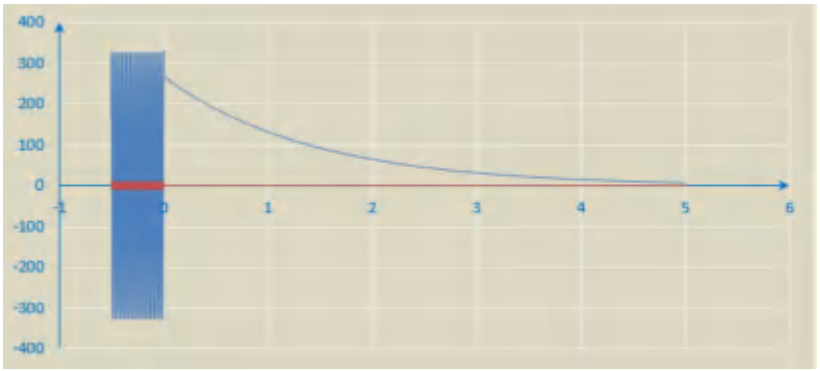
Diagram

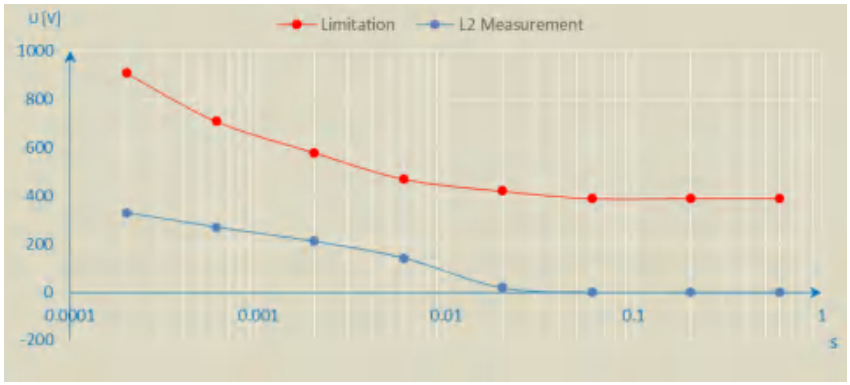
10%Pn output



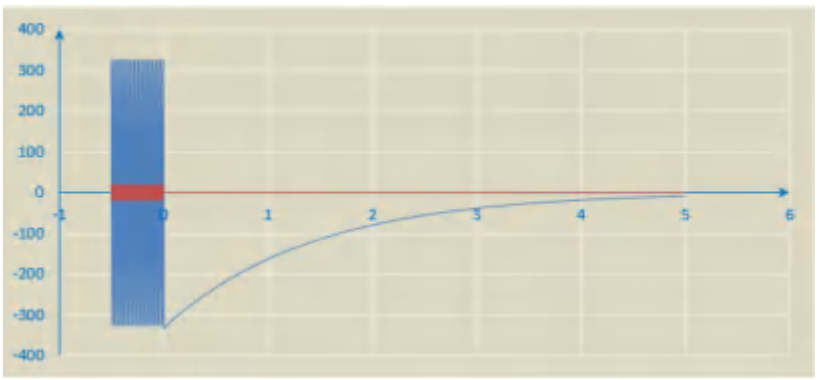


50%Pn output





100%Pn output

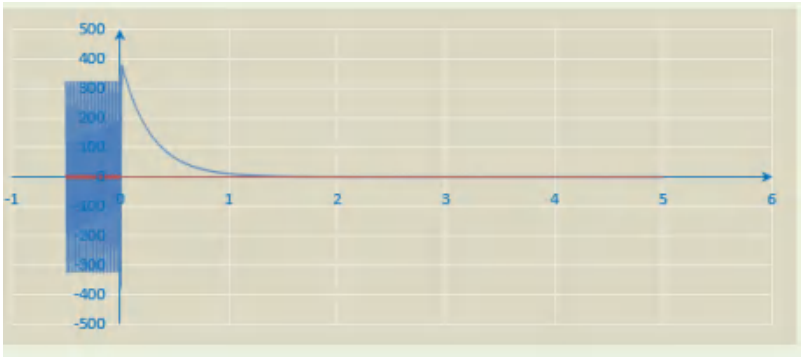


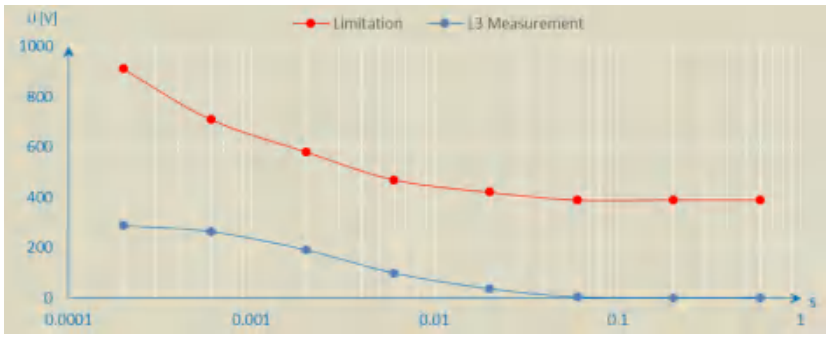
Phase C

Duration [s]	Transient Voltage Limits [V]	Test output apparent power [VA]		
		10% output	50% output	100% output
		10000	50000	100000
		Measurements of Instantaneous Voltage (Line to Neutral) [V]		
0.0002	910	288	372	480
0.0006	710	265	361	467
0.002	580	191	300	435
0.006	470	99	166	340
0.02	420	36	13	16
0.06	390	4	1	1
0.2	390	1	1	1
0.6	390	1	1	1

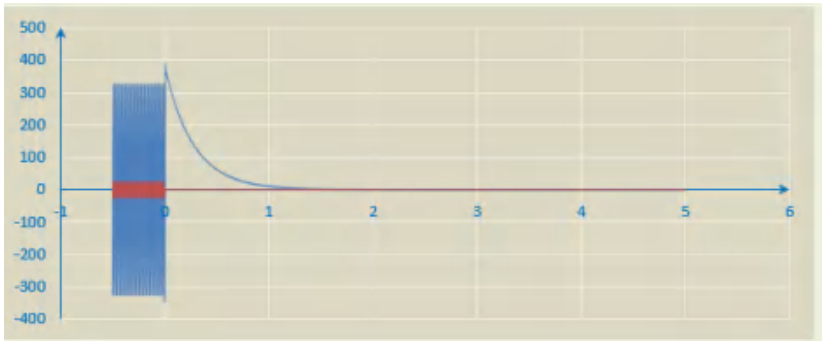
Diagram

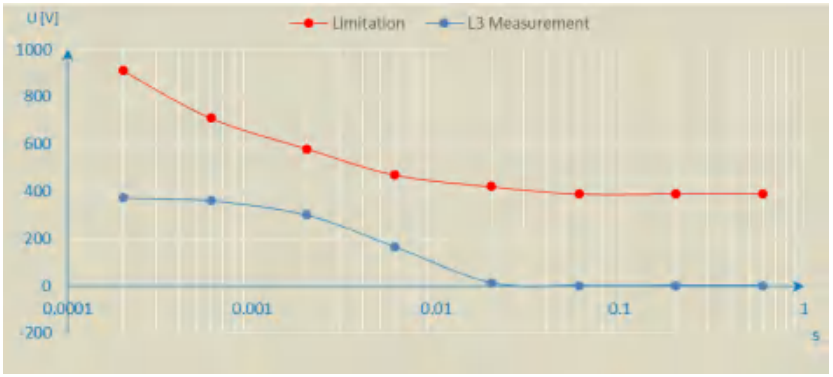
10%Pn output



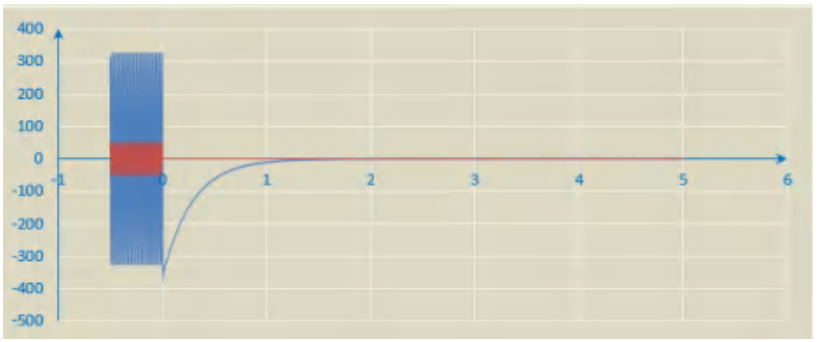


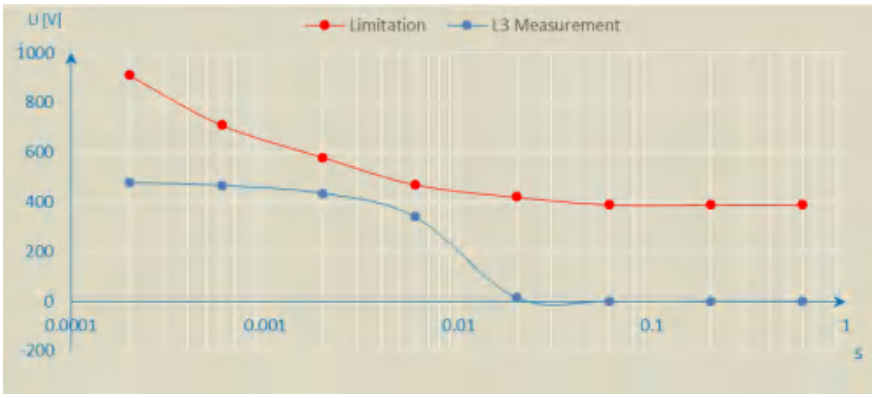
50%Pn output





100%Pn output

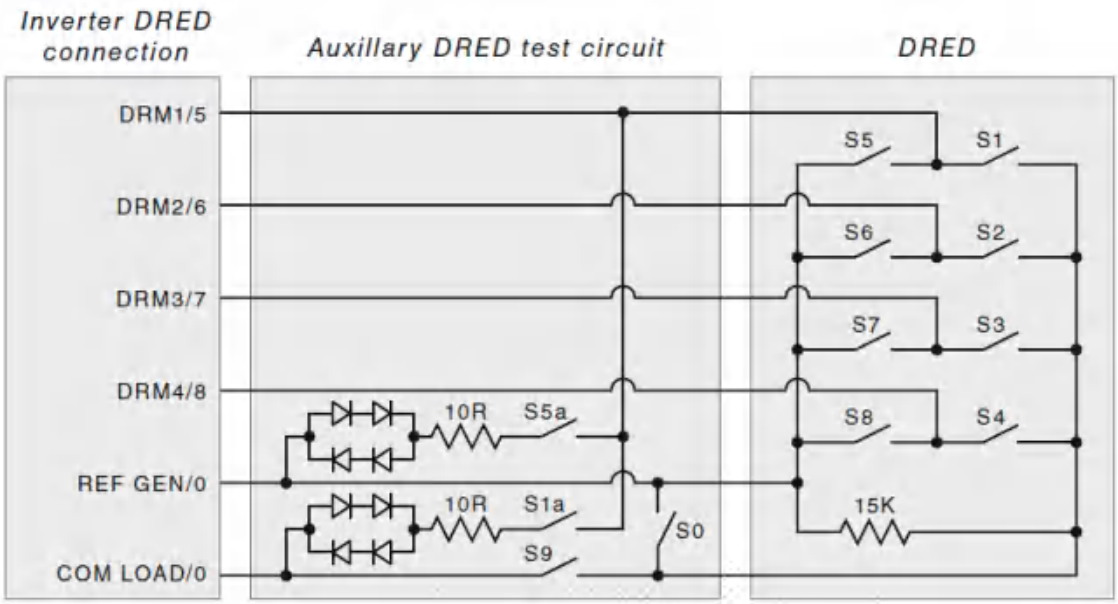




Appendix D	TABLE: DC Injection test			P
Test Conditions I/In	Measurements			Limit
	Idc / In [%]			Idc/In
	L1	L2	L3	
20%	0.318	0.405	0.037	0.5%
60%	0.418	0.452	0.126	0.5%
100%	0.431	0.368	0.081	0.5%
Note(s):				

Additional D	TABLE: DC Injection test in stand-alone mode			P
Test Conditions I/In	Measurements			Limit
	Idc / In [%]			Idc/In
	L1	L2	L3	
20%	0.143	0.093	0.103	0.5%
60%	0.182	0.379	0.169	0.5%
100%	0.241	0.373	0.435	0.5%
Note(s):				

Appendix E	TABLE: Demand Response Modes Testing including disconnection on external signal	P



Demand response test	Active Power		Reactive Power		Switching time	Pass/Fail
	Value	P/Sn	Value	Q/Sn		
DRM 0 at 100%	0.37	0.00	393	0.39	1.3s	Pass
DRM 7						
DRM 6 and DRM 7						
DRM 6						
DRM 5 andDRM 6						
DRM 8						
DRM 3						
DRM3 and DRM 2						
DRM2						
DRM1 and DRM2						
DRM4						

Additional 1	TABLE: Voltage fluctuations and flicker			P
Impedance used:		0.15 Ω + j0.15 Ω, 0.1 Ω + j0.1 Ω		
Phase A	Measurement	Plt	0.236	
		Limit	0.65	
		Pst	dc(%)	dmax(%)	d(t) (ms)
		Limit= 1.0	Limit= 3.3	Limit= 4.0	Limit= 500
	1	0.231	-0.045	-0.611	0.0
	2	0.236	-0.068	-0.627	0.0
	3	0.236	-0.021	-0.596	0.0
	4	0.236	-0.010	-0.554	0.0
	5	0.233	-0.012	-0.595	0.0
	6	0.233	0.012	-0.592	0.0
	7	0.235	0.068	0.557	0.0
	8	0.235	0.002	0.591	0.0
	9	0.234	-0.011	-0.556	0.0
	10	0.239	0.050	-0.572	0.0
	11	0.236	-0.029	-0.640	0.0
	12	0.250	-0.027	-0.623	0.0
Phase B	Measurement	Plt	0.254	
		Limit	0.65	
		Pst	dc(%)	dmax(%)	d(t) (ms)
		Limit= 1.0	Limit= 3.3	Limit= 4.0	Limit= 500
	1	0.250	-0.072	0.591	0.0
	2	0.256	-0.095	-0.581	0.0
	3	0.251	-0.094	-0.641	0.0
	4	0.253	0.077	-0.594	0.0
	5	0.250	-0.029	-0.655	0.0
	6	0.250	-0.021	-0.649	0.0
	7	0.251	0.007	0.586	0.0
	8	0.254	0.025	-0.586	0.0
	9	0.253	-0.010	0.608	0.0
	10	0.258	-0.031	-0.596	0.0
	11	0.257	-0.043	-0.592	0.0
	12	0.261	0.077	0.570	0.0

	Measurement	Plt	0.232		
		Limit	0.65		
		Pst	dc(%)	dmax(%)	d(t) (ms)
		Limit= 1.0	Limit= 3.3	Limit= 4.0	Limit= 500
Phase C	1	0.230	0.021	0.590	0.0
	2	0.236	-0.048	0.597	0.0
	3	0.232	-0.106	-0.597	0.0
	4	0.231	0.015	0.593	0.0
	5	0.229	0.098	0.579	0.0
	6	0.229	0.032	0.585	0.0
	7	0.233	0.006	0.651	0.0
	8	0.231	0.118	0.651	0.0
	9	0.229	0.018	0.663	0.0
	10	0.231	0.043	0.588	0.0
	11	0.232	-0.001	-0.599	0.0
	12	0.239	0.031	0.586	0.0

Additional 2	TABLE: Current balance for three-phase inverters				P
Test Conditions I/In	Measurements			Limit	
	Current [A]			Max Current Unbalance [%]	limit
	L1	L2	L3		
50%	72.12	72.37	72.76	0.49	5%
100%	143.55	144.90	144.15	0.49	5%
Note(s):					

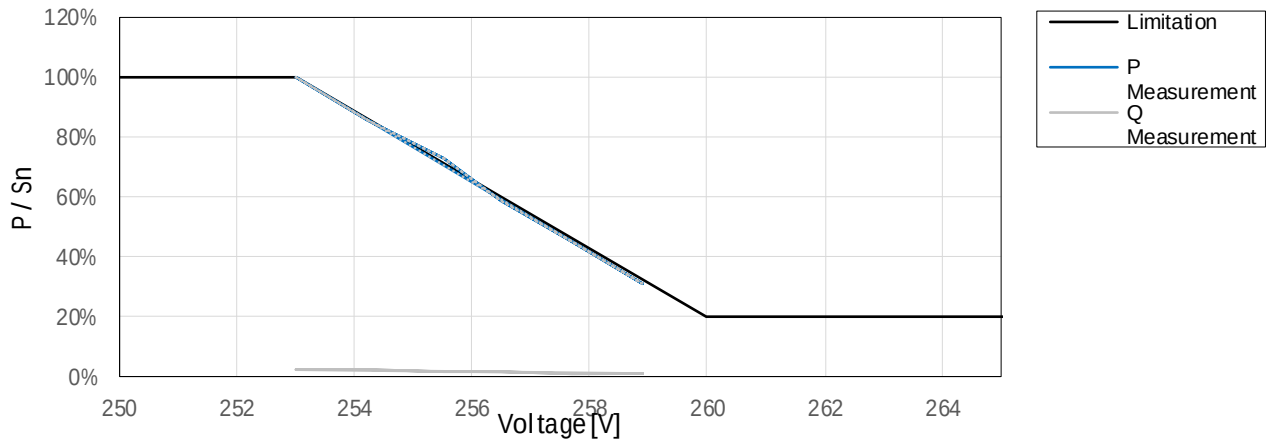
Additional 2	TABLE: Current balance for three-phase inverters in stand-alone mode				P
Test Conditions I/In	Measurements			Limit	
	Current [A]			Max Current Unbalance [%]	limit
	L1	L2	L3		
50%	65.35	72.00	76.17	2.93	5%
100%	135.14	147.03	146.73	1.71	5%
Note(s):					

Appendix F.1.1	TABLE: Fixed power factor mode						P
Test Conditions		Measurements				Target value	Limit
I/In	cosφ	P / Sn	Q / Sn	cosφ	ab / su	cosφ	cosφ
25%	1.0	25.06%	0.17%	1.00	ab	1.0	±0.01
50%	1.0	50.07%	0.24%	1.00	ab	1.0	±0.01
75%	1.0	75.10%	0.32%	1.00	ab	1.0	±0.01
100%	1.0	100.20%	0.39%	1.00	ab	1.0	±0.01
25%	0.8su	21.10%	15.70%	0.80	su	0.8su	±0.01
50%	0.8su	42.00%	31.60%	0.80	su	0.8su	±0.01
75%	0.8su	62.92%	47.20%	0.80	su	0.8su	±0.01
100%	0.8su	83.90%	62.67%	0.80	su	0.8su	±0.01
25%	0.8ab	20.90%	-15.85%	0.80	ab	0.8ab	±0.01
50%	0.8ab	41.60%	-31.50%	0.80	ab	0.8ab	±0.01
75%	0.8ab	62.48%	-47.31%	0.80	ab	0.8ab	±0.01
100%	0.8ab	83.50%	-63.32%	0.80	ab	0.8ab	±0.01
Note(s :							

Appendix F.1.2	TABLE: Fixed reactive power mode						P
Test Conditions		Measurements				Target value	Limit
P/Sn	Q/Sn	P / Sn	Q / Sn	cosφ	ab / su	Q/Sn	ΔQ/Sn
20%	60%su	19.86%	60.20%	0.31	su	60%su	±4%
60%	60%su	59.94%	60.31%	0.70	su	60%su	±4%
80%	60%su	79.99%	60.37%	0.80	su	60%su	±4%
20%	60%ab	20.22%	-58.16%	0.31	ab	60%ab	±4%
60%	60%ab	60.29%	-58.02%	0.70	ab	60%ab	±4%
80%	60%ab	80.33%	-57.96%	0.80	ab	60%ab	±4%
Note(s):							

Appendix G.2.1	TABLE: Volt-wat response mode						P
P(U) curve settings: Australia A	Points	Vw1	Vw2				
	U [V]	253	260				
	P/Sn	100%	20%				
Q(U) function		Disabled					
Test Conditions	Measurements				Target	Limits	
U [V]	U [V]	P / Sn	$T_{settling}$ [s]	Q / Sn	P / Sn	ΔP / Sn	$T_{settling}$ [s]
253	253.0	99.90%	--	0.63%	100%	± 4%	≤ 10
254.2	254.1	85.51%	1.7	0.60%	86%	± 4%	≤ 10
255.4	255.3	72.88%	1.4	0.57%	73%	± 4%	≤ 10
256.6	256.6	60.11%	1.2	0.55%	59%	± 4%	≤ 10
257.8	257.8	45.48%	1.1	0.52%	45%	± 4%	≤ 10
259	259.0	31.73%	1.1	0.49%	31%	± 4%	≤ 10
257.8	257.8	45.63%	1.4	0.52%	45%	± 4%	≤ 10
256.6	256.6	60.36%	1.1	0.55%	59%	± 4%	≤ 10
255.4	255.3	73.12%	1.4	0.58%	73%	± 4%	≤ 10
254.2	254.1	85.66%	1.8	0.61%	86%	± 4%	≤ 10
253	253.0	99.90%	1.6	0.63%	100%	± 4%	≤ 10
259	259.0	32.31%	1.1	0.49%	31%	± 4%	≤ 10

Following configuration shall be inspected			
Australia A	Available	Australia B	Available
Australia C	Available	New Zealand	Available
P(U) Configurable range	Points	Vw1	Vw2
	U [V]	235-255	240-265
	P/Sn	100%	0-20%
Note(s):			
Plotting			



Appendix G.2.2	TABLE: Combined volt-var and volt-watt response modes									P
P(U) curve settings: Australia A	Points			Vw1			Vw2			
	U [V]			253			260			
	P/Sn			100%			20%			
Q(U) function				Enabled						
Q(U) curve settings: Australia A	Points			Vv1	Vv2		Vv3		Vv4	
	U [V]			207	220		240		258	
	Q/Sn			44%	0%		0%		-60%	
Test Conditions	Measurements						Target		Limits	
U [V]	U [V]	P/Sn	$T_{settling}$ [s]	Q/Sn	ΔQ/ Sn	$T_{settling}$ [s]	Q/Sn	P / Sn	ΔQ, ΔP / Sn	$T_{settling}$ [s]
240	240.0	100.16%	1.1	-1.25%	-1.25%	1.1	0%	100%	≤ ±4%	≤ 10
243.6	243.6	98.94%	7.1	-13.64%	-1.64%	8.7	-12%	99%	≤ ±4%	≤ 10
247.2	247.2	96.00%	3.0	-26.28%	-2.28%	6.0	-24%	97%	≤ ±4%	≤ 10
250.8	250.7	91.54%	3.8	-38.22%	-2.22%	6.5	-36%	93%	≤ ±4%	≤ 10
254.4	254.4	74.78%	6.6	-50.30%	-2.30%	8.2	-48%	84%	≤ ±4%*	≤ 10
258	258.0	31.50%	6.5	-57.49%	2.51%	7.1	-60%	43%	≤ ±4%*	≤ 10
254.4	254.4	74.74%	4.3	-50.30%	-2.30%	6.7	-48%	84%	≤ ±4%*	≤ 10

250.8	250.7	91.52%	2.6	-38.19%	-2.19%	6.1	-36%	93%	≤ ±4%	≤ 10
247.2	247.2	95.96%	3.4	-26.19%	-2.19%	5.3	-24%	97%	≤ ±4%	≤ 10
243.6	243.6	98.85%	2.9	-13.53%	-1.53%	4.9	-12%	99%	≤ ±4%	≤ 10
240	240.0	100.04%	5.6	-1.13%	-1.13%	8.4	0%	100%	≤ ±4%	≤ 10
220	220.0	95.65%	0.2	1.21%	1.21%	2.2	0%	100%	≤ ±4%*	≤ 10
217.4	217.4	94.05%	0	10.70%	1.70%	3.8	9%	100%	≤ ±4%*	≤ 10
214.8	214.7	91.46%	1.3	20.04%	2.04%	4.0	18%	98%	≤ ±4%*	≤ 10
212.2	212.3	87.86%	2.4	29.22%	3.22%	5.0	26%	96%	≤ ±4%*	≤ 10
209.6	209.6	83.40%	2.6	37.82%	2.82%	7.3	35%	94%	≤ ±4%*	≤ 10
207	207.0	79.20%	2.5	43.70%	-0.30%	7.1	44%	90%	≤ ±4%*	≤ 10
209.6	209.6	83.43%	2.5	37.75%	2.75%	7.5	35%	94%	≤ ±4%*	≤ 10
212.2	212.3	87.88%	3.0	29.13%	3.13%	6.3	26%	96%	≤ ±4%*	≤ 10
214.8	214.7	91.43%	1.7	20.03%	2.03%	6.4	18%	98%	≤ ±4%*	≤ 10
217.4	217.4	94.00%	2.5	10.74%	1.74%	6.0	9%	100%	≤ ±4%*	≤ 10
220	220.0	95.60%	0	1.25%	1.25%	5.5	0%	100%	≤ ±4%*	≤ 10
259	259.0	20.47%	3.3	-56.16%	3.84%	7.1	-60%	31%	≤ ±4%*	≤ 10

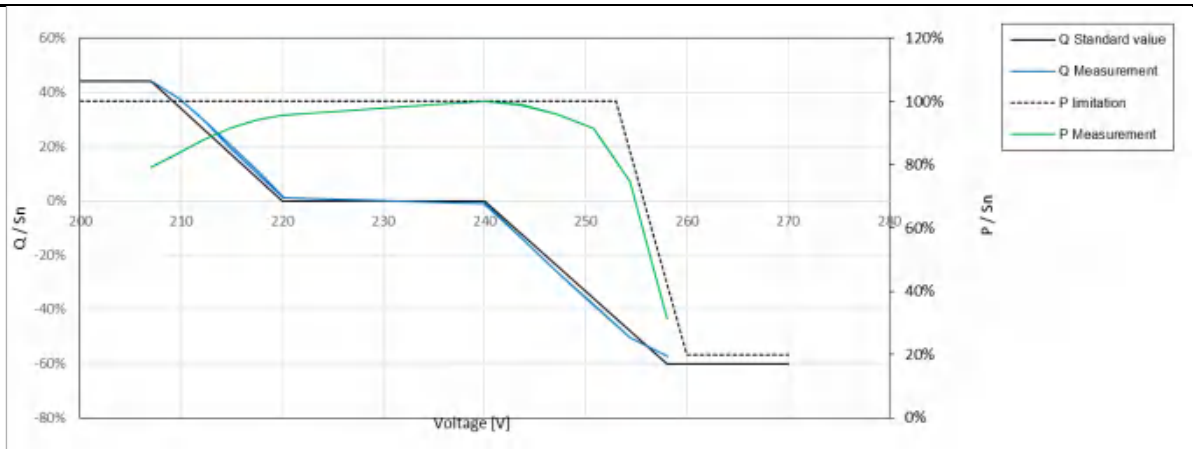
Following configuration shall be inspected

Australia A	Available	Australia B	Available
Australia C	Available	New Zealand	Available

P(U) Configurable range	Points	Vw1		Vw2	
	U [V]	235-255		240-265	
	P/Sn	100%		0-20%	
Q(U) Configurable range	Points	Vv1	Vv2	Vv3	Vv4
	U [V]	180-230	180-230	230-265	230-265
	P/Sn	30-60%	0%	0%	-30--60%

Note(s):* Apparent current limitation

Plotting


60%
40%
20%
0%
-20%
-40%
-60%
-80%
Q / Sn
200
210
220
230
240
250
260
270
280
Voltage [V]
120%
100%
80%
60%
40%
20%
0%
P / Sn
Q Standard value
Q Measurement
P limitation
P Measurement

Appendix G.2.3	TABLE: Volt-watt mode for charging of multiple mode inverters with energy storage	P

P(U) curve settings: Australia A	Points	Vw1-ch		Vw2-ch		
	U [V]	207		215		
	P/Sn	-20%		-100%		
Q(U) function		Enabled				
Q(U) curve settings: Australia A	Points	Vv1	Vv2	Vv3	Vv4	
	U [V]	207	220	240	258	
	P/Sn	44%	0%	0%	-60%	

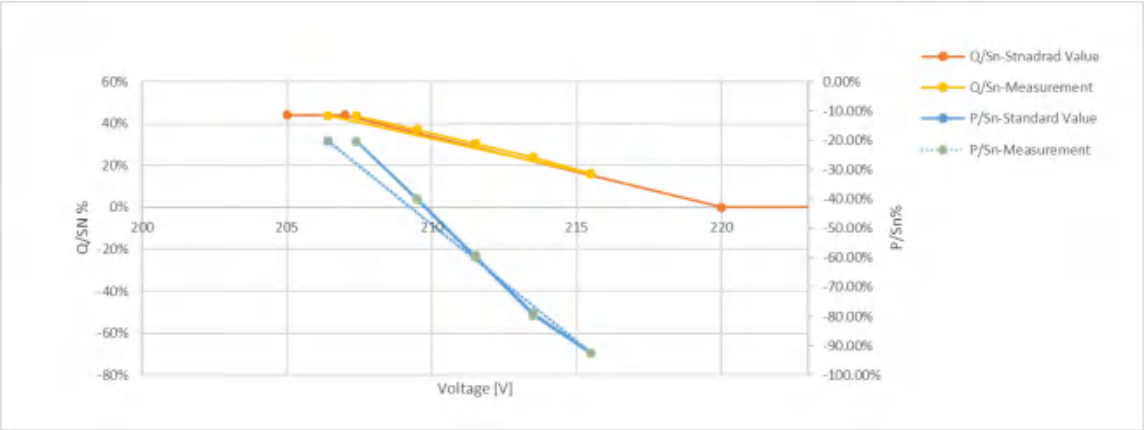
Test Conditions	Measurements						Target		Limits	
U [V]	U [V]	P/Sn	$T_{settling}$ [s]	Q/Sn	ΔQ/ Sn	$T_{settling}$ [s]	Q / Sn	P / Sn	ΔQ, ΔP / Sn	$T_{settling}$ [s]
215	215.5	-92.48%	-	15.76%	0.16%	-	17%	-99%	≤ ±4%*	≤ 10
213	213.4	-79.65%	1.2	23.59%	0.24%	9.6	24%	-80%	≤ ±4%	≤ 10
211	211.2	-59.92%	1.0	30.34%	0.30%	9.4	30%	-60%	≤ ±4%	≤ 10
209	209.5	-40.14%	1.1	37.04%	0.37%	9.5	37%	-40%	≤ ±4%	≤ 10
207	207.3	-20.37%	1.1	43.68%	0.44%	9.5	44%	-20%	≤ ±4%	≤ 10
209	209.0	-39.92%	1.2	37.12%	0.37%	9.4	37%	-40%	≤ ±4%	≤ 10
211	211.4	-59.34%	1.0	30.48%	0.30%	9.6	30%	-60%	≤ ±4%	≤ 10
213	213.4	-78.95%	1.3	23.82%	0.24%	9.5	24%	-80%	≤ ±4%	≤ 10
215	215.3	-92.37%	1.2	16.09%	0.16%	9.6	17%	-99%*	≤ ±4%	≤ 10
206	206.0	-20.14%	1.1	43.85%	0.44%	9.8	44%	-20%	≤ ±4%	≤ 10

Following configuration shall be inspected					
Australia A	Available	Australia B		Available	
Australia C	Available	New Zealand		Available	
P(U) Configurable range	Points	Vw1-ch		Vw2-ch	
	U [V]	180-230		240-265	
	P/Sn	0--20%		-100%	
Q(U) Configurable range	Points	Vv1	Vv2	Vv3	Vv4

	U [V]	180-230	180-230	230-265	230-265
	P/Sn	30-60%	0%	0%	30--60%

Note(s):*Apparent current limitation

Plotting



Appendix H	TABLE: Active anti-islanding test	P
The method used to provide active anti-islanding protection:	☒ Frequency shift ☐ Frequency instability ☐ Power variation ☐ Current injection ☐ Other:_____	
EUT type:	☐ Single PV inverter ☐ Single-phase combination, number of inverter under test_____ ☒ Single-phase inverters used in three phase combinations, number of inverters under test___1___	

☒ Test according the IEC 62116: 2014 (Without reactive power output)

Conditions	P_W [kW]	Q_L [kVar]	Q_C [kVar]	Q_f	Trip time [ms]	Limitation [ms]
PR: -10% QC: +10%	L1: 29.43	L1: 32.00	L1: 32.02	1.088	589	
	L2: 29.52	L2: 31.80	L2: 31.94	1.080		2000
	L3: 29.70	L3: 32.00	L3: 32.01	1.078		
PR: -10% QC: +5%	L1: 29.43	L1: 32.00	L1: 31.56	1.080	613	
	L2: 29.52	L2: 31.80	L2: 31.49	1.072		2000
	L3: 29.70	L3: 32.00	L3: 31.55	1.070		
PR: -10% QC: 0%	L1: 29.43	L1: 32.00	L1: 31.11	1.072	608	
	L2: 29.52	L2: 31.80	L2: 31.04	1.064		2000
	L3: 29.70	L3: 32.00	L3: 31.10	1.062		
PR: -10% QC: -5%	L1: 29.43	L1: 32.00	L1: 30.66	1.064	563	
	L2: 29.52	L2: 31.80	L2: 30.59	1.057		2000
	L3: 29.70	L3: 32.00	L3: 30.65	1.055		
PR: -10% QC: -10%	L1: 29.43	L1: 32.00	L1: 30.20	1.056	549	
	L2: 29.52	L2: 31.80	L2: 30.14	1.049		2000
	L3: 29.70	L3: 32.00	L3: 30.19	1.047		
PR: -5% QC: +10%	L1: 31.06	L1: 32.00	L1: 32.02	1.031	612	
	L2: 31.16	L2: 31.80	L2: 31.94	1.023		2000
	L3: 31.35	L3: 32.00	L3: 32.01	1.021		
PR: -5% QC: -10%	L1: 31.06	L1: 32.00	L1: 30.20	1.001	582	
	L2: 31.16	L2: 31.80	L2: 30.14	0.994		2000
	L3: 31.35	L3: 32.00	L3: 30.19	0.991		
PR: 0% QC: +10%	L1: 32.70	L1: 32.00	L1: 32.02	0.979	617	
	L2: 32.80	L2: 31.80	L2: 31.94	0.972		2000
	L3: 33.00	L3: 32.00	L3: 32.01	0.970		
PR: -5%	L1: 31.06	L1: 32.00	L1: 31.56	1.023	587	

QC: +5%	L2: 31.16	L2: 31.80	L2: 31.49	1.016		2000
	L3: 31.35	L3: 32.00	L3: 31.55	1.014		
PR: -5% QC: 0%	L1: 31.06	L1: 32.00	L1: 31.11	1.016	583	
	L2: 31.16	L2: 31.80	L2: 31.04	1.008		2000
	L3: 31.35	L3: 32.00	L3: 31.10	1.006		
PR: -5% QC: -5%	L1: 31.06	L1: 32.00	L1: 30.66	1.008	490	
	L2: 31.16	L2: 31.80	L2: 30.59	1.001		2000
	L3: 31.35	L3: 32.00	L3: 30.65	0.999		
PR: 0% QC: +5%	L1: 32.70	L1: 32.00	L1: 31.56	0.972	608	
	L2: 32.80	L2: 31.80	L2: 31.49	0.965		2000
	L3: 33.00	L3: 32.00	L3: 31.55	0.963		
PR: 0% QC: 0%	L1: 32.70	L1: 32.00	L1: 31.11	0.965	595	
	L2: 32.80	L2: 31.80	L2: 31.04	0.958		2000
	L3: 33.00	L3: 32.00	L3: 31.1	0.956		
PR: 0% QC: -5%	L1: 32.70	L1: 32.00	L1: 30.65	0.958	571	
	L2: 32.80	L2: 31.80	L2: 30.59	0.951		2000
	L3: 33.00	L3: 32.00	L3: 30.65	0.949		
PR: +5% QC: +5%	L1: 34.33	L1: 32.00	L1: 31.56	0.926	603	
	L2: 34.44	L2: 31.80	L2: 31.49	0.919		2000
	L3: 34.65	L3: 32.00	L3: 31.55	0.917		
PR: +5% QC: 0%	L1: 34.33	L1: 32.00	L1: 31.11	0.919	538	
	L2: 34.44	L2: 31.80	L2: 31.04	0.912		2000
	L3: 34.65	L3: 32.00	L3: 31.10	0.910		
PR: +5% QC: -5%	L1: 34.33	L1: 32.00	L1: 30.65	0.912	578	
	L2: 34.44	L2: 31.80	L2: 30.59	0.906		2000
	L3: 34.65	L3: 32.00	L3: 30.65	0.904		
PR: 0% QC: -10%	L1: 32.70	L1: 32.00	L1: 30.20	0.951	573	
	L2: 32.80	L2: 31.80	L2: 30.14	0.944		2000
	L3: 33.00	L3: 32.00	L3: 30.19	0.942		
PR: +5% QC: +10%	L1: 34.33	L1: 32.00	L1: 32.02	0.932	597	
	L2: 34.44	L2: 31.80	L2: 31.94	0.925		2000
	L3: 34.65	L3: 32.00	L3: 32.01	0.924		
PR: +5% QC: -10%	L1: 34.33	L1: 32.00	L1: 30.20	0.906	579	
	L2: 34.44	L2: 31.80	L2: 30.14	0.899		2000
	L3: 34.65	L3: 32.00	L3: 30.19	0.897		

PR: +10% QC: +10%	L1: 35.97	L1: 32.00	L1: 32.02	0.890	590	
	L2: 36.08	L2: 31.80	L2: 31.94	0.883		2000
	L3: 36.30	L3: 32.00	L3: 32.01	0.882		
PR: +10% QC: +5%	L1: 35.97	L1: 32.00	L1: 31.56	0.883	593	
	L2: 36.08	L2: 31.80	L2: 31.49	0.877		2000
	L3: 36.30	L3: 32.00	L3: 31.55	0.875		
PR: +10% QC: 0%	L1: 35.97	L1: 32.00	L1: 31.11	0.877	597	
	L2: 36.08	L2: 31.80	L2: 31.04	0.871		2000
	L3: 36.30	L3: 32.00	L3: 31.10	0.869		
PR: 10% QC: -5%	L1: 35.97	L1: 32.00	L1: 30.65	0.871	592	
	L2: 36.08	L2: 31.80	L2: 30.59	0.864		2000
	L3: 36.30	L3: 32.00	L3: 30.65	0.863		
PR: +10% QC: -10%	L1: 35.97	L1: 32.00	L3: 30.20	0.864	560	
	L2: 36.08	L2: 31.80	L2: 30.14	0.858		2000
	L3: 36.30	L3: 32.00	L3: 30.19	0.856		
Power 66%						
Conditions	P_W [kW]	Q_L [kVA]	Q_C [kVA]	Q_f	Trip time [ms]	Limitation [ms]
PR: 0% QC: -5%	L1: 21.50	L1: 22.00	L1: 20.88	0.997	581	
	L2: 21.60	L2: 21.90	L2: 20.82	0.989		2000
	L3: 21.70	L3: 22.00	L3: 20.87	0.987		
PR: 0% QC: -4%	L1: 21.50	L1: 22.00	L1: 20.98	0.999	564	
	L2: 21.60	L2: 21.90	L2: 20.92	0.991		2000
	L3: 21.70	L3: 22.00	L3: 20.97	0.990		
PR: 0% QC: -3%	L1: 21.50	L1: 22.00	L1: 21.07	1.001	589	
	L2: 21.60	L2: 21.90	L2: 21.01	0.993		2000
	L3: 21.70	L3: 22.00	L3: 21.06	0.992		
PR: 0% QC: -2%	L1: 21.50	L1: 22.00	L1: 21.16	1.004	575	
	L2: 21.60	L2: 21.90	L2: 21.10	0.995		2000
	L3: 21.70	L3: 22.00	L3: 21.15	0.994		
PR: 0% QC: -1%	L1: 21.50	L1: 22.00	L1: 21.26	1.006	568	
	L2: 21.60	L2: 21.90	L2: 21.20	0.998		2000
	L3: 21.70	L3: 22.00	L3: 21.25	0.996		
PR: 0% QC: 0%	L1: 21.50	L1: 22.00	L1: 21.35	1.008	606	
	L2: 21.60	L2: 21.90	L2: 21.29	1.000		2000
	L3: 21.70	L3: 22.00	L3: 21.34	0.999		

PR: 0% QC: +1%	L1: 21.50	L1: 22.00	L1: 21.44	1.010	579	2000
	L2: 21.60	L2: 21.90	L2: 21.38	1.002		
	L3: 21.70	L3: 22.00	L3: 21.43	1.001		
PR: 0% QC: +2%	L1: 21.50	L1: 22.00	L1: 21.53	1.012	602	
	L2: 21.60	L2: 21.90	L2: 21.47	1.004		2000
	L3: 21.70	L3: 22.00	L3: 21.53	1.003		
PR: 0% QC: +3%	L1: 21.50	L1: 22.00	L1: 21.63	1.015	585	
	L2: 21.60	L2: 21.90	L2: 21.57	1.006		2000
	L3: 21.70	L3: 22.00	L3: 21.62	1.005		
PR: 0% QC: +4%	L1: 21.50	L1: 22.00	L1: 21.72	1.017	602	
	L2: 21.60	L2: 21.90	L2: 21.66	1.008		2000
	L3: 21.70	L3: 22.00	L3: 21.71	1.007		
PR: 0% QC: +5%	L1: 21.50	L1: 22.00	L1: 21.82	1.019	603	
	L2: 21.60	L2: 21.90	L2: 21.75	1.010		2000
	L3: 21.70	L3: 22.00	L3: 21.81	1.009		
Power 33%						
Conditions	P_W [kW]	Q_L [kVA]	Q_C [kVA]	Q_f	Trip time [ms]	Limitation [ms]
PR: 0% QC: -5%	L1: 10.80	L1: 11.00	L1: 10.23	0.982	562	
	L2: 10.80	L2: 10.98	L2: 10.21	0.980		2000
	L3: 10.80	L3: 10.99	L3: 10.23	0.982		
PR: 0% QC: -4%	L1: 10.80	L1: 11.00	L1: 10.27	0.984	563	
	L2: 10.80	L2: 10.98	L2: 10.25	0.982		2000
	L3: 10.80	L3: 10.99	L3: 10.27	0.984		
PR: 0% QC: -3%	L1: 10.80	L1: 11.00	L1: 10.32	0.987	558	
	L2: 10.80	L2: 10.98	L2: 10.30	0.985		2000
	L3: 10.80	L3: 10.99	L3: 10.32	0.986		
PR: 0% QC: -2%	L1: 10.80	L1: 11.00	L1: 10.36	0.988	599	
	L2: 10.80	L2: 10.98	L2: 10.34	0.987		2000
	L3: 10.80	L3: 10.99	L3: 10.36	0.988		
PR: 0% QC: -1%	L1: 10.80	L1: 11.00	L1: 10.40	0.990	690	
	L2: 10.80	L2: 10.98	L2: 10.38	0.988		2000
	L3: 10.80	L3: 10.99	L3: 10.40	0.990		
PR: 0% QC: 0%	L1: 10.80	L1: 11.00	L1: 10.45	0.993	558	
	L2: 10.80	L2: 10.98	L2: 10.43	0.991		2000
	L3: 10.80	L3: 10.99	L3: 10.45	0.992		

PR: 0% QC: +1%	L1: 10.80	L1: 11.00	L1: 10.49	0.995	588	
	L2: 10.80	L2: 10.98	L2: 10.47	0.993		2000
	L3: 10.80	L3: 10.99	L3: 10.49	0.994		
PR: 0% QC: +2%	L1: 10.80	L1: 11.00	L1: 10.54	0.997	594	
	L2: 10.80	L2: 10.98	L2: 10.52	0.995		2000
	L3: 10.80	L3: 10.99	L3: 10.54	0.997		
PR: 0% QC: +3%	L1: 10.80	L1: 11.00	L1: 10.58	0.999	564	
	L2: 10.80	L2: 10.98	L2: 10.56	0.997		2000
	L3: 10.80	L3: 10.99	L3: 10.58	0.998		
PR: 0% QC: +4%	L1: 10.80	L1: 11.00	L1: 10.63	1.001	573	
	L2: 10.80	L2: 10.98	L2: 10.61	0.999		2000
	L3: 10.80	L3: 10.99	L3: 10.63	1.001		
PR: 0% QC: +5%	L1: 10.80	L1: 11.00	L1: 10.67	1.003	583	
	L2: 10.80	L2: 10.98	L2: 10.65	1.001		2000
	L3: 10.80	L3: 10.99	L3: 10.67	1.003		
Remark:						

Appendix I (a)	TABLE: Undervoltage and overvoltage trip settings test								P	
Condition	Setting [V]	Measurement Trip value [V]							Limitation [V]	
		L1		L2		L3				
U>	265	264.9		265.3		265.2			±2.3	
		264.6		265.3		265.2				
		264.6		265.0		265.0				
	Setting [ms]	Measurement Trip time [ms]							Limitation [ms]	
		L1		L2		L3				
	1000-2000	1672		1528		1506			1000-2000	
		1622		1488		1519				
		1711		1438		1508				
	Reconnection									
	U [V]	Delay time [s]			Power Gradient [%Pn/min]				Limitation	
		L1	L2	L3	L1	L2	L3			
	255	No reconnection							No reconnect	
	251	109.5	109.6	109.5	16.6	16.6	16.6		≥ 60	16.7
Condition	Setting [V]	Measurement Trip value [V]							Limitation [V]	
		L1		L2		L3				
U>>	275	No measurement required							±2.3	
	Setting [ms]	Measurement Trip time [ms]							Limitation [ms]	
		L1		L2		L3				
	100	181		126		120			≤200	
		123		184		122				
		128		127		124				
	Reconnection									
	U [V]	Delay time [s]			Power Gradient [%Pn/min]				Limitation	
		L1	L2	L3	L1	L2	L3			
	230	112.6	112.4	112.4	16.5	16.5	16.5		≥ 60	16.7

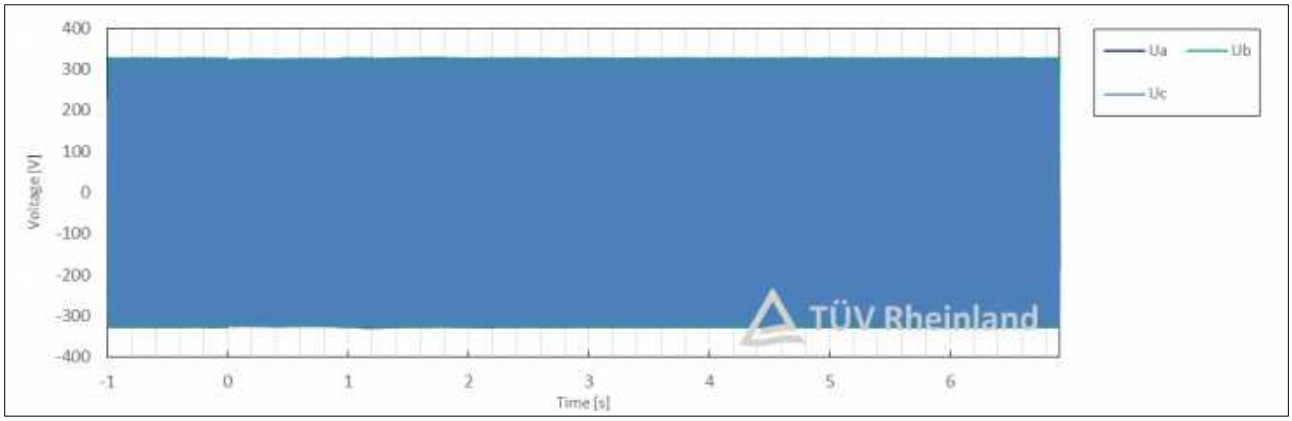
Condition	Setting [V]	Measurement Trip value [V] L1	L2	L3	Limitation [V]
U<	180	180.3	180.3	180.3	±2.3
		180.3	180.3	180.3	
		180.3	180.3	180.3	
	Setting [ms]	Measurement Trip time [ms] L1	L2	L3	Limitation [ms]
	10000	10100	10050	10120	10000-11000
		10150	10010	10090	
		10160	10070	10110	
	Reconnection				
	U [V]	Delay time [s] L1	L2	L3	Power Gradient [%Pn/min] L1	L2	L3	Limitation	
	203	No reconnection						No reconnect	
	207	107.4	107.5	107.4	16.6	16.6	16.6	≥ 60	16.7

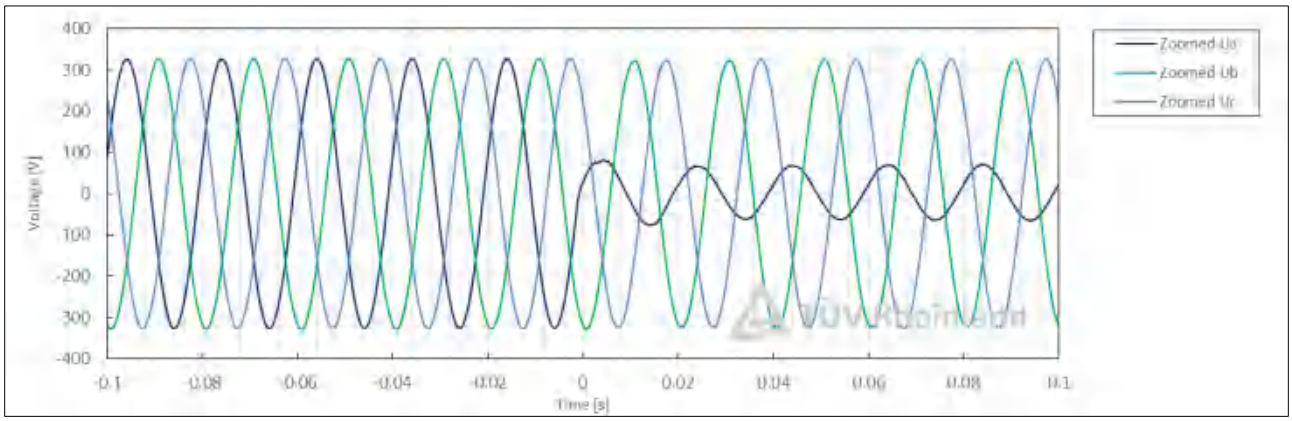
Condition	Setting [V]	Measurement Trip value [V] L1	L2	L3	Limitation [V]
U<<	70	No measurement required			±2.3
	Setting [ms]	Measurement Trip time [ms] L1	L2	L3	Limitation [ms]
	1000	1615	1603	1659	1000-2000
		1618	1616	1662	
		1664	1633	1625	
	Voltage withstand tests at 50V see table Appendix I (c)				
	Reconnection				
	U [V]	Delay time [s] L1	L2	L3	Power Gradient [%Pn/min] L1	L2	L3	Limitation	
	230	111.9	111.8	112.0	16.5	16.5	16.5	≥ 60	16.7

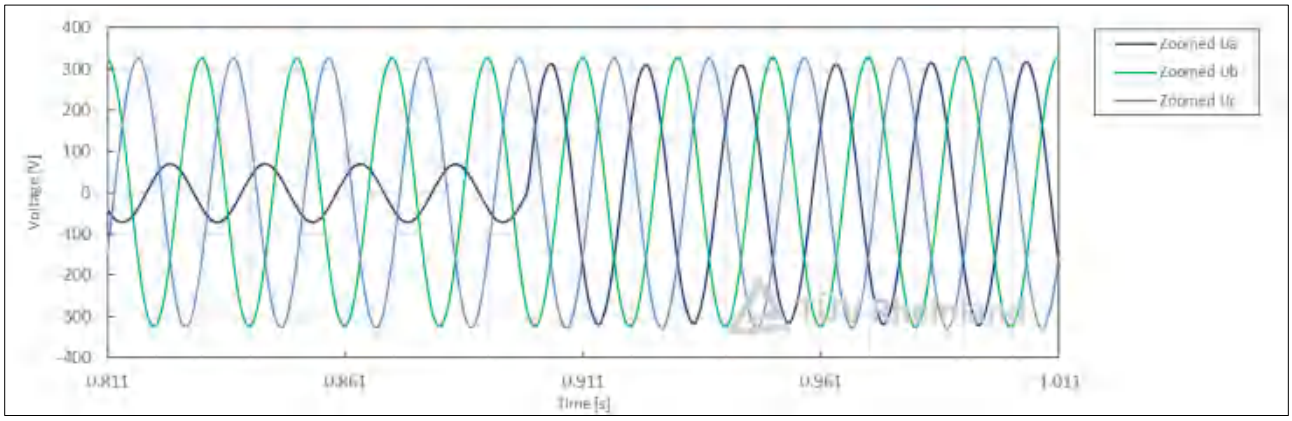
Note(s):

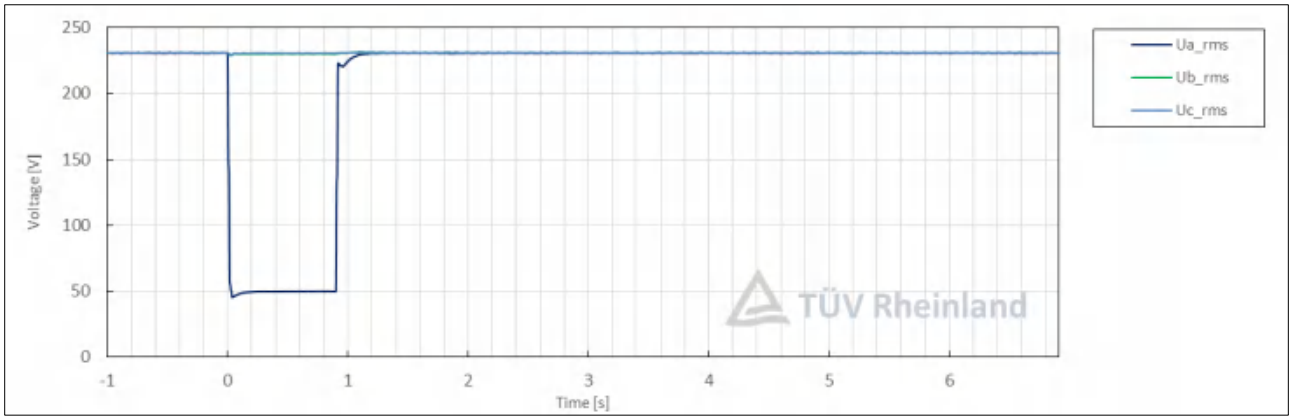
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)				P
L1					
Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.1
	1	Fault type (phase)	--	--	--	1-phase fault (L1 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	910
	4	Point of fault entry (step under 70V)	Total	--	ms	5
	5	Point of fault clearance (step over 70V)	Total	--	ms	915
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.01
	12		Phase 2			0.04
	13		Phase 3			0.04
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.181
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

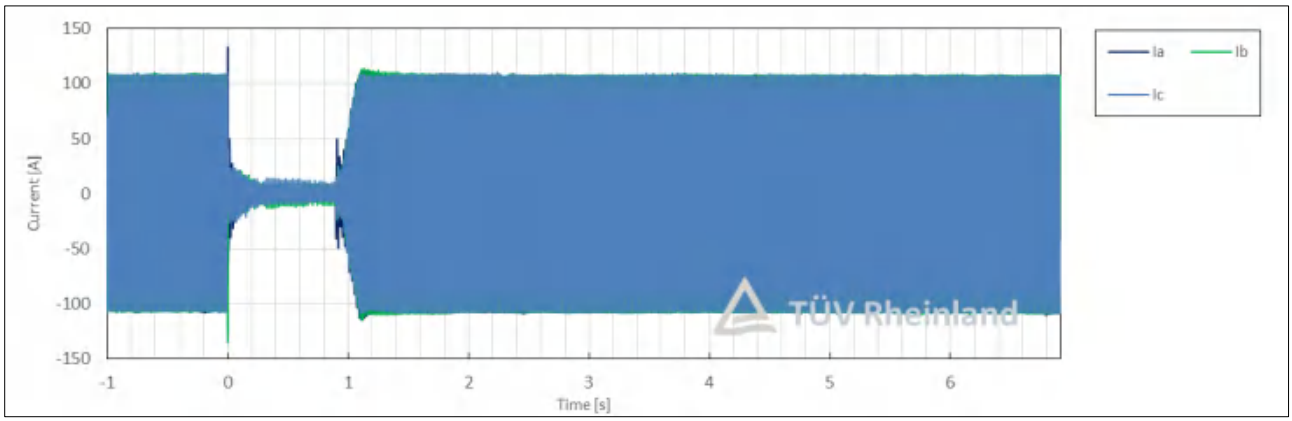
Test No. 1.1
1-phase fault (L1 phase)

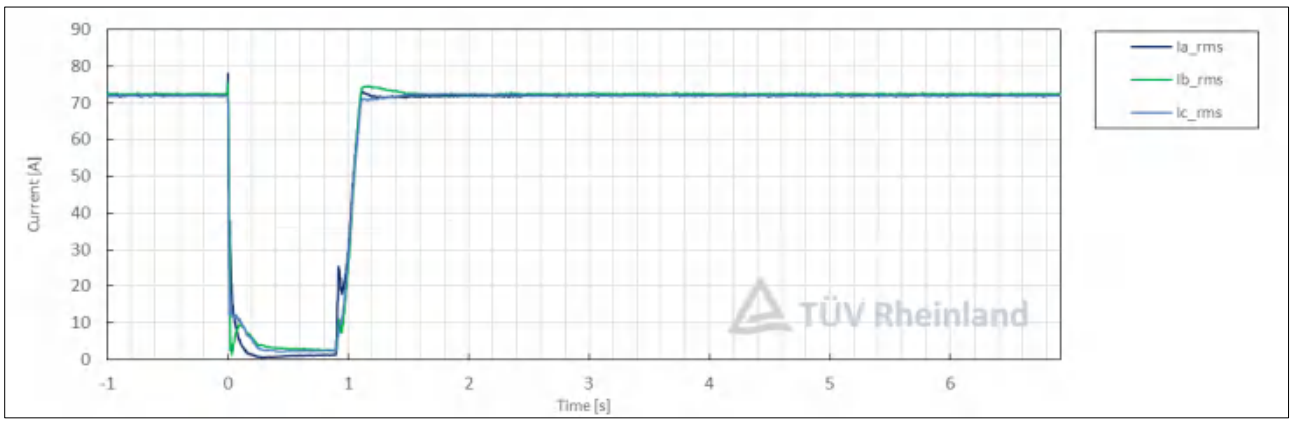


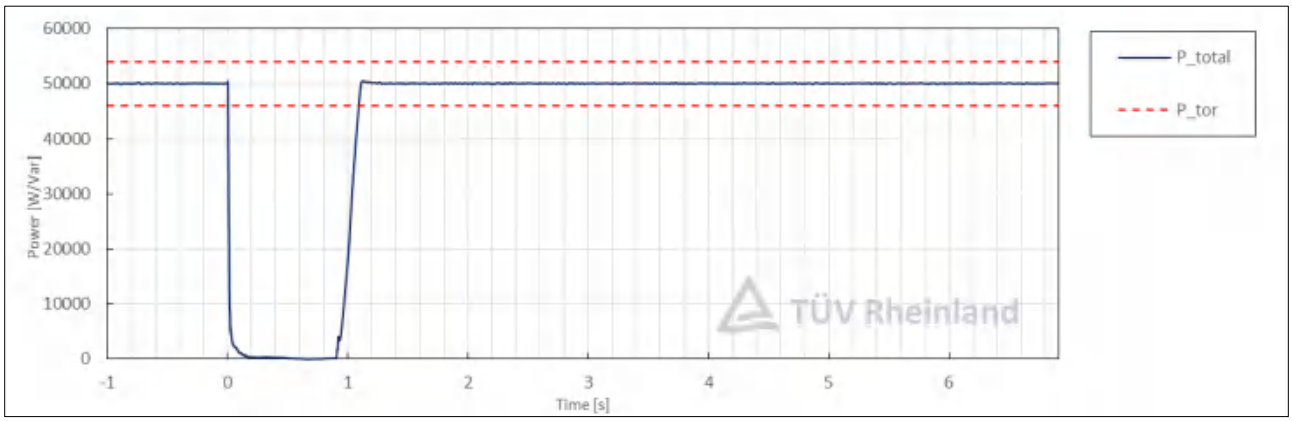





Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

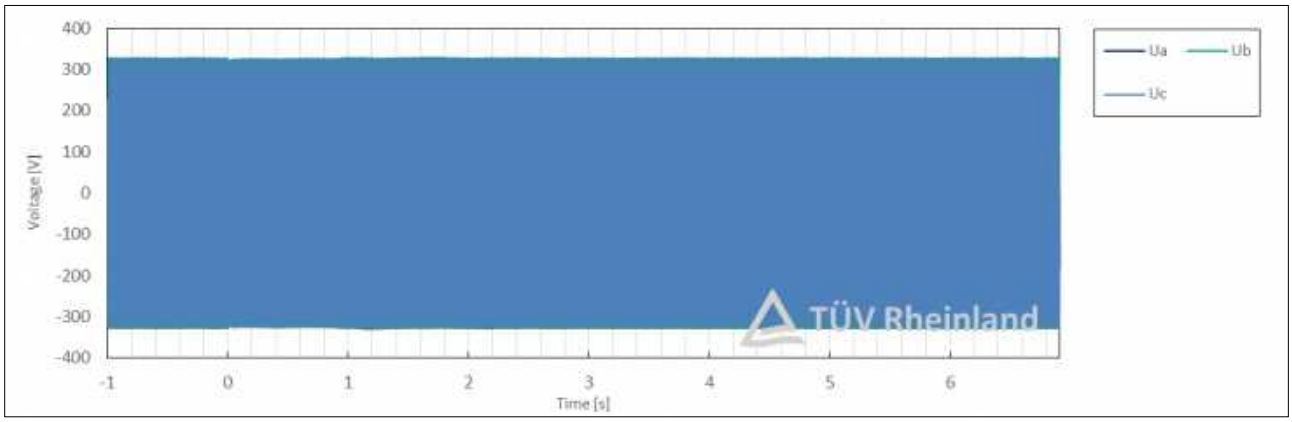

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

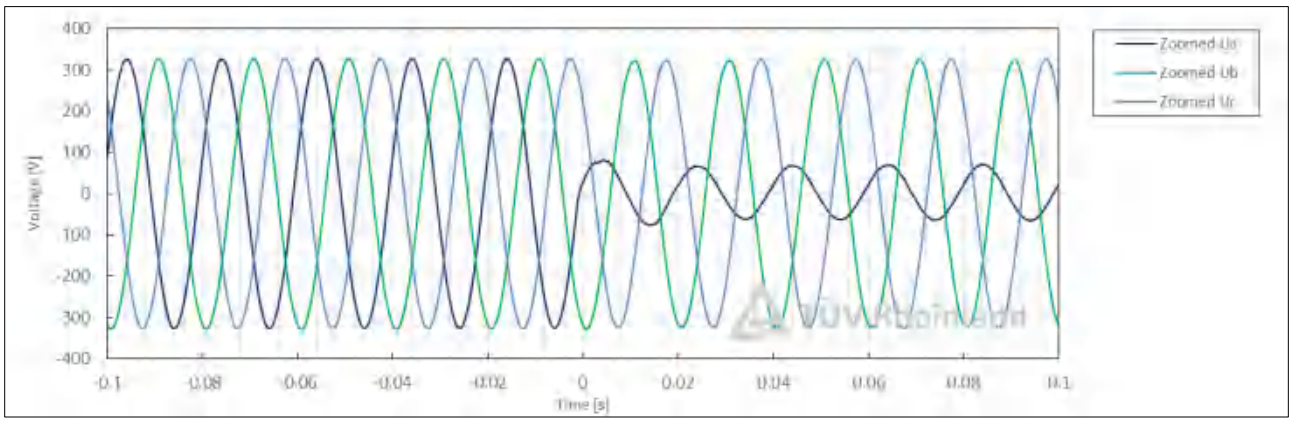

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

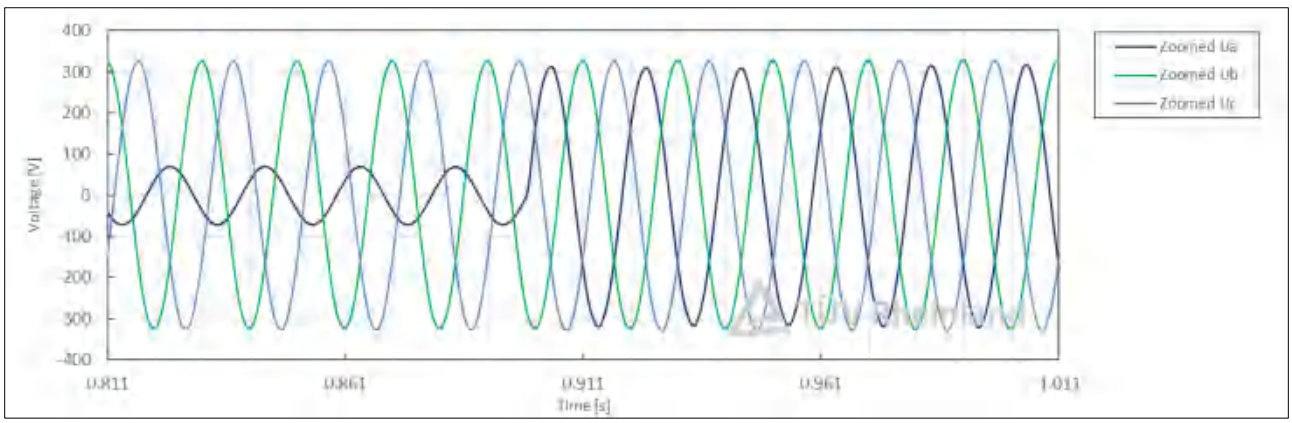

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

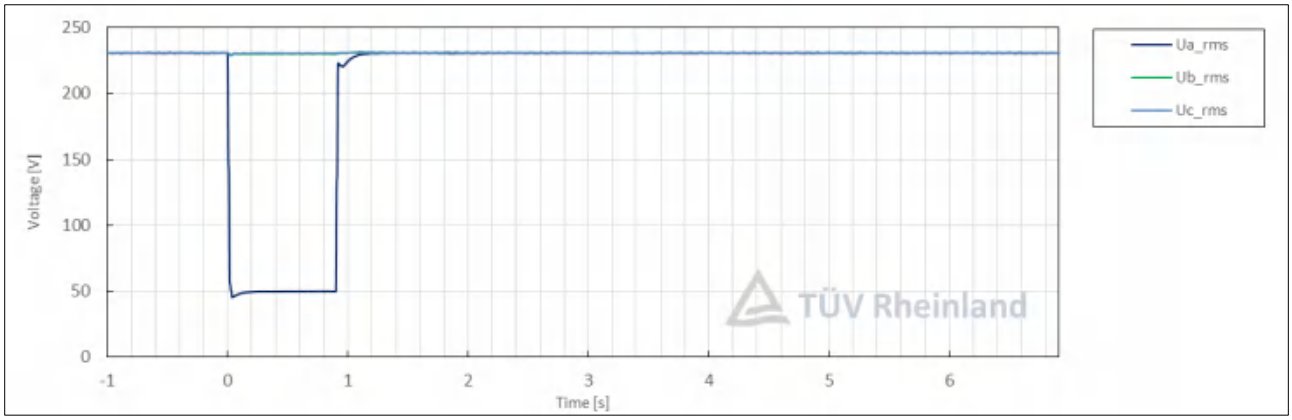
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)					P
L1						
Condition						Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.2
	1	Fault type (phase)	--	--	--	1-phase fault (L1 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	910
	4	Point of fault entry (step under 70V)	Total	--	ms	5
	5	Point of fault clearance (step over 70V)	Total	--	ms	915
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.01
	12		Phase 2			0.04
	13		Phase 3			0.04
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.181
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

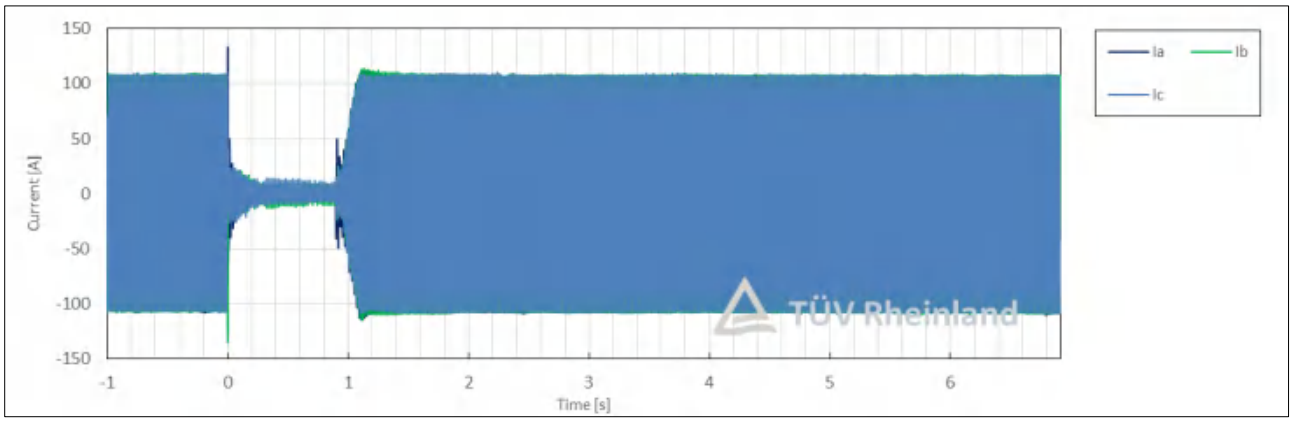
Test No. 1.2
1-phase fault (L1 phase)

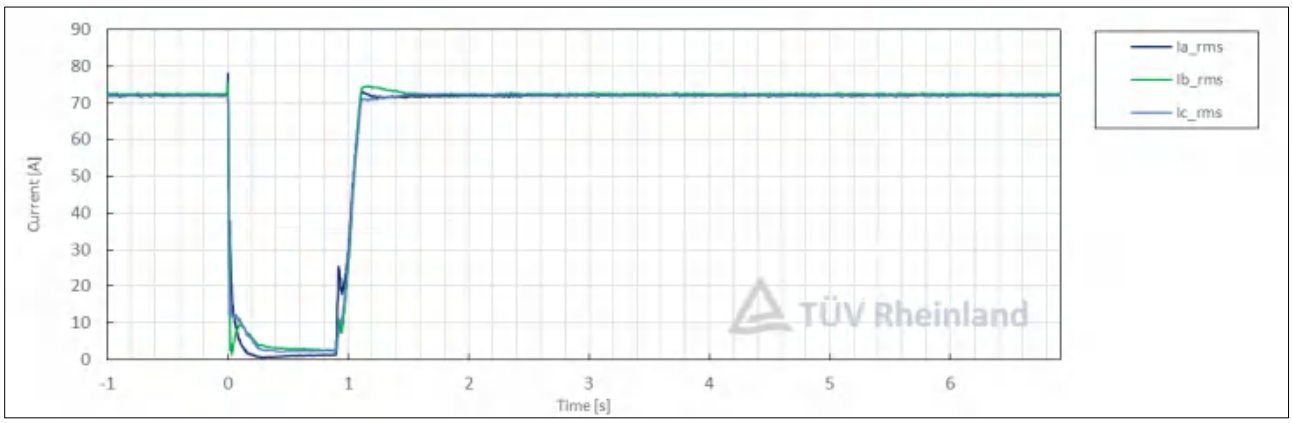


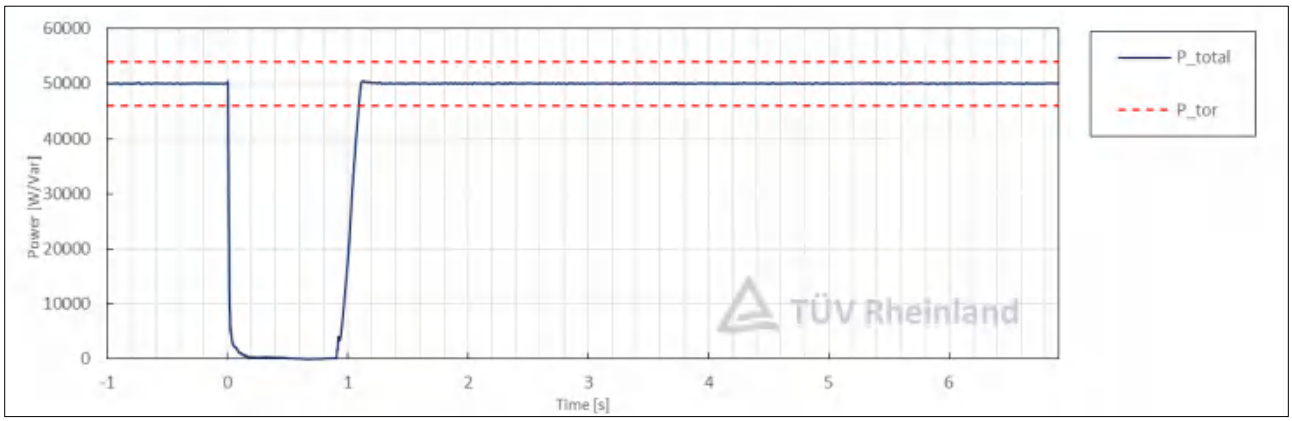





Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

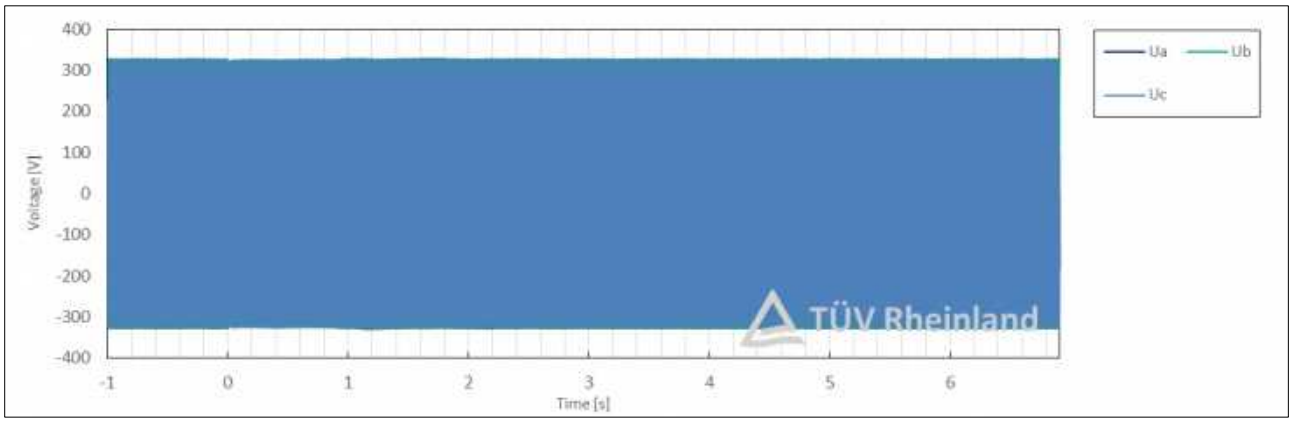

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

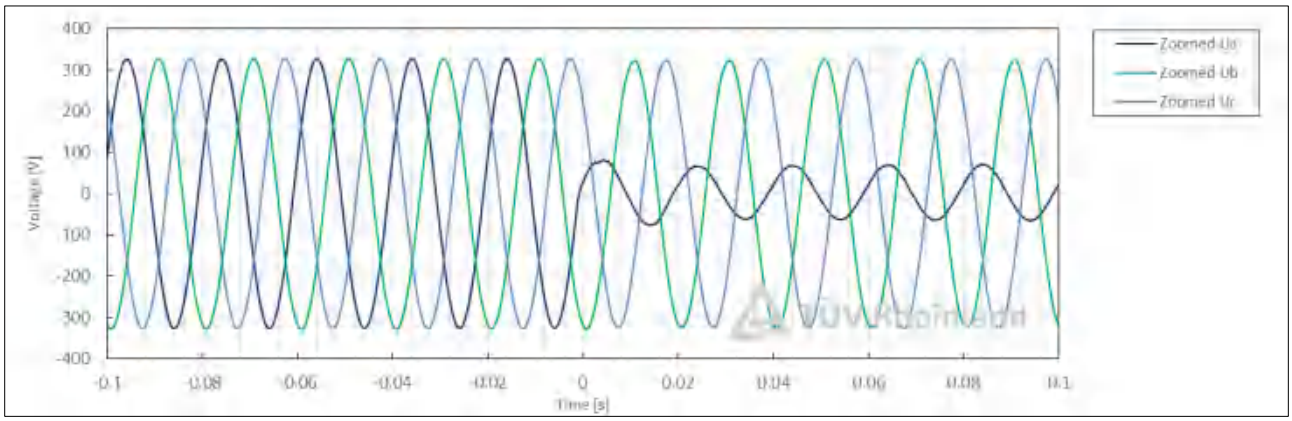

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

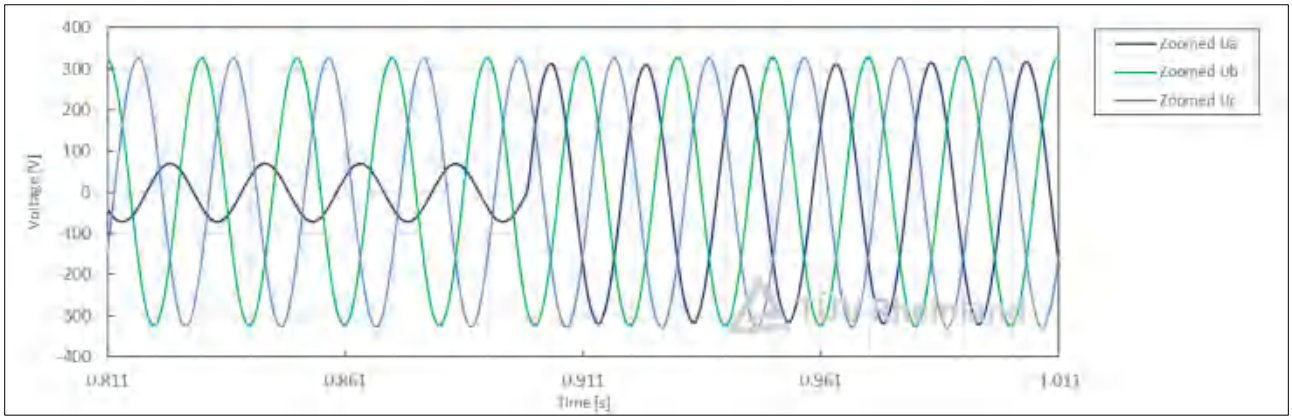
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)					P
L1						
	Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.3
	1	Fault type (phase)	--	--	--	1-phase fault (L1 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	910
	4	Point of fault entry (step under 70V)	Total	--	ms	5
	5	Point of fault clearance (step over 70V)	Total	--	ms	915
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.01
	12		Phase 2			0.04
	13		Phase 3			0.04
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00

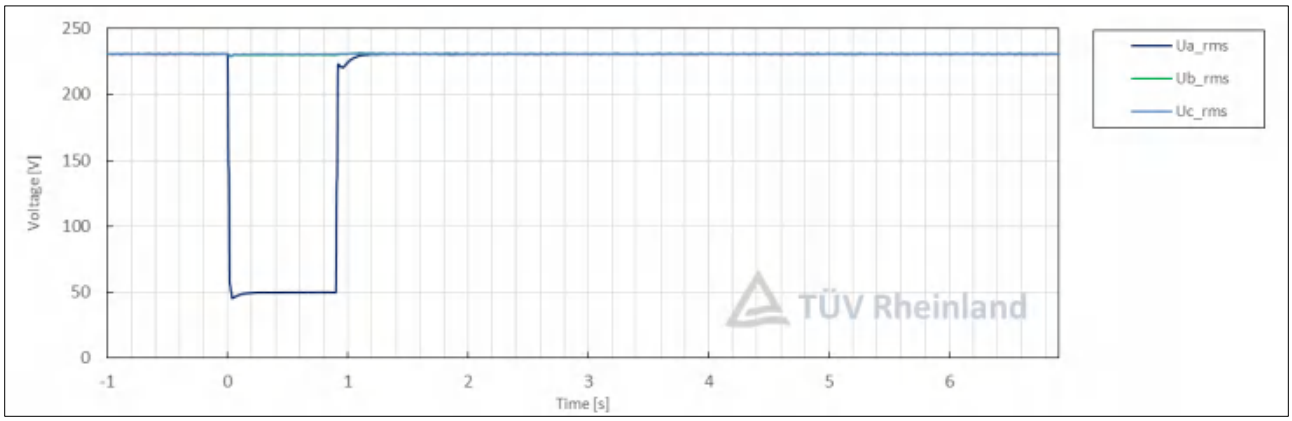
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.181
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

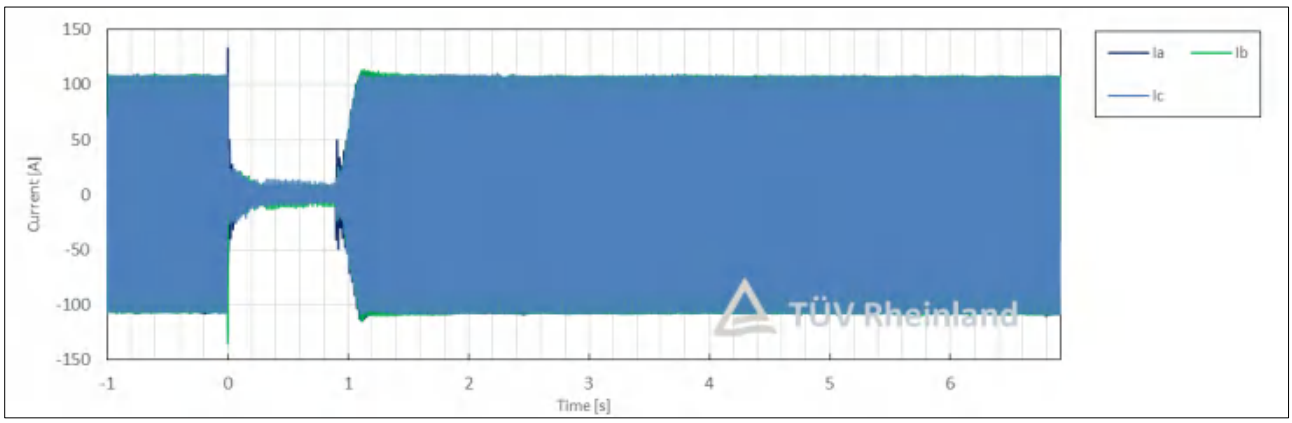
Test No. 1.3
1-phase fault (L1 phase)

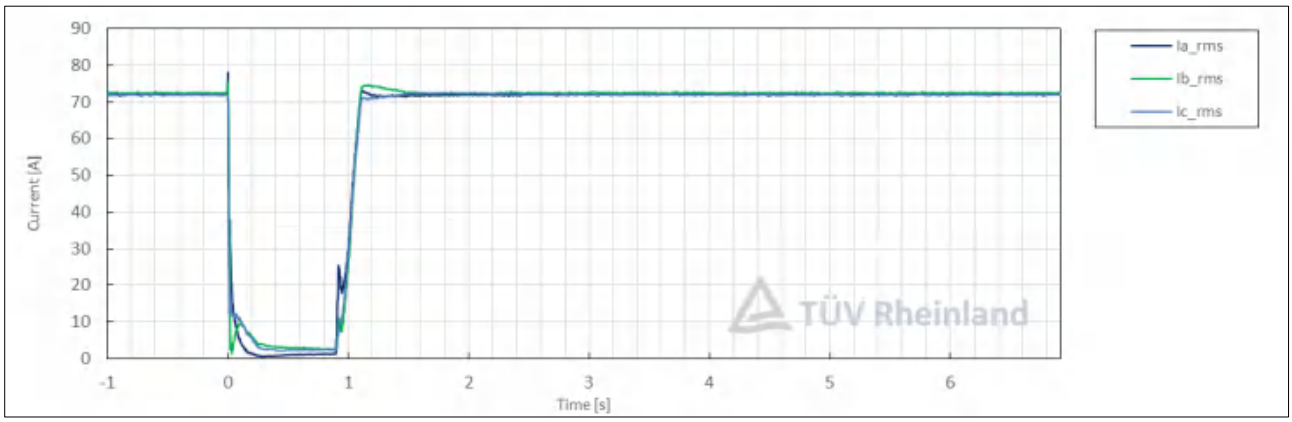


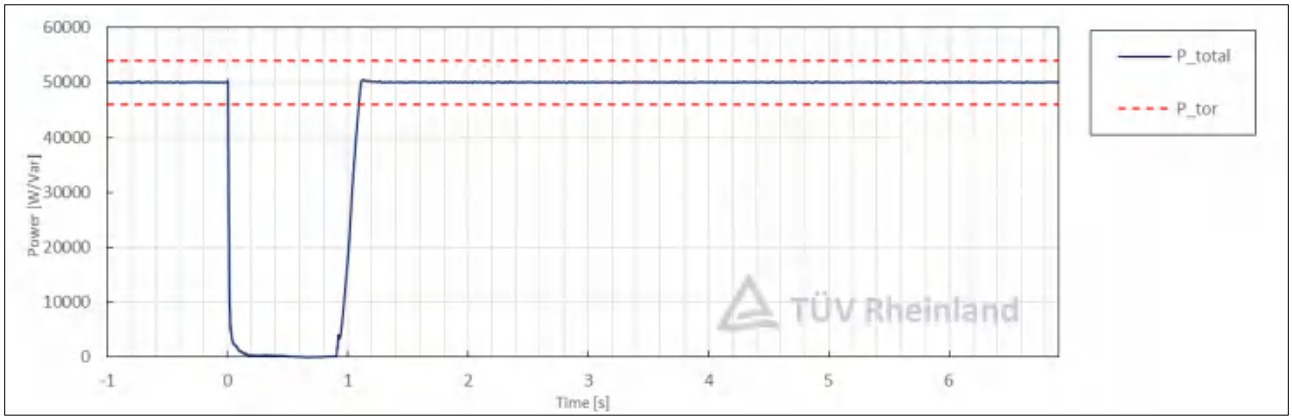



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

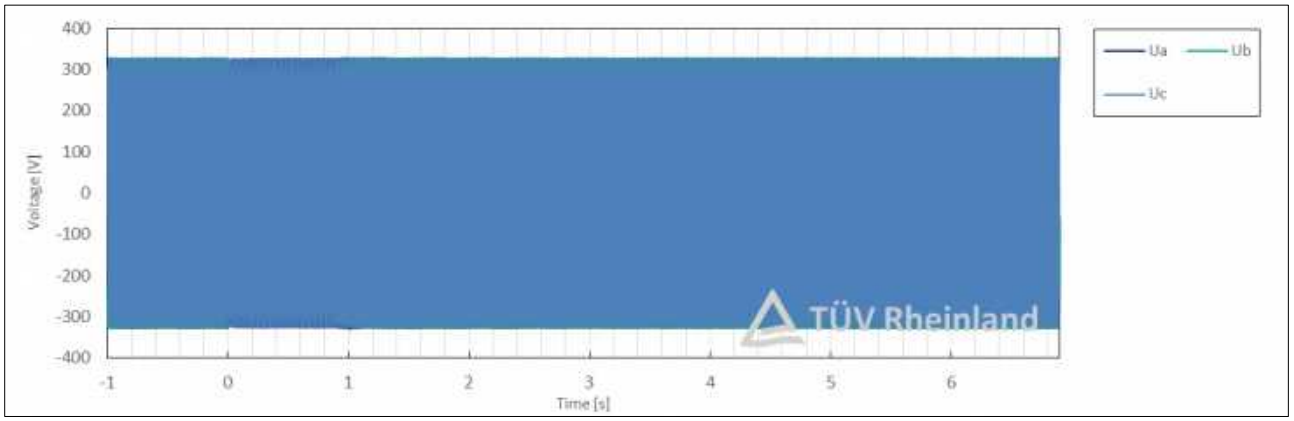

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

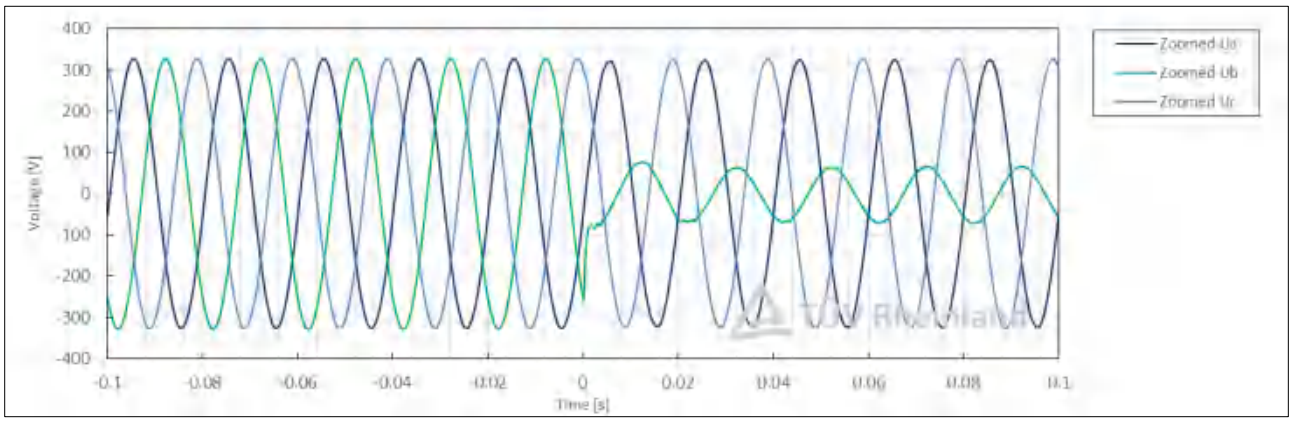


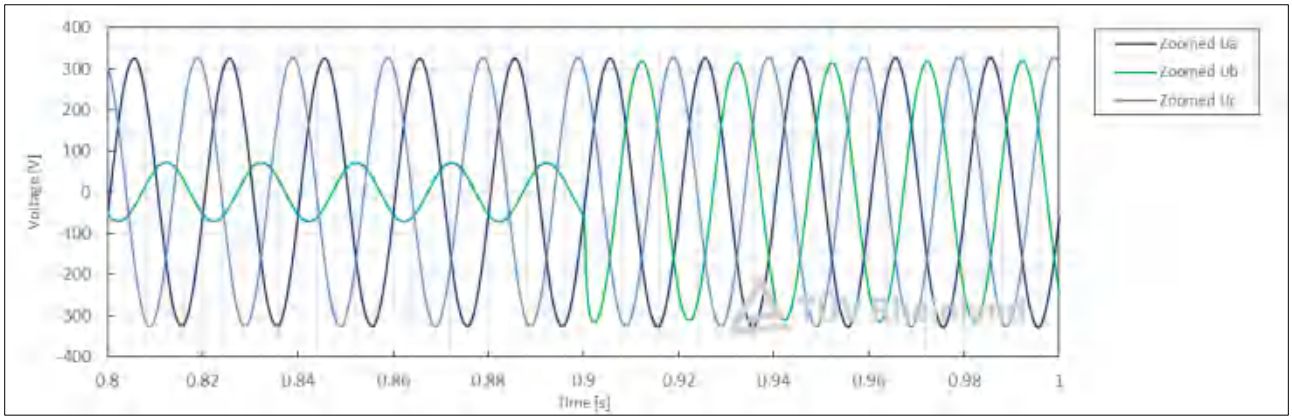
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)				P
L2					
Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.1
	1	Fault type (phase)	--	--	--	1-phase fault (L2 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	910
	4	Point of fault entry (step under 70V)	Total	--	ms	4
	5	Point of fault clearance (step over 70V)	Total	--	ms	914
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.04
	12		Phase 2			0.01
	13		Phase 3			0.04
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00

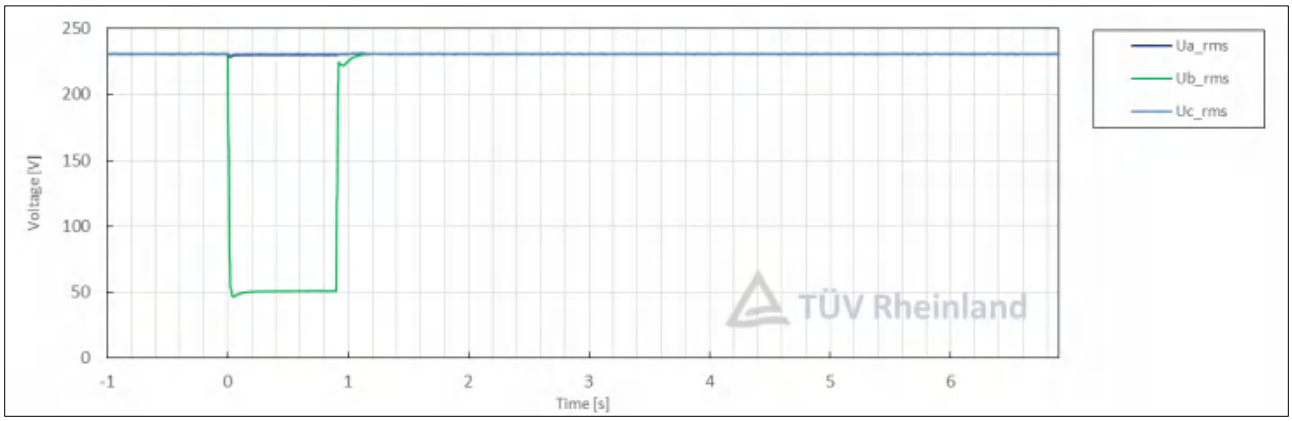
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.191
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

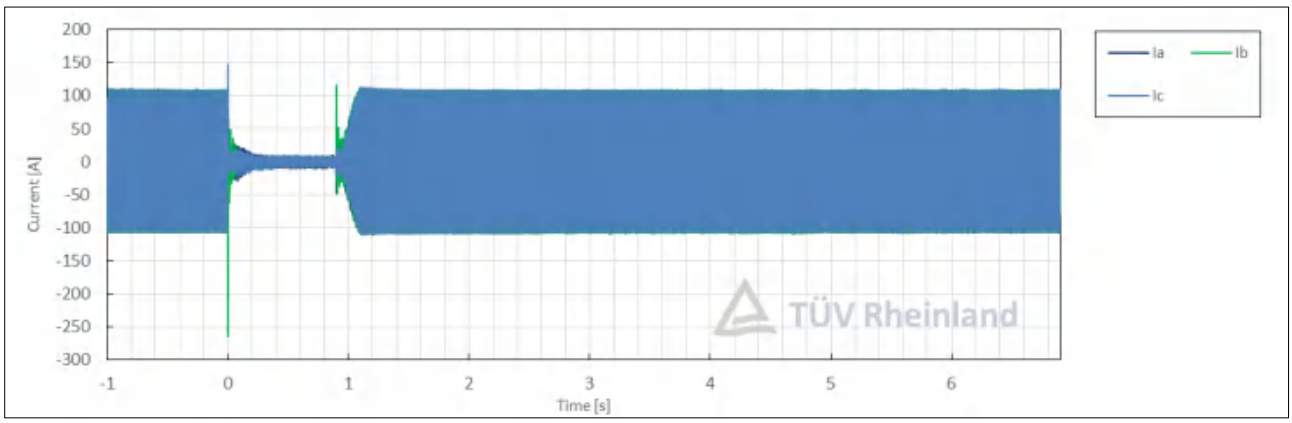
Test No. 2.1
1-phase fault (L2 phase)

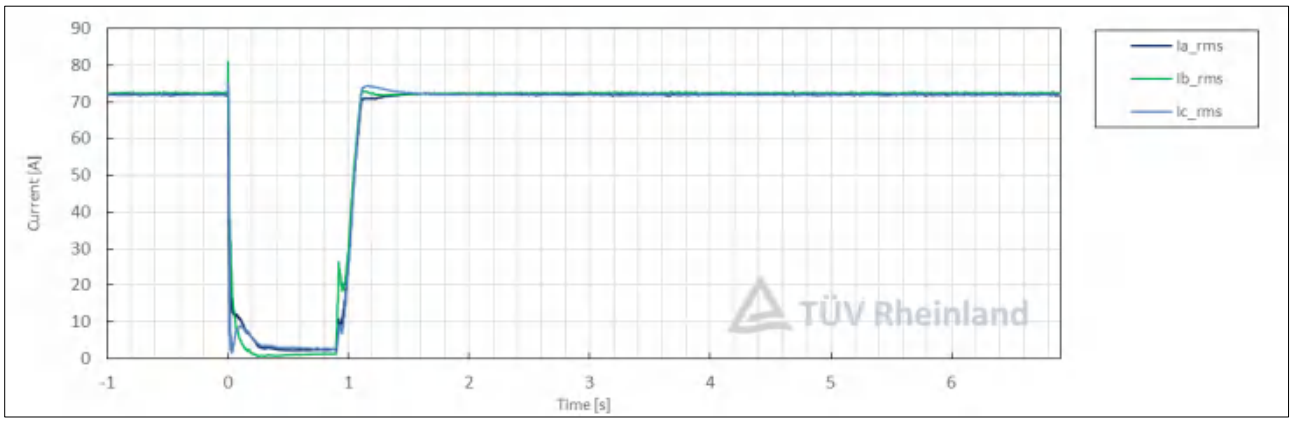


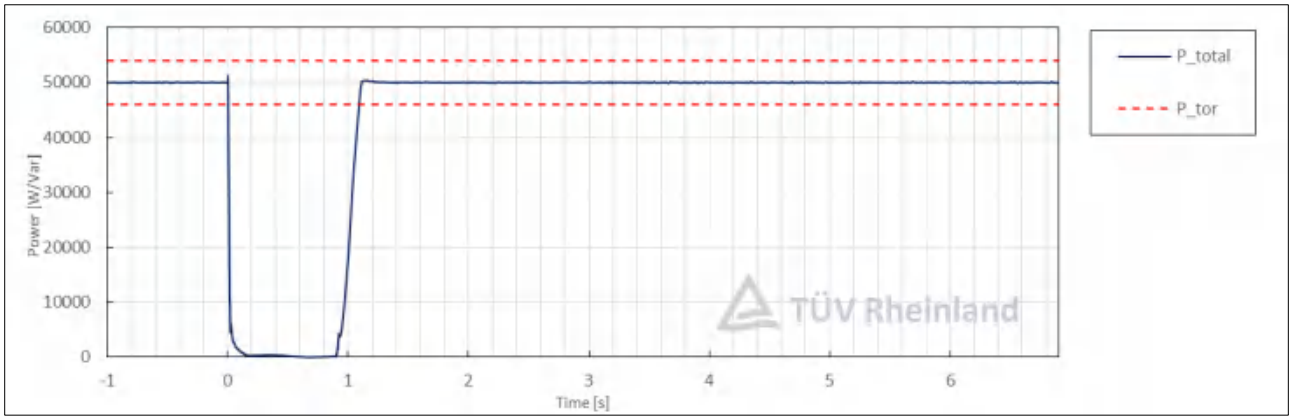



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

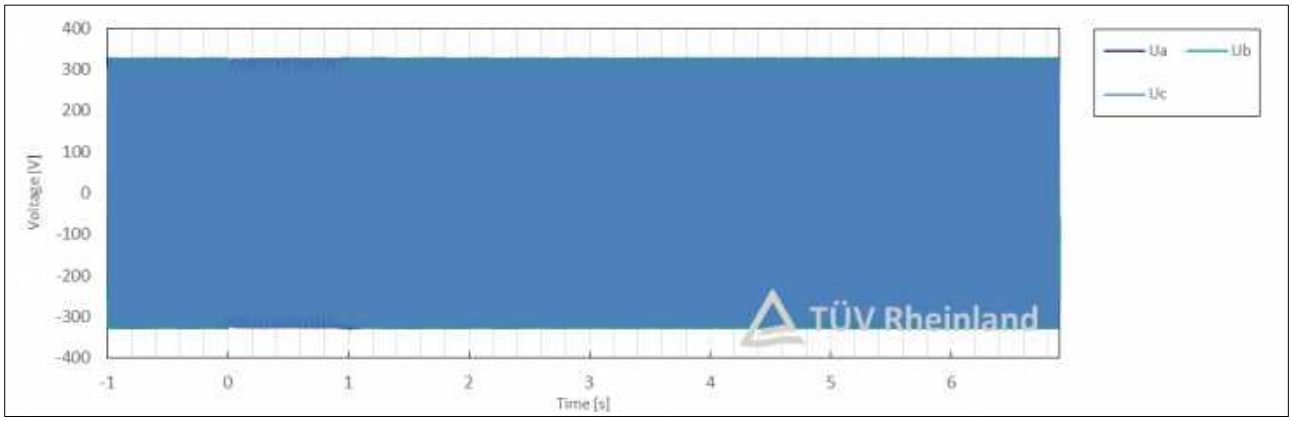

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

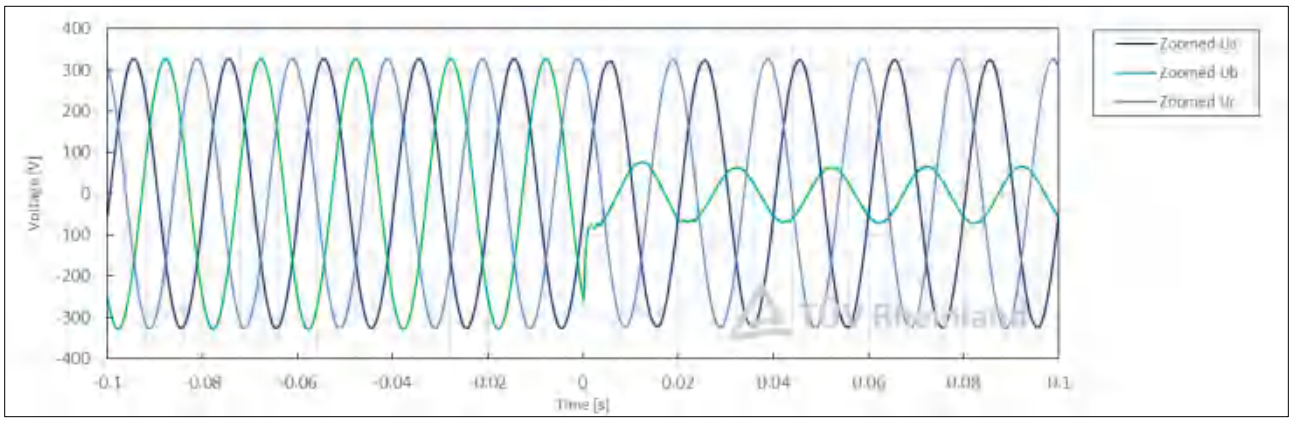


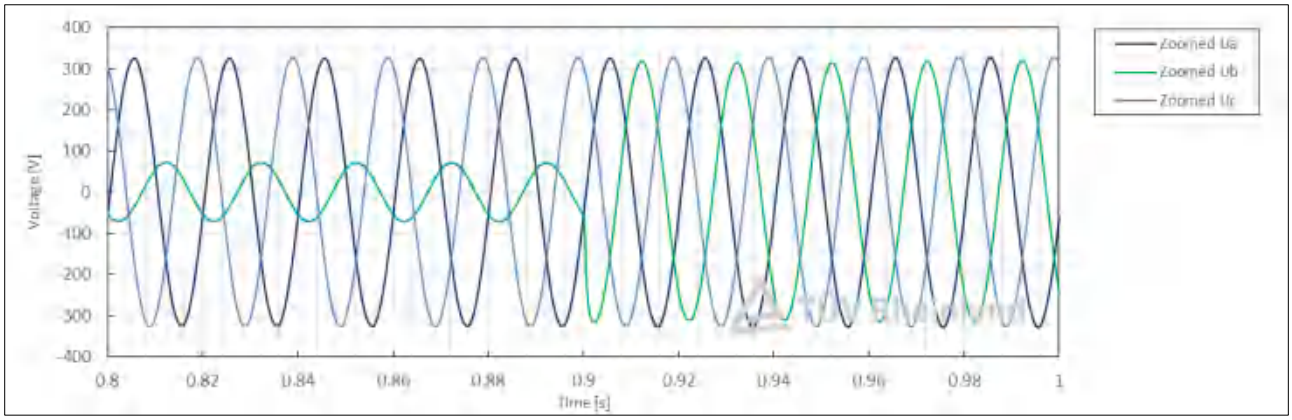
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)				P
L2					
Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.2
	1	Fault type (phase)	--	--	--	1-phase fault (L2 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	929
	4	Point of fault entry (step under 70V)	Total	--	ms	4
	5	Point of fault clearance (step over 70V)	Total	--	ms	933
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.22
	11	Line current	Phase 1	t1+200ms	p.u.	0.02
	12		Phase 2			0.01
	13		Phase 3			0.02
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00

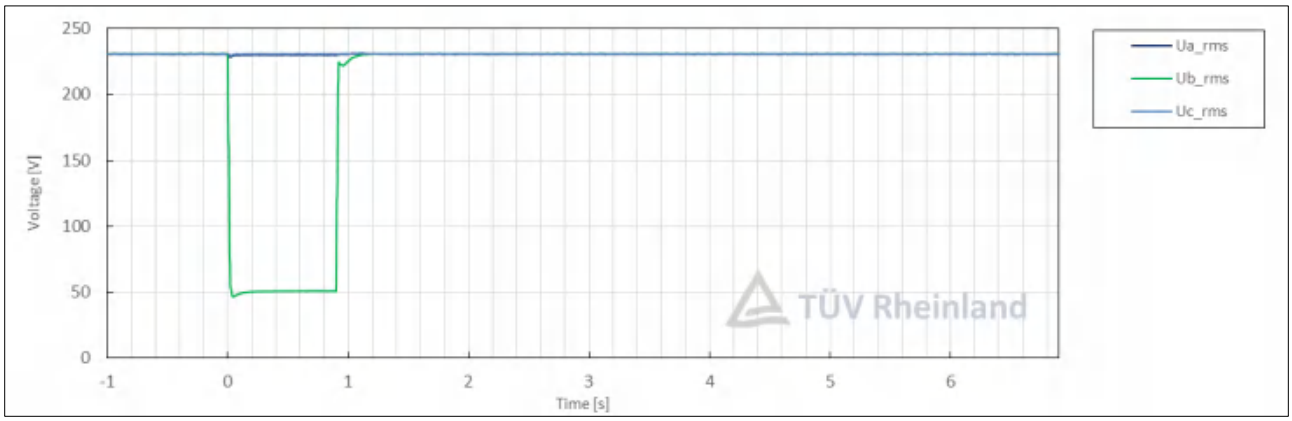
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.49
	17	Active power rising time	Total	--	s (<400ms)	0.121
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

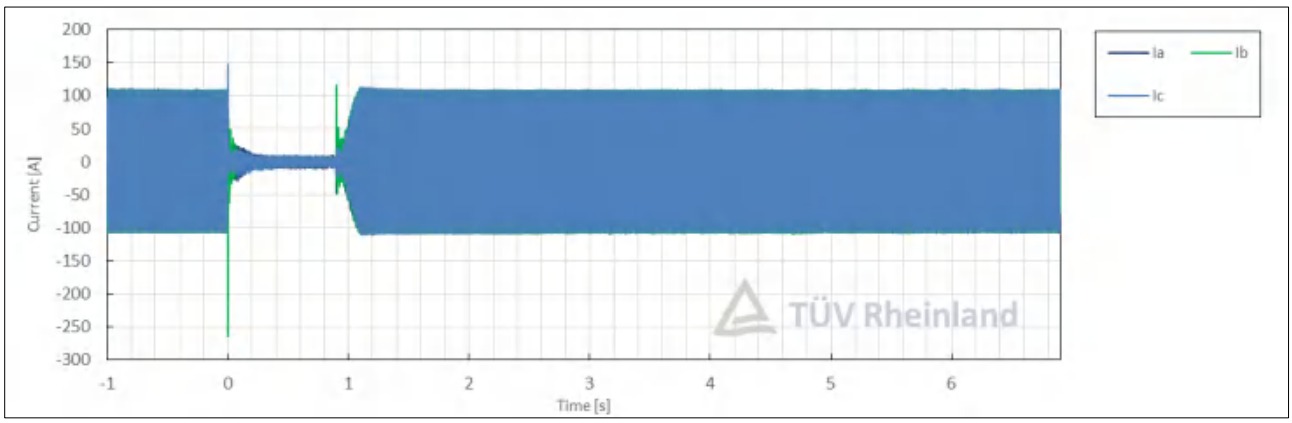
Test No. 2.2
1-phase fault (L2 phase)

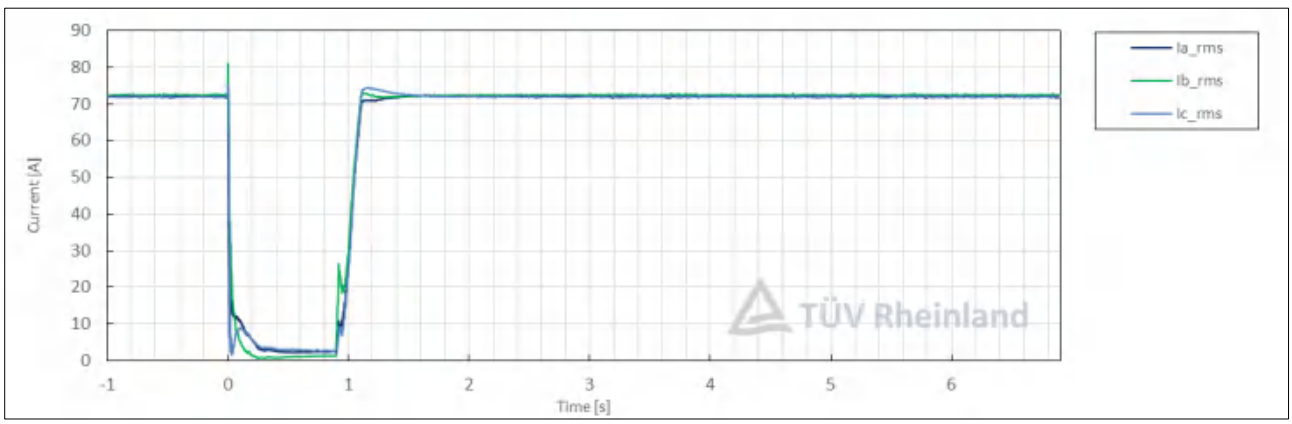


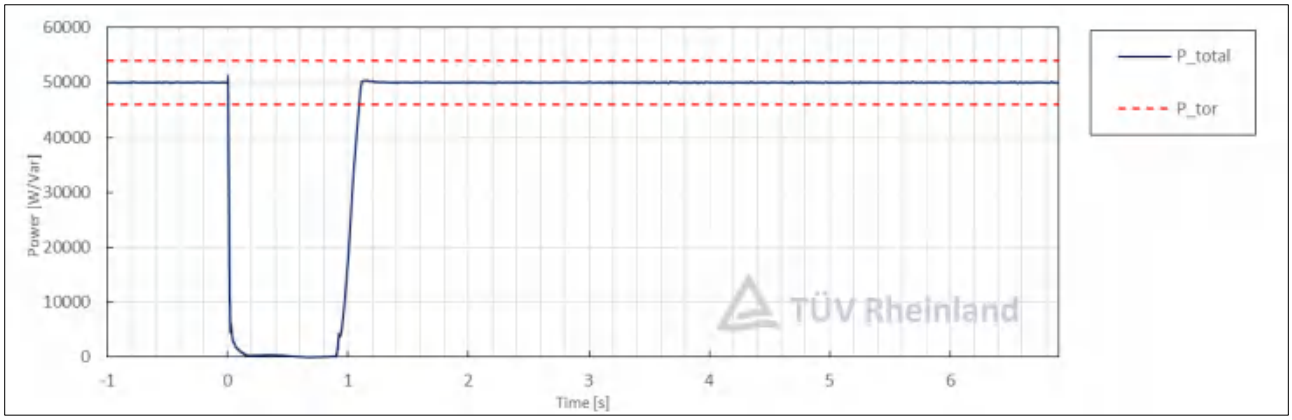



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

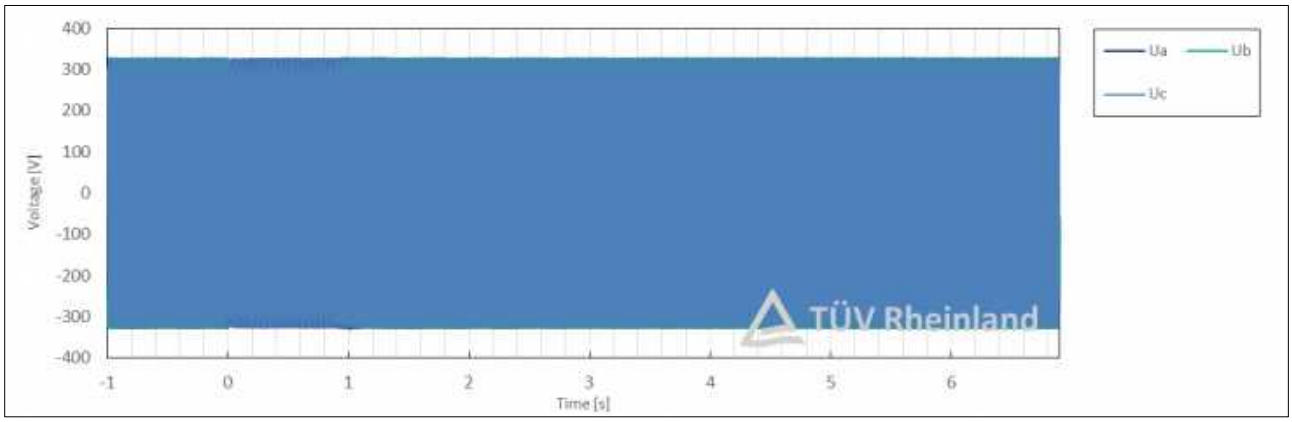

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

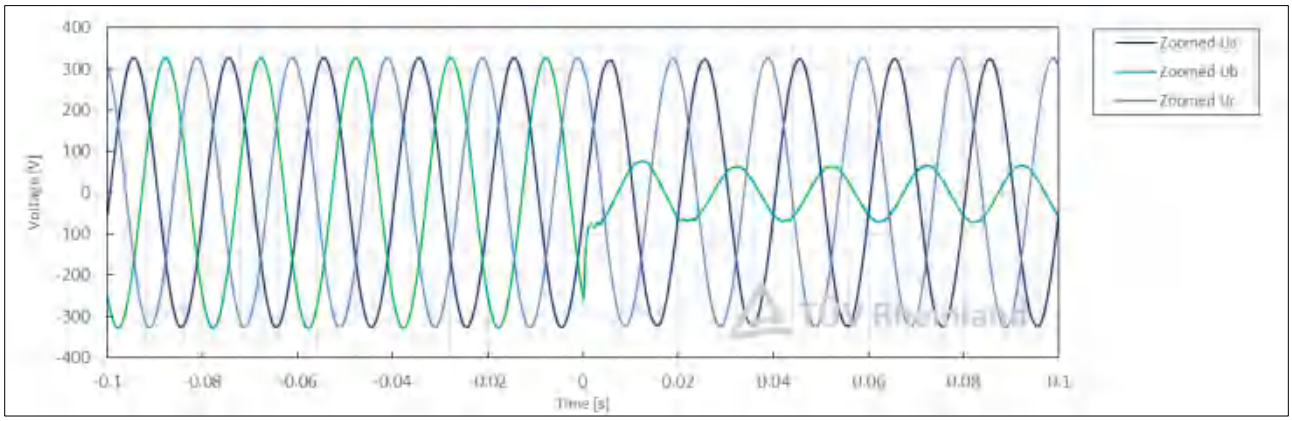


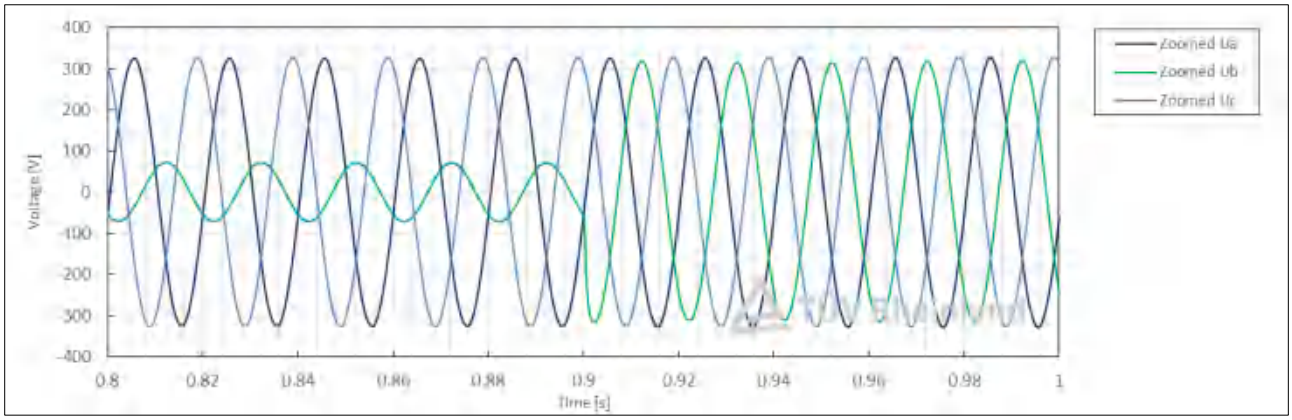
Appendix I (c)	TABLE: Undervoltage ride through test (U<<)				P
L2					
Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.3
	1	Fault type (phase)	--	--	--	1-phase fault (L2 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	910
	4	Point of fault entry (step under 70V)	Total	--	ms	4
	5	Point of fault clearance (step over 70V)	Total	--	ms	914
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.04
	12		Phase 2			0.01
	13		Phase 3			0.04
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00

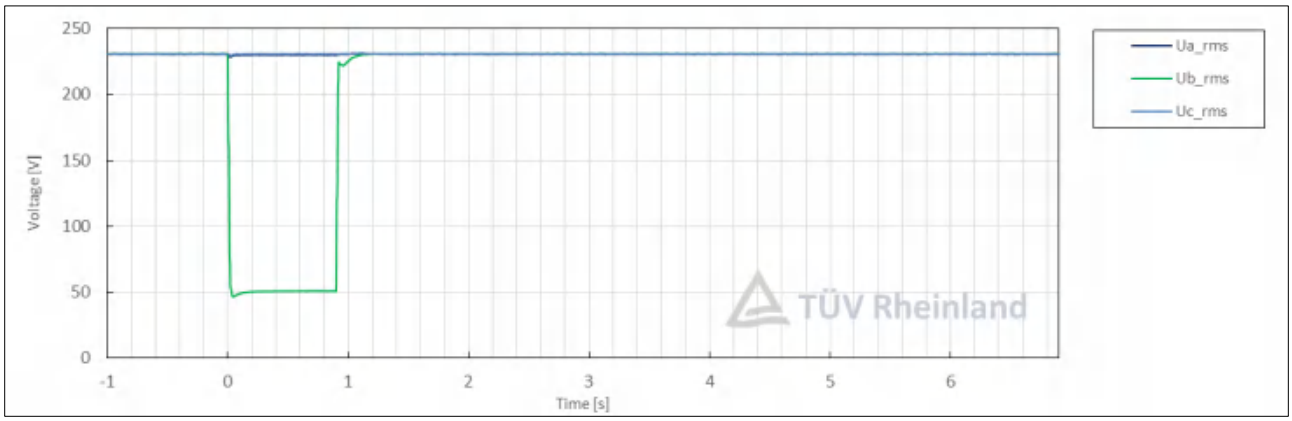
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.191
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

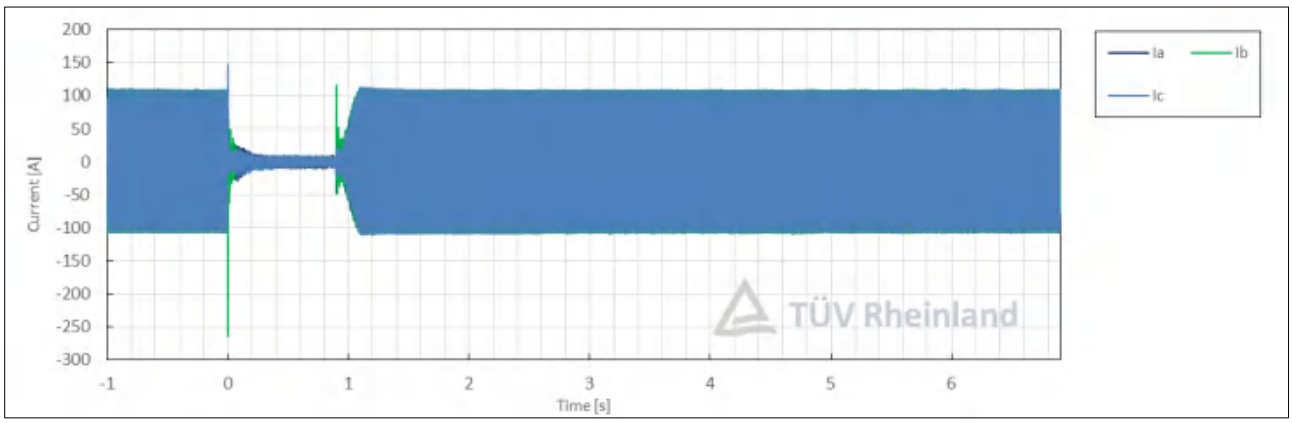
Test No. 2.3
1-phase fault (L2 phase)

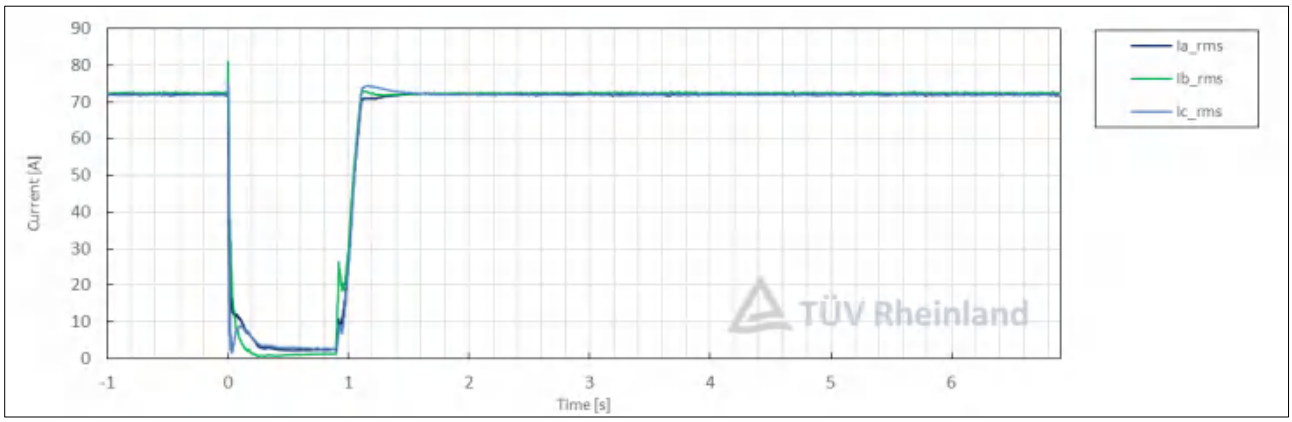


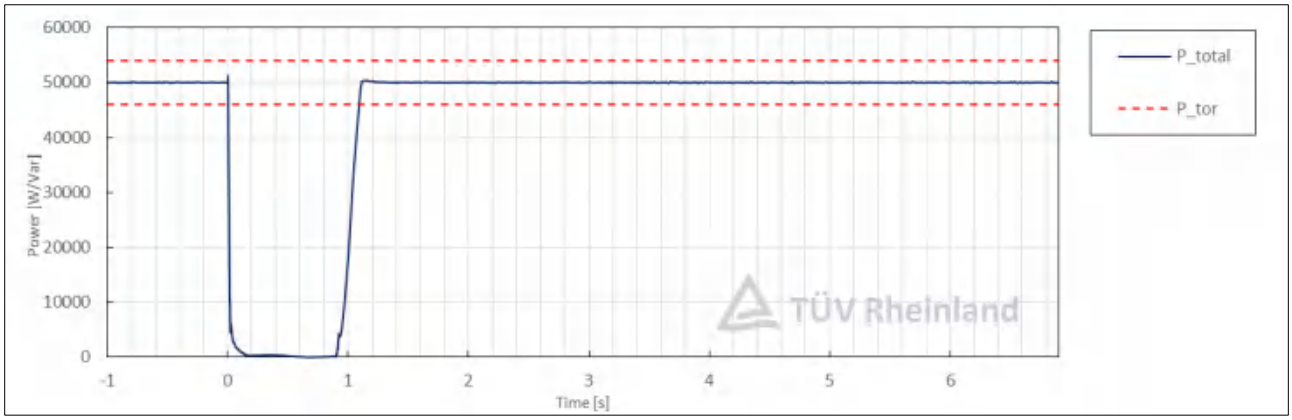



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

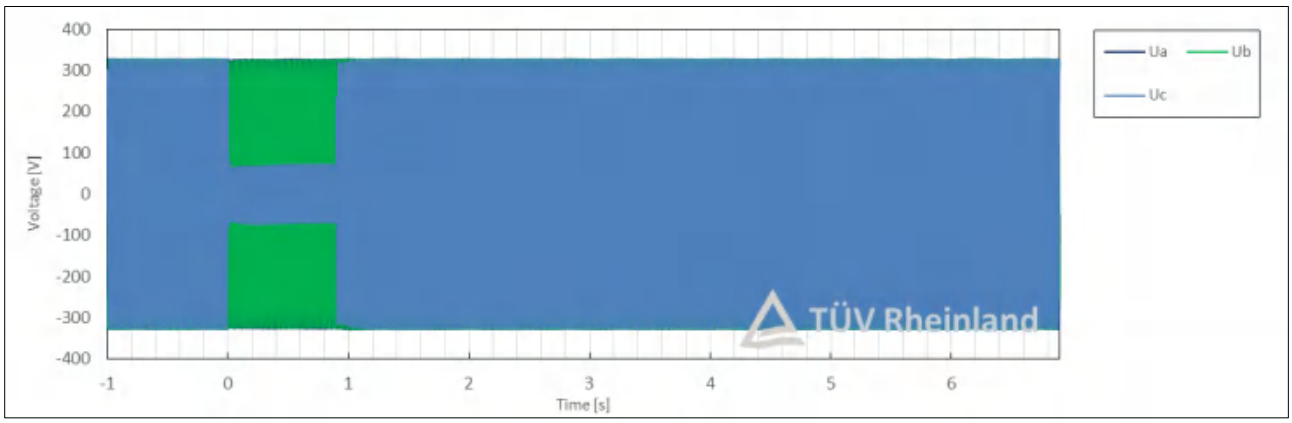

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

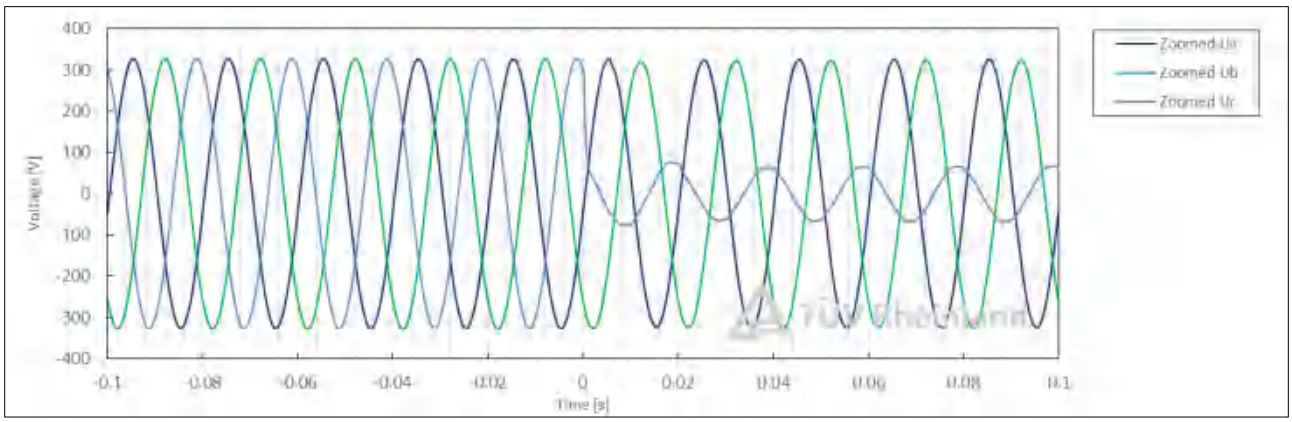


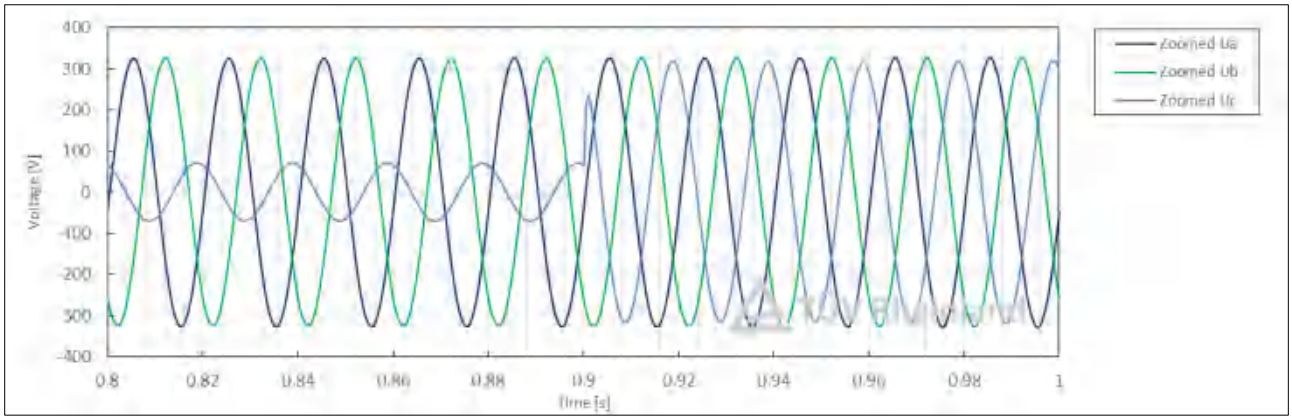
L3						
	Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.1
	1	Fault type (phase)	--	--	--	1-phase fault (L3 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	909
	4	Point of fault entry (step under 70V)	Total	--	ms	9
	5	Point of fault clearance (step over 70V)	Total	--	ms	918
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.04
	12		Phase 2			0.04
	13		Phase 3			0.01
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.195

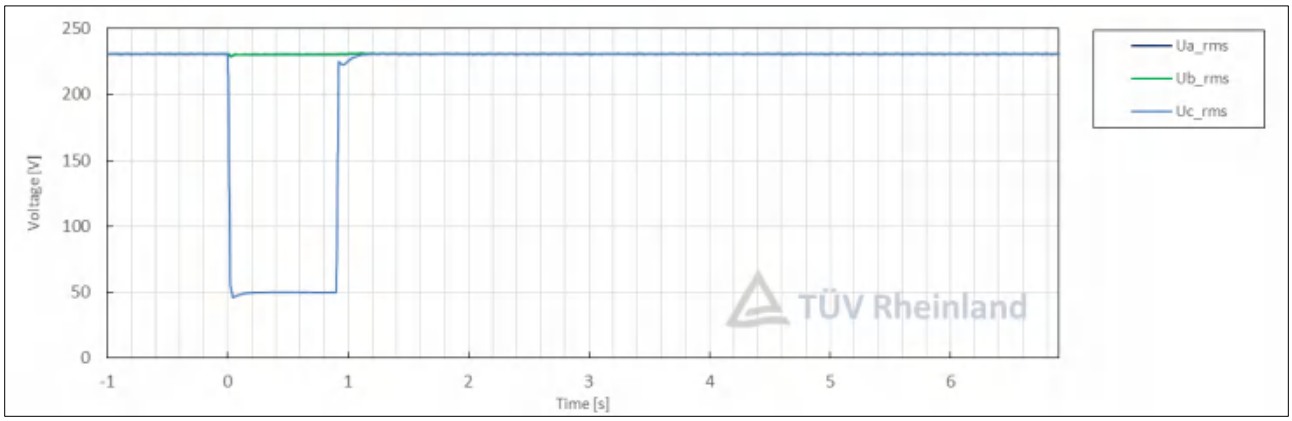
	18	Remain connect all time	--	--	Yes / No	Yes
Note:						

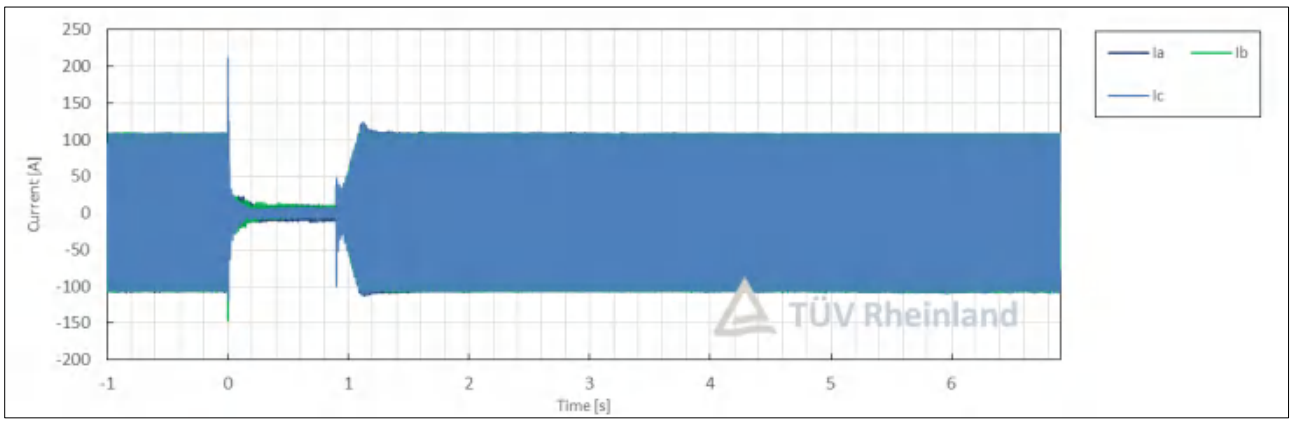
Test No. 3.1
1-phase fault (L3 phase)

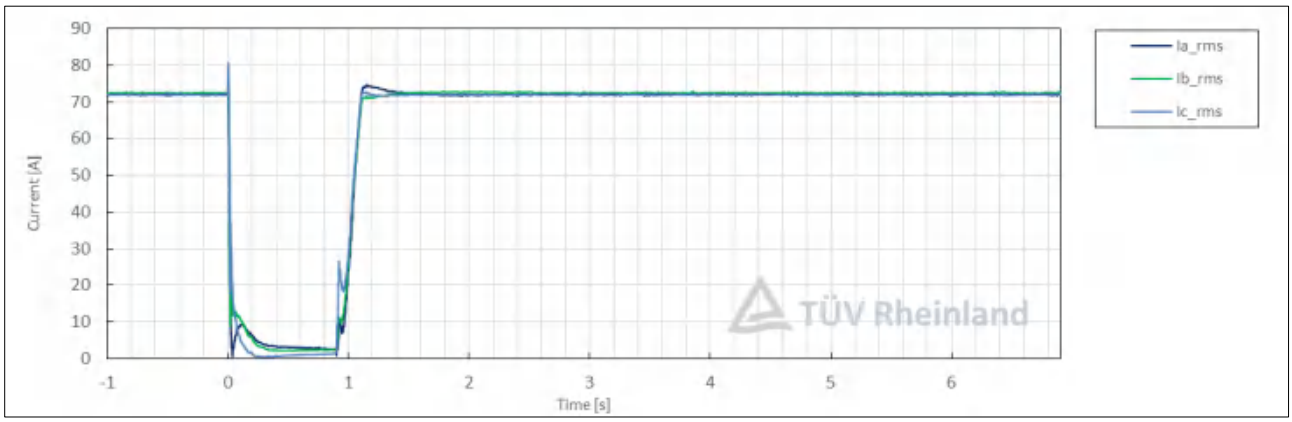


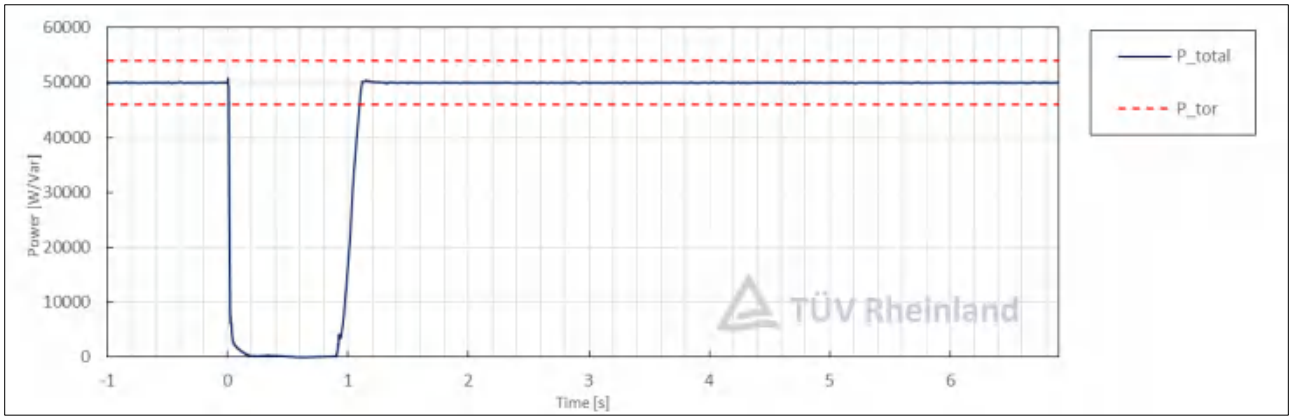



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

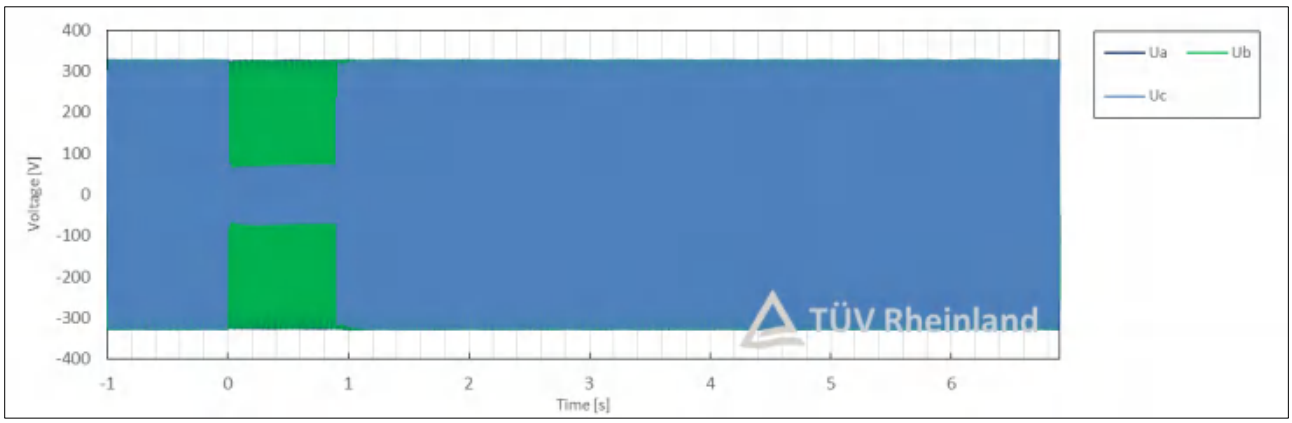

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

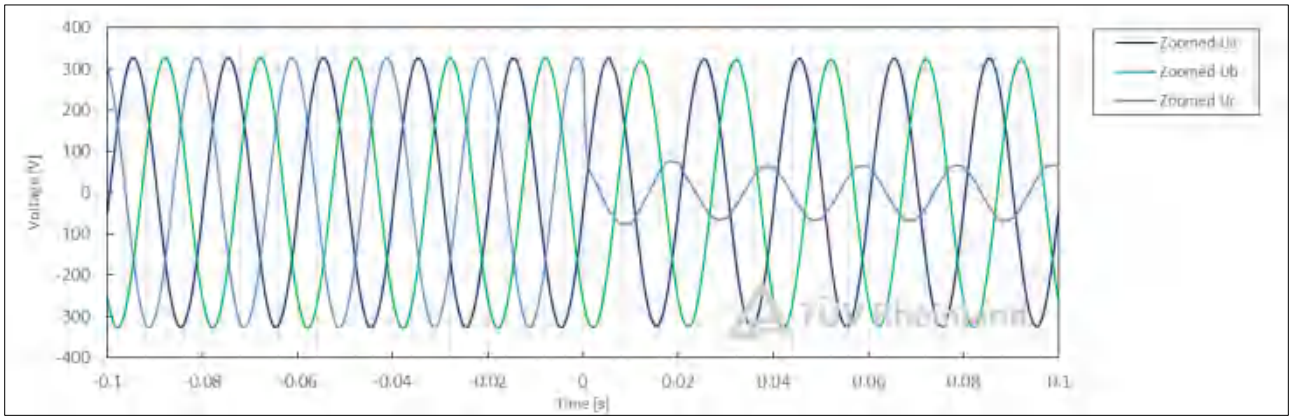


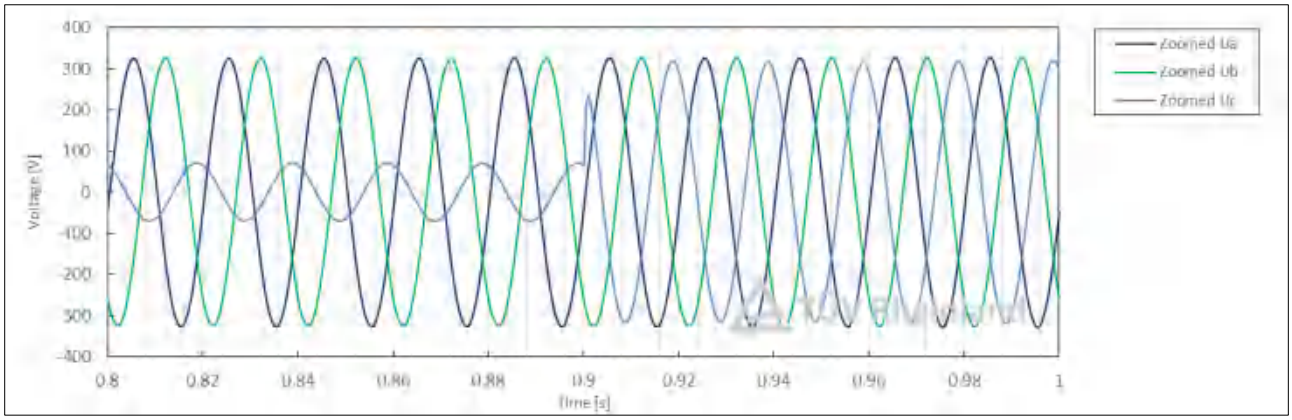
L3						
	Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.2
	1	Fault type (phase)	--	--	--	1-phase fault (L3 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	909
	4	Point of fault entry (step under 70V)	Total	--	ms	9
	5	Point of fault clearance (step over 70V)	Total	--	ms	918
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.21
	11	Line current	Phase 1	t1+200ms	p.u.	0.04
	12		Phase 2			0.04
	13		Phase 3			0.01
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.50
	17	Active power rising time	Total	--	s (<400ms)	0.195
	18	Remain connect all time	--	--	Yes / No	Yes

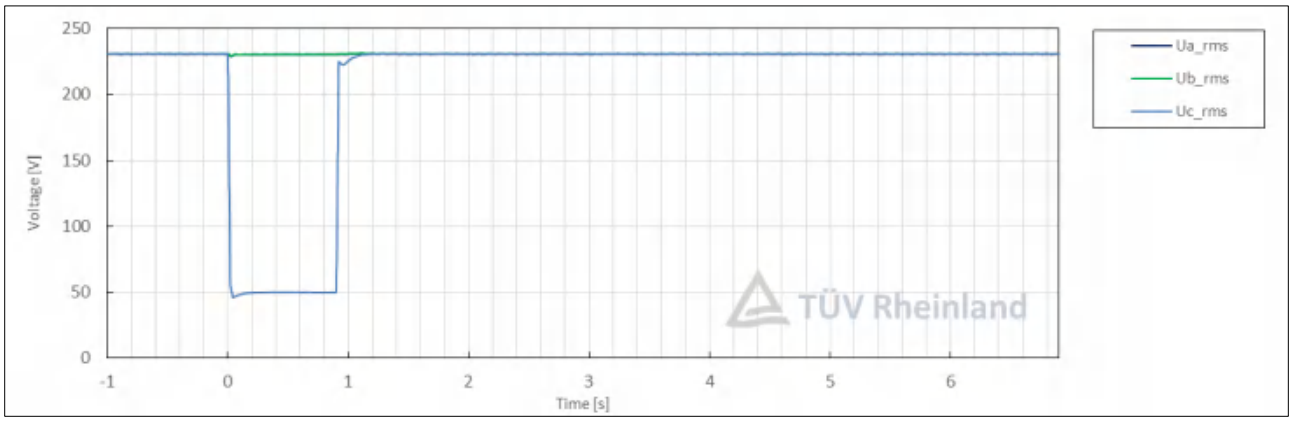
Note:

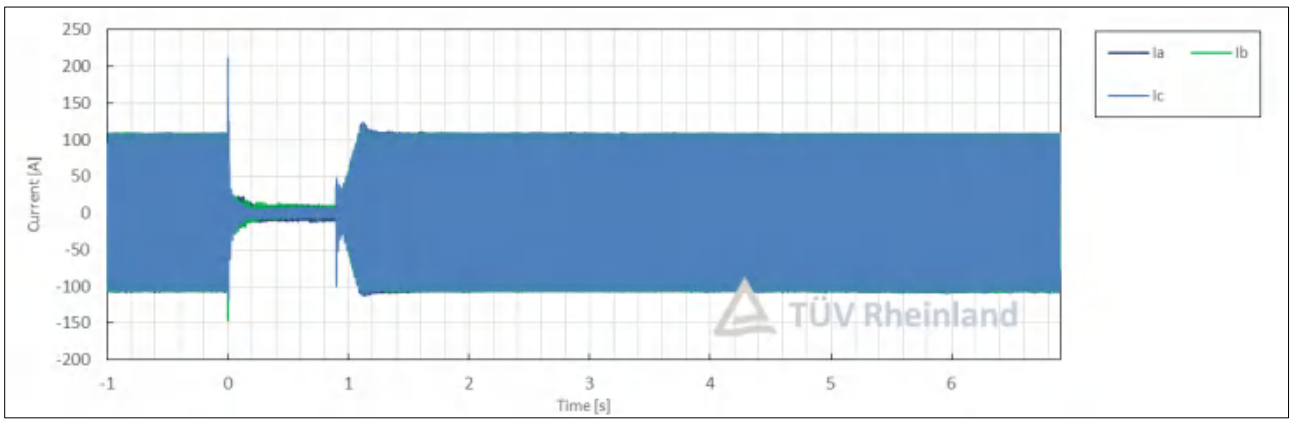
Test No. 3.2
1-phase fault (L3 pase)

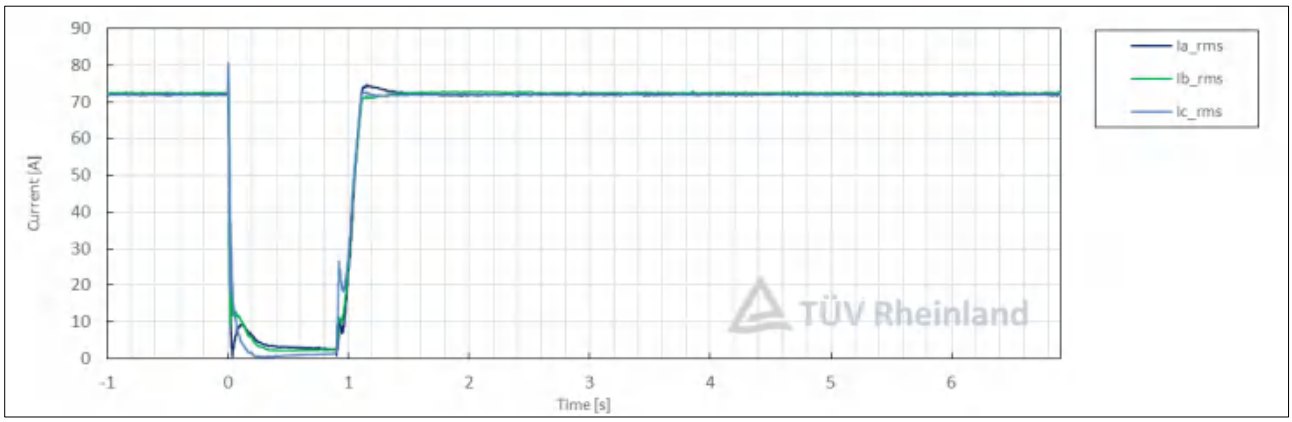


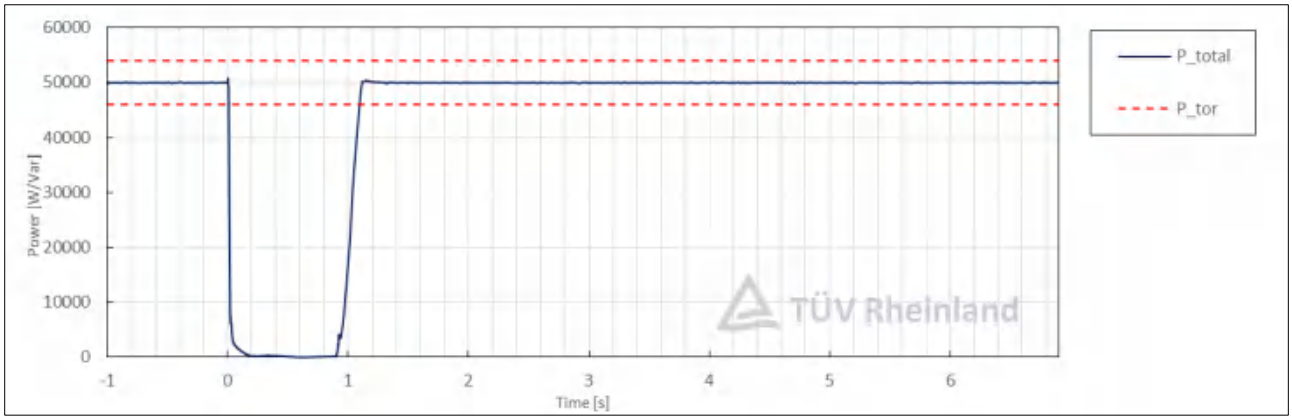



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

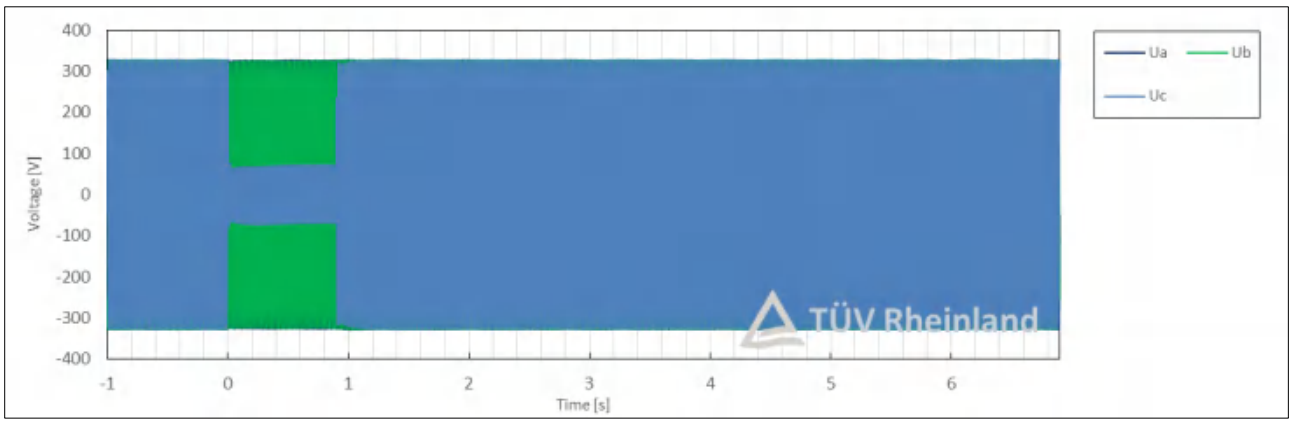

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

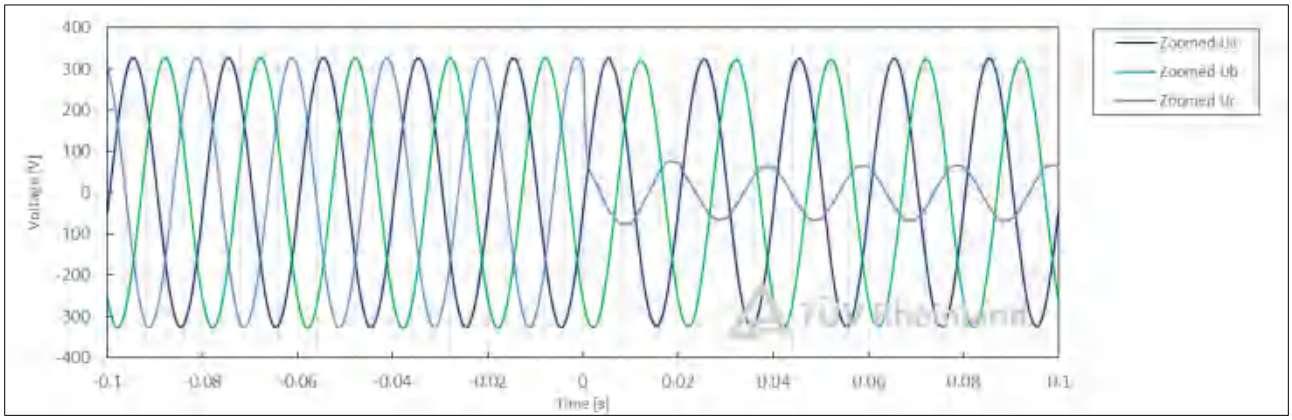


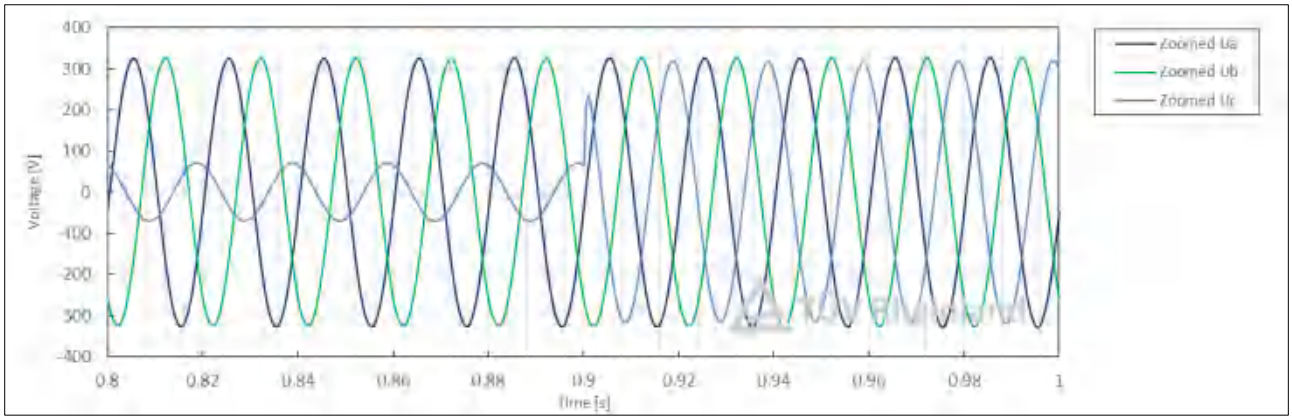
L3						
	Condition					Measurement
	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.3
	1	Fault type (phase)	--	--	--	1-phase fault (L3 phase)
	2	Setting voltage depth	Line to Neutral	--	p.u.	0.22
	3	Setting dip duration (below 70V)	Line to Neutral	--	ms	929
	4	Point of fault entry (step under 70V)	Total	--	ms	9
	5	Point of fault clearance (step over 70V)	Total	--	ms	938
	6	Voltage depth	Total	t1+100ms to t2	p.u.	0.22
Before dip <t1	7	Voltage	Line to neutral	t1-500ms to t1-100ms	p.u.	1.00
	8	Current	Total	t1-500ms to t1-100ms	p.u.	0.50
	9	Active power	Total	t1-500ms to t1-100ms	p.u.	0.50
During dip t1 to t2	10	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.22
	11	Line current	Phase 1	t1+200ms	p.u.	0.02
	12		Phase 2			0.02
	13		Phase 3			0.01
	14	Active power	Total	t1+200ms to t2-20ms	p.u.	0.00
After dip > t2	15	Voltage	Line to neutral	t2+100ms to t2+800ms	p.u.	1.00
	16	Active power	Total	t2+400ms	p.u. (0.46 to 0.54)	0.49
	17	Active power rising time	Total	--	s (<400ms)	0.130
	18	Remain connect all time	--	--	Yes / No	Yes

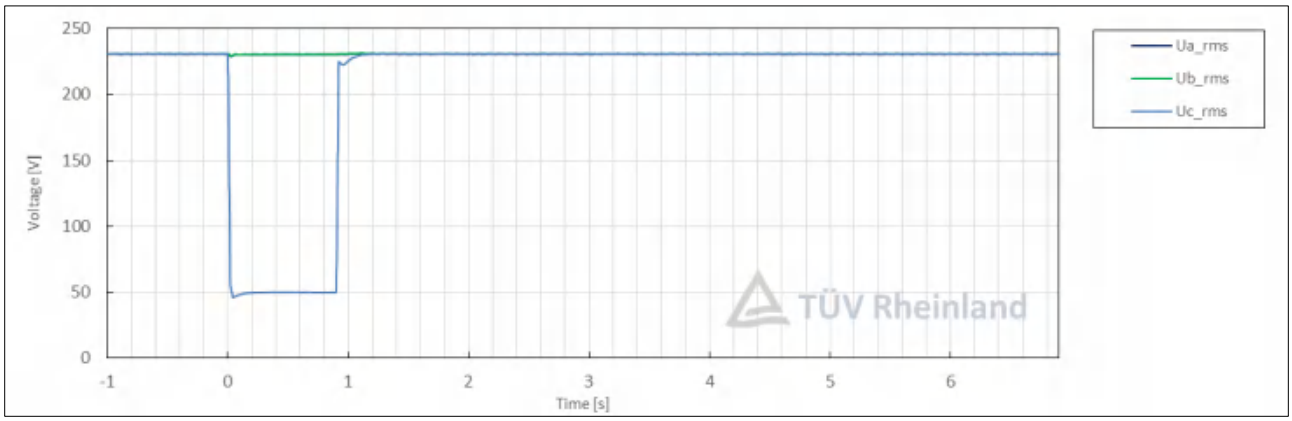
Note:

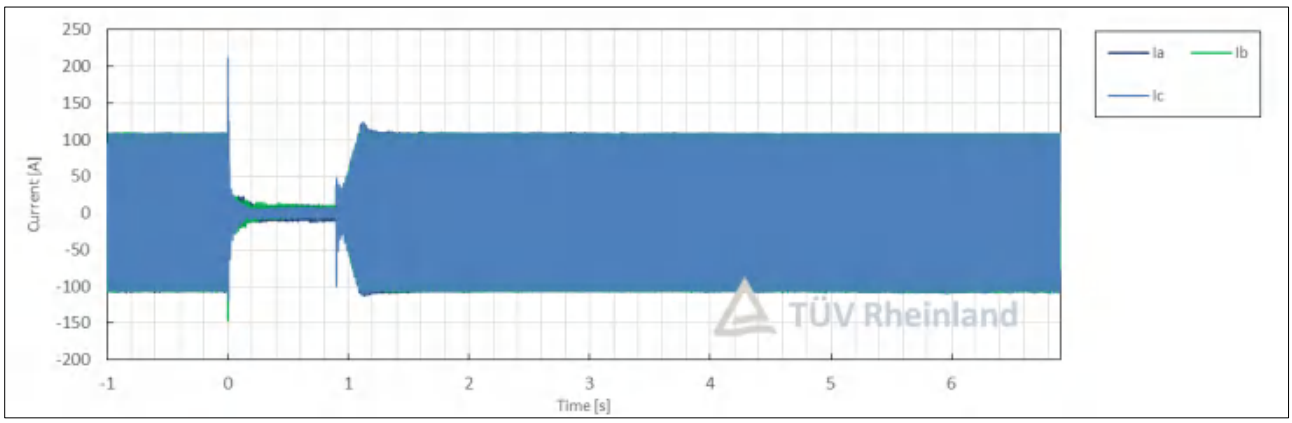
Test No. 3.3
1-phase fault (L3 pase)

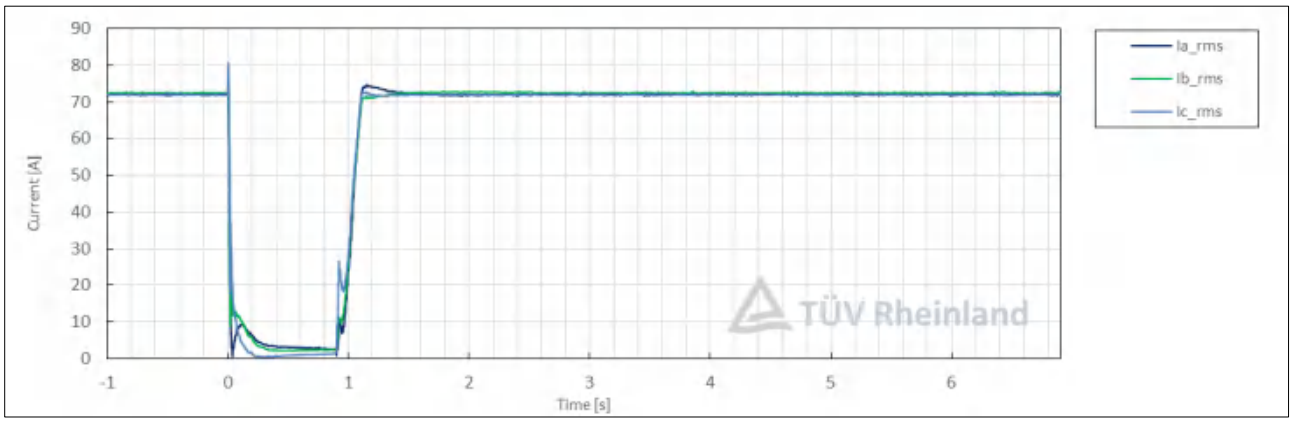


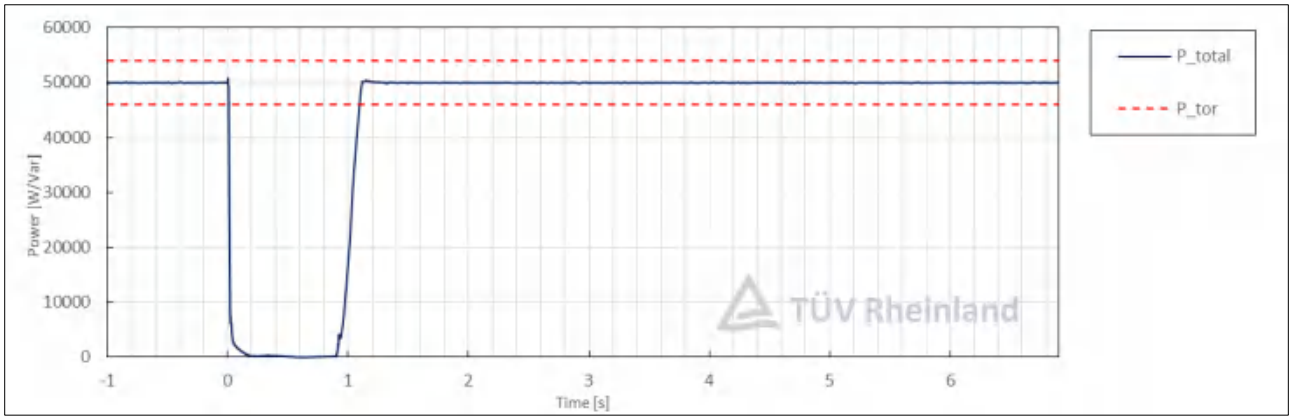



Voltage [V]
Time [s]
Zoomed Ua
Zoomed Ub
Zoomed Uc


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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

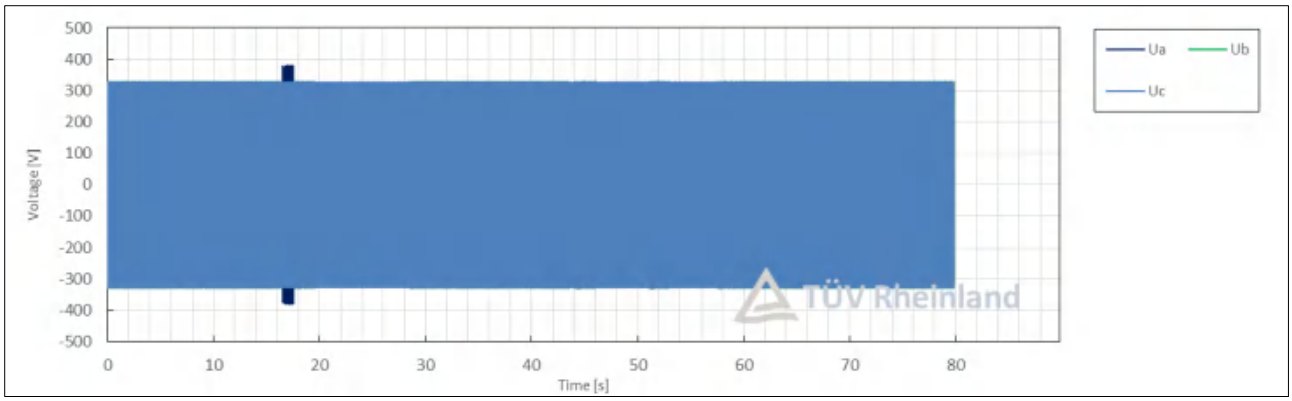

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

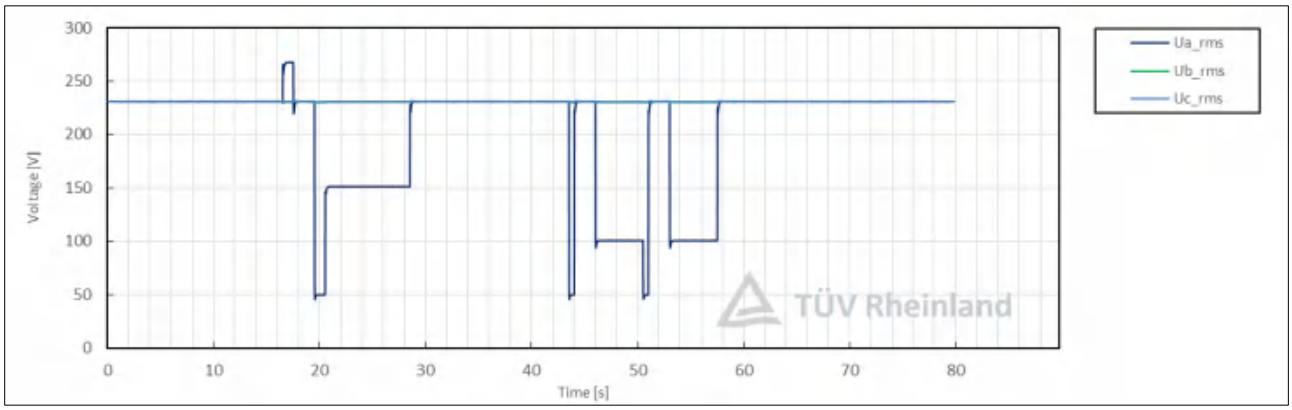


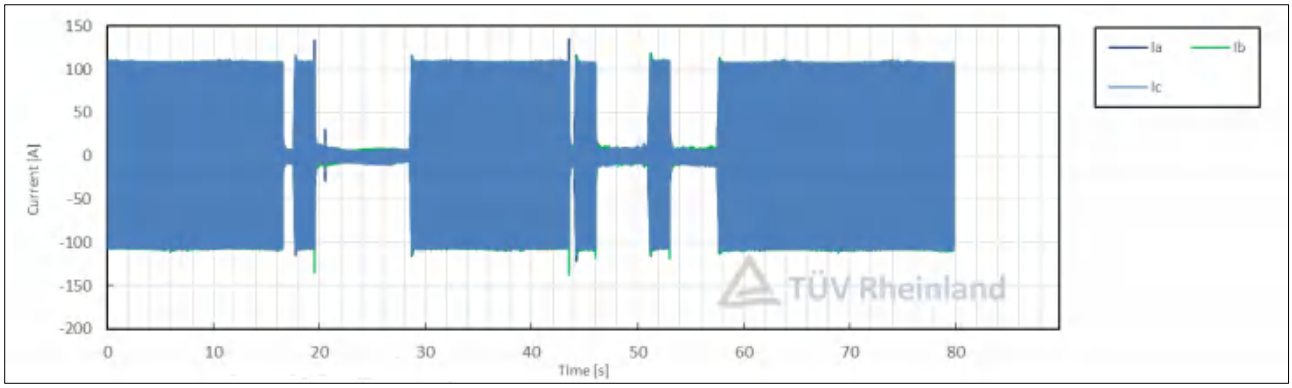
Appendix I (d)	TABLE: Voltage disturbance withstand tests						P
Phase L1							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.12	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

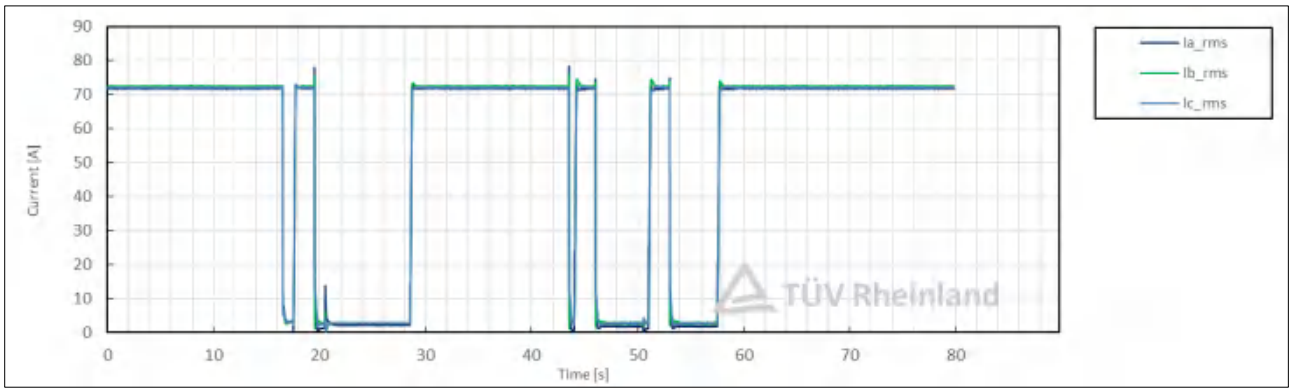
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

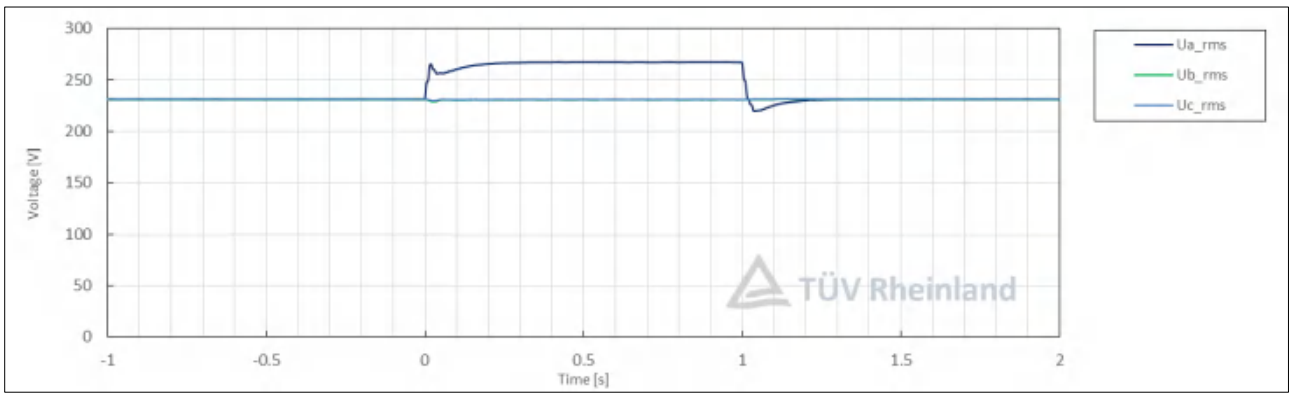
Diagram

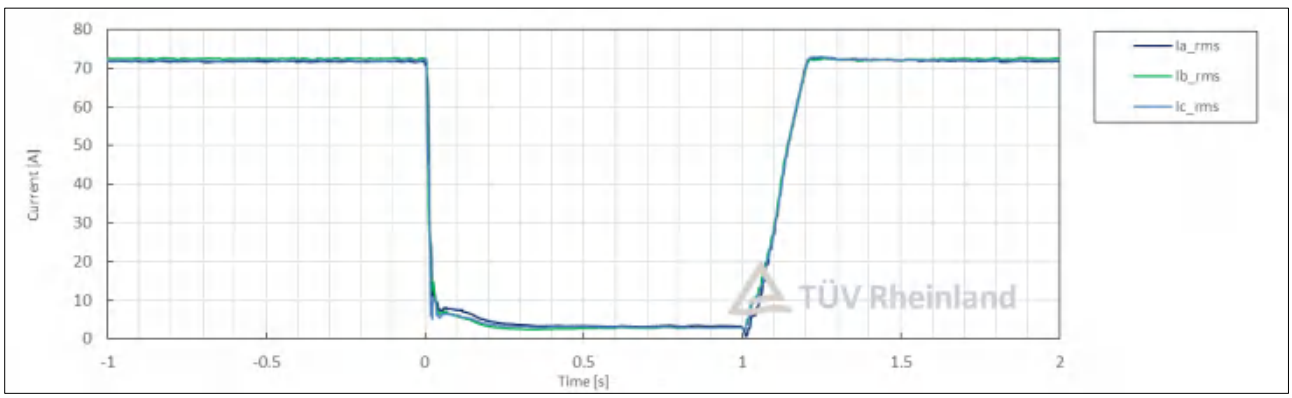


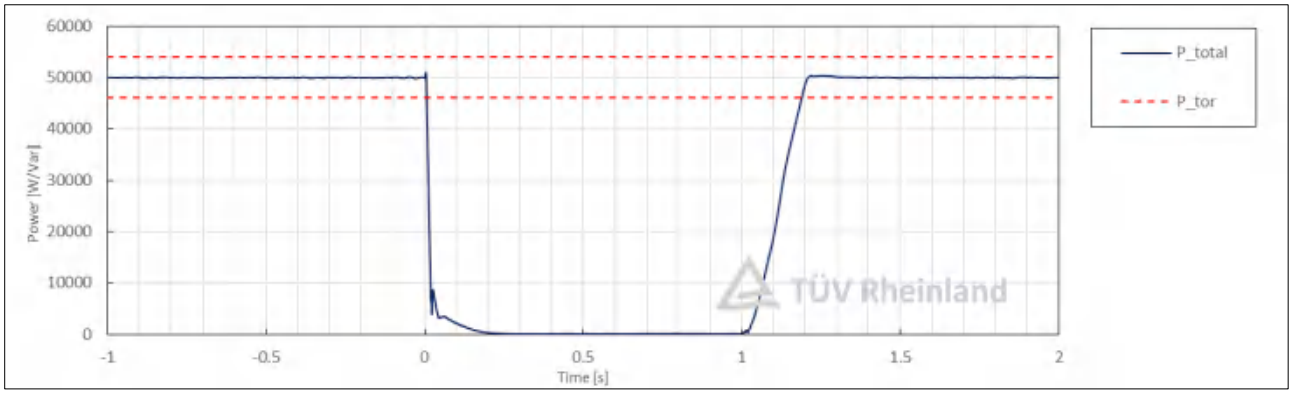


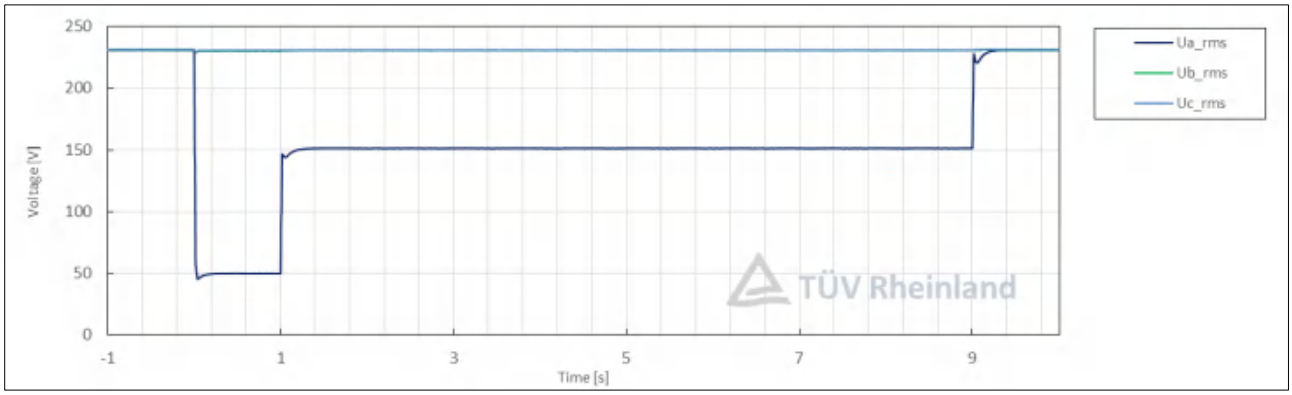

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

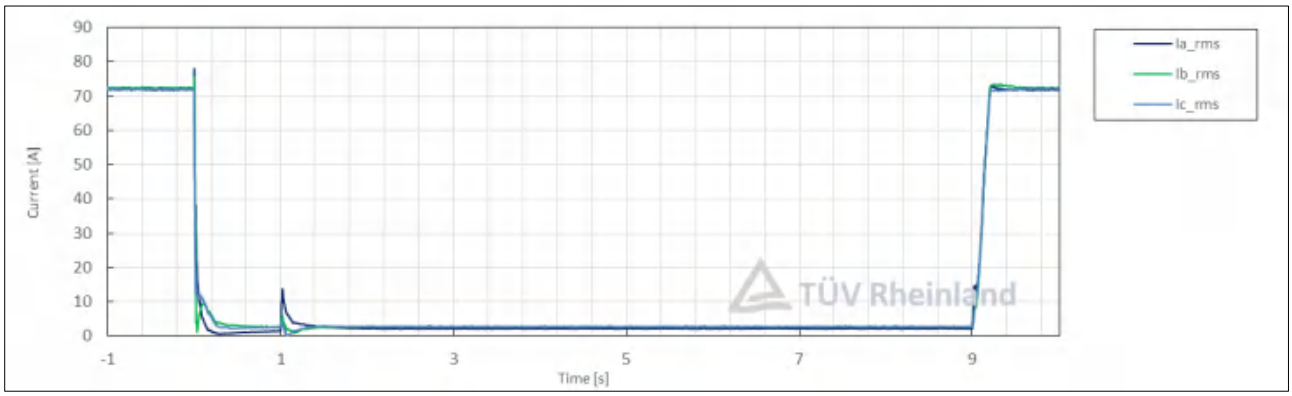

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

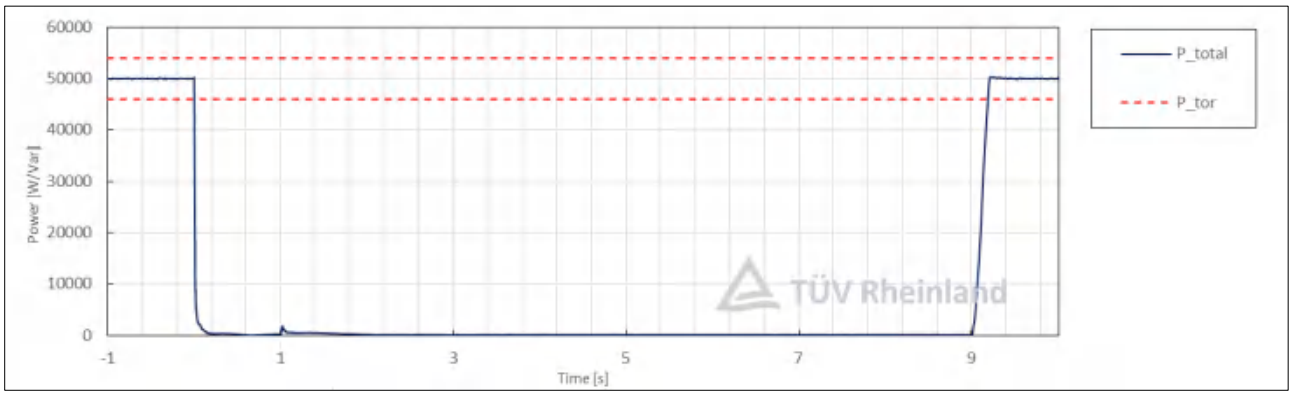

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

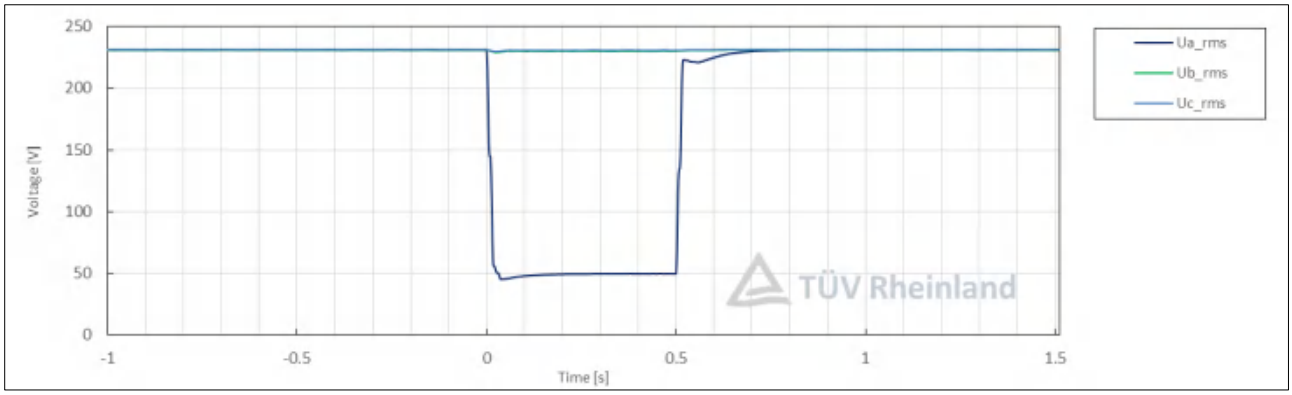

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

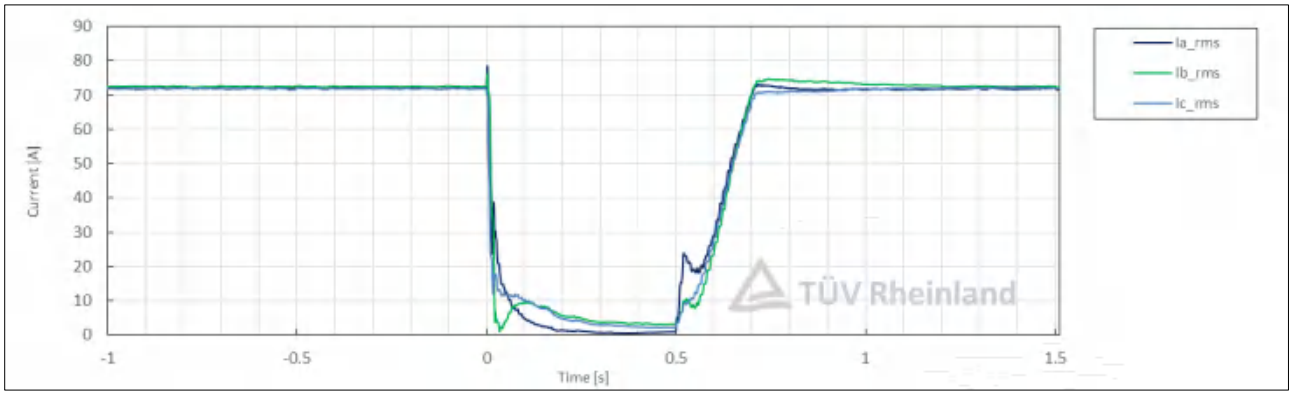

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

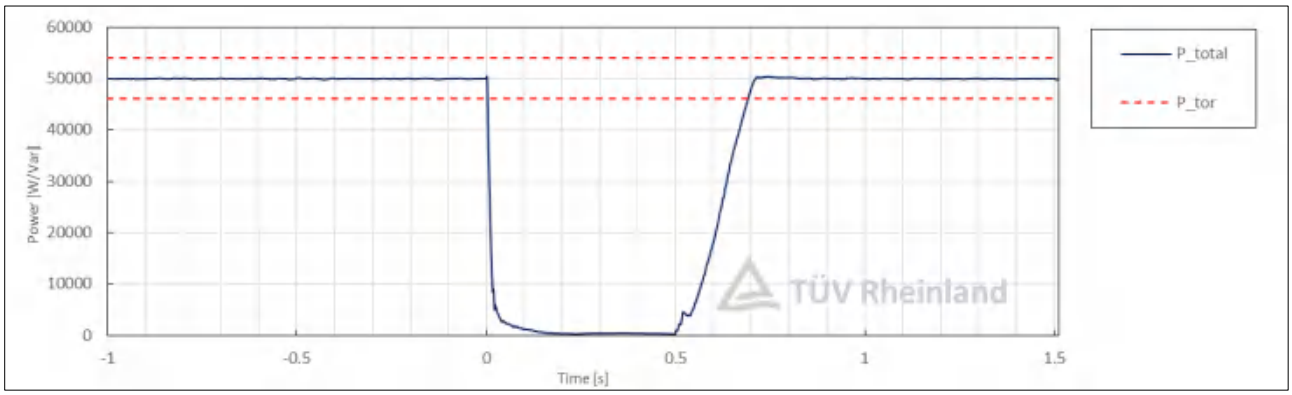

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

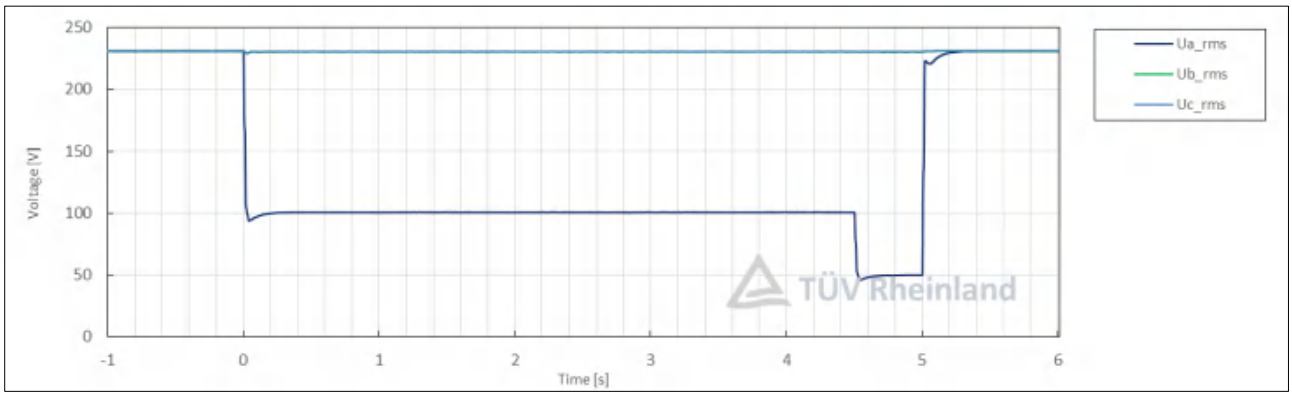

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

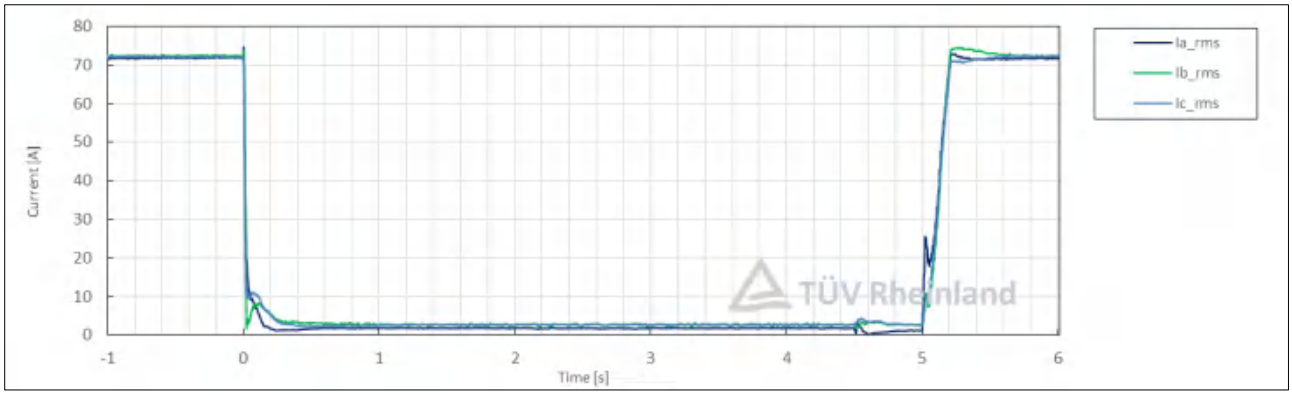

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

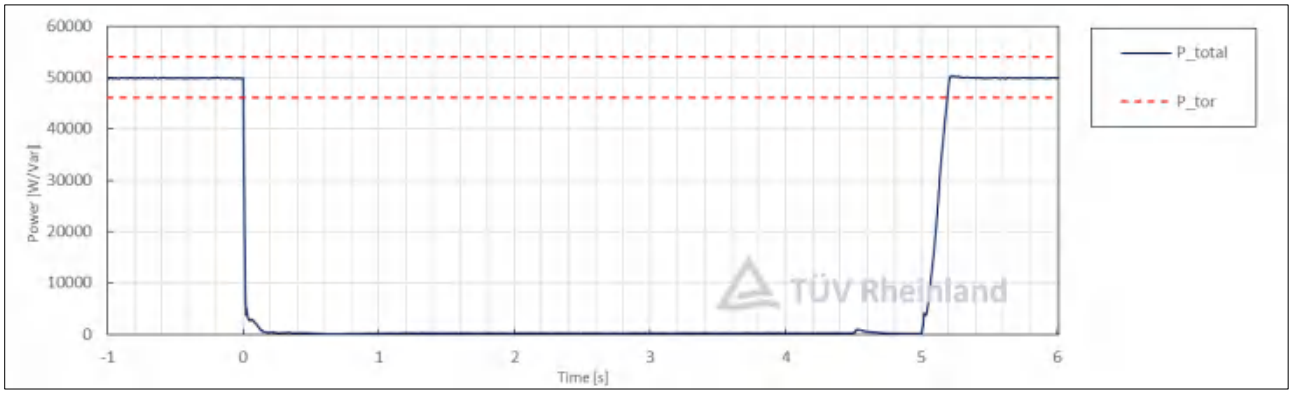

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

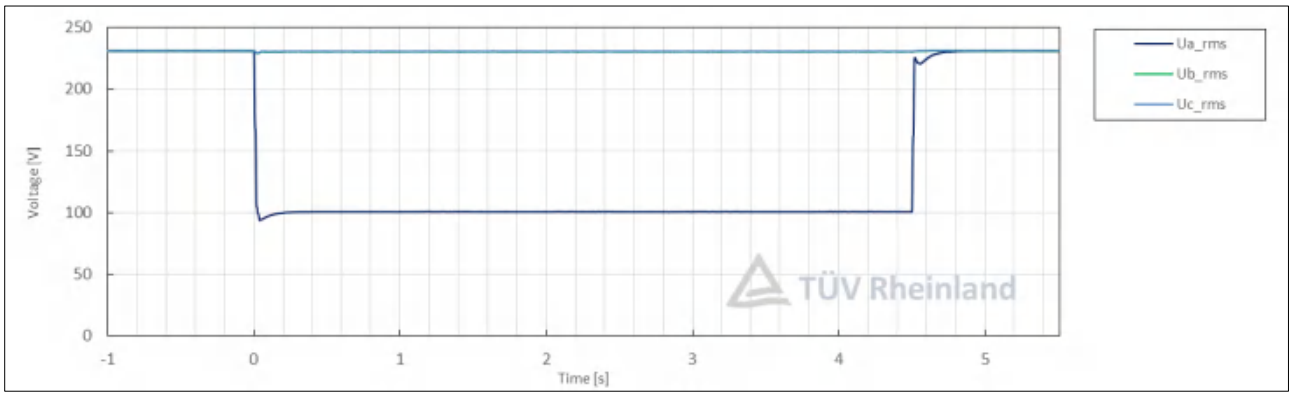

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

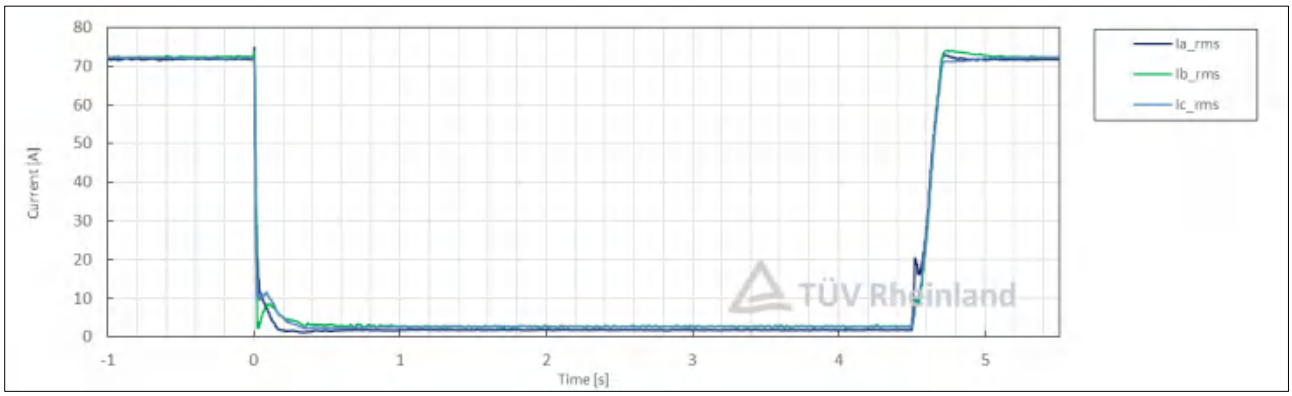

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

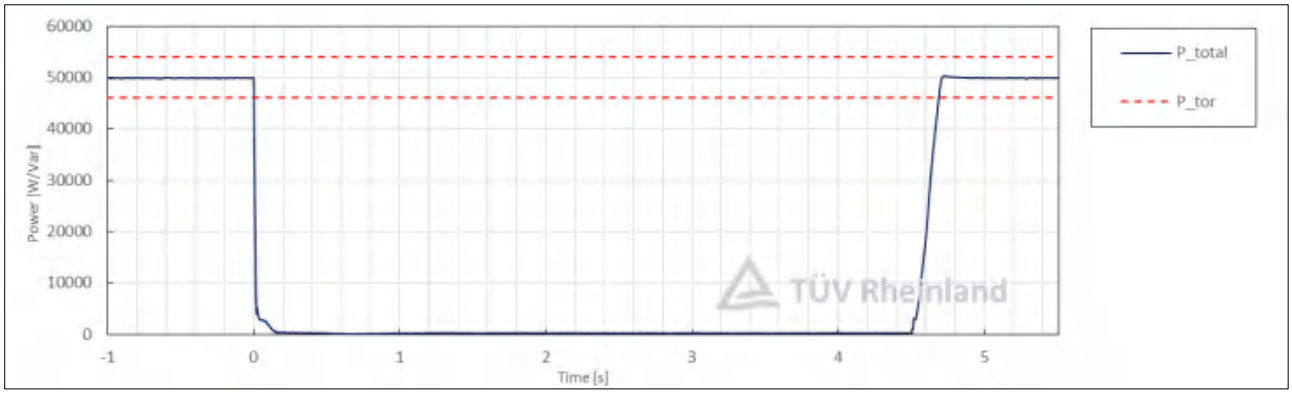

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

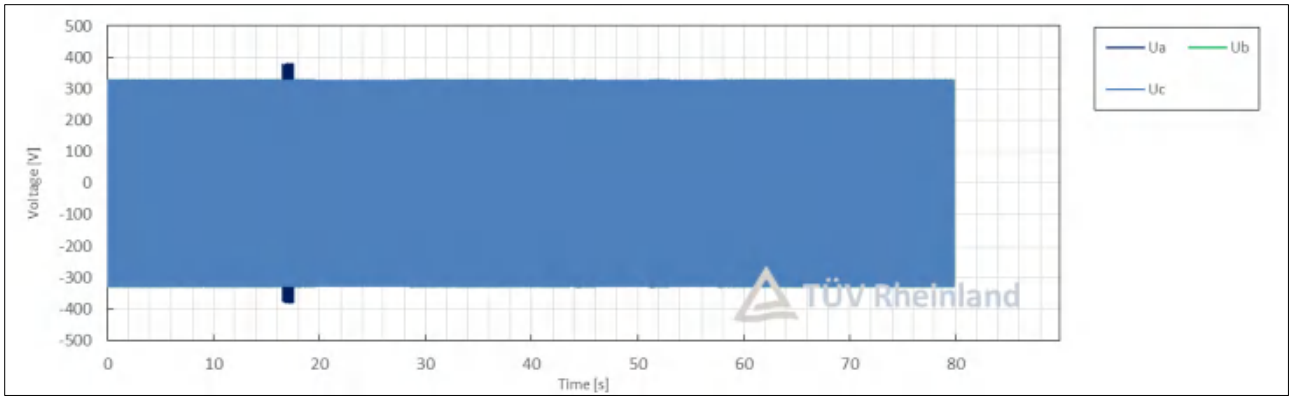

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

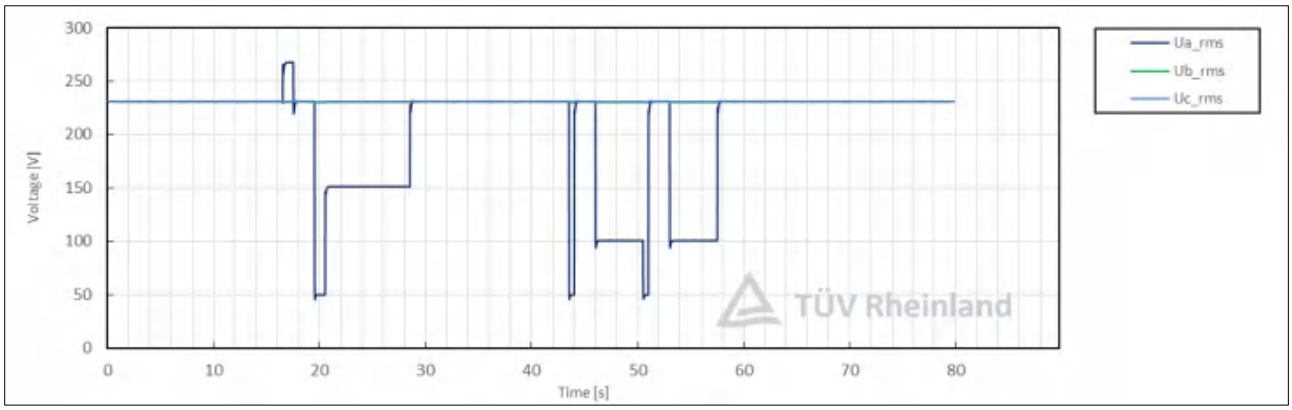


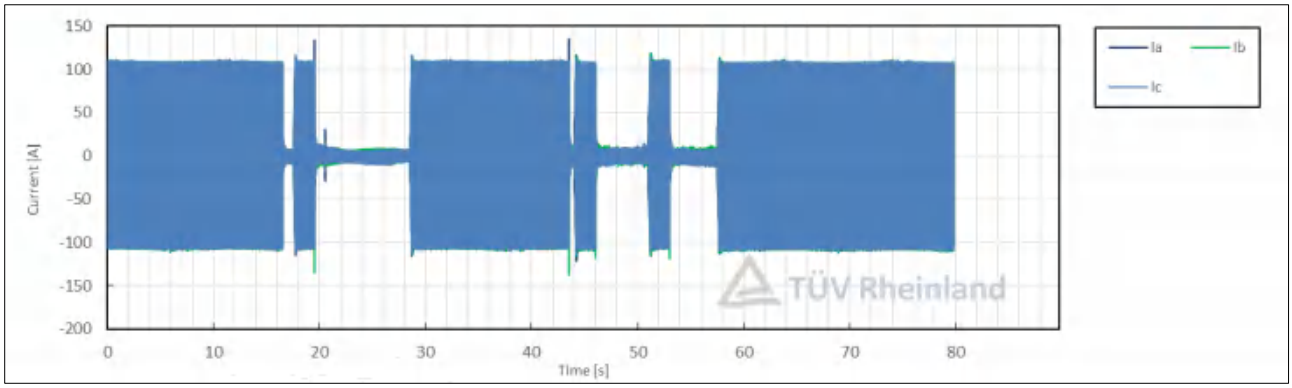
Appendix I (d)	TABLE: Voltage disturbance withstand tests						P
Phase L1							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.12	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)

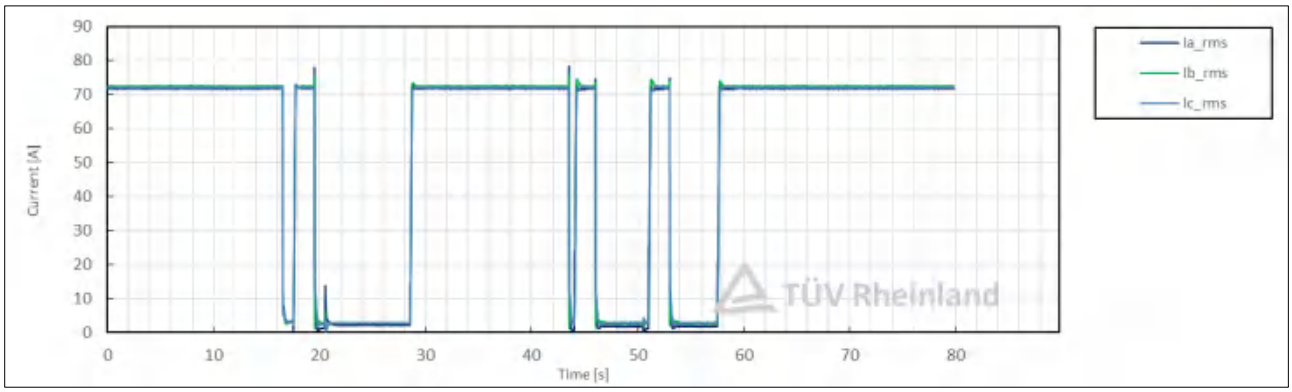
Voltage return 230V		Active power	Total		p.u.	0.50	0.46-0.54
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

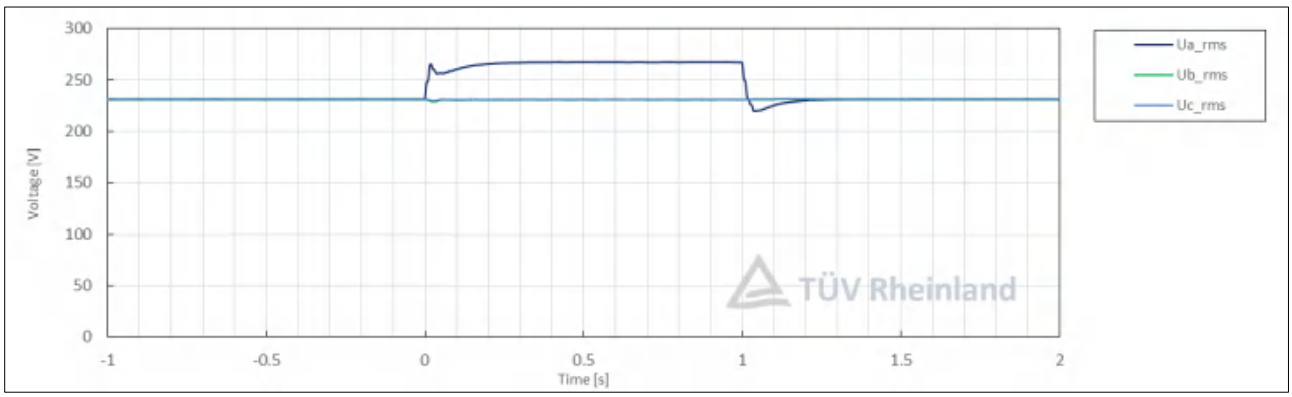
Diagram

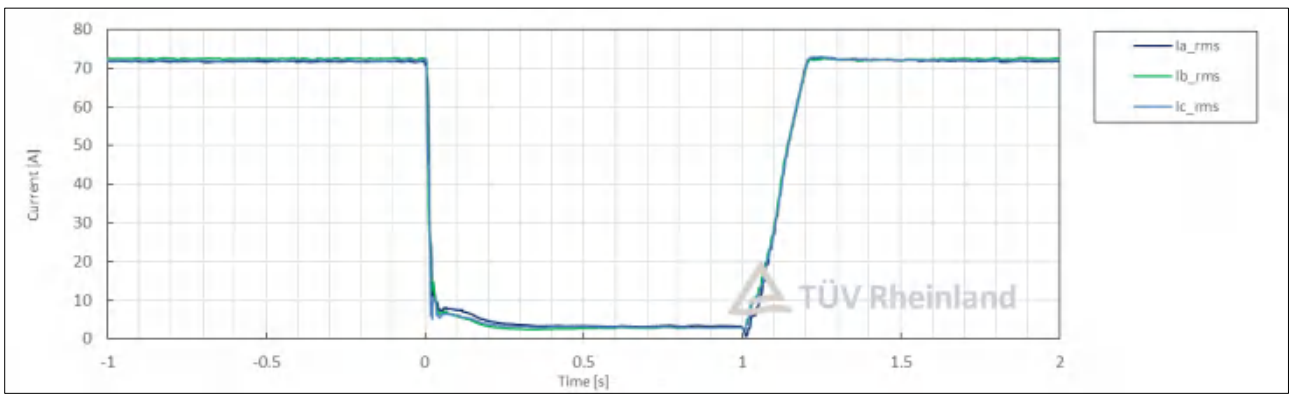


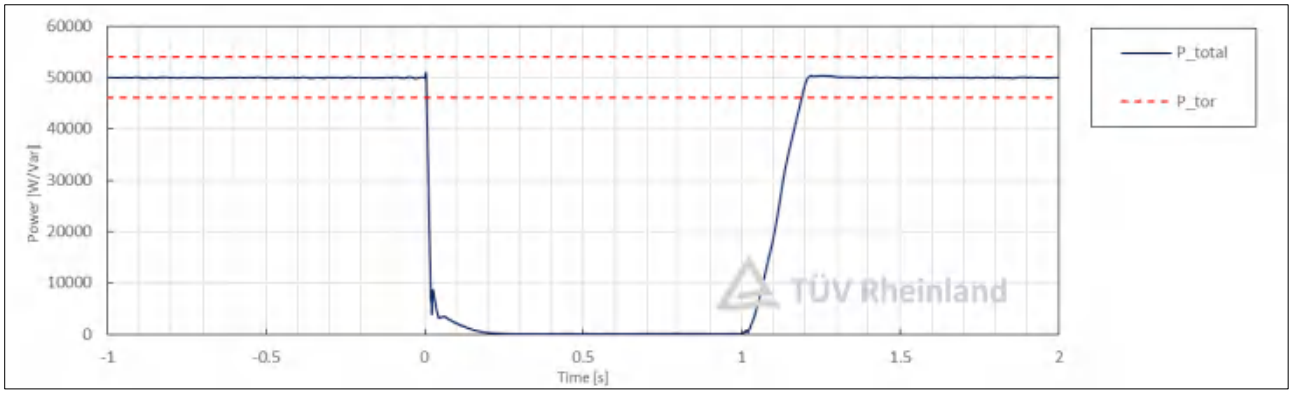


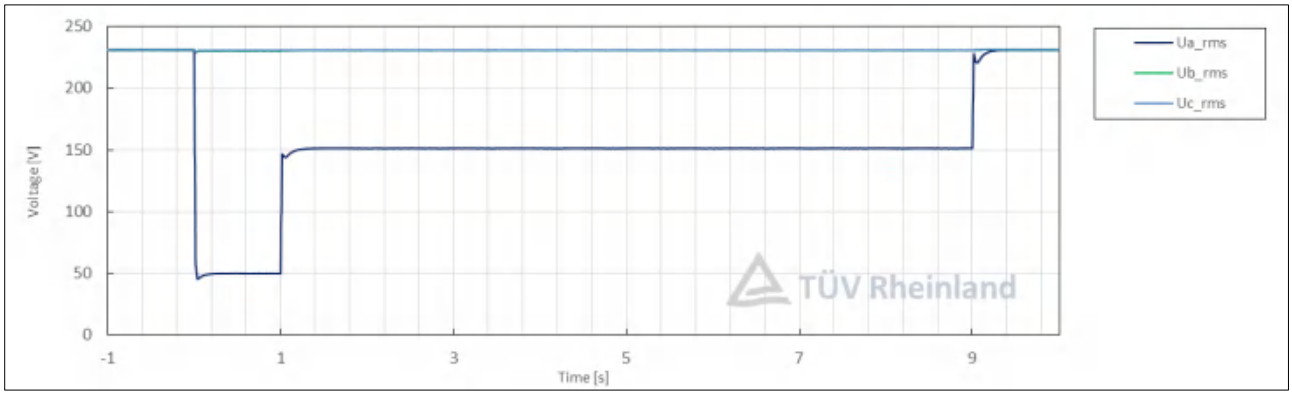

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

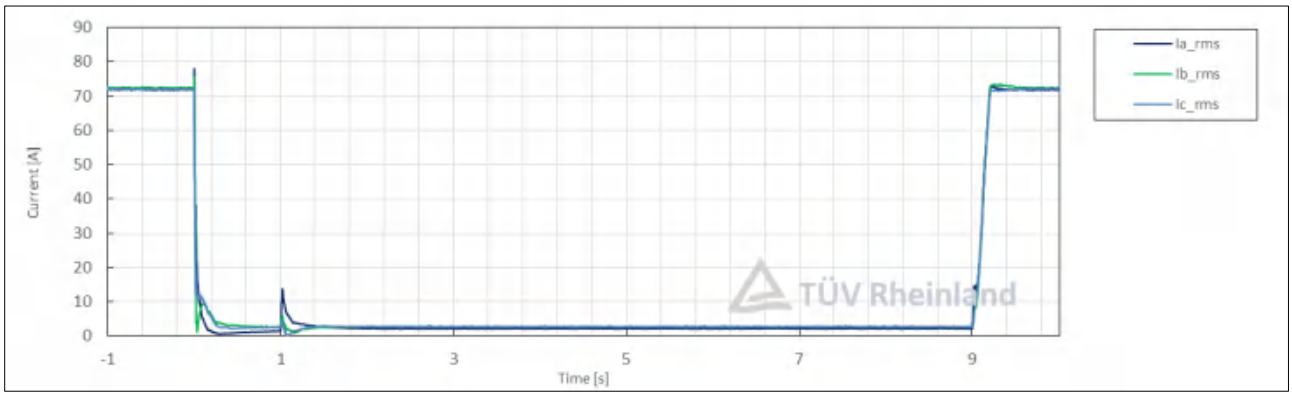

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

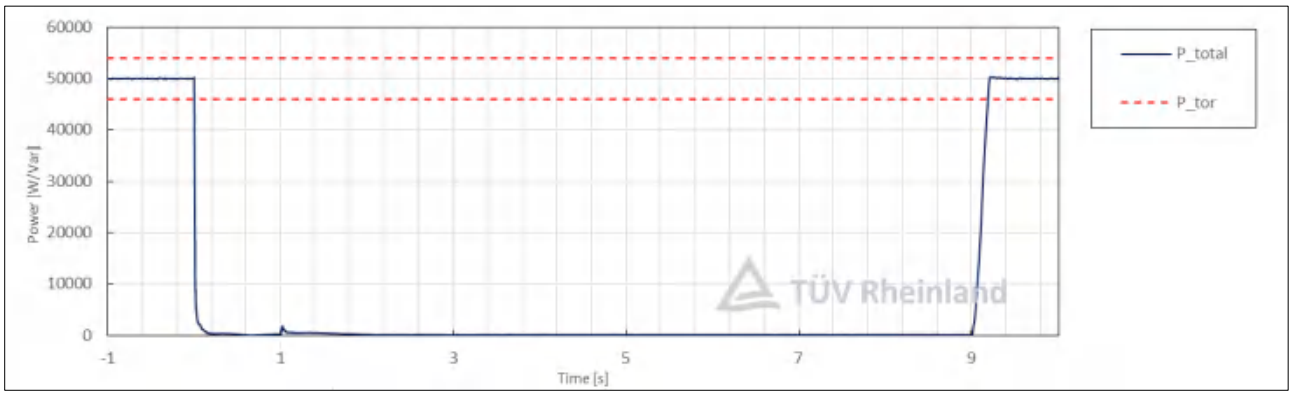

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

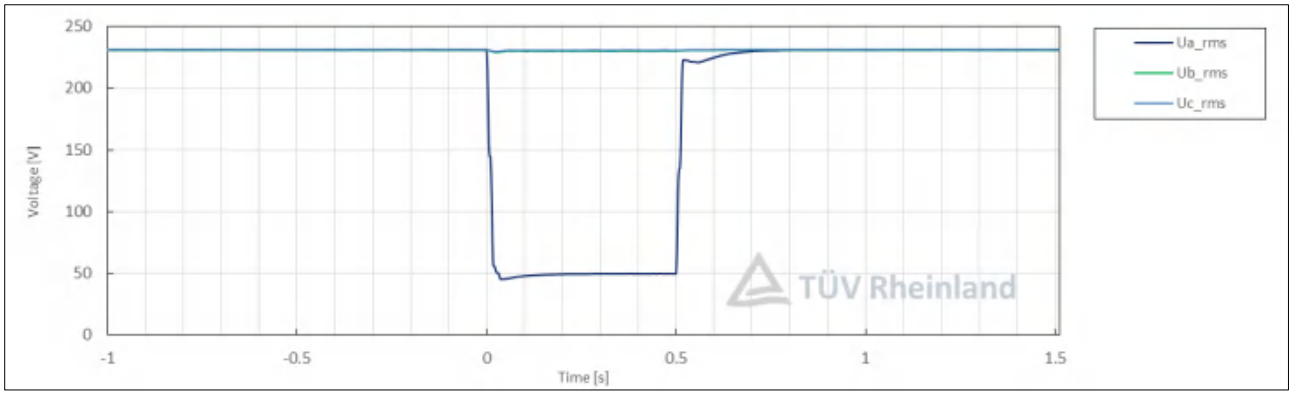

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

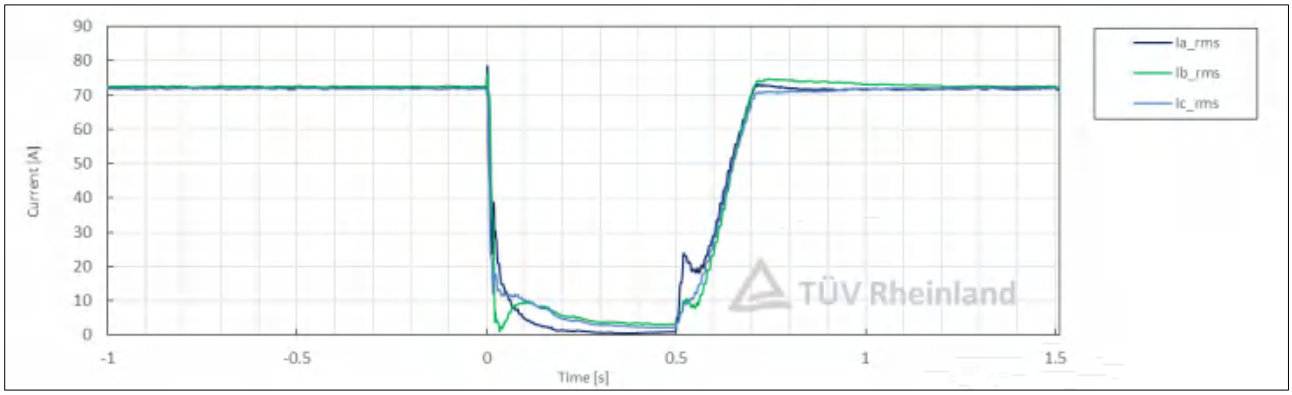

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

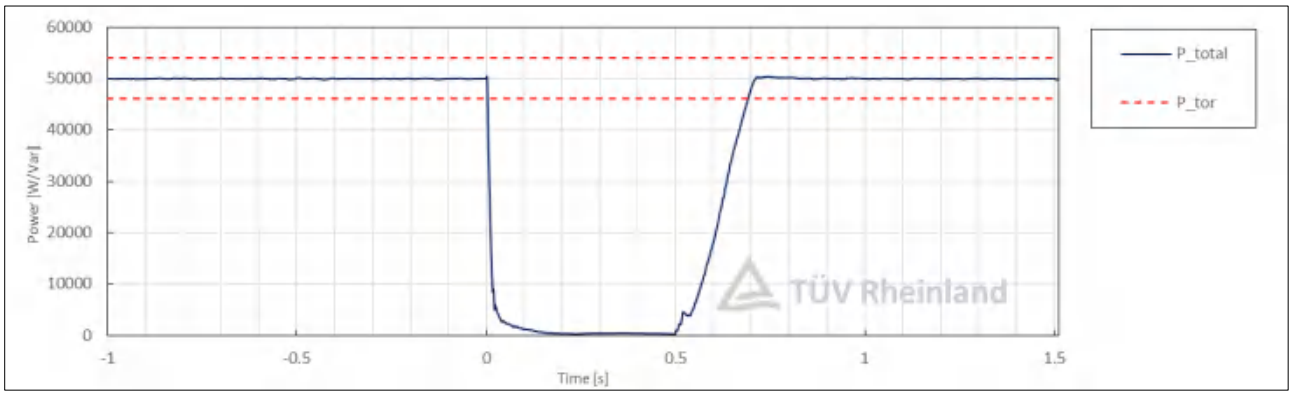

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

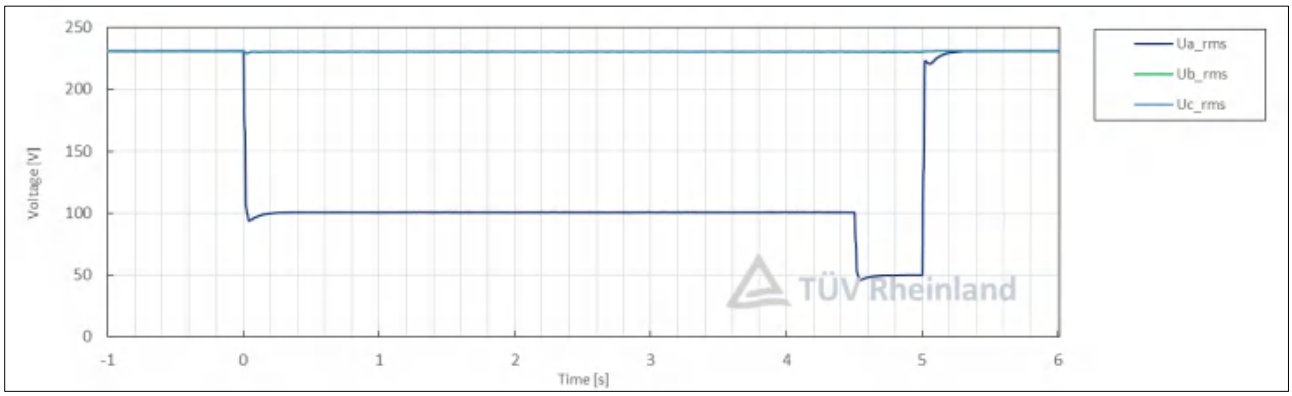

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

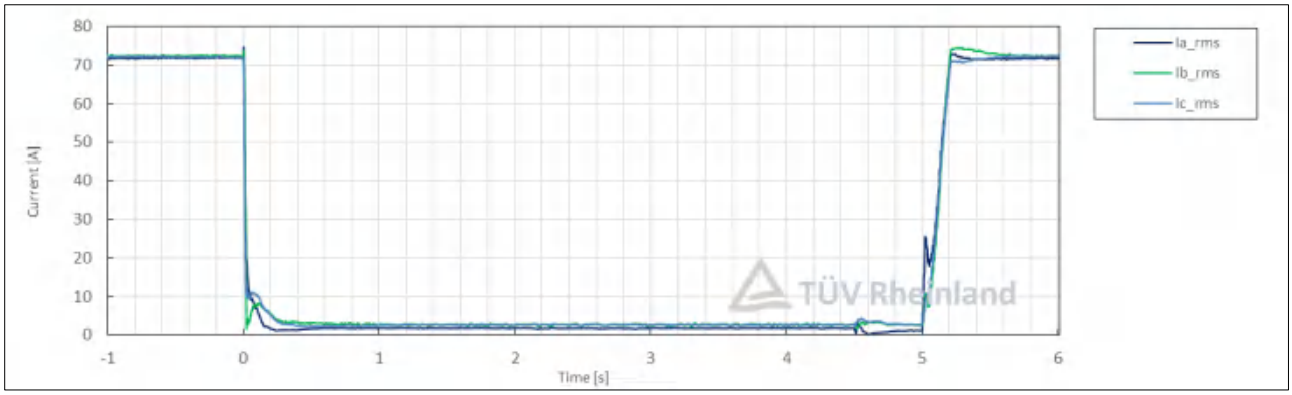

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

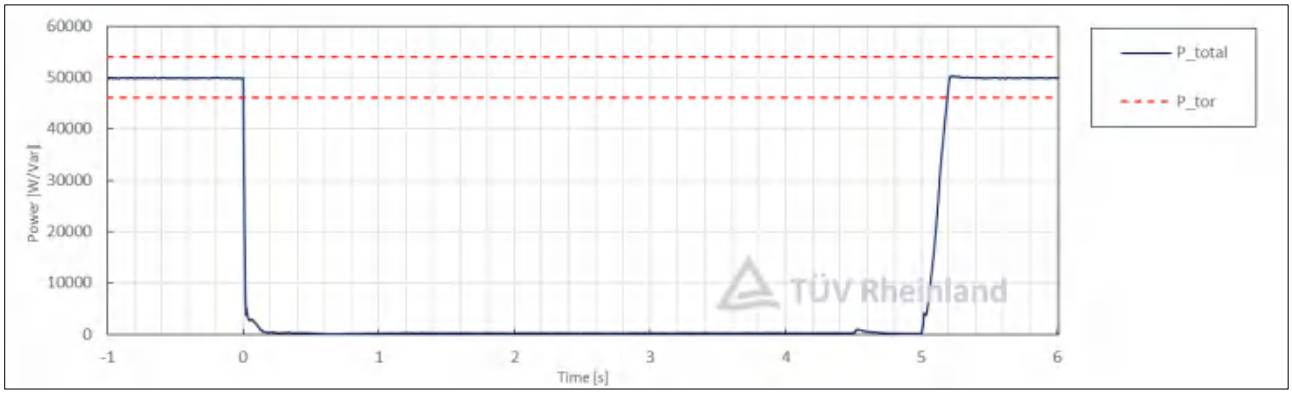

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

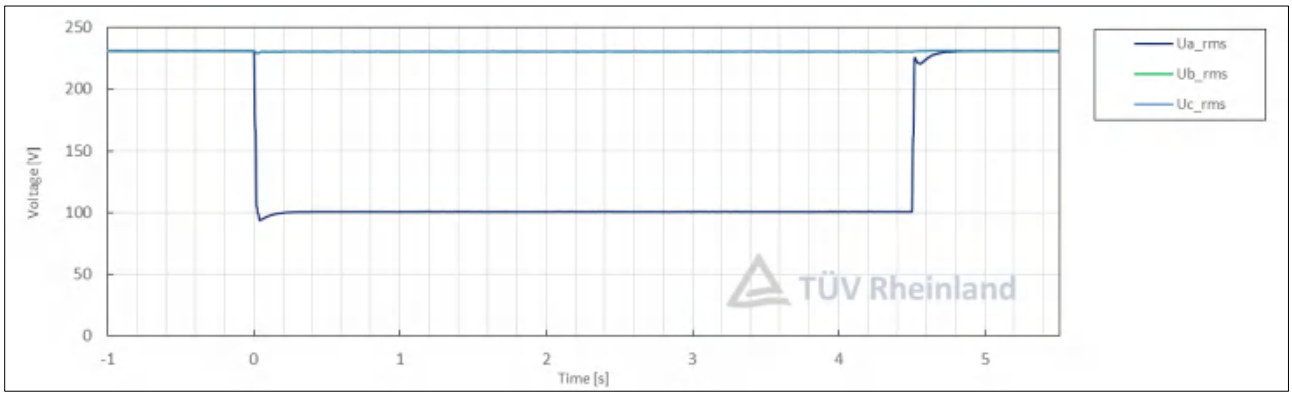

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

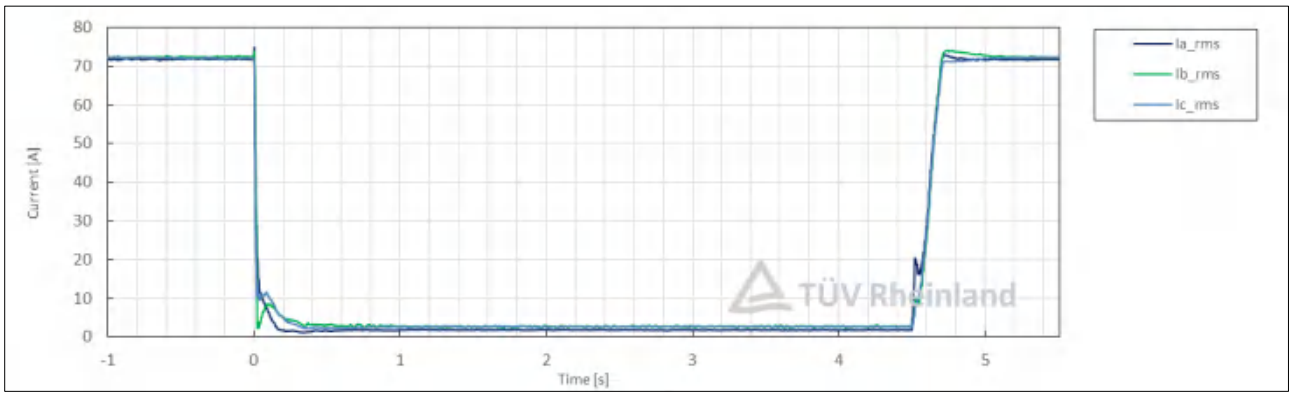

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

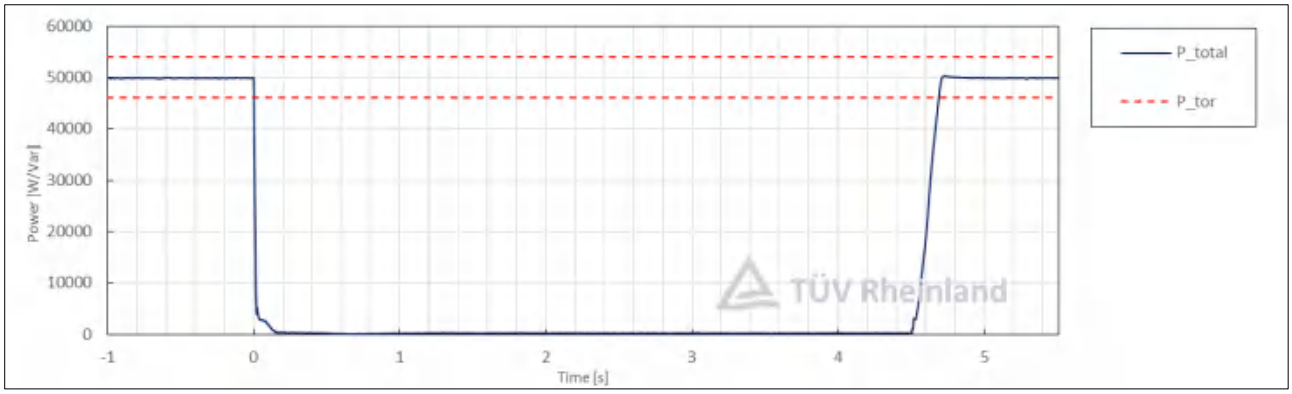

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

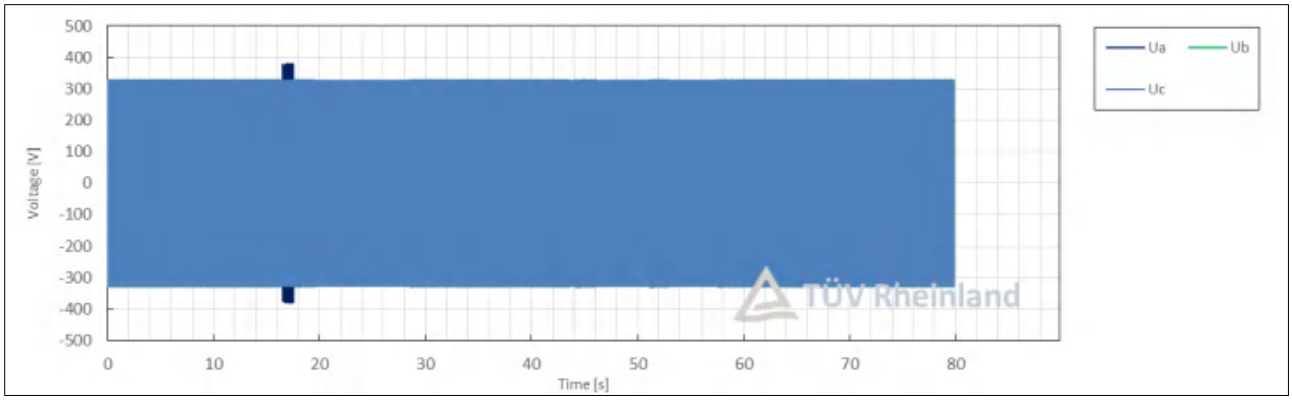

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

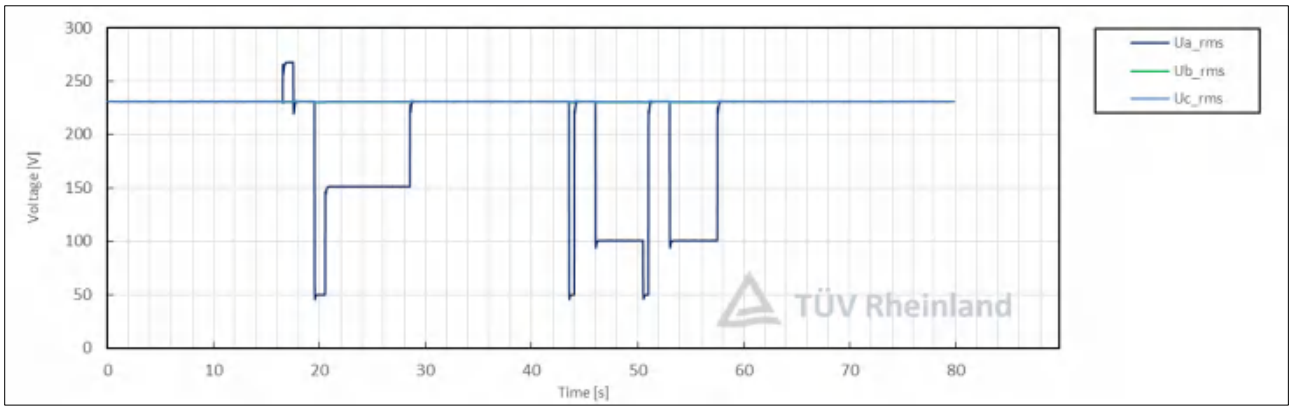


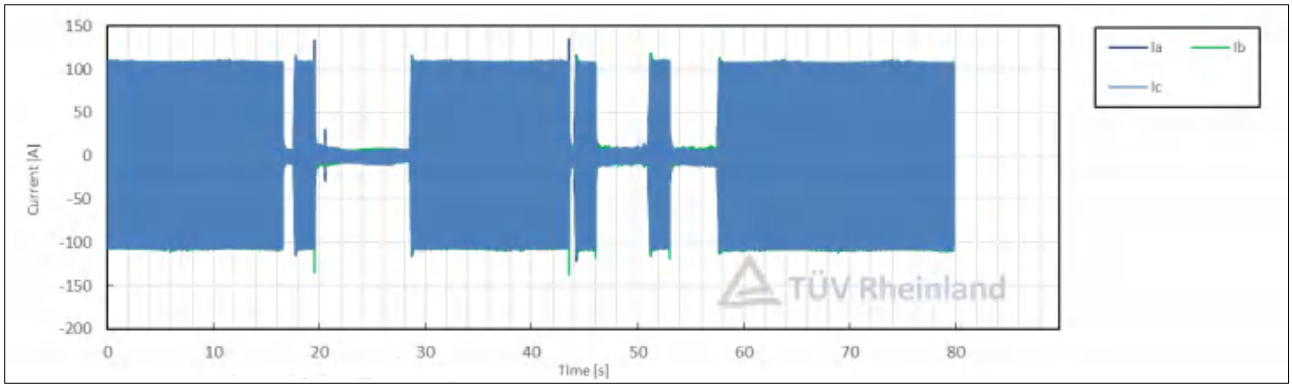
Appendix I (d)	TABLE: Voltage disturbance withstand tests						P
Phase L1							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.12	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)

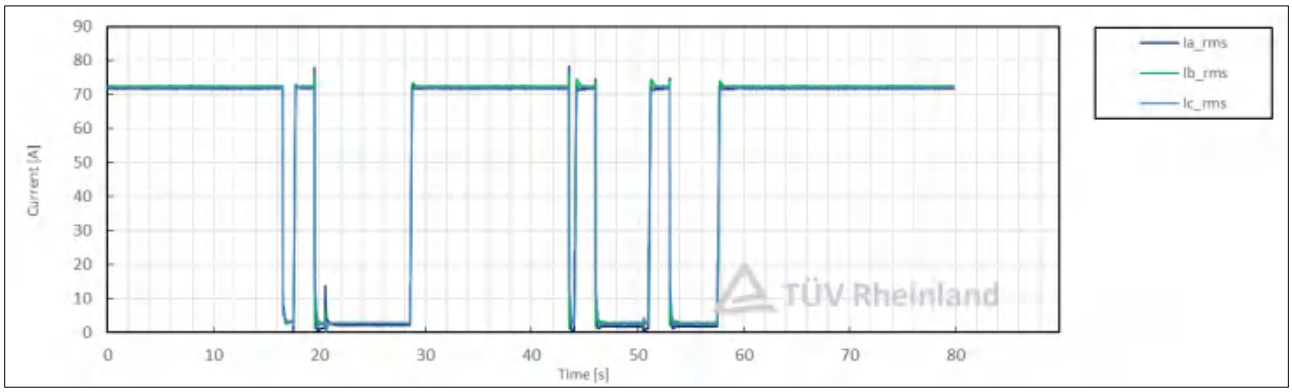
Voltage return 230V		Active power	Total		p.u.	0.50	0.46-0.54
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

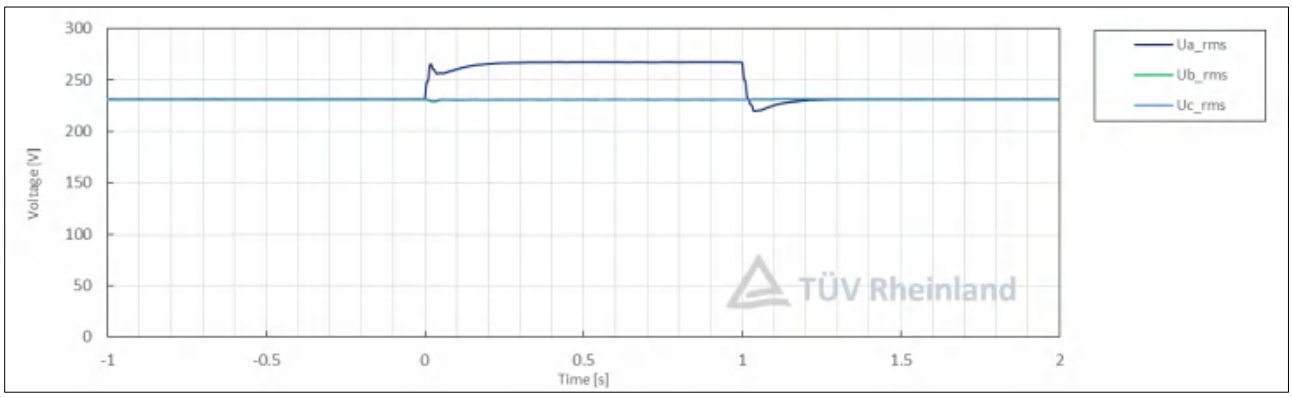
Diagram

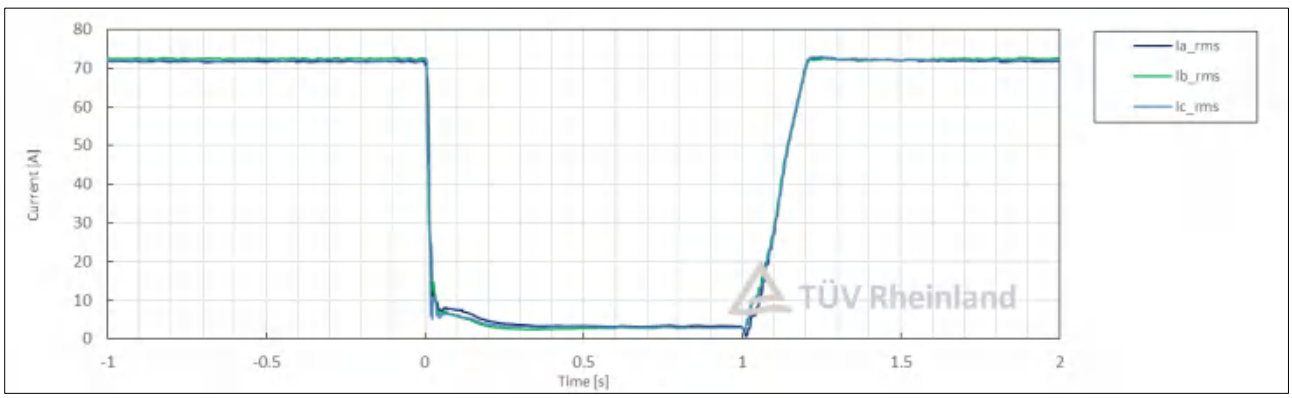


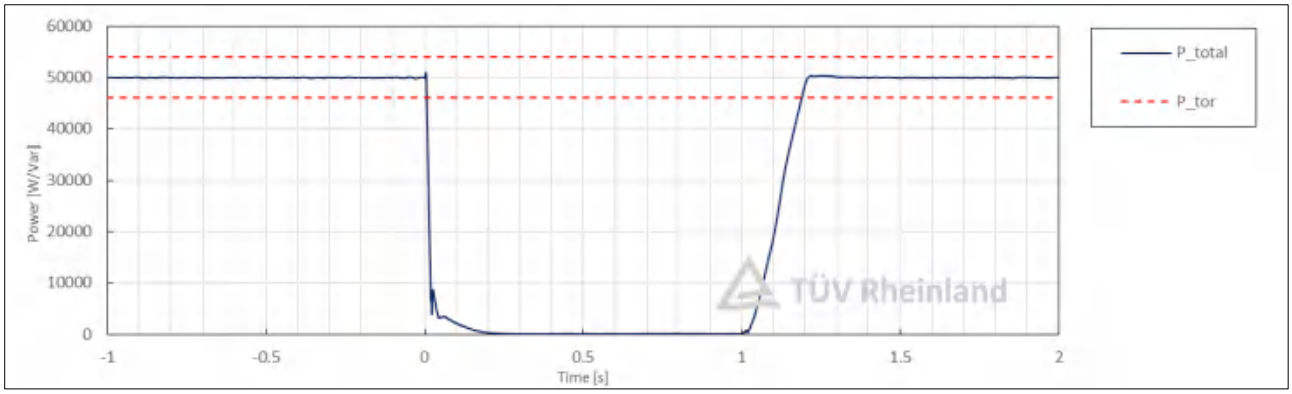


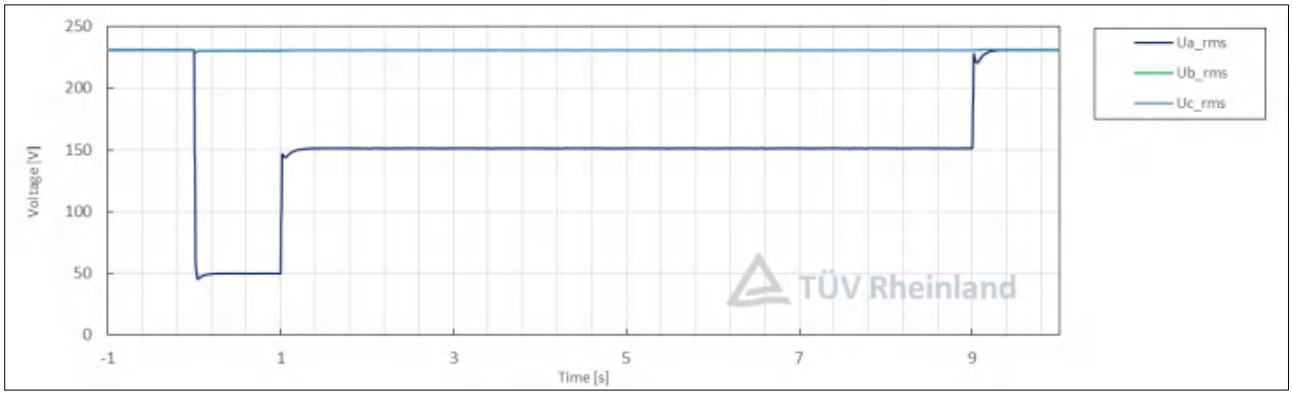

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

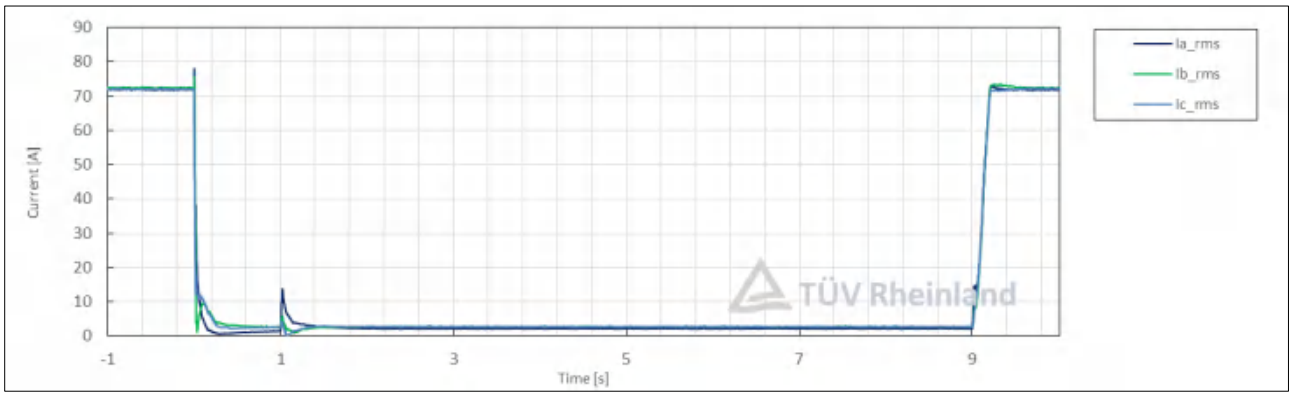

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

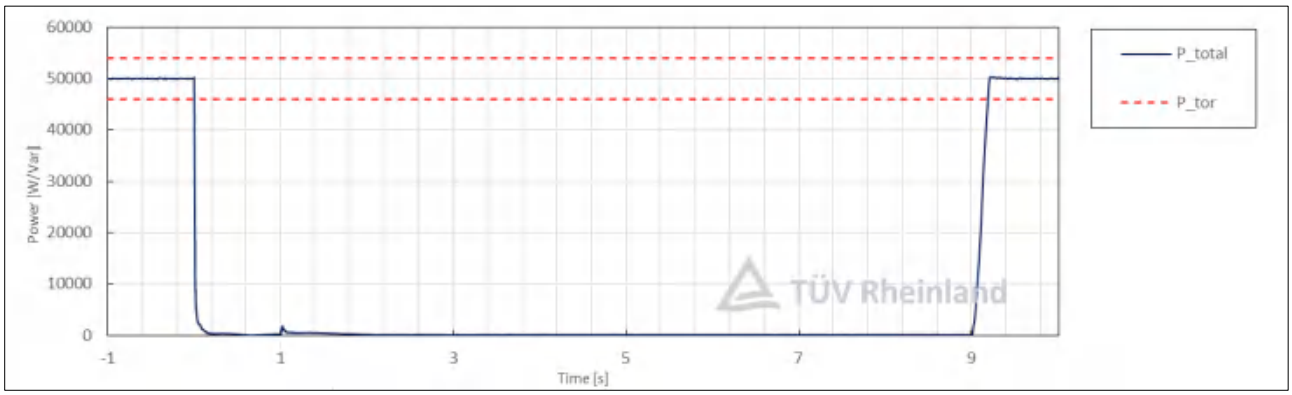

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

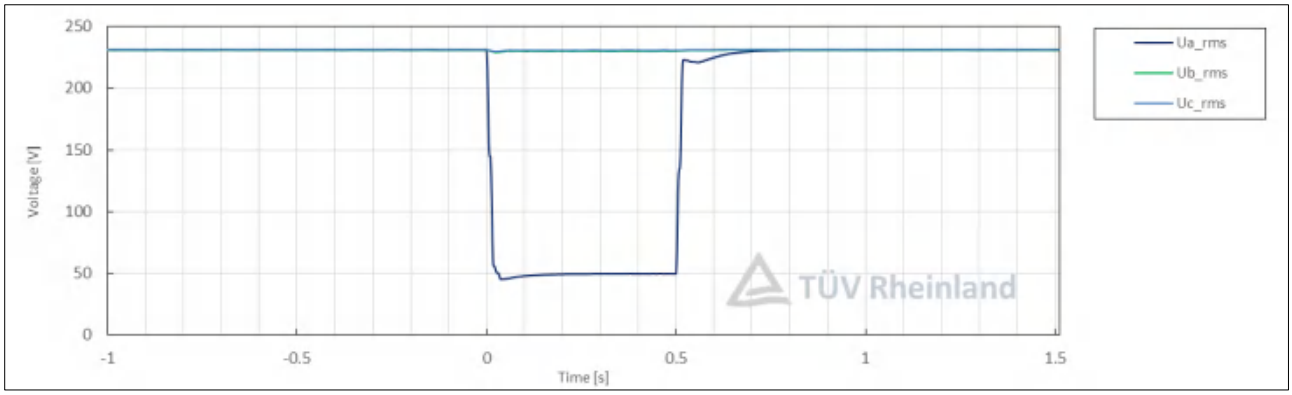

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

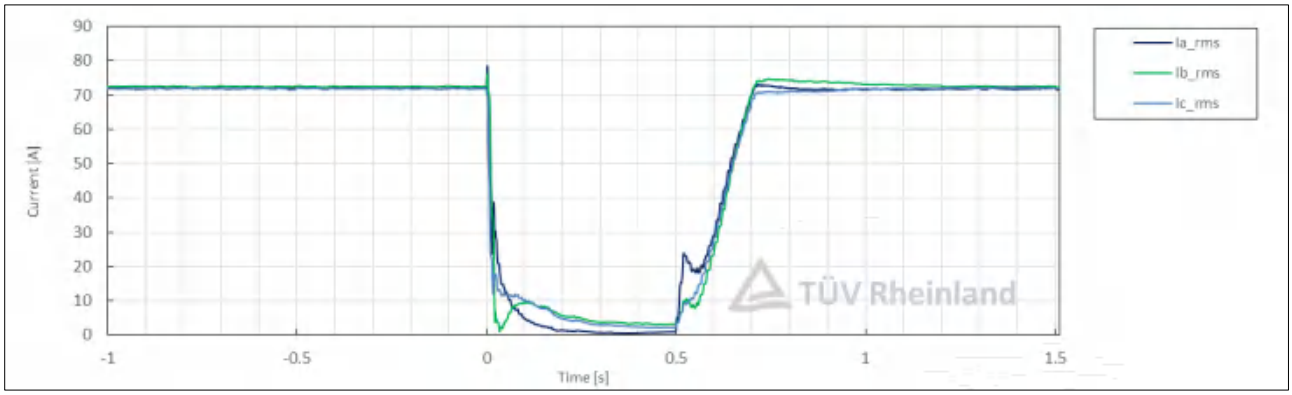

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

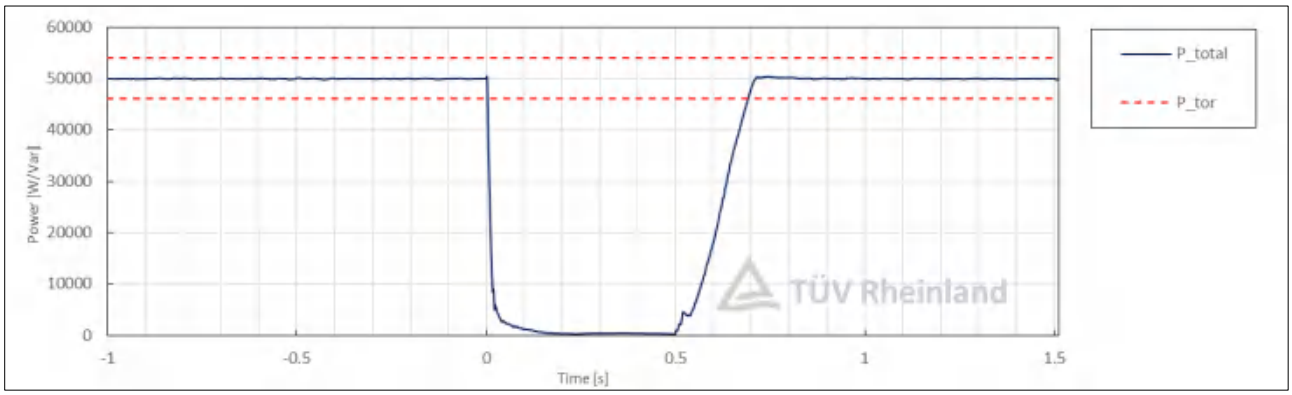

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

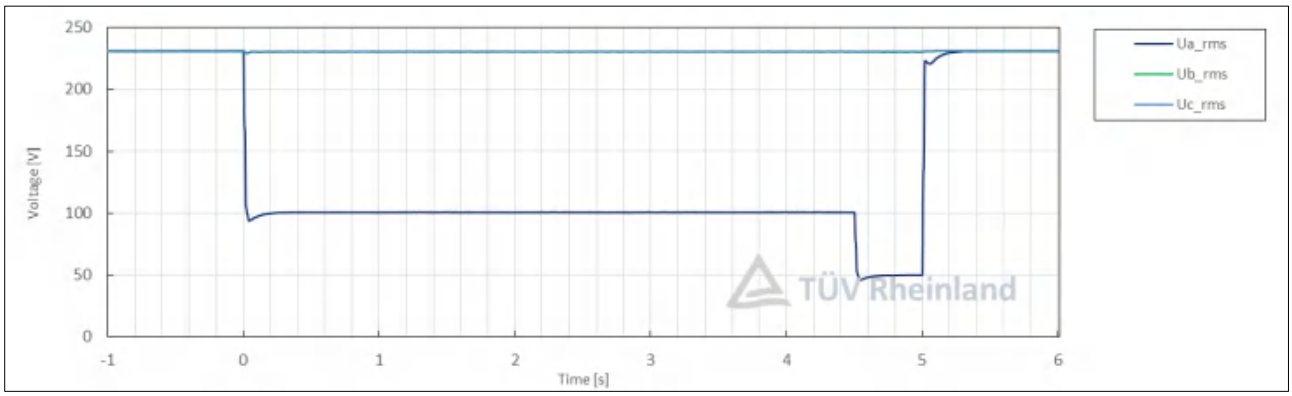

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

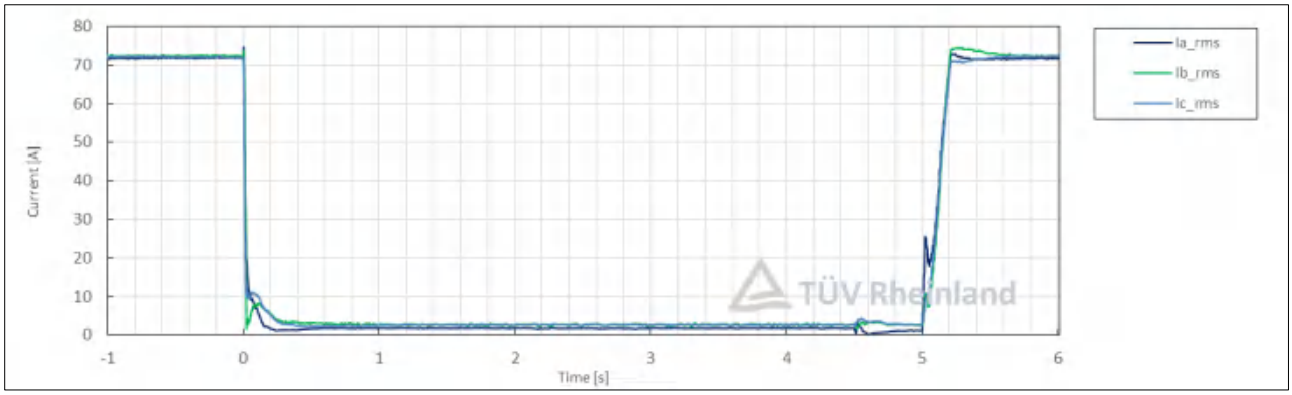

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

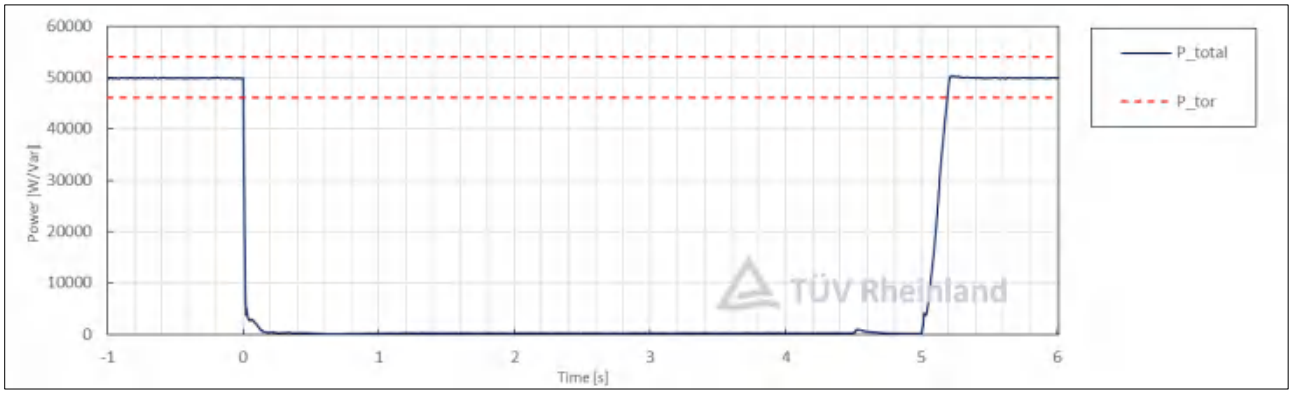

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

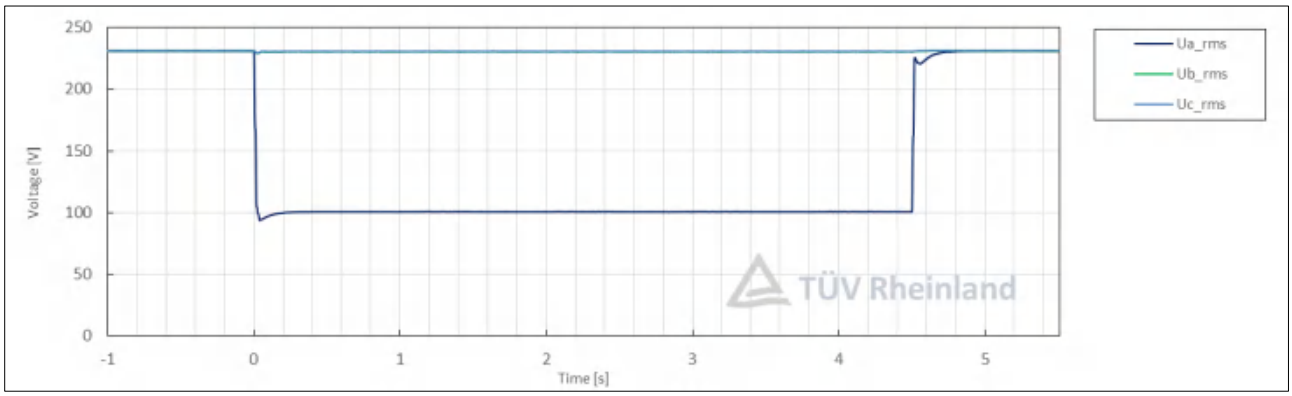

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

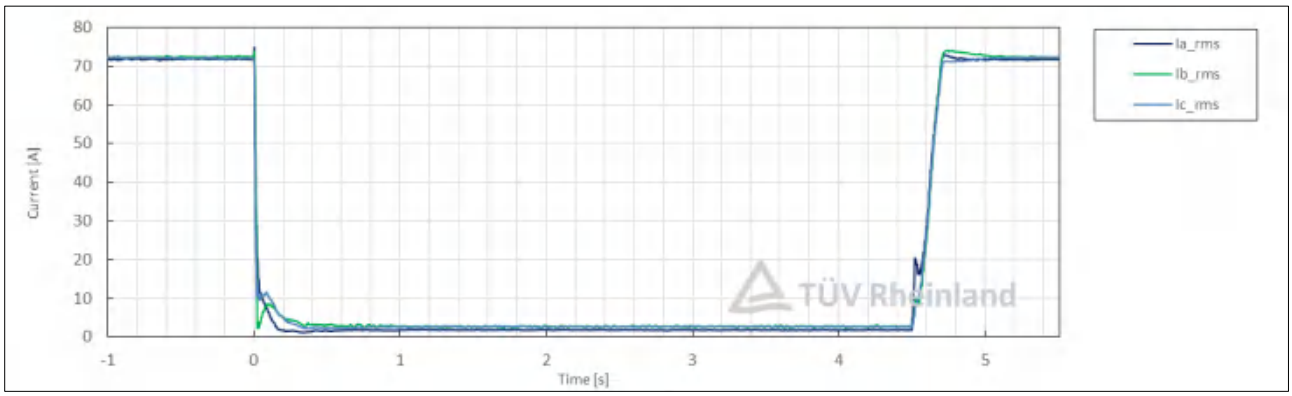

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

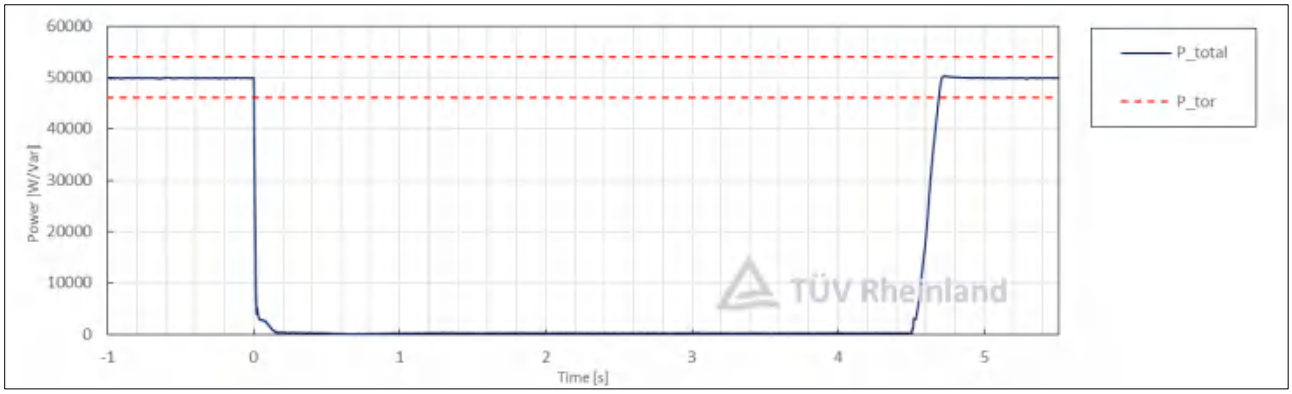

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

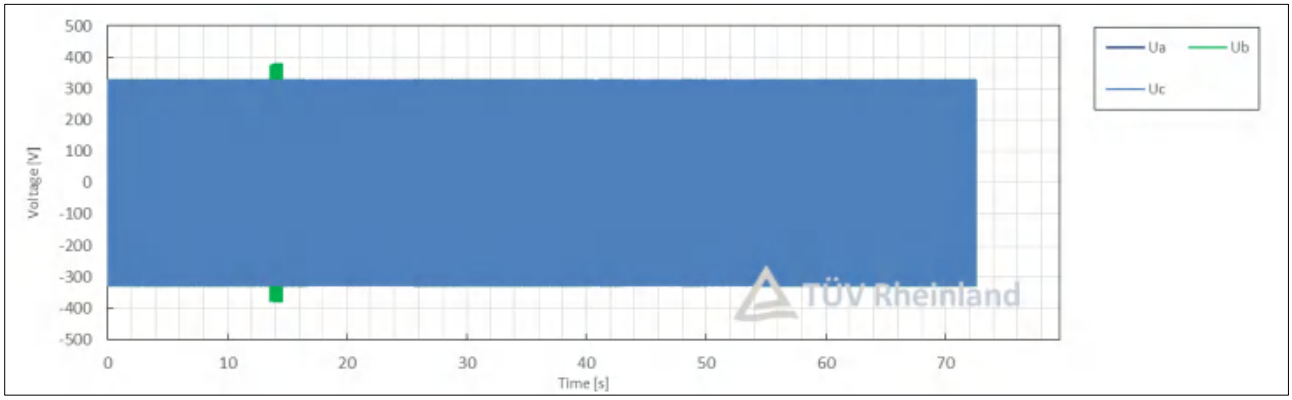

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

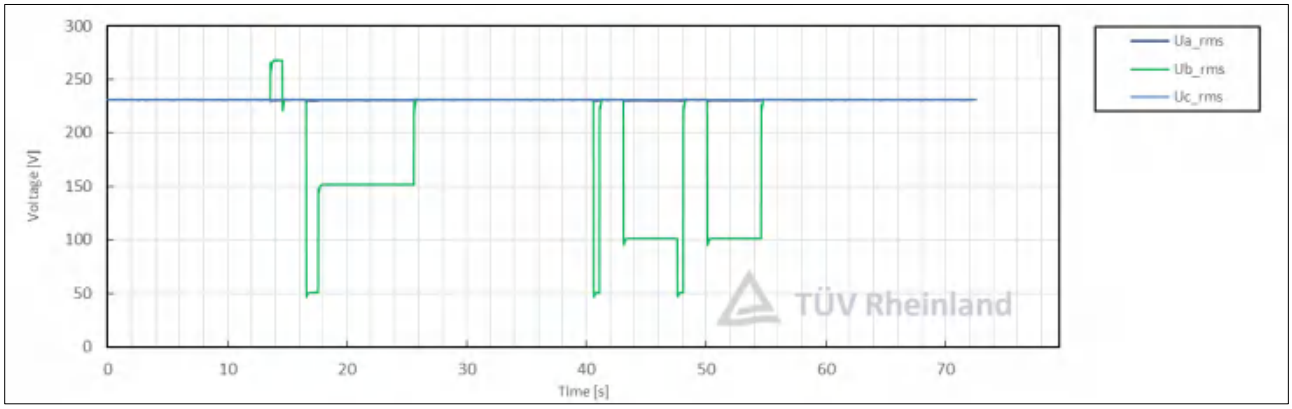


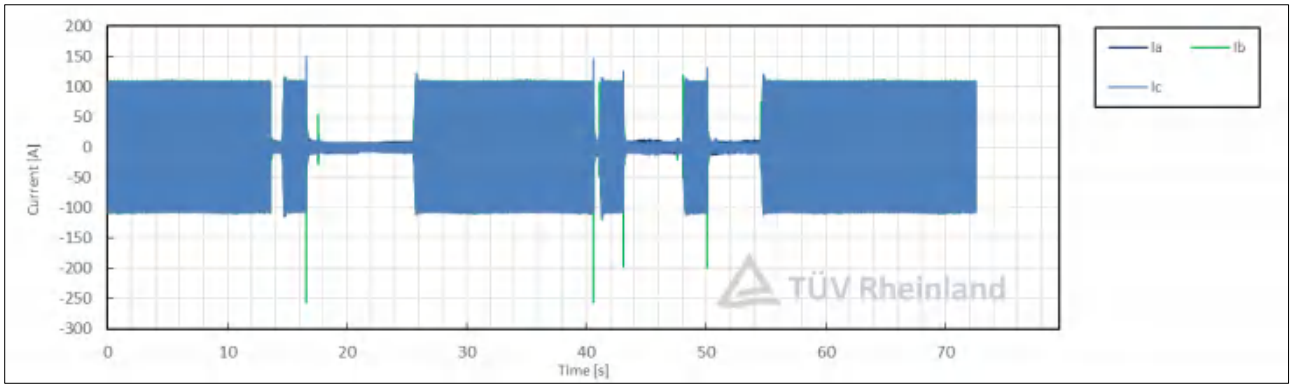
Phase L2							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.4
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.66	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

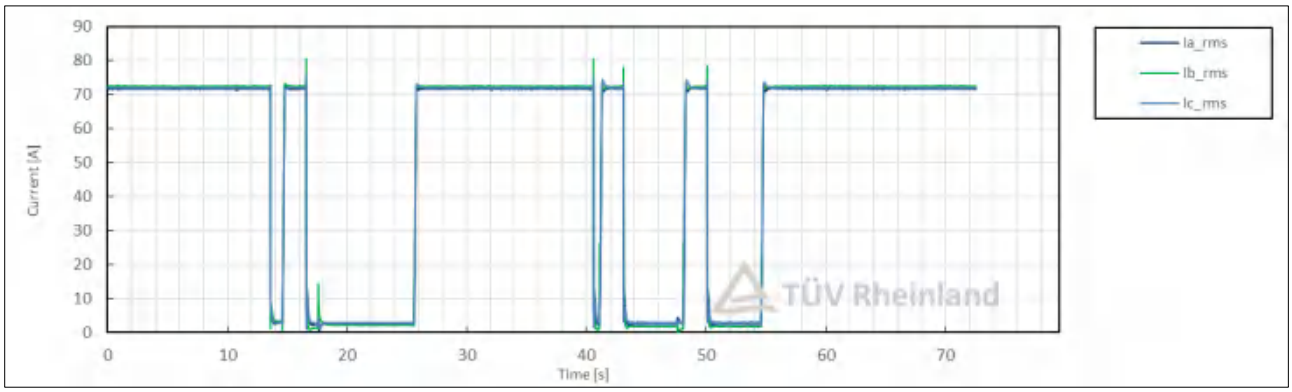
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.22	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

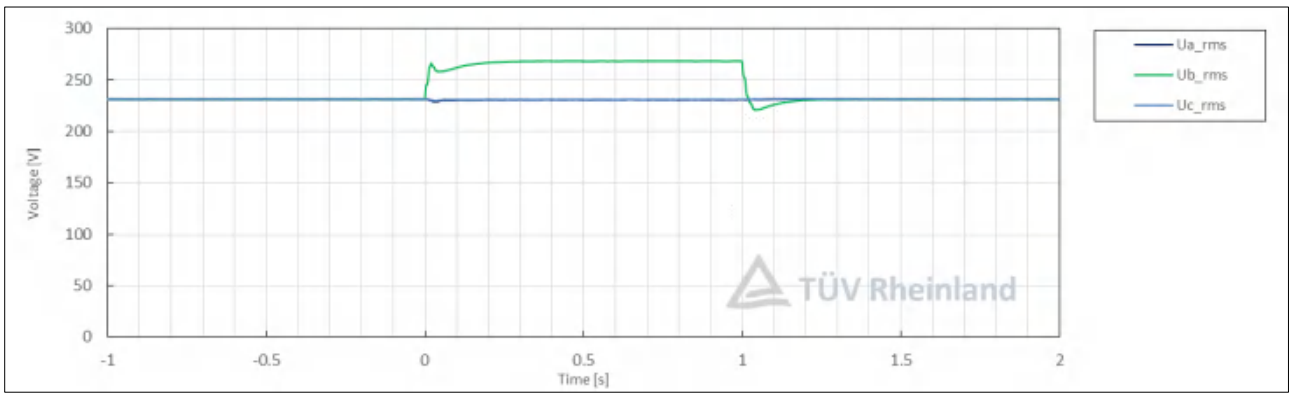
Diagram

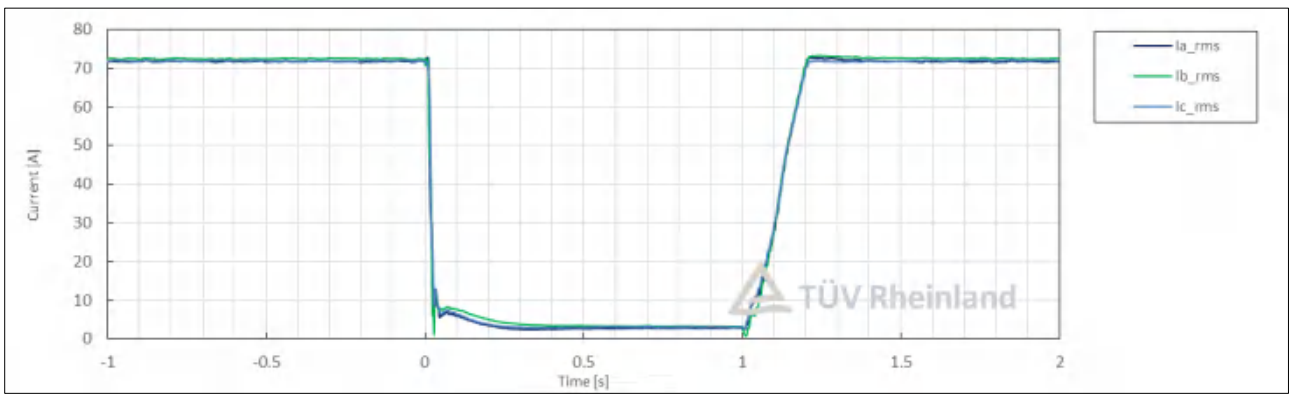


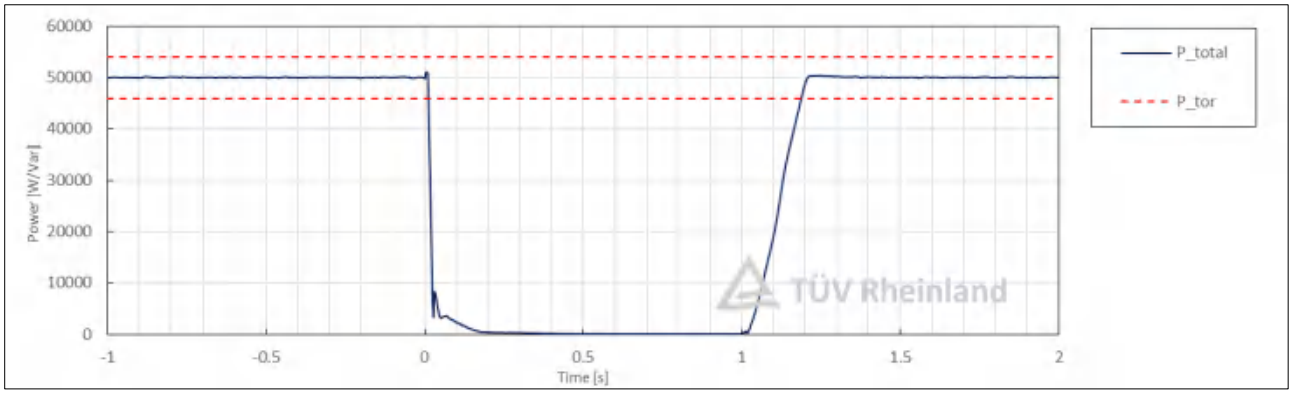


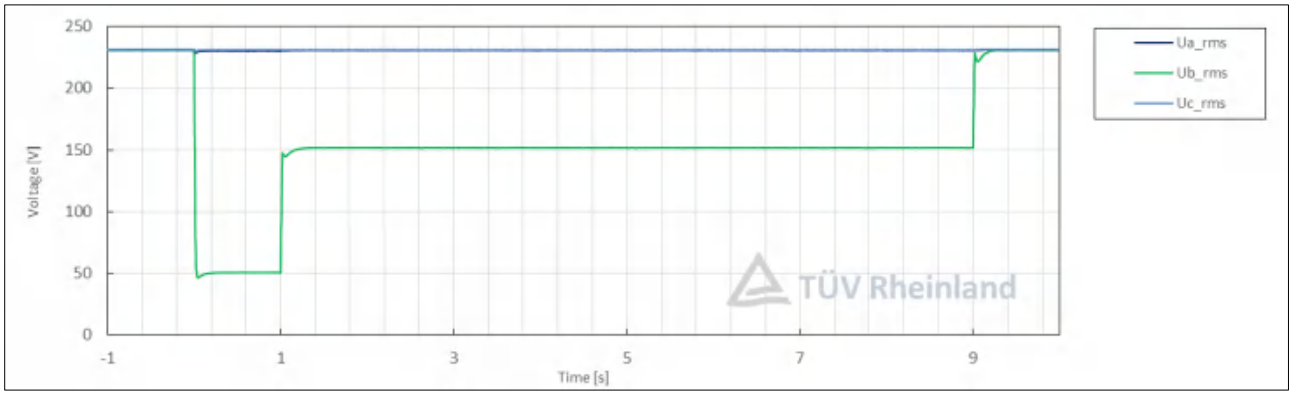

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

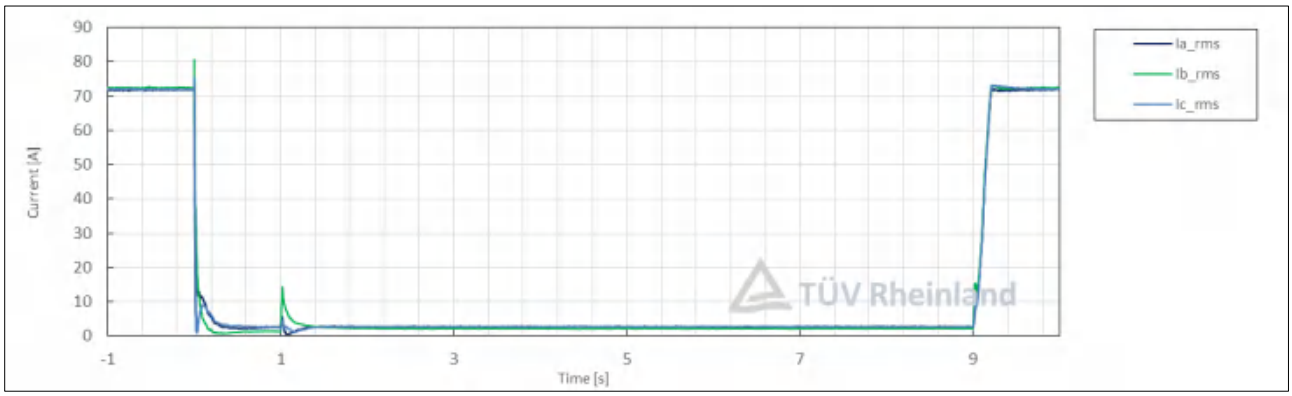

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

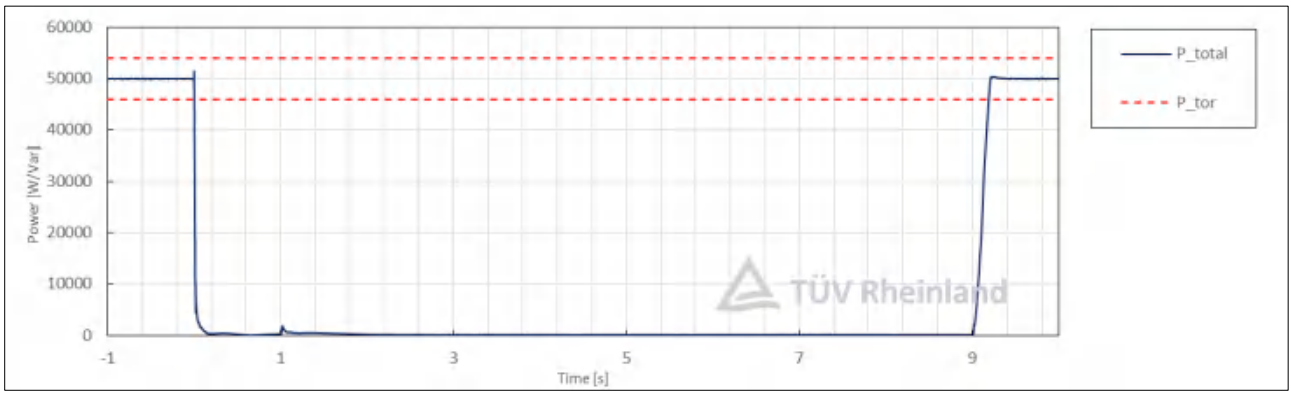

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

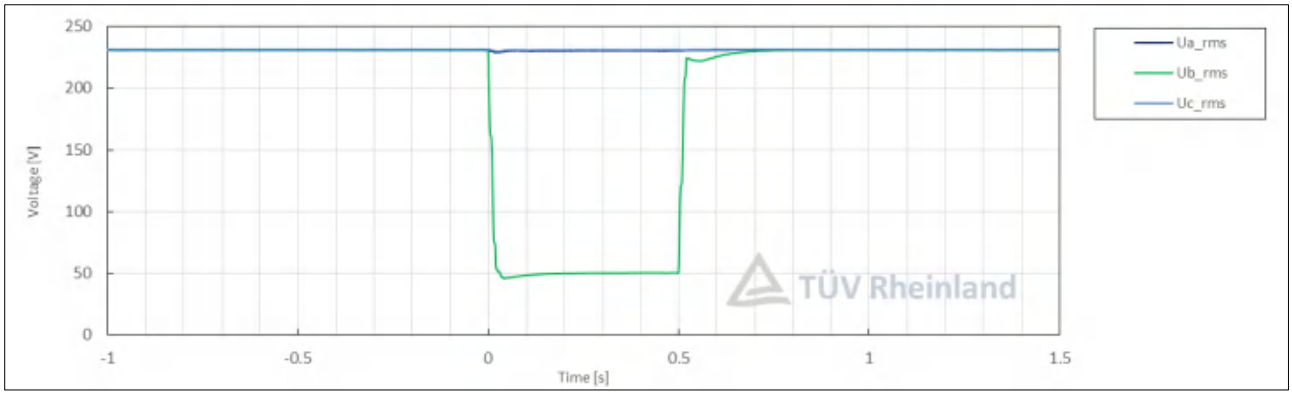

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

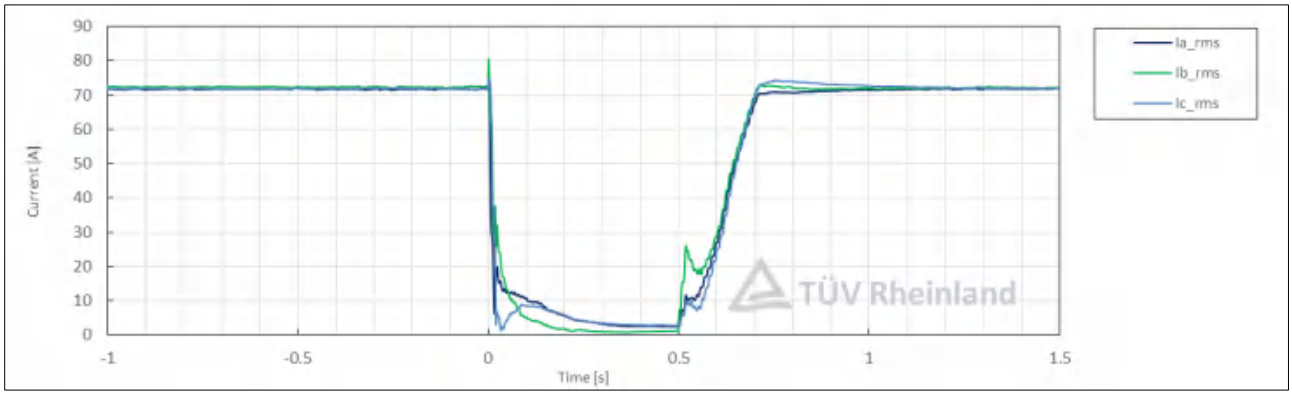

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

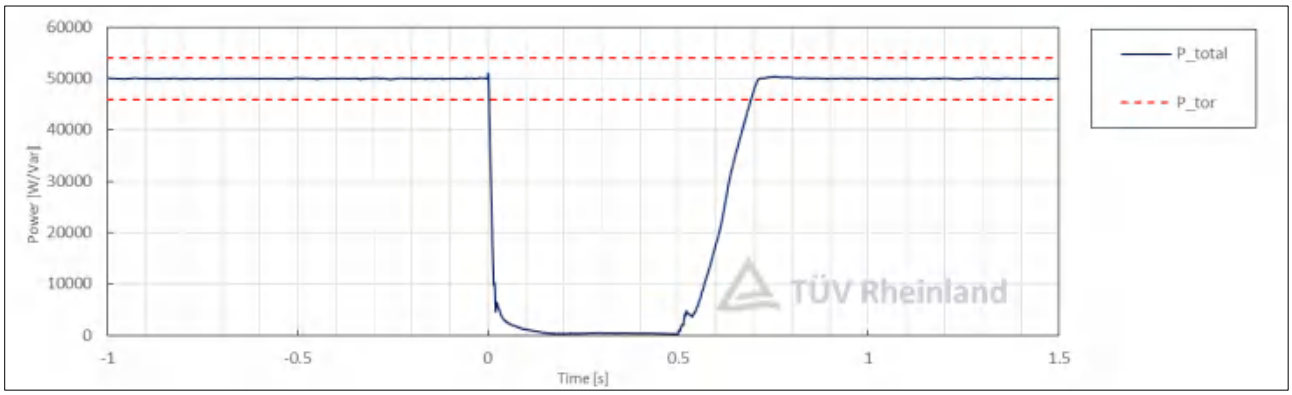

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

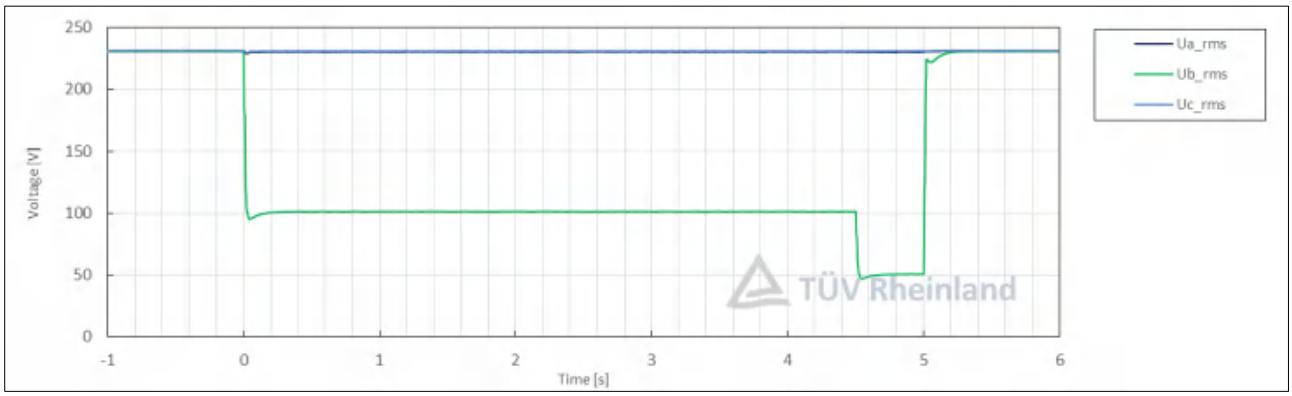

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

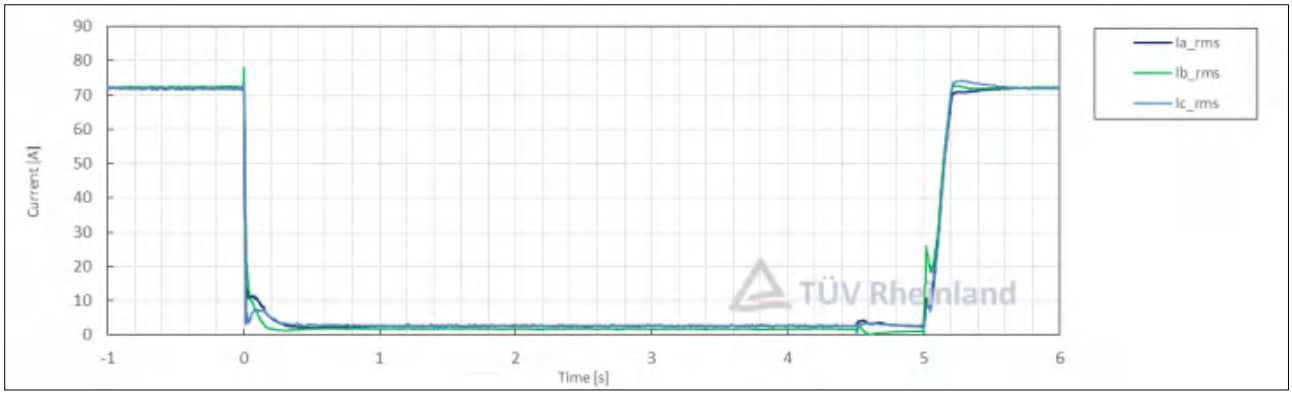

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

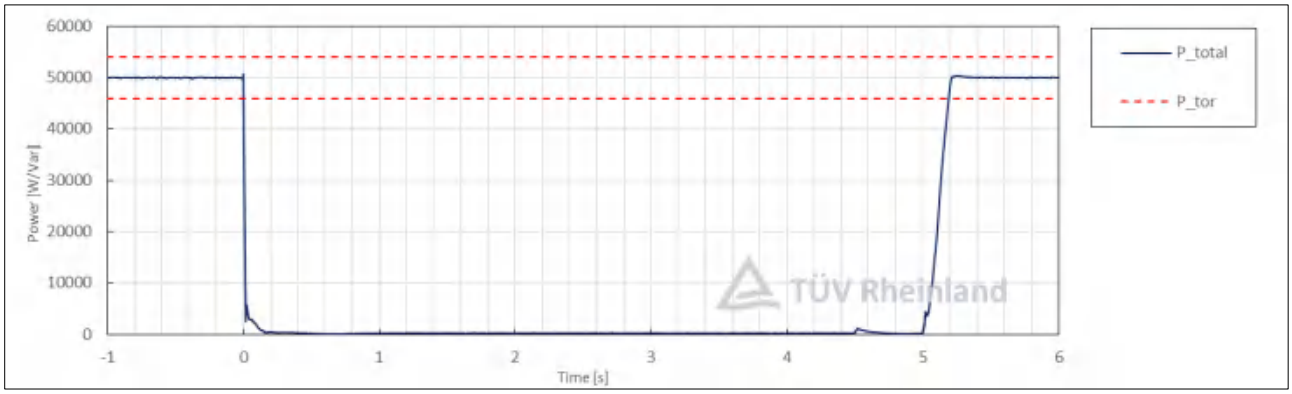

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

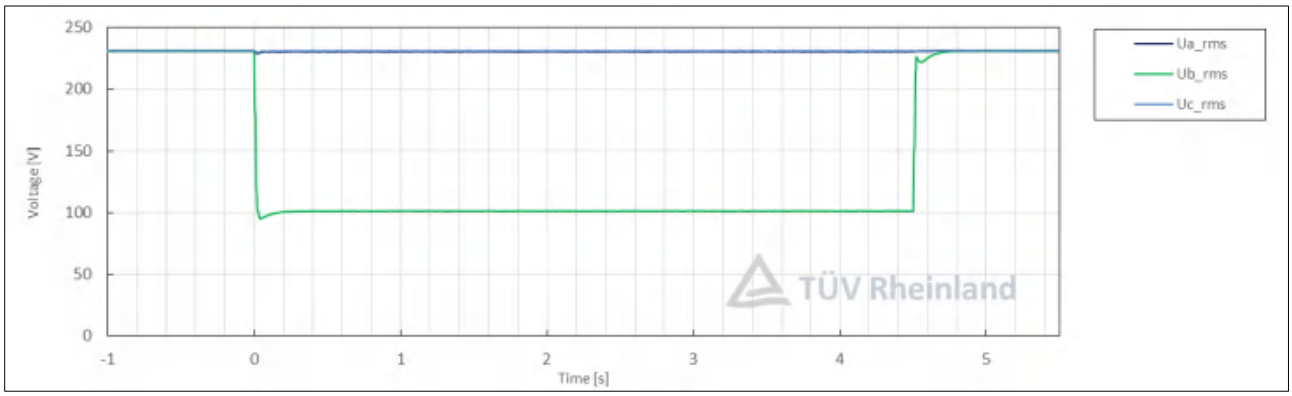

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

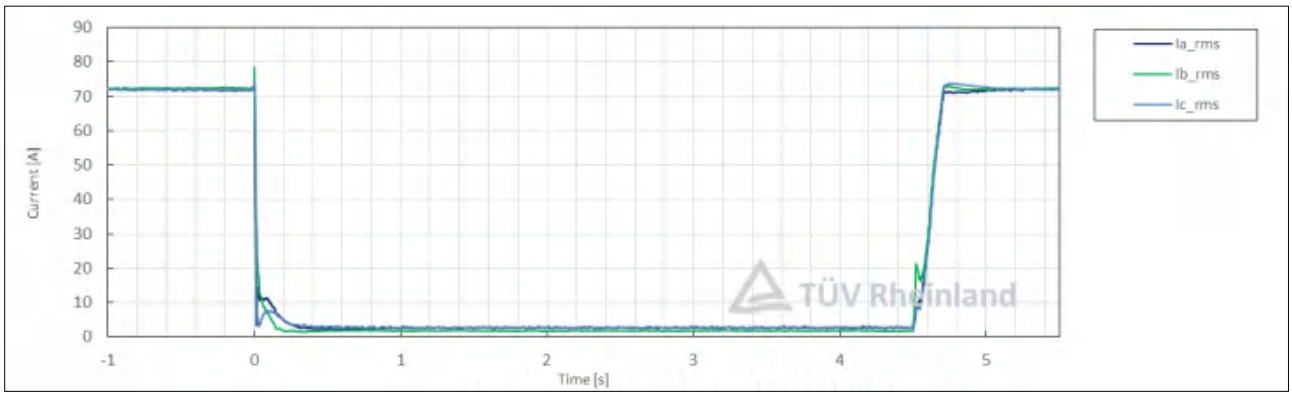

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

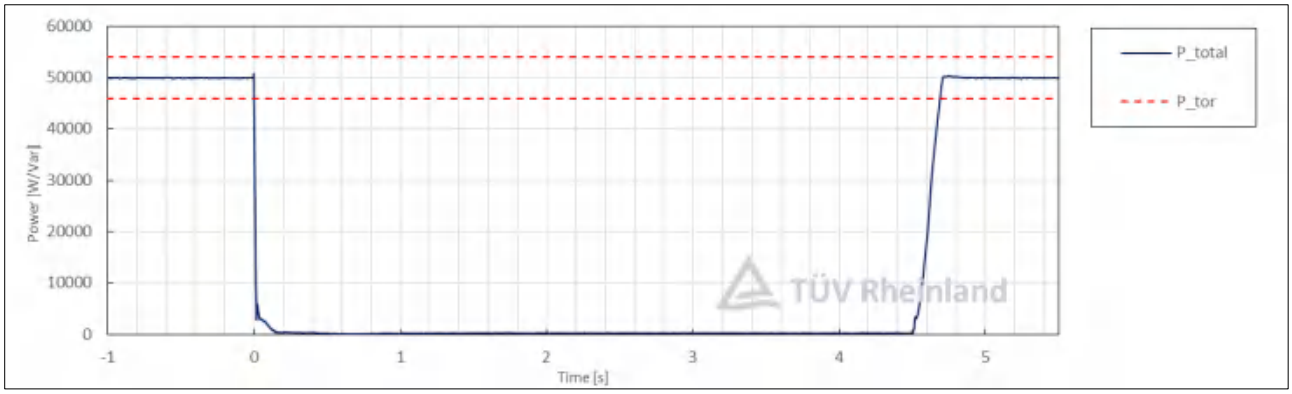

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

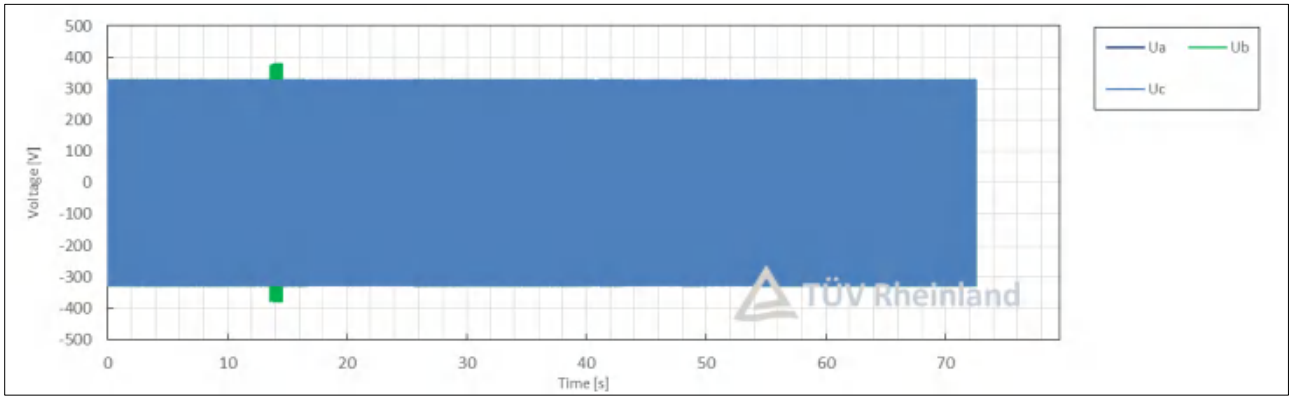

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

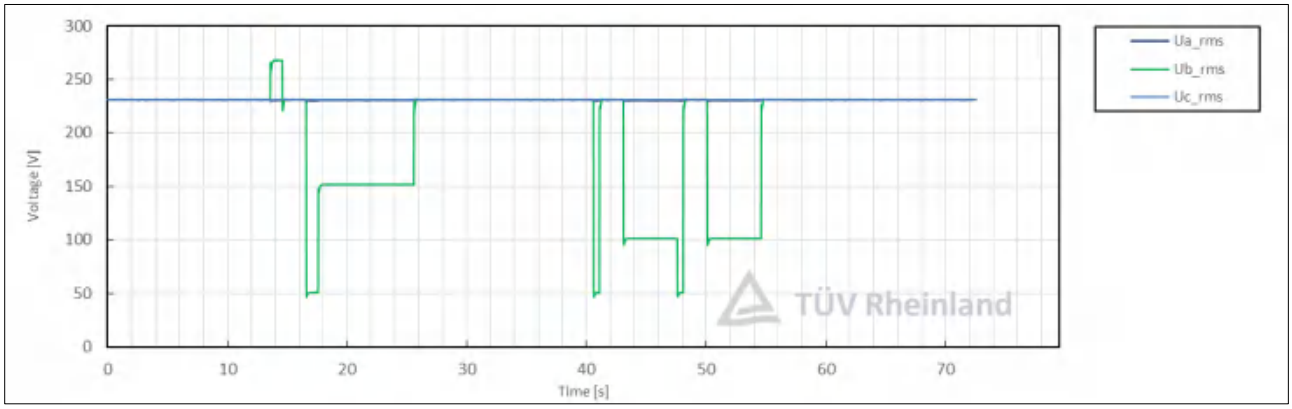


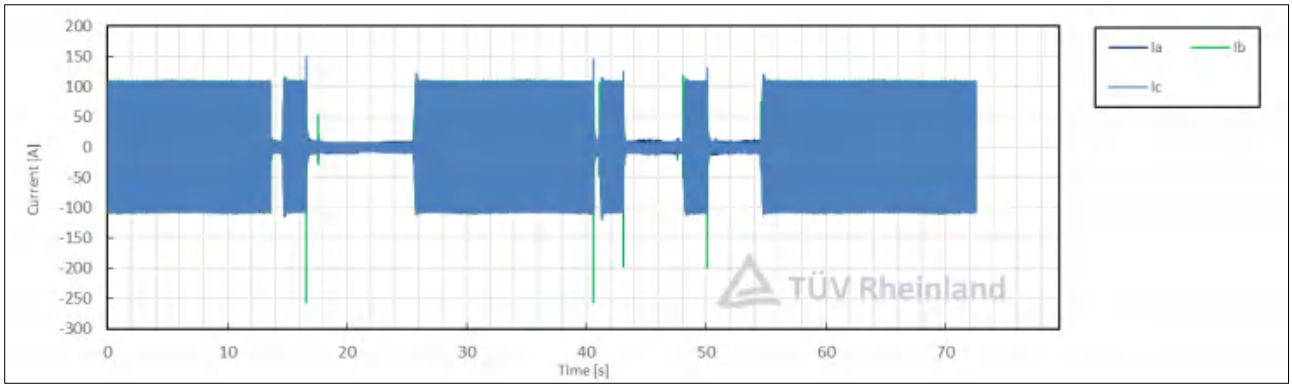
Phase L2							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.4
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.66	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

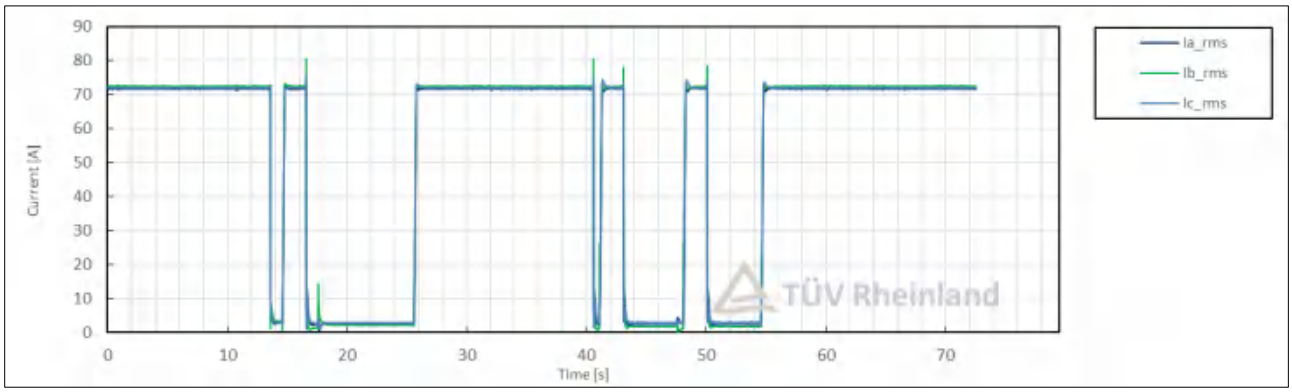
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.22	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

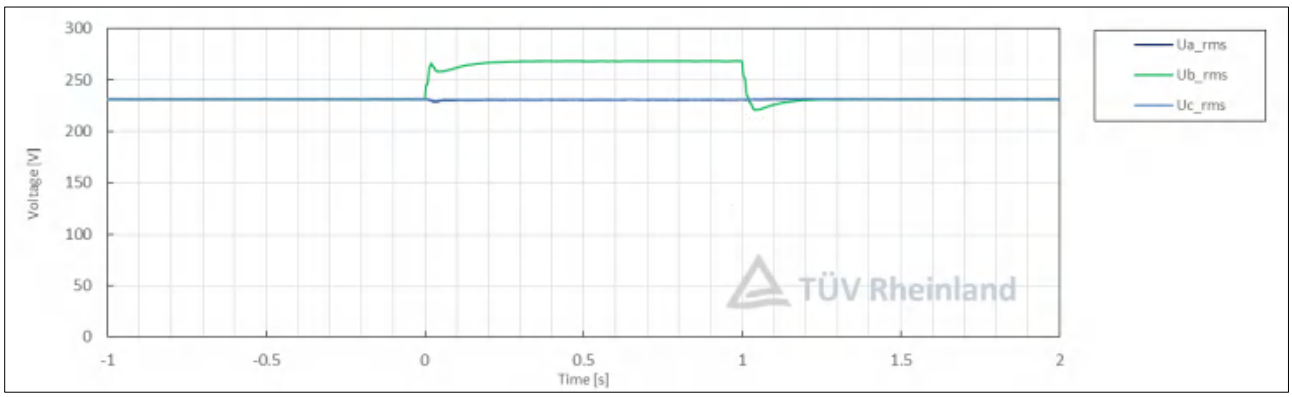
Diagram

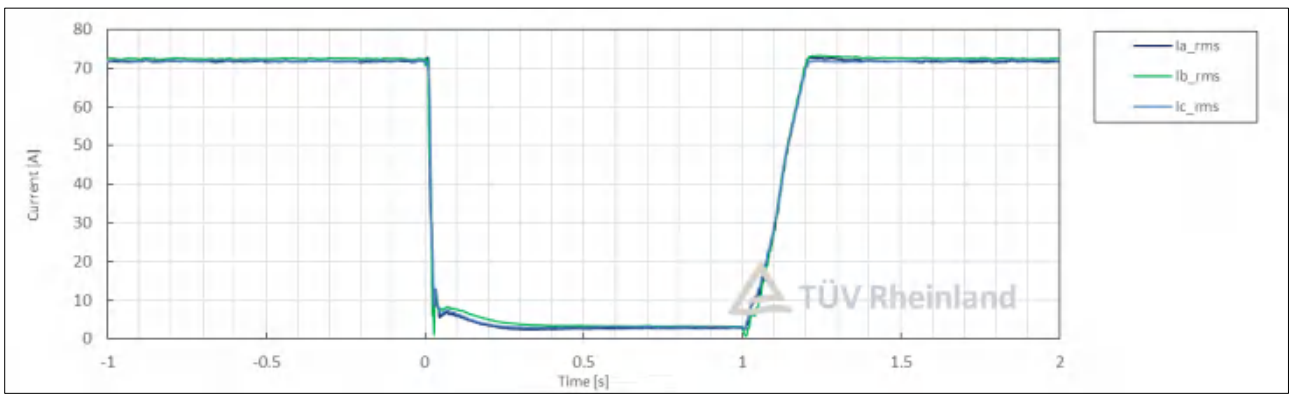


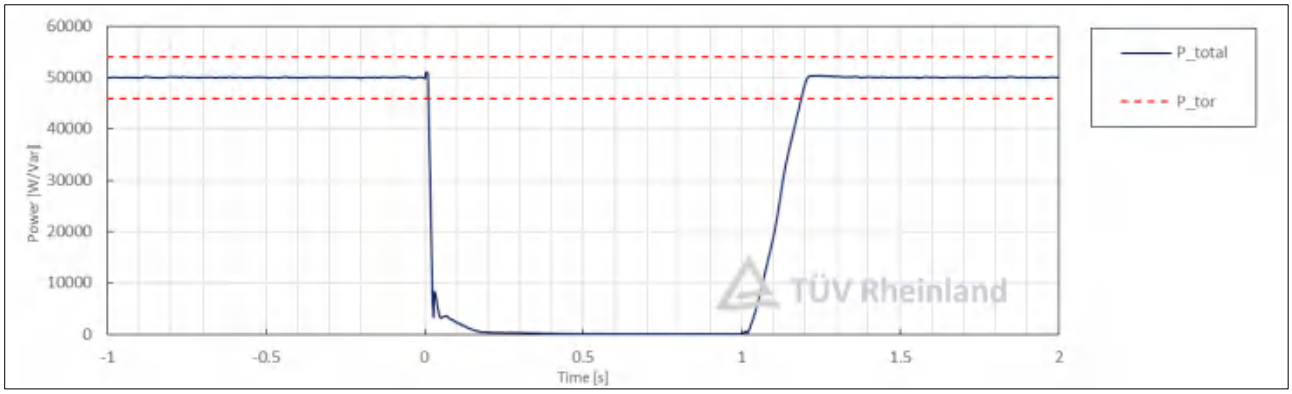


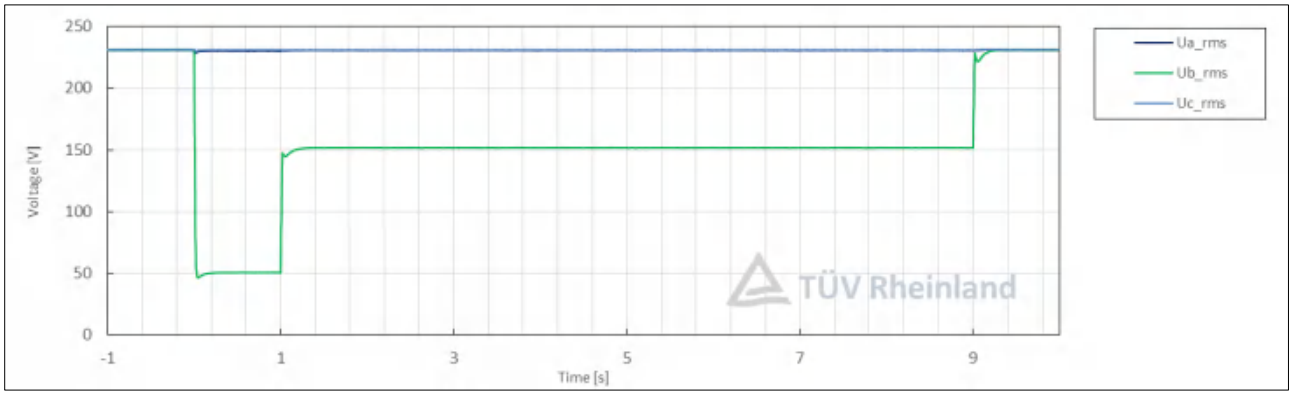

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

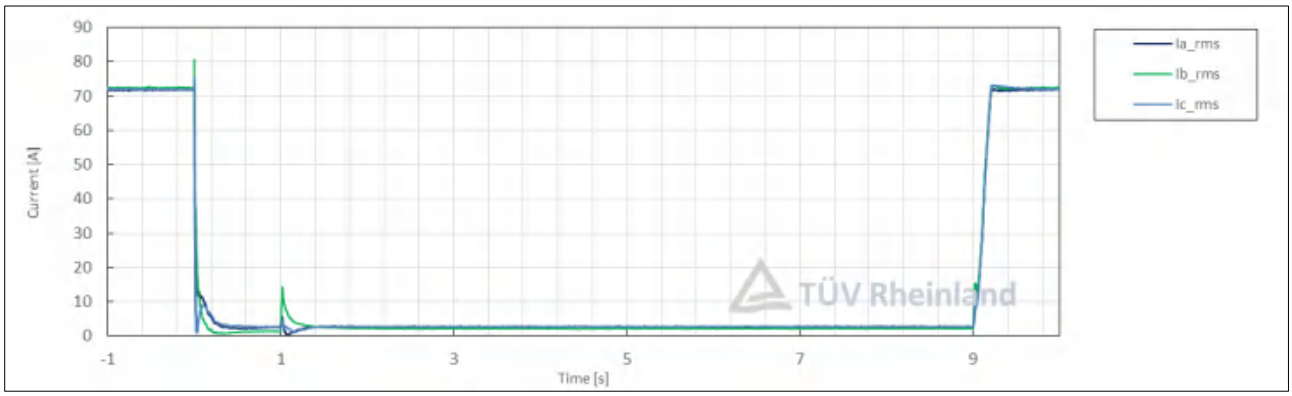

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

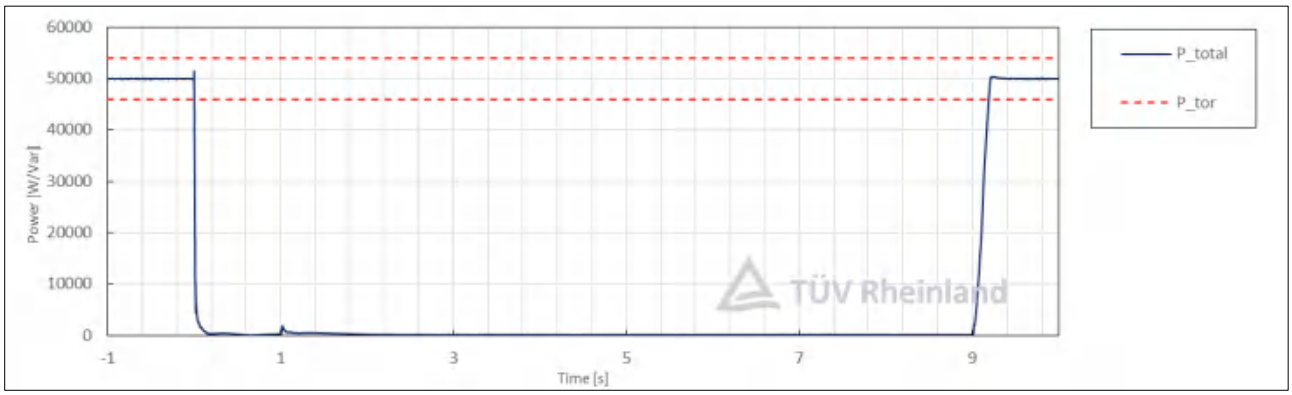

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

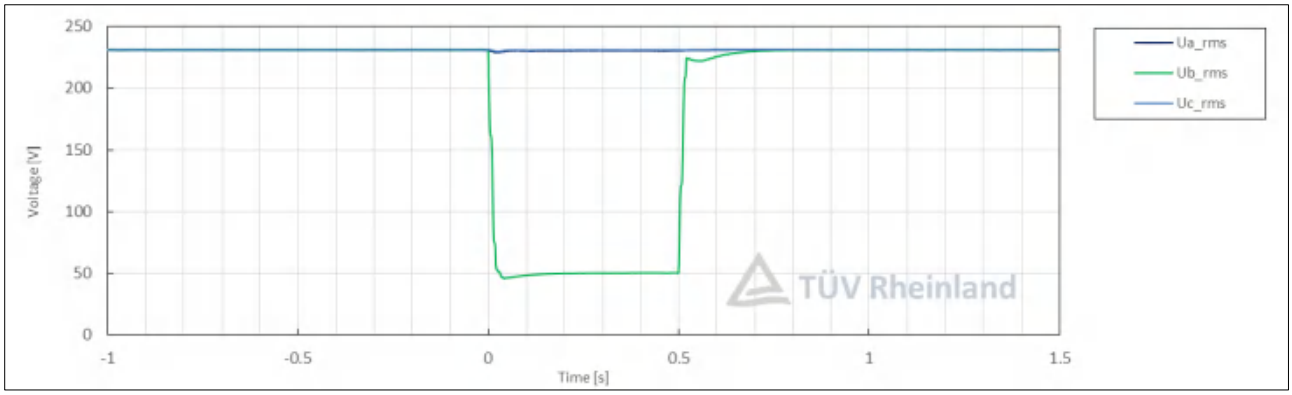

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

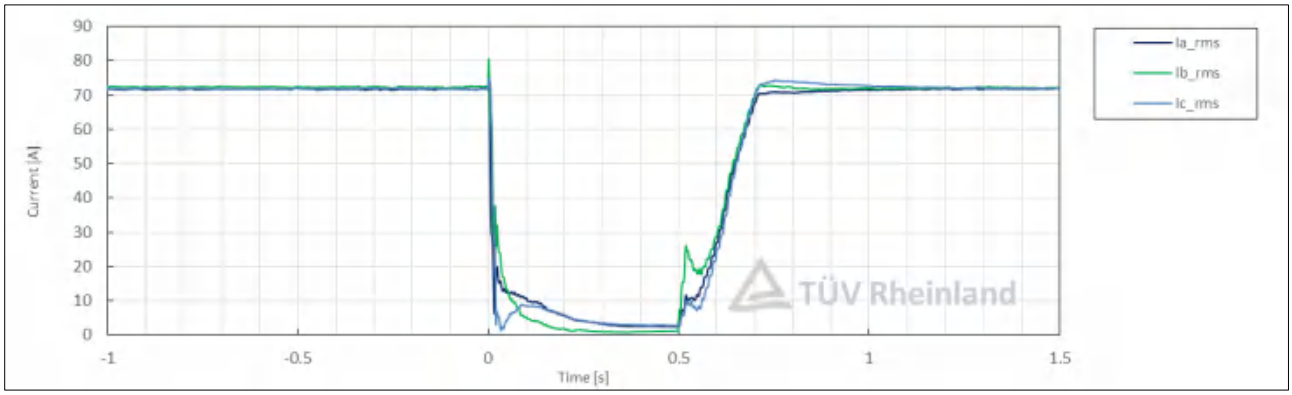

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

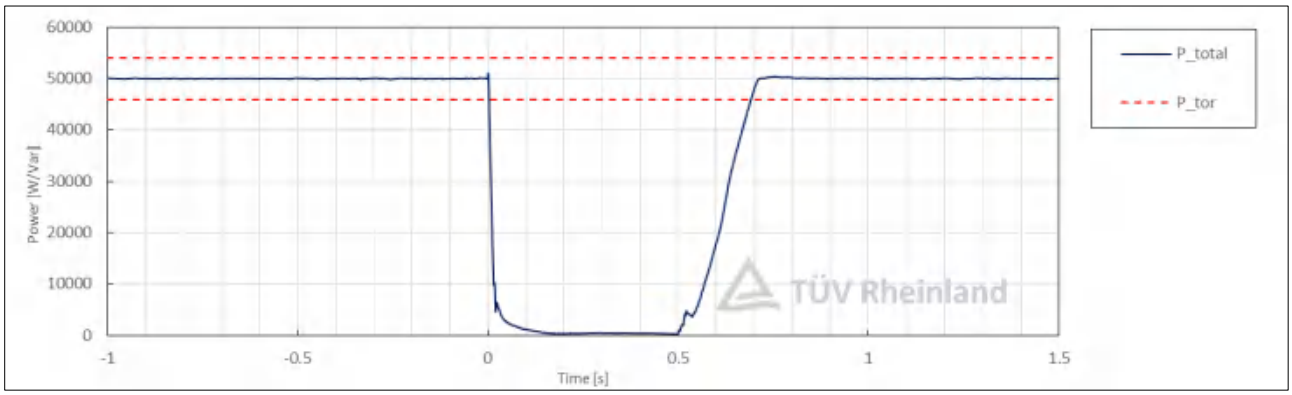

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

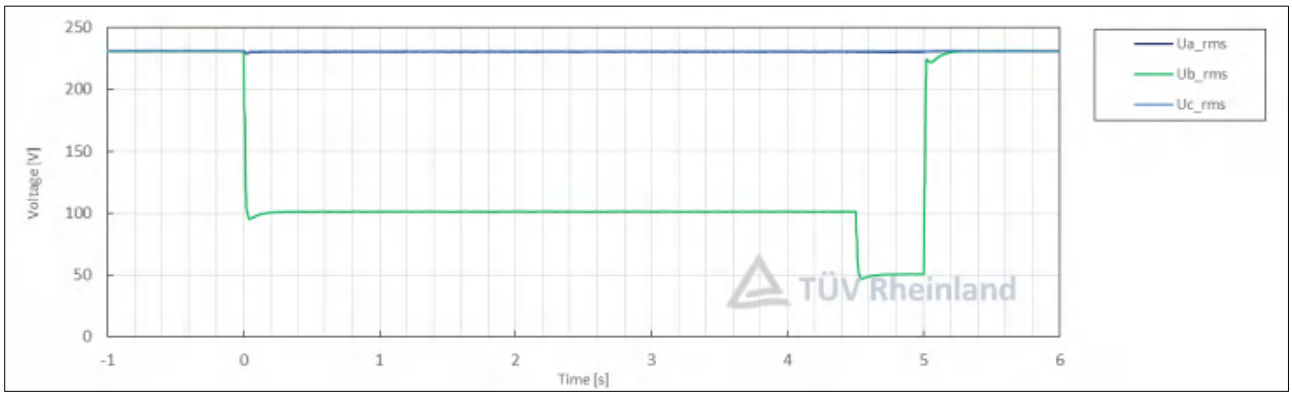

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

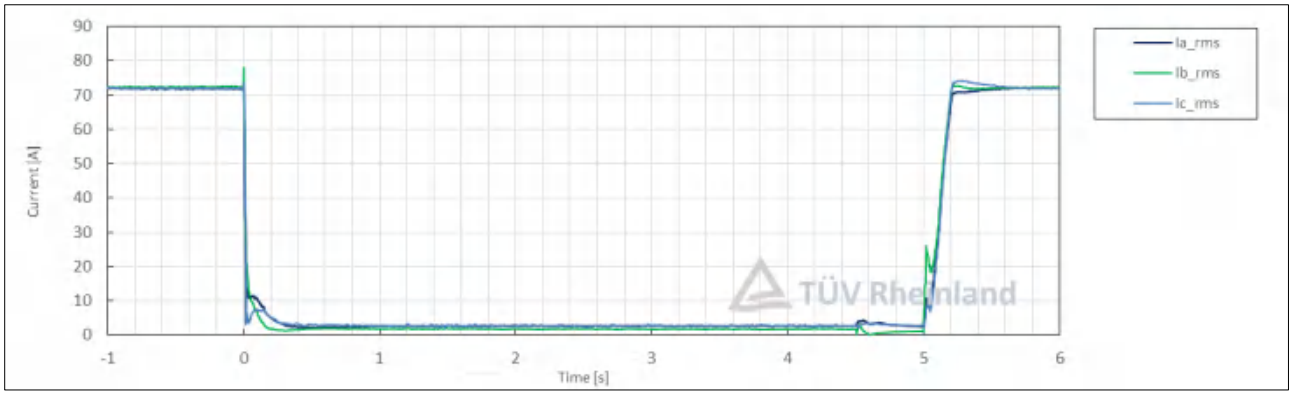

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

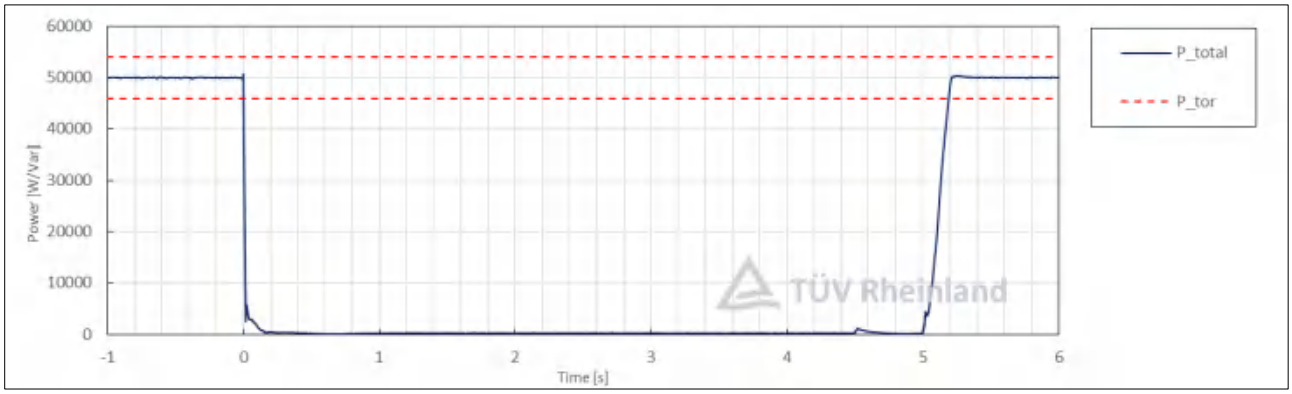

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

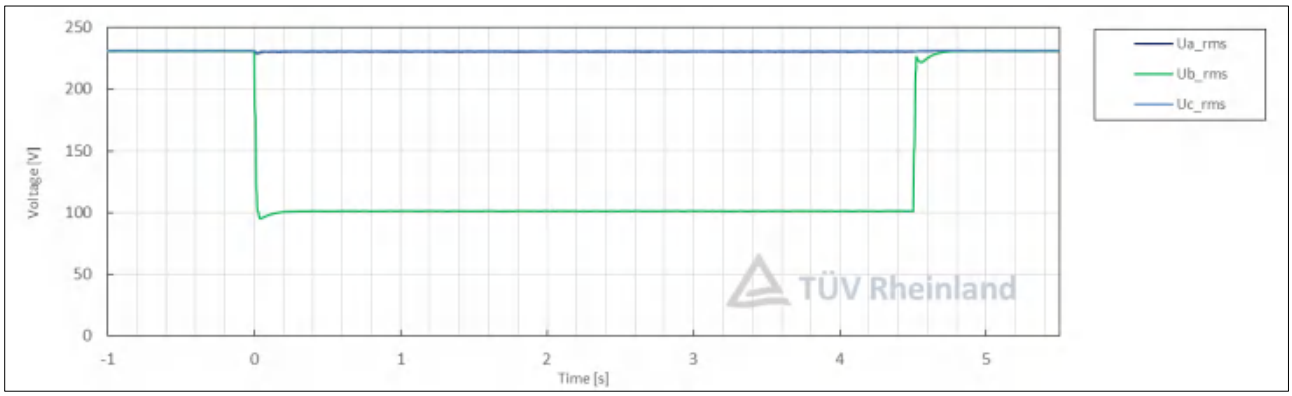

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

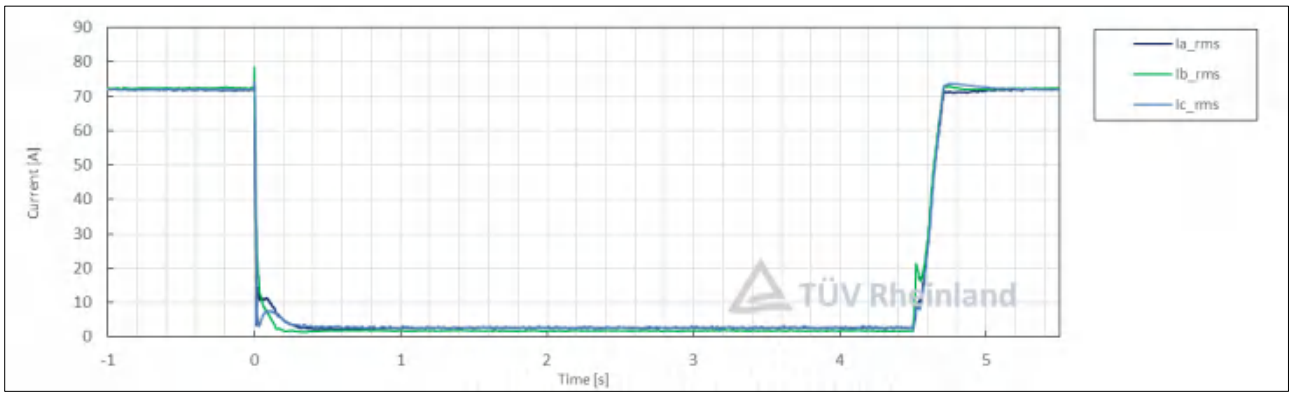

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

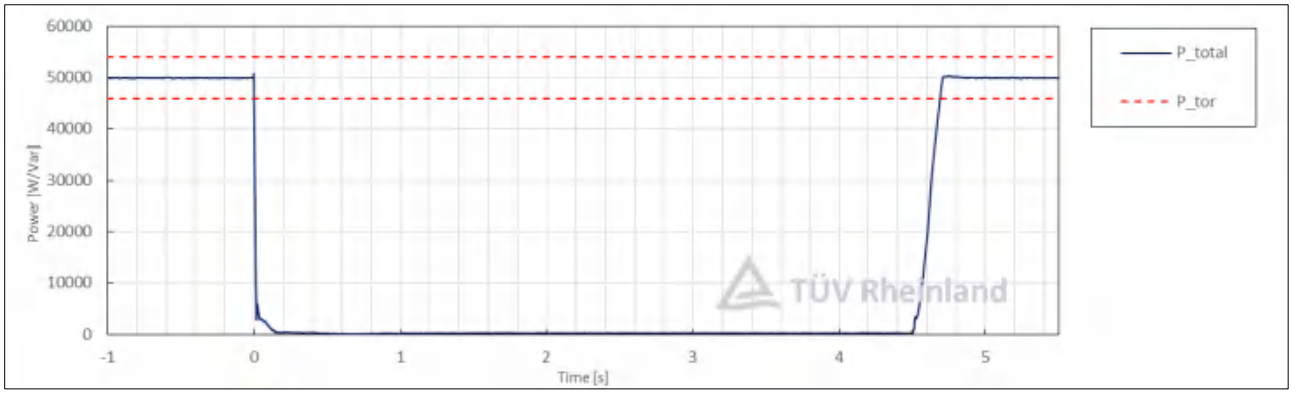

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

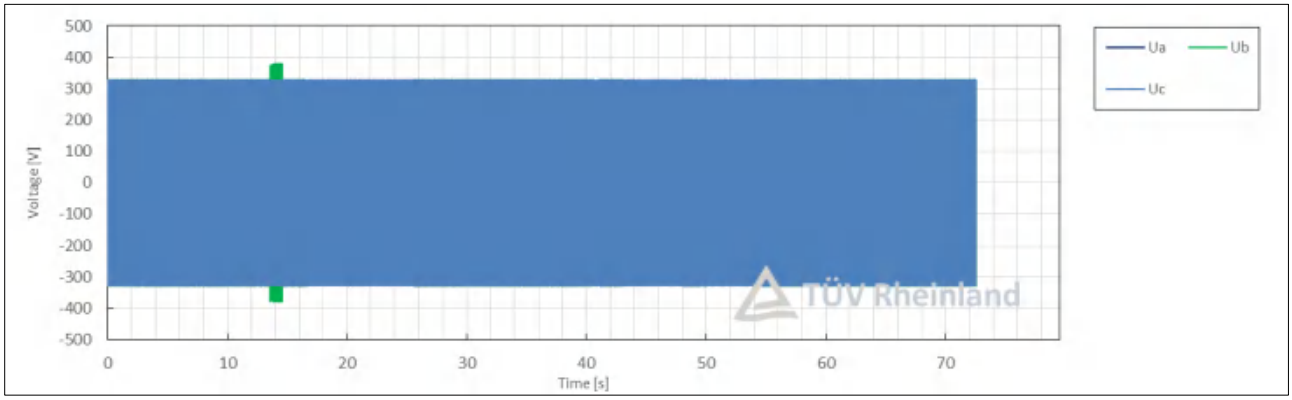

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

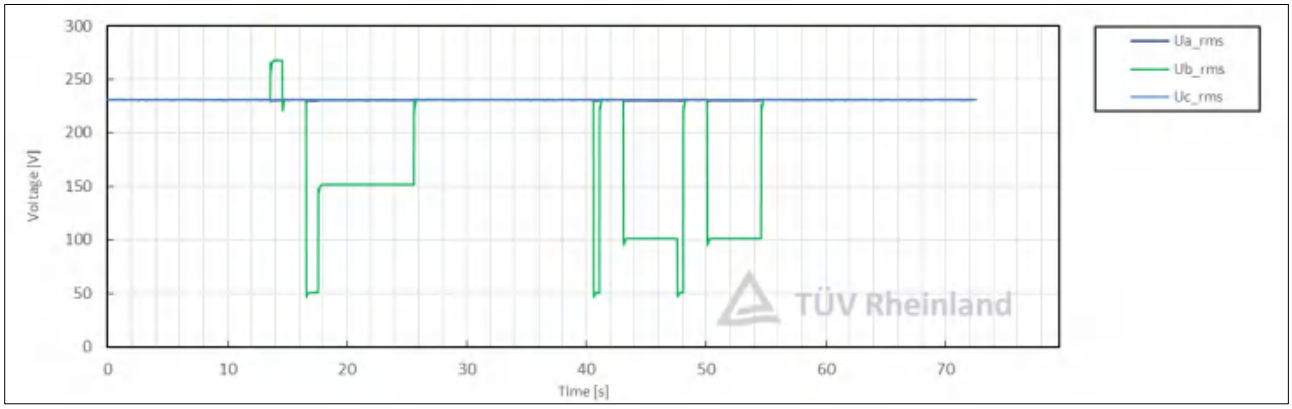


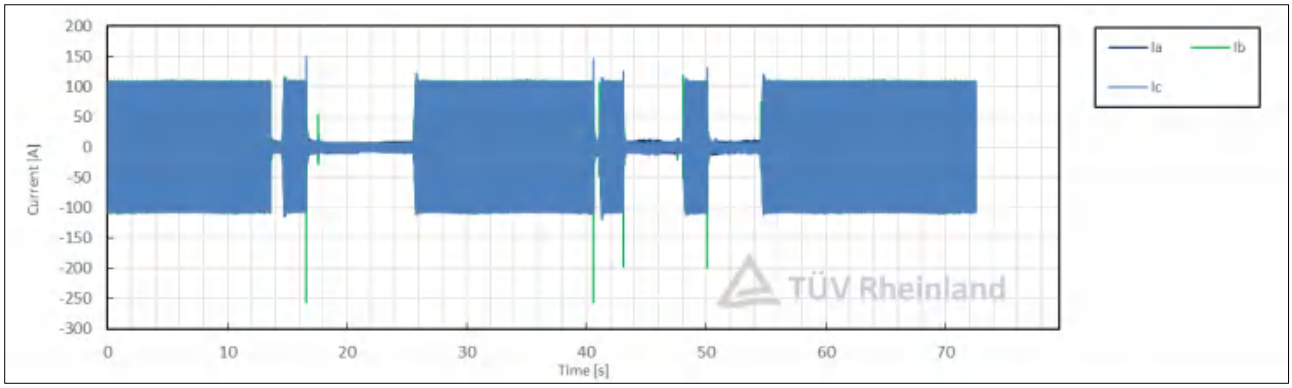
Phase L2							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.4
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.66	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

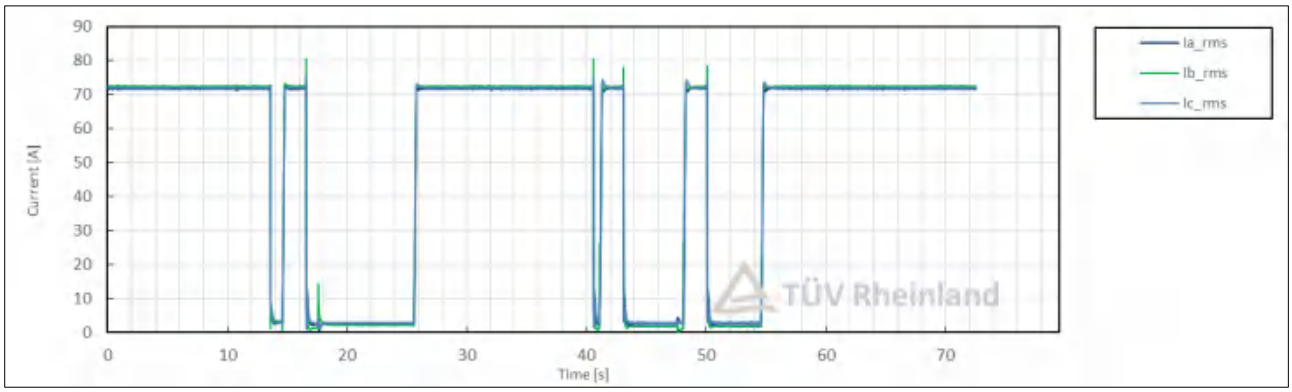
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.22	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

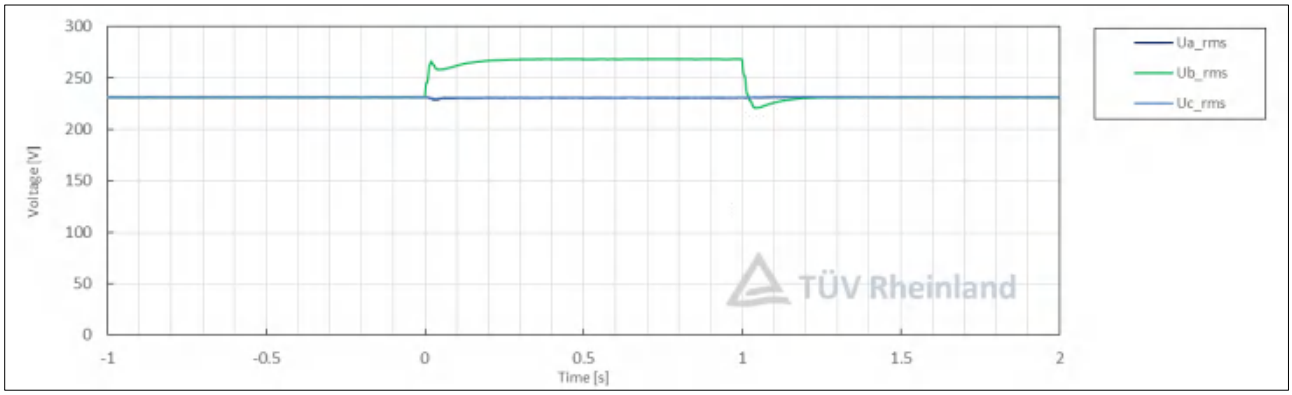
Diagram

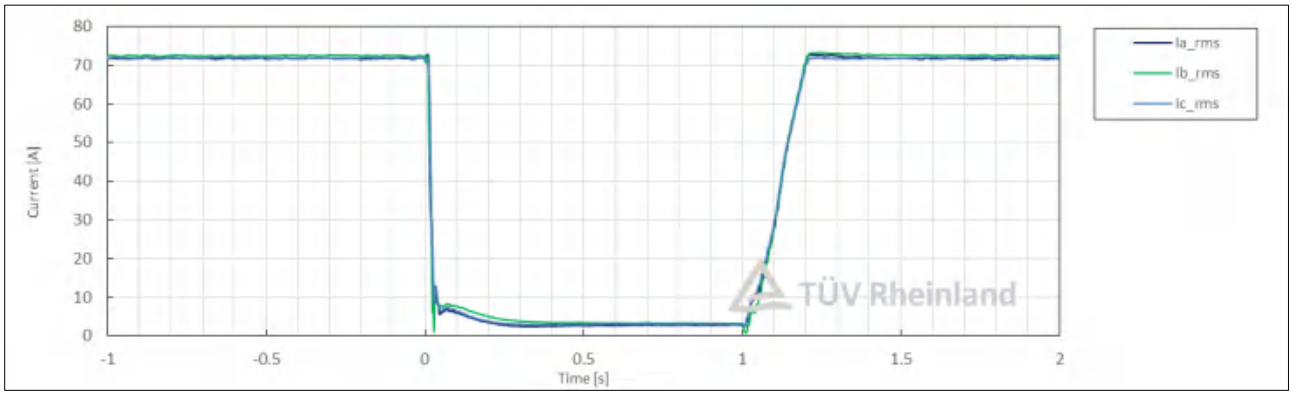


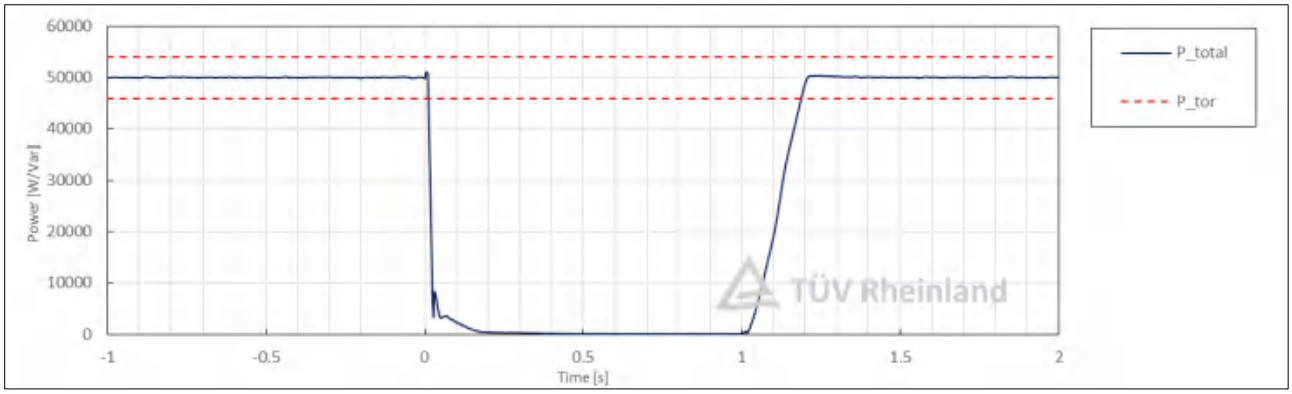



Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland


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


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


60000
50000
40000
30000
20000
10000
0
Power [W/Var]
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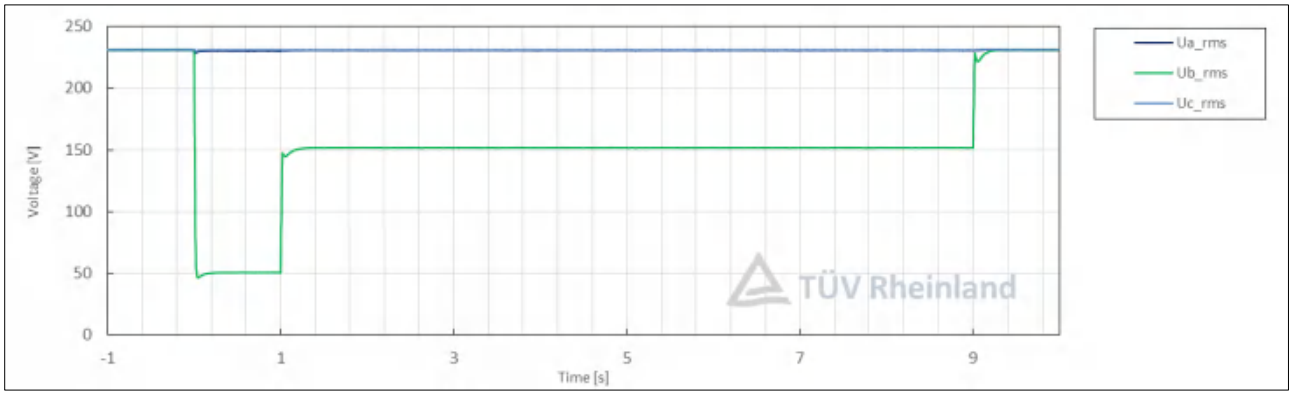
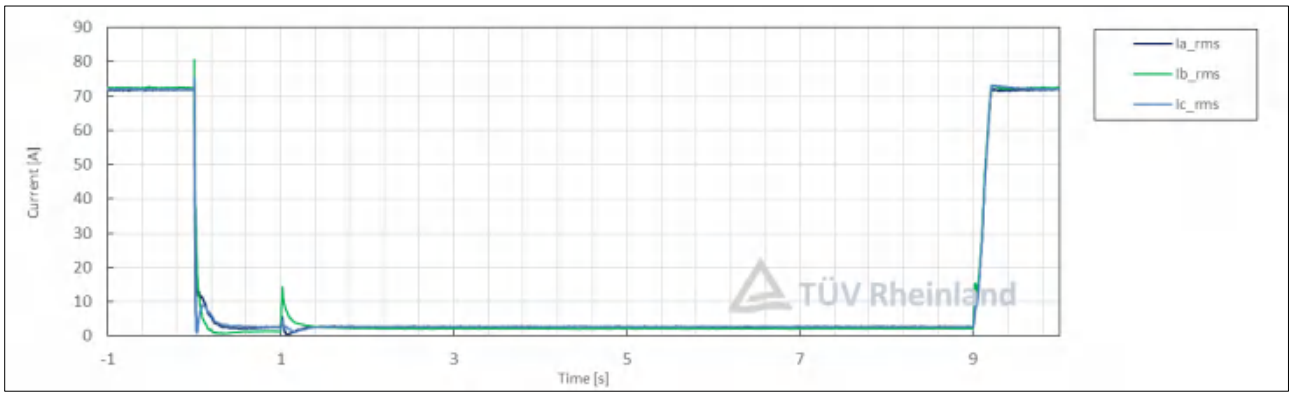
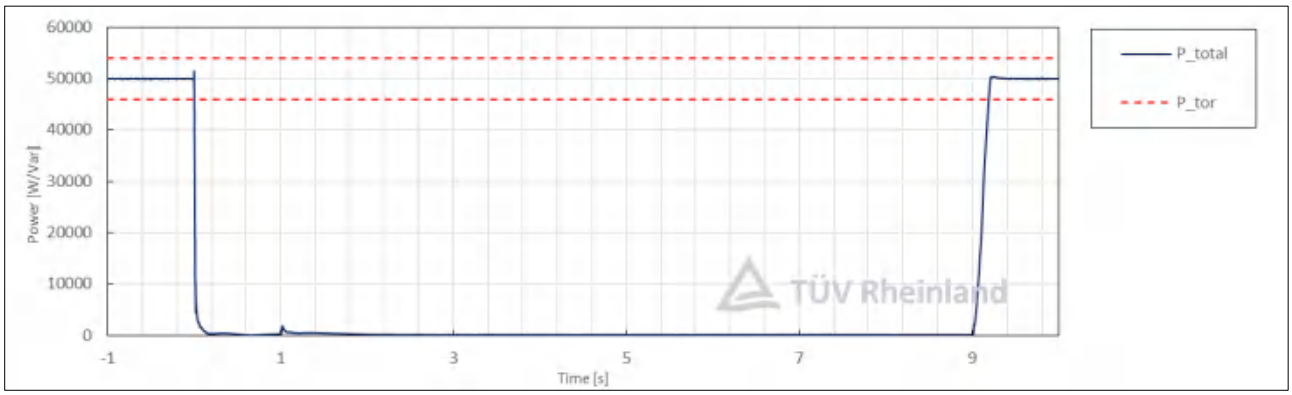
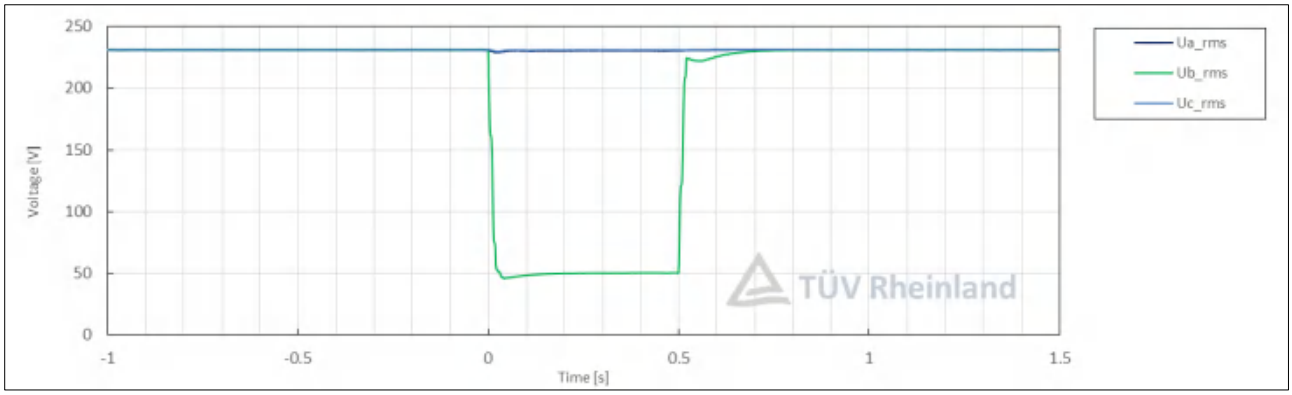
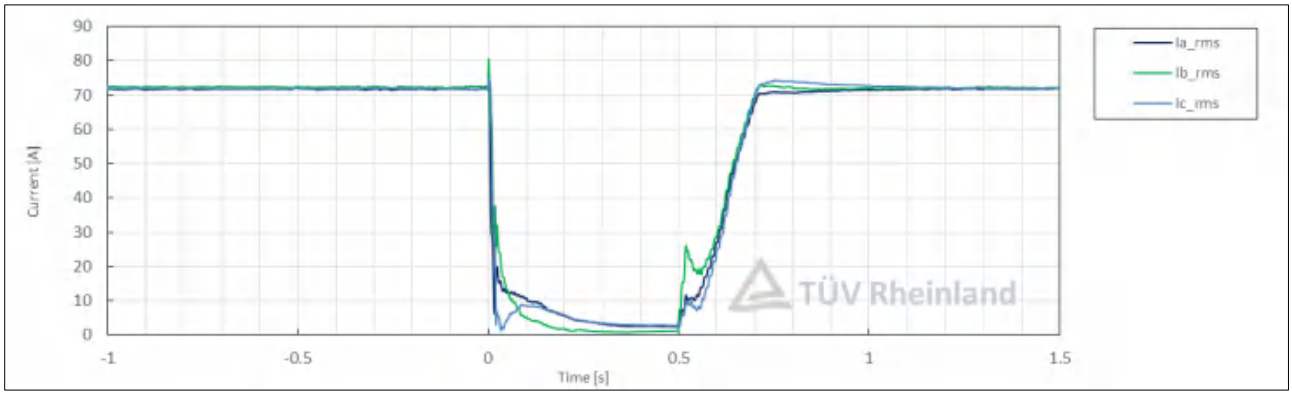
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

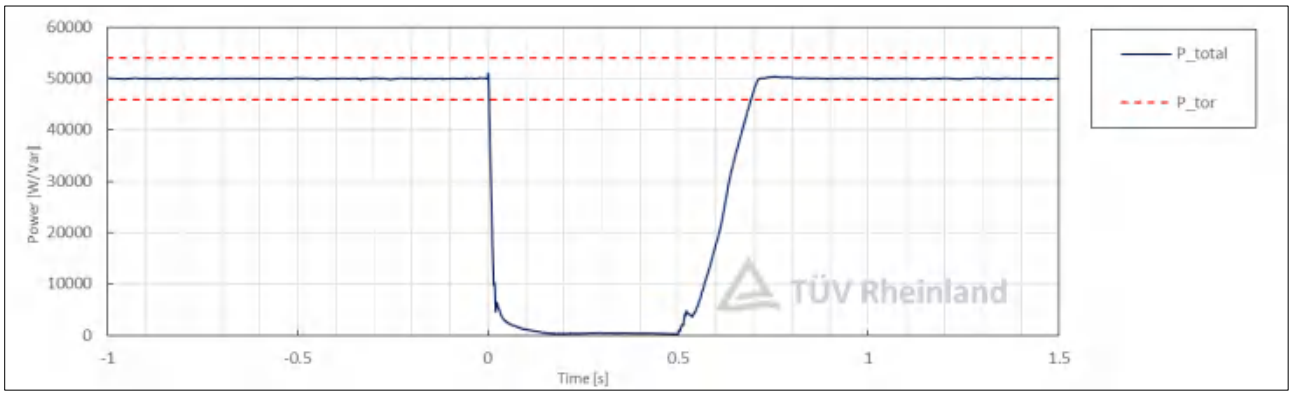

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

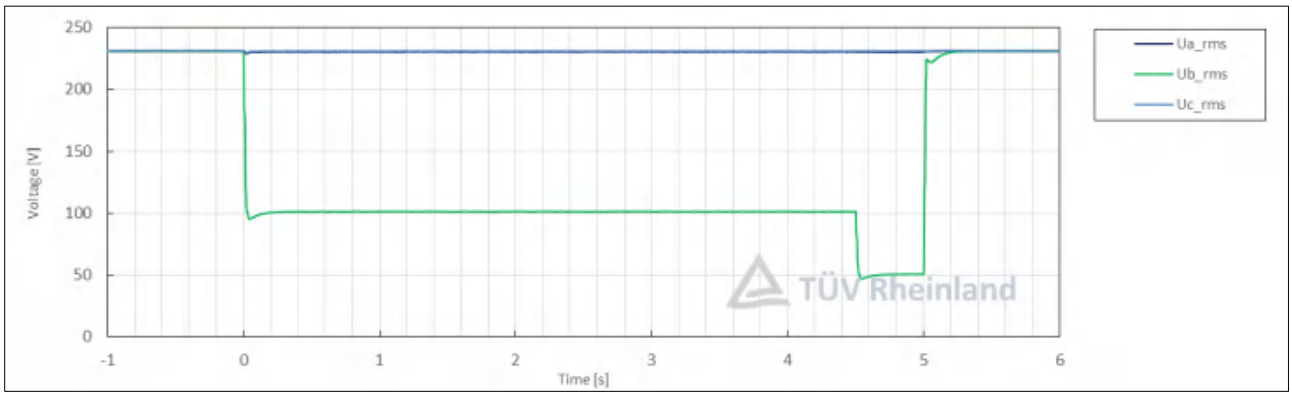

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

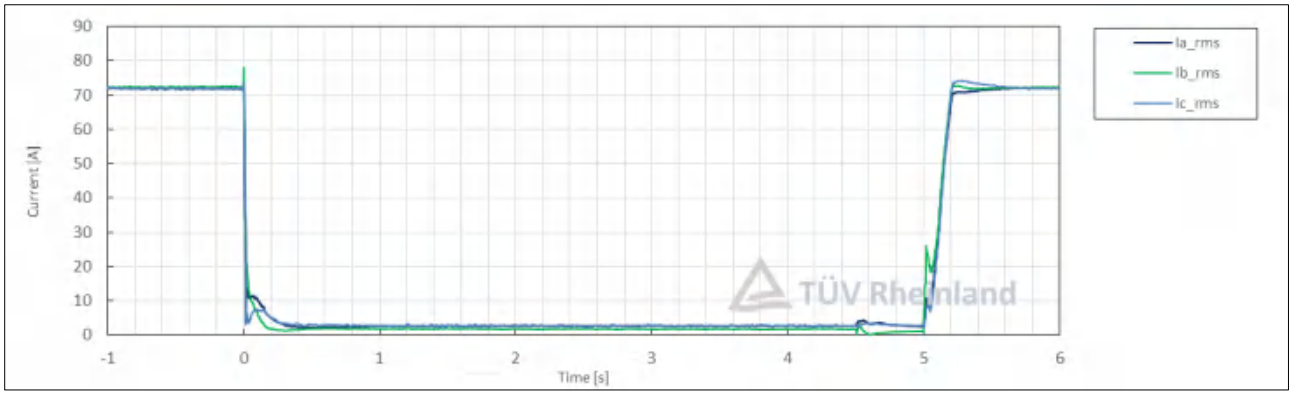

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

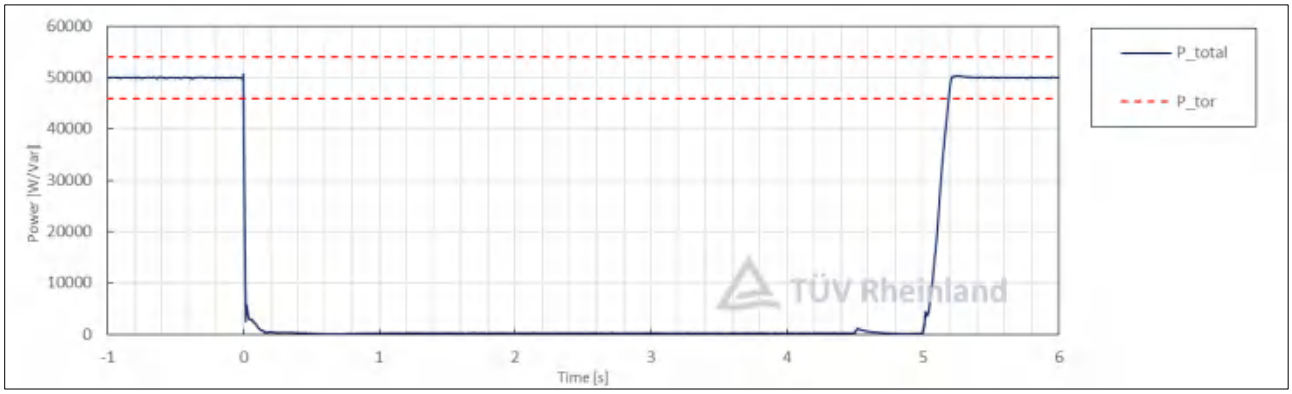

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

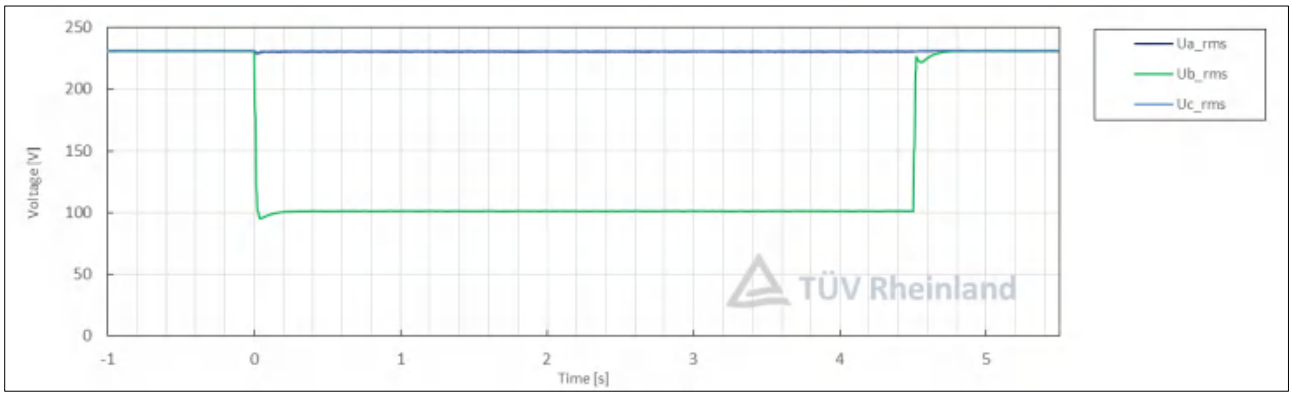

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

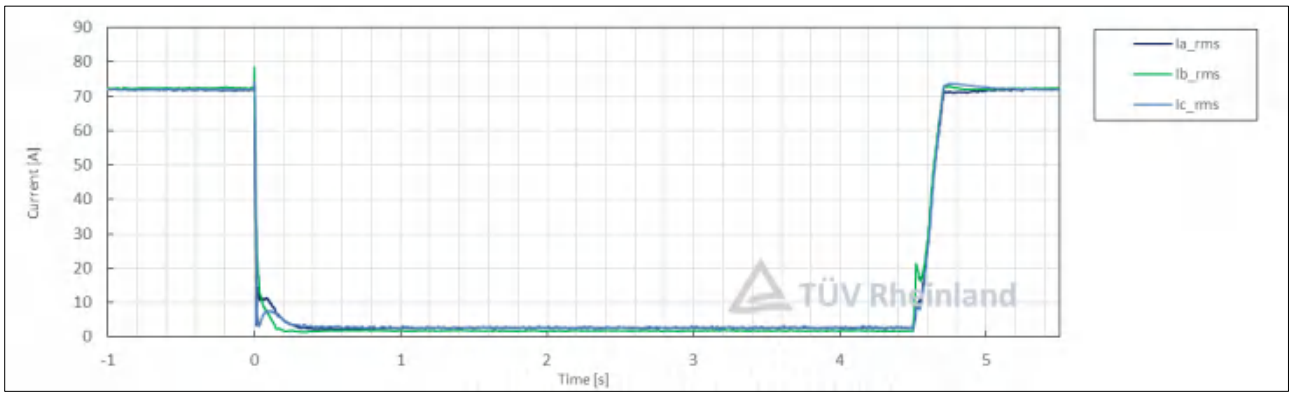

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

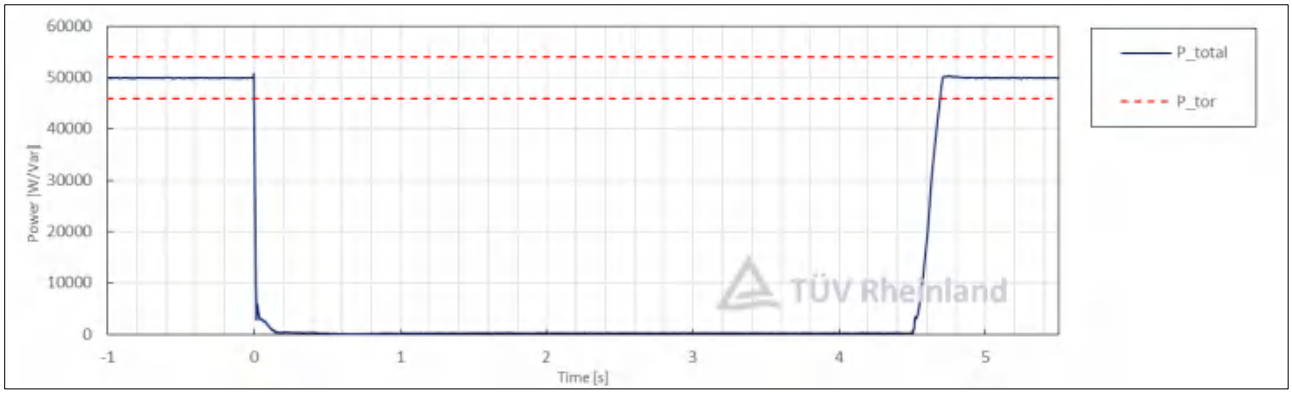

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

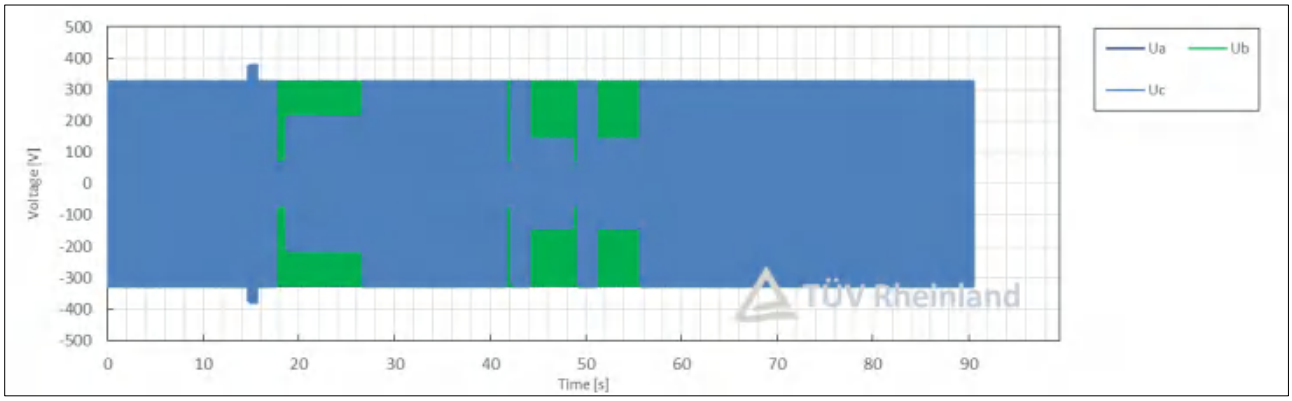

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

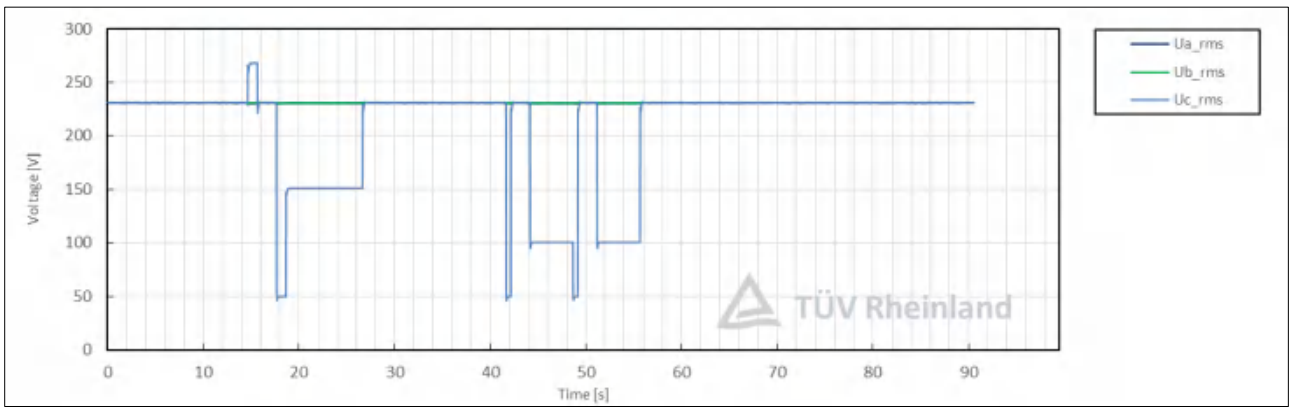


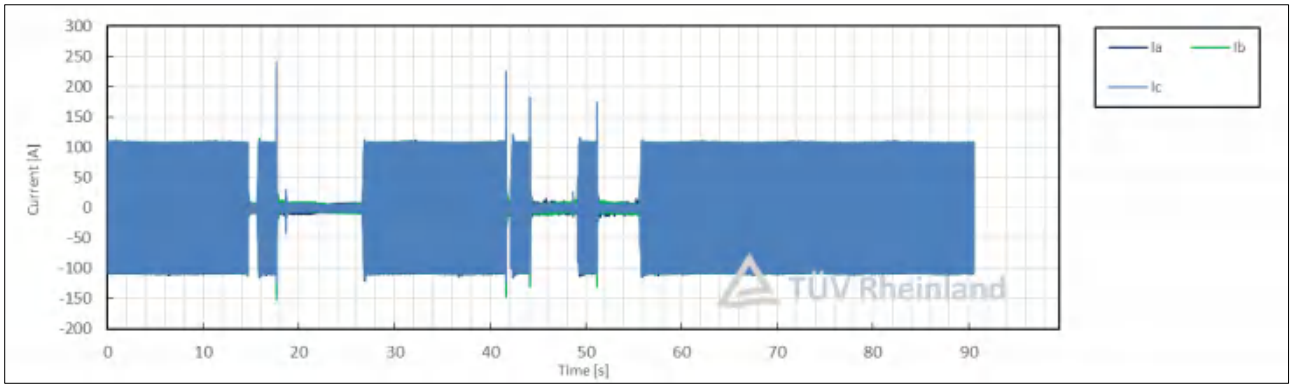
Phase L3							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

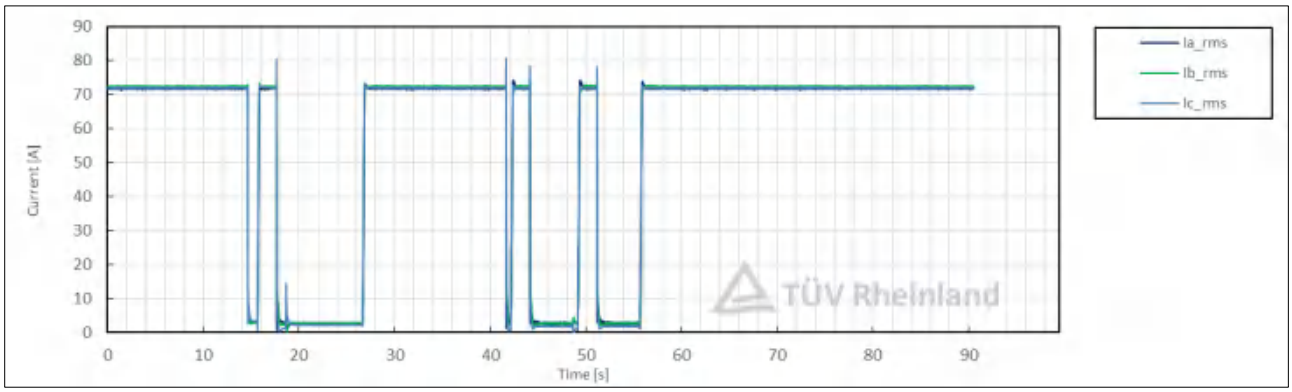
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

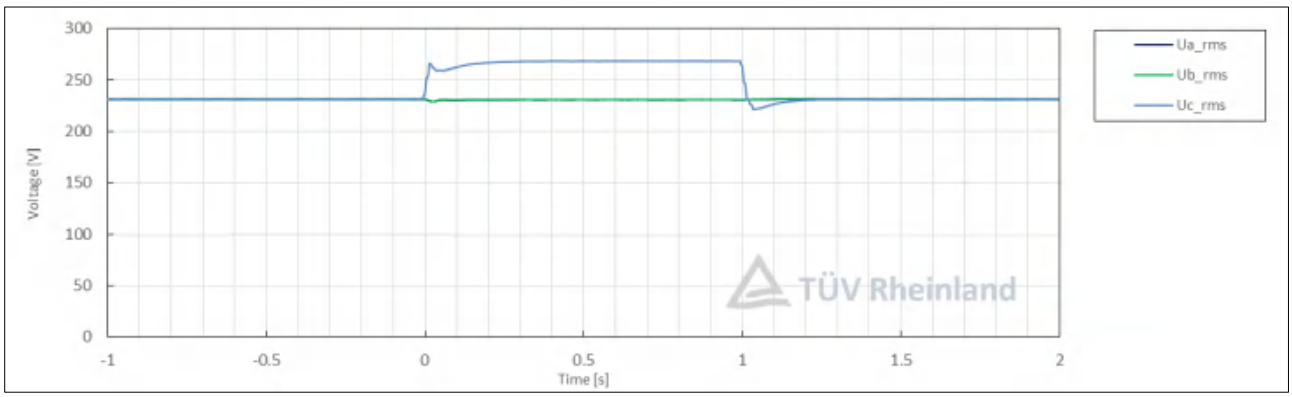
Diagram

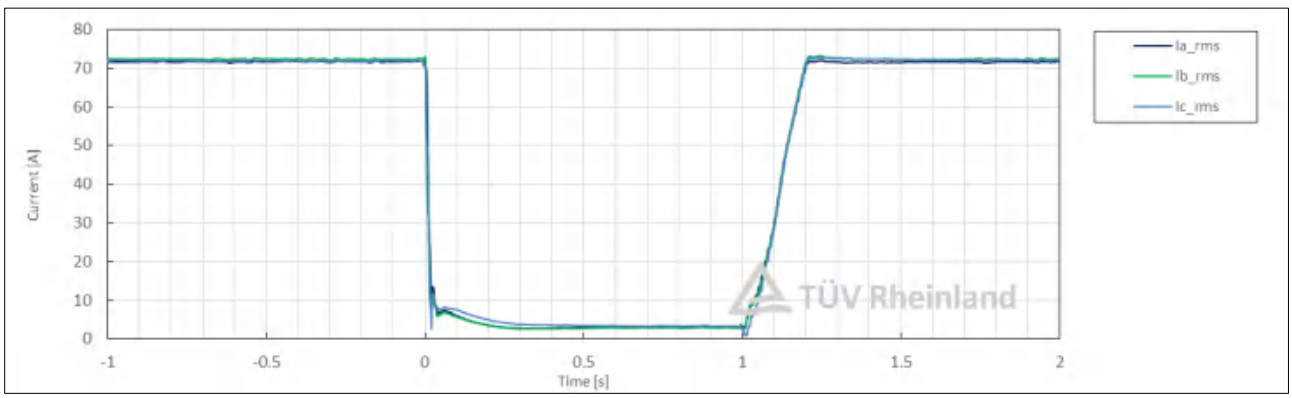


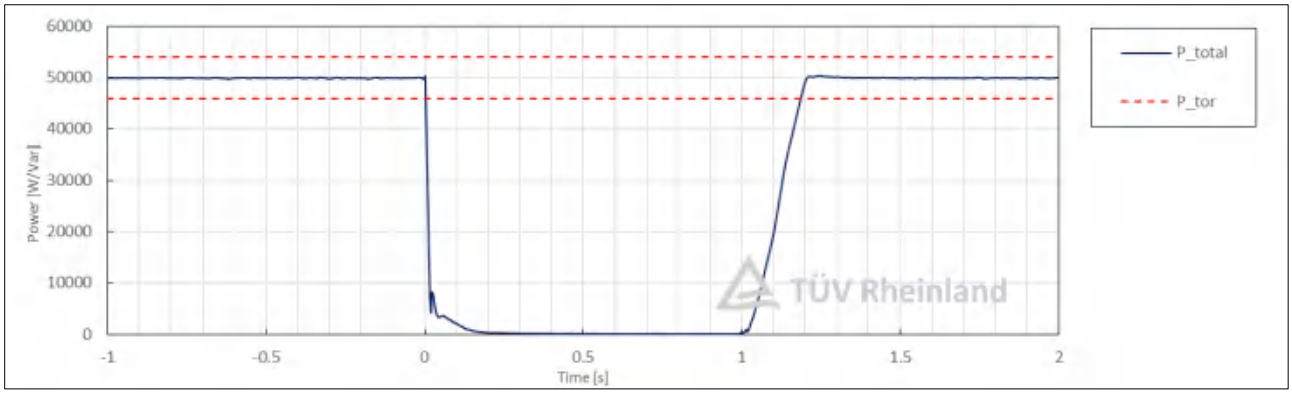



Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland


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


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


60000
50000
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30000
20000
10000
0
Power [W/Var]
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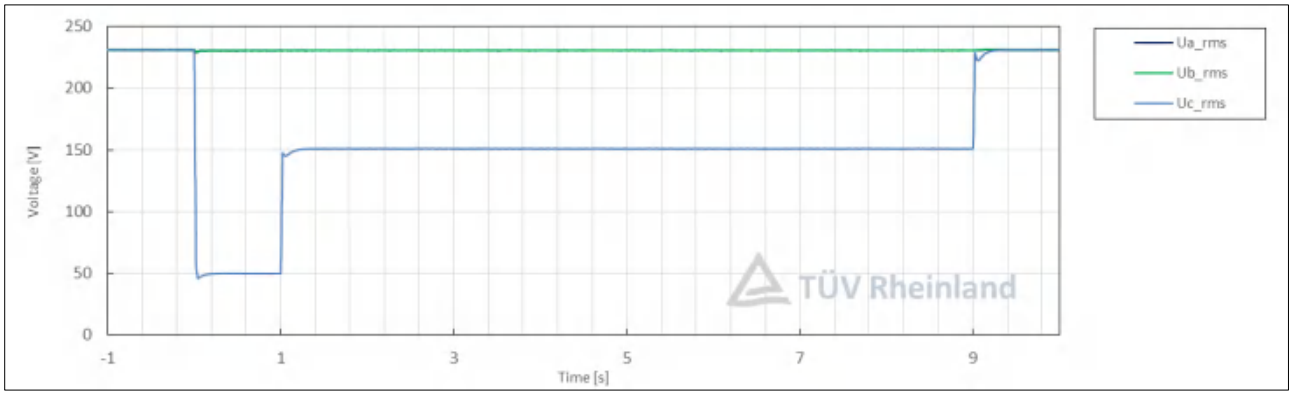
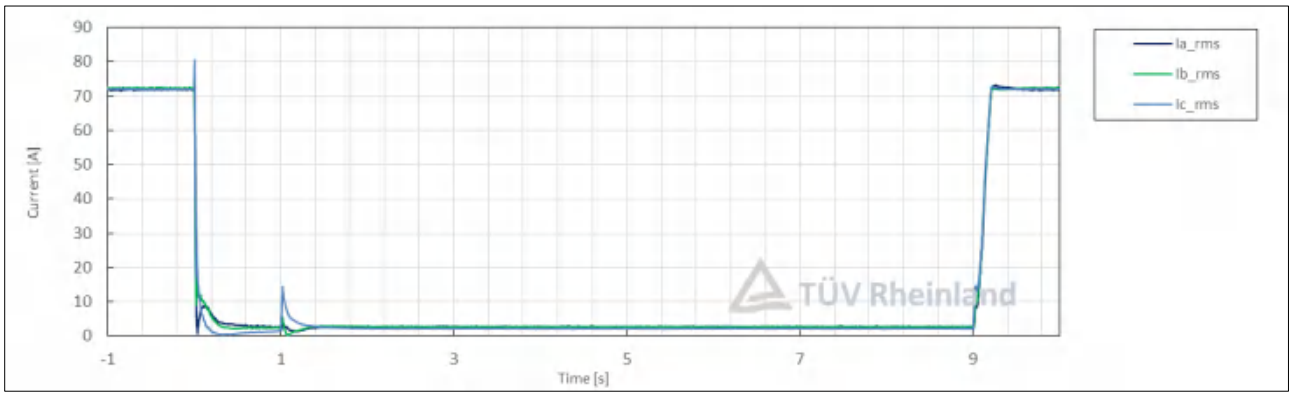
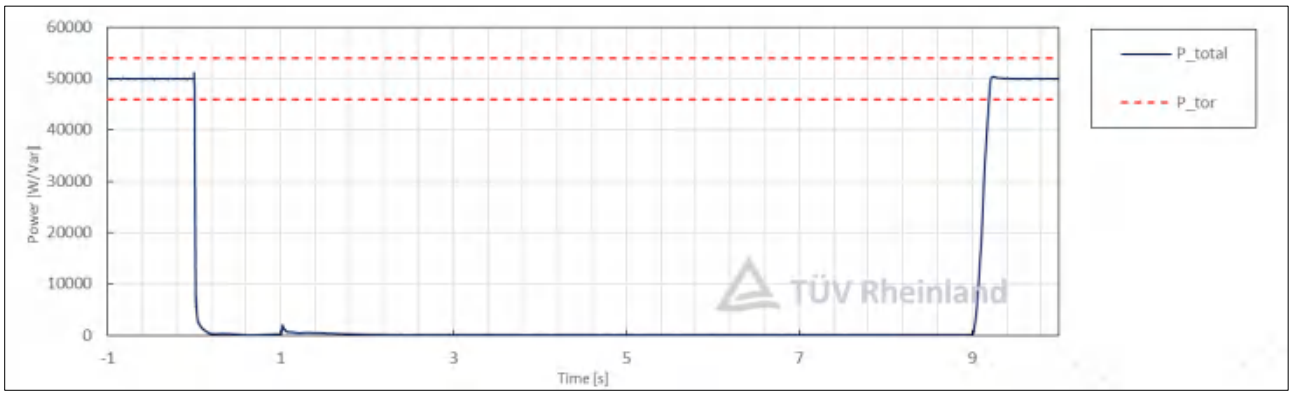
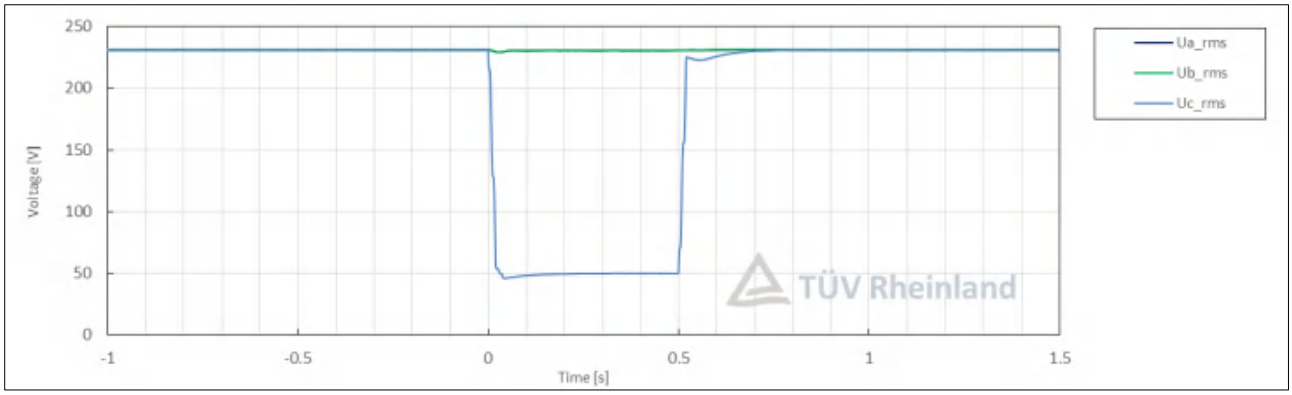
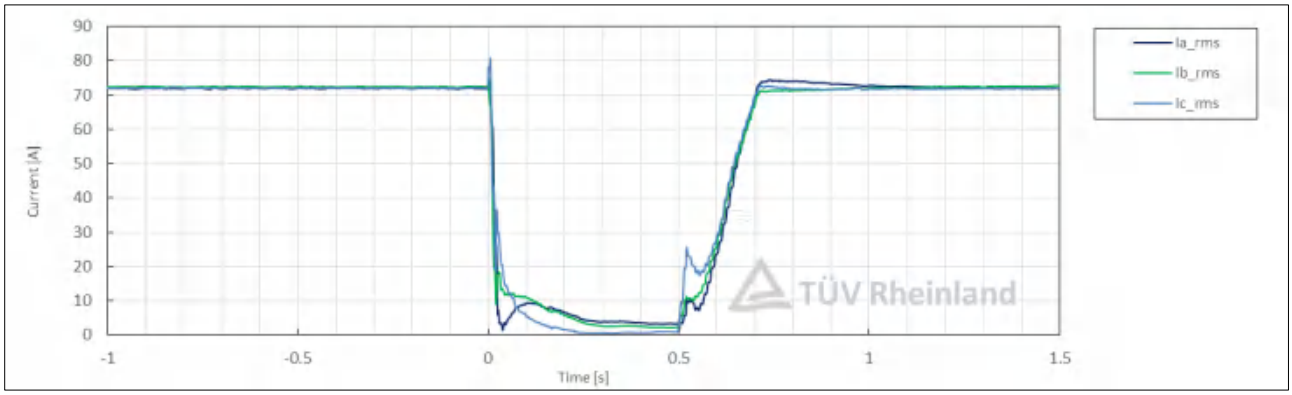
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

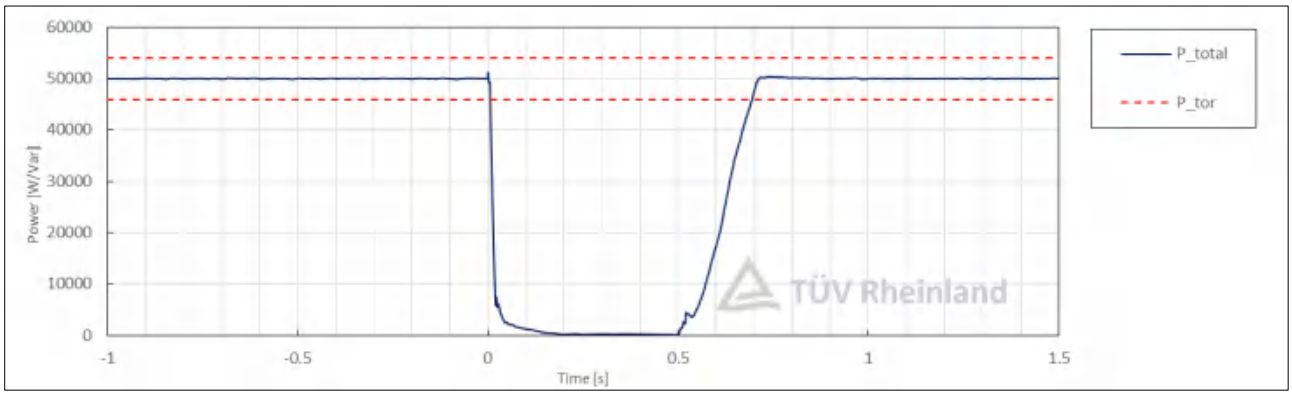

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

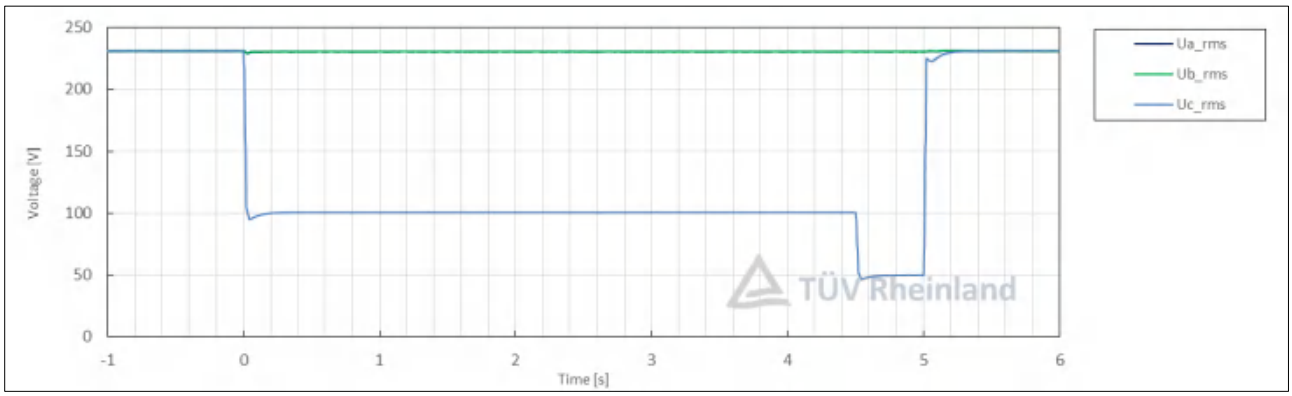

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

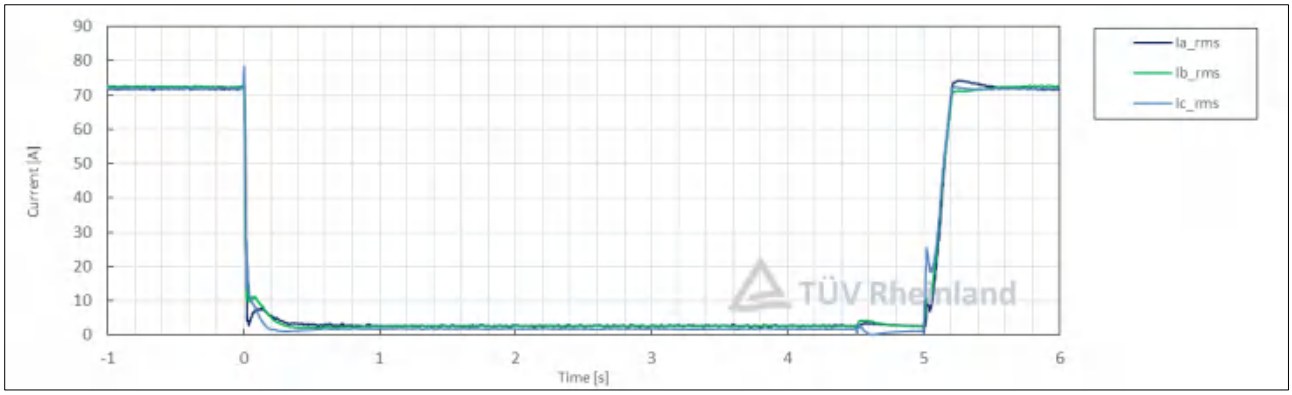

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

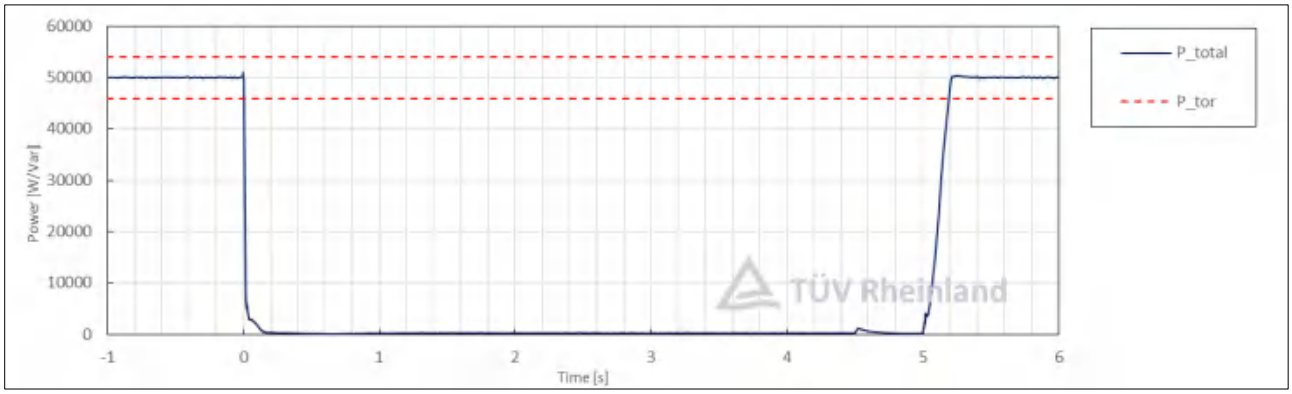

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

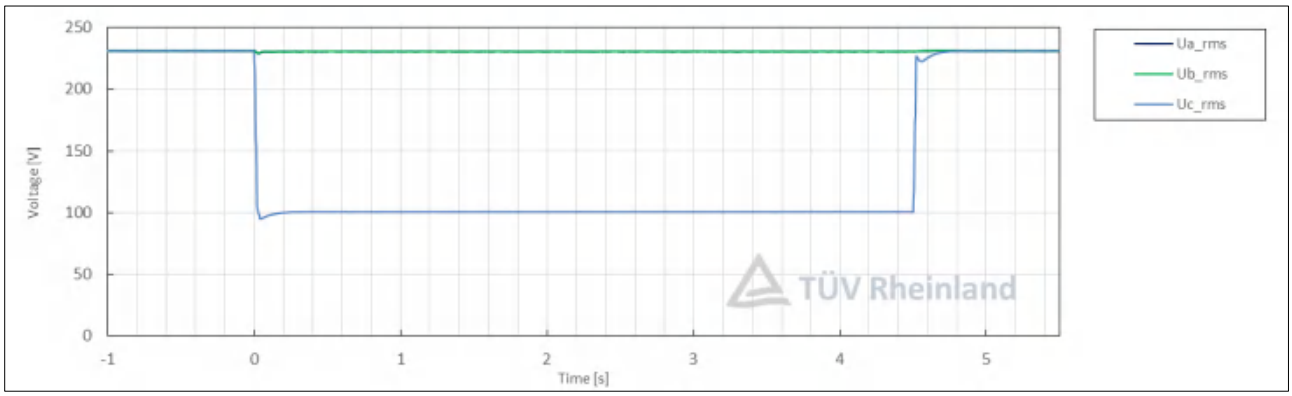

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

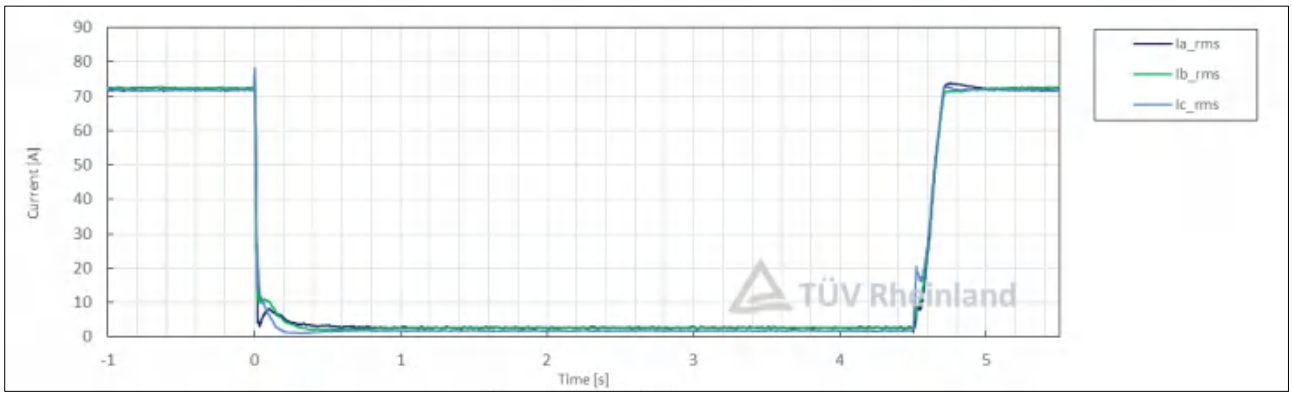

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

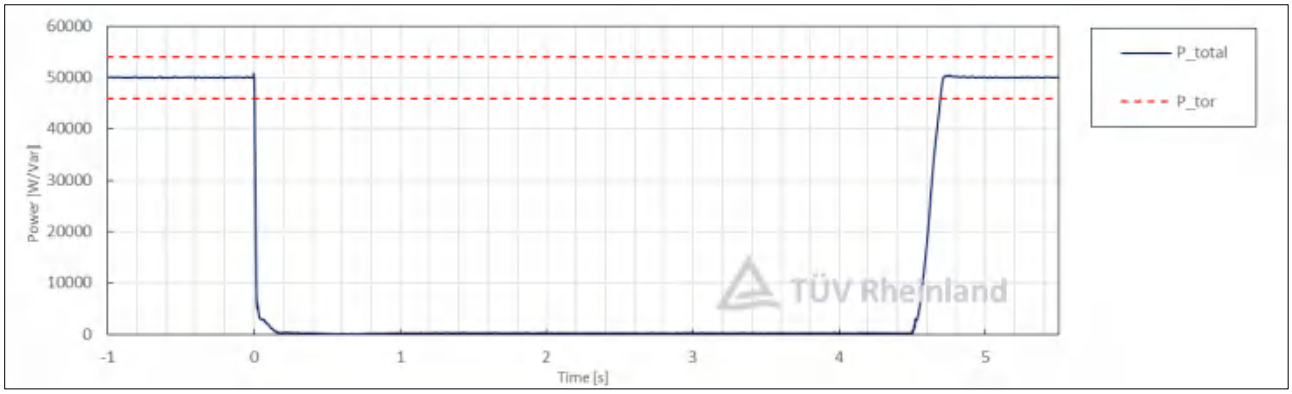

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

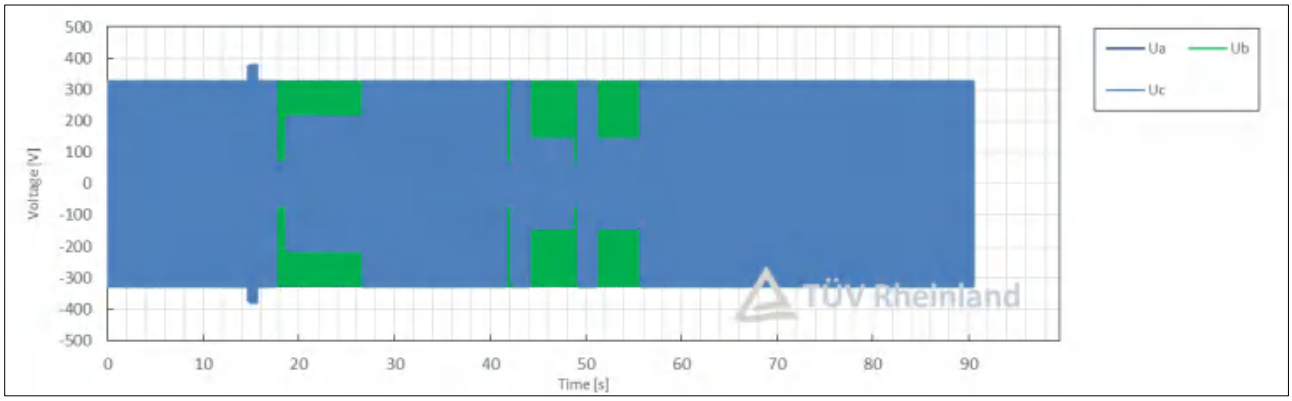

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

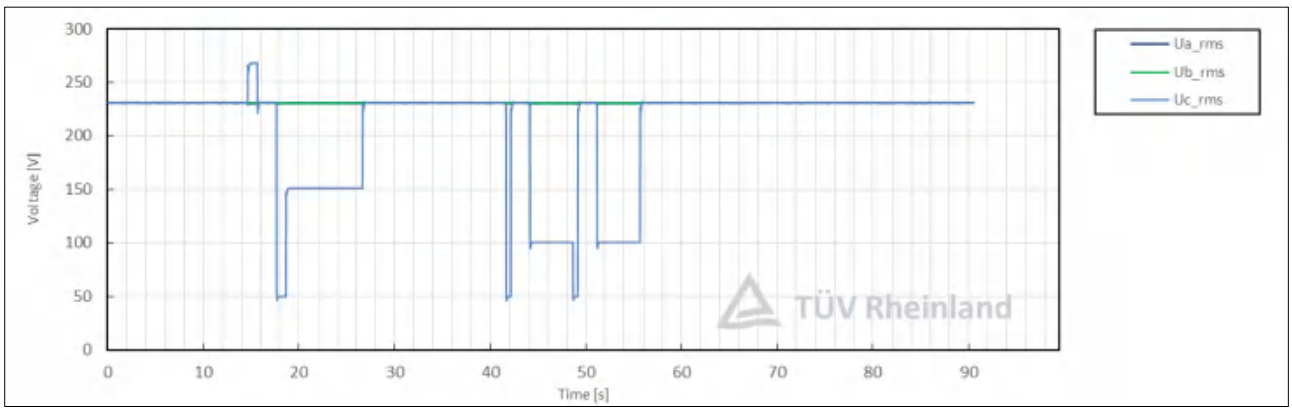


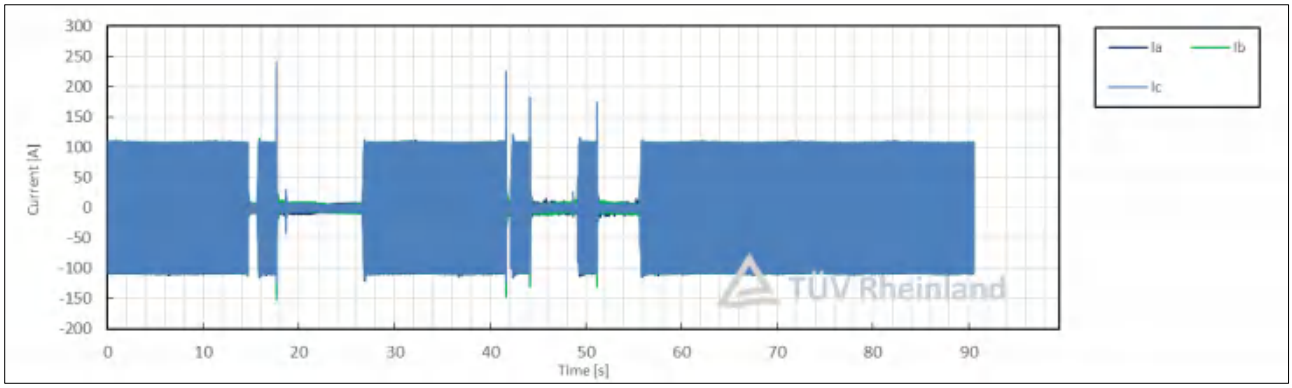
Phase L3							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

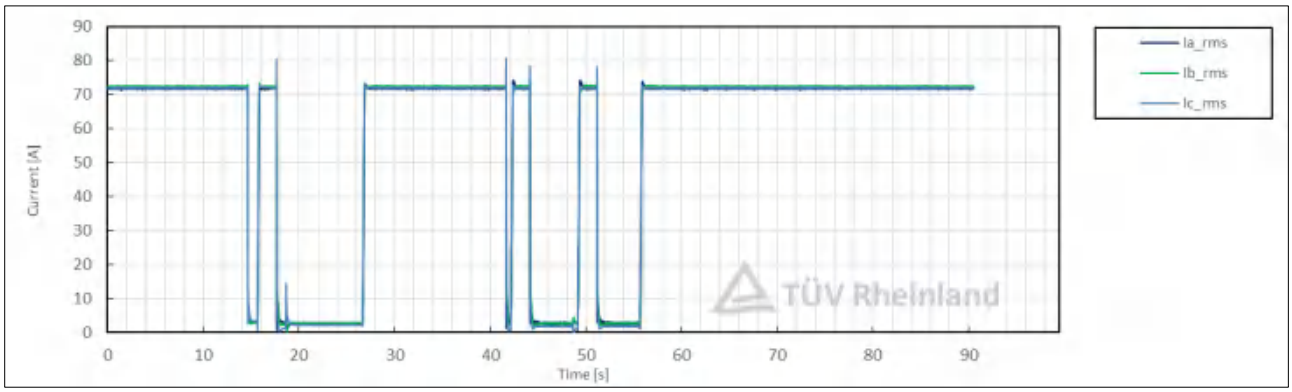
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

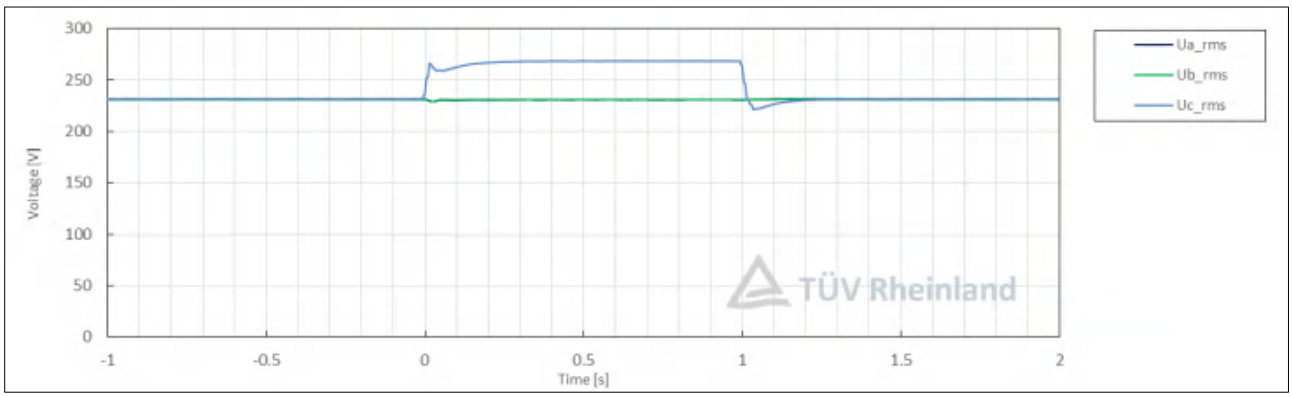
Diagram

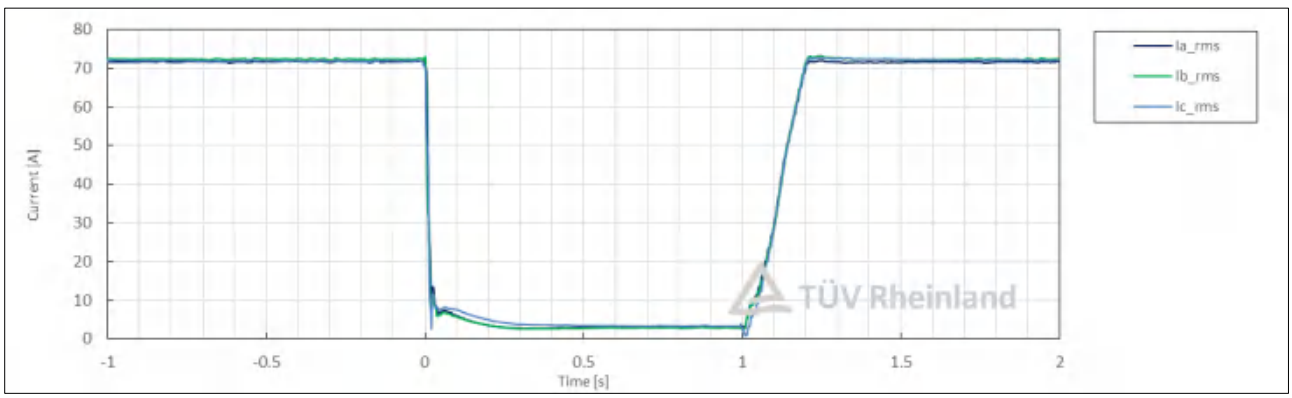


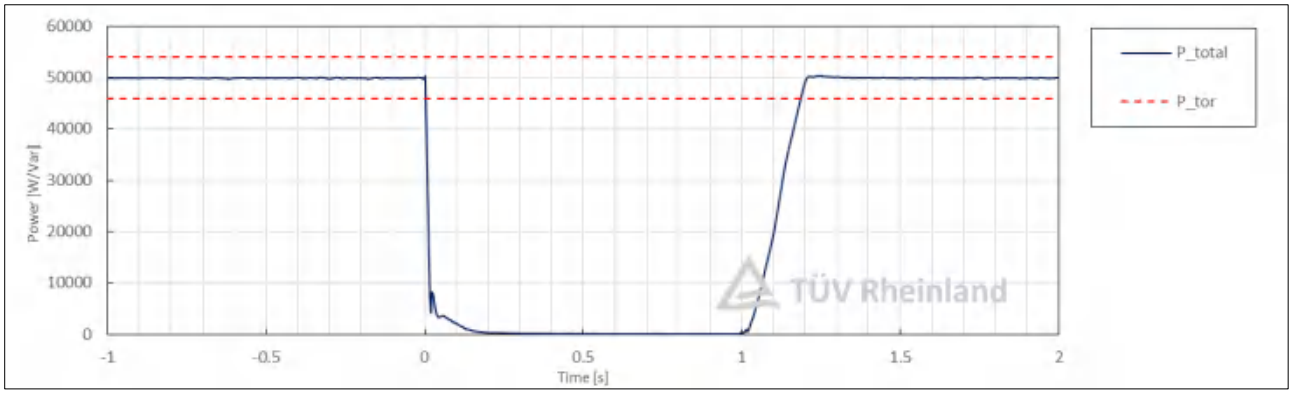


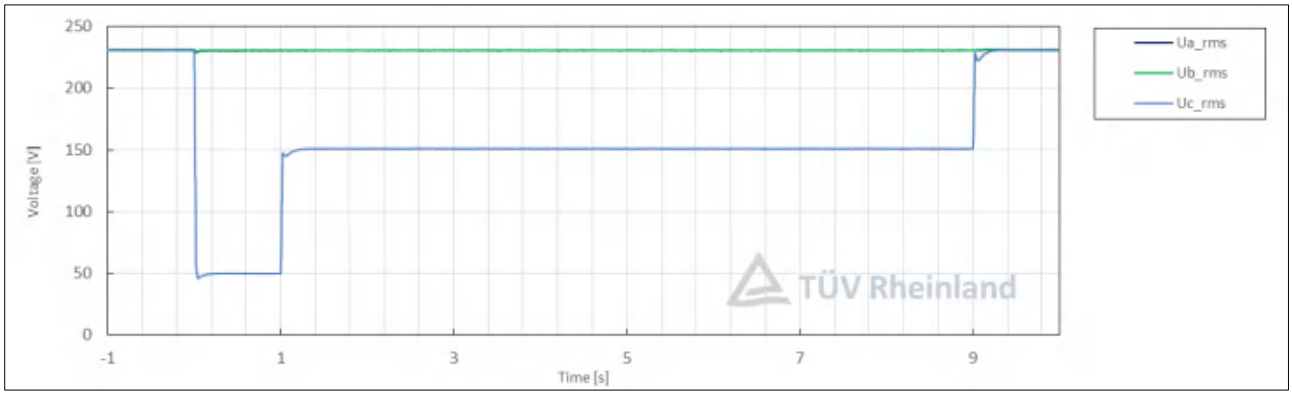

Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland

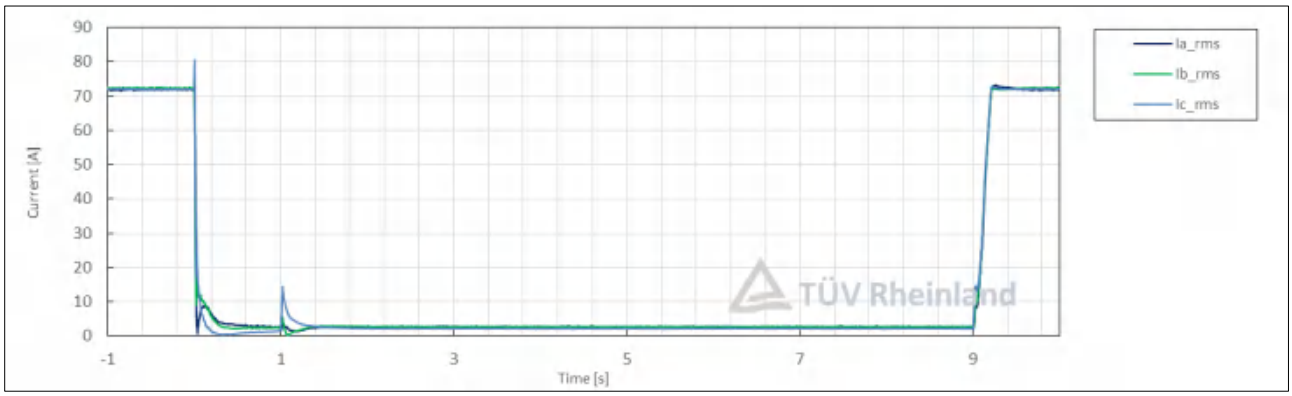

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

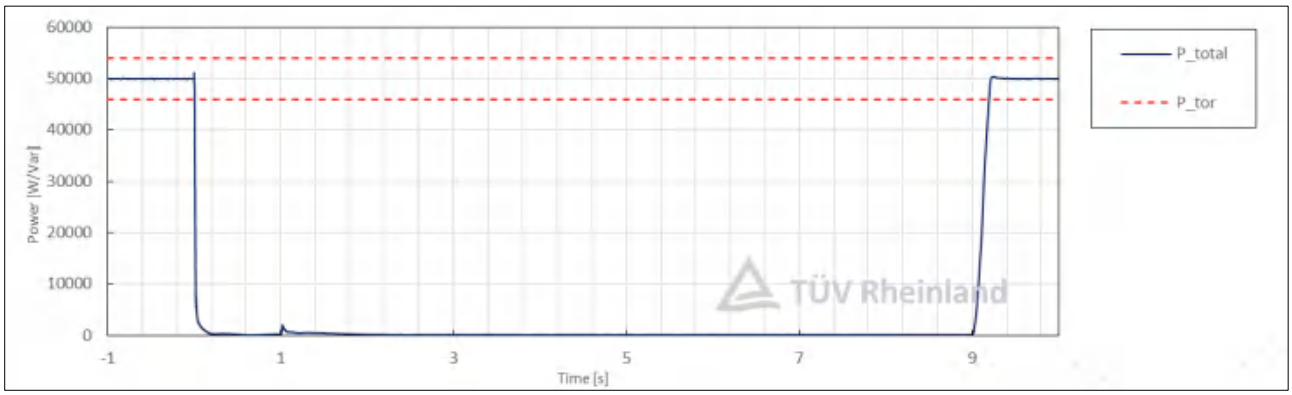

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

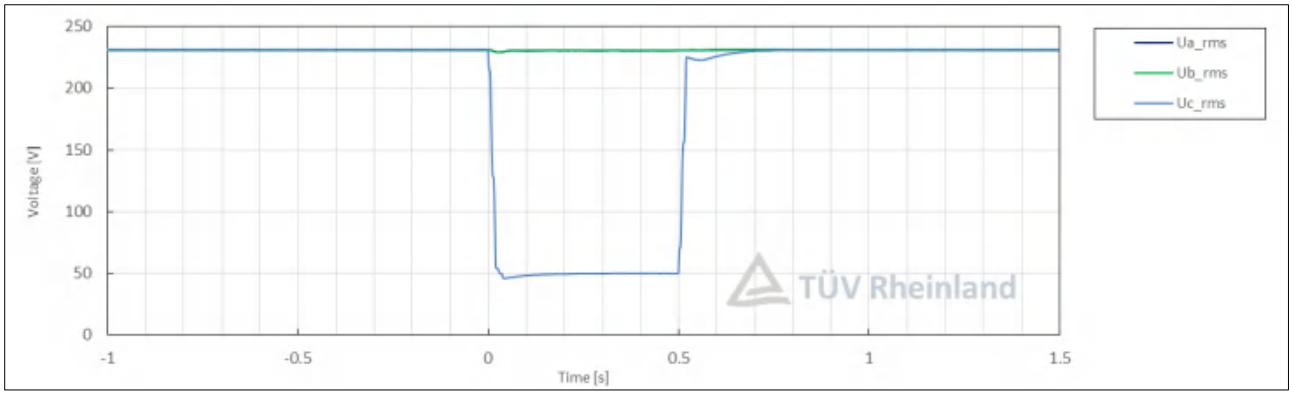

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

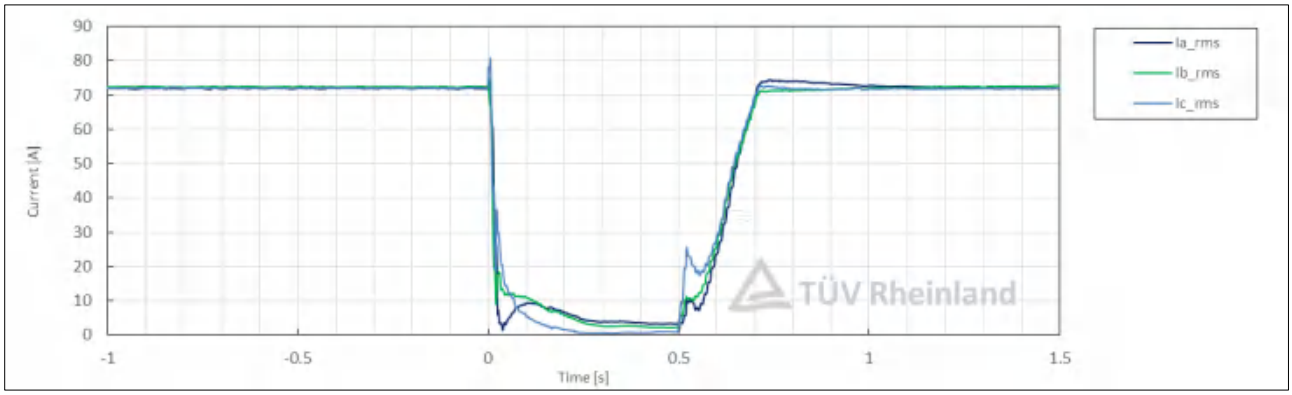

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

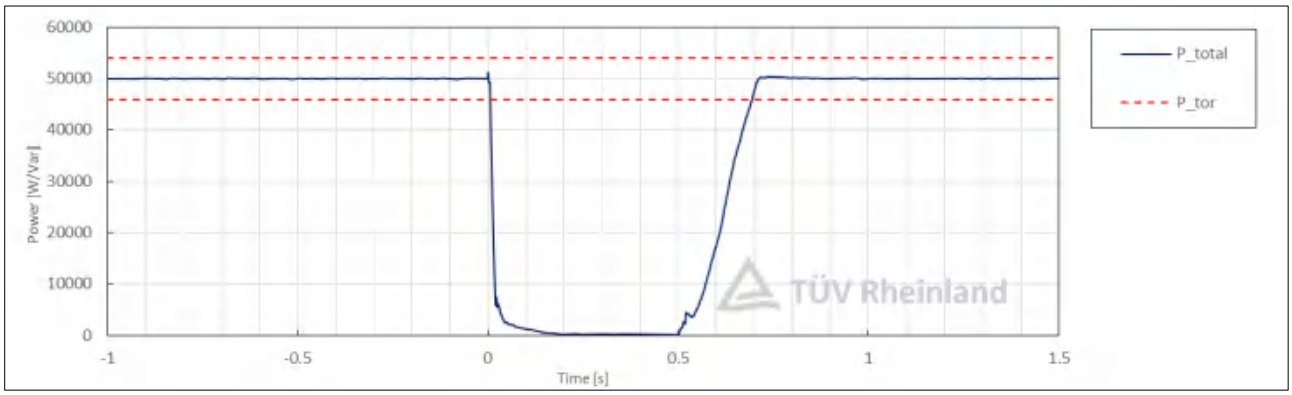

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

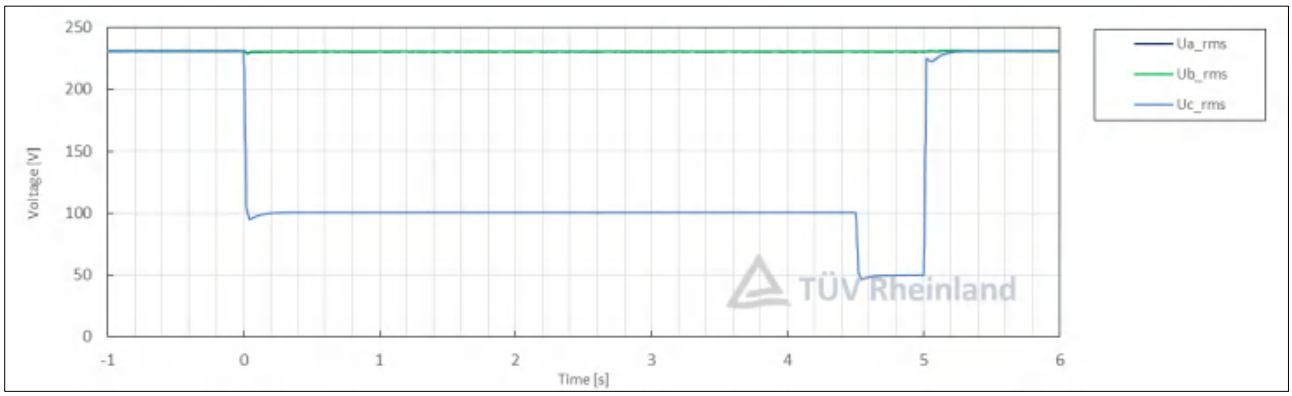

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

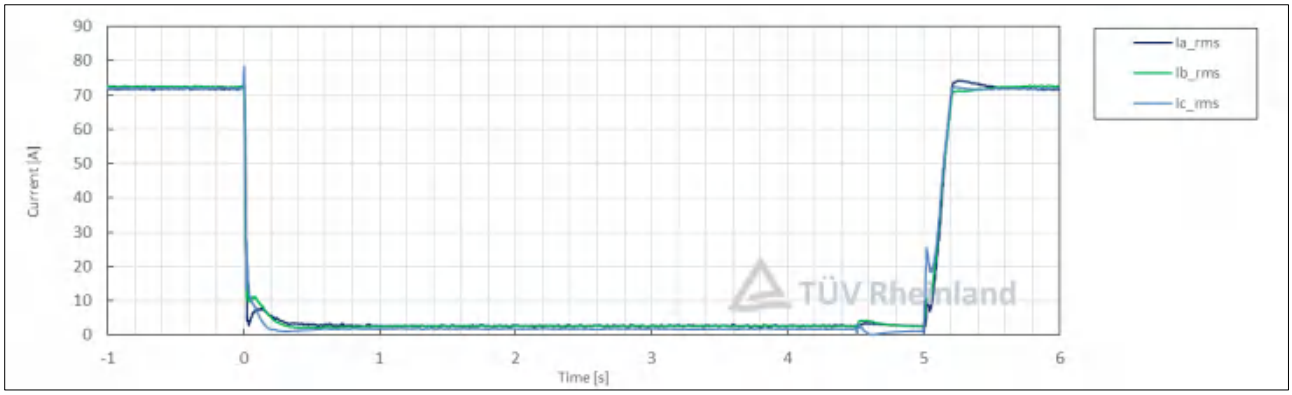

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

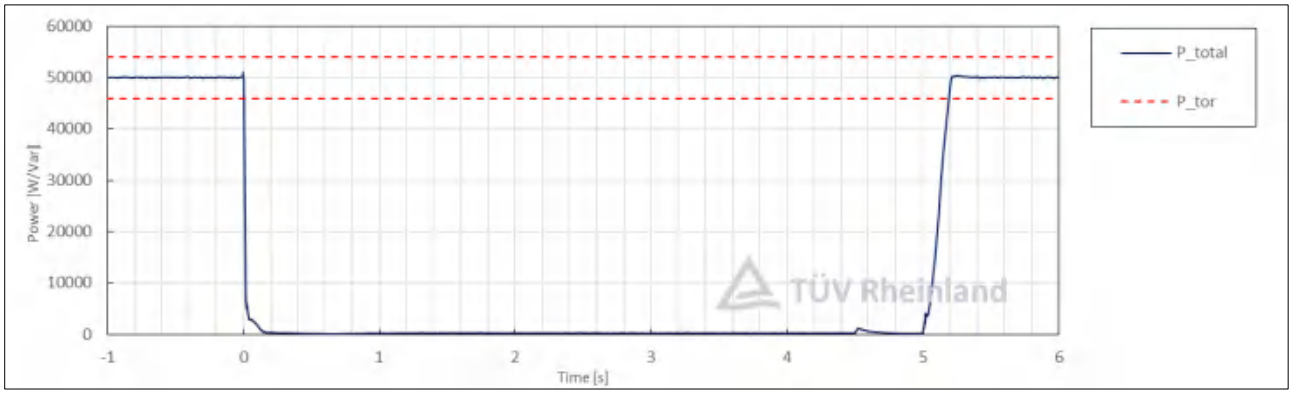

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

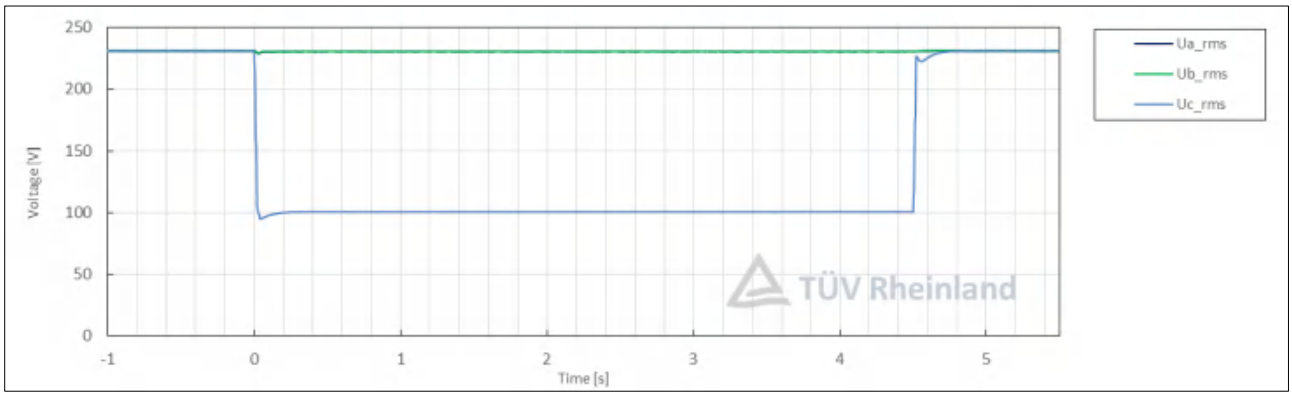

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

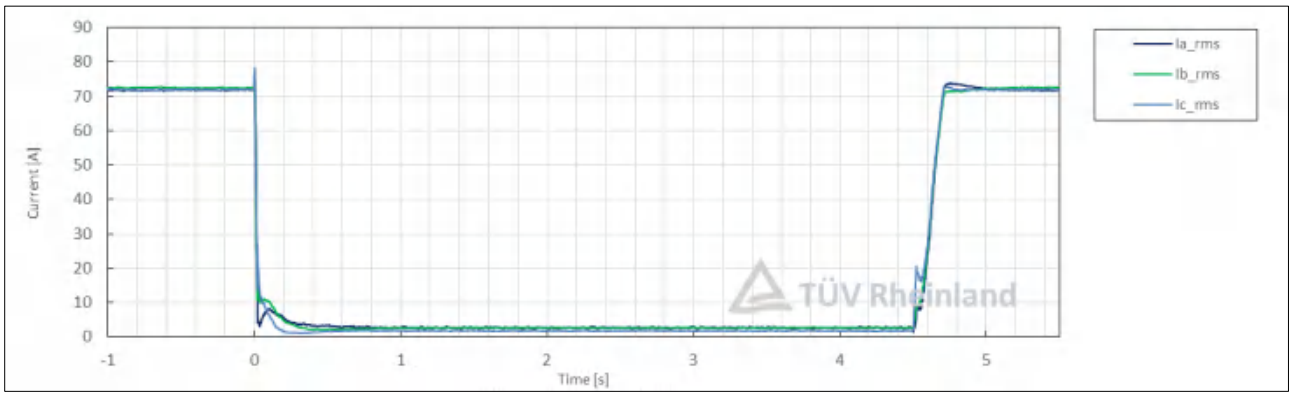

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

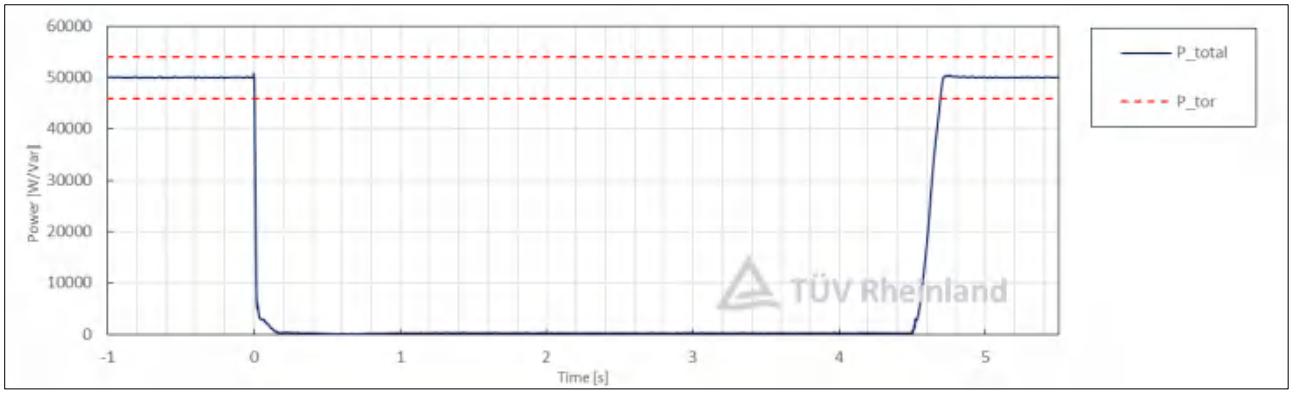

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

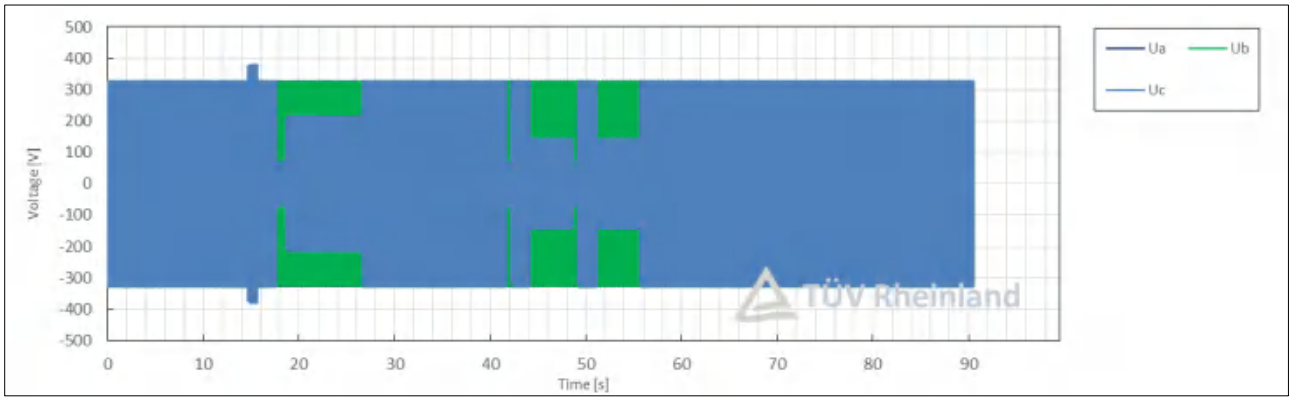

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

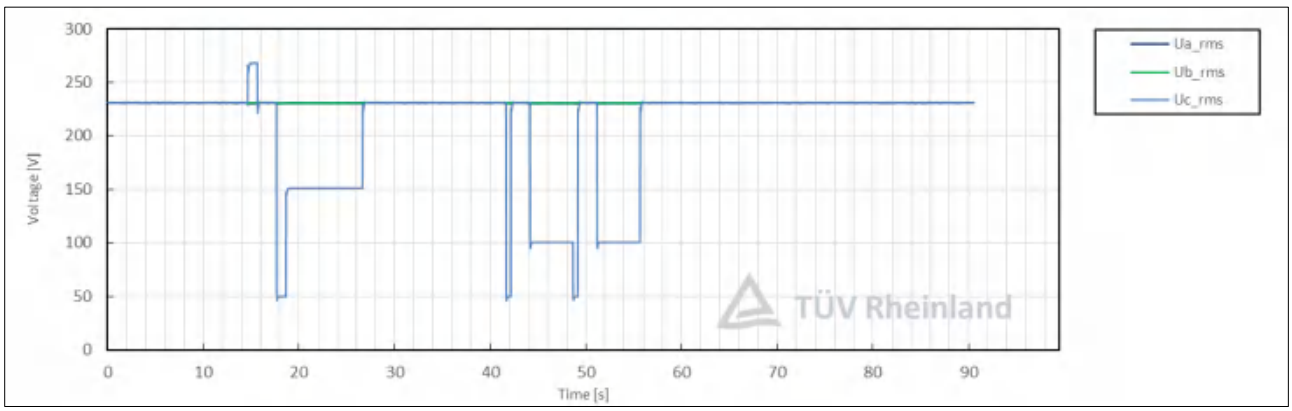


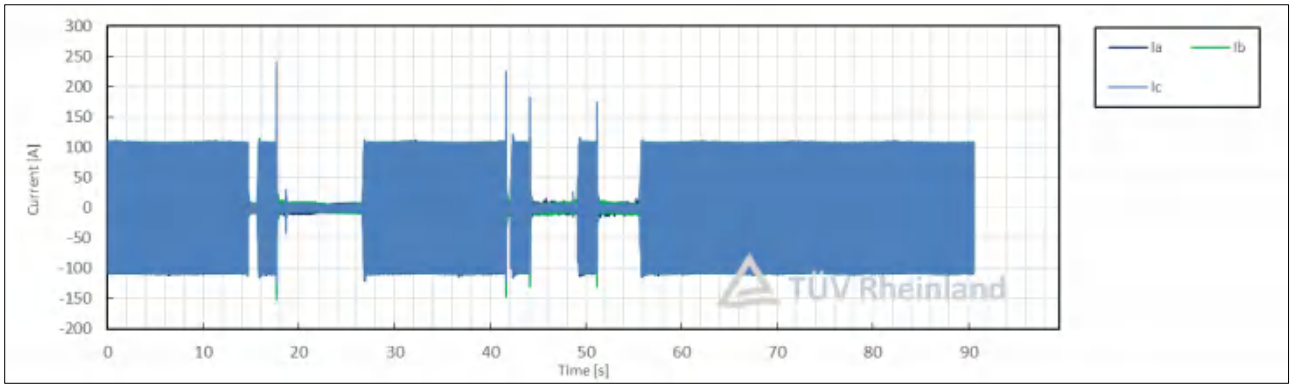
Phase L3							
Item	Duration	Parameter	Phase ref.	Time ref.	unit	Measure	Limit
Initial Status 230V	1s	Voltage	Line to neutral	--	p.u.	1.00	1.0(230V)
		Active power	Total	--	p.u.	0.50	0.5
1st voltage dip 267.5V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	1.13	1.163 (267.5V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0 (230V)
		Active power	Total		p.u.	0.50	0.46-0.54
2nd voltage dip 50V	1s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 150V	8s	Voltage	Line to neutral	200ms after dip recovery	p.u.	0.65	0.652 (150V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	15s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
3rd voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

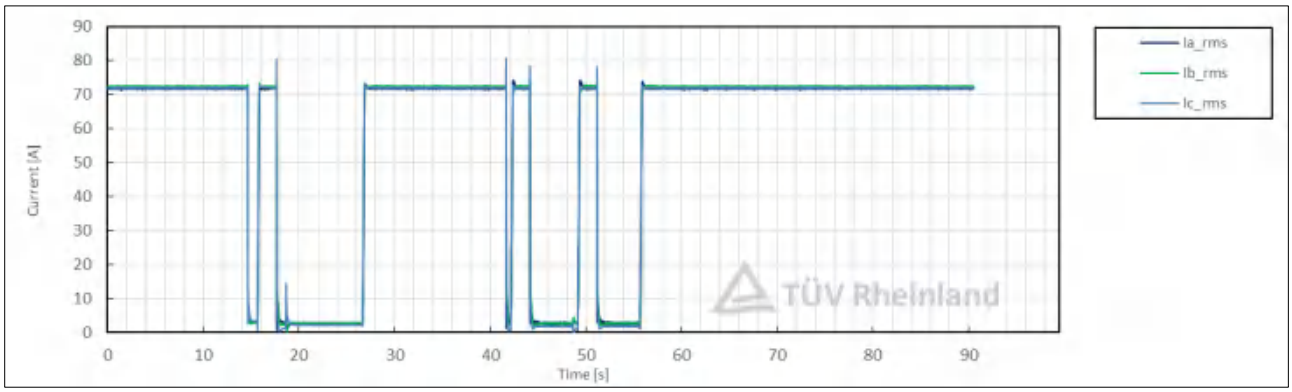
4th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
5th voltage dip 50V	0.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.21	0.217 (50V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	2s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54
6th voltage dip 100V	4.5s	Voltage	Line to neutral	200ms after dip begin	p.u.	0.42	0.435 (100V)
		Active power	Total		p.u.	0.00	≤± 0.04
Voltage return 230V	1s	Voltage	Line to neutral	400ms after dip recovery	p.u.	1.00	1.0(230V)
		Active power	Total		p.u.	0.50	0.46-0.54

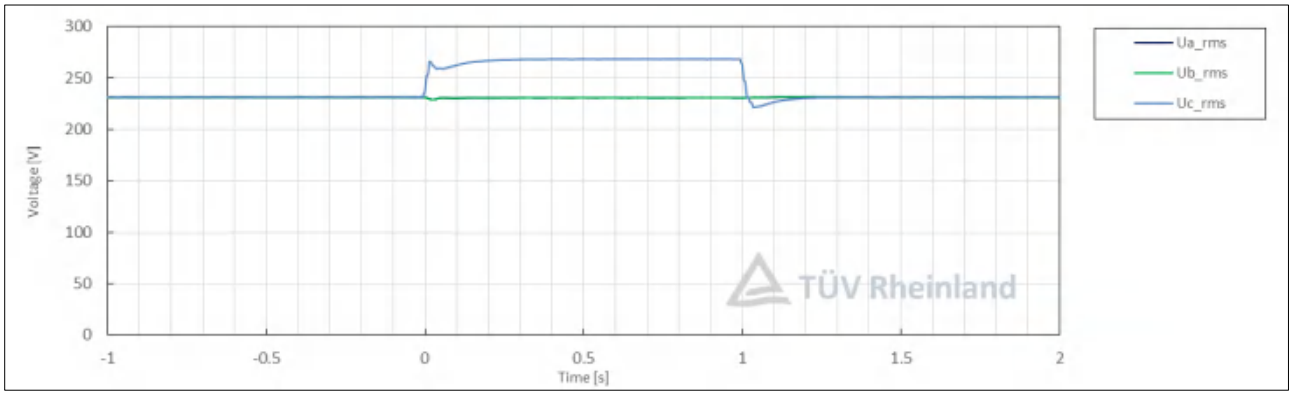
Diagram

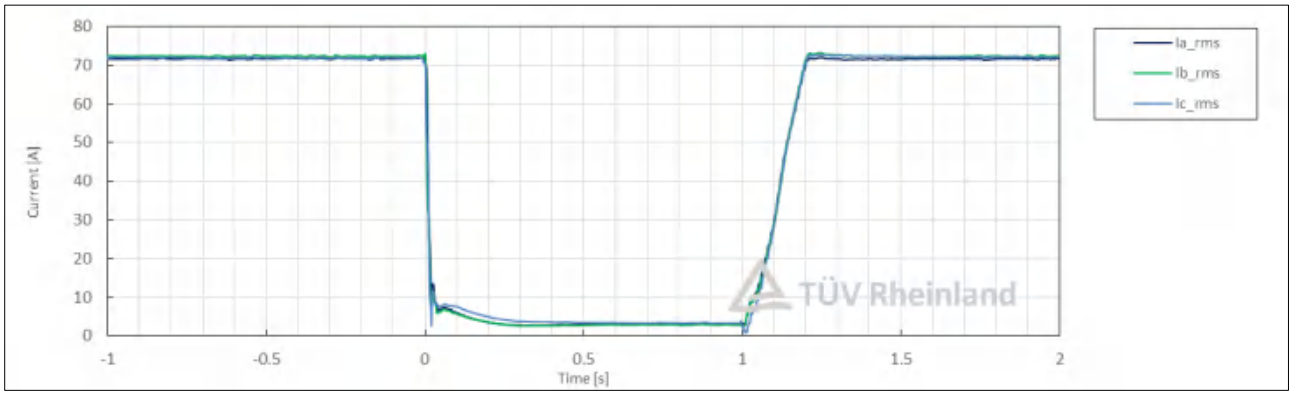


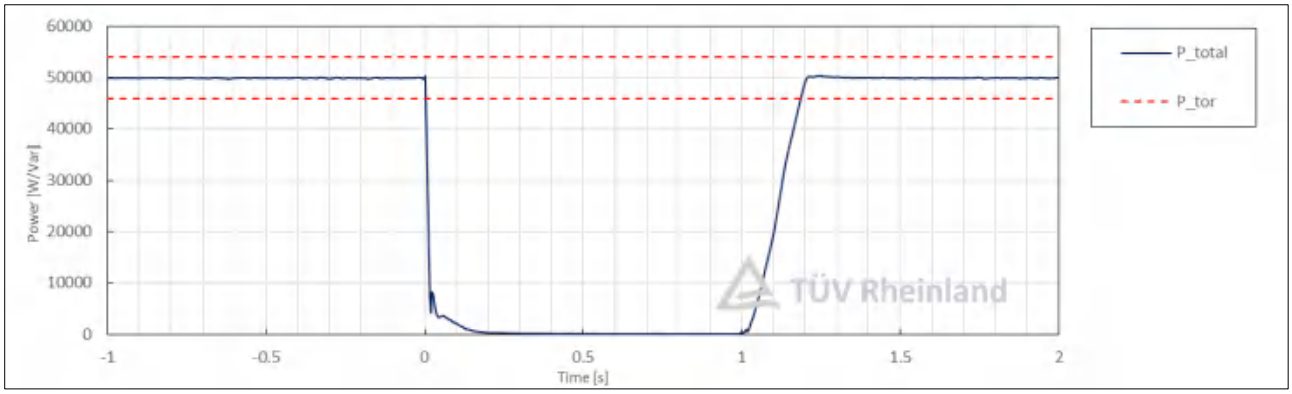



Current [A]
Time [s]
Ia
Ib
Ic
TÜV Rheinland


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


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


60000
50000
40000
30000
20000
10000
0
Power [W/Var]
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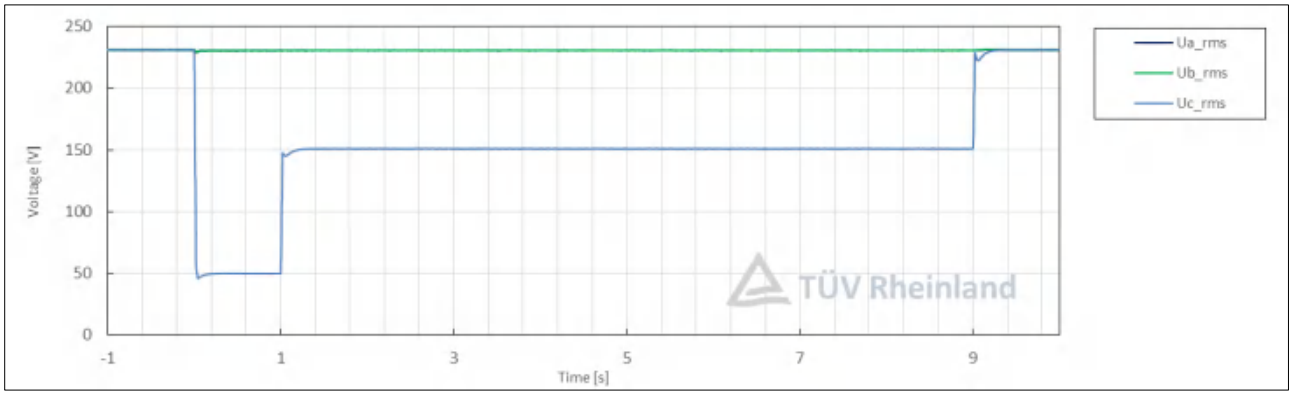
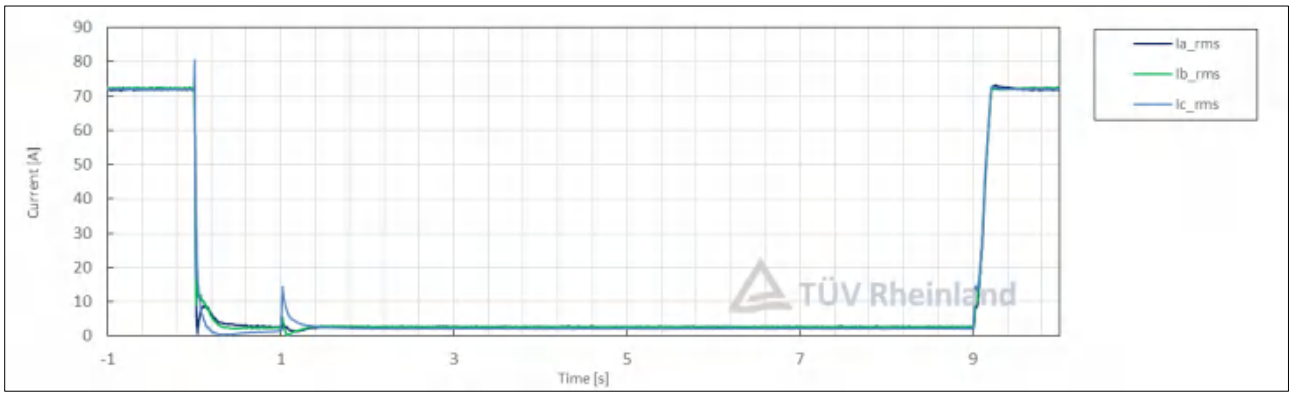
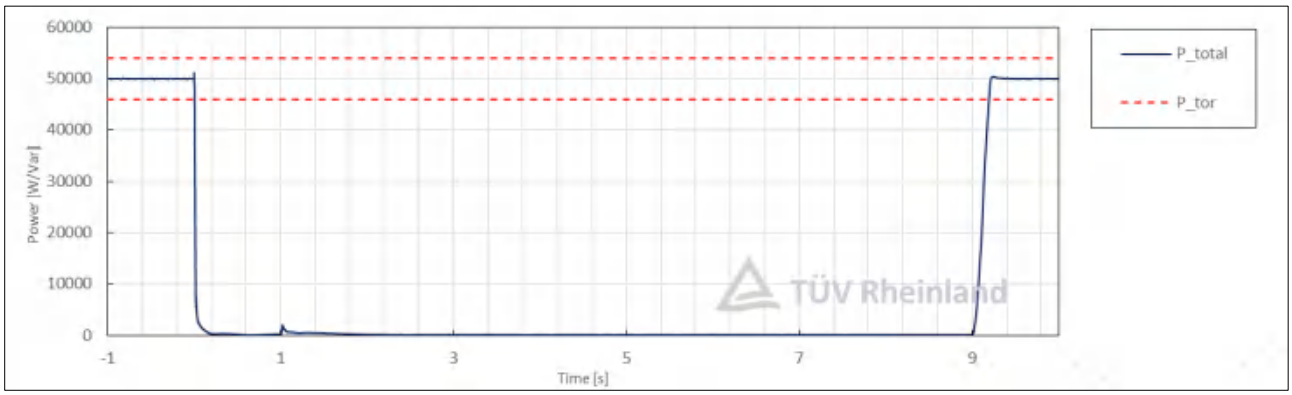
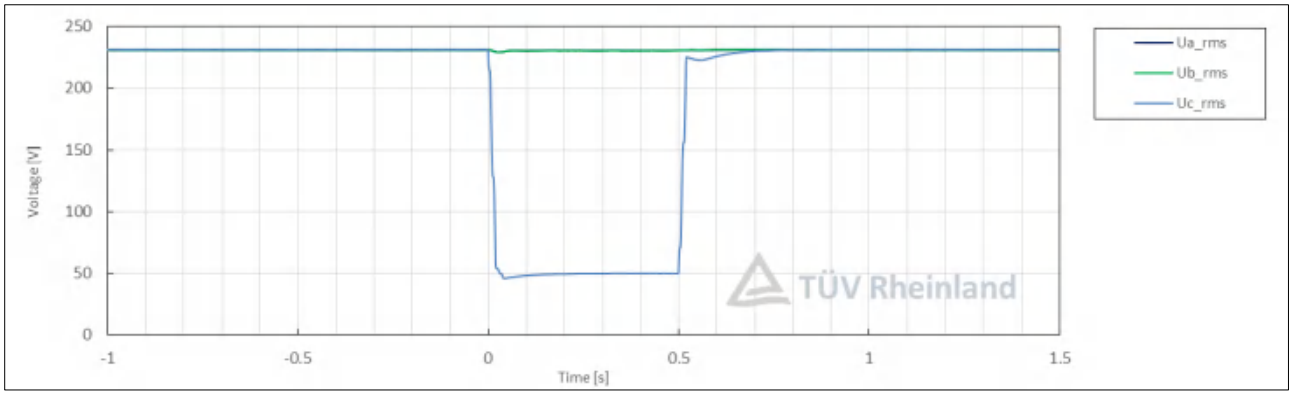
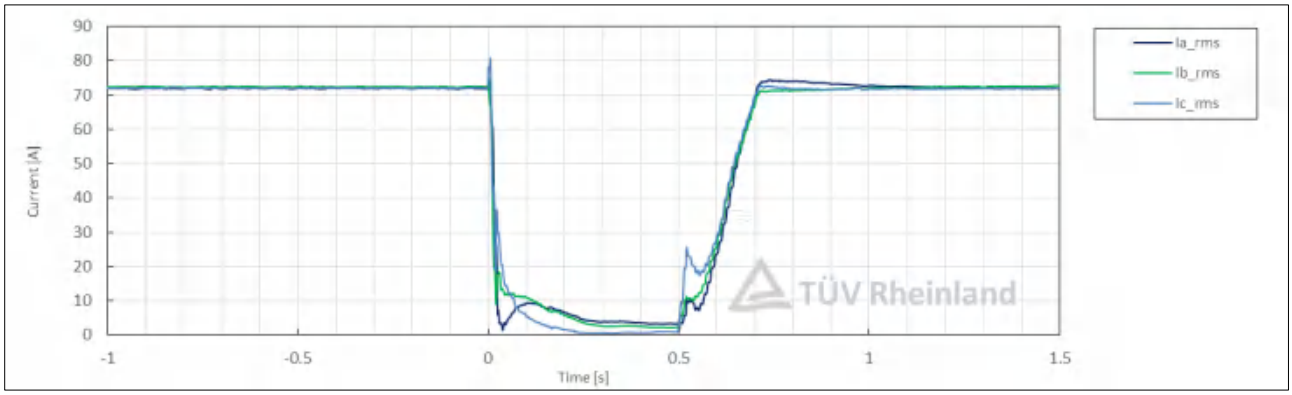
-0.5
0
0.5
1
1.5
2
Time [s]
P_total
P_tor
TÜV Rheinland

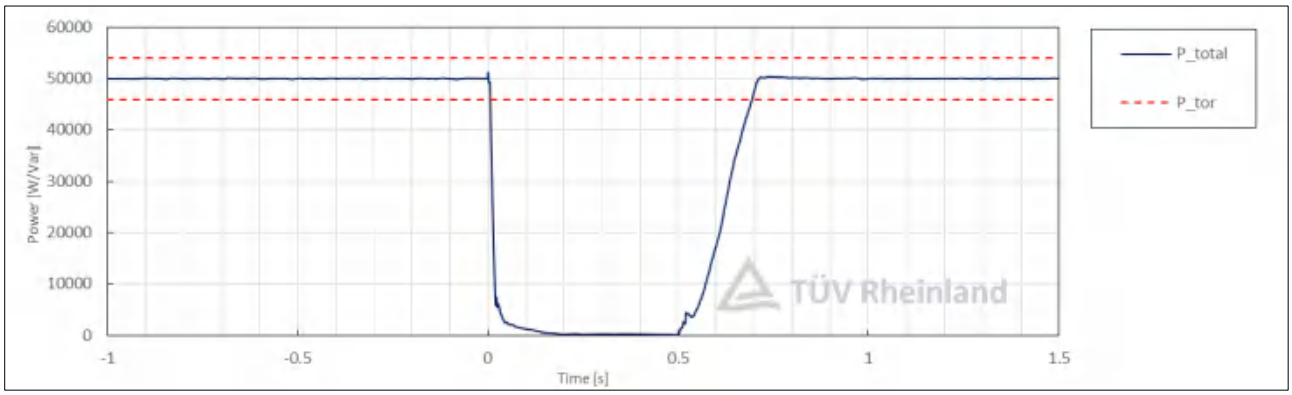

250
200
150
100
50
0
Voltage [V]
-1
1
3
5
7
9
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

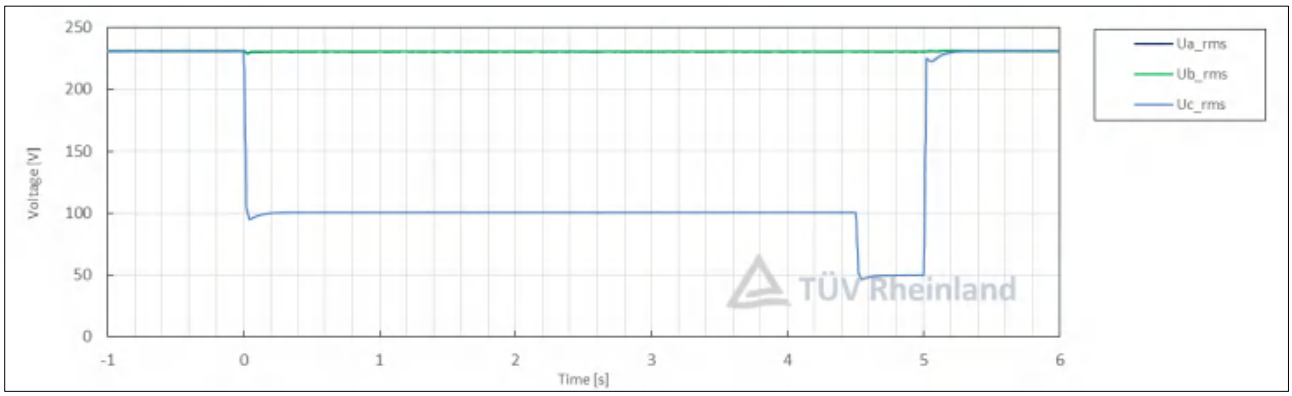

90
80
70
60
50
40
30
20
10
0
Current [A]
-1
1
3
5
7
9
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

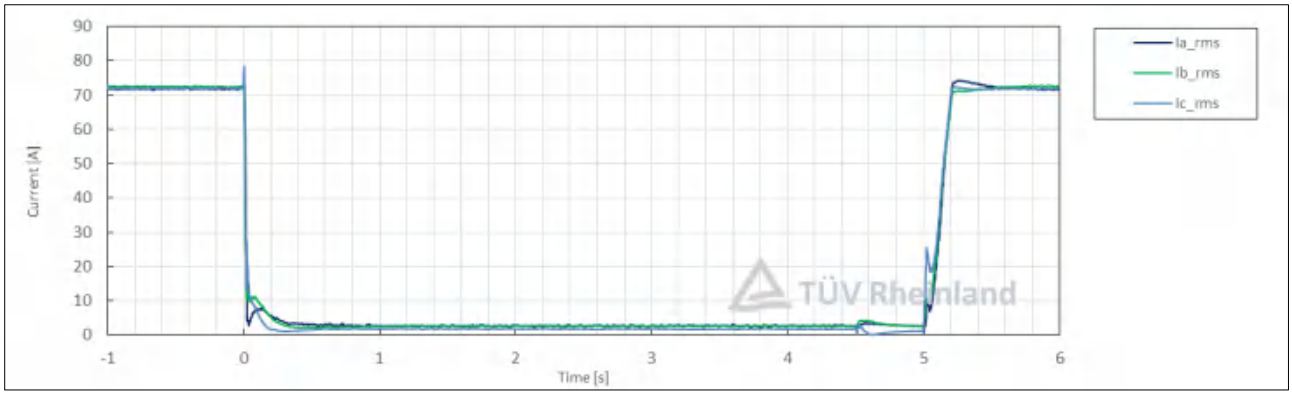

60000
50000
40000
30000
20000
10000
0
Power [W/Var]
-1
1
3
5
7
9
Time [s]
P_total
P_tor
TÜV Rheinland

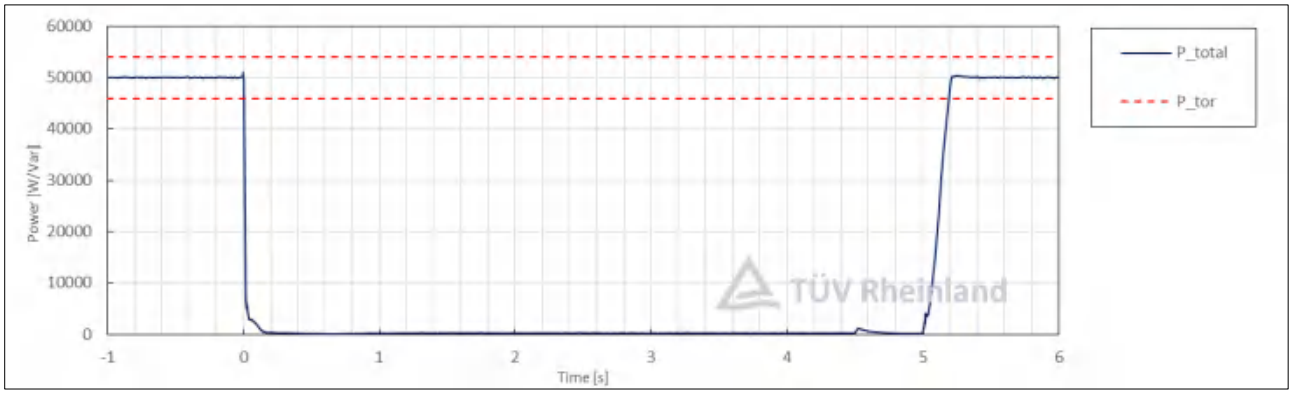

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland

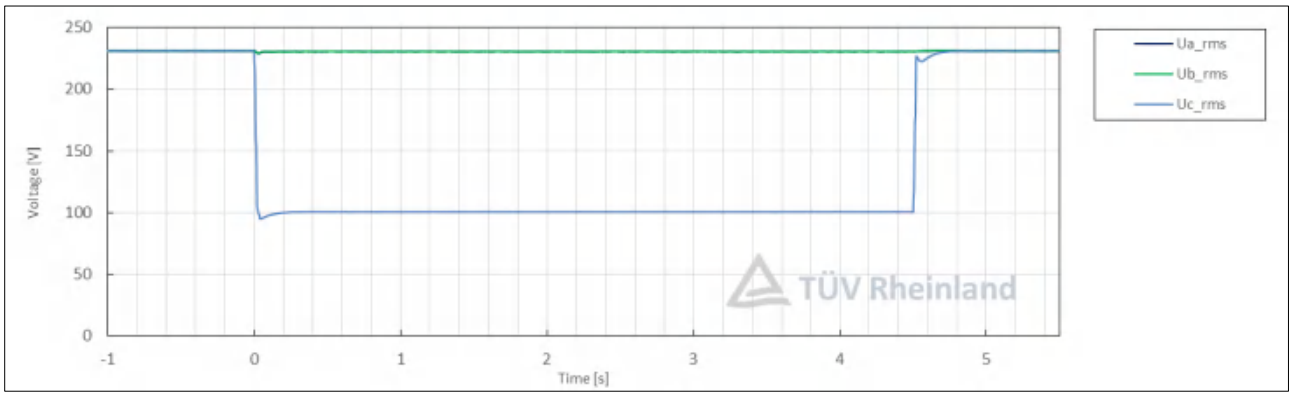

Current [A]
Time [s]
Ia_rms
Ib_rms
Ic_rms
TÜV Rheinland

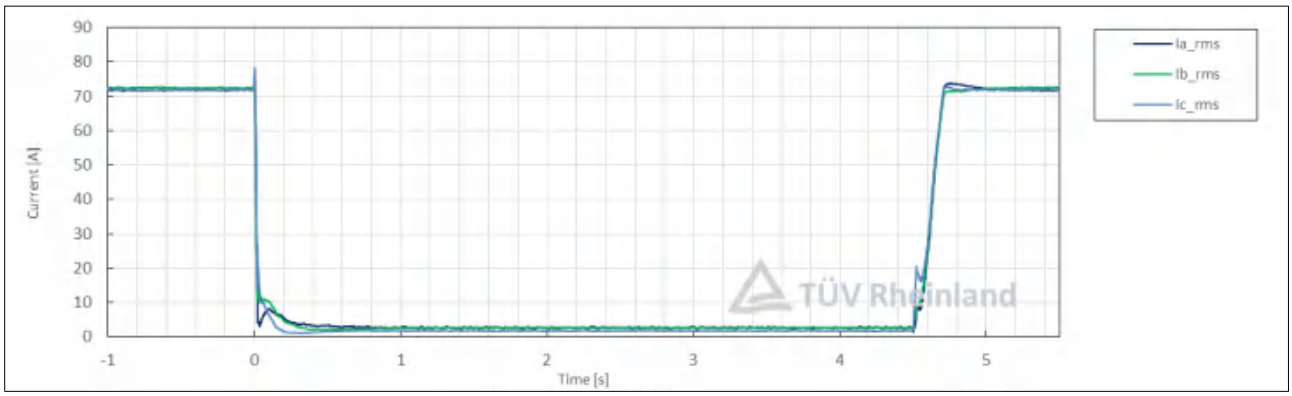

Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland

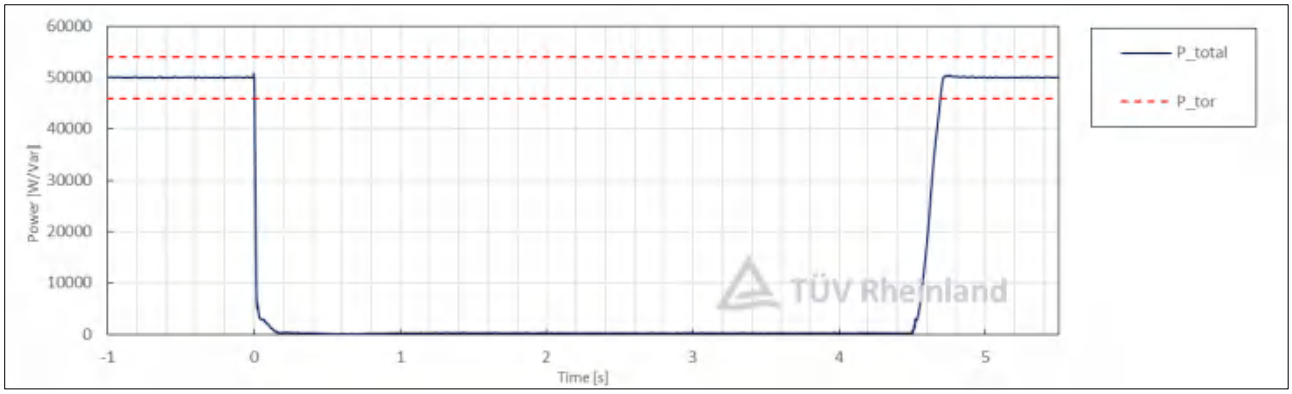

Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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


Power [W/Var]
Time [s]
P_total
P_tor
TÜV Rheinland


Voltage [V]
Time [s]
Ua_rms
Ub_rms
Uc_rms
TÜV Rheinland


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



Appendix I (e)	TABLE: Underfrequency and overfrequency trip settings test				P	
Condition	Setting Australia A [Hz]	Measurement Trip value [Hz]			Limitation [Hz]	
F>	52.0	52.0	51.99	52.0	±0.01	
	Setting Australia A [ms]	Measurement Trip time [ms]			Limitation [ms]	
	100	182	181	182	≤200	
	Reconnection					
	f [Hz]	Delay time [s]	Power Gradient [%Pn/min]		Limitation	
	50.0	67.2	15.3		≥ 60	16.7
	50.2	No reconnection				
	50.1	69.0	15.5		≥ 60	16.7
Condition	Setting Australia A [Hz]	Measurement Trip value [Hz]			Limitation [Hz]	
F<	47.0	47.0	47.0	47.0	±0.01	
	Setting Australia A [ms]	Measurement Trip time [ms]				
	1000	1463	1511	1469	1000-2000	
	Reconnection					
	f [Hz]	Delay time [s]	Power Gradient [%Pn/min]		Limitation	
	50.0	64.8	15.3		≥ 60	16.7
	47.4	No reconnection				
	48.0	65.0	15.3		≥ 60	16.7

Following configuration shall be inspected			
Australia A	Available	Australia B	Available
Australia C	Available	New Zealand	Available

Note(s):

Appendix I (g)	TABLE: Voltage phase angle shift test					P
Test Condition		Trip position	Duration [ms]	Time ref.	Measurement	Limit
					P / Pn	P / Pn
L1	Initial-> Initial+60°	Zero-cross	502	--	No disconnect	No disconnect
L1	Initial+60°->Initial	Peak / trough	500	400ms after shiftting	0.49	0.46-0.54
L2	Initial-> Initial+60°	Zero-cross	502	--	No disconnect	No disconnect
L2	Initial+60°->Initial	Peak / trough	500	400ms after shiftting	0.50	0.46-0.54
L3	Initial-> Initial+60°	Zero-cross	502	--	No disconnect	No disconnect
L3	Initial+60°->Initial	Peak / trough	500	400ms after shiftting	0.51	0.46-0.54
All	Initial-> Initial+20°	Zero-cross	60004	--	No disconnect	No disconnect
All	Initial+20°-> Initial	Peak / trough	500	400ms after shiftting	0.51	0.46-0.54
Note(s):						

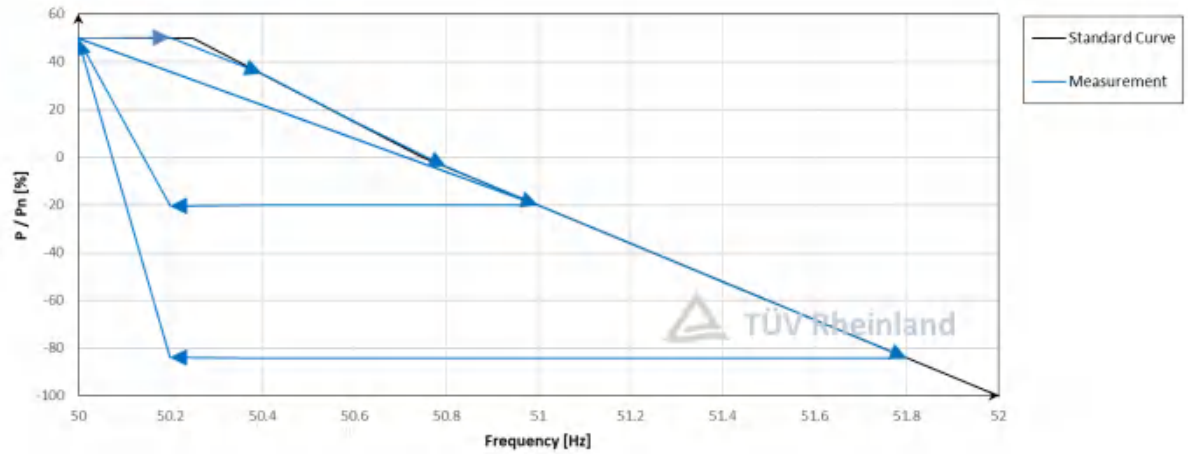
Appendix J (a)	TABLE: Sustained for voltage variations						P
No.	Setting Australia A [V]	Measurement			Limitation		
		Vnom-max [V]	Trip time [s]	Reconnect time [s]	Vnom-max [V]	Trip time [s]	Reconnect time [s]
1	258	259.4	0.122	72.0	≤ ±2.3	≤ 30	≥ 60
2		259.5	0.099	70.3			
3		259.5	0.101	72.8			

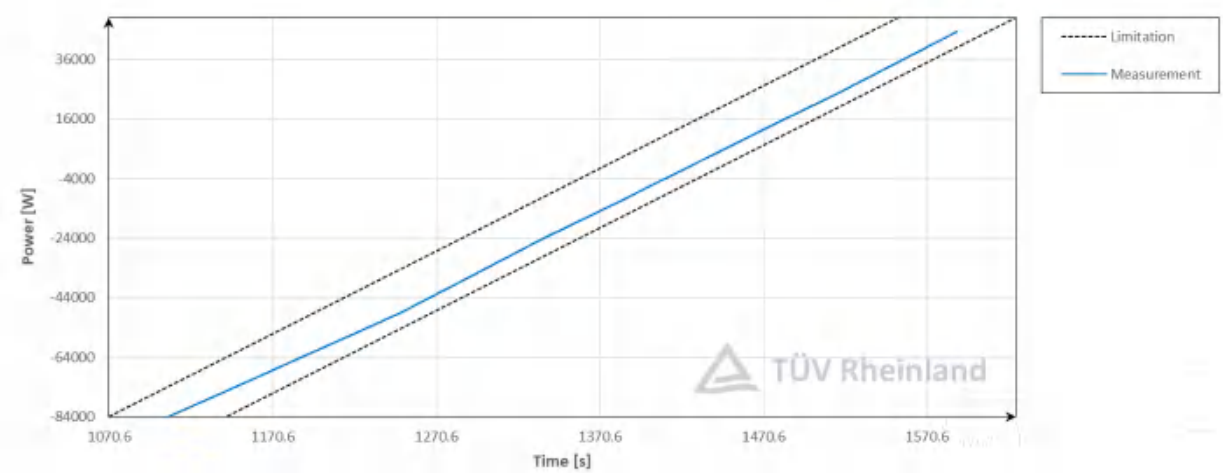
Appendix J (d)	TABLE: Test for an increase in frequency for inverters with energy storage									P
LFSM-O curve settings: Australia A	Points			f_{ULCO}			$f_{trasition}$			f_{Pmin}
	Hz			50.25			50.75			52.0
Test Conditions	Measurements					Target value	Δ	Limit		
f [Hz]	P/Pn [%]	$T_{initial}$ [s]	$T_{stabilize}$ [s]	Power ramp [%/min]		P/Pn [%]	Δ P/Pn [%]	Δ P/Pn [%]	$T_{initial}$ [s]	$T_{stabilize}$ [s]
50.0	50.0	--	--	--		50	0.0	≤ ±4	≤ 1	≤ 10
50.2	50.0	--	--	--		50	0.0			
50.4	35.0	0.5	0.6	--		35	0.0			
50.6	15.0	0.1	0.3	--		15	0.0			
50.8	-4.0	0.0	0.3	--		-4	0.0			
51.0	-20.1	0.4	0.5	--		-20	-0.1			
51.2	-36.1	0.4	0.5	--		-36	-0.1			
51.4	-52.1	0.1	0.3	--		-52	-0.1			
51.6	-68.1	0.2	0.3	--		-68	-0.1			
51.8	-84.1	0.0	0.6	--		-84	-0.1			
51.6	-84.1	--	--	--		-84	-0.1			
51.4	-84.1	--	--	--		-84	-0.1			
51.2	-84.1	--	--	--		-84	-0.1			
51.0	-84.1	--	--	--		-84	-0.1			
50.8	-84.1	--	--	--		-84	-0.1			
50.6	-84.1	--	--	--		-84	-0.1			
50.4	-84.0	--	--	--		-84	0.0			
50.2	-84.0	--	--	--		-84	0.0			
50.0	50.0	23	--	15.3		50	0.0		≥ 20	

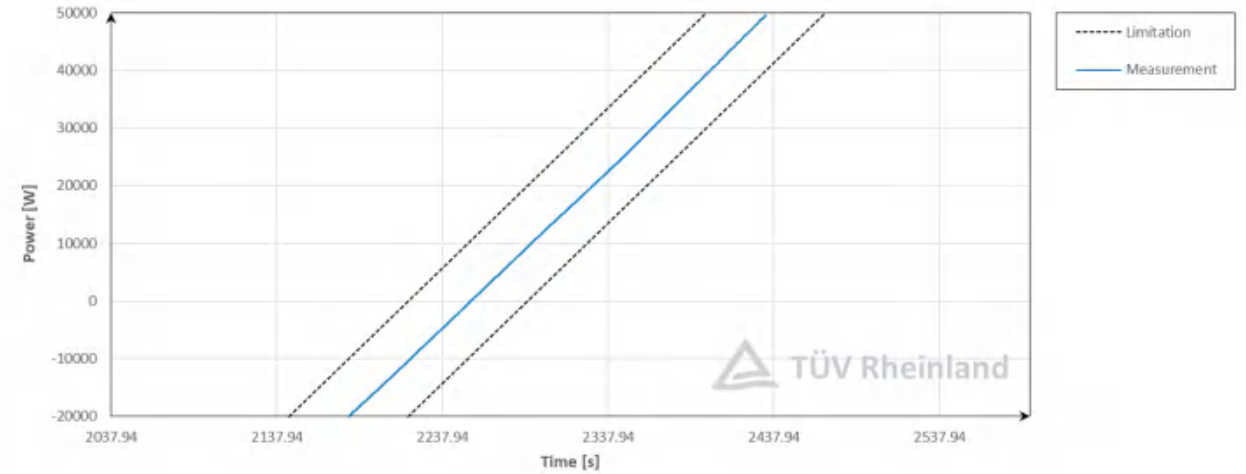
Ramp to 51.0Hz with 4Hz/s	-20.0	0.1	0.7	--	-20	0.0		≤ 1
50.8	-20.0	--	--	--	-20	0.0		
50.6	-20.0	--	--	--	-20	0.0		
50.4	-20.0	--	--	--	-20	0.0		
50.2	-20.0	--	--	--	-20	0.0		
50.0	50.0	23	--	16.4	50	0.0		≥ 20

Following configuration shall be inspected			
Australia A	Available / Not available	Australia B	Available / Not available
Australia C	Available / Not available	New Zealand	Available / Not available

LFSM-O Configurable range	Points	f_{ULCO}	$f_{trasition}$	f_{Pmin}
	Hz	50.1-50.5	50.5-52.0	51.0-53.0





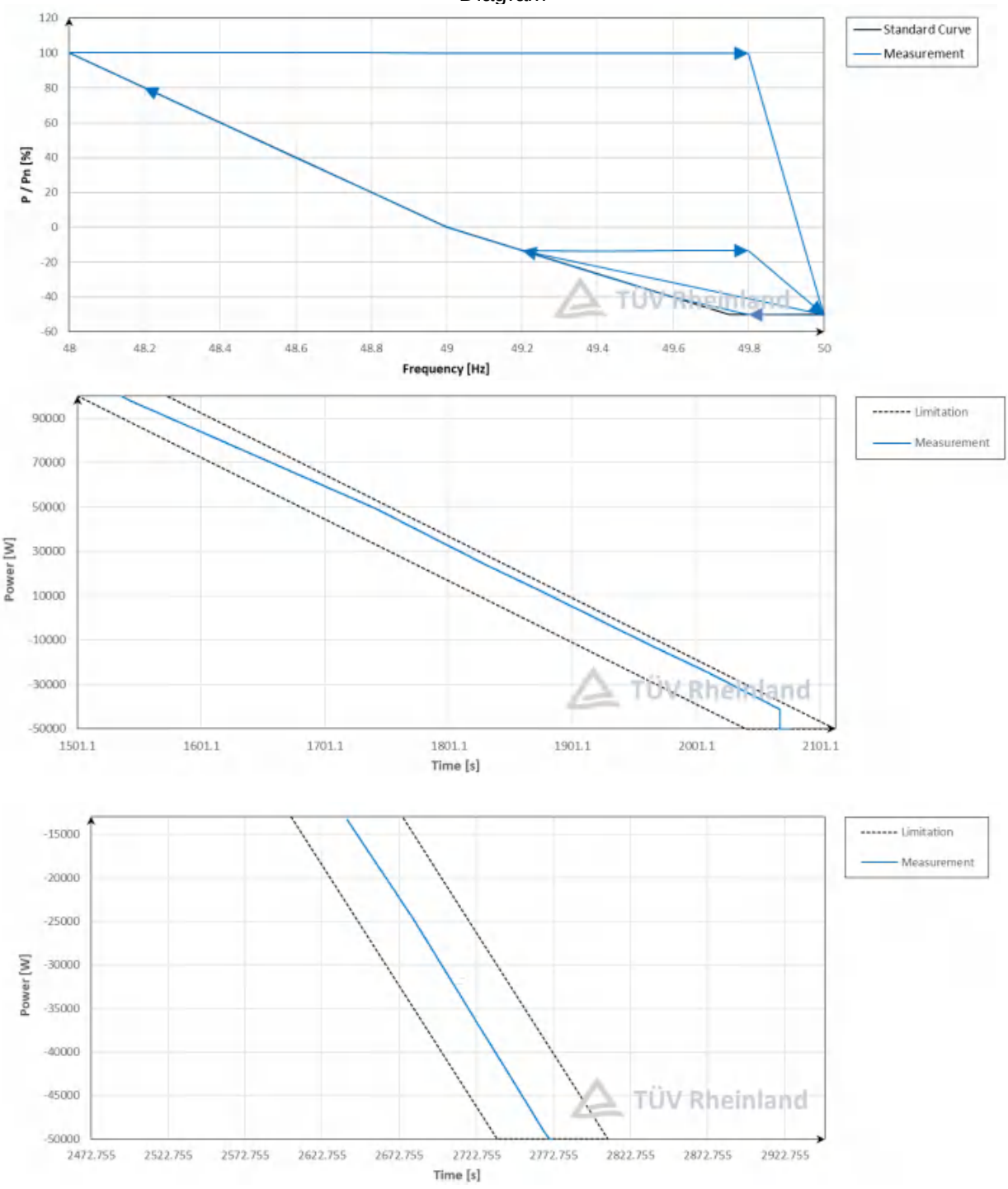

50000
40000
30000
20000
10000
0
-10000
-20000
Power [W]
2037.94
2137.94
2237.94
2337.94
2437.94
2537.94
Time [s]
Limitation
Measurement
TÜV Rheinland

Appendix J (e)	TABLE: Test for an decrease in frequency for inverters with energy storage								P
LFSM-U curve settings: Australia A	Points		f_{LLCO}		$F_{stop-ch}$		f_{Pmax}		
	Hz		49.75		49.0		48.0		
Test Conditions	Measurements				Target value	Δ	Limit		
f [Hz]	P/Pn [%]	$T_{initial}$ [s]	$T_{stabilize}$ [s]	Power ramp [%/min]	P/Pn [%]	Δ P/Pn [%]	Δ P/Pn [%]	$T_{initial}$ [s]	$T_{stabilize}$ [s]
50.0	-50.0	--	--	--	-50	0.0	≤ ±4	≤ 1	≤ 10
49.8	-50.0	--	--	--	-50	0.0			
49.6	-40.0	0.5	0.6	--	-40	0.0			
49.4	-26.7	0.1	0.3	--	-26	-0.7			
49.2	-13.4	0.0	0.7	--	-13	-0.4			
49.0	0.0	0.1	0.3	--	0	0.0			
48.8	20.0	0.6	0.7	--	20	0.0			
48.6	40.0	0.0	0.7	--	40	0.0			
48.4	60.0	0.2	0.5	--	60	0.0			
48.2	80.0	0.4	0.5	--	80	0.0			
48.0	100.0	0.2	0.6	--	100	0.0			
47.8	100.0	--	--	--	100	0.0			
48.0	100.0	--	--	--	100	0.0			
48.2	100.0	--	--	--	100	0.0			
48.4	100.0	--	--	--	100	0.0			
48.6	100.0	--	--	--	100	0.0			
48.8	100.0	--	--	--	100	0.0			
49.0	100.0	--	--	--	100	0.0			
49.2	100.0	--	--	--	100	0.0			
49.4	100.0	--	--	--	100	0.0			
49.6	100.0	--	--	--	100	0.0			
49.8	99.9	--	--	--	100	-0.1			
50.0	-50.0	22	--	15.7	-50	0.0		≥ 20	
Ramp to 49.2Hz with 4Hz/s	-13.4	4.1	4.9	--	-13	-0.4			
49.4	-13.4	--	--	--	-13	-0.4		≤ 1	
49.6	-13.4	--	--	--	-13	-0.4			
49.8	-13.4	--	--	--	-13	-0.4			
50.0	-50.0	23	--	16.9	-50	0.0		≥ 20	

Following configuration shall be inspected					
Australia A	Available / Not available		Australia B		Available / Not available
Australia C	Available / Not available		New Zealand		Available / Not available
	Points	f_{LLCO}		$F_{stop-ch}$	f_{Pmax}

LFSM-O Configurable range	Hz	49.5-49.9	48-49.5	47-49

Diagram



Revision History:

Date YYYY-MM-DD	Contents of modification (latest on top)	Prepared by	Approved by
2021-01-27	Originated and released into QM system	Tobias Yang	Weichun Li

P H O T O D O C U M E N T A T I O N

CN24N4VE 001

INPPCS-100/0.4-W-14-C1-OS, INPPCS-100/0.4-W-24-C1-OS

Langfang IN-Power Electric Co., Ltd.

This documentation consists of 22 pages (excluding this cover page).

Figure 1 Front view

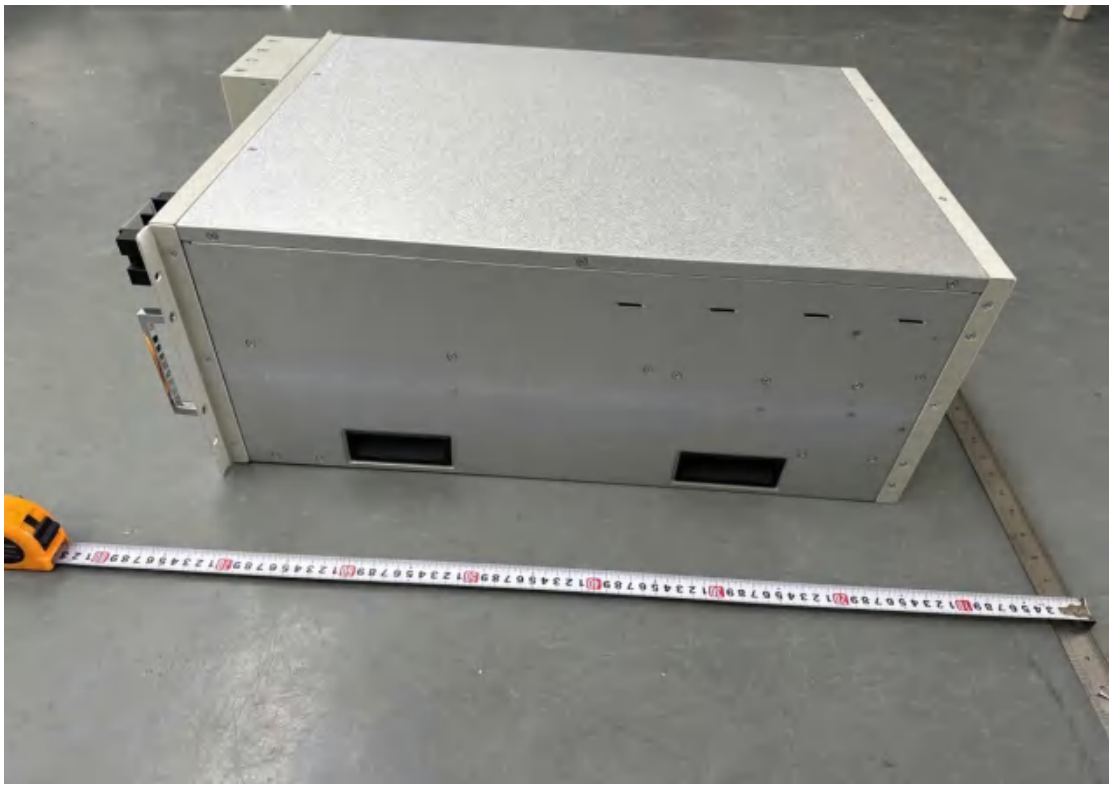


Figure 2 Left side view

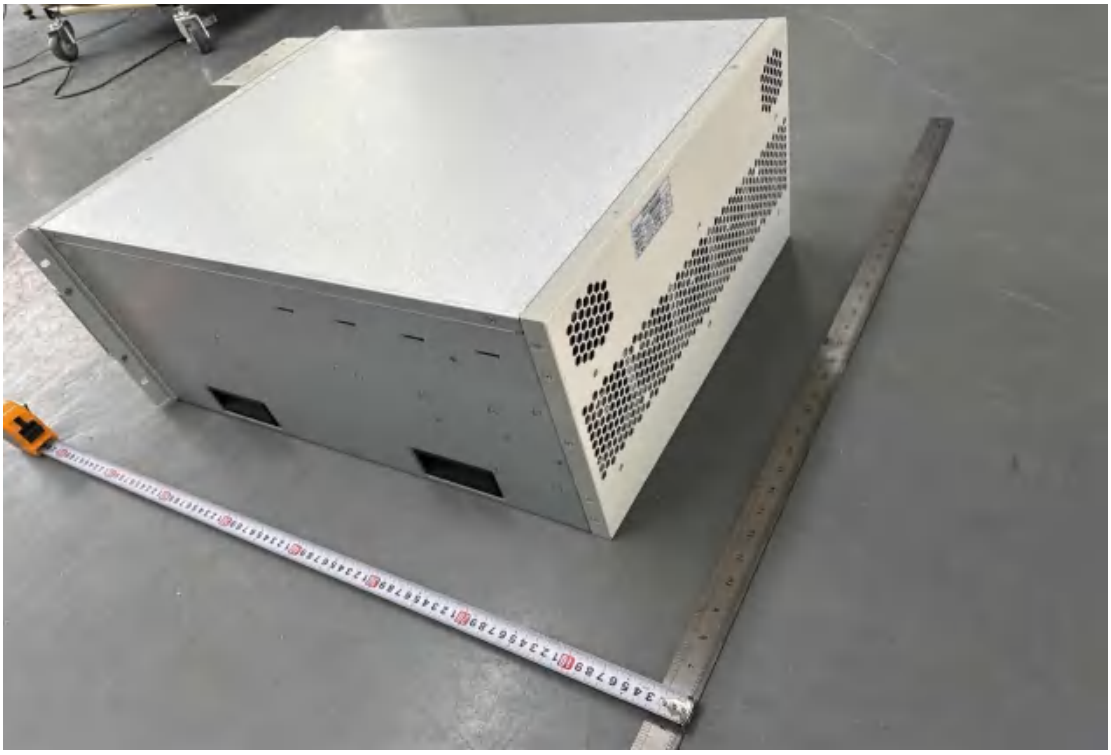


Figure 3 Left front side view 2

Figure 3 rear side view (INPPCS-100/0.4-W-14-C1-OS)

Figure 4 rear side view (INPPCS-100/0.4-W-24-C1-OS)

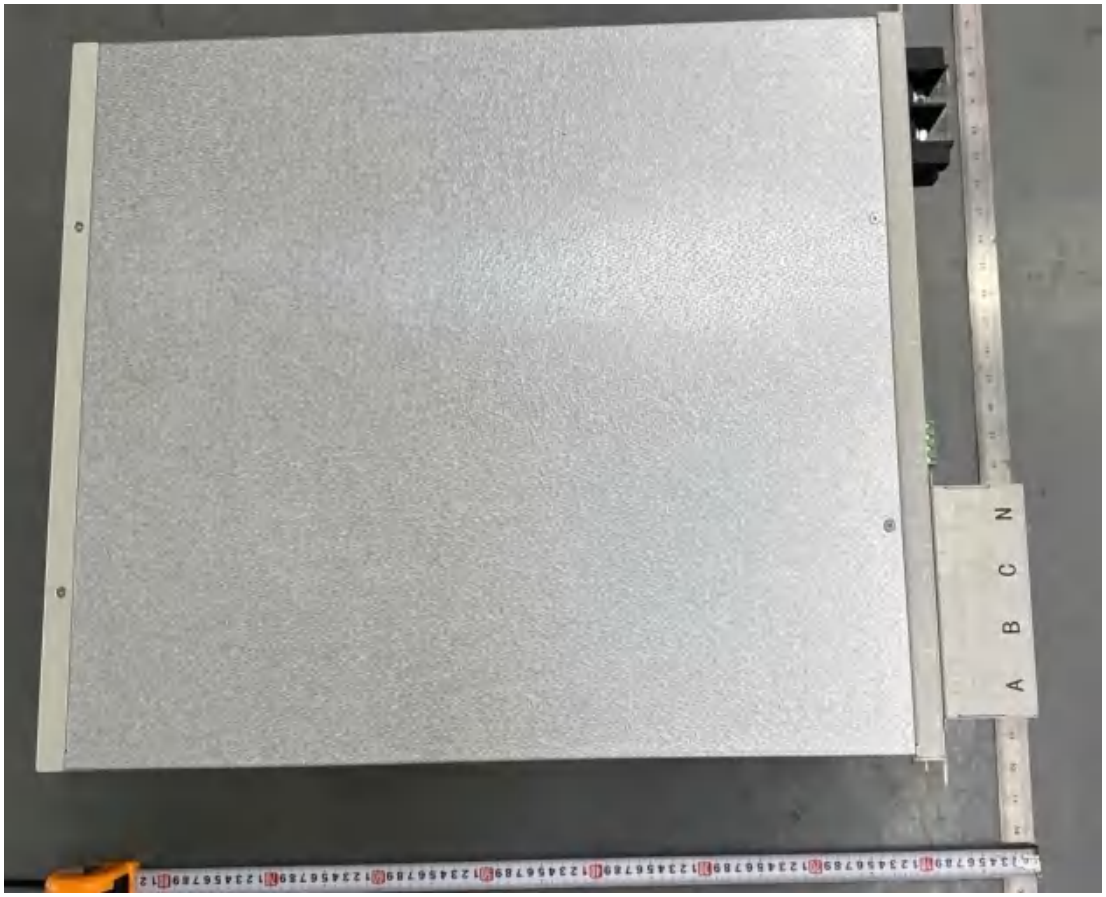


Figure 5 top view (INPPCS-100/0.4-W-14-C1-OS)

Figure 6 Inside view without upper enclosure

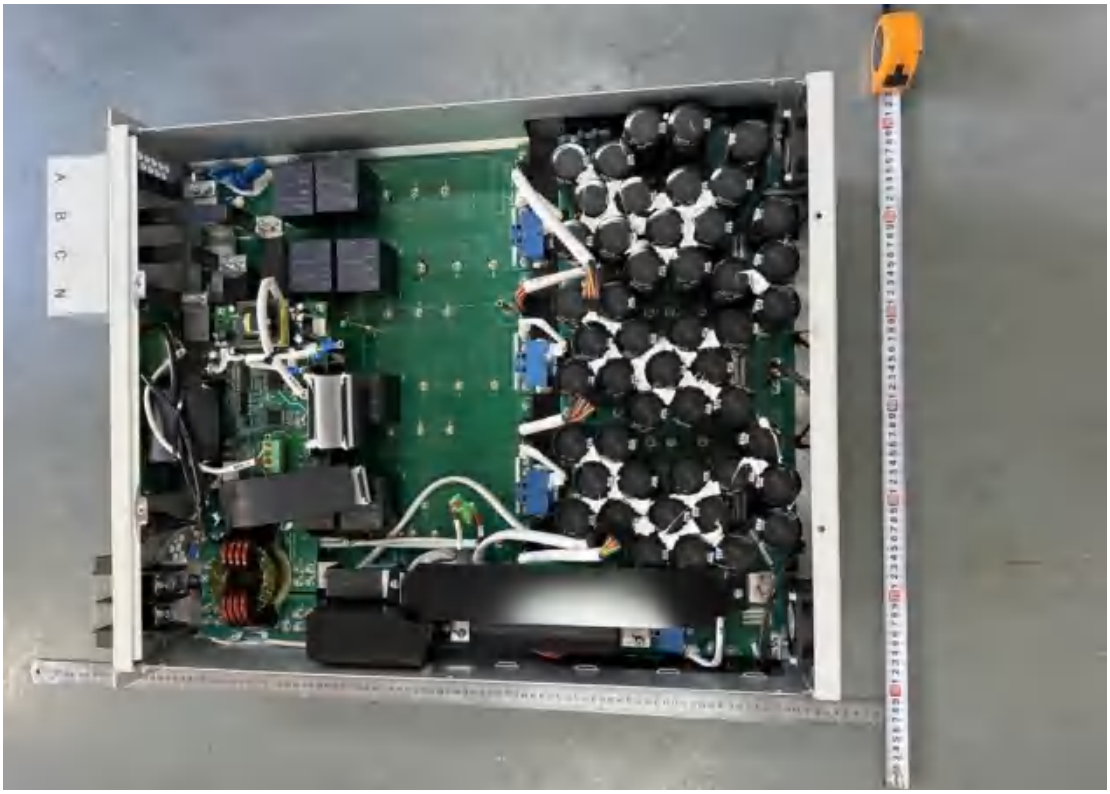


Figure 8 Inside view without control board

Figure 9 Inside view without control board, isolation board

Figure 10 Inside view without control board, isolation board, Capacitor board, and DC filter board

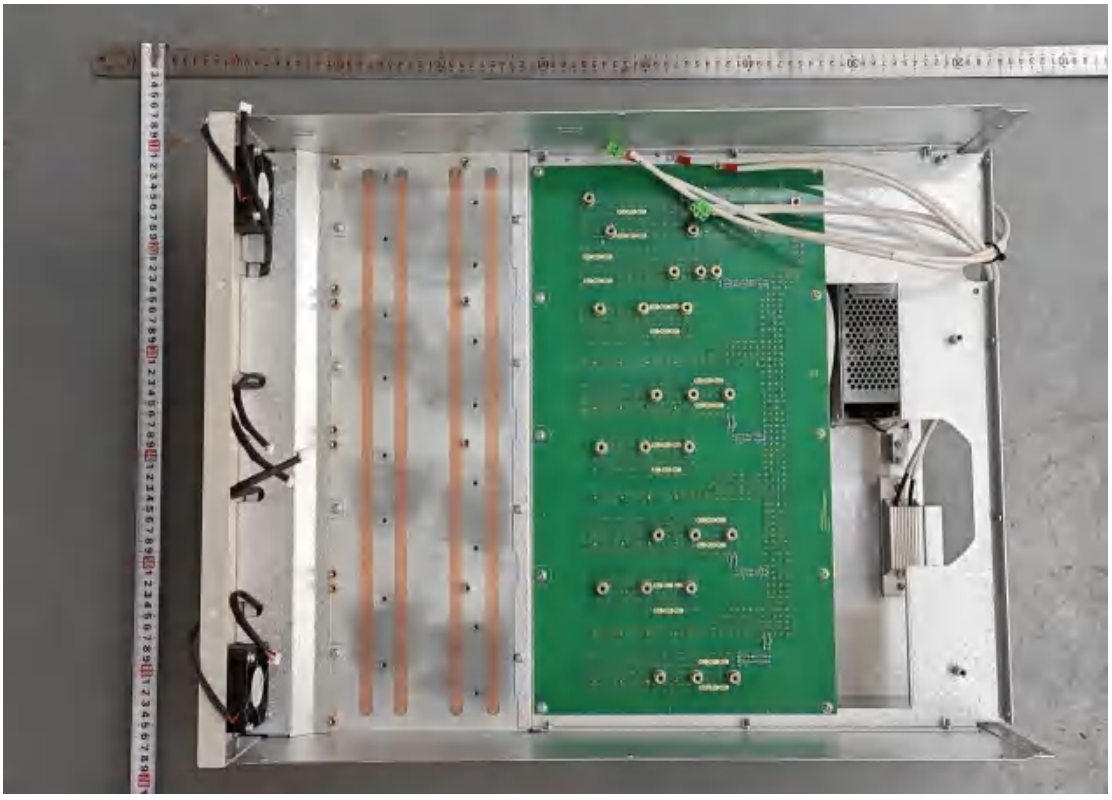


Figure 11 Inside view without control board, isolation board, Capacitor board, DC filter board, power board and relay board

Figure 12 Inside view of enclosure without PCBs

Figure 13 component side of core board

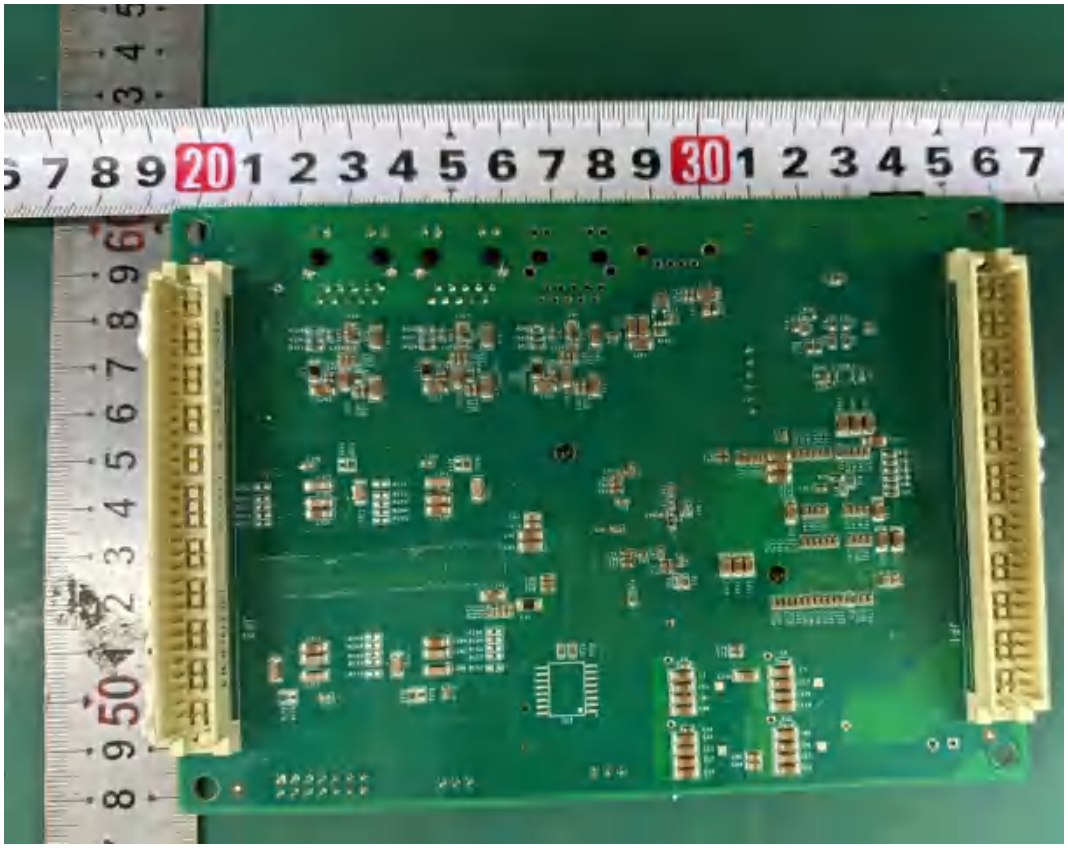


Figure 14 Trace side of core board

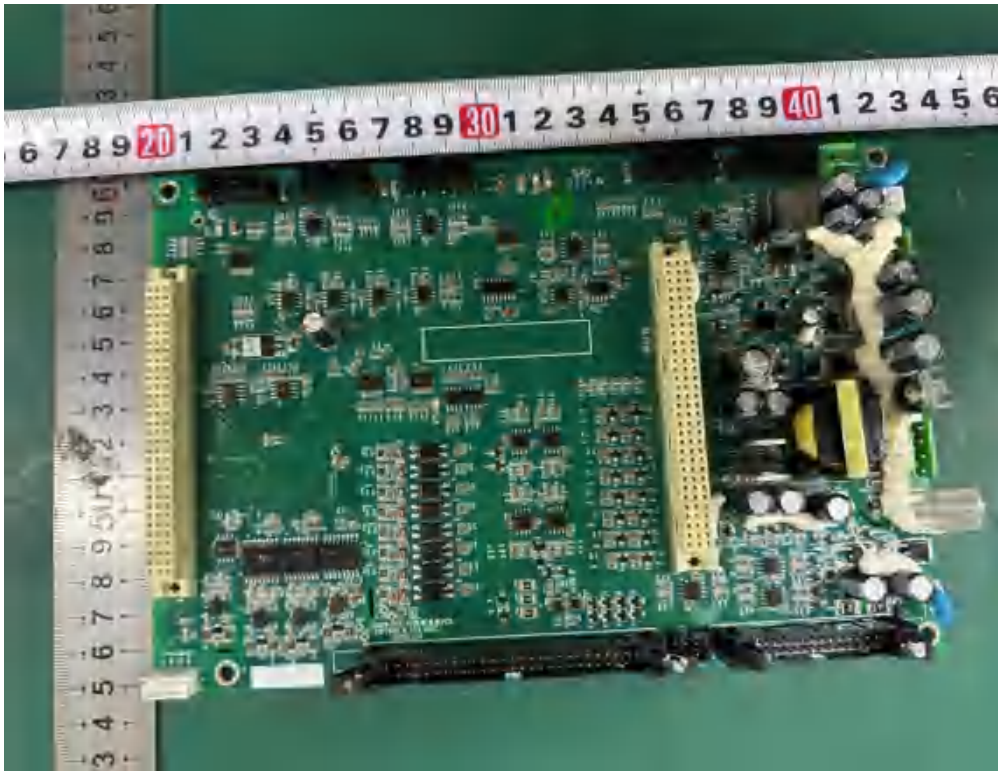


Figure 15 component side of control board

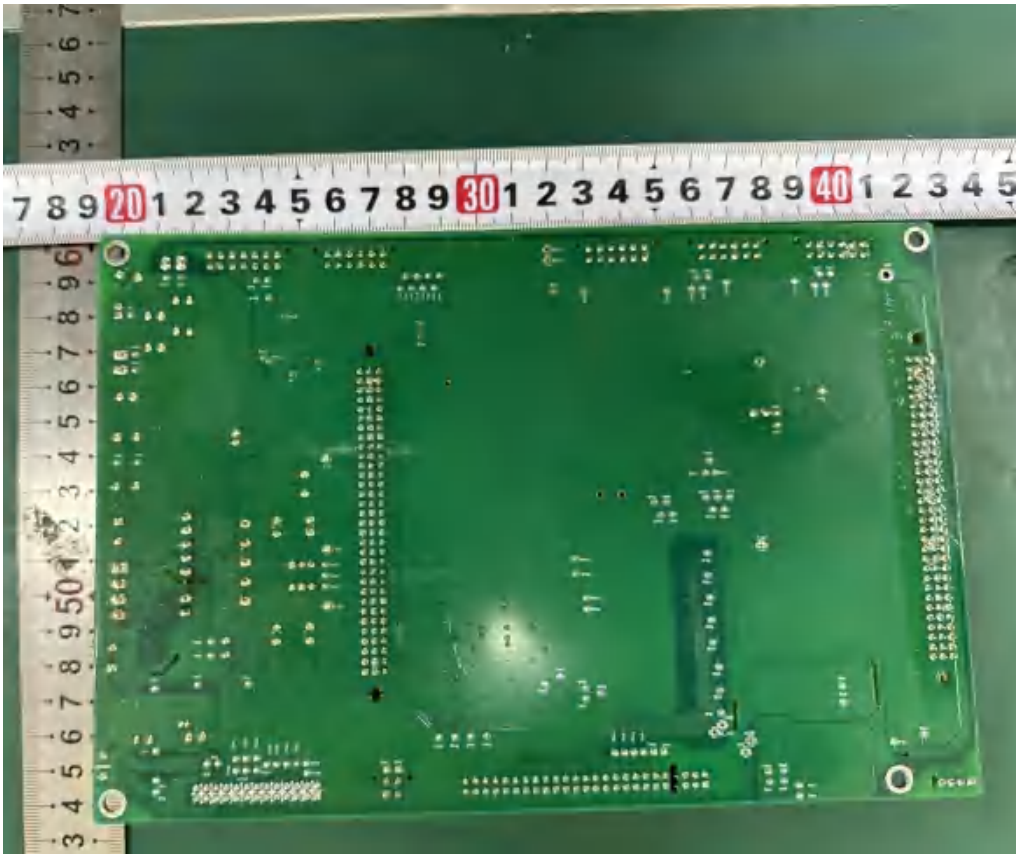


Figure 16 trace side of control board

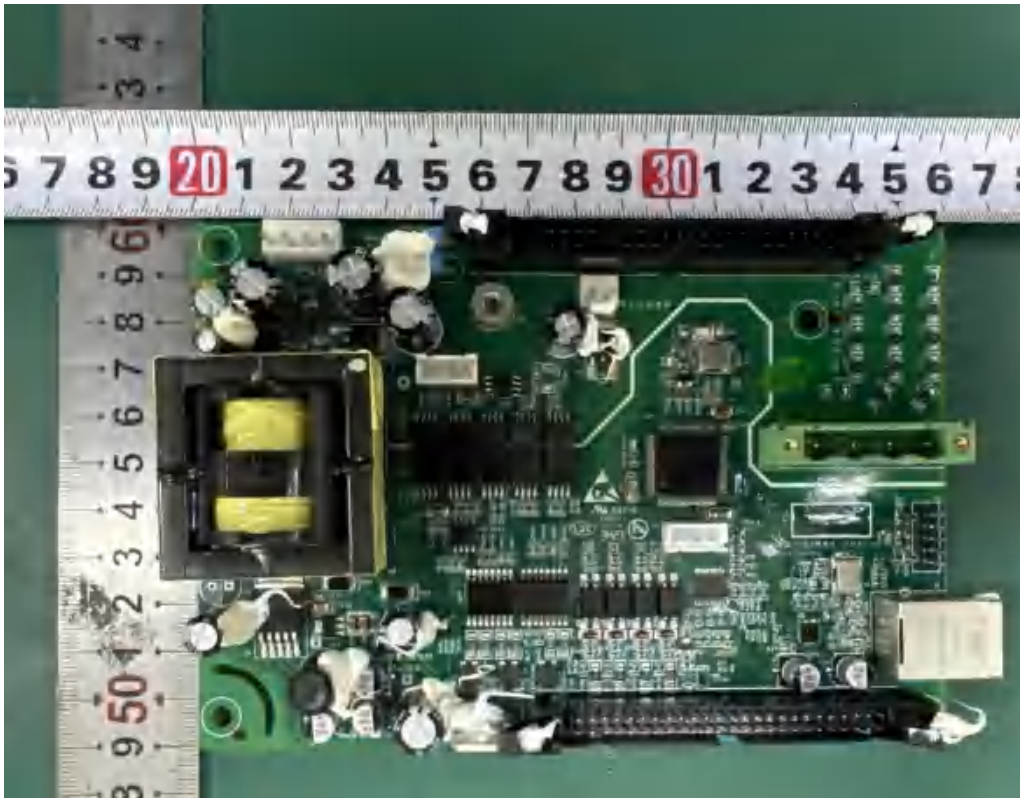


Figure 17 component side of isolation board

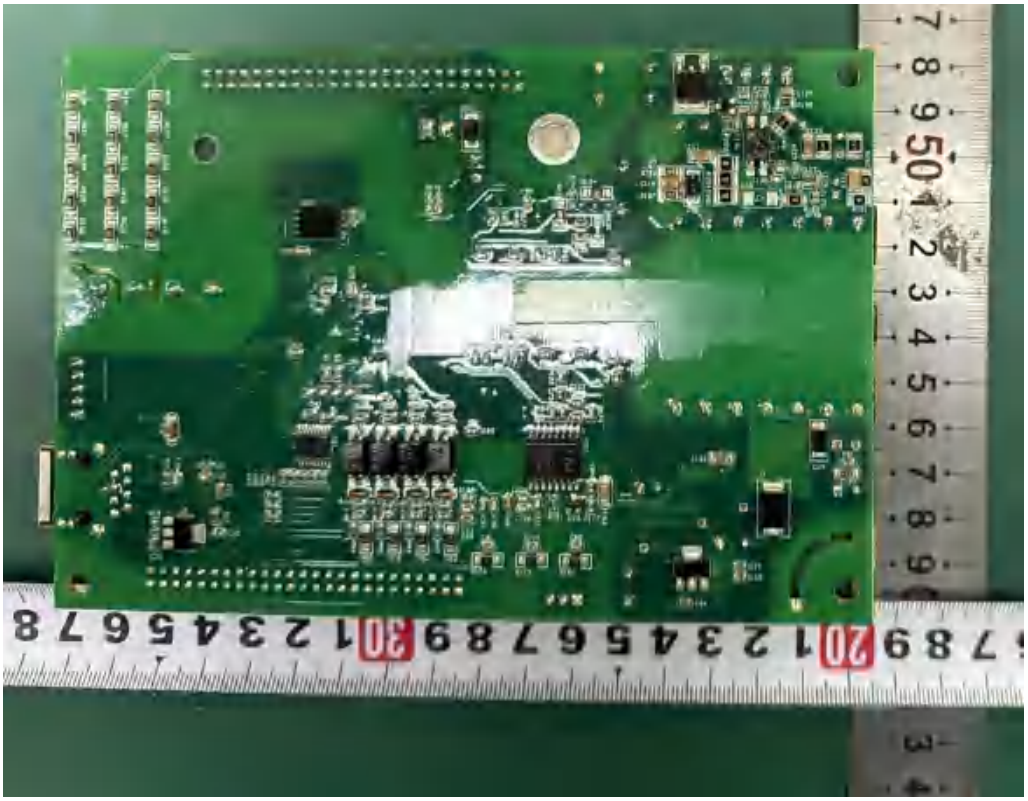


Figure 18 trace side of isolation board

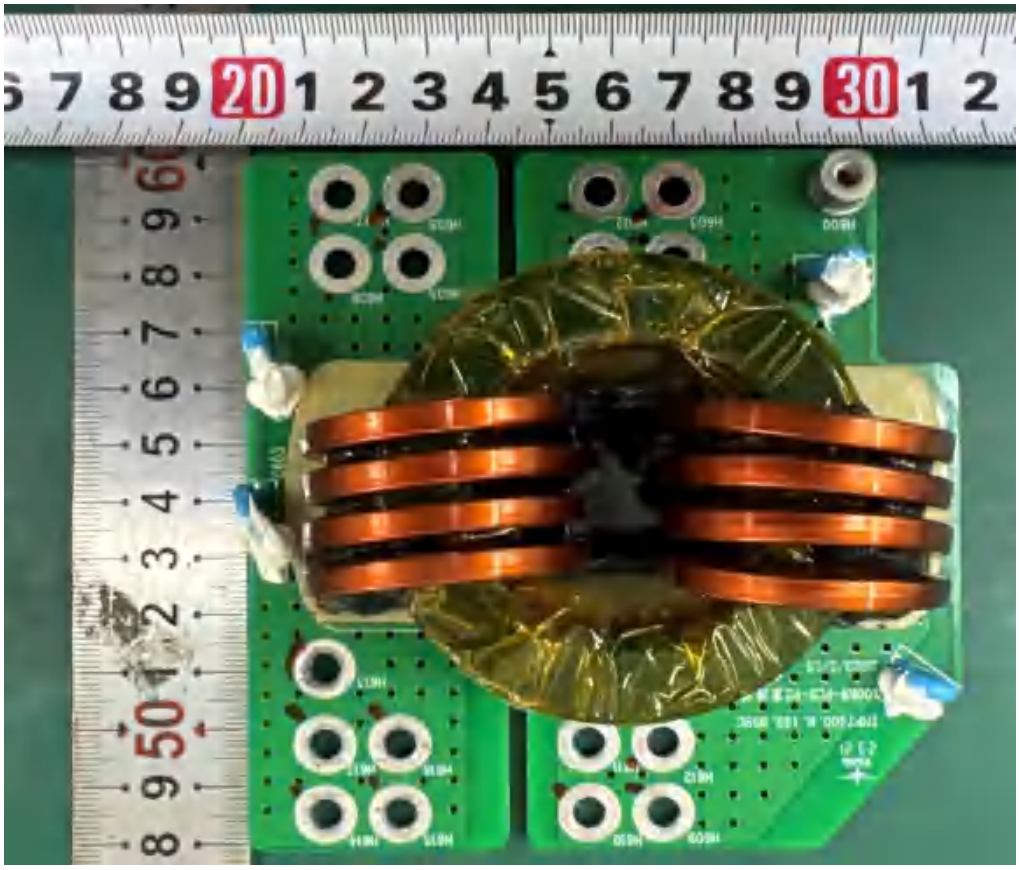


Figure 19 component side of DC filter board

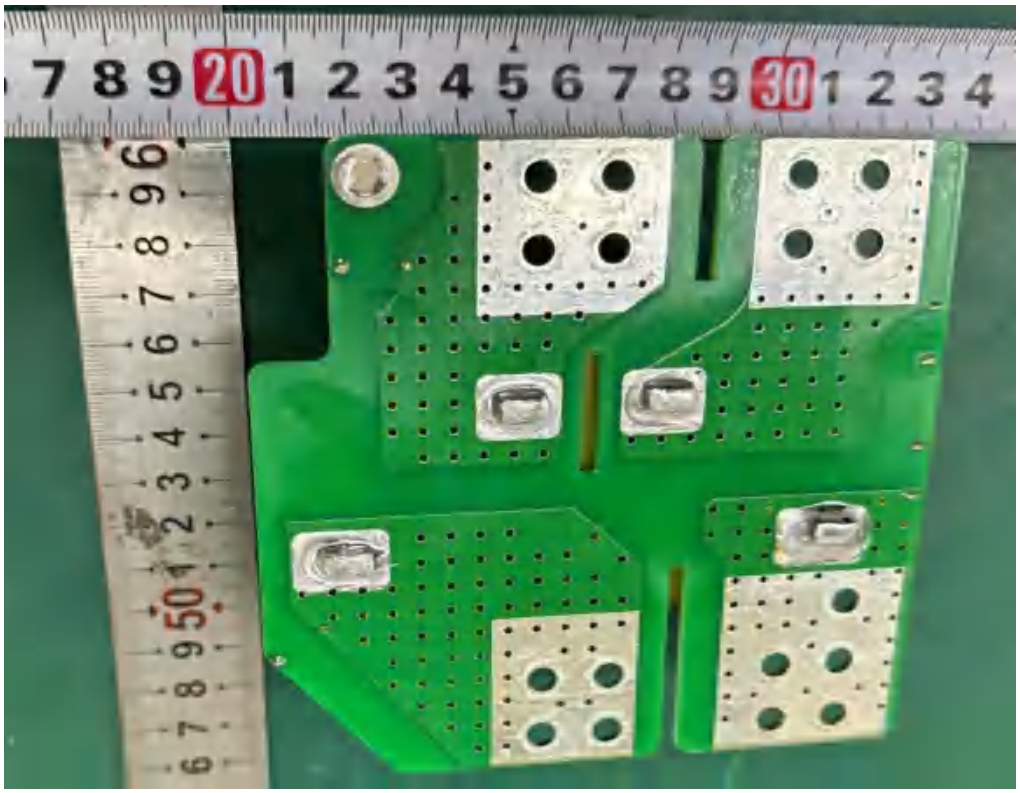


Figure 20 trace side of DC filter board

Figure 21 component side of capacitor board

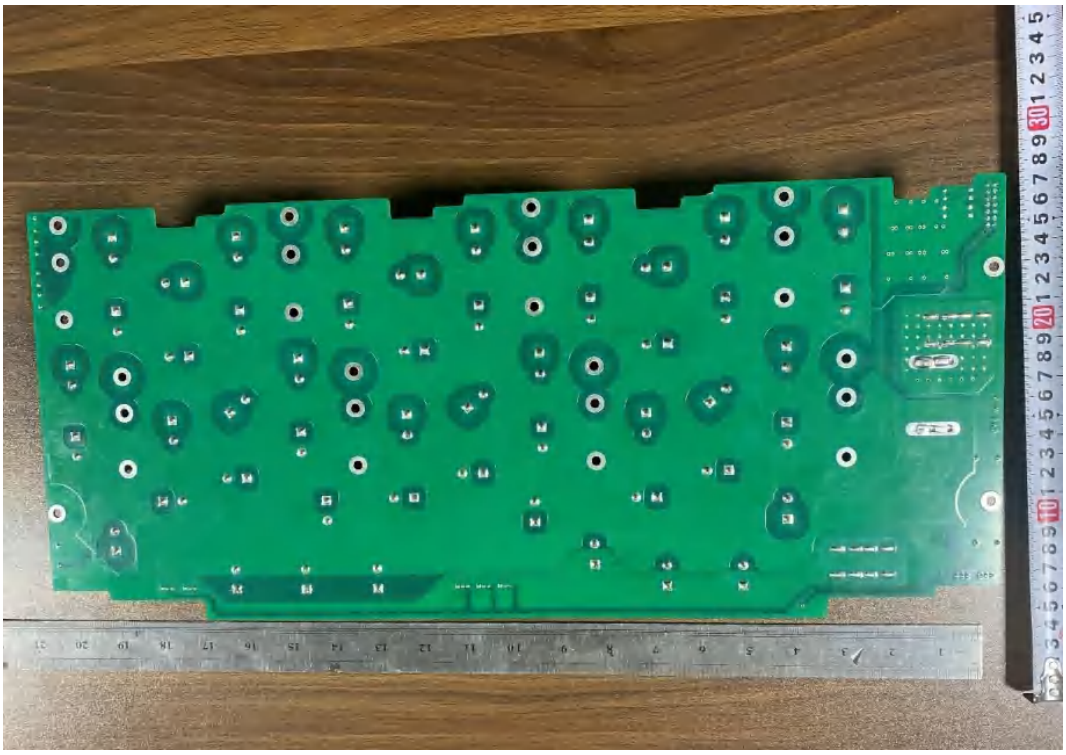


Figure 22 Trace side of capacitor board

Figure 23 component side of power board

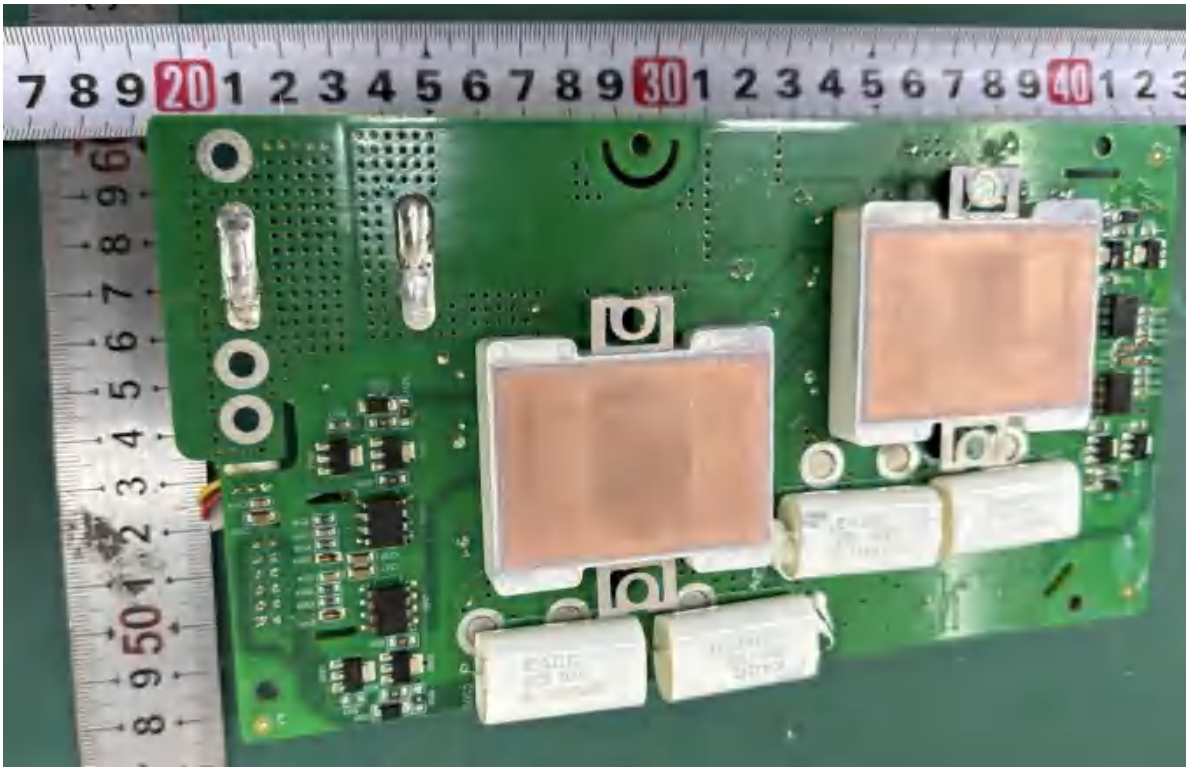


Figure 24 component side of power board

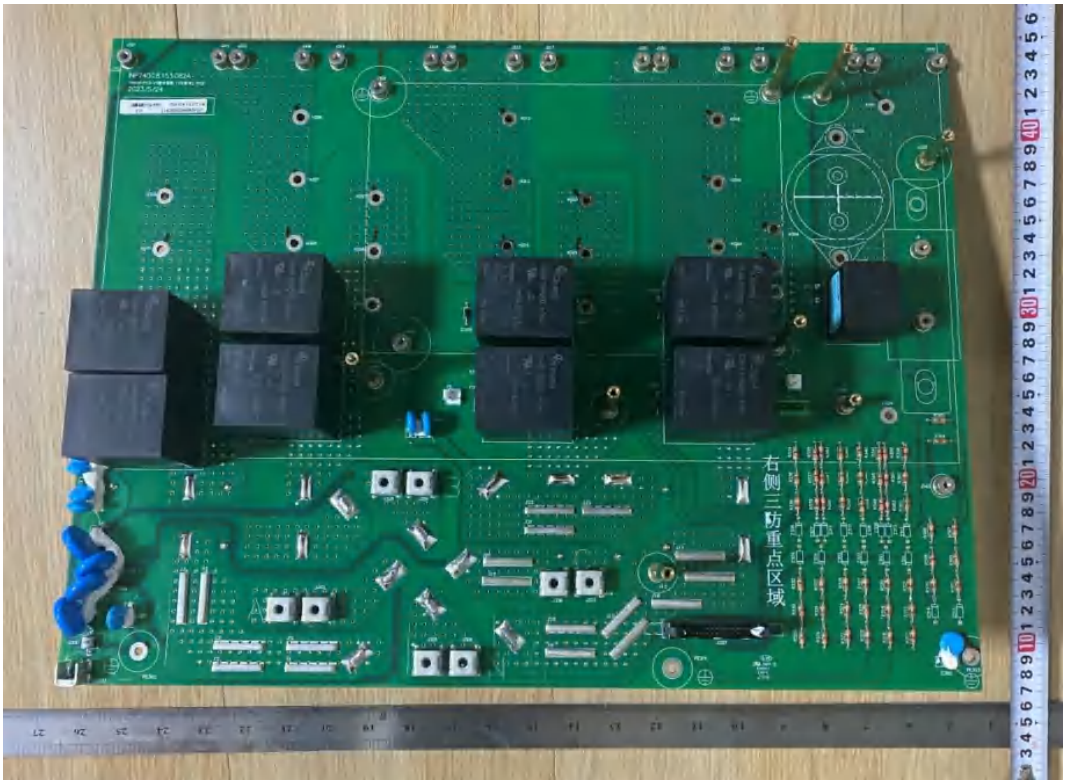


Figure 25 component side of relay board

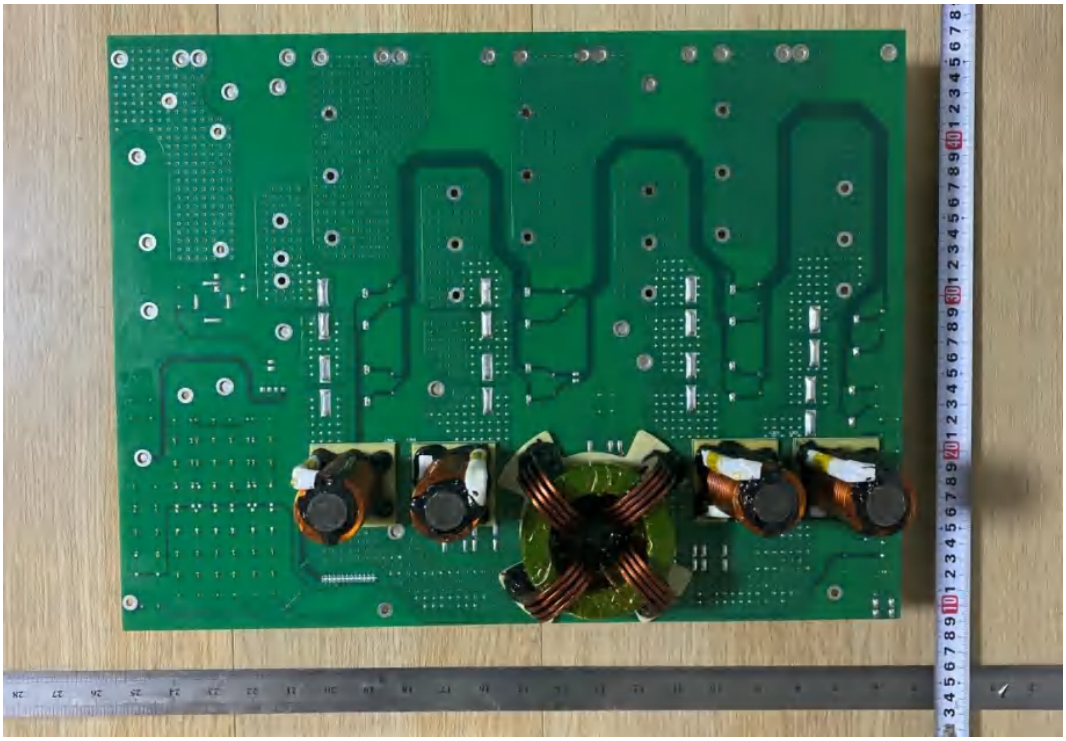


Figure 26 trace side of relay board

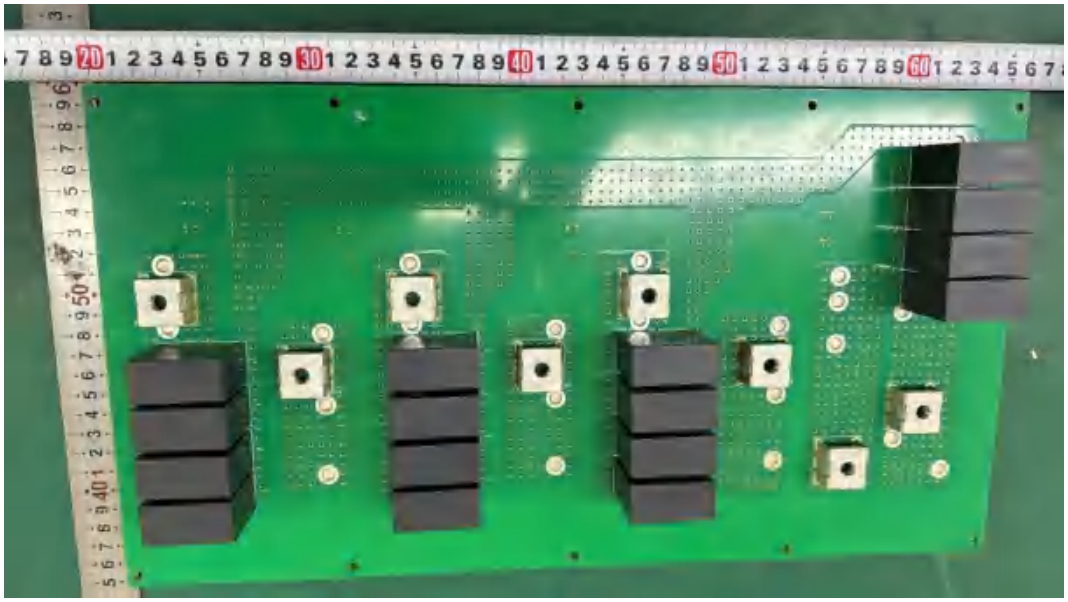


Figure 27 component side of relay board

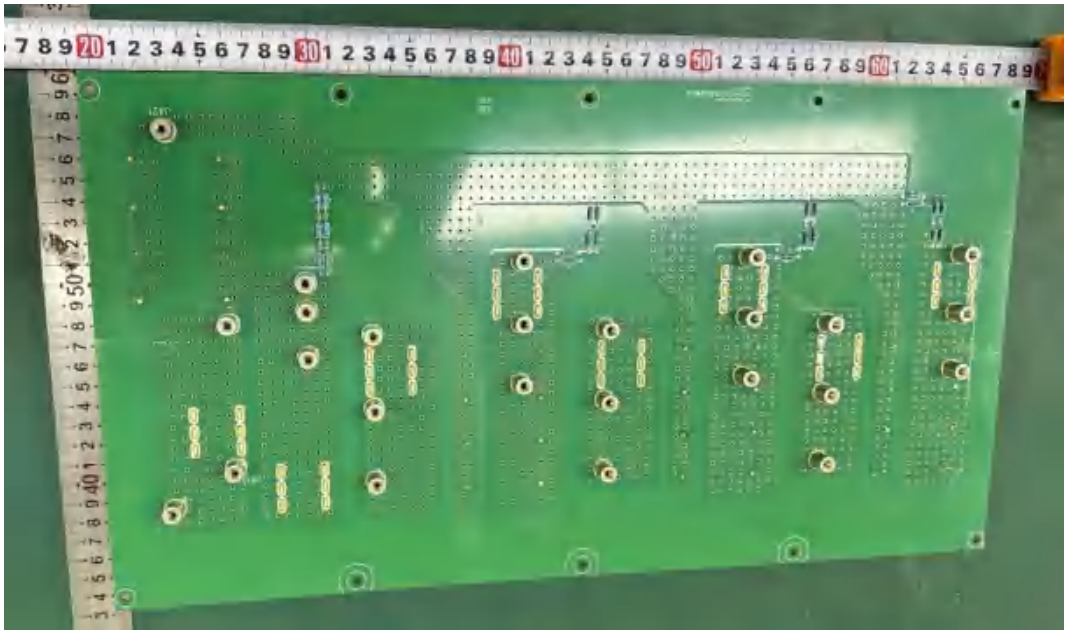


Figure 28 trace side of relay board

Figure 29 component side of terminal board

Figure 30 trace side of terminal board

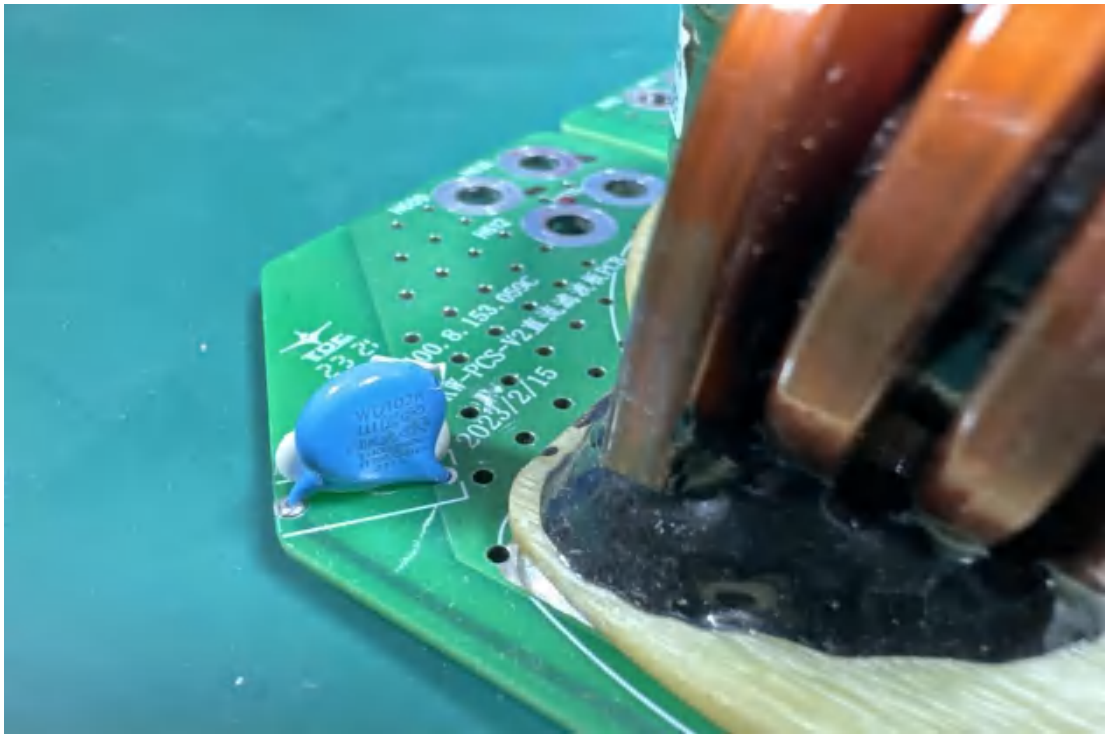


Figure 31 Y capacitor

Figure 32 Fan

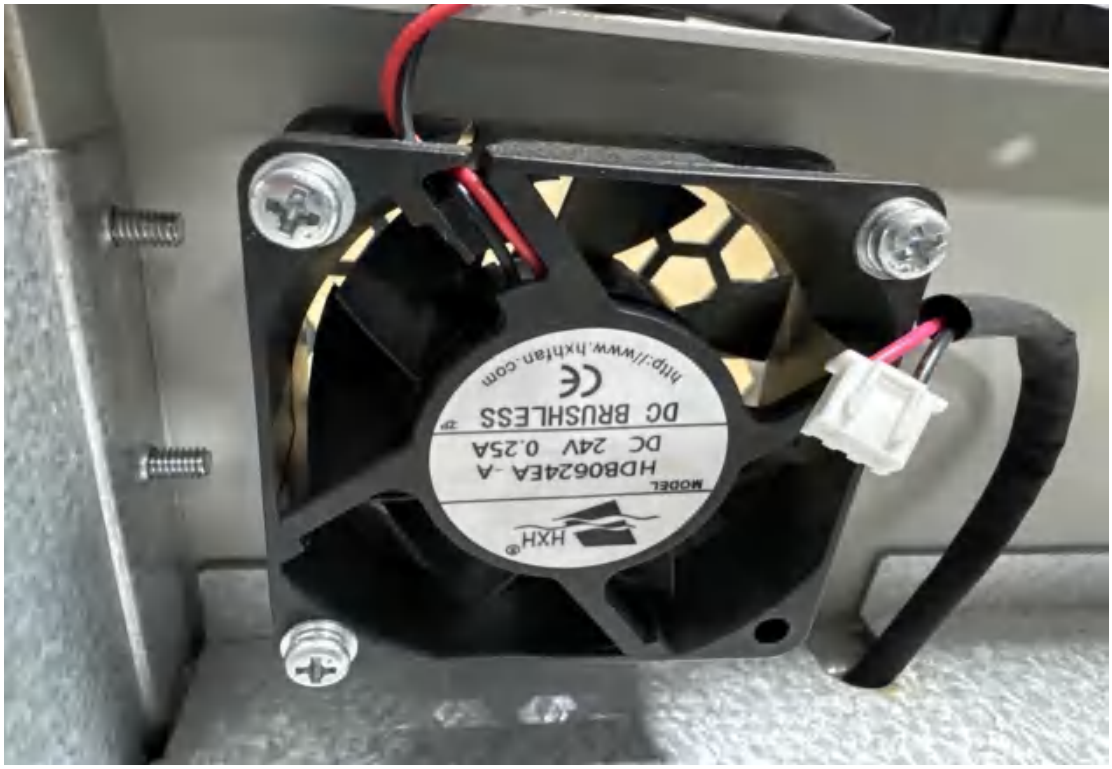


Figure 33 Fan

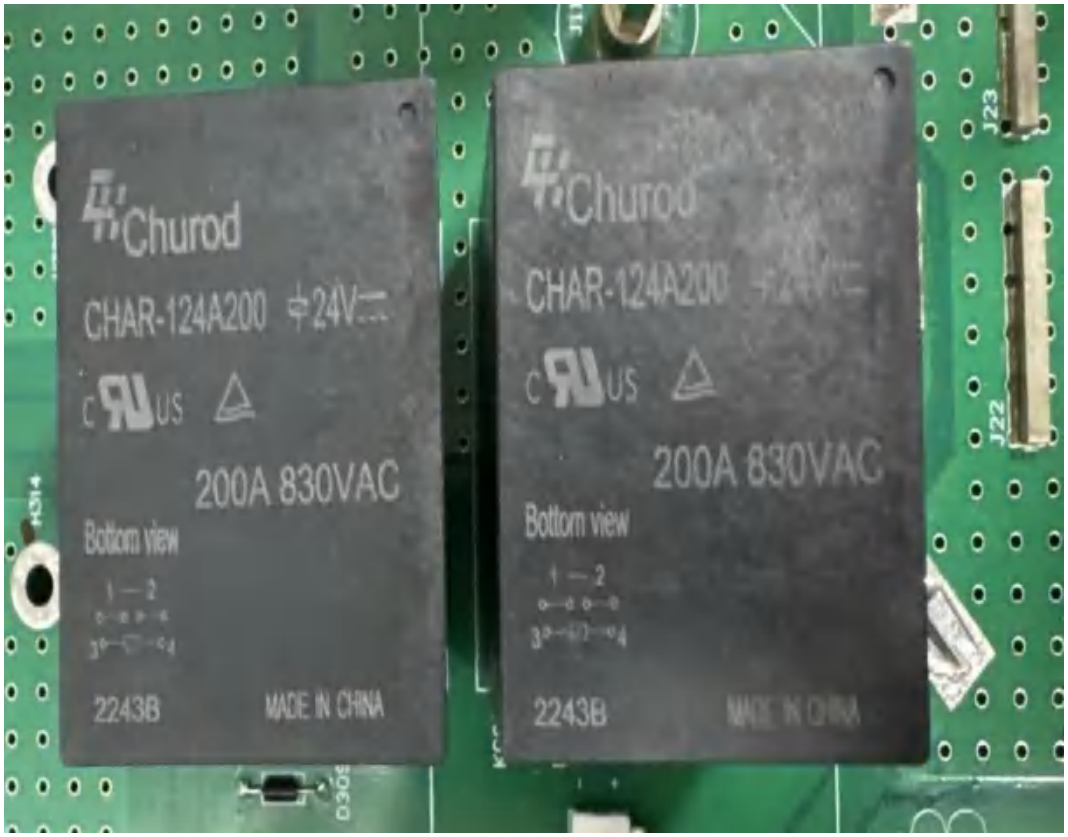


Figure 34 relay

Figure 35 DC contactor

Figure 36 Fuse

Figure 37 SPSDC power

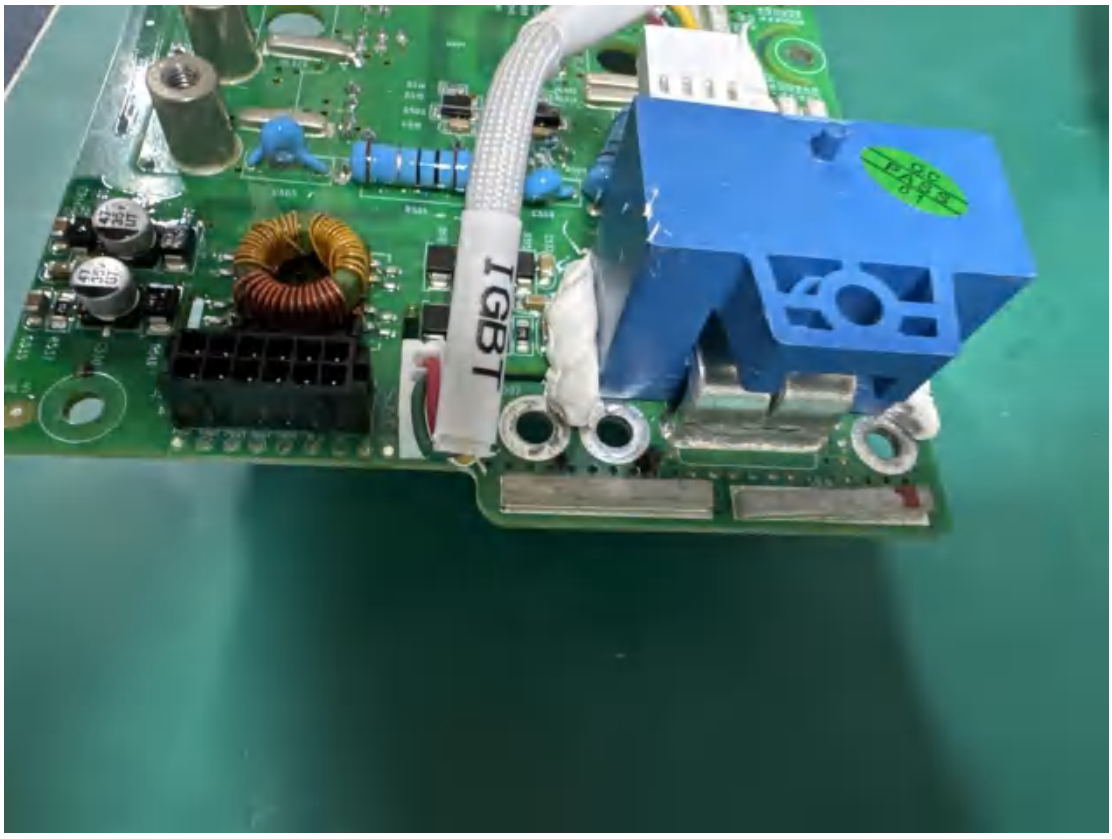


Figure 38 current sensor

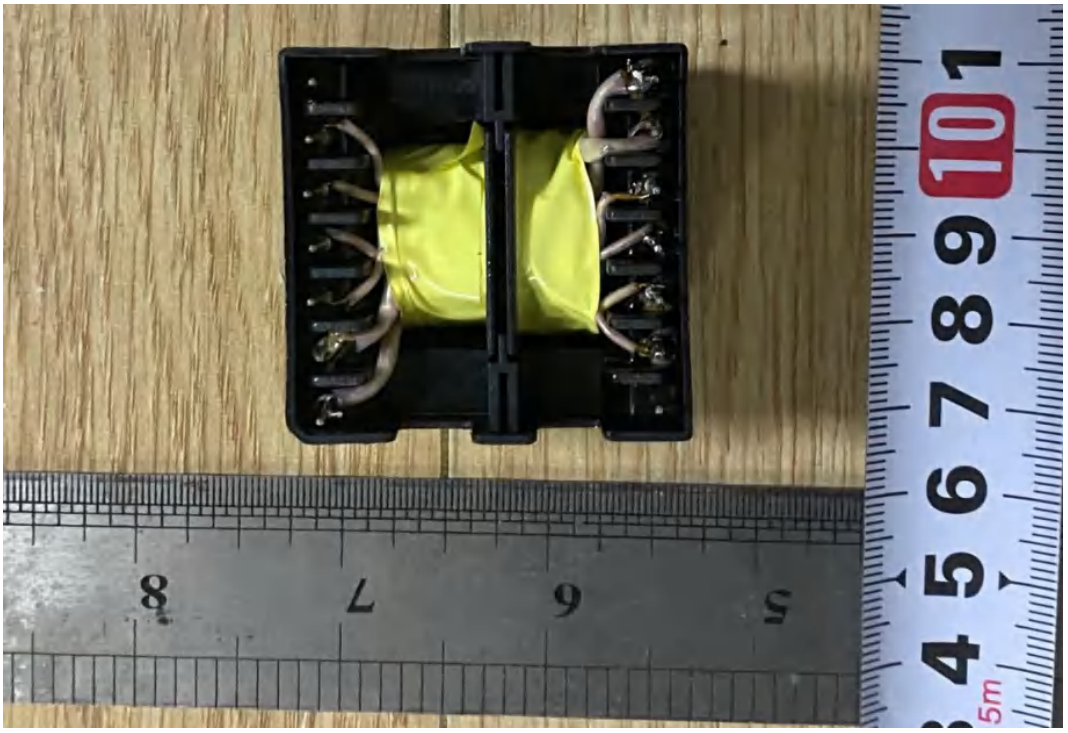


Figure 39 isolation transformer

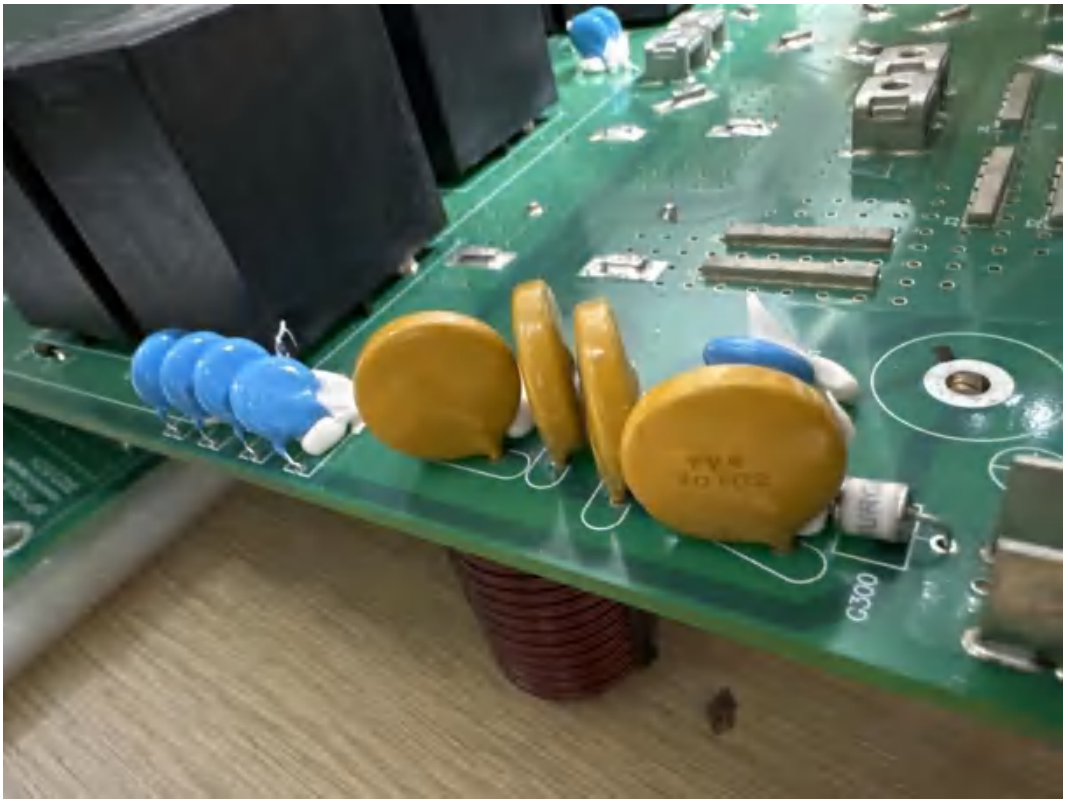


Figure 40 SPD

Figure 41 High frequency inductor

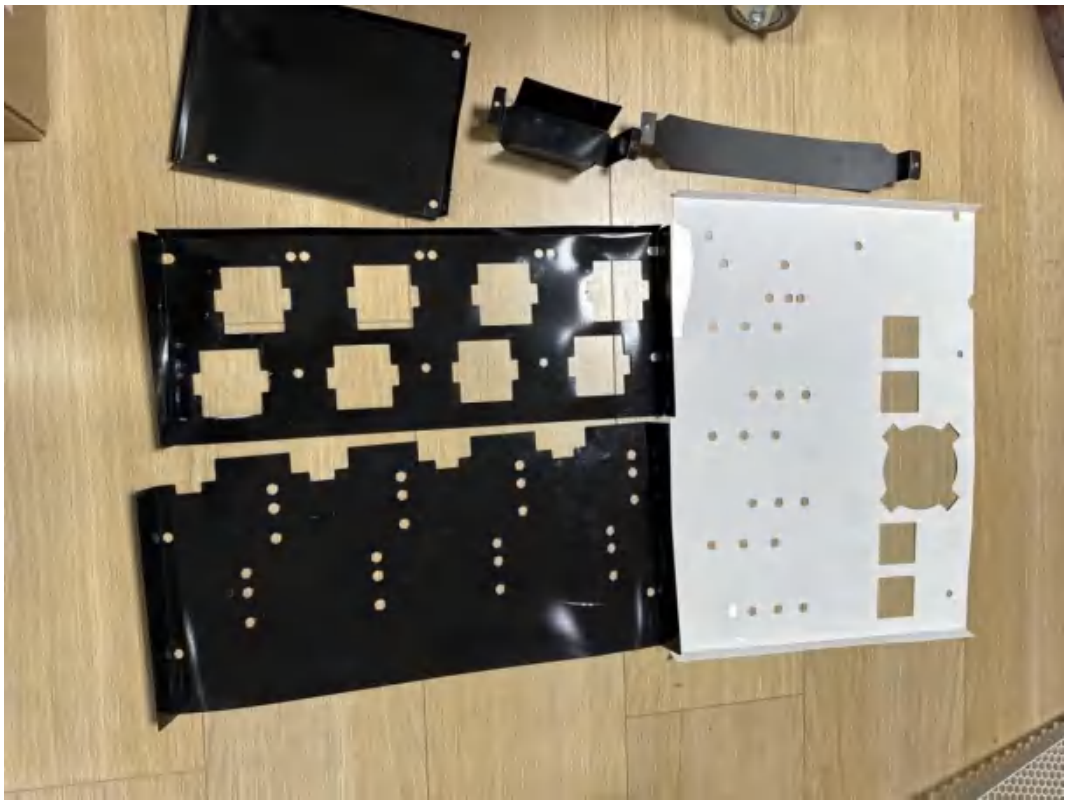


Figure 42 insulation sheets

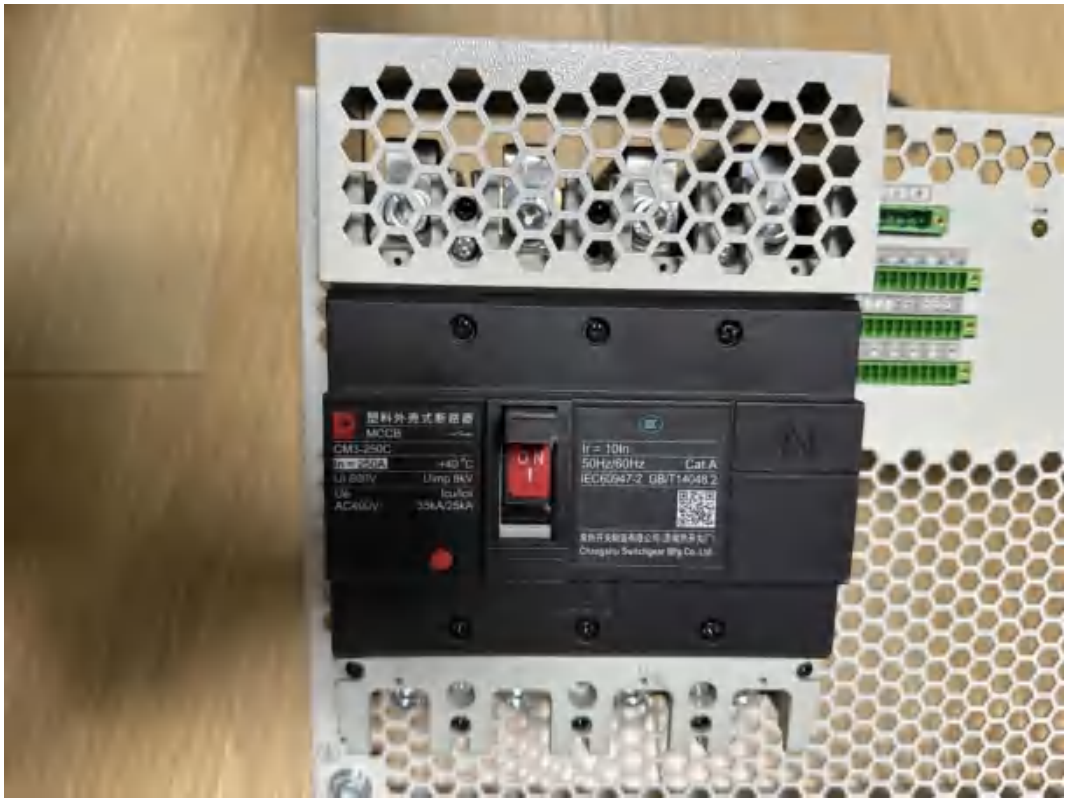


Figure 43 circuit breaker