Product Service

TEST REPORT **Standard Engineering Recommendation G99,** **Issue 1 – Amendment 6, 09 March 2020** **TUV SUD Test report for Requirements for the connection of generation equipment in parallel with public distribution networks**	
Report reference No. :	70.409.21.036.05-00
Date of issue :	2021-06-18
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Test laboratory :	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
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Testing location :	Shanghai Testing & Inspection Institute For Electrical Equipment Co., Ltd. No. 505 Wuning Road, Putuo District, 200063, Shanghai, China
Client :	Ginlong Technologies Co., Ltd.
Address :	No.57 Jintong Road, Binhai Industrial Park, Xiangshan, 315712 Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Contact person	Mr. Pan Ruyi
Standard :	This TUV SUD test report form is based on the following requirements: G99/1-6:2020
TRF originated by :	TUV SUD Certification and Testing (China) Co., Ltd. Shanghai Branch Mr. Kai Zhao
Copyright blank test report :	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service GmbH. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
Scheme :	☐ GS, ☐ TÜV Mark, ☐ EU-Directive, ☐ without certification ☒ Type verification of conformity
Non-standard test method :	☒ No ☐ Yes, see details under Summary
National deviations :	GB
Number of pages (Report) :	117
Number of pages (Attachments) :	N/A

Compiled by..... : Jianyong Li Jialin Qian

(+ signature)

Approved by.....: Kai Zhao

(+ signature)

TÜV®

Test sample.....................................:	Engineering sample
Type of test object .... :	PV Grid Tied Inverter
Trademark .... :	solis
Model and/or type reference .... :	Solis-80K-5G, Solis-100K-5G, Solis-110K-5G, S5-GC80K, S5-GC100K, S5-GC110K
Rating(s) .... :	See copy of marking plate on page 5 - 7
Manufacturer .... :	Ginlong Technologies Co., Ltd.
Address .... :	No.57 Jintong Road, Binhai Industrial Park, Xiangshan, 315712 Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Sub-contractors/ tests (clause) .... :	Shanghai Testing & Inspection Institute For Electrical Equipment Co., Ltd.
Name .... :	All clauses
Order description… .... :	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
Date of order……… .... :	2021-01-26
Date of receipt of test item .... :	2021-01-26
Date(s) of performance of test .... :	2021-01-26 to 2021-05-29

Test item particulars:

All the tests results confirmed to the requirements of the standard.

Attachments: N/A

General remarks:

"(see remark #)" refers to a remark appended to the report.
"(see appended table)" refers to a table appended to the report.
Throughout this report a point is used as the decimal separator.
The test results presented in this report relate only to the object tested.
This report shall not be reproduced except in full without the written approval of the testing laboratory.

Summary of testing:

☐ deviation(s) found

☒ no deviations found

Individual inverter assessed based on component basis.

Firmware version: V22

All models are family design products, for models differences, pls. see **Characteristic data.**

Test basis of manufacturer declaration for their products application.

☒ Type A	☒ Type B	☐ Type C	☐ Type D
A Power Generating Module with a Connection Point below 110 kV and a Registered Capacity of 0.8 kW or greater but less than 1 MW.	A Power Generating Module with a Connection Point below 110 kV and Registered Capacity of 1 MW or greater but less than 10 MW.	A Power Generating Module with a Connection Point below 110 kV and a Registered Capacity of 10 MW or greater but less than 50 MW.	A Power Generating Module with a Connection Point at or greater than 110 kV, and/or with a Registered Capacity of 50 MW or greater.

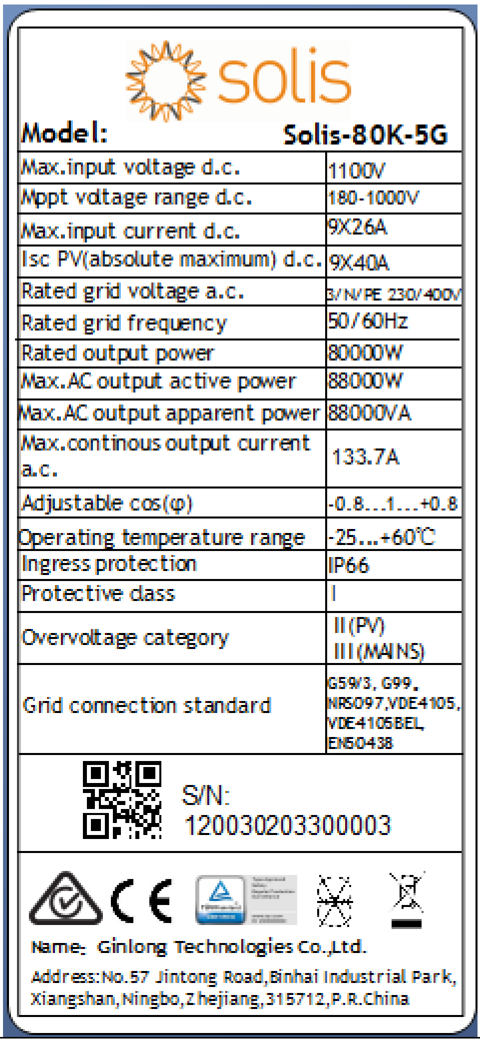
Test results provide the evidence that the capability of single PGU (representative inverter) to compliance with technical requirements for Type A and Type B Power Park Module, additional power system simulation study and compliance and commissioning testing on power park module are decided by DNO.

All tests were conducted on representative mode Solis-110K-5G of family design products, results of the measurement of Solis-110K-5G should be transferred in whole to other power generation units, test items below according to G99-1/6:2020 in details:

1) Type A Compliance Verification Report for Inverter Connected Power Generating Modules		
Clause(s)	Tests	Samples for testing in details
	Operating range	Solis-110K-5G
10.6 and A7.1.2.1	Disconnection times	Solis-110K-5G
10.6 and A7.1.2.2	Over / Under Voltage	Solis-110K-5G
10.6 and A7.1.2.3	Over / Under Frequency	Solis-110K-5G
10.6 and A7.1.2.4	Loss of Mains Protection	Solis-110K-5G
10.6 and A7.1.2.5	Re-connection	Solis-110K-5G
10.6 and A7.1.2.6	Frequency Drift and Step Change Stability test	Solis-110K-5G
A7.1.3	Limited Frequency Sensitive Mode – Over (LFSM-O)	Solis-110K-5G
A7.1.4.1	Harmonics	Solis-110K-5G
A7.1.4.2	Power Factor	Solis-110K-5G
A7.1.4.3	Voltage Flicker	Solis-110K-5G
A7.1.4.4	DC Injection	Solis-110K-5G

A.7.1.5	Short Circuit Current Contribution	Solis-110K-5G
2) Type A Power Generating Module Technical Requirements		
11.1.3	Remote disconnection with a logic interface	Solis-110K-5G
11.1.5	Reactive power capability	Solis-110K-5G
11.2.1	Capability of continuing to operate under frequency range	Solis-110K-5G
11.2.2	Rate of change of frequency withstand capability	Solis-110K-5G
11.2.3	Output power with falling frequency	Solis-110K-5G
11.2.4	Limited Frequency Sensitive Mode – Over frequency	Solis-110K-5G
11.4	Voltage Limits and Control	Solis-110K-5G
3) Type B Power Generating Module Technical Requirements		
12.1.3.5	Active power adjustment	Solis-110K-5G
12.2.1	Capability of continuing to operate under frequency range	Solis-110K-5G
12.2.2	Rate of change of frequency withstand capability	Solis-110K-5G
12.2.3	Output power with falling frequency	Solis-110K-5G
12.2.4	Limited Frequency Sensitive Mode – Over (LFSM-O)	Solis-110K-5G
12.3	Fault Ride Through and Phase Voltage Unbalance	Solis-110K-5G
12.4	Voltage Limits and Control	Solis-110K-5G
12.5	Reactive Capability	Solis-110K-5G
12.6	Fast Fault Current Injection	Solis-110K-5G

Copy of marking plate:



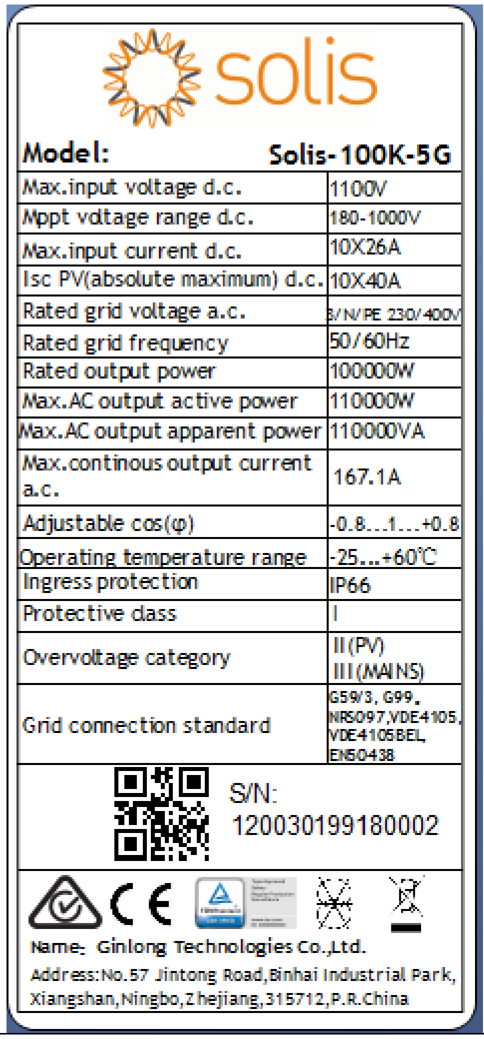
solis

Model:	Solis-80K-5G
Max.input voltage d.c.	1100V
Mppt voltage range d.c.	180-1000V
Max.input current d.c.	9X26A
Isc PV(absolute maximum) d.c.	9X40A
Rated grid voltage a.c.	3/N/PE 230/400V
Rated grid frequency	50/60Hz
Rated output power	80000W
Max.AC output active power	88000W
Max.AC output apparent power	88000VA
Max.continous output current a.c.	133.7A
Adjustable cos(φ)	-0.8…1…+0.8
Operating temperature range	-25…+60℃
Ingress protection	IP66
Protective class	I
Overvoltage category	II(PV) III(MAINS)
Grid connection standard	G59/3, G99, NRS097,VDE4105, VDE4105BEL, EN50438

S/N: 120030203300003

Name: Ginlong Technologies Co.,Ltd.

Address:No.57 Jintong Road,Binhai Industrial Park, Xiangshan,Ningbo,Zhejiang,315712,P.R.China



solis

Model:	Solis-100K-5G
Max.input voltage d.c.	1100V
Mppt voltage range d.c.	180-1000V
Max.input current d.c.	10X26A
Isc PV(absolute maximum) d.c.	10X40A
Rated grid voltage a.c.	3/N/PE 230/400V
Rated grid frequency	50/60Hz
Rated output power	100000W
Max.AC output active power	110000W
Max.AC output apparent power	110000VA
Max.continous output current a.c.	167.1A
Adjustable cos(φ)	-0.8…1…+0.8
Operating temperature range	-25…+60℃
Ingress protection	IP66
Protective class	I
Overvoltage category	II(PV) III(MAINS)
Grid connection standard	G59/3, G99, NRS097,VDE4105, VDE4105BEL, EN50438

S/N: 120030199180002

Name: Ginlong Technologies Co.,Ltd.

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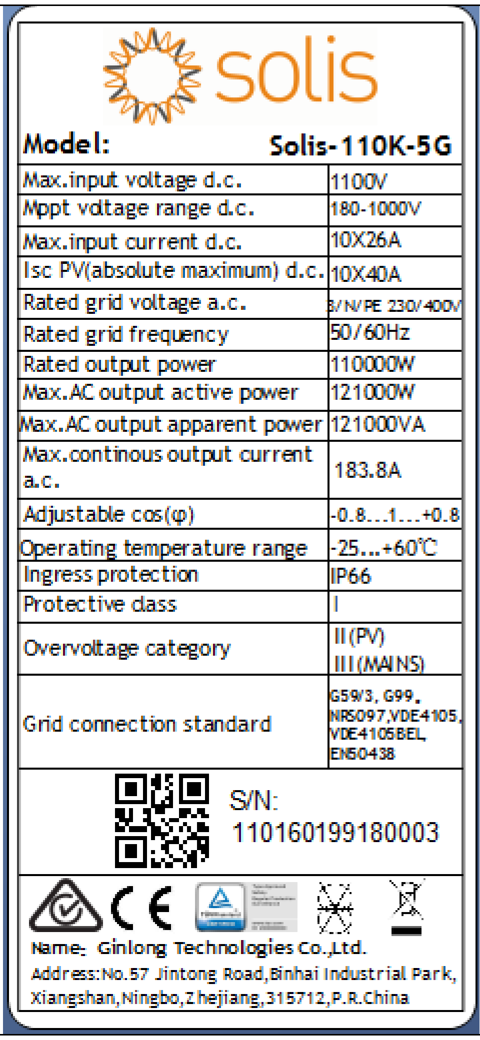
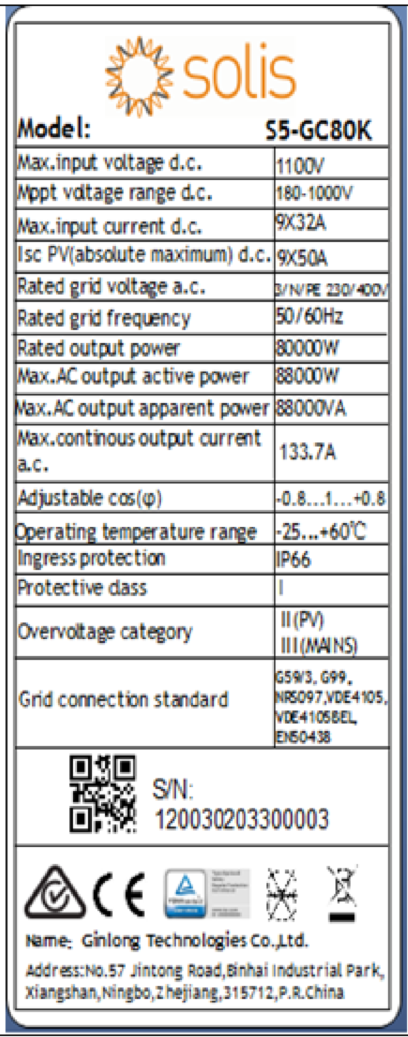
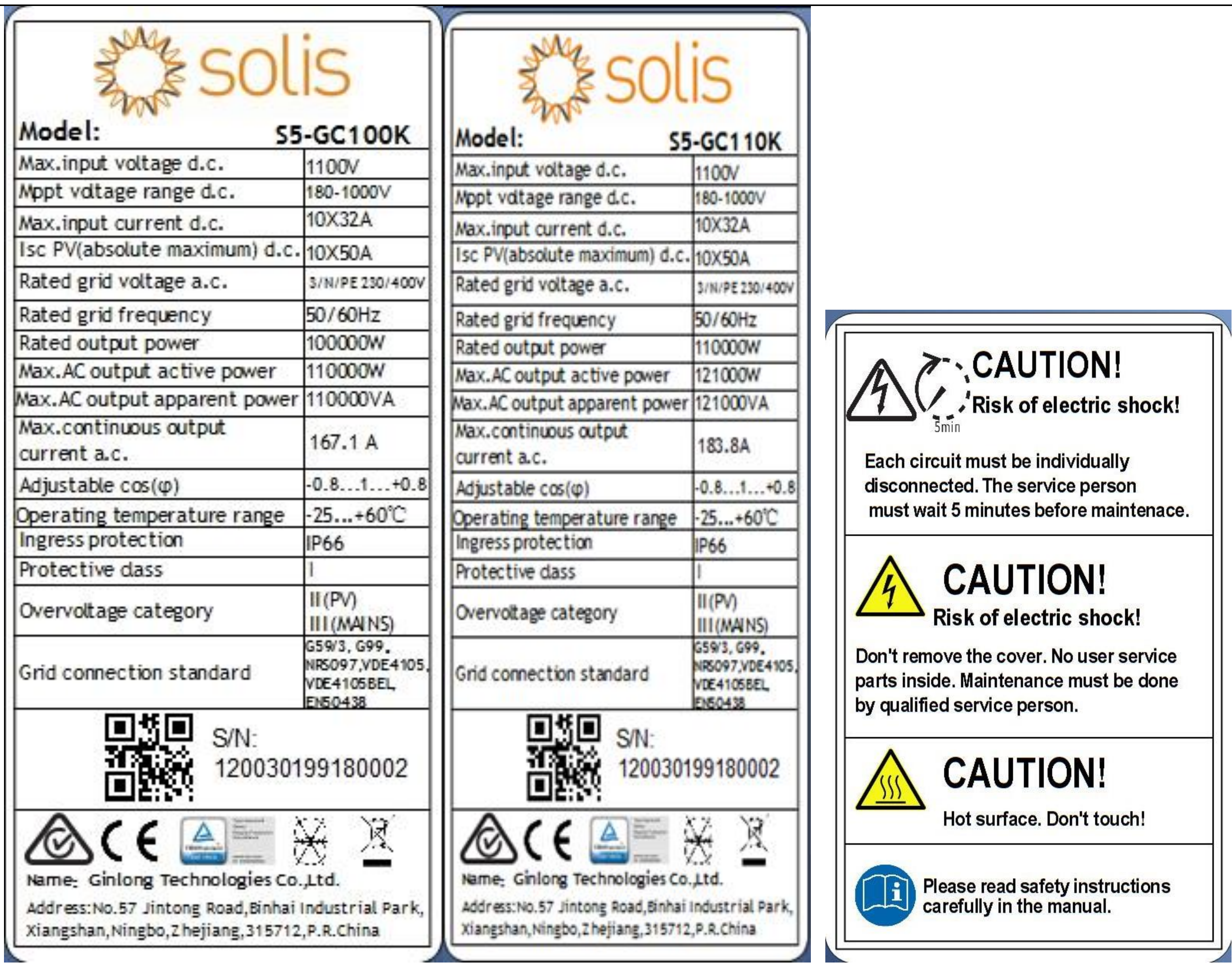

solis
Model: Solis-110K-5G
Max.input voltage d.c. 1100V
Mppt voltage range d.c. 180-1000V
Max.input current d.c. 10X26A
Isc PV(absolute maximum) d.c. 10X40A
Rated grid voltage a.c. 3/N/PE 230/400V
Rated grid frequency 50/60Hz
Rated output power 110000W
Max.AC output active power 121000W
Max.AC output apparent power 121000VA
Max.continous output current a.c. 183.8A
Adjustable cos(φ) -0.8…1…+0.8
Operating temperature range -25…+60℃
Ingress protection IP66
Protective class I
Overvoltage category II(PV) III(MAINS)
Grid connection standard G59/3, G99, NRS097,VDE4105, VDE4105BEL, EN50438
S/N: 110160199180003
Name: Ginlong Technologies Co.,Ltd.
Address:No.57 Jintong Road,Binhai Industrial Park, Xiangshan,Ningbo,Zhejiang,315712,P.R.China


solis
Model: S5-GC80K
Max.input voltage d.c. 1100V
Mppt voltage range d.c. 180-1000V
Max.input current d.c. 9X32A
Isc PV(absolute maximum) d.c. 9X50A
Rated grid voltage a.c. 3/N/PE 230/400V
Rated grid frequency 50/60Hz
Rated output power 80000W
Max.AC output active power 88000W
Max.AC output apparent power 88000VA
Max.continous output current a.c. 133.7A
Adjustable cos(φ) -0.8…1…+0.8
Operating temperature range -25…+60℃
Ingress protection IP66
Protective class I
Overvoltage category II(PV) III(MAINS)
Grid connection standard G59/3, G99, NRS097,VDE4105, VDE4105BEL, EN50438
S/N: 120030203300003
Name: Ginlong Technologies Co.,Ltd.
Address:No.57 Jintong Road,Binhai Industrial Park, Xiangshan,Ningbo,Zhejiang,315712,P.R.China



Marking plate material: pressure-sensitive unprinted label stocks stamped into aluminium surface; Suitable for outdoor use with respect to exposure to Ultraviolet Light, Water Exposure and thermal transfer printed label stock applications, -60°C to 95°C
An additional PET film provided to cover label.

Picture of the product

Representative model Solis-110K-5G

Front

Front/left inclined

Internal view

Characteristic data(following data are exact from user manual directly for reference)

Max. input voltage:	1100 Vd.c.
Mppt voltage range:	180-1000 Vd.c.
Max. input current:	9 x 26 A (Solis-80K-5G), 9 x 32 A (S5-GC80K), 10 x 26 A (Solis-100K-5G, Solis-110K-5G), 10 x 32 A (S5-GC100K, S5-GC110K)
Isc PV(absolute maximum):	9 x 40 A (Solis-80K-5G), 9 x 50 A (S5-GC80K), 10 x 40 A (Solis-100K-5G, Solis-110K-5G), 10 x 50 A (S5-GC100K, S5-GC110K)
Rated grid voltage:	3/N/PE~, 230/400 V
Rated grid frequency:	50 Hz
Rated output power:	80000 W (Solis-80K-5G), 100000 W (Solis-100K-5G), 110000 W (Solis-110K-5G), 80000 W (S5-GC80K), 100000 W (S5-GC100K), 110000 W (S5-GC110K)
Max. AC output active power:	88000 W (Solis-80K-5G), 110000 W (Solis-100K-5G), 121000 W (Solis-110K-5G), 88000 W (S5-GC80K), 110000 W (S5-GC100K), 121000 W (S5-GC110K)

Max. AC output apparent power:	88000 VA (Solis-80K-5G), 110000 VA (Solis-100K-5G), 121000 VA (Solis-110K-5G), 88000 VA (S5-GC80K), 110000 VA (S5-GC100K), 121000 VA (S5-GC110K)
Max. continuous output current:	133.7 A (Solis-80K-5G), 167.1 A (Solis-100K-5G), 183.8 A (Solis-110K-5G), 133.7 A (S5-GC80K), 167.1 A (S5-GC100K), 183.8 A (S5-GC110K)
Adjustable displacement factor:	-0.8…1…+0.8
Operating temperature Range:	-25 °C…+60 °C
Ingress Protection:	IP66
Protective Class:	I
Overvoltage category:	II(PV), III(Mains)
Inverter topology:	Non-isolated

Characteristic data Factory:

Note: Type verification of conformity, no FI required.

Purpose of the product

These device are transformer-less grid-connected PV inverters which convert direct current optimized by photovoltaic DC conditioner to alternating current, and they are intended to be connected in parallel with the public LV distribution grid directly to supply common load.

They are intended for professional incorporation into PV system, and they are assessed on a component test basis.

Possible test case verdicts:

- test case does not apply to the test object .... :	N/A (not applicable / not included in the order)
- test object does meet the requirement....................... :	P (Pass)
- test object does not meet the requirement................. :	F (Fail)

Possible suffixes to the verdicts:

- suffix for detailed information for the client……………..:	- C (Comment)
- suffix for important information for factory inspection...:	- M (Manufacturing)

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Clause	Requirement – Test	Result – Remark	Verdict

6	**Connection Application**		N/A
6.1	General	Type test of PGU only, take into condsideration in applicable connection application stage	N/A
6.1.1	This document describes the processes that shall be adopted for both connection of a single Power Generating Module and installations that comprise of a number of Power Generating Modules.		N/A
6.1.2	Type A Power Generating Module(s) ≤ 16A per phase and EREC G98 compliant		N/A
6.1.3	Power Park Modules		N/A
6.1.4	Synchronous Power Generating Modules		N/A
6.1.5	Illustrative examples		N/A
6.1.6	Interaction with the NETSO		N/A
6.2	Application for Connection		N/A
6.2.1	Information about the Power Generating Module(s) is needed by the DNO so that it can assess the effect that a Power Generating Facility may have on the Distribution Network. This document details the parameters to be supplied by a Generator wishing to connect Power Generating Module(s) that do not comply with EREC G98 to a Distribution Network. This document also enables the DNO to request more detailed information if required.		N/A
6.2.2	Integrated Micro Generation and Storage procedure		N/A
6.2.3	Power Generating Facilities which include Type A Power Generating Modules		N/A
6.2.4	Power Generating Facilities which include Type B, Type C or Type D Power Generating Modules		N/A
6.3	System Analysis for Connection Design Type A, Type B, Type C and Type D		N/A
6.4	Provision of Information		N/A
6.4.1	General		N/A
6.4.2	Information Required for all Type A, Type B, Type C and Type D Power Generating Facilities		N/A
6.4.3	Additional Power Generating Module, Plant and Equipment Data Required for some Power Generating Facilities		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
6.4.4	Extra Information for Embedded Medium Power Stations to be Provided to Meet Grid Code Requirements		N/A
6.4.5	Information Provided by the DNO to Generators		N/A
7	**Connection Arrangements**		P
7.1	Operating Modes		P
7.2	Long-Term Parallel Operation	Operation in this mode only	P
7.3	Infrequent Short-Term Parallel Operation		N/A
7.4	Switched Alternative-Only Operation		N/A
7.4.1	General		N/A
7.4.2	Changeover Operated at HV		N/A
7.4.3	Changeover Operated at LV		N/A
7.5	Phase Balance of Type A Power Generating Module output at LV	Three phase balanced inverter unit	P
7.6	Type A Power Generating Module capacity for single and split LV phase supplies	Three phase balanced inverter unit	N/A
7.7	Voltage Management Units in Generator's Installation	Integrated into inverter unit and external unit maybe required in final installations	P
8	**Earthing**		N/A
8.1	The earthing arrangements of the Power Generating Module shall satisfy the requirements of DPC4 of the Distribution Code.	Take into consideration in final installations	N/A
8.2	Power Generating Modules with a Connection Point at HV	Take into consideration in final installations	N/A
8.3	Power Generating Modules with a Connection Point at LV	Take into consideration in final installations	N/A
9	**Network Connection Design and Operation**		P
9.1	General Criteria	Inverter unit type tested	P
9.2	Network Connection Design for Power Generating Modules		P
9.3	Step Voltage Change and Rapid Voltage Change		P
9.4	Power Quality		P
9.4.1	The connection and operation of Power Generating Modules may cause Phase (Voltage)		P

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict

	Unbalance and/or a distortion of the Distribution Network voltage waveform resulting in voltage fluctuations and harmonics		
9.4.2	Flicker	See appendix table	P
9.4.3	Harmonic Emissions	See appendix table	P
9.4.4	Voltage imbalance	See appendix table	P
9.4.5	Power factor	See appendix table	P
9.4.6	DC Injection	See appendix table	P
9.5	System Stability		N/A
9.6	Island Mode	Not operated in this mode	N/A
9.7	Fault Contributions and Switchgear Considerations	Take into consideration in final installation	N/A

10	**Protection**		P
10.1	General	Inverter unit type tested	P
10.2	Co-ordinating with DNO's Distribution Network's Existing Protection		P
10.3	Protection Requirements		P
10.4	Loss of Mains (LoM)		P
10.5	Additional DNO Protection	Take into consideration in final installation	N/A
10.6	Protection Settings		P
10.6.1	The following notes aim to explain the settings requirements as given in Section 10.6.7 below	LV protection	P
10.6.2	Loss of Mains	See appendix table	P
10.6.3	Under Voltage	See appendix table	P
10.6.4	Over Voltage	See appendix table	P
10.6.5	Over Frequency	See appendix table	P
10.6.6	Under Frequency	See appendix table	P
10.6.7	Protection Settings	Settings for Long-Term Parallel Operation applicable	P
10.6.8	Over and Under voltage protection must operate independently for all three phases in all cases		P
10.6.9	The settings in Table 10.1 should generally be applied to all Power Generating Modules. In exceptional circumstances Generators have the option to agree alternative settings with the DNO if there are valid justifications in that the Power		P

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	Generating Module may become unstable or suffer damage with the settings specified in Table 10.1. The agreed settings should be recorded in the Connection Agreement		
10.6.10	Once the settings of relays have been agreed between the Generator and the DNO they must not be altered without the written agreement of the DNO. Any revised settings should be recorded again in the amended Connection Agreement		P
10.6.11	The under/over voltage and frequency protection may be duplicated to protect the Power Generating Module when operating in island mode although different settings may be required		N/A
10.6.12	For LV connected Power Generating Modules the voltage settings will be based on the 230 V nominal system voltage. In some cases Power Generating Modules may be connected to LV systems with non-standard operating voltages. Paragraph 10.6.14 details how suitable settings can be calculated based upon the HV connected settings in Table 10.1. Note that Power Generating Modules with non-standard LV protection settings need to be agreed by the DNO on a case by case basis		N/A
10.6.13	Where an installation contains Power Factor correction equipment which has a variable susceptance controlled to meet the Reactive Power demands, the probability of sustained generation is increased. For LV installations, additional protective equipment provided by the Generator, is required as in the case of self-excited asynchronous machines		N/A
10.6.14	Non-Standard private LV networks calculation of appropriate protection settings		N/A
10.6.15	The Generator shall provide a means of displaying the protection settings so that they can be inspected if required by the DNO to confirm that the correct settings have been applied. The Manufacturer needs to establish a secure way of displaying the settings in one of the following ways:		P
	a) A display on a screen which can be read;		P
	b) A display on an electronic device which can communicate with the Power Generating Module and confirm that it is the correct device by means of a Identification number / name permanently fixed to the device and		P

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Clause	Requirement – Test	Result – Remark	Verdict
	visible on the electronic device screen at the same time as the settings;		
	c) Display of all settings including nominal voltage and current outputs, alongside the identification number / name of the device, permanently fixed to the Power Generating Module.		N/A
10.6.16	Whilst the protection schemes and settings for internal electrical faults should mitigate any damage to the Power Generating Module they must not jeopardise the performance of a Power Generating Module, in line with the requirements set out in this EREC		P
10.6.17	The Generator shall organise its protection and control devices in accordance with the following priority ranking (from highest to lowest) for Type B, Type C and Type D Power Generating Modules		P
	(a) network and Power Generating Module protection; (b) synthetic inertia, if applicable; (c) frequency control (Active Power adjustment - if any); (d) power restriction (if any); and (e) power gradient constraint (if any).	Considered	P
10.6.18	For the avoidance of doubt where an internal fault on the Power Generating Module occurs during any significant event on the Total System, the Power Generating Module's internal protection should trip the module to ensure safety and minimise damage to the Power Generating Module.		P
10.7	Typical Protection Application Diagrams	Noticed	N/A

11	**Type A Power Generating Module Technical Requirements**		P
11.1	Power Generating Module Performance and Control Requirements – General		P
11.1.1	The requirements of this Section 11 do not apply in full to:		N/A
	(a) Power Generation Facilities that are designed and installed for infrequent short term parallel operation only; or (b) Electricity Storage Power Generation Modules within the Power Generating Facility.		N/A
11.1.2	The Active Power output of a Power Generating Module should not be affected by voltage changes within the statutory limits declared by		P

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	the DNO in accordance with the ESQCR.		
11.1.3	Power Generating Modules connected to the DNO's Distribution Network shall be equipped with a logic interface (input port) in order to cease Active Power output within 5 s following an instruction being received at the input port.		P
11.1.4	Each item of a Power Generating Module and its associated control equipment must be designed for stable operation in parallel with the Distribution Network.		P
11.1.5	When operating at rated power the Power Generating Module shall be capable of operating at a Power Factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the DNO.		P
11.1.6	As part of the connection application process the Generator shall agree with the DNO the set points of the control scheme for voltage control, Power Factor control or Reactive Power control as appropriate. These settings, and any changes to these settings, shall be agreed with the DNO and recorded in the Connection Agreement. The information to be provided is detailed in Schedule 5a and Schedule 5b of the Data Registration Code.		P
11.1.7	Load flow and System Stability studies may be necessary to determine any output constraints or post fault actions necessary for n-1 fault conditions and credible n-2 conditions (where n-1 and n-2 conditions are the first and second outage conditions as, for example, specified in EREC P2) involving a mixture of fault and planned outages. The Connection Agreement should include details of the relevant outage conditions. It may be necessary under these fault conditions, where the combination of Power Generating Module output, load and through flow levels leads to circuit overloading, to rapidly disconnect or constrain the Power Generating Module.		N/A
11.2	Frequency response		P
11.2.1	Under abnormal conditions automatic low-frequency load-shedding provides for load reduction down to 47 Hz.		P
	In exceptional circumstances, the frequency of the DNO's Distribution Network could rise above 50.5 Hz. Therefore all Power Generating Modules should be capable of continuing to operate in parallel with the Distribution Network in accordance with the following:		P

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	(a) 47 Hz – 47.5 Hz Operation for a period of at least 20 s is required each time the frequency is within this range.		P
	(b) 47.5 Hz – 49.0 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range.		P
	(c) 49.0 Hz – 51.0 Hz Continuous operation of the Power Generating Module is required		P
	(d) 51.0 Hz –51.5 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range.		P
	(e) 51.5 Hz – 52 Hz Operation for a period of at least 15 minutes is required each time the frequency is within this range		P
11.2.2	With regard to the rate of change of frequency withstand capability, a Power Generating Module shall be capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hz/s as measured over a period of 500 ms unless disconnection was triggered by a rate of change of frequency type loss of mains protection or by the Power Generating Module's own protection system for a co-incident internal fault as detailed in paragraph 10.6.18.		P
11.2.3	Output power with falling frequency		P
11.2.4	Limited Frequency Sensitive Mode – Over frequency		P
11.3	Fault Ride Through and Phase Voltage Unbalance		P
11.3.1	Where it has been specifically agreed between the DNO and the Generator that a Power Generating Facility will contribute to the DNO's Distribution Network security, (eg for compliance with EREC P2) the Power Generating Module(s) may be required to withstand, without tripping, the effects of a close up three phase fault and the Phase (Voltage) Unbalance imposed during the clearance of a close-up phase-to-phase fault, in both cases cleared by the DNO's main protection. The DNO will advise the Generator in each case of the likely tripping time of the DNO's protection, and for phase-phase faults, the likely value of Phase (Voltage) Unbalance during the fault clearance time.		P
11.3.2	In the case of phase to phase faults on the DNO's system that are cleared by system back-		P

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Clause	Requirement – Test	Result – Remark	Verdict
	up protection which will be within the plant short time rating on the DNO's Distribution Network the DNO, on request during the connection process, will advise the Generator of the expected Phase (Voltage) Unbalance.		
11.4	Voltage Limits and Control		P
11.4.1	Where a Power Generating Module is remote from a Network voltage control point it may be required to withstand voltages outside the normal statutory limits. In these circumstances, the DNO should agree with the Generator the declared voltage and voltage range at the Connection Point. Immunity of the Power Generating Module to voltage changes of ± 10% of the declared voltage is recommended, subject to design appraisal of individual installations.		P
11.4.2	The connection of a Power Generating Module to the Distribution Network shall be designed in such a way that operation of the Power Generating Module does not adversely affect the voltage profile of and voltage control employed on the Distribution Network. ETR 126 provides DNOs with guidance on active management solutions to overcome voltage control limitations. Information on the voltage regulation and control arrangements will be made available by the DNO if requested by the Generator.		P
11.4.3	The final responsibility for control of Distribution Network voltage does however remain with the DNO.		P
11.4.4	Automatic Voltage Control (AVC) schemes employed by the DNO often assume that power flows from parts of the Distribution Network operating at a higher voltage to parts of the Distribution Network operating at lower voltages. Export from Power Generating Modules in excess of the local loads may result in power flows in the reverse direction. In this case AVC referenced to the low voltage side may not operate correctly without an import of Reactive Power and relay settings appropriate to this operating condition. When load current compounding is used with the AVC and the penetration level of Power Generating Modules becomes significant compared to normal loads, it may be necessary to switch any compounding out of service.		N/A
11.4.5	Power Generating Modules can cause problems if connected to networks employing AVC schemes which use negative reactance compounding and line drop compensation due to		N/A

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Clause	Requirement – Test	Result – Remark	Verdict

	changes in Active Power and Reactive Power flows. ETR 126 provides guidance on connecting generation to such networks using techniques such as removing the generation circuit from the AVC scheme using cancellation CTs.		

12	**Type B Power Generating Module Technical Requirements**		P
12.1	Power Generating Module Performance and Control Requirements - General		P
12.1.1	The requirements of this Section 12 do not apply in full to: (a) Power Generation Facilities that are designed and installed for infrequent short term parallel operation only; or (b) Electricity Storage Power Generation Modules within the Power Generating Facility.		P
12.1.2	The Active Power output of a Power Generating Module should not be affected by voltage changes within the statutory limits declared by the DNO in accordance with the ESQCR.		P
12.1.3	Power Generating Modules shall be equipped with a communication interface (input port) in order to be able to reduce Active Power output following an instruction at the input port.		P
12.1.4	The Power Generating Module and its associated control equipment must be designed for stable operation in parallel with the Distribution Network.		P
12.1.5	Load flow and System Stability studies may be necessary to determine any output constraints or post fault actions necessary for n-1 fault conditions and credible n-2 conditions (where n-1 and n-2 conditions are the first and second outage conditions as, for example, specified in EREC P2) involving a mixture of fault and planned outages. The Connection Agreement should include details of the relevant outage conditions. It may be necessary under these fault conditions, where the combination of Power Generating Module output, load and through flow levels leads to circuit overloading, to rapidly disconnect or constrain the Power Generating Module.		N/A
12.2	Frequency response		P
12.2.1	Under abnormal conditions automatic low-frequency load-shedding provides for load reduction down to 47 Hz. In exceptional		P

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Clause	Requirement – Test	Result – Remark	Verdict
	circumstances, the frequency of the DNO's Distribution Network could rise above 50.5 Hz. Therefore all Power Generating Modules should be capable of continuing to operate in parallel with the Distribution Network in accordance with the following:		
	(a) 47 Hz – 47.5 Hz Operation for a period of at least 20 s is required each time the frequency is within this range.		P
	(b) 47.5 Hz – 49.0 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range.		P
	(c) 49.0Hz – 51.0 Hz Continuous operation of the Power Generating Module is required.		P
	(d) 51.0 Hz –51.5 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range.		P
	(e) 51.5 Hz – 52 Hz Operation for a period of at least 15 minutes is required each time the frequency is within this range.		P
12.2.2	With regard to the rate of change of frequency withstand capability, a Power Generating Module shall be capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms unless disconnection was triggered by a rate of change of frequency type loss of mains protection or by the Power Generating Module's own protection system for a co-incident internal fault as detailed in paragraph 10.6.18.		P
12.2.3	Output power with falling frequency		P
12.2.4	Limited Frequency Sensitive Mode – Over frequency		P
12.3	Fault Ride Through and Phase Voltage Unbalance		P
12.3.1	Paragraphs 12.3.1.1 to 12.3.1.7 inclusive set out the Fault Ride Through, principles and concepts applicable to Synchronous Power Generating Modules and Power Park Modules, subject to disturbances from faults on the Network up to 140 ms in duration.		P
12.3.2	In addition to paragraphs 12.3.1.1 – 12.3.1.7, where it has been specifically agreed between the DNO and the Generator that a Power Generating Facility will contribute to the DNO's Distribution Network security (eg for compliance with EREC P2) the Power Generating Module(s)		P

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Clause	Requirement – Test	Result – Remark	Verdict
	may be required to withstand, without tripping, the effects of a close up three phase fault and the Phase (Voltage) Unbalance imposed during the clearance of a close-up phase-to-phase fault, in both cases cleared by the DNO's main protection. The DNO will advise the Generator in each case of the likely tripping time of the DNO's protection, and for phase-phase faults, the likely value of Phase (Voltage) Unbalance during the fault clearance time.		
12.3.3	In the case of phase to phase faults on the DNO's system that are cleared by system back-up protection which will be within the plant short time rating on the DNO's Distribution Network the DNO, on request during the connection process, will advise the Generator of the expected Phase (Voltage) Unbalance.		P
12.3.4	Other Fault Ride Through Requirements		P
	(a) In the case of a Power Park Module, the requirements in this Section 12.3. do not apply when the Power Park Module is operating at less than 5% of its Registered Capacity or during very high primary energy source conditions when more than 50% of the Generating Units in a Power Park Module have been shut down or disconnected under an emergency shutdown sequence to protect Generator's plant and apparatus.		P
	(b) For the avoidance of doubt the requirements specified in this Section 12.3 do not apply to Power Generating Modules connected to an unhealthy circuit and islanded from the Distribution Network even for delayed auto reclosure times.		P
12.4	Voltage Limits and Control		P
12.4.1	Where a Power Generating Module is remote from a Network voltage control point it may be required to withstand voltages outside the normal statutory limits. In these circumstances, the DNO should agree with the Generator the declared voltage and voltage range at the Connection Point. Immunity of the Power Generating Module to voltage changes of ± 10% of the declared voltage is recommended, subject to design appraisal of individual installations.		P
12.4.2	The connection of a Power Generating Module to the Distribution Network shall be designed in such a way that operation of the Power Generating Module does not adversely affect the voltage profile of and voltage control employed		P

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Clause	Requirement – Test	Result – Remark	Verdict
	on the Distribution Network. ETR 126 provides DNOs with guidance on active management solutions to overcome voltage control limitations. Information on the voltage regulation and control arrangements will be made available by the DNO if requested by the Generator.		
12.4.3	Excitation Performance Requirements		N/A
12.4.4	The final responsibility for control of Distribution Network voltage does however remain with the DNO.		N/A
12.4.5	Automatic Voltage Control (AVC) schemes employed by the DNO often assume that power flows from parts of the Distribution Network operating at a higher voltage to parts of the Distribution Network operating at lower voltages. Export from Power Generating Modules in excess of the local loads may result in power flows in the reverse direction. In this case AVC referenced to the low voltage side may not operate correctly without an import of Reactive Power and relay settings appropriate to this operating condition. When load current compounding is used with the AVC and the penetration level of Power Generating Modules becomes significant compared to normal loads, it may be necessary to switch any compounding out of service.		N/A
12.4.6	Power Generating Modules can cause problems if connected to networks employing AVC schemes which use negative reactance compounding and line drop compensation due to changes in Active Power and Reactive Power flows. ETR 126 provides guidance on connecting generation to such networks using techniques such as removing the generation circuit from the AVC scheme using cancellation CTs.		N/A
12.5	Reactive Capability		P
12.5.1	When supplying Registered Capacity all Power Generating Modules must be capable of continuous operation at any points between the limits of 0.95 Power Factor lagging and 0.95 Power Factor leading at the Connection Point or the Generating Unit terminals as appropriate for the Power Generating Facility and as agreed with the DNO.		P
12.5.2	At Active Power output levels other than Registered Capacity, all Synchronous Power Generating Modules or Generating Units within a Power Park Module must be capable of continuous operation at any point between the		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Reactive Power capability limits identified on the Generator Performance Chart. Generators should take any site demand such as auxiliary supplies and the Active Power and Reactive Power losses of the Power Generating Module transformer or Station Transformer into account unless advised otherwise by the DNO.		
12.6	Fast Fault Current Injection		P
12.6.1	Fast Fault Current injection is necessary to support the Total System during a fault on the Transmission System. The design of Fast Fault Current injection is tailored to this, and does not relate directly to faults on the Distribution Network, not least as those will tend to have longer clearing times than those of the Transmission System for which Fast Fault Current injection is designed. In this Section 12.6 the faults referred to are Transmission System faults which clear within 140 ms and which will be seen in the Distribution Network as a voltage depression.		P
12.6.2	Each Power Park Module shall be required to satisfy the following requirements:		P
	(a) For any balanced or unbalanced fault on the Transmission System which results in the voltage at the Connection Point falling below 0.9 pu each Power Park Module shall, unless otherwise agreed with the DNO, be required to inject a current above the shaded area shown in Figure 12.5 (a) and Figure 12.5 (b). For the purposes of this requirement, the maximum rated current is taken to be the maximum current each Generating Unit can supply when operating at Registered Capacity and 0.95 Power Factor at a nominal voltage of 1.0 pu. For example, in the case of a 1 MW Power Park Module the Registered Capacity would be taken as 1 MW and the rated Reactive Power would be taken as 0.33 MVAr (ie Rated MW output operating at 0.95 Power Factor lead or 0.95 Power Factor lag) giving a MVA rating of 1.05 MVA. For the avoidance of doubt, where the phase voltage at the Connection Point is not zero, the injected current shall be in proportion to the retained voltage at the Connection Point but shall still be required to remain above the shaded area in Figure 12.5(a) and Figure 12.5(b).		P
	(b) In addition, the injected current from each Power Park Module shall be in proportion and remain in phase with the change in system voltage at the Connection Point during the period of the voltage depression. For the avoidance of		P

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Clause	Requirement – Test	Result – Remark	Verdict
	doubt, the injected current will be purely reactive for a retained voltage of zero and the reactive component of the injected current will fall in inverse proportion to the retained voltage at the Connection Point. The voltage generated from the injected current of the Power Park Module shall be in phase with the retained voltage at the Connection Point, whilst the total injected current remains above the shaded area in diagrams 12.5(a) and 12.5(b). Also, as can been seen on the diagrams a small delay time of no greater than 20 ms once the voltage falls to below 0.9 pu is permitted before injection of the in phase reactive current.		
	(c) The Inverter is permitted to block (ie reduce the current injection) when the voltage at the Connection Point has returned to >0.85 pu in order to mitigate against the risk of transient overvoltage instability that would otherwise occur due to transient overvoltage excursions. Figure 12.5 (a) and Figure 12.5 (b) show the required current injection during the duration of the voltage depression. Where the Generator is able to demonstrate to the DNO that blocking is required in order to prevent the risk of transient over voltage excursions arising following clearance of the fault, Generators are required to both advise of, and agree on, the control strategy with the DNO, which must also include the approach taken to de-blocking. Notwithstanding this requirement, Generators should be aware of their requirement to fully satisfy the Fault Ride Through requirements of Section 12.3.		P
	(d) Each Power Park Module shall be designed to reduce the risk of transient overvoltage levels arising following voltage restoration. Generators shall be permitted to block where the anticipated transient overvoltage would not otherwise exceed the maximum permitted values specified in paragraph 12.4.1. Any additional requirements relating to transient overvoltage performance will be specified by the DNO.		P
12.7	Operational monitoring		N/A
12.7.1	At each Power Generating Facility the DNO will install their own Telecontrol/SCADA outstation which will generally meet all the DNO's necessary and legal operational data requirements. The DNO will inform the Generator if additional specific data are required.		N/A

13	**Type C and Type D Power Generating Module Technical Requirements**	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
13.1	Power Generating Module Performance and Control Requirements	Not intended to be used in Type C and D declared by manufacturer	N/A
13.1.1	The requirements of this Section 13 do not apply in full to: (a) Power Generation Facilities that are designed and installed for infrequent short term parallel operation only; or (b) Electricity Storage Power Generation Modules within the Power Generating Facility.		N/A
13.1.2	The Active Power output of a Power Generating Module should not be affected by voltage changes within the statutory limits declared by the DNO in accordance with the ESQCR.		N/A
13.1.3	Power Generating Modules shall be capable of adjusting the Active Power setpoint in accordance with instructions issued by the DNO.		N/A
13.1.4	Any changes to the Active Power or voltage/Reactive Power control setpoints must result in the Power Generating Module achieving the new Active Power or voltage/Reactive Power output, as appropriate, within 2 minutes.		N/A
13.1.5	Each item of a Power Generating Module and its associated control equipment must be designed for stable operation in parallel with the Distribution Network.		N/A
13.1.6	Load flow and System Stability studies may be necessary to determine any output constraints or post fault actions necessary for n-1 fault conditions and credible n-2 conditions (where n-1 and n-2 conditions are the first and second outage conditions as, for example, specified in EREC P2) involving a mixture of fault and planned outages. The Connection Agreement should include details of the relevant outage conditions. It may be necessary under these fault conditions, where the combination of Power Generating Module output, load and through flow levels leads to circuit overloading, to rapidly disconnect or constrain the Power Generating Module.		N/A
13.2	Frequency response		N/A
13.2.1	Under abnormal conditions automatic low-frequency load-shedding provides for load reduction down to 47 Hz. In exceptional circumstances, the frequency of the DNO's Distribution Network could rise above 50.5 Hz.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	Therefore all Power Generating Modules should be capable of continuing to operate in parallel with the Distribution Network in accordance with the following:		
	a) 47 Hz – 47.5 Hz Operation for a period of at least 20 s is required each time the frequency is within this range		N/A
	b) 47.5 Hz – 49.0 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range		N/A
	c) 49.0Hz – 51.0 Hz Continuous operation of the Power Generating Module is required		N/A
	d) 51.0 Hz –51.5 Hz Operation for a period of at least 90 minutes is required each time the frequency is within this range.		N/A
	e) 51.5 Hz – 52 Hz Operation for a period of at least 15 minutes is required each time the frequency is within this range.		N/A
13.2.2	With regard to the rate of change of frequency withstand capability, a Power Generating Module shall be capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500 ms unless disconnection was triggered by a rate of change of frequency type loss of mains protection or by the Power Generating Module's own protection system for a co-incident internal fault as detailed in paragraph 10.6.18.		N/A
13.2.3	Output power with falling frequency		N/A
13.2.4	Limited Frequency Sensitive Mode – Over frequency		N/A
13.2.5	Limited Frequency Sensitive Mode – Under frequency (LFSM-U)		N/A
13.2.6	Frequency Sensitive Mode – (FSM)		N/A
13.3	Fault Ride Through		N/A
13.3.1	Paragraphs 13.3.1.1 to 13.3.1.10 inclusive set out the Fault Ride Through, principles and concepts applicable to Synchronous Power Generating Modules and Power Park Modules, subject to disturbances from faults on the Network up to 140 ms in duration.		N/A
13.3.2	In addition to paragraphs 13.3.1.1 – 13.3.1.11 where it has been specifically agreed between the DNO and the Generator that a Power		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	Generating Facility will contribute to the DNO's Distribution Network security, (eg for compliance with EREC P2) the Power Generating Module(s) may be required to withstand, without tripping, the effects of a close up three phase fault and the Phase (Voltage) Unbalance imposed during the clearance of a close-up phase-to-phase fault, in both cases cleared by the DNO's main protection. The DNO will advise the Generator in each case of the likely tripping time of the DNO's protection, and for phase-phase faults, the likely value of Phase (Voltage) Unbalance during the fault clearance time.		
13.3.3	In the case of phase to phase faults on the DNO's system that are cleared by system back-up protection which will be within the plant short time rating on the DNO's Distribution Network the DNO, on request during the connection process, will advise the Generator of the expected Phase (Voltage) Unbalance.		N/A
13.3.4	Other Fault Ride Through Requirements		N/A
	(a) In the case of a Power Park Module, the requirements in paragraph 13.3 do not apply when the Power Park Module is operating at less than 5% of its Registered Capacity or during very high primary energy source conditions when more than 50% of the Generating Units in a Power Park Module have been shut down or disconnected under an emergency shutdown sequence to protect Generator's plant and apparatus.		N/A
	(b) For the avoidance of doubt the requirements specified in this Section 13.3 do not apply to Power Generating Modules connected to an unhealthy circuit and islanded from the Distribution Network even for delayed auto reclosure times.		N/A
13.4	Voltage Limits and Control		N/A
13.4.1	Where a Power Generating Module is remote from a Network voltage control point it may be required to withstand voltages outside the normal statutory limits. In these circumstances, the DNO should agree with the Generator the declared voltage and voltage range at the Connection Point. Immunity of the Power Generating Module to voltage changes of ± 10% of the declared voltage is recommended, but is mandatory for Type D Power Generating Modules, subject to design appraisal of individual installations.		N/A
13.4.2	The connection of a Power Generating Module		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	to the Distribution Network shall be designed in such a way that operation of the Power Generating Module does not adversely affect the voltage profile of and voltage control employed on the Distribution Network. ETR 126 provides DNOs with guidance on active management solutions to overcome voltage control limitations. Information on the voltage regulation and control arrangements will be made available by the DNO if requested by the Generator.		
13.4.3	Synchronous Power Generating Modules Excitation Performance Requirements		N/A
13.4.4	Voltage Control Performance Requirements for Power Park Modules		N/A
13.4.5	As part of the connection application process the Generator shall agree with the DNO the set points of the control scheme for voltage control, Power Factor control or Reactive Power control as appropriate. These settings, and any changes to these settings, shall be agreed with the DNO and recorded in the Connection Agreement. The information to be provided is detailed in Schedule 5a and Schedule 5b of the Data Registration Code.		N/A
13.4.6	The final responsibility for control of Distribution Network voltage does however remain with the DNO.		N/A
13.4.7	Automatic Voltage Control (AVC) schemes employed by the DNO often assume that power flows from parts of the Distribution Network operating at a higher voltage to parts of the Distribution Network operating at lower voltages. Export from Power Generating Modules in excess of the local loads may result in power flows in the reverse direction. In this case AVC referenced to the low voltage side may not operate correctly without an import of Reactive power and relay settings appropriate to this operating condition. When load current compounding is used with the AVC and the penetration level of Power Generating Modules becomes significant compared to normal loads, it may be necessary to switch any compounding out of service.		N/A
13.4.8	Power Generating Modules can cause problems if connected to networks employing AVC schemes which use negative reactance compounding and line drop compensation due to changes in Active Power and Reactive Power flows. ETR 126 provides guidance on connecting generation to such networks using techniques		N/A

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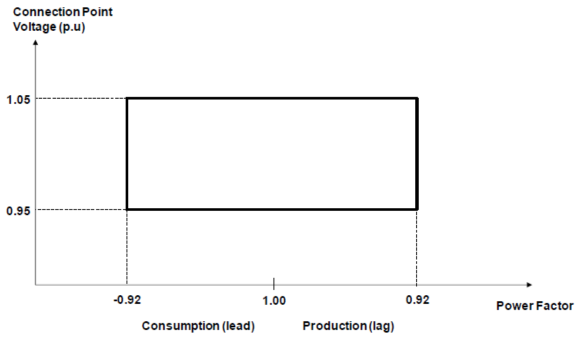
Clause	Requirement – Test	Result – Remark	Verdict
	such as removing the generation circuit from the AVC scheme using cancellation CTs.		
13.5	Reactive Capability		N/A
13.5.1	All Synchronous Power Generating Modules shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 13.10 when operating at Registered Capacity. In some cases, for example, on large industrial sites etc where the Power Generating Module is embedded in the Generator's network, the DNO and Generator might agree a different control point, such as the Power Generating Module's terminals. The performance requirements of the control system including Slope (where applicable) shall be agreed between the DNO and the Generator.		N/A
13.5.2	At Active Power output levels other than Registered Capacity all Generating Units within a Synchronous Power Generating Module must be capable of continuous operation at any point between the Reactive Power capability limit identified on the Generator Performance Chart at least down to the Minimum Generation. At reduced Active Power output, Reactive Power supplied at the Connection Point shall correspond to the Generator Performance Chart of the Synchronous Power Generating Module, taking the auxiliary supplies and the Active Power and Reactive Power losses of the Power Generating Module transformer or Station Transformer into account.  **Figure 13.10 Reactive Power capability requirements (Synchronous Power Generating Modules)**		N/A
13.5.3	All Power Park Modules with a Connection Point voltage above 33 kV, shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 13.11 when operating at Registered Capacity.		N/A

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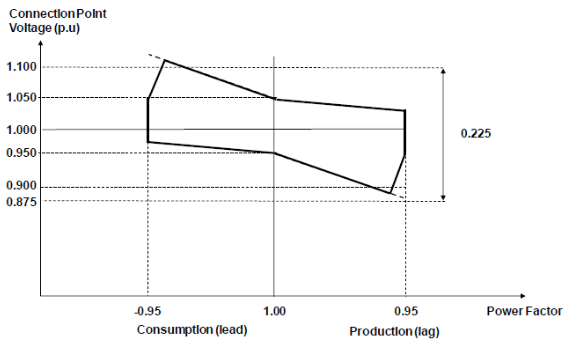
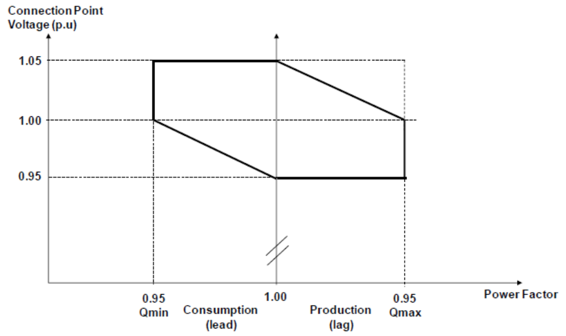
Clause	Requirement – Test	Result – Remark	Verdict
	 **Figure 13.11 Reactive Power capability requirements (Power Park Modules operating at Registered Capacity, voltage above 33 kV)**		
13.5.4	All Power Park Modules with a Connection Point voltage at or below 33 kV shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 13.12 when operating at Registered Capacity.  **Figure 13.12 Reactive Power capability requirements (Power Park Modules operating at Registered Capacity, voltage at or below 33 kV)**		N/A
13.5.5	All Power Park Modules, shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 13.13 when operating below Registered Capacity. With all plant in service, the Reactive Power limits will reduce linearly below 50% Active Power output as shown in Figure 13.13 unless the requirement to maintain the Reactive Power limits defined at Registered Capacity under absorbing Reactive Power conditions down to 20% Active Power output has been specified by the DNO. These Reactive Power limits will be reduced pro rata to the amount of plant in service.		N/A

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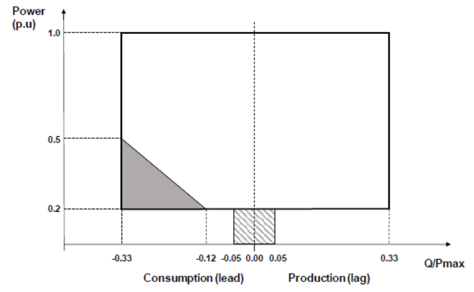
Clause	Requirement – Test	Result – Remark	Verdict
	 **Figure 13.13 Reactive Power capability requirements (Power Park Modules operating below Registered Capacity)**		
13.6	Fast Fault Current Injection		N/A
13.6.1	Fast Fault Current injection is necessary to support the Total System during a fault on the Transmission System. The design of Fast Fault Current injection is tailored to this, and does not relate directly to faults on the Distribution Network, not least as these will tend to have longer clearing times than those of the Transmission System for which Fast Fault Current injection is designed. In this Section 13.6 the faults referred to are Transmission System faults which clear within 140 ms and which will seen in the Distribution Network as a voltage depression.		N/A
13.6.2	Each Power Park Module shall be required to satisfy the following requirements.		N/A
	(a) For any balanced or unbalanced fault on the Transmission System which results in the voltage at the Connection Point falling below 0.9 pu each Power Park Module shall be required to inject a current above the shaded area shown in Figure 13.14(a) and Figure 13.14(b). For the purposes of this requirement, the maximum rated current is taken to be the maximum current each Generating Unit can supply when operating at Registered Capacity and 0.95 Power Factor at a nominal voltage of 1.0 pu. For example, in the case of a 10 MW Power Park Module the Registered Capacity would be taken as 10 MW and the rated Reactive Power would be taken as 3.28 MVAr (ie Rated MW output operating at 0.95 Power Factor lead or 0.95 Power Factor lag) giving an MVA rating of 10.53 MVA. For the avoidance of doubt, where the phase voltage at the Connection Point is not zero, the injected current shall be in proportion to the retained voltage at the Connection Point but shall still be required to remain above the shaded area in Figure 13.14(a) and Figure 13.14(b).		N/A
	(b) In addition, the injected current from each Power Park Module shall be in proportion and		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	remain in phase with the change in system voltage at the Connection Point during the period of the voltage depression. For the avoidance of doubt, the injected current will be purely reactive for a retained voltage of zero and the reactive component of the injected current will fall in inverse proportion to the retained voltage at the Connection Point. The voltage generated from the injected current of the Power Park Module shall be in phase with the retained voltage at the Connection Point, whilst the total injected current remains above the shaded area in diagrams 12.5(a) and 12.5(b). Also, as can been seen on the diagrams a small delay time of no greater than 20 ms once the voltage falls to below 0.9 pu is permitted before injection of the in phase reactive current.		
	c) The Inverter is permitted to block (ie reduce the current injection) when the voltage at the Connection Point has returned to >0.85 pu in order to mitigate against the risk of transient overvoltage instability that would otherwise occur due to transient overvoltage excursions. Figure 12.5 (a) and Figure 12.5 (b) show the required current injection during the duration of the voltage depression. Where the Generator is able to demonstrate to the DNO that blocking is required in order to prevent the risk of transient over voltage excursions arising following clearance of the fault, Generators are required to both advise of, and agree on, the control strategy with the DNO, which must also include the approach taken to de-blocking. Notwithstanding this requirement, Generators should be aware of their requirement to fully satisfy the Fault Ride Through requirements of Section 12.3.		N/A
	(d) Each Power Park Module shall be designed to reduce the risk of transient overvoltage levels arising following voltage restoration. Generators shall be permitted to block where the anticipated transient overvoltage would not otherwise exceed the maximum permitted values specified in paragraph 12.4.1. Any additional requirements relating to transient overvoltage performance will be specified by the DNO.		N/A
13.7	Black Start Capability		N/A
13.7.1	The National Electricity Transmission System will be equipped with Black Start Stations. It will be necessary for each Generator to notify the DNO if its Power Generating Module has a restart capability without connection to an external power supply, unless the Generator shall have previously notified the NETSO accordingly under the Grid		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	Code. Such generation may be registered by the NETSO as a Black Start Station.		
13.8	Technical Requirements for Embedded Medium Power Stations		N/A
13.8.1	Where a Generator in respect of an Embedded Medium Power Station is a party to the CUSC this Section 13.8 will not apply.		N/A
13.8.2	In addition to the requirements of this EREC G99, the DNO has an obligation under ECC 3.3 of the Grid Code to ensure that all relevant Grid Code Connection Condition requirements are met by Embedded Medium Power Stations. These requirements are summarised in ECC 3.4 of the Grid Code. It is incumbent on the Generator who owns any Embedded Medium Power Station to comply with the relevant Grid Code requirements listed in ECC3.4 of the Grid Code as part of compliance with this EREC G99.		N/A
13.8.3	Where data is required by the NETSO from Embedded Medium Power Stations, nothing in the Grid Code or this EREC G99 precludes the Generator from providing the information directly to the NETSO in accordance with Grid Code requirements. However, a copy of the information should always be provided in parallel to the DNO.		N/A
13.8.4	Grid Code Connection Conditions Compliance		N/A
13.9	Operational monitoring	Take into account in final station	N/A
13.9.1	With regard to information exchange:		N/A
	(a) Power Generating Facilities shall be capable of exchanging information with the DNO in real time or periodically with time stamping;		N/A
	(b) the DNO, in coordination with the NETSO, shall specify the content of information exchanges including a precise list of data to be provided by the Power Generating Facility.		N/A
13.9.2	At each Power Generating Facility the DNO will install their own Telecontrol/SCADA outstation which will generally meet all the DNO's necessary and legal operational data requirements. The DNO will inform the Generator if additional specific data are required at the time of the connection offer.		N/A
13.9.3	Additionally each Power Generating Facility shall;		N/A
	(a) be fitted with fault recording and dynamic system monitoring facilities which shall be capable of recording System data including voltage, Active Power, Reactive Power and		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	frequency in accordance with Annex C.6.		
	(b) The settings of the fault recording equipment and dynamic system monitoring equipment (which is required to detect poorly damped power oscillations) including triggering criteria shall be agreed between the Generator and the DNO and recorded in the Connection Agreement.		N/A
	(c) The DNO may also specify that Generators must install power quality monitoring equipment. Any such requirement including the parameters to be monitored would be specified by the DNO in the Connection Agreement.		N/A
	(d) Provisions for the submission fault recording, dynamic system monitoring and power quality data to the DNO including the communications and protocols shall be specified by the DNO in the Connection Agreement.		N/A
13.9.4	The Generator will provide all relevant signals in a format to be agreed between the Generator and the DNO for onsite monitoring. All signals shall be suitably terminated in a single accessible location at the Generators site.		N/A
13.9.5	The Generator shall provide to the DNO a 230 V power supply adjacent to the signal terminal location.		N/A
13.9.6	Frequency sensitive mode (FSM) monitoring in real time		N/A
13.10	Steady State Load Inaccuracies		N/A
13.10.1	The standard deviation of load error at steady state load over a 30 minute period must not exceed 2.5% of a Power Generating Modules Registered Capacity. Where a Power Generating Module is instructed to operate in Frequency sensitive operation, allowance will be made in determining whether there has been an error according to the governor Droop characteristic registered under the DDRC. For the avoidance of doubt in the case of a Power Park Module allowance will be made for the full variation of mechanical power output.		N/A

14	**Installation, Operation and Control Interface**		N/A
14.1	General	Take into consideration in final installations	N/A
14.2	Isolation and Safety Labelling		N/A
14.3	Site Responsibility Schedule		N/A
14.4	Operational and Safety Aspects		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
14.5	Synchronizing and Operational Control		N/A
15	**Common Compliance and Commissioning Requirements for all Power Generating Modules**		P
15.1	Demonstration of Compliance	Test performed on PGU level	P
15.2	Wiring for Type Tested Power Generating Modules		P
15.3	Commissioning Tests / Checks required at all Power Generating Facilities		N/A
15.4	Additional Commissioning requirements for Non Type Tested Interface Protection		N/A
16	**Type A Compliance Testing, Commissioning and Operational Notification**		P
16.1	Type Test Certification	Type tested on PGU level	P
16.2	Connection Process		N/A
16.3	Witnessing and Commissioning		N/A
16.4	Operational Notification		N/A
17	**Type B Compliance Testing, Commissioning and Operational Notification**		P
17.1	General	Type tested on PGU level with consideration of type B module requirements	P
17.2	Connection Process		N/A
17.3	Witnessing and Commissioning		N/A
17.4	Operational Notification		N/A
18	**Type C Compliance Testing, Commissioning and Operational Notification**		N/A
18.1	General		N/A
18.2	Connection Process		N/A
18.3	Witnessing and Commissioning		N/A
18.4	Operational Notification		N/A
19	**Type D Compliance Testing, Commissioning and Operational Notification**		N/A
19.1	General		N/A
19.2	Connection Process		N/A
19.3	Interim Operational Notification		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
19.4	Final Operational Notification		N/A
19.5	Limited Operational Notification		N/A
19.6	Processes Relating to Derogations		N/A
20	**Ongoing Obligations**		N/A
20.1	Periodic Testing for Power Generating Modules		N/A
20.2	Operational Incidents affecting Compliance of any Power Generating Module		N/A
20.3	Changes to the Power Generating Facility or Power Generating Module		N/A
20.4	Notification of Decommissioning		N/A
21	**Manufacturers' Information applicable to Power Park Modules**		P
21.1	General		P
21.2	Manufacturers' Information in respect of Generating Units may cover one (or part of one) or more of the following provisions:		P
	(a) Fault Ride Through capability; (b) Power Park Module mathematical model DDRC 5c.		P
21.3	Reference to a Manufacturer's Data & Performance Report in a Generator's submissions does not by itself constitute compliance with EREC G99.		P
22	**Type Testing and Annex information**		P
22.1	Fully Type Tested and Partially Type Tested equipment		P
22.2	Annex Contents and Form Guidance		P
Annex A	**Type A**		P
A.0	Type A Power Generating Module Forms Cover Sheet		P
A.1	Connection Application Forms for Type A Fully Type Tested Power Generating Facility (<50 kW) (Form A1-1) and Integrated Micro Generation and Storage (Form A1-2)		P
A.2	Type A Compliance Verification Report		P

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
A.3	Installation Document for Type A Power Generating Modules (Form A3-1) and Integrated Micro Generation and Storage (Form A3-2)		P
A.4	Emerging Technologies and other Exceptions		N/A
A.5	Example calculations to determine if unequal generation across different phases is acceptable or not	Take into consideration in final installations	N/A
A.6	Non-Standard private LV networks calculation of appropriate protection settings	Take into consideration in final installations	N/A
A.7	Requirements for Type Testing Power Generating Modules	Inverter unit considered as power park unit	P
A.7.1	Power Park Module Requirements		P
A.7.1.1	Certification & Type Testing Generating Unit Requirements	See appendix table	P
A.7.1.2	Type Verification Functional Testing of the Interface Protection	See appendix table	P
A.7.1.3	Limited Frequency Sensitive Mode – Over (LFSM-O)	See appendix table	P
A.7.1.4	Power Quality	See appendix table	P
A.7.1.5	Short Circuit Current Contribution	See appendix table	P
A.7.1.6	Self-Monitoring - Solid State Disconnection		N/A
A.7.2	Synchronous Power Generating Module Requirements (up to and including 50 kW)	Inverter unit considered as power park unit	N/A
A.7.2.1	Certification & Type Testing Generating Unit Requirements		N/A
A.7.2.2	Type Verification Testing of the Interface Protection Functions		N/A
A.7.2.3	Power Output with Falling Frequency		N/A
A.7.2.4	Limited Frequency Sensitive Mode – Over (LFSM-O)		N/A
A.7.2.5	Power Quality		N/A
A.7.3	Additional Power Generating Module Technology Requirements		P
A.7.3.1	Domestic CHP		N/A
A.7.3.2	Photovoltaic	Noticed	P
A.7.3.3	Fuel Cells		N/A
A.7.3.4	Hydro		N/A
A.7.3.5	Wind		N/A
A.7.3.6	Electricity Storage Device		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
Annex B	**Type B**	Test on inverter level as power park unit	N/A
B.1	Application	take into consideration in application stage	N/A
B.2	Power Generating Module Document Type B	Documents shall be submited in this stage	N/A
B.3	Installation and Commissioning Confirmation Form		N/A
B.4	Simulation Studies for Type B Power Generating Modules	Simulation study not including this type test report	N/A
B.4.1	Scope		N/A
B.4.2	Reactive Capability across the Voltage Range		N/A
B.4.3	Voltage Control and Reactive Power Stability		N/A
B.4.4	Fault Ride Through and Fast Fault Current Injection		N/A
B.4.5	Limited Frequency Sensitive Mode – Over Frequency (LFSM-O)		N/A
B.5	Compliance Testing of Synchronous Power Generating Modules		N/A
B.5.1	Scope		N/A
B.5.2	Excitation System Open Circuit Step Response Tests		N/A
B.5.3	Open & Short Circuit Saturation Characteristics		N/A
B.5.4	Excitation System On-Load Tests		N/A
B.5.5	Reactive Capability		N/A
B.5.6	Governor and Load Controller Response Performance		N/A
B.5.7	Compliance with Output Power with falling frequency Functionality Test		N/A
B.6	Compliance Testing of Power Park Modules	Test on inverter level as power park unit, power park module compliance test should be conducted on site	N/A
B.6.1	Scope		N/A
B.6.2	Pre 20% Synchronised Power Park Module Basic Voltage Control Tests		N/A
B.6.3	Reactive Capability Test		N/A
B.6.4	Voltage Control Tests		N/A
B.6.5	Frequency Response Tests		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict

Annex C	**Type C and Type D**		N/A
C.1	Application		N/A
C.2	Power Generating Module Document Type C and Type D		N/A
C.3	Installation and Commissioning Confirmation Form		N/A
C.4	Performance Requirements For Continuously Acting Automatic Excitation Control Systems For Type C and Type D Synchronous Power Generating Modules		N/A
C.4.1	Scope		N/A
C.4.2	Requirements		N/A
C.5	Performance Requirements for Continuously Acting Automatic Voltage Control Systems for Type C and Type D Power Park Modules		N/A
C.5.1	Scope		N/A
C.5.2	Requirements		N/A
C.5.3	Steady State Voltage Control		N/A
C.5.4	Transient Voltage Control		N/A
C.5.5	Overall Voltage Control System Characteristics		N/A
C.5.6	Reactive Power Control		N/A
C.5.7	Power Factor Control		N/A
C.6	Functional Specification for Dynamic System Monitoring, Fault Recording and Power Quality Monitoring Equipment for Type C and Type D Power Generating Modules		N/A
C.6.1	Purpose and Scope		N/A
C.6.2	Functional Requirements		N/A
C.6.3	Relevant Standards		N/A
C.6.4	Calibration and Testing		N/A
C.7	Simulation Studies for Type C and Type D Power Generating Modules		N/A
C.7.1	Scope		N/A
C.7.2	Power System Stabiliser Tuning		N/A
C.7.3	Reactive Capability across the Voltage Range		N/A
C.7.4	Voltage Control and Reactive Power Stability		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
C.7.5	Fault Ride Through and Fast Fault Current Injection		N/A
C.7.6	Limited Frequency Sensitive Mode – Over Frequency (LFSM-O)		N/A
C.7.7	Limited Frequency Sensitive Mode – Under Frequency (LFSM-U)		N/A
C.7.8	Voltage and Frequency Controller Model Verification and Validation		N/A
C.8	Compliance Testing of Type C and Type D Synchronous Power Generating Modules		N/A
C.8.1	Scope		N/A
C.8.2	Excitation System Open Circuit Step Response Tests		N/A
C.8.3	Open & Short Circuit Saturation Characteristics		N/A
C.8.4	Excitation System On-Load Tests		N/A
C.8.5	Reactive Capability		N/A
C.8.6	Governor and Load Controller Response Performance		N/A
C.8.7	Compliance with Output Power with falling frequency Functionality Test		N/A
C.9	Compliance Testing of Type C and Type D Power Park Modules		N/A
C.9.1	Scope		N/A
C.9.2	Pre 20% Synchronised Power Park Module Basic Voltage Control Tests		N/A
C.9.3	Reactive Capability Test		N/A
C.9.4	Voltage Control Tests		N/A
C.9.5	Frequency Response Tests		N/A
C.10	Minimum Frequency Response Capability Requirement Profile and Operating Range for Type C and Type D Power Generating Modules		N/A
C.10.1	Scope		N/A
C.10.2	Plant Operating Range		N/A
C.10.3	Repeatability of Response		N/A
C.10.4	Testing of Frequency Response Capability		N/A
Annex D			N/A
D.0	Power Generating Module Decommissioning		N/A

Engineering Recommendation G99			
Clause	Requirement – Test	Result – Remark	Verdict
	Confirmation		
D.1	Additional Information Relating to System Stability Studies		N/A
D.2	Loss of Mains (LoM) Protection Analysis		N/A
D.3	Main Statutory and Other Obligations		N/A

TYPE TEST SHEET of A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record:

1. Operating Range: Two tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply, grid simulation set or load bank. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

The **Interface Protection** shall be disabled during the tests. LFSM-O function is disabled as well.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover **Inverter**/rectifier may be replaced by a DC source.

Solis-110K-5G			
	Frequency (Hz)	Voltage (V) (L1-N/L2-N/L3-N)	Active power (W)
Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz**,** **Power Factor** = 1, Period of test 20 s	47.00	195.5/196.3/196.2	92531
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	47.50	195.5/196.3/196.2	92533
Test 3 Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	51.50	253.7/253.2/254.0	110990
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	52.00	254.0/253.0/254.0	111000
Test 5 RoCoF withstand Confirm that the Power Generating Module is capable of staying connected to the Distribution Network	Yes		

and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.	
Remark: clause 11.2.1, 12.2.1 and 13.2.2 is taken into consideration	

2. Power Quality – Harmonics:

For **Power Generating Modules** of **Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5**.** These tests should be carried out as specified in BS EN 61000-3-12 The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 61000-3-12 for three phase equipment.
Power Generating Modules with emissions close to the limits laid down in BS EN 61000-3-12 may require the installation of a transformer between 2 and 4 times the rating of the **Power Generating Module** in order to accept the connection to a **Distribution Network.**

For **Power Generating Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC G5.

Power Generating Module tested to BS EN 61000-3-12

Solis-110K-5G@3/N/PE~, 230/400V

Power Generating Module rating per phase (rpp)	36.7	kVA	Harmonic % = THC / I_{ref} * 100

Harmonic	At 45-55% of **Registered Capacity**		100% of **Registered Capacity**		Limit in BS EN 61000-3-12	
	Measured Value (A)	%	Measured Value (A)	%	1 phase	3 phase
2	0.171	0.108	0.456	0.286	8%	8%
3	0.070	0.044	0.173	0.108	21.6%	Not stated
4	0.082	0.052	0.143	0.090	4%	4%
5	0.692	0.434	1.722	1.080	10.7%	10.7%
6	0.021	0.013	0.047	0.030	2.67%	2.67%
7	1.060	0.665	1.467	0.920	7.2%	7.2%
8	0.024	0.015	0.034	0.021	2%	2%
9	0.030	0.019	0.035	0.022	3.8%	Not stated
10	0.043	0.027	0.052	0.032	1.6%	1.6%
11	0.506	0.317	0.637	0.399	3.1%	3.1%
12	0.020	0.012	0.032	0.020	1.33%	1.33%
13	0.326	0.204	0.448	0.281	2%	2%
14	0.069	0.043	0.072	0.045	-	-

15	0.030	0.019	0.048	0.030	-	-
16	0.025	0.015	0.036	0.022	-	-
17	0.398	0.250	0.529	0.332	-	-
18	0.024	0.015	0.034	0.021	-	-
19	0.107	0.067	0.102	0.064	-	-
20	0.056	0.035	0.086	0.054	-	-
21	0.027	0.017	0.052	0.033	-	-
22	0.059	0.037	0.089	0.056	-	-
23	0.066	0.042	0.117	0.073	-	-
24	0.028	0.017	0.037	0.023	-	-
25	0.178	0.112	0.237	0.149	-	-
26	0.031	0.019	0.066	0.042	-	-
27	0.038	0.024	0.048	0.030	-	-
28	0.069	0.043	0.105	0.066	-	-
29	0.294	0.184	0.316	0.198	-	-
30	0.031	0.019	0.041	0.026	-	-
31	0.091	0.057	0.168	0.105	-	-
32	0.035	0.022	0.038	0.024	-	-
33	0.036	0.022	0.047	0.029	-	-
34	0.035	0.022	0.056	0.035	-	-
35	0.300	0.188	0.406	0.254	-	-
36	0.020	0.013	0.038	0.024	-	-
37	0.070	0.044	0.067	0.042	-	-
38	0.048	0.030	0.071	0.045	-	-
39	0.019	0.012	0.050	0.031	-	-
40	0.025	0.016	0.046	0.029	-	-
THC	0.979		1.626		23%	13%
PWHC	2.047		2.670		23%	22%
Remark:						

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Modules** of **Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC P28.

Solis-110K-5G @3/N/PE~, 230/400V								
	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P st	P lt 2 hours
Measured Values at test impedance	0.589%	0.048%	0%	0.594%	0.063%	0%	0.079	0.076
Normalised to standard impedance	0.589%	0.048%	0%	0.594%	0.063%	0%	0.077	0.073
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.24 *	Ω	X	0.15 *	Ω
Standard Impedance	R	0.24 *	Ω	X	0.15 *	Ω
Maximum Impedance	R	N/A	Ω	X	N/A	Ω

* Applies to three phase and split single phase **Power Generating Modules.**

^ Applies to single phase **Power Generating Module** and **Power Generating Modules** using two phases on a three phase system.

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the **Power Factor** of the generation output is 0.98 or above.

Normalised value = Measured value x reference source resistance/measured source resistance at test point.

Single phase units reference source resistance is 0.4 Ω.

Two phase units in a three phase system reference source resistance is 0.4 Ω.

Two phase units in a split phase system reference source resistance is 0.24 Ω.

Three phase units reference source resistance is 0.24 Ω.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the Standard Impedance.

The stopping test should be a trip from full load operation.

The duration of these tests need to comply with the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below.

4. Power quality. DC injection. The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels ±5%. At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

Solis-110K-5G @3/N/PE~, 230/400V

Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded value (A)	-0.048	-0.325	0.120	-0.187	-0.050	0.236	-0.364	0.095	0.273
As % of rated AC current	-0.03	-0.19	0.07	-0.11	-0.03	0.14	-0.22	0.06	0.16
Limit	0.25%			0.25%			0.25%		
Remark:									

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity**. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Solis-110K-5G @3/N/PE~, 230/400V

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9995	0.9996	0.9996
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3.

Solis-110K-5G @3/N/PE~, 230/400V and -25°C

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20s	47.49Hz	20.22s	47.7Hz / 30 s	No trip
U/F stage 2	47Hz	0.5s	47.00Hz	0.534s	47.2Hz / 19.5 s	No trip
					46.8Hz / 0.45s	No trip

OF	52Hz	0.5s	52.00Hz	0.545s	51.8Hz / 120s	No trip
					52.2Hz / 0.45s	No trip
Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
Solis-110K-5G @3/N/PE~, 230/400V and +25°C						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20s	47.49Hz	20.22s	47.7Hz / 30 s	No trip
U/F stage 2	47Hz	0.5s	47.00Hz	0.535s	47.2Hz / 19.5 s	No trip
					46.8Hz / 0.45s	No trip
OF	52Hz	0.5s	52.00Hz	0.530s	51.8Hz / 120s	No trip
					52.2Hz / 0.45s	No trip
Note. For frequency trip tests the frequency required to trip is the setting ± 0,1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0,2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
Solis-110K-5G @3/N/PE~, 230/400V and +60°C						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip

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U/F stage 1	47.5Hz	20s	47.49Hz	20.34s	47.7Hz / 30 s	No trip
U/F stage 2	47Hz	0.5s	46.99Hz	0.526s	47.2Hz / 19.5 s	No trip
					46.8Hz / 0.45s	No trip
OF	52Hz	0.5s	52.01Hz	0.530s	51.8Hz / 120s	No trip
					52.2Hz / 0.45s	No trip
Note. For frequency trip tests the frequency required to trip is the setting ± 0,1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The “No trip tests” need to be carried out at the setting ± 0,2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Test data record for frequency protection measurement and tripping time			
Iteration	Measured trip frequency (Hz)	Deviation from nominal value (%)	Limit (%)
Under frequency stage 1			
1@-25°C	47.49	-0.02	± 0.2
2@+25°C	47.49	-0.02	± 0.2
3@+60°C	47.49	-0.02	± 0.2
Verification of disconnecting time			

Iteration	Disconnection time (s)	Oscilloscope recorded waveforms
Under frequency stage 1@-25°C		

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1. 47.8Hz—47.2Hz (UF st1 trip setting minus 0.3Hz)	20.22s	
Under frequency stage 1@+25°C		
1. 47.8Hz—47.2Hz (UF st1 trip setting minus 0.3Hz)	20.22s	
Under frequency stage 1@+60°C		

1. 47.8Hz—47.2Hz (UF st1 trip setting minus 0.3Hz)	20.34s	

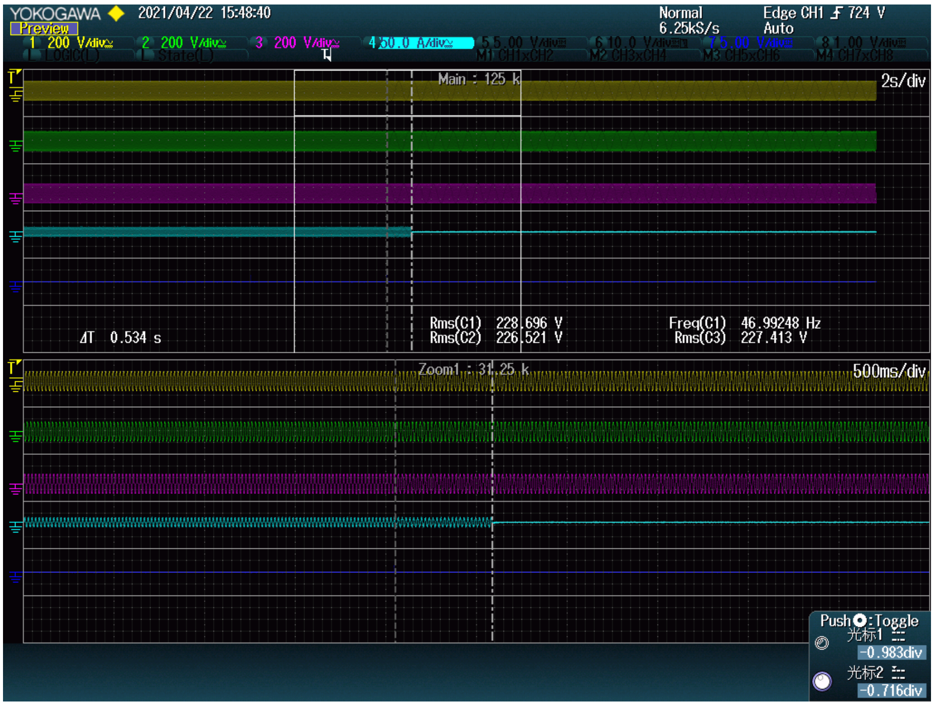
No trip tests - U/F stage 1

Frequency	Hold on time	Confirm no trip
47.7Hz (U/F st1 trip setting plus 0.2Hz)	30s	no trip

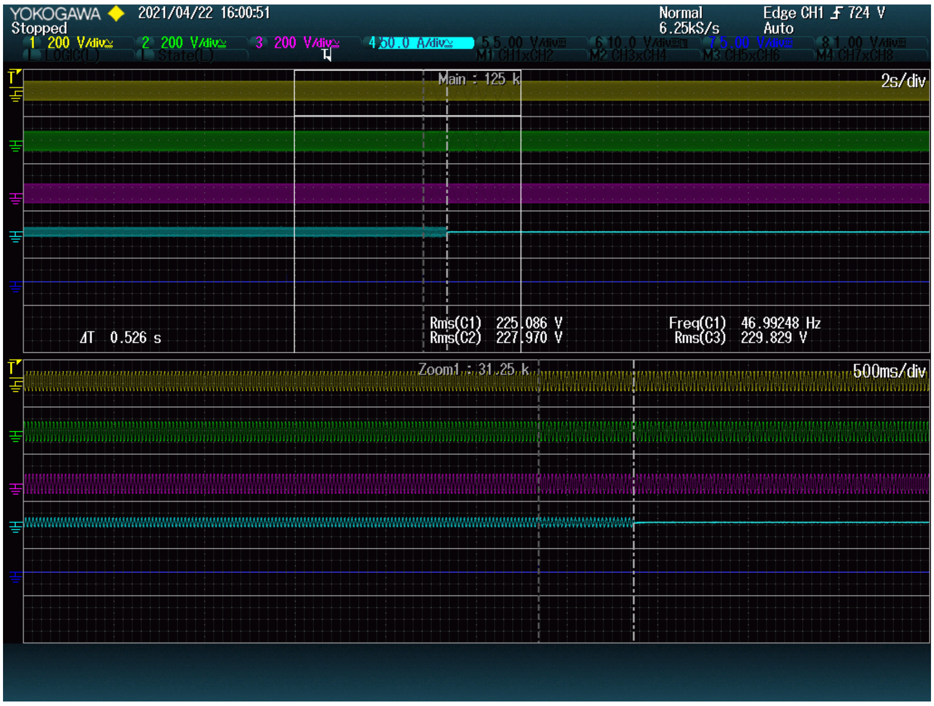
Iteration	Measured trip frequency (Hz)	Deviation from nominal value (%)	Limit (%)
Under frequency stage 2			
1@-25°C	47.00	0	± 0.2
2@+25°C	47.00	0	± 0.2
3@+60°C	46.99	-0.02	± 0.2

Verification of disconnecting time

Iteration	Disconnection time (s)	Oscilloscope recorded waveforms
Under frequency stage 2@-25°C		

<table>
<tr><td>1. 47.3Hz—46.7Hz (UF st2 trip setting minus 0.3Hz)</td><td>0.534s</td><td>
</td></tr>
<tr><td colspan="3">Under frequency stage 2@+25°C</td></tr>
<tr><td>1. 47.3Hz—46.7Hz (UF st2 trip setting minus 0.3Hz)</td><td>0.535s</td><td>
</td></tr>
<tr><td colspan="3">Under frequency stage 2@+60°C</td></tr>
</table>

Product Service

1. 47.3Hz—46.7Hz (UF st2 trip setting minus 0.3Hz)	0.526s	

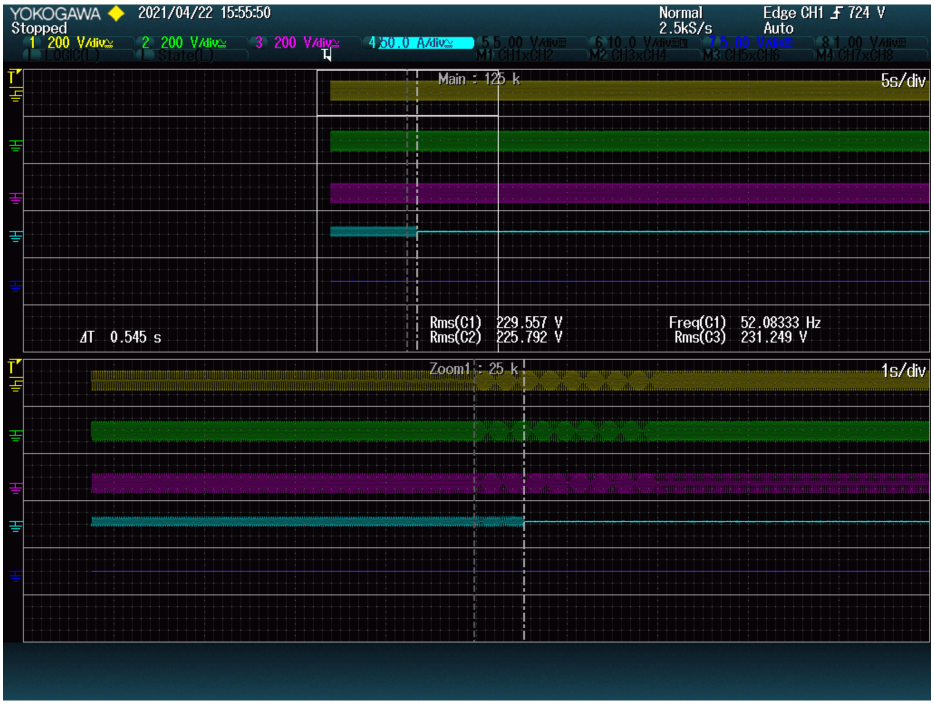
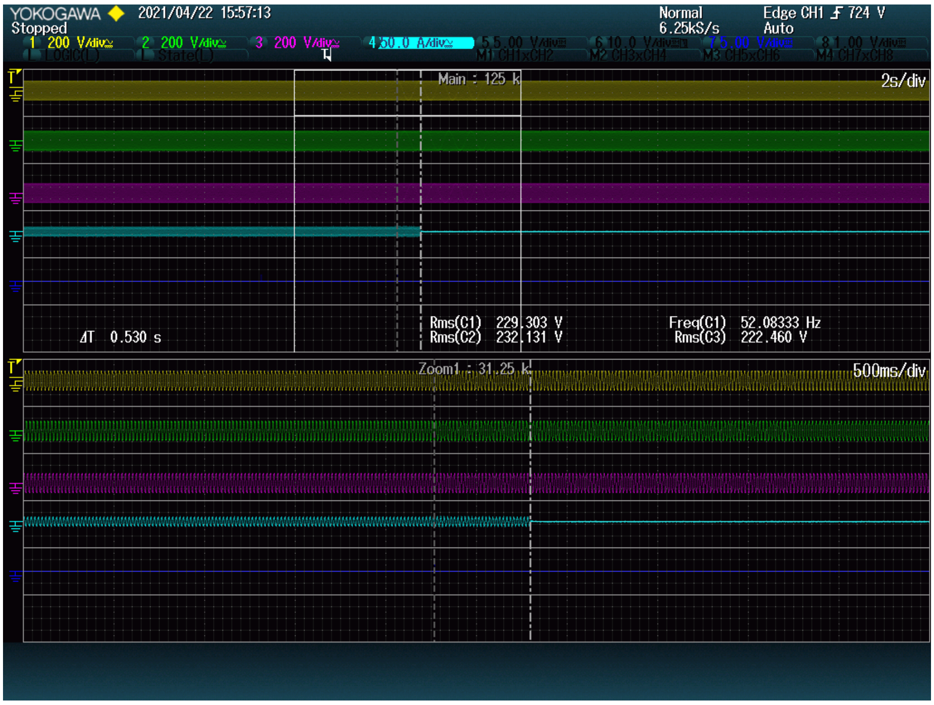
No trip tests - U/F stage 2

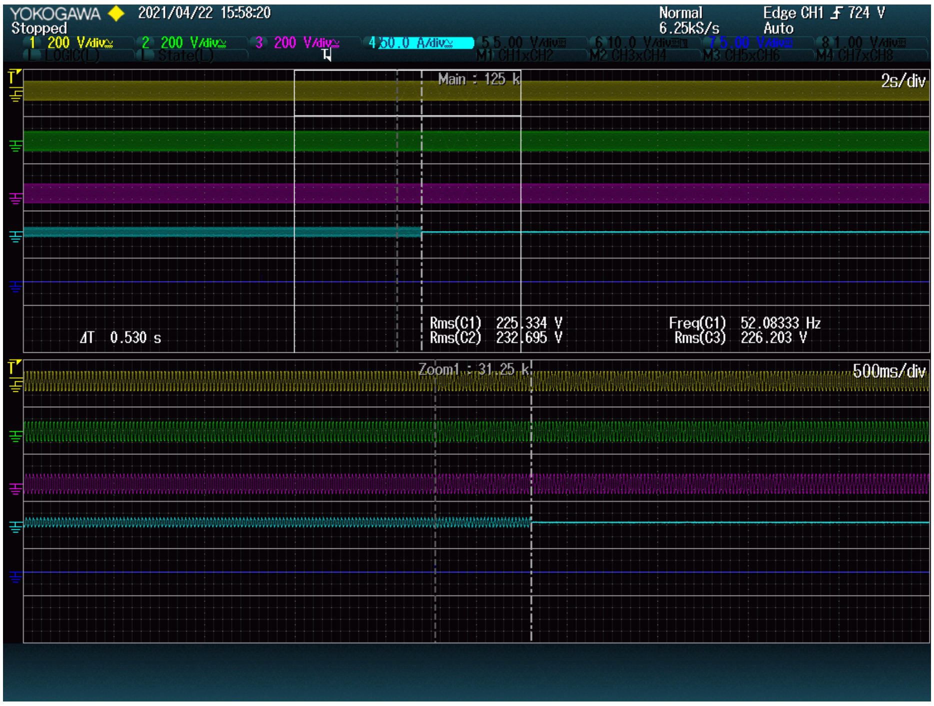
Frequency	Hold on time	Confirm no trip
47.2Hz (U/F st2 trip setting plus 0.2Hz)	19.5 s	no trip
46.8Hz (U/F st2 trip setting minus 0.2Hz)	0.45 s	no trip

Iteration	Measured trip frequency (Hz)	Deviation from nominal value (%)	Limit (%)
Over frequency			
1@-25°C	52.00	0	± 0.2
2@+25°C	52.00	0	± 0.2
3@+60°C	52.01	0.02	± 0.2

Verification of disconnecting time

Iteration	Disconnection time (s)	Oscilloscope recorded waveforms

Over frequency stage 1@-25°C		
1. 51.7Hz—52.3Hz (OF trip setting plus 0.3Hz)	0.545s	
Over frequency stage 1@+25°C		
1. 51.7Hz—52.3Hz (OF trip setting plus 0.3Hz)	0.530s	
Over frequency stage 1@+60°C		

1. 51.7Hz—52.3Hz (OF trip setting plus 0.3Hz)	0.530s	
No trip tests - O/F		
Frequency	Hold on time	Confirm no trip
51.8Hz (O/F trip setting minus 0.2Hz)	120.00 s	no trip
52.2Hz (O/F trip setting plus 0.2Hz)	0.45 s	no trip

7. Protection – Voltage tests: These tests should be carried out in accordance with the Annex A.7.1.2.2.						
Solis-110K-5G@3/N/PE~, 230/400V and -25°C(LV protection)						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	$V_{φ-n}$:184 V (0.8pu)	2.5s	L1-N:183.8V L2-N:183.4V L3-N:183.1V	L1-N:2.925s L2-N:2.945s L3-N:2.915s	$V_{φ-n}$: 188 V / 5.0 s	No trip
					$V_{φ-n}$: 180 V / 2.45s	No trip
O/V stage	$V_{φ-n}$: 262.2	1.0s	L1-N:263.5V L2-N:262.9V	L1-N:1.005s L2-N:1.015s	$V_{φ-n}$: 258.2 V	no trip

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1	V (1.14pu)		L3-N:262.6V	L3-N:1.025s	/ 5.0s	
O/V stage 2	$V_{φ-n}$: 273.7 V (1.19pu)	0.5s	L1-N:274.7V L2-N:274.3V L3-N:273.7V	L1-N:0.515s L2-N:0.535s L3-N:0.505s	$V_{φ-n}$: 269.7 V / 0.95s	No trip
					$V_{φ-n}$: 277.7 V / 0.45s	No trip
Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
Solis-110K-5G@3/N/PE~, 230/400V and +25°C(LV protection)						
Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	$V_{φ-n}$:184 V (0.8pu)	2.5s	L1-N:183.8V L2-N:183.4V L3-N:183.1V	L1-N:2.910s L2-N:2.915s L3-N:2.535s	$V_{φ-n}$: 188 V / 5.0 s	No trip
					$V_{φ-n}$: 180 V / 2.45s	No trip
O/V stage 1	$V_{φ-n}$: 262.2 V (1.14pu)	1.0s	L1-N:263.5V L2-N:262.5V L3-N:262.5V	L1-N:1.015s L2-N:1.025s L3-N:1.025s	$V_{φ-n}$: 258.2 V / 5.0s	no trip
O/V stage 2	$V_{φ-n}$: 273.7 V (1.19pu)	0.5s	L1-N:274.3V L2-N:274.3V L3-N:273.7V	L1-N:0.555s L2-N:0.505s L3-N:0.515s	$V_{φ-n}$: 269.7 V / 0.95s	No trip
					$V_{φ-n}$: 277.7 V / 0.45s	No trip
Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
Solis-110K-5G@3/N/PE~, 230/400V and +60°C(LV protection)						
Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	$V_{φ-n}$:184 V	2.5s	L1-N:183.6V L2-N:183.4V	L1-N:2.895s L2-N:2.995s	$V_{φ-n}$: 188 V	No trip

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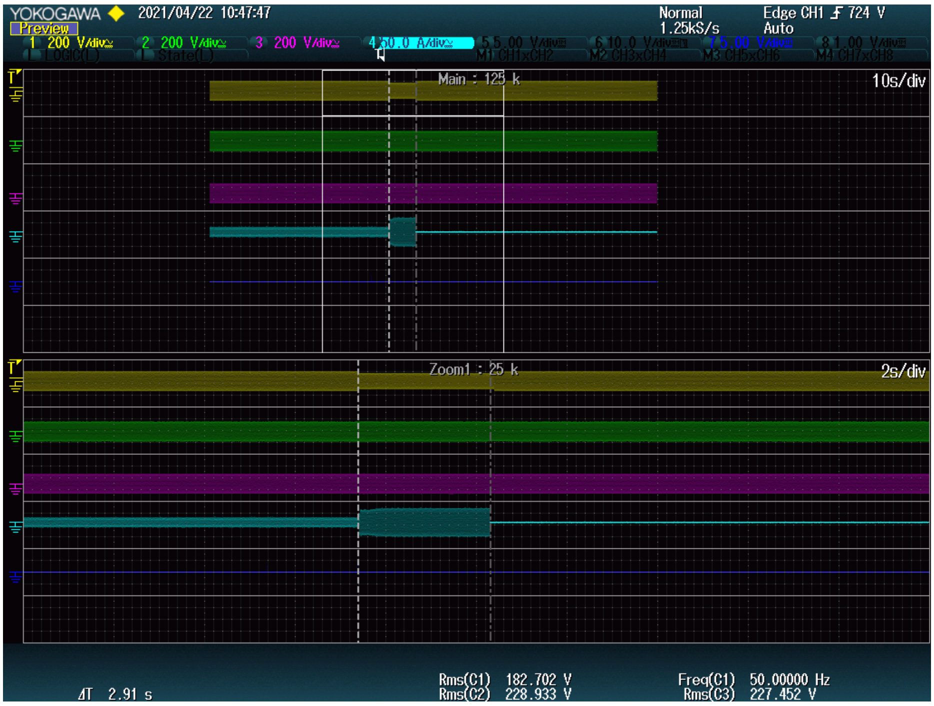
	(0.8pu)		L3-N:182.9V	L3-N:2.885s	/ 5.0 s	
					Vφ-n: 180 V / 2.45s	No trip
O/V stage 1	Vφ-n: 262.2 V (1.14pu)	1.0s	L1-N:263.5V L2-N:262.8V L3-N:262.3V	L1-N:1.025s L2-N:1.025s L3-N:1.015s	Vφ-n: 258.2 V / 5.0s	no trip
O/V stage 2	Vφ-n: 273.7 V (1.19pu)	0.5s	L1-N:274.6V L2-N:274.3V L3-N:273.5V	L1-N:0.515s L2-N:0.525s L3-N:0.535s	Vφ-n: 269.7 V / 0.95s	No trip
					Vφ-n: 277.7 V / 0.45s	No trip
Note for Voltage tests the Voltage required to trip is the setting ±3,45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Test data record for voltage protection measurement and tripping time					
Iteration	Measured voltage(V) and deviation from nominal value (%)				
	Phase L1-N (V)	Deviation (%Un)	Test with phase L2-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
Under voltage					
1 - Vφ-n @-25°C	182.3	0.92	230	230	± 1.5
1 - Vφ-n @+25°C	182.2	0.98	230	230	± 1.5
1 - Vφ-n @+60°C	182.2	0.98	230	230	± 1.5
	Phase L2-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
1 - Vφ-n @-25°C	182.4	0.87	230	230	± 1.5
1 - Vφ-n @+25°C	182.3	0.92	230	230	± 1.5
1 - Vφ-n @+60°C	182.4	0.87	230	230	± 1.5
	Phase L3-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L2-N (V)	Deviation limit (%Un)

1 - $V_{\varphi\text{-}n}$ @-25°C	182.4	0.87	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	182.4	0.87	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	182.3	0.92	230	230	± 1.5

Verification of disconnecting time		
Iteration	Disconnection time (s)	Oscilloscope recorded waveforms
Under voltage		
L1-N@-25°C:		
1. 188V—180V (trip setting minus 4V)	2.925s	
L1-N@+25°C:		

1. 188V—180V (trip setting minus 4V)	2.910s	
L1-N@+60°C:		
1. 188V—180V (trip setting minus 4V)	2.895s	
L2-N@-25°C:		

1. 188V—180V (trip setting minus 4V)	2.945s	
L2-N@+25°C:		
1. 188V—180V (trip setting minus 4V)	2.915s	
L2-N@+60°C:		

1. 188V—180V (trip setting minus 4V)	2.995s	
L3-N@-25°C:		
1. 188V—180V (trip setting minus 4V)	2.915s	
L3-N@+25°C:		

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1. 188V—180V (trip setting minus 4V)	2.935s	
L3-N@+60°C:		
1. 188V—180V (trip setting minus 4V)	2.885s	
No trip tests - U/V		
voltage	Hold on time	Confirm no trip

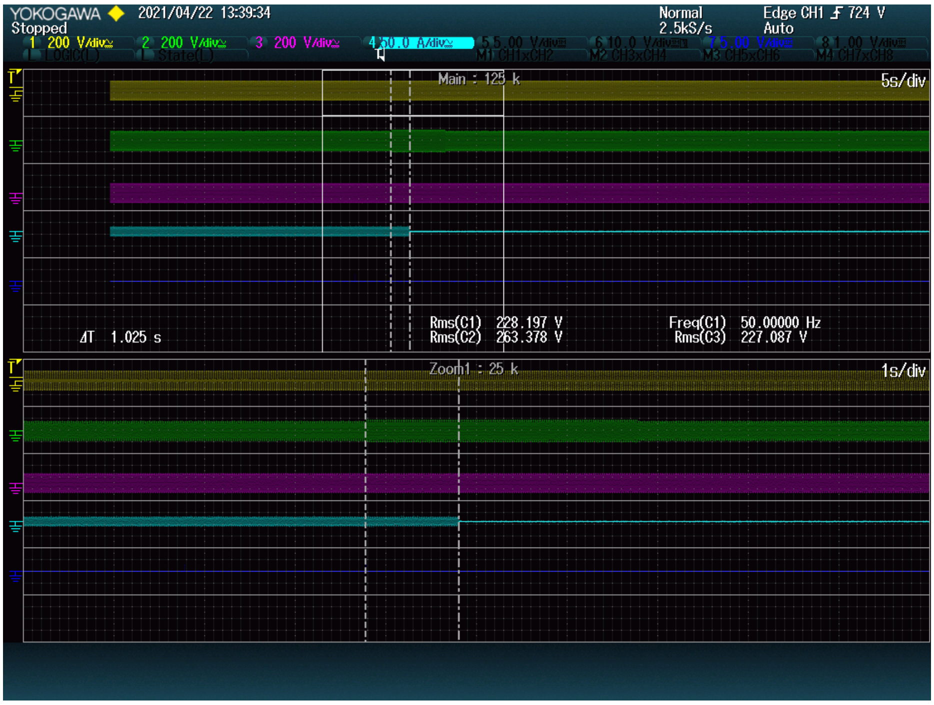
$V_{\varphi\text{-}n}$: 188V (U/V trip setting plus 4V)	5.0s	no trip
$V_{\varphi\text{-}n}$: 180V (U/V trip setting minus 4V)	2.45s	no trip

Iteration	Measured voltage(V) and deviation from nominal value (%)				
	Phase L1-N (V)	Deviation (%Un)	Test with phase L2-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
Over voltage stage 1					
1 - $V_{\varphi\text{-}n}$ @-25°C	262.4	0.08	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	262.4	0.08	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	262.3	0.04	230	230	± 1.5
	Phase L2-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
1 - $V_{\varphi\text{-}n}$ @-25°C	261.8	-0.17	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	261.7	-0.19	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	261.9	-0.11	230	230	± 1.5
	Phase L3-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L2-N (V)	Deviation limit (%Un)
1 - $V_{\varphi\text{-}n}$ @-25°C	261.4	-0.35	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	260.5	-0.65	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	260.4	-0.69	230	230	± 1.5

Verification of disconnecting time		
Iteration	Disconnection time (s)	Oscilloscope recorded waveforms
Over voltage stage 1		
L1-N@-25°C:		

1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.005s	
L1-N@+25°C:		
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.015s	
L1-N@+60°C:		

1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.025s	
L2-N@-25°C:		
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.015s	
L2-N@+25°C:		

1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.025s	
L2-N@+60°C:		
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.025s	
L3-N@-25°C:		

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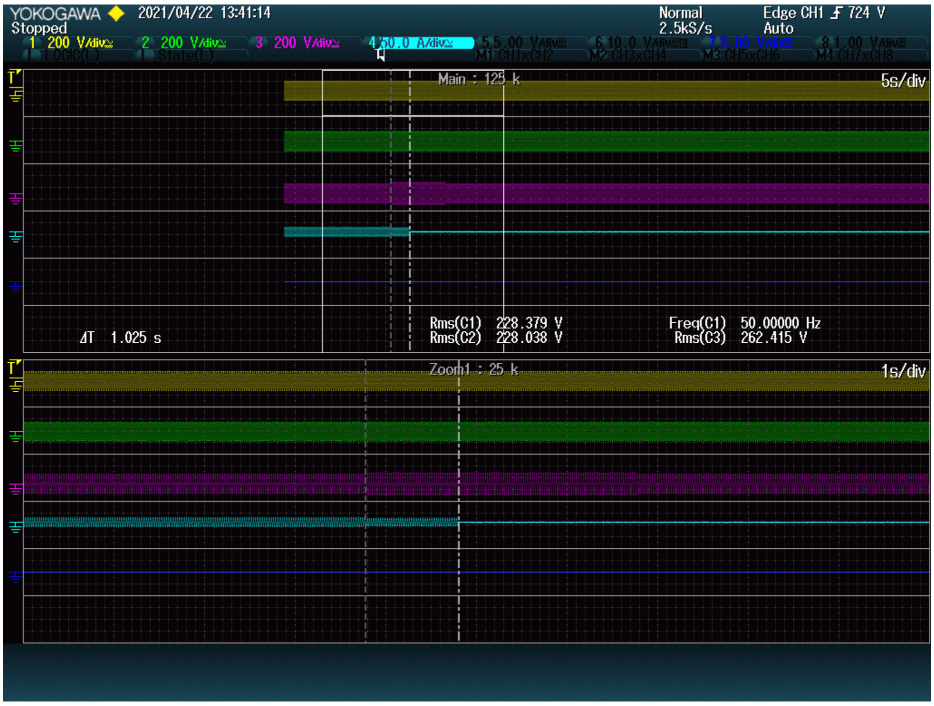
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.025s	
L3-N@+25°C:		
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.025s	
L3-N@+60°C:		

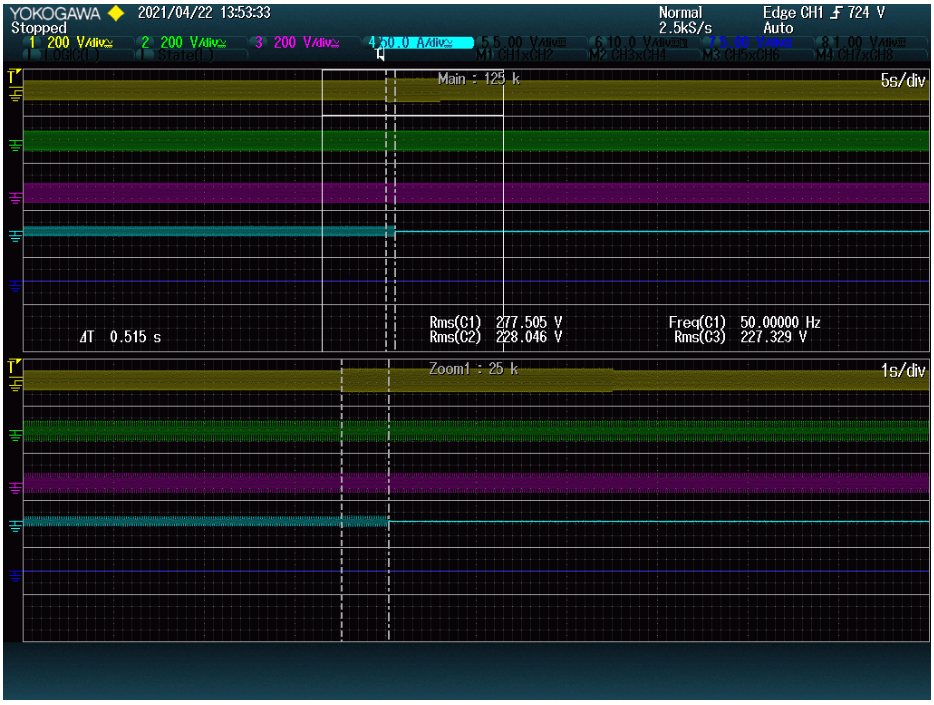
1. 258.2V—266.2V (OV st1 trip setting plus 4V)	1.015s	

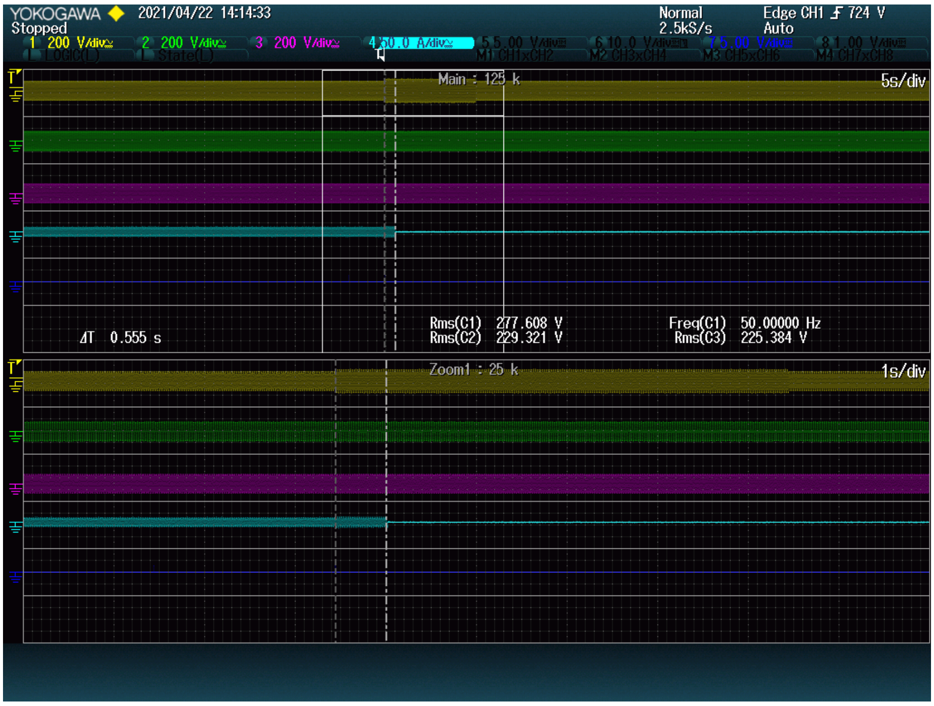
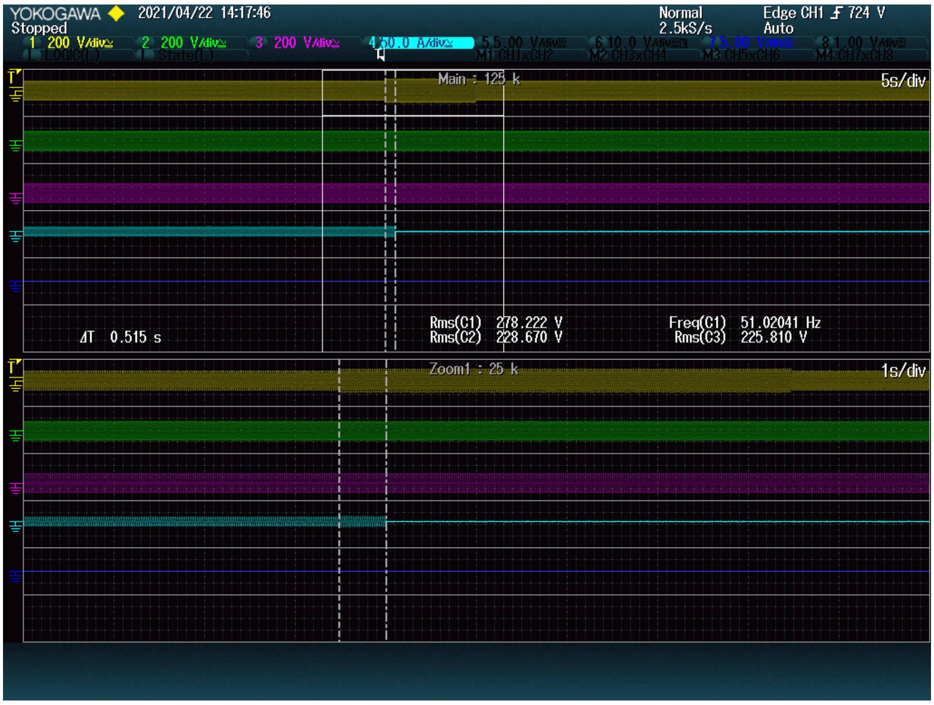
No trip tests - O/V stage 1		
voltage	Hold on time	Confirm no trip
$V_{\varphi\text{-}n}$: 258.2V (O/V st1 trip setting minus 4V)	5.0s	no trip

Iteration	Measured voltage(V) and deviation from nominal value (%)				
	Phase L1-N (V)	Deviation (%Un)	Test with phase L2-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
Over voltage stage 2					
1 - $V_{\varphi\text{-}n}$ @-25°C	274.7	0.43	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	274.3	0.22	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	274.6	0.33	230	230	± 1.5
	Phase L2-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L3-N (V)	Deviation limit (%Un)
1 - $V_{\varphi\text{-}n}$ @-25°C	274.4	0.26	230	230	± 1.5

1 - $V_{\varphi\text{-}n}$ @+25°C	274.3	0.22	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	274.3	0.22	230	230	± 1.5
	Phase L3-N (V)	Deviation (%Un)	Test with phase L1-N (V)	Test with Phase L2-N (V)	Deviation limit (%Un)
1 - $V_{\varphi\text{-}n}$ @-25°C	273.7	0.00	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+25°C	273.5	-0.07	230	230	± 1.5
1 - $V_{\varphi\text{-}n}$ @+60°C	273.5	-0.07	230	230	± 1.5

Verification of disconnecting time

Iteration	Disconnection time (s)	Oscilloscope recorded waveforms
Over voltage stage 2		
L1-N@-25°C:		
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.515s	
L1-N@+25°C:		

1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.555s	
L1-N@+60°C:		
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.515s	
L2-N@-25°C:		

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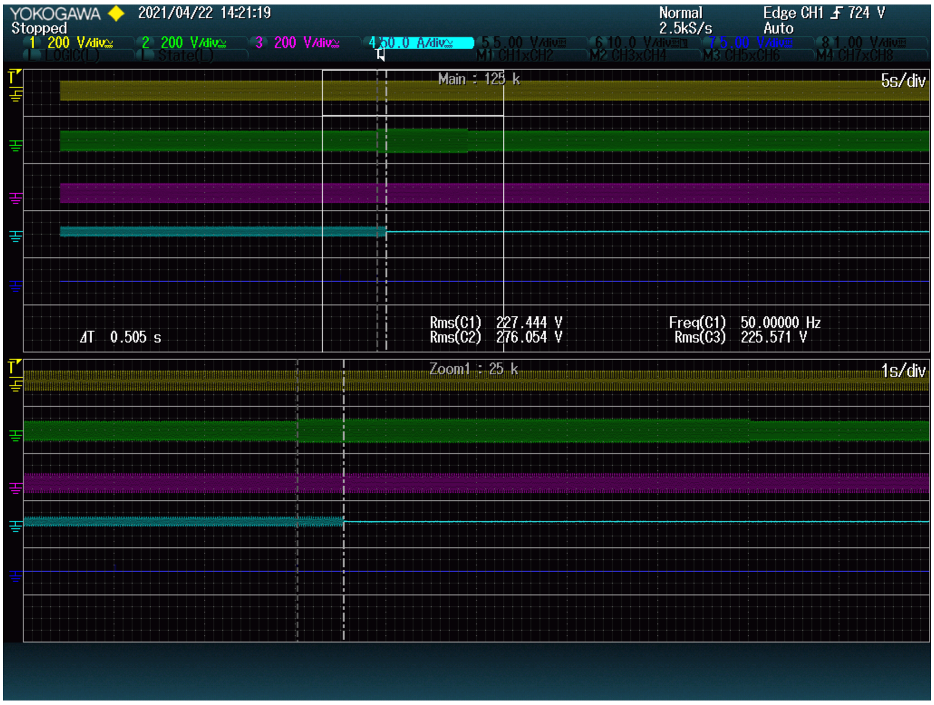
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.535s	
L2-N@+25°C:		
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.505s	
L2-N@+60°C:		

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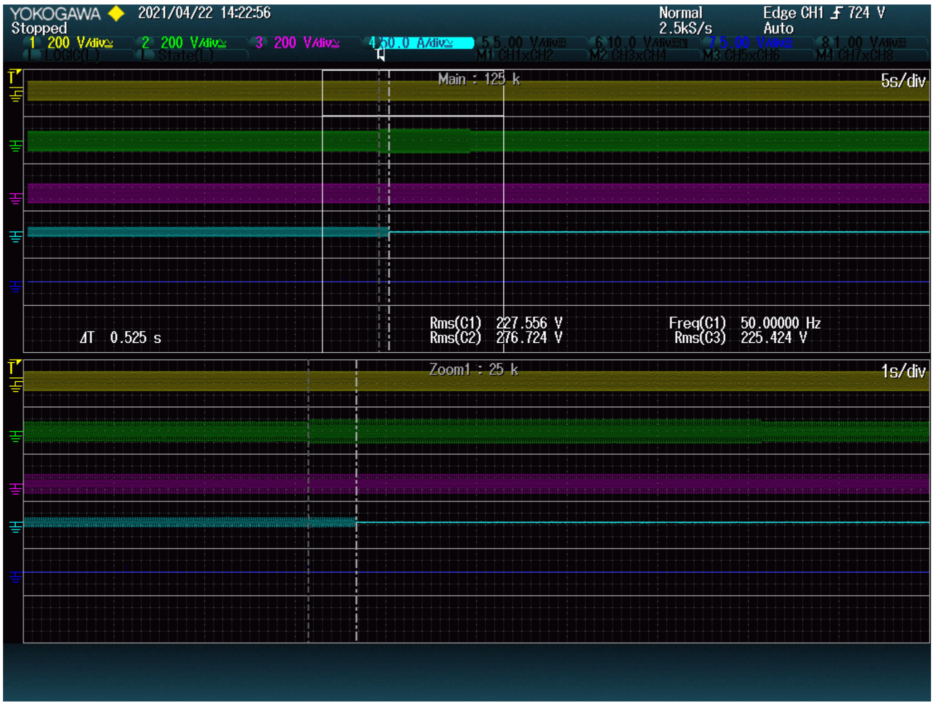
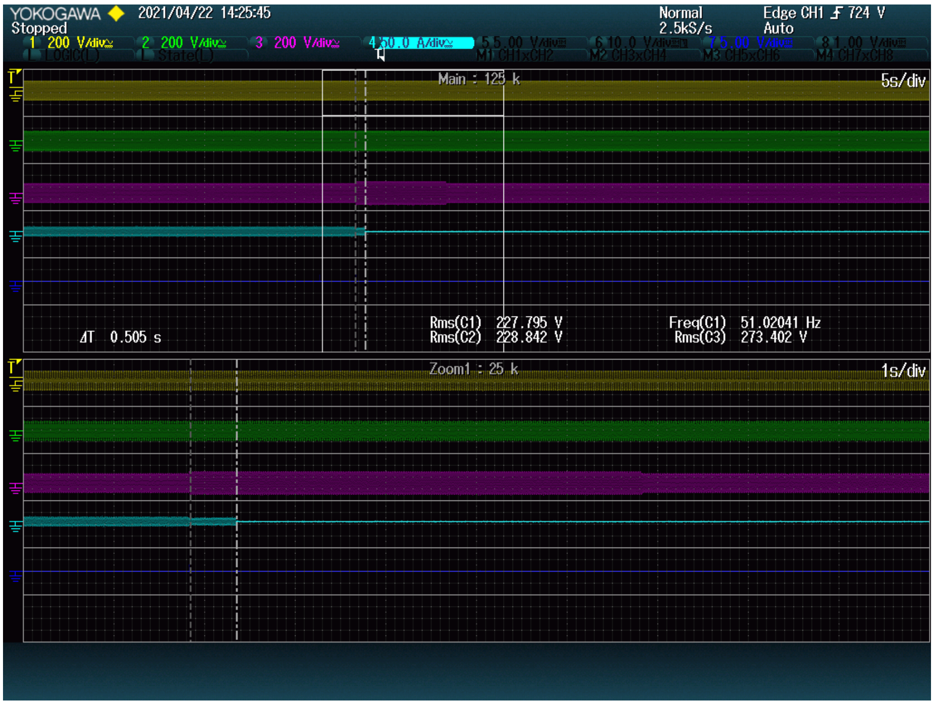
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.525s	
L3-N@-25°C:		
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.505s	
L3-N@+25°C:		

1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.515s	
L3-N@+60°C:		
1. 269.7V—277.7V (OV st2 trip setting plus 4V)	0.535s	
No trip tests - O/V stage 2		
voltage	Hold on time	Confirm no trip

$V_{φ-n}$: 269.7V (O/V st2 trip setting minus 4V)	0.95s	no trip
$V_{φ-n}$: 277.7V (O/V st2 trip setting plus 4V)	0.45s	no trip

8. Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.

Solis-110K-5G@3/N/PE~, 230/400V

These tests should be carried out in accordance with the Annex A.7.1.2.3.

Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5%P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5 s	0.115s	0.208s	0.262s	0.133s	0.165s	0.109s

Test data recorded for islanding protection according BS EN 62116

Curve illustration:

Channel 1, 2, 3: Waveform of current at AC power source connection terminals.
Channel 4, 5, 6: Waveform of PV inverter output current

Channel 7:Trigger signal of turning into island state.

No.	P_{EUT} (% of EUT rating)	Reactive Load (% of Q_L)	P_{AC} (% of nominal)	Q_{AC} (% of nominal)	Run on time (ms)	P_{EUT} (kW)	Actual Q_f	V_{DC}(V)	Remarks
1	100	100	0	0	270.0	110	1	795	Test A, BL

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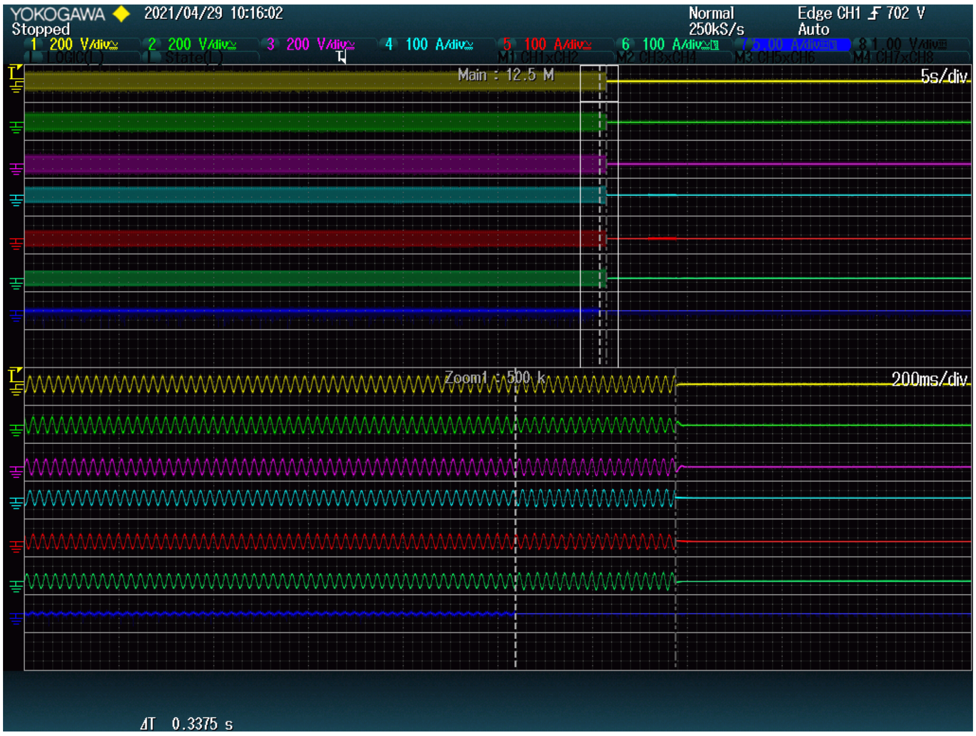
2	66	66	0	0	337.5	72.6	1	590	Test B, BL



3	33	33	0	0	560.0	36.3	1	344	Test C, BL

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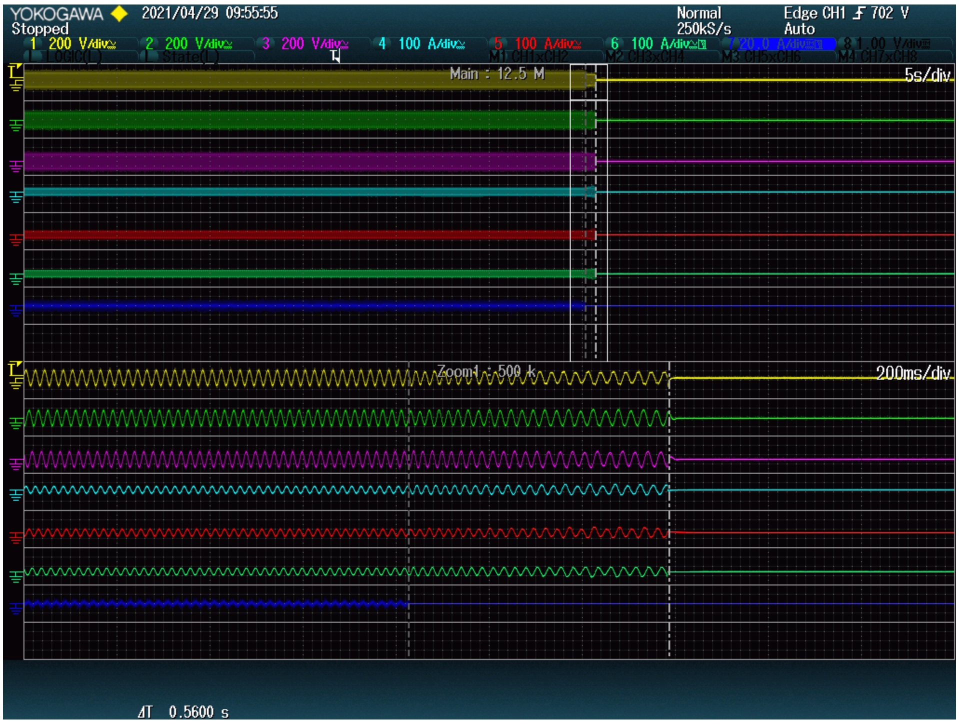


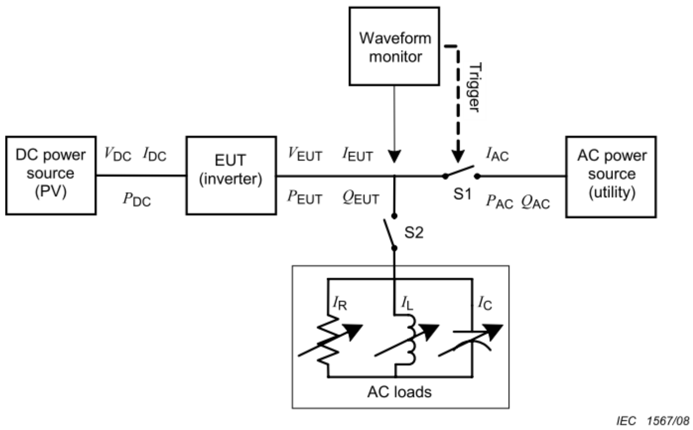
4	100	100	-5	-5	89.8	110	0.97	795	Test A, IB[1]
5	100	100	-5	0	95.3	110	1	795	Test A, IB[1]
6	100	100	-5	+5	99.8	110	1.02	795	Test A, IB[1]
7	100	100	0	-5	100.5	110	0.97	795	Test A, IB[1]
8	100	100	0	+5	102.9	110	1.02	795	Test A, IB[1]
9	100	100	+5	-5	98.7	110	0.98	795	Test A, IB[1]
10	100	100	+5	0	103.5	110	1.02	795	Test A, IB[1]
11	100	100	+5	+5	101.4	110	1.04	795	Test A, IB[1]
12	100	100	-10	+10	76.8	110	1.03	795	Test A, IB[1]
13	100	100	-5	+10	78.5	110	1.03	795	Test A, IB[1]
14	100	100	0	+10	87.3	110	1.04	795	Test A, IB[1]
15	100	100	+5	+10	88.5	110	1.04	795	Test A, IB[1]
16	100	100	+10	+10	90.6	110	1.04	795	Test A, IB[1]
17	100	100	-10	+5	100.5	110	1.02	795	Test A, IB[1]
18	100	100	+10	+5	103.3	110	1.02	795	Test A, IB[1]

19	100	100	-10	0	120.5	110	1.00	795	Test A, IB[1]
20	100	100	+10	0	130.8	110	1.01	795	Test A, IB[1]
21	100	100	-10	-5	101.8	110	0.97	795	Test A, IB[1]
22	100	100	+10	-5	112.4	110	0.96	795	Test A, IB[1]
23	100	100	-10	-10	100.1	110	0.95	795	Test A, IB[1]
24	100	100	-5	-10	89.2	110	0.96	795	Test A, IB[1]
25	100	100	0	-10	87.5	110	0.96	795	Test A, IB[1]
26	100	100	+5	-10	90.3	110	0.97	795	Test A, IB[1]
27	100	100	+10	-10	87.2	110	0.96	795	Test A, IB[1]
28	66	66	0	-5	220.1	72.6	0.96	590	Test B, IB
29	66	66	0	-4	260.3	72.6	0.97	590	Test B, IB
30	66	66	0	-3	278.2	72.6	0.98	590	Test B, IB
31	66	66	0	-2	285.7	72.6	0.98	590	Test B, IB
32	66	66	0	-1	290.5	72.6	0.99	590	Test B, IB
33	66	66	0	1	286.5	72.6	1.01	590	Test B, IB
34	66	66	0	2	270.3	72.6	1.01	590	Test B, IB
35	66	66	0	3	265.2	72.6	1.02	590	Test B, IB
36	66	66	0	4	230.5	72.6	1.03	590	Test B, IB
37	66	66	0	5	190.5	72.6	1.04	590	Test B, IB
38	33	33	0	-5	283.4	36.3	1.04	344	Test C, IB
39	33	33	0	-4	320.1	36.3	1.03	344	Test C, IB
40	33	33	0	-3	420.6	36.3	1.03	344	Test C, IB
41	33	33	0	-2	450.3	36.3	1.02	344	Test C, IB
42	33	33	0	-1	482.1	36.3	1.01	344	Test C, IB
43	33	33	0	1	472.3	36.3	1.01	344	Test C, IB
44	33	33	0	2	430.2	36.3	1.02	344	Test C, IB

45	33	33	0	3	405.1	36.3	1.03	344	Test C, IB
46	33	33	0	4	375.9	36.3	1.03	344	Test C, IB
47	33	33	0	5	286.7	36.3	1.04	344	Test C, IB

Supplementary information:

Test method are refer to BS EN 62116:2014.



Only record Qf at balance condition of 100%, 66% and 33% rated power required in standard and MPP voltage range from 180-1000V with max. system voltage is 1100V.

If range is between X volts and Y volts, 75 % of range = X + 0.75×(Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Single phase test for multi-phase Generating Units. Confirm that when generating in parallel with a network operating at around 50Hz with no network disturbance, that the removal of a single phase connection to the Generating Unit, with the remaining phases connected causes a disconnection of the generating unit within a maximum of 1s.

Ph1 removed	Confirm trip in less than 1s	Ph2 removed	Confirm trip in less than 1s	Ph3 removed	Confirm Trip in less than 1s

Loss of Mains Protection, Vector Shift Stability test. This test should be carried out in accordance with Annex A.7.1.2.6.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	No trip
Negative Vector Shift	50.5 Hz	- 50 degrees	No trip

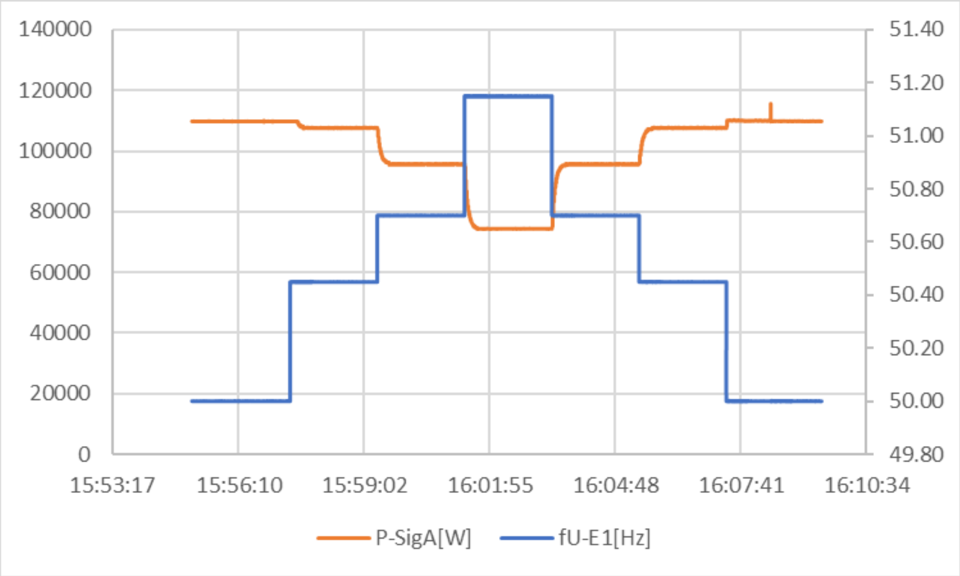
Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6.

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0Hz to 51.0Hz	+0.95 Hzs^{-1}	2.1 s	No trip
51.0Hz to 49.0Hz	-0.95 Hzs^{-1}	2.1 s	No trip
Remark: clause 11.2.2 and 12.2.2 is taken into consideration			

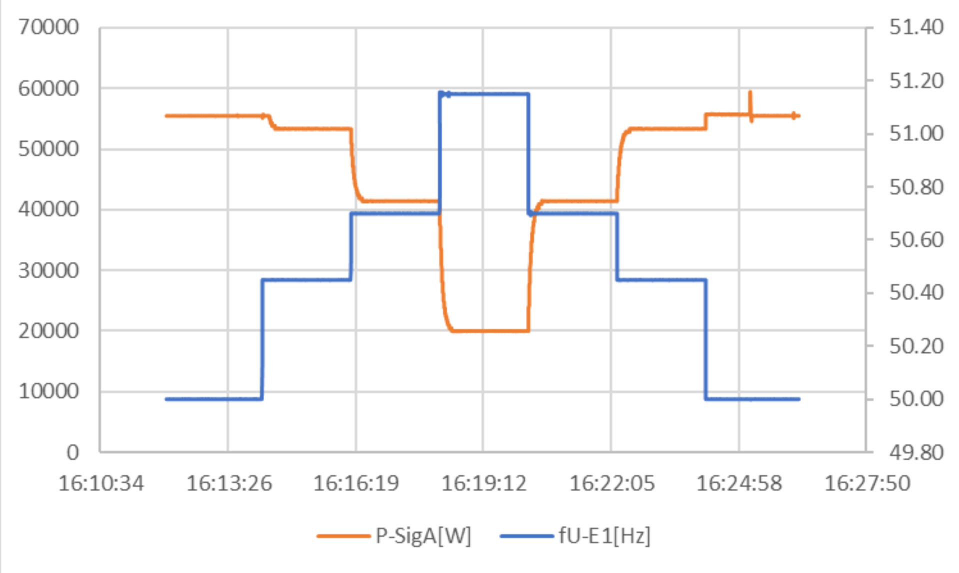
9. Limited Frequency Sensitive Mode – Over frequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.

This test should be carried out in accordance with Annex A.7.1.3.

Solis-110K-5G@3/N/PE~, 230/400V						
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.						**Yes**
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output (W)	**Δ Active Power** achieved within 10s (**%Pmax**)	**Required Δ Active Power** achieved within 10s **(%Pmax)**	Frequency (Hz)	Primary Power Source	**Active Power** Gradient (**droop %**)
Step a) 50.00Hz ±0.01Hz	109823	-	-	50.00	PV simulator (100%Pn)	-
Step b) 50.45Hz ±0.05Hz	107678	-	-	50.45		-
Step c) 50.70Hz ±0.10Hz	95762	9.92	≥3%	50.70		9.93
Step d) 51.15Hz ±0.05Hz	74391	17.71	≥5%	51.15		10.00
Step e) 50.70Hz ±0.10Hz	95412	9.72	≥3%	50.70		9.91
Step f) 50.45Hz ±0.05Hz	107661	-	-	50.45		-
Step g) 50.00Hz ±0.01Hz	109840	-	-	50.00		-



Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	**Δ Active Power** achieved within 10s **(%Pmax)**	**Required Δ Active Power** achieved within 10s **(%Pmax)**	Frequency (Hz)	Primary Power Source	**Active Power** Gradient (**droop %**)
Step a) 50.00Hz ±0.01Hz	55464	-	-	50.00	PV simulator (50%Pn)	-
Step b) 50.45Hz ±0.05Hz	53339	-	-	50.45		-
Step c) 50.70Hz ±0.10Hz	41403	9.92	≥3%	50.70		10.02
Step d) 51.15Hz ±0.05Hz	19995	18.18	≥5%	51.15		9.98
Step e) 50.70Hz ±0.10Hz	41416	9.93	≥3%	50.70		10.01
Step f) 50.45Hz ±0.05Hz	53338	-	-	50.45		-
Step g) 50.00Hz ±0.01Hz	55491	-	-	50.00		-



Remark: clause 11.2.4 and 12.2.4 is taken into consideration

10. Protection – Re-connection timer.					
Solis-110K-5G@3/N/PE~, 230/400V (LV protection)					
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1.					
Time delay setting (s)	Measured delay (s)	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
300	301 *	At 1.16 pu (266.2V)	At 0.78 pu (180V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

Supplementary information:

1. Min. delay time recorded in all cases in above table.

2. “*”: Reconnecting time is the sum of waiting time of both the mains voltage and the mains frequency are within the tolerance range plus additional delay time for all control and adjustment processes safely finished time.

Test data record for reconnection				
Test sequence after trip	connection	Connection allowed	Reconnection time ≥ 20s	Power gradient (% Pn/min)
a) U ≥ (1.14pu + 4V)	No	No	N/A	N/A
b) U ≤ (1.14pu – 4V)	Yes	Yes	Yes (301s)	10.0
c) U ≤ (0.8pu – 4V)	No	No	N/A	N/A

d) U ≥ (0.8pu + 4V)	Yes	Yes	Yes (301s)	10.0
e) F ≤ 47.4 Hz	No	No	N/A	N/A
f) F ≥ 47.6 Hz	Yes	Yes	Yes (301s)	10.0
g) F ≥ 52.1 Hz	No	No	N/A	N/A
h) F ≤ 51.9 Hz	Yes	Yes	Yes (301s)	10.0

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.

Solis-110K-5G@3/N/PE~, 230/400V

For an Inverter output

Time after fault	Volts	Amps
20ms	34.78	74.65
100ms	23.26	0
250ms	23.34	0
500ms	23.38	0
Time to trip	0.053	In seconds

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.7.	
It has been verified that in the event of the solid state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	N/A

13. Wiring functional tests: If required by para 15.2.1,	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	N/A

14. Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module.	Yes

Remark: clause 11.1.3 is taken into consideration

Logic interface is required by some local regulations that can be operated by a simple switch or contactor. When the switch is closed the inverter can operated normally. When the switch is opened, the inverter will reduce it's output power to zero within 5s. Pin5 and Pin6 of RJ45 terminal is used for the logic interface connection.

Please follow below steps to assemble RJ45 connector.

1. Insert the network cable into the communication connection terminal of RJ45.

It is to make use of the facility to cease Active Power output, the DNO will agree with the Generator how the communication path is to be achieved.

Figure 4.27 RJ45 communication connection terminals

2.Use the network wire stripper to strip the insulation layer of the communication cable.

According to the standard line sequence of figure 4.28 connect the wire to the plug of RJ45, and then use a network cable crimping tool to make it tight.

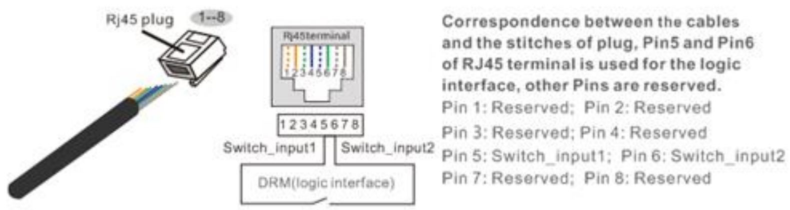


Figure 4.28 Strip the insulation layer and connect to RJ45 plug

3. Connect RJ45 to DRM (logic interface)

After wire connection, please refer chapter 7.5.8.1 to enable the logic interface function.

Additional test with consideration of type A and type B power gererating module technical requirement – test record:

1. Reactive power capability and accuracy measurement					
Solis-110K-5G@3/N/PE~, 230/400V					
Consumption of inductive reactive power					
1. Cos φ set=0.95 (inductive)					
Power - Bin (P/Pn)	Active power P [W]	Reactive power Q [var]	Power factor [cosφ]	Δcos φ	Recommended Δcos φ limit
10%±5%(*)	11669	-3984	0.944	-0.006	-
20%±5%	22410	-7409	0.949	-0.001	≤ ±0.01
30%±5%	34013	-11126	0.950	0	≤ ±0.01
40%±5%	44694	-14548	0.951	0.001	≤ ±0.01
50%±5%	56327	-18286	0.951	0.001	≤ ±0.01
60%±5%	66908	-21653	0.951	0.001	≤ ±0.01
70%±5%	78435	-25367	0.951	0.001	≤ ±0.01
80%±5%	89045	-28771	0.951	0.001	≤ ±0.01
90%±5%	100555	-32516	0.951	0.001	≤ ±0.01
100%±5%(#)	111063	-35895	0.951	0.001	≤ ±0.01

2. Q set=Qmin=-33%Pn (corresponding to 0,95PF)							
Power - Bin (P/Pn)	Active power P		Reactive power Q		Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
	[W]	p.u. [%]	[VA]	p.u. [%]			
0 % ± 5%(*)	5545	5.04	34670	31.52	0.158	-1.48	±10%
10% ± 5%(*)	11536	10.49	34711	31.56	0.315	-1.44	±10%
20% ± 5%	22239	20.22	34811	31.65	0.538	-1.35	±2%
30% ± 5%	33827	30.75	34891	31.72	0.696	-1.28	±2%
40% ± 5%	44614	40.56	34849	31.68	0.788	-1.32	±2%
50% ± 5%	56306	51.19	34740	31.58	0.851	-1.42	±2%
60% ± 5%	67136	61.03	34369	31.24	0.890	-1.76	±2%
70% ± 5%	78691	71.54	34237	31.12	0.917	-1.88	±2%

Power - Bin (P/Pn)	Active power P [W]	p.u. [%]	Reactive power Q [VA]	p.u. [%]	Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
80% ± 5%	90021	81.84	34633	31.48	0.933	-1.52	±2%
90% ± 5%	99488	90.44	34908	31.73	0.944	-1.27	±2%
100% ± 5%(#)	110854	100.78	34892	31.72	0.954	-1.28	±2%
3. Q set=Qmin=-54.5%Pn (maximum capability)							
Power - Bin (P/Pn)	Active power P		Reactive power Q		Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
	[W]	p.u. [%]	[VA]	p.u. [%]			
0 % ± 5%(*)	4925	4.48	-59218	-53.83	0.083	0.67	±10%
10% ± 5%(*)	10875	9.89	-59220	-53.84	0.181	0.66	±10%
20% ± 5%	21670	19.70	-59103	-53.73	0.344	0.77	±2%
30% ± 5%	33326	30.30	-59017	-53.65	0.491	0.85	±2%
40% ± 5%	44009	40.01	-58941	-53.58	0.598	0.92	±2%
50% ± 5%	55638	50.58	-58766	-53.42	0.687	1.08	±2%
60% ± 5%	66297	60.27	-58737	-53.40	0.748	1.10	±2%
70% ± 5%	77876	70.80	-58685	-53.35	0.798	1.15	±2%
80% ± 5%	89424	81.29	-58610	-53.28	0.836	1.22	±2%
90% ± 5%(#)	99017	90.02	-58540	-53.22	0.861	1.28	±2%
100% ± 5%(#)	99010	90.01	-58543	-53.22	0.861	1.28	±2%

Supply of capacitive reactive power					
1. Cos φ set=0.95 (capacitive)					
Power - Bin (P/Pmax)	Active power P[W]	Reactive power Q[var]	Power factor[cosφ]	Δcos φ	Recommended Δcos φ limit
10%±5%(*)	11700	3720	0.950	0	-
20%±5%	22500	7370	0.950	0	≤ ±0.01
30%±5%	34100	11300	0.949	-0.001	≤ ±0.01
40%±5%	44725	14900	0.949	-0.001	≤ ±0.01
50%±5%	56385	18838	0.948	-0.002	≤ ±0.01
60%±5%	66956	22473	0.948	-0.002	≤ ±0.01
70%±5%	78500	26336	0.948	-0.002	≤ ±0.01

80%±5%	89092	29900	0.948	-0.002	≤ ±0.01
90%±5%	101000	33800	0.948	-0.002	≤ ±0.01
100%±5%(#)	111000	37313	0.948	-0.002	≤ ±0.01

2. Q set=Qmax=33%Pn (corresponding to 0.95PF)

Power - Bin (P/Pn)	Active power P		Reactive power Q		Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
	[W]	p.u. [%]	[var]	p.u. [%]			
0 % ± 5%(*)	5129	4.66	35177	31.98	0.147	-1.02	±10%
10% ± 5%(*)	11073	10.07	35189	31.99	0.302	-1.01	±10%
20% ± 5%	21910	19.92	35147	31.95	0.531	-1.05	±2%
30% ± 5%	33558	30.51	35094	31.90	0.691	-1.1	±2%
40% ± 5%	44147	40.13	35150	31.95	0.782	-1.05	±2%
50% ± 5%	55714	50.65	35272	32.07	0.845	-0.93	±2%
60% ± 5%	66078	60.07	35726	32.48	0.882	-0.52	±2%
70% ± 5%	77643	70.58	35780	32.53	0.908	-0.47	±2%
80% ± 5%	88367	80.33	35482	32.26	0.928	-0.74	±2%
90% ± 5%	99938	90.85	34951	31.77	0.943	-1.23	±2%
100% ± 5%(#)	110540	100.49	34784	31.62	0.954	-1.38	±2%

3. Q set=Qmax=54.5%Pn (maximum capability)

Power - Bin (P/Pn)	Active power P		Reactive power Q		Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
	[W]	p.u. [%]	[VA]	p.u. [%]			
0 % ± 5%(*)	4983	4.53	58753	53.41	0.084	-1.09	±10%
10% ± 5%(*)	10939	9.94	58827	53.48	0.183	-1.02	±10%
20% ± 5%	21749	19.77	58967	53.61	0.346	-0.89	±2%
30% ± 5%	33388	30.35	59015	53.65	0.492	-0.85	±2%
40% ± 5%	44107	40.10	59117	53.74	0.598	-0.76	±2%
50% ± 5%	55741	50.67	59197	53.82	0.685	-0.68	±2%
60% ± 5%	66329	60.30	59276	53.89	0.745	-0.61	±2%

Product Service

70% ± 5%	77924	70.84	59359	53.96	0.795	-0.54	±2%
80% ± 5%	89482	81.35	59433	54.03	0.833	-0.47	±2%
90% ± 5%(#)	99114	90.10	59487	54.08	0.857	-0.42	±2%
100% ± 5%(#)	99076	90.07	59491	54.08	0.857	-0.42	±2%
Supply of reactive power with set point Q = 0							
Power - Bin (P/Pn)	Active power P		Reactive power Q		Power factor[cosφ]	ΔQ/Pn[%]	Recommended ΔQ limit [%Pn]
	[W]	p.u. [%]	[VA]	p.u. [%]			
0 % ± 5%(*)	4777	4.34	1068	0.97	0.969	0.97	±10%
10% ± 5%(*)	11674	10.61	1131	1.03	0.991	1.03	±10%
20% ± 5%	22426	20.39	1225	1.11	0.998	1.11	±2%
30% ± 5%	33014	30.01	1307	1.19	0.999	1.19	±2%
40% ± 5%	44653	40.59	1400	1.27	0.999	1.27	±2%
50% ± 5%	55293	50.27	1483	1.35	0.999	1.35	±2%
60% ± 5%	66843	60.77	1574	1.43	0.999	1.43	±2%
70% ± 5%	78384	71.26	1647	1.50	0.999	1.50	±2%
80% ± 5%	88960	80.87	1721	1.56	0.999	1.56	±2%
90% ± 5%	99500	90.45	1792	1.63	0.999	1.63	±2%
100% ± 5%	110988	100.90	1861	1.69	0.999	1.69	±2%

(*): When operating above the active power threshold Pmin equal to 10 % of the nominal active power Pn, the reactive power capability shall be provided with an accuracy of ± 2 % Smax. Up to this apparent power threshold Smin, deviations above 2 % are permissible; nevertheless the accuracy shall always be as good as technically feasible and the exchange of uncontrolled reactive power in this low-power operation mode shall not exceed 10 % of the nominal active power Pn.
Δcos φ limit not recommended below 10 % of the nominal active power Pn.
(#): required reactive power or PF can not achieved due to apparenet power limitation.

Remark: clause 11.1.5 and 12.5 is taken into consideration

The test report must contain the results of measurements of the maximum reactive power absorbed (Qmin) and delivered (Qmax) from the converter also in the form of graph P vs, Q as a function of the active power fed into the grid.

4. Operation mode - fixed displacement factor cosφ
Solis-110K-5G@3/N/PE~, 230/400V

Default in system control	0.950ov	0.960ov	0.970ov	0.980ov	0.990ov	1.000	0.990uv	0.980uv	0.970uv	0.960uv	0.950uv
Measured value at PGU terminals	0.950	0.960	0.970	0.980	0.990	1.000	0.990	0.979	0.969	0.959	0.949

P_{max} with fixed cosφ	Active Power (W) P_{60}(60s mean value after transient oscillation)	cosφ(60s mean value after transient oscillation)	Apparent Power (VA) (60s mean value after transient oscillation) S_{60}	Reactive Power (Var) (60s mean value after transient oscillation)	Cos φ deviation	Cos φ limit
cosφ = 0,950 over-excited	95435	0.951	100364	31015	0.001	≤ ±0.01
cosφ = 0,960 over-excited	110792	0.959	115505	32592	-0.001	≤ ±0.01
cosφ = 0,970 over-excited	110841	0.970	114332	27951	0	≤ ±0.01
cosφ = 0,980 over-excited	110754	0.979	113117	22912	-0.001	≤ ±0.01
cosφ = 0,990 over-excited	110866	0.990	112016	15861	0	≤ ±0.01
cosφ = 1	110821	0.999	110849	1310	-0.001	≤ ±0.01
cosφ = 0,990 under-excited	110690	0.990	111825	-15704	0	≤ ±0.01
cosφ = 0,980 under-excited	110619	0.980	112864	-22296	0	≤ ±0.01
cosφ = 0,970 under-excited	110564	0.970	113944	-27471	0	≤ ±0.01
cosφ = 0,960 under-excited	110517	0.961	115077	-31995	0.001	≤ ±0.01
cosφ = 0,950 under-excited	110453	0.951	116216	-36083	0.001	≤ ±0.01
Remark: clause 11.4 and 12.4 is taken into consideration						

5. Output power with falling frequency

Solis-110K-5G@3/N/PE~, 230/400V						
Test sequence	Voltage (V) (L1-N/L2-N/L3-N)	Current (A) (L1/L2/L3)	Frequency (Hz)	Active Power (W)	Active Power deviation (%)	Limit of power reduction (%)
Test a)	230.2/229.4/229.8	160.6/160.0/160.0	50.50	110837	-	-
Test b)	230.2/229.4/229.8	160.8/161.1/161.1	49.50	110855	0.35 (deviation form 50.5Hz)	-5
Test c)	230.2/229.3/229.8	160.7/161.1/161.0	47.00	110891	0.47(deviation form 50.5Hz)	-5
Remark: clause 11.2.3 and 12.2.3 is taken into consideration						

6. Active power adjustment accuracy measurement

Solis-110K-5G@3/N/PE~, 230/400V

Response external command through power management interface ☒ default as a simple hard-wired current loop interface if not specified by DNO

0	0.1pu	0.2pu	0.3pu	0.4pu	0.5pu	0.6pu	0.7pu	0.8pu	0.9pu	1.0pu
4 mA	5.6 mA	7.2 mA	8.8 mA	10.4 mA	12 mA	13.6 mA	15.2 mA	16.8 mA	18.4 mA	20 mA

Note: this interface can be integrated in a dedicated external device which communicate with inverter.

Power Setting (% of Pn)	Measured Power following time to the new set-point (P_{60s}, 1-minute average) (W)	set-point (W)	Power deviation (% P_n)	Limit of deviation (%)
100%	110819	110000	0.74	<±2.5
90%	99871	99000	0.79	<±2.5
80%	88893	88000	0.81	<±2.5
70%	77915	77000	0.83	<±2.5
60%	66808	66000	0.73	<±2.5
50%	55736	55000	0.67	<±2.5
40%	44615	44000	0.56	<±2.5
30%	33497	33000	0.45	<±2.5
20%	22383	22000	0.35	<±2.5

Product Service

10%	11258	11000	0.23	<±2.5
0% (or technical minimum)	1114	0	1.01	<±2.5
100%	110867	110000	0.79	<±2.5

Diagram for adjustment accuracy:

Test sequence	Measured stable active power of start point P[W]	Measured stable active power of end point P[W]	Time elapsed [s] (from start to time for output power last entered 5% tolerance band around the set-point)
100%P_n to 0% P_n	110831	1087	4
0%P_n to 100% P_n	981	110845	2
Remark: clause 12.1.3.5 is taken into consideration			

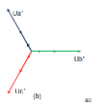
7. Low voltage ride through (LVRT) – Requirement

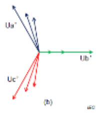
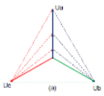
Short circuit current requirements on generating units

Solis-110K-5G@3/N/PE~, 230/400V

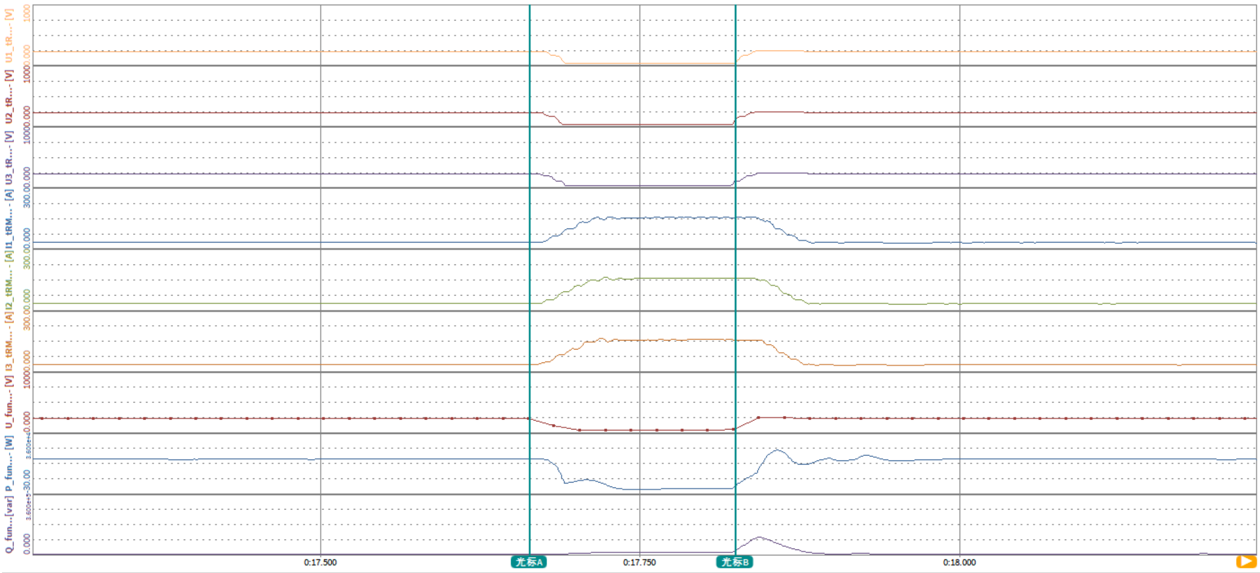
English translation to Chinese characters in oscillogram:

U1 [V]/U2 [V]/U3 [V]: waveform of inverter transient output voltage signal
I1 [A]/I2 [A]/I3 [A]: waveform of inverter transient output current signal
U_fund_SYM+_rc@POWER/0 [V]: full-cycle positive sequence fundamental value of voltage with recalcution rate of 1/ms
P_fund_ SYM+_rc @POWER/0 [W]: full-cycle fundamental component of active power with recalcution rate of 1/ms
Q_fund_ SYM+_rc @POWER/0 [var]: full-cycle fundamental component of reactive power with recalcution rate of 1/ms

Test list	Active power before voltage dip [%Pn]	Amplitude of the residual voltage Phase to phase V/Vn	Measued U1/Un [p.u.]	Reactive current during fault Irms [A]	Duration [ms]	Min. required duration limit [ms]	Power recover time [ms]	90% active power recover time limit [ms]	If total active energy during oscillations greater than rated active energy [Y/N]
Three phase faults 	20 @PF=1	0.85	0.86	34.4	180038	180000	69	<500	N/A
	20 @PF=1	0.70	0.70	131.5	1805	1788	66	<500	N/A

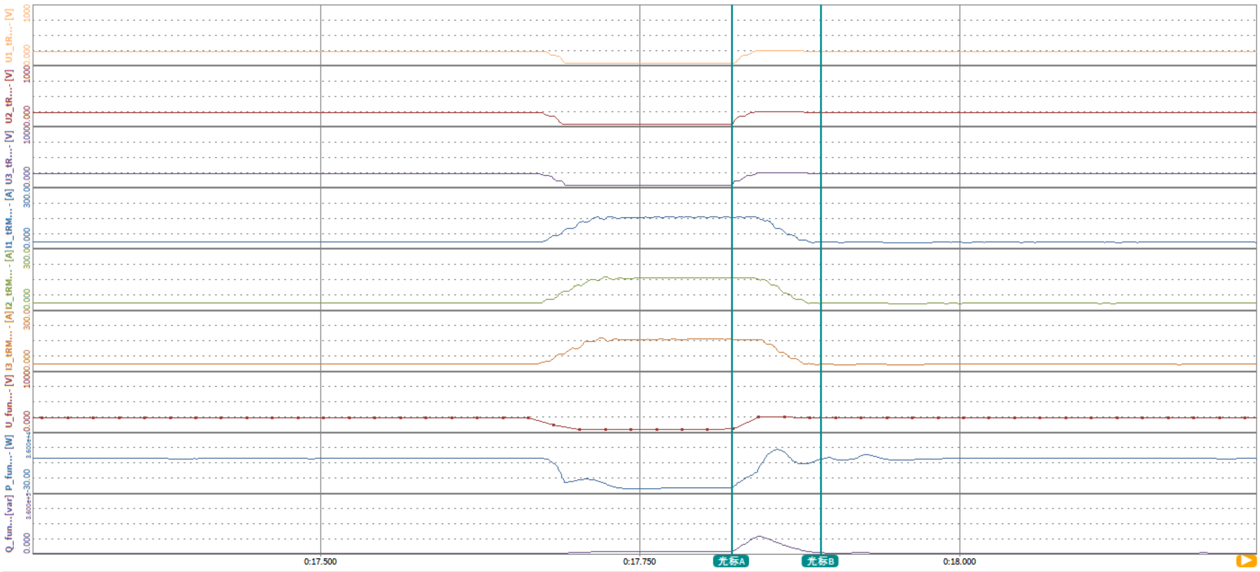
	20 @PF=1	0.40	0.40	155.3	969	964	127	<500	Y
	20 @PF=1	0.10	0.11	151.4	161	140	70	<500	Y
Phase-phase faults with earth 	20 @PF=1	0.85	0.86	34.0	180011	180000	32	<500	N/A
	20 @PF=1	0.70	0.70	130.0	1812	1788	37	<500	N/A
	20 @PF=1	0.40	0.40	148.7	965	964	90	<500	Y
	20 @PF=1	0.10	0.11	96.7	147	140	92	<500	Y
Single phase fault with earth 	20 @PF=1	0.85	0.86	32.8	180106	180000	15	<500	N/A
	20 @PF=1	0.70	0.70	130.2	1803	1788	50	<500	N/A
	20 @PF=1	0.40	0.40	147.6	982	964	46	<500	Y
	20 @PF=1	0.10	0.11	143.0	143	140	43	<500	Y
1) Three-phase symmetrical voltage dip: 10% Vn									
Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:									

Product Service



	A	B	间隔	有效值
时间 [s]	0:17.6636311	0:17.8245178	0.1608866	
U1_tRMS_rc@POWER/0 [V]	230.4436	33.52290	-196.9207	86.27826
U2_tRMS_rc@POWER/0 [V]	230.4652	65.46742	-164.9978	81.58549
U3_tRMS_rc@POWER/0 [V]	230.5098	78.65147	-151.8583	82.16800
I1_tRMS_rc@POWER/0 [A]	29.26991	153.0127	123.7428	135.9220
I2_tRMS_rc@POWER/0 [A]	29.26152	157.8256	128.5641	136.5913
I3_tRMS_rc@POWER/0 [A]	29.26944	152.9776	123.7081	136.7649
U_fundRMS_SYM+@POWER/0 [V]	230.4664	39.11222	-191.3542	111.0405
P_fund_SYM+_rc@POWER/0 [W]	20179.62	3727.587	-16452.03	8631.387
Q_fund_SYM+_rc@POWER/0 [var]	1229.943	18175.91	16945.97	10501.21

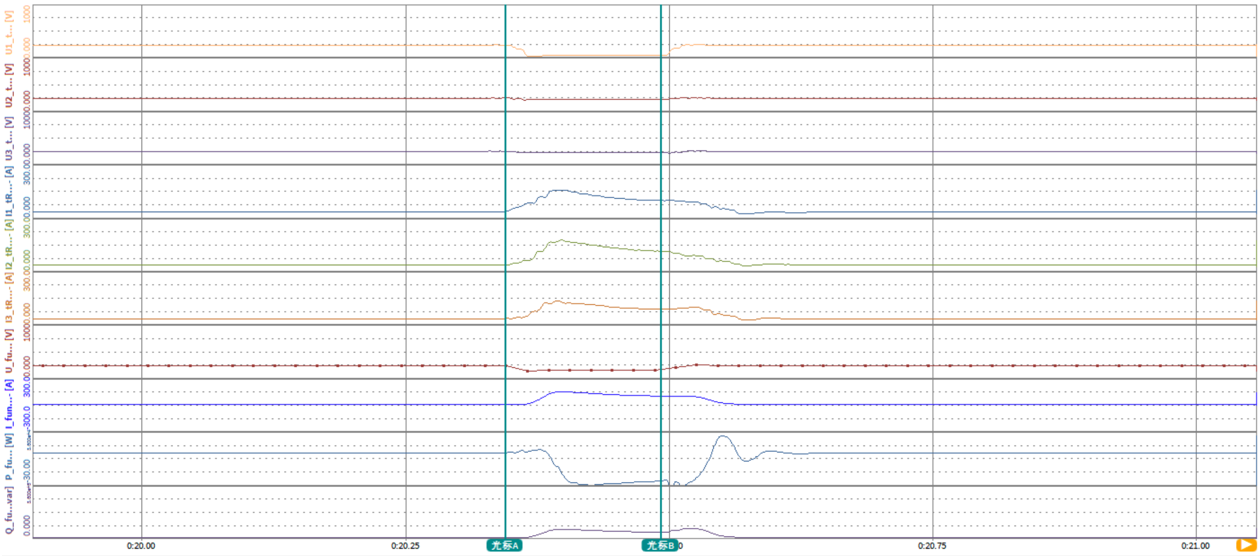
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:17.8217075	0:17.8912612	0.0695536	
U1_tRMS_rc@POWER/0 [V]	28.04844	230.6751	202.6267	210.1527
U2_tRMS_rc@POWER/0 [V]	28.06484	230.7474	202.6825	214.9161
U3_tRMS_rc@POWER/0 [V]	27.68270	230.8330	203.1503	211.1125
I1_tRMS_rc@POWER/0 [A]	154.4598	30.68565	-123.7742	113.0121
I2_tRMS_rc@POWER/0 [A]	154.9723	28.80830	-126.1640	114.5559
I3_tRMS_rc@POWER/0 [A]	154.8125	29.57234	-125.2401	112.7132
U_fundRMS_SYM+@POWER/0 [V]	27.88139	231.0684	203.1870	181.6718
P_fund_SYM+_rc@POWER/0 [W]	2819.280	19750.18	16930.90	17750.48
Q_fund_SYM+_rc@POWER/0 [var]	12626.43	4346.058	-8280.369	58564.63

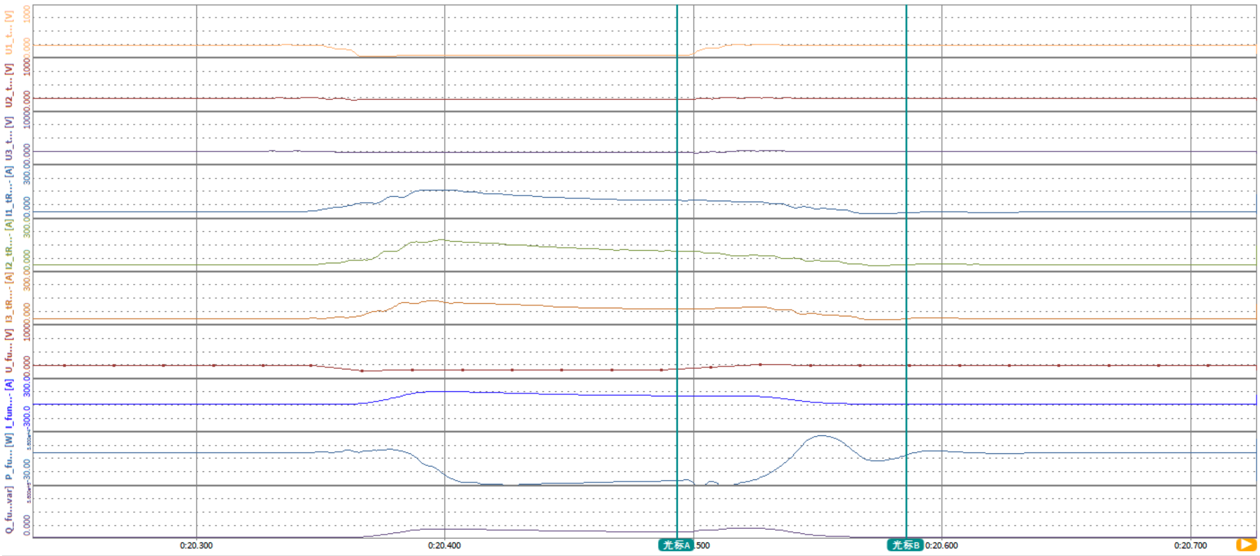
2) Phase-phase asymmetry voltage dip: 10% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:20.3447452	0:20.4921748	0.1474296	
U1_tRMS_rc@POWER/0 [V]	228.1456	26.25978	-201.8858	74.46622
U2_tRMS_rc@POWER/0 [V]	234.6184	203.2324	-31.38602	205.3369
U3_tRMS_rc@POWER/0 [V]	228.4870	203.4419	-25.04509	205.1734
I1_tRMS_rc@POWER/0 [A]	31.14317	96.68014	65.53697	112.7102
I2_tRMS_rc@POWER/0 [A]	32.05335	110.8495	78.79613	125.3085
I3_tRMS_rc@POWER/0 [A]	31.29672	85.72552	54.42880	96.52855
U_fundRMS_SYM+@POWER/0 [V]	230.4881	130.3223	-100.1658	157.5665
I_fund_Q_SYM+_rc@POWER/0 [A]	1.782132	96.69754	94.91541	104.7807
P_fund_SYM+_rc@POWER/0 [W]	21641.08	2338.692	-19302.39	12941.87
Q_fund_SYM+_rc@POWER/0 [var]	1229.500	37773.66	36544.16	41006.12

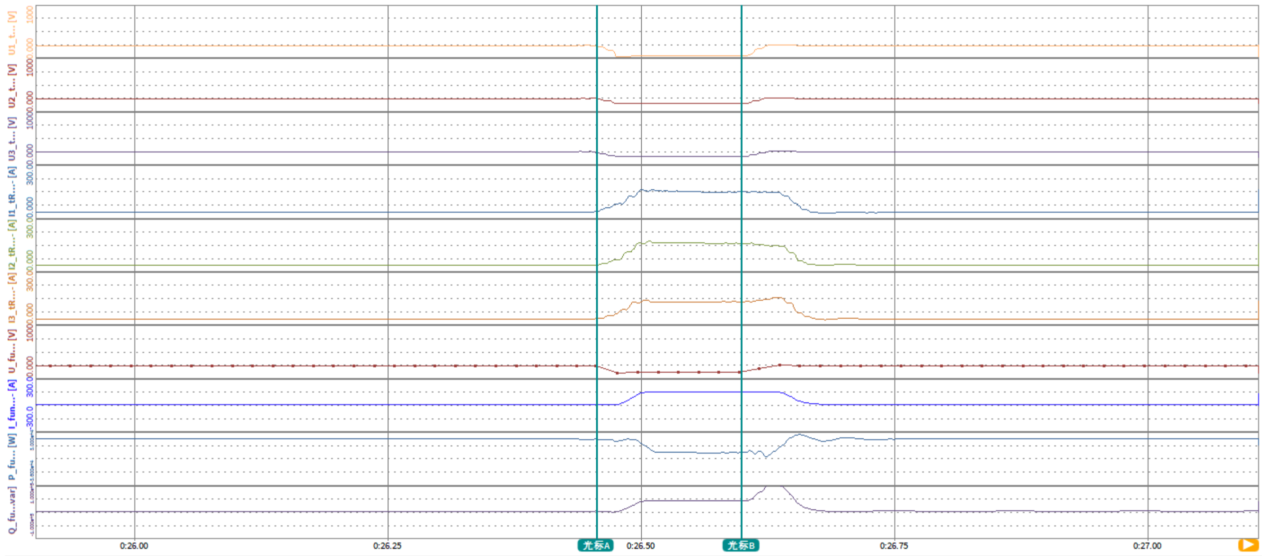
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:20.4933769	0:20.5855374	0.0921605	
U1_tRMS_rc@POWER/0 [V]	26.22219	230.3499	204.1278	212.3127
U2_tRMS_rc@POWER/0 [V]	203.3671	230.2597	26.89268	228.2967
U3_tRMS_rc@POWER/0 [V]	203.4154	230.6220	27.20663	226.1720
I1_tRMS_rc@POWER/0 [A]	96.59117	26.82140	-69.76978	69.45645
I2_tRMS_rc@POWER/0 [A]	110.2493	30.93913	-79.31020	72.56818
I3_tRMS_rc@POWER/0 [A]	85.55328	29.00205	-56.55122	71.53530
U_fundRMS_SYM+@POWER/0 [V]	130.3223	230.3200	99.99774	205.4250
I_fund_Q_SYM+_rc@POWER/0 [A]	96.41639	-1.265722	-97.68211	64.27432
P_fund_SYM+_rc@POWER/0 [W]	2444.705	19534.14	17089.44	17828.11
Q_fund_SYM+_rc@POWER/0 [var]	37668.05	-874.8948	-38542.94	38642.30

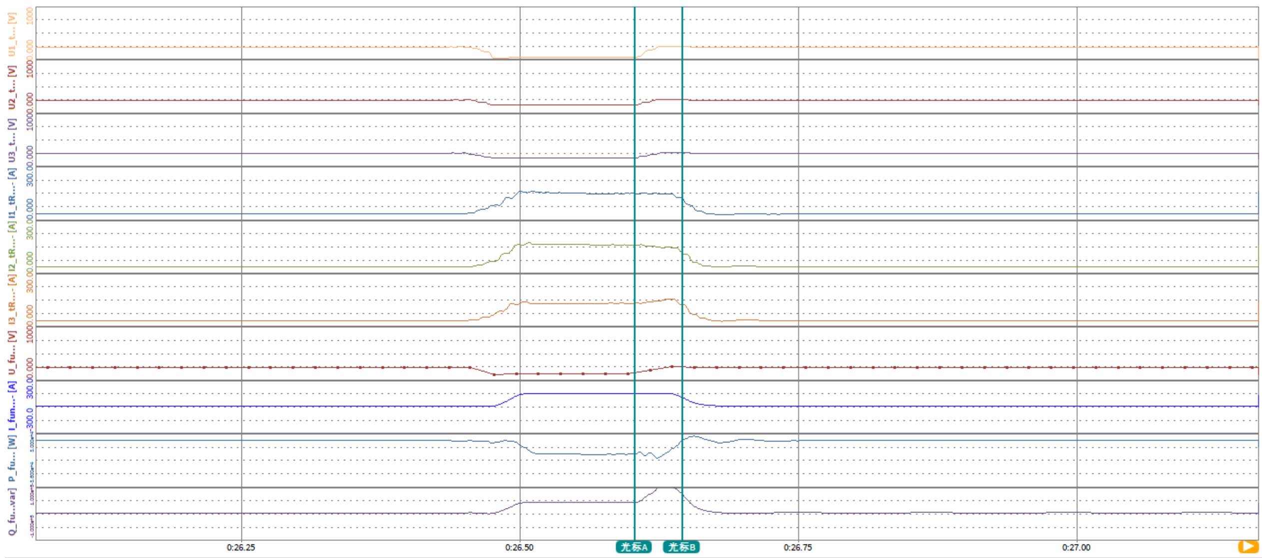
3) Single phase voltage dip: 10% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:26.455767	0:26.599163	0.143396	
U1_tRMS_rc@POWER/0 [V]	228.5761	27.55227	-201.0239	71.59010
U2_tRMS_rc@POWER/0 [V]	237.1844	145.2342	-91.95015	152.3946
U3_tRMS_rc@POWER/0 [V]	218.1835	145.2227	-72.96072	150.1278
I1_tRMS_rc@POWER/0 [A]	36.00497	147.7040	111.6990	134.1034
I2_tRMS_rc@POWER/0 [A]	32.72400	155.3523	122.6283	140.8335
I3_tRMS_rc@POWER/0 [A]	32.80373	130.7594	97.95570	116.5238
U_fundRMS_SYM+@POWER/0 [V]	230.4676	97.28078	-133.1868	135.6742
I_fund_Q_SYM+_rc@POWER/0 [A]	2.936966	142.9606	140.0236	122.6397
P_fund_SYM+_rc@POWER/0 [W]	21731.87	4571.563	-17160.30	12457.66
Q_fund_SYM+_rc@POWER/0 [var]	1984.172	41663.91	39679.74	35494.70

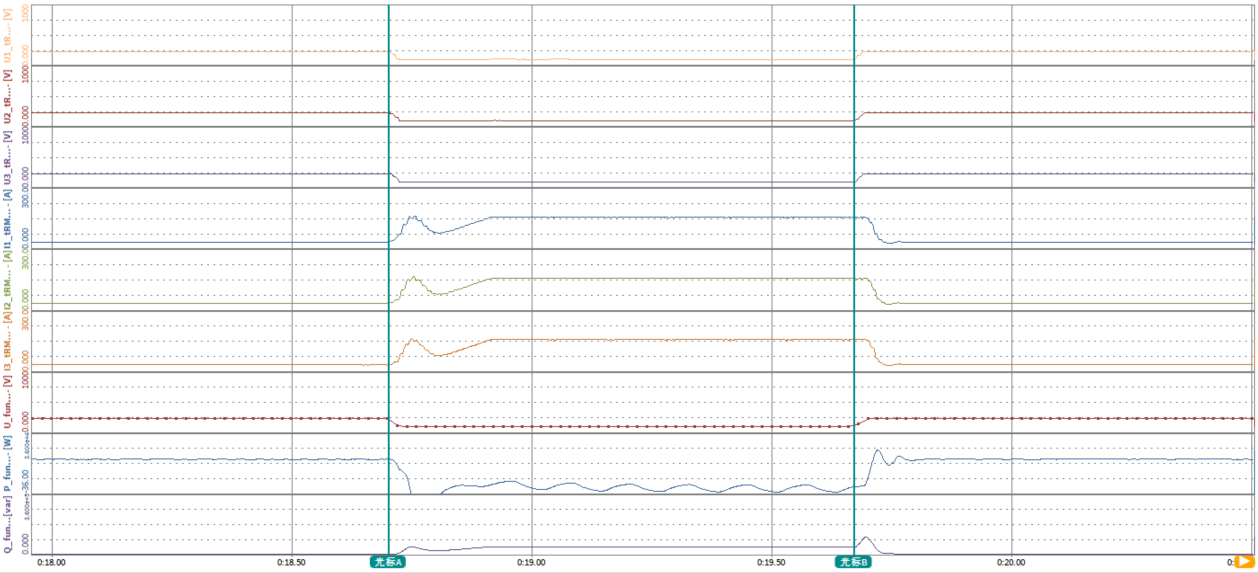
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:26.603055	0:26.645762	0.042708	
U1_tRMS_rc@POWER/0 [V]	27.56362	233.7789	206.2153	188.7818
U2_tRMS_rc@POWER/0 [V]	145.0621	233.9348	88.87267	211.2934
U3_tRMS_rc@POWER/0 [V]	145.2530	234.5105	89.25748	208.8441
I1_tRMS_rc@POWER/0 [A]	147.9625	125.0103	-22.95221	142.8118
I2_tRMS_rc@POWER/0 [A]	155.7851	120.3294	-35.45575	146.3497
I3_tRMS_rc@POWER/0 [A]	130.2025	124.4653	-5.737175	141.0223
U_fundRMS_SYM+@POWER/0 [V]	97.28078	234.6720	137.3912	178.0651
I_fund_Q_SYM+_rc@POWER/0 [A]	143.0280	112.1521	-30.87582	141.2227
P_fund_SYM+_rc@POWER/0 [W]	4581.327	19497.75	14916.42	7978.013
Q_fund_SYM+_rc@POWER/0 [var]	41663.56	78751.90	37088.34	82221.85

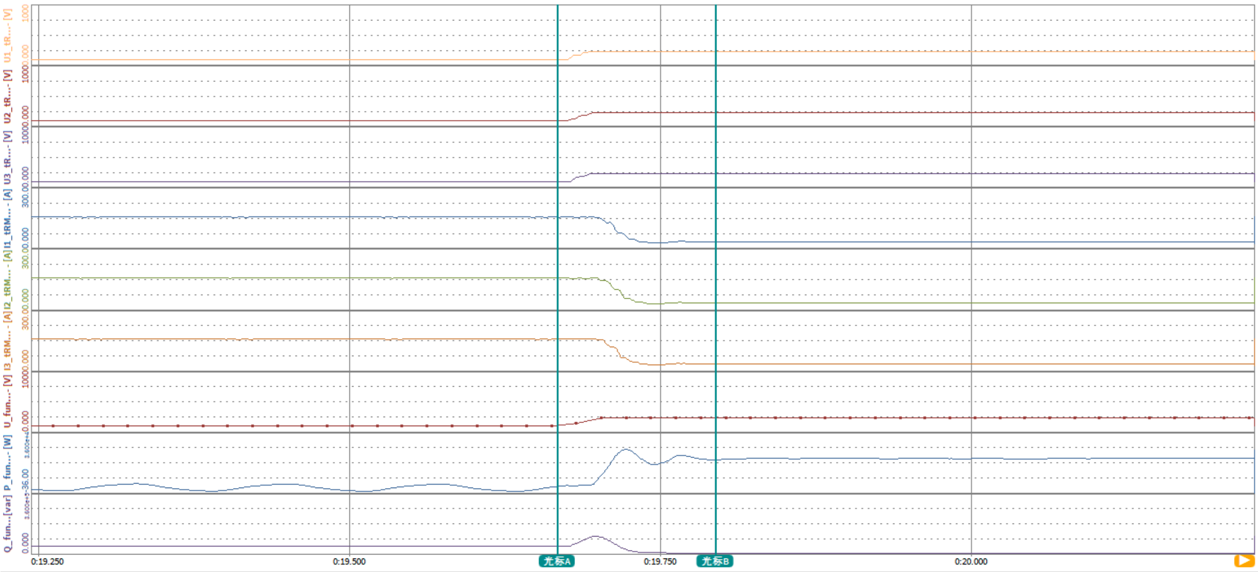
4) Three-phase symmetrical voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:18.702316	0:19.671664	0.969349	
U1_tRMS_rc@POWER/0 [V]	230.6517	92.83928	-137.8125	97.52091
U2_tRMS_rc@POWER/0 [V]	230.8502	92.79099	-138.0592	97.92641
U3_tRMS_rc@POWER/0 [V]	229.8749	92.74375	-137.1311	97.53130
I1_tRMS_rc@POWER/0 [A]	29.23907	154.6582	125.4191	146.4162
I2_tRMS_rc@POWER/0 [A]	29.31324	155.7500	126.4367	146.8145
I3_tRMS_rc@POWER/0 [A]	29.09591	154.6221	125.5262	146.4126
U_fundRMS_SYM+@POWER/0 [V]	230.4707	92.76833	-137.7024	103.4470
P_fund_SYM+_rc@POWER/0 [W]	20142.42	3774.683	-16367.74	5785.321
Q_fund_SYM+_rc@POWER/0 [var]	1228.897	42972.04	41743.14	40955.28

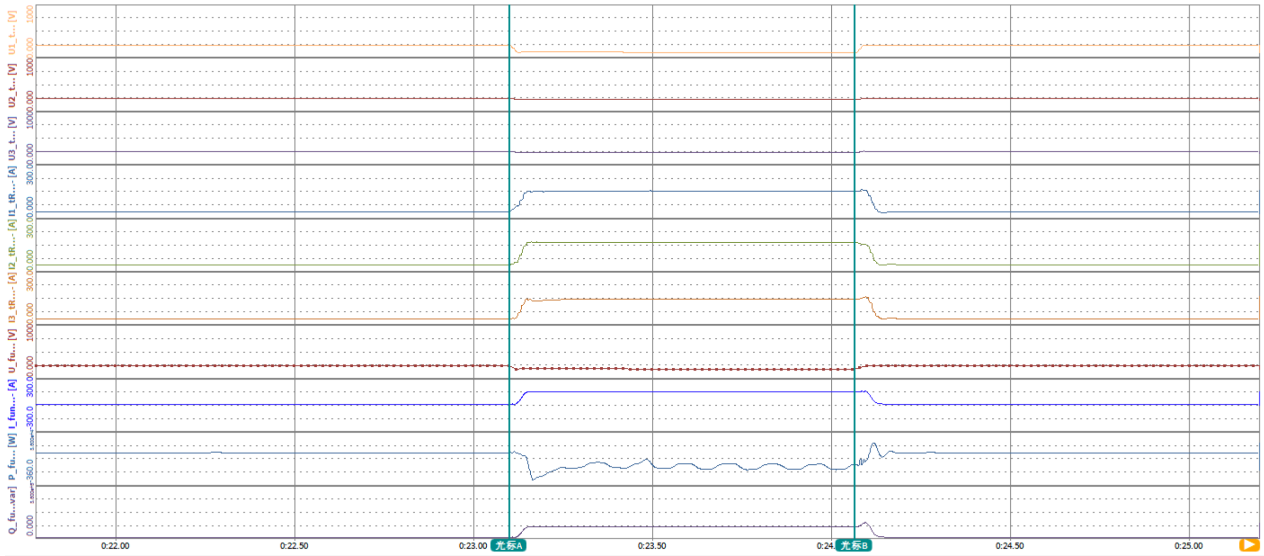
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:19.6673573	0:19.7943375	0.1269802	
U1_tRMS_rc@POWER/0 [V]	92.82699	219.9528	127.1258	207.3017
U2_tRMS_rc@POWER/0 [V]	92.81475	220.1715	127.3568	205.2603
U3_tRMS_rc@POWER/0 [V]	92.71209	220.5065	127.7944	206.5163
I1_tRMS_rc@POWER/0 [A]	154.4914	29.76680	-124.7246	96.38051
I2_tRMS_rc@POWER/0 [A]	154.9680	29.45371	-125.5143	96.84059
I3_tRMS_rc@POWER/0 [A]	155.3418	29.53814	-125.8036	97.74934
U_fundRMS_SYM+@POWER/0 [V]	92.76833	220.1795	127.4112	197.3333
P_fund_SYM+_rc@POWER/0 [W]	3459.384	19487.33	16027.94	17396.23
Q_fund_SYM+_rc@POWER/0 [var]	42973.39	70.95697	-42902.44	47665.33

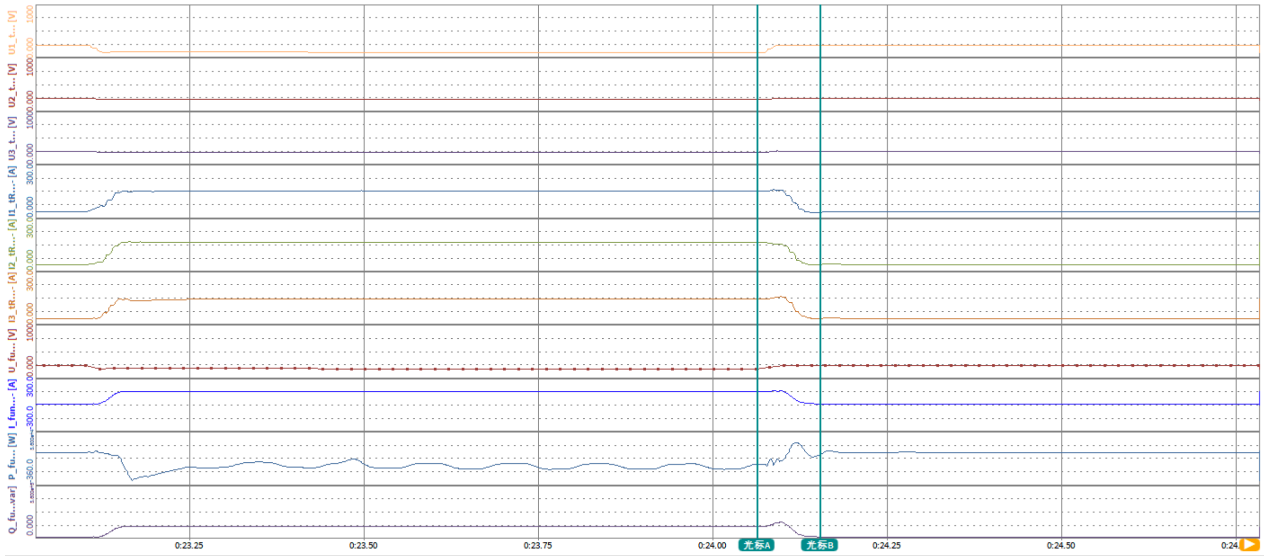
5) Phase-phase asymmetry voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:23.100396	0:24.064375	0.963979	
U1_tRMS_rc@POWER/0 [V]	229.8651	93.12582	-136.7392	97.87417
U2_tRMS_rc@POWER/0 [V]	231.0111	204.8399	-26.17122	206.9437
U3_tRMS_rc@POWER/0 [V]	230.4234	204.8540	-25.56943	207.0281
I1_tRMS_rc@POWER/0 [A]	31.39452	150.7172	119.3226	147.6543
I2_tRMS_rc@POWER/0 [A]	31.55893	160.1608	128.6019	156.5650
I3_tRMS_rc@POWER/0 [A]	31.39590	144.0296	112.6337	140.8830
U_fundRMS_SYM+@POWER/0 [V]	230.4705	161.8198	-68.65067	166.6444
I_fund_Q_SYM+_rc@POWER/0 [A]	1.799902	148.7383	146.9384	145.6134
P_fund_SYM+_rc@POWER/0 [W]	21682.38	13421.10	-8261.287	12681.25
Q_fund_SYM+_rc@POWER/0 [var]	1244.213	72236.85	70992.64	71400.75

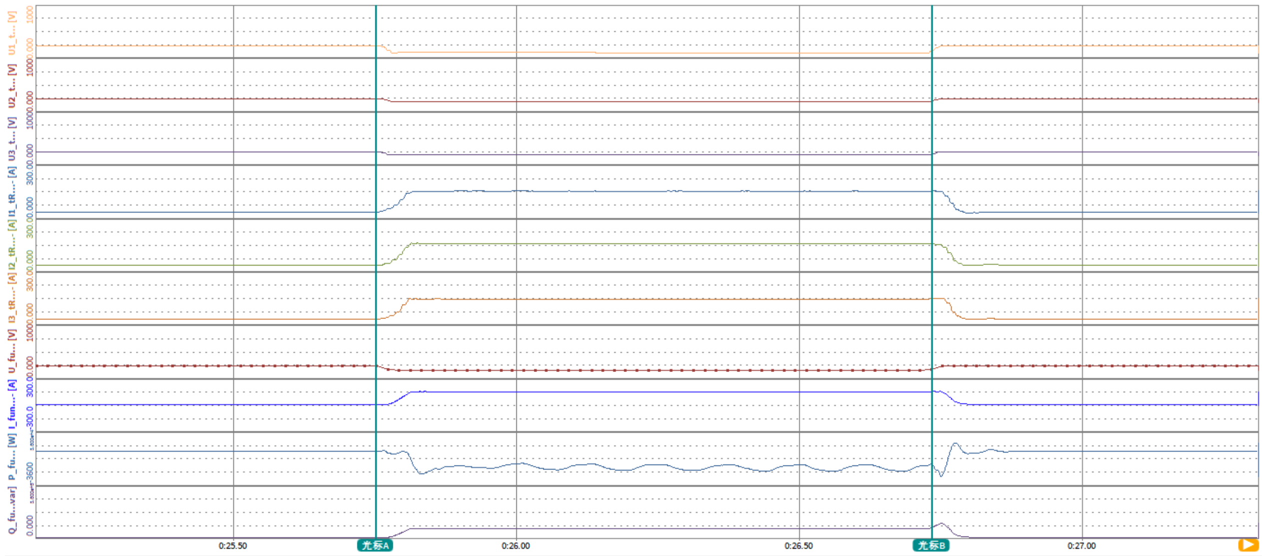
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:24.063189	0:24.153596	0.090407	
U1_tRMS_rc@POWER/0 [V]	93.09238	220.2127	127.1203	197.8989
U2_tRMS_rc@POWER/0 [V]	204.9838	226.2299	21.24615	222.4446
U3_tRMS_rc@POWER/0 [V]	204.7401	226.7525	22.01244	223.4108
I1_tRMS_rc@POWER/0 [A]	150.5350	26.63226	-123.9028	115.3999
I2_tRMS_rc@POWER/0 [A]	160.1331	31.52812	-128.6050	118.2832
I3_tRMS_rc@POWER/0 [A]	143.9587	32.71252	-111.2461	116.7755
U_fundRMS_SYM+@POWER/0 [V]	162.0555	224.4319	62.37645	200.9520
I_fund_Q_SYM+_rc@POWER/0 [A]	148.6684	4.406908	-144.2614	110.8355
P_fund_SYM+_rc@POWER/0 [W]	13340.26	19822.19	6481.922	19685.49
Q_fund_SYM+_rc@POWER/0 [var]	72229.20	2966.655	-69262.55	66599.55

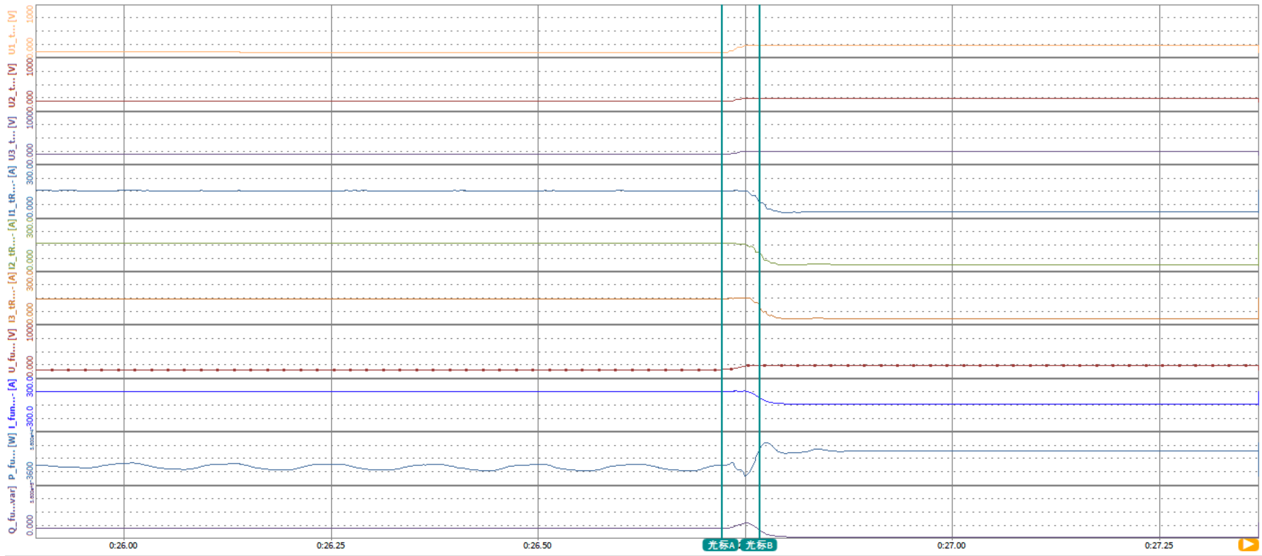
6) Single phase voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:25.751477	0:26.733518	0.982041	
U1_tRMS_rc@POWER/0 [V]	230.4438	121.9379	-108.5058	99.16741
U2_tRMS_rc@POWER/0 [V]	230.4043	167.2354	-63.16885	169.9608
U3_tRMS_rc@POWER/0 [V]	230.4840	182.1386	-48.34538	169.5763
I1_tRMS_rc@POWER/0 [A]	31.40582	148.3470	116.9412	147.9329
I2_tRMS_rc@POWER/0 [A]	31.41244	154.1879	122.7754	151.8502
I3_tRMS_rc@POWER/0 [A]	31.31035	147.9090	116.5986	141.8824
U_fundRMS_SYM+@POWER/0 [V]	230.4446	140.4978	-89.94678	147.0538
I_fund_Q_SYM+_rc@POWER/0 [A]	1.793955	147.5755	145.7815	144.8795
P_fund_SYM+_rc@POWER/0 [W]	21630.13	11898.46	-9731.663	10600.69
Q_fund_SYM+_rc@POWER/0 [var]	1240.208	67429.41	66189.20	61774.91

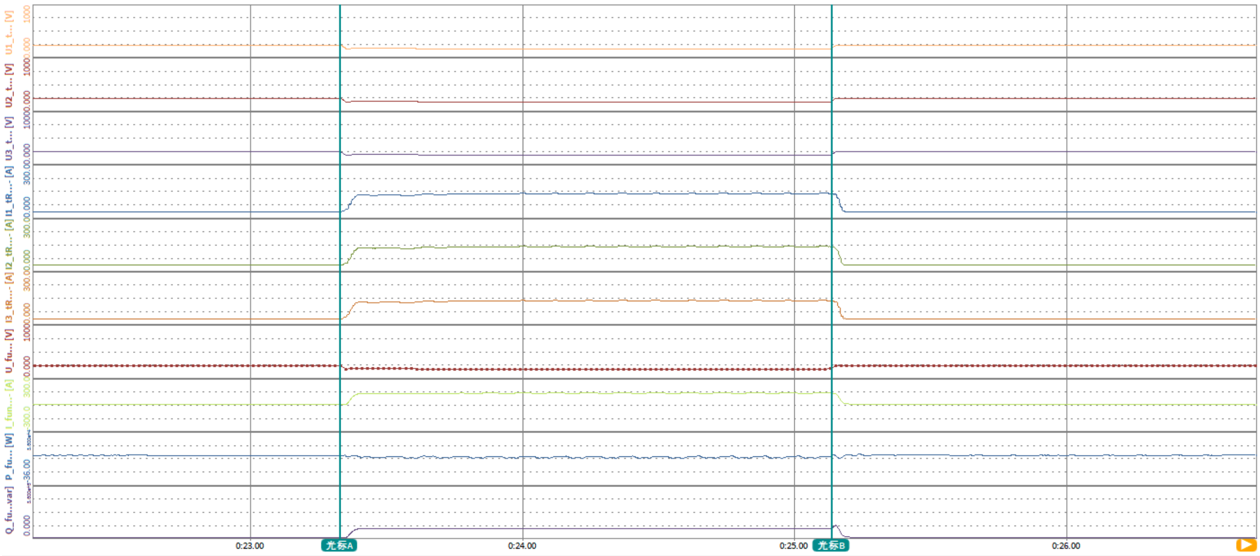
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:26.720829	0:26.766837	0.046008	
U1_tRMS_rc@POWER/0 [V]	92.53329	223.0353	130.5020	175.1519
U2_tRMS_rc@POWER/0 [V]	167.0358	228.4357	61.39993	201.7000
U3_tRMS_rc@POWER/0 [V]	167.0218	228.2038	61.18198	205.6378
I1_tRMS_rc@POWER/0 [A]	151.4718	97.65229	-53.81953	144.3334
I2_tRMS_rc@POWER/0 [A]	155.5058	101.4070	-54.09884	146.3444
I3_tRMS_rc@POWER/0 [A]	145.2902	119.0708	-26.21942	143.9386
U_fundRMS_SYM+@POWER/0 [V]	140.4978	227.5925	87.09470	179.3225
I_fund_Q_SYM+_rc@POWER/0 [A]	148.3026	90.24892	-58.05364	141.9506
P_fund_SYM+_rc@POWER/0 [W]	10885.92	19666.97	8781.051	10150.63
Q_fund_SYM+_rc@POWER/0 [var]	62542.58	61336.48	-1206.102	79749.36

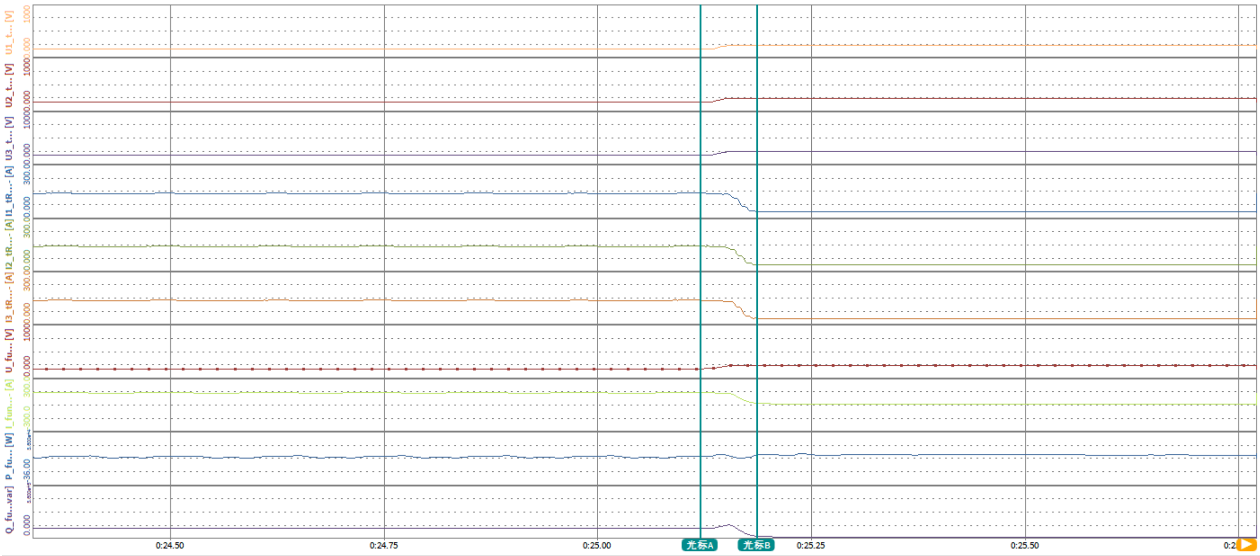
7) Three-phase symmetrical voltage dip: 70% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:23.329994	0:25.135034	1.805040	
U1_tRMS_rc@POWER/0 [V]	230.8221	161.9539	-68.86818	163.3111
U2_tRMS_rc@POWER/0 [V]	229.8956	161.9395	-67.95613	163.1851
U3_tRMS_rc@POWER/0 [V]	230.6256	161.7906	-68.83498	163.0402
I1_tRMS_rc@POWER/0 [A]	29.18821	136.4811	107.2929	132.3010
I2_tRMS_rc@POWER/0 [A]	29.09656	136.6469	107.5503	132.7331
I3_tRMS_rc@POWER/0 [A]	29.11556	135.8623	106.7468	132.2580
U_fundRMS_SYM+@POWER/0 [V]	230.4553	161.9179	-68.53743	164.1001
I_fund_Q_SYM+_rc@POWER/0 [A]	1.770373	130.2442	128.4738	126.5928
P_fund_SYM+_rc@POWER/0 [W]	20084.39	19504.69	-579.6992	18876.22
Q_fund_SYM+_rc@POWER/0 [var]	1223.880	63255.63	62031.75	61672.94

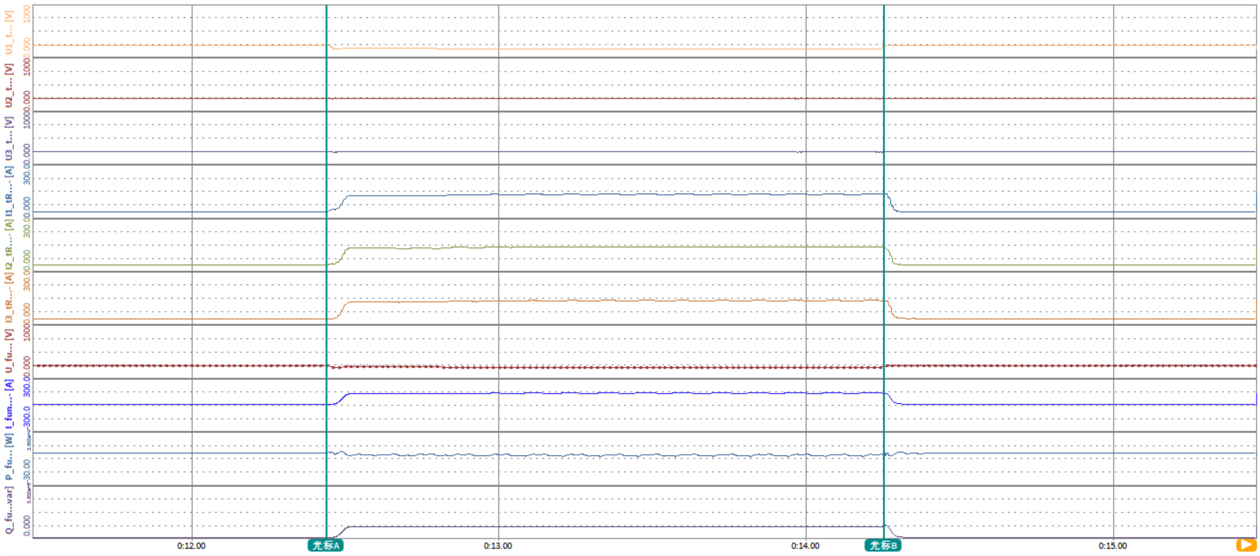
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:25.120071	0:25.186312	0.066241	
U1_tRMS_rc@POWER/0 [V]	161.9754	225.9519	63.97655	202.7490
U2_tRMS_rc@POWER/0 [V]	161.9477	226.0491	64.10141	205.2649
U3_tRMS_rc@POWER/0 [V]	161.8408	226.1270	64.28624	204.2602
I1_tRMS_rc@POWER/0 [A]	137.1856	33.52976	-103.6558	112.7097
I2_tRMS_rc@POWER/0 [A]	137.8554	31.54947	-106.3059	113.7873
I3_tRMS_rc@POWER/0 [A]	137.0961	34.00156	-103.0945	113.4203
U_fundRMS_SYM+@POWER/0 [V]	161.9179	226.5850	64.66710	198.8293
I_fund_Q_SYM+_rc@POWER/0 [A]	131.5643	13.64793	-117.9164	106.9160
P_fund_SYM+_rc@POWER/0 [W]	19167.40	19761.34	593.9375	19239.38
Q_fund_SYM+_rc@POWER/0 [var]	63907.43	9254.821	-54652.61	61330.76

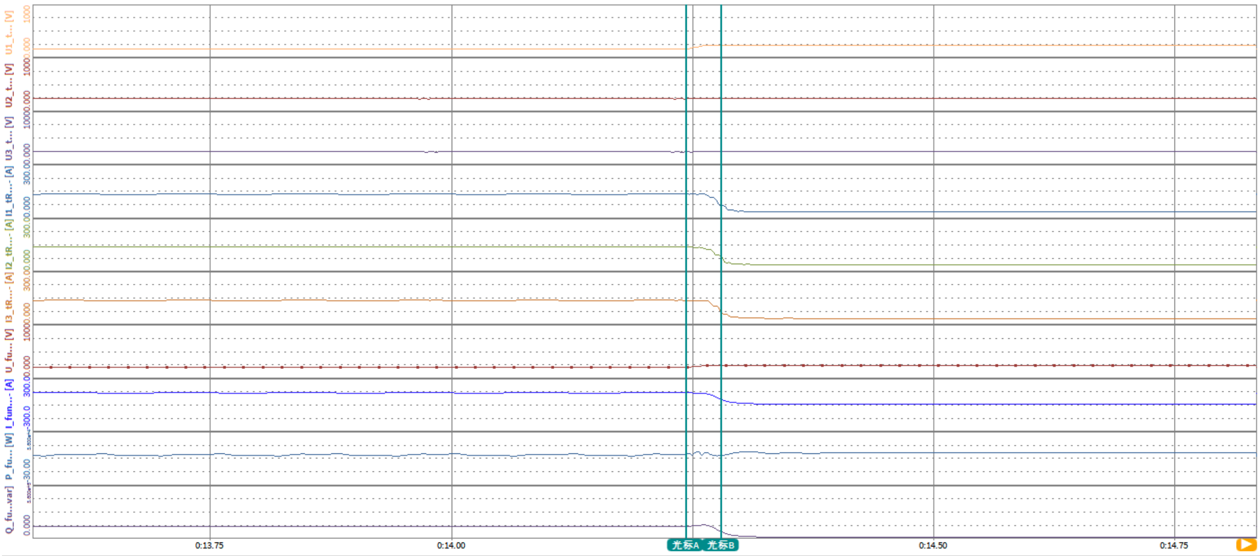
8) Phase-phase asymmetry voltage dip: 70% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:12.439213	0:14.251669	1.812456	
U1_tRMS_rc@POWER/0 [V]	230.4404	177.4208	-53.01959	163.4480
U2_tRMS_rc@POWER/0 [V]	230.4846	222.7929	-7.691666	216.5929
U3_tRMS_rc@POWER/0 [V]	230.4879	215.7693	-14.71867	216.6203
I1_tRMS_rc@POWER/0 [A]	31.47164	132.8421	101.3704	128.3148
I2_tRMS_rc@POWER/0 [A]	31.49015	133.3660	101.8759	131.0656
I3_tRMS_rc@POWER/0 [A]	31.43390	136.2448	104.8109	132.4191
U_fundRMS_SYM+@POWER/0 [V]	230.4726	196.6184	-33.85419	197.9254
I_fund_Q_SYM+_rc@POWER/0 [A]	1.790749	129.9852	128.1944	125.8538
P_fund_SYM+_rc@POWER/0 [W]	21697.91	19875.89	-1822.016	20282.87
Q_fund_SYM+_rc@POWER/0 [var]	1238.137	79387.35	78149.21	74416.85

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

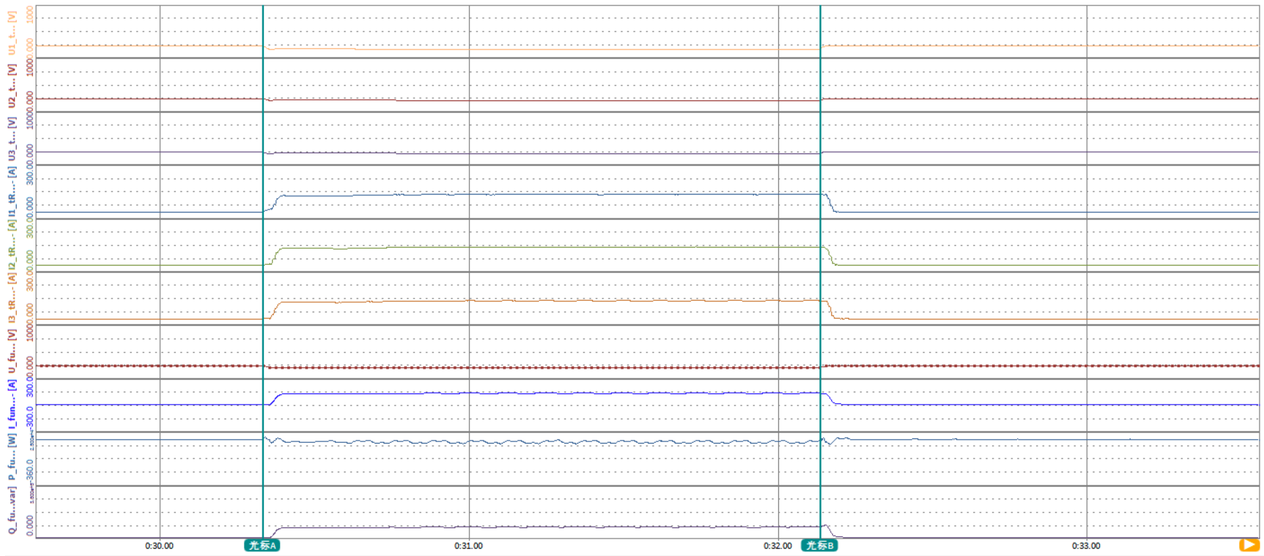


	A	B	间隔	有效值
时间 [s]	0:14.242899	0:14.279414	0.036515	
U1_tRMS_rc@POWER/0 [V]	162.3318	228.0436	65.71178	204.9660
U2_tRMS_rc@POWER/0 [V]	215.2660	228.8277	13.56169	225.0951
U3_tRMS_rc@POWER/0 [V]	215.5813	228.8771	13.29581	223.9554
I1_tRMS_rc@POWER/0 [A]	132.0284	68.53967	-63.48869	122.4287
I2_tRMS_rc@POWER/0 [A]	135.2768	86.60387	-48.67296	122.6076
I3_tRMS_rc@POWER/0 [A]	136.4777	83.36073	-53.11699	126.5622
U_fundRMS_SYM+@POWER/0 [V]	196.4901	229.5073	33.01718	208.1192
I_fund_Q_SYM+_rc@POWER/0 [A]	129.8053	65.99760	-63.80772	118.0452
P_fund_SYM+_rc@POWER/0 [W]	20640.15	19618.98	-1021.172	20645.01
Q_fund_SYM+_rc@POWER/0 [var]	76482.86	45255.94	-31226.92	75929.60

9) Single phase voltage dip: 70% Vn

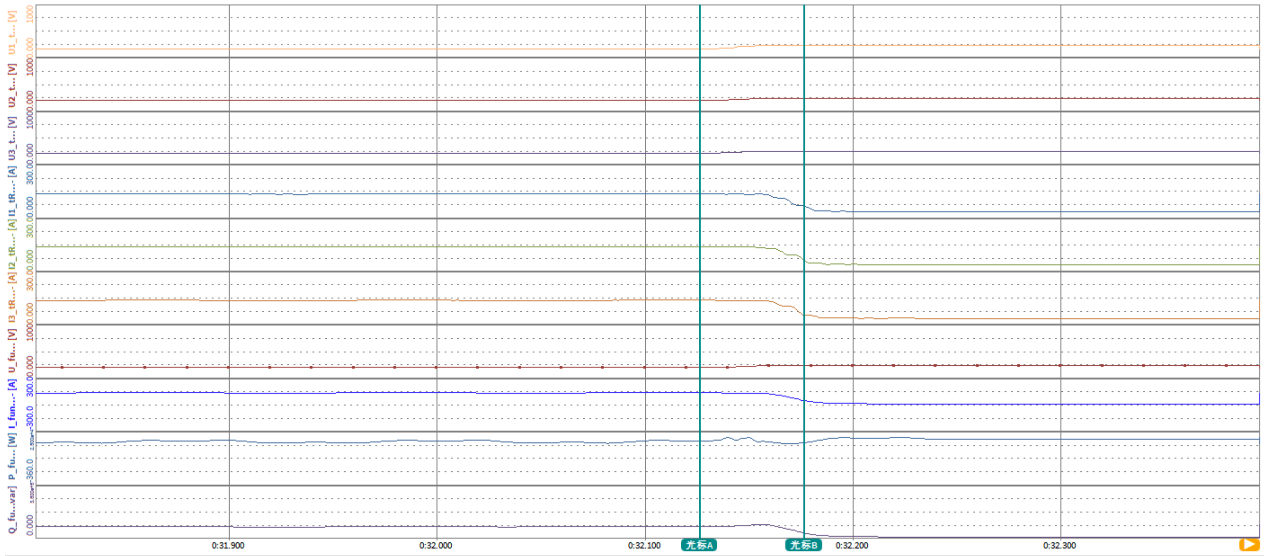
Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:

Product Service



	A	B	间隔	有效值
时间 [s]	0:30.332864	0:32.135695	1.802831	
U1_tRMS_rc@POWER/0 [V]	230.5687	161.9844	-68.58432	163.1092
U2_tRMS_rc@POWER/0 [V]	230.5076	197.4448	-33.06284	198.3396
U3_tRMS_rc@POWER/0 [V]	230.3598	197.4164	-32.94348	198.2069
I1_tRMS_rc@POWER/0 [A]	31.44727	134.0394	102.5922	130.3548
I2_tRMS_rc@POWER/0 [A]	31.49415	135.9290	104.4348	132.1622
I3_tRMS_rc@POWER/0 [A]	31.43106	136.8582	105.4271	132.9760
U_fundRMS_SYM+@POWER/0 [V]	230.4801	184.9769	-45.50320	186.4695
I_fund_Q_SYM+_rc@POWER/0 [A]	1.782442	130.1969	128.4144	126.5336
P_fund_SYM+_rc@POWER/0 [W]	21692.00	20869.48	-822.5195	20364.66
Q_fund_SYM+_rc@POWER/0 [var]	1232.435	72247.47	71015.03	70410.44

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:32.126323	0:32.176638	0.050316	
U1_tRMS_rc@POWER/0 [V]	161.9906	227.1783	65.18771	203.8721
U2_tRMS_rc@POWER/0 [V]	197.4562	227.7497	30.29349	216.1431
U3_tRMS_rc@POWER/0 [V]	197.4341	228.3963	30.96219	218.3159
I1_tRMS_rc@POWER/0 [A]	134.9262	66.19907	-68.72715	121.9716
I2_tRMS_rc@POWER/0 [A]	136.3819	65.87505	-70.50683	123.7223
I3_tRMS_rc@POWER/0 [A]	137.4009	53.88007	-83.52082	125.4833
U_fundRMS_SYM+@POWER/0 [V]	184.9769	229.7289	44.75204	203.7879
I_fund_Q_SYM+_rc@POWER/0 [A]	131.0627	46.38859	-84.67411	117.5748
P_fund_SYM+_rc@POWER/0 [W]	20483.86	19782.17	-701.6895	20606.51
Q_fund_SYM+_rc@POWER/0 [var]	72732.25	31697.33	-41034.92	73467.30

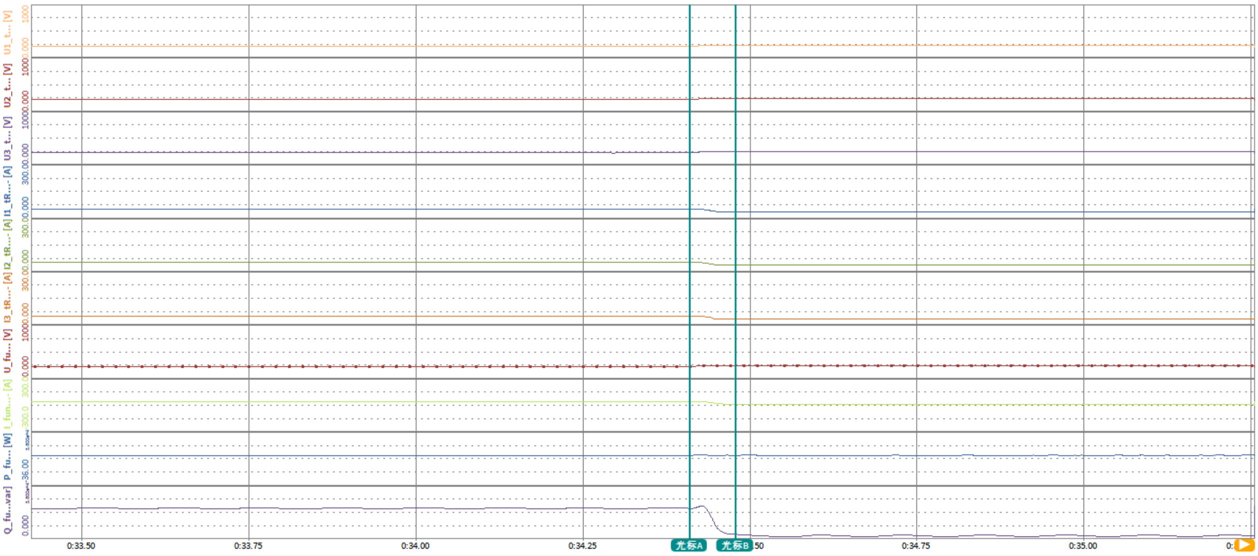
10) Three-phase symmetrical voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:

	A	B	间隔
时间 [s]	0:32.562631	0:212.600248	180.037618
U1_tRMS_rc@POWER/0 [V]	230.4240	198.4226	-32.00146
U2_tRMS_rc@POWER/0 [V]	230.4571	198.3621	-32.09497
U3_tRMS_rc@POWER/0 [V]	230.4700	198.3758	-32.09419
I1_tRMS_rc@POWER/0 [A]	29.23622	48.20193	18.96571
I2_tRMS_rc@POWER/0 [A]	29.23017	48.21041	18.98024
I3_tRMS_rc@POWER/0 [A]	29.21009	48.00612	18.79603
Q_fund_SYM+_rc@POWER/0	1232.566	20466.66	19234.09
U_fund_SYM+_rc@POWER/0	399.1490	343.6122	-55.53680
P_fund_SYM+_rc@POWER/0	20148.73	19991.68	-157.0508
I_fund_P_S...rc@POWER/0	29.14419	33.59078	4.446587
I_fund_Q_S...rc@POWER/0	1.782848	34.38885	32.60601

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

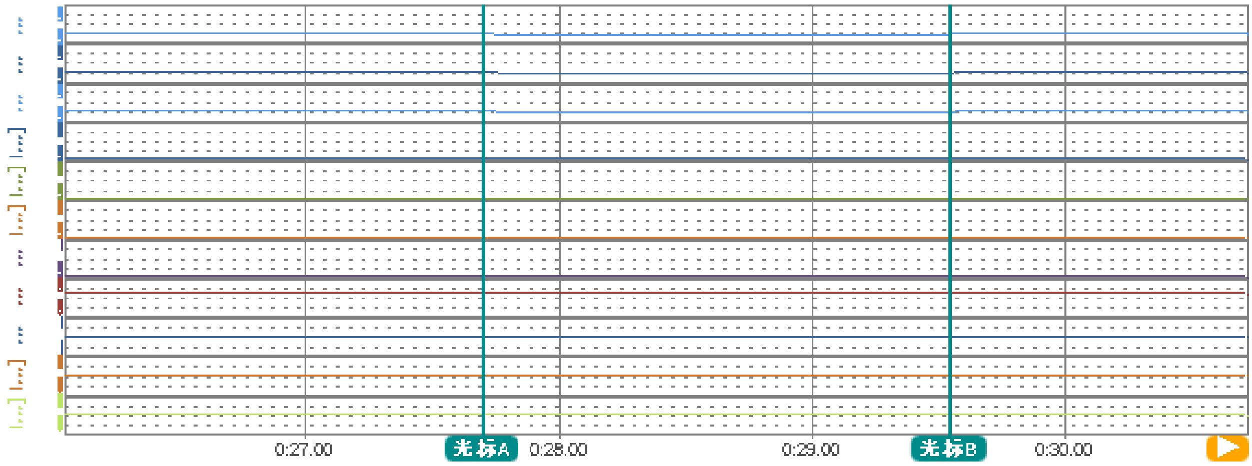
Product Service



	A	B	间隔	有效值
时间 [s]	0:34.409752	0:34.478301	0.068550	
U1_tRMS_rc@POWER/0 [V]	198.3413	229.2326	30.89131	223.4617
U2_tRMS_rc@POWER/0 [V]	198.3718	229.1155	30.74373	223.0103
U3_tRMS_rc@POWER/0 [V]	198.3531	229.2341	30.88100	222.2148
I1_tRMS_rc@POWER/0 [A]	47.98574	28.96412	-19.02162	38.41168
I2_tRMS_rc@POWER/0 [A]	47.93379	29.45676	-18.47703	38.52579
I3_tRMS_rc@POWER/0 [A]	47.74910	28.77732	-18.97178	38.39860
U_fundRMS_SYM+@POWER/0 [V]	198.3834	229.1934	30.80995	217.2054
I_fund_Q_SYM+_rc@POWER/0 [A]	33.92945	3.269653	-30.65980	23.20861
P_fund_SYM+_rc@POWER/0 [W]	20048.16	19775.47	-272.6855	20079.21
Q_fund_SYM+_rc@POWER/0 [var]	20190.04	2248.129	-17941.91	14993.95

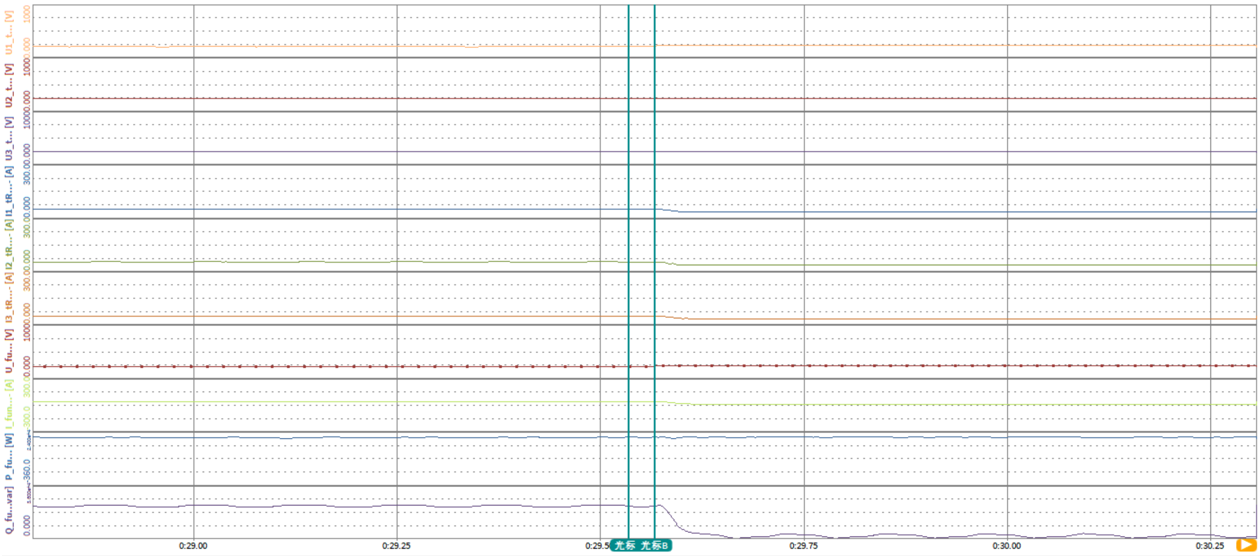
11) Phase-phase asymmetry voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔
时间 [s]	0:27.7018	0:207.7128	180.011
U1_tRMS@POWER/0 [V]	230.4783	198.3634	-32.11483
U2_tRMS@POWER/0 [V]	230.4217	223.0267	-7.395050
U3_tRMS@POWER/0 [V]	230.4458	222.9530	-7.492828
I1_tRMS_rc@POWER/0 [A]	31.45678	47.25759	15.80080
I2_tRMS_rc@POWER/0 [A]	31.51828	48.32451	16.80623
I3_tRMS_rc@POWER/0 [A]	31.43623	46.89377	15.45754
Q_fund_SYM+_rc@POWER/0	1250.867	21372.37	20121.50
U_fund_SYM+_rc@POWER/0	399.1521	371.4914	-27.66068
P_fund_SYM+_rc@POWER/0	21698.88	21759.62	60.73633
I_fund_P_S...rc@POWER/0	31.38617	33.81753	2.431358
I_fund_Q_S...rc@POWER/0	1.809306	33.21569	31.40638

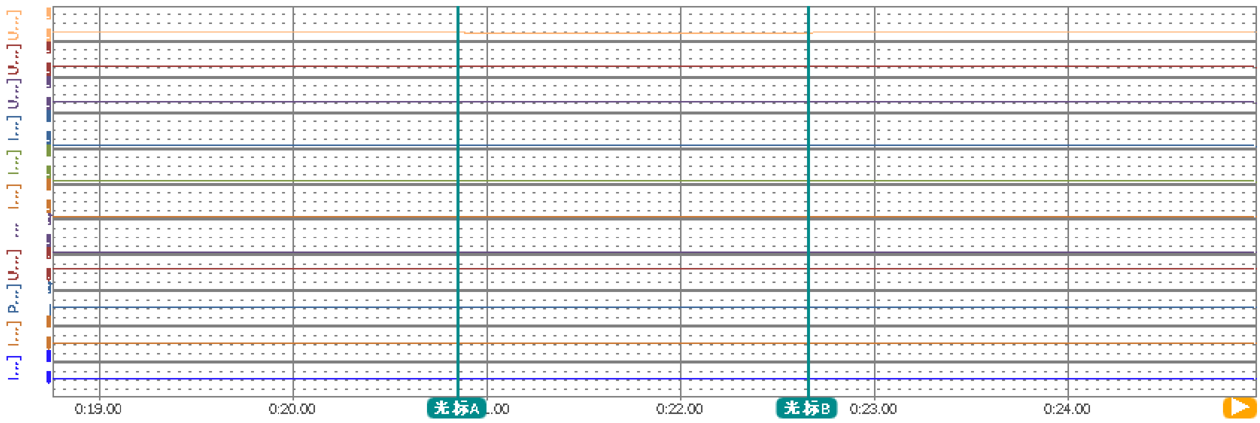
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:29.534764	0:29.566381	0.031616	
U1_tRMS_rc@POWER/0 [V]	198.3836	213.3203	14.93671	199.8493
U2_tRMS_rc@POWER/0 [V]	223.0094	227.5601	4.550720	223.6156
U3_tRMS_rc@POWER/0 [V]	222.9684	225.0285	2.060104	222.9696
I1_tRMS_rc@POWER/0 [A]	47.95518	46.25412	-1.701061	47.03792
I2_tRMS_rc@POWER/0 [A]	48.73749	46.54067	-2.196819	47.84388
I3_tRMS_rc@POWER/0 [A]	47.38367	46.50301	-0.880657	46.74756
U_fundRMS_SYM+@POWER/0 [V]	214.5230	214.4854	-0.037659	214.4999
I_fund_Q_SYM+_rc@POWER/0 [A]	34.04909	32.81056	-1.238525	33.15634
P_fund_SYM+_rc@POWER/0 [W]	21705.68	21726.54	20.86719	21609.31
Q_fund_SYM+_rc@POWER/0 [var]	21910.29	21811.97	-98.32422	21402.55

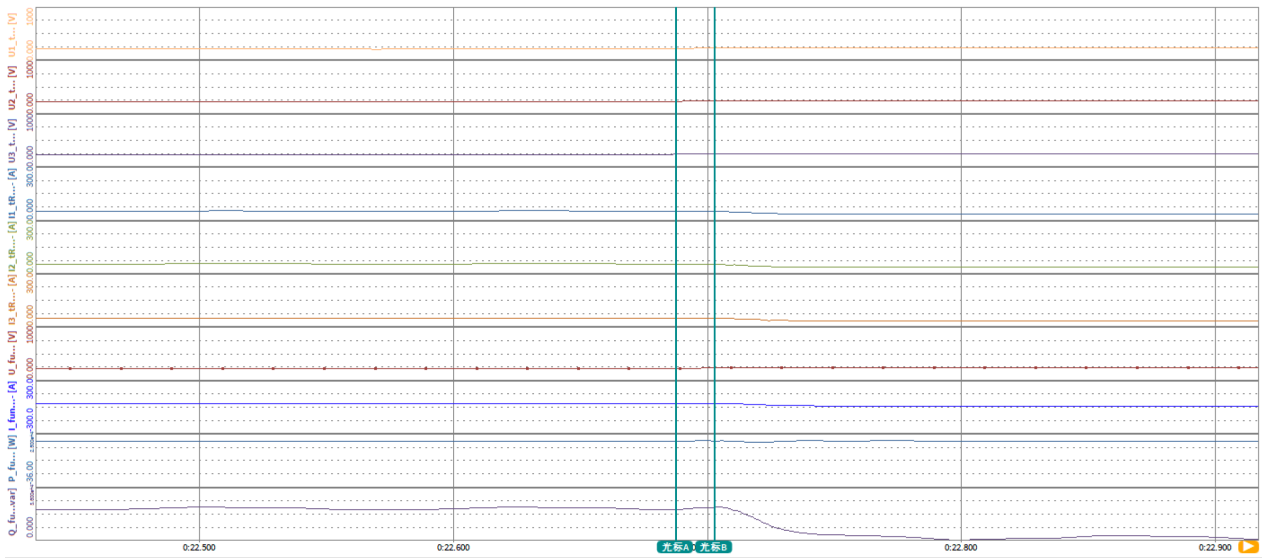
12) Single phase voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:

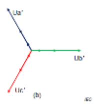


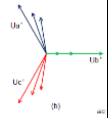
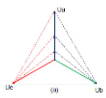
	A	B	间隔
时间 [s]	0:20.85094	0:200.95683	180.10590
U1_tRMS_rc@POWER/0 [V]	230.4400	198.4334	-32.00661
U2_tRMS_rc@POWER/0 [V]	230.4763	214.7266	-15.74971
U3_tRMS_rc@POWER/0 [V]	230.4895	214.7369	-15.75258
I1_tRMS_rc@POWER/0 [A]	31.73134	49.01210	17.28076
I2_tRMS_rc@POWER/0 [A]	31.80974	49.46011	17.65038
I3_tRMS_rc@POWER/0 [A]	31.70567	48.66890	16.96323
Q_fund_SYM+_rc@POWER/0 [var]	1239.734	21843.02	20603.29
U_fund_SYM+_rc@POWER/0 [V]	399.1801	362.2823	-36.89783
P_fund_SYM+_rc@POWER/0 [W]	21894.69	21612.90	-281.7969
I_fund_P_SYM+_rc@POWER/0 [A]	31.66718	34.44334	2.776161
I_fund_Q_SYM+_rc@POWER/0 [A]	1.793077	34.81008	33.01700

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



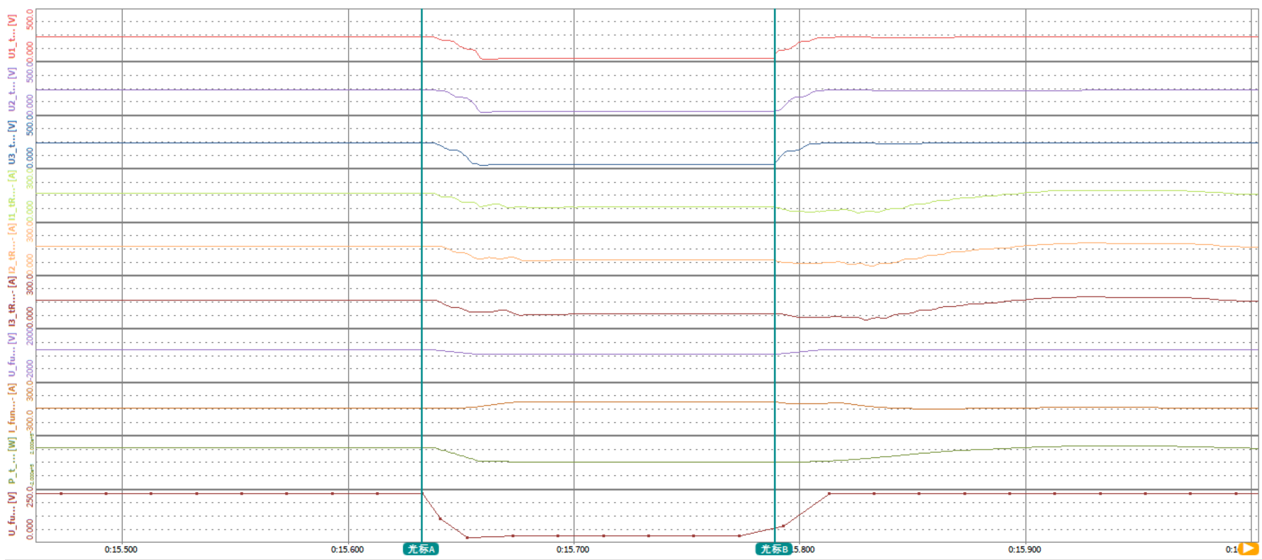
	A	B	间隔	有效值
时间 [s]	0:22.6874402	0:22.7026981	0.0152579	
U1_tRMS_rc@POWER/0 [V]	201.7411	221.0341	19.29294	211.7019
U2_tRMS_rc@POWER/0 [V]	214.6906	225.9715	11.28087	220.0774
U3_tRMS_rc@POWER/0 [V]	216.5884	228.9820	12.39360	223.1358
I1_tRMS_rc@POWER/0 [A]	46.84599	45.77956	-1.066433	46.36017
I2_tRMS_rc@POWER/0 [A]	47.85903	46.21125	-1.647778	47.11345
I3_tRMS_rc@POWER/0 [A]	47.05767	45.90180	-1.155876	46.48999
U_fundRMS_SYM+@POWER/0 [V]	209.1265	212.8277	3.701172	210.9852
I_fund_Q_SYM+_rc@POWER/0 [A]	32.60857	32.52885	-0.079720	32.55417
P_fund_SYM+_rc@POWER/0 [W]	21538.63	21754.46	215.8203	21700.56
Q_fund_SYM+_rc@POWER/0 [var]	20621.32	21962.59	1341.270	21287.48

Test list	Active power before voltage dip [%Pn]	Amplitude of the residual voltage Phase to phase V/Vn	Measued U1/Un [p.u.]	Reactive current during fault Irms [A]	Duration [ms]	Min. required duration limit [ms]	Power recover time [ms]	90% active power recover time limit [ms]	Total active energy during oscillations [kWs]
Three phase faults 	100 @PF=1	0.85	0.86	34.6	180009	180000	38	<500	N/A
	100 @PF=1	0.70	0.70	82.0	1801	1788	90	<500	N/A
	100 @PF=1	0.40	40	80.0	979	964	106	<500	N/A
	100 @PF=1	0.10	0.11	75.7	156	140	107	<500	N/A
Phase-phase faults with earth	100 @PF=1	0.85	0.85	29.5	180008	180000	29	<500	N/A
	100 @PF=1	0.70	0.70	82.4	1802	1788	90	<500	N/A

	100 @PF=1	0.40	0.40	80.5	965	964	109	<500	N/A
	100 @PF=1	0.10	0.11	74.9	163	140	95	<500	N/A
Single phase fault with earth 	100 @PF=1	0.85	0.86	35.0	180126	180000	46	<500	N/A
	100 @PF=1	0.70	0.70	82.2	1805	1788	106	<500	N/A
	100 @PF=1	0.40	0.40	81.0	982	964	90	<500	N/A
	100 @PF=1	0.10	0.11	77.8	161	140	90	<500	N/A

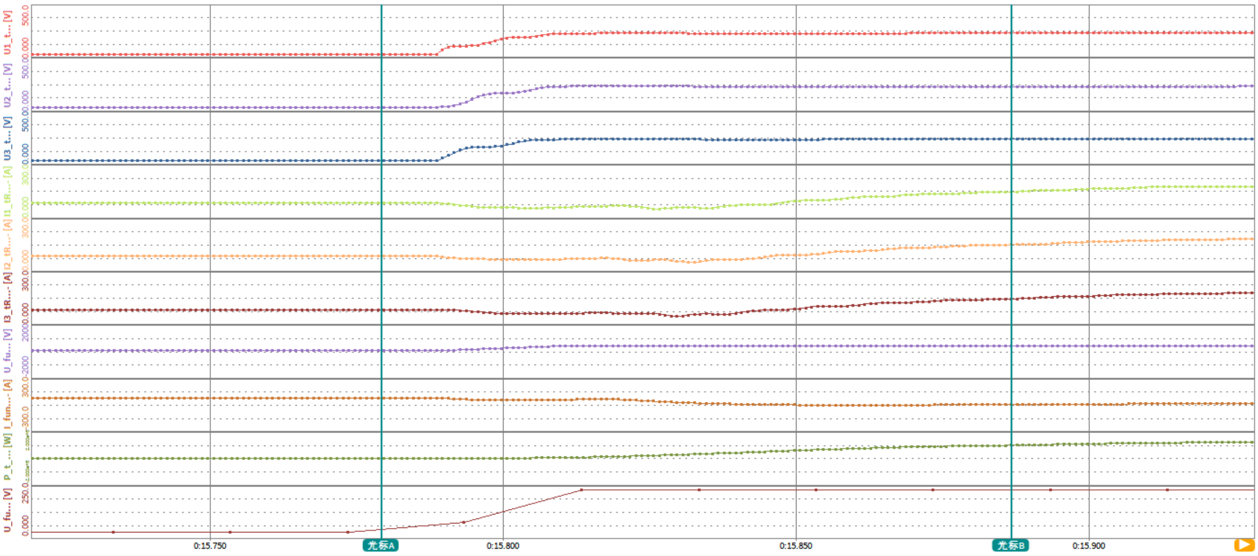
1) Three-phase symmetrical voltage dip: 10% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:15.6326026	0:15.7888500	0.1562473	
U1_tRMS_rc@POWER/0 [V]	230.0325	26.80592	-203.2265	79.92493
U2_tRMS_rc@POWER/0 [V]	230.1780	27.05208	-203.1259	83.29579
U3_tRMS_rc@POWER/0 [V]	231.0039	27.14407	-203.8598	77.56124
I1_tRMS_rc@POWER/0 [A]	160.2023	81.08639	-79.11591	93.09173
I2_tRMS_rc@POWER/0 [A]	160.3370	80.71914	-79.61785	94.89636
I3_tRMS_rc@POWER/0 [A]	160.8427	80.40210	-80.44064	92.35470
U_fund_SYM+_rc@POWER/0 [V]	399.0472	46.74949	-352.2977	128.5889
I_fund_Q_SYM+_rc@POWER/0 [A]	1.898585	75.77652	73.87793	66.73373
P_t_rc@POWER/0 [W]	110883.1	2220.992	-108662.1	33246.58
U_fundRMS_SYM+@POWER/0 [V]	230.4382	27.08907	-203.3491	110.7870

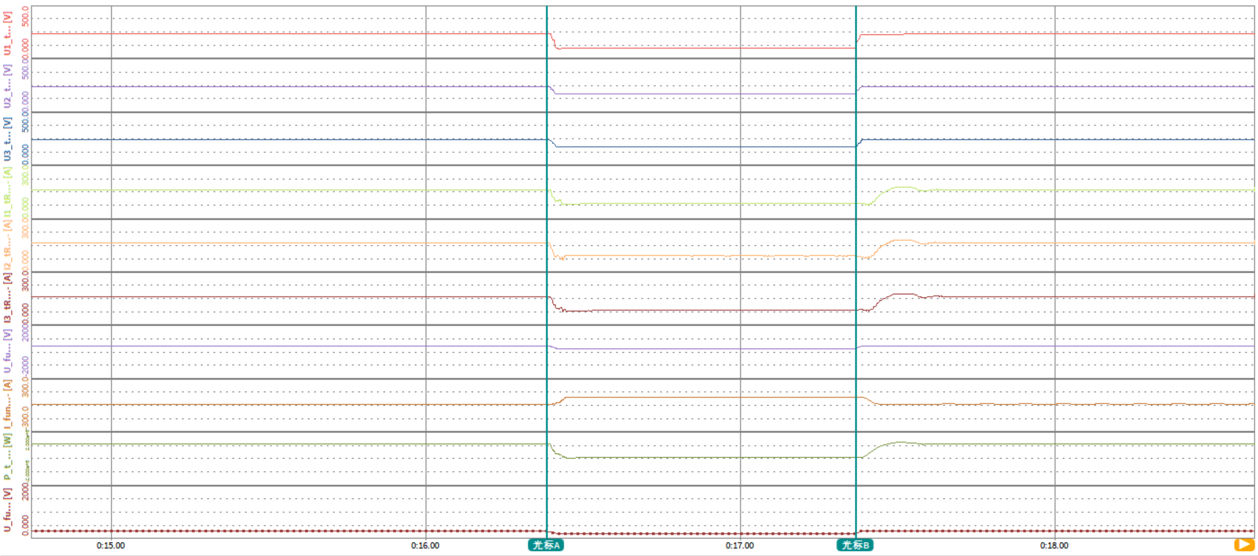
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:15.7792062	0:15.8866574	0.1074512	
U1_tRMS_rc@POWER/0 [V]	26.80902	228.6109	201.8019	205.0885
U2_tRMS_rc@POWER/0 [V]	27.20339	228.1511	200.9477	204.1054
U3_tRMS_rc@POWER/0 [V]	27.15907	228.6892	201.5301	207.6753
I1_tRMS_rc@POWER/0 [A]	81.06512	144.5580	63.49292	89.74015
I2_tRMS_rc@POWER/0 [A]	80.63760	147.0362	66.39864	91.09383
I3_tRMS_rc@POWER/0 [A]	80.55927	147.1216	66.56232	90.98741
U_fund_SYM+_rc@POWER/0 [V]	46.84248	395.7277	348.8852	350.8580
I_fund_Q_SYM+_rc@POWER/0 [A]	75.87675	3.223588	-72.65316	40.70346
P_t_rc@POWER/0 [W]	2203.790	99987.10	97783.31	53048.07
U_fundRMS_SYM+@POWER/0 [V]	27.08907	228.3925	201.3034	189.1180

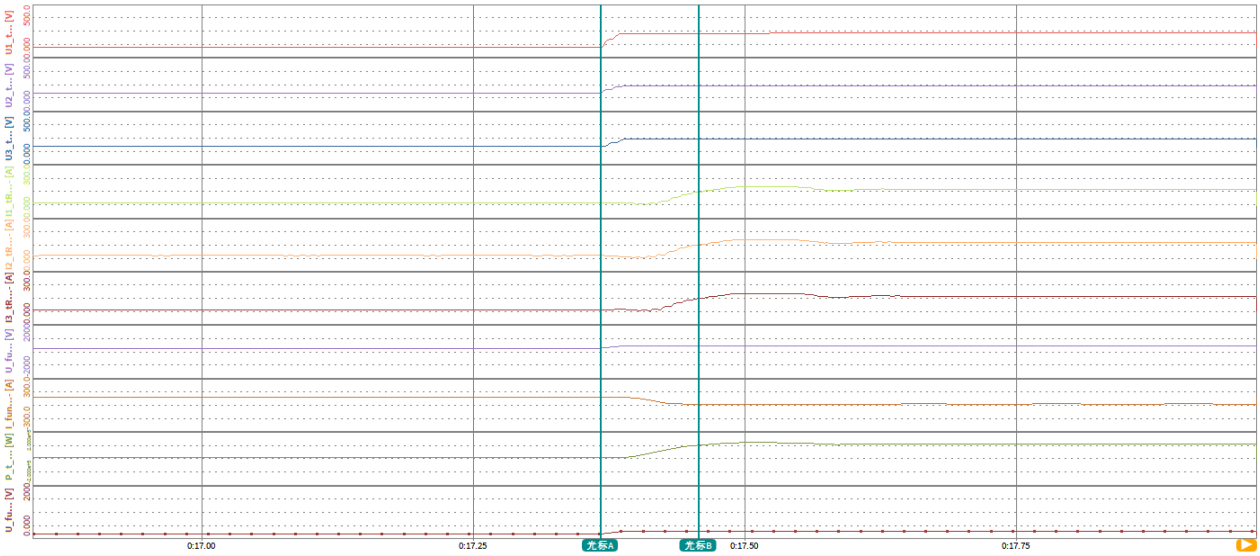
2) Phase-phase asymmetry voltage dip: 10% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:16.384673	0:17.366768	0.982095	
U1_tRMS_rc@POWER/0 [V]	230.2839	92.98172	-137.3022	98.09118
U2_tRMS_rc@POWER/0 [V]	230.5184	165.9605	-64.55783	167.4932
U3_tRMS_rc@POWER/0 [V]	230.4663	165.2902	-65.17606	167.6839
I1_tRMS_rc@POWER/0 [A]	160.3228	82.44276	-77.88001	85.36401
I2_tRMS_rc@POWER/0 [A]	160.4135	86.56436	-73.84915	88.39149
I3_tRMS_rc@POWER/0 [A]	160.3469	82.28709	-78.05978	84.40120
U_fund_SYM+_rc@POWER/0 [V]	399.0945	239.3126	-159.7820	243.9981
I_fund_Q_SYM+_rc@POWER/0 [A]	1.923919	81.02528	79.10137	78.93536
P_t_rc@POWER/0 [W]	110821.4	8346.378	-102475.0	18314.10
U_fundRMS_SYM+@POWER/0 [V]	230.4240	138.3631	-92.06094	143.9187

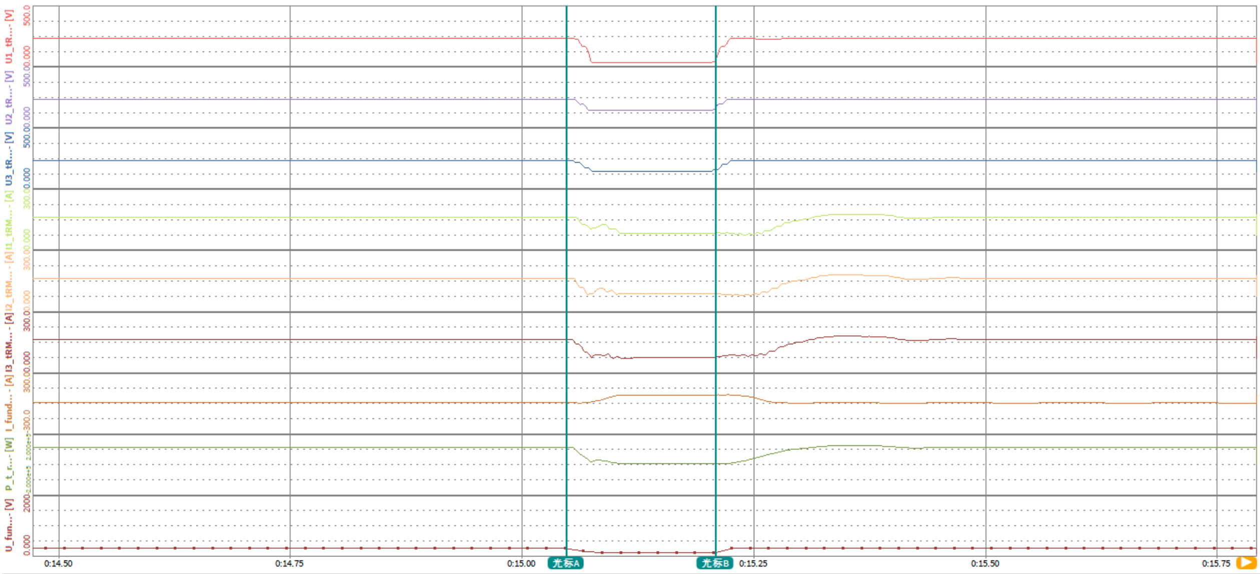
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:17.3668778	0:17.4570176	0.0901398	
U1_tRMS_rc@POWER/0 [V]	92.98172	227.9362	134.9545	214.3628
U2_tRMS_rc@POWER/0 [V]	165.9605	230.4579	64.49742	223.5885
U3_tRMS_rc@POWER/0 [V]	165.2902	230.1169	64.82669	221.0379
I1_tRMS_rc@POWER/0 [A]	82.44276	143.5517	61.10889	96.42203
I2_tRMS_rc@POWER/0 [A]	86.56436	145.2183	58.65396	98.35787
I3_tRMS_rc@POWER/0 [A]	82.28709	146.4246	64.13748	99.44904
U_fund_SYM+_rc@POWER/0 [V]	239.3126	397.5012	158.1887	378.3659
I_fund_Q_SYM+_rc@POWER/0 [A]	81.02528	-0.330748	-81.35603	56.83483
P_t_rc@POWER/0 [W]	8346.378	99742.68	91396.30	53991.69
U_fundRMS_SYM+@POWER/0 [V]	138.3631	229.4346	91.07150	202.9032

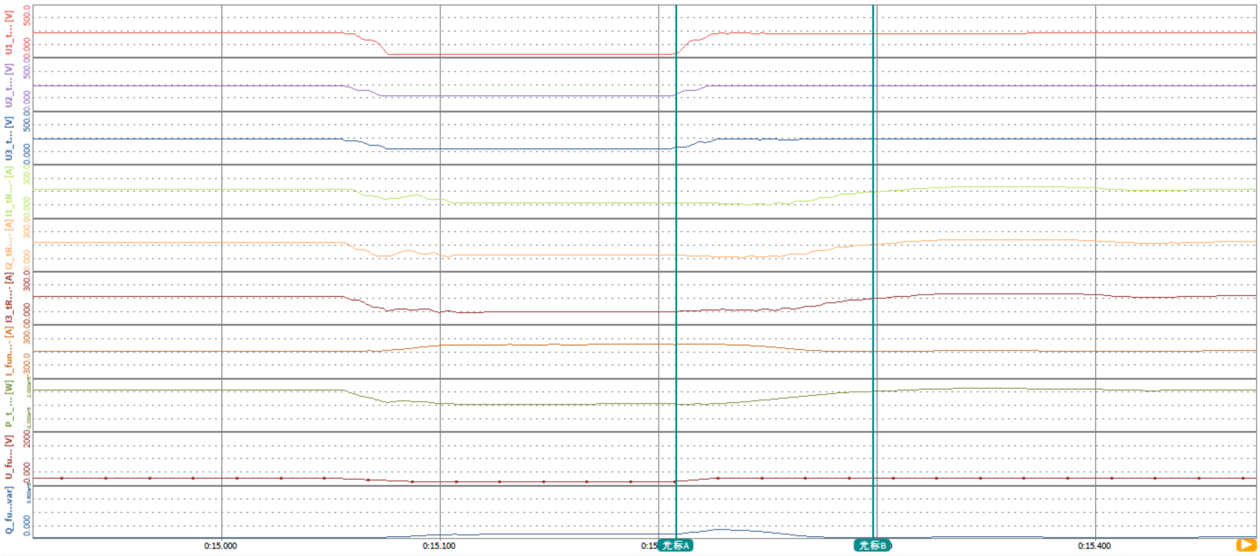
3) Single phase voltage dip: 10% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:15.0479184	0:15.2088497	0.1609313	
U1_tRMS_rc@POWER/0 [V]	230.2597	35.10818	-195.1515	85.62530
U2_tRMS_rc@POWER/0 [V]	230.5286	152.1484	-78.38020	153.6188
U3_tRMS_rc@POWER/0 [V]	230.4242	157.5124	-72.91177	154.8961
I1_tRMS_rc@POWER/0 [A]	160.3271	81.59863	-78.72845	100.0595
I2_tRMS_rc@POWER/0 [A]	160.6821	86.95366	-73.72844	97.62649
I3_tRMS_rc@POWER/0 [A]	160.4870	73.42287	-87.06416	87.82431
I_fund_Q_SYM+_rc@POWER/0 [A]	1.895113	77.80619	75.91108	65.34106
P_t_rc@POWER/0 [W]	110907.6	3933.073	-106974.6	36010.75
U_fundRMS_SYM+@POWER/0 [V]	230.3967	99.16499	-131.2317	124.9433

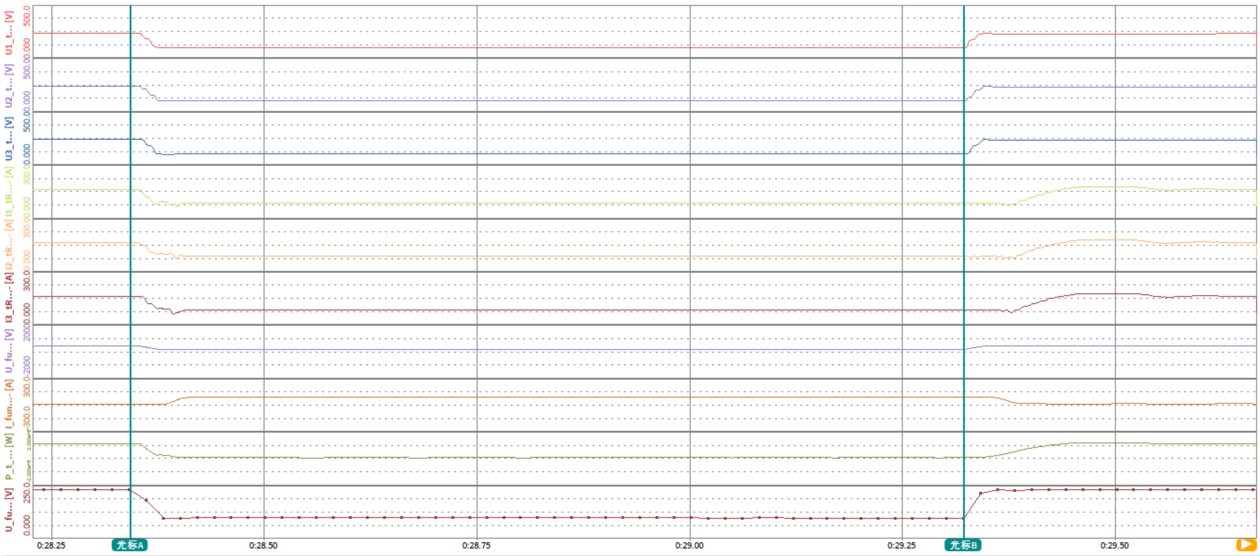
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:15.2080305	0:15.2980720	0.0900414	
U1_tRMS_rc@POWER/0 [V]	34.00212	227.8867	193.8845	214.2861
U2_tRMS_rc@POWER/0 [V]	144.4326	229.2136	84.78099	223.0501
U3_tRMS_rc@POWER/0 [V]	152.3708	228.8536	76.48279	220.6030
I1_tRMS_rc@POWER/0 [A]	81.11296	144.7940	63.68108	97.58362
I2_tRMS_rc@POWER/0 [A]	86.72462	147.8092	61.08463	100.7103
I3_tRMS_rc@POWER/0 [A]	73.53269	147.1034	73.57072	100.1965
I_fund_Q_SYM+_rc@POWER/0 [A]	77.41226	-1.067647	-78.47991	54.08878
P_t_rc@POWER/0 [W]	4147.114	100430.2	96283.09	56191.20
U_fundRMS_SYM+@POWER/0 [V]	99.16499	228.5476	129.3826	209.2727
Q_fund_SYM+_rc@POWER/0 [var]	22851.19	-732.3326	-23583.52	32750.90

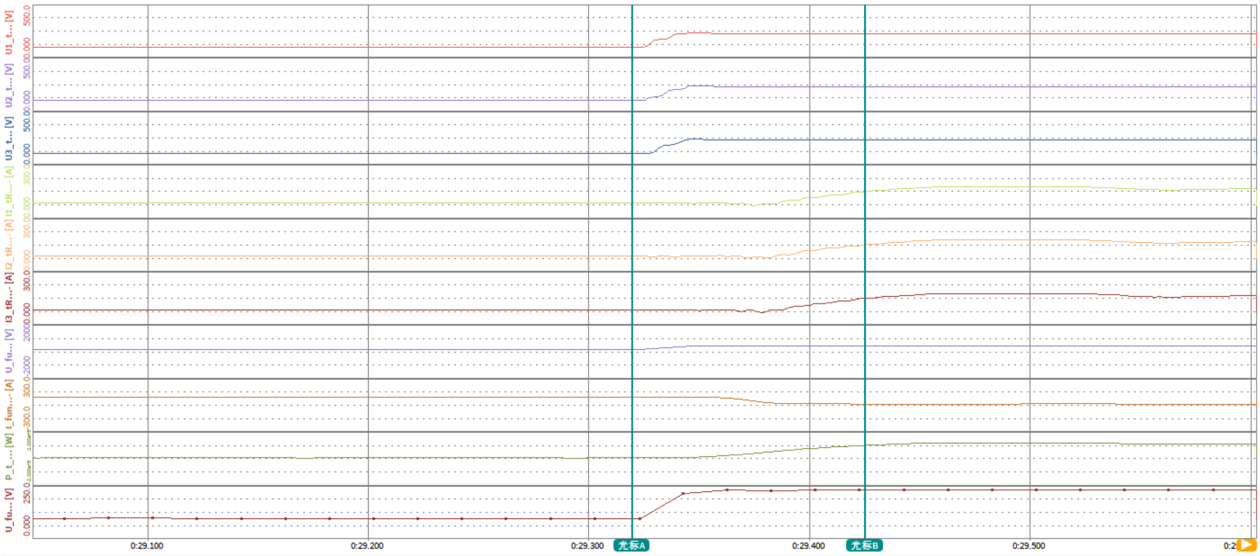
4) Three-phase symmetrical voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:28.343055	0:29.321774	0.978719	
U1_tRMS_rc@POWER/0 [V]	230.2330	92.81456	-137.4184	98.13521
U2_tRMS_rc@POWER/0 [V]	230.4920	92.06178	-138.4302	98.33210
U3_tRMS_rc@POWER/0 [V]	230.4259	92.88955	-137.5364	98.12897
I1_tRMS_rc@POWER/0 [A]	160.3091	81.84193	-78.46718	84.23959
I2_tRMS_rc@POWER/0 [A]	160.4956	82.43064	-78.06495	85.11114
I3_tRMS_rc@POWER/0 [A]	160.3943	80.69302	-79.70131	84.56024
U_fund_SYM+_rc@POWER/0 [V]	399.0265	160.2909	-238.7356	169.5084
I_fund_Q_SYM+_rc@POWER/0 [A]	1.875811	79.96400	78.08819	77.96615
P_t_rc@POWER/0 [W]	110830.5	4476.370	-106354.1	16824.36
U_fundRMS_SYM+@POWER/0 [V]	230.3908	92.55216	-137.8386	104.0759

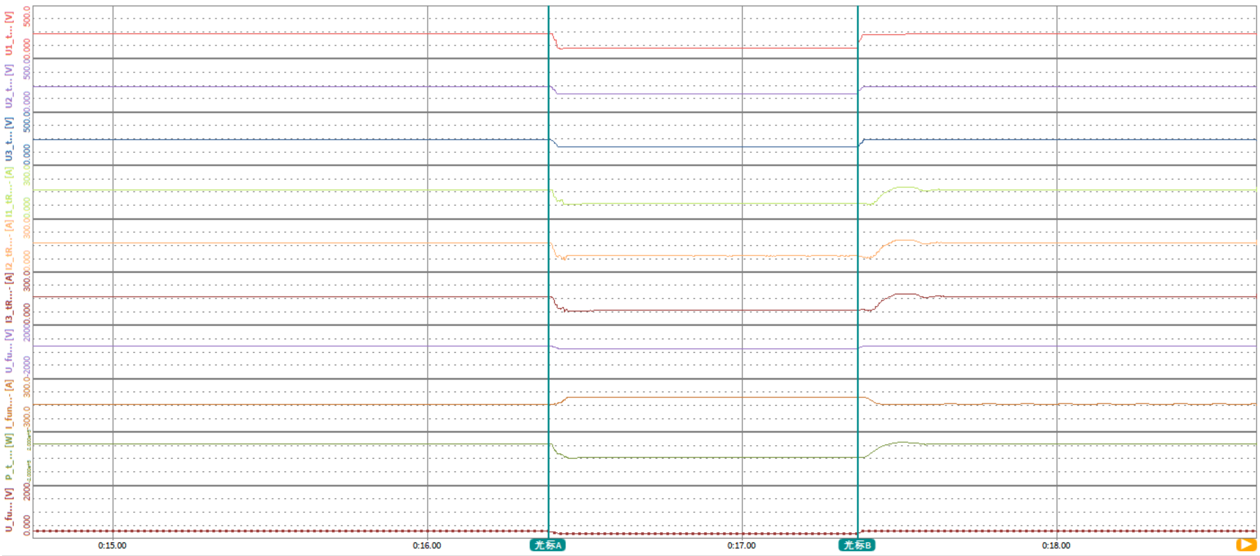
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:29.319638	0:29.425184	0.105546	
U1_tRMS_rc@POWER/0 [V]	93.42379	227.1058	133.6820	212.7109
U2_tRMS_rc@POWER/0 [V]	92.17626	226.8894	134.7131	210.4154
U3_tRMS_rc@POWER/0 [V]	92.16917	225.8727	133.7035	209.8059
I1_tRMS_rc@POWER/0 [A]	80.80853	144.0986	63.29009	96.40462
I2_tRMS_rc@POWER/0 [A]	82.45537	146.6191	64.16376	96.81968
I3_tRMS_rc@POWER/0 [A]	81.36877	148.1924	66.82361	96.77318
U_fund_SYM+_rc@POWER/0 [V]	160.2908	392.5112	232.2203	363.0668
I_fund_Q_SYM+_rc@POWER/0 [A]	79.92145	3.002465	-76.91898	56.06363
P_t_rc@POWER/0 [W]	4390.904	99226.27	94835.37	52502.08
U_fundRMS_SYM+@POWER/0 [V]	92.55216	226.5919	134.0398	195.3983

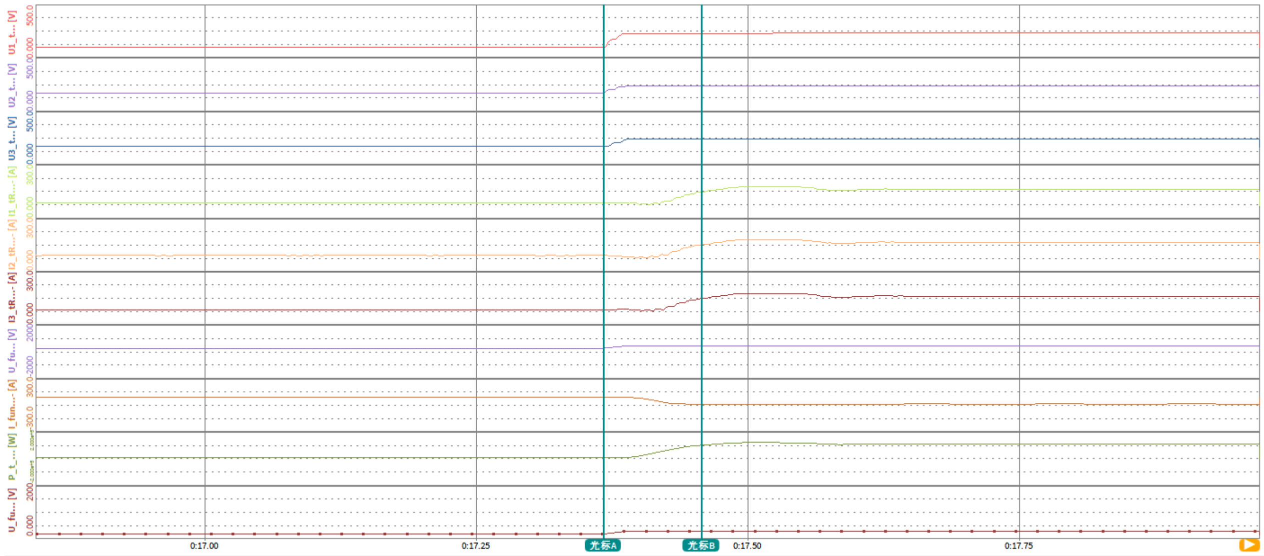
5) Phase-phase asymmetry voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:16.384673	0:17.366768	0.982095	
U1_tRMS_rc@POWER/0 [V]	230.2839	92.98172	-137.3022	98.09118
U2_tRMS_rc@POWER/0 [V]	230.5184	165.9605	-64.55783	167.4932
U3_tRMS_rc@POWER/0 [V]	230.4663	165.2902	-65.17606	167.6839
I1_tRMS_rc@POWER/0 [A]	160.3228	82.44276	-77.88001	85.36401
I2_tRMS_rc@POWER/0 [A]	160.4135	86.56436	-73.84915	88.39149
I3_tRMS_rc@POWER/0 [A]	160.3469	82.28709	-78.05978	84.40120
U_fund_SYM+_rc@POWER/0 [V]	399.0945	239.3126	-159.7820	243.9981
I_fund_Q_SYM+_rc@POWER/0 [A]	1.923919	81.02528	79.10137	78.93536
P_t_rc@POWER/0 [W]	110821.4	8346.378	-102475.0	18314.10
U_fundRMS_SYM+@POWER/0 [V]	230.4240	138.3631	-92.06094	143.9187

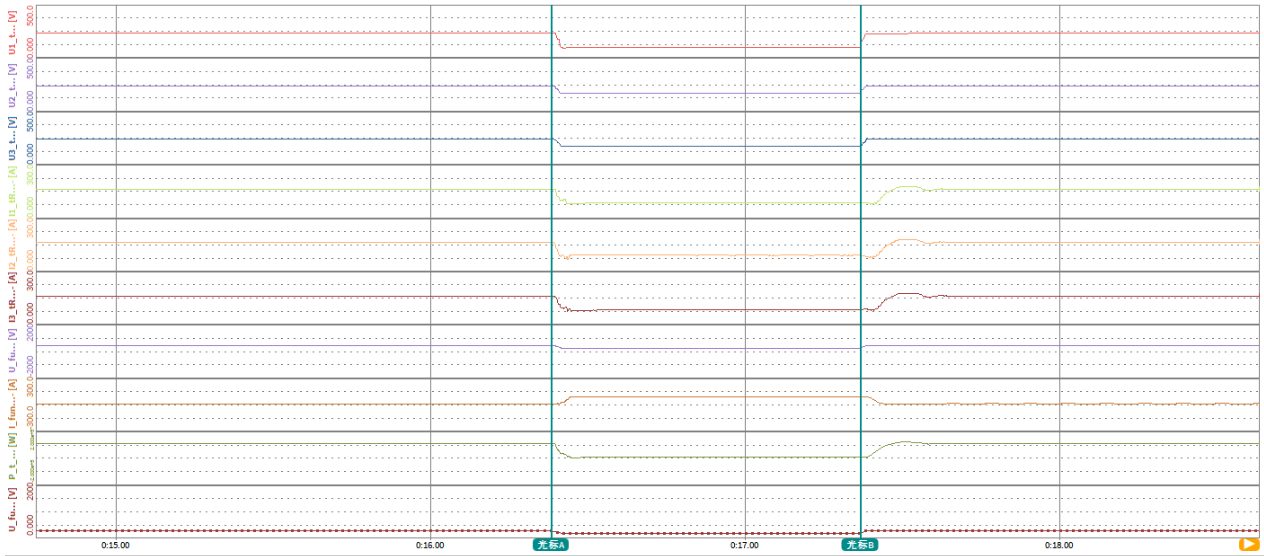
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:17.3668778	0:17.4570176	0.0901398	
U1_tRMS_rc@POWER/0 [V]	92.98172	227.9362	134.9545	214.3628
U2_tRMS_rc@POWER/0 [V]	165.9605	230.4579	64.49742	223.5885
U3_tRMS_rc@POWER/0 [V]	165.2902	230.1169	64.82669	221.0379
I1_tRMS_rc@POWER/0 [A]	82.44276	143.5517	61.10889	96.42203
I2_tRMS_rc@POWER/0 [A]	86.56436	145.2183	58.65396	98.35787
I3_tRMS_rc@POWER/0 [A]	82.28709	146.4246	64.13748	99.44904
U_fund_SYM+_rc@POWER/0 [V]	239.3126	397.5012	158.1887	378.3659
I_fund_Q_SYM+_rc@POWER/0 [A]	81.02528	-0.330748	-81.35603	56.83483
P_t_rc@POWER/0 [W]	8346.378	99742.68	91396.30	53991.69
U_fundRMS_SYM+@POWER/0 [V]	138.3631	229.4346	91.07150	202.9032

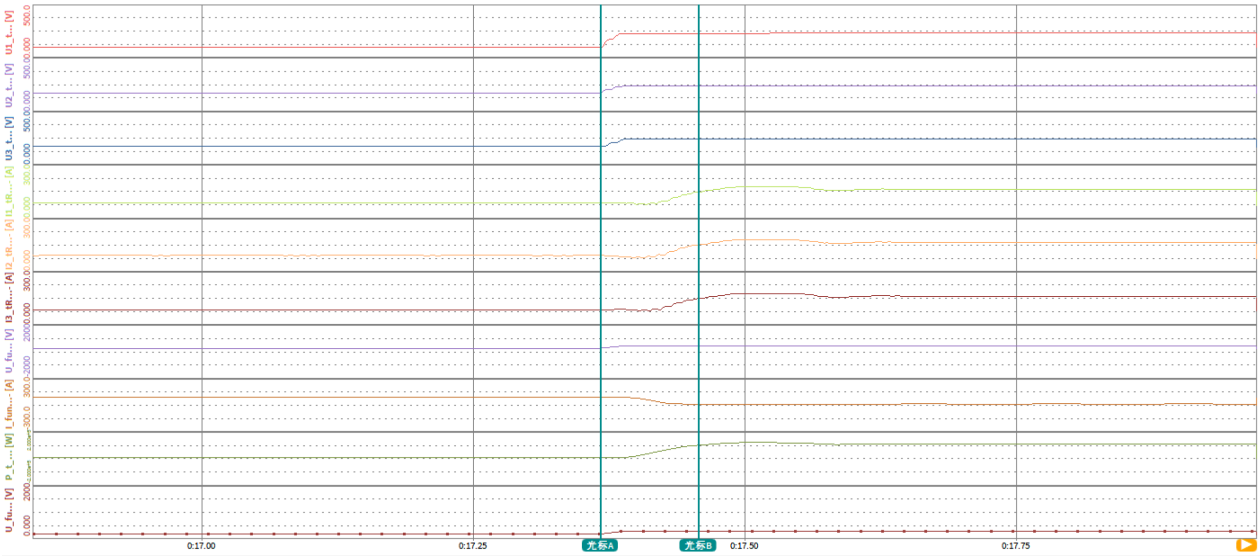
6) Single phase voltage dip: 40% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:16.384673	0:17.366768	0.982095	
U1_tRMS_rc@POWER/0 [V]	230.2839	92.98172	-137.3022	98.09118
U2_tRMS_rc@POWER/0 [V]	230.5184	165.9605	-64.55783	167.4932
U3_tRMS_rc@POWER/0 [V]	230.4663	165.2902	-65.17606	167.6839
I1_tRMS_rc@POWER/0 [A]	160.3228	82.44276	-77.88001	85.36401
I2_tRMS_rc@POWER/0 [A]	160.4135	86.56436	-73.84915	88.39149
I3_tRMS_rc@POWER/0 [A]	160.3469	82.28709	-78.05978	84.40120
U_fund_SYM+_rc@POWER/0 [V]	399.0945	239.3126	-159.7820	243.9981
I_fund_Q_SYM+_rc@POWER/0 [A]	1.923919	81.02528	79.10137	78.93536
P_t_rc@POWER/0 [W]	110821.4	8346.378	-102475.0	18314.10
U_fundRMS_SYM+@POWER/0 [V]	230.4240	138.3631	-92.06094	143.9187

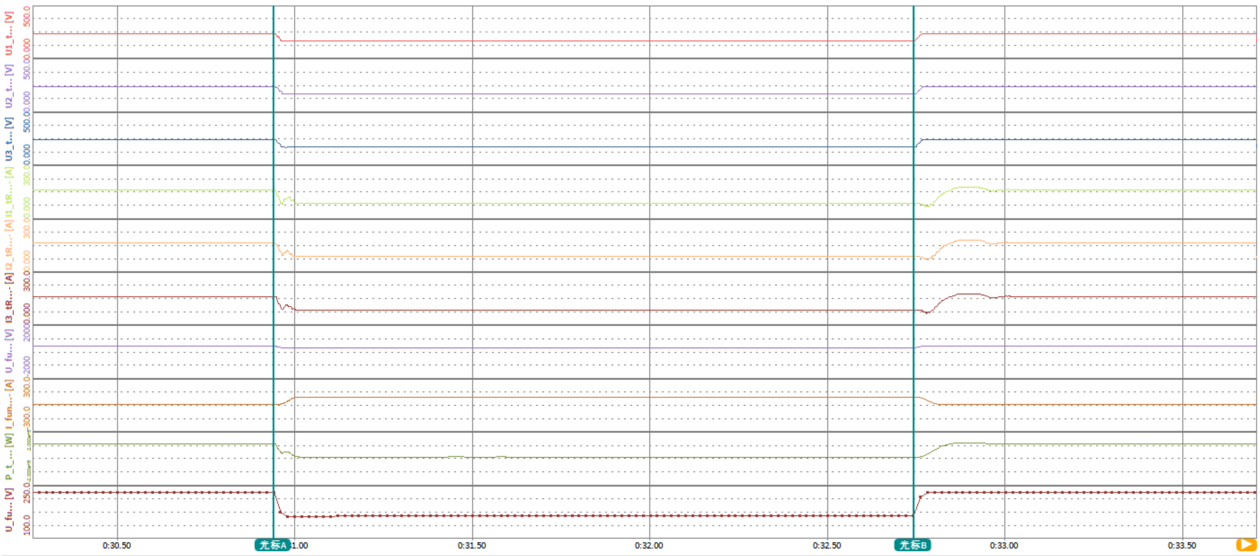
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:17.3668778	0:17.4570176	0.0901398	
U1_tRMS_rc@POWER/0 [V]	92.98172	227.9362	134.9545	214.3628
U2_tRMS_rc@POWER/0 [V]	165.9605	230.4579	64.49742	223.5885
U3_tRMS_rc@POWER/0 [V]	165.2902	230.1169	64.82669	221.0379
I1_tRMS_rc@POWER/0 [A]	82.44276	143.5517	61.10889	96.42203
I2_tRMS_rc@POWER/0 [A]	86.56436	145.2183	58.65396	98.35787
I3_tRMS_rc@POWER/0 [A]	82.28709	146.4246	64.13748	99.44904
U_fund_SYM+_rc@POWER/0 [V]	239.3126	397.5012	158.1887	378.3659
I_fund_Q_SYM+_rc@POWER/0 [A]	81.02528	-0.330748	-81.35603	56.83483
P_t_rc@POWER/0 [W]	8346.378	99742.68	91396.30	53991.69
U_fundRMS_SYM+@POWER/0 [V]	138.3631	229.4346	91.07150	202.9032

7) Three-phase symmetrical voltage dip: 70% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



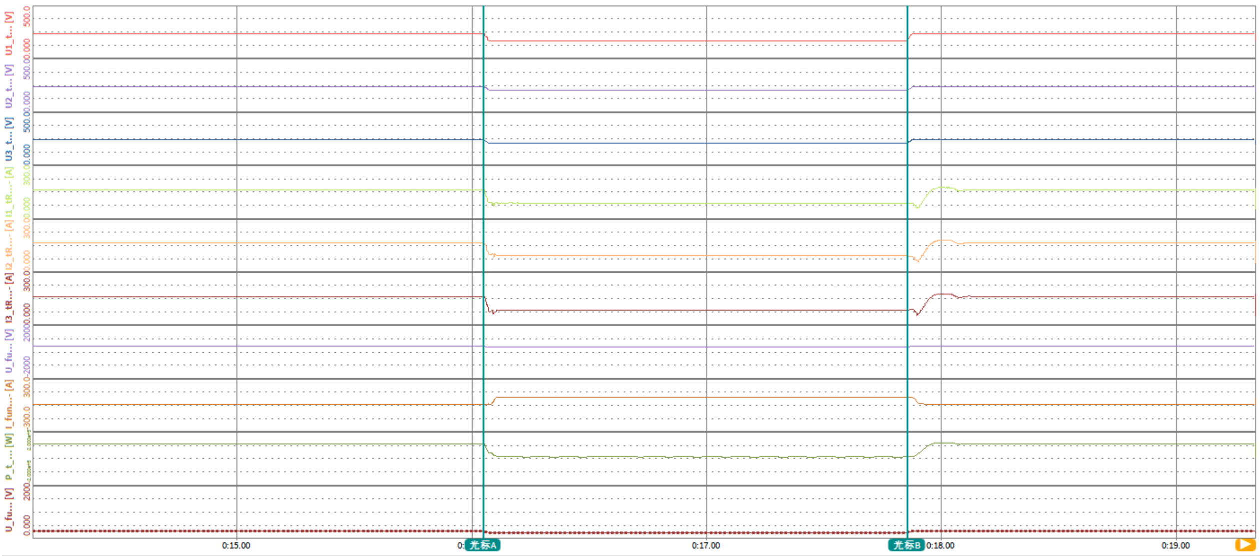
	A	B	间隔	有效值
时间 [s]	0:30.941179	0:32.742346	1.801167	
U1_tRMS_rc@POWER/0 [V]	230.2517	161.6116	-68.64017	162.1491
U2_tRMS_rc@POWER/0 [V]	230.5033	161.5537	-68.94957	162.3118
U3_tRMS_rc@POWER/0 [V]	230.5150	161.3776	-69.13734	162.0933
I1_tRMS_rc@POWER/0 [A]	160.2405	83.87328	-76.36723	85.39309
I2_tRMS_rc@POWER/0 [A]	160.4440	84.07345	-76.37060	85.84139
I3_tRMS_rc@POWER/0 [A]	160.4934	83.79281	-76.70057	85.38604
U_fund_SYM+_rc@POWER/0 [V]	399.0955	279.7429	-119.3526	280.8551
I_fund_Q_SYM+_rc@POWER/0 [A]	1.895212	81.97219	80.07698	80.56436
P_t_rc@POWER/0 [W]	110843.4	8621.265	-102222.1	15324.47
U_fundRMS_SYM+@POWER/0 [V]	230.4349	161.5088	-68.92616	163.2448

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

	A	B	间隔	有效值
时间 [s]	0:32.7444891	0:32.8342276	0.0897385	
U1_tRMS_rc@POWER/0 [V]	161.6133	229.1574	67.54407	218.6613
U2_tRMS_rc@POWER/0 [V]	161.5511	229.3788	67.82767	217.3034
U3_tRMS_rc@POWER/0 [V]	161.3831	229.3672	67.98404	218.6426
I1_tRMS_rc@POWER/0 [A]	83.83556	146.2052	62.36967	94.58550
I2_tRMS_rc@POWER/0 [A]	84.01120	145.3559	61.34467	95.14204
I3_tRMS_rc@POWER/0 [A]	83.79495	143.1433	59.34833	94.91136
U_fund_SYM+_rc@POWER/0 [V]	279.7456	397.1516	117.4060	377.2582
I_fund_Q_SYM+_rc@POWER/0 [A]	81.94436	4.326388	-77.61797	51.97991
P_t_rc@POWER/0 [W]	8609.015	99506.09	90897.07	53669.38
U_fundRMS_SYM+@POWER/0 [V]	161.5088	229.2415	67.73273	206.7031

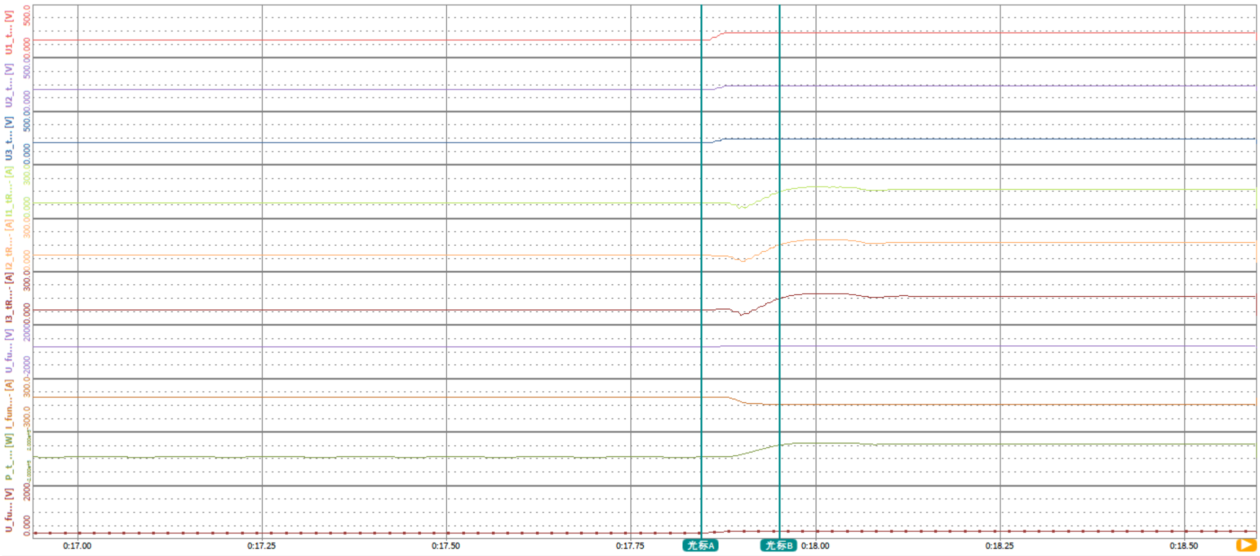
8) Phase-phase asymmetry voltage dip: 70% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔	有效值
时间 [s]	0:16.049469	0:17.854317	1.804848	
U1_tRMS_rc@POWER/0 [V]	230.3181	161.7340	-68.58412	162.4101
U2_tRMS_rc@POWER/0 [V]	230.5480	196.4372	-34.11075	196.8294
U3_tRMS_rc@POWER/0 [V]	230.5121	196.4971	-34.01498	196.8414
I1_tRMS_rc@POWER/0 [A]	160.1671	84.09602	-76.07108	85.49134
I2_tRMS_rc@POWER/0 [A]	160.2473	86.12347	-74.12382	87.70236
I3_tRMS_rc@POWER/0 [A]	160.2299	83.67584	-76.55408	84.84432
U_fund_SYM+_rc@POWER/0 [V]	399.1580	319.0398	-80.11816	319.8311
I_fund_Q_SYM+_rc@POWER/0 [A]	1.863221	82.18722	80.32400	81.29197
P_t_rc@POWER/0 [W]	110738.9	10959.48	-99779.39	15967.05
U_fundRMS_SYM+@POWER/0 [V]	230.4436	184.1849	-46.25867	185.0272

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



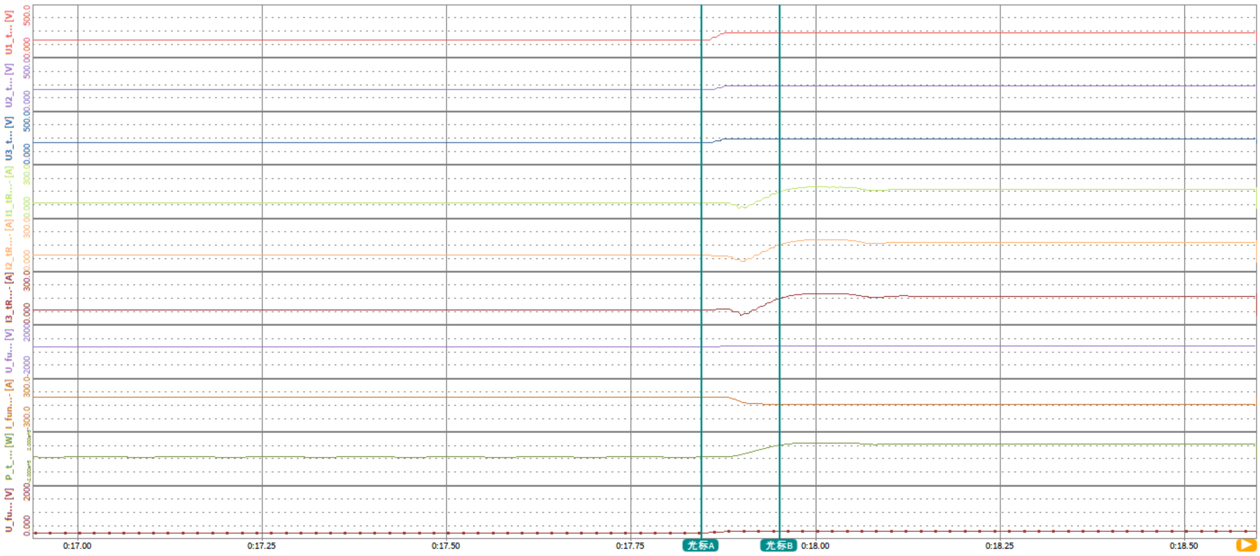
	A	B	间隔	有效值
时间 [s]	0:17.845053	0:17.951053	0.106000	
U1_tRMS_rc@POWER/0 [V]	161.7077	229.8635	68.15587	216.2998
U2_tRMS_rc@POWER/0 [V]	196.4433	230.1687	33.72534	222.2568
U3_tRMS_rc@POWER/0 [V]	196.4853	230.1298	33.64447	223.1223
I1_tRMS_rc@POWER/0 [A]	84.09514	144.9248	60.82965	90.01155
I2_tRMS_rc@POWER/0 [A]	85.72284	146.9647	61.24184	91.47421
I3_tRMS_rc@POWER/0 [A]	83.64272	143.5753	59.93256	91.73521
U_fund_SYM+_rc@POWER/0 [V]	319.0201	398.4560	79.43585	381.3576
I_fund_Q_SYM+_rc@POWER/0 [A]	82.21474	4.235871	-77.97887	55.94715
P_t_rc@POWER/0 [W]	10558.47	99892.58	89334.10	48538.68
U_fundRMS_SYM+@POWER/0 [V]	184.1849	230.0019	45.81703	217.8561

9) Single phase voltage dip: 70% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:

	A	B	间隔	有效值
时间 [s]	0:16.049469	0:17.854317	1.804848	
U1_tRMS_rc@POWER/0 [V]	230.3181	161.7340	-68.58412	162.4101
U2_tRMS_rc@POWER/0 [V]	230.5480	196.4372	-34.11075	196.8294
U3_tRMS_rc@POWER/0 [V]	230.5121	196.4971	-34.01498	196.8414
I1_tRMS_rc@POWER/0 [A]	160.1671	84.09602	-76.07108	85.49134
I2_tRMS_rc@POWER/0 [A]	160.2473	86.12347	-74.12382	87.70236
I3_tRMS_rc@POWER/0 [A]	160.2299	83.67584	-76.55408	84.84432
U_fund_SYM+_rc@POWER/0 [V]	399.1580	319.0398	-80.11816	319.8311
I_fund_Q_SYM+_rc@POWER/0 [A]	1.863221	82.18722	80.32400	81.29197
P_t_rc@POWER/0 [W]	110738.9	10959.48	-99779.39	15967.05
U_fundRMS_SYM+@POWER/0 [V]	230.4436	184.1849	-46.25867	185.0272

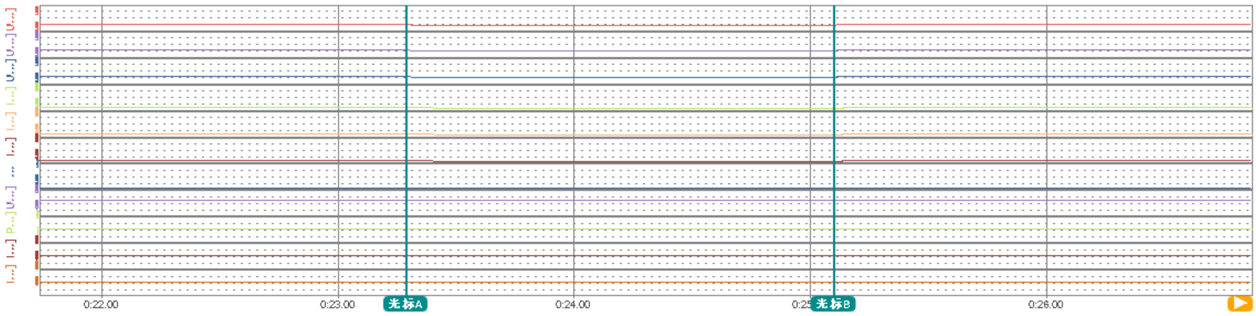
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:



	A	B	间隔	有效值
时间 [s]	0:17.845053	0:17.951053	0.106000	
U1_tRMS_rc@POWER/0 [V]	161.7077	229.8635	68.15587	216.2998
U2_tRMS_rc@POWER/0 [V]	196.4433	230.1687	33.72534	222.2568
U3_tRMS_rc@POWER/0 [V]	196.4853	230.1298	33.64447	223.1223
I1_tRMS_rc@POWER/0 [A]	84.09514	144.9248	60.82965	90.01155
I2_tRMS_rc@POWER/0 [A]	85.72284	146.9647	61.24184	91.47421
I3_tRMS_rc@POWER/0 [A]	83.64272	143.5753	59.93256	91.73521
U_fund_SYM+_rc@POWER/0 [V]	319.0201	398.4560	79.43585	381.3576
I_fund_Q_SYM+_rc@POWER/0 [A]	82.21474	4.235871	-77.97887	55.94715
P_t_rc@POWER/0 [W]	10558.47	99892.58	89334.10	48538.68
U_fundRMS_SYM+@POWER/0 [V]	184.1849	230.0019	45.81703	217.8561

10) Three-phase symmetrical voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



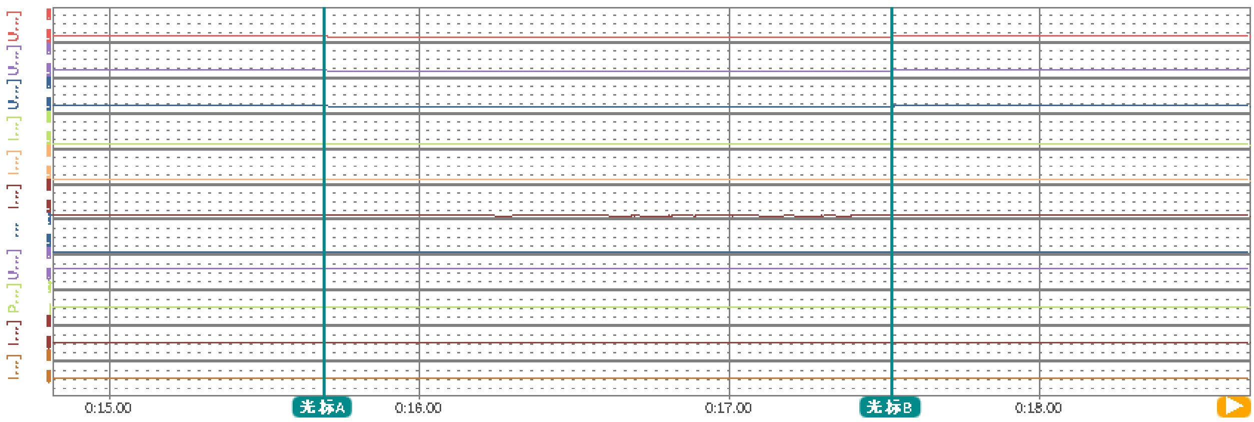
	A	B	间隔
时间 [s]	0:23.290070	0:203.298742	180.008672
U1_tRMS_rc@POWER/0 [V]	230.2322	197.8396	-32.39253
U2_tRMS_rc@POWER/0 [V]	230.5048	198.2869	-32.21794
U3_tRMS_rc@POWER/0 [V]	230.5079	198.1987	-32.30919
I1_tRMS_rc@POWER/0 [A]	160.2778	123.9561	-36.32174
I2_tRMS_rc@POWER/0 [A]	160.5808	123.9811	-36.59967
I3_tRMS_rc@POWER/0 [A]	160.4661	124.1829	-36.28315
Q_fund_SYM+_rc@POWER/0 [var]	1264.546	21614.76	20350.22
U_fund_SYM+_rc@POWER/0 [V]	399.0809	343.1260	-55.95493
P_fund_SYM+_rc@POWER/0 [W]	110876.1	70416.63	-40459.52
I_fund_P_SYM+_rc@POWER/0 [A]	160.4045	118.4844	-41.92014
I_fund_Q_SYM+_rc@POWER/0 [A]	1.829419	36.36941	34.53999

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

	A	B	间隔	有效值
时间 [s]	0:25.1094116	0:25.1470923	0.0376807	
U1_tRMS_rc@POWER/0 [V]	197.8520	230.2173	32.36530	220.4840
U2_tRMS_rc@POWER/0 [V]	198.2805	230.5678	32.28729	222.6297
U3_tRMS_rc@POWER/0 [V]	198.2037	230.4674	32.26369	220.2062
I1_tRMS_rc@POWER/0 [A]	123.5984	147.7253	24.12688	129.2241
I2_tRMS_rc@POWER/0 [A]	123.5811	145.9857	22.40461	129.5596
I3_tRMS_rc@POWER/0 [A]	124.0557	141.8480	17.79224	128.9487
U_fund_SYM+_rc@POWER/0 [V]	343.1323	399.0851	55.95288	382.6073
I_fund_Q_SYM+_rc@POWER/0 [A]	34.64762	11.24293	-23.40469	29.49772
P_t_rc@POWER/0 [W]	70543.37	99601.83	29058.46	83498.74
U_fundRMS_SYM+@POWER/0 [V]	198.1085	230.3118	32.20331	209.5595

11) Phase-phase asymmetry voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:



	A	B	间隔
时间 [s]	0:15.69275	0:195.7005	180.00775
U1_tRMS_rc@POWER/0 [V]	230.2486	198.1419	-32.10672
U2_tRMS_rc@POWER/0 [V]	230.5331	223.2137	-7.319366
U3_tRMS_rc@POWER/0 [V]	230.4539	222.7156	-7.738266
I1_tRMS_rc@POWER/0 [A]	160.2961	141.2169	-19.07922
I2_tRMS_rc@POWER/0 [A]	160.5036	141.5104	-18.99324
I3_tRMS_rc@POWER/0 [A]	160.4320	137.9886	-22.44342
Q_fund_SYM+_rc@POWER/0 [var]	1300.634	19044.58	17743.94
U_fund_SYM+_rc@POWER/0 [V]	399.0757	371.3755	-27.70023
P_fund_SYM+_rc@POWER/0 [W]	110852.4	88109.02	-22743.41
I_fund_P_SYM+_rc@POWER/0 [A]	160.3723	136.9767	-23.39563
I_fund_Q_SYM+_rc@POWER/0 [A]	1.881652	29.60721	27.72556

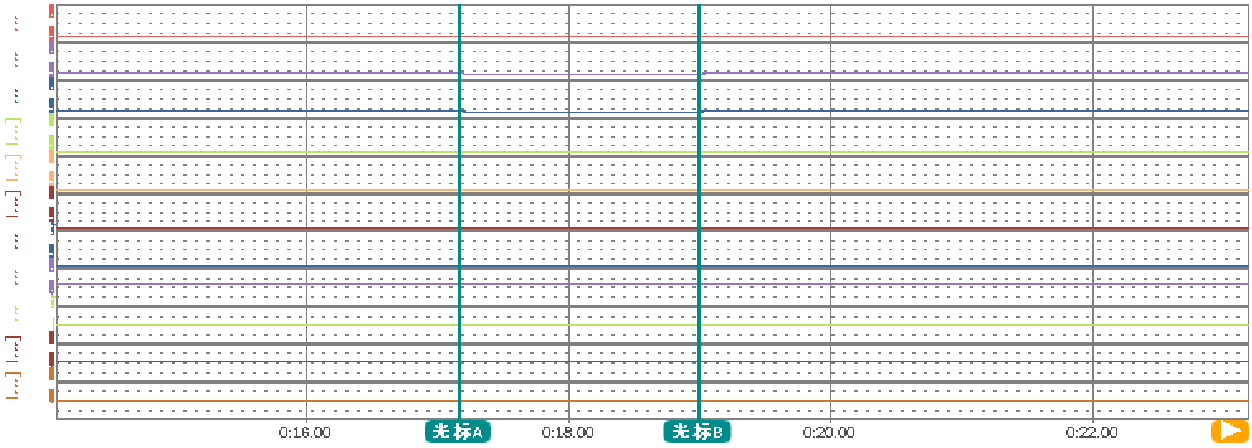
Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

	A	B	间隔	有效值
时间 [s]	0:18.9950992	0:19.0413374	0.0462382	
U1_tRMS_rc@POWER/0 [V]	197.9148	229.9908	32.07600	215.6461
U2_tRMS_rc@POWER/0 [V]	214.5683	230.4006	15.83224	223.9963
U3_tRMS_rc@POWER/0 [V]	214.5186	230.2375	15.71895	222.8024
I1_tRMS_rc@POWER/0 [A]	129.1643	145.0792	15.91487	132.3040
I2_tRMS_rc@POWER/0 [A]	129.6765	147.4949	17.81848	133.1510
I3_tRMS_rc@POWER/0 [A]	128.1931	143.7640	15.57083	132.3152
U_fund_SYM+_rc@POWER/0 [V]	361.7778	398.7244	36.94666	382.1705
I_fund_Q_SYM+_rc@POWER/0 [A]	35.32294	17.49227	-17.83067	29.49682
P_t_rc@POWER/0 [W]	77626.02	99430.23	21804.20	85650.85
U_fundRMS_SYM+@POWER/0 [V]	208.9047	230.2843	21.37953	217.1867

12) Single phase voltage dip: 85% Vn

Graphic of three phase voltage r.m.s. (Line-Neutral), three phase current r.m.s.; voltage, active current, reactive current, active power, reactive power in positive sequence system and duration:

Product Service



	A	B	间隔
时间 [s]	0:17.16893	0:197.29467	180.12574
U1_tRMS_rc@POWER/0 [V]	230.2948	197.9148	-32.38004
U2_tRMS_rc@POWER/0 [V]	230.5070	214.5683	-15.93871
U3_tRMS_rc@POWER/0 [V]	230.4437	214.5186	-15.92513
I1_tRMS_rc@POWER/0 [A]	160.1953	129.1643	-31.03094
I2_tRMS_rc@POWER/0 [A]	160.5138	129.6765	-30.83737
I3_tRMS_rc@POWER/0 [A]	160.4082	128.1931	-32.21512
Q_fund_SYM+_rc@POWER/0	1314.507	22133.97	20819.46
U_fund_SYM+_rc@POWER/0 [V]	399.0812	361.7778	-37.30347
P_fund_SYM+_rc@POWER/0 [W]	110827.3	77632.20	-33195.06
I_fund_P_SYM+_rc@POWER/0	160.3336	123.8909	-36.44274
I_fund_Q_SYM+_rc@POWER/0	1.901696	35.32294	33.42124

Graphic of three phase voltage r.m.s (Line-Neutral), three phase current r.m.s; voltage, active current, reactive current, active power, reactive power in positive sequence system and power recover time:

	A	B	间隔	有效值
时间 [s]	0:18.9950992	0:19.0413374	0.0462382	
U1_tRMS_rc@POWER/0 [V]	197.9148	229.9908	32.07600	215.6461
U2_tRMS_rc@POWER/0 [V]	214.5683	230.4006	15.83224	223.9963
U3_tRMS_rc@POWER/0 [V]	214.5186	230.2375	15.71895	222.8024
I1_tRMS_rc@POWER/0 [A]	129.1643	145.0792	15.91487	132.3040
I2_tRMS_rc@POWER/0 [A]	129.6765	147.4949	17.81848	133.1510
I3_tRMS_rc@POWER/0 [A]	128.1931	143.7640	15.57083	132.3152
U_fund_SYM+_rc@POWER/0 [V]	361.7778	398.7244	36.94666	382.1705
I_fund_Q_SYM+_rc@POWER/0 [A]	35.32294	17.49227	-17.83067	29.49682
P_t_rc@POWER/0 [W]	77626.02	99430.23	21804.20	85650.85
U_fundRMS_SYM+@POWER/0 [V]	208.9047	230.2843	21.37953	217.1867

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Remark: the case considered foresees the presence of a Dy transformer in a secondary substation clause 12.3 and 12.6 is taken into consideration Active power delivered was not oscillated during the period of recovery.

--- End of test report---