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Evaluation Report
No. TRPVP07086/24E/01

Commission testing for Solar Hybrid Inverter

Applicant: **SRNE Solar Co., Ltd**

4-5F, Building 13A, Taihua Wutong Industrial Park, Gushu Development Zone, Hangcheng Street,Baoan, Shenzhen, China PR

File No.: PVP07086/24E-01

Designed: by: Allen Zhang Digitally signed by Allen Zhang Date: 2024.08.14 11:24:14 +08'00' Finn Chen Digitally signed by Finn Chen Date: 2024.08.14 11:41:46 +08'00'

Reviewed: by: Iris Zheng Digitally signed by Iris Zheng Date: 2024.08.14 13:15:49 +08'00'

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Evaluation Report

File No.: PVP07086/24E-01 Report No.: TRPVP07086/24E/01

Applicant..... :	**SRNE Solar Co., Ltd** 4-5F, Building 13A, Taihua Wutong Industrial Park, Gushu Development Zone, Hangcheng Street,Baoan, Shenzhen, China PR
Manufacturer..... :	**SRNE Solar Co., Ltd** 4-5F, Building 13A, Taihua Wutong Industrial Park, Gushu Development Zone, Hangcheng Street,Baoan, Shenzhen, China PR
Factory ..... :	**SRNE SOLAR CO., LTD Dongguan Branch** Room 301, Building 5th, Fuxing Rd No.36, Chang'an Town, Dongguan City, Guangdong Province, China PR
Order No..... :	QT-PVP07086/24E
Date of Application [YYYY-MM-DD]..... :	2024-07-17
Product(s)..... :	Solar Hybrid Inverter
Model type(s)..... :	HESP4880SH3, HESP48100SH3, HESP48120SH3
Type of examination..... :	Commission testing only
Certification program:..... :	BOS-P-01 Rev. 00
Certification fundamental(s)..... :	PN-EN 50549-1:2019+AC:2019-04+Ap1:2020-08; PSE 2018-12; Directive (EU)2016/ 631
Testing Period [YYYY-MM-DD] start/end ..... :	2024-08-08/2024-08-12
Testing Laboratory..... :	**Dongguan BALUN Testing Technology Co., Ltd.** Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China
Annex(es)..... :	Annex 1: Test report no. BL-DG2480048-201 (PN-EN 50549-1:2019+AC:2019-04+Ap1:2020-08; PSE 2018-12; Directive (EU)2016/ 631, 208 pages)

Test results listed in this test report refer exclusively to the mentioned test sample.

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The submitted test samples as described in the reports hereunder are in compliance with the requirements / are tested according to the requirements:

PN-EN 50549-1:2019+AC:2019-04+Ap1:2020-08 - “Wymagania dla instalacji wytwórczych przeznaczonych do równoległego przyłączania do publicznych sieci dystrybucyjnych -- Część 2: Przyłączanie do sieci dystrybucyjnej SN -- Instalacje wytwórcze aż do typu B włącznie”
”

PSE 2018-12-“Wymogi Ogólnego Stosowania wynikające z rozporządzenia komisji UE 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającego kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci - zatwierdzone Decyzją Prezesa Urzędu Regulacji Energetyki DRE.WOSE.7128.550.2.2018.ZJ z dnia 2 stycznia 2019 r”

Directive (EU)2016/ 631-“COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators

中国认可
国际互认
检测
TESTING
CNAS L14701

TEST REPORT

Application number:	PVP07086/24E-01
Applicant:	SRNE Solar Co., Ltd
Address:	4-5F, Building 13A, Taihua Wutong Industrial Park,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
Equipment Type:	Solar Hybrid Inverter
Model Name Under Test:	HESP48120SH3
Series Model Name:	HESP4880SH3, HESP48100SH3, HESP48120SH3
Brand Name:	SRNE
Ratings:	See copy of marking label and model list.
Test Standard:	**PN-EN 50549-1:2019+AC:2019-04+Ap1:2020-08; PSE 2018-12; Directive (EU)2016/ 631**
Sample Arrival Date:	Aug. 08, 2024
Test Date：	Aug. 08, 2024 to Aug. 12, 2024
Date of Issue:	Aug. 13, 2024

ISSUED BY:

Dongguan BALUN Testing Technology Co., Ltd.

Tested by: Leo Sun Leo Sun

Checked by: Tao Zheng Tao Zheng

Approved by: Simon Qi

Revision History

Version	Issue Date	Revisions Content
Rev. 01	Aug. 13, 2024	Initial Issue

List of Attachments:

Attachments 1 – EN 50549-1: 2019 Report No: BL-DG2460315-201

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
4.4 Normal operating range 4.5 Immunity to disturbances 4.6 Active response to frequency deviation 4.7 Power response to voltage changes 4.8 EMC and power quality 4.9 Interface protection 4.10 Connection and reconnection 4.11 Ceasing and reduction of active power on set point 4.12 Remote information exchange 4.13 Requirements regarding single fault tolerance of interface protection system and interface switch	Dongguan BALUN Testing Technology Co., Ltd. Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China

☒ **All the tests results fulfils the requirements of PN-EN 50549-1:2019+AC:2019-04+Ap1:2020-08; PSE 2018-12; Directive (EU)2016/ 631**

Copy of marking plate:

Solar Hybrid Inverter

Model Name	HESP4880SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	6000W/6000W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	23.2Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	16000VA
Max. power	16000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	11.6Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	8000VA
Nominal power	8000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	180Ad.c./180Ad.c.

SN:

5min RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

WARNING FIRE HAZARD:
SUITABLE FOR MOUNTING ON CONCRETE
OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST
HAVE BEEN TURNED OFF BEFORE SERVICING

MADE IN CHINA

Solar Hybrid Inverter

Model Name	HESP48100SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	7500W/7500W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	29Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	20000VA
Max. power	20000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	14.5Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	10000VA
Nominal power	10000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	220Ad.c./220Ad.c.

SN:

5min RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

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CAUTION:THE DC AND AC BREAKER MUST
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MADE IN CHINA

Solar Hybrid Inverter

Model Name	HESP48120SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	9000W/9000W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	35Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	24000VA
Max. power	24000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	17.4Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	12000VA
Nominal power	12000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	260Ad.c./260Ad.c.

SN:

5min

RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

WARNING FIRE HAZARD:
SUITABLE FOR MOUNTING ON CONCRETE
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CAUTION:THE DC AND AC BREAKER MUST
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MADE IN CHINA

Test item particulars ..... :	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment ..... :	Class I
Mass of equipment (kg) ..... :	See model list.
Possible test case verdicts:	
- test case does not apply to the test object .....:	N/A
- test object does meet the requirement .....:	P (Pass)
- test object was not evaluated for the requirement:	N/E
- test object does not meet the requirement .....:	F (Fail)

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... :	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of Manufacturer (ies) ..... :	**SRNE Solar Co.,Ltd** 4-5F, Building 13A, Taihua Wutong Industrial Park,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
Name and address of factory (ies) ..... :	**SRNE SOLAR CO., LTD Dongguan Branch** Room 301, Building 5th, Fuxing Rd No.36, Chang'an Town, Dongguan City, Guangdong Province, China PR

General product information:

The equipment under test (EUT) is a Solar Hybrid Inverter. During the working process of the inverter, the DC power generated by the battery and photovoltaic terminal is converted into stable AC power, which can be fed into the grid or off-grid loads. When charging, the inverter can charge the battery through the power grid and the photovoltaic terminal, at this time the maximum charging power of the inverter is 12000W, when only the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.

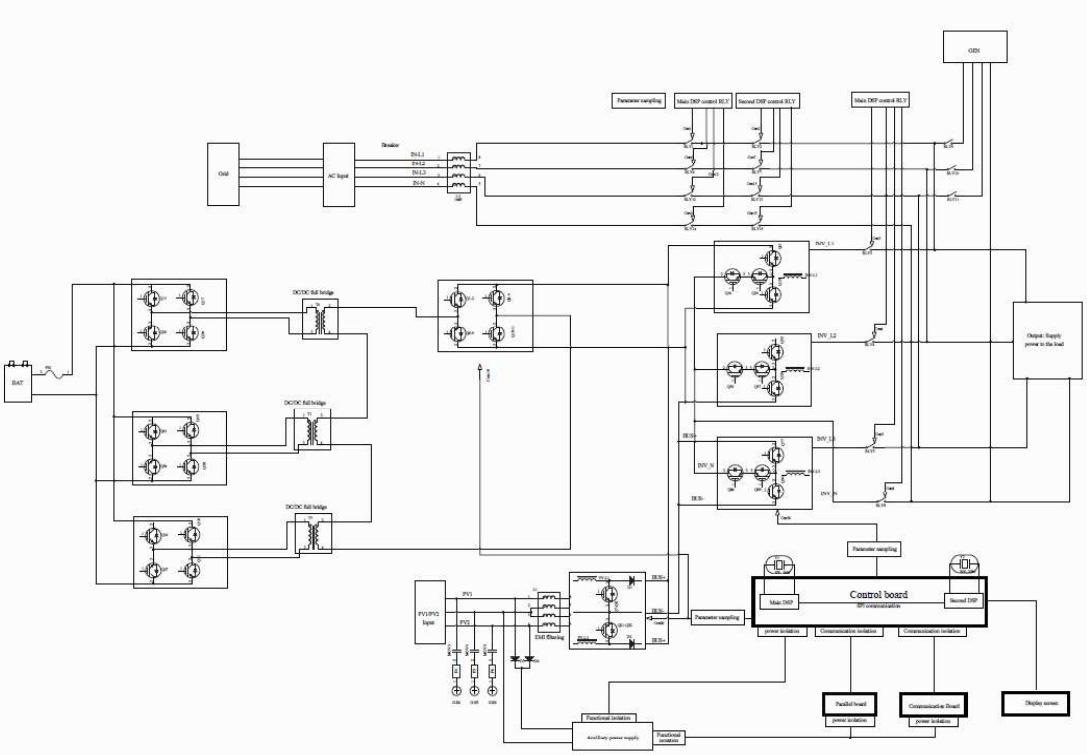
Differences of the models:

Solar Hybrid Inverter: HESP4880SH3, HESP48100SH3, HESP48120SH3 with the same appearance, topology, PCB board and software, the output power and input power are different and controlled by software.

Software Version：V9.40
Hardware version: V3.0

Unless otherwise specified, all the tests were conducted on the model HESP48120SH3.

Block diagram of the Hybrid Inverter:



Model list:

Model or Type designation		HESP4880SH3	HESP48100SH3	HESP48120SH3
PV input	Max. Voltage [Vd.c.]	800		
	MPP Voltage Range [Vd.c.]	200~650		
	Max. PV Input Current [Ad.c.]	22/22		
	DC Short-circuit current [Ad.c.]	37/37		
	Overvoltage Category (OVC)	II		
BAT Side	Battery Type	Lead-acid / Li-ion		
	Battery voltage range [Vd.c.]	40~60		
	Battery voltage range for nominal power [Vd.c.]	48V		
	Max. Grid Charge Current	100	120	120
	Max. Charge/Discharge Current [Ad.c.]	180/180	220/220	260/260
On-grid input	Rated Input Voltage [Va.c.]	3L/N/PE 230/400		
	Rated Input Frequency [Hz]	50/60		
	Max. phase current [Aa.c.]	23.2	29	35
	Max apparent power [VA]	16000	20000	24000
	Power Factor cosφ [λ]	0.8 leading to 0.8 lagging		
On-grid output	Rated Output Voltage [Va.c.]	3L/N/PE 230/400		
	Rated Output Frequency [Hz]	50/60		
	Rated Output Power [W]	8000	10000	12000
	Max. Output Power [VA]	8000	10000	12000
	Rated/Max. Output Current [Aa.c.]	11.6	14.5	17.4
	Power Factor cosφ [λ]	0.8 leading to 0.8 lagging		
	Overvoltage Category (OVC)	III		
System	Type of inverter	Non-isolated		
	Protective Class	Class I		
	Enclosure Protection (IP)	IP65		
	Operating Temperature Range [ºC]	-25~60(＞45℃ derate)		
	Dimensions W*L*H [mm]	670*440*240		
	Weight [kg]	39		

General remarks:

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

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

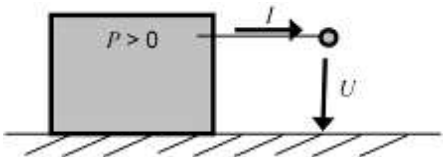
The following suffixes are used for variables in tables and figures:

- "P_n" for the nominal active power:
  $P_n = U_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3}\ U_n \times I_n \times \cos \varphi_n$ (three-Phase)
- "P_M" for the momentary power
- "(c)" for over-excited
- "(i)" for under-excited

Active and reactive power:

The regarded system of the voltage and current vectors is the load view (Figure 2):

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



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

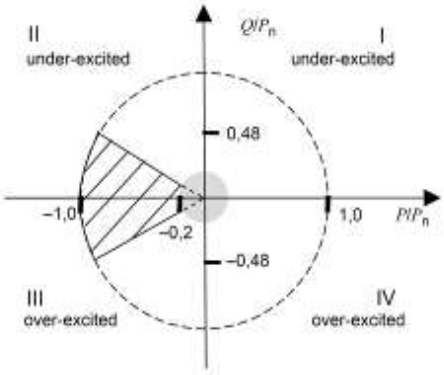


Figure 2

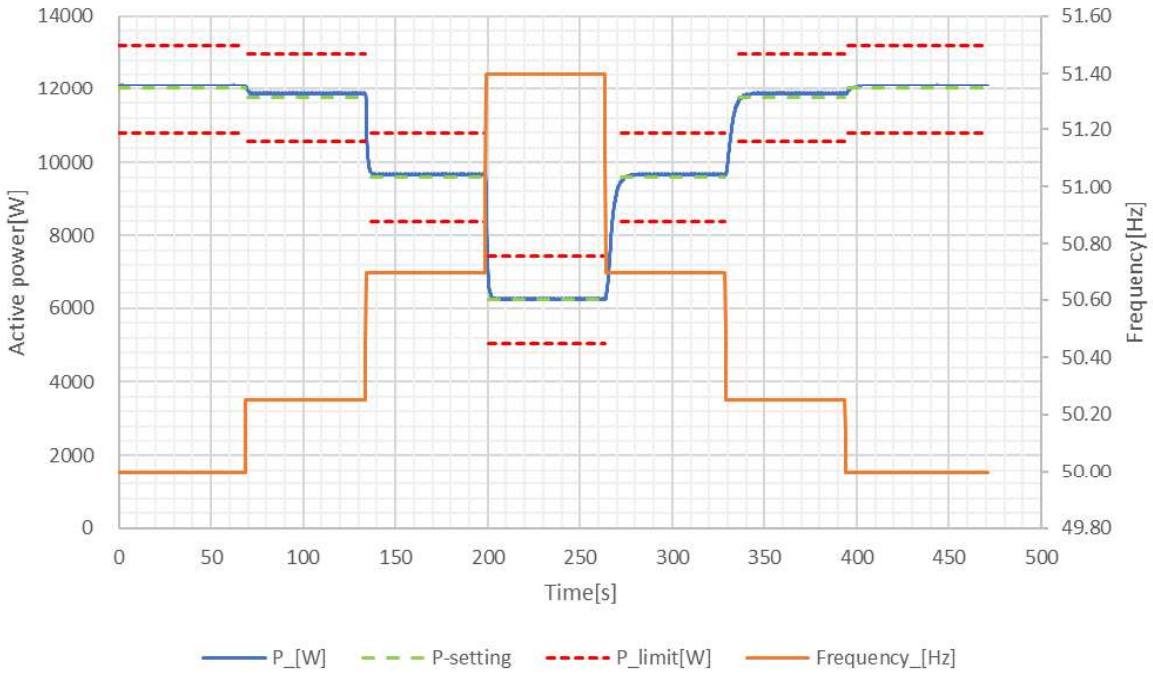
PN-EN 50549-1:2019: Normal operating range			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.4.2	Operating frequency range	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.4.3	Minimal requirement for active delivery at underfrequency		**P**
4.4.4	Continuous Operating voltage range		**P**

PN-EN 50549-1:2019: Immunity to disturbances			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.5.2	Rate of change of frequency (RoCoF) immunity	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.5.3	Under-voltage ride through (UVRT)	For partial test item: Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.5.4	Over-voltage ride through (OVRT)	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**

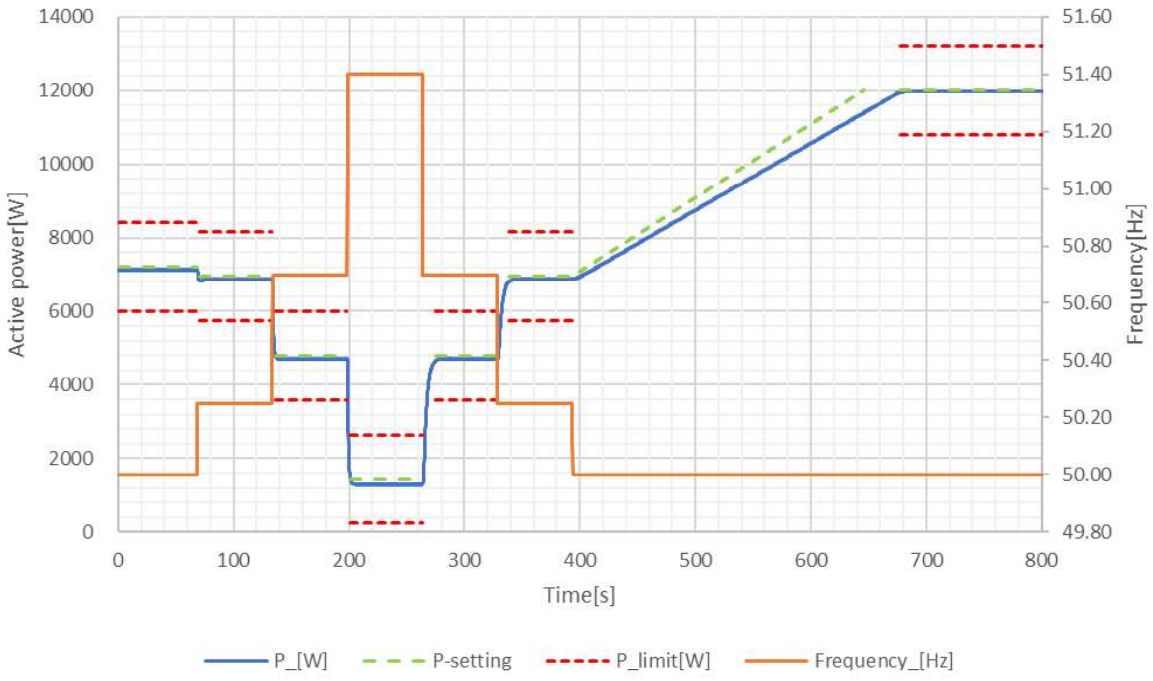
PN-EN 50549-1:2019: Active response to frequency deviation			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.6.1	Power response to overfrequency		**P**
4.6.2	Power response to underfrequency		**P**

4.6.1 Power response to over-frequency							P
Test:							
1-min mean value [Hz]:	a) 50.00	b) 50.25	c) 50.70	d) 51.40	e) 50.70	f) 50.25	g) 50.00
1. Measurement a) to g): Active power output =100% P_{Emax} s=5% (40% P_{Emax} / Hz), threshold frequency for start/return: 50.2Hz							
Frequency [Hz]:	50.00	50.25	50.70	51.40	50.70	50.25	50.00
P_M [W]:	N/A	11760	9600	6240	9600	11760	N/A
P_{E60} [W]:	12103	11858	9672	6268	9664	11839	12100
$\Delta P_{E60}/P_M$ [%]:	N/A	0.82	0.60	0.24	0.53	0.66	N/A
Test:							
1-min mean value [Hz]:	a) 50.00	b) 50.25	c) 50.70	d) 51.40	e) 50.70	f) 50.25	g) 50.00
2. Measurement a) to g): Active power output 60% after freezing = 100% P_{Emax} s=5% (40% P_{Emax} / Hz), threshold frequency for start/return: 50.2Hz							
Frequency [Hz]:	50.00	50.25	50.70	51.40	50.70	50.25	50.00
P_M [W]:	N/A	6960	4800	1440	4800	6960	N/A
P_{E60} [W]:	7129	6871	4709	1288	4706	6870	11965
$\Delta P_{E60}/P_M$ [%]:	N/A	0.75	0.76	1.27	0.79	0.75	N/A
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}						

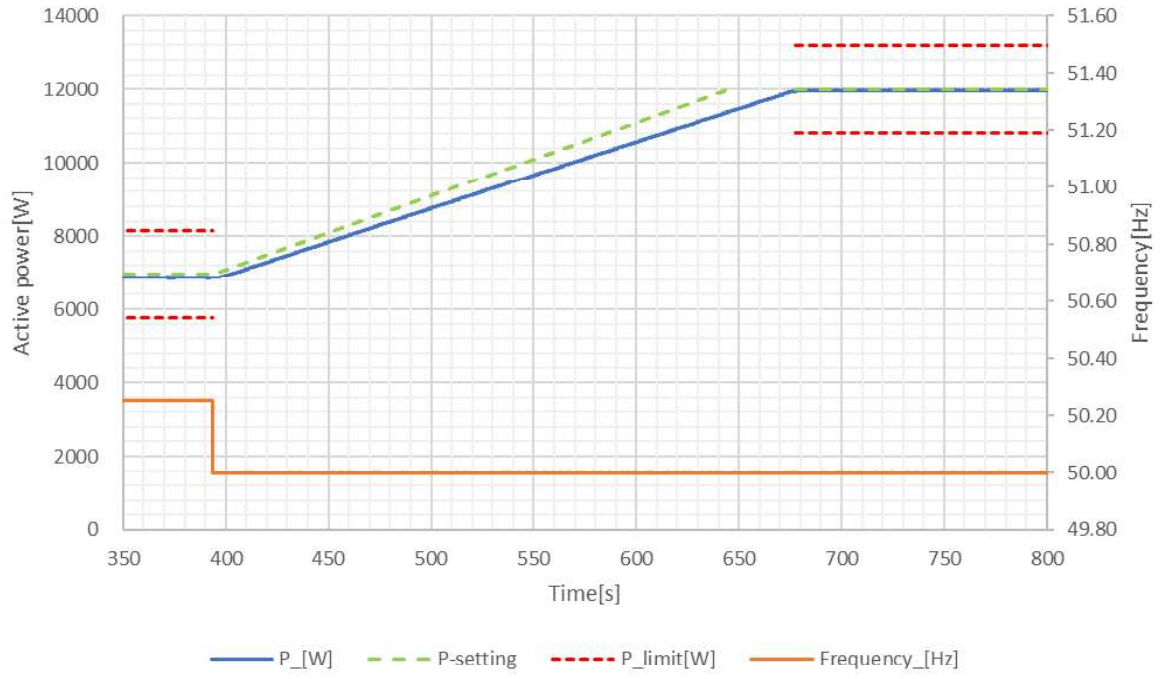
Graph of Measurement 1.: Active power output > 80% P_{Emax}



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



Graph of power gradient:



Test:

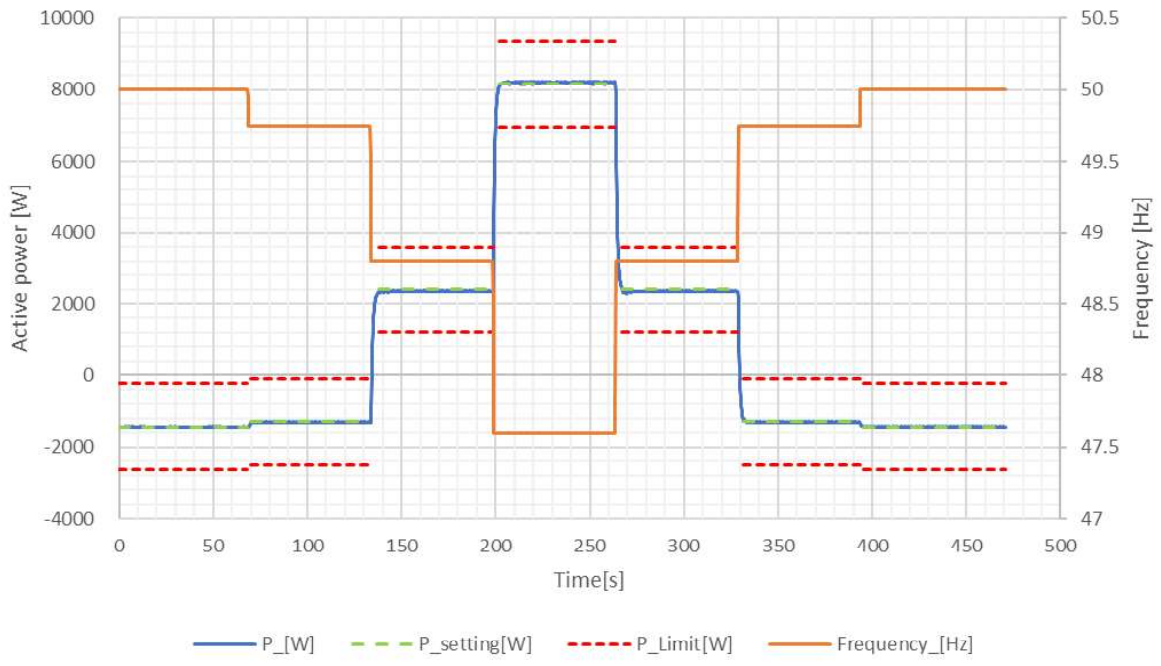
The test is conducted for two powers. First, the test must start at a power =100% P_{Emax} ("Measurement 1"), and in a second test, for a power 60% P_{Emax} ("Measurement 2"). In the second test, after freezing of the P_M, the available active power output must be increased to a value =100% P_{Emax}, and after the network frequency of 50.2 Hz is fallen below, the rise of the active power gradient must be recorded.
Point g) must be held until the micro-generator is again feeding in with the active power output available.

Assessment criterion:

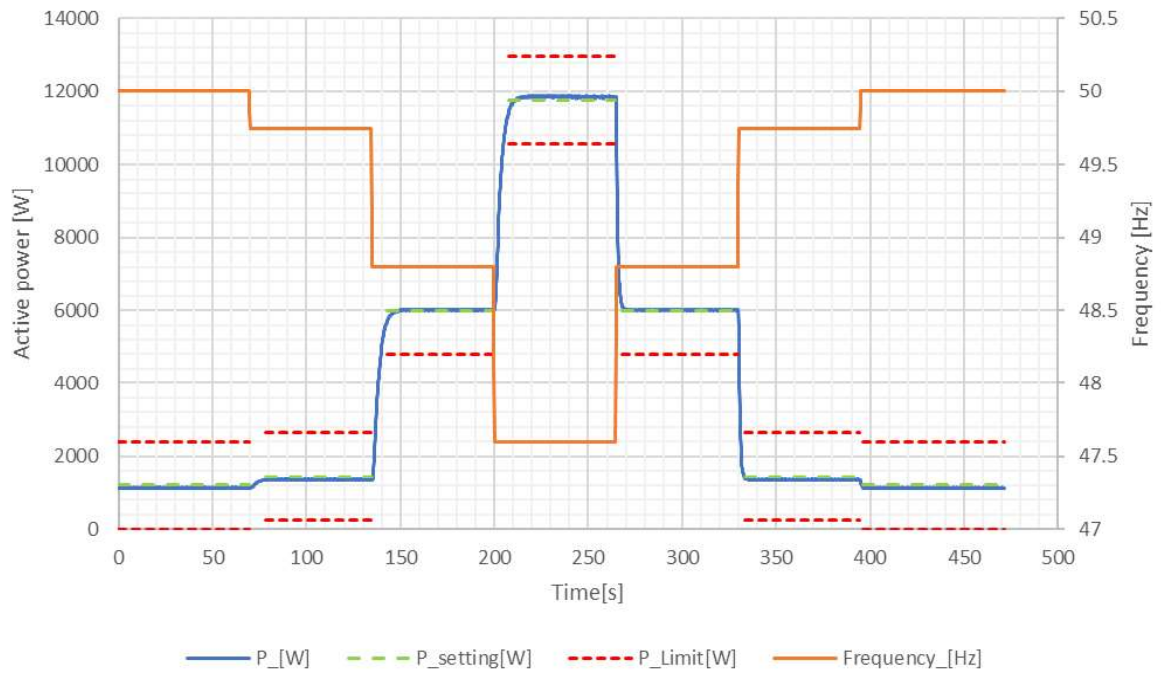
For f = 50.2 Hz, the value of the P_M active power currently being generated is "frozen".
a) For adjustable micro-generators when:
1) the active power reduces between measuring points b) and f) given above with the set gradient P_M per Hz for a increasing frequency (or rises for a frequency decreasing again).
2) the maximum active power gradient occurring in point is less than the configured maximum active power per minute
3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_{Emax} by more than ± 10%.
4) the settling time is equal or below 2 s with an intentional delay set to zero
b) For partly adjustable micro-generators
1) when they behave as in a) within their adjustment range, and
2) when outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51.5 Hz.

4.6.2 Power response to under-frequency (For Electrical Energy Storage System unit (EESS) only)							**P**
Test:							
1-min mean value [Hz]:	a) 50.00	b) 49.75	c) 48.80	d) 47.60	e) 48.80	f) 49.75	g) 50.00
1. Measurement a) to g): Active power output =-20% P_{EMAX} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 49.8Hz							
Frequency [Hz]:	50.00	49.75	48.80	47.60	48.80	49.75	50.00
P_M [W]:	N/A	-1296	2400	8160	2400	-1296	N/A
P_{E60} [W]:	-1452	-1309	2344	8207	2343	-1302	-1446
$\Delta P_{E60}/P_M$ [%]:	N/A	0.11	0.46	-0.39	0.48	0.05	N/A
Test:							
1-min mean value [Hz]:	a) 50.00	b) 49.75	c) 48.80	d) 47.60	e) 48.80	f) 49.75	g) 50.00
2. Measurement a) to g): Active power output 10% after freezing = 10% P_{EMAX} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 49.8Hz							
Frequency [Hz]:	50.00	49.75	48.80	47.60	48.80	49.75	50.00
P_M [W]:	N/A	1440	6000	11760	6000	1440	N/A
P_{E60} [W]:	1120	1356	5999	11839	6007	1352	1115
$\Delta P_{E60}/P_M$ [%]:	N/A	0.70	0.01	-0.66	-0.06	0.74	N/A
Test:							
1-min mean value [Hz]:	a) 50.00	b) 49.75	c) 48.80	d) 47.60	e) 48.80	f) 49.75	g) 50.00
3. Measurement a) to g): Active power output 60% after freezing = 60% P_{EMAX} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 49.8Hz							
Frequency [Hz]:	50.00	49.75	48.80	47.60	48.80	49.75	50.00
P_M [W]:	N/A	7440	12000	12000	12000	7440	N/A
P_{E60} [W]:	7244	7475	12072	12094	12091	7472	7237
$\Delta P_{E60}/P_M$ [%]:	N/A	-0.29	-0.60	-0.79	-0.76	-0.27	N/A
Limit $\Delta P/P_{1min}$:	± 10 % of P_n						

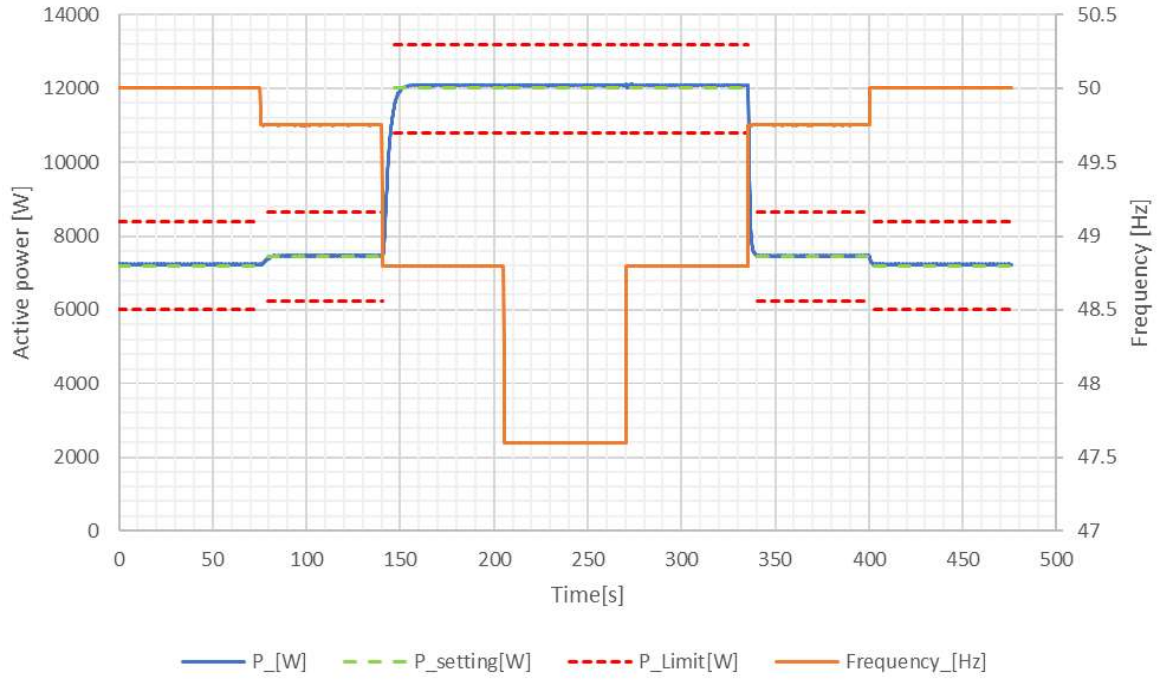
Graph of Measurement 1.: Active power output -20% P_{EMAX}



Graph of Measurement 2.: Active power output 10% P_{EMAX}



Graph of Measurement 3.: Active power output 60% P_{EMAX}



Test:

The test is conducted for three powers. First, the test must start at a power =-20% Pn ("Measurement 1"), in a second test, for a power 10% Pn ("Measurement 2"), and in a third test, for a power 60% Pn ("Measurement 3").

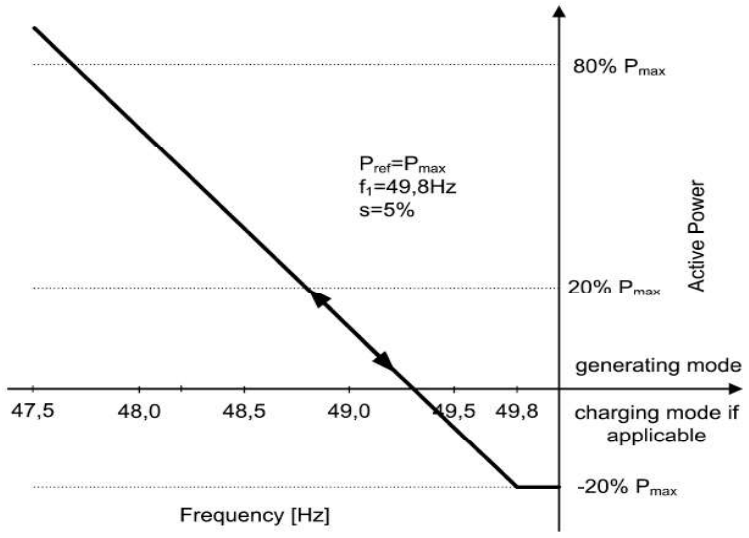


Figure 11 — Active power frequency response underfrequency in case of storage device. Example with 20 % power charging at passing of threshold frequency f1

PN-EN 50549-1:2019: Power response to voltage changes			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.7.2	Voltage support by reactive power	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.7.3	Voltage related active power reduction		**P**
4.7.4	Short circuit current requirements on generating plants		**P**

PN-EN 50549-1:2019: EMC and power quality			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.8	EMC and power quality	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
	Harmonic current emission		**P**
	Switching frequency emission		**P**
	Switching operations		**P**
	Flicker and voltage fluctuations		**P**
	DC injection		**P**
	Unbalance		**P**
	Additional requirements for grid protection of synchronous power generating plants		**P**

PN-EN 50549-1:2019: Interface protection			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.9.3	Requirements on voltage and frequency protection		**P**
4.9.3.2	Undervoltage protection		**P**
4.9.3.3	Overvoltage protection		**P**
4.9.3.4	Overvoltage 10 min mean protection	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.9.3.5	Underfrequency protection		**P**
4.9.3.6	Overfrequency protection		**P**
4.9.4	Means to detect island situation	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	**P**
4.9.4.2	Requirements for islanding detection		**P**

4.9.3 Requirements on voltage and frequency protection Checklist						--
Several points to check						
Clause(s) / subclause(s) of this EN	**Ref**	**Parameter**	**Typical value range**	**Value default**		
4.3.2 Interface switch	n.a.	Single fault tolerance for interface switch required	yes | no	yes		
4.4.2 Operating frequency range “PSE Article 13.1(a)(i)” “NC RFG Article 13.1(a)”	A,B	47,0 – 47,5 Hz Duration	0 – 20 s	0s		
	A,B	47,5 – 48,5 Hz Duration	30 – 90 min	≥30 min		
	A,B	48,5 – 49,0 Hz Duration	30 – 90 min	≥30 min		
	A,B	49,0 – 51,0 Hz Duration	not configurable	unlimited		
	A,B	51,0 – 51,5 Hz Duration	30 – 90 min	≥30 min		
	A,B	51, 5 – 52 Hz Duration	0 – 15 min	0 s		
4.4.3 Minimal requirement for active power delivery at underfrequency “PSE Article 13.4” “NC RFG Article 13.4”	A,B	Reduction threshold	49 Hz – 49,5 Hz	Electronic inverter no power reduction take place		
	A,B	Maximum reduction rate	0 – 10 % PM/Hz	≤ 2 %		
4.4.4 Continuous operating voltage range “PSE Article 16.2(a)(i)” “NC RFG Article 16.2(a)(i)”	n.a.	Upper limit	not configurable	115% Un		
	n.a.	Lower limit	not configurable	85% Un		
4.5.2 Rate of change of frequency (ROCOF) immunity (ROCOF) immunity “PSE Article 13.1(b)” “NC RFG Article 13.1(b)”	A,B	ROCOF withstand capability (defined with a sliding measurement window of 500 ms)	not defined	≥2,5 Hz/s For type A ≥2,0 Hz/s For type B		
		non-synchronous generating technology:				
		synchronous generating technology:				
4.5.3.2 Generating plant with non-synchronous generating technology “PSE Article 14.3(a)(i), 14.3(b), 16.3(a)(i), 16.3(c), 20.2(b)(c), 20.3(a), 21.3(e)” “NC RFG Article 14.3(a), 14.3(b), 16.3(a), 16.3(c), 20.2 (b)(c),	B	Maximum power resumption time	not defined	N/A		
	B	Voltage-Time-Diagram	“PSE Article 14.3(a)(i), 14.3(b)” Type B	Time [s]	U [p.u.]	
				0,15	0,05	
				2,50	0,85	
			“PSE Article 16.3(a)(i), 16.3(c)” Type C, Type D	0,15	0,00	
				2,50	0,85	
	B	Fast fault current	Rated value	(rated current)		

20.3 (a), 21.3(e)"	B	Post-fault active power recovery	configurable	start 90% Un
	B	Maximum allowed time for active power recovery (counting time from fault clearance)	configurable	≤ 5 s
	B	Magnitude for active power recovery	configurable	≥ 90 %
	B	Accuracy of active power recovery	not configurable	≤ 10 %
	B	Reactive power contribution has priority	yes | no	yes
4.6.1 Power response to overfrequency "PSE Article 13.2(a)(f)" "NC RFG Article 13.2"	A,B	Threshold frequency f1	50,2 Hz – 52 Hz	50,2 Hz
	A,B	Droop	2 % – 12 %	5 %
	A,B	Power reference	PM | Pmax	Pmax
	n.a.	Intentional delay	0 – 2 s	0s
	n.a.	Deactivation threshold fstop	50,0 Hz – f1	deactivated
	n.a.	Deactivation time tstop	0 – 600 s	-
	A	Acceptance of staged disconnection	yes | no	no
4.6.2 Power response to underfrequency "PSE Article 15.2(c)(i), (d)(i), (d)(iii), (d)(iv), (d)(v)" "NC RFG Article 15.2(c)(i), (d)(i), (d)(iii), (d)(iv), (d)(v)"	n.a.	Threshold frequency f_1	49,8 Hz – 46 Hz	49,8 Hz
	n.a.	Droop	2 – 12 %	5 %
	n.a.	Power reference	P_M | P_{max}	P_{max}
	n.a.	Intentional delay	0 – 2 s	0 s
4.7.2.2 Capabilities "PSE Article 20.2(a), 21.3(b)(i), (c)(i), (c)(iv), (d)(iv), (d) (vi), (d)(vii)" "NC RFG Article 20.2(a), 21.3(b), (c), (c), (d)"	B	Reactive power range overexcited	0 – 0,6	0,33
	B	Reactive power range underexcited	0 – 0,6	0,33
	B	Active factor range overexcited	0,8 – 1	0,9
	B	Active factor range underexcited	0,8 – 1	0,9
4.7.2.3 Control modes	n.a.	Enabled control mode	Q setp. Q(U) cos φ setp. cos φ (P)	disabled enabled disabled disabled
4.7.2.3.2 Setpoint control modes	n.a.	Q setpoint and excitation	0 – 60 % P_D	0
	n.a.	cos φ setpoint and excitation	1 – 0,9	1

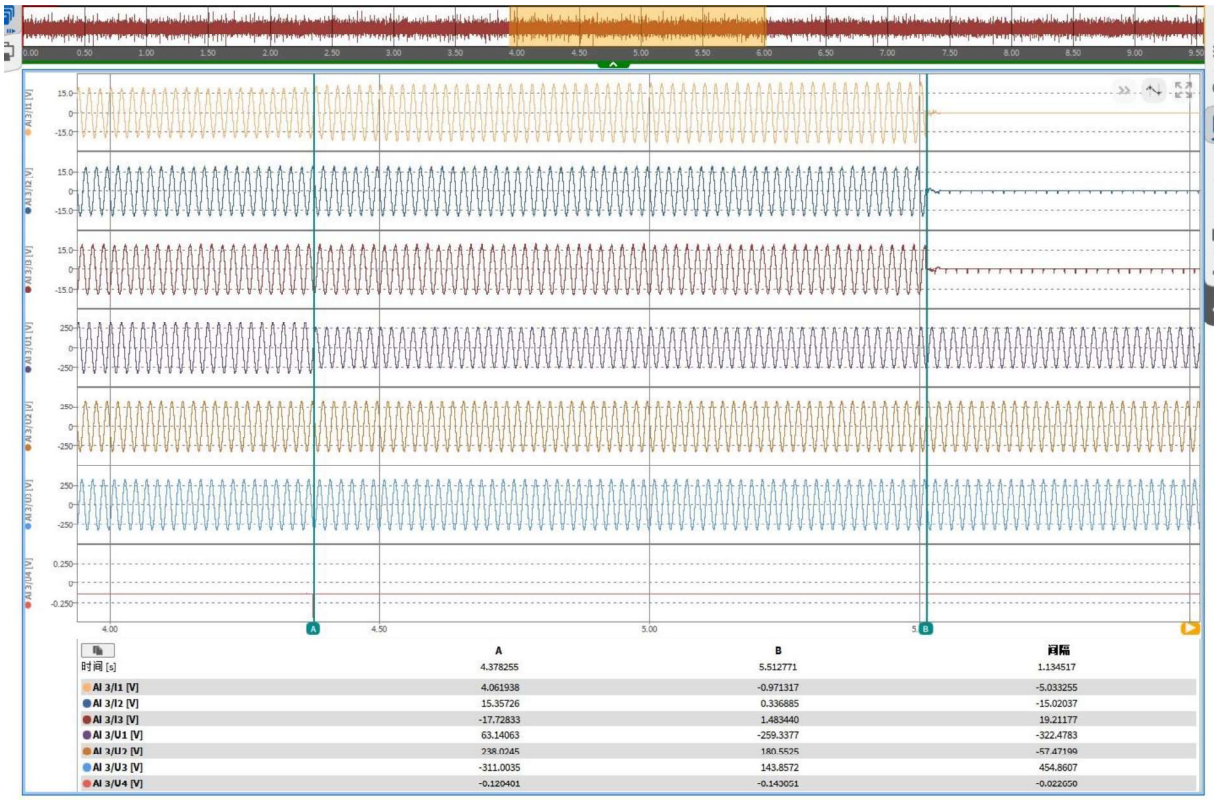
4.7.2.3.3 Voltage related control modes	n.a.	Characteristic curve	-	-
	n.a.	Time constant	3 s – 60 s	10 s
	n.a.	Min cos φ	0,0 – 1	0,9
	n.a.	Lock in power	0 % – 20 %	deactivated
	n.a.	Lock out power	0 % – 20 %	deactivated
4.7.2.3.4 Power related control mode	n.a.	Characteristic curve	-	disabled
4.7.4.2.1 Voltage support during faults and voltage steps General “PSE Article 20.2(b)(c), 20.3(a)” “NC RFG Article 20.2(b)(c), 20.3(a)”	B	Enabling	enable | disable	disabled
	B	Static voltage range overvoltage	1,0 Uc – 1,2 Uc	N/A
	B	Static voltage range undervoltage	0,2 Uc – 1,0 Uc	N/A
	B	Insensivity range of ΔU50per	0 % – 15 %	5 %
	B	Gradient k1	0 – 6	2
	B	Gradient k2	0 – 6	2
4.7.4.2.2 Zero current mode for converter connected generating technology	n.a.	Enabling	enable | disable	disabled
	n.a	Static voltage range overvoltage	100 % U_n – 120 % U_n	120 % U_n
	n.a	Static voltage range undervoltage	20 % U_n – 100 % U_n	50 % U_n
4.9.2 Requirements on voltage and frequency protection	n.a	Threshold for protection as dedicated device [in A or kW, kVA]	16 A – 250 kVA	Interface protection integrated
	B	Undervoltage threshold stage 1	0,2 U_n – 1 U_n	0.85 U_n For type A 0.8 U_n For type B
	B	Undervoltage operate time stage 1	0 s – 10 s	1.2 s For type A 3 s For type B
	B	Undervoltage threshold stage 2	0,2 U_n – 1 U_n	/
	B	Undervoltage operate time stage 2	0 s – 10 s	/
	B	Overvoltage threshold stage 1	1,0 U_n – 1,2 U_n	1.15 U_n
	B	Overvoltage operate time stage 1	0 s – 10 s	0.1 s
	B	Overvoltage threshold stage 2	1,0 U_n – 1,3 U_n	/
	B	Overvoltage operate time stage 2	0 s – 10 s	/
	B	Overvoltage threshold 10 min mean protection	1,0 U_n – 1,15 U_n	1.1 U_n

	B	Underfrequency threshold stage 1	47,0 Hz– 50,0 Hz	47.5 Hz
	B	Underfrequency operate time stage 1	0 s – 10 s	1 s
	B	Underfrequency threshold stage 2	47,0 Hz – 50,0 Hz	/
	B	Underfrequency operate time stage 2	0 s – 10 s	/
	B	Overfrequency threshold stage 1	50,0 Hz – 52,0 Hz	51.5 Hz
	B	Overfrequency operate time stage 1	0 s – 10 s	0.3 s
	B	Overfrequency threshold stage 2	50,0 Hz – 52,0 Hz	/
	B	Overfrequency operate time stage 2	0 s – 10 s	/
4.10.2 Automatic reconnection after tripping “PSE Article 13.7, 14.4(a)” “NC RFG Article 13.7, 14.4”	B	Lower frequency	47,0 Hz – 50,0 Hz	49,0 Hz
	B	Upper frequency	50,0 Hz – 52,0 Hz	50,05 Hz
	B	Lower voltage	50 % U_n – 100 % U_n	85 % U_n
	B	Upper voltage	100 % U_n – 120 % U_n	110 % U_n
	B	Observation time	10 s – 600 s	60 s
	B	Active power increase gradient	6 % – 3000 %/min	10 %PEMAX /min
4.10.3 Starting to generate electrical power “PSE Article 13.7, 14.4(a)” “NC RFG Article 13.7, 14.4“	A,B	Lower frequency	47,0 Hz – 50,0 Hz	49,0 Hz
	A,B	Upper frequency	50,0 Hz – 52,0 Hz	50,05 Hz
	A,B	Lower voltage	50 % – 100 % U_n	85 % U_n
	A,B	Upper voltage	100 % – 120 % U_n	110 % U_n
	A,B	Observation time	10 s – 600 s	60 s
	A,B	Active power increase gradient	6 % – 3000 %/min	10 %PEMAX /min
4.11.1 Ceasing active power “PSE Article 13.6, 14.2(b), 15.2 (a)(b)” “NC RFG Article 13.6, 14.2(a)”	A,B	Remote operation of the logic interface	yes | no	yes Modbus signal via RS485 can be used to change or cease active power output.
4.11.2 Reduction of active power on set point “PSE Article 13.6, 15.2 (a)(b)” “NC RFG Article 13.6, 14.2(a)”	B	Remote operation NOTE: If yes further definition is provided by the DSO	yes | no	yes Modbus signal via RS485 can be used to change or cease active power output.
4.12 Remote information exchange	B	Remote information exchange required	yes | no	No

“PSE Article 14.5(d)(i)”		NOTE: If yes further definition is provided by the DSO		

4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under voltage) (Threshold value refer for default) (Three phase type, Phase L1-N)					P
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	$0.85U_n$±1% U_n	1.1 s ≤ t ≤ 1.2 s	$1.1U_n$±1% U_n	2.9 s ≤ t ≤ 3.0 s	
Trip value [V]	195.63		253.43		
	195.67		253.34		
	195.60		253.55		
	195.59		253.46		
	195.57		253.47		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	1.125	U_n To $U_{th\text{-}high}$ + 5%U_n	2.941	
		1.135		2.929	
		1.124		2.919	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	--	--	$1.15U_n$±1% U_n	t ≤ 0.1 s	
Trip value [V]	--		264.75		
	--		264.77		
	--		264.73		
	--		264.69		
	--		264.72		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	--	U_n To $U_{th\text{-}high}$ + 5%U_n	0.073	
		--		0.079	
		--		0.073	

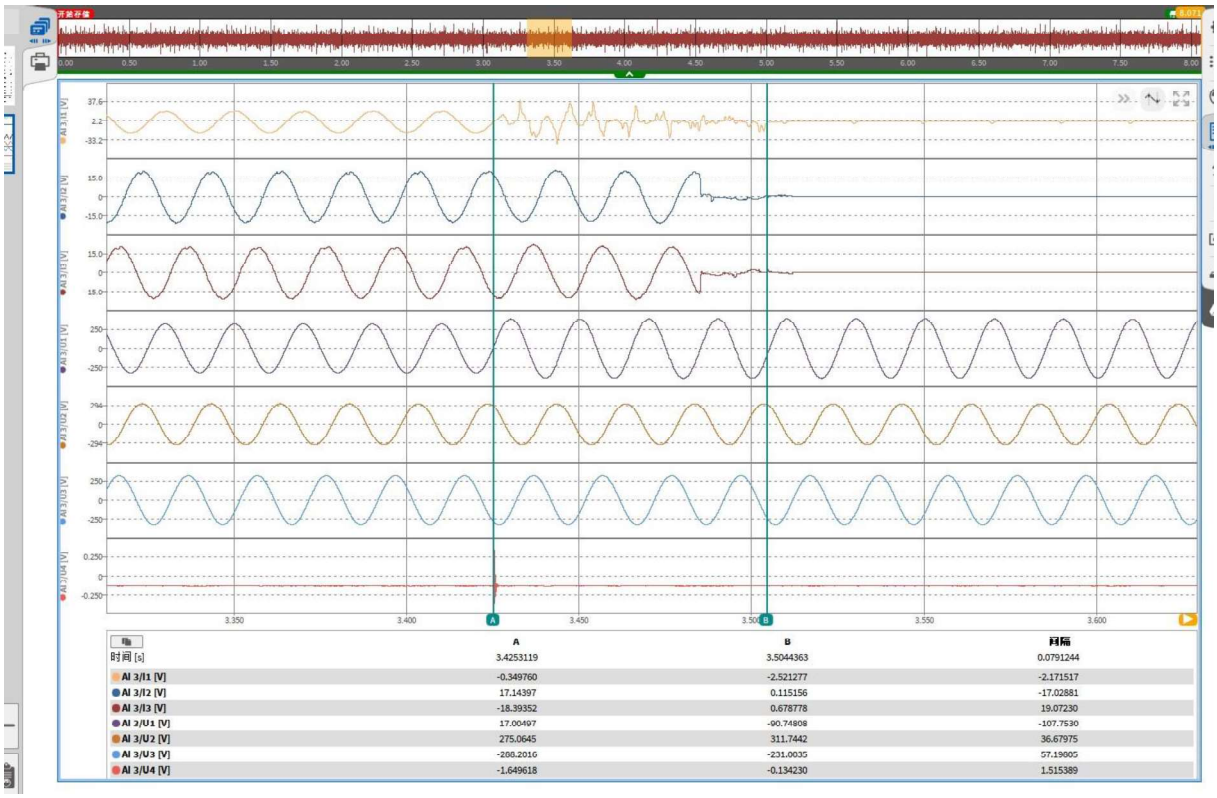
Scope pictures of the disconnection time
Under-voltage - Stage 1



Scope pictures of the disconnection time
Over-voltage - Stage 1

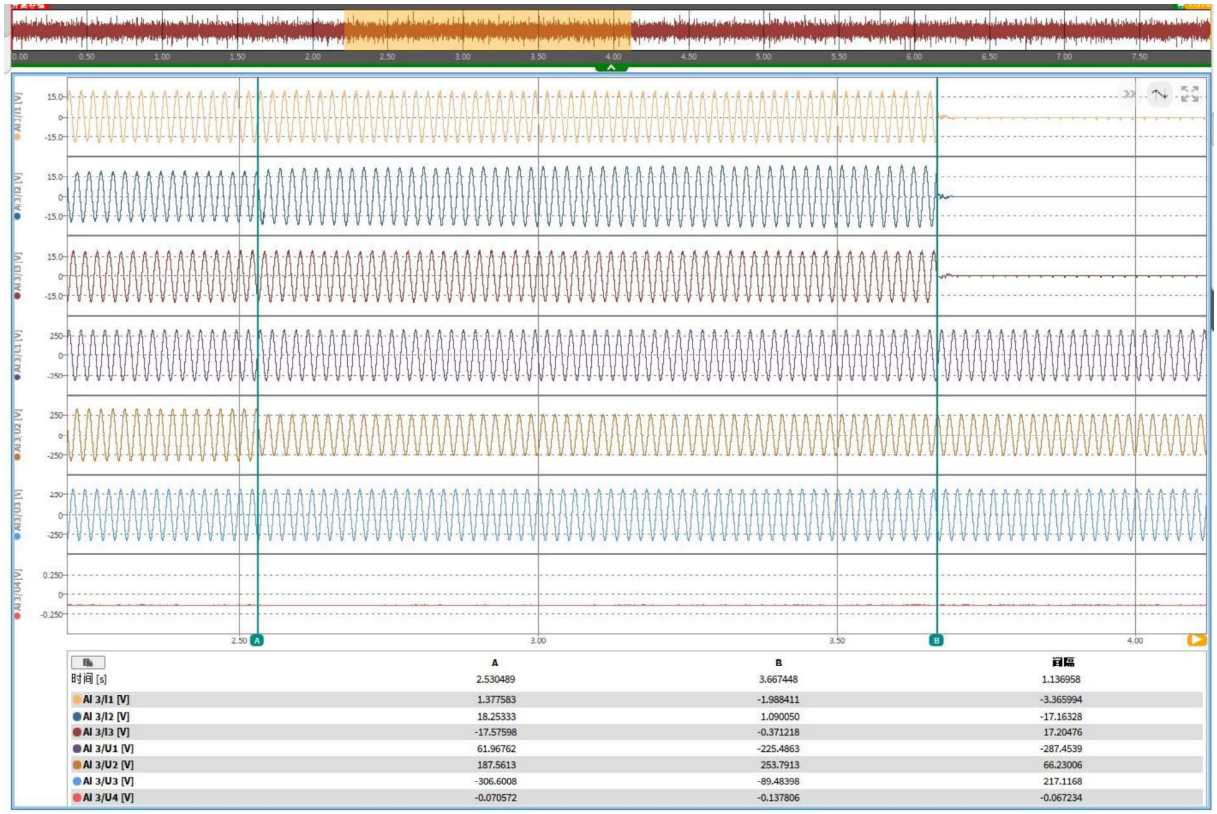


Over-voltage - Stage 2



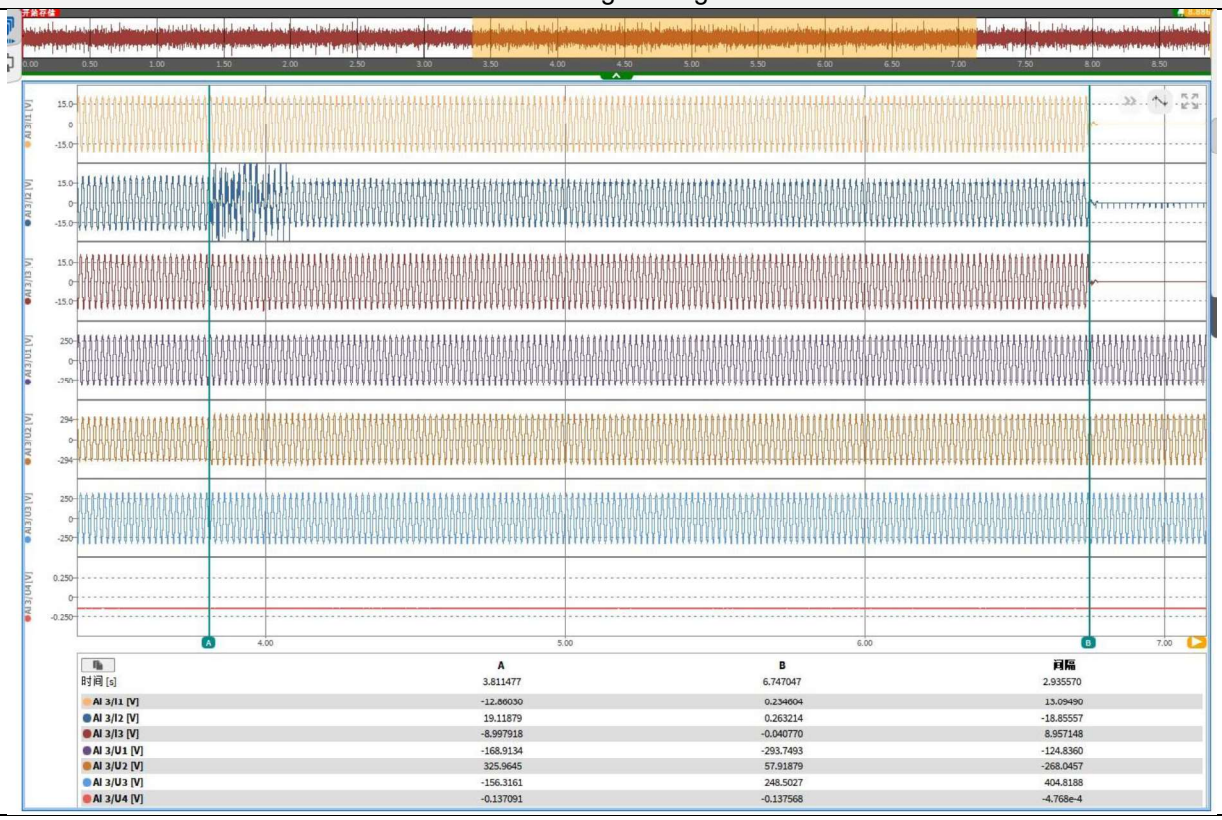
4.9.3 Requirements on voltage and frequency protection **4.9.3.1 General (Interface protection: Over/under voltage)** **(Threshold value refer for default)** **(Three phase type, Phase L2-N)**					**P**
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	$0.85U_n$±1% U_n	1.1 s ≤ t ≤ 1.2 s	$1.1U_n$±1% U_n	2.9 s ≤ t ≤ 3.0 s	
Trip value [V]	195.75		253.33		
	195.77		253.37		
	195.68		253.22		
	195.69		253.55		
	195.70		253.43		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	1.124	U_n To $U_{th\text{-}high}$ + 5%U_n	2.936	
		1.137		2.933	
		1.133		2.922	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	--	--	$1.15U_n$±1% U_n	t ≤ 0.1 s	
Trip value [V]	--		264.63		
	--		264.62		
	--		264.65		
	--		264.59		
	--		264.60		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	--	U_n To $U_{th\text{-}high}$ + 5%U_n	0.067	
		--		0.062	
		--		0.071	

Scope pictures of the disconnection time
Under-voltage - Stage 1



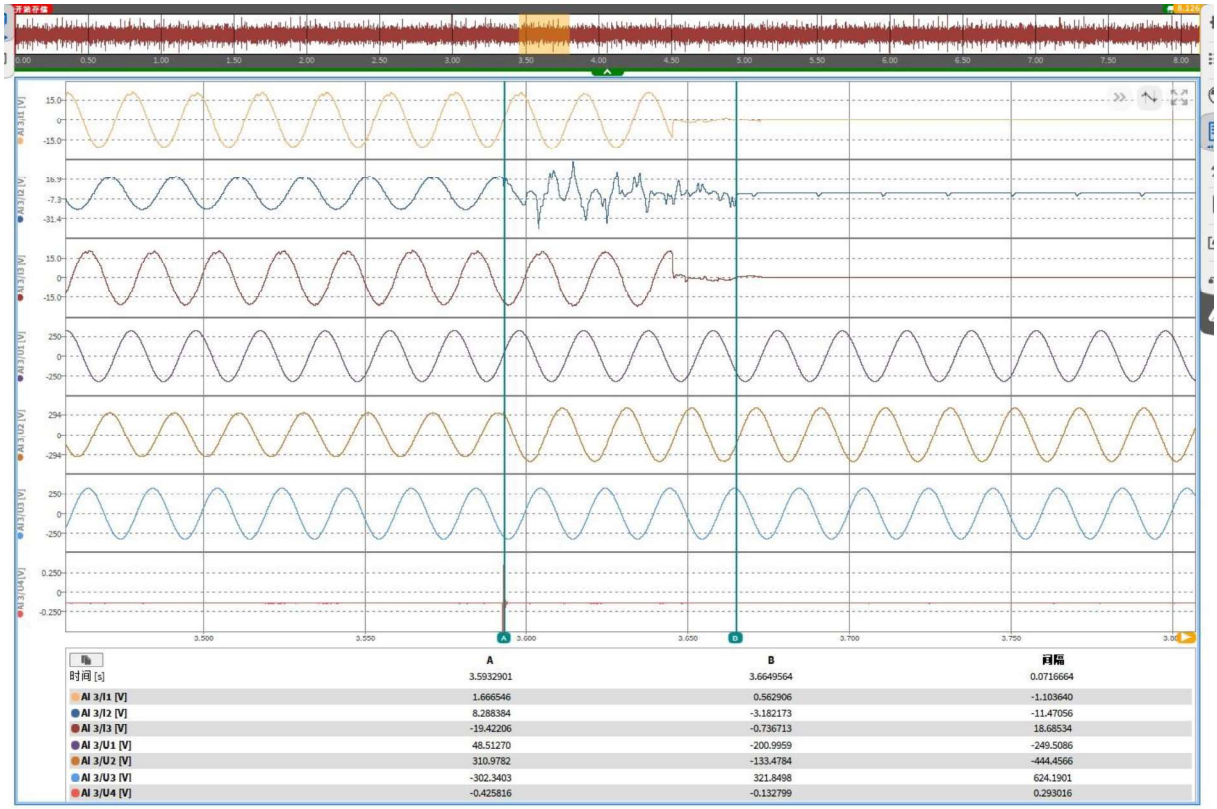
时间 [s]	A	B	间隔
AI 3/I1 [V]	1.377583	-1.988411	-3.365994
AI 3/I2 [V]	18.25333	1.090050	-17.16328
AI 3/I3 [V]	-17.57598	-0.371218	17.20476
AI 3/U1 [V]	61.96762	-225.4863	-287.4539
AI 3/U2 [V]	187.5613	253.7913	66.23006
AI 3/U3 [V]	-306.6008	-89.48398	217.1168
AI 3/U4 [V]	-0.070572	-0.137806	-0.067234

Scope pictures of the disconnection time
Over-voltage - Stage 1



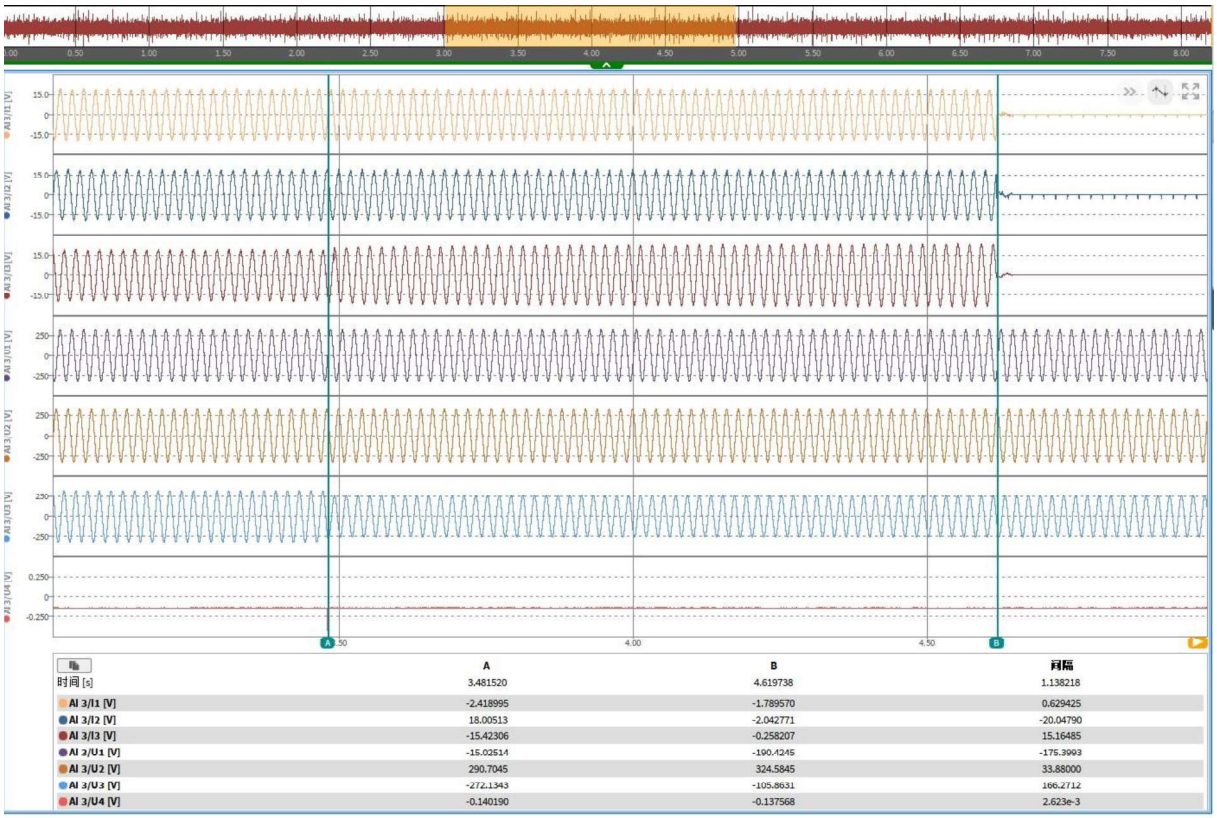
时间 [s]	A	B	间隔
AI 3/I1 [V]	-12.86030	0.234604	13.09490
AI 3/I2 [V]	19.11879	0.263214	-18.85557
AI 3/I3 [V]	-8.997918	-0.040770	8.957148
AI 3/U1 [V]	-168.9134	-293.7493	-124.8360
AI 3/U2 [V]	325.9645	57.91879	-268.0457
AI 3/U3 [V]	-156.3161	248.5027	404.8188
AI 3/U4 [V]	-0.137091	-0.137568	-4.768e-4

Over-voltage - Stage 2



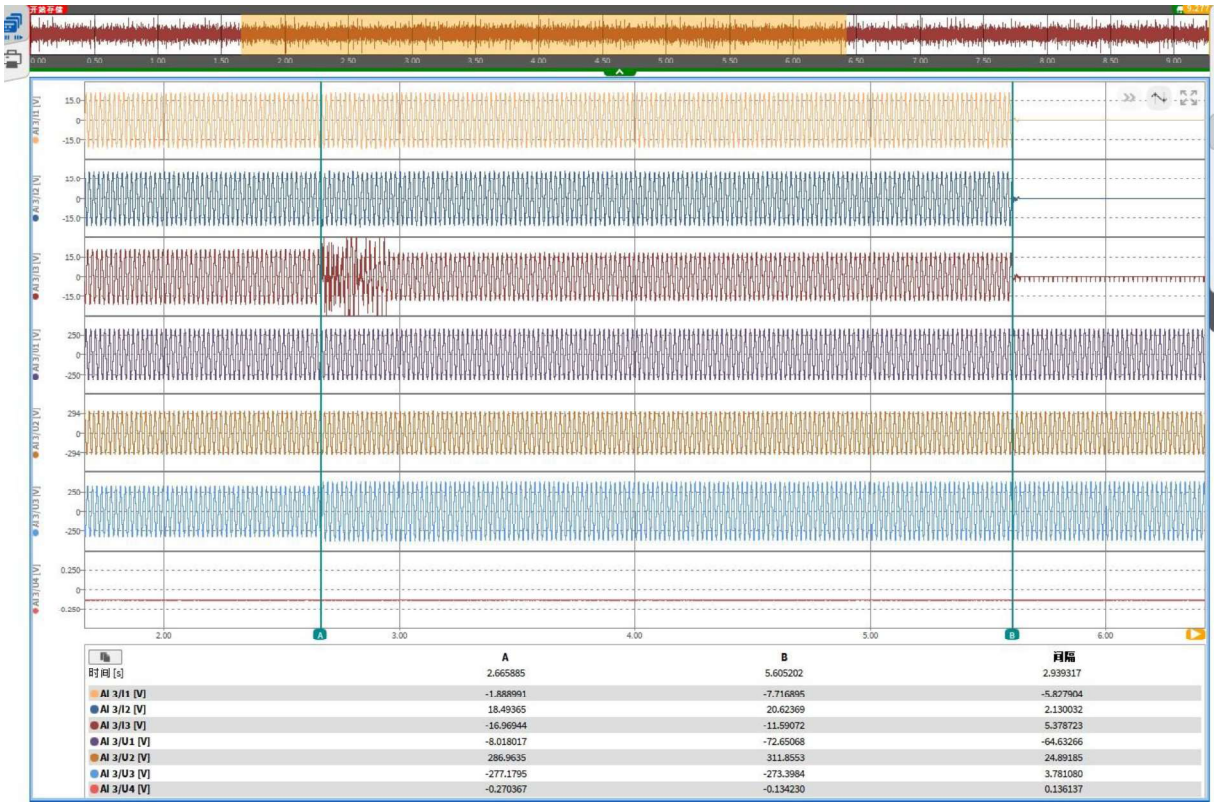
4.9.3 Requirements on voltage and frequency protection **4.9.3.1 General (Interface protection: Over/under voltage)** **(Threshold value refer for default)** **(Three phase type, Phase L3-N)**					**P**
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	$0.85U_n$±1% U_n	1.1 s ≤ t ≤ 1.2 s	$1.1U_n$±1% U_n	2.9 s ≤ t ≤ 3.0 s	
Trip value [V]	195.73		253.38		
	195.79		253.35		
	195.77		253.36		
	195.75		253.35		
	195.69		253.36		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	1.130	U_n To $U_{th\text{-}high}$ + 5%U_n	2.936	
		1.138		2.939	
		1.133		2.928	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	--	--	$1.15U_n$±1% U_n	t ≤ 0.1 s	
Trip value [V]	--		264.66		
	--		264.72		
	--		264.69		
	--		264.58		
	--		264.66		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	--	U_n To $U_{th\text{-}high}$ + 5%U_n	0.065	
		--		0.057	
		--		0.062	

Scope pictures of the disconnection time
Under-voltage - Stage 1



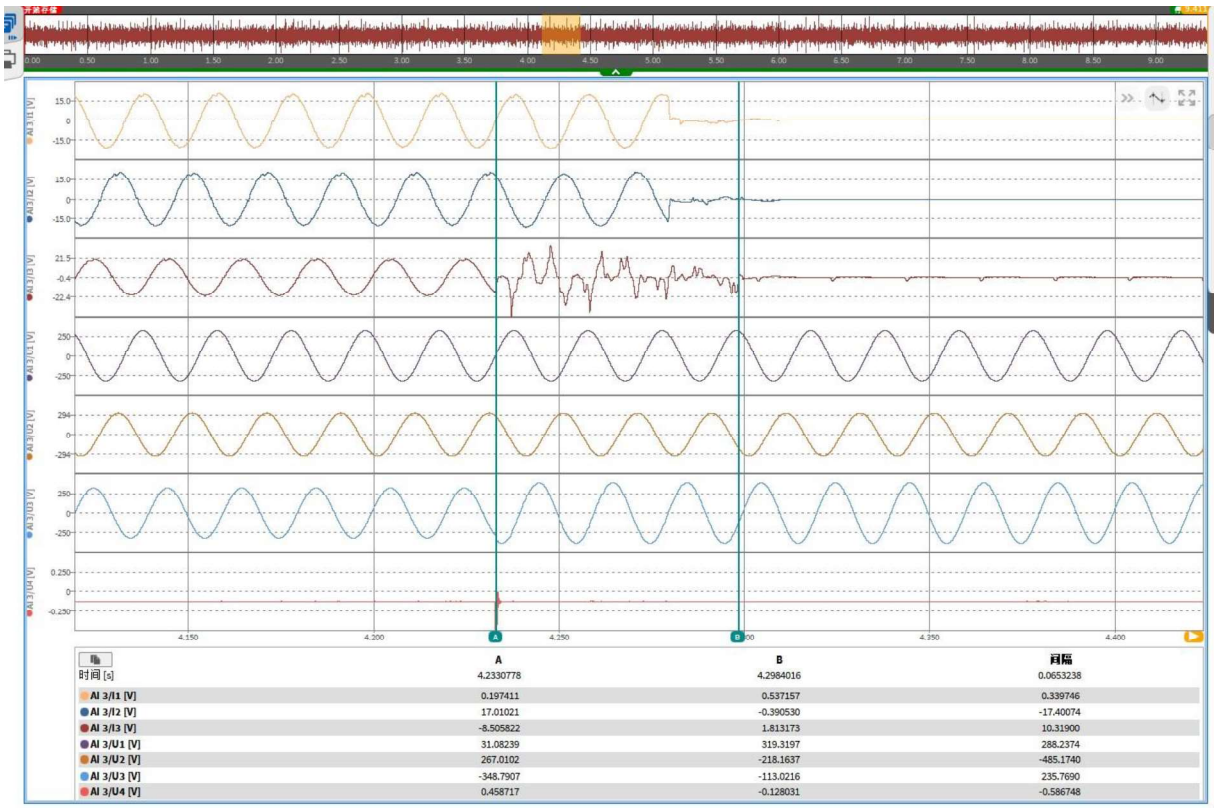
时间 [s]	A	B	间隔
AI 3/I1 [V]	-2.418995	-1.789570	0.629425
AI 3/I2 [V]	18.00513	-2.042771	-20.04790
AI 3/I3 [V]	-15.42306	-0.258207	15.16485
AI 3/U1 [V]	-15.02514	-190.4245	-175.3993
AI 3/U2 [V]	290.7045	324.5845	33.88000
AI 3/U3 [V]	-272.1343	-105.8631	166.2712
AI 3/U4 [V]	-0.140190	-0.137568	2.623e-3

Scope pictures of the disconnection time
Over-voltage - Stage 1



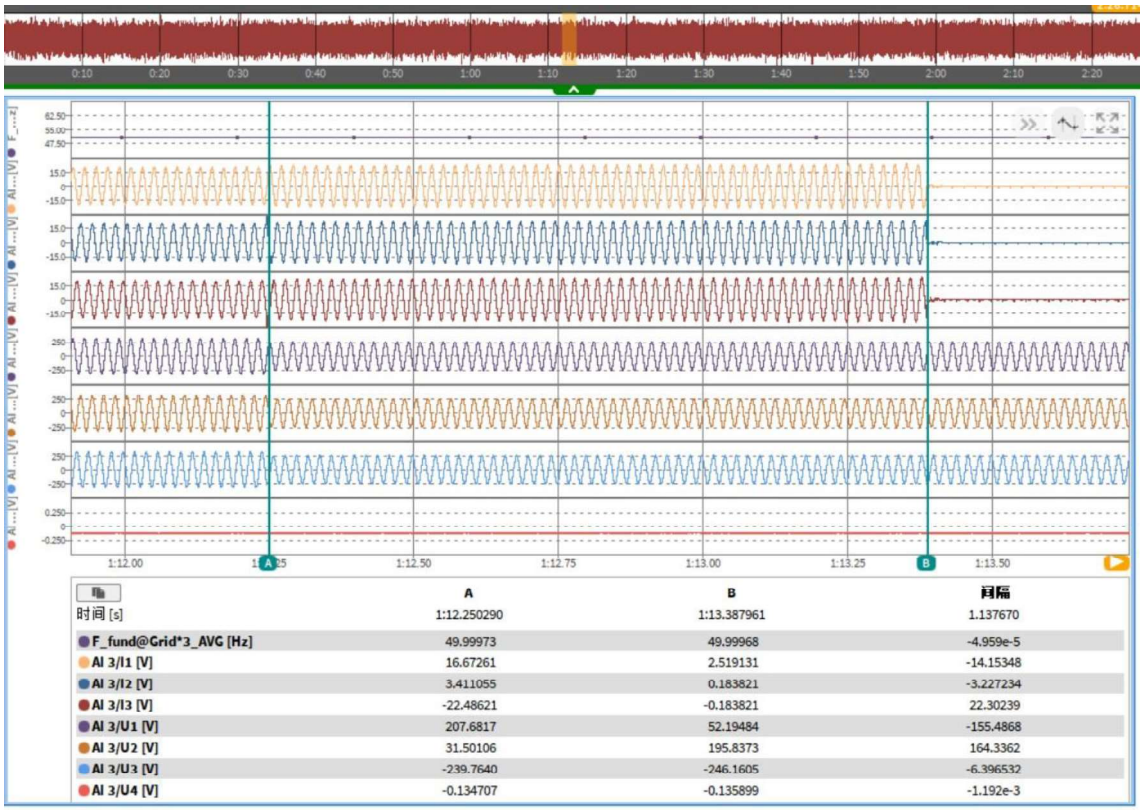
时间 [s]	A	B	间隔
AI 3/I1 [V]	-1.888991	-7.716895	-5.827904
AI 3/I2 [V]	18.49365	20.62369	2.130032
AI 3/I3 [V]	-16.96944	-11.59072	5.378723
AI 3/U1 [V]	-8.018017	-72.65068	-64.63266
AI 3/U2 [V]	286.9635	311.8553	24.89185
AI 3/U3 [V]	-277.1795	-273.3984	3.781080
AI 3/U4 [V]	-0.270367	-0.134230	0.136137

Over-voltage - Stage 2



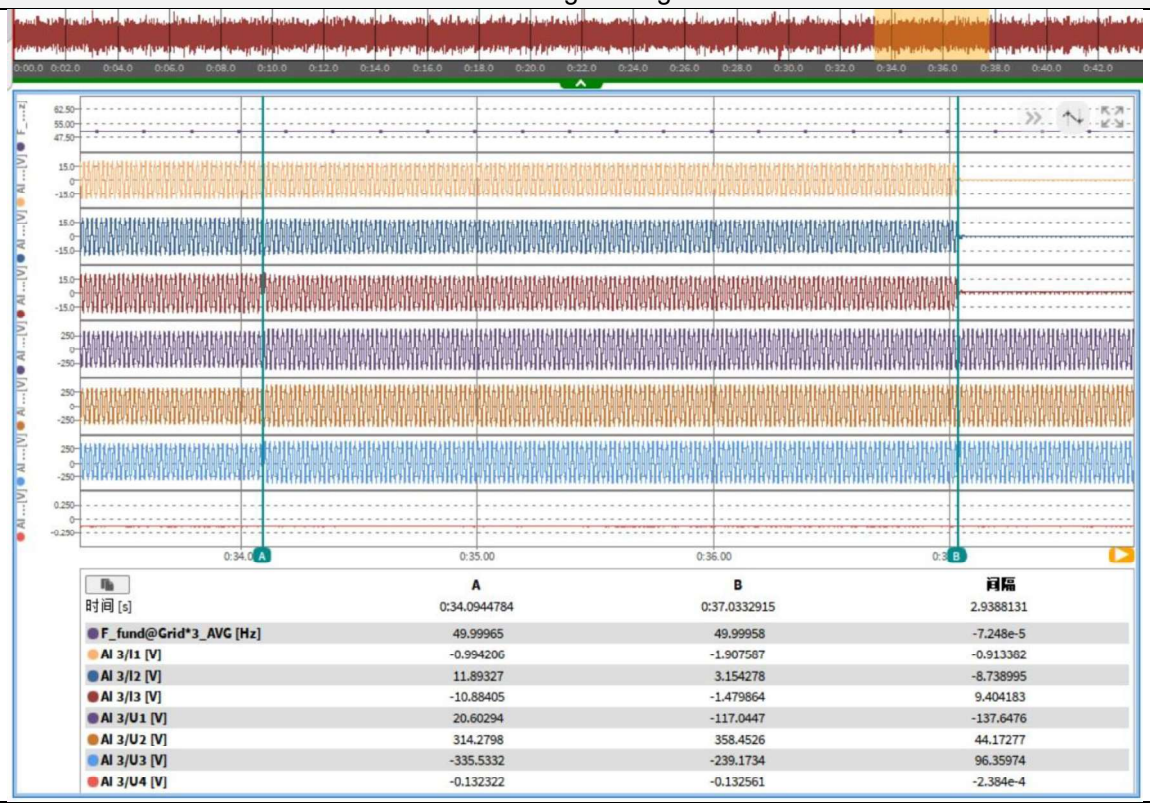
4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under voltage) (Threshold value refer for default) (Three phase type, Phase L1-L2-L3-N)					P
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	$0.85U_n$±1% U_n	1.1 s ≤ t ≤ 1.2 s	$1.1U_n$±1% U_n	2.9 s ≤ t ≤ 3.0 s	
Trip value [V]	195.65		253.44		
	195.66		253.59		
	195.65		253.47		
	195.67		253.55		
	195.62		253.67		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	1.138	U_n To $U_{th\text{-}high}$ + 5%U_n	2.923	
		1.121		2.929	
		1.125		2.939	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	--	--	$1.15U_n$±1% U_n	t ≤ 0.1 s	
Trip value [V]	--		264.73		
	--		264.75		
	--		264.69		
	--		264.72		
	--		264.69		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	--	U_n To $U_{th\text{-}high}$ + 5%U_n	0.086	
		--		0.092	
		--		0.087	

Scope pictures of the disconnection time
Under-voltage - Stage 1



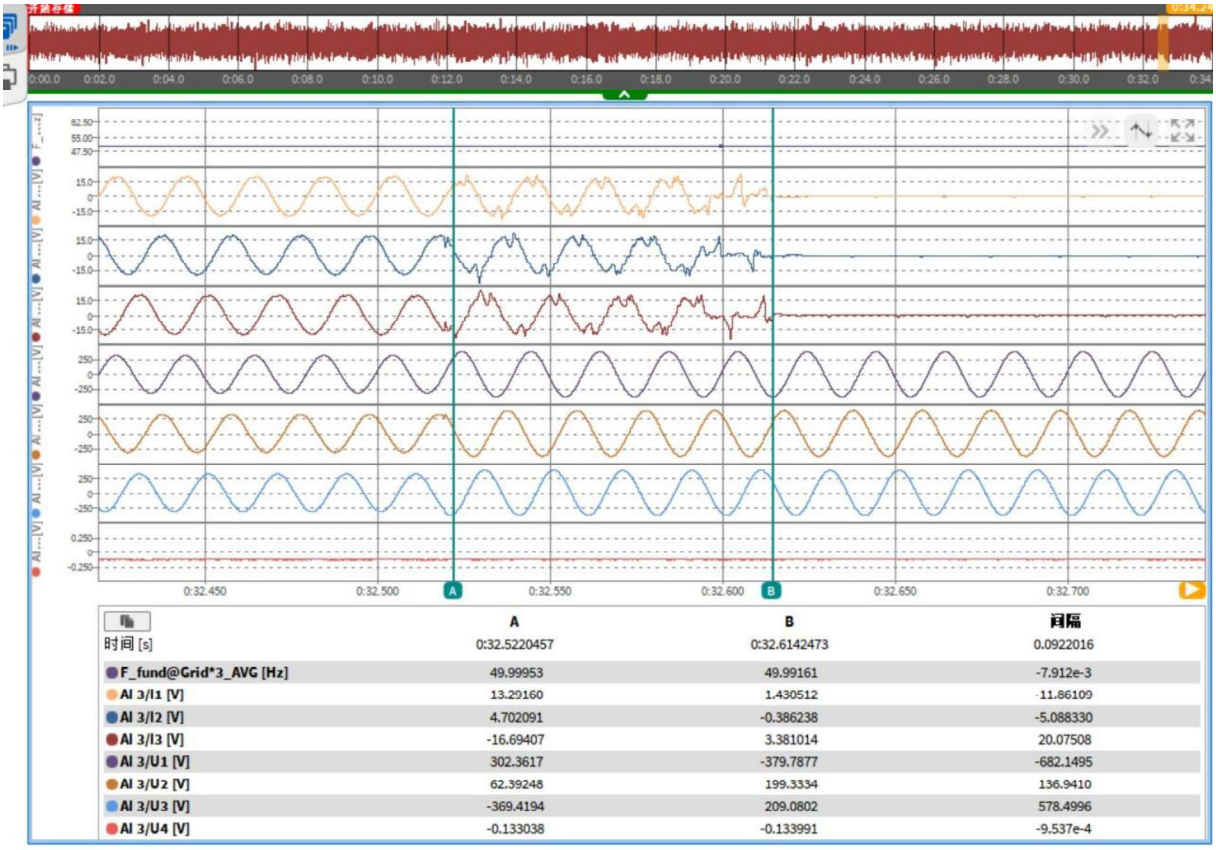
时间 [s]	A 1:12.250290	B 1:13.387961	间隔 1.137670
F_fund@Grid*3_AVG [Hz]	49.99973	49.99968	-4.959e-5
AI 3/I1 [V]	16.67261	2.519131	-14.15348
AI 3/I2 [V]	3.411055	0.183821	-3.227234
AI 3/I3 [V]	-22.48621	-0.183821	22.30239
AI 3/U1 [V]	207.6817	52.19484	-155.4868
AI 3/U2 [V]	31.50106	195.8373	164.3362
AI 3/U3 [V]	-239.7640	-246.1605	-6.396532
AI 3/U4 [V]	-0.134707	-0.135899	-1.192e-3

Scope pictures of the disconnection time
Over-voltage - Stage 1



时间 [s]	A 0:34.0944784	B 0:37.0332915	间隔 2.9388131
F_fund@Grid*3_AVG [Hz]	49.99965	49.99958	-7.248e-5
AI 3/I1 [V]	-0.994206	-1.907587	-0.913382
AI 3/I2 [V]	11.89327	3.154278	-8.738995
AI 3/I3 [V]	-10.88405	-1.479864	9.404183
AI 3/U1 [V]	20.60294	-117.0447	-137.6476
AI 3/U2 [V]	314.2798	358.4526	44.17277
AI 3/U3 [V]	-335.5332	-239.1734	96.35974
AI 3/U4 [V]	-0.132322	-0.132561	-2.384e-4

Over-voltage - Stage 2



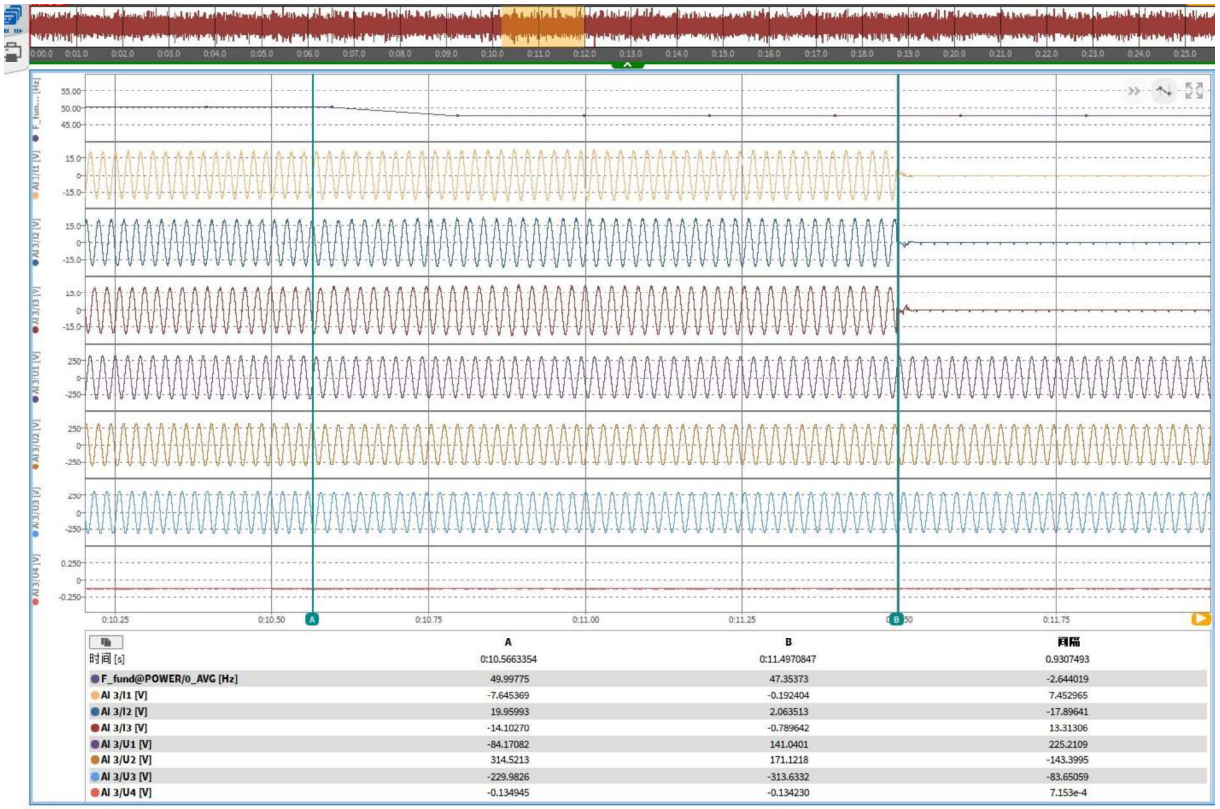
时间 [s]	A 0:32.5220457	B 0:32.6142473	间隔 0.0922016
F_fund@Grid*3_AVG [Hz]	49.99953	49.99161	-7.912e-3
AI 3/I1 [V]	13.29160	1.430512	-11.86109
AI 3/I2 [V]	4.702091	-0.386238	-5.088330
AI 3/I3 [V]	-16.69407	3.381014	20.07508
AI 3/U1 [V]	302.3617	-379.7877	-682.1495
AI 3/U2 [V]	62.39248	199.3334	136.9410
AI 3/U3 [V]	-369.4194	209.0802	578.4996
AI 3/U4 [V]	-0.133038	-0.133991	-9.537e-4

4.9.3 Requirements on voltage and frequency protection **4.9.3.1 General (Interface protection: Over/under frequency)** **(Threshold value refer for default)**					**P**
Test conditions	Output power: ≥50%Pn; U_n = 100%U_n				
Stage 1	**Under-frequency**		**Over-frequency**		
Parameter	Frequency	Time	Frequency	Time	
Limit	47.5 Hz±0.05 Hz	0.9s≤ t ≤1s	51.5 Hz±0.05 Hz	0.2s≤ t ≤0.3s	
Trip value [Hz]	47.492		51.487		
	47.492		51.488		
	47.492		51.489		
	47.493		51.492		
	47.493		51.489		
Trip time [s]	50.0 Hz To 47.4Hz	0.919	50.0 Hz To 51.6 Hz	0.234	
		0.931		0.221	
		0.916		0.225	

Note:
For under-frequency testing the applied frequency is varied from f_n down to $f_{th\text{-}low}$ -0.1 Hz in steps of 0.025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at switch the protection function trips and shall be within $f_{th\text{-}low}$ ± 0.05 Hz.
For over-frequency testing the applied frequency is varied from f_n up to $f_{th\text{-}high}$ + 0.1 Hz in steps of 0.025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at which the protection function trips and shall be within $f_{th\text{-}high}$ ± 0.05 Hz.
The oscilloscope pictures below show the measured worst case disconnection times.

Scope pictures of the disconnection time

Under-frequency stage 1



时间 [s]	A 0:10.5663354	B 0:11.4970847	间隔 0.9307493
F_fund@POWER/0_AVG [Hz]	49.99775	47.35373	-2.644019
AI 3/I1 [V]	-7.645369	-0.192404	7.452965
AI 3/I2 [V]	19.95993	2.063513	-17.89641
AI 3/I3 [V]	-14.10270	-0.789642	13.31306
AI 3/U1 [V]	-84.17082	141.0401	225.2109
AI 3/U2 [V]	314.5213	171.1218	-143.3995
AI 3/U3 [V]	-229.9826	-313.6332	-83.65059
AI 3/U4 [V]	-0.134945	-0.134230	7.153e-4

Over-frequency stage 1



时间 [s]	A 0:10.7493802	B 0:10.9831785	间隔 0.2337983
F_fund@POWER/0_AVG [Hz]	49.98034	50.29802	0.317675
AI 3/I1 [V]	0.071526	1.818180	1.746655
AI 3/I2 [V]	19.31477	1.686573	-17.62819
AI 3/I3 [V]	-21.24739	-1.145125	20.10226
AI 3/U1 [V]	30.83039	142.0379	111.2075
AI 3/U2 [V]	256.1684	157.6707	-98.49764
AI 3/U3 [V]	-283.8481	-300.5467	-16.69860
AI 3/U4 [V]	0.467062	-0.134230	-0.601292

4.9.4.2 Requirements for islanding detection				P
Setting values	Frequency change df/dt [Hz/s]..... :			2.0Hz/s
	Disconnecting time [s]..... :			<0.2s
Test:				
P_{Emax} in %	100% ±5%			
Test condition	Start Frequency	Change	End Frequency	Connection
Test 1: (*)	51.0 Hz	2.4Hz/s	48.6 Hz	Always connected
Test 2: (*)	48.6 Hz	2.4Hz/s	51.0 Hz	Always connected
Test 3: (*)	48.4 Hz	2.6Hz/s	51.0 Hz	Disconnected <0.2s
Test 4: (*)	51.0 Hz	2.6Hz/s	48.4 Hz	Disconnected <0.2s
Limit	disconnected time <0.2s			
Note:				

PN-EN 50549-1:2019: Connection and starting to generate electrical power			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.10.2	Automatic reconnection after tripping		**P**
4.10.3	Starting to generate electrical power		**P**

4.10 Connection and starting to generate electrical power **4.10.2 Automatic reconnection after tripping** **4.10.3 Starting to generate electrical power**		**P**
Setting value	Min. voltage for connected to grid :	195.5V
	Max. voltage for connected to grid :	253.0V
	Min. Frequency for connected to grid :	49.00Hz
	Max. Frequency for connected to grid :	50.05Hz
	Observation time (≥60s) :	60s

Test:

	Voltage conditons	
a) Start up for voltage range	<85% Un for twice of observation time	>110% Un for twice of observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	≥85% Un within twice setting observation time	≤110% Un within twice setting observation time
Reconnection time [s]	75.2	73.6
Limit:	Connected after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
c) In voltage range after voltage failture	≥85% Un for twice of setting observation time	≤110% Un for twice of setting observation time
Reconnection time [s]	68.8	66.4
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	
	Frequency conditions	
d) Start up for frequency range	<49.00 Hz for twice of setting observation time	>50.05 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	≥49.00 Hz within twice of setting observation time	≤50.05 Hz within twice of setting observation time
Reconnection time [s]	75.2	70.8
Limit:	Connected after setting delay time(≥60s)	

Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
f) In frequency range after frequency failture	≥49.00 Hz for twice of setting observation time	≤50.05 Hz for twice of setting observation time
Reconnection time [s]	76.0	72.8
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	

Test:

Test condition b) and c): voltage within the limits of 85% to 110%U_n.

Test condition e) and f): frequency within the limits of 49.00Hz to 50.05Hz.

In order to avoid continuous starting and disengaging operations of the interface protection relay. the disengaging value of frequency and voltage functions shall be above 2 % deviating from the operate value.

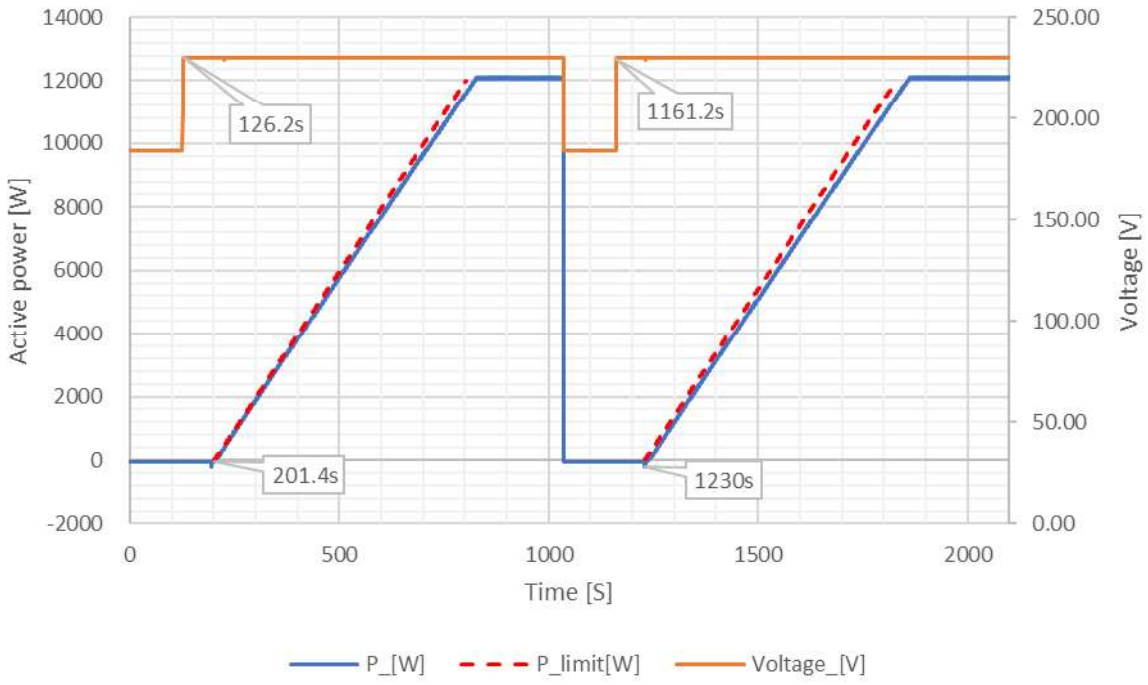
Assessment criterion:

a) the micro generator connects respectively starts generating electrical power only in the permitted range of voltage and frequency and

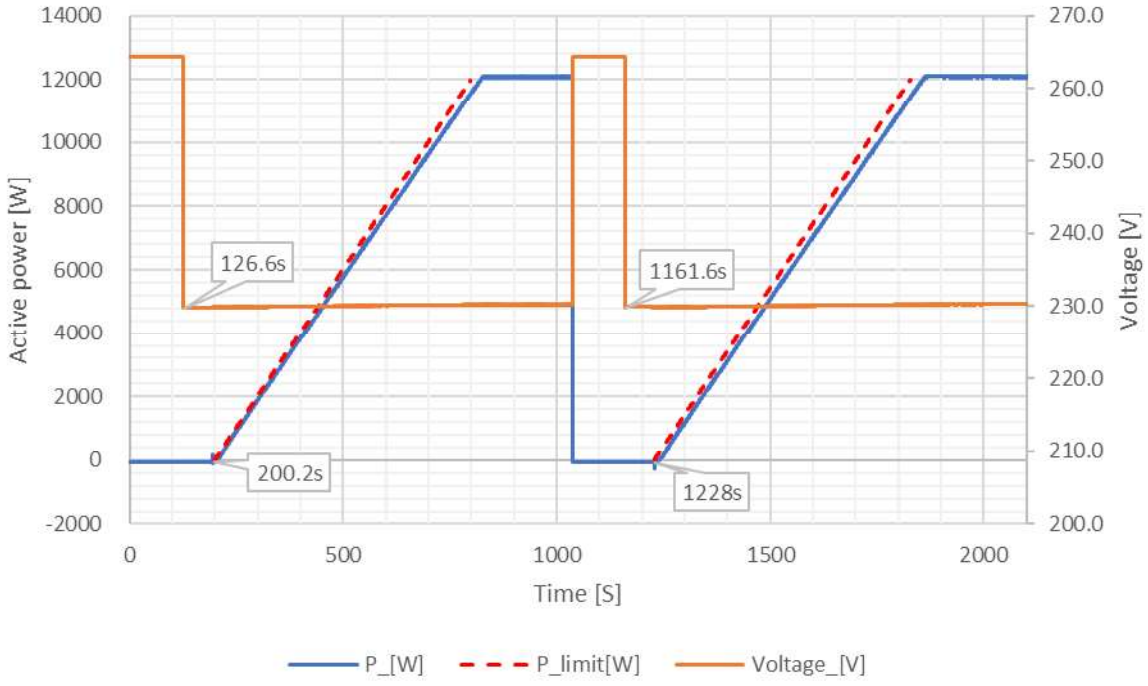
b) for adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute and

c) for non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min.

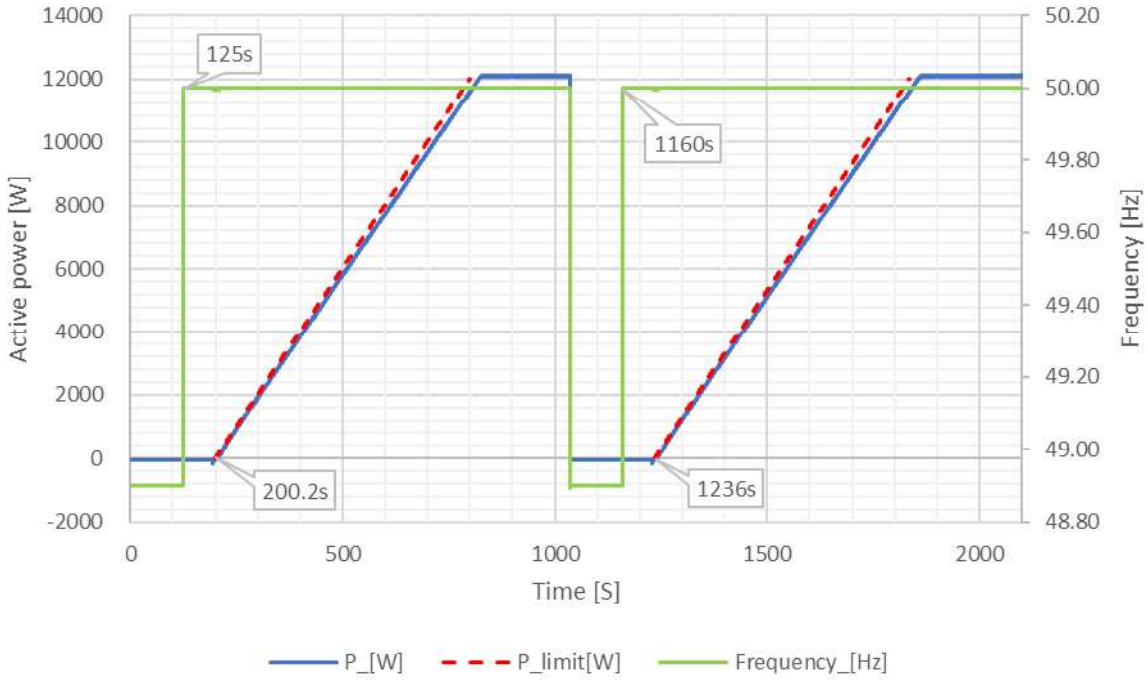
Graph of the gradual power supply: Test b) for ≥ 85% U_n



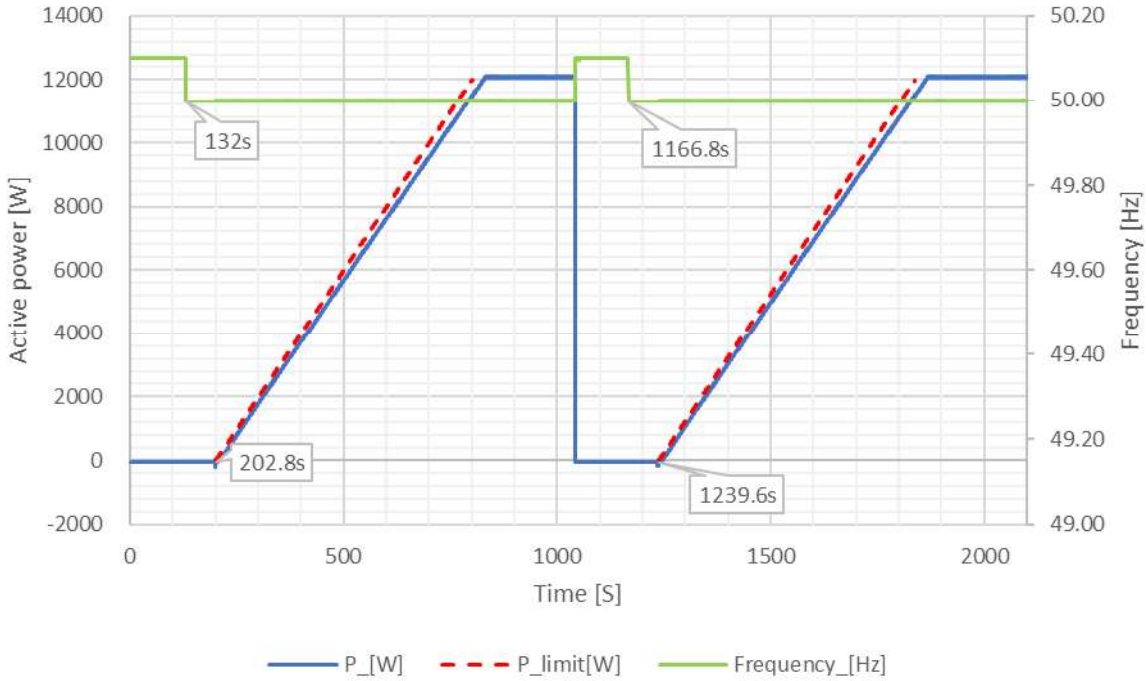
Graph of the gradual power supply: Test b) for ≤ 110% U_n



Graph of the gradual power supply: Test e) for ≥ 49.00Hz



Graph of the gradual power supply: Test e) for ≤ 50.05Hz



PN-EN 50549-1:2019: Ceasing and reduction of active power on set point			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.11.1	Ceasing active power	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EN 50549-1:2019+AC:2019-04 report: BL-DG2460315-201	P
4.11.2	Reduction of active power on set point		P

Pictures of the unit



Figure 1. Over view



Figure 2. Over view

Pictures of the unit



Figure 3. Over view



Figure 4. Over view

Pictures of the unit



Figure 5. Over view

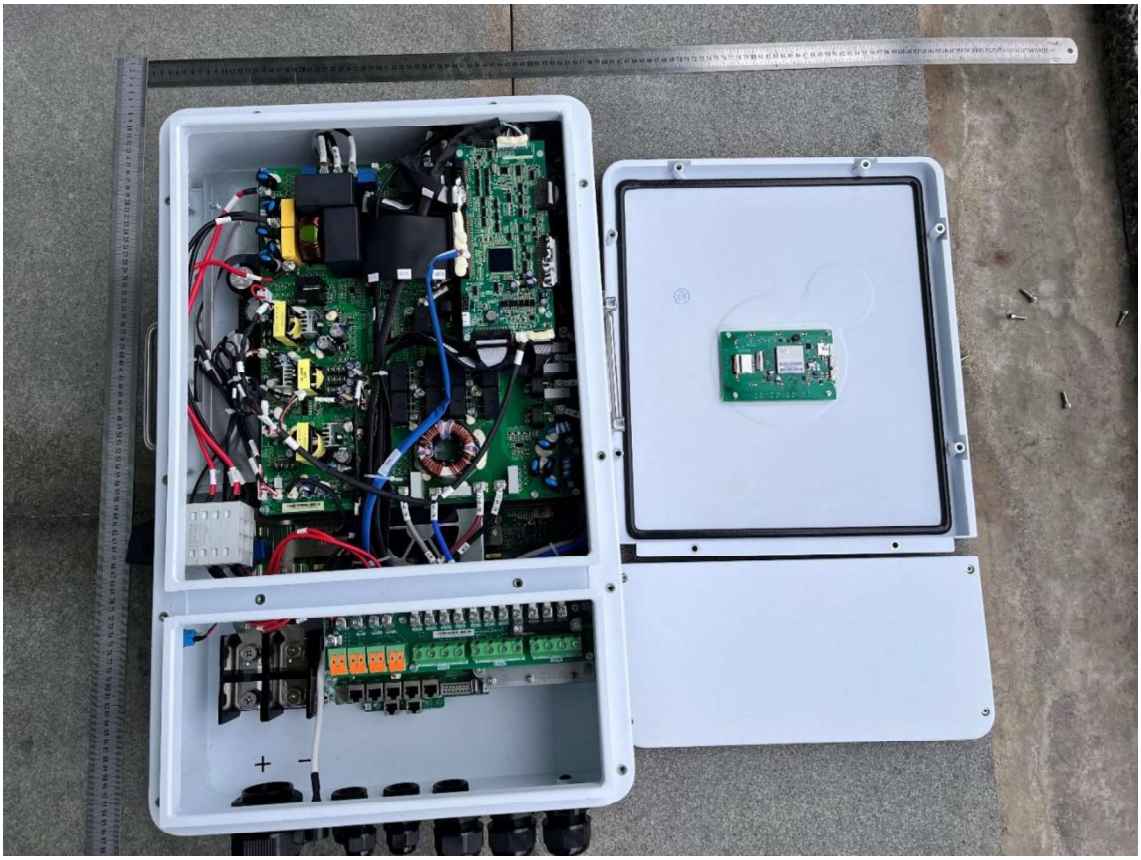


Figure 6. Internal view

Test Equipment list				
No	**Test Equipment**	**Equipment model**	**Equipment No.**	**Calibration due date**
1	AC source	WPLA-330200KVA	BZ-DGD-L204	2024/11/01
2	DC source	WPLA-150KW	BZ-DGD-L013	2024/11/01
3	Power analyzer	DEWE2-PA7	BZ-DGD-L119	2024/10/20
4	AC/DC current sensor	CT6863-05	BZ-DGD-L026-1	2025/01/22
5	AC/DC current sensor	CT6863-05	BZ-DGD-L026-2	2025/01/22
6	AC/DC current sensor	CT6863-05	BZ-DGD-L026-4	2025/01/22
7	AC/DC current sensor	CT6863-05	BZ-DGD-L026-5	2025/01/22

Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.

2. The report without China inspection body and laboratory Mandatory Approval (CMA) mark has no effect of proving to the society.

3. For the report with CNAS mark, the items marked with "☆" are not within the accredited scope.

4. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the “inspection and testing dedicated stamp” or test report stamp.

5. The test data and results are only valid for the tested samples provided by the customer.

6. This report shall not be partially reproduced without the written permission of the laboratory.

7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--- End of report---

Attachments 1 – EN 50549-1: 2019 Report No: BL-DG2460315-201

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国际互认
检测
TESTING
CNAS L14701

TEST REPORT

Application number:	PVP05017/24E-01
Applicant:	SRNE Solar Co.,Ltd
Address:	4-5F,Building13A,Taihua Wutong Industrial Park, Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA
Equipment Type:	Solar Hybrid Inverter
Model Name Under Test:	HESP48120SH3
Model Name:	HESP4880SH3, HESP48100SH3, HESP48120SH3
Brand Name:	SRNE
Ratings:	See copy of marking label and model list.
Test Standard:	**EN 50549-1:2019+AC:2019-04** **EN 50549-1:2019+A1:2023☆**
Sample Arrival Date:	Jun. 11, 2024
Test Date：	Jun. 11, 2024 to Jun. 24, 2024
Date of Issue:	Jul. 01, 2024

ISSUED BY:

Dongguan BALUN Testing Technology Co., Ltd.

Tested by: Leo Sun

Leo Sun

Checked by: Tao Zheng

Tao Zheng

Approved by: Simon Qi

CERTIFICATION • CONSULTING • SOLUTION • SERVICE
BALUN Dongguan

Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jul. 01, 2024	Initial Issue

List of Attachments:

None.

Summary of testing:

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

Tests performed (name of test and test clause):	**Testing location:**
4.4 Normal operating range 4.5 Immunity to disturbances 4.6 Active response to frequency deviation 4.7 Power response to voltage changes 4.8 EMC and power quality 4.9 Interface protection 4.10 Connection and reconnection 4.11 Ceasing and reduction of active power on set point 4.12 Remote information exchange 4.13 Requirements regarding single fault tolerance of interface protection system and interface switch	Dongguan BALUN Testing Technology Co., Ltd. Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China

☒ **All the tests results fulfils the requirements of EN 50549-1:2019+AC:2019-04, EN 50549-1:2019+A1:2023☆**

Copy of marking plate:

Solar Hybrid Inverter

Model Name	HESP4880SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	6000W/6000W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	23.2Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	16000VA
Max. power	16000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	11.6Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	8000VA
Nominal power	8000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	180Ad.c./180Ad.c.

SN:

5min RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

WARNING FIRE HAZARD:
SUITABLE FOR MOUNTING ON CONCRETE
OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST
HAVE BEEN TURNED OFF BEFORE SERVICING

MADE IN CHINA

Solar Hybrid Inverter

Model Name	HESP48100SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	7500W/7500W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	29Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	20000VA
Max. power	20000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	14.5Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	10000VA
Nominal power	10000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	220Ad.c./220Ad.c.

SN:

5min RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

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MADE IN CHINA

Solar Hybrid Inverter

Model Name	HESP48120SH3
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	9000W/9000W
Absolute max. voltage	800Vd.c./800Vd.c.
MPPT voltage range	200Vd.c.-650Vd.c.
Max. input current	22Ad.c./22Ad.c.
Isc PV	37Ad.c./37Ad.c.
AC INPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Max.phase current	35Aa.c.
Nominal frequency	50/60Hz
Max. apparent power	24000VA
Max. power	24000W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	3L/N/PE 230/400Va.c.
Rated phase current	17.4Aa.c.
Nominal frequency	50/60Hz
Rated apparent power	12000VA
Nominal power	12000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	260Ad.c./260Ad.c.

SN:

5min

RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd

Address:4-5, Building13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

WARNING FIRE HAZARD:
SUITABLE FOR MOUNTING ON CONCRETE
OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST
HAVE BEEN TURNED OFF BEFORE SERVICING

MADE IN CHINA

Test item particulars.....:	
Equipment mobility .....:	Permanent connection
Operating condition .....:	Continuous
Class of equipment .....:	Class I
Mass of equipment (kg) .....:	100
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object was not evaluated for the requirement:	N/E
- test object does not meet the requirement.....:	F (Fail)

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of Manufacturer (ies)..... :	**SRNE Solar Co.,Ltd** 4-5F, Building13A, Taihua Wutong Industrial Park, Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA.
Name and address of factory (ies) ..... :	**SRNE SOLAR CO.,LTD Dongguan Branch** Room 301, Building 5th, Fuxing Rd No.36, Chang'an Town, Dongguan City, Guangdong Province, China PR.

General product information:

The equipment under test (EUT) is a Solar Hybrid Inverter. During the working process of the inverter, the DC power generated by the battery and photovoltaic terminal is converted into stable AC power, which can be fed into the grid or off-grid loads. When charging, the inverter can charge the battery through the power grid and the photovoltaic terminal, at this time the maximum charging power of the inverter is 12000W, when only the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.

Differences of the models:

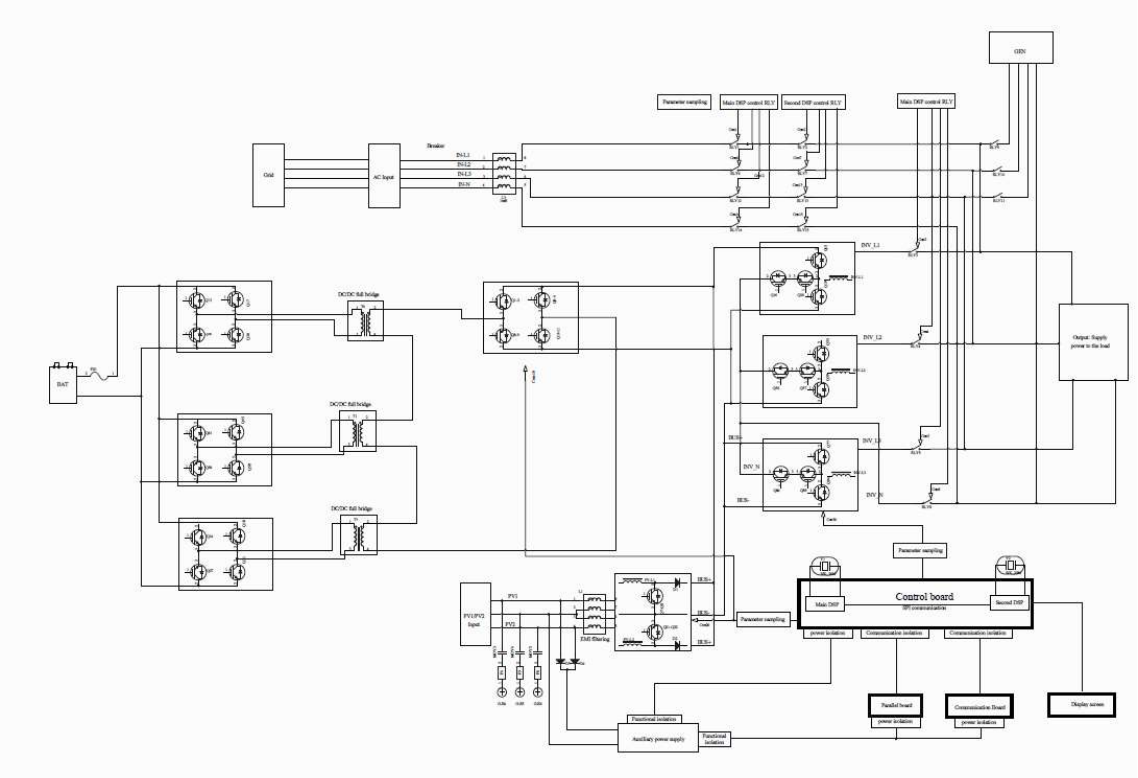
Solar Hybrid Inverter: HESP4880SH3, HESP48100SH3, HESP48120SH3 with the same appearance, topology, PCB board and software, the output power and input power are different and controlled by software.

If no specification, all the tests are conducted on model HESP48120SH3.

Software Version：V9.40

Hardware version: V3.0

Block diagram of the Power Conversion System:



Model list:

Model or Type designation		HESP4880SH3	HESP48100SH3	HESP48120SH3
PV input	Max. Voltage [Vd.c.]	800		
	MPP Voltage Range [Vd.c.]	200~650		
	Max. PV Input Current [Ad.c.]	22/22		
	DC Short-circuit current [Ad.c.]	37/37		
	Overvoltage Category (OVC)	II		
BAT Side	Battery Type	Lead-acid / Li-ion		
	Battery voltage range [Vd.c.]	40~60		
	Battery voltage range for nominal power[Vd.c.]	48V		
	Max. Grid Charge Current	100	120	120
	Max. Charge/Discharge Current [Ad.c.]	180/180	220/220	260/260
On-grid input	Rated Input Voltage [Va.c.]	3L/N/PE 230/400		
	Rated Input Frequency [Hz]	50/60		
	Max. phase current [Aa.c.]	23.2	29	35
	Max apparent power [VA]	16000	20000	24000
	Power Factor cosφ [λ]	0.8 leading to 0.8 lagging		
On-grid output	Rated Output Voltage [Va.c.]	3L/N/PE 230/400		
	Rated Output Frequency [Hz]	50/60		
	Rated Output Power [W]	8000	10000	12000
	Max. Output Power [VA]	8000	10000	12000
	Max. Output Current [Aa.c.]	11.6	14.5	17.4
	Power Factor cosφ [λ]	0.8 leading to 0.8 lagging		
	Overvoltage Category (OVC)	III		
System	Type of inverter	Non-isolated		
	Protective Class	Class I		
	Enclosure Protection (IP)	IP65		
	Operating Temperature Range [°C]	-25~60(＞45℃ derate)		
	Dimensions W*L*H [mm]	670*440*240		
	Weight [kg]	39		

General remarks:

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

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

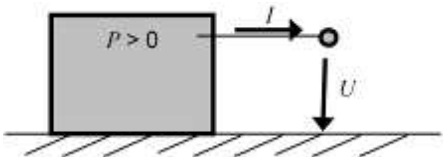
The following suffixes are used for variables in tables and figures:

- "P_n" for the nominal active power:
  $P_n = U_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3} U_n \times I_n \times \cos \varphi_n$ (three-Phase)
- "P_M" for the momentary power
- "(c)" for over-excited
- "(i)" for under-excited

Active and reactive power:

The regarded system of the voltage and current vectors is the load view (Figure 2):

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



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

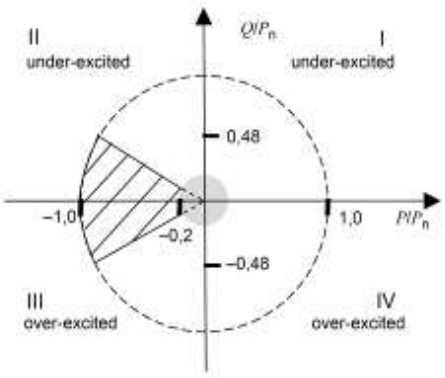


Figure 2

EN 50549-1, clause 4: Tests		
Clause	**Test requirement (According to table C.1)**	**Result**
4.4	Normal operating range	**P**
4.5	Immunity to disturbances	**P**
4.6	Active response to frequency deviation	**P**
4.7	Power response to voltage variations and voltage changes	**P**
4.8	EMC and power quality	**P**
4.9	Interface protection	**P**
4.10	Connection and starting to generate electrical power	**P**
4.11	Ceasing and reduction of active power on set point	**P**
4.12	Remote information exchange	**P**
4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	**P**

EN 50549-1: Normal operating range		
Clause	**Test requirement**	**Result**
4.4.2	Operating frequency range	**P**
4.4.3	Minimal requirement for active delivery at underfrequency	**P**
4.4.4	Continuous Operating voltage range	**P**

4.4.2 Operating frequency range 4.4.4 Continuous operating voltage range		P
Setting values	Over-voltage [V]:	1.1Un (253V)
	Under-voltage [V]:	0.85Un (195.5V)
	Over-frequency [Hz]:	51.0
	Under-frequency [Hz]:	47.0

- Test 1: U = 0.85Un (195.5 V); f = 47.0 Hz; P = 1.00 Sn; cosφ = 1, Period of test 20 seconds
- Test 2: U = 0.85Un (195.5 V); f = 47.5 Hz; P = 1.00 Sn; cosφ = 1, Period of test 90 minutes
- Test 3: U = 1.10Un (253.0 V); f = 51.5 Hz; P = 1.00 Sn; cosφ = 1, Period of test 90 minutes
- Test 4: U = 1.10Un (253.0 V); f = 52.0 Hz; P = 1.00 Sn; cosφ = 1, Period of test 15 minutes

Test :

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ
1	195.86	47.00	10433	0.996
2	195.86	47.50	10433	0.996
3	253.34	51.50	12005	0.999
4	253.34	52.00	11997	0.999

Note:

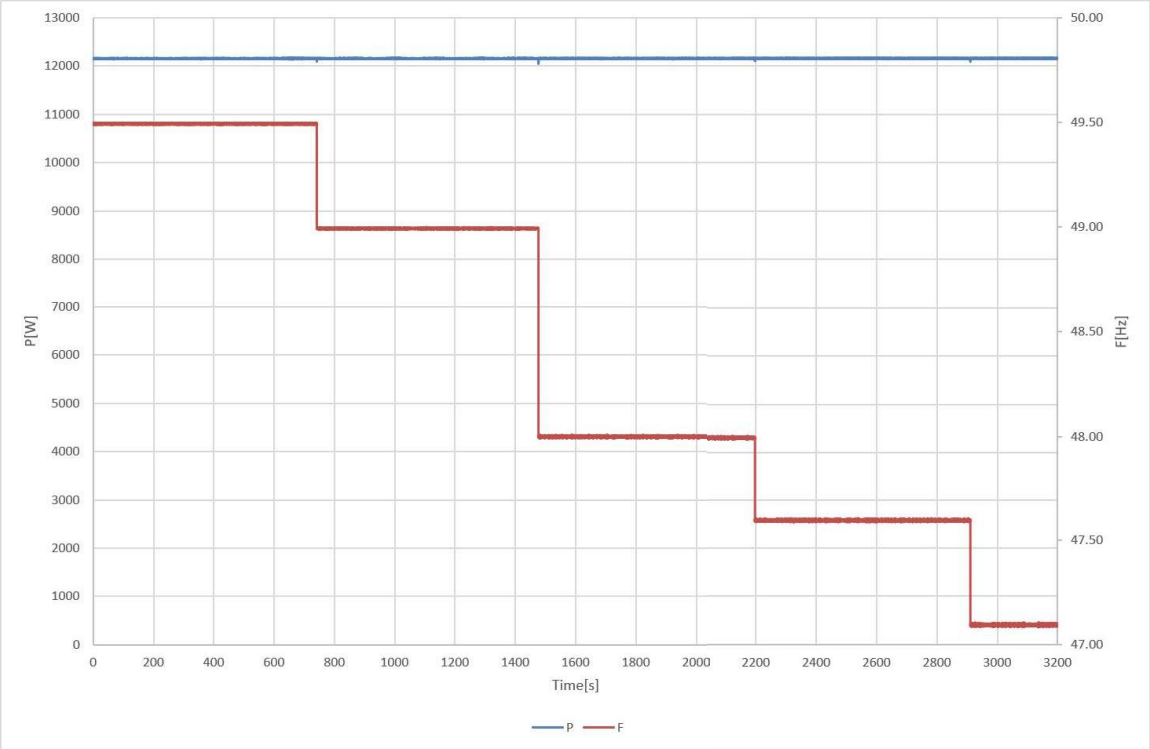
During the tests the interface protection was disabled.

Operation at reduced power is allowed during test 1 and 2, equal to the maximum power that can be supplied on reaching the maximum output current limit ($P \geq 0.85\ S_n$).

During the sequence of test 3, automatic adjustment to reduce power in the case of over-frequency was disabled.

4.4.3	Minimal requirement for active power delivery at under-frequency	P

Graph of frequency a) to b) to c):



	Switch to:				
5-min mean value (each)	a) 49.50 [Hz]	b) 49.00 [Hz]	c) 48.00 [Hz]	d) 47.60 [Hz]	e) 47.10 [Hz]
Frequency [Hz]:	49.50	49.00	48.00	47.60	47.10
Active power [W]:	12156	12156	12156	12157	12157
$\Delta P/P_M$ [%] per 1 Hz:	--	0.00	0.00	0.00	0.00

Test:

Operating points a) to e) must be kept for at least 5 minutes.

The test must be carried out at 100% P_n.

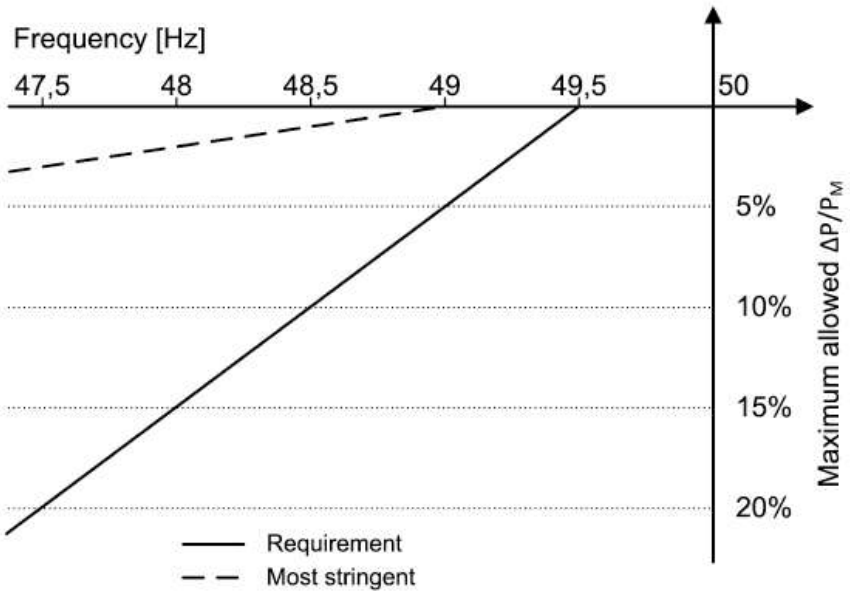
With a programmable AC source, the PGU is operated at 100% P_n and 49.50 ± 0.01 Hz, Since then the frequency has changed to 49.00Hz, 48.00Hz, 47.60Hz, 47.10Hz, A 5-min mean value is recorded both before and after the frequency change.

Assessment criterion:

The test is passed when the micro-generator

- The frequency should then be set to 49.5 Hz for 5 minutes. The output should remain at 100% of registered Capacity.
- The frequency should then be set to 49.0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 99% of registered Capacity.
- The frequency should then be set to 48.0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 97% of registered Capacity.
- The frequency should then be set to 47.6 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 96.2% of registered Capacity.

- The frequency should then be set to 47.1 Hz and held at this frequency for 20s. The Active Power output must not be below 95.0% of registered Capacity and the Synchronous Power Generating Module must not trip in less than the 20s



Maximum allowable power reduction in case of under-frequency

EN 50549-1: Immunity to disturbances			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.5.2	Rate of change of frequency (ROCOF) immunity		**P**
4.5.3 & 4.5.4 & 4.7.4	Under-voltage ride through (UVRT) Over-voltage ride through (OVRT)		**P**
4.5.5	Phase jump immunity		**P**

4.5.2 Rate of change of frequency (ROCOF) immunity				P
	Start Frequency	**Change**	**End Frequency**	**Confirm no trip**
Positive Frequency drift	49Hz	+2.5Hz/sec	51Hz	No trip
Negative Frequency drift	51Hz	-2.5Hz/sec	49Hz	No trip

Note:

For the step change test the Generating Unit should be operated with a measureable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 seconds to complete the test. The Generating Unit should not trip during this test.

For frequency drift tests the Generating Unit should be operated with a measureable output at the start frequency and then the frequency changed in a ramp function at 2Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least 10 seconds. The Generating Unit should not trip during this test.

4.5.3 **4.5.4** **4.7.4**	**Low voltage ride through (LVRT)** **High voltage ride through (HVRT)** **Zero current mode for converter connected generating plants**	**P**

General:

If the voltage on the generator terminals falls below <0.8 U_n and if the generator terminals exceed the voltage of> 1.15 U_n (start of fault), generator must pass through voltage dips without any current being drawn into the grid Network operator (limited dynamic network support).
This requirement is met if, for a voltage dip below 0.8 U_n or at a voltage increase above 1.15 U_n, the injected current of the generating unit (s) and / or the memory 60 ms after occurrence of this voltage dip in any outer conductor 20% of the rated current I_r and does not exceed> 10% I_r after 100 ms.

After the voltage returned to continuous operating voltage range of -15% U_n to +10% U_n, 90 % of pre fault power or available power whichever is the smallest shall be resumed as fast as possible, but at the latest within 1 s unless the DSO and the responsible party requires another value.

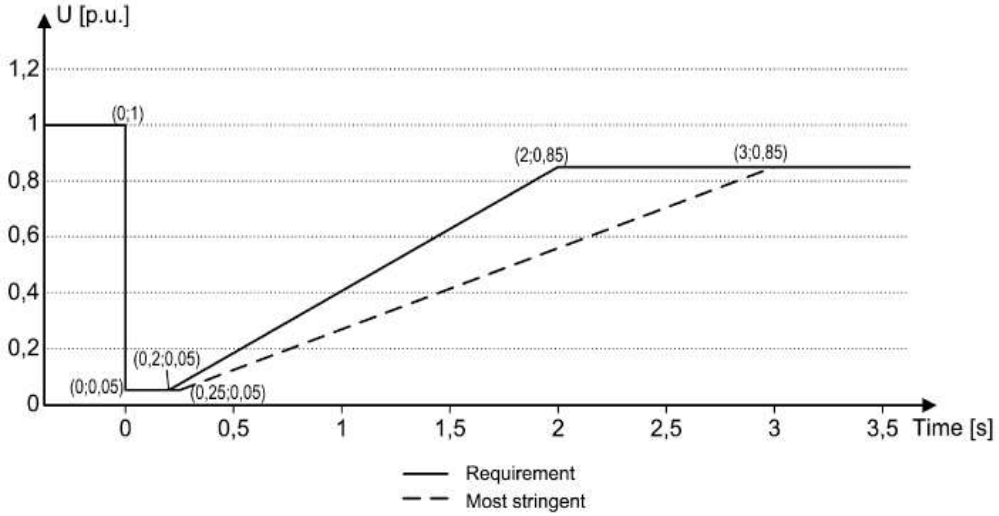


Figure 6 — Low voltage ride through capability for non-synchronous generating technology

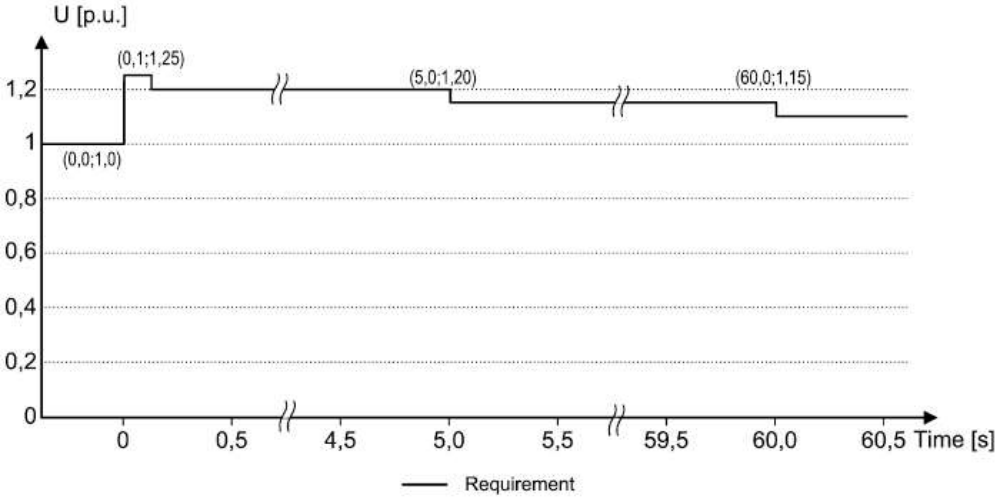


Figure 8 — High voltage ride through capability

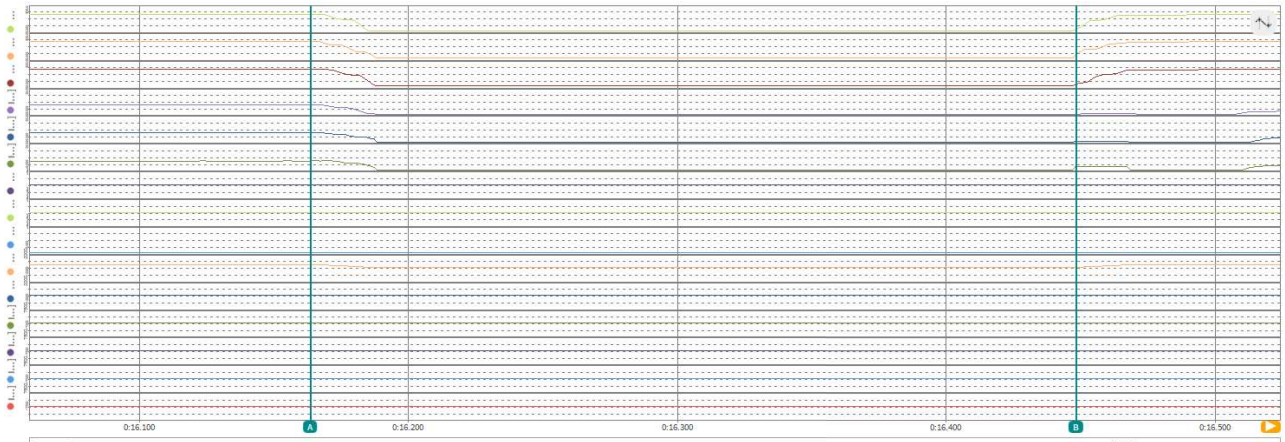
Graph of LVRT test							
List of tests	**Voltage dip to (p.u.)**	**Limit for fault duration [ms]**	**Duration fault [ms]**	**Active power Recover time [ms]**	**Limit percentage of Injected current after 60ms [p.u. In]**	**Percentage of Injected current after 60ms [p.u. In]**	**Result**
symmetrical Three phase fault - UVRT							
VD1.1 (P = 1)	0.03	≥ 250	285	402	≤0.1 p.u	0.00	P
VD1.2 (P = 0.2)	0.03	≥ 250	281	402	≤0.1 p.u	0.00	P
VD2.1 (P = 1)	0.25	≥950	1005	521	≤0.1 p.u	0.01	P
VD2.2 (P = 0.2)	0.25	≥950	1003	406	≤0.1 p.u	0.01	P
VD3.1 (P = 1)	0.52	≥1800	1998	510	≤0.1 p.u	0.02	P
VD3.2 (P = 0.2)	0.52	≥1800	2013	517	≤0.1 p.u	0.02	P
VD4.1 (P = 1)	0.75	≥2700	3003	501	≤0.1 p.u	0.03	P
VD4.2 (P = 0.2)	0.75	≥2700	3023	512	≤0.1 p.u	0.03	P
VD5.1 (P = 1)	0.90	≥60020	60101	517	-	-	P
VD5.2 (P = 0.2)	0.90	≥60020	60111	434	-	-	P
Asymmetrical Two phase fault - UVRT							
VD6.1 (P = 1)	0.03	≥ 250	301	513	≤0.1 p.u	0.09	P
VD6.2 (P = 0.2)	0.03	≥ 250	304	422	≤0.1 p.u	0.04	P
VD7.1 (P = 1)	0.22	≥950	1009	430	≤0.1 p.u	0.05	P
VD7.2 (P = 0.2)	0.22	≥950	1006	400	≤0.1 p.u	0.04	P
VD8.1 (P = 1)	0.50	≥1800	2010	492	≤0.1 p.u	0.04	P

Graph of LVRT test							
List of tests	**Voltage dip to (p.u.)**	**Limit for fault duration [ms]**	**Duration fault [ms]**	**Active power Recover time [ms]**	**Limit percentage of Injected current after 60ms [p.u. In]**	**Percentage of Injected current after 60ms [p.u. In]**	**Result**
VD8.2 (P = 0.2)	0.50	≥1800	2020	534	≤0.1 p.u	0.04	P
VD9.1 (P = 1)	0.75	≥2700	3022	459	≤0.1 p.u	0.04	P
VD9.2 (P = 0.2)	0.75	≥2700	2971	371	≤0.1 p.u	0.04	P
VD10.1 (P = 1)	0.90	≥60020	61625	48	--	--	P
VD10.2 (P = 0.2)	0.90	≥60020	61268	44	--	--	P
Symmetrical Three phase fault - OVRT							
VS1.1 (P = 1)	1.25	≥ 120	152	477	≤0.1 p.u	0.05	P
VS1.2 (P = 0.2)	1.25	≥ 120	151	505	≤0.1 p.u	0.05	P
VS2.1.1 (P = 1)	1.20	≥ 5020	5221	516	≤0.1 p.u	0.05	P
VS2.1.2 (P = 0.2)	1.20	≥ 5020	5190	569	≤0.1 p.u	0.05	P
VS2.2.1 (P = 1)	1.15	≥60020	60283	372	--	--	P
VS2.2.2 (P = 0.2)	1.15	≥60020	61165	380	--	--	P
Asymmetrical Two phase fault - OVRT							
VS3.1 (P = 1)	1.25	≥ 120	147	519	≤0.1 p.u	0.06	P
VS3.2 (P = 0.2)	1.25	≥ 120	150	465	≤0.1 p.u	0.04	P
VS4.1.1 (P = 1)	1.20	≥ 5020	5212	714	≤0.1 p.u	0.06	P

Graph of LVRT test							
List of tests	**Voltage dip to (p.u.)**	**Limit for fault duration [ms]**	**Duration fault [ms]**	**Active power Recover time [ms]**	**Limit percentage of Injected current after 60ms [p.u. In]**	**Percentage of Injected current after 60ms [p.u. In]**	**Result**
VS4.1.2 (P = 0.2)	1.20	≥ 5020	5220	637	≤0.1 p.u	0.06	P
VS4.2.1 (P = 1)	1.15	≥60020	60107	465	--		P
VS4.2.2 (P = 0.2)	1.15	≥60020	60101	530	--		P

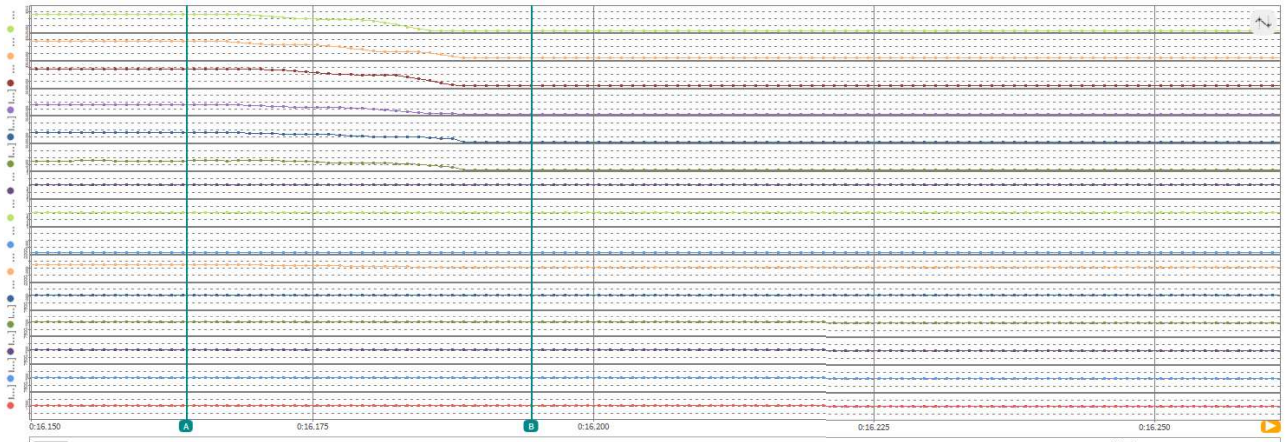
Test - VD1.1

Duration fault time



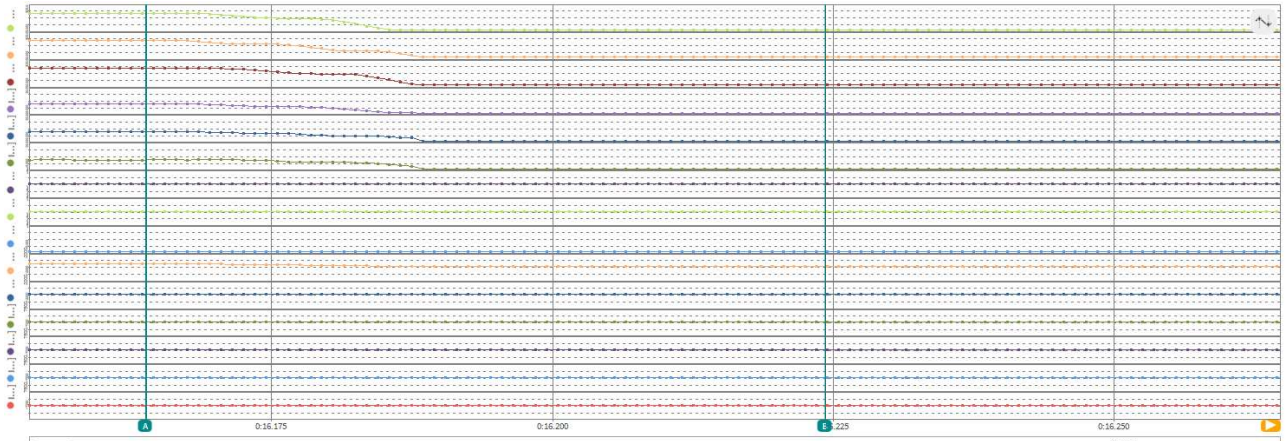
时间 [s]	A 0:16.1638302	B 0:16.4484733	间隔 0.2846432
U1_tRMS_rc@AC [V]	231.8144	6.960999	-224.8534
U2_tRMS_rc@AC [V]	228.6070	6.998811	-221.6082
U3_tRMS_rc@AC [V]	230.8340	6.963468	-223.8705
I1_tRMS_rc@AC [A]	17.72583	0.071259	-17.65457
I2_tRMS_rc@AC [A]	17.58695	0.062391	-17.52456
I3_tRMS_rc@AC [A]	17.46345	0.061453	17.40200
P_t_rc@AC [W]	12156.59	0.033264	-12156.56
Q_fund_rc@AC [var]	201.4060	0.451909	-200.9541
S_t_rc@AC [VA]	12160.76	1.360628	-12159.40
U_fund_SYM+_rc@AC [V]	386.9070	12.04726	-386.8598
U_fund_SYM-_rc@AC [V]	2.479806	0.044551	-2.435256
I_fund_P_SYM+_rc@AC [A]	17.57660	7.985e-5	-17.57652
I_fund_P_SYM-_rc@AC [A]	0.071102	5.566e-4	-0.070545
I_fund_Q_SYM+_rc@AC [A]	0.291830	0.021665	-0.270165
I_fund_Q_SYM-_rc@AC [A]	-0.062733	-4.954e-4	0.062237

Injected current at 30ms



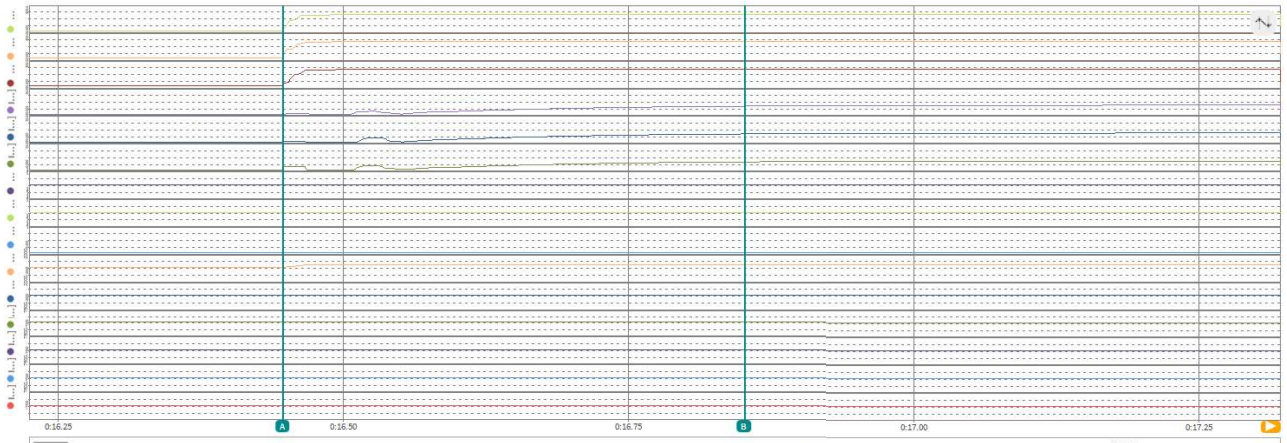
时间 [s]	A 0:16.1638302	B 0:16.1945162	间隔 0.0306861
U1_tRMS_rc@AC [V]	231.8144	7.020913	-224.7934
U2_tRMS_rc@AC [V]	228.6070	6.958370	-221.6486
U3_tRMS_rc@AC [V]	230.8340	6.932064	-223.9019
I1_tRMS_rc@AC [A]	17.72583	0.068730	-17.65710
I2_tRMS_rc@AC [A]	17.58695	0.060948	-17.52600
I3_tRMS_rc@AC [A]	17.46345	0.057386	-17.40609
P_t_rc@AC [W]	12156.59	0.026086	-12156.56
Q_fund_rc@AC [var]	201.4060	0.435817	-200.9702
S_t_rc@AC [VA]	12160.76	1.304305	-12159.46
U_fund_SYM+_rc@AC [V]	386.9070	12.02094	-386.8801
U_fund_SYM-_rc@AC [V]	2.479806	0.053254	-2.426552
I_fund_P_SYM+_rc@AC [A]	17.57660	-2.839e-4	-17.57688
I_fund_P_SYM-_rc@AC [A]	0.071102	1.699e-3	-0.069403
I_fund_Q_SYM+_rc@AC [A]	0.291830	0.020915	-0.270915
I_fund_Q_SYM-_rc@AC [A]	-0.062733	4.996e-4	0.063232

Injected current at 60ms



时间 [s]	A 0:16.1638302	B 0:16.2242792	间隔 0.0604490
U1_tRMS_rc@AC [V]	231.8144	7.005732	-224.8086
U2_tRMS_rc@AC [V]	228.6070	6.957637	-221.6493
U3_tRMS_rc@AC [V]	230.8340	6.930363	-223.9036
I1_tRMS_rc@AC [A]	17.72583	0.067617	-17.65822
I2_tRMS_rc@AC [A]	17.58695	0.057096	-17.52985
I3_tRMS_rc@AC [A]	17.46345	0.056731	17.40672
P_t_rc@AC [W]	12156.59	0.044149	-12156.54
Q_fund_rc@AC [var]	201.4060	0.481815	-200.9242
S_t_rc@AC [VA]	12160.76	1.264125	-12159.50
U_fund_SYM+_rc@AC [V]	388.0070	12.01980	-386.8872
U_fund_SYM-_rc@AC [V]	2.479806	0.032090	-2.447757
I_fund_P_SYM+_rc@AC [A]	17.57660	6.404e-4	-17.57596
I_fund_P_SYM-_rc@AC [A]	0.071102	-3.754e-4	-0.071477
I_fund_Q_SYM+_rc@AC [A]	0.291830	0.023148	-0.268682
I_fund_Q_SYM-_rc@AC [A]	-0.062733	-1.945e-4	0.062538

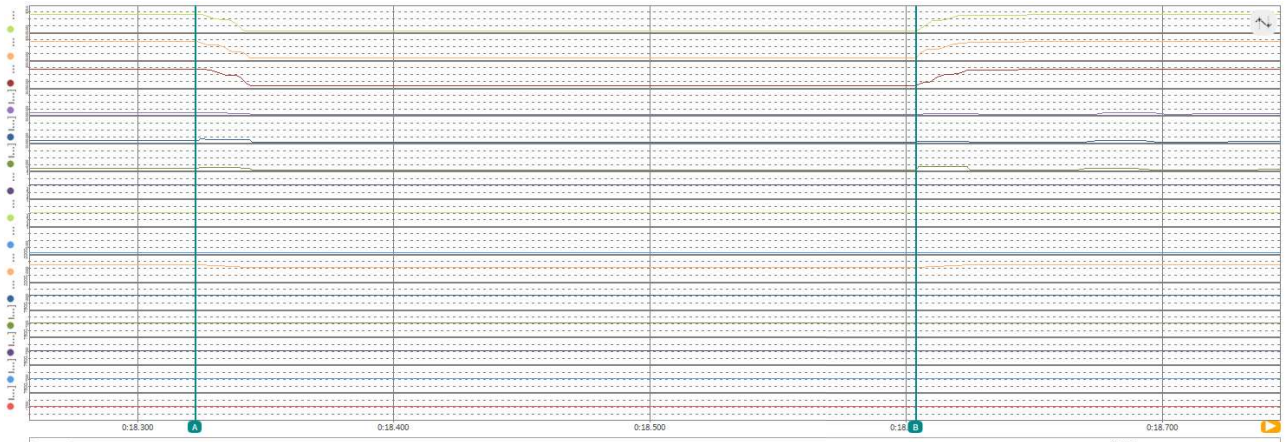
Recover time – Active power



时间 [s]	A 0:16.4474458	B 0:16.8516893	间隔 0.4042434
U1_tRMS_rc@AC [V]	7.043366	230.6357	223.5923
U2_tRMS_rc@AC [V]	6.961433	230.2368	223.2754
U3_tRMS_rc@AC [V]	6.919601	230.3575	223.4379
I1_tRMS_rc@AC [A]	0.071713	15.81360	15.74189
I2_tRMS_rc@AC [A]	0.062563	15.90067	15.83810
I3_tRMS_rc@AC [A]	0.060482	15.57090	15.51042
P_t_rc@AC [W]	0.025038	10891.46	10891.43
Q_fund_rc@AC [var]	0.460063	201.1633	200.7033
S_t_rc@AC [VA]	1.359139	10894.97	10893.61
U_fund_SYM+_rc@AC [V]	12.04634	399.0764	387.0301
U_fund_SYM-_rc@AC [V]	0.103297	0.444439	0.341142
I_fund_P_SYM+_rc@AC [A]	-3.337e-4	15.75653	15.75686
I_fund_P_SYM-_rc@AC [A]	-2.737e-4	0.111793	0.112067
I_fund_Q_SYM+_rc@AC [A]	0.022054	0.290988	0.268934
I_fund_Q_SYM-_rc@AC [A]	5.247e-4	-0.039646	-0.040170

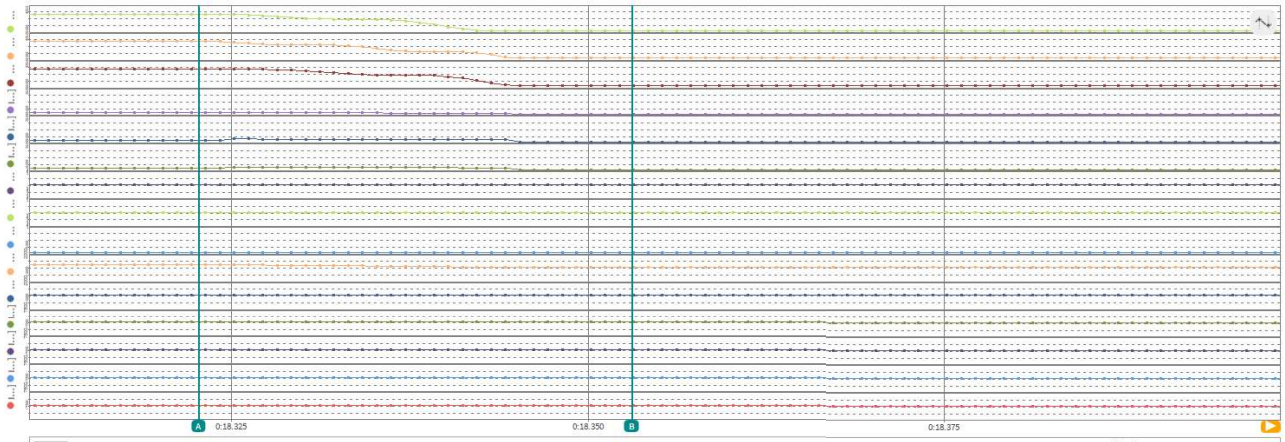
Test - VD1.2

Duration fault time



时间 [s]	A 0:18.3227394	B 0:18.6037092	间隔 0.2809698
U1_tRMS_rc@AC [V]	229.7582	7.040186	-222.7181
U2_tRMS_rc@AC [V]	228.8535	6.955133	-221.8984
U3_tRMS_rc@AC [V]	232.4961	6.962535	-225.5336
I1_tRMS_rc@AC [A]	3.461610	0.079340	-3.382269
I2_tRMS_rc@AC [A]	3.481705	0.068829	-3.412876
I3_tRMS_rc@AC [A]	3.458026	0.064819	-3.393207
P_t_rc@AC [W]	2385.469	0.034290	-2385.435
Q_fund_rc@AC [var]	-13.33519	0.475683	13.81087
S_t_rc@AC [VA]	2396.111	1.488589	-2394.623
U_fund_SYM+_rc@AC [V]	398.7747	12.06849	-386.7062
U_fund_SYM-_rc@AC [V]	3.700682	0.052114	-3.648568
I_fund_P_SYM+_rc@AC [A]	3.447084	-2.829e-4	-3.447367
I_fund_P_SYM-_rc@AC [A]	6.984e-4	-5.022e-4	-1.201e-3
I_fund_Q_SYM+_rc@AC [A]	-0.019440	0.022757	0.042197
I_fund_Q_SYM-_rc@AC [A]	0.013218	-2.979e-4	-0.013516

Injected current at 30ms



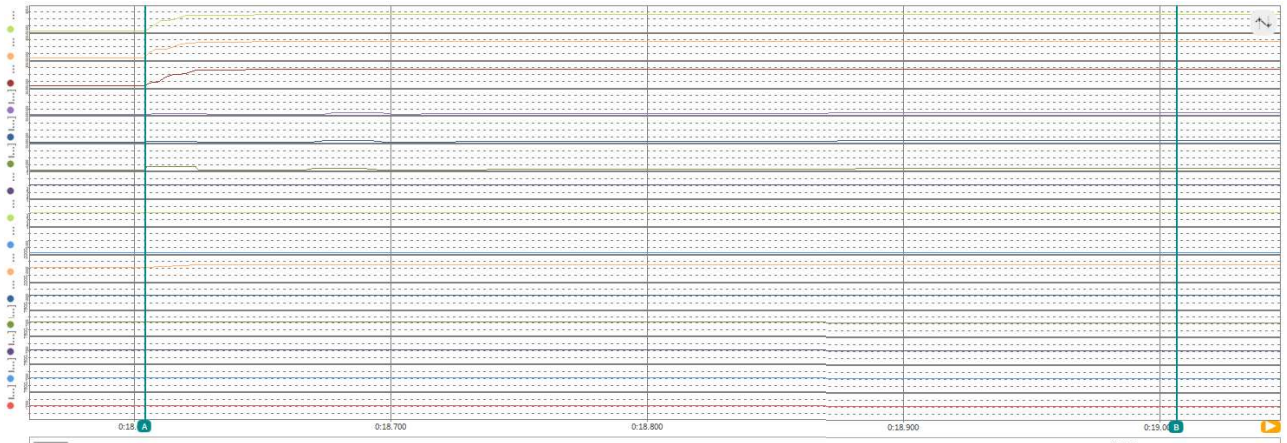
时间 [s]	A 0:18.3227394	B 0:18.3530848	间隔 0.0303453
U1_tRMS_rc@AC [V]	229.7582	7.036758	-222.7215
U2_tRMS_rc@AC [V]	228.8535	6.967778	-221.8858
U3_tRMS_rc@AC [V]	232.4961	6.937260	-225.5588
I1_tRMS_rc@AC [A]	3.461610	0.077656	-3.383954
I2_tRMS_rc@AC [A]	3.481705	0.064109	-3.417596
I3_tRMS_rc@AC [A]	3.458026	0.062460	-3.395565
P_t_rc@AC [W]	2385.469	0.060432	-2385.409
Q_fund_rc@AC [var]	-13.33519	0.448696	13.78388
S_t_rc@AC [VA]	2396.111	1.426447	-2394.685
U_fund_SYM+_rc@AC [V]	398.7747	12.04234	-386.7323
U_fund_SYM-_rc@AC [V]	3.700682	0.042746	-3.657936
I_fund_P_SYM+_rc@AC [A]	3.447084	6.360e-4	-3.446448
I_fund_P_SYM-_rc@AC [A]	6.984e-4	6.606e-5	-6.324e-4
I_fund_Q_SYM+_rc@AC [A]	-0.019440	0.021511	0.040950
I_fund_Q_SYM-_rc@AC [A]	0.013218	-2.436e-4	-0.013461

Injected current at 60ms



时间 [s]	A 0:18.3227394	B 0:18.3832935	间隔 0.0605541
U1_tRMS_rc@AC [V]	229.7582	7.028626	-222.7296
U2_tRMS_rc@AC [V]	228.8535	6.968677	-221.8849
U3_tRMS_rc@AC [V]	232.4961	6.948830	-225.5473
I1_tRMS_rc@AC [A]	3.461610	0.075673	-3.385937
I2_tRMS_rc@AC [A]	3.481705	0.066379	-3.415326
I3_tRMS_rc@AC [A]	3.458026	0.060644	3.397382
P_t_rc@AC [W]	2385.469	0.026011	-2385.443
Q_fund_rc@AC [var]	-13.33519	0.449917	13.78511
S_t_rc@AC [VA]	2396.111	1.415852	-2394.695
U_fund_SYM+_rc@AC [V]	398.7747	12.04764	-386.7270
U_fund_SYM-_rc@AC [V]	3.700682	0.031176	-3.669506
I_fund_P_SYM+_rc@AC [A]	3.447084	-8.936e-4	-3.447978
I_fund_P_SYM-_rc@AC [A]	6.984e-4	1.382e-3	6.835e-4
I_fund_Q_SYM+_rc@AC [A]	-0.019440	0.021559	0.040998
I_fund_Q_SYM-_rc@AC [A]	0.013218	-1.296e-4	-0.013347

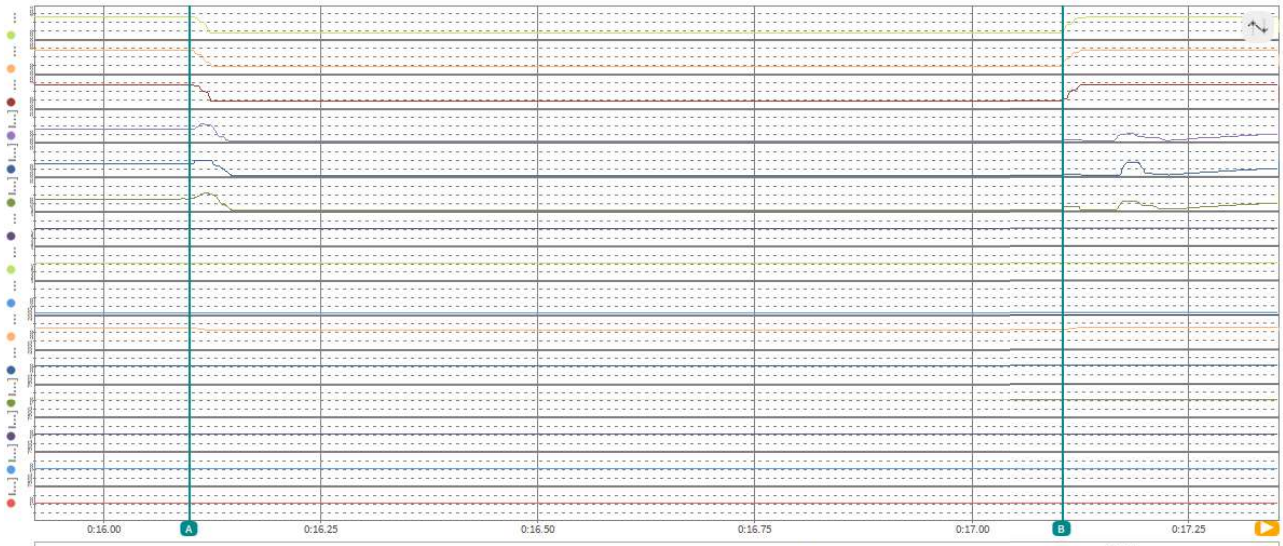
Recover time – Active power



时间 [s]	A 0:18.6041721	B 0:19.0064521	间隔 0.4022800
U1_tRMS_rc@AC [V]	7.040186	230.6510	223.6108
U2_tRMS_rc@AC [V]	6.955133	230.2090	223.2539
U3_tRMS_rc@AC [V]	6.962535	230.3322	223.3697
I1_tRMS_rc@AC [A]	0.079340	3.129086	3.049745
I2_tRMS_rc@AC [A]	0.068829	3.130438	3.061609
I3_tRMS_rc@AC [A]	0.064819	3.111325	3.046506
P_t_rc@AC [W]	0.034290	2152.013	2151.979
Q_fund_rc@AC [var]	0.475683	-21.12896	-21.60464
S_t_rc@AC [VA]	1.488589	2159.020	2157.531
U_fund_SYM+_rc@AC [V]	12.06840	399.0557	386.9872
U_fund_SYM-_rc@AC [V]	0.052114	0.418346	0.366232
I_fund_P_SYM+_rc@AC [A]	-2.829e-4	3.113281	3.113564
I_fund_P_SYM-_rc@AC [A]	-5.022e-4	4.233e-3	4.735e-3
I_fund_Q_SYM+_rc@AC [A]	0.022757	-0.030567	-0.053324
I_fund_Q_SYM-_rc@AC [A]	-2.979e-4	-0.011792	-0.011494

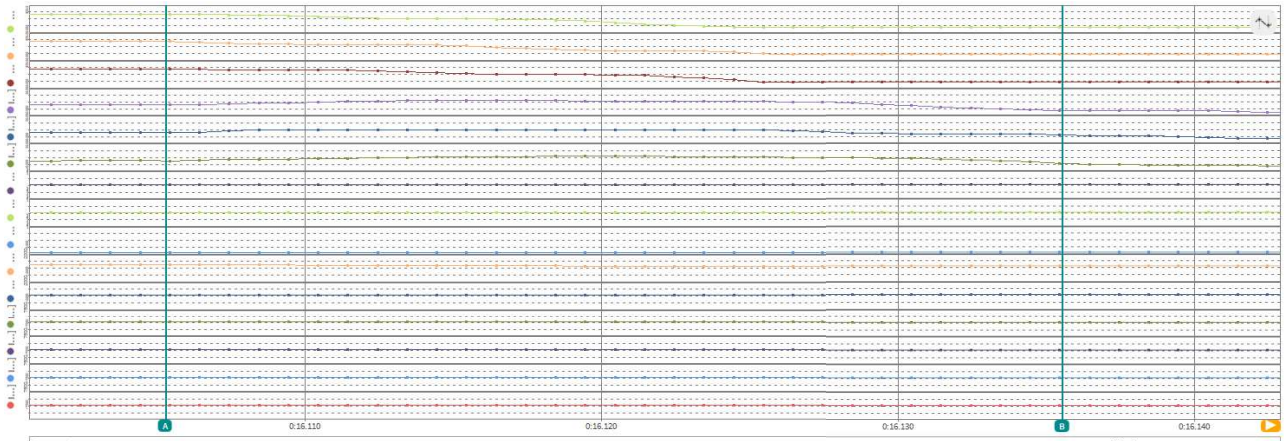
Test – VD2.1

Duration fault time



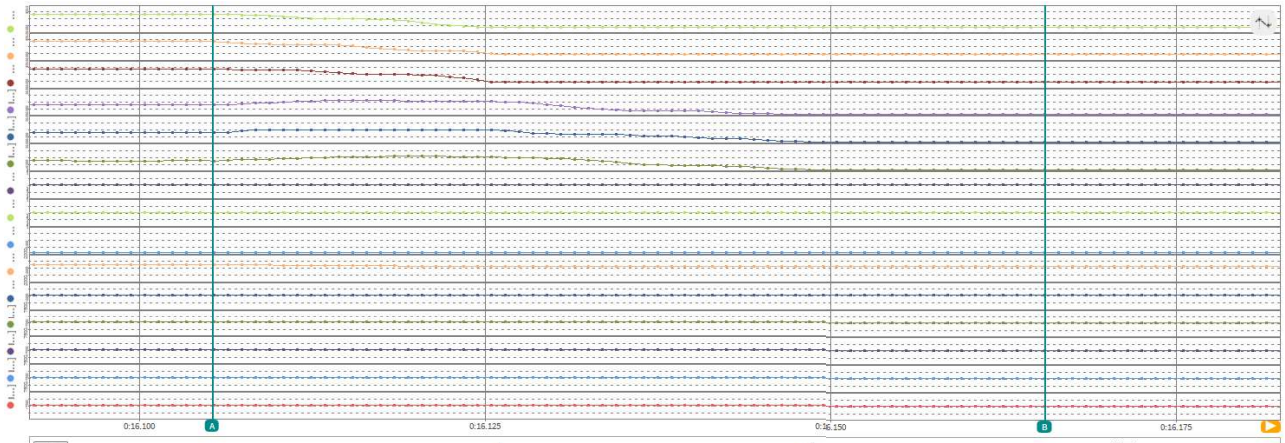
时间 [s]	A 0:16.099601	B 0:17.105008	间隔 1.005407
U1_tRMS_rc@AC [V]	231.5685	58.06478	-173.5037
U2_tRMS_rc@AC [V]	230.2971	57.59021	-172.7068
U3_tRMS_rc@AC [V]	229.3440	57.25242	-172.0916
I1_tRMS_rc@AC [A]	17.70999	0.326456	-17.38353
I2_tRMS_rc@AC [A]	17.69581	0.313698	-17.38211
I3_tRMS_rc@AC [A]	17.36620	0.321491	-17.04471
P_t_rc@AC [W]	12155.06	-18.75137	-12173.81
Q_fund_rc@AC [var]	195.6349	36.08691	-159.5480
S_t_rc@AC [VA]	12159.20	55.42767	-12103.77
U_fund_SYM+_rc@AC [V]	398.9880	99.78864	-299.1993
U_fund_SYM-_rc@AC [V]	2.213773	0.892630	-1.321142
I_fund_P_SYM+_rc@AC [A]	17.58146	-0.108693	-17.69016
I_fund_P_SYM-_rc@AC [A]	0.157226	-7.404e-4	-0.157966
I_fund_Q_SYM+_rc@AC [A]	0.283363	0.208800	-0.074563
I_fund_Q_SYM-_rc@AC [A]	-0.053836	-1.184e-3	0.052653

Injected current at 30ms



时间 [s]	A 0:16.1053095	B 0:16.1355467	间隔 0.0302372
U1_tRMS_rc@AC [V]	229.6789	57.59961	-172.0793
U2_tRMS_rc@AC [V]	230.2196	57.87637	-172.3433
U3_tRMS_rc@AC [V]	231.3326	57.53871	-173.7939
I1_tRMS_rc@AC [A]	17.55929	7.203905	-10.35539
I2_tRMS_rc@AC [A]	17.68484	13.29289	-4.391953
I3_tRMS_rc@AC [A]	17.52685	11.89629	-5.630555
P_t_rc@AC [W]	12154.75	1112.382	-11042.36
Q_fund_rc@AC [var]	198.1391	463.5318	265.3927
S_t_rc@AC [VA]	12158.93	1868.784	-10290.15
U_fund_SYM+_rc@AC [V]	399.0046	99.69300	-299.1411
U_fund_SYM-_rc@AC [V]	1.423859	0.079207	-1.344652
I_fund_P_SYM+_rc@AC [A]	17.57899	6.284513	-11.29448
I_fund_P_SYM-_rc@AC [A]	9.530e-3	0.552367	0.542837
I_fund_Q_SYM+_rc@AC [A]	0.286465	2.681757	2.395292
I_fund_Q_SYM-_rc@AC [A]	0.060117	-2.132498	-2.192615

Injected current at 60ms



时间 [s]	A 0:16.1053095	B 0:16.1654709	间隔 0.0601614
U1_tRMS_rc@AC [V]	229.6789	54.73482	-174.9441
U2_tRMS_rc@AC [V]	230.2196	54.86397	-175.3557
U3_tRMS_rc@AC [V]	231.3326	54.79983	-176.5327
I1_tRMS_rc@AC [A]	17.55929	0.176445	-17.38285
I2_tRMS_rc@AC [A]	17.68484	0.191394	-17.49345
I3_tRMS_rc@AC [A]	17.52685	0.188390	-17.33846
P_t_rc@AC [W]	12154.75	-0.026701	-12154.77
Q_fund_rc@AC [var]	198.1391	27.85796	-170.2812
S_t_rc@AC [VA]	12158.93	30.48207	-12128.45
U_fund_SYM+_rc@AC [V]	399.0046	94.90607	-304.0965
U_fund_SYM-_rc@AC [V]	1.423859	0.033544	-1.390315
I_fund_P_SYM+_rc@AC [A]	17.57899	-3.142e-4	-17.57931
I_fund_P_SYM-_rc@AC [A]	9.530e-3	2.618e-3	-6.912e-3
I_fund_Q_SYM+_rc@AC [A]	0.286465	0.169460	-0.117004
I_fund_Q_SYM-_rc@AC [A]	0.060117	7.051e-4	-0.059412

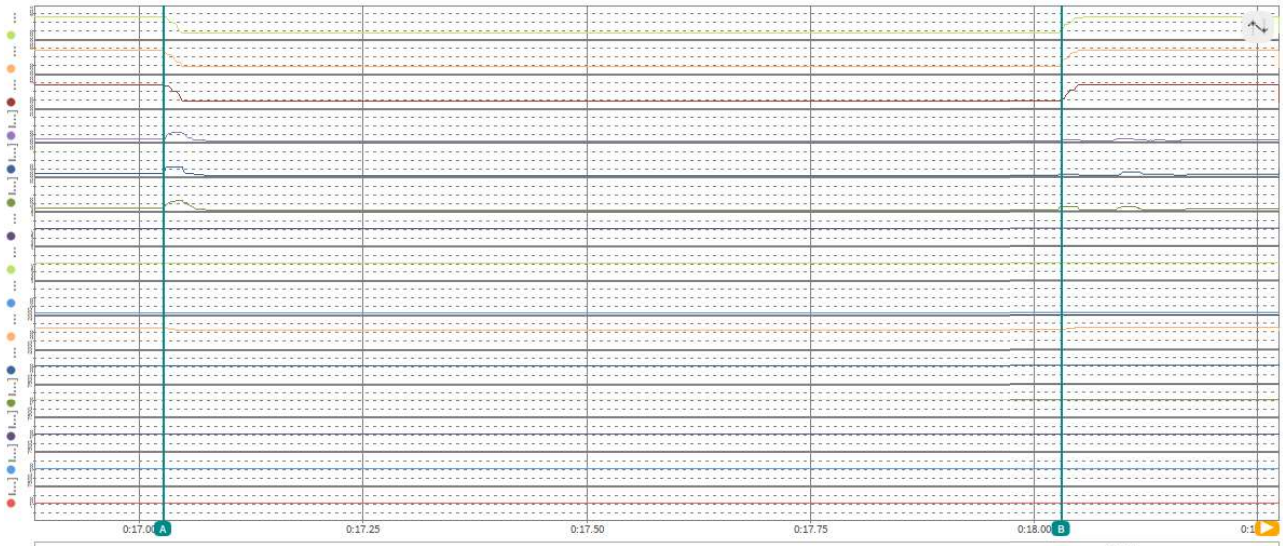
Recover time – Active power



时间 [s]	A 0:17.106563	B 0:17.628035	间隔 0.521473
U1_tRMS_rc@AC [V]	58.69871	230.6600	171.9613
U2_tRMS_rc@AC [V]	73.96101	230.2270	156.2660
U3_tRMS_rc@AC [V]	67.15067	230.3512	163.2005
I1_tRMS_rc@AC [A]	0.466747	16.80348	16.33673
I2_tRMS_rc@AC [A]	1.529612	16.81026	15.28065
I3_tRMS_rc@AC [A]	5.102103	16.55736	11.45526
P_t_rc@AC [W]	-192.2655	11555.47	11747.73
Q_fund_rc@AC [var]	9.426783	212.8592	203.4324
S_t_rc@AC [VA]	483.1388	11560.07	11076.94
U_fund_SYM+_rc@AC [V]	106.6416	399.0812	292.4396
U_fund_SYM-_rc@AC [V]	7.427526	0.418429	-7.009097
I_fund_P_SYM+_rc@AC [A]	-0.388153	16.71669	17.10484
I_fund_P_SYM-_rc@AC [A]	-0.261990	0.069204	0.331194
I_fund_Q_SYM+_rc@AC [A]	0.036865	0.307921	0.271056
I_fund_Q_SYM-_rc@AC [A]	0.205109	-0.054101	-0.259210

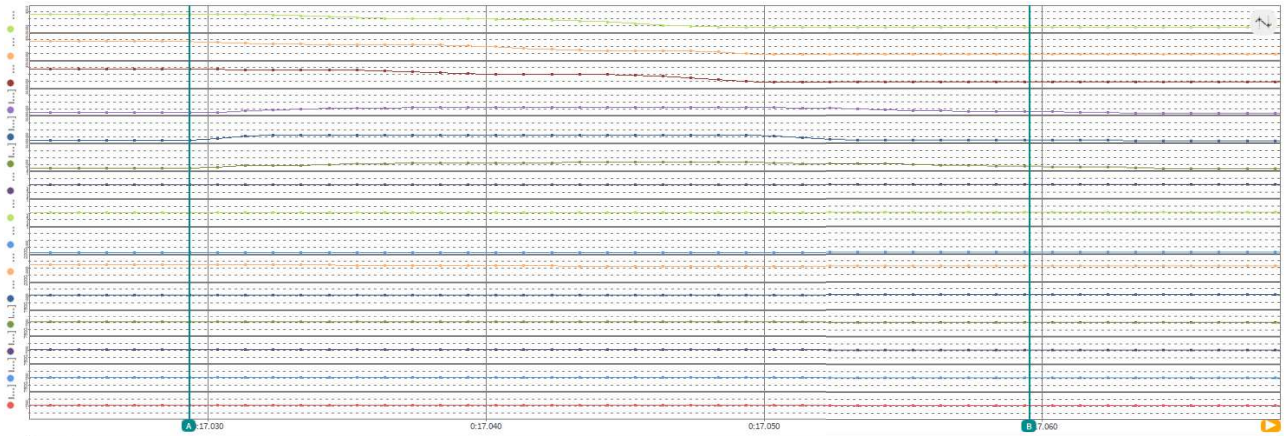
Test – VD2.2

Duration fault time



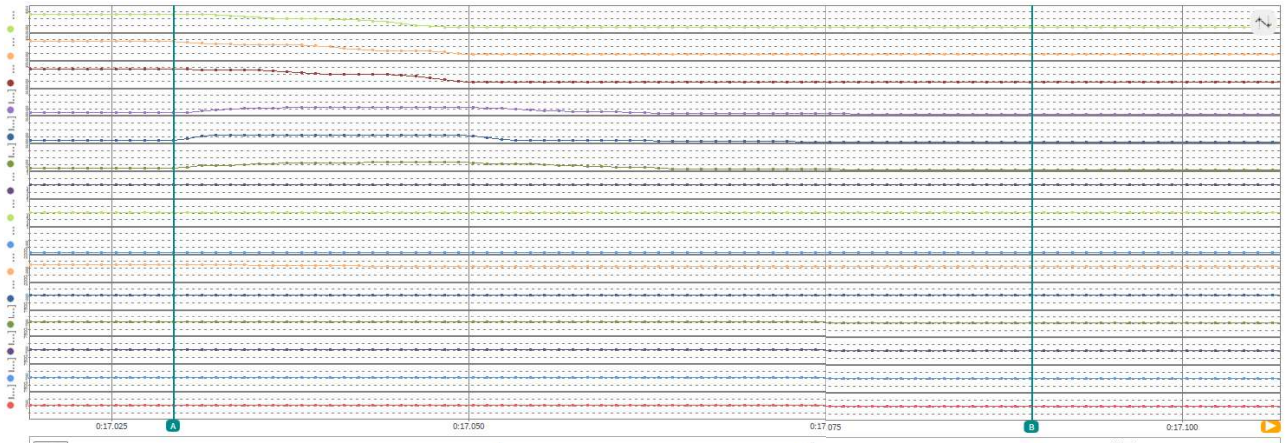
时间 [s]	A 0:17.0275987	B 0:18.0306218	间隔 1.0030232
U1_tRMS_rc@AC [V]	230.4026	57.58938	-172.8132
U2_tRMS_rc@AC [V]	229.3441	63.13069	-166.2134
U3_tRMS_rc@AC [V]	231.3509	60.78951	-170.5614
I1_tRMS_rc@AC [A]	3.418770	0.464005	-2.954765
I2_tRMS_rc@AC [A]	3.467050	1.409139	-2.057910
I3_tRMS_rc@AC [A]	3.427024	4.080267	0.653244
P_t_rc@AC [W]	2365.475	-138.1692	-2503.645
Q_fund_rc@AC [var]	5.896862	22.98633	17.08946
S_t_rc@AC [VA]	2375.686	363.7191	-2011.967
U_fund_SYM+_rc@AC [V]	398.9286	102.0644	-296.8642
U_fund_SYM-_rc@AC [V]	1.524591	2.896423	1.371832
I_fund_P_SYM+_rc@AC [A]	3.420945	-0.323891	-3.744836
I_fund_P_SYM-_rc@AC [A]	-0.010187	-0.208157	-0.197971
I_fund_Q_SYM+_rc@AC [A]	8.513e-3	0.127359	0.118846
I_fund_Q_SYM-_rc@AC [A]	6.778e-3	0.095760	0.088982

Injected current at 30ms



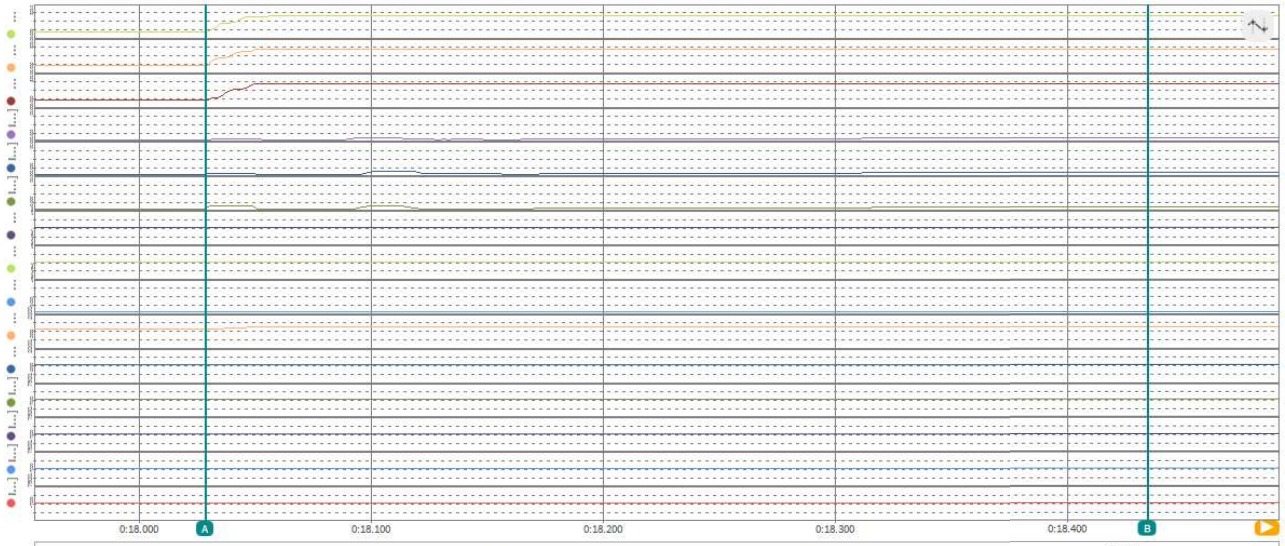
时间 [s]	A 0:17.0293349	B 0:17.0595355	间隔 0.0302006
U1_tRMS_rc@AC [V]	229.7959	57.73693	-172.0590
U2_tRMS_rc@AC [V]	229.9431	58.36093	-171.5822
U3_tRMS_rc@AC [V]	231.3665	57.76973	-173.5968
I1_tRMS_rc@AC [A]	3.409945	4.686669	1.276724
I2_tRMS_rc@AC [A]	3.471539	3.205607	-0.265932
I3_tRMS_rc@AC [A]	3.440119	6.166957	2.726679
P_t_rc@AC [W]	2368.021	-99.32038	-2467.342
Q_fund_rc@AC [var]	7.706002	279.5780	271.8720
S_t_rc@AC [VA]	2377.776	813.9418	-1563.834
U_fund_SYM+_rc@AC [V]	398.9344	100.3667	-298.5657
U_fund_SYM-_rc@AC [V]	1.458687	0.542061	-0.916626
I_fund_P_SYM+_rc@AC [A]	3.424443	-0.620981	-4.045424
I_fund_P_SYM-_rc@AC [A]	3.405e-3	1.332533	1.329128
I_fund_Q_SYM+_rc@AC [A]	0.011101	1.616480	1.605379
I_fund_Q_SYM-_rc@AC [A]	0.017221	-1.473159	-1.490380

Injected current at 60ms



时间 [s]	A 0:17.0293349	B 0:17.0894635	间隔 0.0601286
U1_tRMS_rc@AC [V]	229.7959	55.66705	-174.1288
U2_tRMS_rc@AC [V]	229.9431	55.60826	-174.3348
U3_tRMS_rc@AC [V]	231.3665	55.50466	-175.8619
I1_tRMS_rc@AC [A]	3.409945	0.192920	-3.217025
I2_tRMS_rc@AC [A]	3.471539	0.193353	-3.278186
I3_tRMS_rc@AC [A]	3.440119	0.186261	-3.253858
P_t_rc@AC [W]	2368.021	0.351458	-2367.670
Q_fund_rc@AC [var]	7.706002	29.07615	21.37015
S_t_rc@AC [VA]	2377.776	31.82967	-2345.946
U_fund_SYM+_rc@AC [V]	396.9344	96.28047	-302.6539
U_fund_SYM-_rc@AC [V]	1.458687	0.168306	-1.290381
I_fund_P_SYM+_rc@AC [A]	3.424443	1.791e-3	-3.422652
I_fund_P_SYM-_rc@AC [A]	3.405e-3	3.868e-4	-3.019e-3
I_fund_Q_SYM+_rc@AC [A]	0.011101	0.174362	0.163262
I_fund_Q_SYM-_rc@AC [A]	0.017221	-3.397e-3	-0.020618

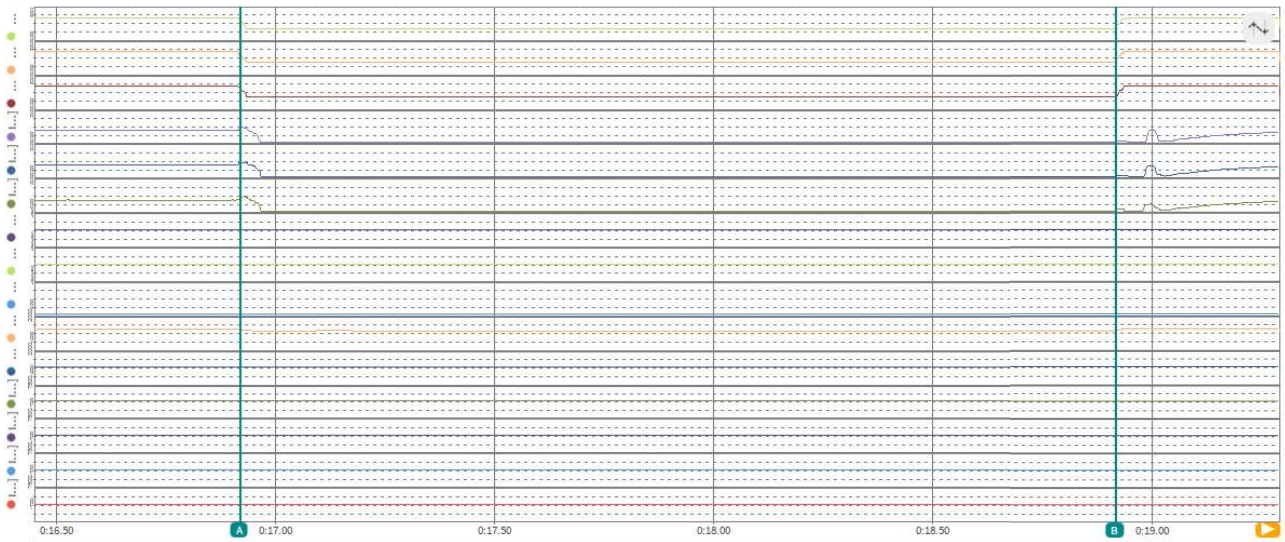
Recover time – Active power



时间 [s]	A 0:18.0289068	B 0:18.4346250	间隔 0.4057182
U1_tRMS_rc@AC [V]	58.01416	230.6438	172.6297
U2_tRMS_rc@AC [V]	57.65550	230.2330	172.5775
U3_tRMS_rc@AC [V]	57.21223	230.3417	173.1294
I1_tRMS_rc@AC [A]	0.327682	3.069446	2.741764
I2_tRMS_rc@AC [A]	0.312078	3.133769	2.821691
I3_tRMS_rc@AC [A]	0.322748	3.092155	2.769407
P_t_rc@AC [W]	-18.82806	2129.686	2148.514
Q_fund_rc@AC [var]	36.25683	-17.06565	-53.32248
S_t_rc@AC [VA]	55.46836	2141.698	2086.230
U_fund_SYM+_rc@AC [V]	99.77322	399.0708	299.2976
U_fund_SYM-_rc@AC [V]	0.848207	0.391193	-0.457014
I_fund_P_SYM+_rc@AC [A]	-0.109118	3.080855	3.189973
I_fund_P_SYM-_rc@AC [A]	-1.349e-3	0.010142	0.011491
I_fund_Q_SYM+_rc@AC [A]	0.209826	-0.024645	-0.234470
I_fund_Q_SYM-_rc@AC [A]	-2.373e-3	-0.025116	-0.022743

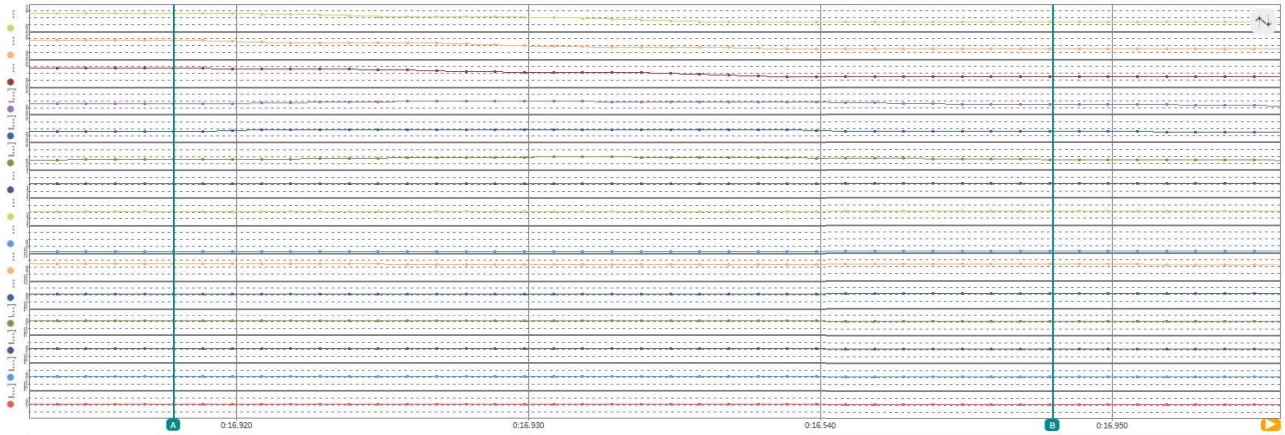
Test – VD3.1

Duration fault time



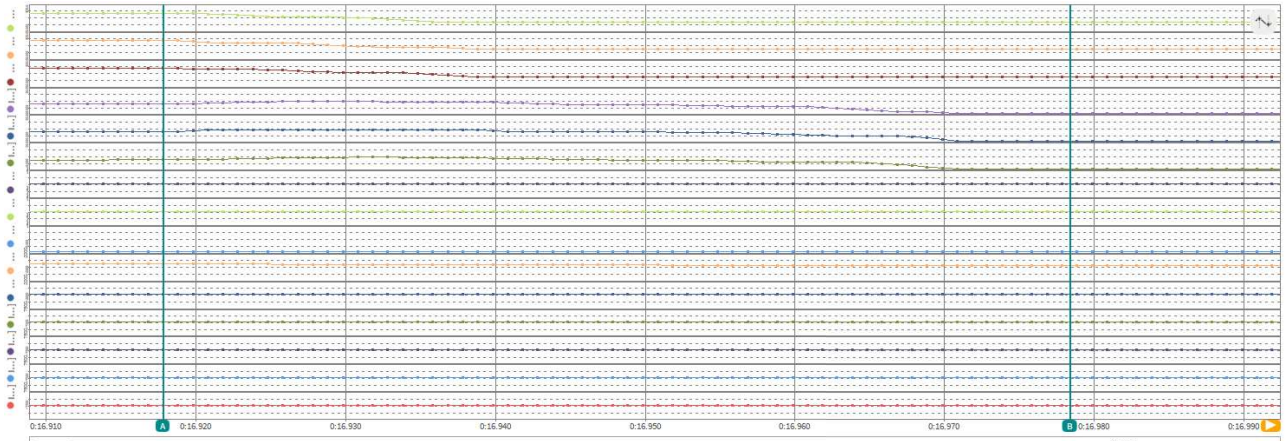
时间 [s]	A 0:16.919888	B 0:18.917557	间隔 1.997670
U1_tRMS_rc@AC [V]	231.0504	115.7747	-115.2757
U2_tRMS_rc@AC [V]	228.1026	115.3284	-112.7742
U3_tRMS_rc@AC [V]	229.4417	114.6394	-114.8023
I1_tRMS_rc@AC [A]	17.70412	0.515315	-17.18881
I2_tRMS_rc@AC [A]	18.20531	0.500864	-17.70445
I3_tRMS_rc@AC [A]	17.87540	0.512372	-17.36302
P_t_rc@AC [W]	12182.60	-43.91082	-12226.51
Q_fund_rc@AC [var]	206.8632	136.0723	-70.79083
S_t_rc@AC [VA]	12344.58	176.1622	-12168.42
U_fund_SYM+_rc@AC [V]	397.0136	199.5892	-197.4244
U_fund_SYM-_rc@AC [V]	3.447408	1.655162	-1.792246
I_fund_P_SYM+_rc@AC [A]	17.81553	-0.127256	-17.94278
I_fund_P_SYM-_rc@AC [A]	-0.157205	-1.476e-3	0.155729
I_fund_Q_SYM+_rc@AC [A]	0.301551	0.393625	0.092074
I_fund_Q_SYM-_rc@AC [A]	-0.084974	-1.190e-3	0.083784

Injected current at 30ms



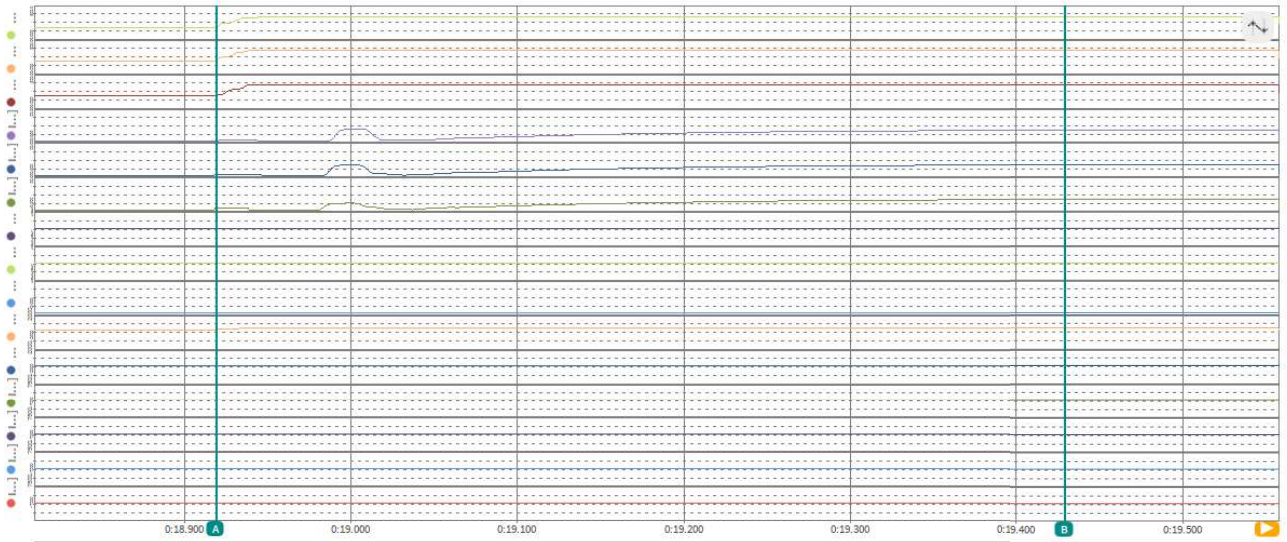
时间 [s]	A 0:16.917854	B 0:16.947953	间隔 0.030099
U1_tRMS_rc@AC [V]	230.2319	115.9277	-114.3042
U2_tRMS_rc@AC [V]	230.1220	116.0200	-114.1019
U3_tRMS_rc@AC [V]	230.8885	115.6988	-115.1897
I1_tRMS_rc@AC [A]	17.61392	16.23339	-1.380529
I2_tRMS_rc@AC [A]	17.71002	17.59174	-0.118277
I3_tRMS_rc@AC [A]	17.52754	17.18212	-0.345415
P_t_rc@AC [W]	12173.37	5666.411	-6506.959
Q_fund_rc@AC [var]	193.8698	602.3359	408.4662
S_t_rc@AC [VA]	12177.66	5910.845	-6266.813
U_fund_SYM+_rc@AC [V]	399.0034	200.7054	-198.3581
U_fund_SYM-_rc@AC [V]	0.478624	0.167002	-0.311622
I_fund_P_SYM+_rc@AC [A]	17.60894	16.28301	-1.325926
I_fund_P_SYM-_rc@AC [A]	-0.038751	0.028361	0.067113
I_fund_Q_SYM+_rc@AC [A]	0.280403	1.733141	1.452738
I_fund_Q_SYM-_rc@AC [A]	0.051415	-0.895892	-0.947307

Injected current at 60ms



时间 [s]	A	B	间隔
	0:16.917854	0:16.978383	0.060530
U1_tRMS_rc@AC [V]	230.2319	112.0901	-118.1418
U2_tRMS_rc@AC [V]	230.1220	112.0195	-118.1025
U3_tRMS_rc@AC [V]	230.8885	111.9101	-118.9784
I1_tRMS_rc@AC [A]	17.61392	0.359982	-17.25394
I2_tRMS_rc@AC [A]	17.71002	0.364353	-17.34566
I3_tRMS_rc@AC [A]	17.52754	0.356952	17.17059
P_t_rc@AC [W]	12173.37	-0.449780	-12173.82
Q_fund_rc@AC [var]	193.8698	119.4470	-74.42276
S_t_rc@AC [VA]	12177.66	121.1117	-12056.55
U_fund_SYM+_rc@AC [V]	399.0634	193.9971	-205.0664
U_fund_SYM-_rc@AC [V]	0.478624	0.138927	-0.339697
I_fund_P_SYM+_rc@AC [A]	17.60894	-1.429e-3	-17.61037
I_fund_P_SYM-_rc@AC [A]	-0.038751	2.448e-3	0.041199
I_fund_Q_SYM+_rc@AC [A]	0.280403	0.355484	0.075081
I_fund_Q_SYM-_rc@AC [A]	0.051415	-2.072e-3	-0.053487

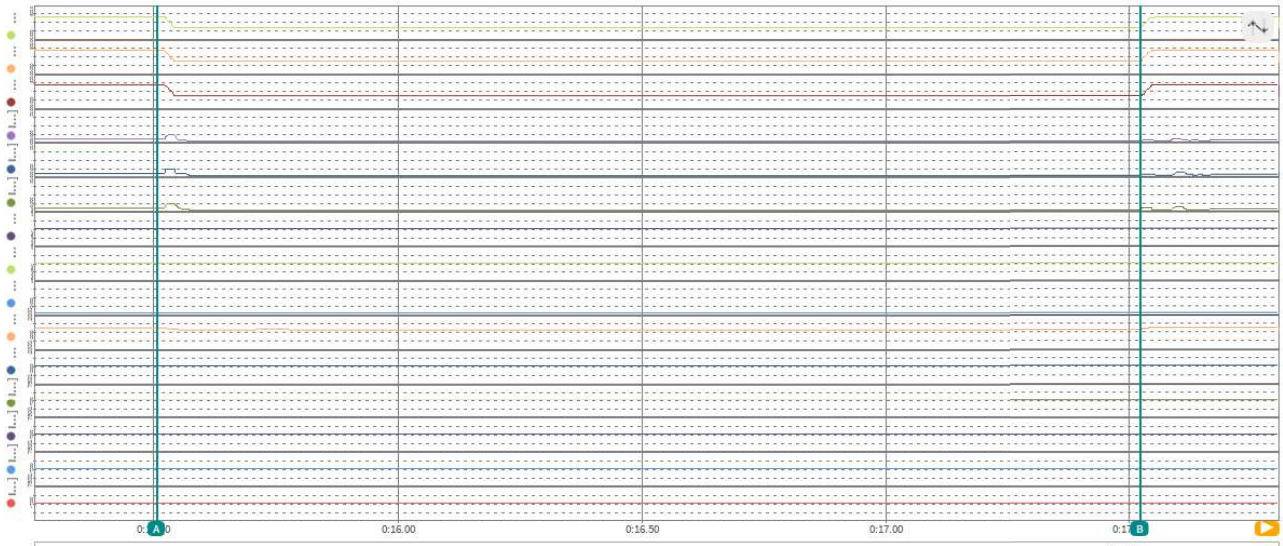
Recover time – Active power



时间 [s]	A	B	间隔
	0:18.919118	0:19.429049	0.509931
U1_tRMS_rc@AC [V]	115.1205	230.6402	115.5197
U2_tRMS_rc@AC [V]	115.3615	230.2294	114.8680
U3_tRMS_rc@AC [V]	115.2810	230.3369	115.0559
I1_tRMS_rc@AC [A]	0.513967	16.75754	16.24357
I2_tRMS_rc@AC [A]	0.503602	16.76114	16.25754
I3_tRMS_rc@AC [A]	0.508815	16.53433	16.02552
P_t_rc@AC [W]	-44.58969	11527.73	11572.32
Q_fund_rc@AC [var]	136.1741	211.4181	75.24405
S_t_rc@AC [VA]	175.9210	11532.34	11356.42
U_fund_SYM+_rc@AC [V]	199.6165	399.0630	199.4466
U_fund_SYM-_rc@AC [V]	0.607422	0.445327	-0.162095
I_fund_P_SYM+_rc@AC [A]	-0.129060	16.67737	16.80643
I_fund_P_SYM-_rc@AC [A]	-1.140e-3	0.068338	0.069478
I_fund_Q_SYM+_rc@AC [A]	0.393851	0.305809	-0.088042
I_fund_Q_SYM-_rc@AC [A]	8.594e-4	-0.017128	-0.017988

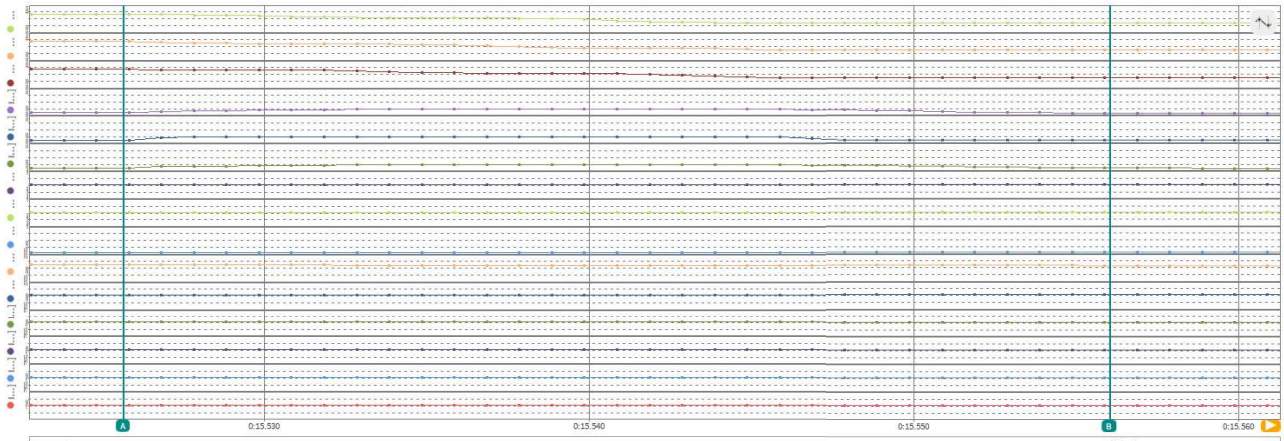
Test – VD3.2

Duration fault time



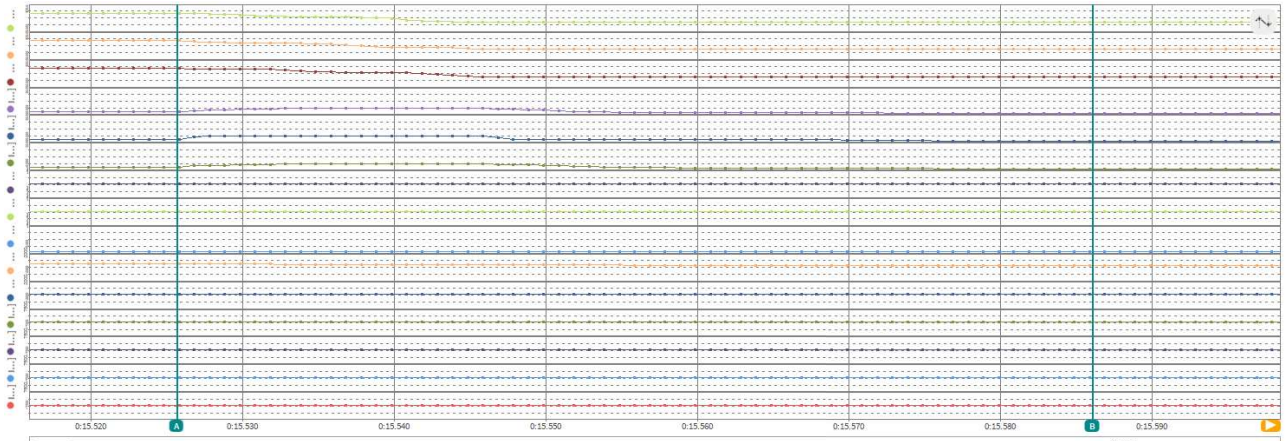
时间 [s]	A 0:15.508104	B 0:17.521406	间隔 2.013302
U1_tRMS_rc@AC [V]	230.6404	114.8232	-115.8172
U2_tRMS_rc@AC [V]	230.6682	115.5638	-115.1044
U3_tRMS_rc@AC [V]	229.8155	115.3804	-114.4351
I1_tRMS_rc@AC [A]	3.468600	0.505748	-2.962852
I2_tRMS_rc@AC [A]	3.475743	0.478208	-2.997534
I3_tRMS_rc@AC [A]	3.433567	0.491728	-2.941840
P_t_rc@AC [W]	2380.431	-40.19610	-2420.627
Q_fund_rc@AC [var]	2.928583	135.6398	132.7112
S_t_rc@AC [VA]	2390.829	170.0708	-2220.759
U_fund_SYM+_rc@AC [V]	398.9933	199.6031	-199.3902
U_fund_SYM-_rc@AC [V]	1.076450	1.151734	0.075284
I_fund_P_SYM+_rc@AC [A]	3.443231	-0.116170	-3.559401
I_fund_P_SYM-_rc@AC [A]	0.022941	2.926e-3	-0.020015
I_fund_Q_SYM+_rc@AC [A]	4.239e-3	0.392367	0.388128
I_fund_Q_SYM-_rc@AC [A]	-1.398e-3	-4.710e-3	-3.312e-3

Injected current at 30ms



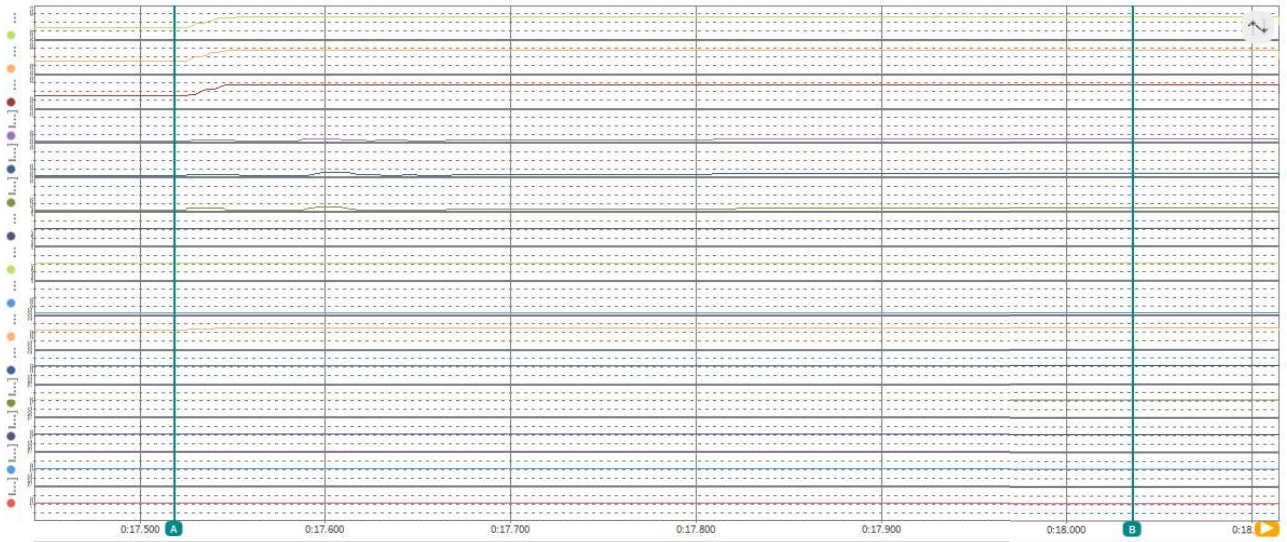
时间 [s]	A 0:15.525696	B 0:15.556016	间隔 0.030320
U1_tRMS_rc@AC [V]	230.0963	115.4515	-114.6448
U2_tRMS_rc@AC [V]	230.3053	115.5031	-114.8021
U3_tRMS_rc@AC [V]	230.7144	115.2263	-115.4881
I1_tRMS_rc@AC [A]	3.459410	2.258861	-1.200549
I2_tRMS_rc@AC [A]	3.476354	3.204836	-0.271518
I3_tRMS_rc@AC [A]	3.470506	2.937645	-0.532861
P_t_rc@AC [W]	2386.221	402.7982	-1983.423
Q_fund_rc@AC [var]	-0.202257	238.3976	238.5998
S_t_rc@AC [VA]	2397.316	969.4514	-1427.865
U_fund_SYM+_rc@AC [V]	398.9675	199.8638	-199.1237
U_fund_SYM-_rc@AC [V]	0.376202	0.149608	-0.226595
I_fund_P_SYM+_rc@AC [A]	3.451614	1.159497	-2.292117
I_fund_P_SYM-_rc@AC [A]	4.524e-3	-0.660557	-0.665081
I_fund_Q_SYM+_rc@AC [A]	-2.920e-4	0.689322	0.689614
I_fund_Q_SYM-_rc@AC [A]	0.012744	-0.756218	-0.768962

Injected current at 60ms



时间 [s]	A	B	间隔
	0:15.525696	0:15.586047	0.060351
U1_tRMS_rc@AC [V]	230.0963	113.0183	-117.0779
U2_tRMS_rc@AC [V]	230.3053	112.8015	-117.5037
U3_tRMS_rc@AC [V]	230.7144	112.7021	-118.0123
I1_tRMS_rc@AC [A]	3.459410	0.368165	-3.091246
I2_tRMS_rc@AC [A]	3.476354	0.367536	-3.108818
I3_tRMS_rc@AC [A]	3.470506	0.365035	3.105471
P_t_rc@AC [W]	2386.221	-0.141251	-2386.362
Q_fund_rc@AC [var]	-0.202257	122.4091	122.6113
S_t_rc@AC [VA]	2397.316	124.2083	-2273.108
U_fund_SYM+_rc@AC [V]	308.0875	105.4410	-203.5465
U_fund_SYM-_rc@AC [V]	0.376202	0.284277	-0.091926
I_fund_P_SYM+_rc@AC [A]	3.451614	-5.316e-4	-3.452146
I_fund_P_SYM-_rc@AC [A]	4.524e-3	6.339e-4	-3.890e-3
I_fund_Q_SYM+_rc@AC [A]	-2.920e-4	0.361606	0.361898
I_fund_Q_SYM-_rc@AC [A]	0.012744	8.097e-4	-0.011935

Recover time – Active power



时间 [s]	A	B	间隔
	0:17.519028	0:18.035703	0.516675
U1_tRMS_rc@AC [V]	115.0740	230.6565	115.5825
U2_tRMS_rc@AC [V]	114.8826	230.1908	115.3082
U3_tRMS_rc@AC [V]	115.8108	230.2881	114.4773
I1_tRMS_rc@AC [A]	0.505000	3.303699	2.798699
I2_tRMS_rc@AC [A]	0.480766	3.308297	2.827531
I3_tRMS_rc@AC [A]	0.490418	3.222492	2.732073
P_t_rc@AC [W]	-40.29216	2255.271	2295.563
Q_fund_rc@AC [var]	135.4321	6.630565	-128.8015
S_t_rc@AC [VA]	170.1398	2265.661	2095.521
U_fund_SYM+_rc@AC [V]	199.6059	399.0229	199.4170
U_fund_SYM-_rc@AC [V]	0.701299	0.495212	-0.206087
I_fund_P_SYM+_rc@AC [A]	-0.116582	3.262915	3.379496
I_fund_P_SYM-_rc@AC [A]	2.687e-3	0.021762	0.019075
I_fund_Q_SYM+_rc@AC [A]	0.391729	9.570e-3	-0.382159
I_fund_Q_SYM-_rc@AC [A]	1.721e-3	-8.872e-3	-0.010593

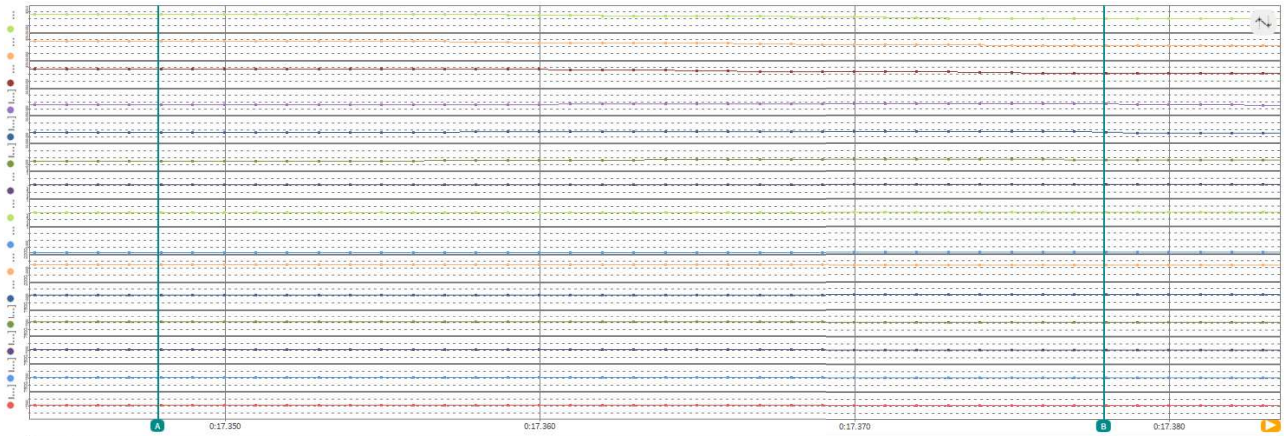
Test – VD4.1

Duration fault time



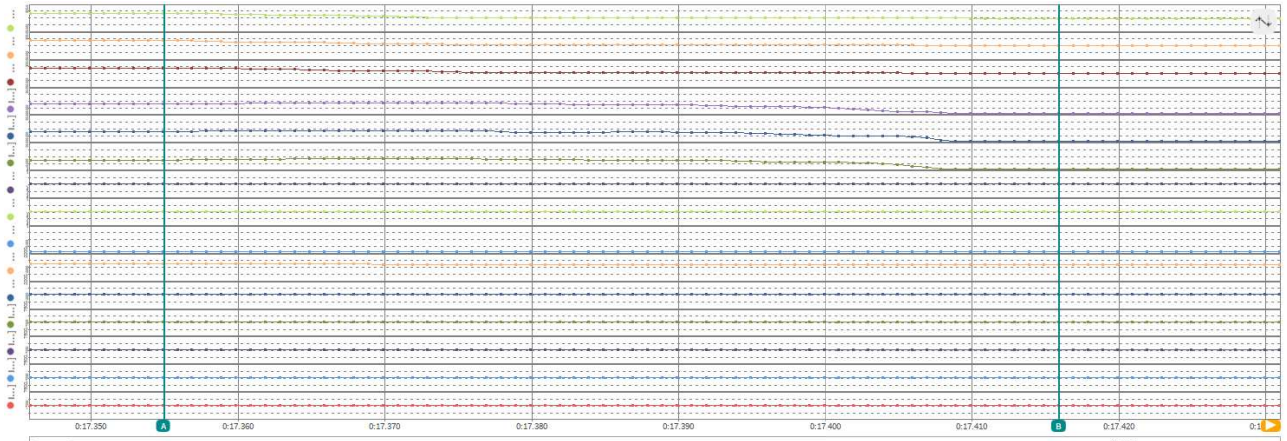
时间 [s]	A 0:17.348392	B 0:20.351233	间隔 3.002841
U1_tRMS_rc@AC [V]	230.6288	172.6013	-58.02753
U2_tRMS_rc@AC [V]	230.2505	172.8199	-57.43062
U3_tRMS_rc@AC [V]	230.3710	173.0690	-57.30199
I1_tRMS_rc@AC [A]	17.65405	0.630319	-17.02373
I2_tRMS_rc@AC [A]	17.71190	0.609026	-17.10288
I3_tRMS_rc@AC [A]	17.43788	0.616194	-16.82169
P_t_rc@AC [W]	12162.72	-44.77135	-12207.49
Q_fund_rc@AC [var]	187.8488	293.3005	105.4517
S_t_rc@AC [VA]	12166.89	320.6898	-11846.20
U_fund_SYM+_rc@AC [V]	399.0830	299.3440	-99.73904
U_fund_SYM-_rc@AC [V]	0.425346	0.794882	0.369536
I_fund_P_SYM+_rc@AC [A]	17.59517	-0.086443	-17.68161
I_fund_P_SYM-_rc@AC [A]	0.020734	3.185e-3	-0.017549
I_fund_Q_SYM+_rc@AC [A]	0.271803	0.565701	0.293897
I_fund_Q_SYM-_rc@AC [A]	-0.074865	1.328e-5	0.074878

Injected current at 30ms



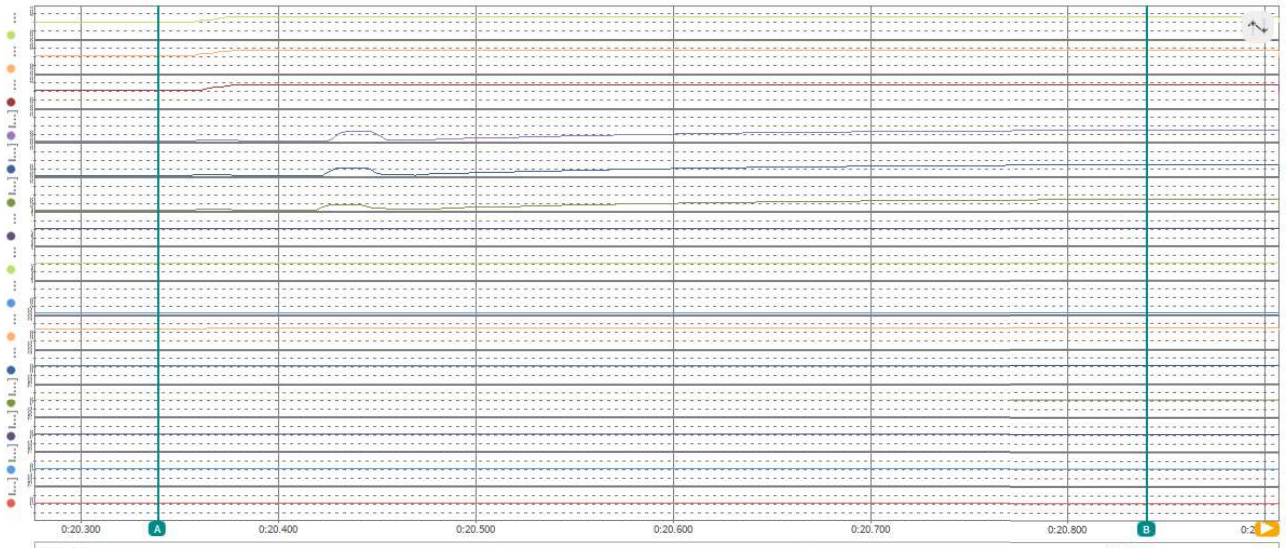
时间 [s]	A 0:17.347876	B 0:17.377919	间隔 0.030043
U1_tRMS_rc@AC [V]	230.6371	173.4447	-57.19241
U2_tRMS_rc@AC [V]	230.2516	173.1678	-57.08379
U3_tRMS_rc@AC [V]	230.3655	173.0192	-57.34627
I1_tRMS_rc@AC [A]	17.65882	19.49413	1.835306
I2_tRMS_rc@AC [A]	17.71580	19.28732	1.571516
I3_tRMS_rc@AC [A]	17.43400	18.77609	1.342061
P_t_rc@AC [W]	12163.96	9736.808	-2427.155
Q_fund_rc@AC [var]	184.7460	388.0450	203.2990
S_t_rc@AC [VA]	12168.06	9969.720	-2198.345
U_fund_SYM+_rc@AC [V]	399.0856	299.9972	-99.08862
U_fund_SYM-_rc@AC [V]	0.652707	0.472969	-0.179737
I_fund_P_SYM+_rc@AC [A]	17.59704	18.71876	1.121717
I_fund_P_SYM-_rc@AC [A]	0.060646	0.080771	0.020125
I_fund_Q_SYM+_rc@AC [A]	0.267351	0.746982	0.479631
I_fund_Q_SYM-_rc@AC [A]	-0.072674	-0.091803	-0.019130

Injected current at 60ms



时间 [s]	A 0:17.354973	B 0:17.415924	间隔 0.060951
U1_tRMS_rc@AC [V]	230.6557	168.6118	-62.04395
U2_tRMS_rc@AC [V]	230.2697	168.5253	-61.74431
U3_tRMS_rc@AC [V]	230.3492	168.4434	-61.90585
I1_tRMS_rc@AC [A]	17.62715	0.539028	-17.08813
I2_tRMS_rc@AC [A]	17.71461	0.550608	-17.16400
I3_tRMS_rc@AC [A]	17.44247	0.608316	16.83415
P_t_rc@AC [W]	12158.71	-16.72409	-12175.44
Q_fund_rc@AC [var]	195.0864	271.9485	76.86205
S_t_rc@AC [VA]	12162.80	286.1448	-11876.65
U_fund_SYM+_rc@AC [V]	300.0990	291.8933	-107.2057
U_fund_SYM-_rc@AC [V]	0.910484	0.140931	-0.769553
I_fund_P_SYM+_rc@AC [A]	17.58819	-0.033342	-17.62153
I_fund_P_SYM-_rc@AC [A]	0.105155	9.824e-3	-0.095331
I_fund_Q_SYM+_rc@AC [A]	0.282246	0.537916	0.255670
I_fund_Q_SYM-_rc@AC [A]	-0.025609	-0.021560	4.049e-3

Recover time – Active power



时间 [s]	A 0:20.339293	B 0:20.840210	间隔 0.500917
U1_tRMS_rc@AC [V]	172.9732	230.6365	57.66333
U2_tRMS_rc@AC [V]	172.3275	230.2392	57.91167
U3_tRMS_rc@AC [V]	173.1814	230.3715	57.19006
I1_tRMS_rc@AC [A]	0.624147	16.58876	15.96461
I2_tRMS_rc@AC [A]	0.610854	16.59419	15.98334
I3_tRMS_rc@AC [A]	0.615119	16.39698	15.78186
P_t_rc@AC [W]	-44.12846	11419.76	11463.89
Q_fund_rc@AC [var]	292.5923	199.7358	-92.85648
S_t_rc@AC [VA]	319.7548	11424.00	11104.25
U_fund_SYM+_rc@AC [V]	299.3371	399.0871	99.75000
U_fund_SYM-_rc@AC [V]	0.753499	0.313699	-0.439799
I_fund_P_SYM+_rc@AC [A]	-0.085212	16.52015	16.60536
I_fund_P_SYM-_rc@AC [A]	-2.153e-3	0.081633	0.083787
I_fund_Q_SYM+_rc@AC [A]	0.564348	0.288945	-0.275403
I_fund_Q_SYM-_rc@AC [A]	-2.944e-4	-0.059672	-0.059377

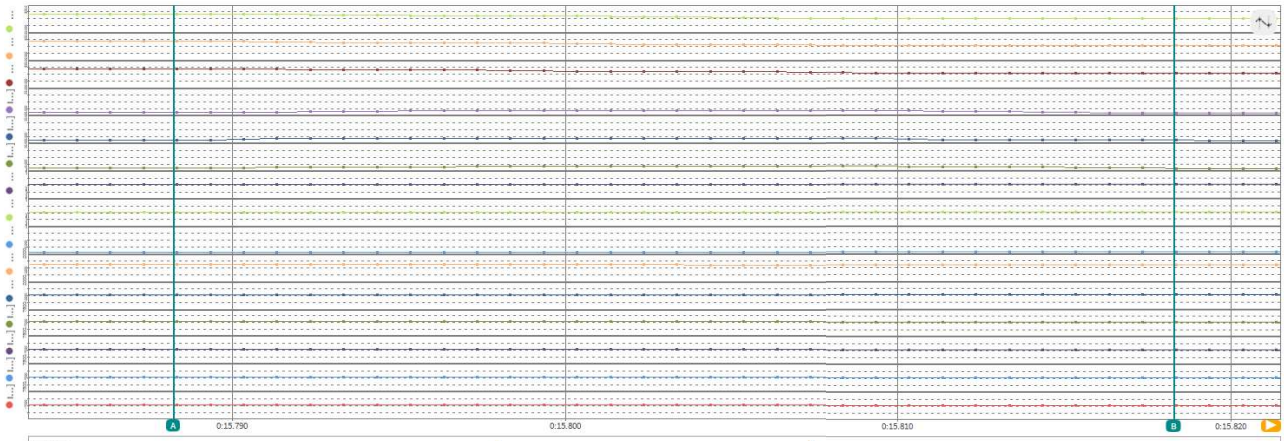
Test – VD4.2

Duration fault time



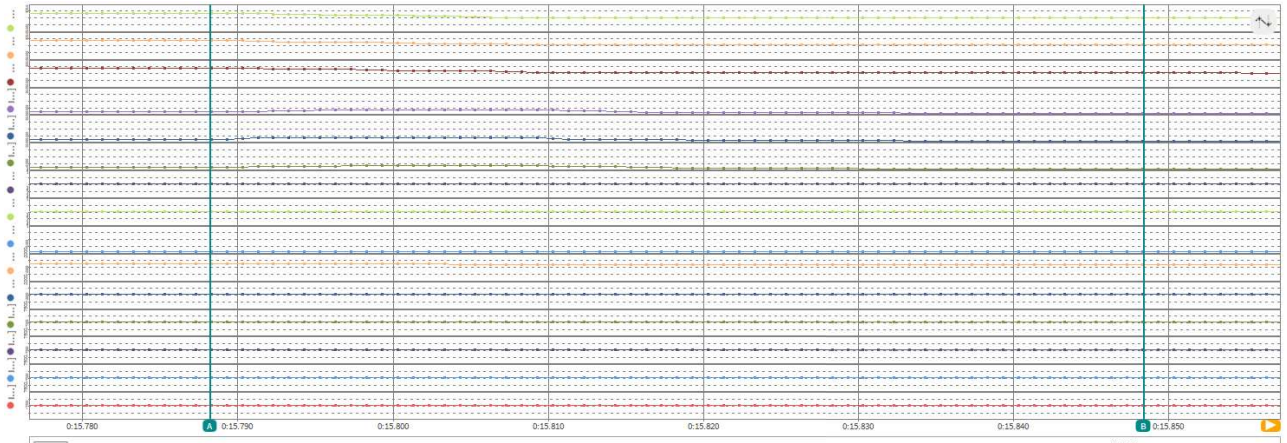
时间 [s]	A 0:15.771787	B 0:18.795737	间隔 3.023950
U1_tRMS_rc@AC [V]	230.3977	192.0135	-38.38420
U2_tRMS_rc@AC [V]	230.7332	194.1663	-36.56689
U3_tRMS_rc@AC [V]	229.9522	178.6175	-51.33469
I1_tRMS_rc@AC [A]	3.483572	1.465729	-2.017843
I2_tRMS_rc@AC [A]	3.553423	0.896767	-2.656656
I3_tRMS_rc@AC [A]	3.432234	0.908563	-2.523671
P_t_rc@AC [W]	2400.279	-171.6561	-2571.935
Q_fund_rc@AC [var]	-31.65733	367.4204	399.0777
S_t_rc@AC [VA]	2411.750	617.8472	-1793.902
U_fund_SYM+_rc@AC [V]	398.9894	323.4914	-75.49805
U_fund_SYM-_rc@AC [V]	1.725854	16.01714	14.29129
I_fund_P_SYM+_rc@AC [A]	3.472569	-0.263811	-3.736380
I_fund_P_SYM-_rc@AC [A]	0.039019	-0.103421	-0.142440
I_fund_Q_SYM+_rc@AC [A]	-0.045834	0.660453	0.706287
I_fund_Q_SYM-_rc@AC [A]	2.683e-3	-0.091407	-0.094090

Injected current at 30ms



时间 [s]	A 0:15.788254	B 0:15.818293	间隔 0.030039
U1_tRMS_rc@AC [V]	230.5044	172.1537	-58.35065
U2_tRMS_rc@AC [V]	229.7667	172.2751	-57.49167
U3_tRMS_rc@AC [V]	230.8147	172.2726	-58.54210
I1_tRMS_rc@AC [A]	3.523511	1.923676	-1.599836
I2_tRMS_rc@AC [A]	3.512182	2.641731	-0.870451
I3_tRMS_rc@AC [A]	3.463994	2.926328	-0.537668
P_t_rc@AC [W]	2407.648	972.3653	-1435.283
Q_fund_rc@AC [var]	-39.93145	298.8044	338.7358
S_t_rc@AC [VA]	2418.708	1290.398	-1128.310
U_fund_SYM+_rc@AC [V]	398.9901	298.3134	-100.6766
U_fund_SYM-_rc@AC [V]	1.023561	0.187627	-0.835934
I_fund_P_SYM+_rc@AC [A]	3.483179	1.877508	-1.605672
I_fund_P_SYM-_rc@AC [A]	-0.014443	0.675259	0.689701
I_fund_Q_SYM+_rc@AC [A]	-0.057811	0.578355	0.636166
I_fund_Q_SYM-_rc@AC [A]	3.352e-4	-0.107387	-0.107723

Injected current at 60ms



时间 [s]	A 0:15.788254	B 0:15.848384	间隔 0.060130
U1_tRMS_rc@AC [V]	230.5044	170.6393	-59.86504
U2_tRMS_rc@AC [V]	229.7667	169.7622	-60.00452
U3_tRMS_rc@AC [V]	230.8147	169.6081	-61.20663
I1_tRMS_rc@AC [A]	3.523511	0.533734	-2.989777
I2_tRMS_rc@AC [A]	3.512182	0.540199	-2.971983
I3_tRMS_rc@AC [A]	3.463994	0.550355	2.913639
P_t_rc@AC [W]	2407.648	-3.125441	-2410.774
Q_fund_rc@AC [var]	-39.93145	272.4220	312.3535
S_t_rc@AC [VA]	2418.708	276.1262	-2142.582
U_fund_SYM+_rc@AC [V]	308.0901	204.4512	-104.5389
U_fund_SYM-_rc@AC [V]	1.023561	0.538451	-0.485110
I_fund_P_SYM+_rc@AC [A]	3.483179	-6.199e-3	-3.489379
I_fund_P_SYM-_rc@AC [A]	-0.014443	-1.415e-3	0.013028
I_fund_Q_SYM+_rc@AC [A]	-0.057811	0.534175	0.591987
I_fund_Q_SYM-_rc@AC [A]	3.352e-4	-0.013205	-0.013540

Recover time – Active power



时间 [s]	A 0:18.79199	B 0:19.30364	间隔 0.51165
U1_tRMS_rc@AC [V]	173.4442	230.6328	57.18858
U2_tRMS_rc@AC [V]	179.0562	230.1831	51.12686
U3_tRMS_rc@AC [V]	175.3228	230.3111	54.98830
I1_tRMS_rc@AC [A]	0.654960	3.294416	2.639456
I2_tRMS_rc@AC [A]	0.879140	3.311691	2.432551
I3_tRMS_rc@AC [A]	0.861102	3.284391	2.423289
P_t_rc@AC [W]	-68.48066	2267.877	2336.357
Q_fund_rc@AC [var]	293.8575	-11.34431	-305.2018
S_t_rc@AC [VA]	421.9853	2278.528	1856.542
U_fund_SYM+_rc@AC [V]	304.0040	399.0180	95.01401
U_fund_SYM-_rc@AC [V]	5.645021	0.344027	-5.300994
I_fund_P_SYM+_rc@AC [A]	-0.121545	3.281004	3.402549
I_fund_P_SYM-_rc@AC [A]	-0.032864	0.010348	0.043213
I_fund_Q_SYM+_rc@AC [A]	0.557745	-0.016398	-0.574143
I_fund_Q_SYM-_rc@AC [A]	0.018224	-0.019478	-0.037701

Test – VD5.1

Duration fault time



时间 [s]	A 0:13.24212	B 1:14.25870	间隔 1:01.01658
U1_tRMS_rc@AC [V]	205.2737	232.2713	26.99760
U2_tRMS_rc@AC [V]	204.5921	231.9573	27.36519
U3_tRMS_rc@AC [V]	204.5500	231.9389	27.38893
I1_tRMS_rc@AC [A]	16.96145	16.48647	-0.474981
I2_tRMS_rc@AC [A]	17.18006	16.50635	-0.673710
I3_tRMS_rc@AC [A]	16.73279	16.24021	-0.492586
P_t_rc@AC [W]	10415.44	11416.48	1001.049
Q_fund_rc@AC [var]	41.12793	45.55672	4.428791
S_t_rc@AC [VA]	10419.34	11424.84	1005.500
U_fund_SYM+_rc@AC [V]	354.7290	401.9155	47.18649
U_fund_SYM-_rc@AC [V]	0.489883	1.230023	0.740140
I_fund_P_SYM+_rc@AC [A]	16.95131	16.39990	-0.551413
I_fund_P_SYM-_rc@AC [A]	-0.018599	0.120651	0.139249
I_fund_Q_SYM+_rc@AC [A]	0.067005	0.065302	-1.704e-3
I_fund_Q_SYM-_rc@AC [A]	-0.133818	0.021488	0.155305

Recover time – Active power



时间 [s]	A 1:14.19461	B 1:14.71183	间隔 0.51722
U1_tRMS_rc@AC [V]	216.0208	230.6143	14.59354
U2_tRMS_rc@AC [V]	215.4959	230.2312	14.73532
U3_tRMS_rc@AC [V]	210.1573	230.3453	20.18805
I1_tRMS_rc@AC [A]	16.84674	17.62165	0.774914
I2_tRMS_rc@AC [A]	17.05323	17.63766	0.584425
I3_tRMS_rc@AC [A]	17.20494	17.44281	0.237865
P_t_rc@AC [W]	10843.83	12138.22	1294.396
Q_fund_rc@AC [var]	104.2633	195.2587	90.99535
S_t_rc@AC [VA]	10929.89	12142.41	1212.522
U_fund_SYM+_rc@AC [V]	370.0597	399.0535	28.99387
U_fund_SYM-_rc@AC [V]	6.736653	0.458529	-6.278125
I_fund_P_SYM+_rc@AC [A]	16.97281	17.56097	0.588160
I_fund_P_SYM-_rc@AC [A]	-0.232471	0.080024	0.312495
I_fund_Q_SYM+_rc@AC [A]	0.163964	0.282482	0.118518
I_fund_Q_SYM-_rc@AC [A]	-0.069864	-0.028044	0.041821

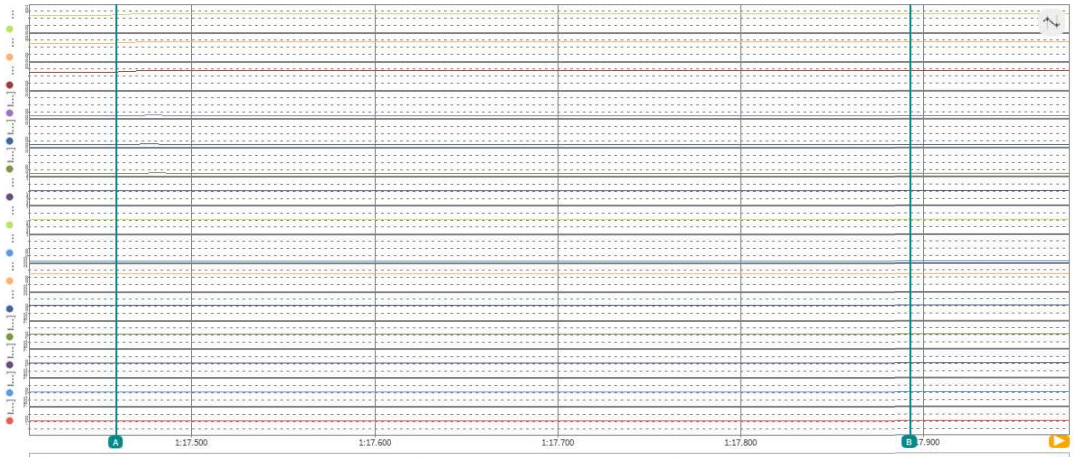
Test – VD5.2

Duration fault time



时间 [s]	A 0:16.28764	B 1:17.40192	间隔 1:01.11428
U1_tRMS_rc@AC [V]	230.6048	207.5747	-23.03008
U2_tRMS_rc@AC [V]	230.1745	207.1966	-22.97795
U3_tRMS_rc@AC [V]	230.3094	207.2702	-23.03920
I1_tRMS_rc@AC [A]	3.498641	3.917205	0.418564
I2_tRMS_rc@AC [A]	3.526192	3.933735	0.407543
I3_tRMS_rc@AC [A]	3.414766	3.842362	0.427596
P_t_rc@AC [W]	2393.898	2406.325	12.42651
Q_fund_rc@AC [var]	-14.21816	-191.1585	-176.9404
S_t_rc@AC [VA]	2404.896	2424.576	19.68042
U_fund_SYM+_rc@AC [V]	398.9961	359.1317	-39.86447
U_fund_SYM-_rc@AC [V]	0.376808	0.491312	0.114504
I_fund_P_SYM+_rc@AC [A]	3.463696	3.867994	0.404297
I_fund_P_SYM-_rc@AC [A]	0.014633	0.010885	-3.749e-3
I_fund_Q_SYM+_rc@AC [A]	-0.020593	-0.307336	-0.286743
I_fund_Q_SYM-_rc@AC [A]	-0.025806	-0.019729	6.077e-3

Recover time – Active power



时间 [s]	A 1:17.45892	B 1:17.89249	间隔 0.43357
U1_tRMS_rc@AC [V]	216.9040	230.6230	13.71901
U2_tRMS_rc@AC [V]	215.6073	230.1752	14.56792
U3_tRMS_rc@AC [V]	211.0810	230.2809	19.19995
I1_tRMS_rc@AC [A]	3.253607	3.522072	0.268465
I2_tRMS_rc@AC [A]	3.479291	3.521279	0.041988
I3_tRMS_rc@AC [A]	3.642653	3.413168	-0.229485
P_t_rc@AC [W]	2038.339	2398.188	359.8495
Q_fund_rc@AC [var]	-37.21326	-7.326133	29.91683
S_t_rc@AC [VA]	2224.776	2408.770	183.9939
U_fund_SYM+_rc@AC [V]	371.1461	398.9904	27.84427
U_fund_SYM-_rc@AC [V]	6.352890	0.469848	-5.883042
I_fund_P_SYM+_rc@AC [A]	3.221626	3.469872	0.248245
I_fund_P_SYM-_rc@AC [A]	-0.294284	0.026247	0.320532
I_fund_Q_SYM+_rc@AC [A]	-0.056068	-0.010636	0.045432
I_fund_Q_SYM-_rc@AC [A]	-0.104184	-0.020101	0.084083

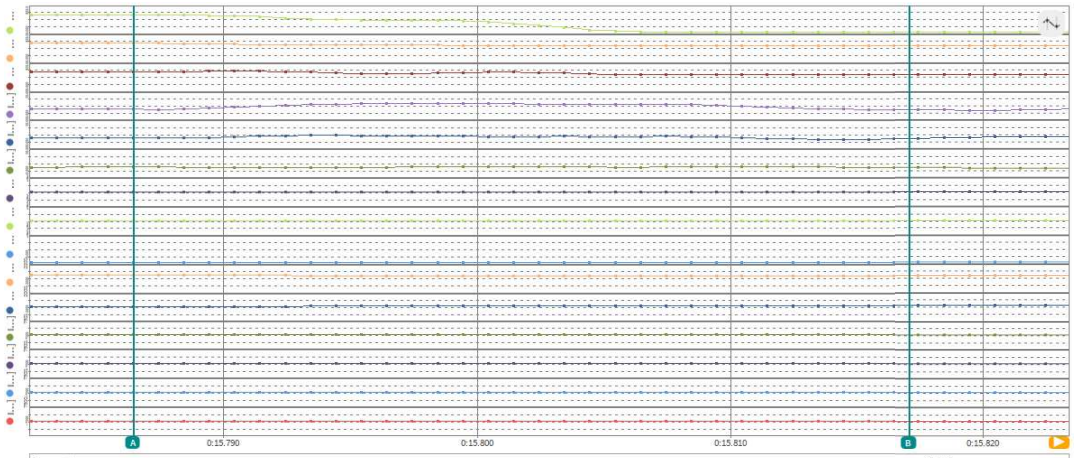
Test – VD6.1

Duration fault time



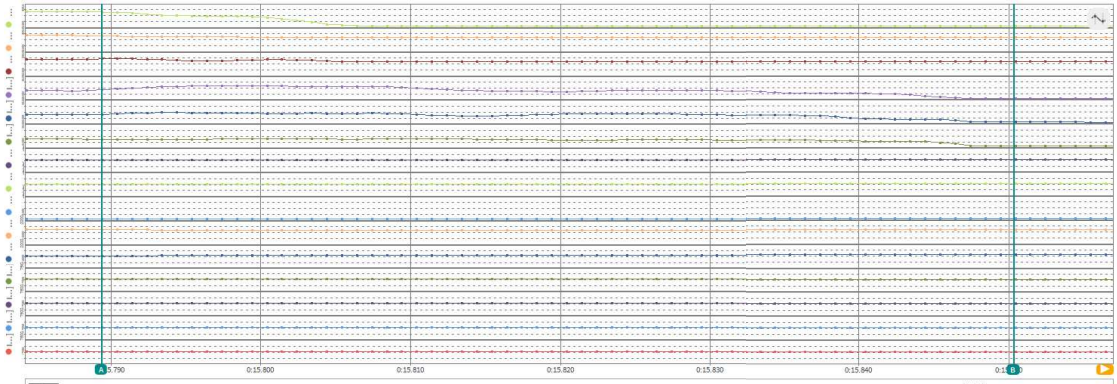
时间 [s]	A 0:15.7864489	B 0:16.0873786	间隔 0.3009296
U1_tRMS_rc@AC [V]	230.0677	7.026514	-223.0412
U2_tRMS_rc@AC [V]	228.7186	200.1649	-28.55370
U3_tRMS_rc@AC [V]	232.5064	200.3916	-32.11484
I1_tRMS_rc@AC [A]	17.60034	0.083126	-17.51721
I2_tRMS_rc@AC [A]	17.59348	0.933672	-16.65981
I3_tRMS_rc@AC [A]	17.58888	0.904382	-16.68450
P_t_rc@AC [W]	12158.56	-126.0461	-12284.61
Q_fund_rc@AC [var]	190.5773	298.1457	107.5683
S_t_rc@AC [VA]	12162.75	368.7030	-11794.05
U_fund_SYM+_rc@AC [V]	398.9084	207.7035	-191.2049
U_fund_SYM-_rc@AC [V]	3.982683	192.6652	188.6825
I_fund_P_SYM+_rc@AC [A]	17.57652	-0.194716	-17.77123
I_fund_P_SYM-_rc@AC [A]	0.089351	-0.168657	-0.258007
I_fund_Q_SYM+_rc@AC [A]	0.275759	0.445877	0.170117
I_fund_Q_SYM-_rc@AC [A]	1.931e-3	0.412641	0.410711

Injected current at 30ms



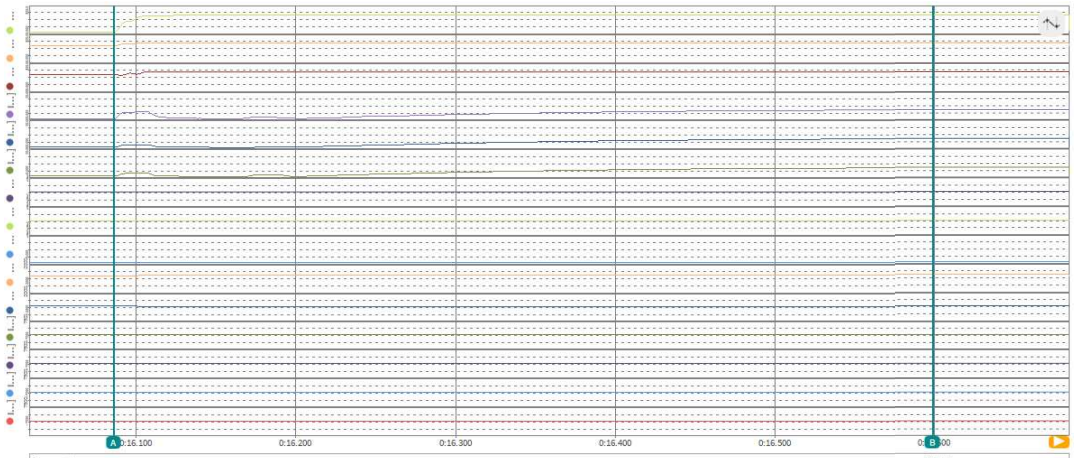
时间 [s]	A 0:15.7864489	B 0:15.8170838	间隔 0.0306349
U1_tRMS_rc@AC [V]	230.0677	8.010525	-222.0572
U2_tRMS_rc@AC [V]	228.7186	200.0809	-28.63770
U3_tRMS_rc@AC [V]	232.5064	200.1889	-32.31750
I1_tRMS_rc@AC [A]	17.60034	16.58356	-1.016779
I2_tRMS_rc@AC [A]	17.59348	16.40177	-1.191711
I3_tRMS_rc@AC [A]	17.58888	16.58874	-1.000145
P_t_rc@AC [W]	12158.56	6375.772	-5782.791
Q_fund_rc@AC [var]	190.5773	1336.601	1146.024
S_t_rc@AC [VA]	12162.75	6735.404	-5427.350
U_fund_SYM+_rc@AC [V]	398.9084	208.1243	-190.7842
U_fund_SYM-_rc@AC [V]	3.982683	191.5317	187.5490
I_fund_P_SYM+_rc@AC [A]	17.57652	13.91345	-3.663061
I_fund_P_SYM-_rc@AC [A]	0.089351	4.056099	3.966749
I_fund_Q_SYM+_rc@AC [A]	0.275759	3.753411	3.477652
I_fund_Q_SYM-_rc@AC [A]	1.931e-3	-0.033698	-0.035629

Injected current at 60ms



时间 [s]	A 0:15.7893882	B 0:15.8503190	间隔 0.0609308
U1_tRMS_rc@AC [V]	232.3958	7.044383	-225.3514
U2_tRMS_rc@AC [V]	225.5232	197.3935	-28.12968
U3_tRMS_rc@AC [V]	233.2928	195.2071	-38.08577
I1_tRMS_rc@AC [A]	18.31239	0.159059	-18.15333
I2_tRMS_rc@AC [A]	17.88808	1.583851	-16.30423
I3_tRMS_rc@AC [A]	17.32605	1.321209	-16.00484
P_t_rc@AC [W]	12148.40	-155.0820	-12303.48
Q_fund_rc@AC [var]	-122.4989	-3.821066	118.6778
S_t_rc@AC [VA]	12331.94	571.6719	-11760.27
U_fund_SYM+_rc@AC [V]	397.9419	203.7113	-194.2306
U_fund_SYM-_rc@AC [V]	7.416093	188.6715	181.2554
I_fund_P_SYM+_rc@AC [A]	17.69395	-0.450335	-18.14429
I_fund_P_SYM-_rc@AC [A]	-0.056551	0.021185	0.077737
I_fund_Q_SYM+_rc@AC [A]	-0.170279	-0.057665	0.112614
I_fund_Q_SYM-_rc@AC [A]	-0.401818	0.055009	0.456827

Recover time – Active power



时间 [s]	A 0:16.0866056	B 0:16.5992585	间隔 0.5126529
U1_tRMS_rc@AC [V]	7.026514	230.6579	223.6314
U2_tRMS_rc@AC [V]	200.1649	230.2384	30.07349
U3_tRMS_rc@AC [V]	200.3916	230.3525	29.96098
I1_tRMS_rc@AC [A]	0.083126	16.56552	16.48239
I2_tRMS_rc@AC [A]	0.933672	16.59683	15.66316
I3_tRMS_rc@AC [A]	0.904382	16.37290	15.46852
P_t_rc@AC [W]	-126.0461	11408.86	11534.91
Q_fund_rc@AC [var]	298.1457	218.9051	-79.24060
S_t_rc@AC [VA]	368.7030	11413.74	11045.03
U_fund_SYM+_rc@AC [V]	207.7035	399.0876	191.3841
U_fund_SYM-_rc@AC [V]	192.6652	0.442248	-192.2230
I_fund_P_SYM+_rc@AC [A]	-0.194716	16.50429	16.69901
I_fund_P_SYM-_rc@AC [A]	-0.168657	0.057389	0.226046
I_fund_Q_SYM+_rc@AC [A]	0.445877	0.316654	-0.129223
I_fund_Q_SYM-_rc@AC [A]	0.412641	-0.040630	-0.453272

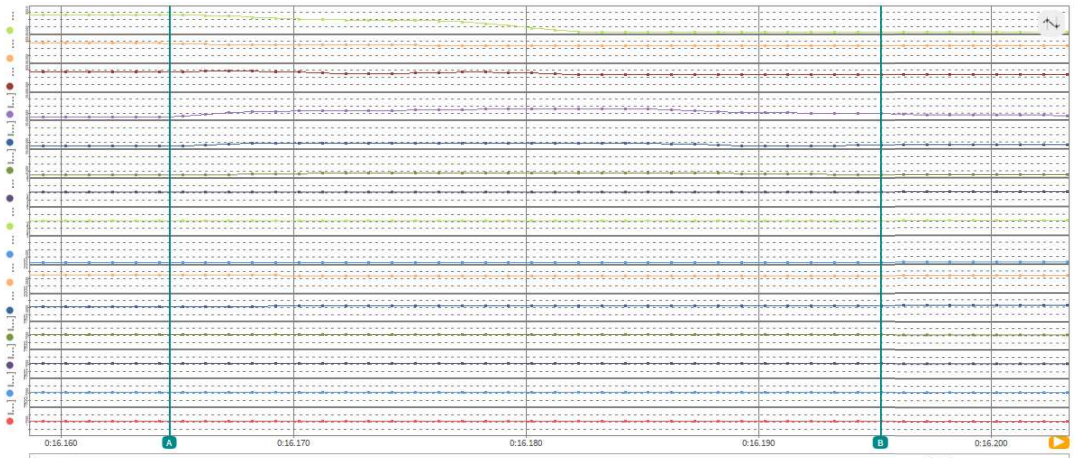
Test – VD6.2

Duration fault time



时间 [s]	A 0:16.1602820	B 0:16.4640886	间隔 0.3038065
U1_tRMS_rc@AC [V]	232.8192	7.030800	-225.7884
U2_tRMS_rc@AC [V]	229.1101	200.2505	-28.85963
U3_tRMS_rc@AC [V]	229.1658	200.3696	-28.79611
I1_tRMS_rc@AC [A]	3.517694	0.088104	-3.429590
I2_tRMS_rc@AC [A]	3.479171	0.914725	-2.564446
I3_tRMS_rc@AC [A]	3.469984	0.891989	-2.577995
P_t_rc@AC [W]	2400.194	-130.0874	-2530.282
Q_fund_rc@AC [var]	-5.623664	296.5532	302.1769
S_t_rc@AC [VA]	2411.301	362.5210	-2048.780
U_fund_SYM+_rc@AC [V]	398.7702	207.7706	-190.9997
U_fund_SYM-_rc@AC [V]	4.386531	192.6587	188.2722
I_fund_P_SYM+_rc@AC [A]	3.470429	-0.200284	-3.670713
I_fund_P_SYM-_rc@AC [A]	0.041745	-0.174573	-0.216318
I_fund_Q_SYM+_rc@AC [A]	-7.950e-3	0.447609	0.455559
I_fund_Q_SYM-_rc@AC [A]	-0.016216	0.405721	0.421937

Injected current at 30ms



时间 [s]	A 0:16.1647038	B 0:16.1952312	间隔 0.0305274
U1_tRMS_rc@AC [V]	228.3663	6.993034	-221.3733
U2_tRMS_rc@AC [V]	231.2570	200.4332	-30.82381
U3_tRMS_rc@AC [V]	231.4339	200.5237	-30.91013
I1_tRMS_rc@AC [A]	3.468663	9.986327	6.517665
I2_tRMS_rc@AC [A]	3.529175	4.677995	1.148820
I3_tRMS_rc@AC [A]	3.451957	3.908148	0.456191
P_t_rc@AC [W]	2396.689	1191.542	-1205.147
Q_fund_rc@AC [var]	1.263237	-27.00890	-28.27214
S_t_rc@AC [VA]	2407.172	1791.136	-616.0355
U_fund_SYM+_rc@AC [V]	398.7587	207.7185	-191.0403
U_fund_SYM-_rc@AC [V]	3.882498	192.9661	189.0836
I_fund_P_SYM+_rc@AC [A]	3.465014	-5.018e-4	-3.465516
I_fund_P_SYM-_rc@AC [A]	0.040455	3.511288	3.470832
I_fund_Q_SYM+_rc@AC [A]	1.493e-3	0.390481	0.388988
I_fund_Q_SYM-_rc@AC [A]	0.031162	-0.492974	-0.524136

Injected current at 60ms



时间 [s]	A 0:16.1647038	B 0:16.2249042	间隔 0.0602004
U1_tRMS_rc@AC [V]	228.3663	7.051929	-221.3144
U2_tRMS_rc@AC [V]	231.2570	196.2489	-35.00809
U3_tRMS_rc@AC [V]	231.4339	196.2782	-35.15567
I1_tRMS_rc@AC [A]	3.468663	0.416461	-3.052201
I2_tRMS_rc@AC [A]	3.529175	0.539570	-2.989605
I3_tRMS_rc@AC [A]	3.451957	0.749544	-2.702413
P_t_rc@AC [W]	2396.689	-95.34540	-2492.034
Q_fund_rc@AC [var]	1.263237	54.71722	53.45398
S_t_rc@AC [VA]	2407.172	255.9460	-2151.226
U_fund_SYM+_rc@AC [V]	398.7587	203.6562	-195.1025
U_fund_SYM-_rc@AC [V]	3.882498	188.3847	184.5022
I_fund_P_SYM+_rc@AC [A]	3.465014	-0.209298	-3.674312
I_fund_P_SYM-_rc@AC [A]	0.040455	-0.063886	-0.104341
I_fund_Q_SYM+_rc@AC [A]	1.493e-3	8.211e-3	6.718e-3
I_fund_Q_SYM-_rc@AC [A]	0.031162	0.158157	0.126995

Recover time – Active power



时间 [s]	A 0:16.4627991	B 0:16.8852151	间隔 0.4224160
U1_tRMS_rc@AC [V]	7.032847	230.6545	223.6216
U2_tRMS_rc@AC [V]	200.2666	230.1873	29.92076
U3_tRMS_rc@AC [V]	200.3852	230.3161	29.93095
I1_tRMS_rc@AC [A]	0.087776	2.999440	2.911663
I2_tRMS_rc@AC [A]	0.915823	3.040992	2.125169
I3_tRMS_rc@AC [A]	0.893334	3.026115	2.132781
P_t_rc@AC [W]	-130.9463	2077.465	2208.411
Q_fund_rc@AC [var]	296.9677	7.759465	-289.2082
S_t_rc@AC [VA]	363.0370	2088.795	1725.758
U_fund_SYM+_rc@AC [V]	207.7873	399.0356	191.2483
U_fund_SYM-_rc@AC [V]	192.6736	0.484441	-192.1892
I_fund_P_SYM+_rc@AC [A]	-0.201501	3.005568	3.207069
I_fund_P_SYM-_rc@AC [A]	-0.175818	0.013475	0.189293
I_fund_Q_SYM+_rc@AC [A]	0.448256	0.011280	-0.436976
I_fund_Q_SYM-_rc@AC [A]	0.406197	-8.501e-3	-0.414698

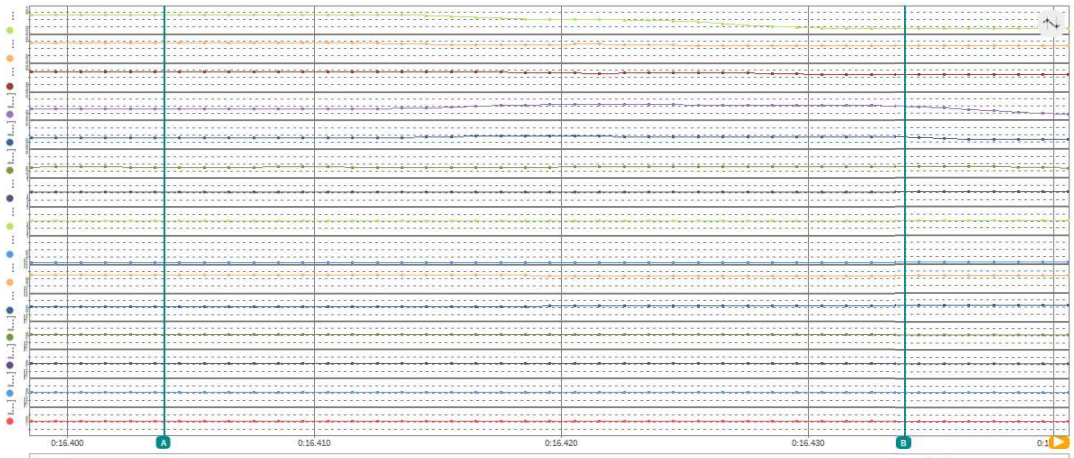
Test – VD7.1

Duration fault time



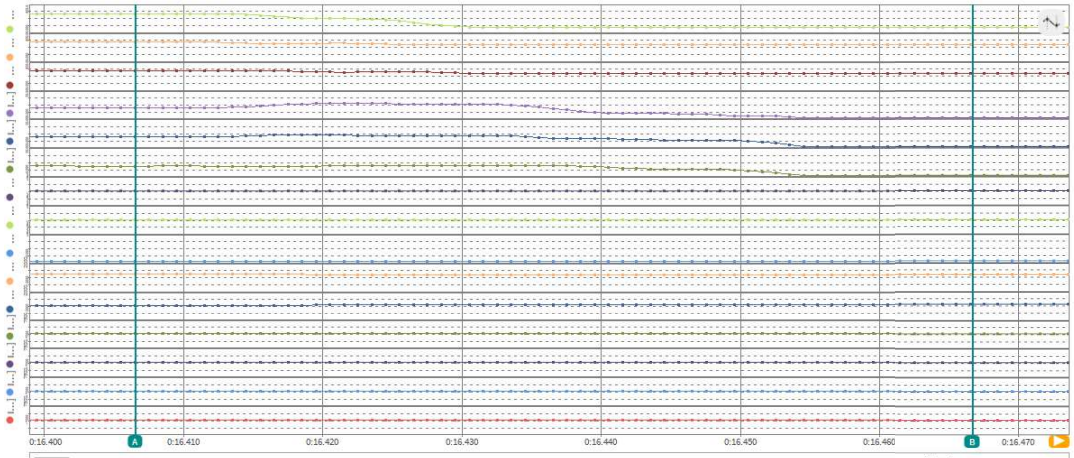
时间 [s]	A 0:16.403915	B 0:17.412793	间隔 1.008879
U1_tRMS_rc@AC [V]	230.2703	57.88543	-172.3849
U2_tRMS_rc@AC [V]	231.3515	204.5403	-26.81113
U3_tRMS_rc@AC [V]	229.6379	202.7919	-26.84599
I1_tRMS_rc@AC [A]	17.61185	0.414431	-17.19742
I2_tRMS_rc@AC [A]	17.78028	0.813943	-16.96634
I3_tRMS_rc@AC [A]	17.41805	0.841441	-16.57660
P_t_rc@AC [W]	12164.46	-52.54819	-12217.01
Q_fund_rc@AC [var]	186.8976	283.7139	96.81625
S_t_rc@AC [VA]	12168.83	361.1110	-11807.71
U_fund_SYM+_rc@AC [V]	399.0204	250.9204	-148.1000
U_fund_SYM-_rc@AC [V]	2.246738	152.3549	150.1081
I_fund_P_SYM+_rc@AC [A]	17.59546	-0.080778	-17.67624
I_fund_P_SYM-_rc@AC [A]	0.165435	-0.057417	-0.222851
I_fund_Q_SYM+_rc@AC [A]	0.270200	0.497801	0.227601
I_fund_Q_SYM-_rc@AC [A]	0.034071	0.255310	0.221239

Injected current at 30ms



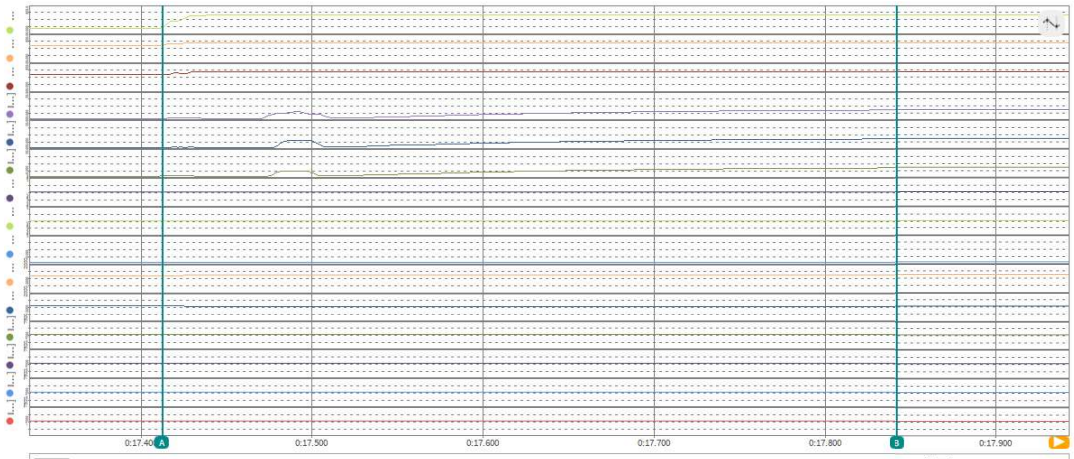
时间 [s]	A 0:16.403915	B 0:16.433949	间隔 0.030034
U1_tRMS_rc@AC [V]	230.2703	59.13829	-171.1320
U2_tRMS_rc@AC [V]	231.3515	201.8502	-29.50125
U3_tRMS_rc@AC [V]	229.6379	202.0117	-27.62624
I1_tRMS_rc@AC [A]	17.61185	23.24793	5.636080
I2_tRMS_rc@AC [A]	17.78028	19.45502	1.674730
I3_tRMS_rc@AC [A]	17.41805	18.55076	1.132713
P_t_rc@AC [W]	12164.46	7930.353	-4234.111
Q_fund_rc@AC [var]	186.8976	1236.657	1049.759
S_t_rc@AC [VA]	12168.83	9049.313	-3119.513
U_fund_SYM+_rc@AC [V]	399.0204	250.4201	-148.6003
U_fund_SYM-_rc@AC [V]	2.246738	149.2661	147.0193
I_fund_P_SYM+_rc@AC [A]	17.59546	18.29074	0.695274
I_fund_P_SYM-_rc@AC [A]	0.165435	-0.155164	-0.320599
I_fund_Q_SYM+_rc@AC [A]	0.270200	2.933983	2.663782
I_fund_Q_SYM-_rc@AC [A]	0.034071	-0.142065	-0.176135

Injected current at 60ms



时间 [s]	A 0:16.406610	B 0:16.466719	间隔 0.060109
U1_tRMS_rc@AC [V]	231.7459	55.02480	-176.7211
U2_tRMS_rc@AC [V]	229.7376	197.8638	-31.87384
U3_tRMS_rc@AC [V]	229.7610	197.9830	-31.77806
I1_tRMS_rc@AC [A]	17.75556	0.188549	-17.56701
I2_tRMS_rc@AC [A]	17.63918	0.791415	-16.84777
I3_tRMS_rc@AC [A]	17.42052	0.621143	-16.79938
P_t_rc@AC [W]	12165.38	-22.53838	-12187.92
Q_fund_rc@AC [var]	184.8389	238.6971	53.85817
S_t_rc@AC [VA]	12169.72	289.9430	-11879.77
U_fund_SYM+_rc@AC [V]	399.0184	243.6243	-155.3941
U_fund_SYM-_rc@AC [V]	2.178120	148.4252	146.2471
I_fund_P_SYM+_rc@AC [A]	17.59524	-0.021343	-17.61659
I_fund_P_SYM-_rc@AC [A]	0.134357	-0.053239	-0.187596
I_fund_Q_SYM+_rc@AC [A]	0.267784	0.444654	0.176870
I_fund_Q_SYM-_rc@AC [A]	-0.070585	0.198626	0.269211

Recover time – Active power



时间 [s]	A 0:17.412747	B 0:17.842534	间隔 0.429787
U1_tRMS_rc@AC [V]	57.88543	230.6724	172.7870
U2_tRMS_rc@AC [V]	204.5403	230.2523	25.71198
U3_tRMS_rc@AC [V]	202.7919	230.3357	27.54381
I1_tRMS_rc@AC [A]	0.414431	16.05530	15.64087
I2_tRMS_rc@AC [A]	0.813943	16.10455	15.29061
I3_tRMS_rc@AC [A]	0.841441	15.97366	15.13222
P_t_rc@AC [W]	-52.54819	11085.96	11138.51
Q_fund_rc@AC [var]	283.7139	199.8201	-83.89378
S_t_rc@AC [VA]	361.1110	11090.93	10729.82
U_fund_SYM+_rc@AC [V]	250.9204	399.0940	148.1736
U_fund_SYM-_rc@AC [V]	152.3549	0.478690	-151.8762
I_fund_P_SYM+_rc@AC [A]	-0.080778	16.03702	16.11779
I_fund_P_SYM-_rc@AC [A]	-0.057417	0.044812	0.102229
I_fund_Q_SYM+_rc@AC [A]	0.497801	0.289071	-0.208731
I_fund_Q_SYM-_rc@AC [A]	0.255310	-0.019291	-0.274601

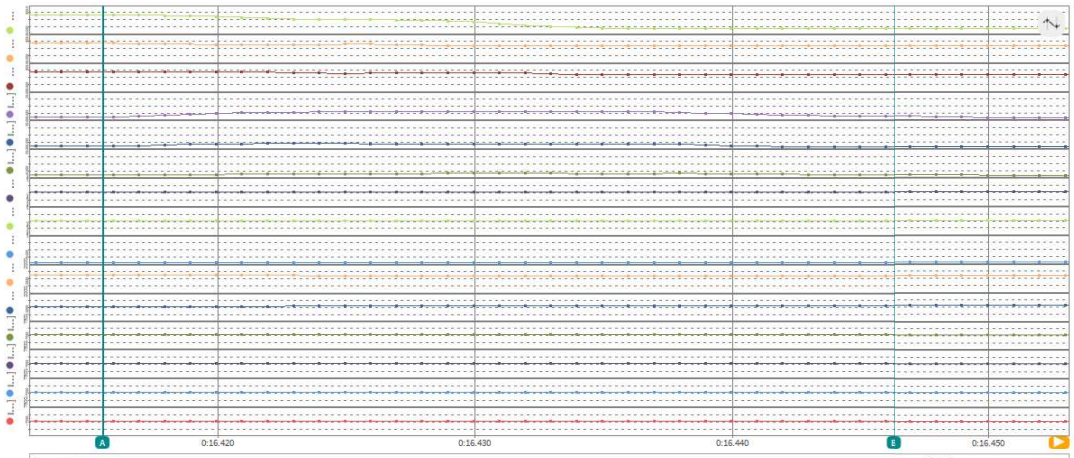
Test – VD7.2

Duration fault time



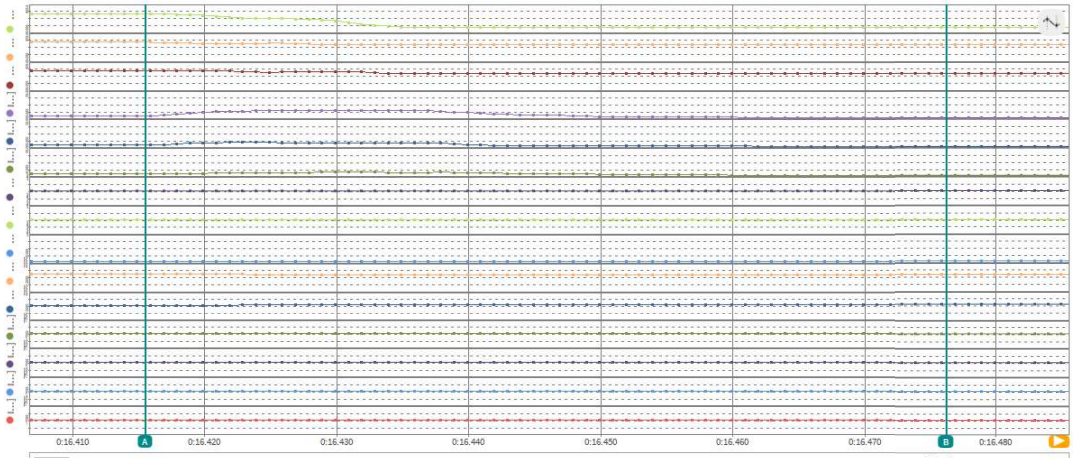
时间 [s]	A 0:16.408677	B 0:17.414661	间隔 1.005984
U1_tRMS_rc@AC [V]	230.3710	57.85822	-172.5127
U2_tRMS_rc@AC [V]	231.2779	202.2788	-28.99910
U3_tRMS_rc@AC [V]	229.4939	201.6311	-27.86272
I1_tRMS_rc@AC [A]	3.476514	0.196267	-3.280247
I2_tRMS_rc@AC [A]	3.502677	0.745619	-2.757058
I3_tRMS_rc@AC [A]	3.463505	0.726905	-2.736600
P_t_rc@AC [W]	2395.070	-41.65553	-2436.725
Q_fund_rc@AC [var]	-11.57312	280.6770	292.2501
S_t_rc@AC [VA]	2405.833	308.7452	-2097.088
U_fund_SYM+_rc@AC [V]	398.9419	249.4895	-149.4524
U_fund_SYM-_rc@AC [V]	2.148583	150.3218	148.1732
I_fund_P_SYM+_rc@AC [A]	3.464781	-0.064478	-3.529259
I_fund_P_SYM-_rc@AC [A]	0.029944	-0.052003	-0.081947
I_fund_Q_SYM+_rc@AC [A]	-0.016755	0.475745	0.492500
I_fund_Q_SYM-_rc@AC [A]	3.179e-3	0.288442	0.285264

Injected current at 30ms



时间 [s]	A 0:16.415554	B 0:16.446318	间隔 0.030763
U1_tRMS_rc@AC [V]	229.6947	57.79920	-171.8955
U2_tRMS_rc@AC [V]	230.1757	201.0575	-29.11827
U3_tRMS_rc@AC [V]	231.2794	201.1641	-30.11533
I1_tRMS_rc@AC [A]	3.487799	4.811265	1.323467
I2_tRMS_rc@AC [A]	3.488109	2.343175	-1.144934
I3_tRMS_rc@AC [A]	3.449250	3.217480	-0.231771
P_t_rc@AC [W]	2391.451	627.1213	-1764.330
Q_fund_rc@AC [var]	-10.34171	228.8053	239.1470
S_t_rc@AC [VA]	2401.748	1396.442	-1005.306
U_fund_SYM+_rc@AC [V]	398.9581	248.4443	-150.5139
U_fund_SYM-_rc@AC [V]	1.349657	149.5868	148.2372
I_fund_P_SYM+_rc@AC [A]	3.457971	0.168016	-3.289954
I_fund_P_SYM-_rc@AC [A]	4.344e-3	2.107443	2.103099
I_fund_Q_SYM+_rc@AC [A]	-0.015074	0.637806	0.652880
I_fund_Q_SYM-_rc@AC [A]	0.021747	-0.176799	-0.198546

Injected current at 60ms



时间 [s]	A 0:16.415554	B 0:16.476236	间隔 0.060681
U1_tRMS_rc@AC [V]	229.6947	55.57638	-174.1183
U2_tRMS_rc@AC [V]	230.1757	198.5870	-31.58878
U3_tRMS_rc@AC [V]	231.2794	198.6050	-32.67445
I1_tRMS_rc@AC [A]	3.487799	0.185834	-3.301965
I2_tRMS_rc@AC [A]	3.488109	0.725937	-2.762173
I3_tRMS_rc@AC [A]	3.449250	0.708494	-2.740757
P_t_rc@AC [W]	2391.451	-41.48935	-2432.940
Q_fund_rc@AC [var]	-10.34171	267.6588	278.0005
S_t_rc@AC [VA]	2401.748	295.2000	-2106.548
U_fund_SYM+_rc@AC [V]	398.9581	244.6473	-154.3108
U_fund_SYM-_rc@AC [V]	1.349657	148.6761	147.3264
I_fund_P_SYM+_rc@AC [A]	3.457971	-0.064145	-3.522116
I_fund_P_SYM-_rc@AC [A]	4.344e-3	-0.056195	-0.060539
I_fund_Q_SYM+_rc@AC [A]	-0.015074	0.460482	0.475556
I_fund_Q_SYM-_rc@AC [A]	0.021747	0.281681	0.259934

Recover time – Active power



时间 [s]	A 0:17.417507	B 0:17.817862	间隔 0.400354
U1_tRMS_rc@AC [V]	58.80865	230.6496	171.8410
U2_tRMS_rc@AC [V]	204.9974	230.1929	25.19545
U3_tRMS_rc@AC [V]	202.1546	230.3213	28.16670
I1_tRMS_rc@AC [A]	0.390957	3.043836	2.652879
I2_tRMS_rc@AC [A]	0.808158	3.041544	2.233387
I3_tRMS_rc@AC [A]	0.835211	3.046709	2.211498
P_t_rc@AC [W]	-44.18838	2092.615	2136.804
Q_fund_rc@AC [var]	284.7312	5.991511	-278.7397
S_t_rc@AC [VA]	357.5035	2103.924	1746.420
U_fund_SYM+_rc@AC [V]	250.9015	399.0384	148.1369
U_fund_SYM-_rc@AC [V]	151.7853	0.488540	-151.2967
I_fund_P_SYM+_rc@AC [A]	-0.070106	3.027468	3.097573
I_fund_P_SYM-_rc@AC [A]	-0.043263	0.016624	0.059887
I_fund_Q_SYM+_rc@AC [A]	0.500193	8.702e-3	-0.491491
I_fund_Q_SYM-_rc@AC [A]	0.256271	-9.299e-3	-0.265570

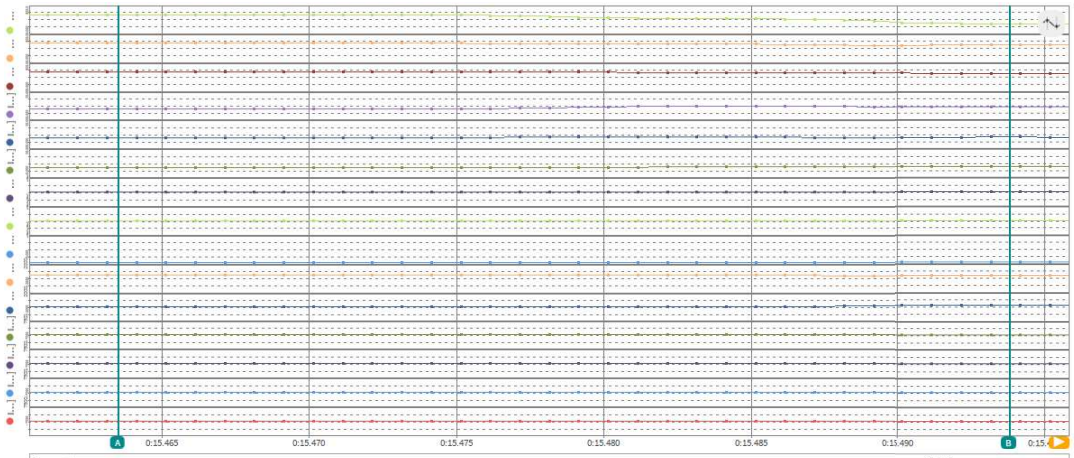
Test – VD8.1

Duration fault time



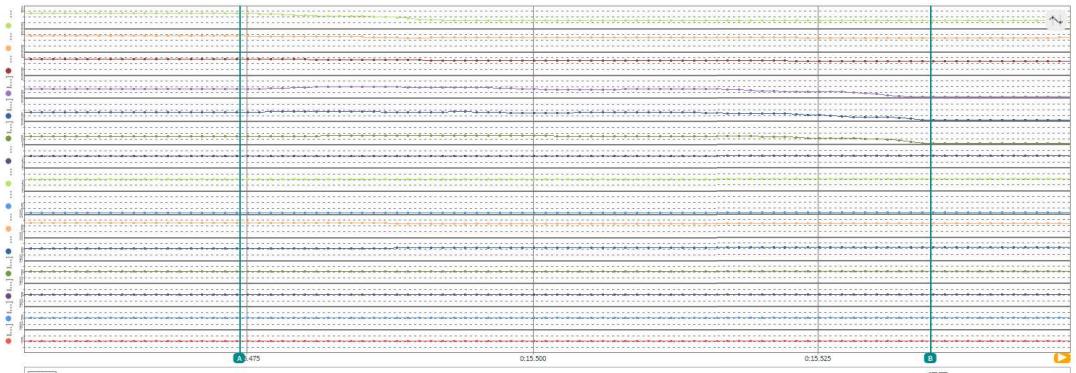
时间 [s]	A 0:15.463531	B 0:17.473255	间隔 2.009724
U1_tRMS_rc@AC [V]	230.1448	115.8968	-114.2480
U2_tRMS_rc@AC [V]	230.3400	206.6315	-23.70847
U3_tRMS_rc@AC [V]	230.7961	206.2187	-24.57733
I1_tRMS_rc@AC [A]	17.64442	0.368808	-17.27561
I2_tRMS_rc@AC [A]	17.69062	0.779229	-16.91139
I3_tRMS_rc@AC [A]	17.47048	0.731666	-16.73882
P_t_rc@AC [W]	12163.62	-43.61467	-12207.23
Q_fund_rc@AC [var]	191.6559	324.1777	132.5218
S_t_rc@AC [VA]	12167.75	354.6402	-11813.11
U_fund_SYM+_rc@AC [V]	399.0870	298.0594	-101.0276
U_fund_SYM-_rc@AC [V]	0.462152	98.58475	98.12260
I_fund_P_SYM+_rc@AC [A]	17.59563	-0.067263	-17.66290
I_fund_P_SYM-_rc@AC [A]	0.027527	-0.051491	-0.079018
I_fund_Q_SYM+_rc@AC [A]	0.277085	0.565831	0.288746
I_fund_Q_SYM-_rc@AC [A]	0.069581	0.187924	0.118343

Injected current at 30ms



时间 [s]	A 0:15.463531	B 0:15.493780	间隔 0.030249
U1_tRMS_rc@AC [V]	230.1448	117.1043	-113.0405
U2_tRMS_rc@AC [V]	230.3400	206.9055	-23.43449
U3_tRMS_rc@AC [V]	230.7961	206.6185	-24.17751
I1_tRMS_rc@AC [A]	17.64442	21.90474	4.260321
I2_tRMS_rc@AC [A]	17.69062	19.22098	1.530363
I3_tRMS_rc@AC [A]	17.47048	17.79415	0.323666
P_t_rc@AC [W]	12163.62	9488.486	-2675.132
Q_fund_rc@AC [var]	191.6559	774.9900	583.3341
S_t_rc@AC [VA]	12167.75	10218.67	-1949.080
U_fund_SYM+_rc@AC [V]	399.0870	299.2453	-99.84171
U_fund_SYM-_rc@AC [V]	0.462152	98.58576	98.12361
I_fund_P_SYM+_rc@AC [A]	17.59563	18.47267	0.877041
I_fund_P_SYM-_rc@AC [A]	0.027527	-0.620850	-0.648377
I_fund_Q_SYM+_rc@AC [A]	0.277085	1.403771	1.126686
I_fund_Q_SYM-_rc@AC [A]	0.069581	0.270351	0.200770

Injected current at 60ms



时间 [s]	A 0:15.474367	B 0:15.534848	间隔 0.060481
U1_tRMS_rc@AC [V]	230.6785	112.1103	-118.5682
U2_tRMS_rc@AC [V]	230.2537	203.7070	-26.54668
U3_tRMS_rc@AC [V]	230.3486	202.5634	-27.78520
I1_tRMS_rc@AC [A]	17.65581	0.365909	-17.28990
I2_tRMS_rc@AC [A]	17.71051	0.766296	-16.94422
I3_tRMS_rc@AC [A]	17.44978	0.709152	-16.74063
P_t_rc@AC [W]	12166.42	-44.17789	-12210.60
Q_fund_rc@AC [var]	181.0756	311.3589	130.2833
S_t_rc@AC [VA]	12170.26	340.7703	-11829.49
U_fund_SYM+_rc@AC [V]	399.1046	292.1394	-106.9652
U_fund_SYM-_rc@AC [V]	0.654962	98.67657	98.02160
I_fund_P_SYM+_rc@AC [A]	17.59917	-0.069626	-17.66880
I_fund_P_SYM-_rc@AC [A]	0.061637	-0.053291	-0.114928
I_fund_Q_SYM+_rc@AC [A]	0.261964	0.554952	0.292987
I_fund_Q_SYM-_rc@AC [A]	-0.051782	0.178986	0.230768

Recover time – Active power



时间 [s]	A 0:17.475353	B 0:17.966861	间隔 0.491508
U1_tRMS_rc@AC [V]	115.6584	230.6856	115.0272
U2_tRMS_rc@AC [V]	208.9718	230.2533	21.28146
U3_tRMS_rc@AC [V]	206.5887	230.3732	23.78445
I1_tRMS_rc@AC [A]	0.466760	16.57910	16.11234
I2_tRMS_rc@AC [A]	0.822863	16.60564	15.78277
I3_tRMS_rc@AC [A]	0.800949	16.48790	15.68695
P_t_rc@AC [W]	-48.28608	11442.09	11490.38
Q_fund_rc@AC [var]	331.5049	187.2091	-144.2958
S_t_rc@AC [VA]	391.4069	11446.43	11055.02
U_fund_SYM+_rc@AC [V]	299.1208	399.1235	100.0027
U_fund_SYM-_rc@AC [V]	100.7477	0.498125	-100.2495
I_fund_P_SYM+_rc@AC [A]	-0.075611	16.55079	16.62641
I_fund_P_SYM-_rc@AC [A]	-0.044938	0.057276	0.102214
I_fund_Q_SYM+_rc@AC [A]	0.584125	0.270819	-0.313306
I_fund_Q_SYM-_rc@AC [A]	0.165597	-0.030046	-0.195643

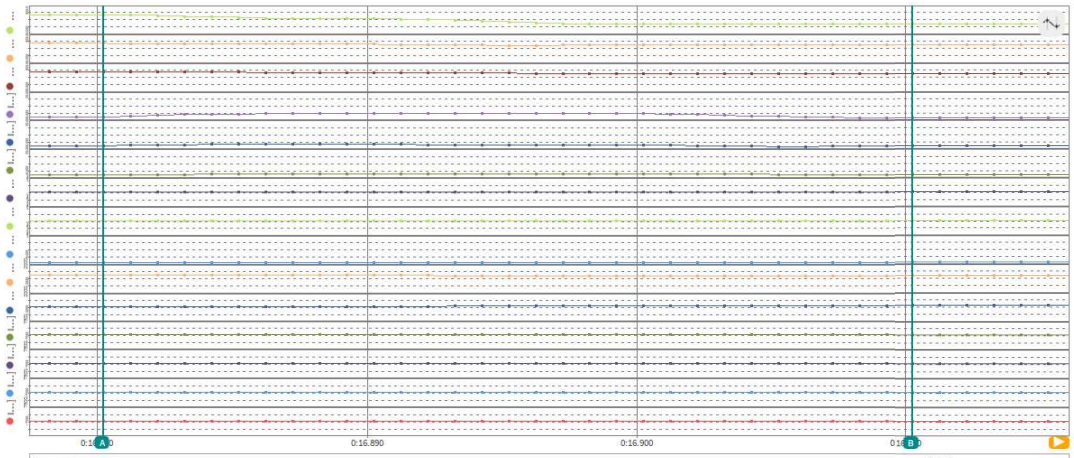
Test – VD8.2

Duration fault time



时间 [s]	A 0:16.860742	B 0:18.880764	间隔 2.020022
U1_tRMS_rc@AC [V]	230.2265	115.2371	-114.9893
U2_tRMS_rc@AC [V]	230.7116	208.5868	-22.12488
U3_tRMS_rc@AC [V]	230.2088	207.0915	-23.11734
I1_tRMS_rc@AC [A]	3.447225	0.472901	-2.974324
I2_tRMS_rc@AC [A]	3.499448	0.799863	-2.699585
I3_tRMS_rc@AC [A]	3.443755	0.780315	-2.663441
P_t_rc@AC [W]	2383.333	-44.89740	-2428.231
Q_fund_rc@AC [var]	-1.728381	327.8803	329.6087
S_t_rc@AC [VA]	2393.789	382.9331	-2010.856
U_fund_SYM+_rc@AC [V]	399.0105	299.0323	-99.97815
U_fund_SYM-_rc@AC [V]	0.956677	101.1332	100.1765
I_fund_P_SYM+_rc@AC [A]	3.447236	-0.069988	-3.517225
I_fund_P_SYM-_rc@AC [A]	0.031317	-0.044191	-0.075508
I_fund_Q_SYM+_rc@AC [A]	-2.493e-3	0.577393	0.579886
I_fund_Q_SYM-_rc@AC [A]	2.188e-3	0.164631	0.162442

Injected current at 30ms



时间 [s]	A 0:16.880205	B 0:16.910222	间隔 0.030016
U1_tRMS_rc@AC [V]	230.0831	115.4662	-114.6169
U2_tRMS_rc@AC [V]	230.5059	205.8571	-24.64874
U3_tRMS_rc@AC [V]	230.5353	205.8671	-24.66821
I1_tRMS_rc@AC [A]	3.484975	2.325866	-1.159109
I2_tRMS_rc@AC [A]	3.477089	3.365973	-0.111116
I3_tRMS_rc@AC [A]	3.405885	3.215828	-0.190057
P_t_rc@AC [W]	2377.951	1207.295	-1170.656
Q_fund_rc@AC [var]	-8.750422	70.63487	79.38529
S_t_rc@AC [VA]	2388.500	1623.502	-764.9980
U_fund_SYM+_rc@AC [V]	399.0070	297.1172	-101.8898
U_fund_SYM-_rc@AC [V]	0.941184	98.97498	98.03380
I_fund_P_SYM+_rc@AC [A]	3.440072	1.761156	-1.678916
I_fund_P_SYM-_rc@AC [A]	0.031114	1.742594	1.711480
I_fund_Q_SYM+_rc@AC [A]	-0.012759	0.280898	0.293657
I_fund_Q_SYM-_rc@AC [A]	0.016937	-0.435670	-0.452607

Injected current at 60ms



时间 [s]	A 0:16.880205	B 0:16.941006	间隔 0.060800
U1_tRMS_rc@AC [V]	230.0831	113.0020	-117.0810
U2_tRMS_rc@AC [V]	230.5059	204.7382	-25.76767
U3_tRMS_rc@AC [V]	230.5353	203.5968	-26.93848
I1_tRMS_rc@AC [A]	3.484975	0.368368	-3.116606
I2_tRMS_rc@AC [A]	3.477089	0.770236	-2.706853
I3_tRMS_rc@AC [A]	3.405885	0.701038	-2.704847
P_t_rc@AC [W]	2377.951	-42.67013	-2420.621
Q_fund_rc@AC [var]	-8.750422	313.8440	322.5944
S_t_rc@AC [VA]	2388.500	342.0523	-2046.447
U_fund_SYM+_rc@AC [V]	399.0070	293.8176	-105.1894
U_fund_SYM-_rc@AC [V]	0.941184	98.99325	98.05206
I_fund_P_SYM+_rc@AC [A]	3.440072	-0.066743	-3.506815
I_fund_P_SYM-_rc@AC [A]	0.031114	-0.051780	-0.082895
I_fund_Q_SYM+_rc@AC [A]	-0.012759	0.557359	0.570117
I_fund_Q_SYM-_rc@AC [A]	0.016937	0.176398	0.159461

Recover time – Active power



时间 [s]	A 0:18.880110	B 0:19.414276	间隔 0.534166
U1_tRMS_rc@AC [V]	115.6680	230.6445	114.9765
U2_tRMS_rc@AC [V]	206.7185	230.2139	23.49541
U3_tRMS_rc@AC [V]	206.8312	230.3339	23.50272
I1_tRMS_rc@AC [A]	0.373098	3.328198	2.955100
I2_tRMS_rc@AC [A]	0.760291	3.382665	2.622375
I3_tRMS_rc@AC [A]	0.717539	3.295721	2.578182
P_t_rc@AC [W]	-42.57959	2295.789	2338.368
Q_fund_rc@AC [var]	322.2024	-7.040571	-329.2430
S_t_rc@AC [VA]	348.7311	2305.483	1956.752
U_fund_SYM+_rc@AC [V]	298.3725	399.0557	100.6832
U_fund_SYM-_rc@AC [V]	99.41768	0.361875	-99.05580
I_fund_P_SYM+_rc@AC [A]	-0.065503	3.321171	3.386673
I_fund_P_SYM-_rc@AC [A]	-0.051191	0.011799	0.062990
I_fund_Q_SYM+_rc@AC [A]	0.561732	-0.010186	-0.571918
I_fund_Q_SYM-_rc@AC [A]	0.185336	-0.023598	-0.208934

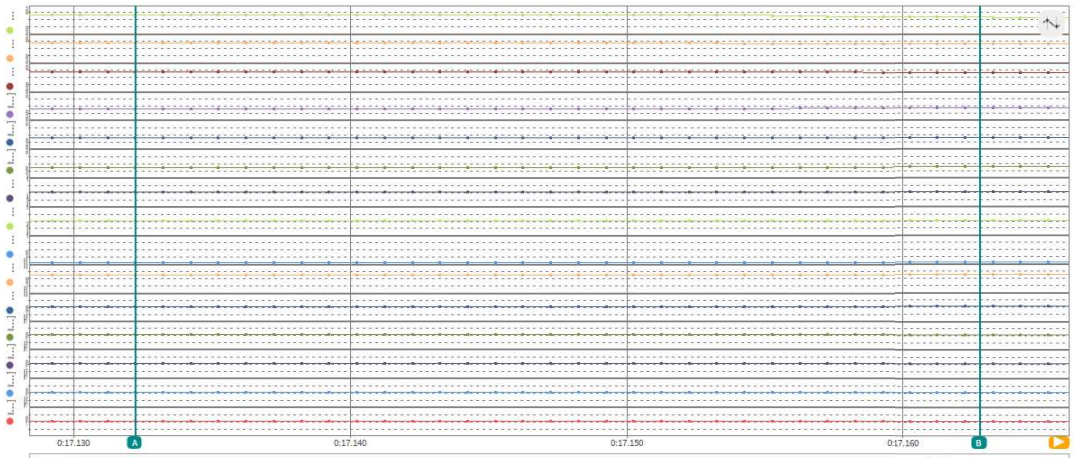
Test – VD9.1

Duration fault time



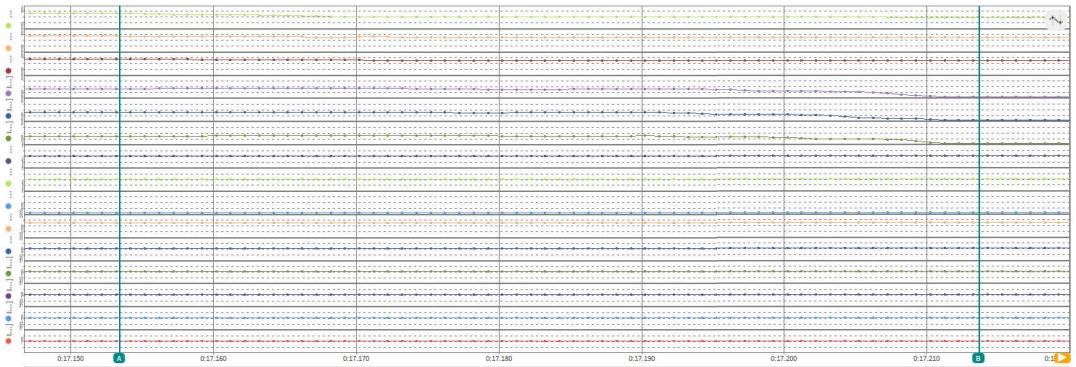
时间 [s]	A 0:17.132239	B 0:20.154650	间隔 3.022410
U1_tRMS_rc@AC [V]	230.6527	175.1606	-55.49207
U2_tRMS_rc@AC [V]	230.2418	218.9302	-11.31161
U3_tRMS_rc@AC [V]	230.3361	214.5200	-15.81612
I1_tRMS_rc@AC [A]	17.68653	0.606243	-17.08029
I2_tRMS_rc@AC [A]	17.73014	0.816055	-16.91409
I3_tRMS_rc@AC [A]	17.42518	0.781333	-16.64385
P_t_rc@AC [W]	12171.01	-52.37854	-12223.39
Q_fund_rc@AC [var]	184.6915	412.7311	228.0397
S_t_rc@AC [VA]	12175.32	452.4604	-11722.86
U_fund_SYM+_rc@AC [V]	399.0771	349.1683	-49.90887
U_fund_SYM-_rc@AC [V]	0.452904	50.41187	49.95897
I_fund_P_SYM+_rc@AC [A]	17.60744	-0.080863	-17.68831
I_fund_P_SYM-_rc@AC [A]	0.090477	-0.031471	-0.121948
I_fund_Q_SYM+_rc@AC [A]	0.267160	0.671741	0.404581
I_fund_Q_SYM-_rc@AC [A]	-0.035520	0.074641	0.110161

Injected current at 30ms



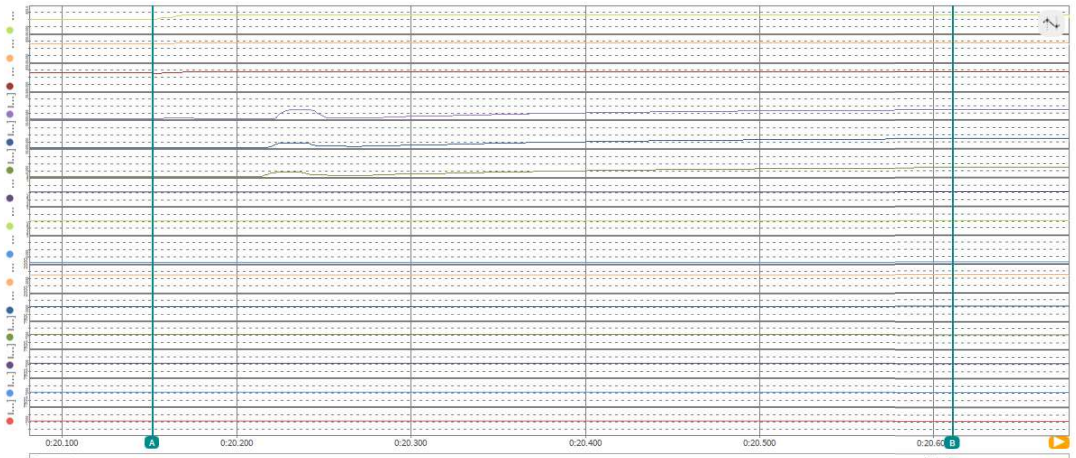
时间 [s]	A 0:17.132239	B 0:17.162784	间隔 0.030544
U1_tRMS_rc@AC [V]	230.6527	204.7822	-25.87053
U2_tRMS_rc@AC [V]	230.2418	222.9101	-7.331680
U3_tRMS_rc@AC [V]	230.3361	223.5497	-6.786453
I1_tRMS_rc@AC [A]	17.68653	20.59635	2.909817
I2_tRMS_rc@AC [A]	17.73014	18.67669	0.946550
I3_tRMS_rc@AC [A]	17.42518	17.81265	0.387468
P_t_rc@AC [W]	12171.01	12058.98	-112.0313
Q_fund_rc@AC [var]	184.6915	202.2706	17.57915
S_t_rc@AC [VA]	12175.32	12363.00	187.6855
U_fund_SYM+_rc@AC [V]	399.0771	373.7434	-25.33377
U_fund_SYM-_rc@AC [V]	0.452904	24.04916	23.59625
I_fund_P_SYM+_rc@AC [A]	17.60744	18.88151	1.274063
I_fund_P_SYM-_rc@AC [A]	0.090477	-1.386699	-1.477176
I_fund_Q_SYM+_rc@AC [A]	0.267160	0.290955	0.023795
I_fund_Q_SYM-_rc@AC [A]	-0.035520	0.322469	0.357989

Injected current at 60ms



时间 [s]	A 0:17.1534782	B 0:17.2136365	间隔 0.0601582
U1_tRMS_rc@AC [V]	230.2820	168.6557	-61.62630
U2_tRMS_rc@AC [V]	228.7142	211.1708	-17.54344
U3_tRMS_rc@AC [V]	231.6625	211.0978	-20.56464
I1_tRMS_rc@AC [A]	17.92741	0.541744	-17.38567
I2_tRMS_rc@AC [A]	17.89244	0.788634	-17.10380
I3_tRMS_rc@AC [A]	17.26297	0.733344	-16.52962
P_t_rc@AC [W]	12183.45	-45.71651	-12229.16
Q_fund_rc@AC [var]	-12.79970	382.8897	395.6894
S_t_rc@AC [VA]	12219.80	412.7119	-11807.08
U_fund_SYM+_rc@AC [V]	398.6442	339.1545	-59.48972
U_fund_SYM-_rc@AC [V]	2.615637	50.56070	47.94506
I_fund_P_SYM+_rc@AC [A]	17.66593	-0.071264	-17.73719
I_fund_P_SYM-_rc@AC [A]	-0.228041	-0.047796	0.180245
I_fund_Q_SYM+_rc@AC [A]	-0.017716	0.638460	0.656176
I_fund_Q_SYM-_rc@AC [A]	-0.155615	0.089917	0.245532

Recover time – Active power



时间 [s]	A 0:20.152051	B 0:20.611071	间隔 0.459021
U1_tRMS_rc@AC [V]	173.4254	230.6727	57.24730
U2_tRMS_rc@AC [V]	216.2135	230.2666	14.05310
U3_tRMS_rc@AC [V]	215.9638	230.3219	14.35808
I1_tRMS_rc@AC [A]	0.557851	16.25797	15.70011
I2_tRMS_rc@AC [A]	0.803003	16.29768	15.49468
I3_tRMS_rc@AC [A]	0.745004	16.10691	15.36190
P_t_rc@AC [W]	-45.73906	11208.33	11254.07
Q_fund_rc@AC [var]	402.3273	198.2967	-204.0306
S_t_rc@AC [VA]	431.2594	11212.85	10781.59
U_fund_SYM+_rc@AC [V]	347.5705	399.0946	51.52414
U_fund_SYM-_rc@AC [V]	50.78294	0.549866	-50.23307
I_fund_P_SYM+_rc@AC [A]	-0.069565	16.21393	16.28350
I_fund_P_SYM-_rc@AC [A]	-0.045245	0.065438	0.110683
I_fund_Q_SYM+_rc@AC [A]	0.654764	0.286832	-0.367931
I_fund_Q_SYM-_rc@AC [A]	0.092810	-8.077e-3	-0.100886

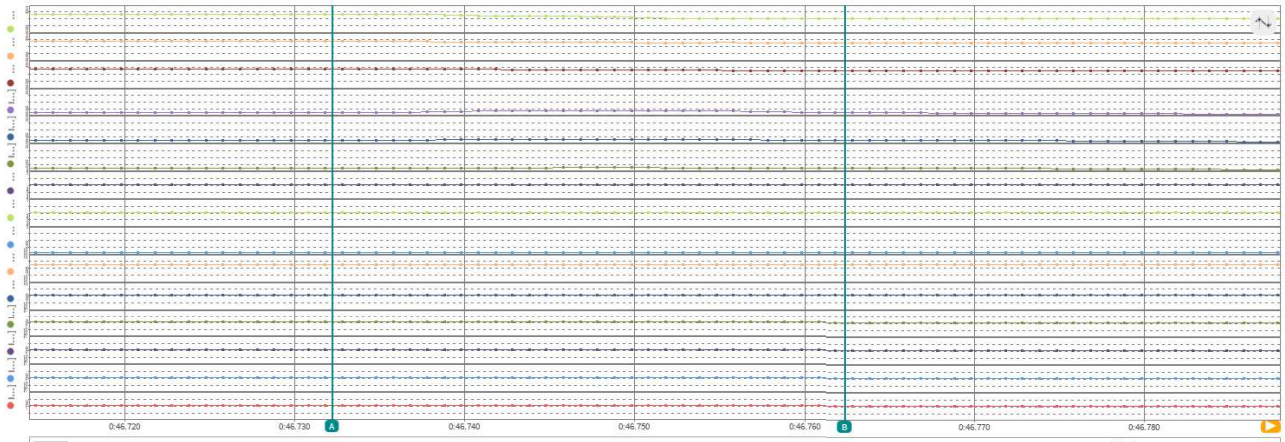
Test – VD9.2

Duration fault time



时间 [s]	A 0:46.732247	B 0:49.702799	间隔 2.970552
U1_tRMS_rc@AC [V]	230.6268	173.0092	-57.61765
U2_tRMS_rc@AC [V]	230.2157	216.4083	-13.80742
U3_tRMS_rc@AC [V]	230.2892	216.4897	-13.79951
I1_tRMS_rc@AC [A]	3.453917	0.558946	-2.894970
I2_tRMS_rc@AC [A]	3.482874	0.794716	-2.688158
I3_tRMS_rc@AC [A]	3.408003	0.738425	2.660578
P_t_rc@AC [W]	2373.207	-43.71565	-2416.922
Q_fund_rc@AC [var]	-6.887242	401.7561	408.6433
S_t_rc@AC [VA]	2383.204	428.5473	-1954.657
U_fund_SYM+_rc@AC [V]	399.0170	347.7422	-51.27478
U_fund_SYM-_rc@AC [V]	0.746210	51.90297	51.15676
I_fund_P_SYM+_rc@AC [A]	3.433368	-0.066237	-3.499605
I_fund_P_SYM-_rc@AC [A]	0.024467	-0.045474	-0.069941
I_fund_Q_SYM+_rc@AC [A]	-9.980e-3	0.653571	0.663551
I_fund_Q_SYM-_rc@AC [A]	2.881e-4	0.090290	0.090002

Injected current at 30ms



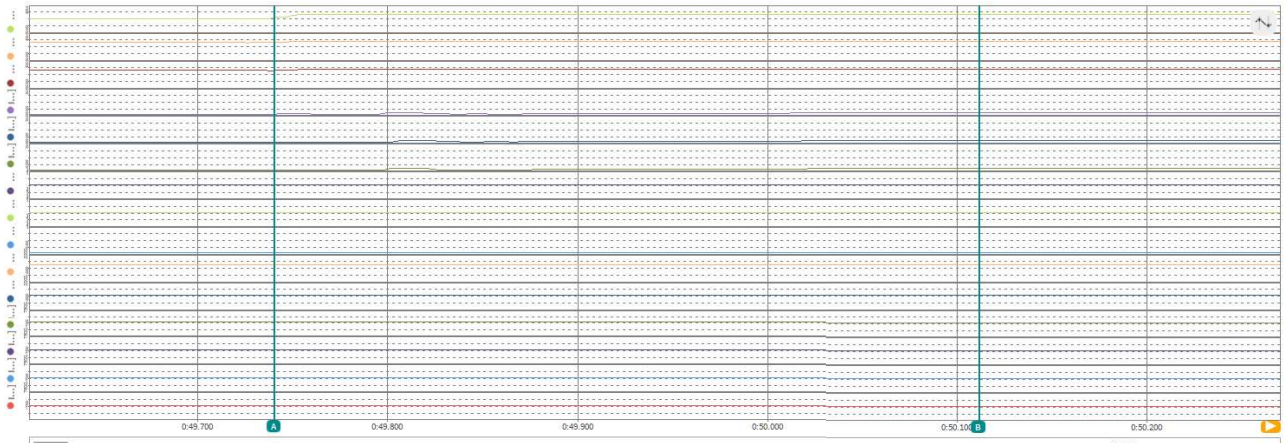
时间 [s]	A 0:46.732247	B 0:46.762382	间隔 0.030135
U1_tRMS_rc@AC [V]	230.6268	172.5371	-58.08971
U2_tRMS_rc@AC [V]	230.2157	215.2116	-15.00409
U3_tRMS_rc@AC [V]	230.2892	215.5048	-14.78444
I1_tRMS_rc@AC [A]	3.453917	3.221678	-0.232239
I2_tRMS_rc@AC [A]	3.482874	3.016240	-0.466634
I3_tRMS_rc@AC [A]	3.408003	3.438097	0.030095
P_t_rc@AC [W]	2373.207	1711.884	-661.3224
Q_fund_rc@AC [var]	-6.887242	293.9596	300.8468
S_t_rc@AC [VA]	2383.204	1945.916	-437.2888
U_fund_SYM+_rc@AC [V]	399.0170	346.2158	-52.80127
U_fund_SYM-_rc@AC [V]	0.746210	51.43317	50.68696
I_fund_P_SYM+_rc@AC [A]	3.433368	2.768989	-0.664379
I_fund_P_SYM-_rc@AC [A]	0.024467	0.545819	0.521352
I_fund_Q_SYM+_rc@AC [A]	-9.980e-3	0.560005	0.569985
I_fund_Q_SYM-_rc@AC [A]	2.881e-4	-0.483356	-0.483644

Injected current at 60ms



时间 [s]	A 0:46.732247	B 0:46.792853	间隔 0.060606
U1_tRMS_rc@AC [V]	230.6268	170.3055	-60.32137
U2_tRMS_rc@AC [V]	230.2157	213.4663	-16.74945
U3_tRMS_rc@AC [V]	230.2892	213.1242	-17.16501
I1_tRMS_rc@AC [A]	3.453917	0.566618	-2.887299
I2_tRMS_rc@AC [A]	3.482874	0.787303	-2.695571
I3_tRMS_rc@AC [A]	3.408003	0.711213	2.696790
P_t_rc@AC [W]	2373.207	-40.65484	-2413.861
Q_fund_rc@AC [var]	-6.887242	384.6306	391.5238
S_t_rc@AC [VA]	2383.204	416.1375	-1967.067
U_fund_SYM+_rc@AC [V]	399.0170	342.5842	-56.43286
U_fund_SYM-_rc@AC [V]	0.746210	51.16004	50.41383
I_fund_P_SYM+_rc@AC [A]	3.433368	-0.061024	-3.494392
I_fund_P_SYM-_rc@AC [A]	0.024467	-0.054022	-0.078489
I_fund_Q_SYM+_rc@AC [A]	-9.980e-3	0.637151	0.647131
I_fund_Q_SYM-_rc@AC [A]	2.881e-4	0.074711	0.074423

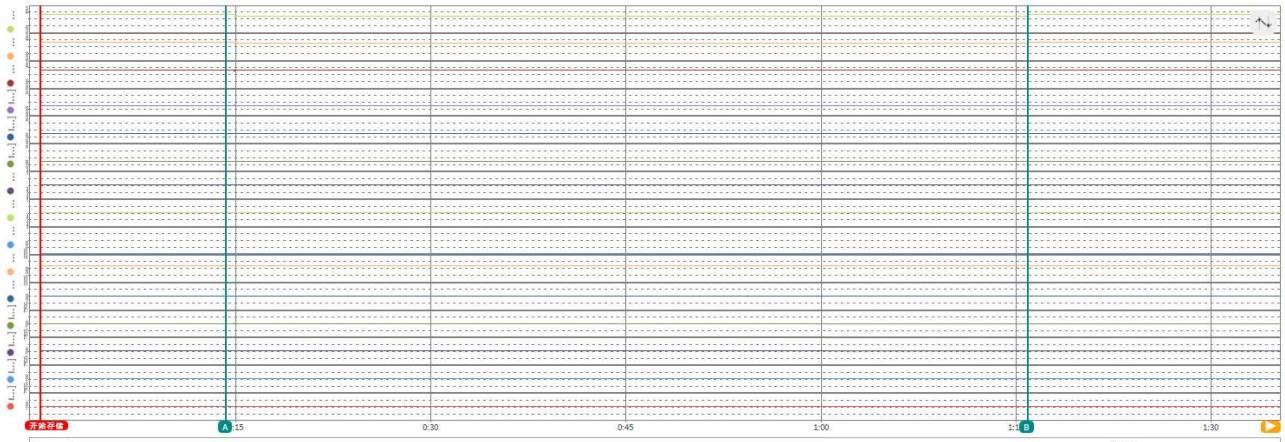
Recover time – Active power



时间 [s]	A 0:49.740467	B 0:50.111403	间隔 0.370936
U1_tRMS_rc@AC [V]	184.3962	230.6367	46.24049
U2_tRMS_rc@AC [V]	222.4936	230.2091	7.715485
U3_tRMS_rc@AC [V]	213.8559	230.3320	16.47612
I1_tRMS_rc@AC [A]	0.716823	3.035869	2.319046
I2_tRMS_rc@AC [A]	0.805539	2.966535	2.160996
I3_tRMS_rc@AC [A]	0.791851	2.947812	2.155962
P_t_rc@AC [W]	-75.51989	2048.166	2123.685
Q_fund_rc@AC [var]	425.2719	3.332025	-421.9398
S_t_rc@AC [VA]	480.7486	2062.082	1581.333
U_fund_SYM+_rc@AC [V]	355.0471	399.0472	43.10016
U_fund_SYM-_rc@AC [V]	42.51261	0.386849	-42.12576
I_fund_P_SYM+_rc@AC [A]	-0.116481	2.963028	3.079509
I_fund_P_SYM-_rc@AC [A]	5.592e-3	0.025177	0.019586
I_fund_Q_SYM+_rc@AC [A]	0.682536	4.783e-3	-0.677753
I_fund_Q_SYM-_rc@AC [A]	0.061012	-9.183e-3	-0.070195

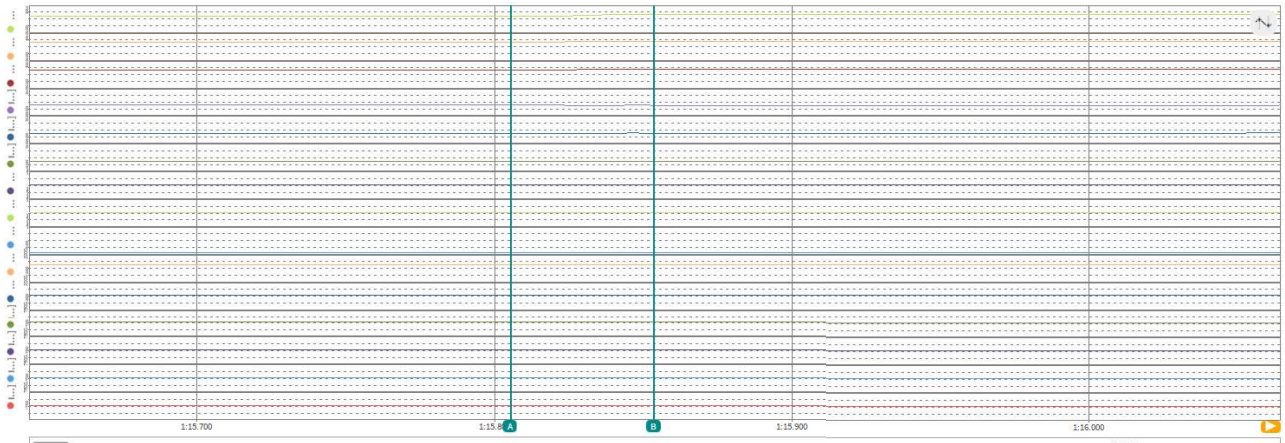
Test – VD10.1

Duration fault time



时间 [s]	A 0:14.24280	B 1:15.86808	间隔 1:01.62528
U1_tRMS_rc@AC [V]	230.6703	232.4422	1.771942
U2_tRMS_rc@AC [V]	230.2507	231.9636	1.712952
U3_tRMS_rc@AC [V]	230.3565	231.9727	1.616180
I1_tRMS_rc@AC [A]	17.67273	16.64424	-1.028498
I2_tRMS_rc@AC [A]	17.68126	17.01910	-0.662167
I3_tRMS_rc@AC [A]	17.48245	16.81715	0.665304
P_t_rc@AC [W]	12170.52	11704.79	-465.7334
Q_fund_rc@AC [var]	190.3341	64.92896	-125.4052
S_t_rc@AC [VA]	12174.89	11717.75	-457.1406
U_fund_SYM+_rc@AC [V]	399.1037	402.0247	2.921021
U_fund_SYM-_rc@AC [V]	0.492140	1.723862	1.231722
I_fund_P_SYM+_rc@AC [A]	17.60548	16.81079	-0.794697
I_fund_P_SYM-_rc@AC [A]	0.088235	0.128450	0.040214
I_fund_Q_SYM+_rc@AC [A]	0.275320	0.094202	-0.181118
I_fund_Q_SYM-_rc@AC [A]	-0.031917	-0.275593	-0.243676

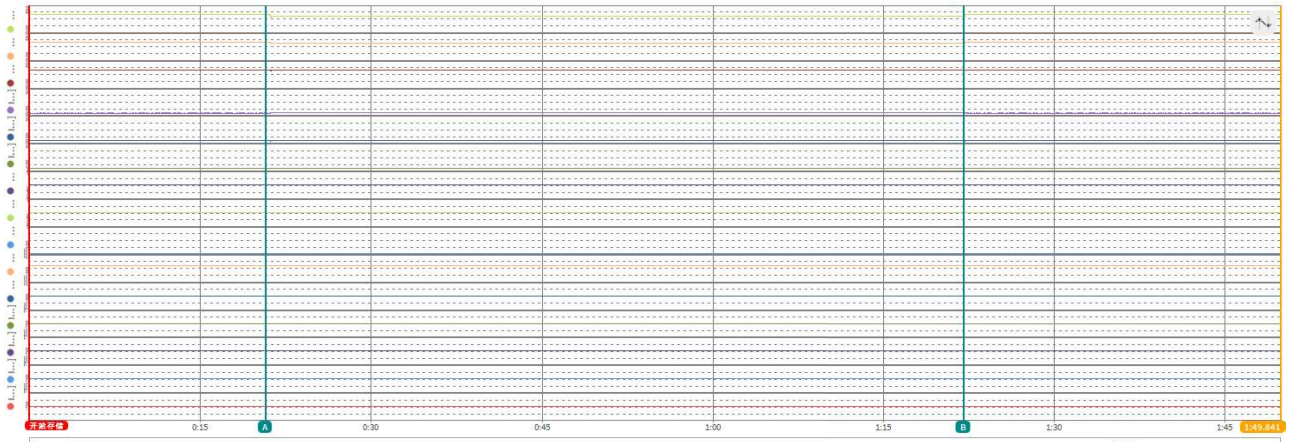
Recover time – Active power



时间 [s]	A 1:15.80539	B 1:15.85367	间隔 0.04828
U1_tRMS_rc@AC [V]	207.5849	231.7493	24.16444
U2_tRMS_rc@AC [V]	225.6405	231.7423	6.101822
U3_tRMS_rc@AC [V]	225.7488	231.8139	6.065048
I1_tRMS_rc@AC [A]	17.85825	17.48480	-0.373451
I2_tRMS_rc@AC [A]	17.17951	16.98272	-0.196791
I3_tRMS_rc@AC [A]	17.02378	17.20773	0.183943
P_t_rc@AC [W]	11423.37	11962.97	539.6035
Q_fund_rc@AC [var]	82.75393	81.62421	-1.129715
S_t_rc@AC [VA]	11426.59	11976.69	550.1006
U_fund_SYM+_rc@AC [V]	380.1367	401.4044	21.26767
U_fund_SYM-_rc@AC [V]	21.15863	1.619471	-19.53916
I_fund_P_SYM+_rc@AC [A]	17.33507	17.20826	-0.126808
I_fund_P_SYM-_rc@AC [A]	0.214680	0.030822	-0.183857
I_fund_Q_SYM+_rc@AC [A]	0.115785	0.116313	5.278e-4
I_fund_Q_SYM-_rc@AC [A]	0.160593	0.016032	-0.144560

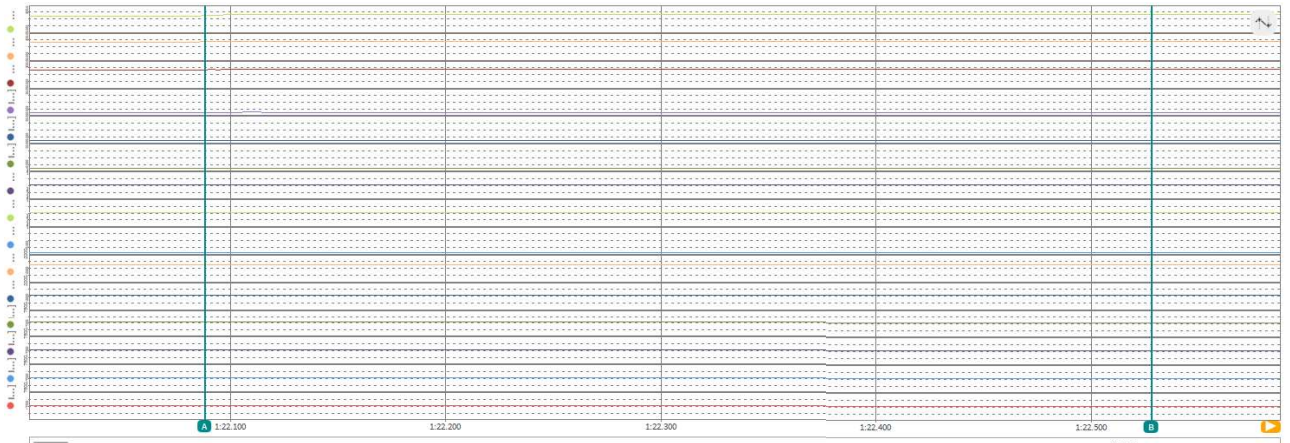
Test – VD10.2

Duration fault time



时间 [s]	A 0:20.75193	B 1:22.01953	间隔 1:01.26760
U1_tRMS_rc@AC [V]	230.6114	207.5788	-23.03252
U2_tRMS_rc@AC [V]	230.2003	225.6091	-4.591248
U3_tRMS_rc@AC [V]	230.2735	225.6861	-4.587418
I1_tRMS_rc@AC [A]	3.448500	3.968370	0.519871
I2_tRMS_rc@AC [A]	3.478755	3.524779	0.046024
I3_tRMS_rc@AC [A]	3.418413	3.486807	0.068395
P_t_rc@AC [W]	2373.014	2391.434	18.42017
Q_fund_rc@AC [var]	6.551885	-84.82661	-91.37850
S_t_rc@AC [VA]	2383.244	2405.896	22.65210
U_fund_SYM+_rc@AC [V]	388.9936	380.0869	-18.90668
U_fund_SYM-_rc@AC [V]	0.481606	21.27754	20.79593
I_fund_P_SYM+_rc@AC [A]	3.433444	3.634780	0.201336
I_fund_P_SYM-_rc@AC [A]	0.018586	-0.058565	-0.077151
I_fund_Q_SYM+_rc@AC [A]	9.499e-3	-0.134590	-0.144089
I_fund_Q_SYM-_rc@AC [A]	-0.017802	0.099707	0.117508

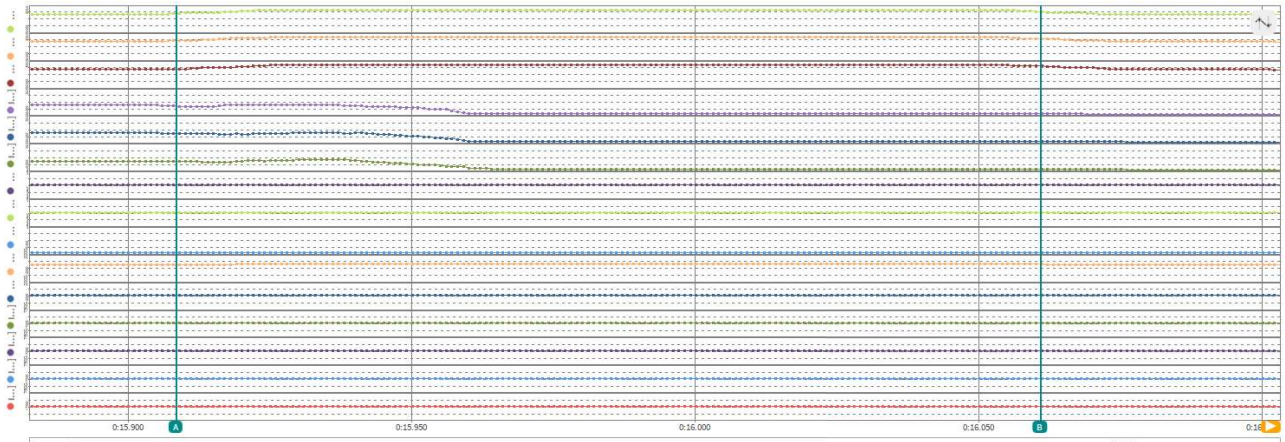
Recover time – Active power



时间 [s]	A 1:22.08843	B 1:22.52781	间隔 0.43938
U1_tRMS_rc@AC [V]	214.9396	230.6074	15.66779
U2_tRMS_rc@AC [V]	228.5915	230.1998	1.608322
U3_tRMS_rc@AC [V]	225.8084	230.3012	4.492813
I1_tRMS_rc@AC [A]	3.386057	3.455137	0.069080
I2_tRMS_rc@AC [A]	3.244699	3.488036	0.243338
I3_tRMS_rc@AC [A]	3.573231	3.432160	0.141071
P_t_rc@AC [W]	2180.860	2380.275	199.4143
Q_fund_rc@AC [var]	51.91848	-14.86274	-66.78123
S_t_rc@AC [VA]	2276.374	2390.196	113.7822
U_fund_SYM+_rc@AC [V]	386.0770	399.0070	12.92908
U_fund_SYM-_rc@AC [V]	15.26519	0.472219	-14.79297
I_fund_P_SYM+_rc@AC [A]	3.273847	3.443822	0.169975
I_fund_P_SYM-_rc@AC [A]	0.255485	0.018269	-0.237216
I_fund_Q_SYM+_rc@AC [A]	0.084801	-0.021495	-0.106296
I_fund_Q_SYM-_rc@AC [A]	-0.182867	-7.911e-3	0.174956

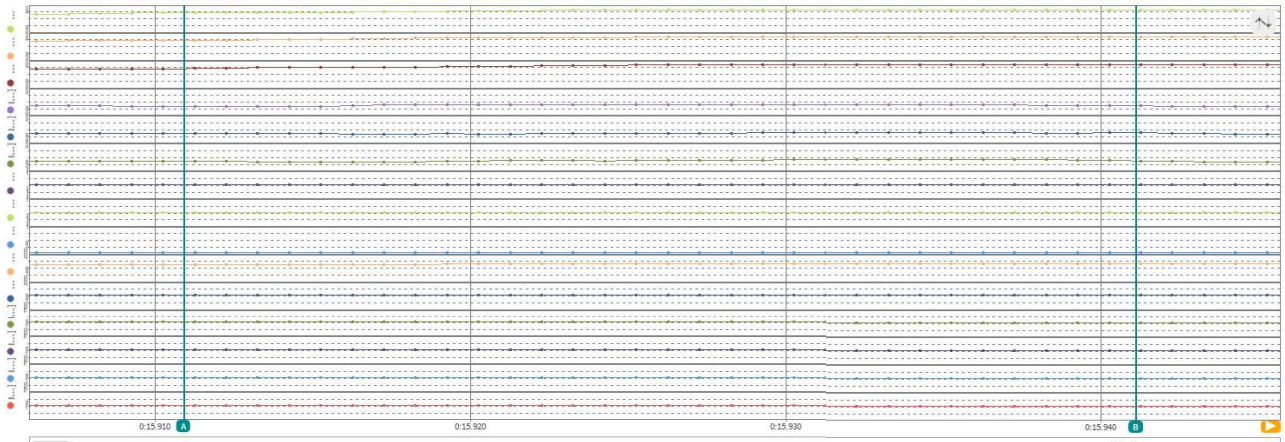
Test – VS1.1

Duration fault time



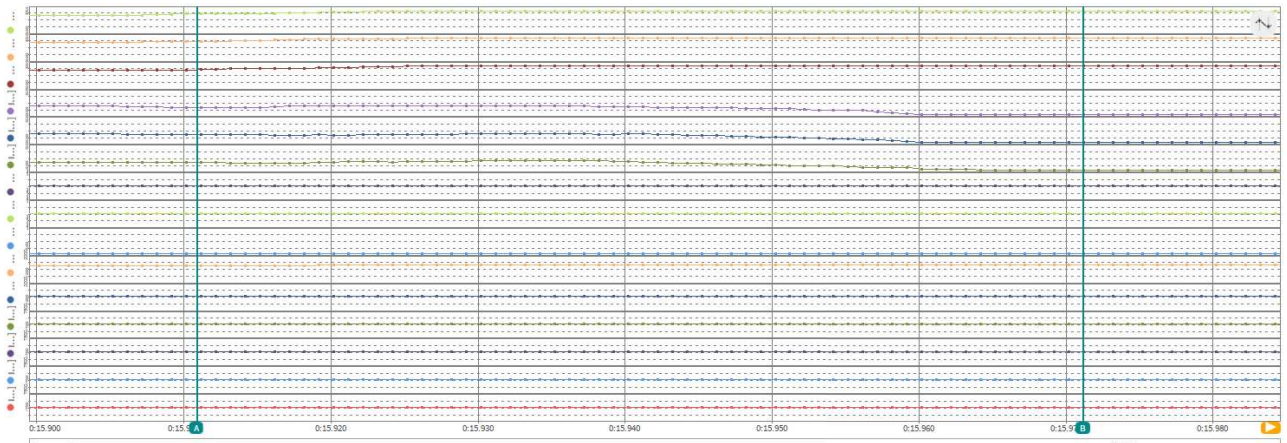
时间 [s]	A 0:15.9085356	B 0:16.0608969	间隔 0.1523614
U1_tRMS_rc@AC [V]	239.9720	269.1159	29.14395
U2_tRMS_rc@AC [V]	246.2334	270.0530	23.81967
U3_tRMS_rc@AC [V]	232.6887	281.9232	49.23456
I1_tRMS_rc@AC [A]	16.56702	0.927035	-15.63999
I2_tRMS_rc@AC [A]	16.22931	1.132854	-15.09645
I3_tRMS_rc@AC [A]	17.21226	1.006976	16.20529
P_t_rc@AC [W]	11466.76	-15.27211	-11482.03
Q_fund_rc@AC [var]	397.0090	716.4774	319.4684
S_t_rc@AC [VA]	11976.92	839.3005	-11137.62
U_fund_SYM+_rc@AC [V]	413.6878	472.1884	58.50064
U_fund_SYM-_rc@AC [V]	12.69823	14.79749	2.099260
I_fund_P_SYM+_rc@AC [A]	16.26180	-0.014291	-16.27609
I_fund_P_SYM-_rc@AC [A]	-0.936034	-6.212e-3	0.929823
I_fund_Q_SYM+_rc@AC [A]	0.553650	0.875577	0.321927
I_fund_Q_SYM-_rc@AC [A]	0.015540	0.015330	-2.099e-4

Injected current at 30ms



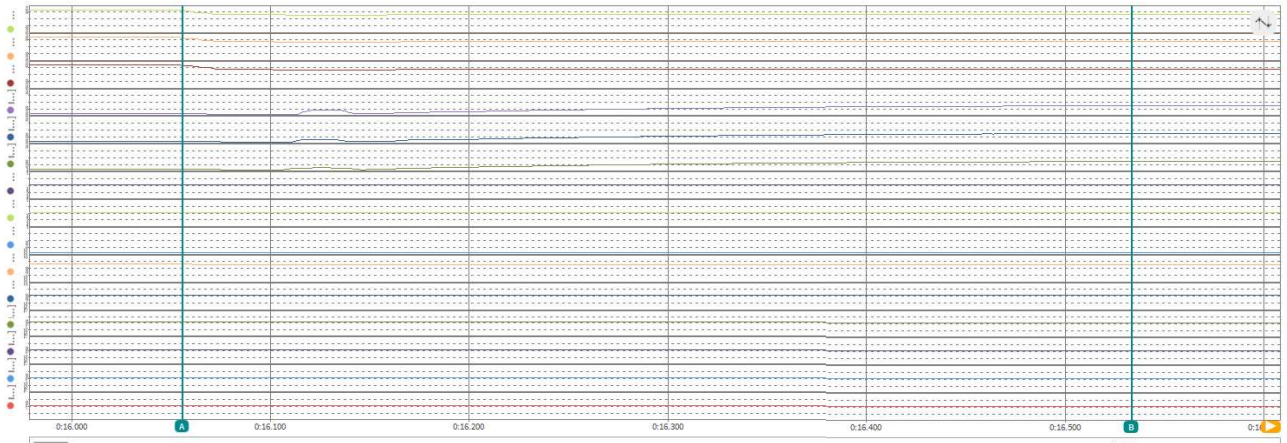
时间 [s]	A 0:15.9109174	B 0:15.9411170	间隔 0.0301996
U1_tRMS_rc@AC [V]	251.4577	288.5264	37.06877
U2_tRMS_rc@AC [V]	249.2186	288.3903	39.17175
U3_tRMS_rc@AC [V]	236.0423	288.1712	52.12892
I1_tRMS_rc@AC [A]	14.80569	16.90726	2.101563
I2_tRMS_rc@AC [A]	16.29736	17.52786	1.230501
I3_tRMS_rc@AC [A]	16.85179	18.08523	1.233437
P_t_rc@AC [W]	10842.08	13541.22	2699.145
Q_fund_rc@AC [var]	590.3368	344.5119	-245.8249
S_t_rc@AC [VA]	11762.34	15144.70	3382.354
U_fund_SYM+_rc@AC [V]	423.3815	499.3531	75.97162
U_fund_SYM-_rc@AC [V]	15.82900	3.469856	-12.35915
I_fund_P_SYM+_rc@AC [A]	15.19616	15.65498	0.458816
I_fund_P_SYM-_rc@AC [A]	-1.097810	0.103960	1.201770
I_fund_Q_SYM+_rc@AC [A]	0.824611	0.403807	-0.420804
I_fund_Q_SYM-_rc@AC [A]	-0.513070	-0.805780	-0.292710

Injected current at 60ms



时间 [s]	A 0:15.9109174	B 0:15.9711803	间隔 0.0602630
U1_tRMS_rc@AC [V]	251.4577	286.7476	35.28996
U2_tRMS_rc@AC [V]	249.2186	286.4232	37.20465
U3_tRMS_rc@AC [V]	236.0423	286.3250	50.28276
I1_tRMS_rc@AC [A]	14.80569	0.953528	-13.85217
I2_tRMS_rc@AC [A]	16.29736	0.938344	-15.35902
I3_tRMS_rc@AC [A]	16.85179	0.939120	15.01267
P_t_rc@AC [W]	10842.08	-50.39391	-10892.47
Q_fund_rc@AC [var]	590.3368	792.7311	202.3943
S_t_rc@AC [VA]	11762.34	811.0792	-10951.27
U_fund_SYM+_rc@AC [V]	423.3815	496.1815	72.79996
U_fund_SYM-_rc@AC [V]	15.82900	2.193448	-13.63555
I_fund_P_SYM+_rc@AC [A]	15.19616	-0.058526	-15.25469
I_fund_P_SYM-_rc@AC [A]	-1.097810	1.828e-3	1.099638
I_fund_Q_SYM+_rc@AC [A]	0.824611	0.922420	0.097809
I_fund_Q_SYM-_rc@AC [A]	-0.513070	9.918e-5	0.513080

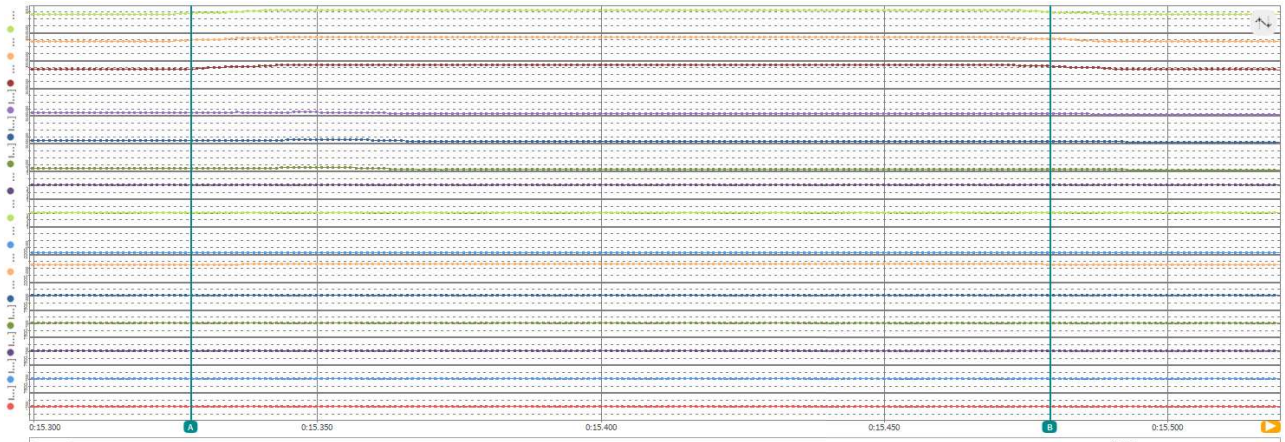
Recover time – Active power



时间 [s]	A 0:16.0559944	B 0:16.5333511	间隔 0.4773567
U1_tRMS_rc@AC [V]	287.3063	230.6776	-56.62875
U2_tRMS_rc@AC [V]	286.7658	230.2465	-56.51926
U3_tRMS_rc@AC [V]	286.7255	230.2106	-56.51492
I1_tRMS_rc@AC [A]	0.945980	16.59533	15.64935
I2_tRMS_rc@AC [A]	0.950688	16.68107	15.73038
I3_tRMS_rc@AC [A]	0.948942	16.39369	15.44466
P_t_rc@AC [W]	-45.47765	11437.22	11482.70
Q_fund_rc@AC [var]	794.1176	213.3017	-580.8158
S_t_rc@AC [VA]	816.4968	11442.91	10626.41
U_fund_SYM+_rc@AC [V]	496.0706	398.0223	-97.94827
U_fund_SYM-_rc@AC [V]	0.753757	0.519517	-0.234240
I_fund_P_SYM+_rc@AC [A]	-0.052716	16.54800	16.60071
I_fund_P_SYM-_rc@AC [A]	3.028e-4	0.093167	0.092865
I_fund_Q_SYM+_rc@AC [A]	0.922576	0.308618	-0.613958
I_fund_Q_SYM-_rc@AC [A]	-8.356e-3	-0.024906	-0.016550

Test – VS1.2

Duration fault time



时间 [s]	A 0:15.3277965	B 0:15.4792496	间隔 0.1514531
U1_tRMS_rc@AC [V]	245.0226	265.1638	20.14124
U2_tRMS_rc@AC [V]	250.6716	268.0314	17.35980
U3_tRMS_rc@AC [V]	234.7635	277.8181	43.05464
I1_tRMS_rc@AC [A]	3.375335	0.914014	-2.461321
I2_tRMS_rc@AC [A]	2.976073	1.095272	-1.880802
I3_tRMS_rc@AC [A]	3.344788	1.029924	2.314864
P_t_rc@AC [W]	1689.267	-12.05736	-1701.324
Q_fund_rc@AC [var]	176.6635	699.9496	523.2861
S_t_rc@AC [VA]	2358.284	822.0621	-1536.222
U_fund_SYM+_rc@AC [V]	410.0474	466.0441	46.09668
U_fund_SYM-_rc@AC [V]	15.30366	13.55850	-1.745154
I_fund_P_SYM+_rc@AC [A]	2.495475	-0.010565	-2.506040
I_fund_P_SYM-_rc@AC [A]	-0.568936	8.709e-3	0.577646
I_fund_Q_SYM+_rc@AC [A]	0.249790	0.866697	0.616907
I_fund_Q_SYM-_rc@AC [A]	-0.186907	0.014994	0.201902

Injected current at 30ms



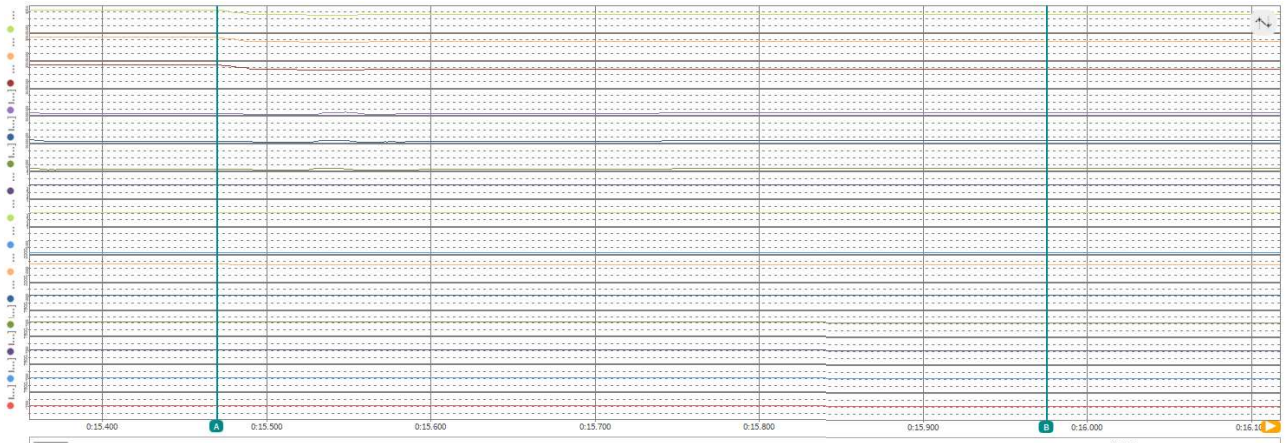
时间 [s]	A 0:15.3288863	B 0:15.3598132	间隔 0.0309270
U1_tRMS_rc@AC [V]	250.8242	287.4734	36.64919
U2_tRMS_rc@AC [V]	251.5630	287.4928	35.92976
U3_tRMS_rc@AC [V]	236.9869	287.1763	50.18936
I1_tRMS_rc@AC [A]	3.219048	2.610246	-0.608802
I2_tRMS_rc@AC [A]	2.987776	4.247306	1.259530
I3_tRMS_rc@AC [A]	3.271694	3.432521	0.160827
P_t_rc@AC [W]	1577.504	1732.758	155.2540
Q_fund_rc@AC [var]	228.5824	278.0528	49.47043
S_t_rc@AC [VA]	2334.378	2957.185	622.8069
U_fund_SYM+_rc@AC [V]	424.8191	497.6576	72.83856
U_fund_SYM-_rc@AC [V]	15.76468	3.481847	-12.28283
I_fund_P_SYM+_rc@AC [A]	2.332282	2.013064	-0.319218
I_fund_P_SYM-_rc@AC [A]	-0.563181	0.529152	1.092333
I_fund_Q_SYM+_rc@AC [A]	0.317308	0.325914	8.606e-3
I_fund_Q_SYM-_rc@AC [A]	-0.176657	-0.505664	-0.329007

Injected current at 60ms



时间 [s]	A 0:15.3277965	B 0:15.3882995	间隔 0.0605030
U1_tRMS_rc@AC [V]	245.0226	287.0758	42.05322
U2_tRMS_rc@AC [V]	250.6716	286.8454	36.17380
U3_tRMS_rc@AC [V]	234.7635	286.7096	51.94615
I1_tRMS_rc@AC [A]	3.375335	0.948512	-2.426824
I2_tRMS_rc@AC [A]	2.976073	0.940185	-2.035888
I3_tRMS_rc@AC [A]	3.344788	0.936910	2.407878
P_t_rc@AC [W]	1689.267	-46.37624	-1735.643
Q_fund_rc@AC [var]	176.6635	793.7059	617.0423
S_t_rc@AC [VA]	2358.284	810.6036	-1547.681
U_fund_SYM+_rc@AC [V]	410.0474	406.8306	76.88916
U_fund_SYM-_rc@AC [V]	15.30366	2.151868	-13.15179
I_fund_P_SYM+_rc@AC [A]	2.495475	-0.053767	-2.549242
I_fund_P_SYM-_rc@AC [A]	-0.568936	2.160e-3	0.571097
I_fund_Q_SYM+_rc@AC [A]	0.249790	0.922340	0.672549
I_fund_Q_SYM-_rc@AC [A]	-0.186907	5.332e-4	0.187440

Recover time – Active power



时间 [s]	A 0:15.4700776	B 0:15.9751794	间隔 0.5051018
U1_tRMS_rc@AC [V]	287.3444	230.6162	-56.72826
U2_tRMS_rc@AC [V]	286.9912	230.1730	-56.81824
U3_tRMS_rc@AC [V]	286.8690	230.2291	-56.63998
I1_tRMS_rc@AC [A]	0.949719	3.241987	2.292268
I2_tRMS_rc@AC [A]	0.942208	3.342702	2.400493
I3_tRMS_rc@AC [A]	0.937515	3.288876	2.351361
P_t_rc@AC [W]	-46.69324	2262.647	2309.341
Q_fund_rc@AC [var]	796.7191	5.264922	-791.4541
S_t_rc@AC [VA]	812.2460	2274.249	1462.003
U_fund_SYM+_rc@AC [V]	407.2054	308.9596	-98.24985
U_fund_SYM-_rc@AC [V]	0.935653	0.351446	-0.584207
I_fund_P_SYM+_rc@AC [A]	-0.054191	3.274071	3.328262
I_fund_P_SYM-_rc@AC [A]	1.669e-3	9.535e-3	7.867e-3
I_fund_Q_SYM+_rc@AC [A]	0.925153	7.664e-3	-0.917489
I_fund_Q_SYM-_rc@AC [A]	-2.022e-3	-0.013177	-0.011154

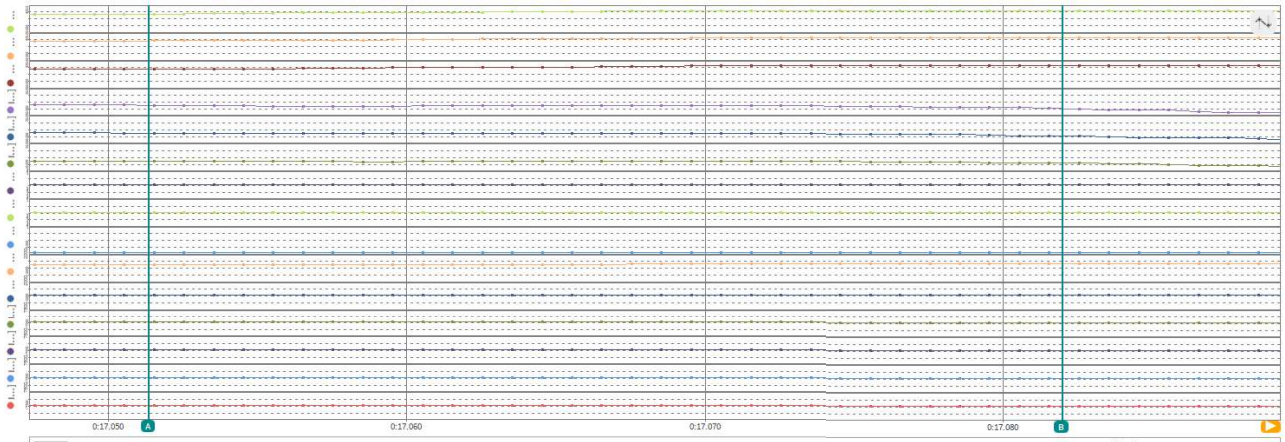
Test – VS2.1.1

Duration fault time



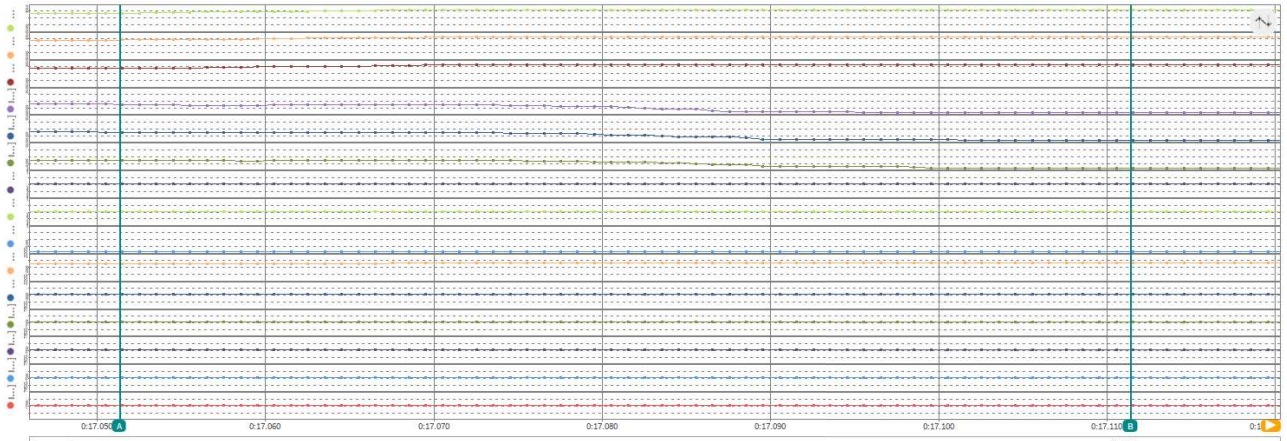
时间 [s]	A 0:17.027516	B 0:22.249300	间隔 5.221784
U1_tRMS_rc@AC [V]	230.6361	276.0714	45.43529
U2_tRMS_rc@AC [V]	230.2502	275.7658	45.51559
U3_tRMS_rc@AC [V]	230.2416	275.6339	45.39229
I1_tRMS_rc@AC [A]	17.61593	0.914506	-16.70142
I2_tRMS_rc@AC [A]	17.67310	0.903880	-16.76924
I3_tRMS_rc@AC [A]	17.46844	0.902615	16.56582
P_t_rc@AC [W]	12150.21	-42.95446	-12193.17
Q_fund_rc@AC [var]	196.7663	734.5601	537.7938
S_t_rc@AC [VA]	12154.07	750.5141	-11403.55
U_fund_SYM+_rc@AC [V]	399.0180	477.7338	78.71579
U_fund_SYM-_rc@AC [V]	0.468307	0.875506	0.407199
I_fund_P_SYM+_rc@AC [A]	17.57994	-0.051922	-17.63186
I_fund_P_SYM-_rc@AC [A]	0.069362	-4.019e-4	-0.069764
I_fund_Q_SYM+_rc@AC [A]	0.284721	0.887737	0.603016
I_fund_Q_SYM-_rc@AC [A]	-0.034312	-3.882e-3	0.030430

Injected current at 30ms



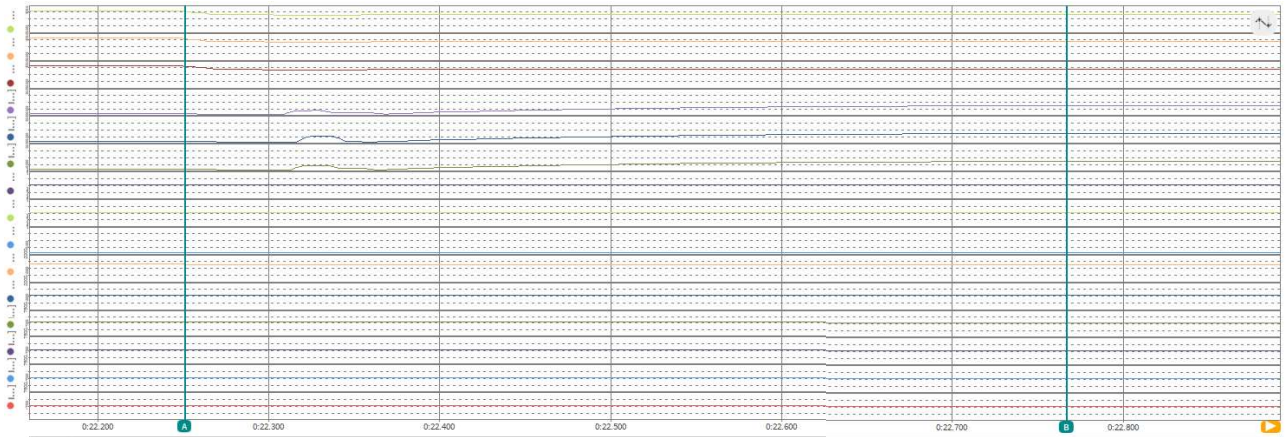
时间 [s]	A 0:17.051368	B 0:17.081971	间隔 0.030603
U1_tRMS_rc@AC [V]	231.0983	276.1384	45.04013
U2_tRMS_rc@AC [V]	234.5296	276.0890	41.55942
U3_tRMS_rc@AC [V]	232.2852	276.2643	43.97911
I1_tRMS_rc@AC [A]	17.58140	12.00724	-5.574159
I2_tRMS_rc@AC [A]	16.99114	11.64825	-5.342891
I3_tRMS_rc@AC [A]	17.13302	12.68007	-4.452951
P_t_rc@AC [W]	11860.60	6650.785	-5209.819
Q_fund_rc@AC [var]	200.0033	80.76659	-119.2367
S_t_rc@AC [VA]	12027.70	10034.67	-1993.038
U_fund_SYM+_rc@AC [V]	402.6086	478.2524	75.64380
U_fund_SYM-_rc@AC [V]	3.109121	2.346887	-0.762234
I_fund_P_SYM+_rc@AC [A]	17.09280	8.010333	-9.082463
I_fund_P_SYM-_rc@AC [A]	-0.452299	-1.195666	-0.743367
I_fund_Q_SYM+_rc@AC [A]	0.285935	0.097569	-0.188366
I_fund_Q_SYM-_rc@AC [A]	0.107062	0.908685	0.801623

Injected current at 60ms



时间 [s]	A 0:17.051368	B 0:17.111389	间隔 0.060020
U1_tRMS_rc@AC [V]	231.0983	275.5287	44.43042
U2_tRMS_rc@AC [V]	234.5296	275.2333	40.70377
U3_tRMS_rc@AC [V]	232.2852	275.1391	42.85390
I1_tRMS_rc@AC [A]	17.58140	0.905917	-16.67548
I2_tRMS_rc@AC [A]	16.99114	0.908866	-16.08228
I3_tRMS_rc@AC [A]	17.13302	0.903413	16.22961
P_t_rc@AC [W]	11860.60	-46.84525	-11907.45
Q_fund_rc@AC [var]	200.0033	731.4752	531.4719
S_t_rc@AC [VA]	12027.70	748.3206	-11279.38
U_fund_SYM+_rc@AC [V]	402.6086	476.7946	74.18600
U_fund_SYM-_rc@AC [V]	3.109121	1.845341	-1.263780
I_fund_P_SYM+_rc@AC [A]	17.09280	-0.056646	-17.14944
I_fund_P_SYM-_rc@AC [A]	-0.452299	3.458e-3	0.455757
I_fund_Q_SYM+_rc@AC [A]	0.285935	0.885734	0.599799
I_fund_Q_SYM-_rc@AC [A]	0.107062	4.113e-3	-0.102949

Recover time – Active power



时间 [s]	A 0:22.251188	B 0:22.766911	间隔 0.515723
U1_tRMS_rc@AC [V]	276.0153	230.6338	-45.38147
U2_tRMS_rc@AC [V]	274.6077	230.2520	-44.35570
U3_tRMS_rc@AC [V]	274.9666	230.2444	-44.72221
I1_tRMS_rc@AC [A]	0.906954	16.77351	15.86656
I2_tRMS_rc@AC [A]	0.990997	16.77469	15.78370
I3_tRMS_rc@AC [A]	0.997891	16.55384	15.55595
P_t_rc@AC [W]	-21.18311	11538.94	11560.13
Q_fund_rc@AC [var]	731.9857	150.8420	-581.1437
S_t_rc@AC [VA]	796.8552	11542.38	10745.52
U_fund_SYM+_rc@AC [V]	476.5291	399.0207	-77.50836
U_fund_SYM-_rc@AC [V]	1.120669	0.341242	-0.779427
I_fund_P_SYM+_rc@AC [A]	-0.022408	16.69544	16.71785
I_fund_P_SYM-_rc@AC [A]	-0.030023	0.060807	0.090830
I_fund_Q_SYM+_rc@AC [A]	0.886883	0.218265	-0.668618
I_fund_Q_SYM-_rc@AC [A]	-0.011391	-0.051906	-0.040515

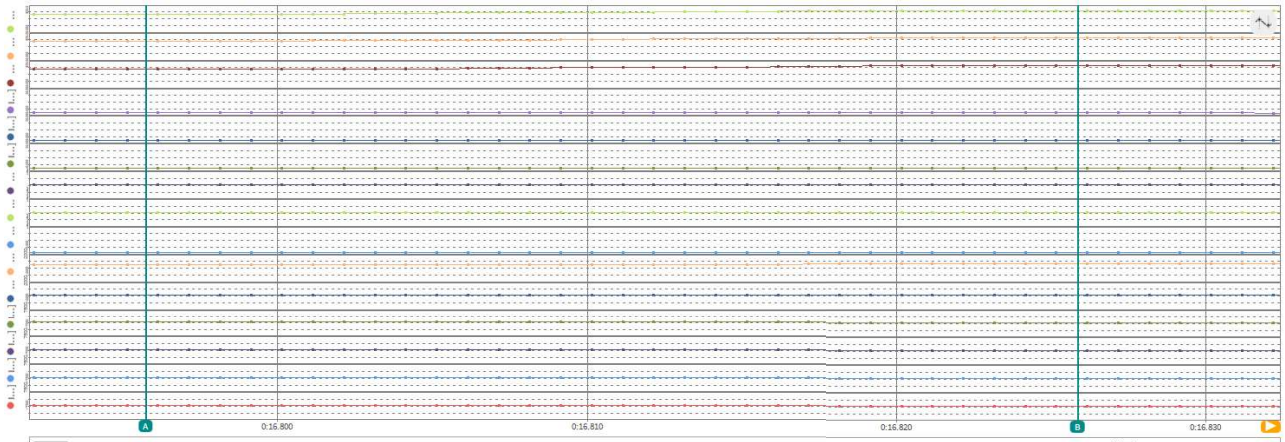
Test – VS2.1.2

Duration fault time



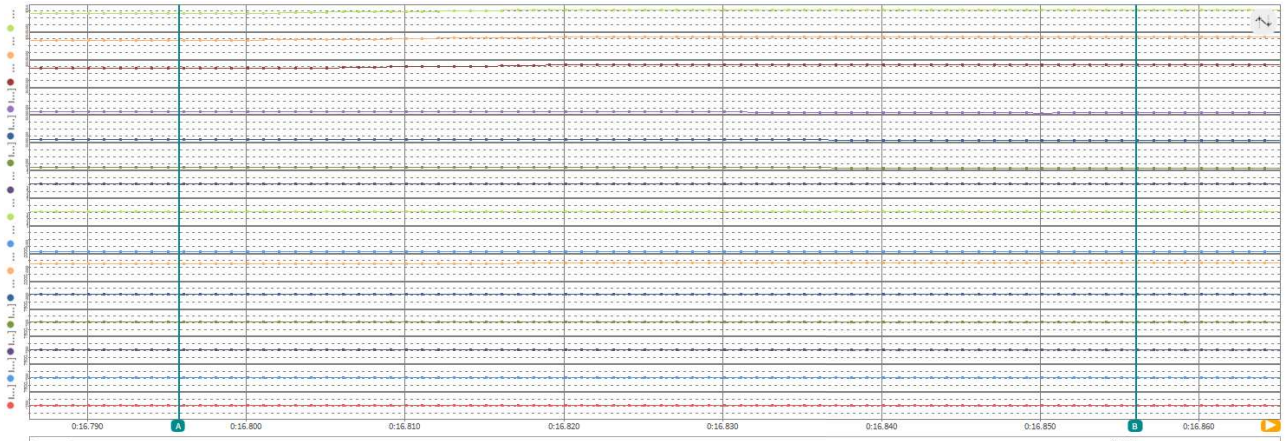
时间 [s]	A 0:16.795774	B 0:21.986164	间隔 5.190390
U1_tRMS_rc@AC [V]	230.5972	276.1390	45.54184
U2_tRMS_rc@AC [V]	230.1741	275.7669	45.59276
U3_tRMS_rc@AC [V]	230.1829	275.6395	45.45262
I1_tRMS_rc@AC [A]	3.478858	0.908577	-2.570281
I2_tRMS_rc@AC [A]	3.443995	0.906583	-2.537412
I3_tRMS_rc@AC [A]	3.478684	0.901348	2.577336
P_t_rc@AC [W]	2385.911	-43.82499	-2429.736
Q_fund_rc@AC [var]	4.434110	734.5346	730.1005
S_t_rc@AC [VA]	2395.667	749.3430	-1646.324
U_fund_SYM+_rc@AC [V]	308.0160	477.7748	78.85883
U_fund_SYM-_rc@AC [V]	0.539089	0.593826	0.054737
I_fund_P_SYM+_rc@AC [A]	3.452659	-0.052988	-3.505648
I_fund_P_SYM-_rc@AC [A]	-1.993e-3	1.833e-3	3.825e-3
I_fund_Q_SYM+_rc@AC [A]	6.435e-3	0.887626	0.881191
I_fund_Q_SYM-_rc@AC [A]	-0.013095	-1.075e-3	0.012020

Injected current at 30ms



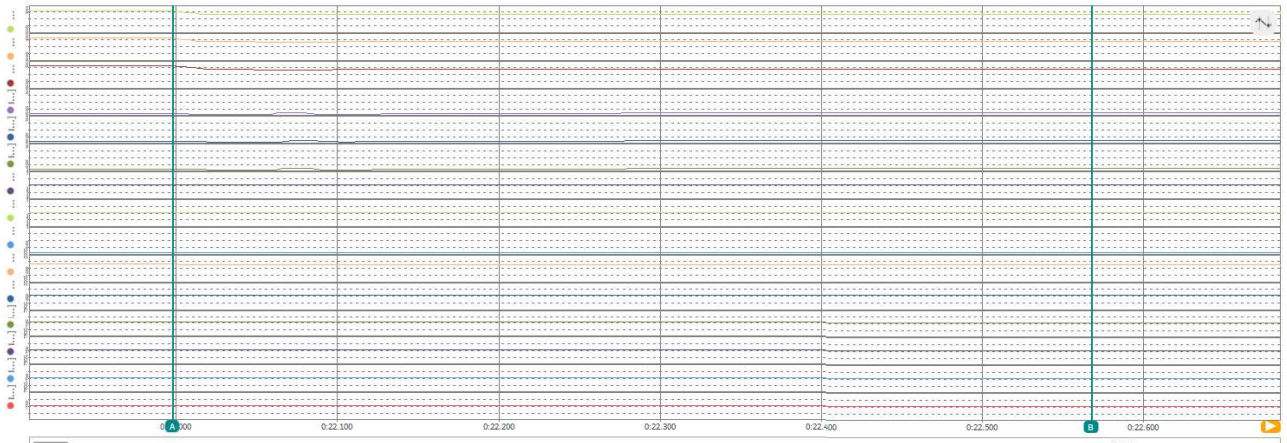
时间 [s]	A 0:16.795774	B 0:16.825856	间隔 0.030082
U1_tRMS_rc@AC [V]	230.5972	276.0580	45.46078
U2_tRMS_rc@AC [V]	230.1741	276.3274	46.15331
U3_tRMS_rc@AC [V]	230.1829	276.0552	45.87233
I1_tRMS_rc@AC [A]	3.478858	3.663424	0.184566
I2_tRMS_rc@AC [A]	3.443995	3.603695	0.159700
I3_tRMS_rc@AC [A]	3.478684	4.050176	0.571491
P_t_rc@AC [W]	2385.911	2474.308	88.39697
Q_fund_rc@AC [var]	4.434110	-165.6521	-170.0862
S_t_rc@AC [VA]	2395.667	3125.189	729.5222
U_fund_SYM+_rc@AC [V]	398.9160	478.1157	79.19971
U_fund_SYM-_rc@AC [V]	0.539089	4.951732	4.412643
I_fund_P_SYM+_rc@AC [A]	3.452659	2.991407	-0.461253
I_fund_P_SYM-_rc@AC [A]	-1.993e-3	0.178474	0.180467
I_fund_Q_SYM+_rc@AC [A]	6.435e-3	-0.195630	-0.202066
I_fund_Q_SYM-_rc@AC [A]	-0.013095	-0.413833	-0.400738

Injected current at 60ms



时间 [s]	A	B	间隔
U1_tRMS_rc@AC [V]	230.5972	275.9394	45.34225
U2_tRMS_rc@AC [V]	230.1741	275.6186	45.44450
U3_tRMS_rc@AC [V]	230.1829	275.4650	45.28209
I1_tRMS_rc@AC [A]	3.478858	0.855437	-2.623422
I2_tRMS_rc@AC [A]	3.443995	0.912024	-2.531971
I3_tRMS_rc@AC [A]	3.478684	0.915228	2.563456
P_t_rc@AC [W]	2385.911	-79.74440	-2465.656
Q_fund_rc@AC [var]	4.434110	707.4836	703.0495
S_t_rc@AC [VA]	2395.667	739.5328	-1656.134
U_fund_SYM+_rc@AC [V]	308.0160	477.4439	78.52792
U_fund_SYM-_rc@AC [V]	0.539089	1.976888	1.437799
I_fund_P_SYM+_rc@AC [A]	3.452659	-0.096093	-3.548752
I_fund_P_SYM-_rc@AC [A]	-1.993e-3	0.055819	0.057812
I_fund_Q_SYM+_rc@AC [A]	6.435e-3	0.855600	0.849165
I_fund_Q_SYM-_rc@AC [A]	-0.013095	-7.983e-3	5.112e-3

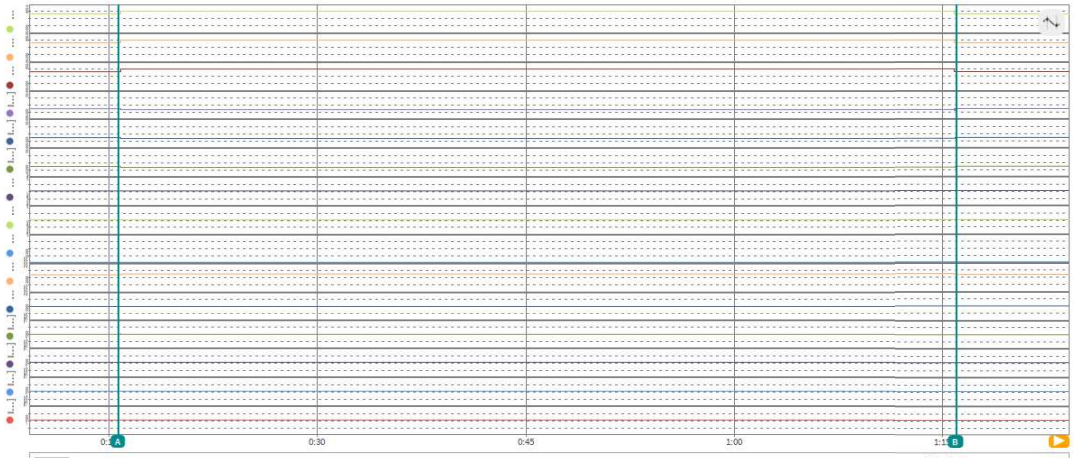
Recover time – Active power



时间 [s]	A	B	间隔
U1_tRMS_rc@AC [V]	276.1712	230.6137	-45.55750
U2_tRMS_rc@AC [V]	275.7701	230.1798	-45.59033
U3_tRMS_rc@AC [V]	275.6250	230.1799	-45.44508
I1_tRMS_rc@AC [A]	0.909529	3.334533	2.425004
I2_tRMS_rc@AC [A]	0.906850	3.386082	2.479232
I3_tRMS_rc@AC [A]	0.900021	3.335322	2.435301
P_t_rc@AC [W]	-44.02138	2307.109	2351.131
Q_fund_rc@AC [var]	734.3610	-7.128105	-741.4891
S_t_rc@AC [VA]	749.3360	2316.121	1566.785
U_fund_SYM+_rc@AC [V]	477.7885	398.9305	-78.85803
U_fund_SYM-_rc@AC [V]	0.899024	0.400193	-0.498831
I_fund_P_SYM+_rc@AC [A]	-0.053217	3.338535	3.391752
I_fund_P_SYM-_rc@AC [A]	8.755e-4	8.395e-3	7.519e-3
I_fund_Q_SYM+_rc@AC [A]	0.887398	-0.010290	-0.897688
I_fund_Q_SYM-_rc@AC [A]	-4.148e-3	-0.023466	-0.019317

Test – VS2.2.1

Duration fault time



时间 [s]	A 0:15.71734	B 1:16.00048	间隔 1:00.28314
U1_tRMS_rc@AC [V]	230.6680	230.4471	-0.220963
U2_tRMS_rc@AC [V]	230.2307	230.0483	-0.182434
U3_tRMS_rc@AC [V]	230.3402	230.1001	-0.240082
I1_tRMS_rc@AC [A]	17.63451	17.45871	-0.175802
I2_tRMS_rc@AC [A]	17.68063	17.51966	-0.160967
I3_tRMS_rc@AC [A]	17.44118	17.19349	-0.247694
P_t_rc@AC [W]	12151.70	12005.06	-146.6396
Q_fund_rc@AC [var]	194.3204	225.7240	31.40356
S_t_rc@AC [VA]	12155.75	12009.90	-145.8477
U_fund_SYM+_rc@AC [V]	399.0818	398.7117	-0.370148
U_fund_SYM-_rc@AC [V]	0.446363	0.245940	-0.200423
I_fund_P_SYM+_rc@AC [A]	17.57929	17.38310	-0.196186
I_fund_P_SYM-_rc@AC [A]	0.078789	0.036085	-0.042704
I_fund_Q_SYM+_rc@AC [A]	0.281111	0.326868	0.045757
I_fund_Q_SYM-_rc@AC [A]	-0.035406	-0.089986	-0.054581

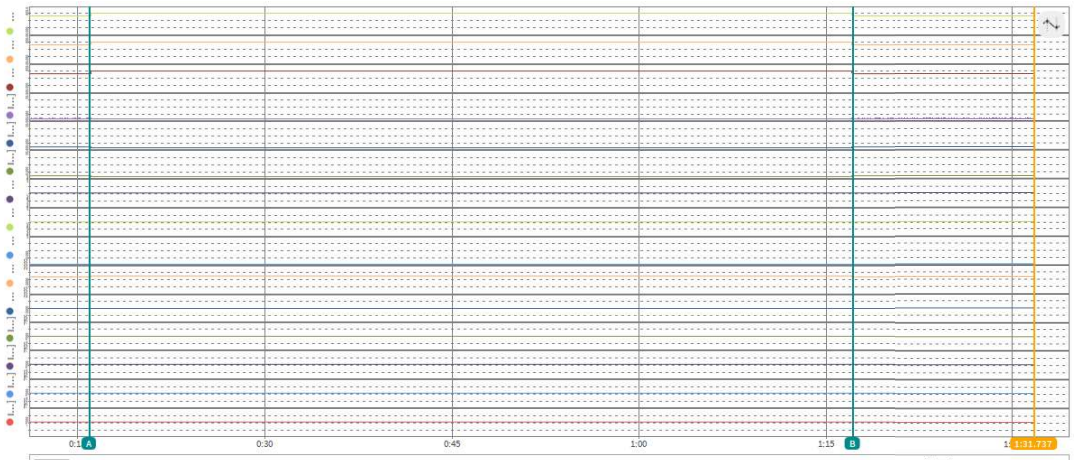
Recover time – Active power



时间 [s]	A 1:15.84341	B 1:16.21553	间隔 0.37211
U1_tRMS_rc@AC [V]	265.1765	230.6124	-34.56413
U2_tRMS_rc@AC [V]	264.7084	230.1722	-34.53619
U3_tRMS_rc@AC [V]	264.8205	230.2930	-34.52754
I1_tRMS_rc@AC [A]	15.28798	17.63319	2.345218
I2_tRMS_rc@AC [A]	15.34653	17.65782	2.311289
I3_tRMS_rc@AC [A]	15.14855	17.41846	2.269916
P_t_rc@AC [W]	12113.70	12138.09	24.39063
Q_fund_rc@AC [var]	531.9371	209.0272	-322.9099
S_t_rc@AC [VA]	12128.01	12142.12	14.10742
U_fund_SYM+_rc@AC [V]	458.8185	398.9899	-59.82858
U_fund_SYM-_rc@AC [V]	0.635255	0.251045	-0.384210
I_fund_P_SYM+_rc@AC [A]	15.24263	17.56349	2.320861
I_fund_P_SYM-_rc@AC [A]	0.060275	0.025155	-0.035119
I_fund_Q_SYM+_rc@AC [A]	0.669393	0.302467	-0.366926
I_fund_Q_SYM-_rc@AC [A]	-0.047164	-0.070323	-0.023159

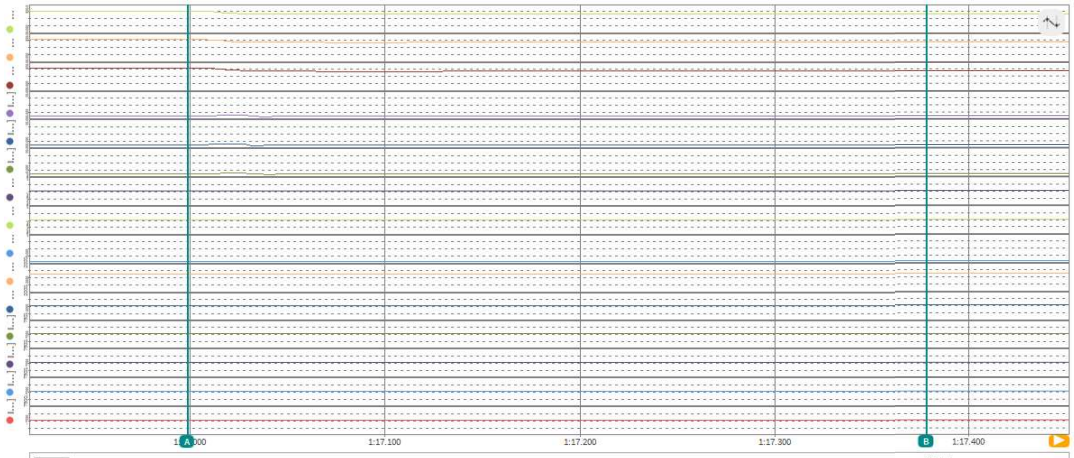
Test – VS2.2.2

Duration fault time



时间 [s]	A 0:15.98082	B 1:17.14594	间隔 1:01.16512
U1_tRMS_rc@AC [V]	230.6548	230.1045	-0.550262
U2_tRMS_rc@AC [V]	230.1803	228.9953	-1.185028
U3_tRMS_rc@AC [V]	230.2861	228.2288	-2.057220
I1_tRMS_rc@AC [A]	3.447405	3.401751	-0.045654
I2_tRMS_rc@AC [A]	3.427431	3.491516	0.064086
I3_tRMS_rc@AC [A]	3.436267	3.413002	-0.023265
P_t_rc@AC [W]	2365.445	2349.487	-15.95801
Q_fund_rc@AC [var]	0.270711	61.01290	60.74219
S_t_rc@AC [VA]	2375.412	2361.244	-14.16724
U_fund_SYM+_rc@AC [V]	399.0147	396.8261	-2.188599
U_fund_SYM-_rc@AC [V]	0.481002	1.026063	0.545061
I_fund_P_SYM+_rc@AC [A]	3.422290	3.417852	-4.439e-3
I_fund_P_SYM-_rc@AC [A]	0.013324	-0.015118	-0.028442
I_fund_Q_SYM+_rc@AC [A]	4.147e-4	0.088707	0.088293
I_fund_Q_SYM-_rc@AC [A]	-0.021016	-0.013518	7.498e-3

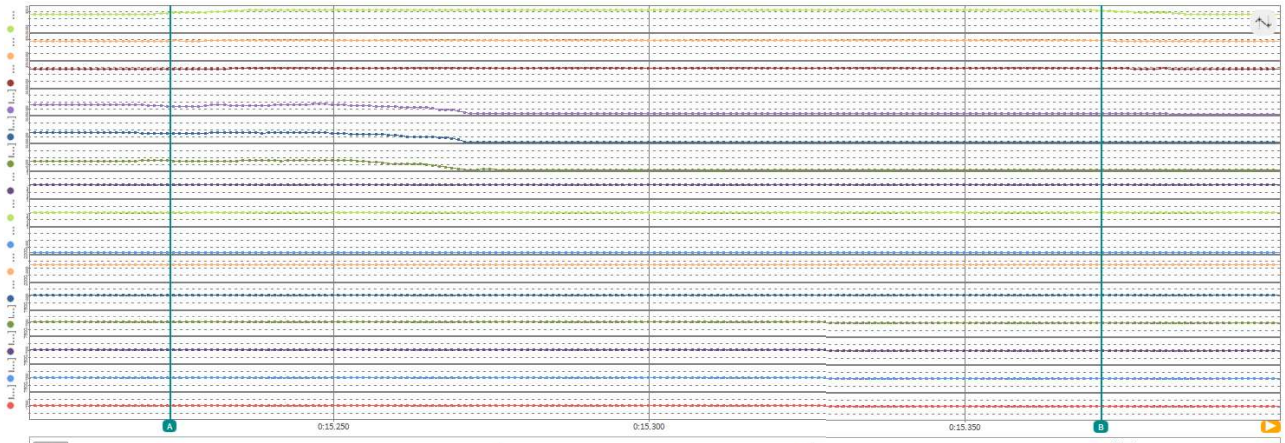
Recover time – Active power



时间 [s]	A 1:16.99878	B 1:17.37834	间隔 0.37956
U1_tRMS_rc@AC [V]	265.2010	230.6078	-34.59319
U2_tRMS_rc@AC [V]	264.6700	230.1457	-34.52428
U3_tRMS_rc@AC [V]	264.7827	230.2013	-34.58145
I1_tRMS_rc@AC [A]	3.010184	3.473332	0.463148
I2_tRMS_rc@AC [A]	2.983293	3.479154	0.495862
I3_tRMS_rc@AC [A]	2.981488	3.403707	0.422219
P_t_rc@AC [W]	2345.278	2375.071	29.79321
Q_fund_rc@AC [var]	323.0811	7.225859	-315.8552
S_t_rc@AC [VA]	2377.338	2385.228	7.889160
U_fund_SYM+_rc@AC [V]	458.7886	398.9198	-59.86877
U_fund_SYM-_rc@AC [V]	0.736566	0.328243	-0.408323
I_fund_P_SYM+_rc@AC [A]	2.951319	3.436935	0.485616
I_fund_P_SYM-_rc@AC [A]	9.795e-3	-6.016e-4	-0.010397
I_fund_Q_SYM+_rc@AC [A]	0.406569	0.010446	-0.396123
I_fund_Q_SYM-_rc@AC [A]	-2.663e-3	-0.011468	-8.805e-3

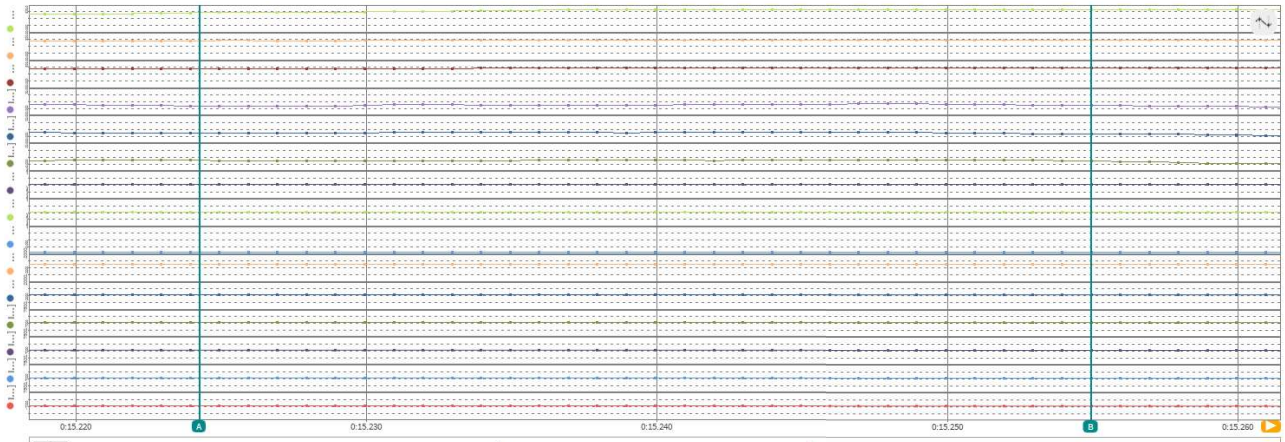
Test – VS3.1

Duration fault time



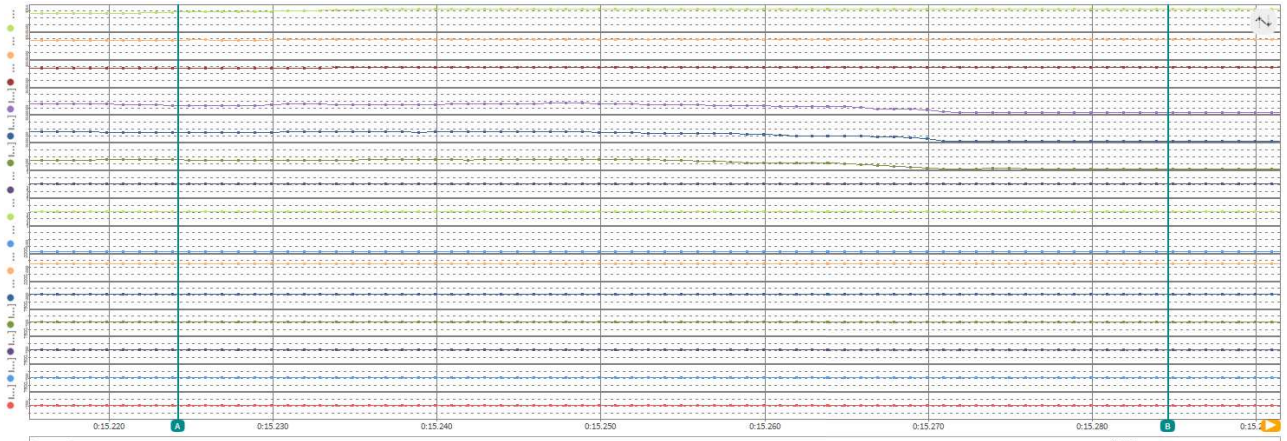
时间 [s]	A 0:15.2242646	B 0:15.3715482	间隔 0.1472836
U1_tRMS_rc@AC [V]	250.1536	284.5518	34.39828
U2_tRMS_rc@AC [V]	238.9659	243.4360	4.470169
U3_tRMS_rc@AC [V]	231.7370	247.5195	15.78249
I1_tRMS_rc@AC [A]	15.09934	1.040213	-14.05913
I2_tRMS_rc@AC [A]	16.65919	0.808098	-15.85109
I3_tRMS_rc@AC [A]	17.58008	0.786004	-16.79407
P_t_rc@AC [W]	11255.89	-37.88245	-11293.77
Q_fund_rc@AC [var]	740.1757	640.8636	-99.31207
S_t_rc@AC [VA]	11832.09	687.2661	-11144.82
U_fund_SYM+_rc@AC [V]	414.7972	446.0925	31.29532
U_fund_SYM-_rc@AC [V]	17.71975	47.44763	29.72788
I_fund_P_SYM+_rc@AC [A]	15.97117	-0.042719	-16.01389
I_fund_P_SYM-_rc@AC [A]	-1.640724	-0.037901	1.602823
I_fund_Q_SYM+_rc@AC [A]	1.032642	0.820569	-0.212074
I_fund_Q_SYM-_rc@AC [A]	-0.054038	0.084740	0.138778

Injected current at 30ms



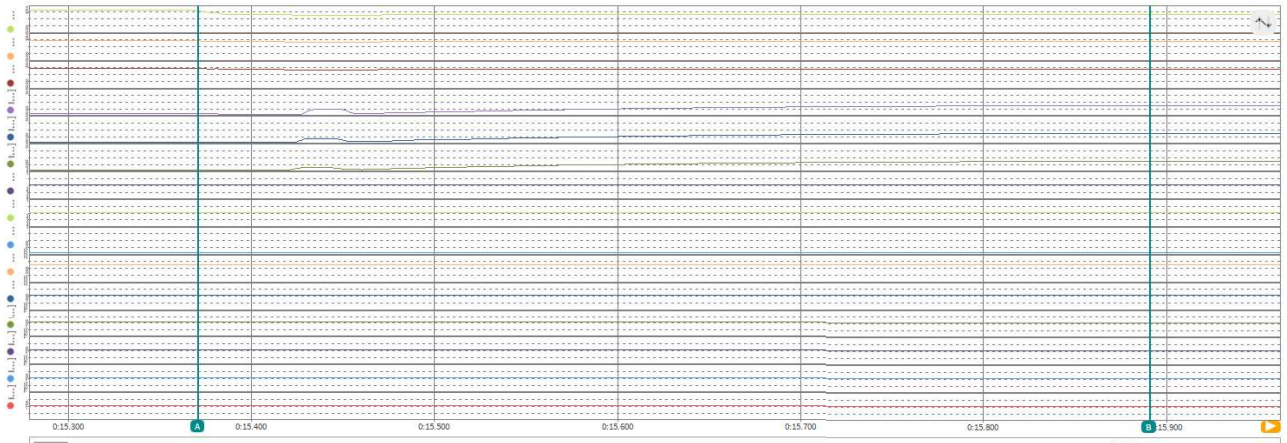
时间 [s]	A 0:15.2242646	B 0:15.2549434	间隔 0.0306788
U1_tRMS_rc@AC [V]	250.1536	288.1387	37.98514
U2_tRMS_rc@AC [V]	238.9659	247.5009	8.535095
U3_tRMS_rc@AC [V]	231.7370	247.3471	15.61006
I1_tRMS_rc@AC [A]	15.09934	16.92911	1.829772
I2_tRMS_rc@AC [A]	16.65919	15.14473	-1.514457
I3_tRMS_rc@AC [A]	17.58008	17.18416	-0.395920
P_t_rc@AC [W]	11255.89	10612.02	-643.8672
Q_fund_rc@AC [var]	740.1757	223.7264	-516.4494
S_t_rc@AC [VA]	11832.09	12876.72	1044.633
U_fund_SYM+_rc@AC [V]	414.7972	450.3861	35.58893
U_fund_SYM-_rc@AC [V]	17.71975	49.83152	32.11177
I_fund_P_SYM+_rc@AC [A]	15.97117	13.82847	-2.142707
I_fund_P_SYM-_rc@AC [A]	-1.640724	-2.065268	-0.424544
I_fund_Q_SYM+_rc@AC [A]	1.032642	0.188129	-0.844514
I_fund_Q_SYM-_rc@AC [A]	-0.054038	0.947546	1.001584

Injected current at 60ms



时间 [s]	A 0:15.2242646	B 0:15.2846221	间隔 0.0603575
U1_tRMS_rc@AC [V]	250.1536	286.8944	36.74084
U2_tRMS_rc@AC [V]	238.9659	245.9680	7.002182
U3_tRMS_rc@AC [V]	231.7370	245.8165	14.07947
I1_tRMS_rc@AC [A]	15.09934	1.065235	-14.03411
I2_tRMS_rc@AC [A]	16.65919	0.795322	-15.86387
I3_tRMS_rc@AC [A]	17.58008	0.788729	16.79135
P_t_rc@AC [W]	11255.89	-51.91817	-11307.81
Q_fund_rc@AC [var]	740.1757	658.1329	-82.04285
S_t_rc@AC [VA]	11832.09	695.1164	-11136.97
U_fund_SYM+_rc@AC [V]	414.7972	447.0615	33.16434
U_fund_SYM-_rc@AC [V]	17.71975	50.11729	32.39754
I_fund_P_SYM+_rc@AC [A]	15.97117	-0.060679	-16.03185
I_fund_P_SYM-_rc@AC [A]	-1.640724	-0.056552	1.584172
I_fund_Q_SYM+_rc@AC [A]	1.032642	0.837617	-0.195025
I_fund_Q_SYM-_rc@AC [A]	-0.054038	0.097504	0.151541

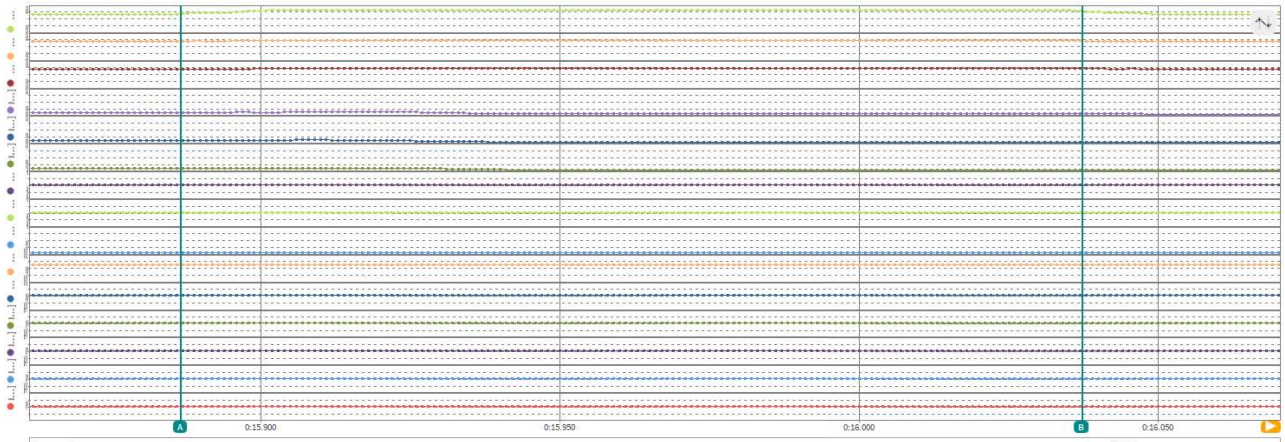
Recover time – Active power



时间 [s]	A 0:15.3711350	B 0:15.8905884	间隔 0.5194534
U1_tRMS_rc@AC [V]	284.5518	230.6667	-53.88512
U2_tRMS_rc@AC [V]	243.4360	230.2316	-13.20441
U3_tRMS_rc@AC [V]	247.5195	230.2463	-17.27319
I1_tRMS_rc@AC [A]	1.040213	16.89906	15.85885
I2_tRMS_rc@AC [A]	0.808098	16.94860	16.14050
I3_tRMS_rc@AC [A]	0.786004	16.72628	15.94028
P_t_rc@AC [W]	-37.88245	11646.89	11684.77
Q_fund_rc@AC [var]	640.8636	218.3819	-422.4818
S_t_rc@AC [VA]	687.2661	11651.32	10964.05
U_fund_SYM+_rc@AC [V]	446.0025	399.0280	-47.06458
U_fund_SYM-_rc@AC [V]	47.44763	0.405469	-47.04216
I_fund_P_SYM+_rc@AC [A]	-0.042719	16.85112	16.89384
I_fund_P_SYM-_rc@AC [A]	-0.037901	0.075035	0.112936
I_fund_Q_SYM+_rc@AC [A]	0.820569	0.315976	-0.504592
I_fund_Q_SYM-_rc@AC [A]	0.084740	-0.039870	-0.124611

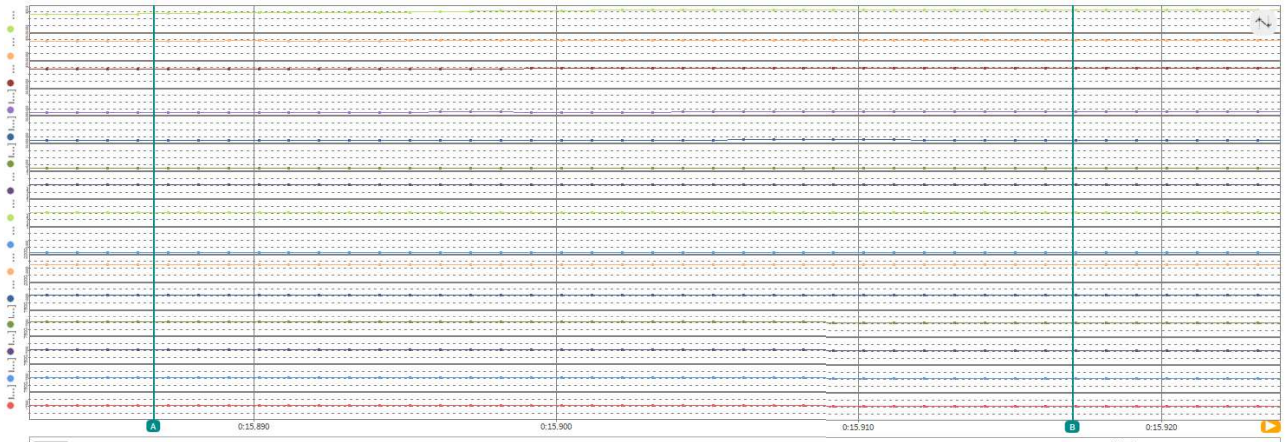
Test – VS3.2

Duration fault time



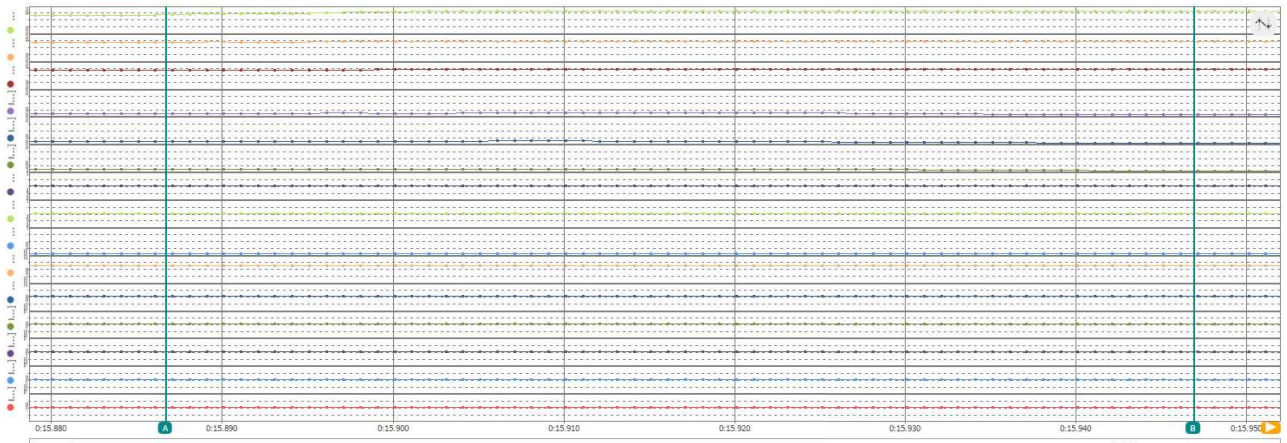
时间 [s]	A 0:15.8867102	B 0:16.0372316	间隔 0.1505214
U1_tRMS_rc@AC [V]	236.1963	278.6464	42.45006
U2_tRMS_rc@AC [V]	234.2138	240.1493	5.935547
U3_tRMS_rc@AC [V]	228.7469	247.1022	18.35526
I1_tRMS_rc@AC [A]	3.344672	1.019136	-2.325536
I2_tRMS_rc@AC [A]	3.152904	0.816308	-2.336595
I3_tRMS_rc@AC [A]	3.699395	0.787566	2.911829
P_t_rc@AC [W]	2181.658	-25.50389	-2207.162
Q_fund_rc@AC [var]	208.4628	627.6969	419.2341
S_t_rc@AC [VA]	2374.678	674.6237	-1700.054
U_fund_SYM+_rc@AC [V]	403.1670	440.4055	37.23853
U_fund_SYM-_rc@AC [V]	7.008013	41.96050	34.95249
I_fund_P_SYM+_rc@AC [A]	3.177227	-0.027102	-3.204329
I_fund_P_SYM-_rc@AC [A]	-0.391199	-0.022572	0.368627
I_fund_Q_SYM+_rc@AC [A]	0.297452	0.815257	0.517806
I_fund_Q_SYM-_rc@AC [A]	0.061707	0.081513	0.019806

Injected current at 30ms



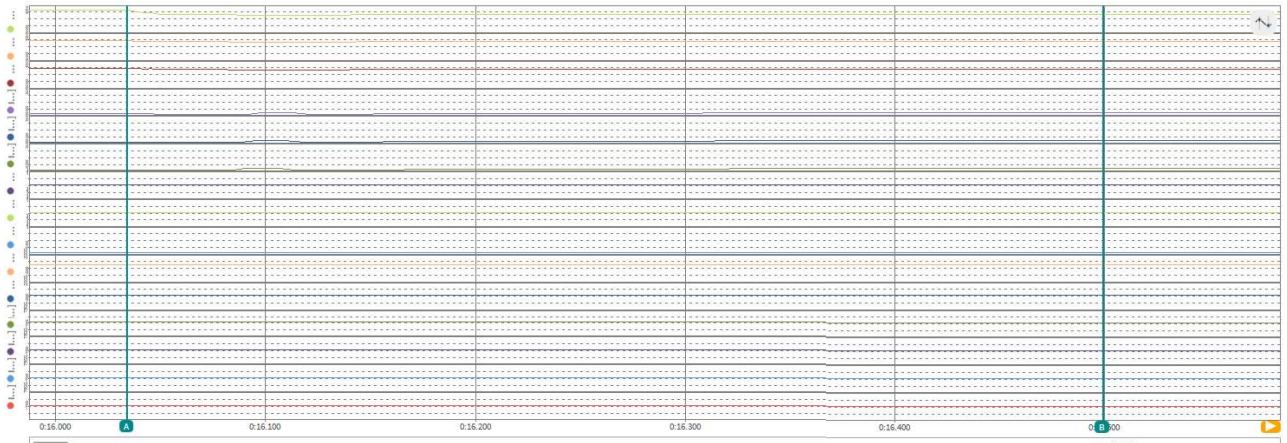
时间 [s]	A 0:15.8867102	B 0:15.9170735	间隔 0.0303632
U1_tRMS_rc@AC [V]	236.1963	287.9337	51.73738
U2_tRMS_rc@AC [V]	234.2138	246.9990	12.78525
U3_tRMS_rc@AC [V]	228.7469	247.0182	18.27124
I1_tRMS_rc@AC [A]	3.344672	4.509404	1.164732
I2_tRMS_rc@AC [A]	3.152904	3.432418	0.279514
I3_tRMS_rc@AC [A]	3.699395	4.111276	0.411881
P_t_rc@AC [W]	2181.658	2744.390	562.7314
Q_fund_rc@AC [var]	208.4628	-1.118496	-209.5813
S_t_rc@AC [VA]	2374.678	3161.773	787.0952
U_fund_SYM+_rc@AC [V]	403.1670	449.7602	46.61923
U_fund_SYM-_rc@AC [V]	7.008013	50.25419	43.24618
I_fund_P_SYM+_rc@AC [A]	3.177227	3.490259	0.313032
I_fund_P_SYM-_rc@AC [A]	-0.391199	0.344335	0.735534
I_fund_Q_SYM+_rc@AC [A]	0.297452	-0.014061	-0.311512
I_fund_Q_SYM-_rc@AC [A]	0.061707	0.144803	0.083096

Injected current at 60ms



时间 [s]	A 0:15.8867102	B 0:15.9468893	间隔 0.0601790
U1_tRMS_rc@AC [V]	236.1963	287.2671	51.07079
U2_tRMS_rc@AC [V]	234.2138	246.2800	12.06628
U3_tRMS_rc@AC [V]	228.7469	246.1752	17.42822
I1_tRMS_rc@AC [A]	3.344672	1.053546	-2.291126
I2_tRMS_rc@AC [A]	3.152904	0.797483	-2.355420
I3_tRMS_rc@AC [A]	3.699395	0.784494	2.914901
P_t_rc@AC [W]	2181.658	-47.96446	-2229.623
Q_fund_rc@AC [var]	208.4628	657.8743	449.4115
S_t_rc@AC [VA]	2374.678	692.1764	-1682.501
U_fund_SYM+_rc@AC [V]	403.1670	448.5669	45.39990
U_fund_SYM-_rc@AC [V]	7.008013	50.17815	43.17014
I_fund_P_SYM+_rc@AC [A]	3.177227	-0.056152	-3.233379
I_fund_P_SYM-_rc@AC [A]	-0.391199	-0.050086	0.341113
I_fund_Q_SYM+_rc@AC [A]	0.297452	0.836012	0.538560
I_fund_Q_SYM-_rc@AC [A]	0.061707	0.098413	0.036706

Recover time – Active power



时间 [s]	A 0:16.0342242	B 0:16.4990813	间隔 0.4648571
U1_tRMS_rc@AC [V]	287.3149	230.6463	-56.66862
U2_tRMS_rc@AC [V]	245.8545	230.2302	-15.62431
U3_tRMS_rc@AC [V]	246.6801	230.2149	-16.46521
I1_tRMS_rc@AC [A]	1.038931	3.204639	2.165707
I2_tRMS_rc@AC [A]	0.812719	3.230217	2.417498
I3_tRMS_rc@AC [A]	0.802805	3.149971	2.347166
P_t_rc@AC [W]	-43.55732	2197.427	2240.984
Q_fund_rc@AC [var]	650.2175	10.56089	-639.6566
S_t_rc@AC [VA]	696.3471	2208.002	1511.655
U_fund_SYM+_rc@AC [V]	448.6887	398.9976	-49.69110
U_fund_SYM-_rc@AC [V]	50.05371	0.431049	-49.62266
I_fund_P_SYM+_rc@AC [A]	-0.050454	3.179370	3.229824
I_fund_P_SYM-_rc@AC [A]	-0.046110	0.021805	0.067915
I_fund_Q_SYM+_rc@AC [A]	0.826892	0.015267	-0.811625
I_fund_Q_SYM-_rc@AC [A]	0.088701	-7.014e-3	-0.095715

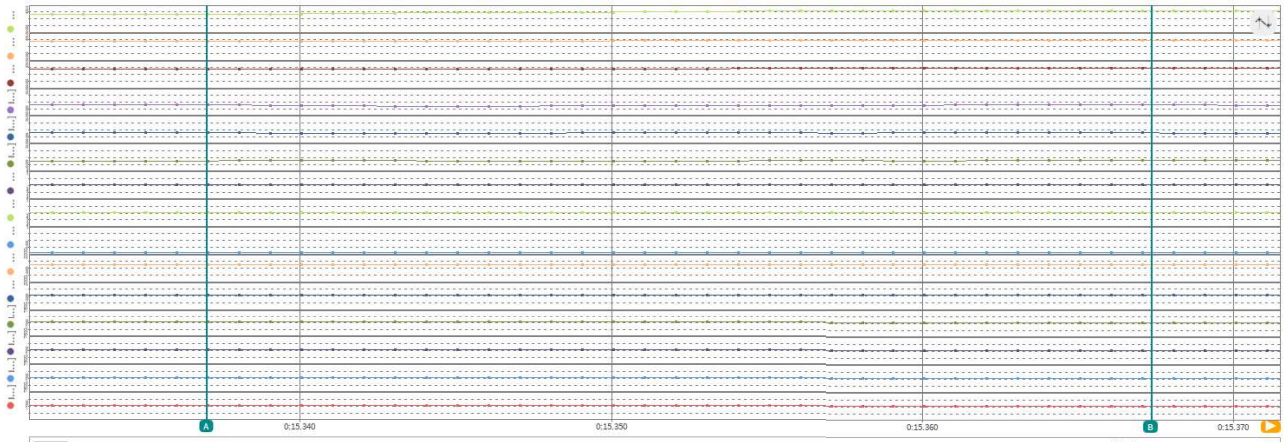
Test – VS4.1.1

Duration fault time



时间 [s]	A 0:15.334265	B 0:20.546097	间隔 5.211832
U1_tRMS_rc@AC [V]	230.6398	255.9398	25.29997
U2_tRMS_rc@AC [V]	230.2621	235.2721	5.009995
U3_tRMS_rc@AC [V]	230.2306	237.4030	7.172363
I1_tRMS_rc@AC [A]	17.62712	0.848260	-16.77886
I2_tRMS_rc@AC [A]	17.71702	0.783771	-16.93325
I3_tRMS_rc@AC [A]	17.45716	0.765970	-16.69119
P_t_rc@AC [W]	12160.25	4.681189	-12155.56
Q_fund_rc@AC [var]	189.3386	573.0991	383.7605
S_t_rc@AC [VA]	12164.25	583.3406	-11580.90
U_fund_SYM+_rc@AC [V]	399.0188	419.5152	20.49643
U_fund_SYM-_rc@AC [V]	0.266101	21.72670	21.46060
I_fund_P_SYM+_rc@AC [A]	17.59431	5.849e-3	-17.58846
I_fund_P_SYM-_rc@AC [A]	0.023218	0.015652	-7.566e-3
I_fund_Q_SYM+_rc@AC [A]	0.273975	0.786173	0.512198
I_fund_Q_SYM-_rc@AC [A]	-0.075484	0.049133	0.124616

Injected current at 30ms



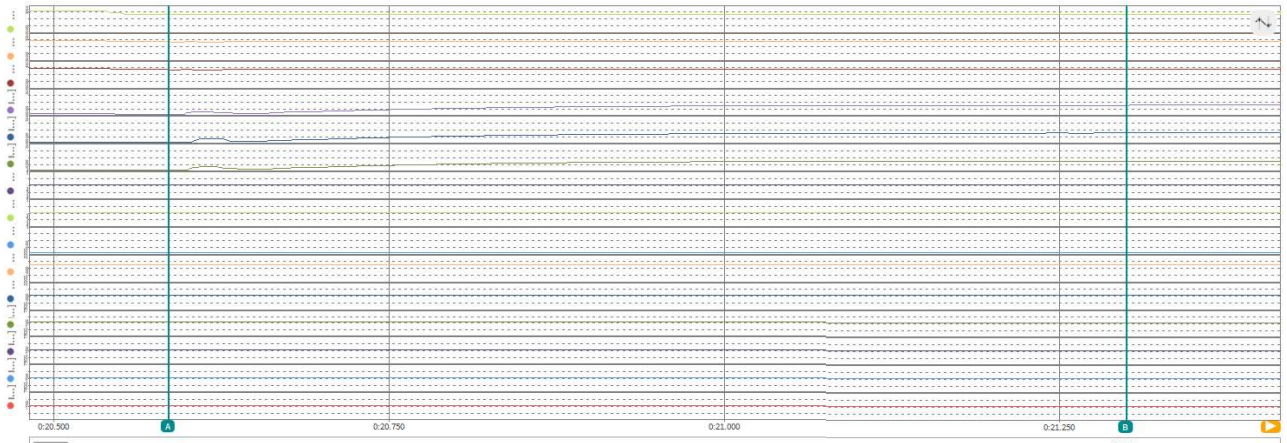
时间 [s]	A 0:15.337030	B 0:15.367334	间隔 0.030305
U1_tRMS_rc@AC [V]	230.6492	277.3776	46.72842
U2_tRMS_rc@AC [V]	230.2477	242.9236	12.67589
U3_tRMS_rc@AC [V]	230.2297	243.0589	12.82928
I1_tRMS_rc@AC [A]	17.62661	18.28897	0.662361
I2_tRMS_rc@AC [A]	17.71004	17.71638	6.344e-3
I3_tRMS_rc@AC [A]	17.46051	17.74984	0.289331
P_t_rc@AC [W]	12159.18	13426.81	1267.629
Q_fund_rc@AC [var]	190.6272	-229.7589	-420.3861
S_t_rc@AC [VA]	12163.19	13690.94	1527.750
U_fund_SYM+_rc@AC [V]	399.0149	439.6662	40.67325
U_fund_SYM-_rc@AC [V]	0.250074	40.34246	40.09238
I_fund_P_SYM+_rc@AC [A]	17.59306	17.57266	-0.020397
I_fund_P_SYM-_rc@AC [A]	0.081648	0.639829	0.558181
I_fund_Q_SYM+_rc@AC [A]	0.275780	-0.267493	-0.543274
I_fund_Q_SYM-_rc@AC [A]	0.025924	-0.305715	-0.331640

Injected current at 60ms



时间 [s]	A 0:15.337030	B 0:15.397821	间隔 0.060791
U1_tRMS_rc@AC [V]	230.6492	275.5807	44.93149
U2_tRMS_rc@AC [V]	230.2477	241.4275	11.17979
U3_tRMS_rc@AC [V]	230.2297	241.2037	10.97404
I1_tRMS_rc@AC [A]	17.62661	1.034473	-16.59214
I2_tRMS_rc@AC [A]	17.71004	0.778726	-16.93131
I3_tRMS_rc@AC [A]	17.46051	0.770439	16.69007
P_t_rc@AC [W]	12159.18	-49.27238	-12208.45
Q_fund_rc@AC [var]	190.6272	622.5582	431.9310
S_t_rc@AC [VA]	12163.19	658.9194	-11504.27
U_fund_SYM+_rc@AC [V]	399.0140	436.7759	37.76102
U_fund_SYM-_rc@AC [V]	0.250074	40.10282	39.85275
I_fund_P_SYM+_rc@AC [A]	17.59306	-0.059931	-17.65299
I_fund_P_SYM-_rc@AC [A]	0.081648	-0.055751	-0.137399
I_fund_Q_SYM+_rc@AC [A]	0.275780	0.815766	0.539986
I_fund_Q_SYM-_rc@AC [A]	0.025924	0.080590	0.054666

Recover time – Active power



时间 [s]	A 0:20.585732	B 0:21.299750	间隔 0.714017
U1_tRMS_rc@AC [V]	228.1636	230.6806	2.517090
U2_tRMS_rc@AC [V]	227.6068	230.2323	2.625519
U3_tRMS_rc@AC [V]	227.5630	230.2618	2.698746
I1_tRMS_rc@AC [A]	0.751673	17.49072	16.73904
I2_tRMS_rc@AC [A]	0.735143	17.51950	16.78436
I3_tRMS_rc@AC [A]	0.726228	17.33916	16.61293
P_t_rc@AC [W]	-11.24775	12057.46	12068.71
Q_fund_rc@AC [var]	499.1545	158.2736	-340.8809
S_t_rc@AC [VA]	504.0905	12060.87	11556.78
U_fund_SYM+_rc@AC [V]	394.5103	399.0458	4.526489
U_fund_SYM-_rc@AC [V]	0.433804	0.366578	-0.067226
I_fund_P_SYM+_rc@AC [A]	-0.016489	17.44445	17.46094
I_fund_P_SYM-_rc@AC [A]	-9.660e-3	0.065367	0.075026
I_fund_Q_SYM+_rc@AC [A]	0.730456	0.229021	-0.501435
I_fund_Q_SYM-_rc@AC [A]	7.226e-3	-0.048417	-0.055642

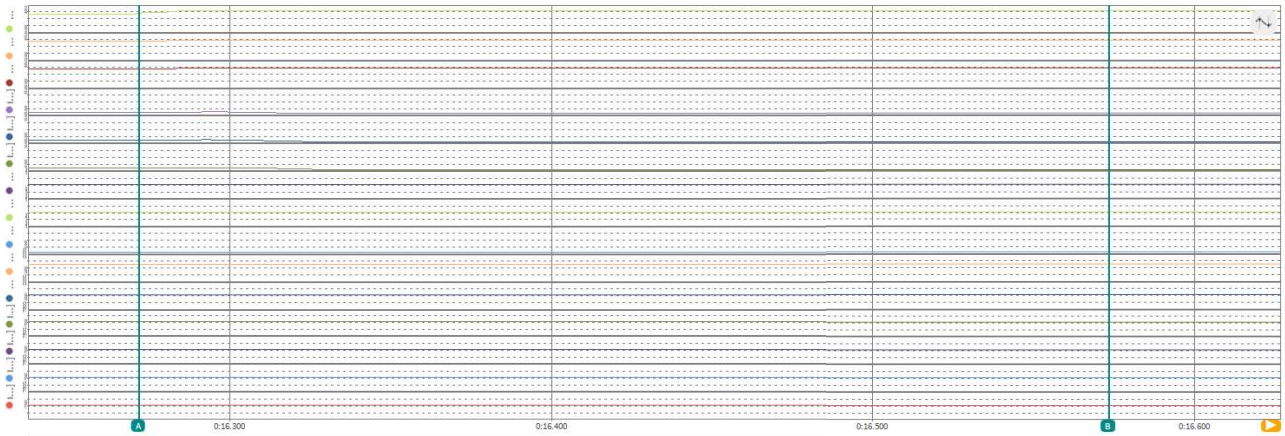
Test – VS4.1.2

Duration fault time



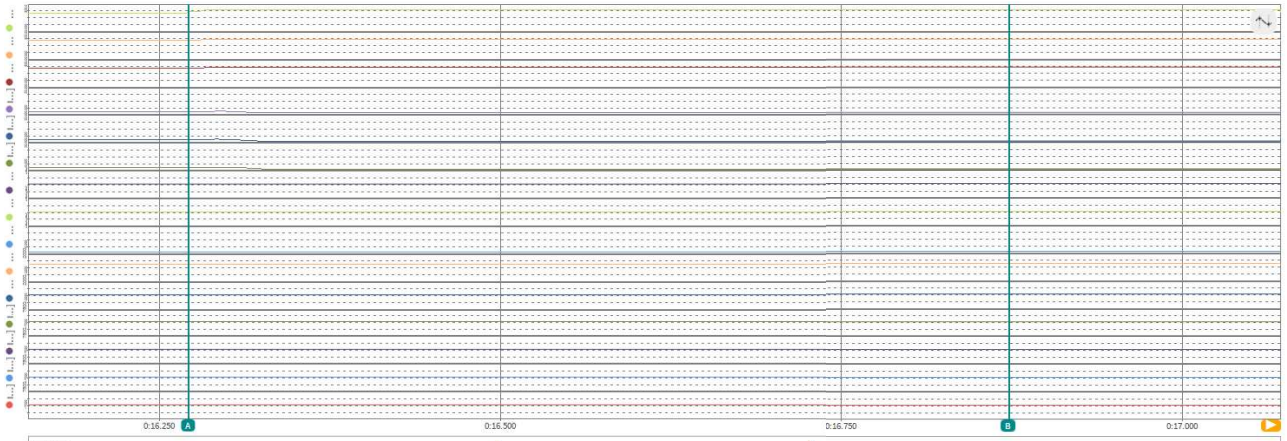
时间 [s]	A 0:16.246969	B 0:21.467015	间隔 5.220046
U1_tRMS_rc@AC [V]	230.6262	276.2093	45.58304
U2_tRMS_rc@AC [V]	230.1890	241.6719	11.48288
U3_tRMS_rc@AC [V]	230.1766	241.6623	11.48569
I1_tRMS_rc@AC [A]	3.404783	1.014176	-2.390607
I2_tRMS_rc@AC [A]	3.496455	0.780445	-2.716010
I3_tRMS_rc@AC [A]	3.412928	0.773859	-2.639072
P_t_rc@AC [W]	2365.596	-44.94005	-2410.536
Q_fund_rc@AC [var]	-2.246317	625.1037	627.3500
S_t_rc@AC [VA]	2375.654	655.7483	-1719.906
U_fund_SYM+_rc@AC [V]	398.9405	437.5944	38.65396
U_fund_SYM-_rc@AC [V]	0.507056	40.50317	39.99611
I_fund_P_SYM+_rc@AC [A]	3.423137	-0.054910	-3.478047
I_fund_P_SYM-_rc@AC [A]	9.121e-3	-0.050414	-0.059535
I_fund_Q_SYM+_rc@AC [A]	-3.218e-3	0.817296	0.820514
I_fund_Q_SYM-_rc@AC [A]	-0.016470	0.081039	0.097509

Injected current at 30ms



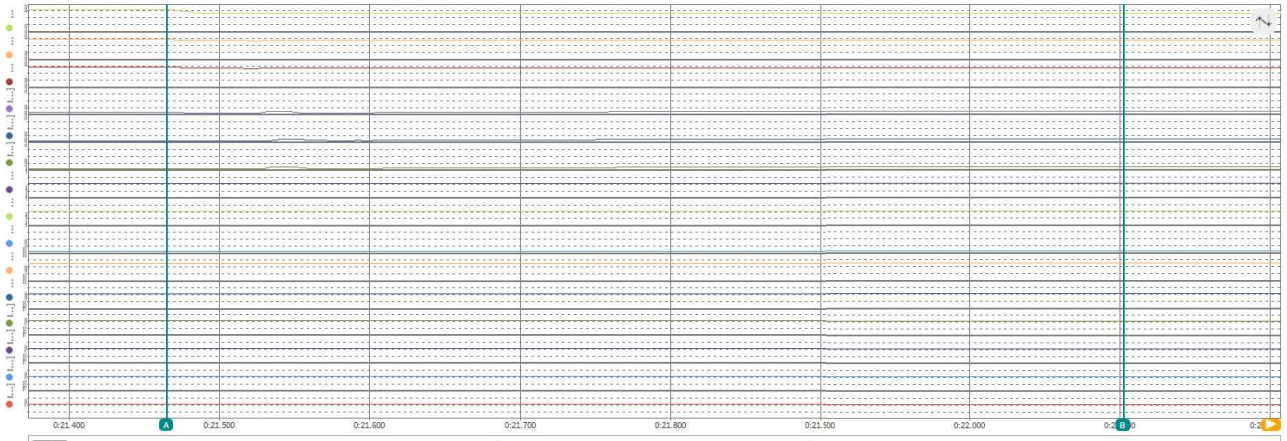
时间 [s]	A 0:16.272005	B 0:16.573232	间隔 0.301226
U1_tRMS_rc@AC [V]	238.3272	276.2319	37.90472
U2_tRMS_rc@AC [V]	234.5275	241.6959	7.168365
U3_tRMS_rc@AC [V]	229.2751	241.6783	12.40314
I1_tRMS_rc@AC [A]	3.268976	1.014670	-2.254305
I2_tRMS_rc@AC [A]	3.059900	0.782431	-2.277469
I3_tRMS_rc@AC [A]	3.612416	0.770250	-2.842165
P_t_rc@AC [W]	2067.806	-44.58572	-2112.392
Q_fund_rc@AC [var]	216.0088	624.6393	408.6305
S_t_rc@AC [VA]	2324.953	655.5473	-1669.406
U_fund_SYM+_rc@AC [V]	404.8744	437.6123	32.73798
U_fund_SYM-_rc@AC [V]	8.412400	40.19023	31.77783
I_fund_P_SYM+_rc@AC [A]	3.010206	-0.054470	-3.064677
I_fund_P_SYM-_rc@AC [A]	-0.495415	-0.047429	0.447985
I_fund_Q_SYM+_rc@AC [A]	0.306913	0.816609	0.509695
I_fund_Q_SYM-_rc@AC [A]	0.056902	0.082046	0.025144

Injected current at 60ms



时间 [s]	A 0:16.272005	B 0:16.872640	间隔 0.600635
U1_tRMS_rc@AC [V]	238.3272	276.1920	37.86478
U2_tRMS_rc@AC [V]	234.5275	241.6735	7.145981
U3_tRMS_rc@AC [V]	229.2751	241.6744	12.39931
I1_tRMS_rc@AC [A]	3.268976	1.014389	-2.254587
I2_tRMS_rc@AC [A]	3.059900	0.781595	-2.278305
I3_tRMS_rc@AC [A]	3.612416	0.775228	-2.837187
P_t_rc@AC [W]	2067.806	-44.17101	-2111.977
Q_fund_rc@AC [var]	216.0088	625.7319	409.7231
S_t_rc@AC [VA]	2324.953	656.4096	-1668.544
U_fund_SYM+_rc@AC [V]	404.8744	437.5742	32.69980
U_fund_SYM-_rc@AC [V]	8.412400	40.17512	31.76272
I_fund_P_SYM+_rc@AC [A]	3.010206	-0.053622	-3.063828
I_fund_P_SYM-_rc@AC [A]	-0.495415	-0.050699	0.444716
I_fund_Q_SYM+_rc@AC [A]	0.306913	0.818120	0.511207
I_fund_Q_SYM-_rc@AC [A]	0.056902	0.082071	0.025169

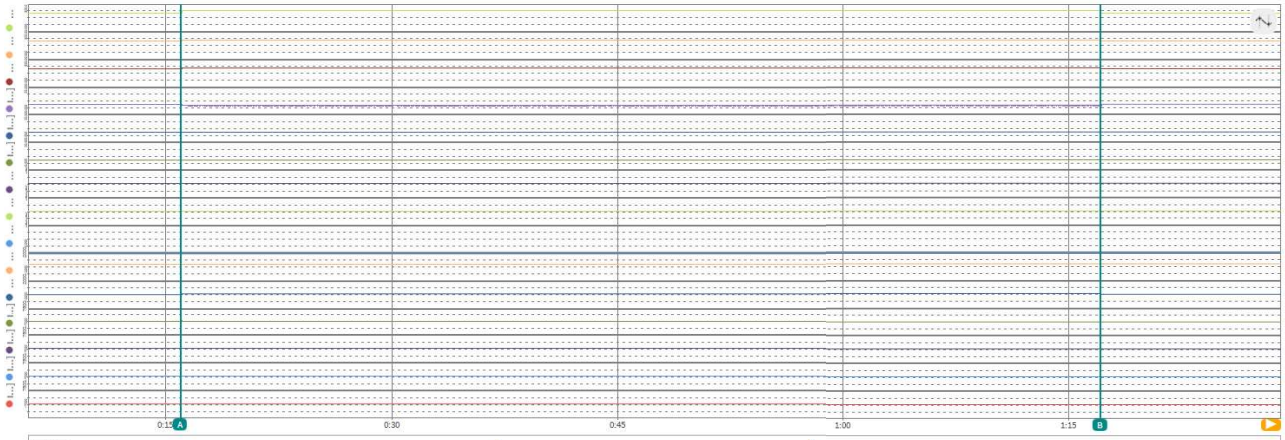
Recover time – Active power



时间 [s]	A 0:21.465118	B 0:22.102163	间隔 0.637045
U1_tRMS_rc@AC [V]	276.1929	230.6325	-45.56046
U2_tRMS_rc@AC [V]	241.6782	230.1757	-11.50255
U3_tRMS_rc@AC [V]	241.6713	230.2154	-11.45586
I1_tRMS_rc@AC [A]	1.014699	3.402767	2.388068
I2_tRMS_rc@AC [A]	0.780186	3.416410	2.636225
I3_tRMS_rc@AC [A]	0.773808	3.370665	2.596857
P_t_rc@AC [W]	-44.60280	2337.195	2381.798
Q_fund_rc@AC [var]	625.2466	-13.17081	-638.4175
S_t_rc@AC [VA]	655.8138	2347.142	1691.328
U_fund_SYM+_rc@AC [V]	437.5492	398.9951	-38.59012
U_fund_SYM-_rc@AC [V]	39.96471	0.403630	-39.56108
I_fund_P_SYM+_rc@AC [A]	-0.054454	3.381890	3.436344
I_fund_P_SYM-_rc@AC [A]	-0.050396	8.728e-3	0.059125
I_fund_Q_SYM+_rc@AC [A]	0.817526	-0.019052	-0.836578
I_fund_Q_SYM-_rc@AC [A]	0.082600	-0.013884	-0.096483

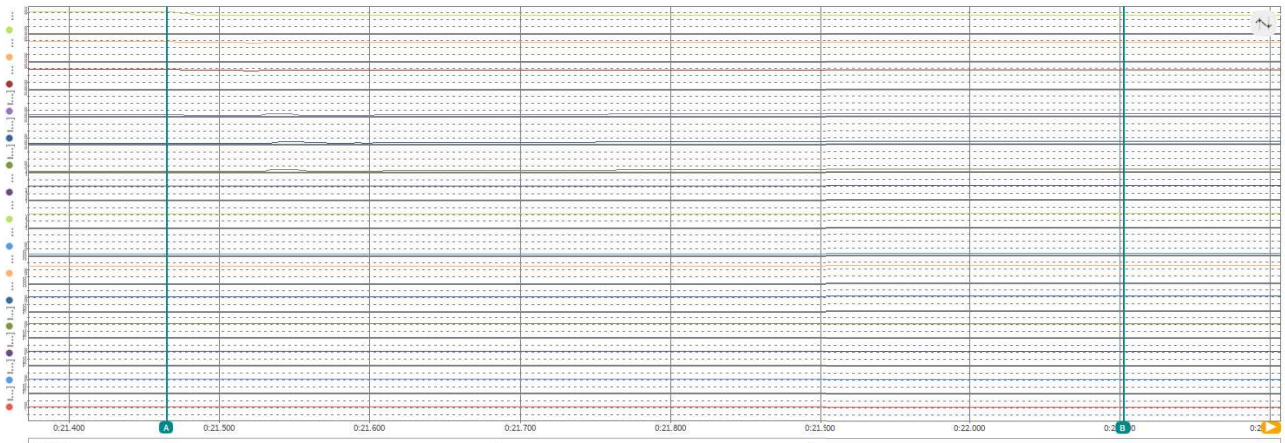
Test – VS4.2.1

Duration fault time



时间 [s]	A 0:16.01327	B 1:17.09156	间隔 1:01.07829
U1_tRMS_rc@AC [V]	230.6282	228.6915	-1.936676
U2_tRMS_rc@AC [V]	230.2489	227.7112	-2.537689
U3_tRMS_rc@AC [V]	230.2550	227.7847	-2.470291
I1_tRMS_rc@AC [A]	17.66998	16.68940	-0.980589
I2_tRMS_rc@AC [A]	17.72086	17.54593	-0.174931
I3_tRMS_rc@AC [A]	17.42023	17.16741	-0.252821
P_t_rc@AC [W]	12162.21	11713.01	-449.2051
Q_fund_rc@AC [var]	189.6093	332.2893	142.6800
S_t_rc@AC [VA]	12166.50	11722.60	-443.8984
U_fund_SYM+_rc@AC [V]	399.0199	395.0112	-4.008636
U_fund_SYM-_rc@AC [V]	0.461146	0.680313	0.219168
I_fund_P_SYM+_rc@AC [A]	17.59722	17.11947	-0.477747
I_fund_P_SYM-_rc@AC [A]	0.091920	-1.290e-3	-0.093210
I_fund_Q_SYM+_rc@AC [A]	0.274294	0.485409	0.211115
I_fund_Q_SYM-_rc@AC [A]	-0.015297	-0.039749	-0.024452

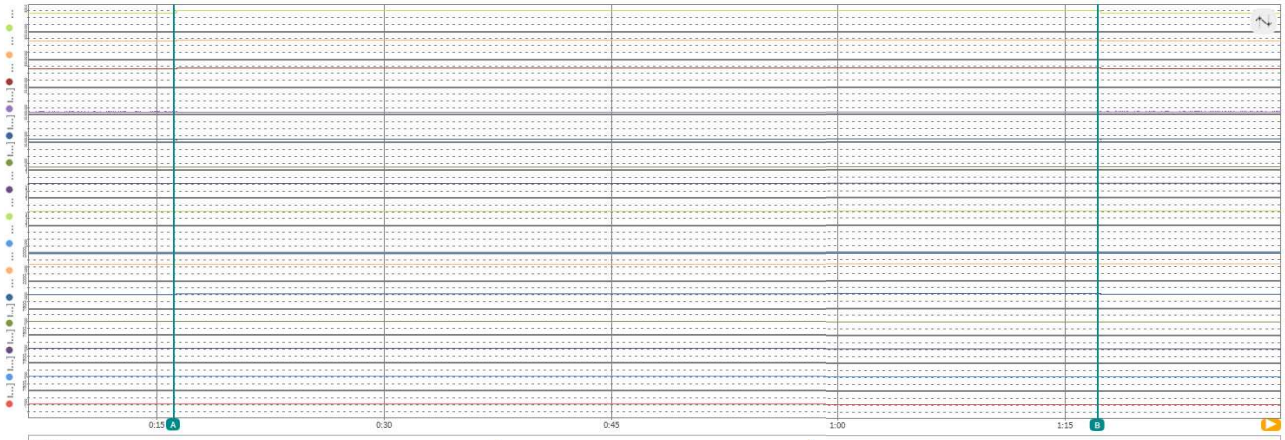
Recover time – Active power



时间 [s]	A 0:21.465118	B 0:22.102163	间隔 0.637045
U1_tRMS_rc@AC [V]	276.1929	230.6325	-45.56046
U2_tRMS_rc@AC [V]	241.6782	230.1757	-11.50255
U3_tRMS_rc@AC [V]	241.6713	230.2154	-11.45586
I1_tRMS_rc@AC [A]	1.014699	3.402767	2.388068
I2_tRMS_rc@AC [A]	0.780186	3.416410	2.636225
I3_tRMS_rc@AC [A]	0.773808	3.370665	2.596857
P_t_rc@AC [W]	-44.60280	2337.195	2381.798
Q_fund_rc@AC [var]	625.2466	-13.17081	-638.4175
S_t_rc@AC [VA]	655.8138	2347.142	1691.328
U_fund_SYM+_rc@AC [V]	437.5492	398.9951	-38.59012
U_fund_SYM-_rc@AC [V]	39.96471	0.403630	-39.56108
I_fund_P_SYM+_rc@AC [A]	-0.054454	3.381890	3.436344
I_fund_P_SYM-_rc@AC [A]	-0.050396	8.728e-3	0.059125
I_fund_Q_SYM+_rc@AC [A]	0.817526	-0.019052	-0.836578
I_fund_Q_SYM-_rc@AC [A]	0.082600	-0.013884	-0.096483

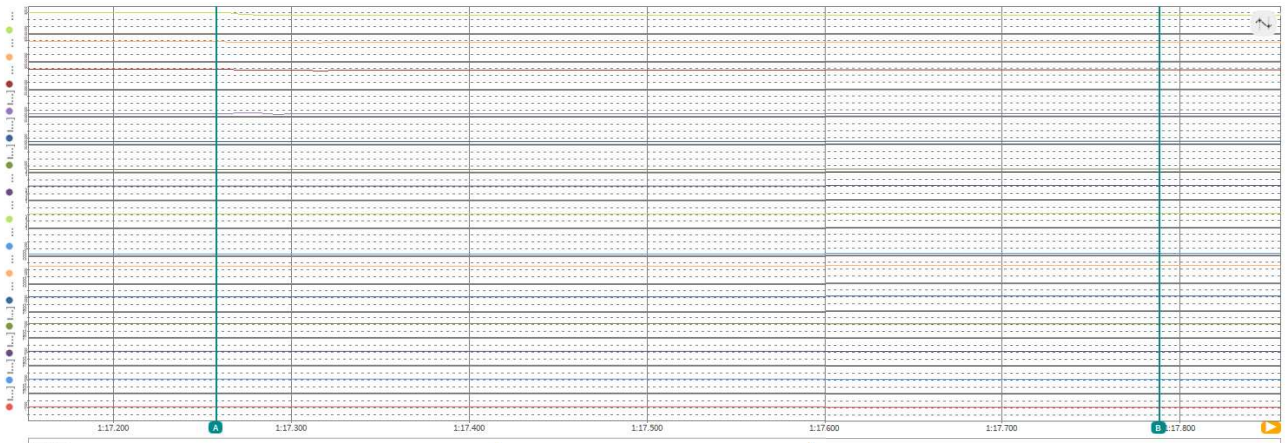
Test – VS4.2.2

Duration fault time

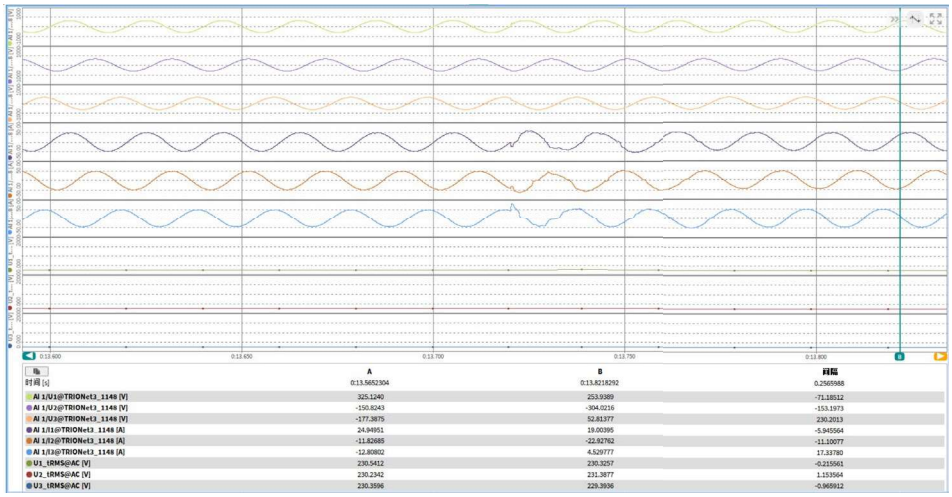
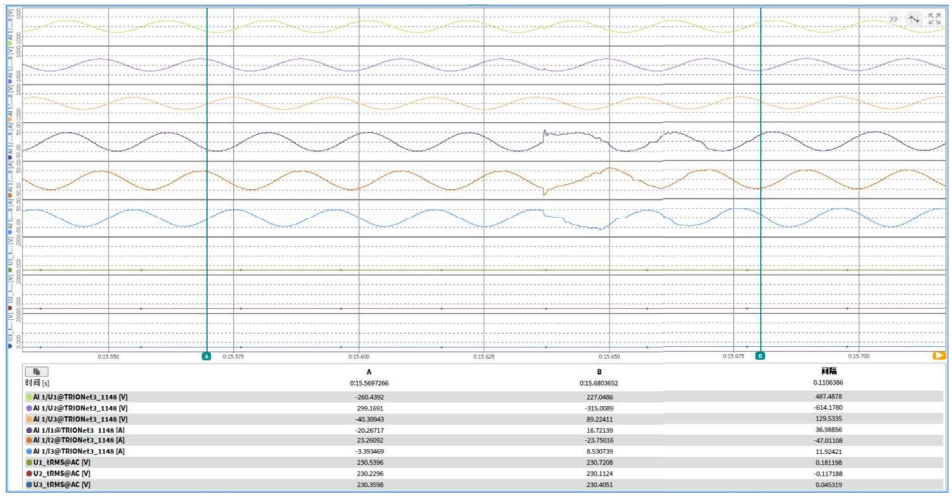


时间 [s]	A 0:16.12473	B 1:17.13423	间隔 1:01.00950
U1_tRMS_rc@AC [V]	230.6430	265.1729	34.52994
U2_tRMS_rc@AC [V]	230.1985	239.3684	9.169907
U3_tRMS_rc@AC [V]	230.1914	239.3977	9.206360
I1_tRMS_rc@AC [A]	3.460031	2.899671	-0.560360
I2_tRMS_rc@AC [A]	3.510780	3.349543	-0.161237
I3_tRMS_rc@AC [A]	3.458796	3.355669	-0.103127
P_t_rc@AC [W]	2392.263	2349.566	-42.69702
Q_fund_rc@AC [var]	-8.391201	165.3764	173.7676
S_t_rc@AC [VA]	2402.393	2374.028	-28.36475
U_fund_SYM+_rc@AC [V]	398.9640	428.8311	29.86713
U_fund_SYM-_rc@AC [V]	0.480554	32.02434	31.54379
I_fund_P_SYM+_rc@AC [A]	3.461555	3.164362	-0.297193
I_fund_P_SYM-_rc@AC [A]	0.017449	-0.030905	-0.048354
I_fund_Q_SYM+_rc@AC [A]	-0.012119	0.215478	0.227597
I_fund_Q_SYM-_rc@AC [A]	-9.781e-3	0.104076	0.113856

Recover time – Active power



时间 [s]	A 1:17.25788	B 1:17.78823	间隔 0.53035
U1_tRMS_rc@AC [V]	265.1550	230.6104	-34.54457
U2_tRMS_rc@AC [V]	239.3943	230.1890	-9.205231
U3_tRMS_rc@AC [V]	239.4016	230.2022	-9.199417
I1_tRMS_rc@AC [A]	2.919254	3.455606	0.536352
I2_tRMS_rc@AC [A]	3.397962	3.452285	0.054323
I3_tRMS_rc@AC [A]	3.300595	3.402105	0.101510
P_t_rc@AC [W]	2352.085	2365.210	13.12476
Q_fund_rc@AC [var]	171.6842	0.595519	-171.0887
S_t_rc@AC [VA]	2377.675	2374.749	-2.926025
U_fund_SYM+_rc@AC [V]	428.8177	398.9467	-29.87097
U_fund_SYM-_rc@AC [V]	31.73345	0.315509	-31.41794
I_fund_P_SYM+_rc@AC [A]	3.167645	3.422476	0.254831
I_fund_P_SYM-_rc@AC [A]	-0.030058	0.010012	0.040070
I_fund_Q_SYM+_rc@AC [A]	0.224670	8.536e-4	-0.223817
I_fund_Q_SYM-_rc@AC [A]	0.098012	-0.011775	-0.109787

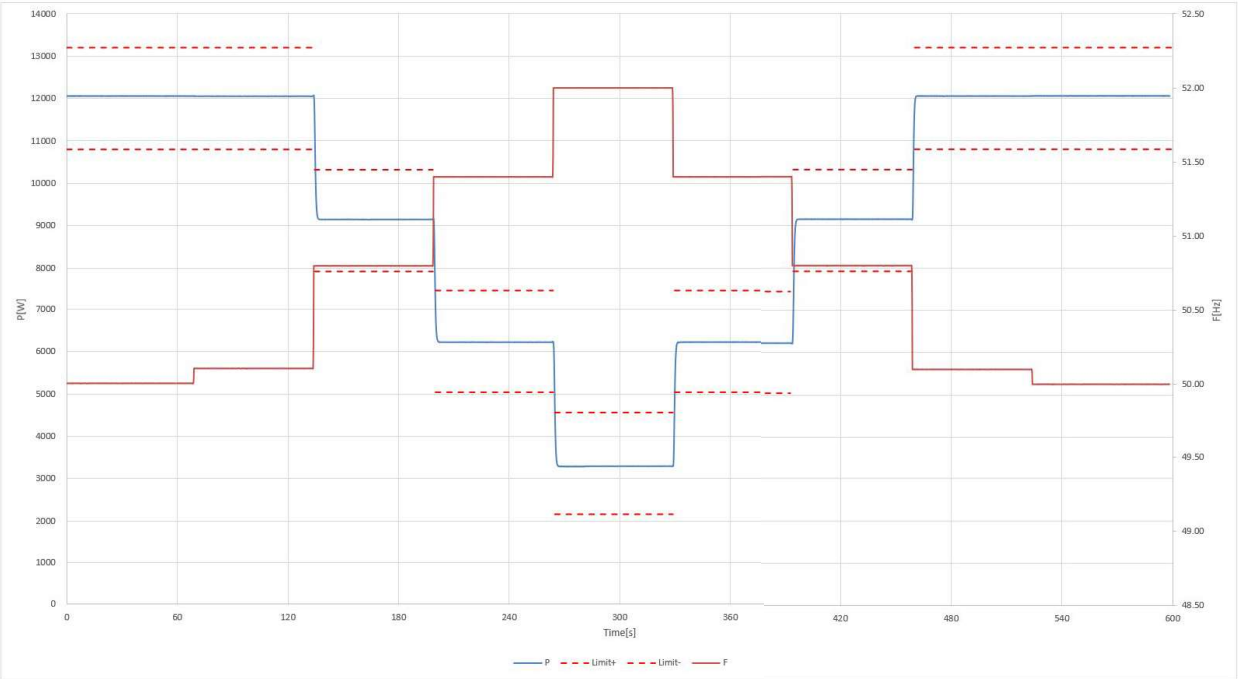
4.5.5	Phase jump immunity	P
	Immunity 20° for all phase	Confirm no trip
Positive Phase jump		No trip
Negative Phase jump		No trip
Note:		

EN 50549-1: Active response to frequency deviation			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.6.1	Power response to over-frequency		**P**
4.6.2	Power response to under-frequency		**P**

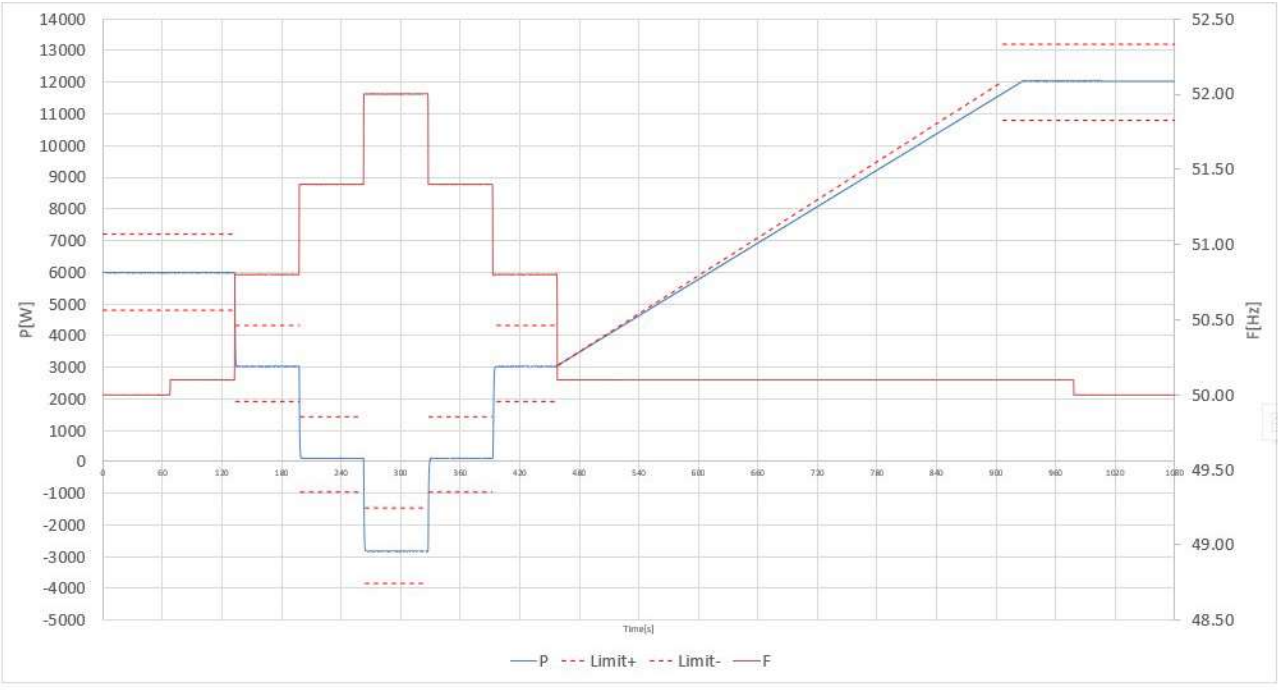
4.6.1 Power response to over-frequency (For synchronous generating and Electrical Energy Storage System unit (EESS) only)									P
Test:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 50.10 ±0.01	c) 50.80 ±0.01	e) 51.40 ±0.01	d) 52.00 ±0.01	f) 51.40 ±0.01	g) 50.80 ±0.01	h) 50.10 ±0.01	i) 50.00 ±0.01
1. Measurement a) to i): Active power output =100% P_{Emax} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 50.2Hz, Pref=PM									
Frequency [Hz]:	50.00	50.10	50.80	51.40	52.00	51.40	50.80	50.10	50.00
P_M [W]:	12000	12000	9120	6240	3360	6240	9120	12000	12000
P_{E60} [W]:	12056	12053	9146	6220	3292	6198	9156	12055	12058
$\Delta P_{E60}/P_M$ [%]:	0.47	0.44	0.22	-0.17	-0.57	-0.35	0.30	0.46	0.48
Dead time (≤2s)	--	--	0.2	0.2	0.2	0.2	0.4	0.4	--
Step response time (≤30s)	--	--	0.6	0.6	0.4	0.4	0.6	0.6	--
Setting time(s)	--	--	0.8	0.8	0.6	0.6	0.8	1.2	--
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								
Test:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 50.10 ±0.01	c) 50.80 ±0.01	e) 51.40 ±0.01	d) 52.00 ±0.01	f) 51.40 ±0.01	g) 50.80 ±0.01	h) 50.10 ±0.01	i) 50.00 ±0.01
2. Measurement a) to i): Active power output 50% after freezing = 100% P_{Emax} s=5%(40% P_{ref} / Hz), threshold frequency for start/return: 50.2Hz, Pref=PM									
Frequency [Hz]:	50.00	50.10	50.80	51.40	52.00	51.40	50.80	50.10	50.00
P_M [W]:	6000	6000	3120	240	-2640	240	3120	12000	12000
P_{E60} [W]:	5980	5980	3044	123	-2811	98	3044	12033	12033
$\Delta P_{E60}/P_M$ [%]:	-0.17	-0.17	-0.63	-0.98	-1.43	-1.18	-0.63	0.28	0.28
Dead time (≤2s)	--	--	0.2	0.4	0.2	0.2	0.2	0.6	--
Step response time (≤30s)	--	--	0.8	0.6	0.8	0.8	0.4	0.8	--
Setting time(s)	--	--	1.0	0.8	0.8	1.0	0.6	1.2	--
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								
Test:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 50.10 ±0.01	c) 50.80 ±0.01	e) 51.40 ±0.01	d) 52.00 ±0.01	f) 51.40 ±0.01	g) 50.80 ±0.01	h) 50.10 ±0.01	i) 50.00 ±0.01
3. Measurement a) to i): Active power output -50% after freezing = 100% P_{Emax} s=5%(40% P_{ref} / Hz), threshold frequency for start/return: 50.2Hz, Pref=PM Note: When the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.									
Frequency [Hz]:	50.00	50.10	50.80	51.40	52.00	51.40	50.80	50.10	50.00
P_M [W]:	-3600	-3600	-5328	-7056	-7200	-7056	-5328	-3600	-3600

P_{E60} [W]:	-3689	-3690	-5354	-7078	-7272	-7078	-5353	-3689	-3690
$\Delta P_{E60}/P_M$ [%]:	-1.24	-1.25	-0.36	-0.31	-1.00	-0.31	-0.35	-1.24	-1.25
Dead time (≤2s)	--	--	0.2	0.4	0.4	0.6	0.6	0.6	--
Step response time (≤30s)	--	--	0.6	0.6	0.8	0.8	0.8	0.8	--
Setting time(s)	--	--	1.2	1.4	1.0	1.0	1.2	1.0	--
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								

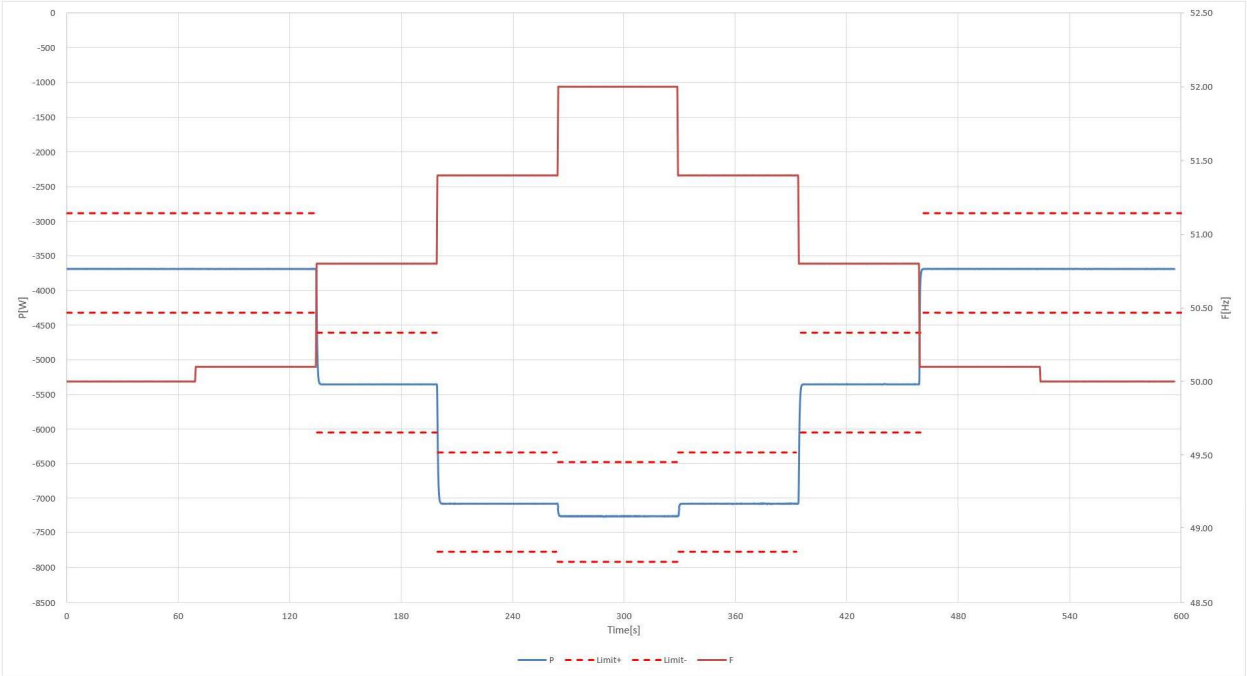
Graph of Measurement 1.: Active power output 100% P_{Emax}



Graph of Measurement 2.: Active power output 50% P_{Emax}



Graph of Measurement 3.: Active power output- 50% P_{Emax}

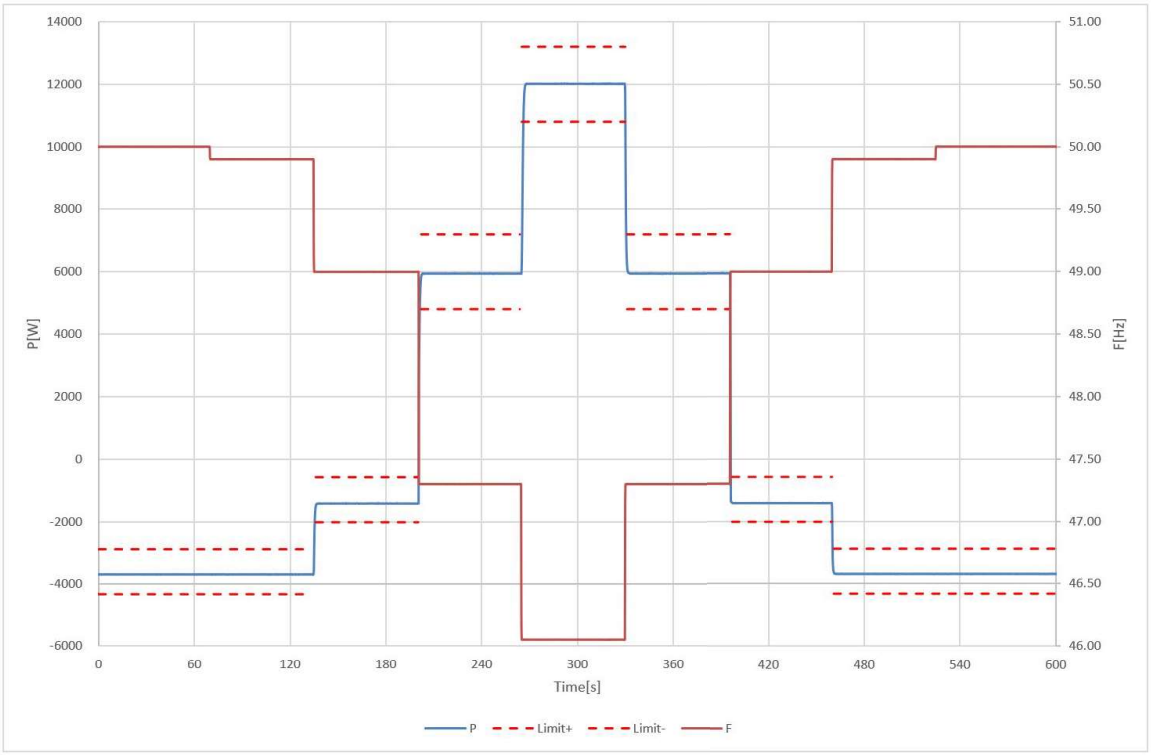


Note: When the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.

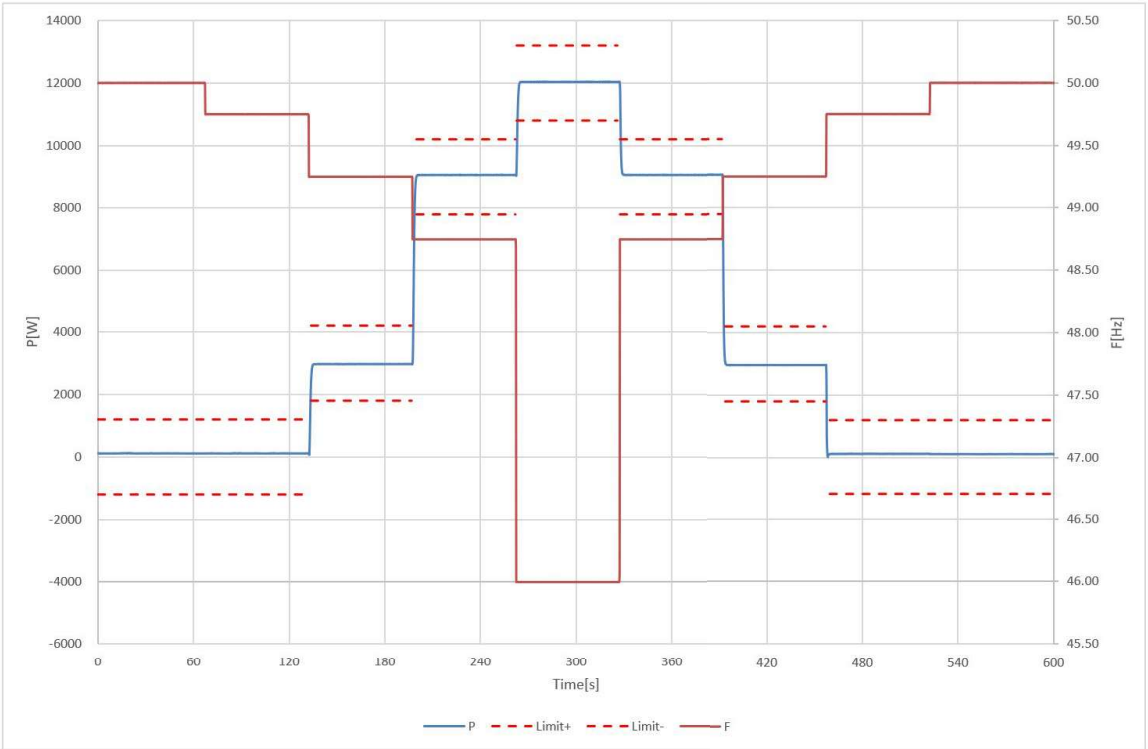
4.6.2 Power response to under-frequency									**P**
Test a:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 49.90 ±0.01	c) 49.00 ±0.01	e) 47.30 ±0.01	d) 46.05 ±0.01	f) 47.30 ±0.01	g) 49.00 ±0.01	h) 49.90 ±0.01	i) 50.00 ±0.01
1. Measurement a) to i): Active power output =-50% P_{Emax} s=5% (40% P_{ref} / Hz), threshold frequency for start/return: 49.8Hz, Pref= P_{Emax} Note: When the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.									
Frequency [Hz]:	50.00	49.90	49.00	47.30	46.05	47.30	49.00	49.90	50.00
P_M [W]:	-3600	-3600	-1296	6000	12000	6000	-1296	-3600	-3600
P_{E60} [W]:	-3690	-3690	-1420	5943	12013	5944	-1419	-3689	-3690
$\Delta P_{E60}/P_M$ [%]:	-1.25	-1.25	-1.72	-0.48	0.11	-0.47	-1.71	-1.24	-1.25
Dead time (≤2s)	--	--	0.4	0.4	0.4	0.2	0.2	0.4	--
Step response time (≤30s)	--	--	0.6	0.6	0.6	0.4	0.4	0.6	--
Setting time(s)	--	--	1.0	1.0	0.8	0.6	0.8	1.2	--
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								
Test b:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 49.75 ±0.01	c) 49.25 ±0.01	e) 48.75 ±0.01	d) 46.00 ±0.01	f) 48.75 ±0.01	g) 49.25 ±0.01	h) 49.75 ±0.01	i) 50.00 ±0.01
2. Measurement a) to i): Active power output =0% P_{Emax} s=2% (100% P_{ref} / Hz), threshold frequency for start/return: 49.5Hz, Pref=PEmax									
Frequency [Hz]:	50.00	49.75	49.25	48.75	46.00	48.75	49.25	49.75	50.00
P_M [W]:	0	0	3000	9000	12000	9000	3000	0	0
P_{E60} [W]:	113	112	2968	9057	12036	9058	2963	117	110
$\Delta P_{E60}/P_M$ [%]:	0.94	0.93	-0.27	0.48	0.30	0.48	-0.31	0.98	0.92
Dead time (≤2s)	--	--	0.6	0.4	0.2	0.4	0.2	0.2	--
Step response time (≤30s)	--	--	0.8	0.6	0.6	0.8	0.4	0.4	--
Setting time(s)	--	--	1.0	1.0	1.2	1.0	0.6	0.8	1.0
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								
Test c:									
1-min mean value [Hz]:	a) 50.00 ±0.01	b) 49.90 ±0.01	c) 49.20 ±0.01	e) 47.40 ±0.01	d) 46.00 ±0.01	f) 47.40 ±0.01	g) 49.20 ±0.01	h) 49.90 ±0.01	i) 50.00 ±0.01
3. Measurement a) to i): Active power output =50% P_{Emax}									

s=12% (16.67% P_{ref} / Hz), threshold frequency for start/return: 49.8Hz, Pref=PEmax									
Frequency [Hz]:	50.00	49.90	49.20	47.40	46.00	47.40	49.20	49.90	50.00
P_M [W]:	6000	6000	7200	10800	12000	10800	7200	6000	6000
P_{E60} [W]:	5980	5980	7174	10814	12035	10815	7175	5981	5981
$\Delta P_{E60}/P_M$ [%]:	-0.17	-0.17	-0.22	0.12	0.29	0.13	-0.21	-0.16	-0.16
Dead time (≤2s)	--	--	0.4	0.2	0.2	0.2	0.4	0.2	--
Step response time (≤30s)	--	--	0.6	0.6	0.4	0.4	0.6	0.4	--
Setting time(s)	--	--	0.8	0.8	0.6	0.8	0.8	0.8	--
Limit $\Delta P/P_{1min}$:	± 10 % of P_{Emax}								
Note: When the power grid charges the inverter, the maximum charging power of the inverter is only 7200W.									

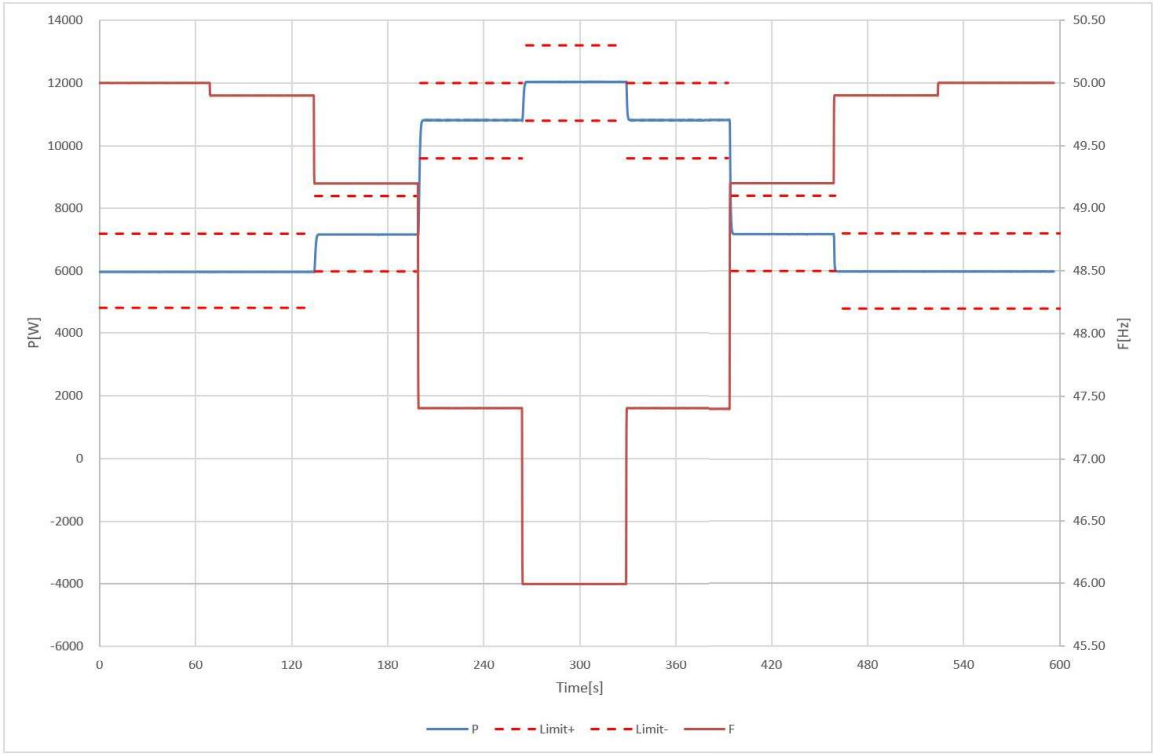
Graph of Measurement 1.: Active power output -50% P_{Emax}



Graph of Measurement 2.: Active power output 0% P_{Emax}



Graph of Measurement 3.: Active power output 50% PEmax



EN 50549-1: Power response to voltage changes			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.7.2.2	Capabilities		**P**
4.7.2.3.2	Setpoint control modes (PF setpoint mode)		**P**
4.7.2.3.2	Setpoint control modes (Q setpoint mode)		**P**
4.7.2.3.3	Voltage related control mode (Q(U) controls)		**P**
4.7.2.3.4	Power related Control mode (cos φ (P) controls)		**P**
4.7.2.3.4	Power related Control mode (Q (P) controls)		**P**
4.7.3	Voltage related active power reduction (P(U) function)		**P**

4.7.2.2 Capabilities 4.7.2.3.2 Fix control modes (cos φ setpoint mode)	P

Description of the reactive power provision within the voltage corridor:

The power provision is limited by the maximum apparent current and maximum apparent and active power (which equals the nominal power values).

The reactive power is prioritized versus the active power.

At overvoltage the apparent and active power threshold limits the injected power. At under voltage the apparent current limitation will also contribute.

A permanent active power reduction can be applied by setting parameter P_{Emax}.

The power control is therefore based on the currents and powers with following values:

Test:	**Apparent current limit [A]**	**Active / Apparent power limit [W / VA]**
HESP48120SH3	17.39	12000 / 12000

This leads to the following operating points (regarding maximum available active power):

	cosφ = 0.90 Inductive	cosφ = 1	cosφ = 0.90 Capacitive
$U / U_n = 1$	P = 10983 W	P = 12163 W	P = 10889 W
	Q = -5246 Var	Q = 310 Var	Q = 5166 Var

cosφ = 1 reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Voltage [V]
10%	1147	229	0.986	230.32
20%	2379	217	0.996	230.33
30%	3608	236	0.998	230.34
40%	4838	230	0.999	230.34
50%	6065	241	0.999	230.35
60%	7291	248	0.999	230.36
70%	8515	260	1.000	230.36
80%	9738	274	1.000	230.37
90%	10956	294	1.000	230.38
100%	12163	310	1.000	230.38
cosφ = 0.90 Inductive reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Voltage [V]
10%	1222	-508	-0.901	230.33
20%	2433	-1078	-0.903	230.33
30%	3613	-1649	-0.903	230.33
40%	4916	-2254	-0.906	230.34
50%	6061	-2786	-0.906	230.35
60%	7238	-3393	-0.904	230.35
70%	8408	-3889	-0.906	230.36
80%	9702	-4456	-0.907	230.36
90%	10818	-5027	-0.906	230.37
100% *	10983	-5246	-0.901	230.37
cosφ = 0.90 Capacitive reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Voltage [V]
10%	1212	564	0.907	230.33
20%	2296	1097	0.902	230.33
30%	3638	1725	0.904	230.34
40%	4673	2231	0.902	230.34
50%	5950	2853	0.902	230.35
60%	7105	3395	0.902	230.36
70%	8318	4009	0.901	230.37
80%	9530	4549	0.902	230.37
90%	10800	5091	0.905	230.38
100% *	10889	5166	0.903	230.38
Note: * Due to the limitation of Smax = 12000VA, active power cannot reach expected value.				

4.7.2.2 Capabilities 4.7.2.3.2 Fix control modes (Q setpoint mode)	P

Description of the reactive power provision within the voltage corridor:

The power provision is limited by the maximum apparent current and maximum apparent and active power (which equals the nominal power values).

The reactive power is prioritized versus the active power.

At overvoltage the apparent and active power threshold limits the injected power. At under voltage the apparent current limitation will also contribute.

The continuous provision is possible within the voltage corridor 85%U_n through 110%U_n.

A permanent active power reduction can be applied by setting parameter P_{Emax}.

The power control is therefore based on the currents and powers with following values:

Test:	**Apparent current limit [A]**	**Active / Apparent power limit [W / VA]**
HESP48120SH3	17.39	12000/12000

This leads to the following operating points (regarding maximum available active power):

	$U / U_n = 0.85$	$U / U_n = 1.0$	$U / U_n = 1.1$
Q_{max} Inductive	P = 10674 W	P = 10825 W	P = 10730 W
	Q = -5838 Var	Q = -5834 Var	Q = -5838 Var
	$U / U_n = 0.85$	$U / U_n = 1.0$	$U / U_n = 1.1$
Q_{max} Capacitive	P = 10669 W	P = 10564 W	P = 10654 W
	Q = 5831 Var	Q = 5789 Var	Q = 5846 Var

This leads to the following operating points (regarding maximum available active power):

Note:

The reactive power resulting in each of the measurement points between 10 % and 90 % of the nominal power is equal or greater than 0.33 PD both in over excited and under excited operation.
The settling time shall be less than one minute.
Reactive power capability shall be provided with an accuracy of ± 2 % Smax above 10%Smax, and reactive power is less than 10%Smax while S is less than 10%Smax.

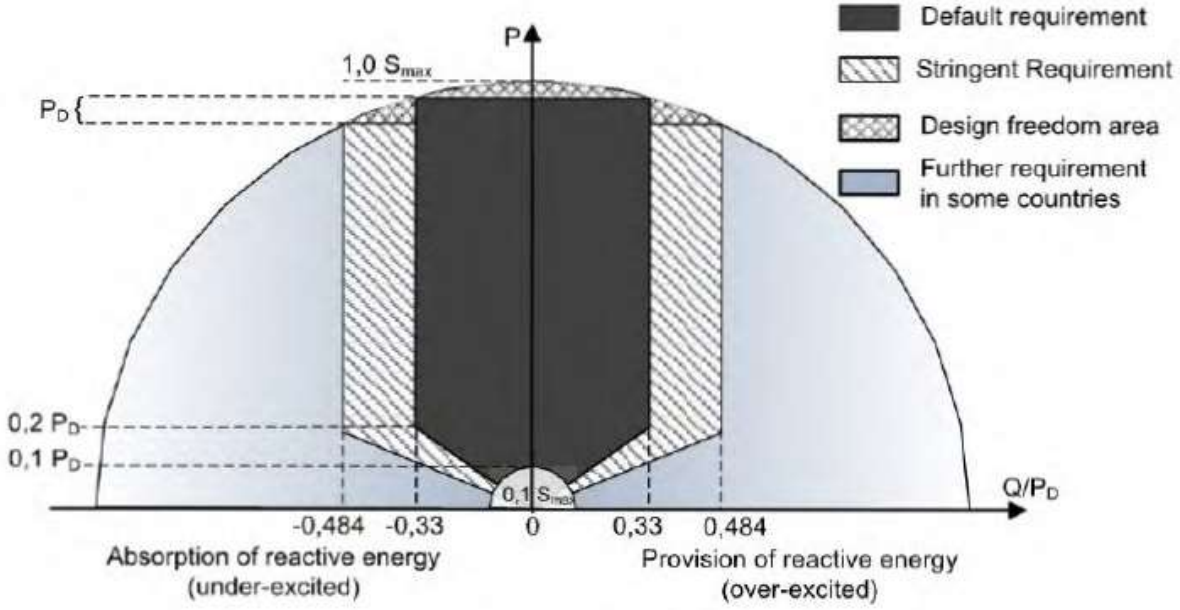


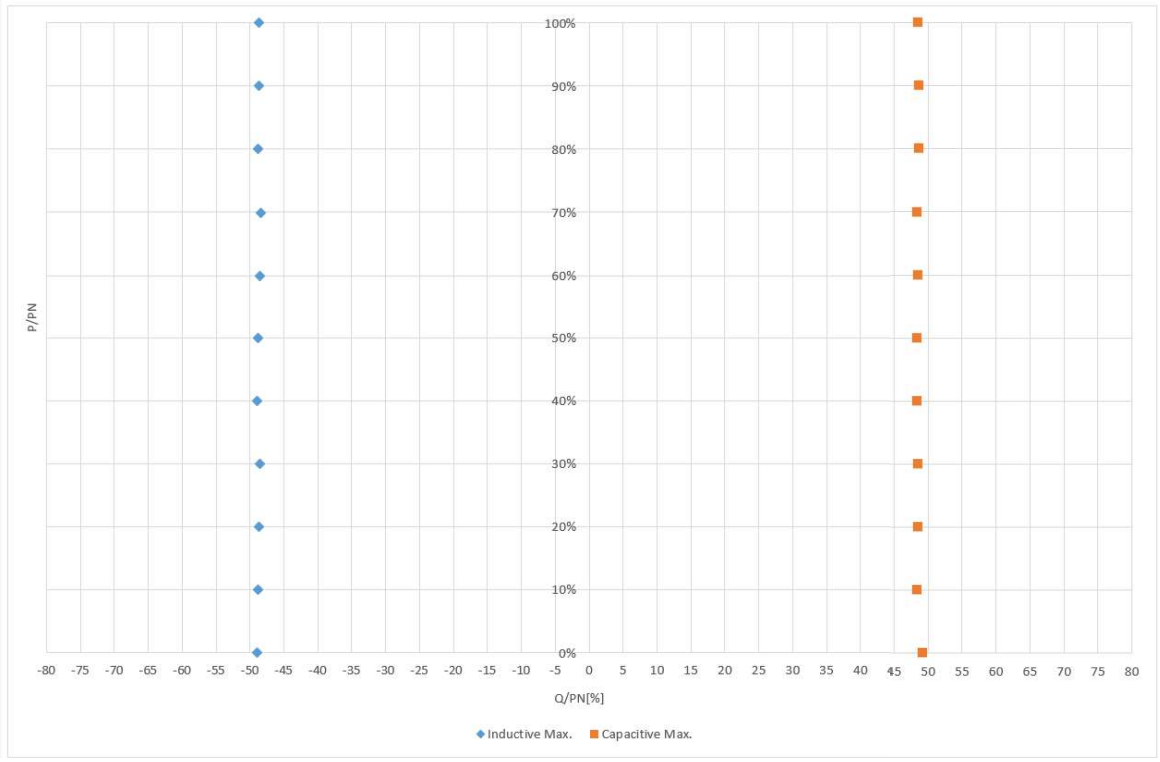
Figure 12 — Reactive power capability at nominal voltage

The rated output voltage of test sample is 230V;

Test: 85%U_n				
Inductive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	593	-5865	-0.100	-0.44
10%	1209	-5854	-0.202	-0.35
20%	2439	-5834	-0.386	-0.18
30%	3668	-5815	-0.533	-0.03
40%	4899	-5867	-0.641	-0.46
50%	6123	-5844	-0.723	-0.27
60%	7307	-5820	-0.782	-0.07
70%	8411	-5801	-0.823	0.09
80%	9601	-5855	-0.854	-0.36
90%*	10674	-5837	-0.877	-0.21
100%*	10674	-5838	-0.877	-0.22
Capacitive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	599	5900	0.101	0.73
10%	1220	5801	0.206	-0.09
20%	2452	5824	0.388	0.10
30%	3623	5818	0.529	0.05
40%	4854	5814	0.641	0.02
50%	6085	5812	0.723	0.00
60%	7174	5821	0.777	0.08
70%	8410	5809	0.822	-0.03
80%	9599	5845	0.852	0.28
90%*	10671	5833	0.876	0.18
100%*	10669	5831	0.876	0.16
Test: 100%U_n				
Inductive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	591	-5879	-0.100	-0.56
10%	1268	-5866	-0.211	-0.45
20%	2497	-5843	-0.393	-0.26
30%	3602	-5823	-0.526	-0.09
40%	4831	-5873	-0.635	-0.51
50%	6057	-5850	-0.719	-0.32
60%	7281	-5827	-0.781	-0.13
70%	8351	-5807	-0.821	0.04
80%	9666	-5856	-0.855	-0.37
90%	10825	-5834	-0.880	-0.18
100%*	10825	-5834	-0.880	-0.18

Capacitive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	607	5814	0.104	0.02
10%	1186	5809	0.200	-0.03
20%	2416	5811	0.384	-0.01
30%	3644	5811	0.531	-0.01
40%	4872	5811	0.642	-0.01
50%	6000	5812	0.718	0.00
60%	7225	5812	0.779	0.00
70%	8399	5812	0.822	0.00
80%	9607	5810	0.856	-0.02
90%	10564	5788	0.877	-0.20
100%*	10564	5789	0.877	-0.19
Test: 110%U_n				
Inductive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	618	-5815	-0.106	-0.03
10%	1234	-5802	-0.208	0.08
20%	2466	-5852	-0.388	-0.33
30%	3695	-5828	-0.535	-0.13
40%	4799	-5806	-0.637	0.05
50%	6026	-5857	-0.717	-0.38
60%	7219	-5833	-0.778	-0.18
70%	8442	-5810	-0.824	0.02
80%	9633	-5860	-0.854	-0.40
90%	10730	-5838	-0.878	-0.22
100%*	10730	-5838	-0.878	-0.22
Capacitive supply reactive power				
Rating power [%}	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Δ Q [%] (<± 2 % Smax)
0%	596	5812	0.102	0.00
10%	1188	5817	0.200	0.04
20%	2298	5812	0.368	0.00
30%	3588	5812	0.525	0.00
40%	4907	5807	0.645	-0.04
50%	6132	5831	0.725	0.16
60%	7294	5854	0.780	0.35
70%	8402	5877	0.819	0.54
80%	9730	5828	0.858	0.13
90%	10654	5846	0.877	0.28
100%*	10654	5846	0.877	0.28

Diagram of the reactive power provision dependencies



Assessment criterion:

The power factor resulting in each of the measurement points between 10 % and 90 % of the nominal power is equal to or lower than 0.80 both in over excited and under excited operation.

Note:

a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.

b) For each of the 10 active power levels, at least 3 under excited and 3 over excited reactive power levels were recorded.

c) 1 min-average-values were calculated using voltage measurements at the basic frequency in a period of 200 ms.

*:the current has reach the max value.

4.7.2.2 Capabilities 4.7.2.3.3 Voltage related control modes (Q (U) controls)	P

Test: 100%P_{Emax}

Settling time set to 0 s or as fast as possible

Operating points	U_{set} [V]	U_{200ms} [V]	Q_{set} [Var]	P_{200ms} [W]	Q_{200ms} [Var]	$Cos\varphi_{200ms}$ [-]
1. Step 100%U_n	230.00	230.36	0	12148	36	1.000
2. Step 92-94%U_n	213.90	214.26	5811	10502	5862	0.872
3. Step 106-108%U_n	246.10	246.46	-5811	10594	-5882	0.873
4. Step 92-94%U_n	213.90	214.27	5811	10504	5863	0.872
5. Step 100%U_n	230.00	230.38	0	12153	36	1.000

Q_{set} levels	Moment of set point change [s]	Moment of settling around set point [s]	Time different [s]	$\Delta Q/\Delta t$ [Var/s]
1. Step -> 2. Step	130.2	144.2	13.0	448
2. Step -> 3. Step	250.0	260.6	10.6	1108
3. Step -> 4. Step	370.2	382.0	11.8	995
4. Step -> 5. Step	490.4	502.6	11.8	493
Maximum settling time for test [s]	13.0			

Test: 50%P_{Emax}

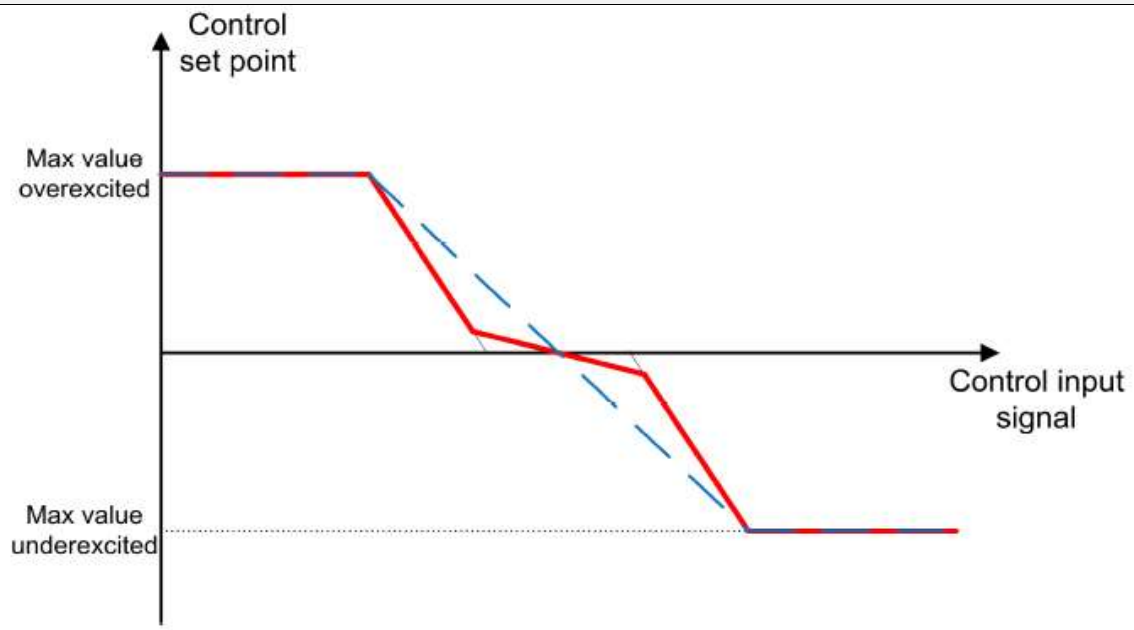
Settling time set to 0 s or as fast as possible

Operating points	U_{set} [V]	U_{200ms} [V]	Q_{set} [Var]	P_{200ms} [W]	Q_{200ms} [Var]	$Cos\varphi_{200ms}$ [-]
1. Step 100%U_n	230.00	230.29	0	6054	-75	0.999
2. Step 92-94%U_n	213.90	214.21	5811	5903	5719	0.716
3. Step 106-108%U_n	246.10	246.40	-5811	5983	-5991	0.713
4. Step 92-94%U_n	213.90	214.22	5811	5905	5736	0.715
5. Step 100%U_n	230.00	230.33	0	6060	-77	0.999

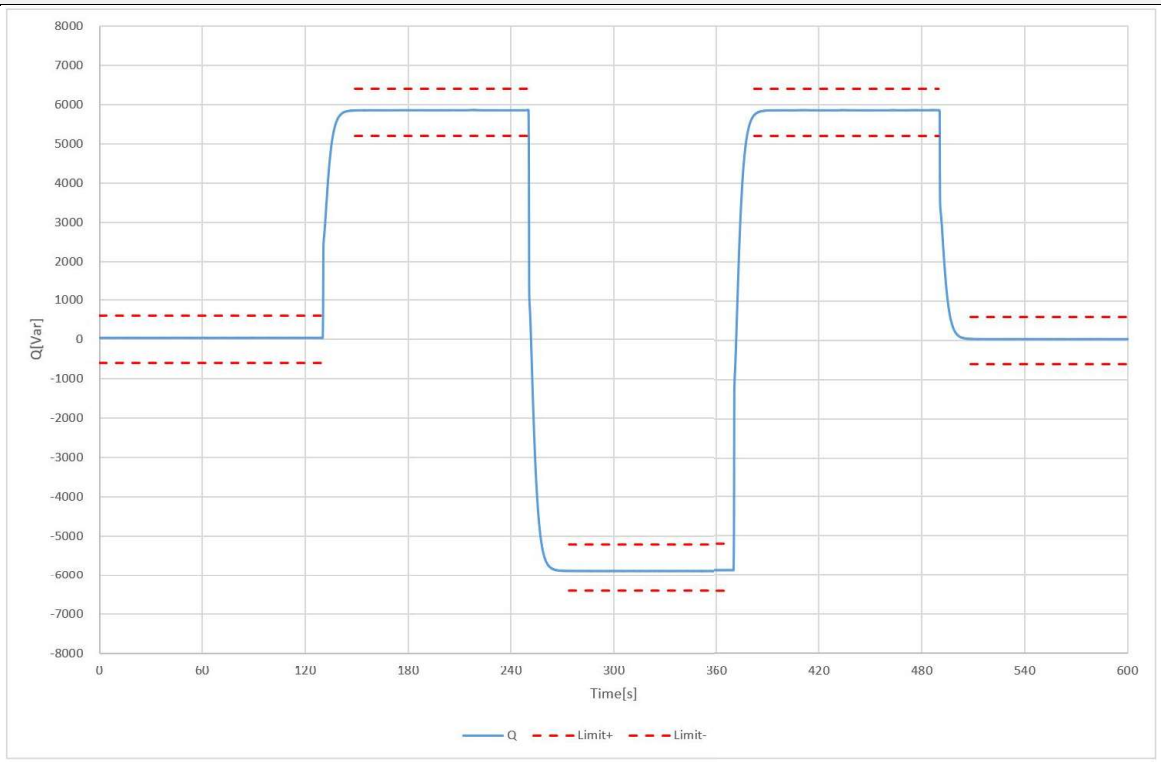
Q_{set} levels	Moment of set point change [s]	Moment of settling around set point [s]	Time different [s]	$\Delta Q/\Delta t$ [Var/s]
1. Step -> 2. Step	136.6	146.8	10.2	568
2. Step -> 3. Step	256.4	270.6	14.2	825
3. Step -> 4. Step	376.2	391.8	15.6	752
4. Step -> 5. Step	496.8	506.4	9.6	606
Maximum settling time for test [s]	15.6			

Note:
Settling times are determined by last entry of Q time-series in 5%S_{Emax} tolerance corridor around the corresponding setpoint.
Note: * Due to the limitation of Smax = 220000VA, active power cannot reach expected value.

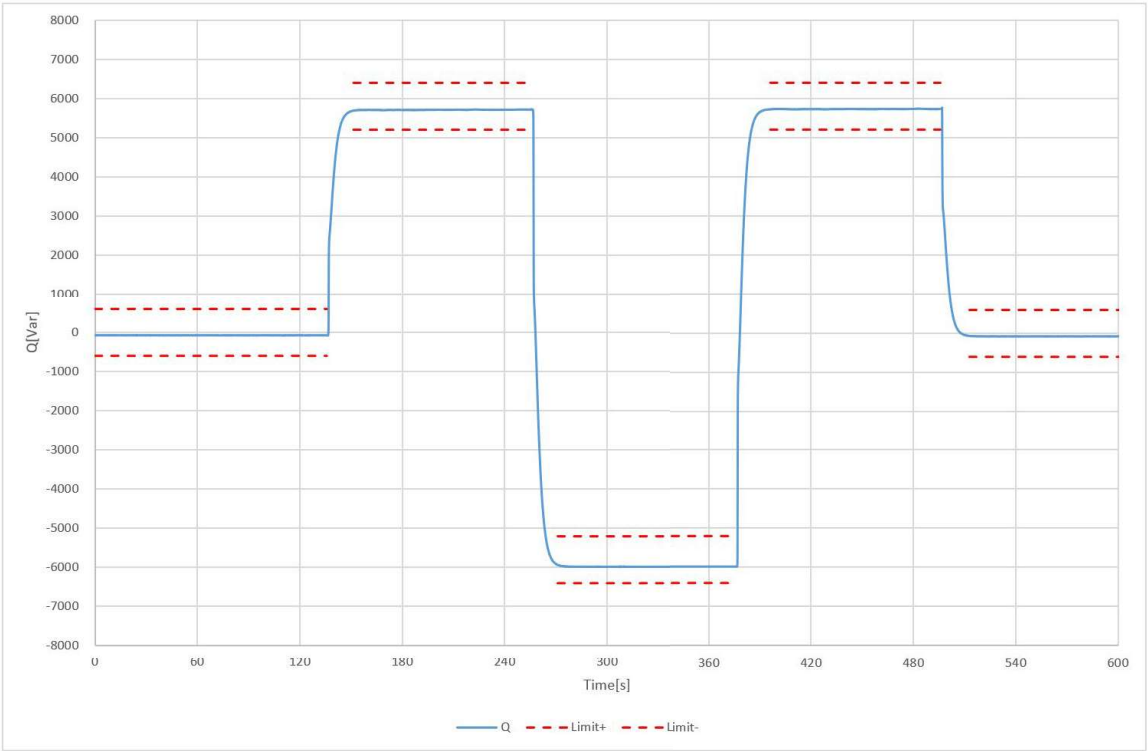
Required curve



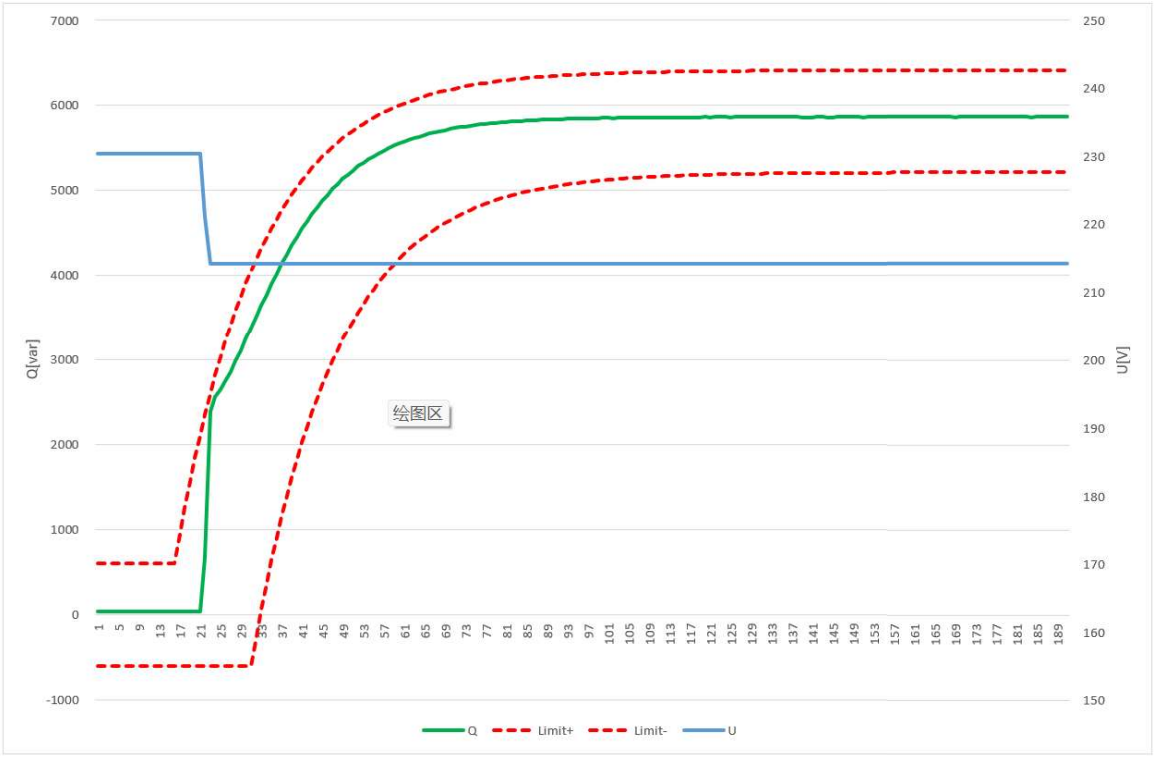
Q(U) diagram for 100%P_n (Settling time 0 s or as fast as possible)



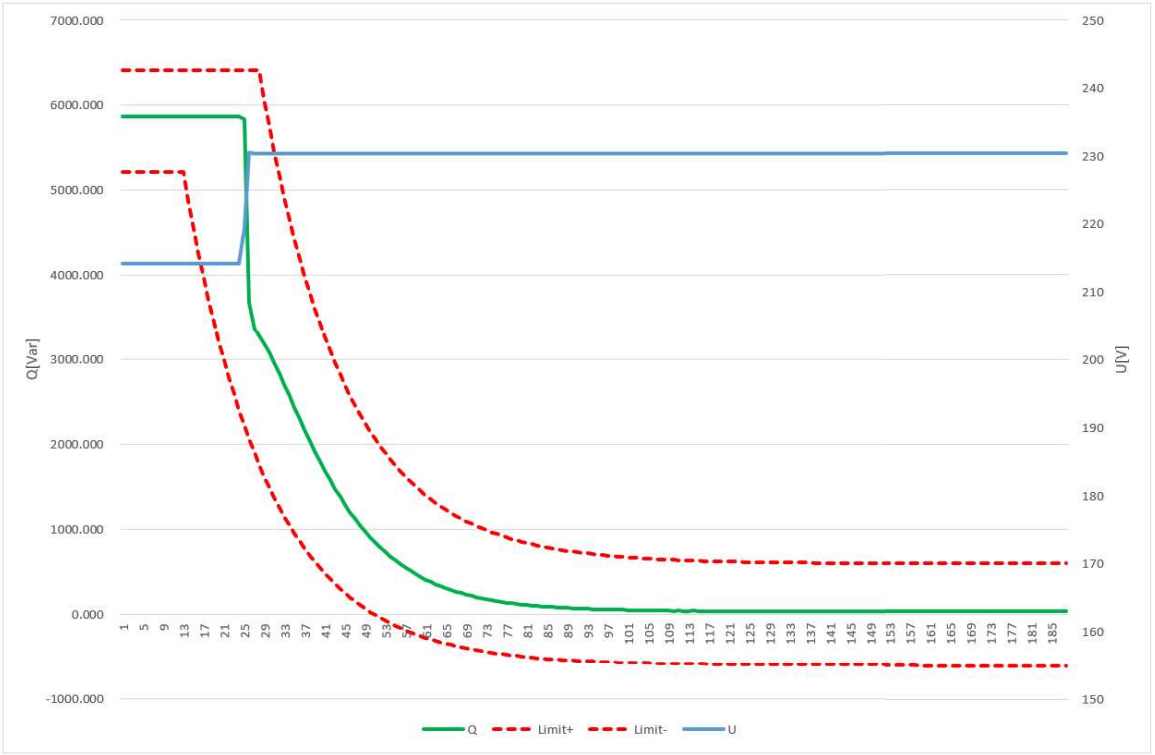
Q(U) diagram for 50%P_n (Settling time 0 s or as fast as possible)



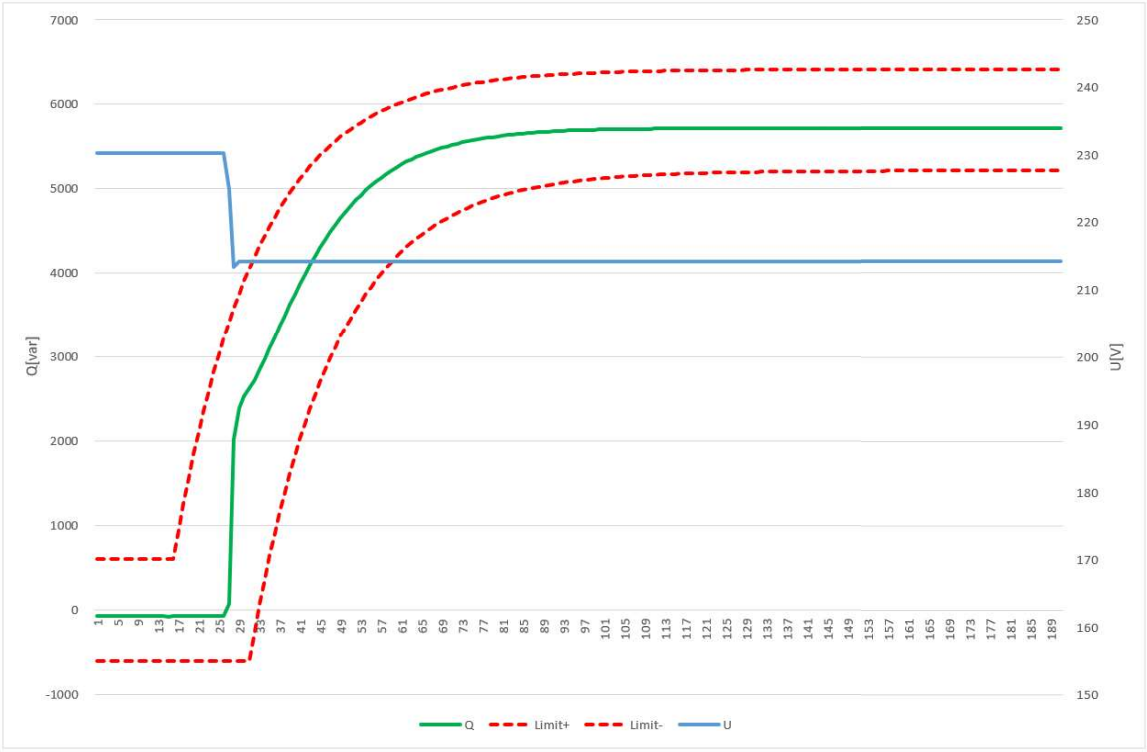
Q(U) Jumps 1.00-0.93(Un) with tolerance for 100%P_n



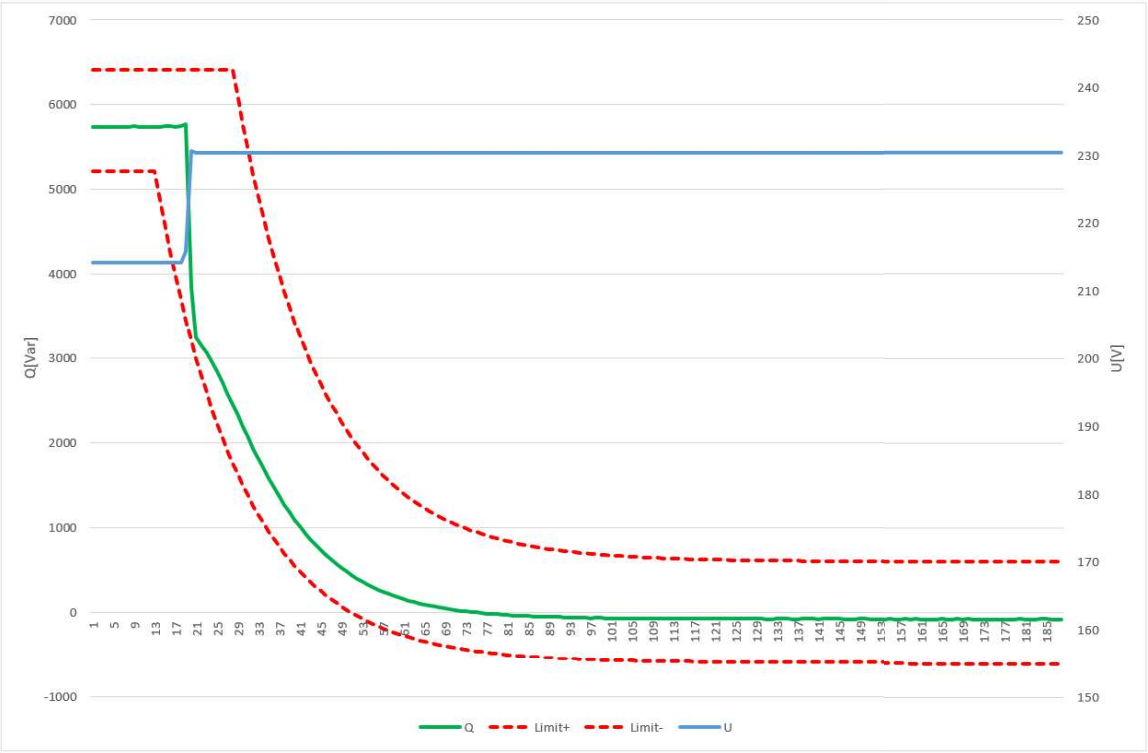
Q(U) Jumps 0.93-1.00(Un) with tolerance for 100%P_n



Q(U) Jumps 1.00-0.93(Un) with tolerance for 50%P_n

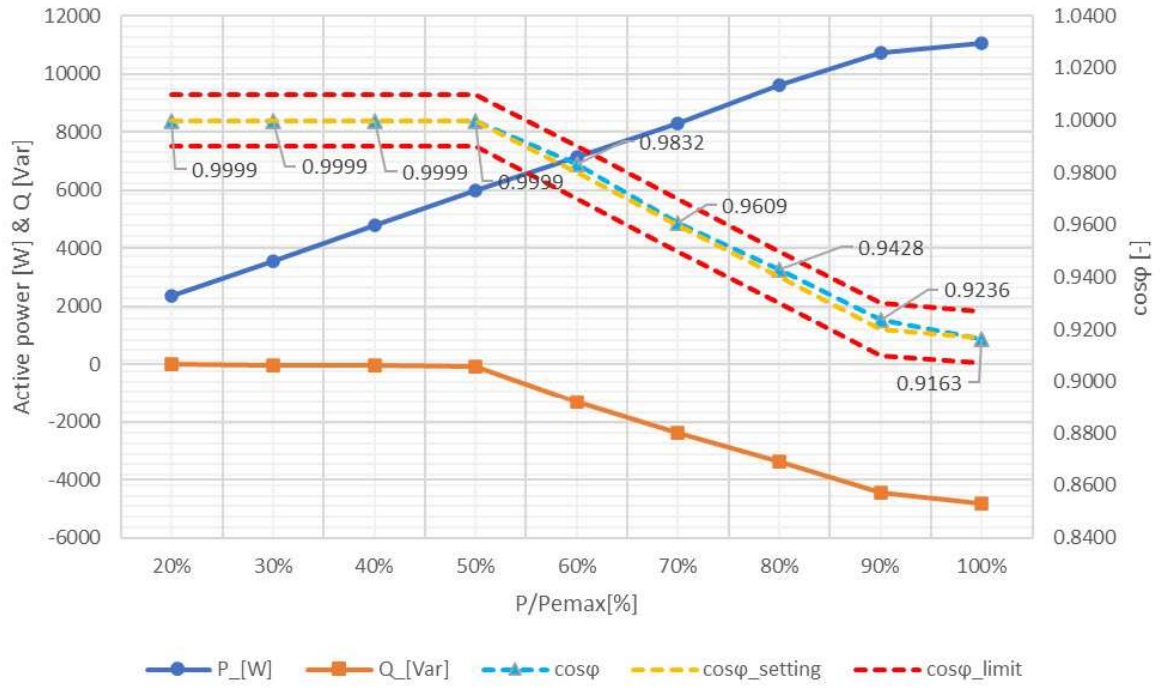


Q(U) Jumps 0.93-1.00(Un) with tolerance for 50%P_n

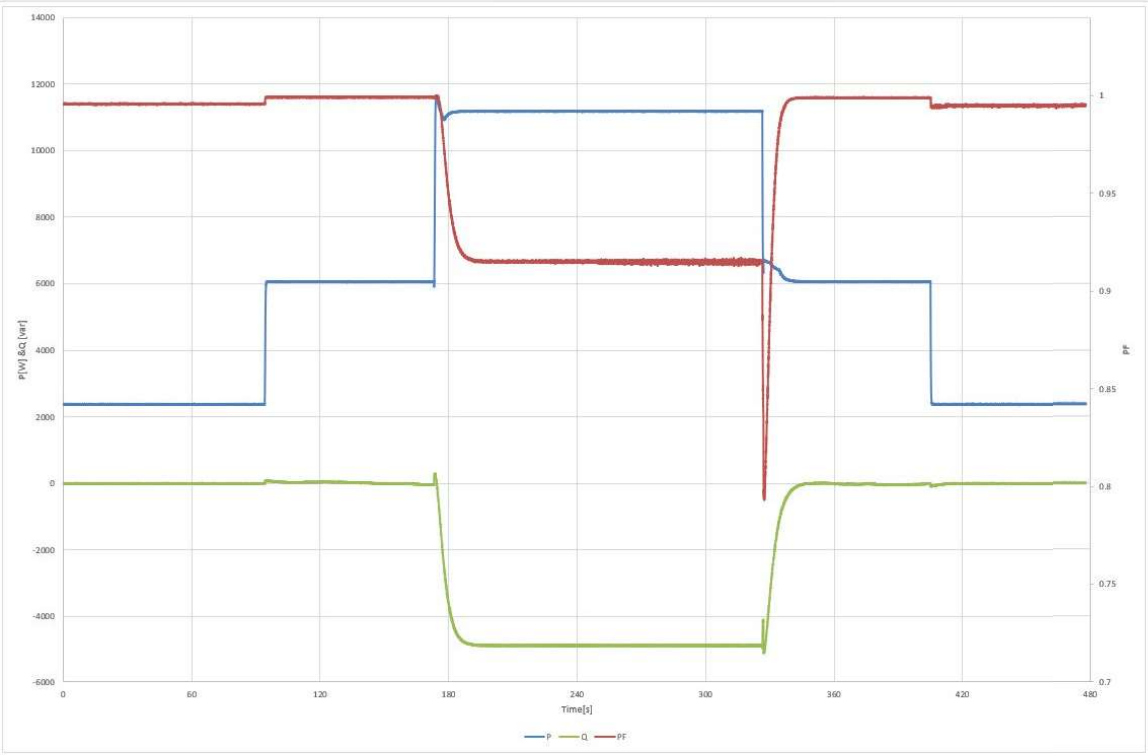


4.7.2.2 Capabilities **4.7.2.3.4 Power related Control mode (cos φ (P) controls)**										**P**
Test a):										
P_{Emax}/P [%]	10	20	30	40	50	60	70	80	90	100*
30 s mean value	10% to 100% P_{Emax}									
U [V]:	230.32	230.00	230.12	230.12	230.13	230.11	230.23	230.21	230.21	230.21
P_{E30} [W]:	1147	2338	3561	4785	6004	7161	8310	9603	10748	11083
P_{E30} of P_{Emax} [%]:	9.48	19.48	29.67	39.88	50.03	59.68	69.25	80.03	89.57	92.36
Q_{E30} [Var]:	-7	-8	-28	-50	-58	-1328	-2393	-3395	-4461	-4843
cos φ_{E30}:	1.000	1.000	1.000	1.000	1.000	0.983	0.961	0.943	0.923	0.916*
cos $\varphi_{setpoint}$ of P_{E30}:	1.000	1.000	1.000	1.000	1.000	0.980	0.960	0.940	0.920	0.900
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0.01									
Test b):										
P_{Emax}/P_n [%]	20			50			100			
30 s mean value	20% to 50% to 100% P_{Emax}									
U [V]:	230.35			230.35			230.37			
P_{E30} [W]:	2378			6064			11179			
P_{E30} of P_{Emax} [%]:	19.76			50.50			93.15			
Q_{E30} [Var]:	216			229			4857			
cos φ_{E30}:	0.996			0.999			0.917*			
cos $\varphi_{setpoint}$ of P_{E30}:	1.000			1.000			0.900			
T_0[s]:	--					9.9				
P_{Emax}/P_n [%]	100			50			20			
30 s mean value	100% to 50% to 20% P_{Emax}									
U [V]:	230.37			230.34			230.33			
P_{E30} [W]:	11179			6068			2377			
P_{E30} [%]:	93.15			50.65			19.89			
Q_{E30} [Var]:	4857			246			217			
cos φ_{E30}:	0.917*			0.999			0.996			
cos $\varphi_{setpoint}$ of P_{E30}:	0.900			1.000			1.000			
T_0 [s]:	9.7					--				
Limit T_0 [s]:	10 s									
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0.01									
Test:										

Graph of cos φ(P): Test a)



Graph of setting (T_0) time: Test b): 20% to 50% to 100%



Test:

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

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

Assessment criterion:

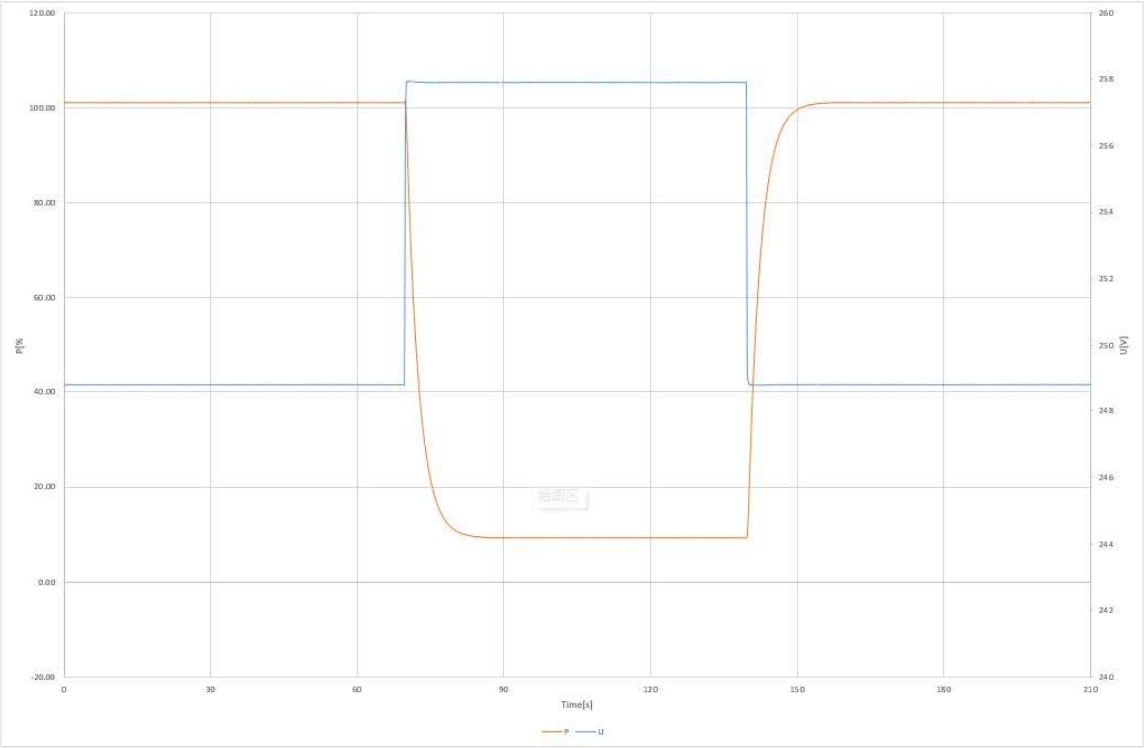
Test 1: cos φ accuracy cos φ (±0.01)

Test 2: cos φ accuracy cos φ (±0.01)

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

*：Due to the maximum current of the testing equipment, the maximum power can only reach approximately 92%Pn. According to the PF curve, the theoretical PF value at this time should be 0.915.

4.7.3 Voltage related active power reduction (P(U) function)			P
	a) threshold -2%U_n (108%U_n)	b) threshold +2%U_n (112%U_n)	c) threshold -2% U_n (108% U_n)
Active power P[W]	12119	1110	12119
Vac [V] measured	248.77	257.92	248.78



Test method:

Proceed as follows:

-- enable the P (V) active power reduction function, according to the modalities indicated by the manufacturer (which must be reported in the test report);

-- adjust the voltage read at the converter output terminals to -2% of the activation threshold declared by the manufacturer and the d.c. so that the active power supplied at the output is equal to the maximum power available in the input;

□ □ adjust the voltage read at the converter output terminals to + 2% of the activation threshold declared by the manufacturer;

-- measure the active power as 1-s averages, reporting the values obtained in a graph as a function of time;

-- within 5 min from the moment of application of the voltage 2% of the activation threshold declared by the manufacturer, verify that the active power supplied by the inverter has been reduced to a value not exceeding 20% * Pn;

-- the voltage read at the converter output terminals is set at -2% of the activation threshold declared by the manufacturer;

-- measure the active power as 1-s averages, reporting the values obtained in a graph as a function of time;

-- verify that the active power supplied by the inverter returns to the value congruent with the power made available by the primary or simulated source.
Assessment criterion: In order to avoid disconnection due to overvoltage protection (see 4.9.2.3 and 4.9.2.4), generating plants/units are allowed to reduce active power output as a function of this rising voltage. The final implemented logic can be chosen by the manufacturer. Nevertheless, this logic shall not cause steps or oscillations in the output power. (Default 3s (=33%P_{EMAX} /second at 100%P_{EMAX} change)

EN 50549-1: EMC and power quality			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.8	Harmonic emission		**P**
4.8	Immunity to harmonics and inter-harmonics		**P**
4.8	Flicker		**P**
4.8	Rapid voltage		**P**
4.8	DC Injection		**P**
4.8	Unbalance		**P**

4.8 EMC and power quality Harmonic current emission (EN 61000-3-12 for more than 16A and less than or equal to 75 A.)	P

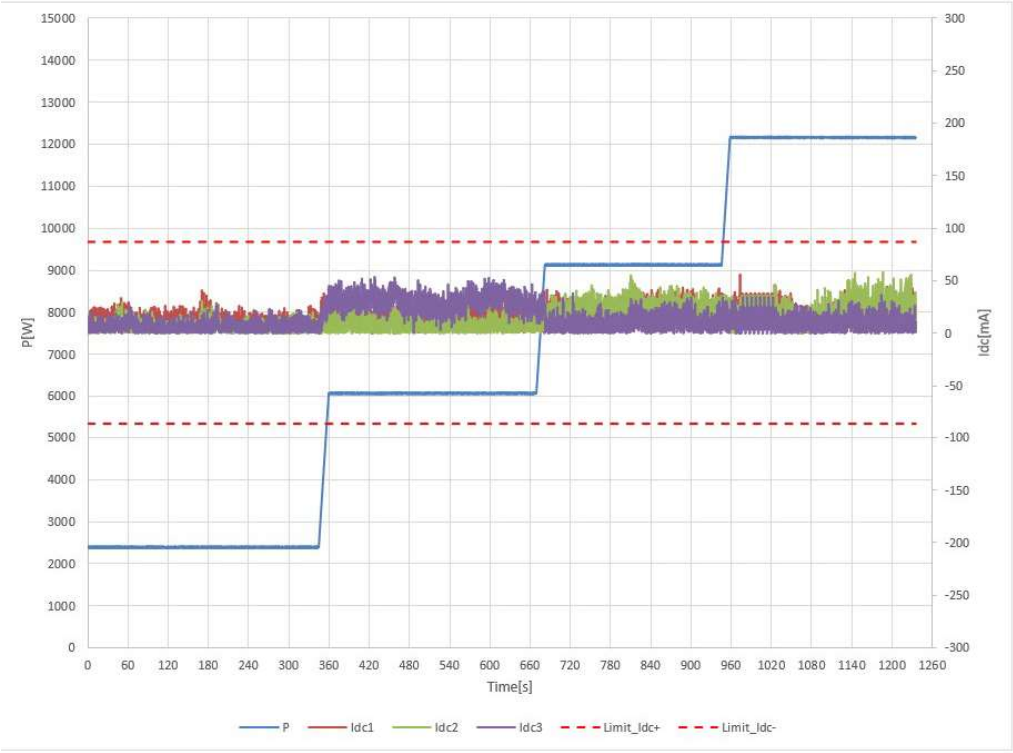
Watts [W]	12078
Vrms [V]	230.53
Arms [A]	17.48
Frequency [Hz]	50.00

Harmonic order n	Current Magnitude [A] at 100% rated output power			% of Fundamental			Harmonic current limit EN 61000-3-12 [%In]
	L1	L2	L3	L1	L2	L3	
1st	17.510	17.446	17.448	100.806	100.439	100.448	
2nd	0.138	0.138	0.156	0.794	0.795	0.900	8
3rd	0.324	0.257	0.309	1.865	1.480	1.779	-
4th	0.113	0.122	0.122	0.651	0.705	0.702	4
5th	0.040	0.046	0.060	0.230	0.267	0.347	10.7
6th	0.085	0.084	0.087	0.489	0.484	0.503	2.66
7th	0.112	0.114	0.119	0.645	0.657	0.685	7.2
8th	0.059	0.062	0.057	0.340	0.356	0.328	2
9th	0.067	0.071	0.073	0.386	0.409	0.419	-
10th	0.046	0.045	0.050	0.265	0.262	0.290	1.6
11th	0.065	0.066	0.068	0.374	0.382	0.390	3.1
12th	0.035	0.034	0.039	0.201	0.194	0.226	1.33
13th	0.042	0.042	0.043	0.242	0.240	0.249	2
14th	0.023	0.021	0.023	0.132	0.121	0.135	-
15th	0.021	0.019	0.021	0.121	0.110	0.121	-
16th	0.015	0.013	0.013	0.086	0.078	0.076	-
17th	0.004	0.008	0.008	0.023	0.043	0.044	-
18th	0.010	0.011	0.010	0.058	0.064	0.060	-
19th	0.010	0.009	0.010	0.058	0.050	0.057	-
20th	0.006	0.005	0.008	0.035	0.031	0.046	-
21th	0.005	0.008	0.008	0.029	0.046	0.044	-
22th	0.007	0.008	0.009	0.040	0.045	0.049	-
23th	0.009	0.011	0.012	0.052	0.062	0.068	-
24th	0.008	0.009	0.009	0.046	0.049	0.053	-
25th	0.008	0.008	0.008	0.046	0.045	0.048	-
26th	0.008	0.008	0.009	0.046	0.045	0.053	-
27th	0.008	0.011	0.010	0.046	0.061	0.056	-
28th	0.008	0.009	0.007	0.046	0.051	0.043	-
29th	0.006	0.005	0.006	0.035	0.028	0.035	-
30th	0.007	0.007	0.007	0.040	0.040	0.038	-
31th	0.007	0.008	0.007	0.040	0.046	0.040	-
32th	0.005	0.006	0.005	0.029	0.036	0.031	-
33th	0.004	0.004	0.005	0.023	0.022	0.027	-
34th	0.004	0.004	0.004	0.023	0.022	0.024	-
35th	0.004	0.004	0.003	0.023	0.025	0.020	-
36th	0.003	0.003	0.004	0.017	0.020	0.021	-
37th	0.005	0.006	0.007	0.029	0.035	0.041	-
38th	0.003	0.005	0.004	0.017	0.026	0.023	-
39th	0.002	0.003	0.004	0.012	0.016	0.023	-
40th	0.004	0.004	0.005	0.023	0.021	0.031	-
THD_{40}	--	--	--	2.424	2.171	2.450	13
PWHD	--	--	--	1.192	1.239	1.287	22

4.8 Flicker and voltage fluctuations				
Method: Measurement was carried out according to the procedure in IEC 61400-21.				
Grid impedance angle, ψ_k	30°	50°	70°	85°
Flicker coefficient, $c(\psi_k)$	0.0165	0.0165	0.0165	0.0165
Short-term flicker, P_{st}	0.0005	0.0005	0.0005	0.0005
Note: The table entries are worst case values. Sk,fic/Sn in the fictitious grid was set to: 33				

4.8 EMC and power quality Rapid voltage changes - Generation units with a rated current				P
Switch-on for any capacity (10% P_{Emax})				
	L1	L2	L3	
Single period effective values of the current [A]	0.23	0.20	0.21	
Single period effective values of the voltage [V]	230.62	230.27	230.17	
k_i value	0.01	0.01	0.01	
k_{imax} value	0.01			
Switch-on for nominal capacity (100% P_{Emax})				
	L1	L2	L3	
Single period effective values of the current [A]	0.26	0.21	0.22	
Single period effective values of the voltage [V]	230.62	230.27	230.35	
k_i value	0.01	0.01	0.01	
k_{imax} value	0.01			
Switch-off for nominal capacity (no emergency shutdown, but operational shutdown) (100% P_{Emax})				
	L1	L2	L3	
Single period effective values of the current [A]	17.41	17.43	17.35	
Single period effective values of the voltage [V]	230.66	230.37	230.25	
k_i value	1.00	1.00	1.00	
k_{imax} value	1.00			

4.8 EMC and power quality DC-Injection					P
Protection limit		**Tested at four power levels limit 0.5% of $I_{AC;nom}$ (87 mA)**			
Output power		~20%	~50%	75%	~100%
Max. test value [mA]	Phase L1	40	36	44	47
	Phase L2	30	28	55	58
	Phase L3	27	54	40	36
Diagram of permanent dc-injection					



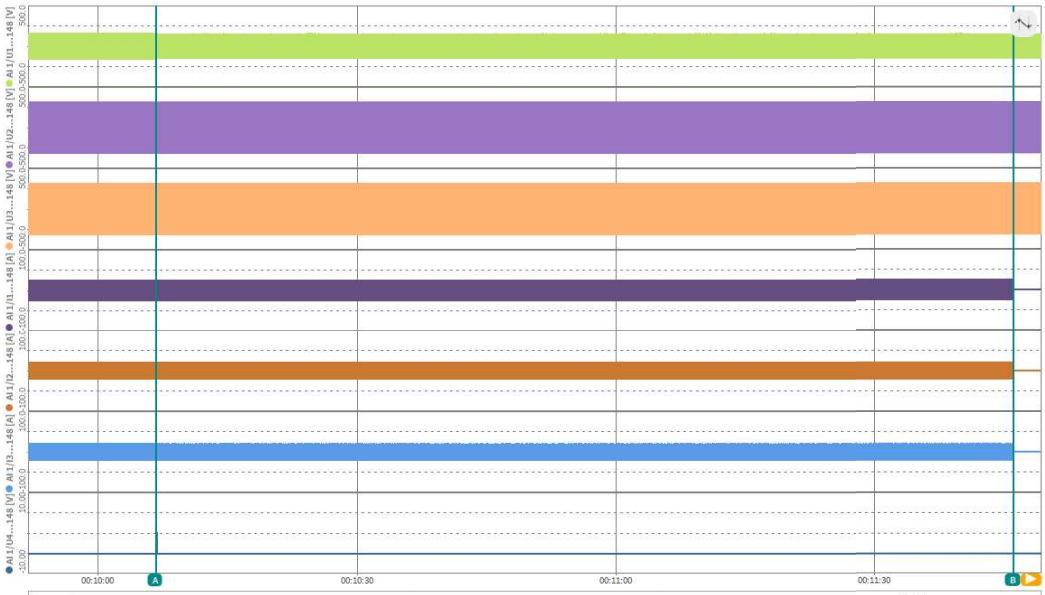
4.8 Unbalance (Three phase type of unit only)							P
Pn [%]	**P [W]**	**U1+ [V]**	**U1- [V]**	**I1+ [A]**	**I1- [A]**	**ui [%]**	**Number of records**
0	-78.19	230.36	0.50	0.13	0.01	6.04	1min
10	1152.98	230.36	0.50	1.67	0.01	0.77	1min
20	2382.73	230.37	0.50	3.45	0.02	0.58	1min
30	3612.34	230.37	0.53	5.23	0.03	0.55	1min
40	4841.68	230.38	0.53	7.01	0.04	0.52	1min
50	6069.09	230.39	0.54	8.78	0.04	0.51	1min
60	7294.65	230.39	0.50	10.55	0.05	0.49	1min
70	8518.32	230.40	0.51	12.32	0.06	0.49	1min
80	9617.28	230.40	0.54	13.91	0.07	0.50	1min
90	10856.51	230.41	0.52	15.71	0.08	0.49	1min
100	11994.45	230.41	0.51	17.35	0.08	0.48	1min

U1+ [V]: Positive voltage
U1- [V]: Negitive voltage
I1+ [A]: Positive current
I1- [A]: Negitive current
Ui%= (I-)/I(+)*100%

EN 50549-1: Interface protection			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.9.3.2	Undervoltage protection		**P**
4.9.3.3	Overvoltage protection		**P**
4.9.3.4	Overvoltage 10 min mean protection		**P**
4.9.3.5	Underfrequency protection		**P**
4.9.3.6	Overfrequency protection		**P**
4.9.4.2	Active methods tested with a resonant circuit		**P**

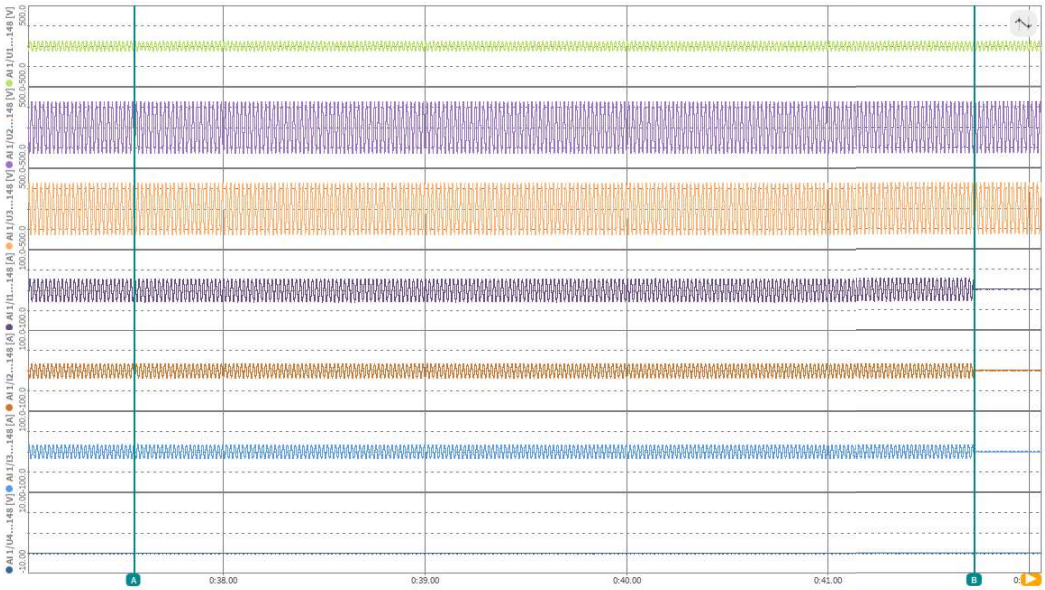
4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under voltage) (Threshold value refer for default) (Three phase type, Phase L1-N)					P
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.50Un±1% Un	99s ≤ t ≤ 100s	1.20Un±1% Un	99s ≤ t ≤ 100s	
Trip value [V]	115.75		276.28		
	115.74		276.46		
	115.74		276.48		
	115.74		276.49		
	115.74		276.34		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	99.26	U_n To $U_{th\text{-}high}$ + 5%U_n	99.19	
		99.14		99.35	
		99.09		99.22	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.20Un±1% Un	4s ≤ t ≤ 5s	1.30Un±1% Un	4s ≤ t ≤ 5s	
Trip value [V]	45.52		300.56		
	44.23		299.29		
	45.52		299.14		
	45.49		300.47		
	45.51		299.23		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	4.14	U_n To $U_{th\text{-}high}$ + 5%U_n	4.49	
		4.15		4.51	
		4.17		4.51	

Scope pictures of the disconnection time
Under-voltage - Stage 1



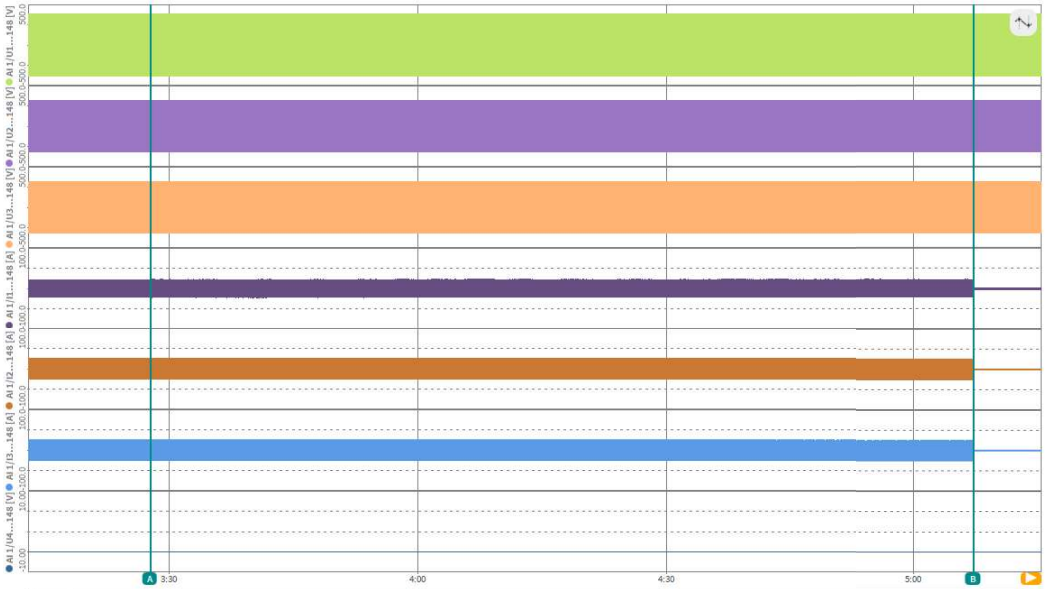
时间 [s]	A 00:10:06.7296	B 00:11:45.9866	间隔 1:39.2570
AI 1/U1@TRIONet3_1148 [V]	-110.0760	-134.8176	-24.74165
AI 1/U2@TRIONet3_1148 [V]	318.0187	1.580238	-316.4385
AI 1/U3@TRIONet3_1148 [V]	-102.3228	279.8789	382.2017
AI 1/I1@TRIONet3_1148 [A]	-20.22426	0.040727	20.26498
AI 1/I2@TRIONet3_1148 [A]	20.53669	0.083056	-20.45363
AI 1/I3@TRIONet3_1148 [A]	-6.773946	-0.043389	6.730557
AI 1/U4@TRIONet3_1148 [V]	-5.164147	-5.167485	-3.338e-3

Under-voltage - Stage 2



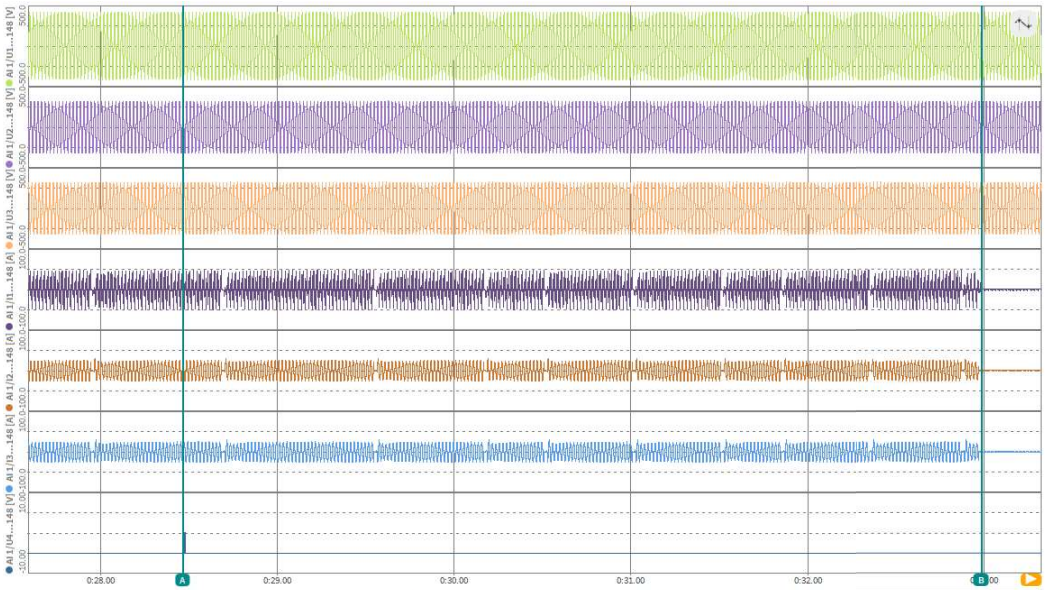
时间 [s]	A 0:37.558145	B 0:41.730133	间隔 4.171988
AI 1/U1@TRIONet3_1148 [V]	-14.61196	-12.82239	1.789570
AI 1/U2@TRIONet3_1148 [V]	-232.2123	306.0096	538.2221
AI 1/U3@TRIONet3_1148 [V]	313.5047	-242.8527	-556.3574
AI 1/I1@TRIONet3_1148 [A]	3.752010	0.232952	-3.519058
AI 1/I2@TRIONet3_1148 [A]	-13.08480	-1.402888	11.68192
AI 1/I3@TRIONet3_1148 [A]	17.47770	-1.155612	-18.63331
AI 1/U4@TRIONet3_1148 [V]	-5.165816	-5.155564	0.010252

Scope pictures of the disconnection time
Over-voltage - Stage 1



时间 [s]	A 3:27.7962	B 5:07.1461	间隔 1:39.3499
AI 1/U1@TRIONet3_1148 [V]	-61.68533	-316.6907	-255.0054
AI 1/U2@TRIONet3_1148 [V]	-253.3500	-34.35674	218.9913
AI 1/U3@TRIONet3_1148 [V]	303.2468	297.0472	-6.199599
AI 1/I1@TRIONet3_1148 [A]	-3.333492	-1.294e-3	3.332198
AI 1/I2@TRIONet3_1148 [A]	-19.26283	0.099149	19.36197
AI 1/I3@TRIONet3_1148 [A]	22.77148	-0.037131	-22.80861
AI 1/U4@TRIONet3_1148 [V]	-5.111695	-5.123616	-0.011921

Over-voltage - Stage 2

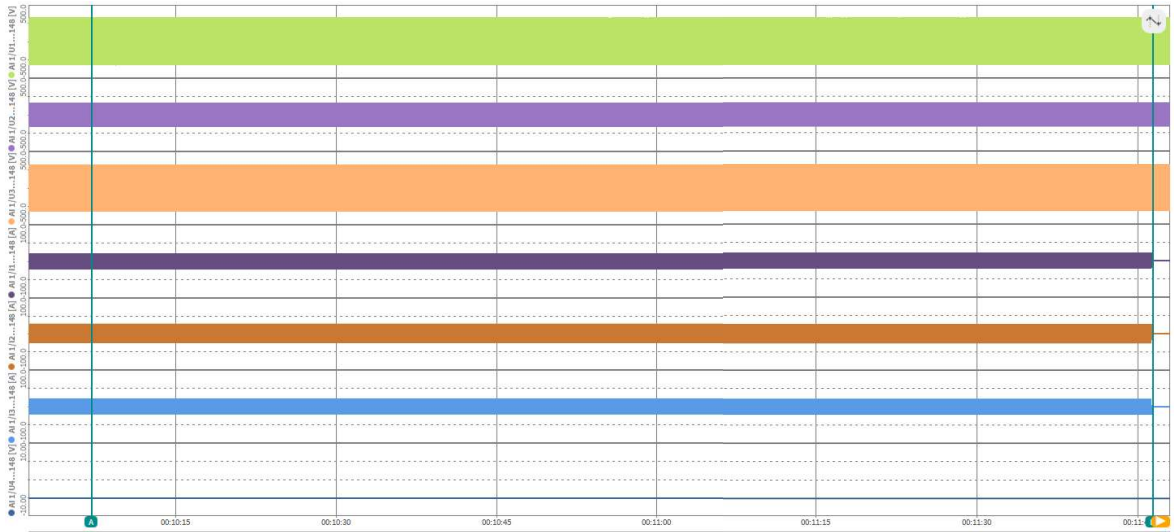


时间 [s]	A 0:28.472295	B 0:32.985493	间隔 4.513199
AI 1/U1@TRIONet3_1148 [V]	-266.8452	423.6479	690.4931
AI 1/U2@TRIONet3_1148 [V]	320.4460	177.0757	-498.4217
AI 1/U3@TRIONet3_1148 [V]	-114.8038	-147.3606	-32.55677
AI 1/I1@TRIONet3_1148 [A]	-16.11422	7.528561	23.64278
AI 1/I2@TRIONet3_1148 [A]	24.77190	-0.423882	-25.19578
AI 1/I3@TRIONet3_1148 [A]	-9.138761	1.219037	10.35780
AI 1/U4@TRIONet3_1148 [V]	-5.141020	-5.150318	-9.298e-3

4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under voltage) (Threshold value refer for default) (Three phase type, Phase L2-N)					P
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.50Un±1% Un	99s ≤ t ≤ 100s	1.20Un±1% Un	99s ≤ t ≤ 100s	
Trip value [V]	112.99		276.22		
	112.99		276.04		
	112.99		276.00		
	112.99		276.05		
	112.99		276.05		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	99.01	U_n To $U_{th\text{-}high}$ + 5%U_n	99.24	
		99.16		99.47	
		99.07		99.20	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.20Un±1% Un	4s ≤ t ≤ 5s	1.30Un±1% Un	4s ≤ t ≤ 5s	
Trip value [V]	45.42		298.73		
	46.01		298.79		
	45.22		298.78		
	45.61		298.81		
	46.10		298.71		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	4.19	U_n To $U_{th\text{-}high}$ + 5%U_n	4.53	
		4.20		4.50	
		4.20		4.51	

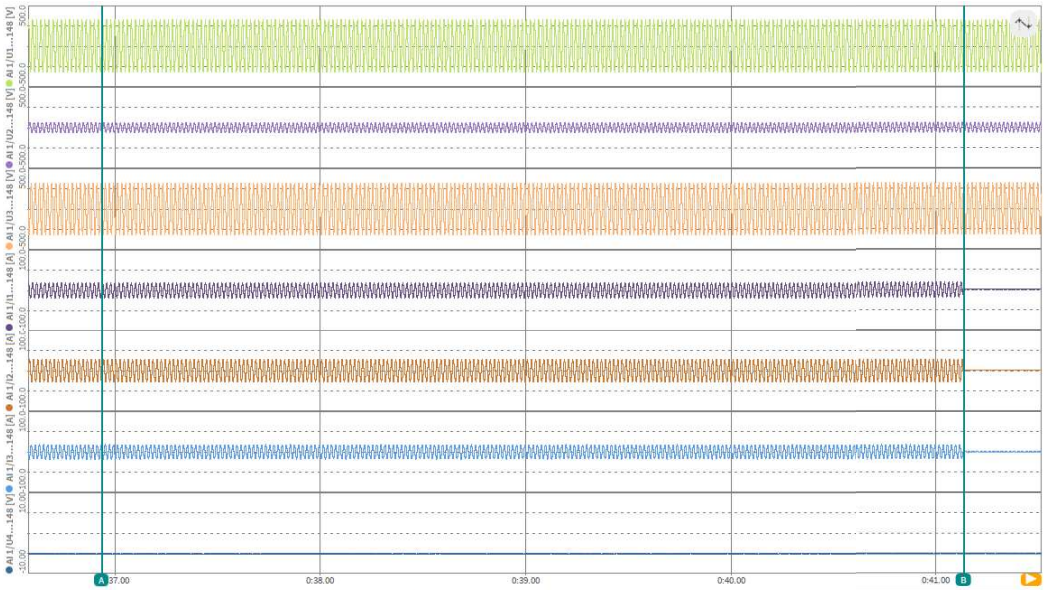
Scope pictures of the disconnection time

Under-voltage - Stage 1



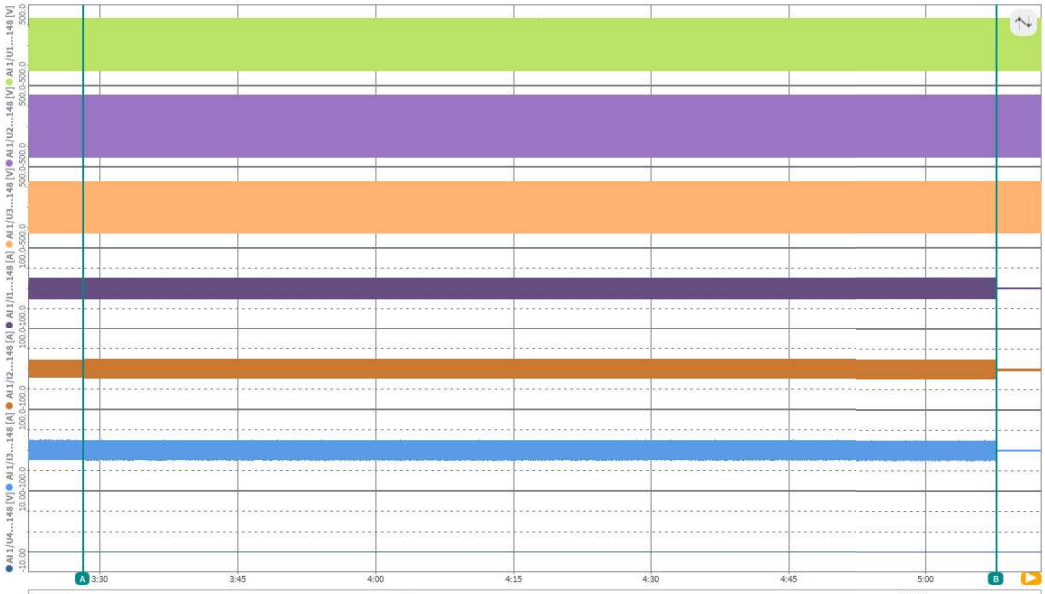
时间 [s]	A 00:10:07.1995	B 00:11:46.3589	间隔 1:39.1594
AI 1/U1@TRIONet3_1148 [V]	268.2438	-297.5595	-565.8033
AI 1/U2@TRIONet3_1148 [V]	13.77773	128.9704	115.1927
AI 1/U3@TRIONet3_1148 [V]	-294.9836	36.94916	331.9328
AI 1/I1@TRIONet3_1148 [A]	17.53320	0.086325	-17.44688
AI 1/I2@TRIONet3_1148 [A]	5.338397	0.048187	-5.290211
AI 1/I3@TRIONet3_1148 [A]	-18.46391	-0.057694	18.40621
AI 1/U4@TRIONet3_1148 [V]	-5.152226	-5.162955	-0.010729

Under-voltage - Stage 2



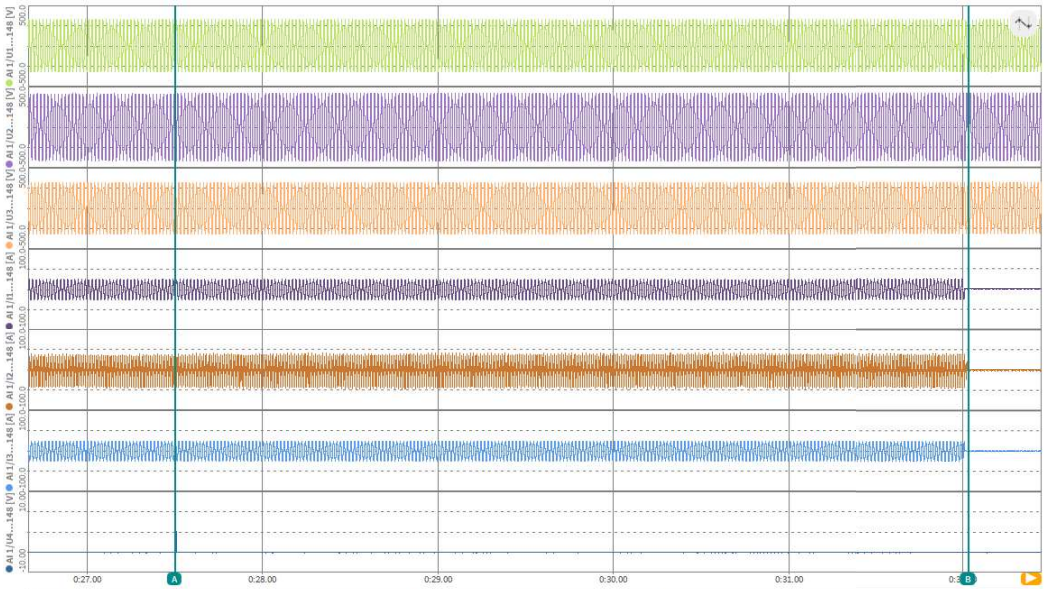
时间 [s]	A 0:36.940284	B 0:41.137943	间隔 4.197660
AI 1/U1@TRIONet3_1148 [V]	117.5311	-164.5229	-282.0540
AI 1/U2@TRIONet3_1148 [V]	57.01447	28.22256	28.79191
AI 1/U3@TRIONet3_1148 [V]	205.5471	323.0696	117.5225
AI 1/I1@TRIONet3_1148 [A]	6.602305	-0.895364	-7.497669
AI 1/I2@TRIONet3_1148 [A]	-29.25942	0.124183	29.38360
AI 1/I3@TRIONet3_1148 [A]	11.69396	-1.376447	-13.07041
AI 1/U4@TRIONet3_1148 [V]	3.576e-3	-5.169154	-5.172730

Scope pictures of the disconnection time
Over-voltage - Stage 1



时间 [s]	A 3:28.19518	B 5:07.66363	间隔 1:39.46844
AI 1/U1@TRIONet3_1148 [V]	324.8100	110.8785	-213.9316
AI 1/U2@TRIONet3_1148 [V]	-170.5364	-383.4055	-212.8670
AI 1/U3@TRIONet3_1148 [V]	-185.3287	211.4797	396.8084
AI 1/I1@TRIONet3_1148 [A]	24.68844	-0.020964	-24.70940
AI 1/I2@TRIONet3_1148 [A]	-10.20500	0.075903	10.28091
AI 1/I3@TRIONet3_1148 [A]	-13.75842	0.015619	13.77404
AI 1/U4@TRIONet3_1148 [V]	-5.128622	-5.125523	3.099e-3

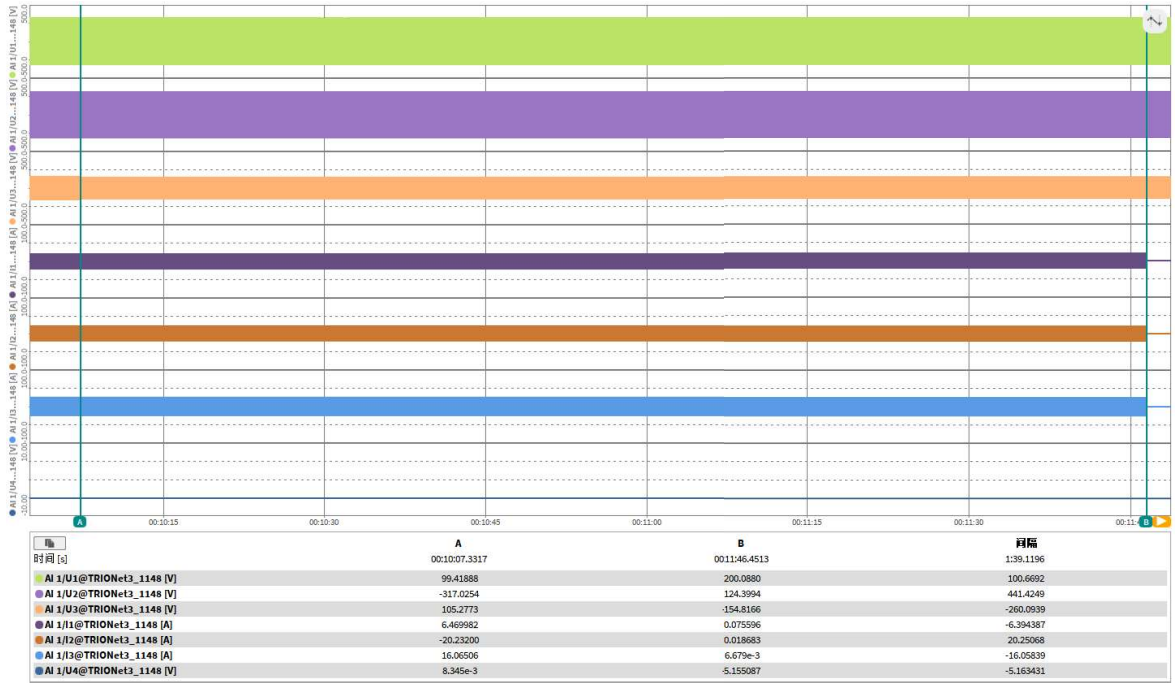
Over-voltage - Stage 2



时间 [s]	A 0:27.502924	B 0:32.028901	间隔 4.525978
AI 1/U1@TRIONet3_1148 [V]	-302.2909	158.1705	460.4614
AI 1/U2@TRIONet3_1148 [V]	63.08937	-421.9382	-485.0276
AI 1/U3@TRIONet3_1148 [V]	256.0783	166.8635	-89.21481
AI 1/I1@TRIONet3_1148 [A]	-23.18363	-0.921292	22.26234
AI 1/I2@TRIONet3_1148 [A]	-1.315269	0.119712	1.434982
AI 1/I3@TRIONet3_1148 [A]	19.19699	0.874820	-18.32217
AI 1/U4@TRIONet3_1148 [V]	-5.151987	-5.151511	4.768e-4

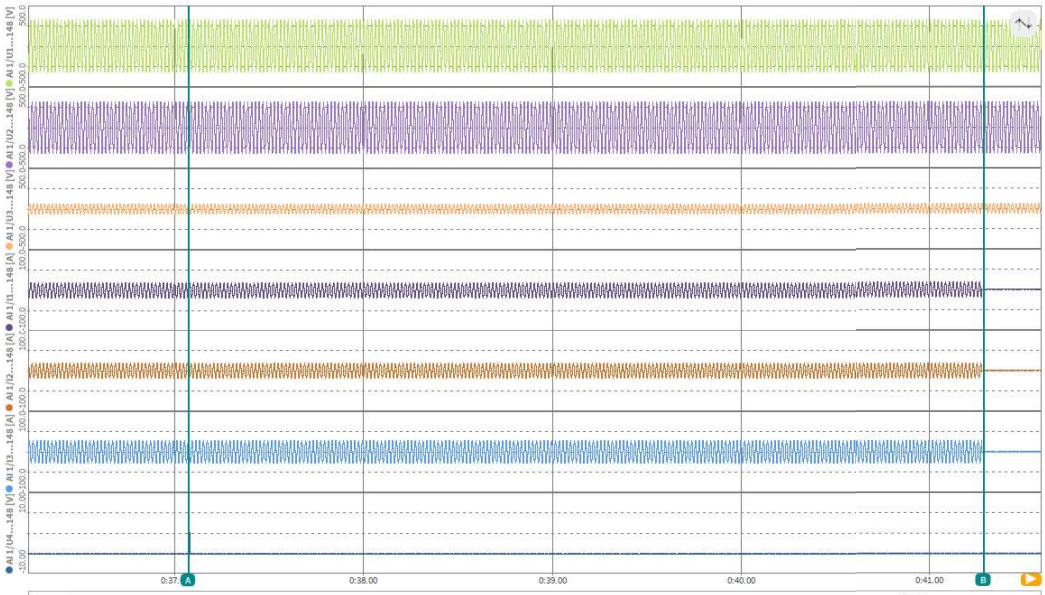
4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under voltage) (Threshold value refer for default) (Three phase type, Phase L3-N)					P
Test conditions	Output power: ≥50%Pn, Frequency: 50±0.2Hz				
Stage 1	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.50Un±1% Un	99s ≤ t ≤ 100s	1.20Un±1% Un	99s ≤ t ≤ 100s	
Trip value [V]	114.64		276.33		
	114.63		275.91		
	114.62		276.01		
	114.61		276.03		
	114.62		275.95		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%Un	99.12	U_n To $U_{th\text{-}high}$ + 5%U_n	99.08	
		99.00		99.33	
		99.11		99.25	
Stage 2	**Under-voltage**		**Over-voltage**		
Parameter	Voltage	Time	Voltage	Time	
Limit	0.20Un±1% Un	4s ≤ t ≤ 5s	1.30Un±1% Un	4s ≤ t ≤ 5s	
Trip value [V]	44.45		298.83		
	45.13		298.92		
	45.23		298.83		
	44.19		298.69		
	46.00		298.92		
Trip time [s]	U_n To $U_{th\text{-}low}$ - 5%U_n	4.20	U_n To $U_{th\text{-}high}$ + 5%U_n	4.52	
		4.21		4.51	
		4.18		4.51	

Scope pictures of the disconnection time
Under-voltage - Stage 1



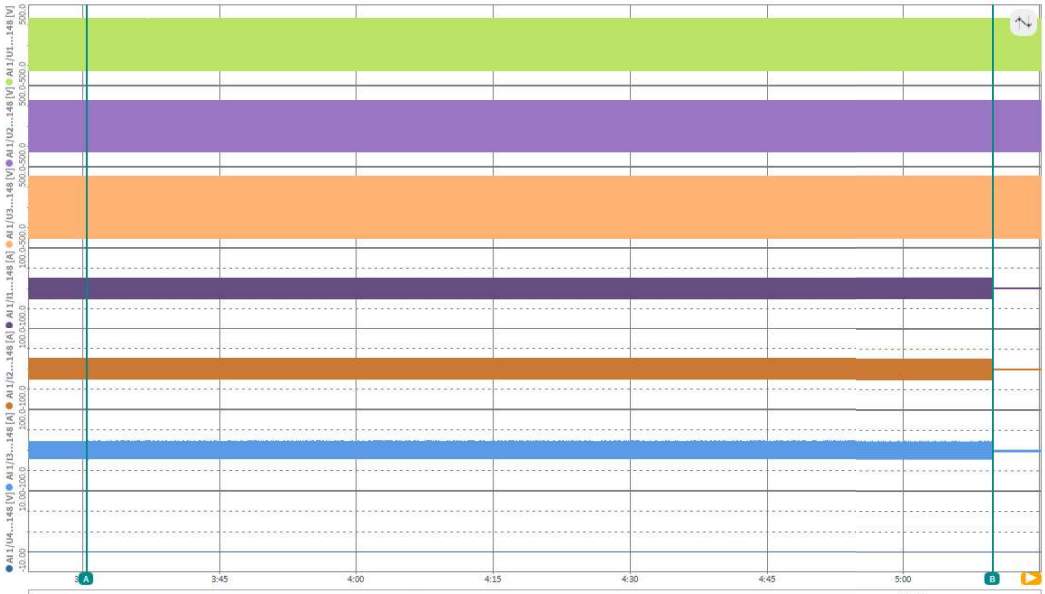
时间 [s]	A 00:10:07.3317	B 00:11:46.4513	间隔 1:39.1196
AI 1/U1@TRIONet3_1148 [V]	99.41888	200.0880	100.6692
AI 1/U2@TRIONet3_1148 [V]	-317.0254	124.3994	441.4249
AI 1/U3@TRIONet3_1148 [V]	105.2773	-154.8166	-260.0939
AI 1/I1@TRIONet3_1148 [A]	6.469982	0.075596	-6.394387
AI 1/I2@TRIONet3_1148 [A]	-20.23200	0.018683	20.25068
AI 1/I3@TRIONet3_1148 [A]	16.06506	6.679e-3	-16.05839
AI 1/U4@TRIONet3_1148 [V]	8.345e-3	-5.155087	-5.163431

Under-voltage - Stage 2



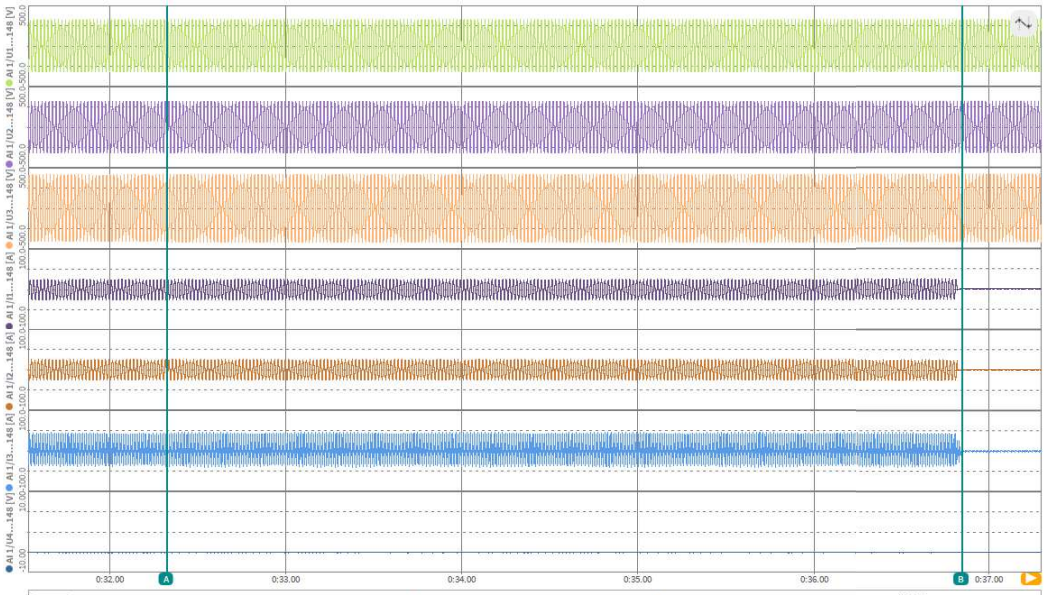
时间 [s]	A 0:37.077895	B 0:41.286937	间隔 4.209041
AI 1/U1@TRIONet3_1148 [V]	-286.5272	323.5901	610.1172
AI 1/U2@TRIONet3_1148 [V]	9.804726	152.3017	-162.1964
AI 1/U3@TRIONet3_1148 [V]	55.51243	-30.44486	-85.95729
AI 1/I1@TRIONet3_1148 [A]	-16.03643	-1.075072	14.96136
AI 1/I2@TRIONet3_1148 [A]	1.112130	-1.155231	-2.267361
AI 1/I3@TRIONet3_1148 [A]	26.93427	0.159564	-26.77471
AI 1/U4@TRIONet3_1148 [V]	-5.172730	-5.165577	7.153e-3

Scope pictures of the disconnection time
Over-voltage - Stage 1



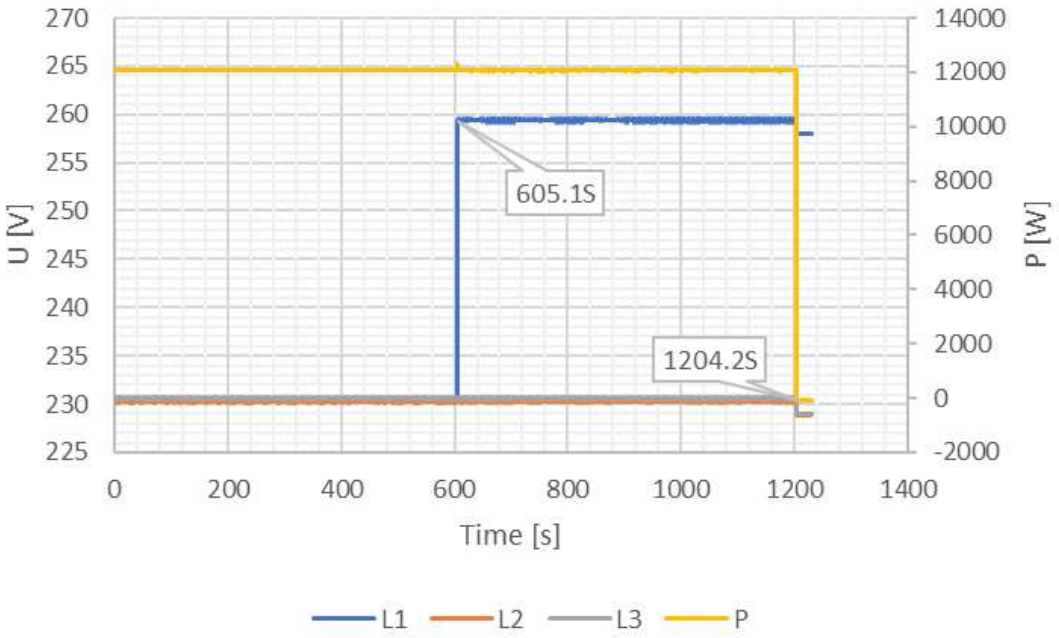
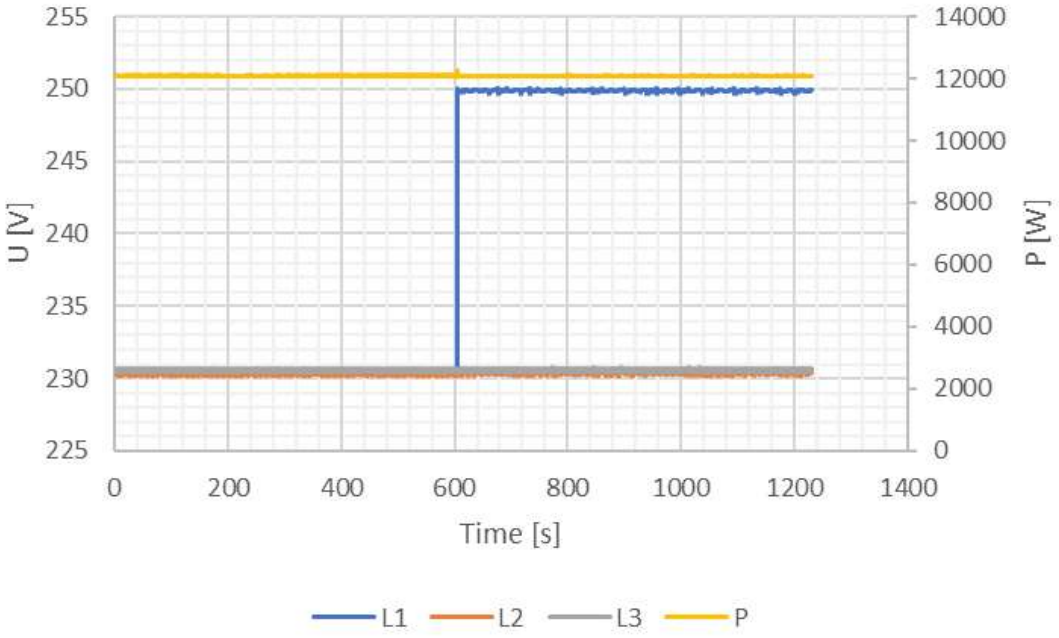
时间 [s]	A 3:30.50702	B 5:09.83540	间隔 1:39.32839
AI 1/U1@TRIONet3_1148 [V]	326.0837	76.85376	-249.2299
AI 1/U2@TRIONet3_1148 [V]	-160.9960	-311.7511	-150.7552
AI 1/U3@TRIONet3_1148 [V]	-197.4242	283.4902	480.9144
AI 1/I1@TRIONet3_1148 [A]	24.83060	-0.011129	-24.84173
AI 1/I2@TRIONet3_1148 [A]	-13.06782	0.075009	13.14282
AI 1/I3@TRIONet3_1148 [A]	-9.524999	-4.944e-3	9.520054
AI 1/U4@TRIONet3_1148 [V]	-5.122662	-5.130291	-7.629e-3

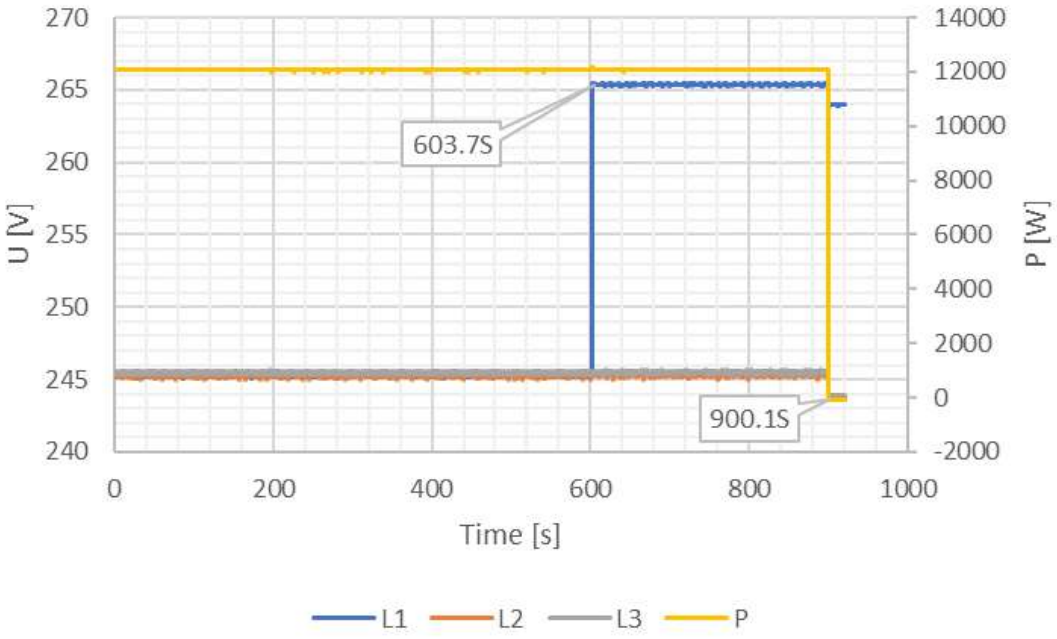
Over-voltage - Stage 2

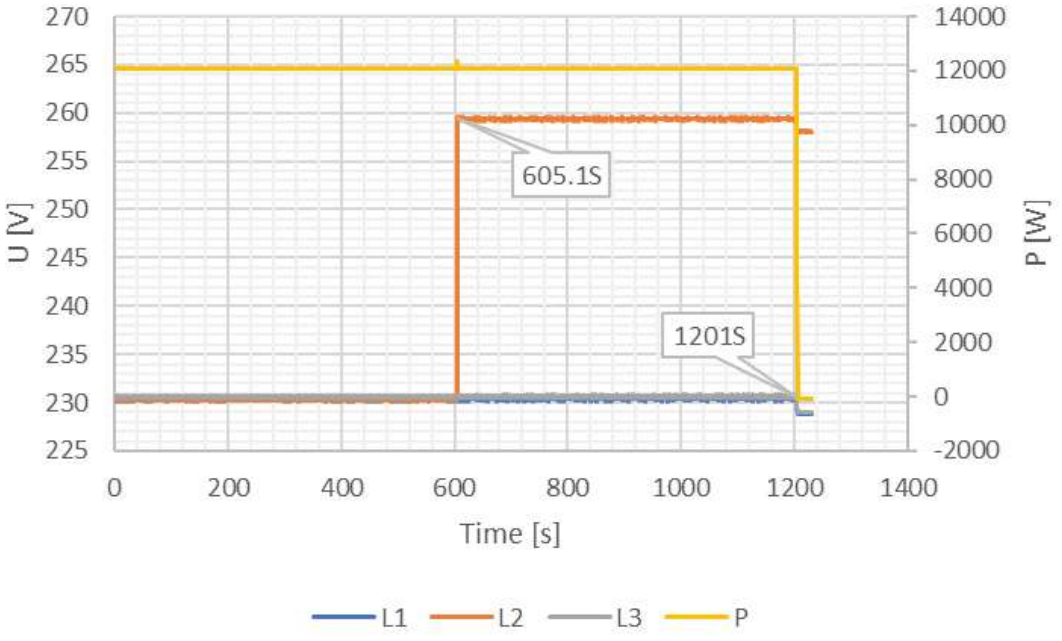
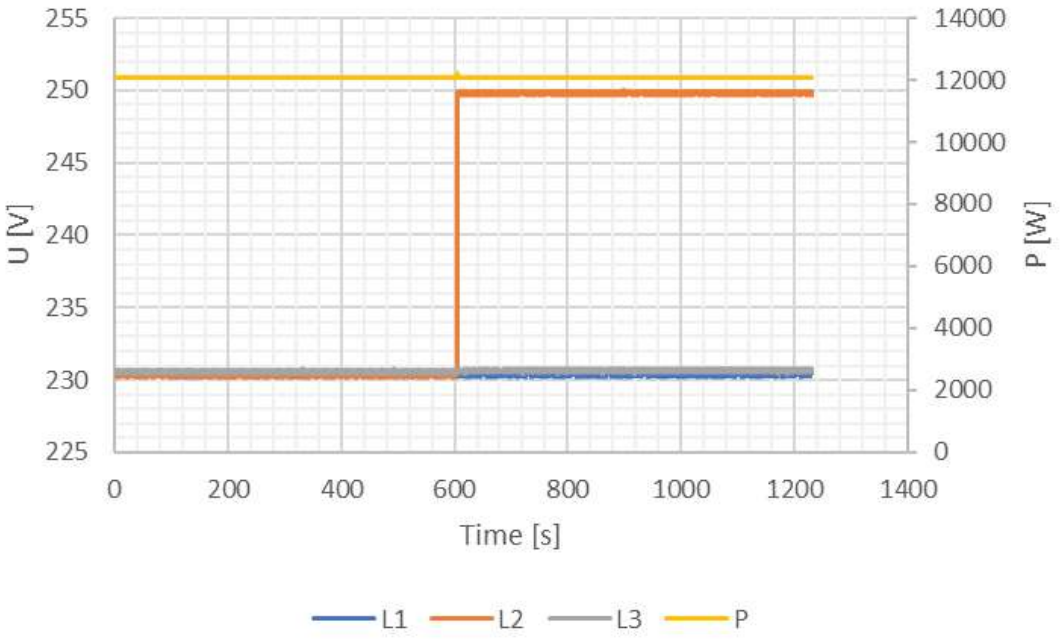


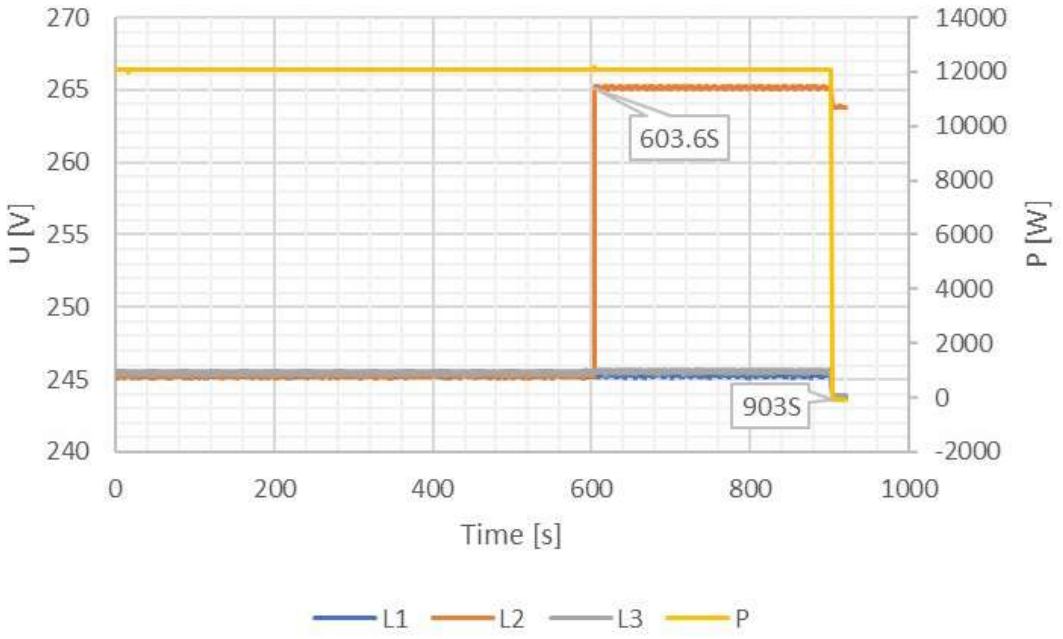
时间 [s]	A 0:32.325958	B 0:36.845100	间隔 4.519142
AI 1/U1@TRIONet3_1148 [V]	-289.6631	-322.4485	-32.78542
AI 1/U2@TRIONet3_1148 [V]	16.15548	160.8584	144.7029
AI 1/U3@TRIONet3_1148 [V]	350.5619	214.8848	-135.6771
AI 1/I1@TRIONet3_1148 [A]	-22.47105	0.066655	22.53771
AI 1/I2@TRIONet3_1148 [A]	1.439359	0.928846	-0.510514
AI 1/I3@TRIONet3_1148 [A]	5.374673	-1.118955	-6.493628
AI 1/U4@TRIONet3_1148 [V]	-5.156756	-5.145788	0.010967

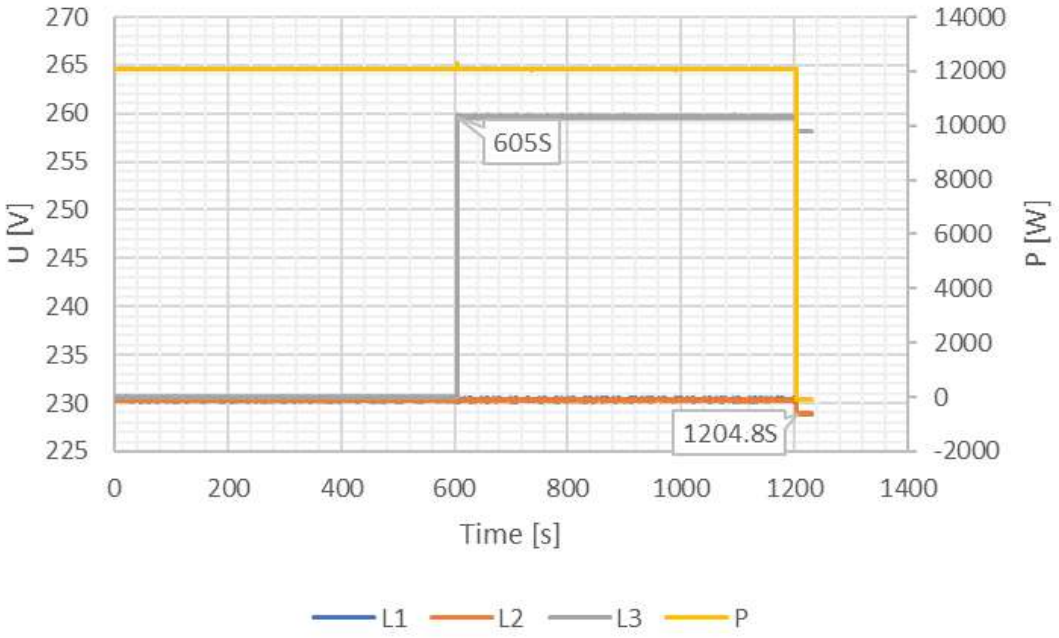
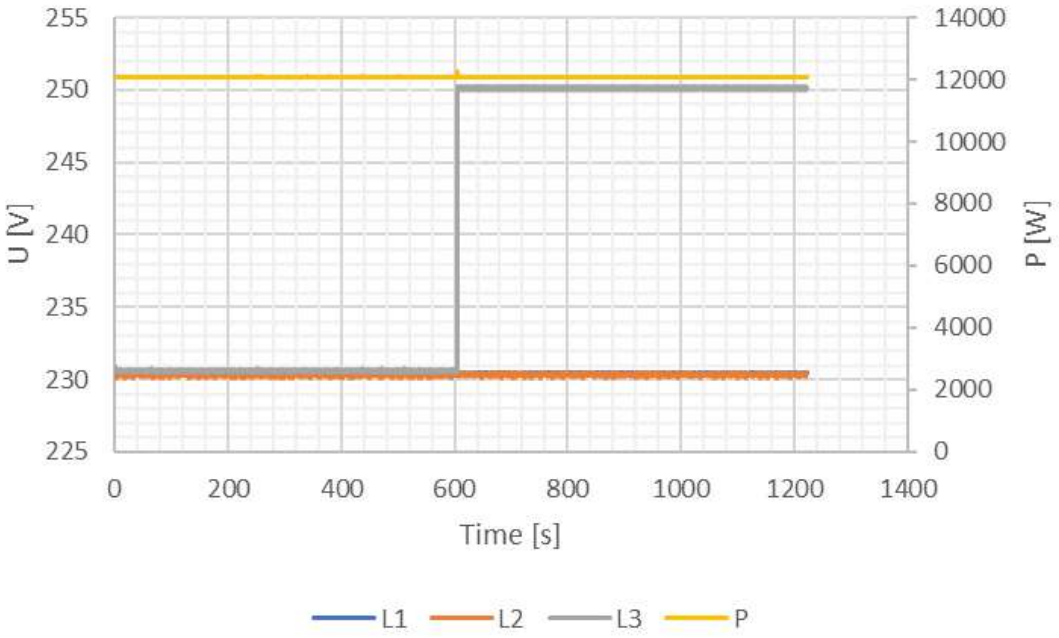
4.9.3 Requirements on voltage and frequency protection **4.9.3.1 General** **(Maximum voltage 10 min mean protection according to EN 50160)** **(Setting value refer EN 50438 for default settings)**			**P**
Setting values of the protection:	Trip value Setting [V]	1.10Un (253V)	
	Setting $T_{disconnection\ trip\ value}$ [s]	600	
	Setting $T_{disconnection}$ [ms]	200	
Test:			
	Disconnection time [s]	Limit [s]	
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n. Disconnection must take place within 600 s.		
	Phase 1:	599.1	≤ 600 s
	Phase 2:	595.9	
	Phase 3:	599.8	
b)	The voltage is set to U_n for 600 s and then to 108% U_n for 600 s. No disconnection should take place.		
	Phase 1:	No disconnection take place.	Disconnection should not take place.
	Phase 2:	No disconnection take place.	
	Phase 3:	No disconnection take place.	
c)	The voltage is set to 106 % U_n and held for 600 s. Thereafter the voltage is set to 114 % U_n. The disconnection should last for half the period as in Point a)*		
	Phase 1:	296.4	The disconnection time should be about 50 % of the value measured in a). *
	Phase 2:	299.4	
	Phase 3:	297.6	
Test: a) This test serves as proof of the measurement accuracy and the maximum set time. b) This test serves as proof of the measurement accuracy c) This test serves as proof of the correct formation of the 1 minute running mean value.			
Assessment criterion: The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1 % of U_N. Limit values: Rise-in voltage protection 1.1 U_N after a max. 600 s, the switch off after 200 ms.			
Note: If only one integrated protection is used for the power generation systems, the value of the rise-in voltage protection of 1.1 U_N may not be changed. *If the setting value is set to 600 s, then the disconnection time can be in the range between 225 s and 375 s.			

Phase 1
Voltage: a) 112%Un

Voltage: b) 108%Un


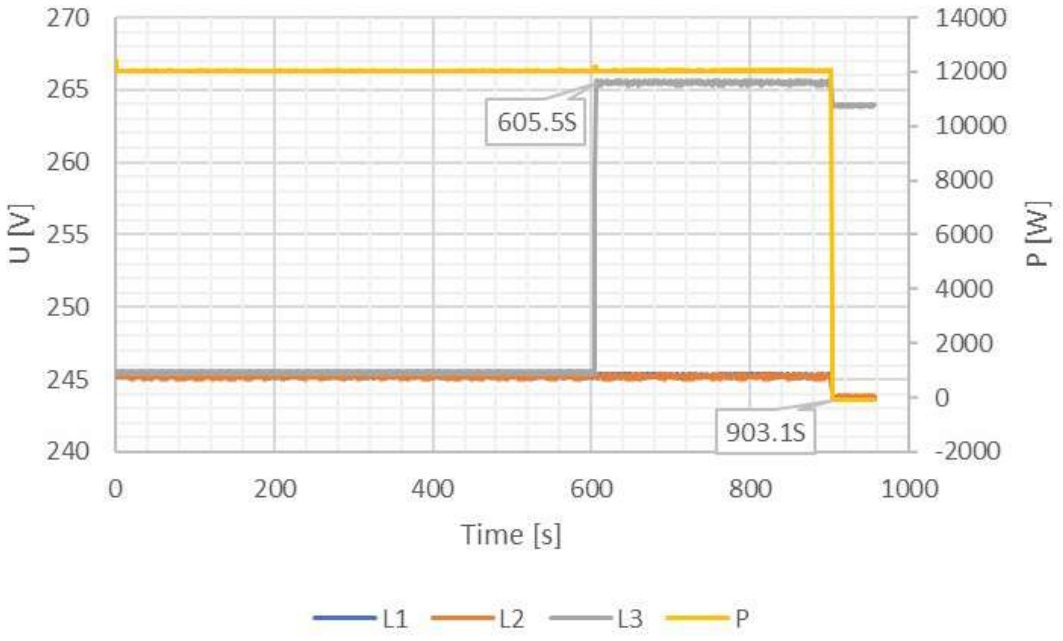
Voltage: c) 114%Un


Phase 2
Voltage: a) 112%Un

Voltage: b) 108%Un


Voltage: c) 114%Un


Phase 3
Voltage: a) 112%Un

Voltage: b) 108%Un


Voltage: c) 114%Un



4.9.3 Requirements on voltage and frequency protection 4.9.3.1 General (Interface protection: Over/under frequency) (Threshold value refer for default)					P
Test conditions	Output power: ≥50%Pn; U_n = 100%U_n				
Stage 1	**Under-frequency**		**Over-frequency**		
Parameter	Frequency	Time	Frequency	Time	
Limit	47.5 Hz±0.05 Hz	99s≤t ≤100s	51.5 Hz±0.05 Hz	99s≤t ≤100s	
Trip value [Hz]	47.50		51.49		
	47.49		51.49		
	47.49		51.49		
	47.49		51.49		
	47.49		51.49		
Trip time [s]	50.0 Hz To 47.4Hz	99.07	50.0 Hz To 51.6 Hz	99.13	
		99.14		99.17	
		99.19		99.19	
Stage 2	**Under-frequency**		**Over-frequency**		
Parameter	Frequency	Time	Frequency	Time	
Limit	47.0 Hz±0.05 Hz	4s≤t≤5s	52.0Hz±0.05 Hz	4s≤t≤5s	
Trip value [Hz]	46.99		51.99		
	46.99		51.99		
	46.99		51.99		
	46.99		51.99		
	46.99		51.99		
Trip time [s]	50.0 Hz To 46.9 Hz	4.23	50.0 Hz To 52.1Hz	4.22	
		4.22		4.22	
		4.23		4.22	

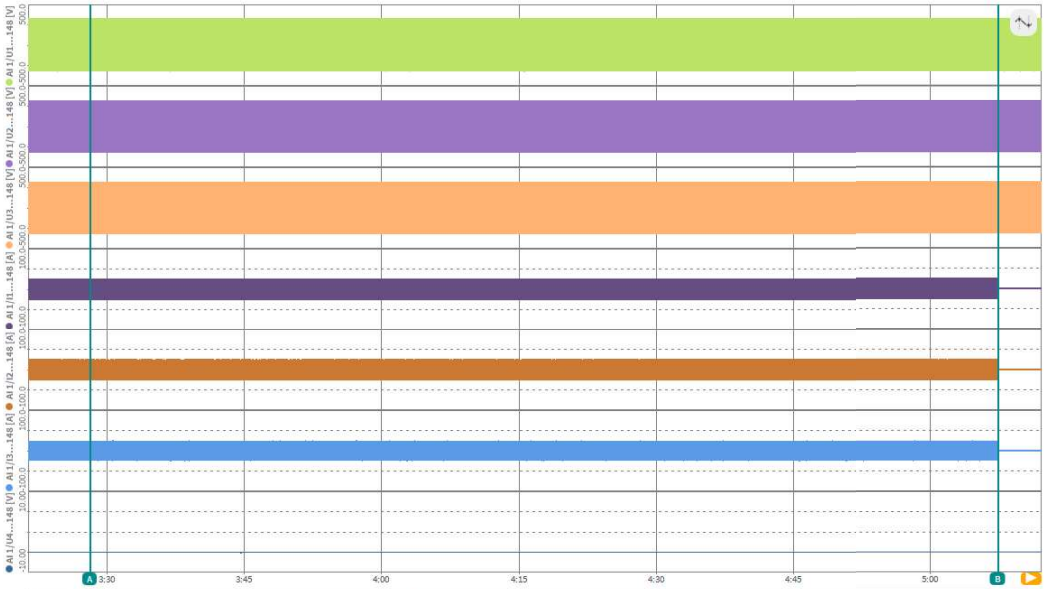
Note:

For under-frequency testing the applied frequency is varied from f_n down to $f_{th\text{-}low}$ -0.1 Hz in steps of 0.025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at switch the protection function trips and shall be within $f_{th\text{-}low}$ ± 0.05 Hz.

For over-frequency testing the applied frequency is varied from f_n up to $f_{th\text{-}high}$ + 0.1 Hz in steps of 0.025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at which the protection function trips and shall be within $f_{th\text{-}high}$ ± 0.05 Hz.

The oscilloscope pictures below show the measured worst case disconnection times.

Scope pictures of the disconnection time
Under-frequency stage1



时间 [s]	A	B	间隔
AI 1/U1@TRIONet3_1148 [V]	325.3470	315.2595	-10.08749
AI 1/U2@TRIONet3_1148 [V]	-144.5832	-85.66022	58.92301
AI 1/U3@TRIONet3_1148 [V]	-183.1141	-230.2683	-47.15419
AI 1/I1@TRIONet3_1148 [A]	24.98974	0.045197	-24.94455
AI 1/I2@TRIONet3_1148 [A]	-11.44419	-5.457e-3	11.43873
AI 1/I3@TRIONet3_1148 [A]	-13.47589	0.015619	13.49151
AI 1/U4@TRIONet3_1148 [V]	-5.150318	-5.139590	0.010729

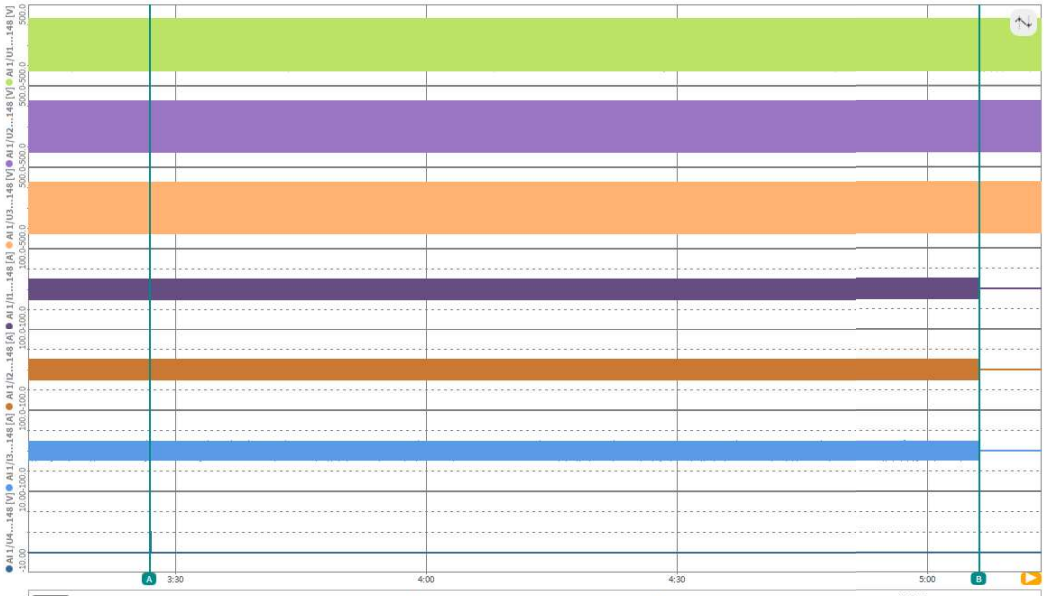
Under-frequency stage2



时间 [s]	A	B	间隔
AI 1/U1@TRIONet3_1148 [V]	-91.05063	-225.0447	-133.9941
AI 1/U2@TRIONet3_1148 [V]	227.2861	313.5274	540.8135
AI 1/U3@TRIONet3_1148 [V]	315.2430	-90.45625	-405.6993
AI 1/I1@TRIONet3_1148 [A]	-6.970568	0.223117	7.193685
AI 1/I2@TRIONet3_1148 [A]	-17.62936	0.347700	17.97706
AI 1/I3@TRIONet3_1148 [A]	23.84794	-0.983057	-24.83100
AI 1/U4@TRIONet3_1148 [V]	-5.152703	-5.157233	-4.530e-3

Scope pictures of the disconnection time

Over-frequency stage1



时间 [s]	A	B	间隔
AI 1/U1@TRIONet3_1148 [V]	256.6779	-316.2942	-572.9721
AI 1/U2@TRIONet3_1148 [V]	-302.1996	214.9627	517.1624
AI 1/U3@TRIONet3_1148 [V]	48.38372	104.3584	55.97473
AI 1/I1@TRIONet3_1148 [A]	19.16756	0.071125	-19.09644
AI 1/I2@TRIONet3_1148 [A]	-23.34694	0.089314	23.43625
AI 1/I3@TRIONet3_1148 [A]	4.307154	-0.039813	-4.346967
AI 1/U4@TRIONet3_1148 [V]	-5.159617	-5.167485	-7.868e-3

Over-frequency stage2



时间 [s]	A	B	间隔
AI 1/U1@TRIONet3_1148 [V]	-107.7032	230.4940	338.1973
AI 1/U2@TRIONet3_1148 [V]	215.3337	82.05846	298.2922
AI 1/U3@TRIONet3_1148 [V]	319.1636	-310.9143	-630.0779
AI 1/I1@TRIONet3_1148 [A]	-8.536084	1.513260	10.04934
AI 1/I2@TRIONet3_1148 [A]	-16.22835	-1.680050	14.54830
AI 1/I3@TRIONet3_1148 [A]	24.09560	1.516762	-22.57884
AI 1/U4@TRIONet3_1148 [V]	-5.168677	-5.161763	6.914e-3

4.9.4.2 Active mothods tested with a resonant circuit

Test circuit and parameters

Parameter	Symbol	Units
EUT DC Input		
DC voltage	V_{DC}	V
DC Current	I_{DC}	A
DC Power	P_{DC}	W
EUT AC ouput		
AC voltage	V_{EUT}	V
AC current	I_{EUT}	A
Real power	P_{EUT}	W
Reactive power	Q_{EUT}	VAr
Test Load		
Resistive load current	I_R	A
Inductive load current	I_L	A
Capacitive load current	I_C	A
AC (utility) power source		
Utility real power	P_{AC}	W
Utility reactive power	Q_{AC}	VAr
Utility current	I_{AC}	A

Block diagram test circuit IEC 62116:2014

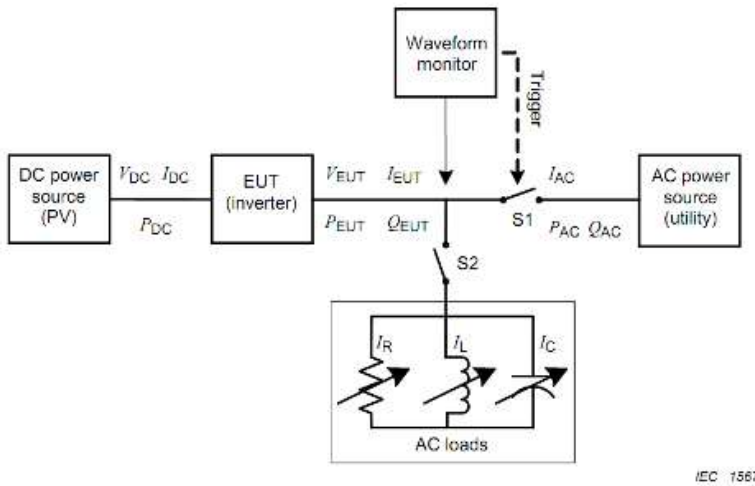


Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

Load imbalance (real, reactive load) for test condition A (EUT output = 100%)	**P**

Test conditions	Frequency: 50+/-0.1Hz U_N=750±8Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) [1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	P_{EUT} [kW]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks [5]
1	100	100	0	0	12	538	1.000	1853	BL
2	100	100	-5	-5	12	538	1.026	846	IB
3	100	100	-5	0	12	538	1.053	445	IB
4	100	100	-5	+5	12	538	1.079	848	IB
5	100	100	0	-5	12	538	0.975	1088	IB
6	100	100	0	+5	12	538	1.025	1770	IB
7	100	100	+5	-5	12	538	0.928	253	IB
8	100	100	+5	0	12	538	0.952	901	IB
9	100	100	+5	+5	12	538	0.976	1510	IB

Parameter at 0% per phase	L= 42.10 mH	R= 13.23 Ω	C= 240.69 µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

[1] P_{EUT}: EUT output power

[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition.

Condition A:

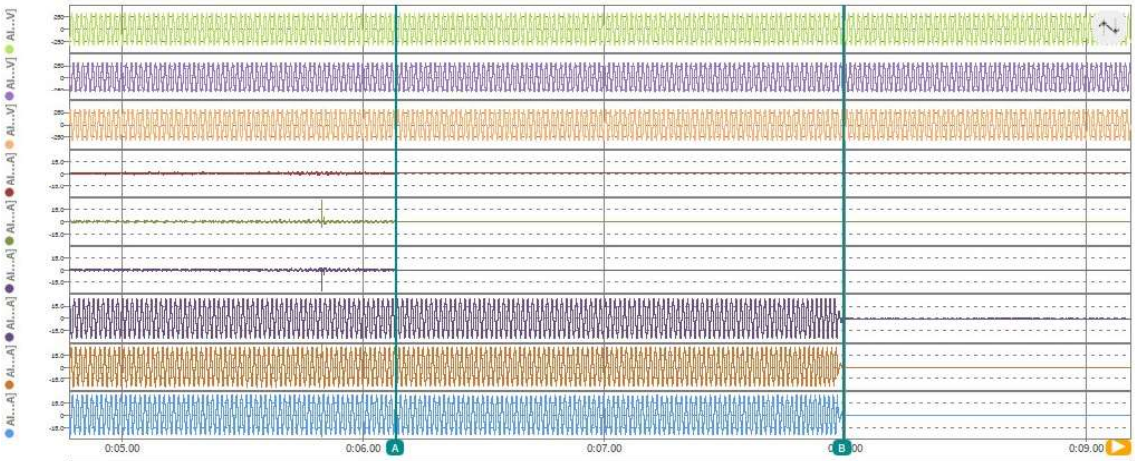
EUT output power P_{EUT} = Maximum [6]

EUT input voltage [6] = >75% of rated input voltage range

[6] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.

[7] Based on EUT rated input operating range. For example, 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.

Scope pictures of the disconnection time
Disconnection at No. 1



	A	B	间隔	有效值
时间 [s]	6.138733	7.992114	1.853382	
AI 1/U2@TRIONet_996 [V]	320.8592	-109.2069	-430.0661	230.0666
AI 1/U3@TRIONet_996 [V]	-114.0621	-211.1874	-97.12530	229.8517
AI 1/U4@TRIONet_996 [V]	-207.0401	319.8297	526.8698	230.1265
AI 1/I2@TRIONet_892 [A]	0.269616	0.296795	0.027180	0.300833
AI 1/I3@TRIONet_892 [A]	0.046758	0.035791	-0.010967	0.062358
AI 1/I4@TRIONet_892 [A]	0.066498	0.050763	-0.015736	0.068530
AI 1/I2@TRIONet_996 [A]	-24.99211	-1.018164	23.97394	17.53829
AI 1/I3@TRIONet_996 [A]	9.231038	-0.197464	-9.428502	17.58159
AI 1/I4@TRIONet_996 [A]	15.89148	1.853155	-14.03833	17.44078

Note:

U2&U3&U4: EUT output voltage signal

I2&I3&I4_996: EUT output current signal

I2&I3&I4_892: Trip signal

Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

Test conditions	Frequency: 50+/-0.1Hz U_N=750±8Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) [1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	P_{EUT} [kW]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks [5]
1	66	66	0	-5	7.92	425	0.975	703	IB
2	66	66	0	-4	7.92	425	0.980	843	IB
3	66	66	0	-3	7.92	425	0.985	915	IB
4	66	66	0	-2	7.92	425	0.990	1066	IB
5	66	66	0	-1	7.92	425	0.995	1399	IB
6	66	66	0	0	7.92	425	0.999	1734	BL
7	66	66	0	+1	7.92	425	1.005	1688	IB
8	66	66	0	+2	7.92	425	1.010	1673	IB
9	66	66	0	+3	7.92	425	1.015	1306	IB
10	66	66	0	+4	7.92	425	1.020	929	IB
11	66	66	0	+5	7.92	425	1.025	495	IB

Parameter at 0% per phase	L=	63.85	mH	R=	20.04	Ω	C=	158.70	µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

[1] P_{EUT}: EUT output power

[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition.

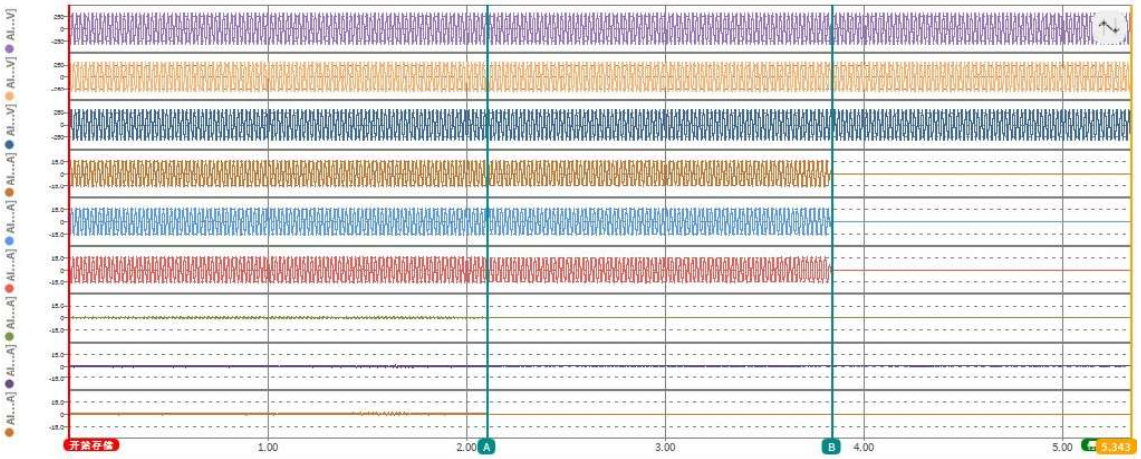
Condition B:

EUT output power P_{EUT} = 50 % – 66 % of maximum

EUT input voltage [6] = 50 % of rated input voltage range, ±10 %

[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 50 % of range =X + 0.5 × (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.

Scope pictures of the disconnection time
Disconnection at No. 6



	A	B	间隔	有效值
时间 [s]	2.104806	3.839166	1.734360	
AI 1/U2@TRIONet_996 [V]	-260.4554	247.8449	508.3003	230.2372
AI 1/U3@TRIONet_996 [V]	299.0475	57.82676	-241.2207	229.8998
AI 1/U4@TRIONet_996 [V]	-39.34741	-306.4048	-267.0574	229.8927
AI 1/I2@TRIONet_996 [A]	13.18279	-0.189635	-13.37242	11.57505
AI 1/I3@TRIONet_996 [A]	-14.83857	0.328433	15.16700	11.63687
AI 1/I4@TRIONet_996 [A]	2.146659	-0.309529	-2.456188	11.48062
AI 1/I2@TRIONet_892 [A]	0.363298	0.351854	-0.011444	0.362158
AI 1/I3@TRIONet_892 [A]	0.098815	0.105490	6.676e-3	0.099736
AI 1/I4@TRIONet_892 [A]	0.106285	0.065277	-0.041008	0.086631

Note:

U2&U3&U4: EUT output voltage signal

I2&I3&I4_996: EUT output current signal

I2&I3&I4_892: Trip signal

Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

Test conditions	Frequency: 50+/-0.1Hz U_N=750±8Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) [1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	P_{EUT} [kW]	V_{DC} [V]	Q_f	Run on Time [ms]	Remarks [5]
1	33	33	0	-5	3.96	290	0.975	713	IB
2	33	33	0	-4	3.96	290	0.980	726	IB
3	33	33	0	-3	3.96	290	0.985	963	IB
4	33	33	0	-2	3.96	290	0.990	999	IB
5	33	33	0	-1	3.96	290	0.995	1196	IB
6	33	33	0	0	3.96	290	0.999	1920	BL
7	33	33	0	+1	3.96	290	1.005	1259	IB
8	33	33	0	+2	3.96	290	1.010	1065	IB
9	33	33	0	+3	3.96	290	1.015	892	IB
10	33	33	0	+4	3.96	290	1.020	324	IB
11	33	33	0	+5	3.96	290	1.025	288	IB

Parameter at 0% per phase	L= 127.69 mH	R= 40.07 Ω	C= 79.35 µF

Note:

RLC is adjusted to min. +/-1% of the inverter rated output power

[1] P_{EUT}: EUT output power

[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition.

Condition C:

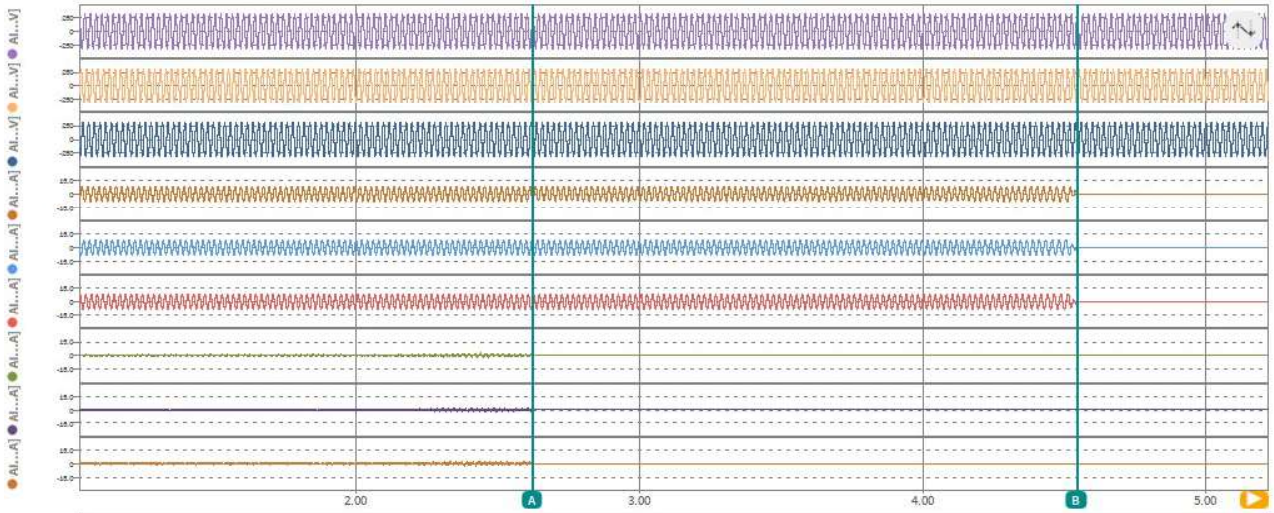
EUT output power P_{EUT} = 25 % – 33 % [6] of maximum

EUT input voltage [7] = <20 % of rated input voltage range

[6] Or minimum allowable EUT output level if greater than 33 %.

[7] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 20 % of range =X + 0.2 × (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.

Scope pictures of the disconnection time
Disconnection at No. 6



	A	B	间隔	有效值
时间 [s]	2.624271	4.543842	1.919571	
AI 1/U2@TRIONet_996 [V]	320.4210	324.7752	4.354239	230.0104
AI 1/U3@TRIONet_996 [V]	-112.2656	-150.8713	-38.60569	230.0234
AI 1/U4@TRIONet_996 [V]	-208.4692	-174.3989	34.07026	229.9925
AI 1/I2@TRIONet_996 [A]	-8.309934	0.117925	8.427859	5.749006
AI 1/I3@TRIONet_996 [A]	2.293956	-0.180829	-2.474785	5.736192
AI 1/I4@TRIONet_996 [A]	5.225835	-0.057759	-5.283594	5.729315
AI 1/I2@TRIONet_892 [A]	0.354715	0.377603	0.022888	0.378457
AI 1/I3@TRIONet_892 [A]	0.141253	0.131239	-0.010014	0.145123
AI 1/I4@TRIONet_892 [A]	0.088642	0.078152	-0.010490	0.076387

Note:

U2&U3&U4: EUT output voltage signal

I2&I3&I4_996: EUT output current signal

I2&I3&I4_892: Trip signal

EN 50549-1: Connection and reconnection			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.10	Connection and reconnection		**P**

4.10 Connection and starting to generate electrical power **4.10.2 Automatic reconnection after tripping** **4.10.3 Starting to generate electrical power**		**P**
Setting value	Min. voltage for connected to grid :	0.85Un (195.5V)
	Max. voltage for connected to grid :	1.1Un (253V)
	Min. Frequency for connected to grid :	49. 5
	Max. Frequency for connected to grid :	Start: 50.1 Reconnection: 50.2
	Observation time (≥60s) :	60

Test:

	Voltage conditons	
a) Start up for voltage range	<85% Un for twice of observation time	>110% Un for twice of observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	≥85% Un within twice setting observation time	≤110% Un within twice setting observation time
Reconnection time [s]	64.2	71.8
Limit:	Connected after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: disable. For recorded gradient see diagram below.	
c) In voltage range after voltage failture	≥85% Un for twice of setting observation time	≤110% Un for twice of setting observation time
Reconnection time [s]	67.8	70.0
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P_{Emax}/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	
	Frequency conditions	
d) Start up for frequency range	<49.50 Hz for twice of setting observation time	>50.10 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	≥49.50 Hz within twice of setting observation time	≤50.10 Hz within twice of setting observation time
Reconnection time [s]	62.6	68.2

Limit:	Connected after setting delay time(≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: disable. For recorded gradient see diagram below.	
f) In frequency range after frequency failture	≥49.50 Hz for twice of setting observation time	≤50.20 Hz for twice of setting observation time
Reconnection time [s]	64.2	66.4
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min. For recorded gradient see diagram below.	

Test:

Test condition b) and c): voltage within the limits of 85% to 110%U_n.

Test condition e) and f): frequency within the limits of 49.50Hz to 50.10Hz.

In order to avoid continuous starting and disengaging operations of the interface protection relay. The disengaging value of frequency and voltage functions shall be above 2 % deviating from the operate value.

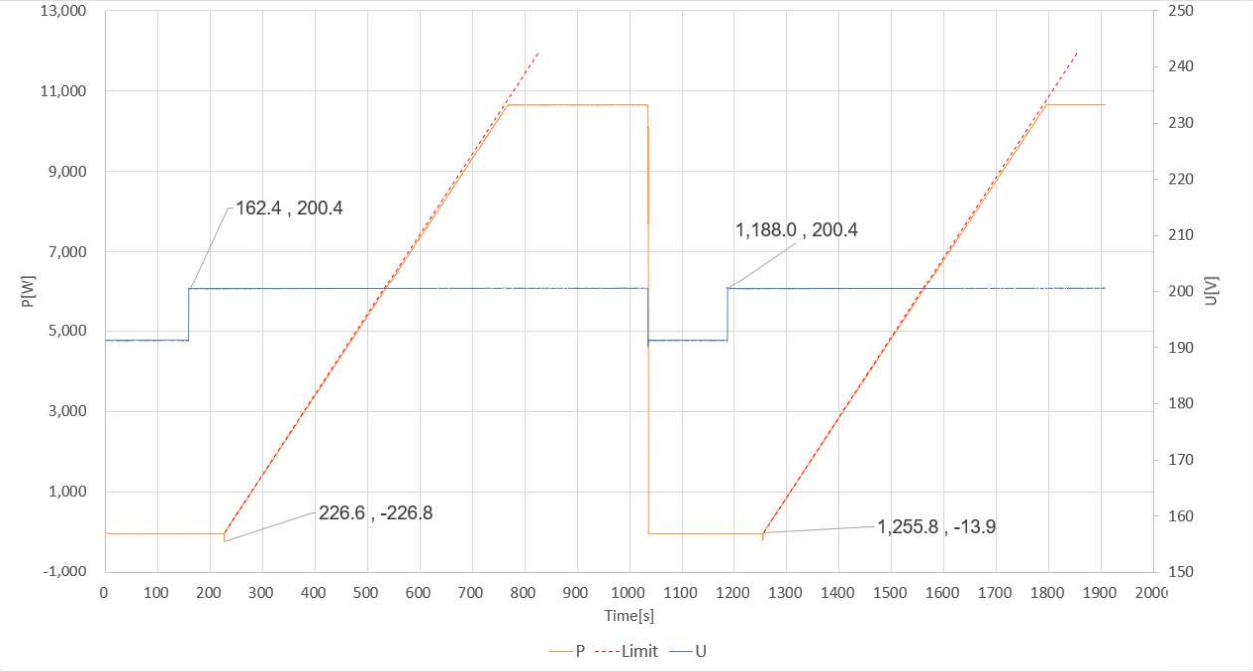
Assessment criterion:

8) the micro generator connects respectively starts generating electrical power only in the permitted range of voltage and frequency and

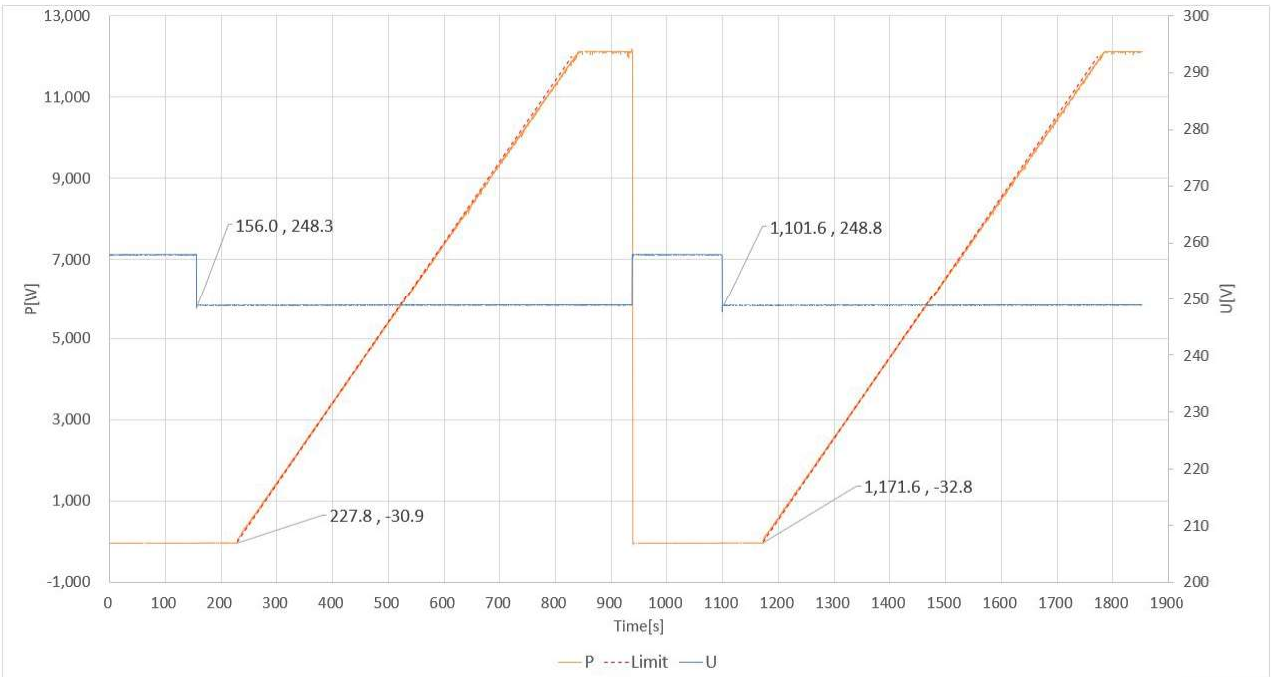
b) for adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute and

c) for non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min.

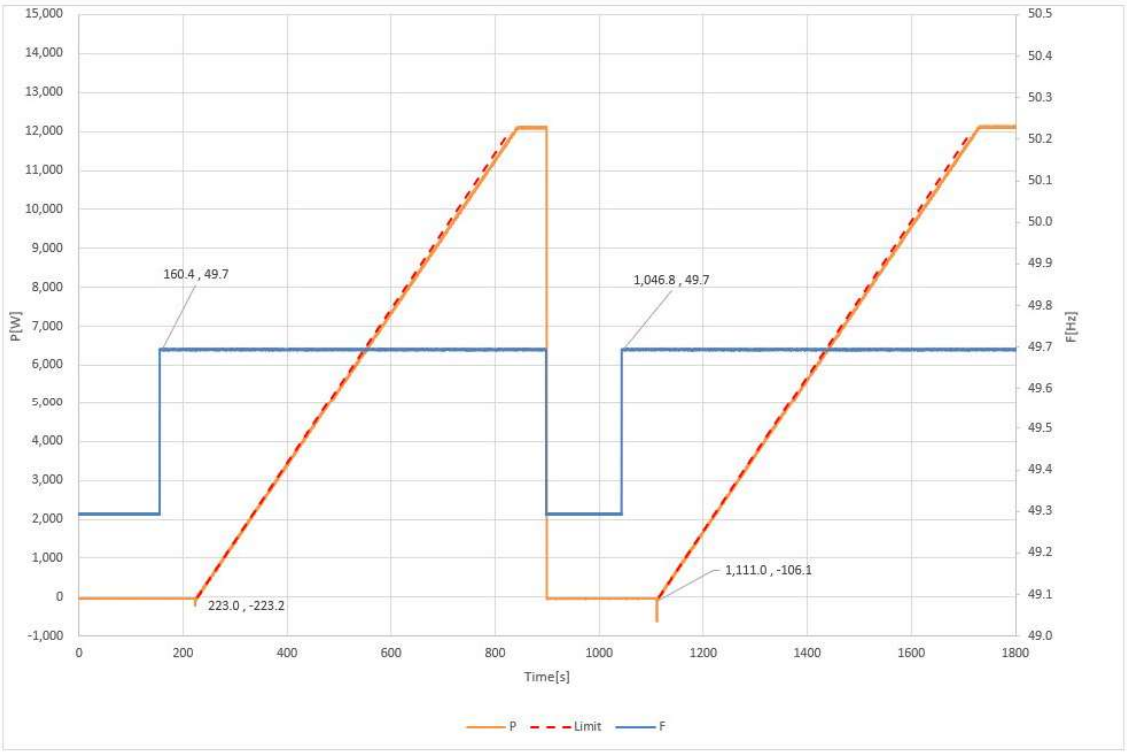
Graph of the gradual power supply: Test b) for≥ 85% U_n



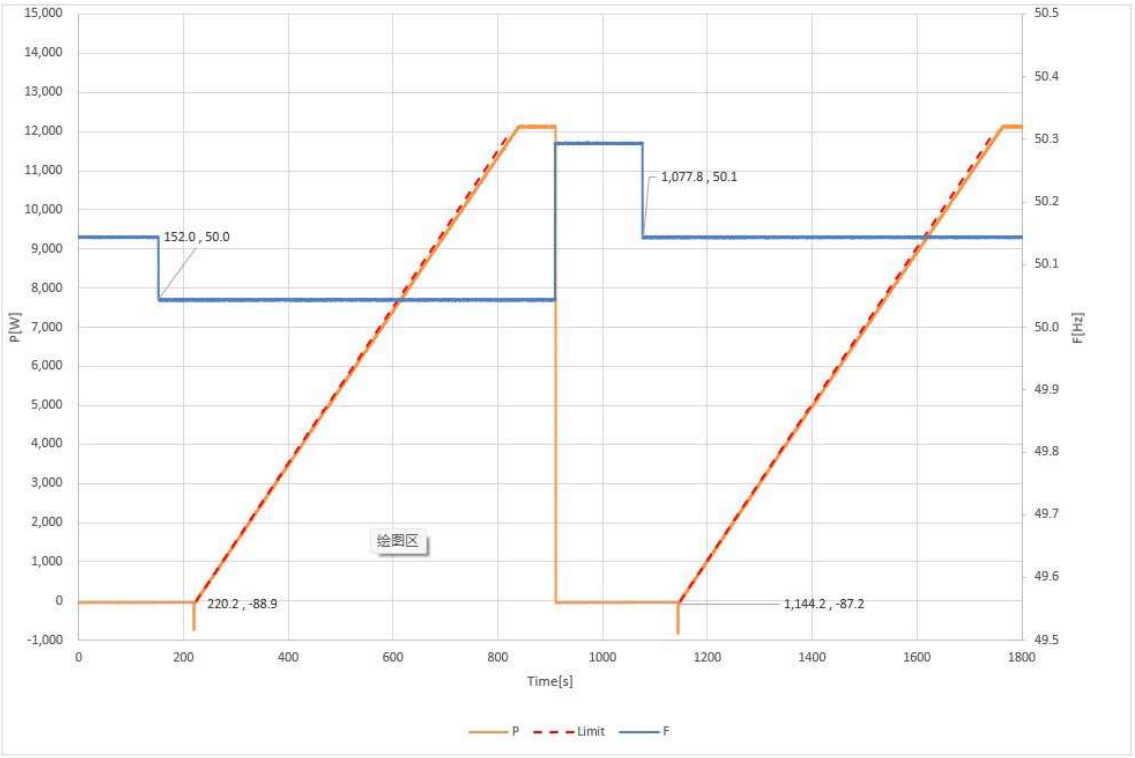
Graph of the gradual power supply: Test b) for ≤ 110% U_n



Graph of the gradual power supply: Test e) for ≥ 49.50Hz



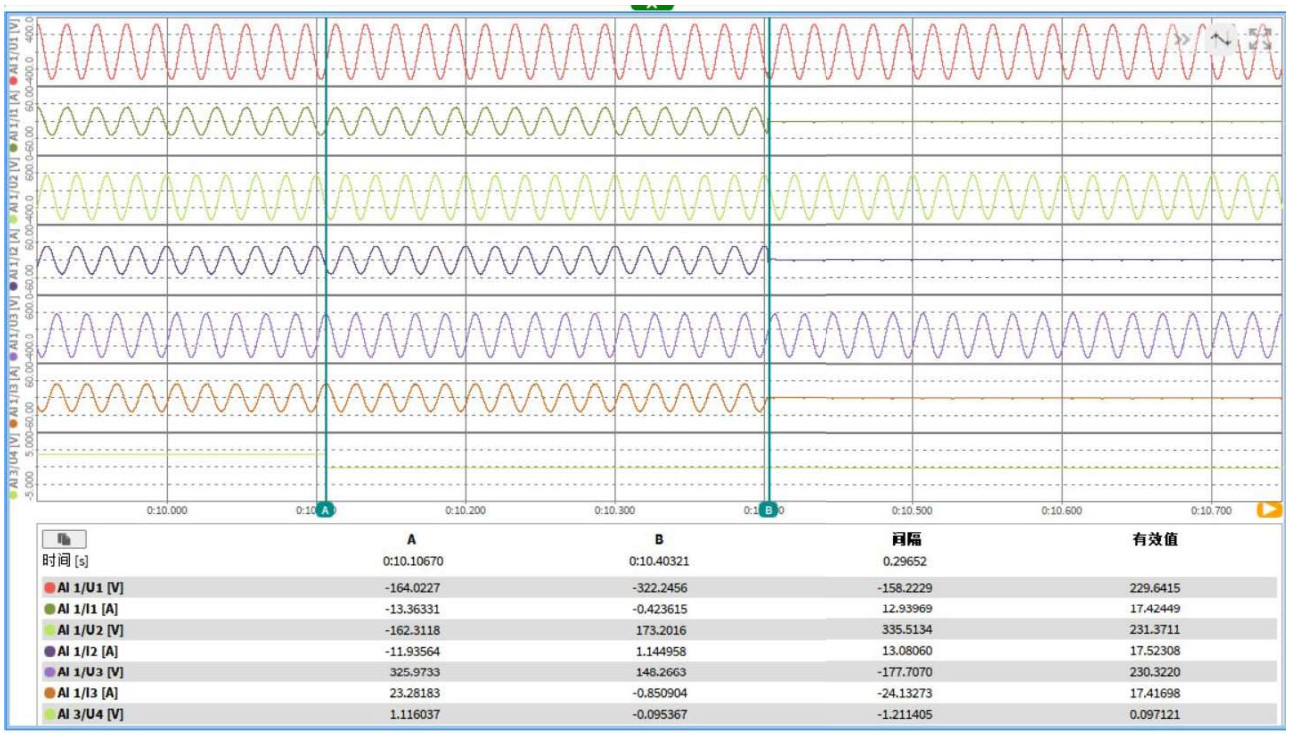
Graph of the gradual power supply: Test e) for ≤ 50.10Hz



EN 50549-1: Ceasing and reduction of active power on set point			
Clause	**Test requirement**	**Test procedure according standard**	**Result**
4.11.1	Ceasing active power		**P**
4.11.2	Reduction of active power onset point		**P**

4.11.1 Ceasing active power	P

Operating time of the monitoring device	
Test:	Remote tripping signal for the external disconnection
Limit [s]:	5 s
Reaction time of the tripping value [s]:	0.297



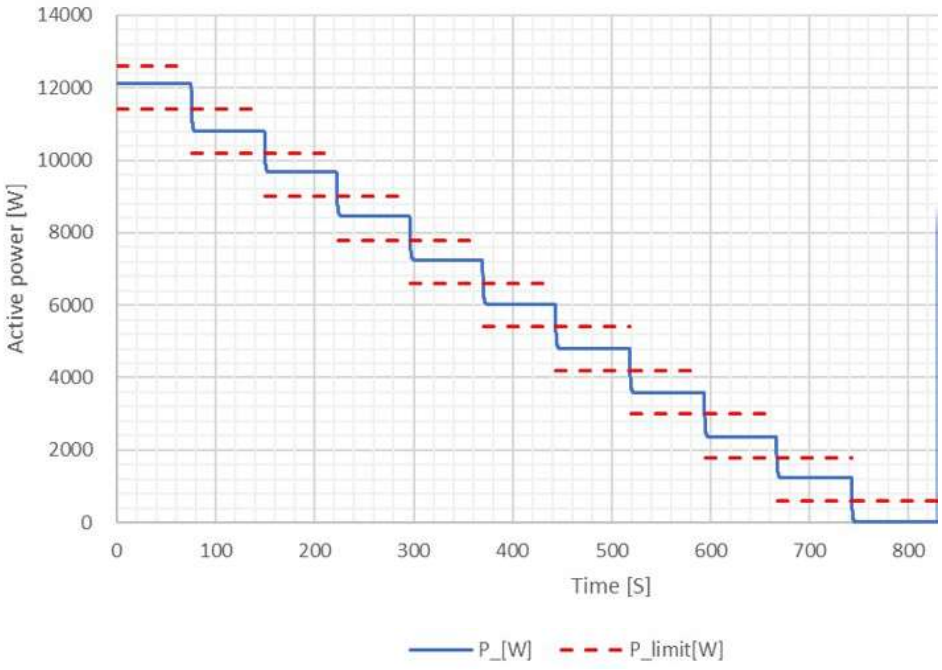
时间 [s]	A 0:10.10670	B 0:10.40321	间隔 0.29652	有效值
AI 1/U1 [V]	-164.0227	-322.2456	-158.2229	229.6415
AI 1/I1 [A]	-13.36331	-0.423615	12.93969	17.42449
AI 1/U2 [V]	-162.3118	173.2016	335.5134	231.3711
AI 1/I2 [A]	-11.93564	1.144958	13.08060	17.52308
AI 1/U3 [V]	325.9733	148.2663	-177.7070	230.3220
AI 1/I3 [A]	23.28183	-0.850904	-24.13273	17.41698
AI 3/U4 [V]	1.116037	-0.095367	-1.211405	0.097121

Note:
Generating plants shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port. If required by the DSO, this includes remote operation.

4.11.2 Reduction of active power on set point 4.12 Remote information exchange	P

Test:

Setpoint power bin [%P_{Emax}]	P_{set} [W]	P_{60} [W]	Deviation [%P_{Emax}]
100%	12000	12107	0.89
90%	10800	10794	-0.05
80%	9600	9679	0.66
70%	8400	8463	0.53
60%	7200	7246	0.39
50%	6000	6027	0.23
40%	4800	4808	0.06
30%	3600	3586	-0.12
20%	2400	2361	-0.33
10%	1200	1238	0.31



	Setpoint power bin [%P_{Emax}]	Deviation [%P_{Emax}]
Max. deviation	100	0.89
Limit $\Delta P_{E60}/P_{Setpoint}$:	± 5 % of P_{Emax}	

Test:

The setpoint signal must be reduced from 100% to 0% P_{Emax}:

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

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

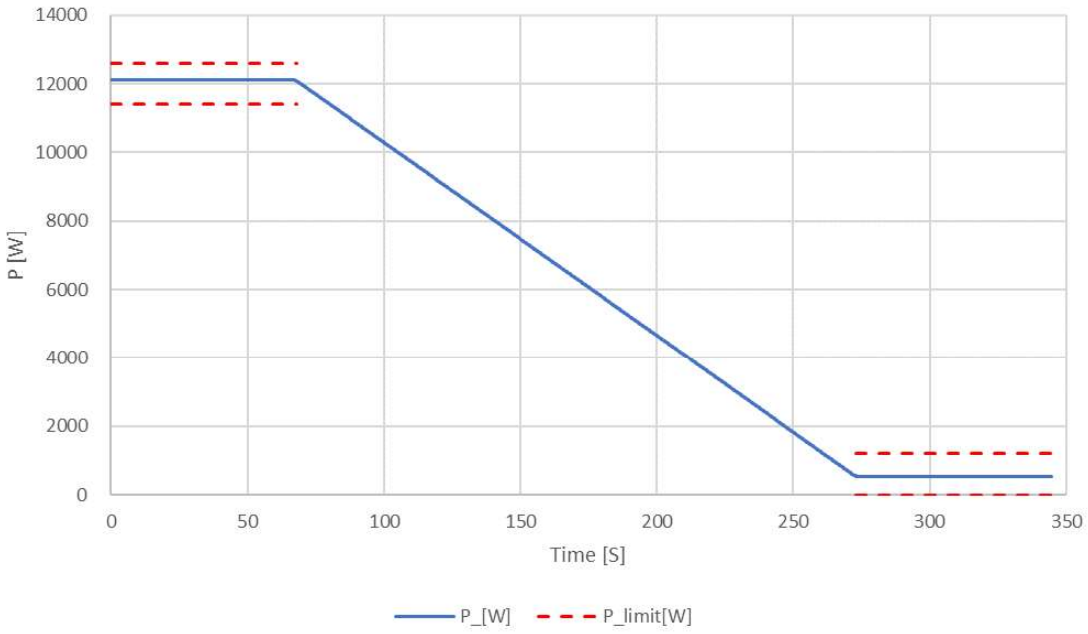
Assessment criterion:

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

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

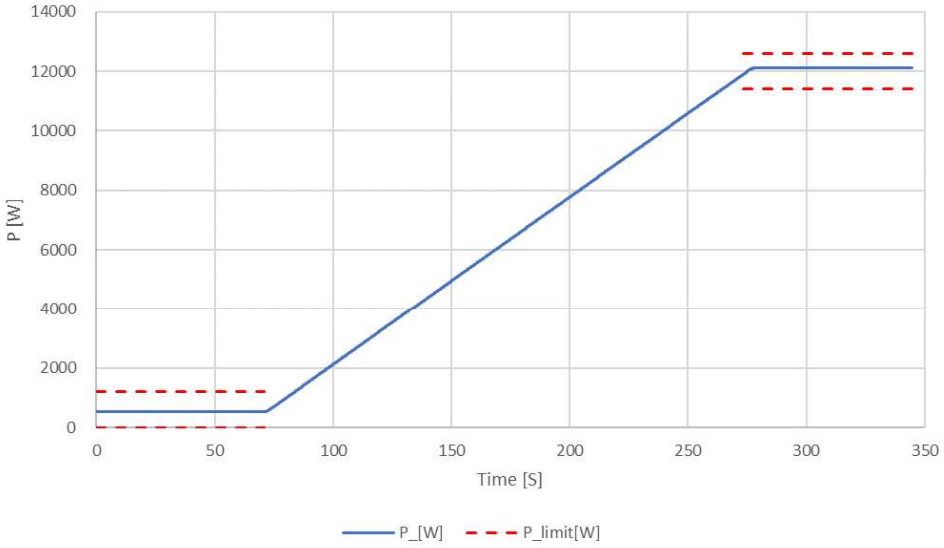
Measurement of the power gradient	**P**

Graph of the adjustment time:



Test:1

1-min mean value	100% of P_{Emax}	5%of P_{Emax}
$P_{Setpoint}$[W]:	12000	600
P_{E60} [W]:	12109	530
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0.91	0.58
Limit $\Delta P_{E60}/P_{Setpoint}$:	± 5%of P_{Emax}	
Measurements $\Delta P/\Delta t$ [$\%P_{rE}$/s]	0.47	
Limit $\Delta P/\Delta t$ [$\%P_{rE}$/s]	0.33-0.66	

Gragh of the adjustment time


Test:2		
1-min mean value	5% of P_{Emax}	100% of P_{Emax}
$P_{Setpoint}$[W]:	600	12000
P_{E60} [W]:	530	12111
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0.58	0.93
Limit $\Delta P_{E60}/P_{Setpoint}$:	± 5 % of P_{Emax}	
Measurements $\Delta P/\Delta t$ [$\%P_{rE}$/s]	0.47	
Limit $\Delta P/\Delta t$ [$\%P_{rE}$ /s]	0.33-0.66	

4.13 Requirements regarding single fault tolerance of interface protection system and interface switch							P
No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1.	Output	Short circuit	800Vdc/230	5S	__	__	EUT shut down immediately. No hazards.
2.	Ventilation hole	Blocked	800Vdc/230	60min	__	__	EUT work normally, no hazard. After 40minutes of “19”,prototype over-temperature protection
3.	Fan for inductors	Blocked	800Vdc/230	60min	__	__	EUT work normally, no hazard, Alarm “21” fan fault, alarm “19” overtermperature protection after 15inutes, no output.
4.	Output	Overload	800Vdc/230	4h	__	__	EUT limit output power by software, overload is impossible.
5.	Output	Incorrect phase sequence	800Vdc/230	10s	__	__	EUT can‘t start. LCD displa ”57” AC_gridphaseseque _fault. No hazards.
6.	IGBT Q21	SC	800Vdc/230	10min	__	__	AC and DC circuit breakers opened, no input and output after EUT work 1 seconds. No hazards.
7.	RLY7	SC	800Vdc/230	10min	__	__	Unit can not operate, no hazard, no fire, no damage.
8.	RLY17	SC	800Vdc/230	10min	__	__	Unit can not operate, no hazard, no fire, no damage.
9.	Bus capacitor C90	SC	800Vdc/230	10min	__	__	Unit can not operate, no hazard, no fire, no damage.
10.	X Capacitor C9	SC	800Vdc/230	10min	__	__	Unit can not operate, no hazard, no fire, no damage.
11.	X Capacitor C54	SC	800Vdc/230	10min	__	__	Unit can not operate, no hazard, no fire, no damage.
12.	Y Capacitor C7	SC	800Vdc/230	10min	__	__	EUT can‘t start to work. No Hazards.
13.	Y Capacitor C74	SC	800Vdc/230	10min	__	__	EUT can‘t start to work. No Hazards.
14.	GFCI R191	OC before startup	650Vdc/230 Vac	10min	__	__	Fault reporting “57”,the LED display red, no hazard, no fire, no damage.
15.	GFCI R191	SC	650Vdc/230	10min	__	__	Fault reporting “57”,the LED display

		before startup	Vac				red, no hazard, no fire, no damage.
16.	RELAY RLY1	SC before startup	650Vdc/230 Vac	10min	__	__	Unit can not operate, the LED display red, no hazard, no fire, no damage.
17.	RELAY RLY2	SC before startup	650Vdc/230 Vac	10min	__	__	Unit can not operate, the LED display red, no hazard, no fire, no damage.
18.	RELAY RLY3	SC before startup	650Vdc/230 Vac	10min	__	__	Unit can not operate, the LED display red, no hazard, no fire, no damage.
19.	RELAY RLY4	SC before startup	650Vdc/230 Vac	10min	__	__	Unit can not operate, the LED display red, no hazard, no fire, no damage.

Note:

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

Assessment criterion:

The NS protection must send a shutdown command to the coupling switch.

If the error is detected, the device is switched off within 10 s after error detection.

If the auxiliary voltage fails with the central NS protection or if the control fails with the integrated NS protection, the switch-off command must be given immediately.

Pictures of the unit

Fig.1--Over view

Fig.2--Over view

Pictures of the unit



Fig.3--Over view



Fig.4--Over view

Pictures of the unit

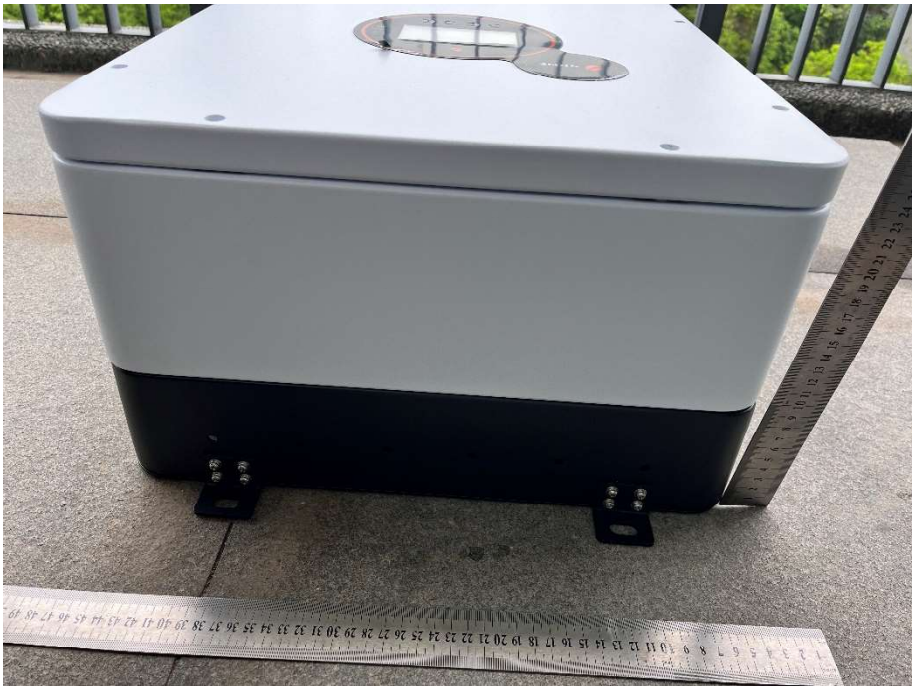


Fig.5--Over view

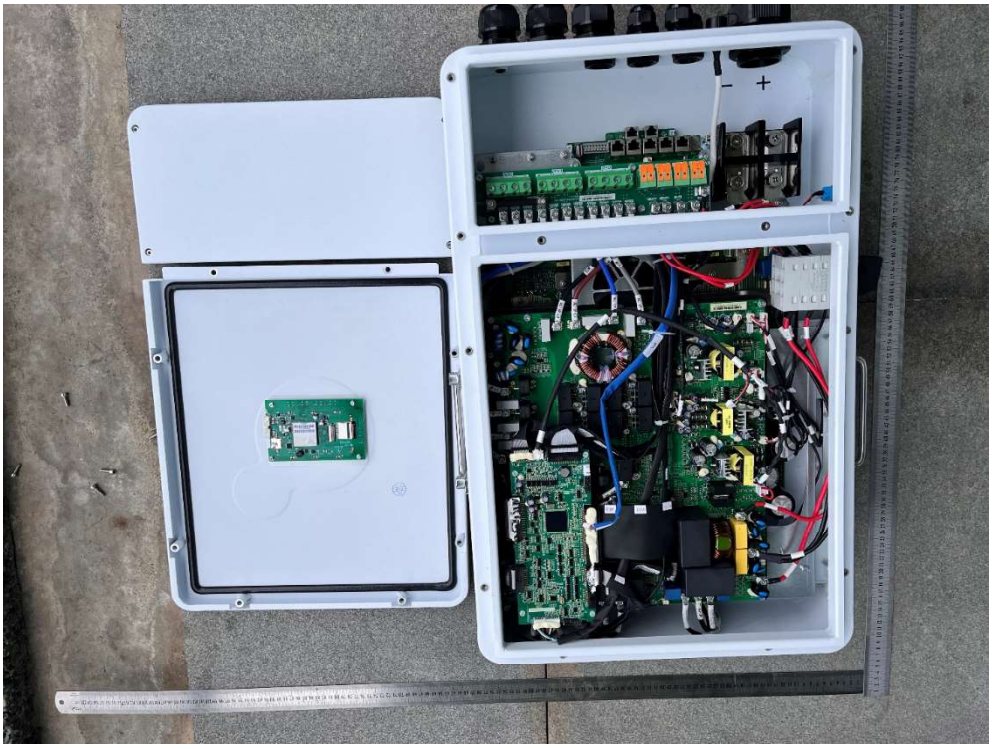


Fig.6-- Internal – remove cover

Test Equipment list				
No	**Test Equipment**	**Equipment model**	**Equipment No.**	**Calibration due date**
1	AC source	WPLA-33-1000KVA	BZ-DGD-L001	2025/01/30
2	DC source	WDGC-1000KW	BZ-DGD-L002	2024/11/01
3	Power analyzer	DEWE2-PA7	BZ-DGD-L119	2024/10/20
4	AC/DC current sensor	CT6863-05	BZ-DGD-L026-1	2025/01/22
5	AC/DC current sensor	CT6863-05	BZ-DGD-L026-2	2025/01/22
6	AC/DC current sensor	CT6863-05	BZ-DGD-L026-4	2025/01/22
7	AC/DC current sensor	CT6863-05	BZ-DGD-L026-5	2025/01/22
8	RLC load	ACLT-38160H	BZ-DGD-L003	2024/11/01

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