Product Service

TEST REPORT
CEI 0-21:2022
TUV SUD Test Report for Reference technical rules for the connection of active and passive users to the LV electrical Utilities

Report No.: Date of issue: Project handler:	64.290.22.31170.01 2023-03-02 Derek Li
Testing laboratory: Address: Testing location:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, P.R. China as above
Client: Client number: Address:	INVT Solar Technology (ShenZhen) Co., Ltd. 093811 6th Floor, Block A INVT Guangming Technology Building Kejie Fourth Road, Shutianpu Community, Matian Guangming District 518000 Shenzhen PEOPLE'S REPUBLIC OF CHINA
Standard:	This TUV SUD test report form is based on the following requirements: CEI 0-21: 2022
TRF number and revision*:*	TRF CEI 0-21: 2022 rev. 0:03/2022
eDoc_ID:	TRF CEI 0-21: 2022
TRF originated by:	TUV SUD Product Service, Mr. Billy Qiu
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
General disclaimer:	This test report may only be quoted in full. Any use for advertising purposes must be granted in writing. This report is the result of a single examination of the object in question and is not generally applicable evaluation of the quality of other products in regular production.
Scheme:	☐ TUV Mark ☒ Type verification of conformity ☐ AoC/CoC for EU-Directive / EU-Regulation: ☐ GS Mark ☐ NRTL Mark ☐ other:
Non-standard test method: National deviations:	☒ No ☐ Yes, see details under *Summary of testing* N/A
Number of pages *(Report)*: Number of pages *(Attachments)*:	127 pages N/A

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Guangzhou Branch, TÜV SÜD Group

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Huangpu Ave. West,Guangzhou, 510656, P.R.China

Test sample: Type of test object: Trademark: Model and/ or type reference:	Solar Inverter Solar Inverter invt iMars XG15KTR, iMars XG17KTR, iMars XG20KTR, iMars XG22KTR, iMars XG25KTR iMars XG15KTR-S, iMars XG17KTR-S, iMars XG20KTR-S, iMars XG22KTR-S, iMars XG25KTR-S
Rating(s):	See rating for page 5
Manufacturer: Manufacturer number: Address:	Same as applicant Same as applicant Same as applicant
Name and address of factory(ies) Factory name: Shenzhen INVT Electric Co., Ltd. (Baoan Factory) Address: 4th to 1st floors of Emerson Industrial Park, No. 3, Fengtang Avenue, Tangwei Community, Fuhai Street, Baoan District, Shenzhen	
Sub-contractors / tests (clause): Name:	N/A N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order: Date of receipt of test item: Date(s) of performance of test:	2022-08-13 2022-11-11 2022-11-11 to 2023-02-01

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Test item particulars:	
Equipment mobility ..... :	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains ..... :	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category..... :	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains ..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV ..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)..... :	+/- 10%
Tested for power systems ..... :	TN system
IT testing, phase-phase voltage (V) ....:	N/A
Class of equipment .....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .....:	25 kg (approx.)
Pollution degree .....:	External(PD3), Internal(PD2)
IP protection class.....:	IP

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Purpose of the product (description of intended use):

(1) This product is a three-phase string-type PV grid-connected inverter, the main function of which is to convert the DC power generated by the PV string into AC power and feed it into the low-voltage grid.

(2) Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the converter.

(3) In order to protect the PCE, user and installer, external DC and AC circuit breaker shall be equipped at the end-use application.

(4) The Interface Protection System according to CEI 0-21:2022 must be installed externally between the inverter output and grid connection point. Options to have adjustable setpoints or other custom features may be required by the interconnecting utility, depending on the impact of the PV system on the portion of the utility system to which it is interconnected.

(5) The installation of the product must meet the requirements of the local distribution system operator and be installed by a professional.

(6) Software version: V1.0

Firmware version:12006-00330

Model differences:

The inverter has 2 kinds of series: KTR, KTR-S series. The KTR series products are the base model.

Two series product have same electric circuits topology design, same enclosure structure design, same main control circuits and firmware. The output power and input current are limited by software.
The differences of different power models:

Model	iMars XG25KTR iMars XG25KTR-S	iMars XG22KTR iMars XG22KTR-S	iMars XG20KTR iMars XG20KTR-S	iMars XG17KTR iMars XG17KTR-S	iMars XG15KTR iMars XG15KTR-S
BOOST Diode	1200V/20A * 1pc + 1200V/30A * 1pc	1200V/20A * 2pcs			
BUS Capacitor	110μF*6 pcs	110μF*4 pcs			
INV inductance	0.74mH	0.82mH			

The differences among two series:

Model	iMars XG25KTR	iMars XG22KTR	iMars XG20KTR	iMars XG17KTR	iMars XG15KTR
Number of strings of each MPPT tracker	2/3	2/2			

Model	iMars XG25KTR-S	iMars XG22KTR-S	iMars XG20KTR-S	iMars XG17KTR-S	iMars XG15KTR-S
Number of strings of each MPPT tracker	1/2	1/1			

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Characteristic data (not shown on the marking plate):

Model	iMars XG15KTR	iMars XG17KTR	iMars XG20KTR	iMars XG22KTR	iMars XG25KTR
PV input terminal parameters					
Maximum input voltage	1100 Vd.c.				
MPPT voltage range	200-1000 Vd.c.				
MPPT voltage range (full load)	480-800 Vd.c.			520-800 Vd.c.	560-800 Vd.c.
Maximum number of input string per tracker	2/2				2/3
Maximum continuous input current	32/32 Ad.c.				32/48 Ad.c.
Isc PV	40/40 Ad.c.				40/60 Ad.c.
AC output rating					
Rated output voltage	3/N/PE, 230/400 Va.c.				
Rated output frequency	50 Hz				
Maximum continuous output current	24.1 Aa.c.	27.2 Aa.c.	32.1 Aa.c.	35.3 Aa.c.	40.1 Aa.c.
Rate output active power	15 kW	17 kW	20 kW	22 kW	25 kW
Maximum output apparent power	16.6 kVA	18.8 kVA	22.2 kVA	24.4 kVA	27.7 kVA
Power factor	0.9inductive(under-excited) to 0.9capacitive(over-excited)				

Model	iMars XG15KTR-S	iMars XG17KTR-S	iMars XG20KTR-S	iMars XG22KTR-S	iMars XG25KTR-S
PV input terminal parameters					
Maximum input voltage	1100 Vd.c.				
MPPT voltage range	200-1000 Vd.c.				
MPPT voltage range (full load)	470-800 Vd.c.	540-800 Vd.c.	690-800 Vd.c.	760-800 Vd.c.	520-800 Vd.c.
Maximum number of input string per tracker	1/1				1/2
Maximum continuous input current	16/16 Ad.c.				16/32 Ad.c.
Isc PV	20/20 Ad.c.				20/40 Ad.c.
AC output rating					
Rated output voltage	3/N/PE, 230/400 Va.c.				
Rated output frequency	50 Hz				
Maximum continuous output current	24.1 Aa.c.	27.2 Aa.c.	32.1 Aa.c.	35.3 Aa.c.	40.1 Aa.c.
Rate output active power	15 kW	17 kW	20 kW	22 kW	25 kW
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1. The unit shall be used at specified ambient conditions:
Outdoor, temperature range: -25 °C to 60 °C.

Specification for CEI 0-21 is listed as in below:

DISPOSITIVO DI INTERFACCIA Interface Device	PROTEZIONE DI INTERFACCIA Interface Protection Device	DISPOSITIVO DI CONVERSIONE STATICA Static Conversion Device	DISPOSITIVO DI GENERAZIONE TOTANTE Rotating Device
☐	☐	☒	☐

Attachments:

N/A

If additional information is necessary, please provide

N/A

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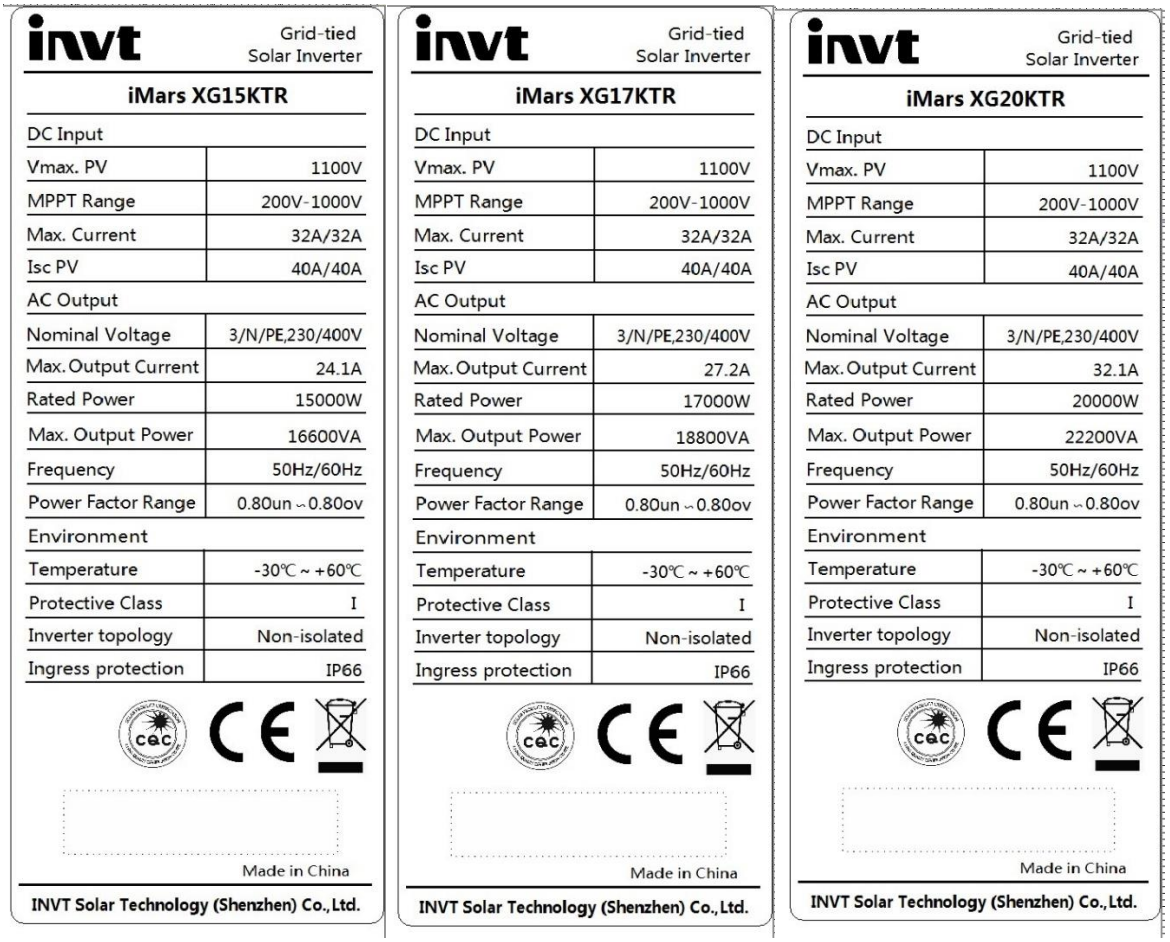
Copy of marking plate:



invt Grid-tied Solar Inverter

iMars XG15KTR

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	32A/32A
Isc PV	40A/40A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	24.1A
Rated Power	15000W
Max. Output Power	16600VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un ~ 0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co., Ltd.

invt Grid-tied Solar Inverter

iMars XG17KTR

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	32A/32A
Isc PV	40A/40A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	27.2A
Rated Power	17000W
Max. Output Power	18800VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un ~ 0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co., Ltd.

invt Grid-tied Solar Inverter

iMars XG20KTR

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	32A/32A
Isc PV	40A/40A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	32.1A
Rated Power	20000W
Max. Output Power	22200VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un ~ 0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

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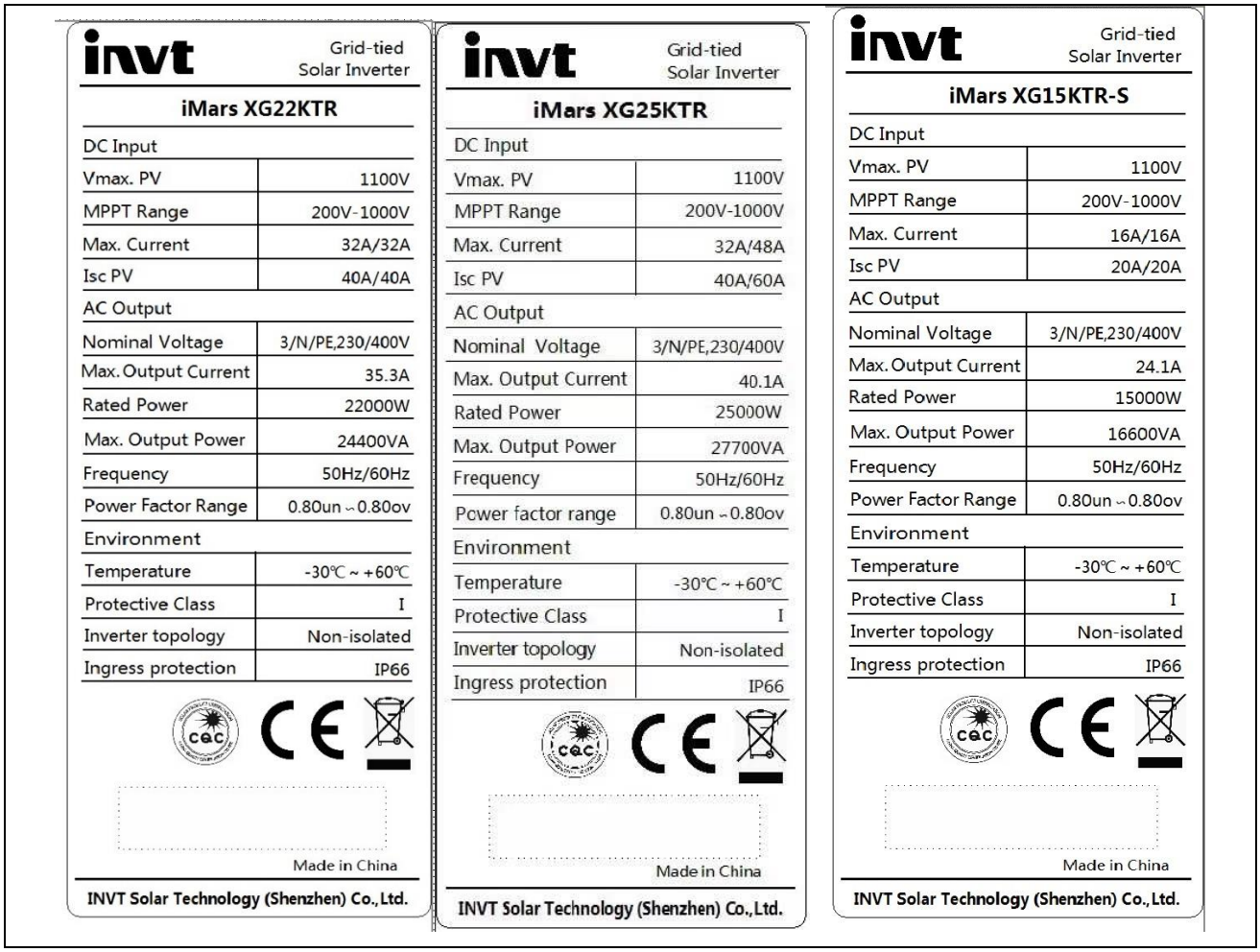

invt Grid-tied Solar Inverter

iMars XG22KTR

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	32A/32A
Isc PV	40A/40A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	35.3A
Rated Power	22000W
Max. Output Power	24400VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

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invt Grid-tied Solar Inverter

iMars XG25KTR

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	32A/48A
Isc PV	40A/60A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	40.1A
Rated Power	25000W
Max. Output Power	27700VA
Frequency	50Hz/60Hz
Power factor range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt Grid-tied Solar Inverter

iMars XG15KTR-S

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	16A/16A
Isc PV	20A/20A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	24.1A
Rated Power	15000W
Max. Output Power	16600VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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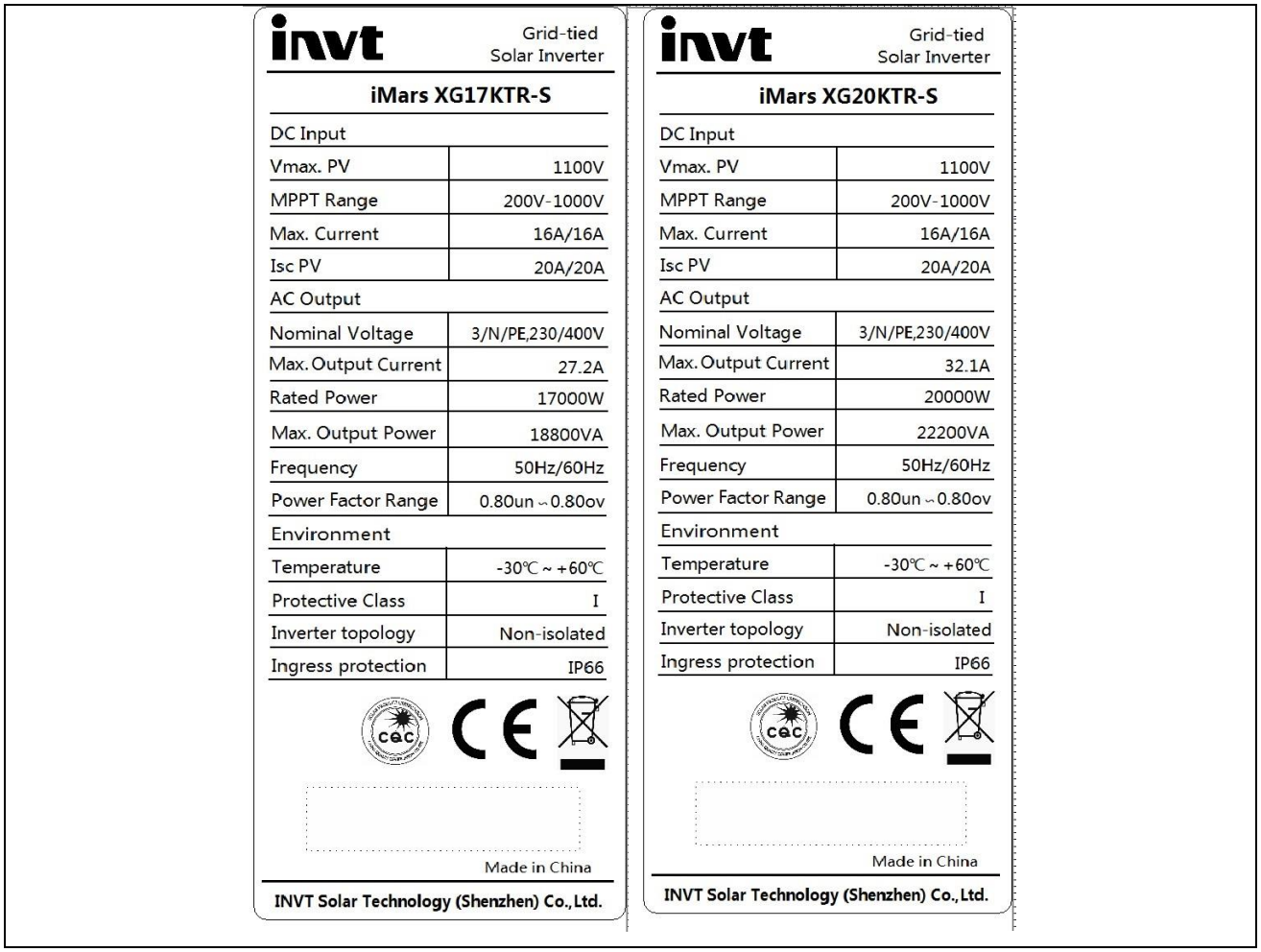

invt Grid-tied Solar Inverter

iMars XG17KTR-S

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	16A/16A
Isc PV	20A/20A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	27.2A
Rated Power	17000W
Max. Output Power	18800VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt Grid-tied Solar Inverter

iMars XG20KTR-S

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	16A/16A
Isc PV	20A/20A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	32.1A
Rated Power	20000W
Max. Output Power	22200VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un～0.80ov
Environment	
Temperature	-30℃～+60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

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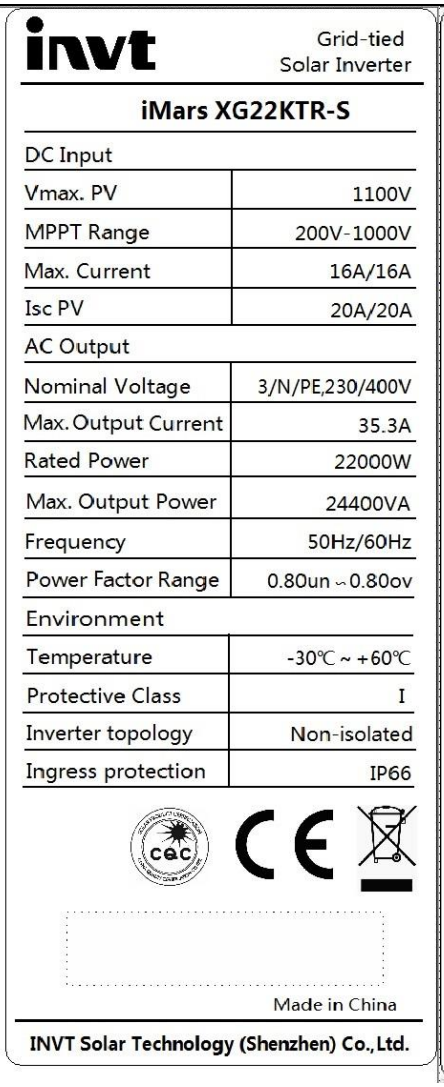

invt Grid-tied Solar Inverter

iMars XG22KTR-S

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	16A/16A
Isc PV	20A/20A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	35.3A
Rated Power	22000W
Max. Output Power	24400VA
Frequency	50Hz/60Hz
Power Factor Range	0.80un ~ 0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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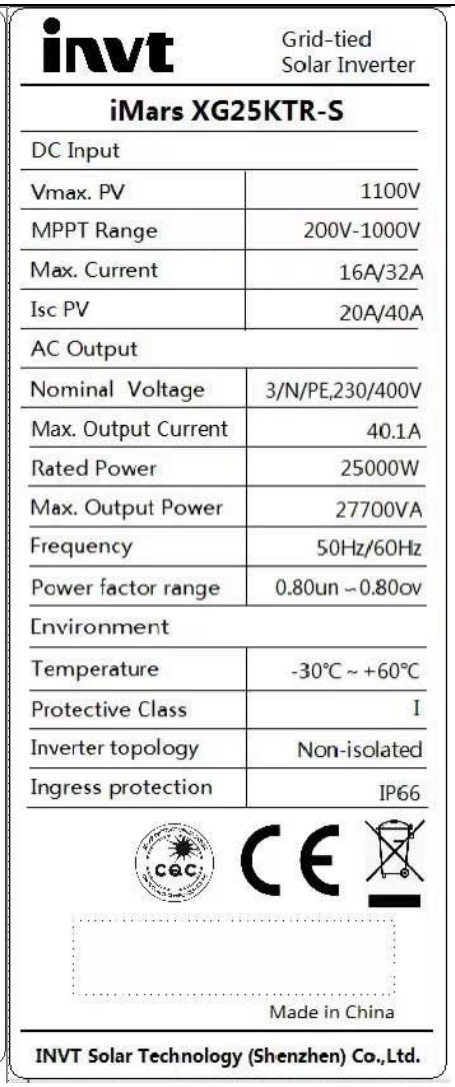

invt Grid-tied Solar Inverter

iMars XG25KTR-S

DC Input	
Vmax. PV	1100V
MPPT Range	200V-1000V
Max. Current	16A/32A
Isc PV	20A/40A
AC Output	
Nominal Voltage	3/N/PE,230/400V
Max. Output Current	40.1A
Rated Power	25000W
Max. Output Power	27700VA
Frequency	50Hz/60Hz
Power factor range	0.80un ~ 0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

Remark: For application of this standard, the nominal voltage is 230/400 Va.c., and the test is base on power factor range: 0.9inductive(under-excited) to 0.9capacitive(over-excited), the nominal frequency is 50Hz.

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Pictures of the product:

Over view (LCD cover board)

Over view (alternative LED cover board)

Internal View

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Terminal View

Remark: For different series of products, the manufacturer will seal the partially PV port. All models use the same PCB board. The difference between 25K and other models is that the pins are still the same after disassembly and replacement according to different products.

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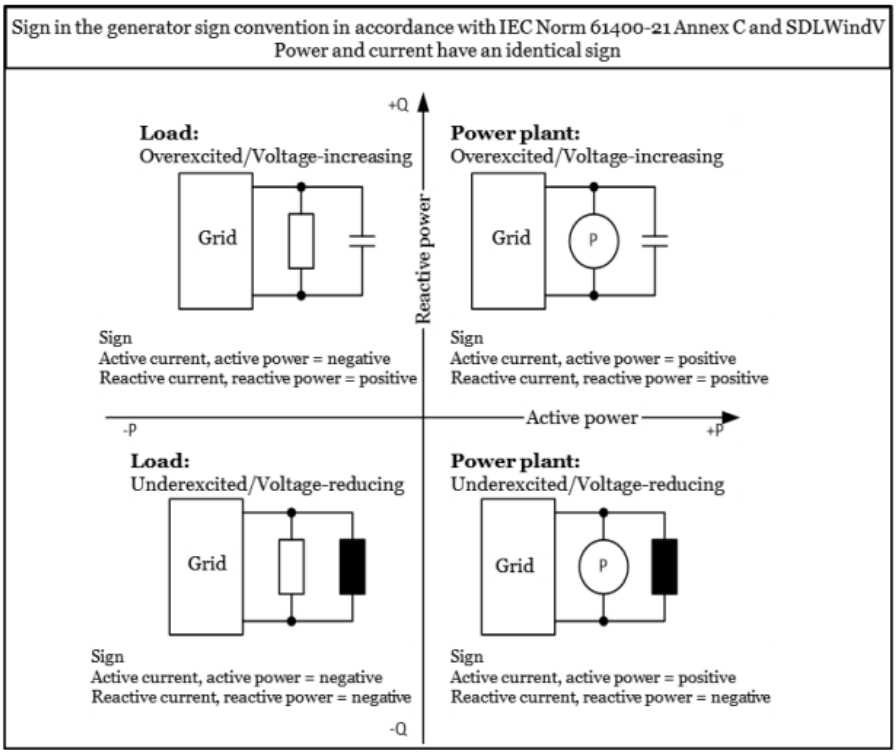
Summary of testing:

Tests performed (name of test and test clause):

Test items below according to CEI 0-21:2022, at rated voltage 230/400 Va.c. and at rated frequency 50Hz.

During the below test, sign in the generator sign convention consiederd:



	Inductive (under-excited)	Capacitive(over-excited)
Generator (Discharge mode)	IV. Quadrant P > 0, the equipment supplies active power from the mains (Discharge mode) Q < 0, the equipment draws reactive power from the mains (inductive behaviour)	I. Quadrant P > 0, the equipment supplies active power from the mains (Discharge mode) Q > 0, the equipment supplies reactive power to the mains (capacitive behaviour)
Consumer (Charge mode)	III. Quadrant P < 0, the equipment supplies active power from the mains (Charge mode) Q < 0, the equipment draws reactive power from the mains (inductive behaviour)	II. Quadrant P < 0, the equipment draw active power from the mains (Charge mode) Q > 0, the equipment supplies reactive power to the mains (capacitive behaviour)

Clause	Requirement + Test
B.1 a) b)	Harmonic emission limits
B.1 c)	Voltage fluctuation and flicker
B.1.1	Conditions for connection, reconnection and gradual increase of power
B.1.2.1&B 1.2.2	Reactive power
B.1.2.3	Reactive power exchange at an assigned level
B.1.2.4	Response time to an assigned step level change

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B.1.2.5	Automatic supply of reactive power according to a characteristic curve cos φ = f (P)
B.1.2.6	Automatic exchange of reactive power according to a characteristic curve Q = f (V)
B1.3.1	Automatic limitation the active power for voltage value close to 110% of the nominal voltage
B.1.3.2	Control of active power in the presence of transients on the transmission network
B1.3.3	Verification of the operating range in voltage and frequency
B.1.3.3.1	Reduction of active power in the presence of under-frequency transients on the transmission network
B.1.3.4	Active Power Limitation upon external command from Distributor
B.1.4.1	Verification of the emission DC component
B.1.4.2	Verification of protection against the DC component of the output current
B.1.5	Verification of insensitivity to voltage dips (LVRT capability)
B.1.6	Verification of insensitivity to the mismatch of phase automatic reclosing

If no special indicates, all the tests are applied for model: iMars XG25KTR

☐ deviation(s) found

☒ no deviations found

Additional information on non-standard test method(s)

Sub clause: N/A

Page: N/A

Rational: N/A

Possible test case verdicts:

test case does not apply to the test object: N/A (not applicable / not included in the order)

test object does meet the requirement: P (Pass)

test object does not meet the requirement: F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report a **dot** is used as the decimal separator.

The test results presented in this report relate only to the object tested.

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Clause	Requirement + Test	Result – Remark	Verdict
8	**Technical connection rules for active Users**		P
8.1	Neutral delivered by the DSO		N/A
8.2	Connection scheme of an active U.S.: expected devices		N/A
8.3	Single-phase/three-phase connection to the distribution network		N/A
8.4	Operation of the production facility		P
8.5	Network services		P
8.6	Protection systems	Unit power > 11.08 kW, should be installed in final installation as a dedicated device	N/A
8.7	Operating Regulations for Active User		P
8.8	Field verification tests		N/A
8.9	Technical documentation of the Active User connection point		P
9	**Provisions for electromagnetic compatibility**		N/A
10	**Measurement of continuity and voltage quality**		N/A
11	**Connection technical rules for distribution networks**		N/A
12	**Electrical energy measurement systems**		P
Annex A	**Features and tests for the Interface Protection System (SPI)**	Unit power > 11.08 kW, should be installed in final installation as a dedicated device	N/A
A.1	Types of tests		N/A
A.2	Characteristics of the SPI		N/A
A.3	Adjustment ranges for SPI		N/A
A.4	Pes checks and tests		N/A
A.4.1	Characteristics of the relay test box		N/A
A.4.2	Features of the BT network simulator		N/A
A.4.3	Functional tests on SPI		N/A
A.4.4	Self-testing		N/A
A.4.5	Single fault tolerance		N/A
A.4.6	EMC compatibility tests		N/A
A.4.7	Climate compatibility tests		N/A
A.4.8	Insulation tests		N/A
A.4.9	Tests of overloadability of measuring circuits		N/A

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Clause	Requirement + Test	Result – Remark	Verdict
A.4.10	Conformity of equipment		N/A
A.4.11	Automatism to avoid current imbalances in production		N/A
Annex B	**Tests on generators connected to the grid by means of static converters**		P
B.1	Tests		P
B.1.1	Conditions of connection, reconnection and gradual power supply		P
B.1.1.1	Verification of connection and reconnection conditions		P
B.1.1.2	Verification of gradual delivery of active power		P
B.1.2	Exchange of reactive power		P
B.1.2.1	Verification of construction requirements: capability of reactive power		P
B.1.2.2	How to perform and record the test		P
B.1.2.2.1	Inverters in systems with a total power of up to 11.08 kW	Unit power > 11.08 kW	N/A
B.1.2.2.2	Inverters in systems with a total power exceeding 11.08 kW		P
B.1.2.3	Exchange of reactive power according to an assigned level		P
B.1.2.4	Response time to a step change of the assigned level		P
B.1.2.5	Automatic reactive power delivery according to a characteristic curve cosφ = f(P)		P
B.1.2.5.1	Verification of compliance with the methods of application of the standard dispensing curve		P
B.1.2.6	Automatic exchange of reactive power according to a characteristic curve Q = f(V)		P
B.1.3	Limitation of active power		P
B.1.3.1	Automatic limitation of active power for voltage values close to 110 % of the rated voltage		P
B.1.3.2	Regulation of active power in the presence of overfrequency transients on the transmission network		P
B.1.3.3	Verification of the operating range in voltage and frequency		P
B.1.3.4	Limitation of active power on external control from the DSO		P
B.1.4	Emission of continuous component in the output current		P

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Clause	Requirement + Test	Result – Remark	Verdict
B.1.4.1	Verification of continuous component emission		P
B.1.4.2	Verification of protection against continuous component input		P
B.1.5	Verification of insensitivity to voltage drops (UVRT capability)		P
B.1.6	Verification of insensitivity to automatic reclosures in phase discordance		P
B.1.6.1	Simulated network testing:		P
B.1.6.2	Test on distribution network by coupling transformer		P
B.1.6.3	Distribution network testing, frequency drift simulation		P
B.1.6.4	Extension of results		P
Annex Bbis	**Tests on storage systems**		N/A
Bbis.1	Introduction		N/A
Bbis.2	Execution of tests		N/A
Bbis.3	List of tests and reference conditions		N/A
Bbis.4	Verification of the operating range in voltage and frequency		N/A
Bbis.5	Conditions of connection, reconnection and gradual power delivery		N/A
Bbis.5.1	Checking connection and reconnection conditions		N/A
Bbis.5.2	Verification of the gradual delivery/absorption of active power		N/A
Bbis.6	Reactive power exchange		N/A
Bbis.6.1	Verification of construction requirements: capability of reactive power		N/A
Bbis.6.2	How to perform and record the test		N/A
Bbis.6.3	Exchange of reactive power according to an assigned level		N/A
Bbis.6.4	Methods of execution of the test and recording of the results (hypothesis of adjustment by Q)		N/A
Bbis.6.5	Response time to a step change in the assigned level		N/A
Bbis.6.6	Automatic reactive power delivery according to a characteristic curve cosφ = f(P)		N/A
Bbis.6.7	Verification of compliance with the methods of application of the standard dispensing curve cosφ = f(P)		N/A
Bbis.6.8	Automatic exchange of reactive power according to a characteristic curve Q=f(V)		N/A

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Clause	Requirement + Test	Result – Remark	Verdict
Bbis.6.9	Verification of compliance to the modes of application of the characteristic curve Q=f(V)		N/A
Bbis.7	Active power regulation		N/A
Bbis.7.1	Automatic limitation of active power for voltage values close to 110 % of the rated voltage		N/A
Bbis.7.2	Verification of automatic reduction of active power in the presence of overfrequency transients on the network		N/A
Bbis.7.3	Verification of the automatic increase of the active power in the presence of subfrequency transmitters on the network		N/A
Bbis 7.4	Verification of the regulation of the active power on external control coming from the DSO		N/A
Bbis.8	Output of continuous component in the output current		N/A
Bbis.8.1	Verification of continuous component emission		N/A
Bbis.8.2	Verification of protections against continuous component input		N/A
Bbis.9	Verification of insensitivity to voltage drops (UVRT capability)		N/A
Bbis.9.1	UVRT – method of execution and recording of tests		N/A
Bbis.9.2	Test circuits – requirements		N/A
Bbis.10	Verification of insensitivity to automatic reclosures in phase discordance		N/A
Bbis.10.1	Simulated Network Test		N/A
Bbis.10.2	Testing on distribution network by coupling transformer		N/A
Bbis.10.3	Distribution Network Testing, Frequency Drift Simulation		N/A
Annex Bter	**Synchronous and asynchronous generation group compliance**		N/A
Bter.1	Execution of tests		N/A
Bter.2	List of tests and reference conditions		N/A
Bter.3	Voltage quality measurements		N/A
Bter.4	Verification of the operating range in voltage and frequency		N/A
Bter.5	Verification of synchronization and loading conditions		N/A
Bter.6	Verification of construction requirements regarding reactive power exchange		N/A

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Clause	Requirement + Test	Result – Remark	Verdict
Bter.7	Verification of construction requirements regarding active power regulation		N/A
Bter.8	Verification of insensitivity to voltage variations (VFRT capability)		N/A
Bter.9	Method for modelling and validating the mathematical model of a synchronous generation group)		N/A
Annex C	**Equipment Compliance**		N/A
Annex D	**Signals on CEI EN 61850 protocol**		N/A
Annex E	**Participation of Distributed Generation (GD) units in voltage control**		N/A
Annex F	**Limiting the active power of Distributed Generation (GD) units**		N/A
Annex G	**Regulations for the operation of production plants in parallel with the DSO LV network**		N/A
Annex Gbis	**Regulations for the operation of production plants < 0.8 kW in parallel with the DSO LV network**		N/A
Annex H	**Characteristics of the relay test box**		N/A
Annex I	**Evaluation of the angle at the reclosing**		N/A

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B.1 a) b)	Harmonic emission limits	P
B.1 b)	Harmonics emission limits for class A (unit in % percent to nominal current) according to CEI EN 61000-3-12	

Minimal Short Circuit Ratio R_{sce}:	33
Value of Short Circuit Power S_{sc} corresponding to R_{sce}:	825000 VA
Equipment Phases: Single Phase / Interphase / Three Phase (delete as appropriate)	Three Phase
Ambient temperature:	20±2 °C
Humidity (RH %):	65%RH

Harmon. Nr.	P/ P_n									Limits [%]
	33% (L1/L2/L3)			66%(L1/L2/L3)			100%(L1/L2/L3)			
Current emission limits [%] – Table of Average values of entire test observation										
2	0.253%	0.327%	0.379%	0.558%	0.607%	0.692%	0.802%	0.805%	0.952%	8
3	0.082%	0.088%	0.125%	0.089%	0.110%	0.137%	0.104%	0.118%	0.143%	21.6
4	0.182%	0.270%	0.248%	0.365%	0.482%	0.425%	0.519%	0.668%	0.574%	4
5	0.234%	0.349%	0.332%	0.377%	0.448%	0.344%	0.466%	0.515%	0.428%	10.7
6	0.026%	0.019%	0.012%	0.045%	0.029%	0.018%	0.082%	0.057%	0.027%	2.67
7	0.129%	0.086%	0.055%	0.112%	0.162%	0.213%	0.266%	0.314%	0.399%	7.2
8	0.024%	0.034%	0.030%	0.015%	0.025%	0.021%	0.028%	0.036%	0.043%	2
9	0.063%	0.017%	0.077%	0.075%	0.009%	0.080%	0.084%	0.010%	0.088%	3.8
10	0.016%	0.016%	0.018%	0.028%	0.024%	0.032%	0.026%	0.015%	0.029%	1.6
11	0.047%	0.041%	0.053%	0.053%	0.068%	0.066%	0.068%	0.085%	0.082%	3.1
12	0.007%	0.005%	0.005%	0.008%	0.005%	0.006%	0.014%	0.007%	0.010%	1.33
13	0.037%	0.032%	0.032%	0.029%	0.030%	0.023%	0.024%	0.035%	0.027%	2
14	0.007%	0.009%	0.008%	0.015%	0.017%	0.015%	0.014%	0.012%	0.010%	-
15	0.004%	0.004%	0.006%	0.005%	0.002%	0.005%	0.008%	0.004%	0.008%	-
16	0.004%	0.007%	0.005%	0.009%	0.008%	0.011%	0.008%	0.005%	0.009%	-
17	0.012%	0.011%	0.014%	0.019%	0.020%	0.022%	0.021%	0.023%	0.026%	-
18	0.003%	0.001%	0.003%	0.004%	0.003%	0.004%	0.004%	0.003%	0.004%	-
19	0.006%	0.004%	0.006%	0.009%	0.010%	0.008%	0.014%	0.020%	0.017%	-
20	0.003%	0.003%	0.003%	0.006%	0.006%	0.007%	0.004%	0.004%	0.005%	-
21	0.002%	0.003%	0.003%	0.002%	0.002%	0.003%	0.003%	0.002%	0.004%	-
22	0.001%	0.002%	0.001%	0.005%	0.005%	0.006%	0.005%	0.004%	0.006%	-
23	0.006%	0.006%	0.007%	0.009%	0.010%	0.009%	0.014%	0.015%	0.015%	-
24	0.001%	0.001%	0.001%	0.001%	0.002%	0.001%	0.002%	0.002%	0.002%	-
25	0.006%	0.006%	0.006%	0.004%	0.005%	0.005%	0.002%	0.002%	0.002%	-

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26	0.001%	0.001%	0.001%	0.004%	0.005%	0.003%	0.004%	0.003%	0.004%	-
27	0.001%	0.001%	0.001%	0.002%	0.001%	0.002%	0.002%	0.002%	0.002%	-
28	0.001%	0.001%	0.001%	0.003%	0.002%	0.002%	0.003%	0.002%	0.002%	-
29	0.006%	0.005%	0.006%	0.006%	0.006%	0.007%	0.002%	0.002%	0.003%	-
30	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	-
31	0.005%	0.005%	0.005%	0.017%	0.017%	0.015%	0.007%	0.009%	0.008%	-
32	0.001%	0.001%	0.001%	0.004%	0.004%	0.001%	0.001%	0.002%	0.002%	-
33	0.001%	0.001%	0.001%	0.004%	0.002%	0.004%	0.002%	0.002%	0.002%	-
34	0.001%	0.000%	0.001%	0.002%	0.001%	0.002%	0.003%	0.003%	0.004%	-
35	0.003%	0.003%	0.003%	0.013%	0.012%	0.012%	0.016%	0.015%	0.016%	-
36	0.000%	0.000%	0.000%	0.002%	0.003%	0.002%	0.002%	0.002%	0.002%	-
37	0.001%	0.001%	0.001%	0.002%	0.003%	0.002%	0.029%	0.031%	0.028%	-
38	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.002%	0.003%	0.005%	-
39	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.004%	0.003%	0.006%	-
40	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.003%	0.003%	0.001%	-
THC/I_{ref}(2^{th} to 40^{th})	0.430%	0.567%	0.588%	0.788%	0.922%	0.926%	1.111%	1.220%	1.273%	13
PWHC/I_{ref}(14^{th} to 40^{th})	0.021%	0.021%	0.024%	0.039%	0.040%	0.040%	0.050%	0.052%	0.052%	22
Ambient temperature:						-30 °C				
Humidity (RH %):						-				
Harmon. Nr.	P/ P_n									Limits [%]
	33% (L1/L2/L3)			66%(L1/L2/L3)			100%(L1/L2/L3)			
Current emission limits [%] – Table of Average values of entire test observation										
2	0.282%	0.358%	0.422%	0.597%	0.666%	0.756%	0.890%	0.941%	1.062%	8
3	0.087%	0.103%	0.122%	0.095%	0.124%	0.148%	0.115%	0.127%	0.161%	21.6
4	0.203%	0.296%	0.261%	0.401%	0.535%	0.467%	0.591%	0.758%	0.664%	4
5	0.175%	0.298%	0.289%	0.332%	0.405%	0.287%	0.425%	0.472%	0.382%	10.7
6	0.027%	0.020%	0.012%	0.048%	0.030%	0.020%	0.086%	0.051%	0.040%	2.67
7	0.127%	0.070%	0.066%	0.125%	0.154%	0.224%	0.277%	0.308%	0.409%	7.2
8	0.026%	0.036%	0.036%	0.016%	0.026%	0.024%	0.038%	0.043%	0.053%	2
9	0.063%	0.017%	0.077%	0.077%	0.011%	0.084%	0.088%	0.014%	0.091%	3.8
10	0.014%	0.017%	0.017%	0.025%	0.023%	0.029%	0.028%	0.016%	0.030%	1.6
11	0.043%	0.037%	0.051%	0.042%	0.062%	0.059%	0.054%	0.075%	0.071%	3.1
12	0.009%	0.005%	0.006%	0.009%	0.006%	0.005%	0.015%	0.009%	0.011%	1.33
13	0.036%	0.031%	0.032%	0.023%	0.025%	0.018%	0.017%	0.028%	0.021%	2

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14	0.007%	0.010%	0.009%	0.014%	0.016%	0.014%	0.014%	0.014%	0.011%	-
15	0.005%	0.003%	0.006%	0.005%	0.003%	0.005%	0.010%	0.006%	0.009%	-
16	0.005%	0.007%	0.006%	0.009%	0.009%	0.010%	0.009%	0.006%	0.009%	-
17	0.014%	0.011%	0.015%	0.017%	0.019%	0.020%	0.018%	0.020%	0.023%	-
18	0.003%	0.002%	0.003%	0.004%	0.003%	0.003%	0.006%	0.005%	0.005%	-
19	0.007%	0.005%	0.007%	0.008%	0.009%	0.008%	0.012%	0.018%	0.015%	-
20	0.003%	0.004%	0.003%	0.006%	0.007%	0.007%	0.005%	0.006%	0.006%	-
21	0.002%	0.003%	0.003%	0.002%	0.002%	0.003%	0.005%	0.004%	0.005%	-
22	0.002%	0.002%	0.001%	0.005%	0.005%	0.005%	0.006%	0.005%	0.006%	-
23	0.006%	0.006%	0.007%	0.009%	0.010%	0.008%	0.013%	0.014%	0.013%	-
24	0.001%	0.001%	0.001%	0.001%	0.002%	0.001%	0.004%	0.003%	0.003%	-
25	0.006%	0.006%	0.006%	0.004%	0.005%	0.004%	0.003%	0.003%	0.003%	-
26	0.001%	0.001%	0.001%	0.005%	0.005%	0.003%	0.005%	0.004%	0.004%	-
27	0.001%	0.001%	0.002%	0.002%	0.001%	0.002%	0.003%	0.003%	0.002%	-
28	0.001%	0.001%	0.001%	0.003%	0.002%	0.002%	0.004%	0.003%	0.003%	-
29	0.005%	0.005%	0.006%	0.006%	0.006%	0.006%	0.004%	0.003%	0.004%	-
30	0.001%	0.001%	0.001%	0.001%	0.002%	0.001%	0.003%	0.003%	0.002%	-
31	0.005%	0.005%	0.005%	0.015%	0.015%	0.014%	0.007%	0.007%	0.007%	-
32	0.001%	0.001%	0.001%	0.004%	0.004%	0.001%	0.003%	0.003%	0.003%	-
33	0.001%	0.001%	0.001%	0.004%	0.003%	0.004%	0.003%	0.002%	0.002%	-
34	0.001%	0.001%	0.001%	0.002%	0.002%	0.002%	0.004%	0.004%	0.004%	-
35	0.003%	0.003%	0.003%	0.012%	0.010%	0.011%	0.014%	0.014%	0.014%	-
36	0.001%	0.001%	0.000%	0.002%	0.003%	0.002%	0.003%	0.003%	0.002%	-
37	0.001%	0.001%	0.001%	0.002%	0.004%	0.002%	0.024%	0.026%	0.023%	-
38	0.001%	0.001%	0.000%	0.002%	0.002%	0.001%	0.003%	0.005%	0.006%	-
39	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.003%	0.003%	0.005%	-
40	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.004%	0.004%	0.002%	-
THC/I_{ref}(2^{th} to 40^{th})	0.429%	0.571%	0.601%	0.816%	0.970%	0.979%	1.198%	1.344%	1.389%	13
PWHC/I_{ref}(14^{th} to 40^{th})	0.022%	0.022%	0.025%	0.036%	0.038%	0.037%	0.046%	0.049%	0.048%	22
Ambient temperature:						+60 °C				
Humidity (RH %):						100%RH				
Harmon. Nr.	P/ P_n									Limits [%]
	33% (L1/L2/L3)			66%(L1/L2/L3)			100%(L1/L2/L3)			
Current emission limits [%] – Table of Average values of entire test observation										

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2	0.274%	0.345%	0.410%	0.595%	0.665%	0.757%	0.902%	0.942%	1.076%	8
3	0.086%	0.102%	0.125%	0.094%	0.123%	0.148%	0.118%	0.130%	0.163%	21.6
4	0.198%	0.289%	0.256%	0.401%	0.534%	0.466%	0.595%	0.763%	0.671%	4
5	0.179%	0.303%	0.291%	0.336%	0.408%	0.294%	0.424%	0.470%	0.381%	10.7
6	0.027%	0.019%	0.013%	0.048%	0.030%	0.021%	0.087%	0.053%	0.043%	2.67
7	0.127%	0.073%	0.064%	0.124%	0.154%	0.222%	0.277%	0.308%	0.408%	7.2
8	0.025%	0.035%	0.035%	0.016%	0.026%	0.025%	0.039%	0.044%	0.054%	2
9	0.064%	0.017%	0.077%	0.077%	0.011%	0.083%	0.089%	0.015%	0.091%	3.8
10	0.013%	0.016%	0.016%	0.025%	0.023%	0.029%	0.028%	0.017%	0.031%	1.6
11	0.044%	0.038%	0.051%	0.043%	0.063%	0.060%	0.055%	0.075%	0.071%	3.1
12	0.009%	0.006%	0.006%	0.009%	0.006%	0.006%	0.016%	0.010%	0.013%	1.33
13	0.036%	0.031%	0.032%	0.024%	0.025%	0.019%	0.017%	0.028%	0.022%	2
14	0.007%	0.009%	0.009%	0.014%	0.017%	0.014%	0.015%	0.014%	0.013%	-
15	0.004%	0.003%	0.006%	0.005%	0.002%	0.005%	0.011%	0.006%	0.010%	-
16	0.004%	0.007%	0.006%	0.009%	0.009%	0.010%	0.009%	0.007%	0.010%	-
17	0.013%	0.011%	0.015%	0.017%	0.019%	0.020%	0.018%	0.021%	0.023%	-
18	0.003%	0.002%	0.003%	0.004%	0.003%	0.003%	0.007%	0.005%	0.007%	-
19	0.007%	0.005%	0.007%	0.008%	0.009%	0.008%	0.013%	0.018%	0.015%	-
20	0.003%	0.004%	0.003%	0.006%	0.006%	0.007%	0.006%	0.006%	0.007%	-
21	0.002%	0.003%	0.003%	0.002%	0.002%	0.003%	0.005%	0.004%	0.006%	-
22	0.001%	0.002%	0.001%	0.005%	0.005%	0.006%	0.007%	0.005%	0.006%	-
23	0.006%	0.006%	0.007%	0.009%	0.010%	0.008%	0.013%	0.014%	0.014%	-
24	0.001%	0.001%	0.001%	0.001%	0.002%	0.002%	0.004%	0.004%	0.004%	-
25	0.006%	0.006%	0.006%	0.004%	0.005%	0.004%	0.004%	0.003%	0.004%	-
26	0.001%	0.001%	0.001%	0.004%	0.005%	0.003%	0.005%	0.004%	0.005%	-
27	0.001%	0.001%	0.002%	0.002%	0.001%	0.002%	0.004%	0.003%	0.004%	-
28	0.001%	0.001%	0.001%	0.003%	0.002%	0.002%	0.004%	0.003%	0.004%	-
29	0.005%	0.005%	0.006%	0.006%	0.006%	0.006%	0.004%	0.003%	0.005%	-
30	0.001%	0.001%	0.001%	0.001%	0.002%	0.001%	0.003%	0.003%	0.003%	-
31	0.005%	0.005%	0.005%	0.015%	0.015%	0.014%	0.007%	0.007%	0.007%	-
32	0.001%	0.001%	0.001%	0.004%	0.004%	0.001%	0.003%	0.003%	0.003%	-
33	0.001%	0.001%	0.001%	0.004%	0.003%	0.004%	0.003%	0.002%	0.003%	-
34	0.001%	0.001%	0.001%	0.002%	0.002%	0.003%	0.004%	0.004%	0.005%	-
35	0.003%	0.003%	0.003%	0.012%	0.010%	0.011%	0.014%	0.014%	0.014%	-
36	0.000%	0.000%	0.000%	0.002%	0.003%	0.002%	0.003%	0.003%	0.003%	-
37	0.001%	0.001%	0.001%	0.002%	0.004%	0.002%	0.024%	0.026%	0.023%	-

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38	0.000%	0.000%	0.000%	0.002%	0.002%	0.002%	0.003%	0.005%	0.006%	-
39	0.001%	0.000%	0.000%	0.001%	0.001%	0.001%	0.004%	0.003%	0.005%	-
40	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.004%	0.004%	0.003%	-
THC/I_{ref}(2^{th} to 40^{th})	0.423%	0.562%	0.591%	0.815%	0.970%	0.981%	1.209%	1.347%	1.403%	13
PWHC/I_{ref}(14^{th} to 40^{th})	0.022%	0.022%	0.025%	0.036%	0.038%	0.037%	0.048%	0.049%	0.050%	22

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B.1 c)	voltage fluctuations and flicker	P

The test according to CEI EN 61000-3-11

Measured line voltage at nominal power [V_{rms}](V)			Measured currents at nominal power [I_{rms}](A)		
L1	L2	L3	L1	L2	L3
230.0	230.0	230.0	36.2	36.2	36.2

Frequency (Hz)	50	Nominal Power (W)	25000
Tested at ambient temperature:		20 ± 2°C	

		Starting			Stopping			Running	
% of Pn	Phase(s)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	Pst	Plt
33%Pn	L1	1.041	1.030	0.000	1.037	1.019	0.000	0.259	0.259
	L2	1.037	1.023	0.000	1.035	1.026	0.000	0.258	0.260
	L3	1.052	1.048	0.000	1.054	1.037	0.000	0.296	0.298
66%Pn	L1	2.120	2.111	0.000	2.145	2.103	0.000	0.276	0.299
	L2	2.114	2.093	0.000	2.117	2.095	0.000	0.308	0.330
	L3	2.152	2.133	0.000	2.160	2.130	0.000	0.405	0.417
100%Pn	L1	3.136	3.123	0.000	3.156	3.102	0.000	0.278	0.316
	L2	3.117	3.087	0.000	3.139	3.073	0.000	0.282	0.338
	L3	3.164	3.148	0.000	3.193	3.132	0.000	0.400	0.443
Limits according to CEI EN 61000-3-11		4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Ambient temperature:	-30°C

		Starting			Stopping			Running	
% of Pn	Phase(s)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	Pst	Plt
33%Pn	L1	1.031	1.021	0.000	1.036	1.020	0.000	0.195	0.199
	L2	1.040	1.022	0.000	1.039	1.024	0.000	0.372	0.376
	L3	1.048	1.034	0.000	1.052	1.035	0.000	0.299	0.295
66%Pn	L1	2.131	2.110	0.000	2.130	2.126	0.000	0.225	0.245
	L2	2.116	2.108	0.000	2.127	2.121	0.000	0.338	0.333

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	L3	2.150	2.137	0.000	2.156	2.125	0.000	0.328	0.344
100%Pn	L1	3.146	3.112	0.000	3.159	3.133	0.000	0.318	0.321
	L2	3.132	3.083	0.000	3.136	3.132	0.000	0.369	0.372
	L3	3.182	3.129	0.000	3.183	3.164	0.000	0.433	0.447
Limits according to CEI EN 61000-3-11		4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Ambient temperature:					+60°C				
		Starting			Stopping			Running	
% of Pn	Phase(s)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	d_{max} (%)	d_c (%)	$d_{(t)}$ (ms)	Pst	Plt
33%Pn	L1	1.030	1.007	0.000	1.007	1.003	0.000	0.248	0.242
	L2	1.037	1.001	0.000	1.017	1.009	0.000	0.373	0.338
	L3	1.049	1.003	0.000	1.024	1.007	0.000	0.339	0.303
66%Pn	L1	2.080	2.056	0.000	2.077	2.064	0.000	0.260	0.270
	L2	2.079	2.062	0.000	2.080	2.073	0.000	0.325	0.345
	L3	2.098	2.091	0.000	2.102	2.080	0.000	0.370	0.403
100%Pn	L1	2.504	2.486	0.000	2.538	2.477	0.000	0.281	0.285
	L2	2.507	2.487	0.000	2.527	2.470	0.000	0.313	0.331
	L3	2.537	2.522	0.000	2.556	2.529	0.000	0.450	0.463
Limits according to CEI EN 61000-3-11		4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

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B.1.1	Conditions for connection, reconnection and gradual increase of power	P

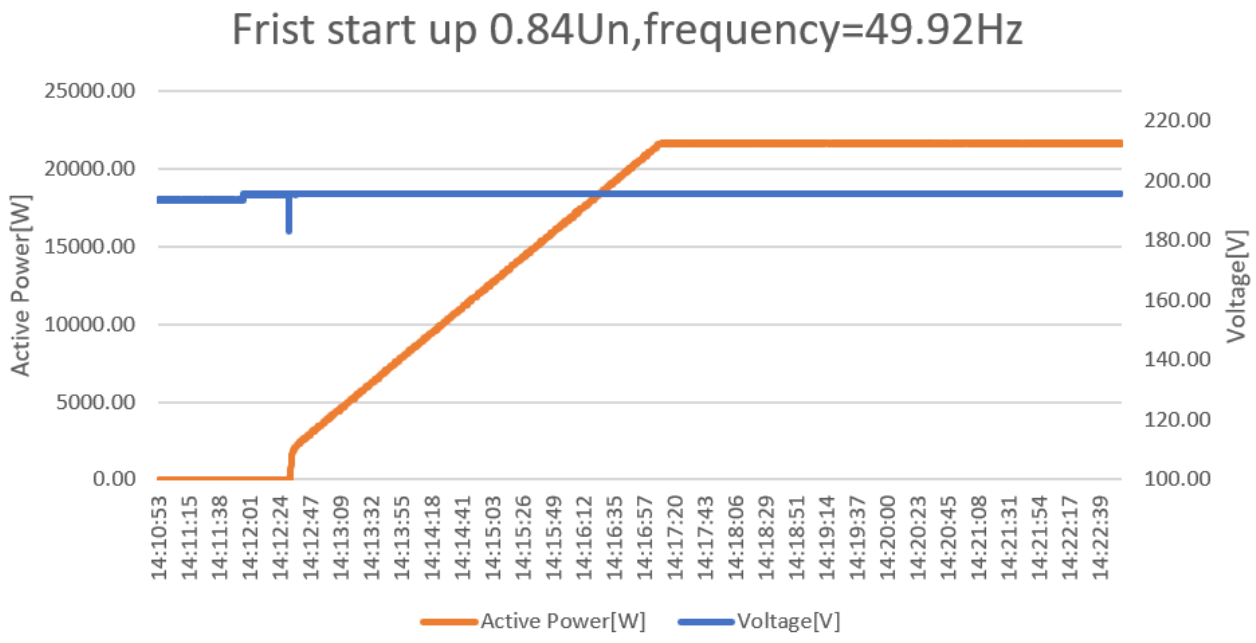
B.1.1.1 a), b) Out of voltage range

a). Switch the inverter on with ac voltage respectively less than 85% and greater than 110% of the nominal value vn (while the frequency must be between 49.9 hz and 50.1 hz), and check that the unit prevents the parallel with the grid – no power output according to network analyzer.

b). After at least 30 s from the time of start of the test referred to in point a), check the persistence of the state "open", i.e. Absence of output power. At this point bring the voltage within the limits - 85 % vn < v <110 % vn - and simultaneously disable the inverter. In these conditions then proceed to rearm, while checking that the parallel with the network and the start of the power delivery does not take place before at least 30 s from the time the inverter is enabled.

Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
0.84 Vn, 49.92 Hz	At least 60s	No connection	No connection
Change voltage from step a) to 0.86 Vn, 49.92 Hz	--	Connection after 30 s	35.6

Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
0.84 Vn, 50.08 Hz	At least 60s	No connection	No connection
Change voltage from step a) to 0.86 Vn, 50.08 Hz	--	Connection after 30 s	38.8

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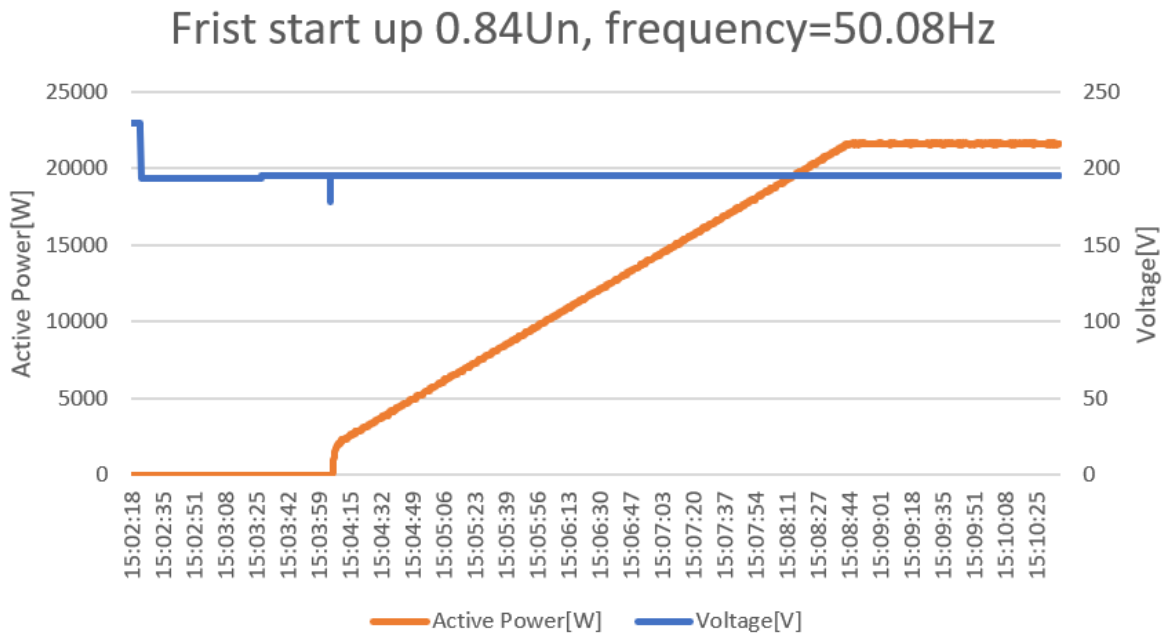
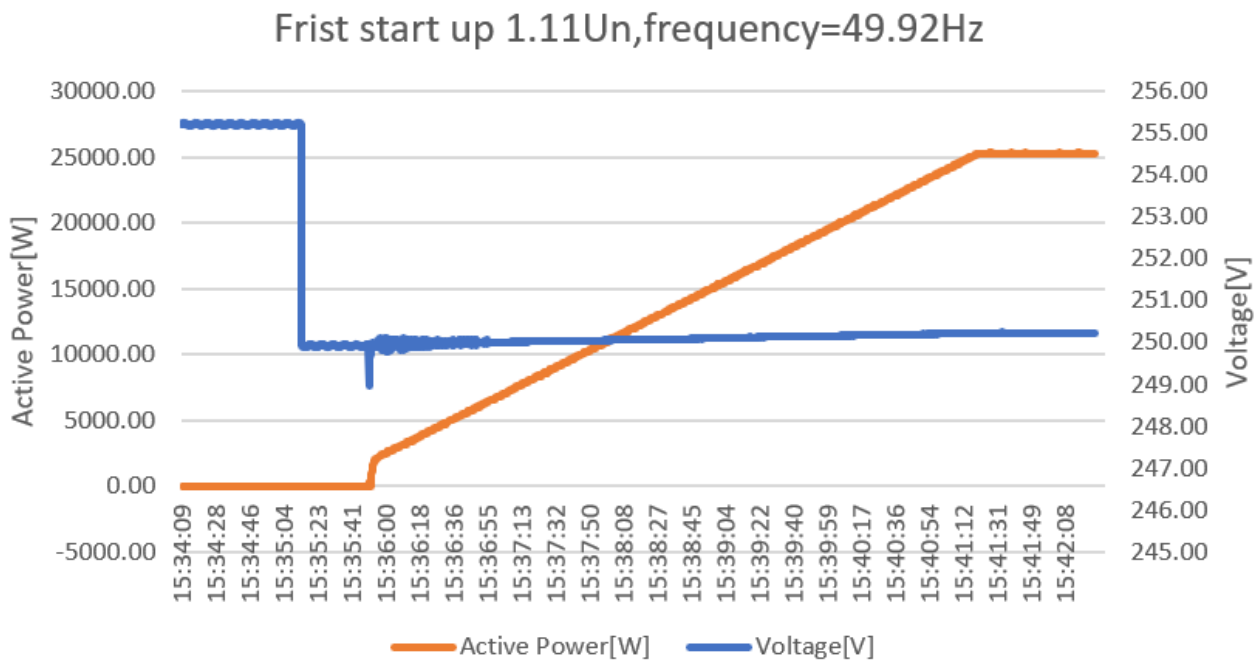
Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
1.11 Vn, 49.92 Hz	At least 60s	No connection	No connection
Change voltage from step a) to 1.09 Vn, 49.92 Hz	--	Connection after 30 s	37.8

Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min



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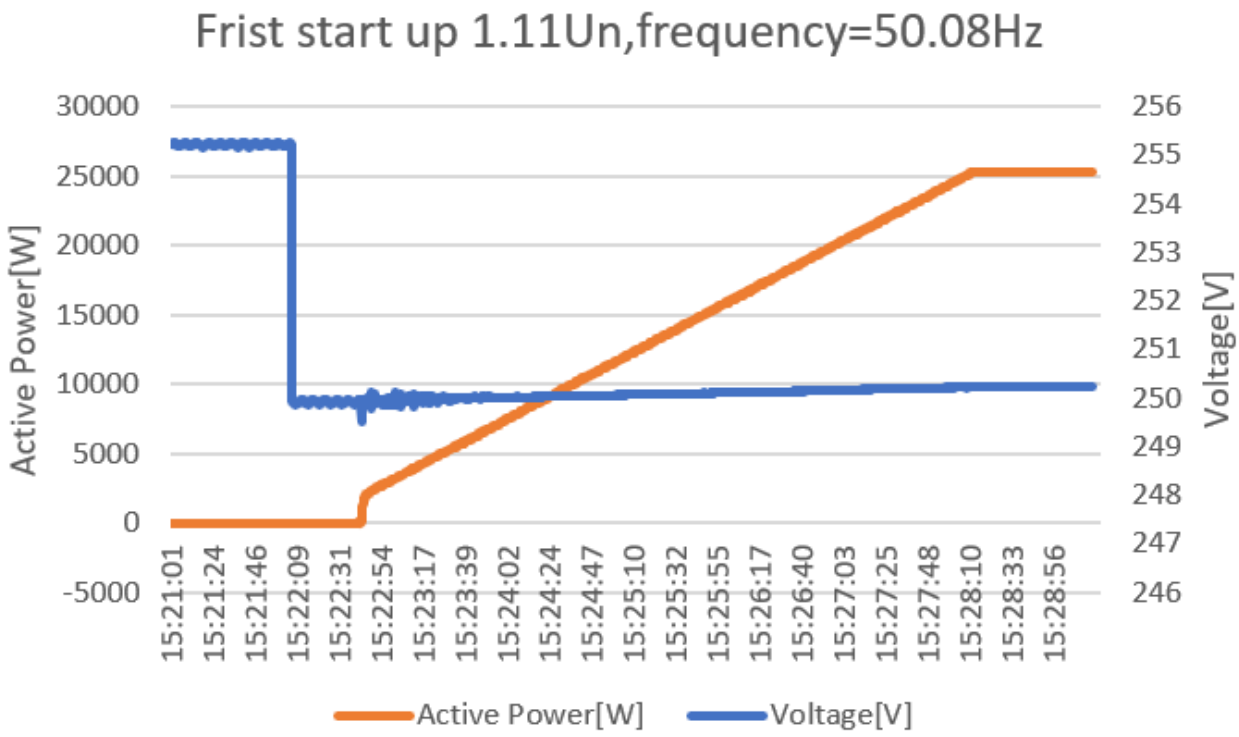
Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
1.11 Vn, 50.08 Hz	At least 60s	No connection	No connection
Change voltage from step a) to 1.09 Vn, 50.08 Hz	--	Connection after 30 s	37.6

Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min



B.1.1.1 c) Out of voltage range

c). At this point it is necessary to simulate with the converter in operation a disconnection due to the voltage being respectively higher and lower than overvoltage and undervoltage thresholds, in order to verify that, when voltage is restored within the expected range 85 % Vn < V < 110 % Vn, the time before reconnection is at least 300 s.

Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 1.00Vn to 0.84 Vn, 49.92 Hz	At least 600s	No connection	No connection
Change voltage to 0.86 Vn, 49.92 Hz	--	Connection after 300 s	324.4

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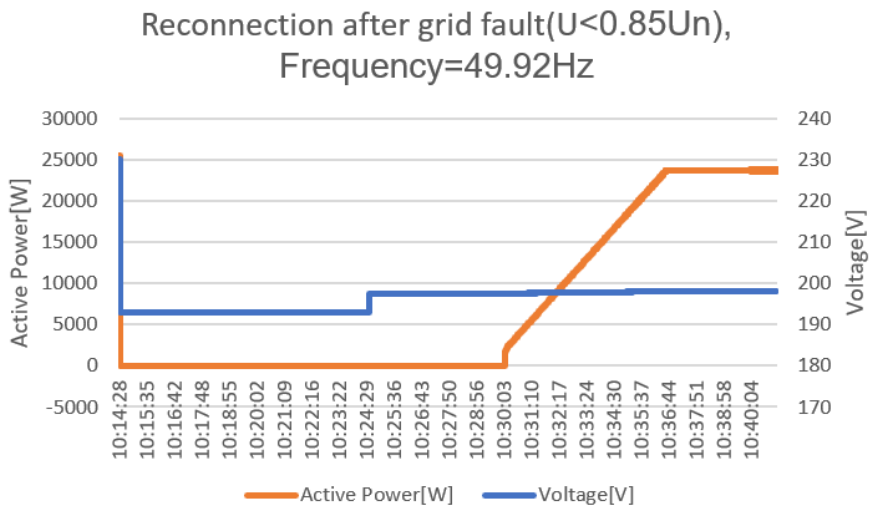
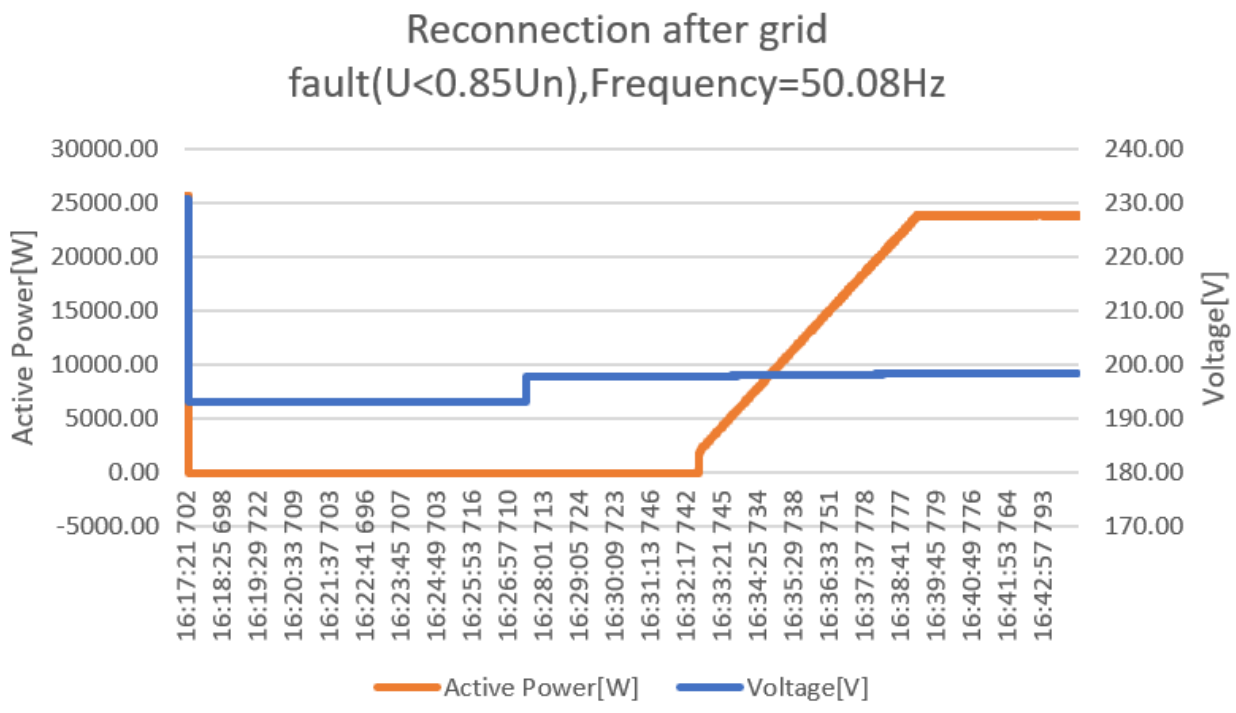
Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 1.00Vn to 0.84Vn, 50.08 Hz	At least 600s	No connection	No connection
Change voltage to 0.86Vn, 50.08 Hz	--	Connection after 300 s	301.6

Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



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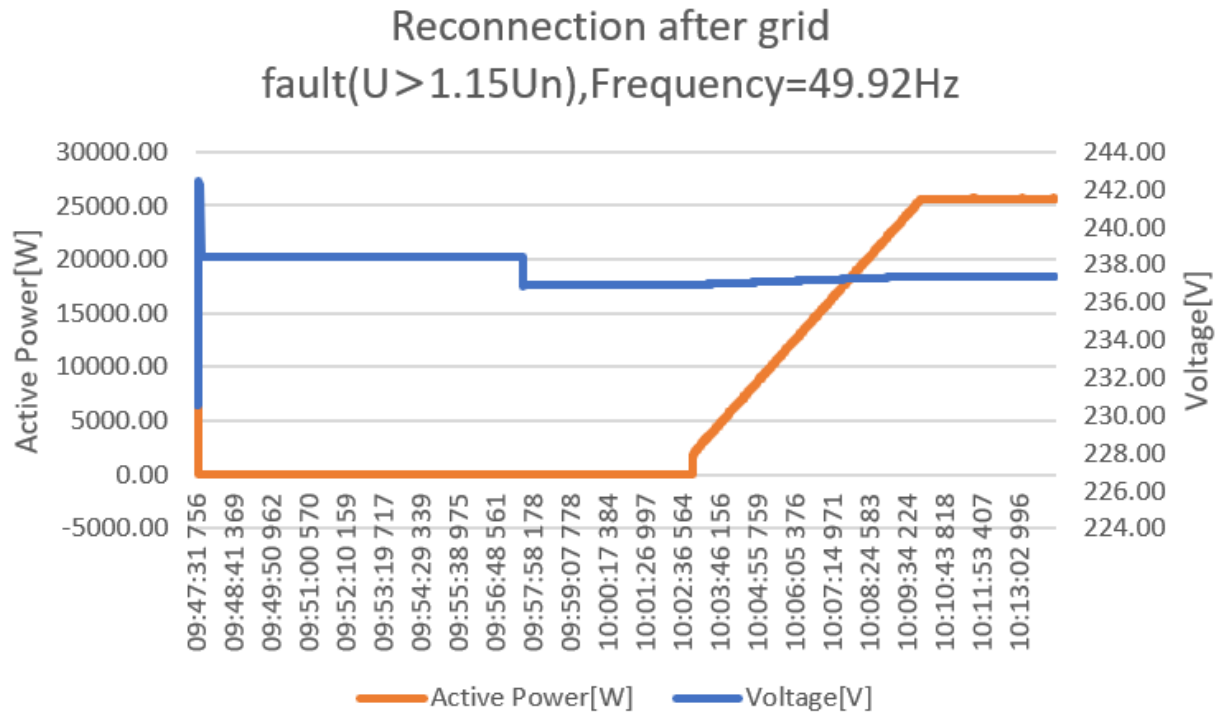
Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 1.00Vn to 1.16Vn then change to 1.11Vn, 49.92 Hz	At least 600s	No connection	No connection
Change voltage to 1.09 Vn, 49.92 Hz	--	Connection after 300 s	312.6

Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 1.00Vn to 1.16Vn then change to 1.11Vn, 50.08 Hz	At least 600s	No connection	No connection
Change voltage to 1.09 Vn, 50.08 Hz	--	Connection after 300 s	343.0

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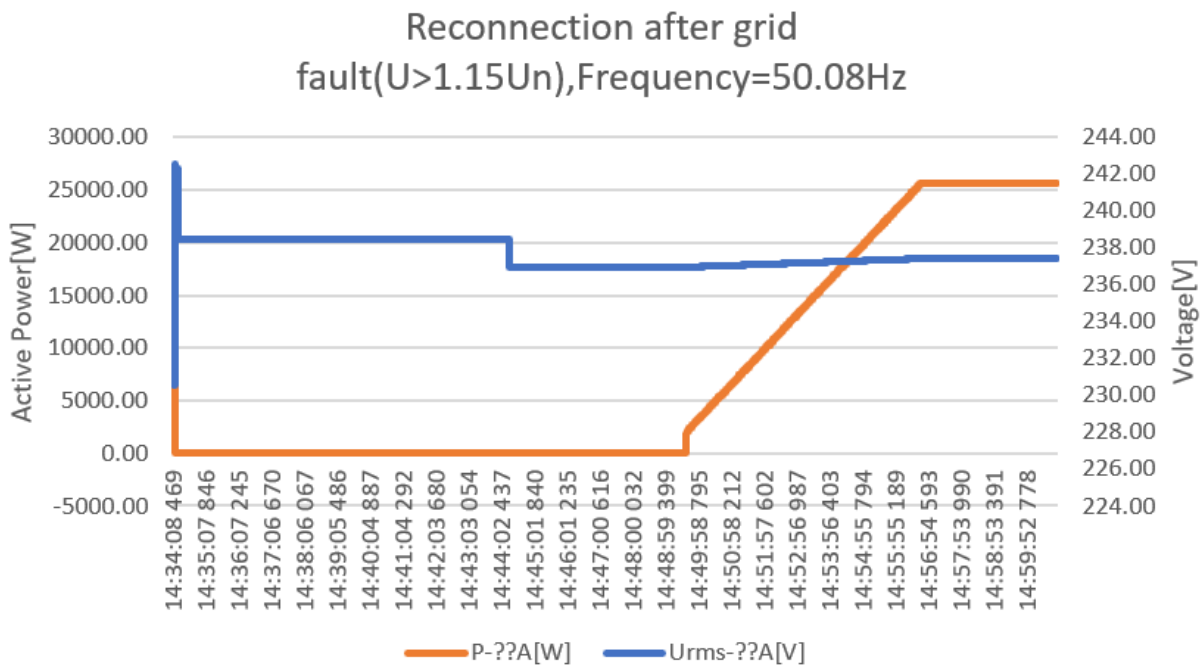
Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Frequency conditions

B.1.1.1 a), d), e) Out of frequency range

a. Switch the inverter on with ac voltage respectively less than 85% and greater than 110% of the nominal value vn (while the frequency must be between 49.9 hz and 50.1 hz), and check that the unit prevents the parallel with the grid – no power output according to network analyzer.

d. Repeat the test in a) within voltage U - 85% A <U <110% Un - and frequency respectively lower than 49.90 Hz and higher than 50.10 Hz, verifying that the unit does not enable the parallel with the network - absence of supply of the power read by the network analyzer

e. After at least 30 s from the time of start of the test referred to in paragraph d) check the persistence of the state "open", i.e. the absence of output power. At this point bring frequency f within the limits - 49.9 Hz < f < 50.1 Hz and simultaneously disable the inverter. In these conditions, then proceed to rearm, while checking that the parallel with the network and the start of the power delivery does not take place before at least 30 s from the activation of the inverter.

Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
49.88 Hz 0.86Vn	At least 60s	No connection	No connection
Change frequency from step 49.88Hz to 49.92Hz, 0.86Vn	--	Connection after 30 s	38.4

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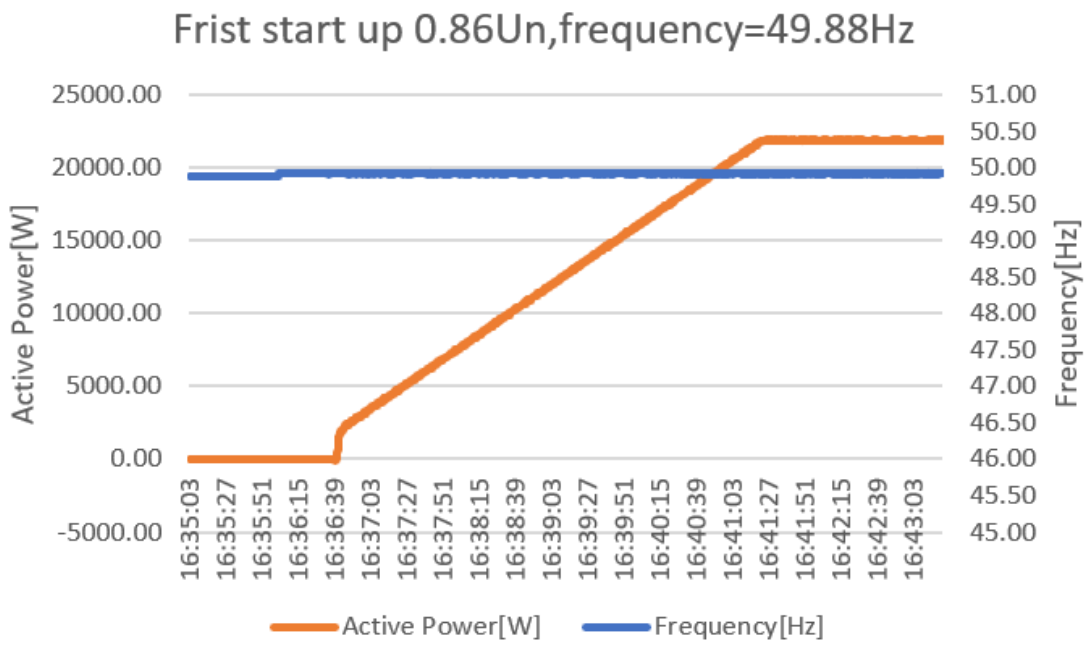
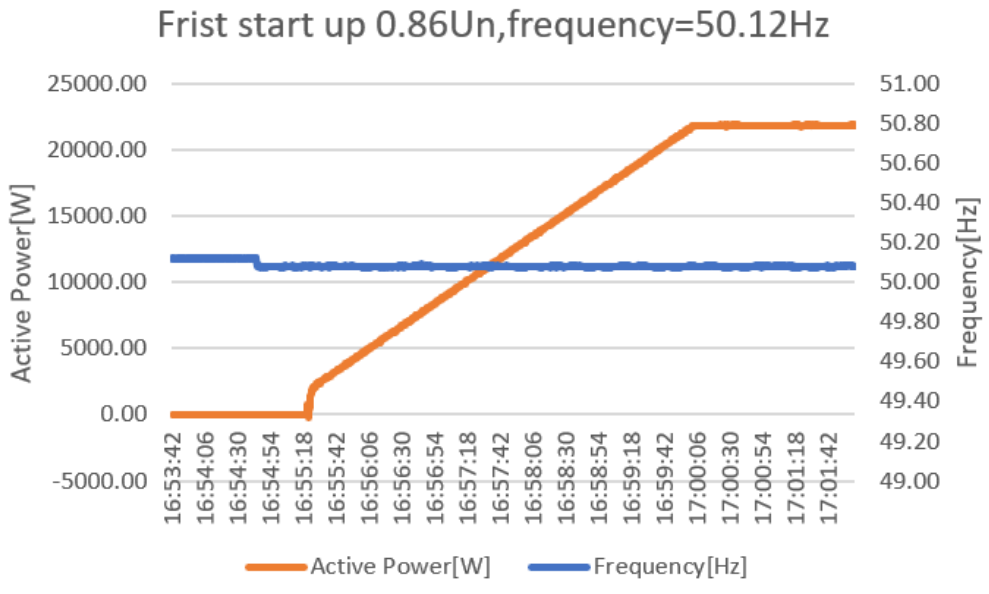
Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
50.12 Hz 0.86Vn	At least 60s	No connection	No connection
Change frequency from step 50.12 Hz to 50.08Hz, 0.86Vn	--	Connection after 30 s	38.4

Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min.



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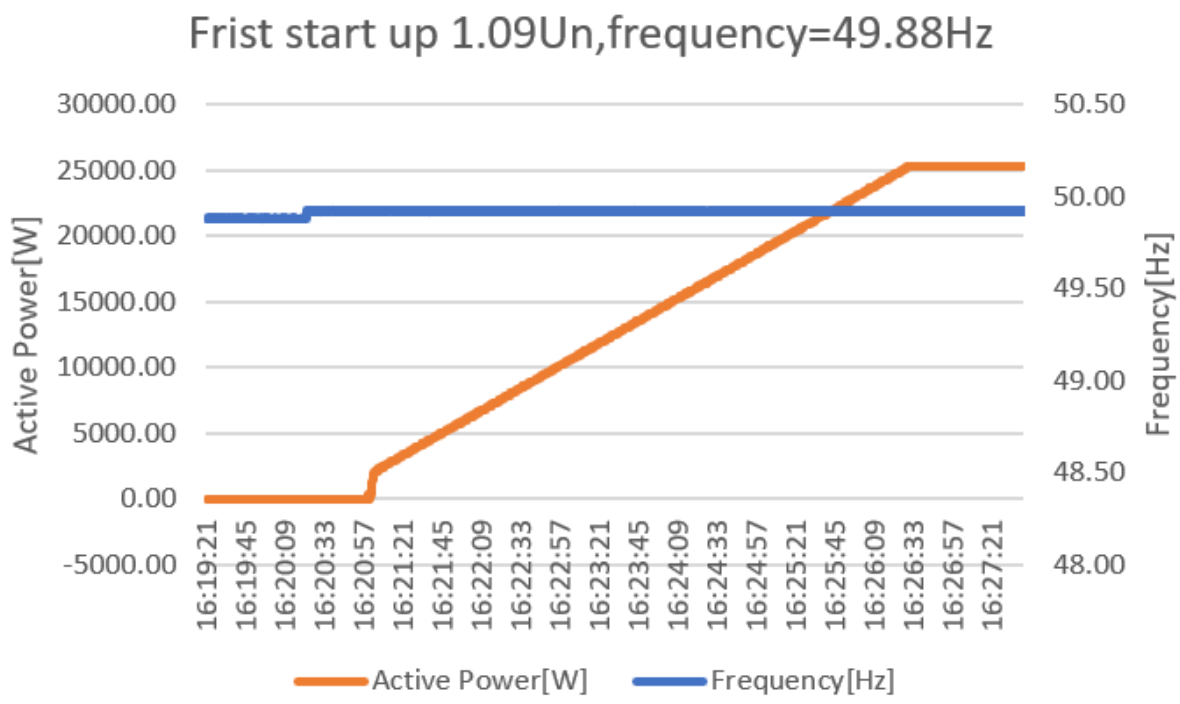
Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
49.88 Hz 1.09Vn	At least 60s	No connection	No connection
Change frequency from step 49.88- Hz to 49.92 Hz, 1.09Vn	--	Connection after 30 s	38.8

Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
50.12 Hz 1.09Vn	At least 60s	No connection	No connection
Change frequency from step 50.12Hz to 50.08Hz, 1.09Vn	--	Connection after 30 s	38.2

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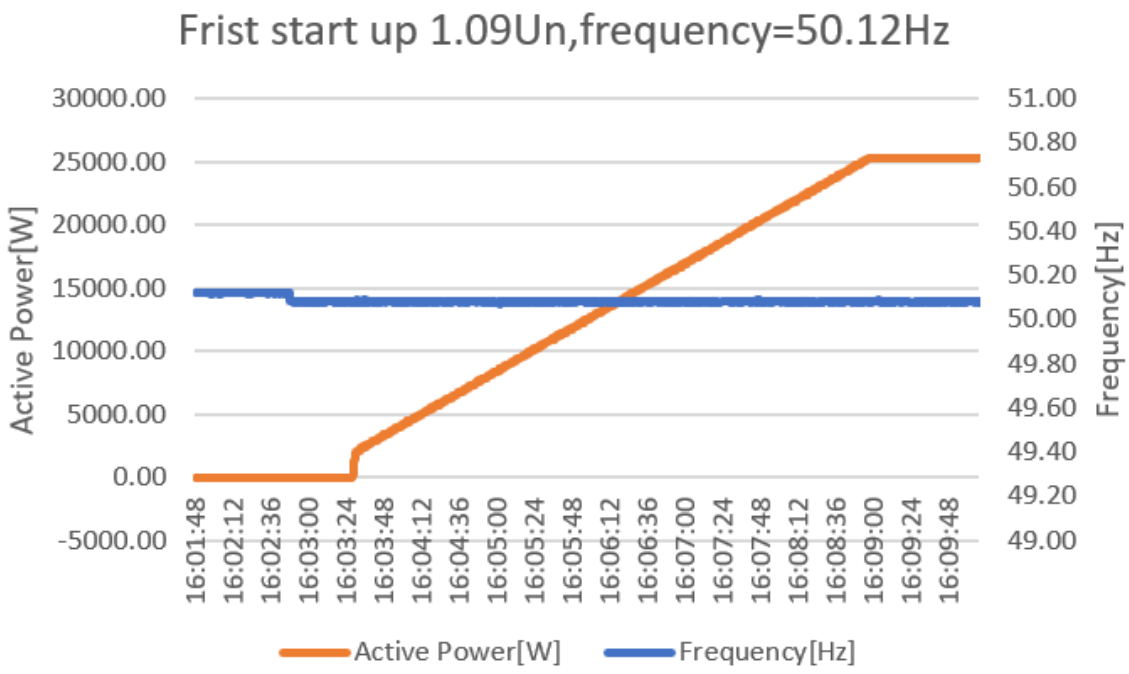
Supplementary information: Gradient should be recorded for at least 30 s until the inverter has the full output power. Max gradient: 20%Pn/min.



B.1.1.1 f) Out of frequency range

f). As for point c), it is necessary to simulate with the inverter in operation a detachment due to the frequency being higher and lower respectively than overfrequency and underfrequency thresholds, in order to verify that, when frequency is restored within the expected range 49.9 Hz < f < 50.1 Hz, the time before reconnection is at least 300 s.

Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 50Hz to 49.78 Hz then change to 49.88 Hz, 0.86Vn	At least 600s	No connection	No connection
Change frequency to 49.92Hz, 0.86Vn	--	Connection after 300 s	300.8

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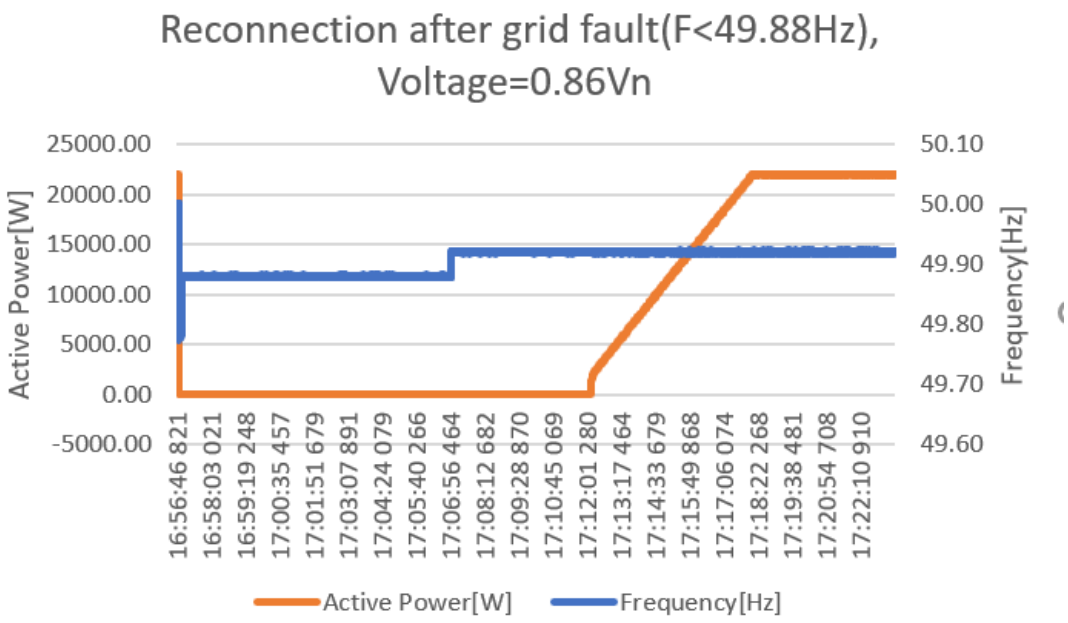
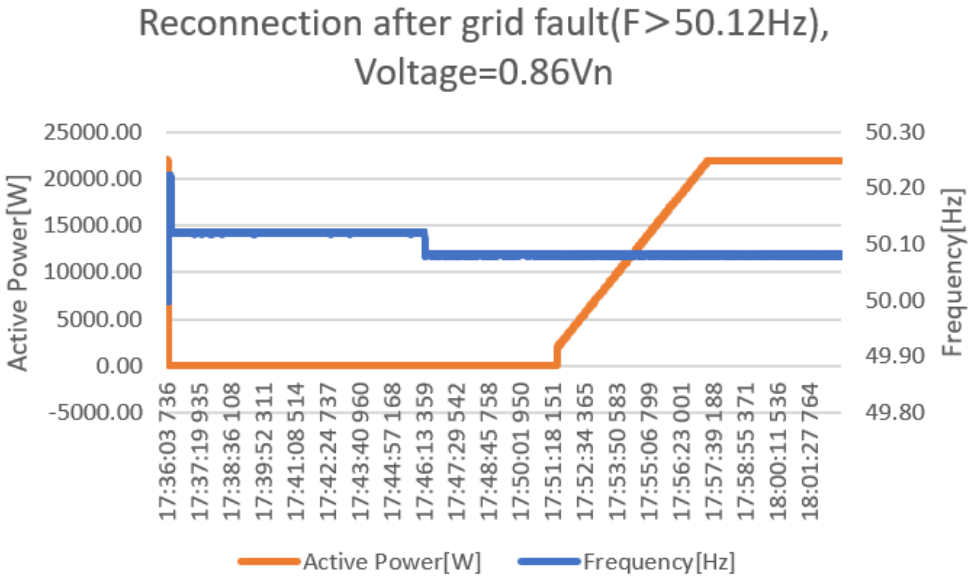
Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 50Hz to 50.22 Hz then change to 50.12 Hz, 0.86Vn	At least 600s	No connection	No connection
Change frequency to 50.08Hz, 0.86Vn	--	Connection after 300 s	303.2

Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



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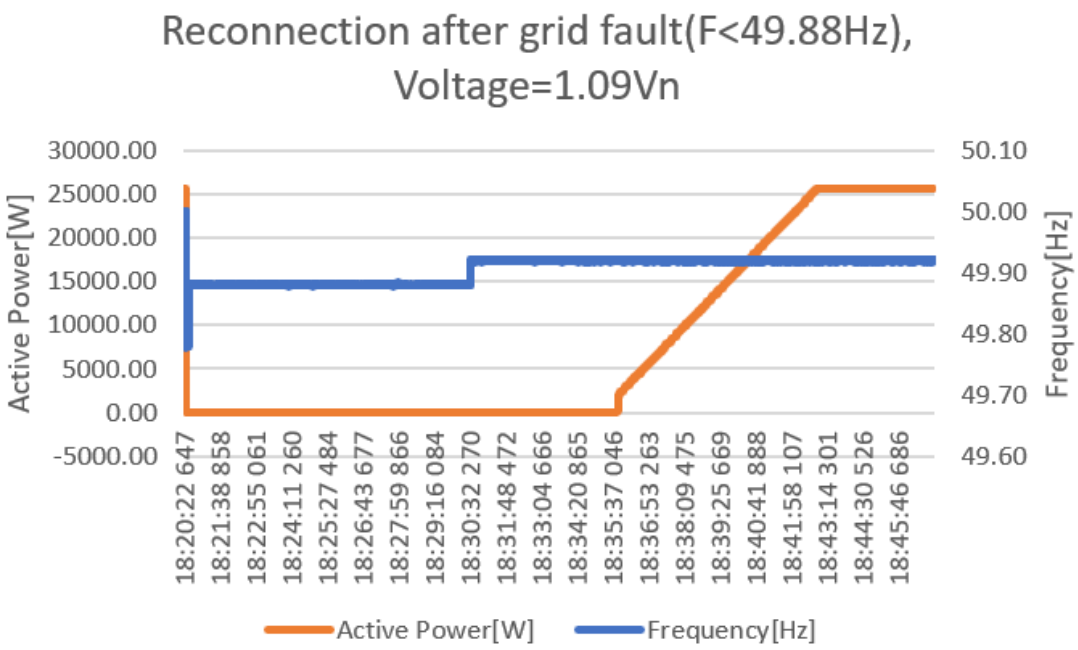
Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 50 Hz to 49.78 Hz then change to 49.88 Hz, 1.09Vn	At least 600s	No connection	No connection
Change frequency to 49.92 Hz, 1.09Vn	--	Connection after 300 s	303.2

Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



Transient program	Holding time	Requirement reconnection time [s]	Reconnection time [s]
Change from 50Hz to 50.22 Hz then change to 50.12 Hz, 1.09Vn	At least 600s	No connection	No connection
Change frequency to 50.08Hz, 1.09Vn	--	Connection after 300 s	303.2

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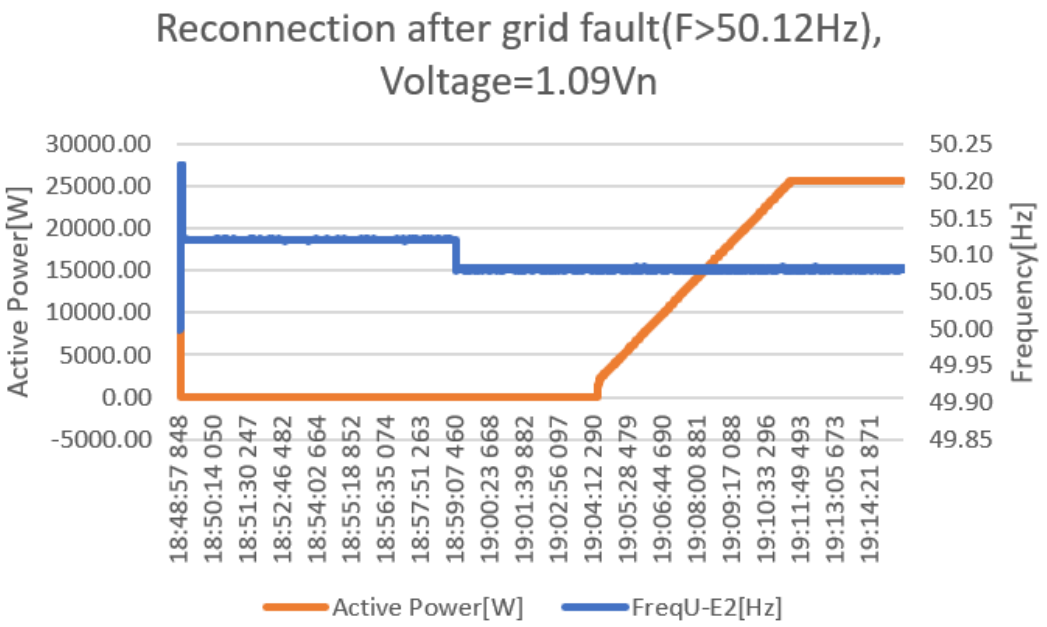
Supplementary information: Gradient should be recorded for at least 300 s until the inverter has the full output power. Max gradient: 20%Pn/min.



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B.1.2.1&B 1.2.2	Reactive power						P
Inductive reactive power absorption, cos φ = 0.9							
Power range (P/Pn)	Active power [W]	Reactive power[var]	Apparent power[VA]	Power factor[cosφ]	Q/P[%]	Deviation ΔQ/Pn [±2.5%]	DC power [W]
0%-10% (*)	1072	-506	1185	0.9042 ind	-47.2%	1.2%	1169
	1072	-506	1185	0.9042 ind	-47.2%	1.2%	1170
	1072	-506	1185	0.9041 ind	-47.2%	1.2%	1168
10%-20% (**)	3704	-1768	4105	0.9024 ind	-47.7%	0.7%	3854
	3704	-1768	4105	0.9024 ind	-47.7%	0.7%	3853
	3706	-1770	4107	0.9023 ind	-47.8%	0.6%	3855
20%-30%	6337	-3019	7020	0.9028 ind	-47.6%	0.8%	6542
	6342	-3022	7025	0.9027 ind	-47.7%	0.7%	6545
	6342	-3023	7026	0.9027 ind	-47.7%	0.7%	6545
30%-40%	8975	-4321	9962	0.9010 ind	-48.1%	0.3%	9237
	8975	-4321	9961	0.9010 ind	-48.1%	0.3%	9237
	8973	-4319	9958	0.9010 ind	-48.1%	0.3%	9232
40%-50%	11357	-5428	12588	0.9022 ind	-47.8%	0.6%	11655
	11336	-5466	12586	0.9007 ind	-48.2%	0.2%	11656
	11340	-5466	12588	0.9008 ind	-48.2%	0.2%	11660
50%-60%	13975	-6704	15500	0.9016 ind	-48.0%	0.4%	14365
	13958	-6784	15520	0.8994 ind	-48.6%	-0.2%	14364
	13959	-6785	15521	0.8994 ind	-48.6%	-0.2%	14364
60%-70%	16604	-7899	18388	0.9030 ind	-47.6%	0.8%	17064
	16583	-7856	18351	0.9037 ind	-47.4%	1.0%	17066
	16588	-7856	18355	0.9038 ind	-47.4%	1.0%	17071
70%-80%	19227	-9197.4	21314	0.9021 ind	-47.8%	0.6%	19782
	19216	-9151	21284	0.9028 ind	-47.6%	0.8%	19783
	19218	-9153	21286	0.9028 ind	-47.6%	0.8%	19786
80%-90%	21799	-10386	24147	0.9028 ind	-47.6%	0.8%	22504
	21840	-10436	24206	0.9023 ind	-47.8%	0.6%	22504
	21845	-10437	24211	0.9023 ind	-47.8%	0.6%	22512
90%-100% (***)	24174	-11550	26792	0.9023 ind	-47.8%	0.6%	24978
	24212	-11585	26841	0.9020 ind	-47.8%	0.6%	24978
	24221	-11596	26854	0.9020 ind	-47.9%	0.5%	24992
Inductive reactive power absorption, Q=Qmin							

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Power range (P/Pn)	Active power [W]	Reactive power[var]	Apparent power[VA]	Power factor[cosφ]	Q/Pn[%]	Deviation ΔQ/Sn [±5.0%]	DC power[W]
0%-10% (*)	1046	-12040	12085	0.0866 ind	-48.2%	0.2%	1323
	1047	-12040	12086	0.0867 ind	-48.2%	0.2%	1326
	1045	-12041	12086	0.0864 ind	-48.2%	0.2%	1322
10%-20% (**)	3685	-11999	12552	0.2936 ind	-48.0%	0.4%	3983
	3687	-12000	12553	0.2937 ind	-48.0%	0.4%	3987
	3688	-11999	12553	0.2938 ind	-48.0%	0.4%	3987
20%-30%	6328	-12015	13580	0.4660 ind	-48.1%	0.3%	6660
	6325	-12014	13578	0.4659 ind	-48.1%	0.3%	6655
	6327	-12014	13578	0.4660 ind	-48.1%	0.3%	6657
30%-40%	8957	-12031	15000	0.5972 ind	-48.1%	0.3%	9327
	8960	-12030	15000	0.5973 ind	-48.1%	0.3%	9332
	8958	-12031	15000	0.5972 ind	-48.1%	0.3%	9329
40%-50%	11324	-12032	16524	0.6854 ind	-48.1%	0.3%	11742
	11326	-12032	16524	0.6854 ind	-48.1%	0.3%	11744
	11326	-12031	16524	0.6855 ind	-48.1%	0.3%	11744
50%-60%	13956	-12001	18406	0.7582 ind	-48.0%	0.4%	14439
	13958	-12001	18408	0.7583 ind	-48.0%	0.4%	14441
	13955	-11999	18405	0.7582 ind	-48.0%	0.4%	14436
60%-70%	16591	-11993	20472	0.8104 ind	-48.0%	0.4%	17142
	16608	-11995	20487	0.8107 ind	-48.0%	0.4%	17160
	16610	-11996	20489	0.8107 ind	-48.0%	0.4%	17162
70%-80%	19239	-12010	22680	0.8483 ind	-48.0%	0.4%	19863
	19240	-12009	22680	0.8483 ind	-48.0%	0.4%	19866
	19240	-12009	22680	0.8483 ind	-48.0%	0.4%	19864
80%-90%	21865	-12038	24960	0.8760 ind	-48.2%	0.2%	22568
	21863	-12037	24958	0.8760 ind	-48.1%	0.3%	22566
	21857	-12036	24952	0.8760 ind	-48.1%	0.3%	22561
90%-100% (***)	24220	-12049	27052	0.8953 ind	-48.2%	0.2%	24998
	24217	-12043	27046	0.8954 ind	-48.2%	0.2%	24993
	24217	-12040	27046	0.8954 ind	-48.2%	0.2%	24993

Capacitive reactive power supply cos φ = 0.9							
Power range (P/Pn)	Active power [W]	Reactive power[var]	Apparent power[VA]	Power factor[cosφ]	Q/P[%]	Deviation ΔQ/Pn [±2.5%]	DC power[W]
0%-10% (*)	1069	526	1192	0.8971 cap	49.2%	0.8%	1150

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	1070	526	1193	0.8973 cap	49.1%	0.7%	1152
	1070	526	1193	0.8973 cap	49.1%	0.7%	1152
10%-20% (**)	3706	1755	4101	0.9038 cap	47.4%	-1.0%	3831
	3706	1755	4101	0.9037 cap	47.4%	-1.0%	3834
	3709	1756	4103	0.9038 cap	47.3%	-1.1%	3835
20%-30%	6344	3100	7062	0.8984 cap	48.9%	0.5%	6525
	6340	3098	7057	0.8985 cap	48.9%	0.5%	6520
	6342	3098	7058	0.8985 cap	48.9%	0.5%	6522
30%-40%	8983	4346	9979	0.9002 cap	48.4%	0.0%	9221
	8978	4343	9973	0.9002 cap	48.4%	0.0%	9214
	8980	4344	9975	0.9002 cap	48.4%	0.0%	9217
40%-50%	11353	5455	12595	0.9013 cap	48.1%	-0.3%	11651
	11352	5452	12593	0.9014 cap	48.0%	-0.4%	11649
	11351	5450	12592	0.9015 cap	48.0%	-0.4%	11648
50%-60%	13983	6628	15475	0.9036 cap	47.4%	-1.0%	14363
	13987	6628	15478	0.9037 cap	47.4%	-1.0%	14368
	13982	6628	15474	0.9036 cap	47.4%	-1.0%	14363
60%-70%	16621	7962	18430	0.9018 cap	47.9%	-0.5%	17082
	16620	7963	18429	0.9018 cap	47.9%	-0.5%	17081
	16620	7964	18429	0.9018 cap	47.9%	-0.5%	17081
70%-80%	19249	9275	21367	0.9009 cap	48.2%	-0.2%	19802
	19251	9273	21368	0.9009 cap	48.2%	-0.2%	19801
	19248	9273	21365	0.9009 cap	48.2%	-0.2%	19801
80%-90%	21872	10493	24259	0.9016 cap	48.0%	-0.4%	22521
	21865	10492	24252	0.9016 cap	48.0%	-0.4%	22516
	21869	10492	24256	0.9016 cap	48.0%	-0.4%	22520
90%-100% (***)	24226	11577	26850	0.9023 cap	47.8%	-0.6%	24964
	24228	11578	26853	0.9023 cap	47.8%	-0.6%	24968
	24227	11577	26851	0.9023 cap	47.8%	-0.6%	24966

Capacitive reactive power supply, Q=Qmax

Power range (P/Pn)	Active power [W]	Reactive power[var]	Apparent power[VA]	Power factor[cosφ]	Q/Pn[%]	Deviation ΔQ/Sn [±5.0%]	DC power[W]
0%-10% (*)	1036	12080	12124	0.0854 cap	48.3%	-0.1%	1276
	1035	12080	12124	0.0854 cap	48.3%	-0.1%	1275
	1038	12080	12125	0.0856 cap	48.3%	-0.1%	1276
	3691	12061	12614	0.2926 cap	48.2%	-0.2%	3957

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10%-20% (**)	3689	12059	12611	0.2925 cap	48.2%	-0.2%	3955
	3691	12061	12614	0.2926 cap	48.2%	-0.2%	3958
20%-30%	6325	12074	13631	0.4640 cap	48.3%	-0.1%	6621
	6321	12071	13626	0.4639 cap	48.3%	-0.1%	6620
	6322	12042	13601	0.4648 cap	48.2%	-0.2%	6620
30%-40%	8957	12059	15022	0.5962 cap	48.2%	-0.2%	9294
	8957	12062	15024	0.5962 cap	48.2%	-0.2%	9295
	8952	12058	15018	0.5961 cap	48.2%	-0.2%	9291
40%-50%	11328	12061	16547	0.6846 cap	48.2%	-0.2%	11709
	11322	12059	16541	0.6844 cap	48.2%	-0.2%	11702
	11325	12061	16545	0.6845 cap	48.2%	-0.2%	11703
50%-60%	13960	12031	18429	0.7575 cap	48.1%	-0.3%	14406
	13959	12037	18432	0.7573 cap	48.1%	-0.3%	14405
	13961	12035	18433	0.7574 cap	48.1%	-0.3%	14407
60%-70%	16592	12012	20484	0.8100 cap	48.0%	-0.4%	17104
	16594	12012	20486	0.8100 cap	48.0%	-0.4%	17104
	16592	12013	20484	0.8100 cap	48.1%	-0.3%	17100
70%-80%	19223	12000	22661	0.8483 cap	48.0%	-0.4%	19804
	19223	11999	22661	0.8483 cap	48.0%	-0.4%	19806
	19218	12000	22657	0.8482 cap	48.0%	-0.4%	19799
80%-90%	21849	11999	24927	0.8765 cap	48.0%	-0.4%	22508
	21841	11999	24920	0.8764 cap	48.0%	-0.4%	22500
	21841	12003	24922	0.8764 cap	48.0%	-0.4%	22496
90%-100% (***)	24217	11974	27016	0.8964 cap	47.9%	-0.5%	24956
	24218	11974	27017	0.8964 cap	47.9%	-0.5%	24956
	24217	11972	27015	0.8964 cap	47.9%	-0.5%	24951

Reactive power(Q=0)

Power range (P/Pn)	Active power [W]	Reactive power[var]	Apparent power[VA]	Power factor[cosφ]	Q/Pn[%]	Deviation ΔQ/Sn [±5.0%]	DC power[W]
0%-10% (*)	1064	145	1136	0.9368 cap	0.6%	0.6%	1098
	1062	148	1134	0.9362 cap	0.6%	0.6%	1097
	1063	145	1135	0.9365 cap	0.6%	0.6%	1095
10%-20% (**)	3708	124	3729	0.9942 cap	0.5%	0.5%	3789
	3712	124	3734	0.9942 cap	0.5%	0.5%	3793
	3711	123	3733	0.9942 cap	0.5%	0.5%	3793
20%-30%	6346	395	6358	0.9980 cap	1.6%	1.6%	6480

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	6344	391	6356	0.9981 cap	1.6%	1.6%	6477
	6338	385	6350	0.9981 cap	1.5%	1.5%	6470
30%-40%	8980	383	8988	0.9991 cap	1.5%	1.5%	9171
	8979	379	8987	0.9991 cap	1.5%	1.5%	9170
	8980	382	8988	0.9991 cap	1.5%	1.5%	9171
40%-50%	11347	387	11354	0.9994 cap	1.5%	1.5%	11594
	11352	389	11359	0.9994 cap	1.6%	1.6%	11596
	11349	391	11355	0.9994 cap	1.6%	1.6%	11595
50%-60%	13982	400	13988	0.9996 cap	1.6%	1.6%	14308
	13983	399	13989	0.9996 cap	1.6%	1.6%	14308
	13984	399	13990	0.9996 cap	1.6%	1.6%	14311
60%-70%	16613	411	16618	0.9997 cap	1.6%	1.6%	17011
	16613	414	16618	0.9997 cap	1.7%	1.7%	17014
	13984	399	13990	0.9996 cap	1.6%	1.6%	14311
70%-80%	19240	439	19245	0.9997 cap	1.8%	1.8%	19722
	19240	425	19245	0.9998 cap	1.7%	1.7%	19725
	19240	445	19245	0.9997 cap	1.8%	1.8%	19723
80%-90%	21868	452	21872	0.9998 cap	1.8%	1.8%	22437
	21864	480	21869	0.9998 cap	1.9%	1.9%	22433
	21868	462	21873	0.9998 cap	1.8%	1.8%	22438
90%-100% (***)	24229	477	24233	0.9998 cap	1.9%	1.9%	24877
	24226	442	24230	0.9998 cap	1.8%	1.8%	24873
	24225	436	24229	0.9998 cap	1.7%	1.7%	24871

(*) For output power less than 10% of nominal power, the generator, must not exchange reactive greater than 10% of the nominal power.
(**) For output powers of less than 20% of rated power the generator must not exchange a reactive power higher than 10% of the rated power.
(***) Ensure that the minimum requirement for cosφ is sustained steadily when thermal balance is achieved

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B.1.2.3	Reactive power exchange at an assigned level			P
	Setpoint of reactive power Q/Pn[%]	Measured reactive power Q/Pn[%]	Deviation from setpoint ΔQ/Pn[%]	Limit ΔQ/Pn[%]
$-Q_{min}$	-48.43	-48.20%	0.23%	±2.5%
0	0	1.46%	1.46%	±2.5%
$+Q_{max}$	+48.43	48.32%	0.11%	±2.5%

B.1.2.4	Response time to an assigned step level change					P
Test 1: 50% Pn						
Point	Active power [W]	Transient	Voltage [Vac]	Q_{E60} [Var]	Tr [s]	Limit [s]
1	12704	0 -> Qmax|ind	230.1 230.1 230.1	140→-12018	2.1	10
2	12794	Qmax|ind -> Qmax|cap	230.1 230.1 230.1	-12018→11930	4.4	10
3	12714	Qmax|cap -> 0	230.1 230.1 230.1	11930→160	2.4	10
Test 2: 100% Pn						
Point	Active power [W]	Transient	Voltage [Vac]	Q_{E60} [Var]	Tr [s]	Limit [s]
1	25013	0 -> Qmax|ind	230.1 230.2 230.1	156→-11975	3.0	10
2	25023	Qmax|ind -> Qmax|cap	230.2 230.1 230.1	-11975→12030	4.4	10
3	25705	Qmax|cap -> 0	230.1 230.2 230.1	12030→211	2.4	10

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B.1.2.5	Automatic supply of reactive power according to a characteristic curve cos φ = f (P)						P
P/Pn [%]	Active power P [W]	Vout set-point [V]	Reactive power Q(Var)	Cos φ measured	Cos φ set-point	ΔQ/Pn[%]	Limit ΔQ/Pn[%]
20 %	5049	1.04 Vn	273	0.9985 cap	1.00	1.1%	±2.5%
30 %	7675	1.04 Vn	238	0.9995 cap	1.00	1.0%	±2.5%
40 %	10330	1.04 Vn	249	0.9997 cap	1.00	1.0%	±2.5%
50 %	12717	1.04 Vn	276	0.9998 cap	1.00	1.1%	±2.5%
60 %	15337	1.04 Vn	151	0.9999 cap	1.00	0.6%	±2.5%
60 %	15302	1.06Vn	-3018	0.9811 ind	0.98	0.1%	±2.5%
70 %	17915	1.06 Vn	-5184	0.9606 ind	0.96	0.3%	±2.5%
80 %	20533	1.06 Vn	-7455	0.9400 ind	0.94	0.8%	±2.5%
90 %	22884	1.06 Vn	-9777	0.9196 ind	0.92	0.8%	±2.5%
100 %*	24993	1.06 Vn	-12188	0.8988 ind	0.90	0.3%	±2.5%
100 %*	25007	1.01 Vn	-11975	0.9019 ind	0.90	0.5%	±2.5%
100 %	25023	0.99 Vn	-409	0.9999 ind	1.00	1.6%	±2.5%

Supplementary information:

1.Default lock-in voltage: 1.05Vn ; Default lock-out voltage: 1.00Vn.

2. “*” : The active power does not reach the set value at this time because of the maximum apparent power limitation.

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B.1.2.6	**Automatic exchange of reactive power according to a characteristic curve Q = f (V)**	P

V_{1S} = 1.08 Vn; V_{2S} = 1.1 Vn; V_{1i} = 0.92 Vn; V_{2i} = 0.9 Vn;

as well as the value of the lock-in of active power (default value = 0.2 Pn).

as well as the value of the lock-out of voltage (default value = 1.0 Un).

Qmin

P/Pn [%] Set-point	Vac [V] set-point	P [W] Measured	U [V] measured	Q [Var] measured	Q [Var] expected	Δ Q (≤ ± 2.5 % Pn)
<20%	1.07 Vn	3740	246.1 246.5 246.1	449	≈0 (< ± 2.5 % Pn)	1.8%
<20%	1.09 Vn	3738	250.1 250.1 250.2	476	≈0 (< ± 2.5 % Pn)	1.9%
<20% → 30%	1.09 Vn	6326	250.1 250.2 250.1	-5910	-0.5 Qmin (within 10sec)	0.6%
40 %	1.09 Vn	10280	250.2 250.2 250.3	-6049	-0.5 Qmin	0.0%
50 %	1.09 Vn	12610	250.2 250.1 250.2	-6095	-0.5 Qmin	-0.2%
60 %	1.09 Vn	15143	250.2 250.2 250.3	-6139	-0.5 Qmin	-0.3%
70 %	1.09 Vn	17821	250.1 250.2 250.1	-6188	-0.5 Qmin	-0.5%
80 %	1.09 Vn	20516	250.2 250.3 250.2	-6240	-0.5 Qmin	-0.7%
90 %	1.09 Vn	22891	250.1 250.2 250.1	-6254	-0.5 Qmin	-0.8%
100 %	1.09 Vn	24864	250.2 250.1 250.1	-6240	-0.5 Qmin	-0.7%
100 %*	1.1 Vn	24833	253.1 253.2 253.3	-12216	-Qmin	-0.4%
100% - 10%	1.1 Vn	2220	252.8 252.9 253.0	-11770	-Qmin	1.3%
≤5%	1.1 Vn	1129	252.8 252.9 253.0	558	≈0 (< ± 2.5 % Pn)	2.2%

Qmax

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P/Pn [%] Set-point	Vac [V] set-point	P [W] Measured	V_{pos} [V] measured	Q [Var] measured	Q [Var] expected	Δ Q (≤ ± 2.5 % Pn)
<20%	0.93 Vn	3730	214.0 214.0 214.0	251	≈0 (< ± 2.5 % Pn)	1.0%
<20%	0.91 Vn	3736	209.3 209.2 209.2	230	≈0 (< ± 2.5 % Pn)	0.9%
<20% → 30%	0.91 Vn	6354	209.4 209.3 209.4	6095	0.5 Qmax (within 10sec)	0.2%
40 %	0.91 Vn	10301	209.4 209.4 209.3	6059	0.5 Qmax	0.0%
50 %	0.91 Vn	12668	209.3 209.3 209.3	6093	0.5 Qmax	0.2%
60 %	0.91 Vn	15300	209.3 209.3 209.4	6017	0.5 Qmax	-0.1%
70 %	0.91 Vn	17921	209.3 209.1 209.3	6087	0.5 Qmax	0.1%
80 %	0.91 Vn	20544	209.3 209.3 209.3	6043	0.5 Qmax	0.0%
90 %	0.91 Vn	22372	209.3 209.4 209.3	6040	0.5 Qmax	-0.1%
100 %**	0.91 Vn	24319	209.7 209.7 209.8	6092	0.5 Qmax	-0.2%
100 % **	0.90 Vn	21971	207.2 207.3 207.3	11876	Qmax	0.9%
10%	0.90 Vn	2542	206.9 207.0 207.1	12194	Qmax	-0.3%
≤5%	0.90 Vn	1168	206.9 206.9 207.0	417	≈0 (< ± 2.5 % Pn)	-1.7%

Supplementary information:

1. "*" : The active power does not reach the set value at this time because of the maximum apparent power limitation.

2. "**": Because of limitation of output current, the active power and apparent power were limited at 0.90Vn, and could not reach required 100% rated active power value when deliver Q setting.

3. Expected $Q_{max.\ over\text{-}excited}$ and $Q_{max.\ under\text{-}excited}$ are based on cos θ = ±0.9

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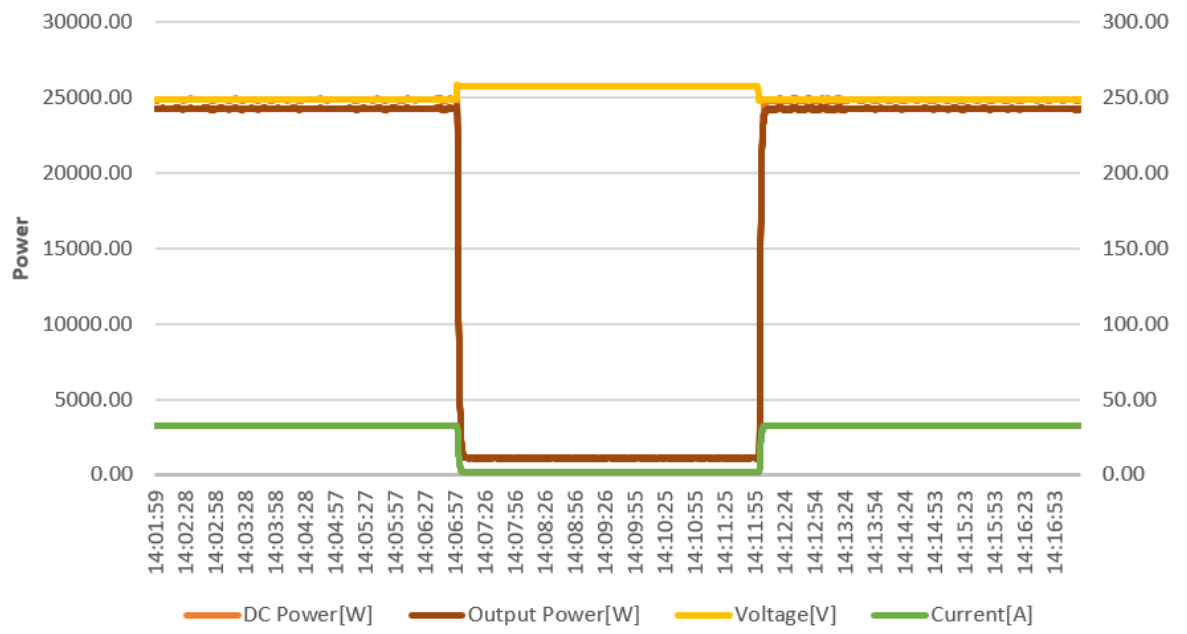
B.1.3.1	Automatic limitation the active power for voltage value close to 110% of the nominal voltage				P
	Voltage set-point (V)	Grid voltage (V)	Current (A)	Output power (W)	Limit
Step 1)	-2% V declared	248.4	34.37	24255	-
Step 2)	+2% V declared	257.6	5.22	1096	≤ 20% Pn
Step 3)	-2% V declared	248.9	34.35	24248	-



Supplementary information: Declared activation threshold voltage: 110%Vn.

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B.1.3.2	Control of active power in the presence of transients on the transmission network	P

Over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient droop s=2.6%, (a gradient of 76.92% of P_{imax} per hertz)

Test Sequence A, P=100% Pn

Step #	Expected power (W)	Frequency (Hz)	Measured active power (W)	Δ P(W)	Δ P/Pn[%]	Limit
1 (t1)	--	47.51	25208	--	--	--
2 (t2)	--	50+0.15	25215	--	--	--
3 (t3)	21334	50+0.40	20885	449	1.8%	±2.5% Pn
4 (t4)	17456	50+0.60	17023	433	1.7%	±2.5% Pn
5 (t5)	204	50+1.49	263	59	0.2%	±2.5% Pn
6 (t6)	--	50+0.11	5	--	--	±2.5% Pn
7 (t7)	--	50	See below table	--	--	--

Step #	Freq (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active power (W)	ΔP Arise during next 1 min (W)	Gradient of charge rate ΔP/t (%P_{imax}-P_{imin}W/min)	Limit rate (≤20% Pimax-Pimin) (Yes/No)
7 (t7)	50.00	0.0min	38	--	--	--
7 (t7)	50.00	0.0min	The time that the active power start increases after the frequency change to 50.00Hz (s)			302s
7 (t7)	50.00	0.5min	1596	3347	13.4%	Yes
7 (t7)	50.00	1.0min	3231	3326	13.3%	Yes
7 (t7)	50.00	1.5min	4943	3255	13.0%	Yes
7 (t7)	50.00	2.0min	6557	3327	13.3%	Yes
7 (t7)	50.00	2.5min	8198	3273	13.1%	Yes
7 (t7)	50.00	3.0min	9884	3230	12.9%	Yes
7 (t7)	50.00	3.5min	11471	3339	13.4%	Yes
7 (t7)	50.00	4.0min	13114	3289	13.2%	Yes
7 (t7)	50.00	4.5min	14810	3222	12.9%	Yes
7 (t7)	50.00	4.5min	16403	3353	13.4%	Yes
7 (t7)	50.00	5.0min	18032	3294	13.2%	Yes
7 (t7)	50.00	5.5min	19756	3188	12.8%	Yes
7 (t7)	50.00	6.0min	21326	3293	13.2%	Yes

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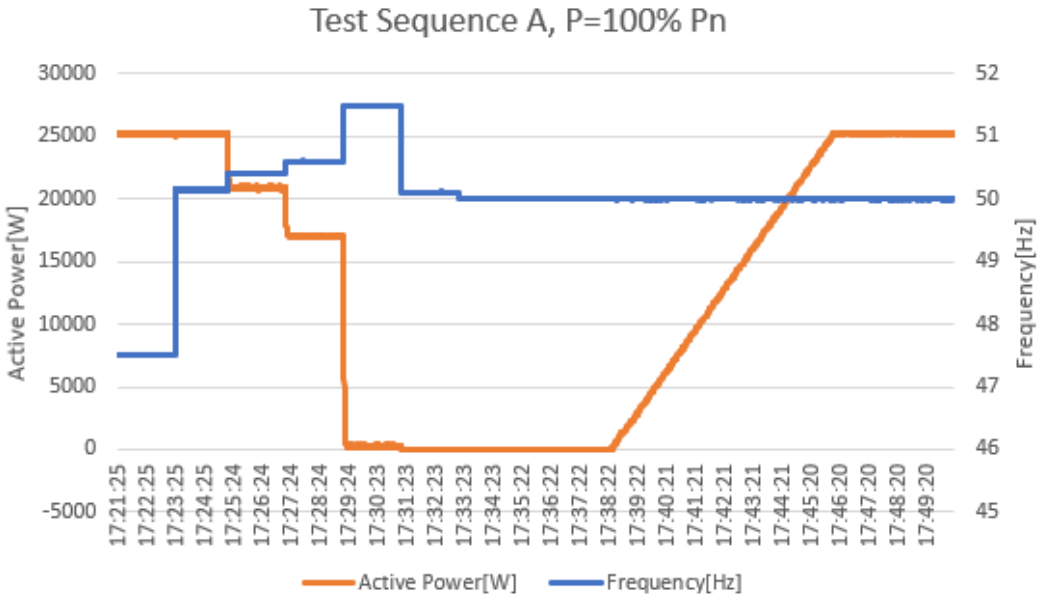
7 (t7)	50.00	6.5min	22944	2243	9.0%	Yes
7 (t7)	50.00	7.0min	24619	579	2.3%	Yes
7 (t7)	50.00	7.5min	25187	-	-	-
7 (t7)	50.00	8.0min	25198	-	-	-

Supplementary information:

File recovery after over-frequency transient:



Test Sequence B, P=50%Pn: inverter DC input power is set to 50% of maximum active output power first. After the inverter step into frequency range above 50.2Hz, the inverter available input power is set to 100% of maximum active output.

Step #	Expected power (W)	Frequency (Hz)	Measured active power (W)	Δ P	Δ P/Pn	Limit
1 (t'1)	50% Pn	47.51	12522	--	--	±2.5% Pn
2 (t'2)	50% Pn	50+0.15	12526	--	--	±2.5% Pn
3 (t'3)	10597	50+0.40	10435	162	0.6%	±2.5% Pn
4 (t'4)	8671	50+0.60	8465	206	0.8%	±2.5% Pn
5 (t'5)	198	50+1.49	2	196	0.8%	±2.5% Pn
6 (t'6)	--	50+0.11	2	--	--	±2.5% Pn
7 (t'7)	--	50	See below table	--	--	--
Step #	Freq (Hz)	Time after reconnection (min)	Measured active power (W)	ΔP Arise during next 1 min (W)	Gradient of charge rate ΔP/t (W/ min,)	Limit rate (≤20% $P_{imax-Pmin}$) (Yes/No)

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7 (t'7)	50.00	0.0min	2	1850	14.8%	--
7 (t'7)	50.00	0.0min	The time that the active power start increases after the frequency change to 50.00Hz (s)			304s
7 (t'7)	50.00	0.5min	807	1874	15.0%	Yes
7 (t'7)	50.00	1.0min	1852	1731	13.8%	Yes
7 (t'7)	50.00	1.5min	2681	1786	14.3%	Yes
7 (t'7)	50.00	2.0min	3583	1686	13.5%	Yes
7 (t'7)	50.00	2.5min	4467	1796	14.4%	Yes
7 (t'7)	50.00	3.0min	5269	1798	14.4%	Yes
7 (t'7)	50.00	3.5min	6263	1770	14.2%	Yes
7 (t'7)	50.00	4.0min	7067	1832	14.7%	Yes
7 (t'7)	50.00	4.5min	8033	1639	13.1%	Yes
7 (t'7)	50.00	5.0min	8899	1823	14.6%	Yes
7 (t'7)	50.00	5.5min	9672	1829	14.6%	Yes
7 (t'7)	50.00	6.0min	10722	1722	13.8%	Yes
7 (t'7)	50.00	6.5min	11501	--	--	--
7 (t'7)	50.00	7.0min	12444	--	--	--
Mearsure the time when reach P_{imax}						
Step #	Freq (Hz)	Time after reconnection (min)	Measured active power (W)	ΔP Arise during next 1 min (W)	Gradient of charge rate ΔP/t (W/ min,)	Limit rate (≤20%P_{nom}) (Yes/No)
7 (t'7)	50.00	7.0min+30s	14150	3553	14.2%	Yes
7 (t'7)	50.00	7.5min+30s	15901	3570	14.3%	Yes
7 (t'7)	50.00	8.0min+30s	17676	3439	13.8%	Yes
7 (t'7)	50.00	8.5min+30s	19473	3449	13.8%	Yes
7 (t'7)	50.00	9.0min+30s	21280	3601	14.4%	Yes

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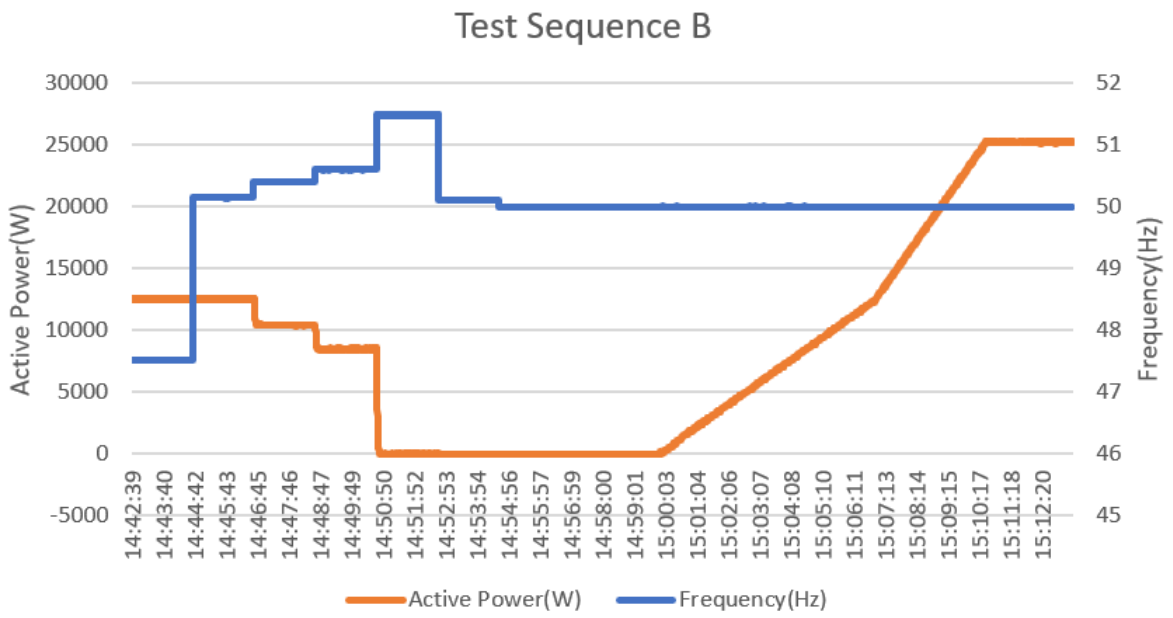
7 (t'7)	50.00	9.5min+30s	23049	2086	8.3%	Yes
7 (t'7)	50.00	10.0min+30s	24710	297	1.2%	Yes
7 (t'7)	50.00	10.5min+30s	25216	--	--	--
7 (t'7)	50.00	11.0min+30s	25273	--	--	--

Supplementary information:

File recovery after over-frequency transient:



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B.1.3.3	Verification of the operating range in voltage and frequency	P

Test 1: V = 110% * Vn; f = 51.5 Hz; P = 100% * Pn; Cos φ = 1 (duration: at least 5 minutes)

Test 2: V = 85% * Vn; f = 50.0 Hz; P = 100% * Pn; Cos φ = 1;

	Voltage (V)	Current (A)	Active power (W)	Apparent power (VA)	Frequency (Hz)	Power factor
Test 1	253.1 253.2 253.2	33.7	25595	25599	51.50	0.9998
Test 2	195.4 195.3 195.4	40.1	23442	23473	50.00	0.9987

Note: For test, the function of LFSM-O is disabled.

B.1.3.3.1	Reduction of active power in the presence of under-frequency transients on the transmission network	P

Step #	The calculated active output power as per feature curve Pminimum (W)	Frequency (Hz)	Measured active power (W)	Deviation of Pshall (W) less than Pmeasure ? (Yes/No)
1 (t1)	100%Pn	50.00	25540	Yes
2 (t2)	100%Pn	49.50	25274	Yes
3 (t3)	95%Pn	49.00	24238	Yes
4 (t4)	90%Pn	48.50	24301	Yes
5 (t5)	85%Pn	48.00	24268	Yes
6 (t6)	80%Pn	47.50	24238	Yes

Supplementary information: N/A

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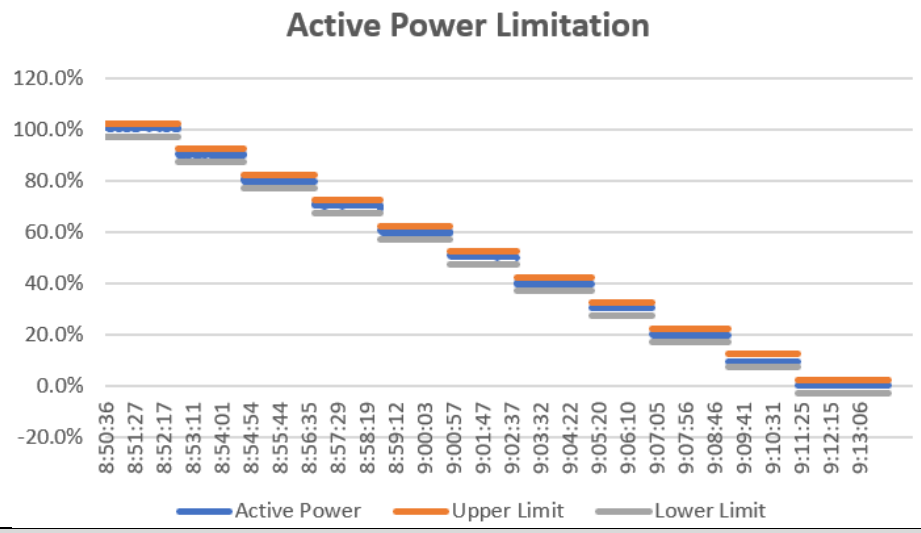
B.1.3.4	Active Power Limitation upon external command from Distributor			P
Set-point P/Pn [%]	Set-point P [W]	Measured P [W]	Accuracy[%Pn]	Required accuracy [%Pn]
100%	25000	25211	0.8%	±2.5%
90%	22500	22627	0.5%	±2.5%
80%	20000	19963	-0.1%	±2.5%
70%	17500	17641	0.6%	±2.5%
60%	15000	15010	0.0%	±2.5%
50%	12500	12633	0.5%	±2.5%
40%	10000	10041	0.2%	±2.5%
30%	7500	7654	0.6%	±2.5%
20%	5000	5028	0.1%	±2.5%
10%	2500	2368	-0.5%	±2.5%
0	0	97	0.4%	±2.5%



Response time measurement after a setting			
100%Pn to 30%Pn	Measured active power (W)	Time for output power last entered 2.5% tolerance band around the set-point	Limit
	24954 -> 7653	9.0s	<50s
100%Pn to 15%Pn	Measured active power (W)	Time for output power last entered 2.5% tolerance band around the set-point	Limit
	24998 -> 3726	10.0s	<60s

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B.1.4.1	Verification of the emission DC component							P
Test is performed at an ambient temperature of 20±2°C								
Power level P/Pn(%)	Active power (W)	Voltage (V)	Current (A)	PF	Cos φ	d.c.(mA)	d.c.(%Ir)	Limit(%Ir)
Phase L1								
33 ± 5%	2800	229.8	12.2	0.9995	0.9995	51.98	0.14%	0.5%
66 ± 5%	5581	230.0	24.3	0.9999	0.9999	42.43	0.12%	0.5%
100 ± 5%	8462	230.1	36.8	0.9999	0.9999	59.03	0.16%	0.5%
Phase L2								
33 ± 5%	2842	229.9	12.4	0.9995	0.9995	137.68	0.38%	0.5%
66 ± 5%	5634	230.1	24.5	0.9999	0.9999	43.40	0.12%	0.5%
100 ± 5%	8524	230.3	37.0	0.9999	0.9999	40.94	0.11%	0.5%
Phase L3								
33 ± 5%	2823	230.0	12.3	0.9991	0.9991	75.45	0.21%	0.5%
66 ± 5%	5621	230.1	24.4	0.9998	0.9998	84.13	0.23%	0.5%
100 ± 5%	8511	230.3	37.0	0.9999	0.9999	93.10	0.26%	0.5%
Test is performed at an ambient temperature of -30±2°C								
Power level P/Pn(%)	Active power (W)	Voltage (V)	Current (A)	PF	Cos φ	d.c.(mA)	d.c.(%Ir)	Limit(%Ir)
Phase L1								
33 ± 5%	2797	229.8	12.2	0.9995	0.9995	28.14	0.08%	0.5%
66 ± 5%	5597	230.0	24.3	0.9999	0.9999	60.09	0.17%	0.5%
100 ± 5%	8473	230.1	36.8	0.9999	0.9999	63.60	0.18%	0.5%
Phase L2								
33 ± 5%	2840	229.9	12.4	0.9995	0.9995	104.58	0.29%	0.5%
66 ± 5%	5650	230.1	24.6	0.9999	0.9999	90.70	0.25%	0.5%
100 ± 5%	8535	230.3	37.1	0.9999	0.9999	79.15	0.22%	0.5%

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Phase L3								
33 ± 5%	2820	229.9	12.3	0.9990	0.9991	84.17	0.23%	0.5%
66 ± 5%	5634	230.1	24.5	0.9997	0.9997	70.83	0.20%	0.5%
100 ± 5%	8520	230.3	37.0	0.9999	0.9999	74.55	0.21%	0.5%
Test is performed at an ambient temperature of 60±2°C								
Power level P/Pn(%)	Active power (W)	Voltage (V)	Current (A)	PF	Cos φ	d.c.(mA)	d.c.(%Ir)	Limit(%Ir)
Phase L1								
33 ± 5%	2796	229.8	12.2	0.9995	0.9995	29.09	0.08%	0.5%
66 ± 5%	5593	230.0	24.3	0.9999	0.9999	64.09	0.18%	0.5%
100 ± 5%	8473	230.2	36.8	0.9999	0.9999	62.50	0.17%	0.5%
Phase L2								
33 ± 5%	2839	229.9	12.4	0.9995	0.9995	103.66	0.29%	0.5%
66 ± 5%	5647	230.1	24.5	0.9999	0.9999	86.79	0.24%	0.5%
100 ± 5%	8535	230.3	37.1	0.9999	0.9999	75.24	0.21%	0.5%
Phase L3								
33 ± 5%	2819	229.9	12.3	0.9990	0.9991	79.64	0.22%	0.5%
66 ± 5%	5631	230.1	24.5	0.9997	0.9997	60.90	0.17%	0.5%
100 ± 5%	8520	230.3	37.0	0.9999	0.9999	79.68	0.22%	0.5%

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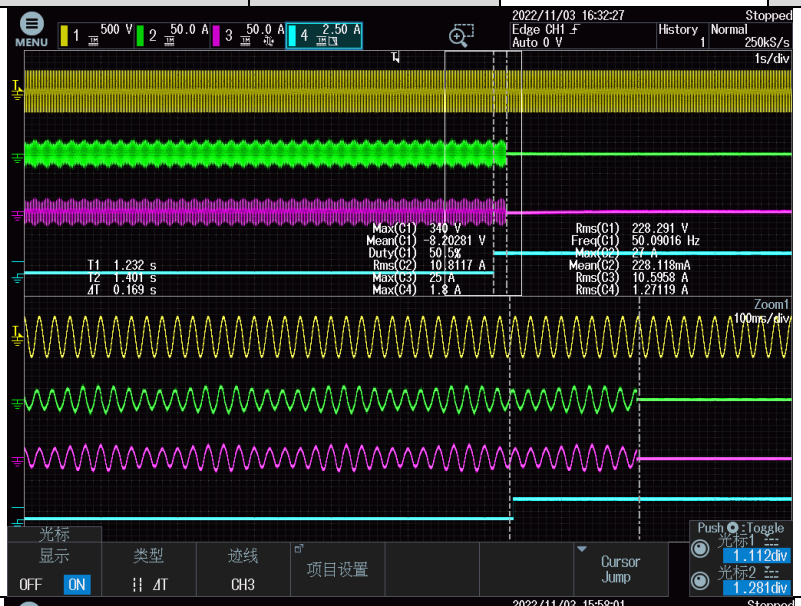
B.1.4.2	Verification of protection against the DC component of the output current	P

Test is performed at an ambient temperature of 20±2°C

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.172	
	100 ± 5%		0.172	

33 ± 5%



66 ± 5%

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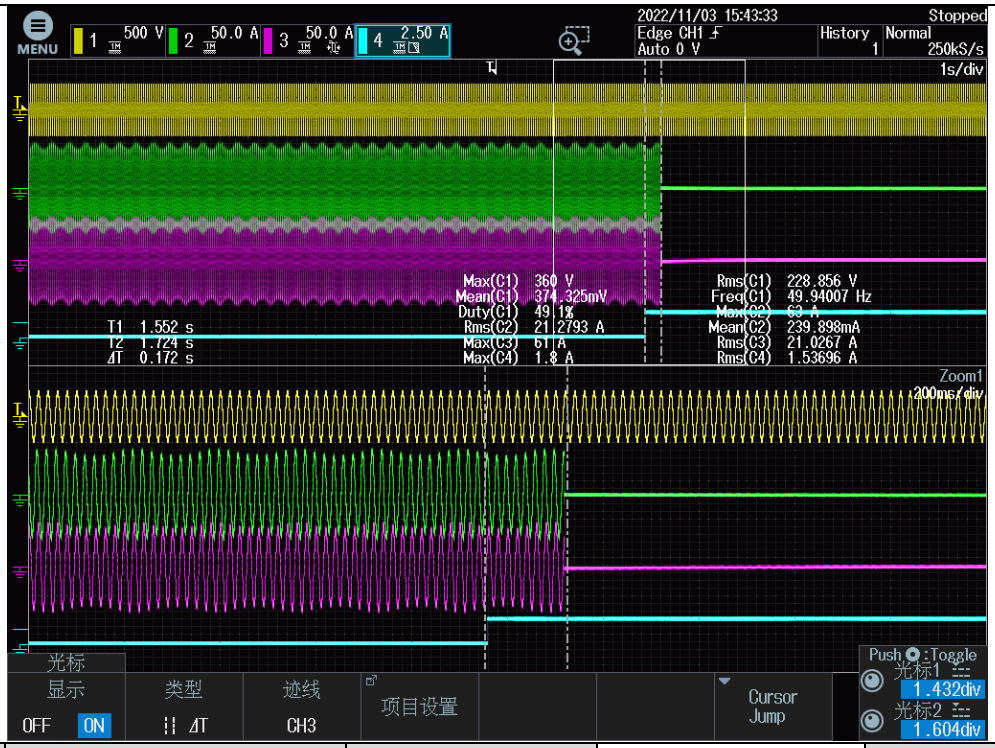
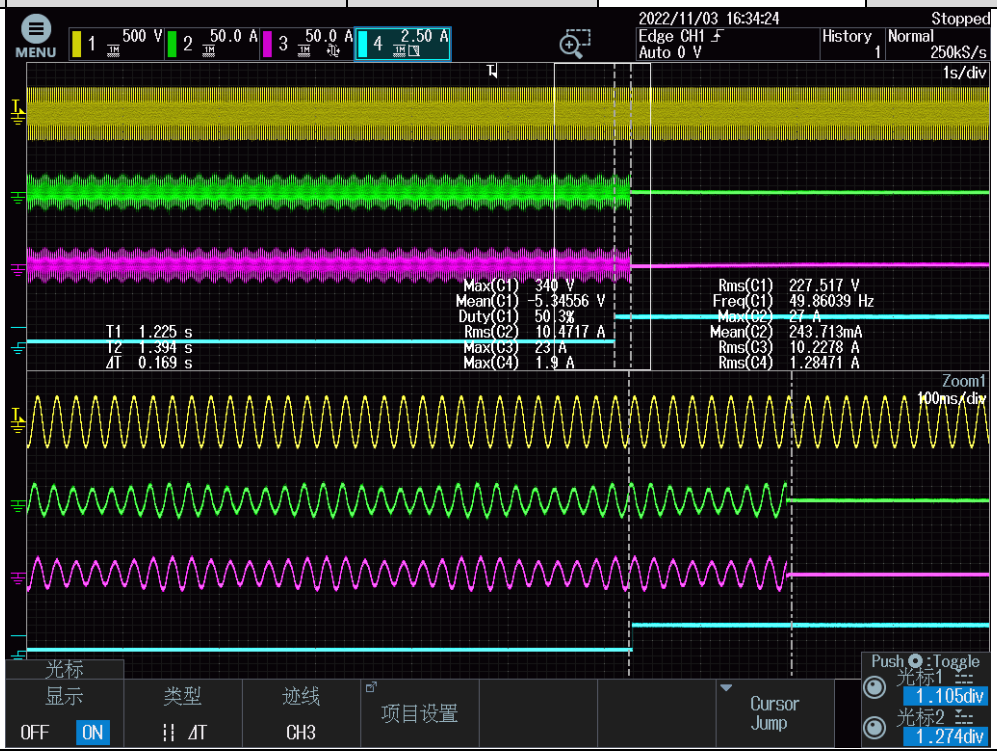
100 ± 5%				
L2	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.172	
	100 ± 5%		0.172	
33 ± 5%				

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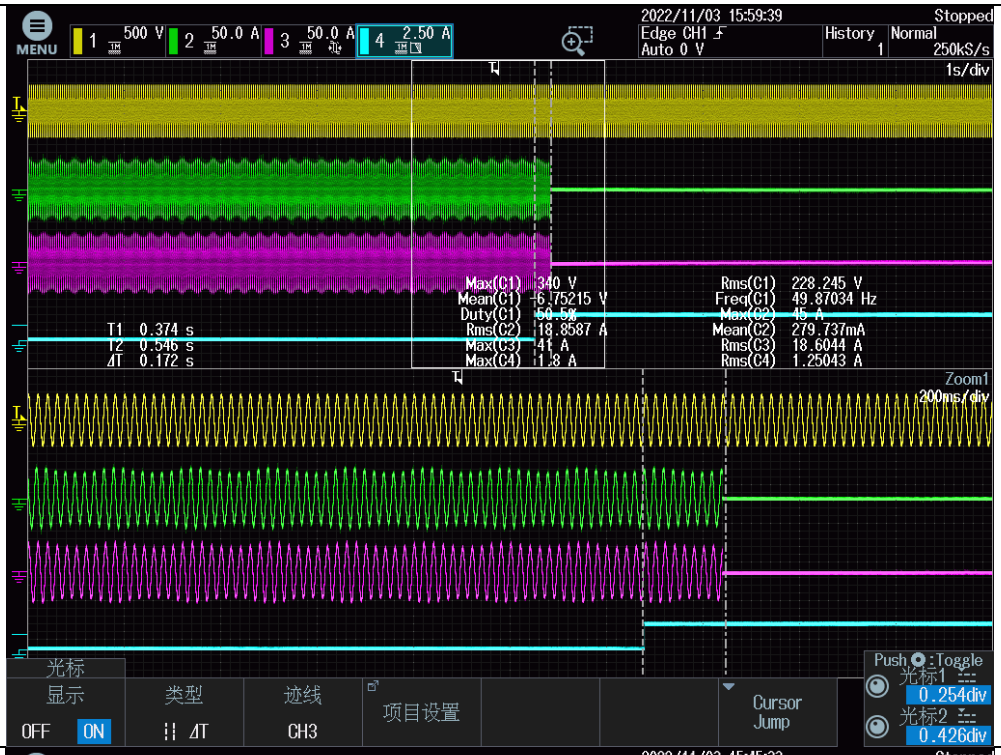
66 ± 5%				
100 ± 5%				
L3	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.172	
	100 ± 5%		0.172	

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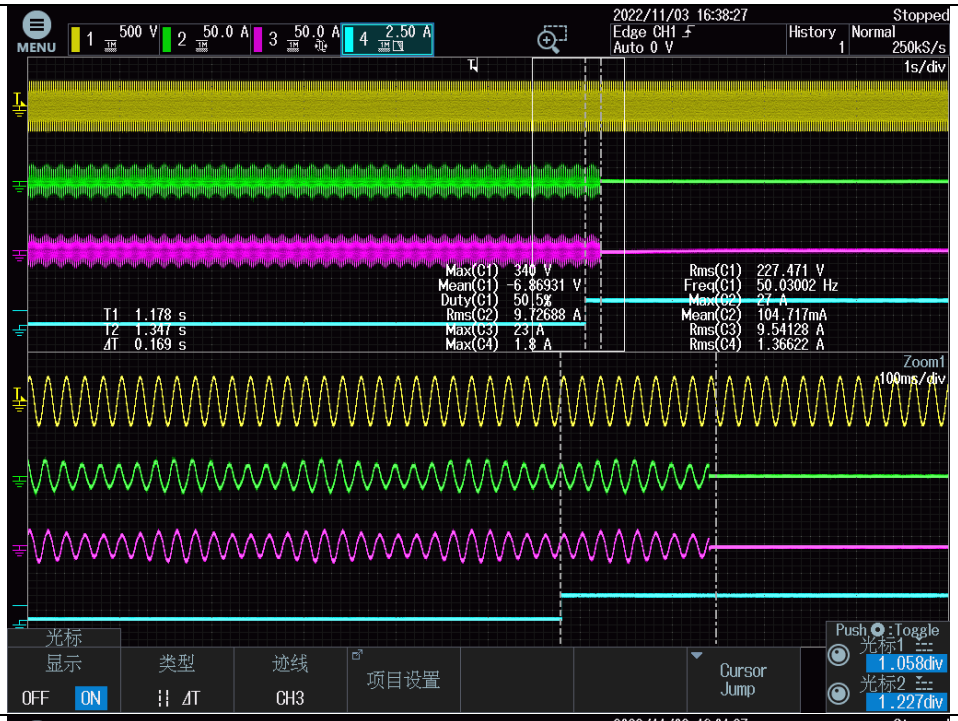
33 ± 5%	
66 ± 5%	

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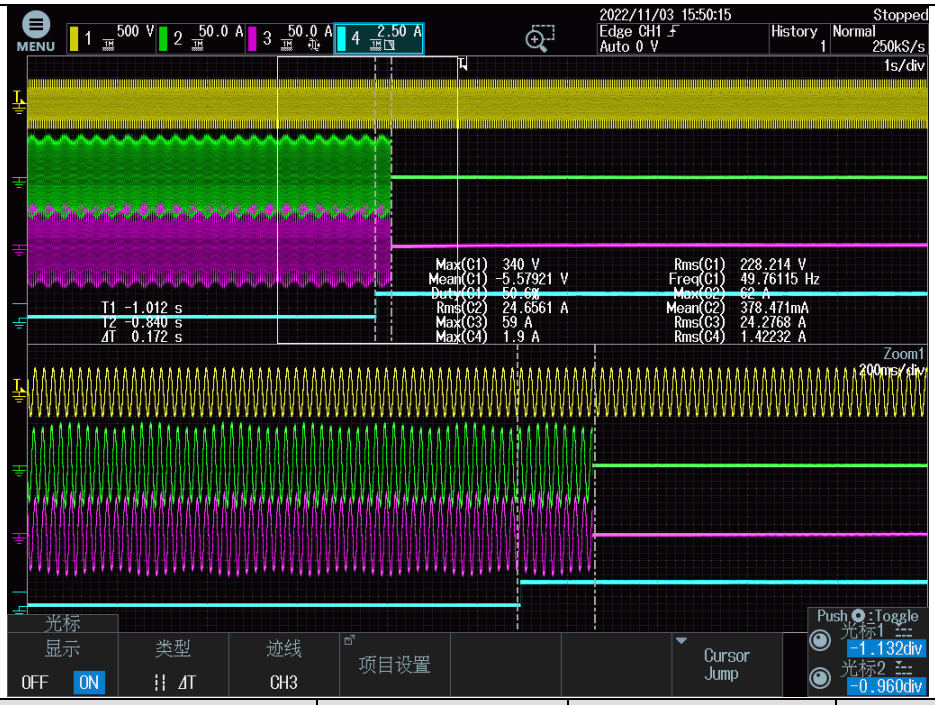
100 ± 5%	

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

33 ± 5%	

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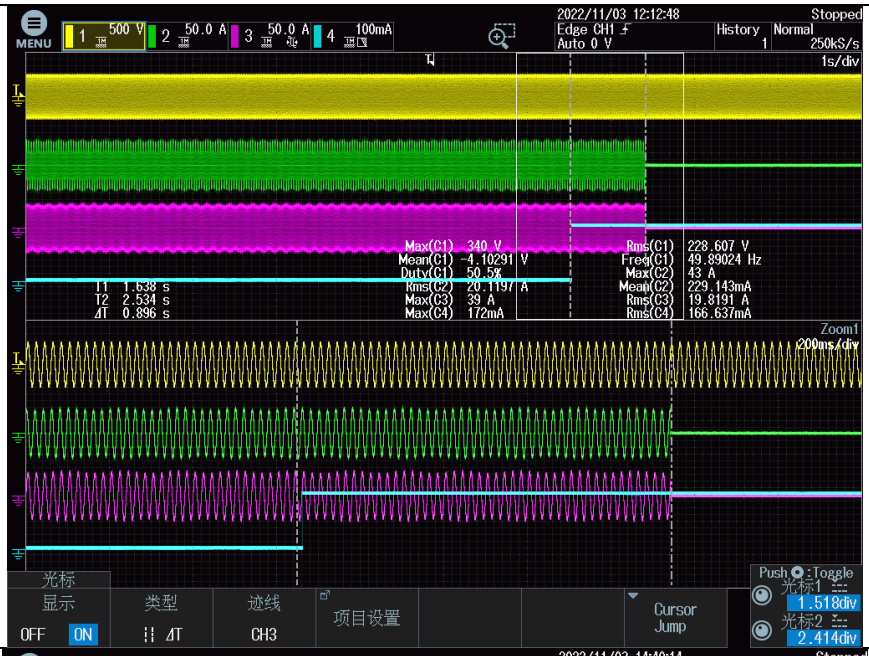
66 ± 5%					
100 ± 5%					
L2	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

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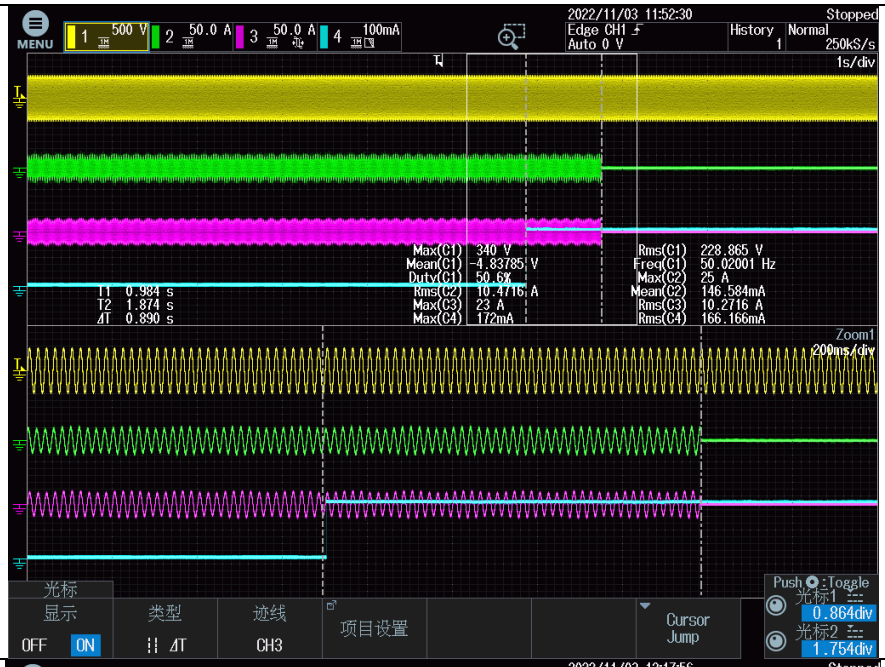
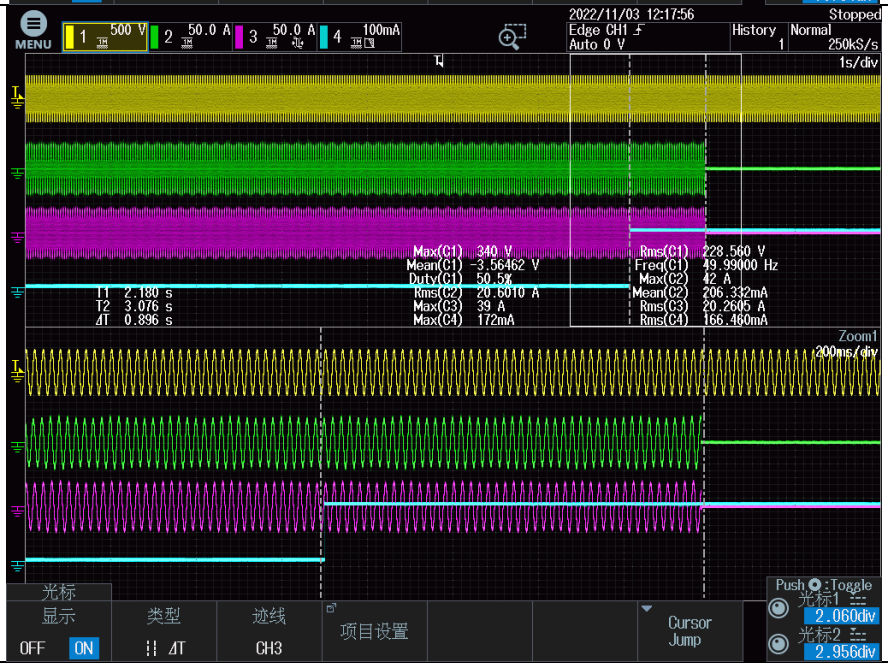
33 ± 5%		
66 ± 5%		

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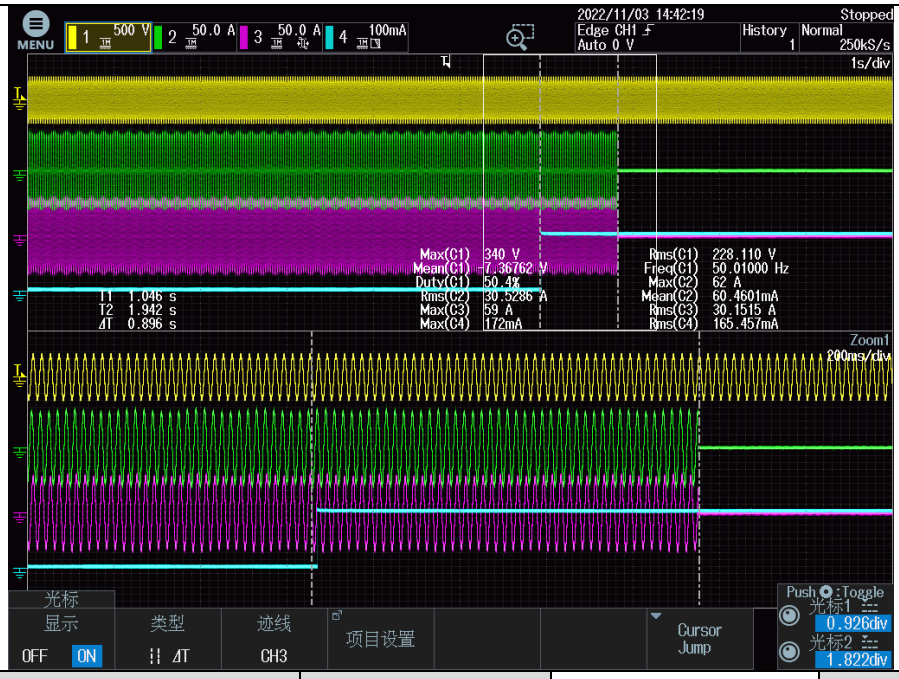
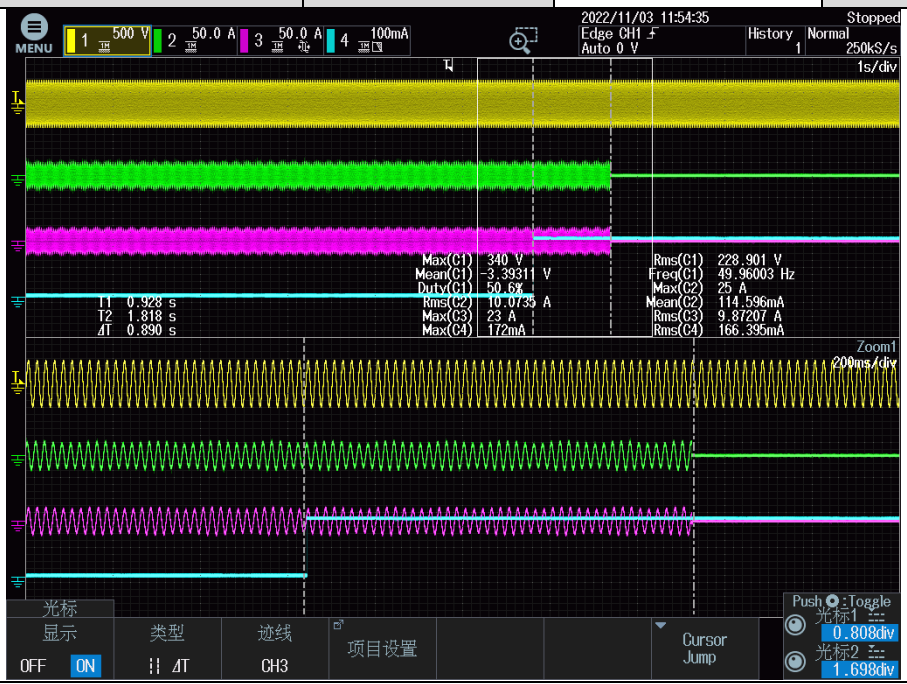
100 ± 5%				
L3	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	
33 ± 5%				

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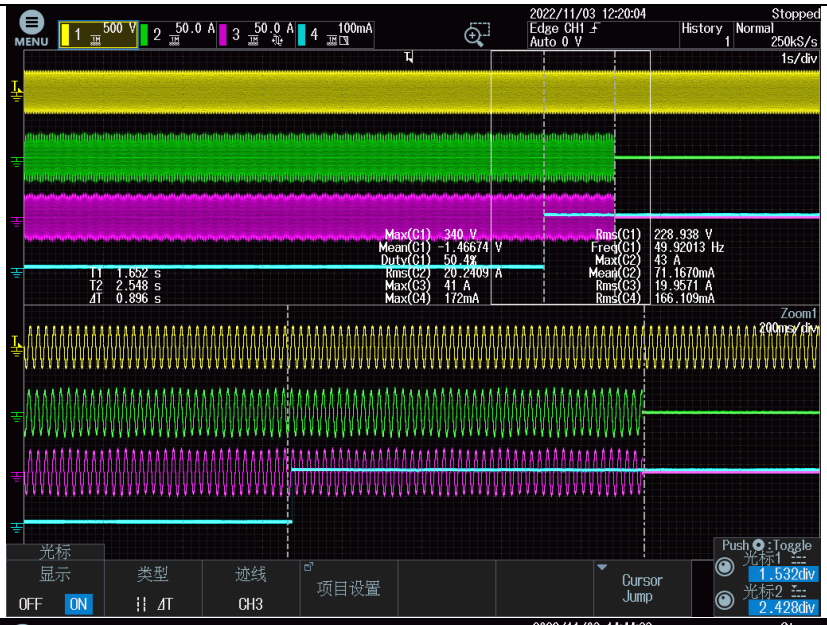
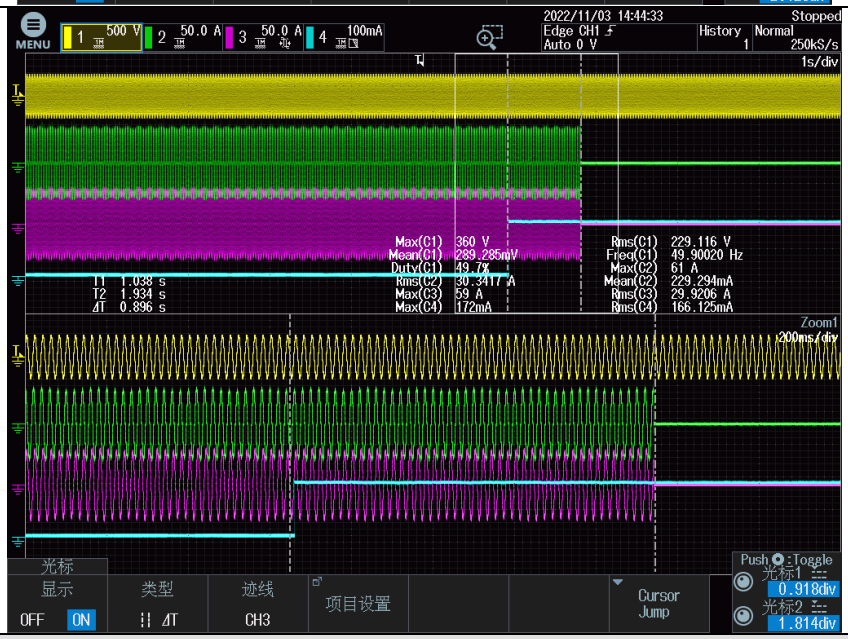
66 ± 5%		
100 ± 5%		

Test is performed at an ambient temperature of -30±2°C

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.172	
	100 ± 5%		0.178	

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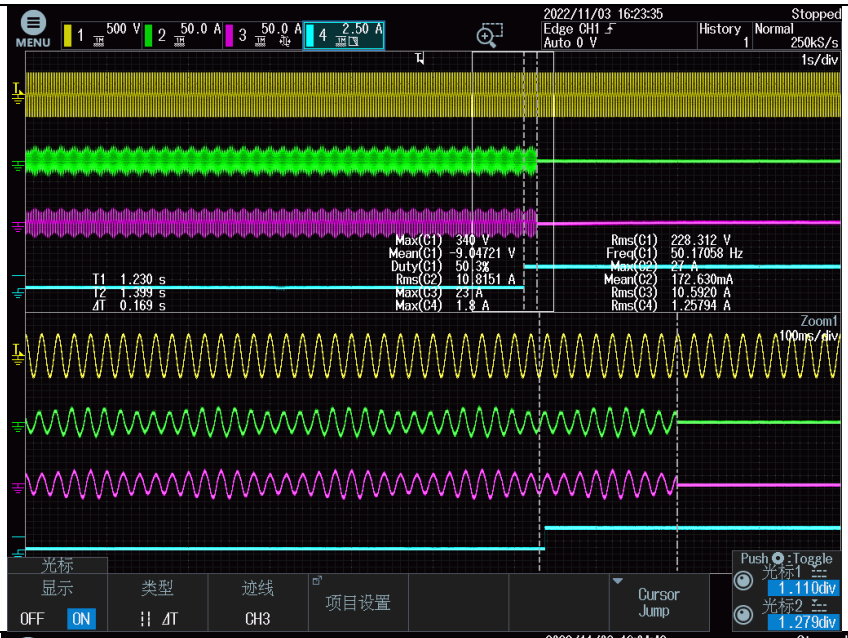
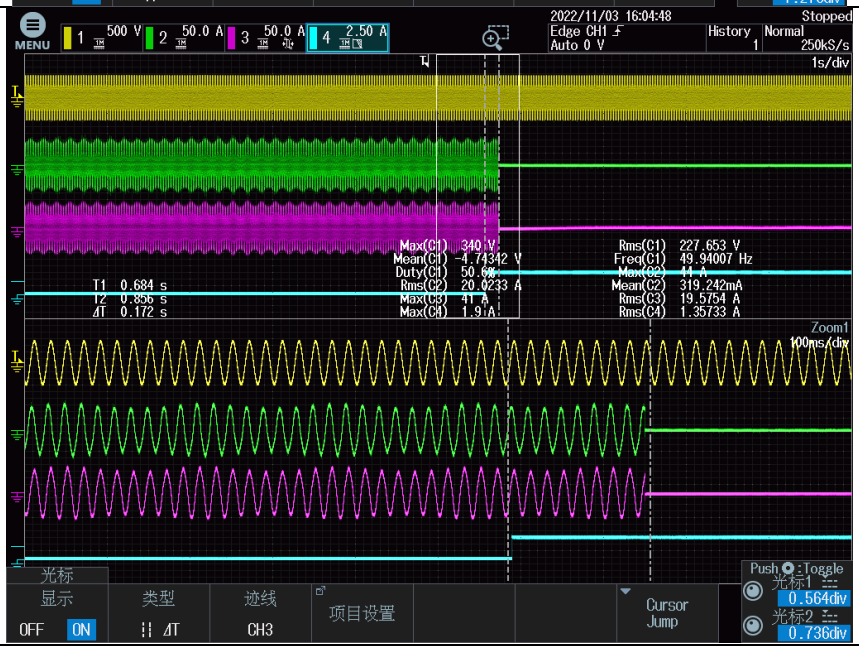
33 ± 5%		
66 ± 5%		

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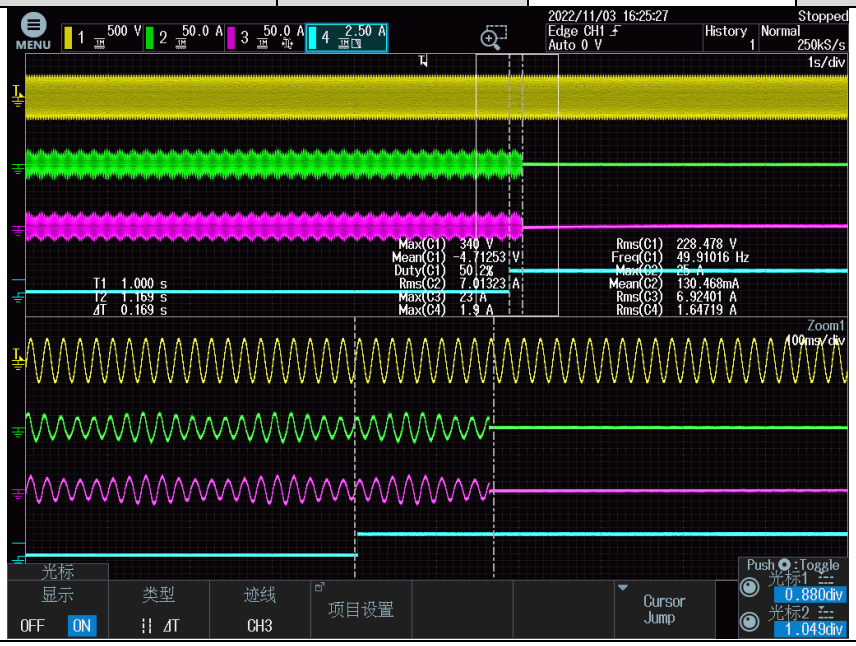
100 ± 5%				
L2	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.169	
	100 ± 5%		0.178	
33 ± 5%				

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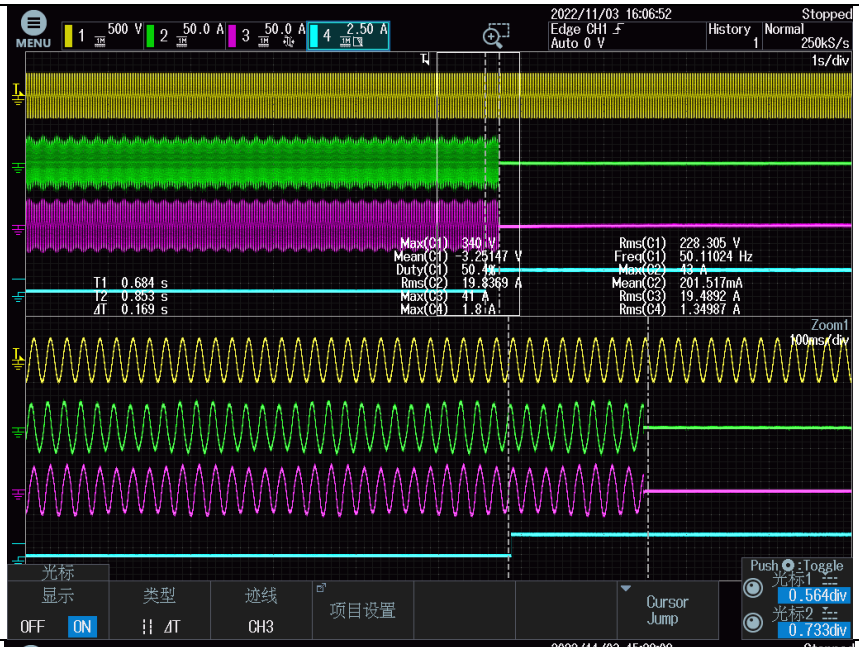
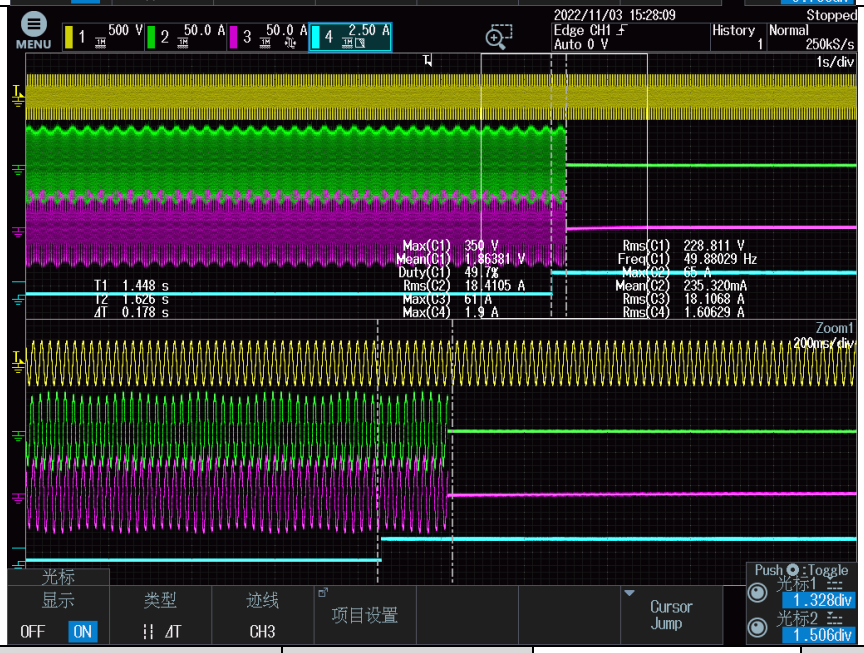
66 ± 5%				
100 ± 5%				
L3	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.169	
	100 ± 5%		0.172	

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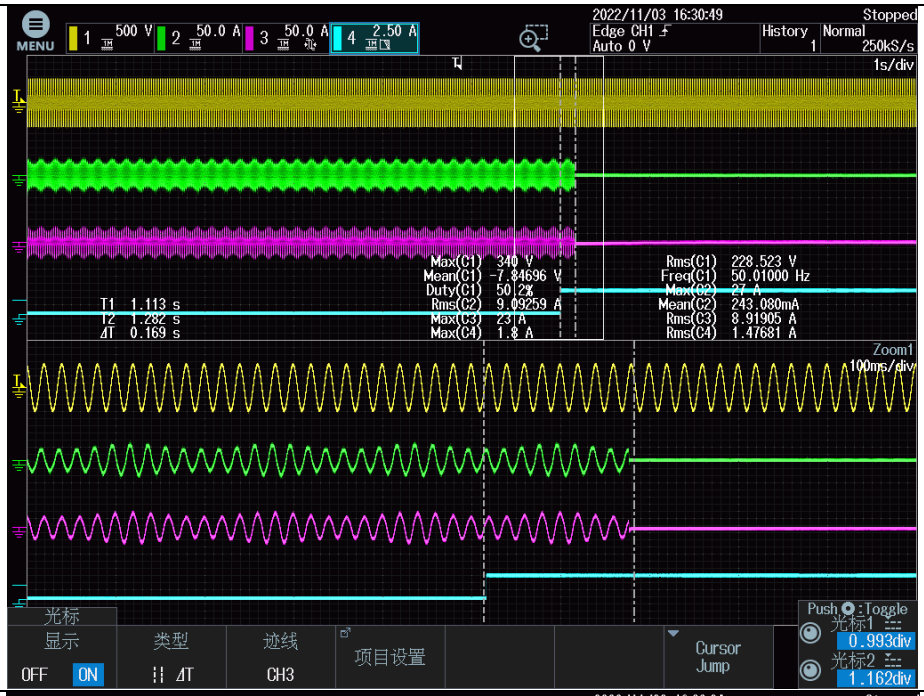
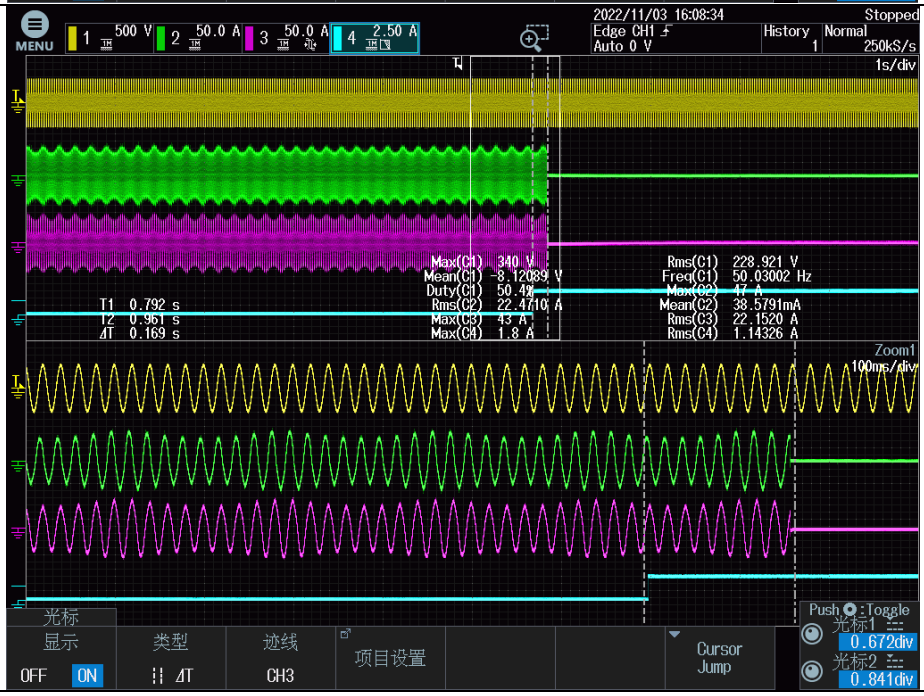
33 ± 5%	
66 ± 5%	

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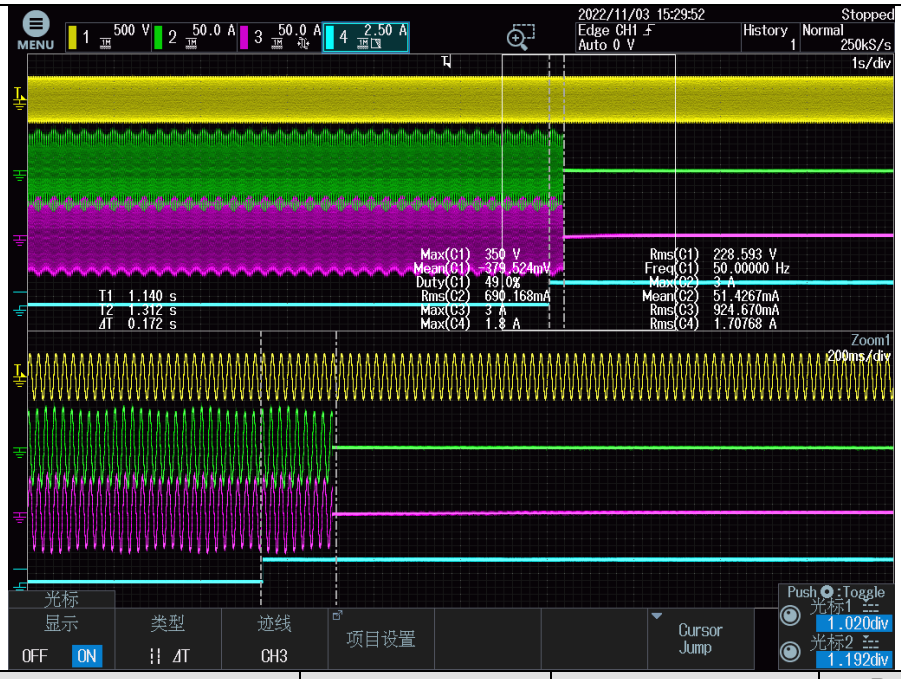
100 ± 5%	

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

33 ± 5%	

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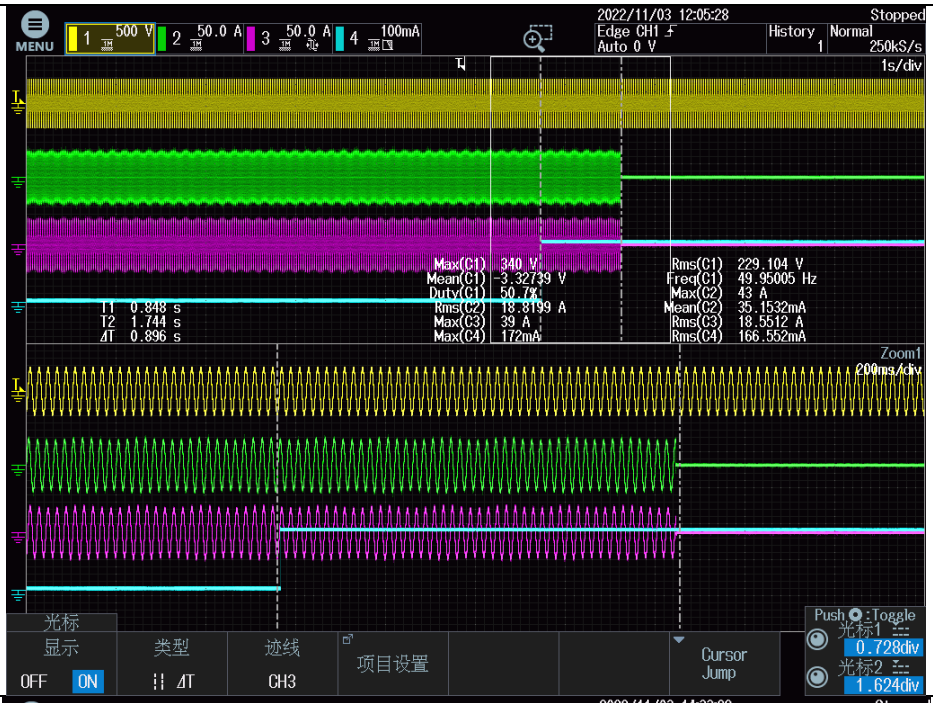
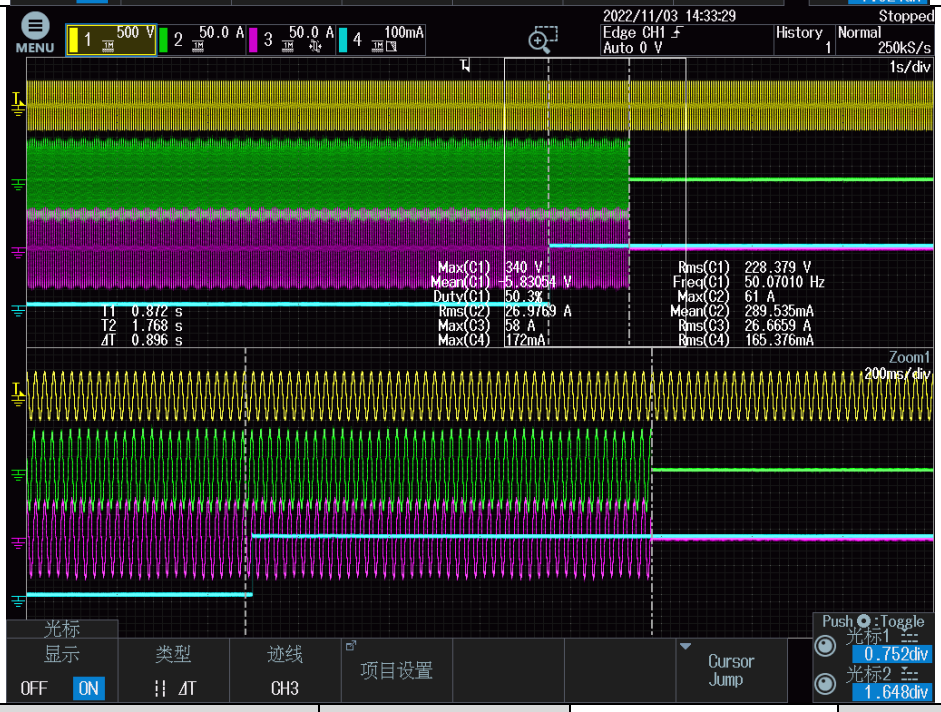
66 ± 5%				
100 ± 5%				
L2	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

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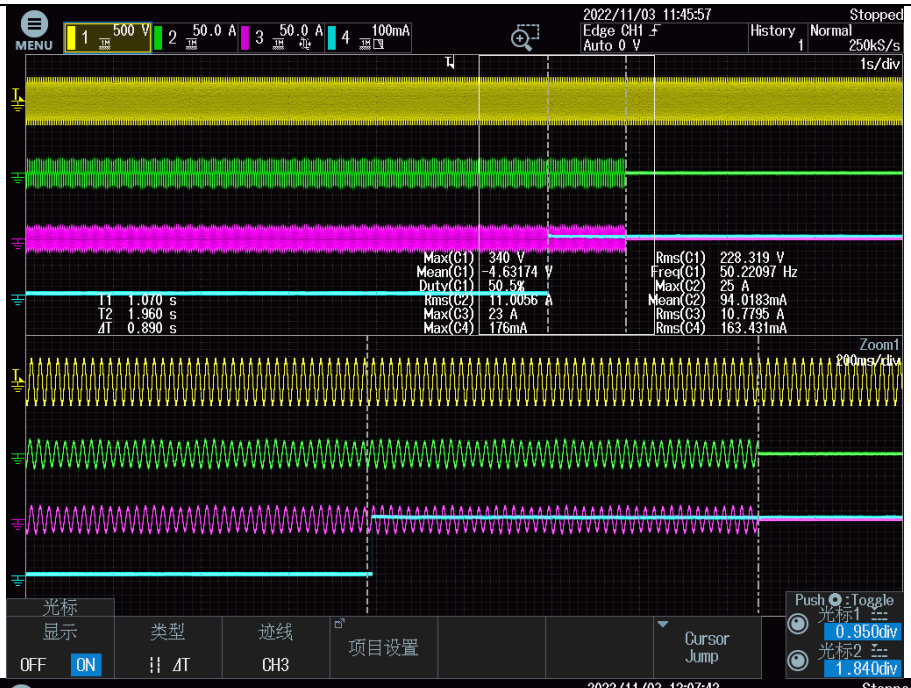
33 ± 5%		
66 ± 5%		

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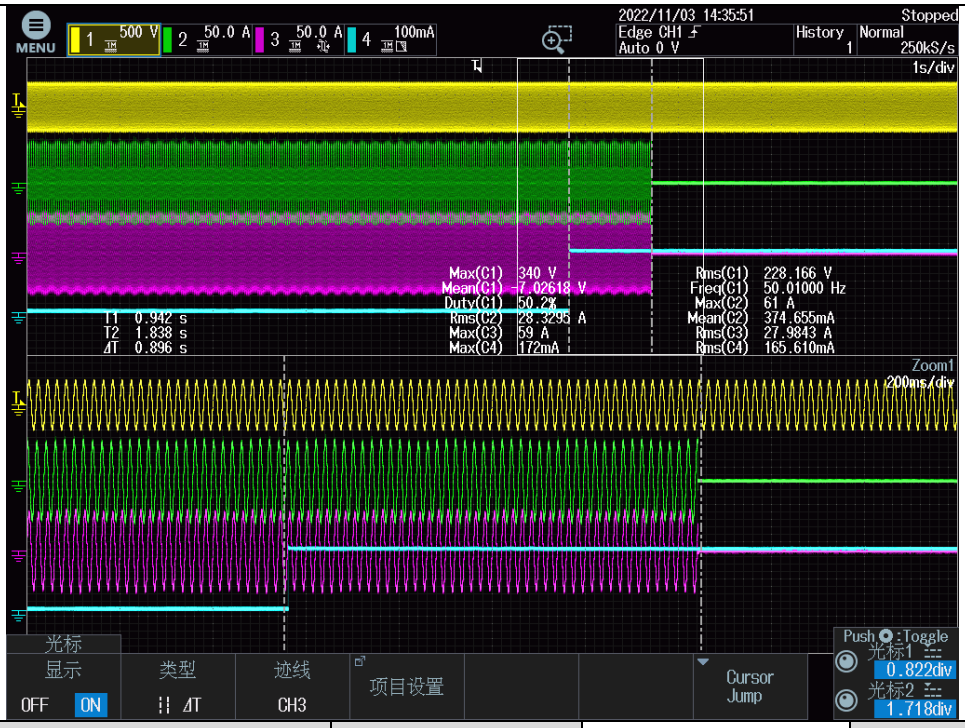
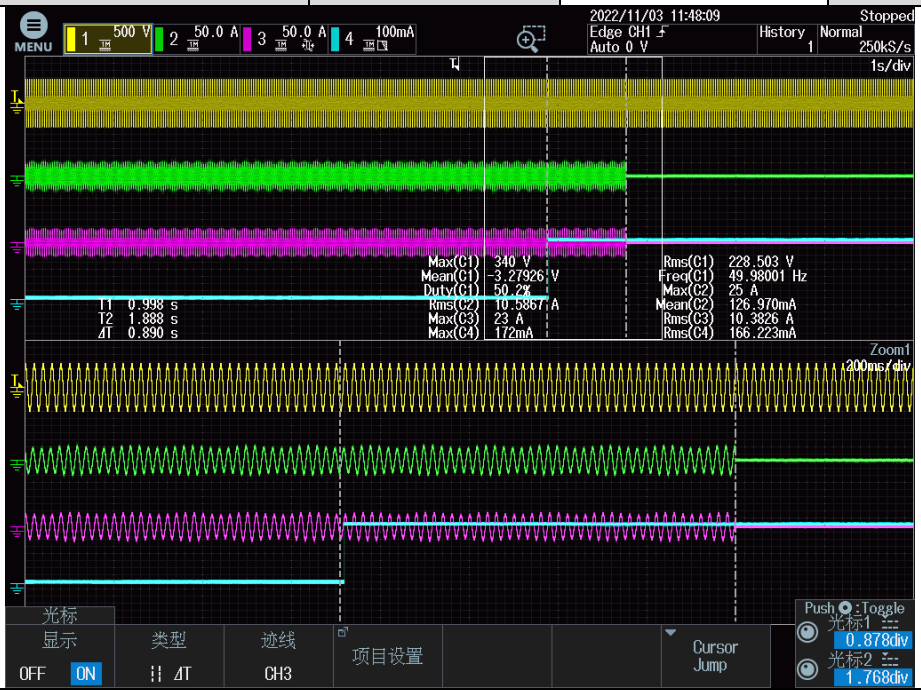
100 ± 5%				
L3	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	
33 ± 5%				

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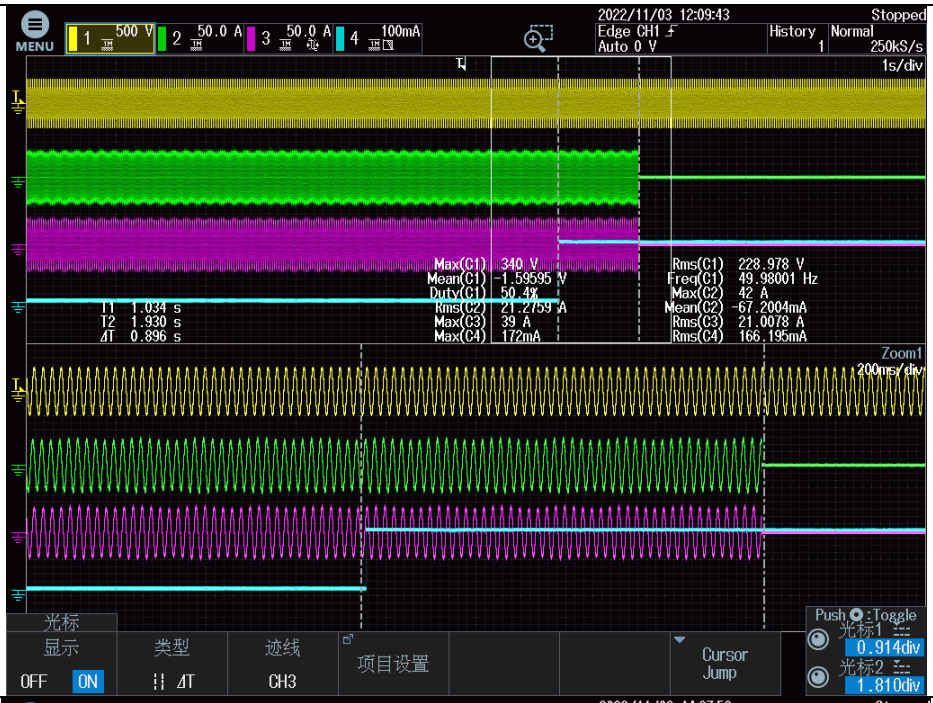
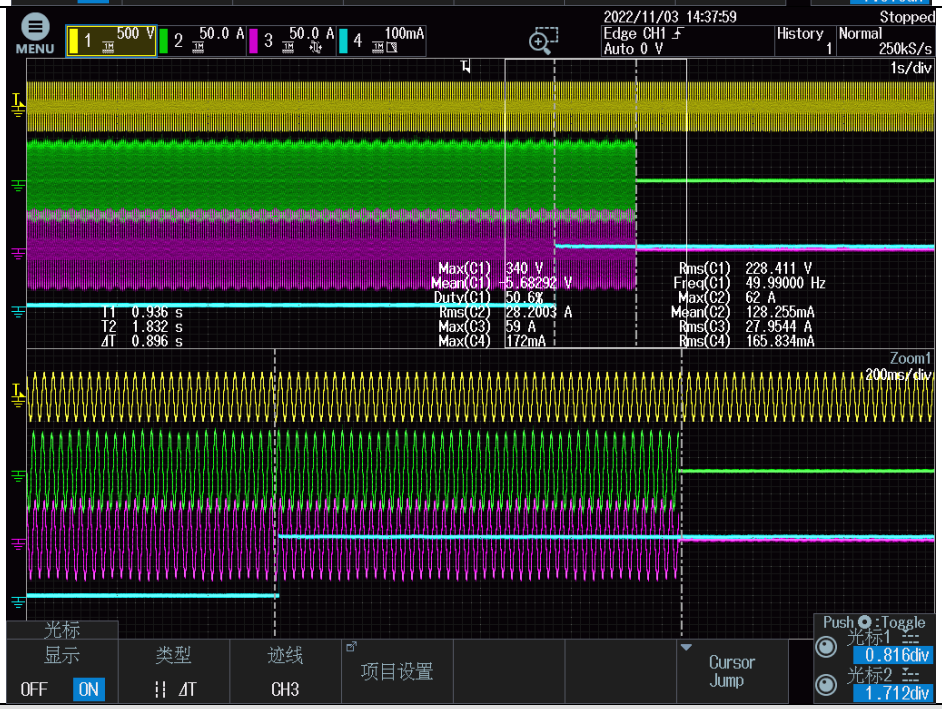
66 ± 5%	
100 ± 5%	

Test is performed at an ambient temperature of 60±2°C

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.169	
	100 ± 5%		0.178	

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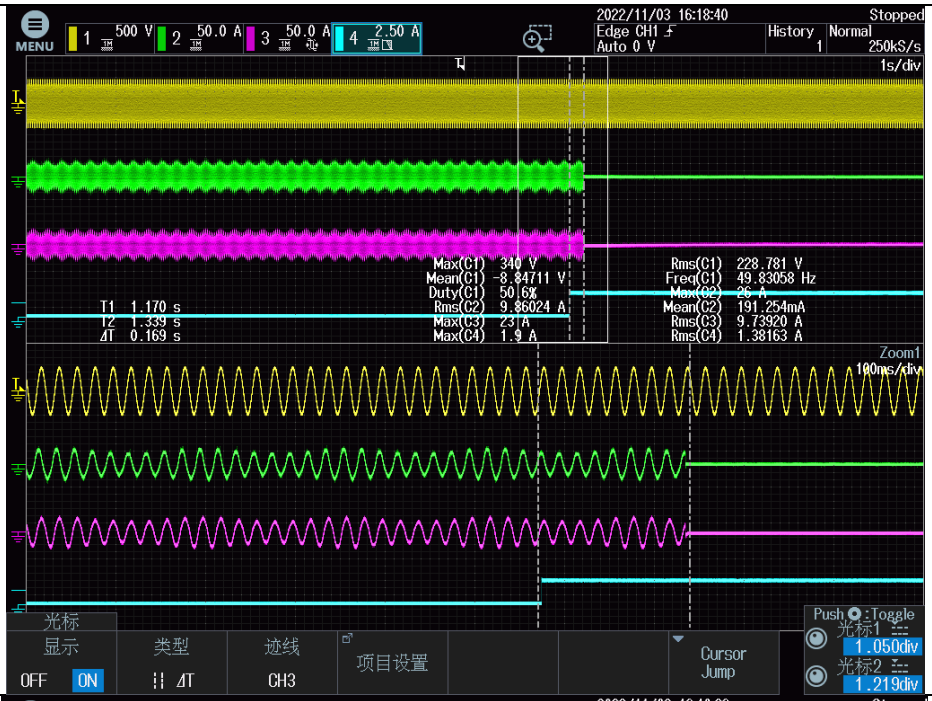
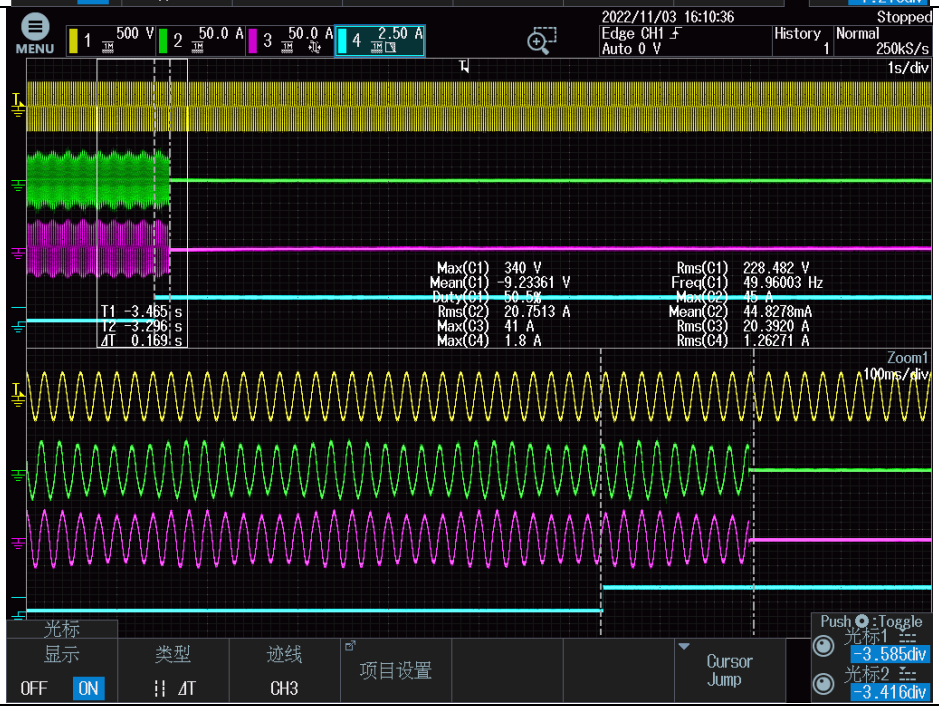
33 ± 5%		
66 ± 5%		

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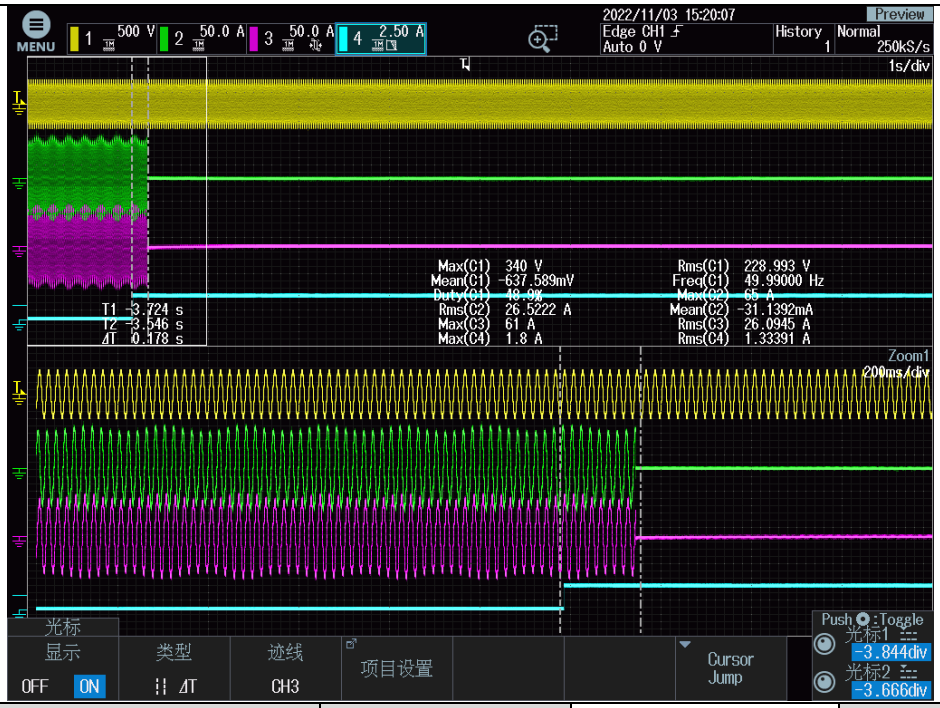
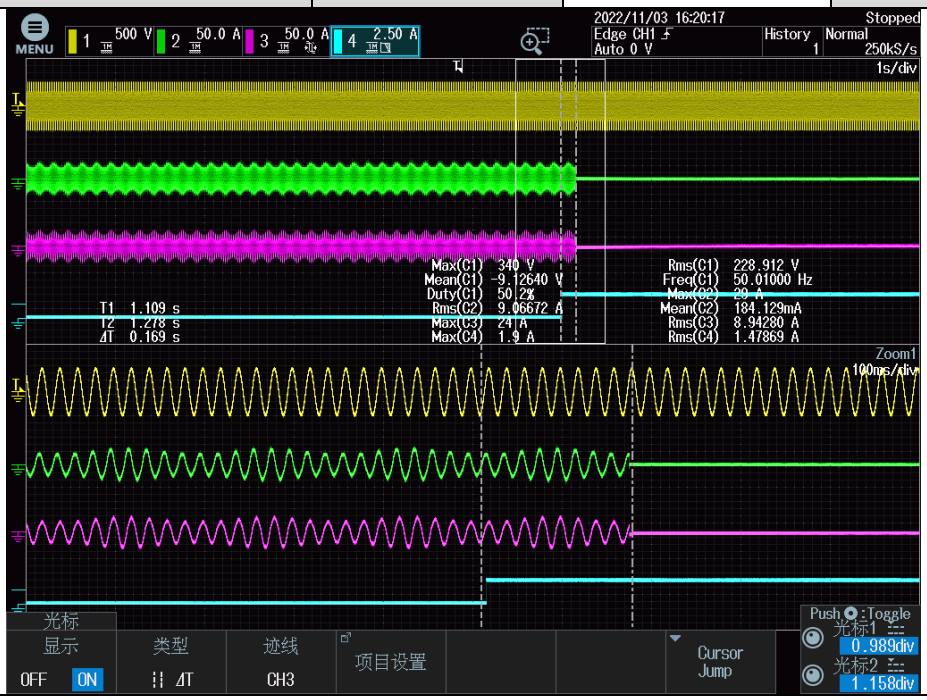
100 ± 5%				
L2	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.169	
	100 ± 5%		0.178	
33 ± 5%				

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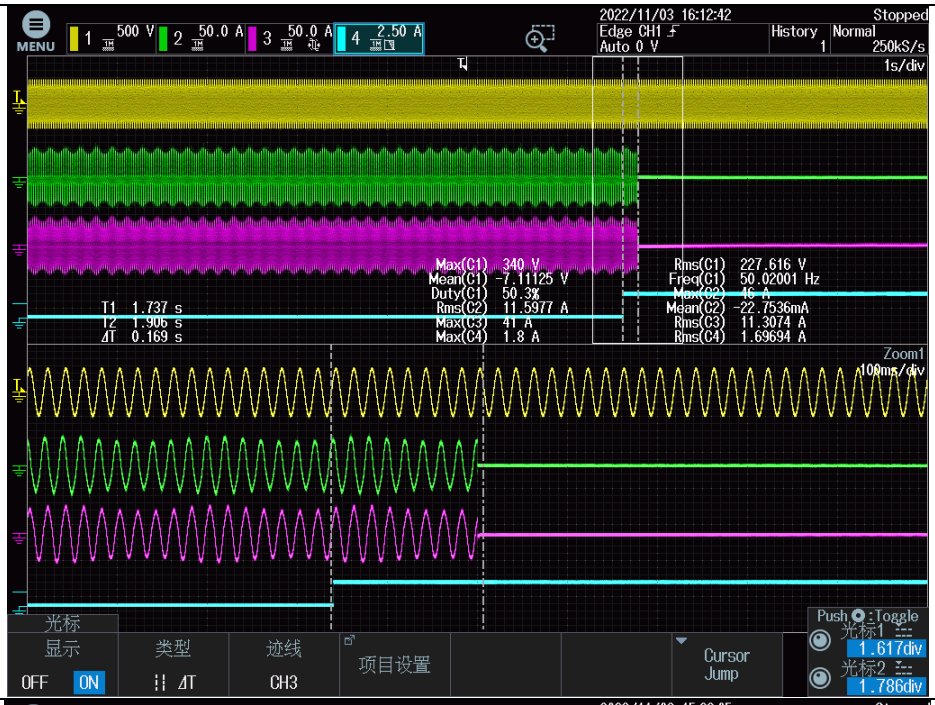
66 ± 5%				
100 ± 5%				
L3	33 ± 5%	1 A	0.169	0.2 s
	66 ± 5%		0.169	
	100 ± 5%		0.178	

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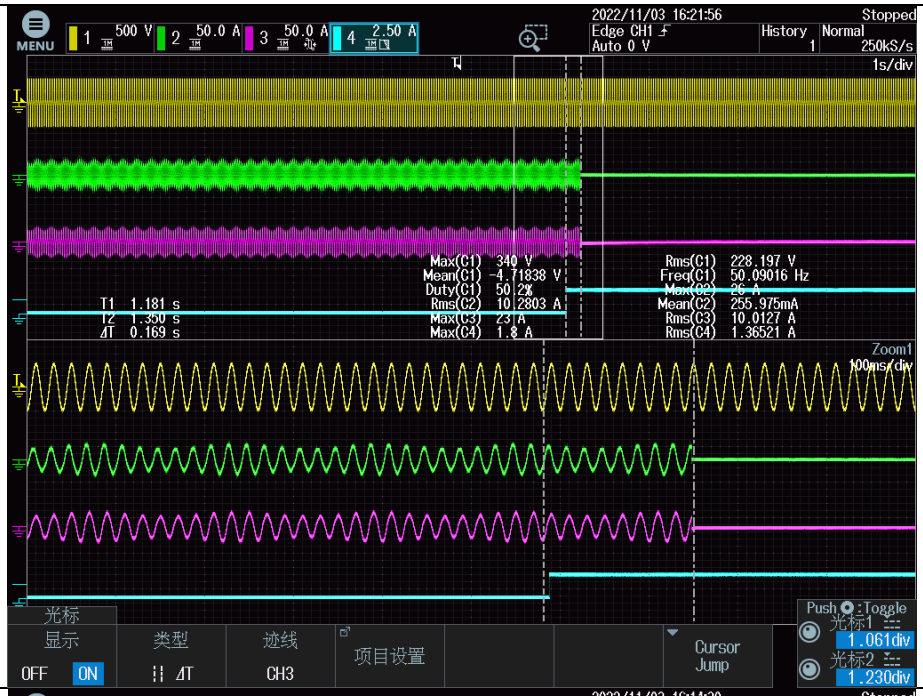
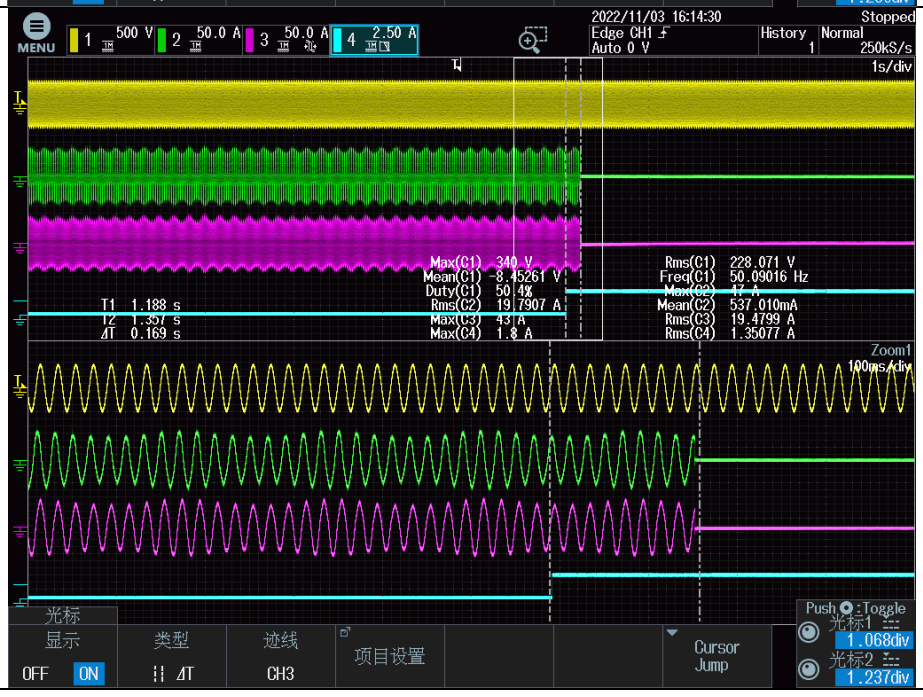
33 ± 5%		
66 ± 5%		

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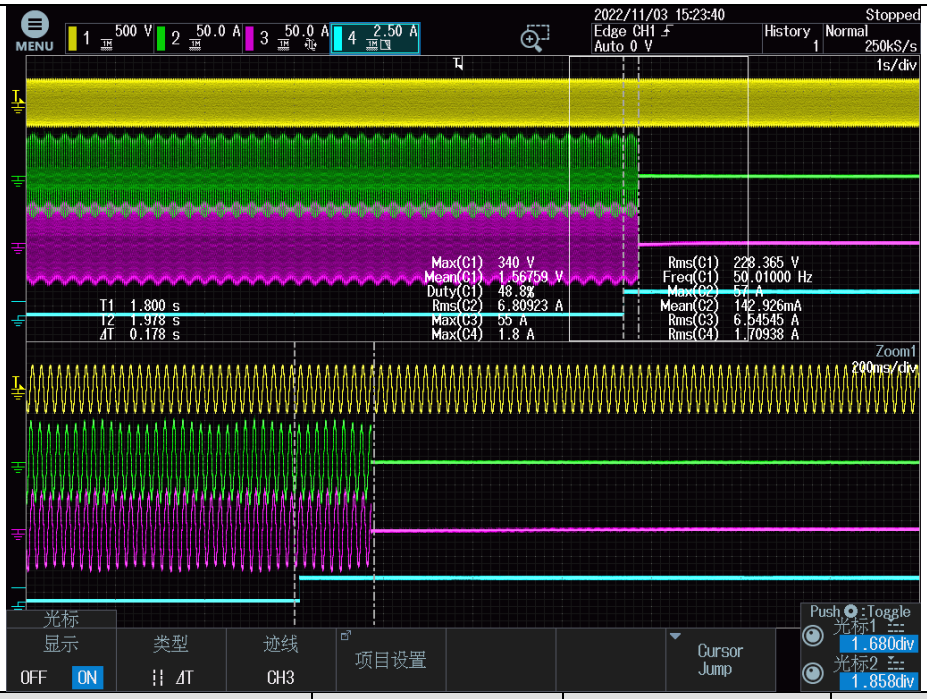
100 ± 5%	

Phase	Power level P/Pn(%)	DC component	Tripping time (s)	Required tripping time
L1	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

33 ± 5%	

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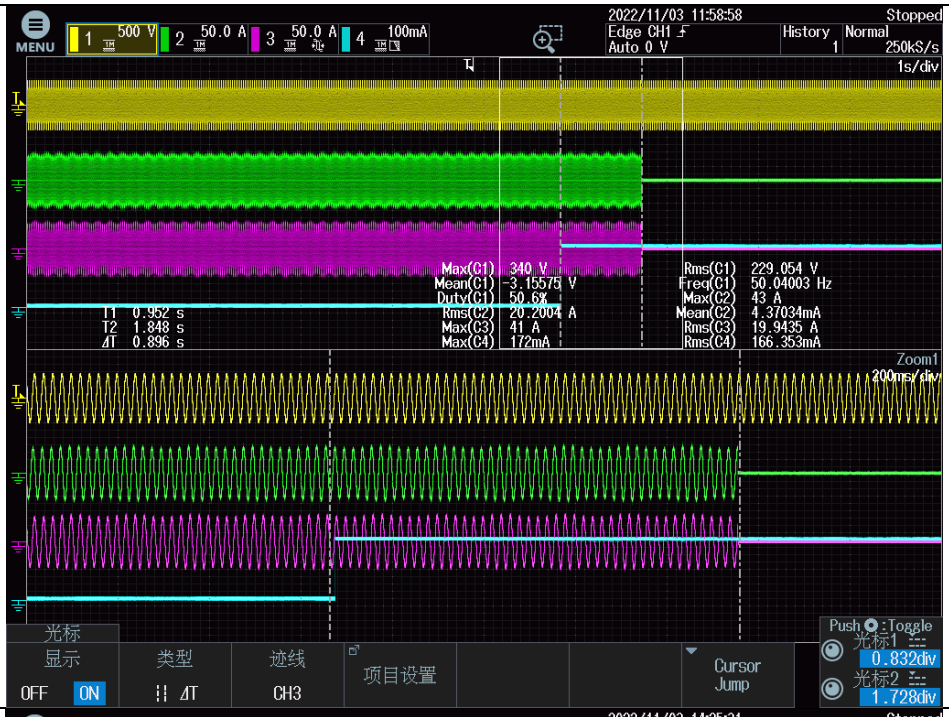
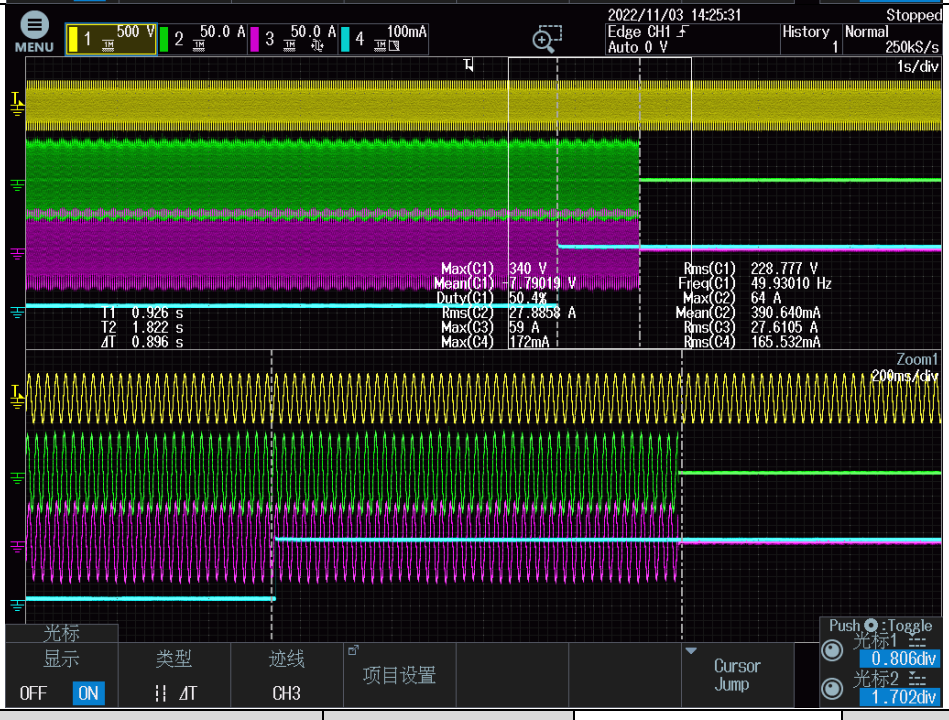
66 ± 5%				
100 ± 5%				
L2	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	

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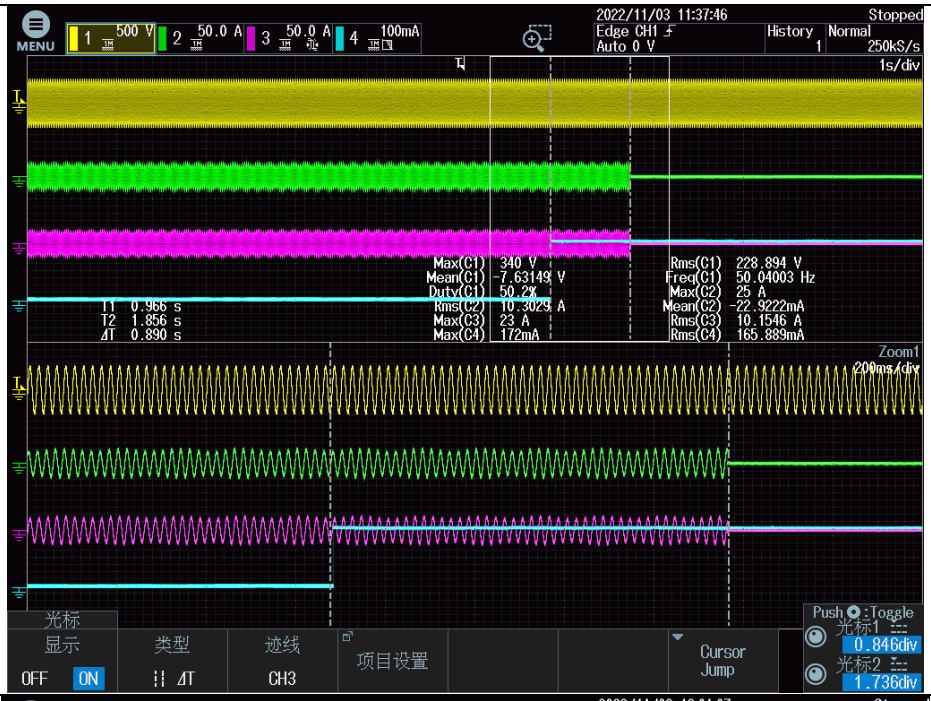
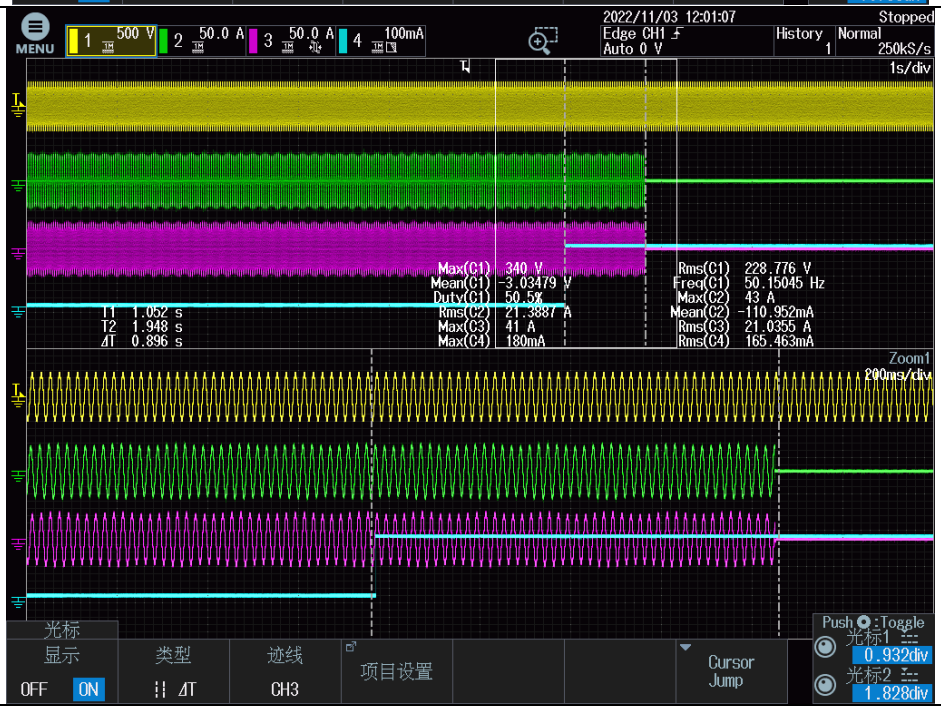
33 ± 5%	
66 ± 5%	

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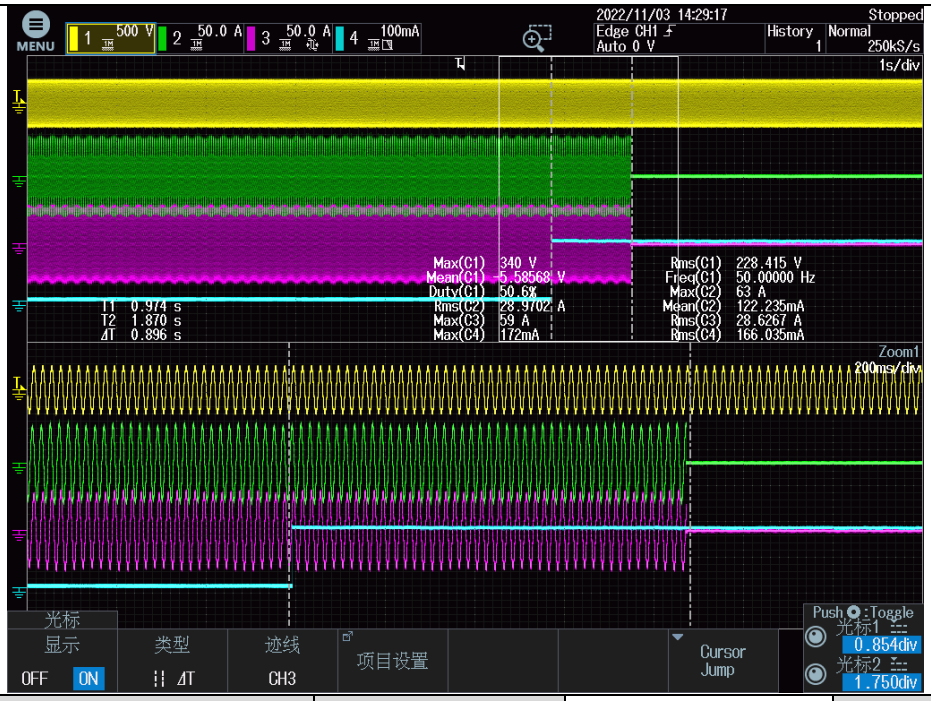
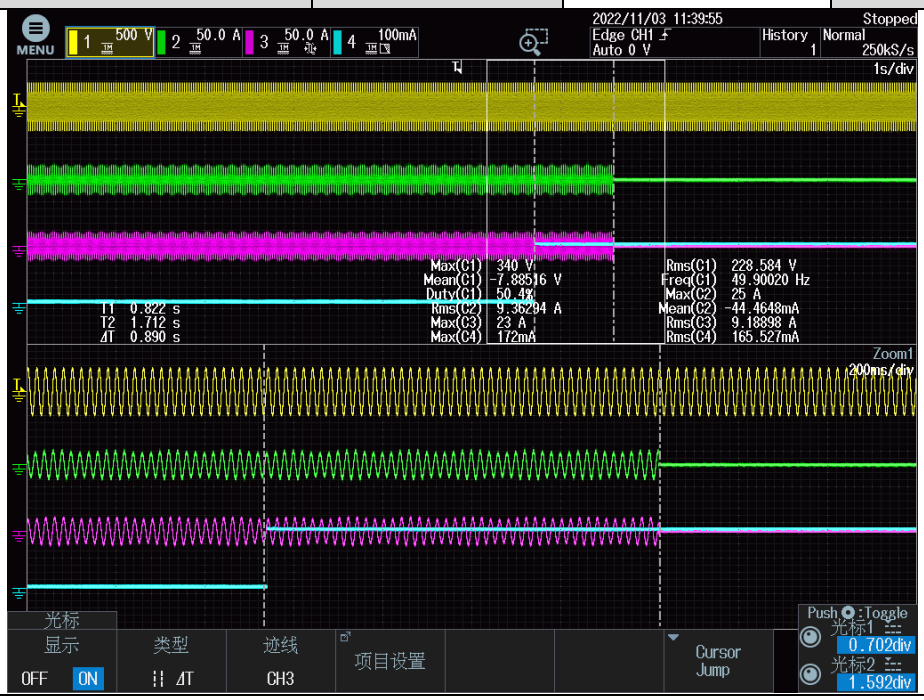
100 ± 5%				
L3	33 ± 5%	0.5 % In	0.890	1.0s
	66 ± 5%		0.896	
	100 ± 5%		0.896	
33 ± 5%				

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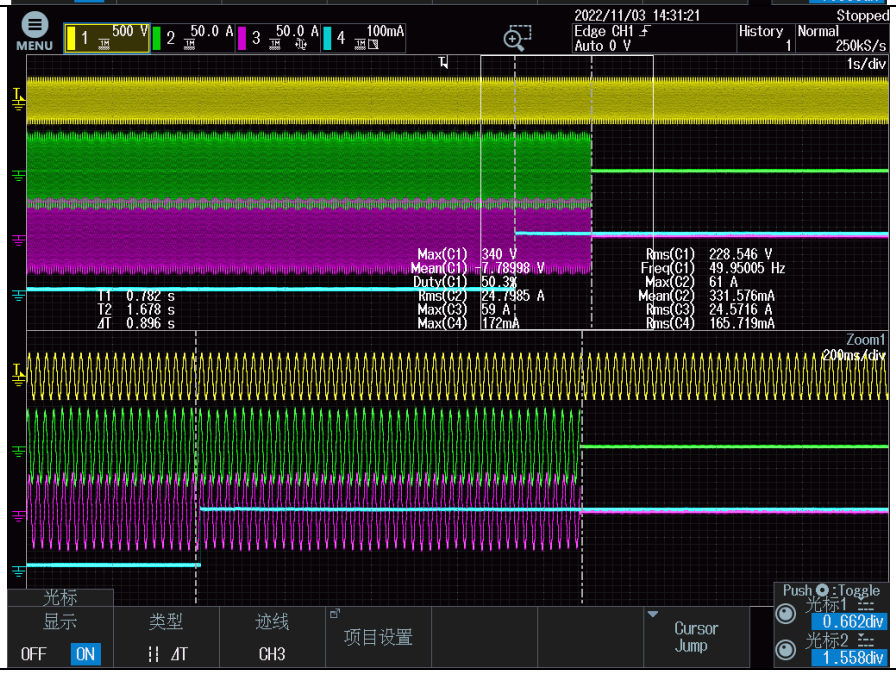
66 ± 5%		
100 ± 5%		

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B.1.5	Verification of insensitivity to voltage dips (LVRT capability)			P
Item	test	Amplitude of the residual voltage Phase to phase V/Vn	Duration [ms]	Active Power and reactive power recover time limit [ms]
UVRT				
1s	Three-phase symmetrical fault	0.10 ± 0.05 (V_1/Vn)	200 ± 20	400
1a	Asymmetrical two-phase fault	0.10 ± 0.05 (V_1/Vn)	200 ± 20	400
2s	Three-phase symmetrical fault	0.25 ± 0.05 (V_2/Vn)	400 ± 20	400
2a	Asymmetrical two-phase fault	0.25 ± 0.05 (V_2/Vn)	400 ± 20	400
3s	Three-phase symmetrical fault	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400
3a	Asymmetrical two-phase fault	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400
4s	Three-phase symmetrical fault	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400
4a	Asymmetrical two-phase fault	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400
5	Asymmetrical two-phase fault at BT	0.10 ± 0.05 (V_5/Vn)	200 ± 20	400
6	Asymmetrical two-phase fault at BT	0.50 ± 0.05 (V_6/Vn)	850 ± 20	400

Pn in %	20%Pn

Test number 1s, 10%Vn, 200ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	23.0	Voltage after fault– Phase 1	230.3
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	23.0	Voltage after fault– Phase 2	230.2
Voltage before fault – Phase 3	230.2	Voltage during fault– Phase 3	23.0	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)
Current before fault – Phase 1	7.3	Current during fault– Phase 1	0.1	Current after fault– Phase 1	7.0
Current before 9fault – Phase 2	7.3	Current during fault– Phase 2	0.1	Current after fault– Phase 2	7.1
Current before fault – Phase 3	7.3	Current during fault– Phase 3	0.1	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

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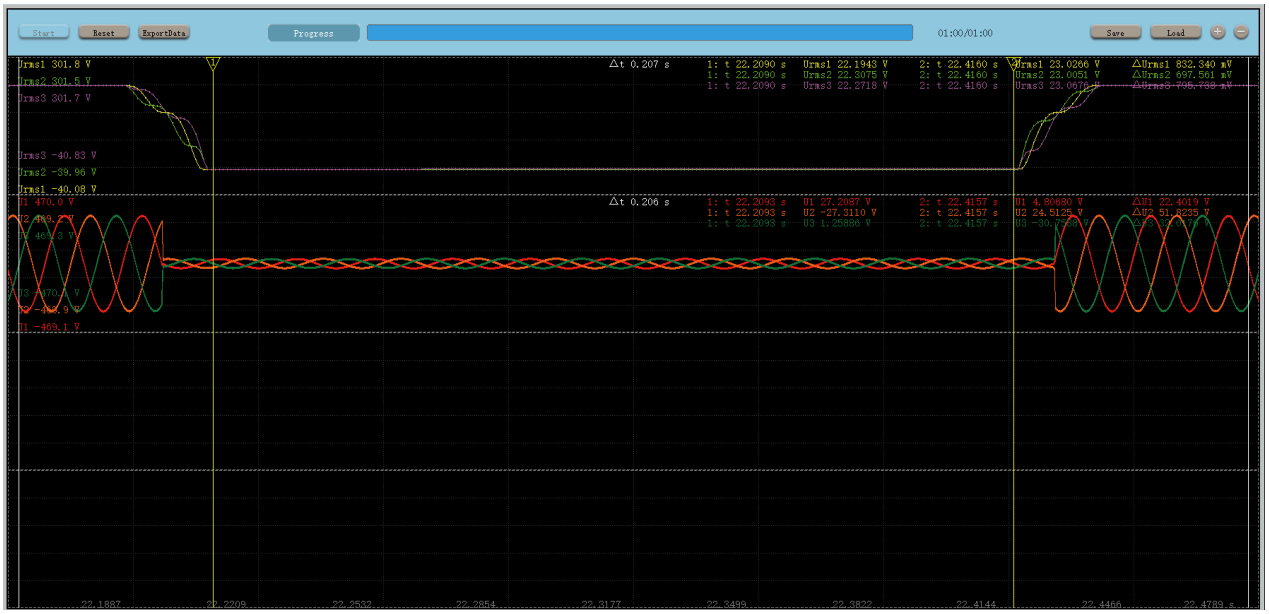
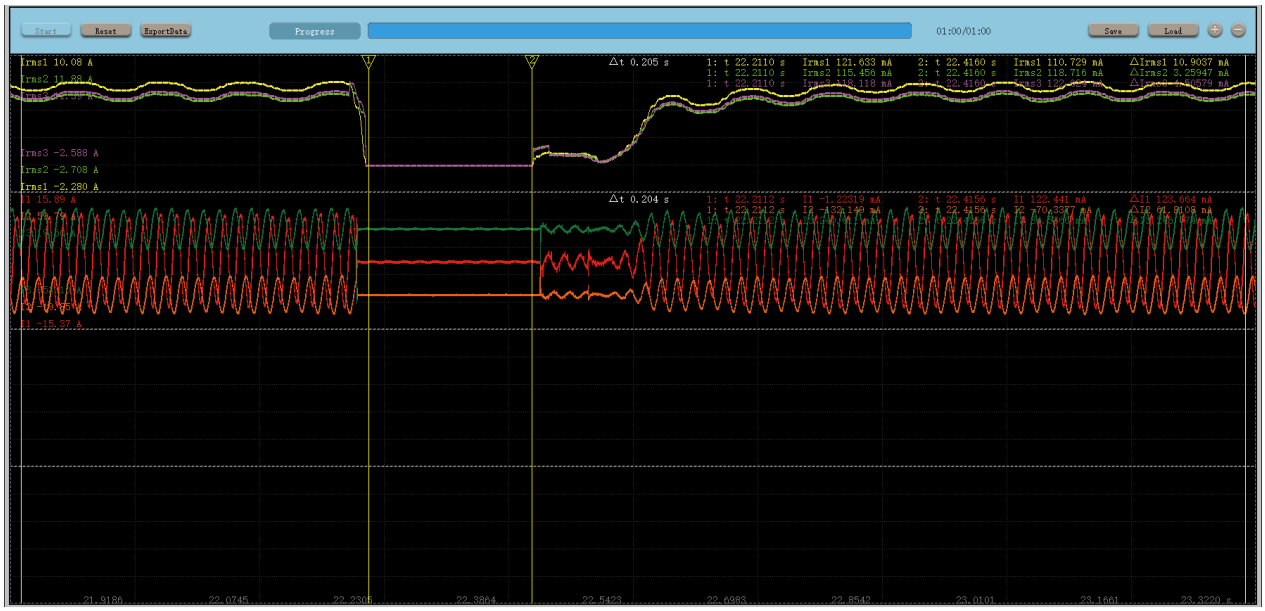
Duration [ms]	207	Power recover time [ms]	243
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
4946	4948	103	104

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):

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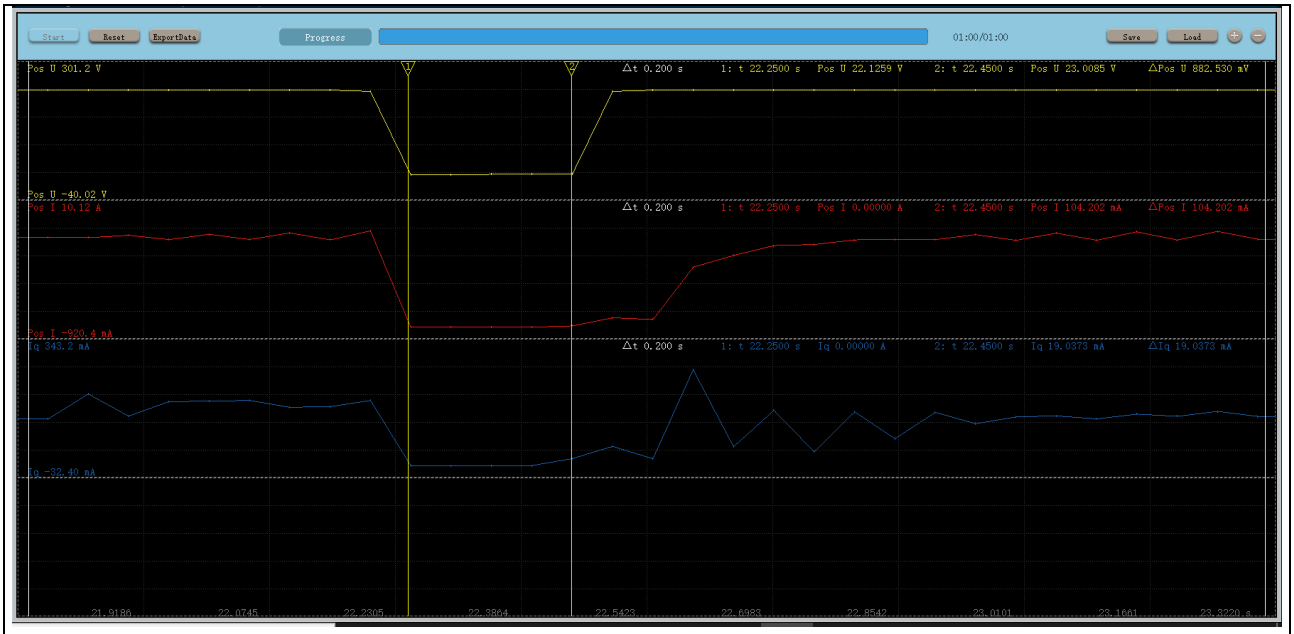
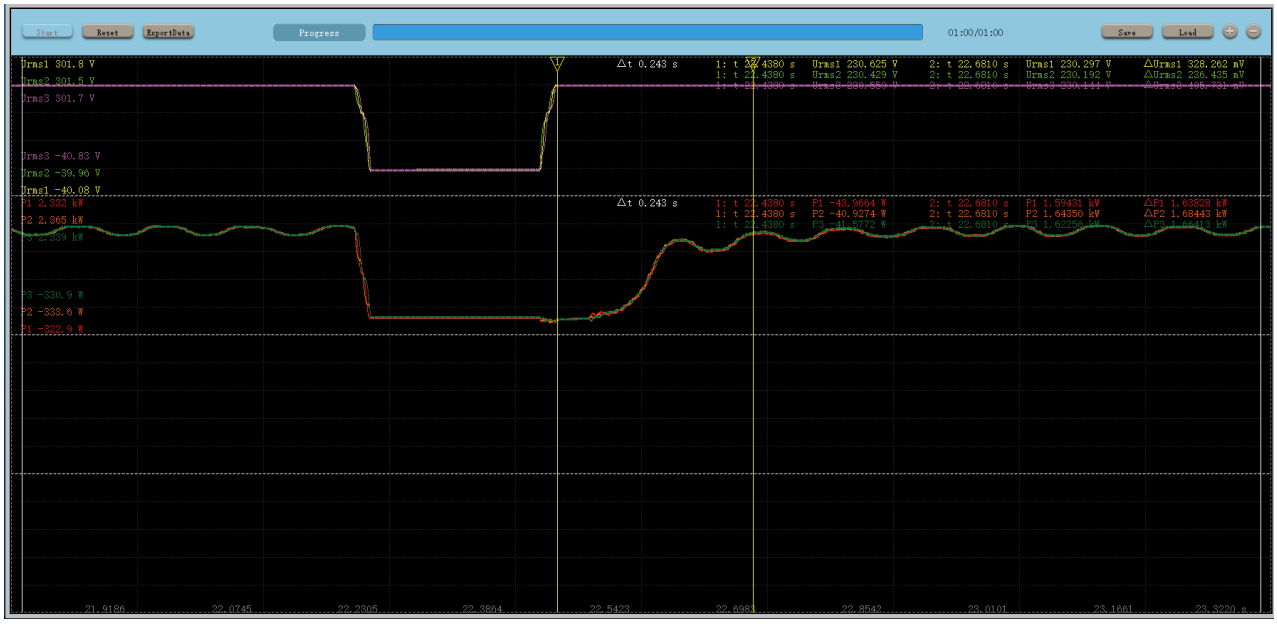


Power recover time:



Test number 2s, 25%Vn, 400ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	57.5	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	57.5	Voltage after fault– Phase 2	230.2
Voltage before fault – Phase 3	230.1	Voltage during fault– Phase 3	57.5	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)

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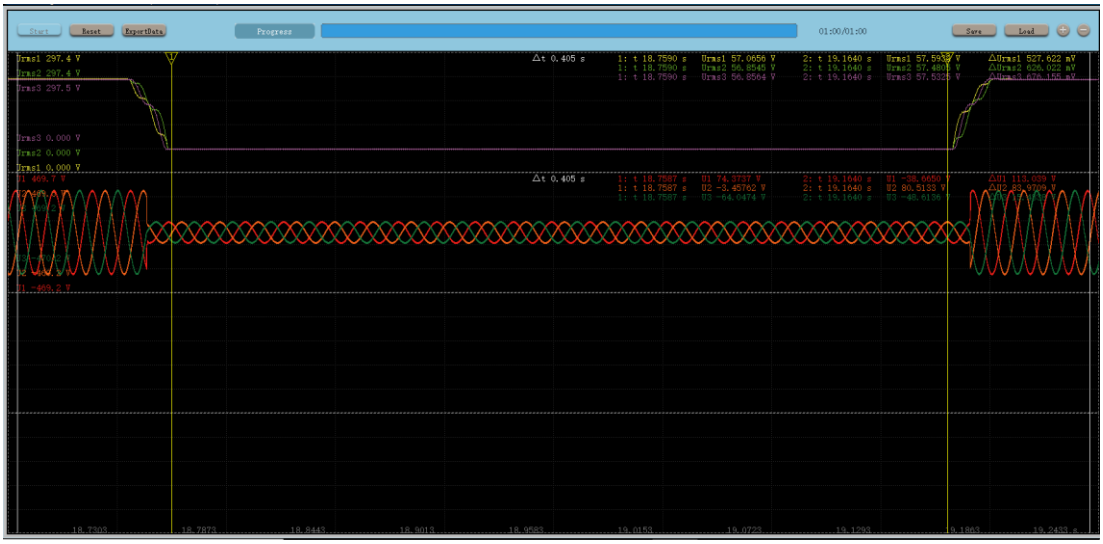
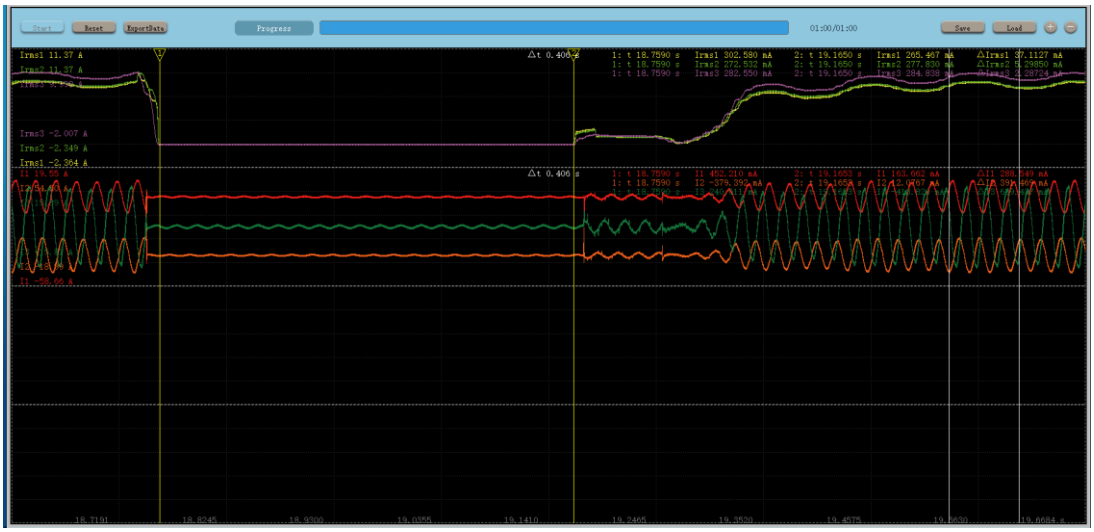
Current before fault – Phase 1	7.4	Current during fault– Phase 1	0.3	Current after fault– Phase 1	7.3
Current before fault – Phase 2	7.4	Current during fault– Phase 2	0.2	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.4	Current during fault– Phase 3	0.2	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	400	Power recover time [ms]	250
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
5123	5191	442	103

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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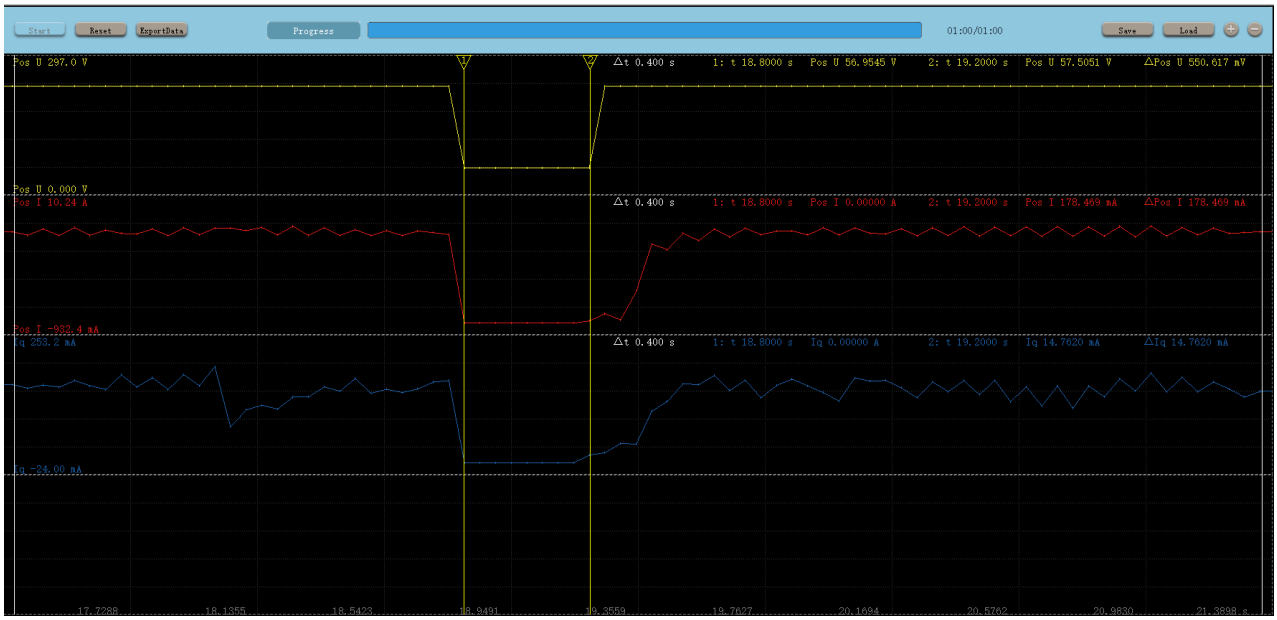
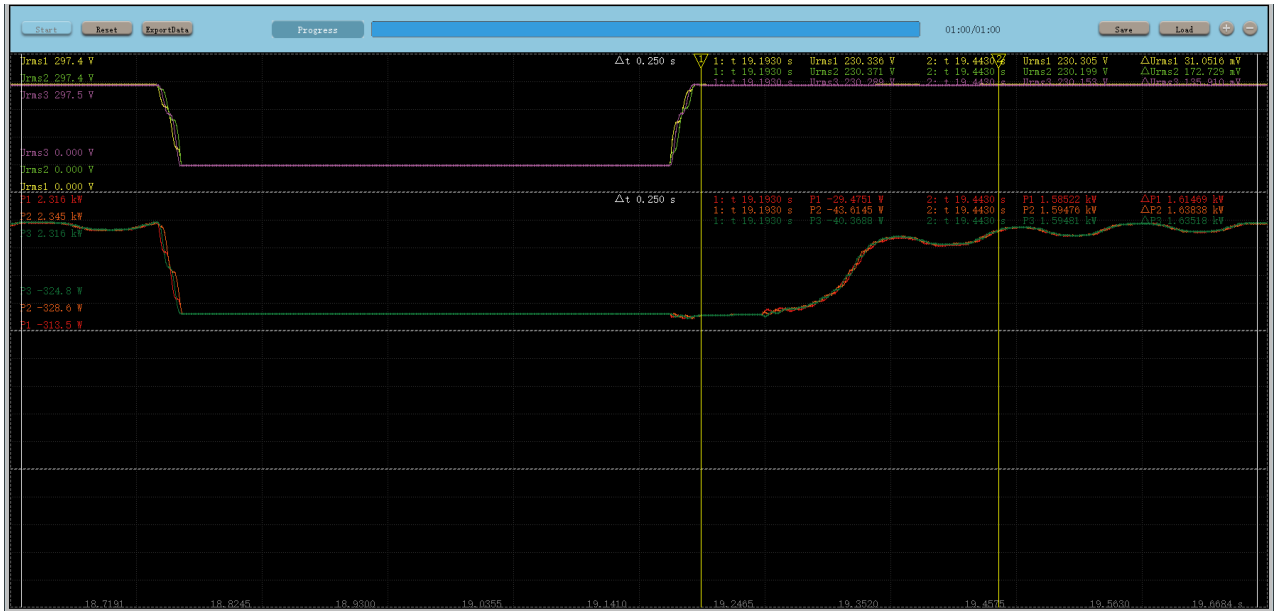
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 3s, 50%Vn, 850ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.2	Voltage during fault– Phase 1	115.1	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	115.1	Voltage after fault– Phase 2	230.1
Voltage before fault – Phase 3	230.3	Voltage during fault– Phase 3	115.1	Voltage after fault– Phase 3	230.0
	Current(A)		Current(A)		Current(A)

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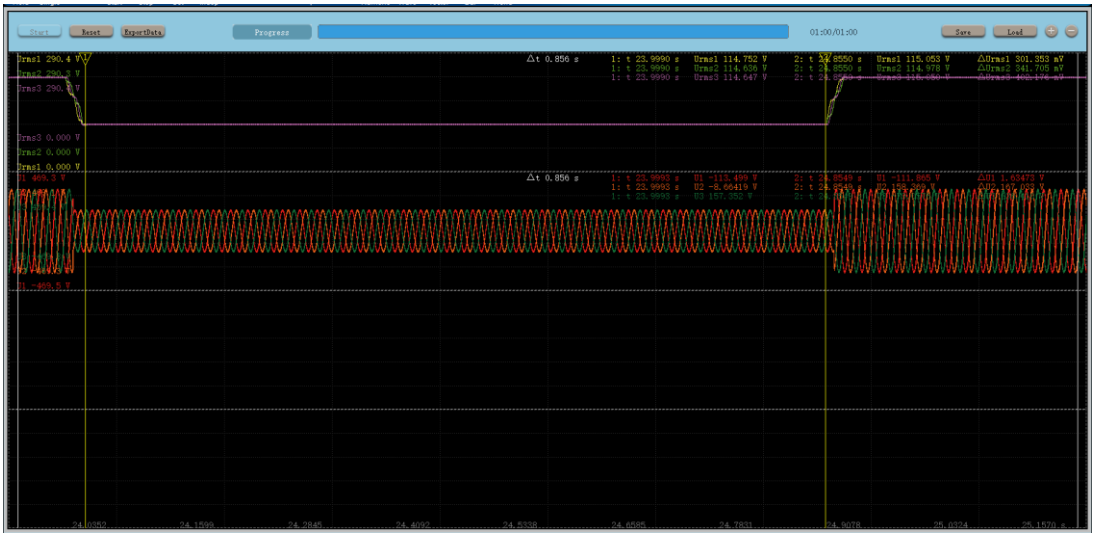
Current before fault – Phase 1	7.1	Current during fault– Phase 1	0.2	Current after fault– Phase 1	7.3
Current before fault – Phase 2	7.1	Current during fault– Phase 2	0.2	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.1	Current during fault– Phase 3	0.3	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	856	Power recover time [ms]	234
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
4948	4952	102	97

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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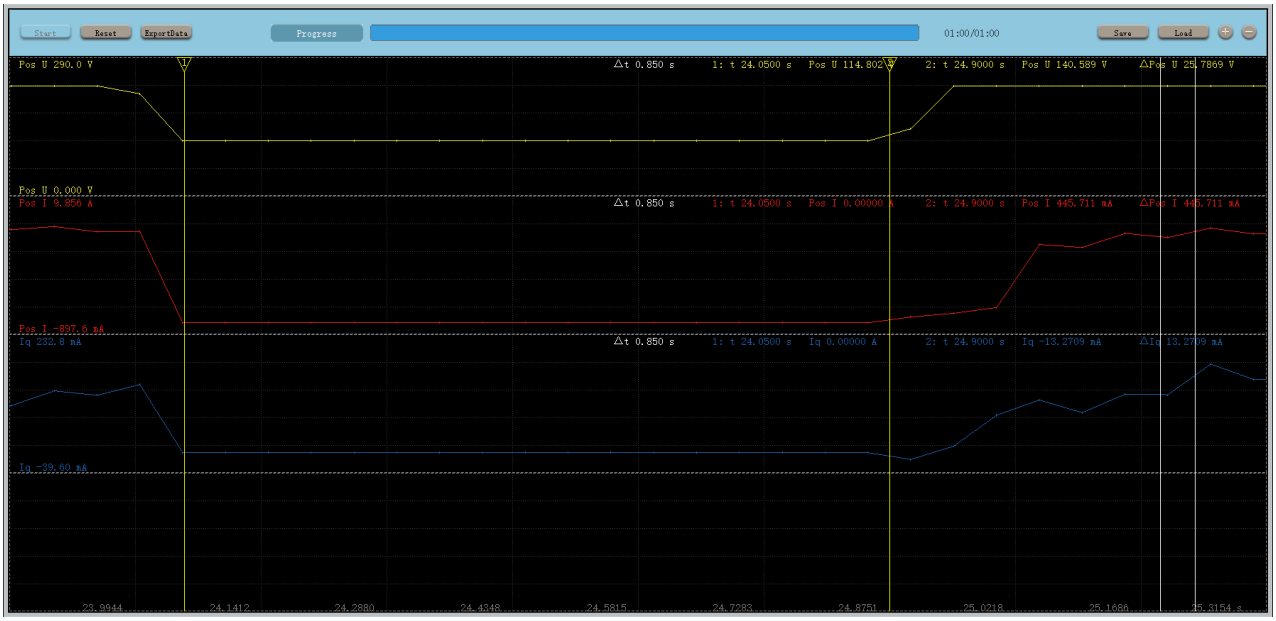
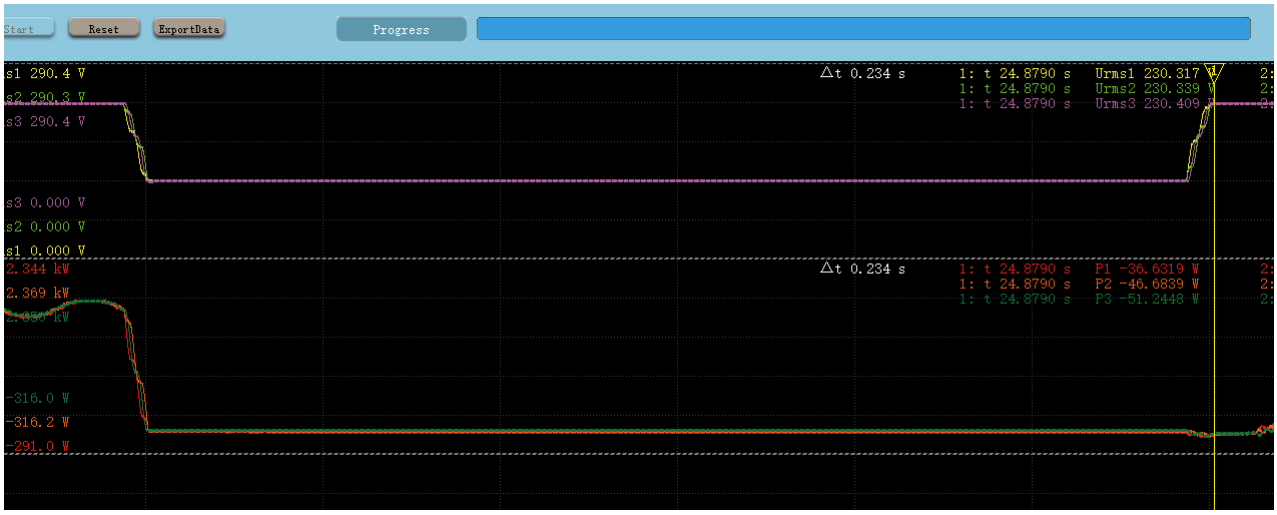
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 4s, 75%Vn, 1300ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	173.0	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	173.0	Voltage after fault– Phase 2	230.2
Voltage before fault – Phase 3	230.1	Voltage during fault– Phase 3	173.0	Voltage after fault– Phase 3	230.0
	Current(A)		Current(A)		Current(A)
Current before fault – Phase 1	7.5	Current during fault– Phase 1	0.2	Current after fault– Phase 1	7.2

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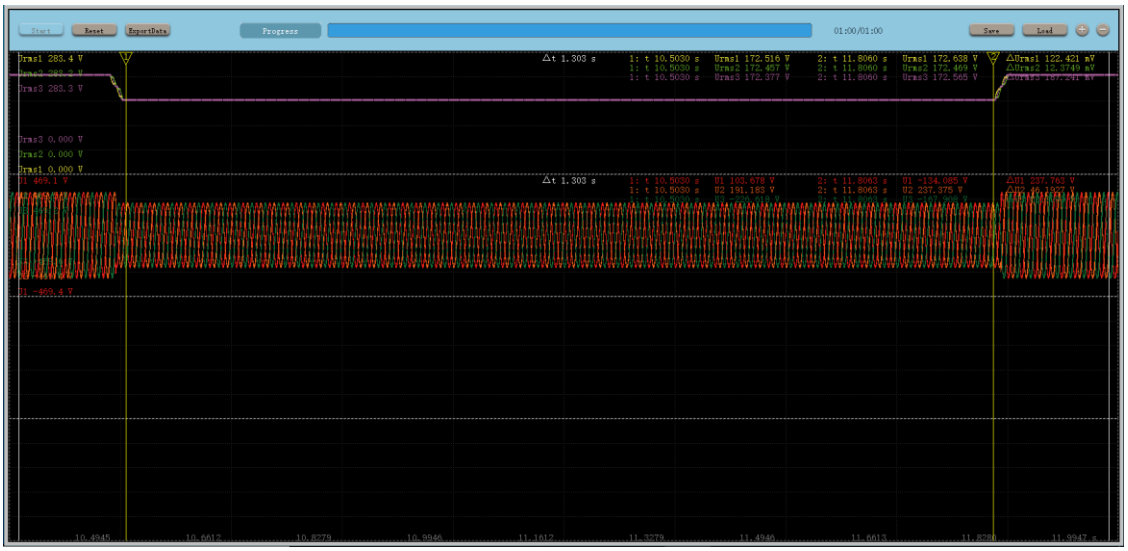
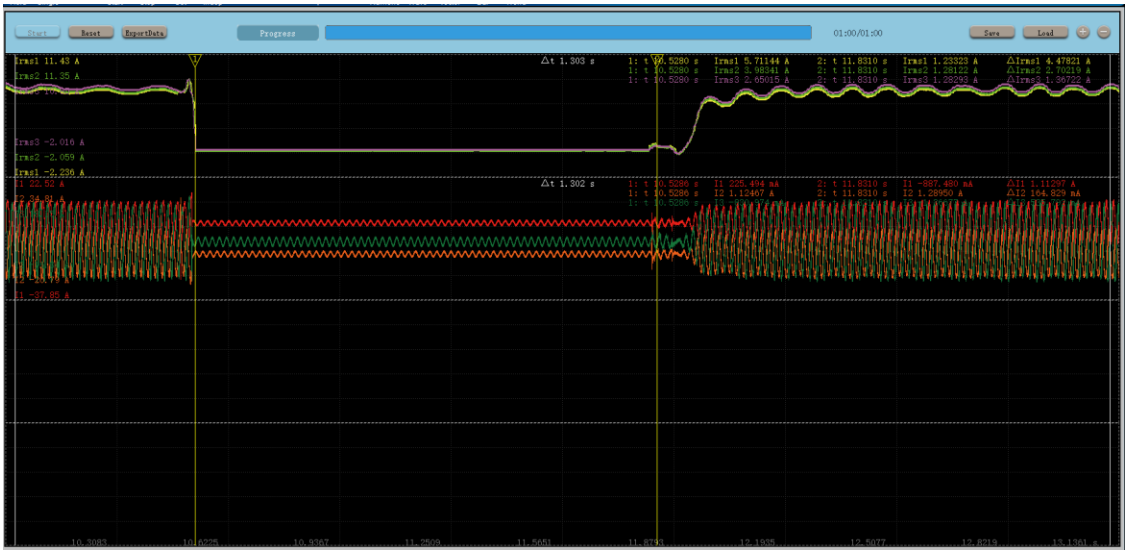
Current before fault – Phase 2	7.6	Current during fault– Phase 2	0.2	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.5	Current during fault– Phase 3	0.2	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	1300	Power recover time [ms]	254
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
5193	5196	97	93

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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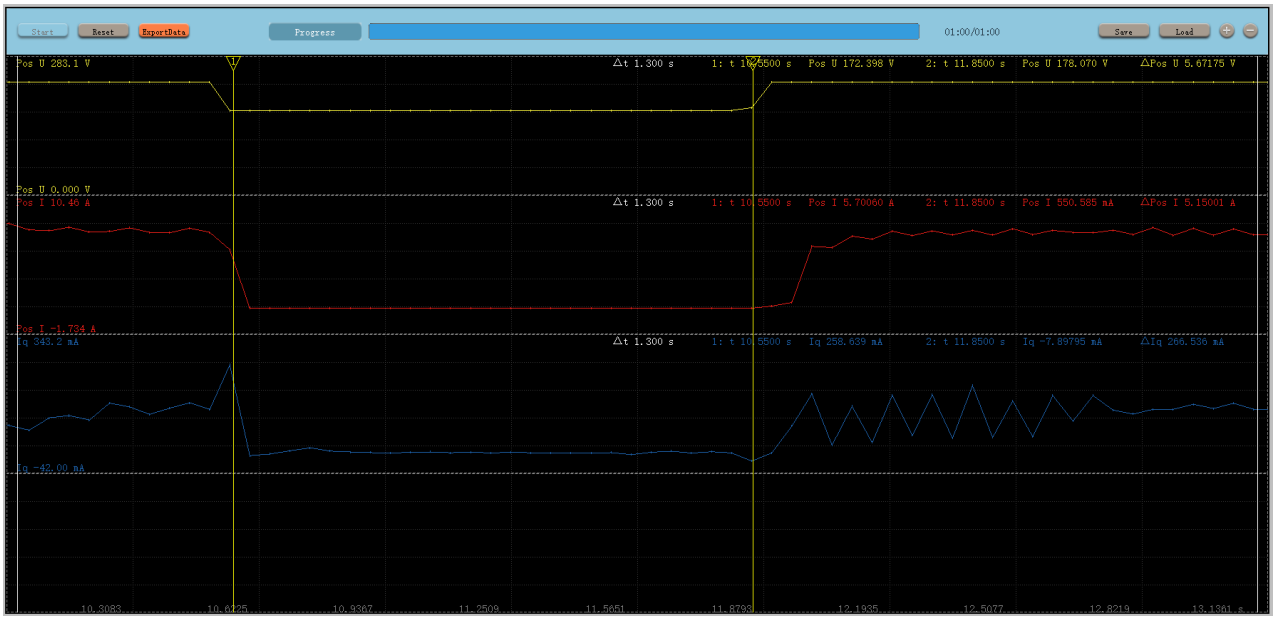
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 1a, 10%Vn, 200ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	200.3	Voltage after fault– Phase 1	230.3
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	200.3	Voltage after fault– Phase 2	230.2
Voltage before fault – Phase 3	230.1	Voltage during fault– Phase 3	23.0	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)

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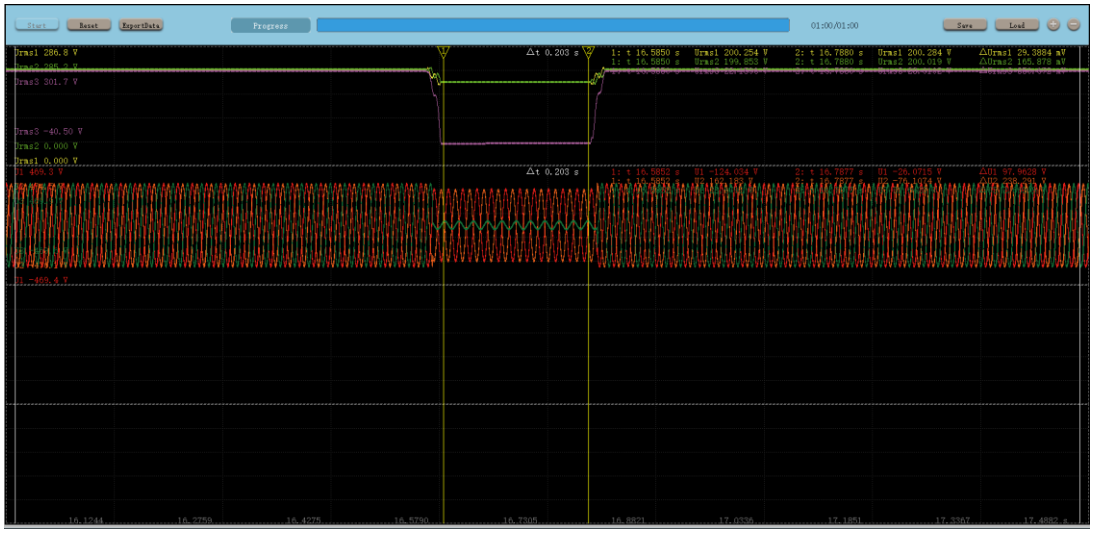
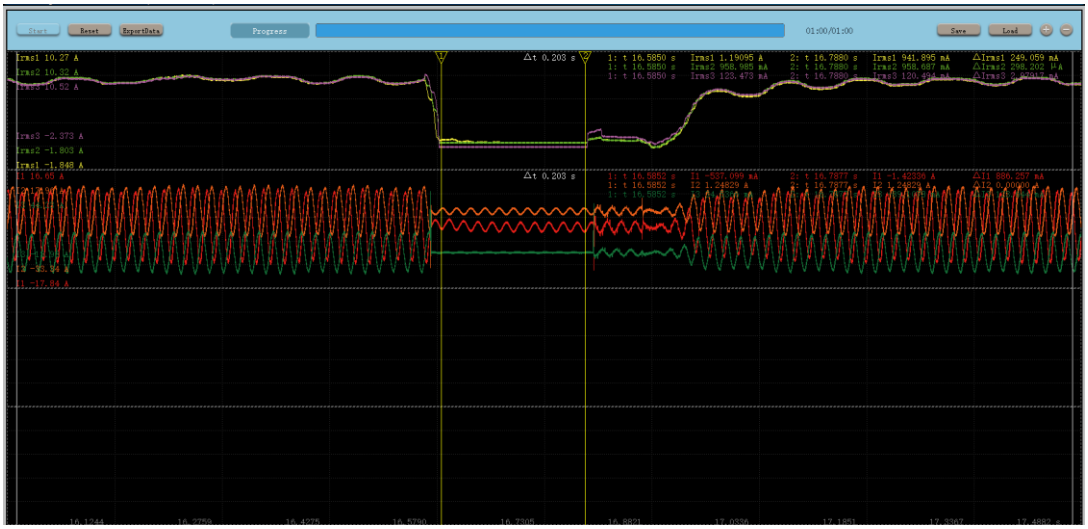
Current before fault – Phase 1	7.4	Current during fault– Phase 1	0.4	Current after fault– Phase 1	7.3
Current before fault – Phase 2	7.5	Current during fault– Phase 2	0.4	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.5	Current during fault– Phase 3	0.4	Current after fault– Phase 3	7.3
Disconnection during fault or after fault				No	

Duration [ms]	203	Power recover time [ms]	261
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
4976	4986	100	97

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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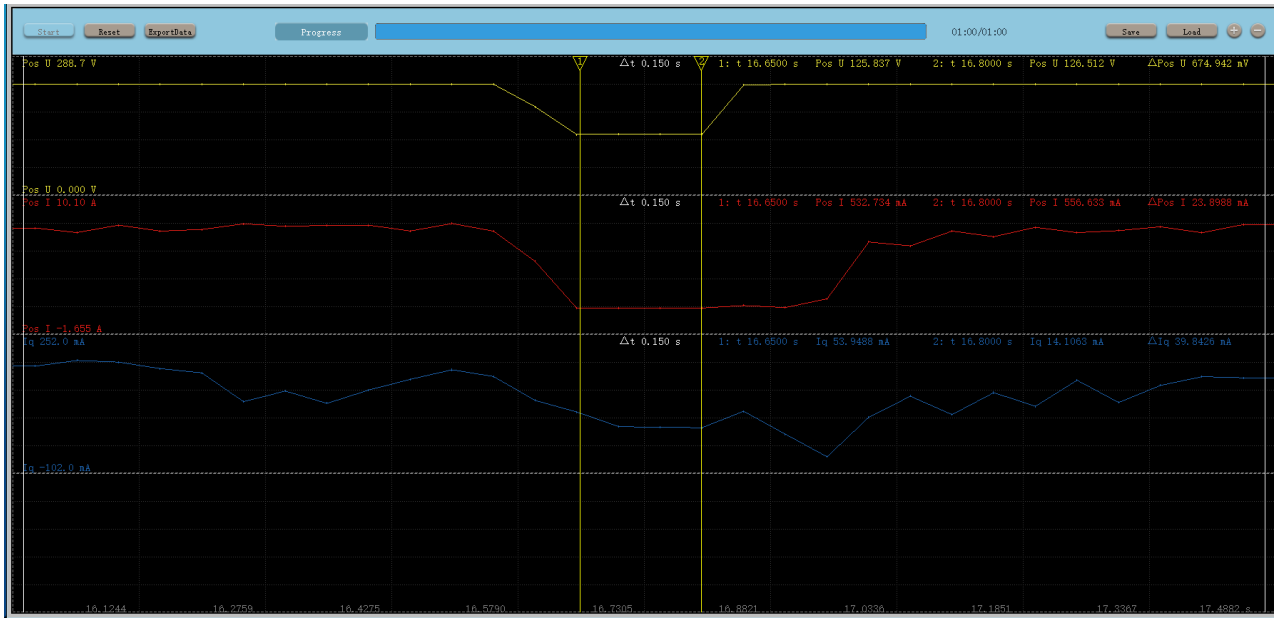
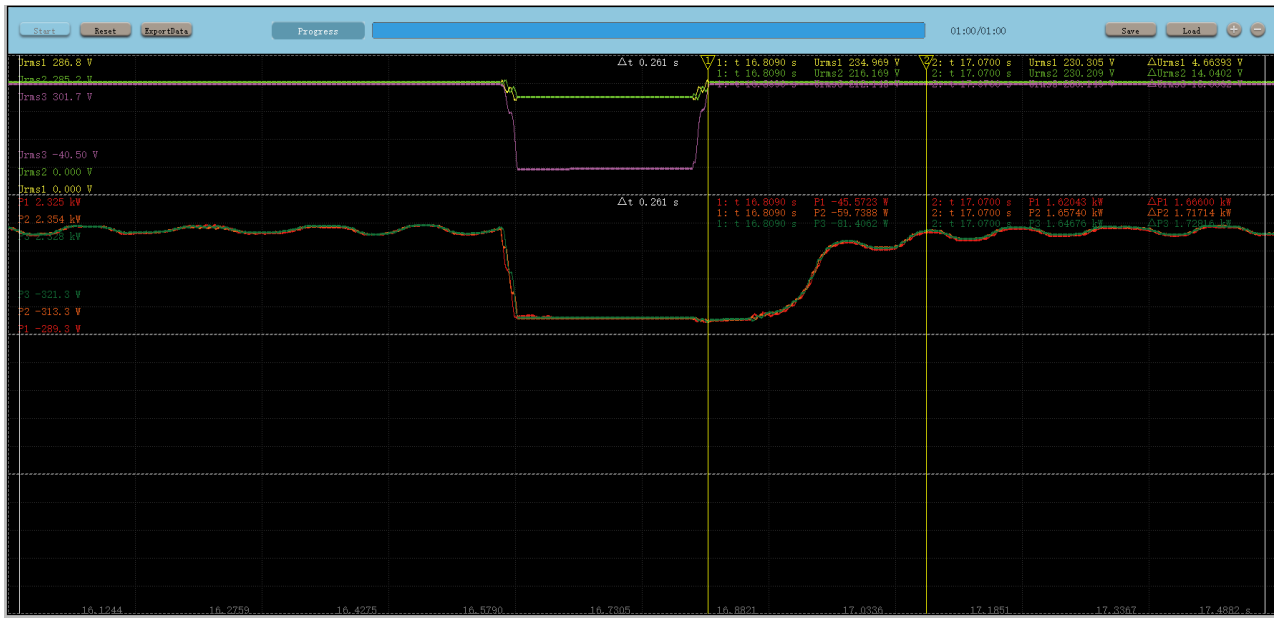
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 2a, 25%Vn, 400ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	202.5	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	202.6	Voltage after fault– Phase 2	230.2
Voltage before fault – Phase 3	230.1	Voltage during fault– Phase 3	57.5	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)

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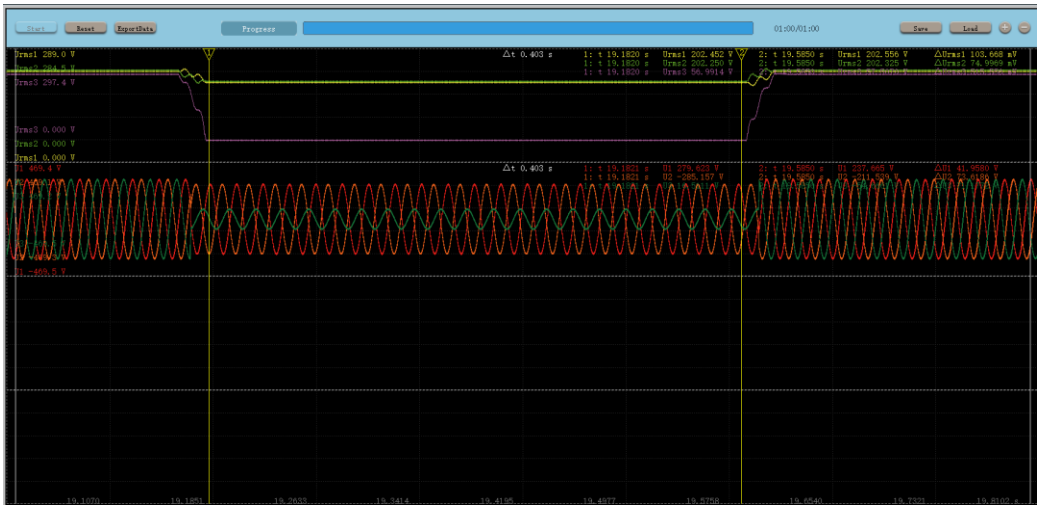
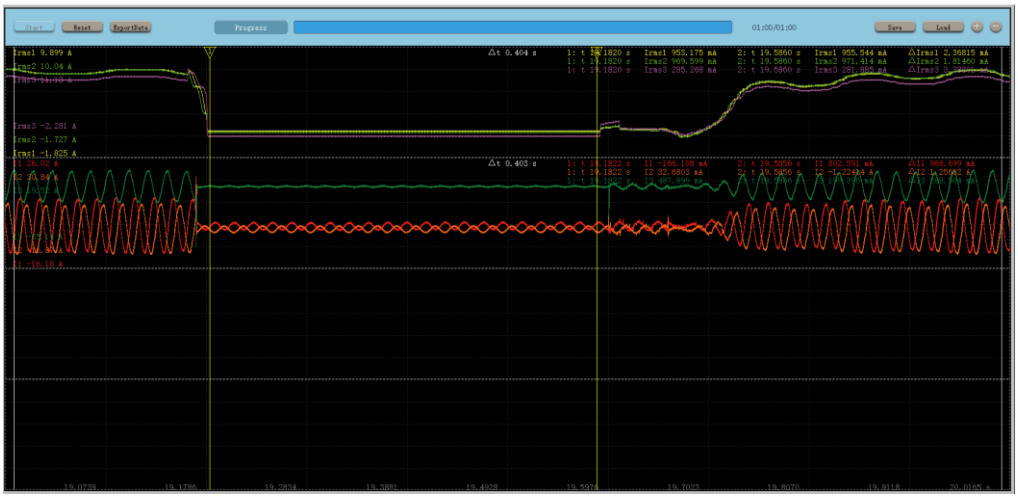
Current before fault – Phase 1	7.0	Current during fault– Phase 1	0.2	Current after fault– Phase 1	7.2
Current before fault – Phase 2	7.1	Current during fault– Phase 2	0.3	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.1	Current during fault– Phase 3	0.2	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	403	Power recover time [ms]	256
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
5132	5113	113	108

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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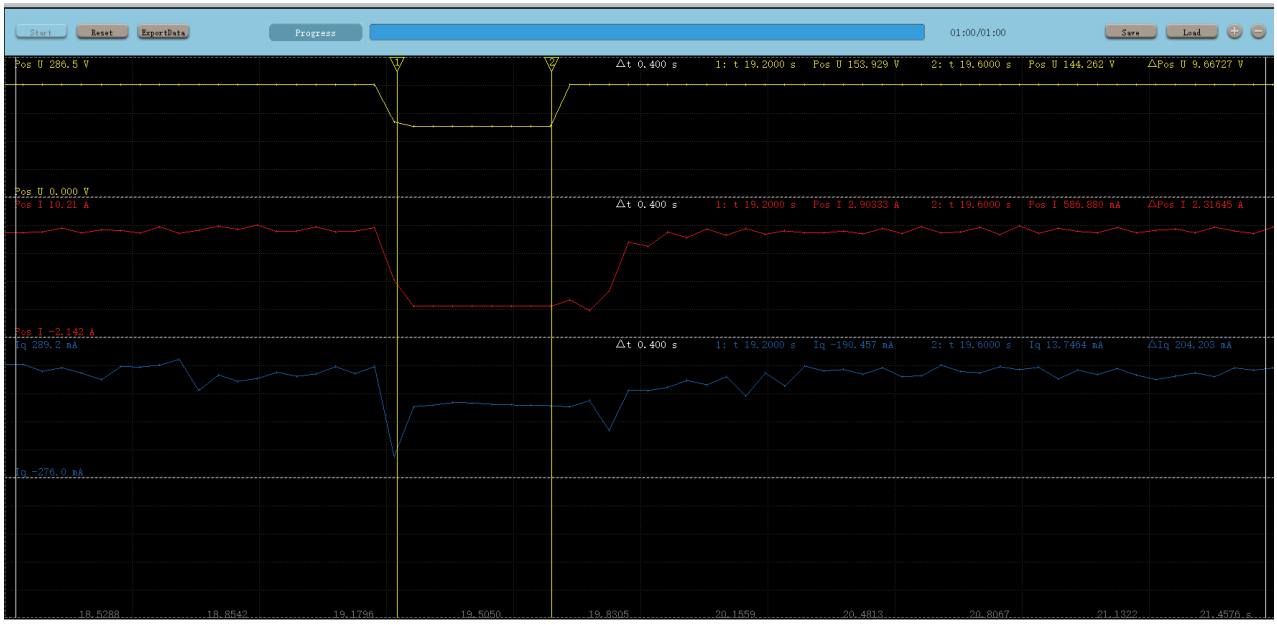
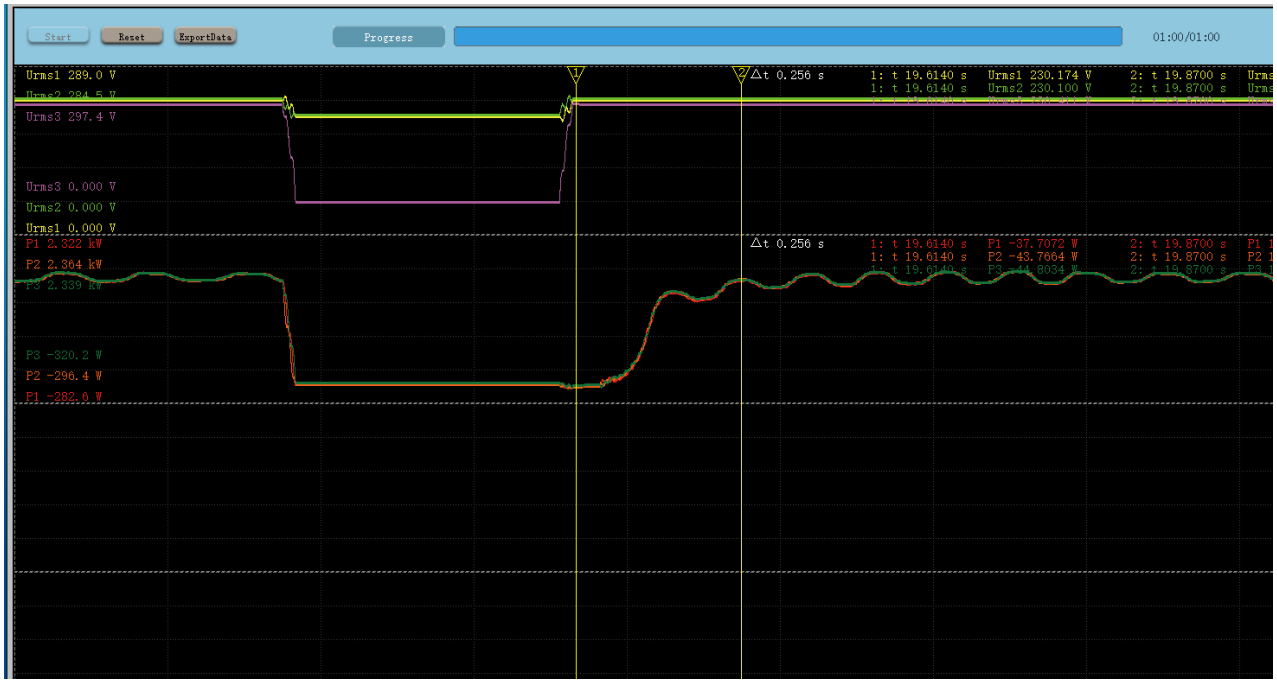
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 3a, 50%Vn, 850ms, asymmetrical ltwo-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	207.2	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.3	Voltage during fault– Phase 2	207.1	Voltage after fault– Phase 2	230.3

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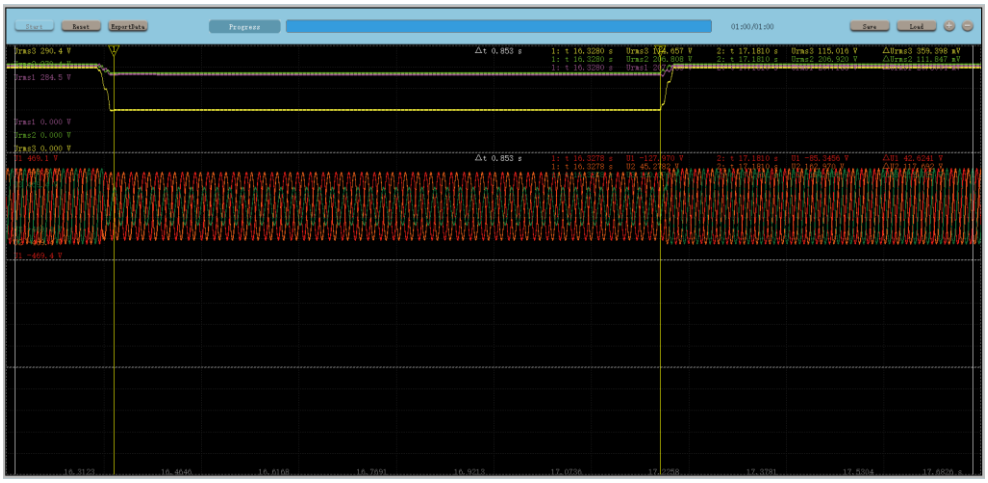
Voltage before fault – Phase 3	230.3	Voltage during fault– Phase 3	115.3	Voltage after fault– Phase 3	230.3
	Current(A)		Current(A)		Current(A)
Current before fault – Phase 1	7.6	Current during fault– Phase 1	0.5	Current after fault– Phase 1	7.3
Current before fault – Phase 2	7.7	Current during fault– Phase 2	0.4	Current after fault– Phase 2	7.2
Current before fault – Phase 3	7.7	Current during fault– Phase 3	0.3	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	853	Power recover time [ms]	244
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
5040	5050	-113	-116

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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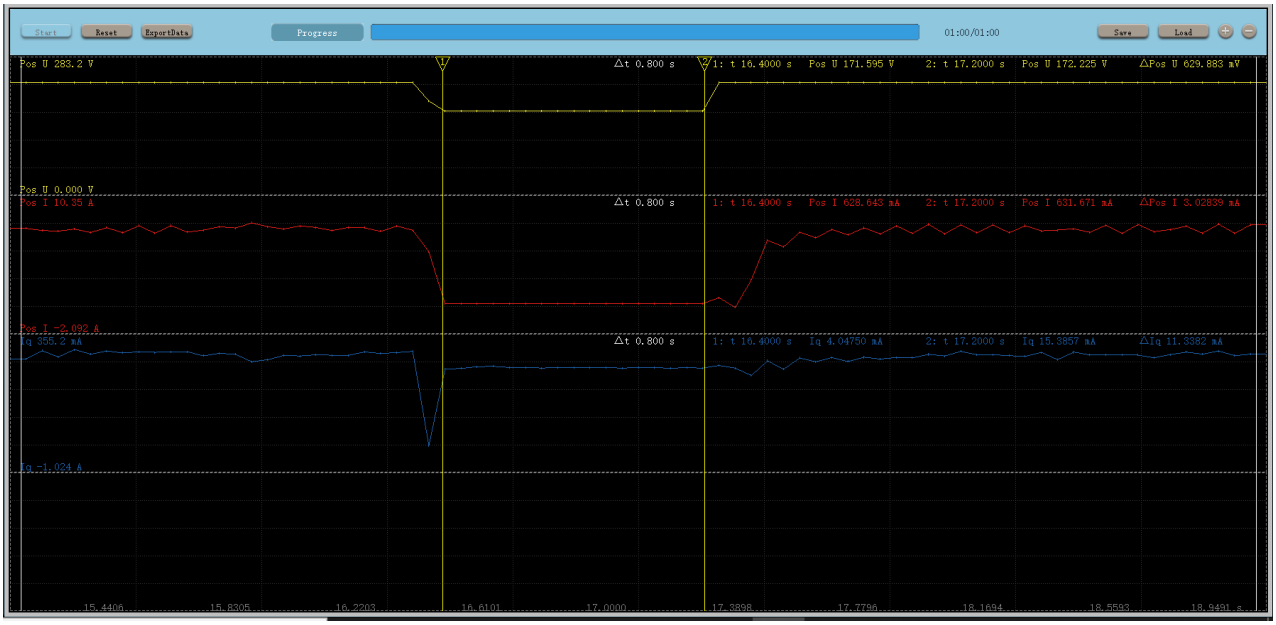
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 4a, 75%Vn, 1300ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	216.4	Voltage after fault– Phase 1	230.4
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	216.5	Voltage after fault– Phase 2	230.3
Voltage before fault – Phase 3	230.3	Voltage during fault– Phase 3	172.5	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)

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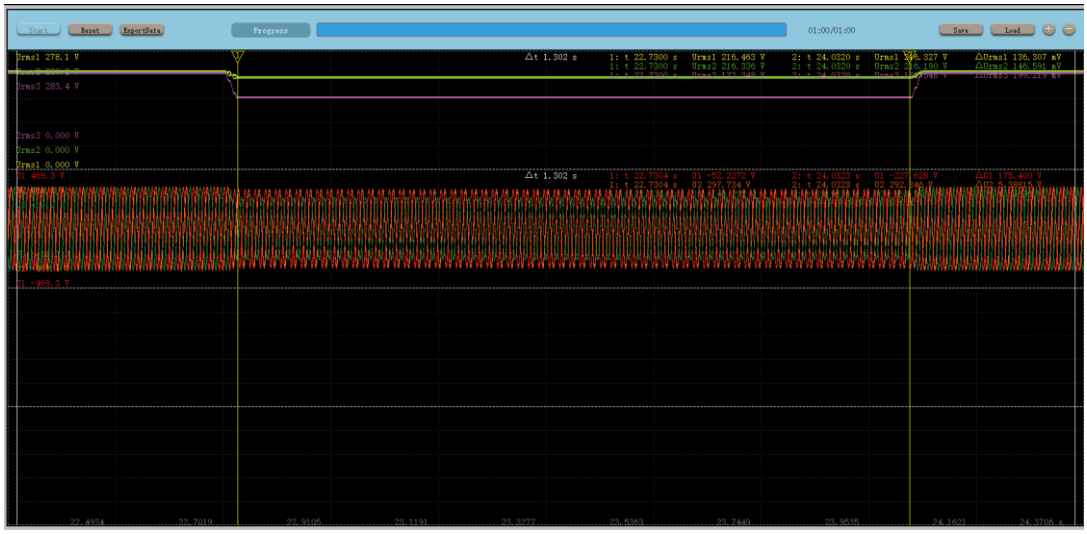
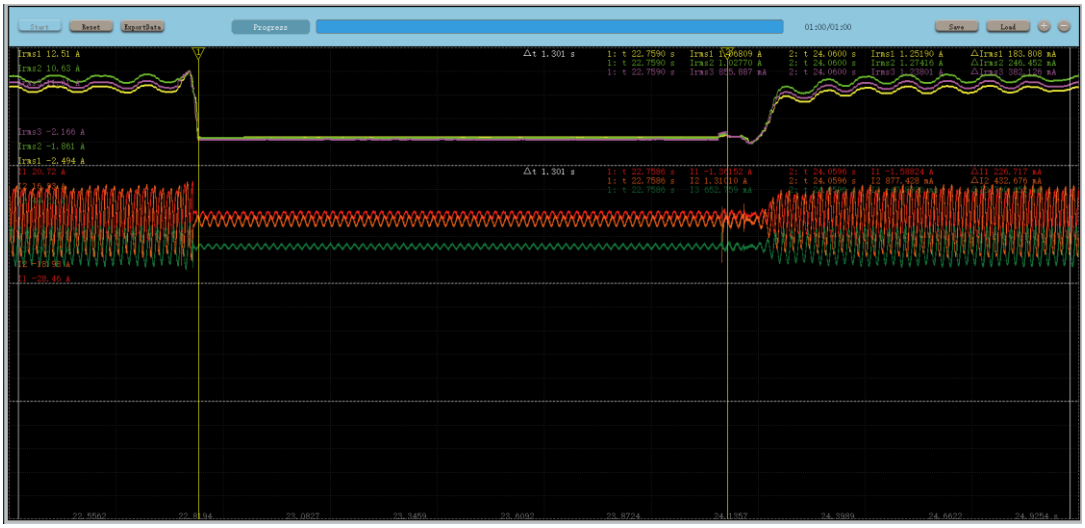
Current before fault – Phase 1	6.9	Current during fault– Phase 1	0.3	Current after fault– Phase 1	7.2
Current before fault – Phase 2	7.0	Current during fault– Phase 2	0.3	Current after fault– Phase 2	7.2
Current before fault – Phase 3	7.0	Current during fault– Phase 3	0.5	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	1302	Power recover time [ms]	239
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
4922	4909	107	104

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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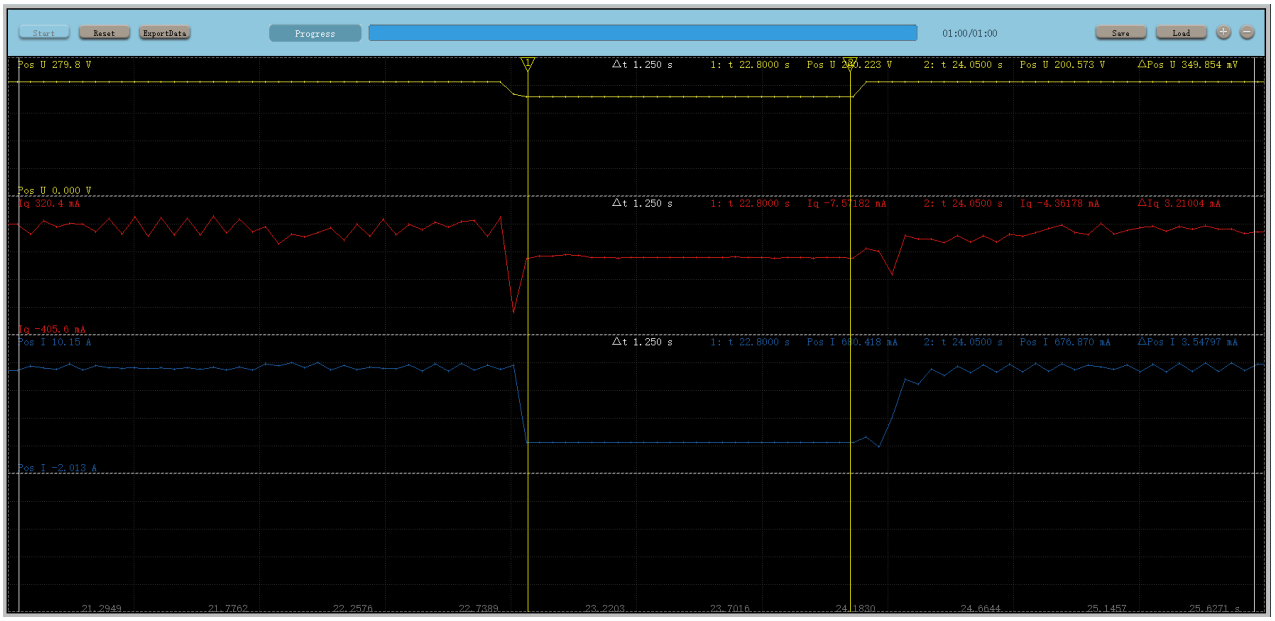
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 5, 10%Vn, 200ms, asymmetrical two-phase LV fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	230.3	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.2	Voltage during fault– Phase 2	23.0	Voltage after fault– Phase 2	230.1
Voltage before fault – Phase 3	230.2	Voltage during fault– Phase 3	23.1	Voltage after fault– Phase 3	230.1
	Current(A)		Current(A)		Current(A)

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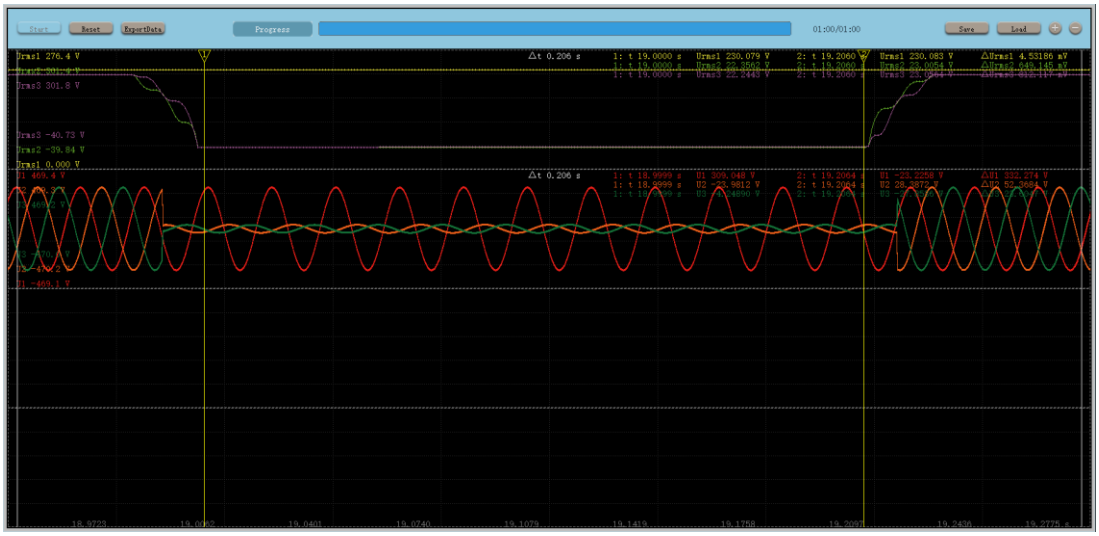
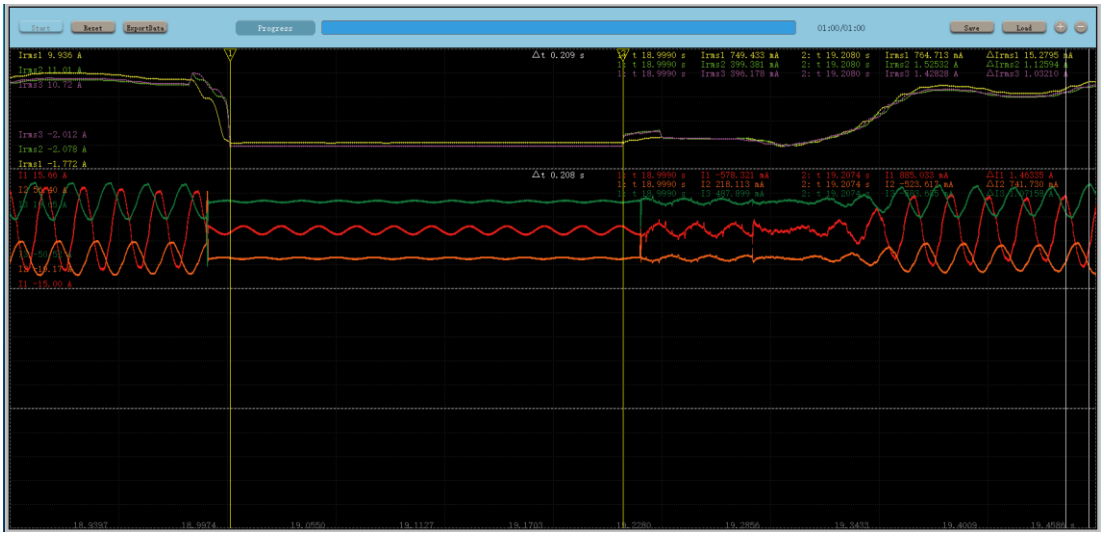
Current before fault – Phase 1	7.3	Current during fault– Phase 1	0.4	Current after fault– Phase 1	7.2
Current before fault – Phase 2	7.2	Current during fault– Phase 2	0.1	Current after fault– Phase 2	7.3
Current before fault – Phase 3	7.2	Current during fault– Phase 3	0.2	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	206	Power recover time [ms]	254
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
4909	4915	114	118

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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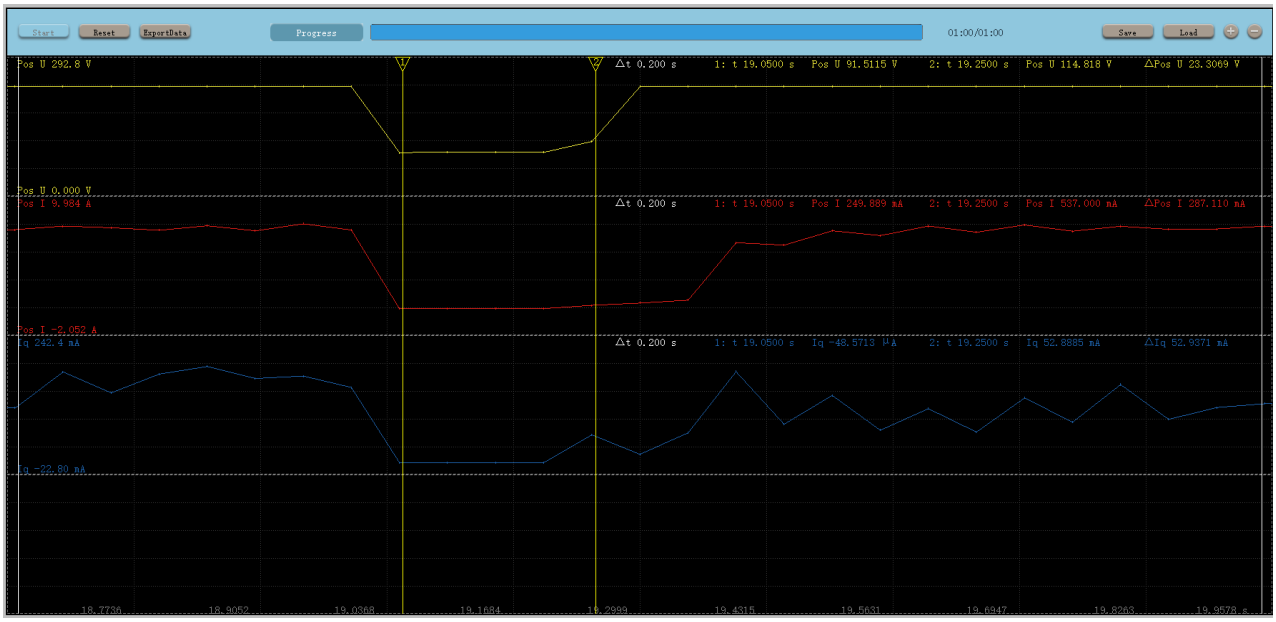
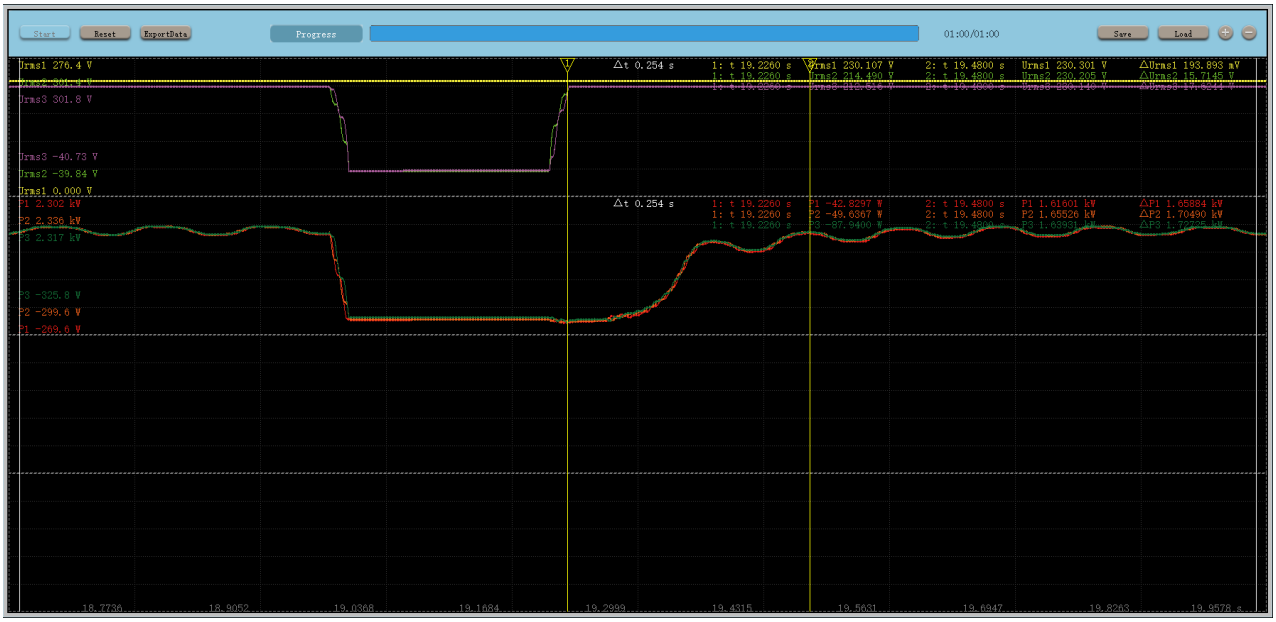
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 6, 50%Vn, 850ms, asymmetrical two-phase LV fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.3	Voltage during fault– Phase 1	230.2	Voltage after fault– Phase 1	230.1
Voltage before fault – Phase 2	230.3	Voltage during fault– Phase 2	115.2	Voltage after fault– Phase 2	230.1
Voltage before fault – Phase 3	230.3	Voltage during fault– Phase 3	115.3	Voltage after fault– Phase 3	230.3
	Current(A)		Current(A)		Current(A)

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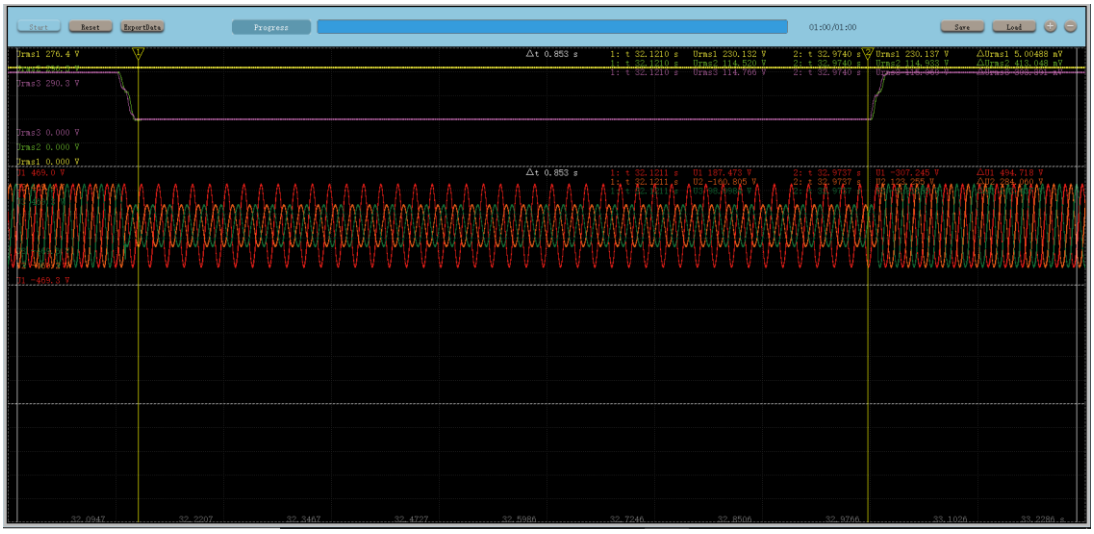
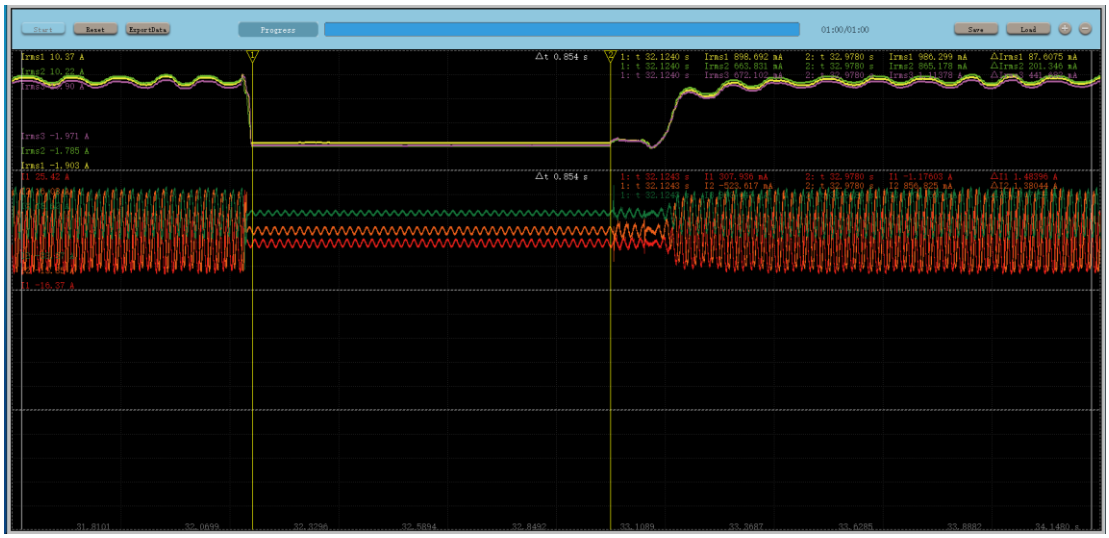
Current before fault – Phase 1	7.2	Current during fault– Phase 1	0.4	Current after fault– Phase 1	7.3
Current before fault – Phase 2	7.2	Current during fault– Phase 2	0.4	Current after fault– Phase 2	7.2
Current before fault – Phase 3	7.2	Current during fault– Phase 3	0.4	Current after fault– Phase 3	7.2
Disconnection during fault or after fault				No	

Duration [ms]	853	Power recover time [ms]	276
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
5071	5076	109	-110

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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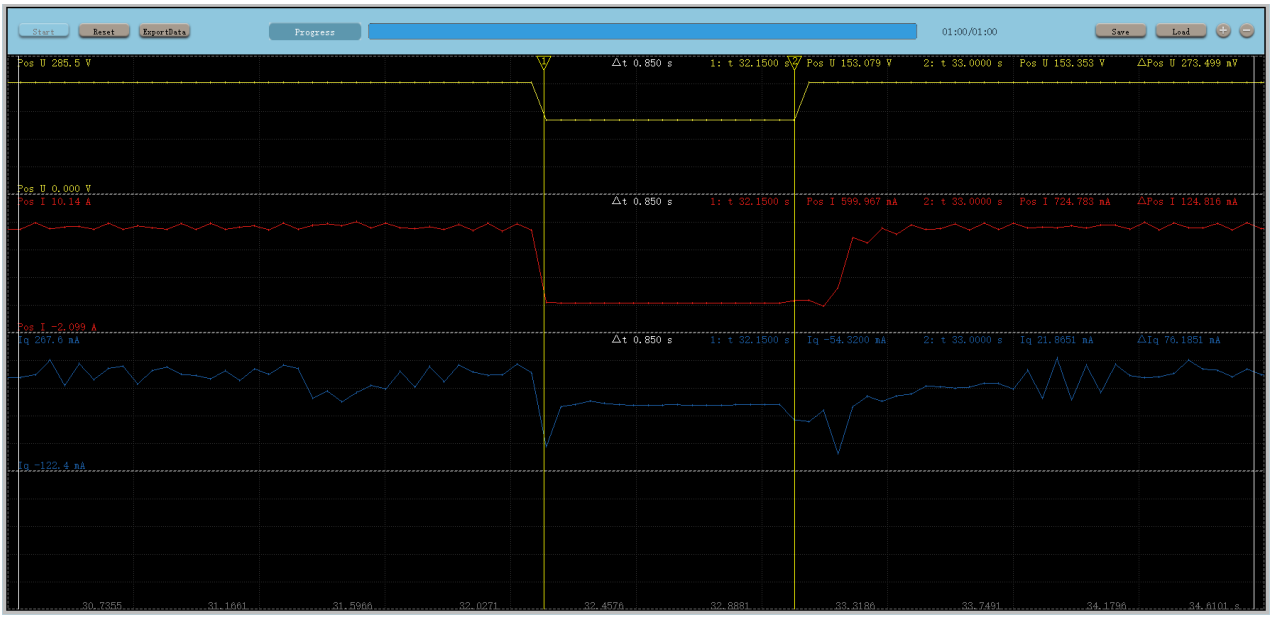
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Pn in %	100%Pn

Test number 1s, 10%Vn, 200ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	23.0	Voltage after fault– Phase 1	230.5
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	23.0	Voltage after fault– Phase 2	230.5
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	23.0	Voltage after fault– Phase 3	230.5

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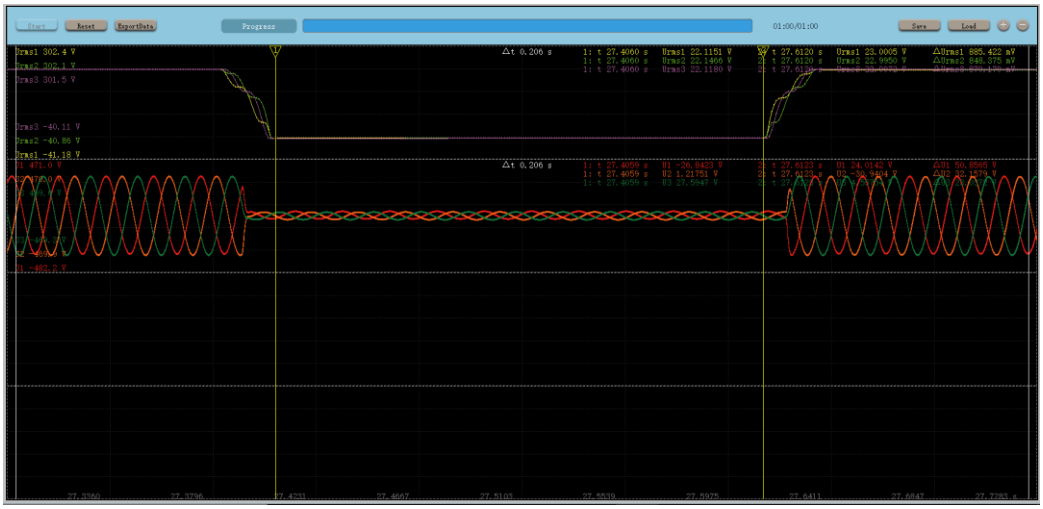
	Current(A)		Current(A)		Current(A)
Current before fault – Phase 1	36.8	Current during fault– Phase 1	0.2	Current after fault– Phase 1	36.3
Current before fault – Phase 2	37.3	Current during fault– Phase 2	0.1	Current after fault– Phase 2	37.3
Current before fault – Phase 3	37.3	Current during fault– Phase 3	0.1	Current after fault– Phase 3	37.3
Disconnection during fault or after fault				No	

Duration [ms]	206	Power recover time [ms]	380
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25276	25240	19.5	-4.4

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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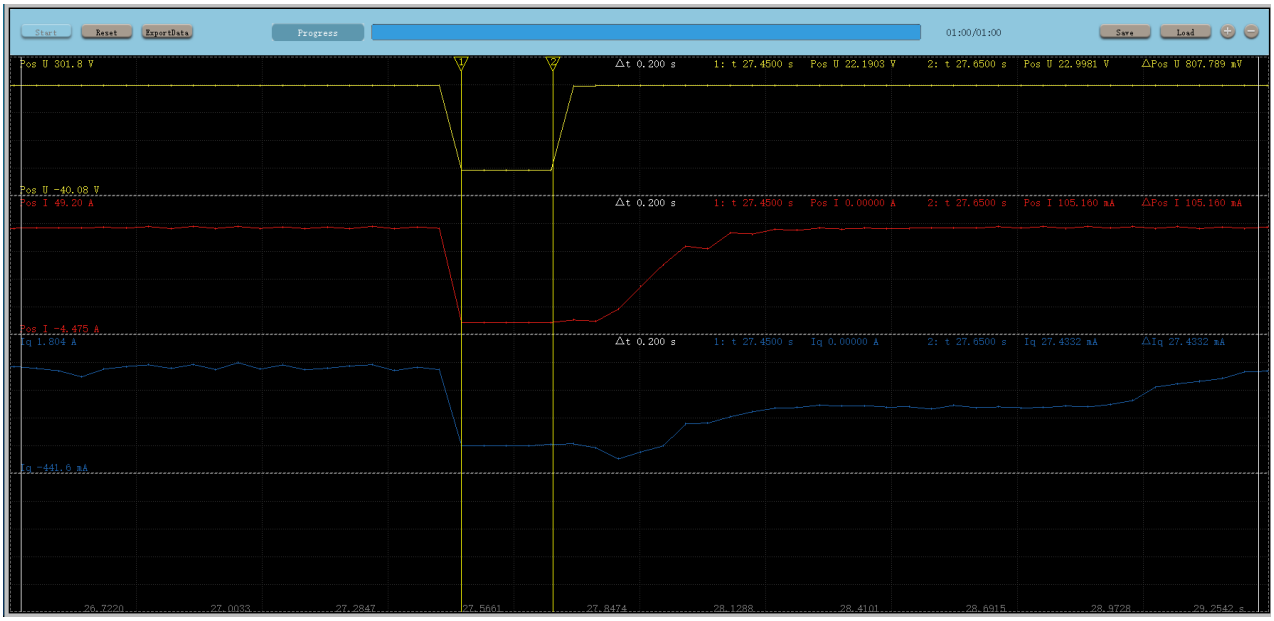
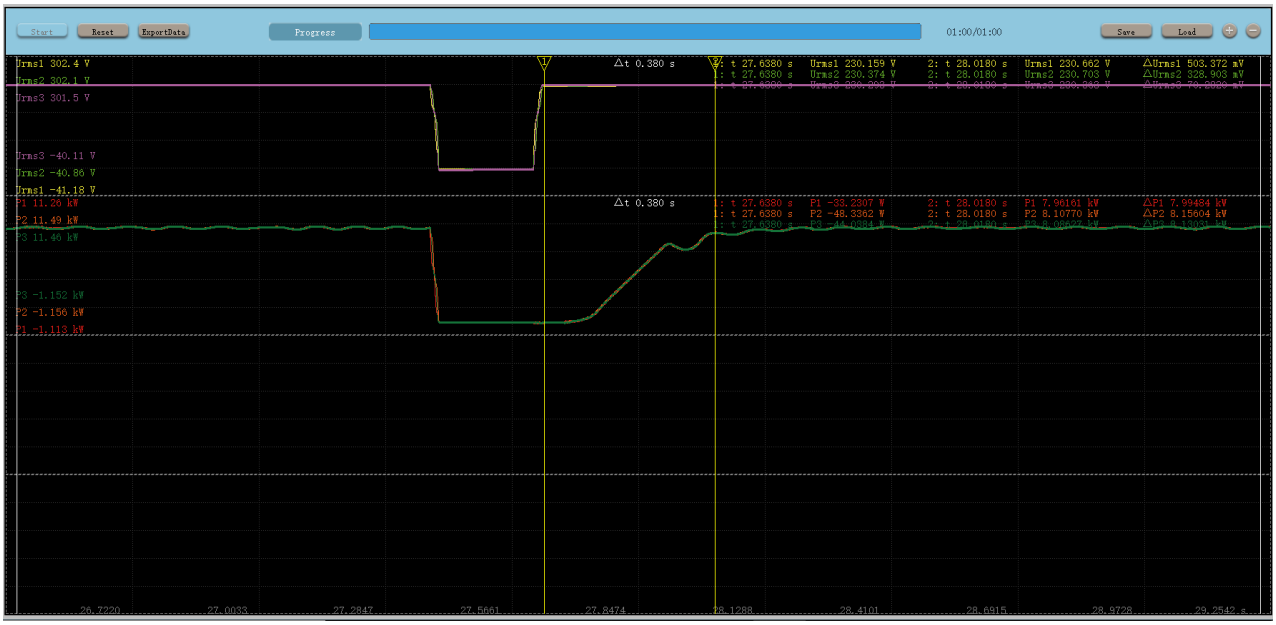
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 2s, 25%Vn, 400ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.8	Voltage during fault– Phase 1	57.5	Voltage after fault– Phase 1	230.4
Voltage before fault – Phase 2	230.7	Voltage during fault– Phase 2	57.6	Voltage after fault– Phase 2	230.5
Voltage before fault – Phase 3	230.8	Voltage during fault– Phase 3	57.5	Voltage after fault– Phase 3	230.4
	Current(A)		Current(A)		Current(A)

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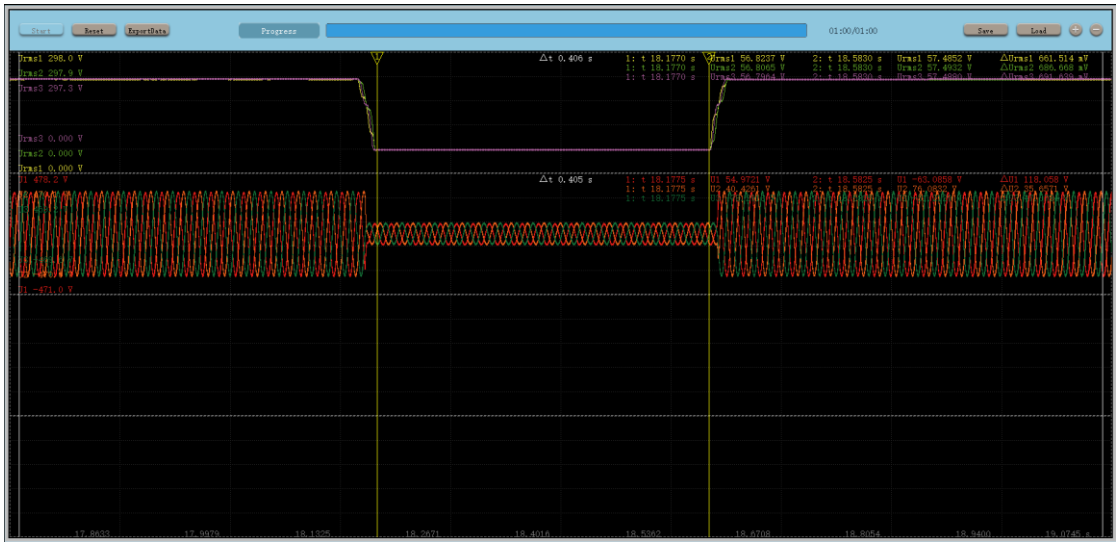
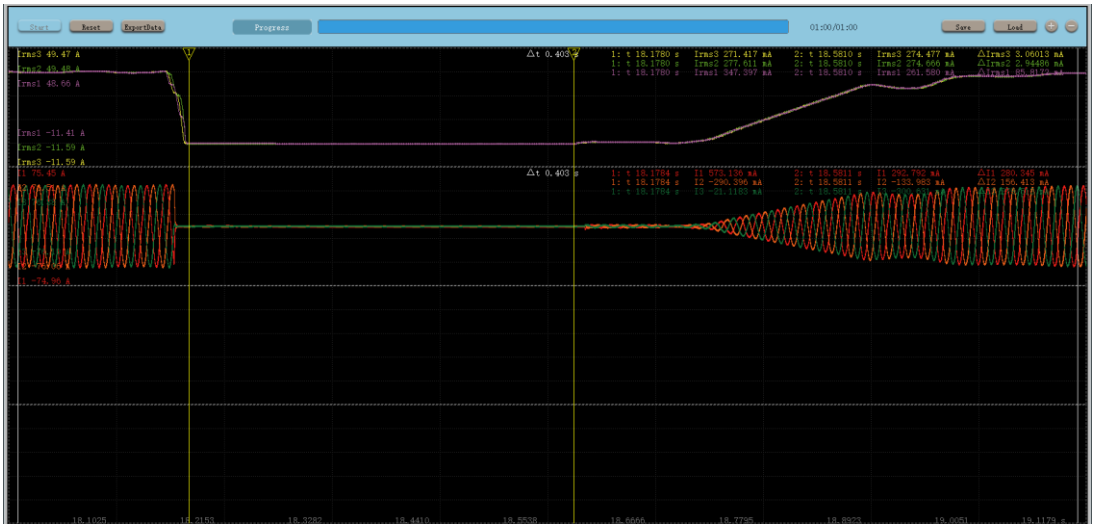
Current before fault – Phase 1	36.1	Current during fault– Phase 1	0.1	Current after fault– Phase 1	36.3
Current before fault – Phase 2	36.2	Current during fault– Phase 2	0.1	Current after fault– Phase 2	36.3
Current before fault – Phase 3	36.2	Current during fault– Phase 3	0.2	Current after fault– Phase 3	36.3
Disconnection during fault or after fault				No	

Duration [ms]	406	Power recover time [ms]	384
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
24954	24990	10.5	-5.9

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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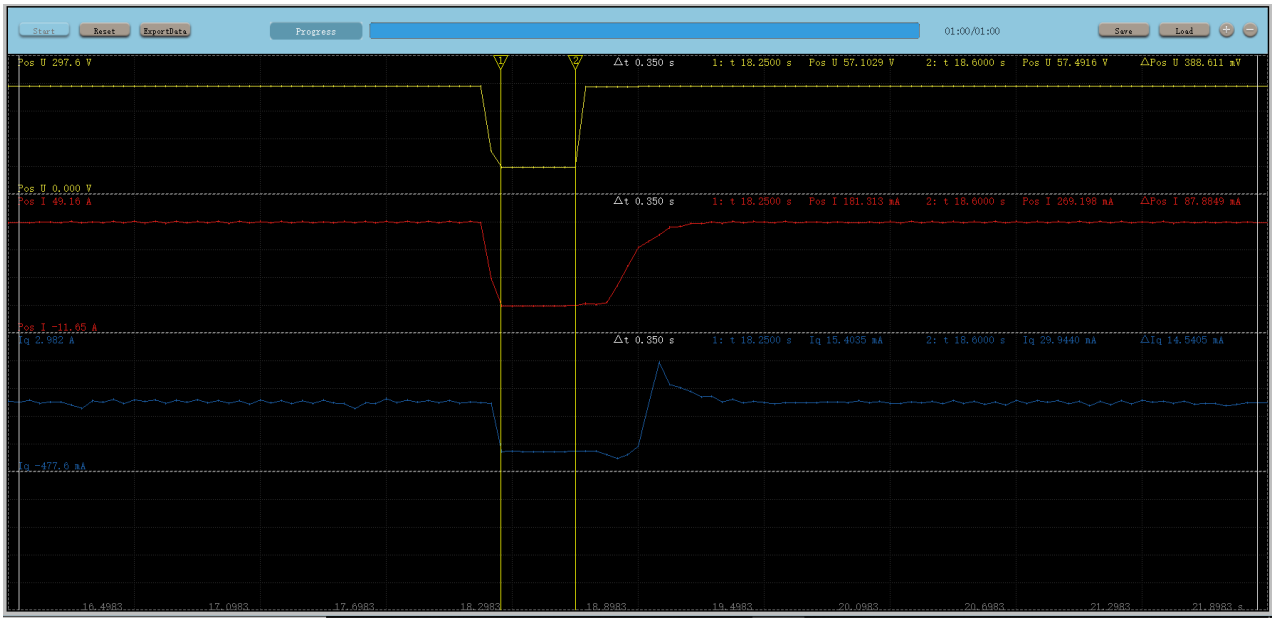
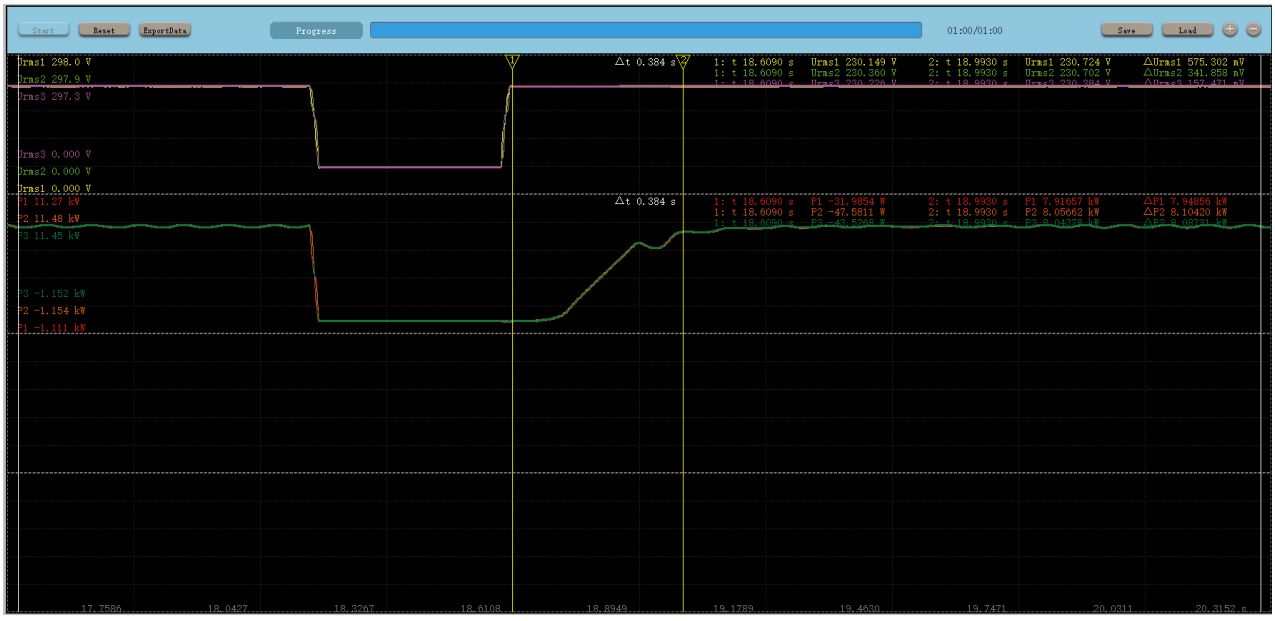
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 3s, 50%Vn, 850ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.8	Voltage during fault– Phase 1	115.1	Voltage after fault– Phase 1	230.6
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	115.1	Voltage after fault– Phase 2	230.4
Voltage before fault – Phase 3	230.8	Voltage during fault– Phase 3	115.0	Voltage after fault– Phase 3	230.6
	Current(A)		Current(A)		Current(A)

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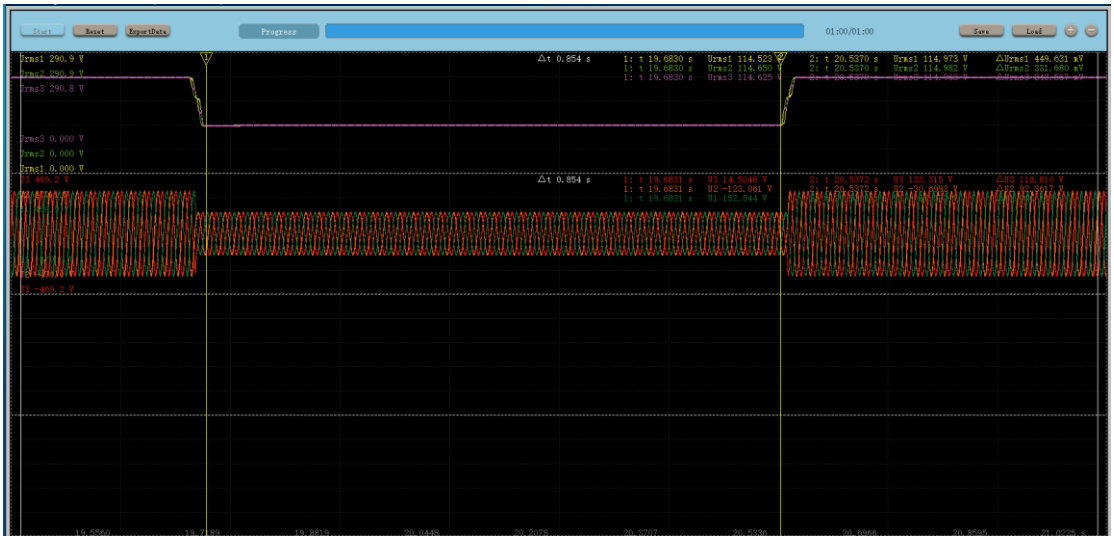
Current before fault – Phase 1	36.2	Current during fault– Phase 1	0.2	Current after fault– Phase 1	36.4
Current before fault – Phase 2	36.2	Current during fault– Phase 2	0.3	Current after fault– Phase 2	36.4
Current before fault – Phase 3	36.3	Current during fault– Phase 3	0.3	Current after fault– Phase 3	36.4
Disconnection during fault or after fault				No	

Duration [ms]	854	Power recover time [ms]	377
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25090	25149	126	-66

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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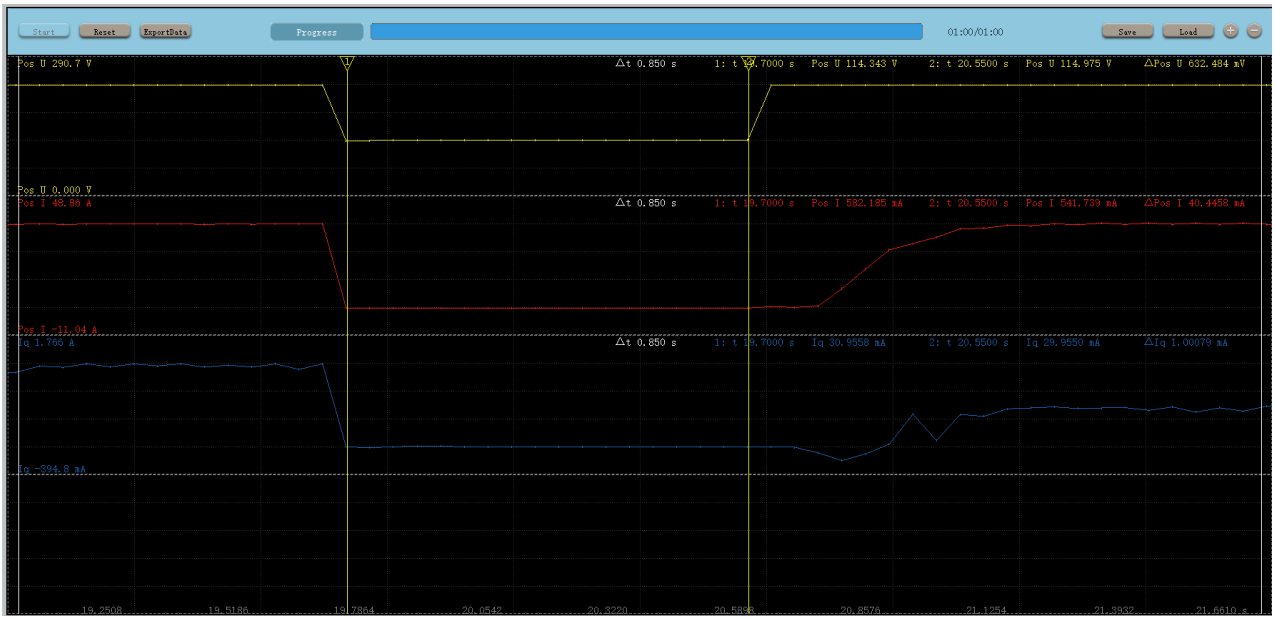
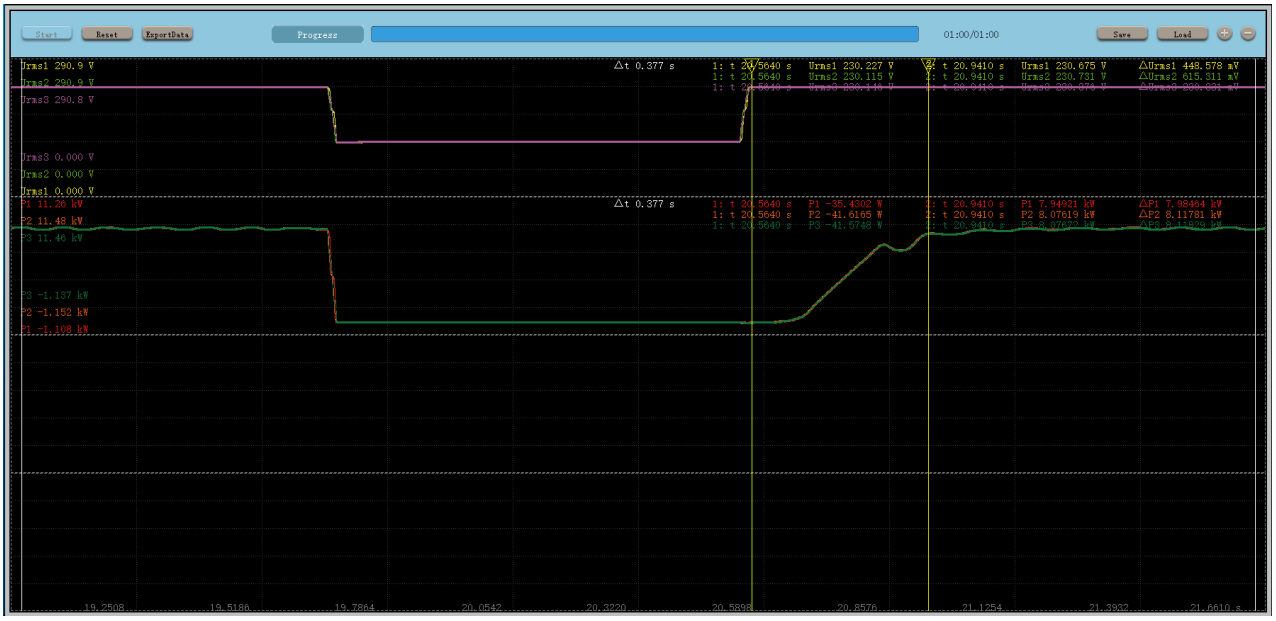
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 4s, 75%Vn, 1300ms, three-phase symmetrical fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	172.5	Voltage after fault– Phase 1	230.5
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	172.5	Voltage after fault– Phase 2	230.5
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	172.5	Voltage after fault– Phase 3	230.4
	Current(A)		Current(A)		Current(A)

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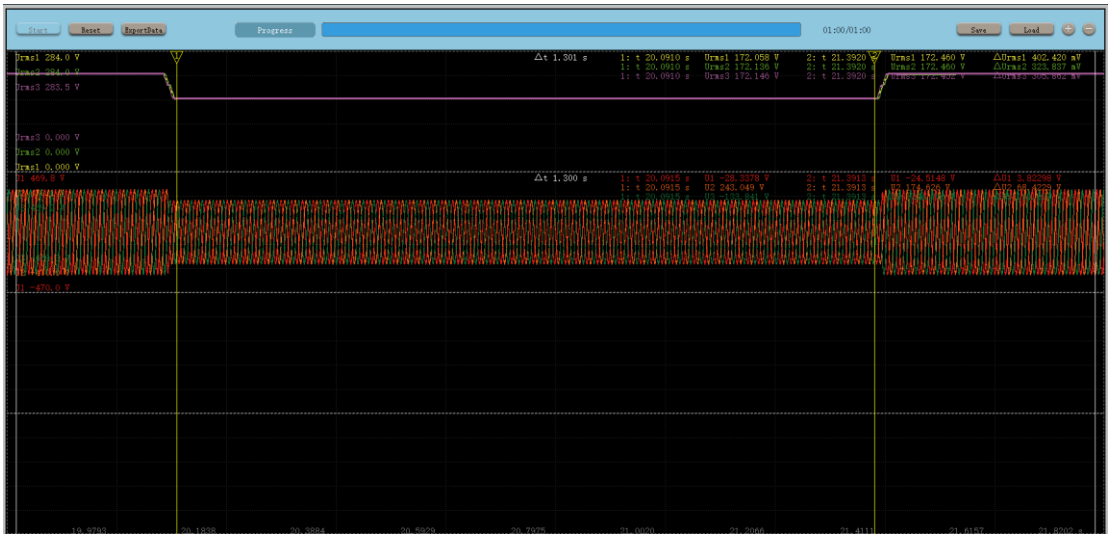
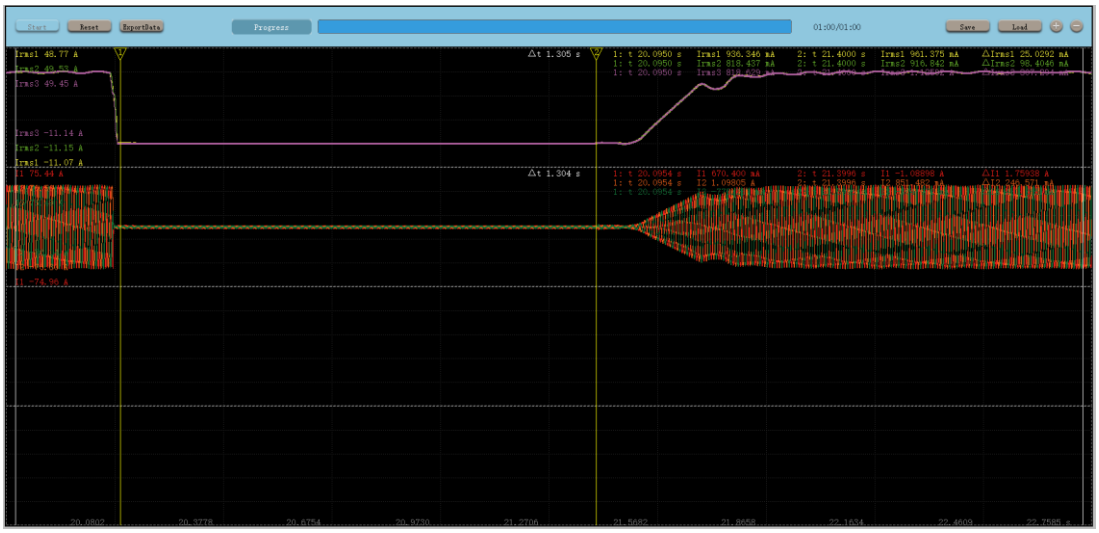
Current before fault – Phase 1	36.1	Current during fault– Phase 1	0.3	Current after fault– Phase 1	36.2
Current before fault – Phase 2	36.8	Current during fault– Phase 2	0.4	Current after fault– Phase 2	36.2
Current before fault – Phase 3	36.7	Current during fault– Phase 3	0.2	Current after fault– Phase 3	36.2
Disconnection during fault or after fault				No	

Duration [ms]	1301	Power recover time [ms]	378
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25307	25314	123	-33

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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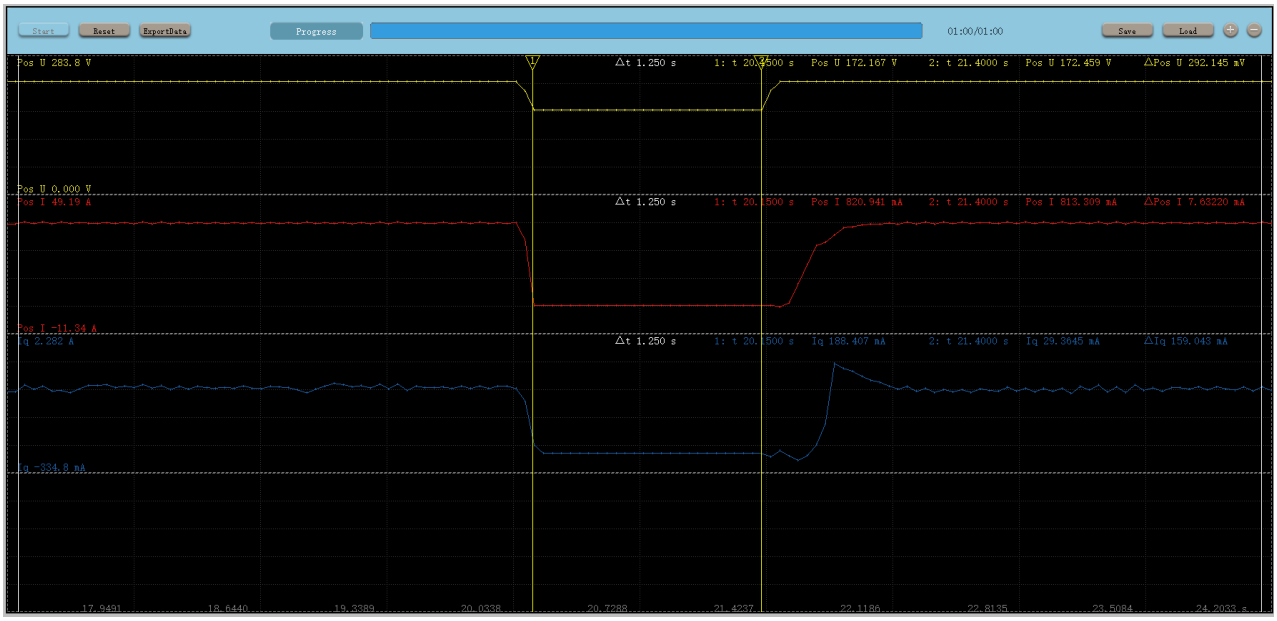
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 1a, 10%Vn, 200ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	200.4	Voltage after fault– Phase 1	230.6
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	200.4	Voltage after fault– Phase 2	230.6
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	23.0	Voltage after fault– Phase 3	230.7
	Current(A)		Current(A)		Current(A)

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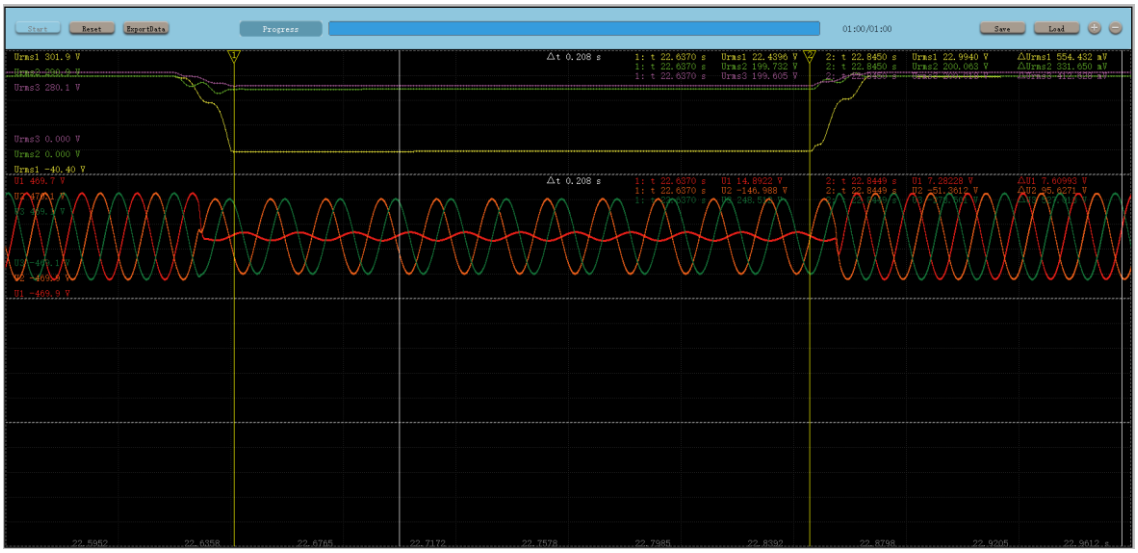
Current before fault – Phase 1	36.4	Current during fault– Phase 1	0.3	Current after fault– Phase 1	36.5
Current before fault – Phase 2	36.9	Current during fault– Phase 2	0.2	Current after fault– Phase 2	36.6
Current before fault – Phase 3	36.9	Current during fault– Phase 3	0.1	Current after fault– Phase 3	36.6
Disconnection during fault or after fault				No	

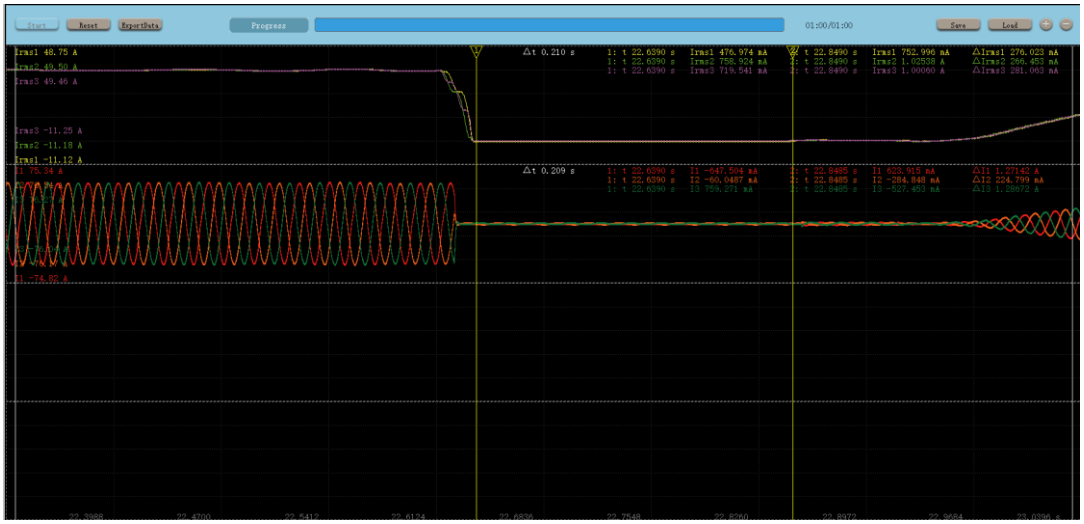
Duration [ms]	208	Power recover time [ms]	375

Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25252	25248	73	-10

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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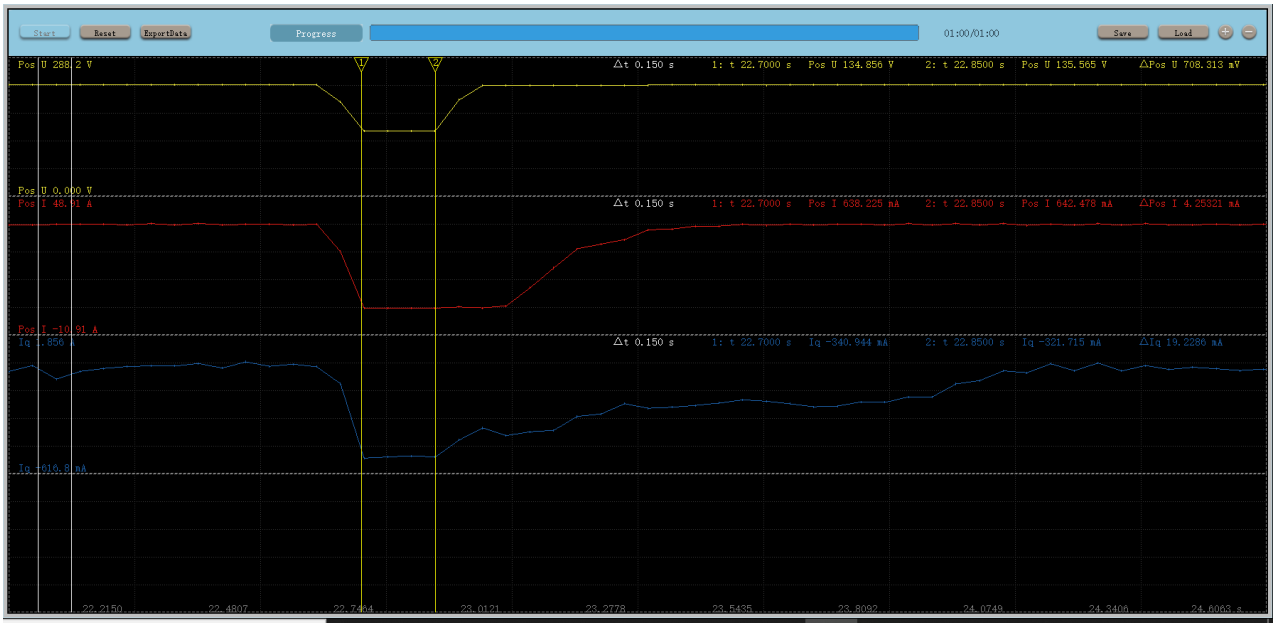
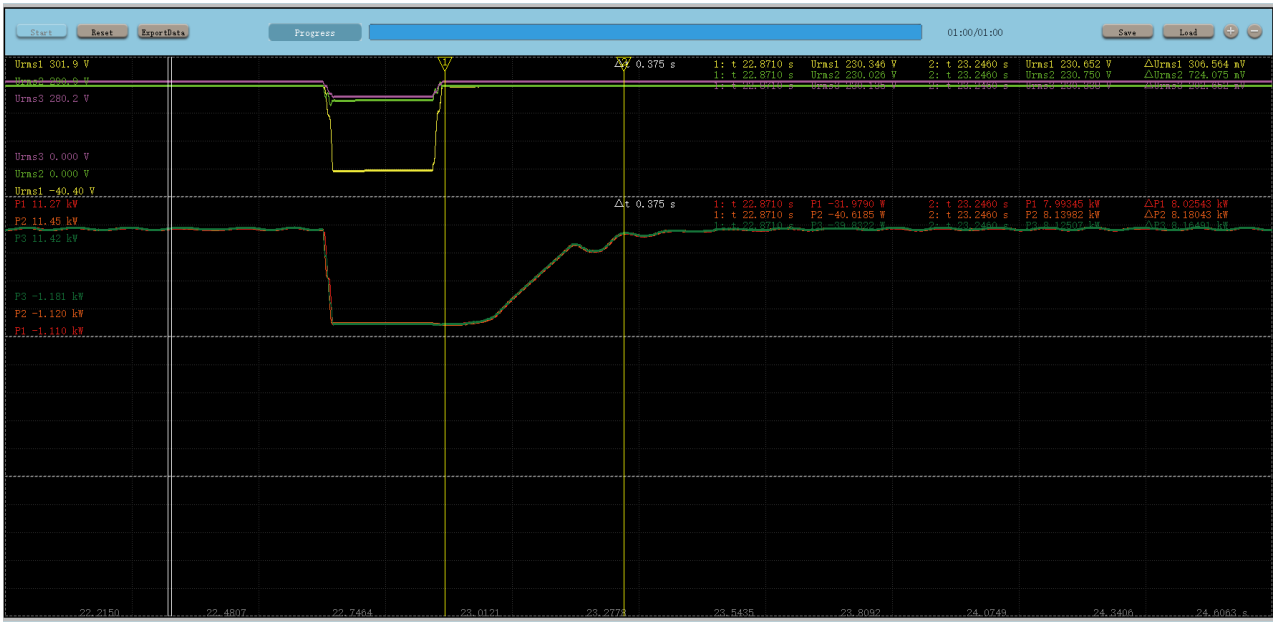
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 2a, 25%Vn, 400ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	202.5	Voltage after fault– Phase 1	230.6
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	202.6	Voltage after fault– Phase 2	230.7
Voltage before fault – Phase 3	230.5	Voltage during fault– Phase 3	57.5	Voltage after fault– Phase 3	230.6
	Current(A)		Current(A)		Current(A)

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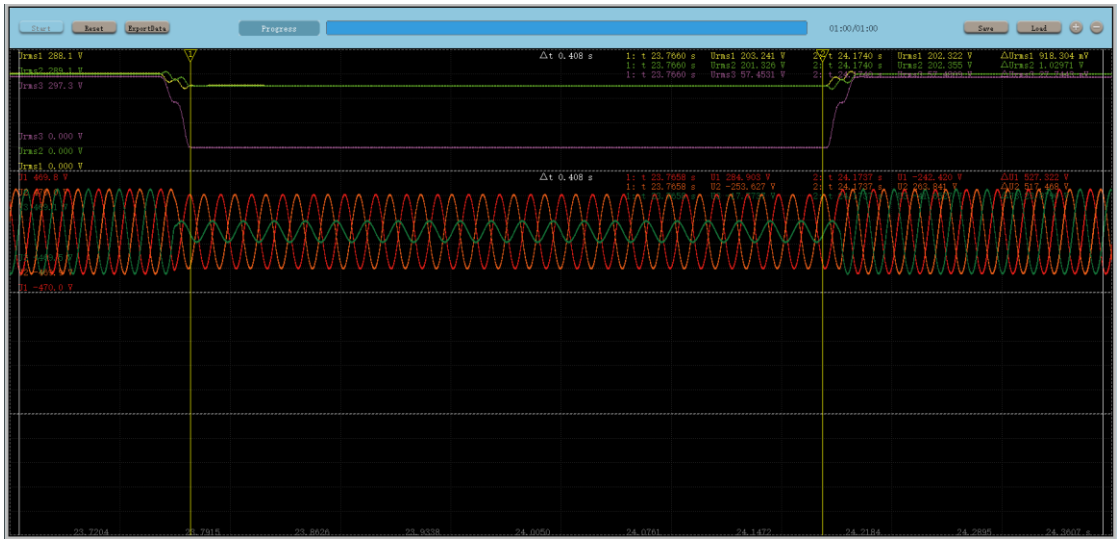
Current before fault – Phase 1	37.0	Current during fault– Phase 1	0.2	Current after fault– Phase 1	36.6
Current before fault – Phase 2	37.2	Current during fault– Phase 2	0.2	Current after fault– Phase 2	37.2
Current before fault – Phase 3	37.2	Current during fault– Phase 3	0.2	Current after fault– Phase 3	37.1
Disconnection during fault or after fault				No	

Duration [ms]	408	Power recover time [ms]	372
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25213	25110	29	-39

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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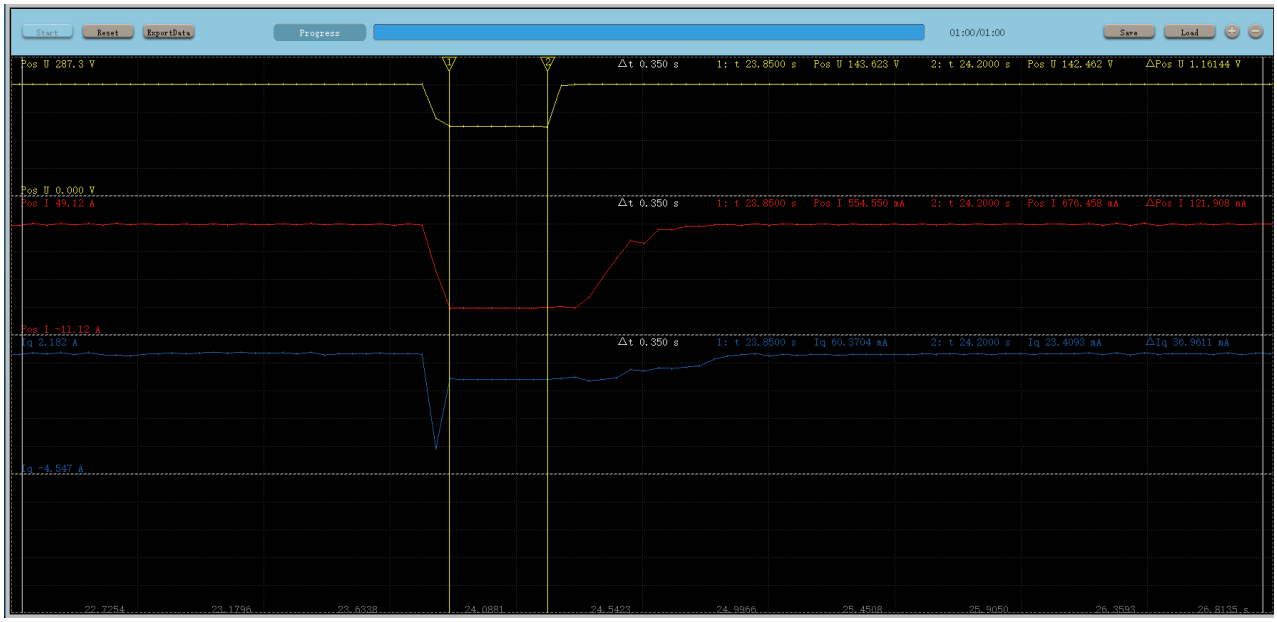
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 3a, 50%Vn, 850ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	207.3	Voltage after fault– Phase 1	230.7
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	207.3	Voltage after fault– Phase 2	230.6
Voltage before fault – Phase 3	230.5	Voltage during fault– Phase 3	115.1	Voltage after fault– Phase 3	230.6
	Current(A)		Current(A)		Current(A)

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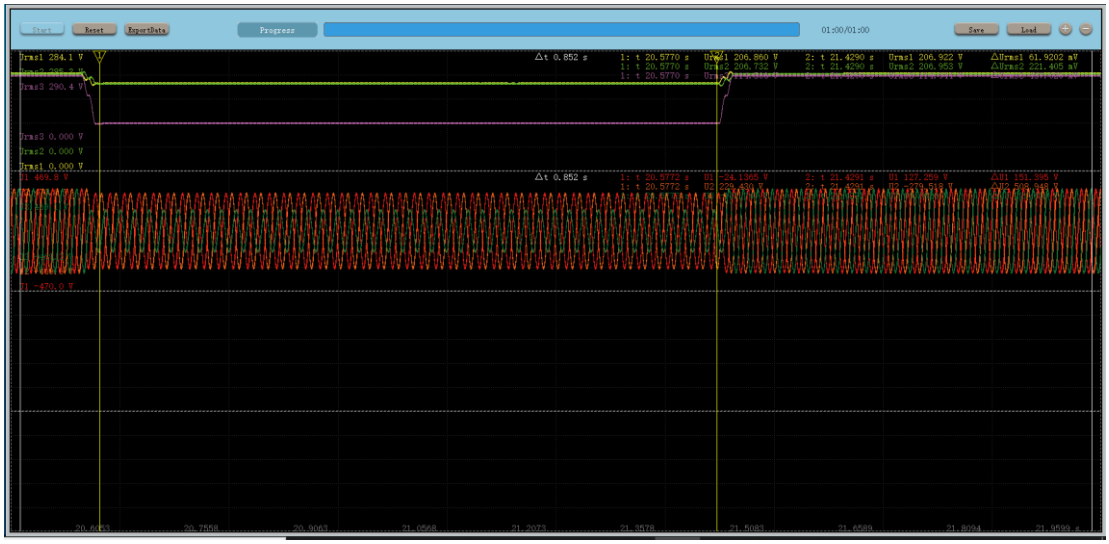
Current before fault – Phase 1	36.0	Current during fault– Phase 1	0.6	Current after fault– Phase 1	36.5
Current before fault – Phase 2	36.6	Current during fault– Phase 2	0.5	Current after fault– Phase 2	36.1
Current before fault – Phase 3	36.5	Current during fault– Phase 3	0.3	Current after fault– Phase 3	36.3
Disconnection during fault or after fault				No	

Duration [ms]	852	Power recover time [ms]	384
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25127	25121	77	19

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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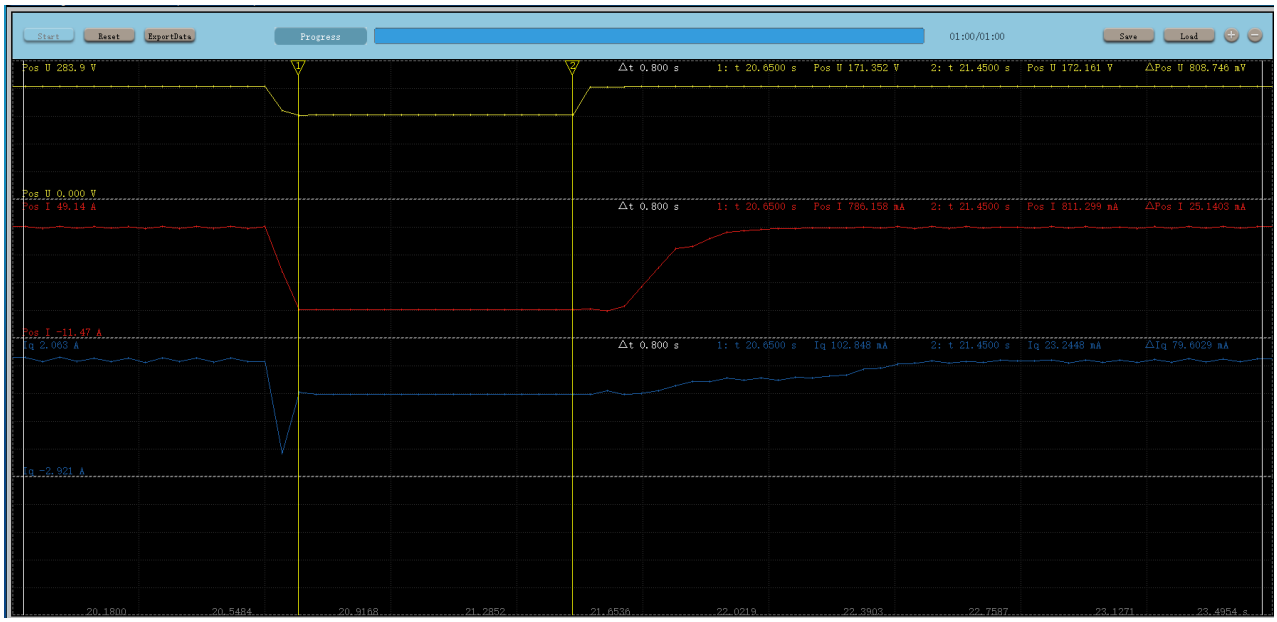
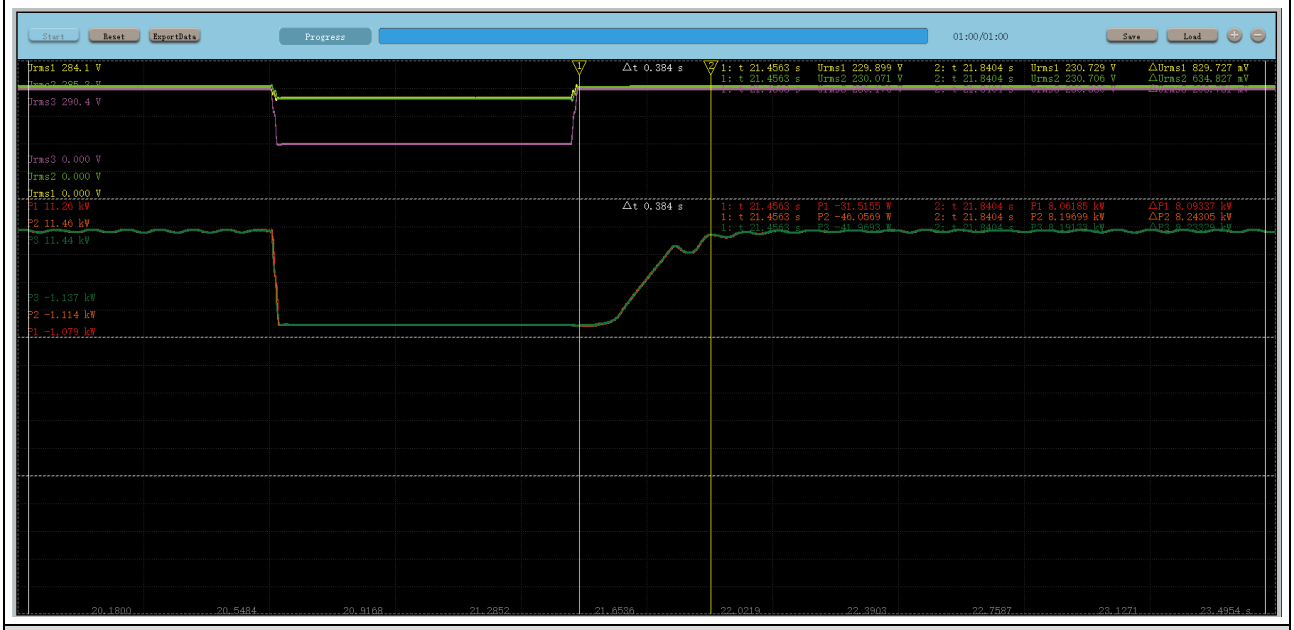
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 4a, 75%Vn, 1300ms, asymmetrical two-phase fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	216.5	Voltage after fault– Phase 1	230.7
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	216.5	Voltage after fault– Phase 2	230.6
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	172.8	Voltage after fault– Phase 3	230.5
	Current(A)		Current(A)		Current(A)

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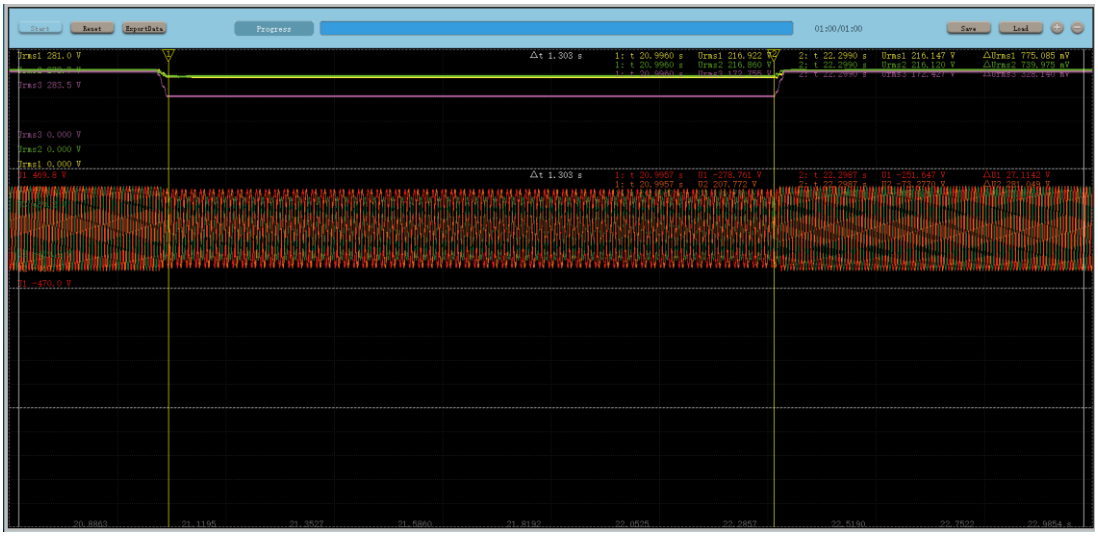
Current before fault – Phase 1	37.0	Current during fault– Phase 1	0.3	Current after fault– Phase 1	36.8
Current before fault – Phase 2	37.6	Current during fault– Phase 2	0.4	Current after fault– Phase 2	36.8
Current before fault – Phase 3	37.8	Current during fault– Phase 3	0.5	Current after fault– Phase 3	36.8
Disconnection during fault or after fault				No	

Duration [ms]	1303	Power recover time [ms]	365
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25138	25126	18	-21

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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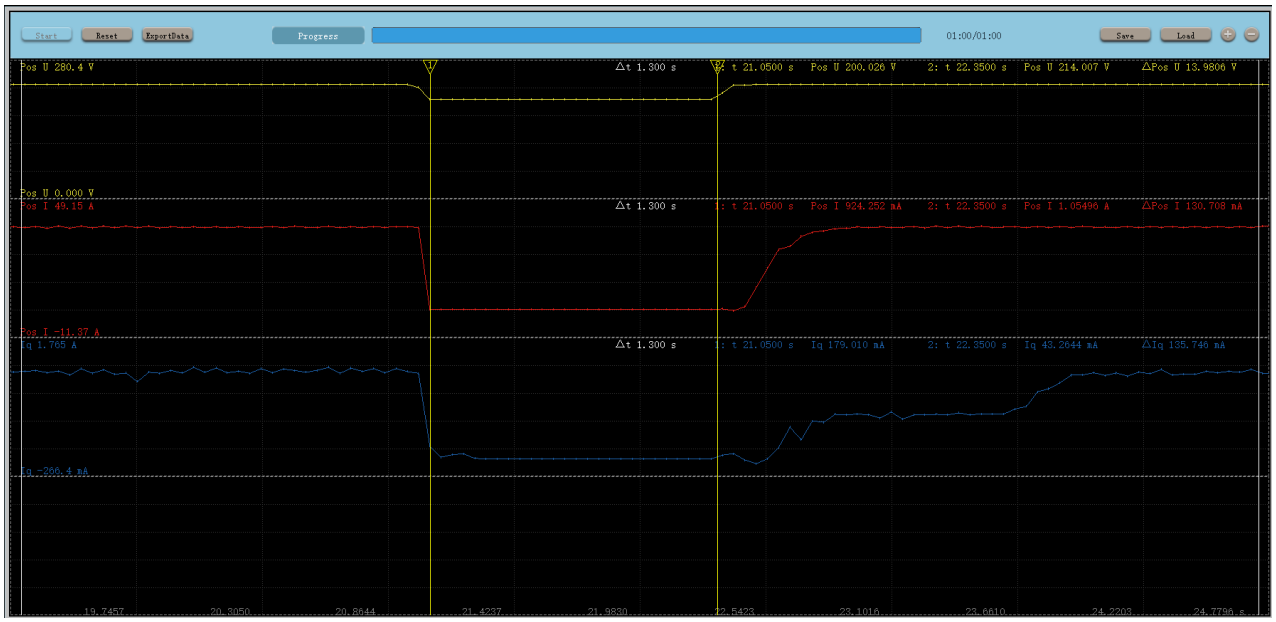
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:

Test number 5, 10%Vn, 200ms, asymmetrical two-phase LV fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	230.4	Voltage after fault– Phase 1	230.6
Voltage before fault – Phase 2	230.8	Voltage during fault– Phase 2	23.0	Voltage after fault– Phase 2	230.6
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	23.1	Voltage after fault– Phase 3	230.5
	Current(A)		Current(A)		Current(A)

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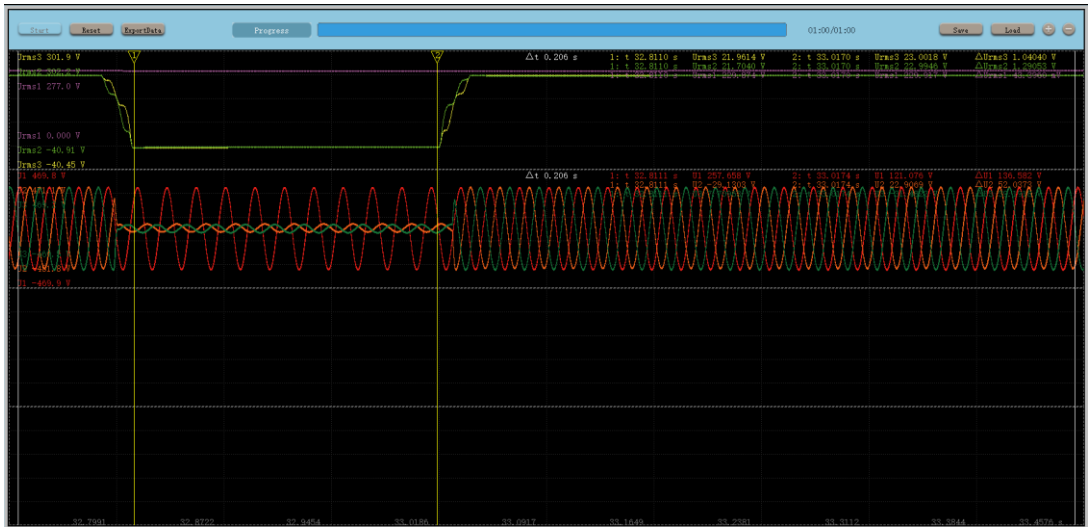
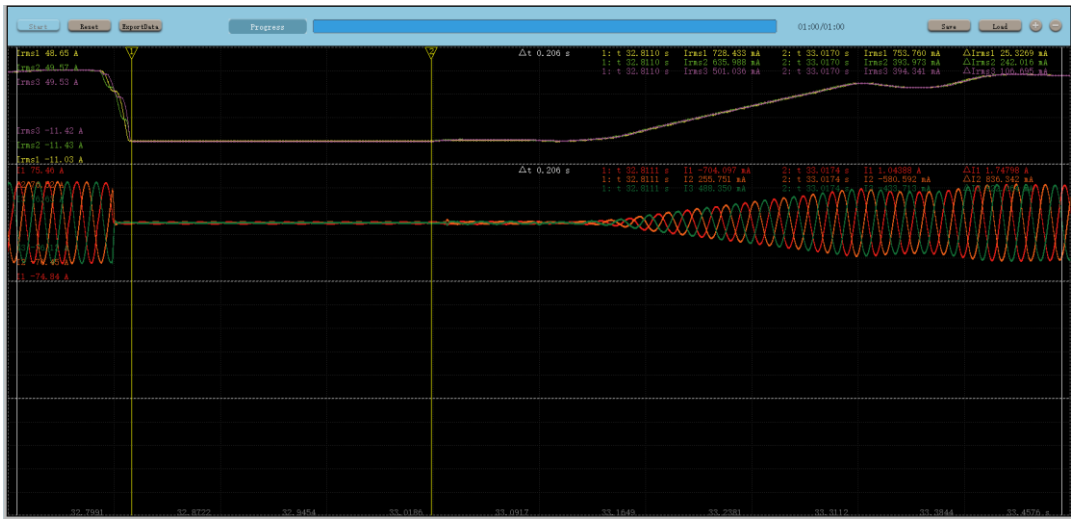
Current before fault – Phase 1	36.7	Current during fault– Phase 1	0.4	Current after fault– Phase 1	36.8
Current before fault – Phase 2	37.4	Current during fault– Phase 2	0.4	Current after fault– Phase 2	36.9
Current before fault – Phase 3	37.3	Current during fault– Phase 3	0.6	Current after fault– Phase 3	36.6
Disconnection during fault or after fault				No	

Duration [ms]	205	Power recover time [ms]	365
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25270	25252	106	-24

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):



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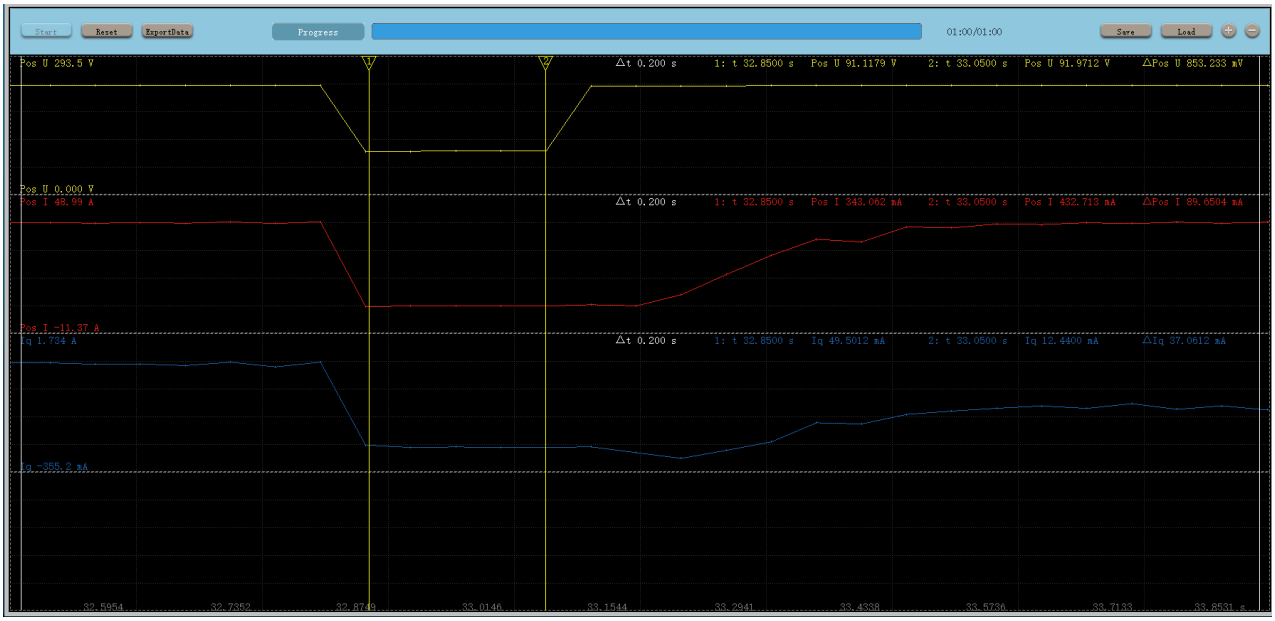
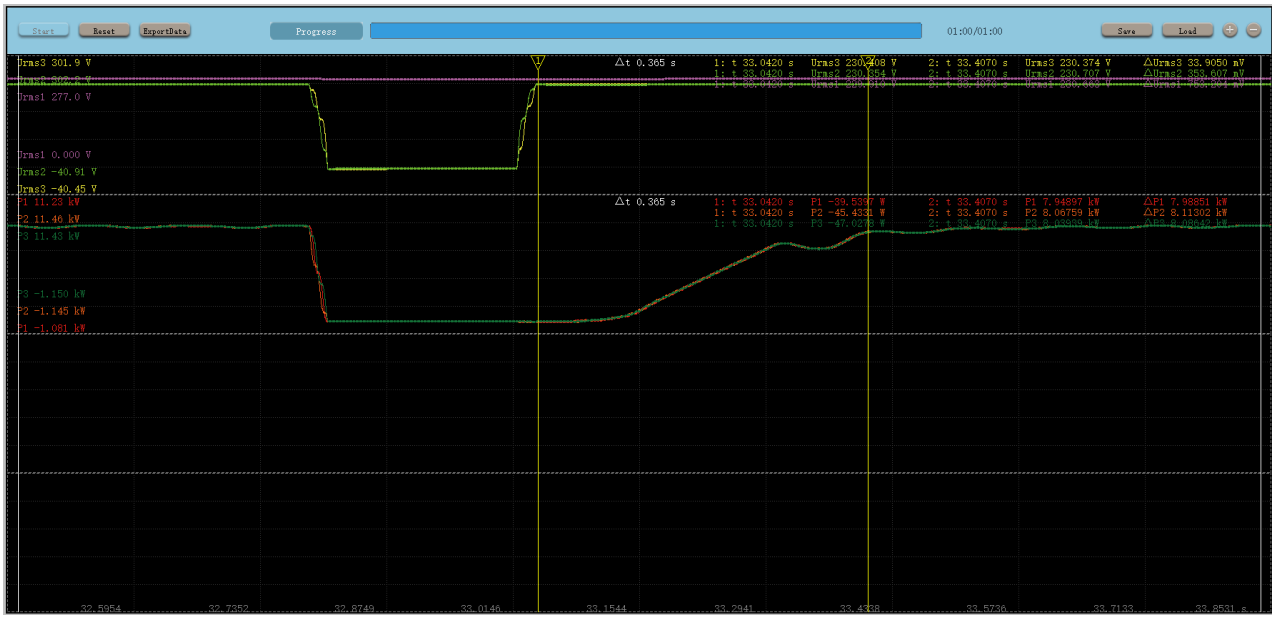
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



Test number 6, 50%Vn, 850ms, asymmetrical two-phase LV fault					
	Voltage(V)		Voltage(V)		Voltage(V)
Voltage before fault – Phase 1	230.7	Voltage during fault– Phase 1	230.5	Voltage after fault– Phase 1	230.6
Voltage before fault – Phase 2	230.7	Voltage during fault– Phase 2	115.1	Voltage after fault– Phase 2	230.6
Voltage before fault – Phase 3	230.4	Voltage during fault– Phase 3	115.2	Voltage after fault– Phase 3	230.6
	Current(A)		Current(A)		Current(A)

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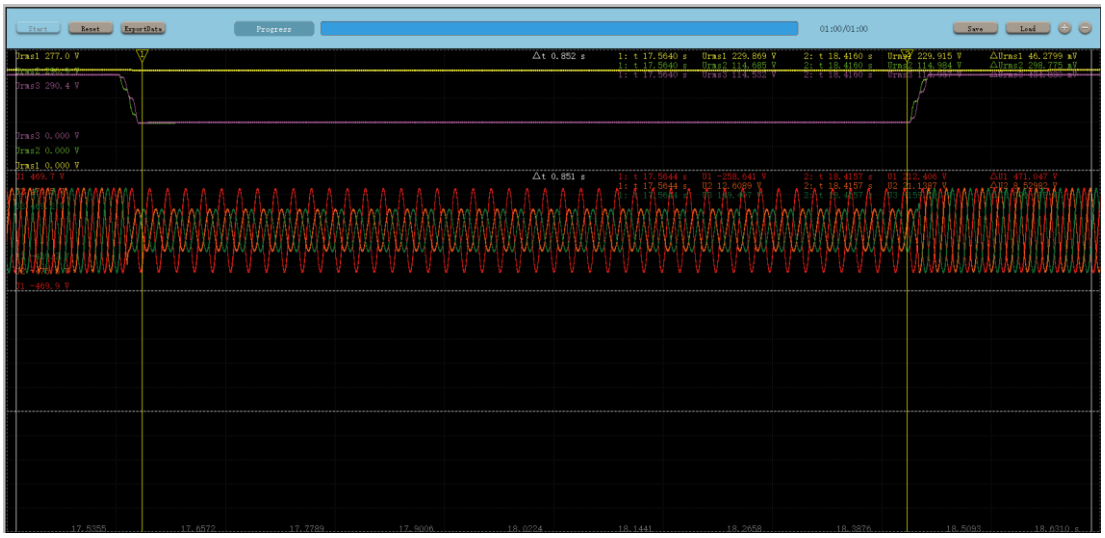
Current before fault – Phase 1	36.0	Current during fault– Phase 1	0.4	Current after fault– Phase 1	36.0
Current before fault – Phase 2	36.6	Current during fault– Phase 2	0.4	Current after fault– Phase 2	36.5
Current before fault – Phase 3	36.6	Current during fault– Phase 3	0.4	Current after fault– Phase 3	36.0
Disconnection during fault or after fault				No	

Duration [ms]	852	Power recover time [ms]	367
Measured active power before fault (W)	Measured active power (@400ms)after fault (W)	Measured reactive power before fault (Var)	Measured reactive power (@400ms) after fault (Var)
25146	25187	107	-89

Waveform of each phase (Phase-to-Neutral voltages and RMS Phase-to-Neutral voltages as moving averages during a cyrle):



Waveform of each phase (Phase-to-Neutral currents and RMS Phase-to-Neutral currents as moving averages during a cyrle):

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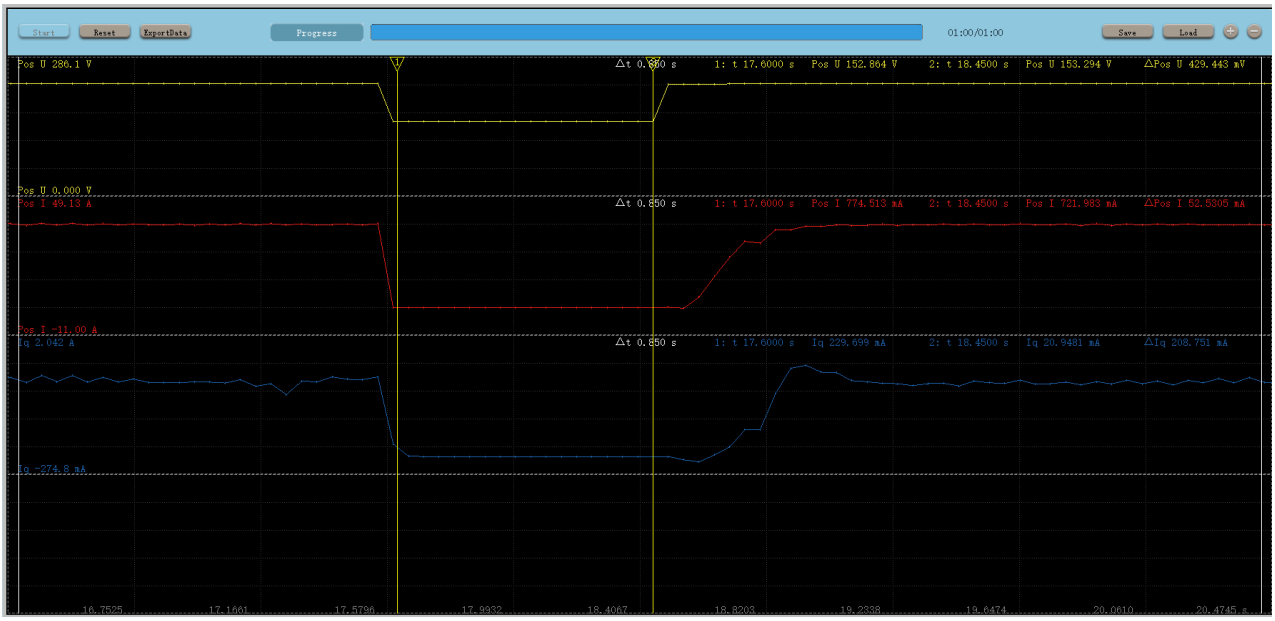
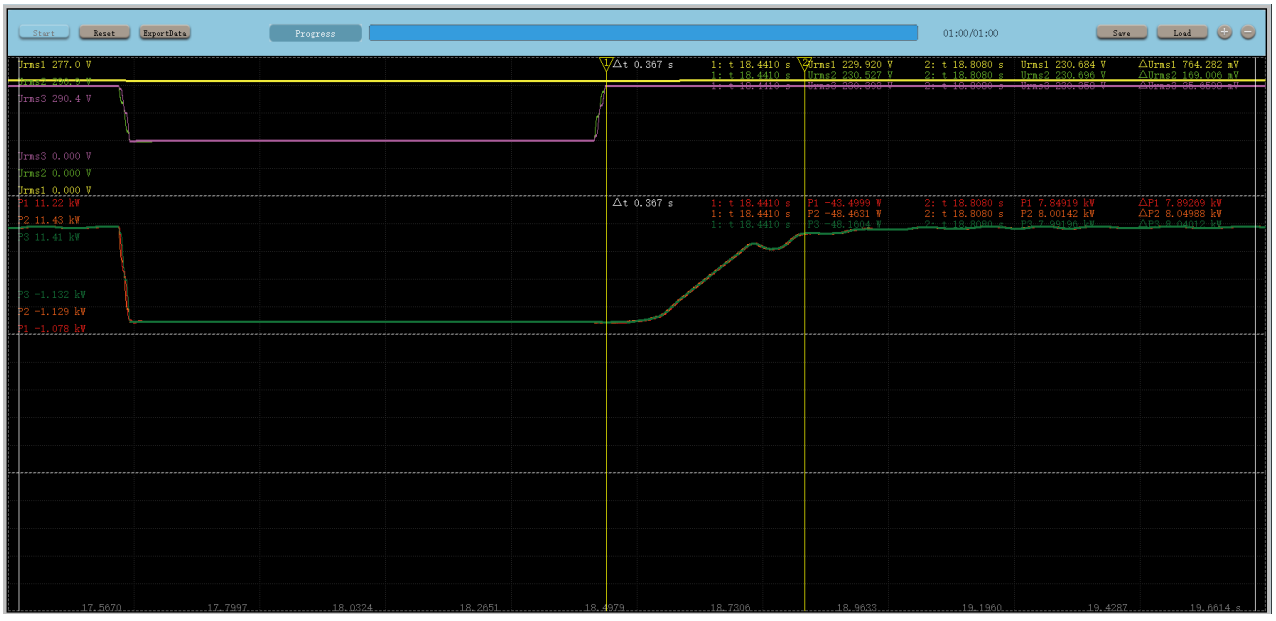
Waveform of voltage, active power and current, reactive power and current(fundamental positive sequence):



Power recover time:



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B.1.6	Verification of insensitivity to automatic reclosing under phase mismatching	P

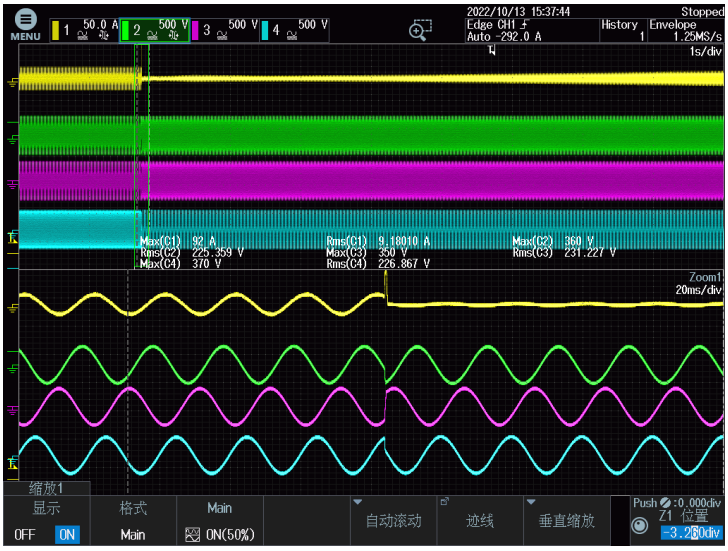
Phase shift	Test voltage[V]	Power output[W]	Angle between voltages before the phase shift	Angle between voltages after the phase shift	Observition: Damage of the inverter as the result of the test? (Yes / No)
90°	230	25347	0°	+90°	No
180°	230	25435	0°	+180°	No

Test on simulated network

Before the operation of phase shift, the system should be operated at least 5 min or the time needed to stabilize the inside temperature of the inverter.

Attach the current curve from 20ms before to at least 200ms after the phase shift.

Current curve at 90° phase shift (@33% Pn):



Current curve at 90° phase shift (@66% Pn):

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Current curve at 90° phase shift (@100% Pn):,

Current curve at 180° phase shift @33% Pn):

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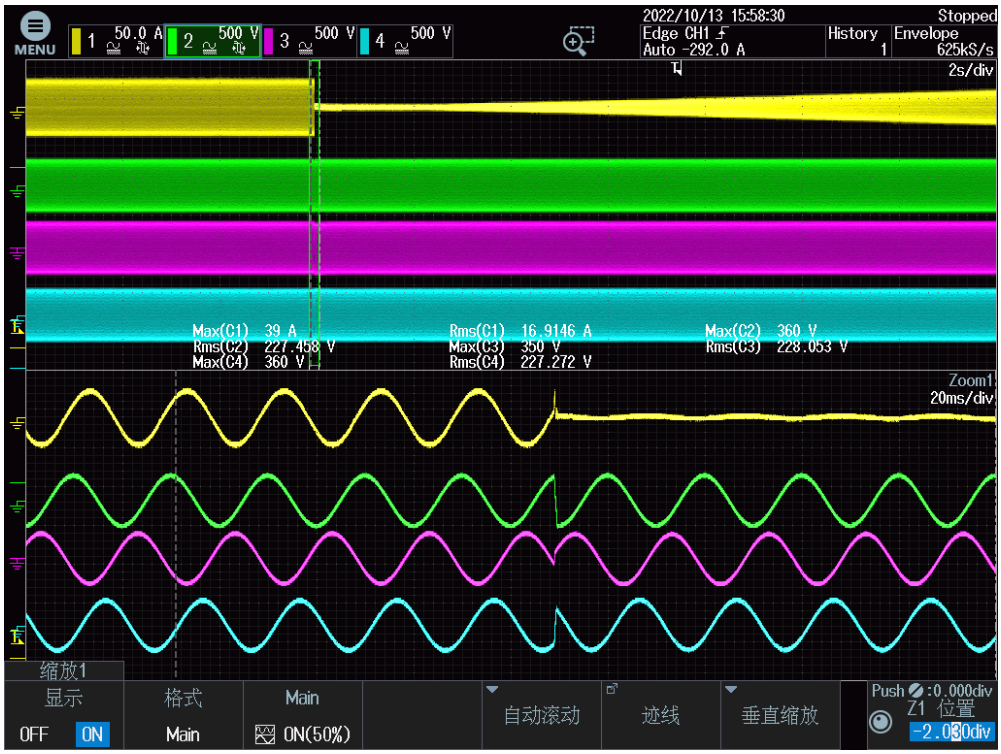
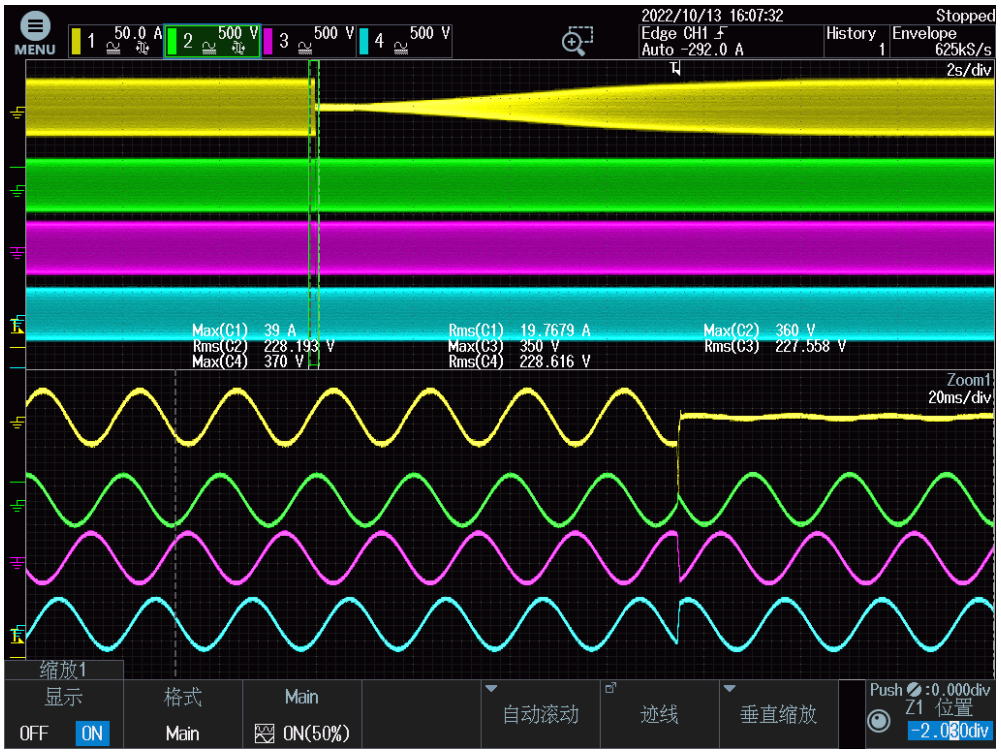
Current curve at 180° phase shift @66% Pn):



Current curve at 180° phase shift (@100% Pn):



. ……End of test report……..……..

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