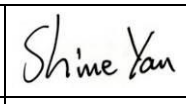
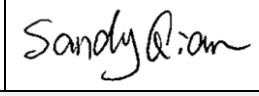
TEST REPORT
CEI 0-21
Reference technical rules for the connection of active and passive users to the LV networks of electrical distribution companies

Report	
Report Number. ..... :	6157903.50
Date of issue..... :	2023-05-26
Total number of pages	168 pages
Testing Laboratory ..... :	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Address ..... :	No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China
Applicant's name ..... :	Afore New Energy Technology (Shanghai) Co., Ltd.
Address ..... :	Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China
Test specification:	
Standard..... :	CEI 0-21:2022-03
Test procedure ..... :	Type test
Non-standard test method……..:	N/A
Test Report Form No. ..... :	CEI 0-21_V3.0
Test Report Form(s) Originator ..... :	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Master TRF ..... :	Dated 2022-04
Test item description..... :	On-Grid PV Inverter
Trade Mark..... :	Afore
Manufacturer ..... :	Afore New Energy Technology (Shanghai) Co., Ltd. Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China
Model/Type reference..... :	HNS3000TL, HNS3600TL-1, HNS3600TL, HNS4000TL, HNS5000TL, HNS6000TL, HNS7000TL, HNS8000TL, HNS9000TL, HNS10000TL
Ratings..... :	See product marking plate on page 4 and ratings of the test products in page 8 to 10.

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**Testing Laboratory:**	DEKRA Testing and Certification (Suzhou) Co., Ltd.	
Testing location/ address ..... :		No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China	
☐	~~**Associated Testing Laboratory:**~~		
~~**Testing location/ address ..... :**~~			
Tested by (name, function, signature) ..... :		Shine Yan (ENG)	
Approved by (name, function, signature) .. :		Sandy Qian (REW)	
☐	~~**Testing procedure: CTF Stage 1:**~~		
~~**Testing location/ address ..... :**~~			
~~**Tested by (name, function, signature) ..... :**~~			
~~**Approved by (name, function, signature) .. :**~~			
☐	~~**Testing procedure: CTF Stage 2:**~~		
~~**Testing location/ address ..... :**~~			
~~**Tested by (name + signature) ..... :**~~			
~~**Witnessed by (name, function, signature) . :**~~			
~~**Approved by (name, function, signature) .. :**~~			
☐	~~**Testing procedure: CTF Stage 3:**~~		
☐	~~**Testing procedure: CTF Stage 4:**~~		
~~**Testing location/ address ..... :**~~			
~~**Tested by (name, function, signature) ..... :**~~			
~~**Witnessed by (name, function, signature) . :**~~			
~~**Approved by (name, function, signature) .. :**~~			
~~**Supervised by (name, function, signature) :**~~			

List of Attachments (including a total number of pages in each attachment):

Annex 1: ISO 9001 certificate (1 pages)

Annex 2: Datasheet of the relay (12 pages)

Annex 3: Pictures of the unit (8 pages)

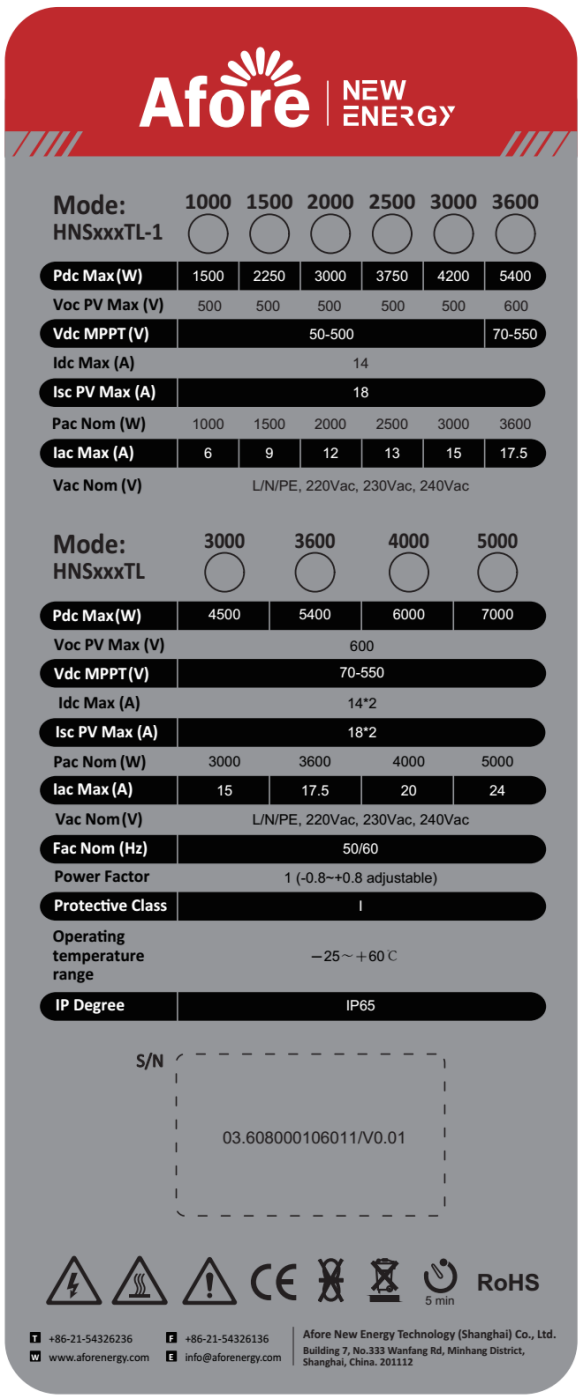
Summary of testing:

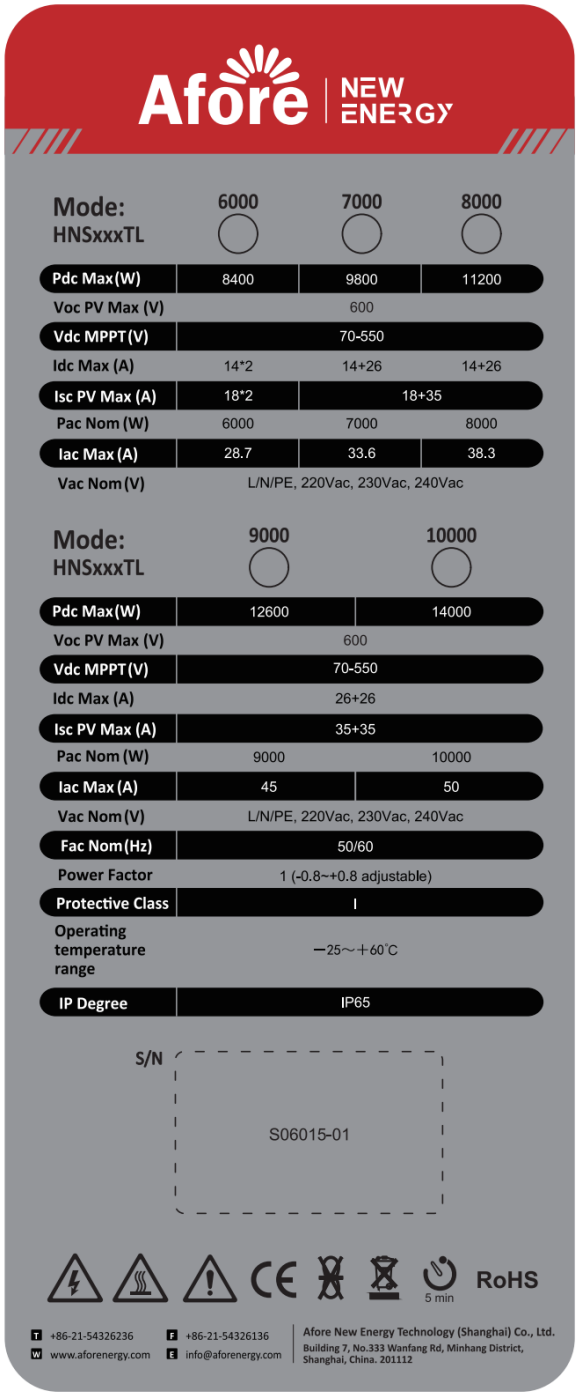
Tests performed (name of test and test clause):	**Testing location:**
All tests (except clause 4.6 EMC tests)	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
4.6 EMC tests (The EMC test reports provided by the customer)	1. Intertek Testing Services Shanghai Building No.86, 1198 Qinzhou Road (North), Caohejing Development Zone, Shanghai 200233, China Report No.: 210400879SHA-001 Accreditation Number: 3309.02 (A2LA-ILAC) 2. Shanghai Inspection and Testing Institute of Instruments and Automation Systems Co., Ltd. No.103, Caobao Road, Xuhui District, Shanghai, China Report No.: J22-604-WT-02 Accreditation Number: L0130 (CNAS-ILAC)

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

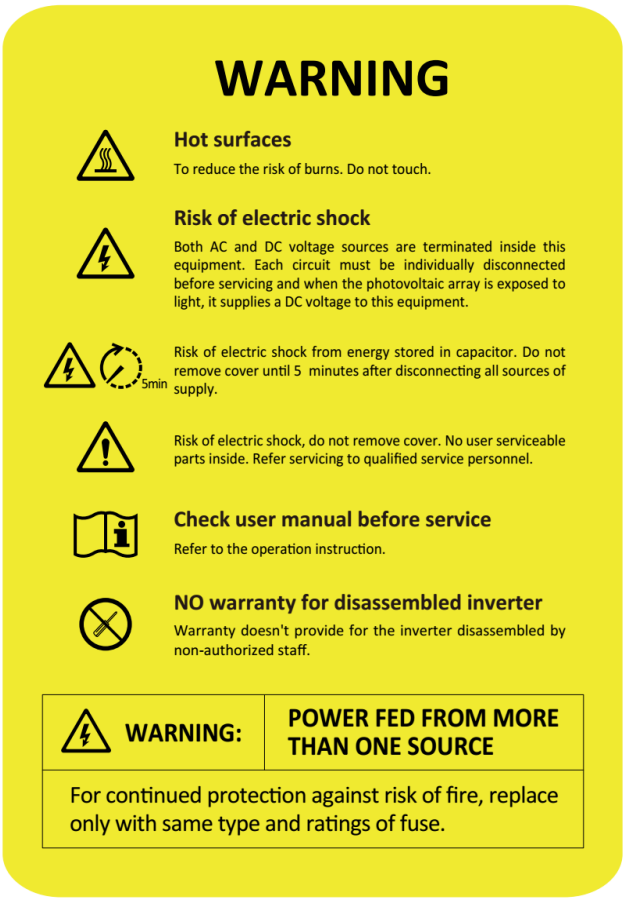
Marking label:





Remark: According to customer's requirement, these models were evaluated under the grid frequency of 50 Hz.

Warning label:



Test item particulars:				
Equipment mobility	:	movable fixed	hand-held transportable	stationary for building-in
Connection to the mains	:	pluggable equipment permanent connection		direct plug-in 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 (%)	:	-90 / +110 %		
Tested for power systems	:	TN		
IT testing, phase-phase voltage (V)	:	N/A		
Class of equipment	:	Class I Not classified	Class II	Class III
Mass of equipment (kg)	:	Refer to the specifications table		
Pollution degree	:	Outside PD3; Inside PD2		
IP protection class	:	IP65		
Possible test case verdicts:				
- test case does not apply to the test object	:	N/A		
- test object does meet the requirement	:	P (Pass)		
- test object does not meet the requirement	:	F (Fail)		
- this clause is information reference for installation	:	Info.		
Testing:				
Date of receipt of test item	:	2022-12-14 (samples provided by applicant)		
Date (s) of performance of tests	:	2022-12-15 to 2023-04-24		

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

The measurement result is considered in conformance with the requirement if it is within the prescribed limit. It is not necessary to account the uncertainty associated with the measurement result.

This report is only for reference and is not used for legal proof function in China market.

Name and address of factory (ies):

Afore New Energy Technology (Shanghai) Co., Ltd.

Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China

General product information:

The testing unit is a Class I grid-interactive PV inverter for outdoor installation (IP65). The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of one is error.

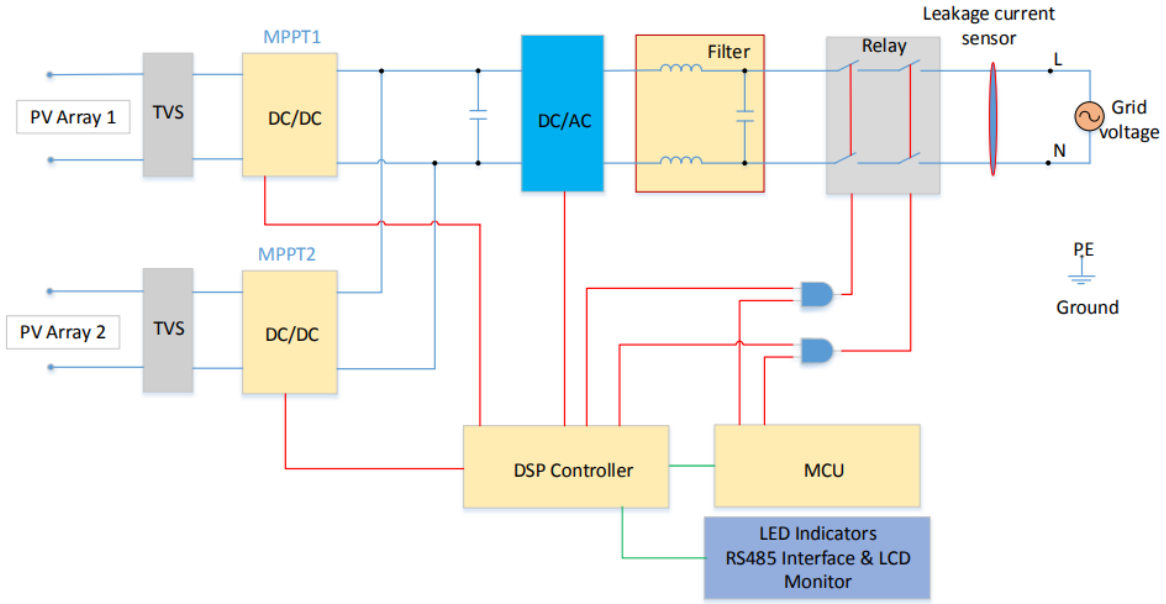
Description of the power circuit:

The internal control is redundant built, it consists of master controller and slave controller, the master controller can control relays, measures voltage, frequency, AC current with injected DC, insulation resistance and residual current. The slave controller can control the relays, measures the voltage and frequency. Both controllers communicate with each other.

The voltage and frequency measurement achieved with resistors in serial, which are connected directly to line and neutral. Both controllers get these signals and calculate the data.

The unit provides two relays in series in each phase. The relays were test before each start up. In addition, both controllers can stop the power bridge.

Block Diagram



Model difference:

All models have same circuit diagram, PWB layout and software. Only different enclosure and fan. And different power devices and ratings. HNS3000TL, HNS3600TL-1, HNS3600TL, HNS4000TL, HNS5000TLhave same enclosure, heatsink, circuit diagram and PWB layout. And with AC connector.
HNS6000TL, HNS7000TL, HNS8000TL, HNS9000TL, HNS10000TL have same enclosure, heatsink, circuit diagram and PWB layout. And with AC terminal, outlet bushing.
HNS6000TL, HNS7000TL, HNS8000TL have internal fan, HNS9000TL, HNS10000TL with internal and external fan.
The output power is derated by software.

The product was tested on:

Hardware version：V06
Software version：V06

Specifications table					
Model	HNS3000TL	HNS3600TL -1	HNS3600TL	HNS4000TL	HNS5000TL
PV input					
P pv Max(W)	4500	5400	5400	6000	7000
Vmax PV (Vdc) (absolute Max.)	600	600	600	600	600
Isc PV (absolute Max.) (A)	18 x 2	18	18 x 2	18 x 2	18 x 2
Number MPP trackers	2	1	2	2	2
Number input strings	1/1	1	1/1	1/1	1/1
Max. PV input current (A)	14 x 2	14	14 x 2	14 x 2	14 x 2
MPPT voltage range (Vdc)	70-550	70-550	70-550	70-550	70-550
Vdc range @ full power (Vdc)	110-550	265-550	130-550	145-550	180-550
AC Grid (output)					
Normal AC Voltage (VAC)	L/N/PE, 220 Vac, 230 Vac, 240 Vac				
Frequency (Hz)	50 / 60				
Normal AC Current (A)	13.1	15.7	15.7	17.4	21.8
Max. cont. output current (A)	15	17.5	17.5	20	24
Normal Power (W)	3000	3600	3600	4000	5000
Rated Apparent Power (VA)	3000	3600	3600	4000	5000
Max. cont. Power (W)	3000	3600	3600	4000	5000
Max. cont. Apparent Power (VA)	3000	3600	3600	4000	5000
Power factor(adjustable)	1.0(-0.8~ +0.8)				
Others					
Protective class	Class I				
Ingress protection (IP)	IP65				
Temperature (℃)	-25℃ to +60℃ (Derating 45℃)				
Inverter Isolation	Non-isolated				
Overvoltage category	OVC III (AC Main), OVC II (PV)				

Specifications table					
Model	HNS6000TL	HNS7000TL	HNS8000TL	HNS9000TL	HNS10000TL
PV input					
P pv Max(W)	8400	9800	11200	12600	14000
Vmax PV (Vdc) (absolute Max.)	600	600	600	600	600
Isc PV (absolute Max.) (A)	18 x 2	18+35	18+35	35 x 2	35 x 2
Number MPP trackers	2	2	2	2	2
Number input strings	1/1	1/2	1/2	2/2	2/2
Max. PV input current (A)	14 x 2	14+26	14+26	26 x 2	26 x 2
MPPT voltage range (Vdc)	70-550	70-550	70-550	70-550	70-550
Vdc range @ full power (Vdc)	220-550	220-550	220-550	220-550	220-550
AC Grid (output)					
Normal AC Voltage (VAC)	L/N/PE, 220 Vac, 230 Vac, 240 Vac				
Frequency (Hz)	50 / 60				
Normal AC Current (A)	26.1	30.5	34.8	39.2	43.5
Max. cont. output current (A)	28.7	33.6	38.3	45	50
Normal Power (W)	6000	7000	8000	9000	10000
Rated Apparent Power (VA)	6000	7000	8000	9000	10000
Max. cont. Power (W)	6000	7000	8000	9000	10000
Max. cont. Apparent Power (VA)	6000	7000	8000	9000	10000
Power factor(adjustable)	1.0(-0.8~ +0.8)				
Others					
Protective class	Class I				
Ingress protection (IP)	IP65				
Temperature (℃)	-25℃ to +60℃ (Derating 45℃)				
Inverter Isolation	Non-isolated				
Overvoltage category	OVC III (AC Main), OVC II (PV)				

Clause	Test Item	Remark	P / F / N/A
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum frequency		P
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum voltage		P
A.4.3.3.1	Insensitivity to harmonics of the frequency relay		P
A.4.3.3.2	Remote trip signal		P
A.4.3.3.3	Communication Signal		P
A.4.3.4	Verification of insensitivity to the frequency derivative		P
A.4.4	Self -test		P
A.4.5	Single fault tolerance		P
A.4.7	Climatic compatibility tests		P
A.4.8	Insulation tests (CEI EN 60255-5)		P
A.4.9	Test for the overload capacity of measuring circuits		P
A.4.11	Automatic mechanism to prevent current imbalance during production		P
B.1 a)/b)	Harmonic current emission		P
B.1 c)	Flicker emission		P
B.1.1	Conditions of connection, reconnection and gradual power supply		P
B.1.2.2.1	Reactive power capability - Inverter in systems with total capacity up to 11.08 kW	≤11.08 kW	N/A
B.1.2.2.2	Reactive power capability - Inverter in systems with total capacity greater than 11.08 kW	>11.08 kW	P
B.1.2.3	Reactive power supply at a given level (greater 11.08 kW systems, but can requested for smaller systems as well)	>11.08 kW *	P
B.1.2.4	Response time to an assigned step level change (greater 11.08 kW systems)	>11.08 kW *	P
B.1.2.5	Automatic supply of reactive power according to the characteristic curve cos φ = f(P)		P
B.1.2.6	Automatic supply of reactive power according to the characteristic curve Q= f(V) (greater 11.08kW systems)	>11.08 kW *	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	Adjustment of active power in the presence of over-frequency transistors on the transmission network		P
B.1.3.3	Verification of the operating range in voltage and frequency		P
B.1.3.3.1	Reduction of active power in the presence of transient under-frequency on transmission network		P
B.1.3.4	Limitation of active power by external control from the distributor		P
B.1.4.1	Checking the DC component output current		P
B.1.4.2	Checking the protection against DC input		P
B.1.5	Checking insensitivity of voltage dips [LVRT and OVRT (8.5.1-figure 30) capability[[greater 11.08 kW systems]	>11.08 kW *	P
B.1.6	Checking the insensitivity to automatic reclosing during phase discordance		P

Remark:
** The tests described in this paragraph are mandatory only for inverters used in plants with a power greater than 11.08 kW, but at the request of the manufacturer they can also be carried out and documented for smaller size converters.*

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Clause	Requirement - Test	Result - Remark	Verdict

A.3	TABLE: Adjustment ranges for the SPI							P
Voltage values								
Threshold	85% U_n (27.S1)	t_{min} (27.S1)	15% U_n (27.S2)	t_{min} (27.S2)	110% U_n (59.S1)	t_{max} (59.S1)	115% U_n (59.S2)	t_{max} (59.S2)
Range	0.2-1.0 U_n	0.05-5 s	0.05-1.0 U_n	0.05-5 s	1.0-1.2 U_n	0.2-10 s	1.0-1.3 U_n	0.05-1.0 s
Steps	0.05 U_n	0.05 s	0.05 U_n	0.05 s	0.01 U_n	0.1 s	0.01 U_n	0.05 s
Frequency values								
Threshold	49.50 Hz (81<.S1)	t_{min} (81<.S1)	47.50 Hz (81<.S2)	t_{min} (81<.S2)	50.50 Hz (81>.S1)	t_{max} (81>.S1)	51.50 Hz (81>.S2)	t_{max} (81>.S2)
Range	47.0-50.0 Hz	0.05-5s	47.0-50.0 Hz	0.05-5s	50.0-52.0 Hz	0.05-5 s	50.0-52.0 Hz	0.05-5 s
Steps	0.1 Hz	0.05 s	0.1 Hz	0.05 s	0.1 Hz	0.05 s	0.1 Hz	0.05 s

Table 13 - SPI adjustments (with the exception of systems with power less than 800 W)

Protection	Intervention threshold	Intervention time (time elapsing between the instant the anomalous condition detected by the protection starts and the release of the trip command)
Maximum voltage (59.S1, 10 min moving average measurement, in accordance with CEI EN 61000-4-30)	1,10 Vn	Variable according to the initial and final voltage value, maximum 603 s.
Maximum voltage (59.S2)	1,15 Vn	0,2 s
Minimum voltage (27.S1)	0,85 Vn	1,5 s
Minimum voltage (27.S2) *	0,15 Vn	0,2 s
Maximum frequency (81>.S1)** ◊	50,2 Hz	0,1 s
Minimum frequency (81<.S1)** ◊	49,8 Hz	0,1 s
Maximum frequency (81>.S2) ◊	51,5 Hz	0,1 s or 1 s §
Minimum frequency (81<.S2) ◊	47,5 Hz	0,1 s or 4 s §

* The value indicated for the intervention time must be adopted when the total power is higher than 11.08 kW, while for lower powers, an intervention time without intentional delay can be optionally used. In the case of synchronous generators, the value can be raised to 0.7 Vn and t = 0.150 s

** Threshold enabled only with external signal at high value and with high local command.

◊ For voltage values below 0.2 Vn, the maximum / minimum frequency protection must be inhibited.

§ In this regard, see what is reported in the text that follows Figure 35.

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Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.1 & A.4.3.2	TABLE: Test procedure for maximum/minimum frequency (81.S2) (stand alone, use of the SPI on the basis of local information only)						P
Model	HNS10000TL						
	Under frequency:			**Over frequency:**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Ambient temperature							
Limit [Hz]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.51	47.50	47.51	51.50	51.49	51.51	
Trip time limit [ms]:	100 ms			100 ms			
Measurement the trip time [ms]:	92.1	92.7	90.9	97.8	95.6	95.2	
-25°C temperature							
Limit [Hz]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.50	47.50	47.51	51.51	51.50	51.50	
Trip time limit [ms]:	100 ms			100 ms			
Measurement the trip time [ms]:	92.9	91.3	92.6	95.2	92.4	93.6	
+60°C temperature							
Limit [ms]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.50	47.49	47.50	51.49	51.50	51.49	
Trip time limit [ms]:	100 ms			100 ms			
Measurement the trip time [ms]:	94.2	96.8	91.4	95.7	96.3	94.1	

Assessment criterion:
For frequencies of between 47,5 Hz and 51,5 Hz (±0,1% fn) automatic disconnection from the network as a result of a deviation in frequency is not permitted.
Limit values:
Frequency decrease protection f<47,5 Hz 100 ms
Frequency increase protection f>51,5 Hz 100 ms
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% V_n for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % V_n for voltage recovery thresholds
- ±20 mHz for frequency recovery thresholds

For **each repetition** of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms

Note:
*If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test.

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Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.1 & A.4.3.2	**TABLE: Test procedure for maximum/minimum frequency (81.S2) (use of SPI on the basis of local readings and external information/commands)**						**P**
Model	HNS10000TL						
	Under frequency:			**Over frequency:**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Ambient temperature							
Limit [Hz]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.49	47.51	47.51	51.51	51.50	51.51	
Trip time limit [ms]:	4000 ms			1000 ms			
Measurement the trip time [ms]:	3982	3975	3979	995.3	997.6	996.4	
-25°C temperature							
Limit [Hz]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.50	47.50	47.51	51.50	51.50	51.51	
Trip time limit [ms]:	4000 ms			1000 ms			
Measurement the trip time [ms]:	3977	3975	3979	993.8	994.3	997.9	
+60°C temperature							
Limit [ms]:	47,50 Hz (81<.S2)			51,50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.50	47.51	47.51	51.51	51.51	51.50	
Trip time limit [ms]:	4000 ms			1000 ms			
Measurement the trip time [ms]:	3976	3986	3974	993.7	993.1	997.3	

Assessment criterion:
For frequencies of between 47.5 Hz and 51.5 Hz (±0.1% fn) automatic disconnection from the network as a result of a deviation in frequency is not permitted.
Limit values:
Frequency decrease protection f<47,5 Hz 4000 ms
Frequency increase protection f>51,5 Hz 1000 ms
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% V_n for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % V_n for voltage recovery thresholds
- ±20 mHz for frequency recovery thresholds

For **each repetition** of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms

Note:
*If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.1 & A4.3.2	**TABLE: Test procedure for maximum/minimum frequency functions (81.S1)**						**P**
Model	HNS10000TL						
	Under frequency:			**Over frequency:**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Ambient temperature							
Tripping threshold limit [Hz]:	49,80 (81<.S1)			50,20 (81>.S1)			
Measurement accuracy of the tripping value [Hz]:	49.82	49.81	49.80	50.20	50.21	50.21	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	94.2	94.8	95.2	93.6	95.6	96.8	
-25°C temperature							
Tripping threshold limit [Hz]:	49,80 (81<.S1)			50,20 (81>.S1)			
Measurement accuracy of the tripping value [Hz]:	49.81	49.80	49.79	50.21	50.21	50.20	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	97.2	91.8	99.3	95.5	91.8	93.9	
+60°C temperature							
Tripping threshold limit [Hz]:	49,80 (81<.S1)			50,20 (81>.S1)			
Measurement accuracy of the tripping value [Hz]:	49.81	49.79	49.81	50.21	50.20	50.21	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	91.5	92.7	92.5	91.8	94.1	94.3	
Note: Threshold enabled only with external signal at high value and with high local command.							

Assessment criterion:
For frequencies of between 49.8 Hz and 50.2 Hz automatic disconnection from the network as a result of a deviation in frequency is not permitted.
Limit values:
Frequency decrease protectionf<49.8 Hz100 ms
Frequency increase protectionf>50.2 Hz100 ms
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% V_n for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % V_n for voltage recovery thresholds
- ±20 mHz for frequency recovery thresholds

For **each repetition** of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms

Note:
*If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test (such as -25°C / +60°C).

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.1 & A.4.3.2	**TABLE: Test procedure for maximum/minimum voltage (27.S1)**		**P**
Model:	HNS10000TL		
	Under voltage:		
A) STEPS for trip value [V to V]:	1.1 threshold -> decrease by 0.5% Vn steps		
D) STEP for trip time [V to V]:	1.1 threshold -> 0.9 threshold		
Ambient temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.54	195.42	195.36
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1494	1488	1492
-25°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.38	195.71	196.01
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1496	1499	1495
+60°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.69	195.82	195.55
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1493	1496	1497

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% V_n for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % V_n for voltage recovery thresholds
- ±20 mHz for frequency recovery thresholds

For **each repetition** of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms
*If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test (such as -25°C / +60°C).

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.1 & A.4.3.2	**TABLE: Test procedure for maximum/minimum voltage (27.S2) (59.S2)**						**P**
Model	HNS10000TL						
	Under voltage:			**Over voltage:**			
A) STEPS for trip value [V to V]:	1.1 threshold -> decrease by 0.5% Vn steps			0.9 threshold -> increase by 0.5% Vn steps			
D) STEP for trip time [V to V]:	1.1 threshold -> 0.9 threshold			0.9 threshold -> 1.08 threshold			
Ambient temperature							
Limit [V]:	34.5 V (27.S2)			264.5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.51	34.53	34.51	264.52	264.58	265.12	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	196.6	191.2	198.2	194.6	195.6	195.9	
-25°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.49	34.50	34.51	264.58	264.51	264.56	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	192.2	194.4	191.3	196.5	197.3	194.3	
+60°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.48	34.52	34.51	264.59	264.55	264.59	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	198.8	192.1	191.9	197.6	197.5	197.2	

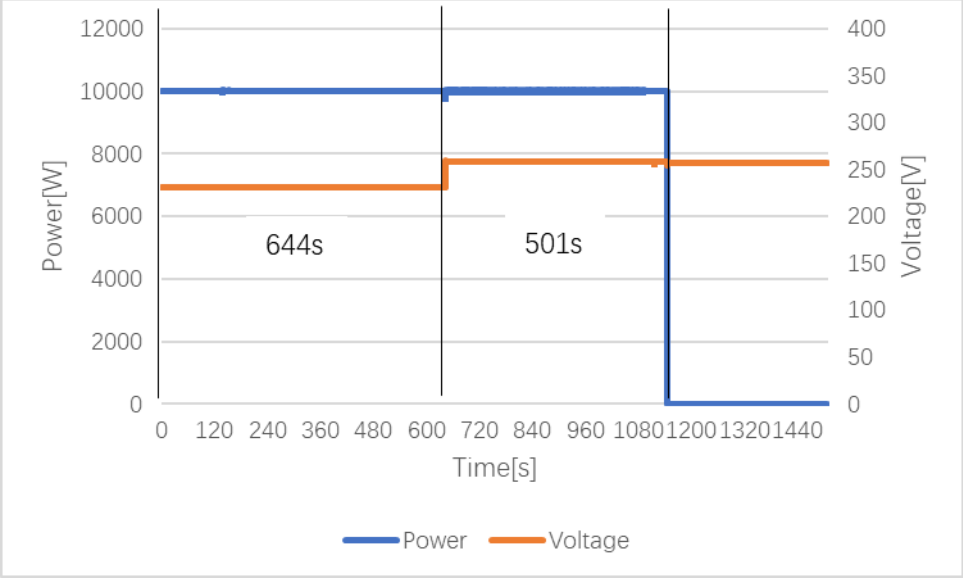
Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% V_n for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % V_n for voltage recovery thresholds
- ±20 mHz for frequency recovery thresholds

For **each repetition** of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms
*If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test (such as -25°C / +60°C).

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

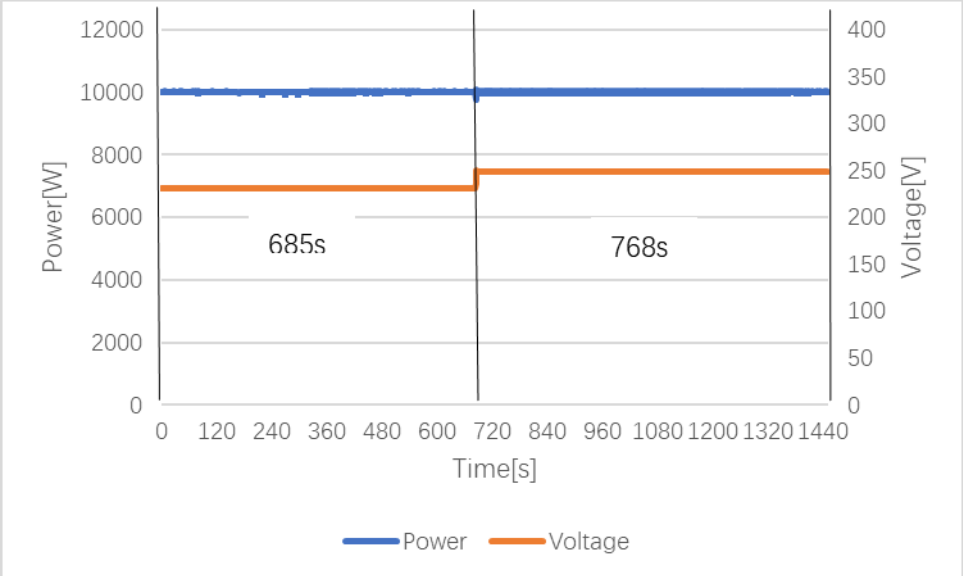
A.4.3.1 & A.4.3.2	**TABLE: Measuring the rise-in voltage protection as a running 10-minute mean value (59.S1)**		**P**
Model:	HNS10000TL		
Test:		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n (257.6 V). Disconnection must take place within 603 s.		
	Phase 1	501	≤ 603 s
	Phase 2	-	
	Phase 3	-	
b)	The voltage is set to U_n for 600 s and then to 108% U_n (248.4 V) for 600 s. No disconnection should take place.		
	Phase 1	No disconnection	Disconnection should not take place.
	Phase 2	-	
	Phase 3	-	
c)	The voltage is set to 106 % U_n (243.8 V) and held for 600 s. Thereafter the voltage is set to 114 % U_n (262.6 V). Disconnection must take place within 300 s or about 50 % of the disconnection time measured in point a).*		
	Phase 1	285	The disconnection time should be about 50 % of the value measured in a). *
	Phase 2	-	
	Phase 3	-	

Note:
*If the setting value is set to 600 s, then the disconnection time can be in the range between 225 s and 375 s.

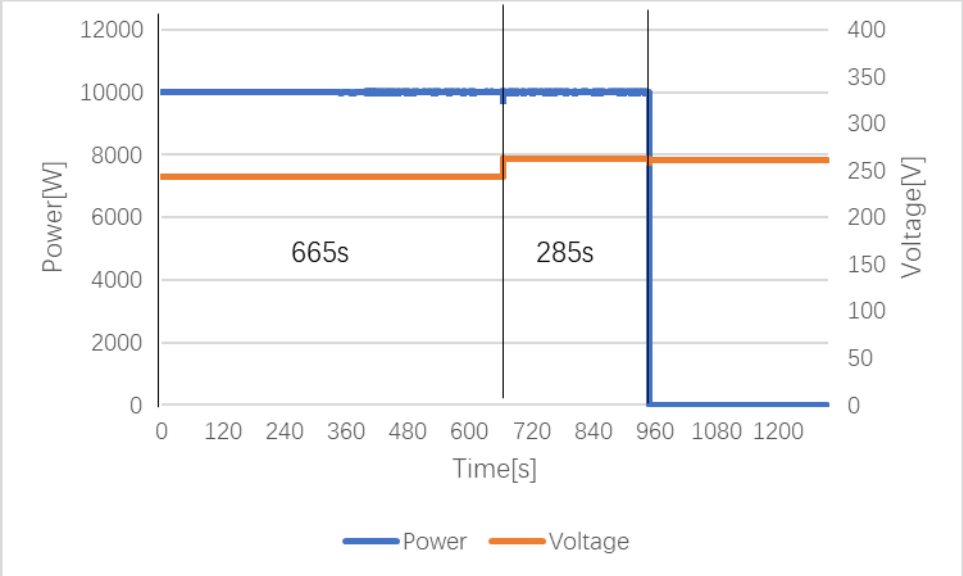


a)

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict



b)



c)

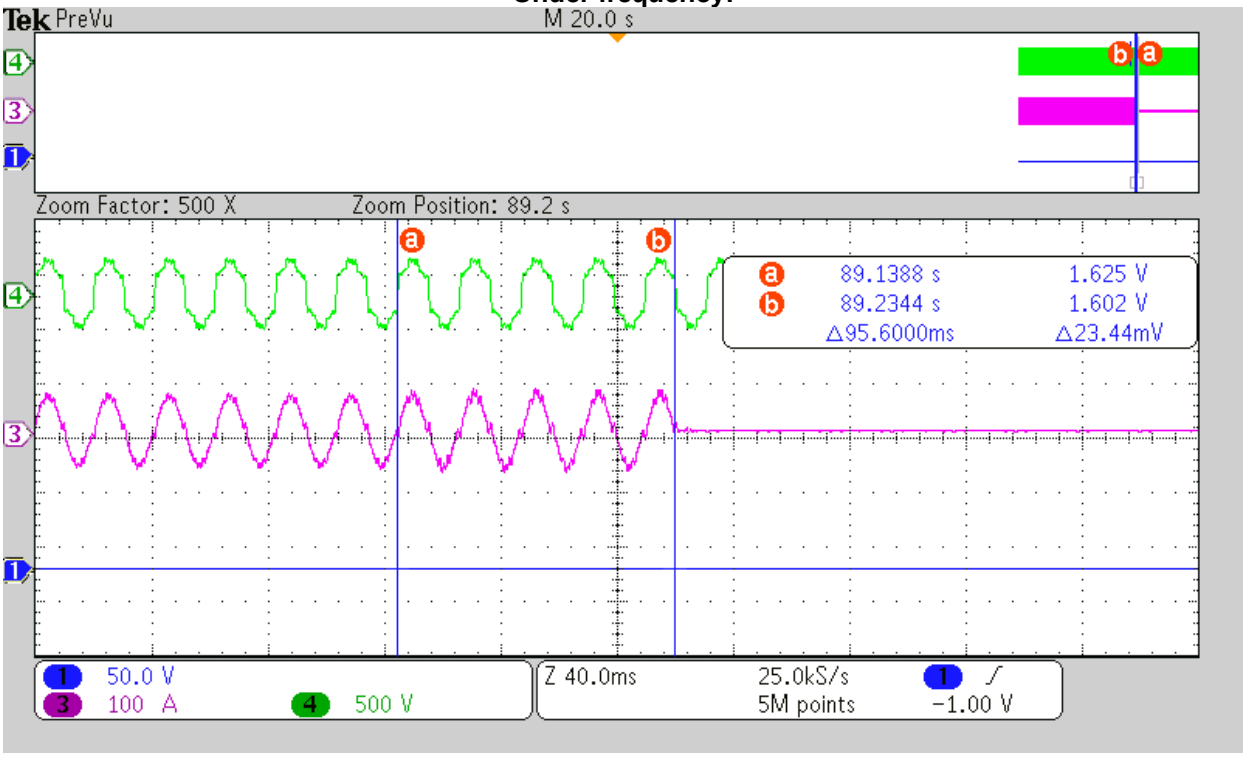
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.3.1	**TABLE: Insensitivity to harmonics of the frequency relay**								**P**
Mode	HNS10000TL								
Grid simulator settings according to Table 17:	Harmonics order:	2nd	3rd	5th	7th	9th	11th	13th	17th
	$\%U_n$:	4.0	10.0	12.0	10.0	3.0	7.0	6.0	4.0

Operating time of the monitoring device:

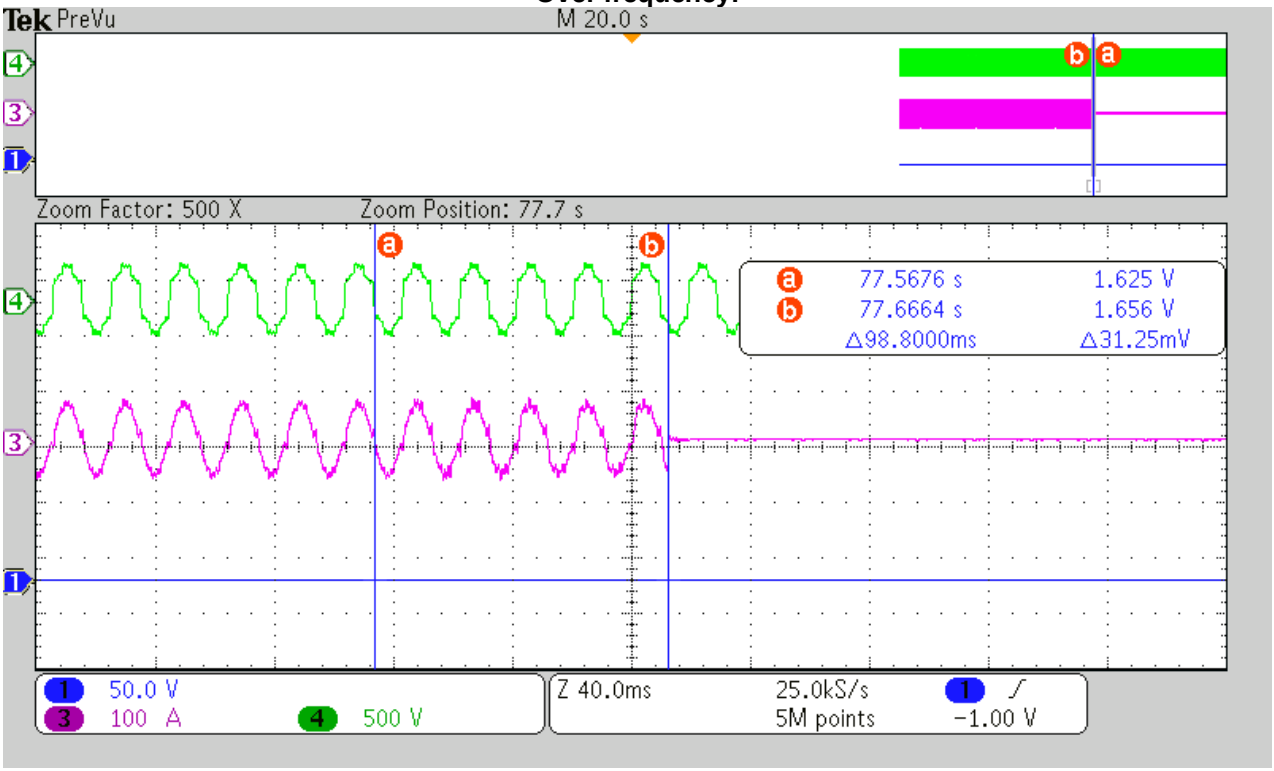
	Under frequency:			**Over frequency:**		
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps		
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold		
Limit [Hz]:	47.50			51.50		
Measurement accuracy of the tripping value [V]:	47.49	47.49	47.48	51.51	51.52	51.51
	100 ms			100 ms		
Measurement the trip time [ms]:	95.6	94.8	96.8	98.8	93.2	98.0

Under frequency:



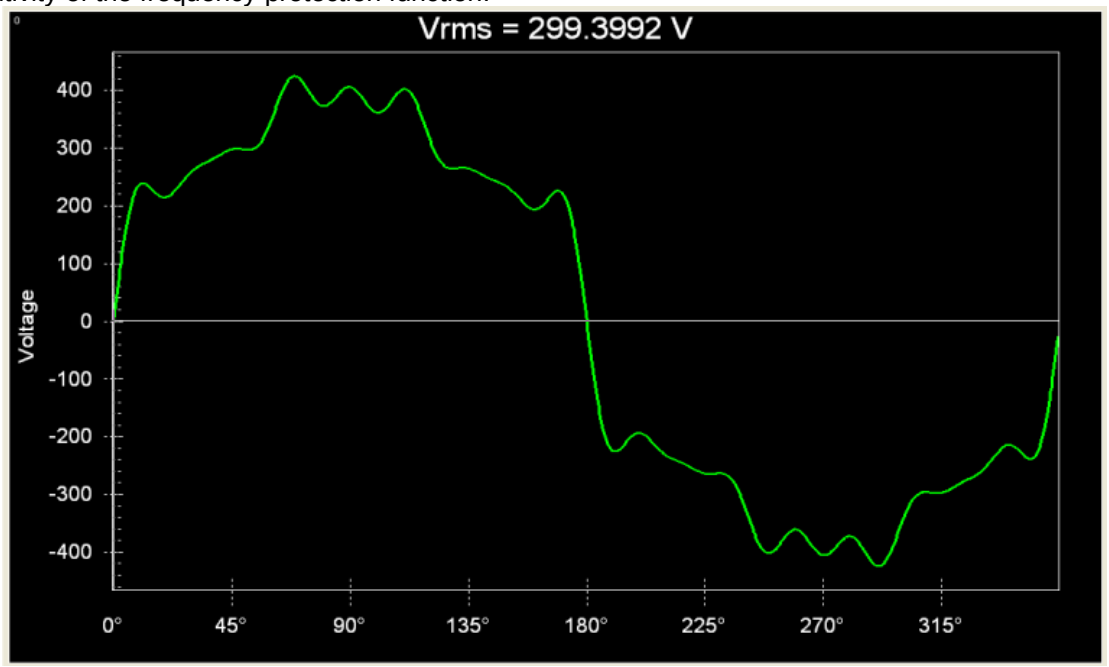
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Over frequency:



Note:
The setting value and the trip value of the frequency may not vary by more than **±20mHz** and **3%±20ms**.
Differences between the test values: **±20mHz** and **1%±20ms.**

Screenshot of voltage waveform, distorted as required by CEI 0-21 Table 17 – Harmonics for the insensitivity of the frequency protection function.

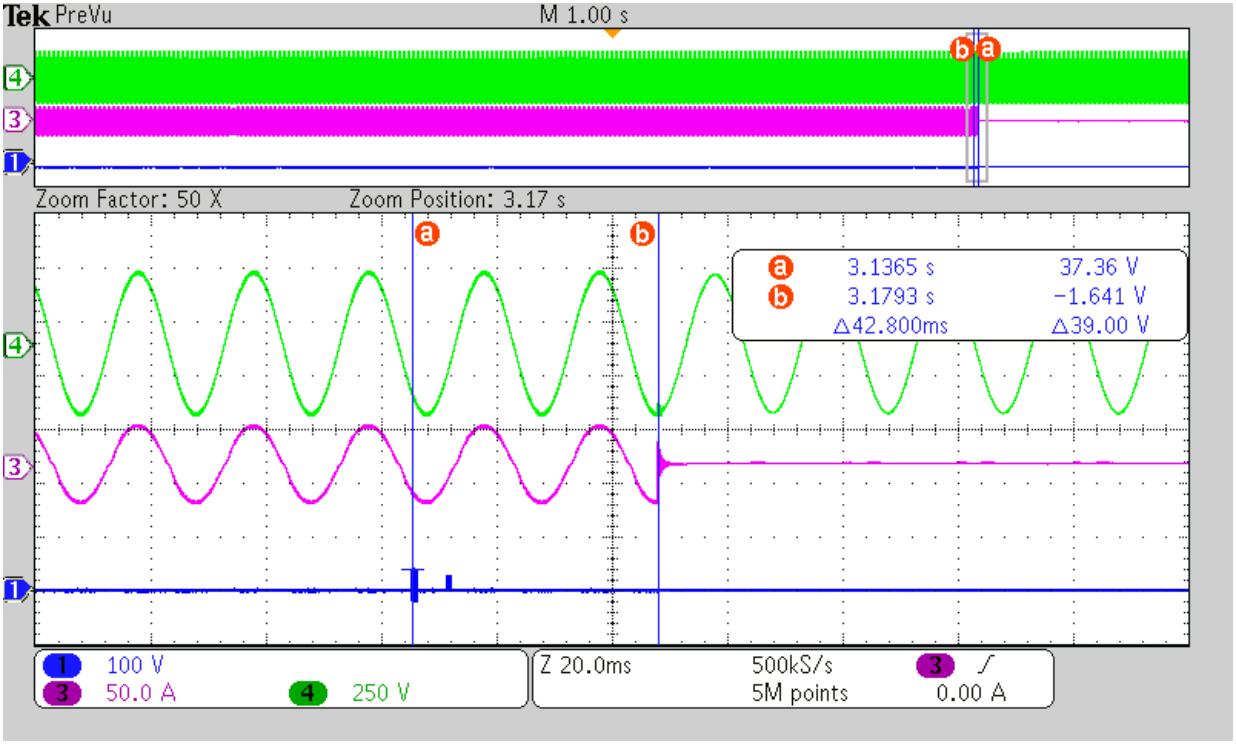


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.3.2	TABLE: Remote trip signal	P
Model	HNS10000TL	

Test:	Remote tripping signal for the external disconnection
Limit [ms]:	50
Measurement time of the tripping value [ms]:	42.8

Graph of remote trip signal:



Note:
The protection interface has to have a maximum delay of the remote tripping signal from receiving to transmitting to the DDI of 50ms.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.3.3	TABLE: Communication Signal		P
Model	HNS10000TL		
Enlargement of the frequency limits:		**Yes**	**No**
Enabled the trip of the functions 81<.S1 (49.8Hz) and 81>.S1 (50.2Hz) without communication signal		☒	☐
Enabled the trip of the functions 81<.S2 (47.5Hz) and 81>.S2 (51.5Hz) with communication signal		☒	☐

Note:

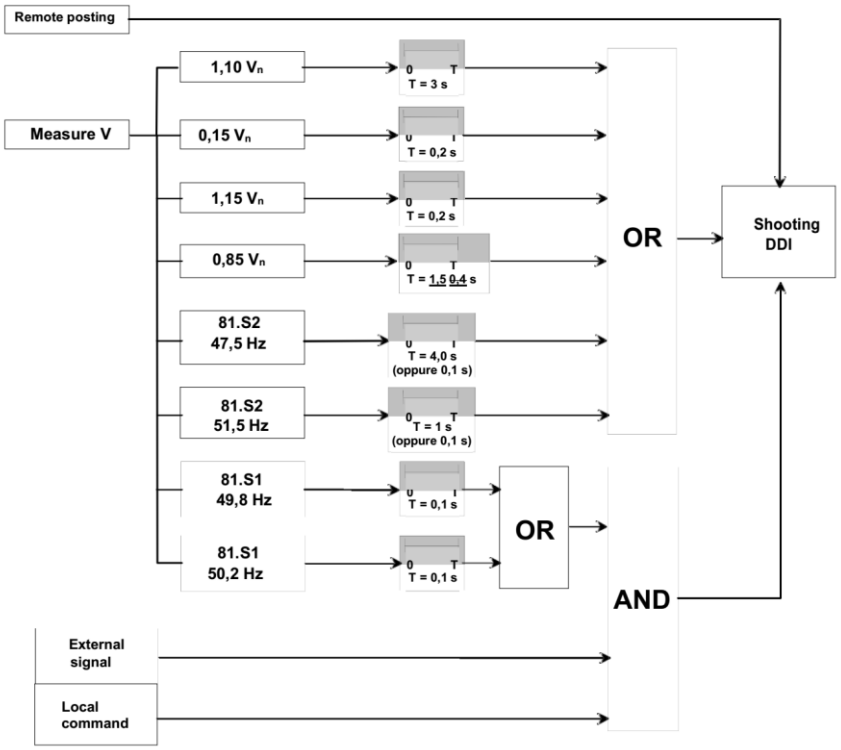


Figure 35 - Functional logic diagram of the SPI of the power park modules (the values in brackets refer to the transitory operating mode of the SPI)

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.4	**TABLE: Verification of insensitivity to the frequency derivative (ROCOF)**						**P**
Model	HNS10000TL						
Setting threshold (81 >)		Setting trip time		Setting threshold (81 <)		Setting trip time	
51.5 Hz		0.15 s		47.5 Hz		0.15 s	
Step	Frequency		Change time	Output power (W)	Result (Continuous operation or not)		Requirement
	Begin	End					
1)	47.55 Hz	47.55 Hz	10.0 s	10274	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	10283	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	10281	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	10270	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	10265	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	10267	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	10273	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	10276	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	10269	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	10270	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	10267	Continuous operation		Stay connected
5)	47.55 Hz	47.55 Hz	10.0 s	10273	Continuous operation		Stay connected

Test procedure:

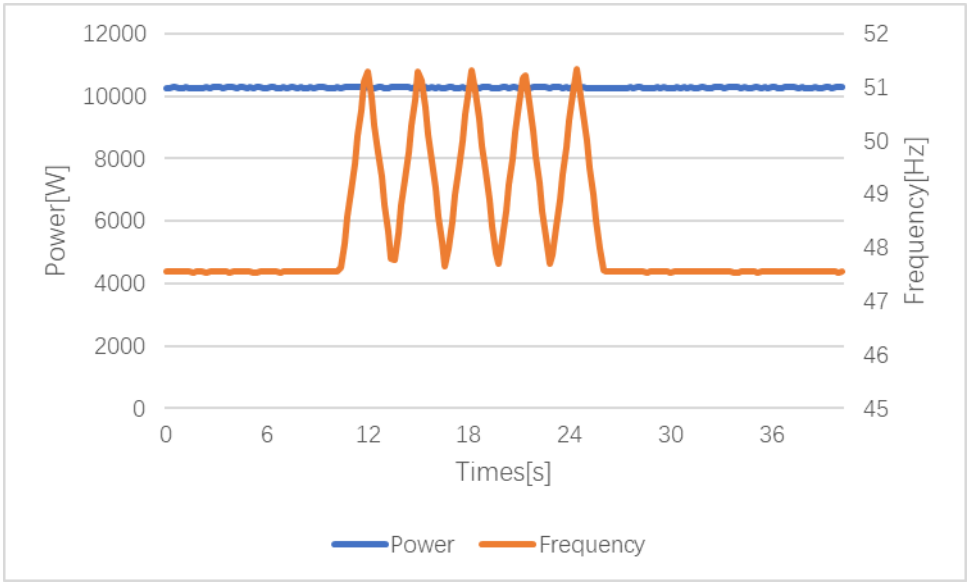
1) Apply a three-phase of symmetrical voltages of direct cyclic sequence having an amplitude of 100% of the rated voltage and a frequency of 47.550 Hz;
2) increase the frequency of the three-phase voltages, with ramp steps having an amplitude of 12.5 mHz and duration of 5 ms, until reaching the frequency value of 51.450 Hz;
3) decrease the frequency of the three-phase voltages, with ramp steps having an amplitude equal to 12.5 mHz and duration 5 ms until reaching the frequency value of 47.550 Hz;
4) repeat the tests referred to in points 2 and 3 above four times, for a total of 5 positive and negative ramps.
5) Apply a three-phase of symmetrical voltages of direct cyclic sequence having an amplitude of 100% of the rated voltage and a frequency of 47.550 Hz for 10 s.

Note:

When considering a sliding measurement window of 1.56 s, these profiles have a maximum RoCoF of 2.5 Hz/s.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Diagram:



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.4	**TABLE: Self-test**			**P**
Model	HNS10000TL			
Software version: Control board: V06, Display board: V06				
Can the self-test be activated from any user? (☒ YES; ☐ NO)				
Do the procedures be written / described in the user manual? (☒ YES; ☐ NO)				
Can the self-test results and the preset values be clearly readable / displayed? (☒ YES; ☐ NO)				
Accuracy		Threshold	Disconnection time	Tolerance
Overvoltage 59.S1	Reading	253.0V	601000ms	Is the voltage thresholds deviation within 1%? (☒ YES, ☐NO) Is the time deviation within 3% ± 20 ms? (☒ YES, ☐NO)
	Default	253.0 V	<603000 ms	
Overvoltage 59.S2	Reading	264.6V	198ms	
	Default	264.5 V	200 ms	
Undervoltage 27.S1	Reading	195.4V	1490ms	
	Default	195.5 V	1500 ms	
Undervoltage 27.S2	Reading	34.4V	196ms	
	Default	34.5 V	200 ms	
Overfrequency 81>.S1	Reading	50.2 Hz	95 ms	Is the frequency thresholds deviation within ± 20 mHz? (☒ YES, ☐NO) Is the time deviation within 3% ± 20 ms? (☒ YES, ☐NO)
	Default	50.2 Hz	100 ms	
Overfrequency 81>.S2	Reading	51.5 Hz	98 ms	
	Default	51.5 Hz	100 ms	
Underfrequency 81<.S2	Reading	49.8 Hz	99 ms	
	Default	49.8 Hz	100 ms	
Underfrequency 81<.S2	Reading	47.5 Hz	97 ms	
	Default	47.5 Hz	100 ms	

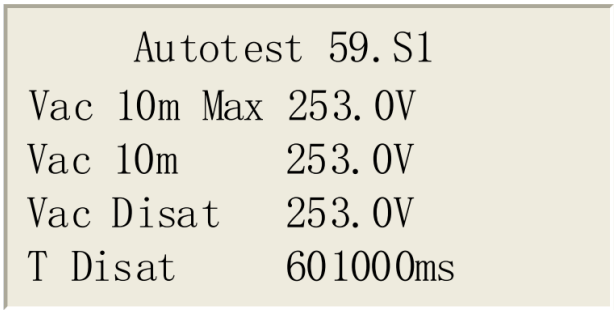
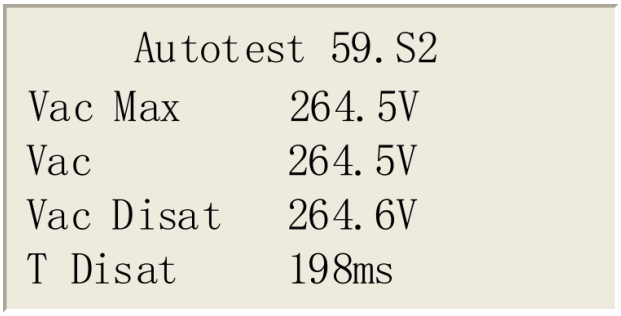
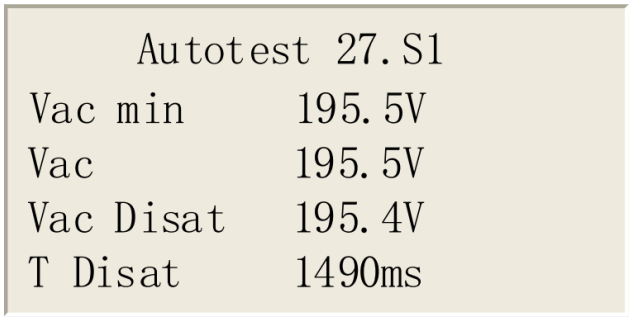
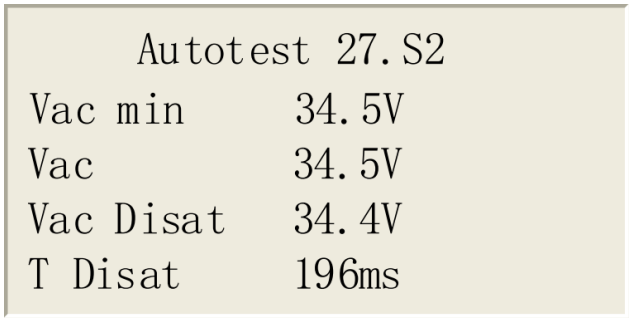
Note:

In the event that the interface protection functions are integrated into the inverter, at least one self-test system must be provided to check the maximum / minimum frequency and maximum / minimum voltage functions provided for in the SPI as described below:

- for each frequency and voltage protection function, the rise or fall intervention threshold shall be linearly varied with a ramp ≤ 0,05 Hz/s or ≤ 0,05 Vn/s for frequency and voltage protection respectively;
- this determines, at a certain point of the test, the coincidence between the threshold and the current value of the controlled magnitude (frequency or voltage) and therefore the intervention of the protection and the consequent opening of the interface device.

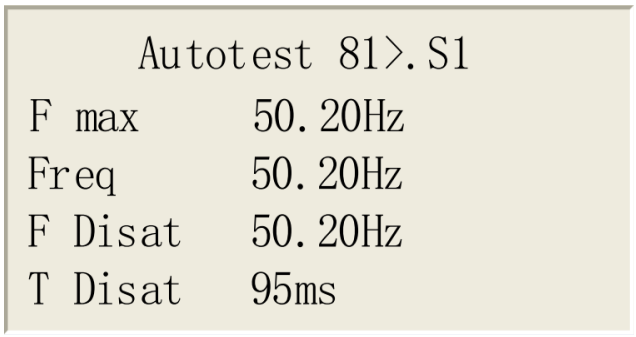
For each test the values of the quantities and the intervention times shall be viewable by the tester as well as the current value of the voltage and frequency detected by the converter.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

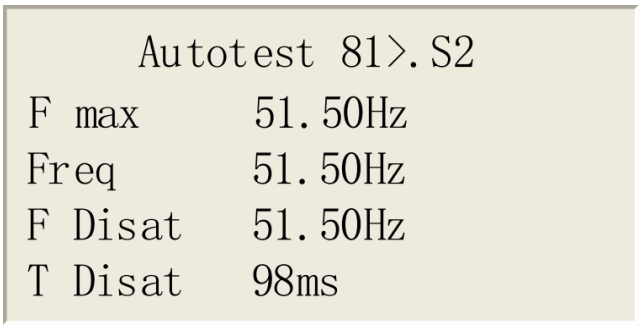
Diagram of auto-test:
Overvoltage 59.S1 
Overvoltage 59.S2 
Undervoltage 27.S1 
Undervoltage 27.S2 

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

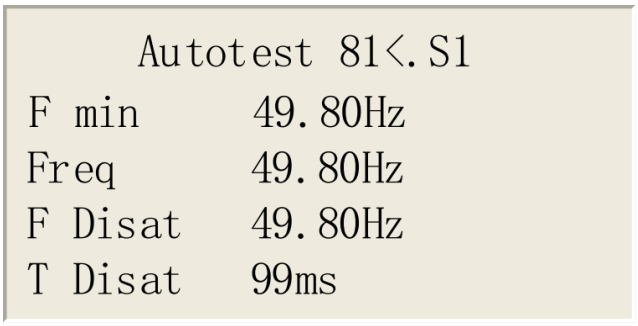
Overfrequency 81>S1



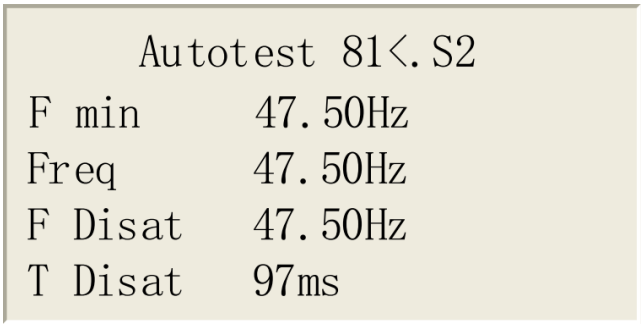
Overfrequency 81>S2



Underfrequency 81<S1



Underfrequency 81<S2



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.5	**TABLE: Single fault tolerance**				**P**
Model	HNS10000TL				
Ambient temperature (°C) ……..……:					25°C
No.	component No.	fault	test voltage (V)	test time	result
1	ISO Relay(ALFG1)	Short circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Iso Fault. No danger, no hazard, no fires
2	Monitoring Relay - L(RL2)	Pin1 to Pin2 short circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
3	Monitoring Relay - L(RL2)	Pin1 to Pin2 open circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
4	Monitoring Relay - L(RL2)	Pin3 to Pin4 short circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
5	Monitoring Relay - L(RL2)	Pin3 to Pin4 open circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
6	Monitoring Relay - N(RL1)	Pin1 to Pin2 short circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
7	Monitoring Relay - N(RL1)	Pin1 to Pin2 open circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
8	Monitoring Relay - N(RL1)	Pin3 to Pin4 short circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
9	Monitoring Relay - N(RL1)	Pin3 to Pin4 open circuit before start up inverter	360Vdc-230Vac	3min	Unit can't operating, error massage: Relay Fault. No danger, no hazard, no fires
10	AC voltage measure (R113)	Pin1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit shut down, Error message：Grid Volt Fault. No danger, no hazard, no fires
11	AC voltage measure (C34)	Pin1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit shut down, Error message：Grid Volt Fault. No danger, no hazard, no fires
12	AC current measure(C208)	Pin1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit can't operating, error message: Inv Over Current.No damage, no hazard, no fire.
13	AC frequency measure(C20)	Pin1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit shut down, error message: Grid Freq Fault.No danger, no hazard, no fires
14	DC current measure(C249)	Pin1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit shut down,error message: PV1 Over Current. No danger, no hazard, no fire

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

15	Bus cap(C45)	Pin1-Pin2 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start-up, No damage, no hazard, no fire.
16	COM-of CPU1-CPU2(U15)	Pin 58 Open circuit	360Vdc-230Vac	3min	Unit shut down. error message: Communication lose.No damage, no hazard, no fire.
17	CPU1 Failure - Power(C105)	Pin 1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit shut down. No damage, no hazard, no fire
18	CPU1 Failure - Reset (C141)	Pin 1-Pin2 Short circuit	360Vdc-230Vac	3min	Unit can't operating,No damage ,no hazard ,no fire
19	EEPROM(U20)	Pin 5 Open circuit	360Vdc-230Vac	3min	EEPROM read and write function is abnormal. No damage, no hazards.
20	EEPROM(U20)	Pin 6 Open circuit	360Vdc-230Vac	3min	EEPROM read and write function is abnormal. No damage, no hazards.
21	Drive optocoupler(U10)	Pin1-Pin2 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start-up, No damage, no hazard, no fire.
22	power tube Boost(Q2)	Pin2-Pin3 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start-up, No damage, no hazard, no fire.
23	Diode(D54)	Short circuit	360Vdc-230Vac	3min	Unit normal operation, No danger ,no hazard ,no fire
24	power tube IGBT(QA1)	Pin1-Pin3 Short circuit	360Vdc-230Vac	3min	Unit shut down, error massage: Self Lock.No danger, no hazard ,no fire
25	power tube IGBT(QA1)	Pin2-Pin3 Short circuit	360Vdc-230Vac	3min	Unit shut down, error message: Inv Over Current.No damage, no hazard ,no fire
26	power tube IGBT(QA2)	Pin2-Pin3 Short circuit	360Vdc-230Vac	3min	Unit shut down, error message: Inv Over Current.No damage ,no hazard ,no fire
27	GFCI check(--)	Short circuit	360Vdc-230Vac	3min	Unit shut down, error message: GFCI Fault.No damage, no hazard ,no fire
28	Transformer short circuit tests +20V(AF-SPS-H1)	Pin12-Pin13 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
29	Transformer short circuit tests +8V(AF-SPS-H1)	Pin15-Pin16 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
30	Transformer short circuit tests +12V(AF-SPS-H1)	Pin15-Pin18 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
31	Transformer short circuit tests +5V(AF-SPS-H1)	Pin19-Pin20 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

32	Transformer short circuit tests +5.1V(AF-SPS-H1)	Pin22-Pin24 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
33	Transformer short circuit tests -5V(AF-SPS-H1)	Pin25-Pin26 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
34	Transformer short circuit tests +15V(AF-SPS-H1)	Pin28-Pin29 Short circuit before start up	360Vdc-230Vac	3min	Unit can not start up, No damage, no hazard, no fire.
35	power tube MOS-SPS(Q2)	G-DShort circuit	360Vdc-230Vac	3min	SPS no output, no danger, no hazard, no fire
36	Output L to N(--)	short circuit	360Vdc-230Vac	3min	Unit shut down, error message:Inv Over Current. No damage, no hazard, no fire
37	Output L to PE(--)	short circuit	360Vdc-230Vac	3min	Unit shut down, error message:Grid Volt Fault. No damage, no hazard, no fire
38	Output N to PE(--)	short circuit	360Vdc-230Vac	3min	Unit shut down, error message:Grid Volt Fault. No damage, no hazard, no fire
39	DC(--)	--	360Vdc-230Vac	3min	Unit shut down. No damage, no hazard, no fire
40	AC(--)	--	360Vdc-230Vac	3min	Unit can not start up. No damage, no hazard, no fire.
41	Overload(--)	Output overload (110%)	360Vdc-230Vac	3min	Unit normal operation,No damage, no hazard, no fire
42	Cooling system failure – Blanketing test(--)	Put the unit to box	360Vdc-230Vac	3min	1 hour power run at 80%
43	PV+ to PV-(--)	Reverse polarity	360Vdc-230Vac	3min	Unit can not start up, no danger, no hazard, no fire
44	Output L - N(--)	Reverse polarity before start up	360Vdc-230Vac	3min	Unit normal operation. No damage, no hazard, no fire.

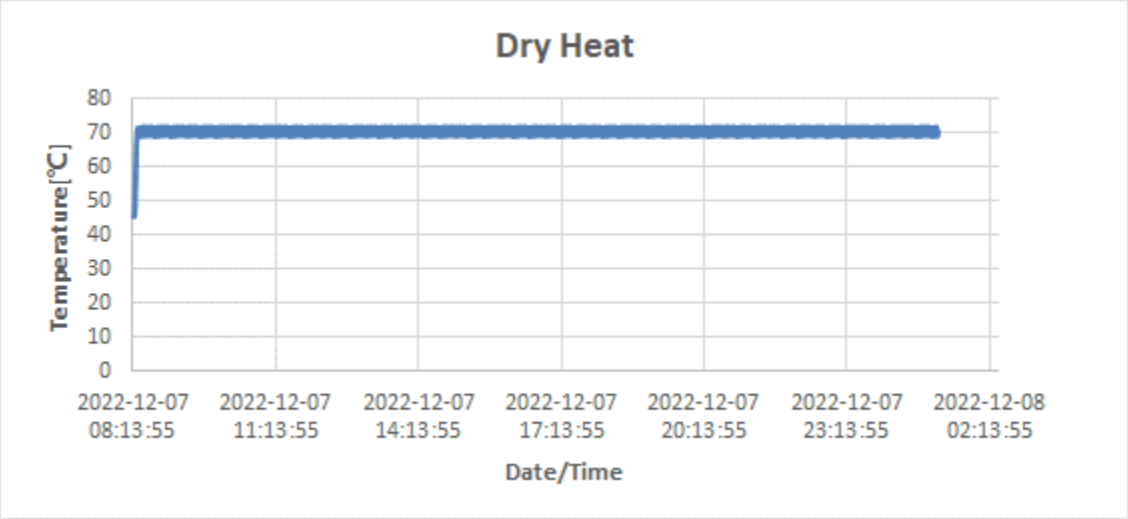
Supplementary information:
Tests performed under abnormal or fault conditions shall be tested with a source capable of 1,25 to 1,5 times the PCE rated maximum input current (Isc PV) for that input.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

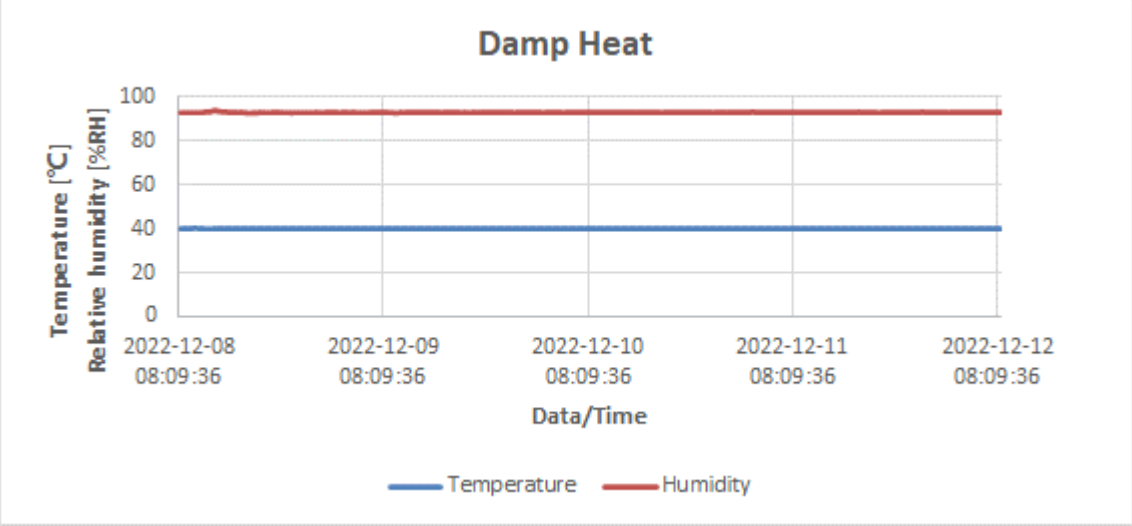
A.4.7	**TABLE: Climatic compatibility tests**			**P**
Model	HNS10000TL			
Climatic tests of unpowered equipment:				
Temperature	Relative humidity	Standards	Test time	
70°C ± 2°C	--	EN 60068-2-2	16h	
40°C ± 2°C	93% ± 3%	EN 60068-2-78	4 days	
-25°C ± 2°C	--	EN 60068-2-1	16h	
-25°C -> +70°C ± 2°C	--	EN 60068-2-14	3h @ -25°C, 3h @ +70°C	
Climatic tests of powered equipment:				
Temperature	Relative humidity	Standards	Test time	
60°C± 2°C*	--	EN 60068-2-2	16h	
40°C ± 2°C	93% ± 3%	EN 60068-2-78	4 days	
-25°C ± 2°C	--	EN 60068-2-1	16h	
-25°C -> +60°C ± 2°C*	--	EN 60068-2-14	3h @ -25°C, 3h @ +60°C	
Note: The unit is not allowed to be damaged while testing. *If the PV inverter max operating temperature above 55°C, please use the max operating temperature in the test.				

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of unpowered equipment:

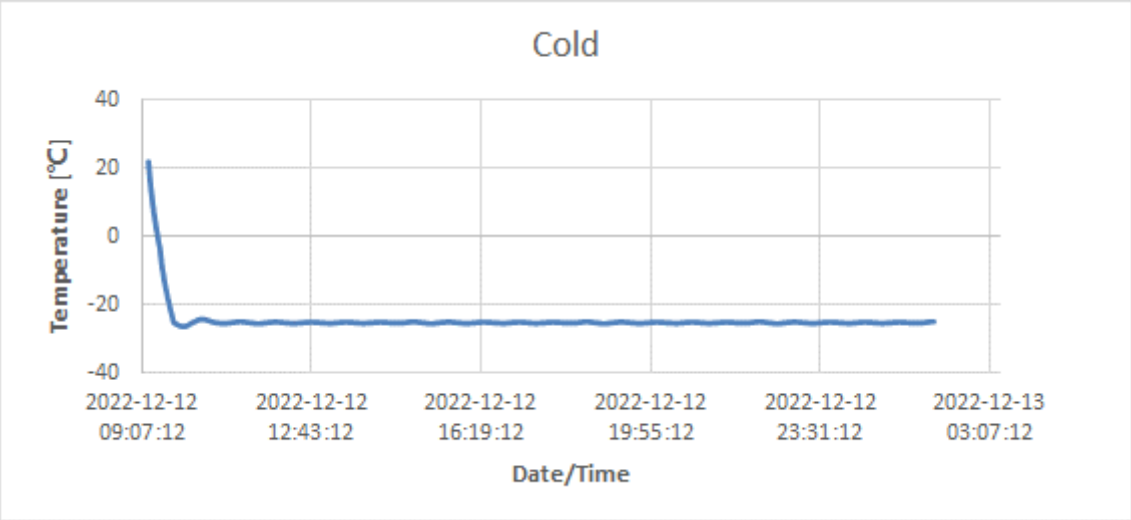


Temperature diagram of unpowered equipment:

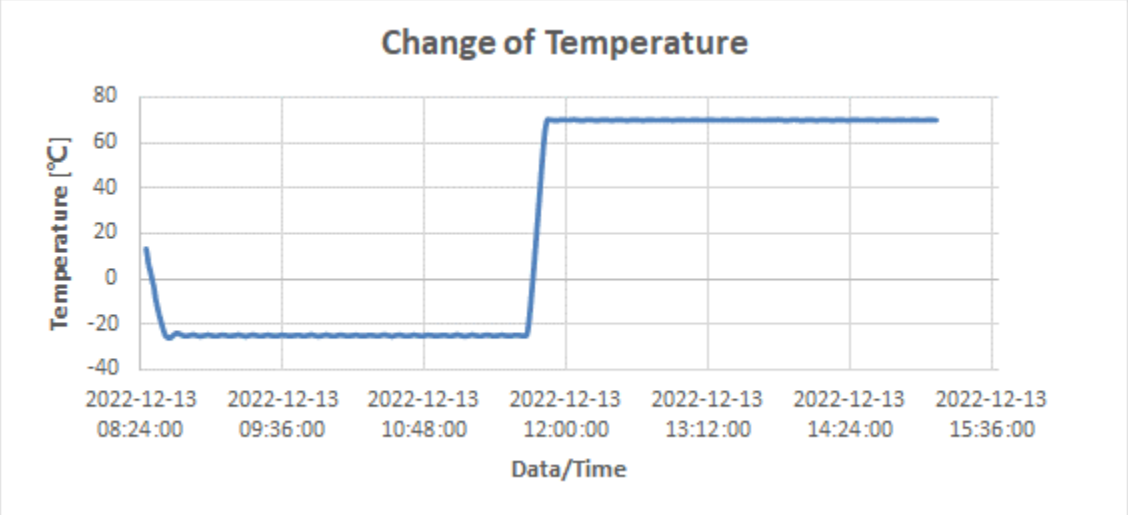


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of unpowered equipment:

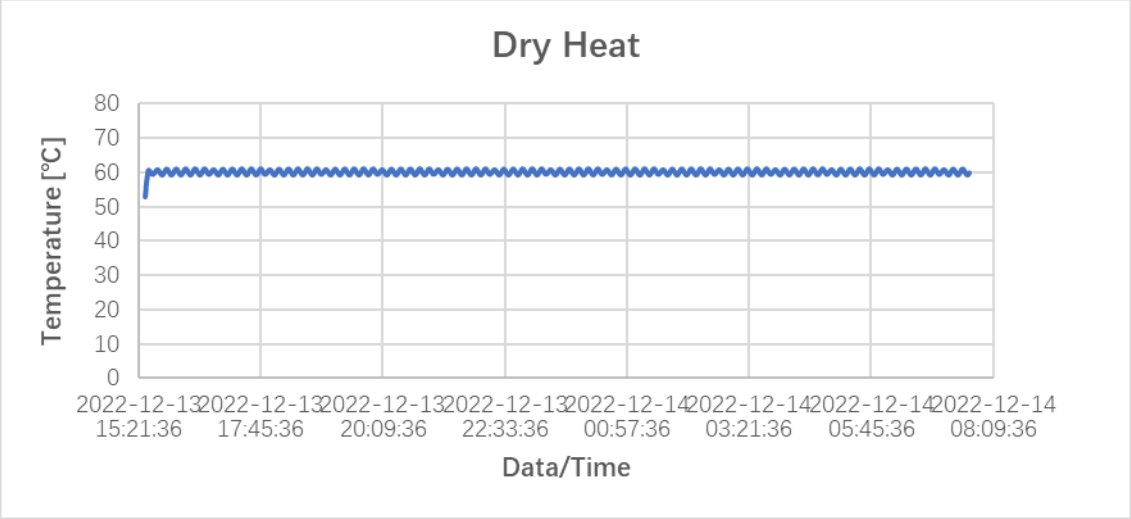


Temperature diagram of unpowered equipment:

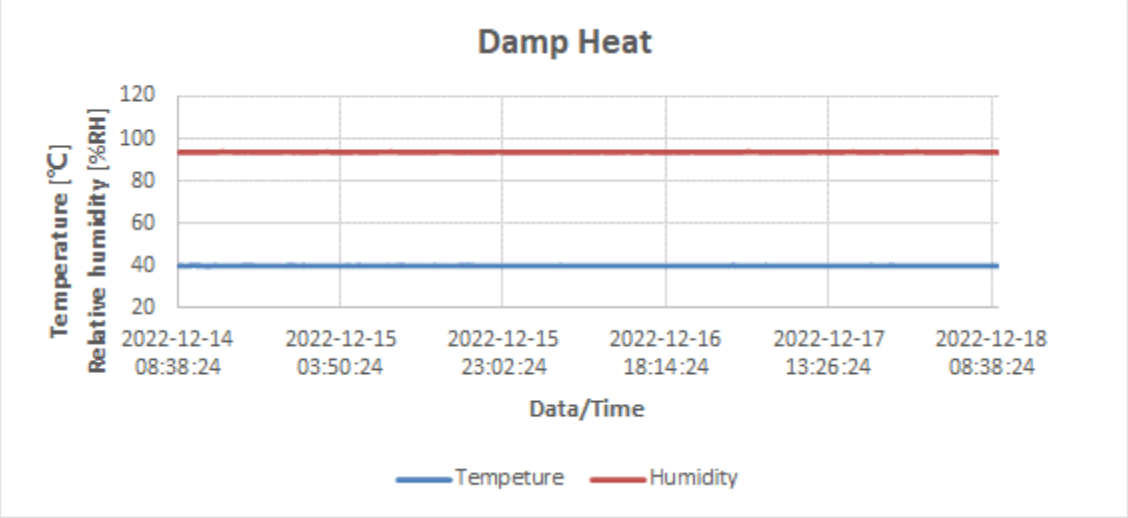


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of unpowered equipment:

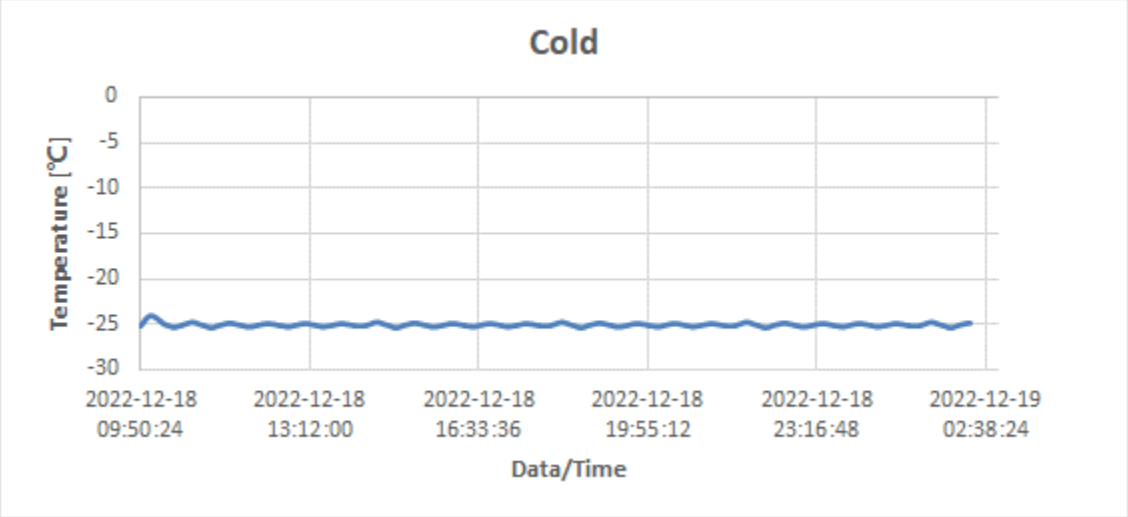


Temperature diagram of unpowered equipment:

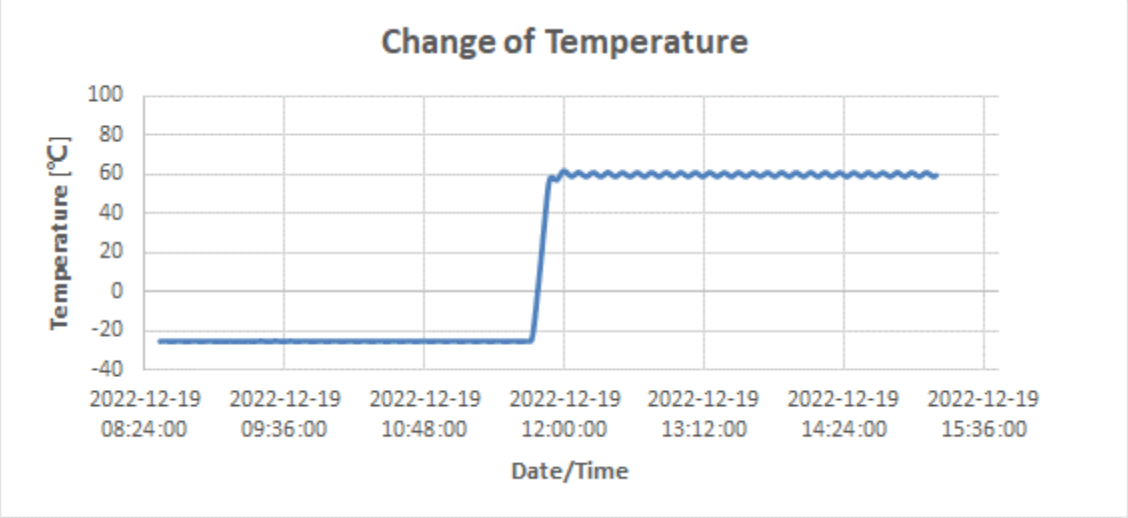


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of unpowered equipment:



Temperature diagram of unpowered equipment:



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.8	**TABLE: Insulation tests (CEI EN 60255-5)**		**P**
Model	HNS10000TL		
Location		Test voltage	Result
Rigidity of electricity:			
AC to PE		2 kVac / 2.8kVdc	P
DC to PE		2 kVac / 2.8kVdc	P
AC to communication port		2 kVac / 2.8kVdc	P
DC to communication port		2 kVac / 2.8kVdc	P
Impulse test:			
AC to PE		5 kV (1.2/50µs)	P
DC to PE		5 kV (1.2/50µs)	P
AC to communication port		5 kV (1.2/50µs)	P
DC to communication port		5 kV (1.2/50µs)	P
Measurement of the insulation resistance:			
AC to PE		>100 MΩ at 500 Vdc	P
DC to PE		>100 MΩ at 500 Vdc	P
AC to communication port		>100 MΩ at 500 Vdc	P
DC to communication port		>100 MΩ at 500 Vdc	P
Note:			

A.4.9	**TABLE: Test for the overload capacity of measuring circuits**		**P**
Model	HNS10000TL		
Voltage		Test time	Result:
≥130%U_N		permanent	P
≥150%U_N		1s	P
Note: The unit is not allowed to be damaged while testing. The measurement circuit must show after the test the same values like befor the test.			

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.11	**TABLE: Automatic mechanism to prevent current imbalance during production**		**P**
Model	HNS10000TL		
Test No. 1			
Imbalance of power:		Test time:	Limit:
6kW<P<10kW		30min	max. 30 min
Test No.2			
Imbalance of power:		Test time:	Limit:
P>10kW		1min	max. 1 min

Note:
Test No.1
- System operating at its nominal conditions;
- Creation of a permanent artificial imbalance greater than 6 kW and less than 10 kW ;
- Checking the disconnection of the entire production system using the interface device (DDI) within a maximum time of 30 min.

Test No.2:
- System operating at its nominal conditions;
- Creation of a permanent artificial imbalance greater than 10 kW ;
- Checking the disconnection of the entire production system using the interface device (DDI) within a maximum time of 1 min.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) / b)	**TABLE: Harmonic current emission**	**P**
Model	HNS10000TL	
☒ CEI EN 61000-3-2 ☒ CEI EN 61000-3-12		
☒ Ambient temperature ☒ -25°C temperature ☒ +60°C temperature		
☒ 100% P_n ☒ 66% P_n ☒ 33% P_n		
Note: *If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test (such as -25°C / +60°C).		

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 25°C, 100% P_n (CEI EN 61000-3-12)	P
Model	HNS10000TL	

Active power (W)	10272
Voltage (V)	230.13
Current (A)	44.66
Power Factor	0.9995
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	43.473	--	--	99.989	--	--	--
2nd	0.058	--	--	0.133	--	--	8
3rd	0.563	--	--	1.295	--	--	N/A
4th	0.020	--	--	0.046	--	--	4
5th	0.256	--	--	0.589	--	--	10,7
6th	0.032	--	--	0.075	--	--	2,7
7th	0.091	--	--	0.209	--	--	7,2
8th	0.035	--	--	0.080	--	--	2
9th	0.085	--	--	0.195	--	--	N/A
10th	0.024	--	--	0.055	--	--	1,6
11th	0.053	--	--	0.123	--	--	3,1
12th	0.027	--	--	0.063	--	--	1,3
13th	0.048	--	--	0.111	--	--	2
14th	0.027	--	--	0.061	--	--	N/A
15th	0.060	--	--	0.137	--	--	N/A
16th	0.015	--	--	0.036	--	--	N/A
17th	0.024	--	--	0.055	--	--	N/A
18th	0.022	--	--	0.052	--	--	N/A
19th	0.042	--	--	0.096	--	--	N/A
20th	0.025	--	--	0.057	--	--	N/A
21st	0.034	--	--	0.079	--	--	N/A
22nd	0.013	--	--	0.030	--	--	N/A
23rd	0.032	--	--	0.073	--	--	N/A
24th	0.017	--	--	0.038	--	--	N/A
25th	0.010	--	--	0.023	--	--	N/A
26th	0.013	--	--	0.031	--	--	N/A
27th	0.009	--	--	0.020	--	--	N/A
28th	0.015	--	--	0.036	--	--	N/A
29th	0.022	--	--	0.051	--	--	N/A
30th	0.013	--	--	0.029	--	--	N/A
31st	0.008	--	--	0.018	--	--	N/A
32nd	0.007	--	--	0.017	--	--	N/A
33rd	0.009	--	--	0.021	--	--	N/A
34th	0.006	--	--	0.014	--	--	N/A
35th	0.014	--	--	0.033	--	--	N/A
36th	0.011	--	--	0.026	--	--	N/A
37th	0.007	--	--	0.016	--	--	N/A
38th	0.007	--	--	0.016	--	--	N/A
39th	0.007	--	--	0.016	--	--	N/A
40th	0.009	--	--	0.020	--	--	N/A
THD	--	--	--	1.542	--	--	13
PWHD	--	--	--	1.156	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	**TABLE: Harmonics measurement under test condition -25°C, 100% P_n(CEI EN 61000-3-12)**	**P**
Model	HNS10000TL	

Active power (W)	10272
Voltage (V)	230.11
Current (A)	44.66
Power Factor	0.9995
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	43.473	--	--	99.989	--	--	--
2nd	0.052	--	--	0.119	--	--	8
3rd	0.566	--	--	1.303	--	--	N/A
4th	0.024	--	--	0.055	--	--	4
5th	0.255	--	--	0.585	--	--	10,7
6th	0.030	--	--	0.069	--	--	2,7
7th	0.098	--	--	0.225	--	--	7,2
8th	0.039	--	--	0.090	--	--	2
9th	0.080	--	--	0.184	--	--	N/A
10th	0.028	--	--	0.064	--	--	1,6
11th	0.055	--	--	0.125	--	--	3,1
12th	0.028	--	--	0.065	--	--	1,3
13th	0.049	--	--	0.112	--	--	2
14th	0.028	--	--	0.064	--	--	N/A
15th	0.060	--	--	0.138	--	--	N/A
16th	0.018	--	--	0.041	--	--	N/A
17th	0.026	--	--	0.061	--	--	N/A
18th	0.022	--	--	0.052	--	--	N/A
19th	0.042	--	--	0.096	--	--	N/A
20th	0.024	--	--	0.055	--	--	N/A
21st	0.034	--	--	0.078	--	--	N/A
22nd	0.015	--	--	0.034	--	--	N/A
23rd	0.033	--	--	0.076	--	--	N/A
24th	0.015	--	--	0.035	--	--	N/A
25th	0.011	--	--	0.024	--	--	N/A
26th	0.015	--	--	0.035	--	--	N/A
27th	0.008	--	--	0.018	--	--	N/A
28th	0.016	--	--	0.037	--	--	N/A
29th	0.022	--	--	0.050	--	--	N/A
30th	0.012	--	--	0.027	--	--	N/A
31st	0.009	--	--	0.020	--	--	N/A
32nd	0.006	--	--	0.014	--	--	N/A
33rd	0.009	--	--	0.020	--	--	N/A
34th	0.007	--	--	0.015	--	--	N/A
35th	0.015	--	--	0.034	--	--	N/A
36th	0.009	--	--	0.021	--	--	N/A
37th	0.007	--	--	0.016	--	--	N/A
38th	0.007	--	--	0.017	--	--	N/A
39th	0.007	--	--	0.017	--	--	N/A
40th	0.009	--	--	0.021	--	--	N/A
THD	--	--	--	1.549	--	--	13
PWHD	--	--	--	1.169	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 60°C, 100% P_n (CEI EN 61000-3-12)	P

Model	HNS10000TL
Active power (W)	10274
Voltage (V)	230.11
Current (A)	44.67
Power Factor	0.9995
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	43.473	--	--	99.989	--	--	--
2nd	0.051	--	--	0.117	--	--	8
3rd	0.573	--	--	1.317	--	--	N/A
4th	0.022	--	--	0.050	--	--	4
5th	0.251	--	--	0.578	--	--	10,7
6th	0.033	--	--	0.076	--	--	2,7
7th	0.092	--	--	0.211	--	--	7,2
8th	0.035	--	--	0.080	--	--	2
9th	0.080	--	--	0.183	--	--	N/A
10th	0.029	--	--	0.066	--	--	1,6
11th	0.057	--	--	0.132	--	--	3,1
12th	0.029	--	--	0.067	--	--	1,3
13th	0.049	--	--	0.112	--	--	2
14th	0.029	--	--	0.067	--	--	N/A
15th	0.061	--	--	0.140	--	--	N/A
16th	0.018	--	--	0.041	--	--	N/A
17th	0.026	--	--	0.060	--	--	N/A
18th	0.021	--	--	0.049	--	--	N/A
19th	0.041	--	--	0.095	--	--	N/A
20th	0.024	--	--	0.055	--	--	N/A
21st	0.035	--	--	0.080	--	--	N/A
22nd	0.016	--	--	0.036	--	--	N/A
23rd	0.032	--	--	0.075	--	--	N/A
24th	0.015	--	--	0.035	--	--	N/A
25th	0.011	--	--	0.025	--	--	N/A
26th	0.015	--	--	0.035	--	--	N/A
27th	0.008	--	--	0.017	--	--	N/A
28th	0.015	--	--	0.035	--	--	N/A
29th	0.022	--	--	0.051	--	--	N/A
30th	0.011	--	--	0.026	--	--	N/A
31st	0.008	--	--	0.019	--	--	N/A
32nd	0.006	--	--	0.014	--	--	N/A
33rd	0.007	--	--	0.017	--	--	N/A
34th	0.006	--	--	0.013	--	--	N/A
35th	0.014	--	--	0.033	--	--	N/A
36th	0.008	--	--	0.019	--	--	N/A
37th	0.007	--	--	0.016	--	--	N/A
38th	0.007	--	--	0.016	--	--	N/A
39th	0.006	--	--	0.015	--	--	N/A
40th	0.008	--	--	0.019	--	--	N/A
THD	--	--	--	1.558	--	--	13
PWHD	--	--	--	1.161	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 25°C 66% P_n (CEI EN 61000-3-12)	P

Model	HNS10000TL
Active power (W)	6681
Voltage (V)	229.66
Current (A)	29.11
Power Factor	0.9993
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	28.694	--	--	99.993	--	--	--
2nd	0.054	--	--	0.189	--	--	8
3rd	0.248	--	--	0.865	--	--	N/A
4th	0.051	--	--	0.178	--	--	4
5th	0.179	--	--	0.625	--	--	10,7
6th	0.010	--	--	0.035	--	--	2,7
7th	0.039	--	--	0.136	--	--	7,2
8th	0.011	--	--	0.040	--	--	2
9th	0.067	--	--	0.233	--	--	N/A
10th	0.020	--	--	0.069	--	--	1,6
11th	0.025	--	--	0.088	--	--	3,1
12th	0.020	--	--	0.068	--	--	1,3
13th	0.023	--	--	0.080	--	--	2
14th	0.011	--	--	0.038	--	--	N/A
15th	0.028	--	--	0.098	--	--	N/A
16th	0.022	--	--	0.077	--	--	N/A
17th	0.040	--	--	0.139	--	--	N/A
18th	0.012	--	--	0.043	--	--	N/A
19th	0.016	--	--	0.056	--	--	N/A
20th	0.012	--	--	0.041	--	--	N/A
21st	0.010	--	--	0.035	--	--	N/A
22nd	0.013	--	--	0.045	--	--	N/A
23rd	0.022	--	--	0.078	--	--	N/A
24th	0.008	--	--	0.029	--	--	N/A
25th	0.012	--	--	0.043	--	--	N/A
26th	0.011	--	--	0.039	--	--	N/A
27th	0.017	--	--	0.059	--	--	N/A
28th	0.006	--	--	0.021	--	--	N/A
29th	0.009	--	--	0.032	--	--	N/A
30th	0.005	--	--	0.019	--	--	N/A
31st	0.007	--	--	0.023	--	--	N/A
32nd	0.007	--	--	0.024	--	--	N/A
33rd	0.006	--	--	0.020	--	--	N/A
34th	0.006	--	--	0.021	--	--	N/A
35th	0.007	--	--	0.024	--	--	N/A
36th	0.008	--	--	0.027	--	--	N/A
37th	0.006	--	--	0.021	--	--	N/A
38th	0.006	--	--	0.020	--	--	N/A
39th	0.008	--	--	0.029	--	--	N/A
40th	0.007	--	--	0.026	--	--	N/A
THD	--	--	--	1.255	--	--	13
PWHD	--	--	--	1.173	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	**TABLE: Harmonics measurement under test condition -25°C 66% P_n (CEI EN 61000-3-12)**	**P**
Model	HNS10000TL	

Active power (W)	6681
Voltage (V)	229.66
Current (A)	29.11
Power Factor	0.9993
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	28.694	--	--	99.993	--	--	--
2nd	0.059	--	--	0.204	--	--	8
3rd	0.249	--	--	0.867	--	--	N/A
4th	0.045	--	--	0.157	--	--	4
5th	0.184	--	--	0.642	--	--	10,7
6th	0.012	--	--	0.042	--	--	2,7
7th	0.045	--	--	0.158	--	--	7,2
8th	0.016	--	--	0.057	--	--	2
9th	0.064	--	--	0.223	--	--	N/A
10th	0.023	--	--	0.080	--	--	1,6
11th	0.023	--	--	0.079	--	--	3,1
12th	0.021	--	--	0.073	--	--	1,3
13th	0.024	--	--	0.084	--	--	2
14th	0.012	--	--	0.041	--	--	N/A
15th	0.029	--	--	0.100	--	--	N/A
16th	0.023	--	--	0.081	--	--	N/A
17th	0.042	--	--	0.145	--	--	N/A
18th	0.013	--	--	0.044	--	--	N/A
19th	0.015	--	--	0.053	--	--	N/A
20th	0.013	--	--	0.045	--	--	N/A
21st	0.011	--	--	0.038	--	--	N/A
22nd	0.013	--	--	0.044	--	--	N/A
23rd	0.021	--	--	0.075	--	--	N/A
24th	0.008	--	--	0.027	--	--	N/A
25th	0.012	--	--	0.042	--	--	N/A
26th	0.011	--	--	0.040	--	--	N/A
27th	0.017	--	--	0.061	--	--	N/A
28th	0.006	--	--	0.021	--	--	N/A
29th	0.009	--	--	0.031	--	--	N/A
30th	0.006	--	--	0.021	--	--	N/A
31st	0.008	--	--	0.026	--	--	N/A
32nd	0.007	--	--	0.025	--	--	N/A
33rd	0.006	--	--	0.020	--	--	N/A
34th	0.007	--	--	0.023	--	--	N/A
35th	0.007	--	--	0.023	--	--	N/A
36th	0.008	--	--	0.029	--	--	N/A
37th	0.006	--	--	0.021	--	--	N/A
38th	0.006	--	--	0.021	--	--	N/A
39th	0.008	--	--	0.027	--	--	N/A
40th	0.008	--	--	0.029	--	--	N/A
THD	--	--	--	1.263	--	--	13
PWHD	--	--	--	1.199	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 60°C, 66% P_n (CEI EN 61000-3-12)	P
Model	HNS10000TL	

Active power (W)	6682
Voltage (V)	229.66
Current (A)	29.11
Power Factor	0.9993
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	28.694	--	--	99.993	--	--	--
2nd	0.056	--	--	0.195	--	--	8
3rd	0.255	--	--	0.890	--	--	N/A
4th	0.048	--	--	0.166	--	--	4
5th	0.177	--	--	0.617	--	--	10,7
6th	0.011	--	--	0.038	--	--	2,7
7th	0.039	--	--	0.136	--	--	7,2
8th	0.010	--	--	0.035	--	--	2
9th	0.069	--	--	0.239	--	--	N/A
10th	0.021	--	--	0.073	--	--	1,6
11th	0.025	--	--	0.088	--	--	3,1
12th	0.023	--	--	0.082	--	--	1,3
13th	0.025	--	--	0.088	--	--	2
14th	0.012	--	--	0.041	--	--	N/A
15th	0.029	--	--	0.103	--	--	N/A
16th	0.024	--	--	0.082	--	--	N/A
17th	0.043	--	--	0.148	--	--	N/A
18th	0.013	--	--	0.045	--	--	N/A
19th	0.015	--	--	0.054	--	--	N/A
20th	0.012	--	--	0.044	--	--	N/A
21st	0.011	--	--	0.037	--	--	N/A
22nd	0.010	--	--	0.036	--	--	N/A
23rd	0.023	--	--	0.079	--	--	N/A
24th	0.008	--	--	0.027	--	--	N/A
25th	0.011	--	--	0.040	--	--	N/A
26th	0.011	--	--	0.037	--	--	N/A
27th	0.017	--	--	0.061	--	--	N/A
28th	0.006	--	--	0.022	--	--	N/A
29th	0.009	--	--	0.030	--	--	N/A
30th	0.005	--	--	0.019	--	--	N/A
31st	0.007	--	--	0.025	--	--	N/A
32nd	0.007	--	--	0.025	--	--	N/A
33rd	0.005	--	--	0.018	--	--	N/A
34th	0.006	--	--	0.021	--	--	N/A
35th	0.007	--	--	0.025	--	--	N/A
36th	0.008	--	--	0.029	--	--	N/A
37th	0.006	--	--	0.021	--	--	N/A
38th	0.006	--	--	0.019	--	--	N/A
39th	0.007	--	--	0.025	--	--	N/A
40th	0.007	--	--	0.026	--	--	N/A
THD	--	--	--	1.276	--	--	13
PWHD	--	--	--	1.199	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 25°C 33% P_n (CEI EN 61000-3-12)	P

Model	HNS10000TL
Active power (W)	3369
Voltage (V)	229.26
Current (A)	14.73
Power Factor	0.9978
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	14.347	--	--	99.994	--	--	--
2nd	0.059	--	--	0.409	--	--	8
3rd	0.086	--	--	0.597	--	--	N/A
4th	0.032	--	--	0.225	--	--	4
5th	0.064	--	--	0.445	--	--	10,7
6th	0.011	--	--	0.075	--	--	2,7
7th	0.035	--	--	0.246	--	--	7,2
8th	0.014	--	--	0.095	--	--	2
9th	0.018	--	--	0.128	--	--	N/A
10th	0.008	--	--	0.055	--	--	1,6
11th	0.024	--	--	0.170	--	--	3,1
12th	0.013	--	--	0.093	--	--	1,3
13th	0.020	--	--	0.136	--	--	2
14th	0.020	--	--	0.141	--	--	N/A
15th	0.032	--	--	0.225	--	--	N/A
16th	0.018	--	--	0.129	--	--	N/A
17th	0.009	--	--	0.066	--	--	N/A
18th	0.015	--	--	0.106	--	--	N/A
19th	0.021	--	--	0.148	--	--	N/A
20th	0.014	--	--	0.100	--	--	N/A
21st	0.020	--	--	0.139	--	--	N/A
22nd	0.010	--	--	0.067	--	--	N/A
23rd	0.011	--	--	0.078	--	--	N/A
24th	0.005	--	--	0.035	--	--	N/A
25th	0.014	--	--	0.095	--	--	N/A
26th	0.009	--	--	0.063	--	--	N/A
27th	0.010	--	--	0.067	--	--	N/A
28th	0.006	--	--	0.042	--	--	N/A
29th	0.007	--	--	0.052	--	--	N/A
30th	0.004	--	--	0.031	--	--	N/A
31st	0.009	--	--	0.061	--	--	N/A
32nd	0.006	--	--	0.042	--	--	N/A
33rd	0.009	--	--	0.061	--	--	N/A
34th	0.005	--	--	0.033	--	--	N/A
35th	0.007	--	--	0.046	--	--	N/A
36th	0.006	--	--	0.043	--	--	N/A
37th	0.009	--	--	0.061	--	--	N/A
38th	0.006	--	--	0.043	--	--	N/A
39th	0.008	--	--	0.055	--	--	N/A
40th	0.004	--	--	0.028	--	--	N/A
THD	--	--	--	1.214	--	--	13
PWHD	--	--	--	2.075	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	**TABLE: Harmonics measurement under test condition -25°C 33% P_n (CEI EN 61000-3-12)**	**P**
Model	HNS10000TL	

Active power (W)	3367
Voltage (V)	229.26
Current (A)	14.72
Power Factor	0.9978
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	14.347	--	--	99.994	--	--	--
2nd	0.056	--	--	0.393	--	--	8
3rd	0.083	--	--	0.578	--	--	N/A
4th	0.030	--	--	0.207	--	--	4
5th	0.062	--	--	0.431	--	--	10,7
6th	0.014	--	--	0.101	--	--	2,7
7th	0.039	--	--	0.271	--	--	7,2
8th	0.018	--	--	0.123	--	--	2
9th	0.014	--	--	0.100	--	--	N/A
10th	0.009	--	--	0.064	--	--	1,6
11th	0.022	--	--	0.153	--	--	3,1
12th	0.012	--	--	0.084	--	--	1,3
13th	0.020	--	--	0.140	--	--	2
14th	0.019	--	--	0.136	--	--	N/A
15th	0.032	--	--	0.223	--	--	N/A
16th	0.018	--	--	0.127	--	--	N/A
17th	0.009	--	--	0.065	--	--	N/A
18th	0.016	--	--	0.108	--	--	N/A
19th	0.021	--	--	0.150	--	--	N/A
20th	0.015	--	--	0.102	--	--	N/A
21st	0.019	--	--	0.130	--	--	N/A
22nd	0.009	--	--	0.065	--	--	N/A
23rd	0.012	--	--	0.081	--	--	N/A
24th	0.005	--	--	0.036	--	--	N/A
25th	0.013	--	--	0.092	--	--	N/A
26th	0.009	--	--	0.060	--	--	N/A
27th	0.010	--	--	0.070	--	--	N/A
28th	0.006	--	--	0.042	--	--	N/A
29th	0.007	--	--	0.051	--	--	N/A
30th	0.004	--	--	0.029	--	--	N/A
31st	0.008	--	--	0.057	--	--	N/A
32nd	0.006	--	--	0.045	--	--	N/A
33rd	0.008	--	--	0.059	--	--	N/A
34th	0.005	--	--	0.033	--	--	N/A
35th	0.007	--	--	0.045	--	--	N/A
36th	0.006	--	--	0.042	--	--	N/A
37th	0.009	--	--	0.063	--	--	N/A
38th	0.006	--	--	0.043	--	--	N/A
39th	0.008	--	--	0.055	--	--	N/A
40th	0.004	--	--	0.030	--	--	N/A
THD	--	--	--	1.196	--	--	13
PWHD	--	--	--	2.052	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 a)/b)	TABLE: Harmonics measurement under test condition 60°C, 33% P_n (CEI EN 61000-3-12)	P
Model	HNS10000TL	

Active power (W)	3357
Voltage (V)	229.25
Current (A)	14.67
Power Factor	0.9978
Frequency (Hz)	50.00

Harmonics	Current Magnitude (A)			Current Percent of Fundamental (%)			Harmonic Current Limits (%)
	L1 phase	L2 phase	L3 phase	L1 phase	L2 phase	L3 phase	
1st	14.347	--	--	99.994	--	--	--
2nd	0.055	--	--	0.381	--	--	8
3rd	0.084	--	--	0.587	--	--	N/A
4th	0.031	--	--	0.213	--	--	4
5th	0.063	--	--	0.438	--	--	10,7
6th	0.013	--	--	0.090	--	--	2,7
7th	0.035	--	--	0.241	--	--	7,2
8th	0.017	--	--	0.116	--	--	2
9th	0.014	--	--	0.098	--	--	N/A
10th	0.009	--	--	0.060	--	--	1,6
11th	0.024	--	--	0.168	--	--	3,1
12th	0.014	--	--	0.100	--	--	1,3
13th	0.018	--	--	0.129	--	--	2
14th	0.019	--	--	0.133	--	--	N/A
15th	0.031	--	--	0.213	--	--	N/A
16th	0.019	--	--	0.133	--	--	N/A
17th	0.010	--	--	0.067	--	--	N/A
18th	0.016	--	--	0.113	--	--	N/A
19th	0.021	--	--	0.147	--	--	N/A
20th	0.013	--	--	0.094	--	--	N/A
21st	0.019	--	--	0.132	--	--	N/A
22nd	0.007	--	--	0.046	--	--	N/A
23rd	0.012	--	--	0.082	--	--	N/A
24th	0.006	--	--	0.042	--	--	N/A
25th	0.014	--	--	0.100	--	--	N/A
26th	0.008	--	--	0.053	--	--	N/A
27th	0.011	--	--	0.079	--	--	N/A
28th	0.006	--	--	0.045	--	--	N/A
29th	0.007	--	--	0.052	--	--	N/A
30th	0.005	--	--	0.037	--	--	N/A
31st	0.008	--	--	0.056	--	--	N/A
32nd	0.005	--	--	0.036	--	--	N/A
33rd	0.009	--	--	0.062	--	--	N/A
34th	0.005	--	--	0.034	--	--	N/A
35th	0.007	--	--	0.049	--	--	N/A
36th	0.007	--	--	0.051	--	--	N/A
37th	0.009	--	--	0.064	--	--	N/A
38th	0.006	--	--	0.041	--	--	N/A
39th	0.008	--	--	0.056	--	--	N/A
40th	0.004	--	--	0.026	--	--	N/A
THD	--	--	--	1.173	--	--	13
PWHD	--	--	--	2.058	--	--	22

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 25°C (CEI EN 61000-3-2) 100% P_n power condition:

Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.050	--	--	1.080
3rd	0.110	--	--	2.300
4th	0.034	--	--	0.430
5th	0.117	--	--	1.140
6th	0.012	--	--	0.300
7th	0.015	--	--	0.770
8th	0.007	--	--	0.230
9th	0.021	--	--	0.400
10th	0.010	--	--	0.184
11th	0.017	--	--	0.330
12th	0.012	--	--	0.153
13th	0.025	--	--	0.210
14th	0.009	--	--	0.131
15th	0.009	--	--	0.150
16th	0.007	--	--	0.115
17th	0.019	--	--	0.132
18th	0.013	--	--	0.102
19th	0.023	--	--	0.118
20th	0.012	--	--	0.092
21th	0.010	--	--	0.107
22th	0.007	--	--	0.084
23th	0.014	--	--	0.098
24th	0.008	--	--	0.077
25th	0.012	--	--	0.090
26th	0.007	--	--	0.071
27th	0.007	--	--	0.083
28th	0.005	--	--	0.066
29th	0.006	--	--	0.078
30th	0.005	--	--	0.061
31th	0.009	--	--	0.073
32th	0.005	--	--	0.058
33th	0.005	--	--	0.068
34th	0.004	--	--	0.054
35th	0.009	--	--	0.064
36th	0.006	--	--	0.051
37th	0.008	--	--	0.061
38th	0.004	--	--	0.048
39th	0.007	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition -25°C (CEI EN 61000-3-2) 100% P_n power condition:				
Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.047	--	--	1.080
3rd	0.107	--	--	2.300
4th	0.031	--	--	0.430
5th	0.113	--	--	1.140
6th	0.015	--	--	0.300
7th	0.017	--	--	0.770
8th	0.007	--	--	0.230
9th	0.021	--	--	0.400
10th	0.011	--	--	0.184
11th	0.018	--	--	0.330
12th	0.013	--	--	0.153
13th	0.025	--	--	0.210
14th	0.009	--	--	0.131
15th	0.009	--	--	0.150
16th	0.006	--	--	0.115
17th	0.020	--	--	0.132
18th	0.013	--	--	0.102
19th	0.024	--	--	0.118
20th	0.012	--	--	0.092
21th	0.010	--	--	0.107
22th	0.007	--	--	0.084
23th	0.013	--	--	0.098
24th	0.006	--	--	0.077
25th	0.013	--	--	0.090
26th	0.007	--	--	0.071
27th	0.007	--	--	0.083
28th	0.005	--	--	0.066
29th	0.006	--	--	0.078
30th	0.005	--	--	0.061
31th	0.009	--	--	0.073
32th	0.005	--	--	0.058
33th	0.005	--	--	0.068
34th	0.005	--	--	0.054
35th	0.009	--	--	0.064
36th	0.004	--	--	0.051
37th	0.008	--	--	0.061
38th	0.004	--	--	0.048
39th	0.008	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 60°C (CEI EN 61000-3-2) 100% P_n power condition:				
Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.046	--	--	1.080
3rd	0.107	--	--	2.300
4th	0.033	--	--	0.430
5th	0.116	--	--	1.140
6th	0.012	--	--	0.300
7th	0.016	--	--	0.770
8th	0.007	--	--	0.230
9th	0.022	--	--	0.400
10th	0.010	--	--	0.184
11th	0.017	--	--	0.330
12th	0.012	--	--	0.153
13th	0.026	--	--	0.210
14th	0.010	--	--	0.131
15th	0.010	--	--	0.150
16th	0.007	--	--	0.115
17th	0.019	--	--	0.132
18th	0.013	--	--	0.102
19th	0.023	--	--	0.118
20th	0.012	--	--	0.092
21th	0.010	--	--	0.107
22th	0.007	--	--	0.084
23th	0.014	--	--	0.098
24th	0.006	--	--	0.077
25th	0.012	--	--	0.090
26th	0.006	--	--	0.071
27th	0.007	--	--	0.083
28th	0.005	--	--	0.066
29th	0.005	--	--	0.078
30th	0.005	--	--	0.061
31th	0.009	--	--	0.073
32th	0.004	--	--	0.058
33th	0.005	--	--	0.068
34th	0.004	--	--	0.054
35th	0.009	--	--	0.064
36th	0.004	--	--	0.051
37th	0.007	--	--	0.061
38th	0.004	--	--	0.048
39th	0.008	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 25°C (CEI EN 61000-3-2) 66% P_n power condition:

Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.042	--	--	1.080
3rd	0.084	--	--	2.300
4th	0.037	--	--	0.430
5th	0.091	--	--	1.140
6th	0.009	--	--	0.300
7th	0.018	--	--	0.770
8th	0.008	--	--	0.230
9th	0.014	--	--	0.400
10th	0.012	--	--	0.184
11th	0.017	--	--	0.330
12th	0.011	--	--	0.153
13th	0.023	--	--	0.210
14th	0.007	--	--	0.131
15th	0.020	--	--	0.150
16th	0.008	--	--	0.115
17th	0.024	--	--	0.132
18th	0.006	--	--	0.102
19th	0.015	--	--	0.118
20th	0.008	--	--	0.092
21th	0.023	--	--	0.107
22th	0.011	--	--	0.084
23th	0.015	--	--	0.098
24th	0.006	--	--	0.077
25th	0.013	--	--	0.090
26th	0.005	--	--	0.071
27th	0.015	--	--	0.083
28th	0.004	--	--	0.066
29th	0.007	--	--	0.078
30th	0.004	--	--	0.061
31th	0.014	--	--	0.073
32th	0.004	--	--	0.058
33th	0.011	--	--	0.068
34th	0.004	--	--	0.054
35th	0.011	--	--	0.064
36th	0.005	--	--	0.051
37th	0.010	--	--	0.061
38th	0.004	--	--	0.048
39th	0.007	--	--	0.058
40th	0.003	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition -25°C (CEI EN 61000-3-2) 66% P_n power condition:				
Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.045	--	--	1.080
3rd	0.086	--	--	2.300
4th	0.034	--	--	0.430
5th	0.087	--	--	1.140
6th	0.010	--	--	0.300
7th	0.022	--	--	0.770
8th	0.011	--	--	0.230
9th	0.017	--	--	0.400
10th	0.011	--	--	0.184
11th	0.016	--	--	0.330
12th	0.010	--	--	0.153
13th	0.022	--	--	0.210
14th	0.007	--	--	0.131
15th	0.019	--	--	0.150
16th	0.008	--	--	0.115
17th	0.023	--	--	0.132
18th	0.007	--	--	0.102
19th	0.016	--	--	0.118
20th	0.008	--	--	0.092
21th	0.024	--	--	0.107
22th	0.012	--	--	0.084
23th	0.015	--	--	0.098
24th	0.006	--	--	0.077
25th	0.014	--	--	0.090
26th	0.005	--	--	0.071
27th	0.014	--	--	0.083
28th	0.004	--	--	0.066
29th	0.007	--	--	0.078
30th	0.004	--	--	0.061
31th	0.014	--	--	0.073
32th	0.005	--	--	0.058
33th	0.011	--	--	0.068
34th	0.004	--	--	0.054
35th	0.011	--	--	0.064
36th	0.004	--	--	0.051
37th	0.010	--	--	0.061
38th	0.004	--	--	0.048
39th	0.007	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 60°C (CEI EN 61000-3-2) 66% P_n power condition:				
Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.030	--	--	1.080
3rd	0.071	--	--	2.300
4th	0.021	--	--	0.430
5th	0.076	--	--	1.140
6th	0.008	--	--	0.300
7th	0.011	--	--	0.770
8th	0.004	--	--	0.230
9th	0.014	--	--	0.400
10th	0.007	--	--	0.184
11th	0.011	--	--	0.330
12th	0.008	--	--	0.153
13th	0.017	--	--	0.210
14th	0.006	--	--	0.131
15th	0.006	--	--	0.150
16th	0.004	--	--	0.115
17th	0.013	--	--	0.132
18th	0.009	--	--	0.102
19th	0.015	--	--	0.118
20th	0.008	--	--	0.092
21th	0.007	--	--	0.107
22th	0.005	--	--	0.084
23th	0.009	--	--	0.098
24th	0.004	--	--	0.077
25th	0.008	--	--	0.090
26th	0.004	--	--	0.071
27th	0.005	--	--	0.083
28th	0.003	--	--	0.066
29th	0.004	--	--	0.078
30th	0.003	--	--	0.061
31th	0.006	--	--	0.073
32th	0.003	--	--	0.058
33th	0.003	--	--	0.068
34th	0.003	--	--	0.054
35th	0.006	--	--	0.064
36th	0.003	--	--	0.051
37th	0.005	--	--	0.061
38th	0.002	--	--	0.048
39th	0.005	--	--	0.058
40th	0.003	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 25°C (CEI EN 61000-3-2) 33% P_n power condition:

Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.042	--	--	1.080
3rd	0.094	--	--	2.300
4th	0.032	--	--	0.430
5th	0.058	--	--	1.140
6th	0.010	--	--	0.300
7th	0.075	--	--	0.770
8th	0.010	--	--	0.230
9th	0.065	--	--	0.400
10th	0.012	--	--	0.184
11th	0.052	--	--	0.330
12th	0.008	--	--	0.153
13th	0.046	--	--	0.210
14th	0.008	--	--	0.131
15th	0.032	--	--	0.150
16th	0.007	--	--	0.115
17th	0.027	--	--	0.132
18th	0.007	--	--	0.102
19th	0.030	--	--	0.118
20th	0.007	--	--	0.092
21th	0.010	--	--	0.107
22th	0.006	--	--	0.084
23th	0.020	--	--	0.098
24th	0.005	--	--	0.077
25th	0.013	--	--	0.090
26th	0.006	--	--	0.071
27th	0.016	--	--	0.083
28th	0.004	--	--	0.066
29th	0.011	--	--	0.078
30th	0.004	--	--	0.061
31th	0.014	--	--	0.073
32th	0.004	--	--	0.058
33th	0.012	--	--	0.068
34th	0.004	--	--	0.054
35th	0.016	--	--	0.064
36th	0.004	--	--	0.051
37th	0.012	--	--	0.061
38th	0.004	--	--	0.048
39th	0.012	--	--	0.058
40th	0.005	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition -25°C (CEI EN 61000-3-2) 33% P_n power condition:				
Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.040	--	--	1.080
3rd	0.092	--	--	2.300
4th	0.031	--	--	0.430
5th	0.056	--	--	1.140
6th	0.011	--	--	0.300
7th	0.074	--	--	0.770
8th	0.011	--	--	0.230
9th	0.065	--	--	0.400
10th	0.012	--	--	0.184
11th	0.053	--	--	0.330
12th	0.010	--	--	0.153
13th	0.047	--	--	0.210
14th	0.008	--	--	0.131
15th	0.033	--	--	0.150
16th	0.008	--	--	0.115
17th	0.028	--	--	0.132
18th	0.007	--	--	0.102
19th	0.029	--	--	0.118
20th	0.006	--	--	0.092
21th	0.010	--	--	0.107
22th	0.007	--	--	0.084
23th	0.020	--	--	0.098
24th	0.005	--	--	0.077
25th	0.013	--	--	0.090
26th	0.006	--	--	0.071
27th	0.015	--	--	0.083
28th	0.004	--	--	0.066
29th	0.011	--	--	0.078
30th	0.004	--	--	0.061
31th	0.013	--	--	0.073
32th	0.004	--	--	0.058
33th	0.013	--	--	0.068
34th	0.004	--	--	0.054
35th	0.016	--	--	0.064
36th	0.004	--	--	0.051
37th	0.012	--	--	0.061
38th	0.004	--	--	0.048
39th	0.011	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1 a) Harmonics measurement under test condition 60°C (CEI EN 61000-3-2) 33% P_n power condition:

Model	HNS3000TL			
Harmonic	L1 Phase (A)	L2 Phase (A)	L3 Phase (A)	Limit (A)
2nd	0.042	--	--	1.080
3rd	0.095	--	--	2.300
4th	0.036	--	--	0.430
5th	0.056	--	--	1.140
6th	0.012	--	--	0.300
7th	0.077	--	--	0.770
8th	0.008	--	--	0.230
9th	0.067	--	--	0.400
10th	0.013	--	--	0.184
11th	0.052	--	--	0.330
12th	0.010	--	--	0.153
13th	0.047	--	--	0.210
14th	0.008	--	--	0.131
15th	0.032	--	--	0.150
16th	0.007	--	--	0.115
17th	0.028	--	--	0.132
18th	0.007	--	--	0.102
19th	0.031	--	--	0.118
20th	0.006	--	--	0.092
21th	0.011	--	--	0.107
22th	0.009	--	--	0.084
23th	0.020	--	--	0.098
24th	0.006	--	--	0.077
25th	0.013	--	--	0.090
26th	0.006	--	--	0.071
27th	0.014	--	--	0.083
28th	0.005	--	--	0.066
29th	0.011	--	--	0.078
30th	0.004	--	--	0.061
31th	0.013	--	--	0.073
32th	0.004	--	--	0.058
33th	0.014	--	--	0.068
34th	0.004	--	--	0.054
35th	0.016	--	--	0.064
36th	0.007	--	--	0.051
37th	0.013	--	--	0.061
38th	0.004	--	--	0.048
39th	0.011	--	--	0.058
40th	0.004	--	--	0.046

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1 c)	**TABLE: Flicker emission**			**P**
Model	HNS10000TL			
Normal ambient				
Output power:	Flicker limits according to*:	Result:		
		Plt	Pst	dc%
33%	EN61000-3-3 / EN61000-3-11	0.111	0.119	0.029
66%	EN61000-3-3 / EN61000-3-11	0.112	0.118	0.041
100%	EN61000-3-3 / EN61000-3-11	0.241	0.530	0.046
Minimum ambient rating or -25°C				
Output power:	Flicker limits according to*:	Result:		
		Plt	Pst	dc%
33%	EN61000-3-3 / EN61000-3-11	0.121	0.128	0.041
66%	EN61000-3-3 / EN61000-3-11	0.122	0.122	0.043
100%	EN61000-3-3 / EN61000-3-11	0.128	0.143	0.595
Maximum ambient rating or 60°C				
Output power:	Flicker limits according to*:	Result:		
		Plt	Pst	dc%
33%	EN61000-3-3 / EN61000-3-11	0.150	0.169	0.756
66%	EN61000-3-3 / EN61000-3-11	0.152	0.288	0.257
100%	EN61000-3-3 / EN61000-3-11	0.110	0.122	0.343

Note:
* Mains Impedance according EN61000-3-3 / EN61000-3-11: **R_{max} = Ω; jX_{max}= Ω @50Hz (|Z_{max}| = Ω)**

Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c:
$Z_{max} = Z_{ref} * 3,3\% / d_c(P_n)$

The tests should be based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.
If the EUT operating temperature out of -10°C to 55°C, please use the upper and lower operating temperature limit in the test (such as -25°C / +60°C).

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.018	Pass	0.204	Pass	0.0	Pass	0.108	Pass		
2	0.026	Pass	0.202	Pass	0.0	Pass	0.111	Pass		
3	0.028	Pass	0.218	Pass	0.0	Pass	0.112	Pass		
4	0.046	Pass	0.190	Pass	0.0	Pass	0.108	Pass		
5	0.036	Pass	0.198	Pass	0.0	Pass	0.108	Pass		
6	0.025	Pass	0.180	Pass	0.0	Pass	0.108	Pass		
7	0.076	Pass	0.218	Pass	0.0	Pass	0.107	Pass		
8	0.028	Pass	0.195	Pass	0.0	Pass	0.121	Pass		
9	0.018	Pass	0.171	Pass	0.0	Pass	0.106	Pass		
10	0.343	Pass	0.461	Pass	0.0	Pass	0.122	Pass		
11	0.025	Pass	0.226	Pass	0.0	Pass	0.104	Pass		
12	0.016	Pass	0.230	Pass	0.0	Pass	0.105	Pass		
Result		Pass		Pass		Pass		Pass	0.110	Pass

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

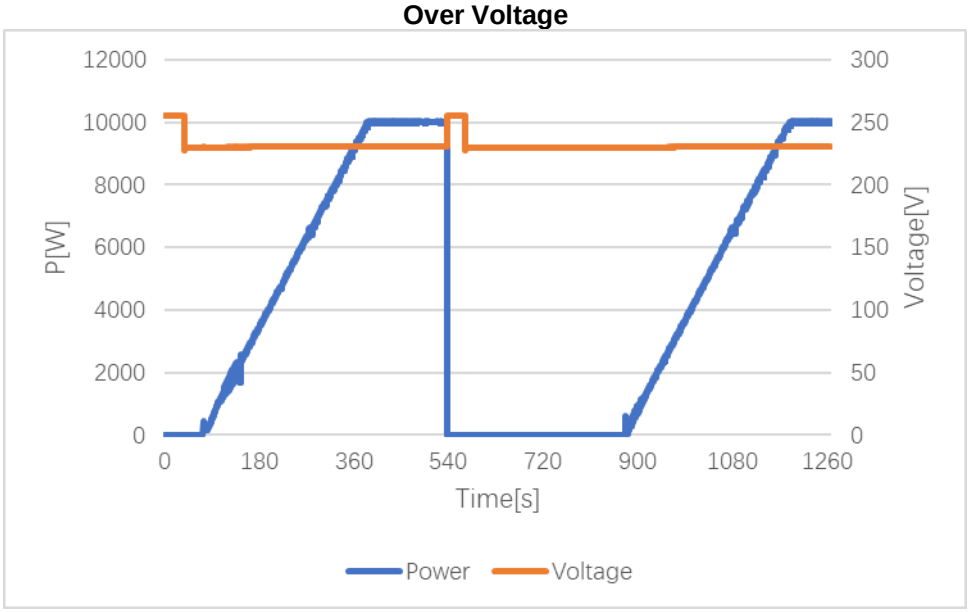
B.1.1	**TABLE: Conditions of connection, reconnection and gradual power supply**		**P**
Model	HNS10000TL		
Test:			
Power meter measurment-data:	Sample-Rate:	0.2 s	
	Sample time:	6400	
	Voltage conditons		
a) Out of voltage range	84% U_n for 30s	111% U_n for 30s	
Connection:	No connection	No connection	
Limit	No connection allowed		
b) In voltage range at start-up	85% U_n < U <110% U_n		
Reconnection time [s]	34.4	34.6	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%Pn/min For recorded gradient see diagram underneath		
c) In voltage range after voltage failture	85% U_n < U <110% U_n		
Reconnection time [s]	304.4	304.8	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%Pn/min For recorded gradient see diagram underneath		
	Frequency conditions		
d) Out of frequency range	49.88 ± 0.01	50.12 ± 0.01	
Connection:	No connection	No connection	
Limit	No connection allowed		
e) In frequency range at start-up	49,90 Hz < f < 50,10		
Reconnection time [s]	34.4	34.4	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%Pn/min For recorded gradient see diagram underneath		
f) In frequency range after frequency failture	49.90 Hz < f < 50.10		
Reconnection time [s]	305.4	305.2	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%Pn/min For recorded gradient see diagram underneath		

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

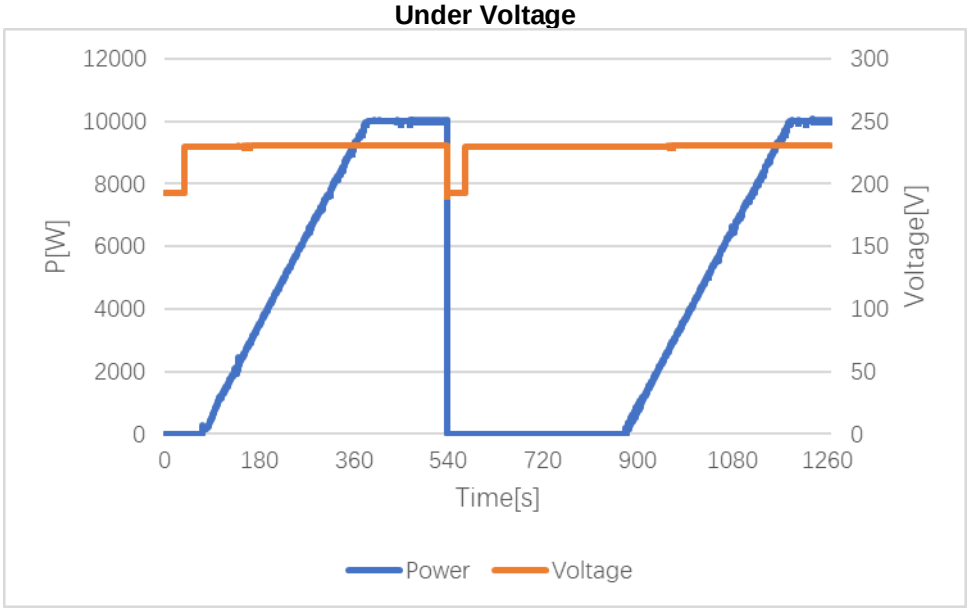
Changable reconnection conditions:	Frequency range: 49Hz-51Hz in 0.05Hz steps (default value: 49.90 and 50.10Hz)	Reconnection time range: 0-900s in steps of 5s (default value: 300s)

Test:
Test condition b) and c): voltage within the limits of 85% to 110%U_n
Test condition e) and f): frequency within the limits of 49.90Hz to 50.10Hz
Max deviation of the gradient: +2.5%P_n

Over Voltage

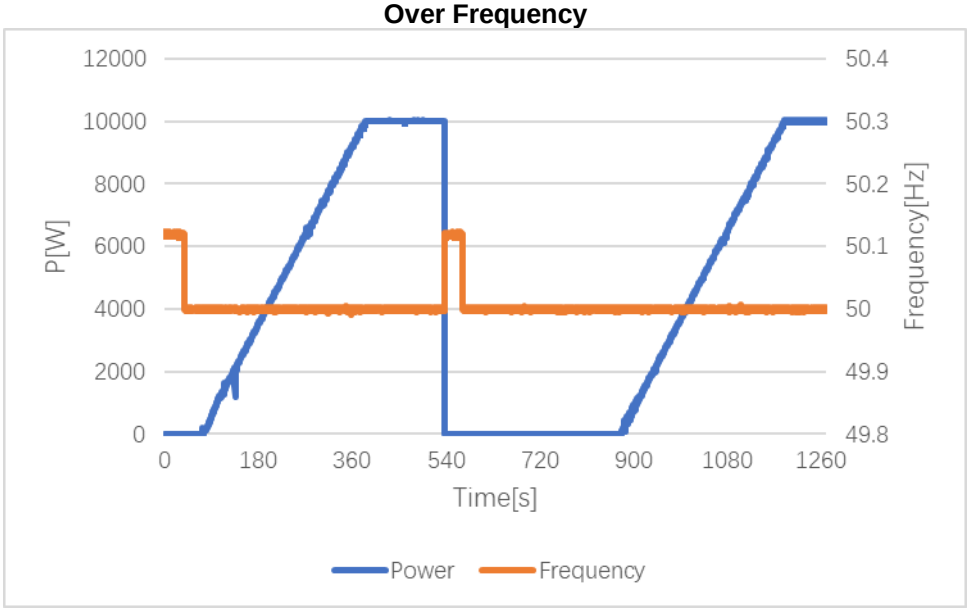


Under Voltage

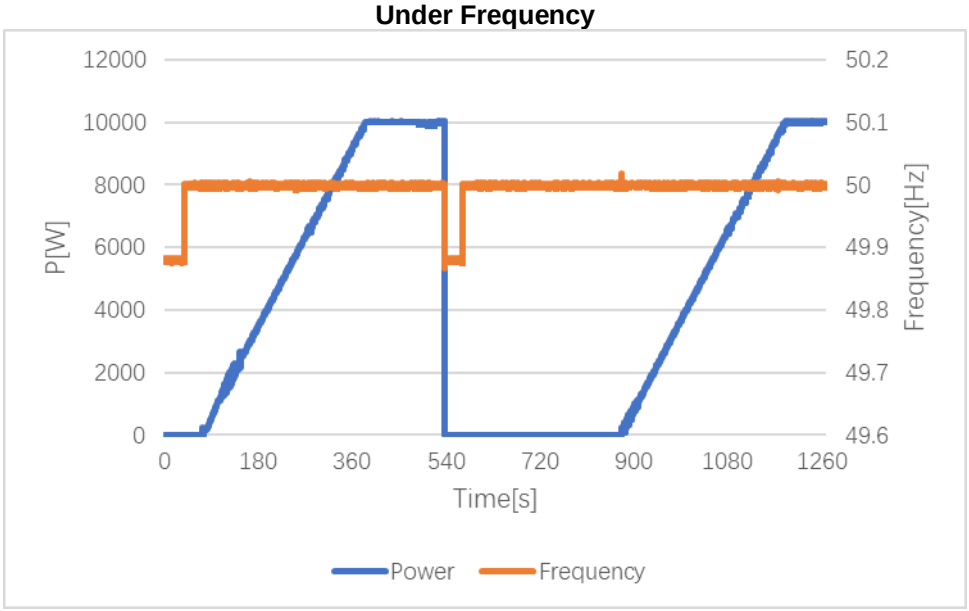


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Over Frequency



Under Frequency



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.2.2	**TABLE: Reactive power capability - Inverter in systems with total capacity greater than 11.08 kW**						**P**
Model	HNS10000TL						
TABLE: Reactive power production with set point Q = 0							
Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
0% -10%(*)	878	8.78%	240	2.40%	922	9.22%	0.9647
10% -20%(**)	1862	18.62%	238	2.38%	1948	19.48%	0.9919
20% -30%	2853	28.53%	241	2.41%	2980	29.80%	0.9964
30% -40%	3855	38.55%	230	2.30%	4017	40.17%	0.9980
40% -50%	4840	48.40%	220	2.20%	5047	50.47%	0.9987
50% -60%	5836	58.36%	154	1.54%	6091	60.91%	0.9990
60% -70%	6829	68.29%	64	0.64%	7096	70.96%	0.9992
70% -80%	7826	78.26%	46	0.46%	8115	81.15%	0.9993
80% -90%	8828	88.28%	-11	-0.11%	9134	91.34%	0.9994
90% -100%(***)	9826	98.26%	-36	-0.36%	10156	101.56%	0.9994
TABLE: Reactive power production with set point Q = -Q_{max}							
Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
0% -10%(*)	810	8.10%	239	2.39%	855	8.55%	0.9591
10% -20%(**)	1853	18.53%	236	2.36%	1940	19.40%	0.9917
20% -30%	2856	28.56%	-4848	-48.48%	2982	29.82%	0.5074
30% -40%	3847	38.47%	-4853	-48.53%	3999	39.99%	0.6210
40% -50%	4833	48.33%	-4863	-48.63%	5034	50.34%	0.7047
50% -60%	5828	58.28%	-4871	-48.71%	6069	60.69%	0.7671
60% -70%	6829	68.29%	-4874	-48.74%	7124	71.24%	0.8137
70% -80%	7816	78.16%	-4885	-48.85%	8112	81.12%	0.8477
80% -90%	8809	88.09%	-4889	-48.89%	9151	91.51%	0.8742
90% -100%(***)	9600	96.00%	-4892	-48.92%	9942	99.42%	0.8908

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

TABLE: Reactive power production with set point Q =+Q_{max}

Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
0% -10%(*)	809	8.09%	239	2.39%	848	8.48%	0.9589
10% -20%(**)	1855	18.55%	238	2.38%	1937	19.37%	0.9917
20% -30%	2858	28.58%	4853	48.53%	2981	29.81%	0.5072
30% -40%	3846	38.46%	4859	48.59%	4010	40.10%	0.6204
40% -50%	4852	48.52%	4865	48.65%	5032	50.32%	0.7059
50% -60%	5836	58.36%	4870	48.70%	6052	60.52%	0.7676
60% -70%	6834	68.34%	4880	48.80%	7071	70.71%	0.8135
70% -80%	7823	78.23%	4883	48.83%	8136	81.36%	0.8481
80% -90%	8827	88.27%	4893	48.93%	9180	91.80%	0.8744
90% -100%(***)	9629	96.29%	4900	49.00%	9972	99.72%	0.8910

Note:
The PV inverter maximum reactive power set point Q = 48.43%P_D.
(*) For power outputs less than 10% of the nominal power the generator must not exchange a reactive power higher than 10% of the nominal power.
(**) For power outputs less than 20% of the nominal power the generator must not exchange a reactive power higher than 10% of the nominal power.
(***)Ensure that the minimum requirement for cos is sustained steadily when thermal balance is achieved.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.3	**TABLE: Reactive power supply at an assigned level (greater 11.08 kW systems, but can requested for smaller systems as well)**			**P**
Model	HNS10000TL			
Power meter measurment data:		Sample-Rate:	0.2 s	
		Samples time:	3 min for each power point	
P_N in %		Qmin/cosφ min (180s)	Q=0/ cosφ=0 (180s)	Qmax/cosφ max (180s)

50% P_n	Reactive power Set point Q/P_n [%]	Reactive power measured Q/P_n [%]	Deviation from set point ΔQ/P_n [%]	Limit [%]
$-Q_{min}$	-48.43%	-48.38%	0.05%	ΔQ ≤ ±2.5% P_n
0	0.00%	2.32%	2.32%	ΔQ ≤ ±2.5% P_n
$+Q_{max}$	48.43%	48.66%	0.23%	ΔQ ≤ ±2.5% P_n

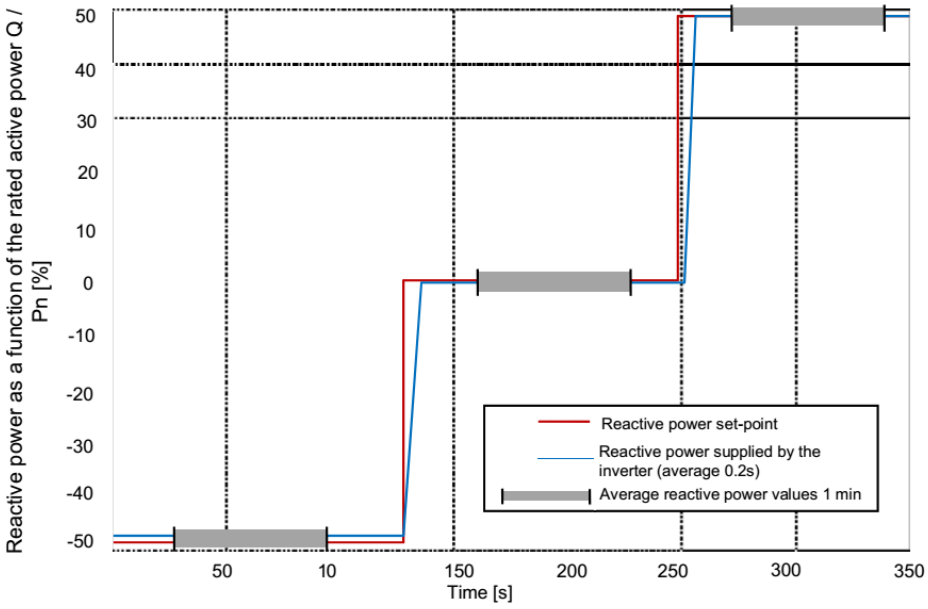


Figure 48 - Measurement of the reactive power delivered based on an external command, accuracy check

Test procedure:

- Set the DC source so that the inverter delivers about 50% of the nominal active power Pn.
- Using the methods and the control parameter established by the manufacturer, vary the reactive power supplied by the converter passing from the maximum inductive value (at least equal to Qmin ≤ -0.4843 Pn) directly to zero (Q = 0), and then go from zero at the maximum capacitive value (equal to Qmax ≥ + 0.4843 Pn).
- Maintain each of the 3 limit set-points for 180 s.
- Calculate the average values of reactive power at 1 min on the basis of the values measured over a window of 200 ms at the fundamental frequency. The calculation of the value on an average of 1 min must start from the samples detected after 30 s from the instant in which the command of the new reactive power regulation set-point is sent, this is to ensure that the system has reached the steady state.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.4	**TABLE: Response time to an assigned step level change (greater 11.08 kW systems)**		**P**
Model	HNS10000TL		
Test:			
Power meter measurment data:	Sample-Rate:	0.2 s	
	Samples time:	at least 2 minutes for each power point	
Test 1: 50% P_{Emax} Q=0→Qmin→Qmax→Q=0	1.2 s		
Test 2: 100% P_{Emax} Q=0→Qmin→Qmax→Q=0	1.4 s		

Test:
DC source should be set to 50% (test1) and 100% (test 2) output power
Starting with Q=0 then Qmin≤ -0.4843 P_n to to Qmax≥ 0.4843 P_n, and then back to Q=0 in doing so each point must be kept for at least 2 minute.

The total tolerance is ΔQ ≤ ±5,0% of P_n or Δcosφ ≤ ±0.01
The maximum response time is 10s.

As for the requirements of the previous paragraph, also in this case the tests are required to inverters used in plants with a total power greater than 11.08 kW, which must also be able to implement a centralized control strategy via remote control signal, issued by the Distributor. However, the manufacturer has the right to voluntarily carry out tests even for smaller inverters.

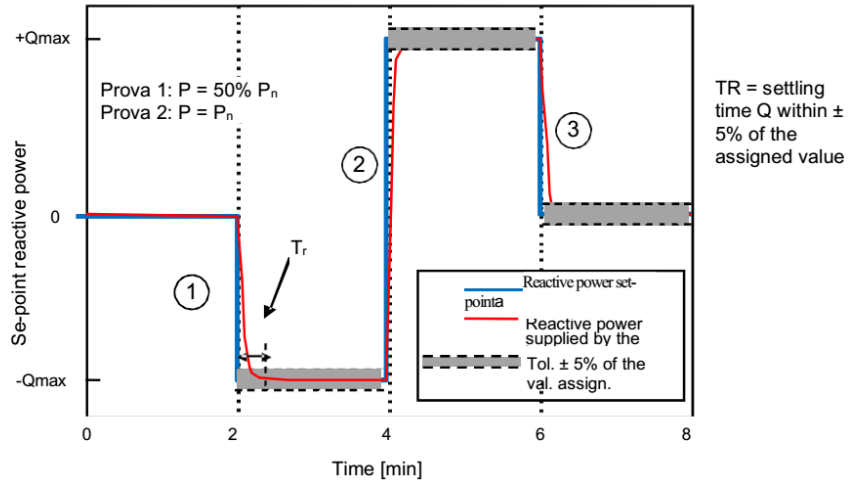
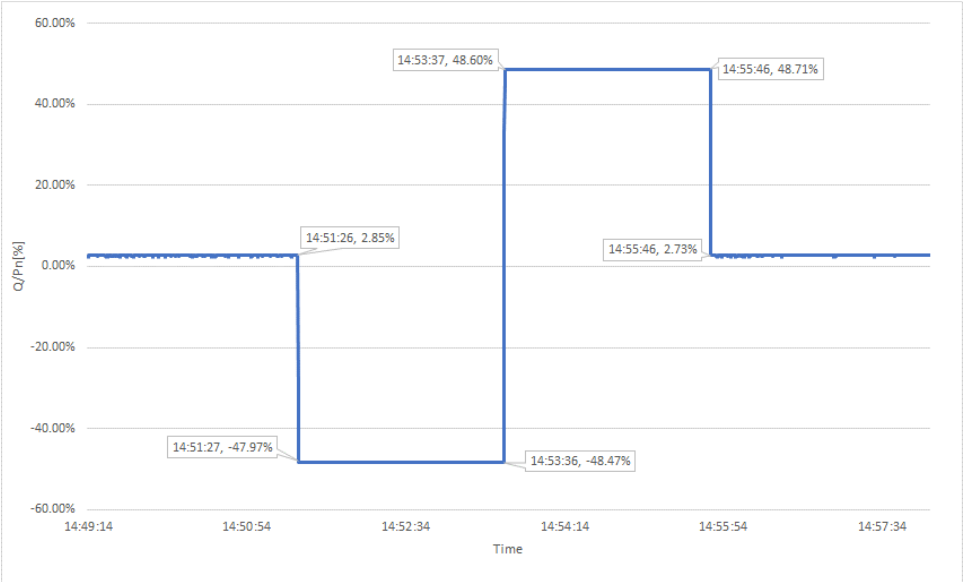


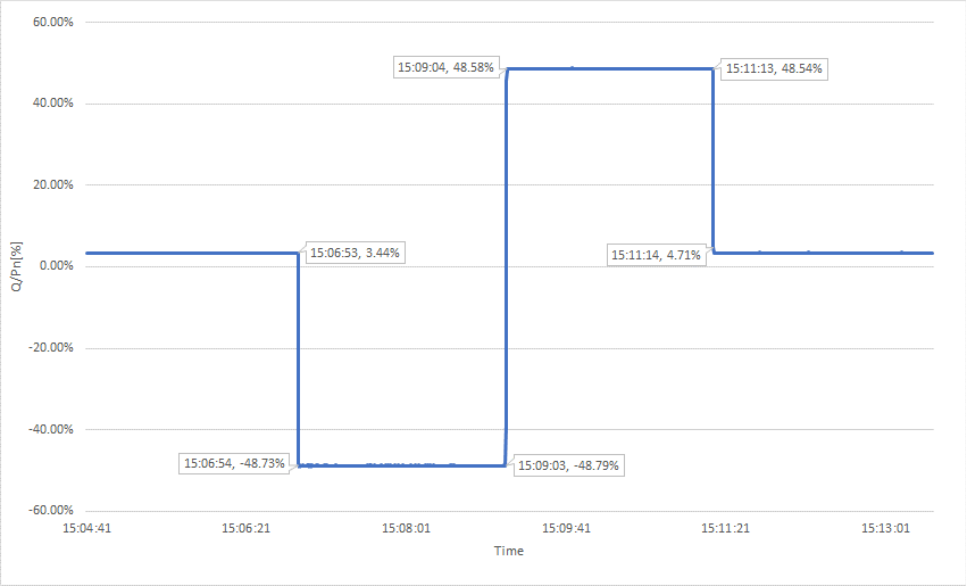
Figure 49 - Measurement of the response time to step changes of the set-point assigned for the reactive power

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test1



Test2



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.5	**TABLE: Automatic supply of reactive power according to the characteristic curve cos φ=f(P)**	**P**
Model	HNS10000TL	

Test:
Test points A-F: Set the system voltage to 1.04V_n (default lock-in value of the manufacture1.05V_n) and increases the active power from 20% P_{Emax} in increments of 10% P_E to 60%.
Test points G-H: Set the system voltage to 1,06V_n increases the active power from 60% P_E to 100% P_{Emax}.
Test points J: Set the system voltage back to V_n at 100% P_{Emax} and check that the inverter still remain in reactive power supply.
The total tolerance is Δcosφ ≤ ±0.01

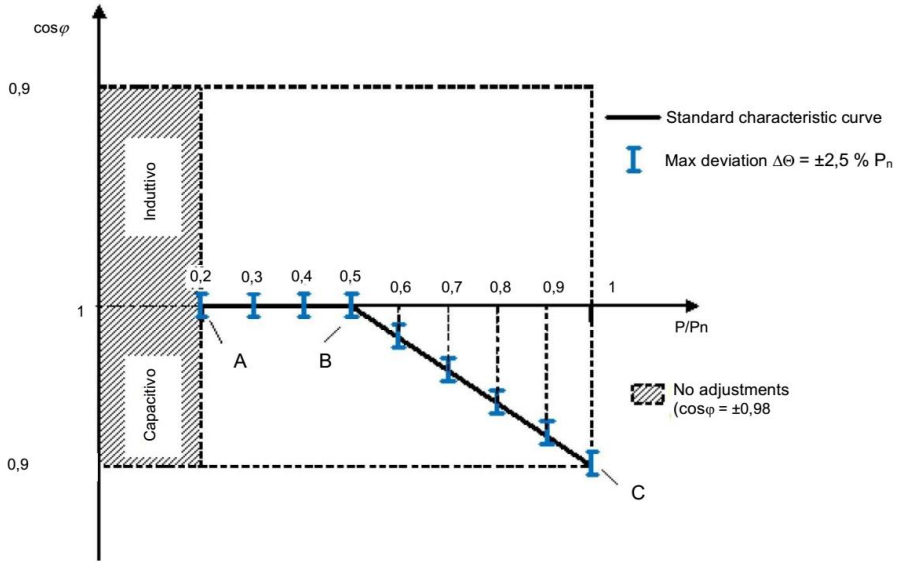


Figure 50 - Standard characteristic curve cosφ = f(P)

Assessment criterion:
Test 1: cos φ accuracy cos φ (±0.01)
Test 2: cos φ accuracy cos φ (±0.01)
For the test to be passed, the cos φ setpoint from the active power must be measured at the terminals of the PGU within a settling time of 10 s.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Model:	HNS10000TL							
P/P_{SMAX} [%]	P[W]	Vout[V]	Q[Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	2083	104.00	262	1.00	0.992	-0.008	≤ ± 0.01	P
30	3035	104.05	263	1.00	0.996	-0.004	≤ ± 0.01	P
40	4018	104.10	270	1.00	0.998	-0.002	≤ ± 0.01	P
50	5017	104.15	247	1.00	0.998	-0.002	≤ ± 0.01	P
60	5986	104.20	224	1.00	0.999	-0.001	≤ ± 0.01	P
60	6034	106.18	-1211	0.98	0.980	0.000	≤ ± 0.01	P
70	6978	106.23	-1986	0.96	0.962	0.002	≤ ± 0.01	P
80	7963	106.27	-2831	0.94	0.942	0.002	≤ ± 0.01	P
90	8942	106.32	-3742	0.92	0.923	0.003	≤ ± 0.01	P
100	9905	106.37	-4708	0.90	0.903	0.003	≤ ± 0.01	P
100	9771	102.38	-4596	0.90	0.905	0.005	≤ ± 0.01	P
100	10027	97.48	-191	1.00	0.999	-0.001	≤ ± 0.01	P

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B1.2.6	TABLE: Automatic supply of reactive power according to the characteristic curve Q= f(V) (greater 11.08kW systems)		P
Over voltage & Under voltage			
Power meter measurement data:	Sample-Rate:	0.2 s	
	Samples:	1000	

Test**:**

Test points A-I: Set the system voltage to 1.07 V_n / 0.93V_n (default lock-in value of the manufacture 1.08 V_n / 0.92V_n) and set up the active power to less than 20%. After stabilisation of this point increase the grid voltage from 0.93 to 0.91 and 1.08 to 1.10 V_n in 1V steps but hold the active power <20% $P_{E.}$ The active power should be now increase to 30% and and then from 30% P_{Emax} in increments of 10% P_E to 100%.

Test points J-K: Set the system voltage to 1.10V_n and 0.90V_n decreases the active power from 100% P_E to 10% P_{Emax} and after at least 30s smaller than 5% P_{Emax}.

The total tolerance is ΔQ ≤ ±2.5% of P_n

The inverter must be able to delay the activation of the curve from 0s - 30s (in 1s steps / default setting: 3s)

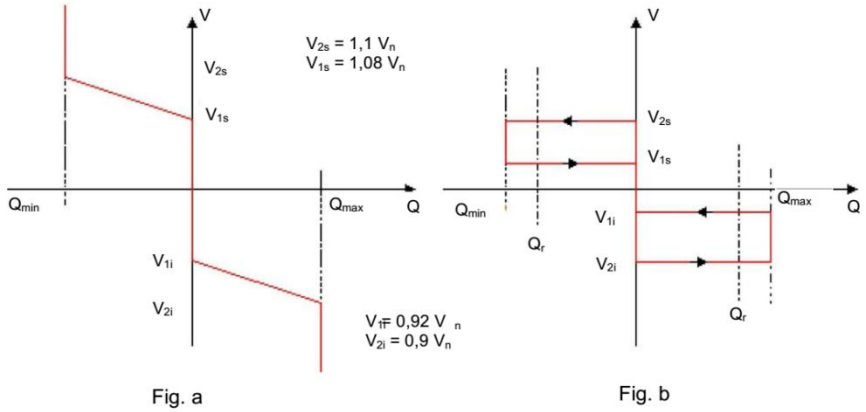


Figure 51 - Standard characteristic curves Q = f (V)

Curve settings:

V_{1s} =1.08V_n; V_{2s} = 1.1V_n

V_{1i} =0.92V_n; V2i = 0.9V_n

(V_{1i}, V_{2i}, V_{1s} and V_{2s} must be programmable in a range 0.9-1.1V_n with steps 0.01V_n)

Assessment criterion:

Test 1: cos φ accuracy cos φ (±0.01)

Test 2: cos φ accuracy cos φ (±0.01)

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

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.6	**TABLE: Automatic supply of reactive power according to the characteristic curve Q= f(V) (greater 11.08kW systems)**					**P**
Model	HNS10000TL					
Q_{min} reactive power in accordance to standard characteristic curve Q=f(V)						
P/P_n [%] Set-point	Vac [V] Set-point	P/P_n [%] measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [$\leq \pm 2.5\% P_n$]
< 20%	1.07Vn	19%	246.05	215	≈0(<±2.5%Pn)	-2.15%
< 20%	1.09Vn	19%	250.66	220	≈0(<±2.5%Pn)	-2.20%
< 20%-> 30%	1.09Vn	30%	250.78	-2201	-0.5 Q_{min} (within 10s)	-2.21%
40%	1.09V_n	40%	250.80	-2237	-0.5 Q_{min}	-1.85%
50%	1.09V_n	50%	250.81	-2284	-0.5 Q_{min}	-1.37%
60%	1.09V_n	60%	250.81	-2337	-0.5 Q_{min}	-0.85%
70%	1.09V_n	70%	250.80	-2346	-0.5 Q_{min}	-0.76%
80%	1.09V_n	80%	250.72	-2360	-0.5 Q_{min}	-0.62%
90%	1.09V_n	90%	250.64	-2415	-0.5 Q_{min}	-0.06%
100%	1.09V_n	100%	250.60	-2482	-0.5 Q_{min}	0.61%
100%	1.1 V_n	100%	253.85	-4829	- Q_{min}	-0.14%
100%->10%	1.1 V_n	9%	253.51	-4858	- Q_{min}	0.15%
10%-> ≤5%	1.1 V_n	4%	253.48	196	≈0 (<±5%P_n)	-1.96%
Q_{max} reactive power in accordance to standard characteristic curve Q=f(V)						
P/P_n [%] Set-point	Vac [V] Set-point	P/P_n [%] measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [$\leq \pm 2.5\% P_n$]
< 20%	0.93V_n	18%	214.02	-248	≈0 (<±2.5%P_n)	2.48%
< 20%	0.91V_n	19%	209.42	-164	≈0 (<±2.5%P_n)	1.64%
< 20%-30%	0.91V_n	30%	209.31	2448	-0.5 Q_{max} (within 10s)	-0.26%
40%	0.91V_n	40%	209.34	2423	-0.5 Q_{max}	-0.02%
50%	0.91V_n	50%	209.27	2419	-0.5 Q_{max}	0.02%
60%	0.91V_n	60%	209.21	2389	-0.5 Q_{max}	0.32%
70%	0.91V_n	70%	209.16	2367	-0.5 Q_{max}	0.54%
80%	0.91V_n	80%	209.08	2319	-0.5 Q_{max}	1.02%
90%	0.91V_n	90%	209.05	2251	-0.5 Q_{max}	1.70%
100%	0.91V_n	95%	209.23	2261	-0.5 Q_{max}	1.61%
100%	0.90V_n	91%	206.21	4797	- Q_{max}	0.46%
100%-10%	0.90V_n	9%	206.56	4817	- Q_{max}	0.26%
10%-5%	0.90V_n	4%	206.46	-241	≈0(<±5%P_n)	2.41%

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Note:

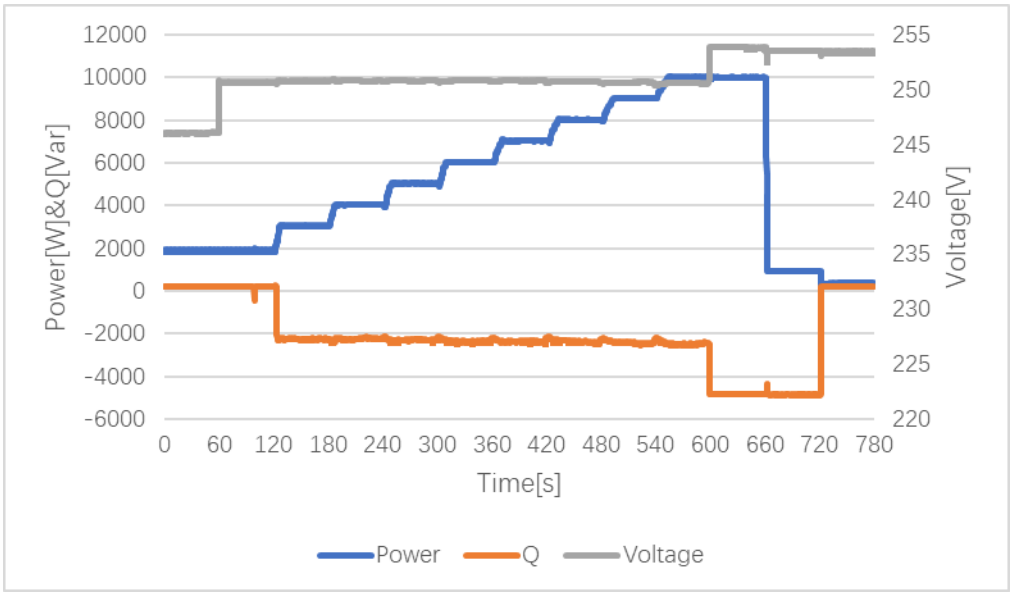
The lock-in value is adjustable between V_n and $1.1V_n$ and the lock-out value between V_n and $0.9V_n$ in 0.01V steps.

The inverter voltage on the AC side of the (inverter) is rated to 400V line to line.

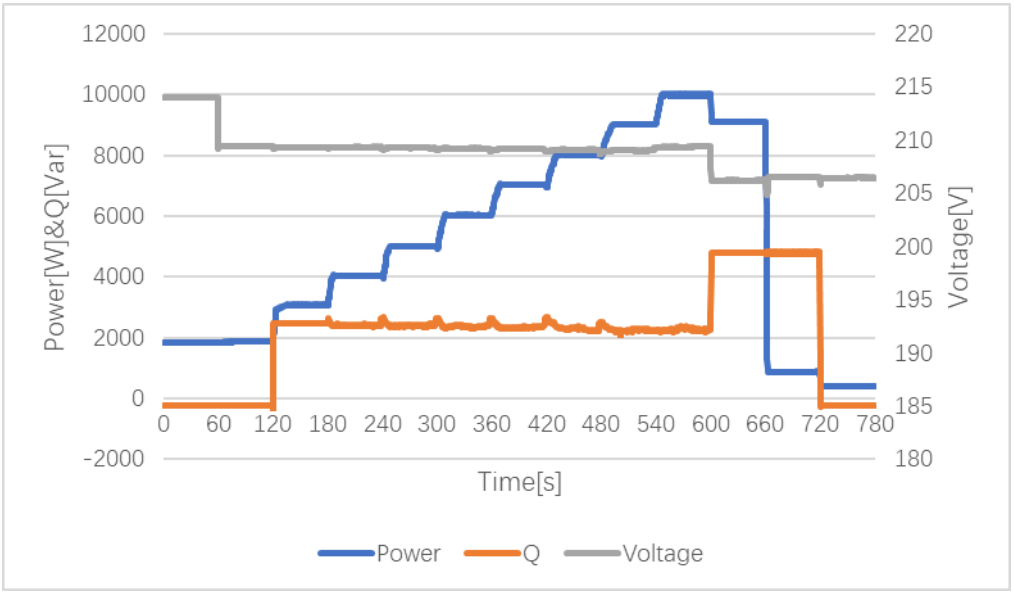
In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.

The under voltage measurement effects the active output power in reference to the reactive output power since the reactive output power has always priority. Therefore the inverter must lower the active output power.

Over Voltage



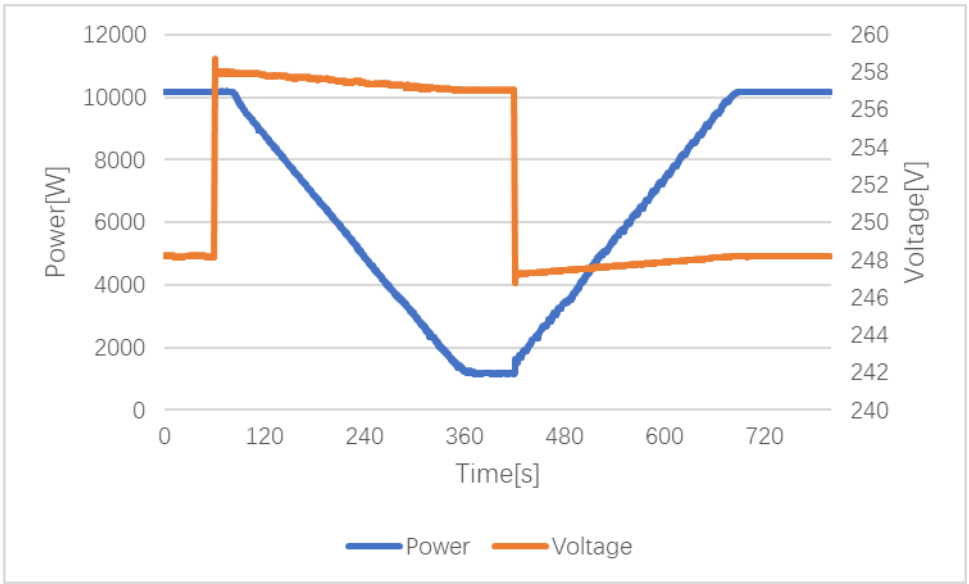
Under Voltage



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.1	**TABLE: Automatic limitation of active power for voltage values close to 110% of the rated voltage**					**P**
Model	HNS10000TL					
Set point		Activation threshold U_1			Deactivation threshold U_2	
U/U_n		110%			112%	
P/P_n		100%			20%	
Step	Set voltage [V/Vn]	Voltage [V]	Measured power [W]	Measured power [%]	Limit	Result
1	1.08	248.21	10179	101.79%	--	P
2	1.12	257.01	1194	11.94%	P <20%P_n	P
3	1.08	248.20	10173	101.73%	--	P

The purpose of the test is to verify the automatic reduction function of the active power delivered when the voltage read at the generator terminals has a value close to 110% of V_n.
Proceed as follows:
- enable the active power reduction function P(U), according to the methods indicated by the manufacturer (which must be reported in the test report);
- adjust the voltage read at the output terminals of the converter to -2% of the activation threshold declared by the manufacturer and the DC source, so that the active power delivered at the output is equal to the maximum power available for injection;
- adjust the voltage read at the output terminals of the converter to + 2% of the activation threshold declared by the manufacturer;
- the active power is measured as averages at 1 s, plotting the values obtained as a function of time;
- within 5 minutes from the instant of application of the voltage + 2% of the activation threshold declared by the manufacturer, it is verified that the active power supplied by the inverter has been reduced to a value not exceeding 20% of P_n
- adjust the voltage read at the output terminals of the converter to -2% of the activation threshold declared by the manufacturer;
- the active power is measured as averages at 1 s, plotting the values obtained as a function of time;
- verify that the active power delivered by the inverter returns to the value congruent with the power made available from the primary or simulated source.



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.2	**TABLE: Adjustment of active power in the presence of over-frequency transistors on the transmission network**						**P**
Model	HNS10000TL						
Test:							
Power meter measurement data:	Sample-Rate:			0.2 s			
	Samples:			60 per frequency Point			
f [Hz] (ramps)	1) 47.51	2) 50.15	3) 50.40	4) 50.60	5) 51.49	6) 50.11	7) 50.00

Test:

The test is conducted for two powers. First, the test must start at a power 100% P_{Emax} ("Measurement 1"), and in a second test, for a power of 50% P_{Emax} ("Measurement 2"). The inverter must reduce the power and stay in this condition, until the grid stays in the limits for more than 300s. In the second test, after freezing of the momentary output power, the available active power output must be increased to a value 100% P_{Emax}, and after the network frequency of 50,3 Hz is fallen below, the rise of the active power gradient must be recorded.

Perform the measurements on 7 points (the frequency value must have an uncertainty of maximum ± 10 mHz) temporally consequent to each other:

1) f = 47.51 Hz (t_1 for sequence A, t1 for sequence B)
2) f = 50 Hz + 0.15 Hz (t_2 for sequence A, t'_2 for sequence B)
3) f = 50 Hz + 0.40 Hz (t_3 for sequence A, t'_3 for sequence B)
4) f = 50 Hz + 0.60 Hz (t_4 for sequence A, t'_4 for sequence B)
5) f = 50 Hz + 1.49 Hz (t_5 for sequence A, t'_5 for sequence B)
6) f = 50 Hz + 0.11 Hz (t_6 for sequence A, t'_6 for sequence B)

Now carry out step 7). bringing the frequency back to the nominal value to verify the conditions of gradual restoration of the maximum supply (sequence A), or to 50% of the maximum power available (sequence B):

7) f = 50 Hz (t_7 for sequence A, t'_7 for sequence B).

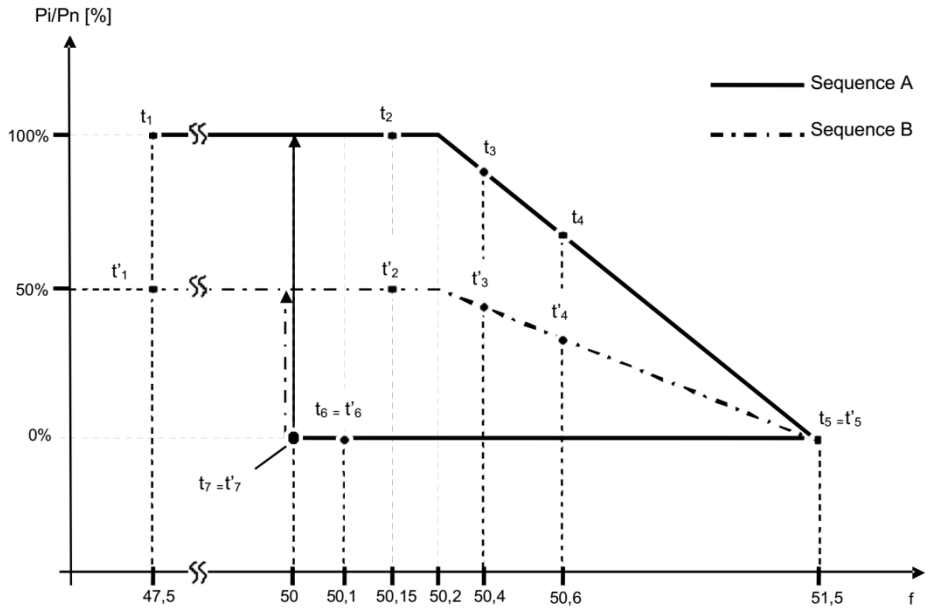
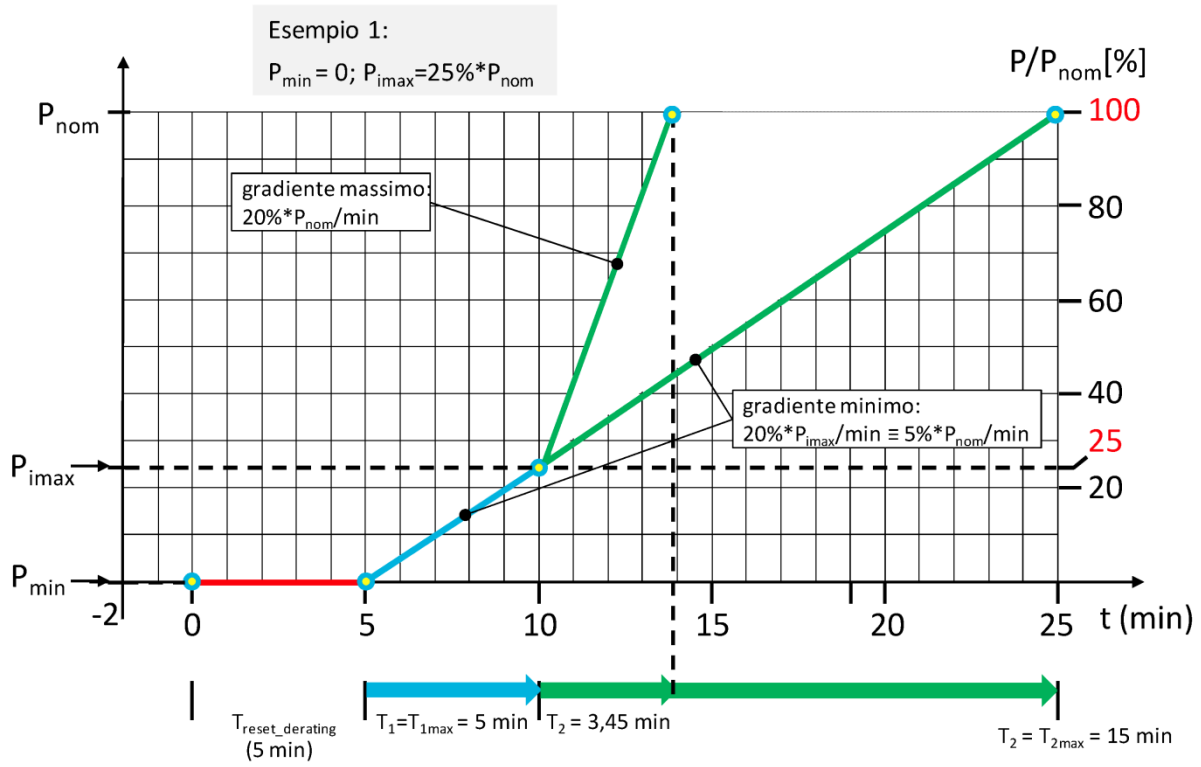


Figure 52 - Curves for limiting active power with respect to frequency

The total tolerance is ΔP ≤ ±2,5% of P_n

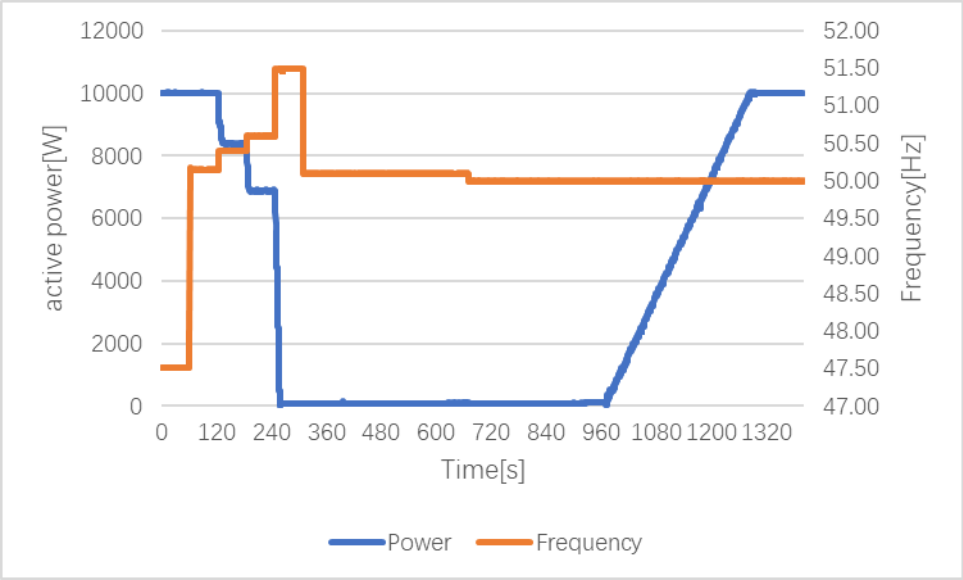
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Limits of the power-up gradient



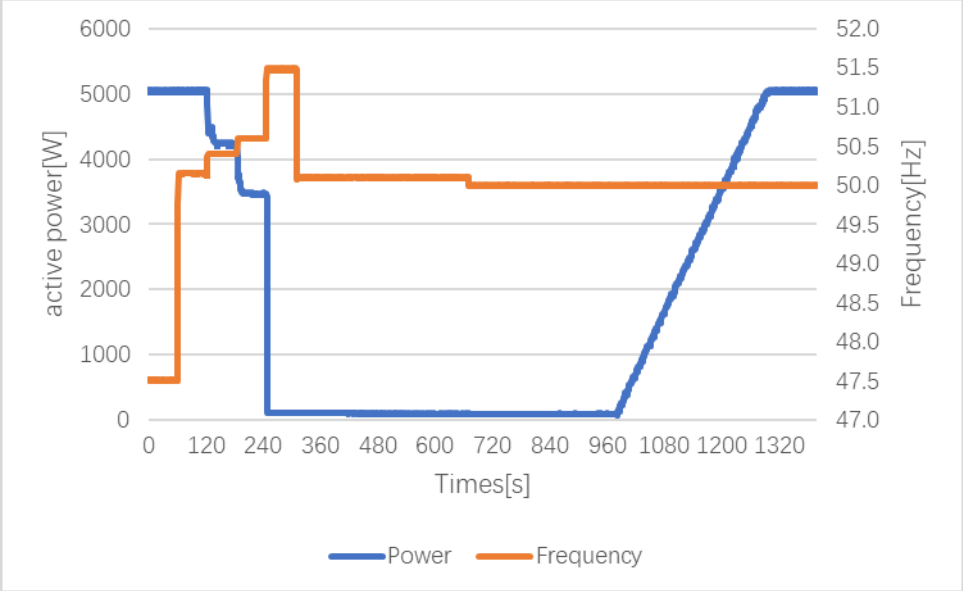
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Sequence A						
Step No.	Set output power [%]	Frequency[Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100	47.51	10000	10012	± 2.5% Pn	t_1
2	100	50.15	10000	10010	± 2.5% Pn	t_2
3	100	50.40	8462	8471	± 2.5% Pn	t_3
4	100	50.60	6923	6945	± 2.5% Pn	t_4
5	100	51.49	77	92	± 2.5% Pn	t_5
6	100	50.10	77	93	± 2.5% Pn	t_6
7	100	50.00	10000	10010	Pn	t_7



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Sequence B						
Step No.	Set output power [%]	Frequency[Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	47.51	5000	5056	± 2.5% Pn	t'_1
2	50	50.15	5000	5057	± 2.5% Pn	t'_2
3	50	50.40	4231	4283	± 2.5% Pn	t'_3
4	50	50.60	3462	3501	± 2.5% Pn	t'_4
5	50	51.49	39	106	± 2.5% Pn	t'_5
6	50	50.10	39	99	± 2.5% Pn	t'_6
7	50	50.00	5000	5055	50% Pn	t'_7



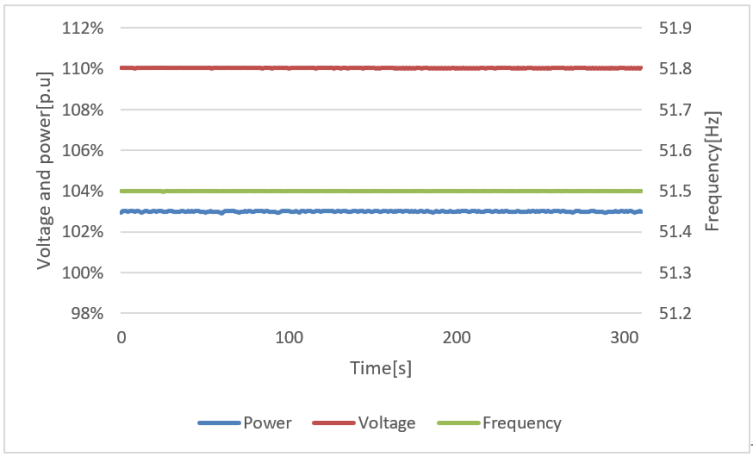
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.3	**TABLE: Verification of the operating range in voltage and frequency**					**P**
Model	HNS10000TL					
Test No.	Voltage (V)	Frequency (Hz)	P (W)	Cos φ	Time (s)	Limit (%P_n)
Test 1	253.11	51.50	10300	0.9994	>5min	± 5
Test 2	196.06	50.00	10051	0.9995	>5min	± 15

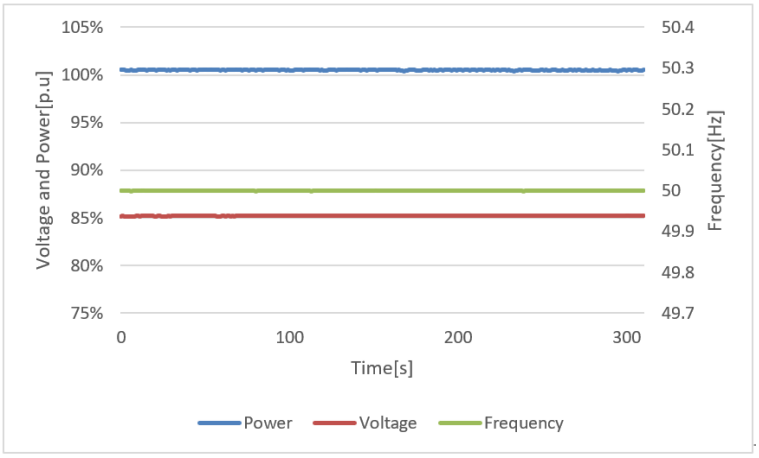
Test 1: V = 110 % * V_n; f = 51,5 Hz; P = 100 %P_n; Cos φ= 1 (Duration: at least 5 minutes)
Test 2: V = 85 % * V_n; f = 50,0 Hz; P = 100 %P_n; Cos φ= 1

Test 1 and 2 have a duration of at least 5 minutes. In Test 2, operation at reduced power is allowed, equal to the maximum deliverable when the maximum output current limit has been reached (P≥85% P_n).
To allow the tests to be carried out, the restrictive frequency thresholds must be disabled.
During the tests it is necessary to disable the automatic regulation in power reduction in case of over-frequency.
The frequency, voltage and active power measured at the generator output terminals must be recorded at a rate of at least 1 sample per second. The delivered power must remain stable within a limit of ± 5%P_n.

Test 1



Test 2

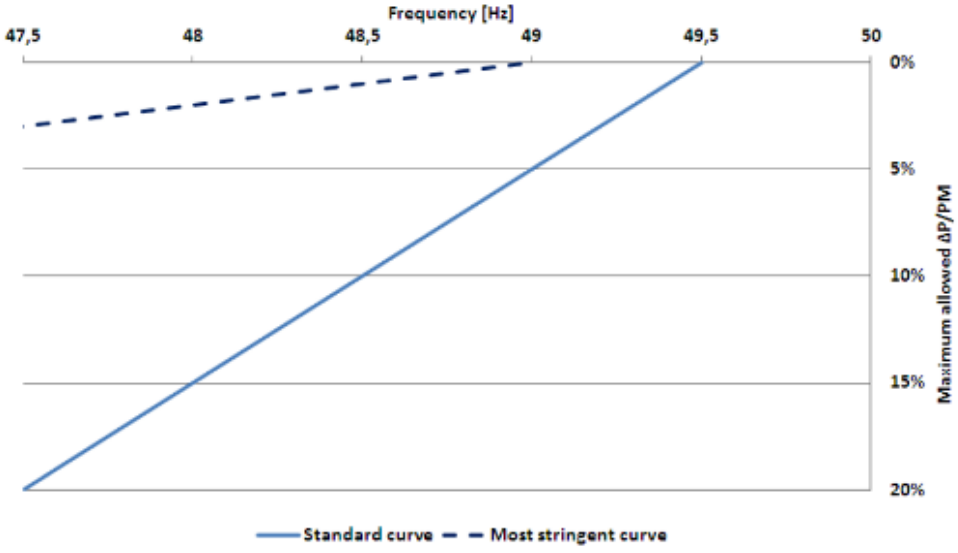


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.3.1	**TABLE: Reduction of active power in the presence of transient under-frequency on transmission network**					**P**
Model:	HNS10000TL					
5-min mean value	50.0 Hz	49.5 Hz	49.0 Hz	48.5 Hz	48.0 Hz	47.5 Hz
Frequency [Hz]:	50.00	49.50	49.00	48.50	48.00	47.50
Active power [kW]:	10009	10006	10004	10001	9999	10012

Test:
The test must be carried out at 100% P_n.
Measurements are carried out at the following operating points:
-Connect the object under test according to the instructions provided by the manufacturer.
-Set all the parameters of the simulated network to the respective values of normal exercise.
-Bring all the parameters of the object under test to the respective values of normal performance, such that the out power of the inverter is equal to the maximum deliverable power.
-Implement measures of active power on 6 points of time from each other on the basis of 50 Hz, and by reducing the frequency of 0.5 Hz with a step up to the minimum value of 47.5 Hz.
The each operating point shall be maintained for at least 5 min.

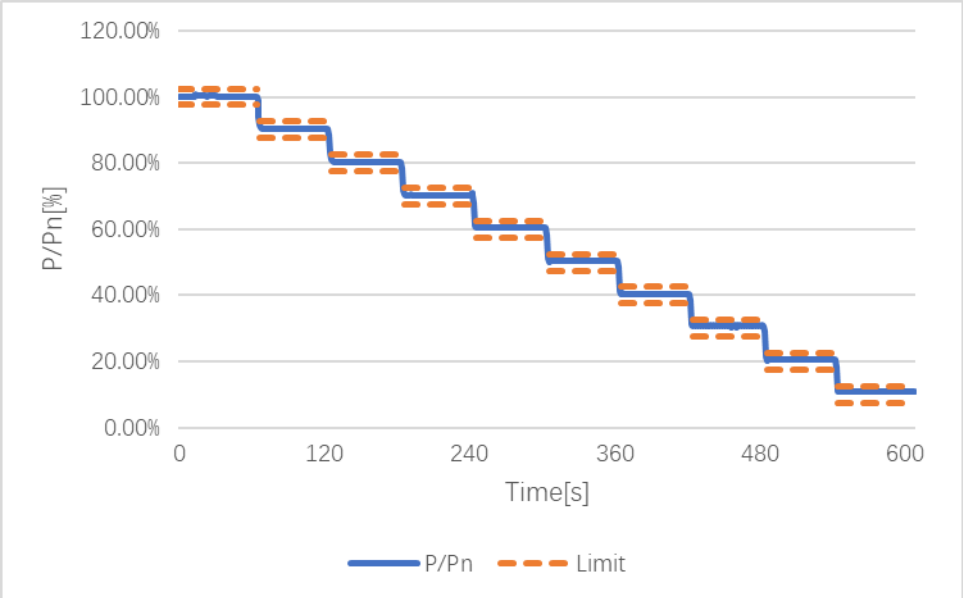
Assessment criterion:
The test is regarded as passed if:
the results should be presented in a table, and on the basis they must extrapolate the trend on a graph that must be greater than the threshold identified by continuous tract of fig. 12a contained in the 8.4.4.
• the power reduction in point c) is less or equal to the allowed power reduction according to 8.4.4.
The power reduction in point c) is less or equal to the power reduction of 10 % P_M per 1 Hz drop.



Maximum allowable power reduction in case of under-frequency

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.4	**TABLE: Limitation of active power by external control from the distributor**			**P**
Model	HNS10000TL			
Set point P [P/P_n]	Set point P [W]	P measured [W]	Deviation (%)	Limit (%P_n)
100	10000	10014	0.14%	--
90	9000	9044	0.44%	± 2.5
80	8000	8042	0.42%	± 2.5
70	7000	7037	0.37%	± 2.5
60	6000	6053	0.53%	± 2.5
50	5000	5057	0.57%	± 2.5
40	4000	4055	0.55%	± 2.5
30	3000	3090	0.90%	± 2.5
20	2000	2079	0.79%	± 2.5
10	1000	1091	0.91%	± 2.5



Test:

The setpoint signal must be reduced from 100% to 10% P_{Emax}:
For adjustable PGUs in increments of 10% P_{Emax}. 1 minute must elapse after every change to the setpoint setting so that the PGU can settle at the new setpoint. Then the active power of the PGU must be measured as a 1-min mean value.

Assessment criterion:

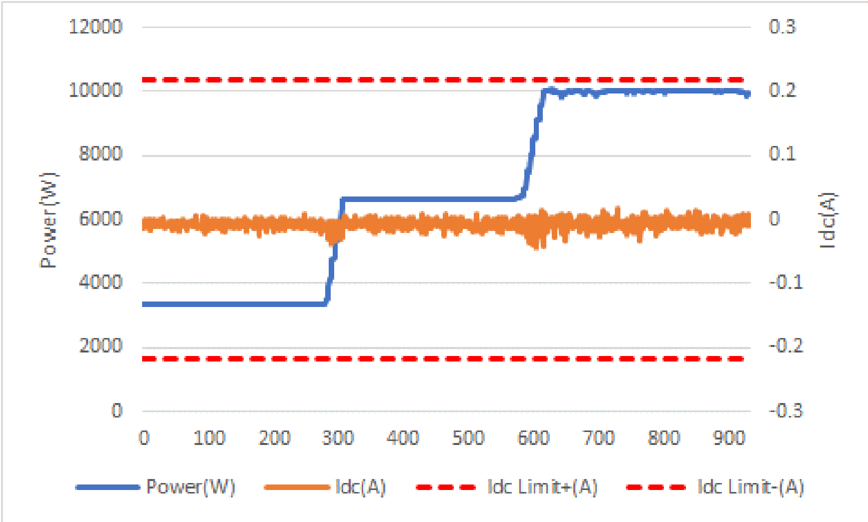
a) for adjustable PGUs:
- no network disconnection above 12,5% P_n
- the active power value does not exceed the setpoint by more than 2,5% P_n
- the setting time determined this way is ≤ 1min

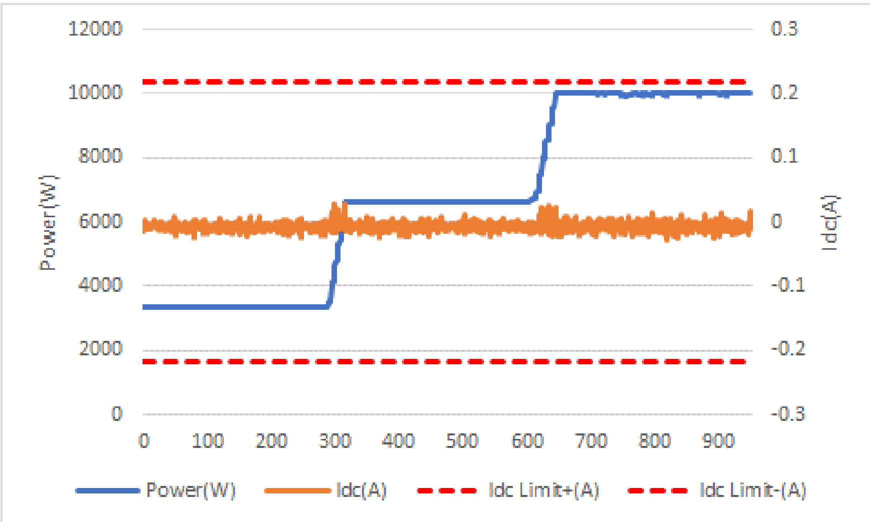
Note:

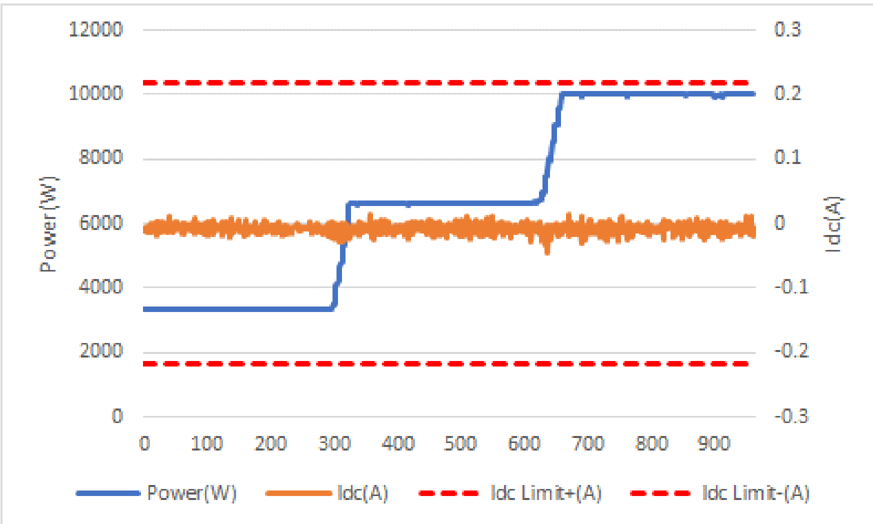
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.4.1	**TABLE: Checking the DC component output**		**P**
Model	HNS10000TL		
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient			
Total output Power (W)	3345	6617	9992
Output Vrms	230.27	230.69	231.12
Output Arms	14.56	28.70	43.25
Cos φ	0.9978	0.9993	0.9995
L1 DC Component (A)	0.008	0.008	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.018%	0.018%	0.019%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-
Minimum ambient rating or 20°C			
Total output Power (W)	3346	6620	9992
Output Vrms	230.27	230.68	231.13
Output Arms	14.57	28.72	43.25
Cos φ	0.9976	0.9993	0.9995
L1 DC Component (A)	0.008	0.008	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.018%	0.018%	0.018%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-
Maximum ambient rating or 60°C			
Total output Power (W)	3344	6616	9997
Output Vrms	230.27	230.67	231.11
Output Arms	14.56	28.70	43.28
Cos φ	0.9975	0.9993	0.9995
L1 DC Component (A)	0.007	0.008	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.016%	0.018%	0.018%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict



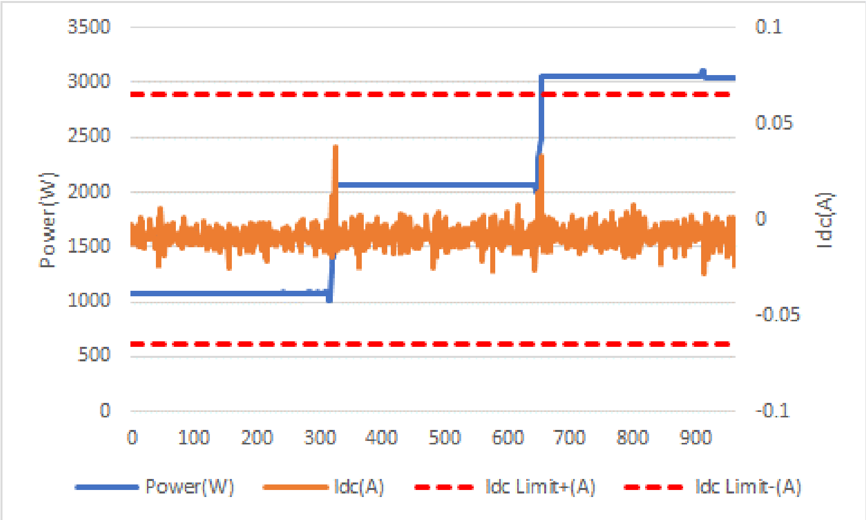


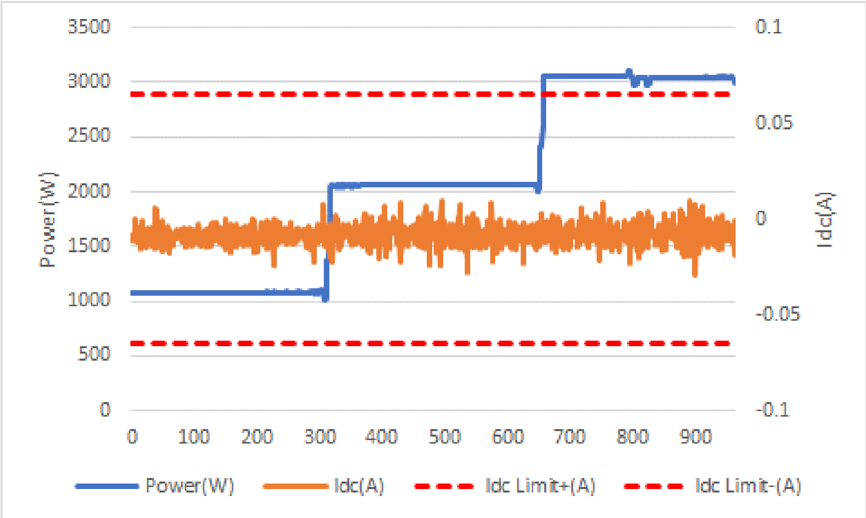


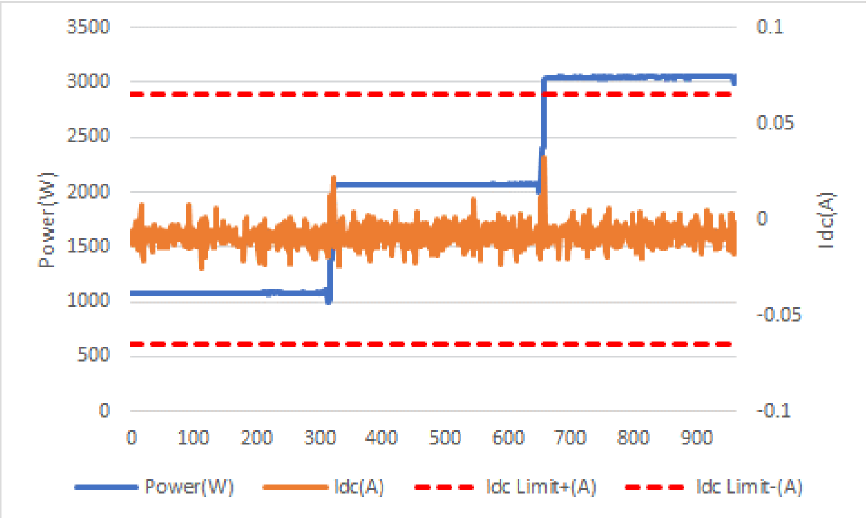
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.4.1	**TABLE: Checking the DC component output**		**P**
Model	HNS3000TL		
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient			
Total output Power (W)	1083	2069	3056
Output Vrms	230.00	230.12	230.25
Output Arms	4.81	9.04	13.31
Cos φ	0.9900	0.9942	0.9973
L1 DC Component (A)	0.009	0.009	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.069%	0.069%	0.061%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-
Minimum ambient rating or 20°C			
Total output Power (W)	1081	2065	3048
Output Vrms	230.12	230.25	230.37
Output Arms	4.80	9.02	13.27
Cos φ	0.9896	0.9939	0.9971
L1 DC Component (A)	0.009	0.008	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.069%	0.061%	0.061%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-
Maximum ambient rating or 60°C			
Total output Power (W)	1083	2071	3047
Output Vrms	230.12	230.26	230.38
Output Arms	4.81	9.05	13.26
Cos φ	0.9896	0.9940	0.9971
L1 DC Component (A)	0.009	0.008	0.008
L2 DC Component (A)	-	-	-
L3 DC Component (A)	-	-	-
L1 DC Component (% I_r)	0.069%	0.061%	0.061%
L2 DC Component (% I_r)	-	-	-
L3 DC Component (% I_r)	-	-	-

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict







CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.4.2	**TABLE: Checking the protection against DC injection**			P
Model	HNS10000TL			
Ambient				
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom}/1s	218.1	218	992.0
66%	+0.5%I_{nom}/1s	220.3	218	993.0
100%	+0.5%I_{nom}/1s	218.6	218	997.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1011	1000	193.5
66%	+1A Idc/200ms	1011	1000	198.5
100%	+1A Idc/200ms	1005	1000	192.2
Model	HNS3000TL			
Actual Power	Limits	Measurement:(mA)	Limiting value:(mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom}/1s	66.15	66	995.0
66%	+0.5%I_{nom}/1s	66.91	66	995.0
100%	+0.5%I_{nom}/1s	66.77	66	992.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1002	1000	194.9
66%	+1A Idc/200ms	1008	1000	196.5
100%	+1A Idc/200ms	1004	1000	195.6
Note: The internal temperature of the EUT must be stabilized.				

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.4.2	TABLE: Checking the protection against DC injection			P
Model:	HNS10000TL			
Minimum ambient rating or 20°C				
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom} /1s	218.1	218	988.0
66%	+0.5%I_{nom} /1s	218.6	218	987.0
100%	+0.5%I_{nom} /1s	218.6	218	996.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1007	1000	192.5
66%	+1A Idc/200ms	1006	1000	198.4
100%	+1A Idc/200ms	1004	1000	199.2
Model:	HNS3000TL			
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom} /1s	66.98	66	991.0
66%	+0.5%I_{nom} /1s	66.74	66	993.0
100%	+0.5%I_{nom} /1s	66.69	66	996.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1006	1000	195.9
66%	+1A Idc/200ms	1006	1000	197.5
100%	+1A Idc/200ms	1008	1000	197.6
Note: The internal temperature of the EUT must be stabilized.				

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.4.2	**TABLE: Checking the protection against DC injection**			P
Model:	HNS10000TL			
Maximum ambient rating or 60°C				
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom} /1s	219.6	218	989.0
66%	+0.5%I_{nom} /1s	219.8	218	998.0
100%	+0.5%I_{nom} /1s	219.1	218	995.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1007	1000	194.9
66%	+1A Idc/200ms	1009	1000	199.4
100%	+1A Idc/200ms	1001	1000	198.6
Model:	HNS3000TL			
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0.5%I_{nom} /1s	67.03	66	993.0
66%	+0.5%I_{nom} /1s	66.82	66	996.0
100%	+0.5%I_{nom} /1s	66.66	66	994.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1007	1000	192.8
66%	+1A Idc/200ms	1008	1000	194.4
100%	+1A Idc/200ms	1008	1000	198.1
Note: The internal temperature of the EUT must be stabilized.				

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CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.5	TABLE: Verification of insensitivity to voltage dips (UVRT and OVRT capability) [greater 11.08kW systems]	P
Model	HNS10000TL	

The purpose of these tests is to ensure that the converter, when used in systems with total capacity greater than 11.08 kW, is insensitive to voltage dips according to the time-amplitude profile shown in the diagram. In particular, the tests must verify that the following functional requirements are met:

- the generator must not disconnect from the grid in the white area above and along the points of the UVRT (V-t) characteristic indicated in Figure 29, where V is the phase-to-phase voltage at the connection point. Supply of active and reactive power prior to the occurrence of the fault can be temporarily interrupted in this area.
- in the area below (grey) the generator can disconnect from the grid.
- within 400 ms from restoring network voltage to within the range of +10% and -15% of nominal voltage, the generator must return to supplying active and reactive power to the network as before the fault, with a maximum tolerance of ±10% of the nominal voltage of the generator. If voltage returns but remains in the range between 85% and 90%, power distribution may be reduced in relation to the generator limits of output power.

Verification of compliance with the requirements of immunity to voltage sags are carried out according to the test sequences shown in Table 31, to be carried out with the generator running respectively:

a) between 10% and 30% of the rated power;
b) and above 90% of the rated power.

Table 12 - Parameters relating to Figure 29 for the fault-ride-through capability of power park modules over 11.08 kW

Uret	0,05 [p.u.]	Tclear	0,2 s
Uclear	0,15 [p.u.]	Trec1	0,2 s
Urec1	0,15 [p.u.]	Trec2	0,2 s
Urec2	0,85 [p.u.]	Trec3	1,5 s

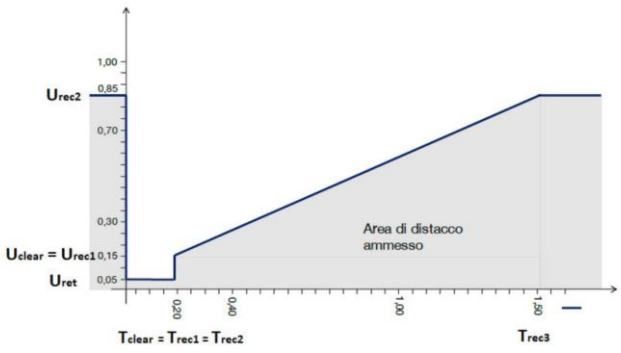


Figure 29

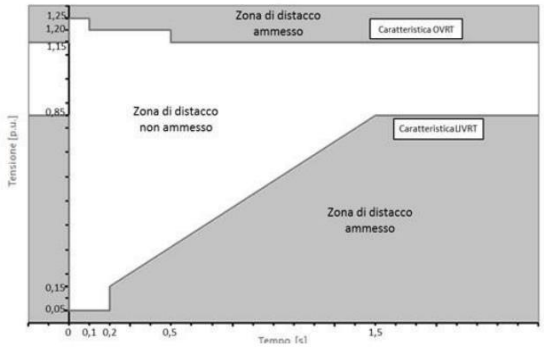


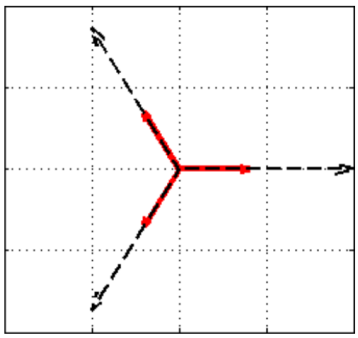
Figure 30

- V-t characteristic in over voltage (OVRT) of Figure 30
- 1) the generator must not disconnect from the grid in the area below and along the points of the indicated characteristic (V-t), where V is the phase-to-phase voltage at the connection point. These values are expressed as a percentage of the rated voltage;
- 2) in the area above (in gray color) the generator can disconnect from the grid;
- 3) the behavior envisaged by the curve in Figure 30 must be guaranteed in the face of increases in one or more voltages, i.e. the disconnection logic must be of the type 1 out of 3: it can be activated for both symmetrical and asymmetrical faults when one of the three voltage measurements exceeds the admitted voltage peak in height and duration. The FRT characteristic required of power park modules over 11.08 kW is shown in Figure 30

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

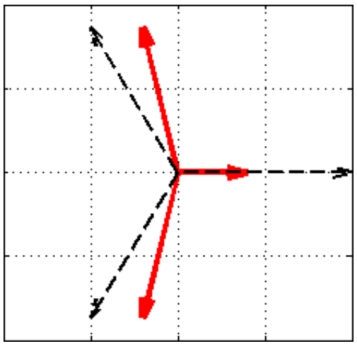
Test sequence:

1) three-phase symmetrical fault (Table 31, Tests N.1s, N.2s, N.3s and N4s)

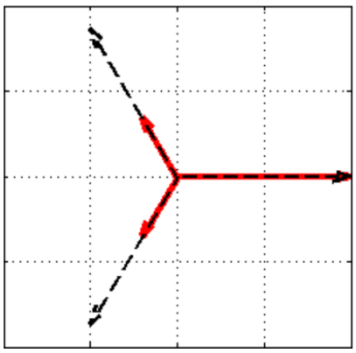


2) two-phase asymmetric fault (Table 31, Tests N.1a, N2a, N.3a and N.4a)

Failure in MV, which causes a variation in LV not only of amplitude but also of the phase relationship of the voltages (the case considered involves the presence of a transformer Dy in the secondary substation).



3) LV two-phase asymmetric fault (Table 31, Tests No. 5 and No. 6)



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Requirement of LVRT and OVRT test:

Table 31 - Test sequences to verify immunity to temporary voltage dips. The amplitude, duration and shape relate to no-load test conditions

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Drop duration limit [ms]	Power re-supply time after restoring network [ms]	Shape (*)
1s – three-phase symmetrical fault	0.10 ± 0.05 (V_1/Vn)	200 ± 20	400	
1a – two-phase asymmetric failure	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 – two-phase asymmetric failure	0.25 ± 0.05 (V_2/Vn)	400 ± 20	400	
3s – three-phase asymmetrical fault	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400	
3a – two-phase asymmetric failure	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400	
4s – three-phase asymmetrical fault	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400	
4a – two-phase asymmetric failure	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400	
5 – LV two-phase asymmetrical fault	0.10 ± 0.05 (V_5/Vn)	200 ± 20	400	
6 – LV two-phase asymmetrical fault	0.50 ± 0.05 (V_6/Vn)	850 ± 20	400	
7 – three-phase symmetrical fault	1.20 ± 0.05(V_7/Vn)	500 ± 20	400	
8 – three-phase symmetrical fault	1.25 ± 0.05(V_8/Vn)	100 ± 20	400	

Test No.	V/V_{nom}	Phase-to-earth voltages			Phase angles		
		$U_1/U_{1,nom}$	$U_2/U_{2,nom}$	$U_3/U_{3,nom}$	φ_{U1}	φ_{U2}	φ_{U3}
1s	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°
1a	0.10 ± 0.05	0.87 ± 0.05	0.87 ± 0.05	0.10 ± 0.05	27°	-147°	120°
2s	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0°	-120°	120°
2a	0.25 ± 0.05	0.88 ± 0.05	0.88 ± 0.05	0.25 ± 0.05	22°	-142°	120°
3s	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°
3a	0.50 ± 0.05	0.90 ± 0.05	0.90 ± 0.05	0.50 ± 0.05	14°	-134°	120°
4s	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0°	-120°	120°
4a	0.75 ± 0.05	0.94 ± 0.05	0.94 ± 0.05	0.75 ± 0.05	7°	-127°	120°
5	0.10 ± 0.05	1	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°
6	0.50 ± 0.05	1	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°
7	1.20 ± 0.05	1.25 ± 0.05	1.25 ± 0.05	1.25 ± 0.05	0°	-120°	120°
8	1.25 ± 0.05	1.20 ± 0.05	1.20 ± 0.05	1.20 ± 0.05	0°	-120°	120°
normal condition	1	1	1	1	0°	-120°	120°

(*) Regardless of the method used to simulate the transients (simulator or impedance network), the falling and rising edges of the voltage must have a duration of less than 10 ms.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

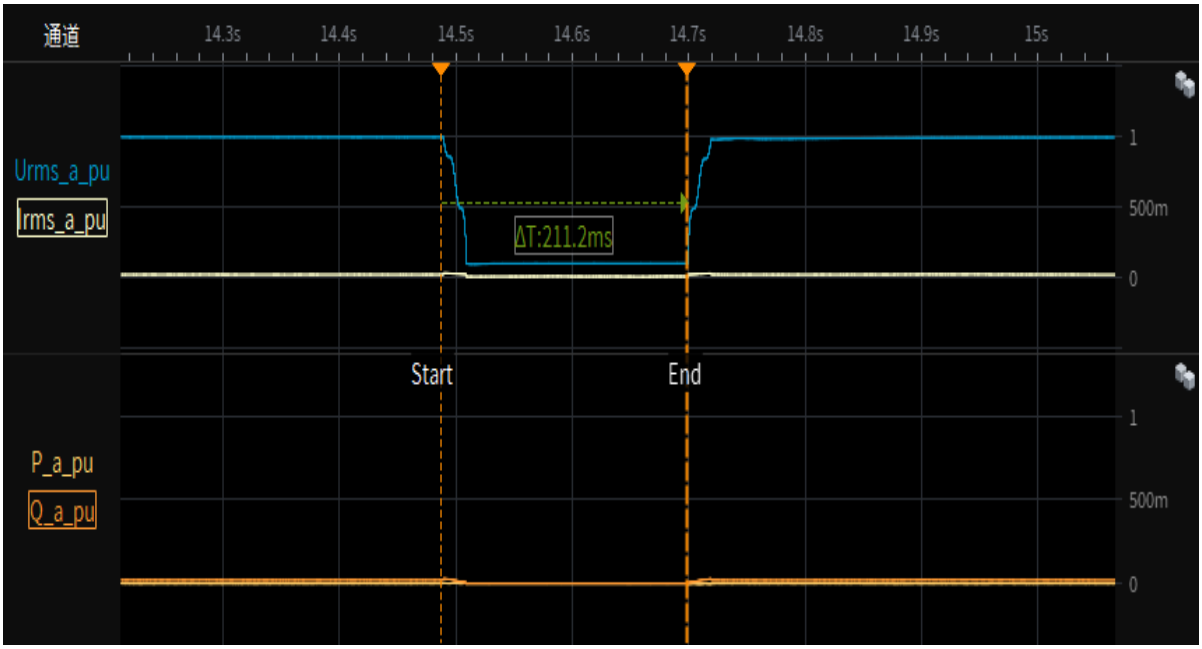
Graph of LVRT and HVRT test:

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Drop duration limit [ms]	Measured drop duration [ms]	Duration of restoring network [ms]
1s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_1/Vn)	200	211	153
1s – three-phase symmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200	211	168
1a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_1/Vn)	200	211	120
1a – two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200	211	163
2s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400	407	142
2s – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400	407	186
2a –two-phase asymmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400	411	184
2a –two-phase asymmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400	411	157
3s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850	860	156
3s – three-phase symmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850	860	182
3a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850	860	167
3a – two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850	860	135
4s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300	1312	144
4s – three-phase symmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300	1312	176
4a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300	1312	154
4a – two-phase asymmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300	1312	153
5 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_5/Vn)	200	210	0
5 – LV two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_5/Vn)	200	210	0
6 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_6/Vn)	850	851	0
6 – LV two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_6/Vn)	850	851	0
7 – HV three-phase symmetrical fault (P = 0.1 – 0.3)	1.20 ± 0.05 (V_7/Vn)	500 ± 20	511	116
7 – HV three-phase symmetrical fault (P > 0.9)	1.20 ± 0.05 (V_7/Vn)	500 ± 20	511	121
8 – HV three-phase symmetrical fault (P = 0.1 – 0.3)	1.25 ± 0.05 (V_8/Vn)	100 ± 20	110	136
8 – HV three-phase symmetrical fault (P > 0.9)	1.25 ± 0.05 (V_8/Vn)	100 ± 20	110	138

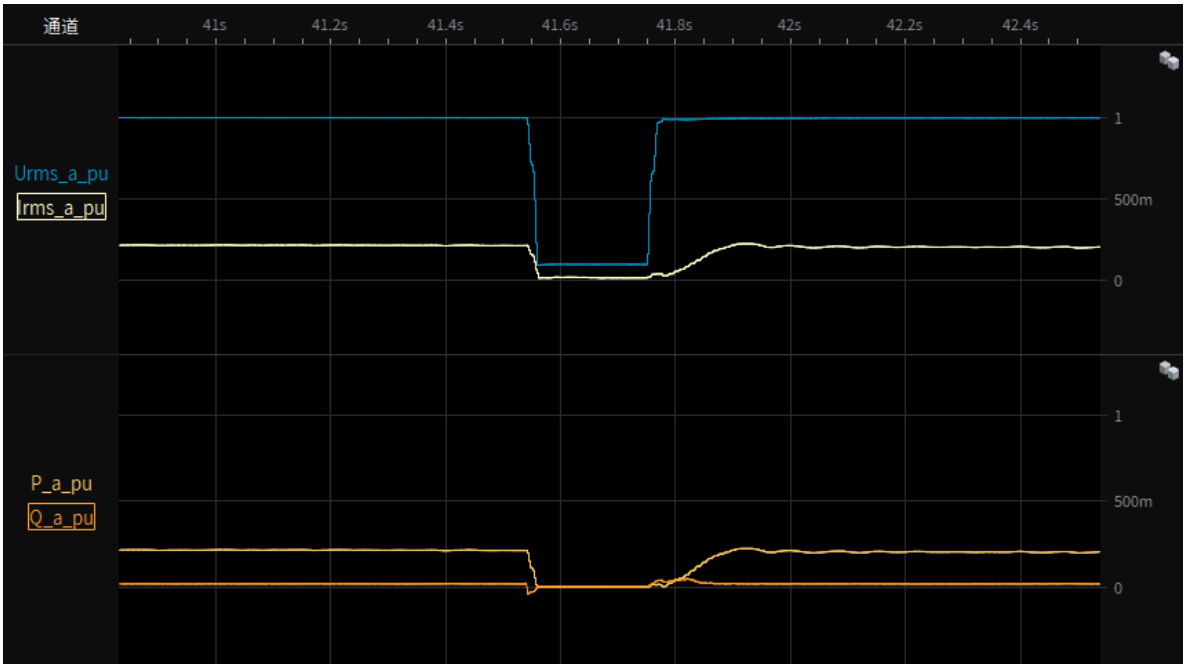
Note:
(*) Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms
The interface protection shall be disabled or adjusted to avoid spurious tripping during testing.
The test conditions are performed as worst case conditions. The inverter feeds maximal active and reactive power during the complete test.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1s-Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A), 0% load
Test overview(voltage,current,active and reactive power)

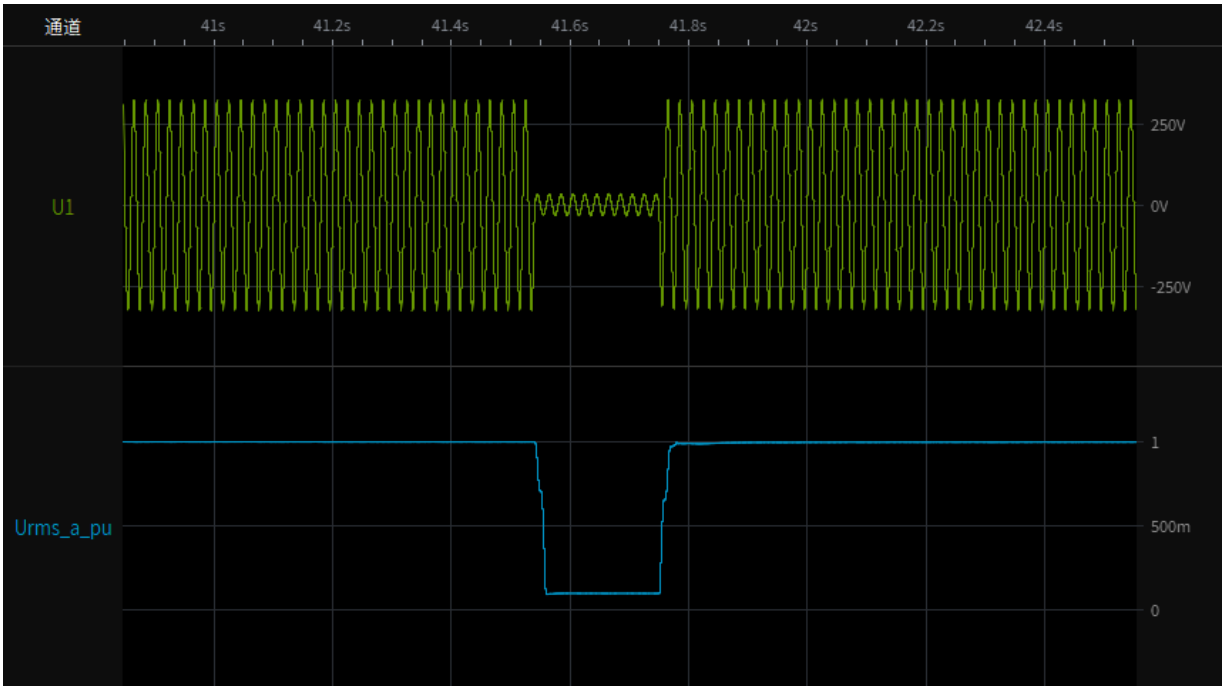


Test 1s-1.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

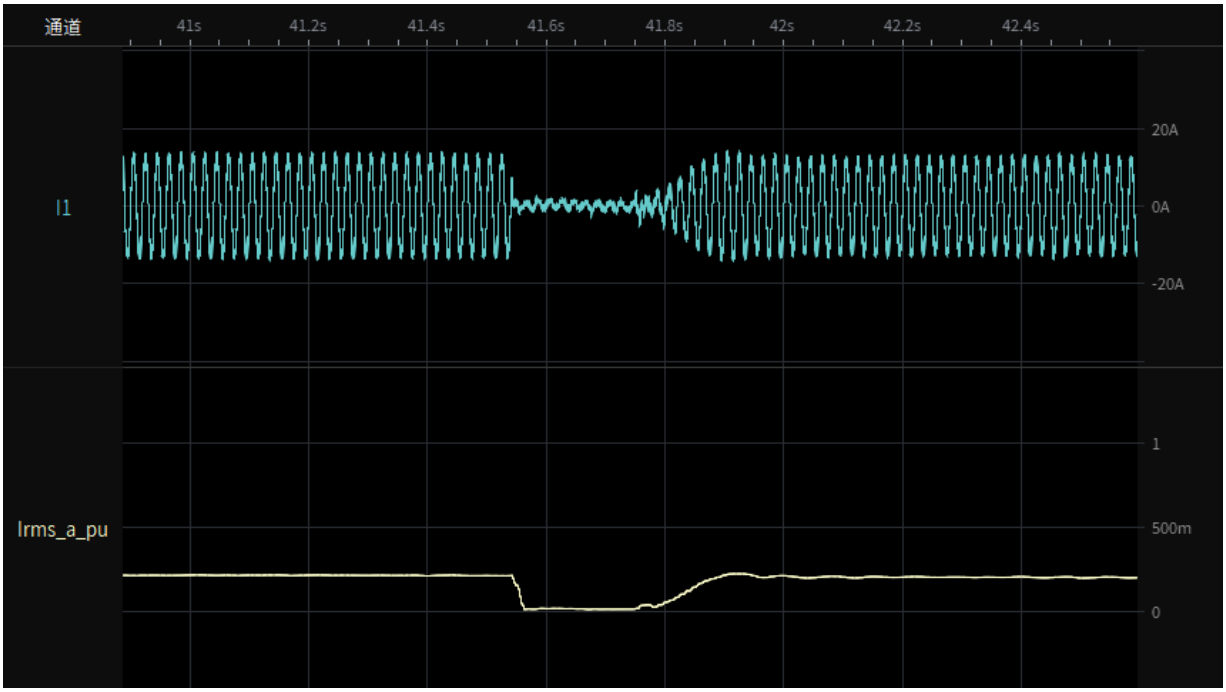


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1s-1.2 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

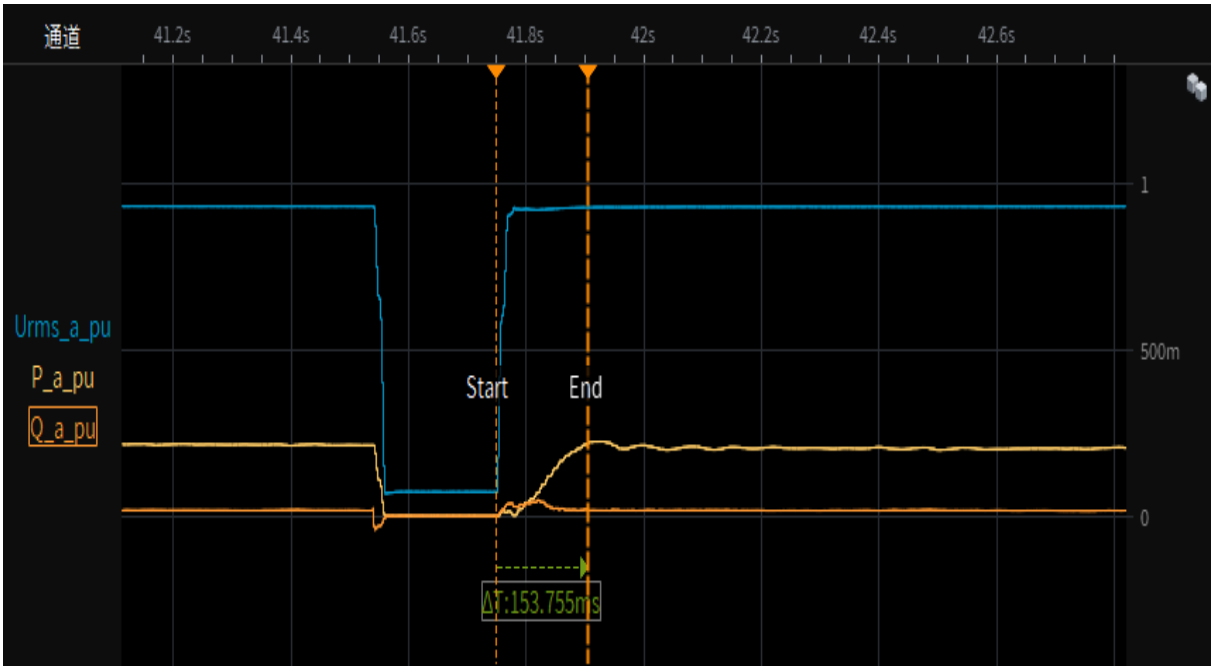


Test 1s-1.3 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

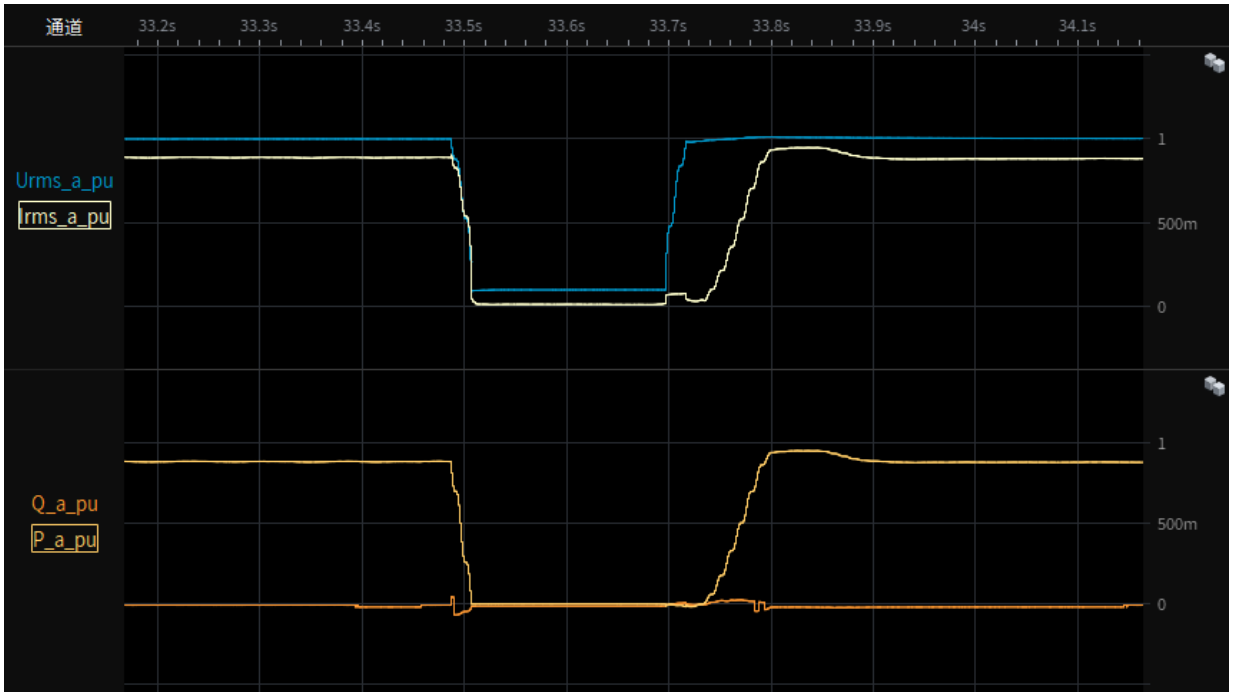


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1s-1.4 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),
20% load restoring time

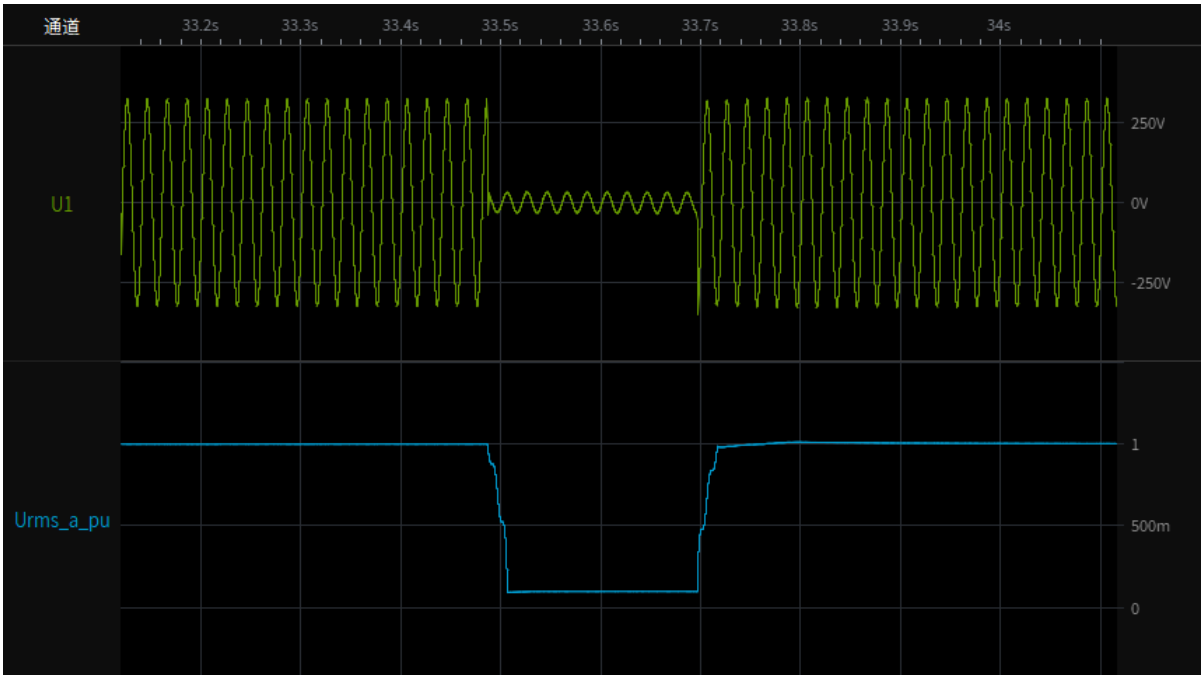


Test 1s-2.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

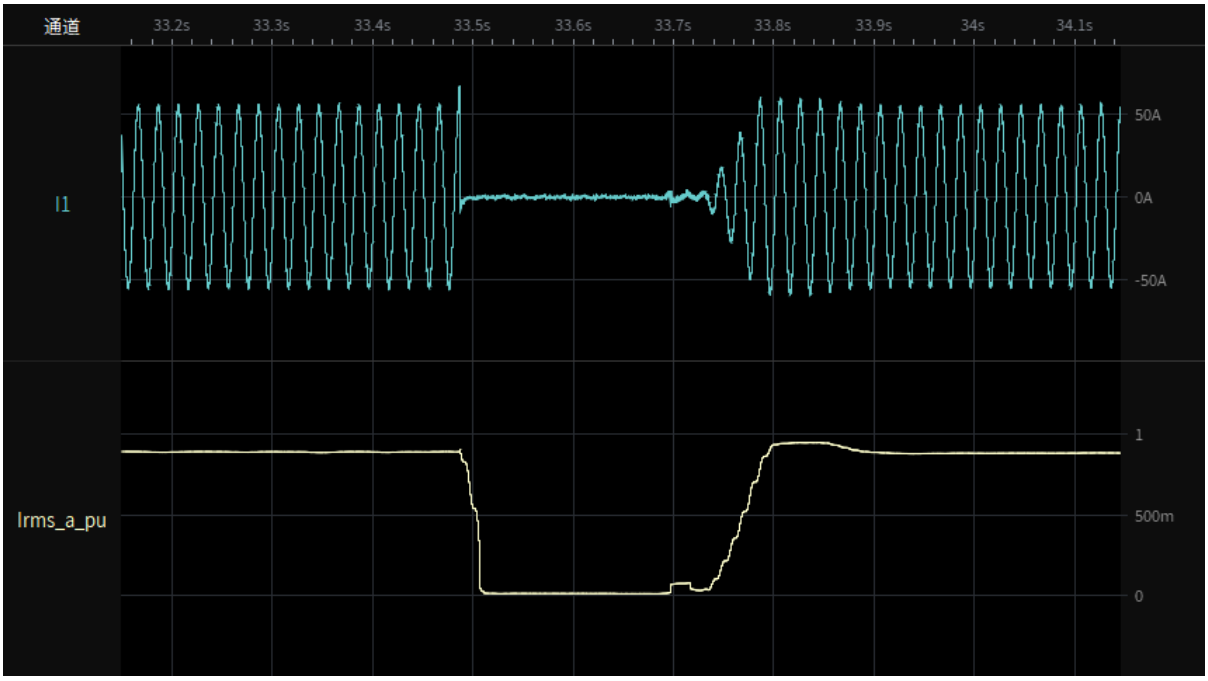


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1s-2.2 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

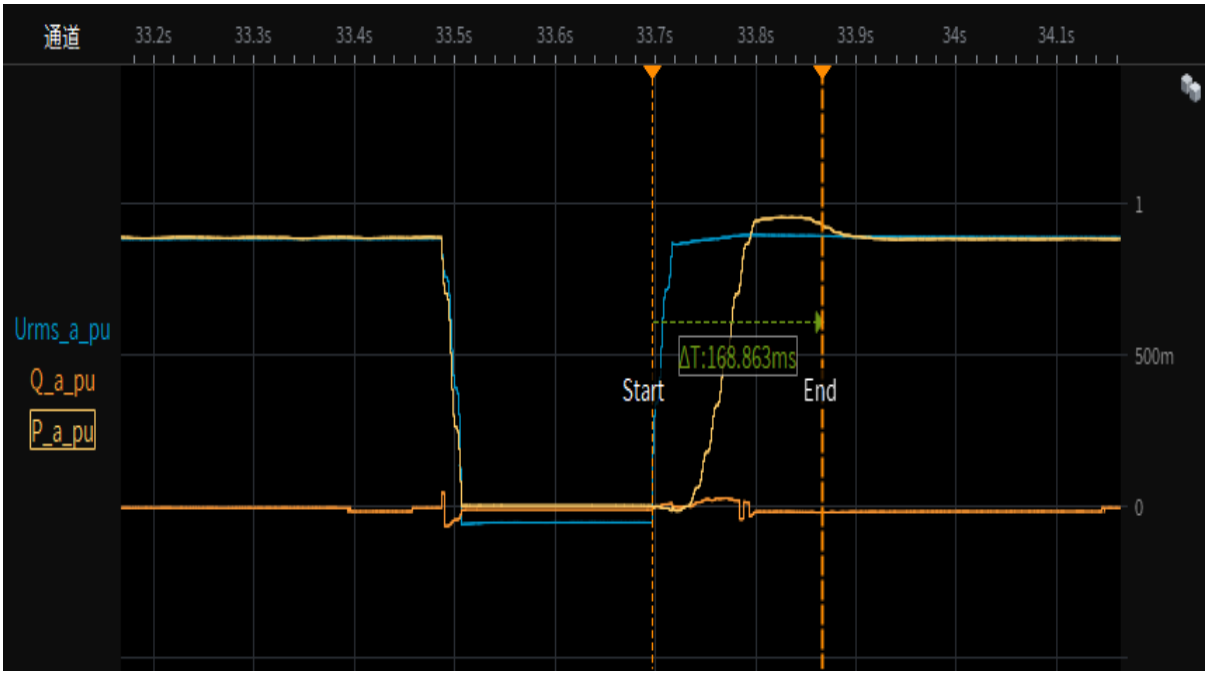


Test 1s-2.3 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

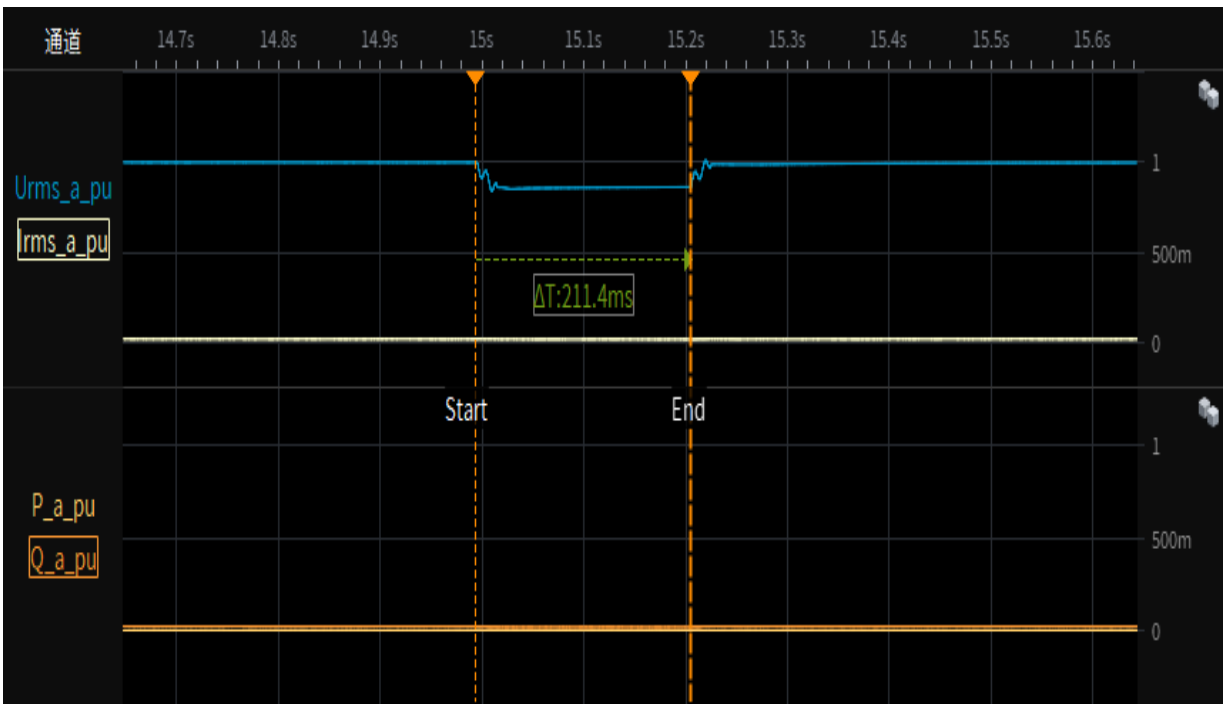


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1s-2.4 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),
95% load restoring time

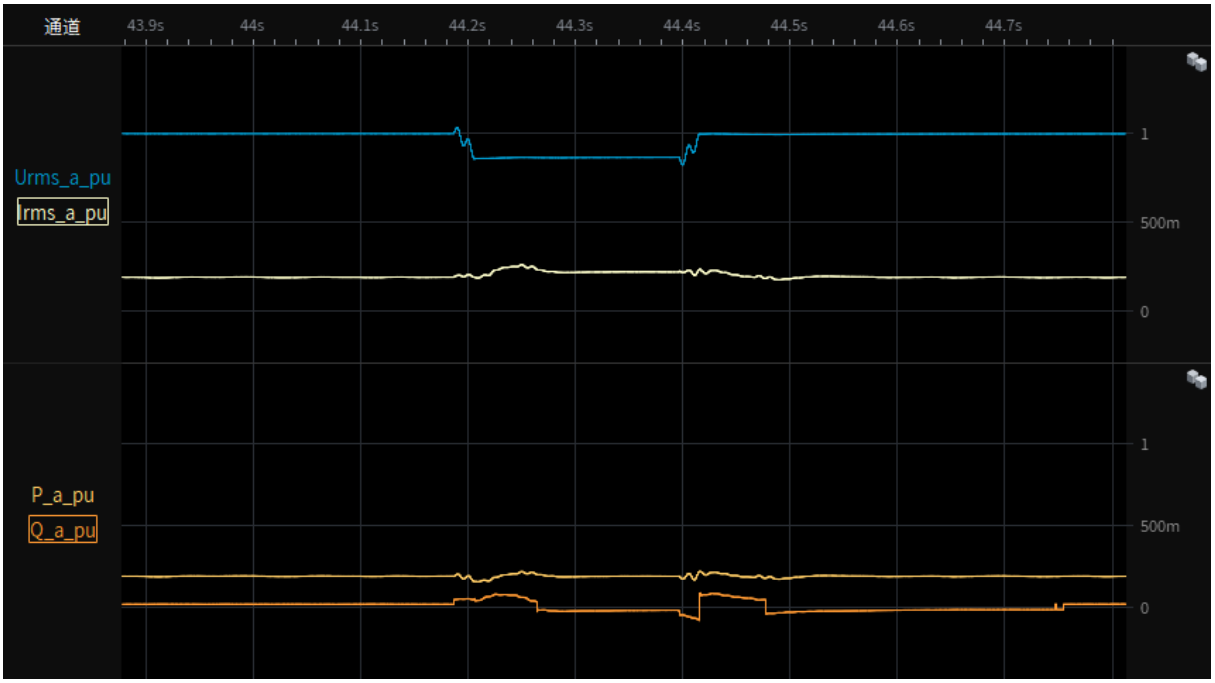


Test 1a- Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

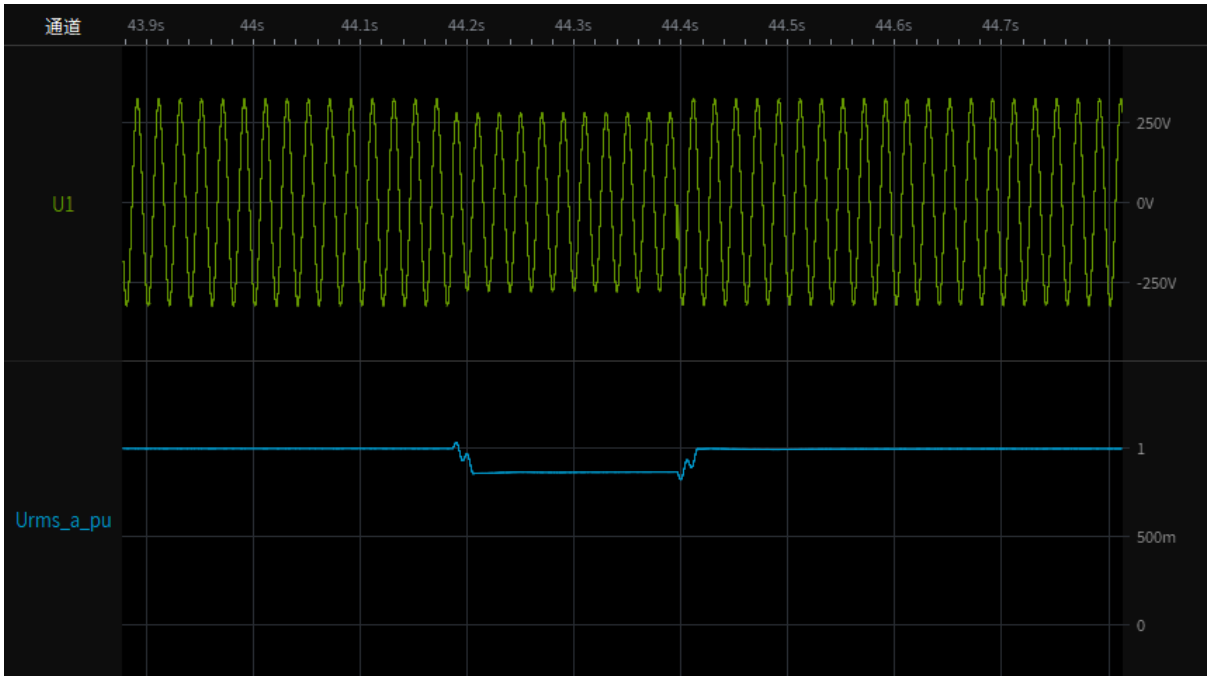


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1a-1.1 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

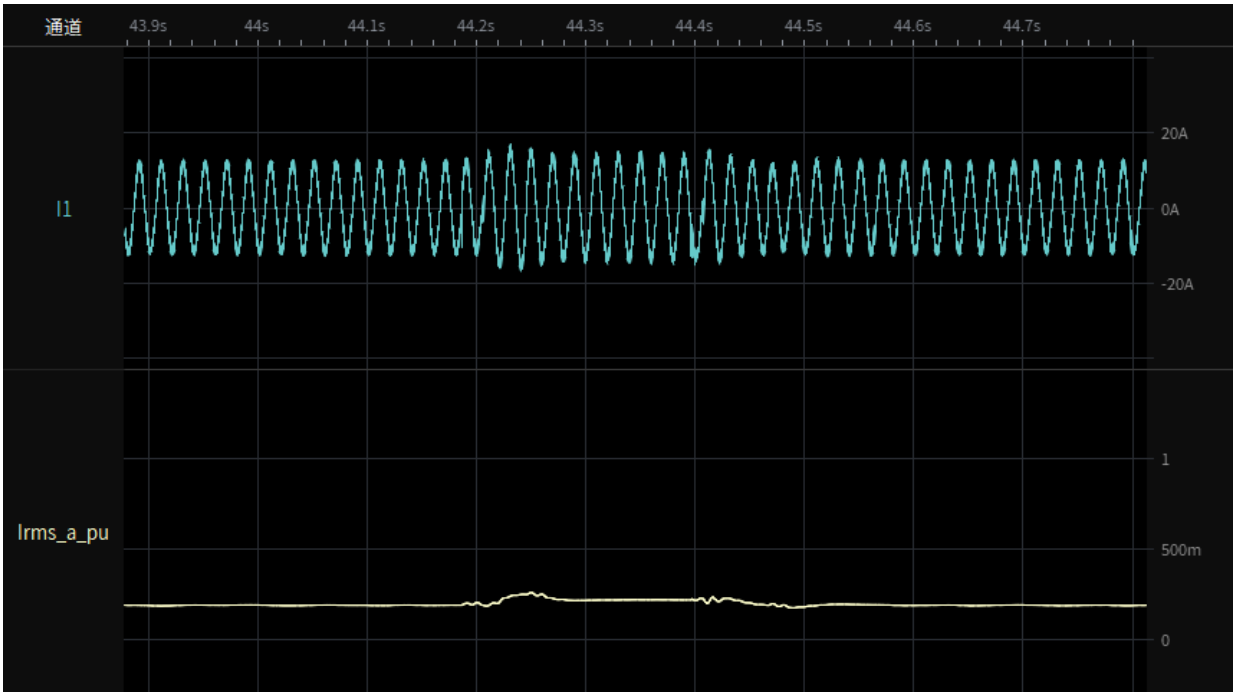


Test 1a-1.2 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

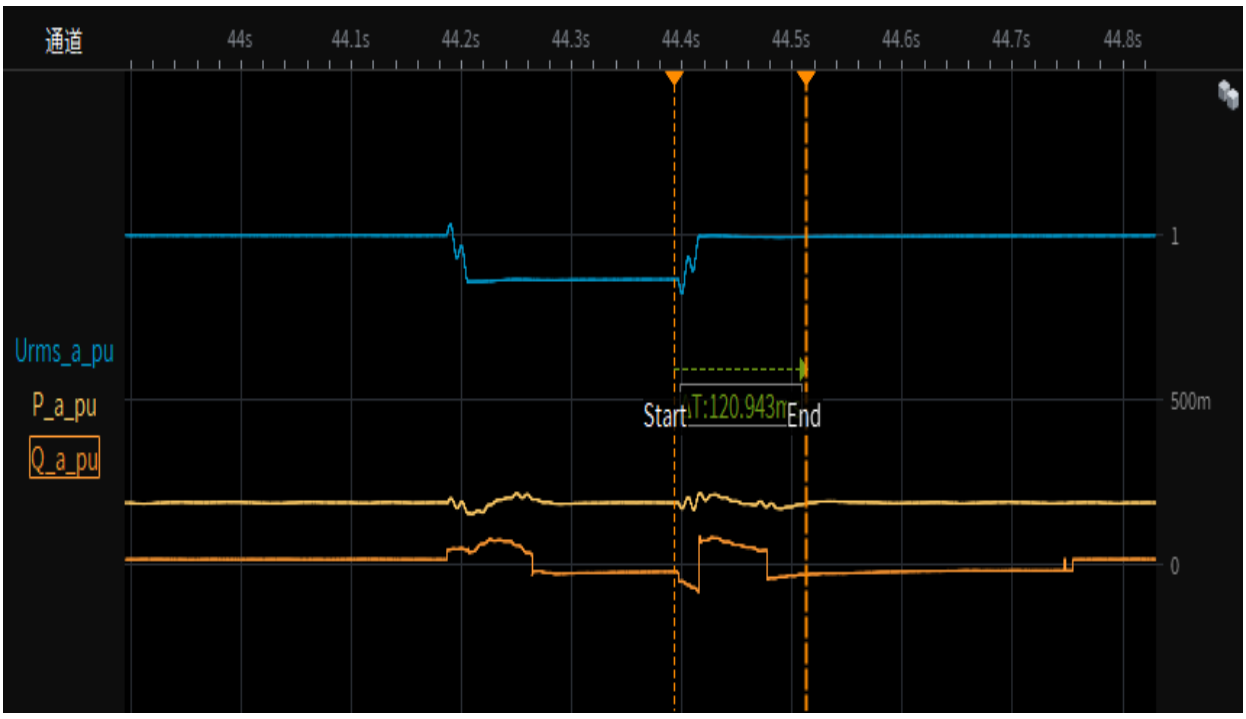


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1a-1.3 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

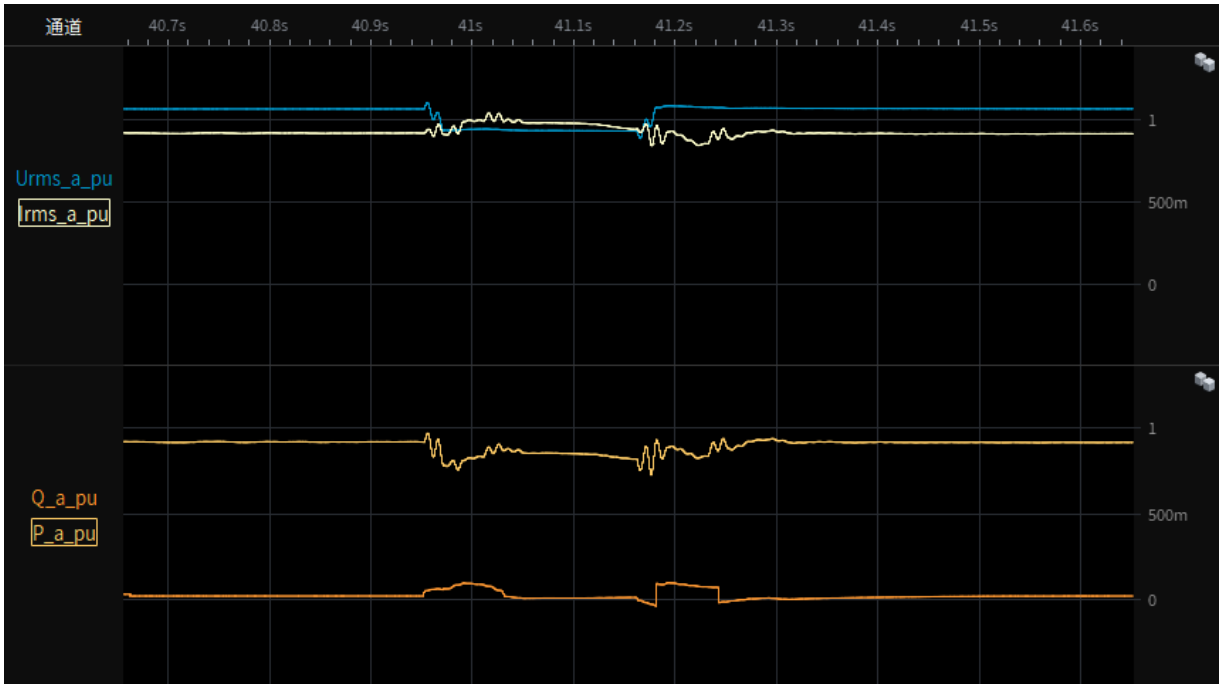


Test 1a-1.4 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),
20% load restoring time

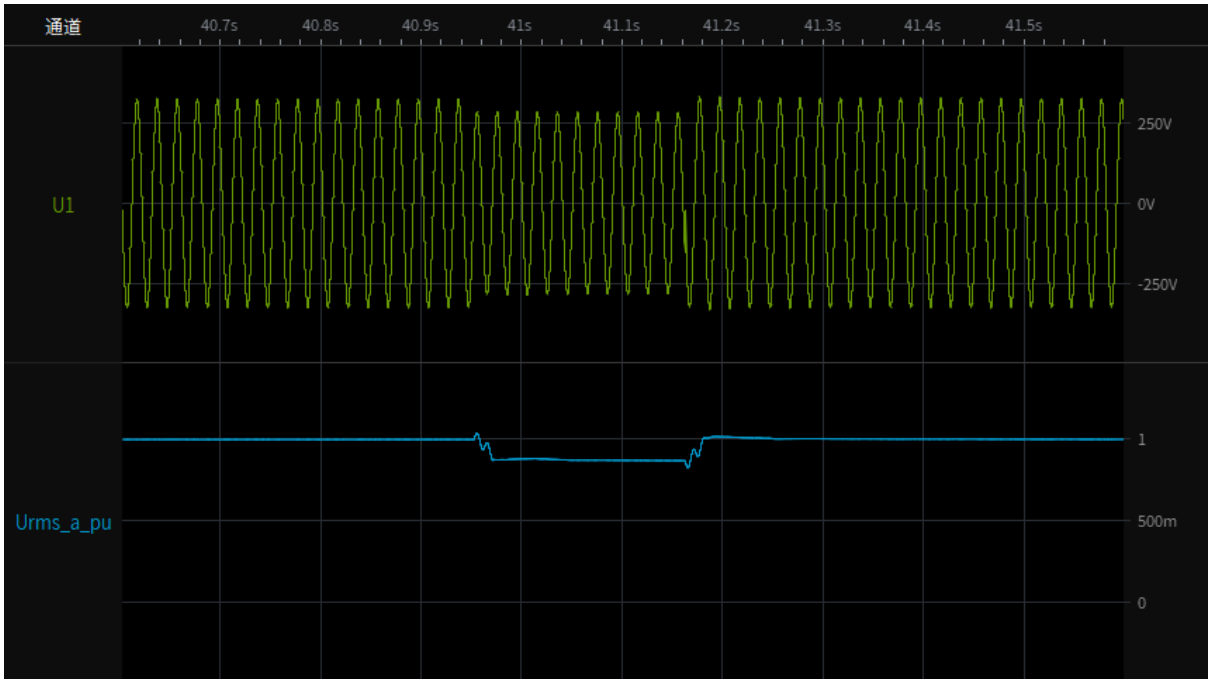


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1a-2.1 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

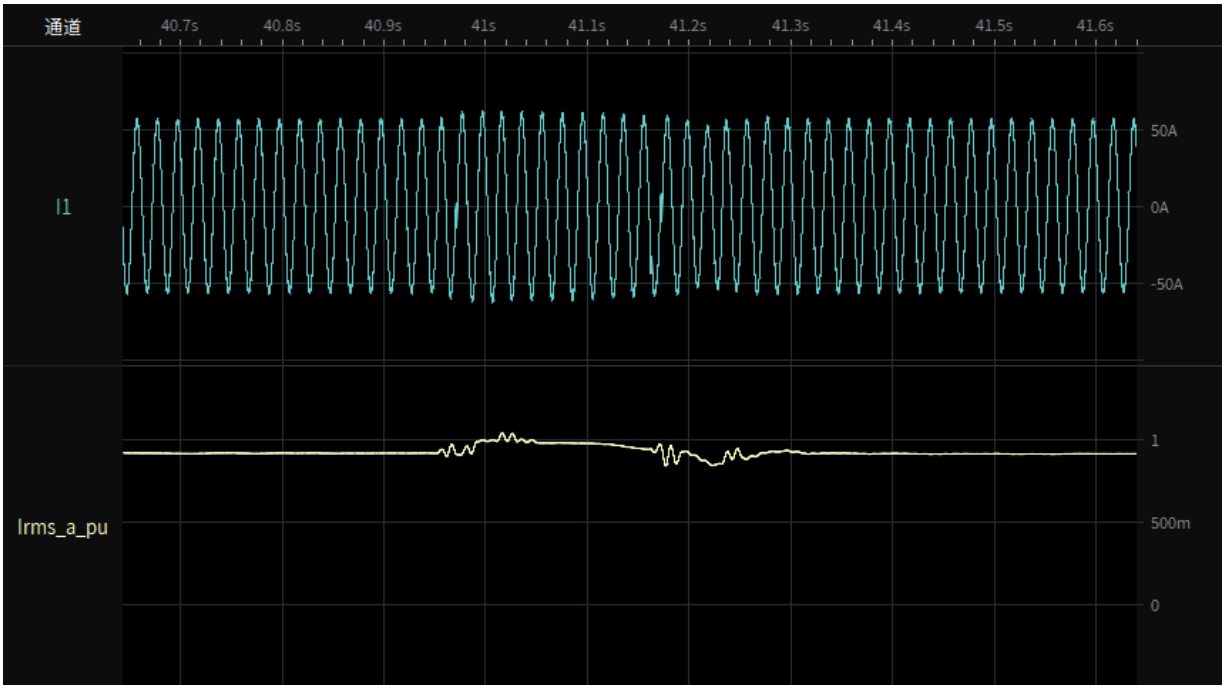


Test 1a-2.2 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

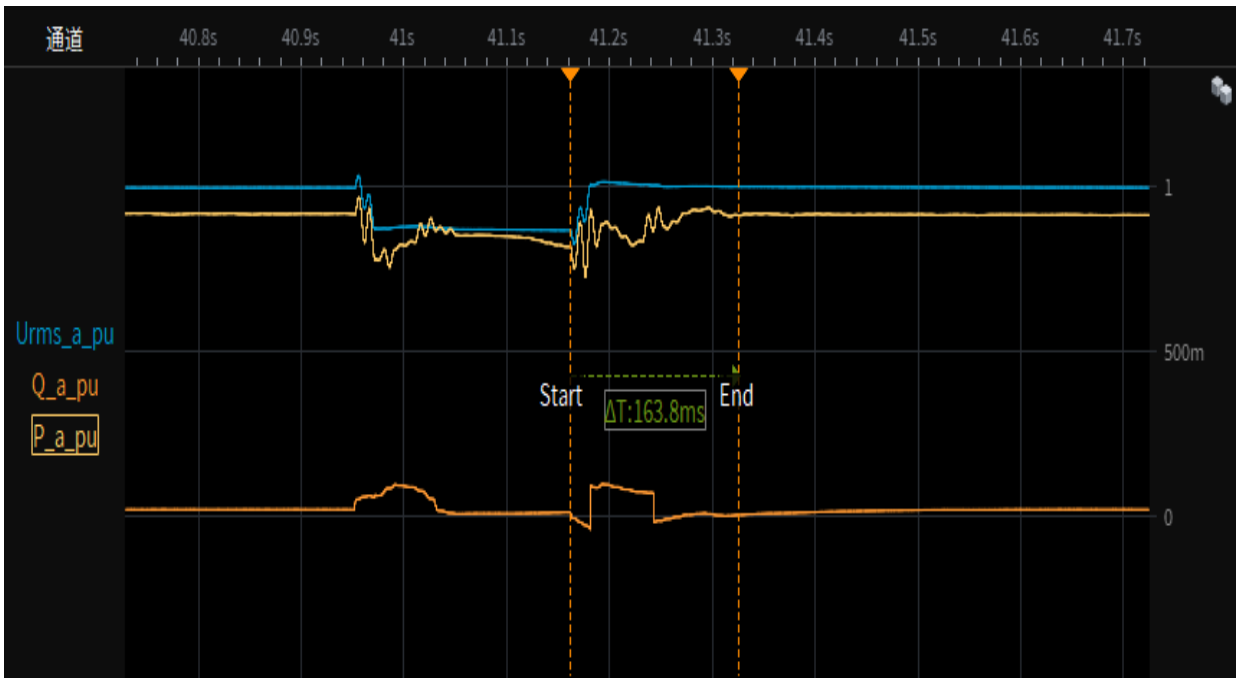


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1a-2.3 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

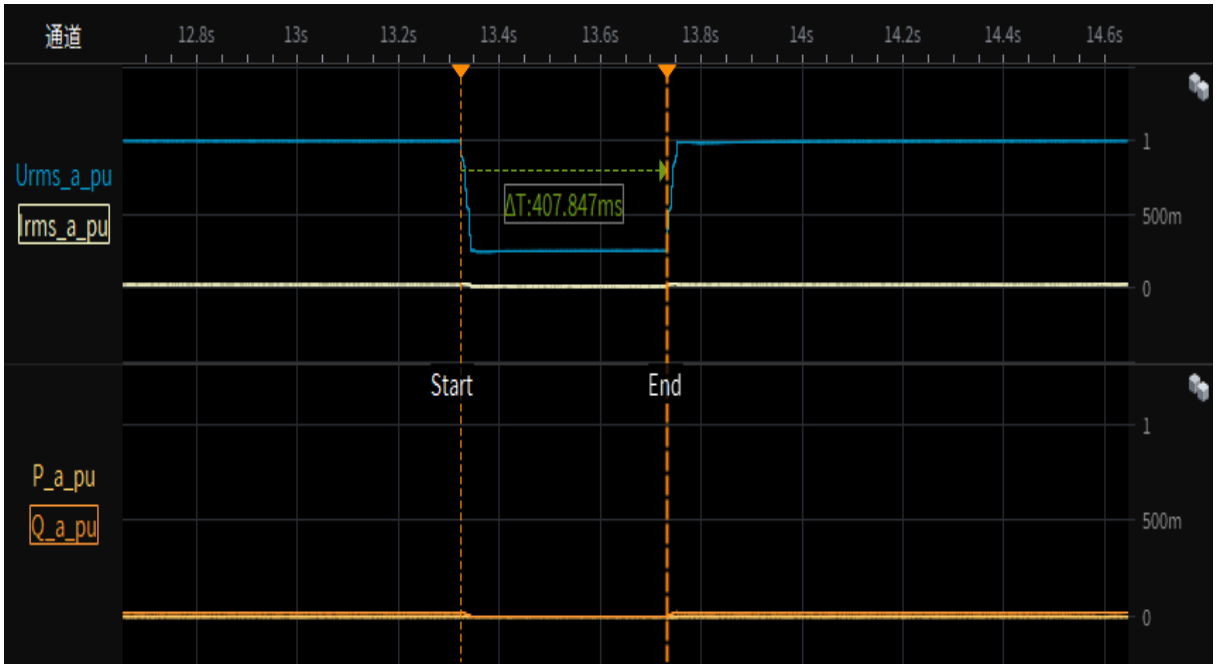


Test 1a-2.4 Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D),
95% load restoring time

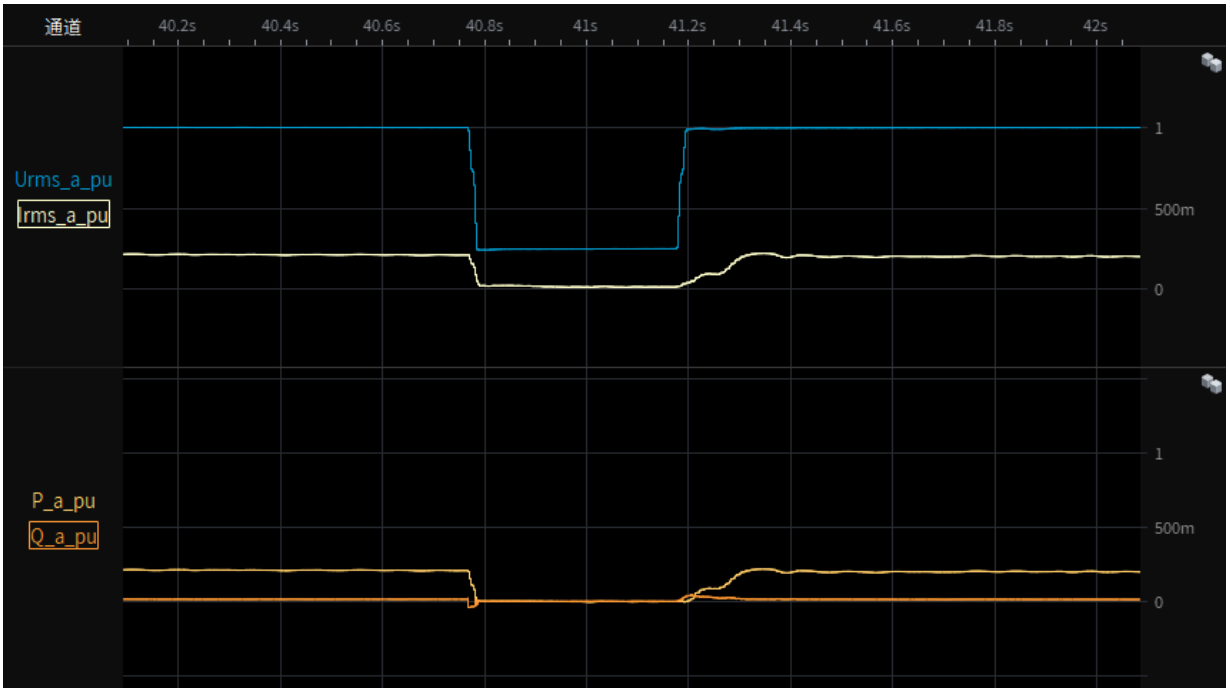


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2s- Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),0% load
Test overview(voltage,current,active and reactive power)

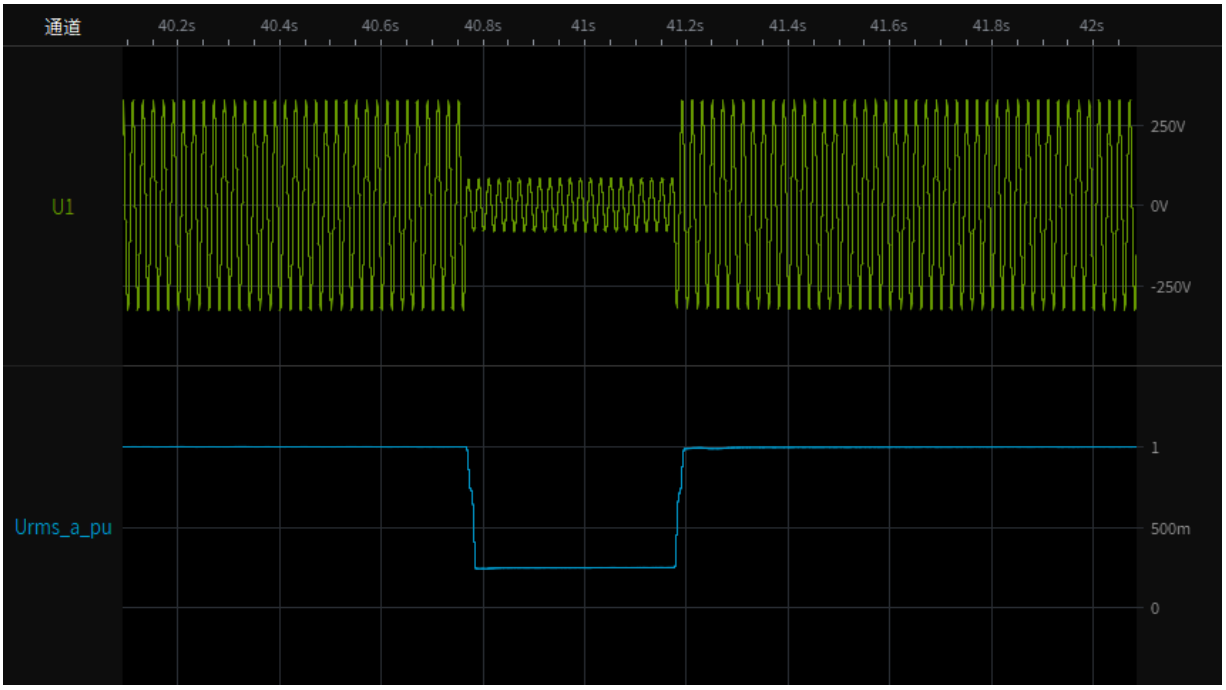


Test 2s-1.1 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

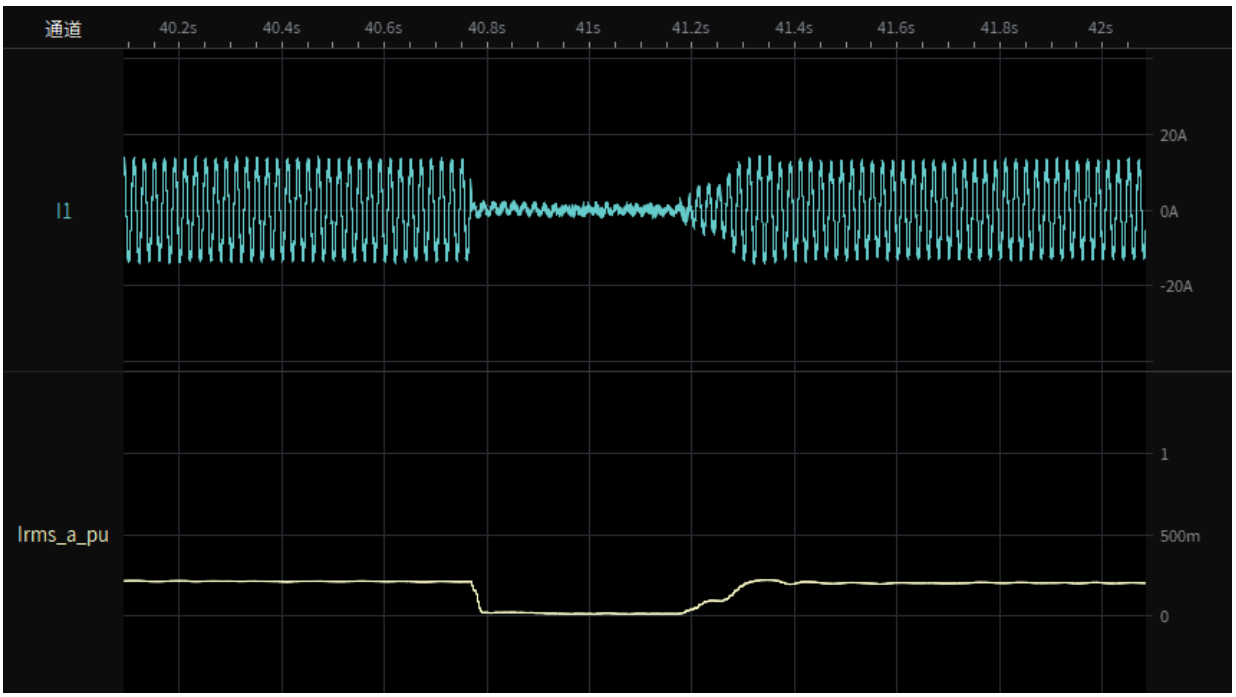


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2s-1.2 Depth of fault phase:0.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

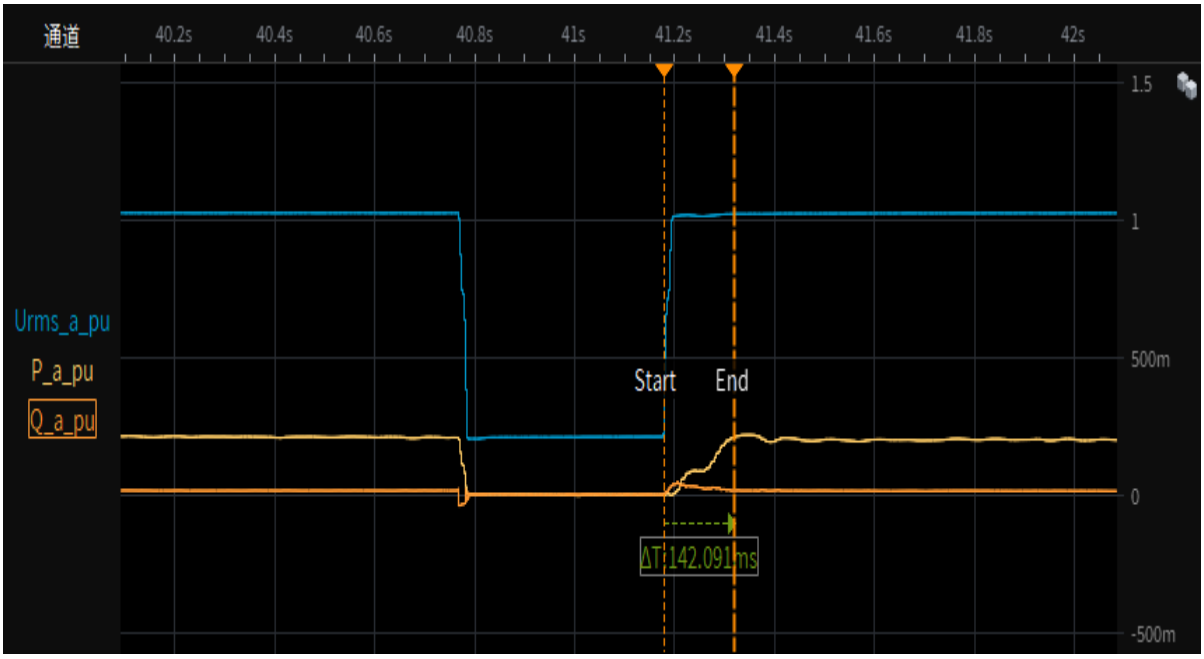


Test 2s-1.3 Depth of fault phase:0.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

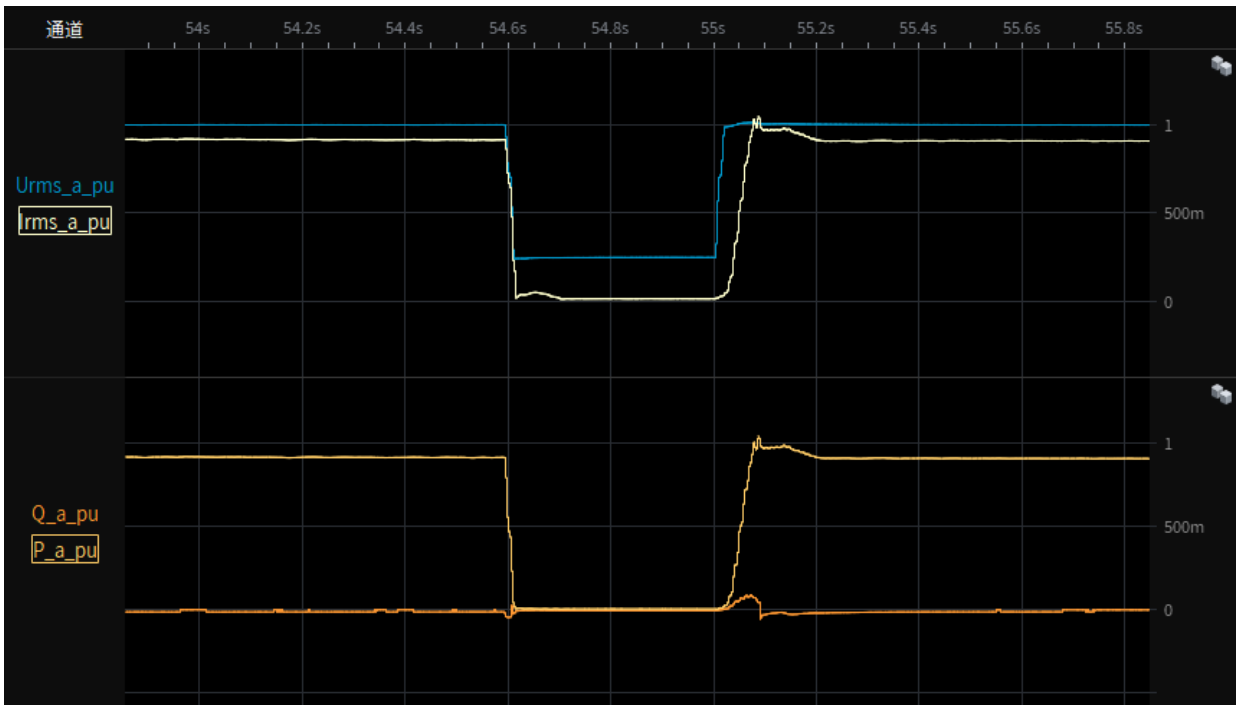


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2s-1.4 Depth of fault phase:0.25p.u.,three-phase-symmetrical (type A),
20% load restoring time

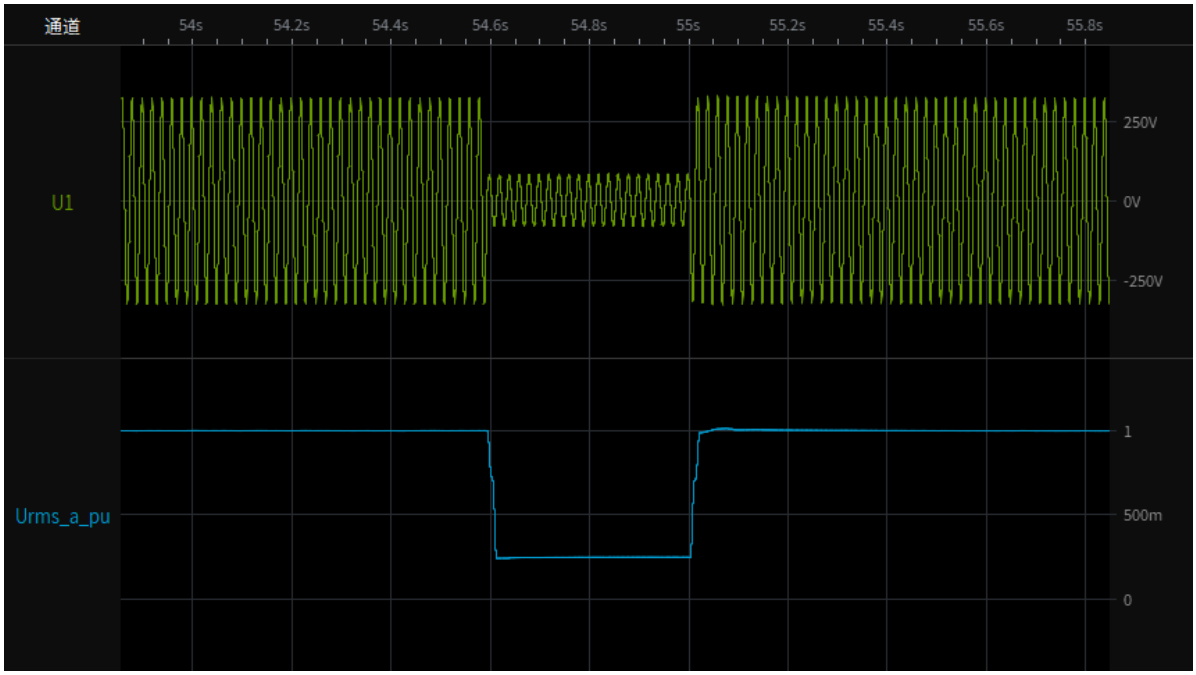


Test 2s-2.1 Depth of fault phase:0.25p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

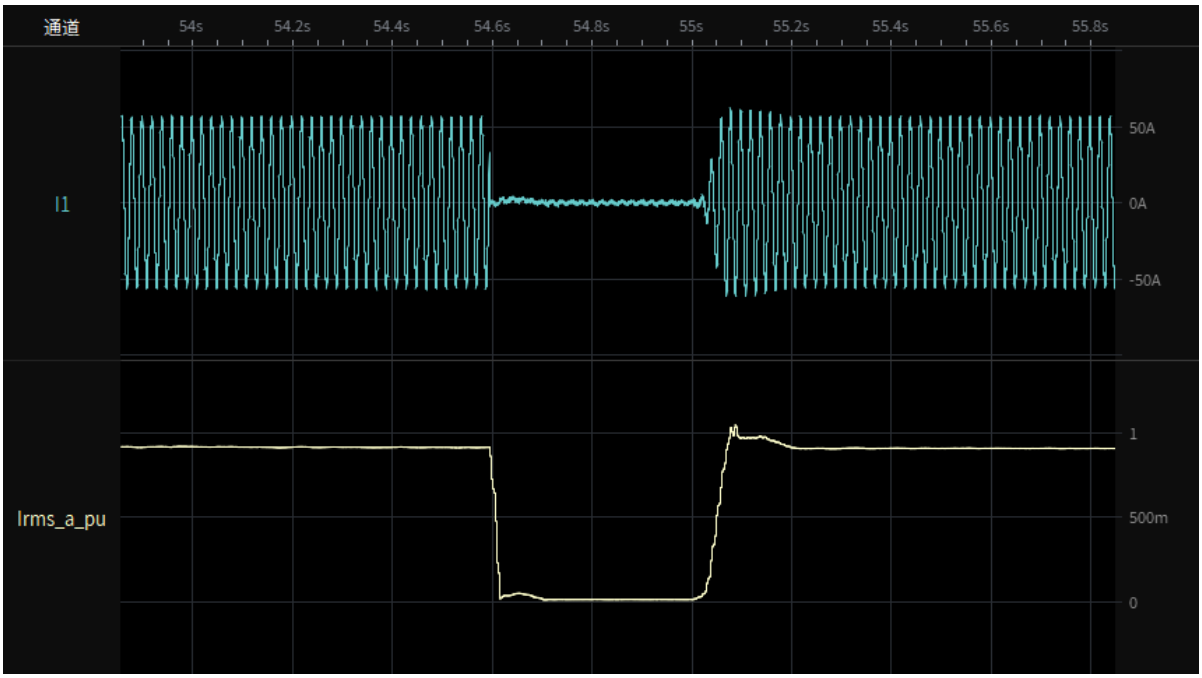


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2s-2.2 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

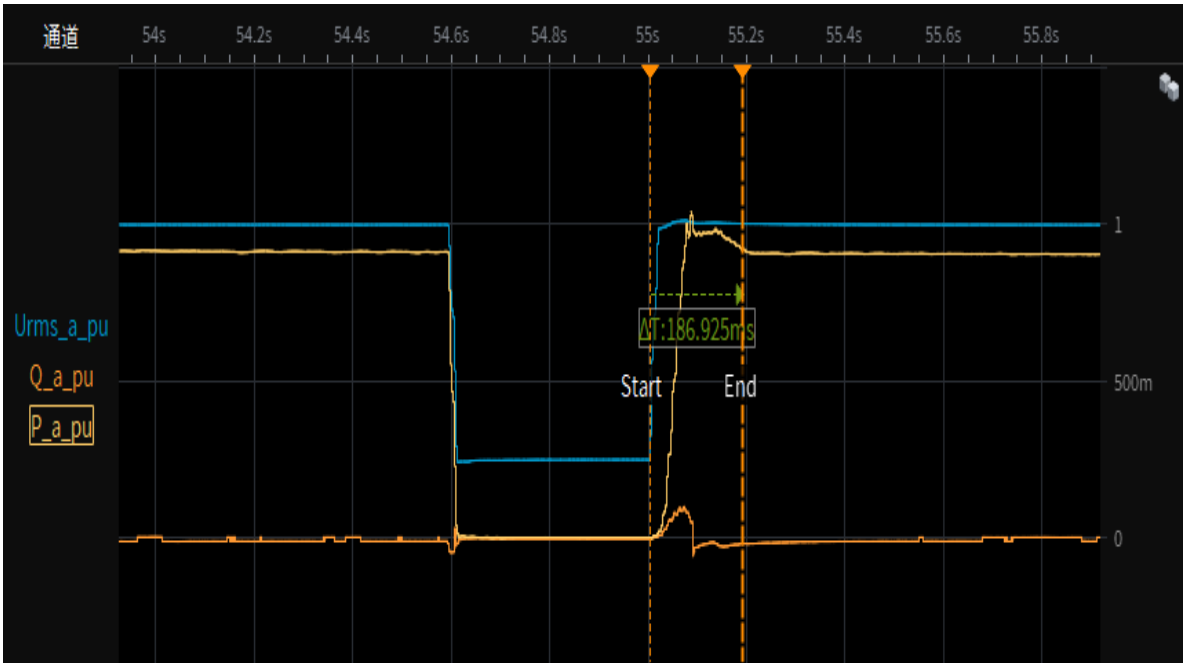


Test 2s-2.3 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

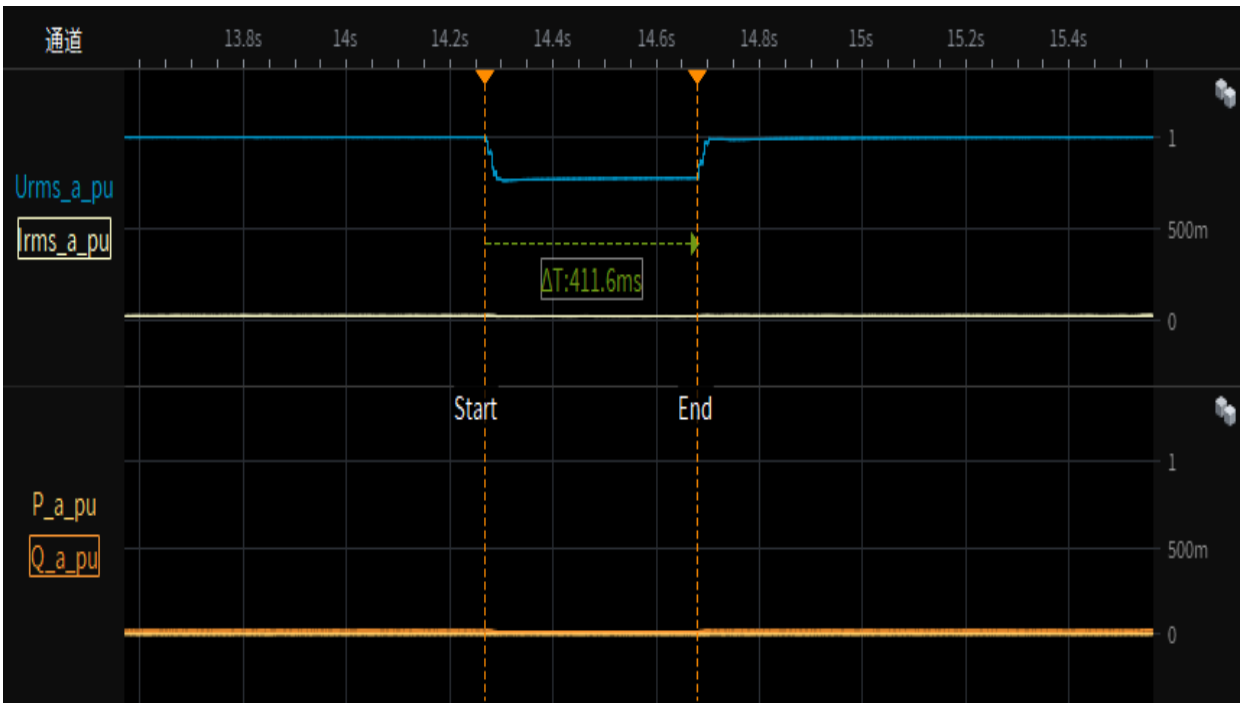


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2s-2.4 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),
95% load restoring time

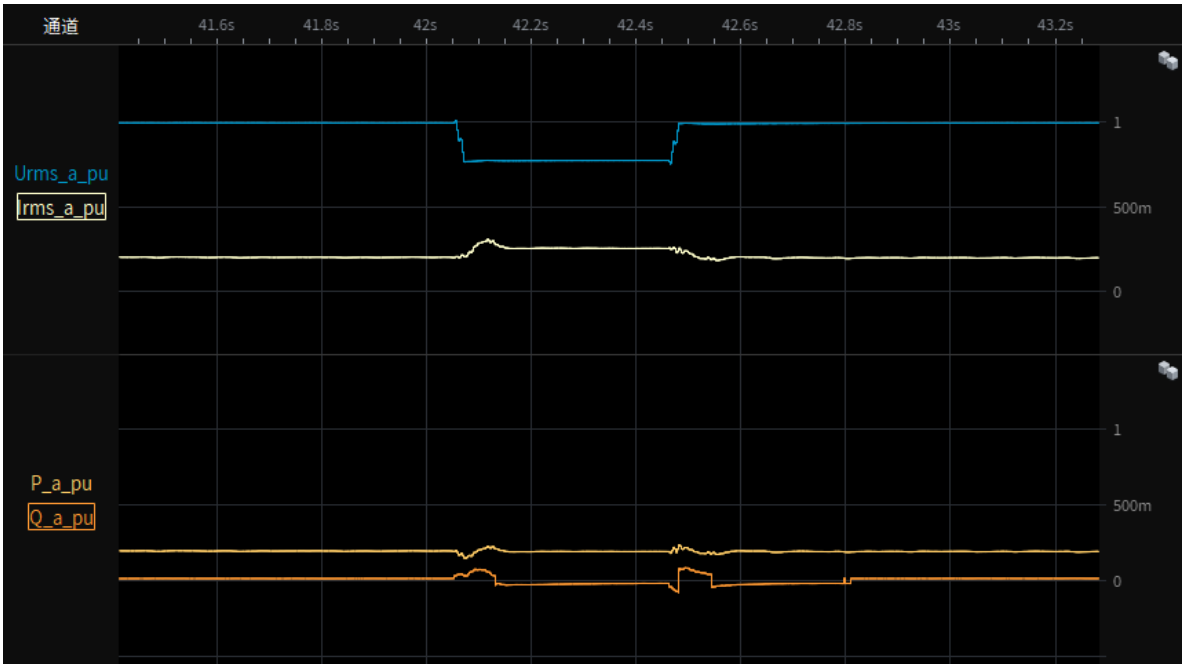


Test 2a- Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

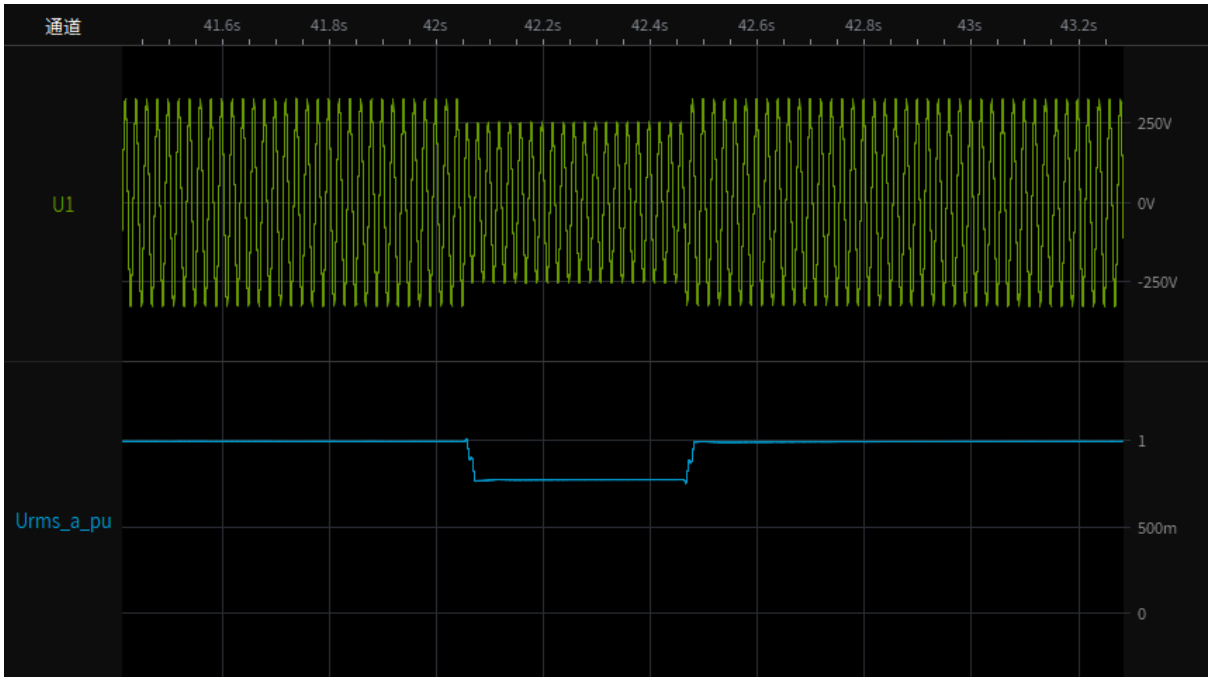


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2a-1.1 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

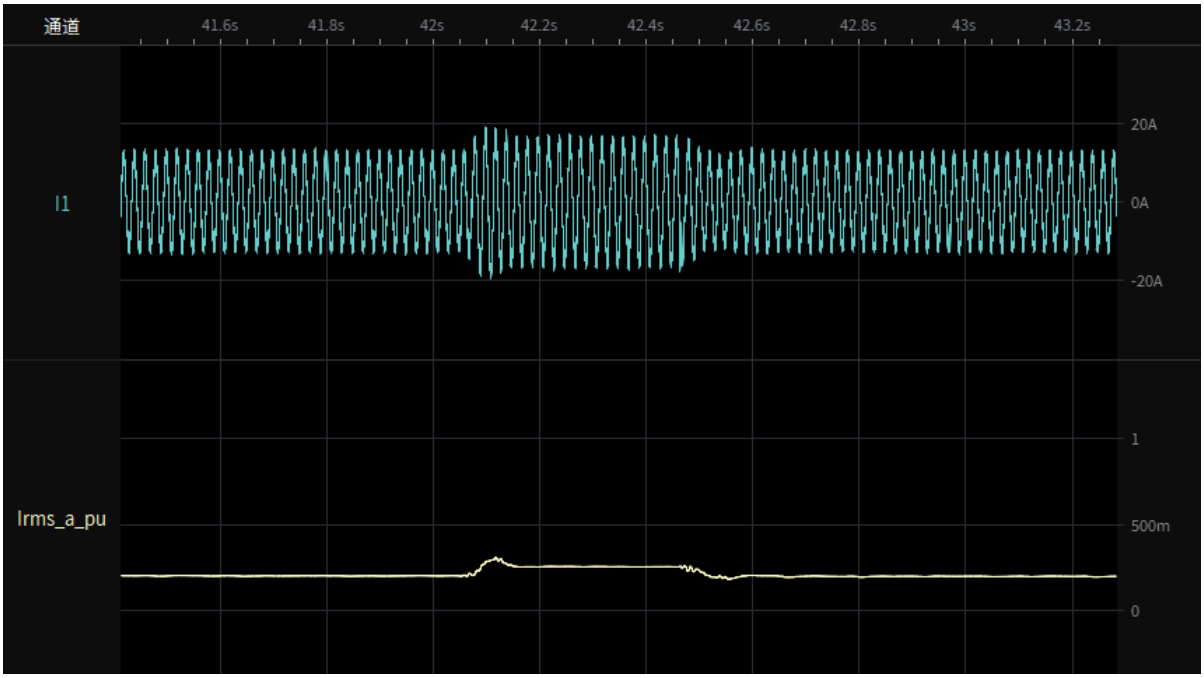


Test 2a-1.2 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

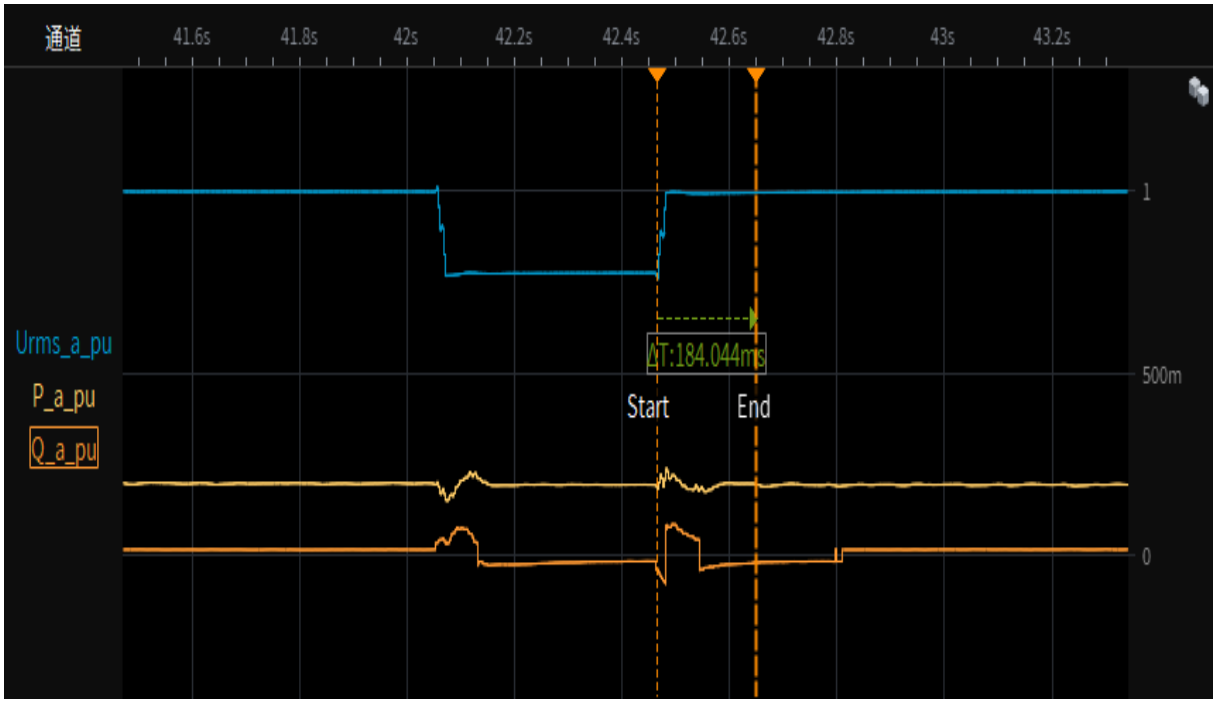


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2a-1.3 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

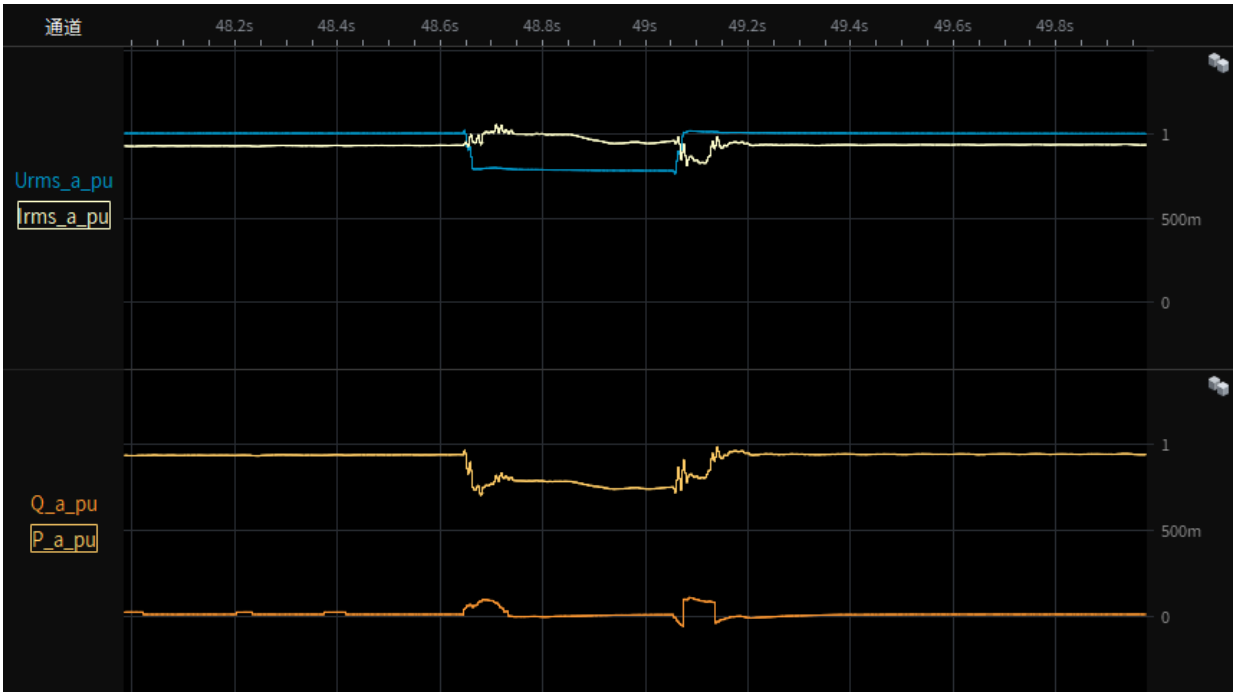


Test 2a-1.4 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),
20% load restoring time

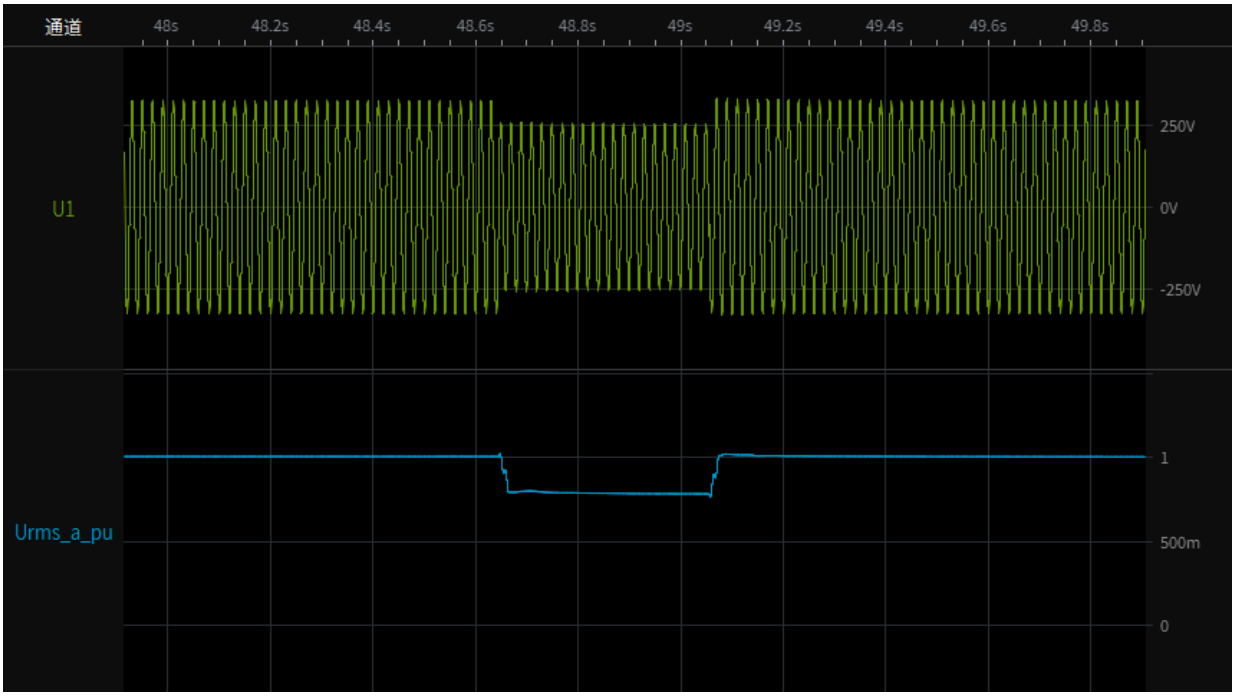


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2a-2.1 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

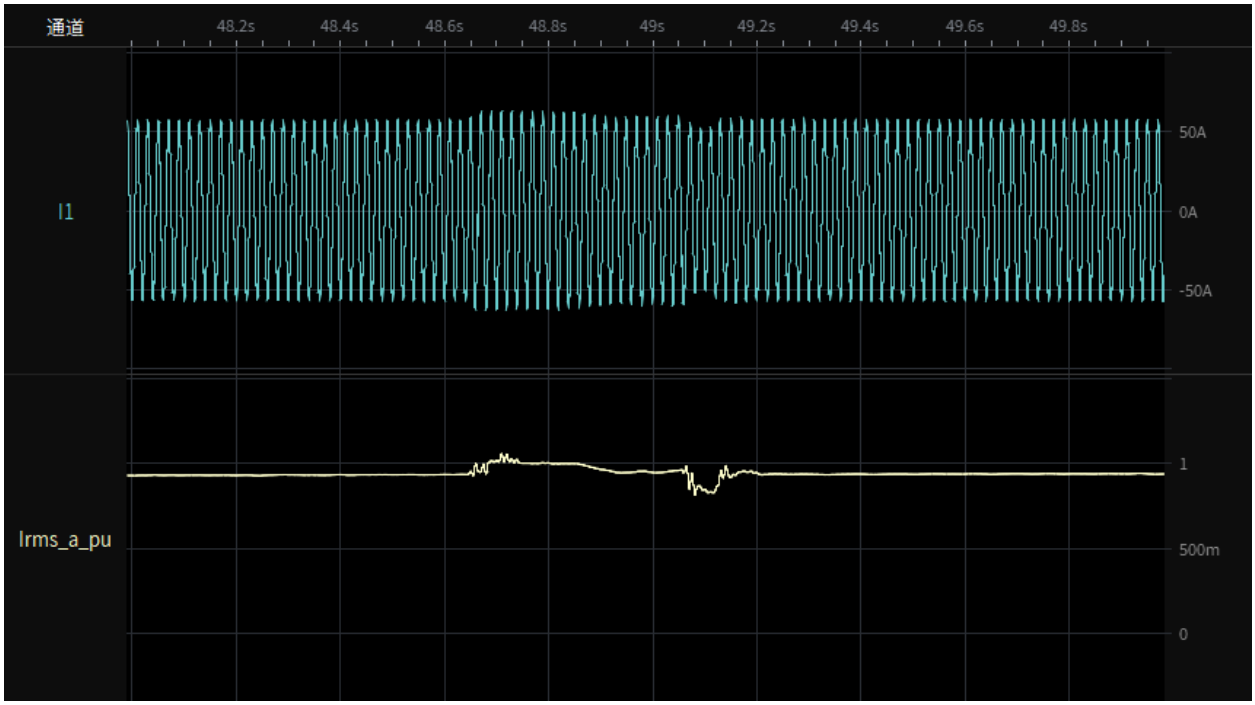


Test 2a-2.2 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

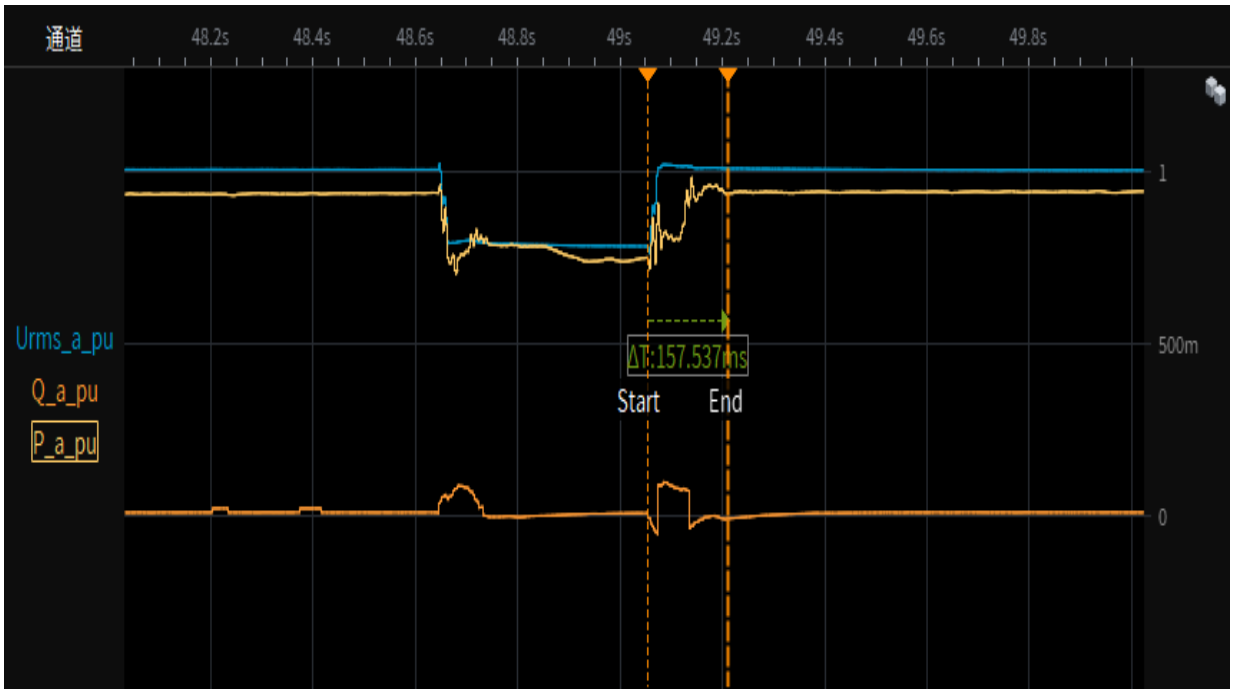


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2a-2.3 Depth of fault phase:0.25p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

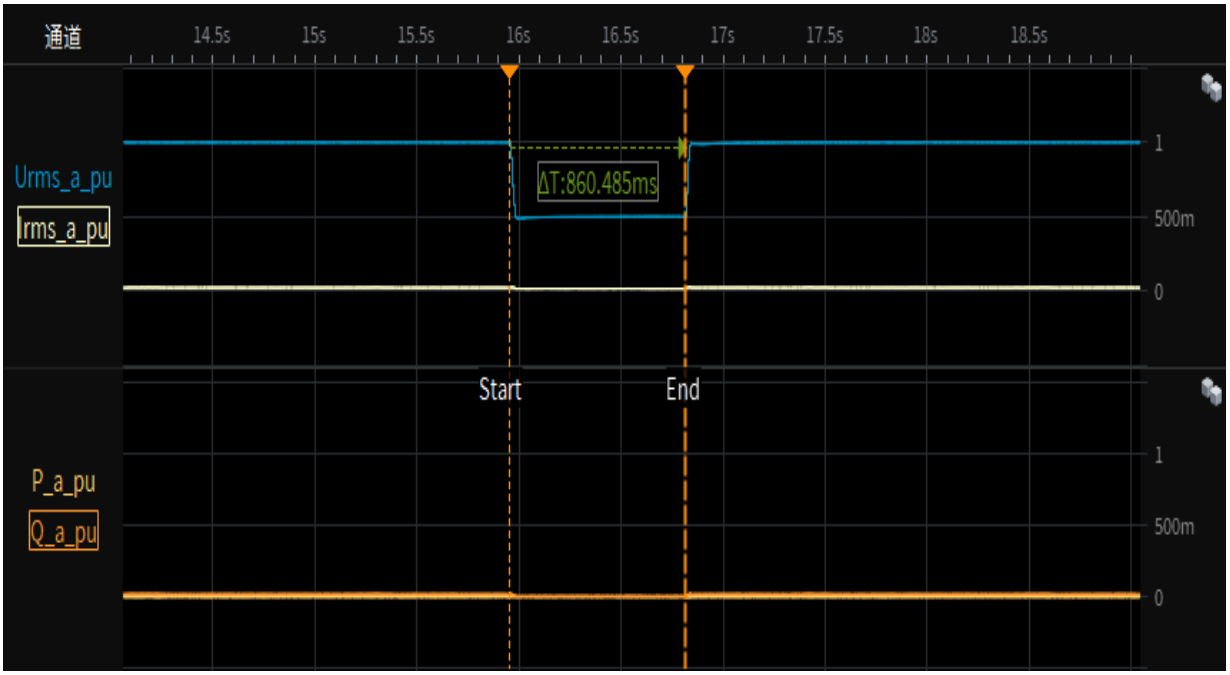


Test 2a-2.4 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),
95% load restoring time

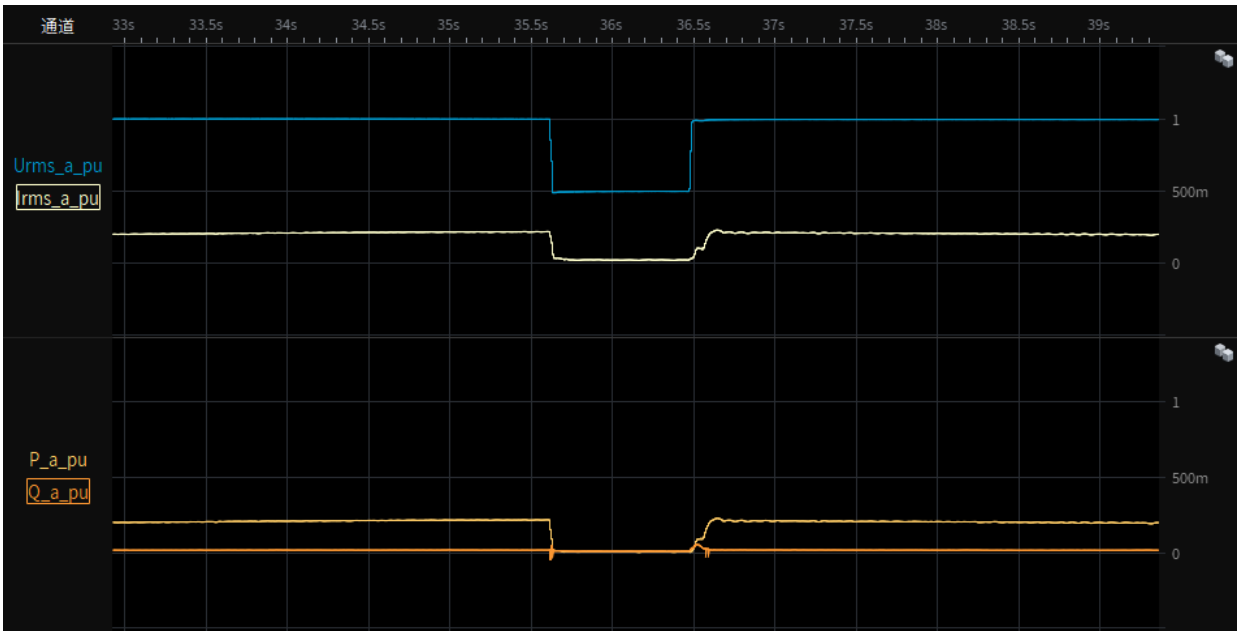


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3s- Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),0% load
Test overview(voltage,current,active and reactive power)

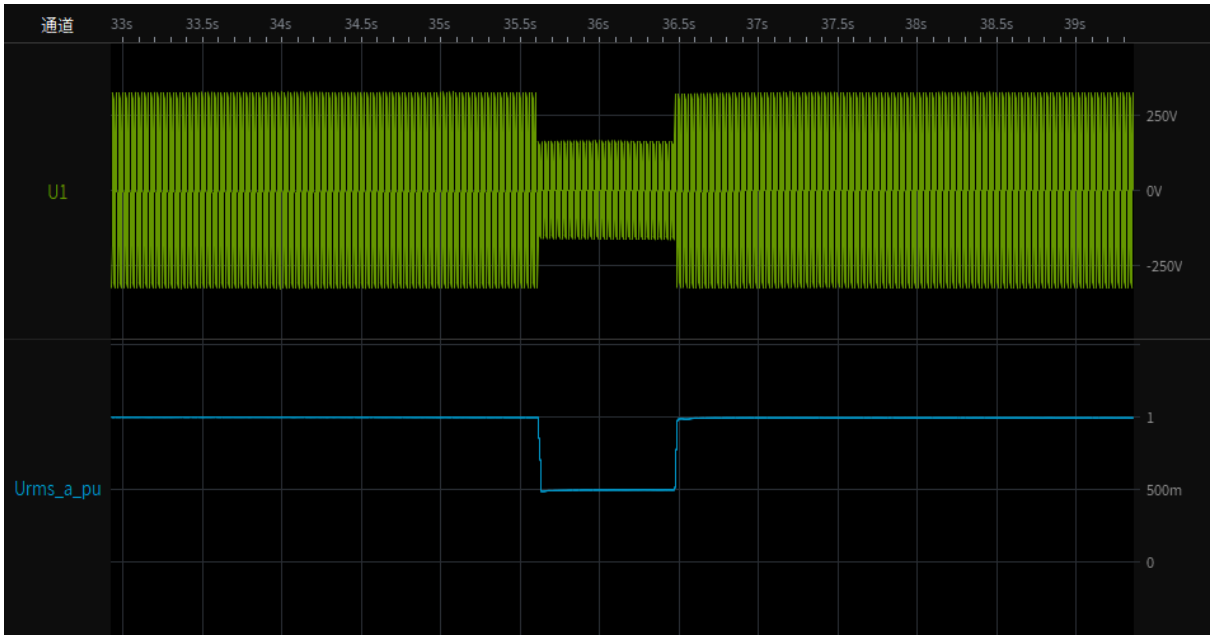


Test 3s-1.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

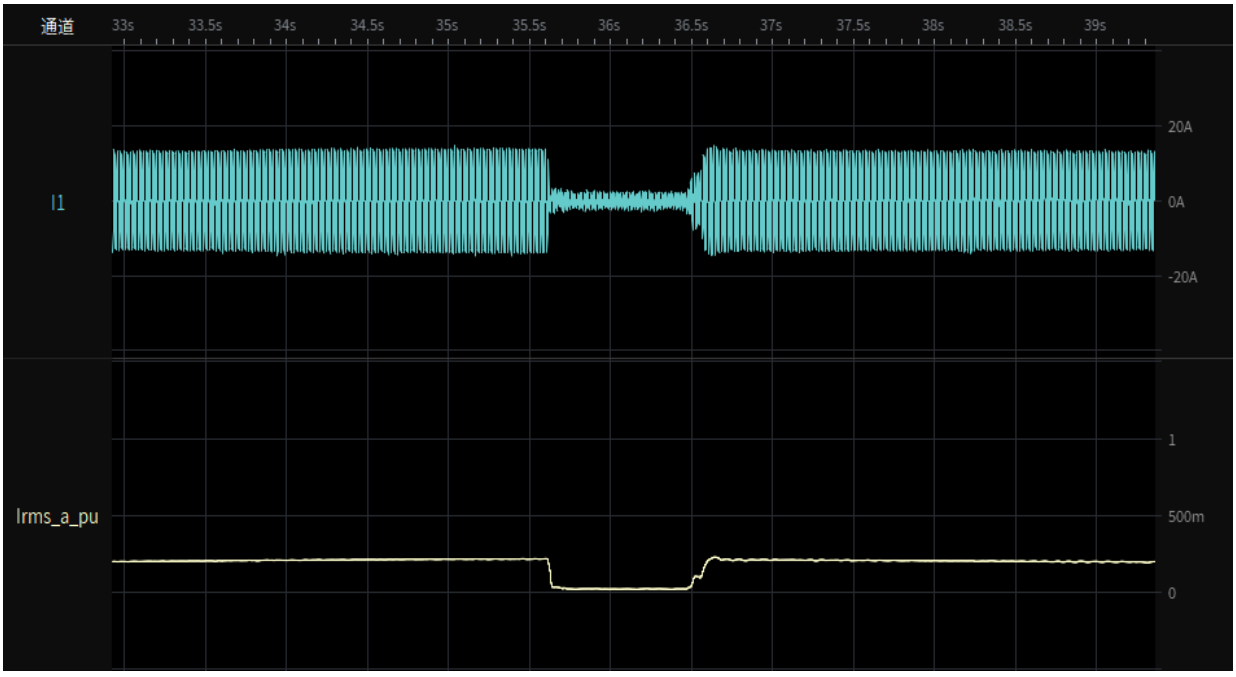


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3s-1.2 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

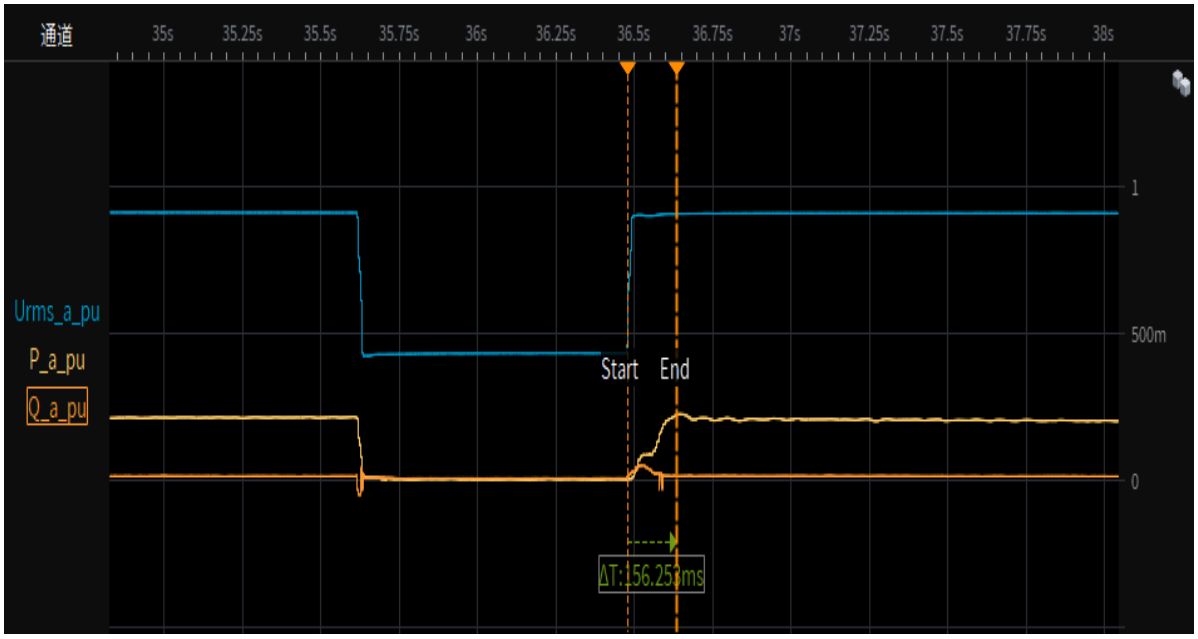


Test 3s-1.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

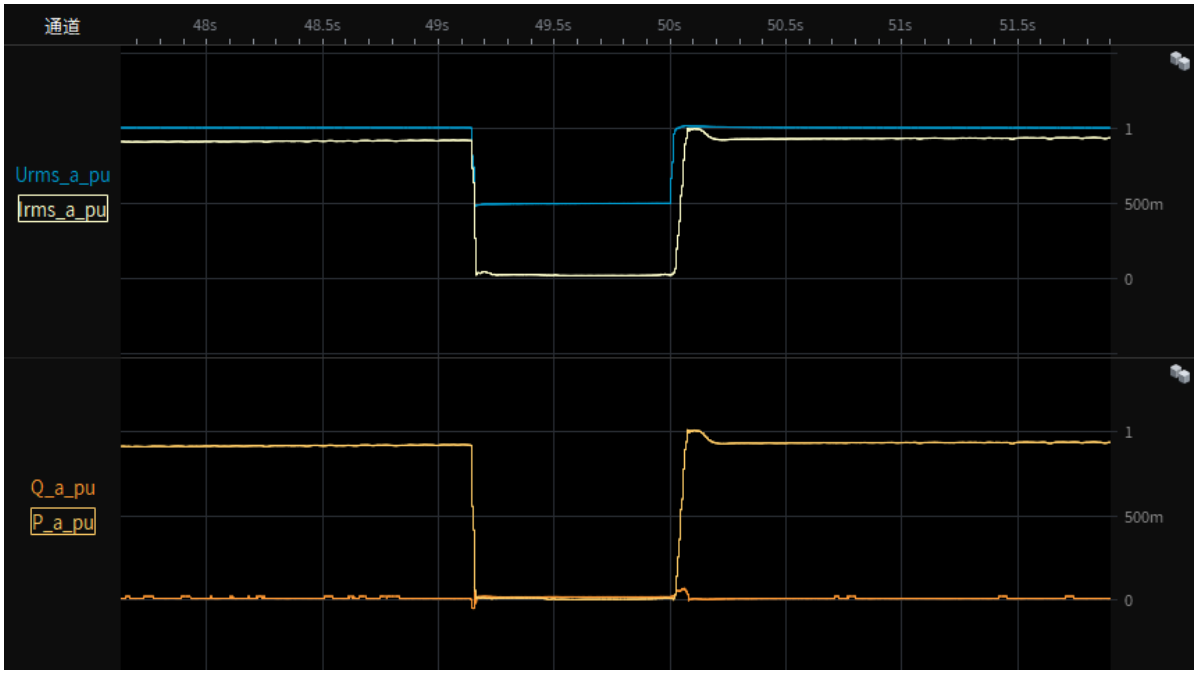


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3s-1.4 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),
20% load restoring time

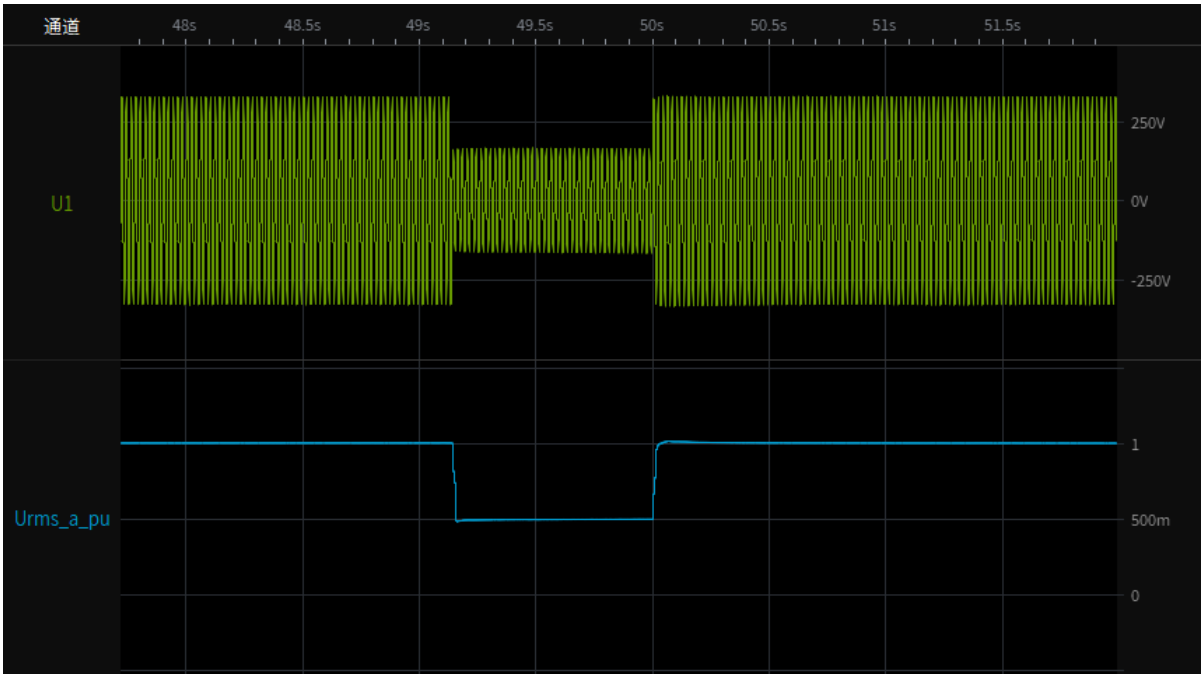


Test 3s-2.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

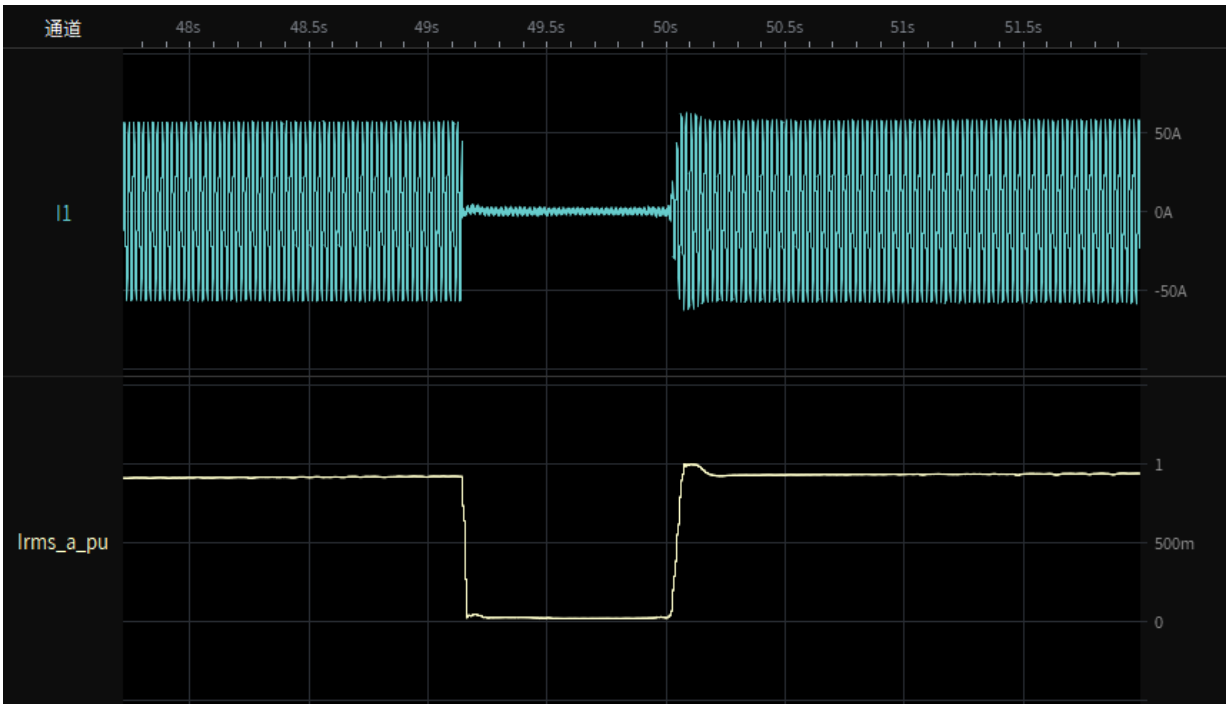


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3s-2.2 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

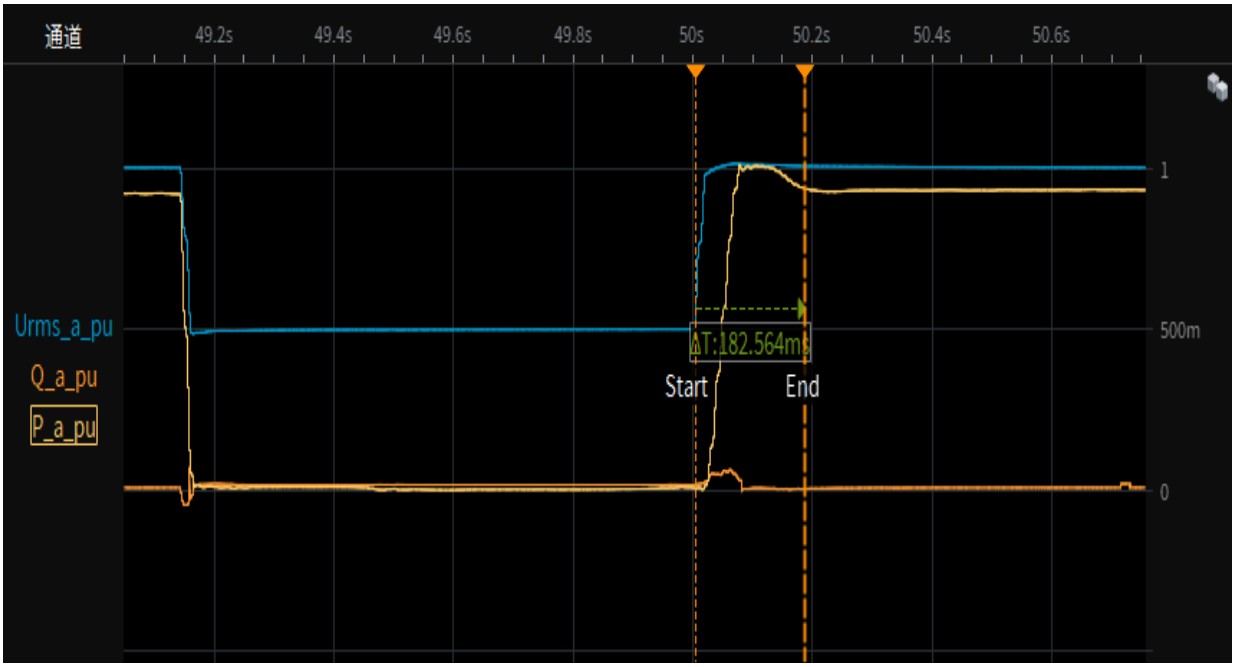


Test 3s-2.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

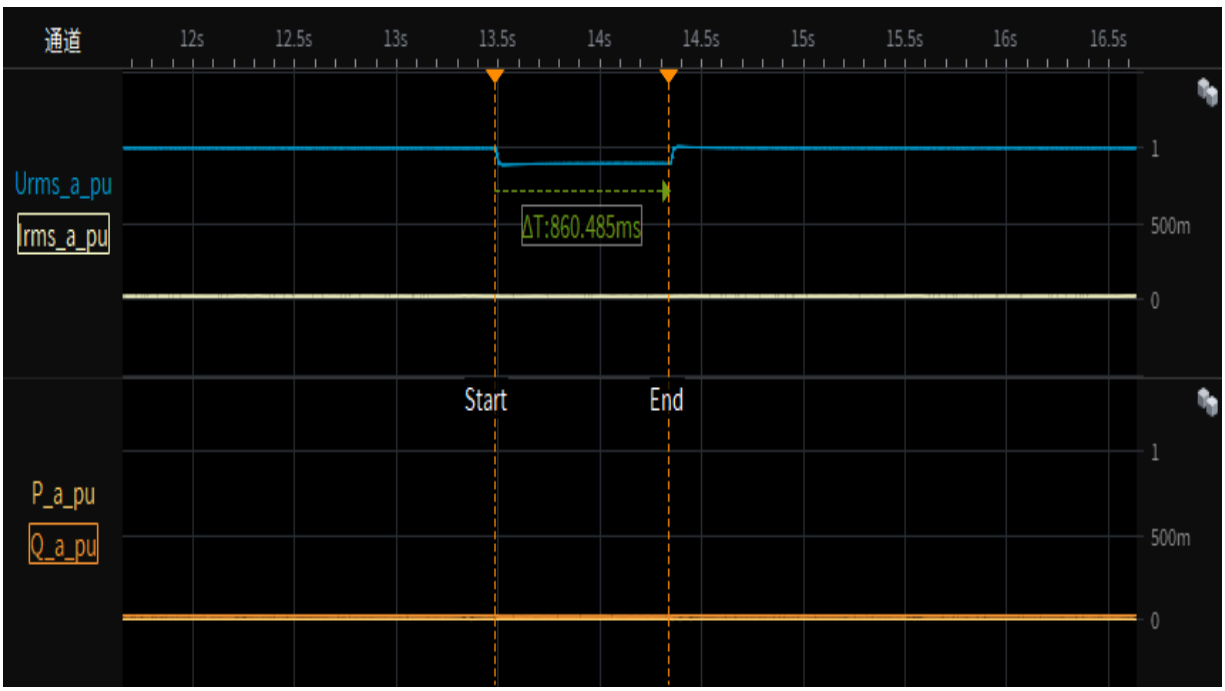


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3s-2.4 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),
95% load restoring time

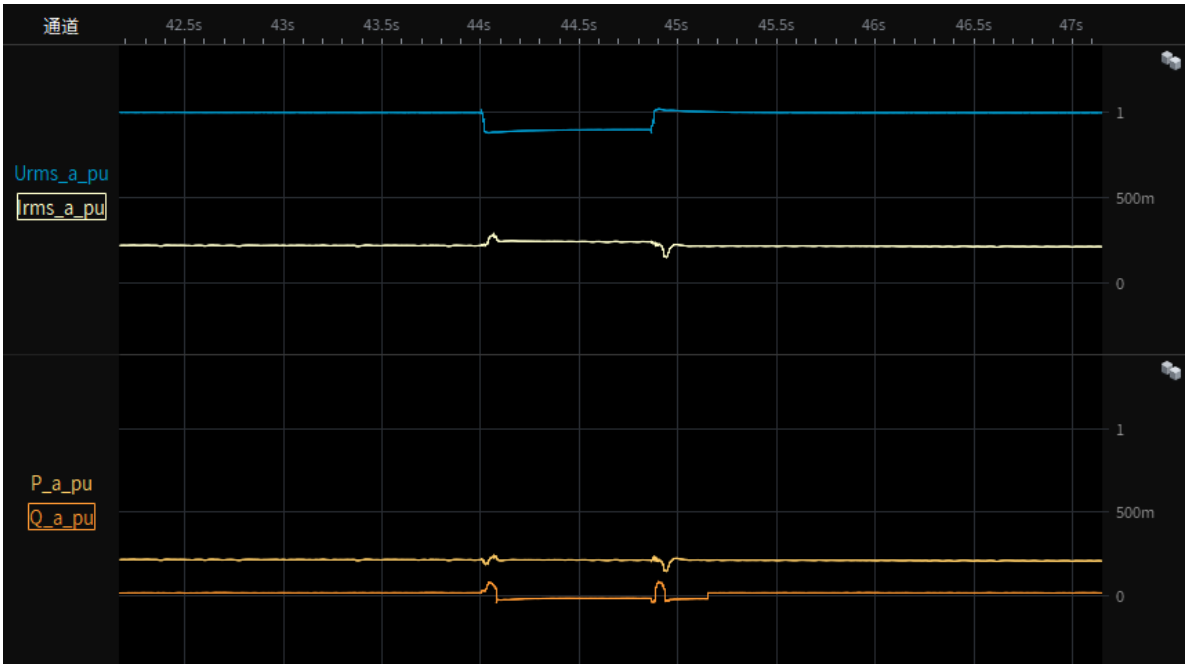


Test 3a- Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

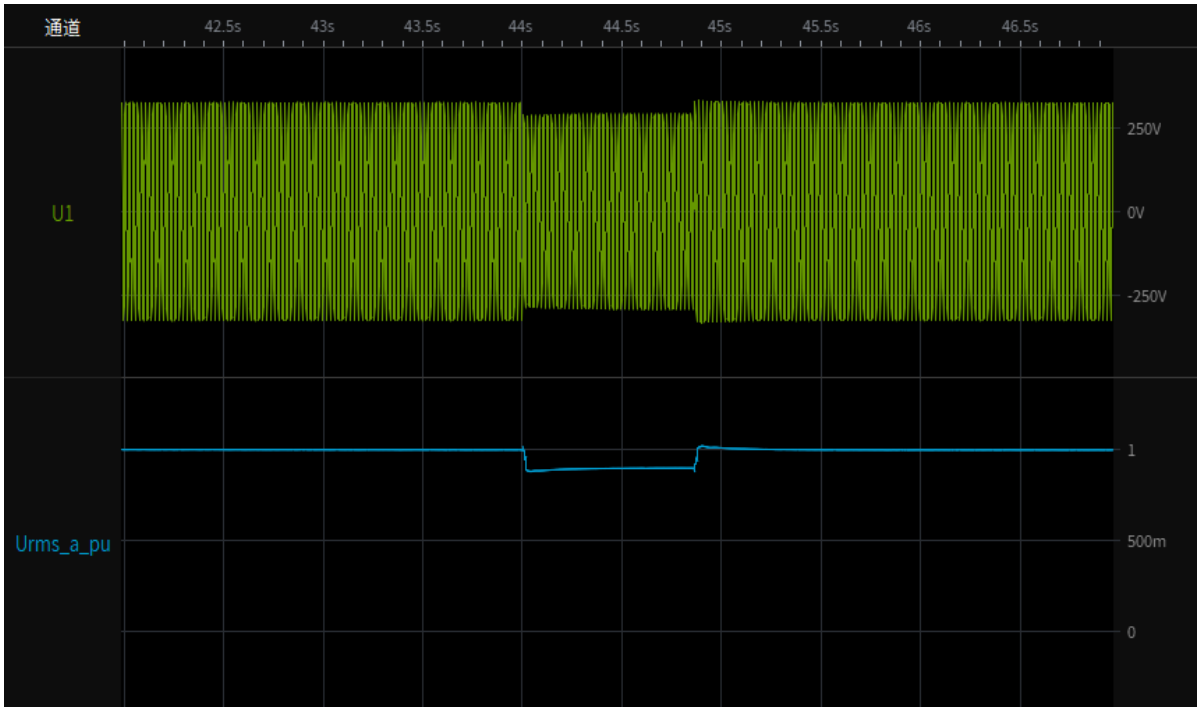


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3a-1.1 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

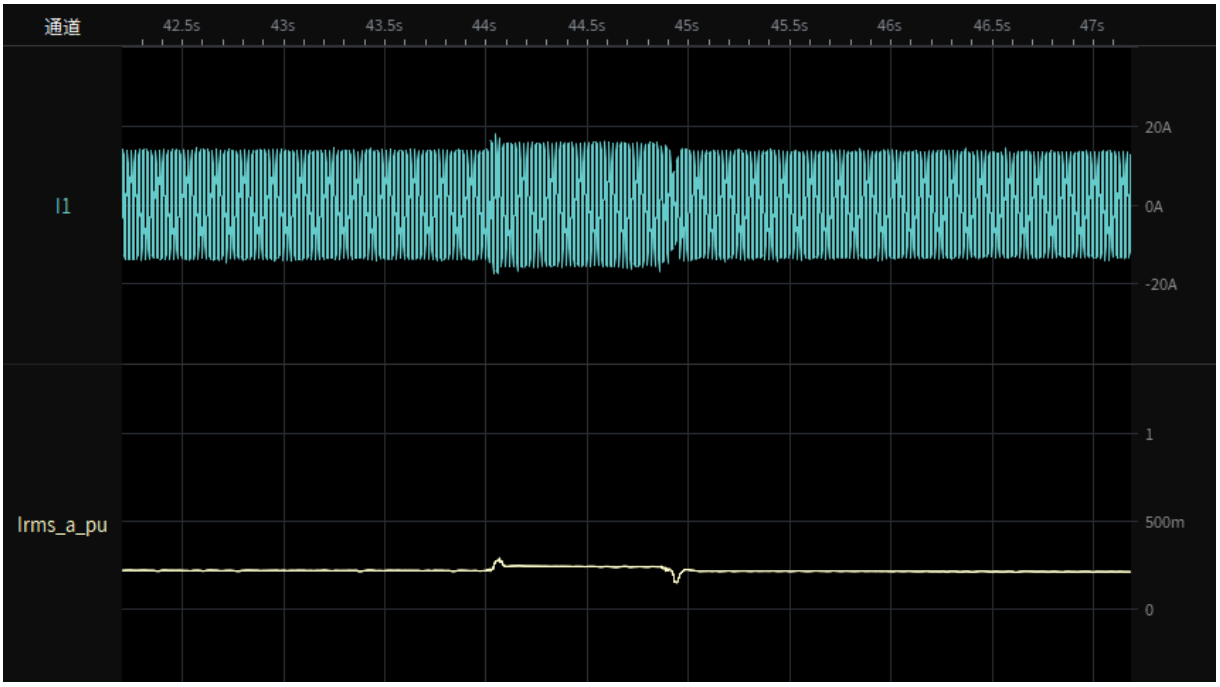


Test 3a-1.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

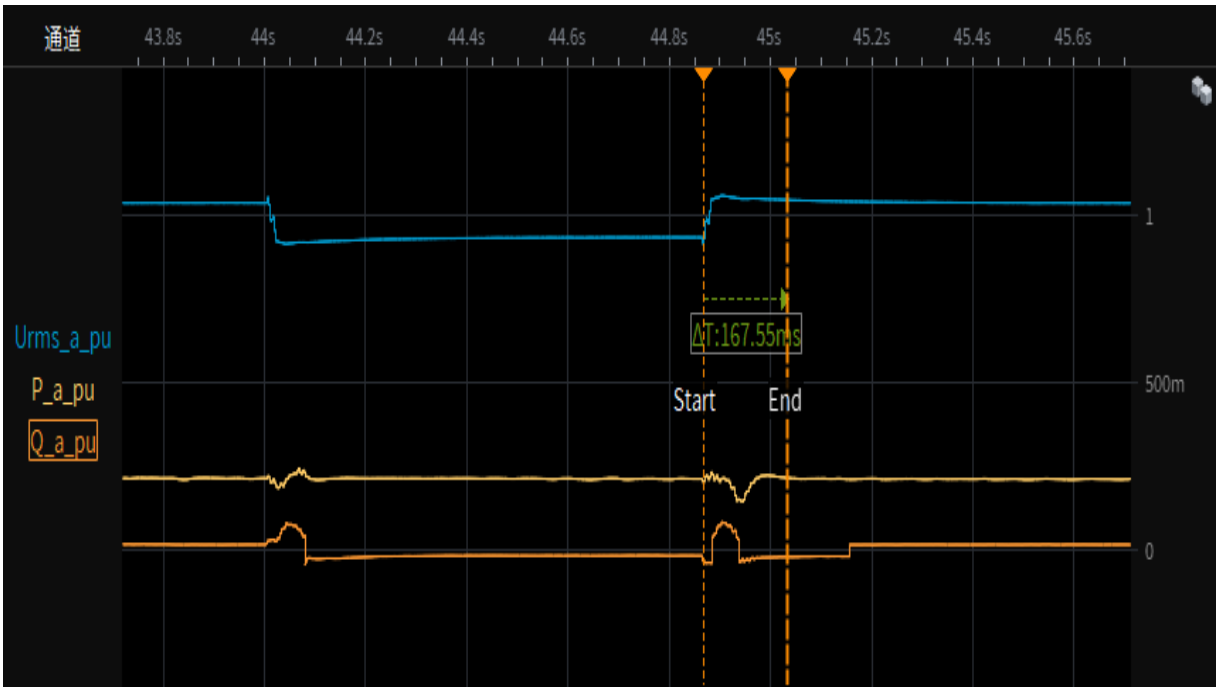


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3a-1.3 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

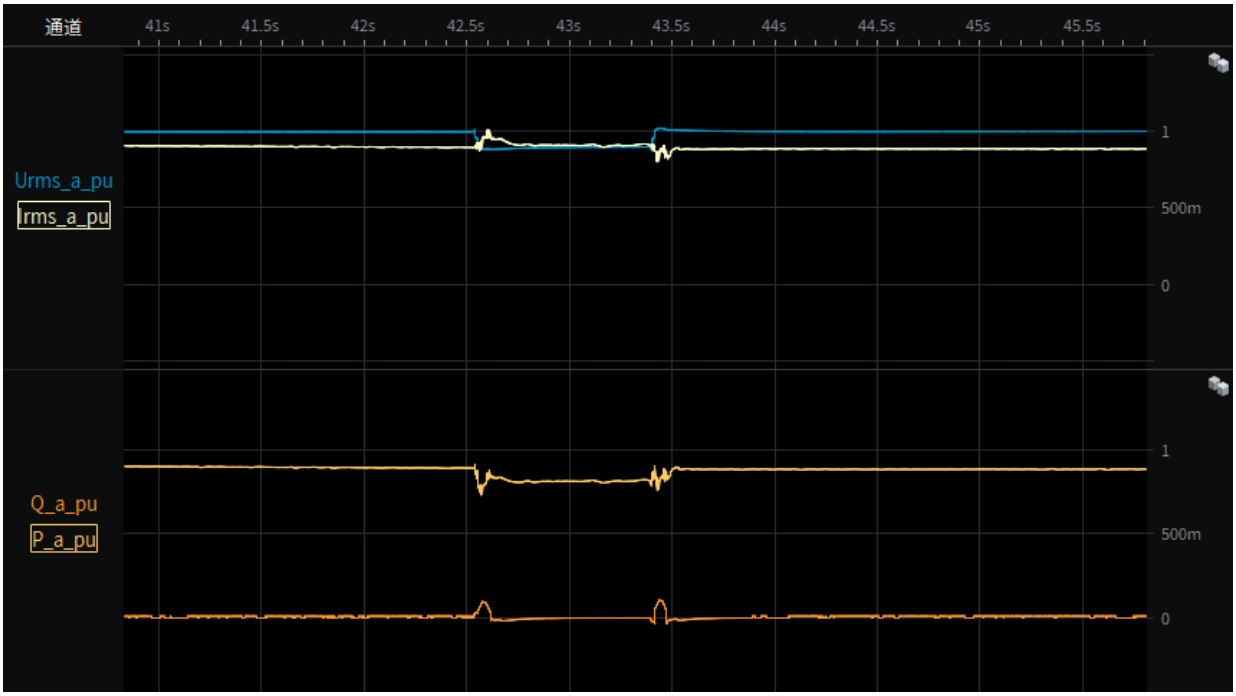


Test 3a-1.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),
20% load restoring time

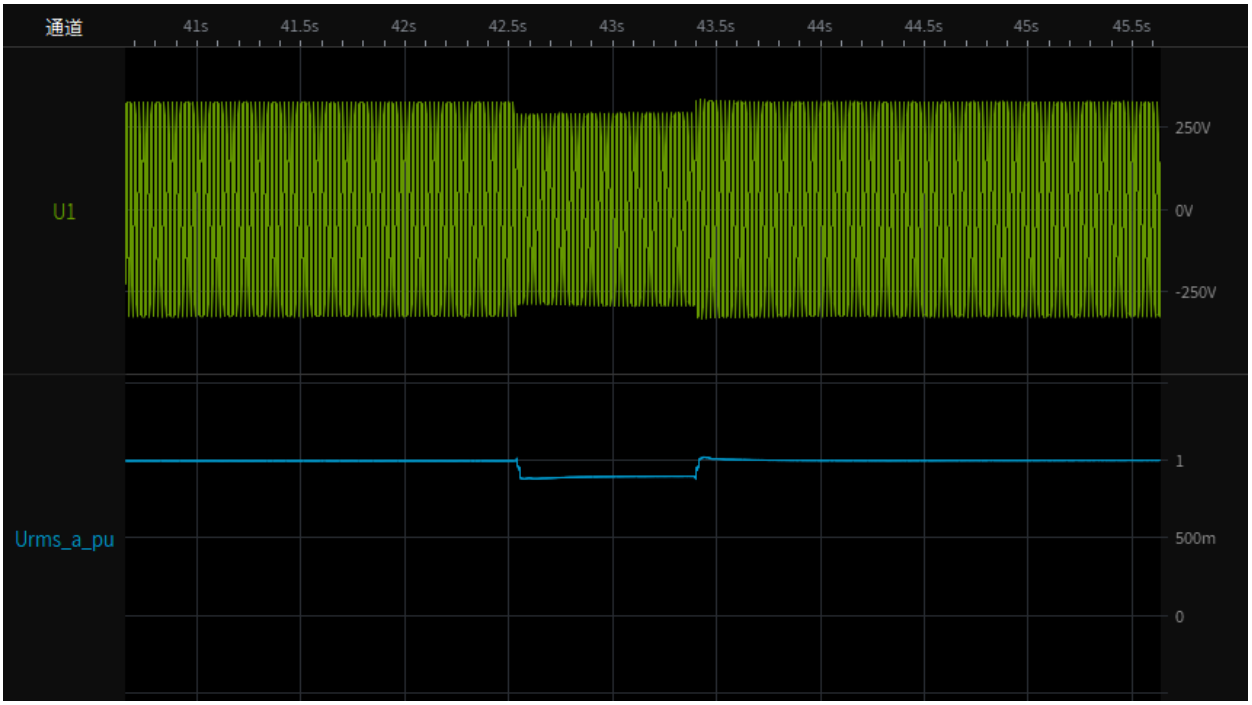


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3a-2.1 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

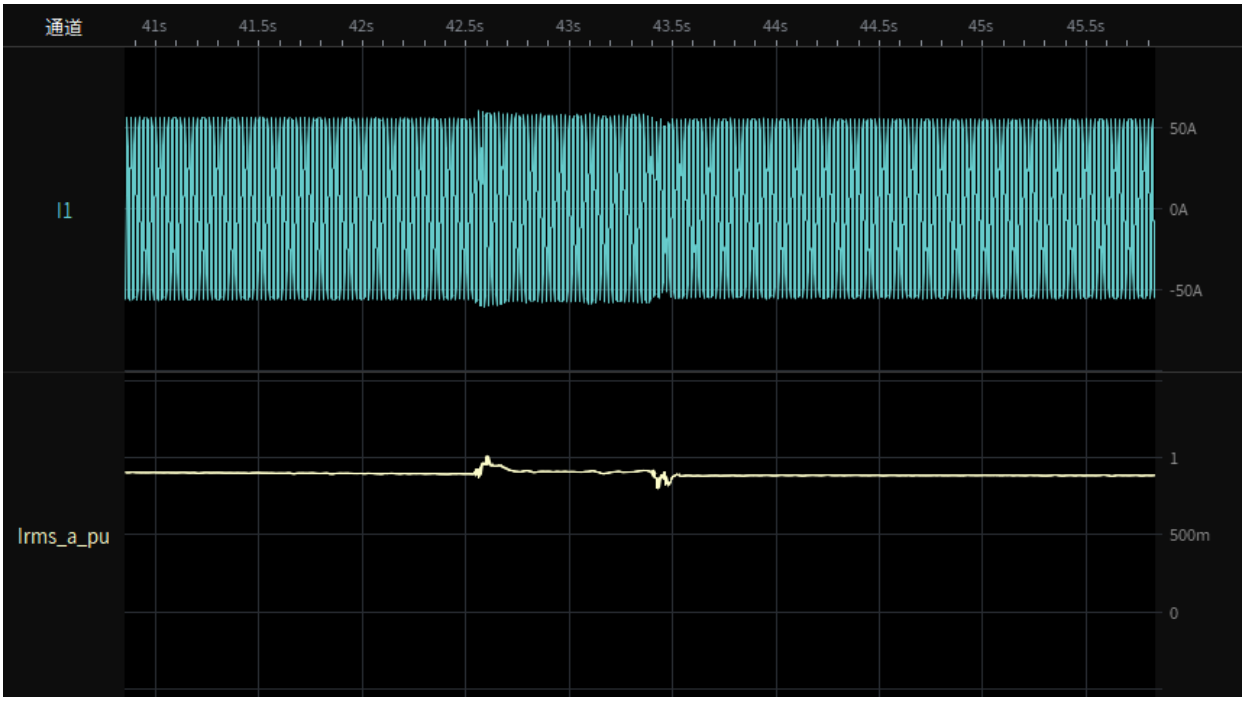


Test 3a-2.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

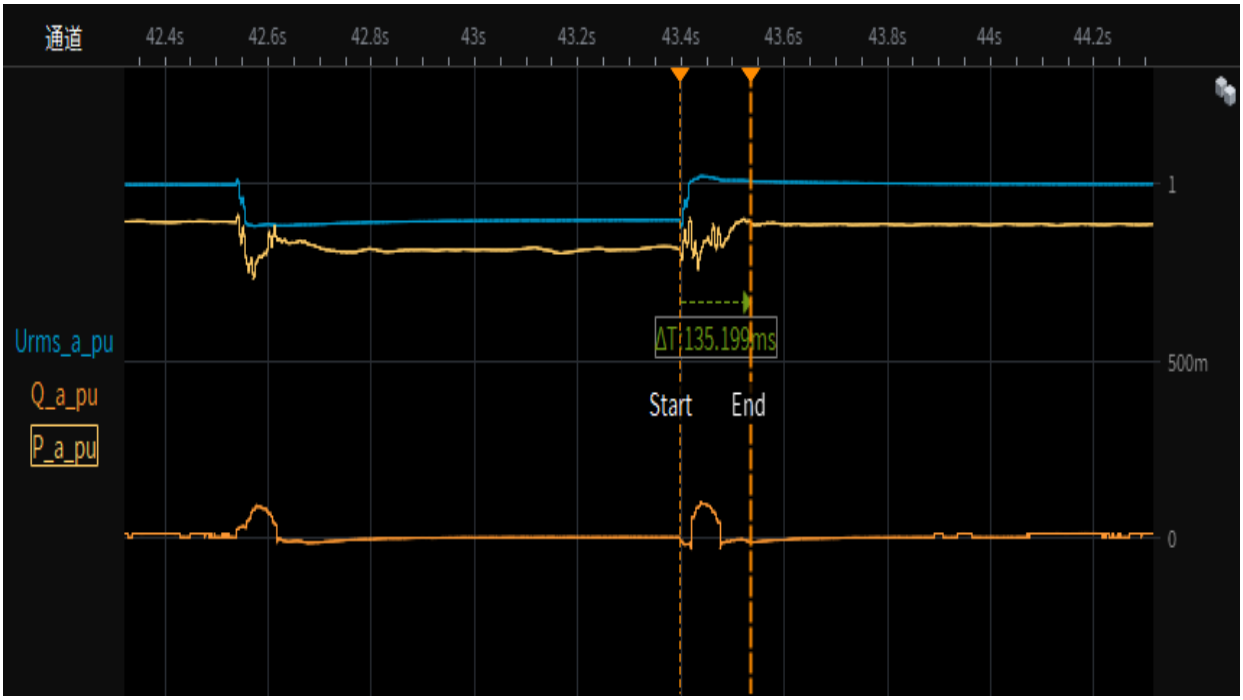


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3a-2.3 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

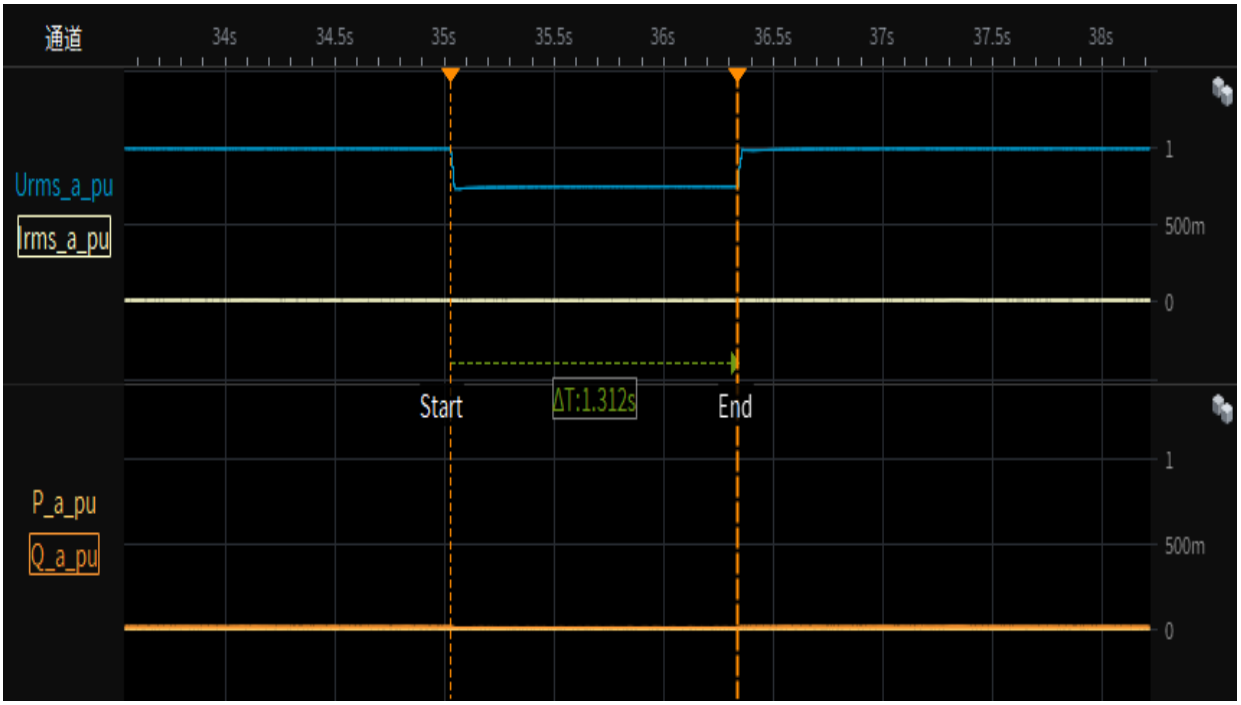


Test 3a-2.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),
95% load restoring time

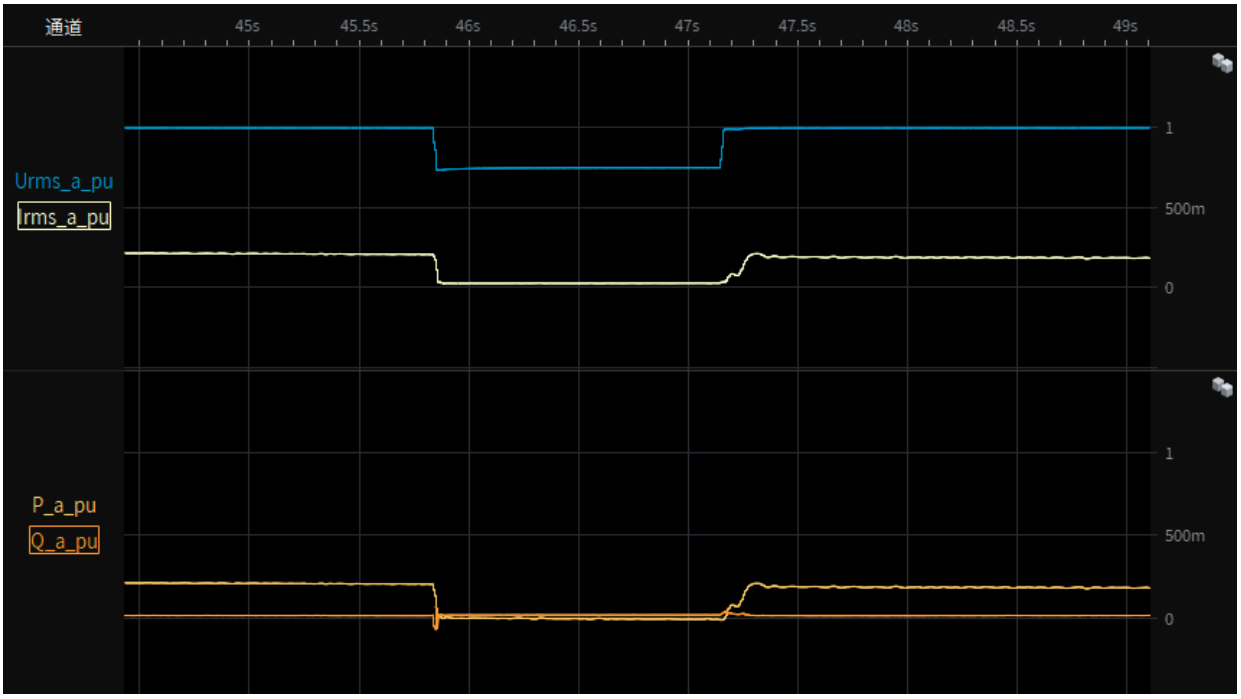


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4s- Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),0% load
Test overview(voltage,current,active and reactive power)

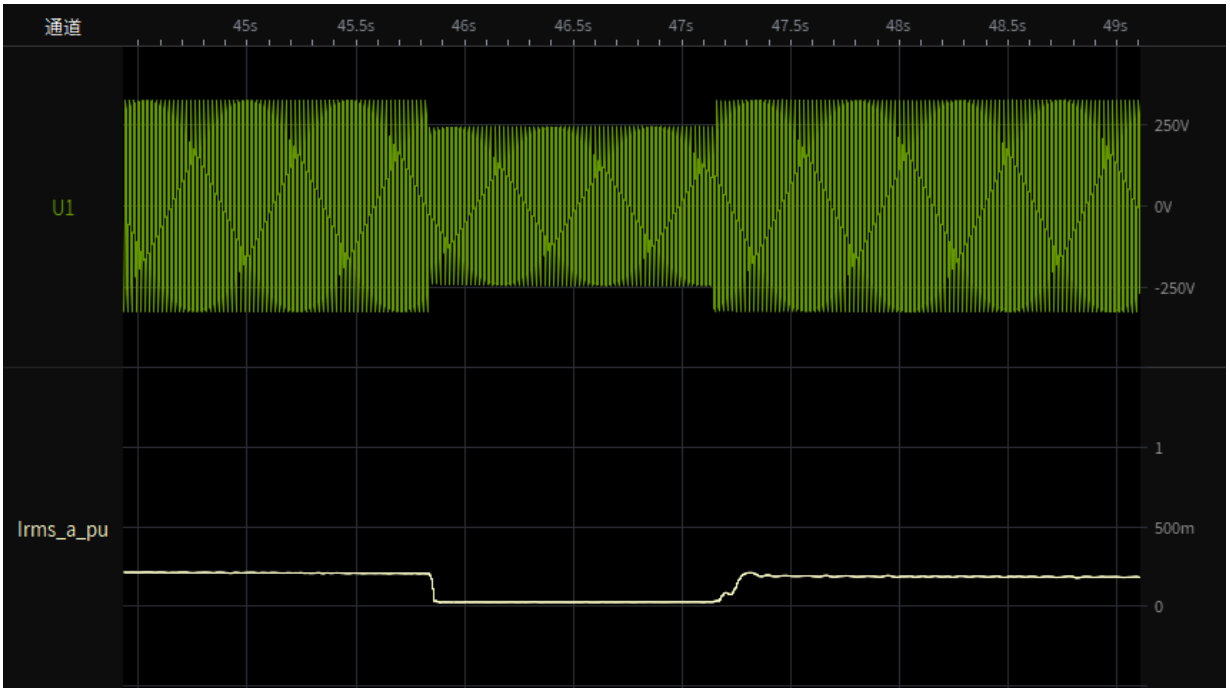


Test 4s-1.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

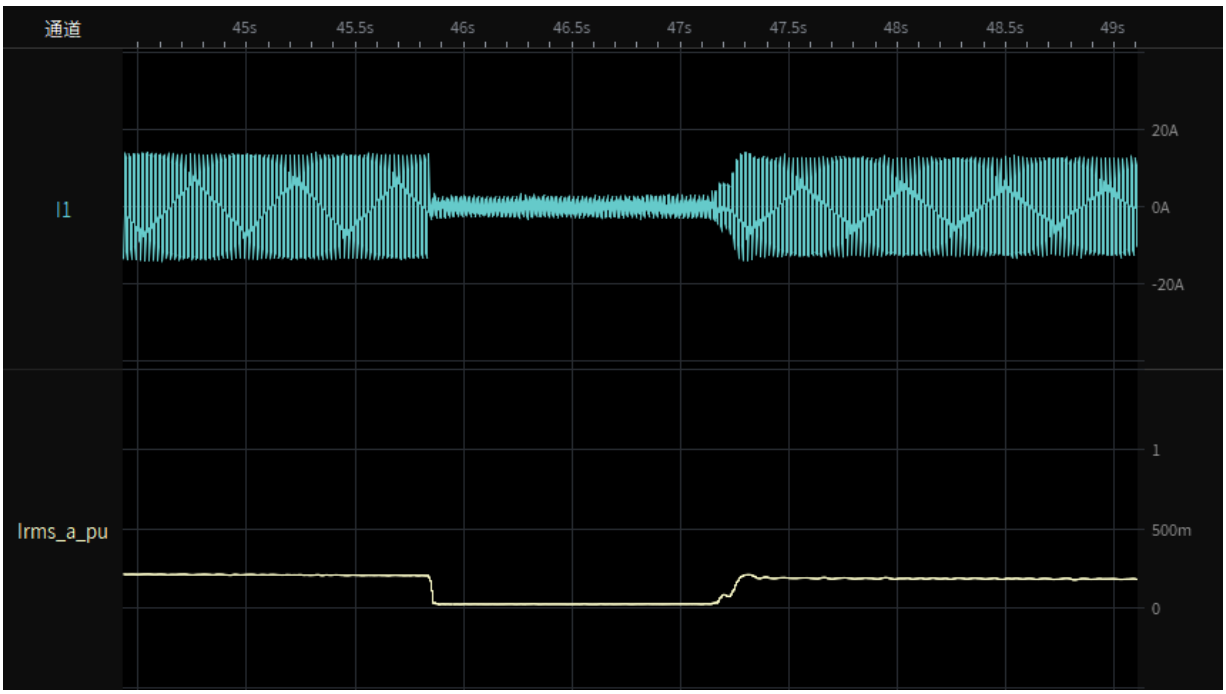


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4s-1.2 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

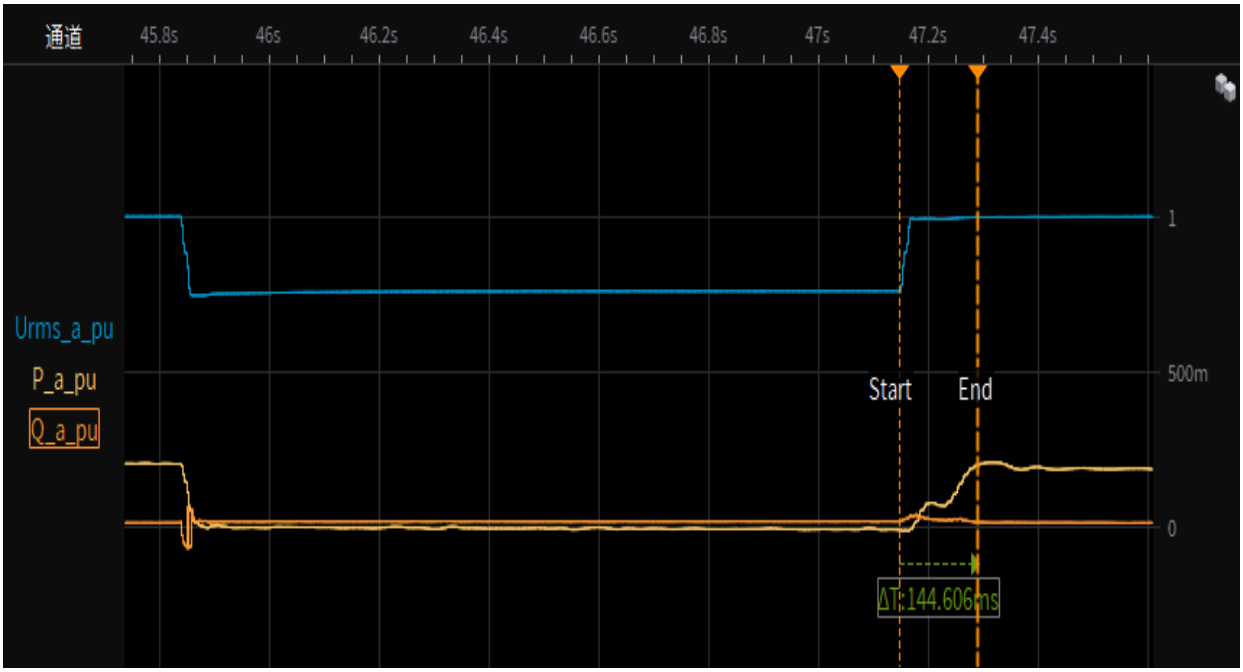


Test 4s-1.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

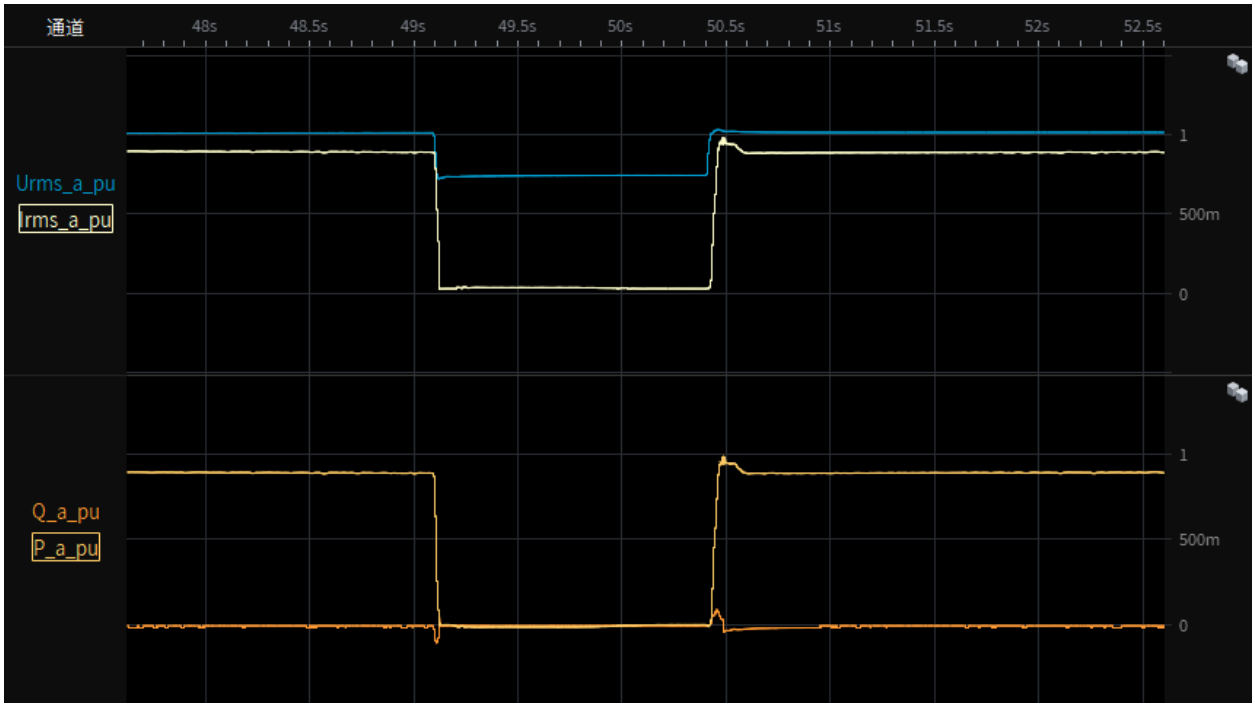


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4s-1.4 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),
20% load restoring time

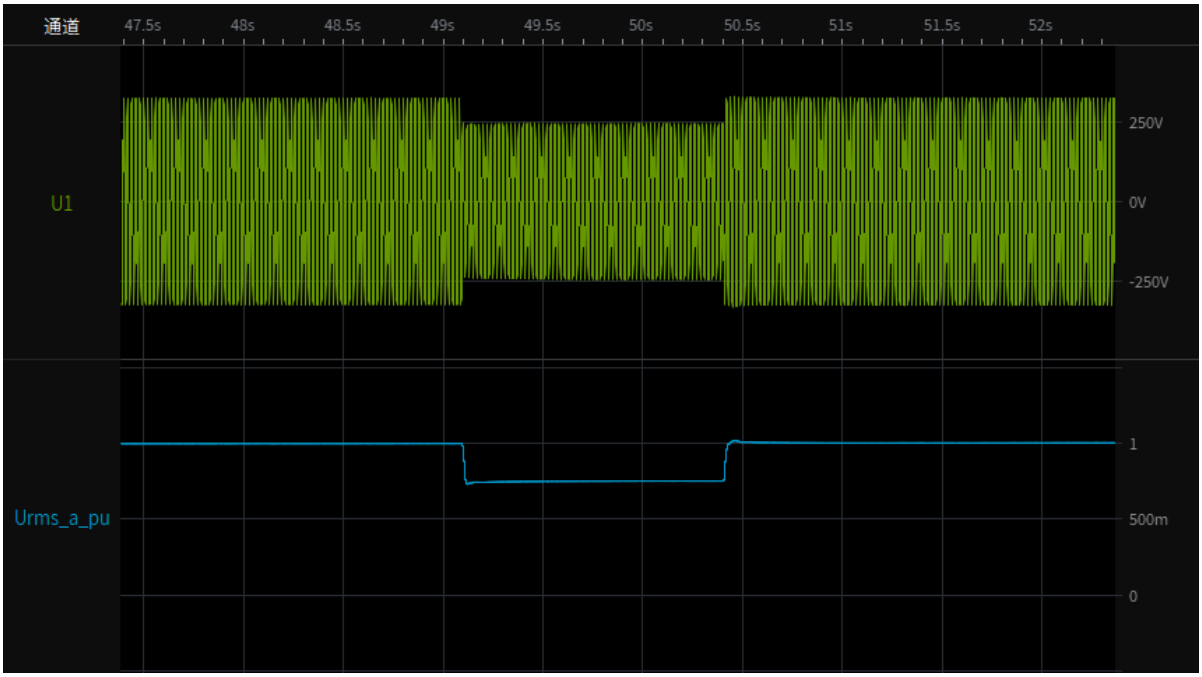


Test 4s-2.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

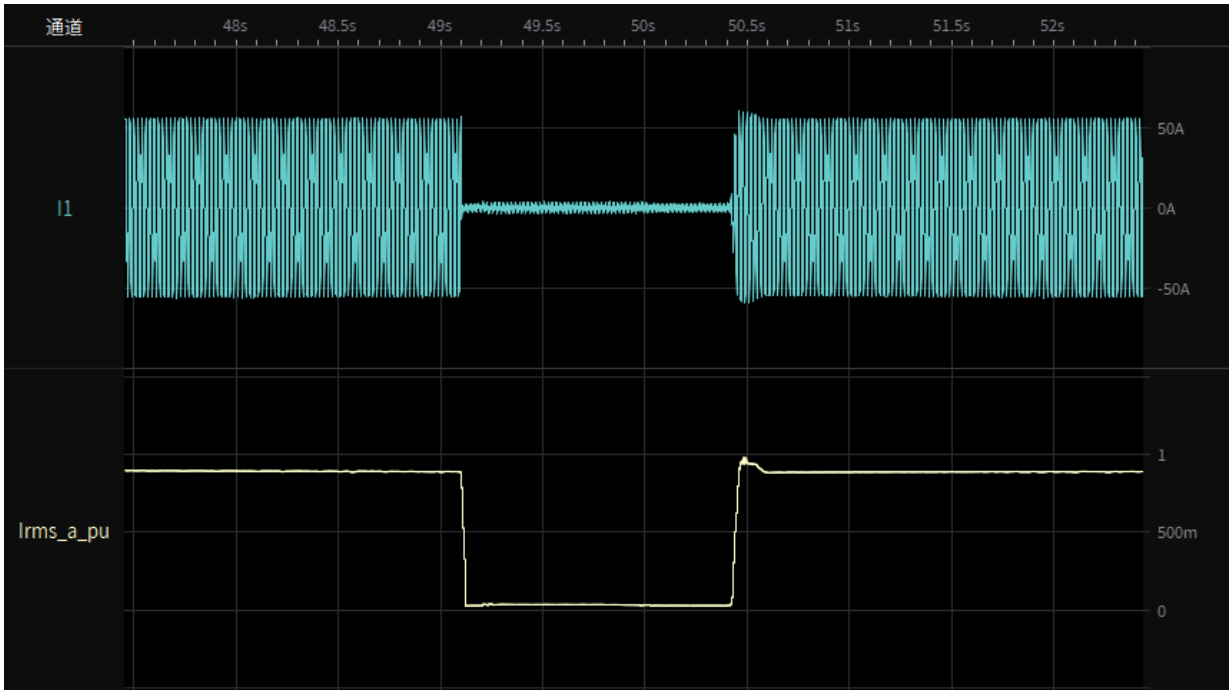


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4s-2.2 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

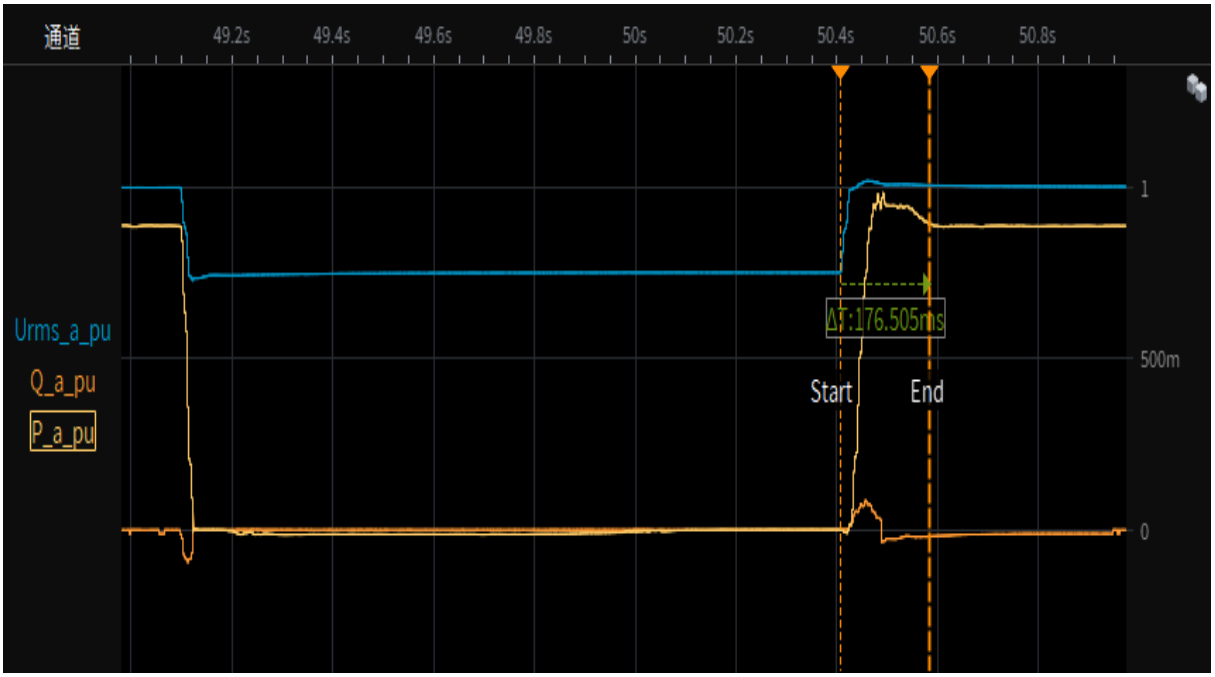


Test 4s-2.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

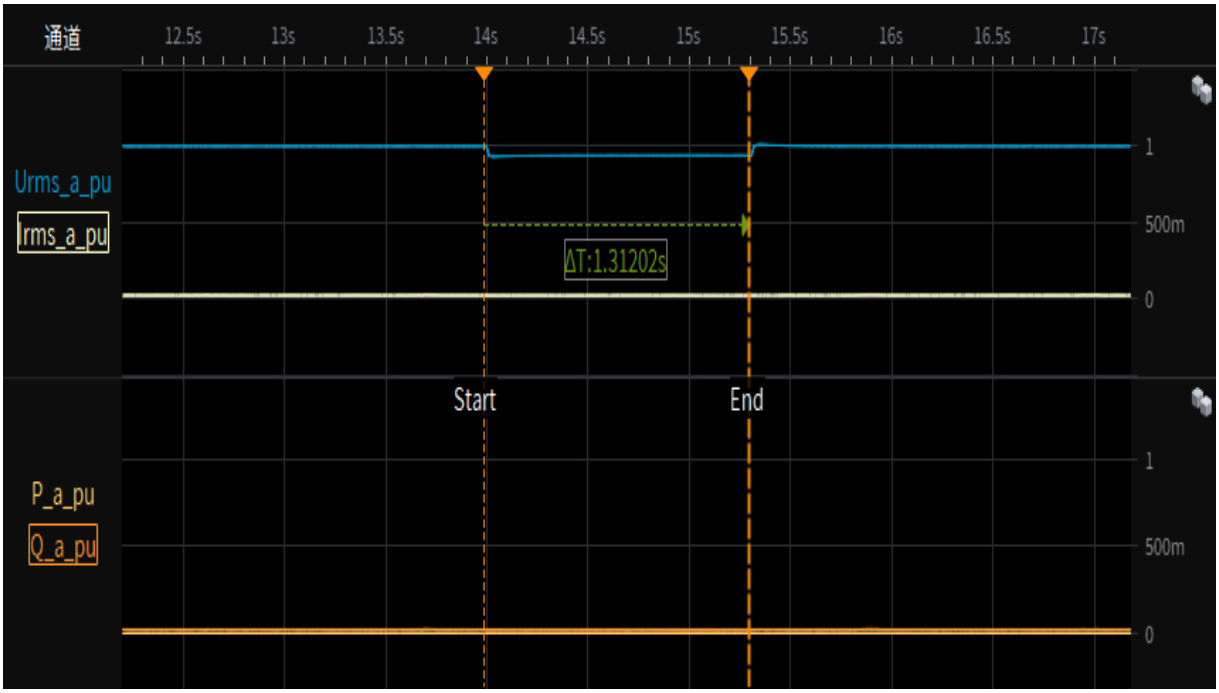


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4s-2.4 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),
95% load restoring time

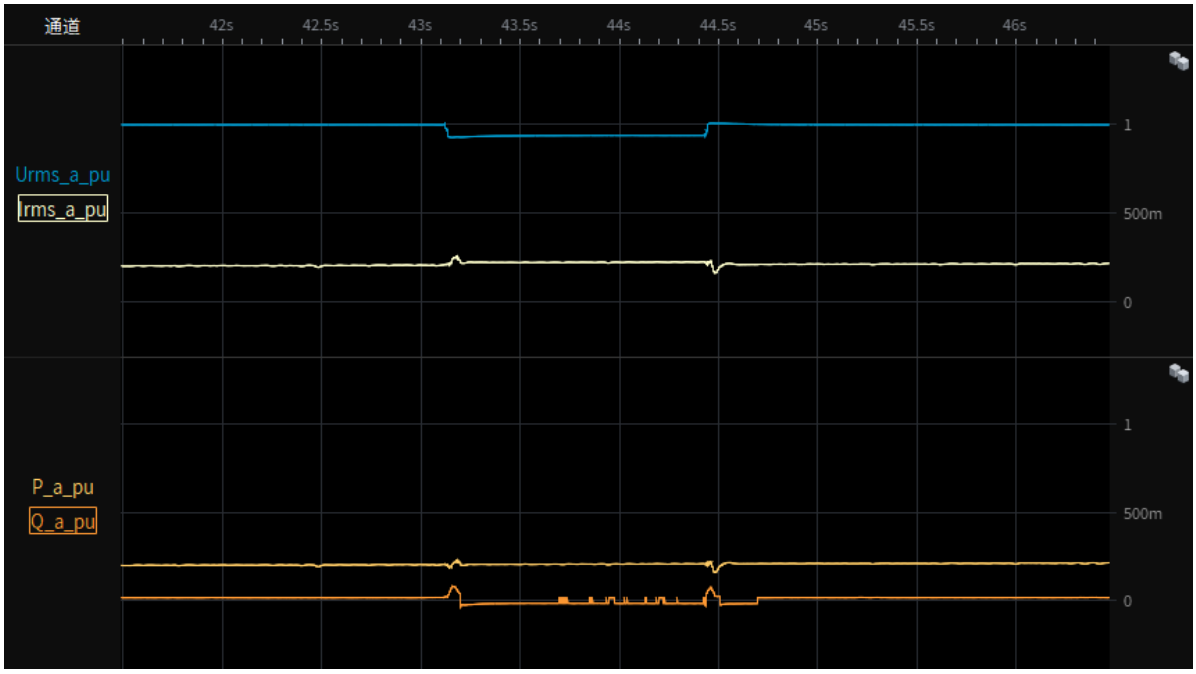


Test 4a- Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

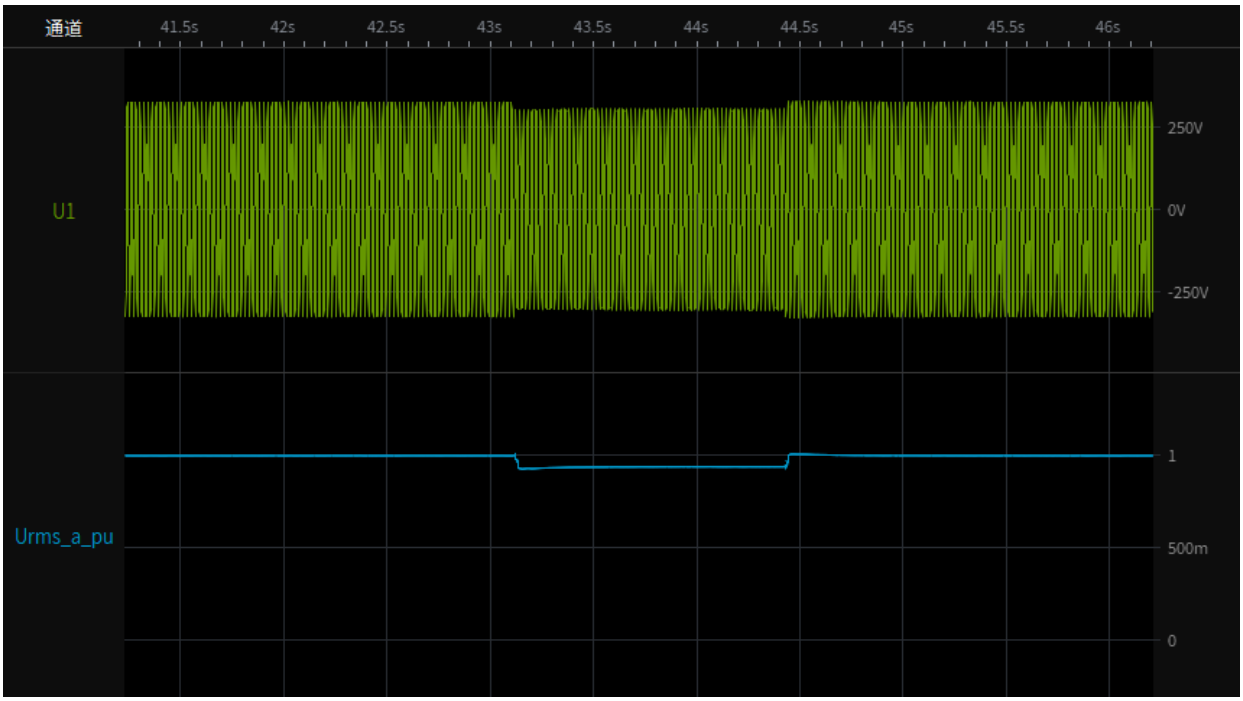


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4a-1.1 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

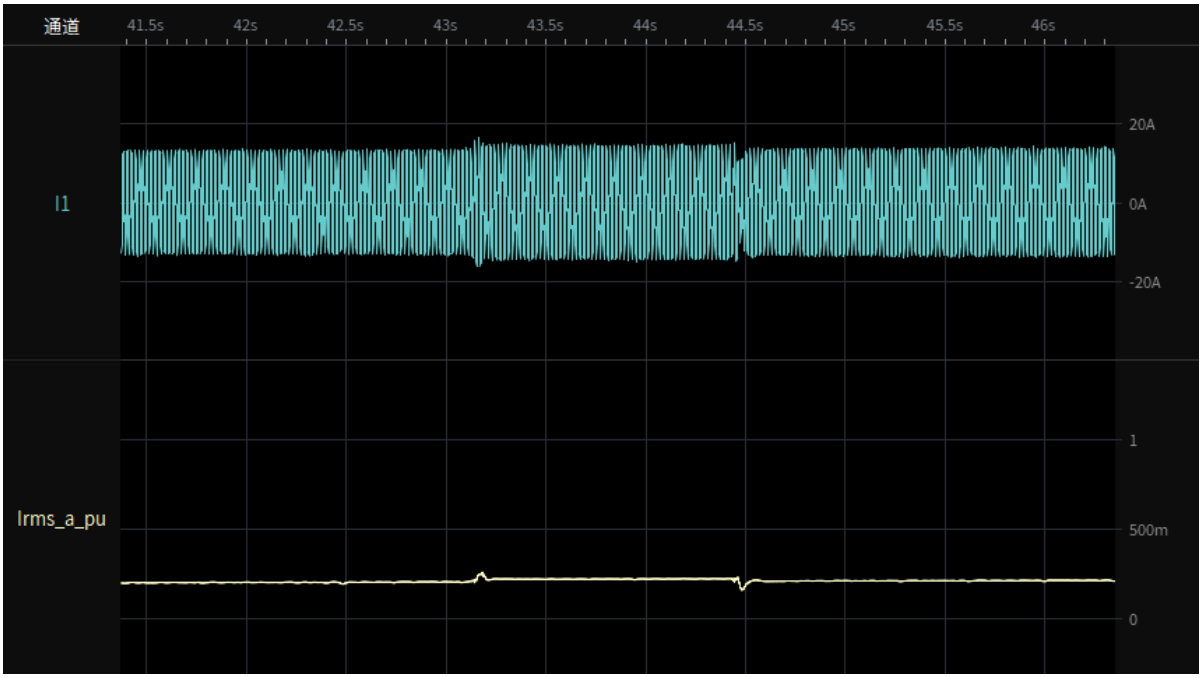


Test 4a-1.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

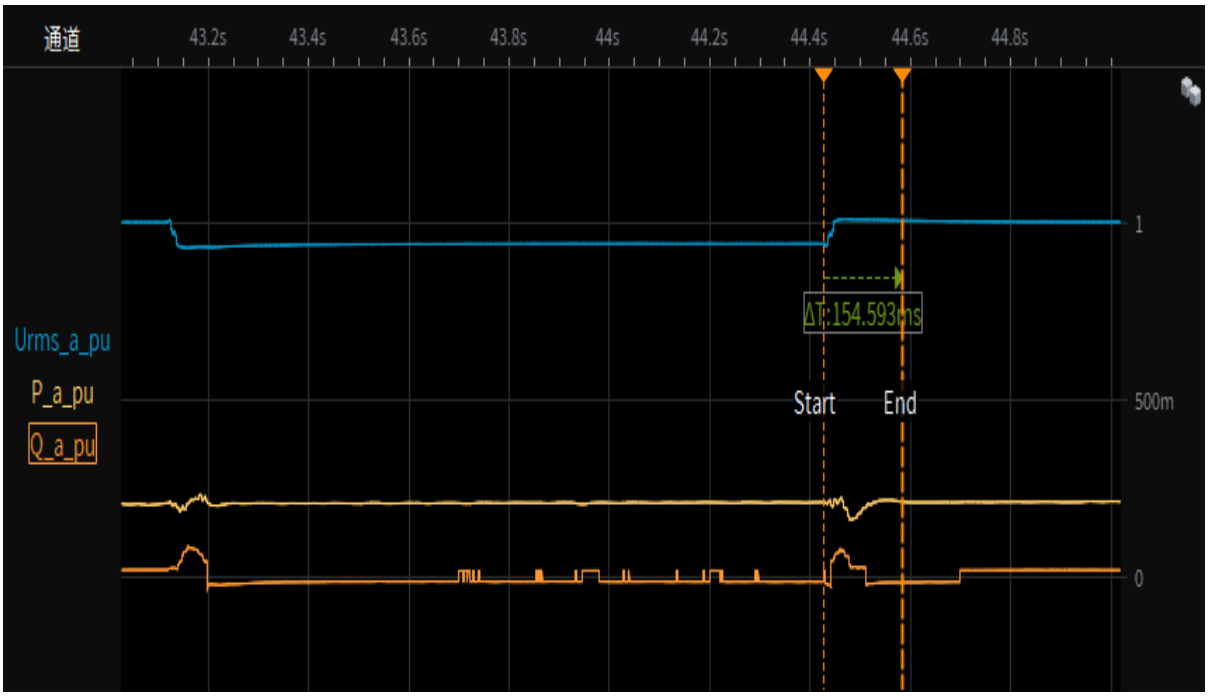


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4a-1.3 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

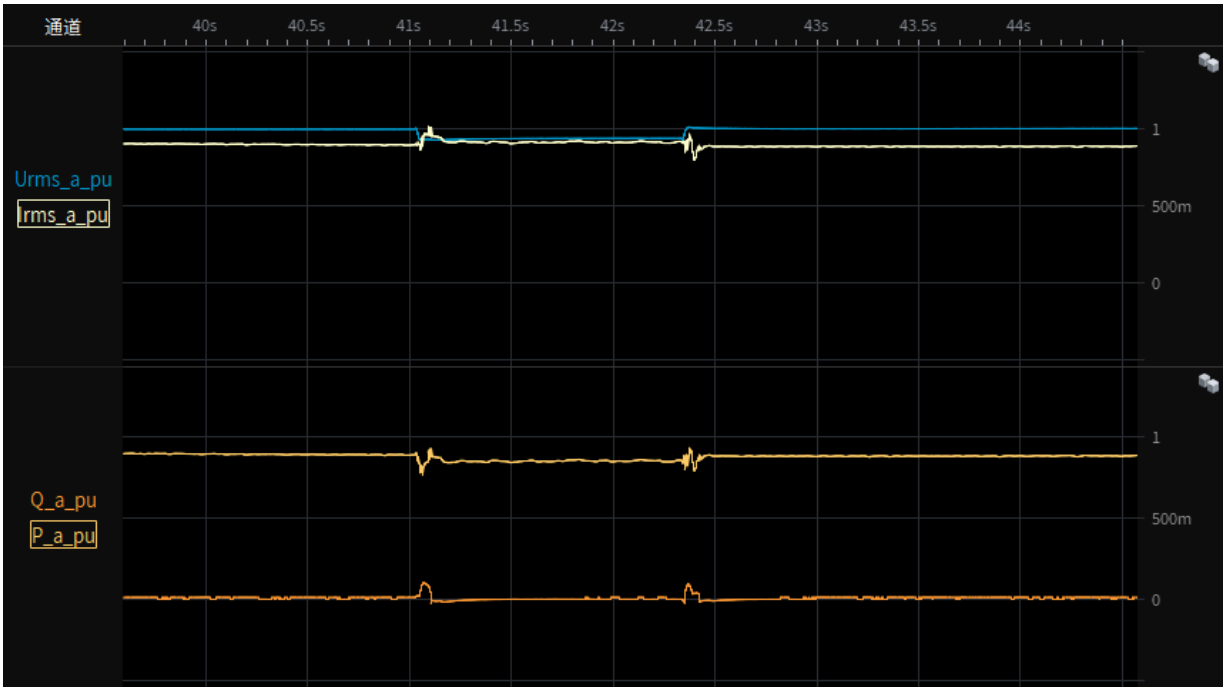


Test 4a-1.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),
20% load restoring time

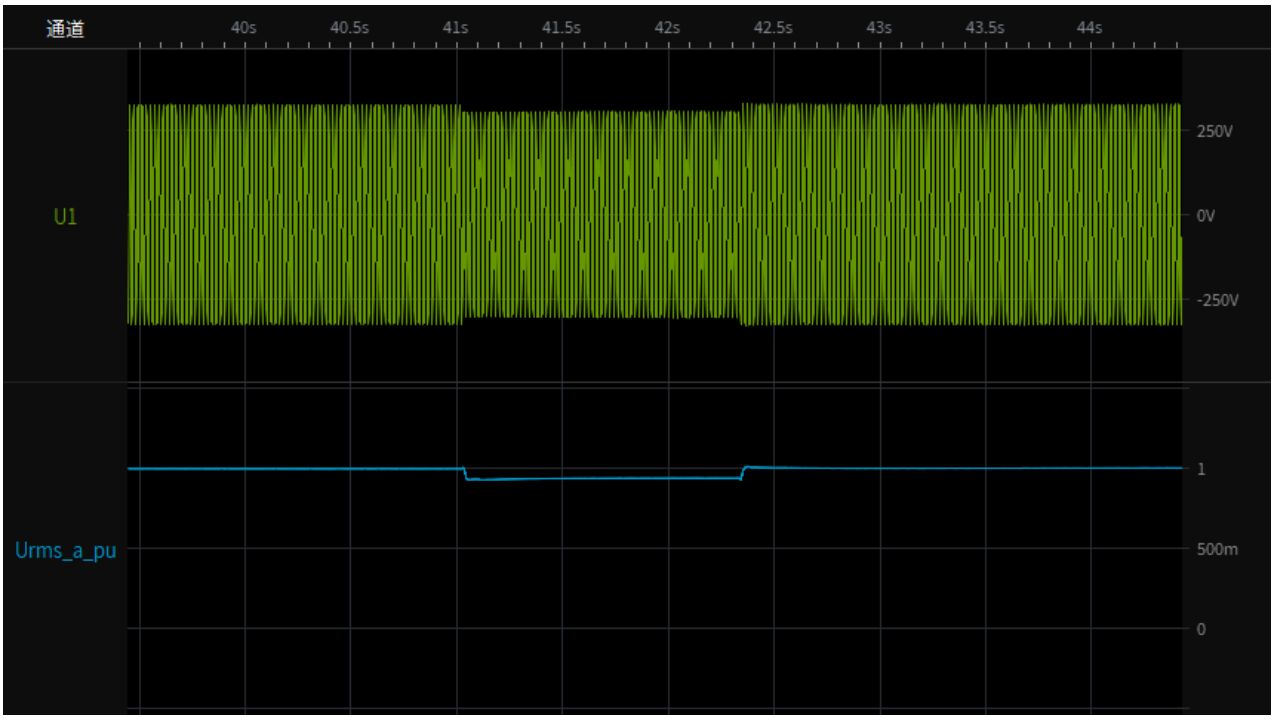


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4a-2.1 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

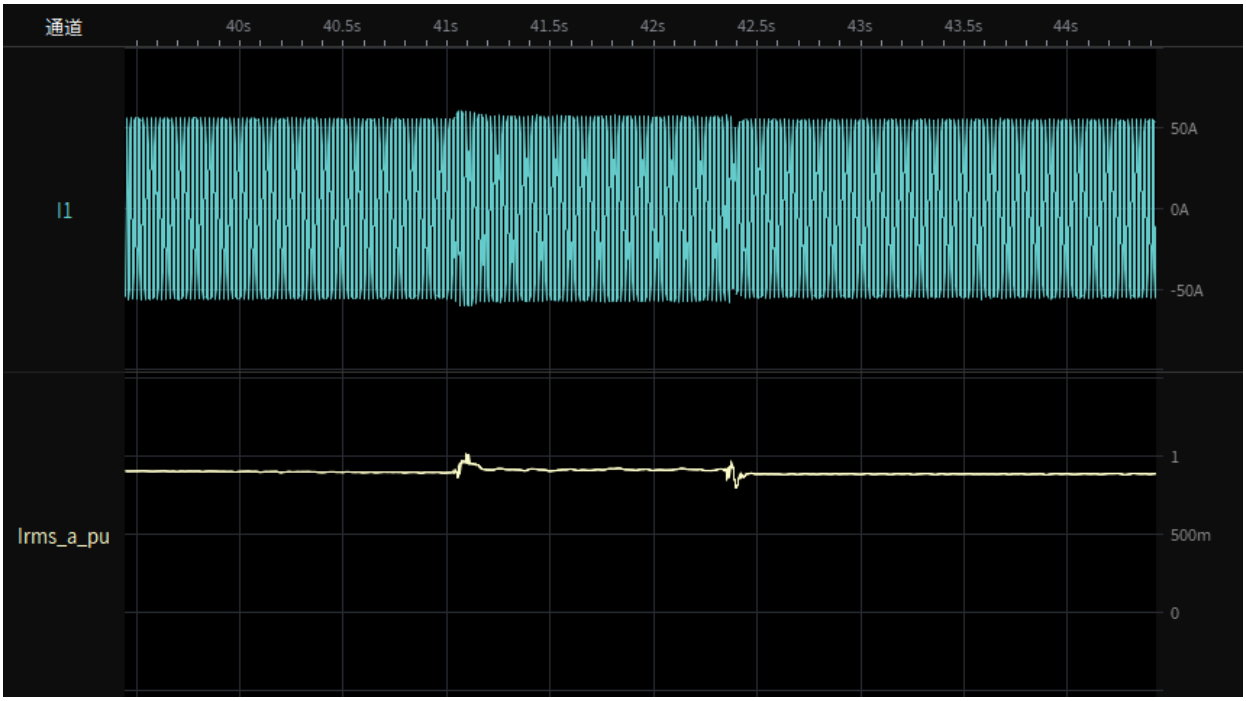


Test 4a-2.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

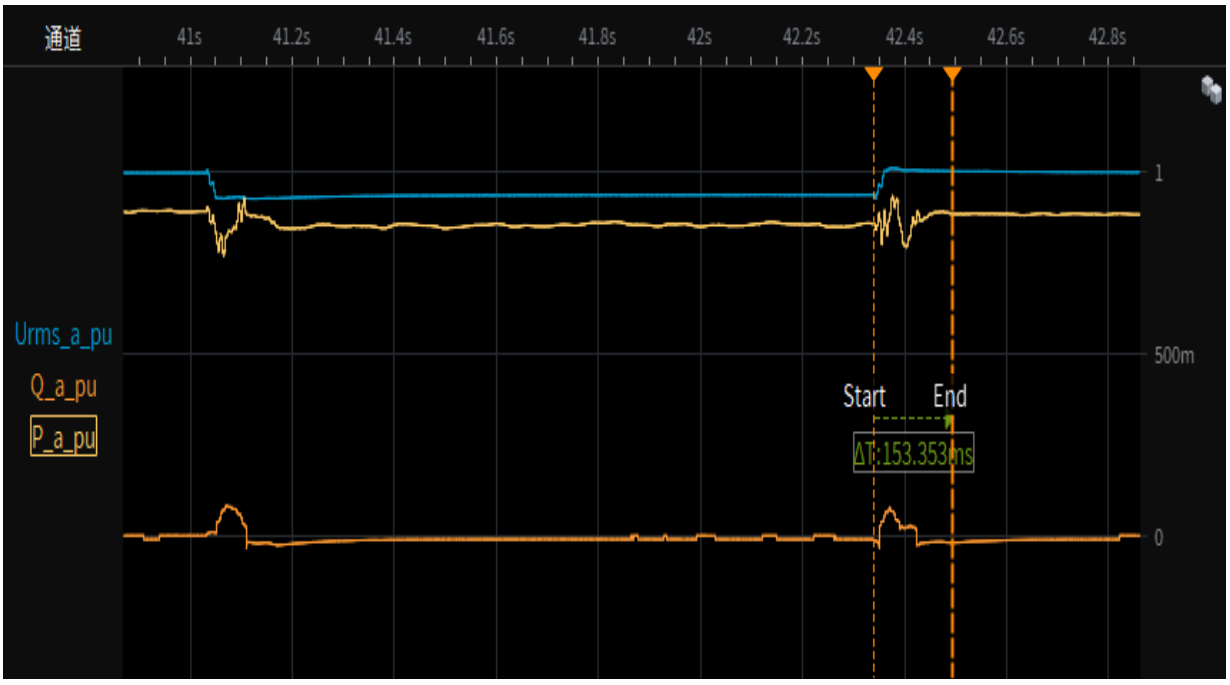


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4a-2.3 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

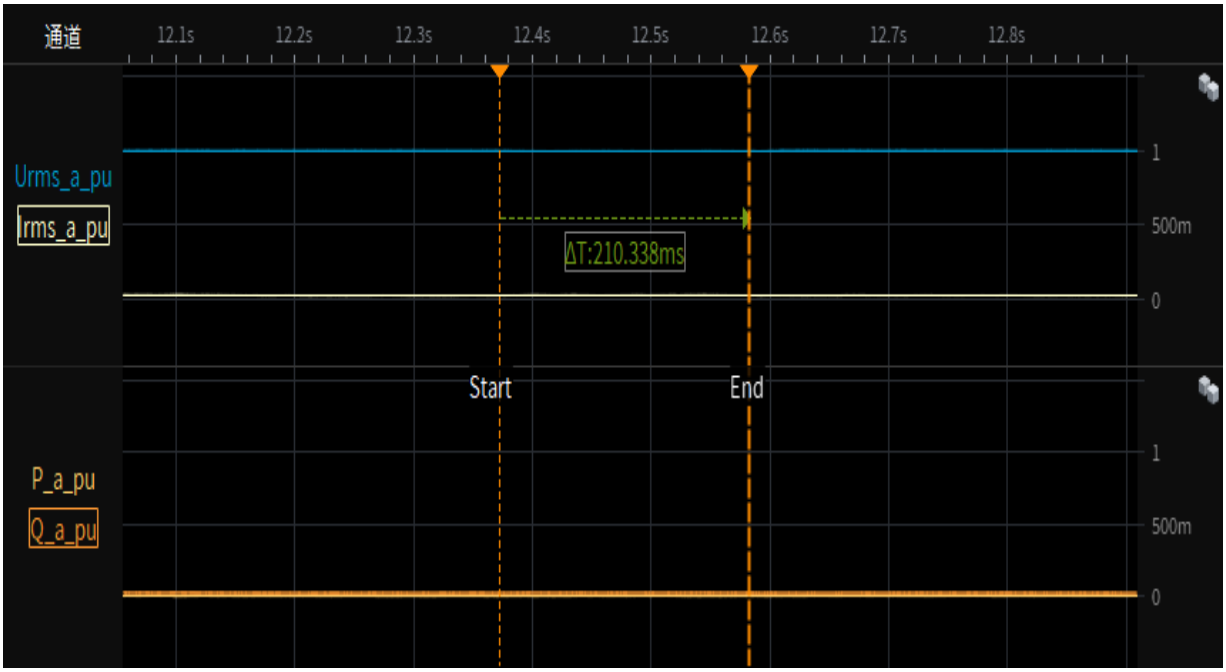


Test 4a-2.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),
95% load restoring time

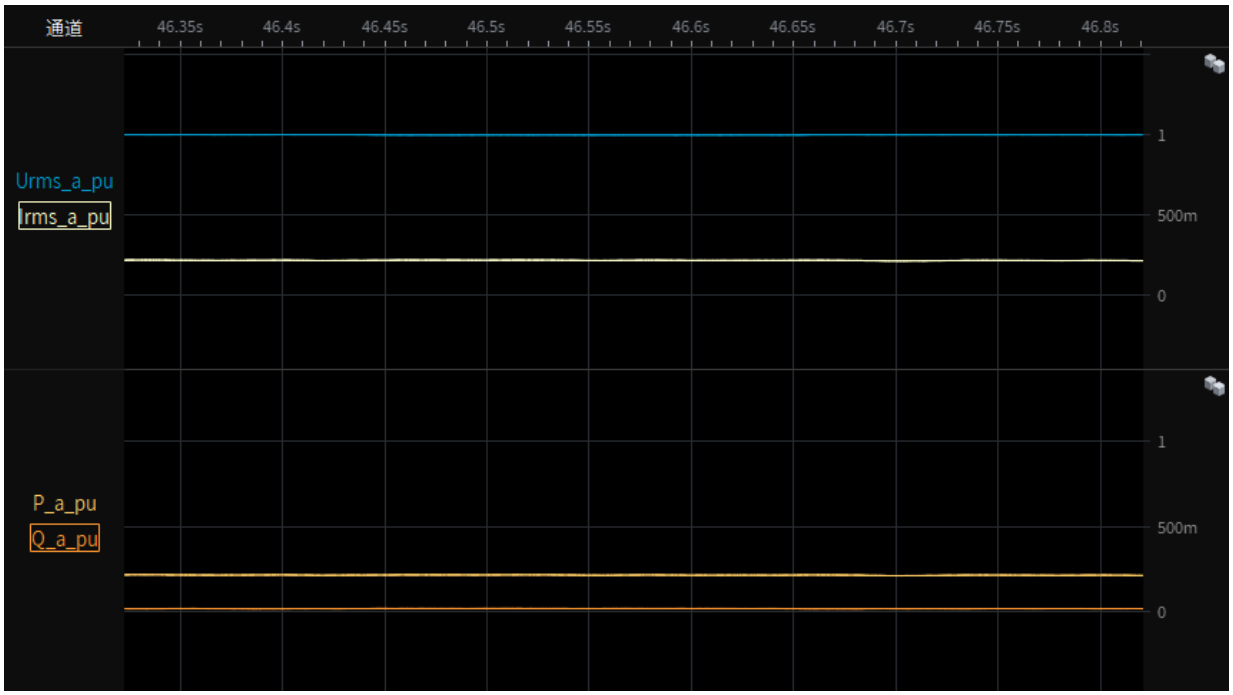


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5- Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

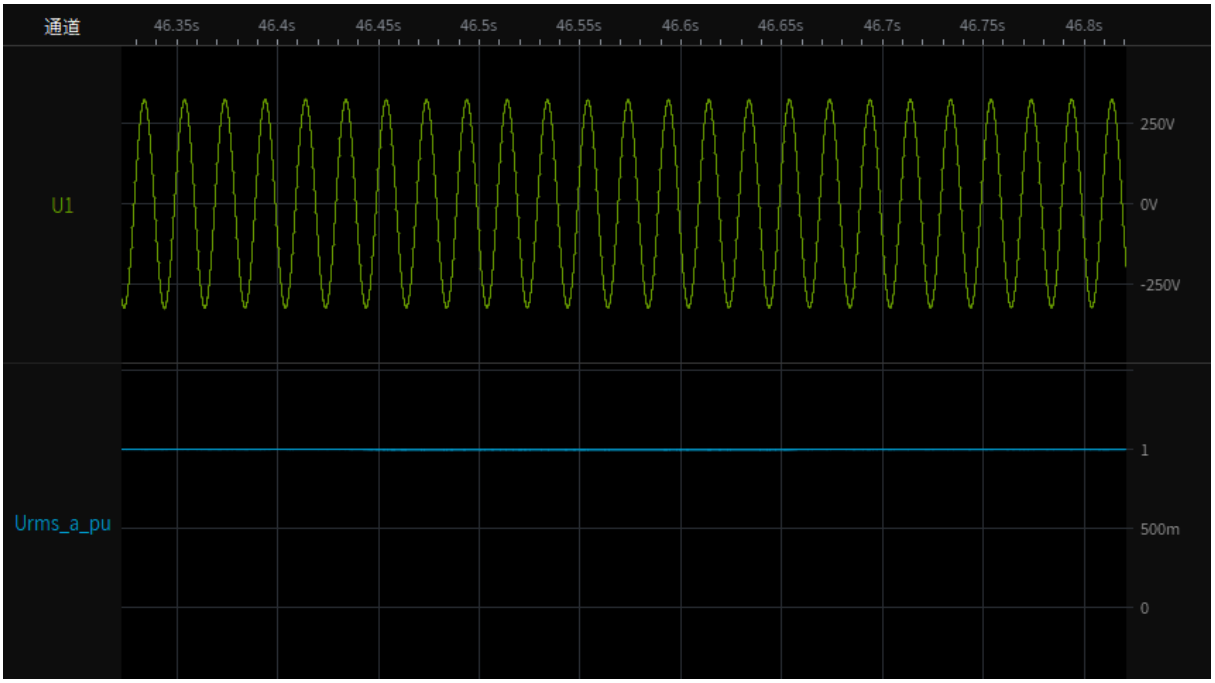


Test 5-1.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

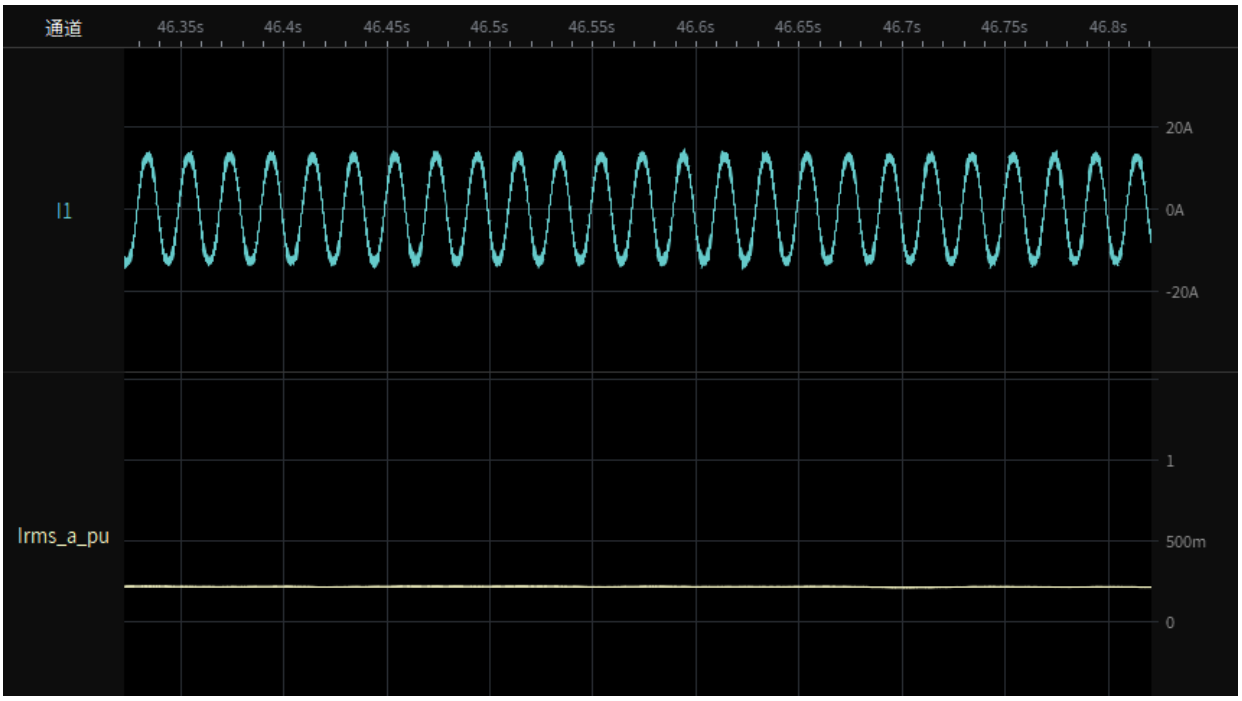


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5-1.2 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

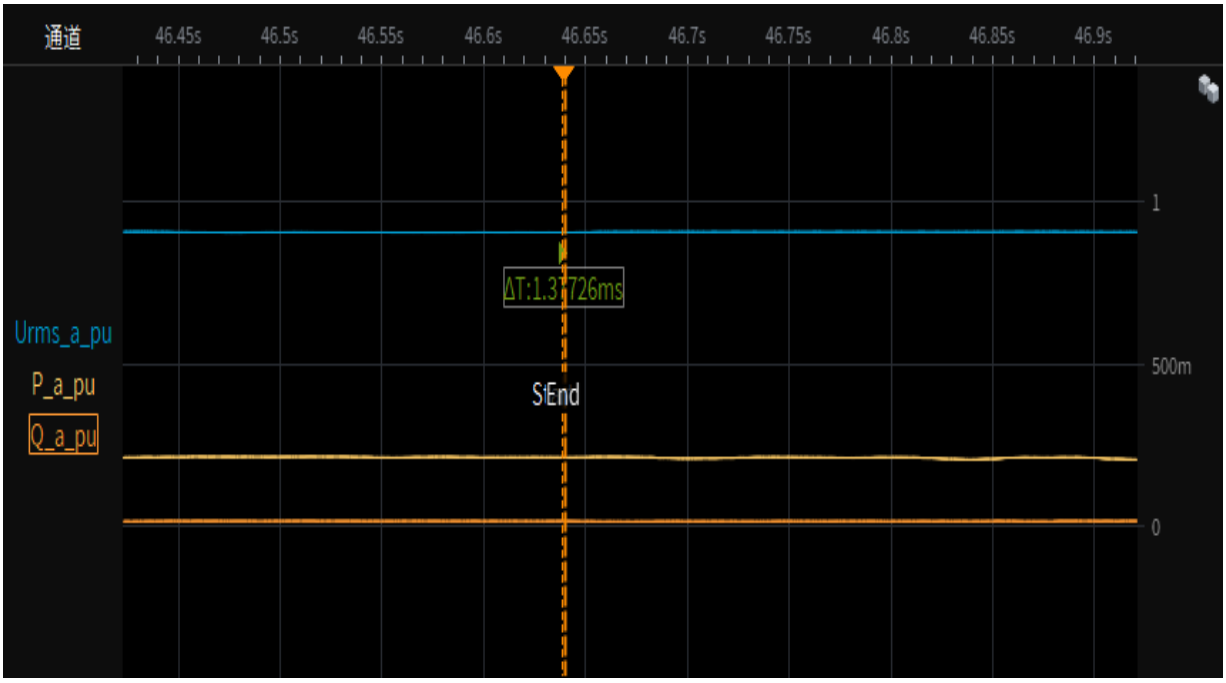


Test 5-1.3 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

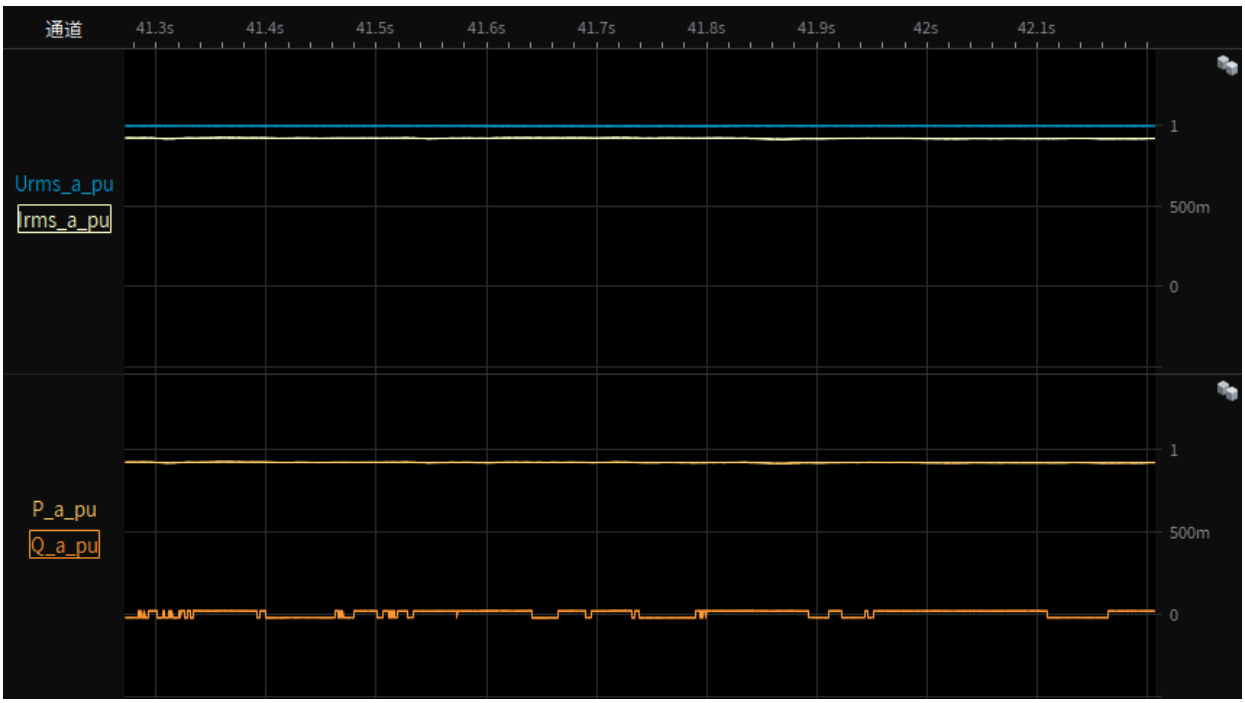


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5-1.4 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D), 20% load restoring time

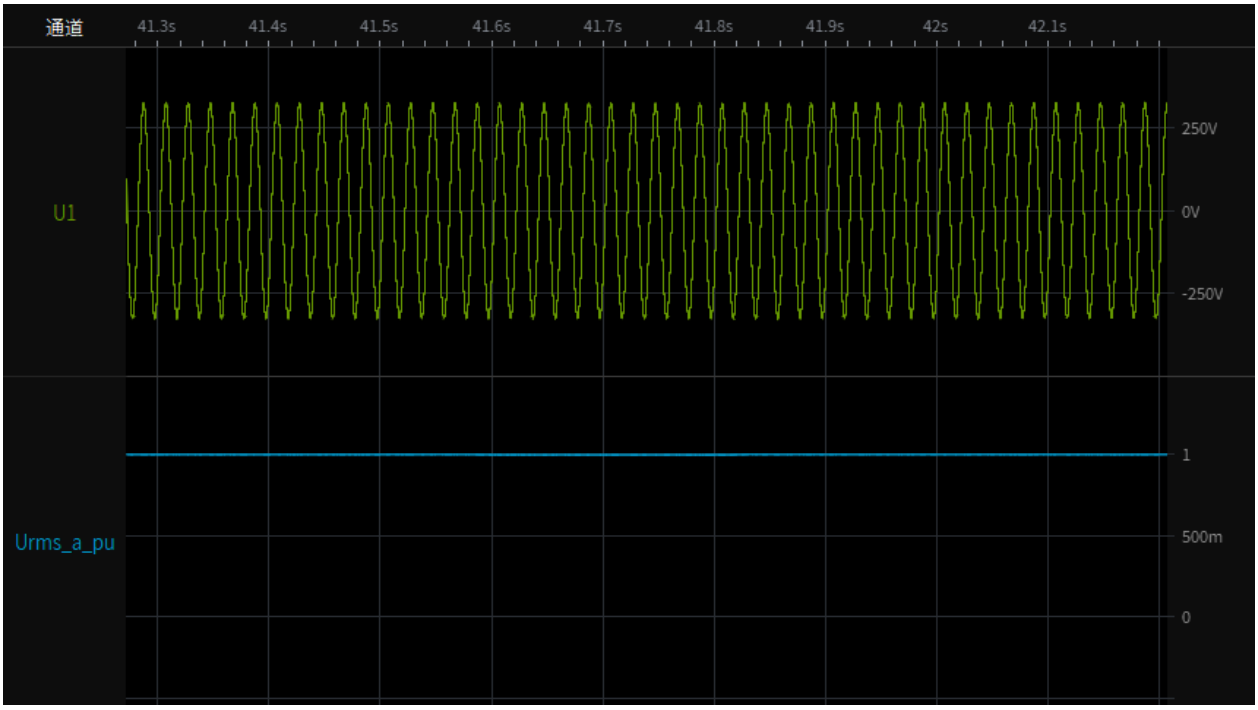


Test 5-2.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

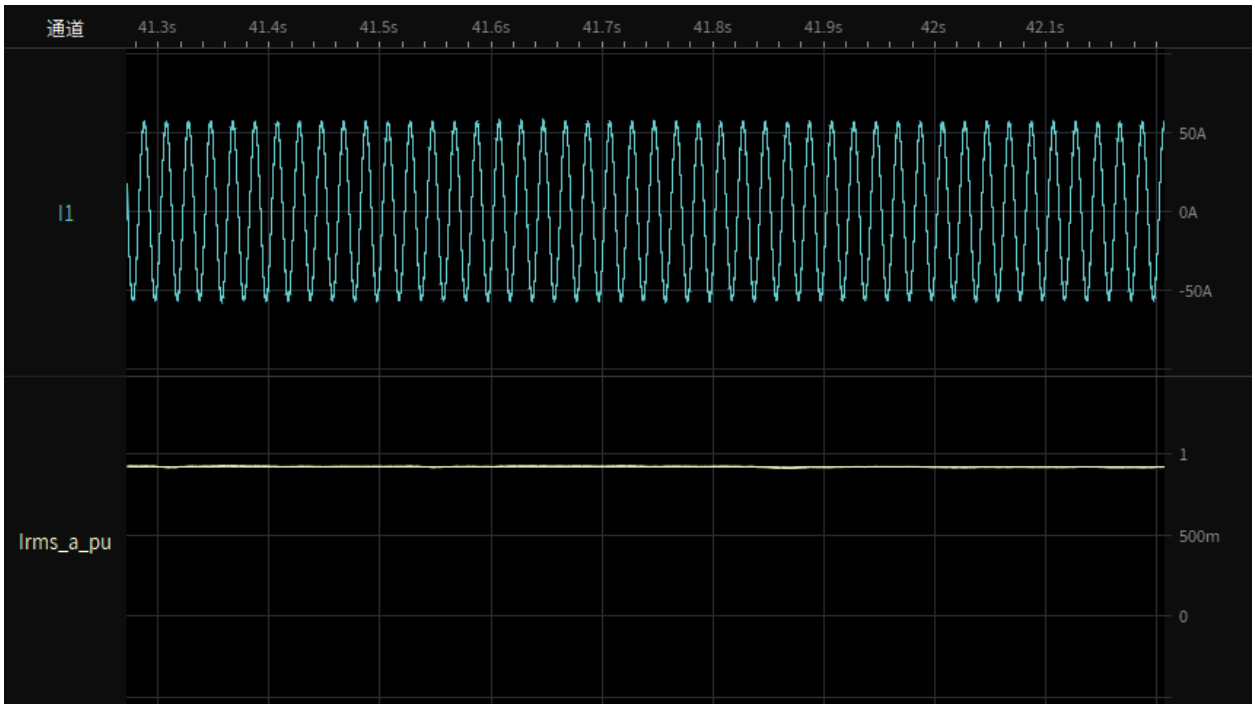


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5-2.2 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

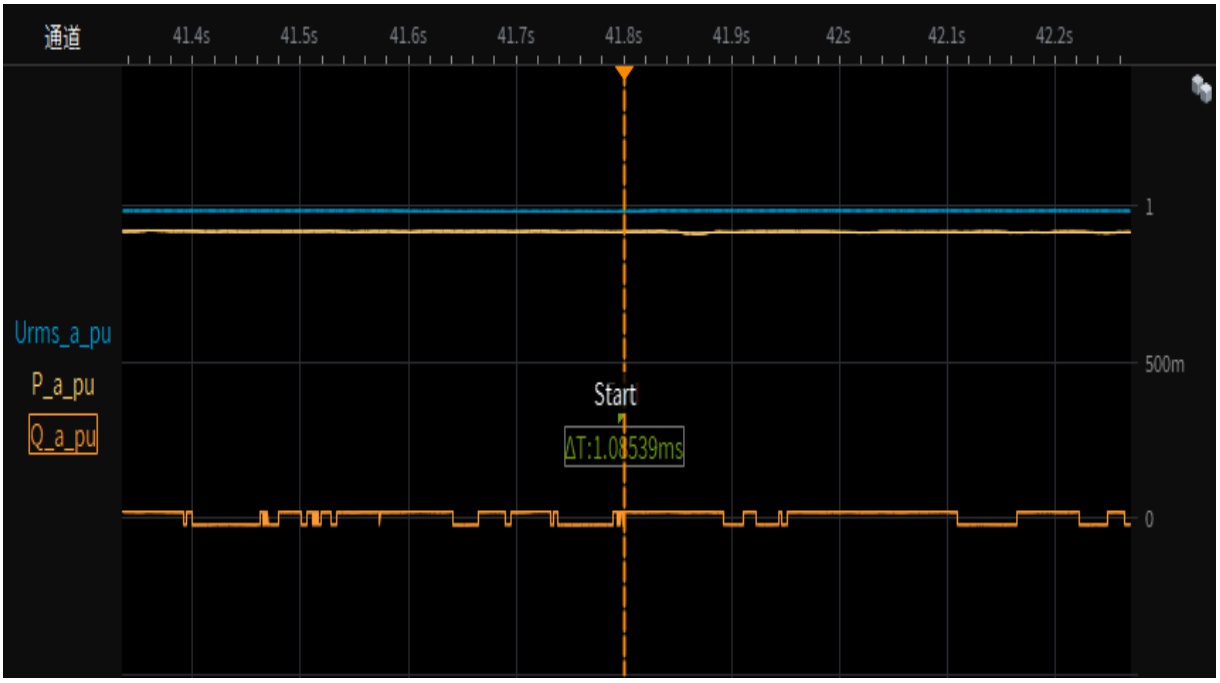


Test 5-2.3 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

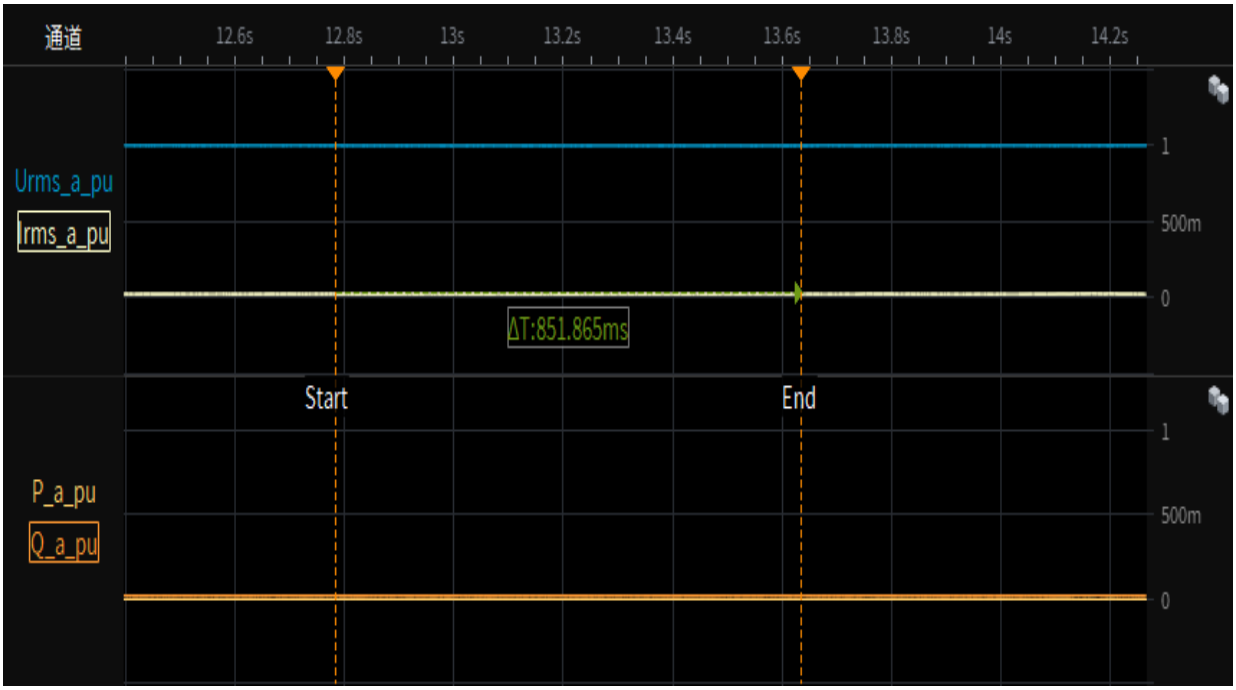


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5-2.4 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D), 95% load restoring time

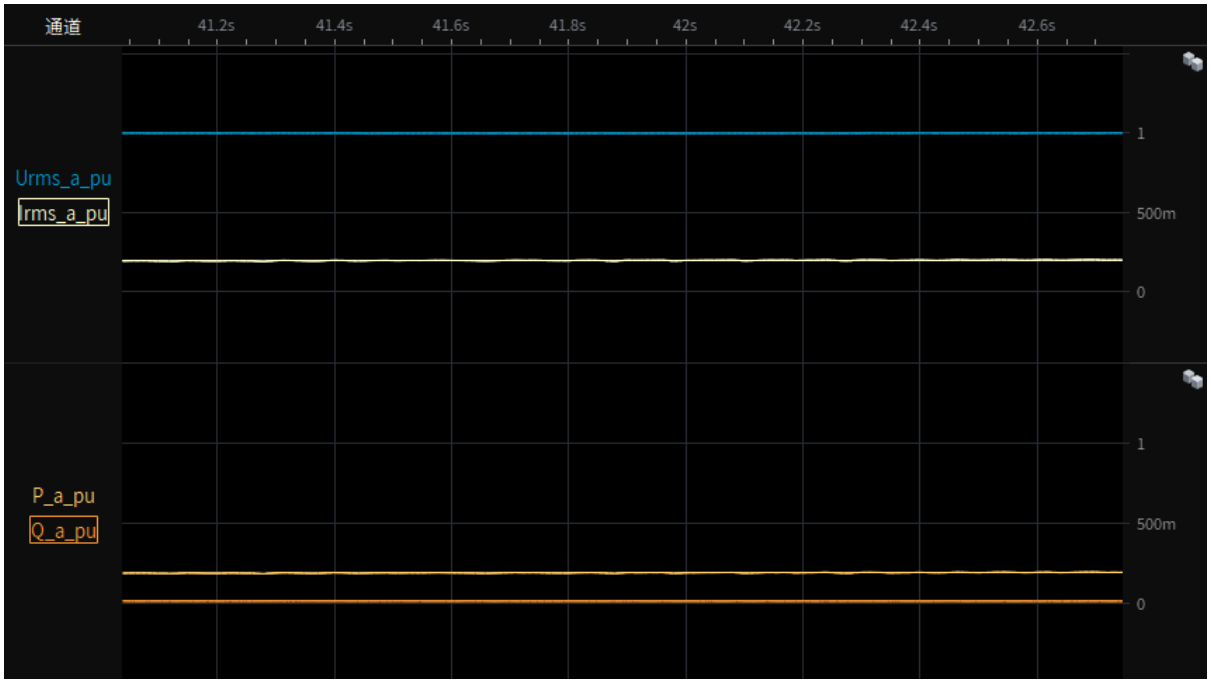


Test 6- Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),0% load
Test overview(voltage,current,active and reactive power)

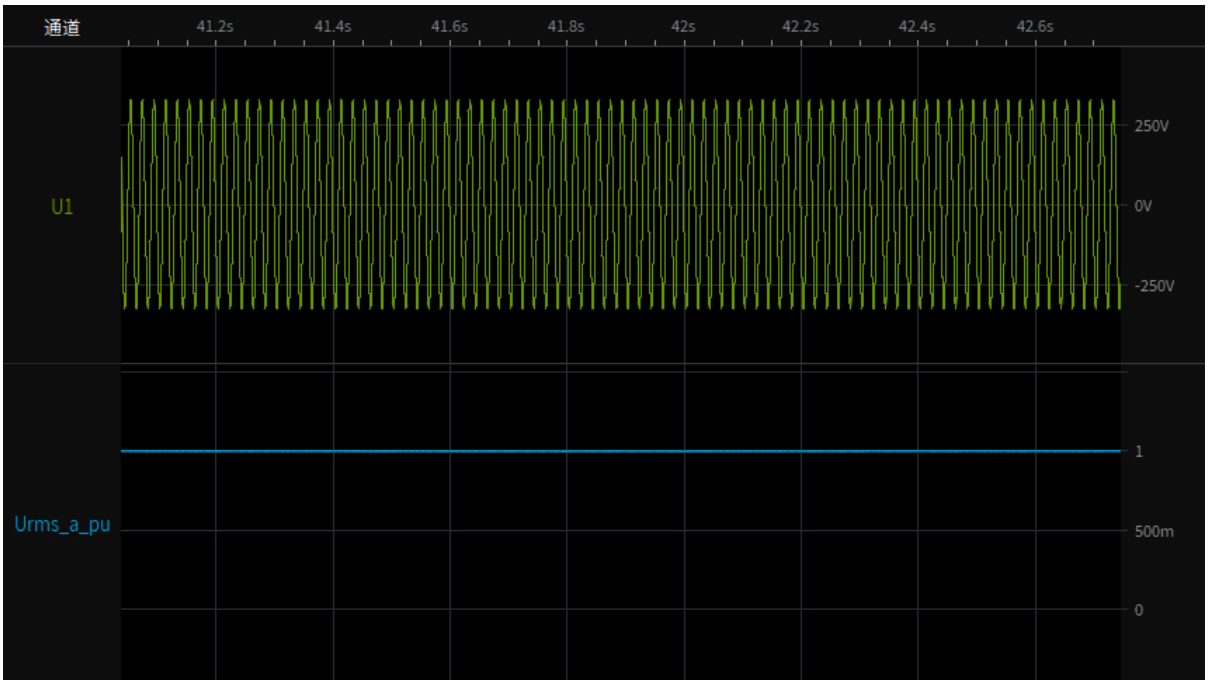


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6-1.1 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

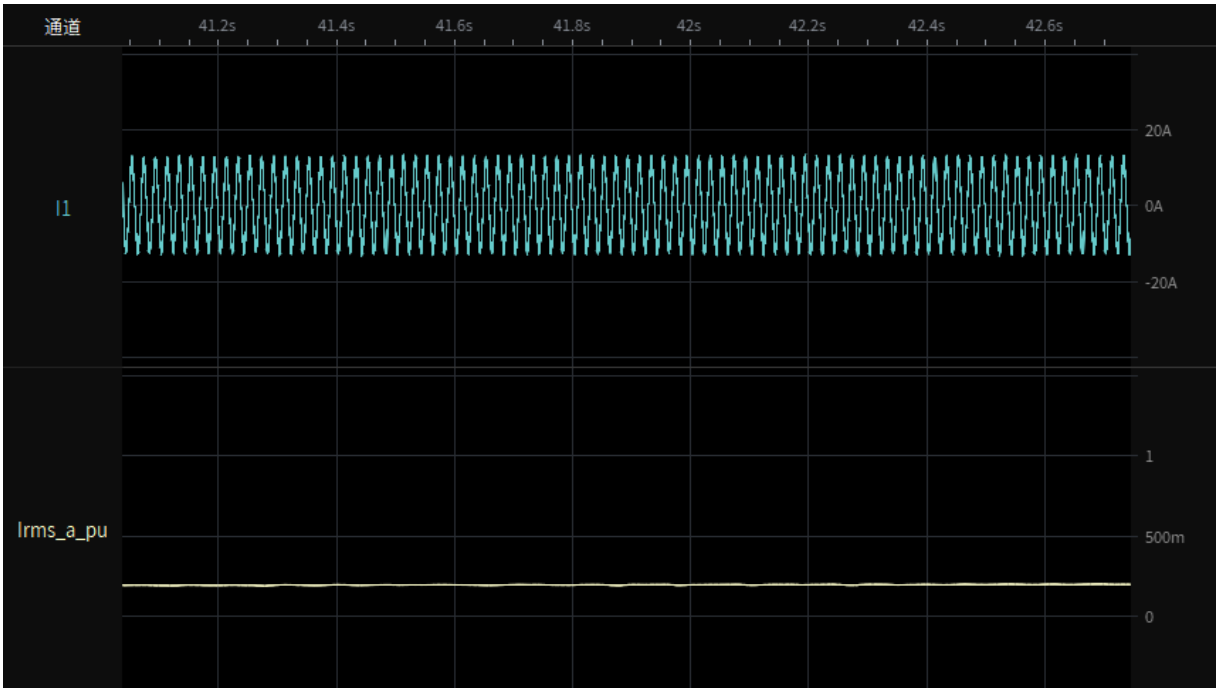


Test 6-1.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

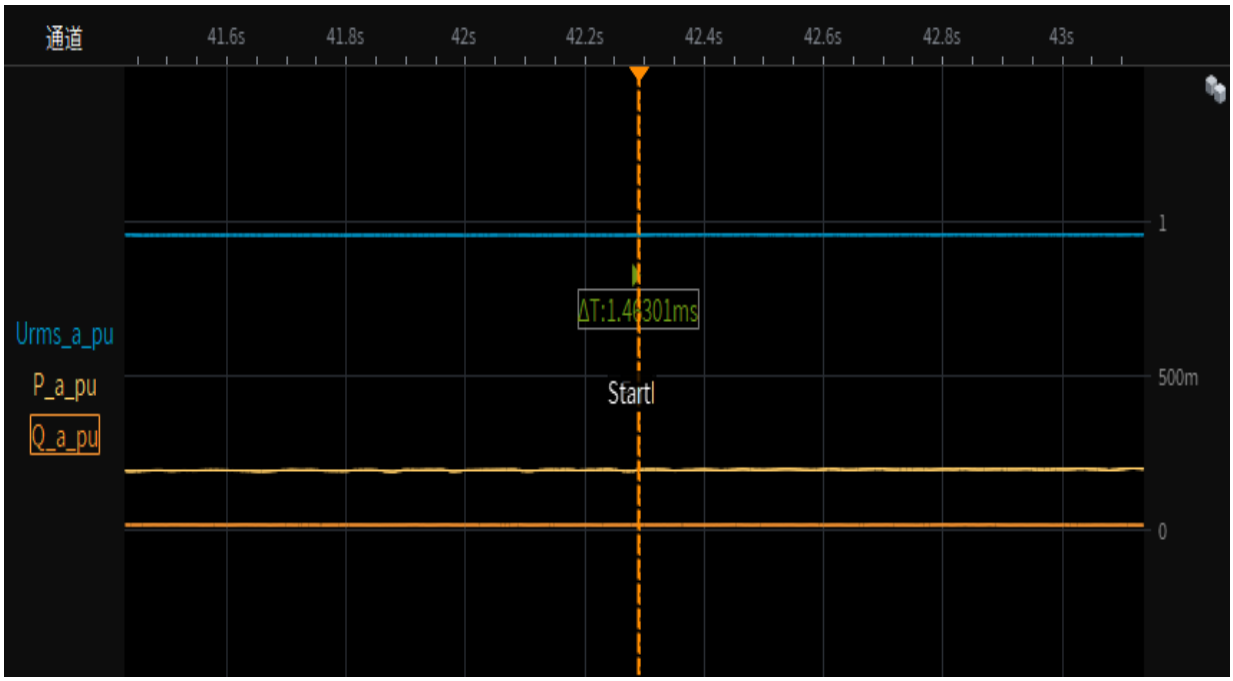


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6-1.3 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

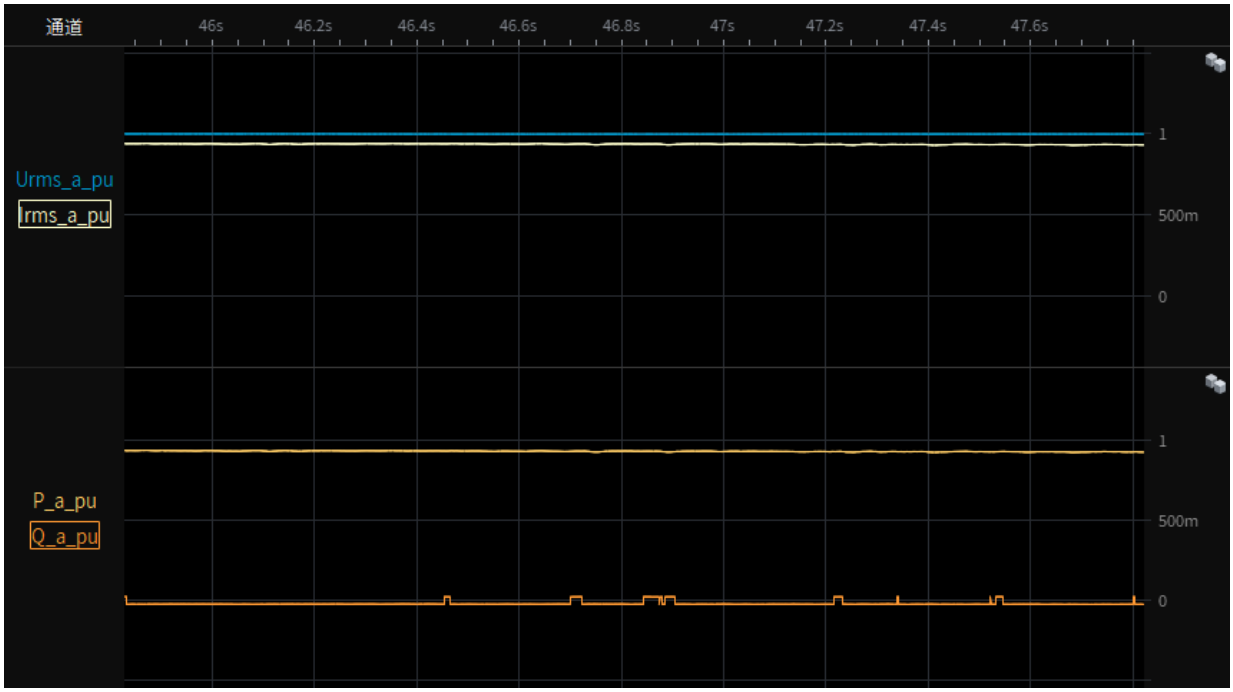


Test 6-1.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),
20% load restoring time

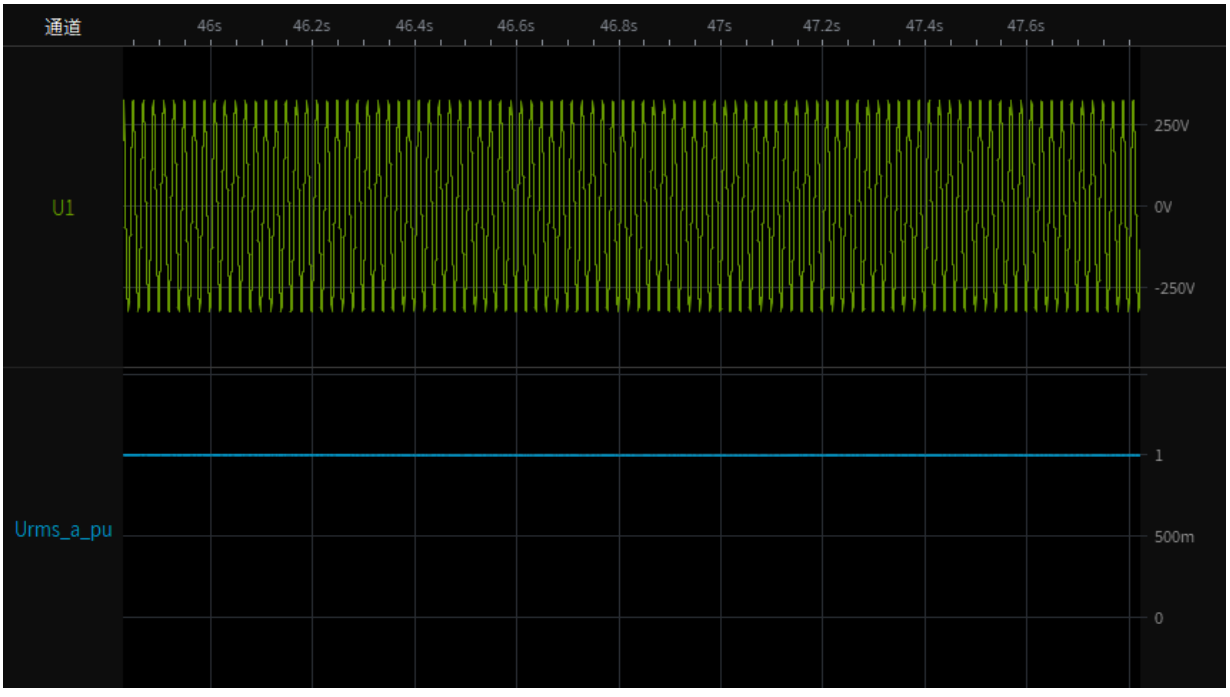


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6-2.1 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

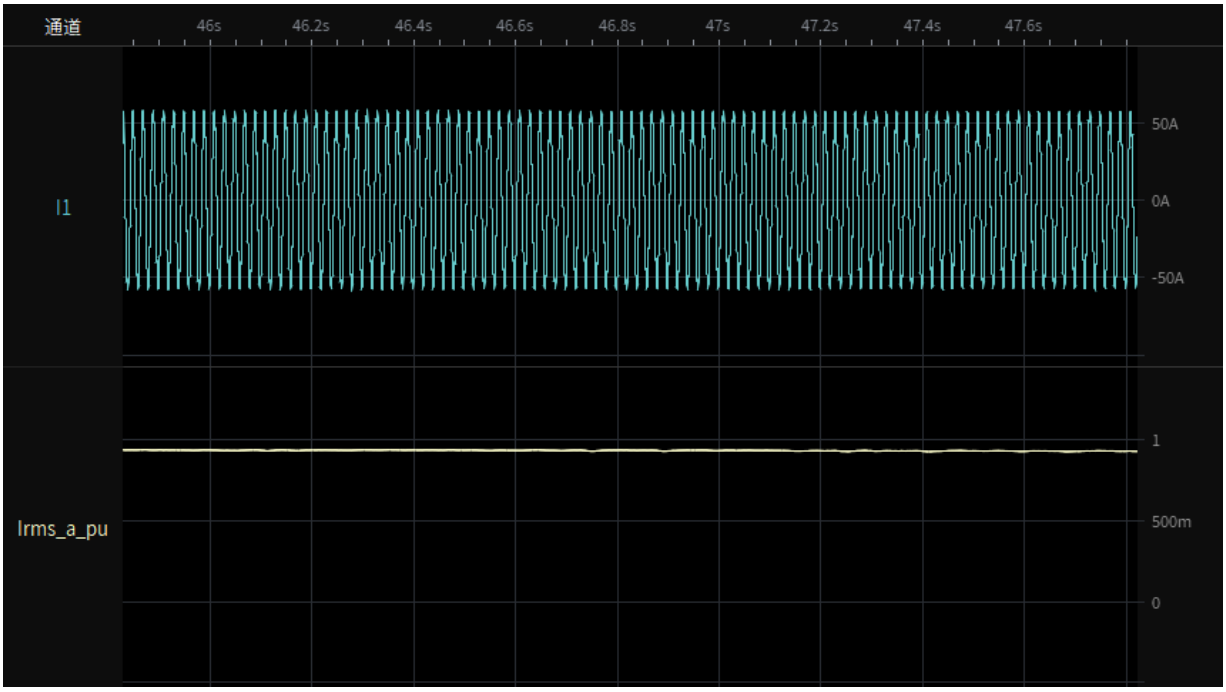


Test 6-2.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

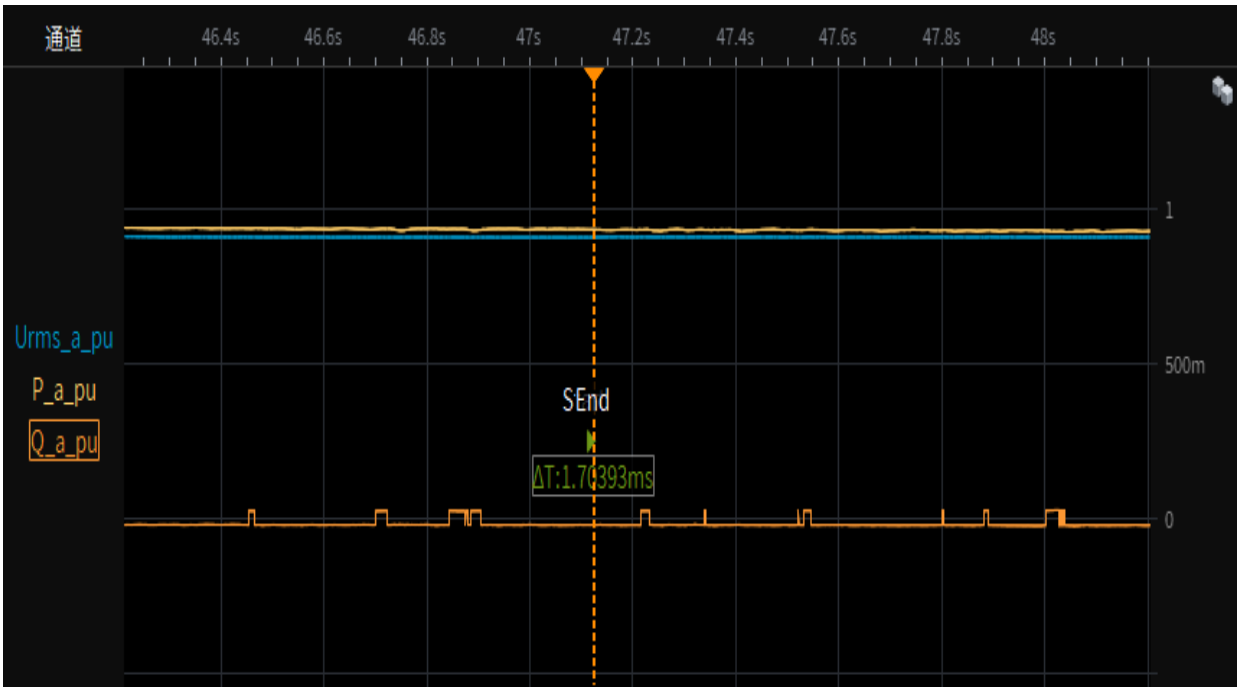


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6-2.3 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

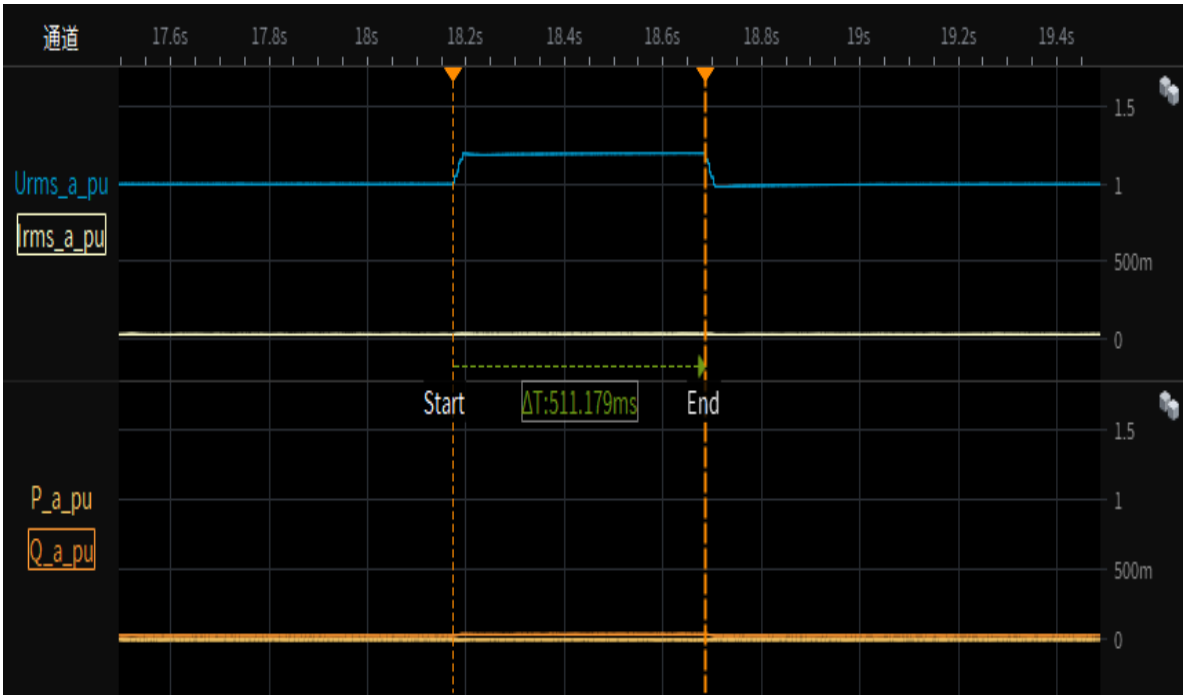


Test 6-2.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),
95% load restoring time

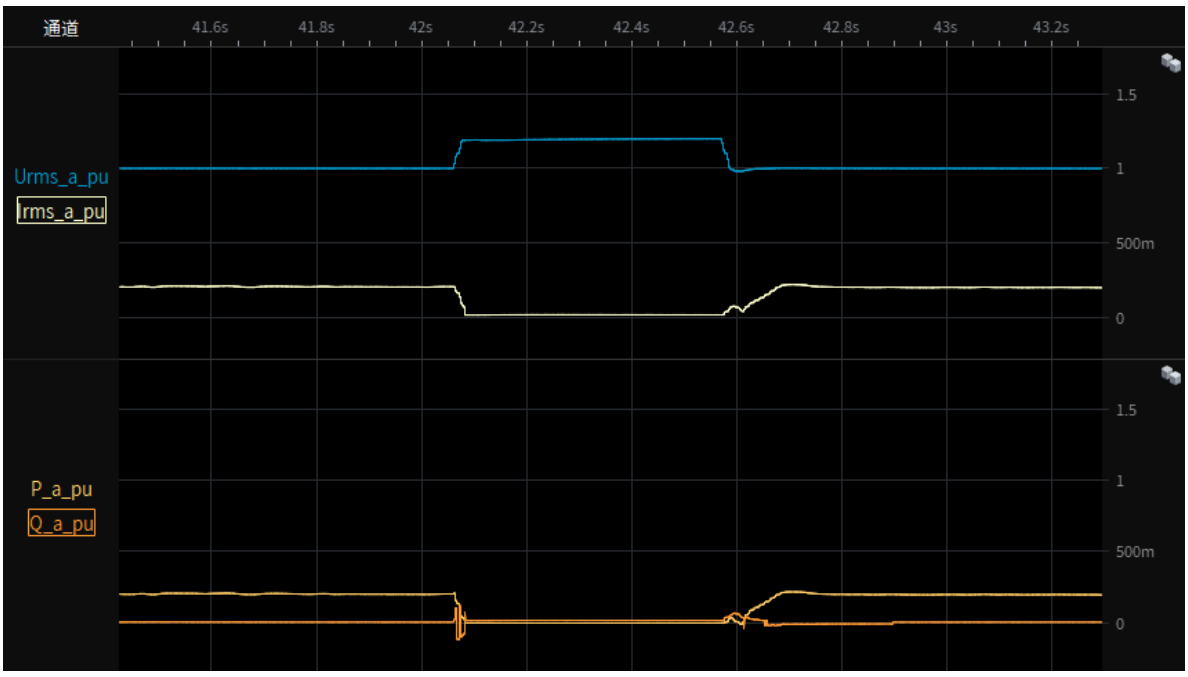


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7-Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A), 0% load
Test overview(voltage,current,active and reactive power)

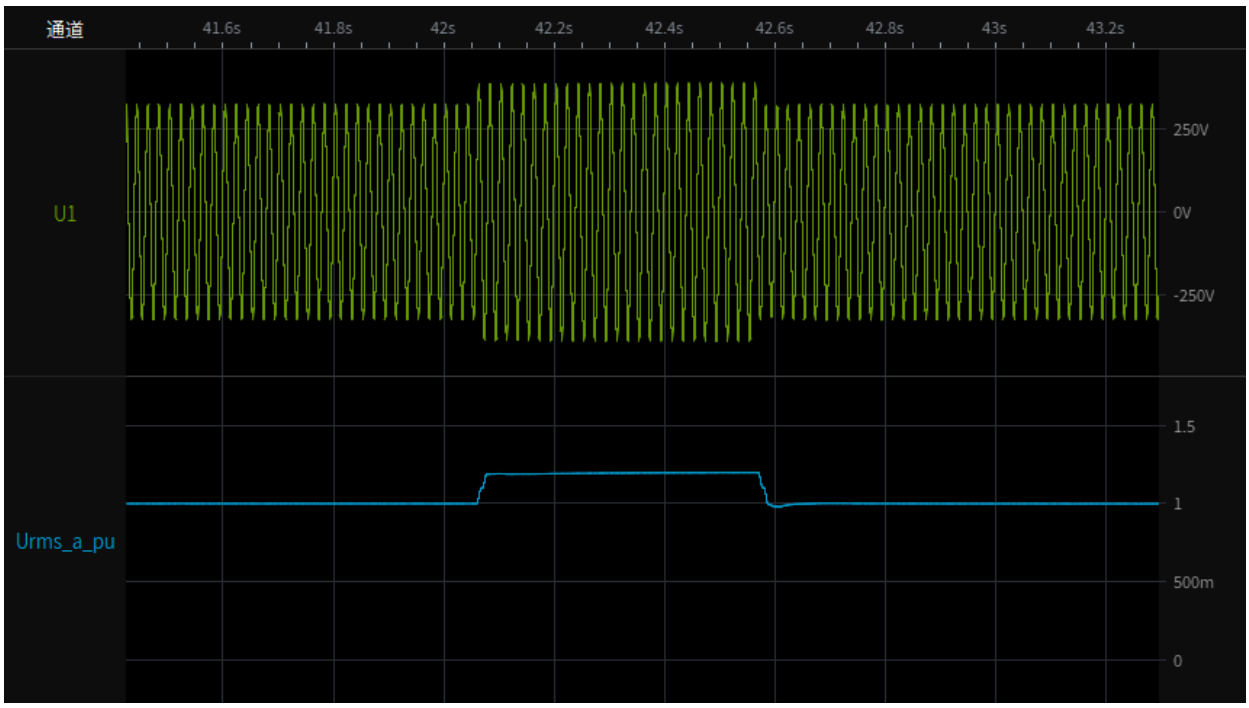


Test 7-1.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

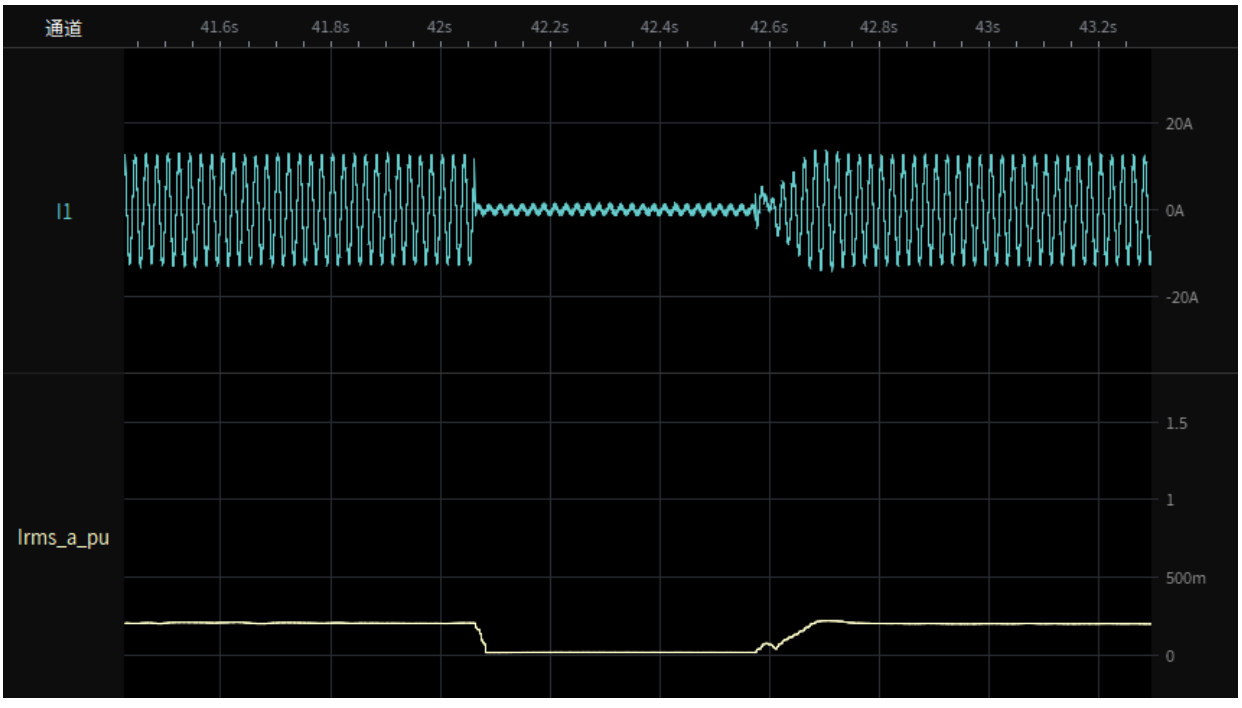


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7-1.2 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

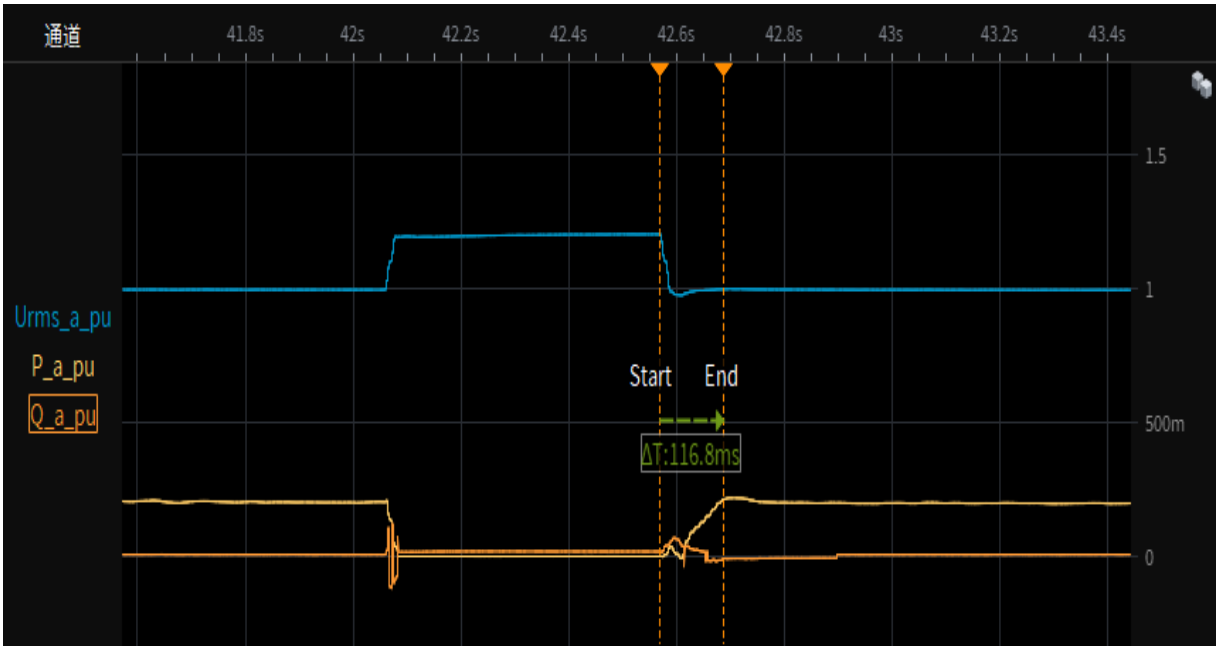


Test 7-1.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

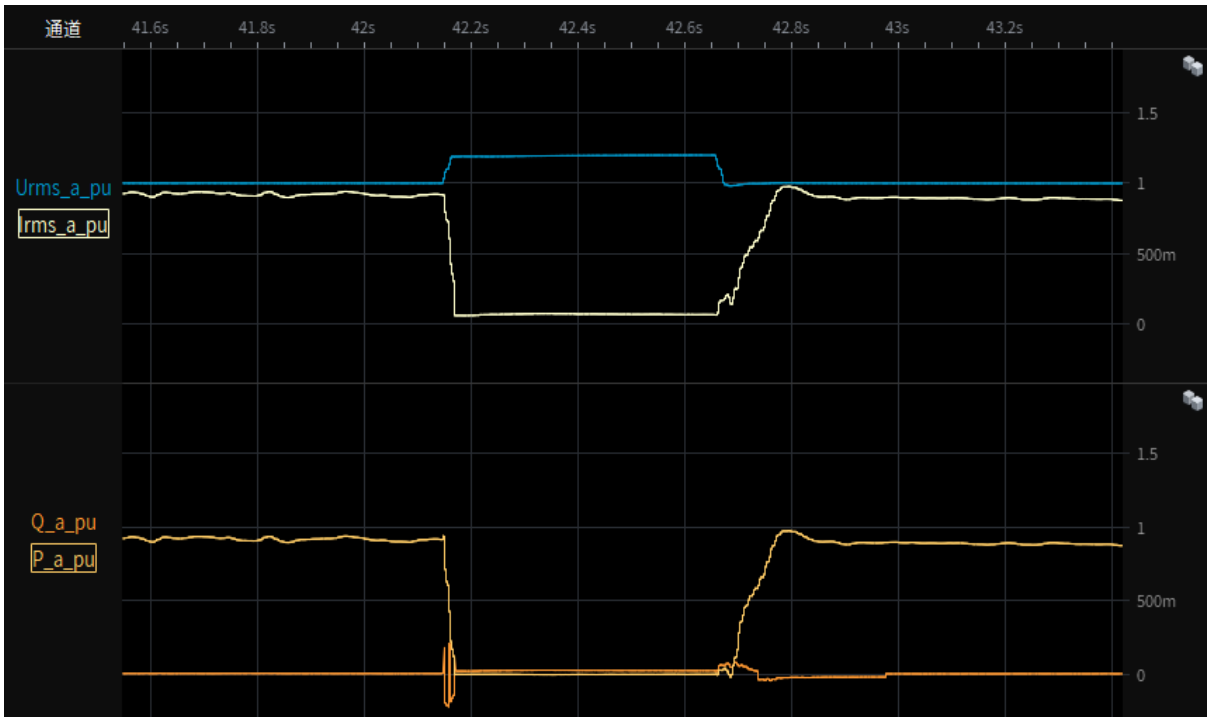


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7-1.4 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load restoring time

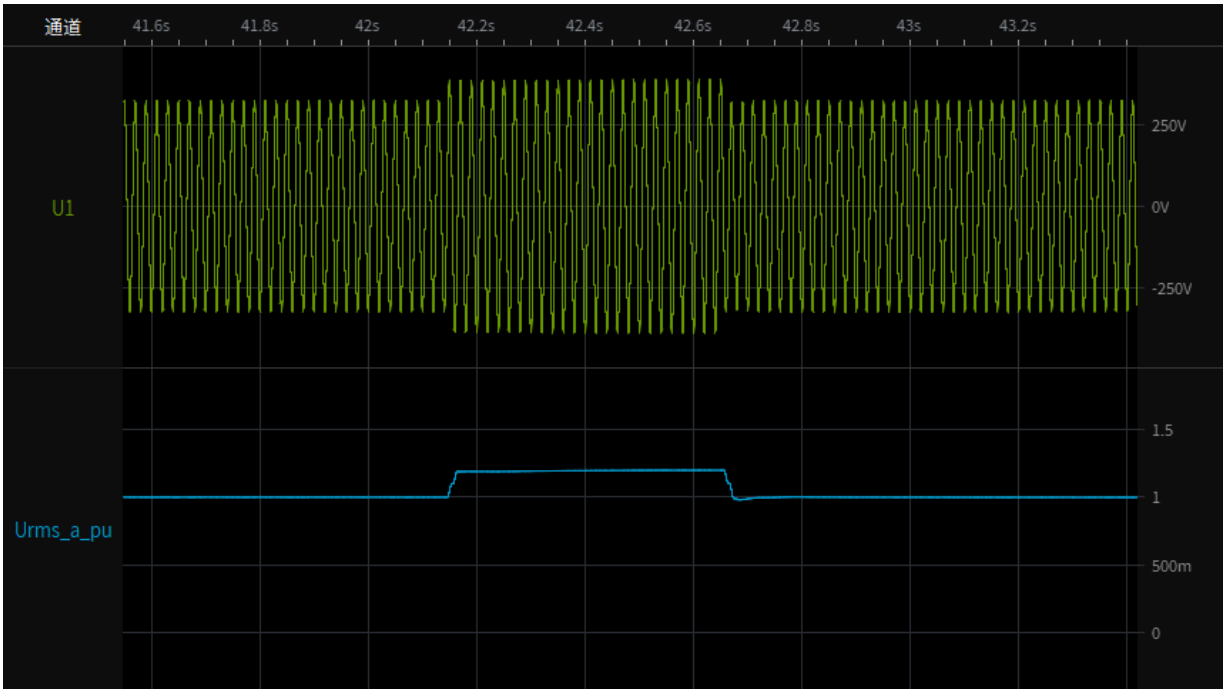


Test 7-2.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load Test overview(voltage,current,active and reactive power)

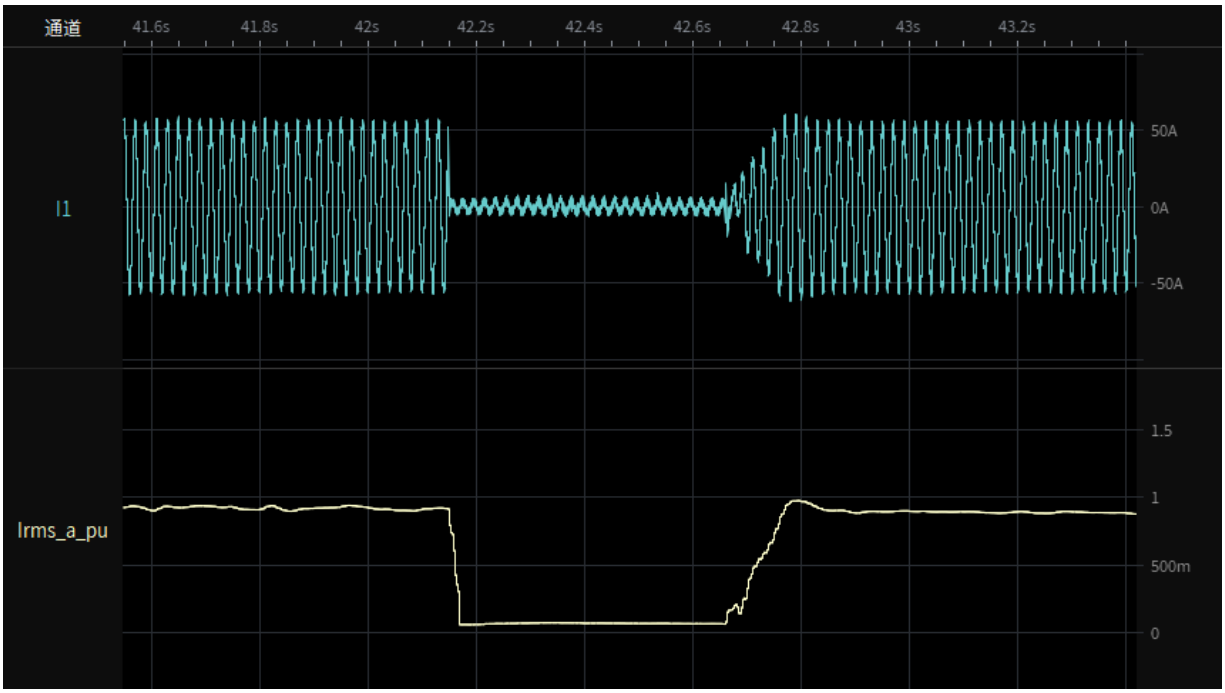


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7-2.2 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

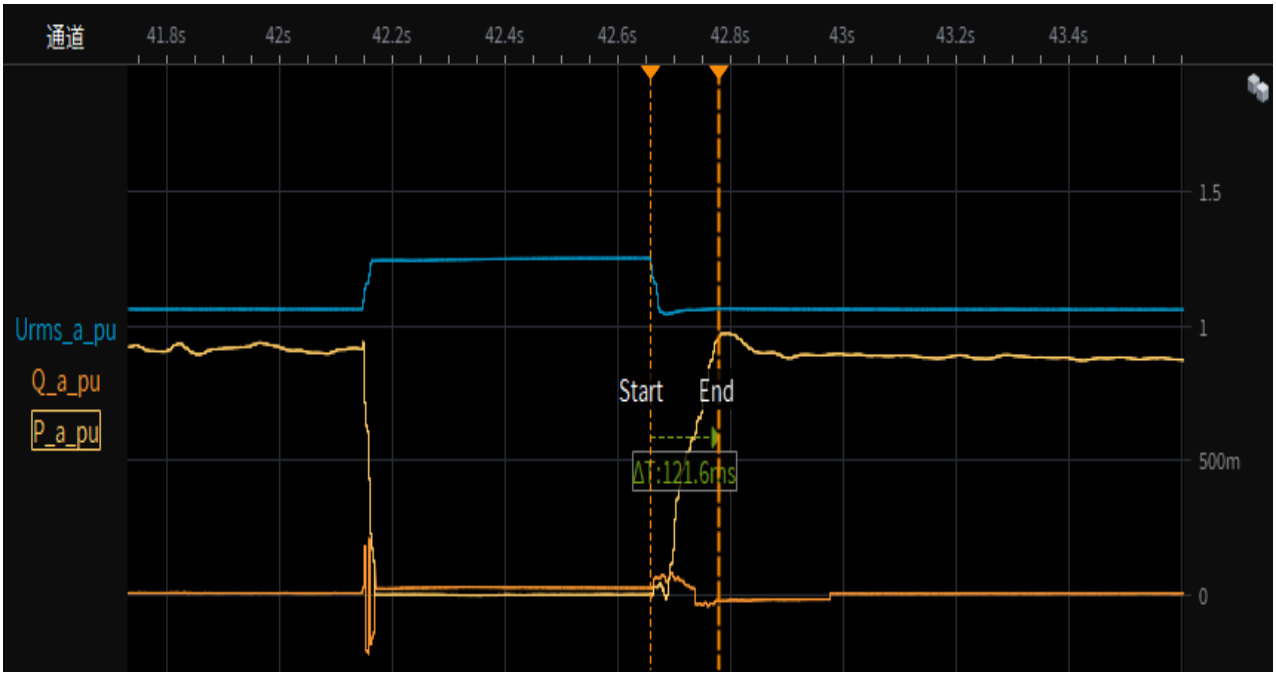


Test 7-2.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

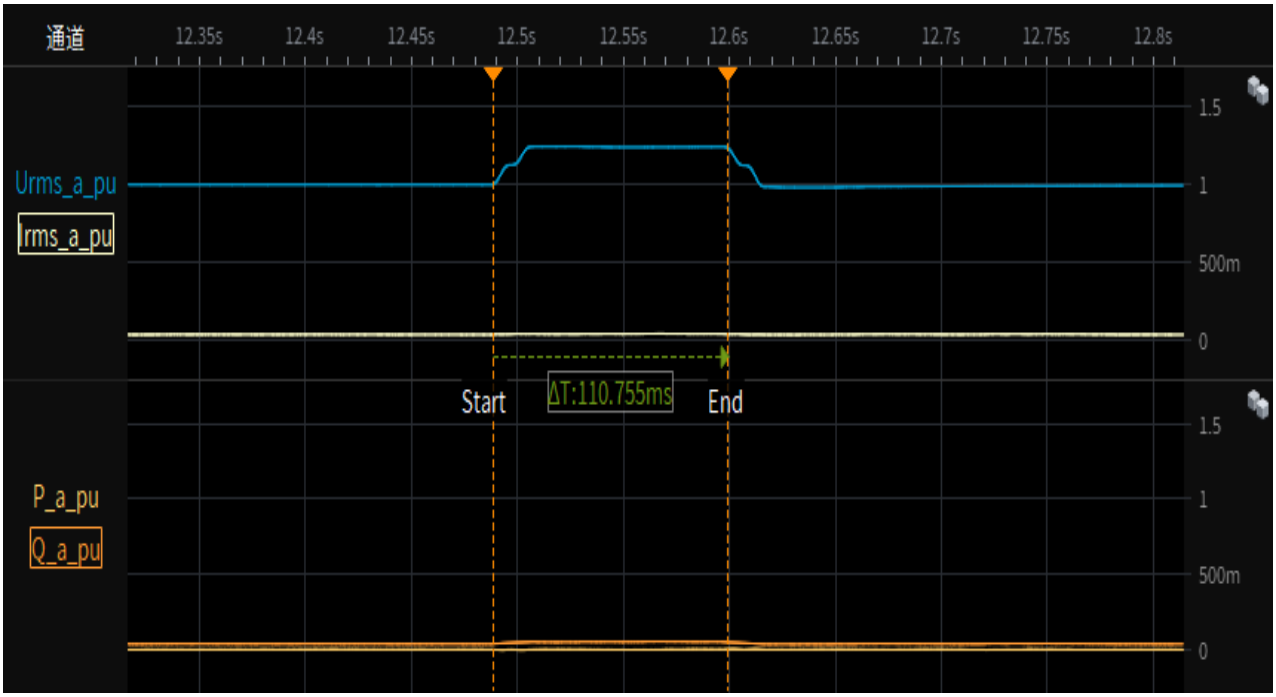


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7-2.4 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A), 95% load restoring time

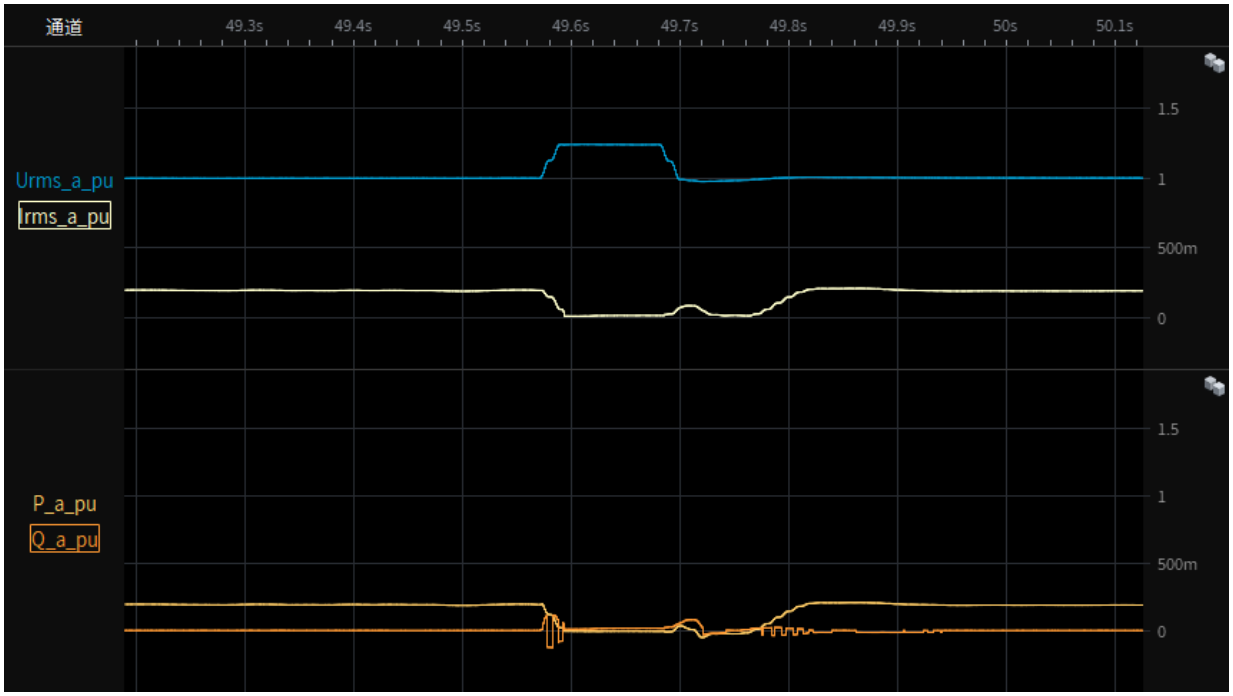


Test 8-Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A), 0% load
Test overview(voltage,current,active and reactive power)

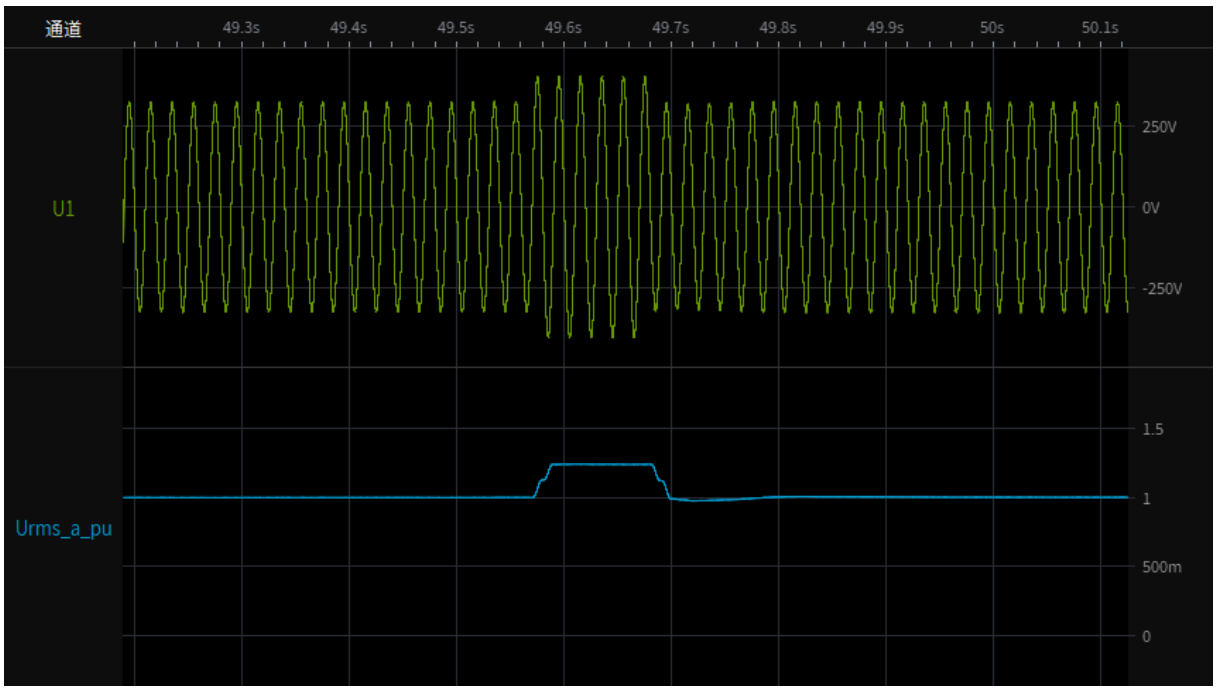


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 8-1.1 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

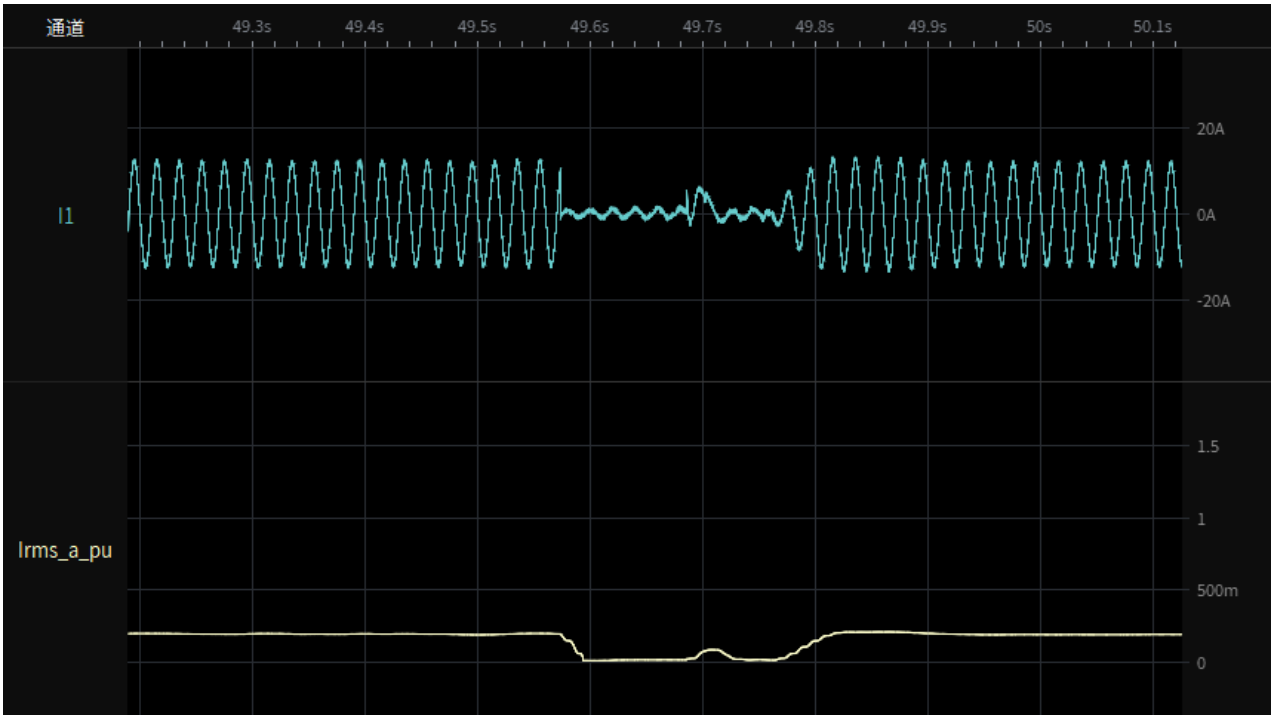


Test 8-1.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

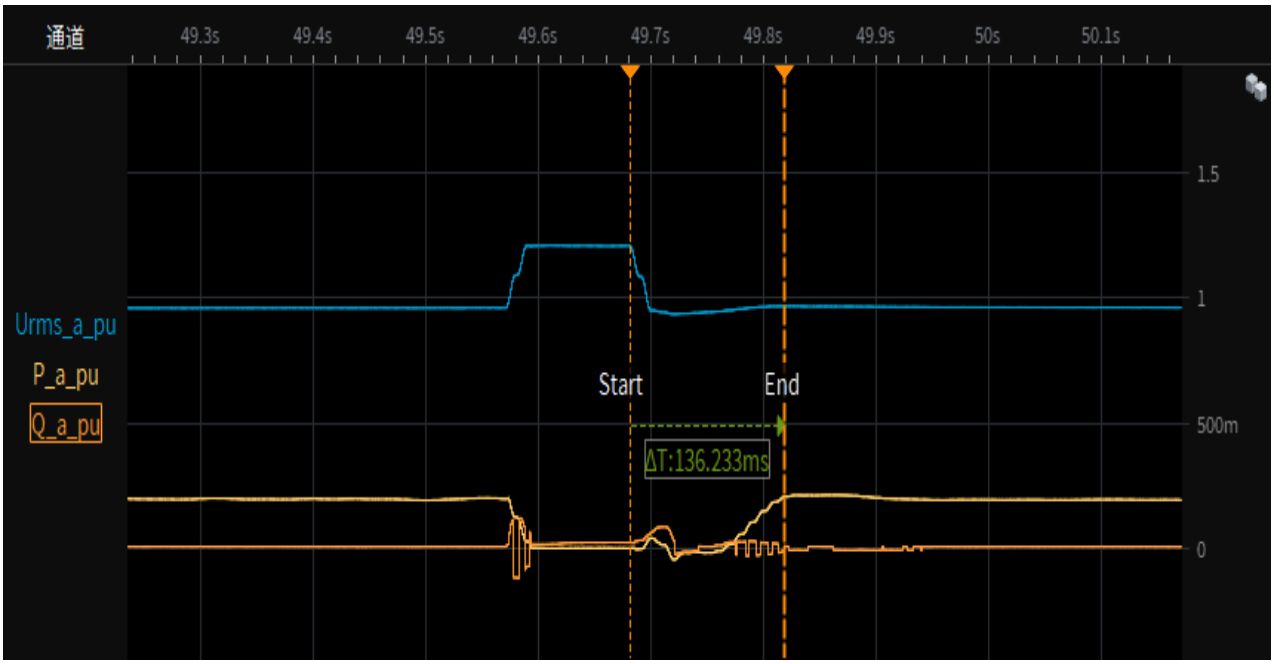


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 8-1.3 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

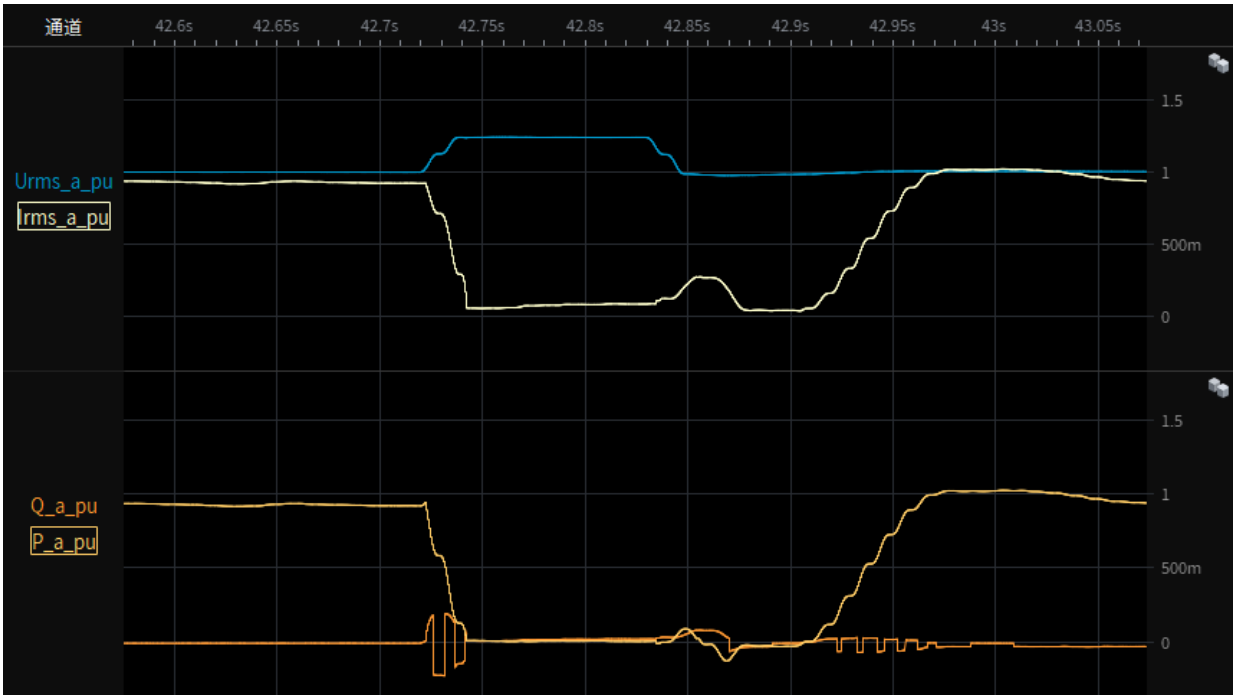


Test 8-1.4 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
restoring time

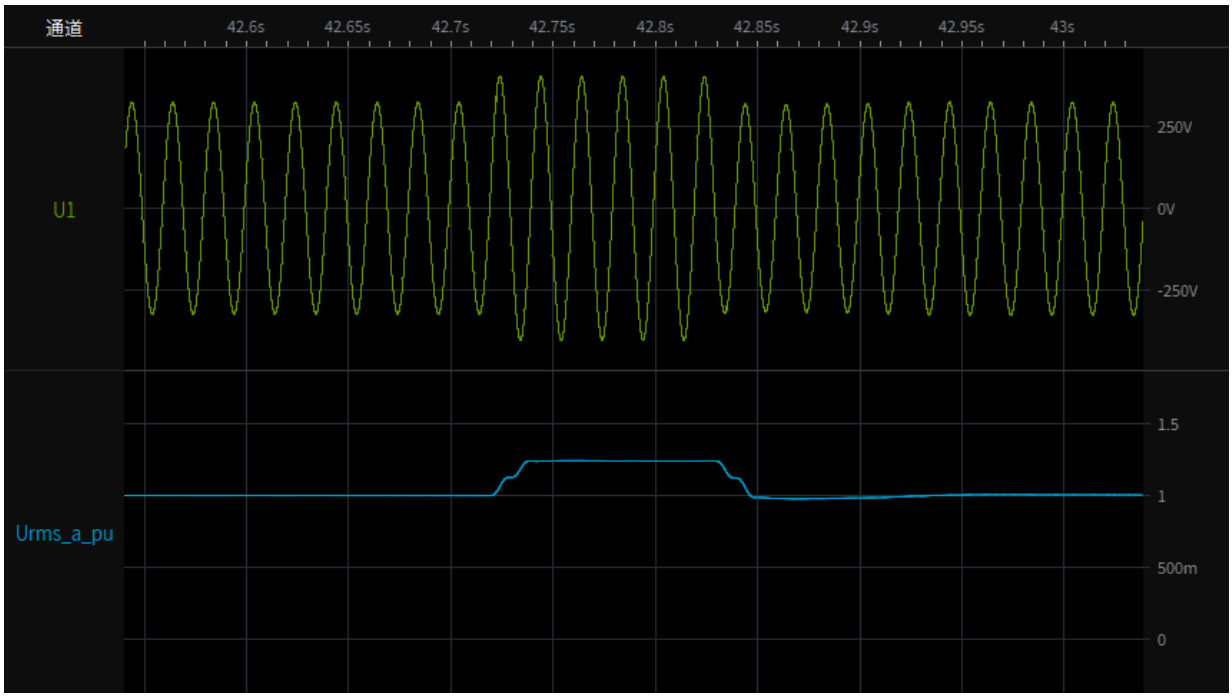


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 8-2.1 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

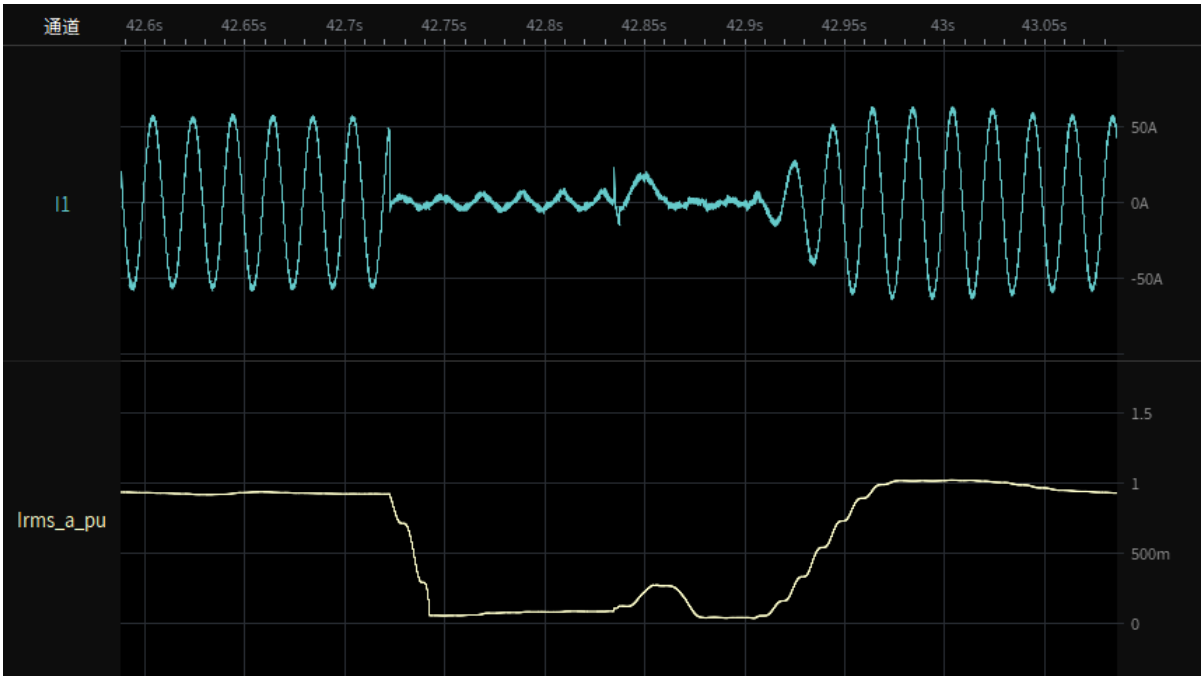


Test 8-2.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

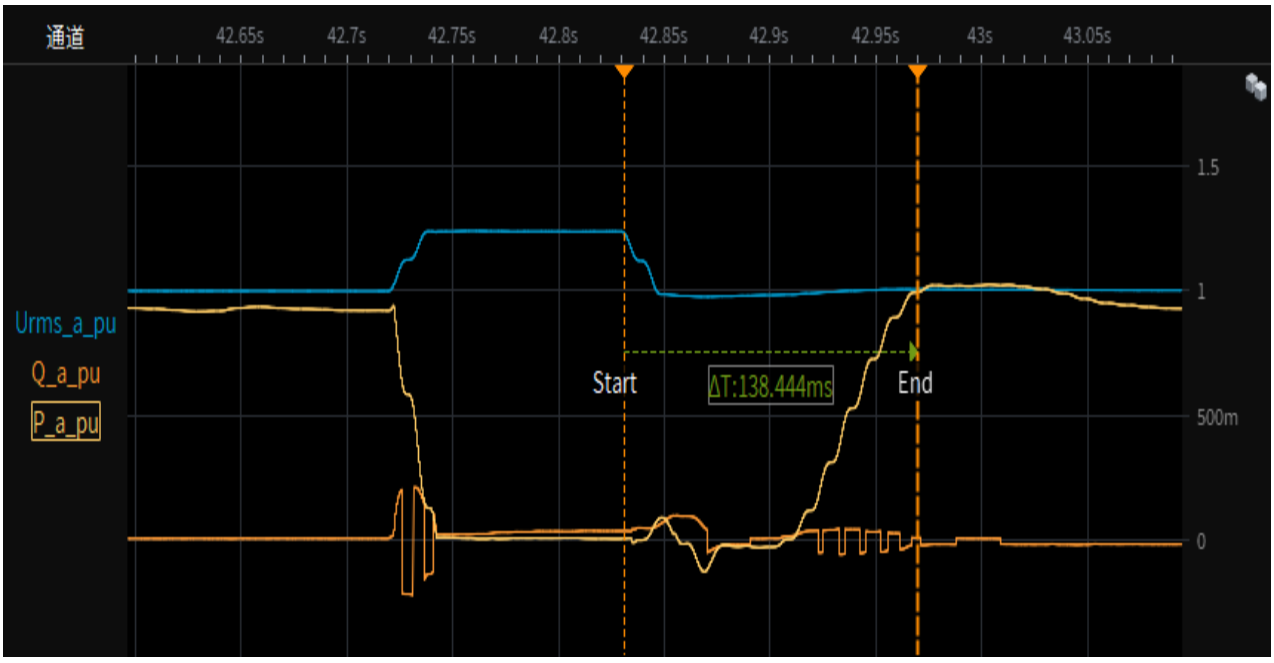


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 8-2.3 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents



Test 8-2.4 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A), 95% load
restoring time



CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.6	**TABLE: Checking the insensitivity to automatic reclosing during phase discordance**				**P**
Model	HNS10000TL				
Test 1: Phase angle shift of 90°					
Power level	Cos φ	Phase shift angle (°)	Current 20 ms before phase shift (A)	Current 200ms after phase shif (A)	Result
100%	0.999	90	43.43	43.40	The PV inverter continue to feed power to grid after phase angle shift has been performed. No damage, no hazard.
Test 2: Phase angle shift of 180°					
Power level (%)	Cos φ	Phase shift angle (°)	Current 20 ms before phase shift (A)	Current 200ms after phase shif (A)	Result
100%	0.999	180	43.47	43.45	The PV inverter continue to feed power to grid after phase angle shift has been performed. No damage, no hazard.

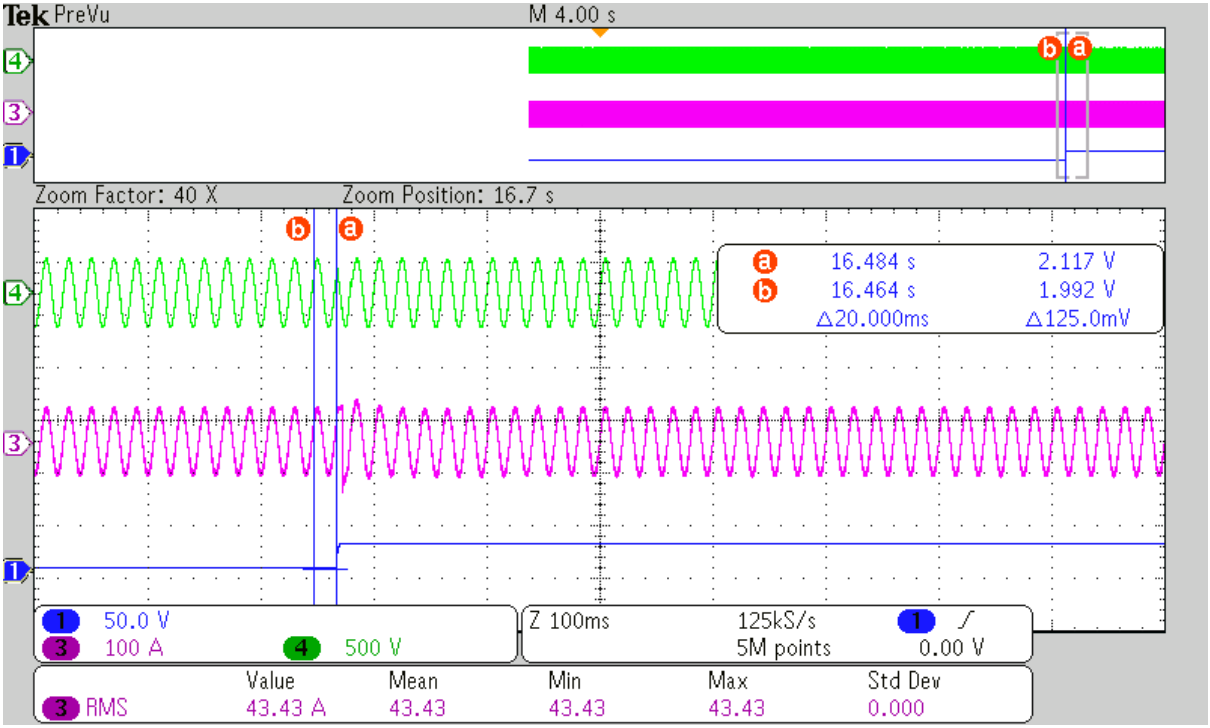
Note:

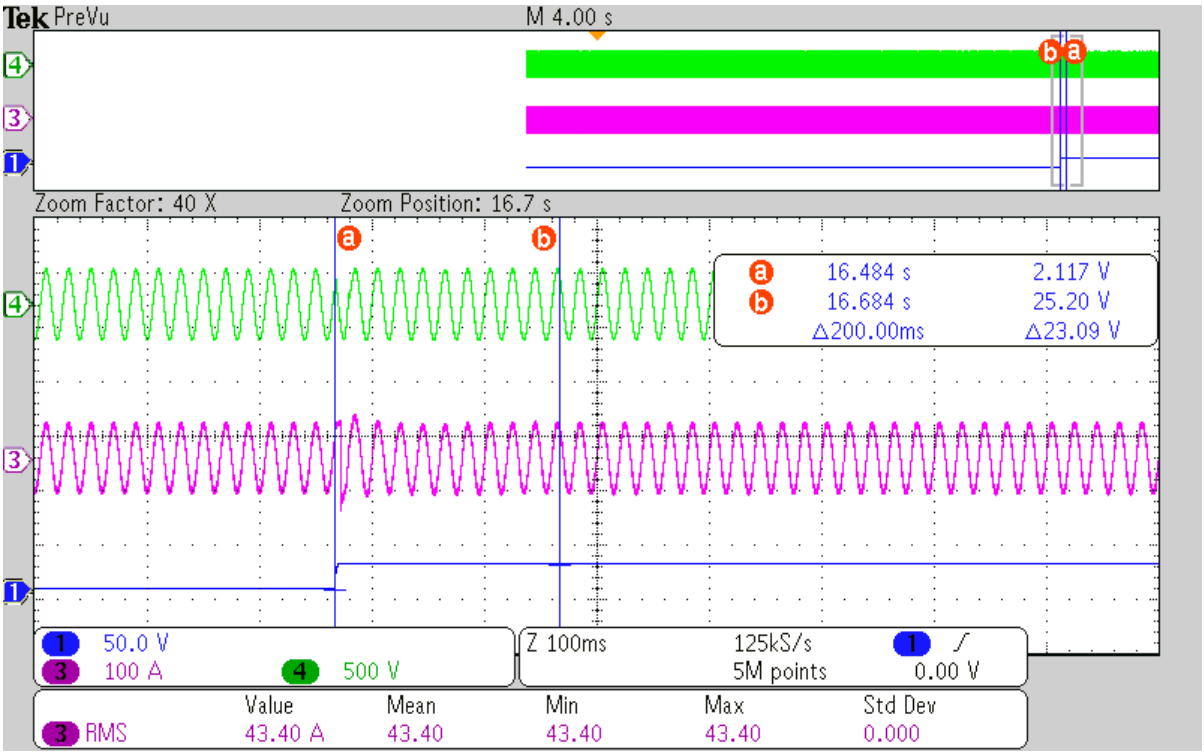
The generator must be brought into operation at rated power. Let the system operate under the set conditions for at least 5 min or the time necessary for the temperature inside the converter to stabilize.

The inverter should be operated with cos φ = 1 and nominal output power. The network simulator should create voltage phase shifts of 90° and 180°. As a result, 20ms before and 200ms after the voltage phase shift, should be documented.

CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

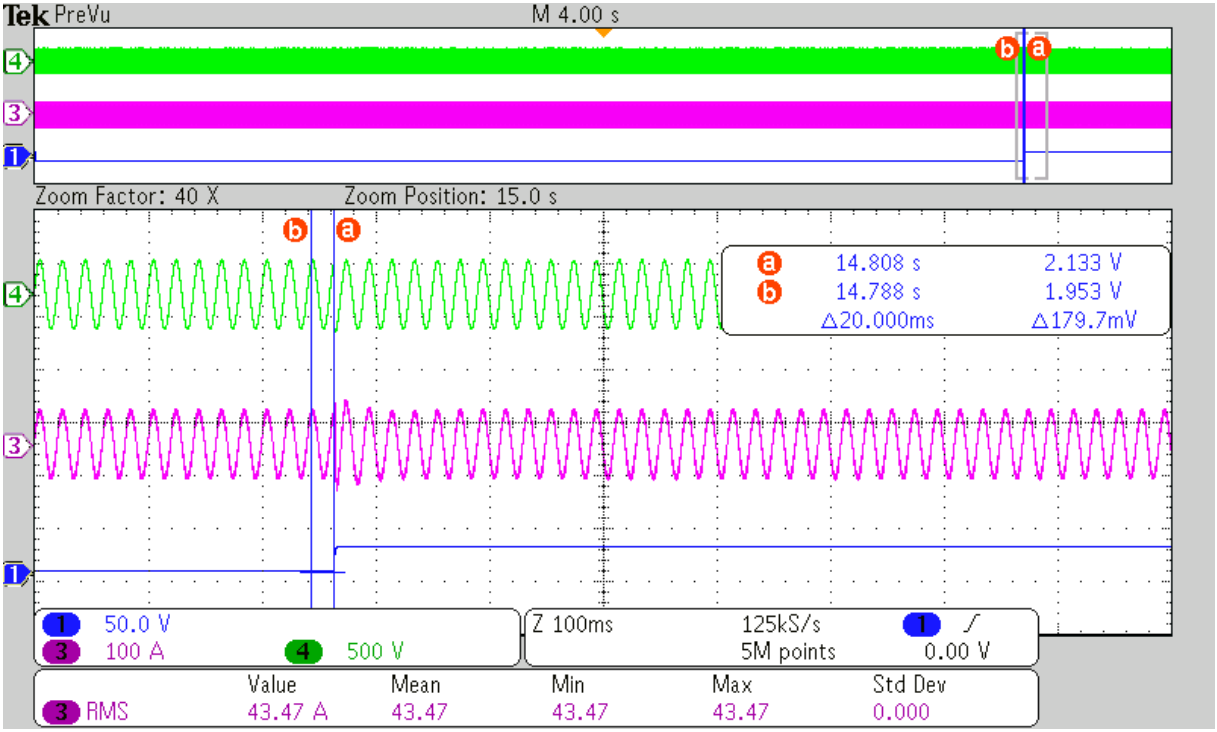
Test 1: Phase angle shift of 90°

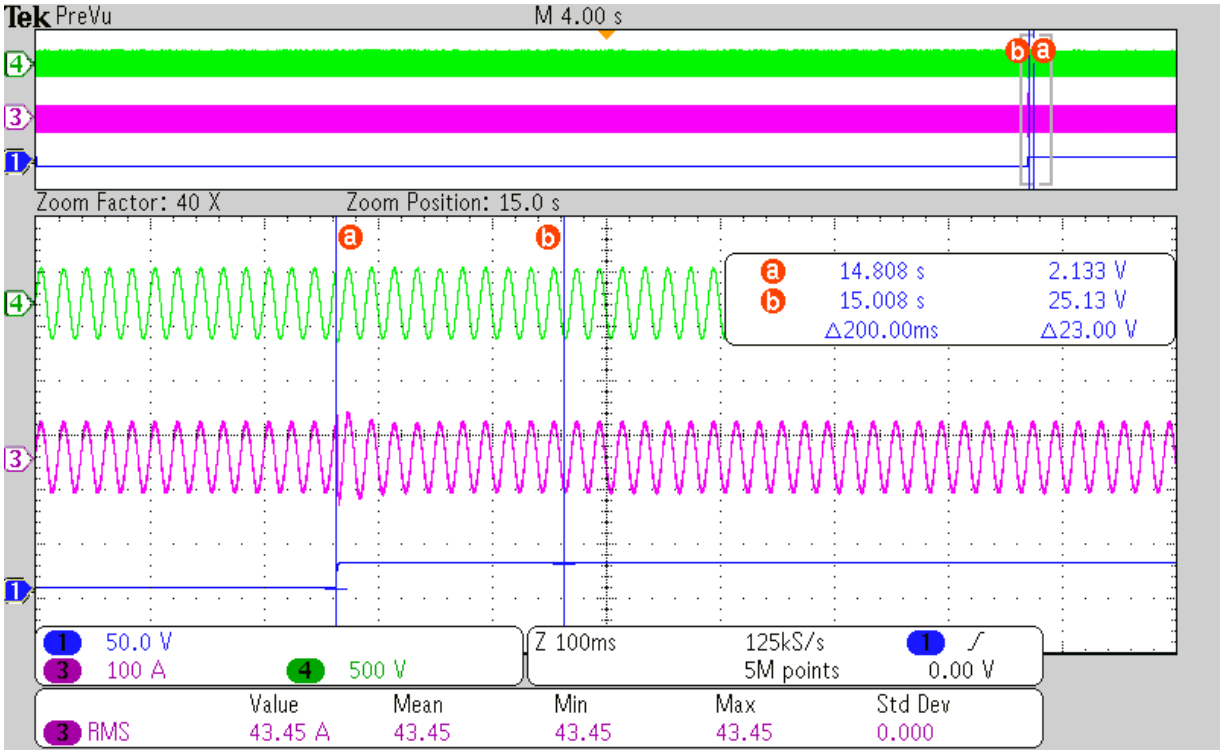




CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2: Phase angle shift of 180°





Annex 1

ISO 9001 certificate

Certificate of Registration

This is to certify that the Quality Management System of

AFORE NEW ENERGY TECHNOLOGY (SHANGHAI) CO., LTD.
Unified social credit code: 91310000561932991K
Registered Address
Building 7, No.333, Wanfang Road, Minhang District, Shanghai
Office & Production Address
Building 7, No.333, Wanfang Road, Minhang District, Shanghai, China

Has been independently assessed and is compliant with the requirements of:

ISO 9001:2015

For the following scope of activities:

R & D and Manufacture of Photovoltaic Inverter

Certificate Number: 1711077Q

Date of initial registration	10/07/2019
Certificate expiry	09/07/2023

(subject to the company maintaining its system to the required standard)

AUTHORISED SIGNATORY
Date of this certificate 11/11/2020, V1

During validity period of the certificate a surveillance audit should becarried out once within each 12 months. The label should be pasted on specified position of right side of the certificate then it is valid. The certificate can be checked out at China CNCA website(www.cnca.gov.cn) and ACM UK website(www.acmcert.com).

ACM-CCAS Limited, Unit 5 Merus Court, Meridian Business Park, Leicester, LE19 1RJ, UK
Local Office-ACM (CHINA) LIMITED, Rm B201, No 352, Waihuan Road, Minhang District, Shanghai 201199, China
T: +86 21 64305860 F: +86 21 64881096 W: www.acmcert.com.cn E: info@acmcert.com.cn

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Annex 2

Datasheet of the relay

产品规格书 Specification FM-M0608-002 Rev1.5

厦门宏发电声股份有限公司

Xiamen Hongfa Electroacoustic Co.,Ltd.

电话 Tel:（86）- 592-6106688

传真 Fax:（86）- 592-6106678

网址 Web site: www.hongfa.com

产品规格书

Specification

文件编号 File No.：4578914GGS005

宏发产品名称 Our Product Name: 继电器 RELAY

宏发产品型号 Our Product model: HF161F-40W/12-HTF(967)

发布日期 Publish Date: 2020.12.16

生产工厂 Production Plant: 中国厦门

版本 Version: a 更改单号 Number of Modification:

宏发审批签字 Signature by Hongfa			顾客确认 Custom Approval
拟制 Make	审核 Check	批准 Approved	负责人 By:
张茂松	傅飞飞	朱艺青	日期 Date:

特别说明：

1.此规格书请顾客在2周内确认，如未在规定时间内答复，则视为同意。

2.自提供规格书之日起2年内，顾客没有下单订货，本规格书失效。

Especially claim:

1.This specification is expected to be checked within 2 weeks.Without feedback after 2 weeks, Hongfa will take it as granted that customer approves of this specification.

This specification will be invalid if no order within 2 years.

保存期限:长期 保存部门:技术系统

- 1 -

产品规格书 Specification

变更履历 Revision Record

顾客 Customer		产品型号 Part No.		
变更版 Version No.	变更日期 Change Date	变更内容 Description	原因 Reason	负责人 By

产品规格书 Relay Specification

1 品种 Type Model

1.1 种类 Kinds: 电磁继电器 Electromagnetic Relay

1.2 型号 Type: HF161F-40W/12-HTF(967)

1.3 外形尺寸 Outline: 30.4mm×15.9mm×23.3mm

1.4 触点形式 Contact Arrangement: 一组常开 1 Form A

1.5 触点材料 Contact Material: $AgSnO_2$

1.6 触点间隙 Contact Gap: ≥1.8 mm

2 安全认证 Safety Approval

认证机构 Certification Agency	认证号 File No.
UL/CUL	E134517
TüV	R 50475730
CQC	CQC20002246447

上述认证号代表该产品取得相关认证，但具体认证内容请以我公司提交的认证证书为准。The above certificate No. is just a license No. Please refer to the certificates we supplied for detail information.

3 线圈额定参数 Coil Rating

at 23 ℃

额定电压 Rated Voltage Vd.c.	动作电压 Operate Voltage Vd.c.	释放电压 Release Voltage Vd.c.	保持电压 Holding Voltage Vd.c.	线圈电阻 Coil Resistance Ω	线圈功耗 Coil Power W 大约 Approx.
12	≤9.0	≥0.6	7.2 (at 85 ℃)	90×(1±10%)	1.6

注 1：线圈保持电压为从线圈施加额定电压 100ms 以后的线圈电压。

Note 1: The coil holding voltage is the voltage of coil after being applied nominal voltage for 100 ms.

注 2：磁路系统专门设计用于这种低保持功耗，当环境温度大于 23℃时，如果不降低线圈功耗，则不允许长期使用！

Note 2: The magnetic system is designed for this reduced holding power, continuous operation without power reduction is not permitted for ambient temperatures of > 23℃!

4 触点参数 Contact Specification

4.1 触点额定负载 Contact Rating: Making 20 A, loading40 A, breaking 20 A, 277 Va.c.

4.2 最大切换电流 Max. Switching Current: 43 A

4.3 最大切换电压 Max. Switching Voltage: 277 Va.c.

4.4 最小适用负载 Min. Applicable Load: 6 V, 1 A

5 性能 Performance

5.1 接触电阻 Contact Resistance: 100 mΩ max. (at 6 Vd.c. 1A)。 （四端法 Four Probe Method）

5.2 动作时间 Operate Time: ≤ 20 ms 。

5.3 释放时间 Release Time: ≤ 10 ms 。

5.4 回跳时间 Bounce Time: ≤ 10 ms 。

5.4.1 电耐久性 Electrical Endurance

结构型式 Version	触点材料 Contact Material	触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 ON：OFF	电耐久性 Electrical Endurance
1H	$AgSnO_2$	阻性负载 resistive Load making 20 A, loading 40 A, breaking 20 A, 277 Va.c.	85℃	1 s: 9 s	3×10^4次(ops)
1H	$AgSnO_2$	阻性负载 resistive Load making 10 A, loading 43 A, breaking 10 A, 277 Va.c.	85℃	1 s: 9 s	3×10^4次(ops)

5.4.2 机械耐久性 Mechanical Endurance

触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 ON：OFF	机械耐久性 Mechanical Endurance
无负载 No load	常温 Room Temperature	0.5 s: 0.5 s	1×10^5 次 (ops)

5.5 介质耐压 Dielectric Strength (漏电流 Leak Current: 1 mA)

5.5.1 断开触点电路的各引出端之间 Between terminals of each opened contact circuit: 2500 Va.c. (50/60 Hz 1 min) 。

5.5.2 所有线圈引出端与所有触点电路引出端之间 Between all coil terminals and all contact circuit terminals: 4500 Va.c. (50/60 Hz 1 min) 。

5.6 绝缘电阻 Insulation Resistance

5.6.1 断开触点电路的各引出端之间 Between terminals of each opened contact circuit: 1000 MΩ (500 Vd.c.) 。

5.6.2 所有线圈引出端与所有触点电路引出端之间 Between all coil terminals and all contact circuit terminals: 1000 MΩ (500 Vd.c.) 。

5.7 线圈温升 Coil Temperature Rise: 70 K max.

以100%额定电压激励100 ms后降为60%额定电压保持，触点负载43 A 。环境温度：85 ℃。

Applied voltage of coil 100% rated voltage for 100 ms holding voltage of coil 60% rated voltage, Carry current of contact 43 A. Environmental temperature is 85 ℃.

5.8 振动 Vibration

稳定性：双振幅 1.5 mm，频率 10 Hz～55 Hz，每个方向各 1 小时，闭合回路的断开或断开回路的闭合时间应不超过 100 μs。

Functional:10 Hz～55 Hz,1.5 mm double amplitude,1 hour Per Cross-axis.No opening or closing of any closed or opened contact circuit respectively shall exceed 100 μs.

5.9 冲击 Shock

稳定性: 98 m/s²（脉冲持续时间 11 ms），6 次(三个相互垂直轴线的每一个方向 6 次，总共 36 次),闭合回路的断开或开路回路的闭合时间应不超过 100 μs。

Functional: 98 m/s²(Duration 11 ms), 6 shocks (six ops in both directions of each of the three mutually perpendicular axes, totally 36 ops), No opening or closing of any closed or opened contact circuit respectively shall exceed 100 μs.

强度: 980 m/s²（脉冲持续时间 6 ms），6 次(三个相互垂直轴线的每一个方向 6 次，总共 36 次）继电器外观、结构和性能不应有异常。

Destructive: 980 m/s²(Duration 6 ms), 6 shocks (six ops in both directions of each of the three mutually perpendicular axes, totally 36 ops) It shall be no abnormalities in appearance, construction and performance.

5.10 引出脚强度 Terminal Strength

PCB 引出脚：在 PCB 引出脚轴线方向上施加 5 N 拉力或压力，持续时间 10 s，继电器应无异常。

PCB Terminal：The relay shall be no abnormalities while bring or press 5 N force for 10 s on the PCB terminals in the directions of its axis.

5.11 耐焊接热 Soldering Heat Resistance

5.11.1 焊接温度 Soldering Temperature：(260±3) ℃

5.11.2 焊接时间 Soldering Time：(10±1) s

5.12 焊接性能 Soldering Ability: (250±3) ℃, (10±1)s 引出端被浸锡部分应有 90%以上连续覆上一层锡层（90% of the dipped portion shall be soldered）。

5.13 耐温性 Temperature Resistance

5.13.1 耐热 Heat Resistance

(85±2) ℃温度中放置 16 h,恢复常温 2 h 后，继电器的结构及性能应无异常。

Must be free from any abnormality in both the construction and characteristics after the relay is lift in a temperature of (85±2) ℃ for 16h and then in room temperature and humidity for 2 h.

5.13.2 耐寒 Cold Resistance

(-40±2) ℃度中放置 16 h,恢复常温 2 h 后，继电器的结构及性能应无异常。

Must be free from any abnormality in both the construction and characteristics after the relay is lift in a temperature of (-40±2) ℃ for 16h and then in room temperature and humidity for 2 h.

5.13.3 耐湿性 Moisture Resistance

在温度(40±2) ℃相对湿度 90%～95% RH 中放置 16 h，恢复常温 2 h 后，继电器的结构及性能应无异常。且绝缘电阻应不小于 50 MΩ(500 Vd.c.)。

Must be free from any abnormality in both the construction and characteristics after the relay is lift in temperature of (40±2) ℃ and humidity of 90% to 95% RH for 16 h and then in room temperature and humidity for 2 h. Insulation resistance however must be 50 MΩ(500 Vd.c.).

6 产品标识 Marking

6.1 外壳颜色 Case Color: 黑色 Black

6.2 印字位置 Marking Position: 侧面 Flank

6.3 印字颜色 Ink Color: 激光打标 Laser Marking

7 标准测试条件 Standards Test Condition

7.1 温度 Temperature: 23℃±5℃

7.2 湿度 Humidity: 25% ～ 75% RH

7.3 方向 Direction of Measurement: 任意 Free

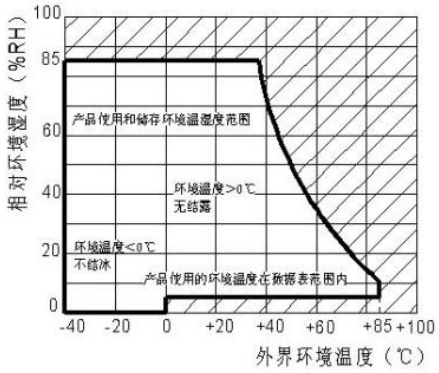
8 使用条件 Operating Condition

8.1 温度 Temperature: -40 ℃～ 85 ℃

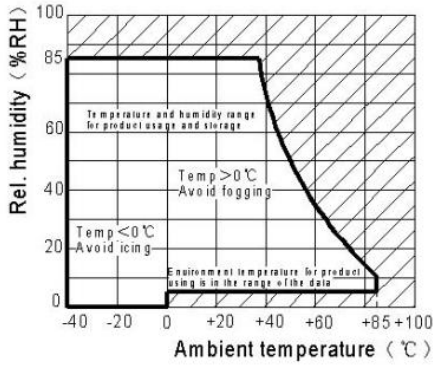
8.2 湿度 Humidity: 5% ～ 85% RH

8.3 安装方向 Mounting Direction: 任意 Free

注：使用环境条件不能导致继电器内部产生结露、结冰，否则会导致继电器失效。另外，湿度范围会随温度而有所不同，因此请控制在下图所示的范围。



Note:The ambient environment of application shall not cause any dewing or icing inside the relay. Otherwise, the relay may fail to work consequently. The humidity range varies with the temperature. Use within the range indicated in the graph below.



9 贮存条件 Storage Condition

9.1 温度 Temperature: 0 ℃ ～ 40 ℃

9.2 湿度 Humidity: 20% ～ 80% RH

9.3 环境 Environment

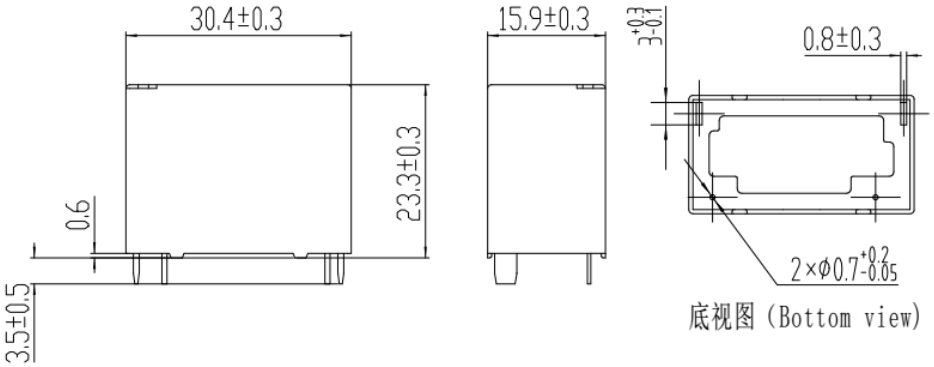
9.3.1 产品贮存场地不能有腐蚀性气体 Store in locations where the product is not exposed to corrosive gas.

9.3.2 贮存中应避免阳光直照产品 Keep product is not exposed to the direct ray of the sun.

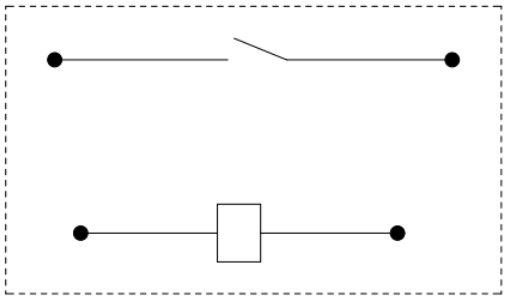
9.3.3 堆码高度 Stacking Height ： ≤ 7 层 layers.

10 产品结构 Configuration

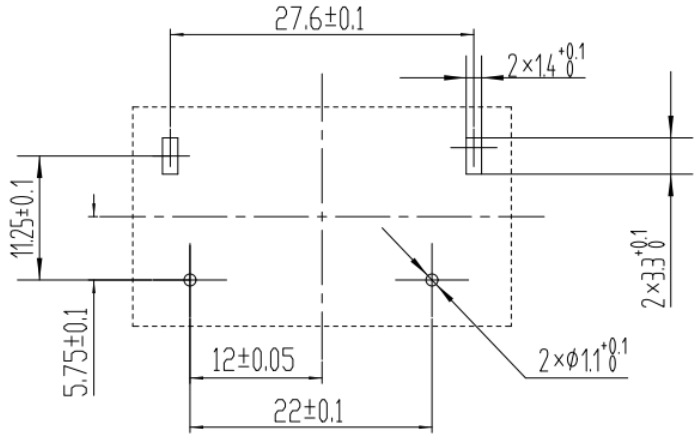
10.1 外形图 Outline Schematic



10.2 接线图(底视) Wiring Diagram(Bottom View)



10.3 安装孔位图 PCB Layout



注：产品外形尺寸未注尺寸公差及 PC 板未注尺寸公差按下表执行。

Note： All unspecified tolerance(including outline dimension and PC board dimension) according to following table.

产品外形尺寸未注尺寸公差 Outline dimensions hadn't specified tolerance		PC板未注尺寸公差 PC board dimensions hadn't specified tolerance
外形尺寸 Outline Dimensions	公差 Tolerance	
≤1	±0.2	±0.1
>1～5	±0.3	
>5	±0.4	

11 订货标记 Ordering Information

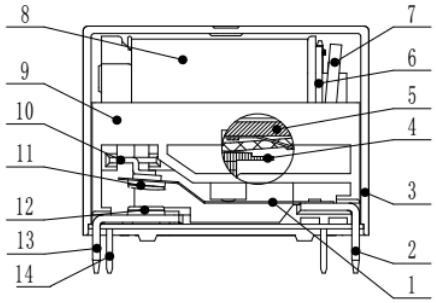
HF161F-40W / 12 - H T F (967)
① ② ③ ④ ⑤ ⑥

① 产品型号 Type	HF161F-40W
② 线圈电压 Coil voltage	12 Vd.c.
③ 触点形式 Contact arrangement	H：一组常开（1 Form A）
④ 触点材料 Contact material	T：$AgSnO_2$
⑤ 绝缘等级 Insulation standard	F：F级（Class F）
⑥ 特殊特性代码 Special code	（967）：线圈功耗 Coil power 约1.6 W,触点间隙 Contact Gap： ≥1.8 mm

12 主要零部件 Important Part And Components

序号 Serial No.	零部件名称 Part And Components Name	材料名称 Material Name	备注 Remark
1	动簧片 Movable spring	铜合金 Copper alloy	
2	动簧焊片 Terminal	纯铜 Copper	
3	外壳 Cover	工程塑料 Engineering plastic	
4	推动块 Driving block	工程塑料 Engineering plastic	
5	轭铁 Yoke	纯铁 Steel	
6	铁芯 Iron core	纯铁 Steel	
7	衔铁 Armature	纯铁 Steel	
8	线圈 Coil	铜线 Copper wire	
9	底座 Base	工程塑料 Engineering plastic	
10	定位片 Fixing bridge	纯铁 Steel	
11	动触点 Move contact	银合金 Silver alloy	
12	静触点 Stationary contact	银合金 Silver alloy	
13	静簧片 Stationary spring	纯铜 Copper	
14	线圈引出脚 Coil Terminal	铜合金 Copper alloy	

结构图 Construction Schematic

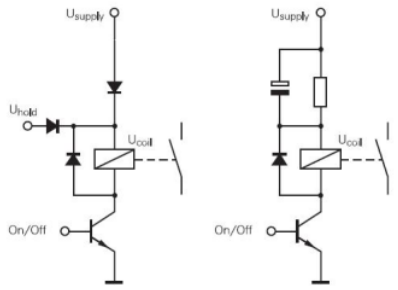


13 其他说明 Others

13.1 非塑封继电器需要防止助焊剂或污染物进入继电器。Unsealed relays should prevent flux or contamination into the relay.

13.2 避免在强磁场条件下使用继电器，外界强磁场会造成继电器动作和释放等参数发生变化。To avoid using relays under strong magnetic field because it will change the parameters of relay such as pull-in and drop-out voltage.

13.3 降低线圈功耗的常用方法是输入线圈额定电压脉冲后降低线圈电压或者使用PWM脉宽调制，如下图所示。Common methods for the reduction of coil power consumption is: reduce coil voltage after a pull-in pulse equivalent to at least the coil’s rated voltage or control the coil voltage by pulse width modulation(PWM).The following figure shows the typical examples.

电容方式 Capacitor Circuit	

PWM	脉冲幅度：1.0～1.5 倍额定电压；脉冲频率：10 kHZ～20 kHz；第一个脉冲宽度：≥100 ms；占空比：≥60%；线圈两端并联续流二极管。即 PWM 驱动下电压有效值为 7.2 Vmin.。If the coil is applied the PWM: pulse amplitude: 1. 0～ 1. 5 times rated voltage; Pulse frequency: 10 kHz～20 kHz; The first pulse width: ≥ 100 ms; Duty cycle: ≥ 60%; The two ends of the coil are connected in parallel with the diode. The voltage effective value of PWM driven is 7.2Vmin..

13.4 对宏发而言，不可能评定继电器在每个应用领域、应用环境的所有性能参数要求，因而，客户应根据具体的使用条件选择与之相匹配的产品，若有疑问，请与宏发联系获得更多的技术支持。但产品的选型责任仅由客户负责。We could not evaluate all the performance and all the parameters for every possible application field and environment.Thus the user should be in a right position to choose the suitable produce for their own application.If there is any query,please contact Hongfa for the technical service.However,it is the use’s responsibility to determine which product should be used only.

13.5 本产品规格书中标称的使用环境温度范围指的是产品在特定负载条件下的最大耐受温度范围。对于防爆规格产品的使用环境温度按相应防爆认证证书的规定。Operating temperature range in this specification refers to the maximum tolerable temperature range under specific load conditions. To explosion-proof product, the ambient temperature should conform to regulations in related explosion-proof certification.

13.6 继电器的电耐久性次数可能会因使用环境条件的不同而有差异。产品的电耐久性能详细情况见认证证书。本产品规格书中电耐久性所列的试验条件、触点负载可能未包含在认证证书中，当使用环境条件与认证条件不同时，电耐久性能需要由具体试验确认。Differences in relay electrical endurance cycles would exist due to difference in operating ambient conditions. The electrical endurance of the products detailed in the safety certificates.The test condition and contact rating for electrical endurance in this specification may not be included in the safety certificates,in case that the condition in real applications is different from safety certificates, the electrical endurance of the relay must be confirmed by tests.

13.7 本产品规格书供客户使用时参考，其中，未明确规定的要求条件，参考“继电器术语解释及使用指南”（见 http://cn.hongfa.com/pdf/Guide_power_signal_cn.pdf）。The specification is for reference only.See to “Terminology and Guidelines”(see http://www.hongfa.com/pdf/Guide_power_signal_en.pdf) for more information.

13.8 为了保持继电器的性能，请注意不要使继电器掉落或受到强冲击。建议掉落后的继电器报废。To maintain the performances of relays, please do not make the relay drop or be shocked strongly. Suggest that the relays dropped be scrapped.

13.9 规格书内的各项性能参数是基于标准测试条件下测得的初始值。All the performance data listed in the datasheet are the initial values tested under standard testing condition.

13.10 环保措施 Environmental Protection

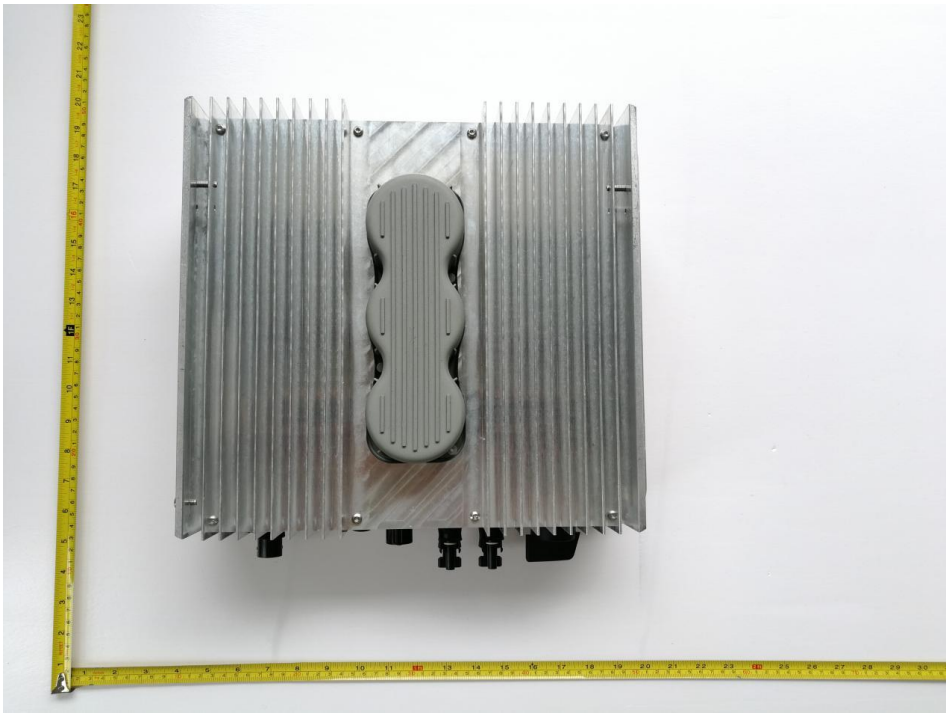
宏发产品均符合 RoHS 要求。Hongfa products are all RoHS compliant.

13.11 宏发保留对产品更改的权利，客户在首次下单之前应确认此规格书内容，必要时可要求我司提供新的规格书。Hongfa reserves the right to make changes. Customers should reconfirm the contents of the specification before first orders and ask for us to supply a new specification if necessary.

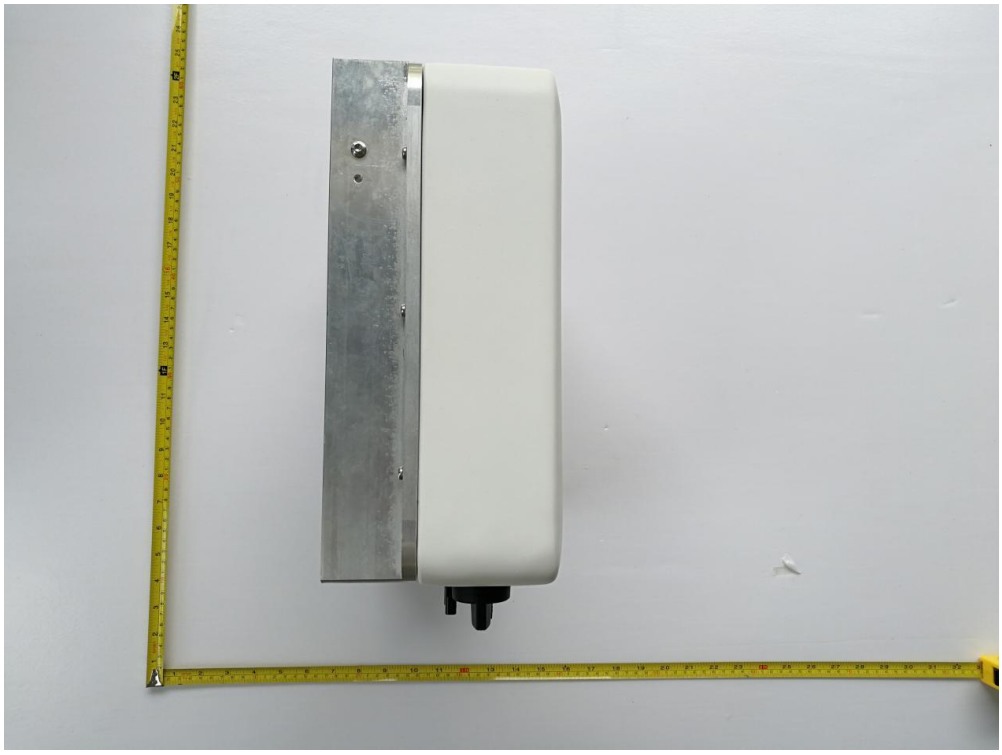
Annex 3

Pictures of the unit

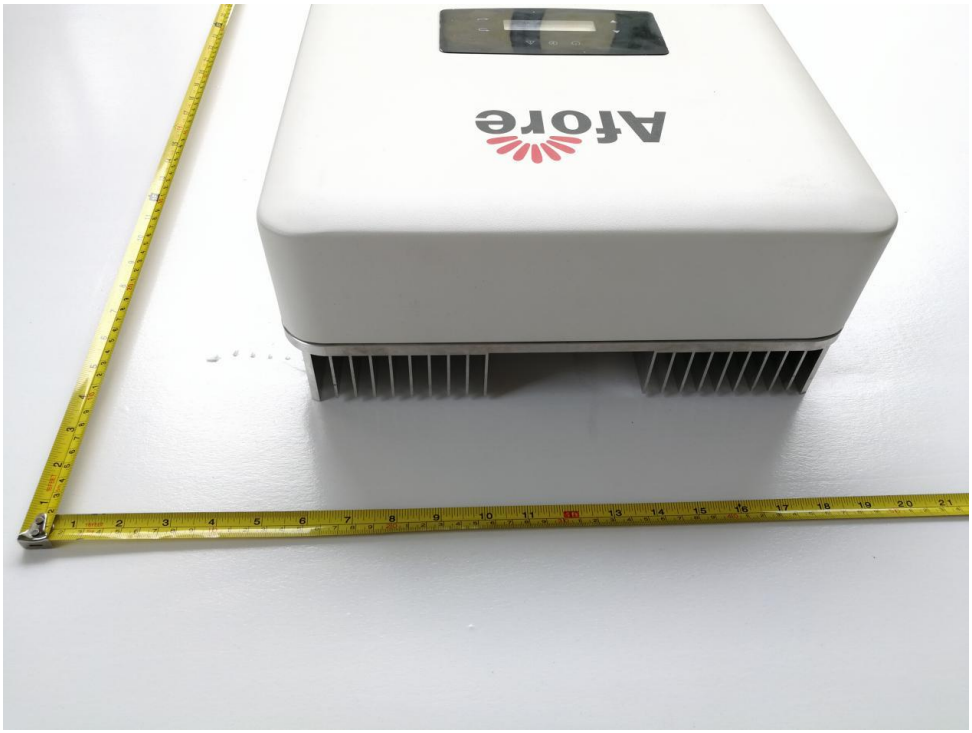
Enclosure Front View for HNS3000TL

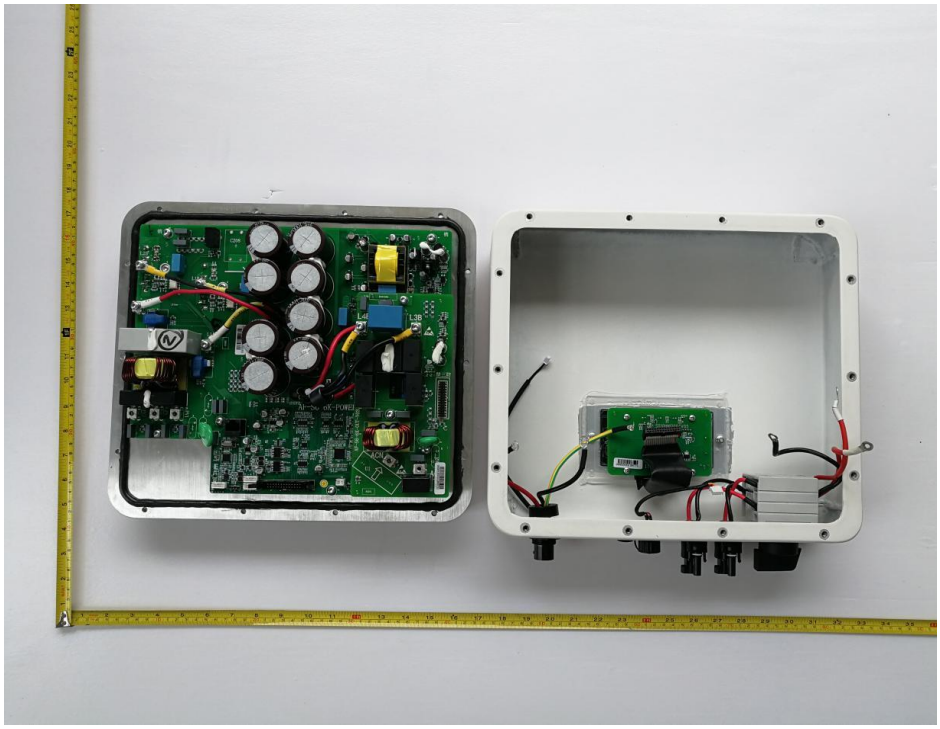
Enclosure Rear View for HNS3000TL


Enclosure Side View (Right) for HNS3000TL

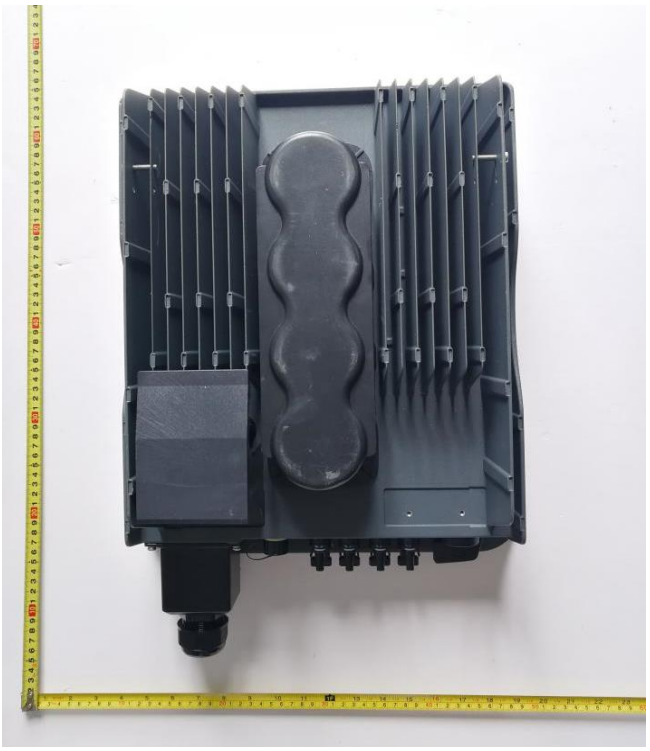


Enclosure Side View (left) for HNS3000TL

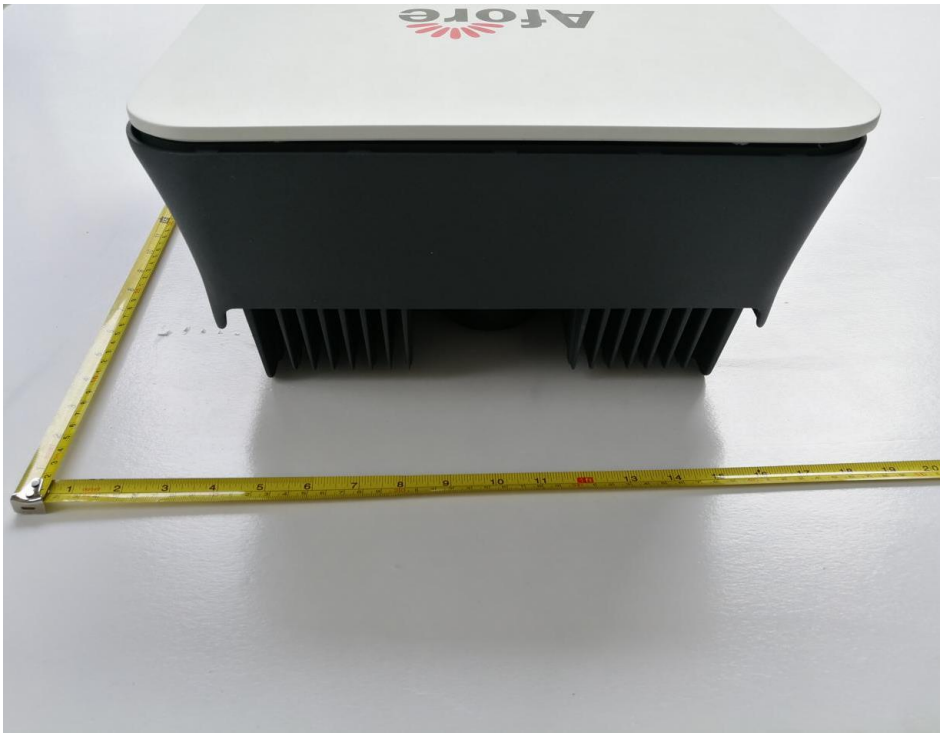
Enclosure Side View (Top) for HNS3000TL

Enclosure Side View (Bottom) for HNS3000TL


Internal view for HNS3000TL

Enclosure Front View for HNS8000TL and HN10000TL


Enclosure Rear View for HNS8000TL

Enclosure Rear View for HNS10000TL


Enclosure Side View for HNS8000TL and HNS10000TL

Enclosure Top Side View for HNS8000TL and HNS10000TL


Enclosure Bottom Side View for HNS8000TL

Enclosure Bottom Side View for HNS10000TL


Internal view for HNS8000TL

Internal view for HNS10000TL


--- End of test report---