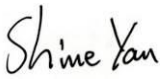
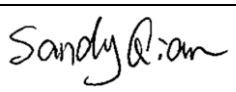
TEST REPORT
CEI 0-21
Reference technical rules for the connection of active and passive users to the LV networks of electrical distribution companies

Report	
Report Number. ..... :	6217736.50
Date of issue..... :	2025-05-30
Total number of pages	350 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 ..... :	Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China
Test specification:	
Standard..... :	CEI 0-21:2022-03+V1:2022-11+V2:2024-01
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..... :	Hybrid Inverter
Trade Mark..... :	Afore
Manufacturer ..... :	Afore New Energy Technology (Shanghai) Co., Ltd. Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China
Model/Type reference..... :	AF36K-TH, AF40K-TH, AF45K-TH, AF50K-TH, AF60K-TH; AF36K-TH-0, AF40K-TH-0, AF45K-TH-0, AF50K-TH-0, AF60K-TH-0;
Ratings..... :	See product marking plate on page 4 and ratings of the test products on 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: IEC 62619 Certificate for used battery (2 pages)

Annex 3: Datasheet of the relay (4 pages)

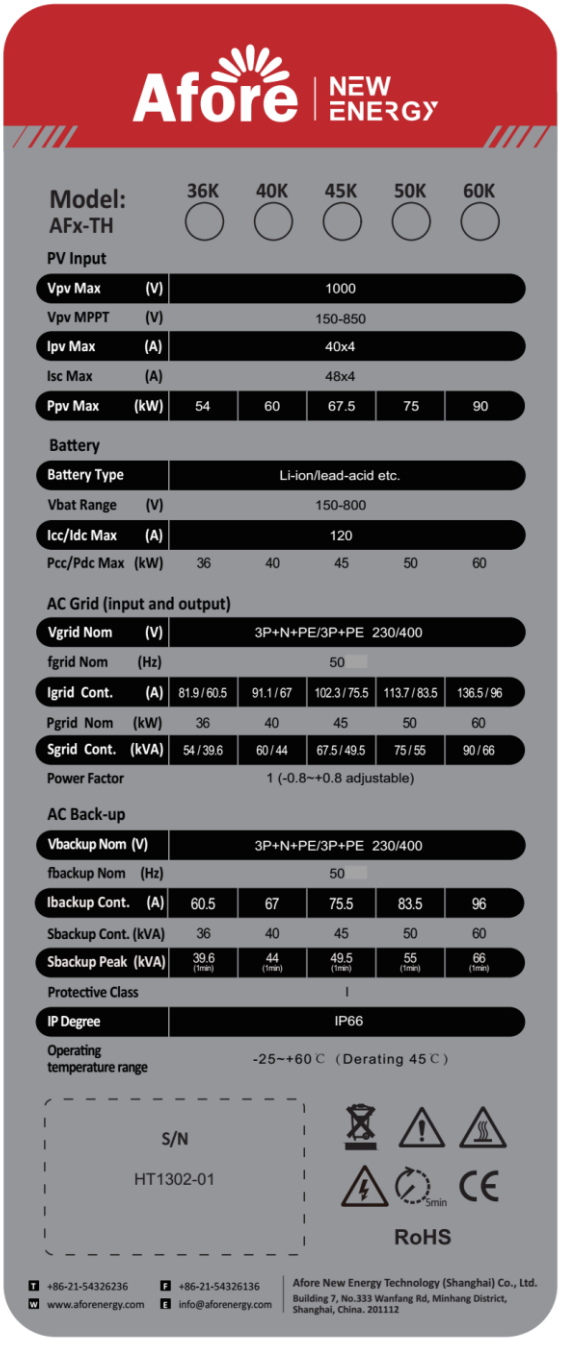
Annex 4: Pictures of the unit (6 pages)

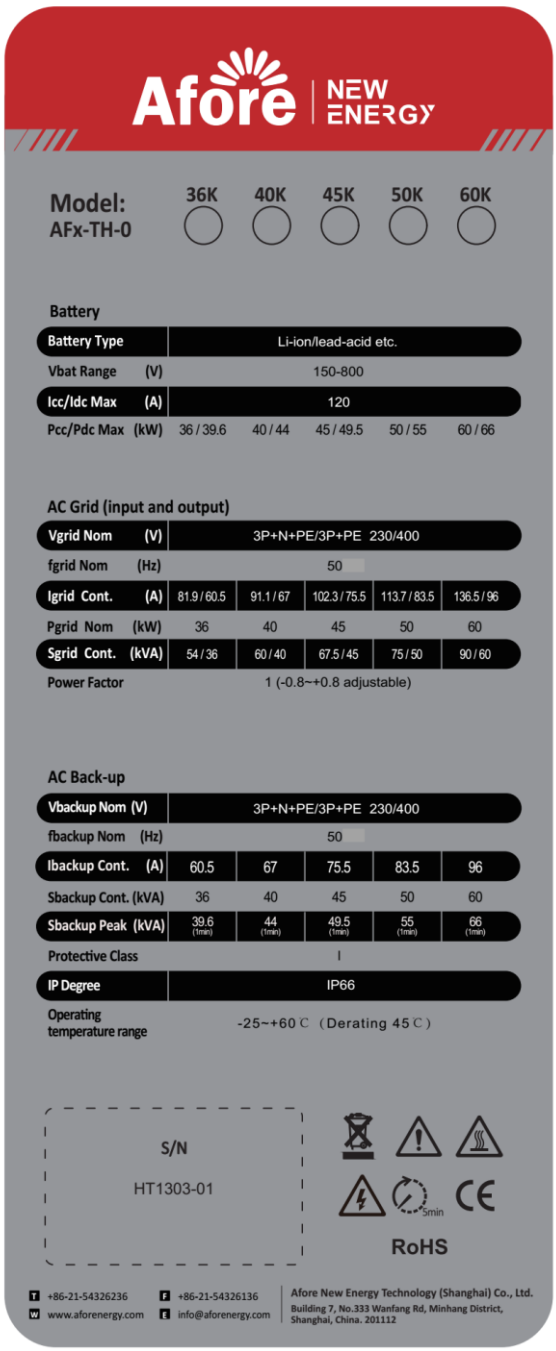
Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
All tests (except clause A.4.6 EMC tests)	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
A.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.: 2408B2791SHA-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.: J25-198-WT Accreditation Number: L0130 (CNAS-ILAC)

Copy of marking plate:

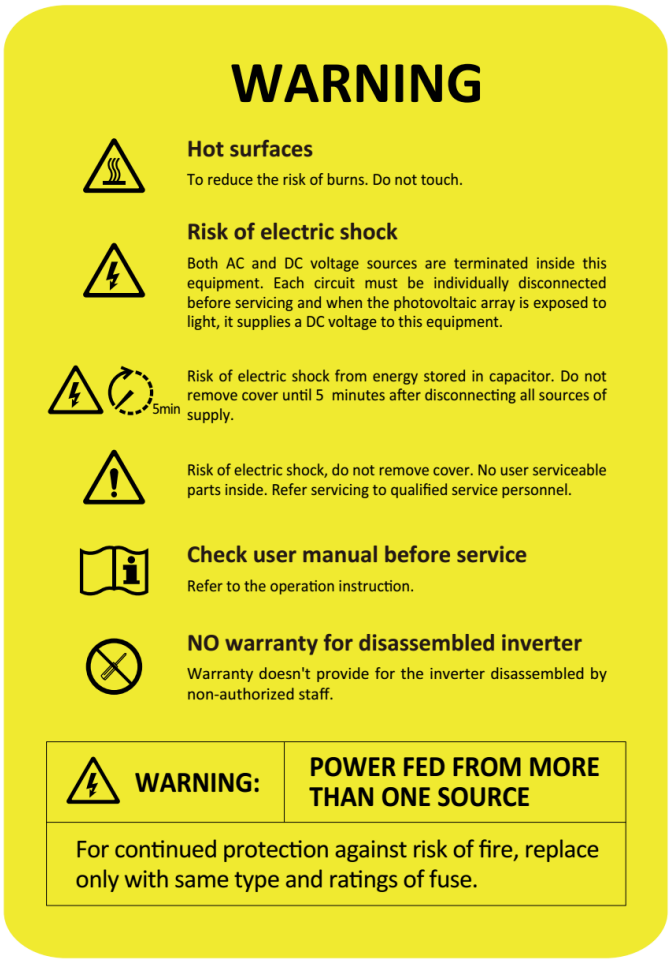
The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.





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 (%)	:	-85 / +115 %		
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)	:	81 kg		
Pollution degree	:	Outside PD3; Inside PD2		
IP protection class	:	IP66		
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	:	2025-01-05 (samples provided by applicant)		
Date (s) of performance of tests	:	2025-01-06 to 2025-05-23		

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.
The clause A.4.6 EMC tests are not in the CNAS scope of DEKRA Testing and Certification (Suzhou) Co., Ltd.
Throughout this report a ☐ comma / ☒ point is used as the decimal separator.
Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.

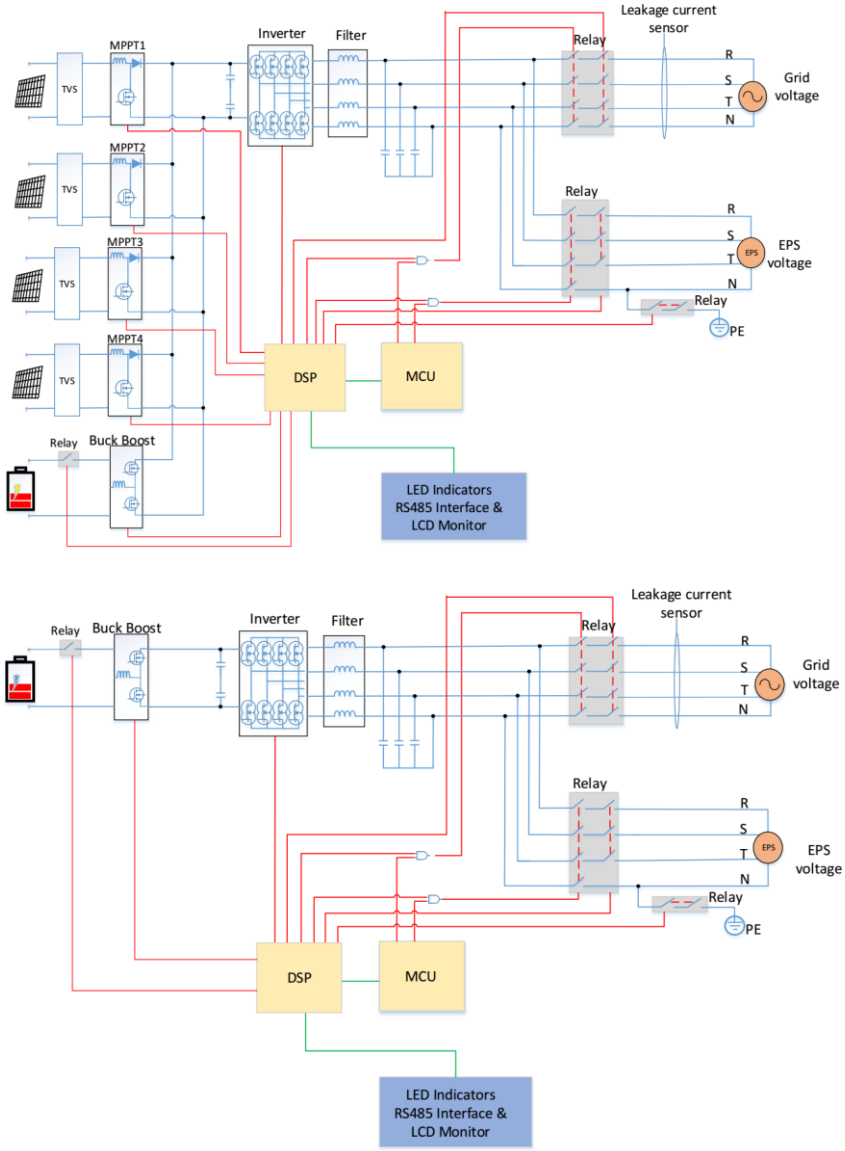
Name and address of factory (ies):

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

Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China

General product information:
The products under test are three-phase storage inverter that convert DC voltage into AC voltage and feed it into the low-voltage public grid or store energy into battery.
The input and output are protected by varistors to earth. The unit is providing EMC filtering at the input and output towards mains. The output is switched off redundant by the high-power switching bridge and two relay in series. This assures that the opening of the output circuit will also operate in case of one error.
The battery port can be charged by the energy from either PV port or AC grid port. The storage inverter does not provide galvanic separation between the PV input and AC output circuit, the battery circuit also does not provide galvanic separation from the PV input or AC output circuit. The storage inverter also can operate under standalone mode beside the grid-connected mode.
Model difference:
All models are identical with hardware version and software version, the output power is derating by software. And differences between models are output rating, PV input string number and PV switch.
AF*-TH-0 (*=36K, 40K, 45K, 50K, 60K) have no PV and PV switch.
Model AF*-TH (*=36K, 40K, 45K, 50K, 60K) have 4 MPPT trackers with 8 input strings and 2 PV switches.

Block diagram



Hardware version: 1.03
Software version: V01

Model	AF36K-TH	AF40K-TH	AF45K-TH	AF50K-TH	AF60K-TH
PV input					
P pv Max (kW)	54	60	67.5	75	90
Vmax PV (Vdc) (absolute Max.)	1000				
Isc PV (absolute Max.) (A)	48*4				
Number MPP trackers	4				
Number input strings	2/2/2/2				
Max. PV input current (A)	40*4				
MPPT voltage range (Vdc)	150-850				
Vdc range @ full power (Vdc)	500-850				
Battery (charge/discharge***)***					
Battery type	Rechargeable Li-ion Battery/ LiFePO4/ Lead-acid				
Battery Normal Voltage Range (Vdc)	150-800 (Field adapt battery voltage range)				
Max charge/discharge Current(A)	120				
Max charge/discharge Power(kW)	36	40	45	50	60
AC Grid (input and output)					
Normal AC Voltage (Vac)	3P+N+PE/3P+PE 230/400				
Frequency (Hz)	50 / 60				
Normal AC Current (A)	52.2	58	65.3	72.5	87
Max. cont. input/output current (A)	81.9 / 60.5	91.1 / 67	102.3 / 75.5	113.7 / 83.5	136.5 / 96
Rated Power (kW)	36	40	45	50	60
Rated Apparent Power (kVA)	36	40	45	50	60
Max. cont. input/output Power (kW)	54 / 39.6	60 / 44	67.5 / 49.5	75 / 55	90 / 66
Max. cont. Apparent input/output Power (kVA)	54 / 39.6	60 / 44	67.5 / 49.5	75 / 55	90 / 66
Power factor(adjustable)	1.0(-0.8~ +0.8)				
AC Load output (stand-alone)					
Normal Voltage (Vac)	3P+N+PE/3P+PE 230/400				
Frequency (Hz)	50 / 60				
Nominal Current (A)	52.2	58	65.3	72.5	87
Max. cont. current (A)	60.5	67	75.5	83.5	96
Rated Apparent Power (kVA)	36	40	45	50	60
Max. cont. Power (kW)	36	40	45	50	60
Max. cont. Apparent Power (kVA)	36	40	45	50	60
Power factor	1.0				
Others					
Ingress protection (IP)	IP66				
Protective class	Class I				
Temperature (℃)	-25℃ to +60℃ (Derating 45℃)				
Inverter Isolation	Non-isolated (PV - AC - BAT)				
Overvoltage category	OVC III (AC Main), OVC II (DC)				

Model	AF36K-TH-0	AF40K-TH-0	AF45K-TH-0	AF50K-TH-0	AF60K-TH-0
Battery (charge/discharge)					
Battery type	Rechargeable Li-ion Battery/ LiFePO4/ Lead-acid				
Battery Normal Voltage Range (Vdc)	150-800 (Field adapt battery voltage range)				
Max charge/discharge Current(A)	120				
Max charge/discharge Power(kW)	36 / 39.6	40 / 44	45 / 49.5	50 / 55	60 / 66
AC Grid (input and output)					
Normal AC Voltage (Vac)	3P+N+PE/3P+PE 230/400				
Frequency (Hz)	50 / 60				
Normal AC Current (A)	52.2	58	65.3	72.5	87
Max. cont. input/output current (A)	81.9 / 60.5	91.1 / 67	102.3 / 75.5	113.7 / 83.5	136.5 / 96
Rated Power (kW)	36	40	45	50	60
Rated Apparent Power (kVA)	36	40	45	50	60
Max. cont. input/output Power (kW)	54 / 36	60 / 40	67.5 / 45	75 / 50	90 / 60
Max. cont. Apparent input/output Power (kVA)	54 / 36	60 / 40	67.5 / 45	75 / 50	90 / 60
Power factor(adjustable)	1.0(-0.8~ +0.8)				
AC Load output (stand-alone)					
Normal Voltage (Vac)	3P+N+PE/3P+PE 230/400				
Frequency (Hz)	50 / 60				
Nominal Current (A)	52.2	58	65.3	72.5	87
Max. cont. current (A)	60.5	67	75.5	83.5	96
Rated Apparent Power (kVA)	36	40	45	50	60
Max. cont. Power (kW)	36	40	45	50	60
Max. cont. Apparent Power (kVA)	36	40	45	50	60
Power factor	1.0				
Others					
Ingress protection (IP)	IP66				
Protective class	Class I				
Temperature (℃)	-25℃ to +60℃ (Derating 45℃)				
Inverter Isolation	Non-isolated (AC - BAT)				
Overvoltage category	OVC III (AC Main), OVC II (DC)				

The battery used for testing with the Hybrid Inverter:

Battery Models	LV-IESS-RH10.240Aa-HBox-n (“n” = 3, 4, 5…15)				
Manufacturer	Dongguan Lithium Valley Energy Co., Ltd.				
Number of battery module in parallel	3	4	5	6	7
Nominal Voltage	153.6 V	204.8 V	256.0 V	307.2 V	358.4 V
Nominal capacity	200 Ah				
Battery System Capacity	30.72 kWh	40.96 kWh	51.20 kWh	61.44 kWh	71.68 kWh
Number of battery module in parallel	8	9	10	11	12
Nominal Voltage	409.6 V	460.8 V	512.0 V	563.2 V	614.4 V
Nominal capacity	200 Ah				
Battery System Capacity	81.92 kWh	92.16 kWh	102.40 kWh	112.64 kWh	122.88 kWh
Number of battery module in parallel	13	14	15	--	
Nominal Voltage	665.6 V	716.8 V	768.0 V	--	
Nominal capacity	200 Ah				
Battery System Capacity	133.12 kWh	143.36 kWh	153.60 kWh	--	
Remark: The CB test certificate No. of the battery: SG SGS-00173 When the batteries are connected in parallel, the charge/ discharge current is superimposed and is limited by the maximum current of the battery port of the Hybrid Inverter. The batteries are not integrated into the Hybrid Inverter and must be installed according to the local regulations.					

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		N/A
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

Clause	Test Item	Remark	P / F / N/A
Hybrid inverter use battery for testing：			
Bbis.3 a)/b)	*Harmonics measurement*		*P*
Bbis.3 c)	*Flicker measurement*		*P*
Bbis.4	*Check the operating range in voltage and frequency*		*P*
Bbis.5	*Conditions of connection, reconnection and gradual power supply*		*P*
Bbis.6.1 & Bbis.6.2	*Checking construction requirements: reactive power capability*		*P*
Bbis.6.3 & Bbis.6.4	*Reactive power production according to an assigned level*	*>11.08 kW **	*P*
Bbis.6.5	*Response time to a step change of the assigned level*	*>11.08 kW **	*P*
Bbis.6.6 & Bbis.6.7	*Automatic production of reactive power according to a characteristic curve cos φ = f(P)*		*P*
Bbis.6.8 & Bbis.6.9	*Automatic reactive power production according to a characteristic curve Q = f(V)*	*>11.08 kW **	*P*
Bbis.7.1	*Active power limitation for voltage values near to 110 % Un*		*P*
Bbis.7.2	*Verification of automatic reduction of active power in the presence of overfrequency transients on the network*		*P*
Bbis.7.3	*Verification of the automatic increase of active power in the presence of underfrequency transients on the network*		*P*
Bbis.7.4	*Active power limitation in coincidence with external command coming from the Electricity Distributor*		*P*
Bbis.7.4.1	*Verification of the settling time at a power increase / decrease command*		*P*
Bbis.8.1	*Verification of continuous component emission*		*P*
Bbis.8.2	*Verification of protections against the continuous DC injection*		*P*
Bbis.9	*Verification of insensitivity to voltage dips (UVRT and OVRT(8.5. 1-figure 30 capability)*	*>11.08 kW*	*P*
Bbis.10	*Verification of insensitivity to automatic reclosing in phase discrepancy*		*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.*			

CEI 0-21			
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.

CEI 0-21			
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	AF60K-TH						
	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	47.35	47.43	51.58	51.55	51.55	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	93.0	97.0	93.0	96.0	92.0	96.0	
-25°C temperature							
Limit [Hz]:	47.50 Hz (81<.S2)			51.50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.45	47.40	47.47	51.60	51.57	51.54	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	96.0	96.0	93.0	94.0	95.0	94.0	
+60°C temperature							
Limit [ms]:	47.50 Hz (81<.S2)			51.50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.45	47.42	47.34	51.51	51.57	51.55	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	97.0	98.0	99.0	96.0	90.0	93.0	

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 protectionf<47,5 Hz100 ms
Frequency increase protectionf<51,5 Hz100 ms
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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 & 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	AF60K-TH						
	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]:	47.43	47.47	47.42	51.53	51.52	51.55	
Trip time limit [ms]:	4000			1000			
Measurement the trip time [ms]:	3980	3980	3990	995	993	991	
-25°C temperature							
Limit [Hz]:	47.50 Hz (81<.S2)			51.50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.40	47.40	47.42	51.58	51.63	51.56	
Trip time limit [ms]:	4000			1000			
Measurement the trip time [ms]:	3960	3980	3990	991	992	998	
+60°C temperature							
Limit [ms]:	47.50 Hz (81<.S2)			51.50 Hz (81>.S2)			
Measurement accuracy of the tripping value [Hz]:	47.39	47.41	47.49	51.51	51.56	51.61	
Trip time limit [ms]:	4000			1000			
Measurement the trip time [ms]:	3970	3990	3990	999	999	997	

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 protectionf<47,5 Hz4000 ms
Frequency increase protectionf<51,5 Hz1000 ms
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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	AF60K-TH						
	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]:	49.70	49.69	49.68	50.36	50.32	50.31	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	93.0	98.0	92.0	90.0	91.0	99.0	
-25°C temperature							
Tripping threshold limit [Hz]:	49.80 (81<.S1)			50.20 (81>.S1)			
Measurement accuracy of the tripping value [Hz]:	49.77	49.71	49.73	50.30	50.27	50.28	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	97.0	94.0	93.0	93.0	98.0	92.0	
+60°C temperature							
Tripping threshold limit [Hz]:	49.80 (81<.S1)			50.20 (81>.S1)			
Measurement accuracy of the tripping value [Hz]:	49.67	49.69	49.74	50.27	50.22	50.24	
Trip time limit [ms]:	100			100			
Measurement the trip time [ms]:	96.0	98.0	98.0	93.0	91.0	92.0	
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% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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:	AF60K-TH		
L1L2L3	**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]:	195.3	195.1	195.2
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1493	1490	1498
-25°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.1	195.3	195.1
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1490	1494	1498
+60°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.2	195.1	195.3
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1490	1497	1493

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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.S1)**		**P**
Model:	AF60K-TH		
L1	**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]:	195.2	195.1	195.3
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1498	1491	1494
-25°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.0	195.2	195.3
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1496	1497	1497
+60°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.1	195.0	195.1
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1498	1492	1492

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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.S1)**		**P**
Model:	AF60K-TH		
L2	**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]:	195.2	195.0	195.1
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1498	1497	1493
-25°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.3	195.1	195.2
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1492	1498	1492
+60°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.0	195.2	195.0
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1491	1490	1494

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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.S1)**		**P**
Model:	AF60K-TH		
L3	**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]:	195.1	195.2	195.2
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1491	1494	1497
-25°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.0	195.0	195.3
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1495	1493	1492
+60°C temperature			
Limit [V]:	195.5 V (27.S1)		
Measurement accuracy of the tripping value [V]:	195.1	195.2	195.2
Trip time limit [ms]:	1500		
Measurement the trip time [ms]:	1491	1493	1498

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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	AF60K-TH						
L1L2L3	**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]:	34.38	34.35	34.37	264.62	264.61	264.53	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	197.0	194.0	198.0	199.0	197.0	193.0	
-25°C temperature							
Limit [V]:	34.5 V (27.S2)			264.5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.25	34.31	34.29	264.55	264.61	264.58	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	191.0	193.0	195.0	199.0	191.0	197.0	
+60°C temperature							
Limit [V]:	34.5 V (27.S2)			264.5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.24	34.39	34.26	264.58	264.54	264.56	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	197.0	191.0	194.0	198.0	193.0	196.0	

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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	AF60K-TH						
L1	**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]:	34.35	34.41	34.28	264.65	264.53	264.61	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	191.0	197.0	192.0	192.0	199.0	191.0	
-25°C temperature							
Limit [V]:	34.5 V (27.S2)			264.5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.22	34.35	34.38	264.60	264.59	264.57	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	198.0	192.0	194.0	199.0	194.0	193.0	
+60°C temperature							
Limit [V]:	34.5 V (27.S2)			264.5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.23	34.27	34.33	264.64	264.53	264.55	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	195.0	192.0	196.0	193.0	193.0	194.0	

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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	AF60K-TH						
L2	**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]:	34.28	34.37	34.27	264.58	264.59	264.57	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	192.0	193.0	198.0	190.0	195.0	193.0	
-25°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.40	34.29	34.27	264.61	264.55	264.53	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	194.0	198.0	195.0	198.0	198.0	196.0	
+60°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.32	34.31	34.33	264.63	264.56	264.57	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	196.0	194.0	193.0	193.0	192.0	194.0	

Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn 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	AF60K-TH						
L3	**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]:	34.33	34.35	34.41	264.54	264.60	264.58	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	197.0	192.0	198.0	191.0	197.0	198.0	
-25°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.25	34.31	34.33	264.57	264.57	264.53	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	198.0	192.0	196.0	192.0	195.0	198.0	
+60°C temperature							
Limit [V]:	34,5 V (27.S2)			264,5 V (59.S2)			
Measurement accuracy of the tripping value [V]:	34.42	34.36	34.20	264.61	264.59	264.56	
Trip time limit [ms]:	200			200			
Measurement the trip time [ms]:	192.0	194.0	198.0	192.0	197.0	194.0	

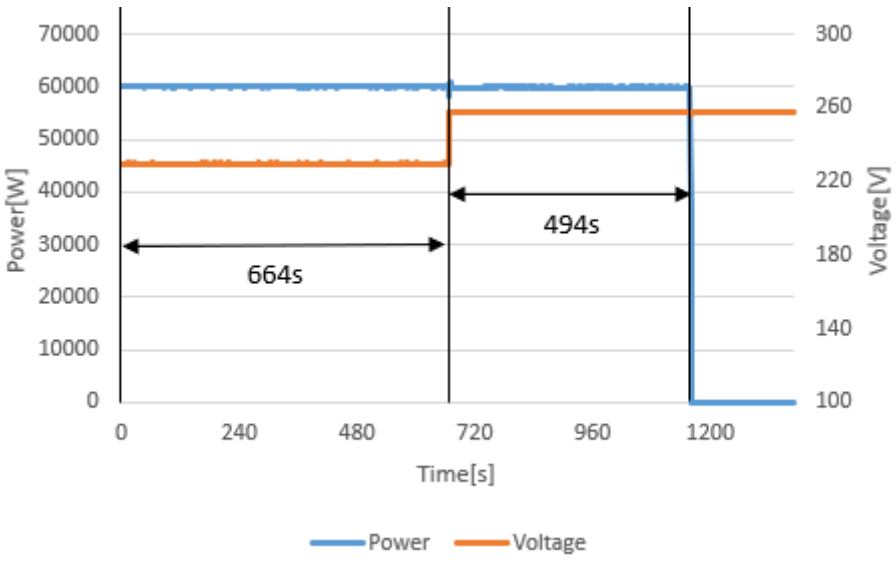
Note:
Verification is pass when the SPI trip occurs within the following limits for at least 3 consecutive tests:
- ≤ 1% Vn for voltage intervention thresholds
- ±20 mHz for frequency intervention thresholds
- ≤ 3 % ± 20 ms for intervention times
- ≤ 1 % Vn for voltage recovery thresholds
- ±20 mHz for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

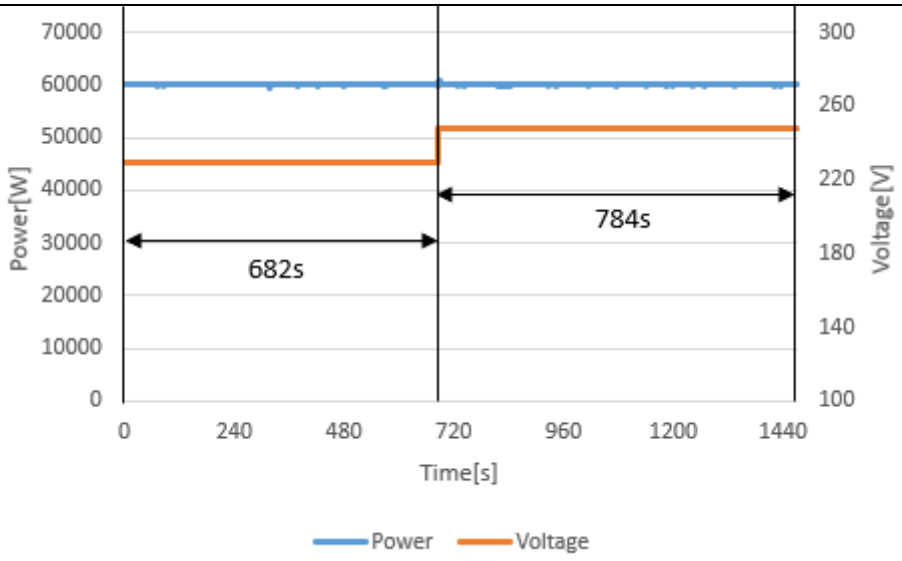
A.4.3.1 & A.4.3.2	**TABLE: Measuring the rise-in voltage protection as a running 10-minute mean value (59.S1)**		**P**
Model:	AF60K-TH		
Test:		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n (257.6 V). Disconnection must take place within 603 s.		
	Phase 1	494	≤ 603 s
	Phase 2	496	
	Phase 3	497	
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	No disconnection	
	Phase 3	No disconnection	
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	288	The disconnection time should be about 50 % of the value measured in a). *
	Phase 2	286	
	Phase 3	287	

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.

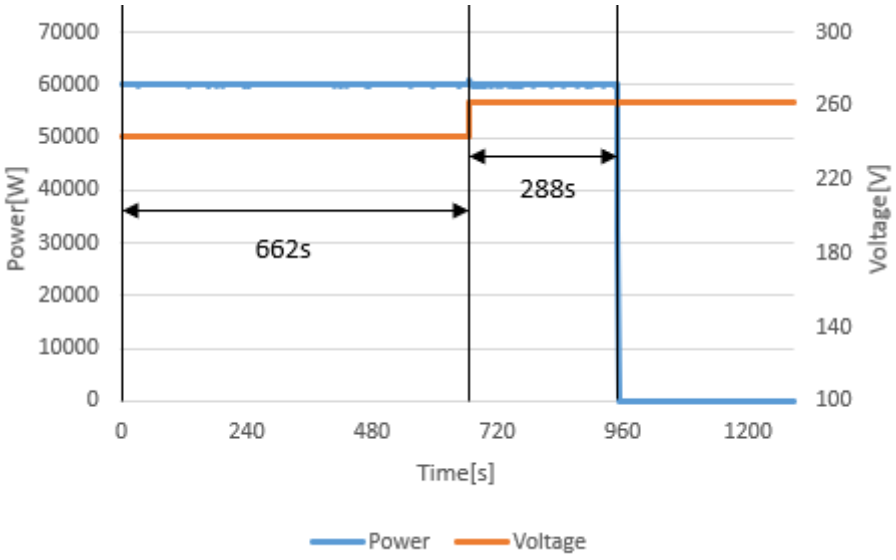


a)

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Clause	Requirement - Test	Result - Remark	Verdict



b)



c)

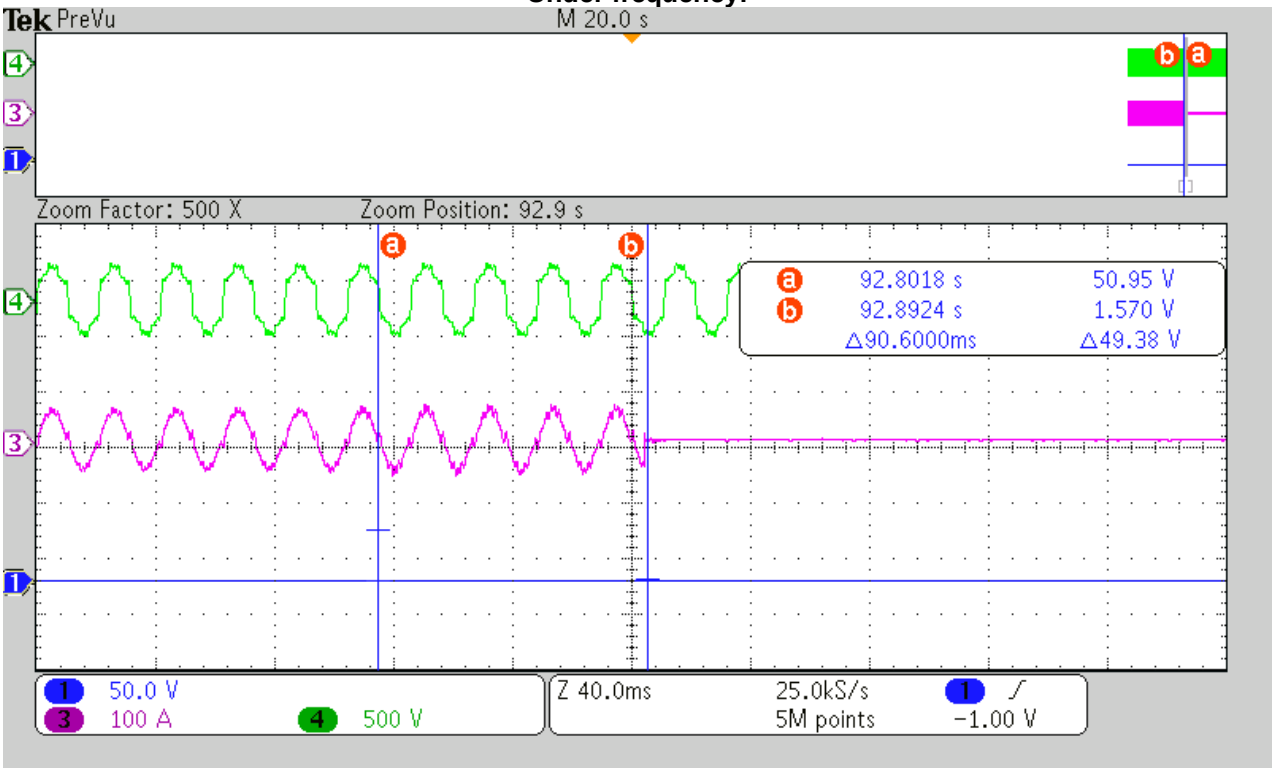
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.3.1	TABLE: Insensitivity to harmonics of the frequency relay								P
Mode	AF60K-TH								
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:

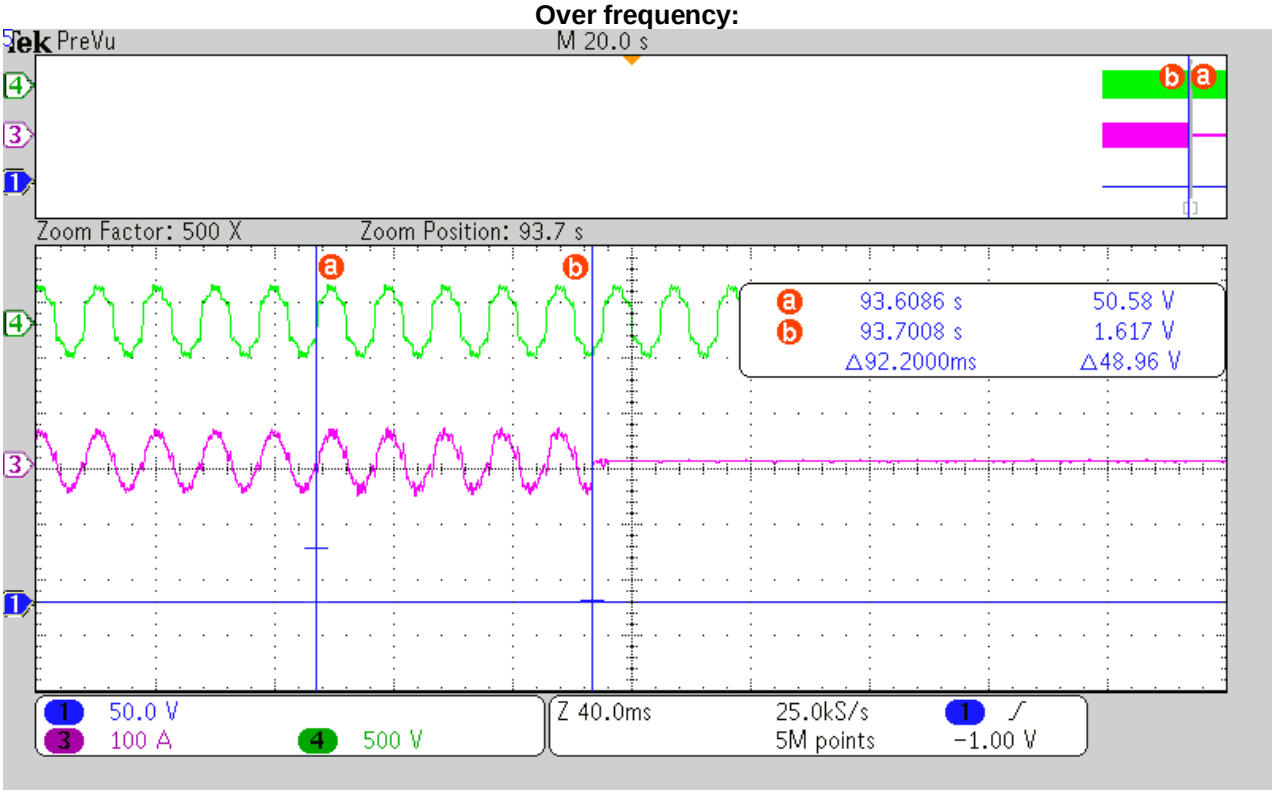
	Under frequency:			Over frequency:		
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps		
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold		
Limit [Hz]:	47.50 Hz			51.50 Hz		
Measurement accuracy of the tripping value [V]:	47.44	47.47	47.45	51.55	51.53	51.54
Trip time limit [ms]:	100			100		
Measurement the trip time [ms]:	93.8	90.6	98.1	95.4	92.2	94.2

Under frequency:



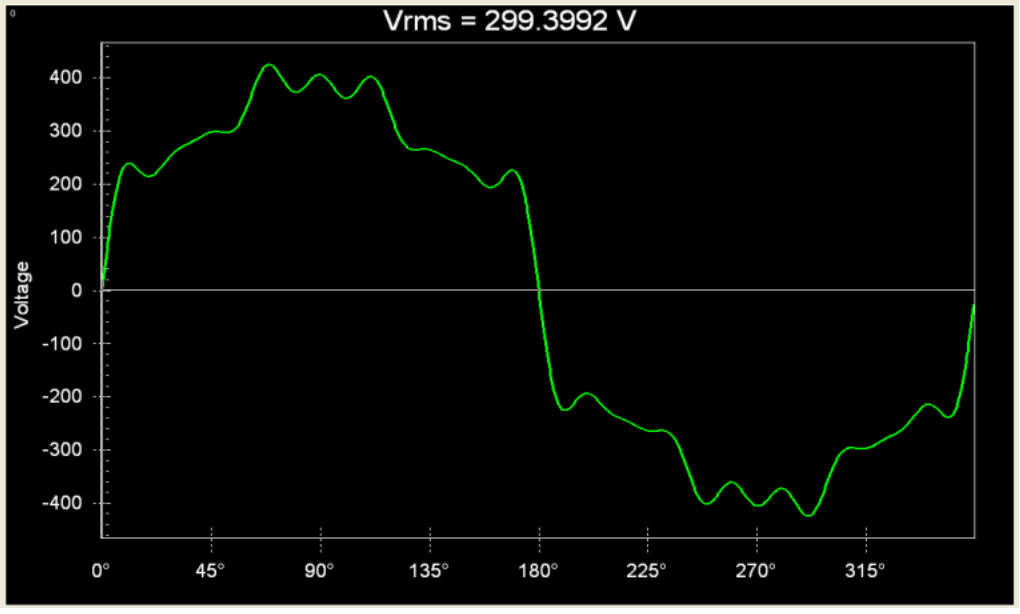
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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.

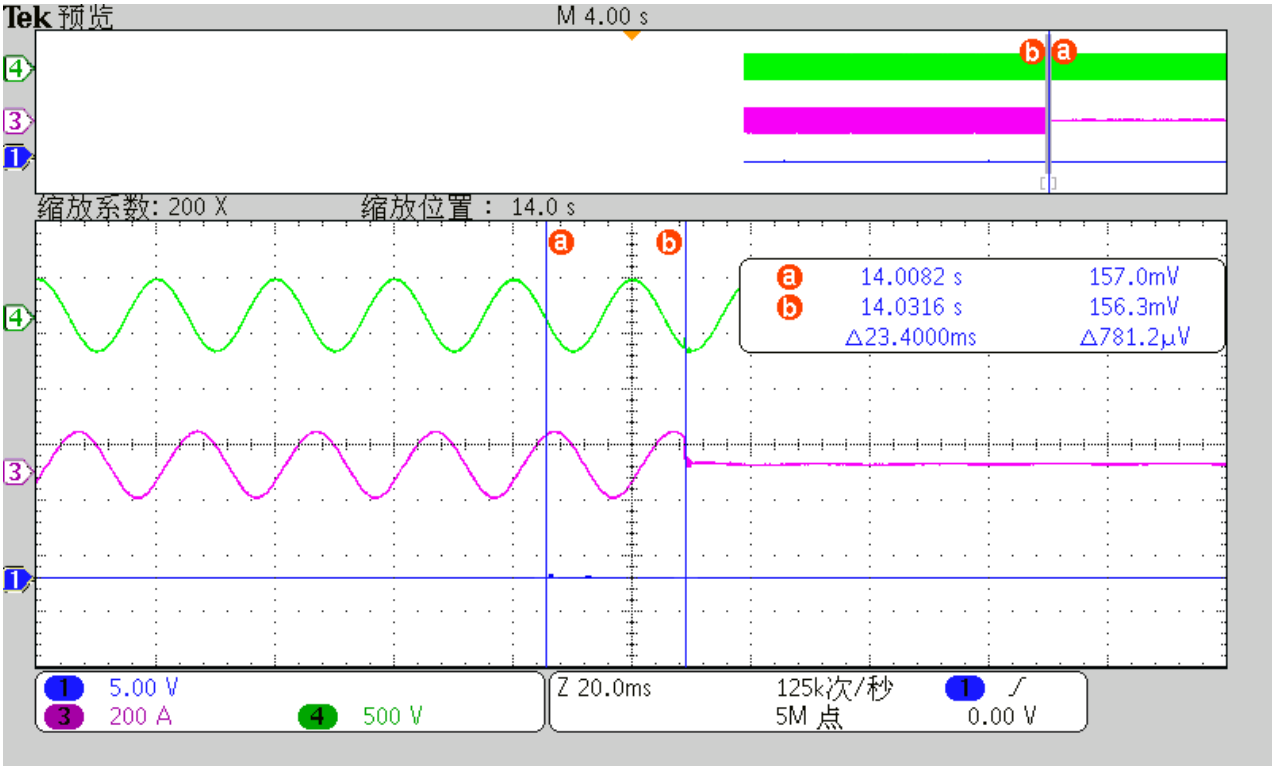


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

A.4.3.3.2	TABLE: Remote trip signal	P
Model	AF60K-TH	

Test:	Remote tripping signal for the external disconnection
Limit [ms]:	50
Measurement time of the tripping value [ms]:	23.4

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	AF60K-TH		
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:

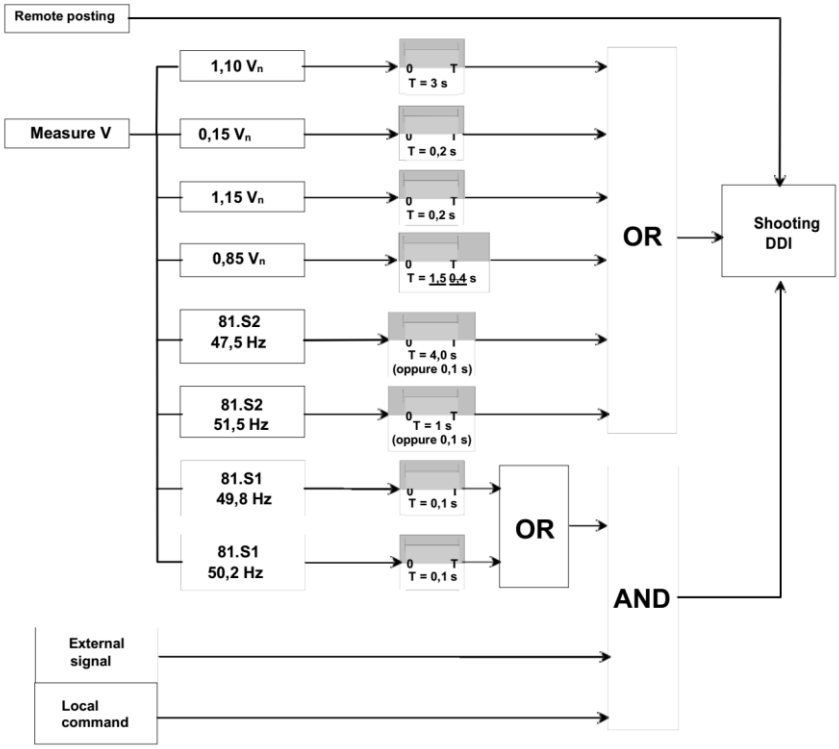


Figure 35 - Functional logic diagram of the SPI of the power park modules (the values in brackets refer to the transitory operating mode of the SPI)

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

A.4.3.4	**TABLE: Verification of insensitivity to the frequency derivative (ROCOF)**						**P**
Model	AF60K-TH						
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	60038	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	60032	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	60016	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	60033	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	60044	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	60044	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	60016	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	60018	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	60031	Continuous operation		Stay connected
2)	47.55 Hz	51.45 Hz	1.56 s	60044	Continuous operation		Stay connected
3)	51.45 Hz	47.55 Hz	1.56 s	60037	Continuous operation		Stay connected
5)	47.55 Hz	47.55 Hz	10.0 s	60024	Continuous operation		Stay connected

Test procedure:

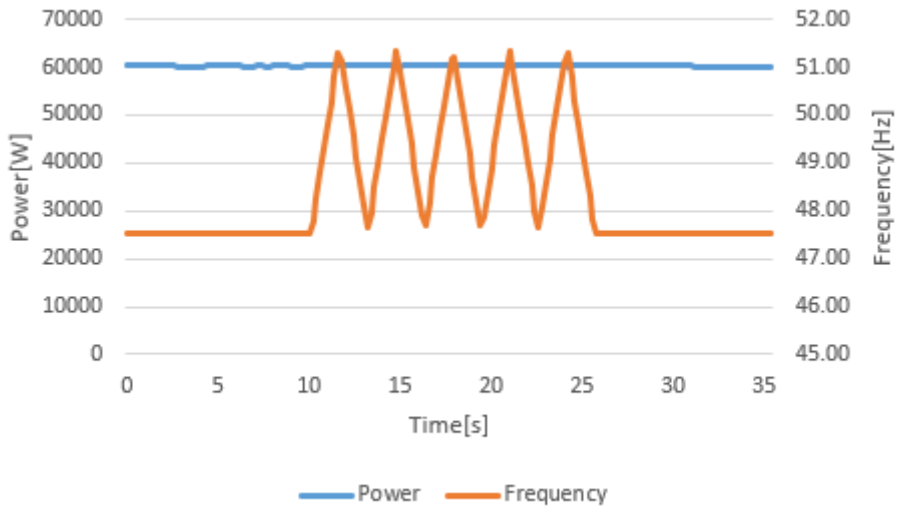
1) Apply a three-phase of symmetrical voltages of direct cyclic sequence having an amplitude of 100% of the rated voltage and a frequency of 47.550 Hz;
2) increase the frequency of the three-phase voltages, with ramp steps having an amplitude of 12.5 mHz and duration of 5 ms, until reaching the frequency 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	AF60K-TH			
Software version: V01				
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	253.0 V	600472 ms	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	264.6 V	198 ms	
	Default	264.5 V	200 ms	
Undervoltage 27.S1	Reading	195.4 V	1498 ms	
	Default	195.5 V	1500 ms	
Undervoltage 27.S2	Reading	34.5 V	196 ms	
	Default	34.5 V	200 ms	
Overfrequency 81>.S1	Reading	50.2 Hz	99 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	97 ms	
	Default	51.5 Hz	100 ms	
Underfrequency 81<.S1	Reading	49.8 Hz	97 ms	
	Default	49.8 Hz	100 ms	
Underfrequency 81<.S2	Reading	47.5 Hz	96 ms	
	Default	47.5 Hz	100 ms	

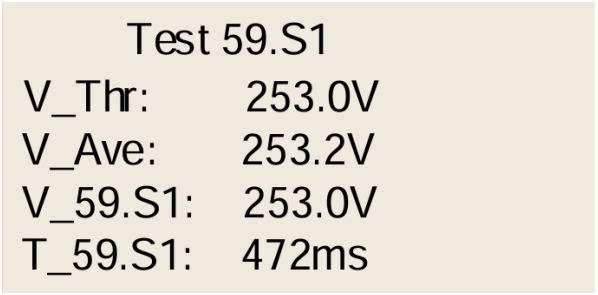
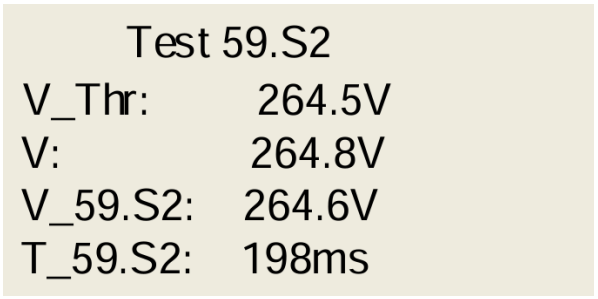
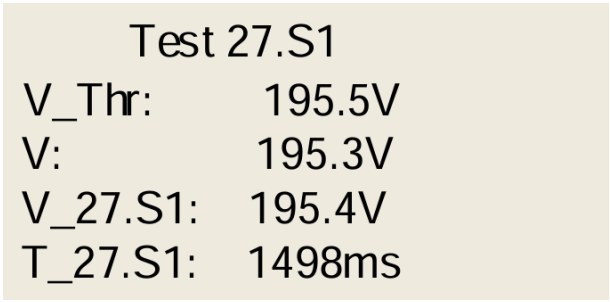
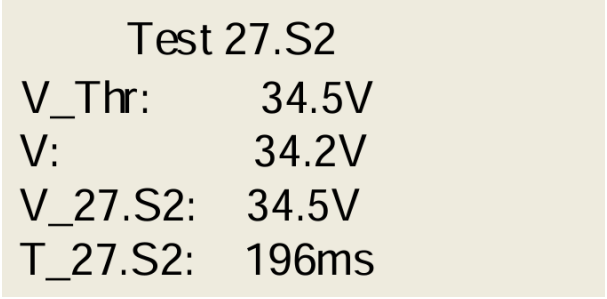
Note:

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.

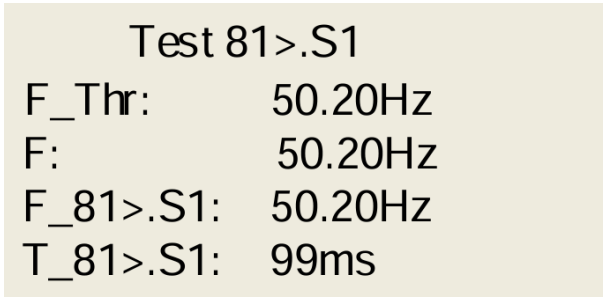
For each test the values of the quantities and the intervention times shall be viewable by the tester as well as the current value of the voltage and frequency detected by the converter.

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

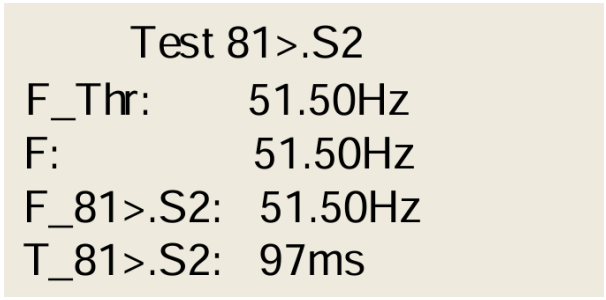
Diagram of auto-test:
Overvoltage 59.S1 
Overvoltage 59.S2 
Undervoltage 27.S1 
Undervoltage 27.S2 

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

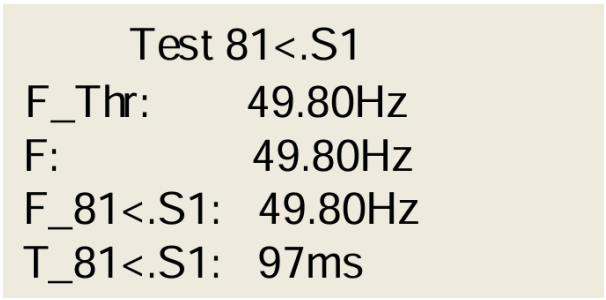
Overfrequency 81>S1



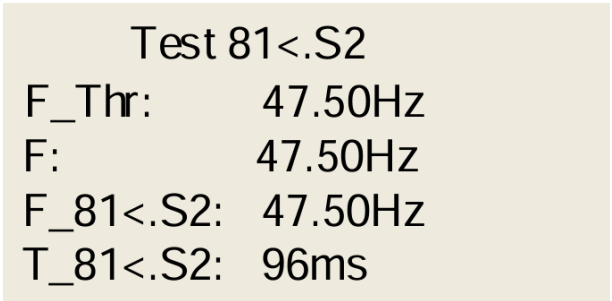
Overfrequency 81>S2



Underfrequency 81<S1



Underfrequency 81<S2



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

A.4.5	**TABLE: Single fault tolerance**				**P**
Model	AF60K-TH				
Ambient temperature (°C) ……..……:					25°C
No.	component No.	fault	test voltage (V)	test time	result
1	ISO Relay(K1)	Short circuit before start up inverter	620Vdc-230Vac	3min	Unit can't operate, error message: Iso Fault. No danger, no hazard, no fire
2	Monitoring Relay - L(K4)	Pin3 to Pin4short circuit before start up inverter	620Vdc-230Vac	3min	Unit can't operate, error message: GridRelay Fault. No danger, no hazard, no fire
3	Monitoring Relay - L(K4)	Pin3 to Pin4open circuit before start up inverter	620Vdc-230Vac	3min	Unit can't operate, error message: GridRelay Fault. No danger, no hazard, no fire
4	Monitoring Relay - N(K5)	Pin3 to Pin4short circuit before start up inverter	620Vdc-230Vac	3min	Unit can't operate, error message: GridRelay Fault. No danger, no hazard, no fire
5	Monitoring Relay - N(K5)	Pin3 to Pin4open circuit before start up inverter	620Vdc-230Vac	3min	Unit can't operate, error message: GridRelay Fault. No danger, no hazard, no fire
6	AC voltage measure1 (D21)	Pin2-Pin3Short circuit	620Vdc-230Vac	3min	Unit shut down, Error message: GridOverVolt Fault. No danger, no hazard, no fire
7	AC voltage measure1(D21)	Pin1-Pin3Short circuit	620Vdc-230Vac	3min	Unit shut down, Error message: GridOverVolt Fault. No danger, no hazard, no fire
8	AC current measure1(D24)	Pin1-Pin3Short circuit	620Vdc-230Vac	3min	Unit can't operate, error message: RInvCurAdChaFault. No danger, no hazard, no fire
9	AC current measure1(D24)	Pin2-Pin3Short circuit	620Vdc-230Vac	3min	Unit can't operate, error message: RInvCurAdChaFault. No danger, no hazard, no fire
10	AC current measure2(D12)	Pin1-Pin3Short circuit	620Vdc-230Vac	3min	Unit can't operate, error message: SInvCurAdChaFault. No danger, no hazard, no fire
11	AC current measure2(D12)	Pin2-Pin3Short circuit	620Vdc-230Vac	3min	Unit can't operate, error message: SInvCurAdChaFault. No danger, no hazard, no fire
12	AC frequency measure(R194)	Pin1-Pin2 Short circuit	620Vdc-230Vac	3min	Unit shut down, error message: GridOverFreq Fault. No danger, no hazard, no fire
13	V-bus measure(R185)	Pin1-Pin2 Short circuit	620Vdc-230Vac	3min	Unit can't operate, Error message: BusAllVoltHwOveFault. No damage, no hazard, no fire.

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

14	DC current measure (R284)	Pin1-Pin2 Short circuit	620Vdc-230Vac	3min	Unit shut down, error message: Pv1HwOverCurrFault. No danger, no hazard, no fire
15	DC current measure2(R308)	Pin1-Pin2 Short circuit	620Vdc-230Vac	3min	Unit shut down, error message: Pv2HwOverCurrFault. No danger, no hazard, no fire
16	DC current measure3(R36)	Pin1-Pin2 Short circuit	620Vdc-230Vac	3min	Unit can't operate, Error message: EnvironmentTemLowFault. No damage, no hazard, no fire.
17	T measure(C91)	Pin1-Pin2Short circuit	620Vdc-230Vac	3min	Unit can't operate, Error message: EnvironmentTemLowFault. No damage, no hazard, no fire.
18	power tubeBoost(Q33)	Pin2-Pin3Short circuit before start up	620Vdc-230Vac	3min	Unit cannot start up, No damage, no hazard, no fire.
19	Diode(D94)	Short circuit	620Vdc-230Vac	3min	Unit normal operation, No danger, no hazard, no fire
20	power tube IGBT(Q4)	Pin2-Pin3Short circuit before start up	620Vdc-230Vac	3min	Unit can’t operate, error message: InvOpenTestErr. No danger, no hazard, no fire
21	power tubeIGBT(Q8)	Pin2-Pin3Short circuit before start up	620Vdc-230Vac	3min	Unit shut down, error message: InvOpenTestErr. No danger, no hazard, no fire
22	GFCI check	Short circuit	620Vdc-230Vac	3min	Unit shut down, error message: LeakCurrFault. No danger, no hazard, no fire
23	Bus cap(C68)	Pin1-Pin2Short circuit before start up	620Vdc-230Vac	3min	Unit cannot start up, No damage, no hazard, no fire.
24	Transformer short circuit tests (T1)	Pin22-Pin24Short circuit	620Vdc-230Vac	10min	Unit cannot start up, No damage, no hazard, no fire.
25	Transformer short circuit tests(T1)	Pin32-Pin36Short circuit	620Vdc-230Vac	10min	Unit cannot start up, No damage, no hazard, no fire.
26	power tubeMOS-SPS(Q21)	G-D Short circuit	620Vdc-230Vac	10min	SPS no output, No danger, no hazard, no fire
27	power tubeMOS-SPS(Q21)	D-S Short circuit	620Vdc-230Vac	10min	SPS no output, No danger, no hazard, no fire
28	Output L to N	short circuit	620Vdc-230Vac	3min	Unit shut down, error message: GridUnderVoltFault. No danger, no hazard, no fire
29	Output L to PE	short circuit	620Vdc-230Vac	3min	Unit shut down, error message: GridLossFault. No danger, no hazard, no fire
30	DC	--	620Vdc-230Vac	10min	Vac=0, VBAT=0
31	AC	--	620Vdc-230Vac	10min	Vdc=0, VBAT=0
32	BAT	--	620Vdc-230Vac	10min	Vdc=0, Vac=0

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

33	Overload	Output overload(110%)	620Vdc-230Vac	30min	Unit normal operation, No danger, no hazard, no fire
34	Cooling system failure – Blanketing test	Put the unit to box	620Vdc-230Vac	2Hour	1 hour power run at 50%
35	PV+ to PV-	Reverse polarity	620Vdc-230Vac	3min	Unit cannot start up, No danger, no hazard, no fire
36	Output L - N	Reverse polarity before start up	620Vdc-230Vac	3min	Unit can't operate, error message: Grid Volt Fault. No danger, no hazard, no fire

Supplementary information:
Abbreviations APS: auxiliary power supply, EM: error message
EUT: equipment under test, SC short circuit, OP: open circuit, O/L: Overloaded
EUT shut down: EUT does not connect to Grid, cease to export power to Grid, the relay is opened.
EUT standby: EUT connects to Grid, ceases to export power to Grid, the relay is closed.

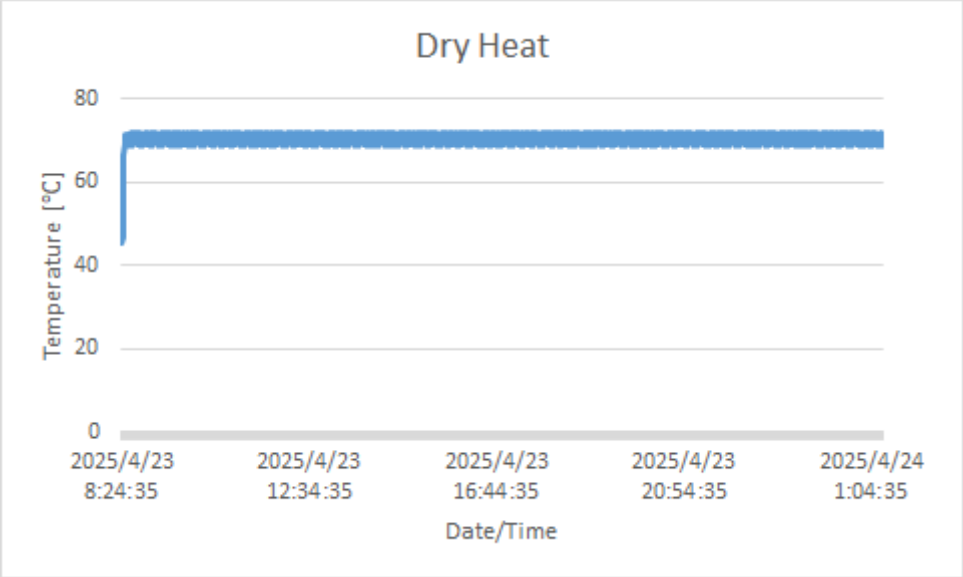
During the test:
Fire cannot propagate beyond the EUT;
Equipment shall not emit molten metal;
Enclosures shall not deform to cause non-compliance with the standard.
Dielectric test is made on RI and BI between Pri. circuit and protective earthing terminal after the test.
No Backfeed voltage on the test.

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

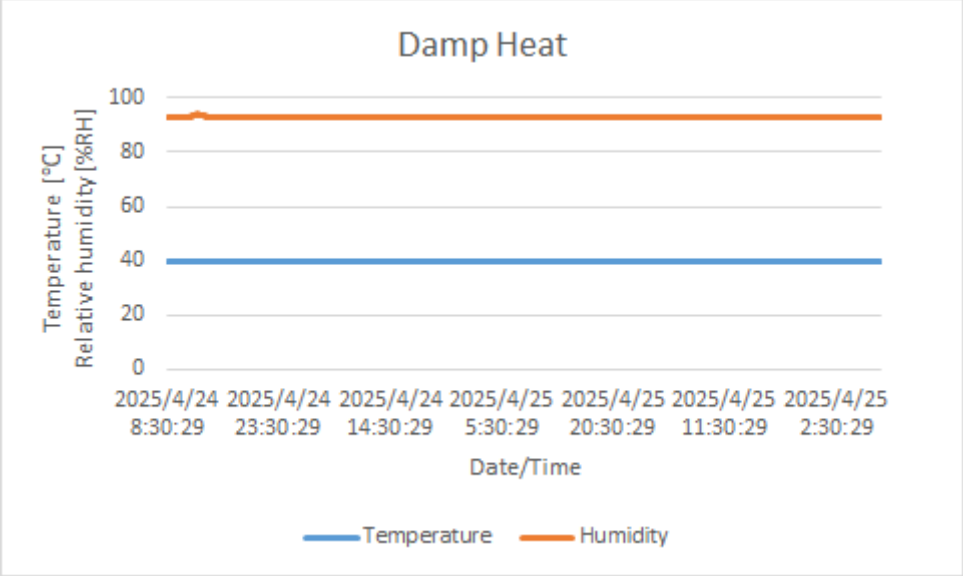
A.4.7	**TABLE: Climatic compatibility tests**			**P**
Model	AF60K-TH			
Climatic tests of unpowered equipment:				
Temperature	Relative humidity	Standards	Test time	
70°C ± 2°C	--	EN 60068-2-2	16h	
40°C ± 2°C	93% ± 3%	EN 60068-2-78	4 days	
-25°C ± 2°C	--	EN 60068-2-1	16h	
-25°C -> +70°C ± 2°C	--	EN 60068-2-14	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:

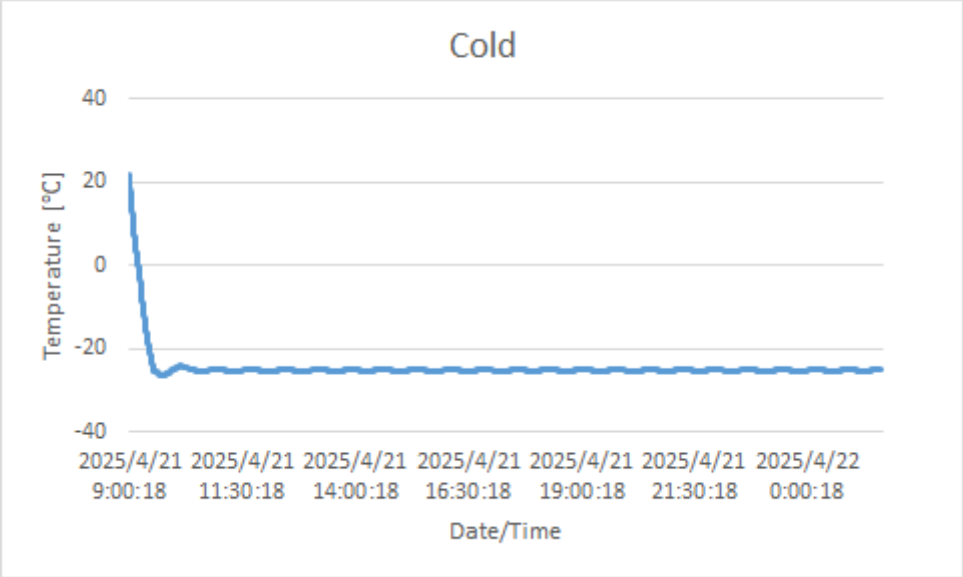


Temperature diagram of unpowered equipment:

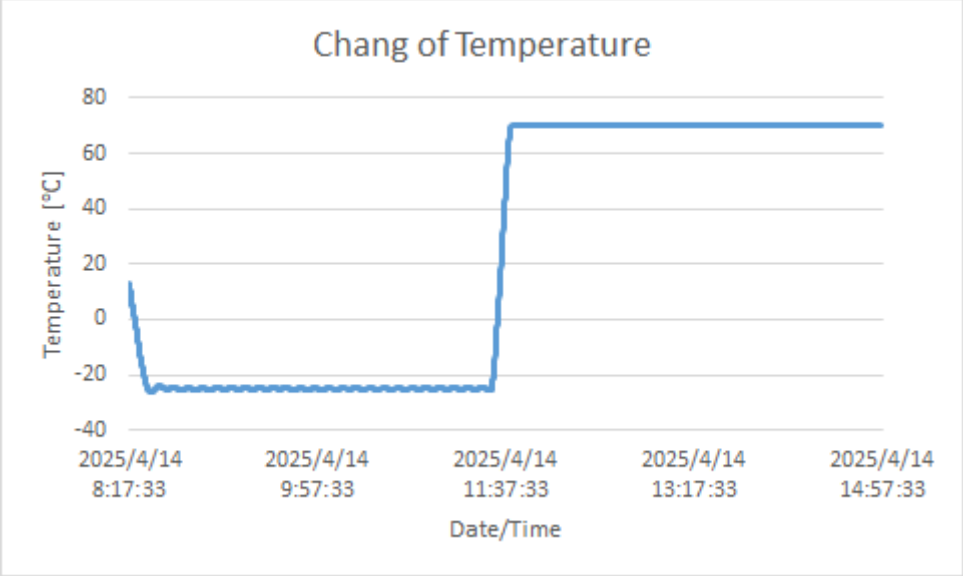


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of unpowered equipment:

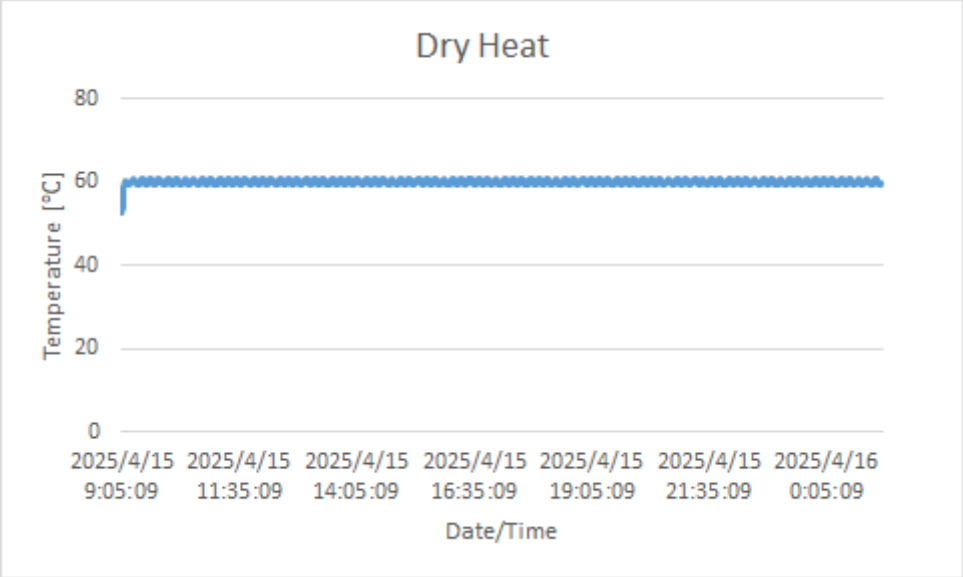


Temperature diagram of unpowered equipment:

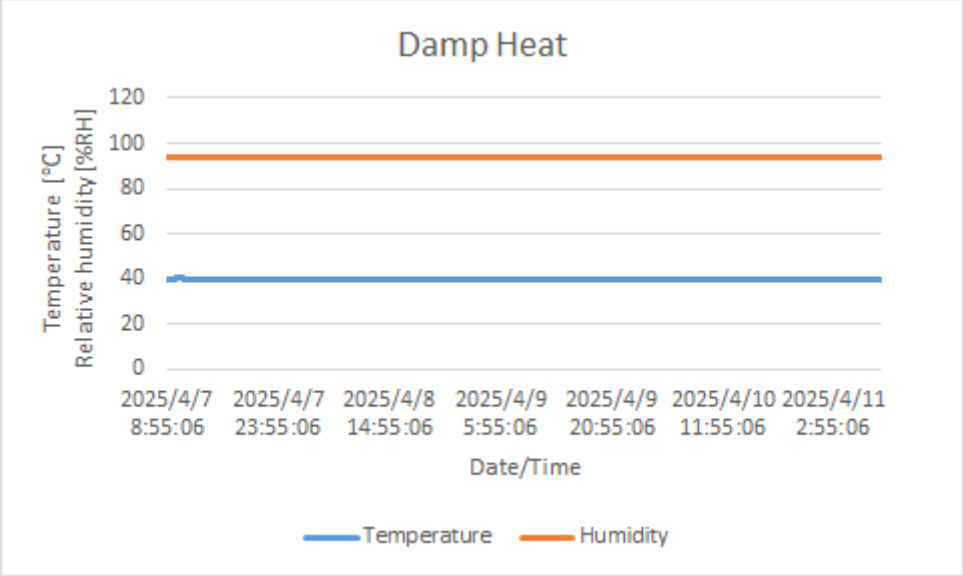


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of powered equipment:

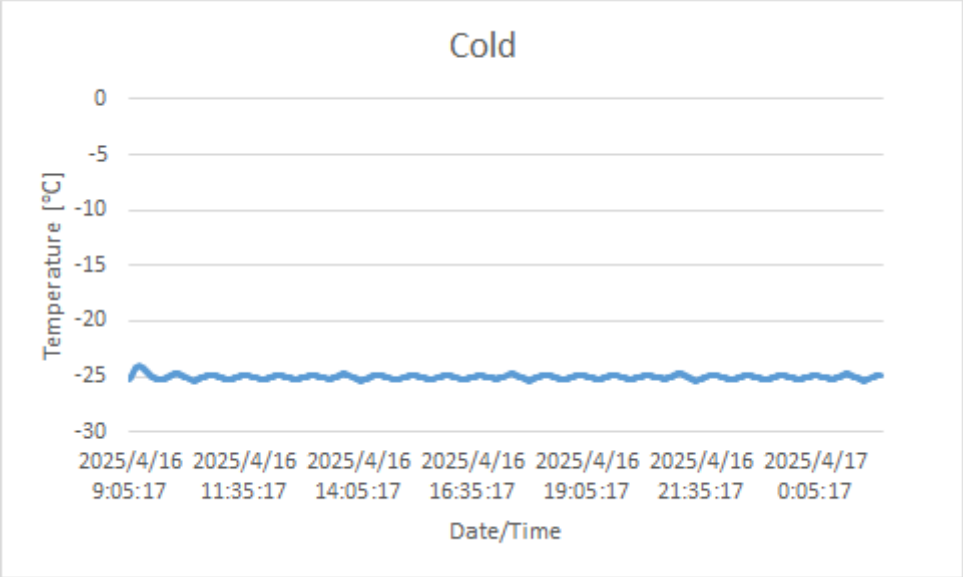


Temperature diagram of powered equipment:

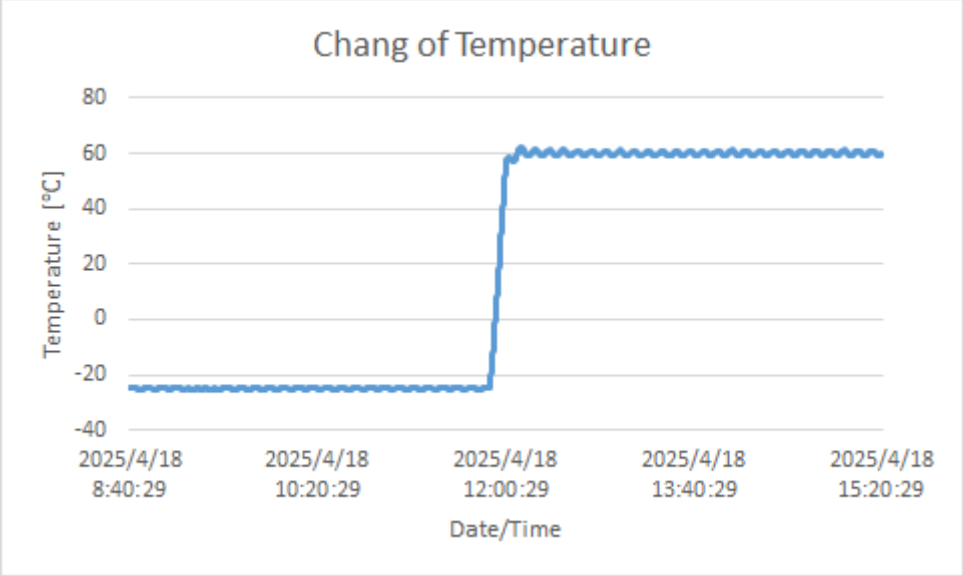


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Temperature diagram of powered equipment:



Temperature diagram of powered equipment:



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

A.4.8	**TABLE: Insulation tests (CEI EN 60255-5)**		**P**
Model	AF60K-TH		
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:			

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

A.4.9	**TABLE: Test for the overload capacity of measuring circuits**		**P**
Model	AF60K-TH		
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**		**N/A**
Model	AF60K-TH		
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	AF60K-TH	
☒ 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 /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	60051 (100% P_n, 25°C)						
Voltage (V)	231.53						
Current (A)	86.52						
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	86.073	86.081	86.068	--	--	--	--
2nd	1.132	0.591	1.303	1.315	0.686	1.513	8
3rd	1.480	1.257	1.531	1.719	1.460	1.778	N/A
4th	0.098	0.235	0.098	0.114	0.273	0.114	4
5th	0.955	0.980	1.059	1.109	1.138	1.230	10.7
6th	0.141	0.253	0.108	0.164	0.293	0.126	2.7
7th	0.461	0.497	0.569	0.535	0.577	0.661	7.2
8th	0.137	0.181	0.084	0.159	0.210	0.098	2
9th	0.147	0.180	0.180	0.171	0.209	0.209	N/A
10th	0.126	0.141	0.067	0.146	0.164	0.078	1.6
11th	0.344	0.297	0.334	0.399	0.345	0.388	3.1
12th	0.116	0.216	0.052	0.135	0.251	0.060	1.3
13th	0.218	0.205	0.260	0.253	0.238	0.302	2
14th	0.116	0.096	0.101	0.135	0.111	0.118	N/A
15th	0.112	0.147	0.049	0.130	0.171	0.057	N/A
16th	0.073	0.096	0.123	0.085	0.112	0.143	N/A
17th	0.162	0.138	0.160	0.189	0.161	0.185	N/A
18th	0.084	0.199	0.040	0.097	0.231	0.046	N/A
19th	0.112	0.115	0.175	0.131	0.133	0.204	N/A
20th	0.100	0.081	0.080	0.116	0.094	0.093	N/A
21st	0.089	0.143	0.051	0.104	0.166	0.059	N/A
22nd	0.050	0.057	0.109	0.058	0.067	0.126	N/A
23rd	0.105	0.089	0.101	0.122	0.103	0.117	N/A
24th	0.054	0.116	0.031	0.063	0.135	0.036	N/A
25th	0.099	0.074	0.092	0.115	0.085	0.107	N/A
26th	0.080	0.032	0.039	0.092	0.038	0.045	N/A
27th	0.085	0.104	0.087	0.098	0.121	0.101	N/A
28th	0.038	0.028	0.075	0.044	0.032	0.087	N/A
29th	0.076	0.095	0.035	0.088	0.110	0.041	N/A
30th	0.052	0.066	0.072	0.060	0.077	0.084	N/A
31st	0.057	0.024	0.043	0.066	0.028	0.050	N/A
32nd	0.059	0.032	0.030	0.069	0.037	0.035	N/A
33rd	0.068	0.027	0.079	0.079	0.032	0.092	N/A
34th	0.025	0.026	0.050	0.029	0.030	0.059	N/A
35th	0.072	0.053	0.057	0.083	0.061	0.066	N/A
36th	0.026	0.021	0.023	0.031	0.024	0.026	N/A
37th	0.051	0.029	0.028	0.059	0.034	0.033	N/A
38th	0.022	0.020	0.021	0.026	0.023	0.025	N/A
39th	0.022	0.017	0.019	0.026	0.020	0.021	N/A
40th	0.023	0.020	0.020	0.027	0.024	0.023	N/A
THD	--	--	--	2.866	2.401	3.087	13
PWHD	--	--	--	2.224	2.375	2.193	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	60052 (100% P_n, -25°C)						
Voltage (V)	231.53						
Current (A)	86.52						
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	86.078	86.086	86.073	--	--	--	--
2nd	1.126	0.566	1.281	1.308	0.657	1.488	8
3rd	1.471	1.267	1.521	1.708	1.472	1.767	N/A
4th	0.099	0.240	0.099	0.115	0.279	0.115	4
5th	0.948	0.969	1.054	1.101	1.126	1.224	10.7
6th	0.139	0.251	0.107	0.162	0.292	0.124	2.7
7th	0.469	0.505	0.574	0.545	0.587	0.667	7.2
8th	0.134	0.175	0.087	0.156	0.203	0.101	2
9th	0.145	0.180	0.180	0.168	0.208	0.208	N/A
10th	0.120	0.139	0.069	0.140	0.161	0.080	1.6
11th	0.343	0.296	0.334	0.399	0.344	0.388	3.1
12th	0.114	0.217	0.051	0.132	0.251	0.059	1.3
13th	0.220	0.208	0.262	0.255	0.241	0.304	2
14th	0.113	0.096	0.104	0.131	0.111	0.121	N/A
15th	0.110	0.147	0.050	0.128	0.171	0.058	N/A
16th	0.072	0.095	0.123	0.084	0.110	0.143	N/A
17th	0.162	0.141	0.162	0.188	0.163	0.188	N/A
18th	0.083	0.196	0.040	0.096	0.227	0.047	N/A
19th	0.116	0.116	0.177	0.134	0.134	0.206	N/A
20th	0.096	0.083	0.081	0.112	0.096	0.094	N/A
21st	0.087	0.141	0.050	0.101	0.164	0.058	N/A
22nd	0.045	0.056	0.104	0.053	0.066	0.120	N/A
23rd	0.104	0.089	0.099	0.121	0.103	0.115	N/A
24th	0.053	0.115	0.030	0.062	0.134	0.034	N/A
25th	0.100	0.074	0.093	0.117	0.086	0.108	N/A
26th	0.077	0.036	0.040	0.089	0.042	0.046	N/A
27th	0.085	0.101	0.086	0.099	0.118	0.100	N/A
28th	0.041	0.029	0.075	0.048	0.034	0.087	N/A
29th	0.076	0.098	0.035	0.089	0.113	0.040	N/A
30th	0.052	0.070	0.076	0.060	0.081	0.088	N/A
31st	0.059	0.022	0.045	0.069	0.026	0.052	N/A
32nd	0.056	0.037	0.033	0.065	0.042	0.039	N/A
33rd	0.070	0.029	0.081	0.082	0.034	0.094	N/A
34th	0.026	0.027	0.047	0.030	0.032	0.055	N/A
35th	0.072	0.053	0.056	0.084	0.061	0.065	N/A
36th	0.028	0.021	0.021	0.033	0.025	0.025	N/A
37th	0.051	0.029	0.028	0.059	0.034	0.032	N/A
38th	0.025	0.017	0.021	0.029	0.020	0.024	N/A
39th	0.020	0.019	0.020	0.024	0.022	0.023	N/A
40th	0.026	0.020	0.023	0.030	0.024	0.027	N/A
THD	--	--	--	2.853	2.394	3.104	13
PWHD	--	--	--	2.217	2.379	2.199	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	60057 (100% P_n, 60°C)						
Voltage (V)	231.54						
Current (A)	86.52						
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	86.080	86.087	86.075	--	--	--	--
2nd	1.114	0.557	1.278	1.294	0.647	1.484	8
3rd	1.470	1.264	1.530	1.707	1.468	1.776	N/A
4th	0.100	0.243	0.100	0.116	0.282	0.116	4
5th	0.948	0.974	1.060	1.101	1.131	1.231	10.7
6th	0.139	0.252	0.103	0.162	0.293	0.119	2.7
7th	0.469	0.502	0.573	0.544	0.583	0.665	7.2
8th	0.136	0.174	0.086	0.158	0.202	0.100	2
9th	0.146	0.181	0.181	0.169	0.210	0.210	N/A
10th	0.123	0.139	0.069	0.143	0.161	0.080	1.6
11th	0.344	0.299	0.336	0.400	0.347	0.390	3.1
12th	0.116	0.217	0.051	0.135	0.252	0.059	1.3
13th	0.222	0.209	0.262	0.258	0.243	0.304	2
14th	0.114	0.097	0.103	0.132	0.112	0.120	N/A
15th	0.111	0.148	0.051	0.129	0.172	0.059	N/A
16th	0.074	0.096	0.121	0.086	0.111	0.140	N/A
17th	0.164	0.143	0.165	0.190	0.167	0.192	N/A
18th	0.084	0.196	0.040	0.098	0.228	0.047	N/A
19th	0.115	0.117	0.177	0.134	0.136	0.205	N/A
20th	0.096	0.081	0.079	0.112	0.094	0.091	N/A
21st	0.090	0.142	0.048	0.105	0.165	0.055	N/A
22nd	0.042	0.057	0.094	0.048	0.066	0.109	N/A
23rd	0.105	0.091	0.102	0.122	0.106	0.118	N/A
24th	0.055	0.116	0.033	0.064	0.134	0.038	N/A
25th	0.096	0.074	0.093	0.112	0.085	0.108	N/A
26th	0.075	0.035	0.039	0.088	0.040	0.045	N/A
27th	0.084	0.100	0.088	0.098	0.116	0.102	N/A
28th	0.042	0.030	0.074	0.049	0.034	0.086	N/A
29th	0.076	0.096	0.031	0.088	0.111	0.036	N/A
30th	0.053	0.069	0.072	0.062	0.080	0.083	N/A
31st	0.059	0.027	0.043	0.068	0.031	0.050	N/A
32nd	0.057	0.036	0.033	0.066	0.042	0.038	N/A
33rd	0.070	0.029	0.081	0.081	0.034	0.095	N/A
34th	0.026	0.027	0.049	0.030	0.031	0.057	N/A
35th	0.072	0.057	0.058	0.084	0.066	0.067	N/A
36th	0.025	0.019	0.023	0.030	0.022	0.027	N/A
37th	0.052	0.031	0.028	0.060	0.035	0.033	N/A
38th	0.023	0.017	0.020	0.026	0.020	0.023	N/A
39th	0.022	0.020	0.022	0.026	0.023	0.025	N/A
40th	0.024	0.020	0.022	0.028	0.023	0.026	N/A
THD	--	--	--	2.859	2.396	3.046	13
PWHD	--	--	--	2.219	2.390	2.188	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	39809 (66% P_n, 25°C)						
Voltage (V)	231.39						
Current (A)	57.44						
Power Factor	0.9985						
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	57.096	57.104	57.092	--	--	--	--
2nd	0.854	0.568	0.875	1.496	0.994	1.532	8
3rd	1.382	1.135	1.454	2.420	1.987	2.544	N/A
4th	0.113	0.260	0.113	0.197	0.455	0.197	4
5th	0.813	0.807	0.939	1.423	1.413	1.643	10.7
6th	0.203	0.297	0.091	0.355	0.520	0.159	2.7
7th	0.383	0.323	0.400	0.671	0.565	0.700	7.2
8th	0.164	0.169	0.106	0.287	0.295	0.186	2
9th	0.139	0.190	0.190	0.244	0.332	0.332	N/A
10th	0.110	0.125	0.134	0.193	0.218	0.234	1.6
11th	0.202	0.194	0.244	0.354	0.340	0.427	3.1
12th	0.131	0.221	0.054	0.229	0.386	0.095	1.3
13th	0.137	0.088	0.146	0.240	0.153	0.256	2
14th	0.102	0.101	0.079	0.179	0.176	0.138	N/A
15th	0.113	0.116	0.113	0.198	0.202	0.197	N/A
16th	0.062	0.049	0.106	0.109	0.086	0.185	N/A
17th	0.039	0.068	0.051	0.069	0.120	0.089	N/A
18th	0.062	0.111	0.022	0.109	0.195	0.039	N/A
19th	0.060	0.064	0.044	0.105	0.112	0.076	N/A
20th	0.051	0.041	0.031	0.089	0.071	0.054	N/A
21st	0.048	0.066	0.109	0.083	0.115	0.191	N/A
22nd	0.059	0.026	0.062	0.104	0.045	0.108	N/A
23rd	0.092	0.107	0.073	0.161	0.186	0.127	N/A
24th	0.034	0.019	0.042	0.059	0.034	0.073	N/A
25th	0.061	0.124	0.084	0.108	0.216	0.148	N/A
26th	0.045	0.025	0.027	0.078	0.043	0.047	N/A
27th	0.106	0.061	0.067	0.186	0.107	0.118	N/A
28th	0.033	0.024	0.027	0.058	0.042	0.047	N/A
29th	0.045	0.043	0.054	0.079	0.076	0.095	N/A
30th	0.027	0.027	0.039	0.048	0.047	0.068	N/A
31st	0.054	0.038	0.051	0.095	0.067	0.089	N/A
32nd	0.021	0.043	0.035	0.037	0.075	0.061	N/A
33rd	0.037	0.047	0.051	0.065	0.083	0.090	N/A
34th	0.020	0.025	0.024	0.035	0.044	0.041	N/A
35th	0.036	0.032	0.057	0.063	0.056	0.100	N/A
36th	0.020	0.023	0.015	0.035	0.039	0.027	N/A
37th	0.017	0.022	0.031	0.029	0.038	0.055	N/A
38th	0.017	0.024	0.020	0.030	0.041	0.035	N/A
39th	0.017	0.016	0.017	0.030	0.028	0.030	N/A
40th	0.020	0.020	0.018	0.035	0.035	0.031	N/A
THD	--	--	--	3.555	3.105	3.806	13
PWHD	--	--	--	2.350	2.525	2.448	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	39805 (66% P_n , -25°C)						
Voltage (V)	231.40						
Current (A)	57.43						
Power Factor	0.9985						
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	57.095	57.102	57.090	--	--	--	--
2nd	0.822	0.530	0.847	1.440	0.928	1.482	8
3rd	1.375	1.142	1.451	2.408	2.000	2.540	N/A
4th	0.108	0.263	0.108	0.189	0.460	0.189	4
5th	0.814	0.813	0.944	1.425	1.424	1.653	10.7
6th	0.201	0.288	0.090	0.351	0.504	0.157	2.7
7th	0.386	0.331	0.396	0.676	0.579	0.694	7.2
8th	0.161	0.161	0.103	0.282	0.281	0.180	2
9th	0.140	0.183	0.183	0.246	0.320	0.320	N/A
10th	0.108	0.121	0.132	0.190	0.212	0.232	1.6
11th	0.204	0.202	0.243	0.358	0.354	0.426	3.1
12th	0.131	0.218	0.052	0.229	0.381	0.092	1.3
13th	0.138	0.097	0.147	0.242	0.169	0.258	2
14th	0.101	0.101	0.080	0.177	0.177	0.140	N/A
15th	0.114	0.112	0.115	0.200	0.196	0.201	N/A
16th	0.063	0.052	0.105	0.111	0.091	0.184	N/A
17th	0.037	0.068	0.050	0.065	0.119	0.087	N/A
18th	0.064	0.112	0.024	0.112	0.197	0.043	N/A
19th	0.058	0.062	0.044	0.101	0.108	0.077	N/A
20th	0.050	0.046	0.029	0.088	0.080	0.052	N/A
21st	0.050	0.063	0.109	0.088	0.110	0.190	N/A
22nd	0.051	0.026	0.064	0.090	0.045	0.111	N/A
23rd	0.095	0.107	0.076	0.166	0.187	0.133	N/A
24th	0.038	0.026	0.042	0.066	0.046	0.074	N/A
25th	0.061	0.129	0.089	0.107	0.225	0.155	N/A
26th	0.045	0.021	0.023	0.078	0.038	0.040	N/A
27th	0.105	0.063	0.074	0.184	0.110	0.130	N/A
28th	0.034	0.022	0.030	0.060	0.039	0.052	N/A
29th	0.043	0.048	0.058	0.076	0.084	0.102	N/A
30th	0.028	0.028	0.039	0.049	0.049	0.068	N/A
31st	0.055	0.042	0.049	0.096	0.073	0.086	N/A
32nd	0.023	0.044	0.036	0.041	0.076	0.062	N/A
33rd	0.039	0.048	0.050	0.069	0.084	0.088	N/A
34th	0.018	0.021	0.024	0.032	0.037	0.041	N/A
35th	0.041	0.033	0.058	0.072	0.058	0.101	N/A
36th	0.021	0.022	0.016	0.037	0.038	0.027	N/A
37th	0.018	0.024	0.030	0.031	0.041	0.052	N/A
38th	0.016	0.023	0.017	0.028	0.040	0.030	N/A
39th	0.016	0.015	0.019	0.027	0.027	0.034	N/A
40th	0.022	0.019	0.017	0.038	0.033	0.030	N/A
THD	--	--	--	3.668	3.104	3.795	13
PWHD	--	--	--	2.362	2.558	2.491	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	39810 (66% P_n, 60°C)						
Voltage (V)	231.39						
Current (A)	57.44						
Power Factor	0.9985						
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	57.100	57.108	57.096	--	--	--	--
2nd	0.828	0.539	0.852	1.450	0.944	1.491	8
3rd	1.375	1.135	1.455	2.406	1.987	2.547	N/A
4th	0.111	0.261	0.111	0.194	0.458	0.194	4
5th	0.815	0.813	0.941	1.427	1.424	1.648	10.7
6th	0.202	0.287	0.088	0.353	0.503	0.154	2.7
7th	0.383	0.328	0.397	0.671	0.573	0.696	7.2
8th	0.162	0.162	0.100	0.283	0.284	0.176	2
9th	0.139	0.183	0.183	0.244	0.321	0.321	N/A
10th	0.108	0.124	0.134	0.189	0.217	0.234	1.6
11th	0.204	0.201	0.243	0.358	0.352	0.425	3.1
12th	0.129	0.218	0.053	0.226	0.381	0.093	1.3
13th	0.134	0.095	0.148	0.235	0.167	0.259	2
14th	0.101	0.100	0.078	0.177	0.175	0.136	N/A
15th	0.115	0.110	0.113	0.201	0.193	0.198	N/A
16th	0.064	0.054	0.106	0.111	0.095	0.185	N/A
17th	0.038	0.069	0.053	0.067	0.121	0.092	N/A
18th	0.062	0.112	0.025	0.109	0.197	0.044	N/A
19th	0.055	0.063	0.042	0.097	0.110	0.074	N/A
20th	0.053	0.046	0.030	0.093	0.080	0.053	N/A
21st	0.050	0.062	0.108	0.088	0.108	0.189	N/A
22nd	0.051	0.027	0.063	0.089	0.048	0.111	N/A
23rd	0.093	0.105	0.074	0.164	0.184	0.130	N/A
24th	0.036	0.022	0.043	0.063	0.038	0.075	N/A
25th	0.061	0.129	0.088	0.107	0.226	0.154	N/A
26th	0.045	0.025	0.023	0.079	0.043	0.040	N/A
27th	0.100	0.064	0.076	0.175	0.112	0.133	N/A
28th	0.035	0.023	0.036	0.061	0.041	0.064	N/A
29th	0.041	0.047	0.055	0.073	0.082	0.096	N/A
30th	0.030	0.027	0.038	0.052	0.047	0.067	N/A
31st	0.055	0.041	0.050	0.096	0.072	0.087	N/A
32nd	0.020	0.043	0.033	0.034	0.075	0.057	N/A
33rd	0.042	0.048	0.049	0.074	0.083	0.086	N/A
34th	0.020	0.024	0.022	0.035	0.043	0.038	N/A
35th	0.038	0.033	0.056	0.066	0.059	0.097	N/A
36th	0.024	0.020	0.016	0.042	0.036	0.027	N/A
37th	0.016	0.019	0.027	0.029	0.034	0.046	N/A
38th	0.016	0.026	0.018	0.028	0.045	0.031	N/A
39th	0.018	0.015	0.021	0.032	0.027	0.037	N/A
40th	0.021	0.021	0.017	0.036	0.037	0.030	N/A
THD	--	--	--	3.645	3.105	3.758	13
PWHD	--	--	--	2.339	2.554	2.472	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	19808 (33% P_n, 25°C)						
Voltage (V)	231.26						
Current (A)	28.72						
Power Factor	0.9942						
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	28.457	28.465	28.453	--	--	--	--
2nd	0.441	0.309	0.445	1.547	1.085	1.563	8
3rd	1.275	1.064	1.318	4.474	3.734	4.624	N/A
4th	0.035	0.253	0.035	0.122	0.889	0.122	4
5th	0.406	0.387	0.482	1.424	1.359	1.692	10.7
6th	0.079	0.065	0.068	0.278	0.229	0.240	2.7
7th	0.229	0.272	0.219	0.802	0.954	0.770	7.2
8th	0.063	0.042	0.053	0.222	0.148	0.187	2
9th	0.161	0.208	0.208	0.563	0.729	0.729	N/A
10th	0.064	0.085	0.076	0.223	0.298	0.267	1.6
11th	0.113	0.060	0.075	0.397	0.212	0.263	3.1
12th	0.094	0.141	0.042	0.332	0.496	0.148	1.3
13th	0.103	0.126	0.184	0.361	0.441	0.645	2
14th	0.055	0.057	0.036	0.194	0.198	0.127	N/A
15th	0.116	0.166	0.056	0.408	0.583	0.195	N/A
16th	0.077	0.056	0.092	0.271	0.195	0.322	N/A
17th	0.196	0.155	0.194	0.687	0.546	0.679	N/A
18th	0.096	0.150	0.042	0.338	0.526	0.146	N/A
19th	0.079	0.081	0.118	0.276	0.283	0.414	N/A
20th	0.109	0.077	0.086	0.383	0.270	0.303	N/A
21st	0.089	0.070	0.112	0.314	0.247	0.392	N/A
22nd	0.043	0.039	0.087	0.152	0.136	0.305	N/A
23rd	0.034	0.034	0.038	0.119	0.121	0.135	N/A
24th	0.033	0.071	0.029	0.115	0.251	0.100	N/A
25th	0.021	0.051	0.061	0.075	0.178	0.213	N/A
26th	0.029	0.024	0.030	0.103	0.085	0.106	N/A
27th	0.066	0.082	0.027	0.233	0.288	0.094	N/A
28th	0.019	0.021	0.049	0.068	0.073	0.170	N/A
29th	0.038	0.024	0.028	0.133	0.085	0.097	N/A
30th	0.053	0.027	0.039	0.187	0.095	0.137	N/A
31st	0.017	0.021	0.036	0.060	0.075	0.127	N/A
32nd	0.038	0.028	0.025	0.132	0.097	0.087	N/A
33rd	0.017	0.021	0.020	0.061	0.073	0.069	N/A
34th	0.031	0.027	0.021	0.108	0.096	0.072	N/A
35th	0.025	0.018	0.019	0.087	0.063	0.066	N/A
36th	0.020	0.035	0.019	0.070	0.122	0.068	N/A
37th	0.012	0.019	0.022	0.044	0.065	0.076	N/A
38th	0.026	0.030	0.017	0.093	0.104	0.060	N/A
39th	0.020	0.033	0.031	0.071	0.117	0.107	N/A
40th	0.016	0.027	0.023	0.056	0.095	0.081	N/A
THD	--	--	--	5.583	4.931	5.755	13
PWHD	--	--	--	5.280	5.461	5.250	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	19809 (33% P_n , -25°C)						
Voltage (V)	231.26						
Current (A)	28.72						
Power Factor	0.9942						
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	28.461	28.470	28.457	--	--	--	--
2nd	0.430	0.296	0.435	1.508	1.037	1.525	8
3rd	1.278	1.064	1.317	4.484	3.732	4.621	N/A
4th	0.035	0.254	0.035	0.122	0.892	0.122	4
5th	0.405	0.389	0.482	1.422	1.363	1.690	10.7
6th	0.079	0.066	0.067	0.278	0.231	0.235	2.7
7th	0.229	0.270	0.219	0.804	0.949	0.768	7.2
8th	0.063	0.043	0.055	0.222	0.153	0.192	2
9th	0.163	0.209	0.209	0.572	0.733	0.733	N/A
10th	0.063	0.083	0.076	0.221	0.291	0.265	1.6
11th	0.113	0.061	0.075	0.398	0.214	0.265	3.1
12th	0.094	0.139	0.043	0.329	0.489	0.150	1.3
13th	0.103	0.124	0.183	0.363	0.436	0.642	2
14th	0.054	0.057	0.036	0.190	0.200	0.128	N/A
15th	0.118	0.166	0.056	0.413	0.583	0.197	N/A
16th	0.079	0.058	0.091	0.277	0.203	0.319	N/A
17th	0.197	0.156	0.193	0.690	0.547	0.676	N/A
18th	0.096	0.150	0.041	0.336	0.525	0.143	N/A
19th	0.079	0.081	0.116	0.276	0.283	0.405	N/A
20th	0.109	0.077	0.087	0.383	0.271	0.305	N/A
21st	0.089	0.071	0.112	0.312	0.250	0.393	N/A
22nd	0.048	0.038	0.092	0.170	0.133	0.324	N/A
23rd	0.031	0.036	0.040	0.110	0.125	0.140	N/A
24th	0.031	0.071	0.027	0.107	0.249	0.094	N/A
25th	0.020	0.050	0.064	0.070	0.176	0.224	N/A
26th	0.029	0.022	0.028	0.102	0.078	0.097	N/A
27th	0.066	0.083	0.023	0.231	0.292	0.080	N/A
28th	0.020	0.021	0.051	0.070	0.073	0.178	N/A
29th	0.037	0.023	0.029	0.130	0.082	0.100	N/A
30th	0.049	0.028	0.036	0.170	0.098	0.126	N/A
31st	0.018	0.022	0.033	0.065	0.077	0.117	N/A
32nd	0.034	0.031	0.026	0.120	0.107	0.093	N/A
33rd	0.015	0.021	0.020	0.052	0.073	0.069	N/A
34th	0.032	0.030	0.022	0.113	0.104	0.078	N/A
35th	0.022	0.016	0.019	0.077	0.055	0.065	N/A
36th	0.022	0.037	0.022	0.078	0.129	0.078	N/A
37th	0.014	0.018	0.022	0.048	0.063	0.076	N/A
38th	0.026	0.027	0.018	0.090	0.093	0.065	N/A
39th	0.022	0.033	0.030	0.076	0.115	0.105	N/A
40th	0.016	0.026	0.024	0.054	0.092	0.085	N/A
THD	--	--	--	5.637	4.879	5.743	13
PWHD	--	--	--	5.264	5.475	5.263	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**						**P**
Model	AF60K-TH						
Active power (W)	19810 (33% P_n, 60°C)						
Voltage (V)	231.26						
Current (A)	28.72						
Power Factor	0.9942						
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	28.461	28.470	28.457	--	--	--	--
2nd	0.436	0.298	0.443	1.530	1.044	1.554	8
3rd	1.280	1.062	1.317	4.490	3.726	4.619	N/A
4th	0.034	0.254	0.034	0.119	0.891	0.119	4
5th	0.406	0.389	0.482	1.423	1.364	1.692	10.7
6th	0.078	0.063	0.068	0.273	0.223	0.237	2.7
7th	0.231	0.273	0.221	0.811	0.957	0.775	7.2
8th	0.063	0.043	0.055	0.222	0.152	0.193	2
9th	0.163	0.208	0.208	0.573	0.731	0.731	N/A
10th	0.063	0.083	0.075	0.220	0.292	0.265	1.6
11th	0.114	0.060	0.075	0.402	0.210	0.264	3.1
12th	0.095	0.140	0.042	0.332	0.491	0.148	1.3
13th	0.101	0.125	0.184	0.356	0.438	0.644	2
14th	0.056	0.058	0.037	0.195	0.205	0.130	N/A
15th	0.117	0.167	0.057	0.412	0.587	0.200	N/A
16th	0.080	0.057	0.093	0.280	0.201	0.325	N/A
17th	0.197	0.158	0.194	0.690	0.555	0.681	N/A
18th	0.095	0.149	0.039	0.334	0.522	0.138	N/A
19th	0.080	0.082	0.118	0.281	0.288	0.414	N/A
20th	0.109	0.075	0.086	0.383	0.263	0.303	N/A
21st	0.089	0.070	0.112	0.312	0.247	0.393	N/A
22nd	0.053	0.039	0.096	0.186	0.136	0.336	N/A
23rd	0.032	0.035	0.037	0.113	0.124	0.131	N/A
24th	0.031	0.073	0.028	0.110	0.255	0.098	N/A
25th	0.021	0.051	0.064	0.075	0.178	0.224	N/A
26th	0.029	0.025	0.028	0.100	0.088	0.098	N/A
27th	0.069	0.086	0.022	0.243	0.301	0.076	N/A
28th	0.019	0.020	0.050	0.067	0.071	0.174	N/A
29th	0.039	0.023	0.028	0.139	0.082	0.099	N/A
30th	0.050	0.027	0.036	0.174	0.093	0.125	N/A
31st	0.018	0.025	0.036	0.062	0.088	0.128	N/A
32nd	0.034	0.029	0.023	0.121	0.102	0.079	N/A
33rd	0.015	0.022	0.019	0.053	0.077	0.066	N/A
34th	0.032	0.029	0.023	0.112	0.103	0.082	N/A
35th	0.022	0.016	0.019	0.077	0.055	0.068	N/A
36th	0.019	0.035	0.023	0.065	0.123	0.080	N/A
37th	0.014	0.017	0.023	0.049	0.060	0.081	N/A
38th	0.025	0.026	0.017	0.088	0.090	0.058	N/A
39th	0.020	0.034	0.033	0.071	0.119	0.115	N/A
40th	0.016	0.026	0.021	0.057	0.092	0.072	N/A
THD	--	--	--	5.507	4.915	5.943	13
PWHD	--	--	--	5.300	5.506	5.302	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	36178 (100% P_n, 25°C)
Voltage (V)	231.37
Current (A)	52.22
Power Factor	0.9982
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	51.893	51.901	51.889	--	--	--	--
2nd	0.769	0.530	0.787	1.480	1.021	1.516	8
3rd	1.365	1.118	1.436	2.629	2.153	2.765	N/A
4th	0.104	0.275	0.104	0.201	0.530	0.201	4
5th	0.752	0.735	0.886	1.448	1.416	1.706	10.7
6th	0.208	0.296	0.093	0.401	0.570	0.180	2.7
7th	0.378	0.301	0.367	0.729	0.580	0.707	7.2
8th	0.164	0.164	0.099	0.316	0.315	0.191	2
9th	0.143	0.182	0.182	0.276	0.351	0.351	N/A
10th	0.099	0.121	0.131	0.190	0.233	0.252	1.6
11th	0.153	0.164	0.207	0.295	0.316	0.398	3.1
12th	0.121	0.201	0.053	0.233	0.388	0.102	1.3
13th	0.088	0.071	0.073	0.170	0.137	0.141	2
14th	0.089	0.105	0.052	0.171	0.202	0.101	N/A
15th	0.117	0.113	0.133	0.225	0.218	0.256	N/A
16th	0.055	0.036	0.099	0.106	0.069	0.191	N/A
17th	0.042	0.041	0.034	0.081	0.079	0.065	N/A
18th	0.039	0.071	0.029	0.075	0.137	0.056	N/A
19th	0.074	0.082	0.046	0.142	0.158	0.089	N/A
20th	0.033	0.034	0.025	0.063	0.065	0.047	N/A
21st	0.060	0.048	0.092	0.116	0.092	0.176	N/A
22nd	0.055	0.033	0.033	0.105	0.063	0.064	N/A
23rd	0.088	0.087	0.093	0.170	0.168	0.180	N/A
24th	0.018	0.042	0.039	0.035	0.082	0.075	N/A
25th	0.016	0.099	0.068	0.030	0.190	0.131	N/A
26th	0.054	0.031	0.030	0.105	0.060	0.058	N/A
27th	0.115	0.109	0.068	0.221	0.210	0.132	N/A
28th	0.032	0.042	0.031	0.062	0.080	0.059	N/A
29th	0.069	0.056	0.059	0.133	0.108	0.114	N/A
30th	0.040	0.034	0.049	0.078	0.066	0.093	N/A
31st	0.018	0.045	0.065	0.035	0.086	0.125	N/A
32nd	0.034	0.044	0.031	0.065	0.084	0.061	N/A
33rd	0.033	0.028	0.058	0.063	0.055	0.112	N/A
34th	0.029	0.029	0.016	0.055	0.056	0.030	N/A
35th	0.026	0.017	0.037	0.050	0.033	0.071	N/A
36th	0.019	0.038	0.027	0.036	0.073	0.052	N/A
37th	0.026	0.015	0.021	0.049	0.028	0.041	N/A
38th	0.022	0.025	0.022	0.042	0.049	0.043	N/A
39th	0.018	0.014	0.016	0.035	0.028	0.032	N/A
40th	0.026	0.024	0.015	0.051	0.047	0.029	N/A
THD	--	--	--	3.776	3.262	3.996	13
PWHD	--	--	--	2.554	2.723	2.628	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	36177 (100% P_n, -25°C)
Voltage (V)	231.37
Current (A)	52.22
Power Factor	0.9982
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	51.892	51.900	51.888	--	--	--	--
2nd	0.775	0.527	0.790	1.492	1.014	1.522	8
3rd	1.362	1.125	1.435	2.622	2.166	2.764	N/A
4th	0.106	0.276	0.106	0.205	0.532	0.205	4
5th	0.752	0.738	0.883	1.449	1.422	1.701	10.7
6th	0.208	0.298	0.093	0.400	0.575	0.179	2.7
7th	0.378	0.302	0.369	0.728	0.581	0.710	7.2
8th	0.165	0.165	0.101	0.318	0.318	0.194	2
9th	0.144	0.181	0.181	0.277	0.348	0.348	N/A
10th	0.101	0.120	0.129	0.194	0.231	0.248	1.6
11th	0.151	0.165	0.205	0.292	0.318	0.394	3.1
12th	0.123	0.202	0.054	0.237	0.389	0.105	1.3
13th	0.087	0.072	0.075	0.168	0.139	0.144	2
14th	0.091	0.104	0.052	0.175	0.201	0.100	N/A
15th	0.118	0.112	0.133	0.227	0.215	0.257	N/A
16th	0.054	0.034	0.098	0.104	0.066	0.189	N/A
17th	0.040	0.040	0.031	0.077	0.077	0.059	N/A
18th	0.041	0.070	0.028	0.079	0.134	0.054	N/A
19th	0.072	0.084	0.049	0.139	0.161	0.094	N/A
20th	0.034	0.034	0.024	0.066	0.065	0.047	N/A
21st	0.058	0.048	0.096	0.111	0.093	0.185	N/A
22nd	0.053	0.036	0.032	0.101	0.069	0.061	N/A
23rd	0.094	0.084	0.095	0.181	0.162	0.184	N/A
24th	0.018	0.042	0.040	0.035	0.081	0.078	N/A
25th	0.020	0.098	0.070	0.039	0.189	0.136	N/A
26th	0.056	0.030	0.027	0.108	0.059	0.052	N/A
27th	0.118	0.112	0.068	0.227	0.217	0.132	N/A
28th	0.025	0.043	0.031	0.049	0.082	0.059	N/A
29th	0.072	0.057	0.060	0.138	0.110	0.116	N/A
30th	0.039	0.033	0.053	0.075	0.063	0.102	N/A
31st	0.018	0.044	0.066	0.034	0.084	0.127	N/A
32nd	0.034	0.046	0.032	0.065	0.088	0.063	N/A
33rd	0.033	0.031	0.063	0.064	0.060	0.121	N/A
34th	0.029	0.031	0.015	0.057	0.059	0.029	N/A
35th	0.027	0.018	0.037	0.051	0.036	0.072	N/A
36th	0.019	0.036	0.029	0.036	0.069	0.056	N/A
37th	0.025	0.015	0.021	0.048	0.029	0.040	N/A
38th	0.023	0.027	0.025	0.043	0.051	0.047	N/A
39th	0.019	0.013	0.016	0.036	0.024	0.030	N/A
40th	0.025	0.024	0.015	0.047	0.046	0.028	N/A
THD	--	--	--	3.841	3.285	3.980	13
PWHD	--	--	--	2.587	2.730	2.684	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	36173 (100% P_n, 60°C)
Voltage (V)	231.37
Current (A)	52.21
Power Factor	0.9982
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	51.887	51.895	51.882	--	--	--	--
2nd	0.780	0.525	0.795	1.502	1.012	1.531	8
3rd	1.363	1.122	1.437	2.625	2.162	2.767	N/A
4th	0.105	0.278	0.105	0.203	0.535	0.203	4
5th	0.753	0.737	0.886	1.450	1.420	1.706	10.7
6th	0.207	0.298	0.095	0.399	0.573	0.182	2.7
7th	0.375	0.301	0.365	0.721	0.580	0.703	7.2
8th	0.166	0.165	0.099	0.321	0.318	0.190	2
9th	0.143	0.181	0.181	0.276	0.350	0.350	N/A
10th	0.099	0.121	0.131	0.191	0.233	0.252	1.6
11th	0.152	0.165	0.204	0.292	0.317	0.392	3.1
12th	0.122	0.201	0.054	0.235	0.388	0.104	1.3
13th	0.086	0.071	0.074	0.165	0.137	0.142	2
14th	0.091	0.102	0.050	0.175	0.197	0.096	N/A
15th	0.117	0.112	0.132	0.226	0.216	0.254	N/A
16th	0.055	0.036	0.100	0.106	0.070	0.192	N/A
17th	0.039	0.040	0.030	0.076	0.078	0.059	N/A
18th	0.040	0.071	0.029	0.077	0.136	0.055	N/A
19th	0.074	0.086	0.052	0.142	0.165	0.099	N/A
20th	0.032	0.034	0.024	0.062	0.065	0.046	N/A
21st	0.058	0.047	0.093	0.111	0.091	0.179	N/A
22nd	0.050	0.034	0.031	0.097	0.065	0.060	N/A
23rd	0.090	0.084	0.092	0.174	0.161	0.177	N/A
24th	0.018	0.041	0.040	0.034	0.079	0.077	N/A
25th	0.021	0.099	0.068	0.040	0.191	0.131	N/A
26th	0.054	0.027	0.028	0.103	0.051	0.054	N/A
27th	0.116	0.108	0.066	0.223	0.209	0.126	N/A
28th	0.026	0.044	0.030	0.050	0.085	0.058	N/A
29th	0.070	0.057	0.061	0.136	0.110	0.118	N/A
30th	0.036	0.034	0.051	0.070	0.065	0.099	N/A
31st	0.018	0.042	0.065	0.035	0.081	0.125	N/A
32nd	0.034	0.044	0.033	0.065	0.085	0.064	N/A
33rd	0.035	0.031	0.057	0.067	0.059	0.110	N/A
34th	0.028	0.026	0.018	0.053	0.051	0.036	N/A
35th	0.029	0.015	0.035	0.055	0.028	0.067	N/A
36th	0.021	0.037	0.026	0.040	0.071	0.051	N/A
37th	0.026	0.016	0.019	0.050	0.030	0.037	N/A
38th	0.022	0.028	0.025	0.043	0.053	0.049	N/A
39th	0.020	0.014	0.017	0.038	0.026	0.033	N/A
40th	0.027	0.020	0.016	0.052	0.039	0.030	N/A
THD	--	--	--	3.822	3.265	4.058	13
PWHD	--	--	--	2.561	2.701	2.632	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	23979 (66% P_n, 25°C)
Voltage (V)	231.29
Current (A)	34.70
Power Factor	0.9960
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	34.425	34.434	34.420	--	--	--	--
2nd	0.523	0.341	0.538	1.518	0.990	1.562	8
3rd	1.305	1.093	1.363	3.786	3.170	3.956	N/A
4th	0.031	0.279	0.031	0.089	0.811	0.089	4
5th	0.521	0.495	0.628	1.510	1.436	1.822	10.7
6th	0.146	0.195	0.075	0.423	0.565	0.217	2.7
7th	0.211	0.186	0.201	0.611	0.540	0.584	7.2
8th	0.091	0.065	0.039	0.263	0.189	0.114	2
9th	0.177	0.176	0.176	0.513	0.510	0.510	N/A
10th	0.069	0.052	0.074	0.199	0.152	0.215	1.6
11th	0.016	0.060	0.065	0.047	0.174	0.189	3.1
12th	0.062	0.089	0.027	0.180	0.259	0.077	1.3
13th	0.060	0.095	0.123	0.175	0.276	0.356	2
14th	0.074	0.054	0.031	0.214	0.156	0.091	N/A
15th	0.120	0.133	0.076	0.349	0.385	0.221	N/A
16th	0.030	0.054	0.040	0.087	0.156	0.115	N/A
17th	0.147	0.075	0.107	0.427	0.218	0.311	N/A
18th	0.070	0.094	0.029	0.202	0.273	0.085	N/A
19th	0.100	0.118	0.168	0.289	0.342	0.487	N/A
20th	0.086	0.039	0.071	0.250	0.113	0.207	N/A
21st	0.105	0.115	0.059	0.304	0.335	0.172	N/A
22nd	0.063	0.028	0.108	0.183	0.081	0.314	N/A
23rd	0.041	0.035	0.039	0.120	0.101	0.112	N/A
24th	0.074	0.139	0.035	0.213	0.403	0.103	N/A
25th	0.047	0.026	0.033	0.135	0.075	0.095	N/A
26th	0.059	0.033	0.039	0.172	0.094	0.112	N/A
27th	0.053	0.038	0.098	0.155	0.111	0.283	N/A
28th	0.030	0.030	0.043	0.087	0.087	0.126	N/A
29th	0.023	0.056	0.055	0.066	0.162	0.161	N/A
30th	0.021	0.034	0.019	0.061	0.100	0.056	N/A
31st	0.032	0.046	0.029	0.093	0.133	0.084	N/A
32nd	0.022	0.017	0.021	0.063	0.049	0.061	N/A
33rd	0.026	0.027	0.034	0.075	0.077	0.099	N/A
34th	0.014	0.017	0.013	0.042	0.048	0.039	N/A
35th	0.018	0.014	0.029	0.053	0.041	0.084	N/A
36th	0.016	0.020	0.021	0.045	0.057	0.061	N/A
37th	0.014	0.016	0.018	0.041	0.046	0.052	N/A
38th	0.016	0.022	0.022	0.046	0.064	0.065	N/A
39th	0.022	0.015	0.014	0.065	0.043	0.039	N/A
40th	0.033	0.032	0.022	0.096	0.093	0.063	N/A
THD	--	--	--	4.778	4.164	5.127	13
PWHD	--	--	--	4.149	4.233	4.139	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	23980 (66% P_n , -25°C)
Voltage (V)	231.29
Current (A)	34.70
Power Factor	0.9960
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	34.427	34.435	34.422	--	--	--	--
2nd	0.528	0.350	0.544	1.533	1.015	1.578	8
3rd	1.307	1.092	1.367	3.792	3.170	3.966	N/A
4th	0.031	0.278	0.031	0.091	0.806	0.091	4
5th	0.521	0.493	0.626	1.513	1.429	1.817	10.7
6th	0.146	0.193	0.075	0.425	0.560	0.217	2.7
7th	0.210	0.184	0.200	0.610	0.534	0.579	7.2
8th	0.092	0.065	0.041	0.267	0.189	0.119	2
9th	0.175	0.175	0.175	0.508	0.509	0.509	N/A
10th	0.070	0.056	0.074	0.203	0.162	0.215	1.6
11th	0.016	0.062	0.066	0.047	0.181	0.193	3.1
12th	0.067	0.091	0.025	0.196	0.265	0.073	1.3
13th	0.059	0.097	0.125	0.171	0.282	0.364	2
14th	0.074	0.055	0.028	0.215	0.159	0.082	N/A
15th	0.118	0.133	0.080	0.343	0.386	0.233	N/A
16th	0.029	0.056	0.040	0.085	0.162	0.116	N/A
17th	0.150	0.072	0.108	0.436	0.208	0.312	N/A
18th	0.067	0.092	0.030	0.194	0.266	0.086	N/A
19th	0.097	0.118	0.168	0.281	0.344	0.486	N/A
20th	0.086	0.038	0.072	0.250	0.109	0.209	N/A
21st	0.103	0.112	0.058	0.297	0.326	0.168	N/A
22nd	0.065	0.030	0.110	0.189	0.088	0.318	N/A
23rd	0.040	0.036	0.036	0.116	0.105	0.104	N/A
24th	0.077	0.137	0.035	0.224	0.399	0.102	N/A
25th	0.043	0.024	0.033	0.126	0.069	0.095	N/A
26th	0.062	0.034	0.044	0.179	0.100	0.128	N/A
27th	0.054	0.040	0.093	0.157	0.116	0.270	N/A
28th	0.029	0.030	0.044	0.085	0.088	0.129	N/A
29th	0.021	0.056	0.057	0.062	0.162	0.165	N/A
30th	0.022	0.040	0.020	0.065	0.116	0.058	N/A
31st	0.031	0.045	0.028	0.089	0.130	0.082	N/A
32nd	0.024	0.020	0.022	0.070	0.058	0.064	N/A
33rd	0.026	0.028	0.034	0.075	0.080	0.098	N/A
34th	0.016	0.020	0.017	0.046	0.057	0.048	N/A
35th	0.020	0.016	0.029	0.058	0.047	0.083	N/A
36th	0.019	0.023	0.021	0.054	0.066	0.061	N/A
37th	0.015	0.015	0.017	0.042	0.044	0.049	N/A
38th	0.019	0.022	0.023	0.054	0.063	0.066	N/A
39th	0.021	0.014	0.015	0.060	0.041	0.045	N/A
40th	0.035	0.034	0.019	0.102	0.099	0.057	N/A
THD	--	--	--	4.799	4.184	5.103	13
PWHD	--	--	--	4.163	4.240	4.144	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	23981 (66% P_n, 60°C)
Voltage (V)	231.29
Current (A)	34.70
Power Factor	0.9960
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	34.428	34.436	34.423	--	--	--	--
2nd	0.539	0.361	0.555	1.565	1.048	1.612	8
3rd	1.302	1.094	1.366	3.777	3.174	3.965	N/A
4th	0.030	0.282	0.030	0.087	0.817	0.087	4
5th	0.521	0.489	0.626	1.511	1.420	1.815	10.7
6th	0.148	0.195	0.075	0.429	0.567	0.218	2.7
7th	0.209	0.182	0.199	0.607	0.529	0.579	7.2
8th	0.093	0.065	0.041	0.269	0.189	0.119	2
9th	0.176	0.176	0.176	0.511	0.510	0.510	N/A
10th	0.071	0.055	0.077	0.206	0.159	0.222	1.6
11th	0.015	0.062	0.066	0.044	0.181	0.191	3.1
12th	0.066	0.094	0.027	0.191	0.274	0.080	1.3
13th	0.060	0.097	0.123	0.174	0.283	0.357	2
14th	0.073	0.053	0.031	0.213	0.155	0.089	N/A
15th	0.120	0.132	0.079	0.348	0.384	0.230	N/A
16th	0.030	0.055	0.039	0.086	0.159	0.114	N/A
17th	0.149	0.071	0.107	0.431	0.207	0.311	N/A
18th	0.068	0.092	0.031	0.197	0.266	0.090	N/A
19th	0.098	0.116	0.167	0.284	0.337	0.485	N/A
20th	0.086	0.040	0.071	0.248	0.116	0.207	N/A
21st	0.103	0.114	0.057	0.299	0.332	0.165	N/A
22nd	0.066	0.027	0.110	0.191	0.077	0.318	N/A
23rd	0.040	0.033	0.035	0.115	0.095	0.102	N/A
24th	0.078	0.138	0.038	0.226	0.401	0.110	N/A
25th	0.043	0.026	0.032	0.125	0.074	0.094	N/A
26th	0.063	0.030	0.041	0.184	0.087	0.119	N/A
27th	0.054	0.034	0.095	0.158	0.098	0.275	N/A
28th	0.028	0.031	0.043	0.081	0.091	0.125	N/A
29th	0.022	0.054	0.059	0.063	0.156	0.170	N/A
30th	0.020	0.036	0.020	0.058	0.105	0.058	N/A
31st	0.031	0.046	0.031	0.091	0.134	0.090	N/A
32nd	0.023	0.018	0.021	0.066	0.053	0.061	N/A
33rd	0.022	0.029	0.037	0.062	0.083	0.107	N/A
34th	0.013	0.017	0.015	0.037	0.049	0.044	N/A
35th	0.018	0.014	0.029	0.052	0.041	0.084	N/A
36th	0.019	0.021	0.021	0.054	0.062	0.060	N/A
37th	0.014	0.014	0.018	0.041	0.042	0.053	N/A
38th	0.015	0.022	0.020	0.043	0.065	0.059	N/A
39th	0.019	0.011	0.013	0.056	0.031	0.038	N/A
40th	0.033	0.032	0.021	0.095	0.094	0.060	N/A
THD	--	--	--	4.873	4.228	5.066	13
PWHD	--	--	--	4.143	4.187	4.152	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	11977 (33% P_n, 25°C)
Voltage (V)	231.21
Current (A)	17.55
Power Factor	0.9842
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	17.296	17.305	17.298	--	--	--	--
2nd	0.268	0.205	0.130	1.542	1.183	0.747	8
3rd	1.176	0.957	1.178	6.772	5.512	6.786	N/A
4th	0.210	0.195	0.210	1.208	1.125	1.208	4
5th	0.523	0.586	0.531	3.014	3.373	3.060	10.7
6th	0.173	0.371	0.202	0.999	2.139	1.165	2.7
7th	0.326	0.328	0.250	1.880	1.889	1.438	7.2
8th	0.162	0.134	0.167	0.931	0.773	0.963	2
9th	0.141	0.209	0.209	0.814	1.205	1.205	N/A
10th	0.045	0.055	0.069	0.261	0.317	0.396	1.6
11th	0.346	0.266	0.336	1.992	1.531	1.935	3.1
12th	0.076	0.167	0.087	0.437	0.959	0.499	1.3
13th	0.226	0.216	0.300	1.300	1.243	1.725	2
14th	0.106	0.071	0.100	0.613	0.409	0.579	N/A
15th	0.125	0.126	0.094	0.721	0.728	0.543	N/A
16th	0.061	0.052	0.071	0.351	0.301	0.411	N/A
17th	0.040	0.019	0.021	0.228	0.110	0.120	N/A
18th	0.033	0.048	0.028	0.192	0.278	0.162	N/A
19th	0.055	0.059	0.094	0.319	0.339	0.541	N/A
20th	0.050	0.019	0.042	0.287	0.107	0.240	N/A
21st	0.056	0.107	0.057	0.324	0.614	0.329	N/A
22nd	0.087	0.031	0.113	0.499	0.181	0.653	N/A
23rd	0.055	0.040	0.046	0.319	0.229	0.266	N/A
24th	0.055	0.125	0.073	0.315	0.718	0.422	N/A
25th	0.027	0.028	0.024	0.157	0.161	0.137	N/A
26th	0.039	0.057	0.031	0.225	0.328	0.178	N/A
27th	0.062	0.039	0.047	0.358	0.224	0.273	N/A
28th	0.036	0.027	0.025	0.205	0.155	0.142	N/A
29th	0.024	0.017	0.038	0.141	0.096	0.217	N/A
30th	0.027	0.018	0.030	0.154	0.102	0.172	N/A
31st	0.027	0.020	0.014	0.155	0.117	0.083	N/A
32nd	0.033	0.037	0.031	0.190	0.211	0.181	N/A
33rd	0.031	0.023	0.022	0.180	0.131	0.127	N/A
34th	0.037	0.025	0.025	0.214	0.143	0.146	N/A
35th	0.026	0.018	0.022	0.152	0.105	0.128	N/A
36th	0.013	0.031	0.026	0.076	0.178	0.147	N/A
37th	0.019	0.022	0.019	0.108	0.127	0.109	N/A
38th	0.018	0.024	0.016	0.103	0.140	0.092	N/A
39th	0.024	0.024	0.017	0.140	0.140	0.096	N/A
40th	0.014	0.016	0.010	0.082	0.093	0.059	N/A
THD	--	--	--	8.950	8.408	9.185	13
PWHD	--	--	--	6.943	7.171	6.955	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	11978 (33% P_n , -25°C)
Voltage (V)	231.22
Current (A)	17.55
Power Factor	0.9842
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	17.295	17.305	17.298	--	--	--	--
2nd	0.273	0.208	0.135	1.570	1.199	0.780	8
3rd	1.177	0.961	1.179	6.781	5.534	6.791	N/A
4th	0.211	0.194	0.211	1.216	1.119	1.216	4
5th	0.526	0.588	0.533	3.028	3.384	3.072	10.7
6th	0.175	0.373	0.203	1.009	2.146	1.171	2.7
7th	0.325	0.328	0.248	1.874	1.888	1.431	7.2
8th	0.161	0.132	0.164	0.930	0.762	0.947	2
9th	0.140	0.209	0.209	0.806	1.204	1.204	N/A
10th	0.045	0.055	0.069	0.257	0.314	0.398	1.6
11th	0.346	0.267	0.337	1.992	1.541	1.944	3.1
12th	0.075	0.166	0.088	0.433	0.958	0.510	1.3
13th	0.225	0.215	0.298	1.296	1.236	1.715	2
14th	0.106	0.072	0.101	0.613	0.413	0.580	N/A
15th	0.125	0.128	0.096	0.718	0.736	0.550	N/A
16th	0.058	0.054	0.070	0.337	0.310	0.404	N/A
17th	0.041	0.018	0.023	0.234	0.101	0.133	N/A
18th	0.036	0.051	0.027	0.206	0.293	0.158	N/A
19th	0.056	0.060	0.092	0.322	0.347	0.532	N/A
20th	0.051	0.020	0.045	0.296	0.116	0.262	N/A
21st	0.057	0.108	0.057	0.327	0.623	0.329	N/A
22nd	0.076	0.033	0.105	0.439	0.190	0.603	N/A
23rd	0.053	0.040	0.045	0.304	0.229	0.259	N/A
24th	0.056	0.123	0.073	0.324	0.709	0.423	N/A
25th	0.030	0.026	0.028	0.174	0.148	0.162	N/A
26th	0.040	0.056	0.031	0.228	0.323	0.180	N/A
27th	0.060	0.041	0.050	0.347	0.237	0.285	N/A
28th	0.034	0.028	0.021	0.196	0.162	0.122	N/A
29th	0.026	0.019	0.038	0.151	0.112	0.221	N/A
30th	0.027	0.018	0.031	0.155	0.104	0.177	N/A
31st	0.027	0.019	0.016	0.156	0.110	0.089	N/A
32nd	0.031	0.035	0.032	0.181	0.203	0.184	N/A
33rd	0.033	0.023	0.023	0.193	0.134	0.132	N/A
34th	0.039	0.023	0.028	0.226	0.135	0.161	N/A
35th	0.026	0.017	0.022	0.148	0.099	0.129	N/A
36th	0.014	0.032	0.024	0.081	0.186	0.136	N/A
37th	0.017	0.023	0.021	0.098	0.132	0.118	N/A
38th	0.017	0.023	0.017	0.101	0.131	0.096	N/A
39th	0.024	0.023	0.014	0.139	0.135	0.083	N/A
40th	0.014	0.016	0.012	0.083	0.092	0.070	N/A
THD	--	--	--	9.570	8.679	9.352	13
PWHD	--	--	--	6.860	7.205	6.902	22

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

B1 a)/b)	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% P_n / 66% P_n / 33% P_n (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH	

Active power (W)	11979 (33% P_n, 60°C)
Voltage (V)	231.22
Current (A)	17.55
Power Factor	0.9842
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	17.296	17.305	17.298	--	--	--	--
2nd	0.263	0.202	0.129	1.517	1.161	0.742	8
3rd	1.177	0.961	1.181	6.778	5.537	6.805	N/A
4th	0.213	0.196	0.213	1.228	1.128	1.228	4
5th	0.526	0.586	0.534	3.032	3.376	3.076	10.7
6th	0.176	0.372	0.203	1.014	2.141	1.168	2.7
7th	0.326	0.328	0.249	1.880	1.890	1.435	7.2
8th	0.160	0.132	0.165	0.924	0.758	0.951	2
9th	0.141	0.209	0.209	0.814	1.206	1.206	N/A
10th	0.045	0.056	0.068	0.262	0.325	0.393	1.6
11th	0.344	0.269	0.337	1.983	1.549	1.942	3.1
12th	0.074	0.166	0.087	0.429	0.959	0.500	1.3
13th	0.224	0.214	0.299	1.291	1.235	1.722	2
14th	0.107	0.073	0.100	0.615	0.420	0.575	N/A
15th	0.126	0.126	0.097	0.727	0.725	0.556	N/A
16th	0.058	0.054	0.070	0.336	0.310	0.403	N/A
17th	0.038	0.016	0.023	0.219	0.094	0.133	N/A
18th	0.037	0.049	0.028	0.214	0.280	0.162	N/A
19th	0.057	0.057	0.093	0.330	0.327	0.533	N/A
20th	0.053	0.021	0.045	0.303	0.118	0.261	N/A
21st	0.060	0.107	0.058	0.346	0.618	0.333	N/A
22nd	0.070	0.029	0.098	0.404	0.169	0.565	N/A
23rd	0.053	0.041	0.046	0.307	0.235	0.266	N/A
24th	0.056	0.122	0.073	0.321	0.701	0.421	N/A
25th	0.031	0.028	0.025	0.177	0.160	0.147	N/A
26th	0.040	0.057	0.033	0.228	0.329	0.188	N/A
27th	0.060	0.038	0.049	0.344	0.216	0.285	N/A
28th	0.032	0.027	0.023	0.184	0.158	0.133	N/A
29th	0.024	0.017	0.038	0.141	0.098	0.221	N/A
30th	0.027	0.018	0.032	0.155	0.106	0.182	N/A
31st	0.028	0.021	0.016	0.163	0.119	0.090	N/A
32nd	0.035	0.036	0.035	0.201	0.209	0.204	N/A
33rd	0.030	0.023	0.023	0.171	0.135	0.132	N/A
34th	0.035	0.027	0.028	0.202	0.155	0.164	N/A
35th	0.030	0.017	0.024	0.171	0.100	0.138	N/A
36th	0.015	0.032	0.023	0.089	0.187	0.135	N/A
37th	0.019	0.022	0.019	0.107	0.127	0.107	N/A
38th	0.019	0.024	0.016	0.107	0.141	0.091	N/A
39th	0.024	0.022	0.015	0.140	0.129	0.086	N/A
40th	0.014	0.017	0.012	0.082	0.098	0.069	N/A
THD	--	--	--	9.558	8.908	9.207	13
PWHD	--	--	--	6.849	7.147	6.866	22

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

B1 c)	**TABLE: Flicker emission**									**P**
Model	AF60K-TH									
Normal ambient										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.096	0.098	0.097	0.103	0.101	0.103	0.035	0.036	0.039
66%	EN61000-3-3 / EN61000-3-11	0.095	0.097	0.095	0.099	0.102	0.100	0.039	0.038	0.038
100%	EN61000-3-3 / EN61000-3-11	0.097	0.097	0.097	0.103	0.103	0.101	0.038	0.038	0.039
Minimum ambient rating -25°C										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.097	0.097	0.097	0.102	0.101	0.102	0.036	0.037	0.038
66%	EN61000-3-3 / EN61000-3-11	0.096	0.096	0.096	0.103	0.103	0.102	0.037	0.031	0.038
100%	EN61000-3-3 / EN61000-3-11	0.096	0.097	0.097	0.103	0.102	0.103	0.037	0.038	0.039
Maximum ambient rating +60°C										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.098	0.097	0.097	0.103	0.103	0.102	0.033	0.036	0.037
66%	EN61000-3-3 / EN61000-3-11	0.097	0.097	0.097	0.102	0.102	0.103	0.038	0.038	0.037
100%	EN61000-3-3 / EN61000-3-11	0.098	0.096	0.097	0.103	0.101	0.103	0.035	0.037	0.038

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).

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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	0.033	Pass	0.275	Pass	0.0	Pass	0.103	Pass		
2	0.030	Pass	0.290	Pass	0.0	Pass	0.094	Pass		
3	0.028	Pass	0.266	Pass	0.0	Pass	0.093	Pass		
4	0.028	Pass	0.279	Pass	0.0	Pass	0.093	Pass		
5	0.028	Pass	0.285	Pass	0.0	Pass	0.097	Pass		
6	0.032	Pass	0.282	Pass	0.0	Pass	0.101	Pass		
7	0.035	Pass	0.270	Pass	0.0	Pass	0.094	Pass		
8	0.028	Pass	0.280	Pass	0.0	Pass	0.095	Pass		
9	0.032	Pass	0.287	Pass	0.0	Pass	0.094	Pass		
10	0.030	Pass	0.282	Pass	0.0	Pass	0.094	Pass		
11	0.029	Pass	0.270	Pass	0.0	Pass	0.093	Pass		
12	0.030	Pass	0.274	Pass	0.0	Pass	0.095	Pass		
Result		Pass		Pass		Pass		Pass	0.096	Pass

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

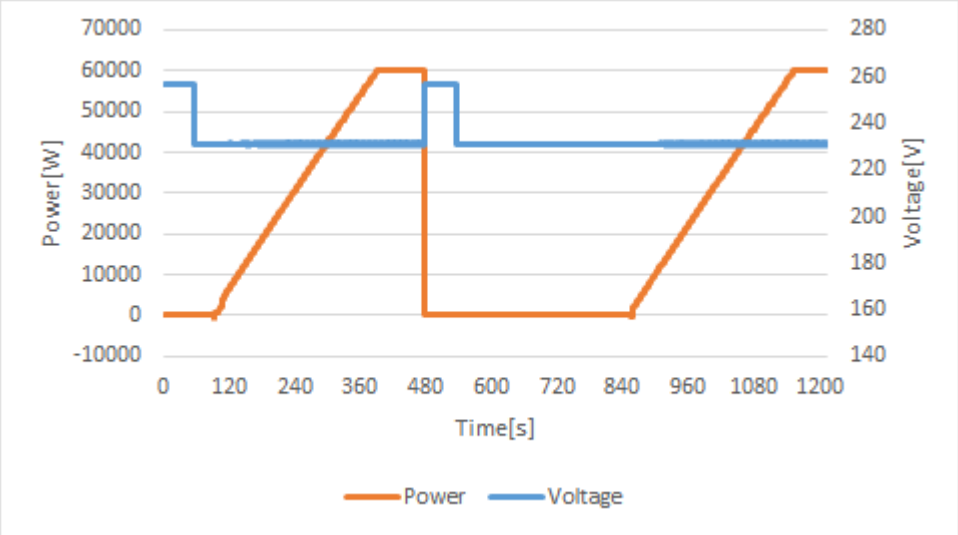
B.1.1	**TABLE: Conditions of connection, reconnection and gradual power supply**		**P**
Model	AF60K-TH		
Test:			
Power meter measurment-data:	Sample-Rate:	0.2 s	
	Sample time:	6400	
	Voltage conditons		
a) Out of voltage range	84% U_n for 30s	111% U_n for 30s	
Connection:	No connection	No connection	
Limit	No connection allowed		
b) In voltage range at start-up	85% U_n < U <110% U_n		
Reconnection time [s]	35	34	
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]	305	307	
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]	33	31	
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]	303	301	
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

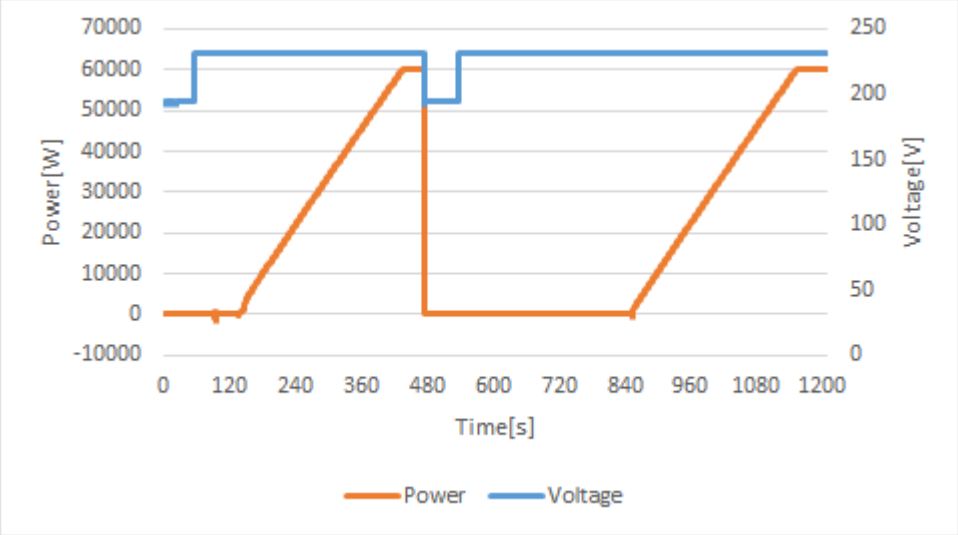
Changable reconnection conditions:	Frequency range: 49Hz-51Hz in 0,05Hz steps (default value: 49,90 and 50,10Hz)	Reconnection time range: 0-900s in steps of 5s (default value: 300s)

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

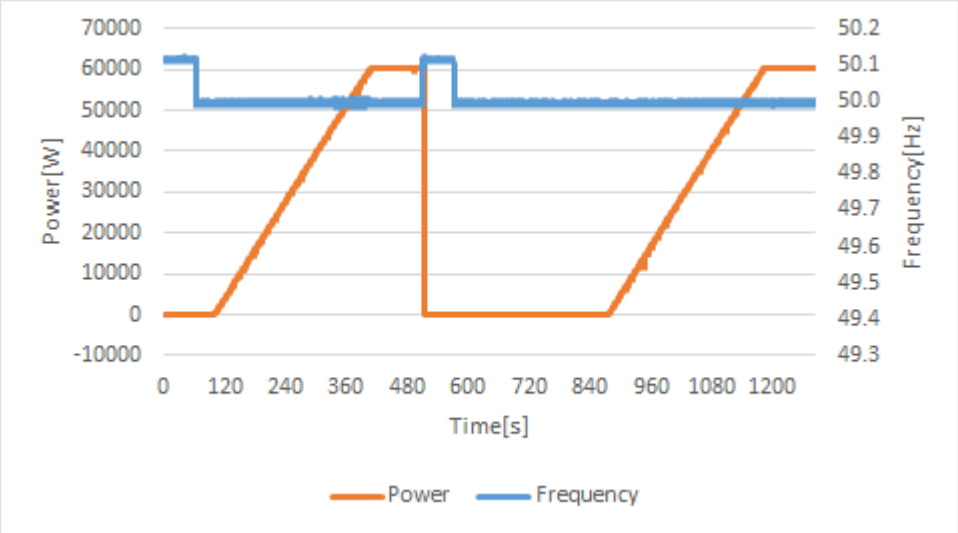


Under Voltage

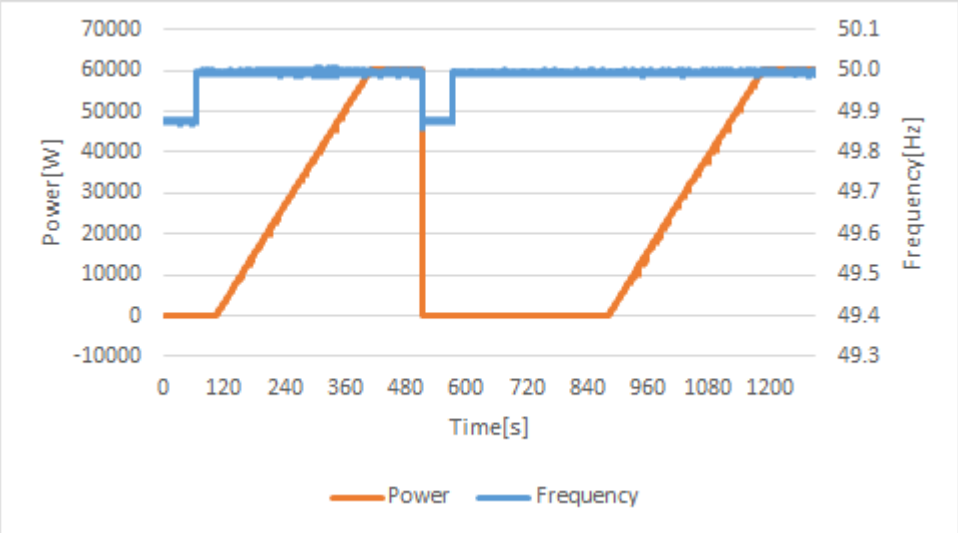


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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	AF60K-TH	

Inductive supply reactive power

Power-Bin [%P_n]	Active power [W]	Reactive Power [Var]	Q/P_n [%]	Power factor [cos φ]	Voltage [Vac]	DC power [W]
0% - 10%(*)	5162	1501	2.50%	0.9602	230.24	5491
10% - 20%(*)	11475	1500	2.50%	0.9916	230.15	12207
20% - 30%	16858	30015	50.02%	0.4898	229.96	17934
30% - 40%	22911	30008	50.01%	0.6069	230.17	24374
40% - 50%	29005	29989	49.98%	0.6952	229.85	30855
50% - 60%	34940	30010	50.02%	0.7586	230.05	37170
60% - 70%	40989	30019	50.03%	0.8068	230.25	43605
70% - 80%	47004	29987	49.98%	0.8430	230.14	50004
80% - 90%	53002	29983	49.97%	0.8704	229.91	56385
90% - 100% (***)	58984	30030	50.05%	0.8911	230.21	62749

Capacitive supply reactive power

Power-Bin [%P_n]	Active power [W]	Reactive Power [Var]	Q/P_n [%]	Power factor [cos φ]	Voltage [Vac]	DC power [W]
0% - 10%(*)	5073	1500	2.50%	0.9589	230.01	5396
10% - 20%(*)	11403	1501	2.50%	0.9914	230.19	12130
20% - 30%	16830	-29999	-50.00%	0.4893	230.07	17904
30% - 40%	22886	-30000	-50.00%	0.6066	230.25	24347
40% - 50%	28862	-29987	-49.98%	0.6935	230.16	30704
50% - 60%	34866	-30030	-50.05%	0.7577	229.93	37092
60% - 70%	40912	-29990	-49.98%	0.8065	229.98	43524
70% - 80%	46937	-30006	-50.01%	0.8425	229.97	49933
80% - 90%	52918	-30002	-50.00%	0.8699	229.86	56296
90% - 100% (***)	58194	-29998	-50.00%	0.8888	230.04	61909

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

Cos phi = 1 no reactive power supply						
Power-Bin [%P_n]	Active power [W]	Reactive Power [Var]	Q/P_n [%]	Power factor [cos φ]	Voltage [Vac]	DC power [W]
0% - 10%(*)	4830	1497	2.50%	0.9539	230.17	5139
10% - 20%(*)	10890	1516	2.53%	0.9901	229.97	11585
20% - 30%	16866	1487	2.48%	0.9960	230.06	17943
30% - 40%	22896	1495	2.49%	0.9978	229.89	24357
40% - 50%	28956	1512	2.52%	0.9986	230.07	30804
50% - 60%	35001	1506	2.51%	0.9990	229.88	37235
60% - 70%	41032	1506	2.51%	0.9993	230.08	43650
70% - 80%	47033	1507	2.51%	0.9995	230.00	50035
80% - 90%	53029	1483	2.47%	0.9996	230.13	56414
90% - 100% (***)	59017	1509	2.52%	0.9996	230.22	62784

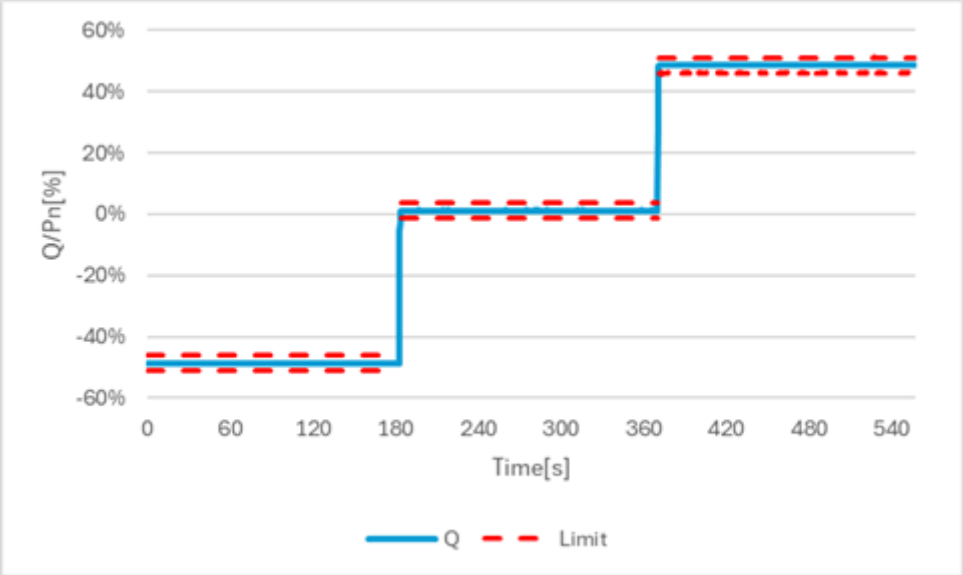
Note:
The PV inverter maximum reactive power set point Q = 48.43%P_n.
(*) For power outputs less than 10% of the nominal power the generator must not exchange a reactive power higher than 10% of the nominal power.
(**) For power outputs less than 20% of the nominal power the generator must not exchange 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	AF60K-TH			
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 $\Delta Q/P_n$ [%]	Limit [%]
$-Q_{min}$	-48.43%	-48.58%	-0.15%	$\Delta Q \leq \pm 2.5\% P_n$
0	0.00%	1.17%	1.17%	$\Delta Q \leq \pm 2.5\% P_n$
$+Q_{max}$	48.43%	48.62%	0.19%	$\Delta Q \leq \pm 2.5\% P_n$

Diagram



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

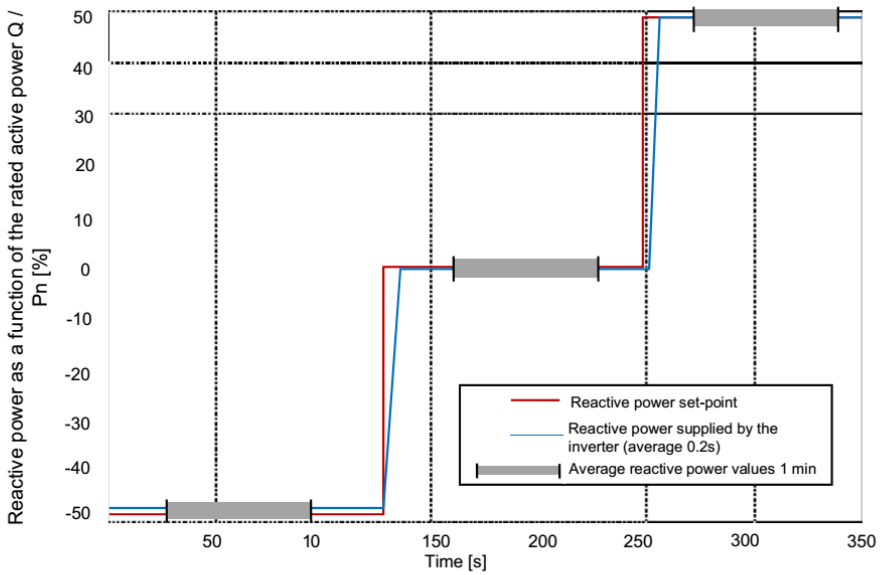


Figure 48 - Measurement of the reactive power delivered based on an external command, accuracy check

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	AF60K-TH		
Power meter measurment data:	Sample-Rate:	0,2 s	
	Samples time:	at least 2 minutes for each power point	
P_{Emax} in %	50	100	
Maximum response time :10 s	2 s	2 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.

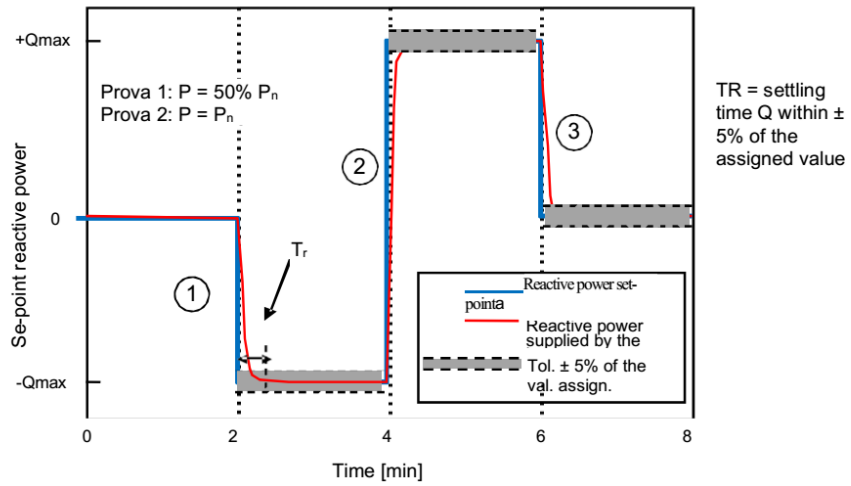
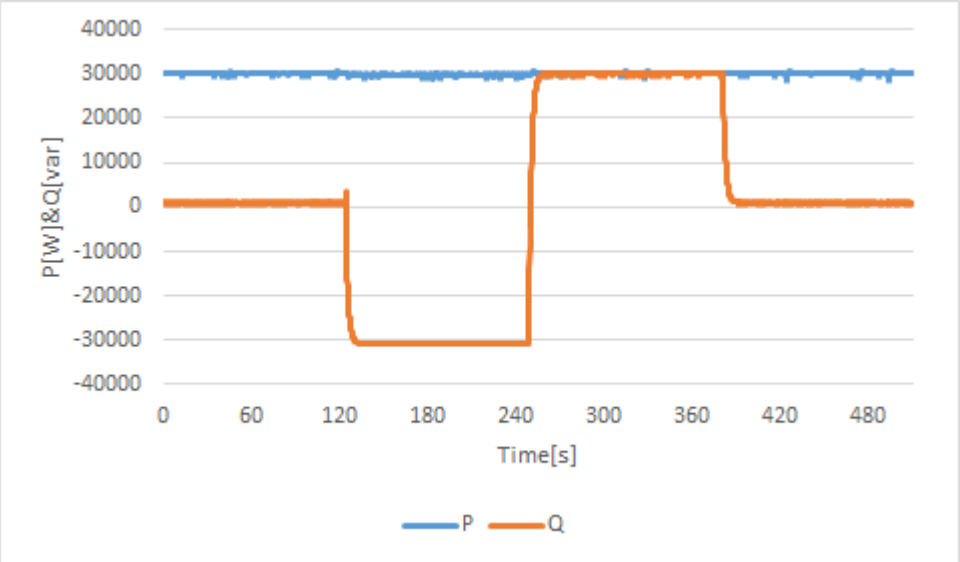


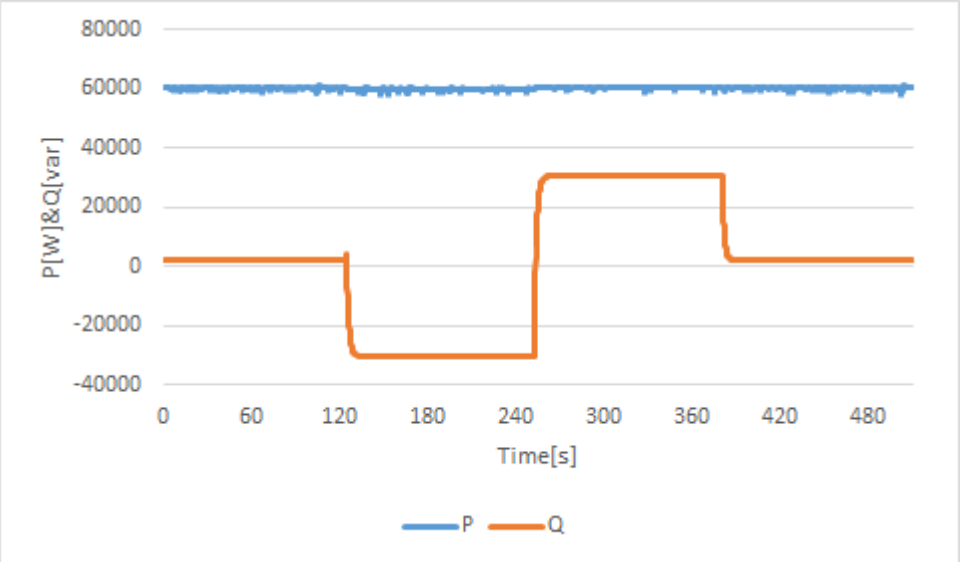
Figure 49 - Measurement of the response time to step changes of the set-point assigned for the reactive power

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

Test1



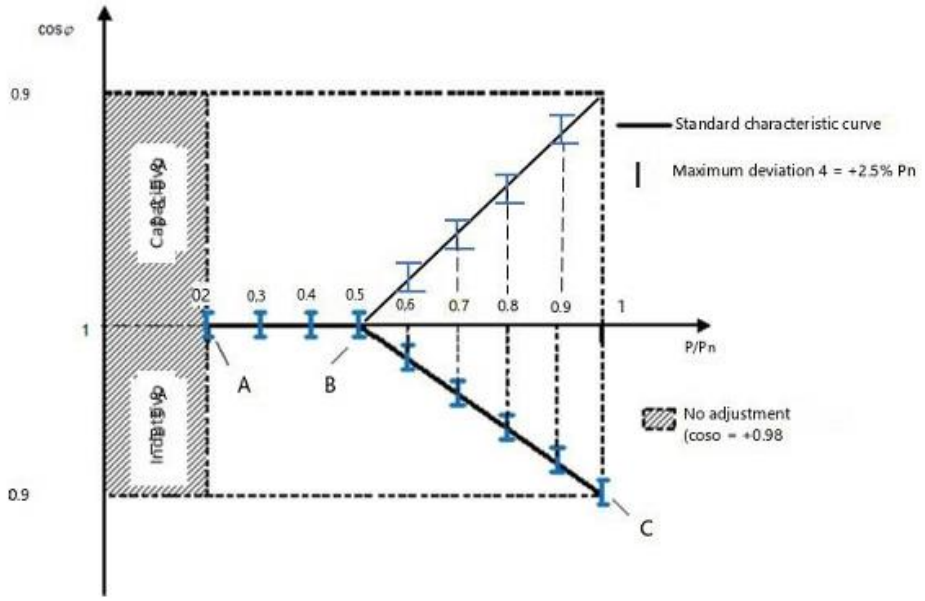
Test2



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	AF60K-TH	

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

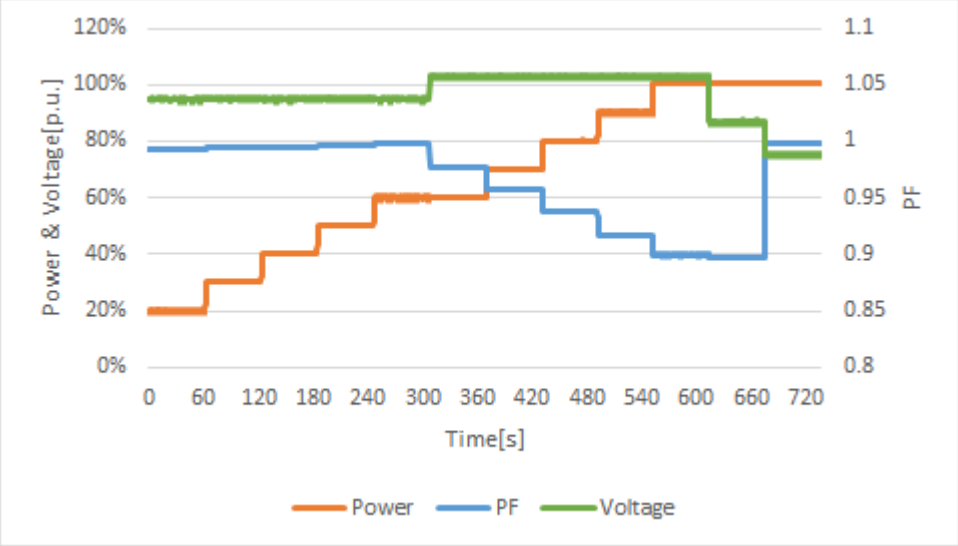


Assessment criterion:
Test 1: cos φ accuracy cos φ (±0,01)
Test 2: cos φ accuracy cos φ (±0,01)
For the test to be passed, the cos φ setpoint from the active power must be measured at the terminals of the PGU within a settling time of 10 s.

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

Model:	AF60K-TH							
P/P_{SMAX}[%]	P[W]	Vout[%]	+Q[Var]	Cos φSetpoint	Cos φmeasured	ΔCosφ	Limit Δcosφ_max	Result
20	12047	238.58	1438	1.00	0.993	-0.007	≤ ± 0.01	P
30	18075	238.60	1936	1.00	0.994	-0.006	≤ ± 0.01	P
40	24068	238.61	2353	1.00	0.995	-0.005	≤ ± 0.01	P
50	30149	238.63	2685	1.00	0.996	-0.004	≤ ± 0.01	P
60	36065	238.59	2316	1.00	0.998	-0.002	≤ ± 0.01	P
60	36189	243.21	7865	0.98	0.977	-0.003	≤ ± 0.01	P
70	42131	243.23	12666	0.96	0.958	-0.002	≤ ± 0.01	P
80	48137	243.22	17859	0.94	0.938	-0.002	≤ ± 0.01	P
90	54156	243.20	23660	0.92	0.916	-0.004	≤ ± 0.01	P
100	60227	243.16	29229	0.90	0.900	0.000	≤ ± 0.01	P
100	60357	233.98	29681	0.90	0.897	-0.003	≤ ± 0.01	P
100	60389	227.25	3218	1.00	0.999	-0.001	≤ ± 0.01	P

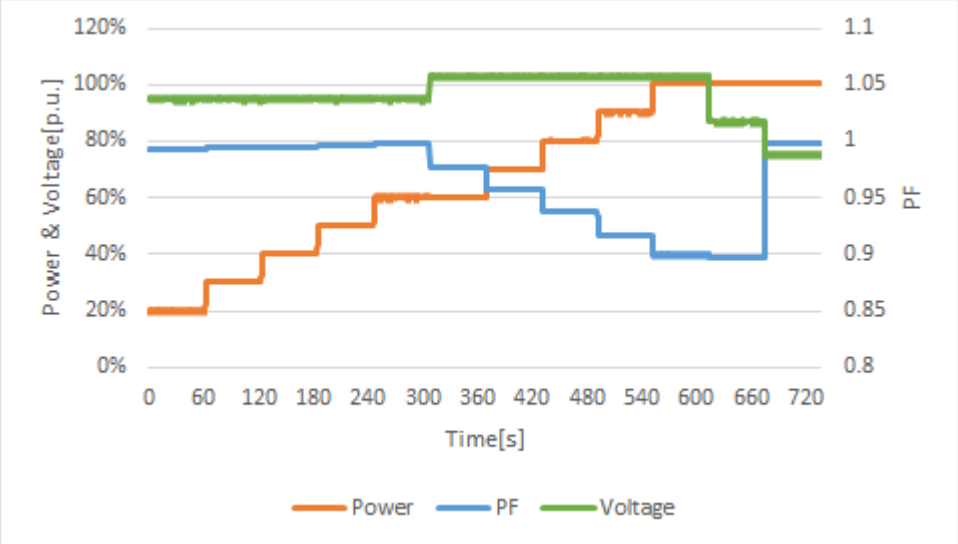
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF60K-TH							
P/P_{SMAX} [%]	P[W]	Vout[%]	-Q[Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	12054	238.60	-1437	1.00	0.993	-0.007	≤ ± 0.01	P
30	18083	238.63	-1930	1.00	0.994	-0.006	≤ ± 0.01	P
40	24076	238.64	-2336	1.00	0.995	-0.005	≤ ± 0.01	P
50	30157	238.66	-2689	1.00	0.996	-0.004	≤ ± 0.01	P
60	36073	238.62	-2317	1.00	0.998	-0.002	≤ ± 0.01	P
60	36196	243.24	-7860	0.98	0.977	-0.003	≤ ± 0.01	P
70	42139	243.26	-12661	0.96	0.958	-0.002	≤ ± 0.01	P
80	48145	243.25	-17856	0.94	0.938	-0.002	≤ ± 0.01	P
90	54164	243.24	-23655	0.92	0.916	-0.004	≤ ± 0.01	P
100	60235	243.19	-29226	0.90	0.900	0.000	≤ ± 0.01	P
100	60365	234.01	-29677	0.90	0.897	-0.003	≤ ± 0.01	P
100	60397	227.28	-3218	1.00	0.999	-0.001	≤ ± 0.01	P

Graph reactive power production according to a characteristic curve cos(phi) = f(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)

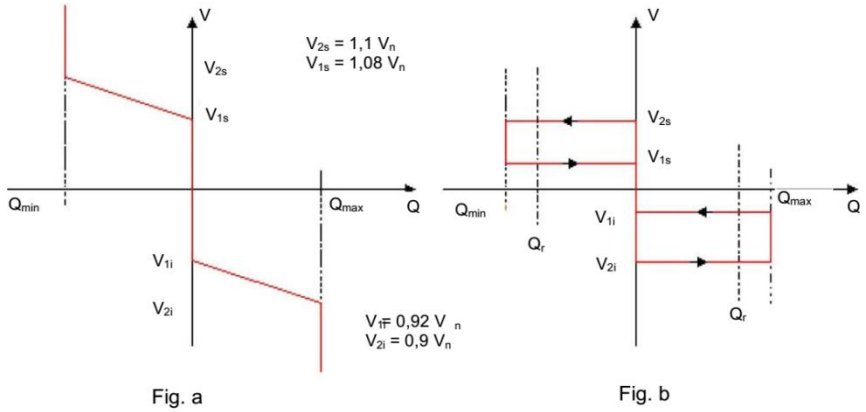


Figure 51 - Standard characteristic curves Q = f (V)

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.

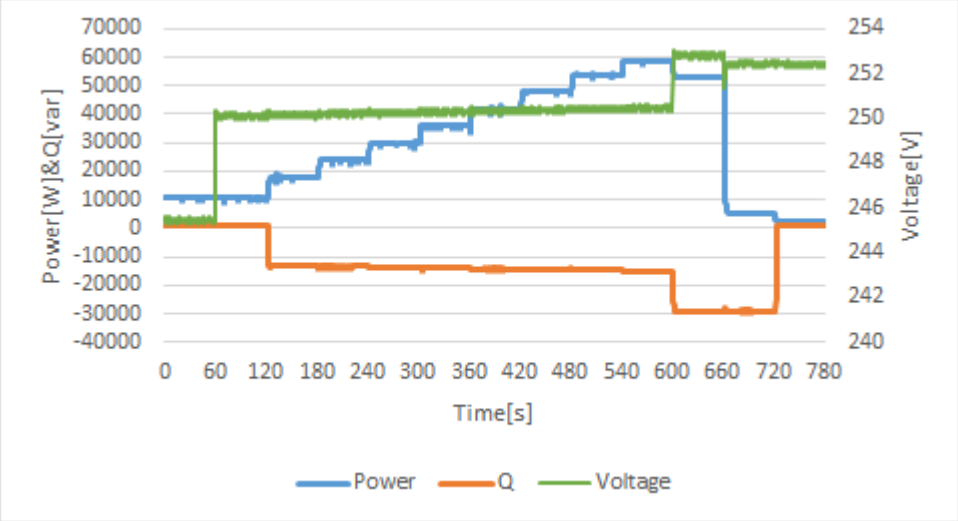
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.2.6	**TABLE: Automatic supply of reactive power according to the characteristic curve Q= f(V) (greater 11.08kW systems)**					**P**
Model	AF60K-TH					
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	18%	245.88	1237.92	≈0(<±2.5%Pn)	2.06%
< 20%	1.09Vn	18%	250.49	1245.66	≈0(<±2.5%Pn)	2.08%
< 20%-> 30%	1.09Vn	30%	250.53	-13199.92	-0.5 Q_{min} (within 10s)	2.22%
40%	1.09V_n	40%	250.57	-13439.71	-0.5 Q_{min}	1.82%
50%	1.09V_n	50%	250.61	-13711.03	-0.5 Q_{min}	1.36%
60%	1.09V_n	60%	250.65	-13986.69	-0.5 Q_{min}	0.90%
70%	1.09V_n	70%	250.69	-14230.05	-0.5 Q_{min}	0.50%
80%	1.09V_n	80%	250.73	-14375.06	-0.5 Q_{min}	0.33%
90%	1.09V_n	90%	250.75	-14694.72	-0.5 Q_{min}	-0.28%
100%	1.09V_n	97%	250.79	-15086.32	-0.5 Q_{min}	-0.93%
100%	1.1 V_n	88%	253.09	-29018.35	- Q_{min}	0.07%
100%->10%	1.1 V_n	9%	252.78	-28988.89	- Q_{min}	0.12%
10%-> ≤5%	1.1 V_n	4%	252.76	761.37	≈0 (<±5%P_n)	1.27%
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%	213.74	979.16	≈0 (<±2.5%P_n)	1.63%
< 20%	0.91V_n	18%	209.10	968.64	≈0 (<±2.5%P_n)	1.61%
< 20%-30%	0.91V_n	31%	209.15	15173.49	-0.5 Q_{max} (within 10s)	1.07%
40%	0.91V_n	41%	209.20	15052.20	-0.5 Q_{max}	0.87%
50%	0.91V_n	51%	209.24	14909.14	-0.5 Q_{max}	0.63%
60%	0.91V_n	61%	209.28	14594.06	-0.5 Q_{max}	0.11%
70%	0.91V_n	71%	209.32	14479.32	-0.5 Q_{max}	-0.08%
80%	0.91V_n	81%	209.37	14453.27	-0.5 Q_{max}	-0.13%
90%	0.91V_n	91%	209.42	14518.08	-0.5 Q_{max}	-0.02%
100%	0.91V_n	98%	209.41	14458.37	-0.5 Q_{max}	-0.12%
100%	0.90V_n	90%	207.07	29397.23	- Q_{max}	0.57%
100%-10%	0.90V_n	9%	206.72	29788.29	- Q_{max}	1.22%
10%-5%	0.90V_n	5%	206.71	1392.03	≈0(<±5%P_n)	2.32%

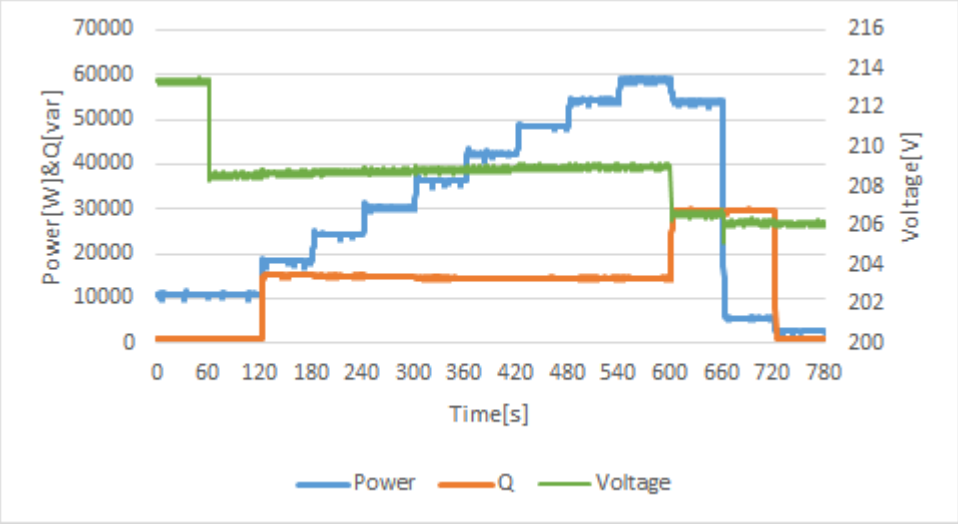
Note:
The lock-in value is adjustable between V_n and 1.1V_n and the lock-out value between V_n and 0.9V_n in 0.01V steps.
The inverter voltage on the AC side of the (inverter) is rated to 400V line to line.
In reference to the circular characteristic, the inverter reduces the active output power to 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.

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

Over Voltage



Under Voltage

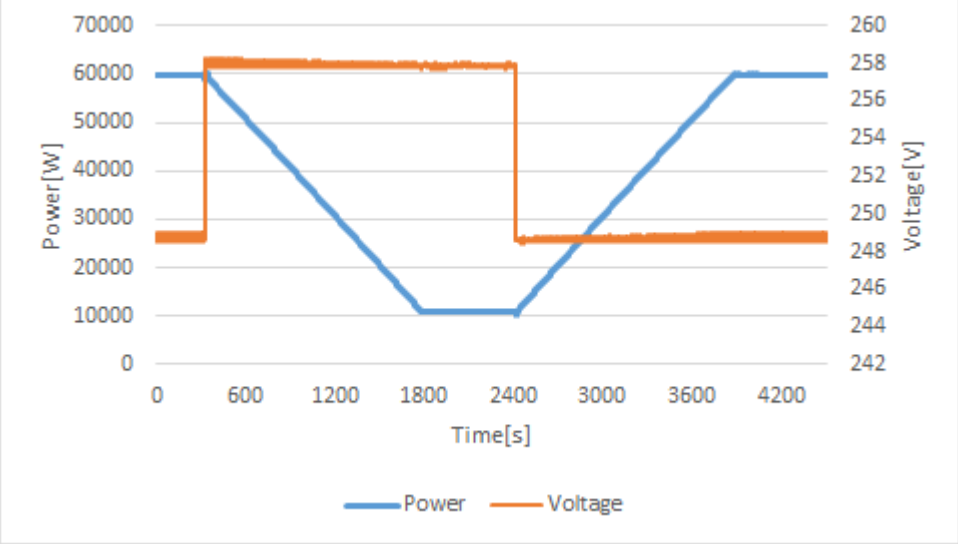


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.1	**TABLE: Automatic limitation of active power for voltage values close to 110% of the rated voltage**					**P**
Model	AF60K-TH					
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	248.79	59912.47	99.85%	--	P
2	1.12	257.94	10736.00	17.89%	P <20%P_n	P
3	1.08	248.74	59940.00	99.90%	--	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	AF60K-TH							
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	
file: 100% P_{Emax}	Sequence A							
file: 50% P_{Emax}	Sequence B							

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).

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

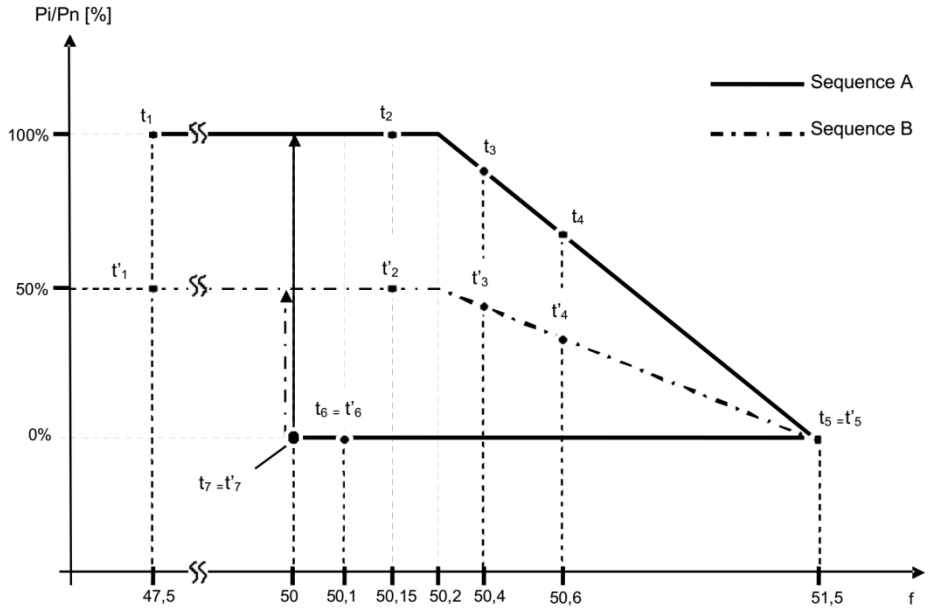
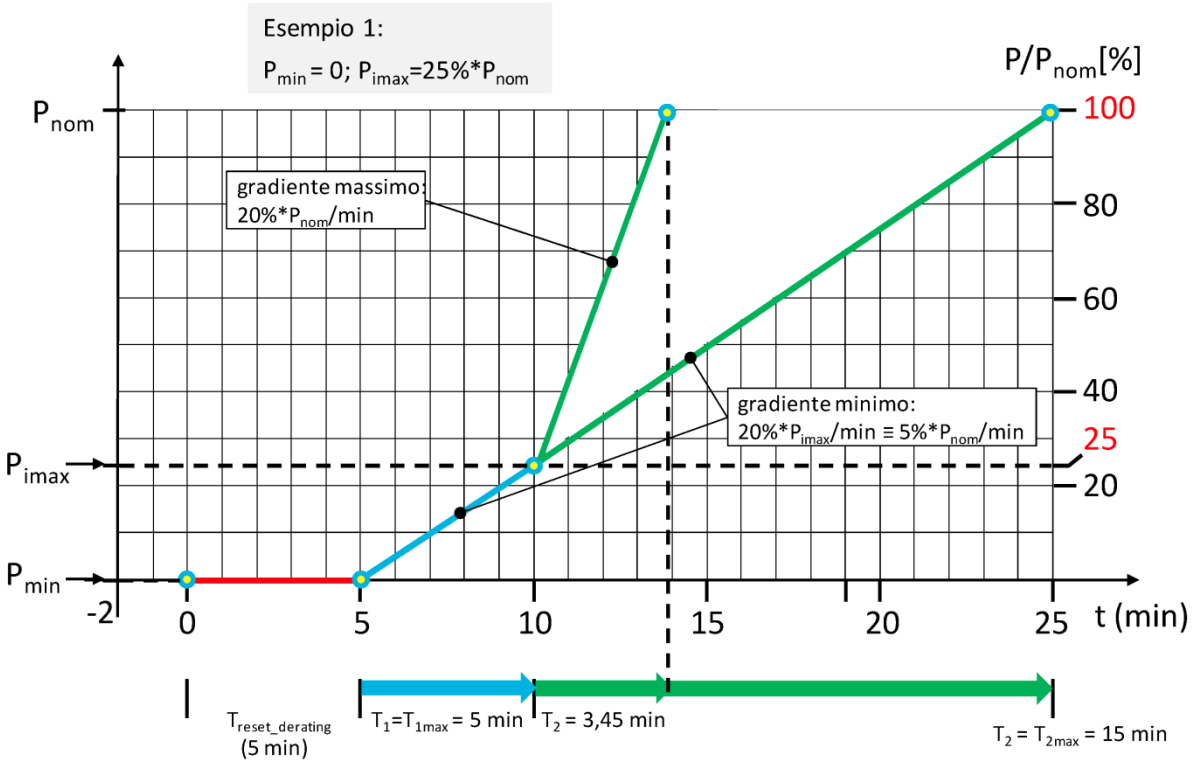


Figure 52 - Curves for limiting active power with respect to frequency

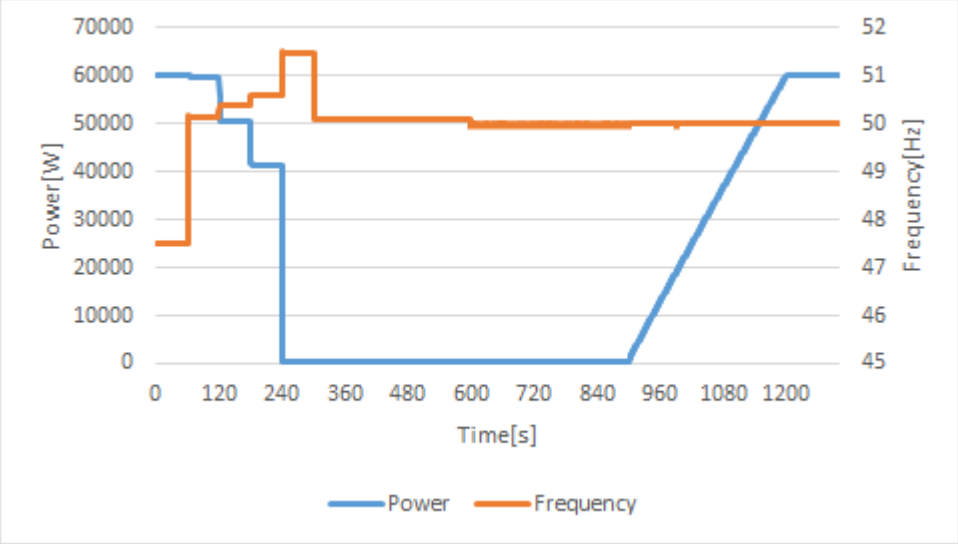
The total tolerance is $\Delta P \leq \pm 2{,}5\%$ of P_n

Limits of the power-up gradient



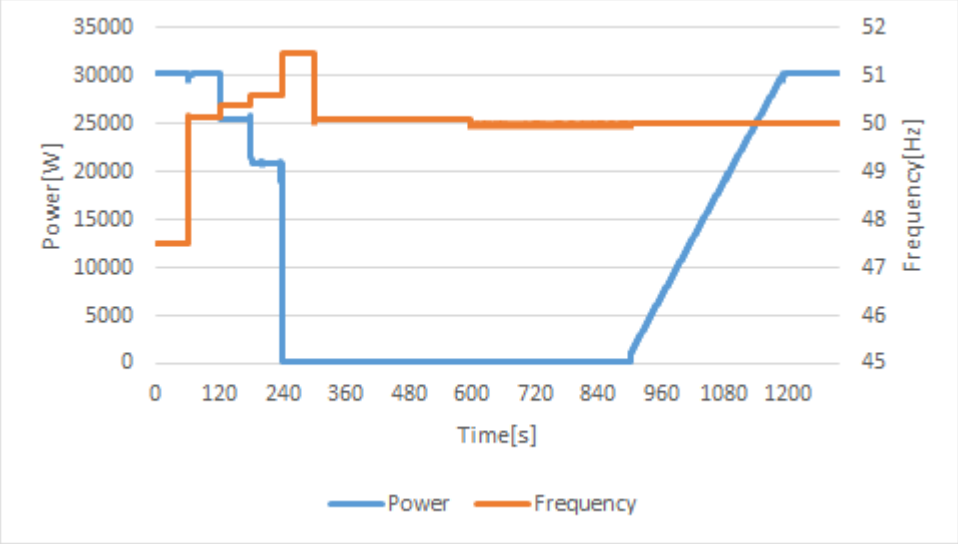
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Sequence A						
Step No.	Set output power [%]	Frequency[Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100	47.51	60000	60251	± 2.5% Pn	t_1
2	100	50.15	60000	59636	± 2.5% Pn	t_2
3	100	50.40	50769	50689	± 2.5% Pn	t_3
4	100	50.60	41538	41571	± 2.5% Pn	t_4
5	100	51.49	462	674	± 2.5% Pn	t_5
6	100	50.10	462	478	± 2.5% Pn	t_6
7	100	50.00	60000	60052	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	30000	30299	± 2.5% Pn	t'_1
2	50	50.15	30000	30270	± 2.5% Pn	t'_2
3	50	50.40	25385	25455	± 2.5% Pn	t'_3
4	50	50.60	20769	20892	± 2.5% Pn	t'_4
5	50	51.49	231	353	± 2.5% Pn	t'_5
6	50	50.10	231	233	± 2.5% Pn	t'_6
7	50	50.00	30000	30387	50% Pn	t'_7

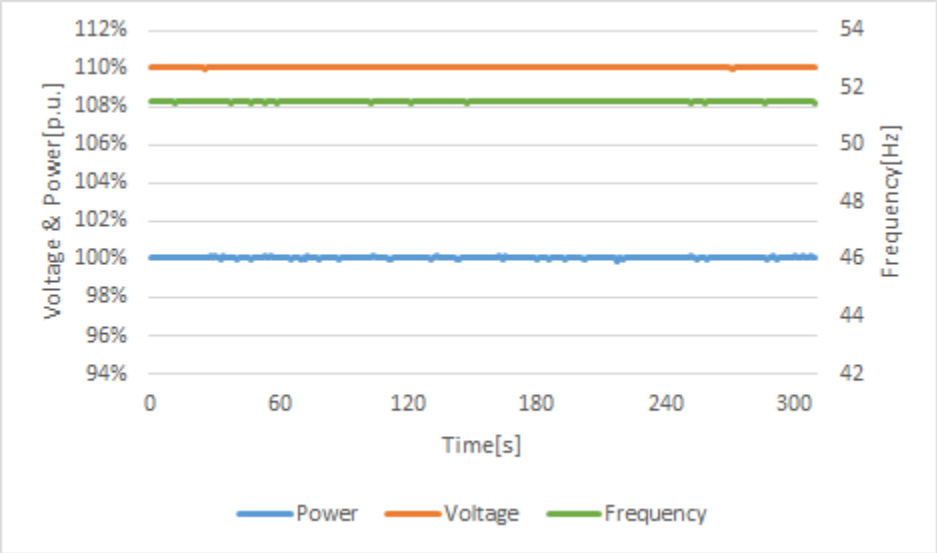


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.3	**TABLE: Verification of the operating range in voltage and frequency**					**P**
Model	AF60K-TH					
Test No.	Voltage (V)	Frequency (Hz)	P (W)	Cos φ	Time (s)	Limit (%P_n)
Test 1	110.07%	51.49	60056	0.9998	>5min	± 5
Test 2	84.82%	49.99	56266	0.9996	>5min	± 15

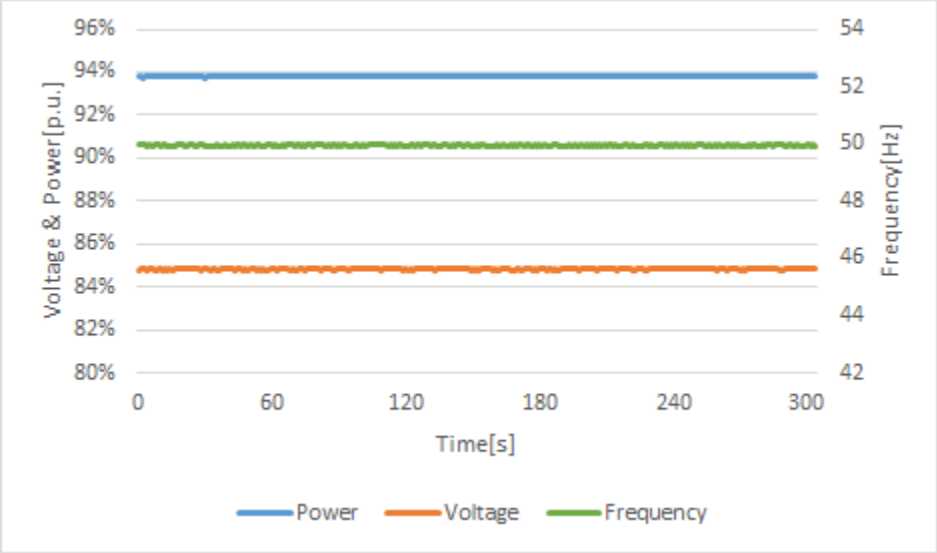
Test 1: V = 110 % * V_n; f = 51,5 Hz; P = 100 %P_n; Cos φ= 1 (Duration: at least 5 minutes)
Test 2: V = 85 % * V_n; f = 50,0 Hz; P = 100 %P_n; Cos φ= 1
Test 1 and 2 have a duration of at least 5 minutes. In Test 2, operation at reduced power is allowed, equal to the maximum deliverable when the maximum 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



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

Test 2

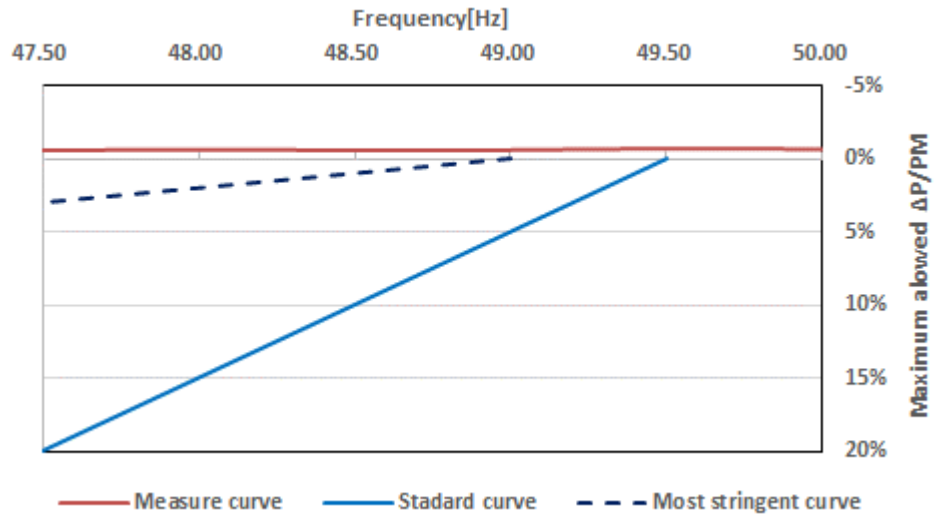


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

B.1.3.3.1	**TABLE: Reduction of active power in the presence of transient under-frequency on transmission network**					**P**
Model:	AF60K-TH					
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 [W]:	60069	60067	60046	60072	60056	60038

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.

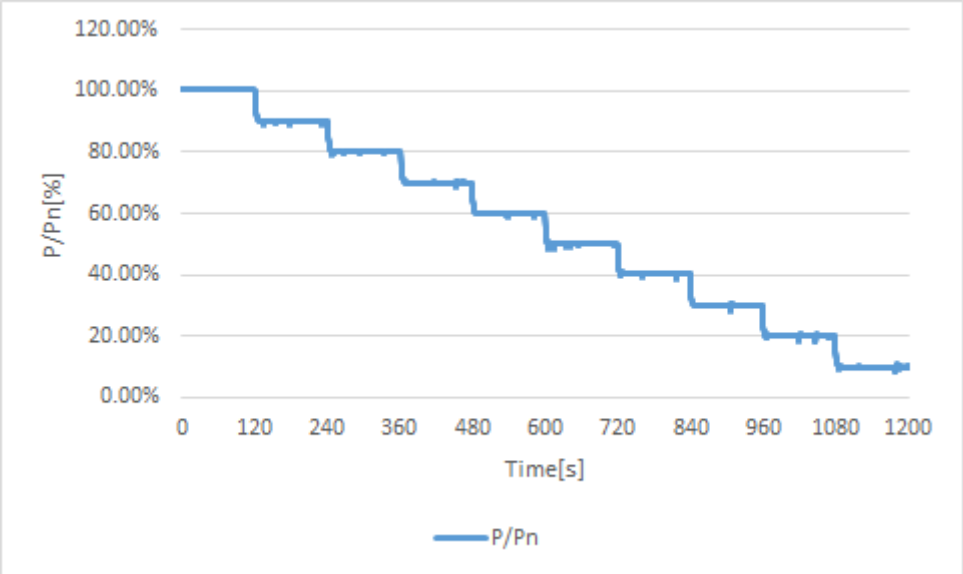
Assessment criterion:
The test is regarded as passed if:
the results should be presented in a table, and on the basis they must extrapolate the trend on a graph that must be greater than the threshold identified by continuous tract of fig. 12a contained in the 8.4.4.
• the power reduction in point c) 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	AF60K-TH			
Set point P [P/P_n]	Set point P [W]	P measured [W]	Deviation (%)	Limit (%P_n)
100	60000	60276	0.46%	--
90	54000	54087	0.16%	± 2.5
80	48000	48121	0.25%	± 2.5
70	42000	42076	0.18%	± 2.5
60	36000	35941	-0.16%	± 2.5
50	30000	30017	0.06%	± 2.5
40	24000	24185	0.77%	± 2.5
30	18000	18013	0.07%	± 2.5
20	12000	12125	1.04%	± 2.5
10	6000	6023	0.38%	± 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

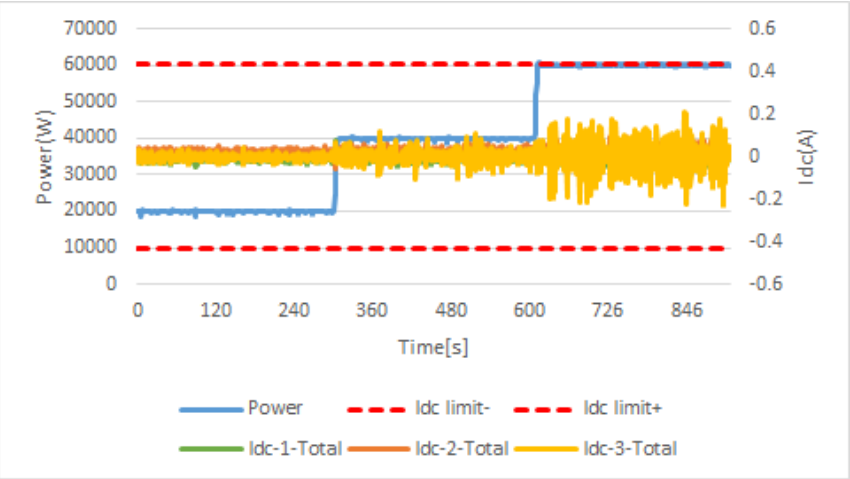
Note:

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

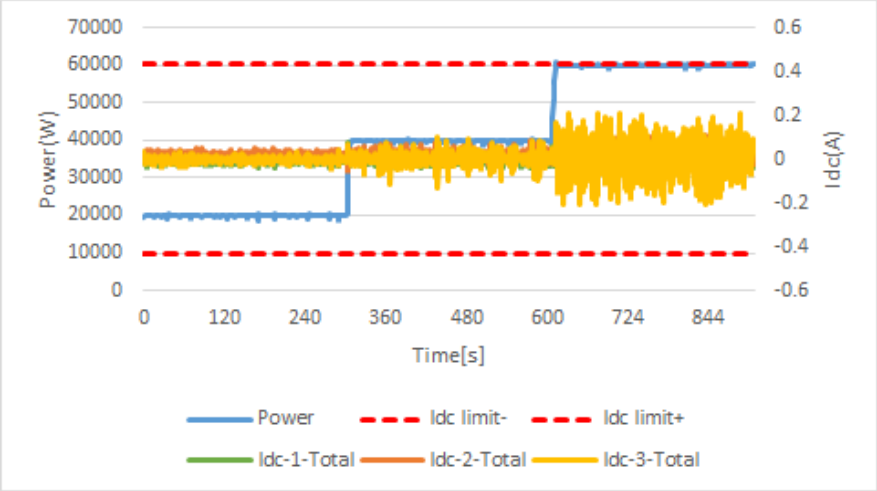
B.1.4.1	**TABLE: Checking the DC component output**		**P**
Model	AF60K-TH		
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient			
Total output Power (W)	19843	39794	59993
Output Vrms	231.20	231.33	231.48
Output Arms	28.78	57.43	86.45
Cos φ	0.9942	0.9985	0.9993
L1 DC Component (A)	0.005	0.005	0.006
L2 DC Component (A)	0.008	0.009	0.011
L3 DC Component (A)	0.004	0.008	0.023
L1 DC Component (% I_r)	0.006%	0.006%	0.007%
L2 DC Component (% I_r)	0.009%	0.010%	0.013%
L3 DC Component (% I_r)	0.004%	0.010%	0.026%
Minimum ambient rating -25°C			
Total output Power (W)	19825	39757	59964
Output Vrms	231.04	231.21	231.36
Output Arms	28.77	57.41	86.46
Cos φ	0.9941	0.9984	0.9993
L1 DC Component (A)	0.005	0.004	0.006
L2 DC Component (A)	0.008	0.009	0.013
L3 DC Component (A)	0.004	0.009	0.029
L1 DC Component (% I_r)	0.006%	0.005%	0.007%
L2 DC Component (% I_r)	0.009%	0.010%	0.015%
L3 DC Component (% I_r)	0.004%	0.010%	0.034%
Maximum ambient rating +60°C			
Total output Power (W)	19861	39820	59977
Output Vrms	231.22	231.35	231.50
Output Arms	28.80	57.46	86.42
Cos φ	0.9942	0.9985	0.9993
L1 DC Component (A)	0.005	0.005	0.005
L2 DC Component (A)	0.008	0.008	0.011
L3 DC Component (A)	0.003	0.007	0.022
L1 DC Component (% I_r)	0.006%	0.006%	0.006%
L2 DC Component (% I_r)	0.009%	0.009%	0.013%
L3 DC Component (% I_r)	0.004%	0.008%	0.025%

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

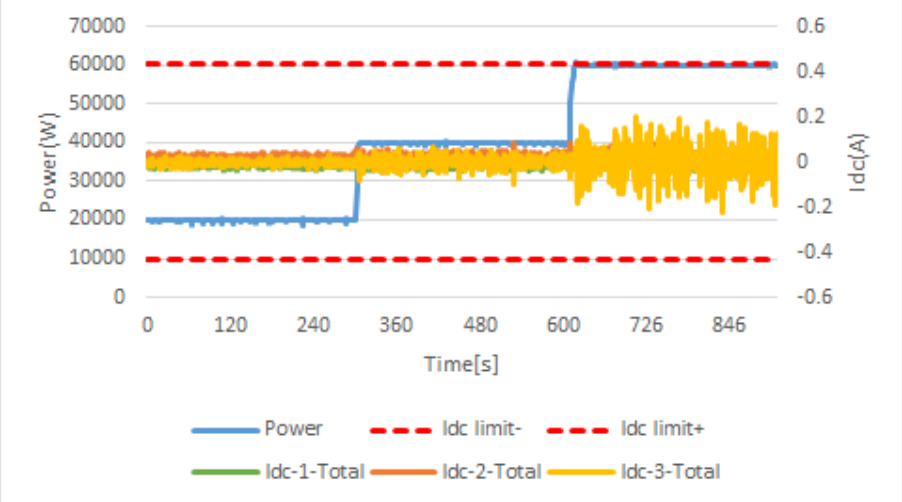
Ambient



Minimum ambient rating -25°C



Maximum ambient rating +60°C

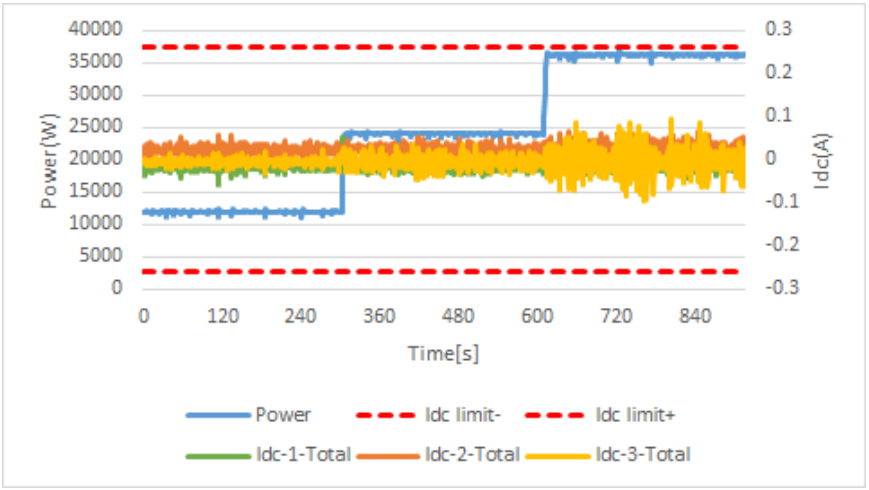


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

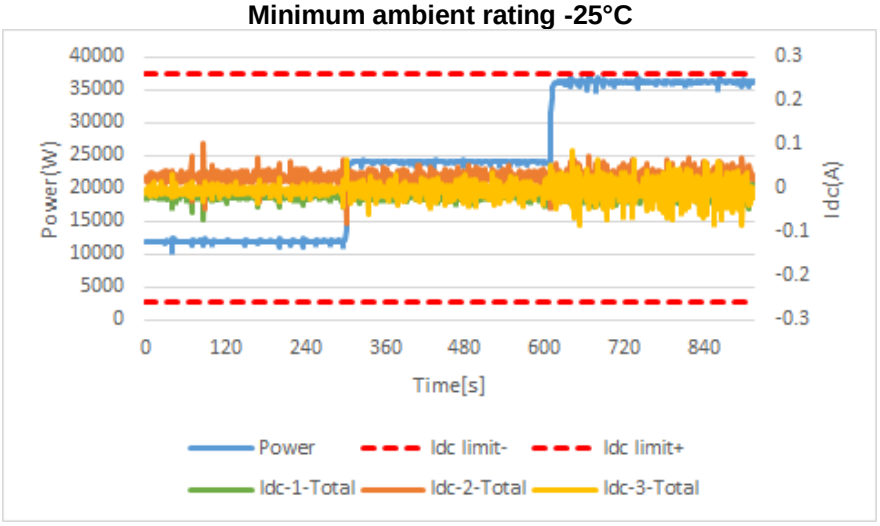
B.1.4.1	**TABLE: Checking the DC component output**		**P**
Model	AF36K-TH		
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient			
Total output Power (W)	11986	23972	36156
Output Vrms	231.19	231.26	231.35
Output Arms	17.56	34.69	52.19
Cos φ	0.9842	0.9960	0.9982
L1 DC Component (A)	0.006	0.006	0.005
L2 DC Component (A)	0.008	0.008	0.009
L3 DC Component (A)	0.002	0.004	0.009
L1 DC Component (% I_r)	0.012%	0.011%	0.010%
L2 DC Component (% I_r)	0.014%	0.014%	0.016%
L3 DC Component (% I_r)	0.004%	0.008%	0.017%
Minimum ambient rating -25°C			
Total output Power (W)	11982	23951	36138
Output Vrms	231.16	231.24	231.33
Output Arms	17.56	34.67	52.17
Cos φ	0.9841	0.9959	0.9981
L1 DC Component (A)	0.006	0.005	0.005
L2 DC Component (A)	0.009	0.009	0.009
L3 DC Component (A)	0.003	0.004	0.008
L1 DC Component (% I_r)	0.011%	0.010%	0.009%
L2 DC Component (% I_r)	0.017%	0.016%	0.017%
L3 DC Component (% I_r)	0.005%	0.008%	0.015%
Maximum ambient rating +60°C			
Total output Power (W)	11982	23947	36152
Output Vrms	231.18	231.26	231.34
Output Arms	17.56	34.66	52.19
Cos φ	0.9841	0.9960	0.9981
L1 DC Component (A)	0.005	0.005	0.005
L2 DC Component (A)	0.008	0.008	0.009
L3 DC Component (A)	0.002	0.004	0.007
L1 DC Component (% I_r)	0.011%	0.010%	0.010%
L2 DC Component (% I_r)	0.016%	0.016%	0.017%
L3 DC Component (% I_r)	0.004%	0.008%	0.014%

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

Ambient



Minimum ambient rating -25°C



Maximum ambient rating +60°C



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

B.1.4.2	**TABLE: Checking the protection against DC injection**			P
Model	AF60K-TH			
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	435.6	434.8	991.0
66%	+0,5%I_{nom} /1s	435.3	434.8	991.0
100%	+0,5%I_{nom} /1s	435.5	434.8	991.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1009	1000	196.0
66%	+1A Idc/200ms	1017	1000	192.0
100%	+1A Idc/200ms	1012	1000	192.0
Model	AF36K-TH			
Actual Power	Limits	Measurement:(mA)	Limiting value:(mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0,5%I_{nom} /1s	261.3	260.9	995.0
66%	+0,5%I_{nom} /1s	261.2	260.9	997.0
100%	+0,5%I_{nom} /1s	261.2	260.9	999.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1012	1000	198.0
66%	+1A Idc/200ms	1015	1000	199.0
100%	+1A Idc/200ms	1013	1000	197.0
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:	AF60K-TH			
Minimum ambient rating -25°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	435.7	434.8	993.0
66%	+0,5%I_{nom} /1s	435.0	434.8	993.0
100%	+0,5%I_{nom} /1s	435.8	434.8	993.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1007	1000	198.0
66%	+1A Idc/200ms	1013	1000	198.0
100%	+1A Idc/200ms	1013	1000	196.0
Model:	AF36K-TH			
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0,5%I_{nom} /1s	261.0	260.9	999.0
66%	+0,5%I_{nom} /1s	261.1	260.9	997.0
100%	+0,5%I_{nom} /1s	261.7	260.9	997.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1006	1000	194.0
66%	+1A Idc/200ms	1008	1000	194.0
100%	+1A Idc/200ms	1010	1000	197.0
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:	AF60K-TH			
Maximum ambient rating +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	435.7	434.8	995.0
66%	+0,5%I_{nom} /1s	435.5	434.8	995.0
100%	+0,5%I_{nom} /1s	435.9	434.8	995.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1010	1000	192.0
66%	+1A Idc/200ms	1011	1000	194.0
100%	+1A Idc/200ms	1013	1000	198.0
Model:	AF36K-TH			
Actual Power	Limits	Measurement:(mA)	Limiting value: (mA)	Disconnection time:(ms)
I_{dc} = 0.5% of I_{nom}				
33%	+0,5%I_{nom} /1s	261.1	260.9	991.0
66%	+0,5%I_{nom} /1s	261.9	260.9	993.0
100%	+0,5%I_{nom} /1s	261.9	260.9	991.0
I_{dc} = 1A				
33%	+1A Idc/200ms	1009	1000	198.0
66%	+1A Idc/200ms	1013	1000	196.0
100%	+1A Idc/200ms	1013	1000	199.0
Note: The internal temperature of the EUT must be stabilized.				

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

B.1.5	TABLE: Verification of insensitivity to voltage dips (UVRT capability) [greater 11.08kW systems]	P
Model	AF60K-TH	

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

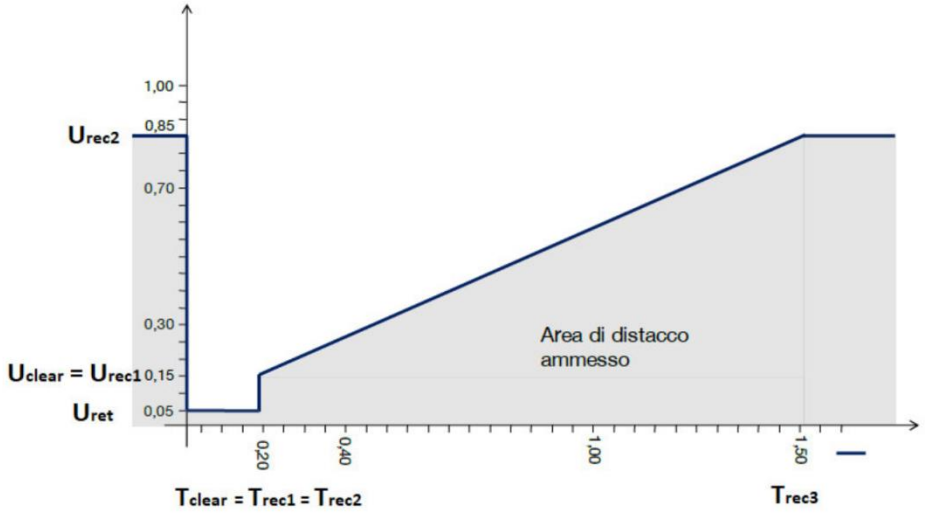
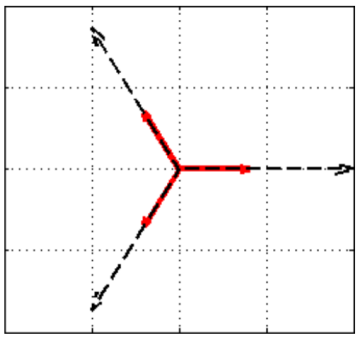


Figure 29 - Fault-ride-through profile of power park modules over 11.08 kW

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

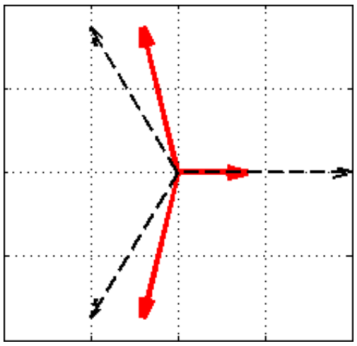
Test sequence:

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

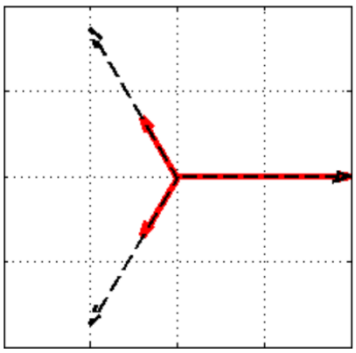


2) two-phase asymmetric fault (Table 31, Tests N.1a, N2a, N.3a and N.4a)

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 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	1.20 ± 0.05	1.20 ± 0.05	1.20 ± 0.05	0°	-120°	120°
8	1.25 ± 0.05	1.25 ± 0.05	1.25 ± 0.05	1.25 ± 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

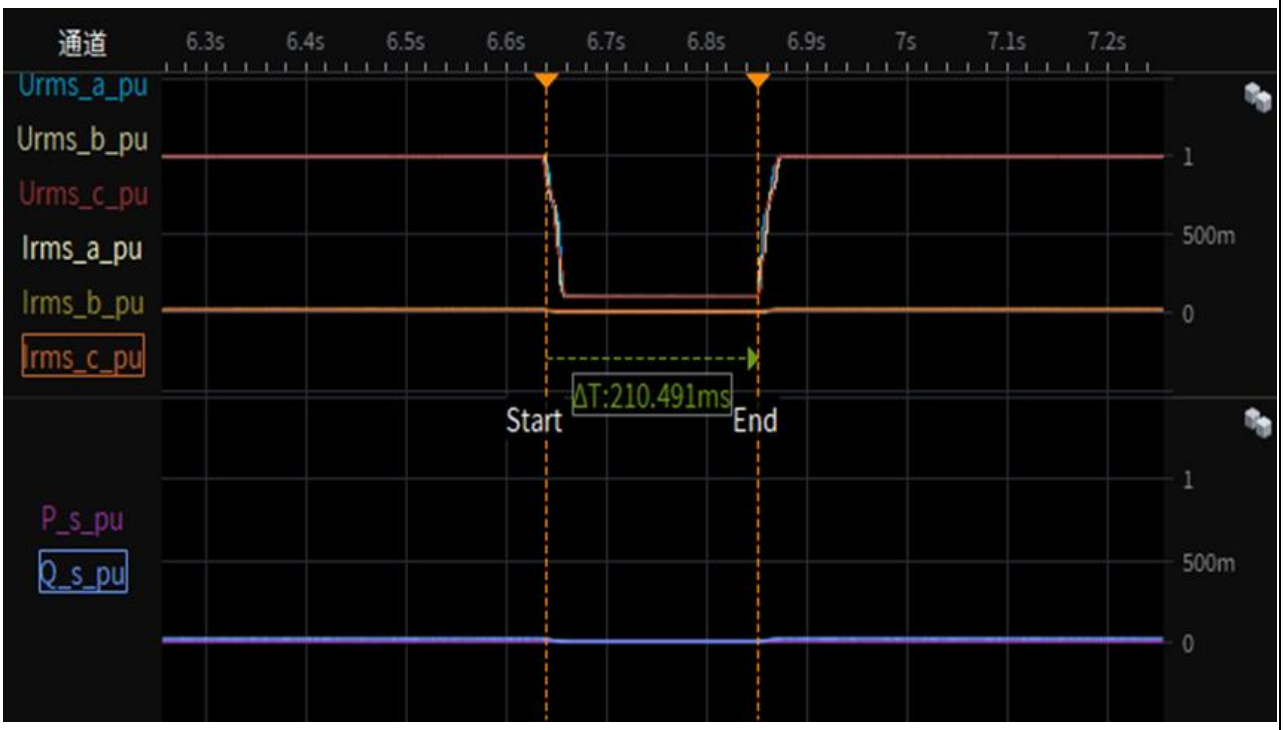
Graph of LVRT and OVRT test:

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 +20	210	121
1s – three-phase symmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	263
1a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	107
1a – two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	50
2s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	129
2s – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	56
2a – three-phase symmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	119
2a – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	223
3s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	120
3s – three-phase symmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	191
3a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	124
3a – two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	179
4s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	112
4s – three-phase symmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	196
4a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	112
4a – two-phase asymmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	189
5 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_5/Vn)	200 +20	210	122
5 – LV two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_5/Vn)	200 +20	210	217
6 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_6/Vn)	400 +20	860	126
6 – LV two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_6/Vn)	400 +20	860	213
7– HV two-phase asymmetrical fault (P = 0.1 - 0.3)	1.20 ± 0.05 (V_7/Vn)	500 +20	510	126
7– HV two-phase asymmetrical fault (P > 0.9)	1.20 ± 0.05 (V_7/Vn)	500 +20	510	213
8– HV two-phase asymmetrical fault (P = 0.1 - 0.3)	1.25 ± 0.05 (V_8/Vn)	100 +20	110	111
8– HV two-phase asymmetrical fault (P > 0.9)	1.25 ± 0.05 (V_8/Vn)	100 +20	110	209

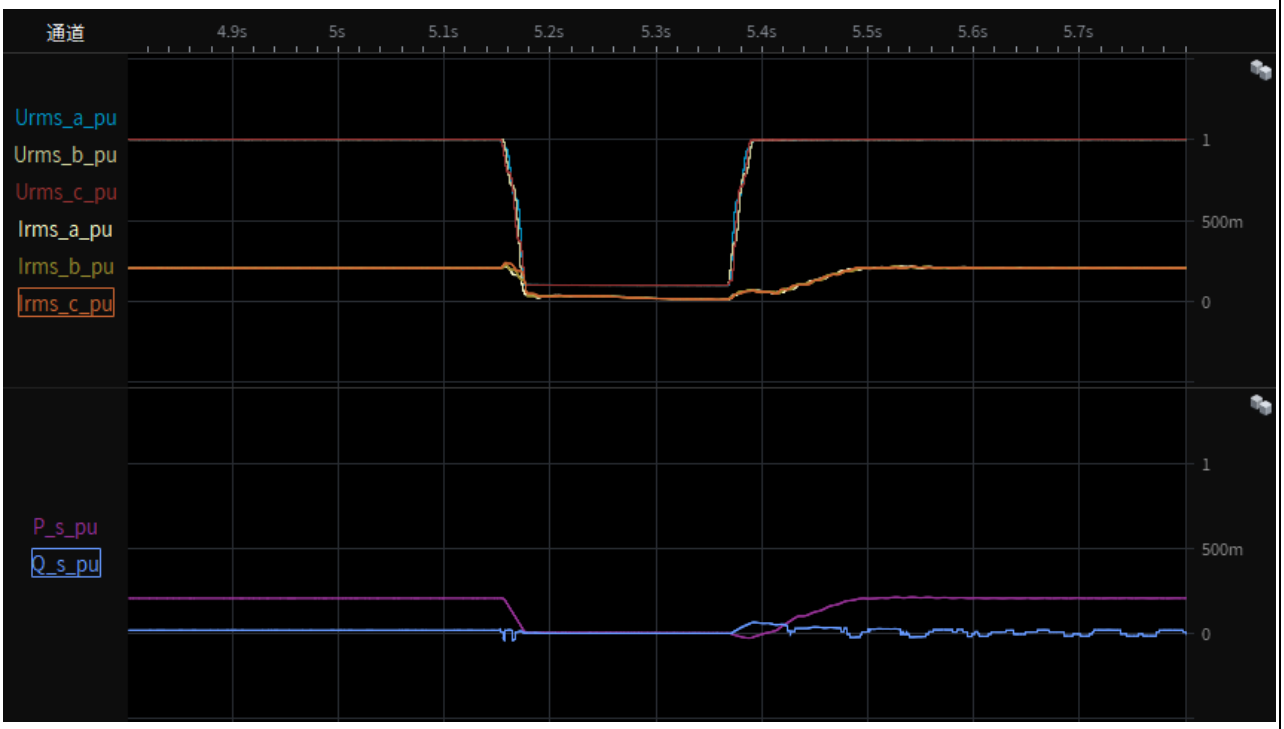
Note:
(*) Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms
The interface protection shall be disabled or adjusted to avoid spurious tripping during testing.
The test conditions are performed as worst case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

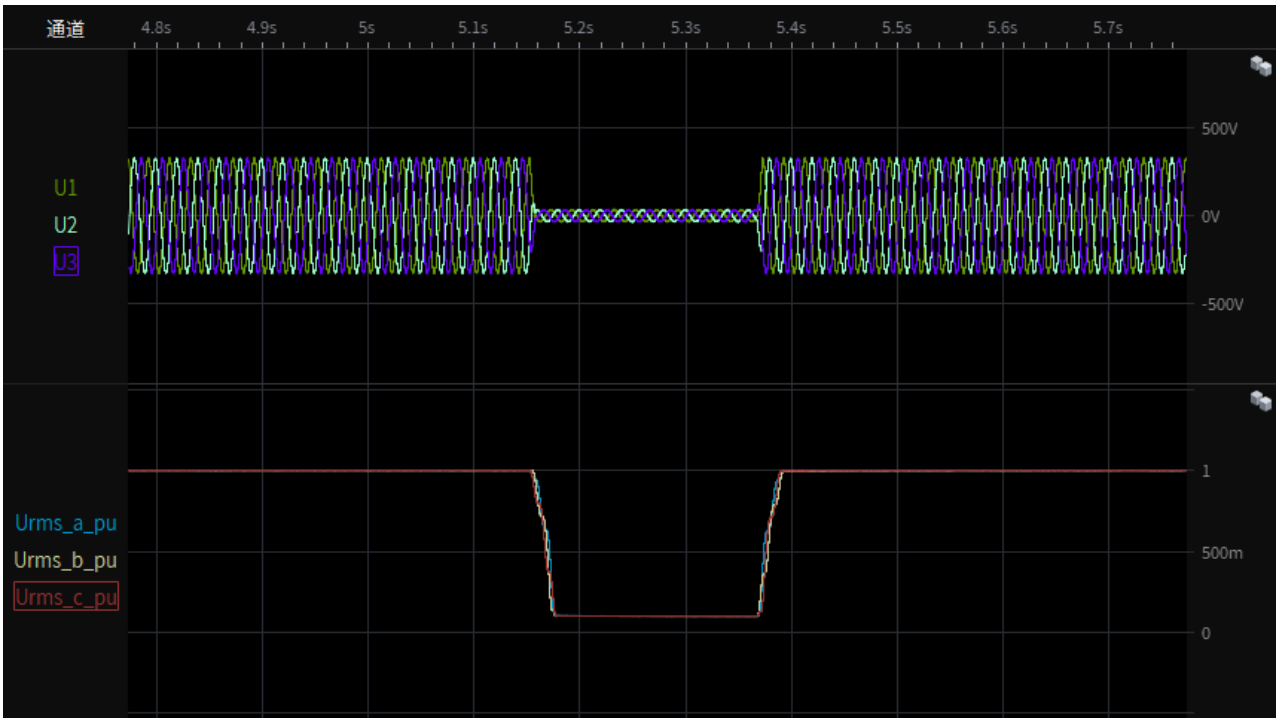


Test 1s-1.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

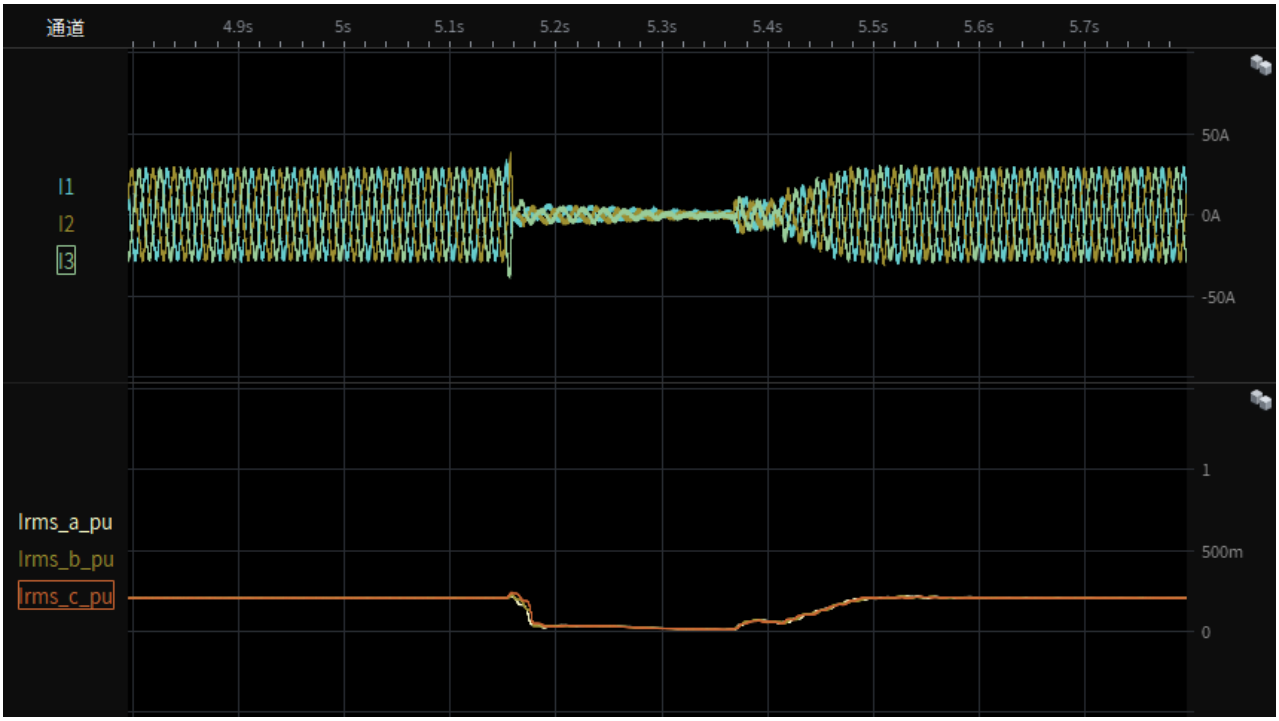


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

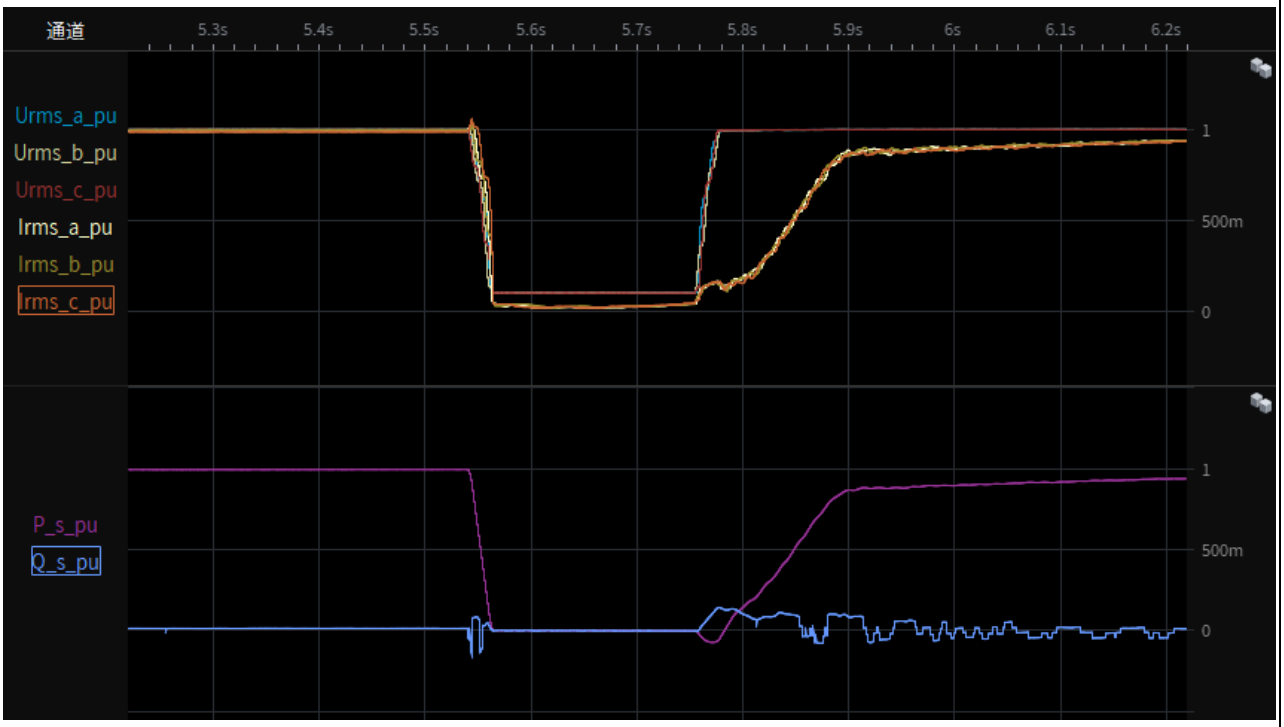


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

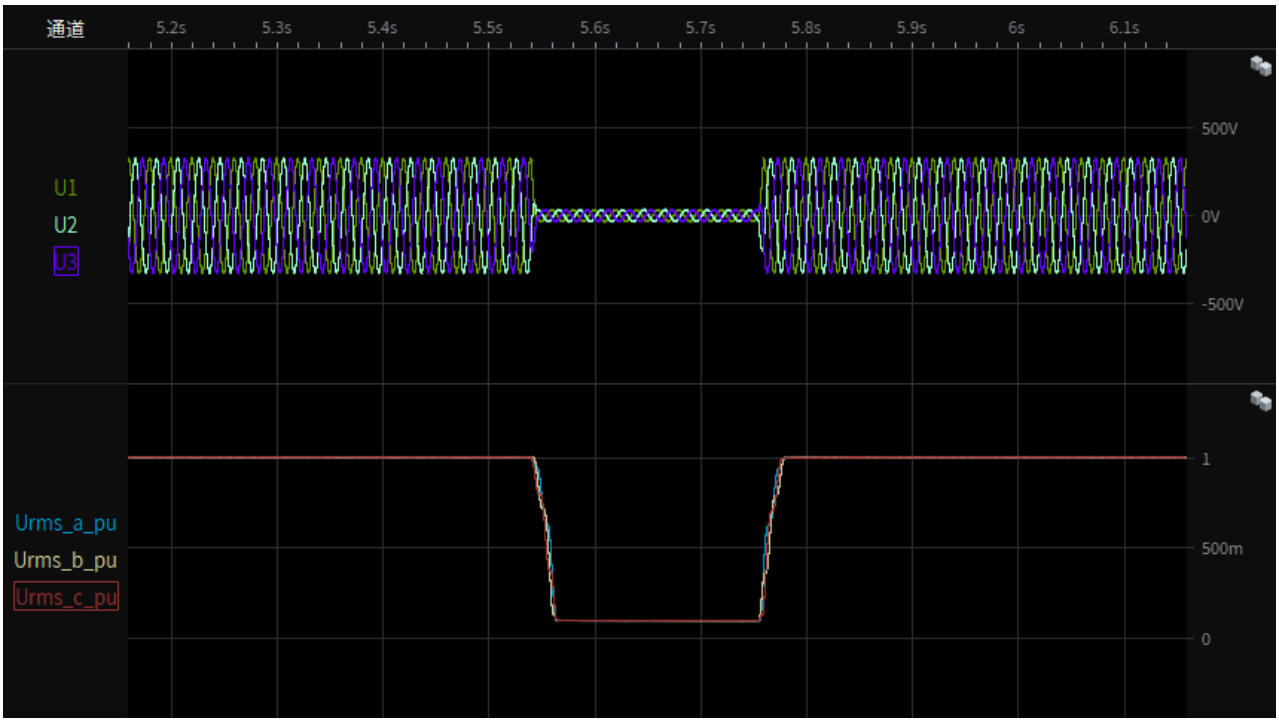


Test 1s-2.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

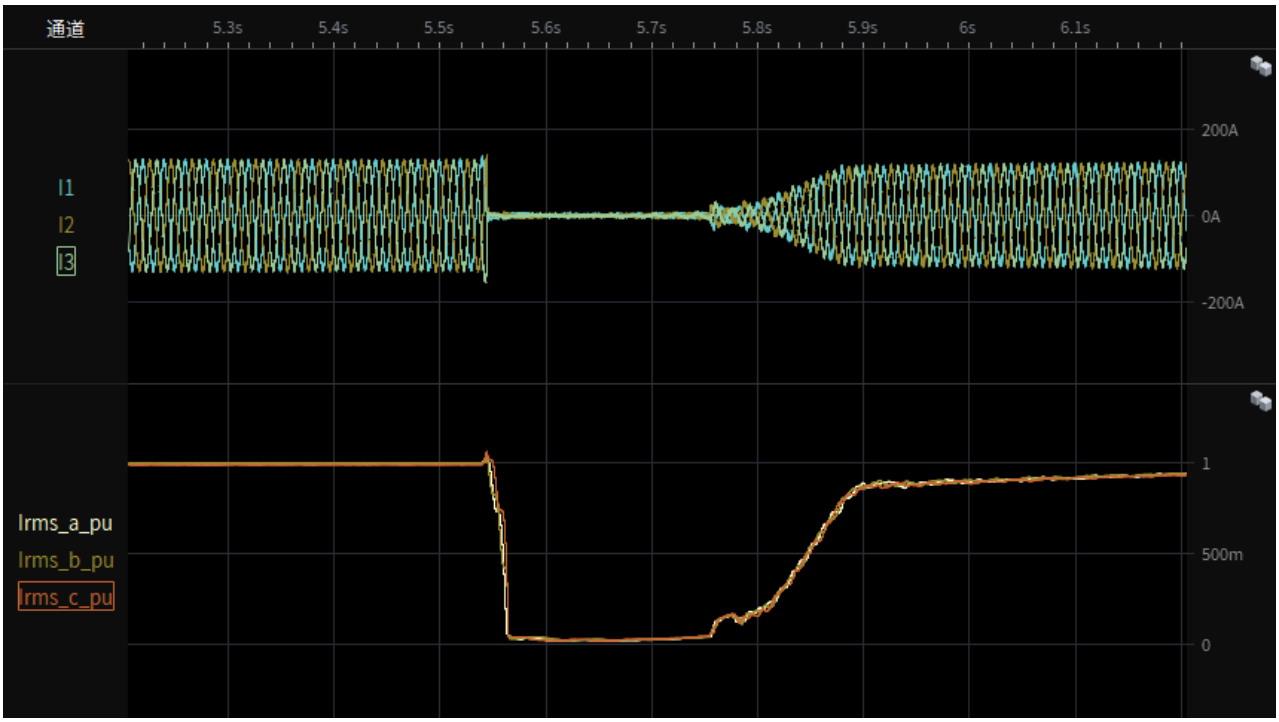


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

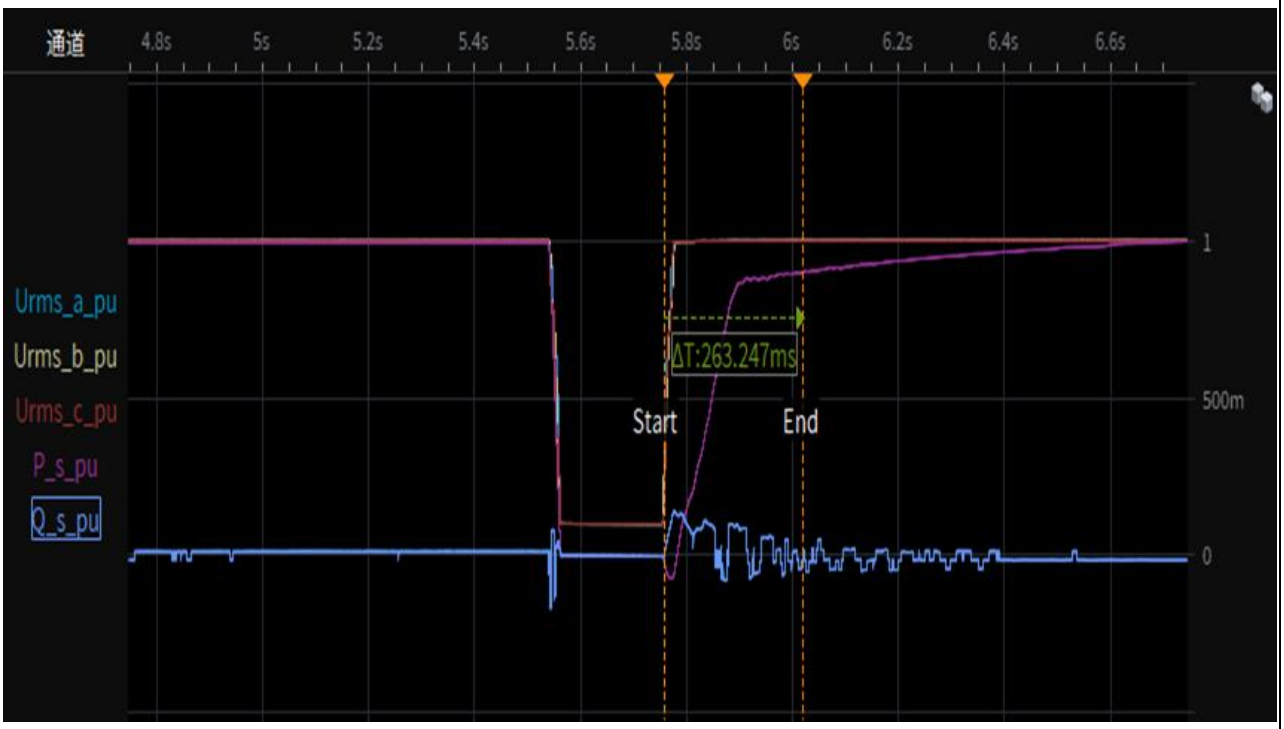


Test 1s-2.3 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

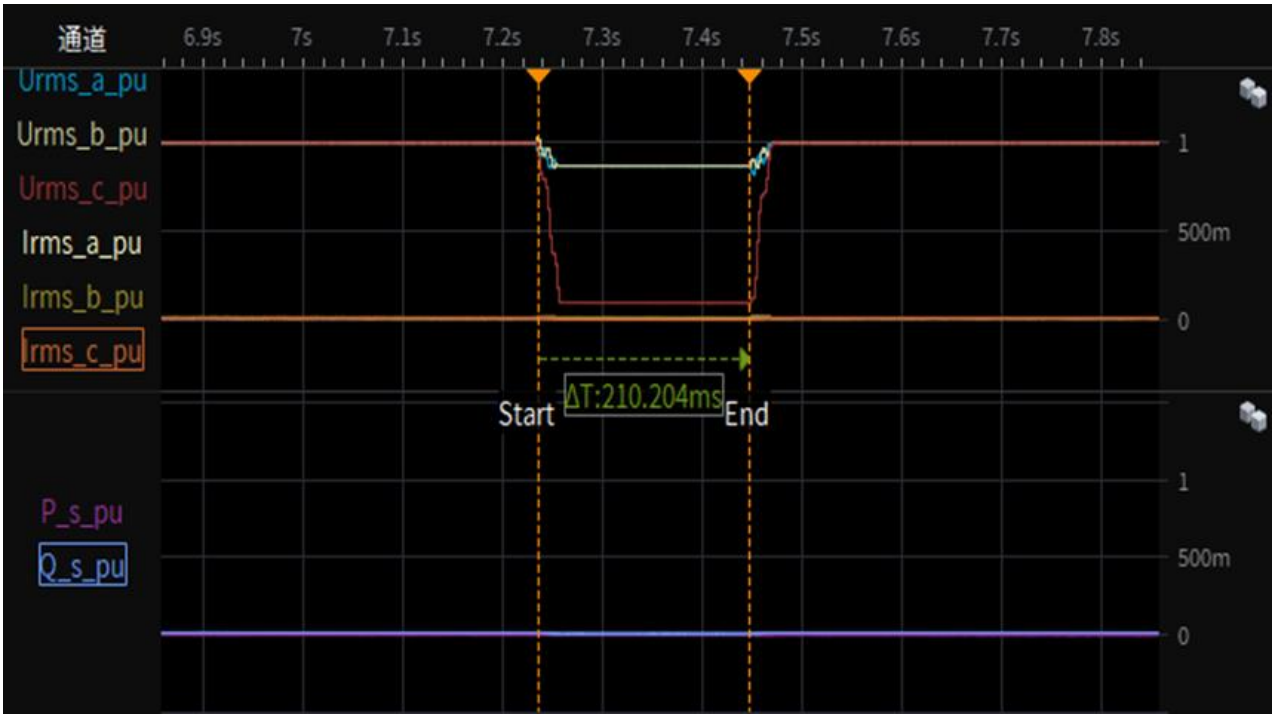


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

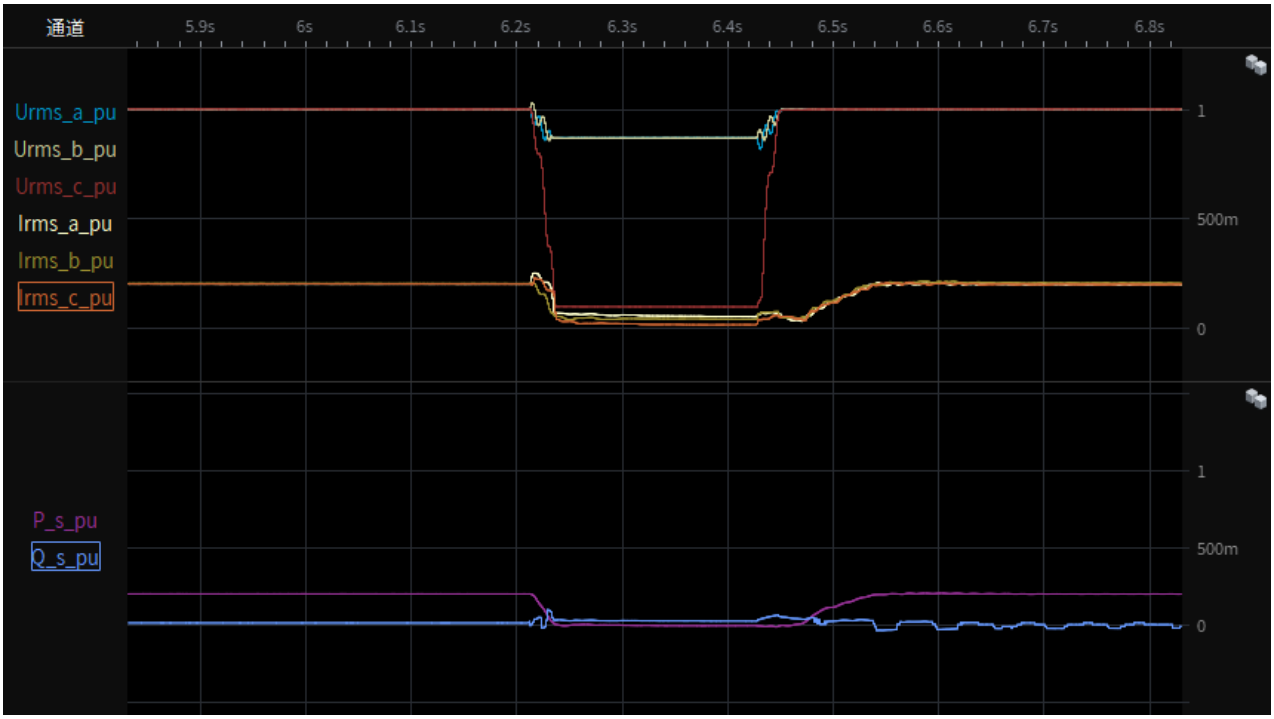


Test 1a-Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

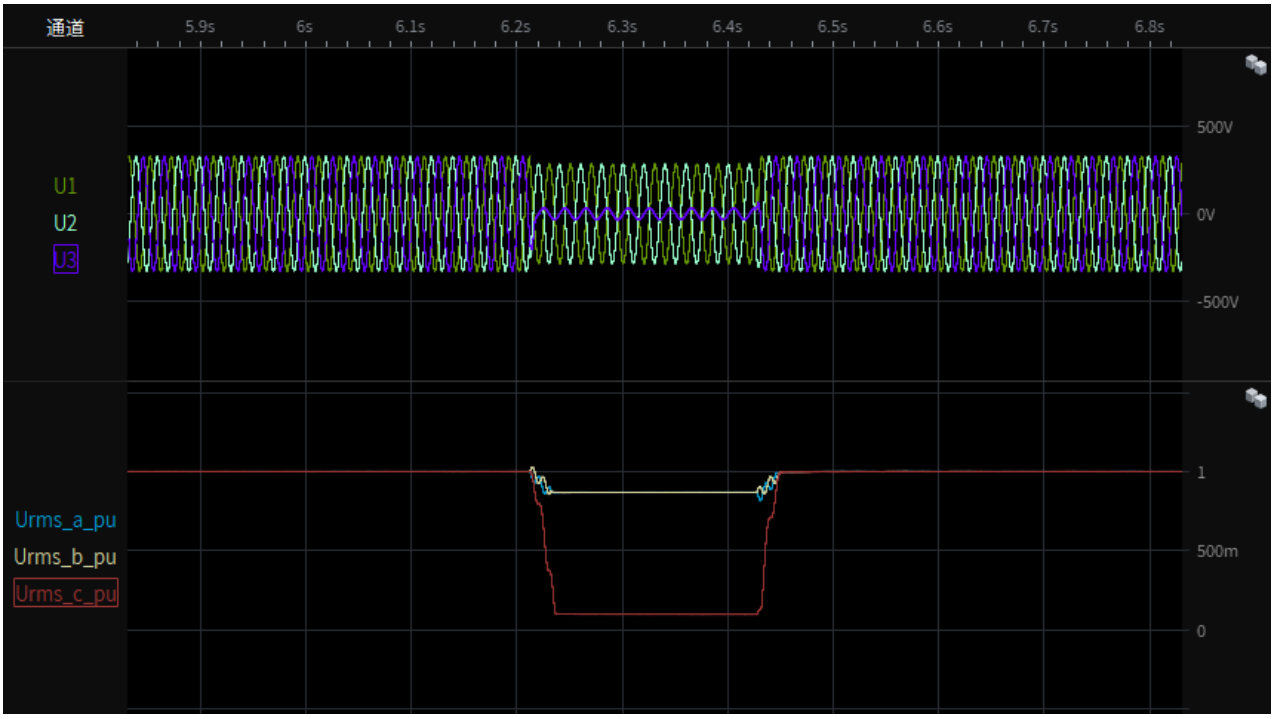


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

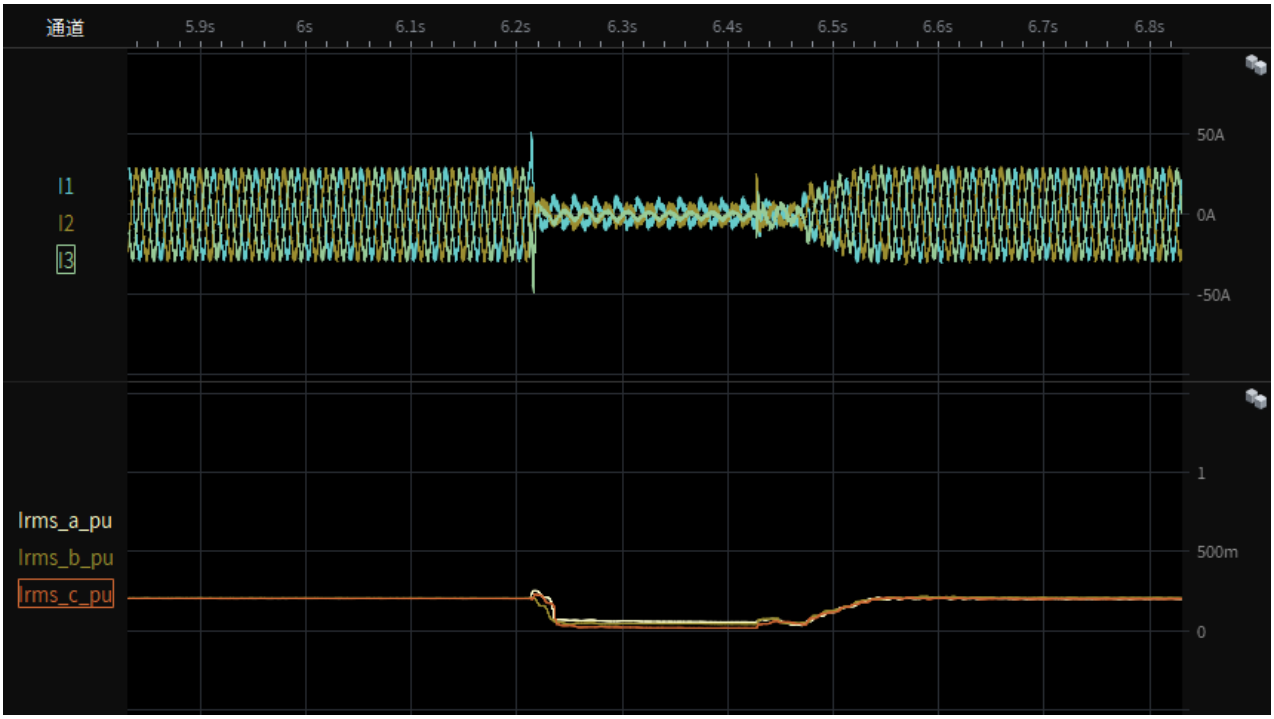


Test 1a-1.2 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

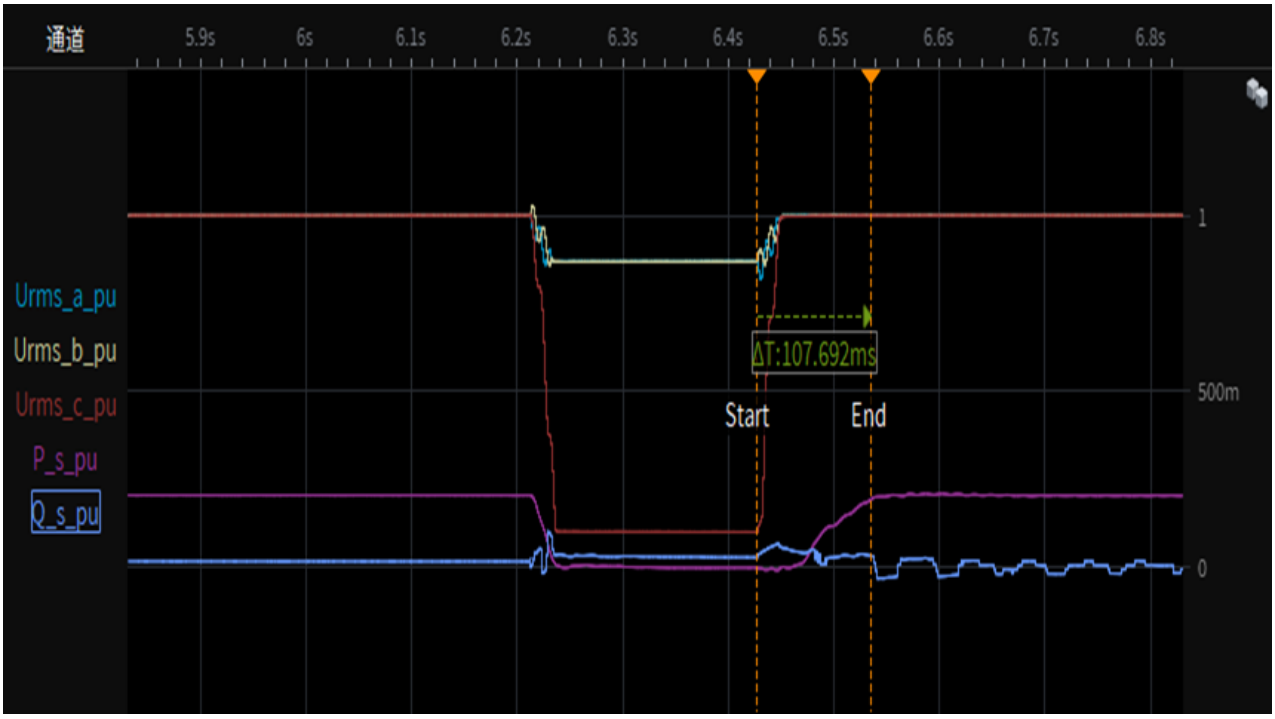


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

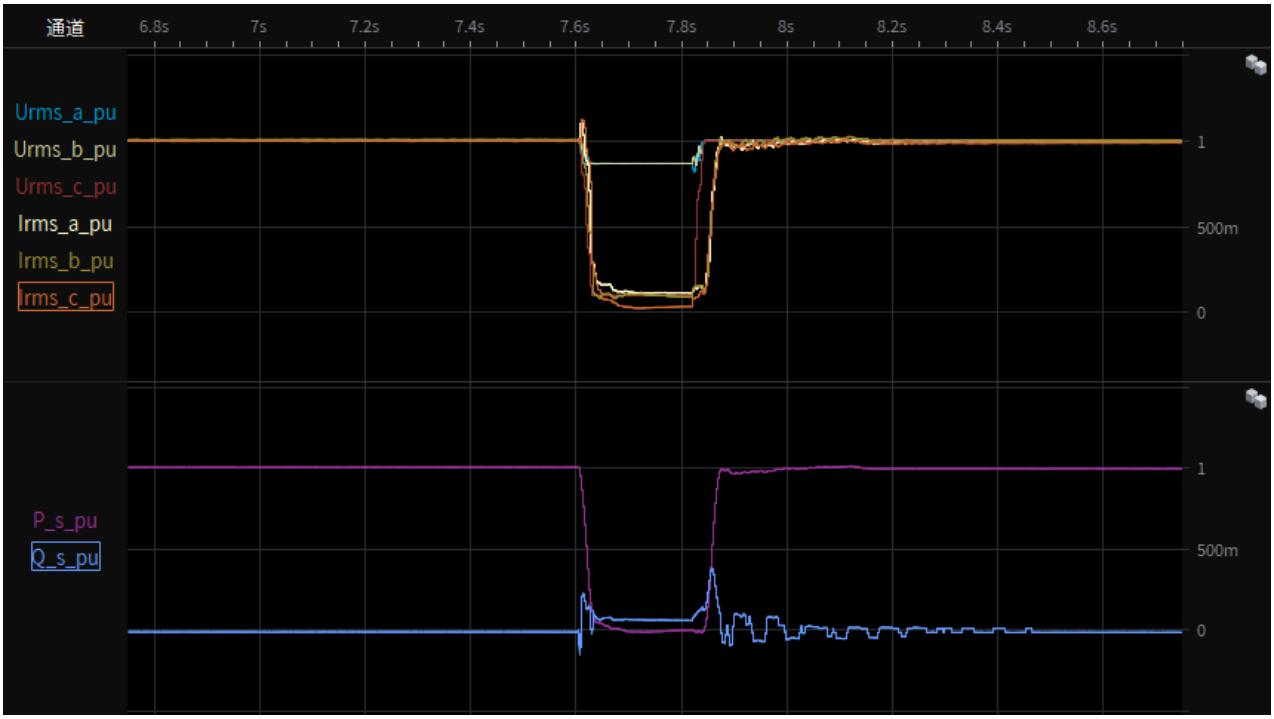


Test 1a-1.4 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),20% load
restoring time

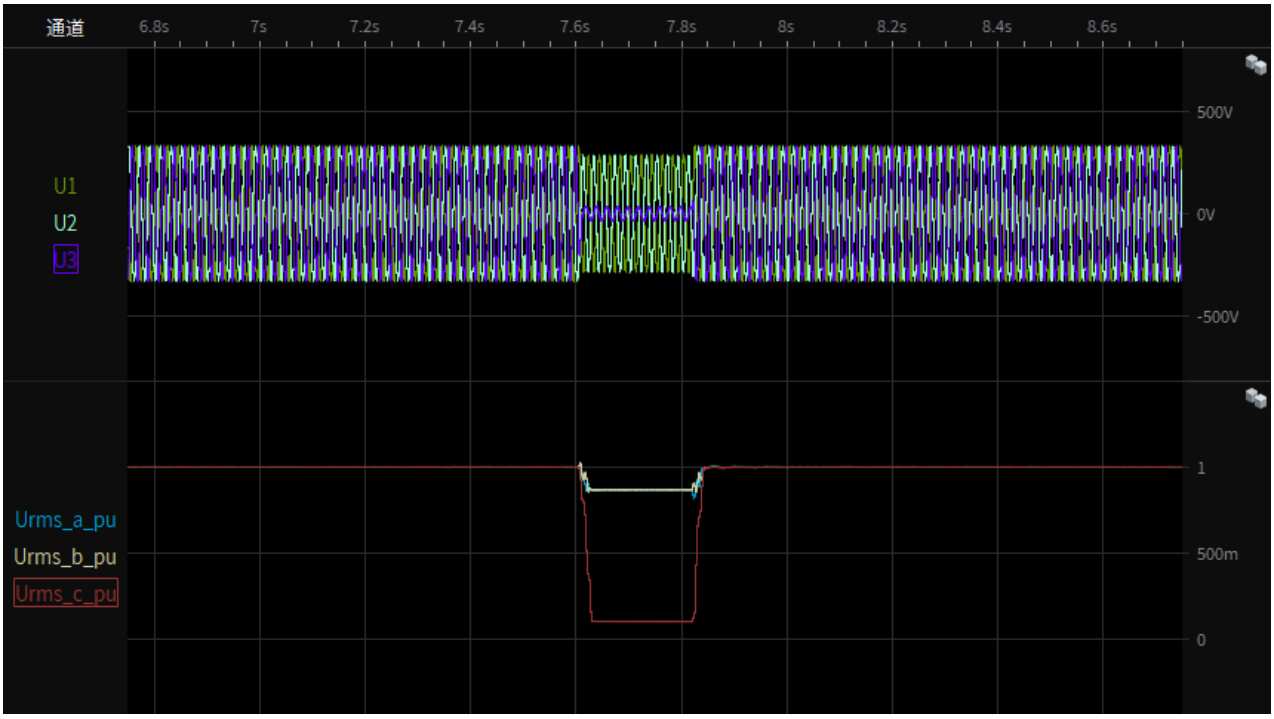


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

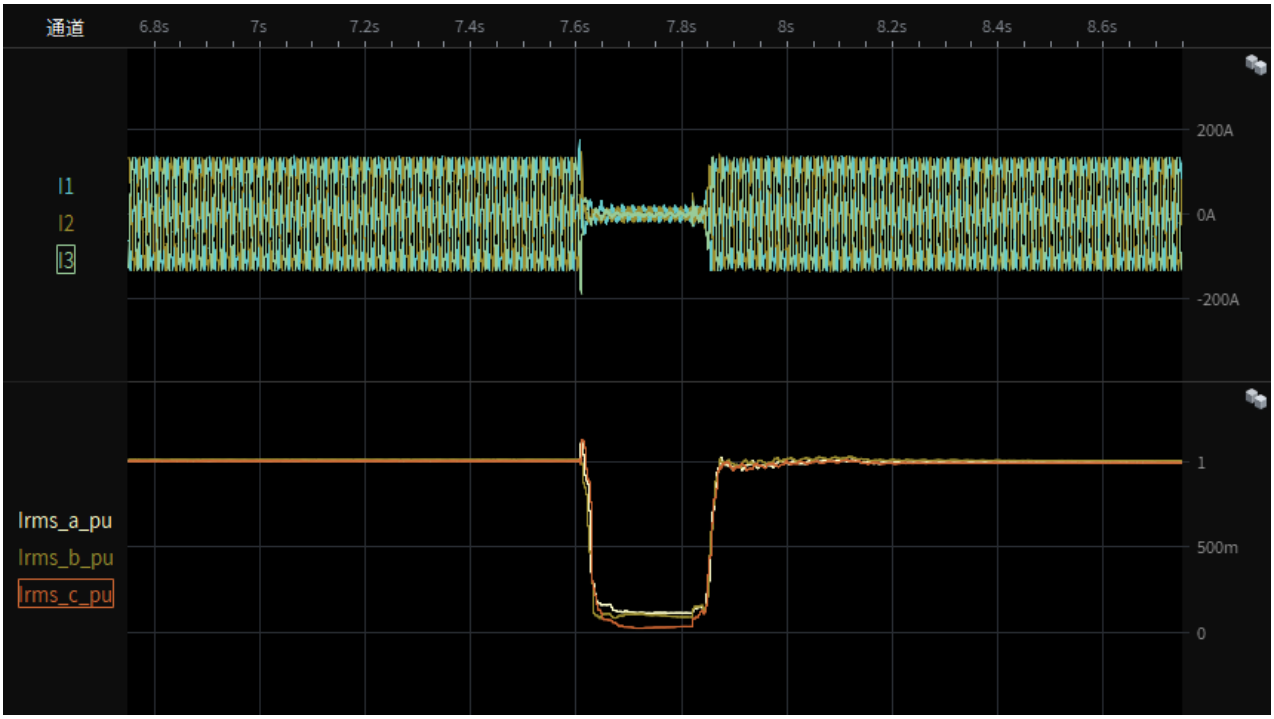


Test 1a-2.2 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages



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

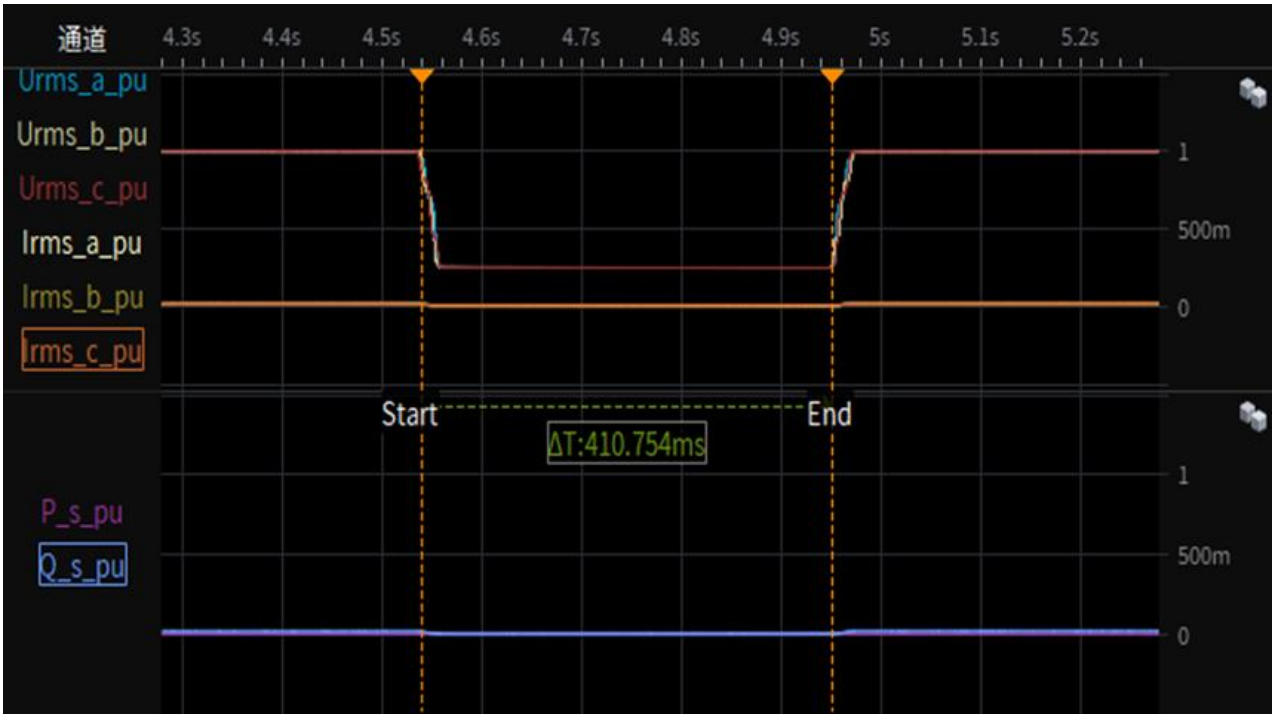


Test 1a-2.4 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D), 95% load
restoring time

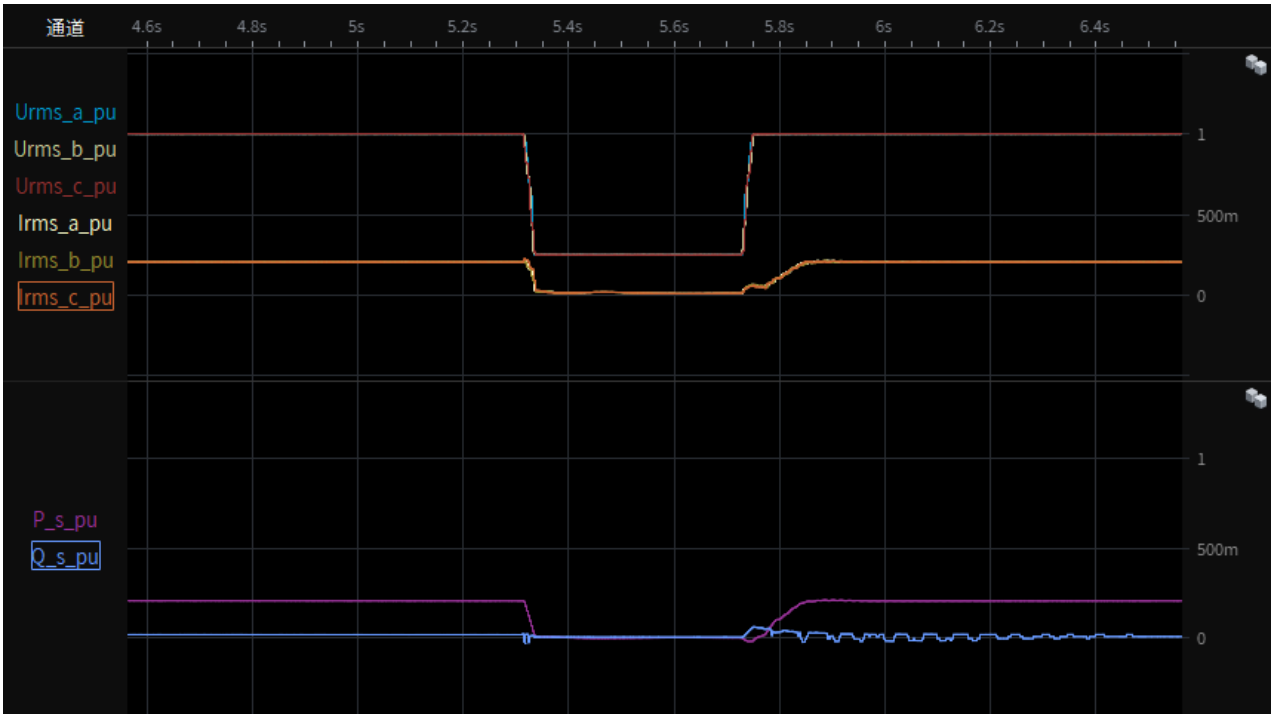


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

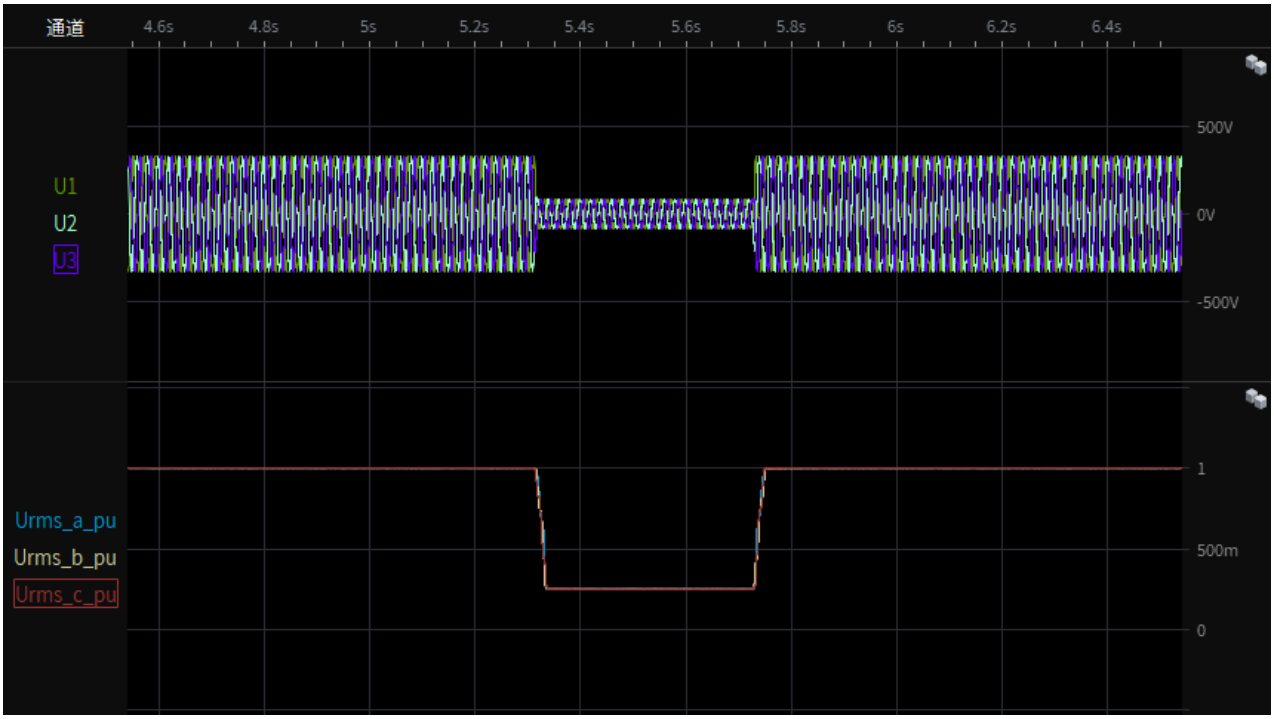


Test 2s-1.1 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

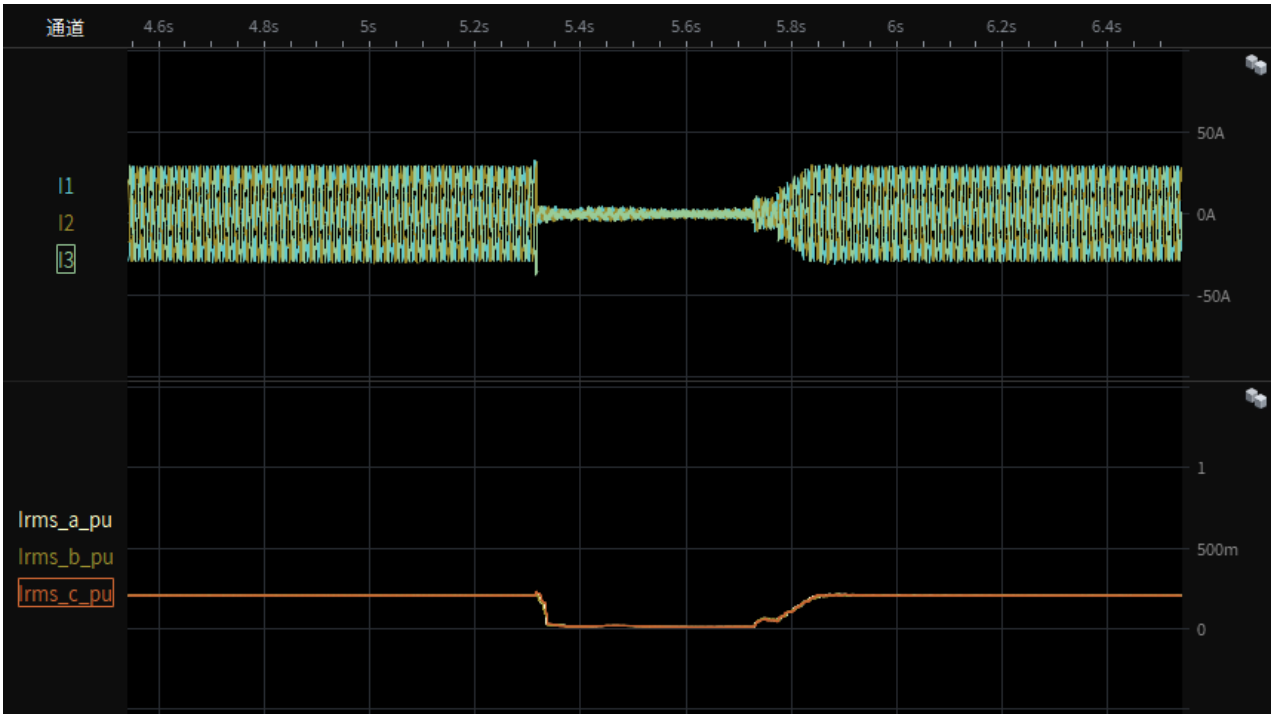


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

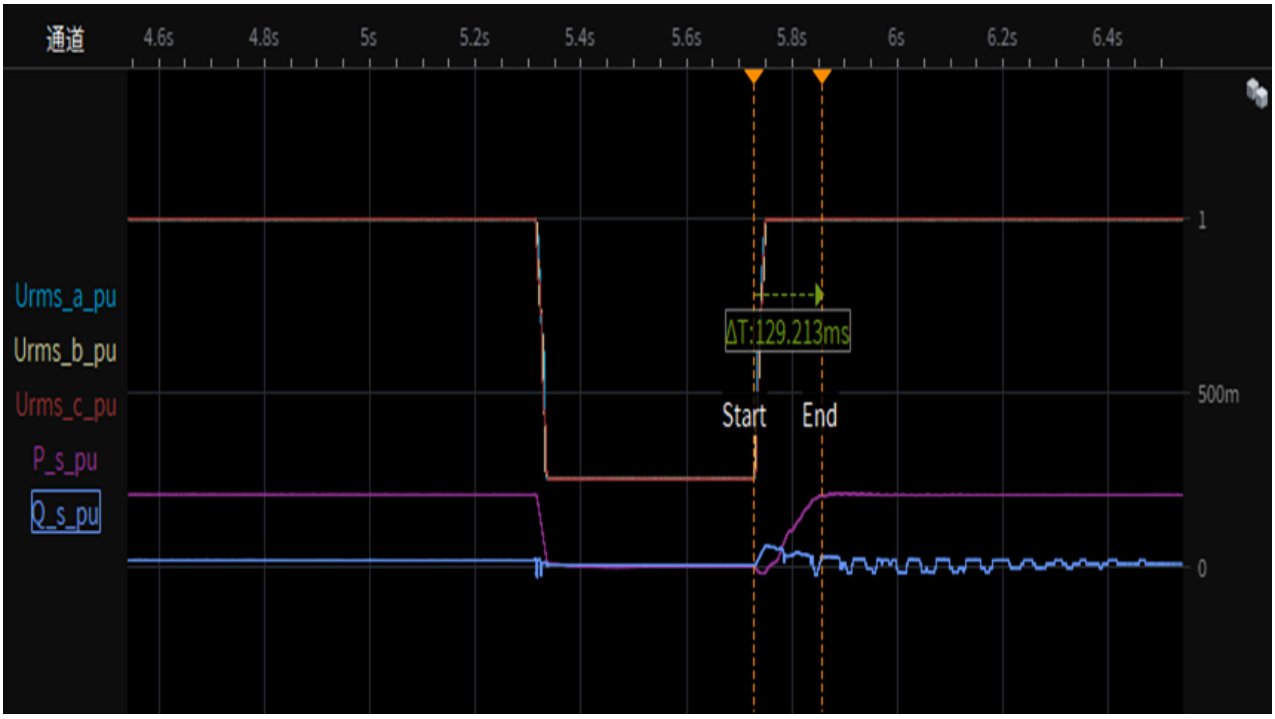


Test 2s-1.3 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

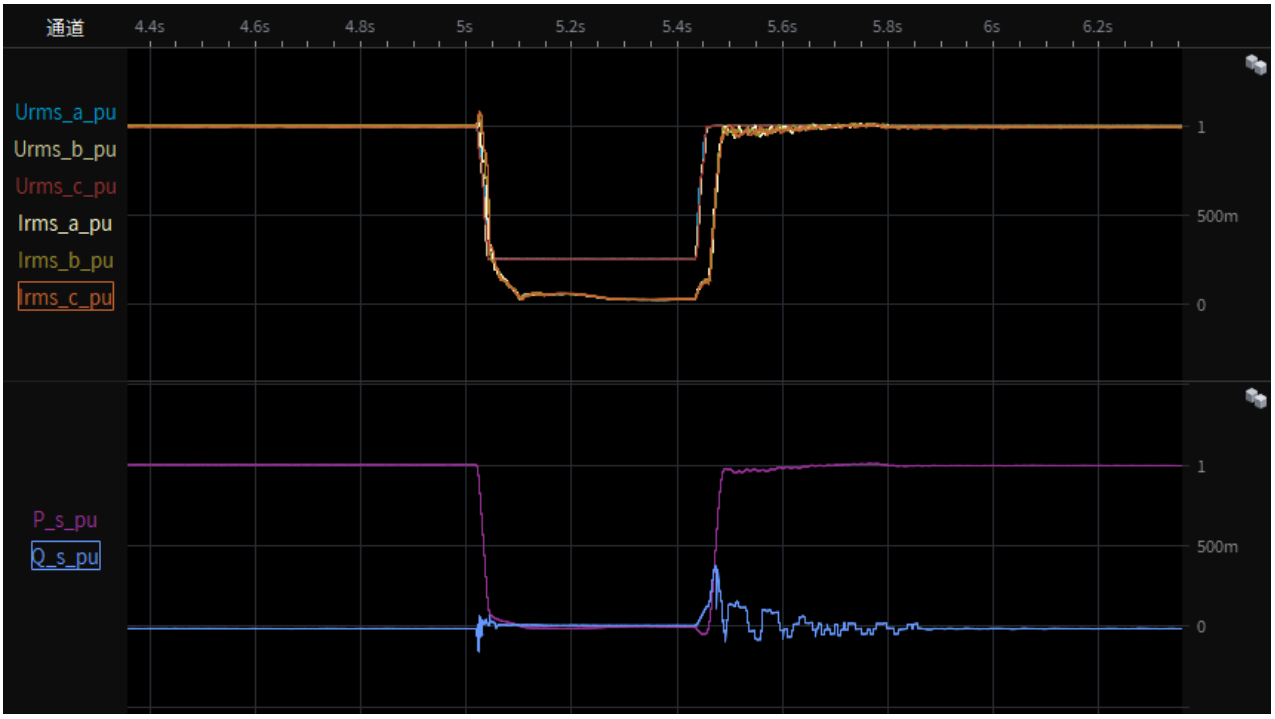


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

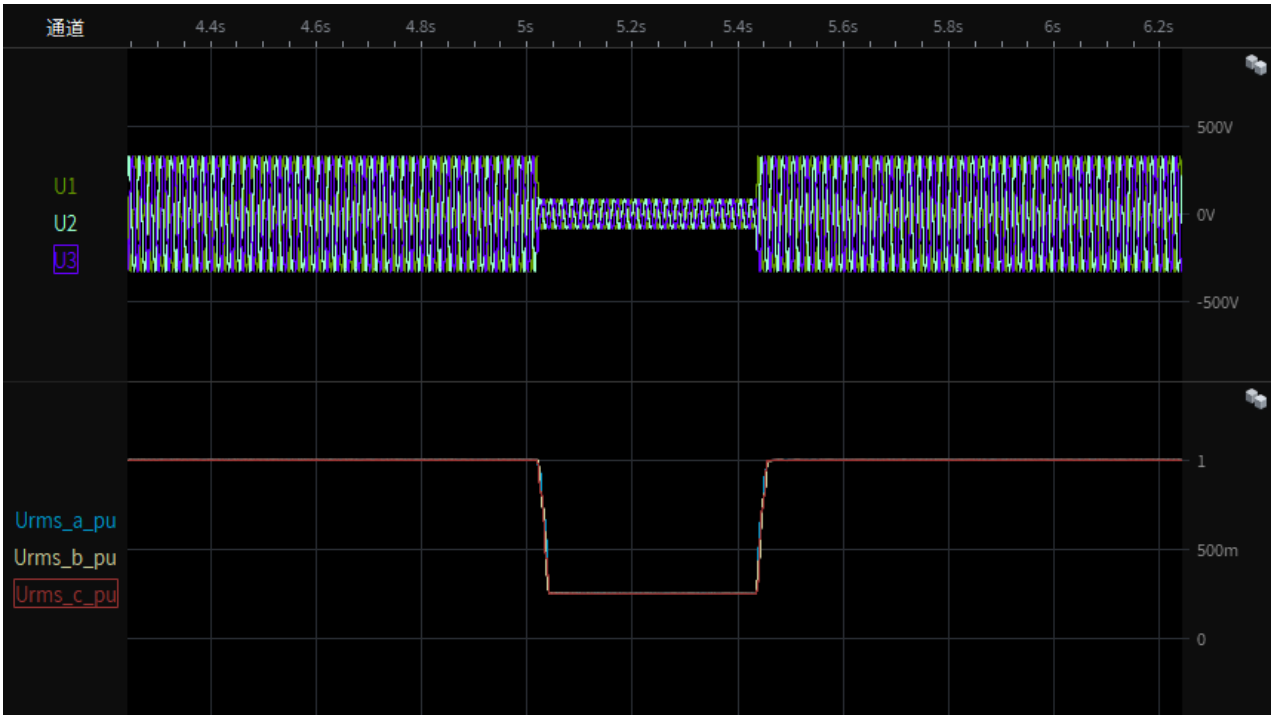


Test 2s-2.1 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

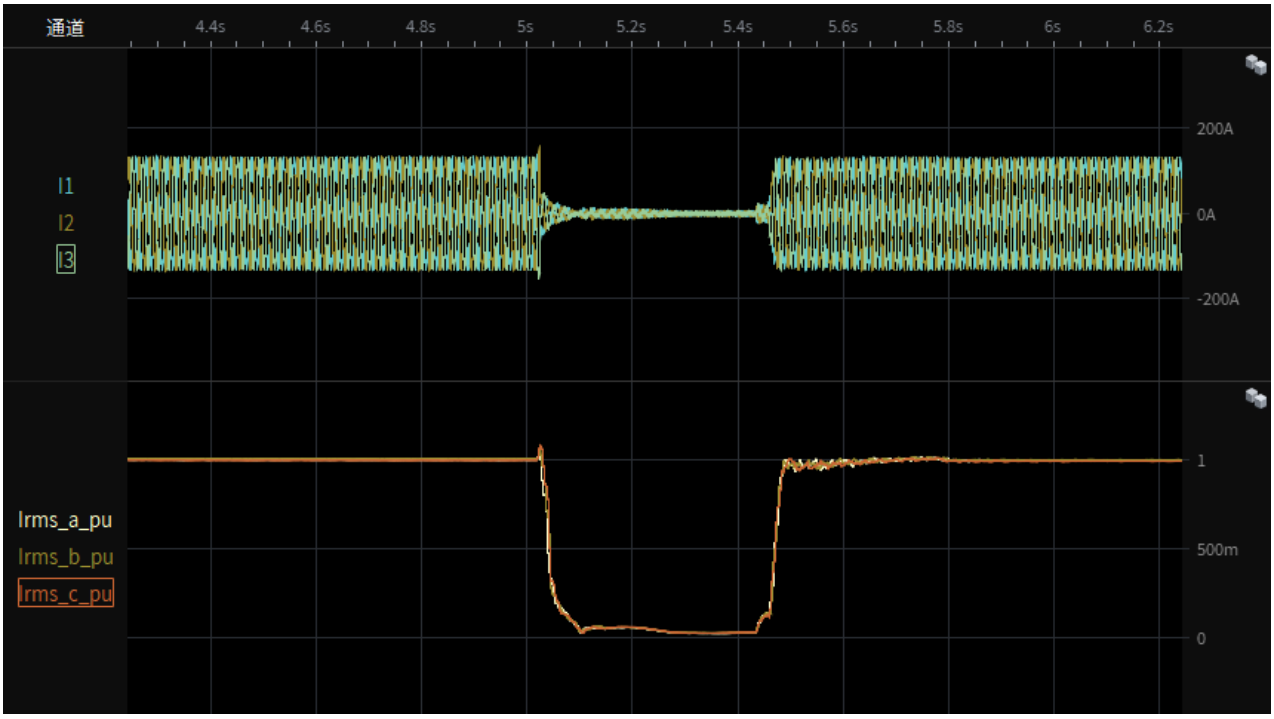


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

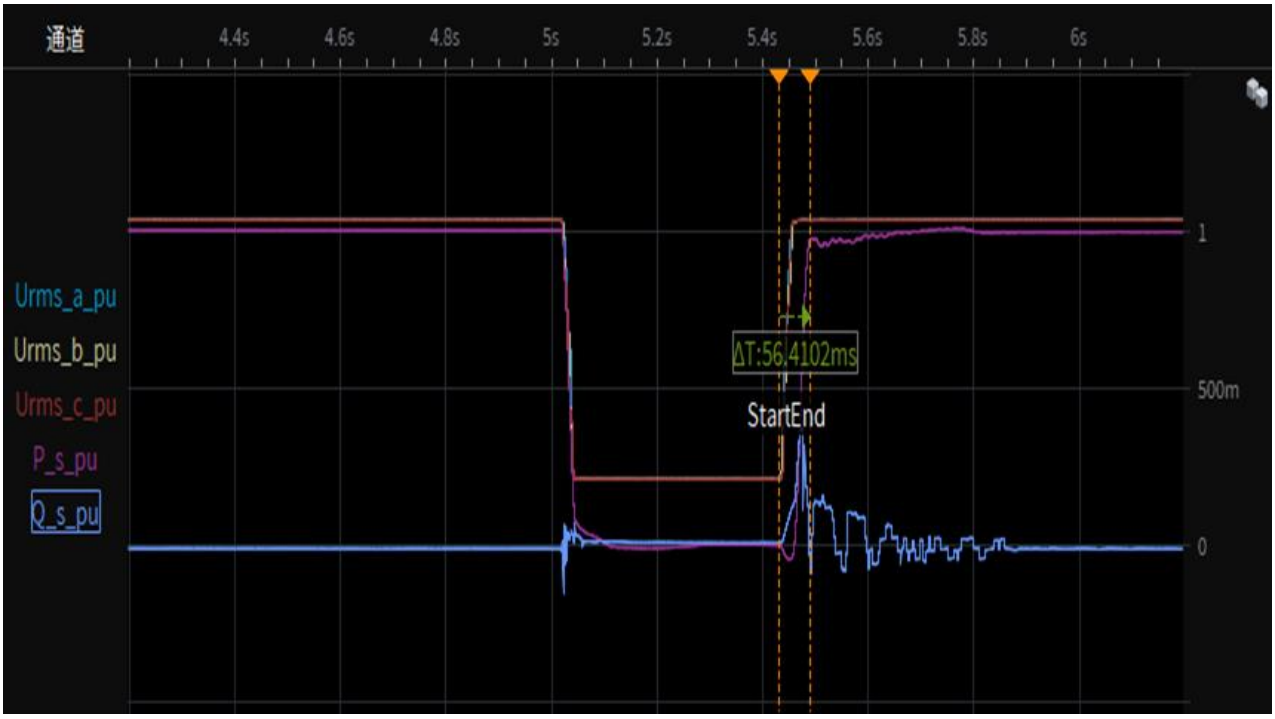


Test 2s-2.3 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

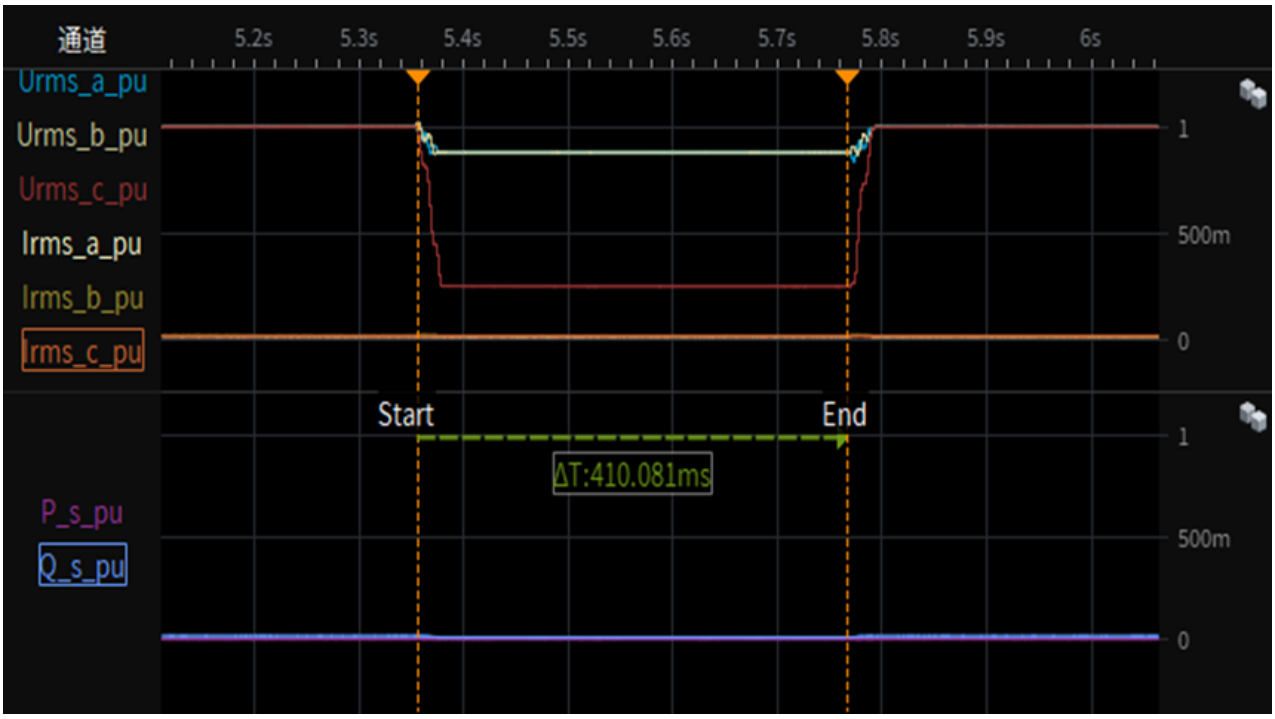


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

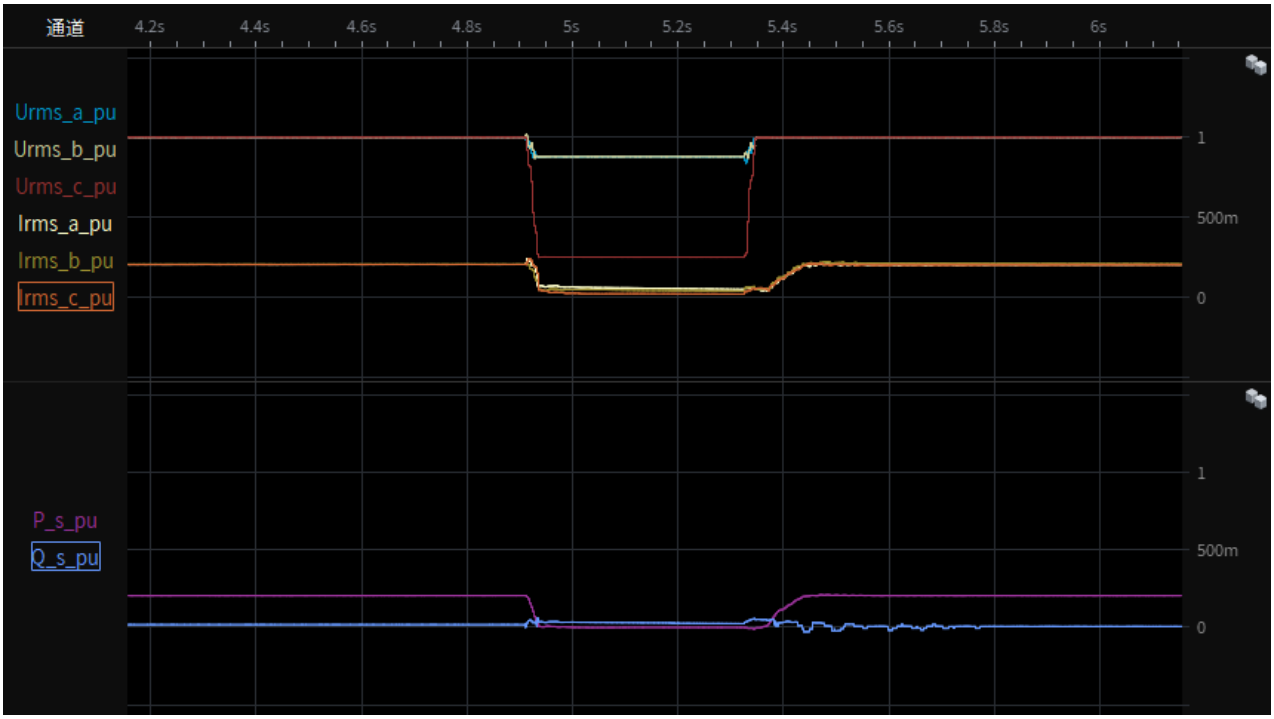


Test 2a-Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

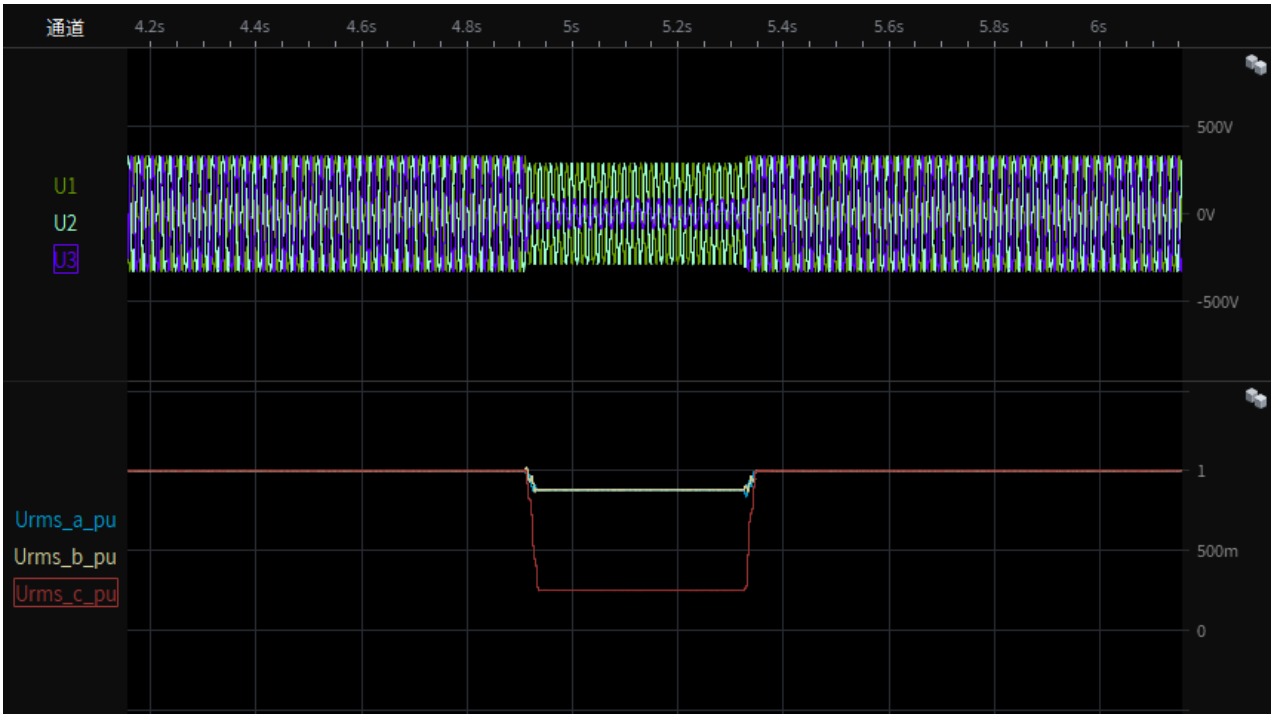


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

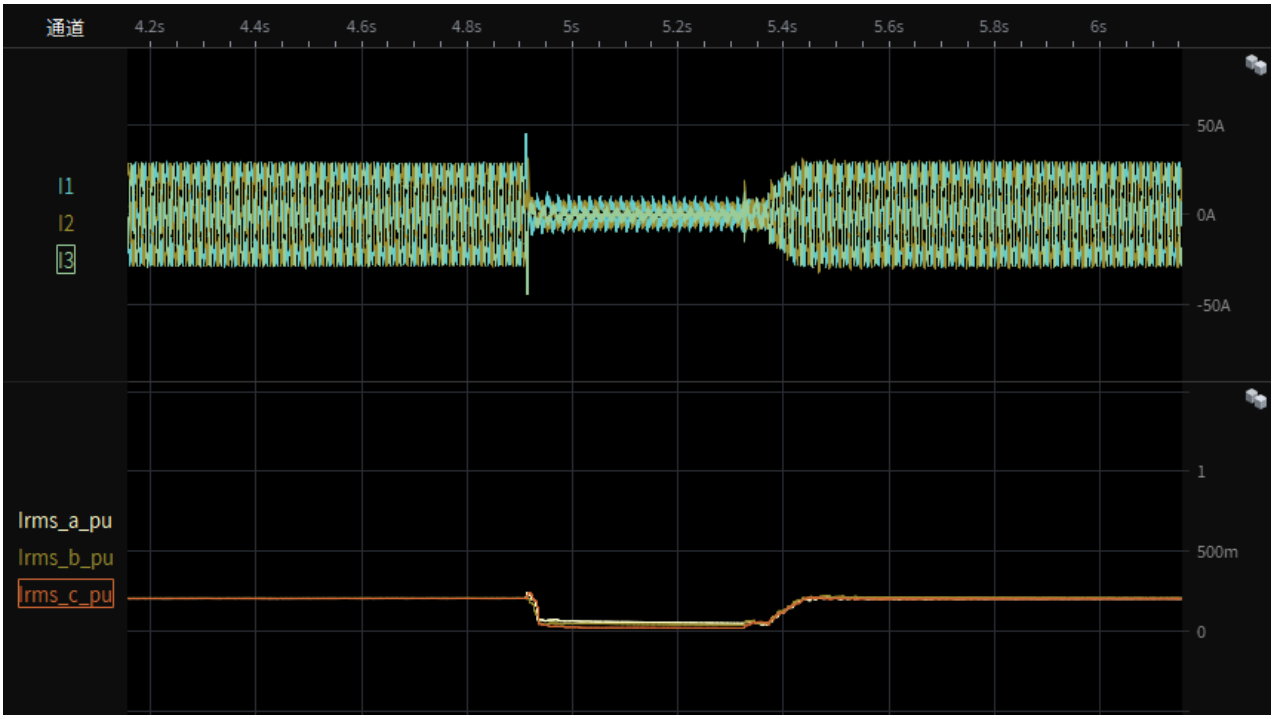


Test 2a-1.2 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

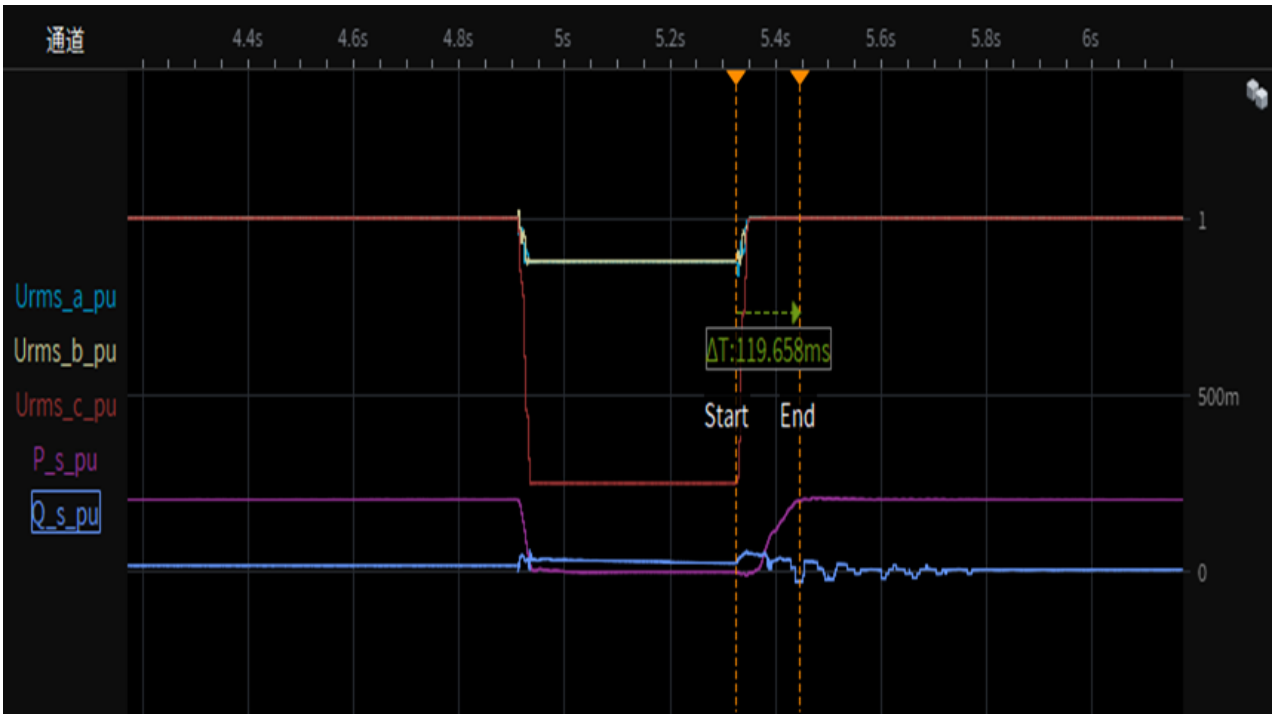


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

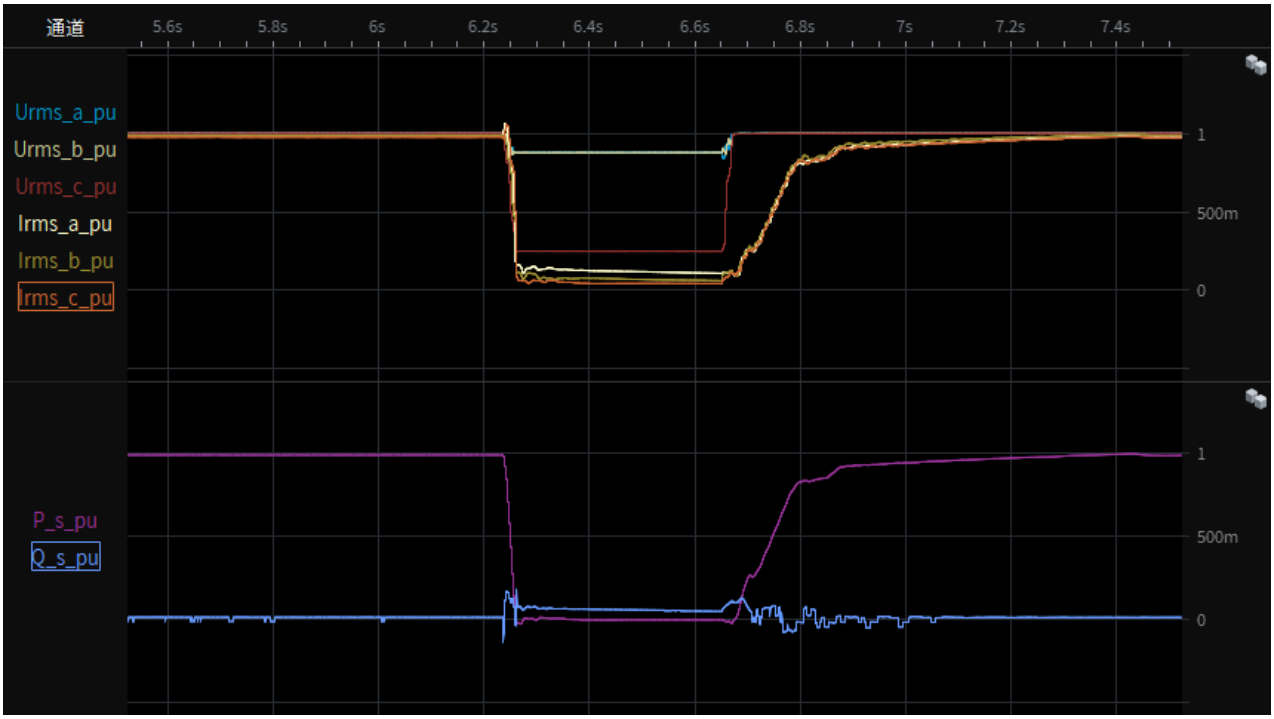


Test 2a-1.4 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),20% load
restoring time

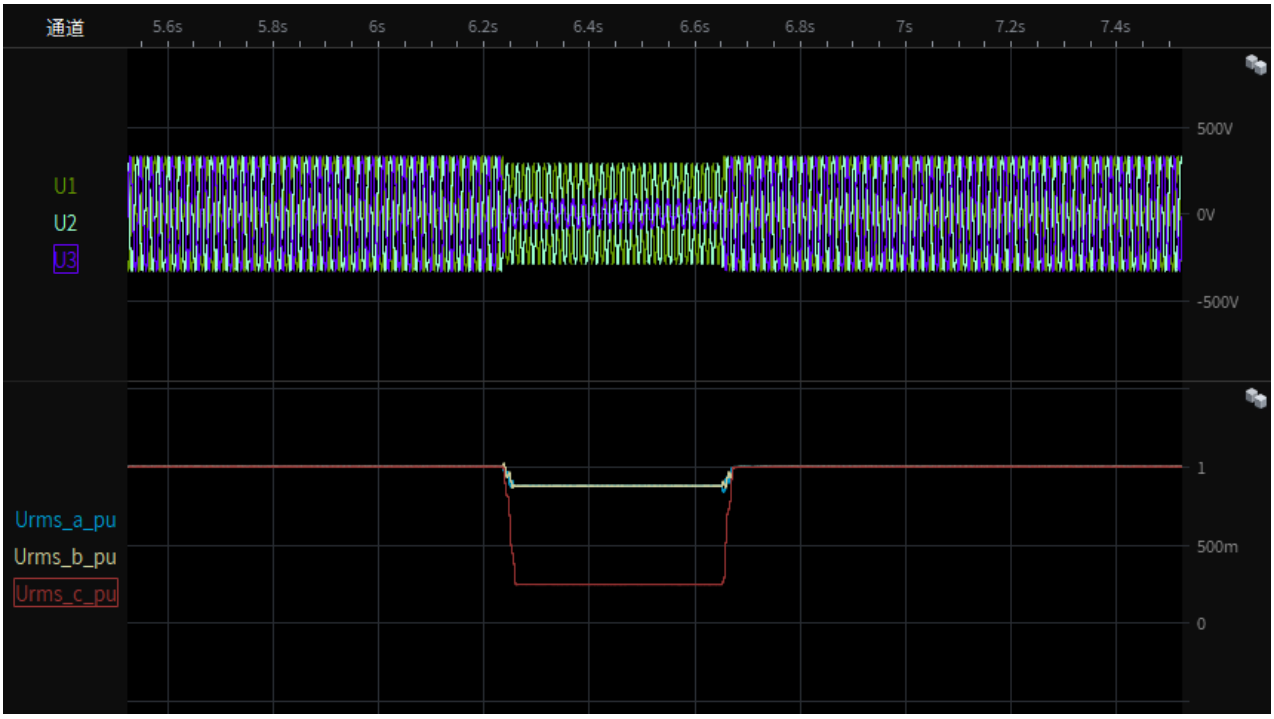


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

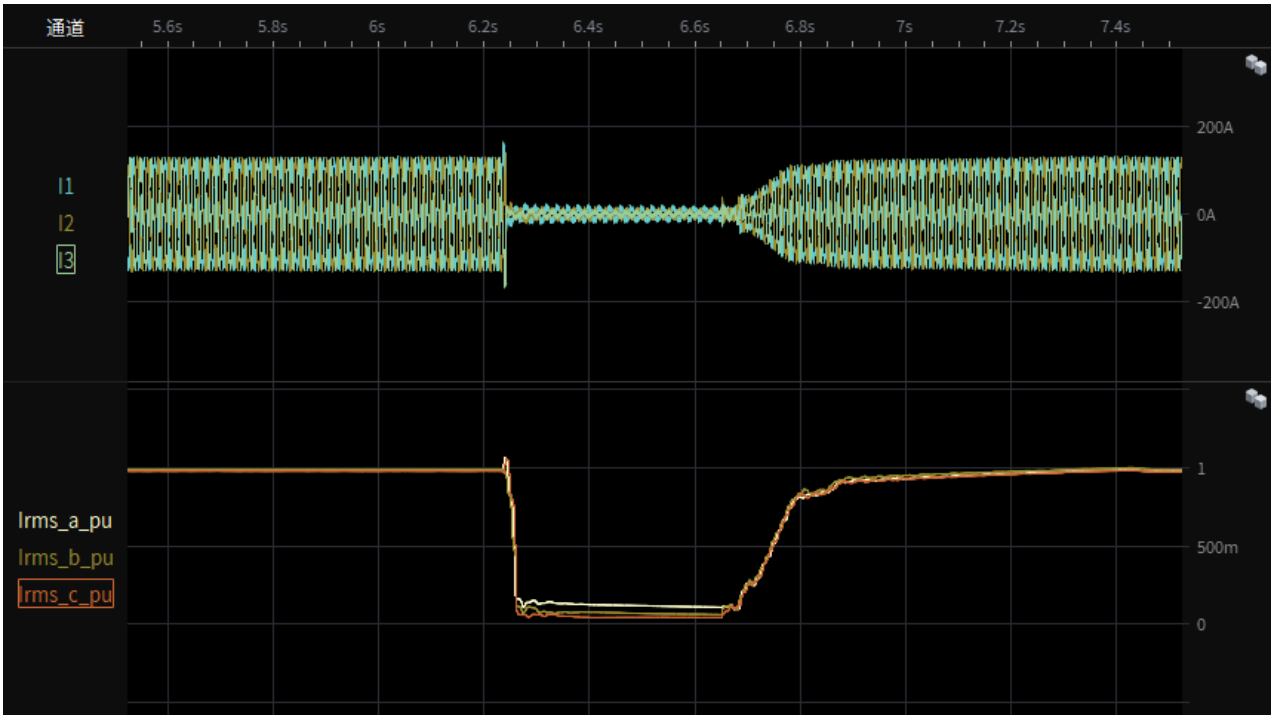


Test 2a-2.2 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages



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

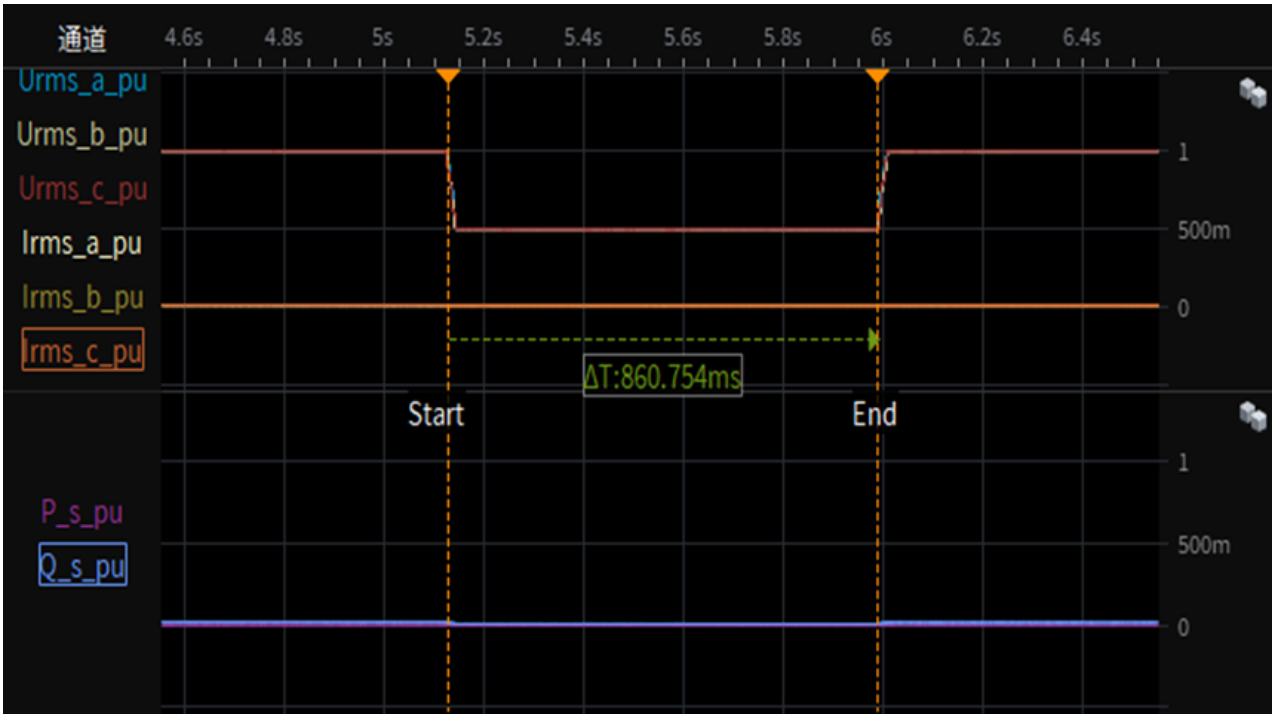


Test 2a-2.4 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

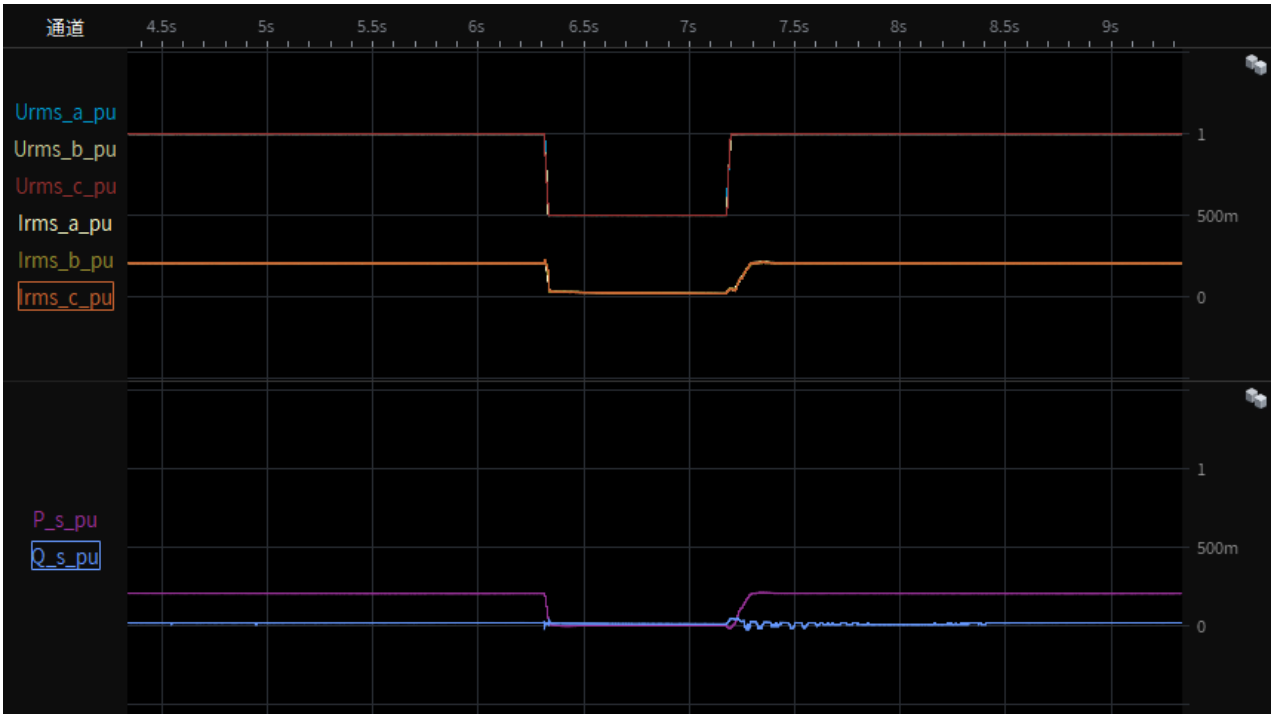


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

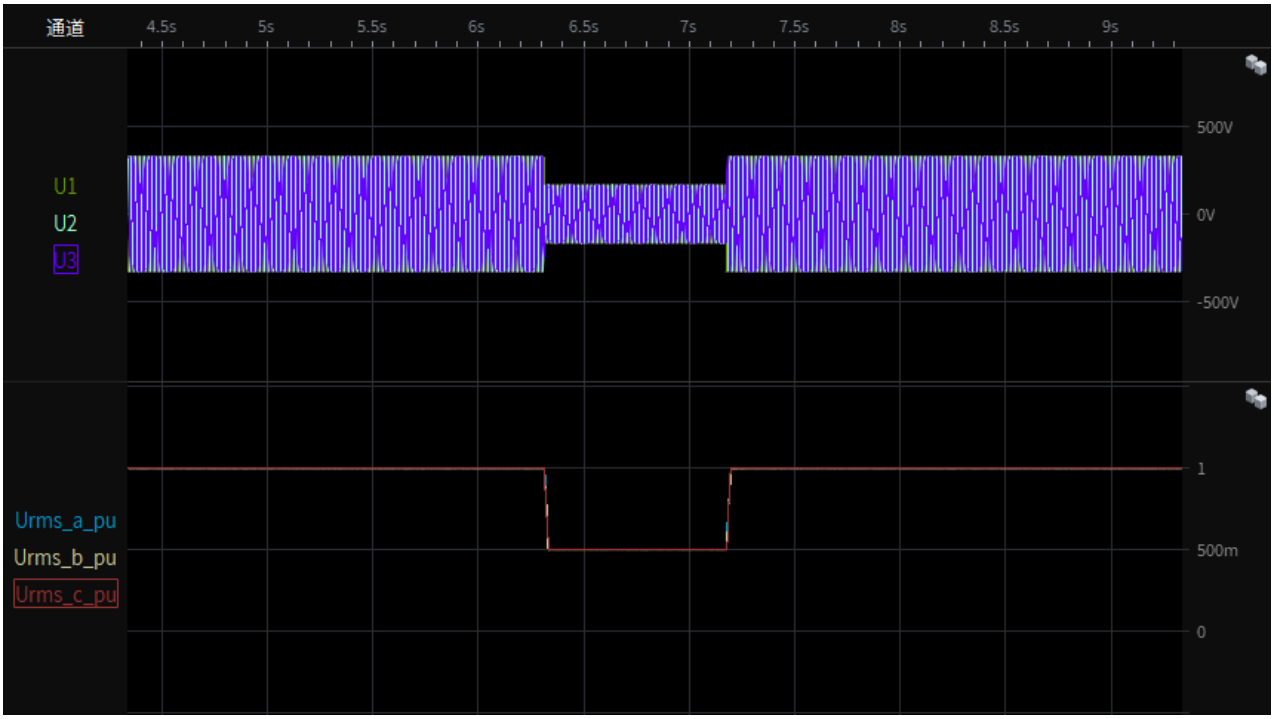


Test 3s-1.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

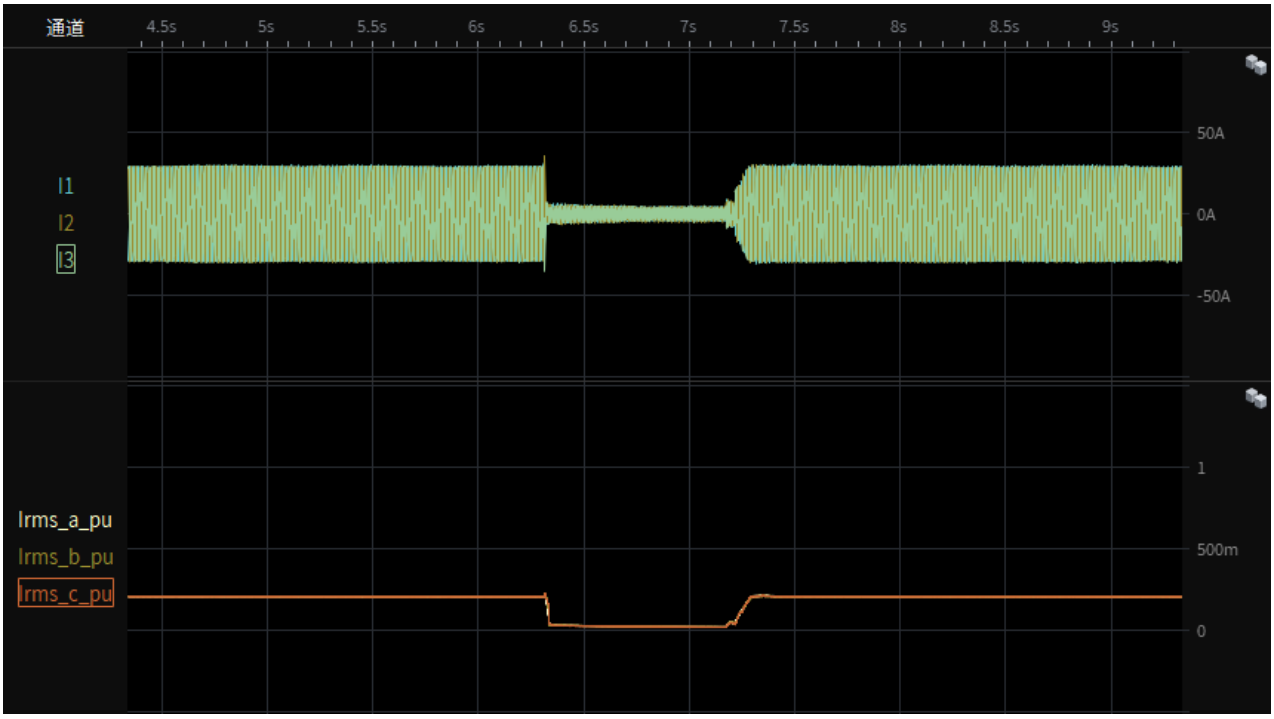


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

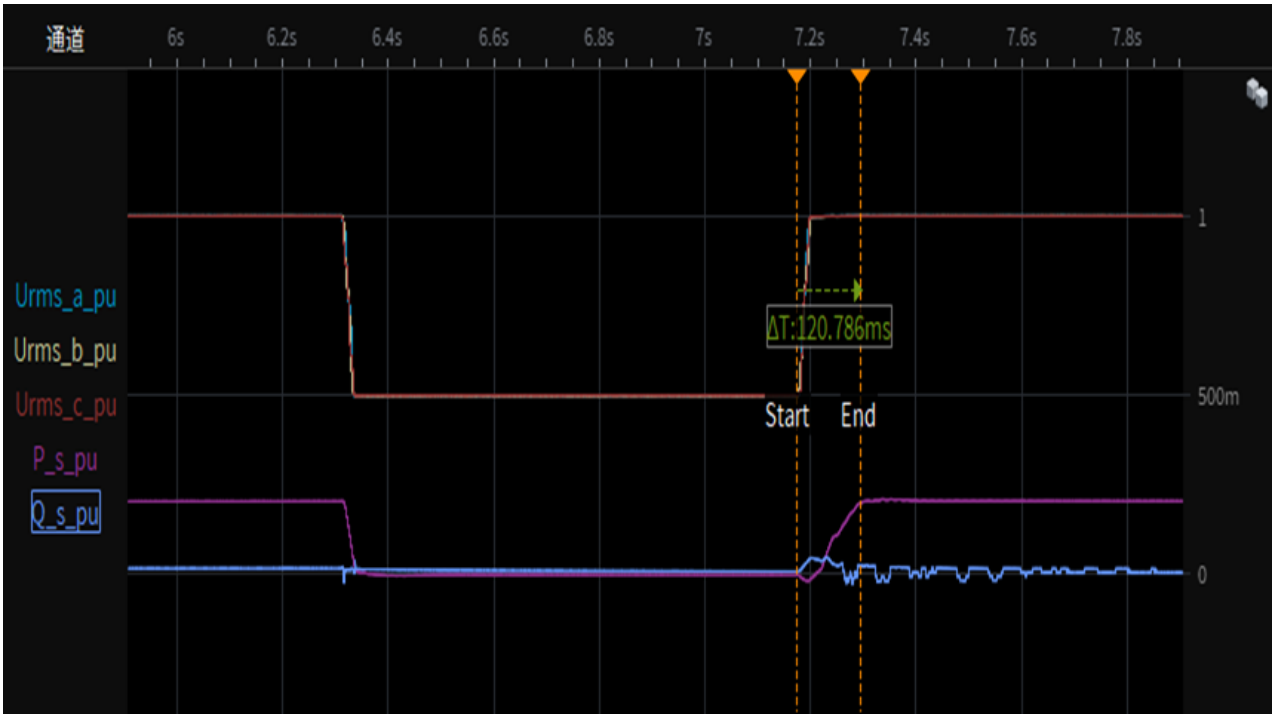


Test 3s-1.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

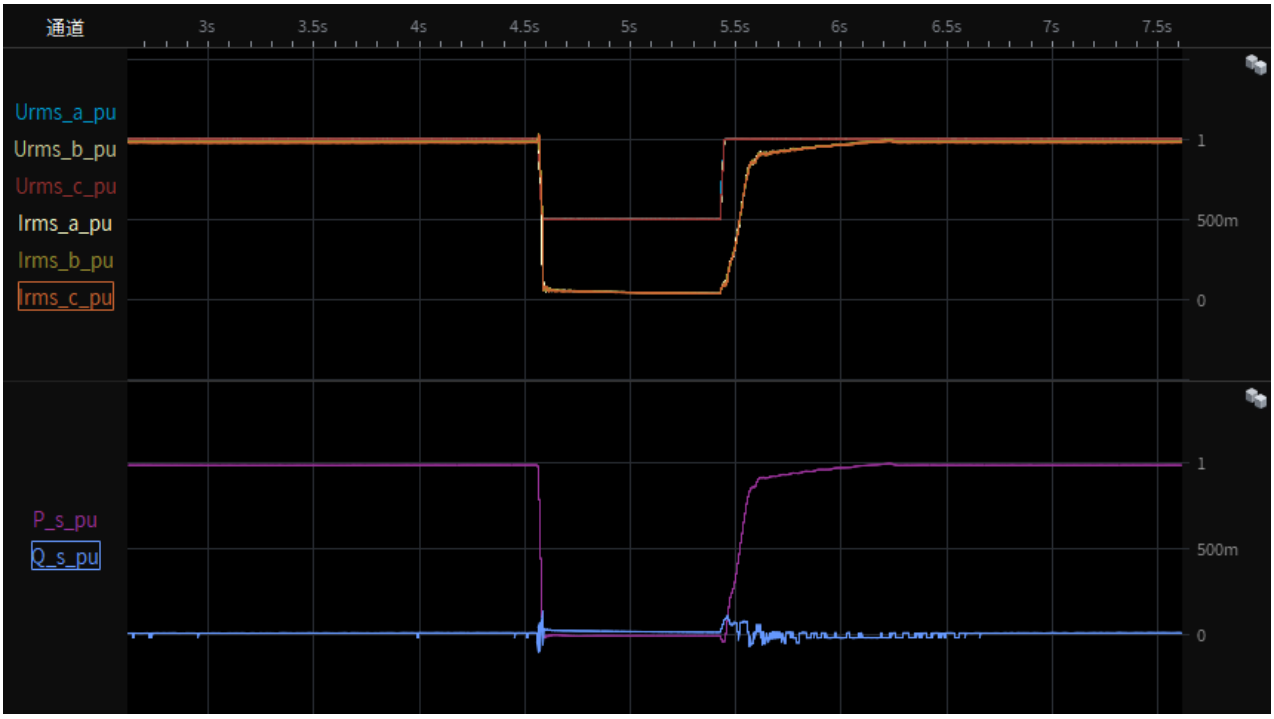


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

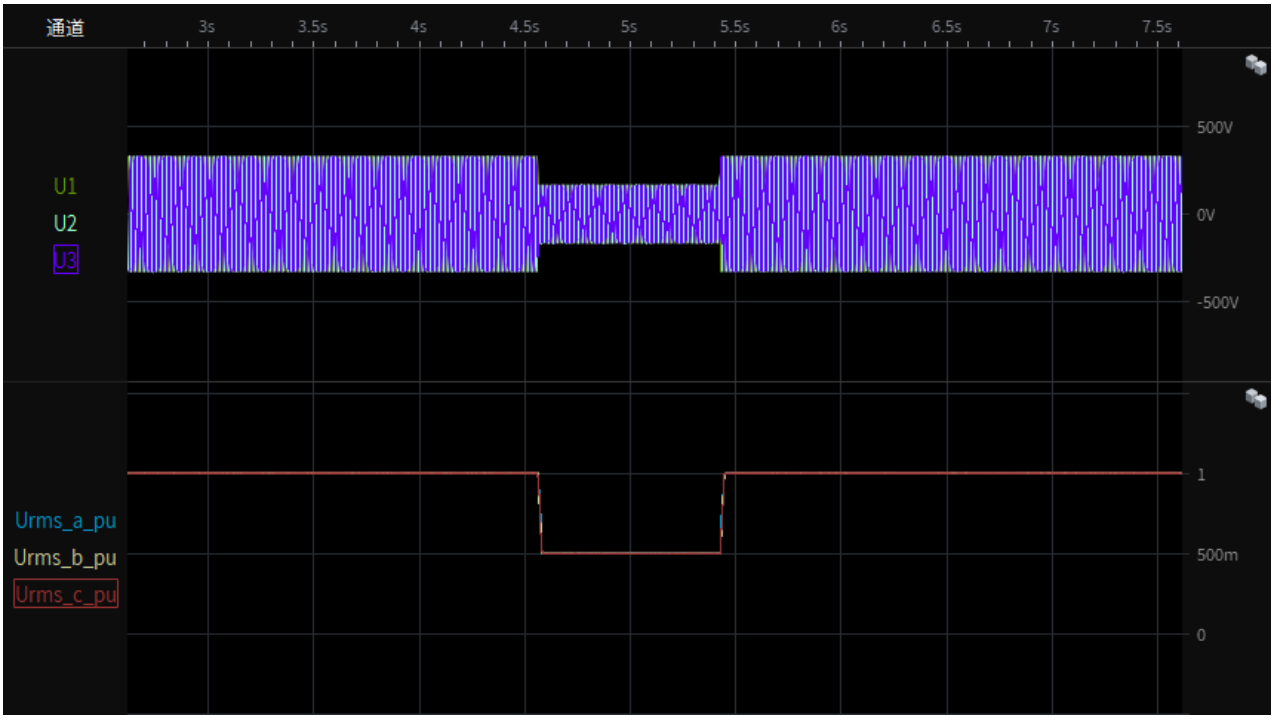


Test 3s-2.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

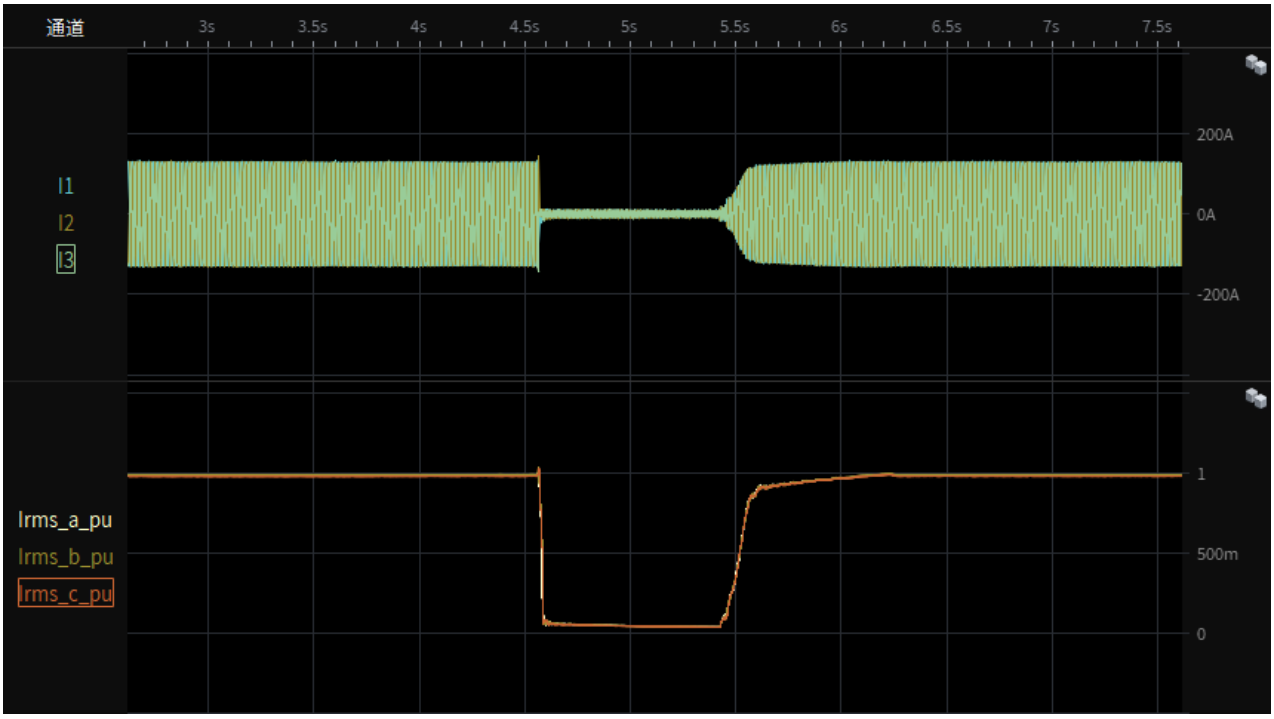


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

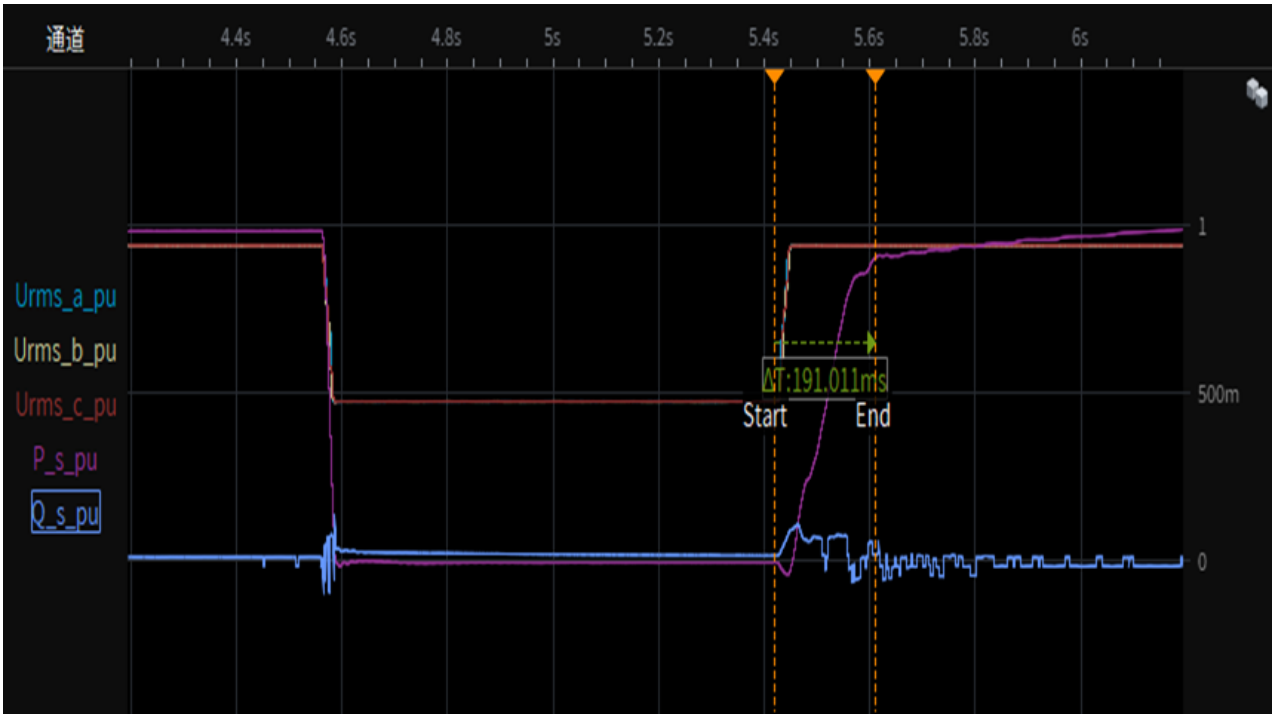


Test 3s-2.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

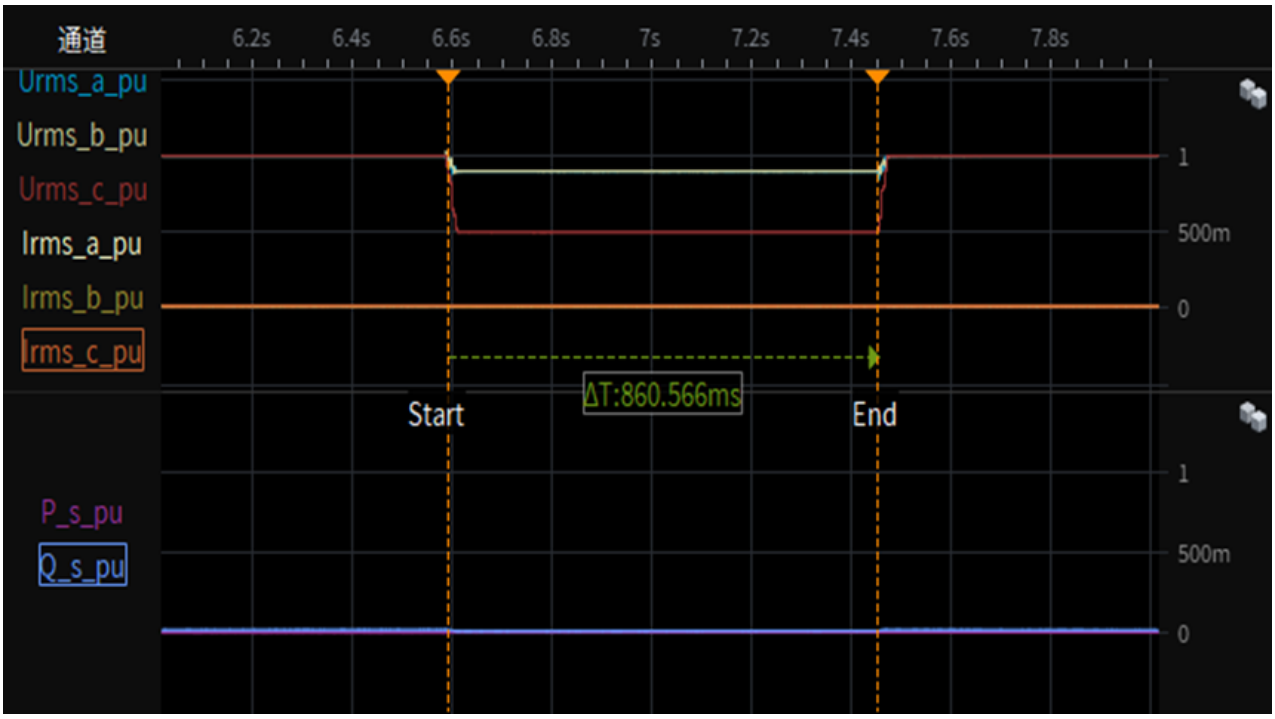


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

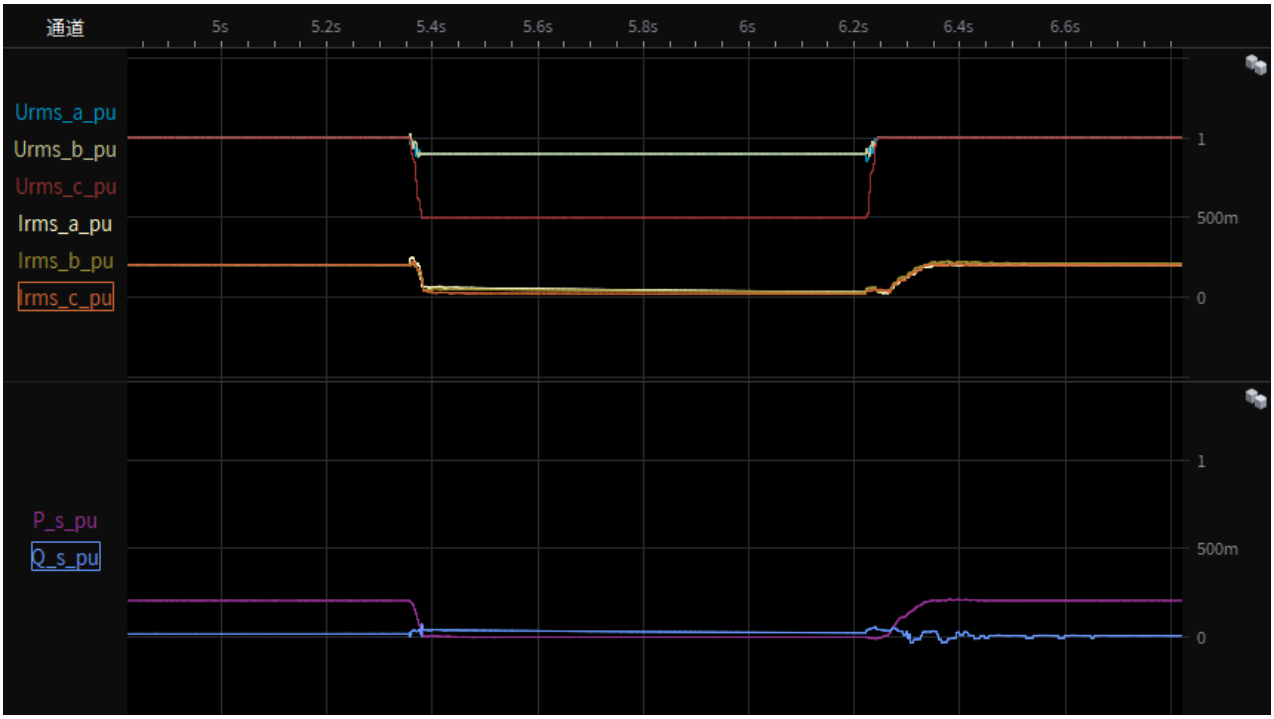


Test 3a-Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

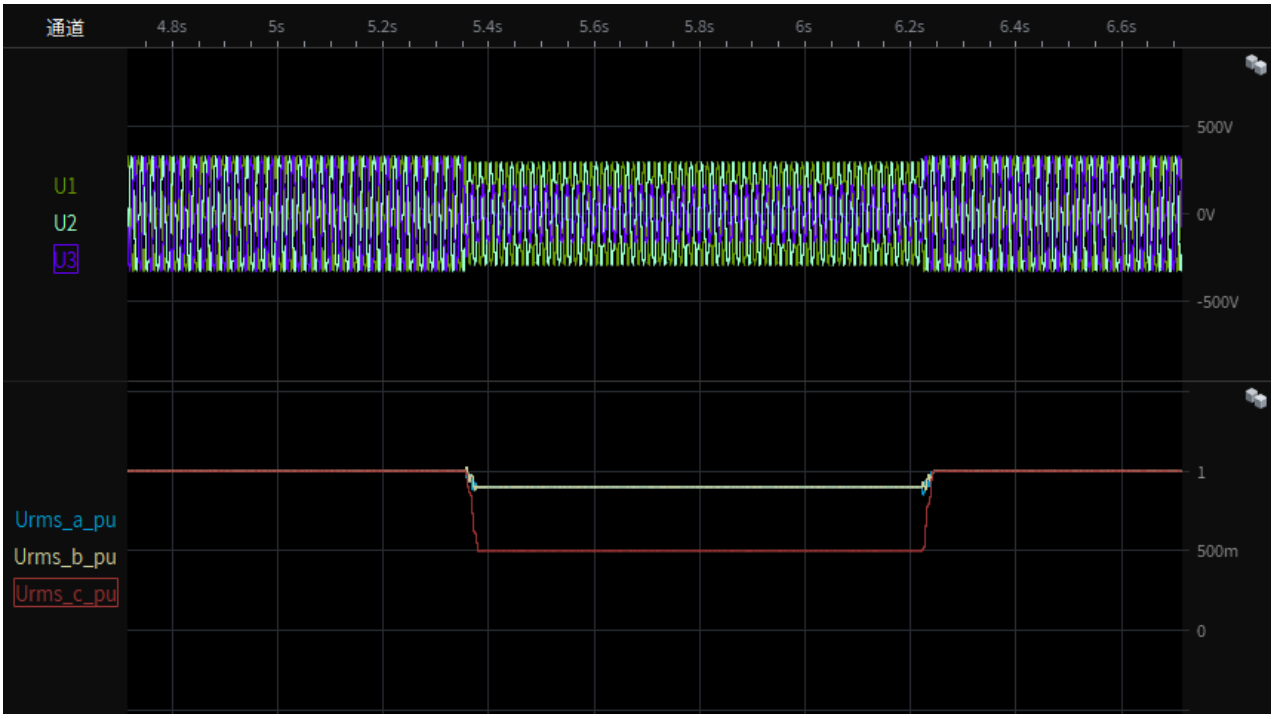


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

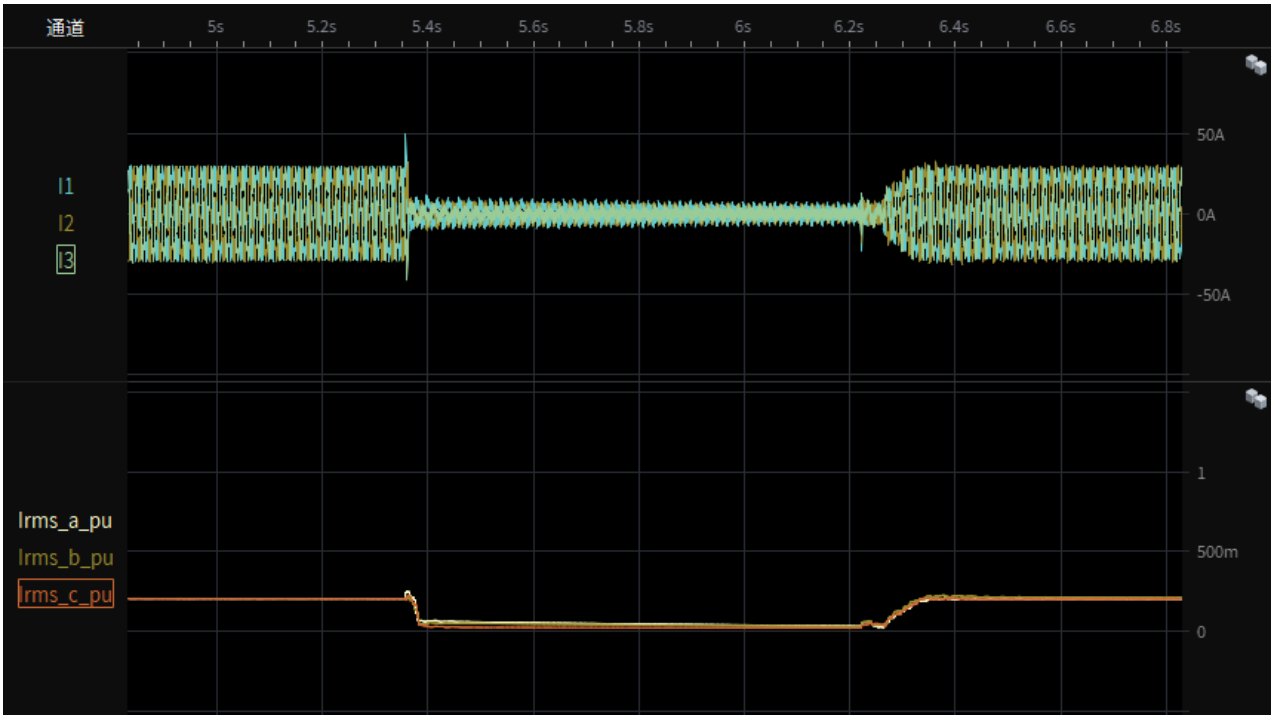


Test 3a-1.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

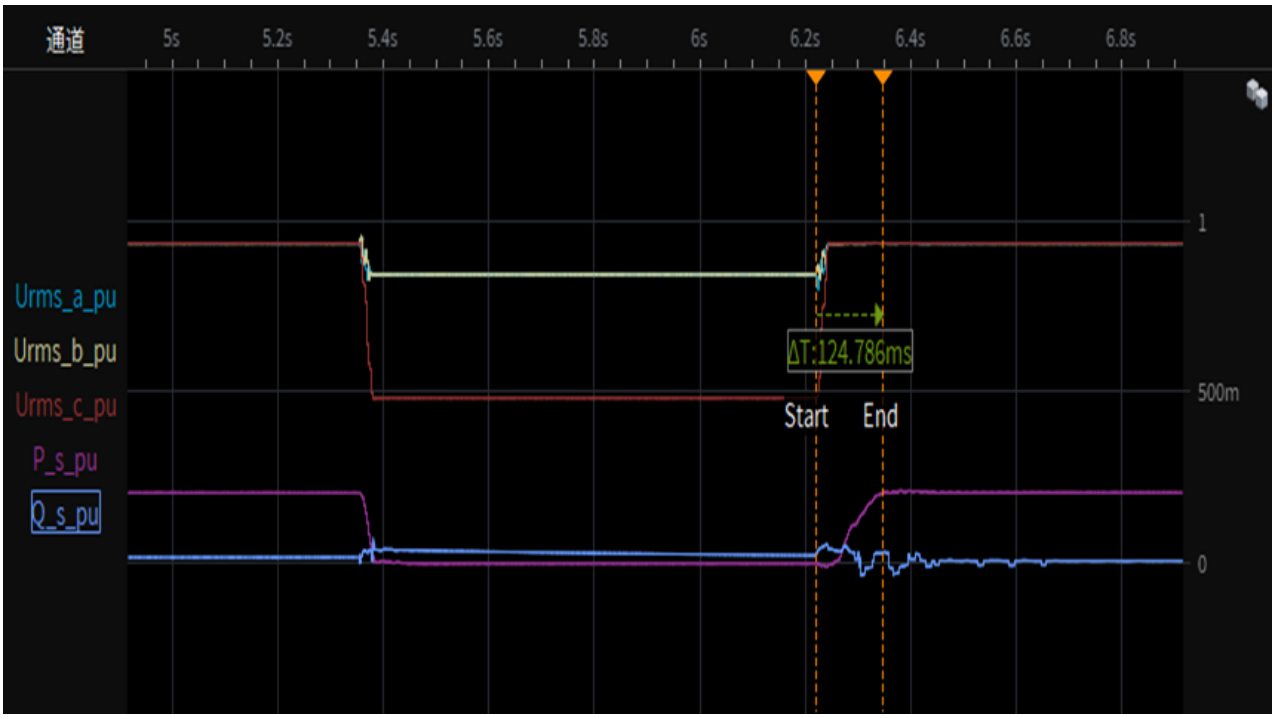


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

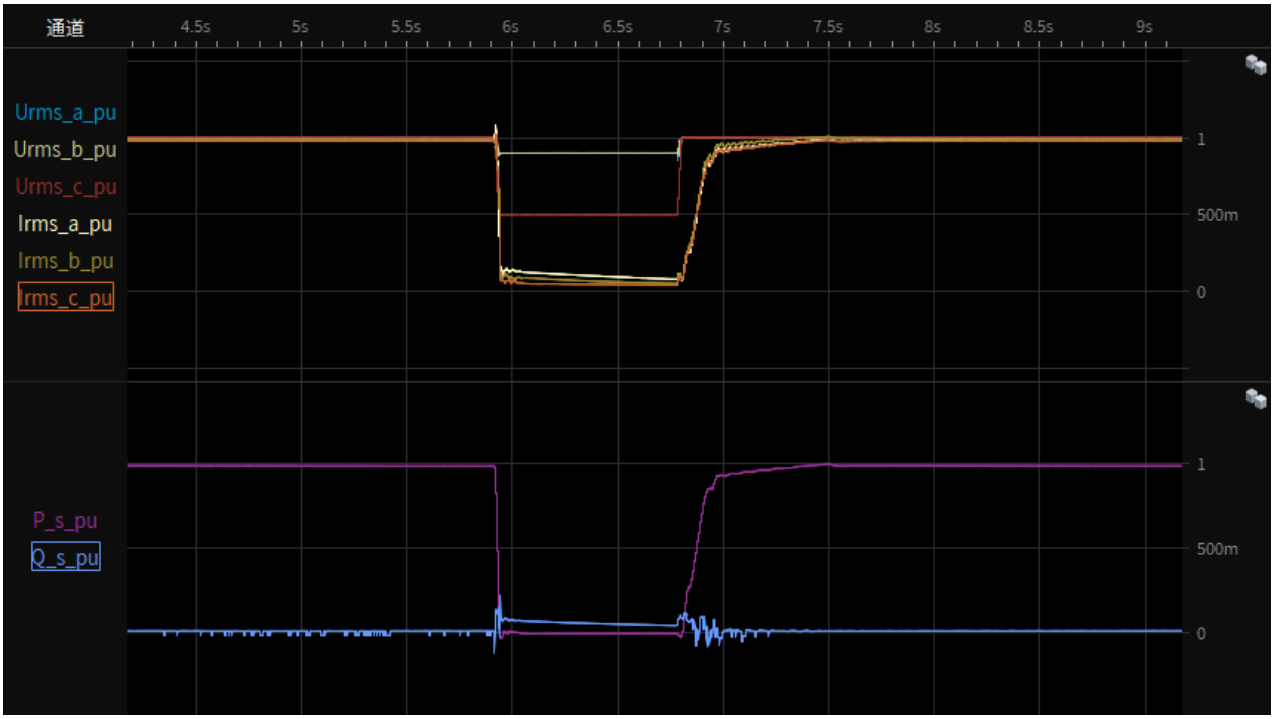


Test 3a-1.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
restoring time

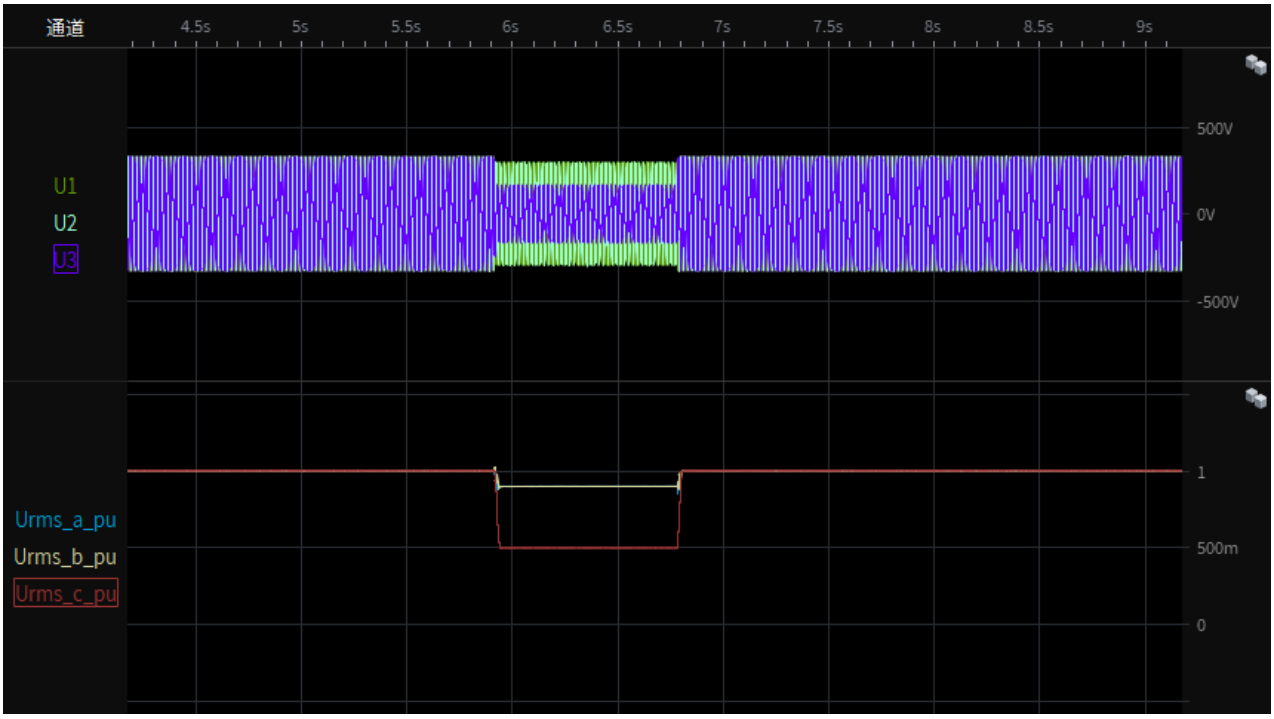


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

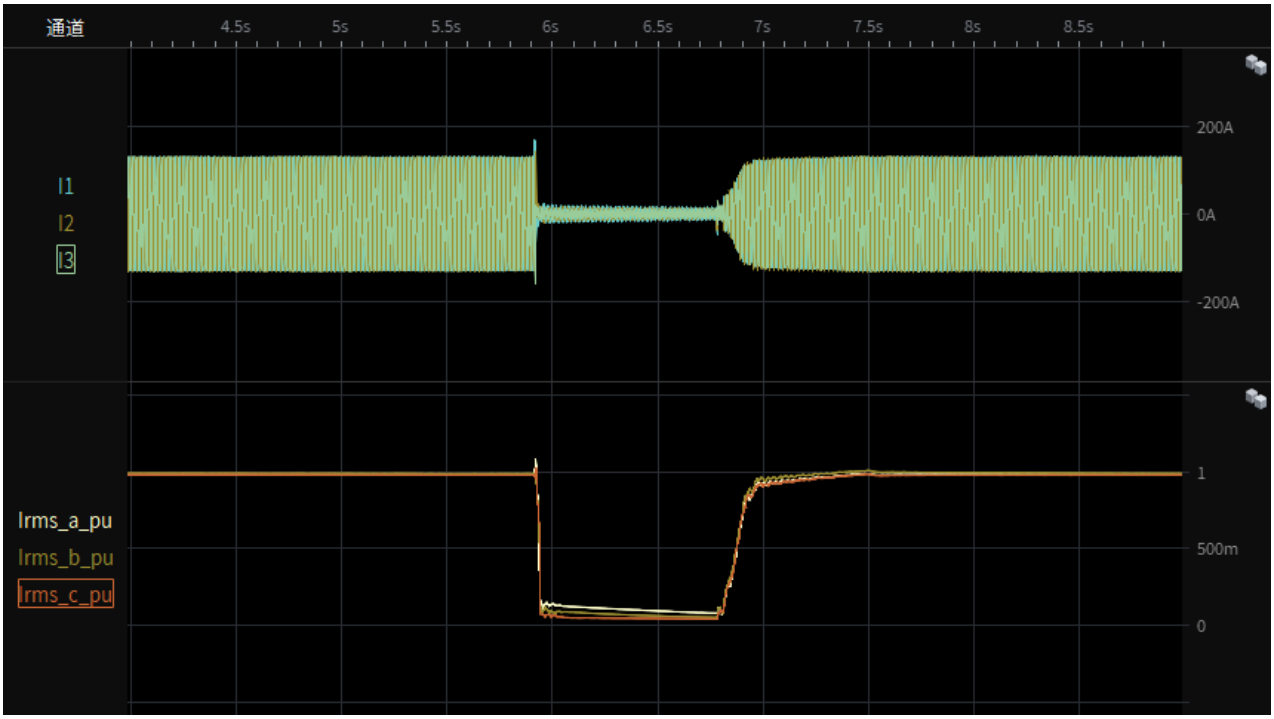


Test 3a-2.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

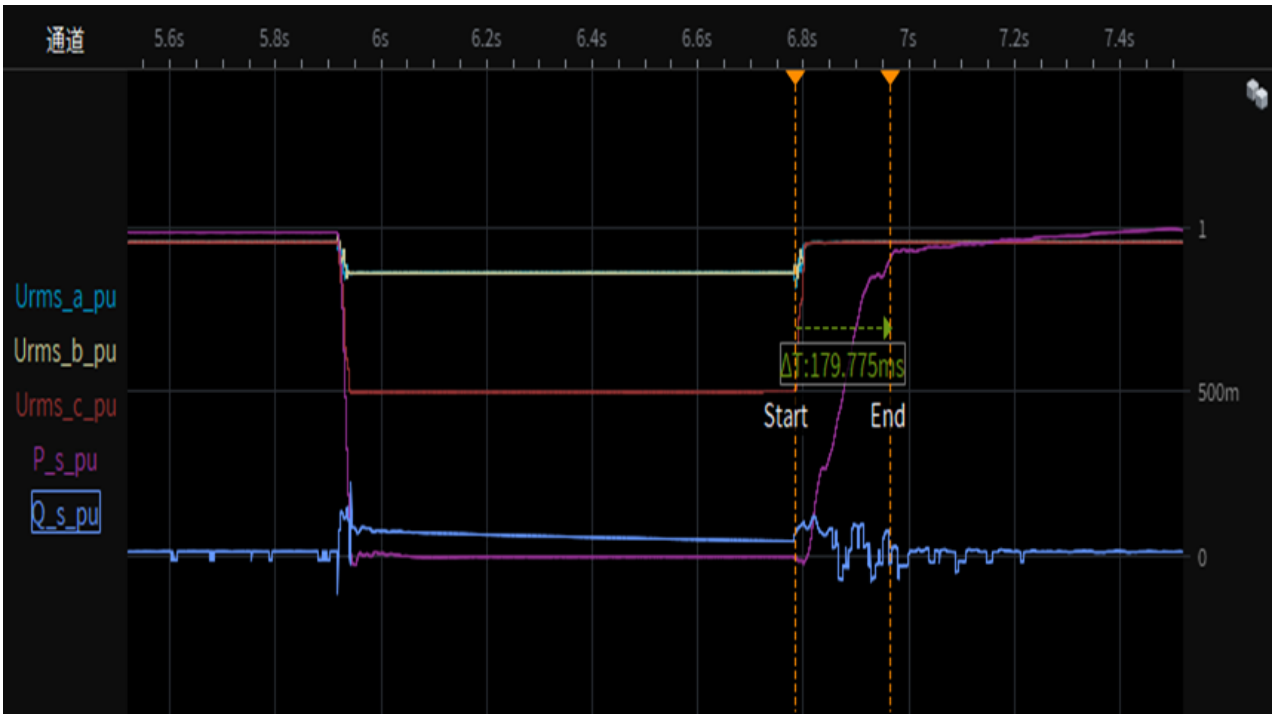


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

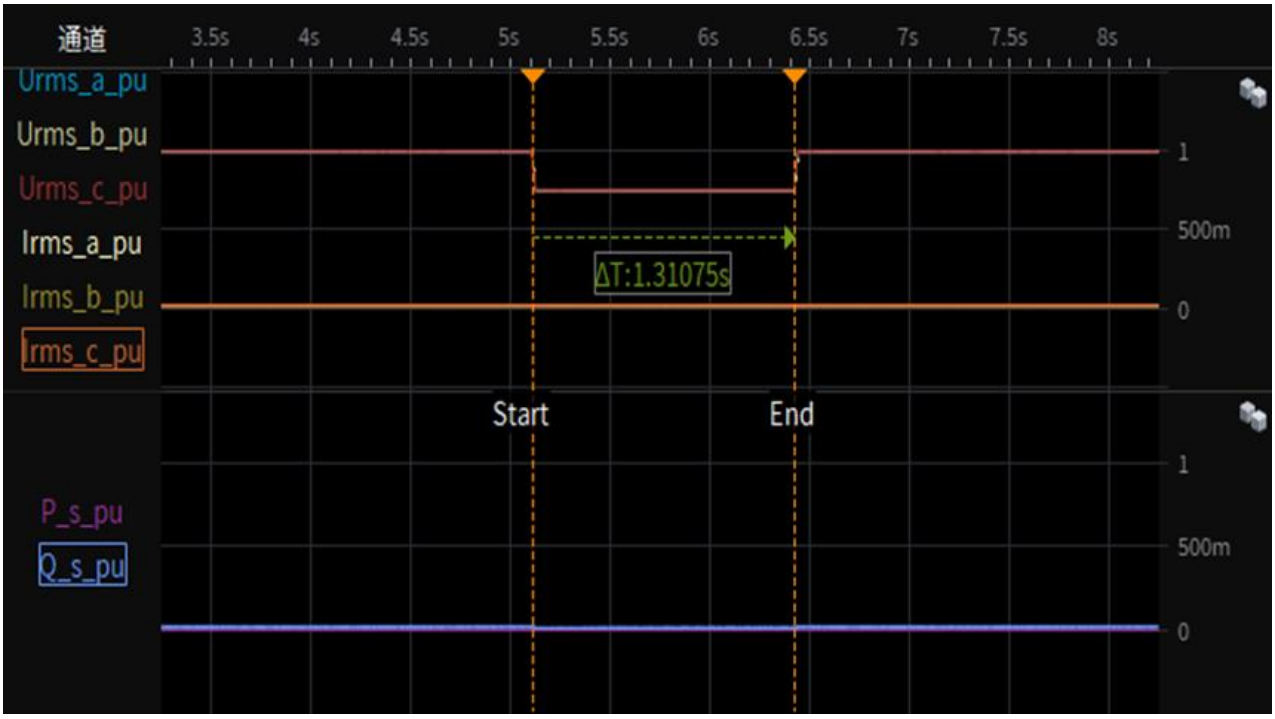


Test 3a-2.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

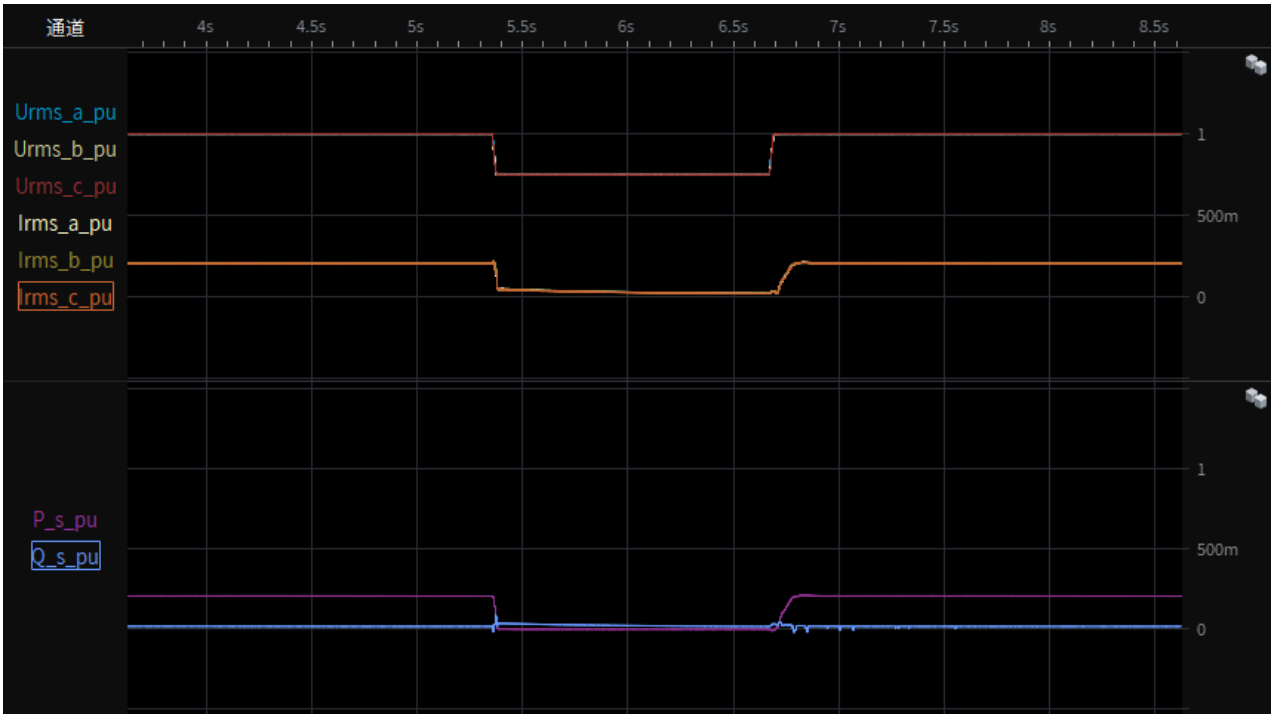


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

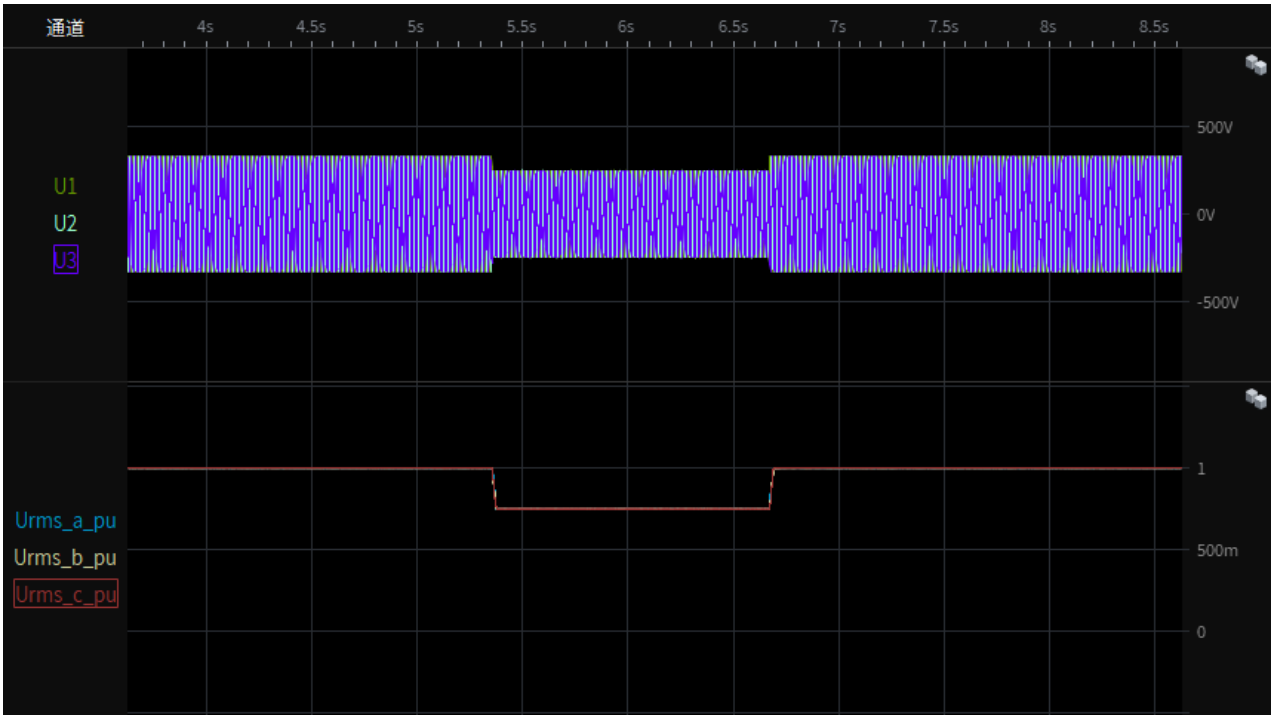


Test 4s-1.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

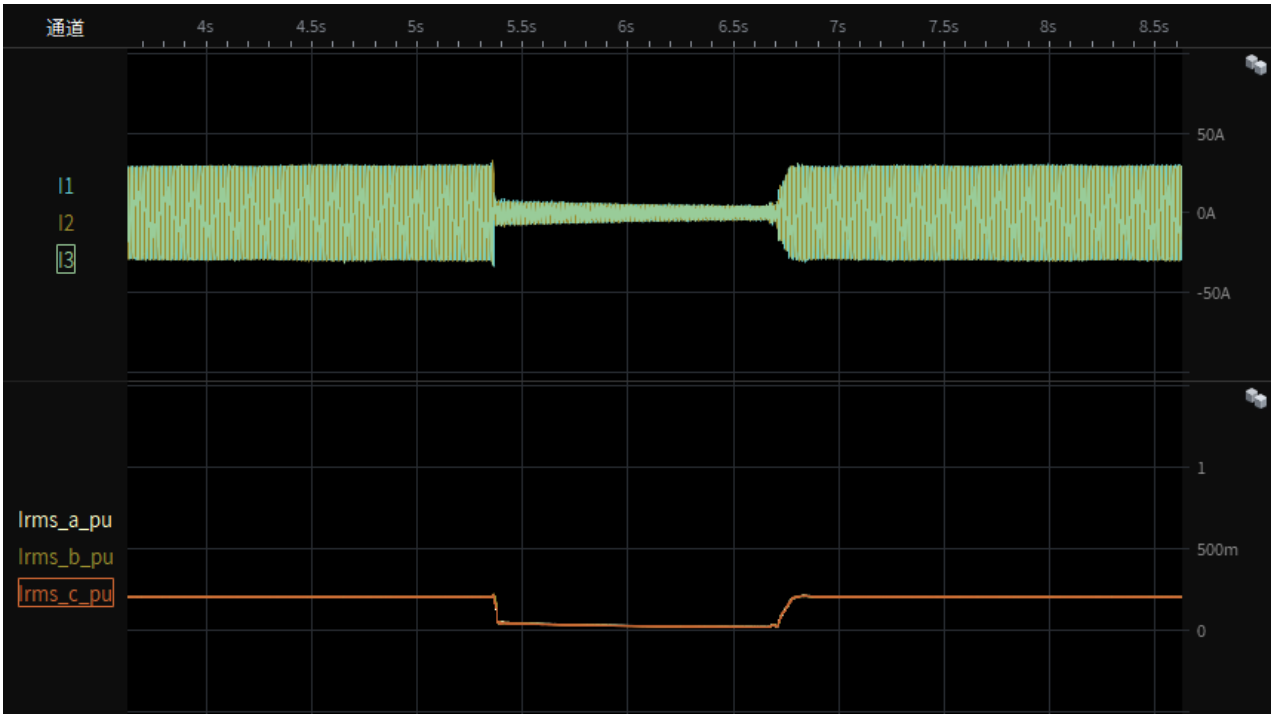


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

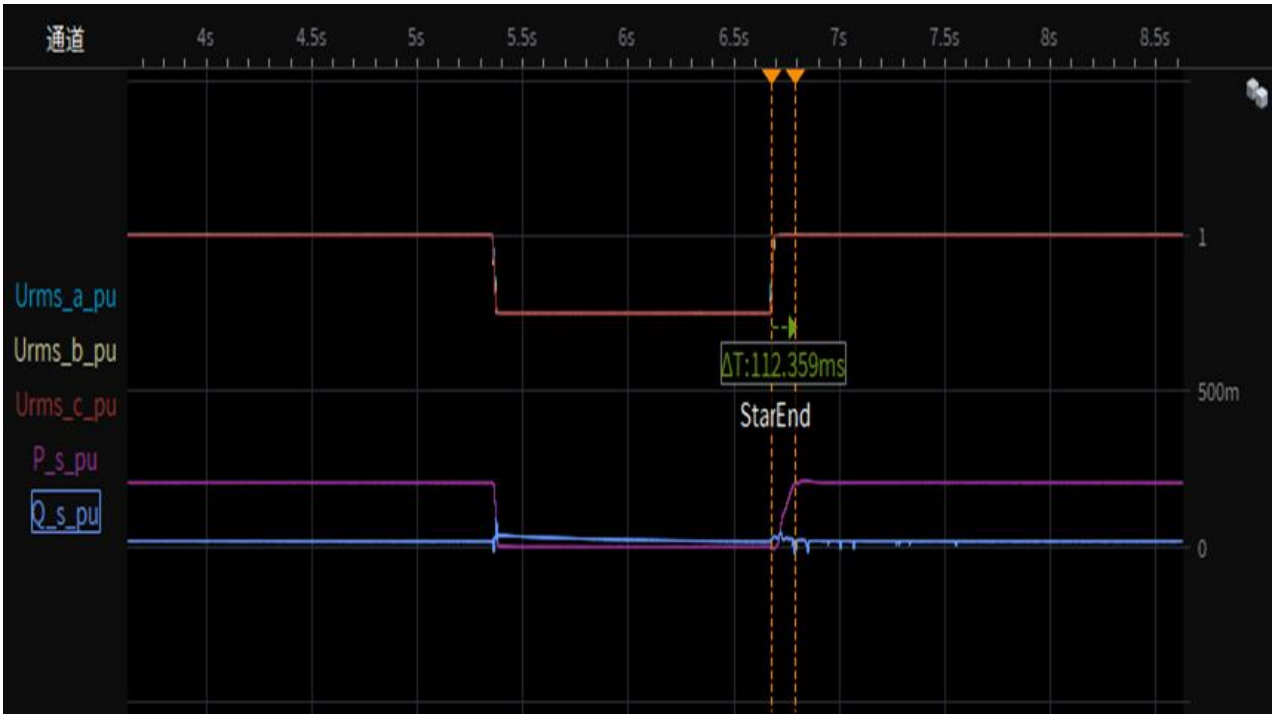


Test 4s-1.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

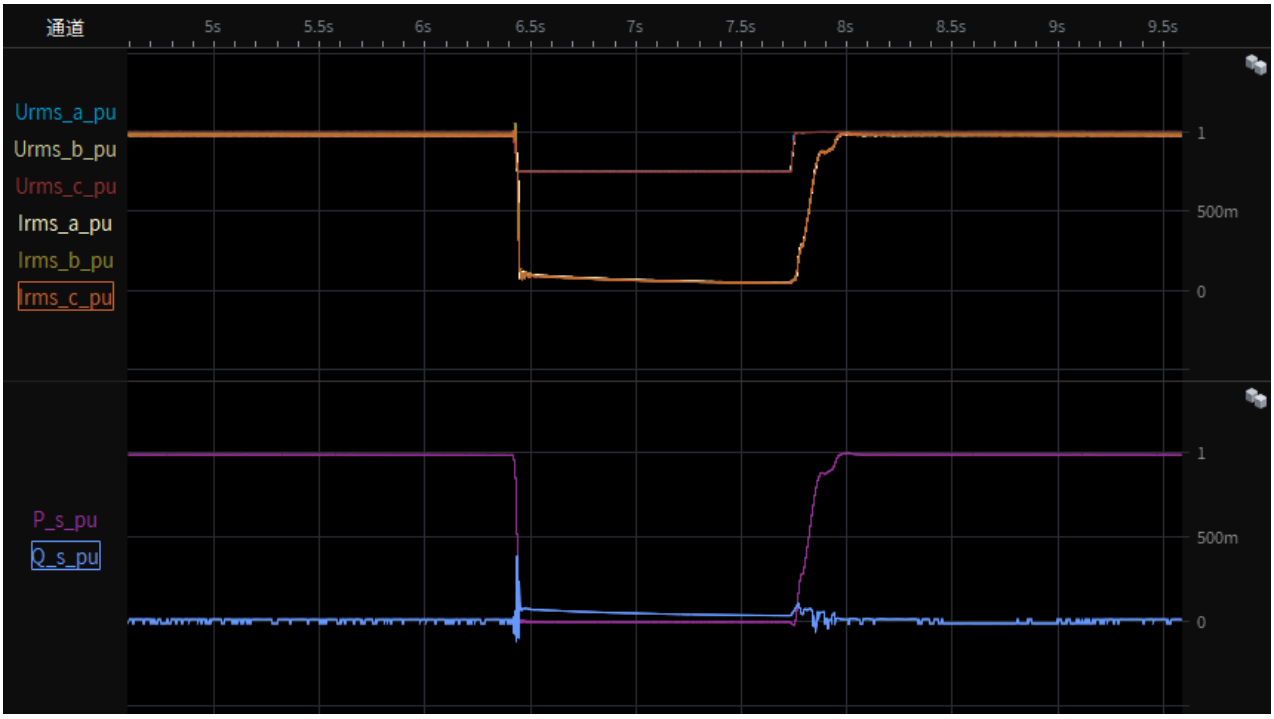


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

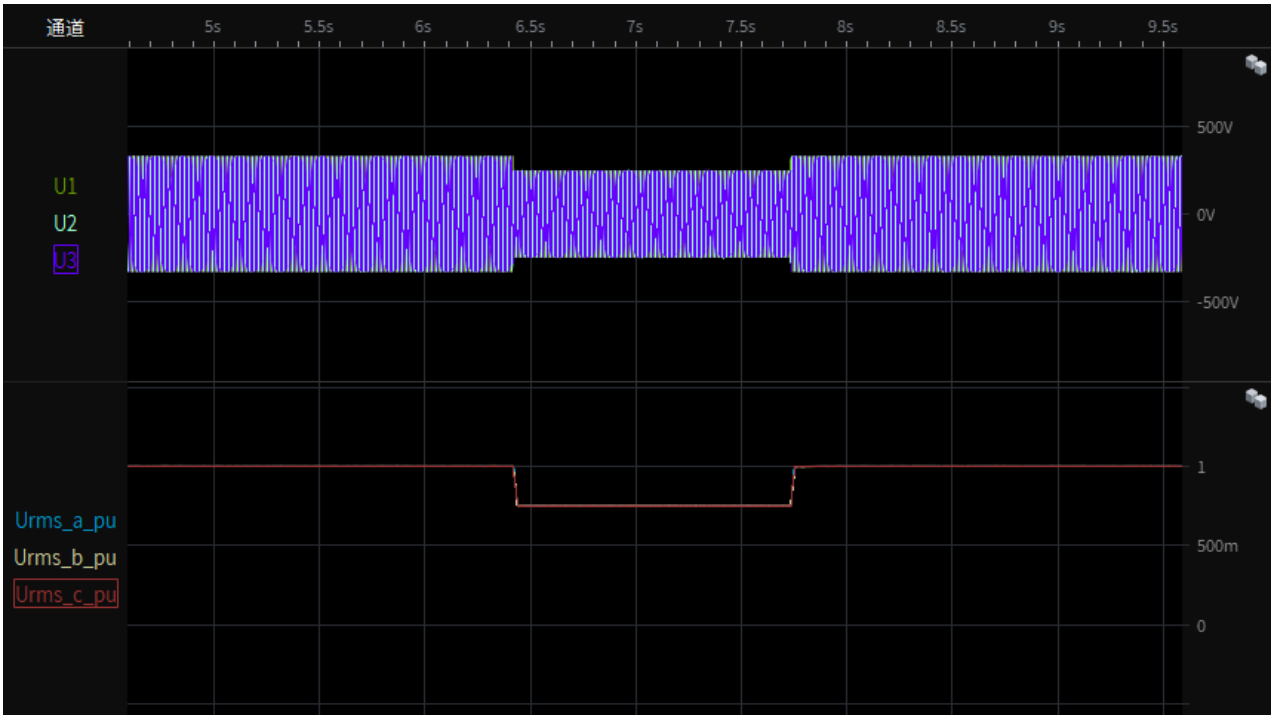


Test 4s-2.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

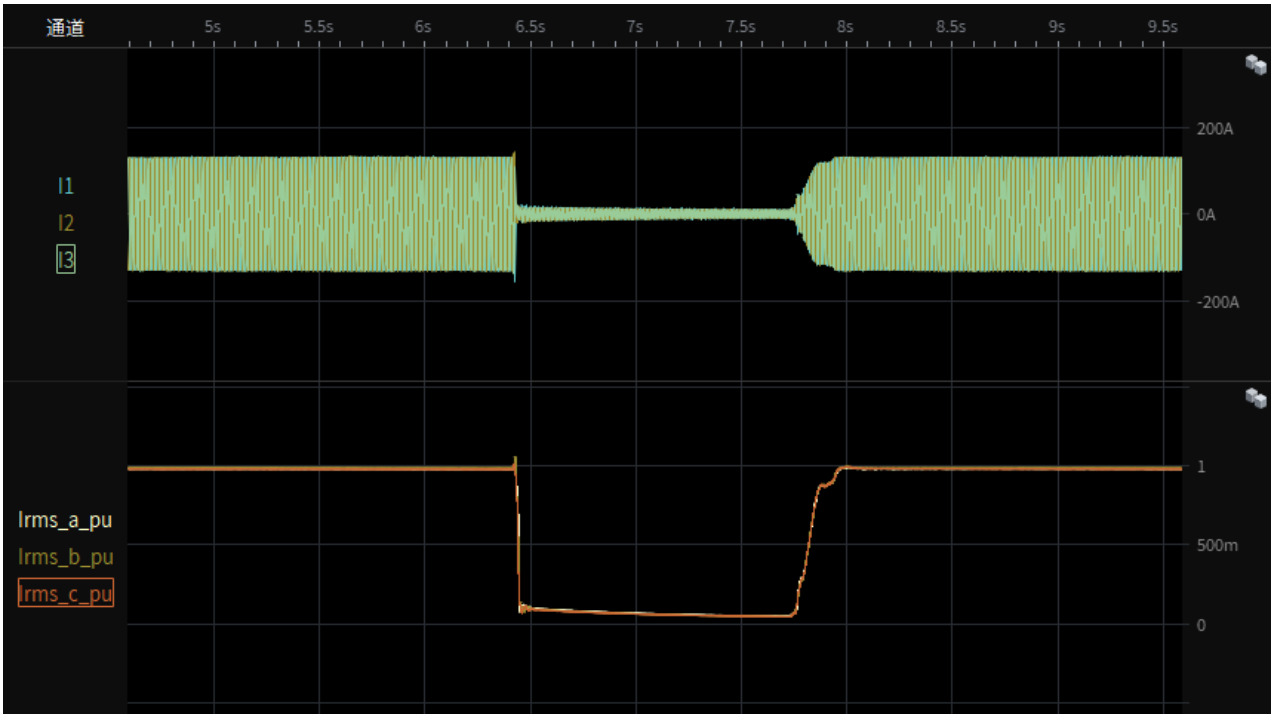


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

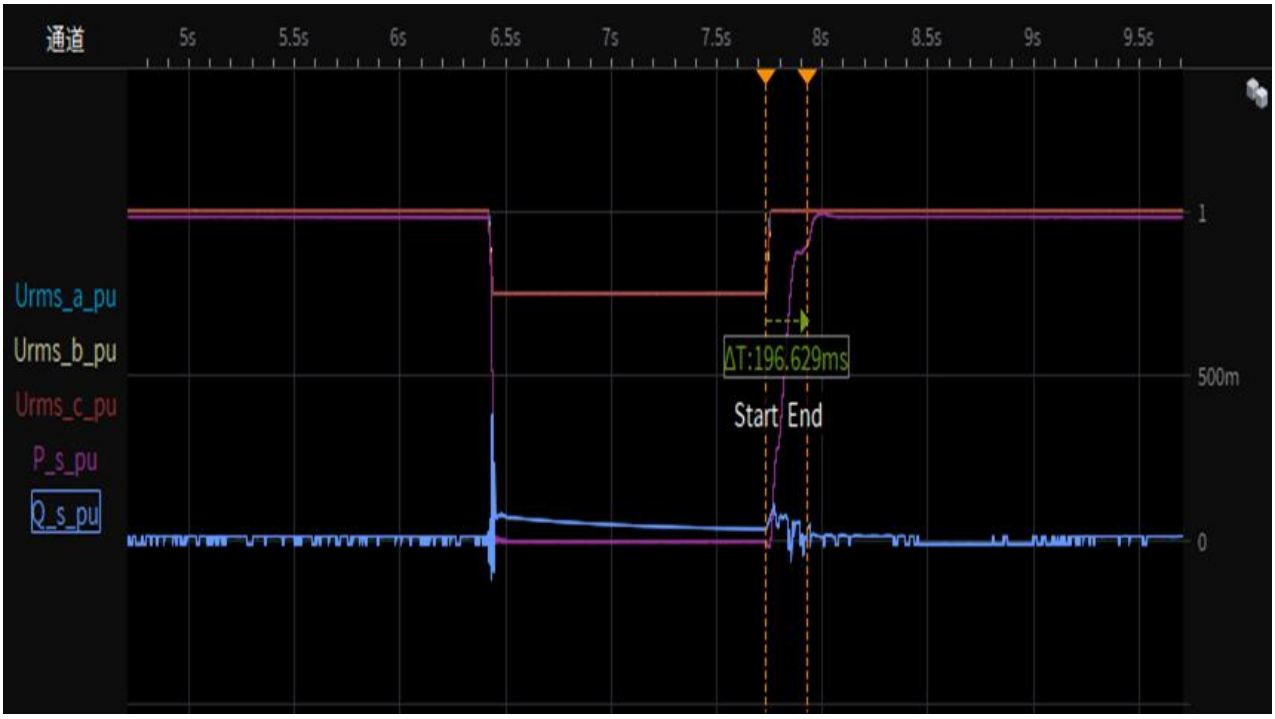


Test 4s-2.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

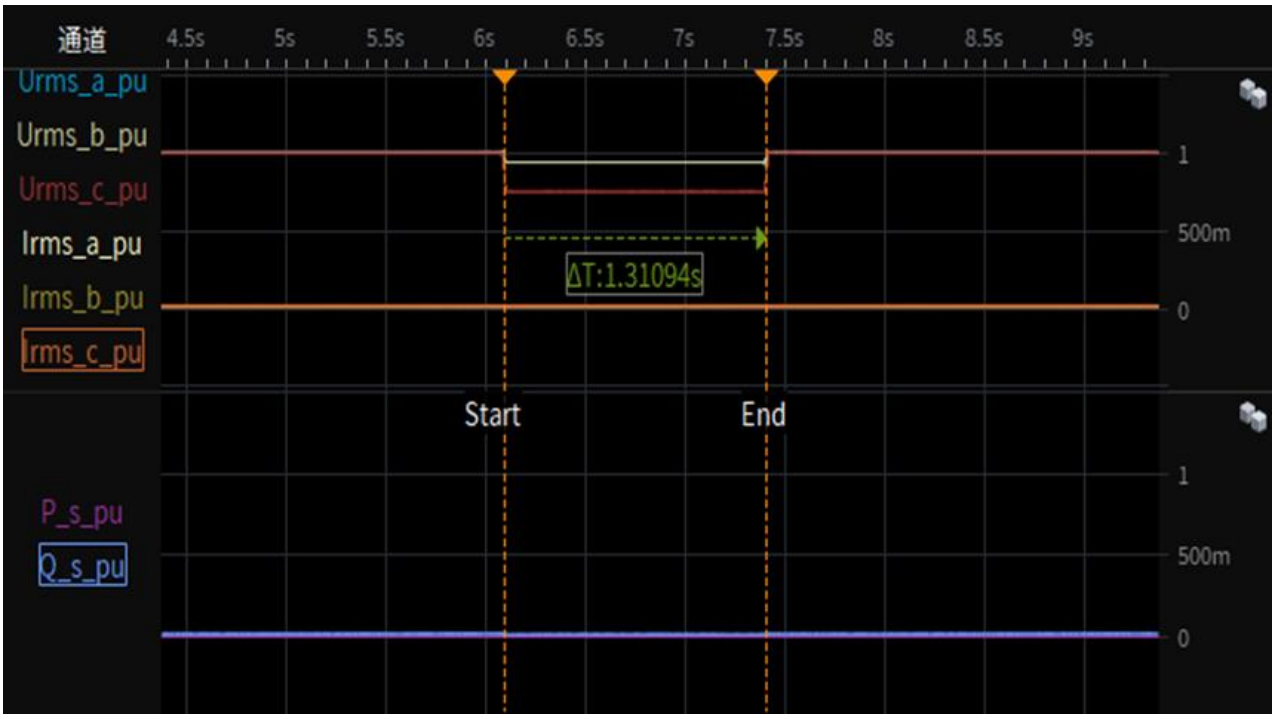


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

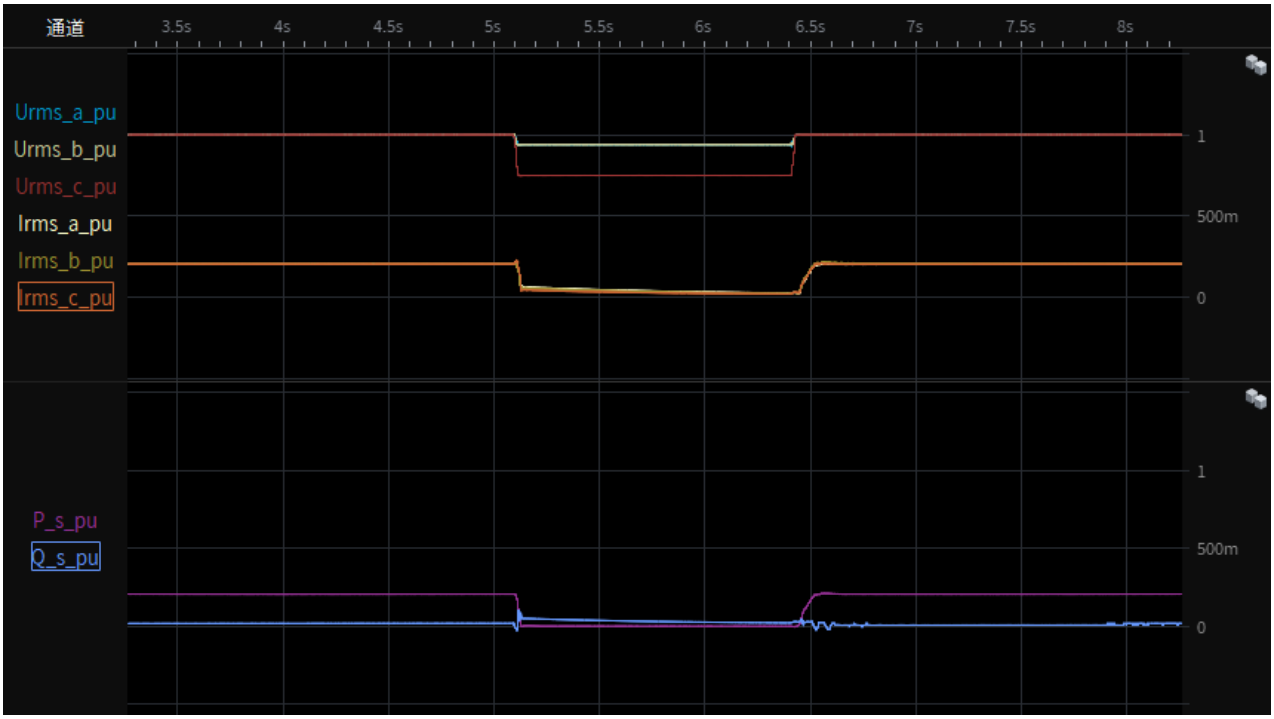


Test 4a-Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

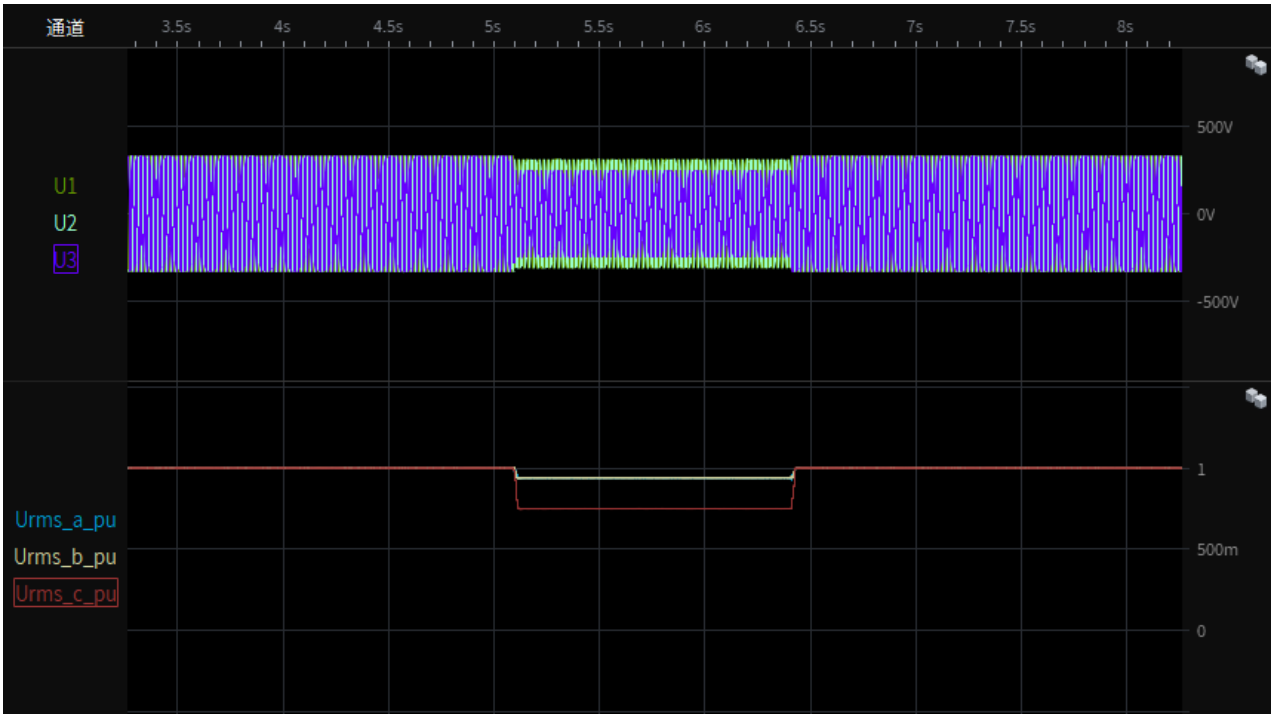


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

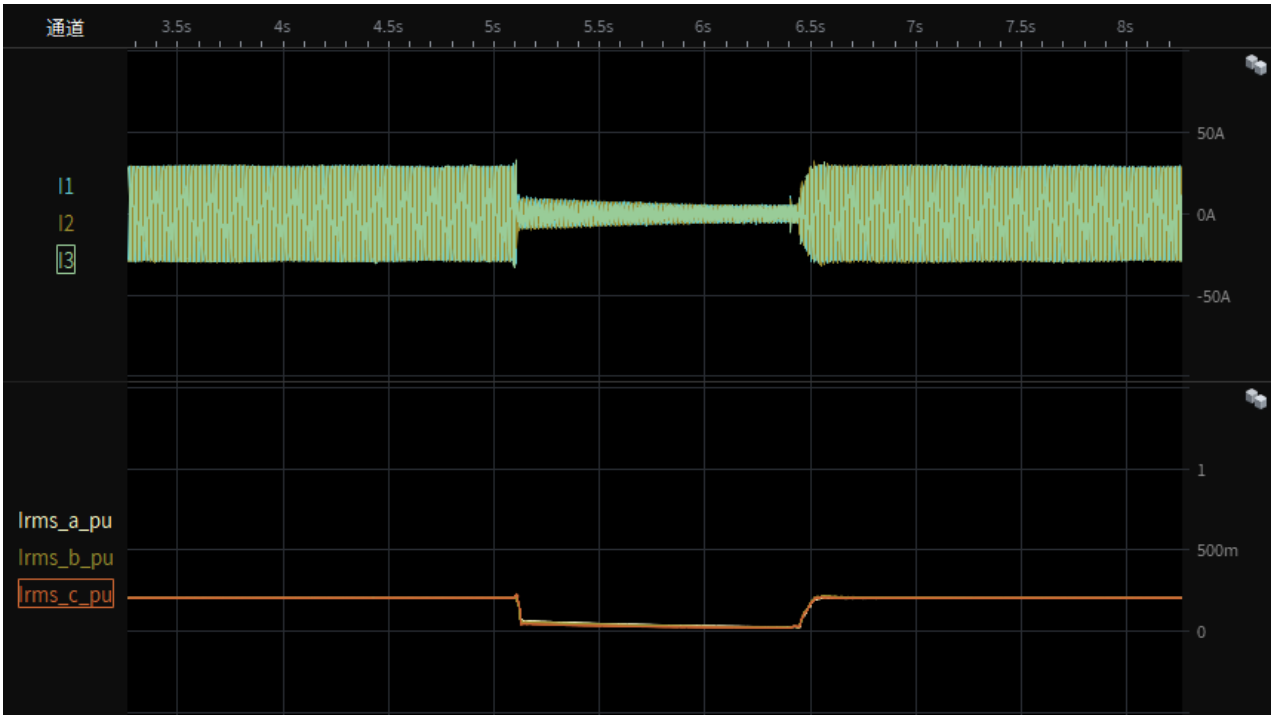


Test 4a-1.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

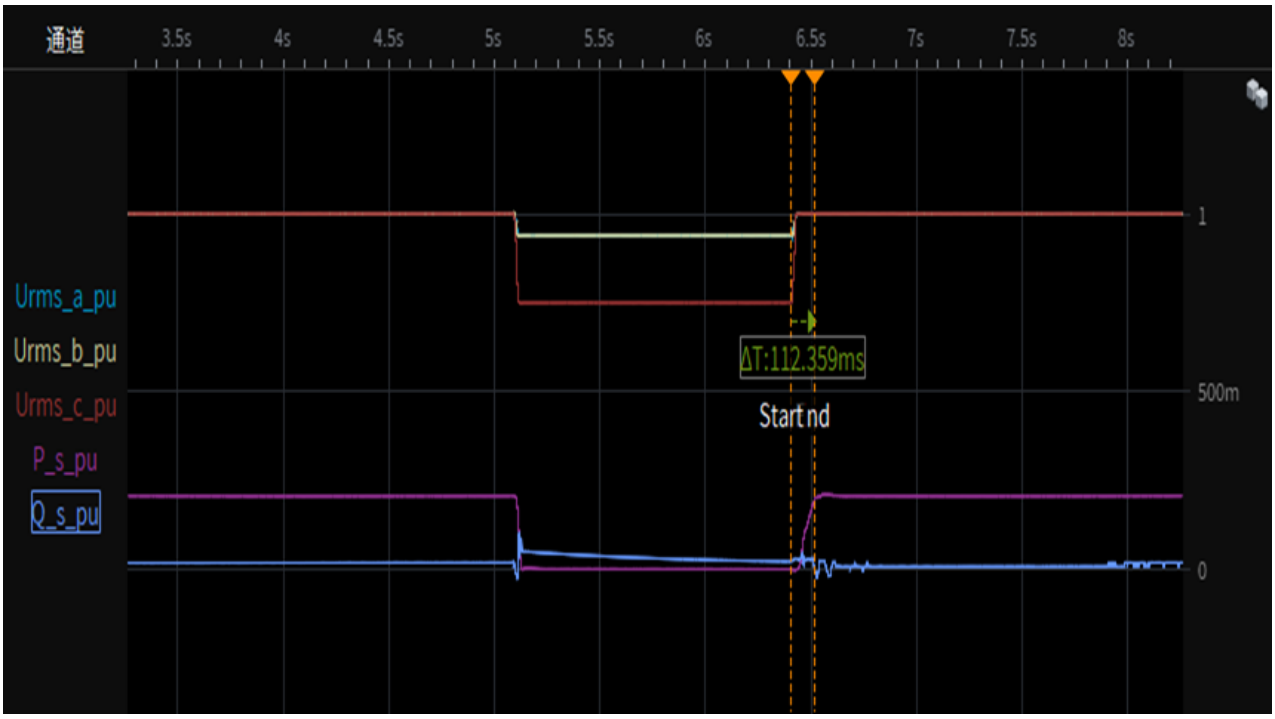


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

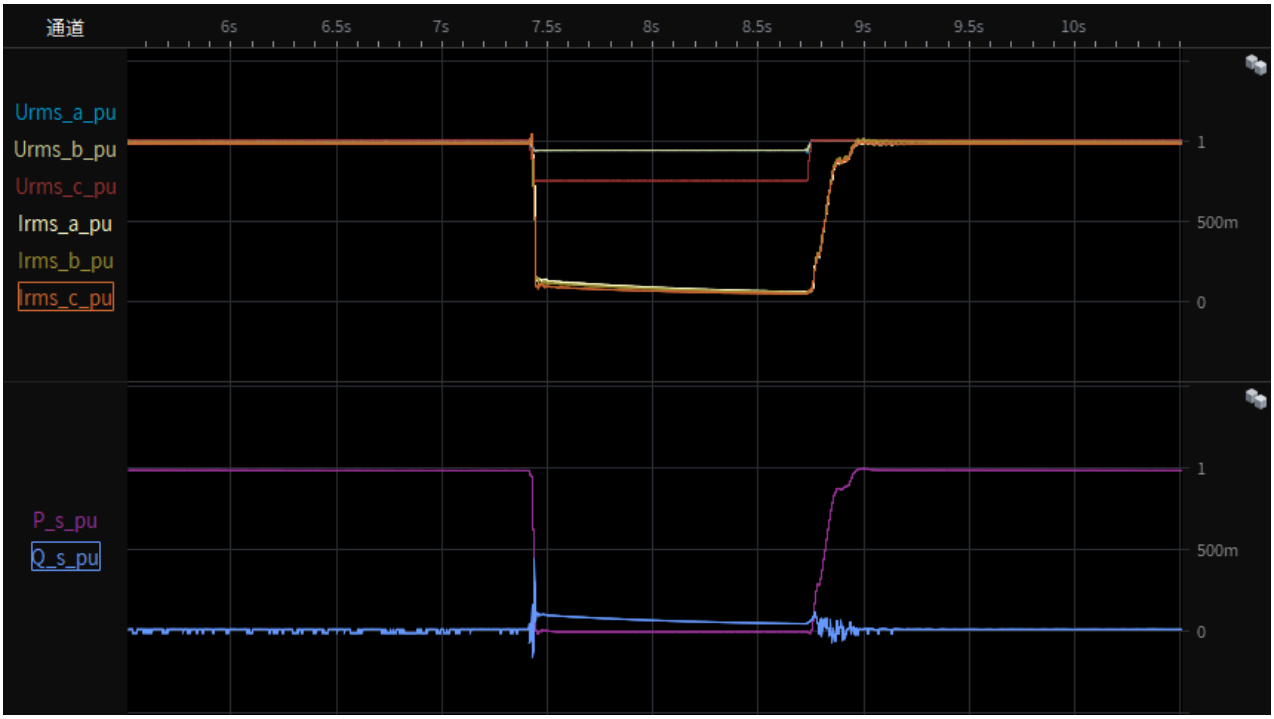


Test 4a-1.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
restoring time

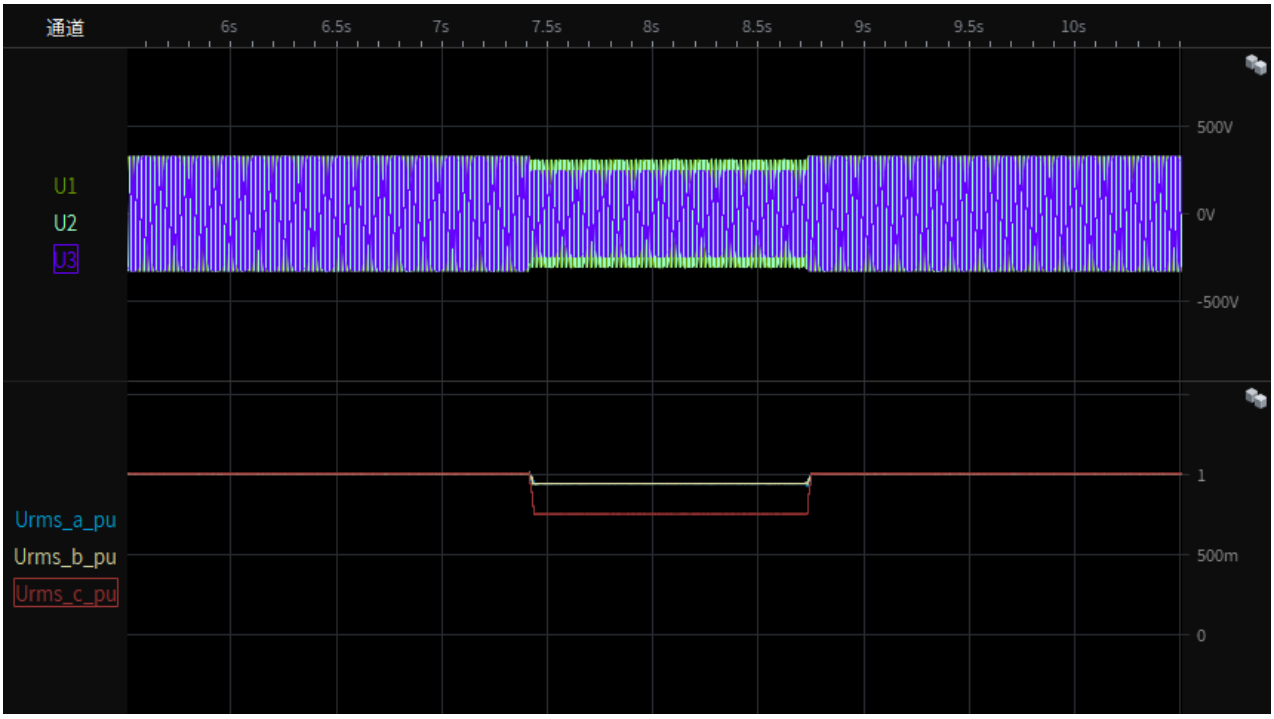


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

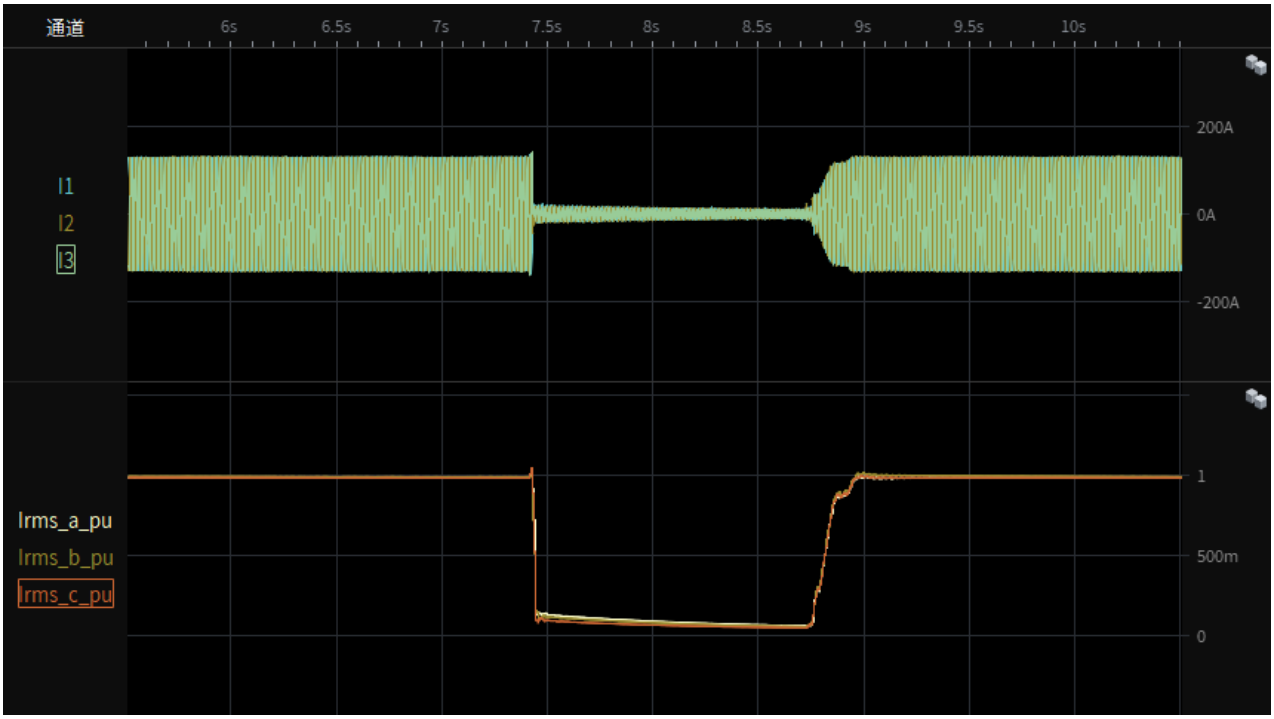


Test 4a-2.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

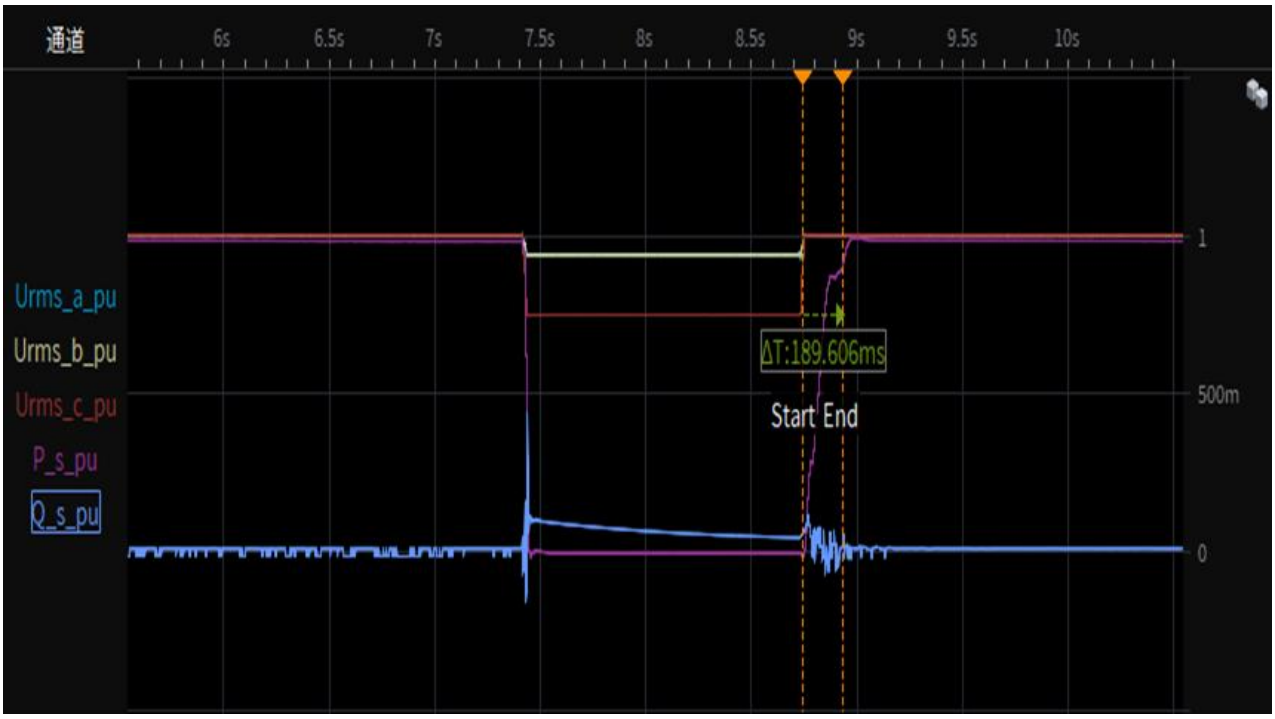


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

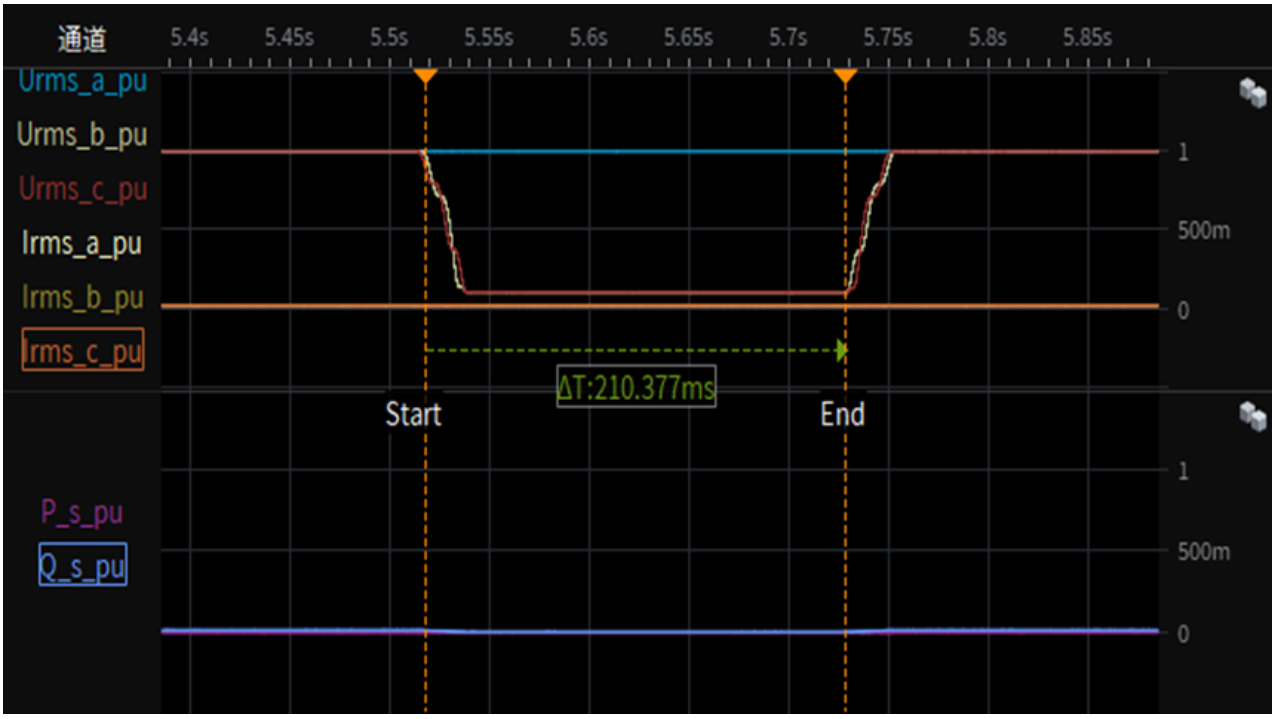


Test 4a-2.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

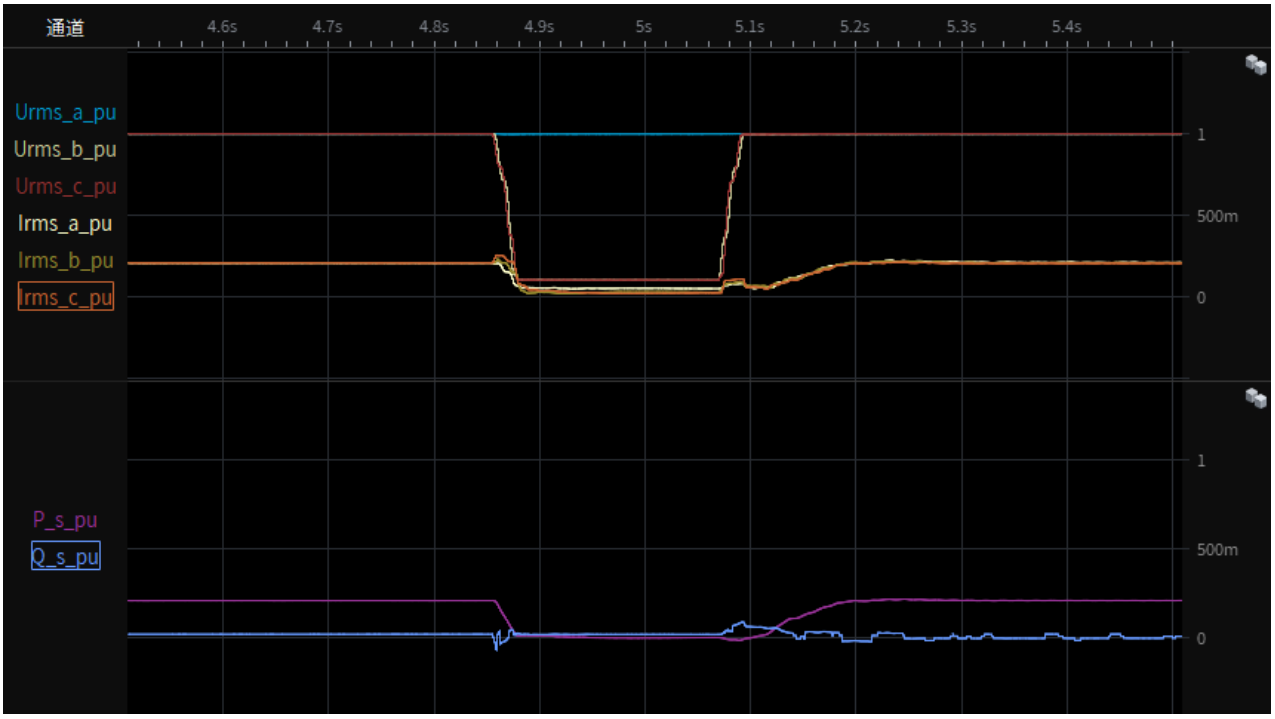


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

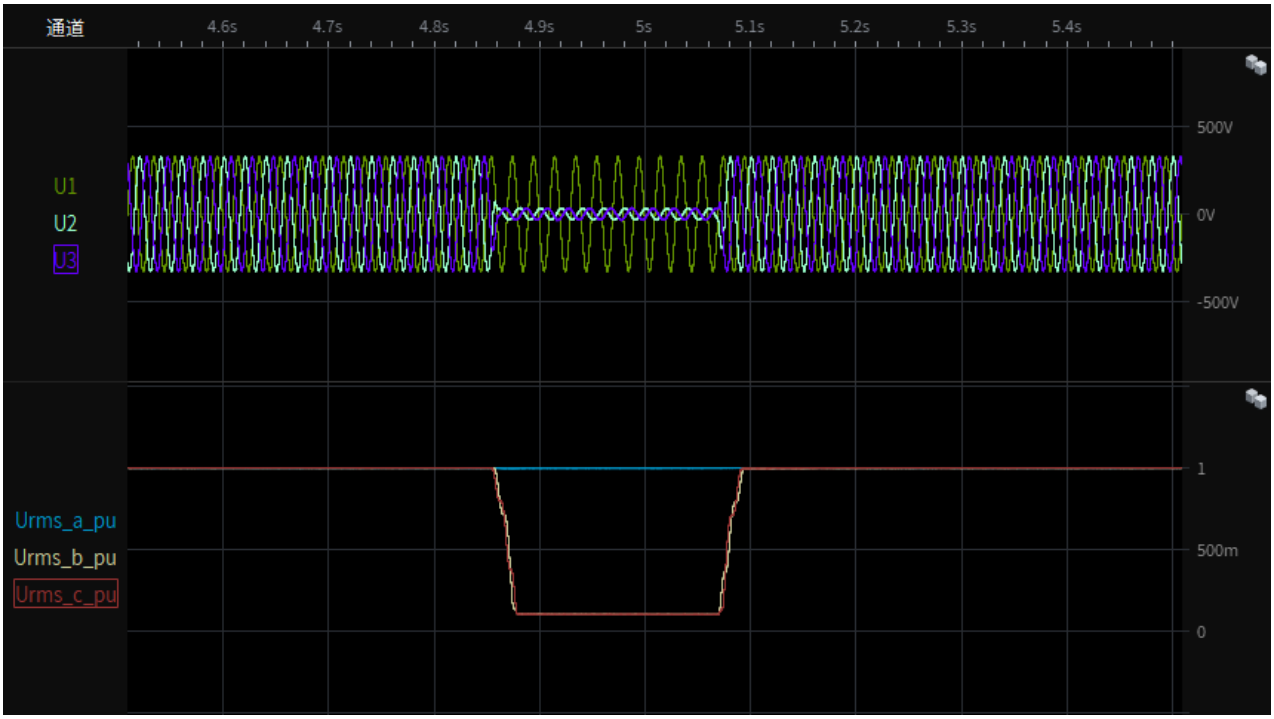


Test 5-1.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

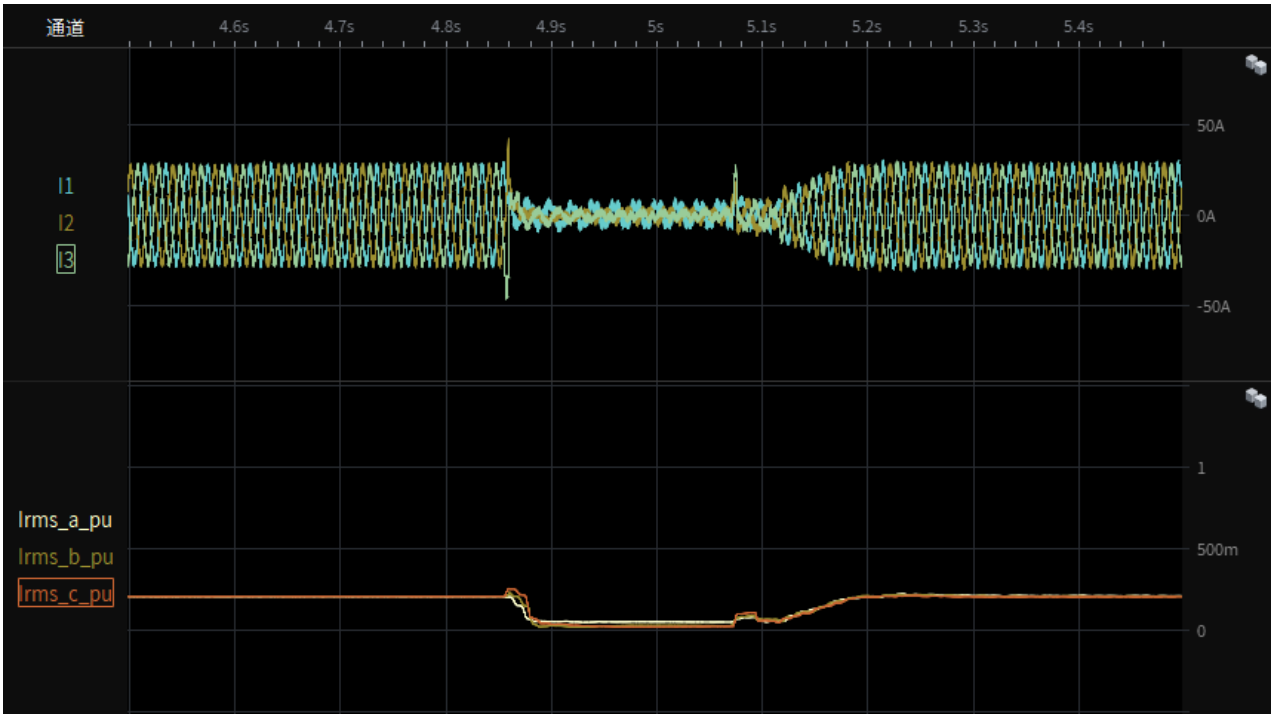


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

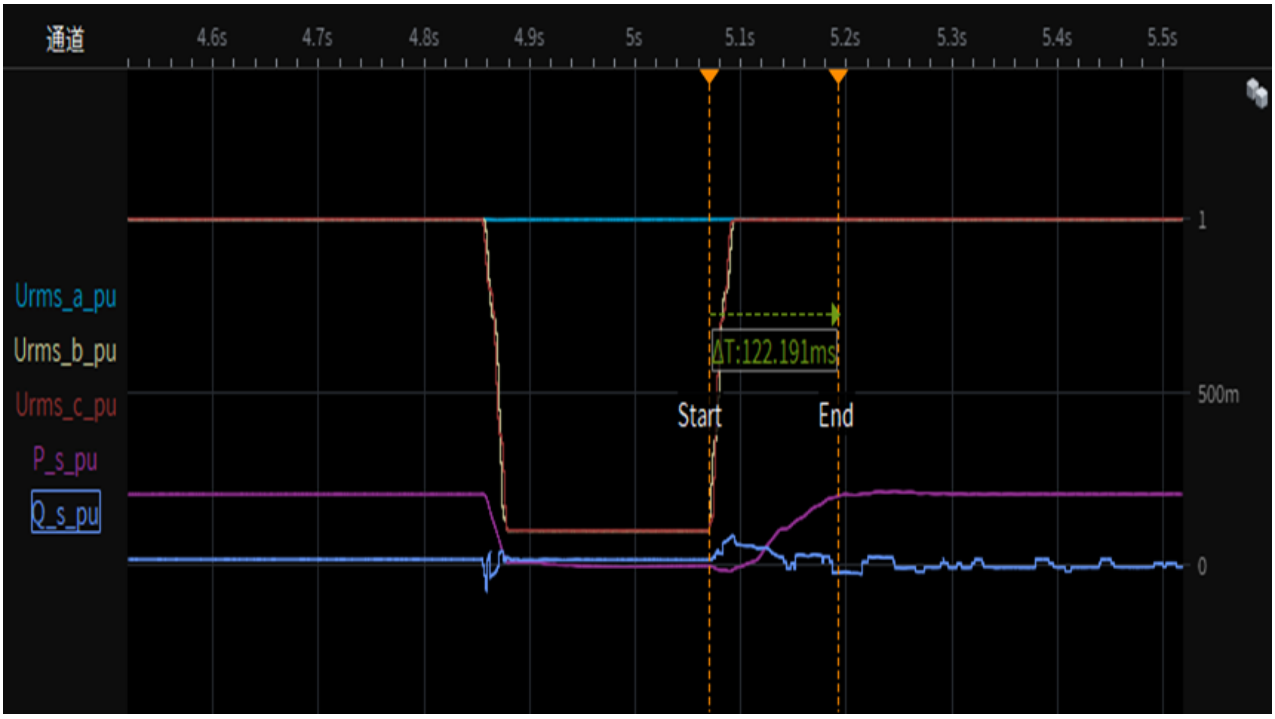


Test 5-1.3 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase currents

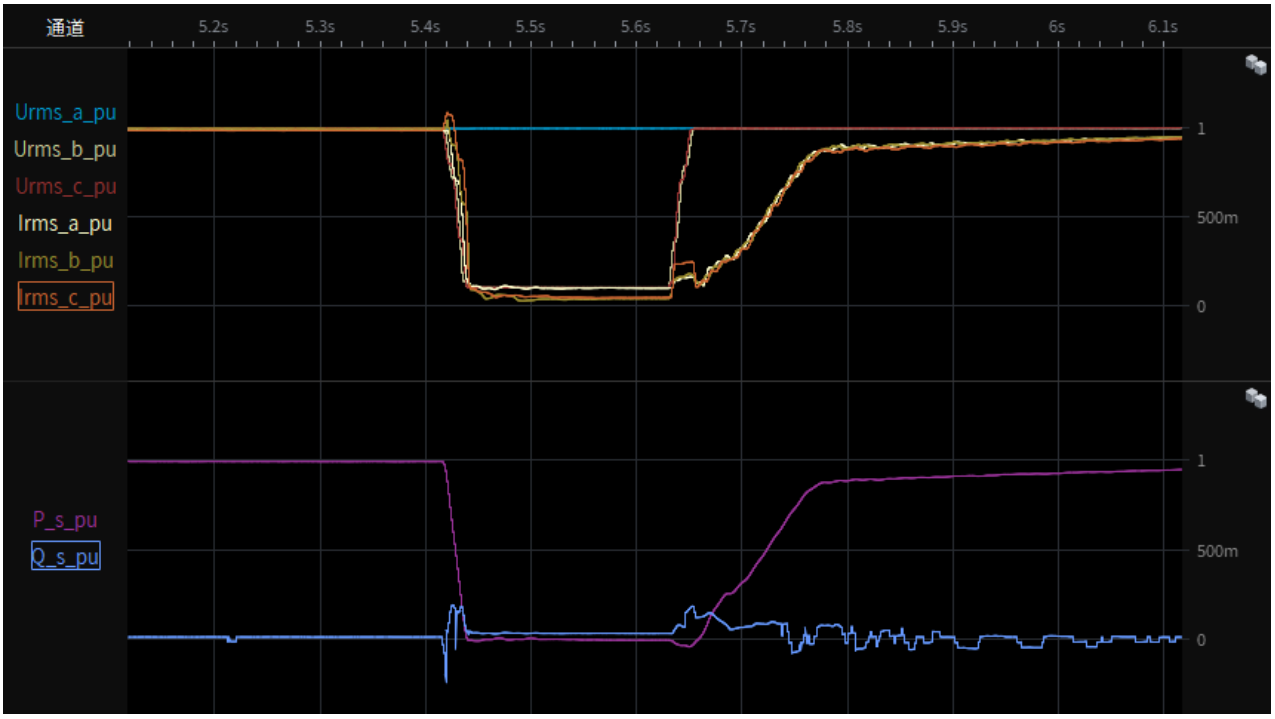


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

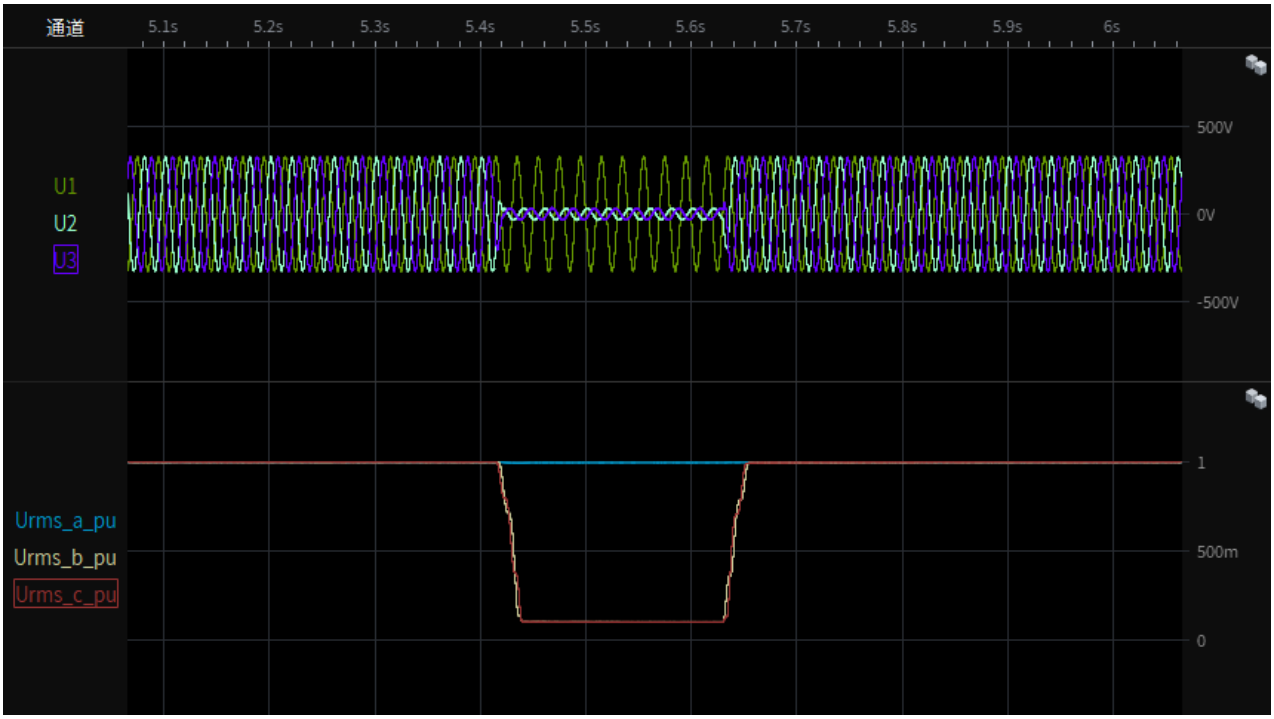


Test 5-2.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Test overview(voltage,current,active and reactive power)

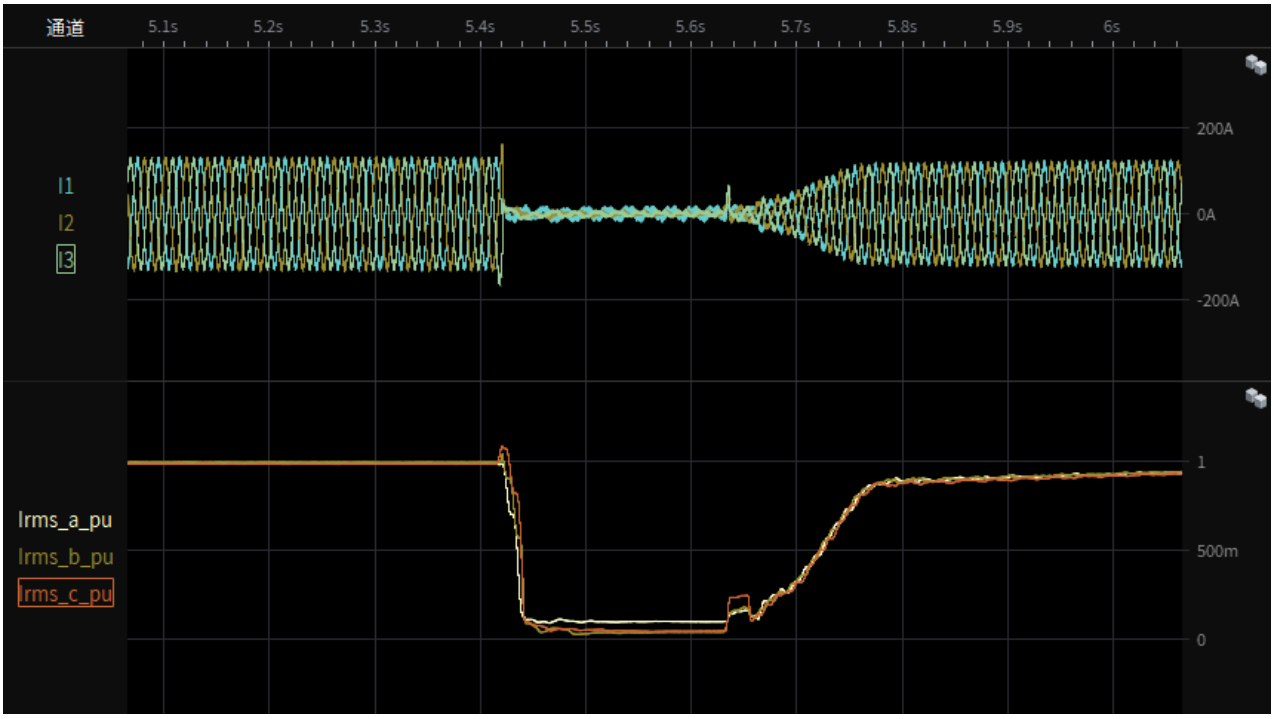


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

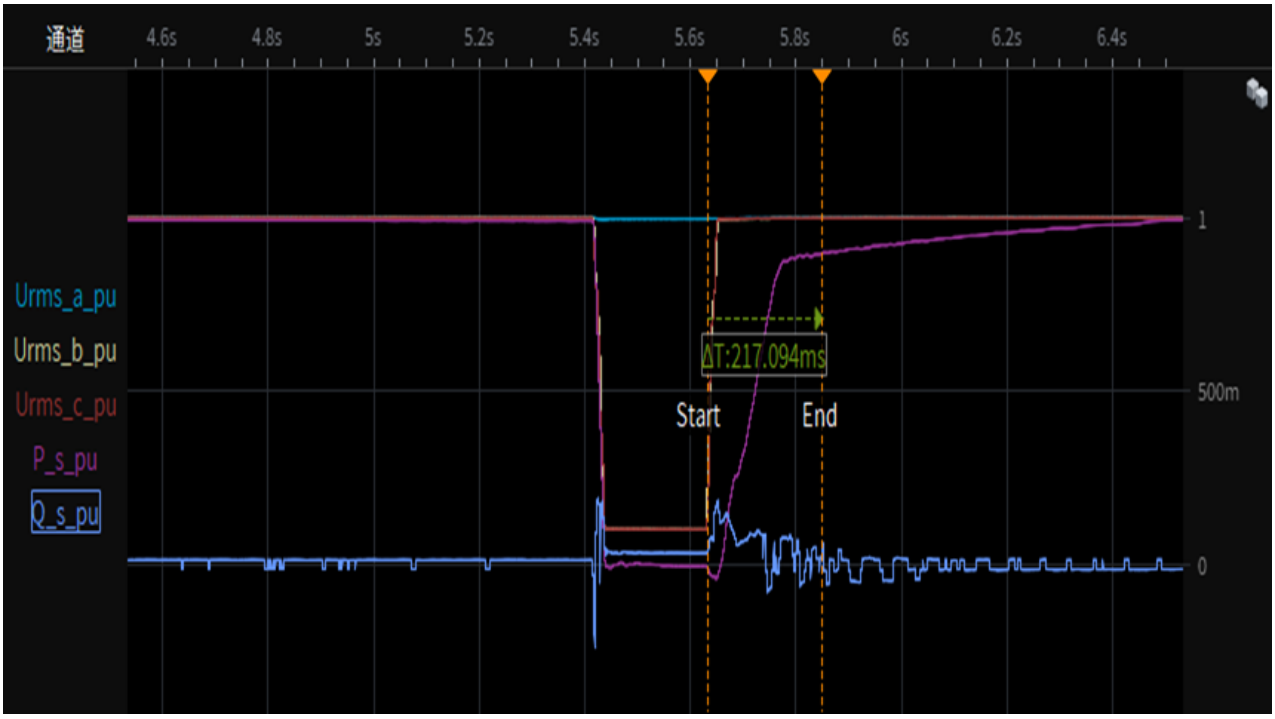


Test 5-2.3 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents



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

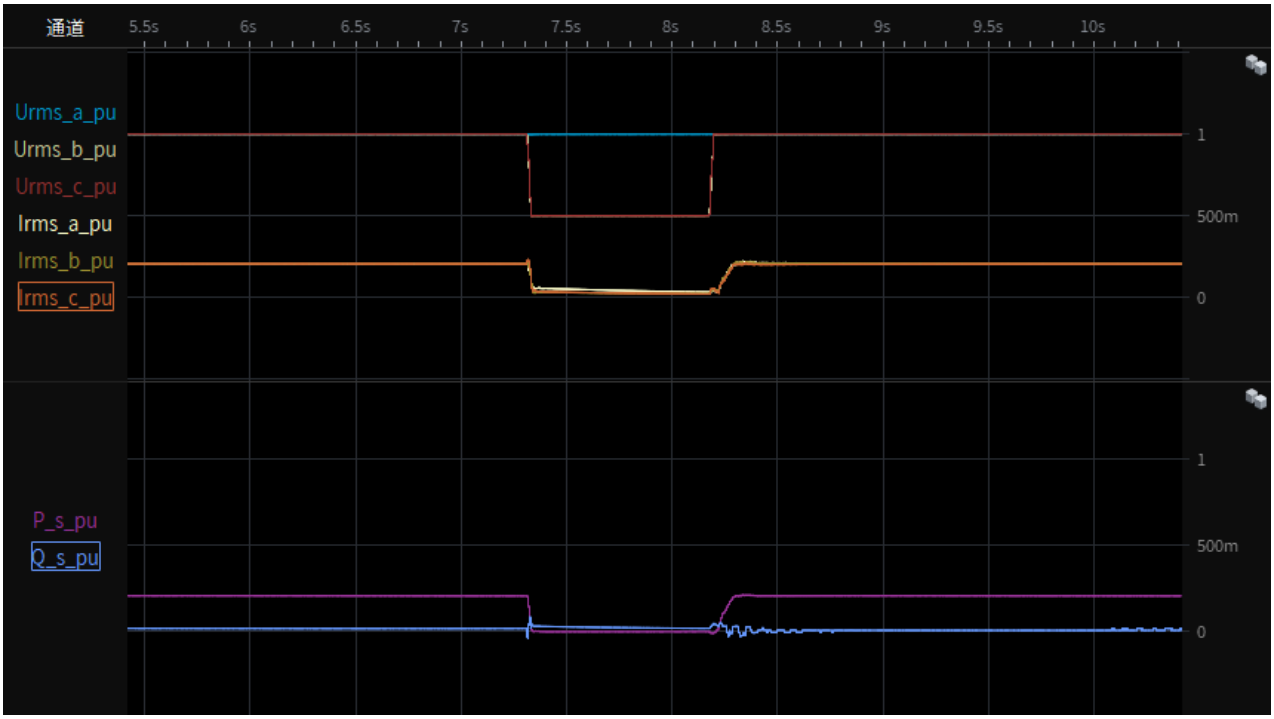


Test 6-Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

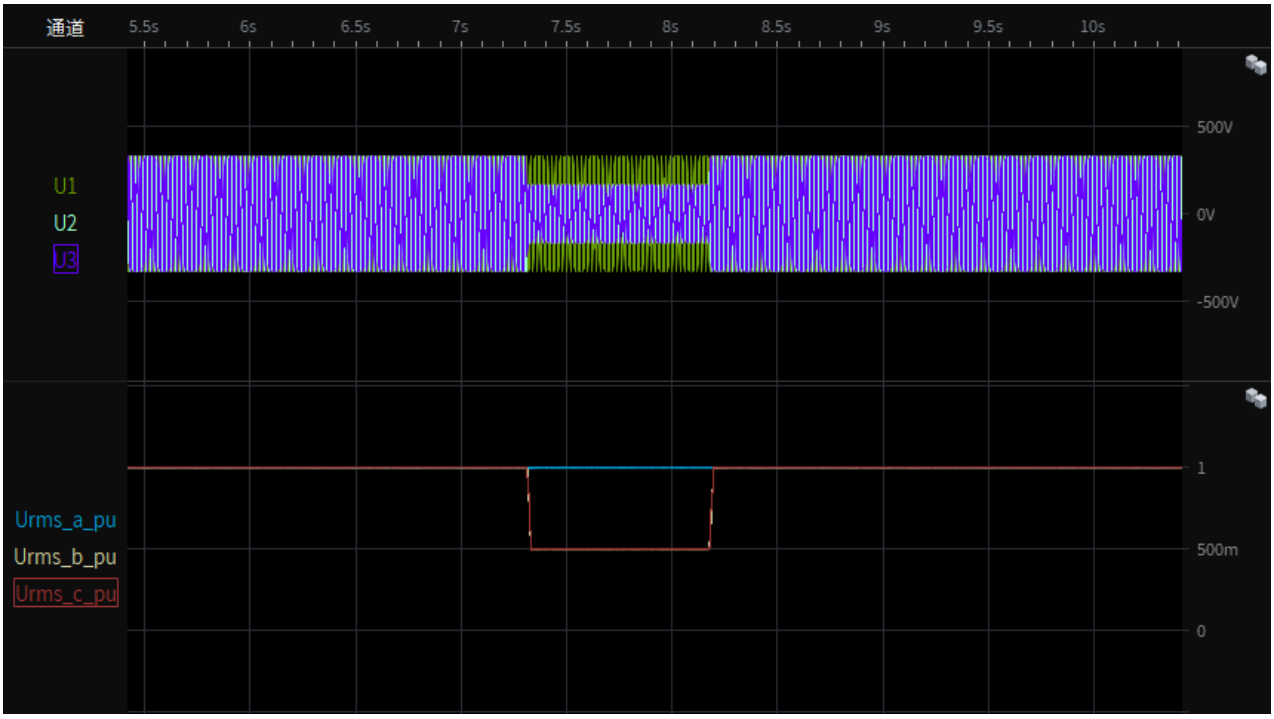


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

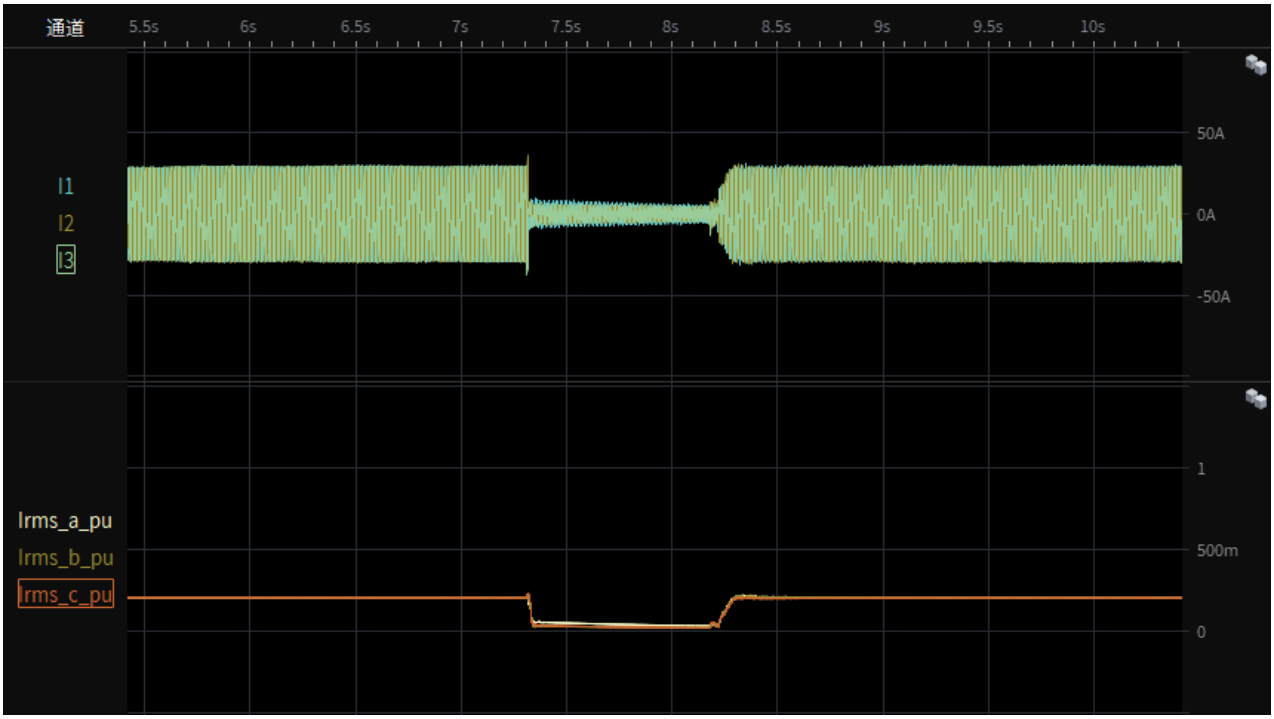


Test 6-1.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages



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

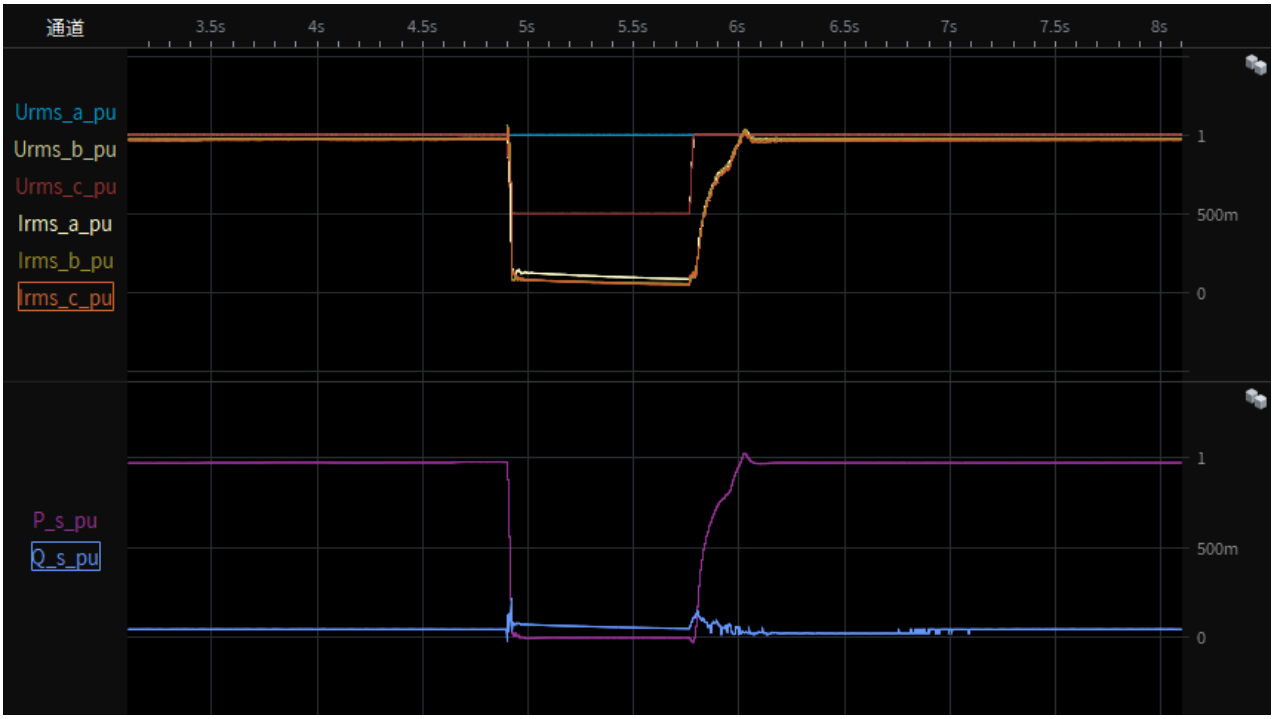


Test 6-1.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
restoring time

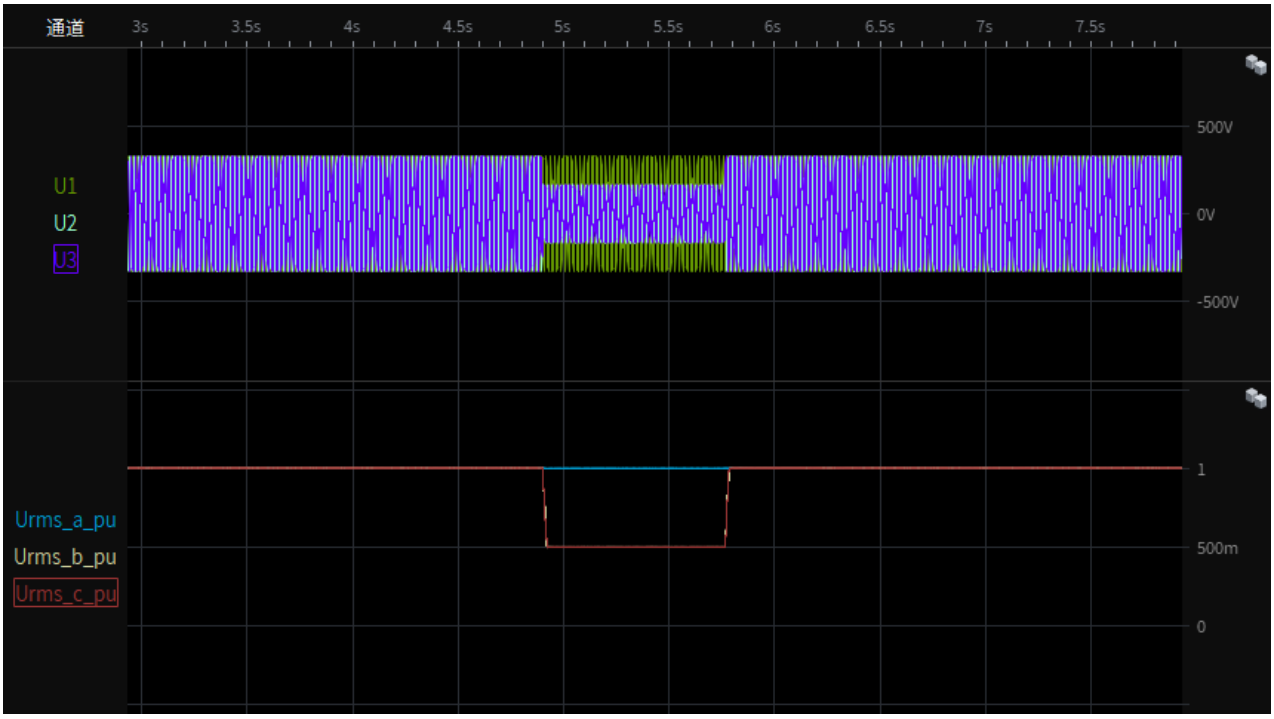


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

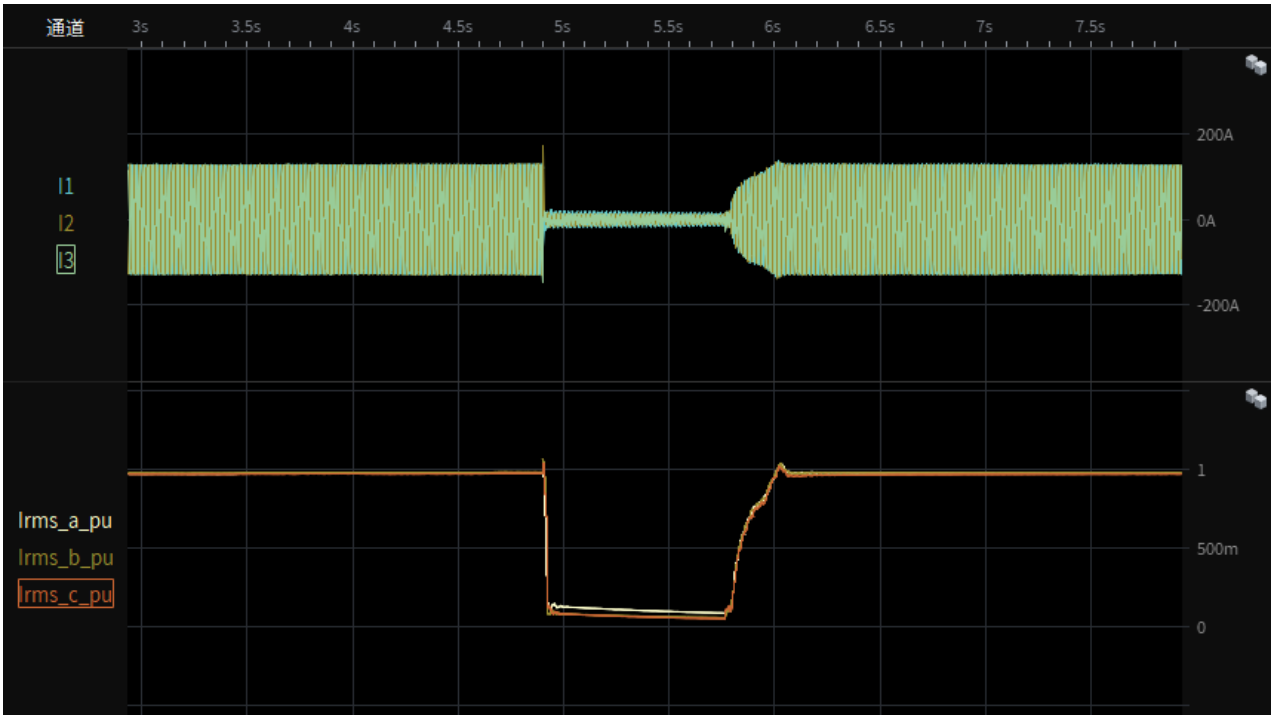


Test 6-2.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

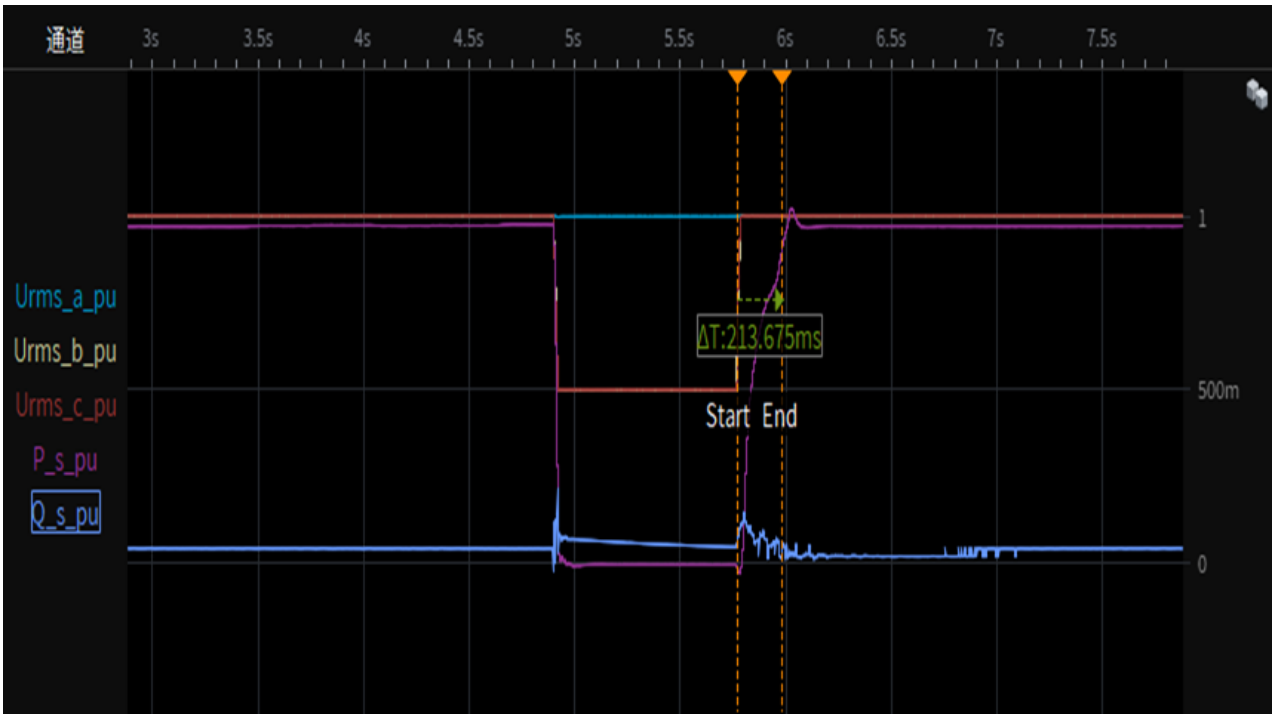


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

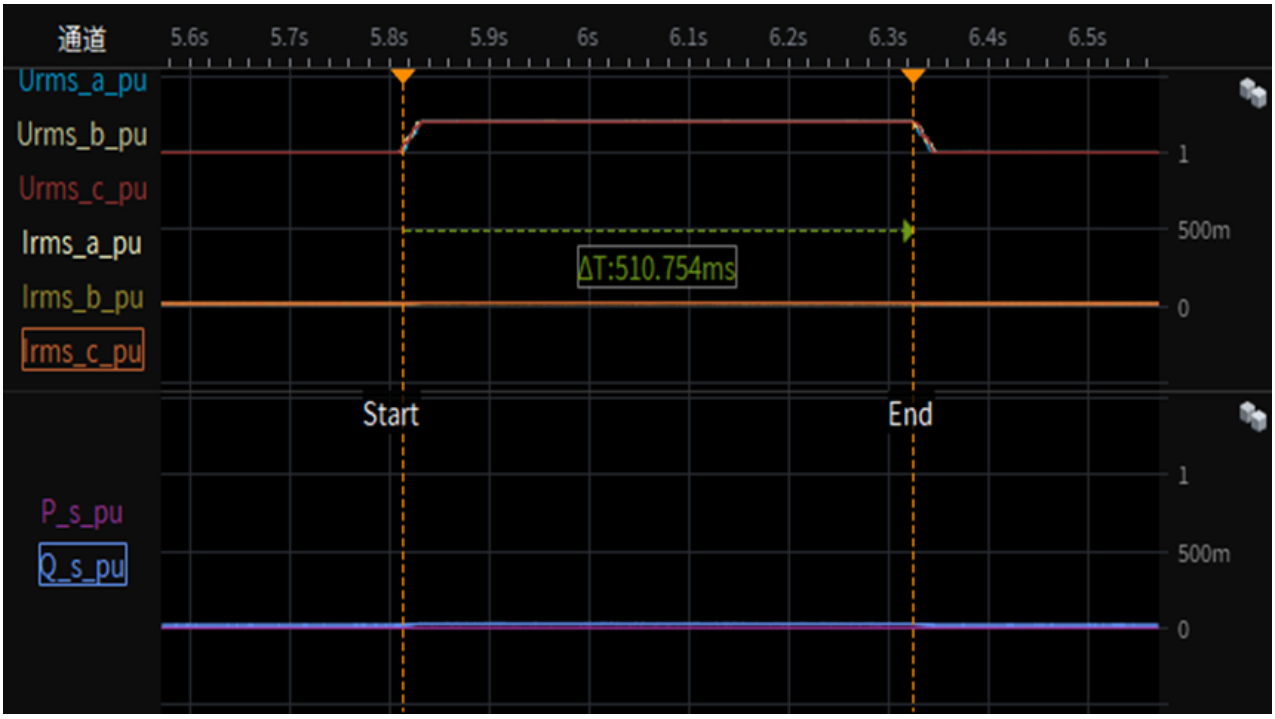


Test 6-2.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D), 95% load
restoring time

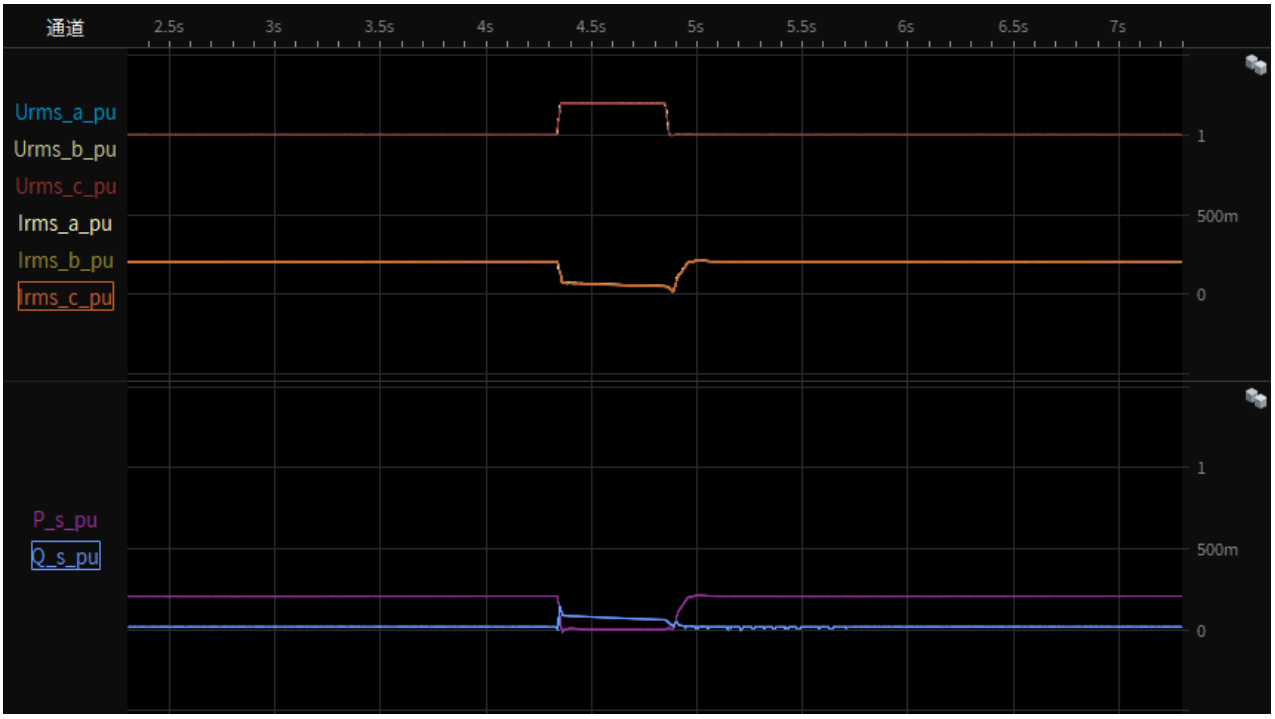


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

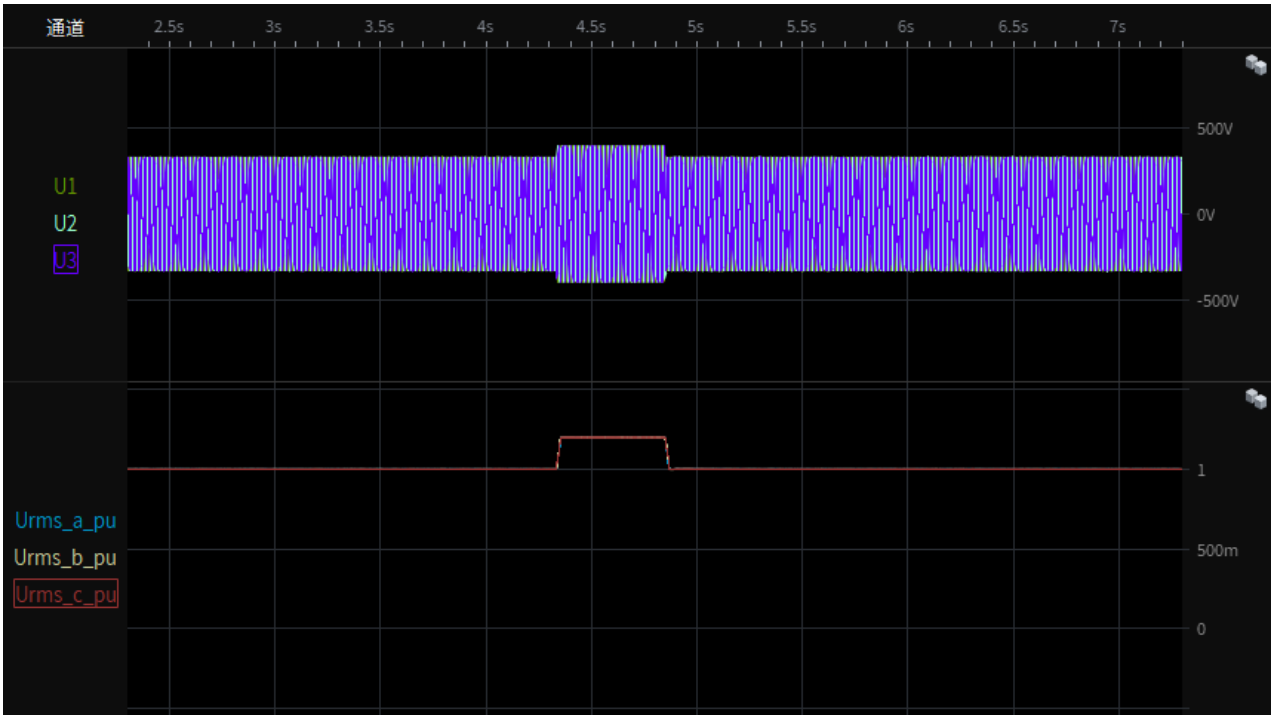


Test 7-1.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

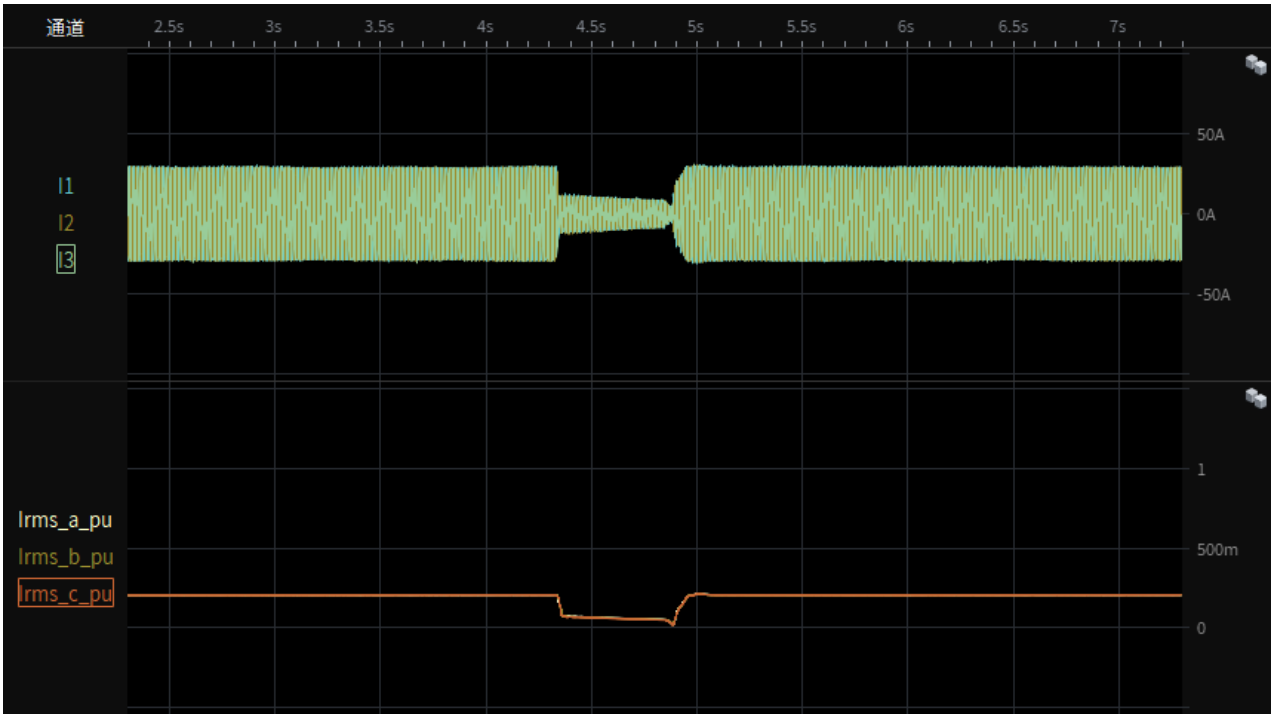


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

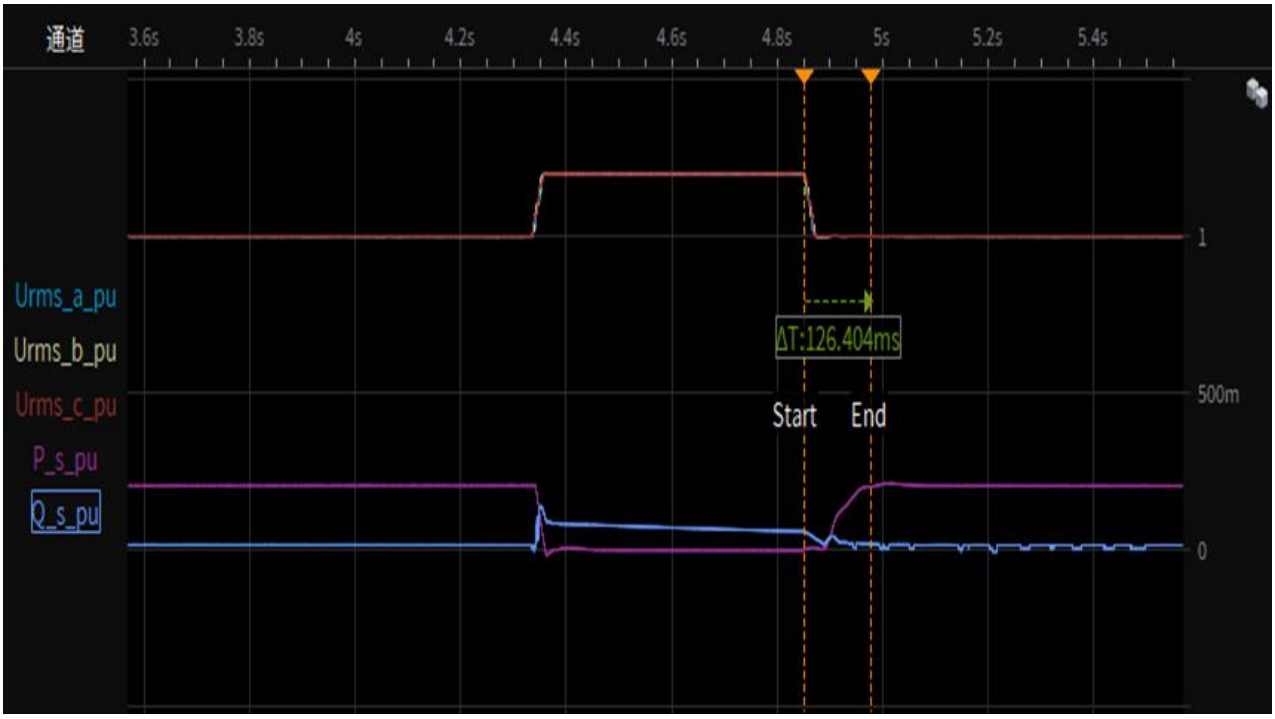


Test 7-1.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

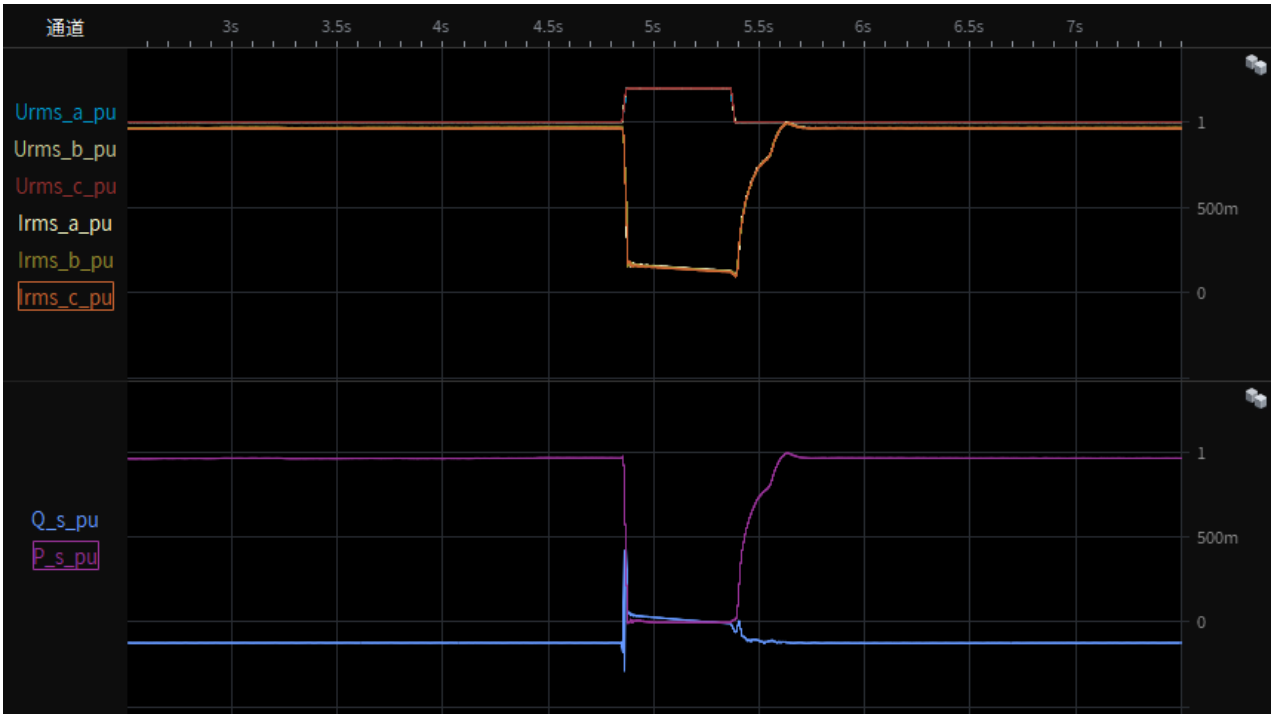


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

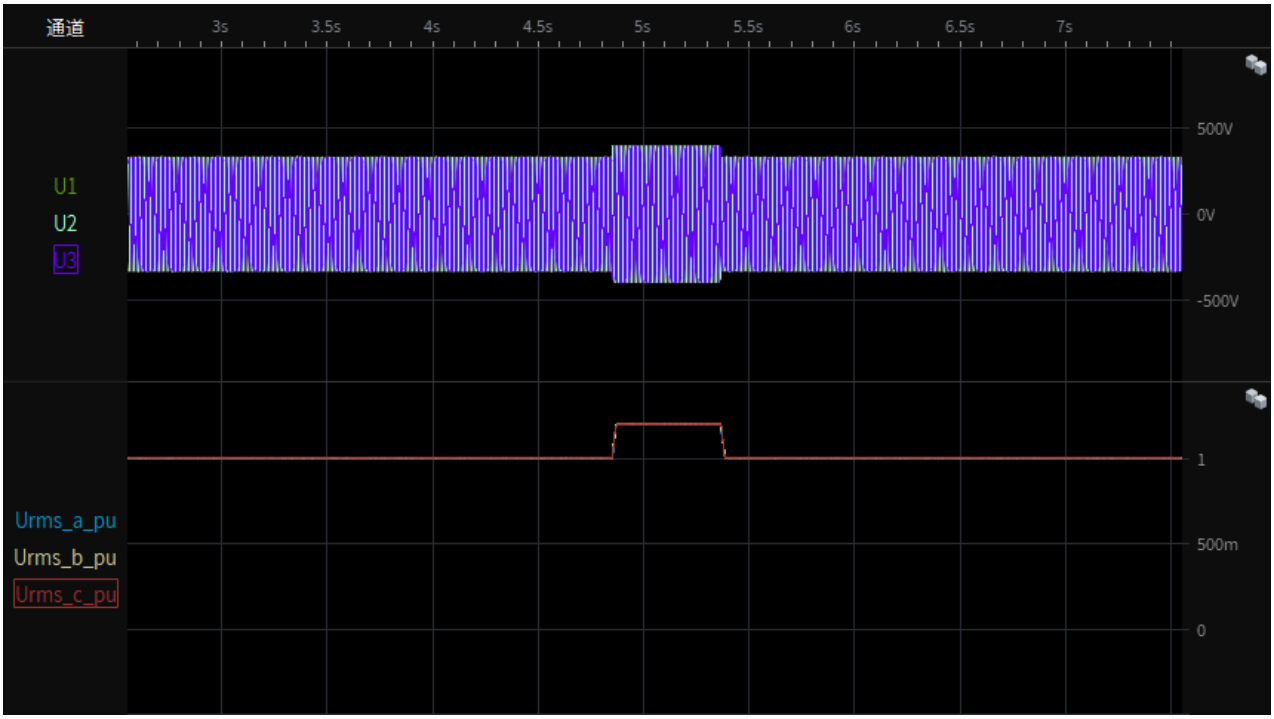


Test 7-2.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

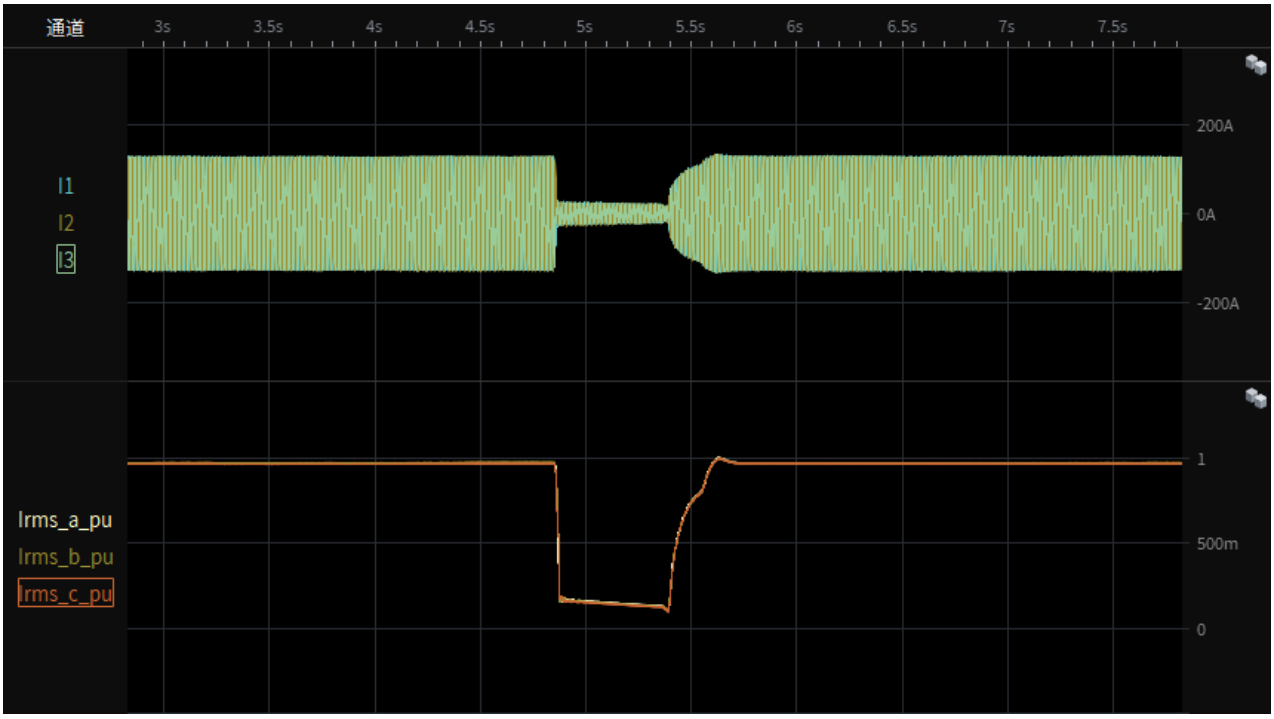


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

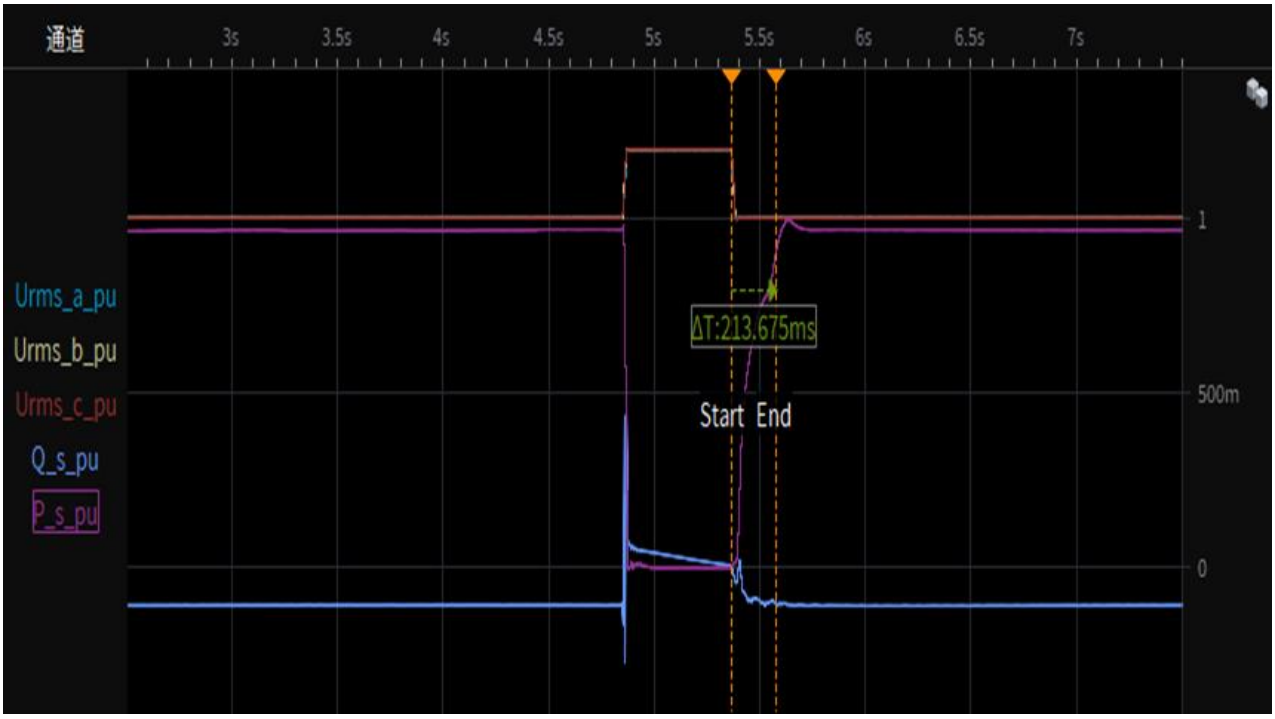


Test 7-2.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

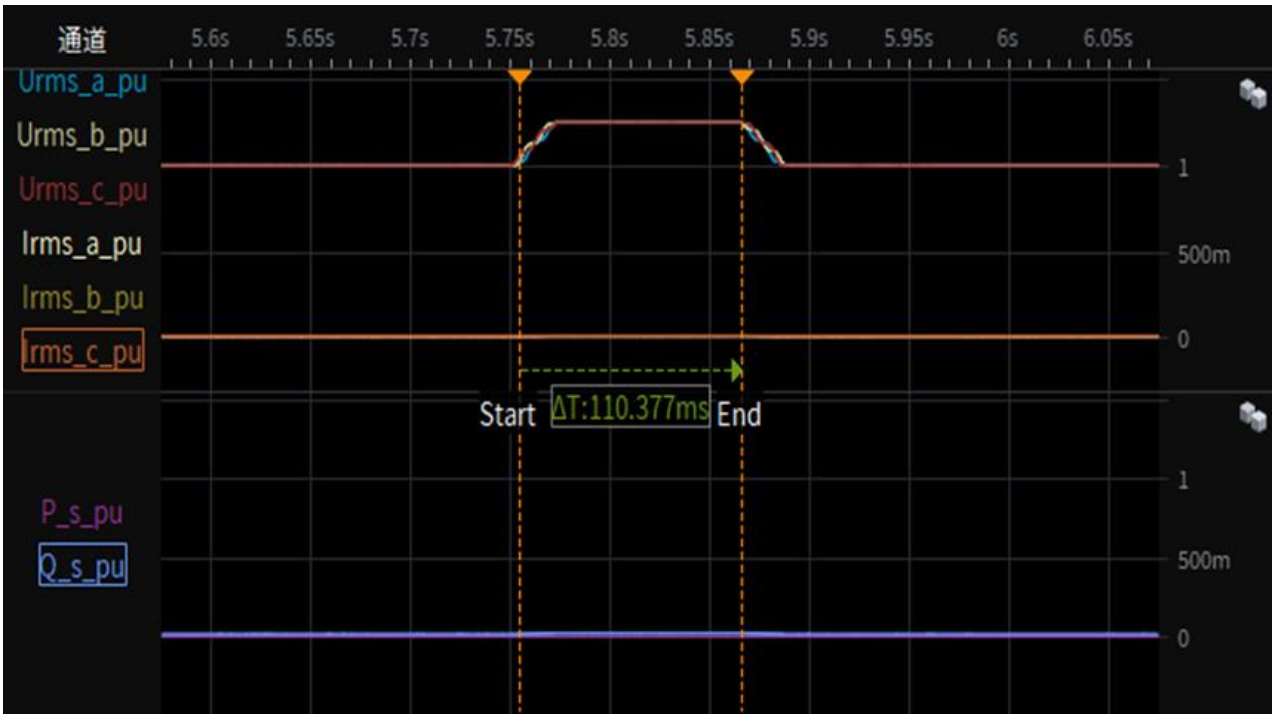


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

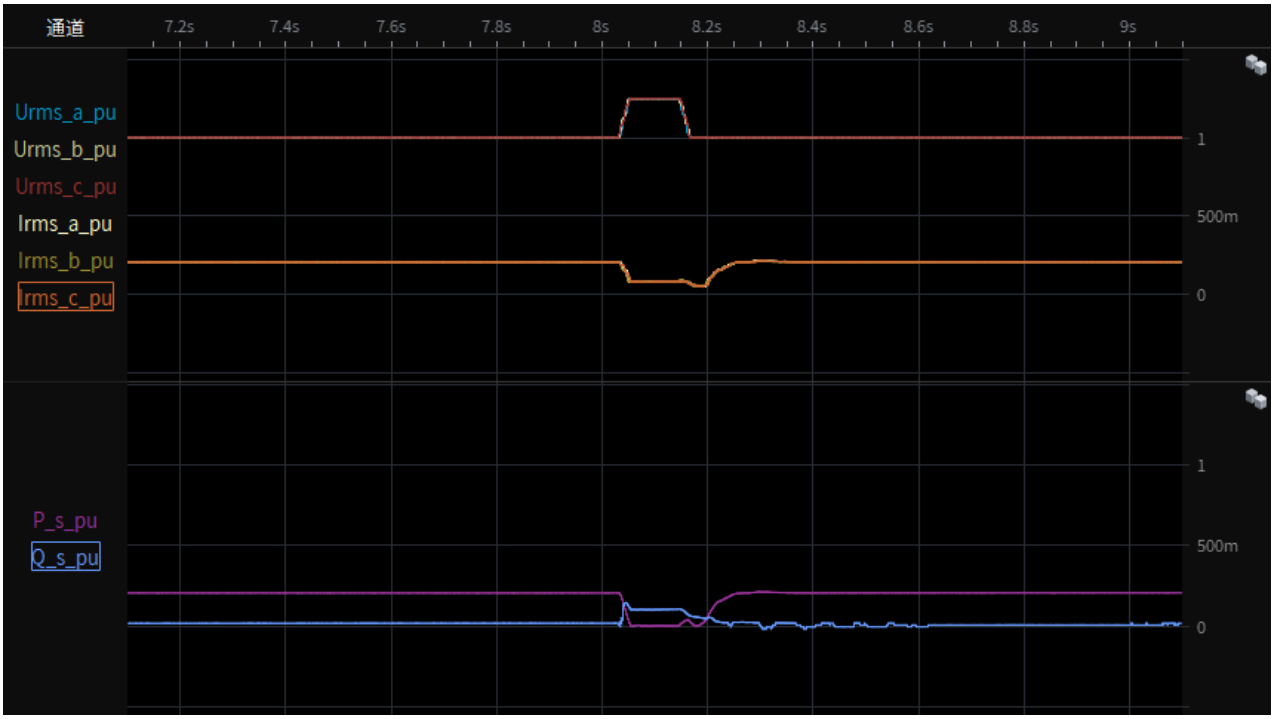


Test 8-Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A), 0% load
Test overview(voltage,current,active and reactive power)

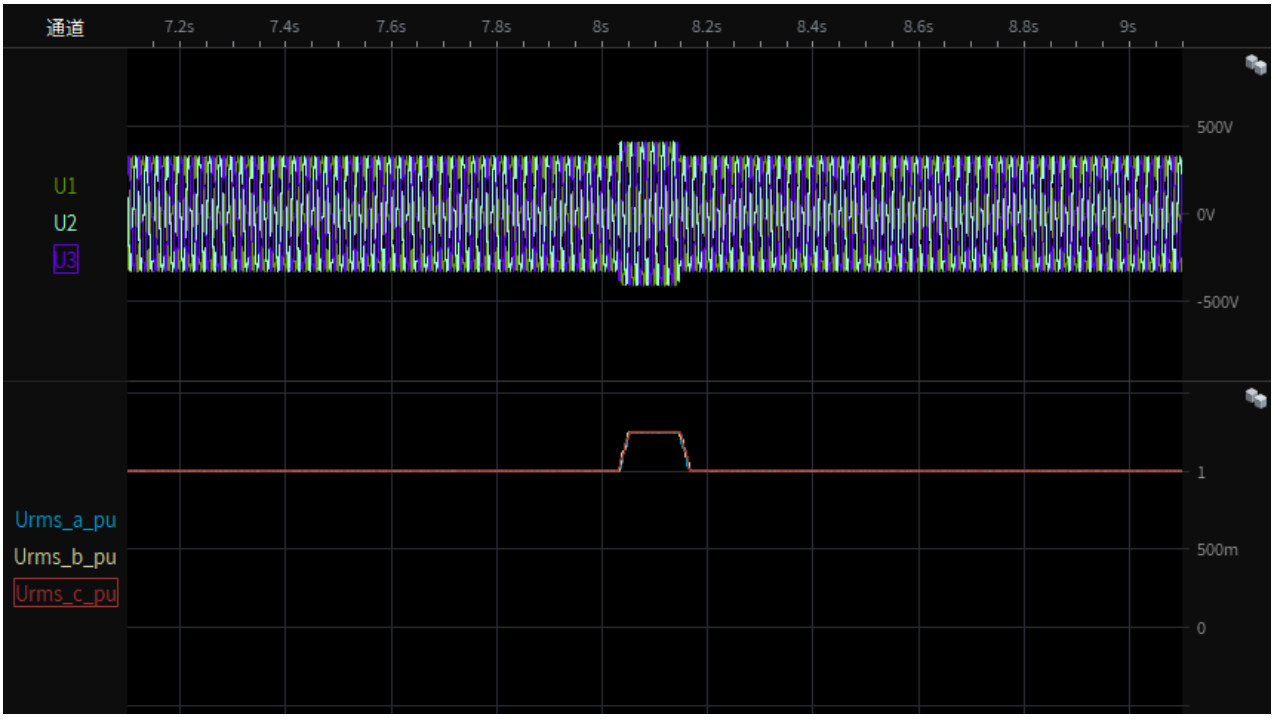


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

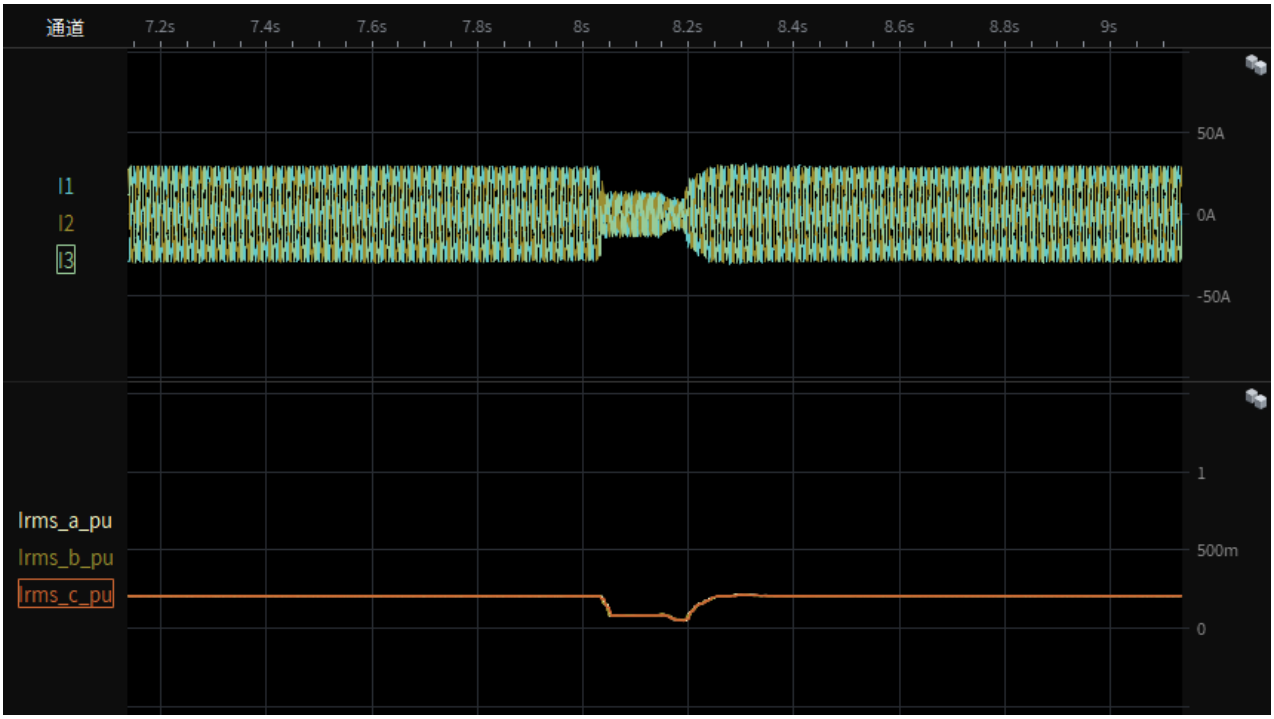


Test 8-1.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

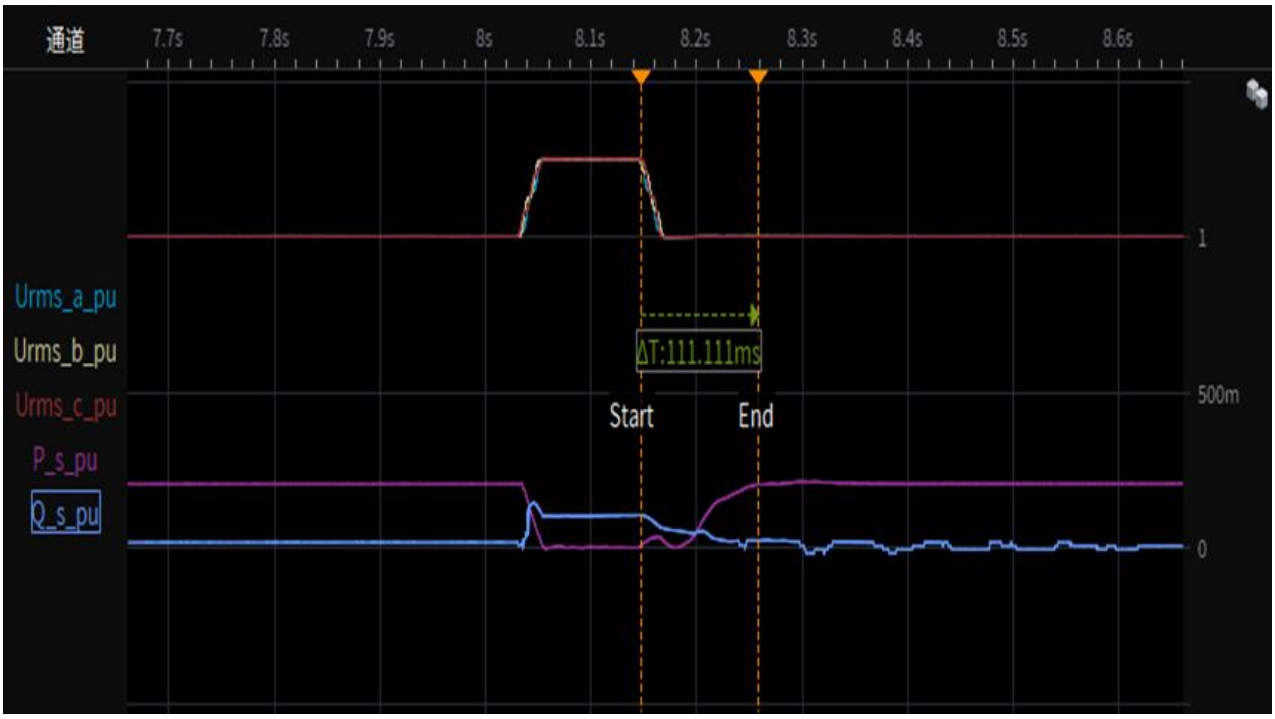


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

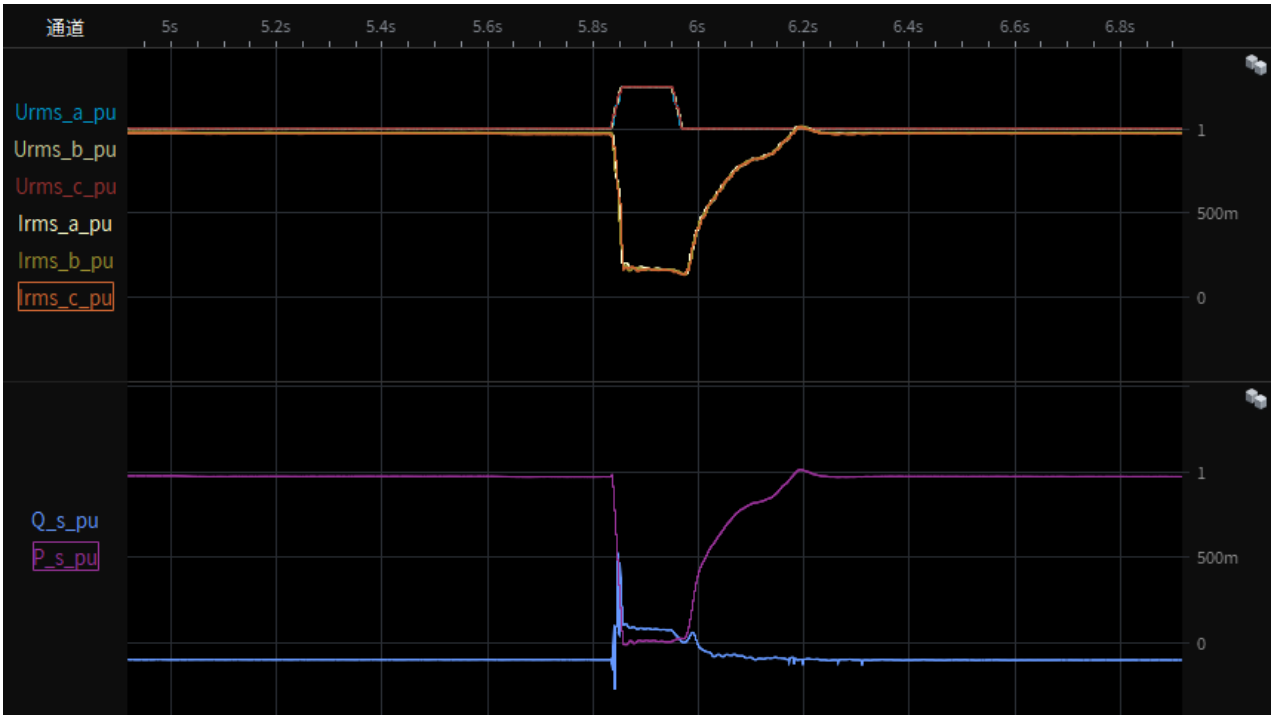


Test 8-1.4 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
restoring time

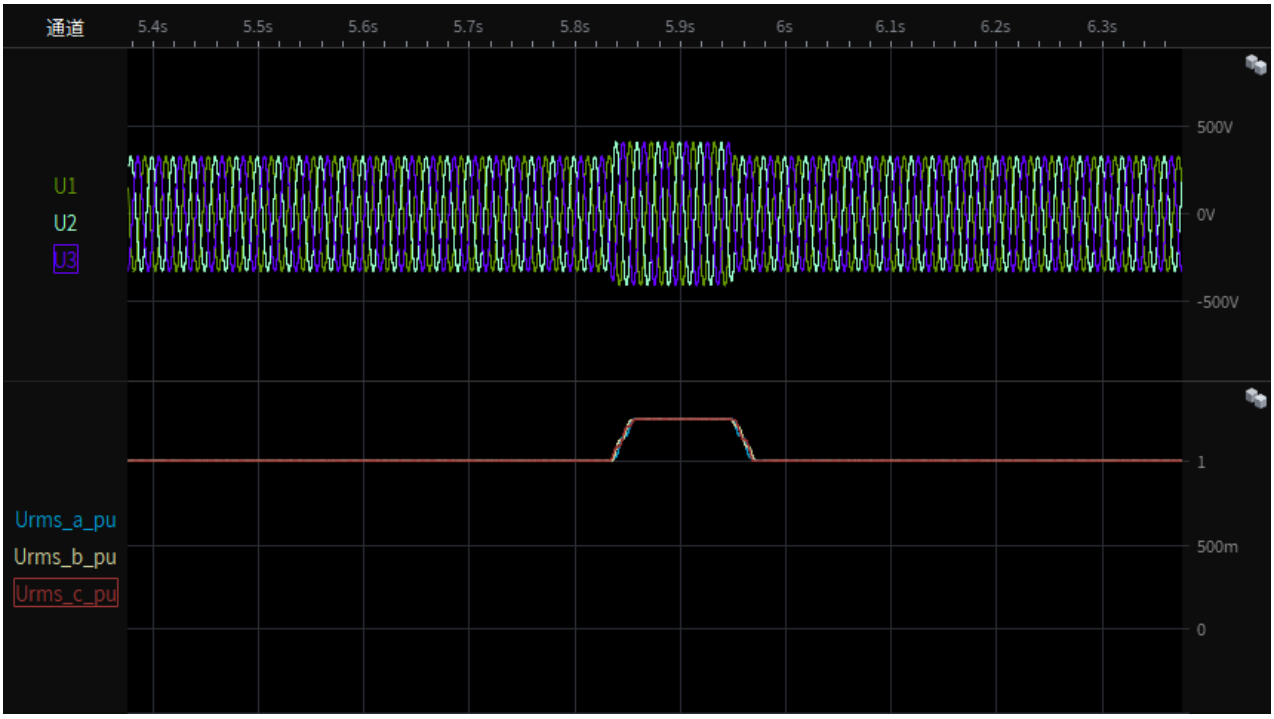


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

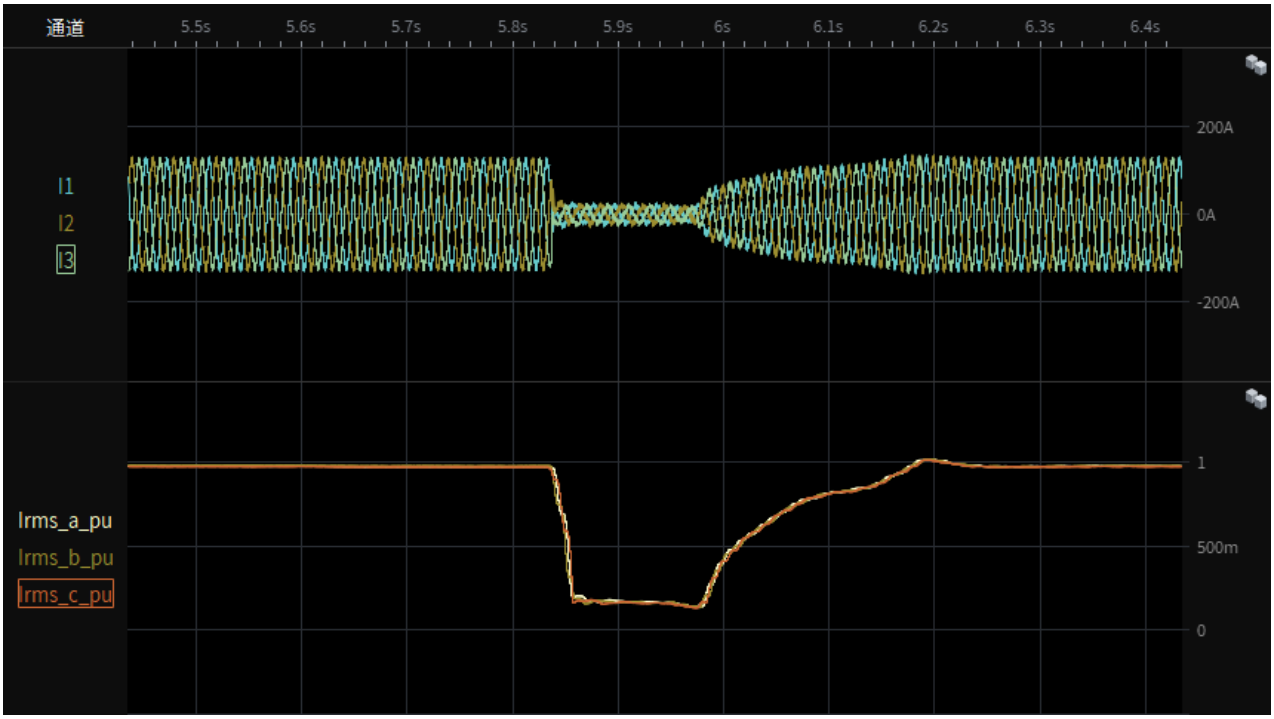


Test 8-2.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

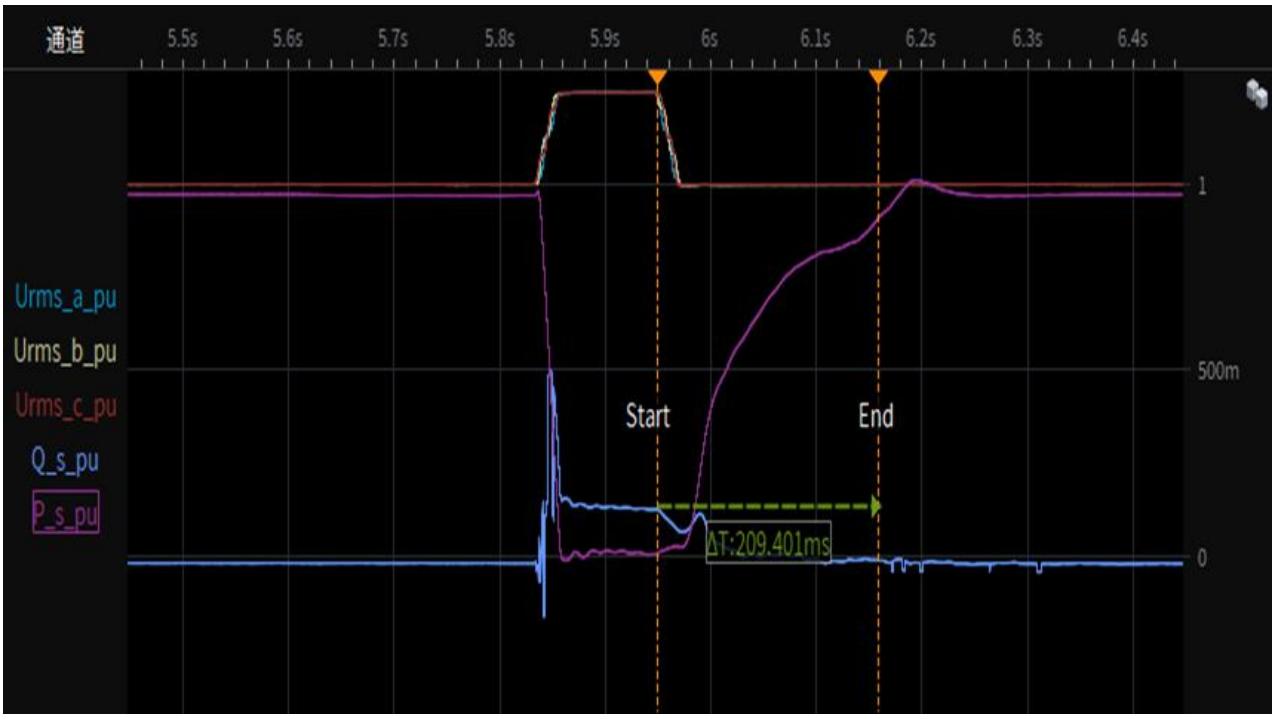


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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	AF60K-TH	

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%	0.9997	90	80.59	81.34	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%	0.9995	180	56.46	0	The inverter is protected off the grid after performing the phase angle conversion and then reconnected to the grid to continue supplying power to the grid. No damage, no danger.

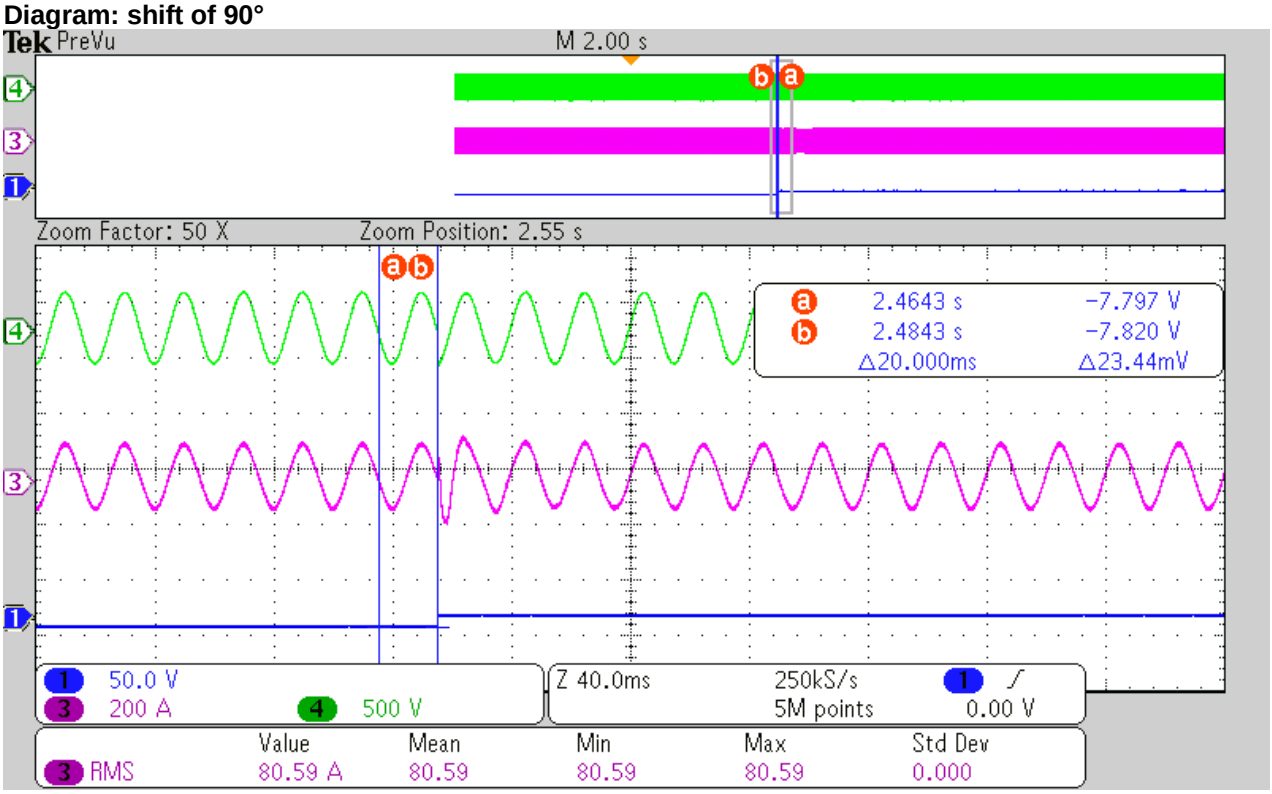
Note:

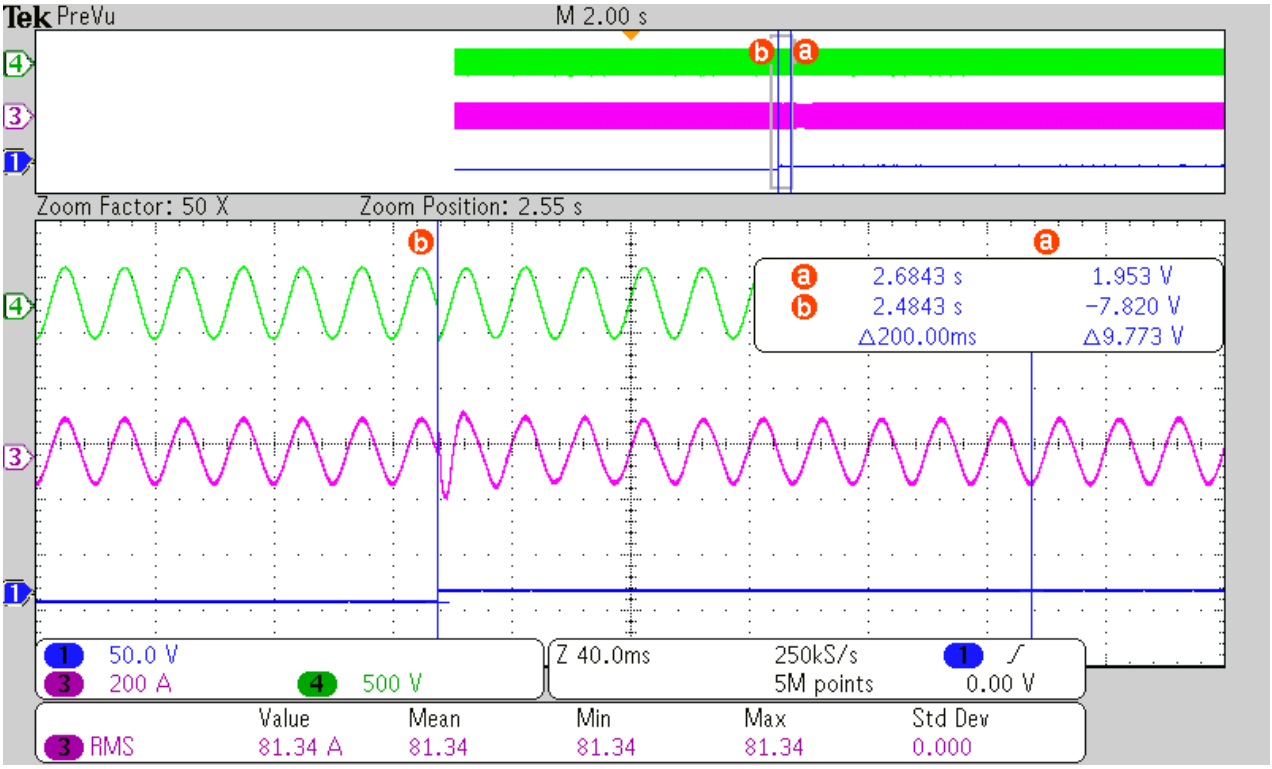
The generator must be brought into operation at rated power. Let the system operate under the set conditions for at least 5 min or the time necessary for the temperature inside the converter to stabilize.

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

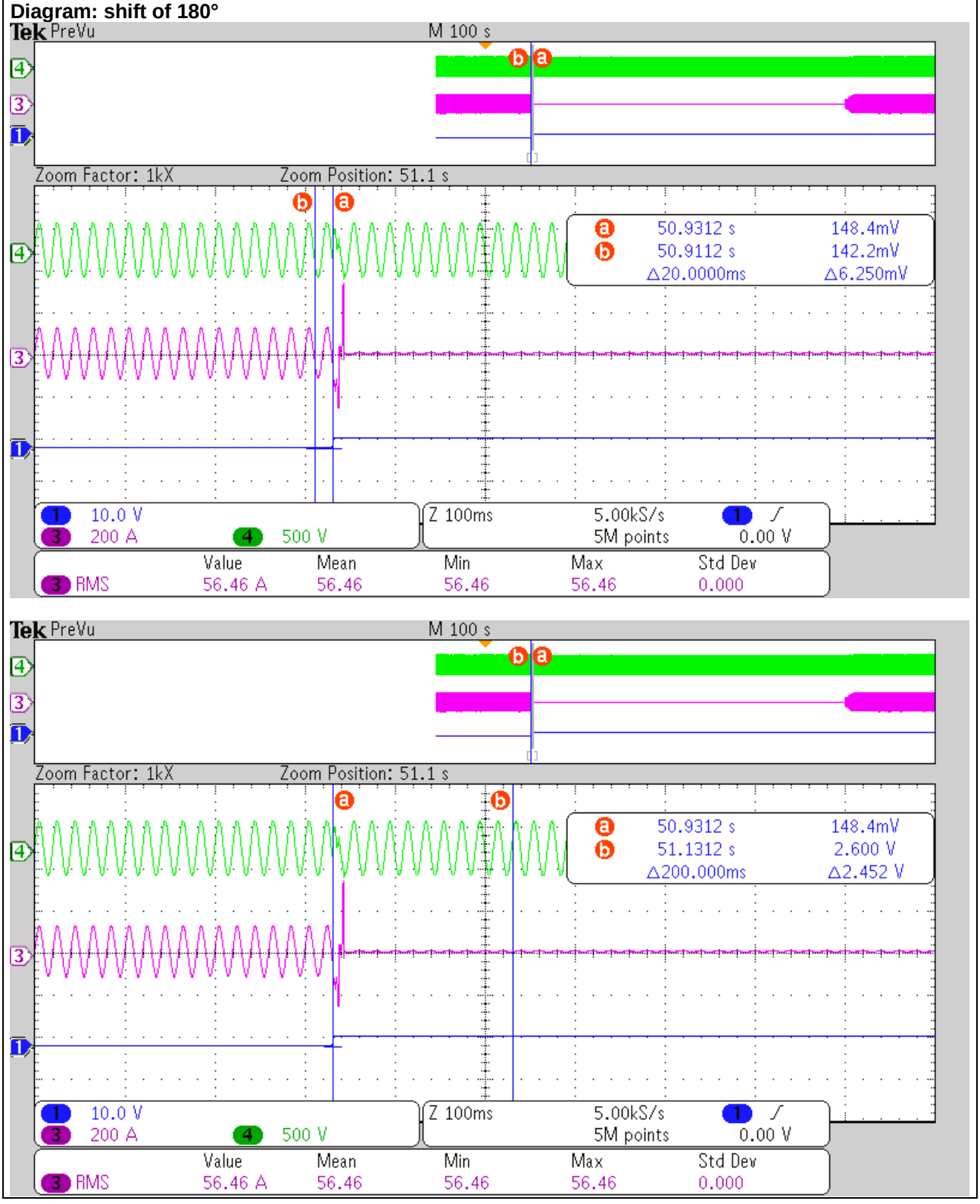
Diagram: shift of 90°





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

Diagram: shift of 180°



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

Bbis.3 a)/b)	**TABLE: Harmonics measurement**	**P**
Mode	AF60K-TH	
☒ CEI EN 61000-3-2 ☒ CEI EN 61000-3-12		
☒ Ambient temperature ☒ -25°C temperature ☒ +60°C temperature		
☒ Full power, 66% and 33% of P_{SMAX} / P_{NINV} ☒ Full power, 66% and 33% of P_{CMAX}		
a) harmonic emission limits, for class A (CEI EN 61000-3-2 or CEI EN 61000-3-12); they must be repeated, for storage systems connected to bidirectional converters, in 6 sessions (at 33%, 66% and 100% of the P_{SMAX}, or P_{NINV} for integrated EESS, and at 33%, 66% and 100% of the P_{CMAX}), and for storage systems connected to unidirectional converters in 3 sessions (at 33%, 66% and 100% of the maximum available discharge power); b) for devices with phase currents higher than 75 A, it is possible to carry out harmonic emission tests with the same criteria provided for by CEI EN 61000-3-12; they must be repeated, for storage systems connected to bidirectional converters, in 6 sessions (at 33%, 66% and 100% of the P_{SMAX}, or P_{NINV} for integrated EESS, and at 33%, 66% and 100% of the P_{CMAX}), and for storage systems connected to unidirectional converters in 3 sessions (at 33%, 66% and 100% of the maximum available discharge power)		
Supplementary information: *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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	14138 (100%, 60°C)
Voltage (V)	230.11
Current (A)	20.87
Power Factor	0.9919
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	20.866	20.862	20.857	--	--	--	--
2nd	0.257	0.271	0.349	1.228	1.298	1.670	8
3rd	1.122	1.235	1.272	5.367	5.907	6.082	N/A
4th	0.181	0.040	0.181	0.866	0.189	0.866	4
5th	0.323	0.340	0.320	1.546	1.627	1.528	10.7
6th	0.174	0.091	0.091	0.831	0.435	0.435	2.7
7th	0.394	0.317	0.395	1.883	1.515	1.889	7.2
8th	0.140	0.141	0.165	0.669	0.675	0.790	2
9th	0.183	0.154	0.154	0.873	0.734	0.734	N/A
10th	0.085	0.091	0.083	0.404	0.436	0.398	1.6
11th	0.145	0.168	0.207	0.694	0.802	0.991	3.1
12th	0.033	0.044	0.027	0.157	0.210	0.129	1.3
13th	0.214	0.253	0.187	1.025	1.212	0.896	2
14th	0.072	0.044	0.094	0.345	0.209	0.449	N/A
15th	0.118	0.094	0.112	0.565	0.449	0.535	N/A
16th	0.066	0.143	0.092	0.316	0.684	0.439	N/A
17th	0.068	0.086	0.081	0.324	0.413	0.385	N/A
18th	0.134	0.050	0.084	0.642	0.241	0.404	N/A
19th	0.033	0.024	0.024	0.159	0.113	0.116	N/A
20th	0.034	0.046	0.022	0.163	0.222	0.106	N/A
21st	0.067	0.050	0.046	0.322	0.237	0.220	N/A
22nd	0.027	0.044	0.041	0.127	0.209	0.197	N/A
23rd	0.030	0.057	0.062	0.144	0.274	0.296	N/A
24th	0.066	0.030	0.055	0.317	0.144	0.262	N/A
25th	0.022	0.040	0.034	0.104	0.189	0.160	N/A
26th	0.033	0.047	0.053	0.156	0.223	0.254	N/A
27th	0.038	0.067	0.053	0.182	0.320	0.256	N/A
28th	0.037	0.056	0.018	0.179	0.266	0.084	N/A
29th	0.050	0.036	0.019	0.238	0.173	0.091	N/A
30th	0.039	0.009	0.022	0.187	0.045	0.107	N/A
31st	0.025	0.035	0.021	0.120	0.167	0.101	N/A
32nd	0.019	0.019	0.015	0.092	0.090	0.074	N/A
33rd	0.010	0.028	0.013	0.046	0.133	0.061	N/A
34th	0.018	0.009	0.012	0.086	0.043	0.056	N/A
35th	0.011	0.019	0.020	0.054	0.092	0.095	N/A
36th	0.018	0.008	0.012	0.088	0.037	0.055	N/A
37th	0.017	0.012	0.018	0.083	0.057	0.084	N/A
38th	0.019	0.012	0.013	0.089	0.060	0.061	N/A
39th	0.015	0.027	0.020	0.070	0.129	0.094	N/A
40th	0.015	0.021	0.019	0.073	0.101	0.091	N/A
THD	--	--	--	6.560	6.904	7.188	13
PWHD	--	--	--	5.620	5.665	5.377	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	9229 (66%, 60°C)
Voltage (V)	230.11
Current (A)	13.50
Power Factor	0.9915
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	13.498	13.495	13.496	--	--	--	--
2nd	0.151	0.183	0.175	1.114	1.352	1.295	8
3rd	0.579	0.650	0.641	4.281	4.809	4.742	N/A
4th	0.110	0.059	0.110	0.816	0.435	0.816	4
5th	0.171	0.234	0.193	1.262	1.729	1.430	10.7
6th	0.032	0.033	0.031	0.237	0.247	0.231	2.7
7th	0.172	0.137	0.143	1.271	1.017	1.061	7.2
8th	0.025	0.030	0.020	0.188	0.221	0.150	2
9th	0.097	0.080	0.080	0.720	0.593	0.593	N/A
10th	0.047	0.038	0.034	0.348	0.279	0.252	1.6
11th	0.052	0.061	0.064	0.383	0.454	0.474	3.1
12th	0.062	0.022	0.036	0.458	0.162	0.264	1.3
13th	0.052	0.085	0.046	0.386	0.626	0.337	2
14th	0.022	0.008	0.024	0.160	0.062	0.180	N/A
15th	0.070	0.022	0.051	0.519	0.162	0.380	N/A
16th	0.025	0.029	0.029	0.185	0.214	0.213	N/A
17th	0.053	0.067	0.069	0.395	0.494	0.507	N/A
18th	0.072	0.025	0.045	0.530	0.188	0.334	N/A
19th	0.036	0.053	0.041	0.266	0.390	0.303	N/A
20th	0.034	0.038	0.038	0.254	0.284	0.282	N/A
21st	0.029	0.046	0.035	0.214	0.342	0.257	N/A
22nd	0.017	0.032	0.018	0.127	0.234	0.134	N/A
23rd	0.022	0.013	0.011	0.159	0.096	0.081	N/A
24th	0.019	0.011	0.011	0.142	0.080	0.085	N/A
25th	0.025	0.022	0.011	0.181	0.165	0.080	N/A
26th	0.007	0.016	0.012	0.051	0.115	0.092	N/A
27th	0.042	0.017	0.031	0.313	0.128	0.231	N/A
28th	0.009	0.017	0.017	0.067	0.129	0.127	N/A
29th	0.008	0.015	0.018	0.062	0.108	0.136	N/A
30th	0.013	0.016	0.023	0.095	0.122	0.173	N/A
31st	0.007	0.012	0.013	0.053	0.090	0.098	N/A
32nd	0.014	0.010	0.015	0.103	0.073	0.108	N/A
33rd	0.006	0.010	0.006	0.046	0.074	0.043	N/A
34th	0.013	0.005	0.011	0.095	0.034	0.084	N/A
35th	0.010	0.012	0.009	0.077	0.092	0.070	N/A
36th	0.016	0.010	0.010	0.116	0.071	0.077	N/A
37th	0.013	0.016	0.005	0.098	0.118	0.041	N/A
38th	0.013	0.010	0.011	0.095	0.077	0.078	N/A
39th	0.006	0.013	0.010	0.042	0.097	0.072	N/A
40th	0.009	0.008	0.006	0.066	0.060	0.047	N/A
THD	--	--	--	5.214	5.689	5.550	13
PWHD	--	--	--	4.918	4.432	4.571	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	4685 (33%, 60°C)
Voltage (V)	230.05
Current (A)	7.05
Power Factor	0.9634
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	7.012	7.010	7.012	--	--	--	--
2nd	0.029	0.029	0.039	0.419	0.410	0.548	8
3rd	0.522	0.546	0.507	7.415	7.760	7.211	N/A
4th	0.012	0.013	0.012	0.167	0.190	0.167	4
5th	0.131	0.127	0.137	1.858	1.801	1.947	10.7
6th	0.007	0.007	0.007	0.097	0.103	0.103	2.7
7th	0.081	0.076	0.079	1.155	1.083	1.130	7.2
8th	0.006	0.005	0.006	0.087	0.077	0.082	2
9th	0.047	0.045	0.045	0.672	0.633	0.633	N/A
10th	0.004	0.003	0.005	0.053	0.049	0.067	1.6
11th	0.027	0.027	0.032	0.391	0.386	0.453	3.1
12th	0.005	0.005	0.006	0.074	0.066	0.078	1.3
13th	0.010	0.009	0.013	0.142	0.125	0.183	2
14th	0.003	0.003	0.003	0.049	0.037	0.047	N/A
15th	0.003	0.004	0.003	0.048	0.056	0.048	N/A
16th	0.003	0.003	0.002	0.038	0.042	0.034	N/A
17th	0.009	0.012	0.009	0.132	0.172	0.129	N/A
18th	0.003	0.003	0.003	0.039	0.039	0.045	N/A
19th	0.013	0.015	0.009	0.183	0.220	0.128	N/A
20th	0.002	0.002	0.002	0.029	0.028	0.034	N/A
21st	0.015	0.016	0.011	0.211	0.228	0.163	N/A
22nd	0.002	0.002	0.003	0.029	0.031	0.045	N/A
23rd	0.016	0.018	0.014	0.231	0.259	0.201	N/A
24th	0.003	0.003	0.003	0.039	0.041	0.040	N/A
25th	0.015	0.016	0.014	0.215	0.228	0.202	N/A
26th	0.003	0.003	0.003	0.036	0.039	0.037	N/A
27th	0.015	0.013	0.016	0.219	0.188	0.224	N/A
28th	0.002	0.003	0.003	0.034	0.047	0.041	N/A
29th	0.012	0.012	0.012	0.164	0.177	0.173	N/A
30th	0.004	0.005	0.004	0.058	0.072	0.056	N/A
31st	0.008	0.009	0.010	0.114	0.131	0.142	N/A
32nd	0.003	0.004	0.003	0.039	0.050	0.048	N/A
33rd	0.005	0.008	0.007	0.068	0.111	0.099	N/A
34th	0.004	0.003	0.004	0.051	0.047	0.051	N/A
35th	0.009	0.006	0.010	0.128	0.084	0.138	N/A
36th	0.004	0.005	0.004	0.055	0.072	0.062	N/A
37th	0.004	0.004	0.005	0.050	0.056	0.065	N/A
38th	0.003	0.003	0.003	0.042	0.040	0.044	N/A
39th	0.005	0.005	0.005	0.068	0.072	0.070	N/A
40th	0.003	0.003	0.003	0.037	0.039	0.039	N/A
THD	--	--	--	8.099	8.414	7.995	13
PWHD	--	--	--	2.915	3.112	2.859	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	-14138 (100%, 60°C)
Voltage (V)	230.11
Current (A)	20.87
Power Factor	-0.9919
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	20.867	20.862	20.858	--	--	--	--
2nd	0.256	0.270	0.349	1.225	1.293	1.669	8
3rd	1.123	1.236	1.272	5.368	5.909	6.082	N/A
4th	0.180	0.039	0.180	0.862	0.187	0.862	4
5th	0.324	0.340	0.319	1.549	1.626	1.526	10.7
6th	0.174	0.090	0.090	0.834	0.432	0.428	2.7
7th	0.393	0.317	0.395	1.879	1.516	1.887	7.2
8th	0.141	0.141	0.166	0.673	0.675	0.796	2
9th	0.182	0.155	0.155	0.872	0.739	0.739	N/A
10th	0.084	0.093	0.084	0.403	0.443	0.402	1.6
11th	0.144	0.168	0.208	0.689	0.804	0.993	3.1
12th	0.032	0.045	0.027	0.152	0.216	0.129	1.3
13th	0.215	0.253	0.187	1.027	1.209	0.895	2
14th	0.071	0.044	0.094	0.341	0.210	0.450	N/A
15th	0.118	0.093	0.111	0.565	0.445	0.533	N/A
16th	0.067	0.144	0.092	0.318	0.686	0.441	N/A
17th	0.067	0.086	0.081	0.320	0.411	0.388	N/A
18th	0.134	0.050	0.084	0.643	0.241	0.402	N/A
19th	0.034	0.023	0.024	0.164	0.110	0.114	N/A
20th	0.034	0.047	0.023	0.165	0.222	0.110	N/A
21st	0.067	0.050	0.045	0.319	0.239	0.216	N/A
22nd	0.027	0.044	0.042	0.129	0.210	0.199	N/A
23rd	0.030	0.058	0.062	0.143	0.277	0.298	N/A
24th	0.066	0.030	0.055	0.314	0.145	0.264	N/A
25th	0.021	0.039	0.033	0.102	0.188	0.159	N/A
26th	0.033	0.047	0.053	0.156	0.226	0.254	N/A
27th	0.038	0.067	0.053	0.181	0.318	0.255	N/A
28th	0.038	0.056	0.018	0.180	0.268	0.085	N/A
29th	0.050	0.037	0.019	0.237	0.175	0.092	N/A
30th	0.039	0.009	0.022	0.188	0.044	0.106	N/A
31st	0.026	0.035	0.021	0.123	0.168	0.100	N/A
32nd	0.020	0.019	0.015	0.095	0.092	0.071	N/A
33rd	0.010	0.028	0.013	0.049	0.136	0.061	N/A
34th	0.018	0.009	0.012	0.088	0.044	0.058	N/A
35th	0.012	0.020	0.020	0.056	0.096	0.096	N/A
36th	0.019	0.008	0.012	0.090	0.038	0.057	N/A
37th	0.017	0.012	0.017	0.083	0.056	0.083	N/A
38th	0.018	0.013	0.013	0.088	0.062	0.061	N/A
39th	0.015	0.027	0.019	0.070	0.127	0.091	N/A
40th	0.016	0.021	0.019	0.075	0.102	0.090	N/A
THD	--	--	--	6.579	6.903	7.187	13
PWHD	--	--	--	5.621	5.679	5.378	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	-9160 (66%, 60°C)
Voltage (V)	230.11
Current (A)	13.41
Power Factor	-0.9913
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	13.400	13.396	13.397	--	--	--	--
2nd	0.150	0.181	0.173	1.117	1.347	1.291	8
3rd	0.578	0.650	0.641	4.309	4.846	4.774	N/A
4th	0.110	0.058	0.110	0.818	0.435	0.818	4
5th	0.169	0.230	0.192	1.258	1.714	1.429	10.7
6th	0.029	0.033	0.031	0.218	0.248	0.229	2.7
7th	0.174	0.139	0.145	1.297	1.033	1.084	7.2
8th	0.026	0.031	0.022	0.197	0.229	0.162	2
9th	0.098	0.080	0.080	0.728	0.597	0.597	N/A
10th	0.047	0.039	0.034	0.351	0.288	0.253	1.6
11th	0.051	0.061	0.065	0.383	0.457	0.481	3.1
12th	0.061	0.022	0.036	0.458	0.164	0.266	1.3
13th	0.053	0.085	0.045	0.397	0.635	0.338	2
14th	0.021	0.009	0.024	0.155	0.063	0.178	N/A
15th	0.070	0.022	0.052	0.522	0.166	0.385	N/A
16th	0.026	0.030	0.029	0.194	0.225	0.219	N/A
17th	0.054	0.067	0.069	0.400	0.502	0.512	N/A
18th	0.072	0.026	0.045	0.539	0.195	0.338	N/A
19th	0.036	0.052	0.041	0.265	0.389	0.305	N/A
20th	0.034	0.039	0.038	0.257	0.287	0.285	N/A
21st	0.028	0.046	0.034	0.211	0.344	0.255	N/A
22nd	0.016	0.031	0.018	0.123	0.228	0.131	N/A
23rd	0.022	0.014	0.012	0.161	0.103	0.089	N/A
24th	0.017	0.011	0.011	0.129	0.081	0.083	N/A
25th	0.024	0.023	0.011	0.180	0.172	0.084	N/A
26th	0.007	0.016	0.014	0.052	0.119	0.103	N/A
27th	0.043	0.018	0.031	0.320	0.135	0.231	N/A
28th	0.009	0.018	0.017	0.066	0.135	0.130	N/A
29th	0.009	0.014	0.018	0.066	0.102	0.138	N/A
30th	0.013	0.017	0.023	0.094	0.124	0.174	N/A
31st	0.007	0.013	0.013	0.052	0.095	0.100	N/A
32nd	0.015	0.010	0.014	0.109	0.073	0.106	N/A
33rd	0.006	0.010	0.006	0.046	0.077	0.043	N/A
34th	0.013	0.005	0.011	0.097	0.035	0.085	N/A
35th	0.011	0.013	0.009	0.078	0.096	0.067	N/A
36th	0.015	0.010	0.010	0.111	0.071	0.076	N/A
37th	0.013	0.015	0.006	0.095	0.115	0.042	N/A
38th	0.012	0.010	0.010	0.093	0.075	0.078	N/A
39th	0.005	0.012	0.010	0.039	0.092	0.074	N/A
40th	0.009	0.008	0.006	0.064	0.058	0.047	N/A
THD	--	--	--	5.463	5.932	5.820	13
PWHD	--	--	--	4.952	4.482	4.610	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	-4713 (33%, 60°C)
Voltage (V)	230.00
Current (A)	7.09
Power Factor	-0.9638
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	7.050	7.048	7.051	--	--	--	--
2nd	0.029	0.029	0.041	0.414	0.404	0.581	8
3rd	0.525	0.548	0.510	7.423	7.752	7.210	N/A
4th	0.013	0.013	0.013	0.181	0.189	0.181	4
5th	0.131	0.127	0.137	1.857	1.801	1.937	10.7
6th	0.007	0.007	0.007	0.103	0.105	0.104	2.7
7th	0.082	0.076	0.080	1.157	1.081	1.131	7.2
8th	0.006	0.005	0.006	0.088	0.077	0.084	2
9th	0.047	0.045	0.045	0.671	0.638	0.638	N/A
10th	0.004	0.004	0.005	0.054	0.052	0.069	1.6
11th	0.028	0.027	0.032	0.390	0.388	0.453	3.1
12th	0.005	0.005	0.006	0.077	0.068	0.079	1.3
13th	0.010	0.009	0.013	0.138	0.127	0.178	2
14th	0.004	0.003	0.003	0.050	0.038	0.047	N/A
15th	0.003	0.004	0.004	0.048	0.056	0.051	N/A
16th	0.003	0.003	0.003	0.039	0.039	0.038	N/A
17th	0.009	0.012	0.009	0.133	0.172	0.128	N/A
18th	0.003	0.003	0.003	0.038	0.038	0.048	N/A
19th	0.013	0.016	0.009	0.182	0.221	0.131	N/A
20th	0.002	0.002	0.003	0.030	0.030	0.038	N/A
21st	0.015	0.016	0.012	0.212	0.229	0.167	N/A
22nd	0.002	0.002	0.004	0.031	0.035	0.050	N/A
23rd	0.016	0.018	0.014	0.230	0.258	0.200	N/A
24th	0.002	0.002	0.003	0.035	0.035	0.037	N/A
25th	0.015	0.016	0.014	0.214	0.230	0.201	N/A
26th	0.003	0.003	0.003	0.037	0.041	0.039	N/A
27th	0.016	0.013	0.016	0.220	0.189	0.221	N/A
28th	0.002	0.003	0.003	0.032	0.046	0.040	N/A
29th	0.012	0.013	0.012	0.164	0.178	0.171	N/A
30th	0.003	0.004	0.003	0.042	0.052	0.048	N/A
31st	0.008	0.009	0.010	0.113	0.130	0.143	N/A
32nd	0.003	0.004	0.004	0.041	0.051	0.050	N/A
33rd	0.005	0.008	0.007	0.068	0.108	0.103	N/A
34th	0.004	0.004	0.004	0.052	0.050	0.050	N/A
35th	0.009	0.006	0.010	0.122	0.081	0.137	N/A
36th	0.003	0.004	0.004	0.041	0.052	0.051	N/A
37th	0.003	0.004	0.004	0.048	0.054	0.061	N/A
38th	0.003	0.003	0.003	0.039	0.044	0.044	N/A
39th	0.005	0.005	0.005	0.068	0.067	0.068	N/A
40th	0.002	0.003	0.003	0.034	0.036	0.039	N/A
THD	--	--	--	8.114	8.396	8.015	13
PWHD	--	--	--	2.884	3.087	2.844	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	14138 (100%, 60°C)
Voltage (V)	230.11
Current (A)	20.87
Power Factor	0.9919
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	20.867	20.862	20.858	--	--	--	--
2nd	0.257	0.271	0.349	1.228	1.296	1.669	8
3rd	1.122	1.236	1.271	5.367	5.911	6.079	N/A
4th	0.180	0.039	0.180	0.862	0.185	0.862	4
5th	0.324	0.341	0.320	1.551	1.630	1.530	10.7
6th	0.174	0.090	0.090	0.834	0.430	0.433	2.7
7th	0.393	0.317	0.395	1.879	1.516	1.890	7.2
8th	0.141	0.140	0.166	0.675	0.671	0.794	2
9th	0.182	0.154	0.154	0.872	0.736	0.736	N/A
10th	0.084	0.093	0.084	0.404	0.443	0.400	1.6
11th	0.144	0.168	0.208	0.689	0.804	0.993	3.1
12th	0.031	0.044	0.027	0.150	0.212	0.129	1.3
13th	0.214	0.253	0.188	1.025	1.209	0.900	2
14th	0.071	0.044	0.094	0.342	0.212	0.450	N/A
15th	0.118	0.093	0.112	0.566	0.445	0.536	N/A
16th	0.066	0.143	0.092	0.318	0.684	0.441	N/A
17th	0.067	0.085	0.082	0.321	0.408	0.390	N/A
18th	0.134	0.049	0.085	0.642	0.237	0.405	N/A
19th	0.034	0.023	0.024	0.165	0.111	0.116	N/A
20th	0.035	0.047	0.023	0.166	0.223	0.109	N/A
21st	0.067	0.050	0.046	0.319	0.238	0.218	N/A
22nd	0.027	0.044	0.041	0.128	0.208	0.198	N/A
23rd	0.030	0.058	0.062	0.143	0.275	0.296	N/A
24th	0.065	0.030	0.054	0.311	0.145	0.260	N/A
25th	0.022	0.039	0.033	0.104	0.187	0.159	N/A
26th	0.033	0.047	0.053	0.156	0.226	0.254	N/A
27th	0.037	0.067	0.053	0.179	0.319	0.256	N/A
28th	0.038	0.056	0.018	0.180	0.266	0.086	N/A
29th	0.050	0.037	0.019	0.237	0.178	0.090	N/A
30th	0.039	0.009	0.022	0.187	0.043	0.105	N/A
31st	0.026	0.035	0.021	0.123	0.167	0.098	N/A
32nd	0.020	0.019	0.015	0.096	0.092	0.072	N/A
33rd	0.010	0.028	0.013	0.048	0.135	0.061	N/A
34th	0.018	0.009	0.012	0.086	0.044	0.058	N/A
35th	0.011	0.020	0.020	0.055	0.094	0.094	N/A
36th	0.019	0.008	0.012	0.089	0.037	0.057	N/A
37th	0.017	0.012	0.017	0.084	0.056	0.082	N/A
38th	0.019	0.013	0.013	0.089	0.061	0.060	N/A
39th	0.014	0.027	0.019	0.069	0.127	0.091	N/A
40th	0.016	0.021	0.019	0.077	0.101	0.090	N/A
THD	--	--	--	6.563	6.897	7.207	13
PWHD	--	--	--	5.614	5.663	5.380	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	9260 (66%, 60°C)
Voltage (V)	230.11
Current (A)	13.55
Power Factor	0.9916
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	13.543	13.539	13.541	--	--	--	--
2nd	0.117	0.198	0.176	0.864	1.460	1.299	8
3rd	0.579	0.650	0.638	4.269	4.792	4.706	N/A
4th	0.124	0.062	0.124	0.911	0.461	0.911	4
5th	0.175	0.232	0.191	1.289	1.712	1.412	10.7
6th	0.032	0.032	0.033	0.235	0.233	0.242	2.7
7th	0.169	0.139	0.145	1.246	1.022	1.070	7.2
8th	0.023	0.031	0.023	0.170	0.231	0.167	2
9th	0.095	0.082	0.082	0.698	0.604	0.604	N/A
10th	0.045	0.041	0.037	0.329	0.304	0.269	1.6
11th	0.052	0.058	0.061	0.381	0.431	0.452	3.1
12th	0.062	0.023	0.036	0.461	0.170	0.265	1.3
13th	0.052	0.081	0.043	0.383	0.600	0.316	2
14th	0.022	0.008	0.023	0.159	0.055	0.167	N/A
15th	0.069	0.022	0.052	0.510	0.165	0.385	N/A
16th	0.025	0.030	0.028	0.186	0.219	0.206	N/A
17th	0.054	0.069	0.070	0.397	0.509	0.514	N/A
18th	0.072	0.026	0.045	0.529	0.192	0.334	N/A
19th	0.037	0.054	0.042	0.270	0.398	0.310	N/A
20th	0.034	0.040	0.041	0.247	0.293	0.303	N/A
21st	0.029	0.046	0.034	0.214	0.340	0.253	N/A
22nd	0.017	0.033	0.020	0.123	0.244	0.148	N/A
23rd	0.022	0.014	0.011	0.166	0.104	0.084	N/A
24th	0.021	0.011	0.011	0.156	0.078	0.083	N/A
25th	0.025	0.023	0.012	0.181	0.172	0.087	N/A
26th	0.007	0.015	0.012	0.051	0.112	0.086	N/A
27th	0.042	0.017	0.030	0.309	0.123	0.224	N/A
28th	0.009	0.019	0.017	0.067	0.140	0.127	N/A
29th	0.008	0.014	0.018	0.059	0.105	0.133	N/A
30th	0.014	0.016	0.022	0.101	0.120	0.164	N/A
31st	0.007	0.012	0.014	0.052	0.089	0.103	N/A
32nd	0.013	0.010	0.015	0.098	0.074	0.112	N/A
33rd	0.006	0.009	0.006	0.043	0.064	0.042	N/A
34th	0.012	0.006	0.012	0.089	0.042	0.090	N/A
35th	0.009	0.013	0.010	0.069	0.096	0.073	N/A
36th	0.016	0.009	0.010	0.116	0.066	0.076	N/A
37th	0.013	0.015	0.005	0.093	0.111	0.037	N/A
38th	0.013	0.011	0.011	0.097	0.083	0.081	N/A
39th	0.006	0.013	0.010	0.042	0.098	0.073	N/A
40th	0.008	0.008	0.007	0.060	0.060	0.053	N/A
THD	--	--	--	5.190	5.763	5.552	13
PWHD	--	--	--	4.894	4.506	4.610	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	4571 (33%, 60°C)
Voltage (V)	230.05
Current (A)	6.89
Power Factor	0.9811
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	6.853	6.851	6.854	--	--	--	--
2nd	0.032	0.028	0.035	0.470	0.402	0.506	8
3rd	0.515	0.537	0.500	7.487	7.806	7.280	N/A
4th	0.011	0.012	0.011	0.160	0.172	0.160	4
5th	0.130	0.125	0.133	1.895	1.821	1.940	10.7
6th	0.007	0.007	0.007	0.100	0.100	0.098	2.7
7th	0.080	0.076	0.078	1.159	1.100	1.134	7.2
8th	0.006	0.005	0.006	0.082	0.078	0.084	2
9th	0.046	0.043	0.043	0.666	0.620	0.620	N/A
10th	0.004	0.003	0.004	0.054	0.050	0.062	1.6
11th	0.026	0.025	0.031	0.377	0.371	0.449	3.1
12th	0.005	0.005	0.005	0.075	0.072	0.071	1.3
13th	0.009	0.008	0.012	0.127	0.112	0.179	2
14th	0.004	0.003	0.003	0.053	0.042	0.049	N/A
15th	0.004	0.005	0.004	0.053	0.070	0.052	N/A
16th	0.003	0.003	0.003	0.040	0.048	0.040	N/A
17th	0.010	0.013	0.009	0.151	0.190	0.133	N/A
18th	0.003	0.003	0.003	0.038	0.038	0.049	N/A
19th	0.014	0.016	0.010	0.198	0.228	0.148	N/A
20th	0.002	0.002	0.003	0.033	0.032	0.041	N/A
21st	0.016	0.016	0.012	0.229	0.235	0.181	N/A
22nd	0.002	0.002	0.003	0.031	0.029	0.045	N/A
23rd	0.017	0.018	0.015	0.241	0.264	0.215	N/A
24th	0.002	0.003	0.003	0.036	0.037	0.041	N/A
25th	0.015	0.016	0.015	0.221	0.239	0.216	N/A
26th	0.003	0.003	0.003	0.040	0.042	0.037	N/A
27th	0.015	0.013	0.016	0.218	0.192	0.227	N/A
28th	0.002	0.003	0.003	0.036	0.044	0.037	N/A
29th	0.011	0.013	0.012	0.160	0.182	0.178	N/A
30th	0.003	0.004	0.003	0.048	0.057	0.049	N/A
31st	0.008	0.009	0.010	0.119	0.132	0.145	N/A
32nd	0.003	0.004	0.004	0.044	0.062	0.052	N/A
33rd	0.005	0.007	0.007	0.073	0.104	0.105	N/A
34th	0.004	0.003	0.003	0.052	0.042	0.047	N/A
35th	0.008	0.005	0.009	0.114	0.071	0.128	N/A
36th	0.003	0.004	0.004	0.049	0.056	0.054	N/A
37th	0.003	0.004	0.004	0.050	0.053	0.059	N/A
38th	0.003	0.003	0.003	0.042	0.042	0.045	N/A
39th	0.005	0.005	0.004	0.071	0.075	0.060	N/A
40th	0.003	0.003	0.003	0.040	0.039	0.039	N/A
THD	--	--	--	8.237	8.476	8.018	13
PWHD	--	--	--	2.994	3.171	2.945	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	-14140 (100%, 60°C)
Voltage (V)	230.11
Current (A)	20.87
Power Factor	-0.9919
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	20.869	20.865	20.861	--	--	--	--
2nd	0.253	0.272	0.347	1.210	1.302	1.661	8
3rd	1.124	1.237	1.271	5.376	5.913	6.077	N/A
4th	0.180	0.039	0.180	0.862	0.187	0.862	4
5th	0.324	0.340	0.321	1.550	1.626	1.533	10.7
6th	0.175	0.090	0.091	0.835	0.433	0.435	2.7
7th	0.393	0.317	0.396	1.881	1.517	1.892	7.2
8th	0.141	0.141	0.167	0.674	0.675	0.797	2
9th	0.182	0.154	0.154	0.870	0.737	0.737	N/A
10th	0.084	0.093	0.084	0.403	0.444	0.399	1.6
11th	0.144	0.169	0.208	0.690	0.806	0.993	3.1
12th	0.032	0.044	0.027	0.151	0.210	0.127	1.3
13th	0.215	0.254	0.188	1.027	1.212	0.899	2
14th	0.072	0.044	0.095	0.344	0.213	0.452	N/A
15th	0.118	0.093	0.112	0.564	0.447	0.535	N/A
16th	0.066	0.143	0.092	0.316	0.684	0.440	N/A
17th	0.067	0.086	0.081	0.322	0.411	0.386	N/A
18th	0.135	0.050	0.085	0.645	0.239	0.405	N/A
19th	0.034	0.024	0.024	0.165	0.114	0.114	N/A
20th	0.035	0.048	0.022	0.167	0.228	0.107	N/A
21st	0.067	0.050	0.045	0.319	0.239	0.217	N/A
22nd	0.027	0.043	0.041	0.128	0.206	0.198	N/A
23rd	0.030	0.057	0.062	0.142	0.274	0.296	N/A
24th	0.066	0.030	0.055	0.315	0.145	0.263	N/A
25th	0.022	0.040	0.033	0.104	0.189	0.158	N/A
26th	0.033	0.047	0.053	0.159	0.227	0.253	N/A
27th	0.038	0.067	0.053	0.182	0.318	0.255	N/A
28th	0.038	0.056	0.018	0.179	0.267	0.086	N/A
29th	0.050	0.037	0.019	0.238	0.175	0.089	N/A
30th	0.040	0.009	0.022	0.190	0.044	0.107	N/A
31st	0.026	0.035	0.021	0.122	0.168	0.098	N/A
32nd	0.020	0.019	0.016	0.094	0.092	0.074	N/A
33rd	0.010	0.028	0.012	0.046	0.134	0.060	N/A
34th	0.018	0.009	0.012	0.088	0.042	0.058	N/A
35th	0.012	0.020	0.020	0.057	0.094	0.095	N/A
36th	0.019	0.008	0.012	0.089	0.037	0.055	N/A
37th	0.017	0.011	0.018	0.081	0.055	0.084	N/A
38th	0.018	0.012	0.013	0.087	0.059	0.061	N/A
39th	0.015	0.027	0.019	0.070	0.127	0.093	N/A
40th	0.016	0.021	0.019	0.076	0.100	0.090	N/A
THD	--	--	--	6.592	6.915	7.199	13
PWHD	--	--	--	5.630	5.670	5.376	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3	

Active power (W)	-9264 (66%, 60°C)
Voltage (V)	230.11
Current (A)	13.55
Power Factor	-0.9915
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	13.548	13.544	13.546	--	--	--	--
2nd	0.138	0.189	0.176	1.015	1.396	1.295	8
3rd	0.579	0.650	0.639	4.270	4.791	4.712	N/A
4th	0.116	0.060	0.116	0.852	0.443	0.852	4
5th	0.173	0.234	0.193	1.273	1.722	1.425	10.7
6th	0.033	0.032	0.032	0.242	0.239	0.239	2.7
7th	0.170	0.138	0.144	1.253	1.015	1.059	7.2
8th	0.024	0.030	0.021	0.179	0.222	0.154	2
9th	0.096	0.081	0.081	0.711	0.595	0.595	N/A
10th	0.046	0.039	0.035	0.340	0.288	0.255	1.6
11th	0.052	0.060	0.063	0.382	0.443	0.462	3.1
12th	0.062	0.022	0.036	0.459	0.166	0.264	1.3
13th	0.052	0.083	0.044	0.383	0.611	0.327	2
14th	0.022	0.008	0.024	0.159	0.058	0.179	N/A
15th	0.070	0.022	0.052	0.516	0.162	0.381	N/A
16th	0.025	0.029	0.029	0.183	0.212	0.210	N/A
17th	0.054	0.068	0.069	0.395	0.498	0.510	N/A
18th	0.071	0.026	0.045	0.523	0.190	0.329	N/A
19th	0.036	0.053	0.042	0.268	0.393	0.308	N/A
20th	0.034	0.039	0.039	0.253	0.288	0.287	N/A
21st	0.029	0.046	0.035	0.217	0.342	0.256	N/A
22nd	0.017	0.032	0.019	0.125	0.238	0.141	N/A
23rd	0.022	0.013	0.011	0.165	0.098	0.080	N/A
24th	0.020	0.011	0.011	0.150	0.081	0.084	N/A
25th	0.025	0.022	0.011	0.182	0.164	0.082	N/A
26th	0.007	0.016	0.012	0.052	0.115	0.090	N/A
27th	0.042	0.017	0.031	0.308	0.127	0.230	N/A
28th	0.009	0.018	0.017	0.066	0.131	0.128	N/A
29th	0.008	0.015	0.018	0.062	0.107	0.135	N/A
30th	0.013	0.017	0.023	0.095	0.122	0.168	N/A
31st	0.007	0.013	0.013	0.054	0.092	0.098	N/A
32nd	0.014	0.010	0.015	0.100	0.074	0.110	N/A
33rd	0.006	0.010	0.006	0.046	0.070	0.041	N/A
34th	0.013	0.005	0.012	0.093	0.038	0.086	N/A
35th	0.010	0.012	0.010	0.076	0.091	0.071	N/A
36th	0.016	0.009	0.010	0.116	0.067	0.075	N/A
37th	0.013	0.015	0.005	0.096	0.113	0.039	N/A
38th	0.013	0.011	0.011	0.096	0.080	0.078	N/A
39th	0.006	0.014	0.010	0.043	0.100	0.071	N/A
40th	0.009	0.008	0.007	0.064	0.060	0.049	N/A
THD	--	--	--	5.195	5.762	5.532	13
PWHD	--	--	--	4.899	4.453	4.577	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBox-3
Active power (W)	-4664 (33%, 60°C)
Voltage (V)	230.05
Current (A)	7.02
Power Factor	-0.9630
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	6.983	6.981	6.984	--	--	--	--
2nd	0.030	0.026	0.039	0.431	0.369	0.554	8
3rd	0.519	0.543	0.505	7.407	7.758	7.210	N/A
4th	0.012	0.014	0.012	0.174	0.194	0.174	4
5th	0.130	0.127	0.136	1.863	1.808	1.938	10.7
6th	0.007	0.007	0.008	0.104	0.097	0.114	2.7
7th	0.081	0.076	0.079	1.159	1.080	1.130	7.2
8th	0.006	0.006	0.006	0.091	0.081	0.093	2
9th	0.047	0.044	0.044	0.670	0.635	0.635	N/A
10th	0.004	0.004	0.005	0.052	0.052	0.067	1.6
11th	0.027	0.027	0.032	0.390	0.384	0.454	3.1
12th	0.005	0.005	0.006	0.074	0.069	0.079	1.3
13th	0.010	0.009	0.012	0.142	0.128	0.178	2
14th	0.003	0.003	0.003	0.048	0.036	0.044	N/A
15th	0.003	0.004	0.003	0.048	0.056	0.050	N/A
16th	0.003	0.003	0.003	0.038	0.043	0.036	N/A
17th	0.009	0.012	0.009	0.135	0.169	0.125	N/A
18th	0.003	0.003	0.003	0.040	0.038	0.049	N/A
19th	0.013	0.015	0.009	0.180	0.218	0.133	N/A
20th	0.002	0.002	0.002	0.031	0.029	0.036	N/A
21st	0.015	0.016	0.011	0.214	0.228	0.162	N/A
22nd	0.002	0.002	0.003	0.030	0.030	0.042	N/A
23rd	0.016	0.018	0.014	0.226	0.260	0.199	N/A
24th	0.003	0.003	0.003	0.037	0.041	0.039	N/A
25th	0.015	0.016	0.014	0.216	0.232	0.195	N/A
26th	0.003	0.003	0.003	0.036	0.038	0.036	N/A
27th	0.015	0.014	0.016	0.218	0.193	0.226	N/A
28th	0.002	0.003	0.003	0.033	0.047	0.043	N/A
29th	0.012	0.013	0.012	0.170	0.180	0.167	N/A
30th	0.004	0.005	0.004	0.062	0.075	0.059	N/A
31st	0.007	0.009	0.010	0.106	0.134	0.144	N/A
32nd	0.003	0.004	0.004	0.039	0.054	0.050	N/A
33rd	0.005	0.008	0.007	0.071	0.110	0.106	N/A
34th	0.004	0.003	0.003	0.054	0.048	0.048	N/A
35th	0.009	0.005	0.009	0.122	0.077	0.131	N/A
36th	0.004	0.005	0.004	0.058	0.068	0.060	N/A
37th	0.004	0.004	0.004	0.053	0.055	0.063	N/A
38th	0.003	0.003	0.003	0.042	0.042	0.041	N/A
39th	0.005	0.005	0.004	0.072	0.067	0.064	N/A
40th	0.002	0.003	0.003	0.034	0.039	0.038	N/A
THD	--	--	--	8.040	8.445	7.932	13
PWHD	--	--	--	2.913	3.129	2.830	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	60789 (100%, 25°C)
Voltage (V)	230.50
Current (A)	88.00
Power Factor	0.9998
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	87.921	87.912	87.916	--	--	--	--
2nd	0.307	1.462	1.139	0.349	1.662	1.295	8
3rd	1.556	1.507	1.605	1.769	1.713	1.825	N/A
4th	0.396	0.146	0.396	0.451	0.166	0.451	4
5th	1.097	1.022	1.002	1.247	1.162	1.139	10.7
6th	0.298	0.049	0.100	0.339	0.056	0.113	2.7
7th	0.396	0.486	0.363	0.451	0.553	0.413	7.2
8th	0.210	0.117	0.093	0.239	0.133	0.105	2
9th	0.176	0.085	0.085	0.200	0.096	0.096	N/A
10th	0.101	0.078	0.129	0.115	0.089	0.146	1.6
11th	0.261	0.321	0.269	0.297	0.365	0.306	3.1
12th	0.189	0.061	0.136	0.215	0.069	0.154	1.3
13th	0.206	0.234	0.195	0.235	0.266	0.221	2
14th	0.102	0.079	0.112	0.116	0.089	0.128	N/A
15th	0.121	0.019	0.091	0.138	0.022	0.104	N/A
16th	0.102	0.068	0.086	0.116	0.077	0.098	N/A
17th	0.123	0.142	0.123	0.140	0.161	0.139	N/A
18th	0.145	0.038	0.088	0.164	0.043	0.100	N/A
19th	0.087	0.115	0.102	0.099	0.131	0.116	N/A
20th	0.042	0.058	0.083	0.048	0.066	0.095	N/A
21st	0.100	0.036	0.072	0.114	0.041	0.081	N/A
22nd	0.054	0.065	0.050	0.062	0.074	0.057	N/A
23rd	0.085	0.064	0.072	0.097	0.073	0.081	N/A
24th	0.110	0.026	0.050	0.125	0.030	0.057	N/A
25th	0.044	0.081	0.065	0.050	0.092	0.074	N/A
26th	0.026	0.051	0.063	0.029	0.058	0.072	N/A
27th	0.101	0.080	0.071	0.115	0.091	0.081	N/A
28th	0.030	0.078	0.023	0.035	0.088	0.026	N/A
29th	0.098	0.021	0.066	0.111	0.024	0.075	N/A
30th	0.084	0.044	0.044	0.095	0.050	0.050	N/A
31st	0.033	0.046	0.057	0.038	0.053	0.065	N/A
32nd	0.024	0.024	0.054	0.028	0.027	0.061	N/A
33rd	0.025	0.090	0.035	0.029	0.102	0.040	N/A
34th	0.021	0.049	0.023	0.024	0.055	0.026	N/A
35th	0.050	0.044	0.044	0.056	0.050	0.050	N/A
36th	0.018	0.026	0.026	0.020	0.029	0.029	N/A
37th	0.022	0.023	0.029	0.025	0.027	0.033	N/A
38th	0.011	0.021	0.018	0.012	0.024	0.021	N/A
39th	0.019	0.021	0.015	0.021	0.024	0.017	N/A
40th	0.012	0.023	0.012	0.014	0.026	0.014	N/A
THD	--	--	--	2.444	2.826	2.656	13
PWHD	--	--	--	2.021	1.734	1.778	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

Active power (W)	60794 (100%, -25°C)
Voltage (V)	230.50
Current (A)	88.00
Power Factor	0.9998
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	87.929	87.921	87.925	--	--	--	--
2nd	0.309	1.464	1.140	0.351	1.665	1.297	8
3rd	1.556	1.506	1.604	1.769	1.712	1.823	N/A
4th	0.395	0.146	0.395	0.449	0.166	0.449	4
5th	1.097	1.023	1.003	1.247	1.163	1.140	10.7
6th	0.297	0.050	0.101	0.338	0.056	0.114	2.7
7th	0.397	0.486	0.365	0.451	0.552	0.415	7.2
8th	0.210	0.116	0.093	0.238	0.132	0.105	2
9th	0.176	0.084	0.084	0.200	0.096	0.096	N/A
10th	0.102	0.078	0.129	0.115	0.089	0.147	1.6
11th	0.262	0.322	0.270	0.298	0.366	0.307	3.1
12th	0.188	0.061	0.136	0.214	0.070	0.154	1.3
13th	0.207	0.234	0.194	0.235	0.266	0.221	2
14th	0.101	0.079	0.112	0.114	0.090	0.128	N/A
15th	0.121	0.019	0.091	0.138	0.022	0.103	N/A
16th	0.102	0.068	0.086	0.116	0.077	0.098	N/A
17th	0.123	0.142	0.122	0.140	0.161	0.139	N/A
18th	0.144	0.037	0.088	0.164	0.043	0.100	N/A
19th	0.088	0.116	0.103	0.100	0.132	0.117	N/A
20th	0.042	0.058	0.083	0.048	0.066	0.094	N/A
21st	0.100	0.036	0.071	0.114	0.041	0.081	N/A
22nd	0.054	0.065	0.051	0.061	0.073	0.058	N/A
23rd	0.085	0.065	0.072	0.097	0.074	0.082	N/A
24th	0.109	0.026	0.050	0.124	0.029	0.057	N/A
25th	0.044	0.081	0.066	0.051	0.092	0.075	N/A
26th	0.026	0.051	0.064	0.030	0.058	0.072	N/A
27th	0.102	0.080	0.071	0.115	0.091	0.081	N/A
28th	0.031	0.078	0.022	0.035	0.088	0.025	N/A
29th	0.098	0.021	0.065	0.111	0.024	0.074	N/A
30th	0.083	0.043	0.044	0.095	0.049	0.050	N/A
31st	0.033	0.046	0.058	0.037	0.053	0.066	N/A
32nd	0.024	0.024	0.054	0.028	0.027	0.061	N/A
33rd	0.026	0.090	0.035	0.030	0.102	0.040	N/A
34th	0.020	0.049	0.024	0.023	0.055	0.027	N/A
35th	0.050	0.044	0.044	0.057	0.050	0.050	N/A
36th	0.017	0.026	0.026	0.020	0.029	0.029	N/A
37th	0.022	0.024	0.029	0.025	0.027	0.033	N/A
38th	0.010	0.021	0.019	0.012	0.024	0.021	N/A
39th	0.019	0.021	0.014	0.022	0.024	0.016	N/A
40th	0.012	0.022	0.012	0.014	0.025	0.014	N/A
THD	--	--	--	2.450	2.816	2.657	13
PWHD	--	--	--	2.019	1.735	1.779	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

Active power (W)	60805 (100%, 60°C)
Voltage (V)	230.50
Current (A)	88.02
Power Factor	0.9998
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	87.947	87.939	87.943	--	--	--	--
2nd	0.305	1.460	1.136	0.347	1.659	1.291	8
3rd	1.556	1.505	1.605	1.769	1.711	1.825	N/A
4th	0.396	0.146	0.396	0.450	0.166	0.450	4
5th	1.096	1.023	1.002	1.246	1.163	1.139	10.7
6th	0.297	0.049	0.102	0.337	0.056	0.116	2.7
7th	0.398	0.487	0.366	0.453	0.554	0.416	7.2
8th	0.210	0.116	0.094	0.238	0.132	0.106	2
9th	0.175	0.084	0.084	0.199	0.096	0.096	N/A
10th	0.102	0.078	0.129	0.115	0.089	0.147	1.6
11th	0.263	0.321	0.270	0.299	0.365	0.307	3.1
12th	0.189	0.060	0.137	0.214	0.069	0.155	1.3
13th	0.207	0.235	0.195	0.236	0.267	0.222	2
14th	0.101	0.079	0.113	0.115	0.090	0.128	N/A
15th	0.121	0.019	0.090	0.137	0.021	0.103	N/A
16th	0.102	0.068	0.086	0.116	0.077	0.098	N/A
17th	0.122	0.142	0.123	0.139	0.161	0.140	N/A
18th	0.145	0.037	0.088	0.164	0.042	0.100	N/A
19th	0.088	0.116	0.102	0.100	0.132	0.116	N/A
20th	0.042	0.059	0.083	0.048	0.067	0.094	N/A
21st	0.100	0.036	0.072	0.114	0.040	0.082	N/A
22nd	0.055	0.065	0.051	0.062	0.074	0.058	N/A
23rd	0.085	0.065	0.072	0.096	0.074	0.082	N/A
24th	0.110	0.025	0.050	0.124	0.029	0.057	N/A
25th	0.045	0.081	0.065	0.051	0.092	0.073	N/A
26th	0.026	0.052	0.063	0.029	0.059	0.072	N/A
27th	0.102	0.079	0.071	0.116	0.090	0.081	N/A
28th	0.031	0.078	0.022	0.035	0.089	0.025	N/A
29th	0.097	0.021	0.066	0.110	0.024	0.074	N/A
30th	0.084	0.044	0.044	0.096	0.050	0.050	N/A
31st	0.034	0.048	0.057	0.039	0.054	0.065	N/A
32nd	0.025	0.024	0.054	0.028	0.027	0.061	N/A
33rd	0.026	0.089	0.035	0.029	0.101	0.040	N/A
34th	0.021	0.049	0.024	0.024	0.055	0.027	N/A
35th	0.050	0.044	0.044	0.056	0.050	0.050	N/A
36th	0.018	0.026	0.026	0.021	0.030	0.029	N/A
37th	0.022	0.024	0.029	0.025	0.027	0.033	N/A
38th	0.011	0.021	0.018	0.012	0.023	0.021	N/A
39th	0.019	0.021	0.015	0.022	0.024	0.017	N/A
40th	0.012	0.023	0.012	0.013	0.026	0.014	N/A
THD	--	--	--	2.447	2.812	2.667	13
PWHD	--	--	--	2.023	1.736	1.778	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	40443 (66%, 25°C)
Voltage (V)	230.33
Current (A)	58.65
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	58.627	58.620	58.622	--	--	--	--
2nd	0.344	0.981	0.953	0.586	1.672	1.625	8
3rd	1.344	1.420	1.422	2.291	2.422	2.425	N/A
4th	0.337	0.189	0.337	0.574	0.322	0.574	4
5th	0.865	0.884	0.791	1.475	1.507	1.349	10.7
6th	0.347	0.074	0.199	0.592	0.126	0.340	2.7
7th	0.282	0.374	0.322	0.481	0.637	0.550	7.2
8th	0.171	0.131	0.148	0.292	0.224	0.253	2
9th	0.168	0.113	0.113	0.286	0.192	0.192	N/A
10th	0.119	0.140	0.124	0.203	0.239	0.211	1.6
11th	0.203	0.255	0.183	0.346	0.435	0.312	3.1
12th	0.207	0.058	0.139	0.353	0.098	0.237	1.3
13th	0.089	0.125	0.130	0.152	0.212	0.222	2
14th	0.080	0.067	0.101	0.136	0.115	0.172	N/A
15th	0.113	0.099	0.096	0.193	0.169	0.163	N/A
16th	0.052	0.099	0.069	0.088	0.169	0.118	N/A
17th	0.083	0.059	0.034	0.141	0.101	0.058	N/A
18th	0.105	0.028	0.066	0.179	0.048	0.112	N/A
19th	0.066	0.038	0.067	0.113	0.065	0.115	N/A
20th	0.033	0.024	0.046	0.056	0.040	0.078	N/A
21st	0.054	0.091	0.051	0.092	0.155	0.087	N/A
22nd	0.015	0.052	0.037	0.026	0.089	0.063	N/A
23rd	0.075	0.047	0.039	0.128	0.080	0.067	N/A
24th	0.029	0.014	0.017	0.049	0.025	0.028	N/A
25th	0.081	0.033	0.043	0.139	0.056	0.073	N/A
26th	0.025	0.016	0.019	0.042	0.028	0.033	N/A
27th	0.064	0.073	0.069	0.108	0.124	0.118	N/A
28th	0.035	0.016	0.023	0.059	0.026	0.039	N/A
29th	0.075	0.052	0.051	0.129	0.088	0.086	N/A
30th	0.024	0.018	0.020	0.041	0.031	0.035	N/A
31st	0.022	0.047	0.041	0.037	0.080	0.070	N/A
32nd	0.021	0.029	0.017	0.036	0.049	0.029	N/A
33rd	0.036	0.045	0.044	0.061	0.076	0.074	N/A
34th	0.024	0.015	0.019	0.042	0.026	0.032	N/A
35th	0.016	0.038	0.019	0.027	0.065	0.033	N/A
36th	0.024	0.015	0.021	0.040	0.025	0.035	N/A
37th	0.010	0.022	0.017	0.016	0.038	0.029	N/A
38th	0.023	0.018	0.016	0.039	0.030	0.028	N/A
39th	0.013	0.015	0.014	0.022	0.026	0.024	N/A
40th	0.016	0.015	0.018	0.027	0.026	0.031	N/A
THD	--	--	--	3.100	3.509	3.394	13
PWHD	--	--	--	2.175	1.958	1.871	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C,100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

Active power (W)	40443 (66%, -25°C)
Voltage (V)	230.33
Current (A)	58.65
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	58.627	58.619	58.621	--	--	--	--
2nd	0.342	0.986	0.957	0.583	1.680	1.632	8
3rd	1.340	1.419	1.420	2.284	2.419	2.421	N/A
4th	0.335	0.186	0.335	0.570	0.318	0.570	4
5th	0.862	0.881	0.786	1.469	1.502	1.341	10.7
6th	0.345	0.075	0.200	0.588	0.127	0.340	2.7
7th	0.283	0.371	0.318	0.482	0.633	0.543	7.2
8th	0.170	0.130	0.149	0.291	0.222	0.255	2
9th	0.168	0.112	0.112	0.286	0.191	0.191	N/A
10th	0.119	0.139	0.123	0.203	0.238	0.209	1.6
11th	0.202	0.253	0.183	0.344	0.431	0.311	3.1
12th	0.207	0.057	0.139	0.353	0.098	0.236	1.3
13th	0.089	0.126	0.131	0.152	0.215	0.223	2
14th	0.079	0.068	0.101	0.134	0.116	0.172	N/A
15th	0.114	0.099	0.097	0.194	0.169	0.165	N/A
16th	0.052	0.099	0.069	0.088	0.169	0.117	N/A
17th	0.083	0.059	0.034	0.142	0.100	0.058	N/A
18th	0.106	0.028	0.066	0.181	0.048	0.113	N/A
19th	0.065	0.039	0.067	0.111	0.067	0.114	N/A
20th	0.032	0.024	0.046	0.055	0.041	0.078	N/A
21st	0.055	0.091	0.052	0.094	0.156	0.088	N/A
22nd	0.015	0.054	0.037	0.025	0.091	0.064	N/A
23rd	0.075	0.047	0.038	0.128	0.081	0.066	N/A
24th	0.030	0.015	0.017	0.051	0.025	0.029	N/A
25th	0.081	0.032	0.044	0.139	0.055	0.074	N/A
26th	0.025	0.016	0.019	0.042	0.027	0.032	N/A
27th	0.062	0.072	0.068	0.106	0.123	0.115	N/A
28th	0.034	0.015	0.022	0.058	0.026	0.038	N/A
29th	0.075	0.051	0.051	0.127	0.087	0.087	N/A
30th	0.024	0.018	0.020	0.041	0.031	0.035	N/A
31st	0.022	0.046	0.041	0.038	0.078	0.070	N/A
32nd	0.021	0.028	0.017	0.035	0.048	0.029	N/A
33rd	0.036	0.045	0.043	0.061	0.076	0.074	N/A
34th	0.024	0.015	0.019	0.041	0.026	0.033	N/A
35th	0.016	0.038	0.020	0.028	0.065	0.035	N/A
36th	0.024	0.014	0.021	0.041	0.024	0.036	N/A
37th	0.010	0.022	0.017	0.017	0.038	0.029	N/A
38th	0.023	0.017	0.016	0.039	0.030	0.027	N/A
39th	0.012	0.015	0.013	0.021	0.025	0.023	N/A
40th	0.015	0.015	0.018	0.026	0.025	0.031	N/A
THD	--	--	--	3.089	3.504	3.389	13
PWHD	--	--	--	2.173	1.956	1.871	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

Active power (W)	40443 (66%, 60°C)
Voltage (V)	230.33
Current (A)	58.65
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	58.629	58.621	58.623	--	--	--	--
2nd	0.342	0.983	0.954	0.583	1.676	1.626	8
3rd	1.341	1.417	1.419	2.286	2.416	2.419	N/A
4th	0.335	0.188	0.335	0.571	0.320	0.571	4
5th	0.863	0.879	0.788	1.471	1.498	1.343	10.7
6th	0.344	0.074	0.198	0.587	0.127	0.338	2.7
7th	0.281	0.372	0.318	0.480	0.634	0.542	7.2
8th	0.170	0.130	0.148	0.290	0.221	0.253	2
9th	0.168	0.113	0.113	0.287	0.193	0.193	N/A
10th	0.119	0.139	0.122	0.203	0.236	0.209	1.6
11th	0.202	0.254	0.183	0.344	0.432	0.311	3.1
12th	0.206	0.057	0.139	0.352	0.097	0.237	1.3
13th	0.090	0.126	0.130	0.153	0.214	0.222	2
14th	0.079	0.068	0.101	0.134	0.115	0.173	N/A
15th	0.114	0.099	0.096	0.194	0.169	0.164	N/A
16th	0.053	0.099	0.069	0.090	0.169	0.117	N/A
17th	0.082	0.059	0.034	0.140	0.101	0.058	N/A
18th	0.106	0.028	0.066	0.181	0.048	0.113	N/A
19th	0.066	0.039	0.067	0.112	0.067	0.115	N/A
20th	0.032	0.024	0.046	0.055	0.041	0.078	N/A
21st	0.055	0.092	0.051	0.094	0.156	0.087	N/A
22nd	0.015	0.053	0.038	0.026	0.091	0.064	N/A
23rd	0.075	0.047	0.039	0.128	0.081	0.066	N/A
24th	0.030	0.015	0.016	0.051	0.025	0.027	N/A
25th	0.081	0.033	0.043	0.138	0.056	0.073	N/A
26th	0.025	0.016	0.019	0.042	0.027	0.032	N/A
27th	0.063	0.072	0.067	0.107	0.123	0.115	N/A
28th	0.034	0.015	0.022	0.057	0.025	0.037	N/A
29th	0.075	0.051	0.051	0.127	0.087	0.086	N/A
30th	0.024	0.018	0.020	0.042	0.031	0.033	N/A
31st	0.022	0.046	0.041	0.038	0.078	0.070	N/A
32nd	0.020	0.028	0.017	0.035	0.048	0.029	N/A
33rd	0.036	0.045	0.043	0.061	0.076	0.074	N/A
34th	0.025	0.015	0.019	0.042	0.026	0.032	N/A
35th	0.017	0.038	0.021	0.028	0.065	0.035	N/A
36th	0.024	0.014	0.021	0.041	0.025	0.036	N/A
37th	0.010	0.022	0.017	0.018	0.038	0.030	N/A
38th	0.023	0.017	0.016	0.038	0.030	0.027	N/A
39th	0.012	0.014	0.013	0.020	0.025	0.023	N/A
40th	0.016	0.015	0.018	0.027	0.025	0.031	N/A
THD	--	--	--	3.093	3.502	3.385	13
PWHD	--	--	--	2.172	1.957	1.865	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

Active power (W)	19854 (33%, 25°C)
Voltage (V)	230.16
Current (A)	29.04
Power Factor	0.9961
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	29.034	29.027	29.028	--	--	--	--
2nd	0.316	0.474	0.510	1.087	1.629	1.756	8
3rd	1.201	1.307	1.320	4.131	4.497	4.542	N/A
4th	0.276	0.167	0.276	0.948	0.573	0.948	4
5th	0.383	0.506	0.394	1.317	1.740	1.356	10.7
6th	0.104	0.065	0.093	0.359	0.225	0.321	2.7
7th	0.276	0.228	0.244	0.949	0.783	0.839	7.2
8th	0.041	0.049	0.047	0.141	0.167	0.160	2
9th	0.175	0.154	0.154	0.602	0.531	0.531	N/A
10th	0.093	0.070	0.076	0.319	0.242	0.263	1.6
11th	0.079	0.090	0.094	0.272	0.311	0.323	3.1
12th	0.137	0.043	0.087	0.471	0.149	0.300	1.3
13th	0.104	0.150	0.072	0.358	0.515	0.247	2
14th	0.051	0.026	0.057	0.176	0.090	0.195	N/A
15th	0.134	0.044	0.102	0.462	0.150	0.352	N/A
16th	0.043	0.051	0.051	0.148	0.175	0.174	N/A
17th	0.109	0.140	0.144	0.374	0.483	0.494	N/A
18th	0.135	0.040	0.093	0.464	0.137	0.319	N/A
19th	0.079	0.113	0.086	0.270	0.389	0.295	N/A
20th	0.072	0.073	0.085	0.249	0.251	0.294	N/A
21st	0.073	0.096	0.074	0.251	0.329	0.256	N/A
22nd	0.042	0.080	0.048	0.145	0.275	0.165	N/A
23rd	0.049	0.028	0.023	0.168	0.096	0.080	N/A
24th	0.071	0.020	0.036	0.243	0.067	0.122	N/A
25th	0.054	0.040	0.026	0.185	0.139	0.088	N/A
26th	0.015	0.023	0.013	0.053	0.079	0.046	N/A
27th	0.055	0.028	0.050	0.190	0.098	0.171	N/A
28th	0.015	0.028	0.023	0.050	0.095	0.081	N/A
29th	0.018	0.043	0.028	0.064	0.149	0.095	N/A
30th	0.024	0.024	0.041	0.082	0.083	0.140	N/A
31st	0.016	0.026	0.027	0.055	0.089	0.094	N/A
32nd	0.021	0.017	0.033	0.071	0.059	0.114	N/A
33rd	0.017	0.015	0.016	0.059	0.053	0.054	N/A
34th	0.016	0.015	0.027	0.057	0.050	0.095	N/A
35th	0.020	0.018	0.024	0.069	0.063	0.083	N/A
36th	0.028	0.011	0.016	0.095	0.036	0.055	N/A
37th	0.019	0.023	0.011	0.067	0.080	0.037	N/A
38th	0.023	0.019	0.017	0.080	0.067	0.059	N/A
39th	0.012	0.034	0.018	0.040	0.117	0.062	N/A
40th	0.016	0.017	0.017	0.054	0.060	0.059	N/A
THD	--	--	--	4.956	5.409	5.356	13
PWHD	--	--	--	4.543	4.182	4.331	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	19855 (33%, -25°C)
Voltage (V)	230.16
Current (A)	29.04
Power Factor	0.9961
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	29.034	29.027	29.028	--	--	--	--
2nd	0.313	0.474	0.510	1.077	1.632	1.753	8
3rd	1.199	1.304	1.316	4.125	4.487	4.526	N/A
4th	0.274	0.166	0.274	0.944	0.571	0.944	4
5th	0.383	0.505	0.395	1.316	1.737	1.360	10.7
6th	0.105	0.065	0.094	0.360	0.223	0.324	2.7
7th	0.274	0.228	0.244	0.944	0.784	0.839	7.2
8th	0.042	0.049	0.047	0.145	0.169	0.160	2
9th	0.176	0.155	0.155	0.607	0.533	0.533	N/A
10th	0.093	0.070	0.076	0.320	0.241	0.262	1.6
11th	0.079	0.091	0.094	0.271	0.313	0.322	3.1
12th	0.136	0.044	0.086	0.469	0.150	0.297	1.3
13th	0.105	0.149	0.070	0.360	0.513	0.242	2
14th	0.051	0.025	0.057	0.175	0.087	0.196	N/A
15th	0.134	0.044	0.103	0.461	0.151	0.354	N/A
16th	0.042	0.050	0.050	0.146	0.172	0.172	N/A
17th	0.108	0.140	0.144	0.370	0.482	0.494	N/A
18th	0.135	0.039	0.093	0.464	0.136	0.318	N/A
19th	0.079	0.113	0.086	0.273	0.387	0.297	N/A
20th	0.073	0.073	0.084	0.250	0.251	0.291	N/A
21st	0.073	0.096	0.074	0.251	0.330	0.256	N/A
22nd	0.042	0.080	0.048	0.144	0.274	0.166	N/A
23rd	0.048	0.028	0.023	0.167	0.097	0.079	N/A
24th	0.071	0.020	0.036	0.243	0.068	0.124	N/A
25th	0.054	0.040	0.025	0.185	0.139	0.087	N/A
26th	0.016	0.023	0.013	0.054	0.079	0.046	N/A
27th	0.054	0.028	0.050	0.187	0.096	0.171	N/A
28th	0.014	0.027	0.024	0.047	0.093	0.081	N/A
29th	0.018	0.044	0.028	0.060	0.151	0.095	N/A
30th	0.024	0.024	0.040	0.082	0.084	0.138	N/A
31st	0.016	0.026	0.026	0.054	0.089	0.091	N/A
32nd	0.020	0.017	0.033	0.070	0.059	0.114	N/A
33rd	0.017	0.015	0.015	0.059	0.051	0.051	N/A
34th	0.017	0.014	0.028	0.058	0.049	0.095	N/A
35th	0.020	0.018	0.023	0.069	0.062	0.081	N/A
36th	0.028	0.011	0.016	0.096	0.037	0.056	N/A
37th	0.020	0.023	0.011	0.067	0.080	0.037	N/A
38th	0.024	0.020	0.017	0.082	0.068	0.058	N/A
39th	0.012	0.034	0.018	0.040	0.116	0.062	N/A
40th	0.016	0.017	0.017	0.056	0.059	0.059	N/A
THD	--	--	--	4.942	5.401	5.343	13
PWHD	--	--	--	4.531	4.175	4.323	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	19854 (33%, 60°C)
Voltage (V)	230.16
Current (A)	29.04
Power Factor	0.9961
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	29.035	29.028	29.029	--	--	--	--
2nd	0.309	0.475	0.510	1.064	1.633	1.754	8
3rd	1.197	1.303	1.313	4.118	4.483	4.516	N/A
4th	0.275	0.167	0.275	0.946	0.574	0.946	4
5th	0.383	0.505	0.394	1.316	1.738	1.355	10.7
6th	0.106	0.065	0.094	0.364	0.222	0.323	2.7
7th	0.273	0.226	0.244	0.940	0.779	0.838	7.2
8th	0.041	0.048	0.047	0.140	0.167	0.163	2
9th	0.176	0.156	0.156	0.607	0.537	0.537	N/A
10th	0.092	0.069	0.076	0.317	0.238	0.262	1.6
11th	0.078	0.090	0.094	0.269	0.311	0.322	3.1
12th	0.136	0.044	0.087	0.468	0.151	0.298	1.3
13th	0.104	0.149	0.071	0.359	0.512	0.243	2
14th	0.051	0.026	0.057	0.177	0.090	0.195	N/A
15th	0.134	0.044	0.103	0.460	0.150	0.354	N/A
16th	0.043	0.051	0.050	0.147	0.175	0.173	N/A
17th	0.108	0.139	0.143	0.371	0.480	0.492	N/A
18th	0.135	0.040	0.093	0.464	0.137	0.319	N/A
19th	0.079	0.112	0.085	0.270	0.386	0.294	N/A
20th	0.072	0.072	0.084	0.248	0.247	0.290	N/A
21st	0.072	0.095	0.074	0.249	0.328	0.256	N/A
22nd	0.042	0.080	0.049	0.146	0.275	0.168	N/A
23rd	0.049	0.028	0.023	0.167	0.095	0.080	N/A
24th	0.069	0.020	0.036	0.239	0.067	0.122	N/A
25th	0.053	0.040	0.025	0.184	0.138	0.088	N/A
26th	0.015	0.023	0.013	0.053	0.080	0.046	N/A
27th	0.055	0.028	0.049	0.188	0.095	0.168	N/A
28th	0.015	0.027	0.024	0.051	0.094	0.082	N/A
29th	0.018	0.044	0.028	0.062	0.150	0.096	N/A
30th	0.024	0.024	0.040	0.082	0.082	0.139	N/A
31st	0.015	0.026	0.027	0.053	0.089	0.095	N/A
32nd	0.021	0.017	0.033	0.071	0.057	0.115	N/A
33rd	0.017	0.015	0.016	0.060	0.051	0.054	N/A
34th	0.017	0.015	0.028	0.057	0.050	0.095	N/A
35th	0.020	0.018	0.024	0.068	0.062	0.083	N/A
36th	0.027	0.011	0.016	0.094	0.037	0.055	N/A
37th	0.020	0.023	0.011	0.068	0.080	0.038	N/A
38th	0.024	0.020	0.017	0.082	0.069	0.057	N/A
39th	0.011	0.034	0.018	0.039	0.115	0.061	N/A
40th	0.016	0.018	0.017	0.054	0.061	0.059	N/A
THD	--	--	--	4.936	5.387	5.338	13
PWHD	--	--	--	4.521	4.160	4.320	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-60811 (100%, 25°C)
Voltage (V)	230.51
Current (A)	88.03
Power Factor	-0.9998
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	87.951	87.942	87.946	--	--	--	--
2nd	0.302	1.454	1.133	0.343	1.653	1.287	8
3rd	1.560	1.505	1.604	1.774	1.711	1.823	N/A
4th	0.396	0.146	0.396	0.451	0.166	0.451	4
5th	1.096	1.022	1.002	1.246	1.161	1.139	10.7
6th	0.296	0.050	0.102	0.336	0.057	0.116	2.7
7th	0.399	0.488	0.365	0.454	0.554	0.415	7.2
8th	0.209	0.116	0.093	0.237	0.131	0.106	2
9th	0.175	0.085	0.085	0.199	0.096	0.096	N/A
10th	0.101	0.078	0.128	0.115	0.089	0.145	1.6
11th	0.262	0.321	0.270	0.298	0.365	0.307	3.1
12th	0.189	0.060	0.136	0.215	0.068	0.154	1.3
13th	0.209	0.235	0.196	0.237	0.267	0.223	2
14th	0.101	0.079	0.112	0.114	0.090	0.127	N/A
15th	0.120	0.019	0.090	0.136	0.022	0.103	N/A
16th	0.102	0.068	0.085	0.116	0.078	0.097	N/A
17th	0.123	0.142	0.123	0.140	0.161	0.140	N/A
18th	0.144	0.038	0.088	0.164	0.043	0.100	N/A
19th	0.088	0.117	0.102	0.100	0.133	0.116	N/A
20th	0.043	0.059	0.083	0.049	0.067	0.095	N/A
21st	0.099	0.036	0.072	0.113	0.041	0.082	N/A
22nd	0.054	0.065	0.051	0.062	0.074	0.058	N/A
23rd	0.085	0.064	0.072	0.096	0.073	0.081	N/A
24th	0.110	0.026	0.050	0.126	0.029	0.056	N/A
25th	0.045	0.081	0.064	0.051	0.093	0.073	N/A
26th	0.026	0.052	0.064	0.030	0.059	0.073	N/A
27th	0.101	0.079	0.071	0.115	0.090	0.081	N/A
28th	0.030	0.078	0.023	0.034	0.089	0.026	N/A
29th	0.096	0.021	0.065	0.109	0.024	0.074	N/A
30th	0.085	0.044	0.044	0.097	0.050	0.050	N/A
31st	0.034	0.048	0.056	0.039	0.055	0.064	N/A
32nd	0.024	0.024	0.055	0.028	0.027	0.062	N/A
33rd	0.026	0.088	0.036	0.029	0.100	0.041	N/A
34th	0.021	0.049	0.024	0.024	0.056	0.027	N/A
35th	0.050	0.044	0.044	0.057	0.050	0.050	N/A
36th	0.018	0.026	0.026	0.021	0.030	0.030	N/A
37th	0.022	0.023	0.029	0.025	0.027	0.033	N/A
38th	0.011	0.021	0.018	0.012	0.023	0.021	N/A
39th	0.018	0.021	0.015	0.021	0.024	0.017	N/A
40th	0.012	0.022	0.012	0.014	0.025	0.014	N/A
THD	--	--	--	2.454	2.804	2.655	13
PWHD	--	--	--	2.021	1.737	1.777	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-60812 (100%, -25°C)
Voltage (V)	230.51
Current (A)	88.03
Power Factor	-0.9998
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	87.946	87.937	87.941	--	--	--	--
2nd	0.305	1.456	1.134	0.346	1.656	1.289	8
3rd	1.562	1.508	1.603	1.775	1.714	1.823	N/A
4th	0.398	0.147	0.398	0.452	0.167	0.452	4
5th	1.095	1.020	1.002	1.245	1.159	1.139	10.7
6th	0.295	0.048	0.101	0.335	0.055	0.115	2.7
7th	0.399	0.487	0.365	0.454	0.554	0.415	7.2
8th	0.208	0.116	0.092	0.237	0.131	0.105	2
9th	0.175	0.084	0.084	0.199	0.096	0.096	N/A
10th	0.101	0.079	0.128	0.114	0.090	0.146	1.6
11th	0.262	0.322	0.270	0.298	0.366	0.306	3.1
12th	0.188	0.060	0.136	0.213	0.068	0.154	1.3
13th	0.207	0.235	0.196	0.236	0.267	0.223	2
14th	0.100	0.079	0.112	0.114	0.089	0.128	N/A
15th	0.120	0.019	0.091	0.136	0.022	0.104	N/A
16th	0.102	0.068	0.085	0.116	0.077	0.097	N/A
17th	0.123	0.143	0.123	0.140	0.162	0.139	N/A
18th	0.145	0.037	0.088	0.165	0.042	0.100	N/A
19th	0.088	0.116	0.103	0.100	0.132	0.117	N/A
20th	0.042	0.059	0.083	0.047	0.067	0.094	N/A
21st	0.099	0.035	0.072	0.112	0.040	0.082	N/A
22nd	0.055	0.065	0.051	0.062	0.074	0.058	N/A
23rd	0.085	0.064	0.071	0.097	0.073	0.081	N/A
24th	0.110	0.025	0.050	0.125	0.029	0.056	N/A
25th	0.045	0.081	0.065	0.051	0.092	0.074	N/A
26th	0.026	0.051	0.064	0.029	0.058	0.072	N/A
27th	0.101	0.079	0.072	0.115	0.090	0.082	N/A
28th	0.030	0.078	0.023	0.034	0.089	0.026	N/A
29th	0.097	0.021	0.066	0.110	0.024	0.075	N/A
30th	0.085	0.044	0.044	0.096	0.051	0.050	N/A
31st	0.034	0.048	0.056	0.039	0.054	0.064	N/A
32nd	0.025	0.024	0.054	0.028	0.027	0.062	N/A
33rd	0.026	0.088	0.036	0.030	0.100	0.041	N/A
34th	0.021	0.049	0.024	0.024	0.056	0.027	N/A
35th	0.049	0.044	0.044	0.056	0.050	0.050	N/A
36th	0.018	0.026	0.026	0.020	0.030	0.030	N/A
37th	0.022	0.023	0.029	0.025	0.027	0.033	N/A
38th	0.011	0.021	0.019	0.012	0.024	0.021	N/A
39th	0.019	0.021	0.014	0.021	0.024	0.016	N/A
40th	0.012	0.022	0.012	0.014	0.026	0.014	N/A
THD	--	--	--	2.453	2.814	2.656	13
PWHD	--	--	--	2.021	1.736	1.779	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-60814 (100%, 60°C)
Voltage (V)	230.51
Current (A)	88.03
Power Factor	-0.9998
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	87.957	87.948	87.952	--	--	--	--
2nd	0.296	1.454	1.135	0.337	1.652	1.291	8
3rd	1.562	1.506	1.603	1.775	1.712	1.822	N/A
4th	0.397	0.146	0.397	0.452	0.166	0.452	4
5th	1.096	1.021	1.001	1.246	1.161	1.138	10.7
6th	0.295	0.049	0.101	0.335	0.056	0.115	2.7
7th	0.400	0.487	0.366	0.454	0.554	0.416	7.2
8th	0.209	0.116	0.093	0.237	0.132	0.106	2
9th	0.175	0.085	0.085	0.199	0.097	0.097	N/A
10th	0.101	0.078	0.128	0.114	0.088	0.146	1.6
11th	0.262	0.321	0.270	0.298	0.365	0.307	3.1
12th	0.189	0.061	0.136	0.214	0.069	0.155	1.3
13th	0.208	0.235	0.195	0.237	0.267	0.222	2
14th	0.100	0.079	0.113	0.114	0.090	0.128	N/A
15th	0.120	0.019	0.091	0.136	0.022	0.103	N/A
16th	0.102	0.068	0.086	0.116	0.077	0.098	N/A
17th	0.124	0.142	0.123	0.140	0.161	0.140	N/A
18th	0.145	0.037	0.088	0.165	0.043	0.100	N/A
19th	0.089	0.116	0.102	0.101	0.132	0.116	N/A
20th	0.041	0.059	0.084	0.047	0.067	0.095	N/A
21st	0.099	0.035	0.072	0.112	0.040	0.082	N/A
22nd	0.055	0.065	0.051	0.063	0.074	0.058	N/A
23rd	0.085	0.065	0.072	0.096	0.073	0.082	N/A
24th	0.110	0.025	0.050	0.125	0.029	0.057	N/A
25th	0.045	0.082	0.065	0.051	0.093	0.073	N/A
26th	0.026	0.051	0.064	0.030	0.059	0.073	N/A
27th	0.101	0.079	0.071	0.115	0.090	0.080	N/A
28th	0.031	0.078	0.022	0.035	0.089	0.025	N/A
29th	0.096	0.021	0.066	0.109	0.024	0.075	N/A
30th	0.085	0.044	0.044	0.096	0.050	0.050	N/A
31st	0.034	0.048	0.056	0.039	0.055	0.064	N/A
32nd	0.025	0.024	0.054	0.028	0.027	0.062	N/A
33rd	0.026	0.089	0.036	0.030	0.101	0.041	N/A
34th	0.021	0.049	0.024	0.024	0.056	0.028	N/A
35th	0.050	0.044	0.044	0.057	0.050	0.050	N/A
36th	0.018	0.026	0.026	0.021	0.030	0.030	N/A
37th	0.022	0.023	0.029	0.026	0.026	0.033	N/A
38th	0.010	0.020	0.018	0.012	0.023	0.021	N/A
39th	0.018	0.021	0.014	0.021	0.024	0.016	N/A
40th	0.012	0.023	0.012	0.014	0.026	0.014	N/A
THD	--	--	--	2.457	2.817	2.653	13
PWHD	--	--	--	2.021	1.737	1.780	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-40457 (66%, 25°C)
Voltage (V)	230.34
Current (A)	58.67
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	58.648	58.640	58.642	--	--	--	--
2nd	0.320	0.981	0.952	0.546	1.672	1.622	8
3rd	1.349	1.416	1.413	2.299	2.413	2.407	N/A
4th	0.333	0.184	0.333	0.568	0.314	0.568	4
5th	0.863	0.875	0.788	1.471	1.492	1.343	10.7
6th	0.341	0.073	0.197	0.581	0.124	0.336	2.7
7th	0.284	0.373	0.317	0.484	0.636	0.540	7.2
8th	0.168	0.130	0.149	0.287	0.222	0.254	2
9th	0.167	0.114	0.114	0.285	0.194	0.194	N/A
10th	0.117	0.139	0.123	0.199	0.236	0.210	1.6
11th	0.204	0.253	0.184	0.348	0.430	0.313	3.1
12th	0.206	0.057	0.138	0.351	0.098	0.235	1.3
13th	0.092	0.126	0.130	0.157	0.215	0.221	2
14th	0.079	0.068	0.100	0.134	0.115	0.171	N/A
15th	0.112	0.098	0.097	0.191	0.168	0.165	N/A
16th	0.052	0.100	0.069	0.089	0.170	0.118	N/A
17th	0.083	0.059	0.035	0.141	0.101	0.059	N/A
18th	0.106	0.029	0.066	0.181	0.049	0.112	N/A
19th	0.065	0.040	0.067	0.111	0.068	0.115	N/A
20th	0.033	0.024	0.045	0.056	0.040	0.077	N/A
21st	0.054	0.091	0.052	0.092	0.155	0.088	N/A
22nd	0.015	0.053	0.038	0.026	0.091	0.064	N/A
23rd	0.075	0.046	0.038	0.128	0.079	0.065	N/A
24th	0.031	0.015	0.016	0.053	0.025	0.028	N/A
25th	0.080	0.033	0.044	0.137	0.057	0.074	N/A
26th	0.023	0.015	0.019	0.039	0.025	0.033	N/A
27th	0.062	0.072	0.067	0.106	0.122	0.114	N/A
28th	0.033	0.015	0.022	0.056	0.025	0.037	N/A
29th	0.076	0.050	0.051	0.129	0.085	0.087	N/A
30th	0.023	0.018	0.018	0.040	0.031	0.031	N/A
31st	0.022	0.047	0.041	0.037	0.079	0.070	N/A
32nd	0.021	0.028	0.017	0.035	0.047	0.029	N/A
33rd	0.037	0.044	0.044	0.064	0.075	0.075	N/A
34th	0.024	0.015	0.019	0.041	0.026	0.032	N/A
35th	0.017	0.038	0.021	0.029	0.064	0.035	N/A
36th	0.023	0.014	0.021	0.040	0.025	0.036	N/A
37th	0.010	0.022	0.017	0.017	0.038	0.029	N/A
38th	0.022	0.017	0.016	0.038	0.029	0.027	N/A
39th	0.013	0.015	0.013	0.021	0.025	0.022	N/A
40th	0.016	0.015	0.018	0.027	0.025	0.030	N/A
THD	--	--	--	3.091	3.489	3.372	13
PWHD	--	--	--	2.166	1.947	1.866	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-40457 (66%, -25°C)
Voltage (V)	230.33
Current (A)	58.67
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	58.648	58.640	58.642	--	--	--	--
2nd	0.312	0.981	0.953	0.532	1.672	1.625	8
3rd	1.349	1.415	1.411	2.298	2.412	2.405	N/A
4th	0.332	0.185	0.332	0.566	0.315	0.566	4
5th	0.861	0.875	0.785	1.467	1.491	1.337	10.7
6th	0.342	0.073	0.198	0.583	0.125	0.338	2.7
7th	0.283	0.372	0.316	0.482	0.633	0.538	7.2
8th	0.167	0.130	0.149	0.285	0.221	0.253	2
9th	0.167	0.113	0.113	0.285	0.193	0.193	N/A
10th	0.117	0.138	0.123	0.200	0.236	0.209	1.6
11th	0.204	0.252	0.184	0.347	0.430	0.313	3.1
12th	0.207	0.057	0.138	0.353	0.097	0.235	1.3
13th	0.091	0.125	0.129	0.155	0.214	0.220	2
14th	0.078	0.068	0.100	0.133	0.117	0.171	N/A
15th	0.112	0.099	0.097	0.191	0.169	0.166	N/A
16th	0.052	0.100	0.069	0.089	0.170	0.118	N/A
17th	0.082	0.059	0.035	0.141	0.100	0.059	N/A
18th	0.107	0.029	0.066	0.183	0.050	0.112	N/A
19th	0.064	0.041	0.067	0.109	0.069	0.114	N/A
20th	0.031	0.024	0.045	0.053	0.041	0.077	N/A
21st	0.054	0.091	0.052	0.093	0.155	0.089	N/A
22nd	0.016	0.054	0.037	0.028	0.092	0.064	N/A
23rd	0.075	0.047	0.038	0.128	0.079	0.065	N/A
24th	0.031	0.014	0.017	0.053	0.024	0.029	N/A
25th	0.080	0.033	0.044	0.136	0.056	0.074	N/A
26th	0.024	0.015	0.019	0.041	0.025	0.032	N/A
27th	0.062	0.072	0.067	0.106	0.123	0.114	N/A
28th	0.032	0.014	0.022	0.055	0.025	0.037	N/A
29th	0.076	0.050	0.051	0.129	0.085	0.086	N/A
30th	0.024	0.019	0.019	0.040	0.032	0.032	N/A
31st	0.022	0.046	0.041	0.038	0.079	0.070	N/A
32nd	0.020	0.028	0.017	0.034	0.048	0.029	N/A
33rd	0.037	0.044	0.044	0.063	0.075	0.075	N/A
34th	0.025	0.015	0.019	0.042	0.026	0.032	N/A
35th	0.017	0.038	0.021	0.029	0.064	0.035	N/A
36th	0.024	0.015	0.021	0.041	0.026	0.036	N/A
37th	0.010	0.022	0.018	0.017	0.038	0.030	N/A
38th	0.022	0.017	0.016	0.038	0.029	0.028	N/A
39th	0.013	0.014	0.013	0.021	0.024	0.022	N/A
40th	0.015	0.014	0.018	0.026	0.025	0.030	N/A
THD	--	--	--	3.083	3.487	3.369	13
PWHD	--	--	--	2.164	1.949	1.866	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-40456 (66%, 60°C)
Voltage (V)	230.33
Current (A)	58.67
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	58.647	58.640	58.642	--	--	--	--
2nd	0.309	0.981	0.950	0.526	1.673	1.620	8
3rd	1.349	1.415	1.409	2.298	2.412	2.402	N/A
4th	0.333	0.185	0.333	0.568	0.315	0.568	4
5th	0.859	0.872	0.784	1.464	1.487	1.337	10.7
6th	0.340	0.073	0.197	0.579	0.124	0.335	2.7
7th	0.282	0.371	0.315	0.481	0.633	0.536	7.2
8th	0.167	0.129	0.148	0.284	0.220	0.252	2
9th	0.167	0.114	0.114	0.285	0.194	0.194	N/A
10th	0.117	0.138	0.122	0.200	0.235	0.208	1.6
11th	0.204	0.252	0.184	0.347	0.430	0.313	3.1
12th	0.206	0.057	0.137	0.352	0.097	0.234	1.3
13th	0.091	0.127	0.129	0.156	0.216	0.221	2
14th	0.078	0.068	0.099	0.133	0.115	0.170	N/A
15th	0.112	0.099	0.097	0.191	0.169	0.165	N/A
16th	0.052	0.100	0.069	0.089	0.170	0.118	N/A
17th	0.082	0.059	0.034	0.140	0.101	0.059	N/A
18th	0.106	0.029	0.066	0.180	0.049	0.112	N/A
19th	0.064	0.041	0.067	0.109	0.070	0.114	N/A
20th	0.032	0.024	0.046	0.054	0.040	0.078	N/A
21st	0.055	0.091	0.052	0.094	0.154	0.088	N/A
22nd	0.015	0.054	0.038	0.025	0.092	0.065	N/A
23rd	0.075	0.046	0.037	0.127	0.078	0.064	N/A
24th	0.031	0.015	0.016	0.054	0.025	0.028	N/A
25th	0.080	0.033	0.044	0.136	0.057	0.075	N/A
26th	0.023	0.015	0.019	0.040	0.026	0.032	N/A
27th	0.062	0.072	0.067	0.106	0.123	0.114	N/A
28th	0.032	0.014	0.022	0.055	0.024	0.038	N/A
29th	0.075	0.049	0.051	0.128	0.084	0.087	N/A
30th	0.024	0.018	0.019	0.041	0.031	0.032	N/A
31st	0.022	0.046	0.041	0.038	0.079	0.070	N/A
32nd	0.020	0.028	0.018	0.034	0.048	0.030	N/A
33rd	0.037	0.044	0.044	0.063	0.075	0.074	N/A
34th	0.024	0.015	0.019	0.042	0.026	0.032	N/A
35th	0.017	0.038	0.021	0.029	0.064	0.036	N/A
36th	0.024	0.015	0.021	0.040	0.025	0.036	N/A
37th	0.010	0.022	0.018	0.018	0.038	0.030	N/A
38th	0.022	0.017	0.016	0.037	0.029	0.027	N/A
39th	0.012	0.014	0.013	0.021	0.025	0.023	N/A
40th	0.016	0.014	0.018	0.027	0.025	0.031	N/A
THD	--	--	--	3.083	3.495	3.367	13
PWHD	--	--	--	2.160	1.946	1.867	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-19856 (33%, 25°C)
Voltage (V)	230.16
Current (A)	29.04
Power Factor	-0.9961
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	29.037	29.030	29.032	--	--	--	--
2nd	0.287	0.487	0.511	0.989	1.674	1.759	8
3rd	1.194	1.290	1.294	4.107	4.438	4.450	N/A
4th	0.266	0.164	0.266	0.915	0.564	0.915	4
5th	0.381	0.502	0.392	1.312	1.726	1.349	10.7
6th	0.109	0.062	0.097	0.374	0.213	0.332	2.7
7th	0.264	0.222	0.243	0.908	0.764	0.836	7.2
8th	0.042	0.047	0.049	0.145	0.160	0.167	2
9th	0.177	0.161	0.161	0.609	0.555	0.555	N/A
10th	0.089	0.066	0.074	0.306	0.227	0.256	1.6
11th	0.078	0.087	0.092	0.269	0.300	0.317	3.1
12th	0.129	0.039	0.084	0.444	0.135	0.287	1.3
13th	0.107	0.148	0.071	0.366	0.510	0.244	2
14th	0.048	0.026	0.056	0.165	0.088	0.193	N/A
15th	0.130	0.047	0.103	0.446	0.163	0.355	N/A
16th	0.042	0.050	0.049	0.143	0.173	0.168	N/A
17th	0.108	0.136	0.140	0.372	0.469	0.483	N/A
18th	0.132	0.038	0.091	0.454	0.129	0.312	N/A
19th	0.079	0.112	0.082	0.271	0.384	0.282	N/A
20th	0.071	0.072	0.082	0.245	0.247	0.281	N/A
21st	0.069	0.095	0.073	0.238	0.328	0.250	N/A
22nd	0.041	0.079	0.049	0.143	0.271	0.169	N/A
23rd	0.047	0.024	0.022	0.163	0.084	0.076	N/A
24th	0.069	0.018	0.035	0.238	0.062	0.122	N/A
25th	0.051	0.037	0.026	0.174	0.128	0.088	N/A
26th	0.016	0.023	0.014	0.054	0.079	0.047	N/A
27th	0.054	0.026	0.049	0.185	0.089	0.168	N/A
28th	0.015	0.024	0.022	0.052	0.084	0.077	N/A
29th	0.018	0.042	0.027	0.063	0.146	0.093	N/A
30th	0.025	0.022	0.038	0.086	0.077	0.131	N/A
31st	0.015	0.025	0.027	0.051	0.087	0.094	N/A
32nd	0.020	0.017	0.031	0.068	0.060	0.108	N/A
33rd	0.016	0.016	0.015	0.053	0.055	0.051	N/A
34th	0.016	0.014	0.027	0.056	0.047	0.094	N/A
35th	0.019	0.017	0.023	0.064	0.060	0.079	N/A
36th	0.027	0.011	0.016	0.093	0.038	0.056	N/A
37th	0.019	0.023	0.011	0.065	0.079	0.038	N/A
38th	0.024	0.019	0.017	0.082	0.066	0.057	N/A
39th	0.011	0.032	0.017	0.038	0.110	0.059	N/A
40th	0.017	0.017	0.018	0.057	0.058	0.061	N/A
THD	--	--	--	4.890	5.356	5.275	13
PWHD	--	--	--	4.435	4.088	4.233	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-19856 (33%, -25°C)
Voltage (V)	230.16
Current (A)	29.05
Power Factor	-0.9961
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	29.040	29.034	29.035	--	--	--	--
2nd	0.288	0.487	0.511	0.991	1.676	1.758	8
3rd	1.193	1.289	1.294	4.104	4.435	4.452	N/A
4th	0.267	0.163	0.267	0.918	0.562	0.918	4
5th	0.381	0.501	0.393	1.311	1.724	1.351	10.7
6th	0.109	0.061	0.096	0.374	0.209	0.329	2.7
7th	0.265	0.222	0.242	0.910	0.762	0.834	7.2
8th	0.043	0.046	0.048	0.148	0.159	0.167	2
9th	0.177	0.161	0.161	0.609	0.555	0.555	N/A
10th	0.089	0.066	0.074	0.307	0.228	0.253	1.6
11th	0.079	0.087	0.092	0.271	0.300	0.318	3.1
12th	0.129	0.039	0.084	0.445	0.134	0.290	1.3
13th	0.107	0.147	0.071	0.367	0.506	0.244	2
14th	0.048	0.025	0.057	0.164	0.086	0.195	N/A
15th	0.129	0.047	0.104	0.445	0.162	0.358	N/A
16th	0.041	0.050	0.049	0.143	0.172	0.169	N/A
17th	0.107	0.137	0.140	0.369	0.470	0.483	N/A
18th	0.132	0.037	0.091	0.453	0.127	0.314	N/A
19th	0.079	0.112	0.082	0.272	0.384	0.282	N/A
20th	0.072	0.072	0.081	0.247	0.247	0.279	N/A
21st	0.069	0.096	0.073	0.239	0.329	0.250	N/A
22nd	0.042	0.079	0.050	0.144	0.271	0.170	N/A
23rd	0.048	0.025	0.022	0.164	0.084	0.076	N/A
24th	0.070	0.018	0.036	0.239	0.062	0.122	N/A
25th	0.050	0.037	0.025	0.173	0.128	0.087	N/A
26th	0.015	0.023	0.014	0.052	0.078	0.048	N/A
27th	0.054	0.027	0.049	0.185	0.093	0.169	N/A
28th	0.015	0.025	0.023	0.051	0.086	0.078	N/A
29th	0.018	0.043	0.027	0.062	0.148	0.093	N/A
30th	0.025	0.022	0.038	0.084	0.077	0.132	N/A
31st	0.015	0.025	0.027	0.050	0.087	0.094	N/A
32nd	0.020	0.017	0.031	0.067	0.058	0.108	N/A
33rd	0.016	0.016	0.014	0.055	0.056	0.050	N/A
34th	0.017	0.014	0.027	0.057	0.048	0.092	N/A
35th	0.018	0.017	0.023	0.063	0.059	0.080	N/A
36th	0.027	0.011	0.016	0.094	0.036	0.054	N/A
37th	0.019	0.023	0.011	0.065	0.078	0.038	N/A
38th	0.024	0.019	0.016	0.082	0.067	0.055	N/A
39th	0.011	0.032	0.017	0.038	0.111	0.060	N/A
40th	0.016	0.017	0.017	0.055	0.058	0.060	N/A
THD	--	--	--	4.898	5.347	5.279	13
PWHD	--	--	--	4.431	4.092	4.239	22

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

Bbis.3	**TABLE: Harmonics measurement under test condition 25°C /-25°C / 60°C, 100% / 66% / 33% P_{SMAX} and P_{CMAX} (CEI EN 61000-3-12)**	**P**

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15
Active power (W)	-19857 (33%, 60°C)
Voltage (V)	230.16
Current (A)	29.05
Power Factor	-0.9961
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	29.041	29.034	29.035	--	--	--	--
2nd	0.285	0.487	0.510	0.980	1.674	1.755	8
3rd	1.193	1.290	1.293	4.104	4.436	4.448	N/A
4th	0.267	0.164	0.267	0.918	0.564	0.918	4
5th	0.382	0.501	0.393	1.314	1.724	1.351	10.7
6th	0.108	0.061	0.096	0.373	0.208	0.330	2.7
7th	0.264	0.222	0.243	0.910	0.764	0.836	7.2
8th	0.043	0.046	0.048	0.147	0.160	0.165	2
9th	0.177	0.162	0.162	0.608	0.556	0.556	N/A
10th	0.089	0.066	0.074	0.307	0.228	0.254	1.6
11th	0.079	0.087	0.092	0.272	0.300	0.317	3.1
12th	0.129	0.039	0.084	0.445	0.133	0.290	1.3
13th	0.107	0.148	0.070	0.367	0.508	0.242	2
14th	0.048	0.025	0.058	0.165	0.086	0.198	N/A
15th	0.129	0.047	0.103	0.445	0.162	0.356	N/A
16th	0.041	0.050	0.050	0.142	0.172	0.170	N/A
17th	0.107	0.137	0.141	0.369	0.470	0.485	N/A
18th	0.132	0.038	0.091	0.454	0.129	0.314	N/A
19th	0.080	0.111	0.082	0.275	0.382	0.282	N/A
20th	0.071	0.071	0.080	0.244	0.246	0.277	N/A
21st	0.070	0.095	0.073	0.239	0.327	0.250	N/A
22nd	0.042	0.079	0.049	0.146	0.271	0.170	N/A
23rd	0.048	0.025	0.022	0.164	0.085	0.075	N/A
24th	0.070	0.018	0.036	0.239	0.061	0.122	N/A
25th	0.051	0.037	0.025	0.176	0.128	0.086	N/A
26th	0.015	0.023	0.013	0.053	0.079	0.046	N/A
27th	0.054	0.027	0.049	0.185	0.092	0.170	N/A
28th	0.015	0.025	0.023	0.051	0.086	0.078	N/A
29th	0.018	0.043	0.027	0.062	0.147	0.095	N/A
30th	0.025	0.022	0.039	0.085	0.077	0.133	N/A
31st	0.015	0.025	0.027	0.050	0.087	0.093	N/A
32nd	0.020	0.017	0.031	0.068	0.059	0.108	N/A
33rd	0.016	0.016	0.014	0.054	0.056	0.049	N/A
34th	0.016	0.014	0.027	0.057	0.049	0.093	N/A
35th	0.019	0.018	0.023	0.065	0.061	0.079	N/A
36th	0.027	0.011	0.016	0.094	0.037	0.055	N/A
37th	0.019	0.023	0.011	0.064	0.078	0.037	N/A
38th	0.024	0.019	0.016	0.083	0.066	0.057	N/A
39th	0.011	0.032	0.017	0.038	0.110	0.059	N/A
40th	0.016	0.017	0.017	0.056	0.057	0.060	N/A
THD	--	--	--	4.887	5.337	5.270	13
PWHD	--	--	--	4.440	4.086	4.240	22

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

Bbis.3 c)	**TABLE: Flicker measurement**	**P**
☒ CEI EN 61000-3-3 ☒ CEI EN 61000-3-11		
☒ Ambient temperature ☒ -25°C temperature ☒ +60°C temperature		
☒ Full power, 66% and 33% of P_{SMAX} / P_{NINV} ☒ Full power, 66% and 33% of P_{CMAX}		
c) limits of voltage fluctuations and flicker (CEI EN 61000-3-3 or CEI EN 61000-3-11); they must be repeated in 6 sessions (at 33%, 66% and 100% of the P_{SMAX}, or P_{NINV} for integrated EESS, and at 33%, 66% and 100% of the P_{CMAX}), and for storage systems connected to unidirectional converters in 3 sessions (at 33%, 66% and 100% of the maximum available power in discharge)		
Supplementary information: *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

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15-Discharge								
Normal ambient									
Output power:	Flicker limits according to*:	Result:							
		Plt			Pst			dc%	
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.101	0.101	0.103	0.114	0.109	0.114	0.051	0.052	0.051
66%	EN61000-3-3 / EN61000-3-11	0.103	0.104	0.102	0.114	0.114	0.112	0.050	0.052	0.051
100%	EN61000-3-3 / EN61000-3-11	0.103	0.100	0.103	0.113	0.110	0.113	0.048	0.044	0.049
Minimum ambient rating -25°C									
Output power:	Flicker limits according to*:	Result:							
		Plt			Pst			dc%	
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.104	0.101	0.100	0.113	0.113	0.111	0.045	0.052	0.049
66%	EN61000-3-3 / EN61000-3-11	0.102	0.104	0.104	0.113	0.113	0.111	0.044	0.045	0.051
100%	EN61000-3-3 / EN61000-3-11	0.099	0.102	0.101	0.106	0.113	0.114	0.049	0.044	0.051
Maximum ambient rating +60°C									
Output power:	Flicker limits according to*:	Result:							
		Plt			Pst			dc%	
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.101	0.099	0.102	0.113	0.112	0.114	0.045	0.046	0.049
66%	EN61000-3-3 / EN61000-3-11	0.105	0.100	0.104	0.114	0.111	0.113	0.052	0.045	0.046
100%	EN61000-3-3 / EN61000-3-11	0.102	0.100	0.100	0.111	0.111	0.112	0.050	0.051	0.049

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

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.

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.034	Pass	0.262	Pass	0.0	Pass	0.097	Pass		
2	0.036	Pass	0.256	Pass	0.0	Pass	0.098	Pass		
3	0.051	Pass	0.269	Pass	0.0	Pass	0.114	Pass		
4	0.044	Pass	0.266	Pass	0.0	Pass	0.097	Pass		
5	0.049	Pass	0.255	Pass	0.0	Pass	0.096	Pass		
6	0.041	Pass	0.275	Pass	0.0	Pass	0.096	Pass		
7	0.039	Pass	0.260	Pass	0.0	Pass	0.096	Pass		
8	0.039	Pass	0.259	Pass	0.0	Pass	0.110	Pass		
9	0.044	Pass	0.275	Pass	0.0	Pass	0.103	Pass		
10	0.038	Pass	0.260	Pass	0.0	Pass	0.104	Pass		
11	0.051	Pass	0.265	Pass	0.0	Pass	0.098	Pass		
12	0.039	Pass	0.257	Pass	0.0	Pass	0.096	Pass		
Result		Pass		Pass		Pass		Pass	0.101	Pass

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

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15-Charge									
Normal ambient										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.104	0.100	0.101	0.113	0.110	0.109	0.050	0.043	0.048
66%	EN61000-3-3 / EN61000-3-11	0.102	0.101	0.103	0.112	0.114	0.111	0.051	0.050	0.047
100%	EN61000-3-3 / EN61000-3-11	0.102	0.101	0.102	0.113	0.112	0.110	0.049	0.049	0.049
Minimum ambient rating -25°C										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.100	0.102	0.101	0.110	0.113	0.111	0.048	0.051	0.052
66%	EN61000-3-3 / EN61000-3-11	0.100	0.102	0.099	0.114	0.113	0.103	0.051	0.049	0.051
100%	EN61000-3-3 / EN61000-3-11	0.101	0.106	0.102	0.112	0.112	0.113	0.051	0.052	0.050
Maximum ambient rating +60°C										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.103	0.102	0.103	0.113	0.114	0.114	0.043	0.050	0.050
66%	EN61000-3-3 / EN61000-3-11	0.100	0.102	0.105	0.105	0.110	0.113	0.051	0.049	0.051
100%	EN61000-3-3 / EN61000-3-11	0.103	0.099	0.101	0.110	0.107	0.112	0.044	0.046	0.052

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

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:
$Z_{max} = Z_{ref} * 3{,}3\% / d_c(P_n)$

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.041	Pass	0.288	Pass	0.0	Pass	0.098	Pass		
2	0.050	Pass	0.263	Pass	0.0	Pass	0.097	Pass		
3	0.034	Pass	0.285	Pass	0.0	Pass	0.108	Pass		
4	0.035	Pass	0.259	Pass	0.0	Pass	0.093	Pass		
5	0.036	Pass	0.274	Pass	0.0	Pass	0.104	Pass		
6	0.036	Pass	0.269	Pass	0.0	Pass	0.102	Pass		
7	0.039	Pass	0.274	Pass	0.0	Pass	0.100	Pass		
8	0.042	Pass	0.268	Pass	0.0	Pass	0.113	Pass		
9	0.041	Pass	0.255	Pass	0.0	Pass	0.099	Pass		
10	0.036	Pass	0.255	Pass	0.0	Pass	0.110	Pass		
11	0.034	Pass	0.272	Pass	0.0	Pass	0.108	Pass		
12	0.035	Pass	0.266	Pass	0.0	Pass	0.112	Pass		
Result		Pass		Pass		Pass		Pass	0.104	Pass

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

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3-Discharge								
Maximum ambient rating +60°C									
Output power:	Flicker limits according to*:	Result:							
		Plt			Pst			dc%	
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.097	0.096	0.097	0.099	0.102	0.103	0.036	0.034	0.037
66%	EN61000-3-3 / EN61000-3-11	0.099	0.099	0.099	0.103	0.104	0.104	0.037	0.036	0.037
100%	EN61000-3-3 / EN61000-3-11	0.098	0.098	0.097	0.101	0.102	0.102	0.036	0.035	0.036

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).

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.025	Pass	0.256	Pass	0.0	Pass	0.099	Pass		
2	0.027	Pass	0.257	Pass	0.0	Pass	0.097	Pass		
3	0.028	Pass	0.269	Pass	0.0	Pass	0.097	Pass		
4	0.029	Pass	0.256	Pass	0.0	Pass	0.098	Pass		
5	0.033	Pass	0.251	Pass	0.0	Pass	0.095	Pass		
6	0.026	Pass	0.271	Pass	0.0	Pass	0.098	Pass		
7	0.033	Pass	0.267	Pass	0.0	Pass	0.098	Pass		
8	0.036	Pass	0.246	Pass	0.0	Pass	0.097	Pass		
9	0.030	Pass	0.246	Pass	0.0	Pass	0.093	Pass		
10	0.030	Pass	0.255	Pass	0.0	Pass	0.096	Pass		
11	0.031	Pass	0.259	Pass	0.0	Pass	0.097	Pass		
12	0.035	Pass	0.257	Pass	0.0	Pass	0.093	Pass		
Result		Pass		Pass		Pass		Pass	0.097	Pass

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

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3-Charge

Maximum ambient rating +60°C

Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.096	0.098	0.098	0.099	0.104	0.104	0.037	0.035	0.036
66%	EN61000-3-3 / EN61000-3-11	0.098	0.098	0.098	0.103	0.103	0.102	0.030	0.034	0.029
100%	EN61000-3-3 / EN61000-3-11	0.098	0.096	0.097	0.104	0.101	0.102	0.036	0.035	0.034

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).

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.024	Pass	0.257	Pass	0.0	Pass	0.097	Pass		
2	0.037	Pass	0.246	Pass	0.0	Pass	0.094	Pass		
3	0.033	Pass	0.244	Pass	0.0	Pass	0.097	Pass		
4	0.023	Pass	0.246	Pass	0.0	Pass	0.098	Pass		
5	0.027	Pass	0.267	Pass	0.0	Pass	0.093	Pass		
6	0.024	Pass	0.244	Pass	0.0	Pass	0.095	Pass		
7	0.025	Pass	0.246	Pass	0.0	Pass	0.094	Pass		
8	0.030	Pass	0.249	Pass	0.0	Pass	0.095	Pass		
9	0.029	Pass	0.255	Pass	0.0	Pass	0.095	Pass		
10	0.023	Pass	0.264	Pass	0.0	Pass	0.099	Pass		
11	0.034	Pass	0.269	Pass	0.0	Pass	0.097	Pass		
12	0.031	Pass	0.247	Pass	0.0	Pass	0.096	Pass		
Result		Pass		Pass		Pass		Pass	0.096	Pass

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

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3-Discharge									
Maximum ambient rating +60°C										
Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.101	0.101	0.101	0.106	0.107	0.107	0.033	0.033	0.033
66%	EN61000-3-3 / EN61000-3-11	0.101	0.101	0.101	0.108	0.107	0.107	0.033	0.030	0.032
100%	EN61000-3-3 / EN61000-3-11	0.100	0.098	0.101	0.105	0.101	0.106	0.031	0.030	0.032

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).

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.029	Pass	0.251	Pass	0.0	Pass	0.103	Pass		
2	0.025	Pass	0.254	Pass	0.0	Pass	0.098	Pass		
3	0.032	Pass	0.268	Pass	0.0	Pass	0.100	Pass		
4	0.030	Pass	0.255	Pass	0.0	Pass	0.097	Pass		
5	0.033	Pass	0.260	Pass	0.0	Pass	0.105	Pass		
6	0.027	Pass	0.258	Pass	0.0	Pass	0.105	Pass		
7	0.028	Pass	0.263	Pass	0.0	Pass	0.105	Pass		
8	0.032	Pass	0.265	Pass	0.0	Pass	0.098	Pass		
9	0.027	Pass	0.258	Pass	0.0	Pass	0.106	Pass		
10	0.030	Pass	0.251	Pass	0.0	Pass	0.098	Pass		
11	0.027	Pass	0.255	Pass	0.0	Pass	0.101	Pass		
12	0.029	Pass	0.258	Pass	0.0	Pass	0.099	Pass		
Result		Pass		Pass		Pass		Pass	0.101	Pass

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

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3-Charge

Maximum ambient rating +60°C

Output power:	Flicker limits according to*:	Result:								
		Plt			Pst			dc%		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
33%	EN61000-3-3 / EN61000-3-11	0.101	0.101	0.100	0.107	0.107	0.106	0.032	0.030	0.033
66%	EN61000-3-3 / EN61000-3-11	0.100	0.099	0.099	0.108	0.107	0.105	0.031	0.033	0.030
100%	EN61000-3-3 / EN61000-3-11	0.100	0.101	0.101	0.107	0.107	0.106	0.033	0.031	0.031

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).

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.029	Pass	0.258	Pass	0.0	Pass	0.102	Pass		
2	0.027	Pass	0.252	Pass	0.0	Pass	0.101	Pass		
3	0.029	Pass	0.254	Pass	0.0	Pass	0.097	Pass		
4	0.030	Pass	0.256	Pass	0.0	Pass	0.107	Pass		
5	0.029	Pass	0.253	Pass	0.0	Pass	0.100	Pass		
6	0.032	Pass	0.263	Pass	0.0	Pass	0.101	Pass		
7	0.028	Pass	0.257	Pass	0.0	Pass	0.098	Pass		
8	0.026	Pass	0.261	Pass	0.0	Pass	0.100	Pass		
9	0.026	Pass	0.256	Pass	0.0	Pass	0.102	Pass		
10	0.027	Pass	0.261	Pass	0.0	Pass	0.098	Pass		
11	0.030	Pass	0.260	Pass	0.0	Pass	0.100	Pass		
12	0.025	Pass	0.257	Pass	0.0	Pass	0.100	Pass		
Result		Pass		Pass		Pass		Pass	0.101	Pass

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

Bbis.4	**TABLE: Check the operating range in voltage and frequency**					**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15					
Supplementary information: P_{SMAX} =60.0 kW P_{CMAX} =60.0 kW						
Test Point	Voltage (%)	Frequency(Hz)	P (W)	cos φ	Time (s)	Result
Test 1	85.03%	47.49	60064	0.9995	>5min	No disconnection
Test 2	109.92%	51.49	60070	0.9997	>5min	No disconnection
Test 3	84.99%	47.49	-60191	-0.9996	>5min	No disconnection
Test 4	109.94%	51.49	-60079	-0.9996	>5min	No disconnection
Test 1: V = 85 % * Vn; f = 47,5 Hz; P = 100 % * PSMAX (PNINV for integrated EESS); cos φ = 1 Test 2: V = 110 % * Vn; f = 51,5 Hz; P = 100 % * PSMAX (PNINV for integrated EESS); cos φ= 1 Test 3: V = 85 % * Vn; f = 47,5 Hz; P = 100 % * PCMAX; cos φ = 1 Test 4: V= 110 % * Vn; f = 51,5 Hz; P = 100 % * PCMAX; cos φ =1 During the tests it is necessary to disable the automatic regulation in reduction / increase of the power in case of over / under frequency.						

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

Diagram of Test 1

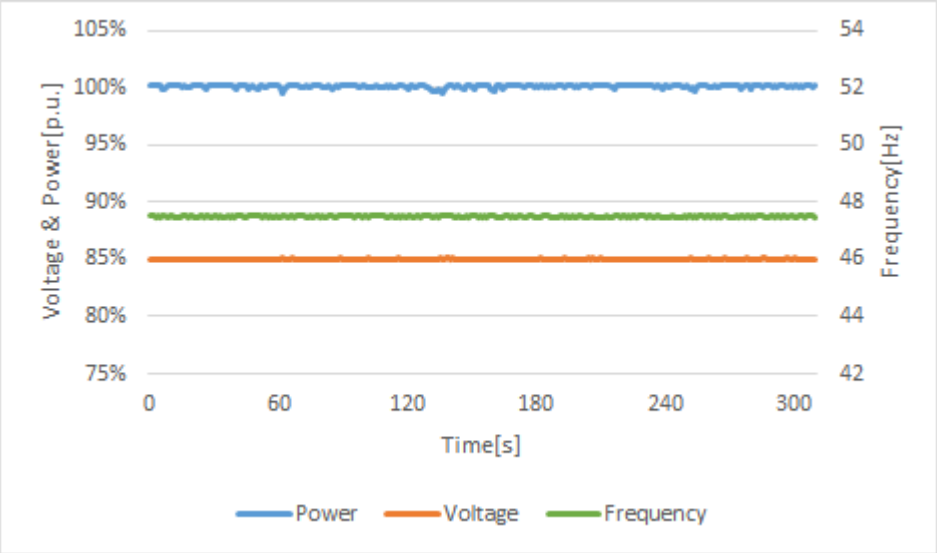
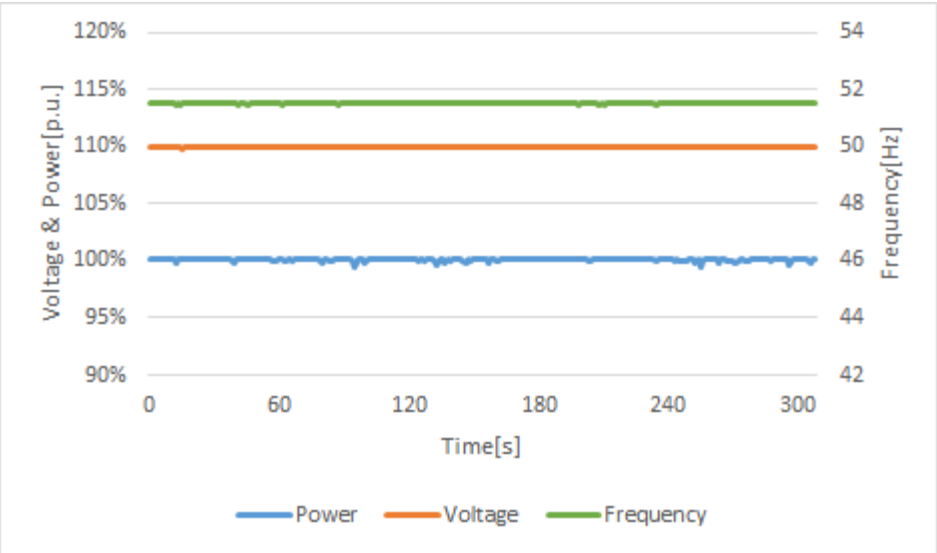


Diagram of Test 2



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

Diagram of Test 3

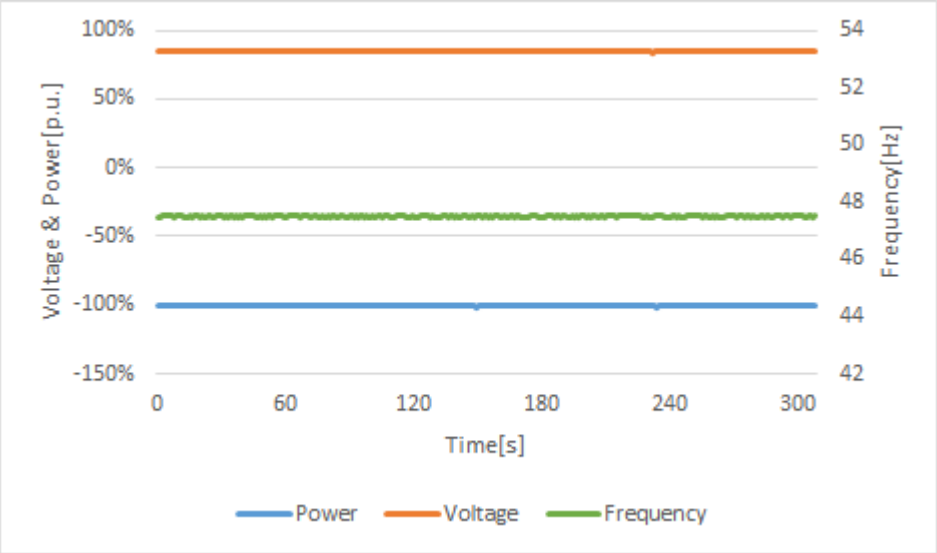
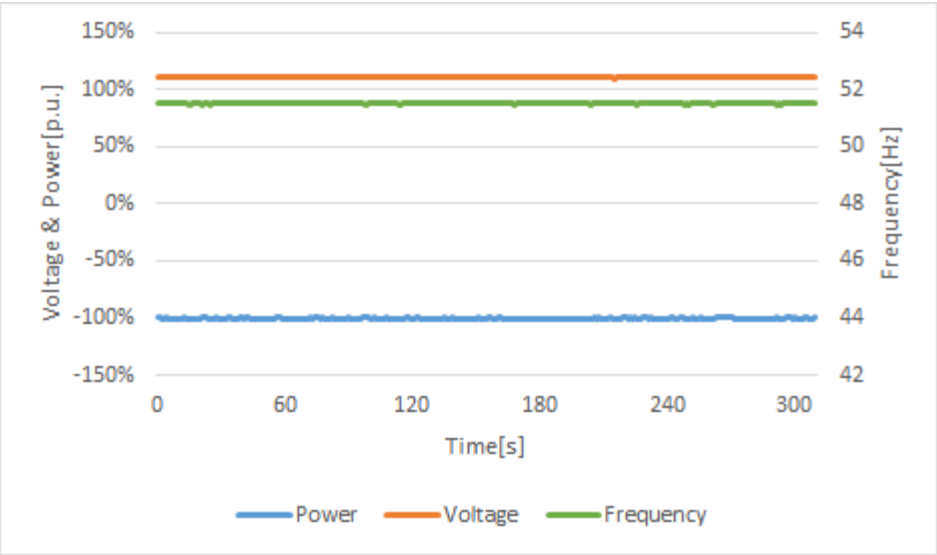


Diagram of Test 4



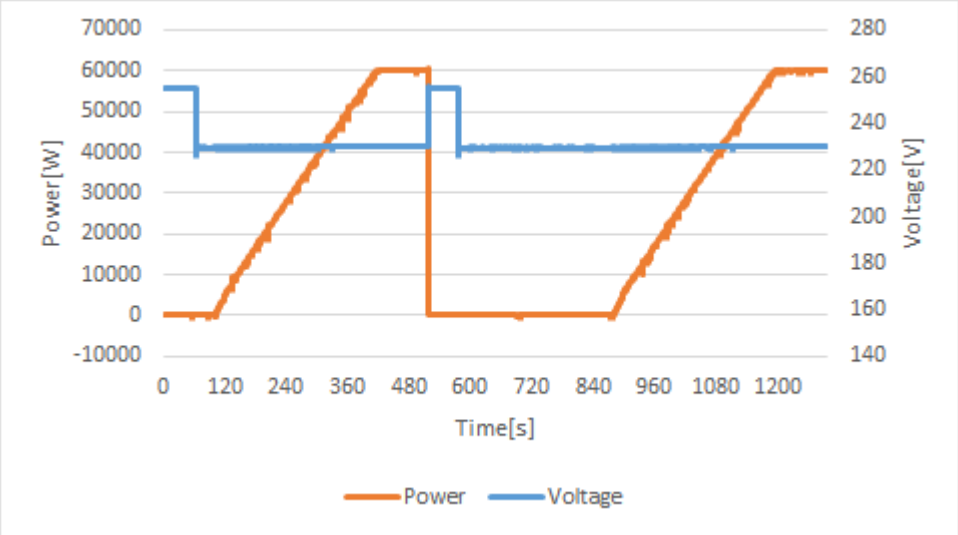
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.5	**TABLE: Conditions of connection, reconnection and gradual power supply**		**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15		
Test:			
Power meter measurment-data:	Sample-Rate:	0.2 s	
	Sample time:		
	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]	32	35	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
c) In voltage range after voltage failture	85% U_n < U <110% U_n		
Reconnection time [s]	306	307	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / 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]	31	33	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
f) In frequency range after frequency failture	49.90 Hz < f < 50.10		
Reconnection time [s]	304	308	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
Changable reconnection conditions:	Frequency range: 49Hz-51Hz in 0,05Hz steps (default value: 49.90 and 50.10Hz)		

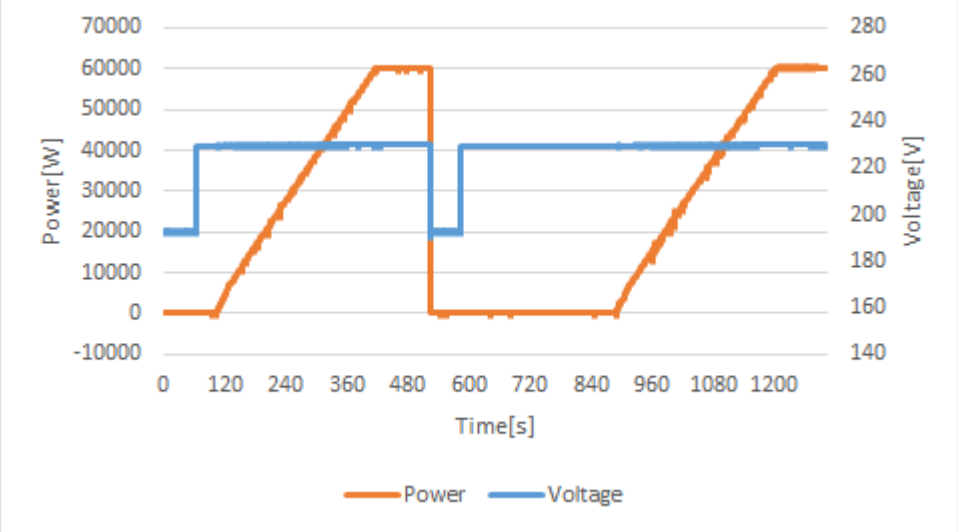
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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_{SMAX} or P_{NINV}		Reconnection time range: 0-900s in steps of 5s (default value: 300s)

Over Voltage

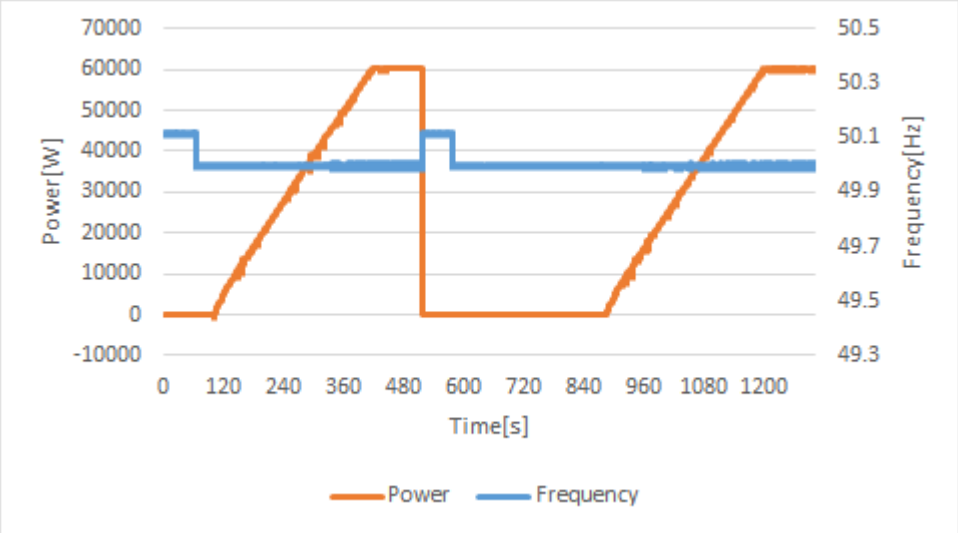


Under Voltage

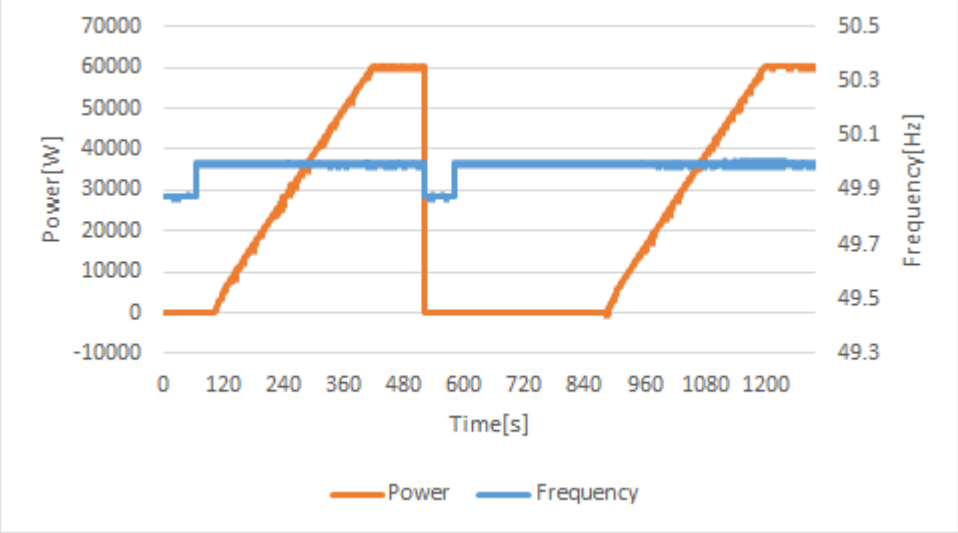


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Over Frequency



Under Frequency



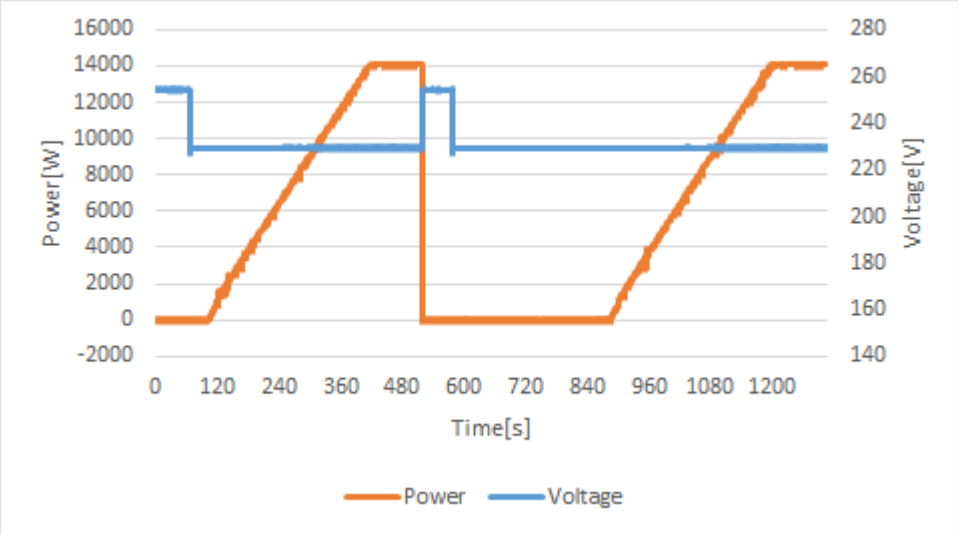
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.5	**TABLE: Conditions of connection, reconnection and gradual power supply**		**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3		
Test:			
Power meter measurment-data:	Sample-Rate:	0.2 s	
	Sample time:	-	
	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]	33	37	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
c) In voltage range after voltage failture	85% U_n < U <110% U_n		
Reconnection time [s]	301	305	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / 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	30	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
f) In frequency range after frequency failture	49.90 Hz < f < 50.10		
Reconnection time [s]	307	305	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
Changable reconnection conditions:	Frequency range: 49Hz-51Hz in 0.05Hz steps (default value: 49.90 and 50.10Hz)		

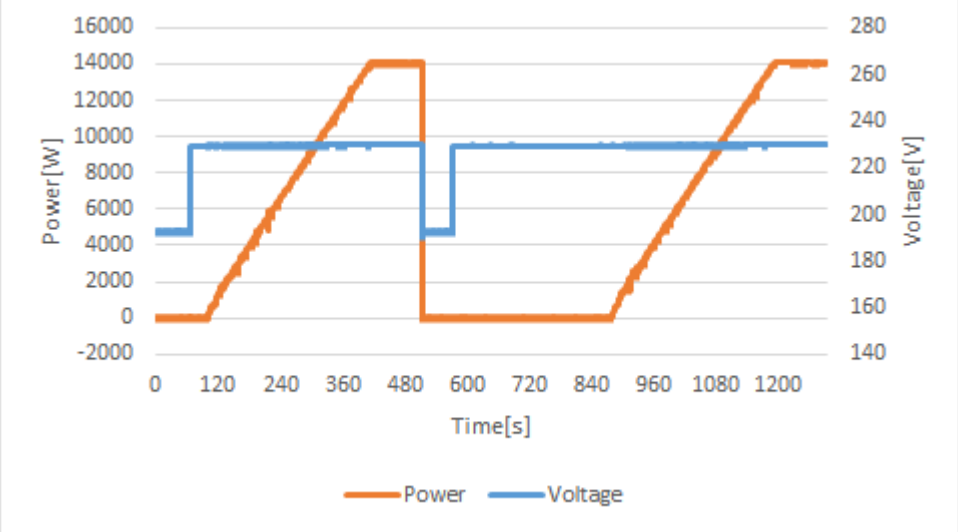
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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_{SMAX} or P_{NINV}		Reconnection time range: 0-900s in steps of 5s (default value: 300s)

Over Voltage

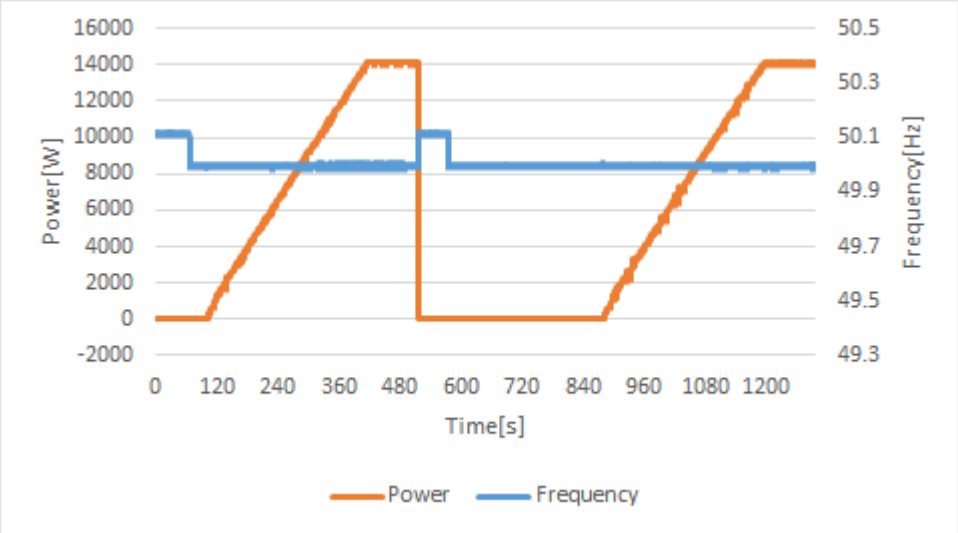


Under Voltage

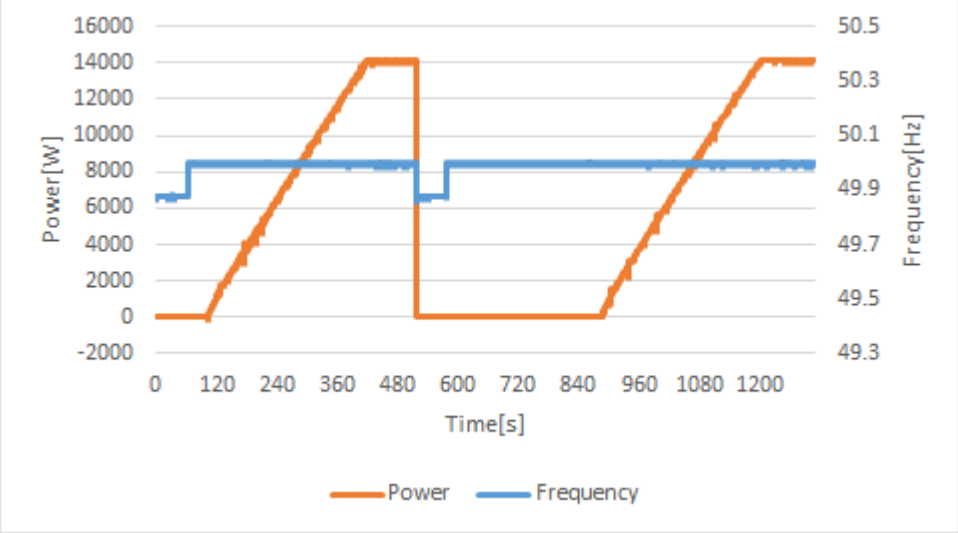


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Over Frequency



Under Frequency



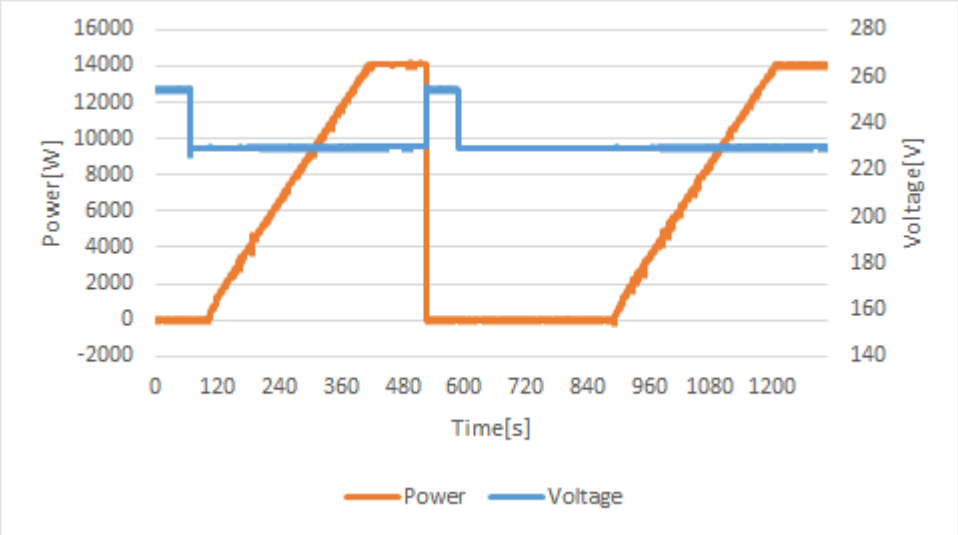
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.5	**TABLE: Conditions of connection, reconnection and gradual power supply**		**P**
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3		
Test:			
Power meter measurment-data:	Sample-Rate:	0.2 s	
	Sample time:	-	
	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	32	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
c) In voltage range after voltage failture	85% U_n < U <110% U_n		
Reconnection time [s]	302	303	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / 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]	37	32	
Limit:	Reconnection after 30s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
f) In frequency range after frequency failture	49.90 Hz < f < 50.10		
Reconnection time [s]	305	302	
Limit:	Reconnection after 300s		
Gradient:	Gradient schould be recorded for at least 300s until the inverter has the full output power. Max gradient: 20%% P_{SMAX} or P_{NINV} / min For recorded gradient see diagram underneath		
Changable reconnection conditions:	Frequency range: 49Hz-51Hz in 0.05Hz steps (default value: 49.90 and 50.10Hz)		

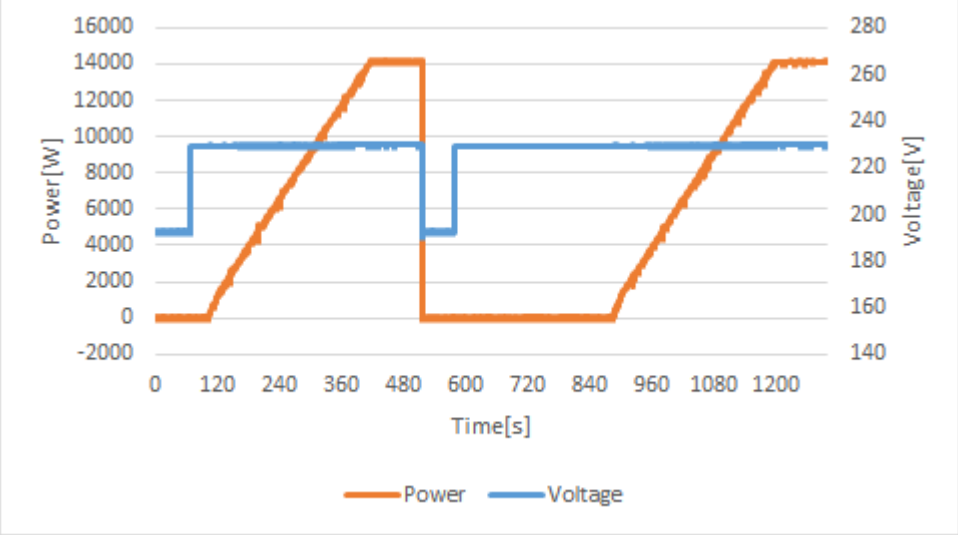
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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_{SMAX} or P_{NINV}		Reconnection time range: 0-900s in steps of 5s (default value: 300s)

Over Voltage

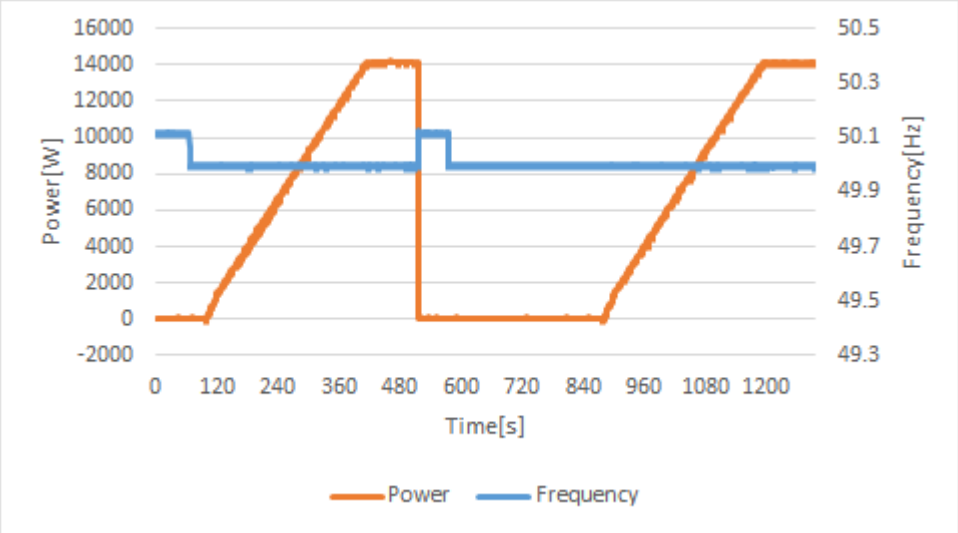


Under Voltage

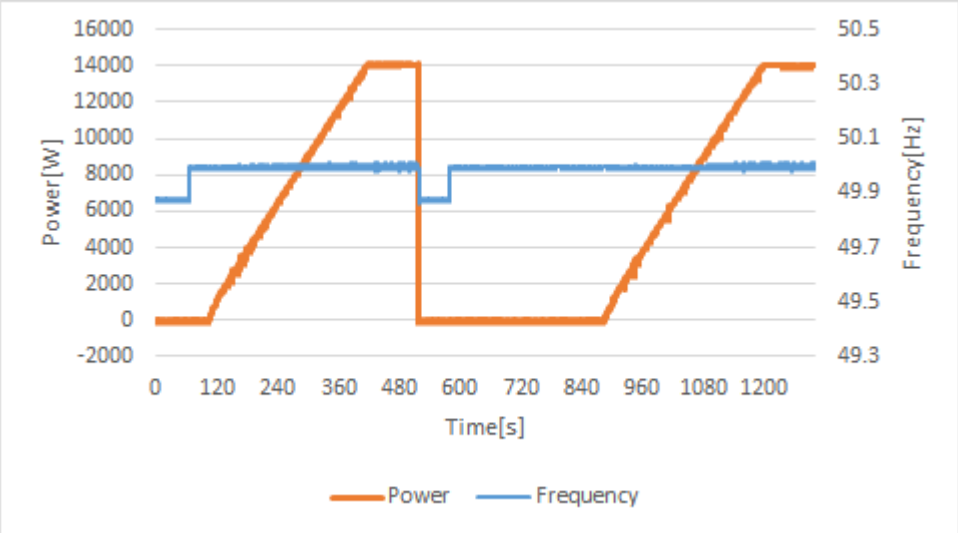


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Over Frequency



Under Frequency



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

Bbis.6.1 Bbis.6.2	**TABLE: Checking construction requirements: reactive power capability**	**P**
Max. cos φ / Q setting point:	☐ **P_{SMAX} ≤ 11.08 kW: Cos φ = 0.9** ☐ **P_{SMAX} > 11.08 kW: Q/P_n% = 48.43%**	

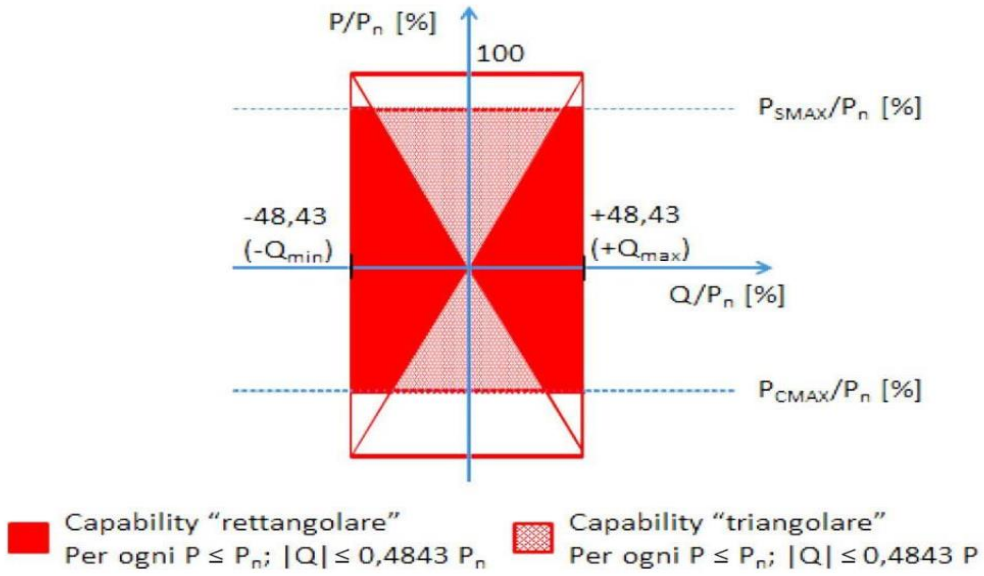


Figure 62 - Capability for a storage system with bidirectional inverter

Supplementary information:
For each of the 10 levels of active power, value of inductive reactive power and value of conductive reactive power must be registered as average values in 1 min, based on the measurements at the fundamental in a window of 200ms.

Positve active power: supply power to the grid
Negative active power: absorb power from grid
Positve DC power: charging battery
Negative DC power: battery discharging

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Clause	Requirement - Test	Result - Remark	Verdict

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15						
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
90% -100% P_{CMAX}	-60001	-100.00%	1501	2.50%	-56401	-94.00%	-0.9997
80% -90% P_{CMAX}	-52779	-87.97%	1496	2.49%	-49613	-82.69%	-0.9996
70% -80% P_{CMAX}	-46774	-77.96%	1501	2.50%	-43968	-73.28%	-0.9995
60% -70% P_{CMAX}	-40850	-68.08%	1509	2.52%	-38399	-64.00%	-0.9993
50% -60% P_{CMAX}	-34759	-57.93%	1500	2.50%	-32674	-54.46%	-0.9990
40% -50% P_{CMAX}	-28850	-48.08%	1497	2.50%	-27119	-45.20%	-0.9986
30% -40% P_{CMAX}	-22829	-38.05%	1499	2.50%	-21459	-35.77%	-0.9978
20% -30% P_{CMAX}	-16808	-28.01%	1512	2.52%	-15799	-26.33%	-0.9958
10% -20% P_{CMAX}	-10769	-17.95%	1505	2.51%	-10123	-16.87%	-0.9900
0% -10% P_{CMAX}	-4789	-7.98%	1486	2.48%	-4502	-7.50%	-0.9538
0% -10% P_{SMAX}	5070	8.45%	1500	2.50%	5393	8.99%	0.9589
10% -20% P_{SMAX}	10800	18.00%	1508	2.51%	11489	19.15%	0.9900
20% -30% P_{SMAX}	16789	27.98%	1499	2.50%	17860	29.77%	0.9959
30% -40% P_{SMAX}	22818	38.03%	1513	2.52%	24275	40.46%	0.9977
40% -50% P_{SMAX}	28894	48.16%	1504	2.51%	30738	51.23%	0.9986
50% -60% P_{SMAX}	34784	57.97%	1520	2.53%	37005	61.67%	0.9990
60% -70% P_{SMAX}	40793	67.99%	1511	2.52%	43397	72.33%	0.9993
70% -80% P_{SMAX}	46792	77.99%	1505	2.51%	49779	82.96%	0.9995
80% -90% P_{SMAX}	52819	88.03%	1496	2.49%	56190	93.65%	0.9996
90% -100% P_{SMAX}	59970	99.95%	1496	2.49%	63798	106.33%	0.9997
TABLE: Reactive power production with set point Q = -Q_{max} (>11.08 kW) or cos φ = -0.9 (≤ 11.08 kW)							
Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-58698	-97.83%	-29996	-49.99%	-55176	-91.96%	-0.8904
80% -90% P_{CMAX}	-53012	-88.35%	-30012	-50.02%	-49831	-83.05%	-0.8702
70% -80% P_{CMAX}	-46570	-77.62%	-30011	-50.02%	-43776	-72.96%	-0.8406
60% -70% P_{CMAX}	-41172	-68.62%	-30015	-50.03%	-38702	-64.50%	-0.8081
50% -60% P_{CMAX}	-34834	-58.06%	-30027	-50.05%	-32744	-54.57%	-0.7574
40% -50% P_{CMAX}	-28896	-48.16%	-29976	-49.96%	-27162	-45.27%	-0.6940
30% -40% P_{CMAX}	-23048	-38.41%	-30007	-50.01%	-21665	-36.11%	-0.6092
20% -30% P_{CMAX}	-16701	-27.83%	-30010	-50.02%	-15699	-26.17%	-0.4863

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Clause	Requirement - Test	Result - Remark	Verdict

10% -20% P_{CMAX}	-11565	-19.28%	1500	2.50%	-10872	-18.12%	-0.9917
0% -10% P_{CMAX}	-4931	-8.22%	1503	2.50%	-4635	-7.72%	-0.9564
0% -10% P_{SMAX}	5060	8.43%	1498	2.50%	5383	8.97%	0.9588
10% -20% P_{SMAX}	11342	18.90%	1497	2.49%	12065	20.11%	0.9914
20% -30% P_{SMAX}	16799	28.00%	-29996	-49.99%	17871	29.79%	0.4887
30% -40% P_{SMAX}	22826	38.04%	-29995	-49.99%	24283	40.47%	0.6056
40% -50% P_{SMAX}	28827	48.04%	-30002	-50.00%	30666	51.11%	0.6929
50% -60% P_{SMAX}	34807	58.01%	-30027	-50.04%	37028	61.71%	0.7572
60% -70% P_{SMAX}	40785	67.98%	-30013	-50.02%	43389	72.31%	0.8054
70% -80% P_{SMAX}	46806	78.01%	-29996	-49.99%	49794	82.99%	0.8419
80% -90% P_{SMAX}	52807	88.01%	-30004	-50.01%	56178	93.63%	0.8694
90% -100% P_{SMAX}	59223	98.71%	-29989	-49.98%	63004	105.01%	0.8921

TABLE: Reactive power production with set point Q =+Q_{max} (>11.08 kW) or cos φ = +0.9 (≤ 11.08 kW)

Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-58782	-97.97%	29992	49.99%	-55255	-92.09%	-0.8907
80% -90% P_{CMAX}	-52778	-87.96%	29967	49.95%	-49611	-82.69%	-0.8696
70% -80% P_{CMAX}	-47396	-78.99%	29982	49.97%	-44552	-74.25%	-0.8451
60% -70% P_{CMAX}	-41456	-69.09%	29998	50.00%	-38969	-64.95%	-0.8101
50% -60% P_{CMAX}	-34648	-57.75%	29973	49.96%	-32569	-54.28%	-0.7563
40% -50% P_{CMAX}	-29043	-48.40%	30015	50.02%	-27300	-45.50%	-0.6954
30% -40% P_{CMAX}	-22707	-37.84%	30000	50.00%	-21344	-35.57%	-0.6036
20% -30% P_{CMAX}	-16820	-28.03%	29976	49.96%	-15811	-26.35%	-0.4894
10% -20% P_{CMAX}	-11395	-18.99%	1499	2.50%	-10712	-17.85%	-0.9914
0% -10% P_{CMAX}	-5056	-8.43%	1498	2.50%	-4753	-7.92%	-0.9588
0% -10% P_{SMAX}	5030	8.38%	1500	2.50%	5352	8.92%	0.9582
10% -20% P_{SMAX}	11352	18.92%	1500	2.50%	12077	20.13%	0.9914
20% -30% P_{SMAX}	16771	27.95%	30016	50.03%	17842	29.74%	0.4878
30% -40% P_{SMAX}	22800	38.00%	30001	50.00%	24255	40.43%	0.6051
40% -50% P_{SMAX}	28797	47.99%	29999	50.00%	30635	51.06%	0.6925
50% -60% P_{SMAX}	34701	57.83%	30016	50.03%	36916	61.53%	0.7563
60% -70% P_{SMAX}	40795	67.99%	29995	49.99%	43399	72.33%	0.8057
70% -80% P_{SMAX}	46780	77.97%	30010	50.02%	49767	82.94%	0.8417
80% -90% P_{SMAX}	52797	87.99%	29993	49.99%	56167	93.61%	0.8695
90% -100% P_{SMAX}	59175	98.62%	29975	49.96%	62952	104.92%	0.8921

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Clause	Requirement - Test	Result - Remark	Verdict

Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3						
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
90% -100% P_{CMAX}	-14005	-100.03%	1506	2.51%	-13164	-94.03%	-0.9940
80% -90% P_{CMAX}	-12309	-87.92%	1505	2.51%	-11571	-82.65%	-0.9923
70% -80% P_{CMAX}	-10940	-78.14%	1511	2.52%	-10283	-73.45%	-0.9903
60% -70% P_{CMAX}	-9513	-67.95%	1501	2.50%	-8942	-63.87%	-0.9873
50% -60% P_{CMAX}	-8111	-57.94%	1494	2.49%	-7625	-54.46%	-0.9829
40% -50% P_{CMAX}	-6713	-47.95%	1492	2.49%	-6310	-45.07%	-0.9754
30% -40% P_{CMAX}	-5313	-37.95%	1498	2.50%	-4994	-35.67%	-0.9613
20% -30% P_{CMAX}	-3918	-27.99%	1501	2.50%	-3683	-26.31%	-0.9323
10% -20% P_{CMAX}	-2531	-18.08%	1508	2.51%	-2380	-17.00%	-0.8579
0% -10% P_{CMAX}	-1125	-8.04%	1509	2.52%	-1057	-7.55%	-0.6040
0% -10% P_{SMAX}	1113	7.95%	1488	2.48%	1184	8.45%	0.6054
10% -20% P_{SMAX}	2531	18.08%	1496	2.49%	2692	19.23%	0.8597
20% -30% P_{SMAX}	3930	28.07%	1499	2.50%	4181	29.86%	0.9329
30% -40% P_{SMAX}	5324	38.03%	1507	2.51%	5664	40.46%	0.9611
40% -50% P_{SMAX}	6721	48.00%	1503	2.50%	7149	51.06%	0.9751
50% -60% P_{SMAX}	8123	58.02%	1499	2.50%	8642	61.73%	0.9828
60% -70% P_{SMAX}	9519	67.99%	1503	2.51%	10126	72.33%	0.9873
70% -80% P_{SMAX}	10939	78.13%	1493	2.49%	11637	83.12%	0.9905
80% -90% P_{SMAX}	12324	88.03%	1485	2.48%	13111	93.65%	0.9925
90% -100% P_{SMAX}	14041	100.29%	1500	2.50%	14937	106.69%	0.9941
TABLE: Reactive power production with set point Q = -Q_{max} (>11.08 kW) or cos φ = -0.9 (≤ 11.08 kW)							
Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-14002	-100.01%	-30021	-50.04%	-13162	-94.01%	-0.4228
80% -90% P_{CMAX}	-12313	-87.95%	-30014	-50.02%	-11575	-82.68%	-0.3796
70% -80% P_{CMAX}	-10934	-78.10%	-30008	-50.01%	-10278	-73.41%	-0.3424
60% -70% P_{CMAX}	-9502	-67.87%	-29991	-49.98%	-8932	-63.80%	-0.3021
50% -60% P_{CMAX}	-8133	-58.09%	-29977	-49.96%	-7645	-54.60%	-0.2619
40% -50% P_{CMAX}	-6711	-47.94%	-30021	-50.03%	-6309	-45.06%	-0.2182
30% -40% P_{CMAX}	-5358	-38.27%	-30028	-50.05%	-5037	-35.98%	-0.1757
20% -30% P_{CMAX}	-3920	-28.00%	-30035	-50.06%	-3685	-26.32%	-0.1295

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Clause	Requirement - Test	Result - Remark	Verdict

10% -20% P_{CMAX}	-2656	-18.97%	1500	2.50%	-2497	-17.83%	-0.8706
0% -10% P_{CMAX}	-1161	-8.29%	1499	2.50%	-1091	-7.79%	-0.6119
0% -10% P_{SMAX}	1110	7.93%	1501	2.50%	1181	8.44%	0.5943
10% -20% P_{SMAX}	2527	18.05%	1500	2.50%	2688	19.20%	0.8597
20% -30% P_{SMAX}	3904	27.89%	-29988	-49.98%	4153	29.67%	0.1291
30% -40% P_{SMAX}	5322	38.01%	-29992	-49.99%	5662	40.44%	0.1748
40% -50% P_{SMAX}	6714	47.95%	-30014	-50.02%	7142	51.01%	0.2183
50% -60% P_{SMAX}	8118	57.99%	-30002	-50.00%	8636	61.69%	0.2612
60% -70% P_{SMAX}	9496	67.83%	-29989	-49.98%	10102	72.16%	0.3019
70% -80% P_{SMAX}	10934	78.10%	-29986	-49.98%	11632	83.09%	0.3426
80% -90% P_{SMAX}	12319	87.99%	-29983	-49.97%	13105	93.61%	0.3801
90% -100% P_{SMAX}	14039	100.28%	-30010	-50.02%	14935	106.68%	0.4238

TABLE: Reactive power production with set point Q =+Q_{max} (>11.08 kW) or cos φ = +0.9 (≤ 11.08 kW)

Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-13990	-99.93%	29984	49.97%	-13150	-93.93%	-0.4229
80% -90% P_{CMAX}	-12295	-87.82%	29989	49.98%	-11558	-82.56%	-0.3794
70% -80% P_{CMAX}	-10920	-78.00%	29992	49.99%	-10264	-73.31%	-0.3422
60% -70% P_{CMAX}	-9527	-68.05%	30008	50.01%	-8956	-63.97%	-0.3027
50% -60% P_{CMAX}	-8116	-57.97%	30002	50.00%	-7629	-54.49%	-0.2612
40% -50% P_{CMAX}	-6736	-48.11%	29962	49.94%	-6332	-45.23%	-0.2194
30% -40% P_{CMAX}	-5314	-37.96%	29992	49.99%	-4995	-35.68%	-0.1745
20% -30% P_{CMAX}	-3917	-27.98%	30015	50.02%	-3682	-26.30%	-0.1294
10% -20% P_{CMAX}	-2651	-18.93%	1500	2.50%	-2492	-17.80%	-0.8701
0% -10% P_{CMAX}	-1174	-8.39%	1501	2.50%	-1104	-7.89%	-0.6157
0% -10% P_{SMAX}	1133	8.09%	1501	2.50%	1205	8.61%	0.6021
10% -20% P_{SMAX}	2514	17.96%	1500	2.50%	2675	19.11%	0.8586
20% -30% P_{SMAX}	3912	27.94%	30009	50.01%	4162	29.73%	0.1293
30% -40% P_{SMAX}	5319	37.99%	29989	49.98%	5659	40.42%	0.1747
40% -50% P_{SMAX}	6705	47.89%	29970	49.95%	7132	50.95%	0.2184
50% -60% P_{SMAX}	8099	57.85%	30002	50.00%	8616	61.54%	0.2607
60% -70% P_{SMAX}	9517	67.98%	29991	49.98%	10125	72.32%	0.3025
70% -80% P_{SMAX}	10909	77.92%	29982	49.97%	11605	82.89%	0.3420
80% -90% P_{SMAX}	12328	88.06%	29998	50.00%	13115	93.68%	0.3802
90% -100% P_{SMAX}	14024	100.17%	29986	49.98%	14919	106.57%	0.4237

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Clause	Requirement - Test	Result - Remark	Verdict

Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3						
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
90% -100% P_{CMAX}	-13971	-99.79%	899	2.50%	-13133	-93.81%	-0.9978
80% -90% P_{CMAX}	-12122	-86.59%	894	2.48%	-11395	-81.39%	-0.9972
70% -80% P_{CMAX}	-10686	-76.33%	898	2.49%	-10045	-71.75%	-0.9964
60% -70% P_{CMAX}	-9499	-67.85%	912	2.53%	-8930	-63.78%	-0.9953
50% -60% P_{CMAX}	-7949	-56.78%	908	2.52%	-7472	-53.37%	-0.9933
40% -50% P_{CMAX}	-6482	-46.30%	904	2.51%	-6093	-43.52%	-0.9901
30% -40% P_{CMAX}	-5177	-36.98%	894	2.48%	-4866	-34.76%	-0.9849
20% -30% P_{CMAX}	-3868	-27.63%	888	2.47%	-3636	-25.97%	-0.9738
10% -20% P_{CMAX}	-2476	-17.69%	903	2.51%	-2327	-16.62%	-0.9379
0% -10% P_{CMAX}	-1068	-7.63%	900	2.50%	-1004	-7.17%	-0.7644
0% -10% P_{SMAX}	926	6.61%	900	2.50%	984	7.03%	0.7179
10% -20% P_{SMAX}	2311	16.51%	904	2.51%	2458	17.56%	0.9296
20% -30% P_{SMAX}	3718	26.56%	899	2.50%	3955	28.25%	0.9711
30% -40% P_{SMAX}	5238	37.41%	899	2.50%	5572	39.80%	0.9850
40% -50% P_{SMAX}	6259	44.70%	901	2.50%	6658	47.56%	0.9894
50% -60% P_{SMAX}	8028	57.34%	910	2.53%	8541	61.00%	0.9934
60% -70% P_{SMAX}	9326	66.61%	914	2.54%	9921	70.87%	0.9951
70% -80% P_{SMAX}	10875	77.68%	908	2.52%	11569	82.64%	0.9964
80% -90% P_{SMAX}	12226	87.33%	895	2.49%	13007	92.90%	0.9972
90% -100% P_{SMAX}	13993	99.95%	891	2.47%	14886	106.33%	0.9979
TABLE: Reactive power production with set point Q = -Q_{max} (>11.08 kW) or cos φ = -0.9 (≤ 11.08 kW)							
Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-13990	-99.93%	-18002	-50.01%	-13151	-93.94%	-0.6137
80% -90% P_{CMAX}	-12398	-88.56%	-18001	-50.00%	-11655	-83.25%	-0.5673
70% -80% P_{CMAX}	-10949	-78.21%	-18009	-50.03%	-10292	-73.52%	-0.5195
60% -70% P_{CMAX}	-9507	-67.91%	-17993	-49.98%	-8936	-63.83%	-0.4672
50% -60% P_{CMAX}	-7981	-57.01%	-18001	-50.00%	-7502	-53.59%	-0.4054
40% -50% P_{CMAX}	-6722	-48.01%	-17992	-49.98%	-6319	-45.13%	-0.3500
30% -40% P_{CMAX}	-5218	-37.27%	-17986	-49.96%	-4905	-35.04%	-0.2787
20% -30% P_{CMAX}	-4009	-28.64%	-18009	-50.03%	-3768	-26.92%	-0.2173

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

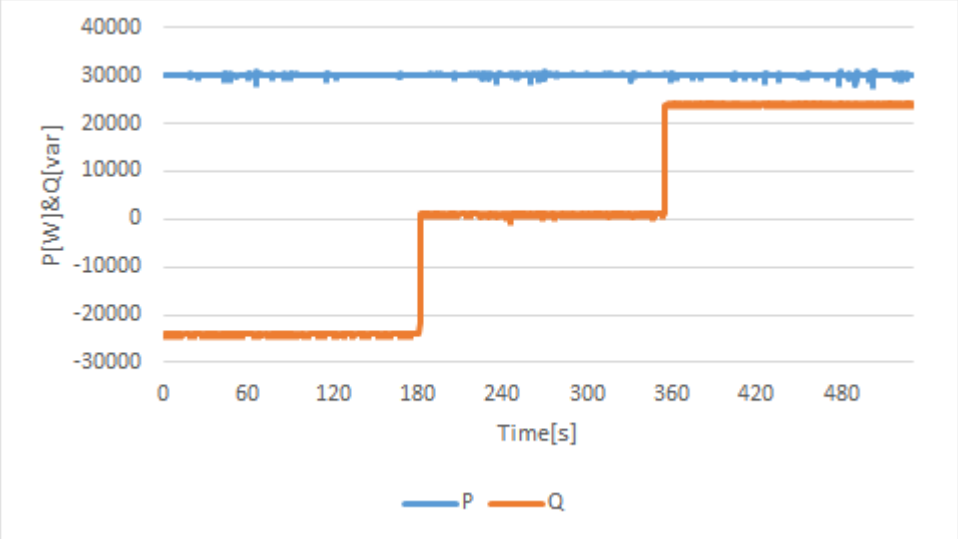
10% -20% P_{CMAX}	-2584	-18.46%	900	2.50%	-2429	-17.35%	-0.9441
0% -10% P_{CMAX}	-928	-6.63%	898	2.49%	-872	-6.23%	-0.7172
0% -10% P_{SMAX}	987	7.05%	901	2.50%	1050	7.50%	0.7370
10% -20% P_{SMAX}	2631	18.79%	902	2.51%	2799	19.99%	0.9457
20% -30% P_{SMAX}	4085	29.18%	-17996	-49.99%	4346	31.04%	0.2214
30% -40% P_{SMAX}	5368	38.35%	-17989	-49.97%	5711	40.79%	0.2860
40% -50% P_{SMAX}	6605	47.18%	-17993	-49.98%	7026	50.19%	0.3447
50% -60% P_{SMAX}	7980	57.00%	-18006	-50.02%	8489	60.64%	0.4052
60% -70% P_{SMAX}	9596	68.54%	-18006	-50.02%	10209	72.92%	0.4704
70% -80% P_{SMAX}	11176	79.83%	-18007	-50.02%	11889	84.92%	0.5274
80% -90% P_{SMAX}	12544	89.60%	-18002	-50.00%	13345	95.32%	0.5718
90% -100% P_{SMAX}	14004	100.03%	-18010	-50.03%	14898	106.41%	0.6139

TABLE: Reactive power production with set point Q =+Q_{max} (>11.08 kW) or cos φ = +0.9 (≤ 11.08 kW)

Power-Bin	Active Power		Reactive Power		DC Power		Power Factor
	W	p.u.	VAr	p.u.	W	p.u.	Cos φ
90% -100% P_{CMAX}	-13959	-99.71%	18018	50.05%	-13121	-93.72%	-0.6125
80% -90% P_{CMAX}	-12372	-88.37%	18002	50.01%	-11630	-83.07%	-0.5664
70% -80% P_{CMAX}	-10917	-77.98%	17997	49.99%	-10261	-73.30%	-0.5187
60% -70% P_{CMAX}	-9472	-67.65%	18006	50.02%	-8903	-63.59%	-0.4656
50% -60% P_{CMAX}	-8083	-57.73%	17993	49.98%	-7598	-54.27%	-0.4098
40% -50% P_{CMAX}	-6810	-48.64%	18008	50.02%	-6401	-45.72%	-0.3538
30% -40% P_{CMAX}	-5356	-38.26%	18000	50.00%	-5035	-35.96%	-0.2853
20% -30% P_{CMAX}	-4013	-28.66%	18007	50.02%	-3772	-26.94%	-0.2175
10% -20% P_{CMAX}	-2686	-19.19%	900	2.50%	-2525	-18.04%	-0.9479
0% -10% P_{CMAX}	-1263	-9.02%	901	2.50%	-1188	-8.48%	-0.8132
0% -10% P_{SMAX}	1148	8.20%	899	2.50%	1221	8.72%	0.7862
10% -20% P_{SMAX}	2542	18.16%	902	2.51%	2704	19.32%	0.9422
20% -30% P_{SMAX}	4021	28.72%	17988	49.97%	4278	30.56%	0.2182
30% -40% P_{SMAX}	5269	37.64%	17995	49.99%	5605	40.04%	0.2811
40% -50% P_{SMAX}	6739	48.14%	18000	50.00%	7170	51.21%	0.3507
50% -60% P_{SMAX}	8160	58.29%	18005	50.02%	8681	62.01%	0.4129
60% -70% P_{SMAX}	9558	68.27%	18002	50.01%	10168	72.63%	0.4690
70% -80% P_{SMAX}	10929	78.07%	17992	49.98%	11626	83.05%	0.5192
80% -90% P_{SMAX}	12278	87.70%	18005	50.01%	13062	93.30%	0.5634
90% -100% P_{SMAX}	13997	99.98%	17985	49.96%	14890	106.36%	0.6142

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

Bbis.6.3 **Bbis.6.4**	**TABLE: Reactive power production according to an assigned level** **(Required for inverter used in plant > 11.08 kW)**			**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15			
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)
file: 50% P_{SMAX}				
50% Pn	Reactive power Set point Q/S_n [%]	Reactive power measured Q/S_n [%]	Deviation from set point $\Delta Q/S_n$ [%]	Limit [%]
$-Q_{min}$ (=40%S_n)	-40.00%	-40.06%	-0.06%	$\Delta Q \leq \pm 5\% S_n$
0	0.00%	1.64%	1.64%	$\Delta Q \leq \pm 5\% S_n$
$+Q_{max}$ (=40%S_n)	40.00%	39.88%	-0.12%	$\Delta Q \leq \pm 5\% S_n$



Test procedure:

c) The test must be performed according to the following steps:
- bring the generator to 50% of the maximum active power available in discharge;
- send to the generator an inductive reactive power set-point equal to 40% of the rated power of the converter (Sn);
- maintain the set-point for a time of 60 s, compatibly with the energy capacity of the storage system;
- measure the reactive power delivered by the inverter, at least 30 seconds after the command of the new reactive power regulation set-point is sent (this is to ensure that the system has reached the steady state).

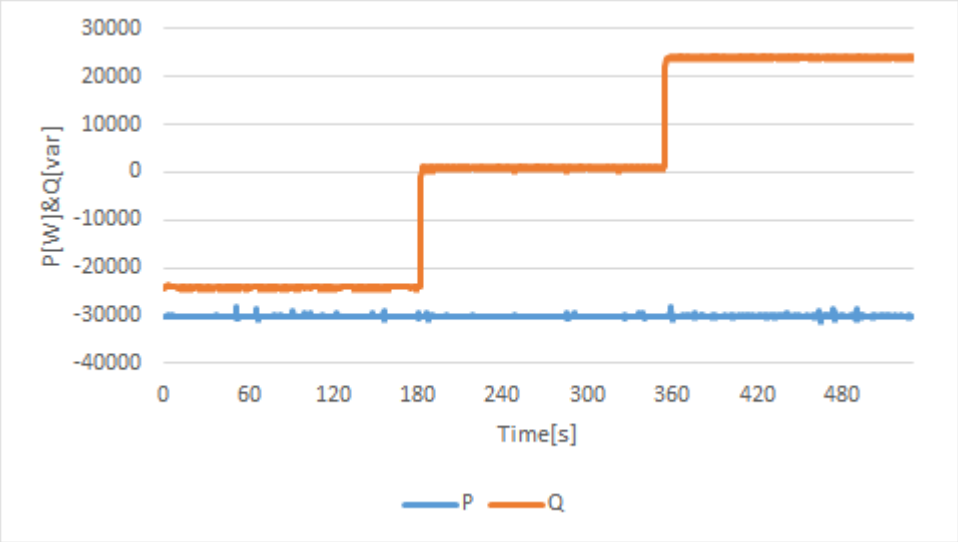
The test is considered successfully passed if the maximum deviation between the assigned level and the current measured value (average value with 1 min window) for the reactive power is equal to:
- ΔQ ≤ ±5 % the nominal apparent power of the converter (direct setting of the reactive power level);
- Δcos φ ≤ ±0,01 (setting via power factor).

d) In the case of storage systems connected to bidirectional converters, the test must also be repeated in the condition of withdrawal of energy from the grid.

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

Bbis.6.3 Bbis.6.4	**TABLE: reactive power production according to an assigned level (Required for inverter used in plant > 11.08 kW)**			**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15			
Power meter measurment data:	Sample-Rate:	0.2 s		
	Samples time:	3 min for each power point		
P (%)	Qmin/cosφ min (180s)	Q=0/ cosφ=0 (180s)	Qmax/cosφ max (180s)	
file: 50% P_{CMAX}				

50% Pn	Reactive power Set point Q/S_n [%]	Reactive power measured Q/S_n [%]	Deviation from set point $\Delta Q/S_n$ [%]	Limit [%]
$-Q_{min}$ (=40%S_n)	-40.00%	-39.96%	0.04%	$\Delta Q \leq \pm 5\% S_n$
0	0.00%	1.65%	1.65%	$\Delta Q \leq \pm 5\% S_n$
$+Q_{max}$ (=40%S_n)	40.00%	39.89%	-0.11%	$\Delta Q \leq \pm 5\% S_n$



Test procedure:

c) The test must be performed according to the following steps:
- bring the generator to 50% of the maximum active power available in discharge;
- send to the generator an inductive reactive power set-point equal to 40% of the rated power of the converter (Sn);
- maintain the set-point for a time of 60 s, compatibly with the energy capacity of the storage system;
- measure the reactive power delivered by the inverter, at least 30 seconds after the command of the new reactive power regulation set-point is sent (this is to ensure that the system has reached the steady state).

The test is considered successfully passed if the maximum deviation between the assigned level and the current measured value (average value with 1 min window) for the reactive power is equal to:
- $\Delta Q \leq \pm 5$ % the nominal apparent power of the converter (direct setting of the reactive power level);
- $\Delta \cos \varphi \leq \pm 0{,}01$ (setting via power factor).

d) In the case of storage systems connected to bidirectional converters, the test must also be repeated in the condition of withdrawal of energy from the grid.

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

Bbis.6.5	**TABLE: Response time to a step change of the assigned level (Required for inverter used in plant > 11.08 kW)**		**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15		
Power meter measurment data:	Sample-Rate:	0,2 s	
	Samples time:	at least 2 minutes for each power point	

Test:

- From the results of the capability tests referred to in Paragraphs Bbis.6.1 and Bbis.6.2, the Qmax | cap and $Qmax|_{ind}$ values of the maximum capacitive and inductive reactive power that can be supplied by the converter at 50% and 100% of the active discharge power maximum (P_{SMAX}; for integrated storage systems, equal to P_{NINV}) and maximum charge, P_{CMAX} (for storage systems connected to bidirectional converters).
- The values measured as averages at 0.2 s of the reactive power during the execution of reactive power regulation commands with step variations, when the storage system respectively delivers a power, should be reported in a graph similar to the exemplary one in Figure 65. active equal to 50% (Test 1) and 100% of the maximum active discharge / charge power (Test 2).
- Note the response time (Tr = settling time in the graph in Figure 65), which is equivalent to the time interval that elapses from the instant of application of the new set-point to the instant in which the reactive power reaches an overall value. within an interval included within a band of ± 5% * Sn of the new assigned value.
- As shown in Figure 65, the response time must be detected in correspondence with a variation of the set-point from zero to $Qmax|_{ind}$ (step 1), from $Qmax|_{ind}$ to $Qmax|_{cap}$ (step 2) and from $Qmax|_{cap}$ to zero (step 3).

The response time values must be documented in the test report, which must also indicate the values of $Qmax|_{cap}$, $Qmax|_{ind}$, of the active power delivered / absorbed during the test and the method used to send the set control command point of reactive power.
The test is passed if the maximum response time detected is less than 10 s under all measurement conditions.

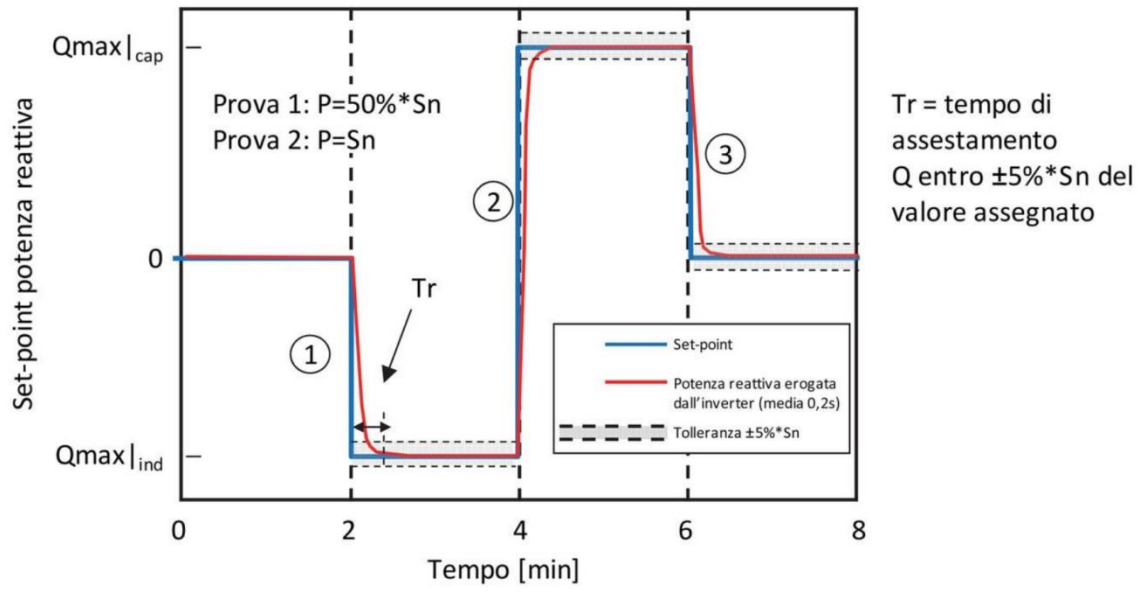
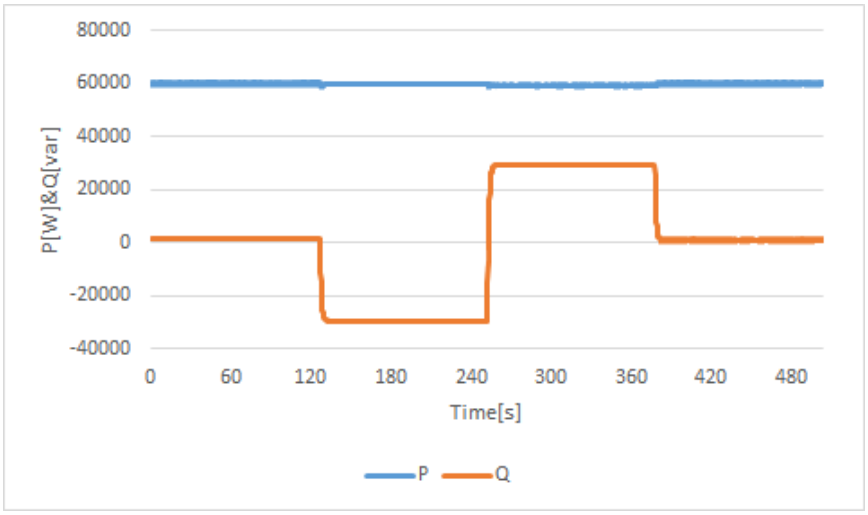


Figure 65 - Measurement of the response time to step changes of the set-point assigned for the reactive power

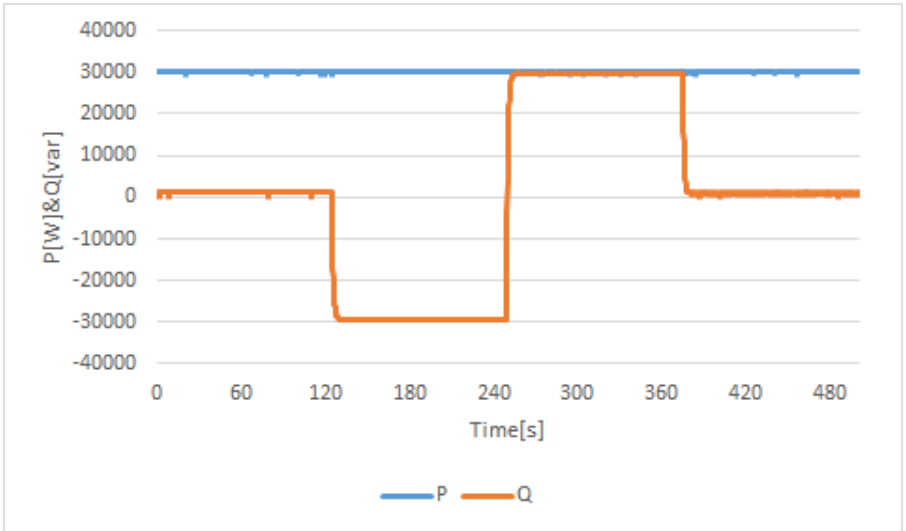
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1 (see Graph 1): 100%P_{SMAX}						
Point	Output power [W]	transient	Vac [V]	Q [VAr]	Tr [s]	Limit [s]
1	59707	0 ® $Q_{max\|ind}$	229.86	-29334	2.0	10
2	59419	$Q_{max\|ind}$ ® $Q_{max\|cap}$	230.01	29303	2.6	10
3	60154	$Q_{max\|cap}$ ® 0	229.94	1368	2.2	10
Test 2 (see Graph 2): 50%P_{SMAX}						
Point	Output power [W]	transient	Vac [V]	Q [VAr]	Tr [s]	Limit [s]
1	30086	0 ® $Q_{max\|ind}$	229.69	-29297	2.0	10
2	30010	$Q_{max\|ind}$ ® $Q_{max\|cap}$	229.85	29526	2.6	10
3	30018	$Q_{max\|cap}$ ® 0	229.77	1172	2.2	10

Graph 1of the reaction time after a step variation of the assigned level (100%-Test 1)



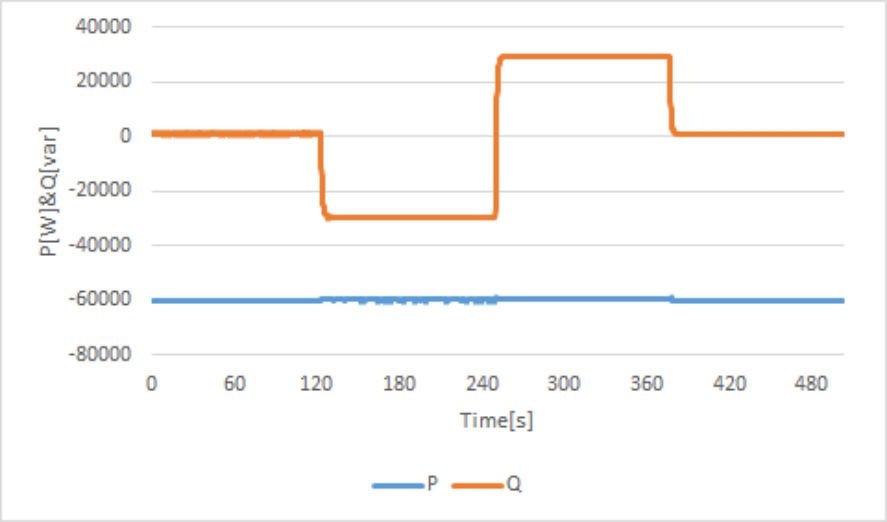
Graph 2 of the reaction time after a step variation of the assigned level (50%-Test 2)



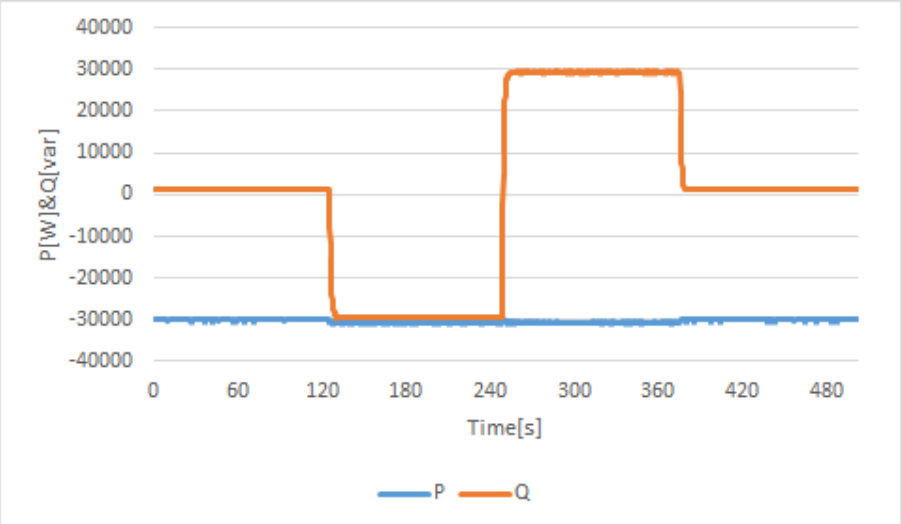
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1 (see Graph 1): 100%P_{CMAX}						
Point	Output power [W]	transient	Vac [V]	Q [VAr]	Tr [s]	Limit [s]
1	-59652	0 ® $Q_{max\|ind}$	229.50	-29283	2.0	10
2	-59566	$Q_{max\|ind}$ ® $Q_{max\|cap}$	229.65	29316	2.8	10
3	-60224	$Q_{max\|cap}$ ® 0	229.58	1136	2.0	10
Test 2 (see Graph 2): 50%P_{Cmax}						
Point	Output power [W]	transient	Vac [V]	Q [VAr]	Tr [s]	Limit [s]
1	-30591	0 ® $Q_{max\|ind}$	229.71	-29339	2.0	10
2	-30594	$Q_{max\|ind}$ ® $Q_{max\|cap}$	229.86	29308	2.4	10
3	-30015	$Q_{max\|cap}$ ® 0	229.79	1332	2.2	10

Graph 1of the reaction time after a step variation of the assigned level (100%-Test 1)

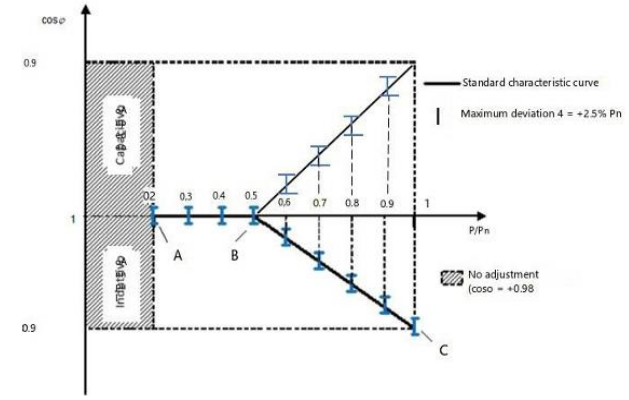


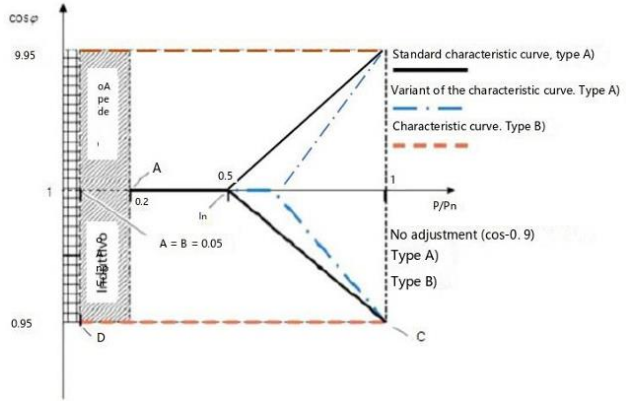
Graph 2 of the reaction time after a step variation of the assigned level (50%-Test 2)



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

Bbis.6.6 Bbis.6.7	**TABLE: Automatic production of reactive power according to a characteristic curve cosφ= f(P)**	**P**
Max. cosφ declared.....:	cosφ: 0.9	
Set value.....:	Lock-in: 1.05 Vn (Vn and 1.1 Vn with steps of 0.01) Lock-out: 0.98 Vn (0.9 Vn and Vn with steps of 0.01)	





A: P = 20%*P_{SMAX}; cos φ = 1

B: P = 50%*P_{SMAX}; cos φ = 1

C: P = P_{SMAX}; cos φ = cos φ_min

where cos φ_ is equal to 0.90 (inductive).

The automatic adjustment mode is disabled when:

the active power P delivered falls below 50% of P_{SMAX} (point B), or P_{NINV} for integrated storage systems, defined as power lock-out, independent of the voltage at the terminals, or

the voltage read at the output terminals of the converter falls below the lock-out limit, to be set at a default value equal to Vn, but which must be adjustable in the interval between 0.9 * Vn and Vn with intervals of 0.01 * Vn.

Supplementary information:

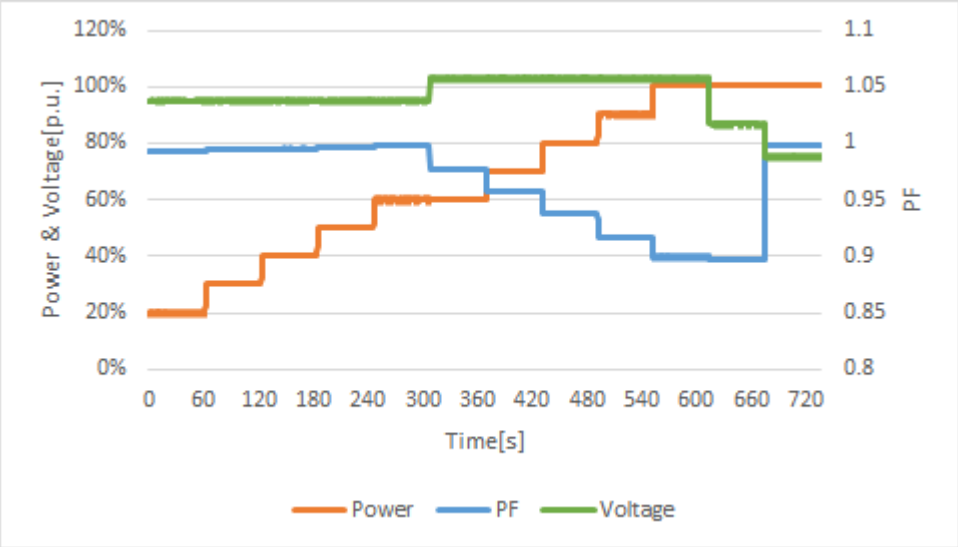
Function must be enabled by a local command of the converter.

Each value must be reach in < 10s.

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

Model:	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15							
P/P_{SMAX} [%]	P[W]	Vout[%]	+Q [Var]	Cosφ Setpoint	Cosφ measured	ΔCosφ	Limit Δcosφ_max	Result
20	12046	238.61	1427	1.00	0.993	-0.007	≤ ± 0.01	P
30	18075	238.63	1919	1.00	0.994	-0.006	≤ ± 0.01	P
40	24068	238.64	2327	1.00	0.995	-0.005	≤ ± 0.01	P
50	30149	238.66	2651	1.00	0.996	-0.004	≤ ± 0.01	P
60	36065	238.62	2259	1.00	0.998	-0.002	≤ ± 0.01	P
60	36189	243.24	7847	0.98	0.977	-0.003	≤ ± 0.01	P
70	42131	243.26	12650	0.96	0.958	-0.002	≤ ± 0.01	P
80	48136	243.24	17843	0.94	0.938	-0.002	≤ ± 0.01	P
90	54156	243.23	23644	0.92	0.916	-0.004	≤ ± 0.01	P
100	60227	243.20	29212	0.90	0.900	0.000	≤ ± 0.01	P
100	60357	234.01	29664	0.90	0.897	-0.003	≤ ± 0.01	P
100	60389	227.28	3103	1.00	0.999	-0.001	≤ ± 0.01	P

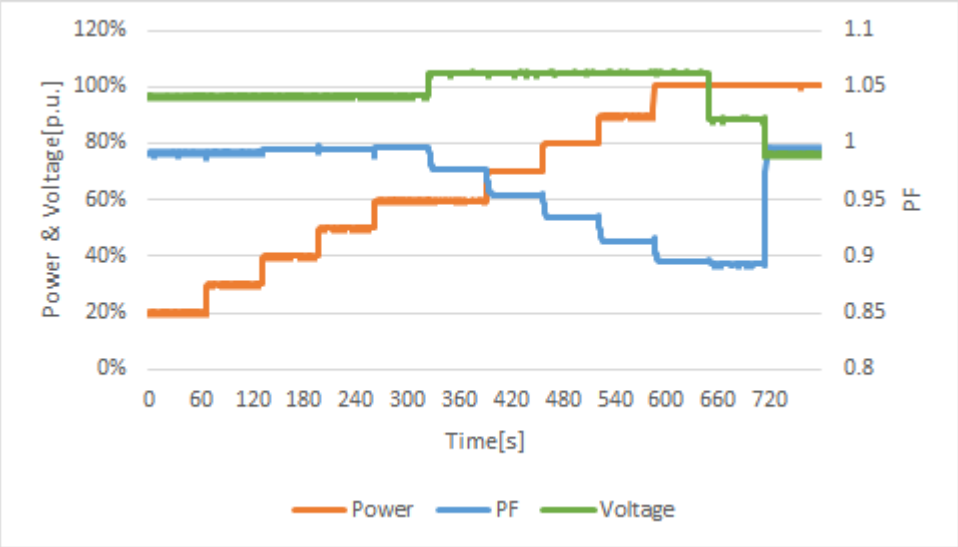
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3							
P/P_{SMAX} [%]	P[W]	Vout[%]	+Q [Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	2818	239.64	369	1.00	0.992	-0.008	≤ ± 0.01	P
30	4206	239.65	537	1.00	0.992	-0.008	≤ ± 0.01	P
40	5598	239.68	606	1.00	0.994	-0.006	≤ ± 0.01	P
50	6985	239.68	753	1.00	0.994	-0.006	≤ ± 0.01	P
60	8362	239.70	745	1.00	0.996	-0.004	≤ ± 0.01	P
60	8348	244.24	1814	0.98	0.977	-0.003	≤ ± 0.01	P
70	9801	244.25	3039	0.96	0.955	-0.005	≤ ± 0.01	P
80	11176	244.26	4257	0.94	0.934	-0.006	≤ ± 0.01	P
90	12545	244.27	5580	0.92	0.914	-0.006	≤ ± 0.01	P
100	14084	244.28	6968	0.90	0.896	-0.004	≤ ± 0.01	P
100	14077	234.86	7093	0.90	0.893	-0.007	≤ ± 0.01	P
100	14059	227.83	1366	1.00	0.995	-0.005	≤ ± 0.01	P

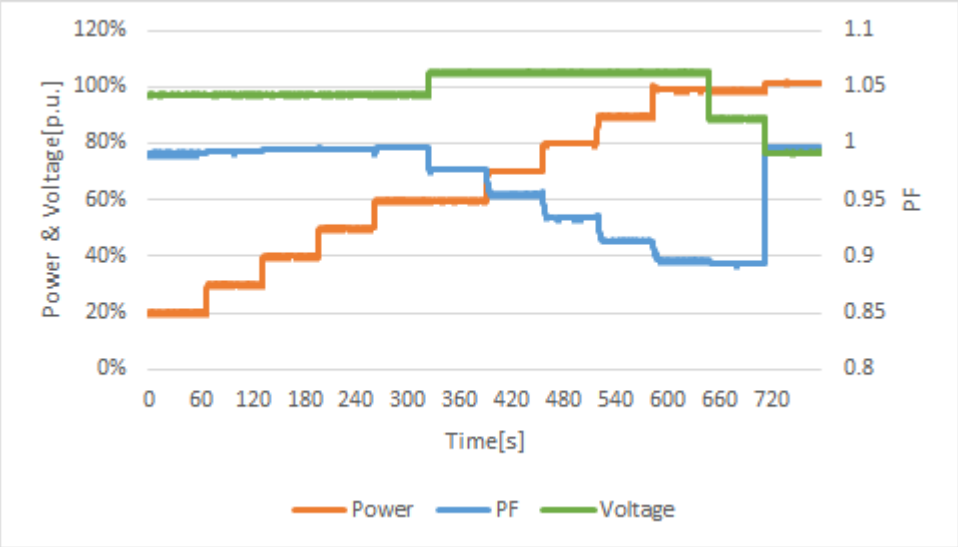
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3							
P/P_{SMAX}[%]	P[W]	Vout[%]	+Q[Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	2817	239.83	366	1.00	0.992	-0.008	≤ ± 0.01	P
30	4203	239.85	526	1.00	0.992	-0.008	≤ ± 0.01	P
40	5597	239.87	608	1.00	0.994	-0.006	≤ ± 0.01	P
50	6983	239.87	720	1.00	0.995	-0.005	≤ ± 0.01	P
60	8361	239.90	798	1.00	0.995	-0.005	≤ ± 0.01	P
60	8347	244.40	1815	0.98	0.977	-0.003	≤ ± 0.01	P
70	9800	244.42	3021	0.96	0.956	-0.004	≤ ± 0.01	P
80	11173	244.43	4238	0.94	0.935	-0.005	≤ ± 0.01	P
90	12541	244.43	5562	0.92	0.914	-0.006	≤ ± 0.01	P
100	13869	244.45	6848	0.90	0.897	-0.003	≤ ± 0.01	P
100	13822	235.00	6946	0.90	0.894	-0.006	≤ ± 0.01	P
100	14174	227.99	1237	1.00	0.996	-0.004	≤ ± 0.01	P

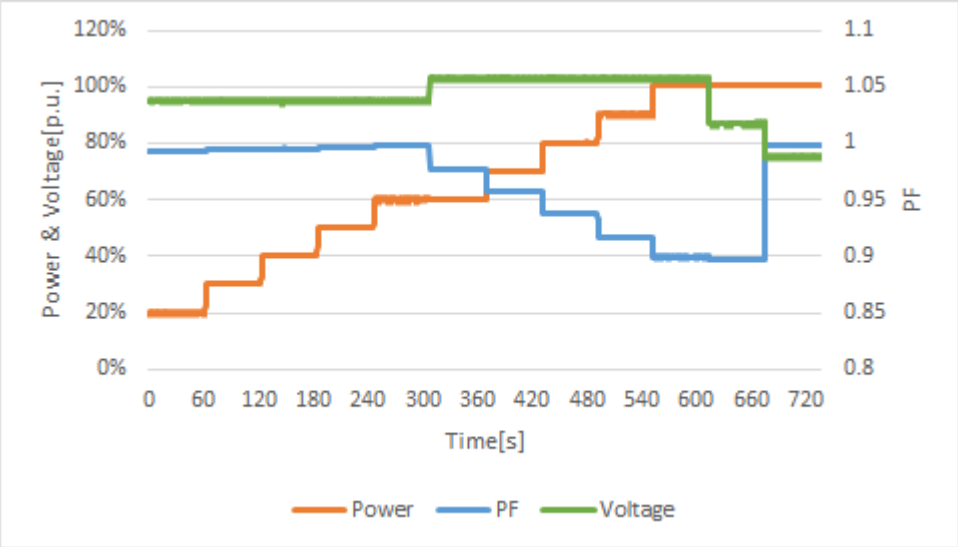
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15							
P/P_{SMAX} [%]	P[W]	Vout[%]	-Q [Var]	Cosφ Setpoint	Cosφ measured	ΔCosφ	Limit Δcosφ_max	Result
20	12046	238.63	-1454	1.00	0.993	-0.007	≤ ± 0.01	P
30	18076	238.66	-1934	1.00	0.994	-0.006	≤ ± 0.01	P
40	24068	238.67	-2346	1.00	0.995	-0.005	≤ ± 0.01	P
50	30150	238.67	-2687	1.00	0.996	-0.004	≤ ± 0.01	P
60	36066	238.64	-2274	1.00	0.998	-0.002	≤ ± 0.01	P
60	36189	243.26	-7869	0.98	0.977	-0.003	≤ ± 0.01	P
70	42132	243.28	-12672	0.96	0.958	-0.002	≤ ± 0.01	P
80	48136	243.27	-17868	0.94	0.938	-0.002	≤ ± 0.01	P
90	54155	243.25	-23669	0.92	0.916	-0.004	≤ ± 0.01	P
100	60226	243.22	-29236	0.90	0.900	0.000	≤ ± 0.01	P
100	60357	234.03	-29688	0.90	0.897	-0.003	≤ ± 0.01	P
100	60389	227.30	-3114	1.00	0.999	-0.001	≤ ± 0.01	P

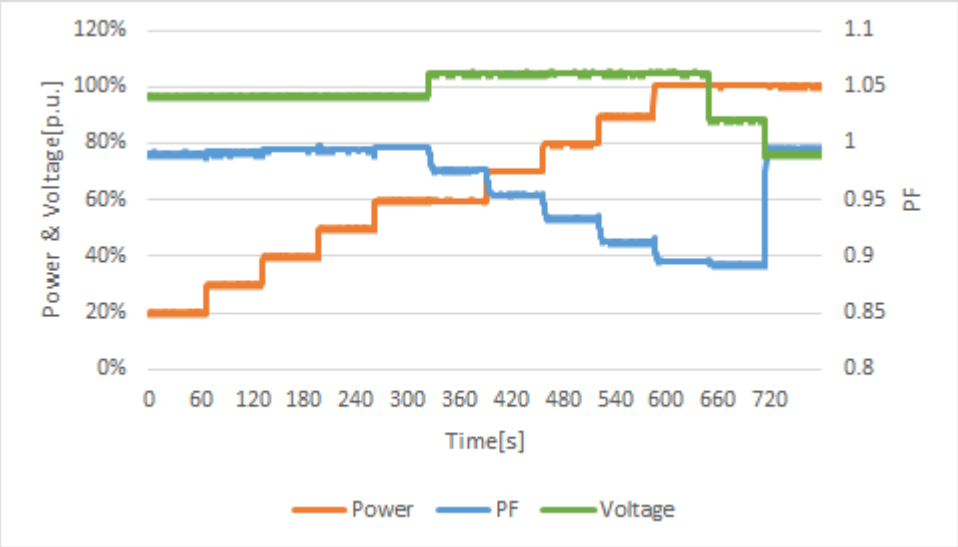
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3							
P/P_{SMAX} [%]	P[W]	Vout[%]	-Q [Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	2808	239.60	-372	1.00	0.991	-0.009	≤ ± 0.01	P
30	4196	239.62	-535	1.00	0.992	-0.008	≤ ± 0.01	P
40	5589	239.64	-609	1.00	0.994	-0.006	≤ ± 0.01	P
50	6975	239.64	-755	1.00	0.994	-0.006	≤ ± 0.01	P
60	8351	239.66	-747	1.00	0.996	-0.004	≤ ± 0.01	P
60	8339	244.21	-1823	0.98	0.977	-0.003	≤ ± 0.01	P
70	9791	244.21	-3043	0.96	0.955	-0.005	≤ ± 0.01	P
80	11166	244.22	-4261	0.94	0.934	-0.006	≤ ± 0.01	P
90	12536	244.23	-5585	0.92	0.913	-0.007	≤ ± 0.01	P
100	14074	244.24	-6972	0.90	0.896	-0.004	≤ ± 0.01	P
100	14068	234.82	-7098	0.90	0.893	-0.007	≤ ± 0.01	P
100	14050	227.79	-1371	1.00	0.995	-0.005	≤ ± 0.01	P

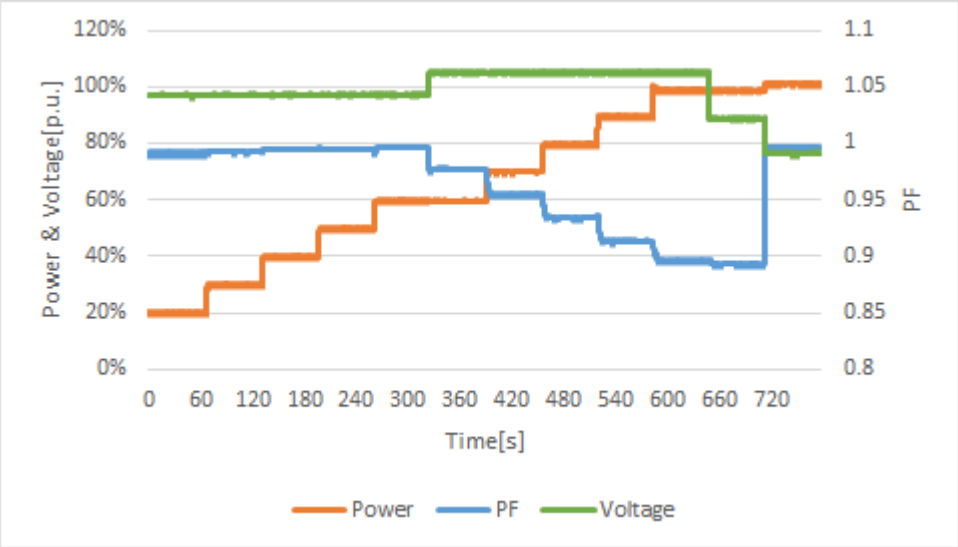
Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Model:	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3							
P/P_{SMAX}[%]	P[W]	Vout[%]	-Q [Var]	Cos φ Setpoint	Cos φ measured	ΔCosφ	Limit Δcosφ_max	Result
20	2801	239.78	-360	1.00	0.992	-0.008	≤ ± 0.01	P
30	4187	239.79	-517	1.00	0.992	-0.008	≤ ± 0.01	P
40	5582	239.82	-598	1.00	0.994	-0.006	≤ ± 0.01	P
50	6969	239.82	-714	1.00	0.995	-0.005	≤ ± 0.01	P
60	8345	239.84	-795	1.00	0.995	-0.005	≤ ± 0.01	P
60	8328	244.35	-1812	0.98	0.977	-0.003	≤ ± 0.01	P
70	9785	244.37	-3016	0.96	0.956	-0.004	≤ ± 0.01	P
80	11159	244.38	-4237	0.94	0.935	-0.005	≤ ± 0.01	P
90	12524	244.39	-5561	0.92	0.914	-0.006	≤ ± 0.01	P
100	13850	244.40	-6843	0.90	0.897	-0.003	≤ ± 0.01	P
100	13803	234.95	-6942	0.90	0.893	-0.007	≤ ± 0.01	P
100	14156	227.94	-1231	1.00	0.996	-0.004	≤ ± 0.01	P

Graph reactive power production according to a characteristic curve cos(phi) = f(P)



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

Bbis.6.8 Bbis.6.9	**TABLE: Automatic reactive power production according to a characteristic curve Q = f(V) (Required for inverter used in plant ≥ 11.08 kW)**	**P**

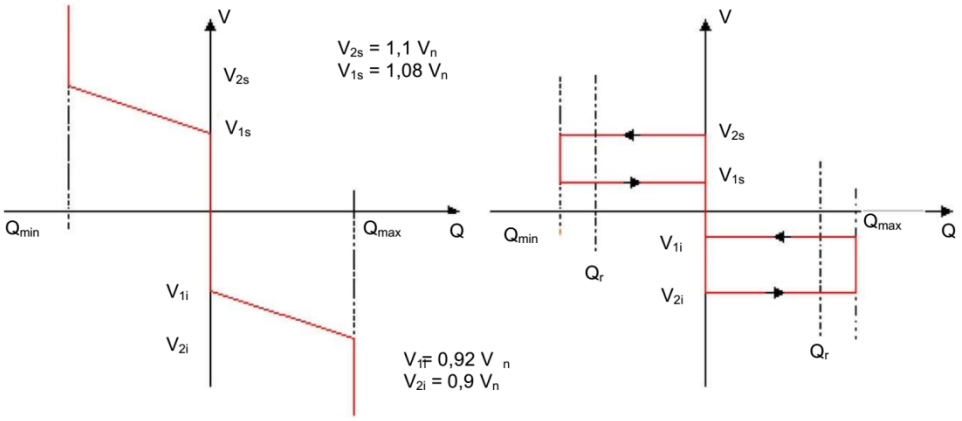


Fig. a Fig. b

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

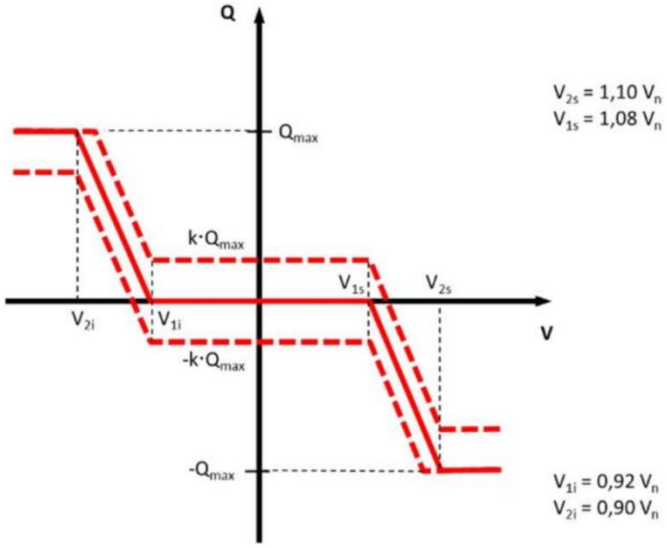


Figure 67 - Standard characteristic curve Q = f (V)

Q = f (V) standard curve default setting value:

Lock-in--> 20%P_{SMAX} (or P_{NINV}) and > 20%P_{CMAX} for bidirectional EESS

Lock-out --> ≤ 5%P_{SMAX} (or P_{NINV}) and ≤ 5%P_{CMAX} for bidirectional EESS

V1s = 1.08Vn; V2s = 1.1Vn;

V1i = 0.92Vn ; V2i = 0.9Vn;

k = 0.1

delay's time of reactive power = 3 seconds

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

Curve A.1 - Test for bidirectional EESS in DISCHARGE with <u>k = +0.1</u>						
Setting Power [%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	ReactivePower expected [Var]	ΔQ
<20%P_{SMAX}	1.07Vn	10849.62	245.73	2907.23	k*Qmax	≤5%Sn
<20%P_{SMAX}	1.09Vn	10575.62	250.47	2056.69	k*Qmax	≤5%Sn
30%P_{SMAX}	1.09Vn	17933.13	250.31	-11618.23	-0.4*Qmax (lock-in) *within 10sec*	≤5%Sn
40%P_{SMAX}	1.09Vn	23982.49	250.33	-11618.20	-0.4*Qmax	≤5%Sn
50%P_{SMAX}	1.09Vn	30019.99	250.34	-11609.98	-0.4*Qmax	≤5%Sn
60%P_{SMAX}	1.09Vn	36067.92	250.36	-11604.09	-0.4*Qmax	≤5%Sn
70%P_{SMAX}	1.09Vn	42053.22	250.38	-11651.31	-0.4*Qmax	≤5%Sn
80%P_{SMAX}	1.09Vn	47942.52	250.38	-11652.42	-0.4*Qmax	≤5%Sn
90%P_{SMAX}	1.09Vn	53921.11	250.40	-11648.16	-0.4*Qmax	≤5%Sn
100%P_{SMAX}	1.09Vn	59662.32	250.41	-11671.24	-0.4*Qmax	≤5%Sn
100%P_{SMAX}	1.1Vn	59670.62	252.67	-26001.34	-0.9*Qmax	≤5%Sn
10%P_{SMAX}	1.1Vn	5443.80	252.54	-26097.43	-0.9*Qmax	≤5%Sn
≤5%P_{SMAX}	1.1Vn	2722.41	252.66	2387.25	k*Qmax (lock-out)	≤5%Sn
Curve B.1 - Test for bidirectional EESS in DISCHARGE with <u>k = +0.1</u>						
Setting Power [%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{SMAX}	0.93Vn	10729.69	213.66	2912.93	k*Qmax	≤5%Sn
<20%P_{SMAX}	0.91Vn	10737.87	209.07	2905.62	k*Qmax	≤5%Sn
30%P_{SMAX}	0.91Vn	17707.78	209.16	17435.84	0.6*Qmax(lock-in)*within 10sec*	≤5%Sn
40%P_{SMAX}	0.91Vn	24017.11	209.16	17430.75	0.6*Qmax	≤5%Sn
50%P_{SMAX}	0.91Vn	30075.20	209.16	17430.76	0.6*Qmax	≤5%Sn
60%P_{SMAX}	0.91Vn	35948.01	209.19	17420.13	0.6*Qmax	≤5%Sn
70%P_{SMAX}	0.91Vn	41952.08	209.21	17416.46	0.6*Qmax	≤5%Sn
80%P_{SMAX}	0.91Vn	47990.53	209.23	17413.91	0.6*Qmax	≤5%Sn
90%P_{SMAX}	0.91Vn	53984.92	209.24	17424.96	0.6*Qmax	≤5%Sn
100%P_{SMAX}	0.91Vn	60180.16	209.26	17396.94	0.6*Qmax	≤5%Sn
100%P_{SMAX}	0.90Vn	60180.74	206.99	28909.56	Qmax	≤5%Sn
10%P_{SMAX}	0.90Vn	5537.97	206.83	29058.08	Qmax	≤5%Sn
≤5%P_{SMAX}	0.90Vn	2691.14	207.01	3430.94	k*Qmax(lock-out)	≤5%Sn

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

Curve A.2 - Test for bidirectional EESS in DISCHARGE with k = -0.1

Setting Power[%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{SMAX}	1.07Vn	10698.39	245.86	-2899.70	-k*Qmax	≤5%Sn
<20%P_{SMAX}	1.09Vn	10627.25	250.52	-3812.33	-k*Qmax	≤5%Sn
30%P_{SMAX}	1.09Vn	18047.29	250.43	-17418.68	-0.6*Qmax (lock-in)*within 10sec*	≤5%Sn
40%P_{SMAX}	1.09Vn	23942.82	250.45	-17419.44	-0.6*Qmax	≤5%Sn
50%P_{SMAX}	1.09Vn	29976.64	250.45	-17412.71	-0.6*Qmax	≤5%Sn
60%P_{SMAX}	1.09Vn	36164.62	250.46	-17413.70	-0.6*Qmax	≤5%Sn
70%P_{SMAX}	1.09Vn	42000.13	250.50	-17419.70	-0.6*Qmax	≤5%Sn
80%P_{SMAX}	1.09Vn	48200.38	250.51	-17421.16	-0.6*Qmax	≤5%Sn
90%P_{SMAX}	1.09Vn	54057.07	250.51	-17421.11	-0.6*Qmax	≤5%Sn
100%P_{SMAX}	1.09Vn	60015.89	250.53	-17421.55	-0.6*Qmax	≤5%Sn
100%P_{SMAX}	1.1Vn	59972.97	252.80	-28936.79	-Qmax	≤5%Sn
10%P_{SMAX}	1.1Vn	5905.75	252.66	-29173.42	-Qmax	≤5%Sn
≤5%P_{SMAX}	1.1Vn	2712.01	252.79	-3178.11	-k*Qmax (lock-out)	≤5%Sn

Curve B.2 - Test for bidirectional EESS in DISCHARGE with k = -0.1

Setting Power[%]	SettingVolatge [V]	OutputPower [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{SMAX}	0.93Vn	10896.26	213.74	-2903.27	-k*Qmax	≤5%Sn
<20%P_{SMAX}	0.91Vn	10840.44	209.14	-2894.97	-k*Qmax	≤5%Sn
30%P_{SMAX}	0.91Vn	17973.11	209.14	11590.60	0.4*Qmax (lock-in) *within 10sec*	≤5%Sn
40%P_{SMAX}	0.91Vn	24003.73	209.15	11610.21	0.4*Qmax	≤5%Sn
50%P_{SMAX}	0.91Vn	29917.56	209.16	11635.79	0.4*Qmax	≤5%Sn
60%P_{SMAX}	0.91Vn	35952.24	209.18	11644.51	0.4*Qmax	≤5%Sn
70%P_{SMAX}	0.91Vn	41943.03	209.20	11650.58	0.4*Qmax	≤5%Sn
80%P_{SMAX}	0.91Vn	47982.73	209.21	11650.81	0.4*Qmax	≤5%Sn
90%P_{SMAX}	0.91Vn	53824.98	209.23	11655.42	0.4*Qmax	≤5%Sn
100%P_{SMAX}	0.91Vn	60074.30	209.25	11662.75	0.4*Qmax	≤5%Sn
100%P_{SMAX}	0.90Vn	60029.33	206.91	25996.18	0.9*Qmax	≤5%Sn
10%P_{SMAX}	0.90Vn	5523.22	206.75	26061.00	0.9*Qmax	≤5%Sn
≤5%P_{SMAX}	0.90Vn	2479.01	206.81	-2815.34	-k*Qmax (lock-out)	≤5%Sn

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

Curve A.1 - Test for bidirectional EESS in CHARGE with <u>k = +0.1</u>						
Setting Power[%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	ReactivePower expected [Var]	ΔQ
<20%P_{CMAX}	1.07Vn	-10881.09	245.84	2899.70	k*Qmax	≤5%Sn
<20%P_{CMAX}	1.09Vn	-10839.90	250.41	2890.06	k*Qmax	≤5%Sn
30%P_{CMAX}	1.09Vn	-18048.46	250.46	-11618.68	-0.4*Qmax (lock-in)*within 10sec*	≤5%Sn
40%P_{CMAX}	1.09Vn	-23942.88	250.47	-11637.36	-0.4*Qmax	≤5%Sn
50%P_{CMAX}	1.09Vn	-29984.60	250.49	-11629.61	-0.4*Qmax	≤5%Sn
60%P_{CMAX}	1.09Vn	-35852.30	250.50	-11629.15	-0.4*Qmax	≤5%Sn
70%P_{CMAX}	1.09Vn	-41841.02	250.52	-11633.55	-0.4*Qmax	≤5%Sn
80%P_{CMAX}	1.09Vn	-48017.35	250.53	-11632.07	-0.4*Qmax	≤5%Sn
90%P_{CMAX}	1.09Vn	-53878.82	250.56	-11632.72	-0.4*Qmax	≤5%Sn
100%P_{CMAX}	1.09Vn	-60117.00	250.57	-11631.21	-0.4*Qmax	≤5%Sn
100%P_{CMAX}	1.1Vn	-59953.45	252.89	-25998.35	-0.9*Qmax	≤5%Sn
10%P_{CMAX}	1.1Vn	-5564.18	252.76	-26227.16	-0.9*Qmax	≤5%Sn
≤5%P_{CMAX}	1.1Vn	-2411.30	252.70	2358.28	k*Qmax (lock-out)	≤5%Sn
Curve B.1 - Test for bidirectional EESS in CHARGE with <u>k = +0.1</u>						
Setting Power [%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{CMAX}	0.93Vn	-10830.91	213.75	2907.94	k*Qmax	≤5%Sn
<20%P_{CMAX}	0.91Vn	-10816.76	209.16	2917.94	k*Qmax	≤5%Sn
30%P_{CMAX}	0.91Vn	-18070.11	209.21	17408.87	0.6*Qmax(lock-in)*within 10sec*	≤5%Sn
40%P_{CMAX}	0.91Vn	-24004.83	209.23	17422.53	0.6*Qmax	≤5%Sn
50%P_{CMAX}	0.91Vn	-30043.25	209.24	17416.20	0.6*Qmax	≤5%Sn
60%P_{CMAX}	0.91Vn	-36084.94	209.27	17432.39	0.6*Qmax	≤5%Sn
70%P_{CMAX}	0.91Vn	-41888.84	209.28	17424.25	0.6*Qmax	≤5%Sn
80%P_{CMAX}	0.91Vn	-47986.03	209.30	17414.74	0.6*Qmax	≤5%Sn
90%P_{CMAX}	0.91Vn	-53979.92	209.32	17425.82	0.6*Qmax	≤5%Sn
100%P_{CMAX}	0.91Vn	-59970.40	209.33	17418.94	0.6*Qmax	≤5%Sn
100%P_{CMAX}	0.90Vn	-59982.71	207.08	28931.70	Qmax	≤5%Sn
10%P_{CMAX}	0.90Vn	-5854.28	206.91	29175.99	Qmax	≤5%Sn
≤5%P_{CMAX}	0.90Vn	-2571.42	206.82	3432.37	k*Qmax(lock-out)	≤5%Sn

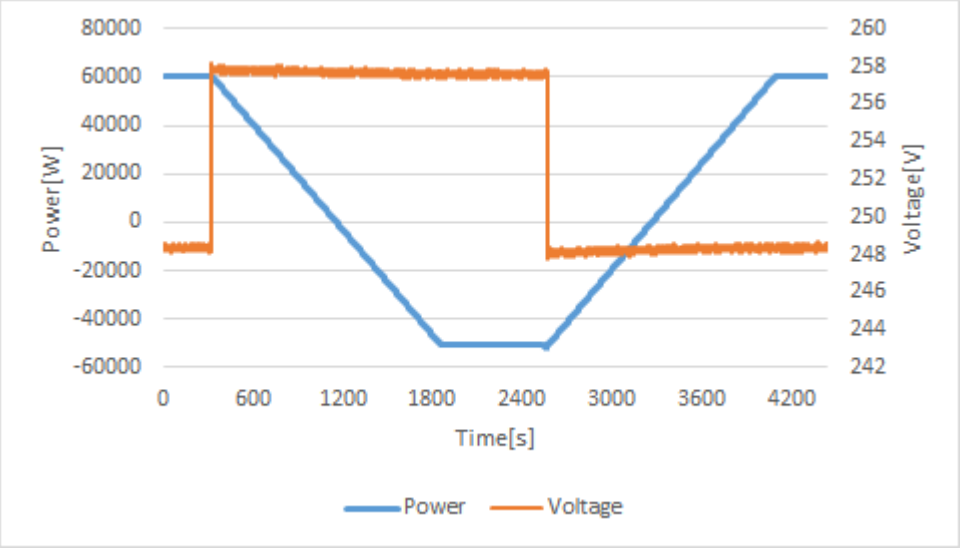
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Curve A.2 - Test for bidirectional EESS in CHARGE with <u>k = -0.1</u>						
Setting Power [%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{CMAX}	1.07Vn	-10801.16	245.78	-2912.19	-k*Qmax	≤5%Sn
<20%P_{CMAX}	1.09Vn	-10794.49	250.38	-2915.88	-k*Qmax	≤5%Sn
30%P_{CMAX}	1.09Vn	-17942.37	250.46	-17419.07	-0.9*Qmax (lock-in)*within 10sec*	≤5%Sn
40%P_{CMAX}	1.09Vn	-23936.24	250.46	-17435.01	-0.6*Qmax	≤5%Sn
50%P_{CMAX}	1.09Vn	-30023.92	250.47	-17434.03	-0.6*Qmax	≤5%Sn
60%P_{CMAX}	1.09Vn	-36045.25	250.49	-17438.82	-0.6*Qmax	≤5%Sn
70%P_{CMAX}	1.09Vn	-41949.40	250.50	-17442.95	-0.6*Qmax	≤5%Sn
80%P_{CMAX}	1.09Vn	-47957.55	250.51	-17439.55	-0.6*Qmax	≤5%Sn
90%P_{CMAX}	1.09Vn	-53927.02	250.53	-17442.72	-0.6*Qmax	≤5%Sn
100%P_{CMAX}	1.09Vn	-59866.80	250.54	-17434.42	-0.6*Qmax	≤5%Sn
100%P_{CMAX}	1.1Vn	-59927.51	252.85	-28916.40	-Qmax	≤5%Sn
10%P_{CMAX}	1.1Vn	-5854.15	252.72	-29101.17	-Qmax	≤5%Sn
≤5%P_{CMAX}	1.1Vn	-2655.84	252.65	-3297.91	-k*Qmax (lock-out)	≤5%Sn
Curve B.2 - Test for bidirectional EESS in CHARGE with <u>k = -0.1</u>						
Setting Power [%]	Setting Volatge [V]	Output Power [W]	Voltage [V]	Reactive Power [Var]	Reactive Power expected [Var]	ΔQ
<20%P_{CMAX}	0.93Vn	-10800.55	213.67	-2899.45	-k*Qmax	≤5%Sn
<20%P_{CMAX}	0.91Vn	-10817.14	209.08	-2890.74	-k*Qmax	≤5%Sn
30%P_{CMAX}	0.91Vn	-17930.23	209.10	11616.69	0.4*Qmax (lock-in)*within 10sec*	≤5%Sn
40%P_{CMAX}	0.91Vn	-23945.42	209.11	11626.14	0.4*Qmax	≤5%Sn
50%P_{CMAX}	0.91Vn	-30039.75	209.12	11626.86	0.4*Qmax	≤5%Sn
60%P_{CMAX}	0.91Vn	-36013.19	209.14	11631.21	0.4*Qmax	≤5%Sn
70%P_{CMAX}	0.91Vn	-41927.04	209.15	11641.25	0.4*Qmax	≤5%Sn
80%P_{CMAX}	0.91Vn	-47940.63	209.16	11640.67	0.4*Qmax	≤5%Sn
90%P_{CMAX}	0.91Vn	-53896.01	209.18	11647.61	0.4*Qmax	≤5%Sn
100%P_{CMAX}	0.91Vn	-59940.85	209.20	11631.62	0.4*Qmax	≤5%Sn
100%P_{CMAX}	0.90Vn	-59920.26	206.86	25958.46	0.9*Qmax	≤5%Sn
10%P_{CMAX}	0.90Vn	-5858.37	206.70	26168.89	0.9*Qmax	≤5%Sn
≤5%P_{CMAX}	0.90Vn	-2737.21	206.67	-2510.22	-k*Qmax(lock-out)	≤5%Sn

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

Bbis.7.1	**TABLE: Active power limitation for voltage values near to 110 % U_n**					**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15					
P_{SMAX} =60000 W P_{CMAX} =60000 W						
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	248.40	60297.44	100.50%	100%	P
2	1.12	257.68	-50988.00	-84.98%	One-way: P <20%P_{SMAX} Biaxially: >80%P_{CMAX}	P
3	1.08	248.30	60468.00	100.78%	100%	P

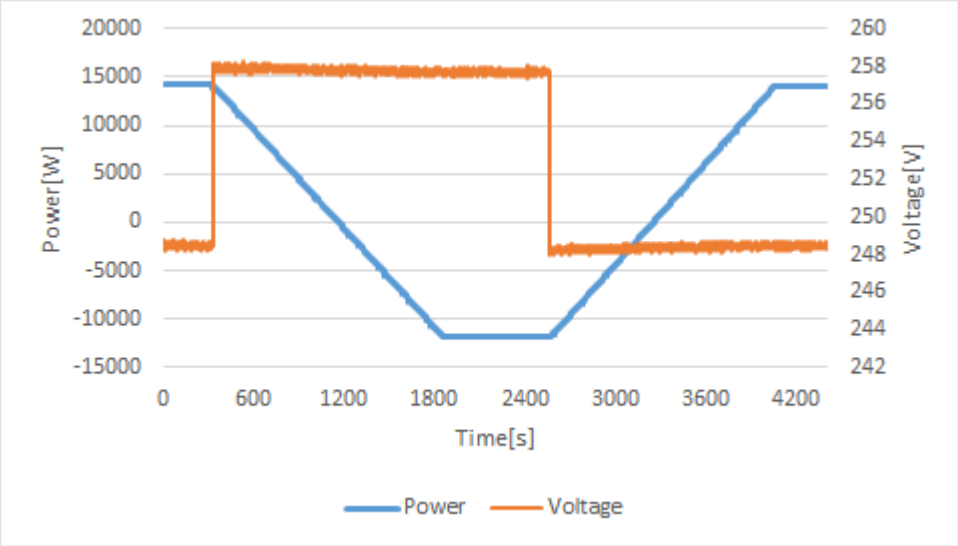
Graph curve P=f(V):



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

Bbis.7.1	**TABLE: Active power limitation for voltage values near to 110 % U_n**					**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3					
P_{SMAX} =14000 W P_{CMAX} =14000 W						
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	248.50	14189.36	101.35%	100%	P
2	1.12	257.79	-11905.00	-85.04%	One-way: P <20%P_{SMAX} Biaxially: >80%P_{CMAX}	P
3	1.08	248.41	14107.00	100.76%	100%	P

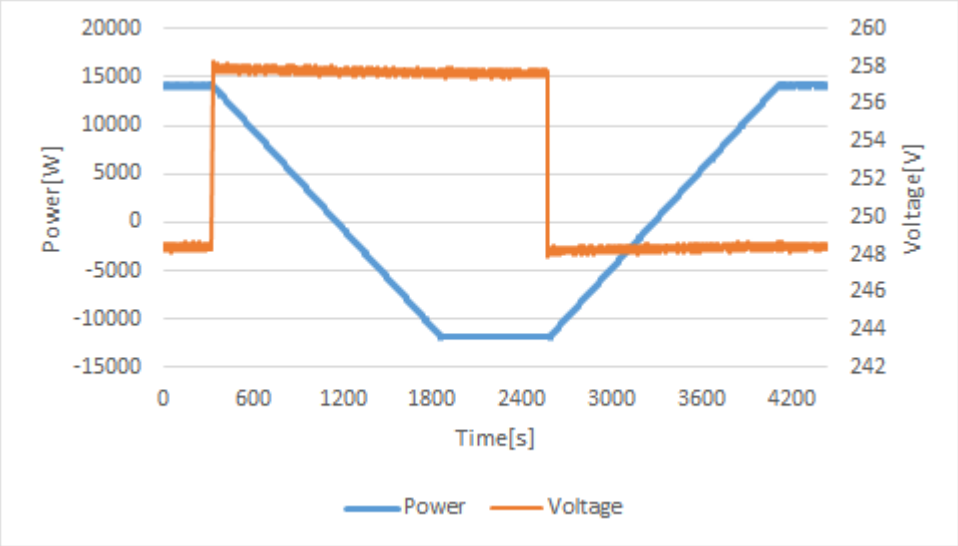
Graph curve P=f(V):



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

Bbis.7.1	**TABLE: Active power limitation for voltage values near to 110 % U_n**					**P**
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3					
P_{SMAX} =14000W P_{CMAX} =14000W						
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	248.45	14142.83	101.02%	100%	P
2	1.12	257.74	-11881.00	-84.86%	One-way: P <20%P_{SMAX} Biaxially: >80%P_{CMAX}	P
3	1.08	248.36	14215.00	101.54%	100%	P

Graph curve P=f(V):



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

Bbis.7.2	**TABLE: Verification of automatic reduction of active power in the presence of overfrequency transients on the network**	P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	
Activation settings..... :	Settable delay from 0s to 1s with step of 50ms (default value: no intentional delay)	

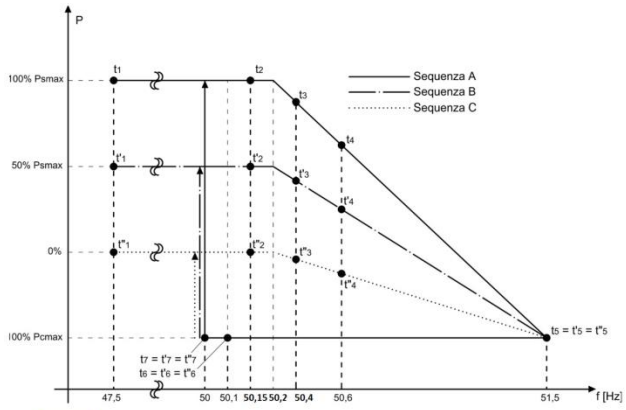


Figure 68 - Active power limitation curves for bidirectional converters

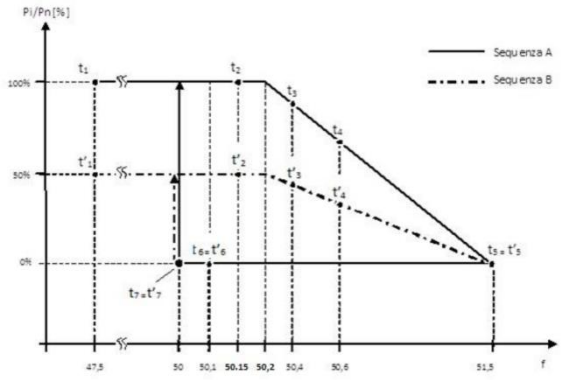


Figure 69 - Active power limitation curves for unidirectional converters

Supplementary information:

- bring all the parameters of the storage system under test to their respective normal operating values, such that the AC power delivered at the output is equal to the maximum AC power that can be delivered for sequence A, i.e. respectively at 50% and 0% in the case of the sequences B and C; energy equal to 80% of the useful capacity, CUS, must be stored in the storage system;
- 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, t'_1 for sequence B, t''_1 for sequence C);
  2. f = 50 Hz + 0,15 Hz (t_2 for sequence A, t'_2 for sequence B, t''_2 for sequence C);
  3. f = 50 Hz + 0,40 Hz (t_3 for sequence A, t'_3 for sequence B, t''_3 for sequence C);
  4. f = 50 Hz + 0,60 Hz (t_4 for sequence A, t'_4 for sequence B, t''_4 for sequence C);
  5. f = 50 Hz + 1,49 Hz (t_5 for sequence A, t'_5 for sequence B, t''_5 for sequence C);
  6. f = 50 Hz + 0,11 Hz (t_6 for sequence A, t'_6 for sequence B, t''^6 for sequence C);
  7. f = 50 Hz (t_7 for sequence A, t'_7 for sequence B, t''_7 for sequence C). The frequency is reported to the nominal value for the verification of the conditions of gradual restoration of the maximum supply (sequence A), that is to say at 50% or 0% of the maximum available power (respectively, sequence B and C).

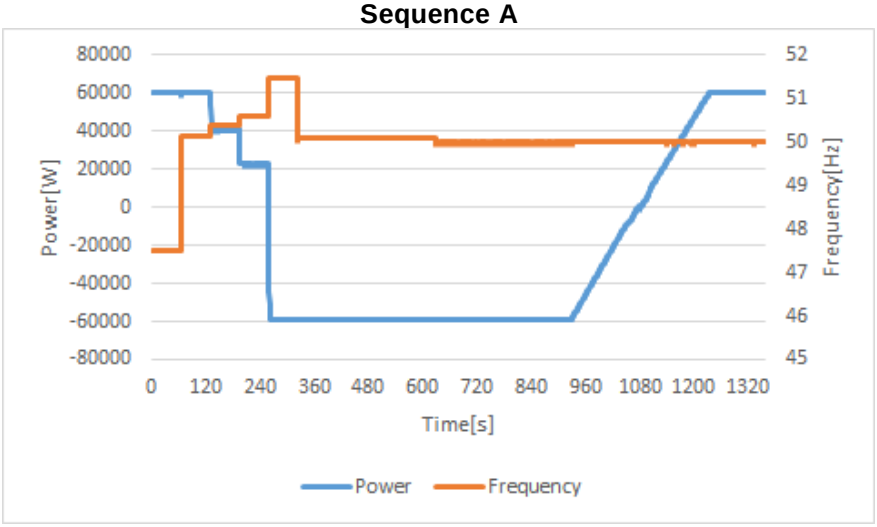
* The sequence C is applicable only for bi-directional converters.

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

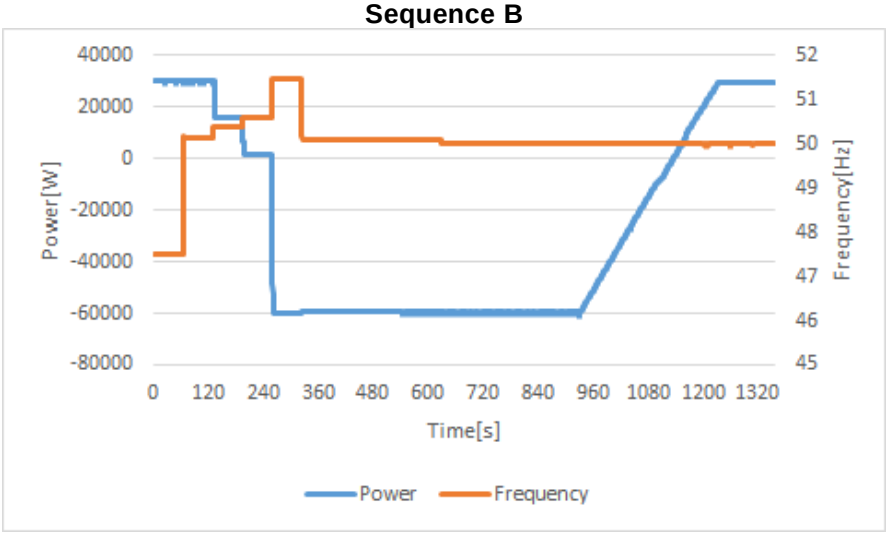
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100	47.51	60000	60016	± 2.5% Pn	t_1
2	100	50.15	60000	60025	± 2.5% Pn	t_2
3	100	50.40	41538	41374	± 2.5% Pn	t_3
4	100	50.60	23077	22561	± 2.5% Pn	t_4
5	100	51.49	-59077	-58496	± 2.5% Pn	t_5
6	100	50.10	-59077	-59049	± 2.5% Pn	t_6
7	100	50.00	60000	60116	Pn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	47.51	30000	30012	± 2.5% Pn	t'_1
2	50	50.15	30000	30018	± 2.5% Pn	t'_2
3	50	50.40	16154	16376	± 2.5% Pn	t'_3
4	50	50.60	2308	2007	± 2.5% Pn	t'_4
5	50	51.49	-59308	-59636	± 2.5% Pn	t'_5
6	50	50.10	-59308	-59437	± 2.5% Pn	t'_6
7	50	50.00	30000	29664	50% Pn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	47.51	0	-9	± 2.5% Pn	t''_1
2	0	50.15	0	-10	± 2.5% Pn	t''_2
3	0	50.40	-9231	-8682	± 2.5% Pn	t''_3
4	0	50.60	-18462	-17908	± 2.5% Pn	t''_4
5	0	51.49	-59538	-59583	± 2.5% Pn	t''_5
6	0	50.10	-59538	-59786	± 2.5% Pn	t''_6
7	0	50.00	0	44	0% Pn	t''_7

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

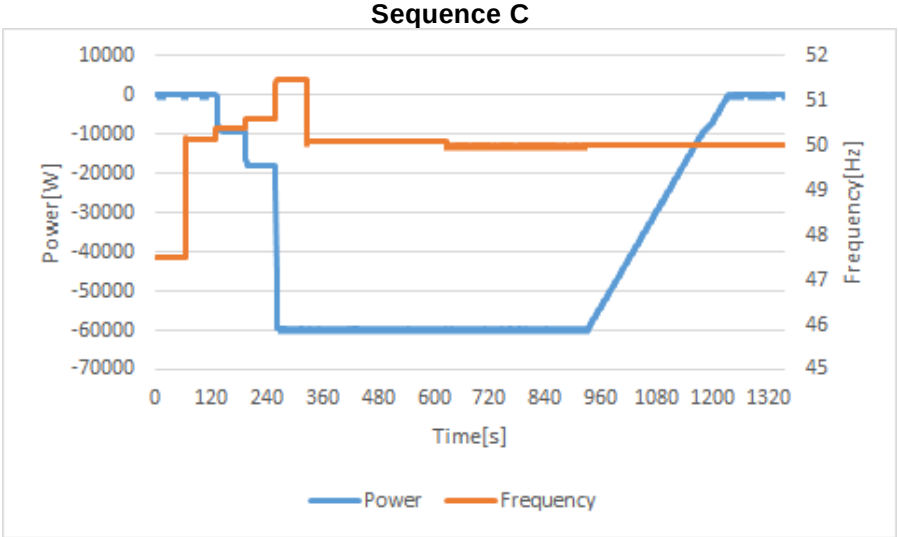
Sequence A



Sequence B



Sequence C

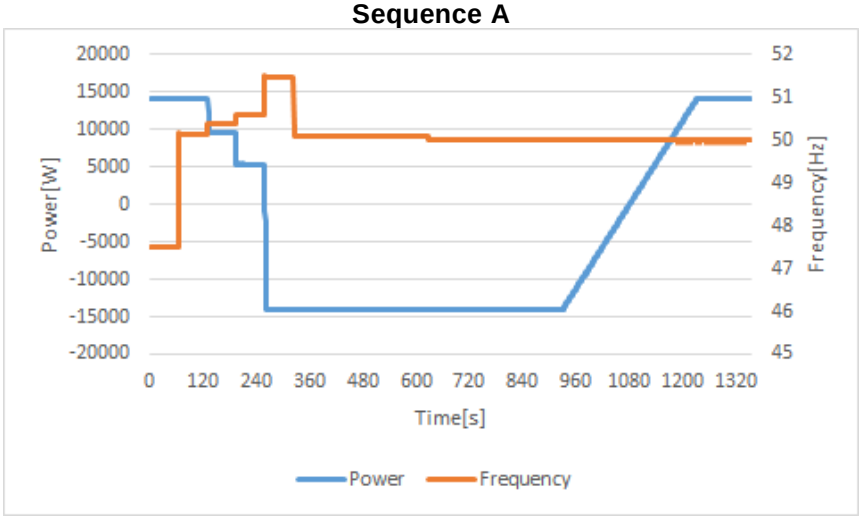


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

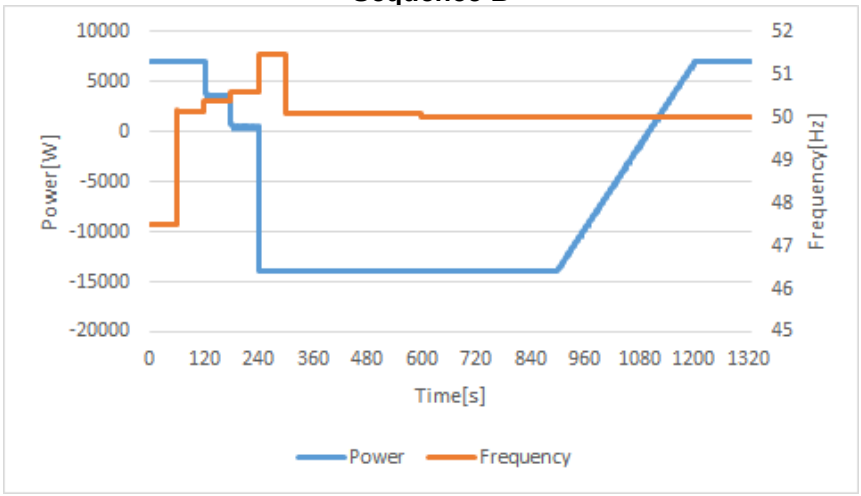
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100	47.51	14000	14176	± 2.5% Pn	t_1
2	100	50.15	14000	14177	± 2.5% Pn	t_2
3	100	50.40	9692	9717	± 2.5% Pn	t_3
4	100	50.60	5385	5397	± 2.5% Pn	t_4
5	100	51.49	-13785	-13814	± 2.5% Pn	t_5
6	100	50.10	-13785	-14108	± 2.5% Pn	t_6
7	100	50.00	14000	14210	Pn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	47.51	7000	7058	± 2.5% Pn	t'_1
2	50	50.15	7000	7059	± 2.5% Pn	t'_2
3	50	50.40	3769	3782	± 2.5% Pn	t'_3
4	50	50.60	538	532	± 2.5% Pn	t'_4
5	50	51.49	-13838	-13819	± 2.5% Pn	t'_5
6	50	50.10	-13838	-13966	± 2.5% Pn	t'_6
7	50	50.00	7000	7033	50% Pn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	47.51	0	12	± 2.5% Pn	t''_1
2	0	50.15	0	15	± 2.5% Pn	t''_2
3	0	50.40	-2154	-2144	± 2.5% Pn	t''_3
4	0	50.60	-4308	-4305	± 2.5% Pn	t''_4
5	0	51.49	-13892	-13886	± 2.5% Pn	t''_5
6	0	50.10	-13892	-13885	± 2.5% Pn	t''_6
7	0	50.00	0	187	0% Pn	t''_7

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

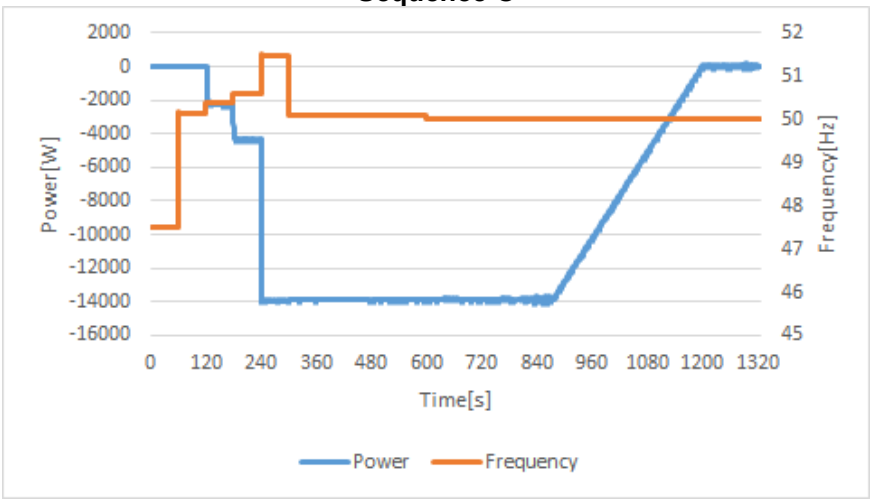
Sequence A



Sequence B



Sequence C

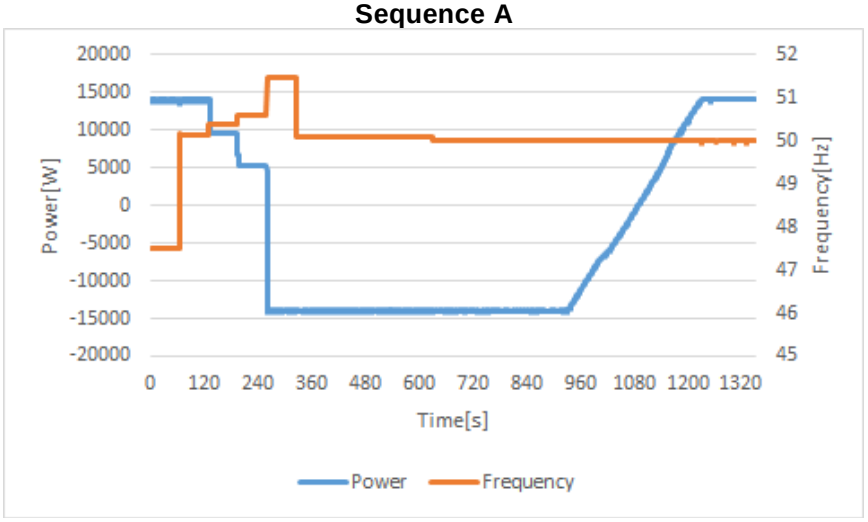


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

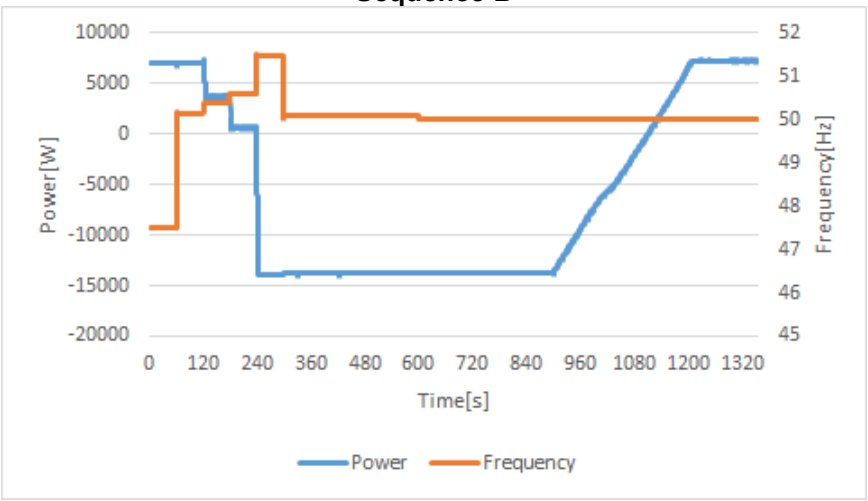
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100	47.51	14000	14054	± 2.5% Pn	t_1
2	100	50.15	14000	14058	± 2.5% Pn	t_2
3	100	50.40	9692	9709	± 2.5% Pn	t_3
4	100	50.60	5385	5351	± 2.5% Pn	t_4
5	100	51.49	-13785	-13762	± 2.5% Pn	t_5
6	100	50.10	-13785	-13970	± 2.5% Pn	t_6
7	100	50.00	14000	14159	Pn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	47.51	7000	7038	± 2.5% Pn	t'_1
2	50	50.15	7000	7048	± 2.5% Pn	t'_2
3	50	50.40	3769	3942	± 2.5% Pn	t'_3
4	50	50.60	538	675	± 2.5% Pn	t'_4
5	50	51.49	-13838	-13718	± 2.5% Pn	t'_5
6	50	50.10	-13838	-13764	± 2.5% Pn	t'_6
7	50	50.00	7000	7322	50% Pn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	47.51	0	-4	± 2.5% Pn	t''_1
2	0	50.15	0	-11	± 2.5% Pn	t''_2
3	0	50.40	-2154	-2116	± 2.5% Pn	t''_3
4	0	50.60	-4308	-4493	± 2.5% Pn	t''_4
5	0	51.49	-13892	-13962	± 2.5% Pn	t''_5
6	0	50.10	-13892	-14161	± 2.5% Pn	t''_6
7	0	50.00	0	65	0% Pn	t''_7

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

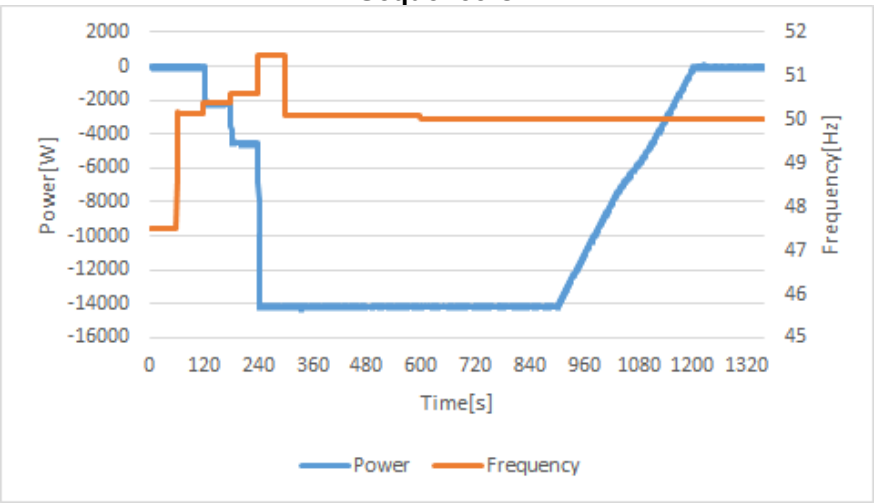
Sequence A



Sequence B

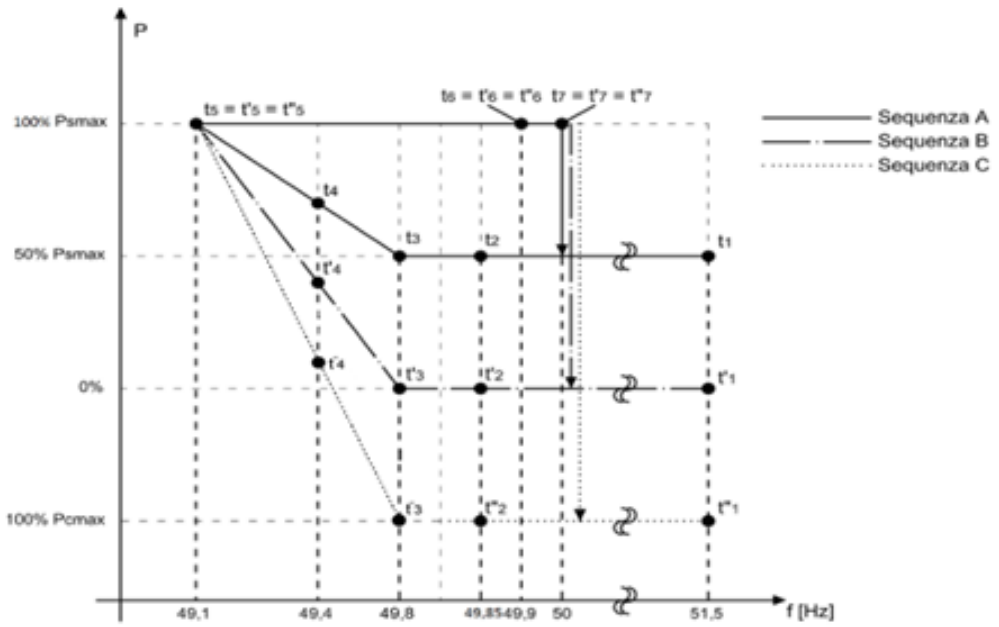


Sequence C



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

Bbis.7.3	**TABLE: Verification of the automatic increase of active power in the presence of underfrequency transients on the network**	P
Activation settings..... ....:	Settable delay from 0s to 1s with step of 50ms (default value: no intentional delay)	



Supplementary information:

The function of power derating under over-frequency was disable for this test.

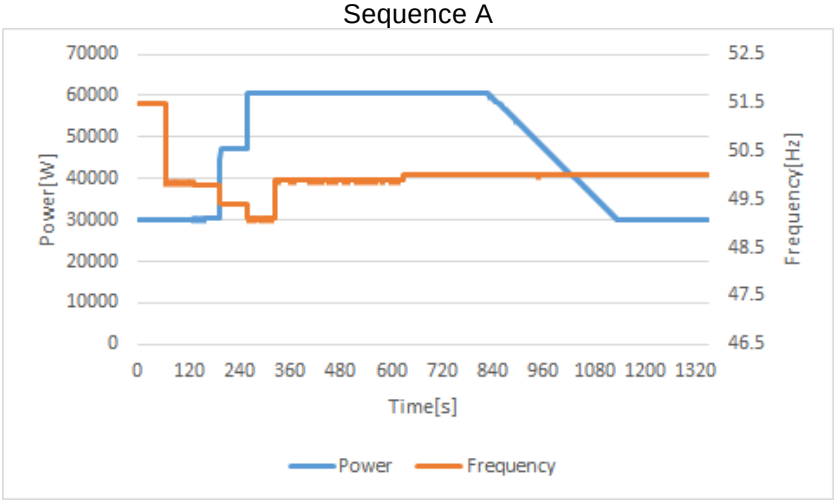
- bring all the parameters of the storage system under test to their respective normal operating values, such that the AC power delivered at the output is respectively equal, for sequences A and B, to 50% and 0% of P_{SMAX} (or P_{NINV} for integrated storage systems) and, for sequence C, 100% of the P_{CMAX}; energy equal to 20% of the useful capacity, CUS, must be stored in the storage system;
- perform the measurements on 7 points (the frequency value must have an uncertainty of maximum ± 10 mHz) temporally consequent to each other:
  1. f = 51,49 Hz (t_1 for sequence A, t'_1 for sequence B, t''_1 for sequence C);
  2. f = 50 Hz - 0,15 Hz (t_2 for sequence A, t'_2 for sequence B, t''_2 for sequence C);
  3. f = 50 Hz - 0,40 Hz (t_3 for sequence A, t'_3 for sequence B, t''_3 for sequence C);
  4. f = 50 Hz - 0,60 Hz (t_4 for sequence A, t'_4 for sequence B, t''_4 for sequence C);
  5. f = 50 Hz - 0,89 Hz (t_5 for sequence A, t'_5 for sequence B, t''_5 for sequence C);
  6. f = 50 Hz - 0,11 Hz (t_6 for sequence A, t'_6 for sequence B, t''_6 for sequence C);
  7. f = 50 Hz (t_7 for the sequence A, t'_7 for the sequence B, t''_7 for the sequence C). The frequency is reported at the nominal value for the verification of the gradual recovery conditions, for sequences A and B, respectively of 50% and 0% of the P_{SMAX} (or of P_{NINV} for integrated storage systems) and, for sequence C, 100% of the P_{CMAX}.

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

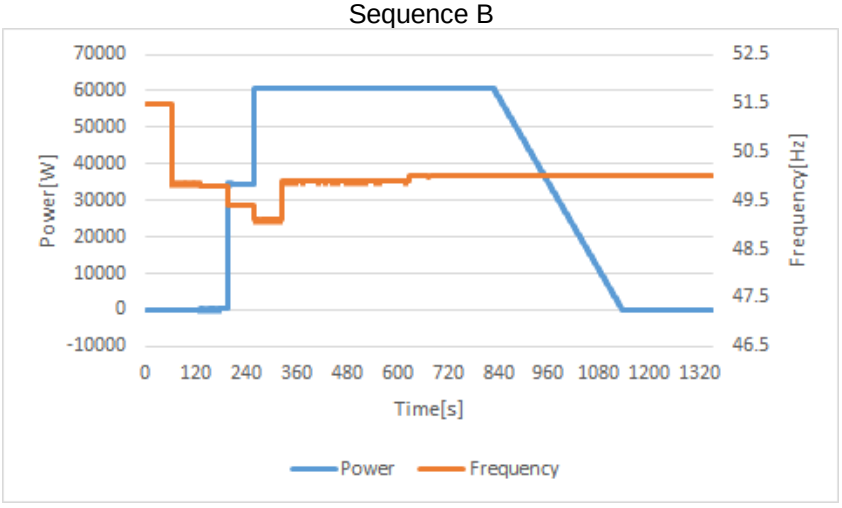
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	51.49	30000	30180	± 2.5% Sn	t_1
2	50	49.85	30000	30177	± 2.5% Sn	t_2
3	50	49.80	30000	30379	± 2.5% Sn	t_3
4	50	49.40	47143	47313	± 2.5% Sn	t_4
5	50	49.10	60000	60528	± 2.5% Sn	t_5
6	50	49.89	60000	60589	± 2.5% Sn	t_6
7	50	50.00	30000	30116	± 2.5% Sn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	51.49	0	-22	± 2.5% Sn	t'_1
2	0	49.85	0	-34	± 2.5% Sn	t'_2
3	0	49.80	0	306	± 2.5% Sn	t'_3
4	0	49.40	34286	34471	± 2.5% Sn	t'_4
5	0	49.10	60000	60520	± 2.5% Sn	t'_5
6	0	49.89	60000	60616	± 2.5% Sn	t'_6
7	0	50.00	0	-100	± 2.5% Sn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100% P_{CMAX}	51.49	-60000	-60267	± 2.5% Sn	t''_1
2	100% P_{CMAX}	49.85	-60000	-60507	± 2.5% Sn	t''_2
3	100% P_{CMAX}	49.80	-60000	-60084	± 2.5% Sn	t''_3
4	100% P_{CMAX}	49.40	8571	8717	± 2.5% Sn	t''_4
5	100% P_{CMAX}	49.10	60000	59421	± 2.5% Sn	t''_5
6	100% P_{CMAX}	49.89	60000	60166	± 2.5% Sn	t''_6
7	100% P_{CMAX}	50.00	-60000	-60328	± 2.5% Sn	t''_7

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

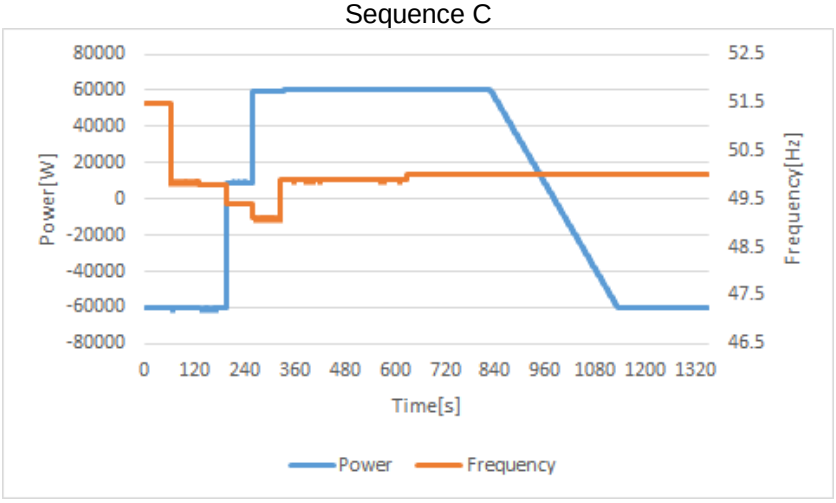
Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence A



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence B



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence C

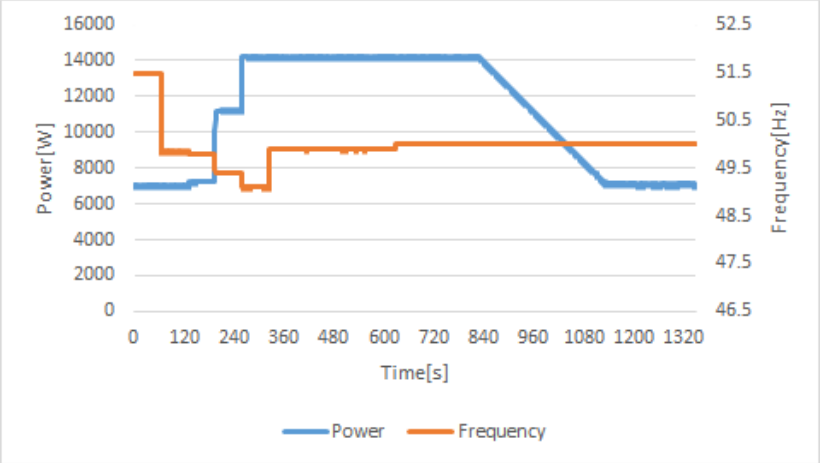


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

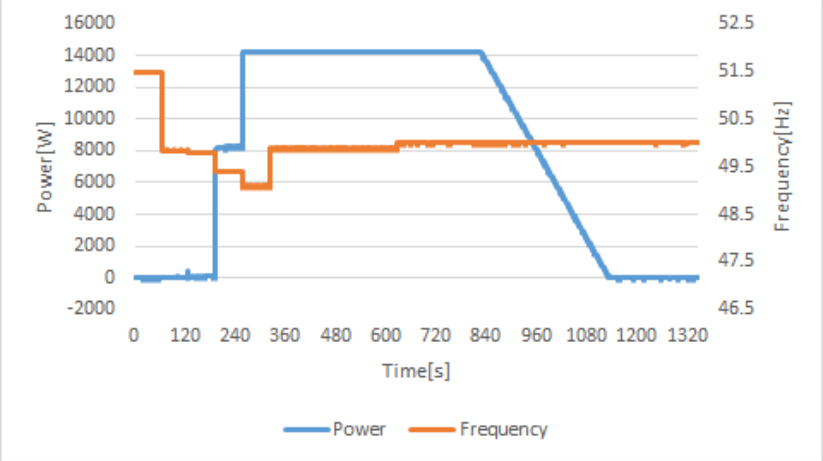
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	51.49	7000	7024	± 2.5% Sn	t_1
2	50	49.85	7000	7021	± 2.5% Sn	t_2
3	50	49.80	7000	7257	± 2.5% Sn	t_3
4	50	49.40	11000	11185	± 2.5% Sn	t_4
5	50	49.10	14000	14191	± 2.5% Sn	t_5
6	50	49.89	14000	14200	± 2.5% Sn	t_6
7	50	50.00	7000	6981	± 2.5% Sn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	51.49	0	19	± 2.5% Sn	t'_1
2	0	49.85	0	20	± 2.5% Sn	t'_2
3	0	49.80	0	71	± 2.5% Sn	t'_3
4	0	49.40	8000	8213	± 2.5% Sn	t'_4
5	0	49.10	14000	14213	± 2.5% Sn	t'_5
6	0	49.89	14000	14234	± 2.5% Sn	t'_6
7	0	50.00	0	-47	± 2.5% Sn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100% P_{CMAX}	51.49	-14000	-14037	± 2.5% Sn	t''_1
2	100% P_{CMAX}	49.85	-14000	-14095	± 2.5% Sn	t''_2
3	100% P_{CMAX}	49.80	-14000	-13957	± 2.5% Sn	t''_3
4	100% P_{CMAX}	49.40	2000	2035	± 2.5% Sn	t''_4
5	100% P_{CMAX}	49.10	14000	13887	± 2.5% Sn	t''_5
6	100% P_{CMAX}	49.89	14000	14054	± 2.5% Sn	t''_6
7	100% P_{CMAX}	50.00	-14000	-14079	± 2.5% Sn	t''_7

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

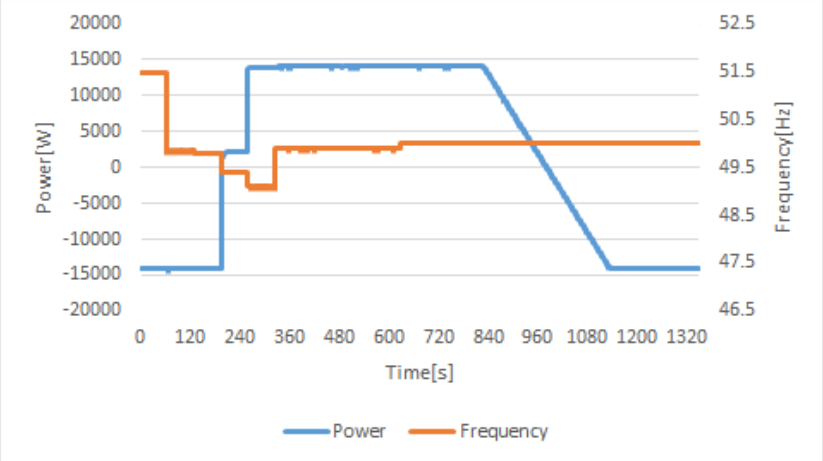
Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence A



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence B



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence C

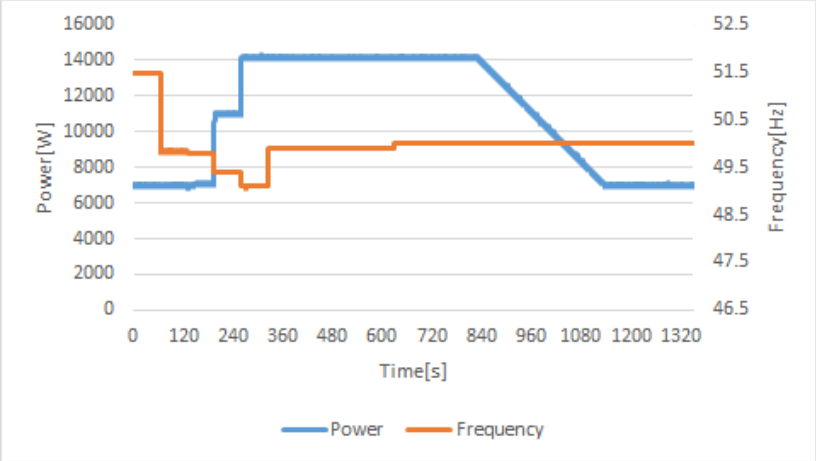


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

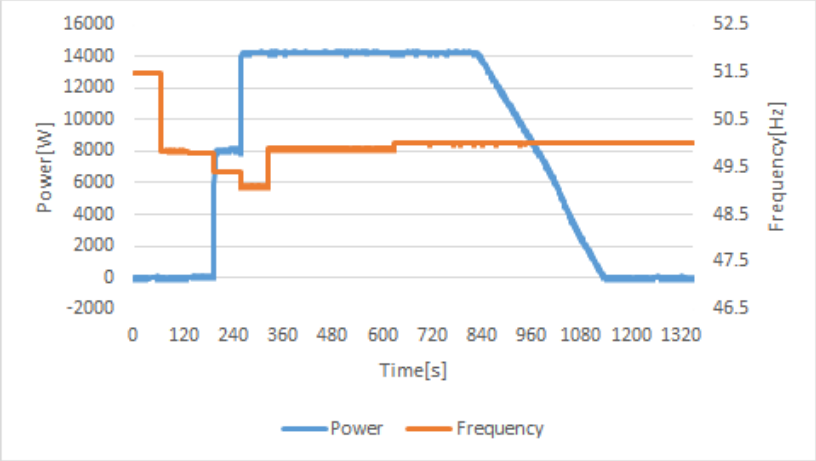
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Sequence A						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	50	51.49	7000	7039	± 2.5% Sn	t_1
2	50	49.85	7000	7035	± 2.5% Sn	t_2
3	50	49.80	7000	7083	± 2.5% Sn	t_3
4	50	49.40	11000	11017	± 2.5% Sn	t_4
5	50	49.10	14000	14182	± 2.5% Sn	t_5
6	50	49.89	14000	14186	± 2.5% Sn	t_6
7	50	50.00	7000	6972	± 2.5% Sn	t_7
Sequence B						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	0	51.49	0	15	± 2.5% Sn	t'_1
2	0	49.85	0	9	± 2.5% Sn	t'_2
3	0	49.80	0	109	± 2.5% Sn	t'_3
4	0	49.40	8000	8049	± 2.5% Sn	t'_4
5	0	49.10	14000	14192	± 2.5% Sn	t'_5
6	0	49.89	14000	14226	± 2.5% Sn	t'_6
7	0	50.00	0	-61	± 2.5% Sn	t'_7
Sequence C						
Step No.	Set output power [%]	Frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100% P_{CMAX}	51.49	-14000	-14139	± 2.5% Sn	t''_1
2	100% P_{CMAX}	49.85	-14000	-14141	± 2.5% Sn	t''_2
3	100% P_{CMAX}	49.80	-14000	-13965	± 2.5% Sn	t''_3
4	100% P_{CMAX}	49.40	2000	1907	± 2.5% Sn	t''_4
5	100% P_{CMAX}	49.10	14000	13865	± 2.5% Sn	t''_5
6	100% P_{CMAX}	49.89	14000	14081	± 2.5% Sn	t''_6
7	100% P_{CMAX}	50.00	-14000	-14233	± 2.5% Sn	t''_7

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

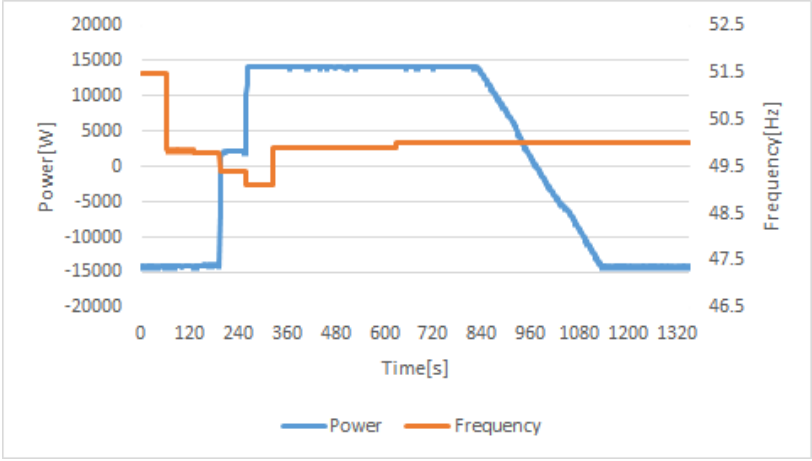
Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence A



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence B



Graph Active power regulation in coincidence with transitory on the transmission grid
Sequence C



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

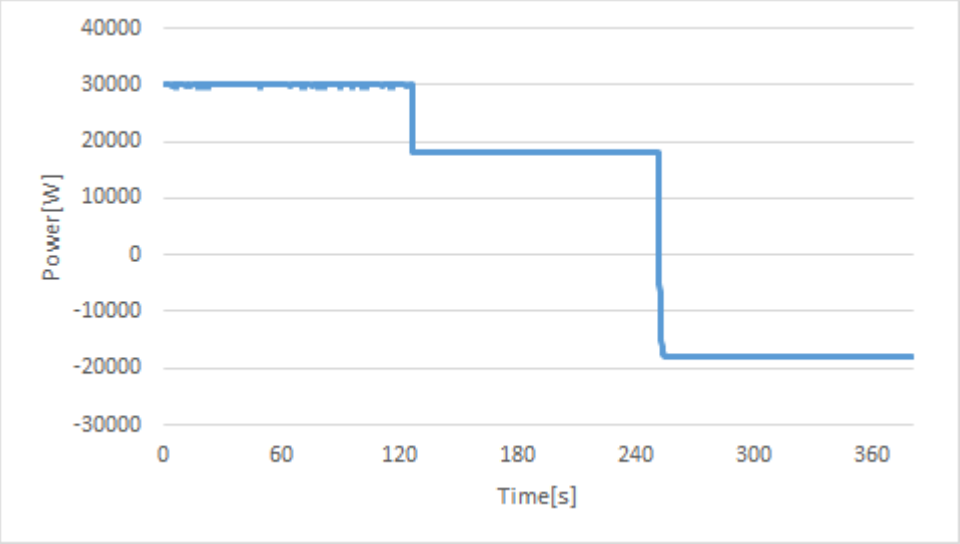
Bbis.7.4	**TABLE: Active power limitation in coincidence with external command coming from the Electricity Distributor**				**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15				
Set Point	P [W]	Actual power [W]	ΔP/Pn%	Limit [%]	Result
50% P_{SMAX}	30000	30002	0.00	--	--
30% P_{SMAX}	18000	18026	0.04	± 2.5 % P_{SMAX}	P
30% P_{CMAX}	-18000	-17778	0.37	± 2.5 % P_{SMAX}	P

The test must be performed according to the following steps:

–Bring the storage system to 50% of the active power available for injection.
–Send to the generator an active power set-point equal to 30% of the P_{SMAX}.
–Maintain the set-point for a time of 60 s, compatibly with the energy capacity of the storage system.
–Measure the active power delivered by the inverter, at least 30 seconds after the command of the new active power regulation set-point is sent (this is to ensure that the system has reached the steady state).

The test is considered to have been successfully passed if the maximum deviation between the assigned level and the current measured value (average value with a window of 1 min.) For the active power is less than ± 2.5%P_{SMAX}.
In the case of storage systems connected to bidirectional converters, repeat the test at 30% of the P_{CMAX}.

Diagram:



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

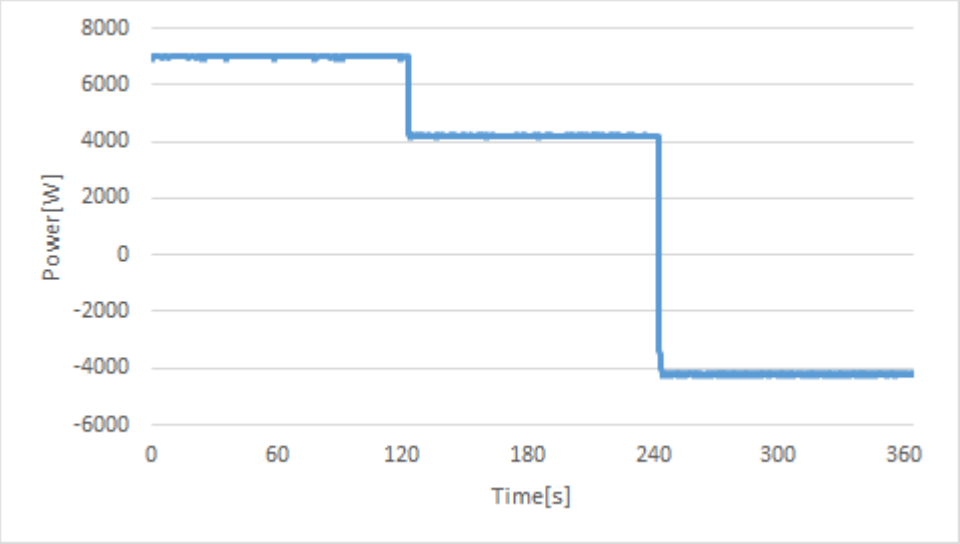
Bbis.7.4	**TABLE: Active power limitation in coincidence with external command coming from the Electricity Distributor**				**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3				
Set Point	P [W]	Actual power [W]	ΔP/Pn%	Limit [%]	Result
50% P_{SMAX}	7000	7010	0.07	--	--
30% P_{SMAX}	4200	4205	0.03	± 2.5 % P_{SMAX}	P
30% P_{CMAX}	-4200	-4196	0.03	± 2.5 % P_{SMAX}	P

The test must be performed according to the following steps:

–Bring the storage system to 50% of the active power available for injection.
–Send to the generator an active power set-point equal to 30% of the P_{SMAX}.
–Maintain the set-point for a time of 60 s, compatibly with the energy capacity of the storage system.
–Measure the active power delivered by the inverter, at least 30 seconds after the command of the new active power regulation set-point is sent (this is to ensure that the system has reached the steady state).

The test is considered to have been successfully passed if the maximum deviation between the assigned level and the current measured value (average value with a window of 1 min.) For the active power is less than ± 2.5%P_{SMAX}.
In the case of storage systems connected to bidirectional converters, repeat the test at 30% of the P_{CMAX}.

Diagram:



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

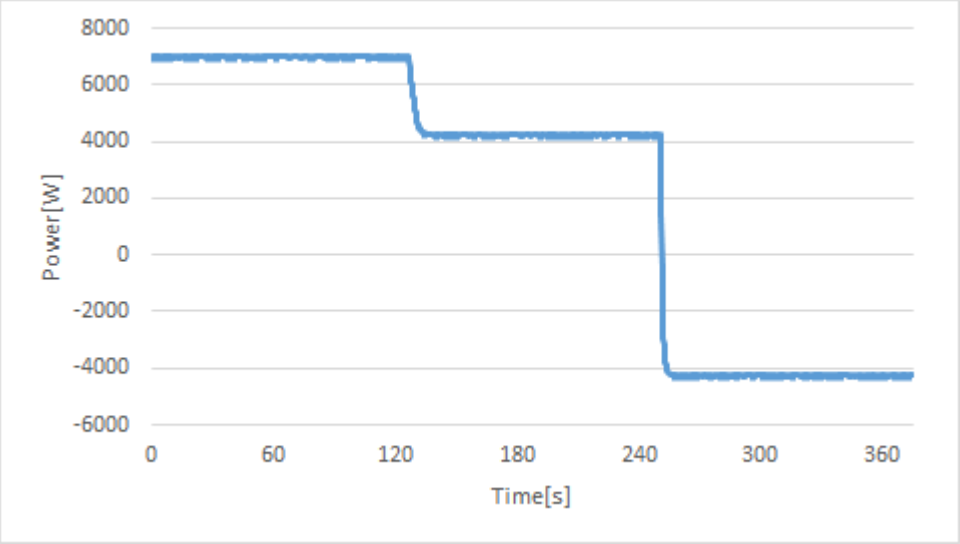
Bbis.7.4	**TABLE: Active power limitation in coincidence with external command coming from the Electricity Distributor**				**P**
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3				
Set Point	P [W]	Actual power [W]	ΔP/Pn%	Limit [%]	Result
50% P_{SMAX}	7000	6988	-0.09	--	--
30% P_{SMAX}	4200	4257	0.41	± 2.5 % P_{SMAX}	P
30% P_{CMAX}	-4200	-4225	-0.18	± 2.5 % P_{SMAX}	P

The test must be performed according to the following steps:

–Bring the storage system to 50% of the active power available for injection.
–Send to the generator an active power set-point equal to 30% of the P_{SMAX}.
–Maintain the set-point for a time of 60 s, compatibly with the energy capacity of the storage system.
–Measure the active power delivered by the inverter, at least 30 seconds after the command of the new active power regulation set-point is sent (this is to ensure that the system has reached the steady state).

The test is considered to have been successfully passed if the maximum deviation between the assigned level and the current measured value (average value with a window of 1 min.) For the active power is less than ± 2.5%P_{SMAX}.
In the case of storage systems connected to bidirectional converters, repeat the test at 30% of the P_{CMAX}.

Diagram:



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

Bbis.7.4.1	**TABLE: Verification of the settling time at a power increase / decrease command**					P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15					
Set Point	P [W]	Actual power [W]	Setting time (s)	ΔP/Pn%	Deviation Limit	Setting time
Bidirectional converters						
100% P_{SMAX} to 30% P_{CMAX}	-18000	-18027	2.6	-0.04	± 2.5 % Pn	≤ 50 s
100% P_{CMAX} to 50% P_{SMAX}	30000	30026	1.8	0.04	± 2.5 % Pn	≤ 50 s
Unidirectional converters						
100% P_{SMAX} to 30% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s
0% P_{SMAX} to 50% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s

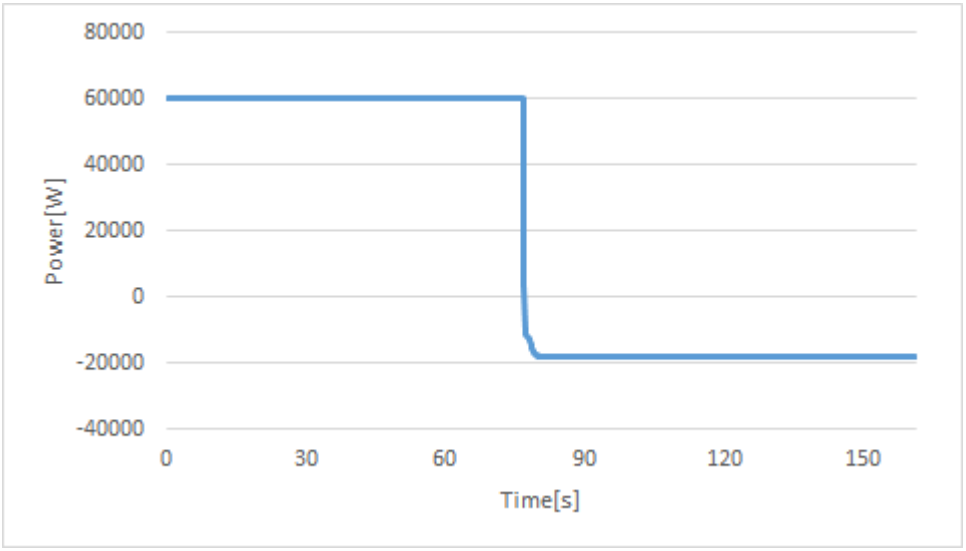
To check the settling time at a command to reduce the active power delivered, or increase the active power absorbed, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{SMAX} to 30% P_{CMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 100% P_{SMAX} to 30% P_{SMAX} at time t_0.

To check the settling time at a command to increase the active power, or reduce the absorbed active power, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{CMAX} to 50% P_{SMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 0%P_{SMAX} to 50%P_{SMAX} at time t_0.

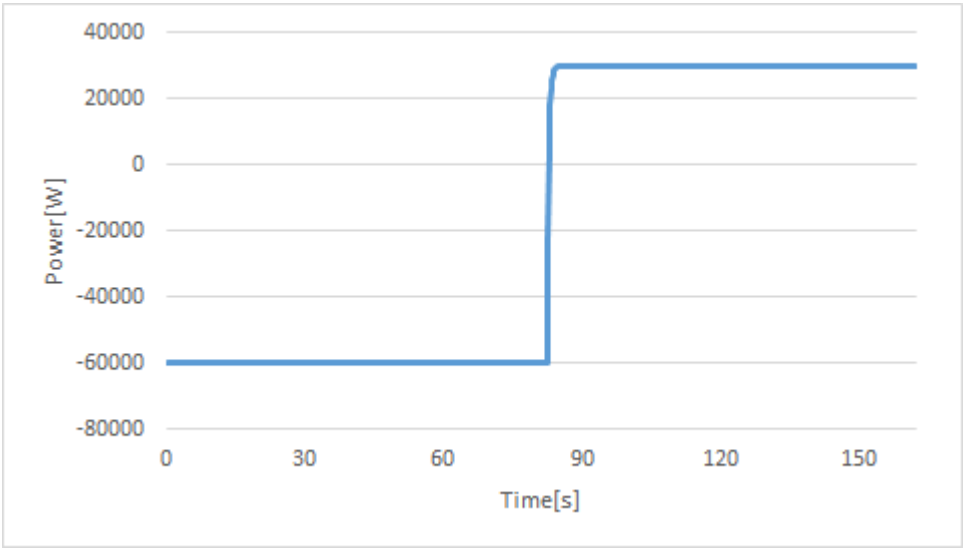
The settling time is the time interval from the instant t_0 of application of the step of increasing / limiting the active power (e.g. 100%P_{SMAX} ->30%P_{SMAX}) to the instant in which the power is stably within a tolerance band of ± 2.5%S_n with respect to the new set value.
The maximum measured settling time must be less than 50 s, and in any case not more than 60 s if the limitation command provides for the passage from 100%Sn to 15%S_n.

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

Graph: 100% P_{SMAX} to 30% P_{CMAX}:



Graph: 100% P_{CMAX} to 50% P_{SMAX}:



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

Bbis.7.4.1	**TABLE: Verification of the settling time at a power increase / decrease command**					P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Set Point	P [W]	Actual power [W]	Setting time (s)	ΔP/Pn (%)	Deviation Limit	Setting time
Bidirectional converters						
100% P_{SMAX} to 30% P_{CMAX}	-4200	-4212	2.6	-0.08	± 2.5 % Pn	≤ 50 s
100% P_{CMAX} to 50% P_{SMAX}	7000	7153	5.2	1.09	± 2.5 % Pn	≤ 50 s
Unidirectional converters						
100% P_{SMAX} to 30% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s
0% P_{SMAX} to 50% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s

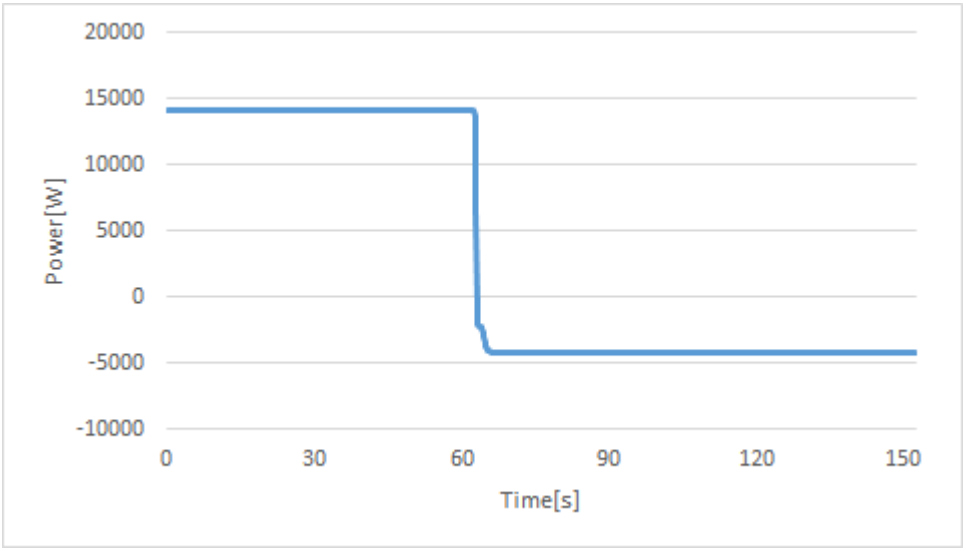
To check the settling time at a command to reduce the active power delivered, or increase the active power absorbed, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{SMAX} to 30% P_{CMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 100% P_{SMAX} to 30% P_{SMAX} at time t_0.

To check the settling time at a command to increase the active power, or reduce the absorbed active power, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{CMAX} to 50% P_{SMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 0%P_{SMAX} to 50%P_{SMAX} at time t_0.

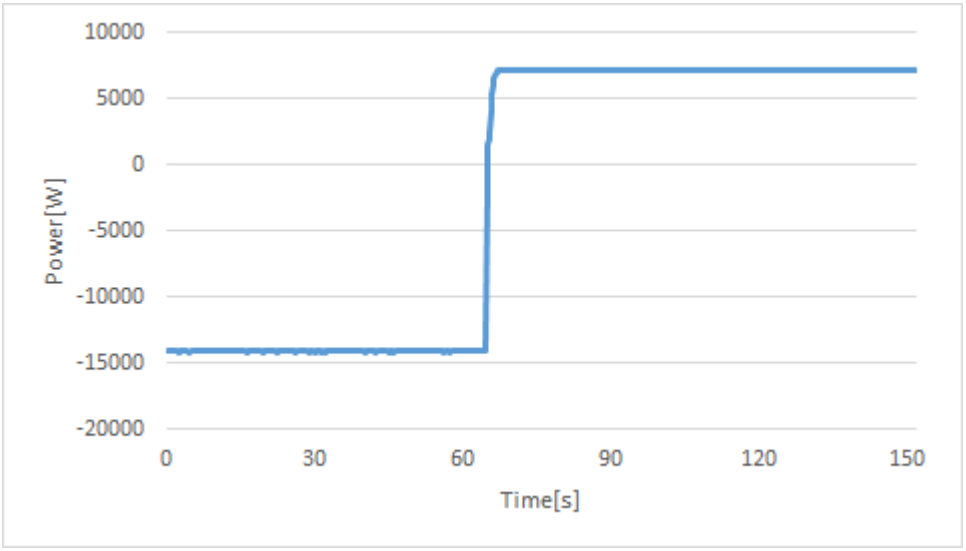
The settling time is the time interval from the instant t_0 of application of the step of increasing / limiting the active power (e.g. 100%P_{SMAX} ->30%P_{SMAX}) to the instant in which the power is stably within a tolerance band of ± 2.5%S_n with respect to the new set value.
The maximum measured settling time must be less than 50 s, and in any case not more than 60 s if the limitation command provides for the passage from 100%Sn to 15%S_n.

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

Graph: 100% P_{SMAX} to 30% P_{CMAX}:



Graph: 100% P_{CMAX} to 50% P_{SMAX}:



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

Bbis.7.4.1	**TABLE: Verification of the settling time at a power increase / decrease command**					P
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3					
Set Point	P [W]	Actual power [W]	Setting time (s)	ΔP/Pn (%)	Deviation Limit	Setting time
Bidirectional converters						
100% P_{SMAX} to 30% P_{CMAX}	-4200	-4206	4.4	-0.04	± 2.5 % Pn	≤ 50 s
100% P_{CMAX} to 50% P_{SMAX}	7000	7089	3.8	0.63	± 2.5 % Pn	≤ 50 s
Unidirectional converters						
100% P_{SMAX} to 30% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s
0% P_{SMAX} to 50% P_{SMAX}	--	--	--	--	± 2.5 % Pn	≤ 50 s

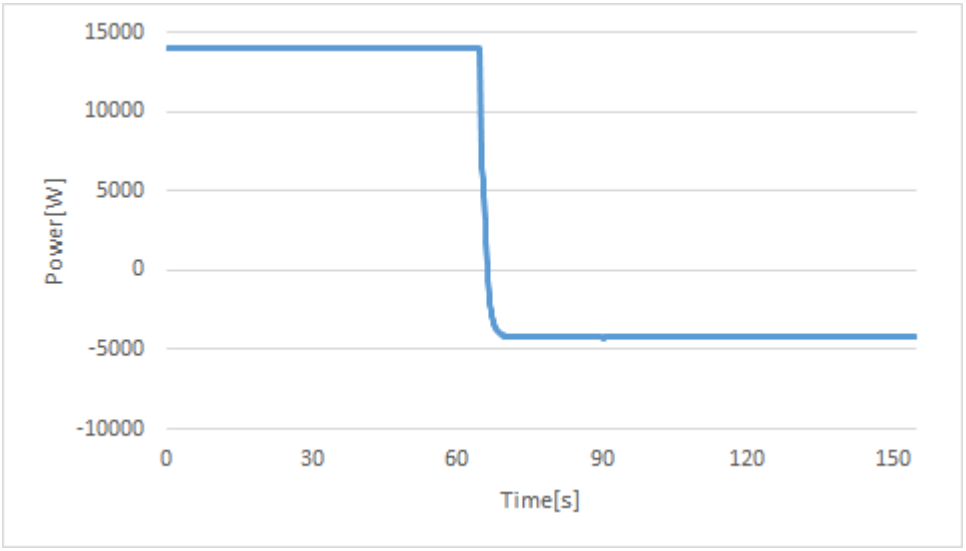
To check the settling time at a command to reduce the active power delivered, or increase the active power absorbed, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{SMAX} to 30% P_{CMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 100% P_{SMAX} to 30% P_{SMAX} at time t_0.

To check the settling time at a command to increase the active power, or reduce the absorbed active power, the test is carried out:
–for storage systems connected to bidirectional converters, by adjusting the regulation parameter from 100%P_{CMAX} to 50% P_{SMAX} at time t_0;
–for storage systems connected to unidirectional converters, by adjusting the regulation parameter from 0%P_{SMAX} to 50%P_{SMAX} at time t_0.

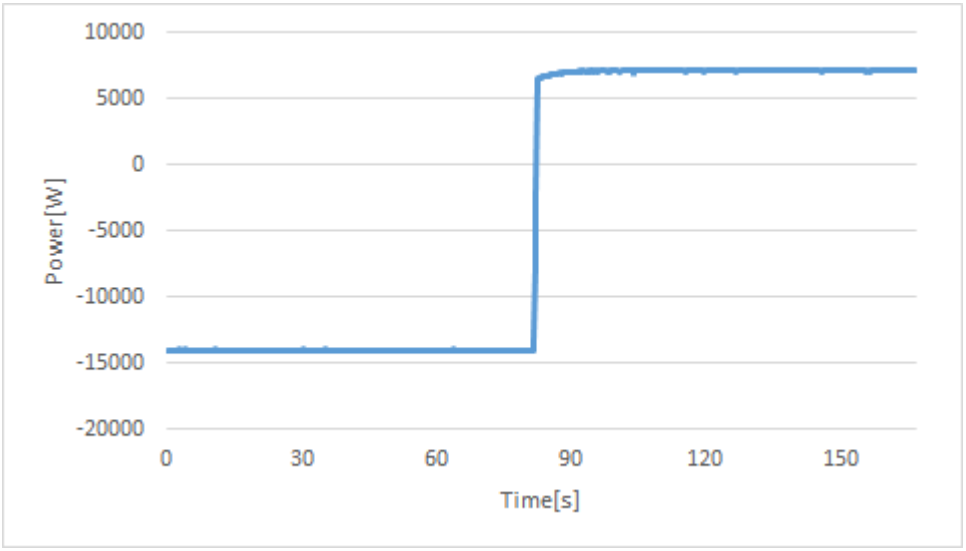
The settling time is the time interval from the instant t_0 of application of the step of increasing / limiting the active power (e.g. 100%P_{SMAX} ->30%P_{SMAX}) to the instant in which the power is stably within a tolerance band of ± 2.5%S_n with respect to the new set value.
The maximum measured settling time must be less than 50 s, and in any case not more than 60 s if the limitation command provides for the passage from 100%Sn to 15%S_n.

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

Graph: 100% P_{SMAX} to 30% P_{CMAX}:

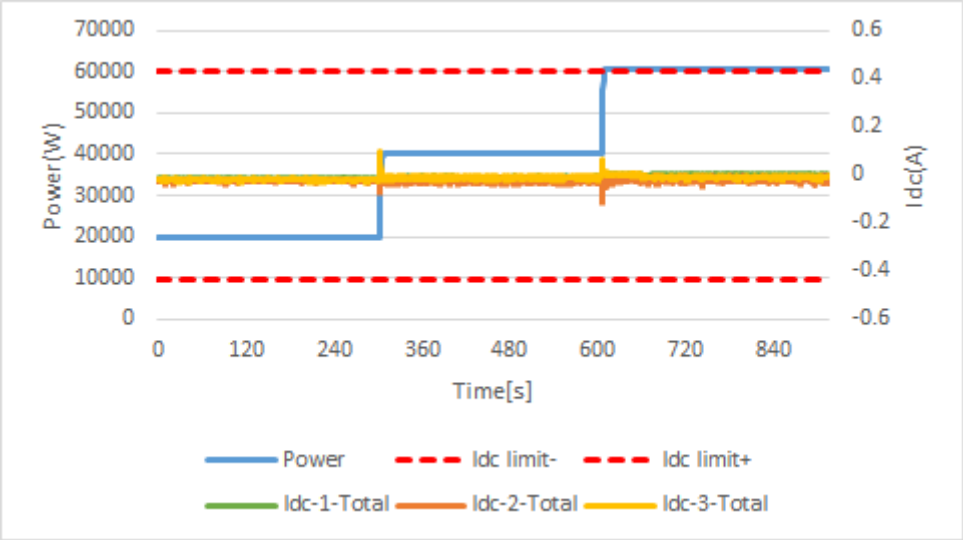


Graph: 100% P_{CMAX} to 50% P_{SMAX}:



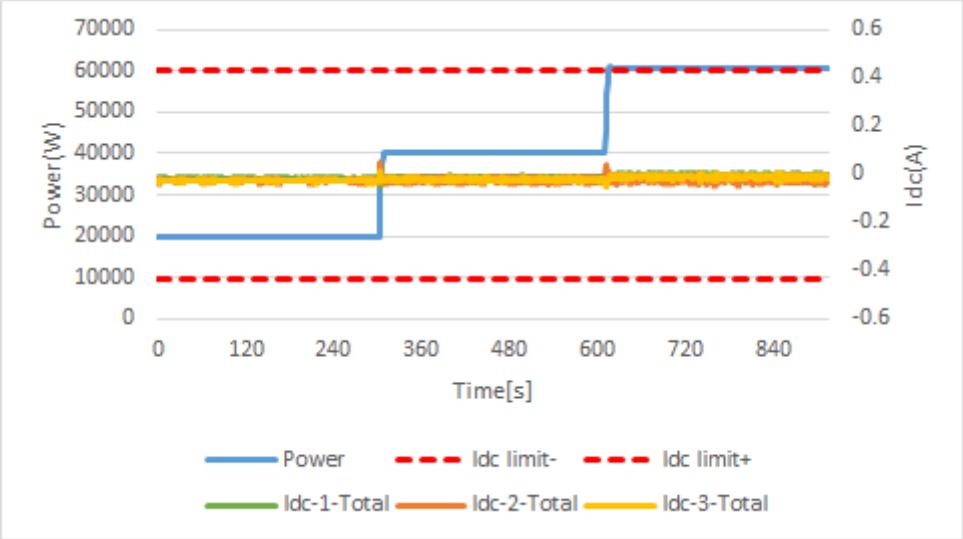
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.8.1	**TABLE: Verification of continuous component emission**		P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15		
Completed test			
Power Level [%P_{SMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Ambient			
Total output Power (W)	19862	40376	60688
Output Vrms	230.16	230.33	230.50
Output Arms	29.01	58.56	87.85
Cos φ	0.9961	0.9993	0.9998
L1 DC Component (A)	0.005	0.003	0.001
L2 DC Component (A)	0.008	0.008	0.007
L3 DC Component (A)	0.006	0.004	0.003
L1 DC Component (% I_r)	0.006%	0.004%	0.001%
L2 DC Component (% I_r)	0.009%	0.009%	0.008%
L3 DC Component (% I_r)	0.007%	0.004%	0.003%



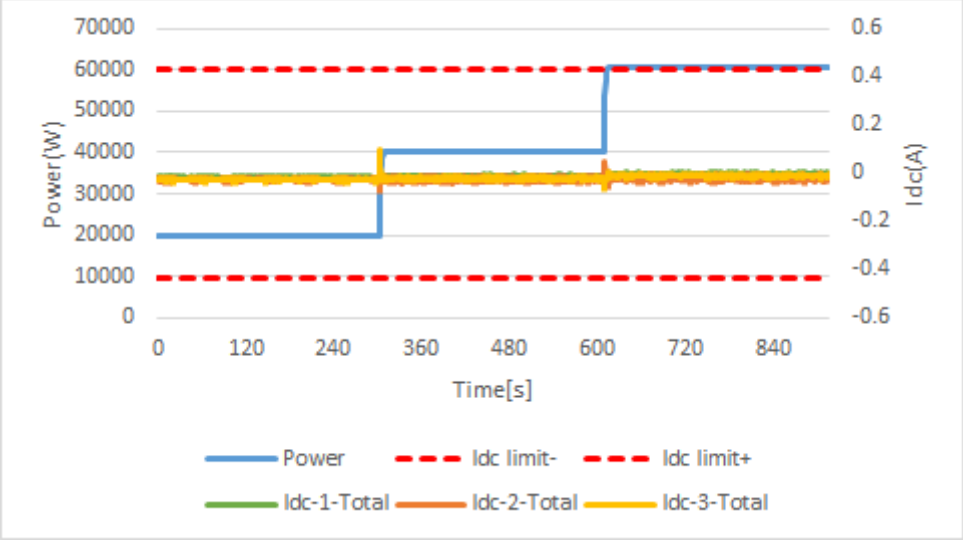
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Minimum ambient rating -25°C			
Total output Power (W)	19862	40403	60748
Output Vrms	230.16	230.33	230.50
Output Arms	29.00	58.60	87.94
Cos φ	0.9961	0.9993	0.9998
L1 DC Component (A)	0.006	0.004	0.001
L2 DC Component (A)	0.009	0.008	0.007
L3 DC Component (A)	0.009	0.007	0.004
L1 DC Component (% I_r)	0.006%	0.004%	0.001%
L2 DC Component (% I_r)	0.010%	0.009%	0.008%
L3 DC Component (% I_r)	0.010%	0.008%	0.004%



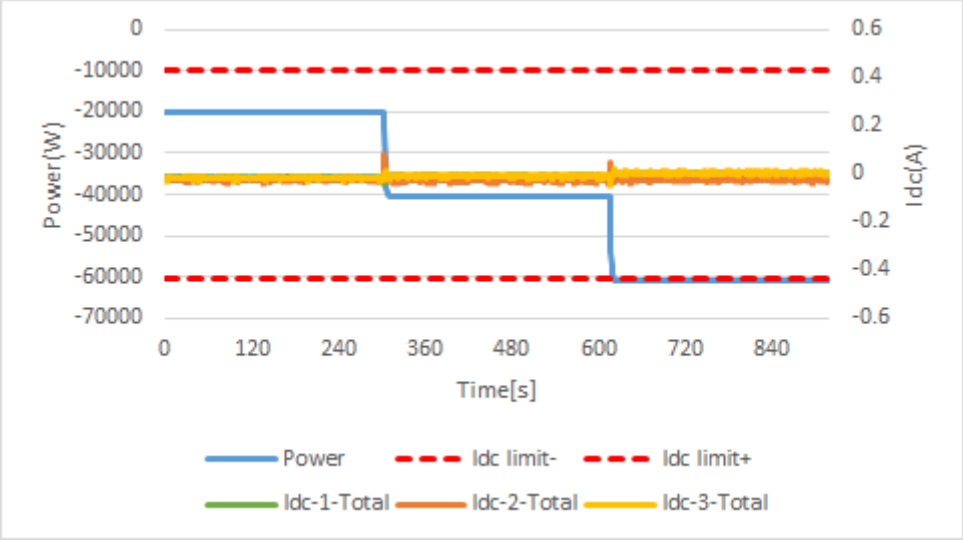
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Maximum ambient rating 60°C			
Total output Power (W)	19879	40419	60735
Output Vrms	230.16	230.33	230.50
Output Arms	29.03	58.62	87.92
Cos φ	0.9961	0.9993	0.9998
L1 DC Component (A)	0.005	0.003	0.001
L2 DC Component (A)	0.009	0.008	0.007
L3 DC Component (A)	0.009	0.007	0.003
L1 DC Component (% I_r)	0.006%	0.004%	0.001%
L2 DC Component (% I_r)	0.010%	0.010%	0.008%
L3 DC Component (% I_r)	0.010%	0.008%	0.004%



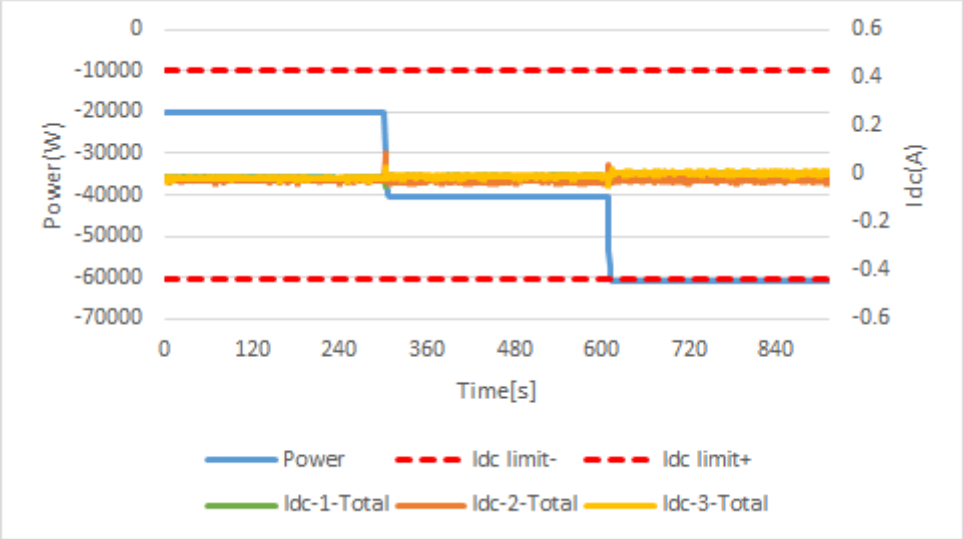
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Power Level [%P_{CMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Ambient			
Total output Power (W)	-19936	-40419	-60769
Output Vrms	230.16	230.33	230.50
Output Arms	29.12	58.62	87.97
Cos φ	-0.9961	-0.9993	-0.9998
L1 DC Component (A)	0.005	0.003	0.001
L2 DC Component (A)	0.008	0.007	0.006
L3 DC Component (A)	0.006	0.003	0.002
L1 DC Component (% I_r)	0.006%	0.004%	0.001%
L2 DC Component (% I_r)	0.009%	0.008%	0.007%
L3 DC Component (% I_r)	0.007%	0.003%	0.002%



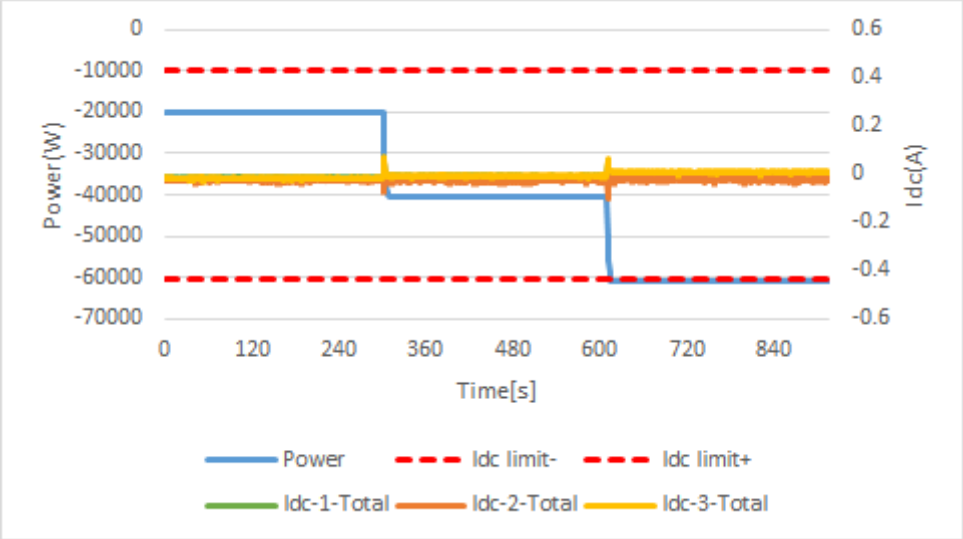
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Minimum ambient rating -25°C			
Total output Power (W)	-19858	-40398	-60780
Output Vrms	230.16	230.33	230.50
Output Arms	29.00	58.59	87.98
Cos φ	-0.9961	-0.9993	-0.9998
L1 DC Component (A)	0.005	0.003	0.001
L2 DC Component (A)	0.008	0.008	0.006
L3 DC Component (A)	0.006	0.003	0.002
L1 DC Component (% I_r)	0.006%	0.004%	0.001%
L2 DC Component (% I_r)	0.009%	0.009%	0.007%
L3 DC Component (% I_r)	0.007%	0.004%	0.002%



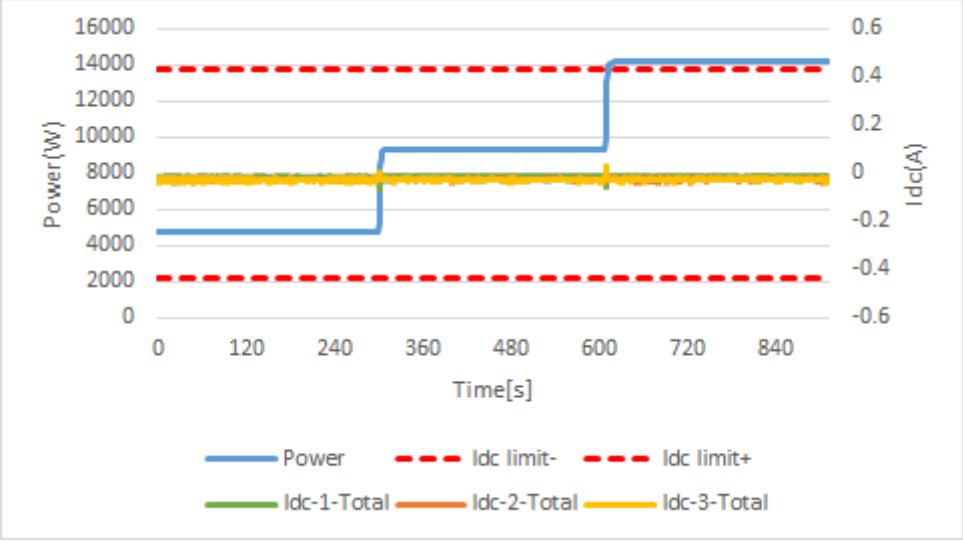
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Maximum ambient rating 60°C			
Total output Power (W)	-19869	-40401	-60746
Output Vrms	230.16	230.33	230.50
Output Arms	29.02	58.59	87.94
Cos φ	-0.9961	-0.9993	-0.9998
L1 DC Component (A)	0.005	0.003	0.001
L2 DC Component (A)	0.008	0.008	0.006
L3 DC Component (A)	0.006	0.002	0.003
L1 DC Component (% I_r)	0.006%	0.003%	0.001%
L2 DC Component (% I_r)	0.009%	0.009%	0.007%
L3 DC Component (% I_r)	0.007%	0.003%	0.003%



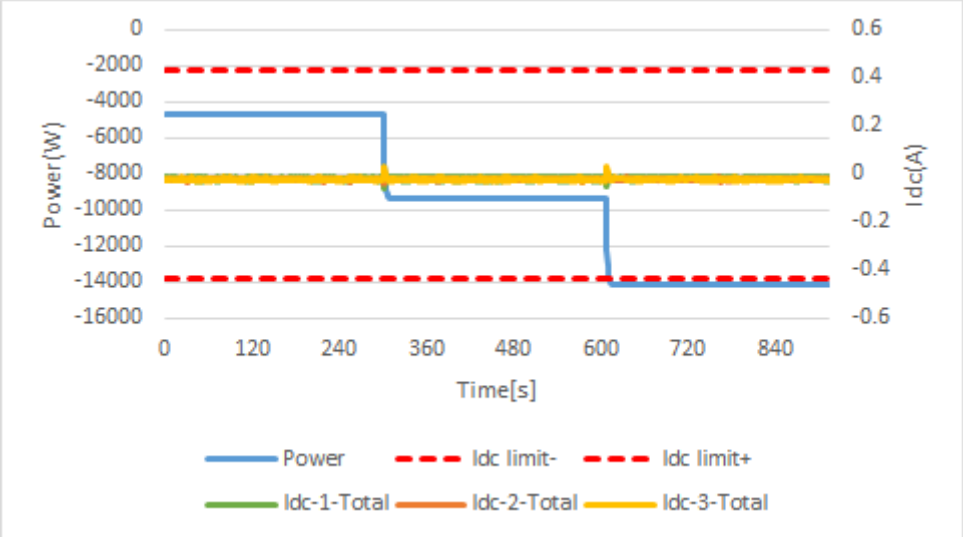
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.8.1	**TABLE: Verification of continuous component emission**		P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3		
Completed test-			
Power Level [%P_{SMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Maximum ambient rating 60°C			
Total output Power (W)	4712	9346	14126
Output Vrms	230.03	230.07	230.11
Output Arms	7.72	14.05	20.80
Cos φ	0.9326	0.9814	0.9919
L1 DC Component (A)	0.007	0.006	0.006
L2 DC Component (A)	0.009	0.009	0.009
L3 DC Component (A)	0.009	0.009	0.009
L1 DC Component (% I_r)	0.008%	0.007%	0.007%
L2 DC Component (% I_r)	0.010%	0.010%	0.010%
L3 DC Component (% I_r)	0.011%	0.011%	0.010%



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

Power Level [%P_{CMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Maximum ambient rating 60°C			
Total output Power (W)	-4711	-9345	-14125
Output Vrms	230.04	230.07	230.11
Output Arms	7.74	14.06	20.80
Cos φ	-0.9323	-0.9813	-0.9919
L1 DC Component (A)	0.006	0.006	0.006
L2 DC Component (A)	0.009	0.008	0.008
L3 DC Component (A)	0.008	0.007	0.007
L1 DC Component (% I_r)	0.007%	0.007%	0.007%
L2 DC Component (% I_r)	0.010%	0.010%	0.009%
L3 DC Component (% I_r)	0.009%	0.008%	0.008%



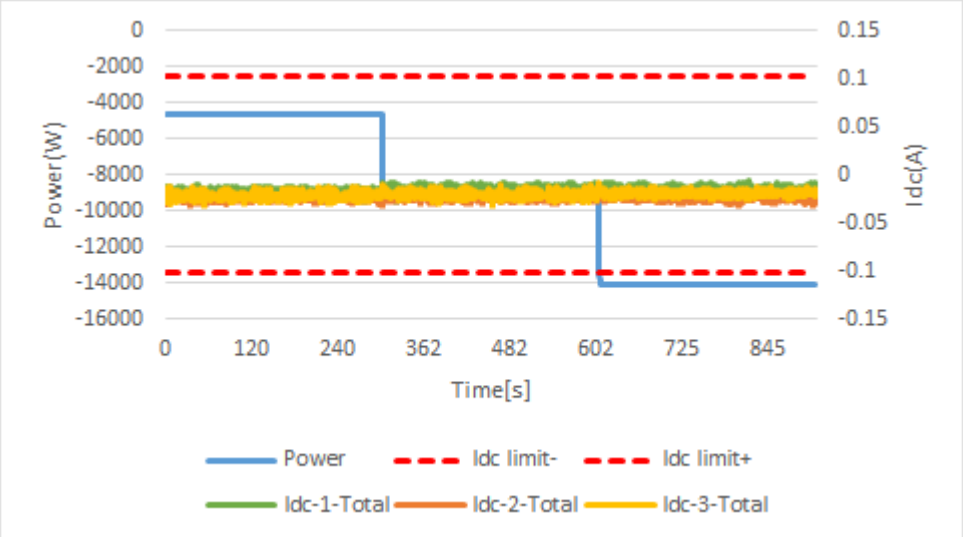
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Bbis.8.1	**TABLE: Verification of continuous component emission**		P
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3		
Completed test			
Power Level [%P_{SMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Maximum ambient rating 60°C			
Total output Power (W)	4710	9346	14127
Output Vrms	230.03	230.07	230.11
Output Arms	7.74	14.06	20.81
Cos φ	0.9321	0.9812	0.9918
L1 DC Component (A)	0.006	0.006	0.006
L2 DC Component (A)	0.009	0.008	0.008
L3 DC Component (A)	0.008	0.007	0.007
L1 DC Component (% I_r)	0.031%	0.030%	0.029%
L2 DC Component (% I_r)	0.042%	0.041%	0.041%
L3 DC Component (% I_r)	0.038%	0.036%	0.033%



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

Power Level [%P_{CMAX}]	**(33 ± 5)%**	**(66 ± 5)%**	**(100 ± 5)%**
Maximum ambient rating 60°C			
Total output Power (W)	-4710	-9352	-14135
Output Vrms	230.03	230.07	230.11
Output Arms	7.74	14.07	20.82
Cos φ	-0.9324	-0.9814	-0.9919
L1 DC Component (A)	0.006	0.006	0.005
L2 DC Component (A)	0.008	0.008	0.008
L3 DC Component (A)	0.007	0.007	0.006
L1 DC Component (% I_r)	0.029%	0.028%	0.026%
L2 DC Component (% I_r)	0.041%	0.040%	0.040%
L3 DC Component (% I_r)	0.036%	0.034%	0.031%



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

Bbis.8.2	**TABLE: Verification of protections against the continuous DC injection**			P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15			
Actual Power **[%P_{SMAX}]**	Limits	Measurement [mA]	Limiting value[mA]	Disconnection time [ms]
Ambient 25°C, I_{dc} = 0.5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.5	434.8	997.0
66%	+0,5%I_{nom} /1s	435.1	434.8	997.0
100%	+0,5%I_{nom} /1s	435.7	434.8	997.0
Minimum ambient rating -25°C, I_{dc} = 0,5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.1	434.8	999.0
66%	+0,5%I_{nom} /1s	435.9	434.8	999.0
100%	+0,5%I_{nom} /1s	435.2	434.8	999.0
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.9	434.8	995.0
66%	+0,5%I_{nom} /1s	435.8	434.8	995.0
100%	+0,5%I_{nom} /1s	435.0	434.8	993.0
Ambient 25°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1015	1000	198.0
66%	+1A Idc/200ms	1010	1000	196.0
100%	+1A Idc/200ms	1016	1000	192.0
Minimum ambient rating -25°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1015	1000	198.0
66%	+1A Idc/200ms	1013	1000	196.0
100%	+1A Idc/200ms	1016	1000	194.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1013	1000	192.0
66%	+1A Idc/200ms	1008	1000	198.0
100%	+1A Idc/200ms	1013	1000	198.0

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

Actual Power **[%P_{CMAX}]**	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [ms]
Ambient 25°C, I_{dc} = 0.5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.3	434.8	992.0
66%	+0,5%I_{nom} /1s	435.8	434.8	991.0
100%	+0,5%I_{nom} /1s	435.5	434.8	993.0
Minimum ambient rating -25°C, I_{dc} = 0,5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.2	434.8	996.0
66%	+0,5%I_{nom} /1s	435.2	434.8	995.0
100%	+0,5%I_{nom} /1s	435.6	434.8	995.0
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0,5%I_{nom} /1s	435.8	434.8	992.0
66%	+0,5%I_{nom} /1s	435.2	434.8	994.0
100%	+0,5%I_{nom} /1s	435.7	434.8	999.0
Ambient 25°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1014	1000	198.0
66%	+1A Idc/200ms	1012	1000	192.0
100%	+1A Idc/200ms	1004	1000	192.0
Minimum ambient rating -25°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1008	1000	196.0
66%	+1A Idc/200ms	1015	1000	196.0
100%	+1A Idc/200ms	1013	1000	194.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1009	1000	196.0
66%	+1A Idc/200ms	1013	1000	198.0
100%	+1A Idc/200ms	1009	1000	198.0

Note:
The internal temperature of the EUT must be stabilized.

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

Bbis.8.2	**TABLE: Verification of protections against the continuous DC injection**			P
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-3			
Actual Power **[%P_{SMAX}]**	Limits	Measurement [mA]	Limiting value[mA]	Disconnection time [ms]
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0.5%I_{nom} /1s	435.4	434.8	993.0
66%	+0.5%I_{nom} /1s	435.8	434.8	995.0
100%	+0.5%I_{nom} /1s	435.8	434.8	991.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1016	1000	195.0
66%	+1A Idc/200ms	1015	1000	199.0
100%	+1A Idc/200ms	1018	1000	193.0
Actual Power **[%P_{CMAX}]**	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [ms]
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0.5%I_{nom} /1s	435.4	434.8	993.0
66%	+0.5%I_{nom} /1s	435.4	434.8	995.0
100%	+0.5%I_{nom} /1s	435.9	434.8	997.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1013	1000	197.0
66%	+1A Idc/200ms	1005	1000	195.0
100%	+1A Idc/200ms	1007	1000	192.0
Note: The internal temperature of the EUT must be stabilized.				

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

Bbis.8.2	**TABLE: Verification of protections against the continuous DC injection**			P
Model	AF36K-TH + LV-IESS-RH10.240Aa-HBOX-3			
Actual Power **[%P_{SMAX}]**	Limits	Measurement [mA]	Limiting value[mA]	Disconnection time [ms]
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0.5%I_{nom} /1s	261.5	260.9	999.0
66%	+0.5%I_{nom} /1s	261.6	260.9	999.0
100%	+0.5%I_{nom} /1s	261.0	260.9	997.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1019	1000	197.0
66%	+1A Idc/200ms	1017	1000	197.0
100%	+1A Idc/200ms	1017	1000	197.0
Actual Power **[%P_{CMAX}]**	Limits	Measurement [mA]	Limiting value [mA]	Disconnection time [ms]
Maximum ambient rating +60°C, I_{dc} = 0,5% of I_{nom}				
33%	+0.5%I_{nom} /1s	261.4	260.9	997.0
66%	+0.5%I_{nom} /1s	261.7	260.9	999.0
100%	+0.5%I_{nom} /1s	261.9	260.9	993.0
Maximum ambient rating +60°C, I_{dc} = 1A				
33%	+1A Idc/200ms	1013	1000	195.0
66%	+1A Idc/200ms	1003	1000	199.0
100%	+1A Idc/200ms	1004	1000	196.0
Note: The internal temperature of the EUT must be stabilized.				

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

Bbis.9	**TABLE: Verification of insensitivity to voltage dips (UVRT and OVRT(8.5. 1-figure 30) capability)**	**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15	

These tests have the purpose of verifying that the storage system, when used in plants with a total power greater than 11.08 kW, is insensitive to voltage drops according to the voltage-time profile indicated in Figure 71, based on what is reported in 8.5.1.

- in the hatched area of Figure 71 the storage system must not disconnect from the grid. In this area it is allowed to temporarily interrupt the supply / absorption of the active and reactive power exchanged with the grid before the onset of the fault;
- 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 drop are carried out according to the test sequences shown in Table 38, to be carried out with the storage system running respectively:
a)between 10% and 30% of P_{SMAX};
b)and above 90% of P_{SMAX}.

In general, regardless of the test circuit used, the result of each sequence should be documented as follows:

–Time trend of active power P, reactive power Q, phase voltages at the output terminals (Vr, Vs and Vt) and related phase currents, as moving average rms values of a network cycle and updated every half cycle (10 ms), over a time window that runs from 100 ms before the start of the test and ends at least after 1 000 ms from the end of the voltage transient (in order to verify the restoration of active and reactive power). The voltage transient ends when the voltage returns to more than 85% of the rated voltage value. For phase currents, in addition to the rms value averaged over a period, the peak value for each phase must also be recorded and documented.
–In the same period of observation, the oscillograms of the voltages and phase currents will have to be reported (possibly with enlarged detail of the trend during the rising and falling voltage fronts).
–The calculation method used to determine the power, the power factor and the reactive current must also be described in the test report.

It will therefore be necessary to carry out at least 12 distinct test sequences, corresponding to 2 residual voltage levels to be replicated in order to simulate the cases of symmetrical three-phase and two-phase asymmetric MV and LV faults. Each sequence must then be repeated with the storage system operating at two levels of initial power delivered (a: 10% * P_{SMAX} - 30% * P_{SMAX}; b:> 90% * P_{SMAX}).

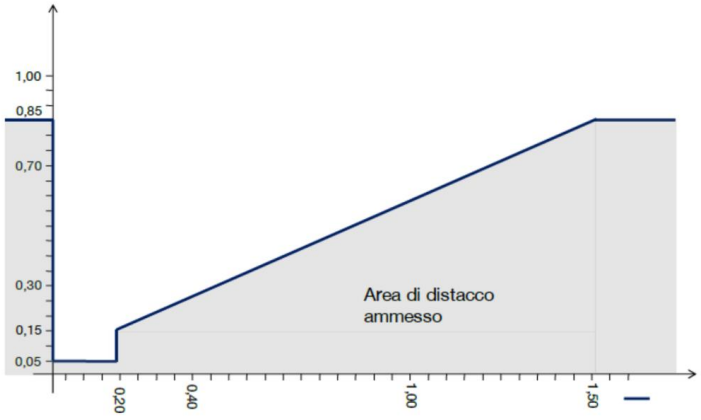


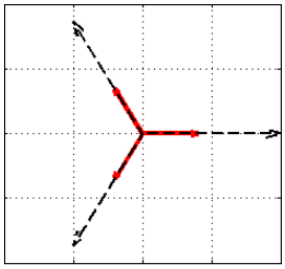
Figure 71 - Requirements for UVRT

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

Bbis.9.2.2 Alternative test methods - network simulator:

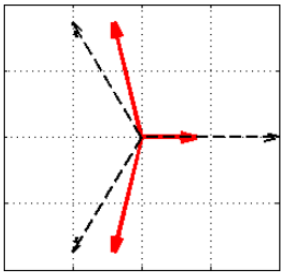
With reference to the list of tests shown in Table 39, the voltage drops that are the subject of these tests are caused by faults produced on the low, medium or high voltage distribution line. The types of faults considered are three:

1) three-phase symmetrical fault (Table 39, Tests No. 1 and 2)



2) two-phase asymmetric fault (Table 39, Tests No. 3 and 4)

A fault 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).

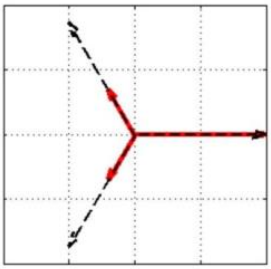


During the two-phase asymmetric fault, the residual amplitude of the 3 voltages and the phase shifts between the phases must comply with the values shown in the following table.

Table 40 - LV phase vectors in the presence of asymmetrical two-phase faults on the primary side of a transformer Dy in the secondary substation

Test No.	V/Vn	Phase-to-earth voltages			Phase angles		
		$u_1/u_{1,n}$	$u_2/u_{2,n}$	$u_3/u_{3,n}$	φ_{u1}	φ_{u2}	φ_{u3}
1a	0,10 ± 0,05	0,87 ± 0,05	0,87 ± 0,05	0,10 ± 0,05	27°	-147°	120°
2a	0,25 ± 0,05	0,88 ± 0,05	0,88 ± 0,05	0,25 ± 0,05	22°	-142°	120°
3a	0,50 ± 0,05	0,90 ± 0,05	0,90 ± 0,05	0,50 ± 0,05	14°	-134°	120°
4a	0,75 ± 0,05	0,94 ± 0,05	0,94 ± 0,05	0,75 ± 0,05	7°	- 127°	120°
normal conditions	1	1	1	1	0°	-120°	120°

3) LV two-phase asymmetric fault (Table 39, Tests No. 5 and 6)



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

Requirement of LVRT test:

Table 39 - 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	1.20 ± 0.05	1.20 ± 0.05	1.20 ± 0.05	0°	-120°	120°
8	1.25 ± 0.05	1.25 ± 0.05	1.25 ± 0.05	1.25 ± 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 OVRT test:				
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15			
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 +20	210	134
1s – three-phase symmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	244
1a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	112
1a – two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20	210	57
2s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	132
2s – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	53
2a – three-phase symmetrical fault (P = 0.1 - 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	123
2a – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20	410	182
3s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	128
3s – three-phase symmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	184
3a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	116
3a – two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20	860	198
4s – three-phase symmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	150
4s – three-phase symmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	199
4a – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	112
4a – two-phase asymmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	1310	198
5 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.10 ± 0.05 (V_5/Vn)	200 +20	210	120
5 – LV two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_5/Vn)	200 +20	210	234
6 – LV two-phase asymmetrical fault (P = 0.1 - 0.3)	0.50 ± 0.05 (V_6/Vn)	850 +20	860	161
6 – LV two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_6/Vn)	850 +20	860	142

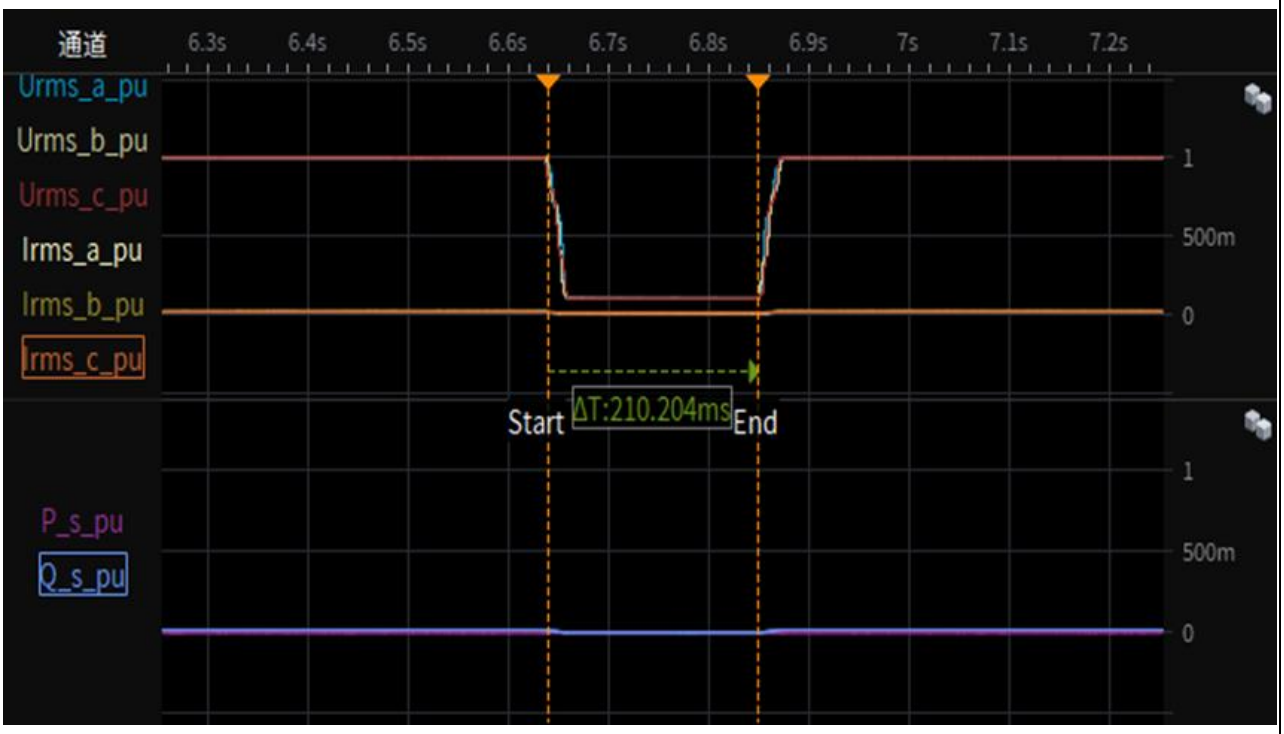
CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

7– HV three-phase symmetrical fault (P = 0.1 - 0.3)	1.20 ± 0.05 (V_7/Vn)	500 +20	510	112
7– HV three-phase symmetrical (P > 0.9)	1.20 ± 0.05 (V_7/Vn)	500 +20	510	222
8–HV three-phase symmetrical fault (P = 0.1 - 0.3)	1.25 ± 0.05 (V_8/Vn)	100 +20	110	125
8– HV three-phase symmetrical (P > 0.9)	1.25 ± 0.05 (V_8/Vn)	100 +20	110	210

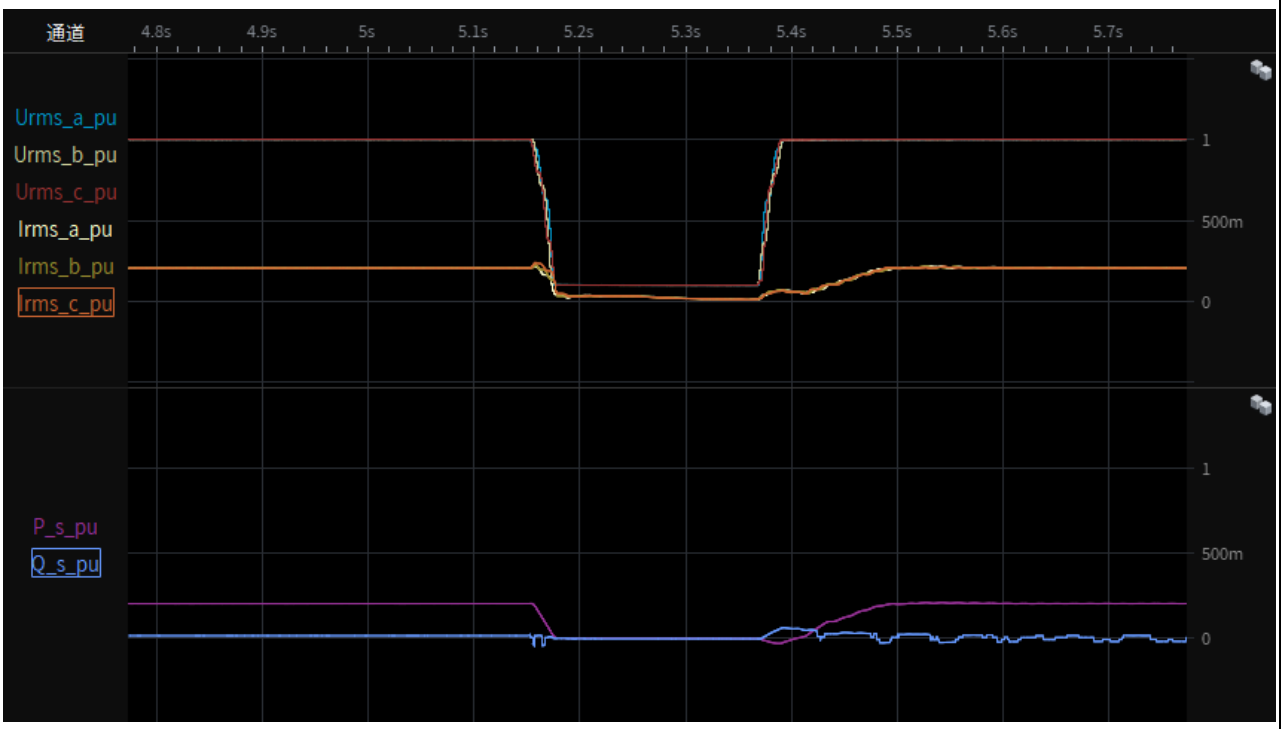
Note:
The interface protection shall be disabled or adjusted to avoid spurious tripping during testing.
The test conditions are performed as worst case conditions. The inverter feeds maximal active and reactive power during the complete test.

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)

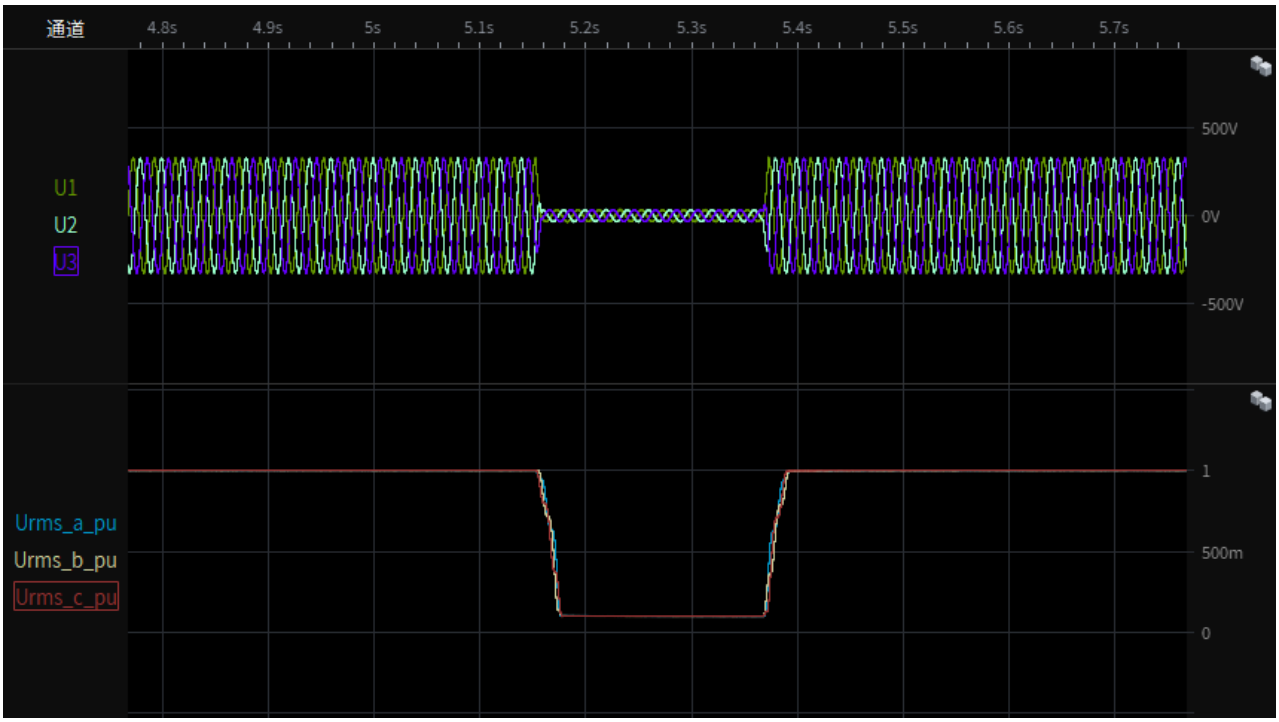


Test 1s-1.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

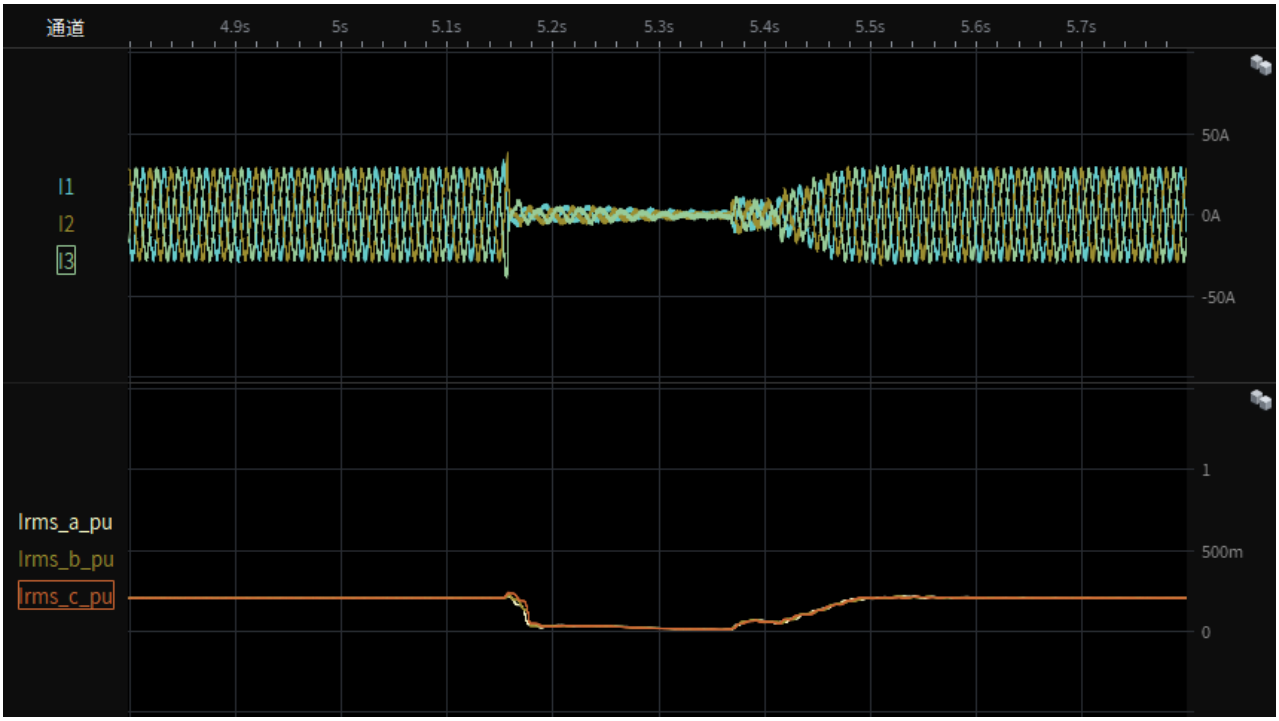


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

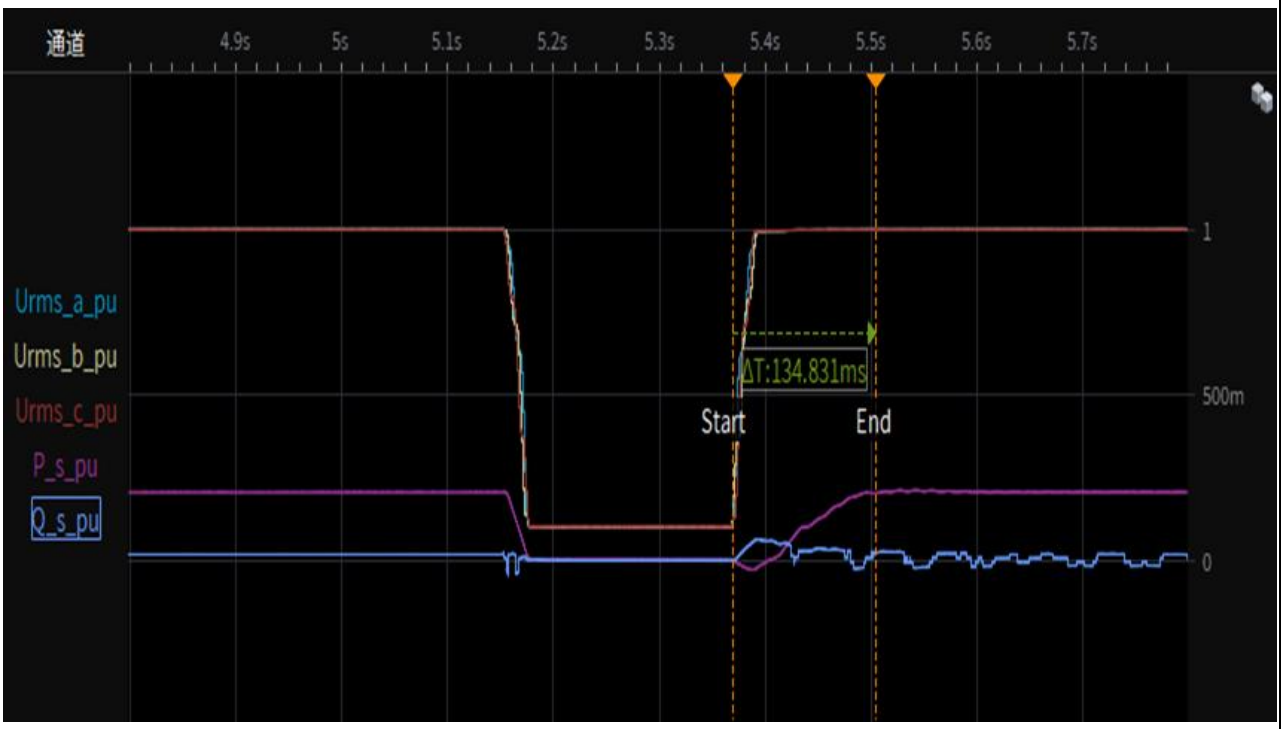


Test 1s-1.3 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

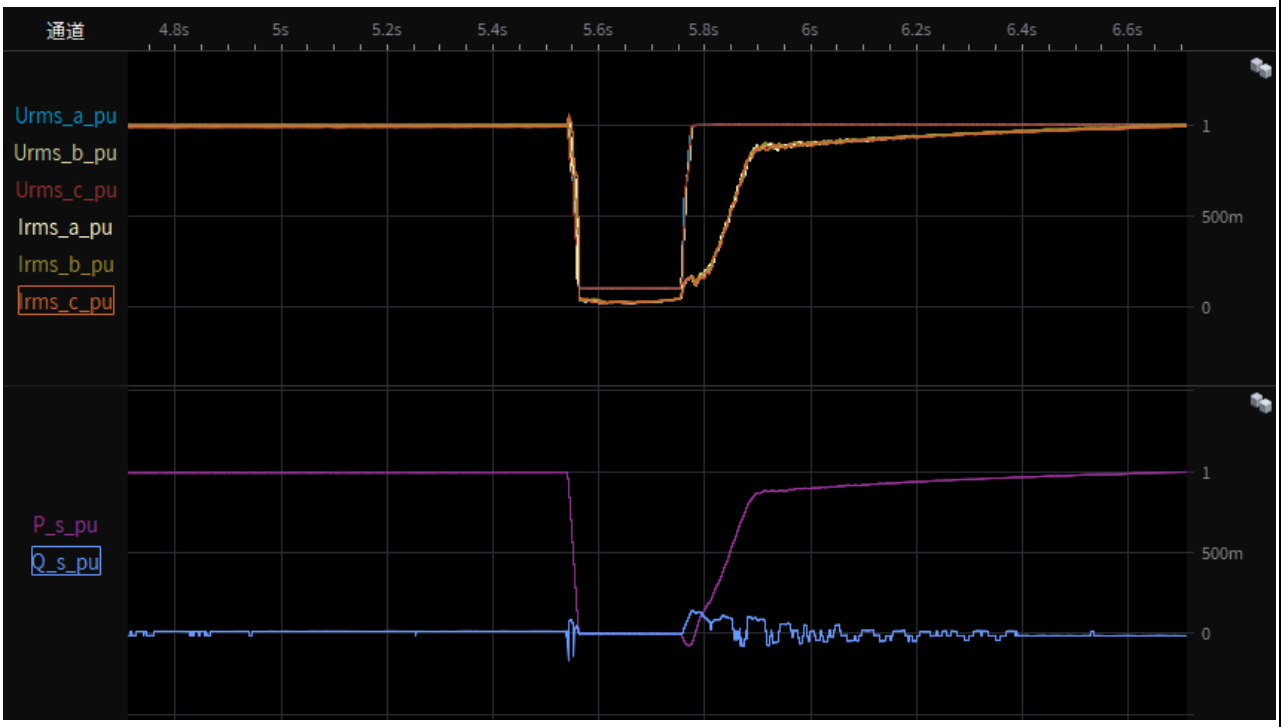


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

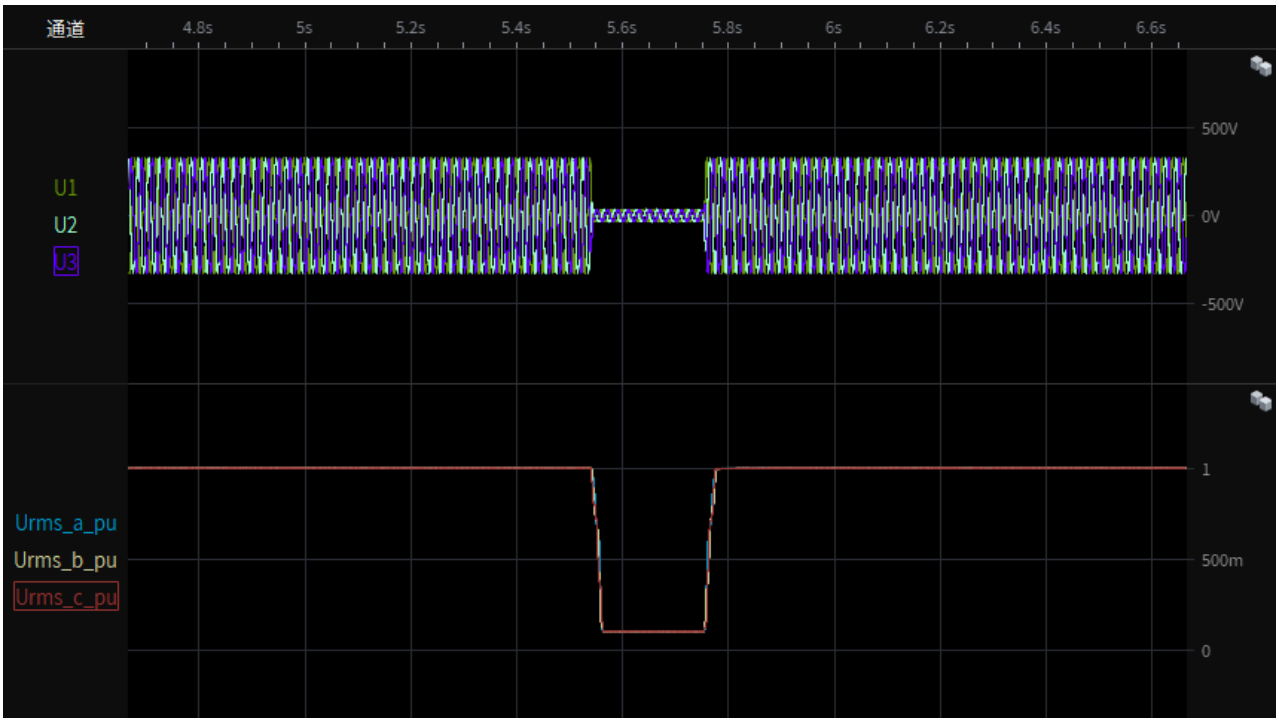


Test 1s-2.1 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

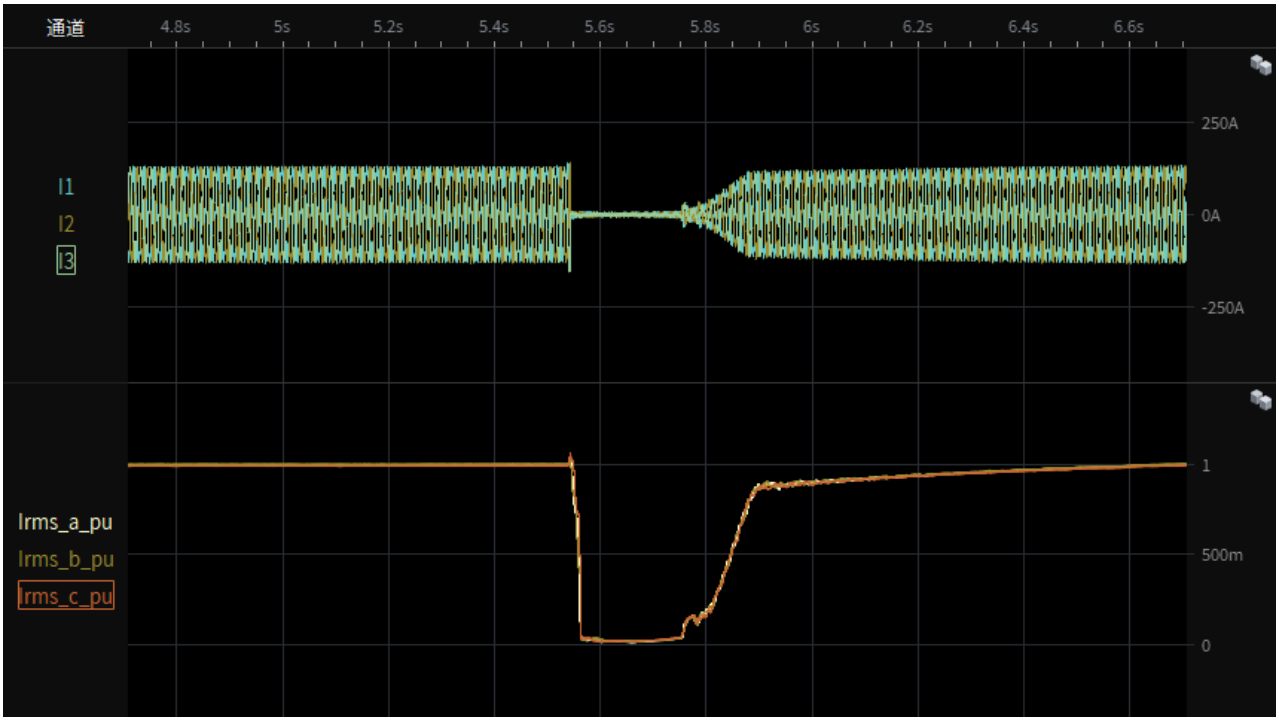


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

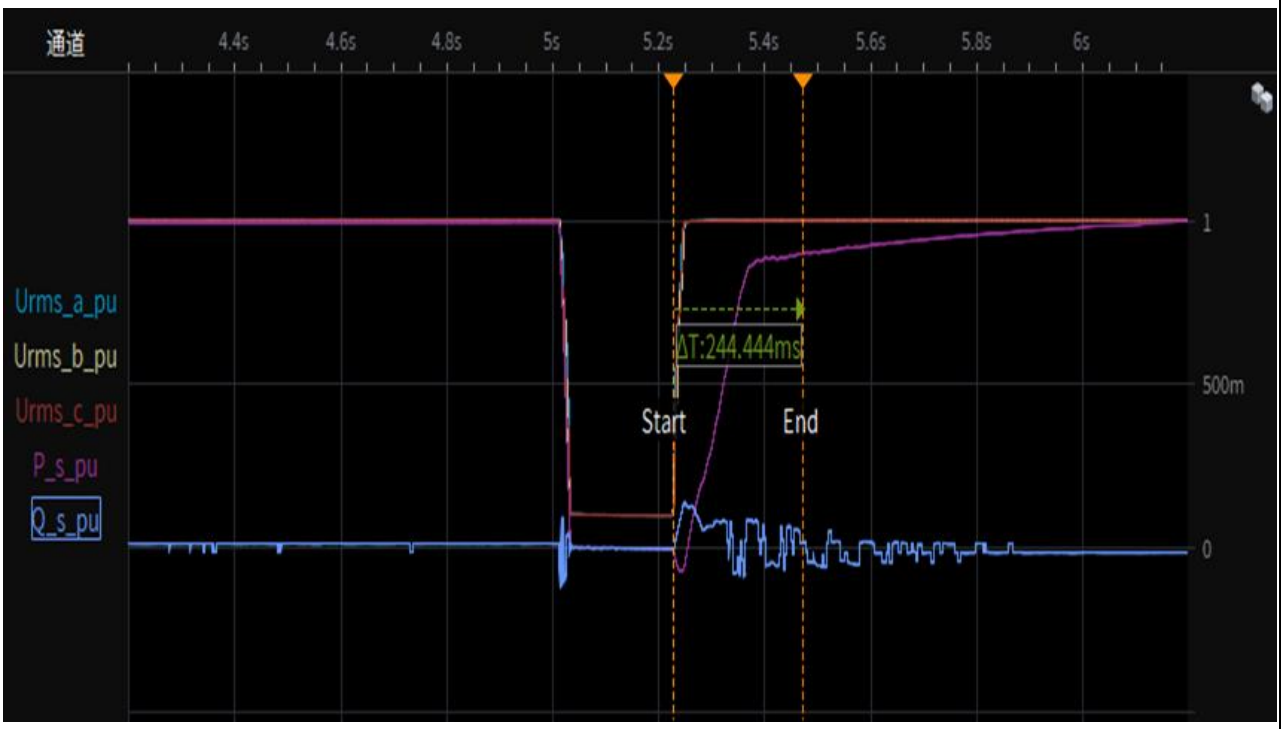


Test 1s-2.3 Depth of fault phase: 0.1p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

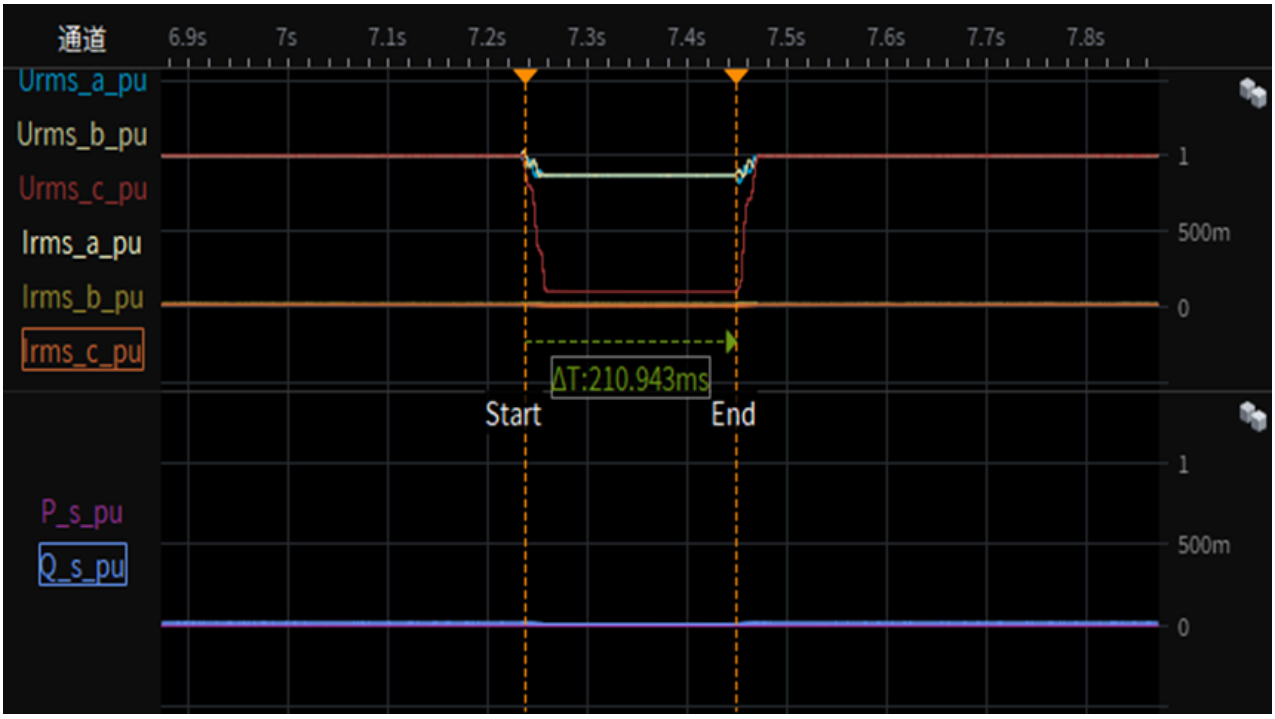


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

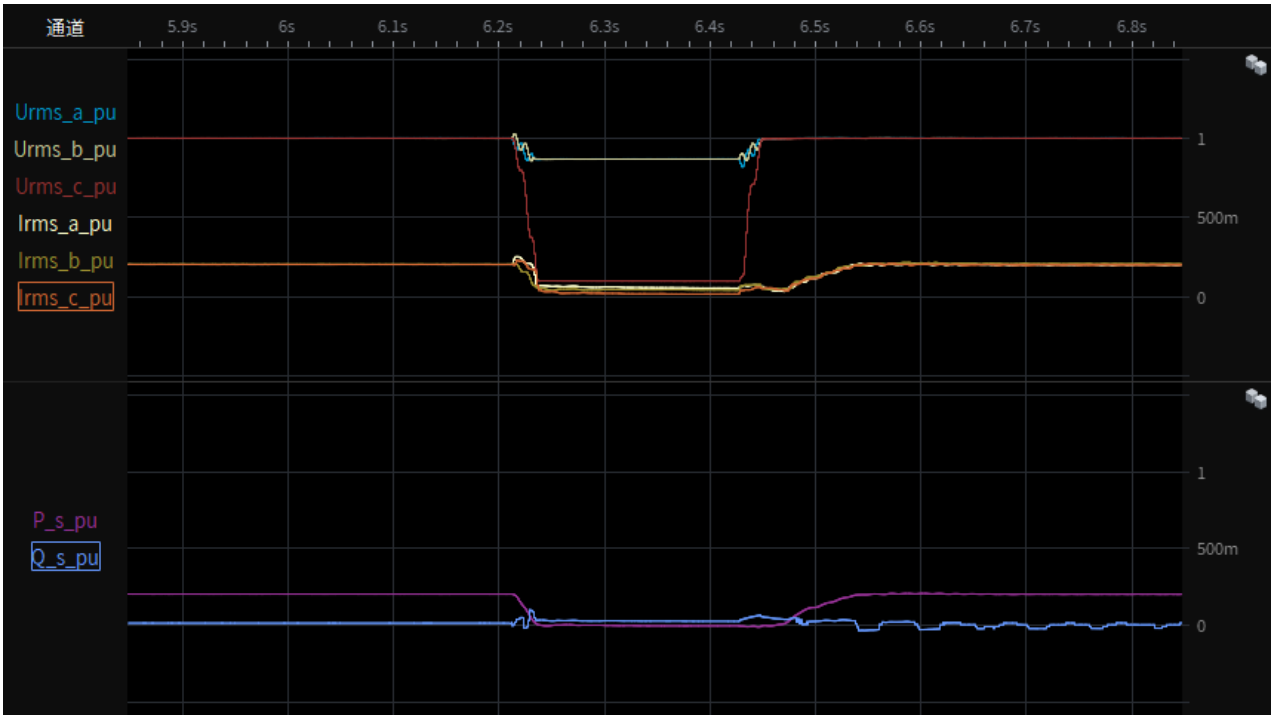


Test 1a-Depth of fault phase: 0.1p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

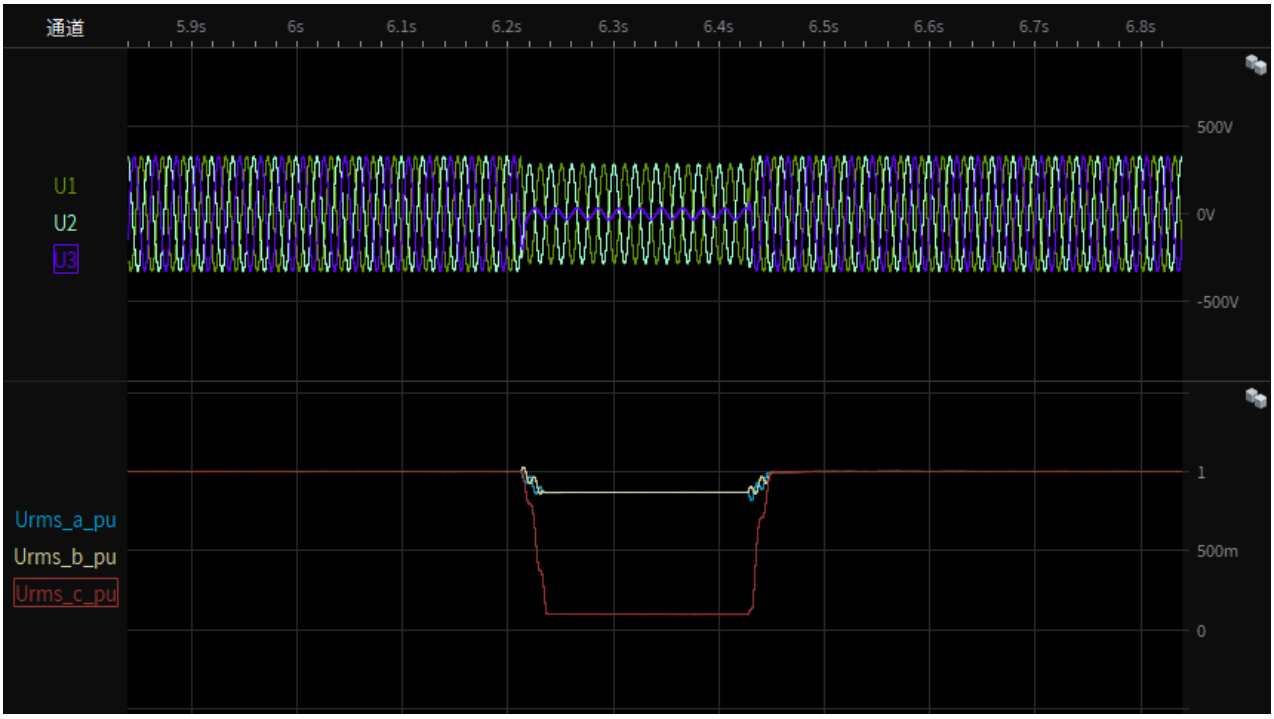


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

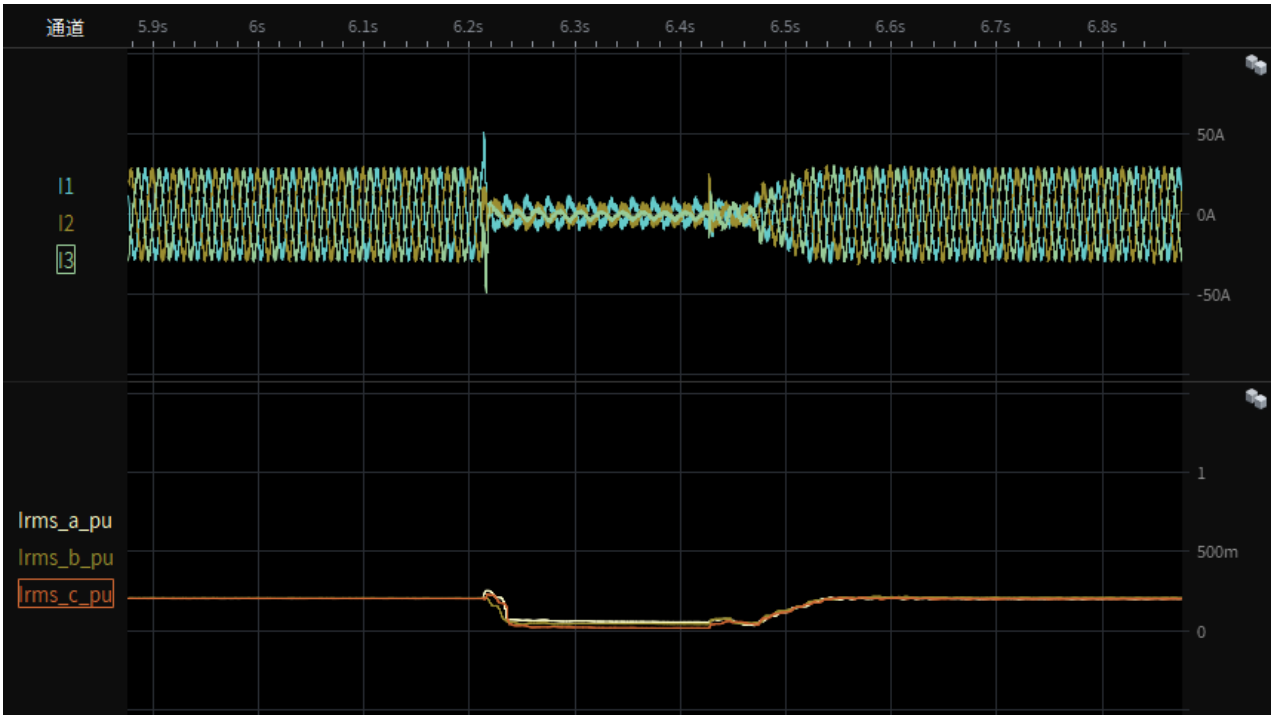


Test 1a-1.2 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

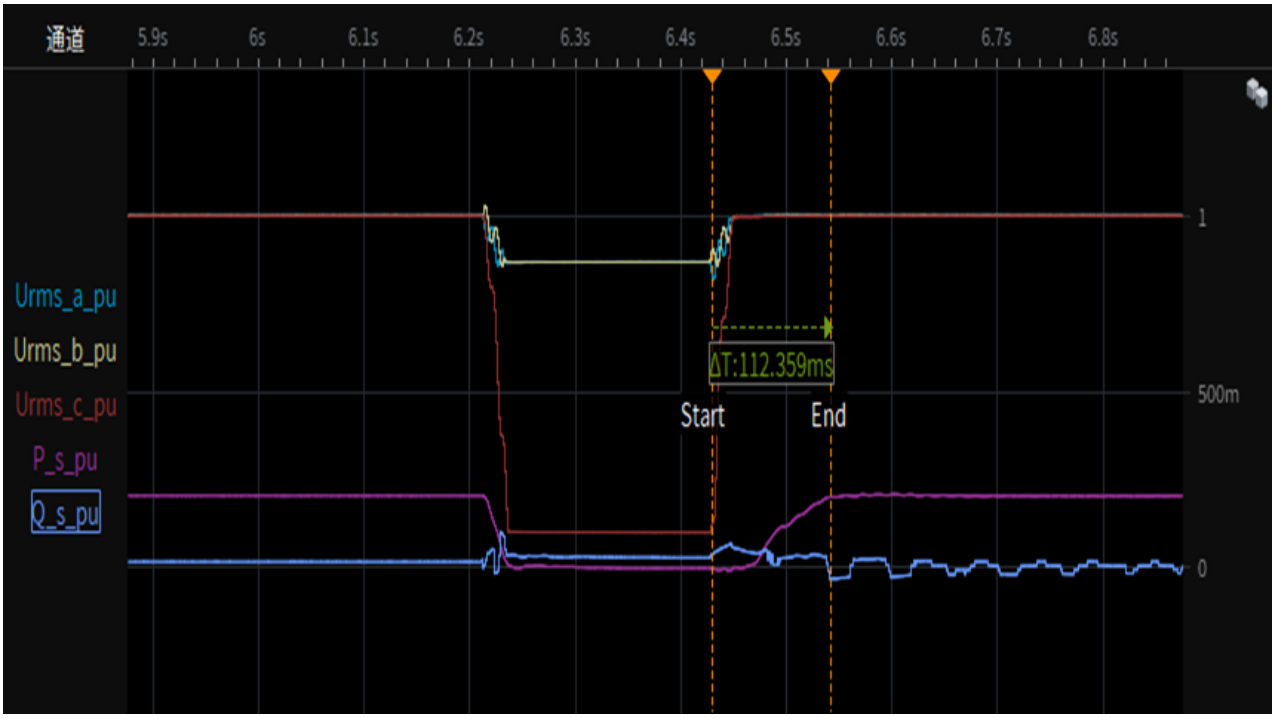


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

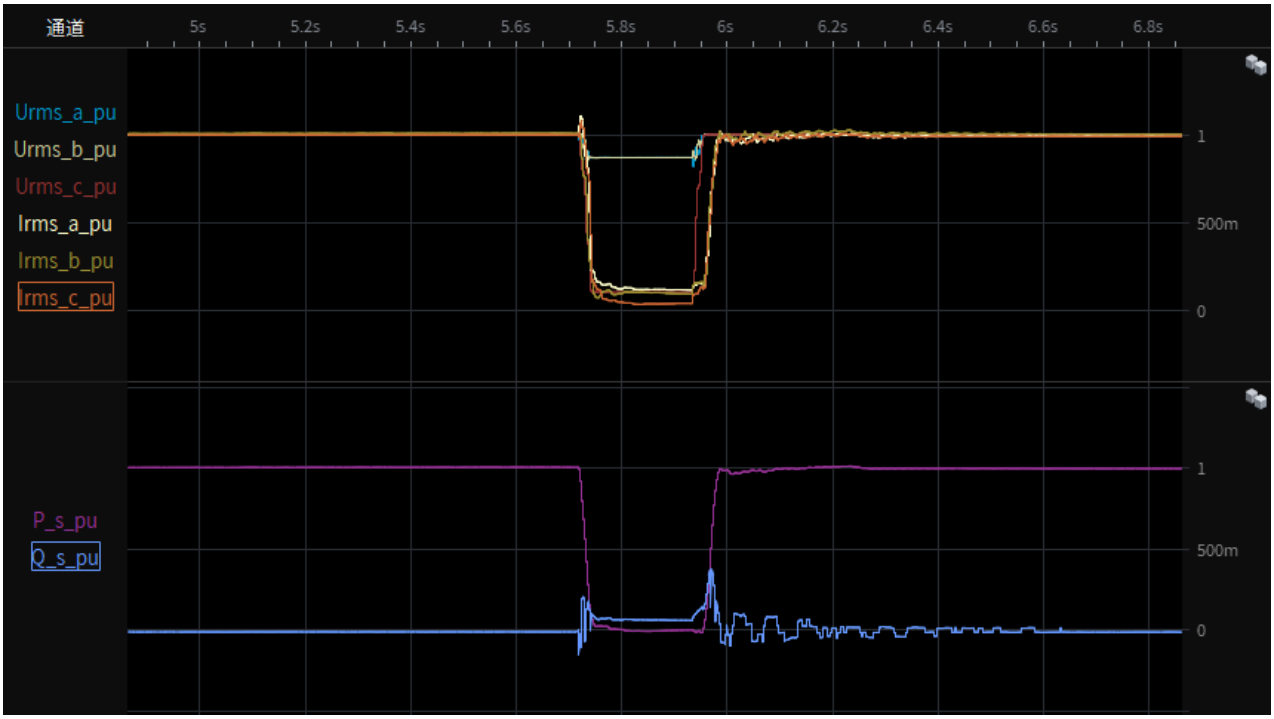


Test 1a-1.4 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),20% load
restoring time

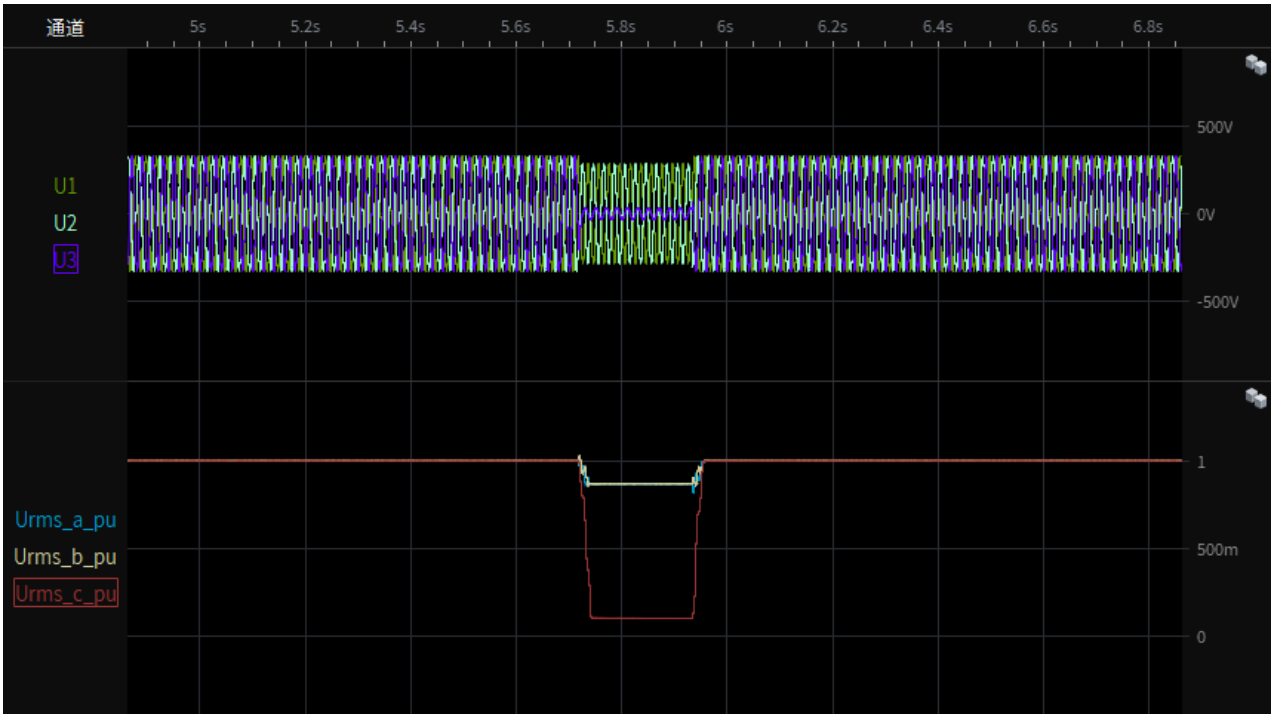


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

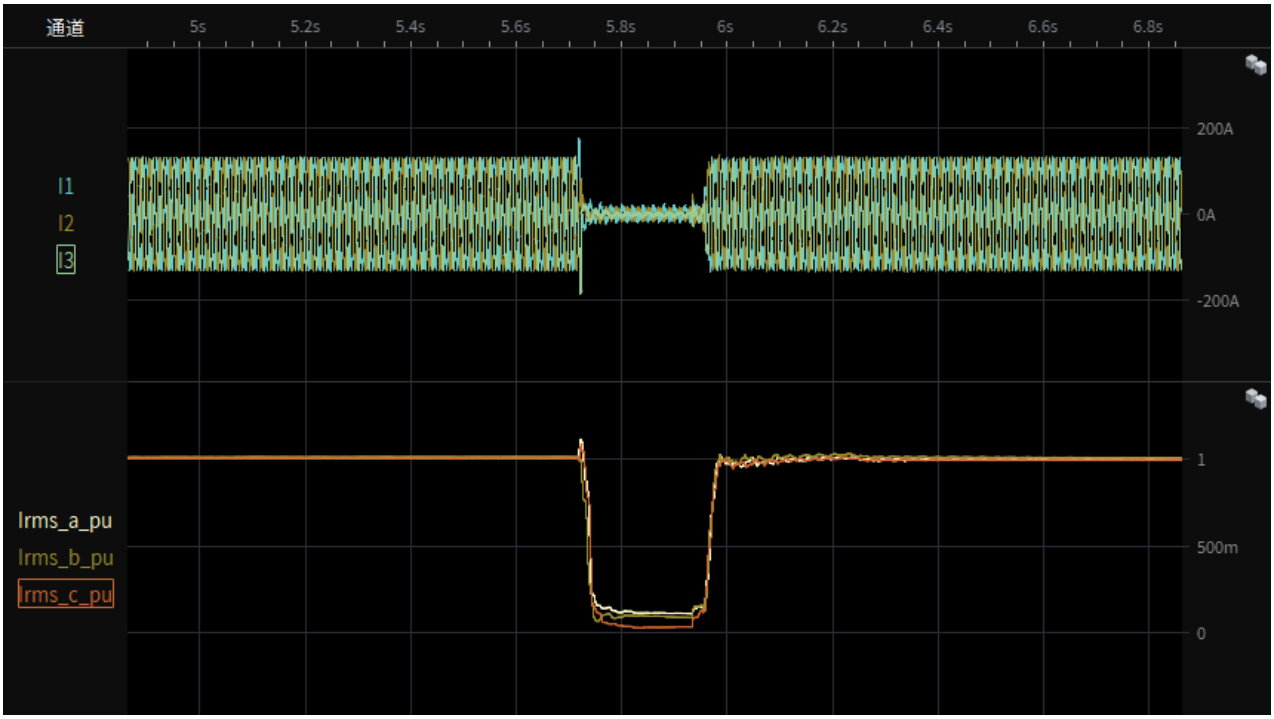


Test 1a-2.2 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

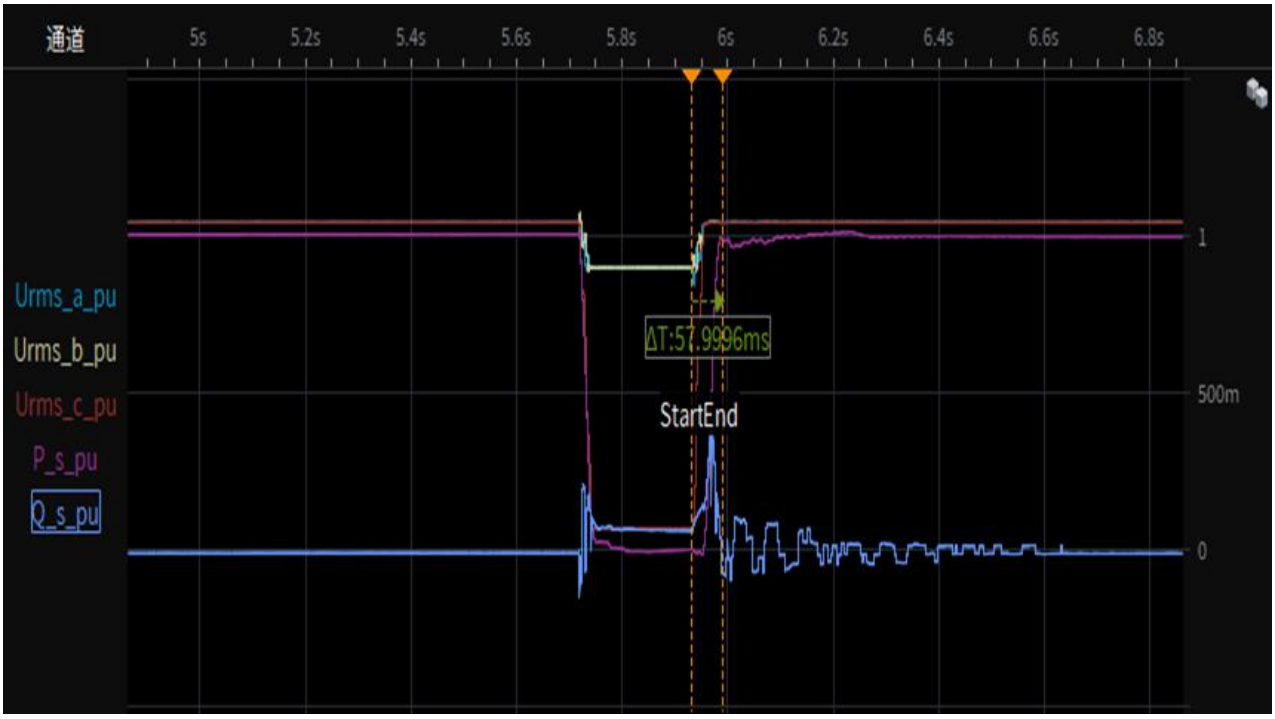


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

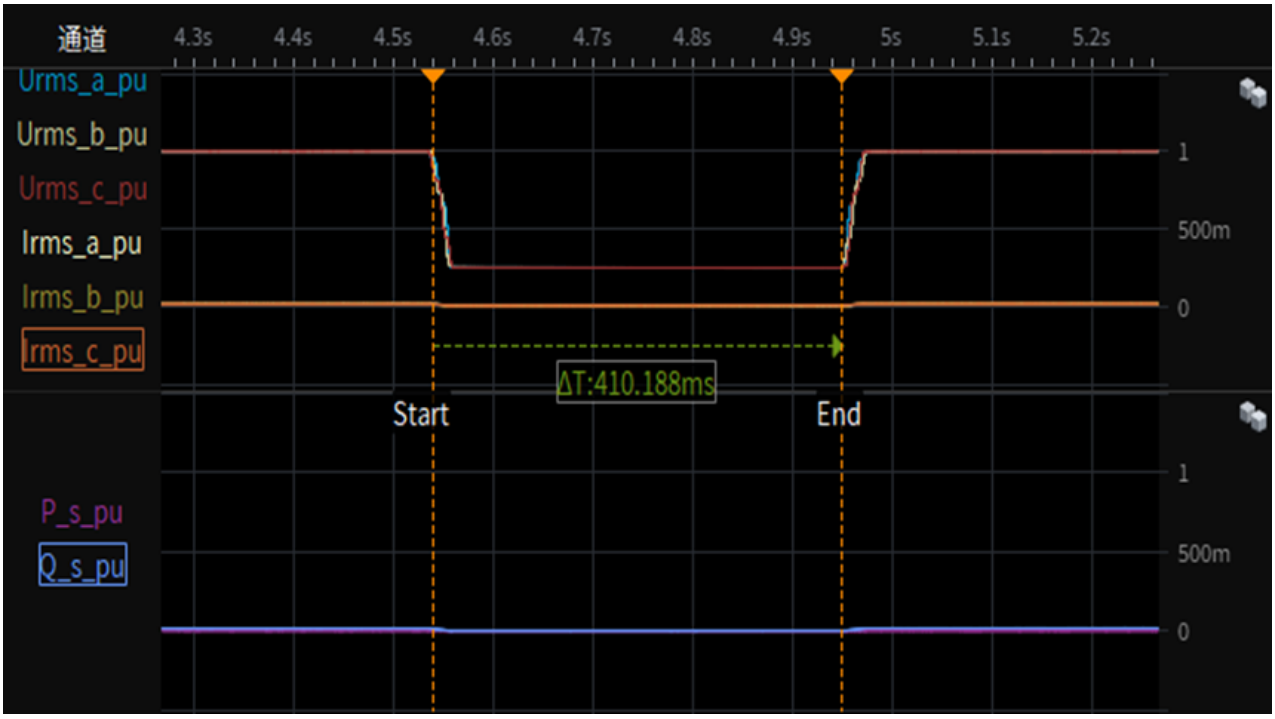


Test 1a-2.4 Depth of fault phase: 0.1p.u., two-phase-asymmetrical (type D), 95% load
restoring time

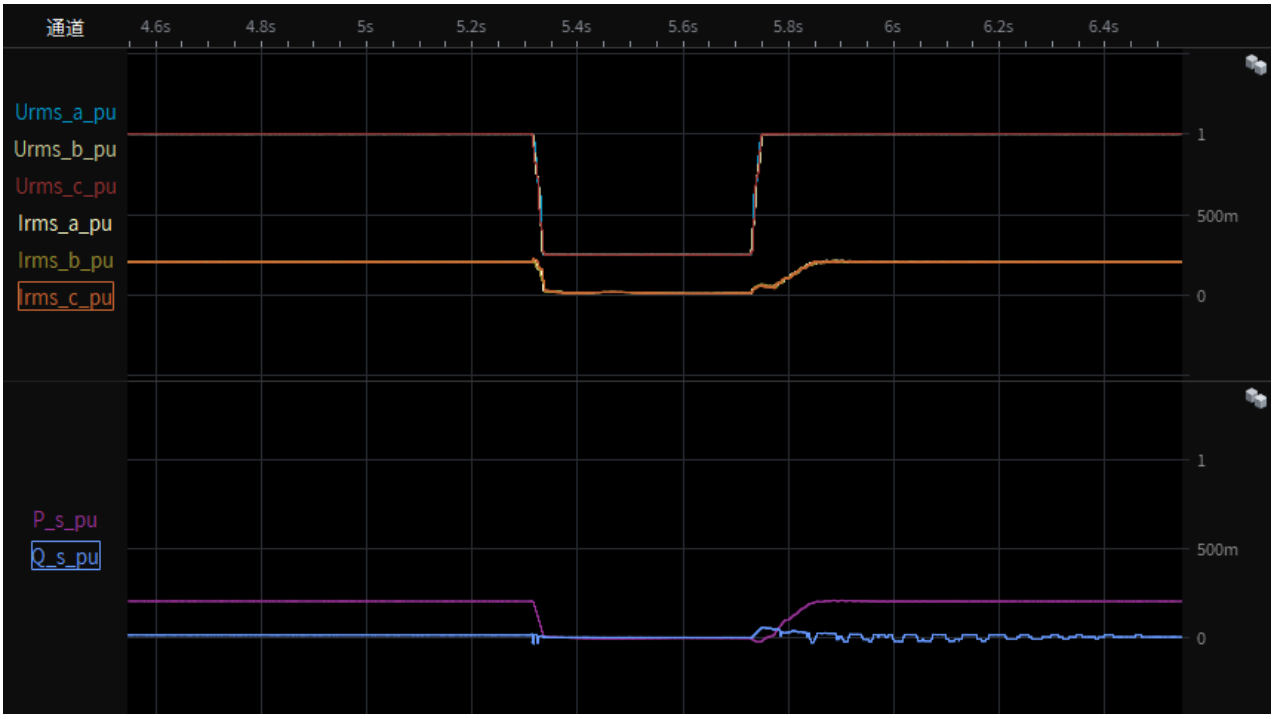


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

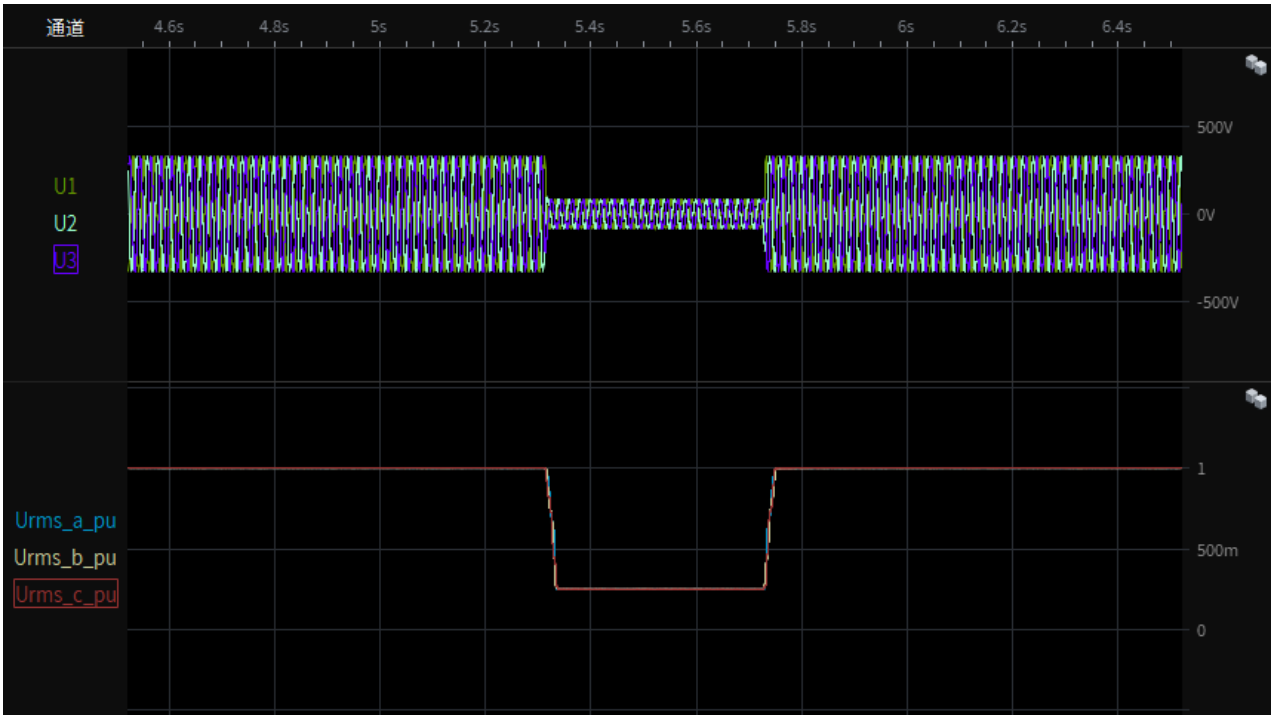


Test 2s-1.1 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

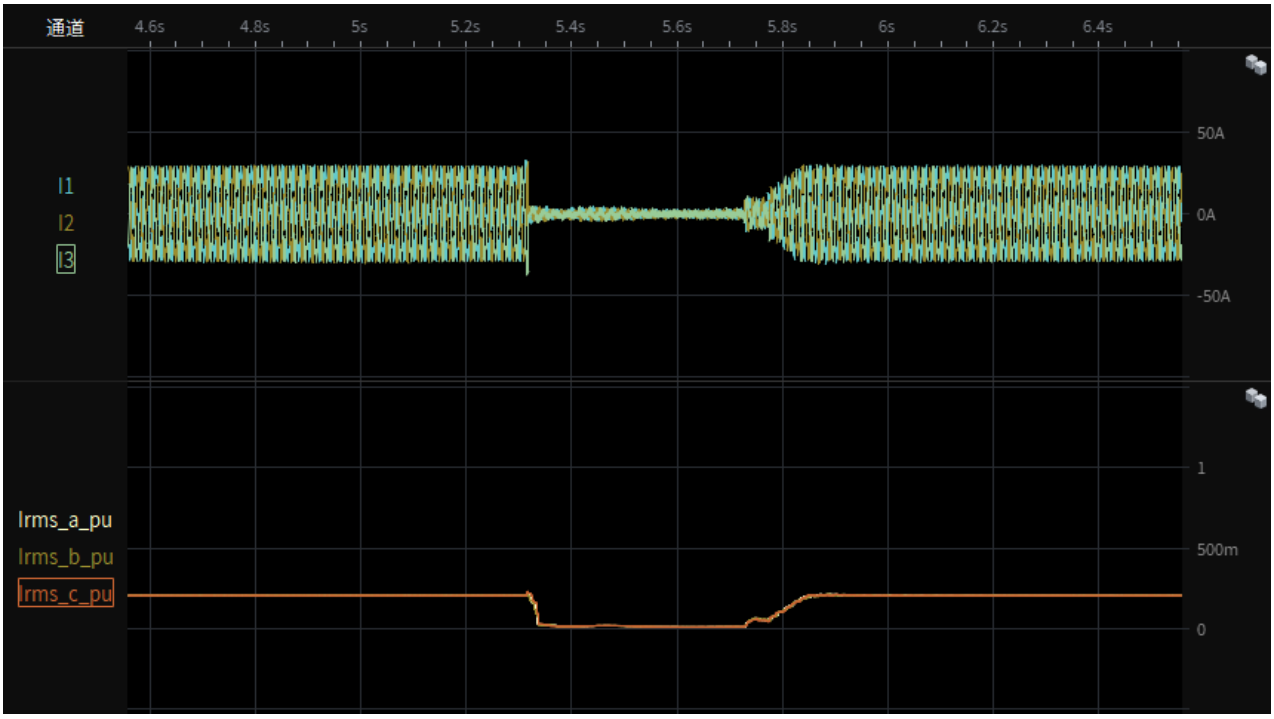


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

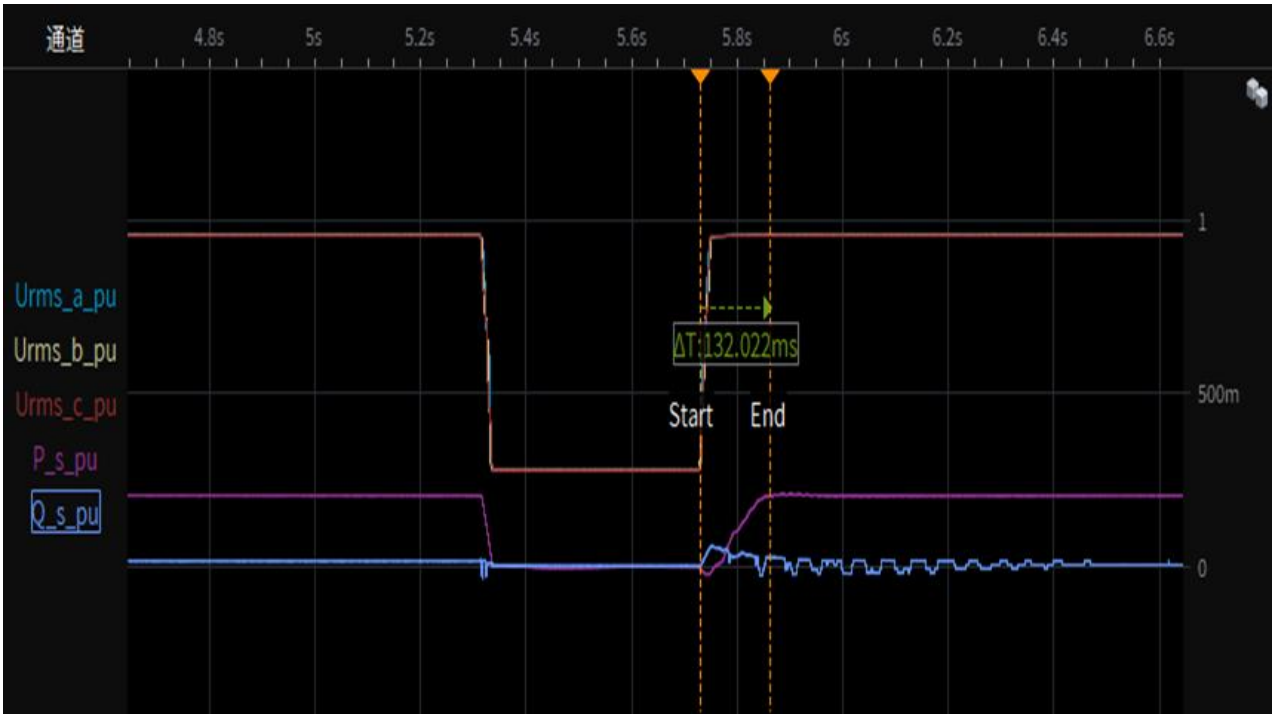


Test 2s-1.3 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

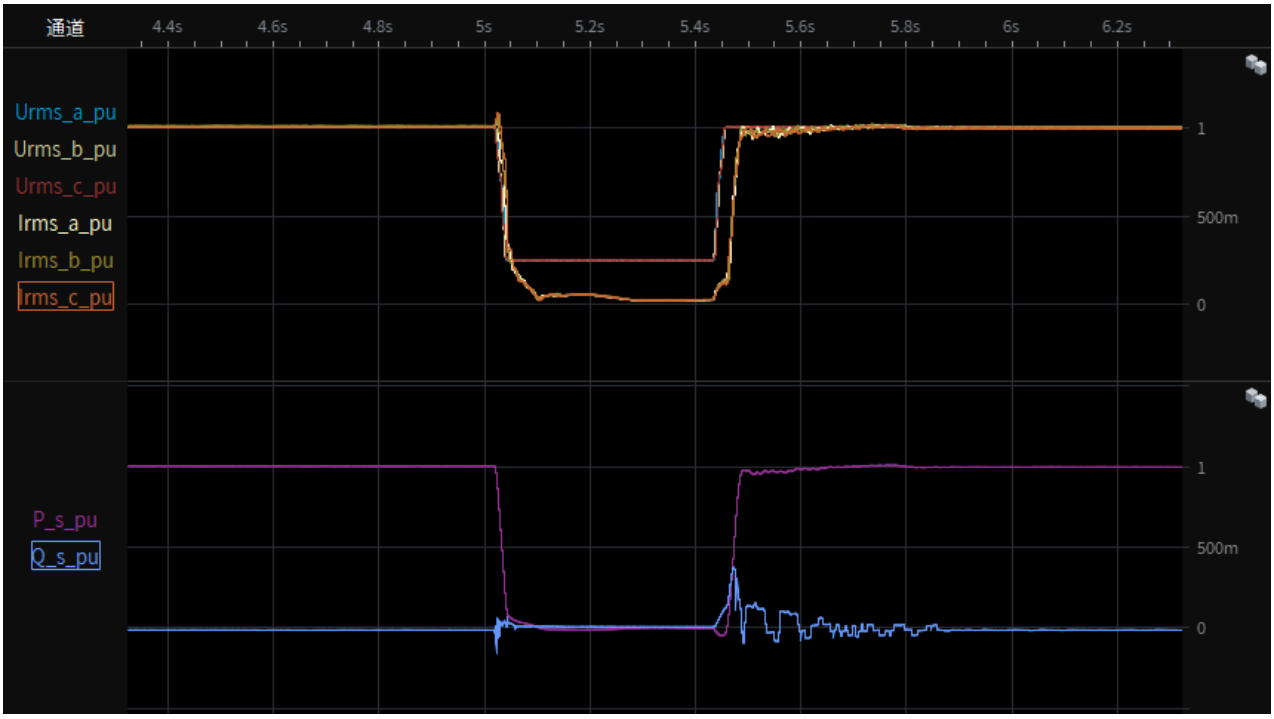


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

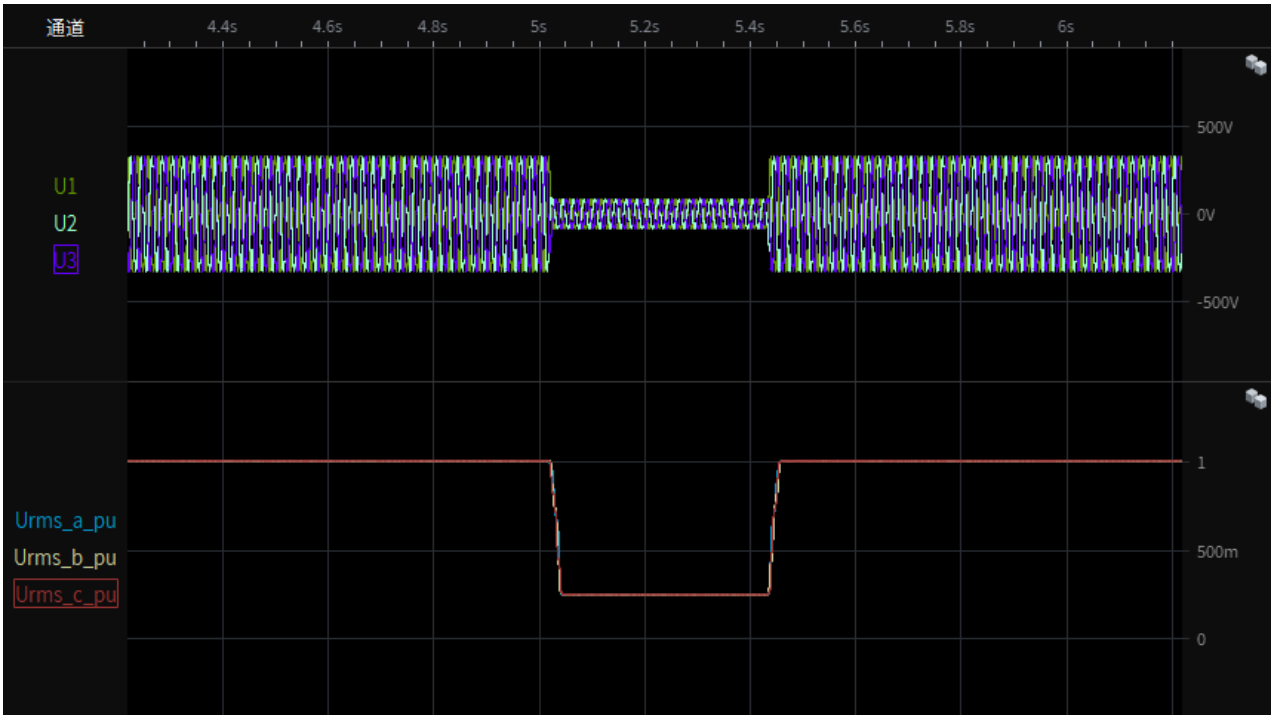


Test 2s-2.1 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

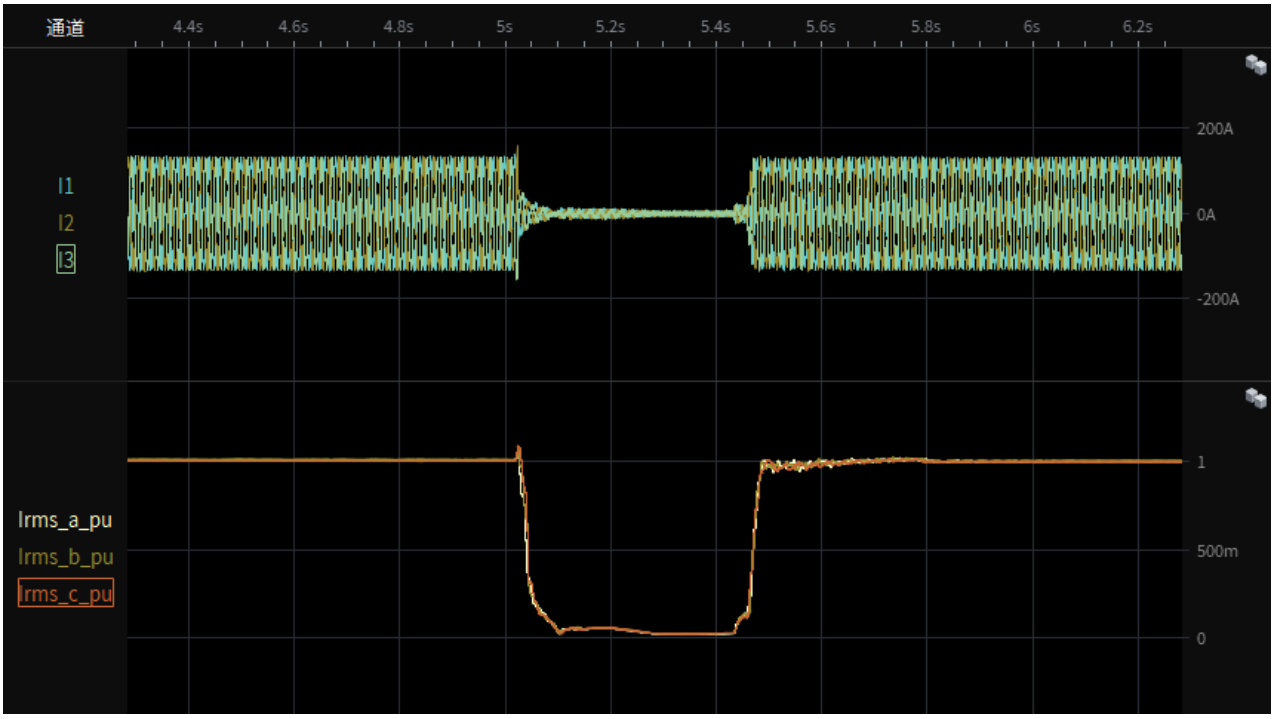


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

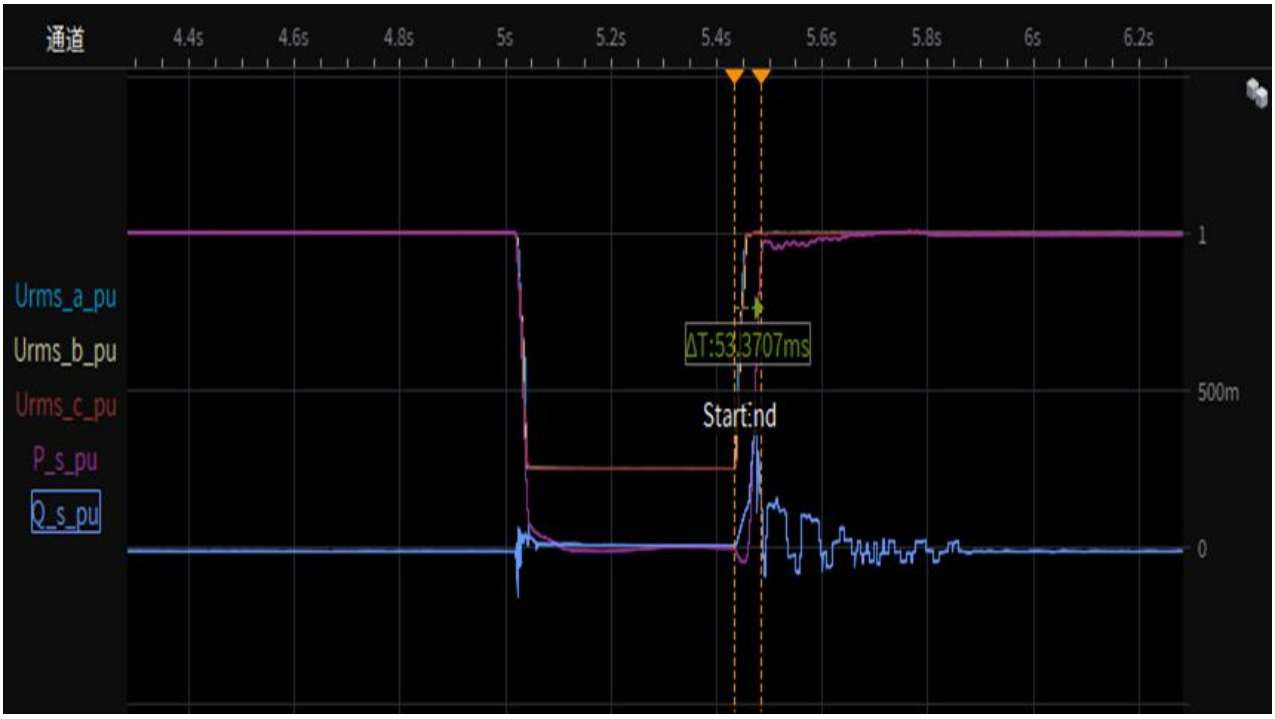


Test 2s-2.3 Depth of fault phase: 0.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

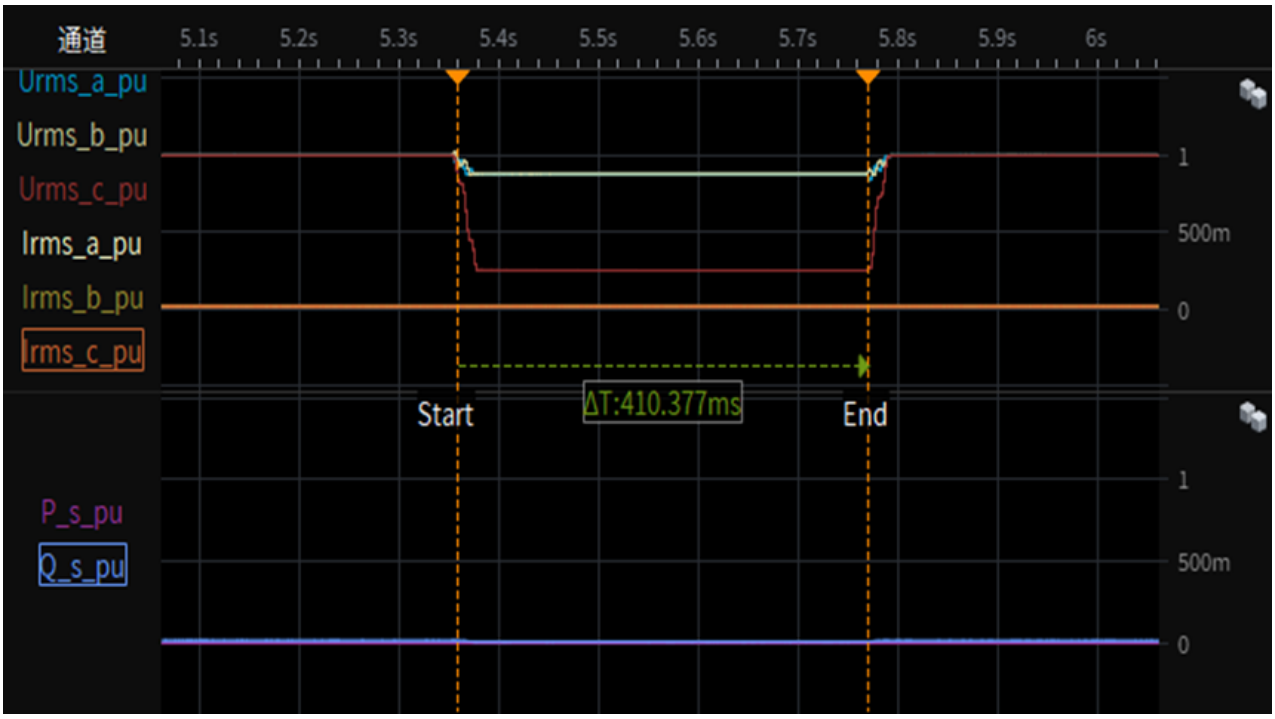


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

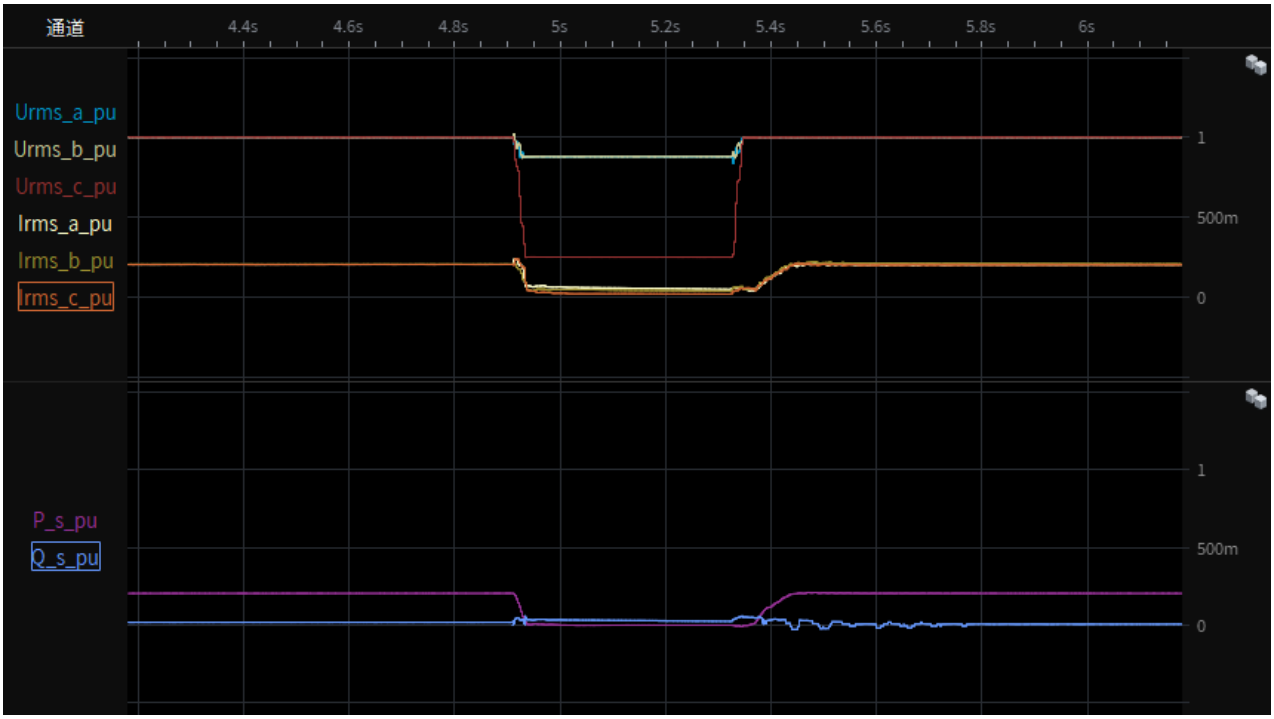


Test 2a-Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

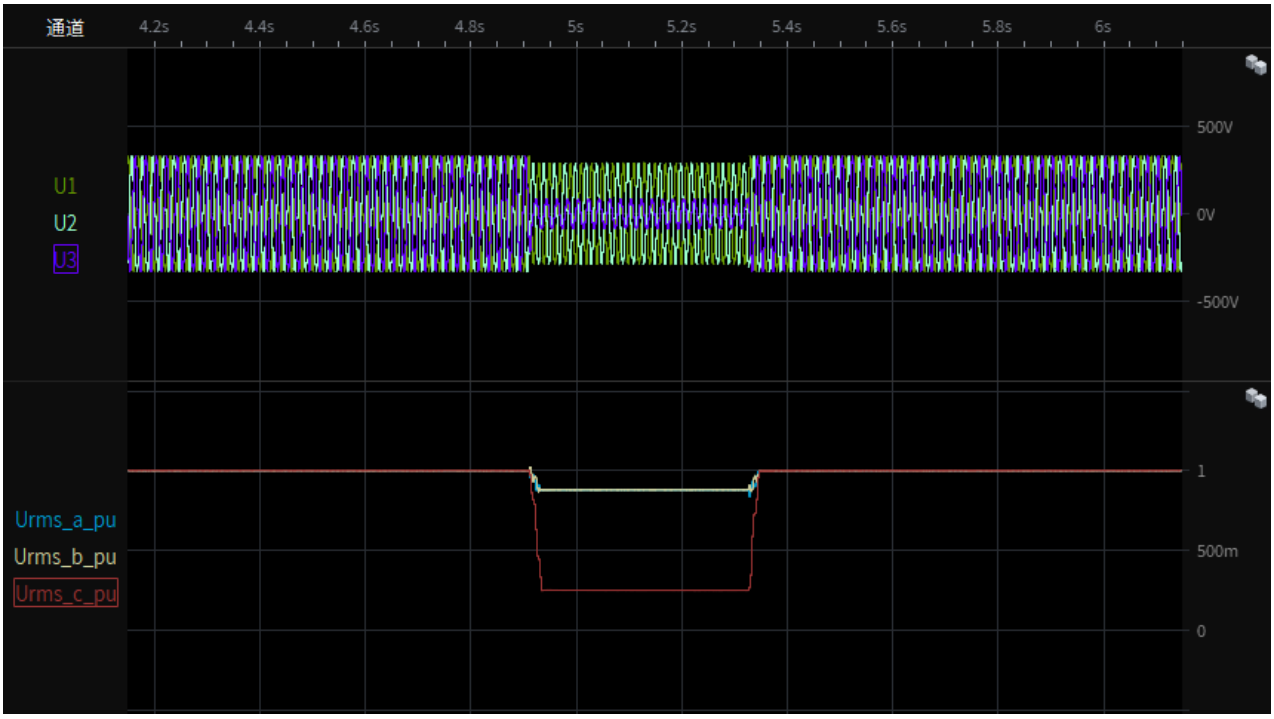


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

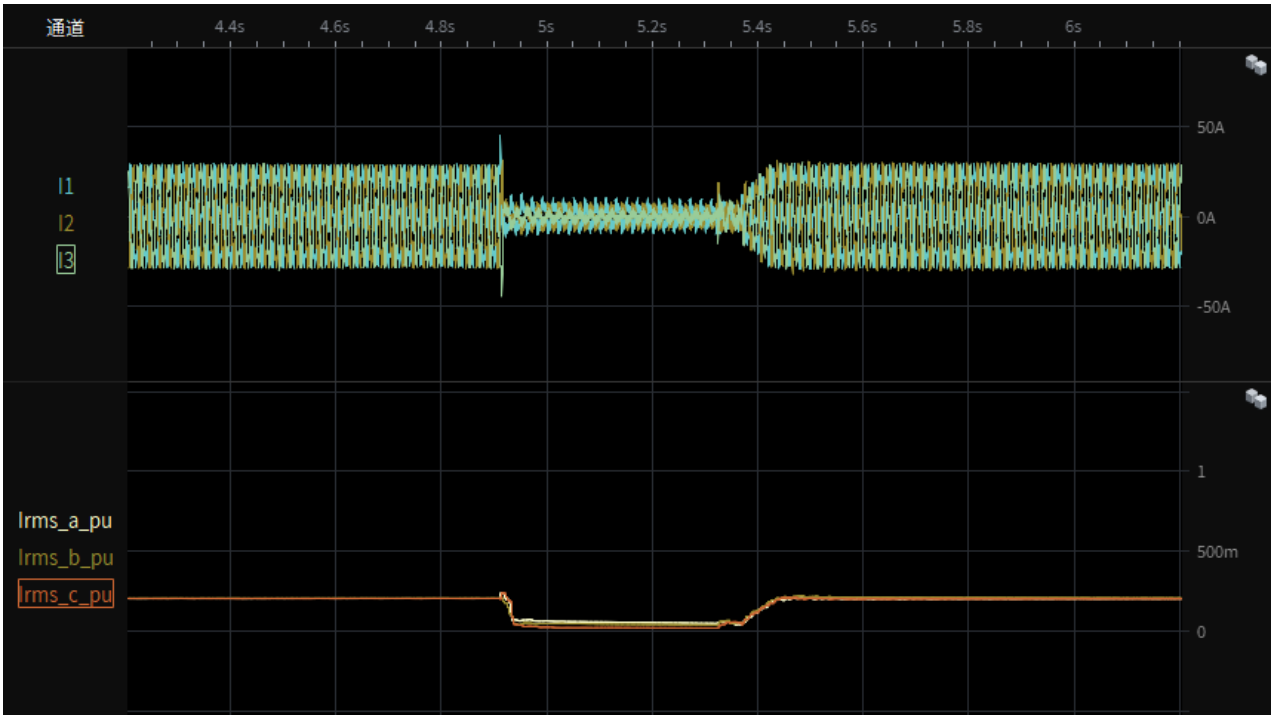


Test 2a-1.2 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

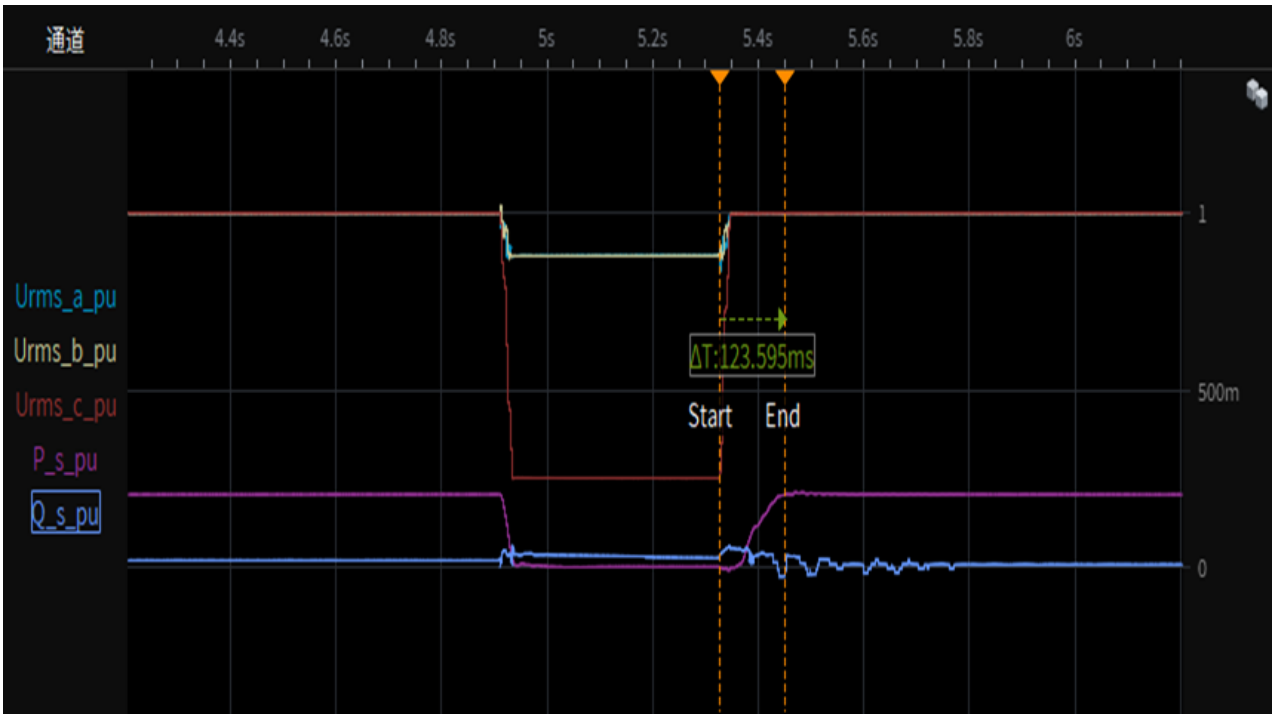


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

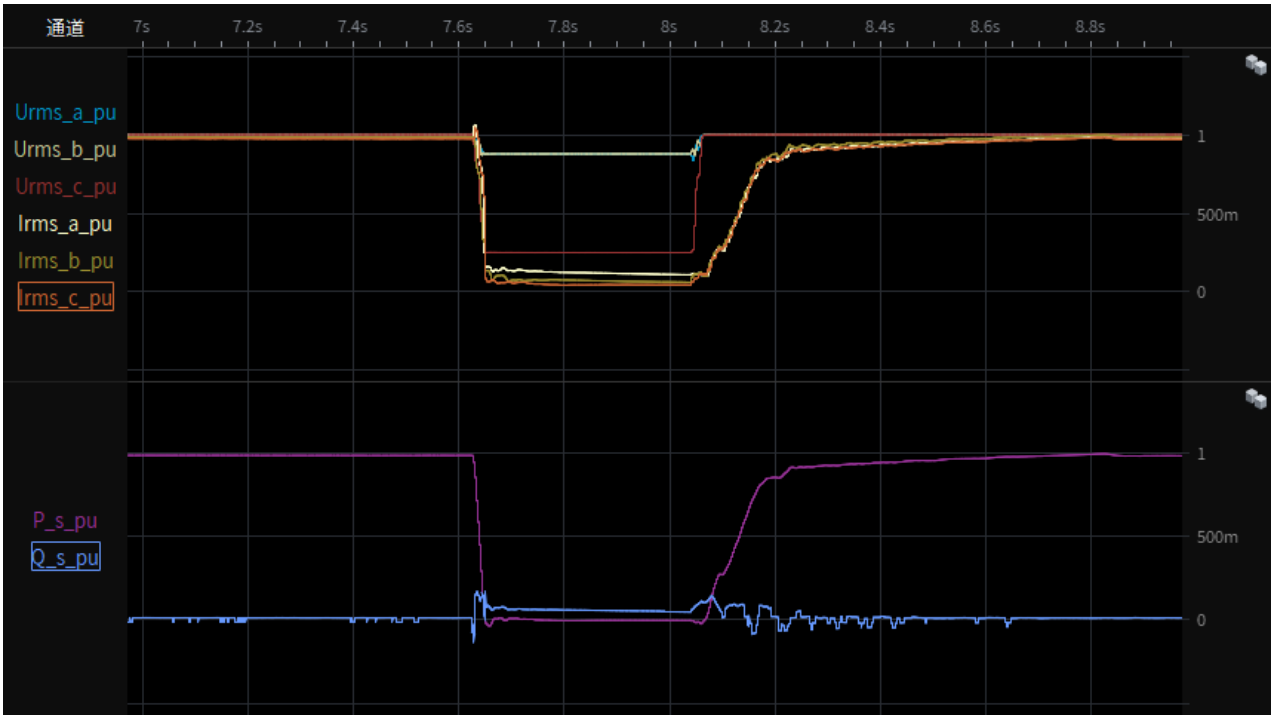


Test 2a-1.4 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),20% load
restoring time

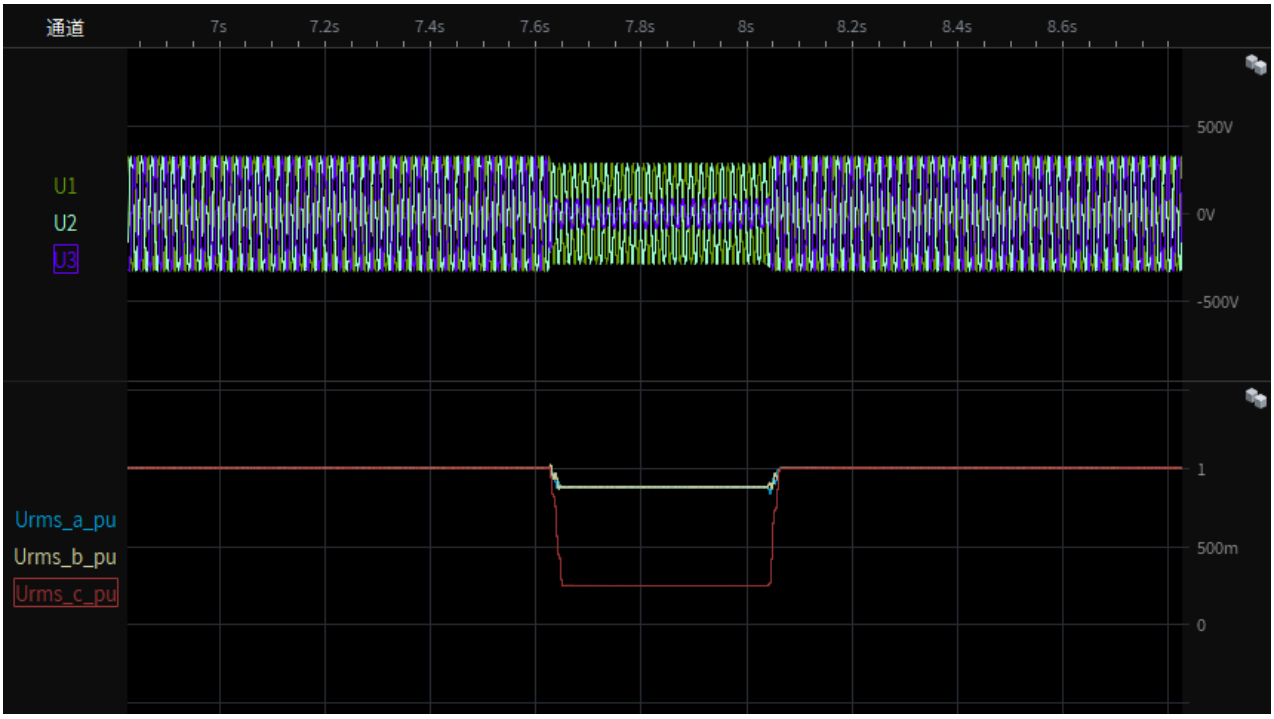


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

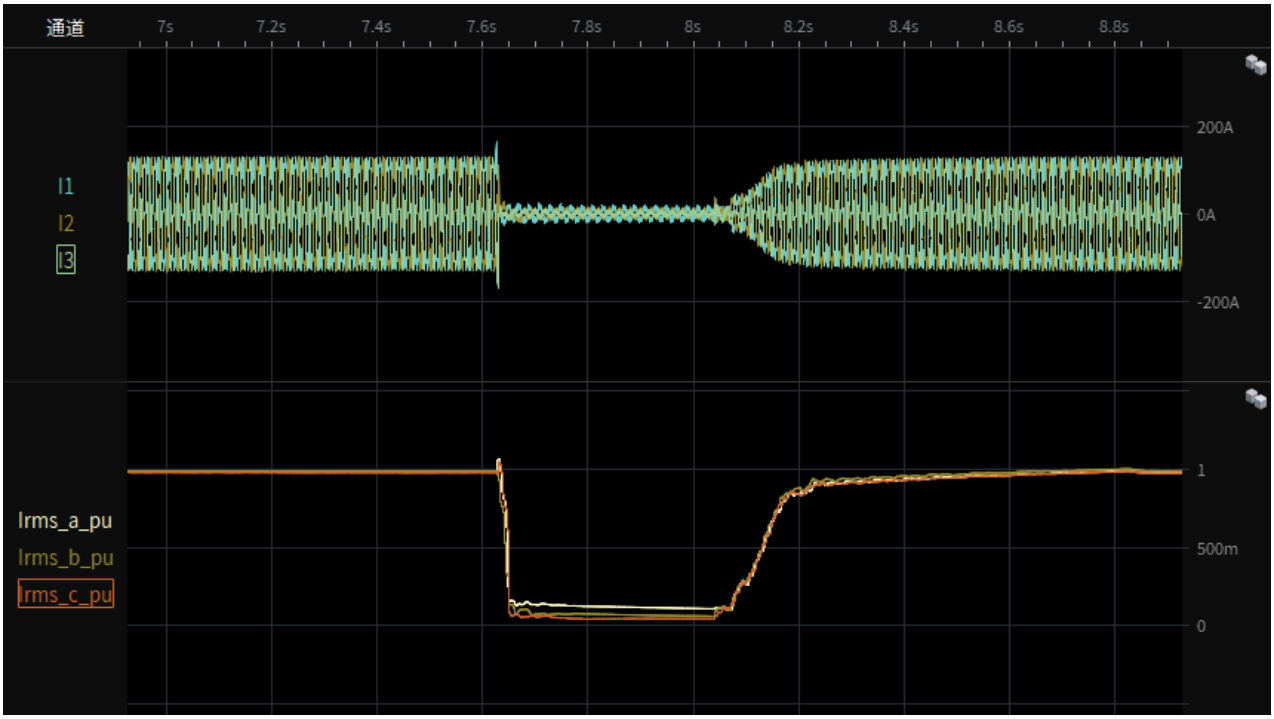


Test 2a-2.2 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages



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

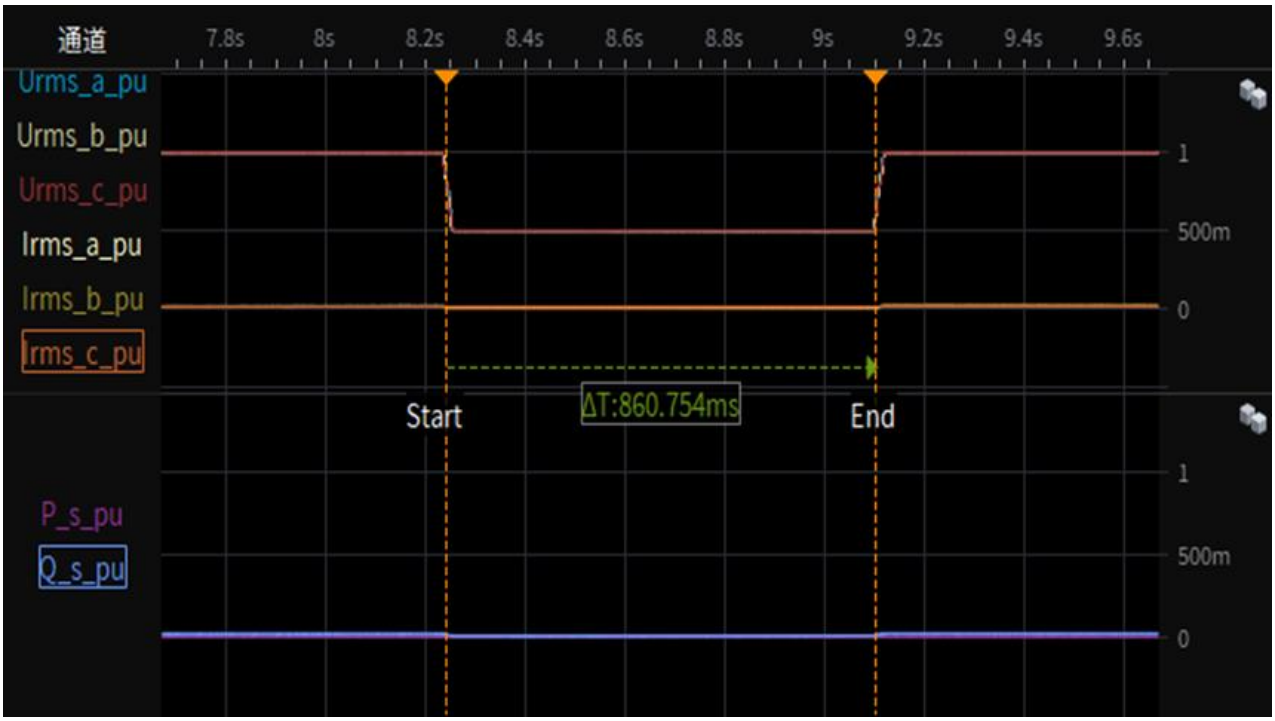


Test 2a-2.4 Depth of fault phase: 0.25p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

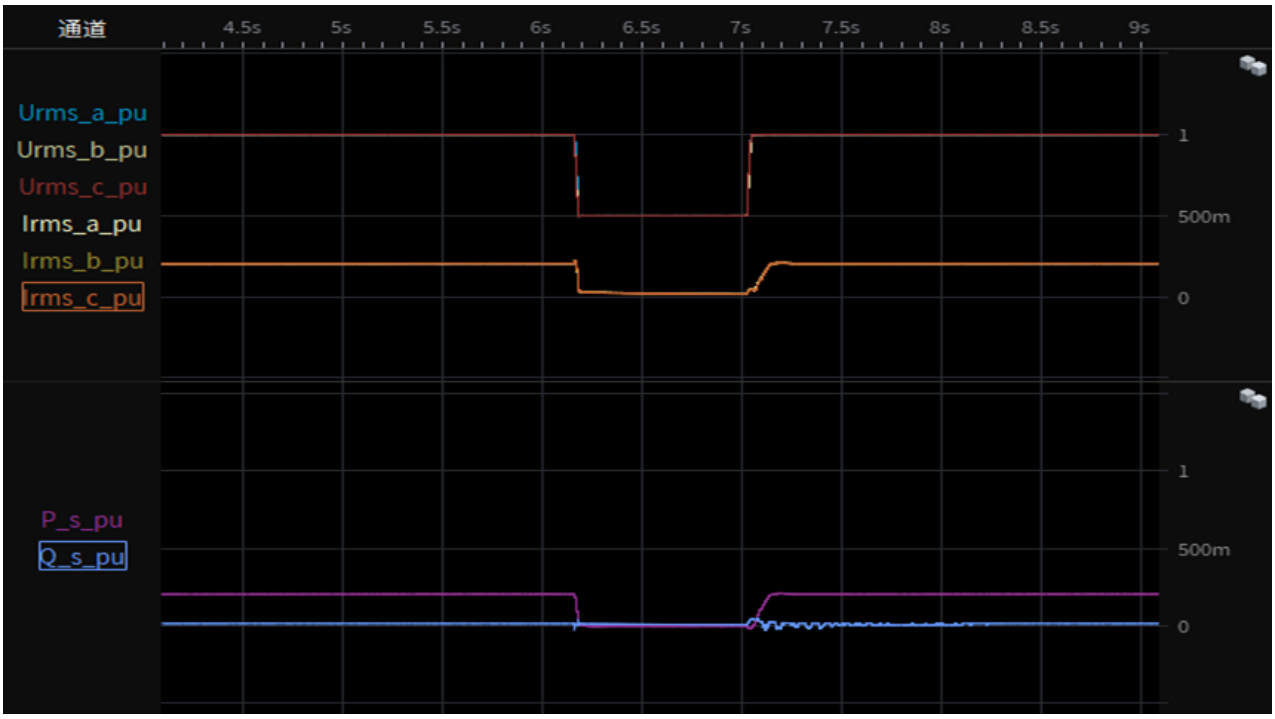


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

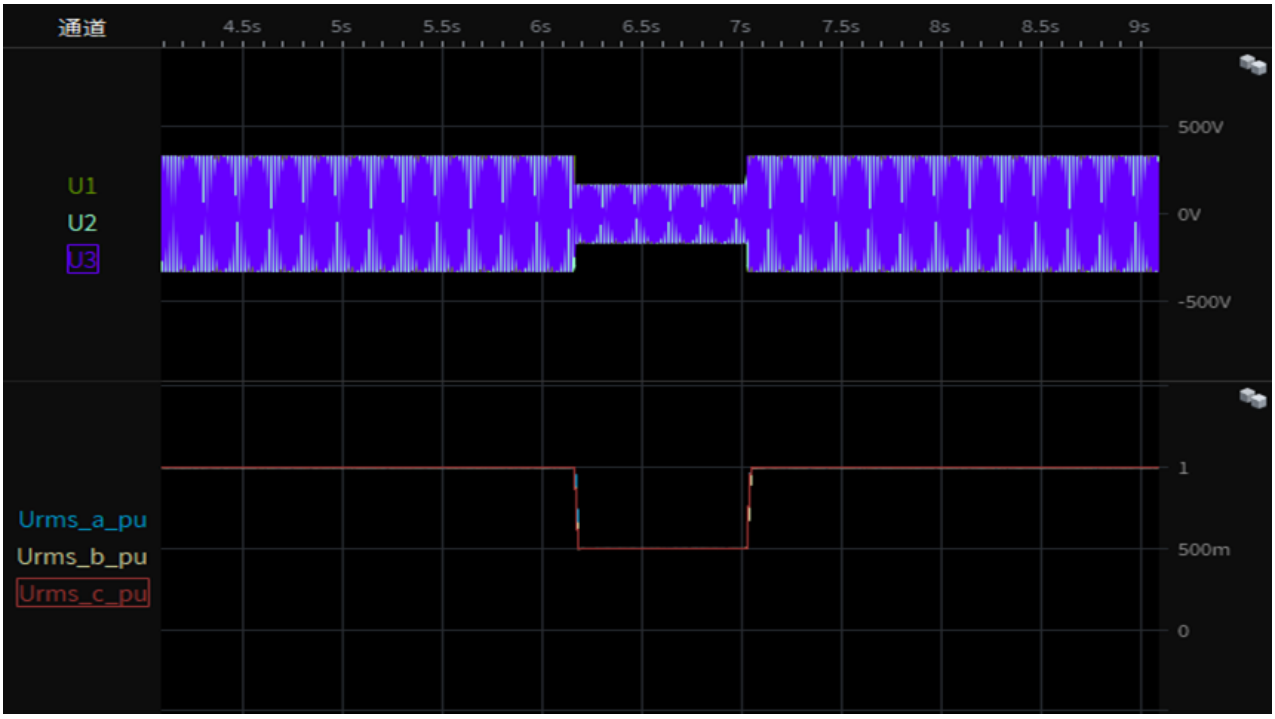


Test 3s-1.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

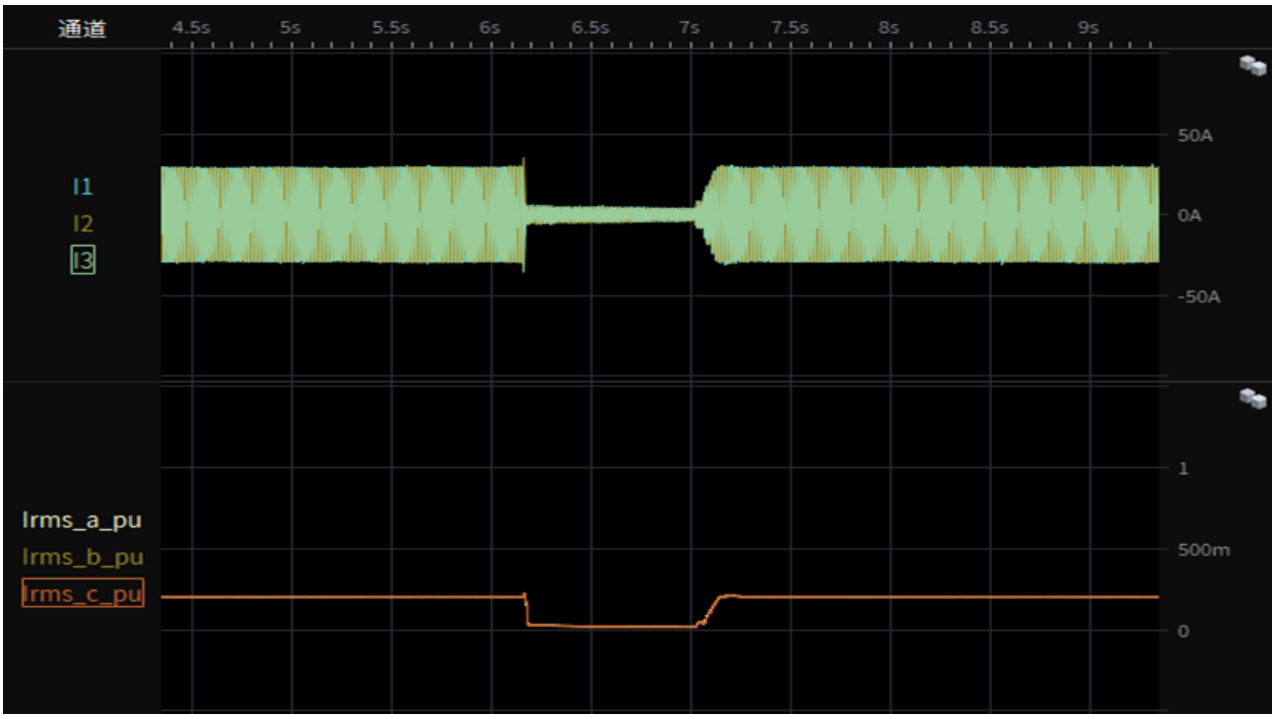


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

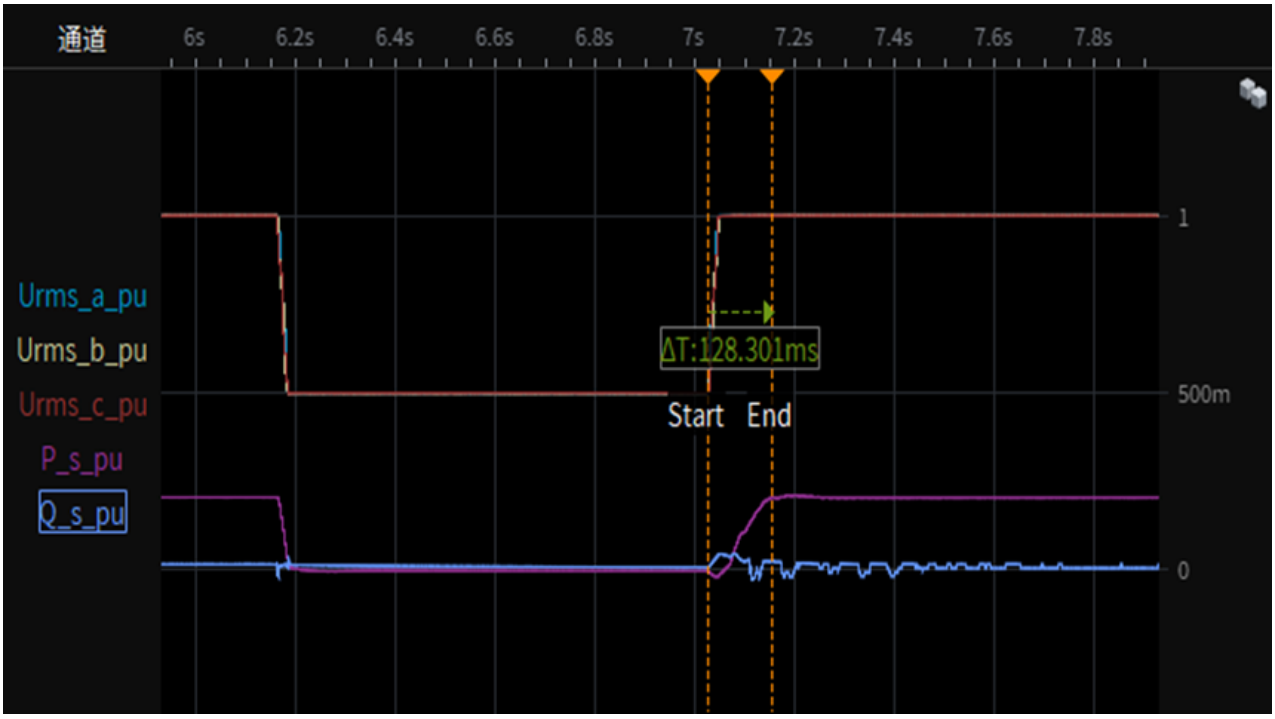


Test 3s-1.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

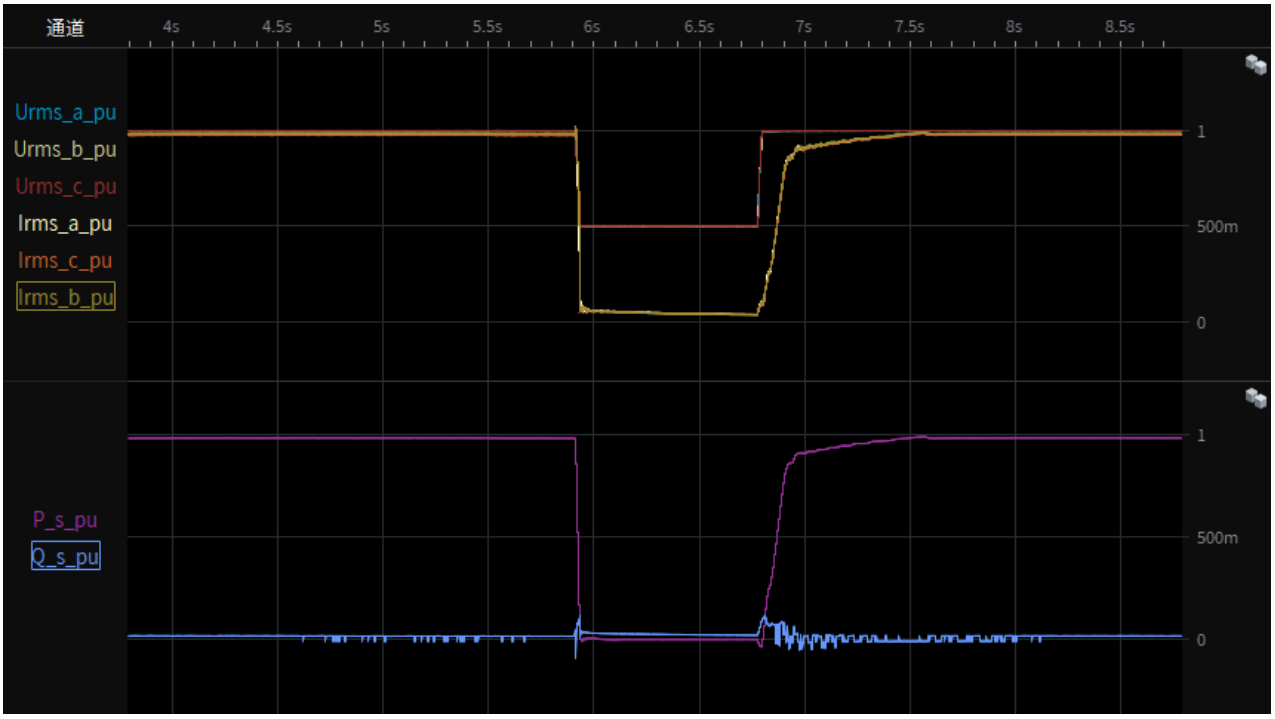


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

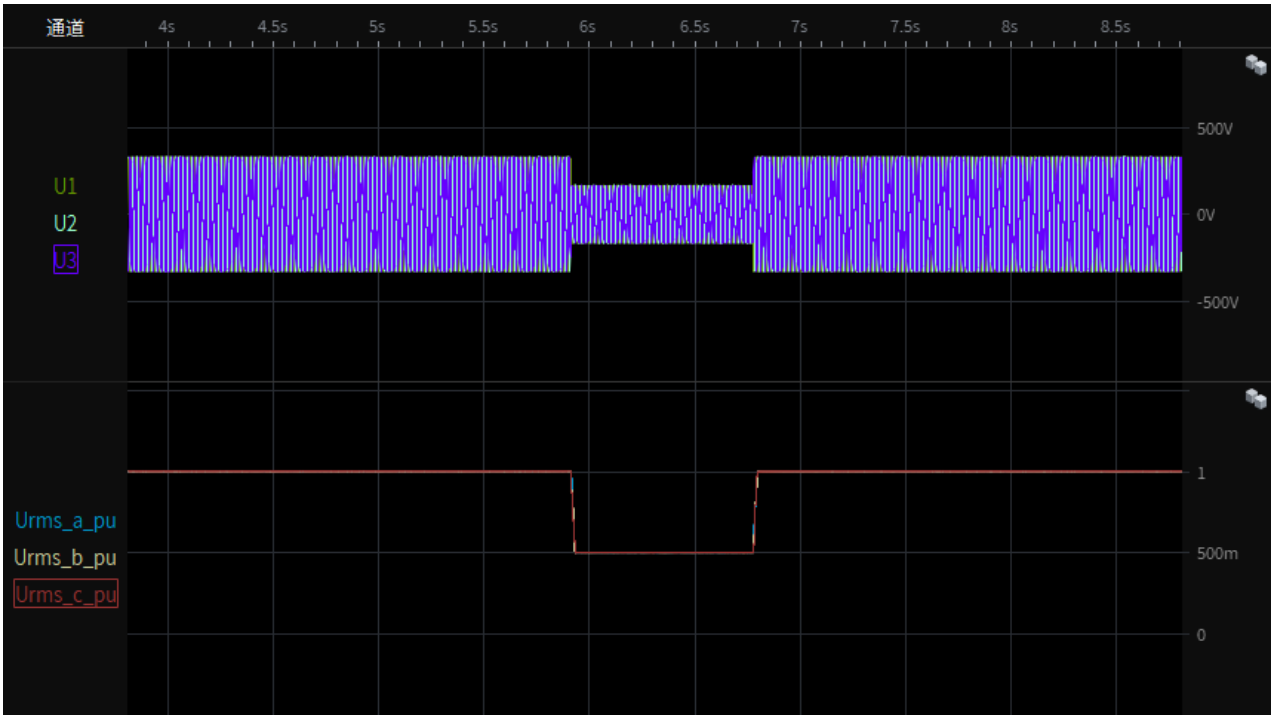


Test 3s-2.1 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

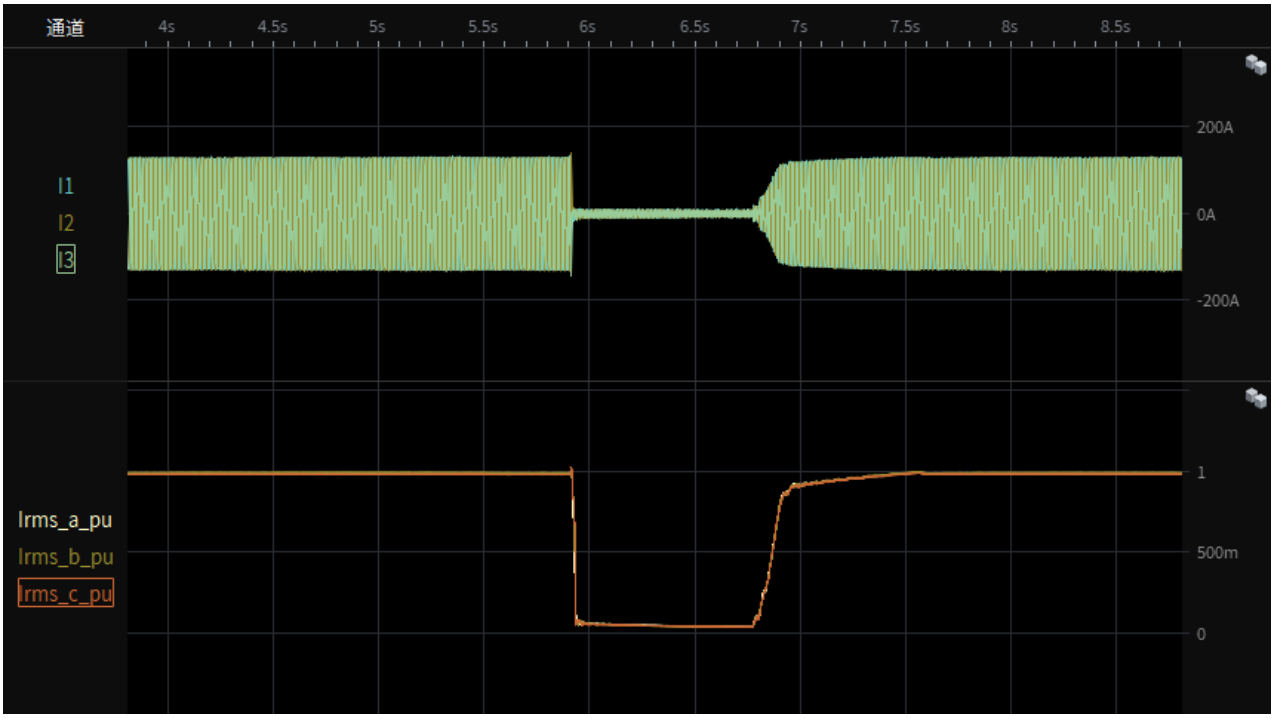


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

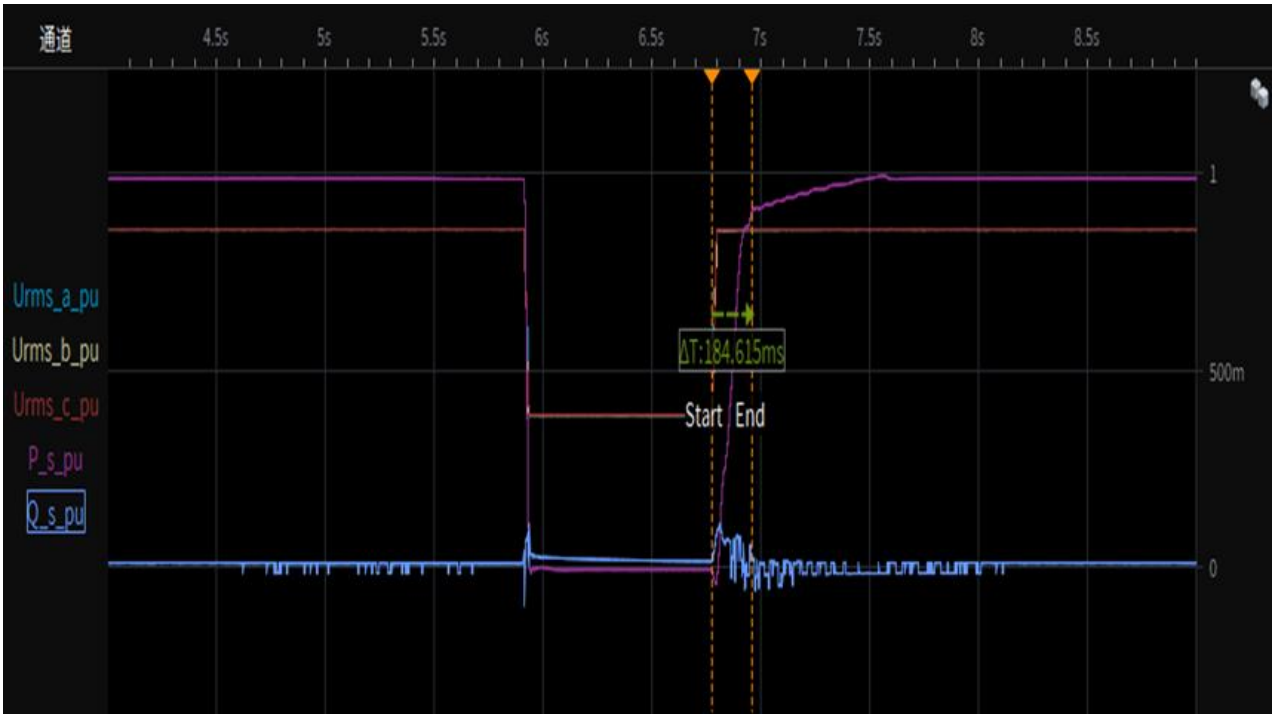


Test 3s-2.3 Depth of fault phase: 0.5p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

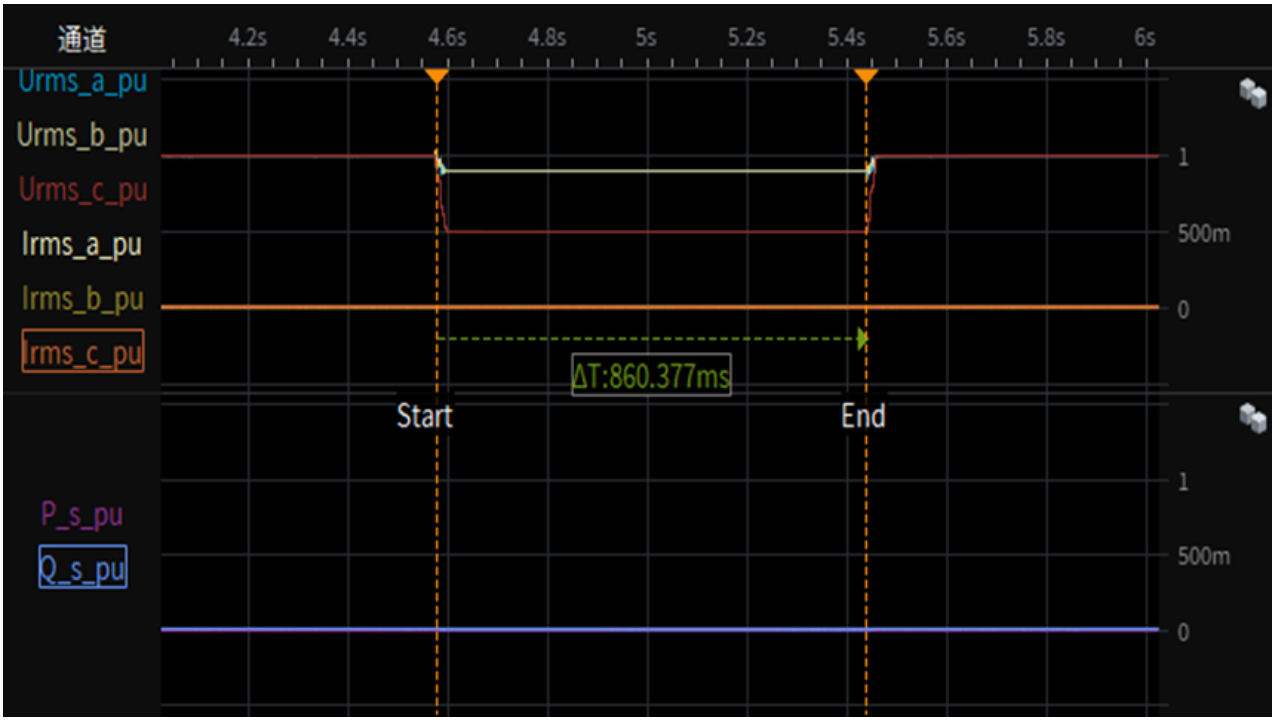


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

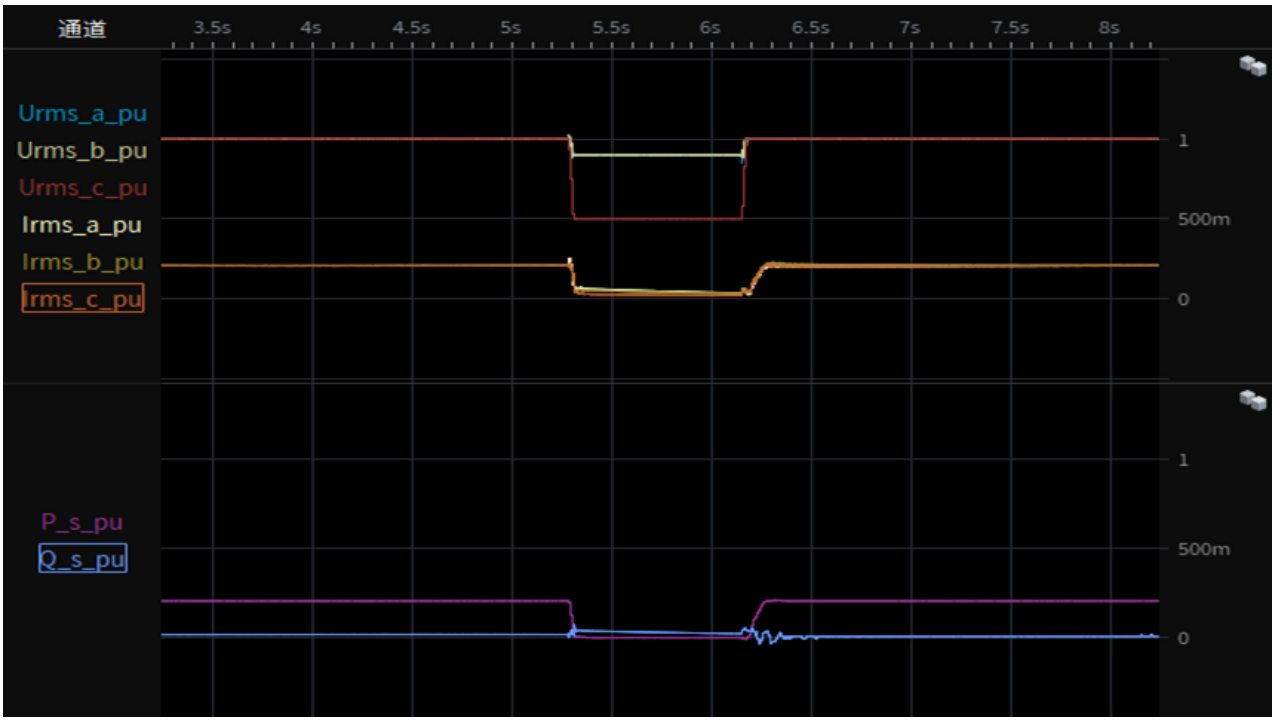


Test 3a-Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

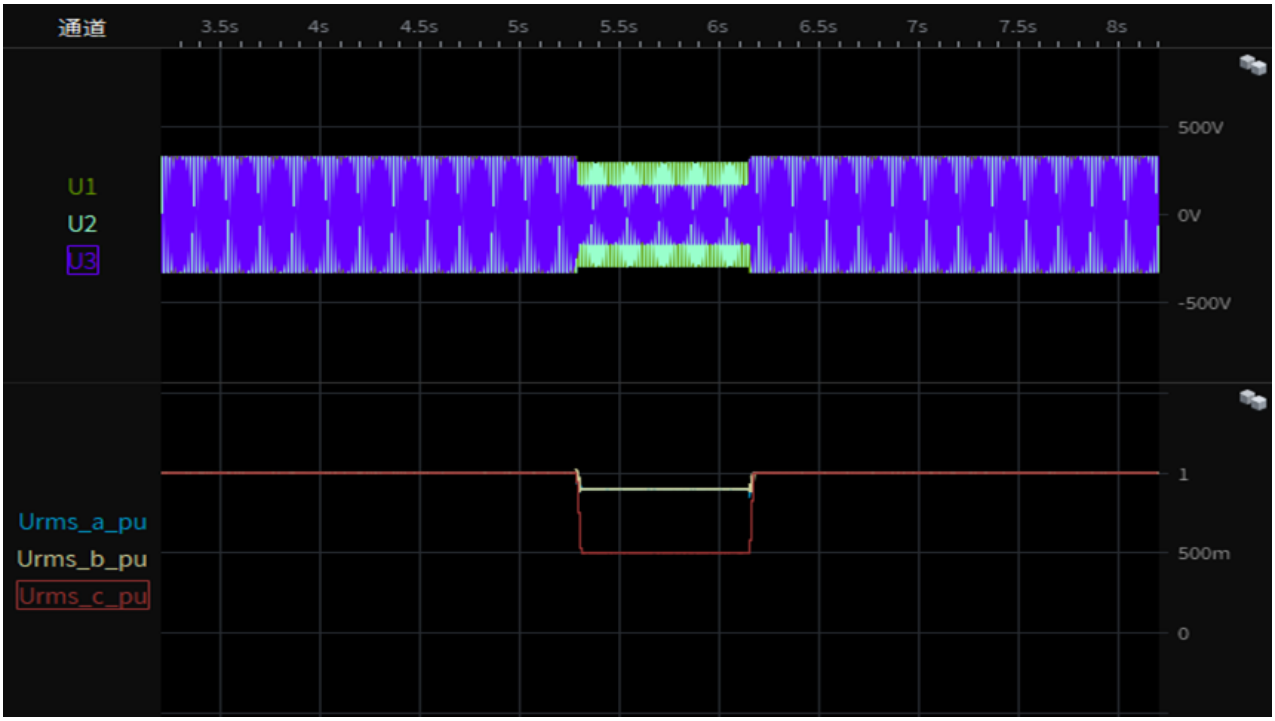


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

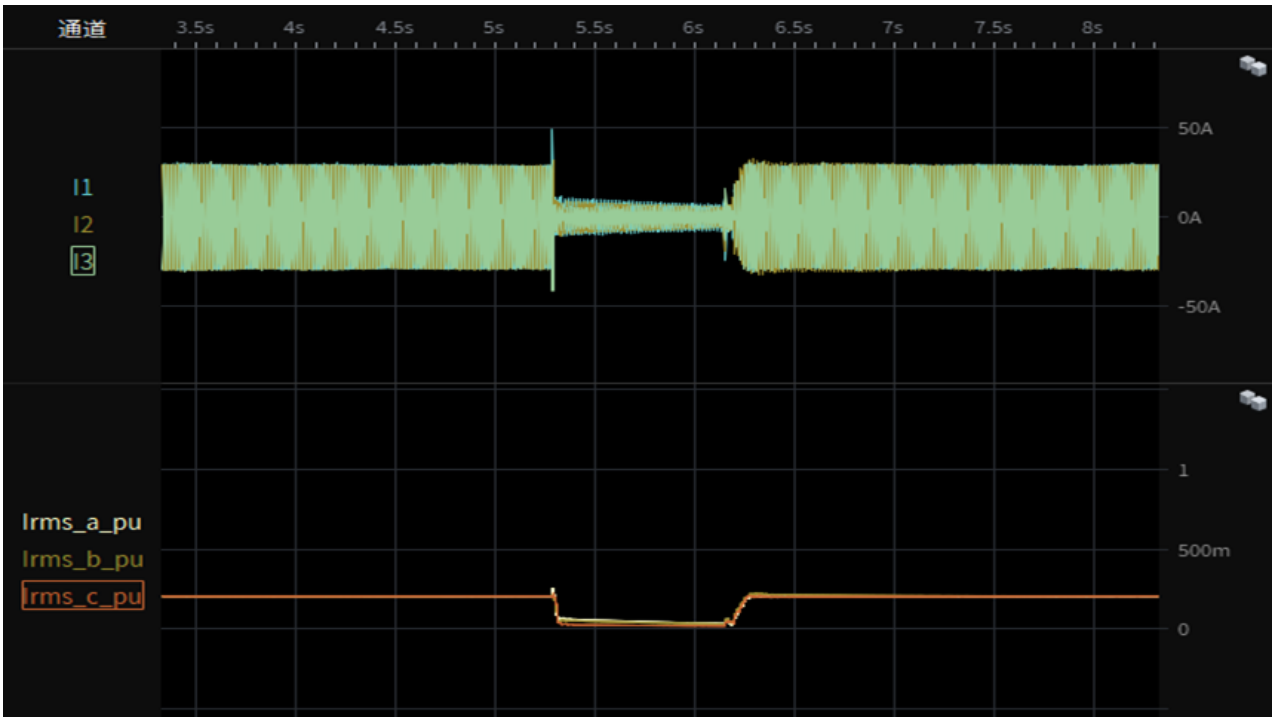


Test 3a-1.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

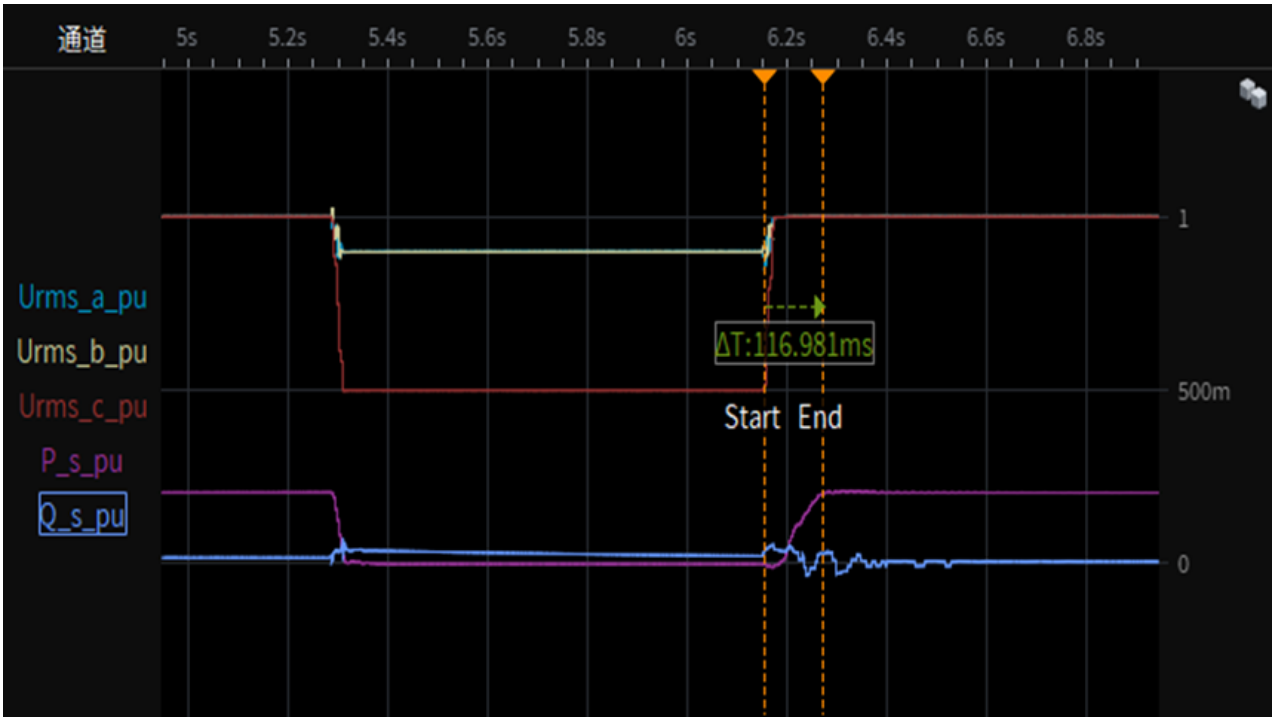


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

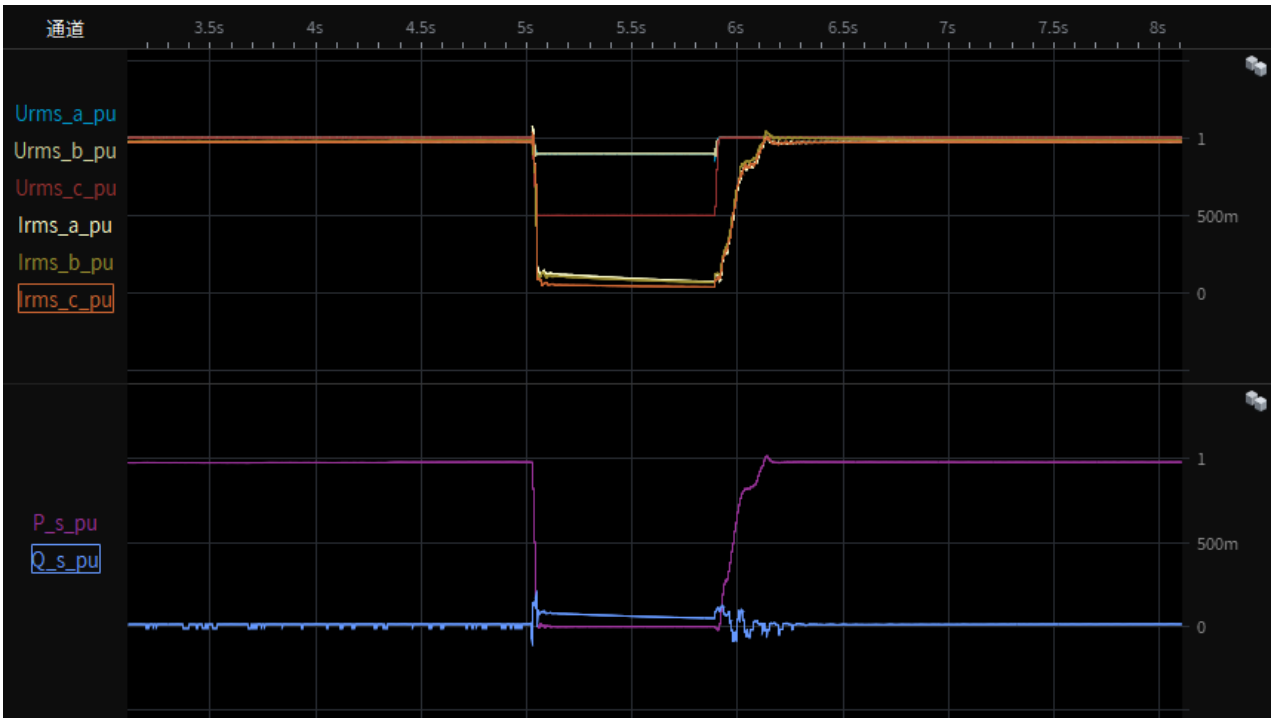


Test 3a-1.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),20% load
restoring time

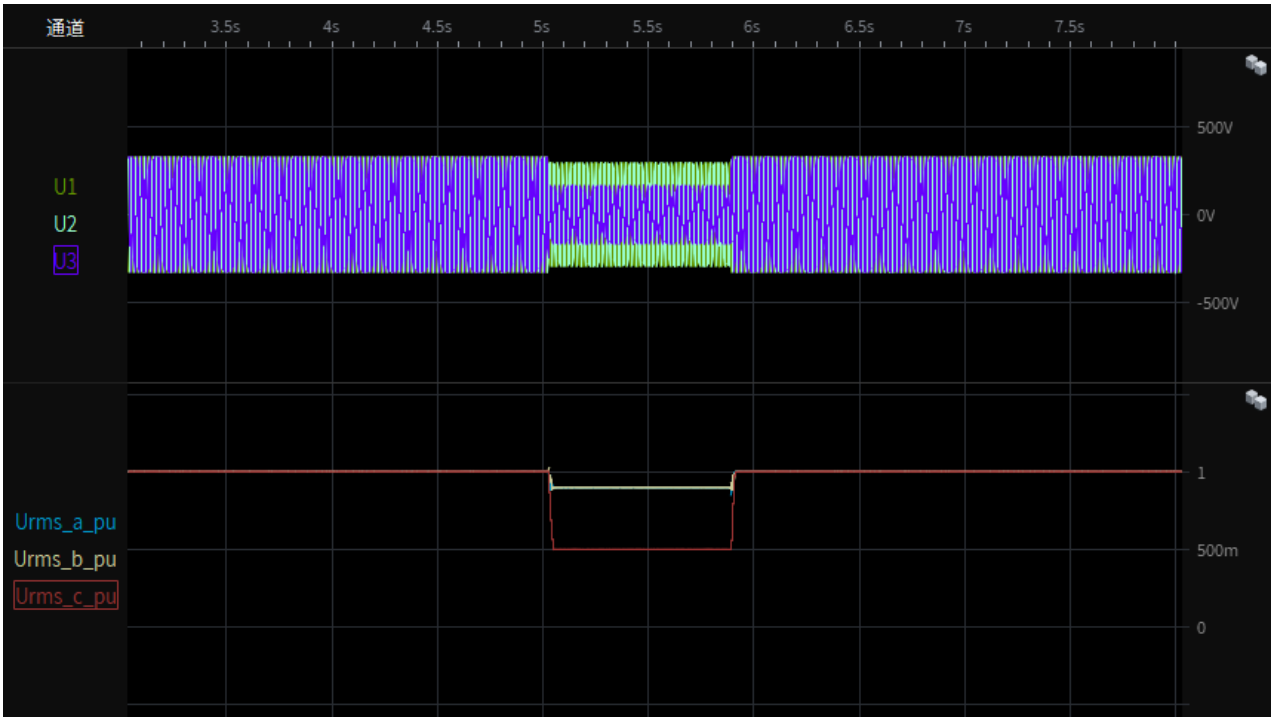


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

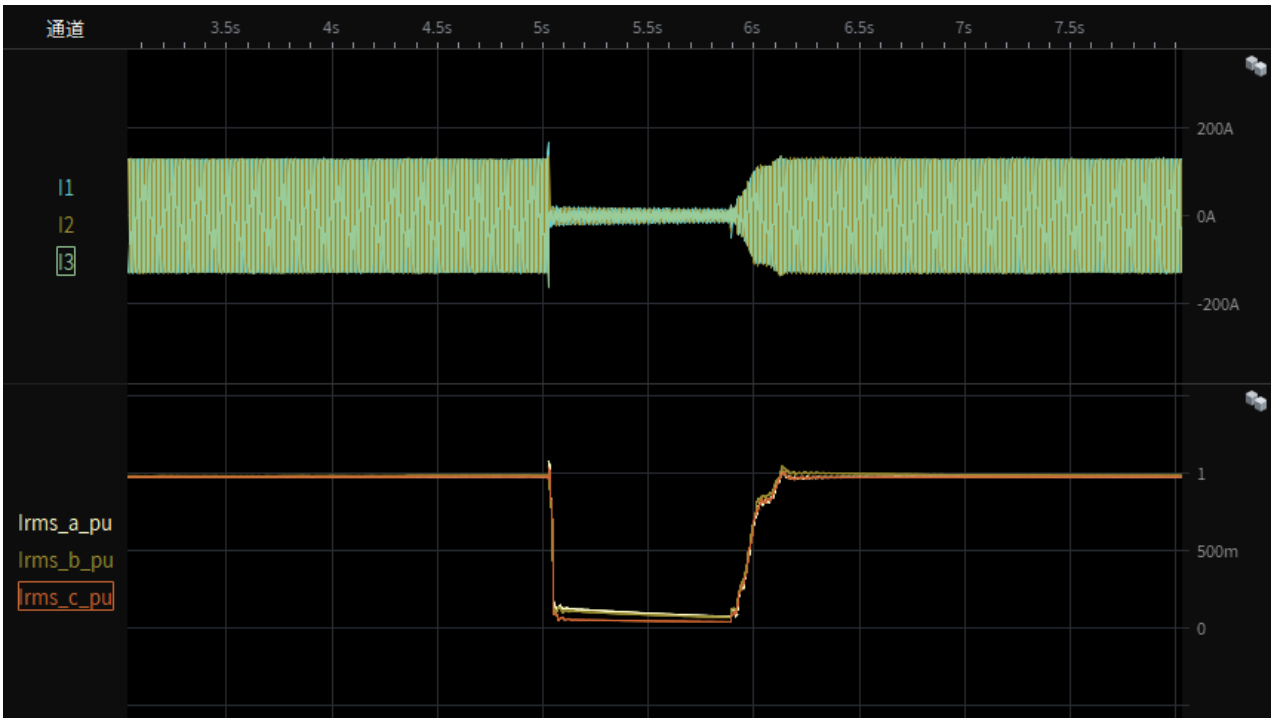


Test 3a-2.2 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

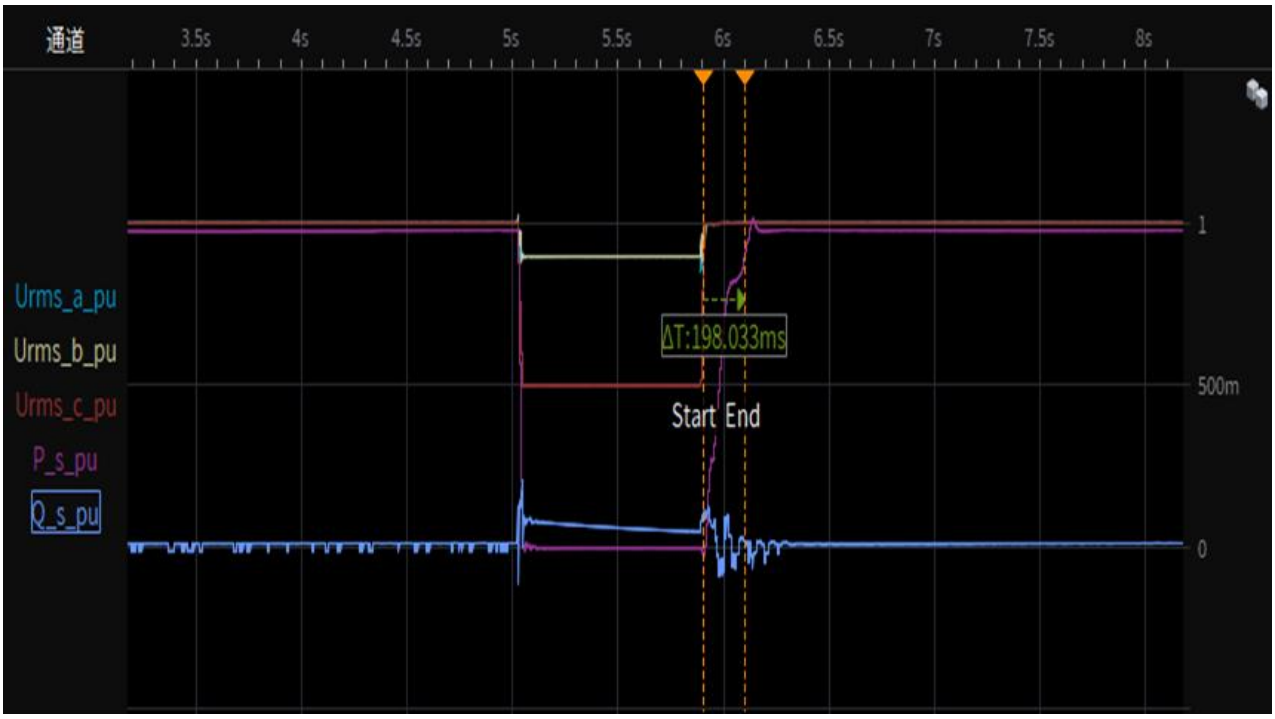


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

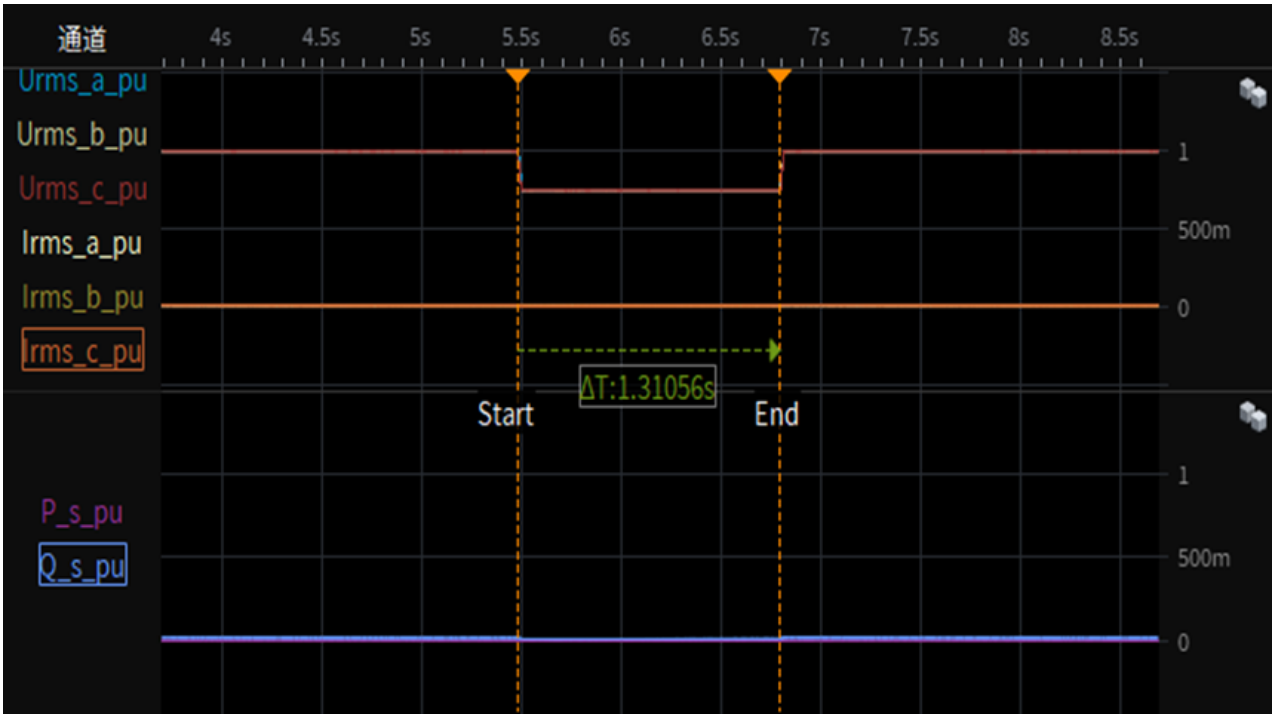


Test 3a-2.4 Depth of fault phase: 0.5p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

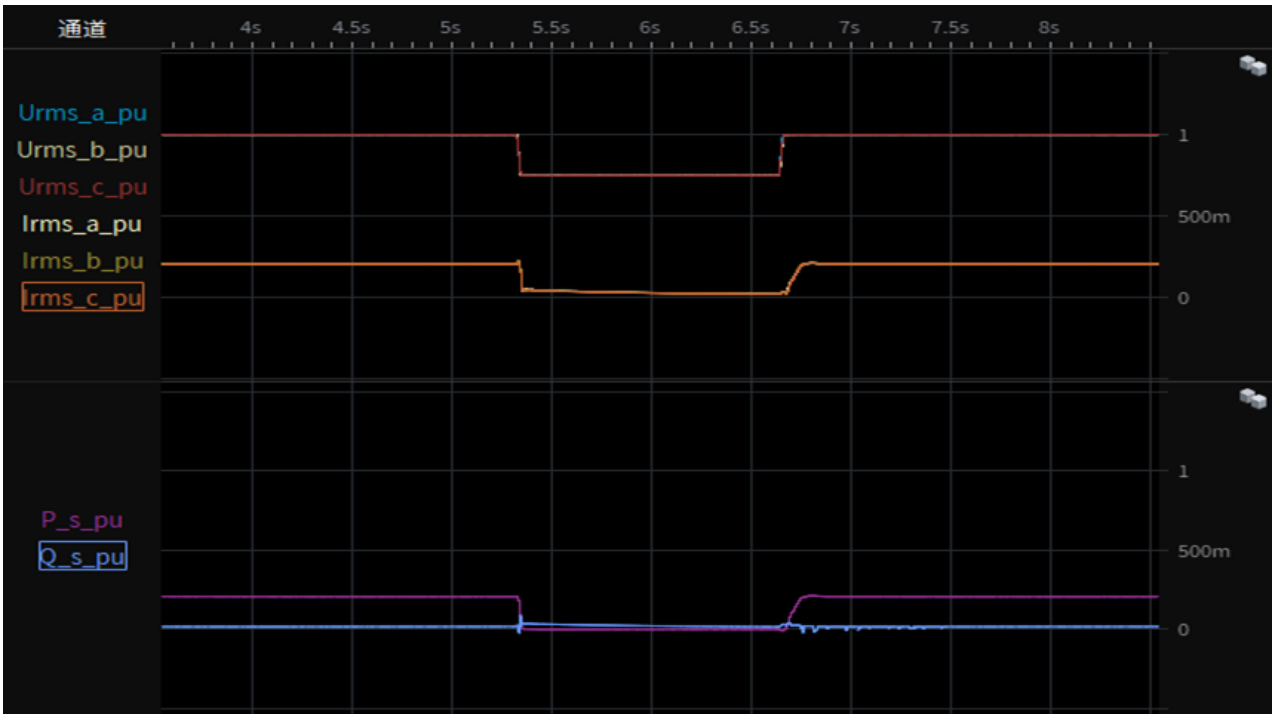


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

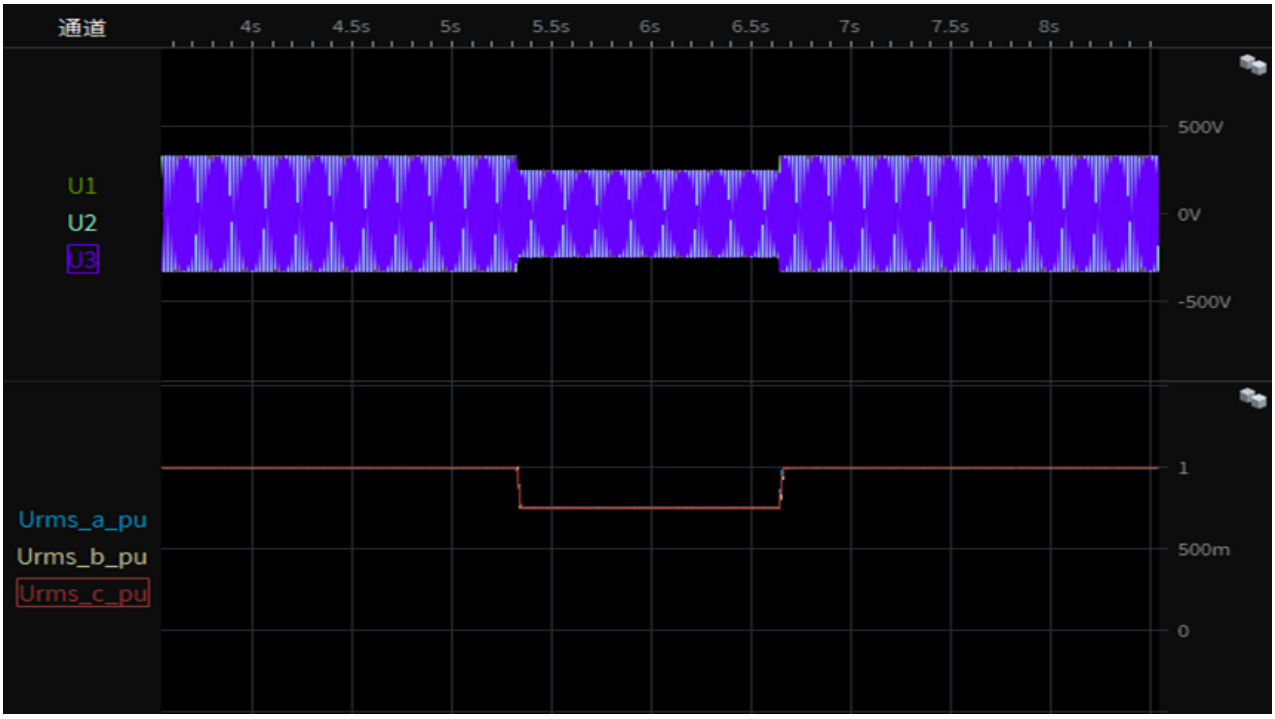


Test 4s-1.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

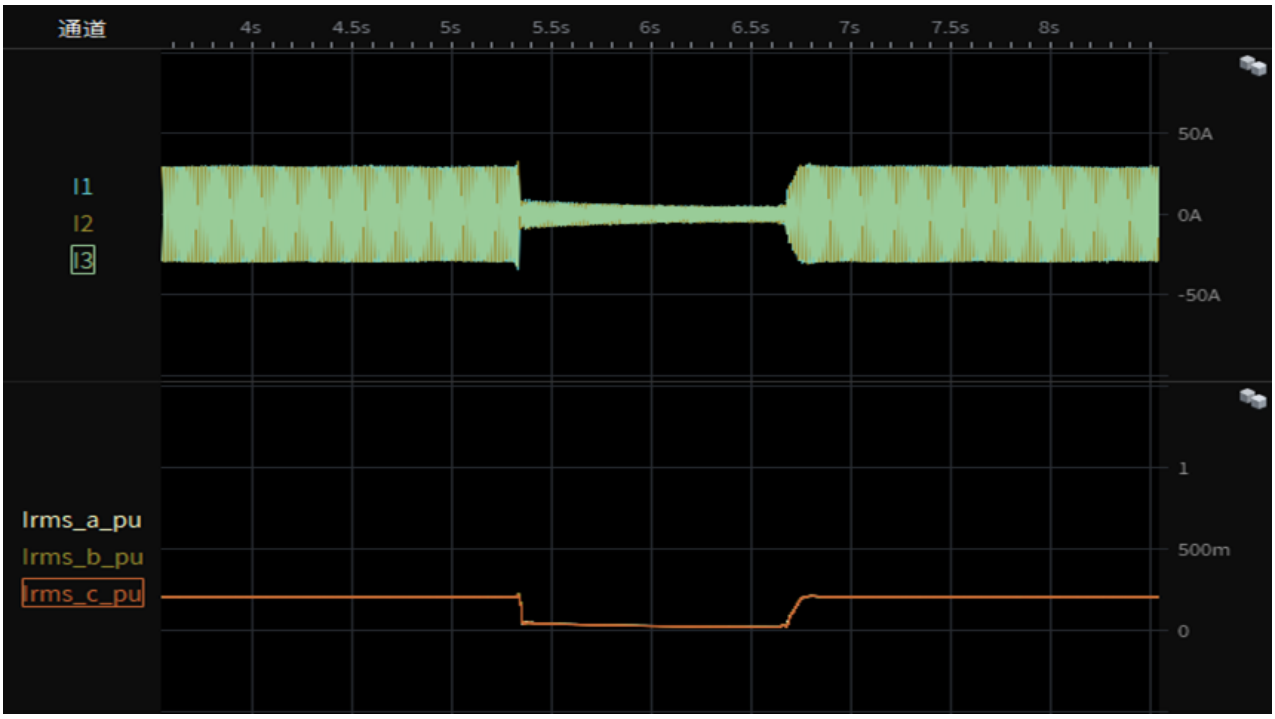


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

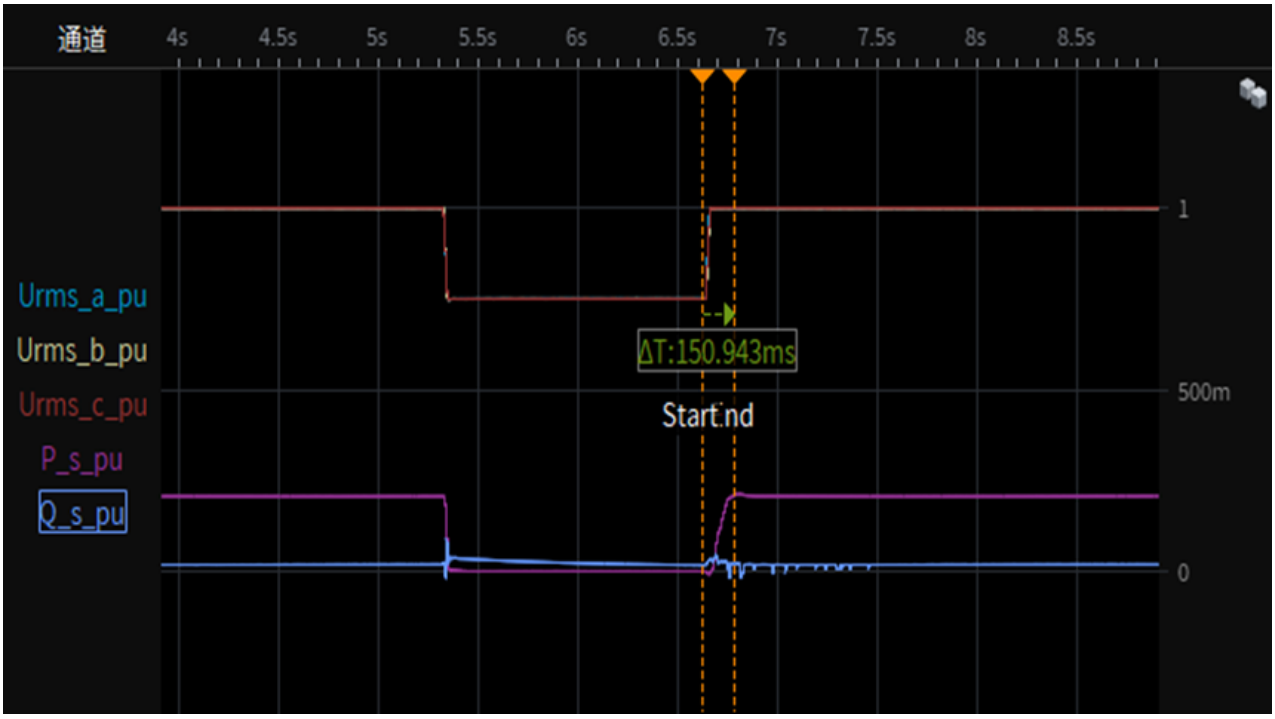


Test 4s-1.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

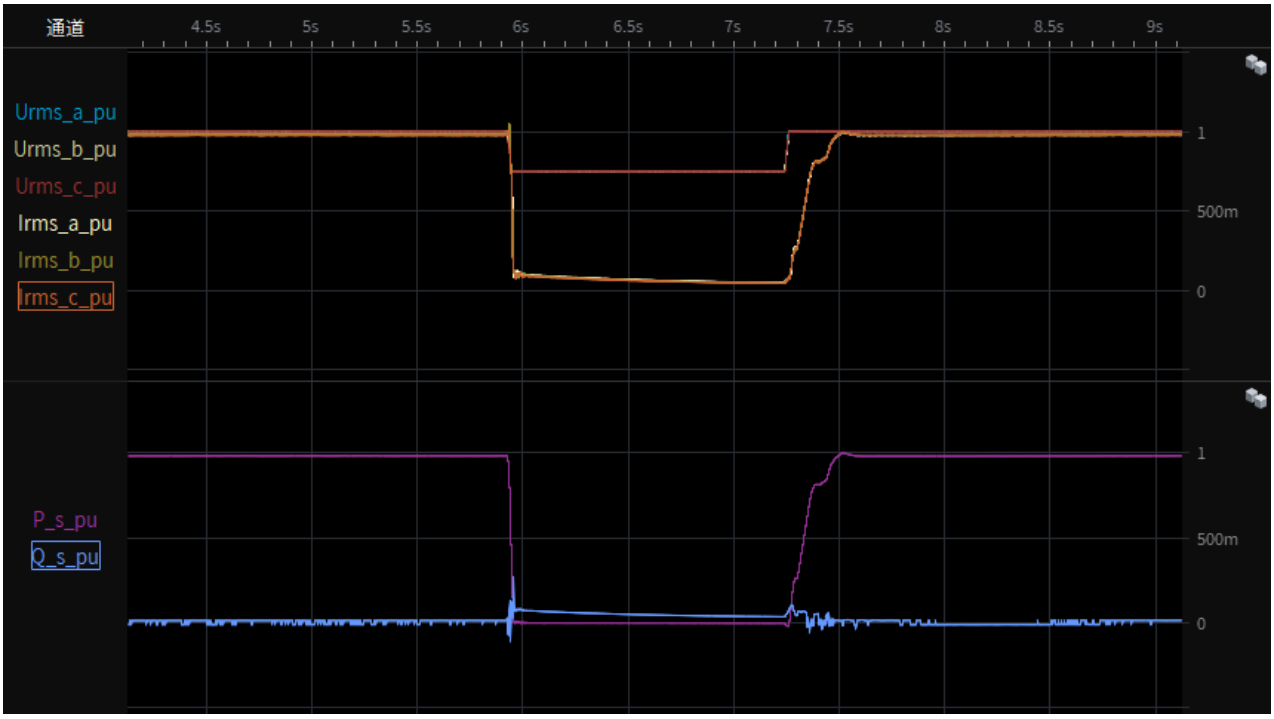


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

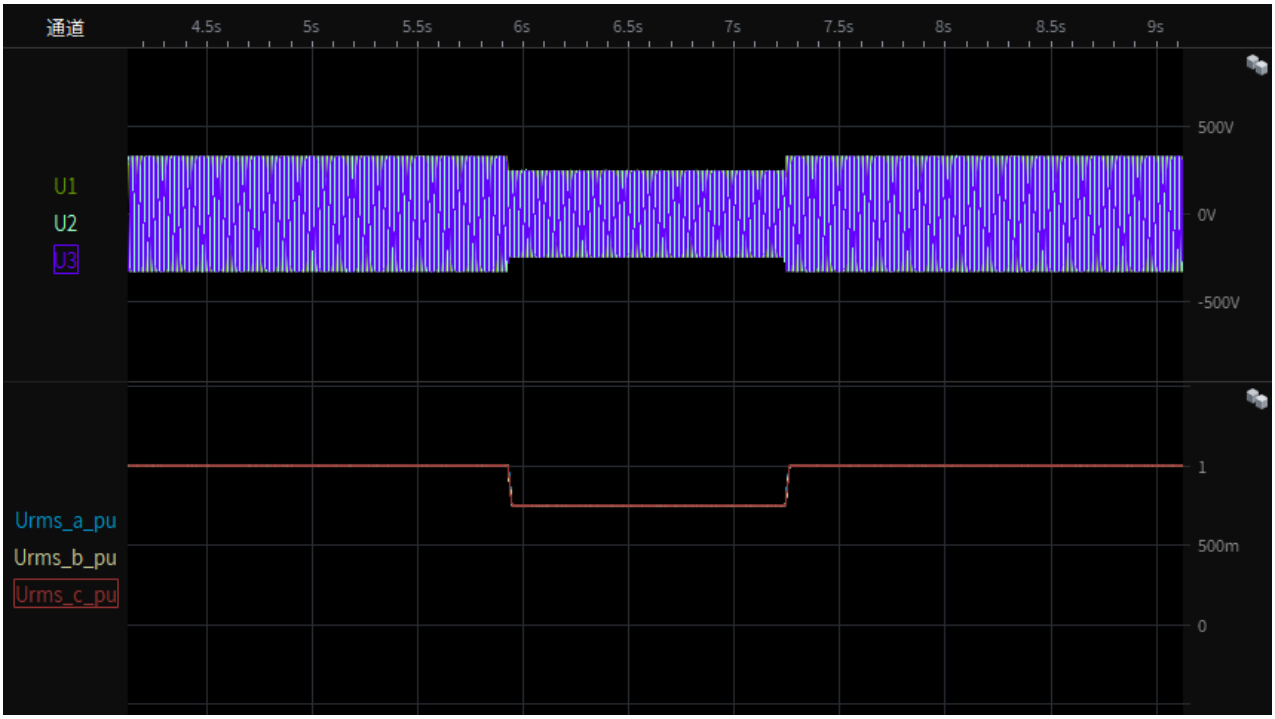


Test 4s-2.1 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

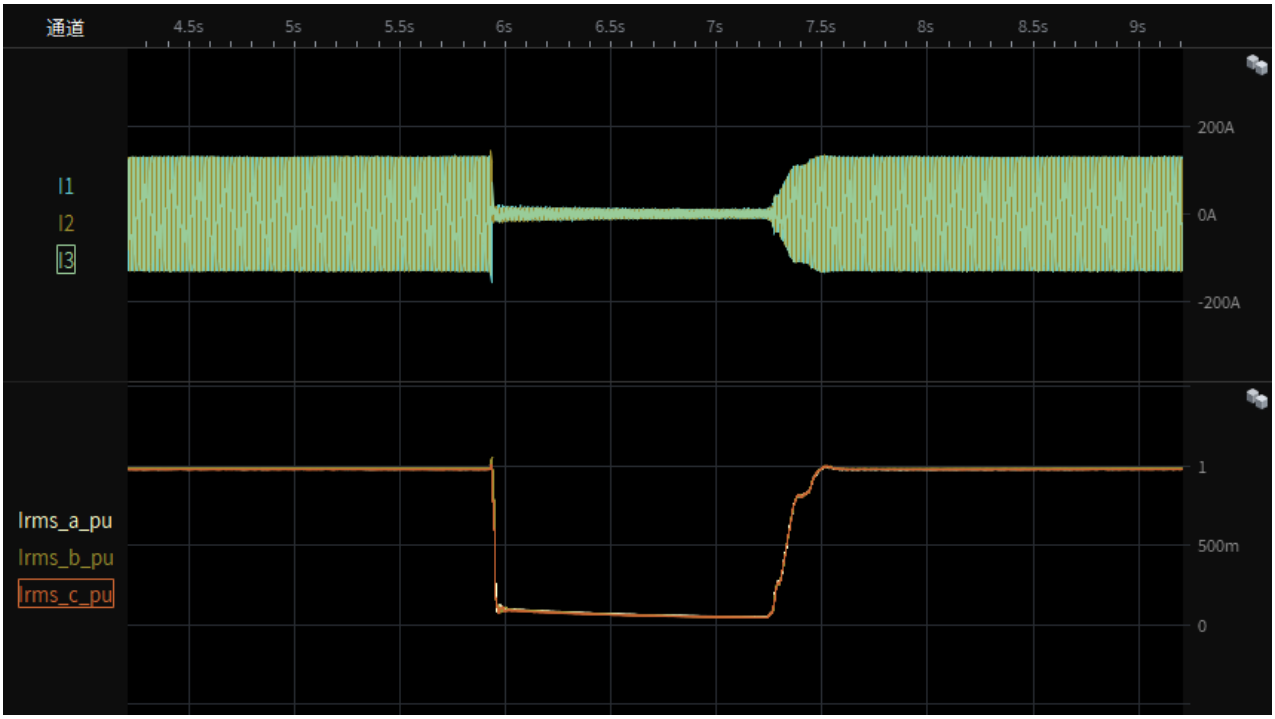


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

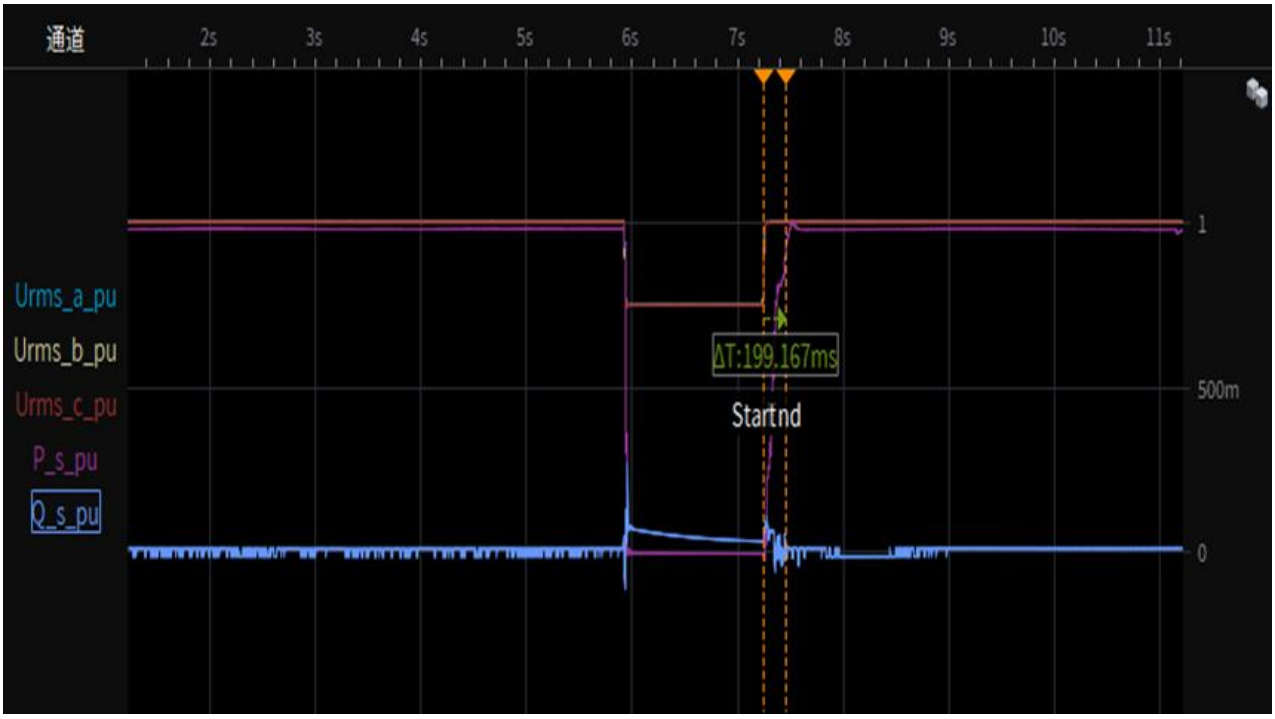


Test 4s-2.3 Depth of fault phase: 0.75p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

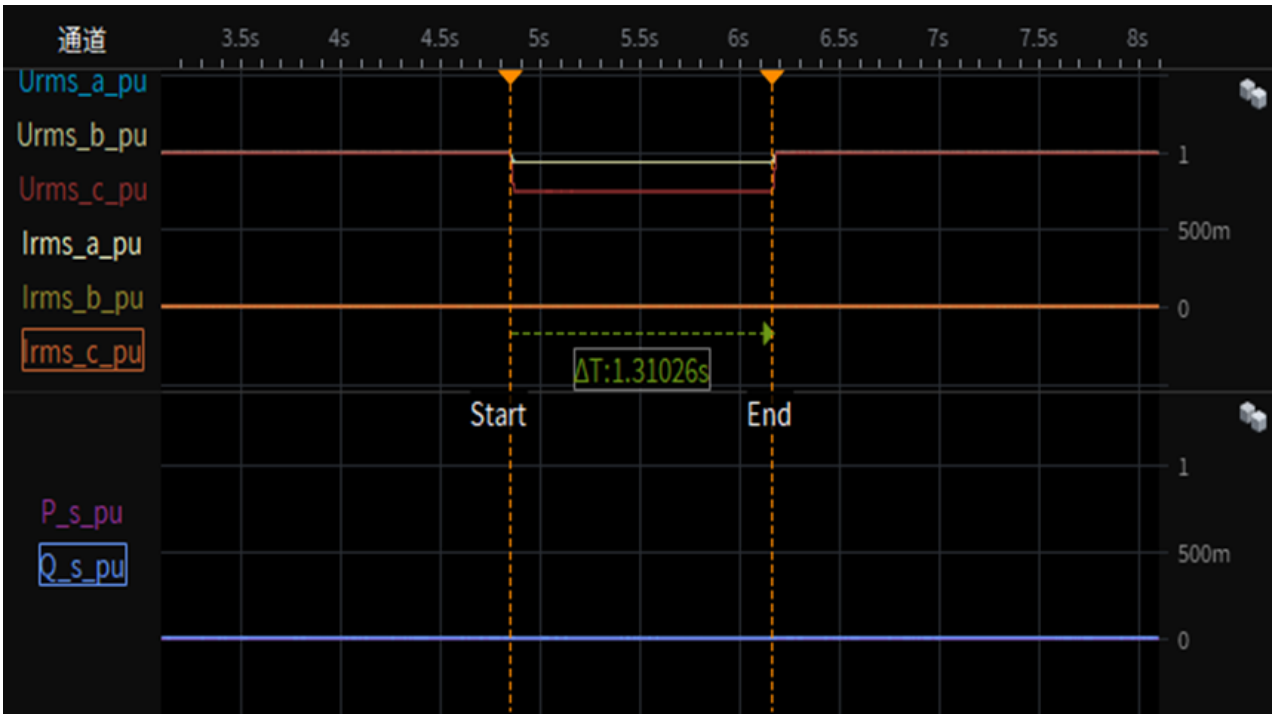


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

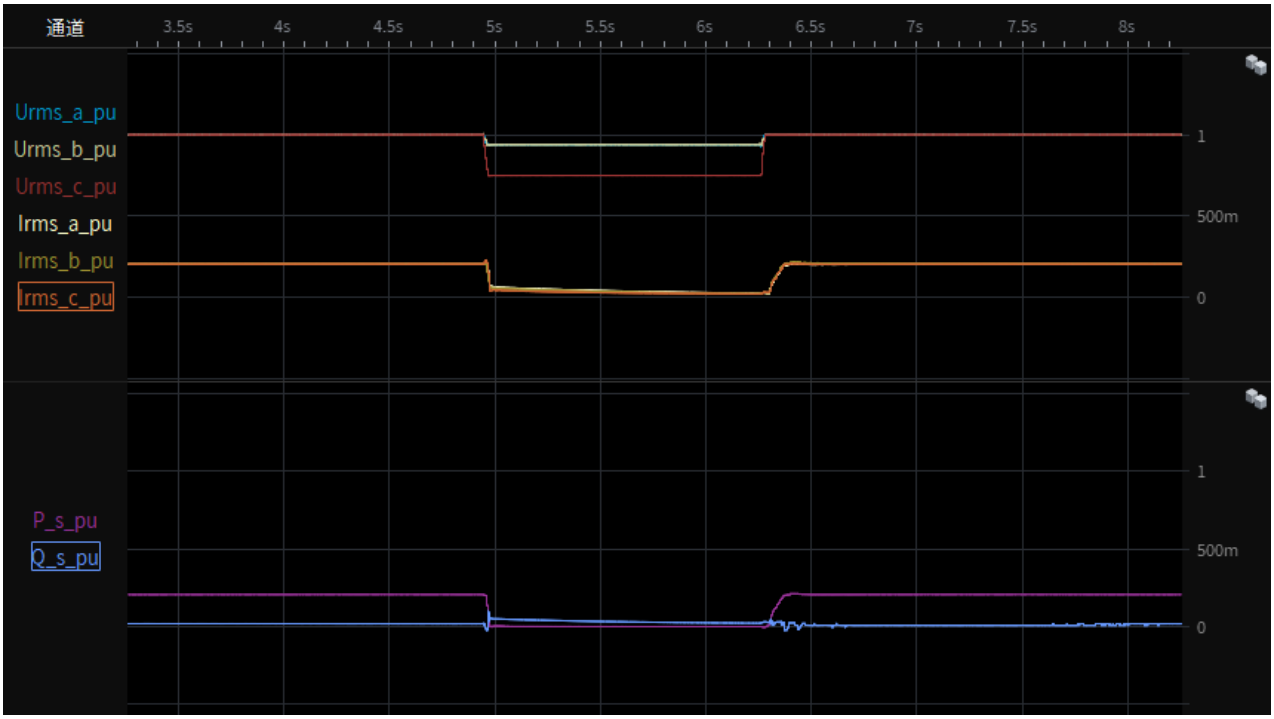


Test 4a-Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

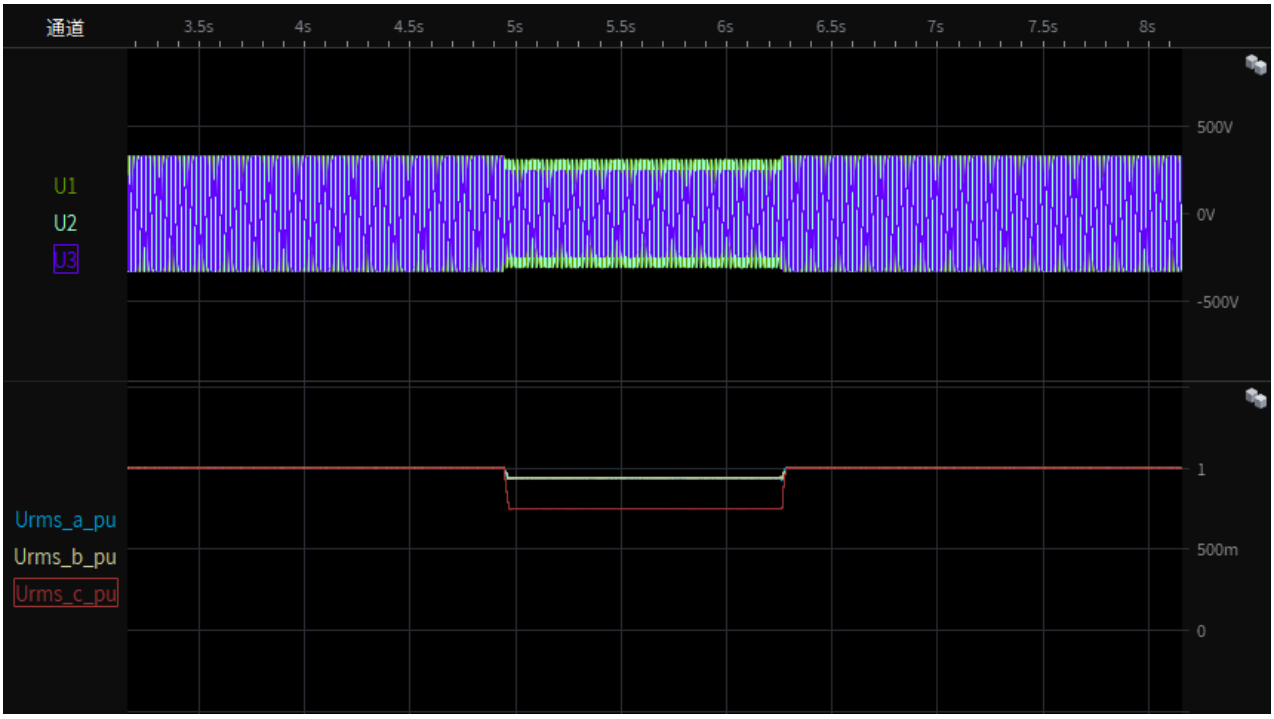


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

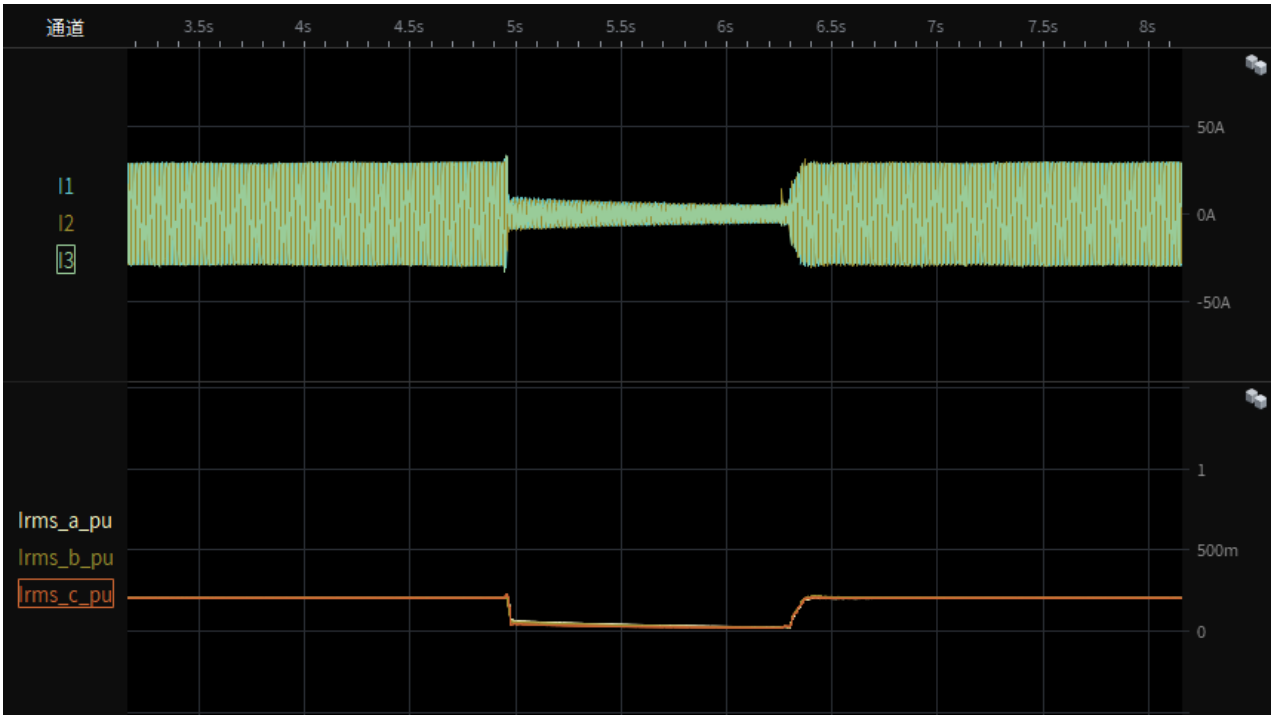


Test 4a-1.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

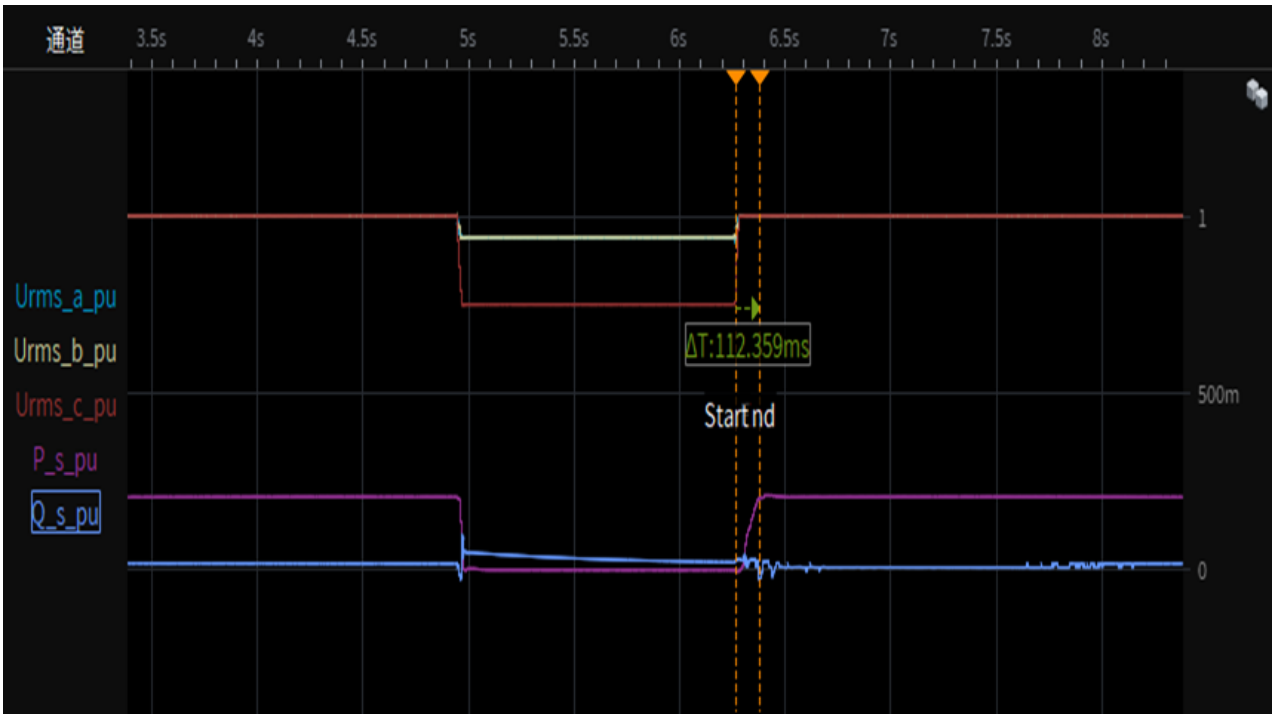


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

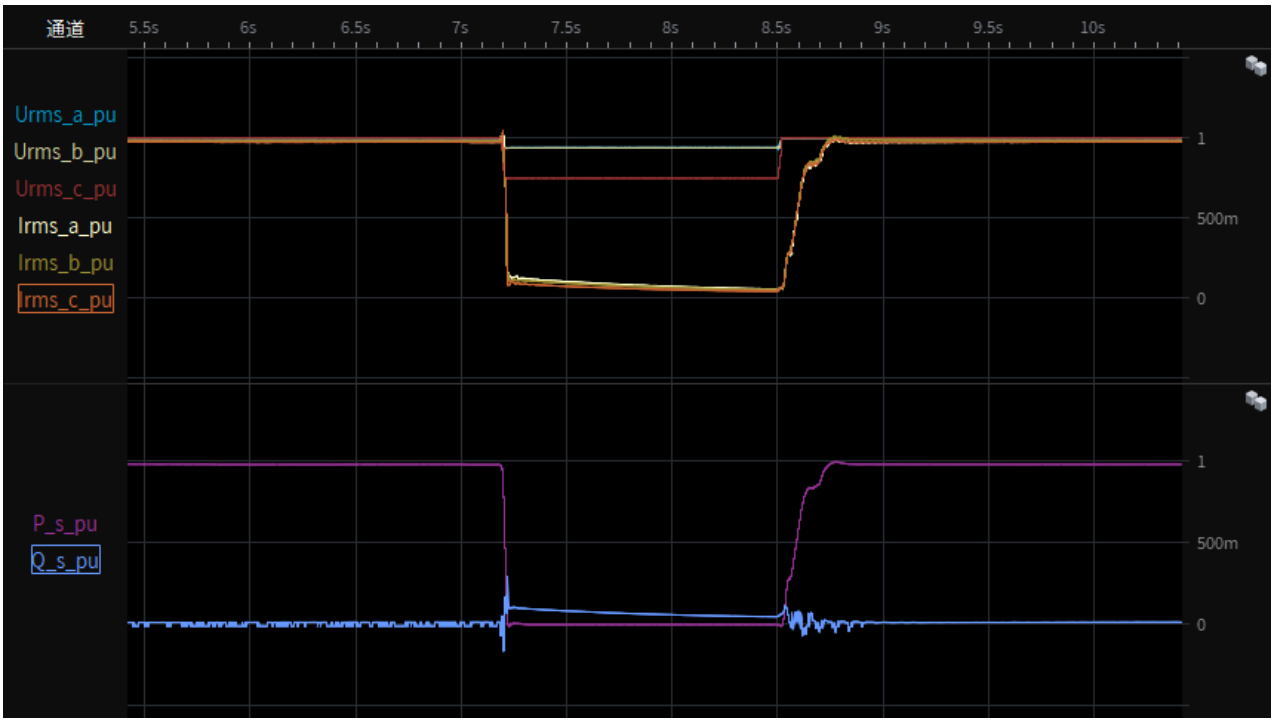


Test 4a-1.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),20% load
restoring time

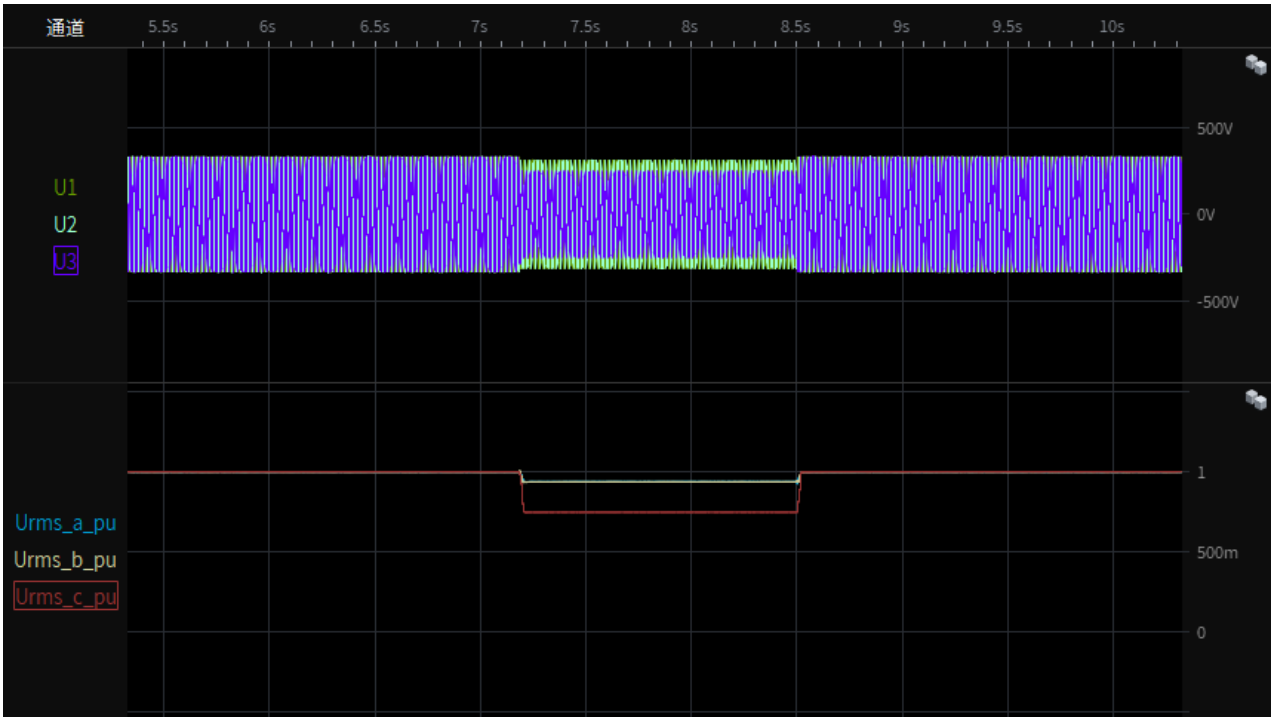


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

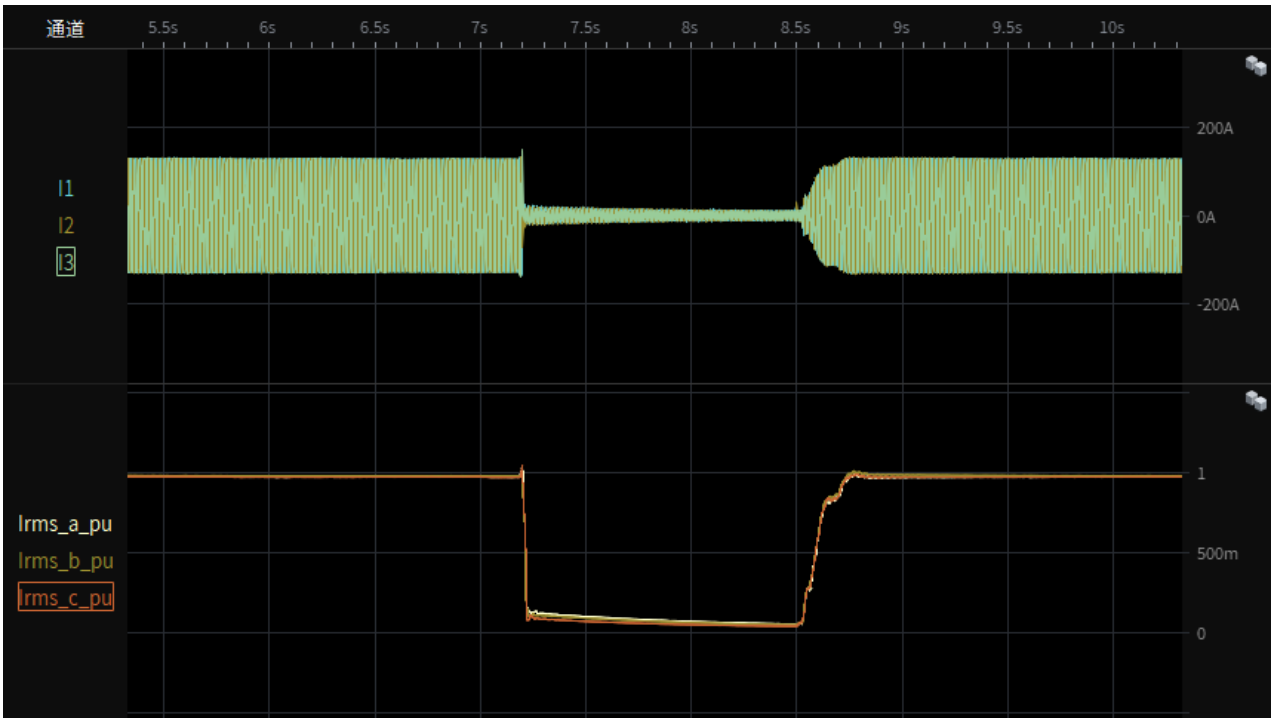


Test 4a-2.2 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

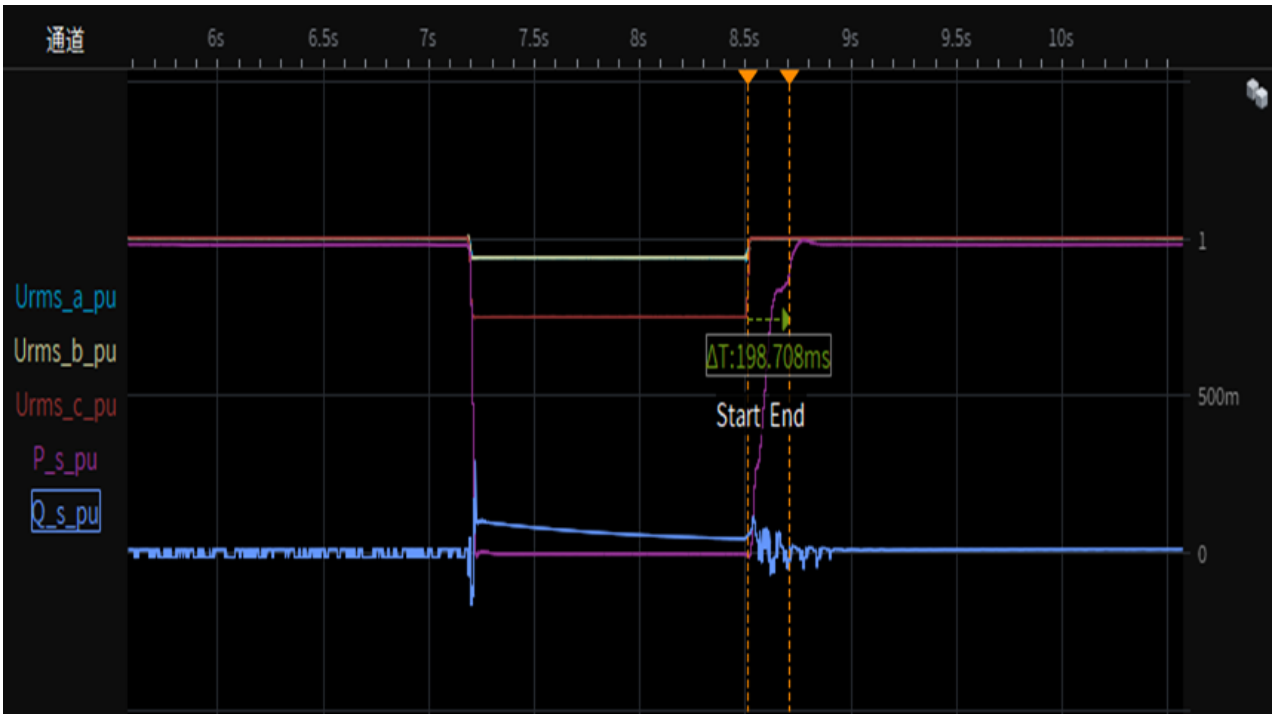


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

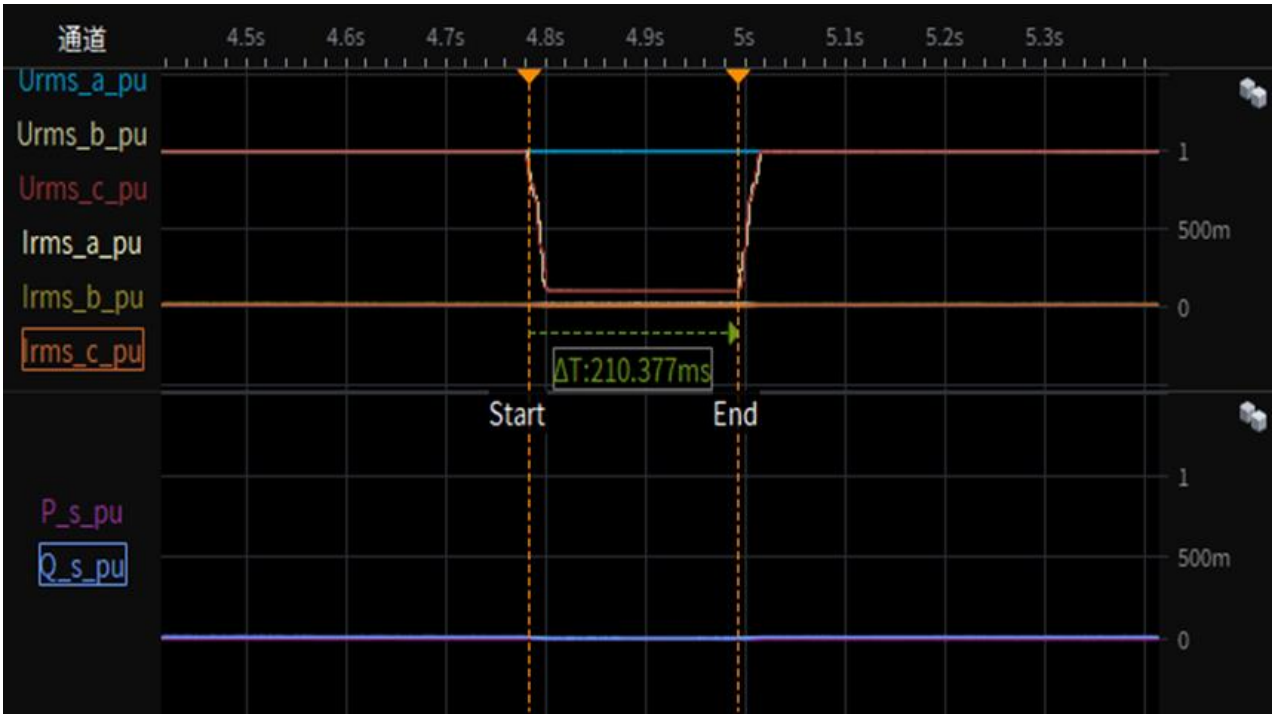


Test 4a-2.4 Depth of fault phase: 0.75p.u.,two-phase-asymmetrical (type D), 95% load
restoring time

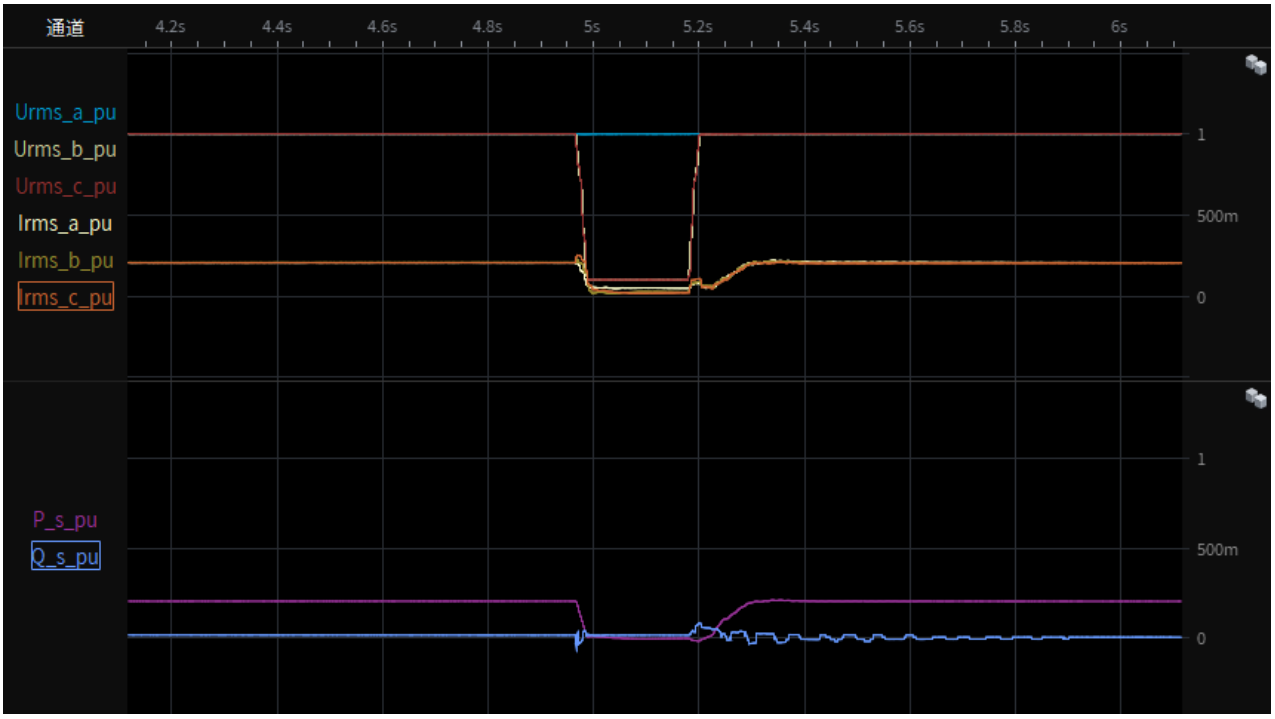


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

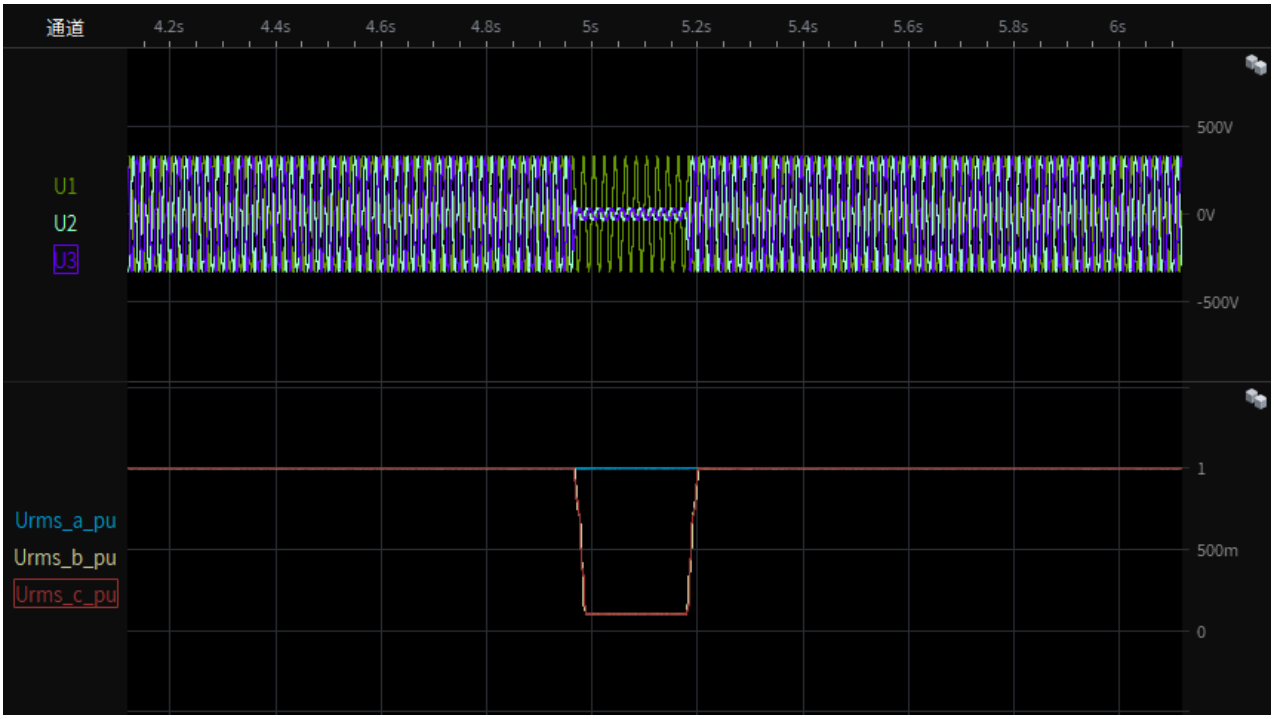


Test 5-1.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),20% load
Test overview(voltage,current,active and reactive power)

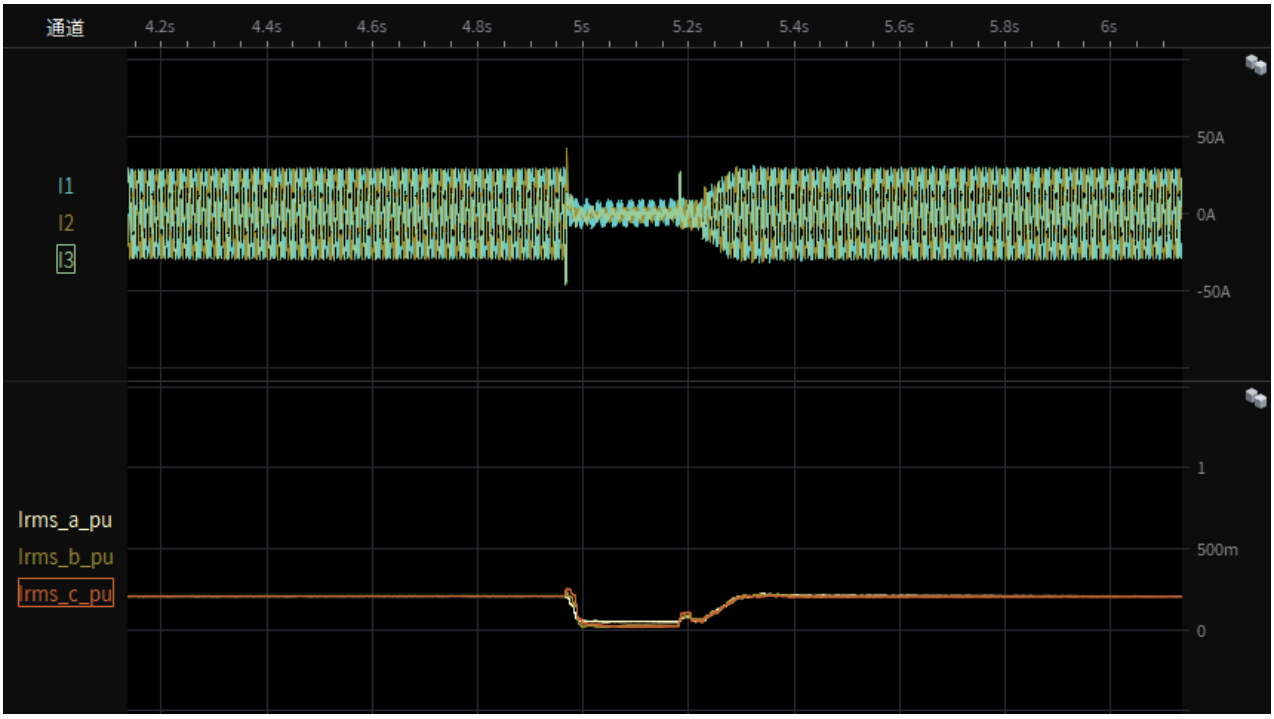


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

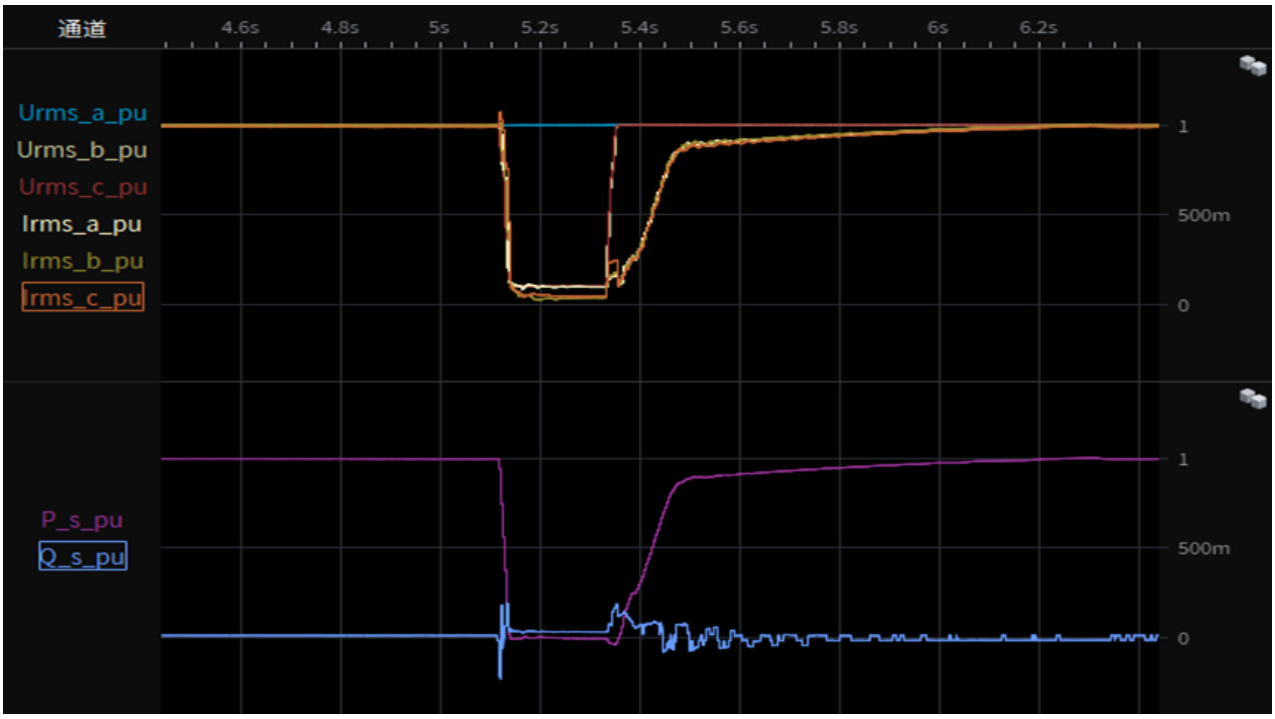


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

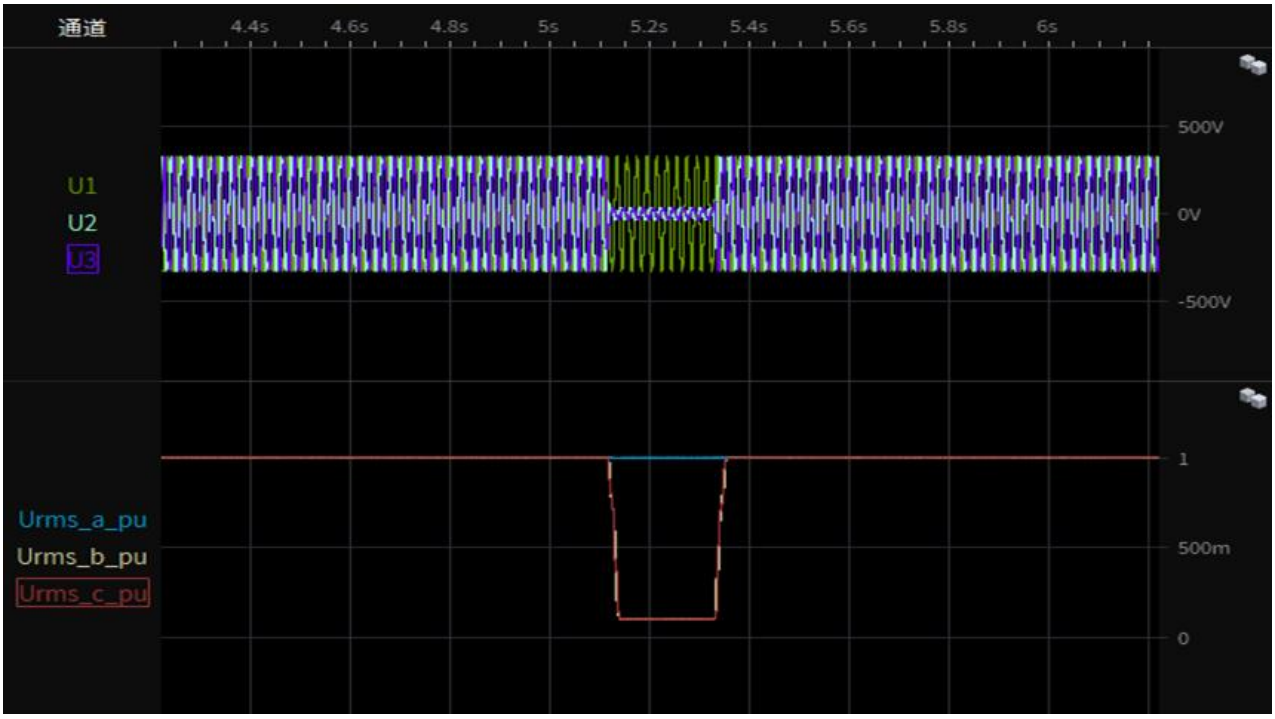


Test 5-2.1 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load Test overview(voltage,current,active and reactive power)

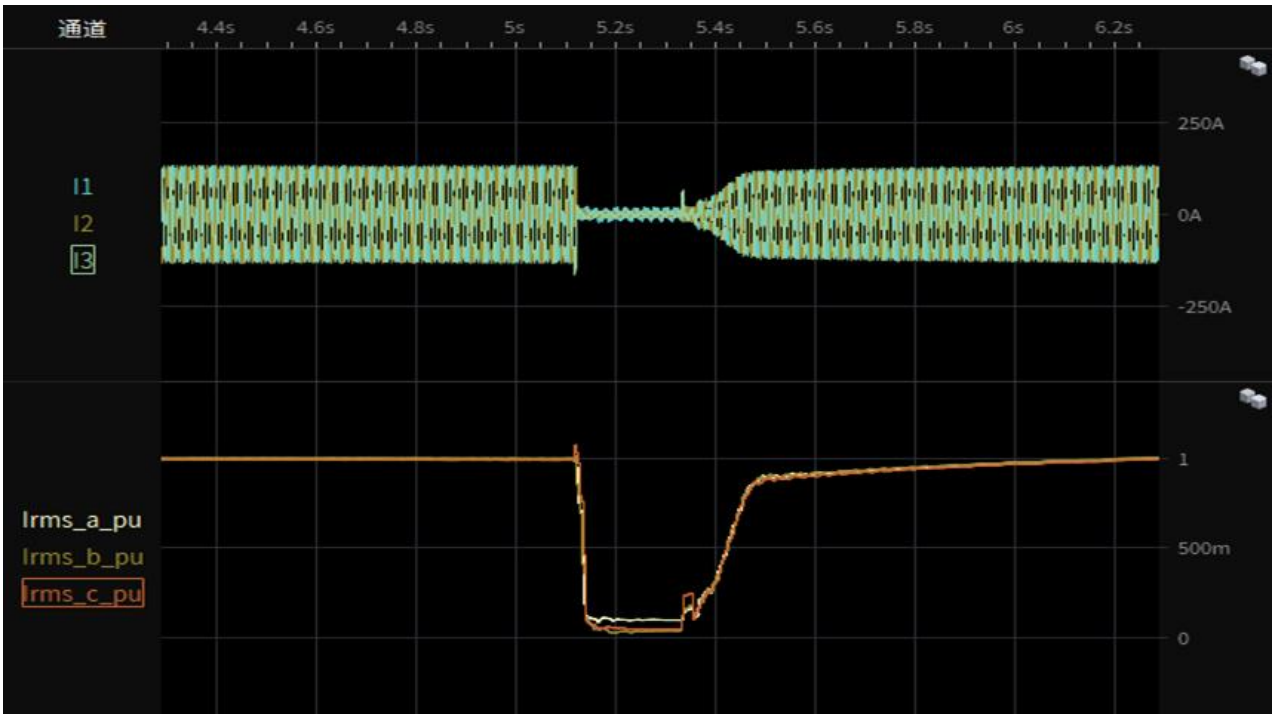


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

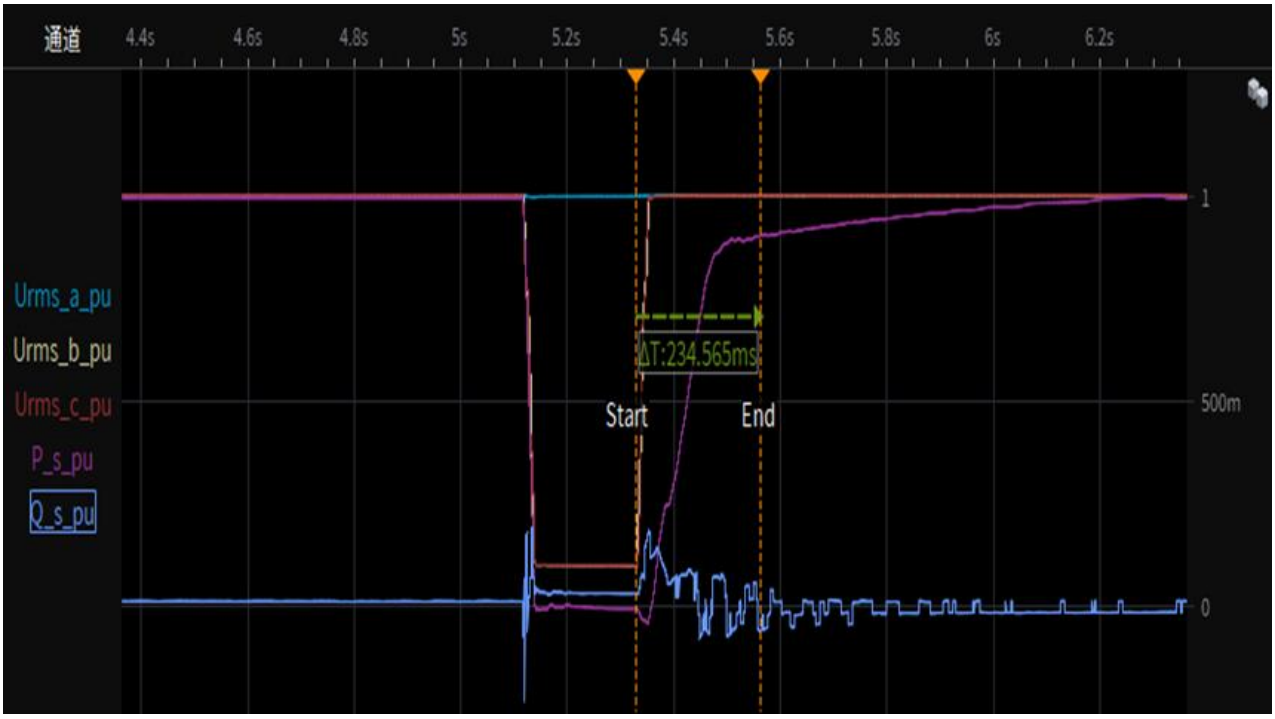


Test 5-2.3 Depth of fault phase: 0.1p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase currents

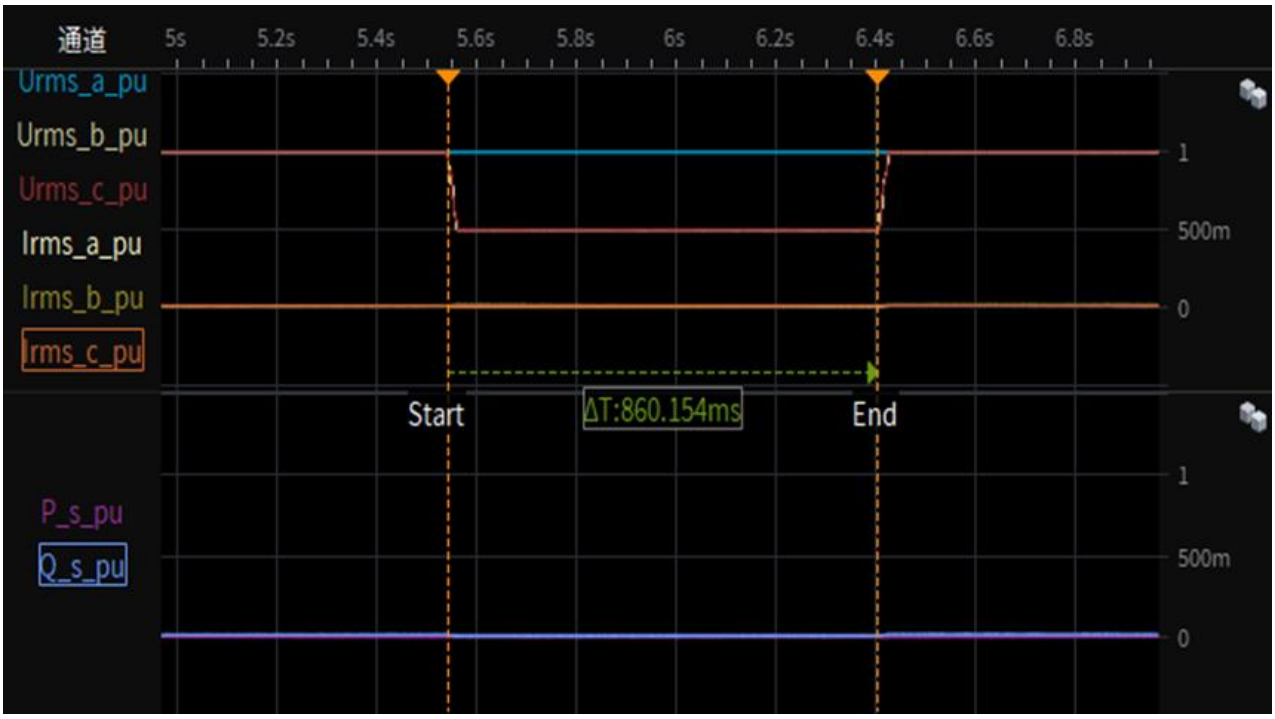


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

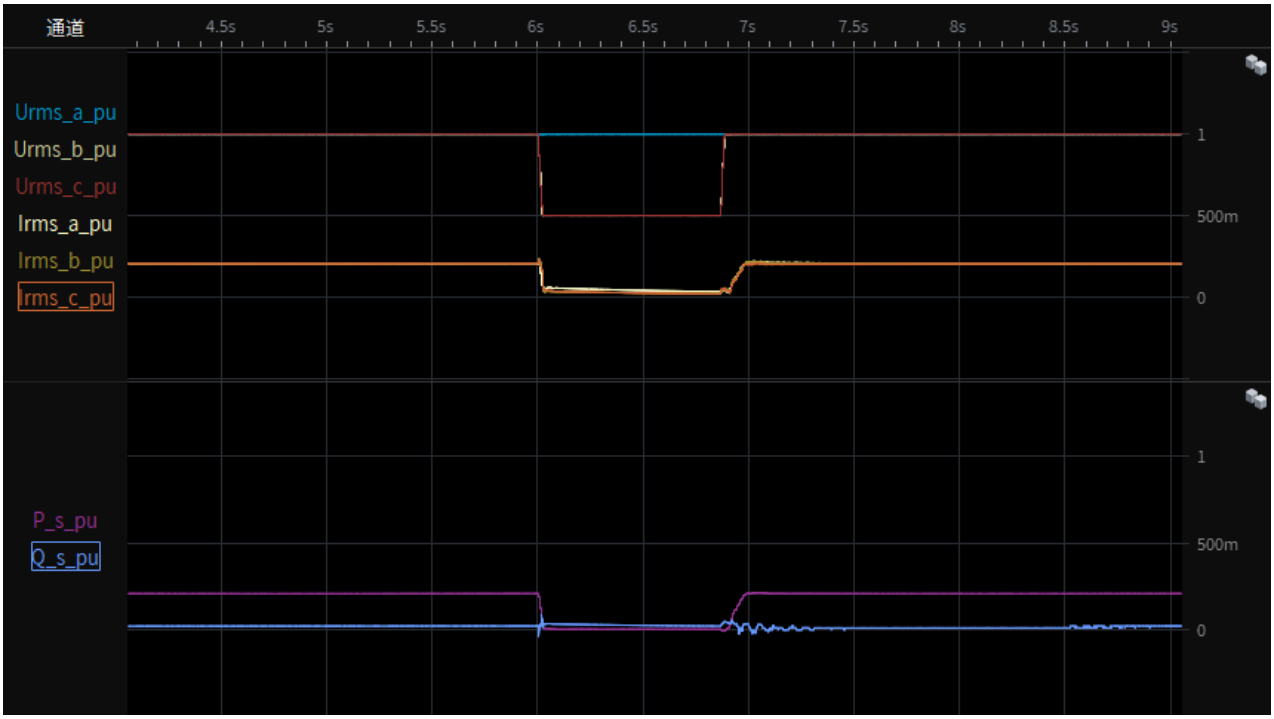


Test 6-Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D), 0% load
Test overview(voltage,current,active and reactive power)

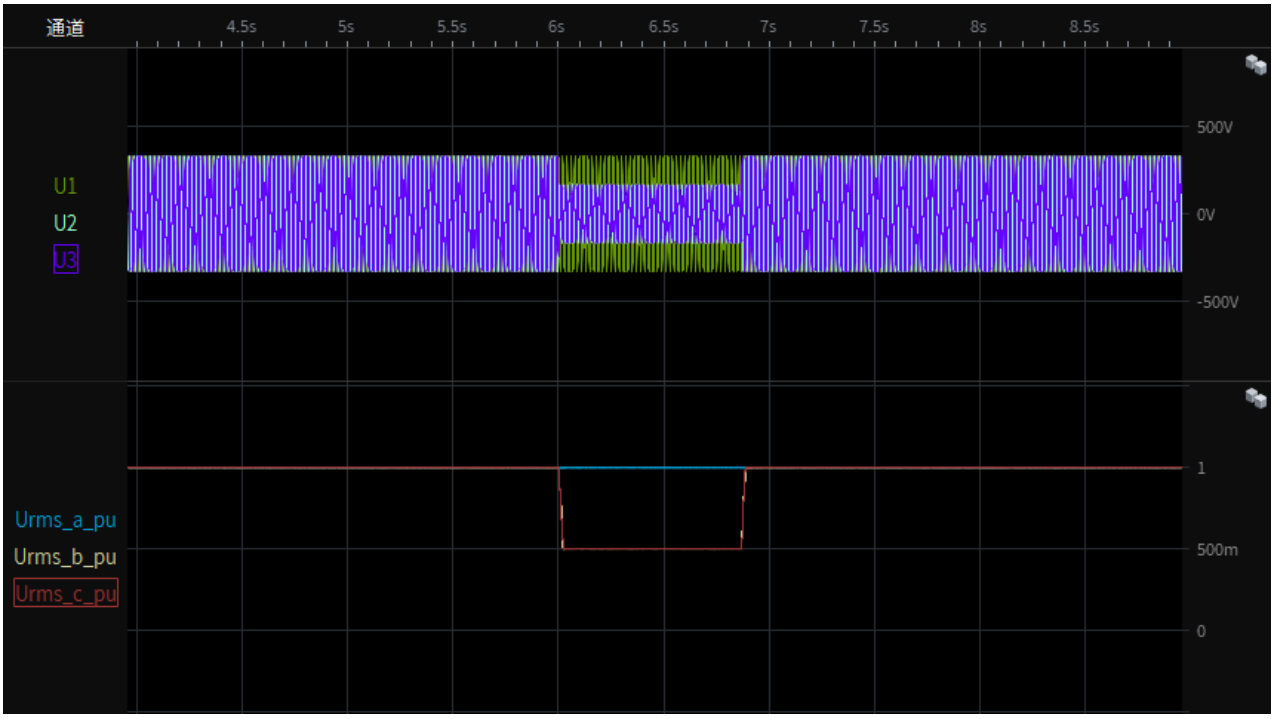


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

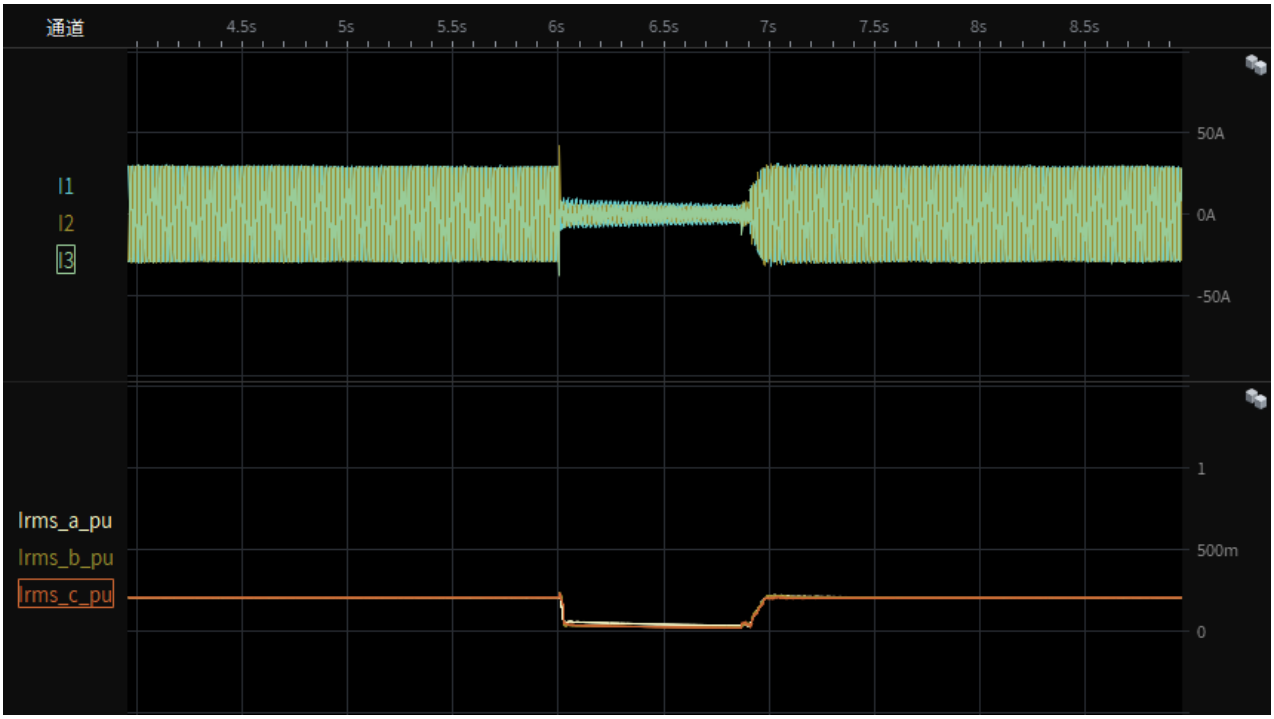


Test 6-1.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

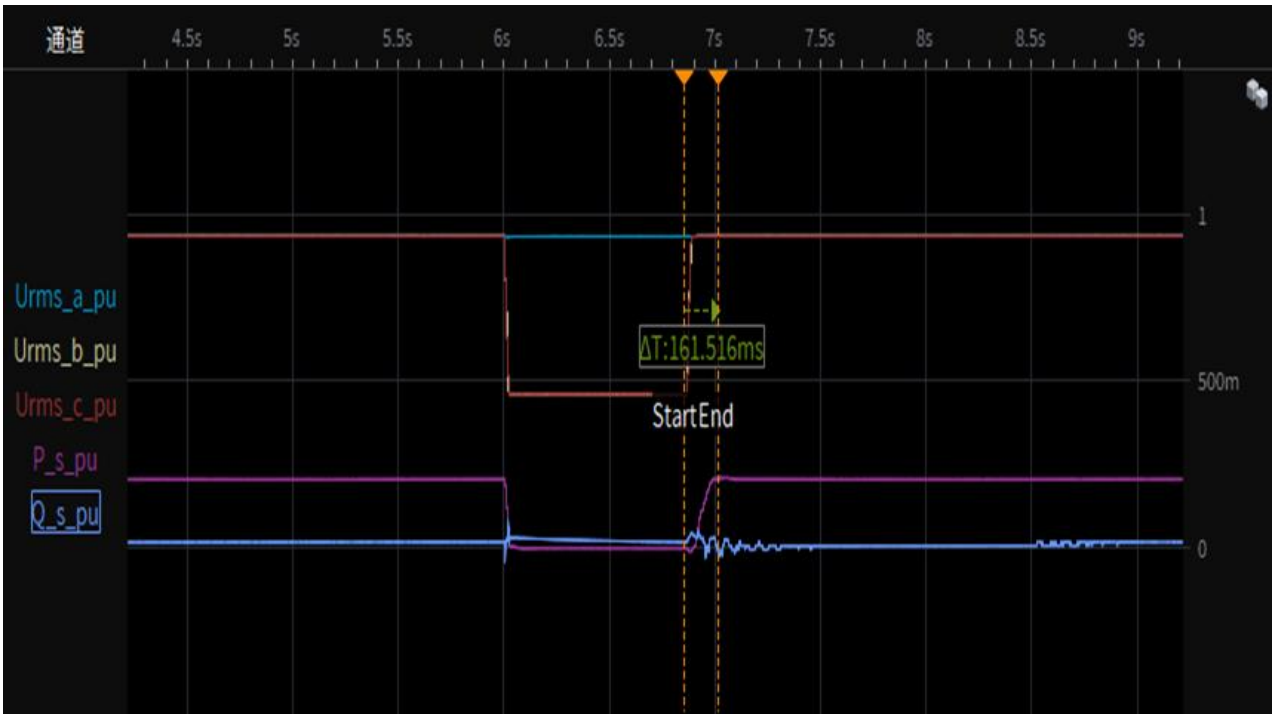


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

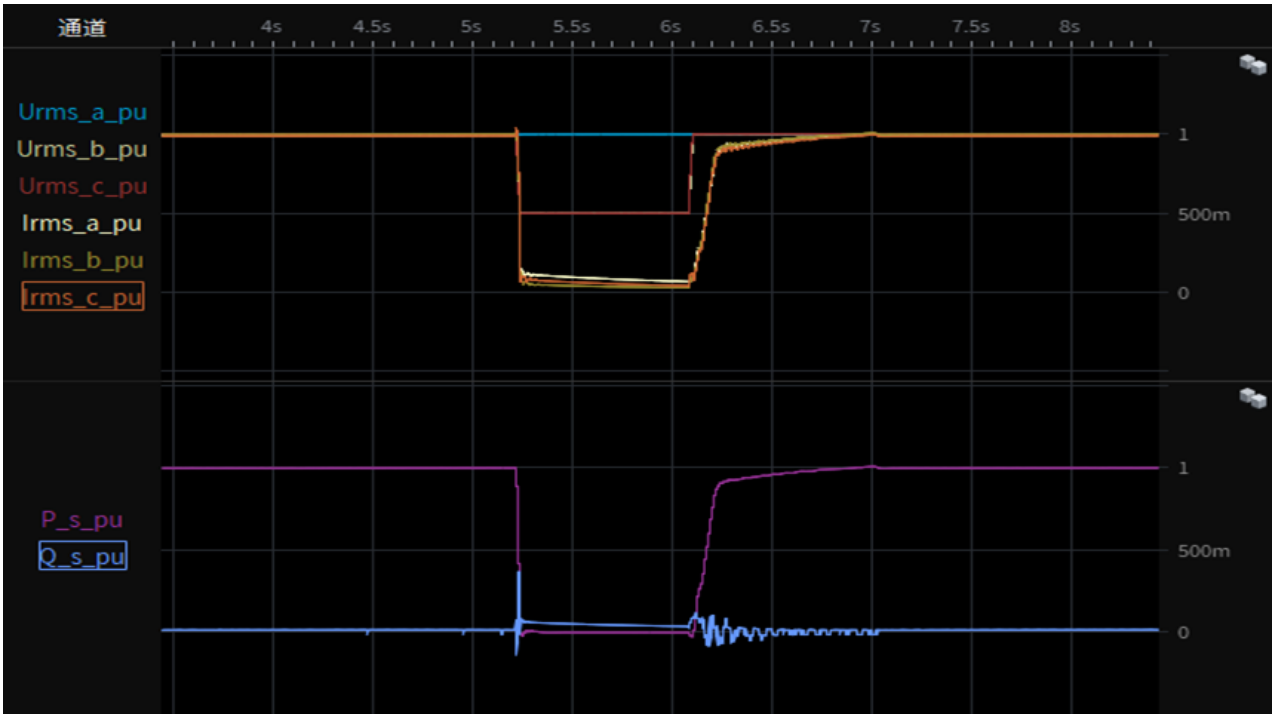


Test 6-1.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),20% load
restoring time

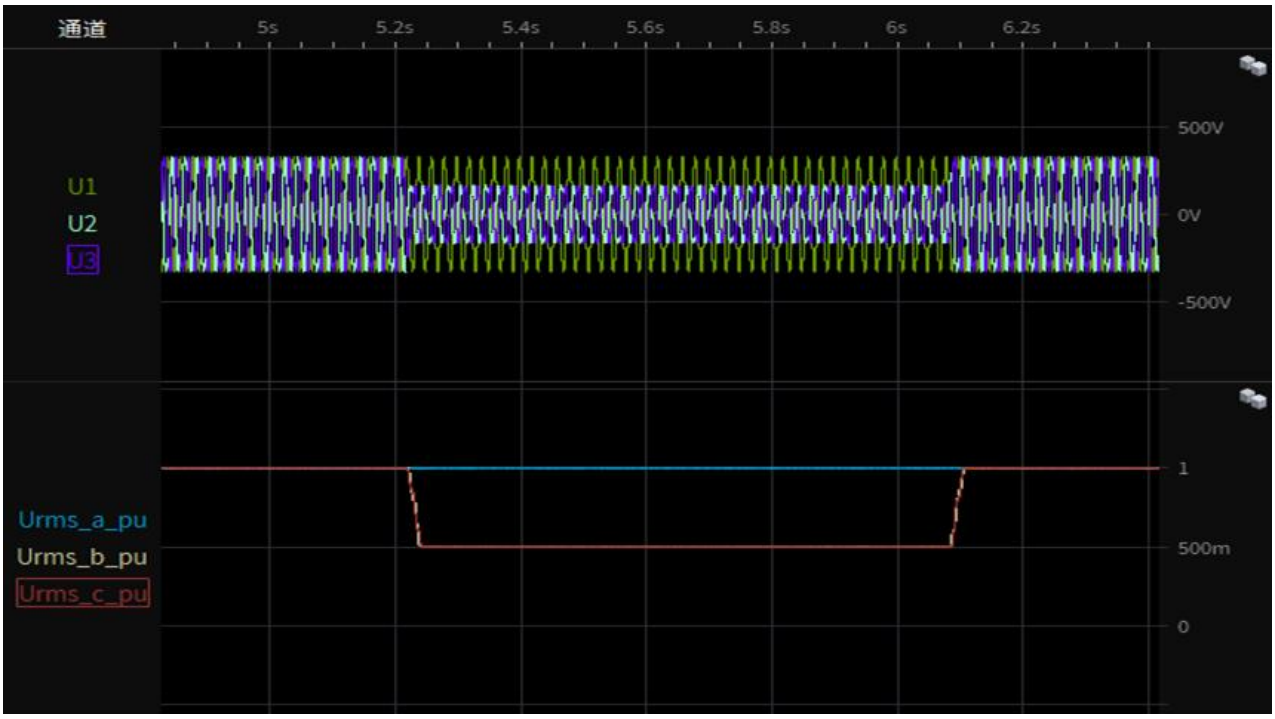


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

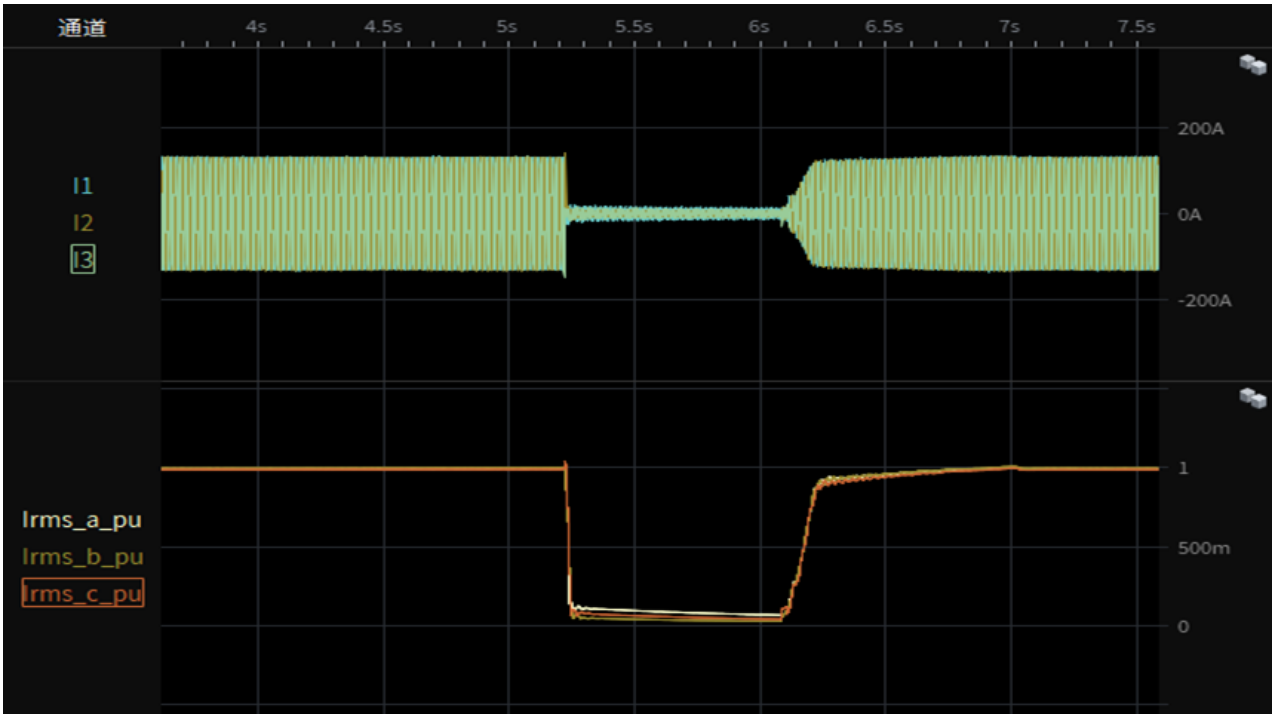


Test 6-2.2 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

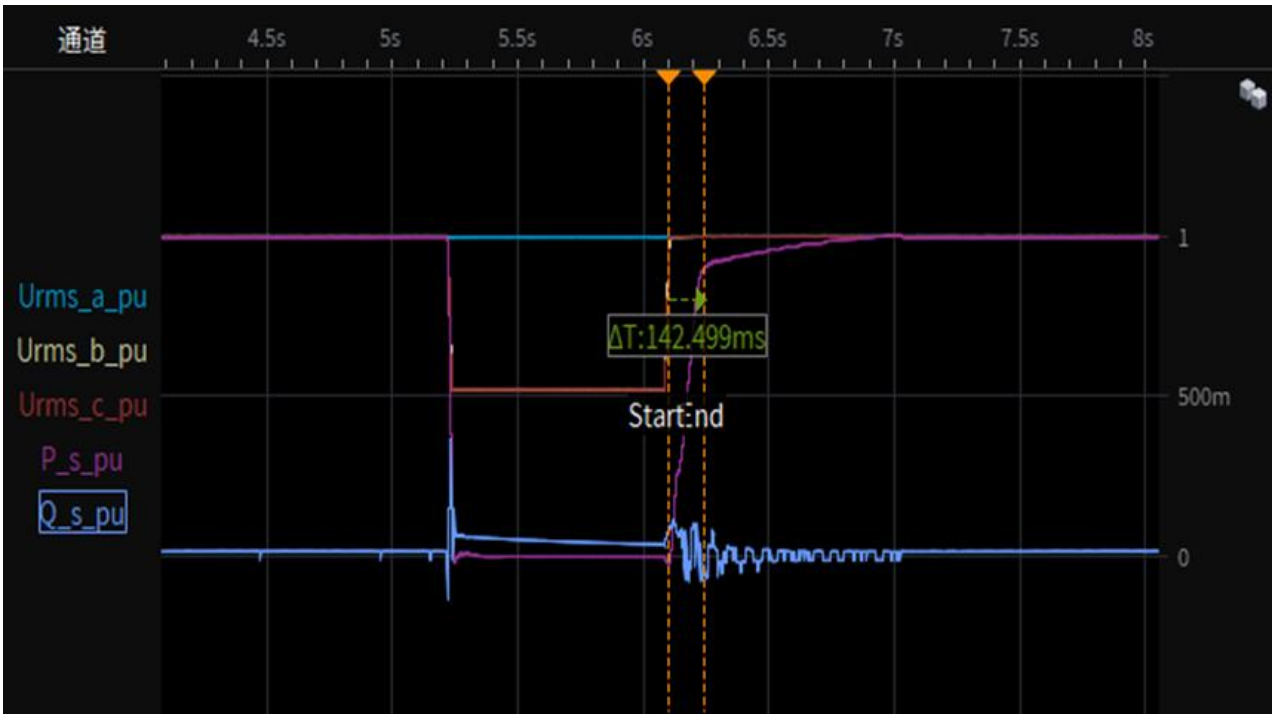


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

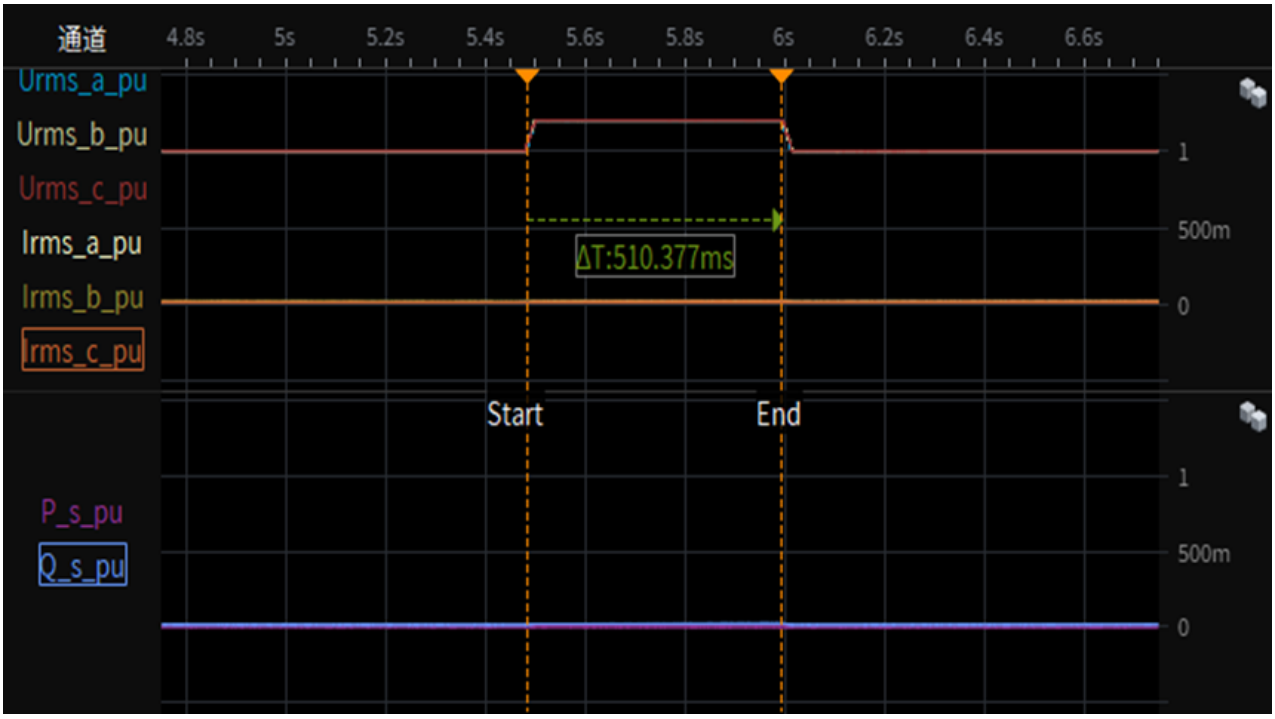


Test 6-2.4 Depth of fault phase: 0.5p.u.,LV two-phase-asymmetrical (type D), 95% load
restoring time

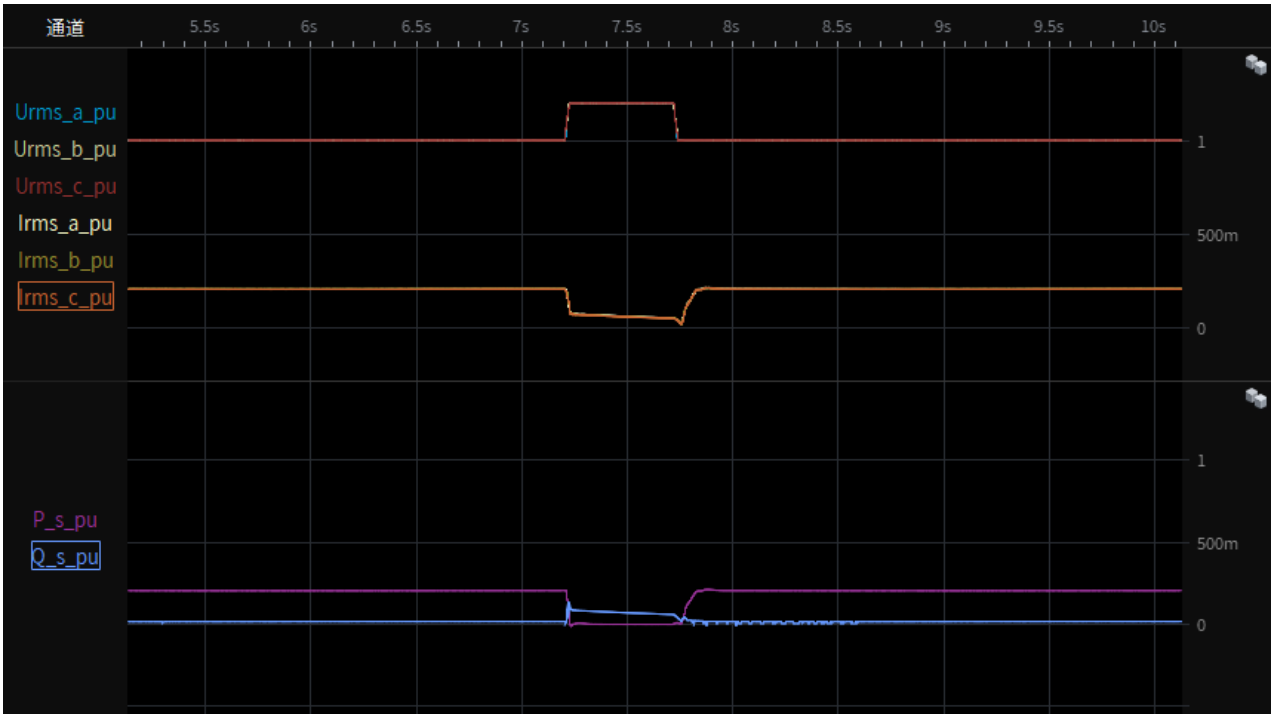


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

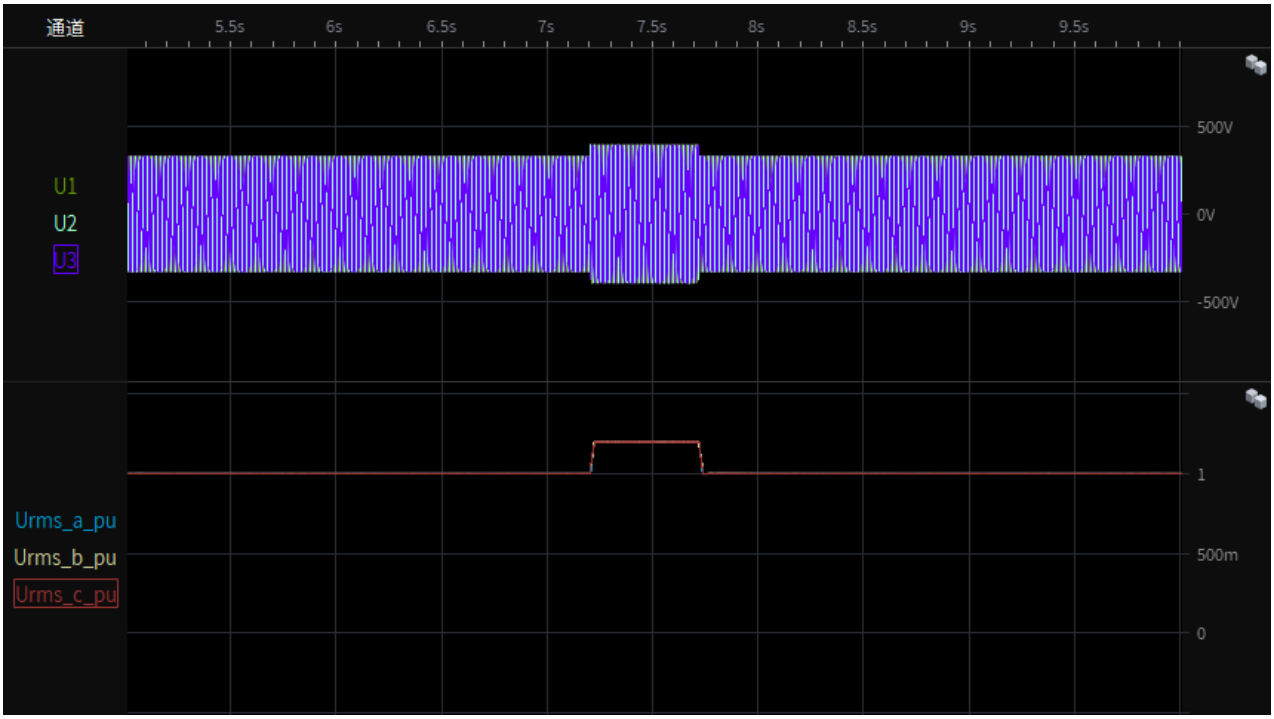


Test 7-1.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Test overview(voltage,current,active and reactive power)

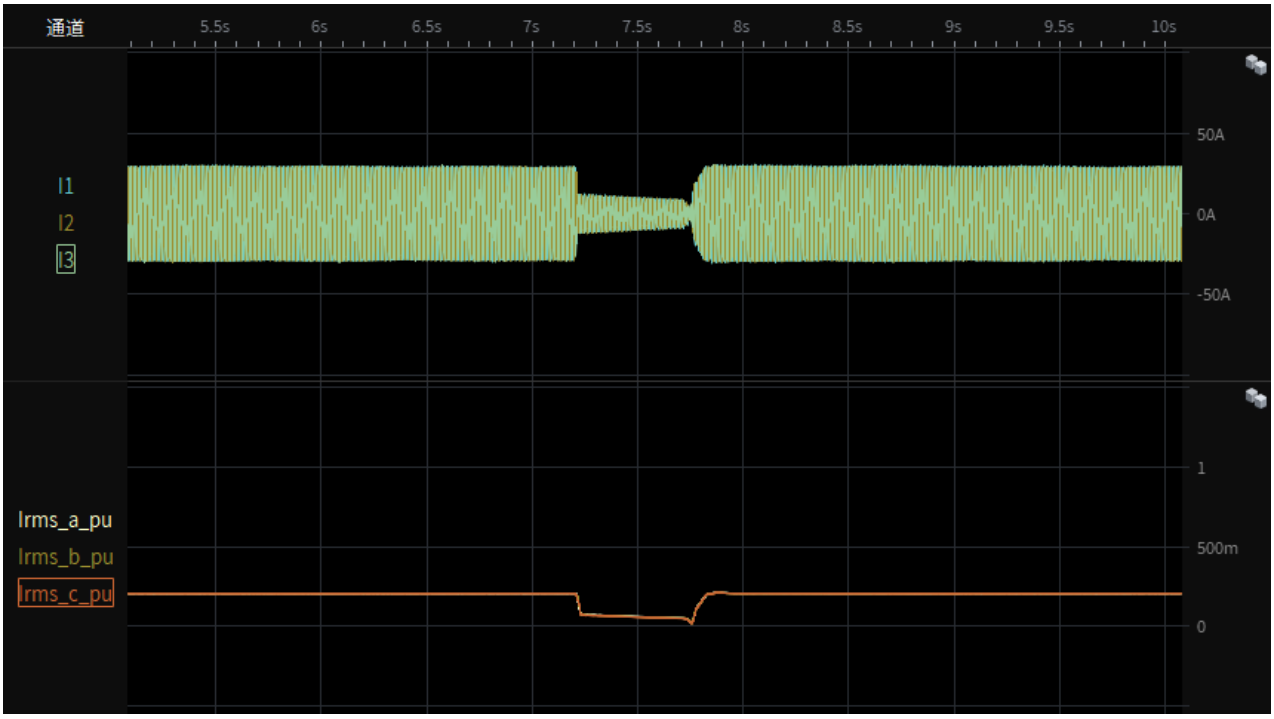


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

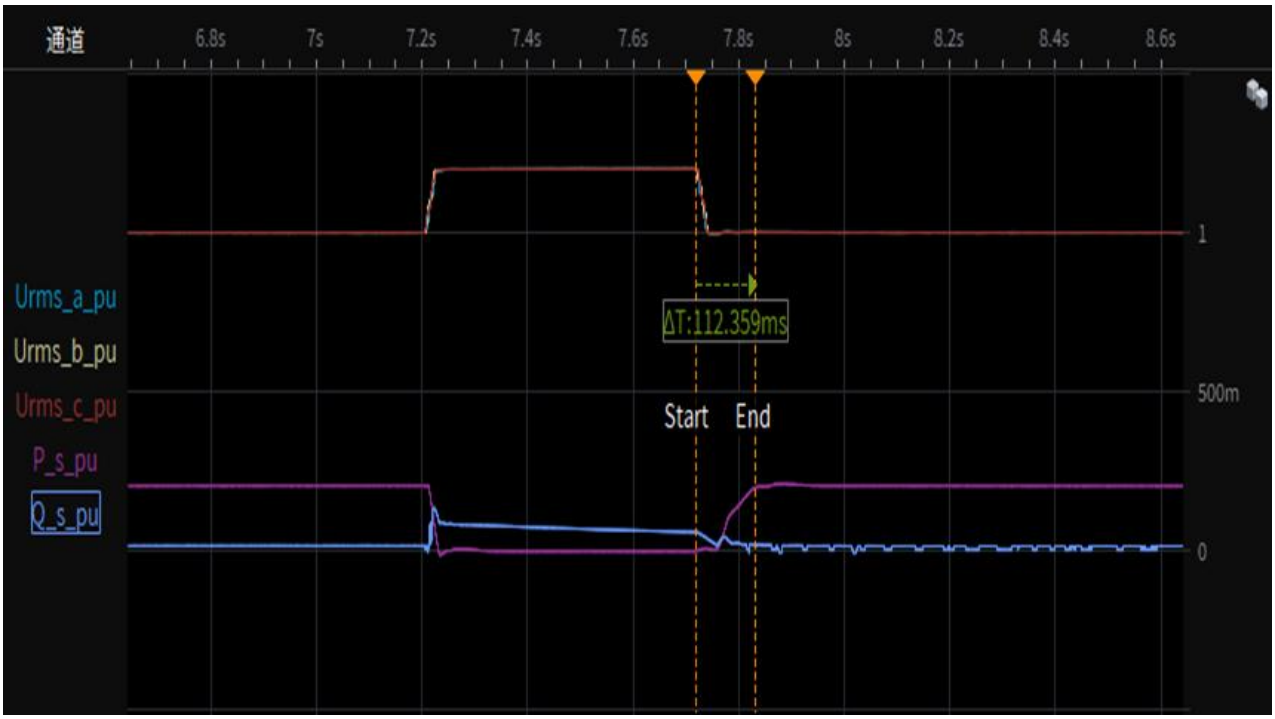


Test 7-1.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase currents

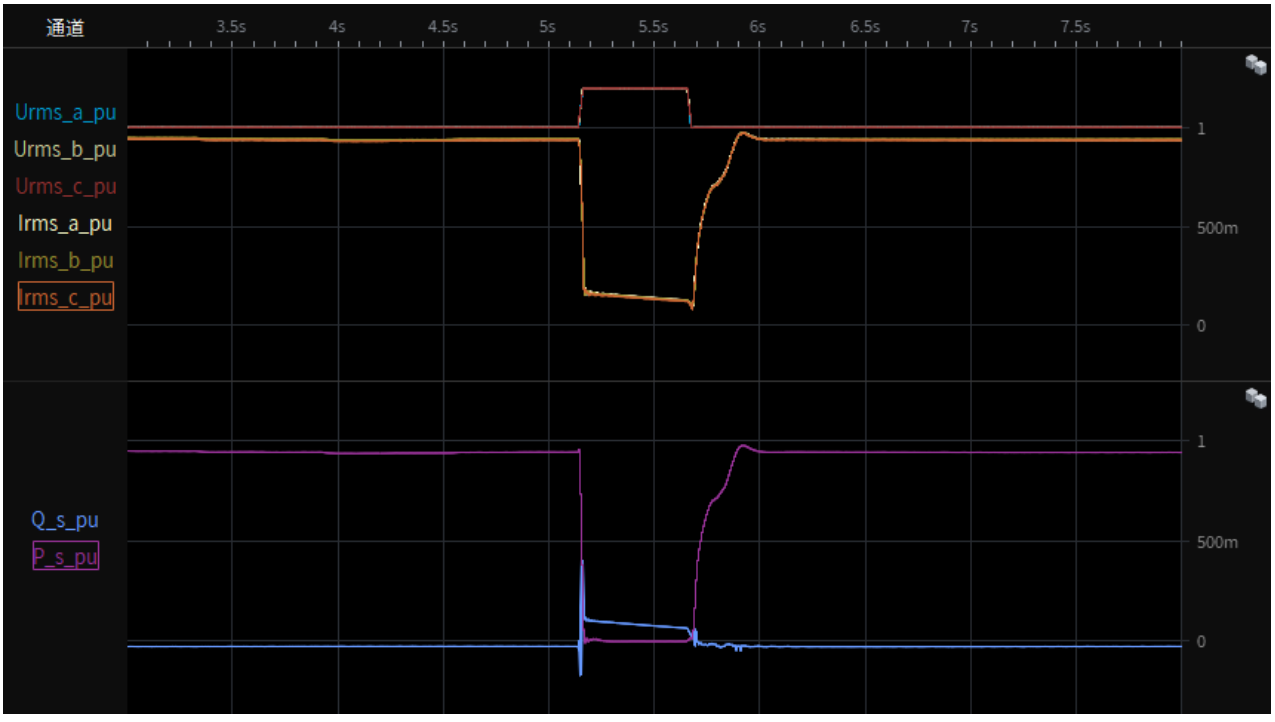


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

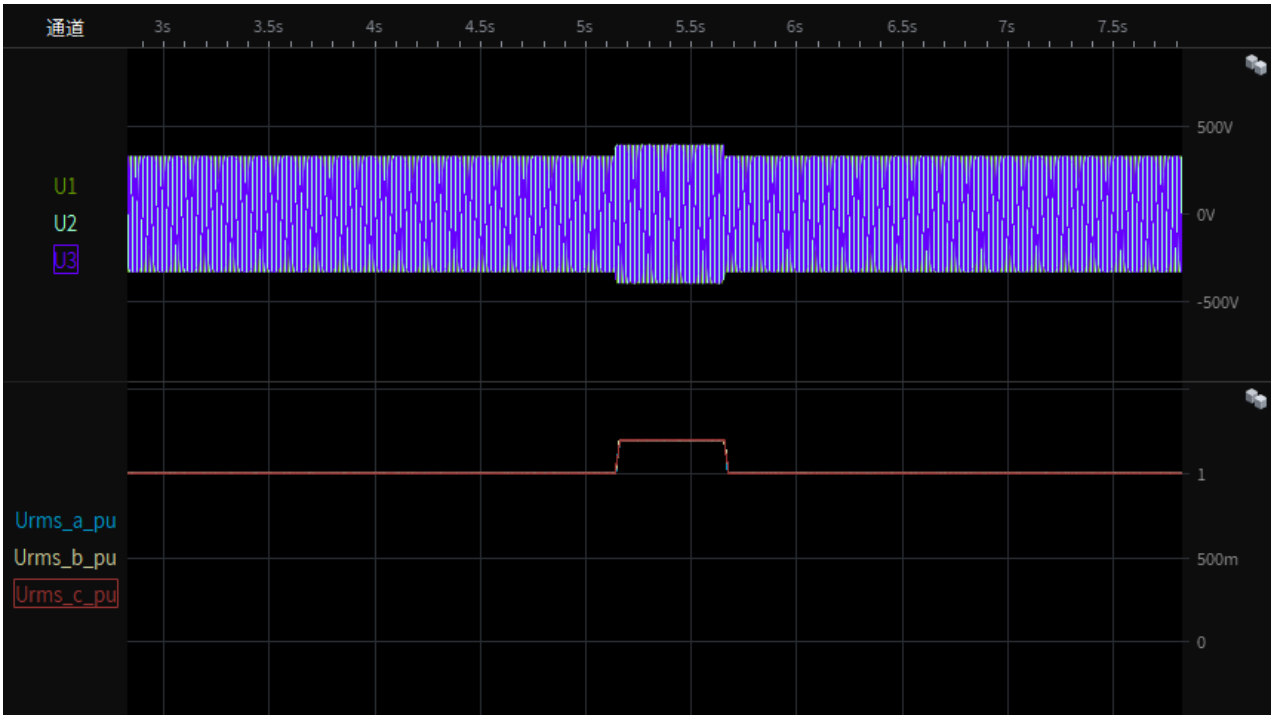


Test 7-2.1 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Test overview(voltage,current,active and reactive power)

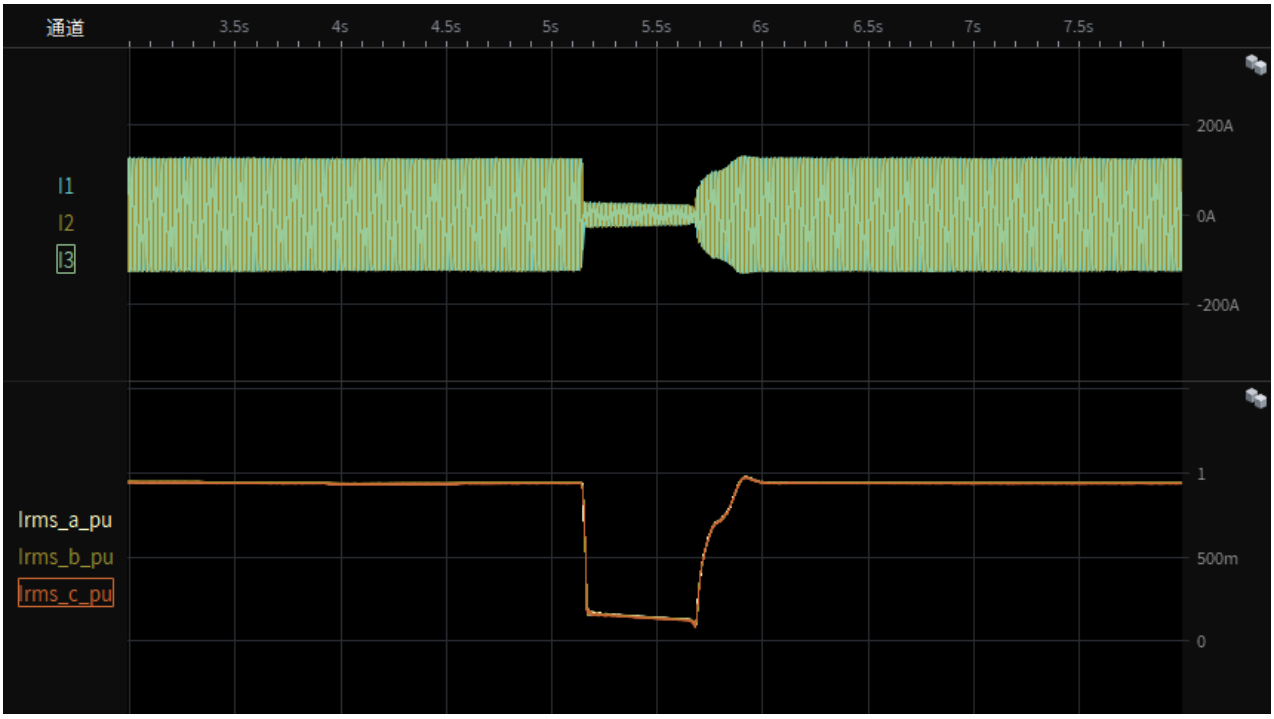


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

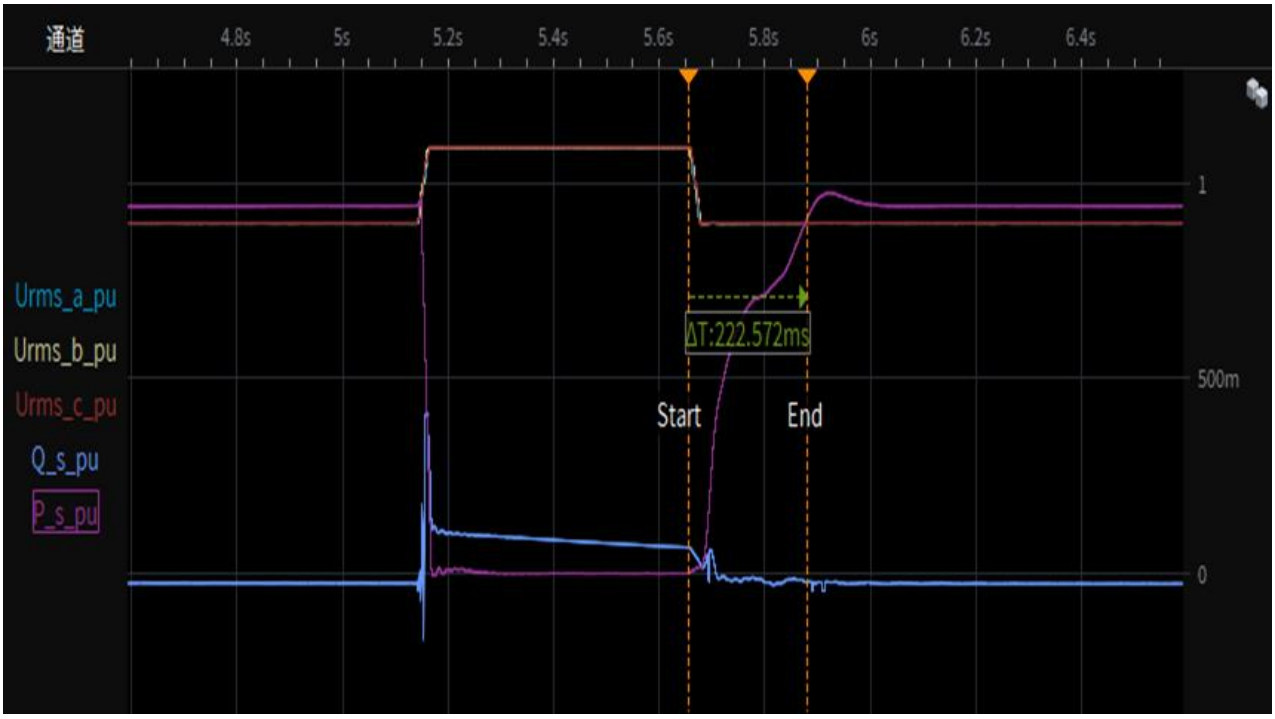


Test 7-2.3 Depth of fault phase: 1.20p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase currents

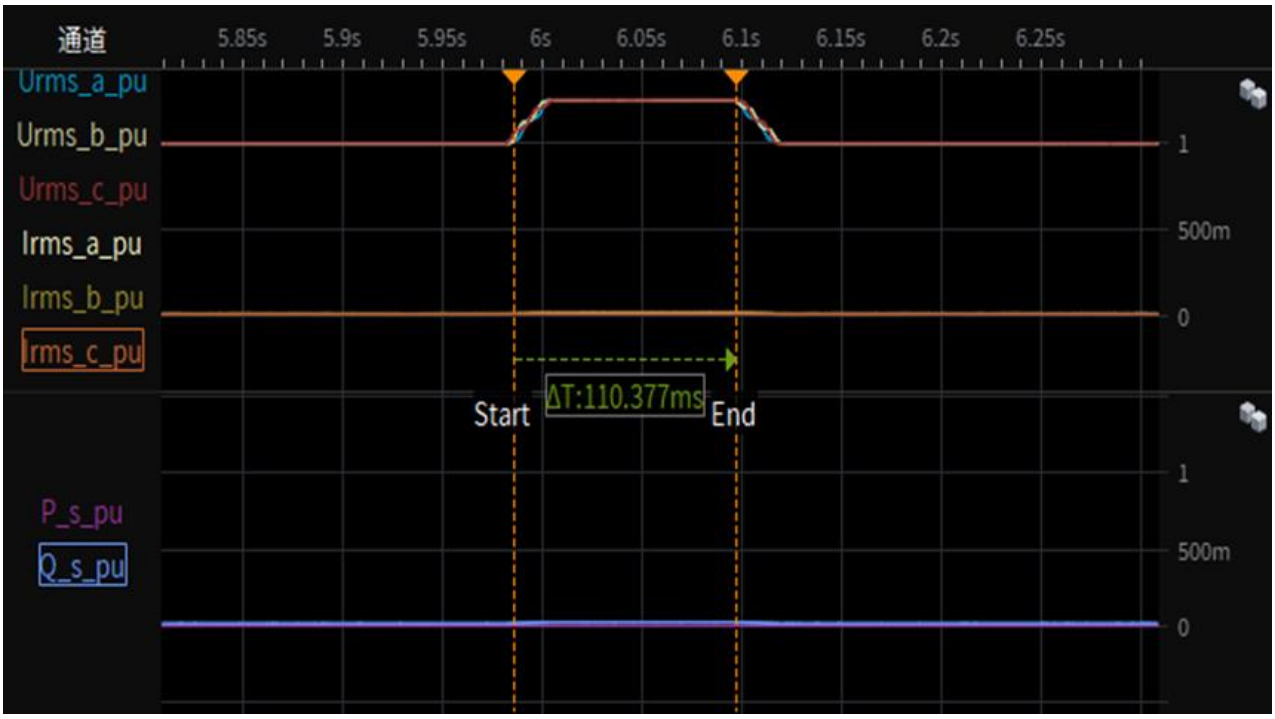


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

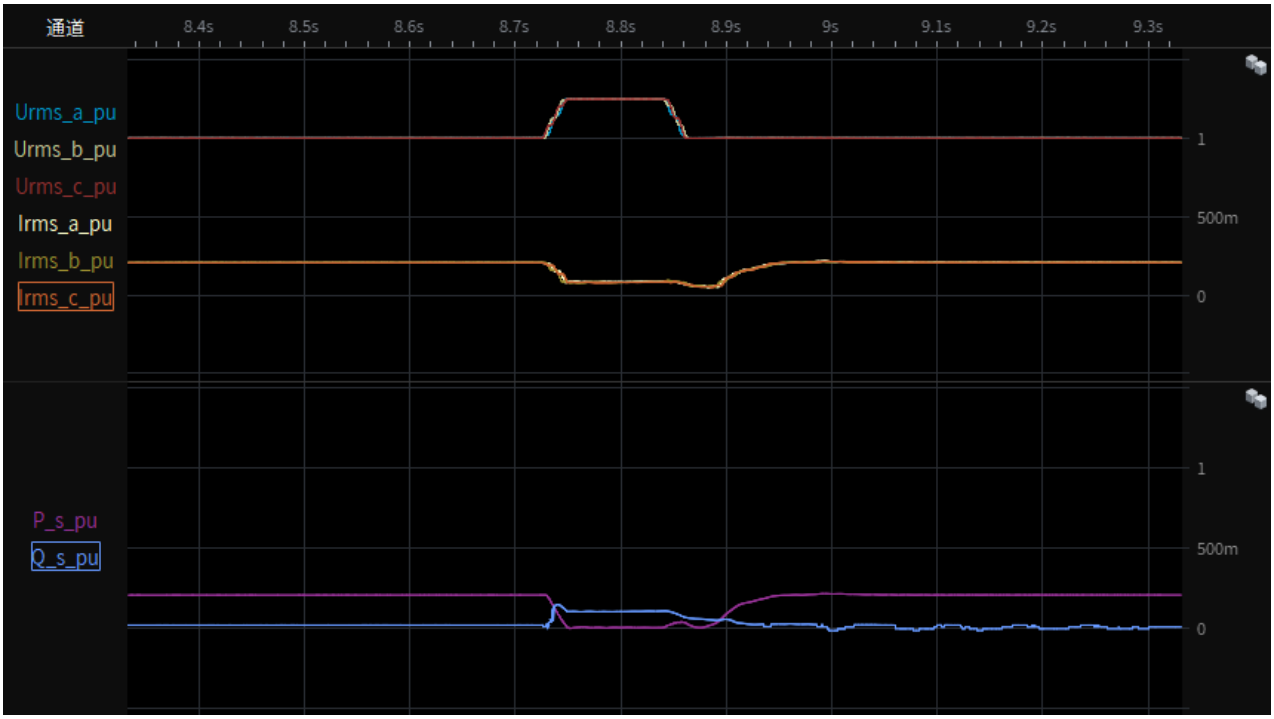


Test 8-Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A), 0% load
Test overview(voltage,current,active and reactive power)

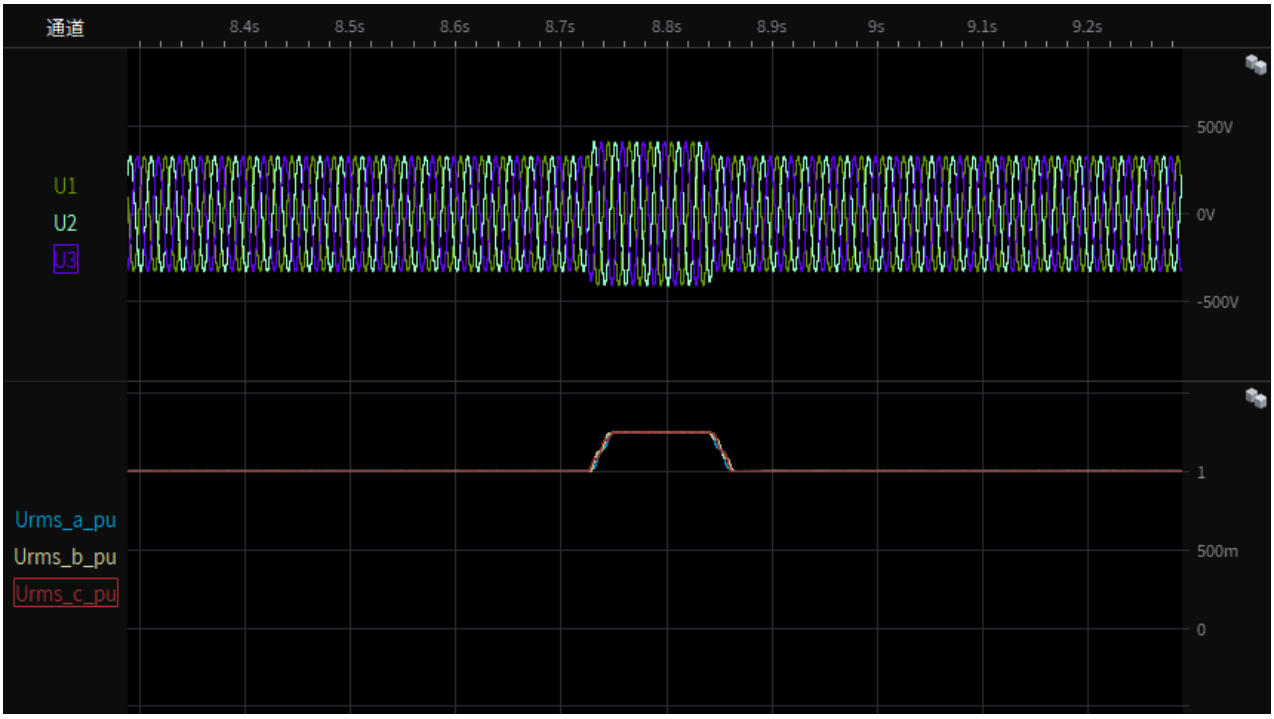


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

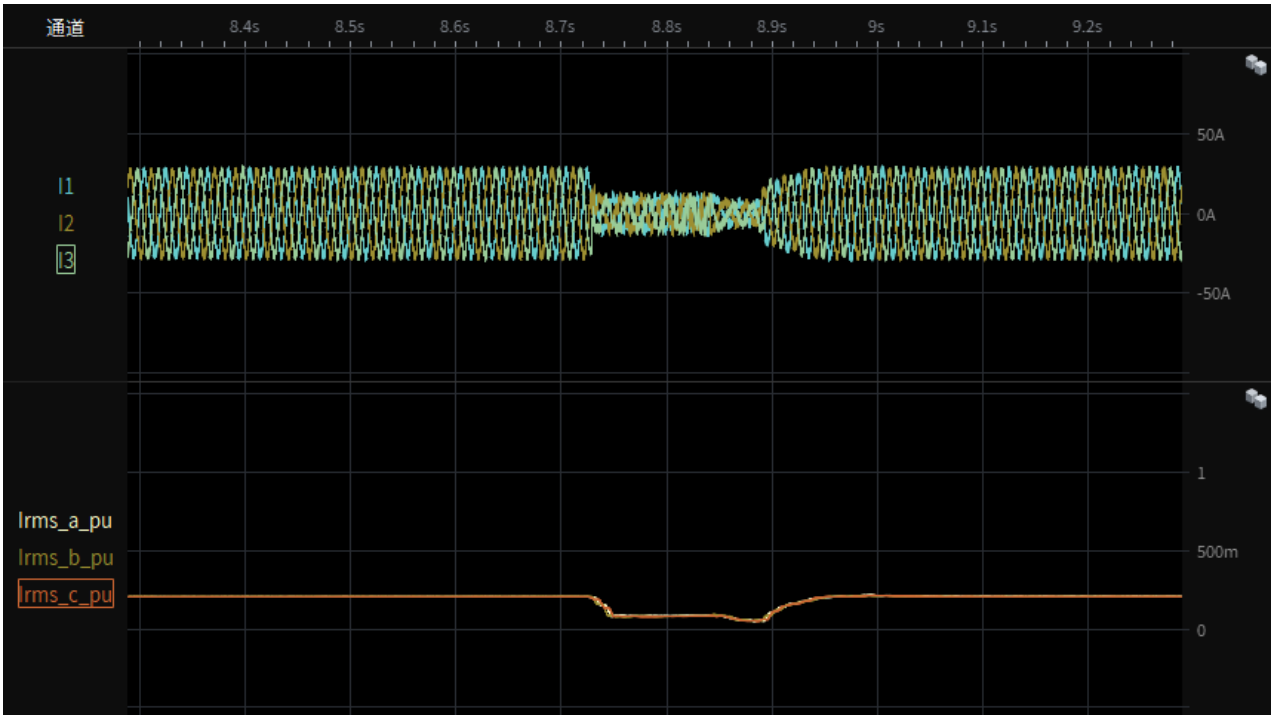


Test 8-1.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
Instantaneous curve and RMS value of phase-to-neutral voltages

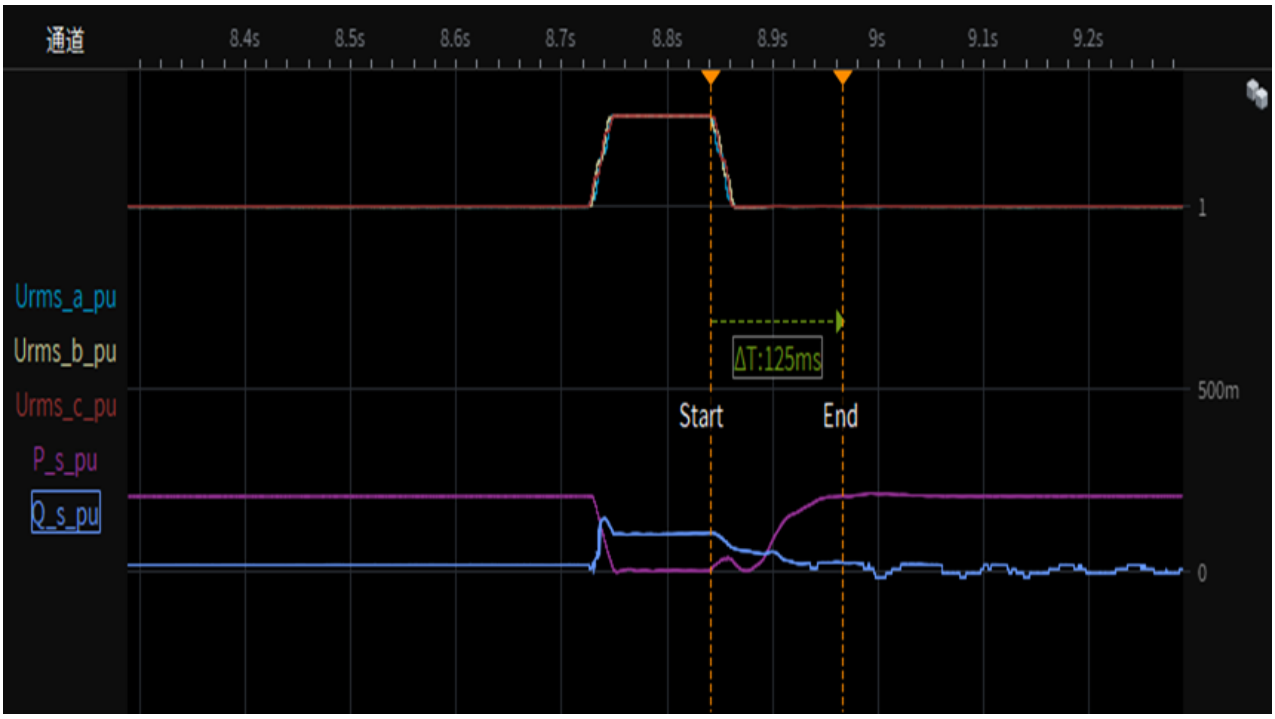


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

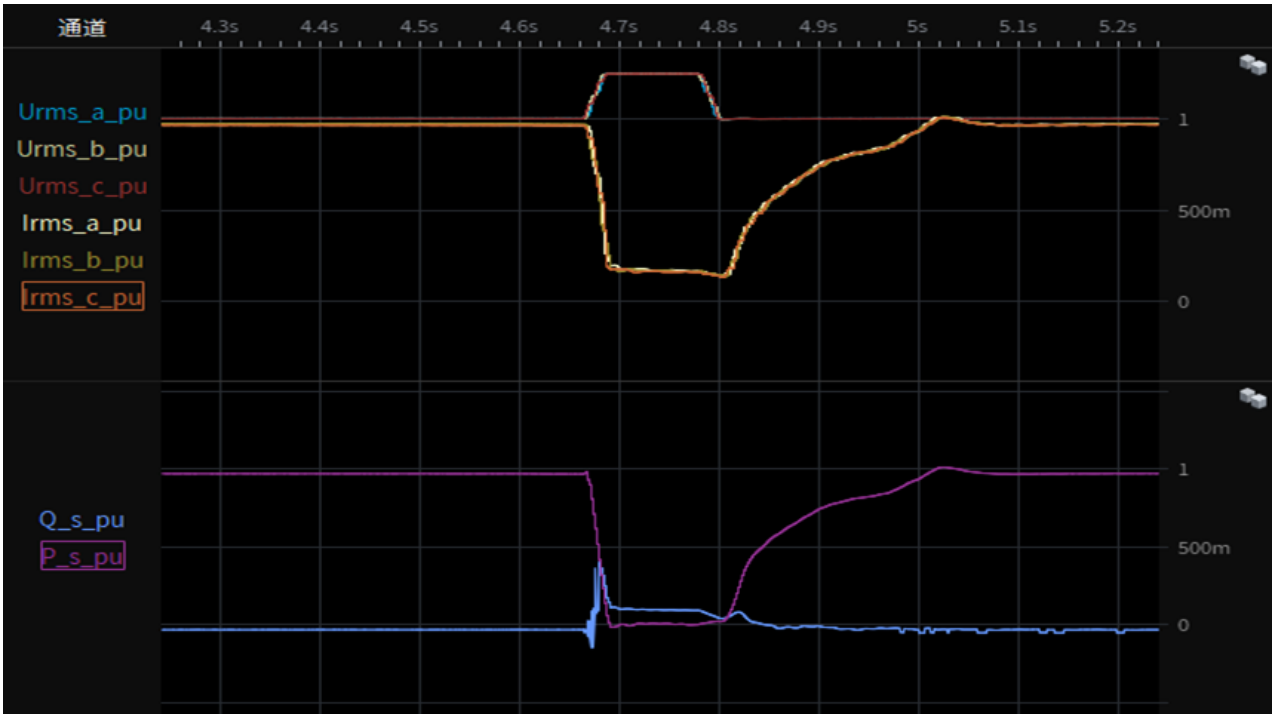


Test 8-1.4 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),20% load
restoring time

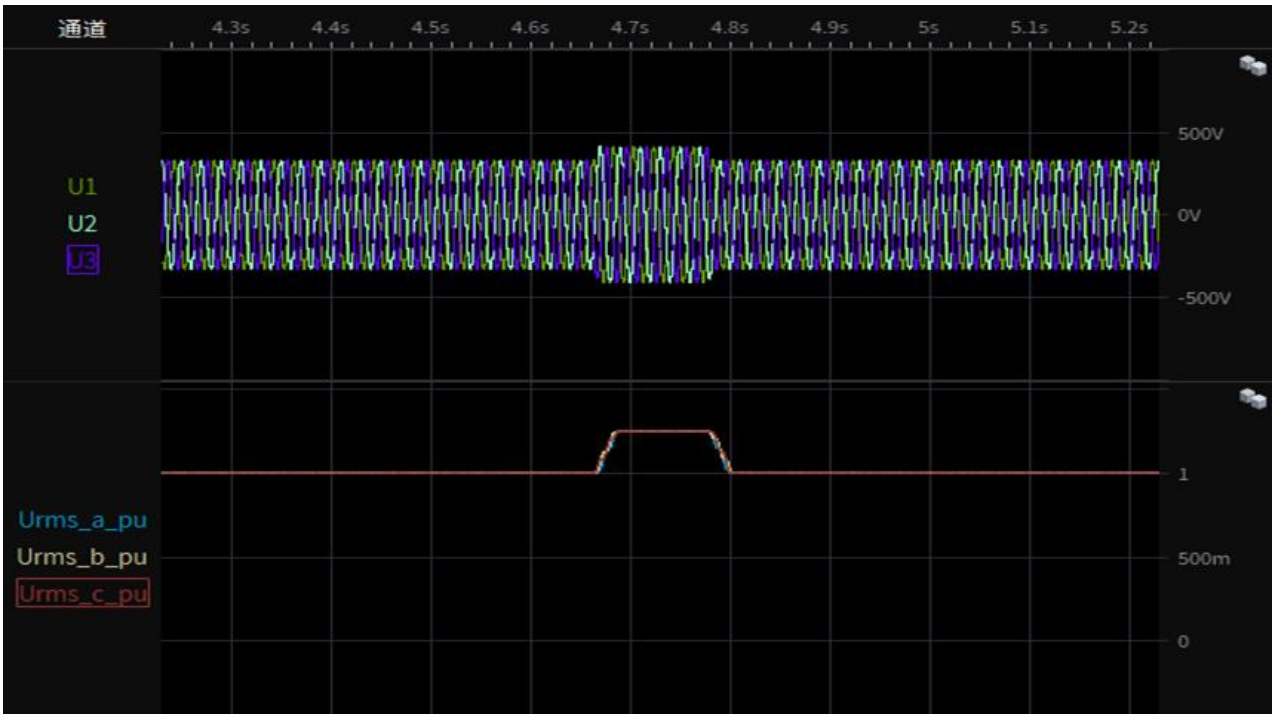


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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)

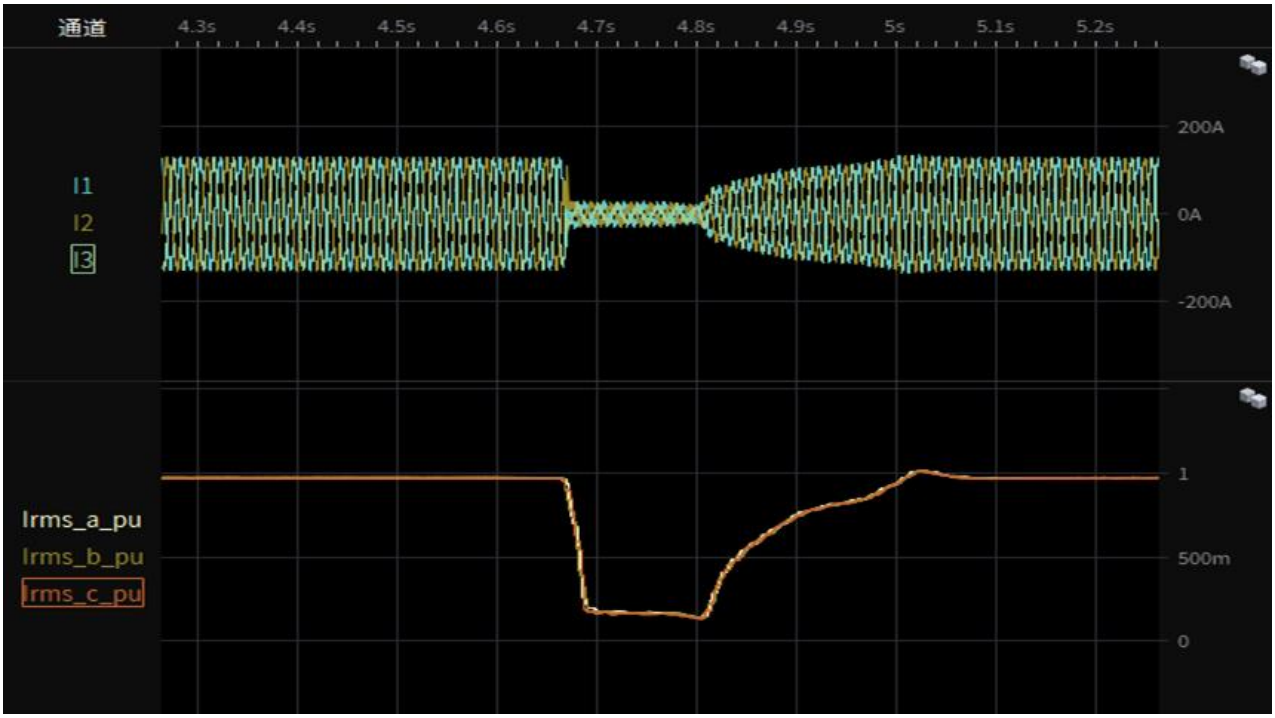


Test 8-2.2 Depth of fault phase: 1.25p.u.,three-phase-symmetrical (type A),95% load
Instantaneous curve and RMS value of phase-to-neutral voltages

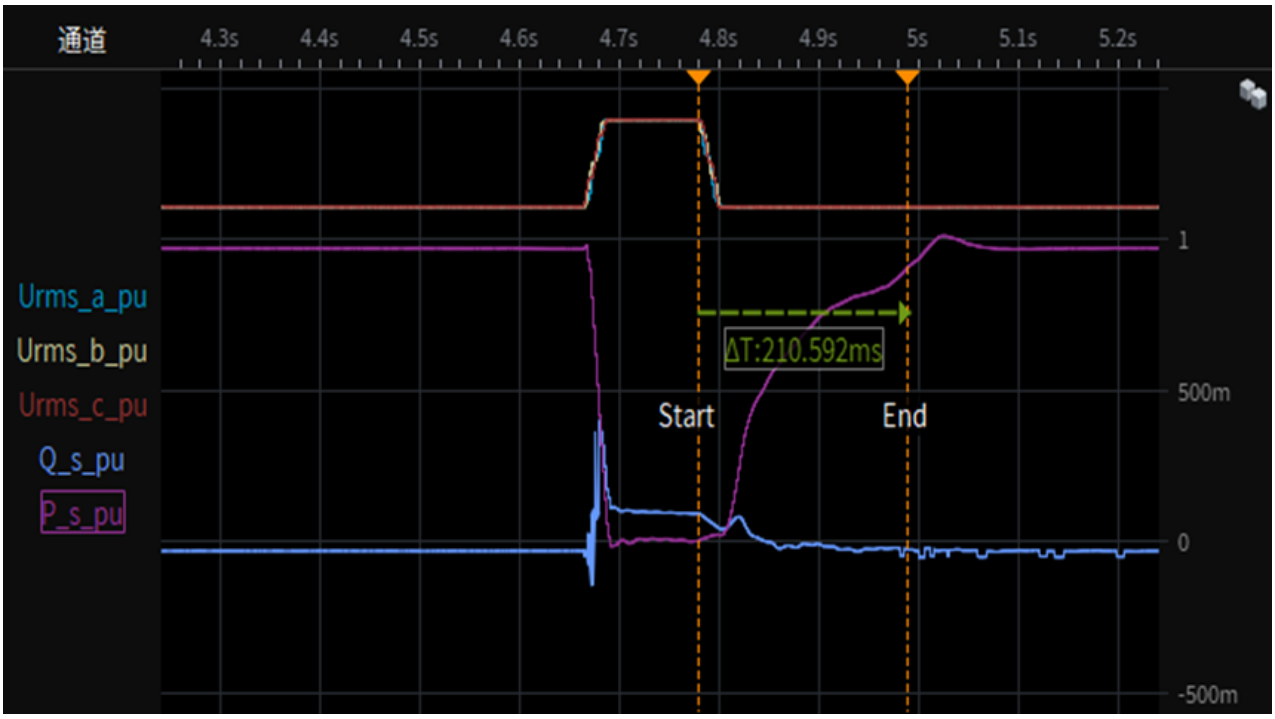


CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

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

Bbis.10	**TABLE: Verification of insensitivity to automatic reclosing in phase discrepancy**				**P**
Model	AF60K-TH + LV-IESS-RH10.240Aa-HBOX-15				
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 shift(A)	Result
100%	0.9998	90	81.90	81.20	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 shift(A)	Result
100%	0.9996	180	57.87	0	The inverter is protected off the grid after performing the phase angle conversion and then reconnected to the grid to continue supplying power to the grid. No damage, no danger.

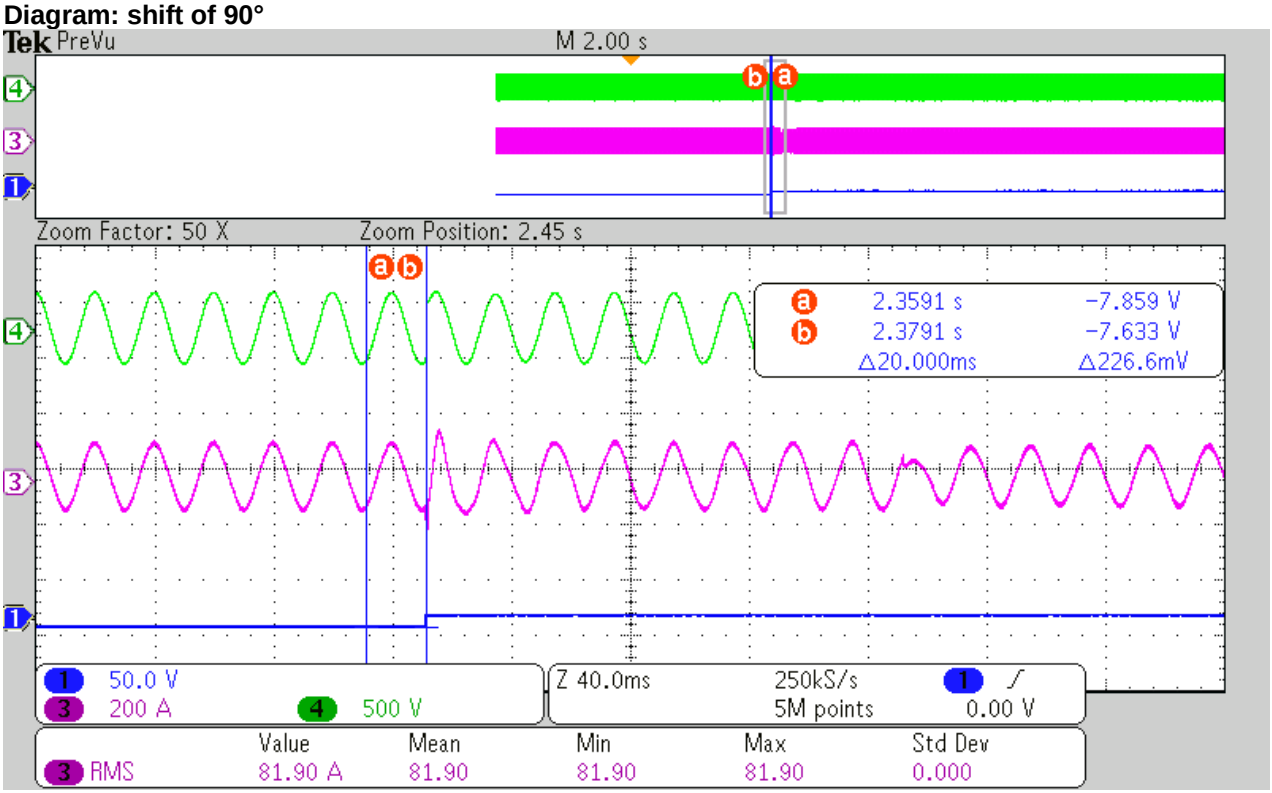
Note:
With reference to the diagram shown in Figure 75 - use of simulated network:
- the network simulator must be able to produce phase jumps in the voltage at the inverter output terminals of 90° and 180° respectively;
- the storage system must operate at a power level compatible with the characteristics of the test circuit and with a unitary power factor (cos φ = 1);
- VR: simulated mains voltage.
- The storage system must be brought into operation at the full power available for discharge. Let the system operate in the set conditions for at least 5 minutes, compatibly with the energy capacity of the EESS, or the time required for the internal temperature of the converter to stabilize.

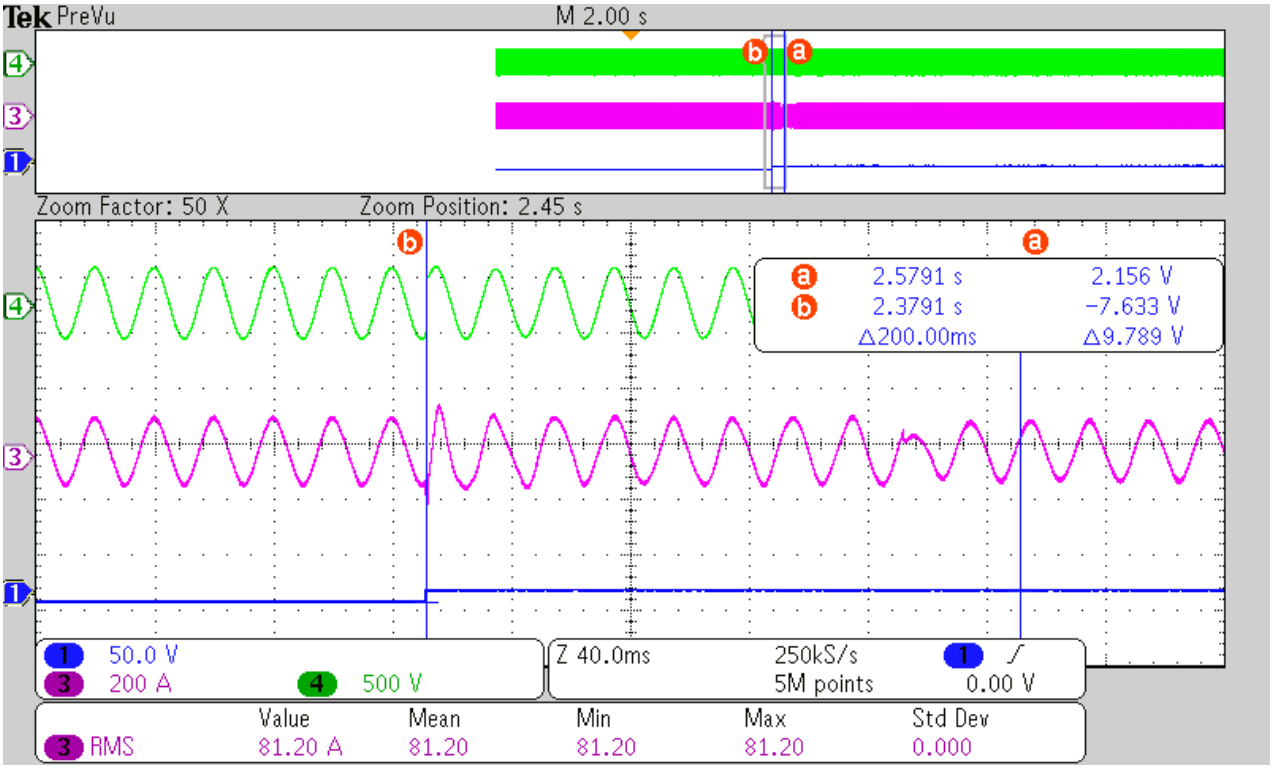
At the end of the stabilization period, 2 tests must be carried out in sequence, inducing a transient that suddenly produces a phase shift angle on the simulated mains voltage VR equal to 90 ° and 180 °.

In the test report, the following must be indicated for each of the two test sequences:
- the angle between the voltage before and after the phase jump, with an instrument having an error of 1°;
- the current of the storage system over a time window that runs from 20 ms before to at least 200 ms after the phase jump of the simulated mains voltage.

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

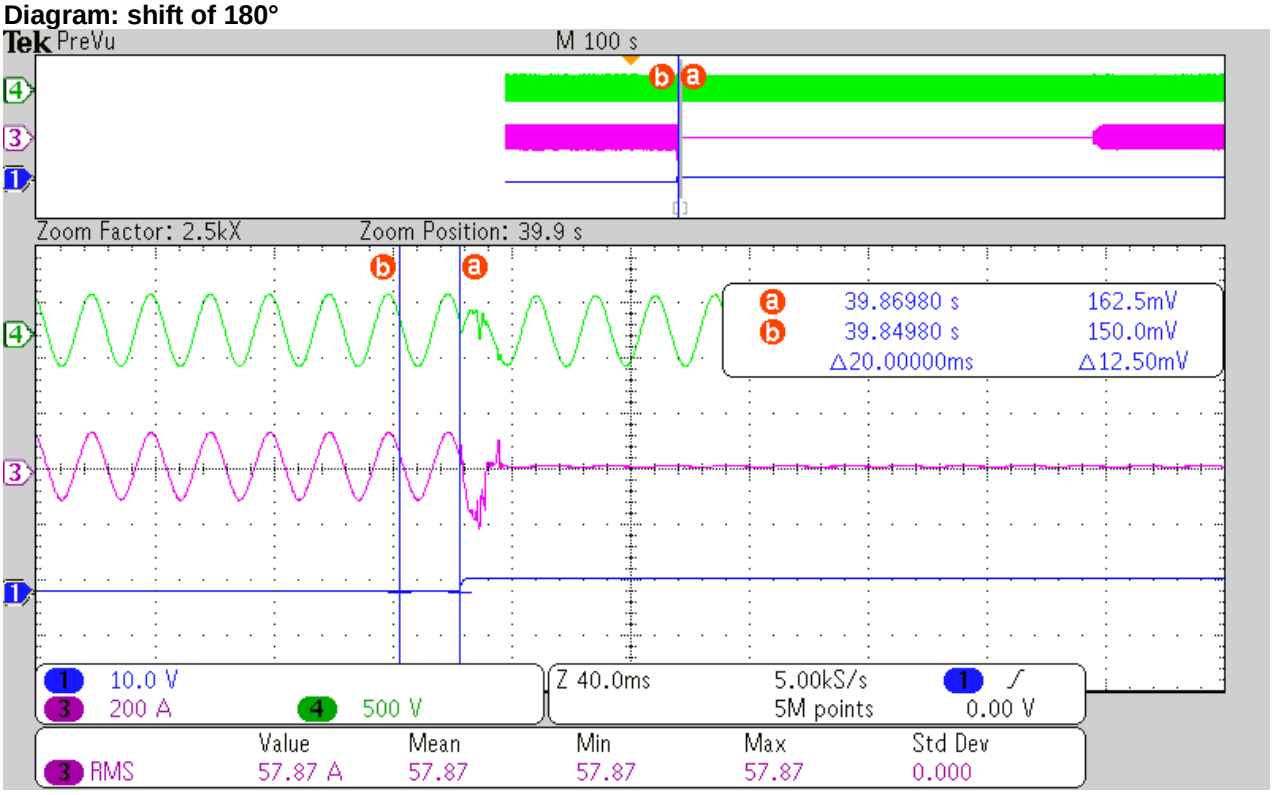
Diagram: shift of 90°

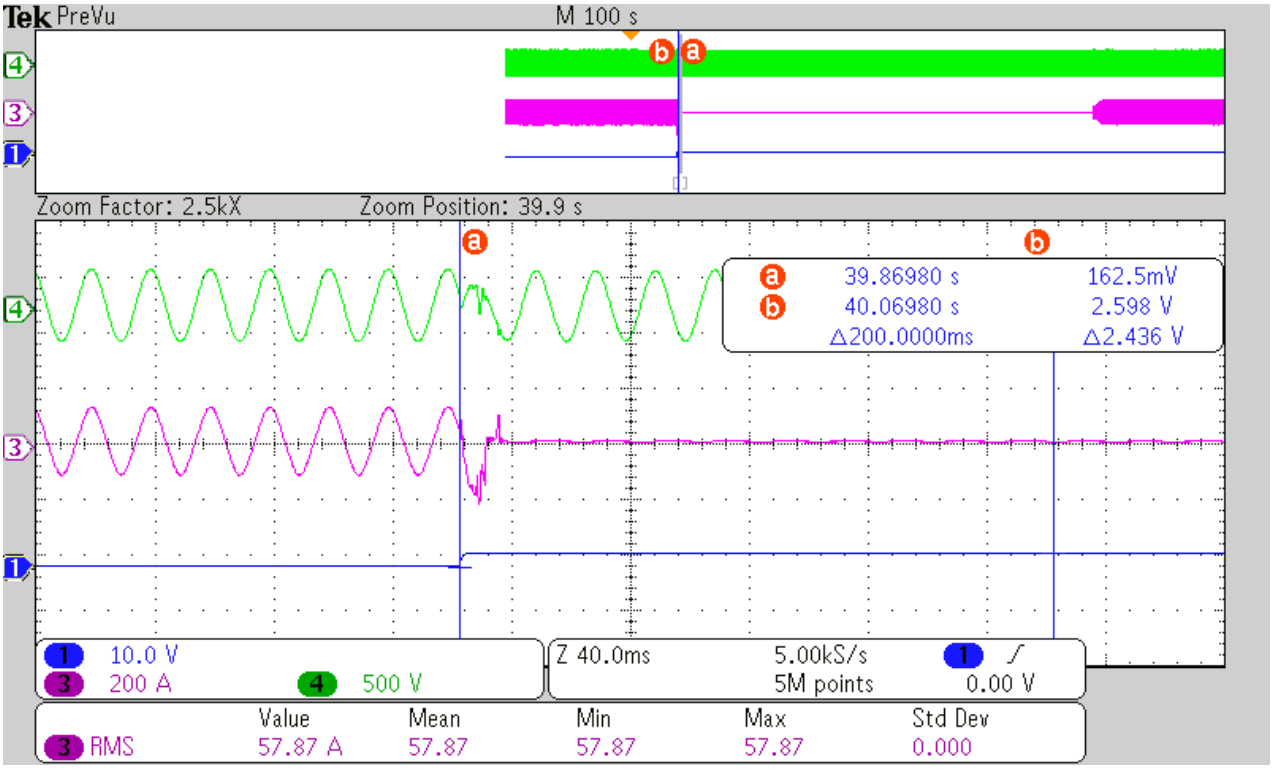




CEI 0-21			
Clause	Requirement - Test	Result - Remark	Verdict

Diagram: shift of 180°





Annex 1
ISO 9001 certificate

CERTIFICATE

Quality Management System
ISO 9001:2015

AFORE NEW ENERGY TECHNOLOGY (SHANGHAI) CO.,LTD.

Certificate No.:	24CN34507669Q
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
Certification Scope:	R & D and Manufacture of Photovoltaic Inverter

IAF 19
This is to certify that the quality management system established and implemented by the above organization meets the standard requirements.
During the validity period of the certificate, the surveillance audit should be carried out once a year and pass the audit, the certificate will continue to be valid.
The certificate can be checked out at the certification body website (www.acmchina.com) and CNCA website (www.cnca.gov.cn).

Date of first registration	**10/07/2017**
Date of this certificate	**04/07/2024**
Date of expiry	**09/07/2026**

Certificate query

IAS ACCREDITED Management Systems Certification Body MSCB-345

General Manager

ACM INTERNATIONAL CERTIFICATION LIMITED
41 Devonshire Street, Ground Floor, Office 1 London, United Kingdom, WIG 7AJ
Local Office-ACM (CHINA) LIMITED, Rm B201, Building 2, No 352, Waihuan Road, Minhang District, Shanghai 201199, China
T: +86 21-64305860 F: +86 21-64881096 W: www.acmchina.com E: info@acmcert.com.cn

Annex 2
IEC 62619 Certificate for used battery

	Ref. Certif. No.
IEC IECEE	SG SGS-00173

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

CB TEST CERTIFICATE

Product	Lithium ion Rechargeable Battery System
Name and address of the applicant	Dongguan Lithium Valley Energy Co., Ltd. Room 101, 4 Fuzhu 4th Street, Zhangyang Community, Zhangmutou Town, Dongguan, Guangdong, China
Name and address of the manufacturer	Dongguan Lithium Valley Energy Co., Ltd. Room 101, 4 Fuzhu 4th Street, Zhangyang Community, Zhangmutou Town, Dongguan, Guangdong, China
Name and address of the factory Note: *When more than one factory, please report on page 2*	See page 2
Ratings and principal characteristics	Battery System: Rated Voltage: 51.2 x n V ("n" = 1,2,3…25); Rated Capacity: 200 Ah; Battery Module: Rated Voltage: 51.2 V; Rated Capacity: 200 Ah
Trademark / Brand (if any)	Lithium Valley technology
Customer's Testing Facility (CTF) Stage used	-
Model / Type Ref.	LV-IESS-RH10.240Aa-HBox-n ("n" = 1,2,3…25)
Additional information (if necessary may also be reported on page 2)	Product name: LV-IESS-RH10.240Aa-HBox National Differences: EU Group Differences, GB
A sample of the product was tested and found to be in conformity with	IEC 62619:2022
As shown in the Test Report Ref. No. which forms part of this Certificate	CQES230500019001

This CB Test Certificate is issued by the National Certification Body

SGS Testing & Control Services Singapore Pte Ltd
30 Boon Lay Way
#03-01 Singapore 609957

Jacob Lu SGS

Date: 21/08/2023 Signature:

Jacob Lu
Certifier

1/2

Ref. Certif. No.

SG SGS-00173

Name and address of the factory

1. Dongguan Lithium Valley Energy Co., Ltd.
Room 101, 4 Fuzhu 4th Street, Zhangyang Community, Zhangmutou Town, Dongguan, Guangdong, China

2. Dongguan Lithium Valley Energy Co., Ltd.
No. 11 Yinyang Road, Zhangyang Community, Zhangmutou Town, Dongguan, Guangdong, China

Date: 21/08/2023

Signature: Jacob Lu

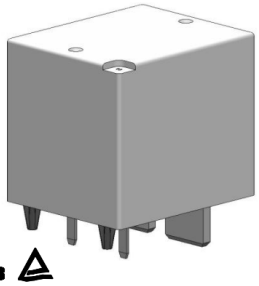
Jacob Lu
Certifier

Annex 3
Datasheet of the relay

Customer :

Type : 511Z Series Relay

Revised : 2019-06-25
Issued : 2018-11-21



■ Features

- □ Heavy duty 200A 830VAC power type.
- □ SPDM contact configuration with large contact gap 4.0mm version.
- □ Conforms to European photovoltaic standard IEC 62109-1.
- □ Coil holding voltage can be reduced to 50~65% of the nominal coil voltage for saving energy.
- □ High performance PCB power relay for photovoltaic power generation systems (solar inverter).
- □ RoHS Compliant.

■ Type List

Terminal style	Contact form	Designation (provided with)
		Flux tight
PCB terminal	1A (SPDM)	511ZP-1AD-F-C M06

■ Ordering Information

511Z P - 1A D - F - C XXX □
1 2 3 4 5 6 7 8

1. 511Z -- Basic series designation
2. P -- PCB terminal
3. 1A -- Form A, Single-pole double make (SPDM)
4. D -- Contact material Ag alloy
5. F -- Class F
6. C -- Flux tight
7. XXX --Special code
8. □ -- Coil voltage (please refer to the coil rating data for the availability)

■ Contact Rating

Rated load (Resistive)	Making 30A, Carrying 180A, Breaking 30A / 800VAC, On 1s/Off 9s, at 85°C, 30K ops.
	Making 30A, Carrying 200A, Breaking 30A / 800VAC, On 1s/Off 9s, at 70°C, 30K ops.
	200A 800VAC, On 1s/Off 9s, at 85°C, 10 ops.
Max. switching current	200A
Max. switching voltage	800VAC
Min. applicable load	1A 6VDC

Customer :

Type : 511Z Series Relay

Revised : 2019-06-25
Issued : 2018-11-21

■ Coil Rating (DC)

Rated voltage (V)	Rated current ±10 % at 23°C (mA)	Coil resistance ±10 % at 23°C (Ω)	Pick up Voltage (Max.) at 23°C (1)	Drop out Voltage (Min.) at 23°C	Continuous voltage at -40~+85°C (2)	Power consumption at rated / holding voltage
12	352.9	34	85 % of rated voltage	5 % of rated voltage	50~65 % of rated voltage	approx. 4.2W / 1.05W~1.78W (2)

Notes：(1) To energize relay properly apply 100%~120% nominal coil voltage for 200ms.

(2) Coil holding voltage is 50~65% of nominal voltage after applying nominal voltage for 200ms.

■ Specification

Contact material	Ag alloy	
Contact gap	4.0mm Min	
Contact resistance (1)	100mΩ Max. (1A/6VDC by 4 pipes mΩ meter) 6mΩ Max. (By voltage drop 20A)	
Operate time (1)	50ms Max.	
Operate bounce time (1)	10ms Max.	
Release time (1)	30ms Max.	
Vibration resistance	Operating extremes	10～50Hz , amplitude 1.5 mm
	Damage limits	10～50Hz , amplitude 1.5 mm
Shock resistance	Operating extremes	10G
	Damage limits	100G
Life expectancy	Mechanical	1,000,000 ops. (frequency 9,000 ops./hr)
Operating ambient temperature	-40~+85°C (no freezing) for 180A -40~+70°C (no freezing) for 200A	
Weight	Approx. 180 g	

Note：(1) Initial value. Operate and release time excluding contact bounce.

(2) Unless otherwise specified, all tests are under room temperature and humidity.

(3) Consider the heat of PCB is necessary, please check the actual condition of PCB.

(4) Applying no diode to this relay. The life expectancy will be lower when a diode is used. To use a varistor (ZNR) could absorb the coil surge of relay that is recommended.

(5) Do not use the relay exceeding the coil rating, contact rating and life expectancy, or this may cause the risk of overheating.

(6) To assure optimum performance, avoid the relay from dropping, hitting, or other unnecessary shocks.

(7) All loads are based on 95 mm^2 harnesses and bus bars.

(8) Please pay attention to the phenomenon of freezing in the low temperature environment below 0°C. Please evaluate the actual use of the environment.

(9) The thermal endurance of magnet wire is 180°C.

(10) Solder resistance: Place the relay terminal in 270 ° C tin solution for 7 seconds. After standing for 2

Customer :

Type : 511Z Series Relay

Revised : 2019-06-25
Issued : 2018-11-21

hours in normal temperature and humidity, the structure and characteristics should not be abnormal. To re-weld, please wait 30 minutes before proceeding.

(11) Please contact Song Chuan for the detailed information.

■ Insulation Data

Insulation resistance (1)	1000MΩ Min. (DC 500V)	
Dielectric strength (1)	Between open contact	: AC 2000V, 50/60Hz 1 min.
	Between contact and coil	: AC 4000V, 50/60Hz 1 min.
Insulation of IEC 61810-1		
Clearance / creepage distances	Between coil to contact	: Double/Reinforce, ≧ 3.0mm / ≧ 16.6mm (for 830VAC)
	Between open contact	: Basic, ≧ 3.0mm / ≧ 12.5mm (for 830VAC)
Rated insulation voltage	250V, 400V, 690V, 830V	
Rated impulse withstand voltage	2500V	
Pollution degree	2	
Rated voltage	230/400/690V/830V	
Overvoltage category	II	
Compliant with European photovoltaic standard		
Contact gap	4.0mm (IEC 62109 and VDE 0126)	

Note：(1) Initial value.

■ Safety Approval

Certified	UL / CUL	TUV
File No.	E88991	R50267102

■ Safety Approval Rating

UL / CUL	TUV
30A 830VAC, Resistive, Carrying current 200A (1)	Making 30A , Carrying 180A , Breaking 30A /830VAC ; T85 (1) Making 30A , Carrying 200A , Breaking 30A /830VAC ; T70 (1)

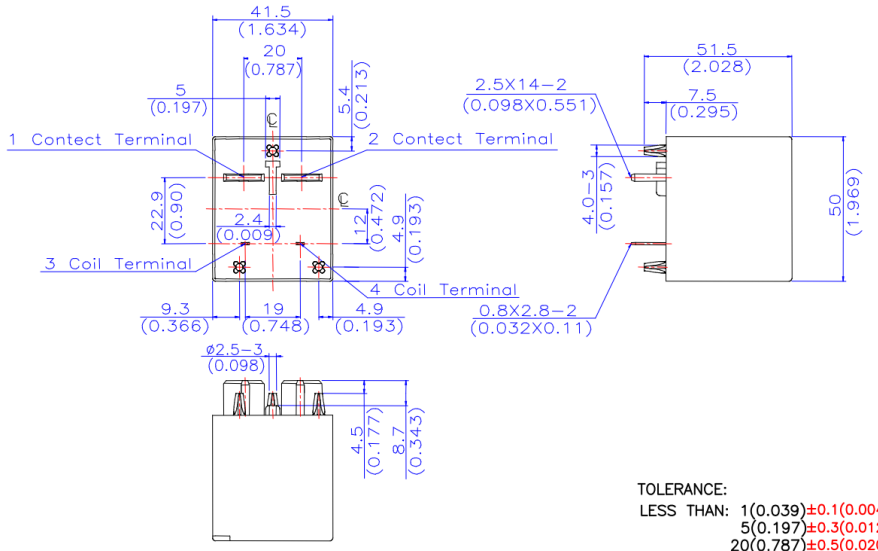
Note：(1) With 50%~55% modulation of nominal coil voltage.

Customer :

Type : 511Z Series Relay

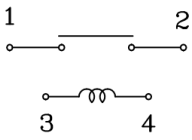
Revised : 2019-06-25
Issued : 2018-11-21

■ Outline Dimensions

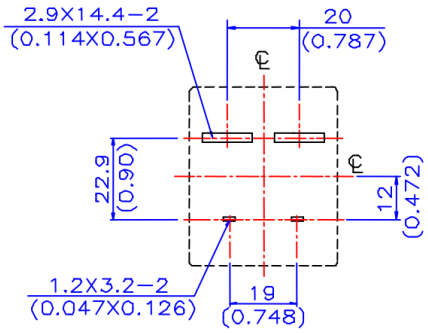


TOLERANCE:
LESS THAN: 1(0.039)±0.1(0.004)
5(0.197)±0.3(0.012)
20(0.787)±0.5(0.020)
MORE THAN:20(0.787)±1(0.039)

■ Wiring Diagram
(Bottom view)



■ PC Board Layout
(Bottom view)



Annex 4
Pictures of the unit

Overview - AF60K-TH

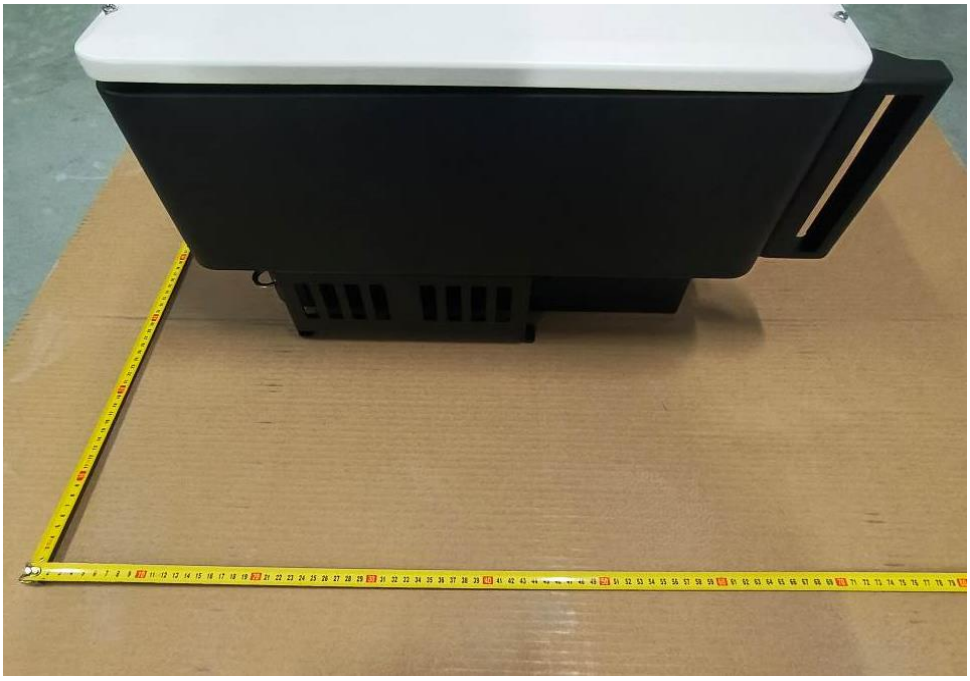


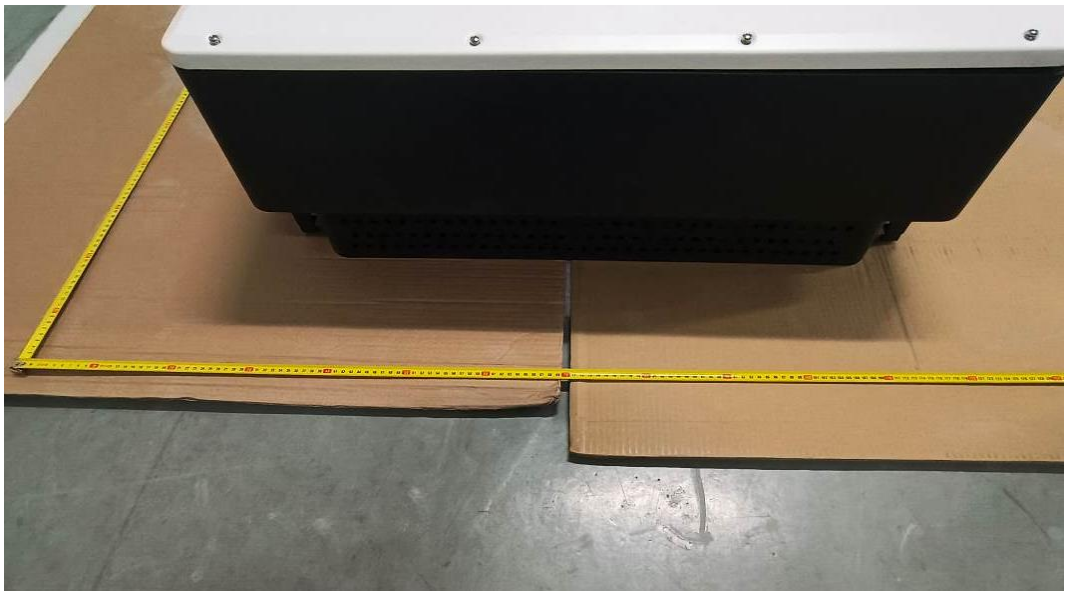
Overview - AF60K-TH-0



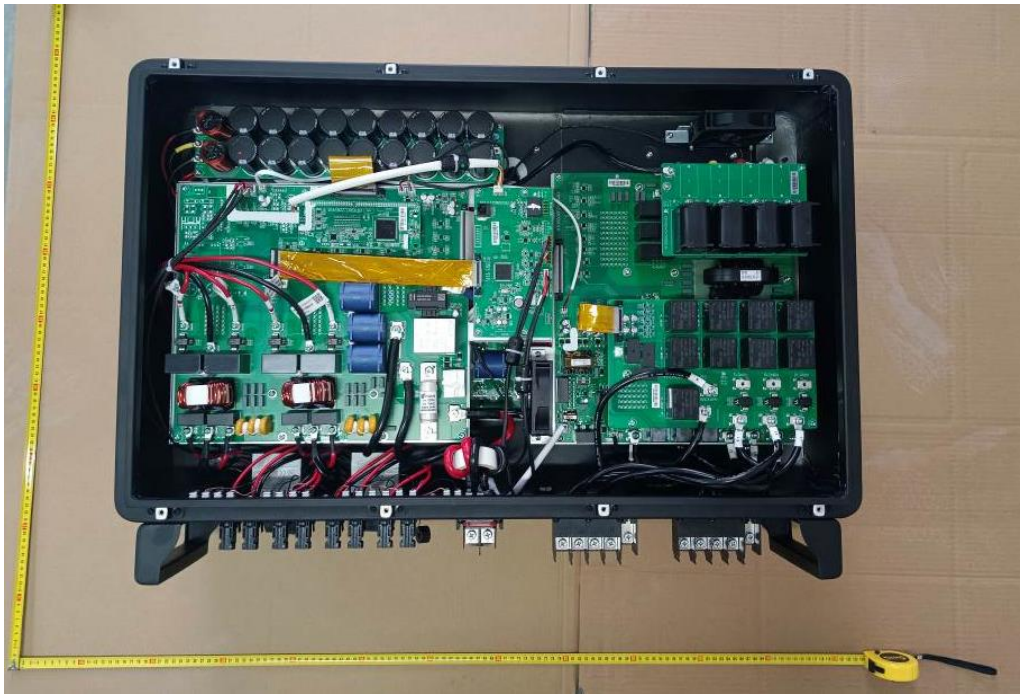
Overview - AF60K-TH

Overview - AF60K-TH-0

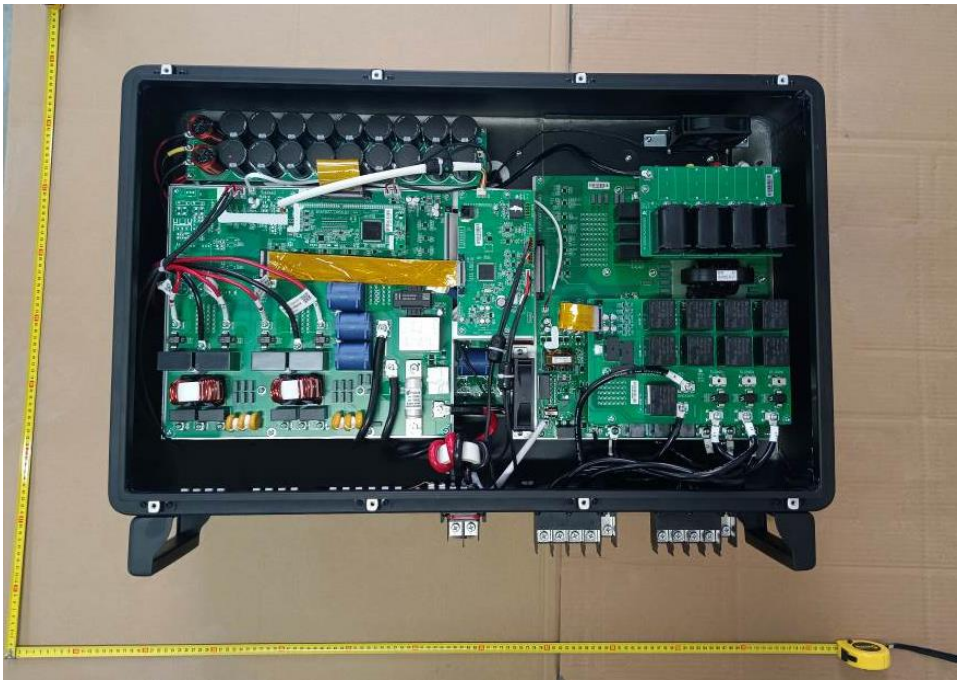

Overview

Overview


Overview

Overview - AF60K-TH


Overview - AF60K-TH-0

Internal view- AF60K-TH


Internal view - AF60K-TH-0



--- End of test report---