



TEST REPORT EN 50549-10:2022 Requirements for generating plants to be connected in parallel with distribution networks - Part 10: Tests for conformity assessment of generating units	
Report	
Report Number.....	6209657.50A
Date of issue	2025-02-25
Total number of pages	259
Testing Laboratory	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Address	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
Applicant's name	Solenso electronic materials Co., LTD.
Address	4F., No. 56, Zili 5th St., Zhongli Dist., Taoyuan City 320, Taiwan
Test specification:	
Standard.....	EN 50549-10:2022, EN 50549-1:2019; EN 50549-1:2019/A1:2023, COMMISSION REGULATION (EU) 2016/631 (NC RfG)
Test procedure	Type test
Non-standard test method.....	N/A
Test Report Form No.	EN 50549-10_V1.0
Test Report Form(s) Originator	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Master TRF	Dated 2024-07-28
Test item description	Microinverter
Trade Mark.....	
Manufacturer	Solenso electronic materials Co., LTD. 4F., No. 56, Zili 5th St., Zhongli Dist., Taoyuan City 320, Taiwan
Model/Type reference	SG1600, SG2000
Ratings	Operating temperature range: - 40°C to + 65°C Protective class: IP67 Power factor range (adjustable): -0.8(lagging)~0.8(leading)
	SG1600: DC: Voltage range:25-55 Vdc, Max Current: 4*14 A, AC: Max. Output Power: 1.6k VA, rated voltage: 230 Vac, Max. current: 6.96 A, 50 Hz, LN-PE
	SG2000: DC: Voltage range:25-55 Vdc, Max Current: 4*16 A, AC: Max. Output Power: 2k VA, rated voltage: 230 Vac, Max. current: 8.7 A, 50Hz , LN-PE

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	Testing Laboratory:	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Testing location/ address:		No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
Tested by (name, function, signature):		Shine Yan (ENG) 
Approved by (name, function, signature):		Sandy Qian (REW) 
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Approved by (name, function, signature).....:		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address.....:		
Tested by (name + signature).....:		
Witnessed by (name, function, signature).....:		
Approved by (name, function, signature).....:		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	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): Appendix 1: Datasheet of the relay (9 pages) Appendix 2: Evaluated protection function and operational capabilities (2 pages) Appendix 3: Template evaluated parameter and parameter range (5 pages) Appendix 4: Pictures (4 pages)	
Summary of testing:	
Tests performed (name of test and test clause):	Testing location:
Original report 6196342.50A: All applicable tests were performed. Amendment 1 Report 6209657.50A: No testing.	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
4.8 EMC and power quality – EMC test (The EMC test report provided by the customer) EMC Test report No.: 6196552.50, Issued by DEKRA Testing and Certification (Shanghai) Co., Ltd.	DEKRA Testing and Certification (Shanghai) Co., Ltd. No.250, Jiangchangsan Road, Jing'an District, Shanghai 200436, China

Copy of marking plate:

Solense PV Microinverter
Model: SG1600

Max.Input Voltage	65V d.c.	Nominal Output Frequency	50Hz
Max. Continuous Input Current	14A*4 d.c.	Over Voltage Category	PV:II ,Mains:III
Range of MPPT Voltage	25-55(V)d.c.	MPPT Efficiency	99.9%
Min./Max. Start Voltage	22-60(V)d.c.	Peak Conversion Efficiency	96.5%
Max.Short-circuit Current	25A*4 d.c.	Protective Rating(IP)	IP67
Max. Continuous Output Power	1600VA	Protective Class	I
Max. Continuous Output Current	6.96A a.c	Pollution Degree	PD3
Output Power Factor	>0.99(Default)	Operating Ambient Temp	-40°C~+65°C
Nominal Output Voltage	230V a.c.		



 Solenso electronic materials
Co., Ltd

Solense PV Microinverter
Model: SG2000

Max.Input Voltage	65V d.c.	Nominal Output Frequency	50Hz
Max. Continuous Input Current	16A*4 d.c.	Over Voltage Category	PV:II ,Mains:III
Range of MPPT Voltage	25-55(V)d.c.	MPPT Efficiency	99.9%
Min./Max. Start Voltage	22-60(V)d.c.	Peak Conversion Efficiency	96.5%
Max.Short-circuit Current	25A*4 d.c.	Protective Rating(IP)	IP67
Max. Continuous Output Power	2000VA	Protective Class	I
Max. Continuous Output Current	8.7A a.c	Pollution Degree	PD3
Output Power Factor	>0.99(Default)	Operating Ambient Temp	-40°C~+65°C
Nominal Output Voltage	230V a.c.		



 Solenso electronic materials
Co., Ltd

Remark:

According to customer's and market requirement, these models were evaluated under the grid voltage 230Vac and frequency of 50 Hz.

Test item particulars:				
Equipment mobility.....	: movable <u>fixed</u>	hand-held transportable	stationary for building-in	
Connection to the mains	: pluggable equipment <u>permanent connection</u>		direct plug-in for building-in	
Environmental category	: <u>outdoor</u>	indoor unconditional	indoor conditional	
Over voltage category Mains.....	: OVC I	OVC II	<u>OVC III</u>	OVC IV
Over voltage category PV.....	: OVC I	<u>OVC II</u>	OVC III	OVC IV
Mains supply tolerance (%)	: ±10%			
Tested for power systems	: TN			
IT testing, phase-phase voltage (V)	: N/A			
Class of equipment	: <u>Class I</u> Not classified	Class II	Class III	
Mass of equipment (kg)	: 5.4 kg			
Pollution degree	: Outside PD3			
IP protection class.....	: IP67			
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.....	: I			
Date (s) of performance of tests.....	: 2024-12-01 to 2024-12-07			
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. Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.				
"(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.				
Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.				
Name and address of factory (ies):				
Zhejiang Wellsun Intelligent Technology Co.,Ltd 109 Yongchang Road, Shifeng Street, Tiantai County, Taizhou City, Zhejiang Province				

General product information:

General product information:

This product is a Single-phase grid-connected photovoltaic inverter, which converts the DC voltage of solar panels into single -phase AC voltage and connects to the 220V/230V/240V grid to achieve power generation function.

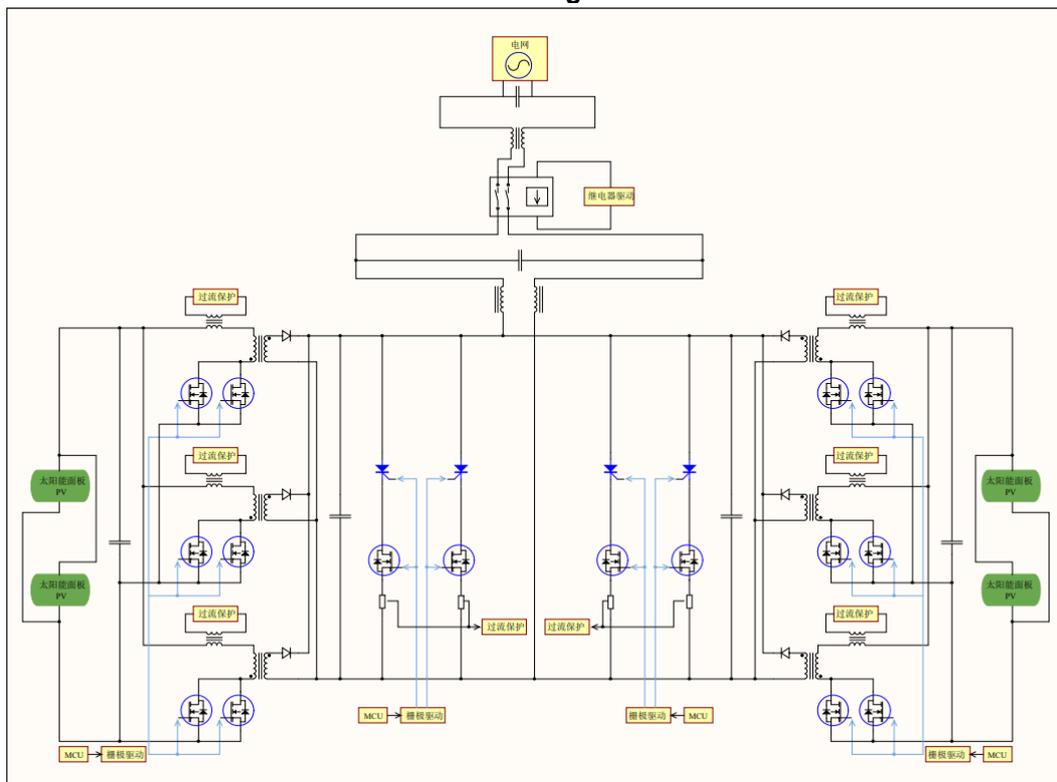
There is an auxiliary power supply inside the product. The AC side has a dedicate relay , which is to ensure the safety and reliability of the system. The product can generate full power up to ambient temperature 45°C. When the temperature exceeds 45°C, the output power derates linearly until maximum ambient temperature 60°C.

Description of the power circuit:

The internal control of the circuit adopts redundant structure, the booster part and the inverter part are controlled by the controller U25. U25 detects DC voltage and current, DC side insulation impedance, AC voltage, current, frequency, leakage current, etc., for boost circuit control and solar power tracking;

Model difference:

Block Diagram

**Model difference:**

Models SG2000, SG1600 are identical except for different rated output power controlled by software.

Hardware version: WS0512Nx1.V03.

Software version: V2.10-2024.06.15

Amendment 1

The report 6209657.50A was based on the report 6196342.50A issued by DEKRA Testing and Certification (Suzhou) Co., Ltd., issued on 2024-11-11, and COC No.: 6196342.01, COC No.: 6196342.02 issued by DEKRA Testing and Certification (Shanghai) Ltd., issued on 2024-11-11. It was issued due to the following modifications:

---Update the the applicant, trade mark, model names and the marking plate.

After technical review, tests were not considered necessary.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test overview:

Test overview:			
5.2.1	Frequency operating range	Table 5.2.1	P
5.2.2	Voltage operating range	Table 5.2.2	P
5.3.1	Immunity to disturbances - Rate of change of frequency (ROCOF)	Table 5.3.1	P
5.3.3	Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)	list available optional modes here Table 5.3.3	P
5.4	Active response to frequency deviation	Table 5.4.3.2, 5.4.3.3	P
5.5.1	Power capabilities assessment	Table 5.5.1.3, 5.5.1.6	P
5.5.2	Voltage support by reactive power - test to determine the reactive power control modes	list available Modes here	P
5.5.2.3	Verification procedure for Set point control	Table 5.5.2.3	P
5.5.2.4	Verification procedure for voltage related control mode for reactive power Q(U)	Table 5.5.2.4	P
5.5.2.5	Verification procedure for power related control modes for reactive power	Table 5.5.2.5	P
5.6	Voltage related active power reduction - P(U)	Table 5.6	P
5.7.1	EMC	See EMC report No. 6208431.50. which complies with EN 61000 series	P
5.7.2	Power Quality	Table 5.7.2.2, 5.7.2.3, 5.7.2.4	P
5.8.3	Verification procedure for generating plants to be connected to a LV distribution network with Interface protection as internal device	Table 5.8.3.2, 5.8.3.3, 5.8.3.4	P
5.8.4	Verification procedure for generating plants to be connected to a LV distribution network with Interface protection as dedicated device	The protection complies with EN 60255-1, EN 60255-26 and EN 60255-27. See Appendix 1	P
5.8.5	Verification procedure for generating plants to be connected to a MV distribution network		N/A
5.8.6	Islanding detection	Table 5.8.6, complies with IEC 62116	P
5.9.3	Automatic reconnection after tripping	Table 5.9	P
5.9.4	Starting to generate electrical power	Table 5.9	P
5.10	Active power reduction on set point	Table 5.10	P
5.11	Remote information exchange	Table 5.11, the applied communication standard is	P
5.12	Requirements regarding single fault tolerance of interface protection system and interface switch	Table 5.12	P
5.13	Model definition and model validation for generating units of synchronous generating technology		N/A

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.2.1	TABLE: Frequency operating range	P
--------------	---	---

Model	SG2000
-------	--------

Opinion 1: Minimum requirement

Test sequence	Test condition		Measurement					Limits
	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ	Duration T (s)	Cont. T
1	85%	47.0	--	--	--	--	600	≥ 300s
2	85%	48.5	--	--	--	--	6000	≥ 1800s
3	110%	51.0	--	--	--	--	6000	≥ 1800s
4	110%	51.5	--	--	--	--	1800	≥ 300s

Note:

* Function of interface protection and activating active power response to over/under frequency and voltage shall be disable.

Opinion 2: Stringent requirement

Test sequence	Test condition		Measurement					Limits
	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ	Duration T (s)	Cont. T*
1	85%	47.0	84.9%	46.99	95.7%	0.999	300	≥ 20 s
2	85%	47.5	84.9%	47.49	95.5%	0.999	7040	≥ 5400s
3	110%	51.5	109.9%	51.49	96.7%	0.999	6000	≥ 5400s
4	110%	52.0	109.9%	51.99	96.7%	0.999	1000	≥ 300 s

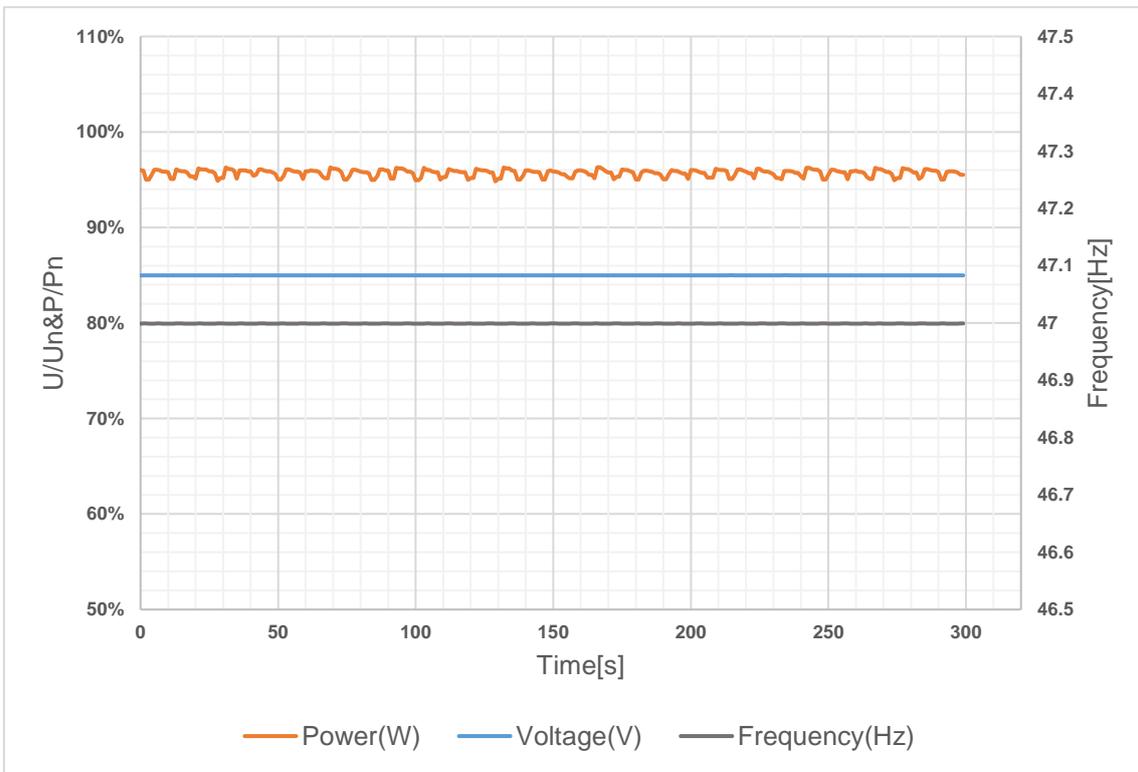
Note:

* Function of interface protection and activating active power response to over/under frequency and voltage shall be disable.

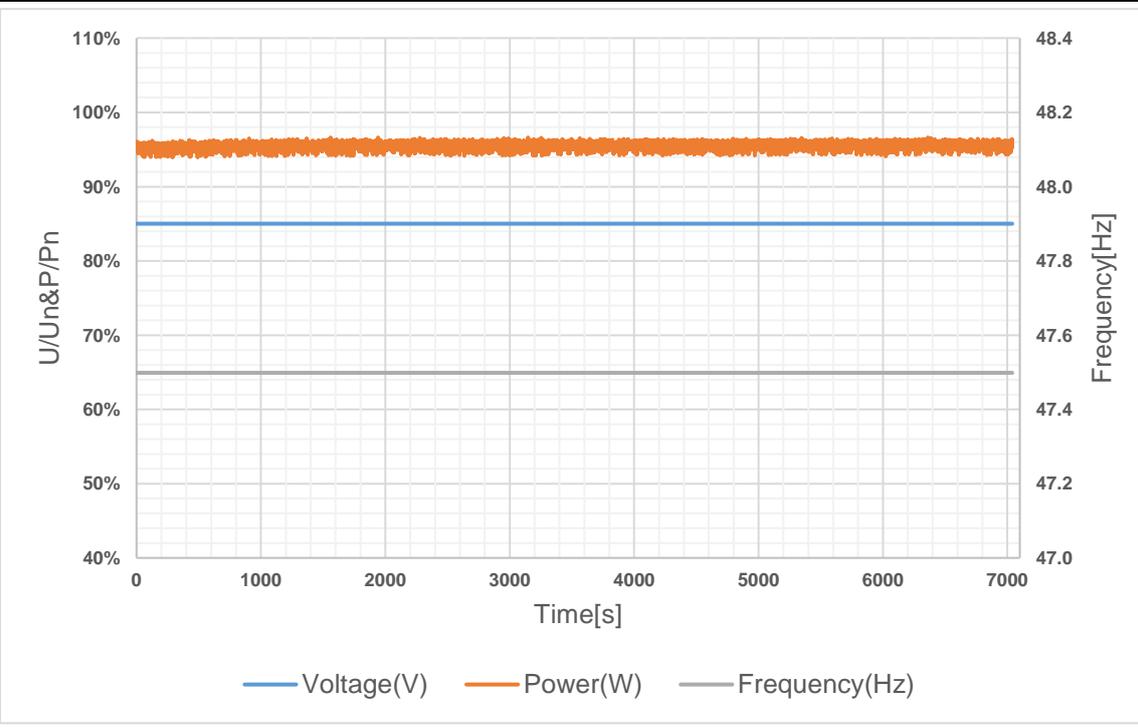
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Test 1: 85% Un / 47.0 Hz



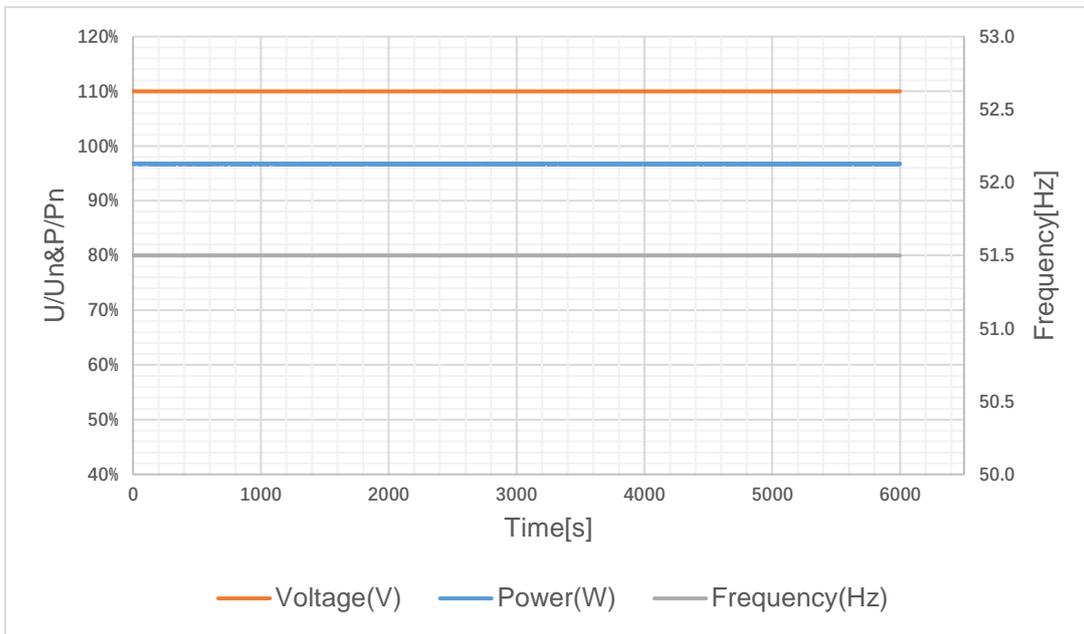
Graph of Test 2: 85% Un / 47.5 Hz



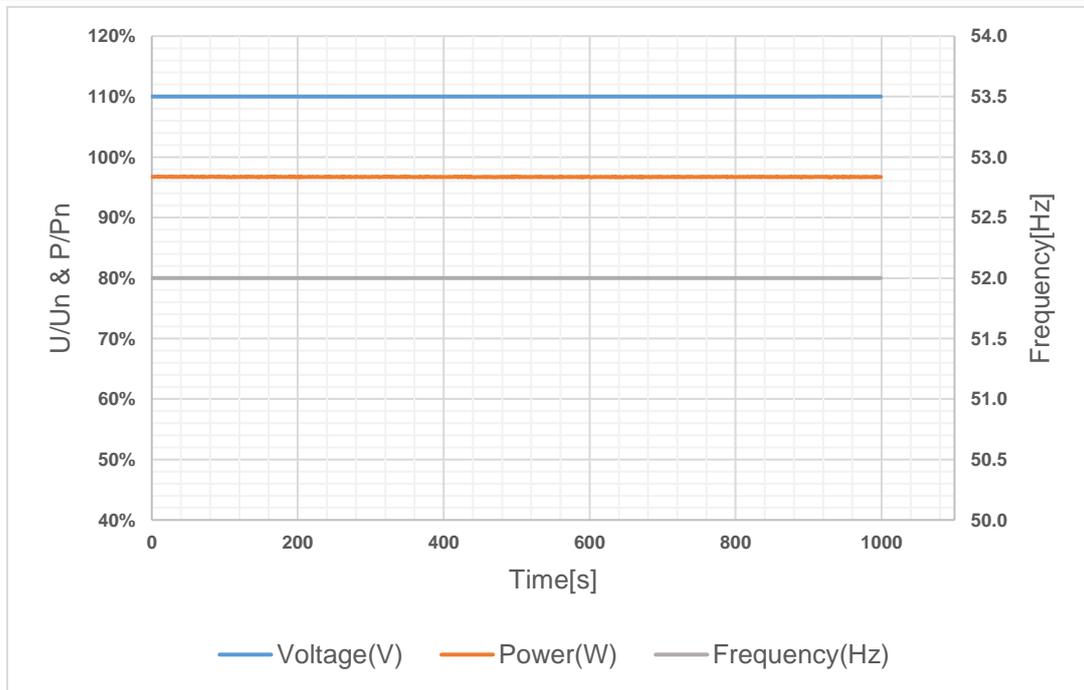
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Test 3: 110% Un / 51.5 Hz



Graph of Test 4: 110% Un / 52.0 Hz



EN 50549-10

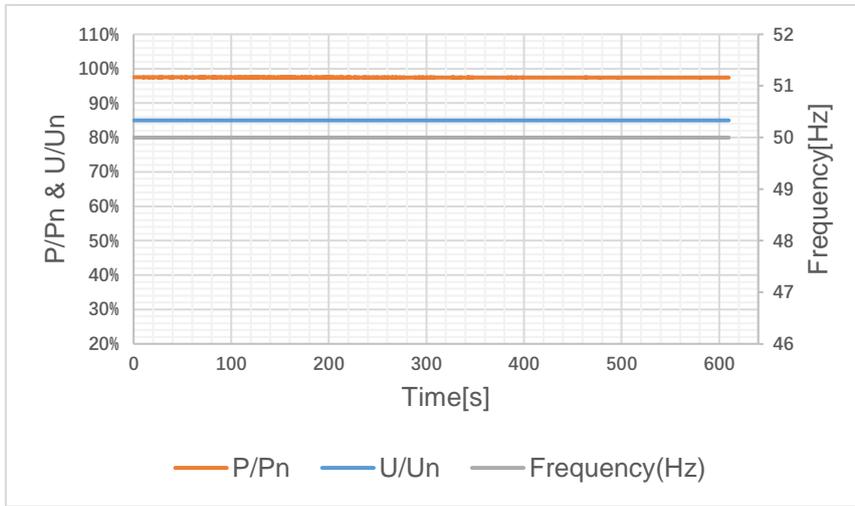
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.2.2	TABLE: Voltage operating range							P
Model	SG2000							
Test sequence	Test condition			Measurement				
	U/U _n	f (Hz)	Time (s)	U/U _n	f (Hz)	P/P _n	Cosφ	Duration T (s)
1	100%	50.0	600	99.99%	49.99	98.96%	0.999	600
2	85%	50.0	600	84.99%	49.99	97.44%	0.999	610
3	100%	50.0	600	99.99%	49.99	98.80%	0.999	622
4	110%	50.0	600	109.99%	49.99	99.19%	0.999	610
5	100%	50.0	600	99.99%	49.99	98.88%	0.999	624
Note:								

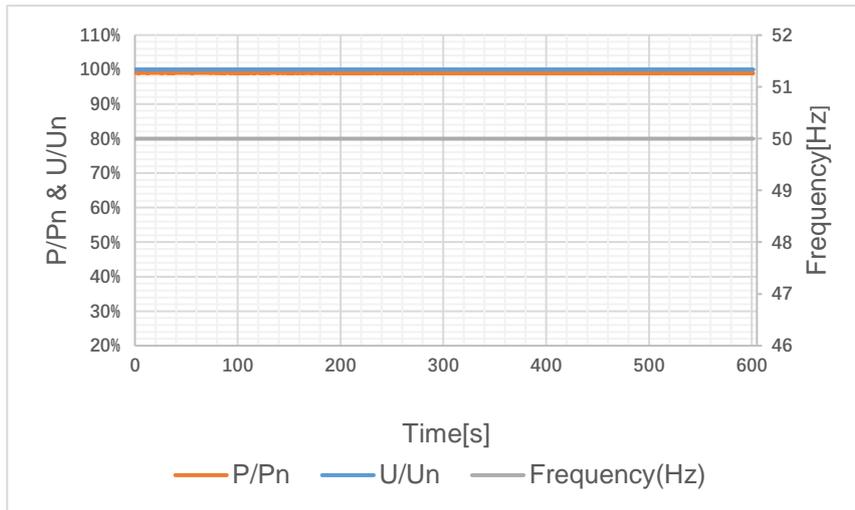
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

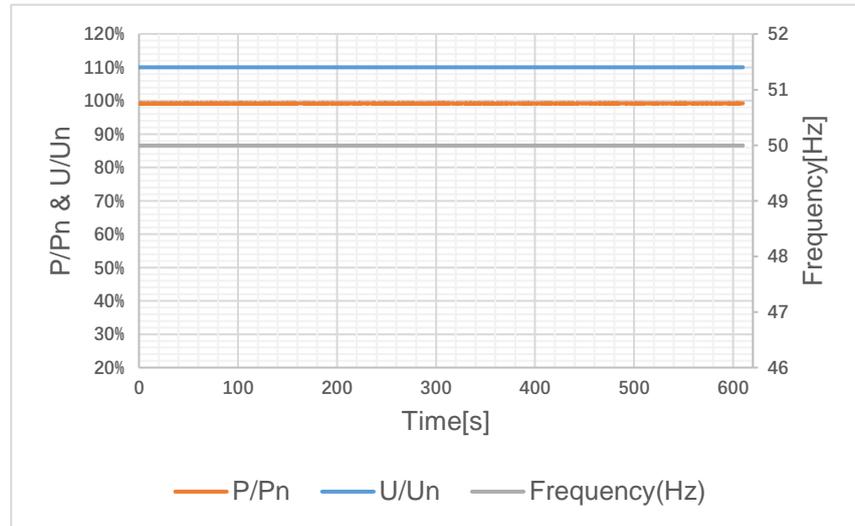
85%Pn



100%Pn



110%Pn



EN 50549-10

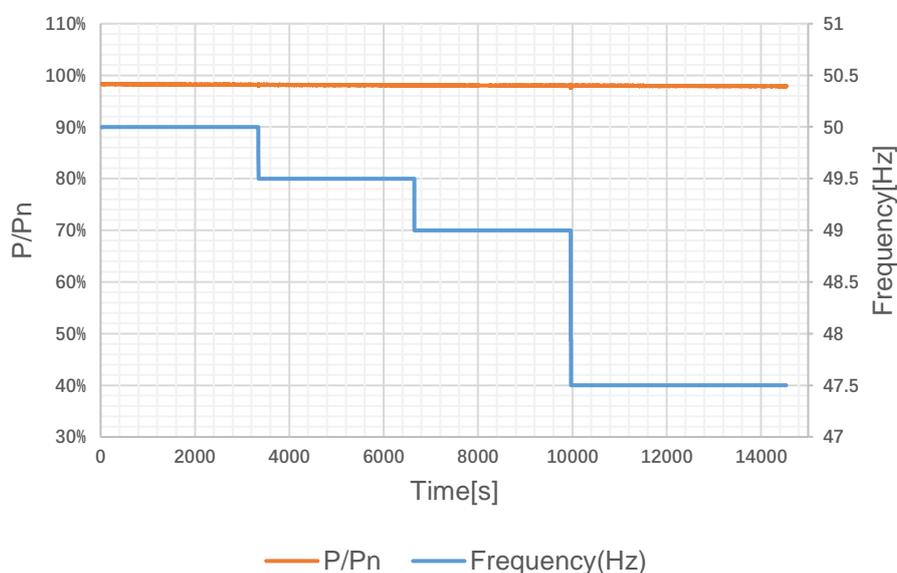
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

4.4.3	TABLE: Minimal requirement for active power delivery at under-frequency								P
Model	SG2000								
<input type="checkbox"/> Opinion 1: Minimum requirement									
Test sequence	Test condition		Measurement						Limits
No.	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ (PF)	ΔP/P _n	ΔP/P _n per 1 Hz	ΔP/P _n per 1 Hz
1	100%	50.0	--	--	--	--	--	--	--
2	100%	49.5	--	--	--	--	--	--	≥ -10%
3	100%	49.0	--	--	--	--	--	--	
4	100%	47.5	--	--	--	--	--	--	
<input type="checkbox"/> Opinion 2: Stringent requiremen									
Test sequence	Test condition		Measurement						Limits
	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ (PF)	ΔP/P _n	ΔP/P _n per 1 Hz	ΔP/P _n per 1 Hz
1	100%	50.0	100%	50.0	97.81%	0.99	-2.19%	--	--
2	100%	49.5	100%	49.5	97.77%	0.99	-2.23%	0.08%	≥ -2%*
3	100%	49.0	100%	49.0	97.79%	0.99	-2.21%	0.04%	
4	100%	47.5	100%	47.5	97.88%	0.99	-2.12%	0.06%	

Note:

* Stringent requirement

P-f Diagram



EN 50549-10

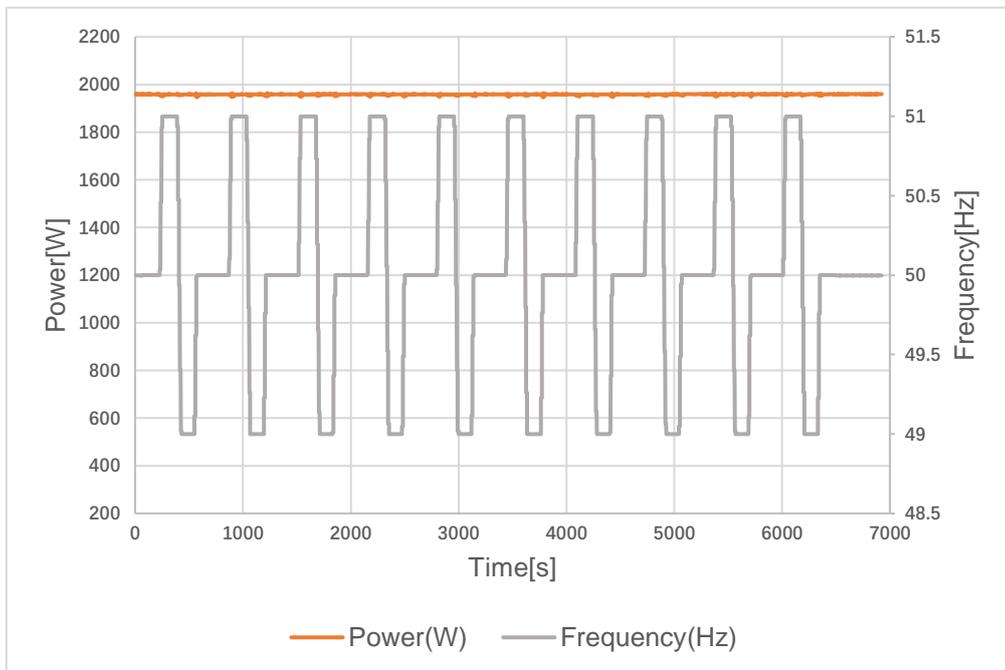
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.3.1	TABLE: Rate of change of frequency (ROCOF) immunity				P	
Model	SG2000					
Voltage (Vac)	230					
Active power (W)	2000					
Test sequence	Test condition				Result	Limits
	Ramp	From	To	Time [s]		
1	0	50.0 Hz	50.0 Hz	3.0	No disconnection	No disconnection
2	+2Hz/s	50.0 Hz	51.0 Hz	0.6		
3	0	51.0 Hz	51.0 Hz	3.0		
4	-2Hz/s	51.0 Hz	49.0 Hz	1.1		
5	0	49.0 Hz	49.0 Hz	3.0		
6	+2Hz/s	49.0 Hz	50.0 Hz	0.6		
7	0	50.0 Hz	50.0 Hz	3		

Note:

The ROCOF immunity is defined with a sliding measurement window of 500 ms.

Graph of Test



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.3.2	TABLE: Phase jump			P	
Model	SG2000				
Test Condition				Result	Limit
P/Pn	Cosφ (PF)	Time	Phase displacement		
> 90%	1	5min	+90°	No damage inverter connected	No damage inverter connected
> 90%	1	5min	-90°	No damage inverter connected	No damage inverter connected
> 90%	1	5min	+180°	No damage inverter connected	No damage inverter connected
> 90%	1	5min	-180°	No damage inverter connected	No damage inverter connected

Graph of Test

Test1



Test2



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test3



Test4



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.3.3	TABLE: Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)					P
Model	SG2000					
For EN 50549-1 type A						
Test	Voltage dip U/Un (p.u.)	VRT fault type	Fault duration (t2-t1) (ms)	P/Pn (p.u.)	Q/Pn (p.u.)	Test No.
1	0.05	A (VD1)	≥200	0.98 to 1.02	0 to ± 0.1	1.1
				0.1 to 0.5		1.2
		D1 (VD6)		0.98 to 1.02		1.3
				0.1 to 0.5		1.4
		D2* (VD6)		0.98 to 1.02		1.5
				0.1 to 0.5		1.6
2	0.25	A (VD2)	≥630	0.98 to 1.02	0 to ± 0.1	2.1
				0.1 to 0.5		2.2
		D1 (VD7)		0.98 to 1.02		2.3
				0.1 to 0.5		2.4
3	0.50	A (VD3)	≥1260	0.98 to 1.02	0 to ± 0.1	3.1
				0.1 to 0.5		3.2
		D1 (VD8)		0.98 to 1.02		3.3
				0.1 to 0.5		3.4
4	0.75	A (VD4)	≥1800	0.98 to 1.02	0 to ± 0.1	4.1
				0.1 to 0.5		4.2
		D1 (VD9)		0.98 to 1.02		4.3
				0.1 to 0.5		4.4
5	0.90	A (VD5)	≥6000	0.98 to 1.02	0 to ± 0.1	5.1
				0.1 to 0.5		5.2
		D1 (VD10)		0.98 to 1.02		5.3
				0.1 to 0.5		5.4
6	1.15	A (VS2.2)	≥60000	0.98 to 1.02	0 to ± 0.1	6.1
				0.1 to 0.5		6.2
		D1 (VS4.2)		0.98 to 1.02		6.3
				0.1 to 0.5		6.4
7	1.20	A (VS2.1)	≥5000	0.98 to 1.02	0 to ± 0.1	7.1
				0.1 to 0.5		7.2
		D1 (VS4.1)		0.98 to 1.02		7.3
				0.1 to 0.5		7.4
8	1.25	A (VS1)	≥100	0.98 to 1.02	0 to ± 0.1	8.1
				0.1 to 0.5		8.2
		D1 (VS3)		0.98 to 1.02		8.3
				0.98 to 1.02		8.4
		D2 (VS3)		0.1 to 0.5		8.5
				0.98 to 1.02		8.6

Note(s):

*Most stringent.

Before EUT test, AC grid shall be measured and recorded test data in empty load test at each condition of test numbers (1.x to 7.x) and VRT fault types (A/D1/D2).

Each case two consecutive tests must be completed successfully.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

For EN 50549-2:2019 and EN50549-1 type B

Test	Voltage dip/swell U/Un [p.u.]	VRT fault type	Fault duration (t2-t1) [ms]	Pmax/Pn [p.u.]	Q/Pmax [p.u.]	K factor	Test No.
1	0.05	VD1	≥ 250	0.98 to 1.02	0 to ± 0.1	2	1.1
				0.1 to 0.5			1.2
		VD6	≥ 250	0.98 to 1.02			1.3
				0.1 to 0.5			1.4
2	0.25	VD2	≥ 910	0.98 to 1.02	0 to ± 0.1	2	2.1
				0.1 to 0.5			2.2
		VD7	≥ 910	0.98 to 1.02			2.3
				0.1 to 0.5			2.4
		VD2	≥ 910	0.1 to 0.5	0 to ± 0.1	active power priority	2.5
						I _q limitation configured to 90 % I _n	2.6
3	0.50	VD3	≥ 1870	0.98 to 1.02	0 to ± 0.1	2	3.1
				0.1 to 0.5			3.2
		VD8	≥ 1870	0.98 to 1.02			3.3
				0.1 to 0.5			3.4
		VD3	≥ 1870	0.98 to 1.02	0 to ± 0.1	Zero current mode	3.5
		4	0.75	VD4	≥ 2690	0.98 to 1.02	0 to ± 0.1
0.1 to 0.5	4.2						
VD9	≥ 2690			0.98 to 1.02	0 to ± 0.1	2	4.3
				0.1 to 0.5			4.4
VD4	≥ 2690			0.1 to 0.5	-Q _{MAX}	2	4.5
					0 to ± 0.1	4	4.7
VD4	≥ 2675			0.98 to 1.02	0 to ± 0.1	Zero current mode	4.8
5	0.90			VD5	≥ 60000	0.98 to 1.02	0 to ± 0.1
		0.1 to 0.5	5.2				
		VD10	0.98 to 1.02	2		5.3	
			0.1 to 0.5			5.4	
		VD5	0.1 to 0.5	5		5.5	
6	1.15	VS2.2	≥ 60000	0.98 to 1.02	0 to ± 0.1	2	6.1
				0.1 to 0.5			6.2
		VS4.2		0.98 to 1.02	0 to ± 0.1		6.3
				0.1 to 0.5			6.4
		VS2.2		0.1 to 0.5	+ Q _{MAX}		6.5
				0.98 to 1.02	0 to ± 0.1		Zero current mode
7	1.20	VS2.1	≥ 5000	0.98 to 1.02	0 to ± 0.1	2	7.1
				0.1 to 0.5			7.2
		VS4.1		0.98 to 1.02	0 to ± 0.1		7.3
				0.1 to 0.5			7.4
		VS2.1		0.1 to 0.5	+ Q _{MAX}		7.5

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

For EN 50549-2:2019 and EN50549-1 type B

Test	Voltage dip/swell U/Un [p.u.]	VRT fault type	Fault duration (t2-t1) [ms]	Pmax/Pn [p.u.]	Q/Pmax [p.u.]	K factor	Test No.
8	1.25	VS1	≥ 100	0.98 to 1.02	0 to ± 0.1	2	8.1
				0.1 to 0.5			8.2
		VS3		0.98 to 1.02			8.3
				0.1 to 0.5			8.4
				0.98 to 1.02	0 to ± 0.1	Zero current mode	8.5

Note(s):

The two consecutive tests as specified in 5.3.3.3 shall be conducted with different DC input voltages:

One test near the minimum DC input voltage, between 0 % – 20 % of the voltage range;

One test near the maximum DC input voltage, between 80 % – 100 % of the voltage range.

EXAMPLE: If voltage range is 300 V – 900 V: 300 V = 0 %; 900 V = 100 %,

$U_{\text{test-min}} = 300 \text{ V} - 420 \text{ V}$ as $300 \text{ V} + 0.2 * 600 \text{ V} = 420 \text{ V}$;

$U_{\text{test-max}} = 780 \text{ V} - 900 \text{ V}$ as $300 + 0.8 * 600 \text{ V} = 780 \text{ V}$

For PV inverter the maximum and minimum DC input voltage shall be the minimum and maximum MPP voltage according to EN 50524.

Table A.1 — Phase vectors on the LV side of a Dy transformer in the presence of asymmetric two-phase fault on the primary MV side

	U/Un (MV side)	Phase-earth voltages (LV side)			Phase angles		
		U1/U1,n	U2/U2,n	U3/U3,n	φU1	φU2	φU3
VD6	0,05 ± 0,05	0,05 ± 0,05	0,87 ± 0,05	0,87 ± 0,05	0°	92°	268
VD7	0,25 ± 0,05	0,25 ± 0,05	0,88 ± 0,05	0,88 ± 0,05	0°	98	262
VD8	0,50 ± 0,05	0,50 ± 0,05	0,90 ± 0,05	0,90 ± 0,05	0°	106	254
VD9	0,75 ± 0,05	0,75 ± 0,05	0,94 ± 0,05	0,94 ± 0,05	0°	113°	247°
VD10	0,9 ± 0,05	0,90 ± 0,05	0,98 ± 0,05	0,98 ± 0,05	0°	117°	243°
normal conditions	1	1	1	1	0°	120°	240°

Table A.2 — Phase vectors on the LV side of a Dy transformer in the presence of asymmetric two-phase overvoltage event on the primary MV side

	U/Un (MV side)	Phase-earth voltages (LV side)			Phase angles		
		U1/U1,n	U2/U2,n	U3/U3,n	φU1	φU2	φU3
VS3	1,25 ± 0,05	1,25 ± 0,05	1,07 ± 0,05	1,07 ± 0,05	0°	126°	234°
VS4	1,15 ± 0,05	1,15 ± 0,05	1,04 ± 0,05	1,04 ± 0,05	0°	124°	236°
normal conditions	1	1	1	1	0°	120°	240°

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	1.1	1.2
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	16:15:13.9	16:59:13.4
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.05	0.05
	5	Setting dip duration	--	--	--	≥200	≥200
	6	Point of fault entry	Total	--	ms	9216.53	9216.53
	7	Point of fault clearance	Total	--	ms	9469.08	9469.08
	8	Fault duration in empty load test	Total	--	ms	253.90	253.90
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.049	0.049
10	Pos.		0.049			0.049	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	0.999	0.999
			L2 to neutral			1.000	0.999
			L3 to neutral			0.999	0.999
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.200
	14	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	15		Pos.			0.994	0.199
	16	Reactive power	Total	t1-10s to t1	p.u.	-0.006	0.004
	17		Pos.			-0.006	0.004
18	Cosφ	--	t1-10s to t1	--	0.999	0.995	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.049	0.999
			L2 to neutral			0.050	0.999
			L3 to neutral			0.049	0.999
			Pos.			0.049	0.999
	22	Line current	Phase 1	t1+60ms	p.u.	0.006	0.006
	23		Phase 2			0.023	0.022
	24		Phase 3			0.017	0.018
	25	Line current	Phase 1	t1+100ms	p.u.	0.006	0.006
	26		Phase 2			0.023	0.022
	27		Phase 3			0.017	0.018
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000	
29		Pos.			0.000	0.000	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999
			L2 to neutral			1.000	0.999
			L3 to neutral			1.000	1.000
31	Active power	Total		p.u.	0.994	0.199	

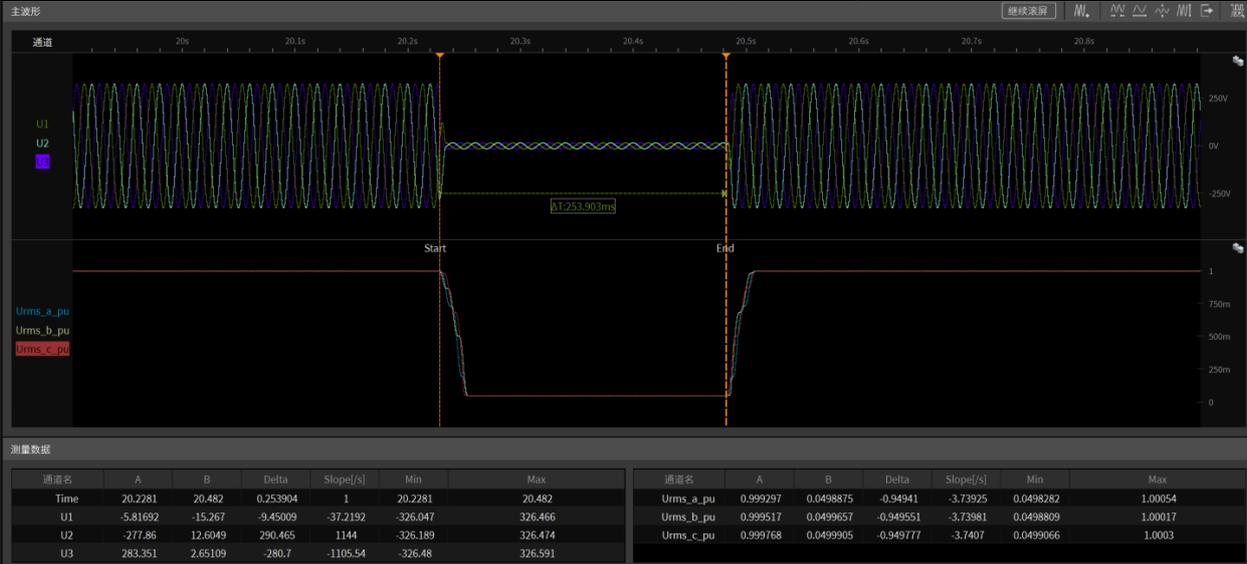
EN 50549-10

Clause	Requirement - Test			Result - Remark			Verdict
	32		Pos.	t2+3s to t2+10s		0.994	0.199
	33	Active power rising time	Pos.	--	s	0.513	0.598
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.006	0.004
	35		Pos.			-0.006	0.004
	36	Reactive power rising time	Pos.	--	s	--	--
	37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes

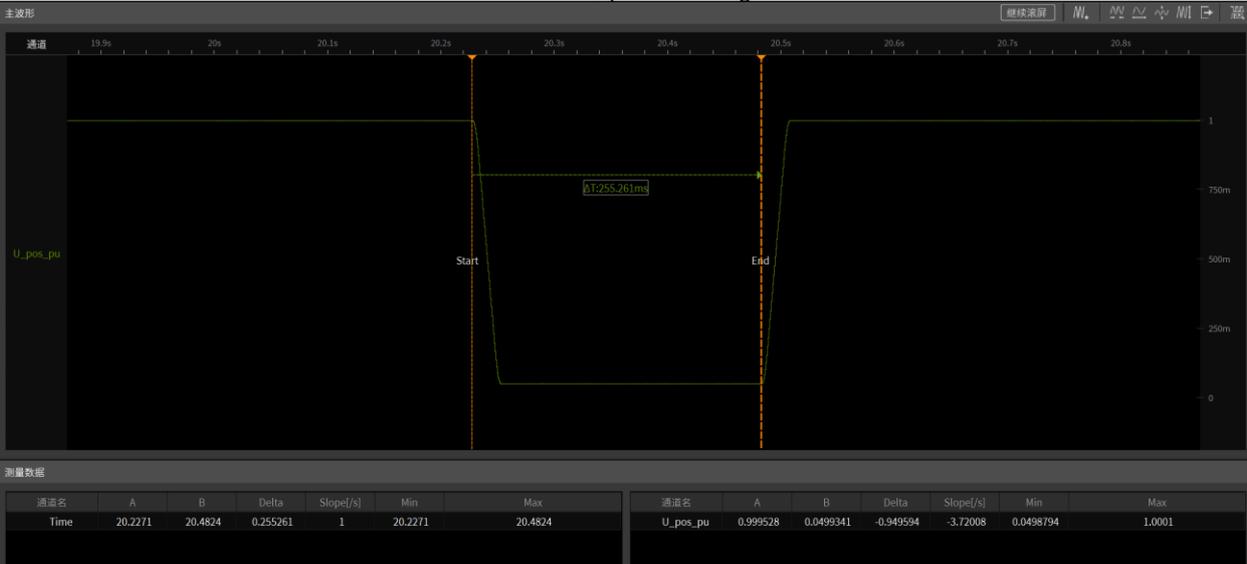
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.1&1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



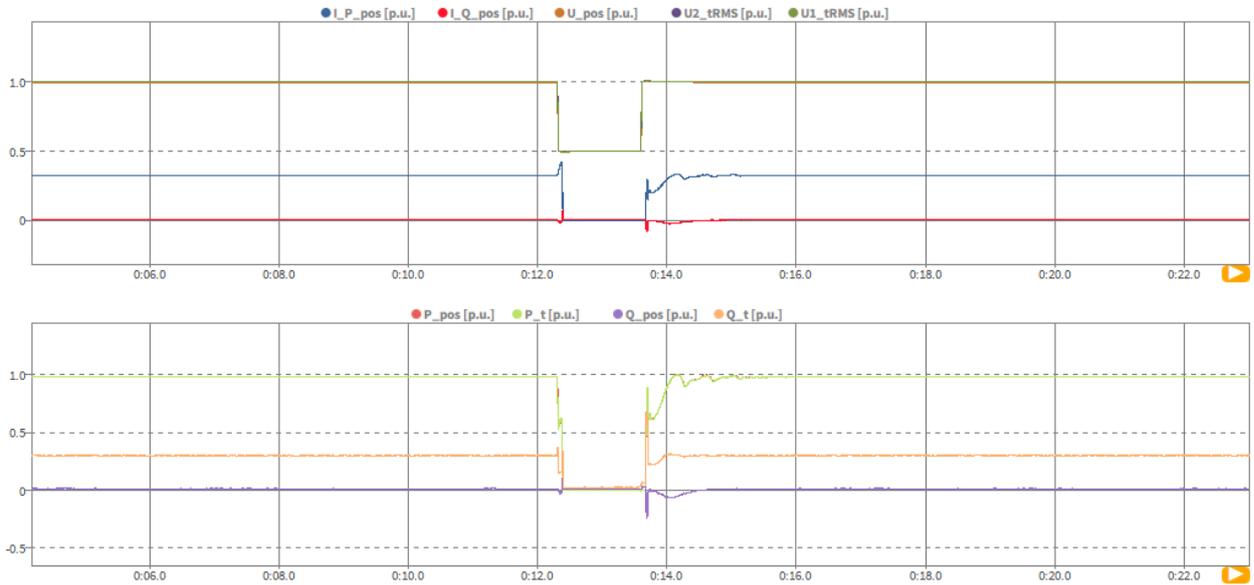
Test 1.1&1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), No load, Positive sequence voltage



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



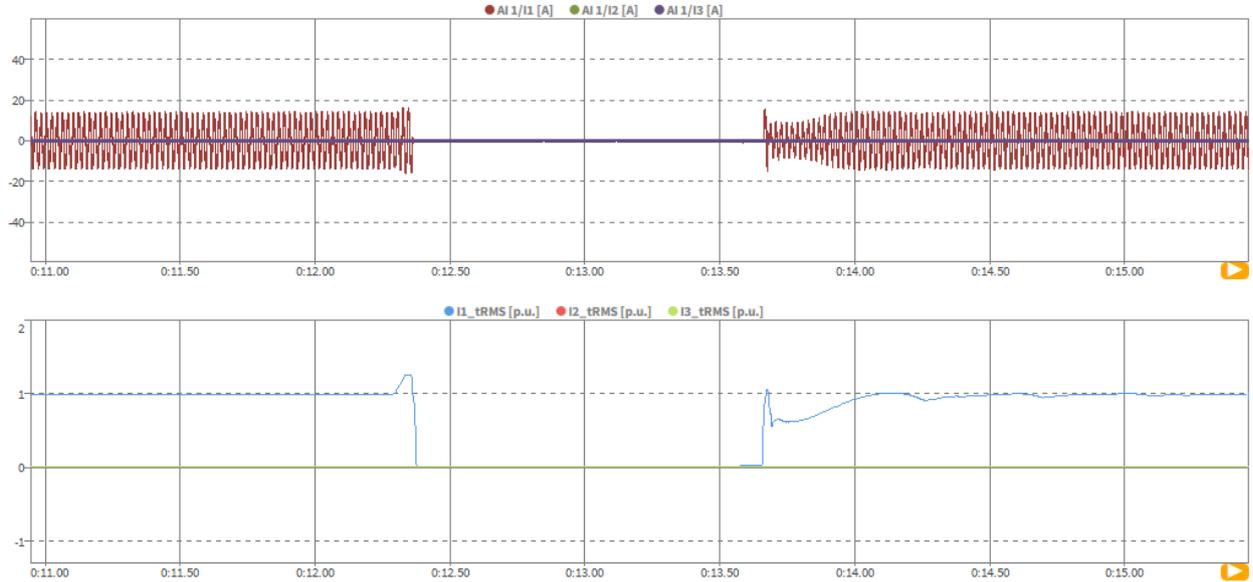
Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase voltages



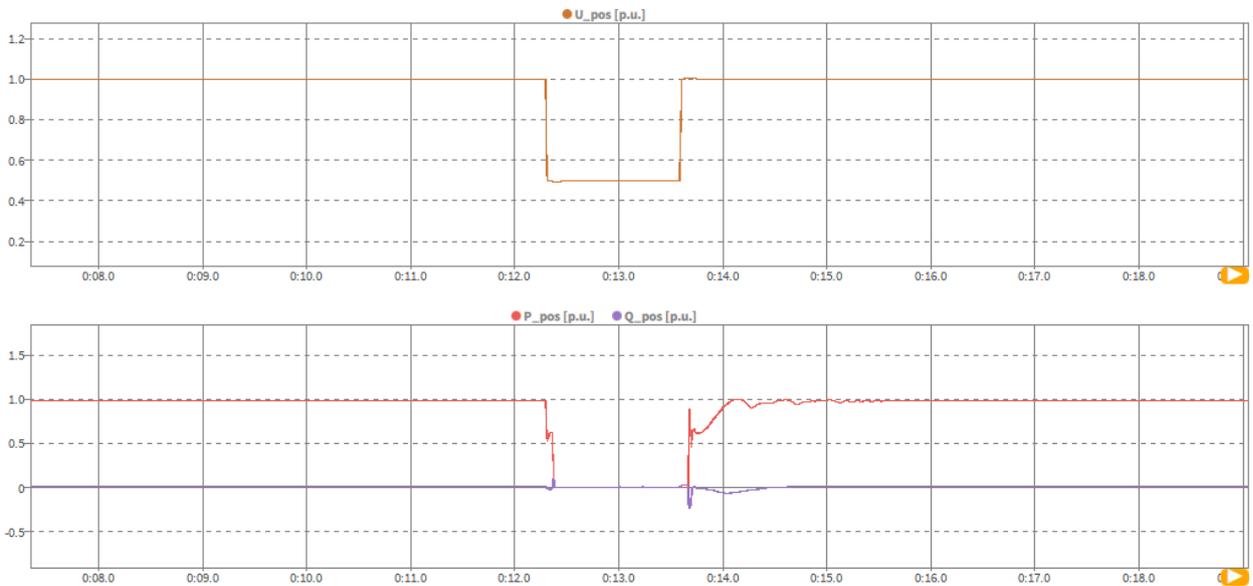
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



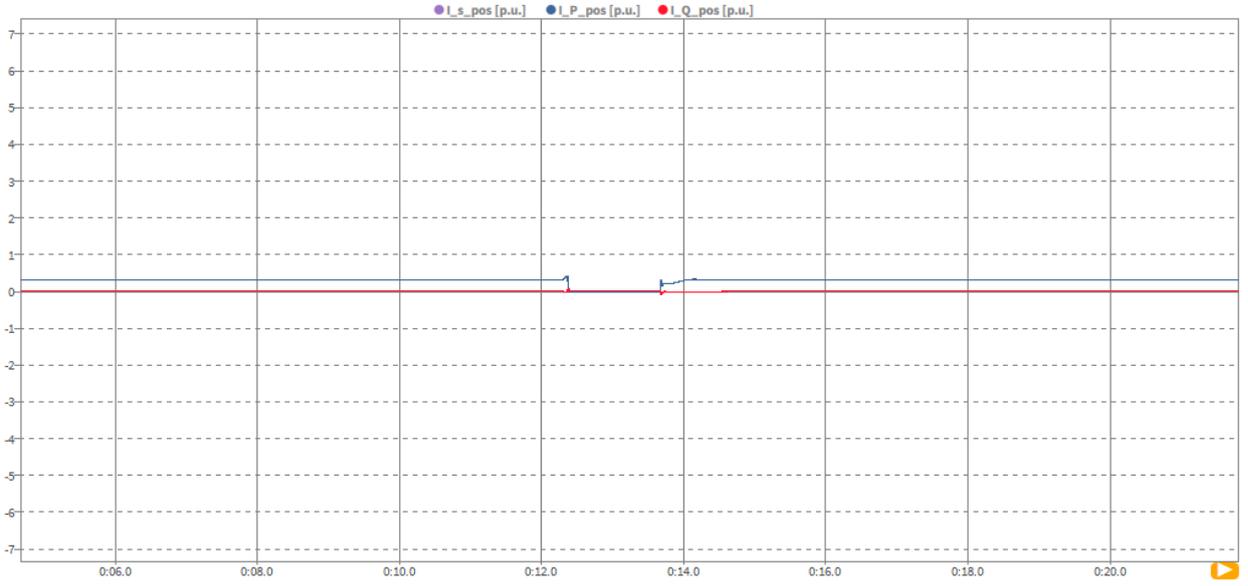
Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

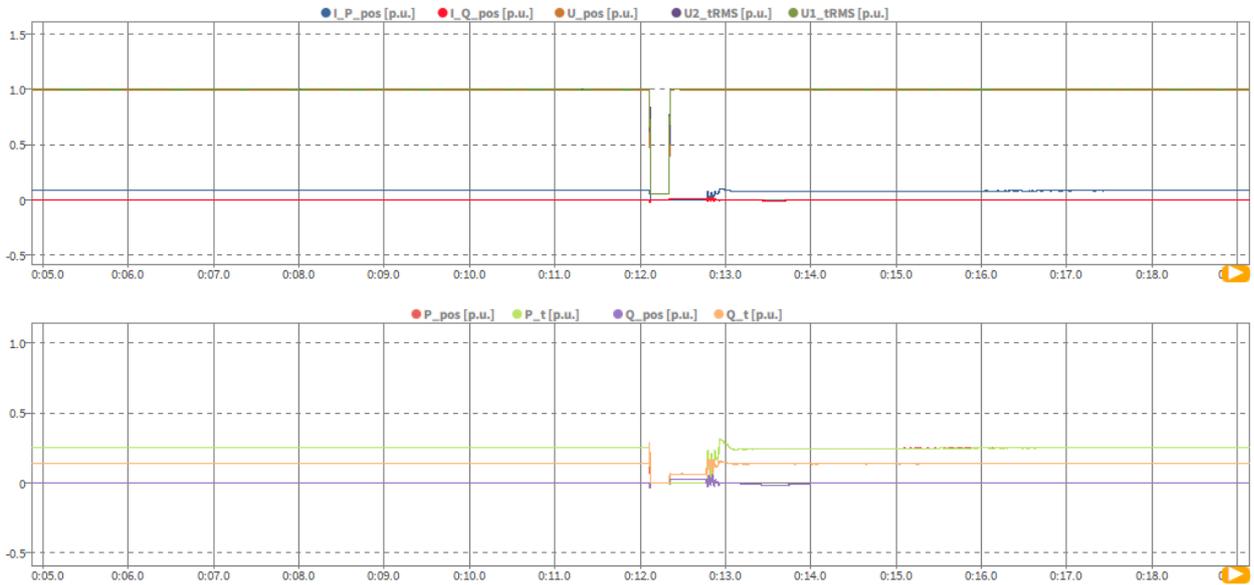
Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



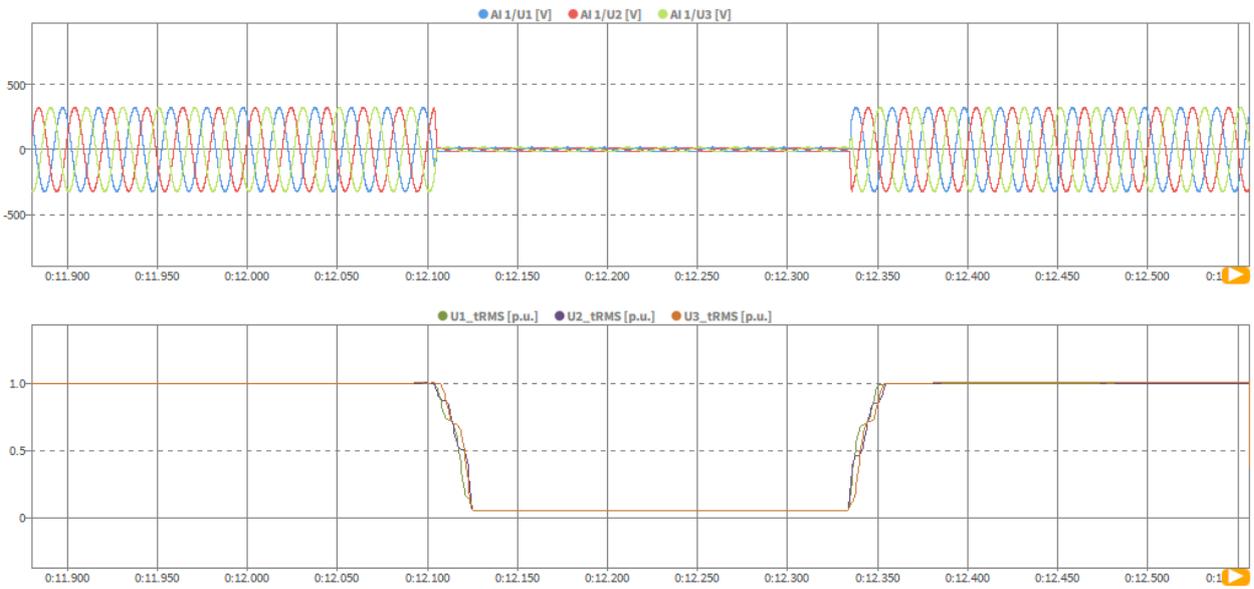
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 20% load, Test overview (voltage, current, active and reactive power positive sequence)



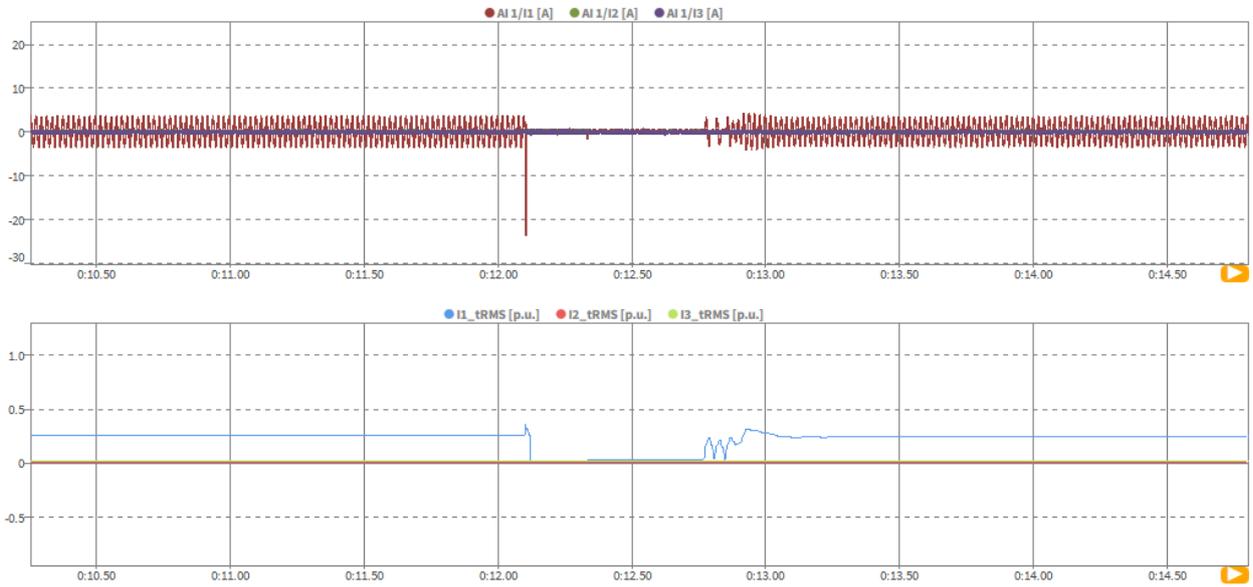
Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 20% load, Instantaneous and RMS values of phase voltages



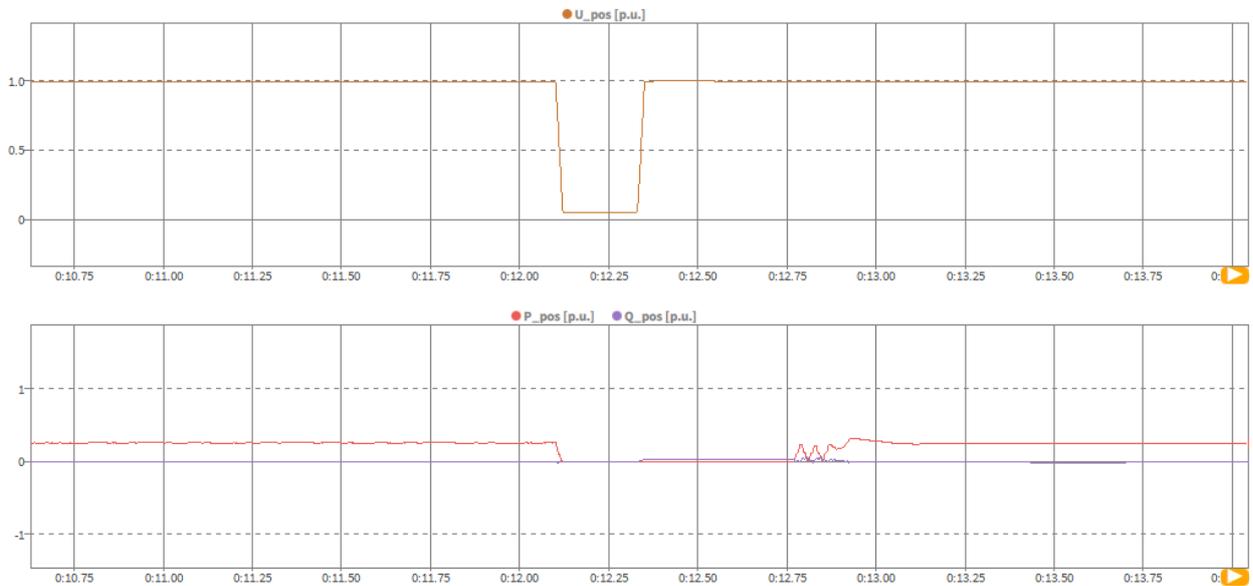
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



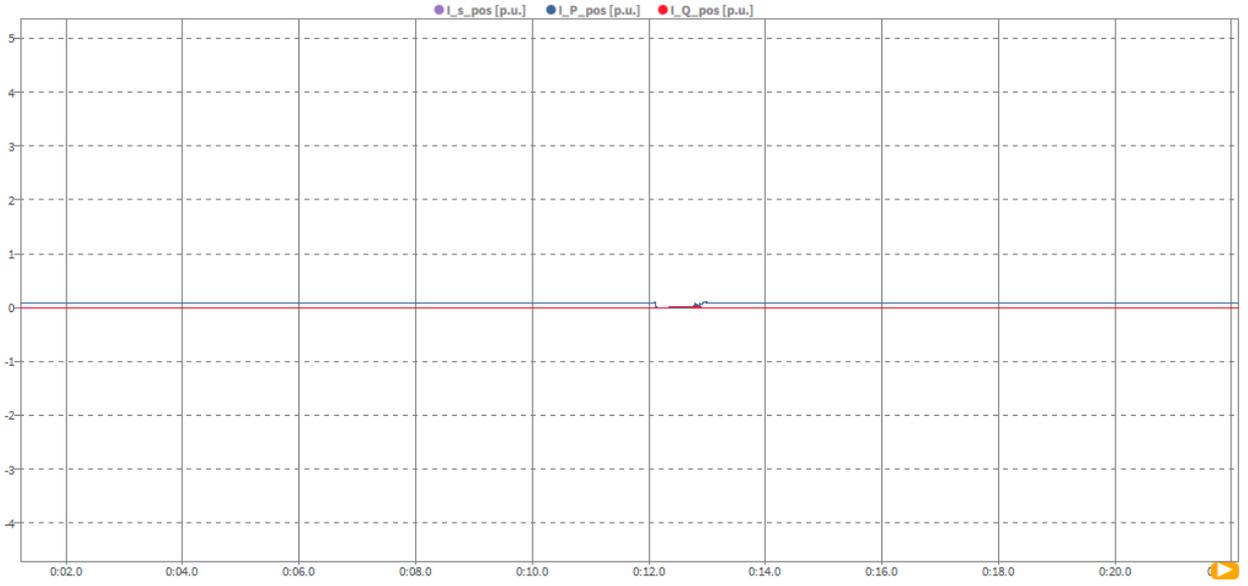
Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	1.3	1.4
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	16:25:13.9	16:39:13.4
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.05	0.05
	5	Setting dip duration	--	--	--	≥200	≥200
	6	Point of fault entry	Total	--	ms	43275	43275
	7	Point of fault clearance	Total	--	ms	43528	43528
	8	Fault duration in empty load test	Total	--	ms	252.666	252.666
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.596	0.596
	10		Pos.			0.049	0.049
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	0.999	0.999
			L2 to neutral			0.999	0.999
			L3 to neutral			0.999	0.999
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.202
	14	Active power	Total	t1-10s to t1	p.u.	0.995	0.201
			Pos.			0.995	0.201
	16	Reactive power	Total	t1-10s to t1	p.u.	-0.004	0.003
Pos.			-0.004			0.003	
18	Cosφ	--	t1-10s to t1	--	0.999	0.995	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.049	0.050
			L2 to neutral			0.869	0.869
			L3 to neutral			0.869	0.869
			Pos.			0.596	0.596
	21		Neg.	--	--		
	22	Line current	Phase 1	t1+60ms	p.u.	0.017	0.017
			Phase 2			0.034	0.034
			Phase 3			0.042	0.042
	25	Line current	Phase 1	t1+100ms	p.u.	0.017	0.017
			Phase 2			0.044	0.045
			Phase 3			0.043	0.042
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000	
		Pos.			0.000	0.000	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	0.999	0.999
			L2 to neutral			0.999	0.999
			L3 to neutral			0.999	0.999
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.995	0.201
			Pos.			0.995	0.201
	33	Active power rising time	Pos.	--	s	0.758	0.434
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.004	0.003
			Pos.			-0.004	0.003
	36	Reactive power rising time	Pos.	--	s	--	--
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

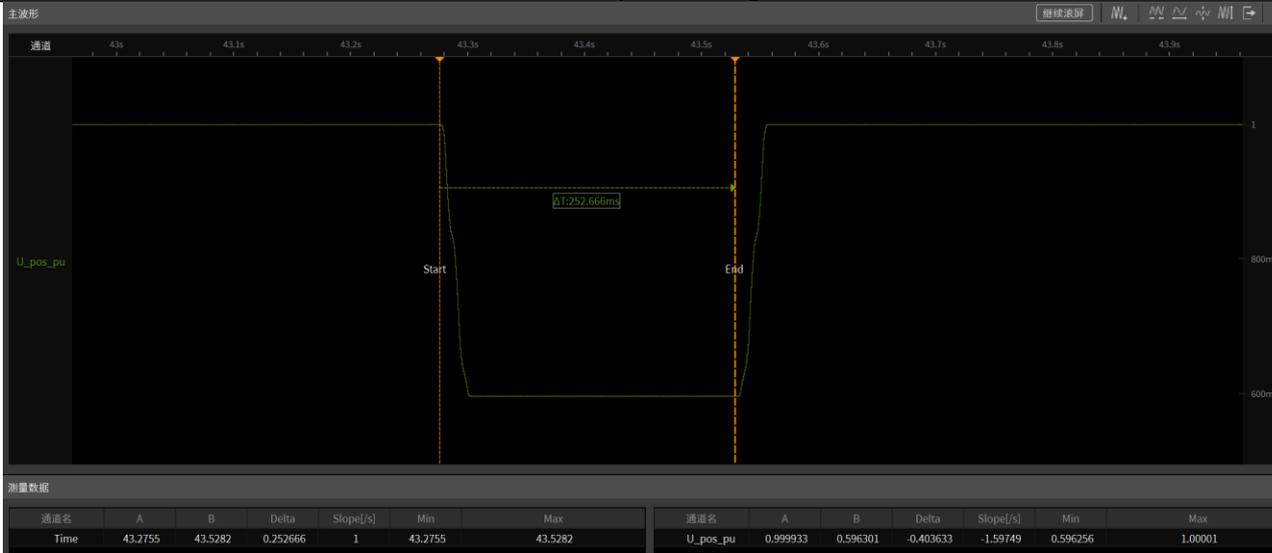
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.3&1.4 Depth of fault phase: 0.05 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



Test 1.3&1.4 Depth of fault phase: 0.05 p.u., three-phase SC (type D1), No load, Positive sequence voltage



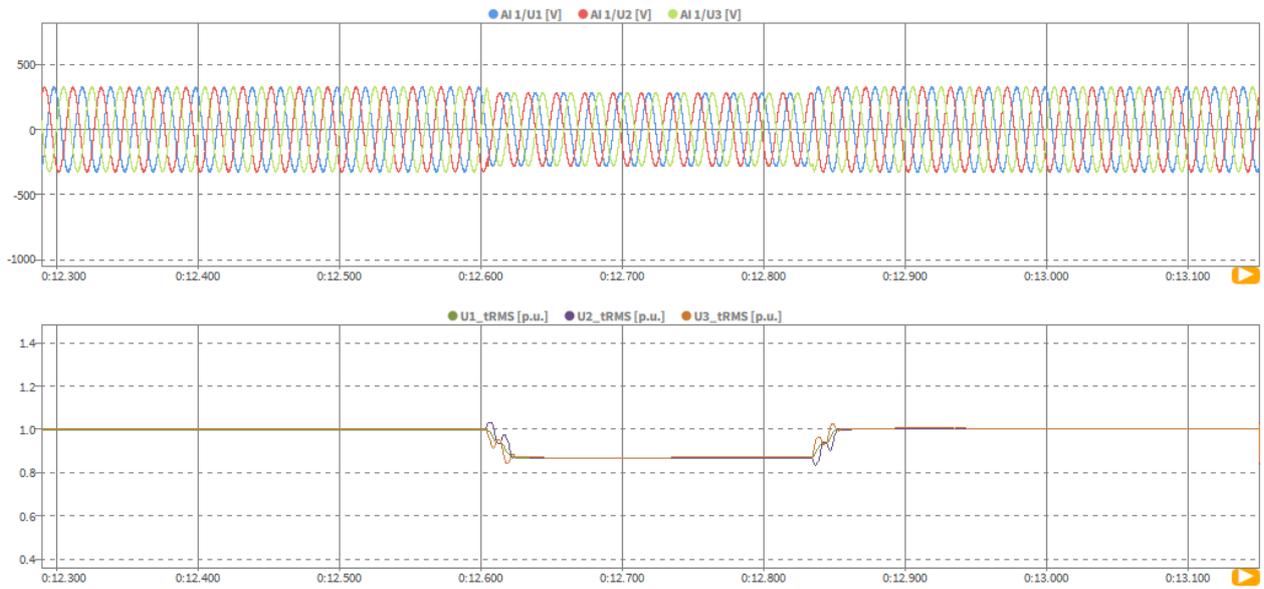
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.3 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



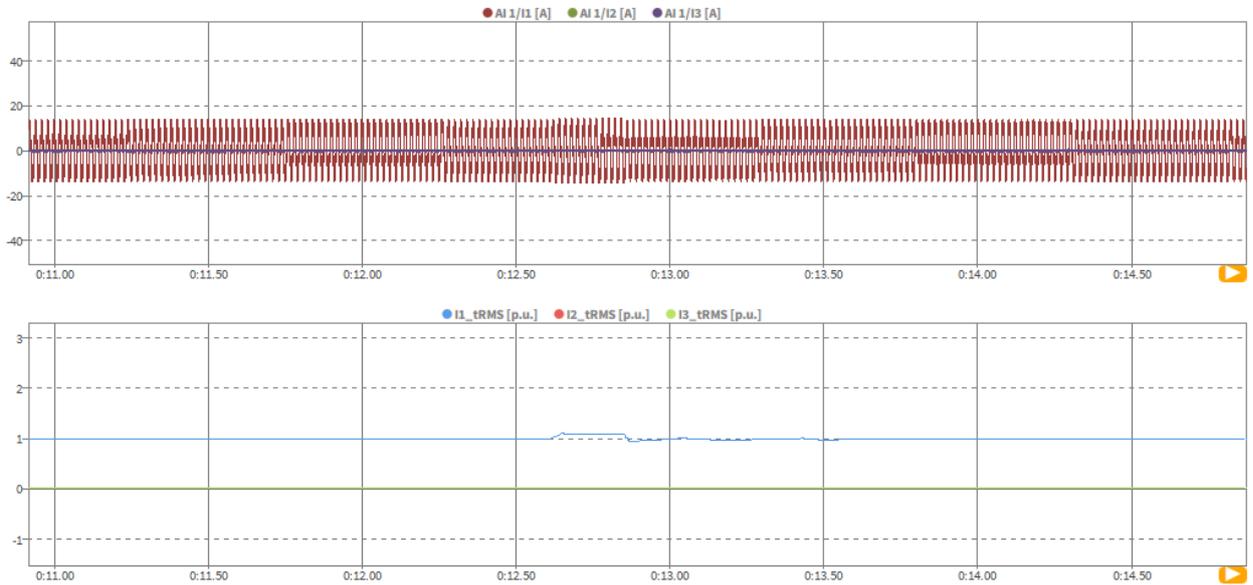
Test 1.3 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 100% load, Instantaneous and RMS values of phase voltages



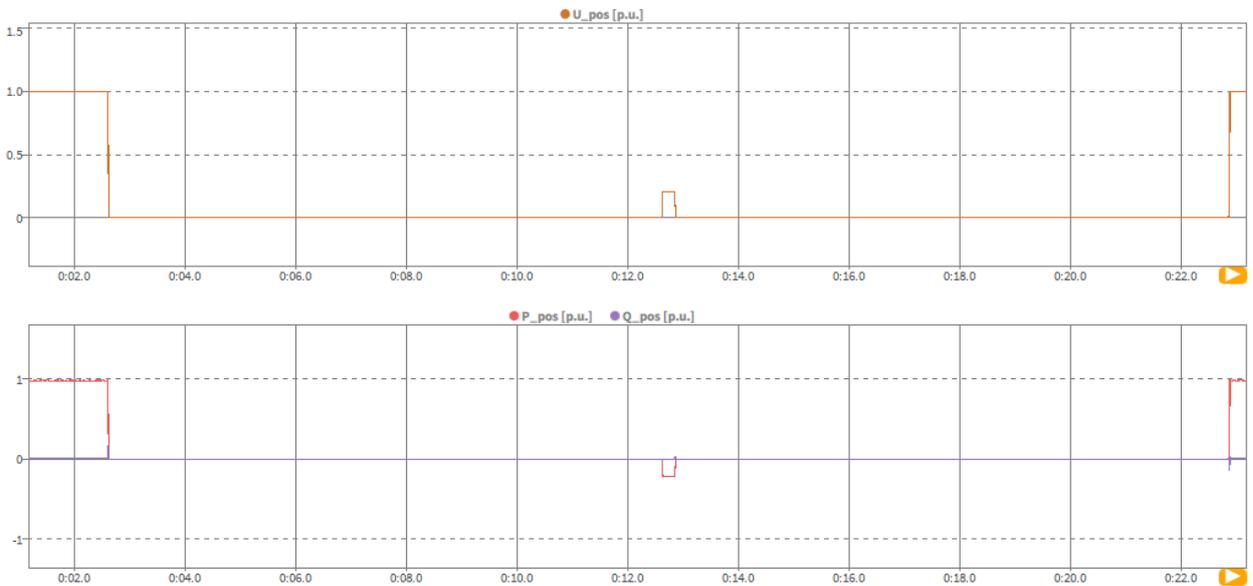
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.3 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 100% load, Instantaneous and RMS values of phase currents



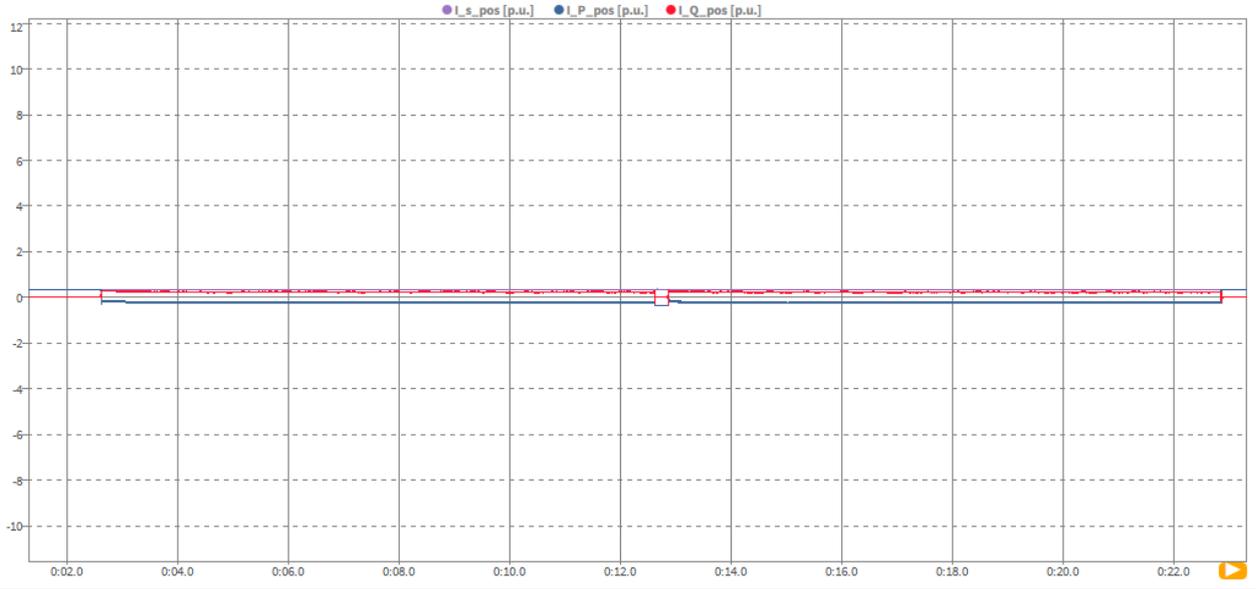
Test 1.3 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

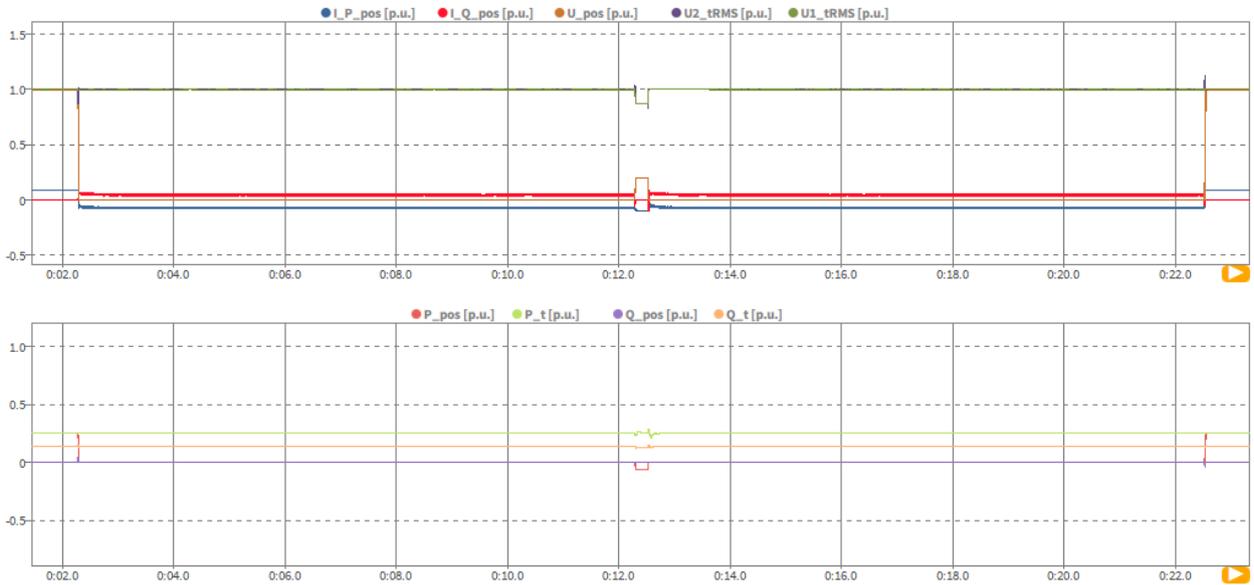
Test 1.3 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 100% load, Positive and negative sequence active, reactive and apparent current



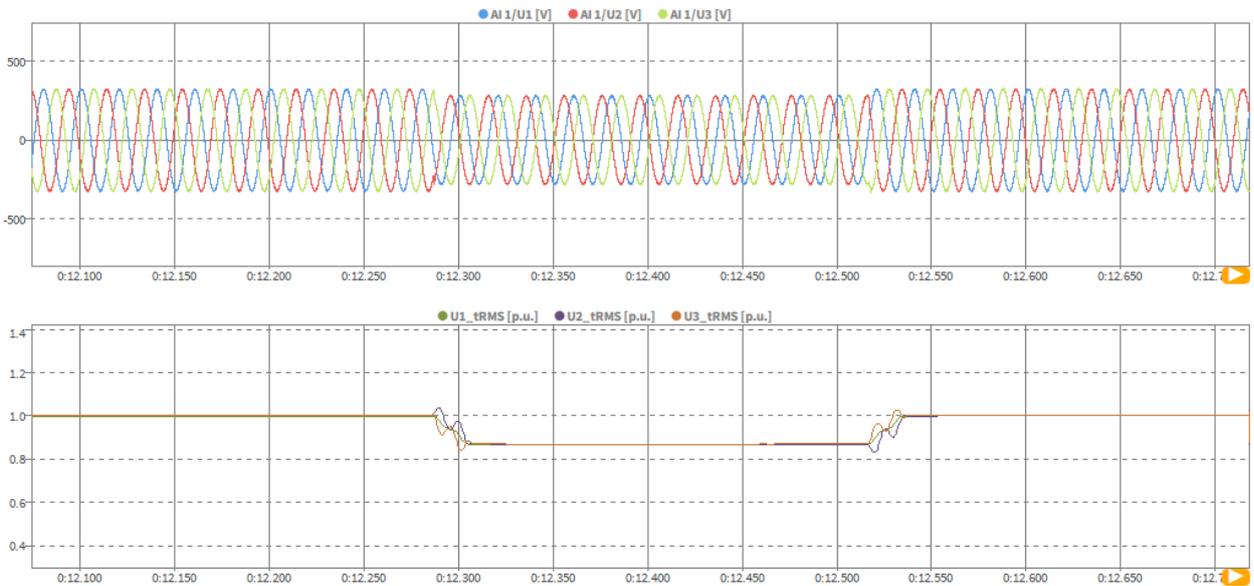
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.4 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



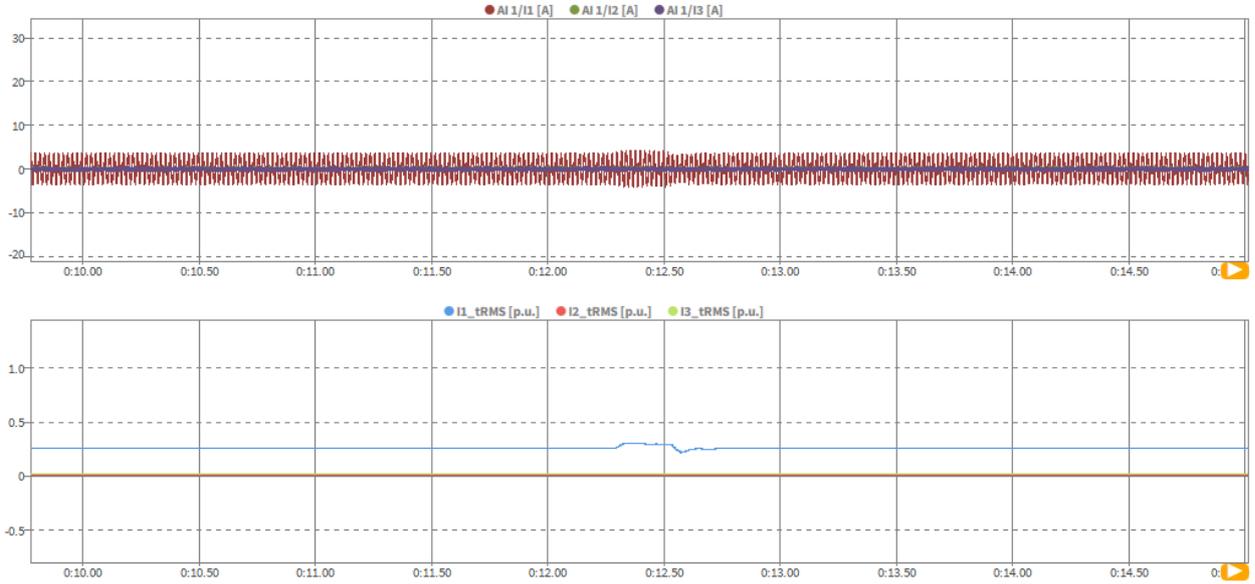
Test 1.4 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 20% load,
Instantaneous and RMS values of phase voltages



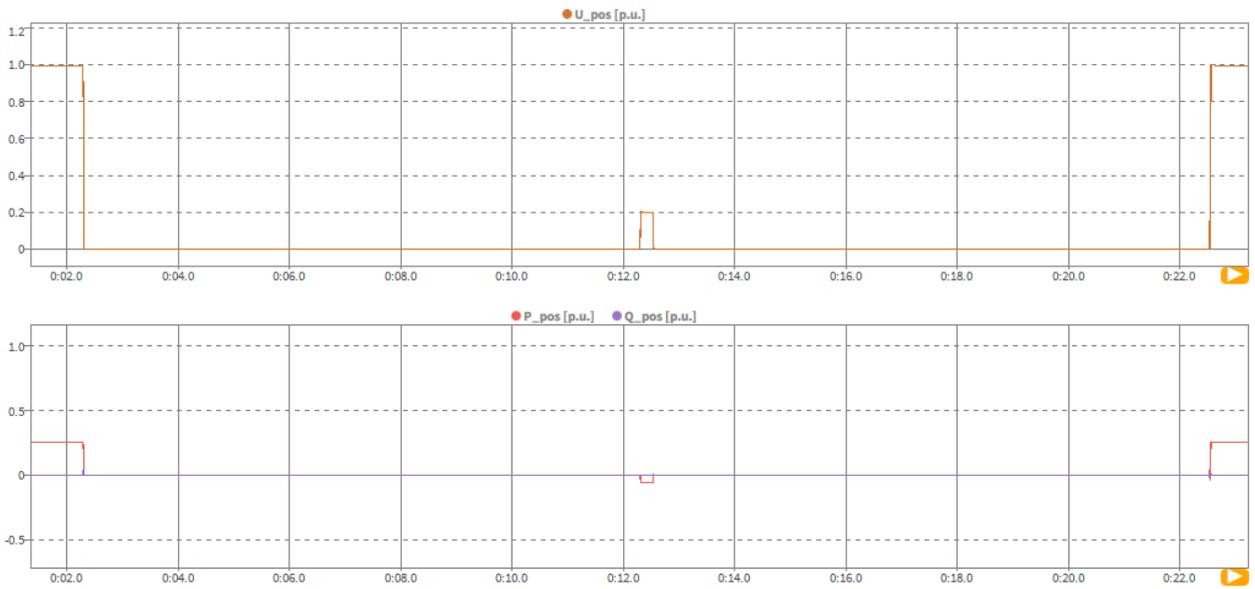
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.4 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 20% load, Instantaneous and RMS values of phase currents



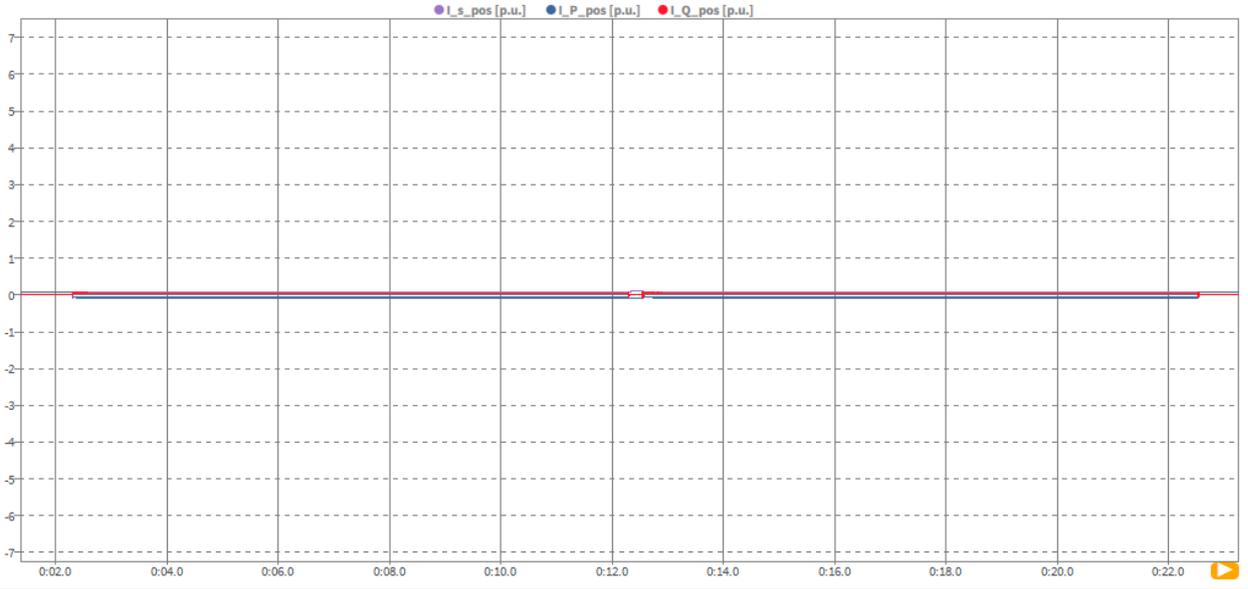
Test 1.4 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.4 Depth of fault phase: 0.05 p.u., 2-phase fault (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	1.5	1.6
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	17:27:13.9	17:36:13.4
	3	Fault type (phase)	--	--	--	D2	D2
	4	Setting voltage depth	Line to line	--	p.u.	0.05	0.05
	5	Setting dip duration	--	--	--	≥200	≥200
	6	Point of fault entry	Total	--	ms	34517	34517
	7	Point of fault clearance	Total	--	ms	35330	35330
	8	Fault duration in empty load test	Total	--	ms	813	813
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.868	0.868
	10		Pos.			0.201	0.201
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	0.999	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			0.999	0.999
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.200
	14	Active power	Total	t1-10s to t1	p.u.	0.995	0.200
	15		Pos.			0.995	0.200
	16	Reactive power	Total	t1-10s to t1	p.u.	-0.004	0.004
17	Pos.		-0.004			0.004	
18	Cosφ	--	t1-10s to t1	--	0.999	0.996	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.868	0.868
			L2 to neutral			0.868	0.868
			L3 to neutral			0.869	0.869
			Pos.			0.201	0.201
	20	Line current	Phase 1	t1+60ms	p.u.	1.041	1.025
	21		Phase 2			--	--
	22		Phase 3			--	--
	23	Line current	Phase 1	t1+100ms	p.u.	0.014	0.014
	24		Phase 2			--	--
	25		Phase 3			--	--
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.220	0.220	
27		Pos.			0.220	0.220	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	0.999	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			0.999	0.999
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.995	0.200
	32		Pos.			0.995	0.200
	33	Active power rising time	Pos.	--	s	--	--
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.004	0.004
35	Pos.		-0.004			0.004	
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

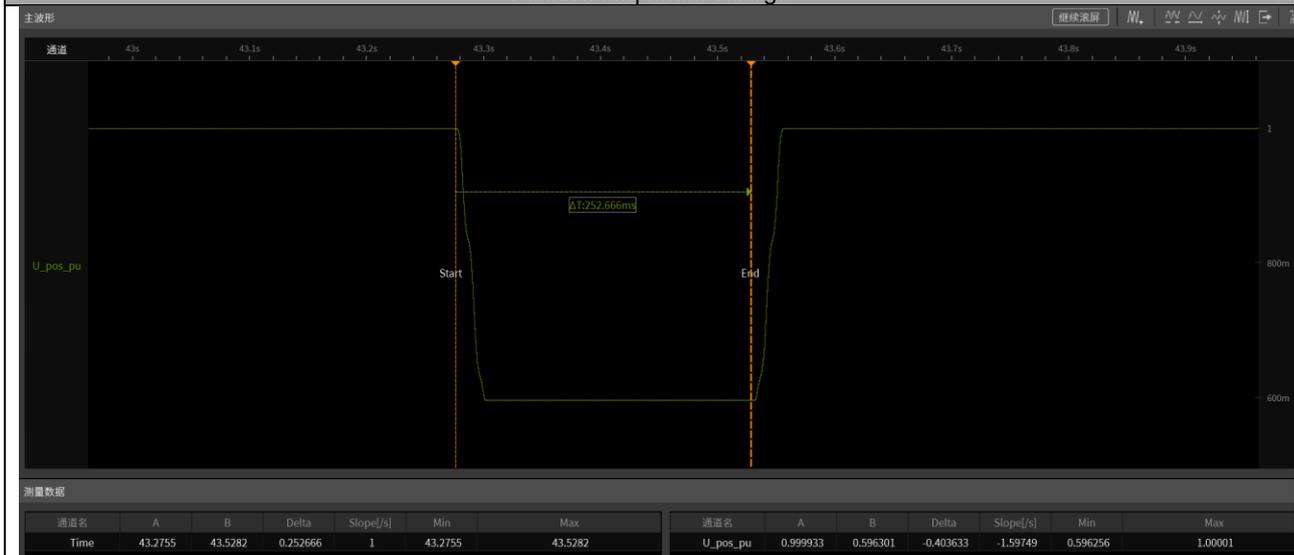
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.5&1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), No load, Instantaneous and RMS values of phase voltages



Test 1.5&1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), No load, Positive sequence voltage



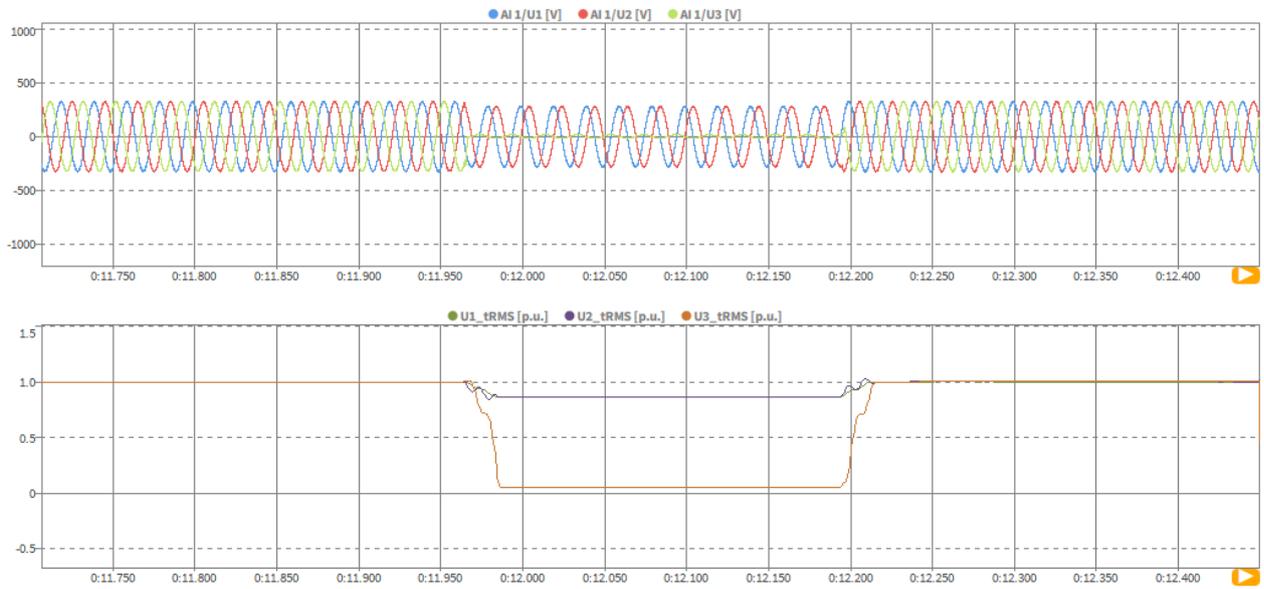
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.5 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



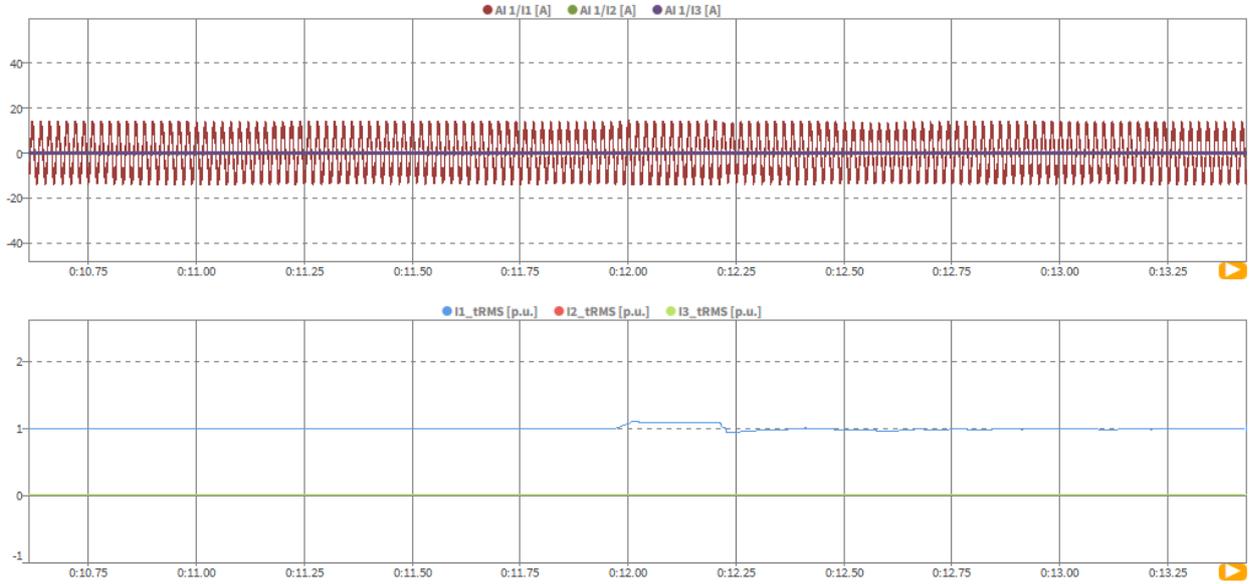
Test 1.5 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 100% load, Instantaneous and RMS values of phase voltages



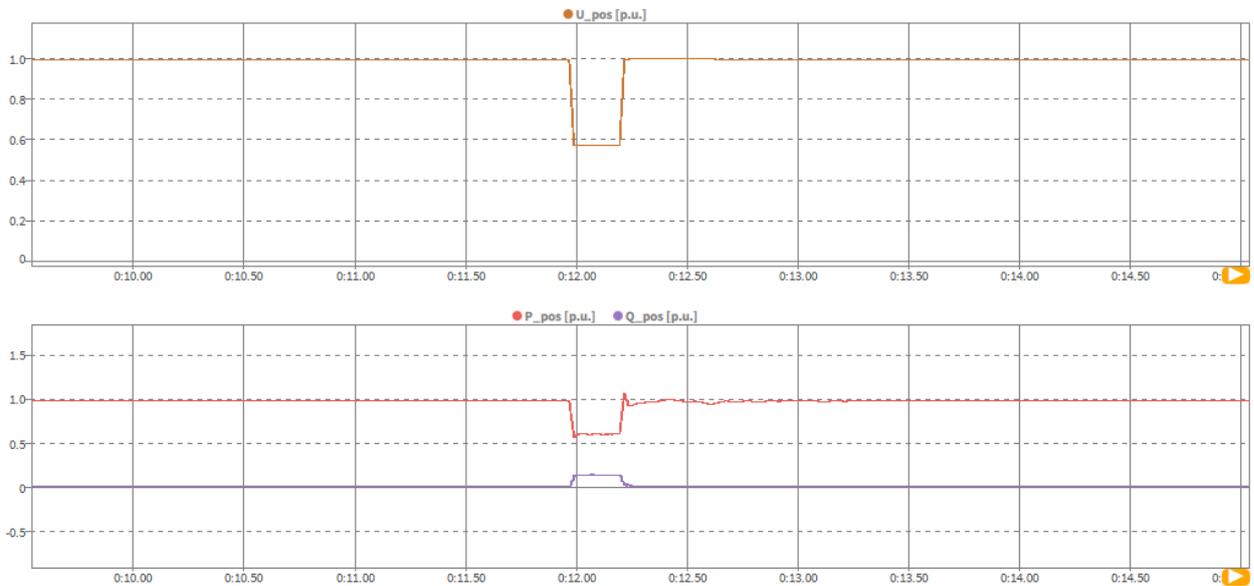
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.5 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents



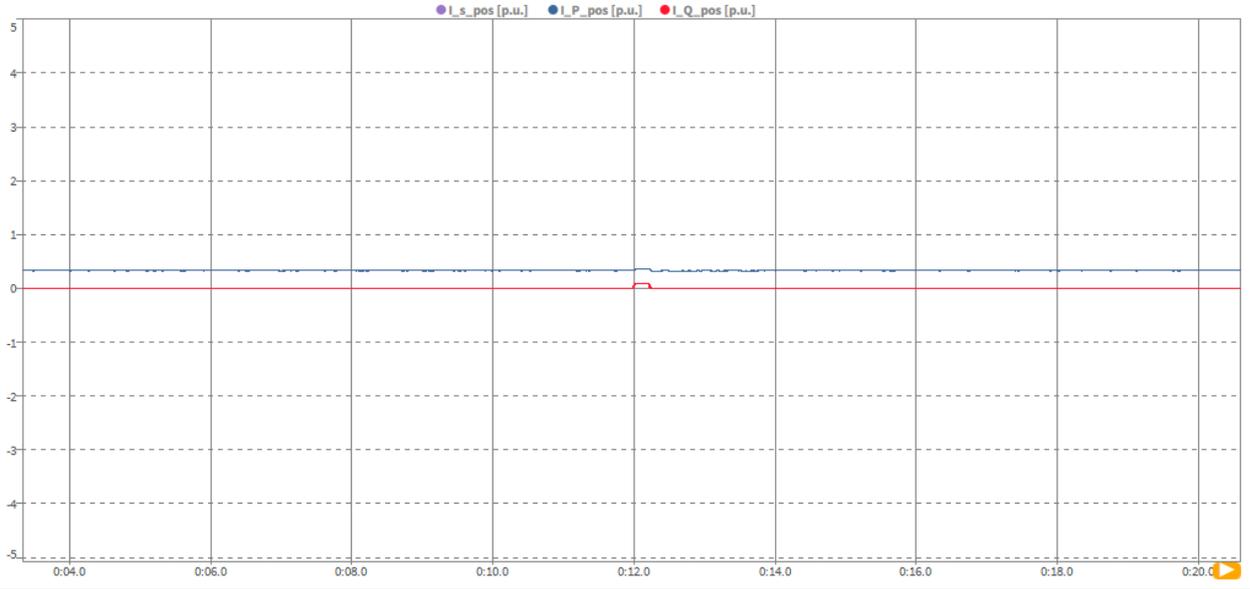
Test 1.5 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

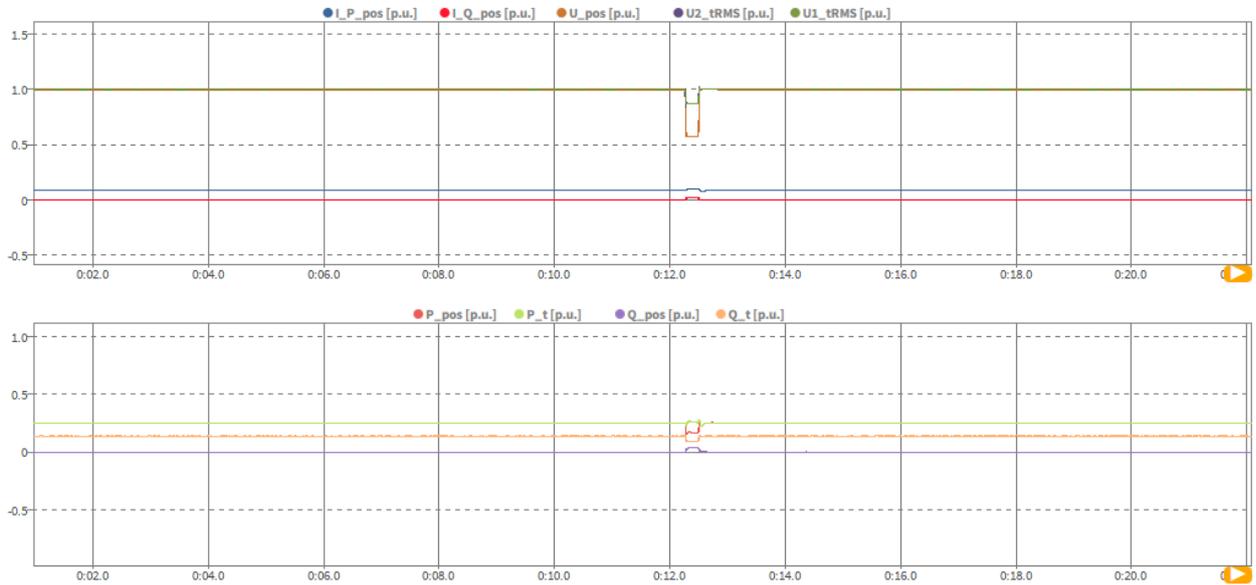
Test 1.5 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 100% load,
Positive and negative sequence active, reactive and apparent current



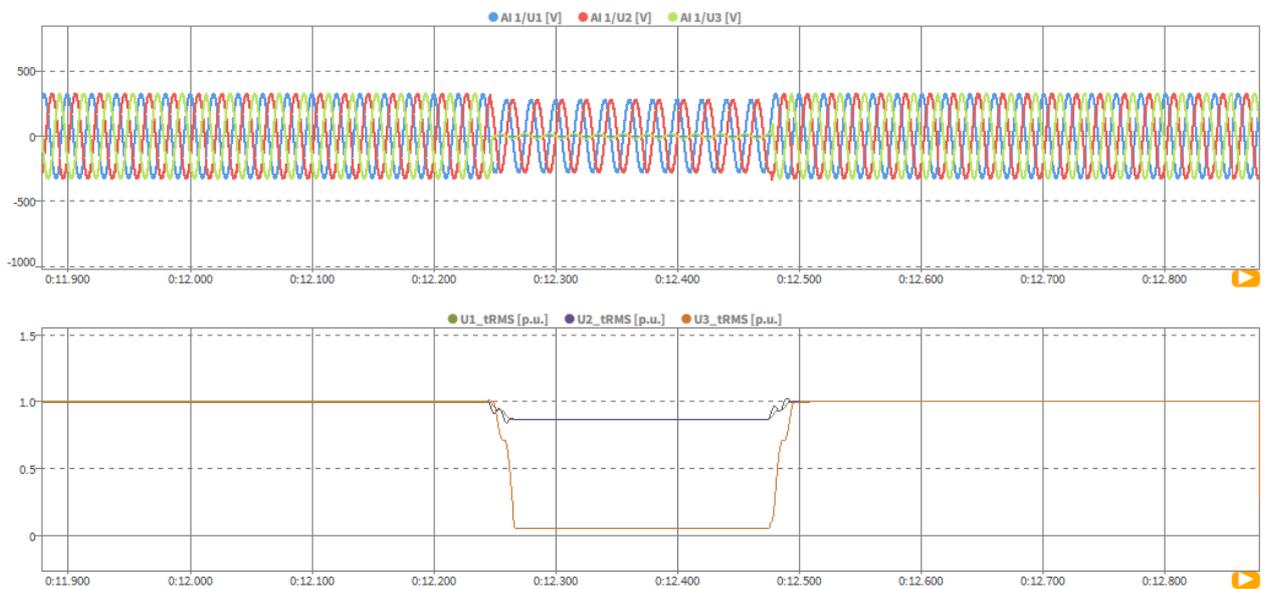
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



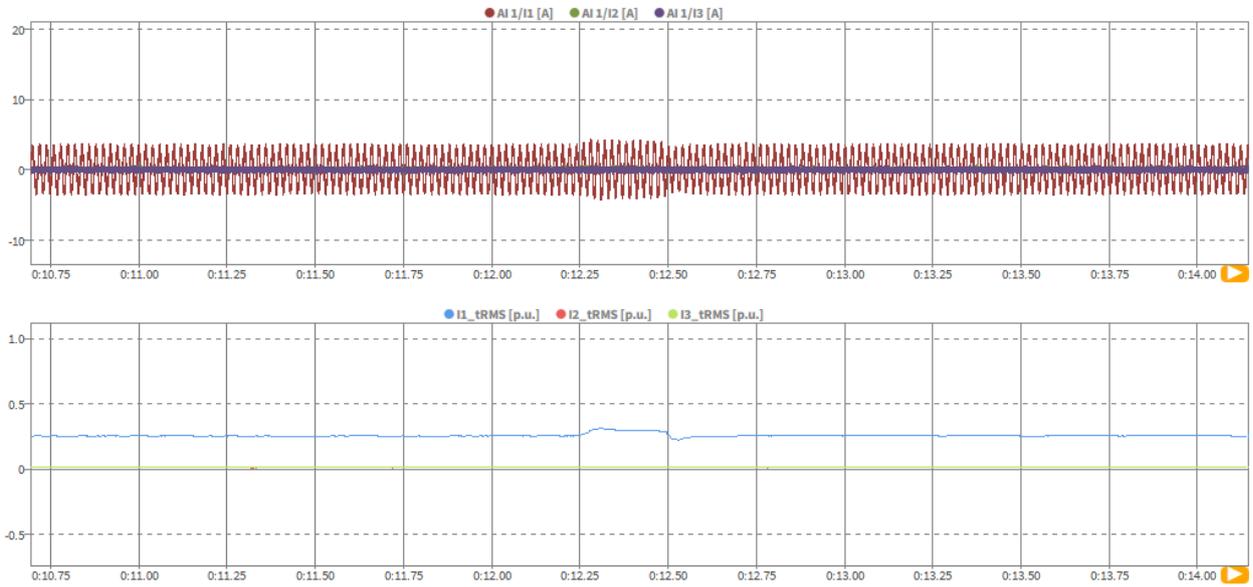
Test 1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 20% load,
Instantaneous and RMS values of phase voltages



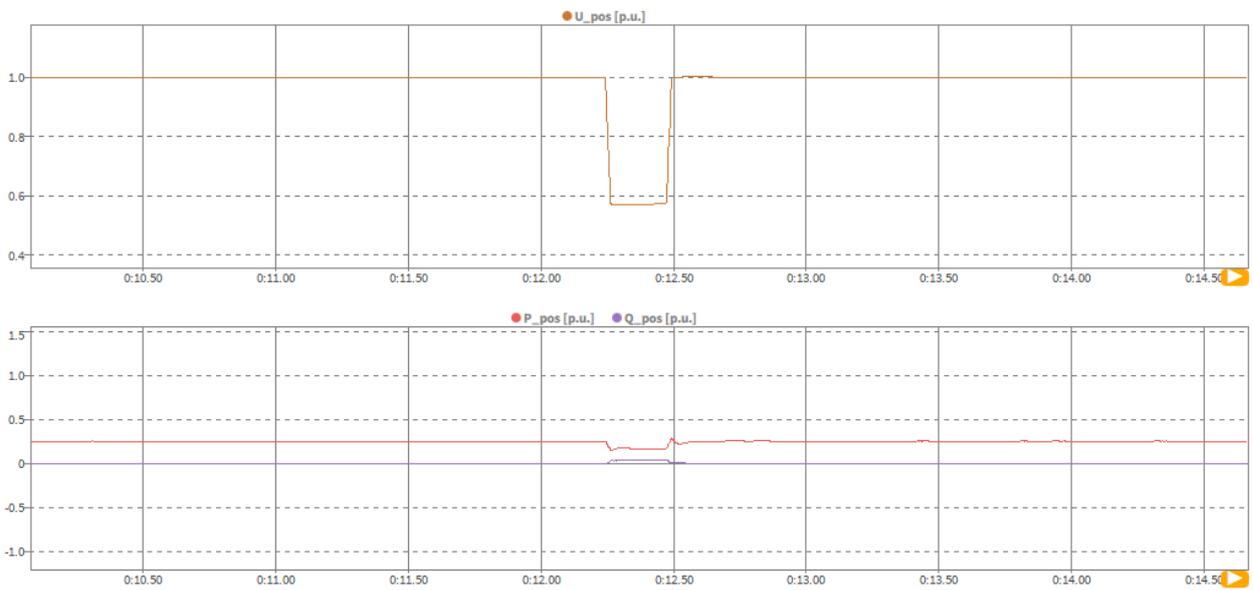
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 20% load, Instantaneous and RMS values of phase currents



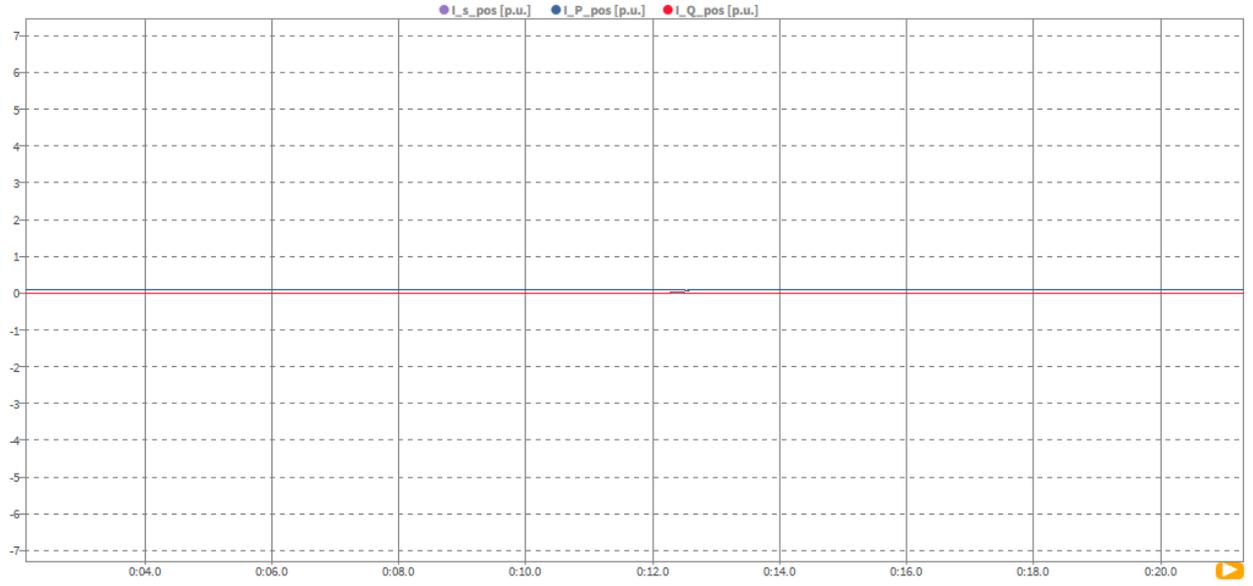
Test 1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 1.6 Depth of fault phase: 0.05 p.u., three-phase SC (type D2), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

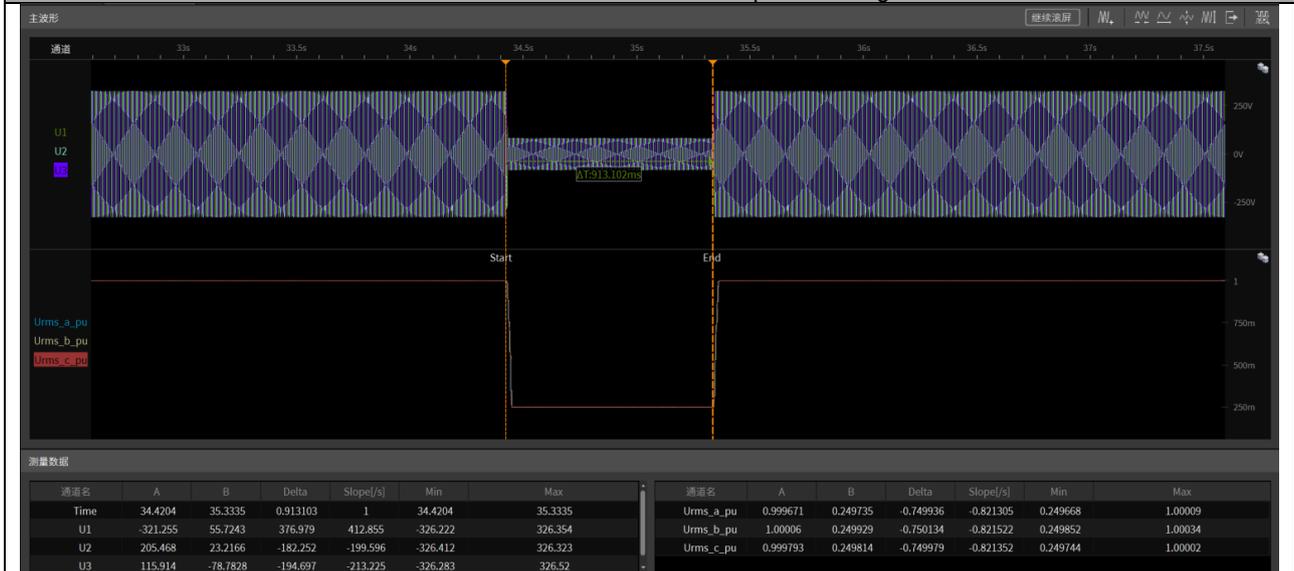
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	2.1	2.2
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	17:27:13.9	17:36:13.4
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.25	0.25
	5	Setting dip duration	--	--	--	≥630	≥630
	6	Point of fault entry	Total	--	ms	34418	34418
	7	Point of fault clearance	Total	--	ms	35330	35330
	8	Fault duration in empty load test	Total	--	ms	912	912
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.249	0.249
	10		Pos.			0.249	0.249
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	0.999	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			0.999	0.999
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.200
	14	Active power	Total	t1-10s to t1	p.u.	0.995	0.200
	15		Pos.			0.995	0.200
	16	Reactive power	Total	t1-10s to t1	p.u.	-0.004	0.004
17	Pos.		-0.004			0.004	
18	Cosφ	--	t1-10s to t1	--	0.999	0.996	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.249	0.250
			L2 to neutral			0.250	0.250
			L3 to neutral			0.250	0.250
	20		Pos.			0.249	0.250
	21		Neg.			--	--
	22	Line current	Phase 1	t1+60ms	p.u.	0.014	0.014
	23		Phase 2			0.025	0.026
	24		Phase 3			0.020	0.020
	25	Line current	Phase 1	t1+100ms	p.u.	0.014	0.014
	26		Phase 2			0.024	0.025
27	Phase 3		0.020			0.020	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000	
29		Pos.			0.000	0.000	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	0.999	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			0.999	0.999
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.995	0.200
	32		Pos.			0.995	0.200
	33	Active power rising time	Pos.	--	s	0.541	0.398
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.004	0.004
	35		Pos.			-0.004	0.004
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

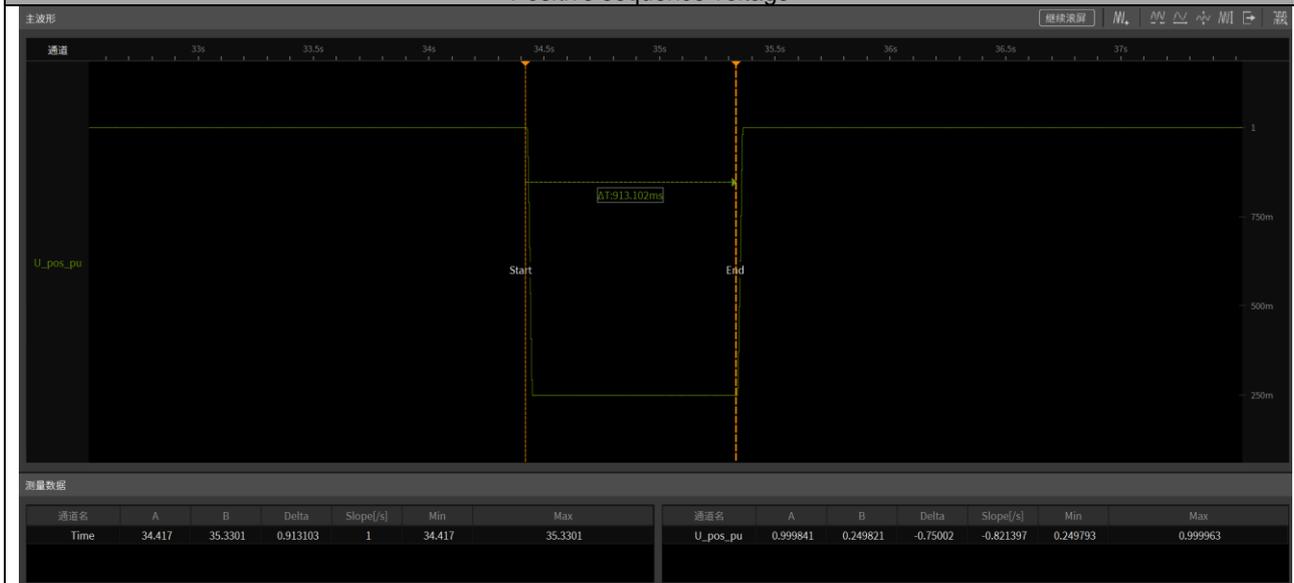
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.1&2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



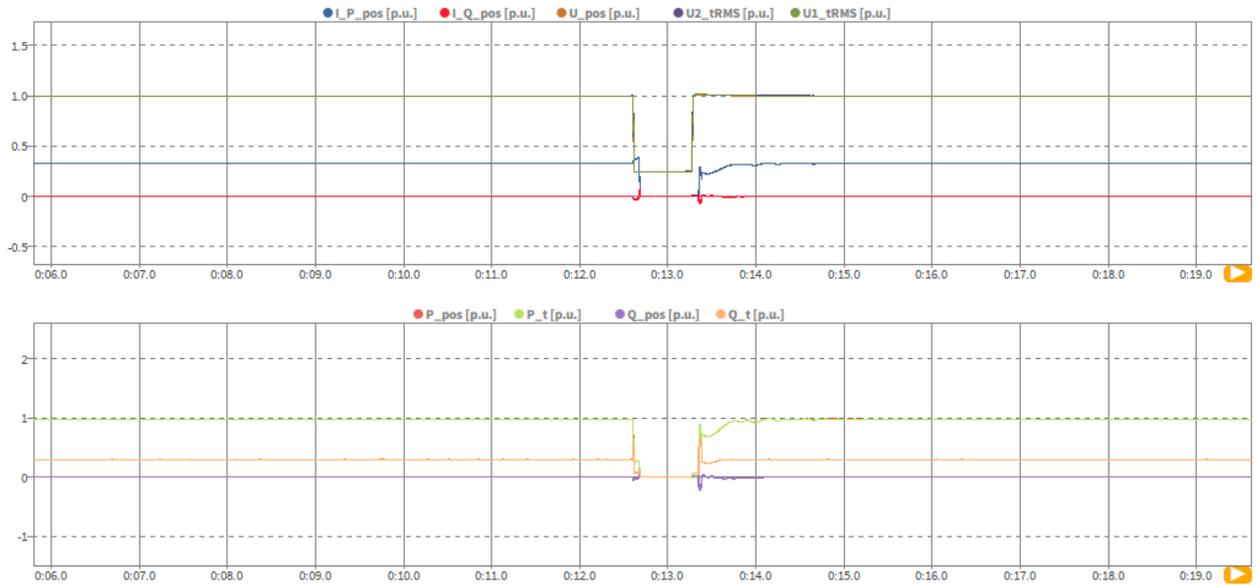
Test 2.1&2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), No load, Positive sequence voltage



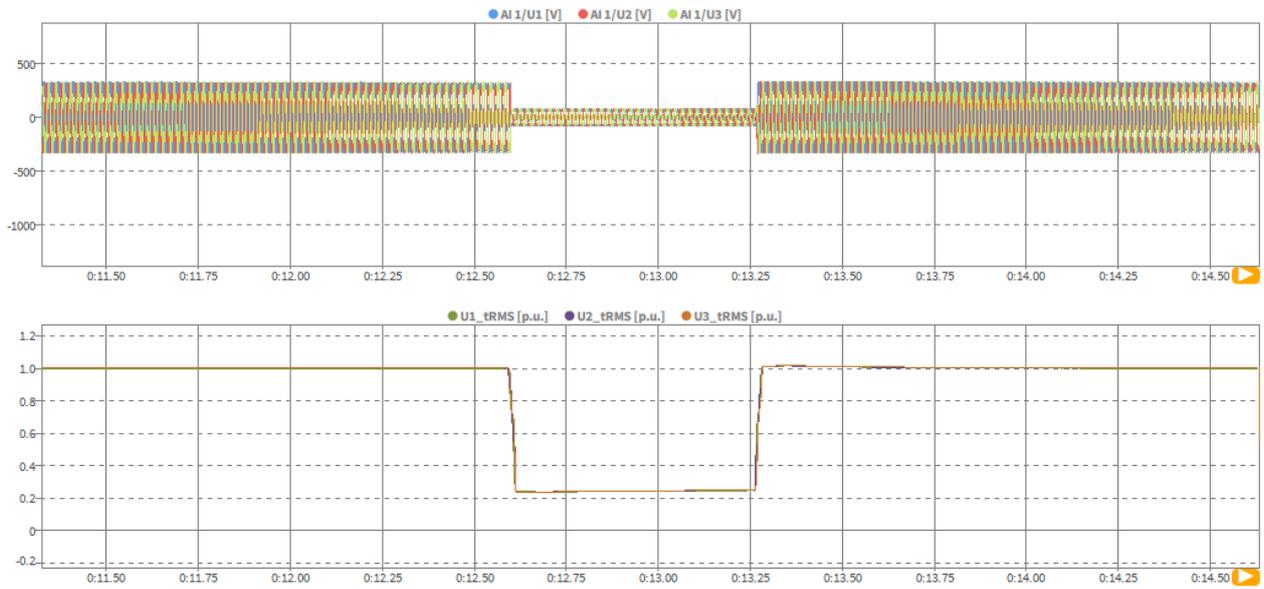
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



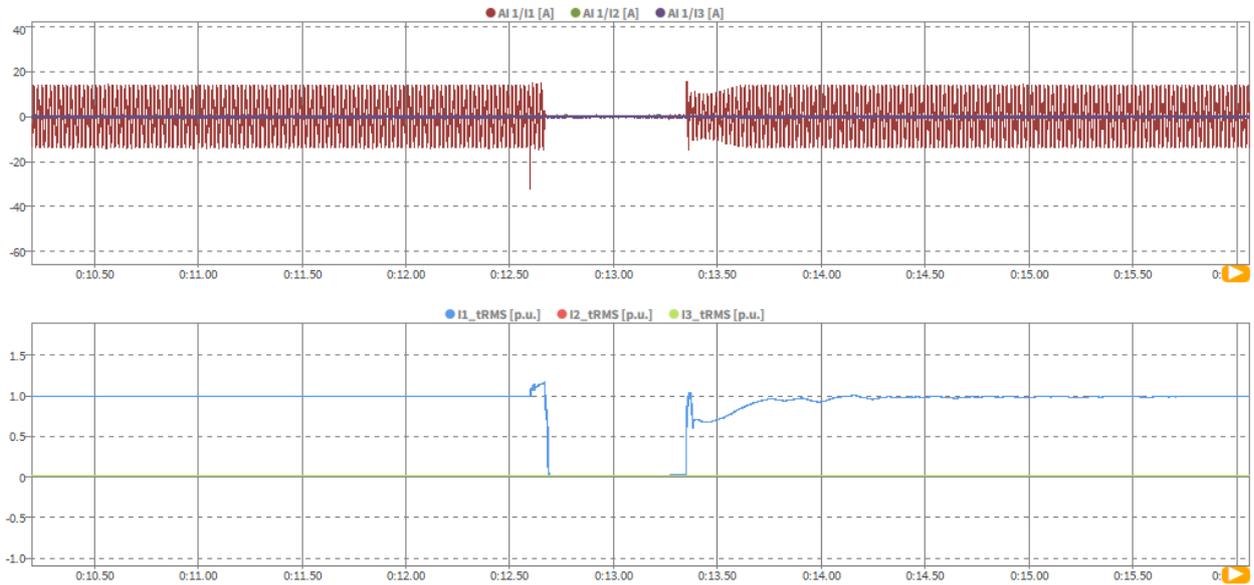
Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase voltages



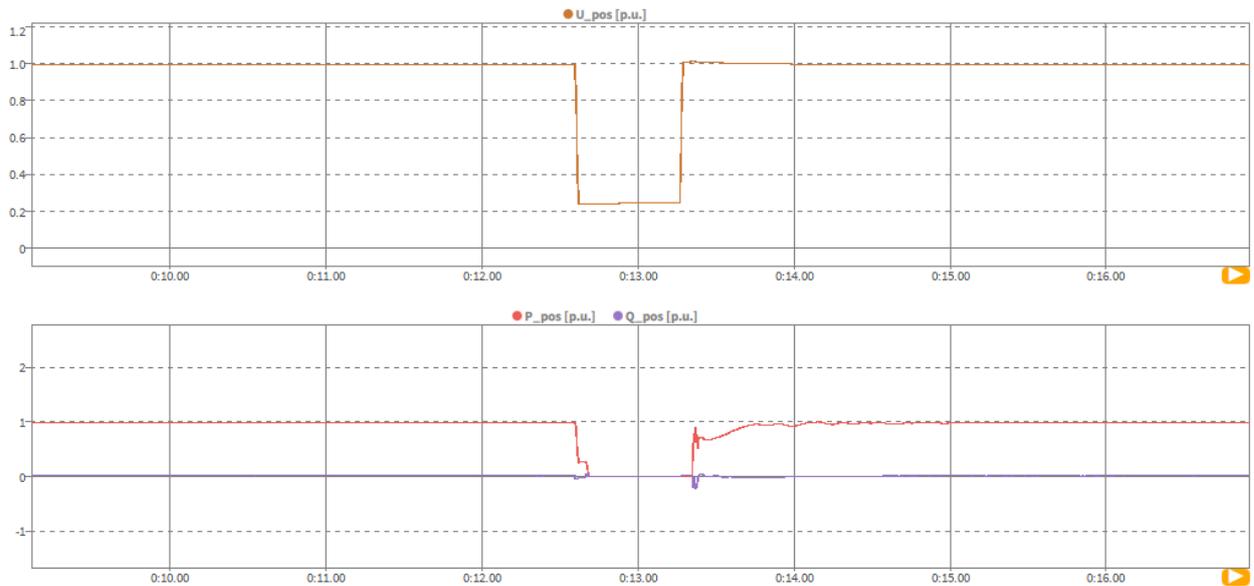
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



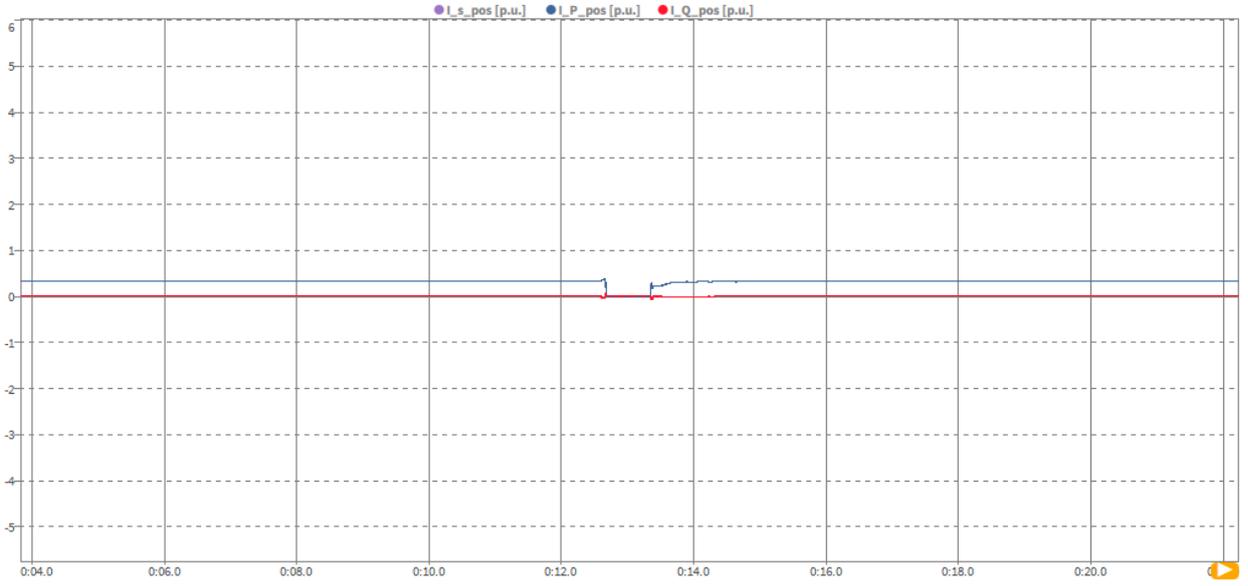
Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

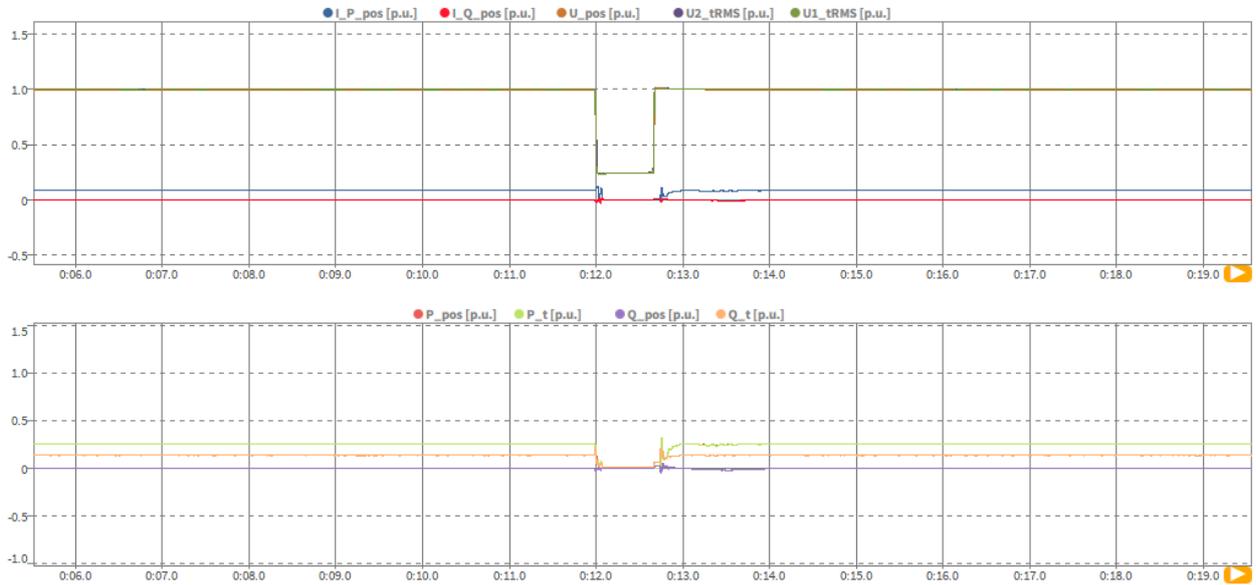
Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



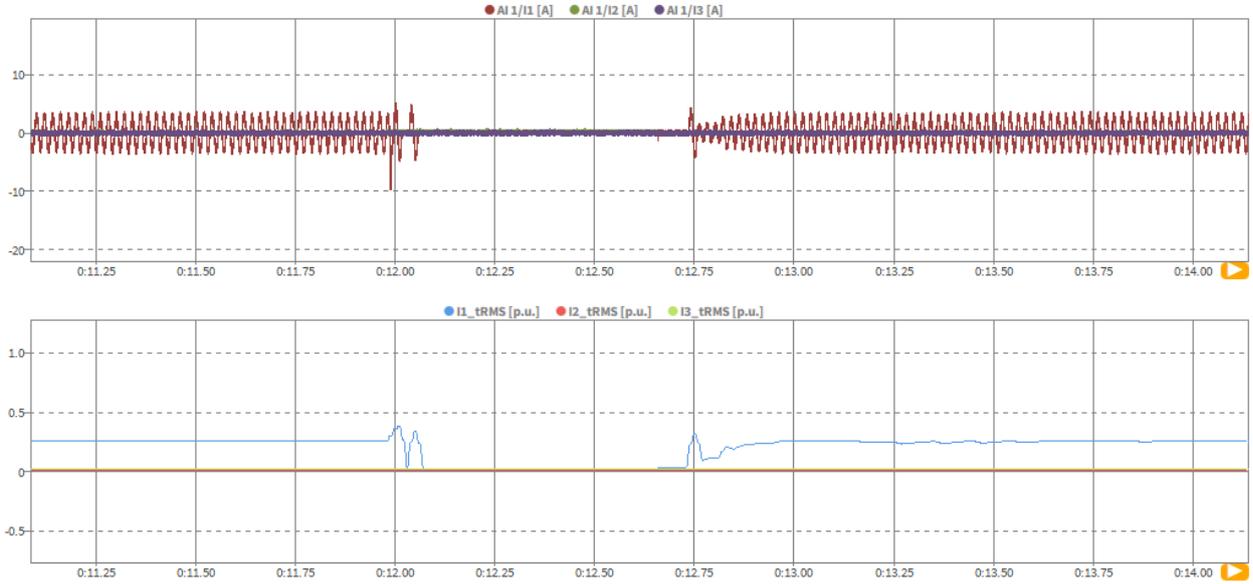
Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



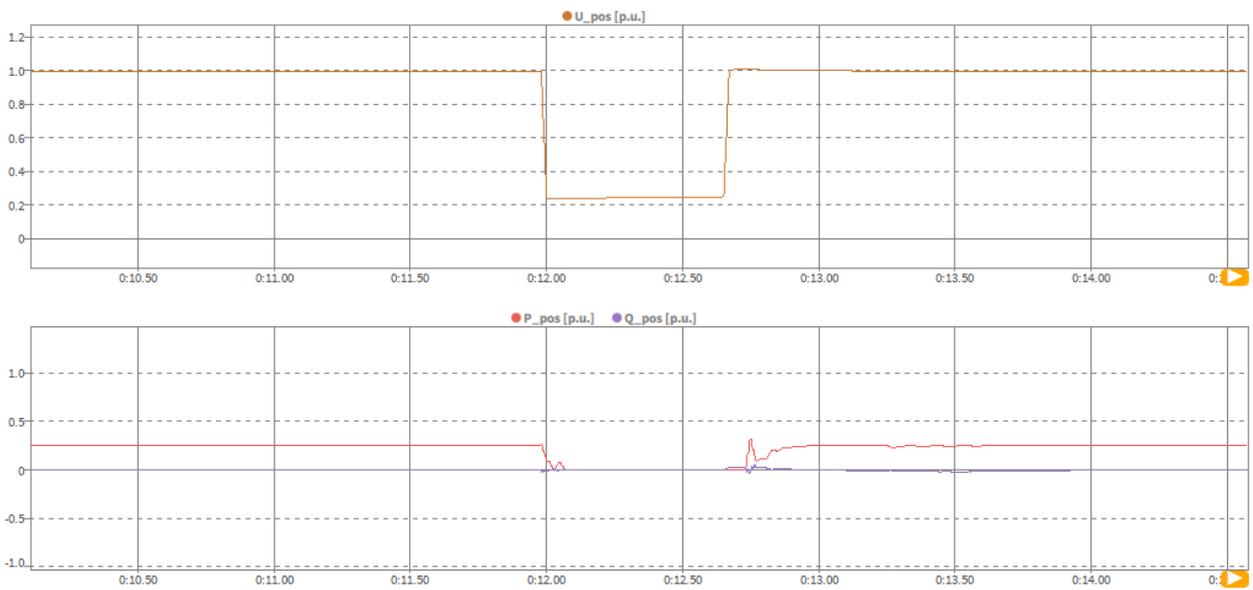
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



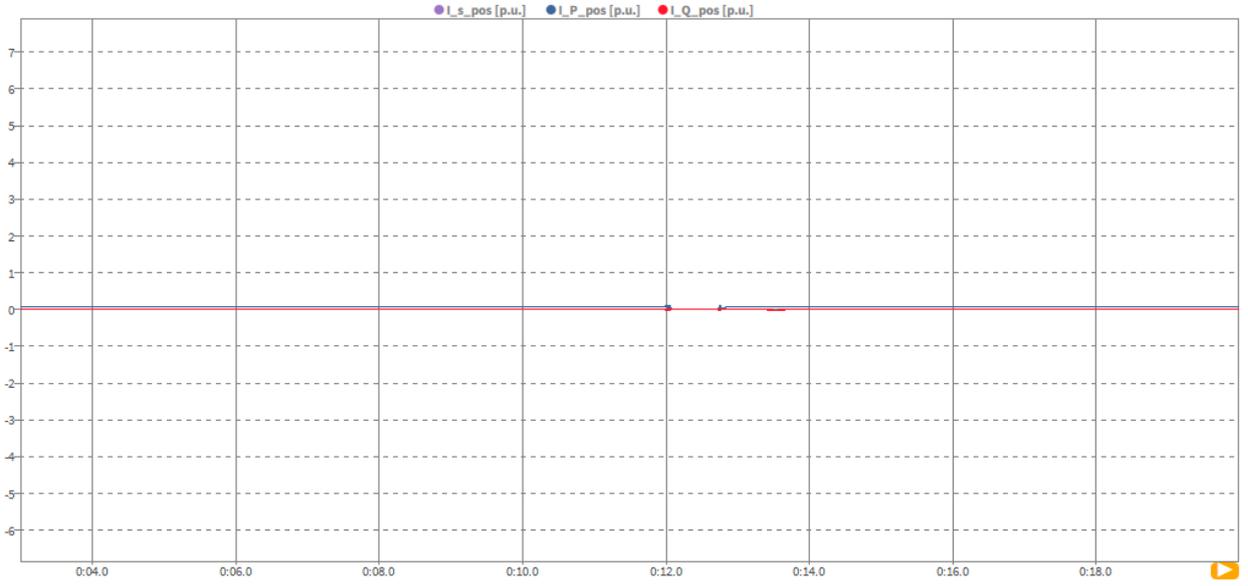
Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

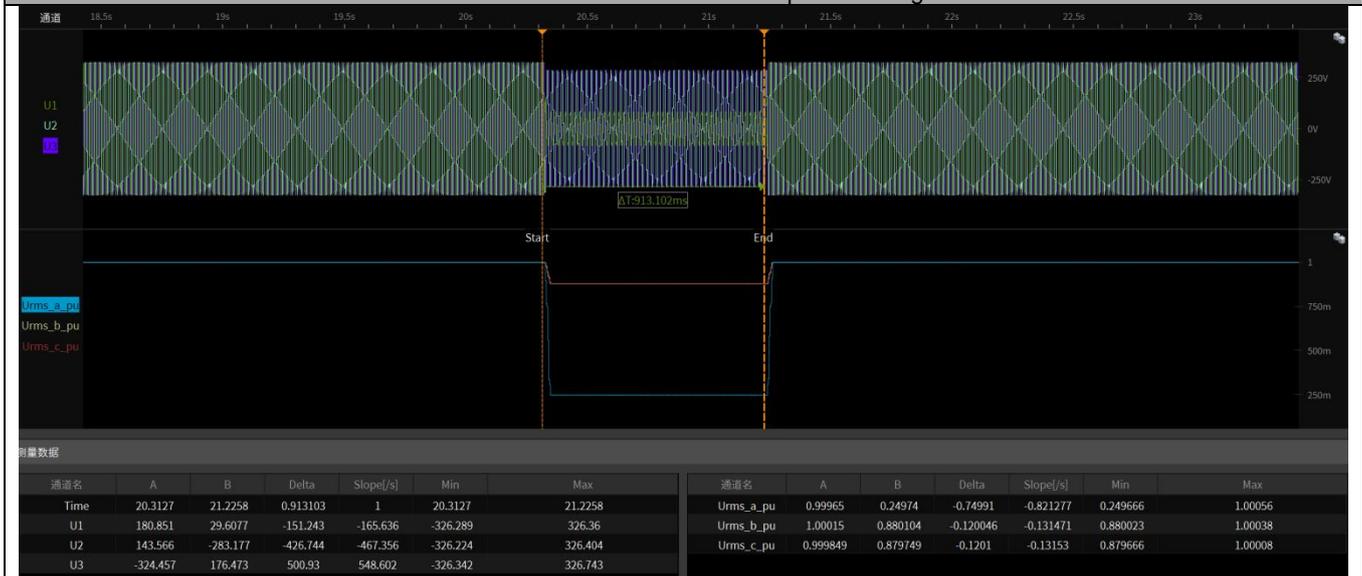
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	2.3	2.4	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	17:33:13.9	17:49:13.4	
	3	Fault type (phase)	--	--	--	D	D	
	4	Setting voltage depth	Line to line	--	--	p.u.	0.25	0.25
	5	Setting dip duration	--	--	--	--	≥630	≥630
	6	Point of fault entry	Total	--	--	ms	20316	20316
	7	Point of fault clearance	Total	--	--	ms	21229	21229
	8	Fault duration in empty load test	Total	--	--	ms	913	913
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.249	0.669	
	10		Pos.			0.669	0.249	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	0.999	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.201	
	14	Active power	Total	t1-10s to t1	p.u.	0.996	0.201	
	15		Pos.			0.996	0.201	
	16	Reactive power	Total	t1-10s to t1	p.u.	-0.007	0.005	
17	Pos.		-0.007			0.005		
18	Cosφ	--	t1-10s to t1	--	0.999	0.996		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.249	0.249	
			L2 to neutral			0.879	0.880	
			L3 to neutral			0.879	0.879	
			Pos.			0.669	0.670	
	20	Line current	Phase 1	t1+60ms	p.u.	0.024	0.024	
	21		Phase 2			0.045	0.045	
	22		Phase 3			0.043	0.043	
	23	Line current	Phase 1	t1+100ms	p.u.	0.024	0.024	
	24		Phase 2			0.045	0.045	
	25		Phase 3			0.043	0.043	
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000		
27		Pos.			0.000	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	0.999	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.996	0.201	
	32		Pos.			0.996	0.201	
	33	Active power rising time	Pos.	--	s	0.439	0.251	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	-0.007	0.005	
	35		Pos.			-0.007	0.005	
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

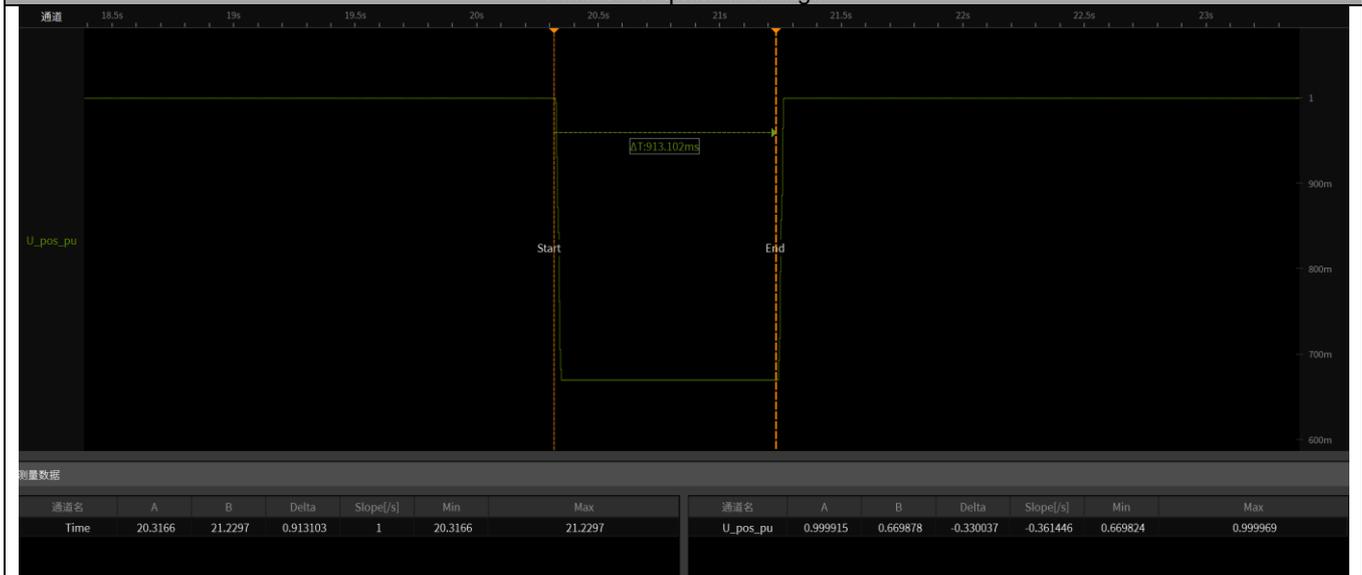
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.3&2.4 Depth of fault phase: 0.25 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



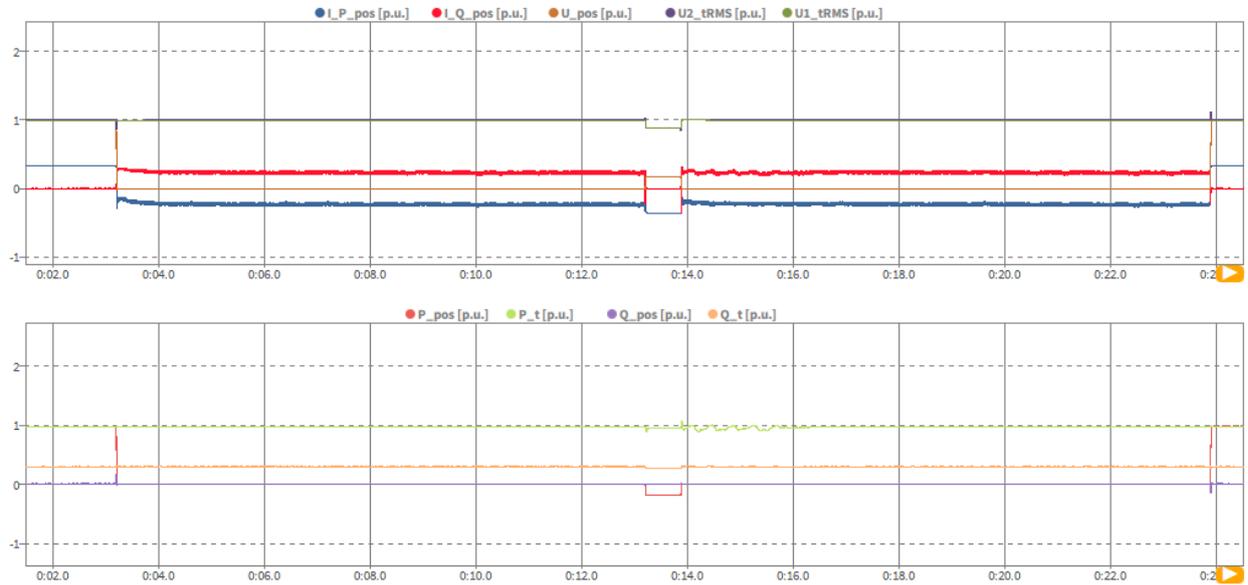
Test 2.3&2.4 Depth of fault phase: 0.25 p.u., three-phase SC (type D1), No load, Positive sequence voltage



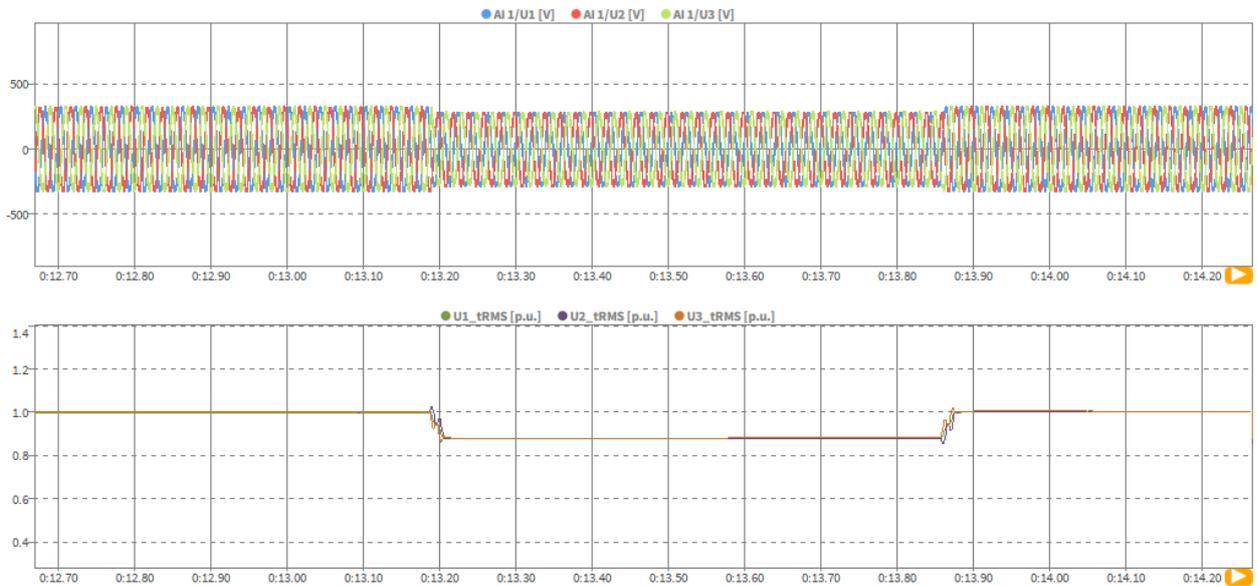
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.3 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



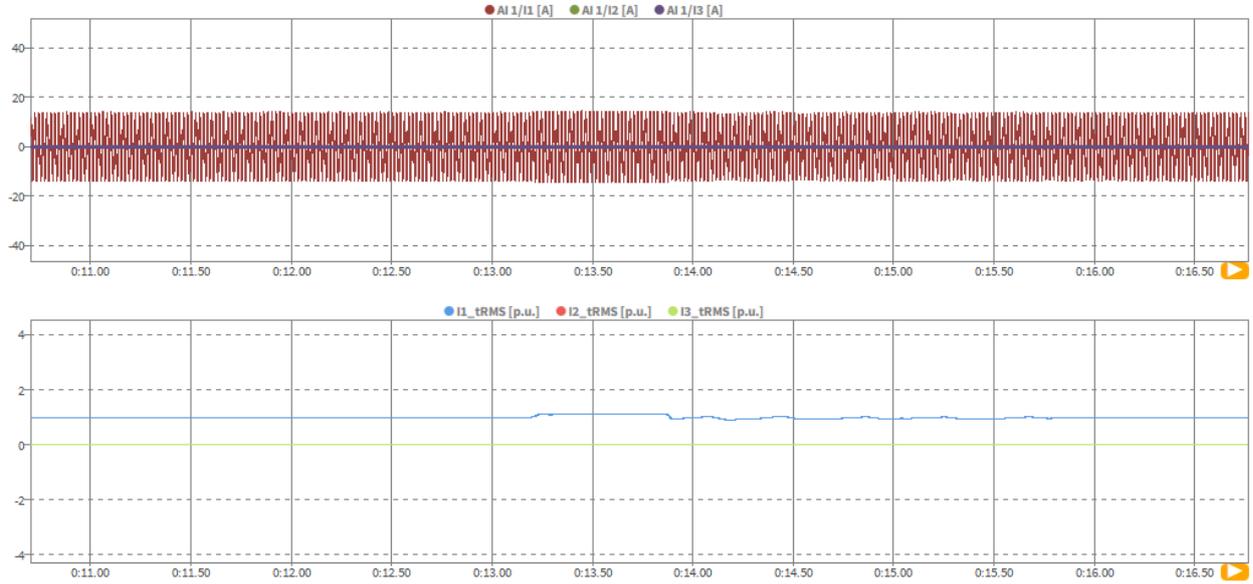
Test 2.3 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 100% load, Instantaneous and RMS values of phase voltages



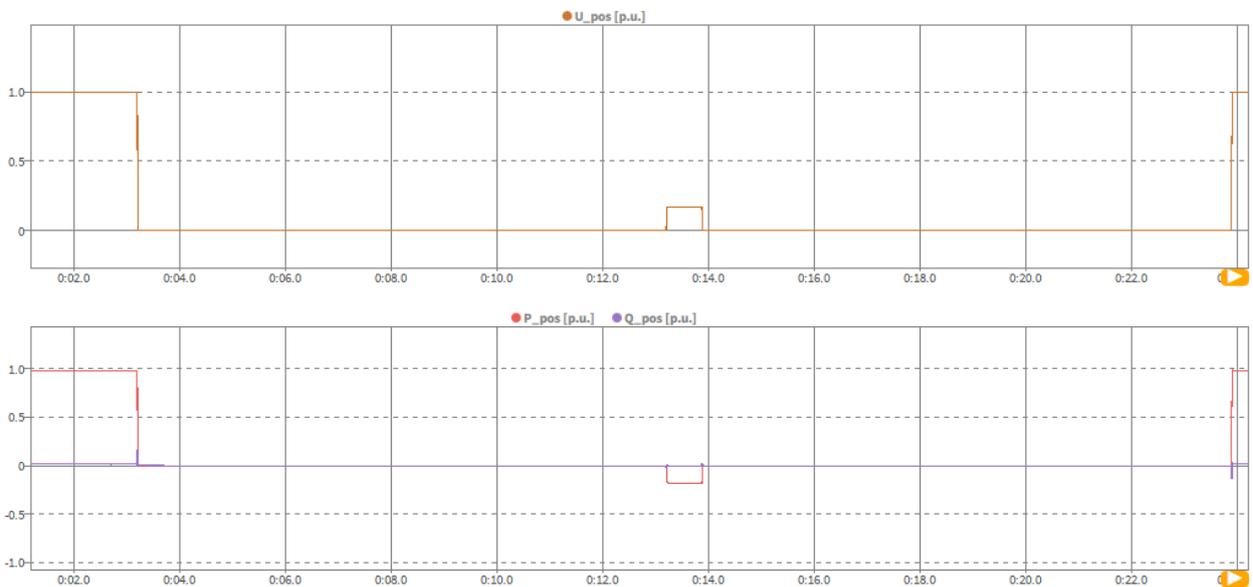
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.3 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 100% load, Instantaneous and RMS values of phase currents



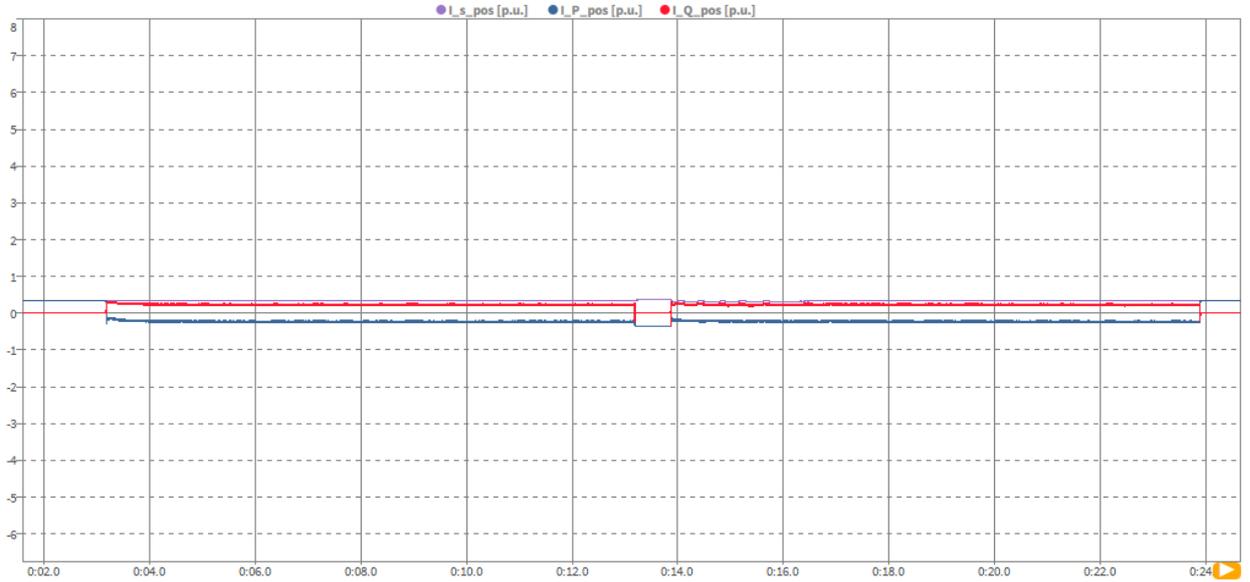
Test 2.3 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

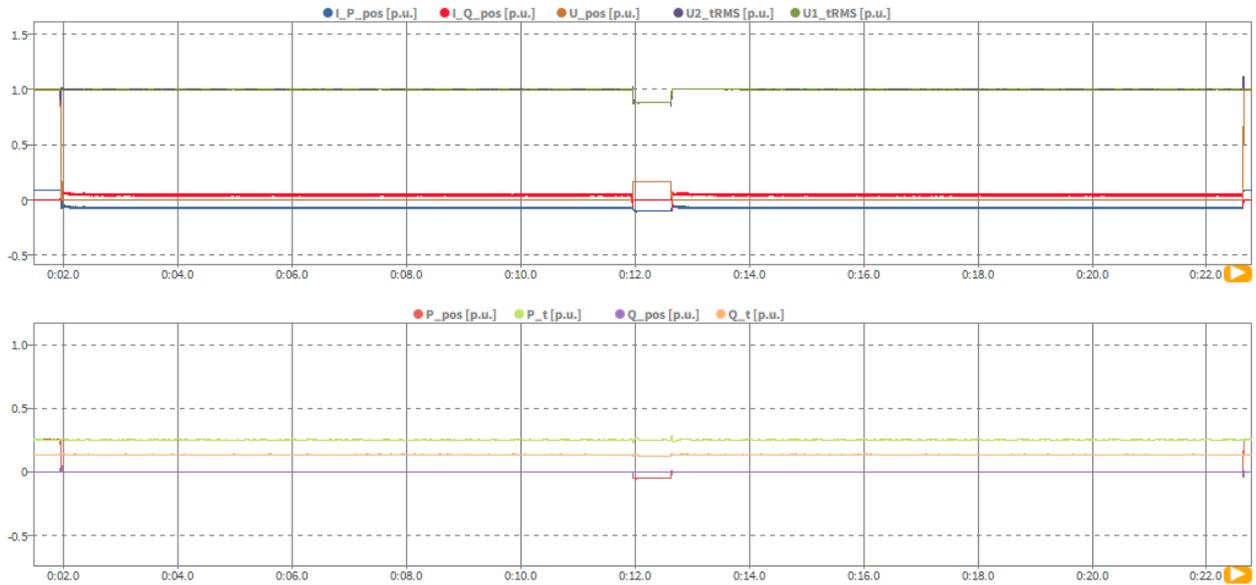
Test 2.3 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 100% load, Positive and negative sequence active, reactive and apparent current



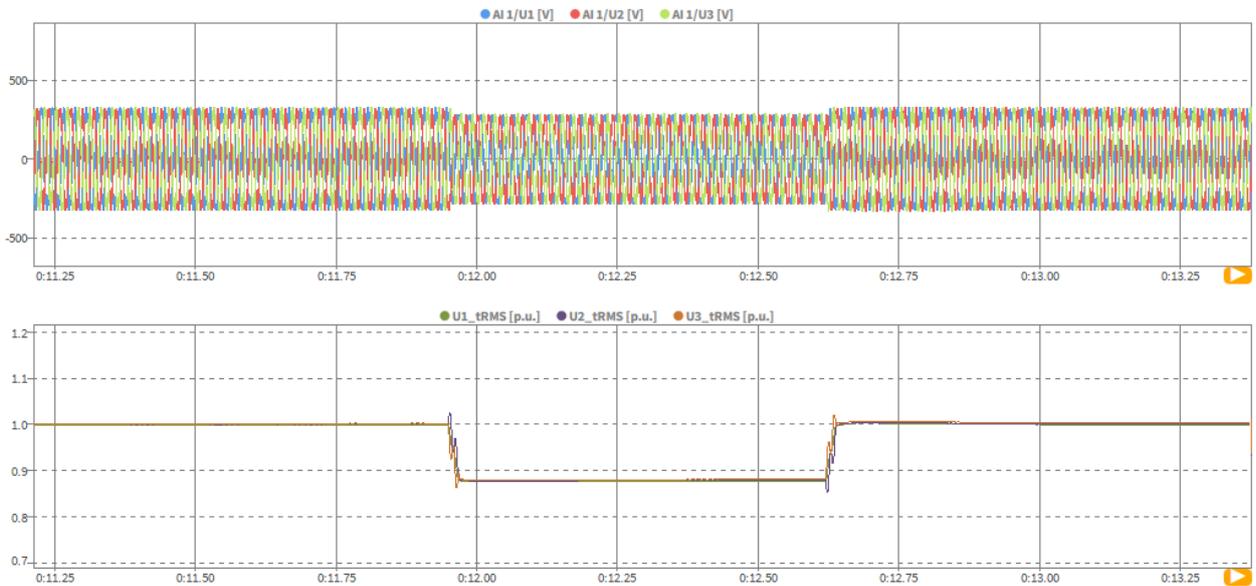
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.4 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



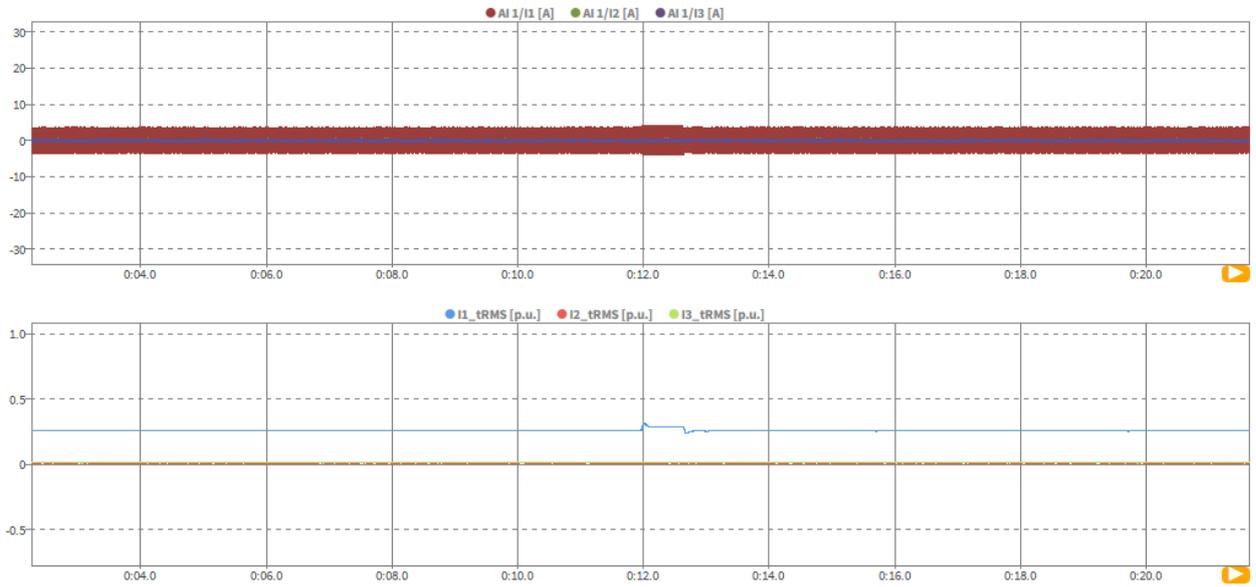
Test 2.4 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 20% load,
Instantaneous and RMS values of phase voltages



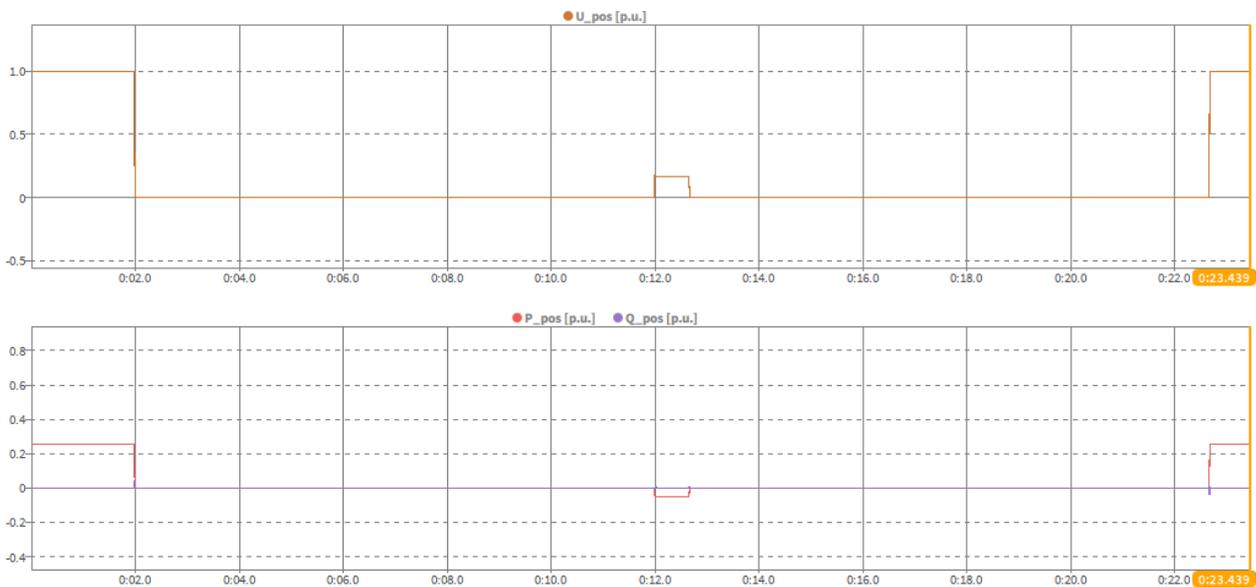
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.4 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 20% load, Instantaneous and RMS values of phase currents



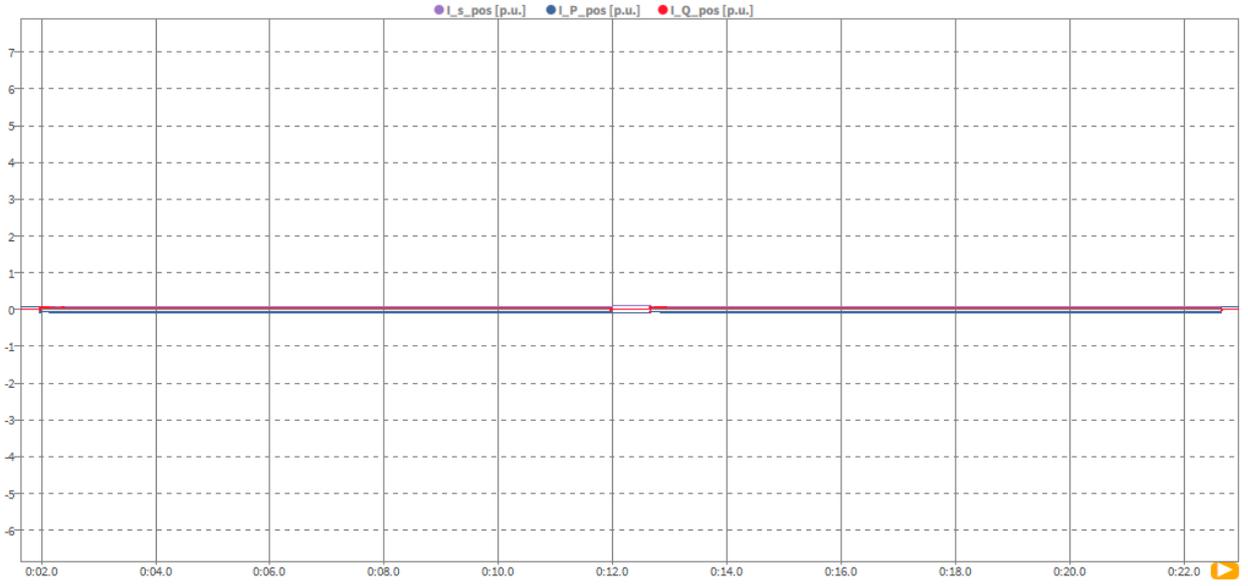
Test 2.4 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 2.4 Depth of fault phase: 0.25 p.u., 2-phase fault (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

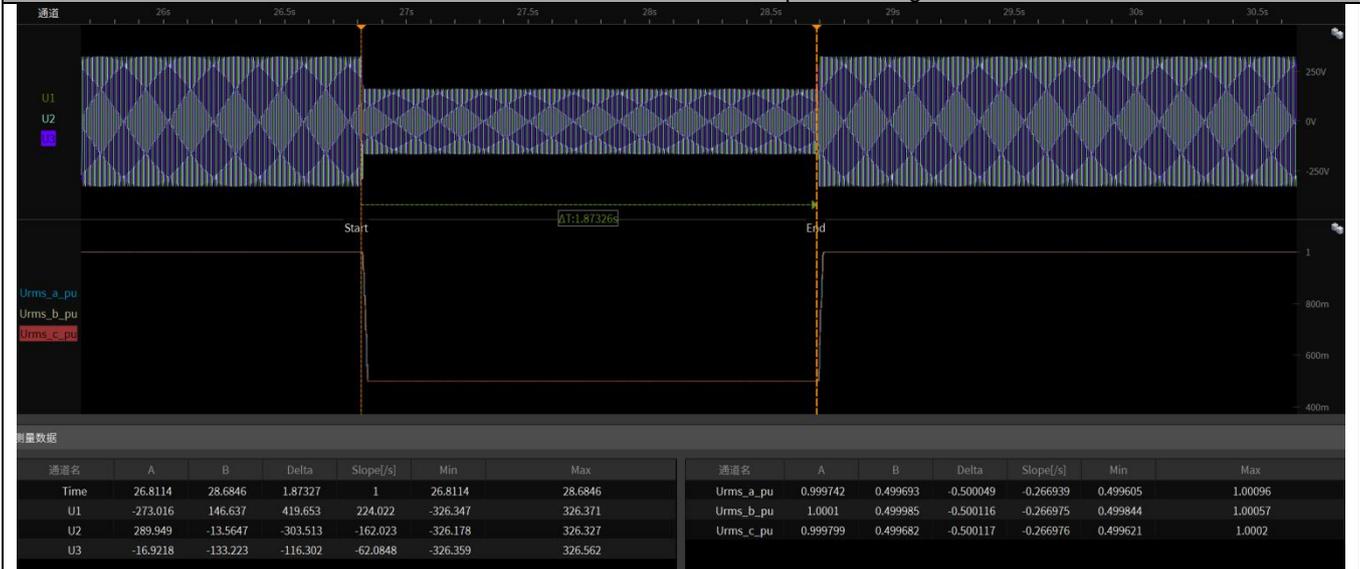
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	3.1	3.2
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	18:11:13.9	18:15:13.4
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.50	0.50
	5	Setting dip duration	--	--	--	≥1260	≥1260
	6	Point of fault entry	Total	--	ms	26.808	26.808
	7	Point of fault clearance	Total	--	ms	28.682	28.682
	8	Fault duration in empty load test	Total	--	ms	1873.720	1873.720
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.499	0.499
	10		Pos.			0.499	0.499
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.004	1.001
			L2 to neutral			1.003	1.002
			L3 to neutral			1.003	1.001
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.997	0.335
	14	Active power	Total	t1-10s to t1	p.u.	1.001	0.335
			Pos.			1.001	0.335
	16	Reactive power	Total	t1-10s to t1	p.u.	0.004	0.006
Pos.			0.004			0.006	
18	Cosφ	--	t1-10s to t1	--	0.996	0.960	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.521	0.521
			L2 to neutral			0.521	0.521
			L3 to neutral			0.521	0.521
	20		Pos.			0.521	0.521
	21		Neg.			--	--
	22	Line current	Phase 1	t1+60ms	p.u.	0.022	0.042
			Phase 2			0.042	0.042
			Phase 3			0.042	0.043
	25	Line current	Phase 1	t1+100ms	p.u.	0.042	0.042
			Phase 2			0.042	0.042
Phase 3			0.042			0.043	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000	
		Pos.			0.000	0.000	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
			L2 to neutral			1.003	1.002
			L3 to neutral			1.003	1.001
	31	Active power	Total	t2+3s to t2+10s	p.u.	1.001	0.335
			Pos.			1.001	0.335
	33	Active power rising time	Pos.	--	s	0.768	0.392
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.004	0.006
			Pos.			0.004	0.006
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

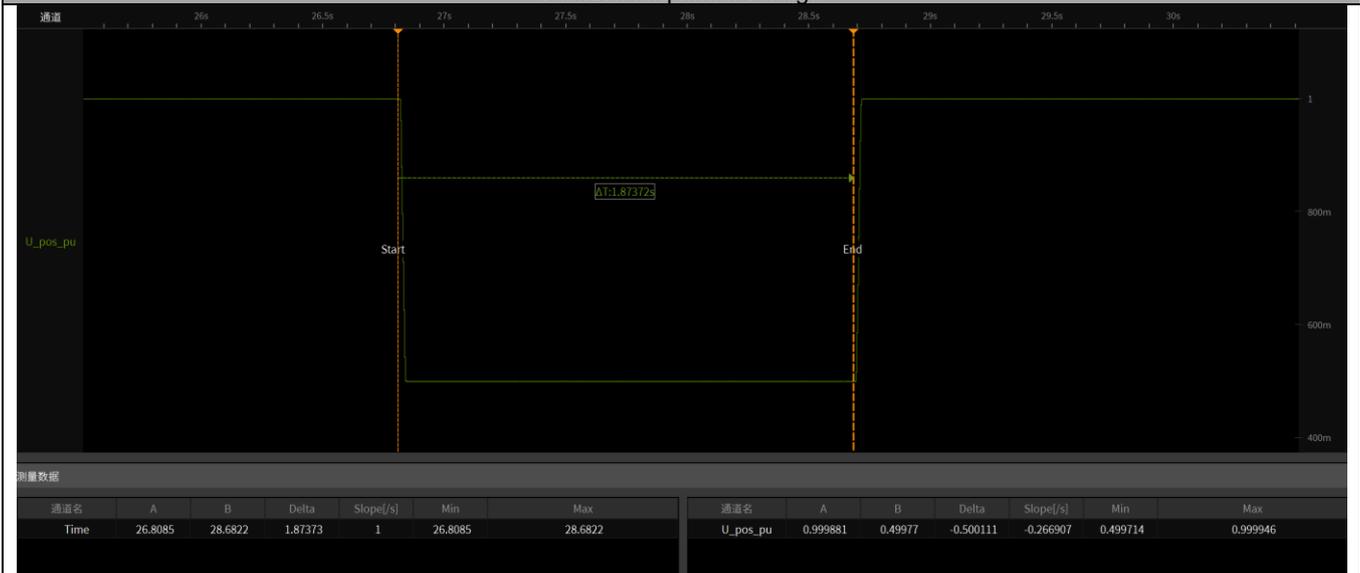
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.1&3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



Test 3.1&3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), No load, Positive sequence voltage



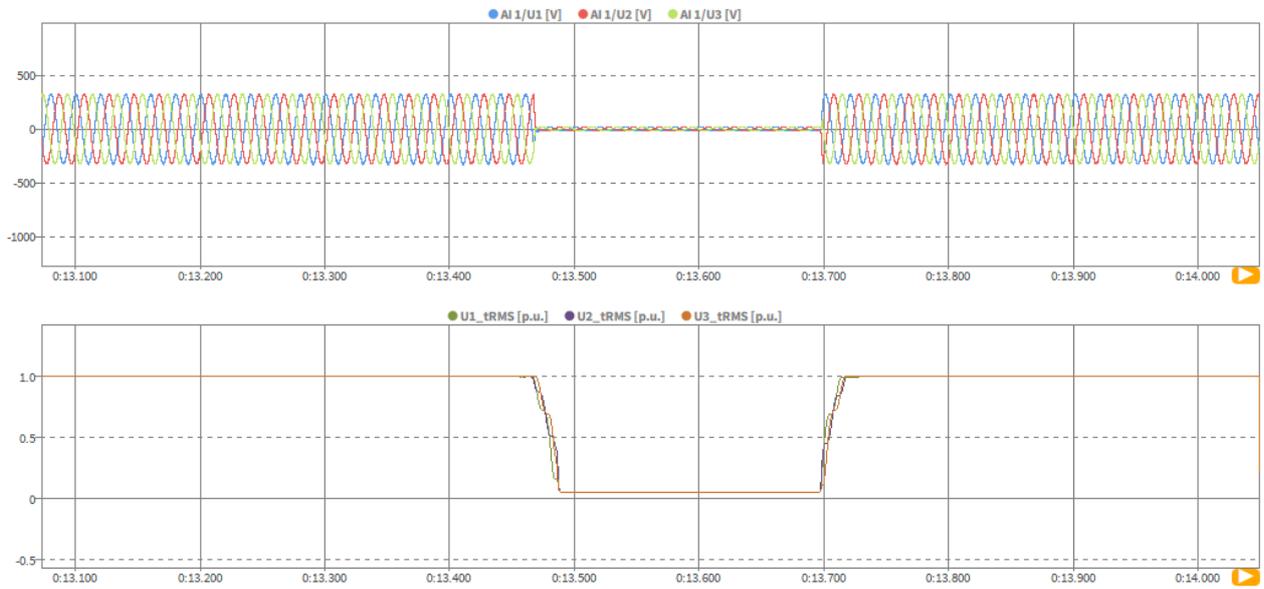
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.1 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 100% load,
Test overview (voltage, current, active and reactive power positive sequence)



Test 3.1 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages



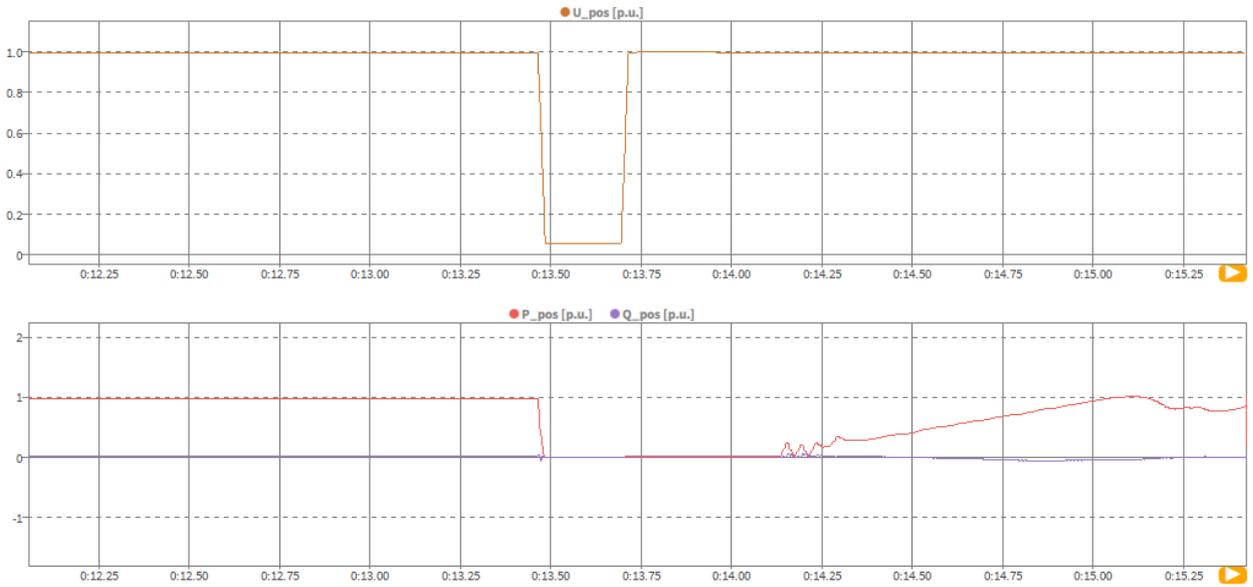
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.1 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



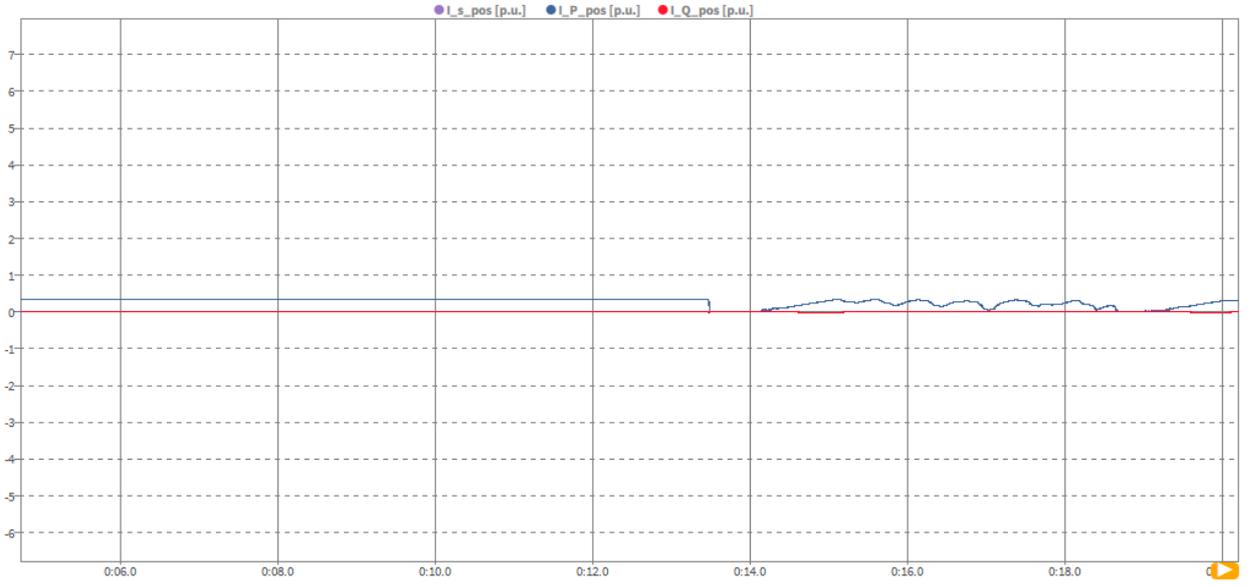
Test 3.1 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

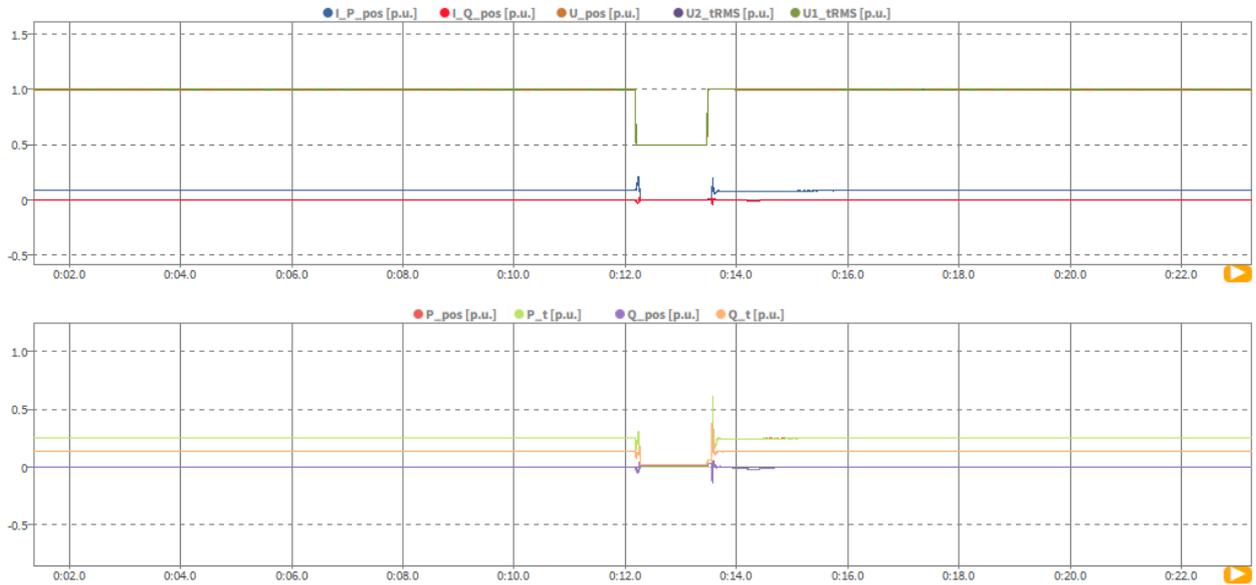
Test 3.1 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



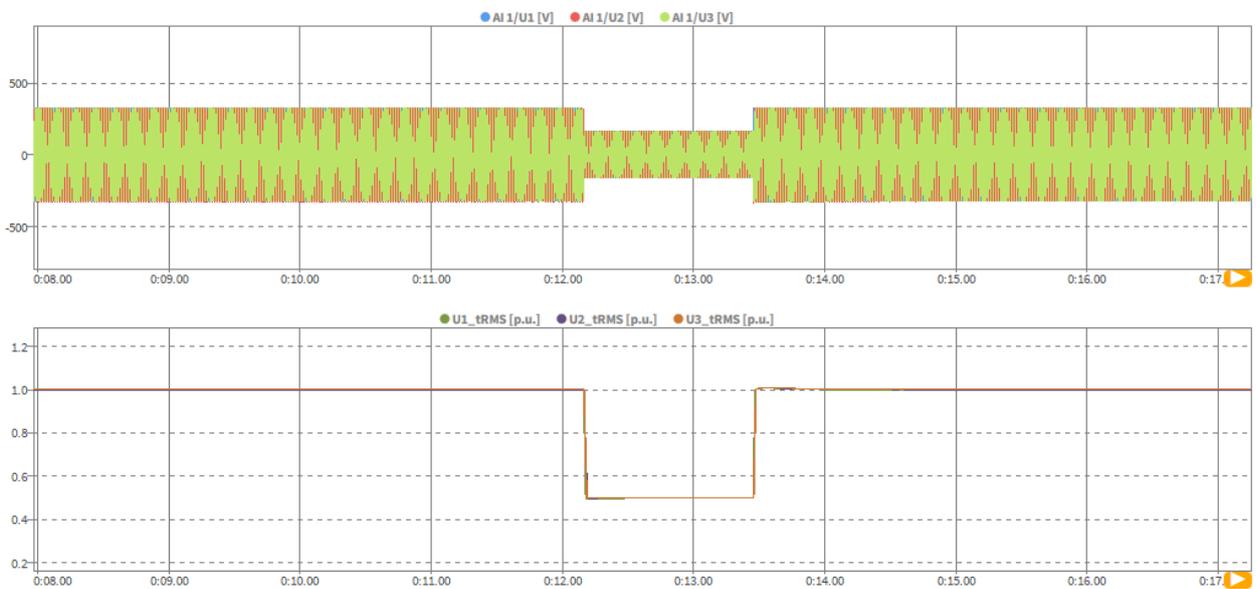
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.2 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



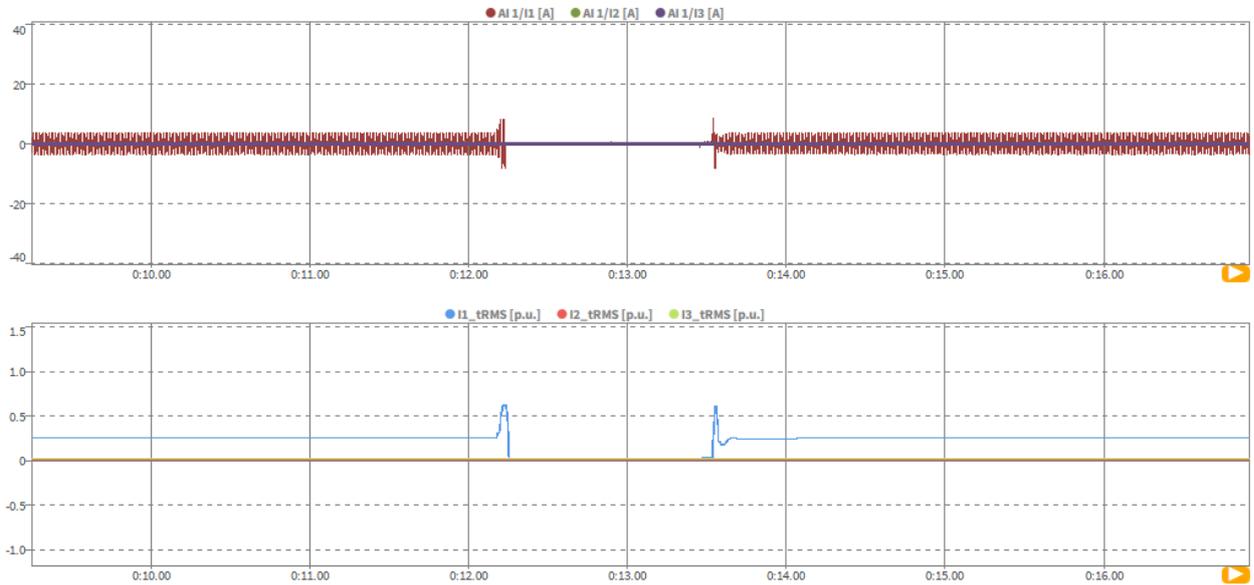
Test 3.2 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



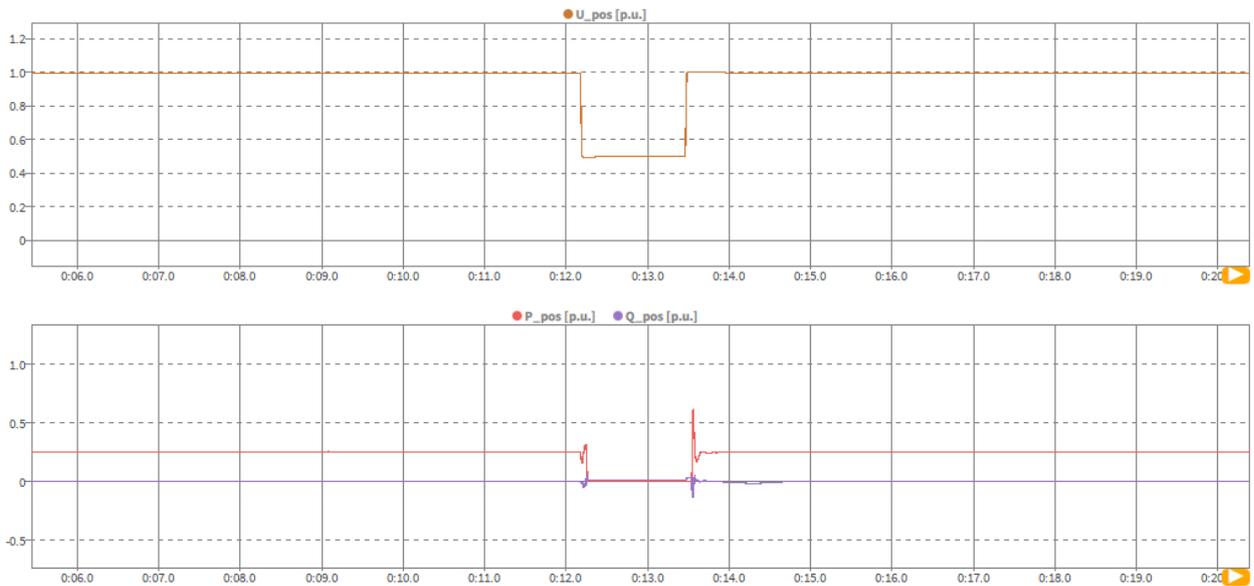
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.2 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase currents



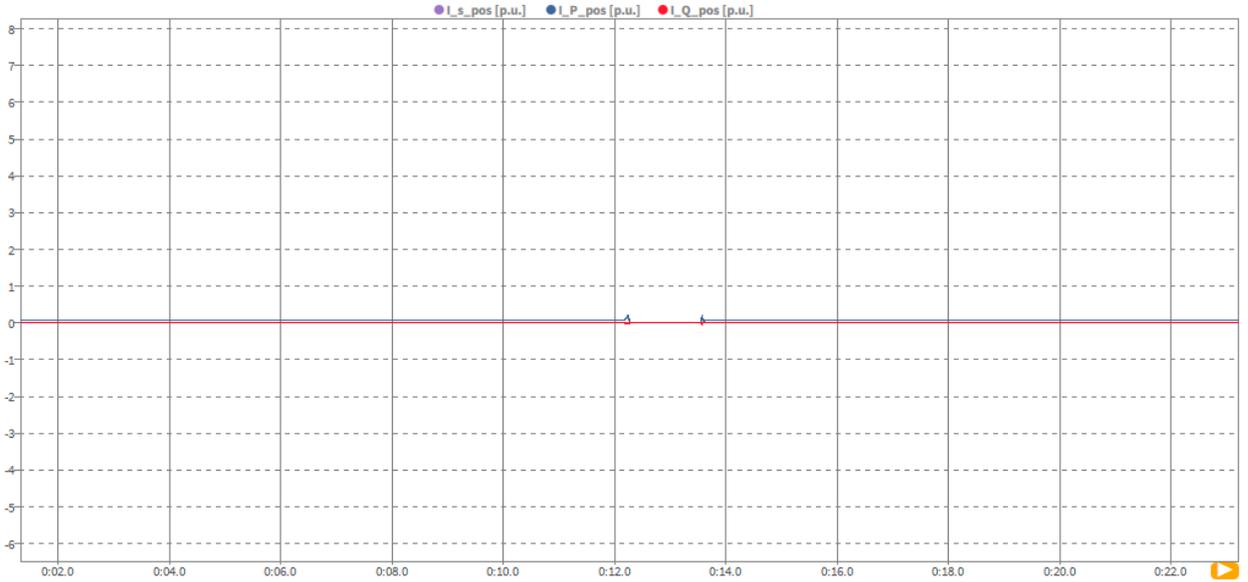
Test 3.2 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 20% load,
Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.2 Depth of fault phase: 0.50 p.u, three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

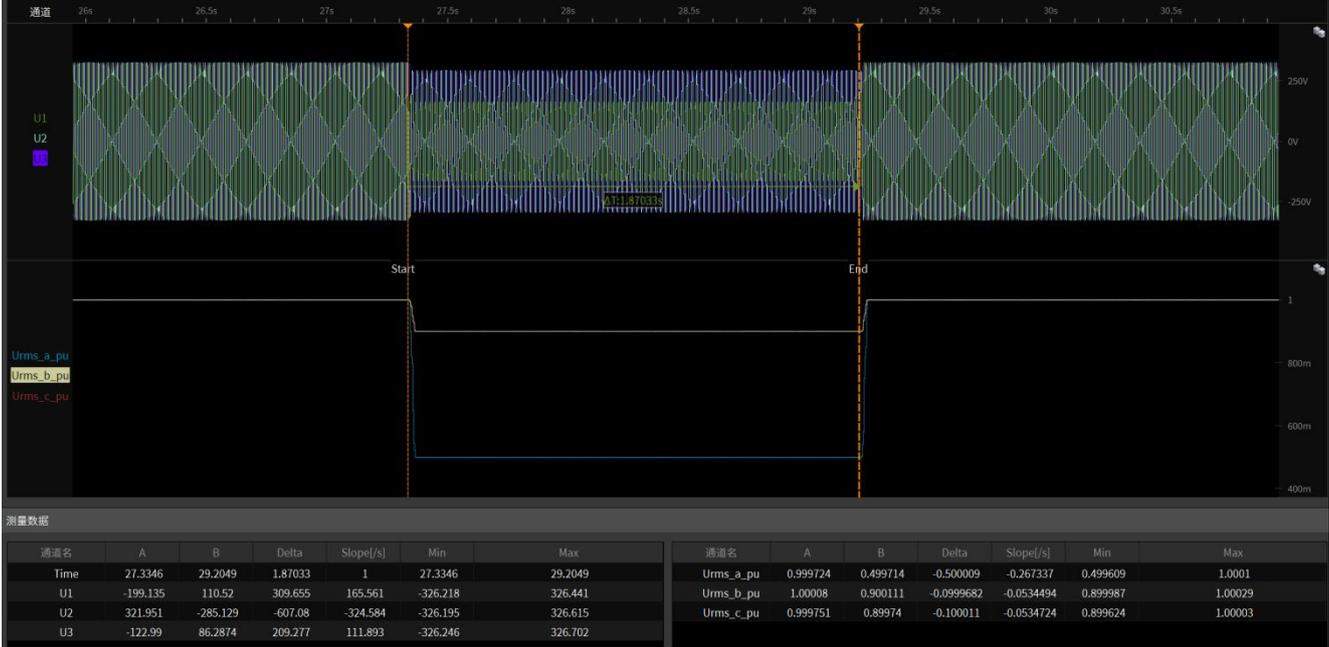
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	3.3	3.4	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	18:25:13.8	18:34:13.2	
	3	Fault type (phase)	--	--	--	D1	D1	
	4	Setting voltage depth	Line to line	--	--	p.u.	0.50	0.50
	5	Setting dip duration	--	--	--	--	≥1260	≥1260
	6	Point of fault entry	Total	--	--	ms	27330	27330
	7	Point of fault clearance	Total	--	--	ms	29207	29207
	8	Fault duration in empty load test	Total	--	--	ms	1877	1877
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.499	0.499	
	10		Pos.			0.766	0.766	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.004	1.002	
			L2 to neutral			1.003	1.001	
			L3 to neutral			1.004	1.002	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.335	
	14	Active power	Total	t1-10s to t1	p.u.	1.000	0.335	
	15		Pos.			1.000	0.335	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.004	0.006	
17	Pos.		0.004			0.006		
18	Cosφ	--	t1-10s to t1	--	0.995	0.960		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.501	0.501	
			L2 to neutral			0.902	0.902	
			L3 to neutral			0.902	0.902	
			Pos.			0.768	0.769	
	20	Line current	Phase 1	t1+60ms	p.u.	0.041	0.041	
	21		Phase 2			0.074	0.074	
	22		Phase 3			0.074	0.074	
	23	Line current	Phase 1	t1+100ms	p.u.	0.041	0.041	
	24		Phase 2			0.074	0.074	
	25		Phase 3			0.074	0.074	
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000		
27		Pos.			0.000	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.004	1.002	
			L2 to neutral			1.003	1.001	
			L3 to neutral			1.004	1.002	
	31	Active power	Total	t2+3s to t2+10s	p.u.	1.000	0.335	
	32		Pos.			1.000	0.335	
	33	Active power rising time	Pos.	--	s	0.477	0.364	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.004	0.006	
35	Pos.		0.004			0.006		
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.3&3.4 Depth of fault phase: 0.50 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



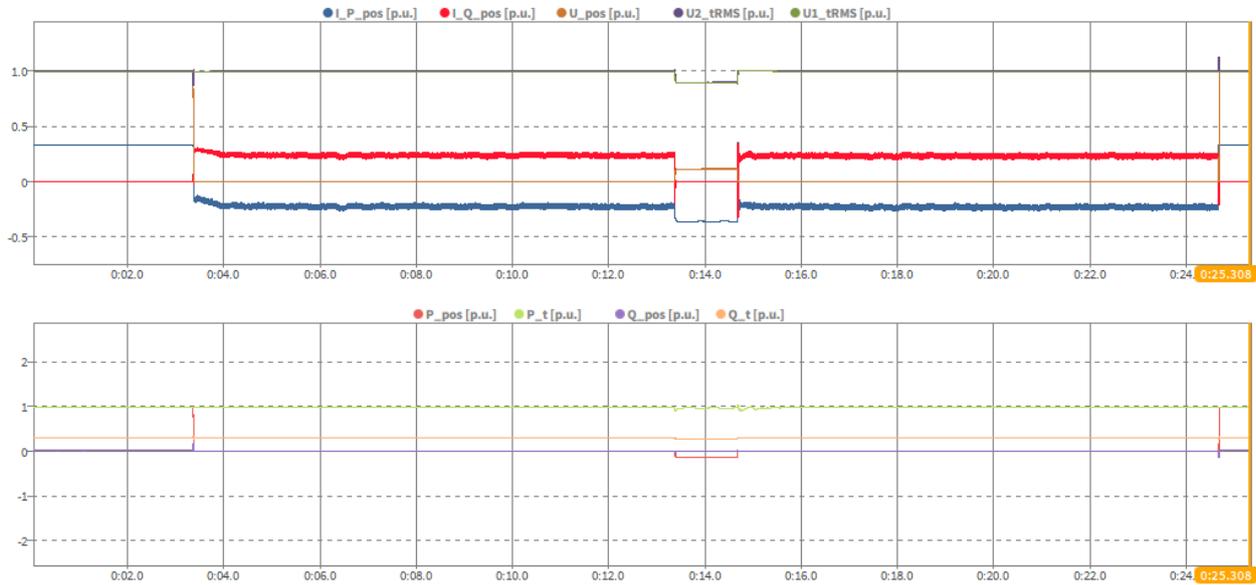
Test 3.3&3.4 Depth of fault phase: 0.50 p.u., three-phase SC (type D1), No load, Positive sequence voltage



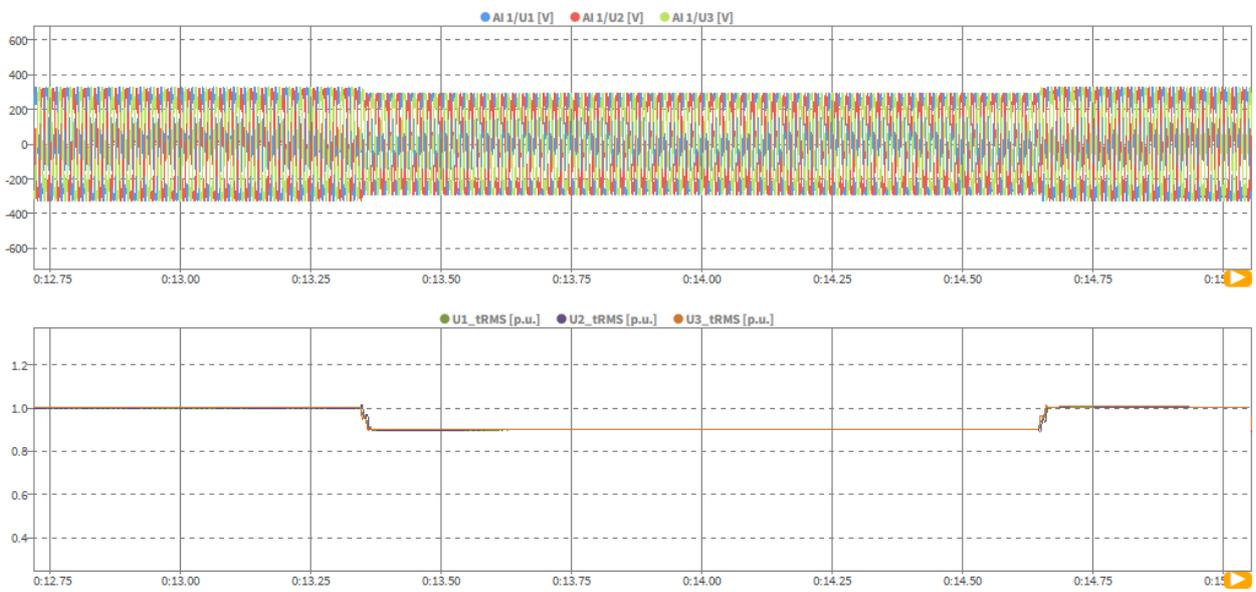
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.3 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 100% load,
Test overview (voltage, current, active and reactive power positive sequence)



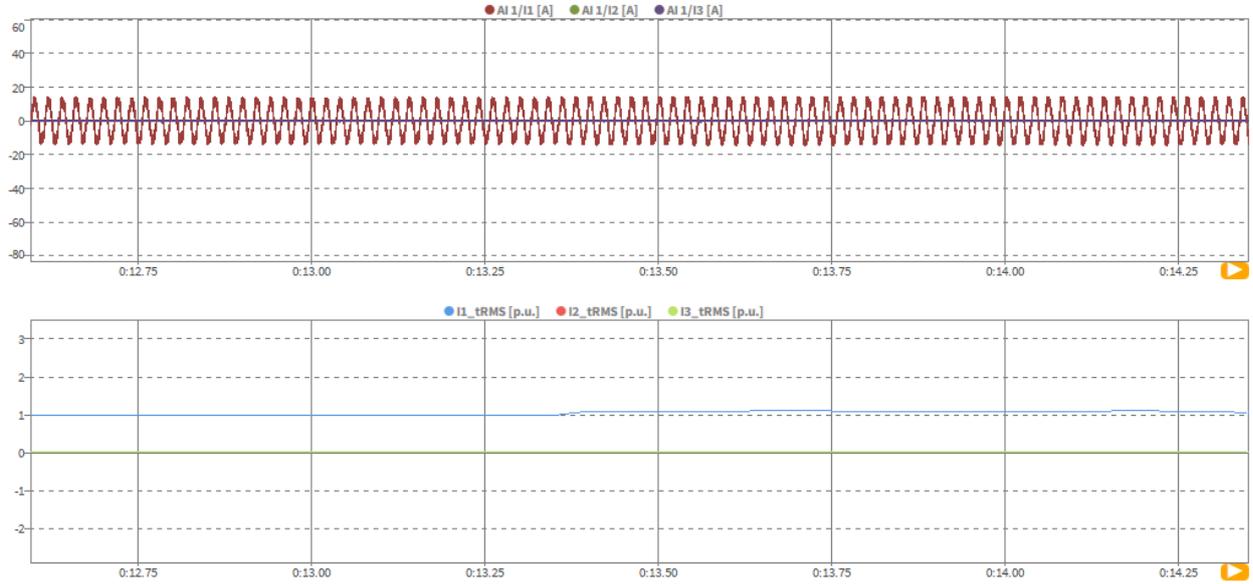
Test 3.3 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 100% load,
Instantaneous and RMS values of phase voltages



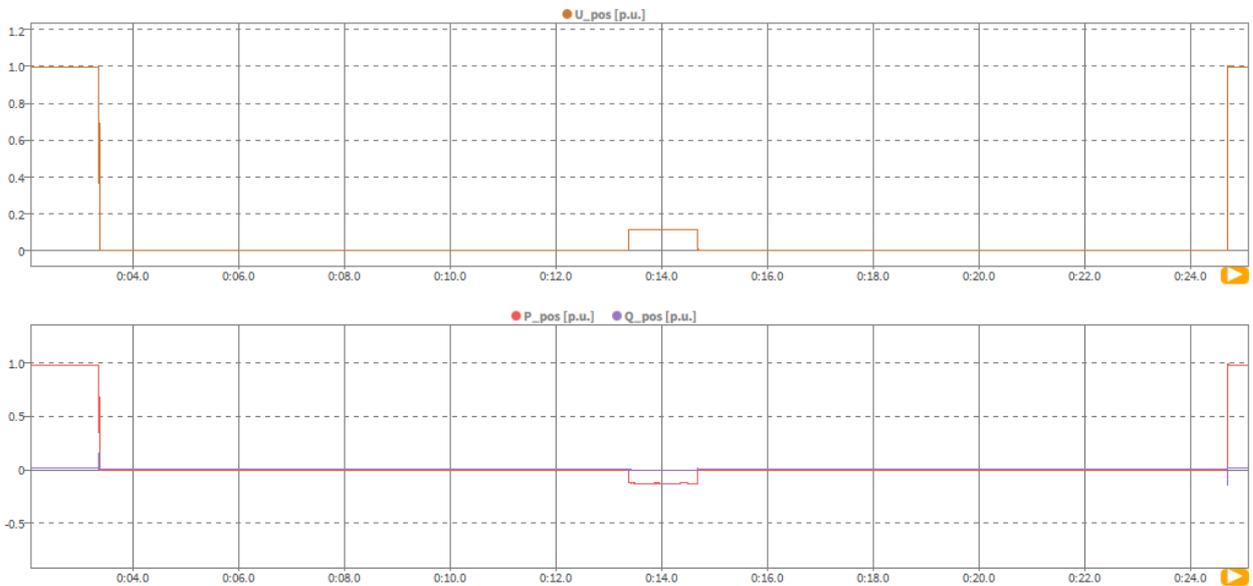
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.3 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 100% load,
Instantaneous and RMS values of phase currents



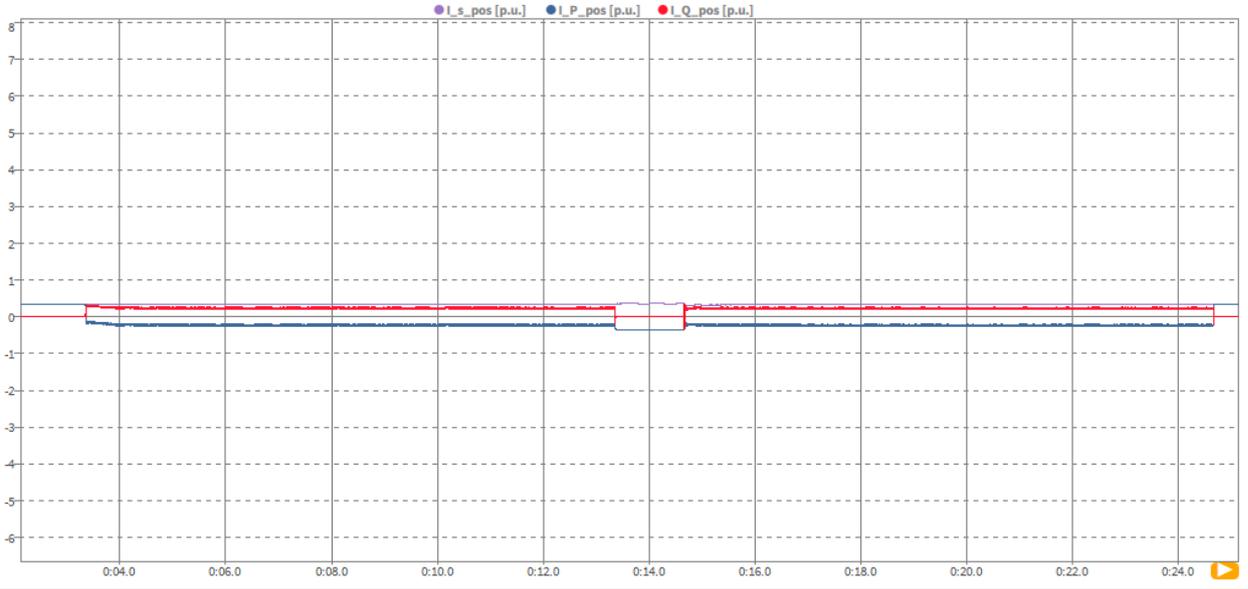
Test 3.3 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 100% load,
Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

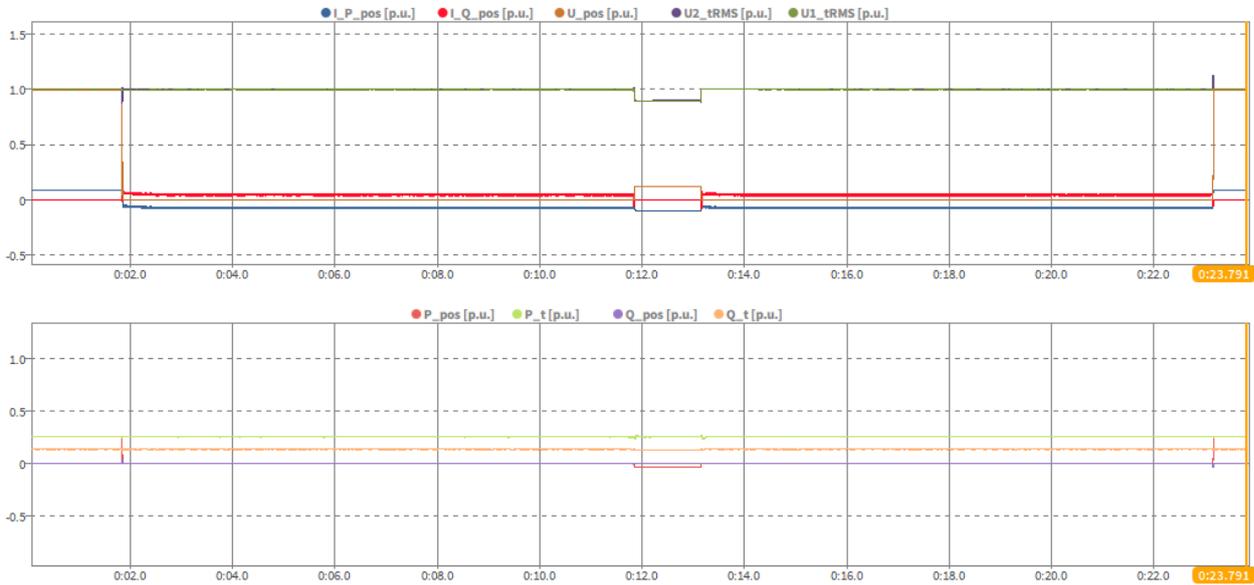
Test 3.3 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



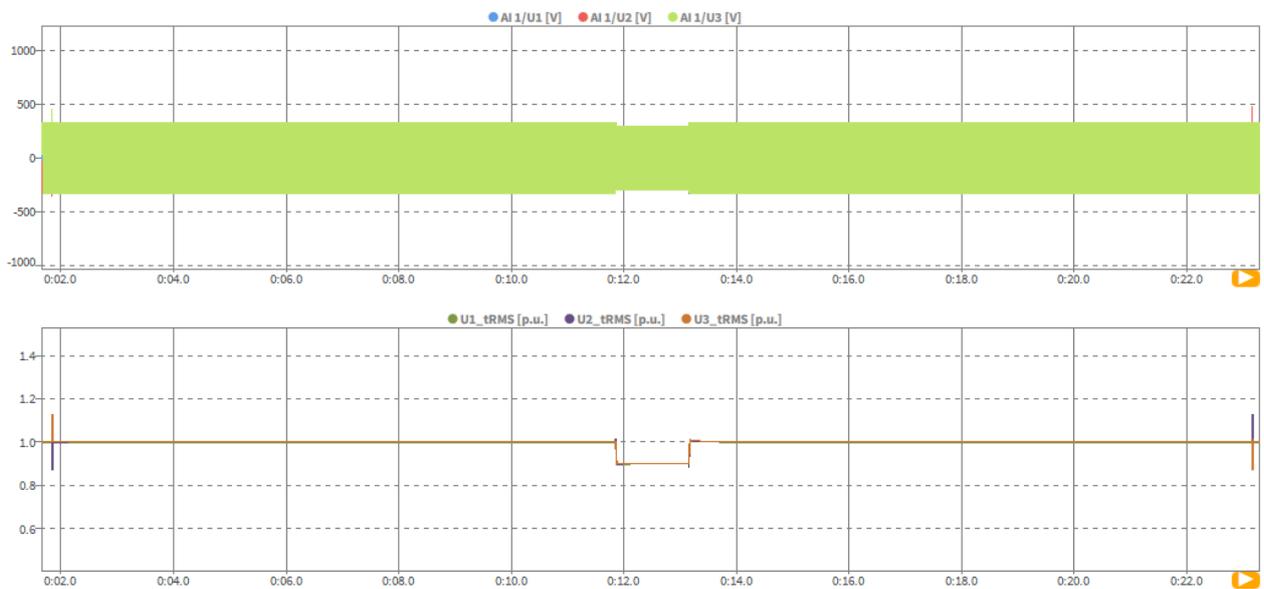
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.4 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



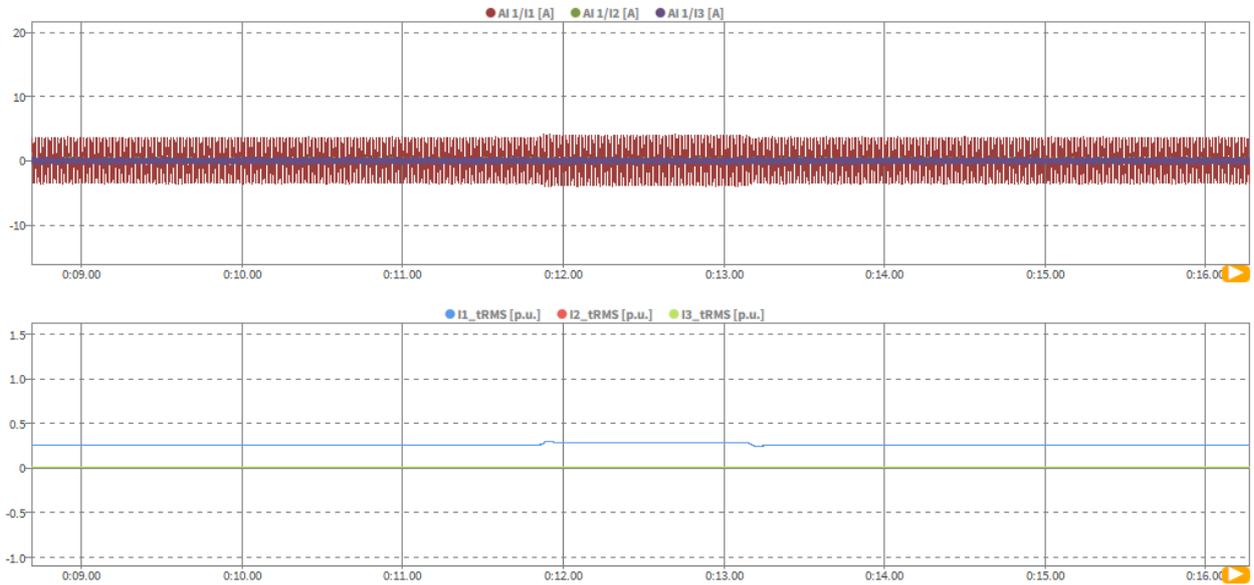
Test 3.4 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 20% load,
Instantaneous and RMS values of phase voltages



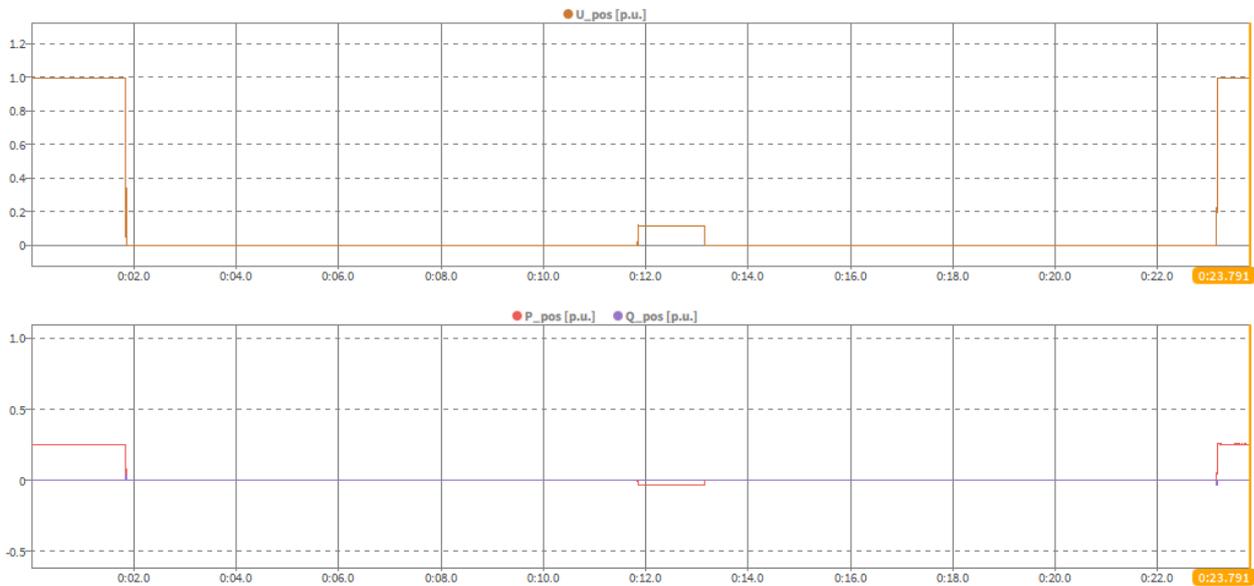
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.4 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 20% load, Instantaneous and RMS values of phase currents



Test 3.4 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 3.4 Depth of fault phase: 0.50 p.u, 2-phase fault (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

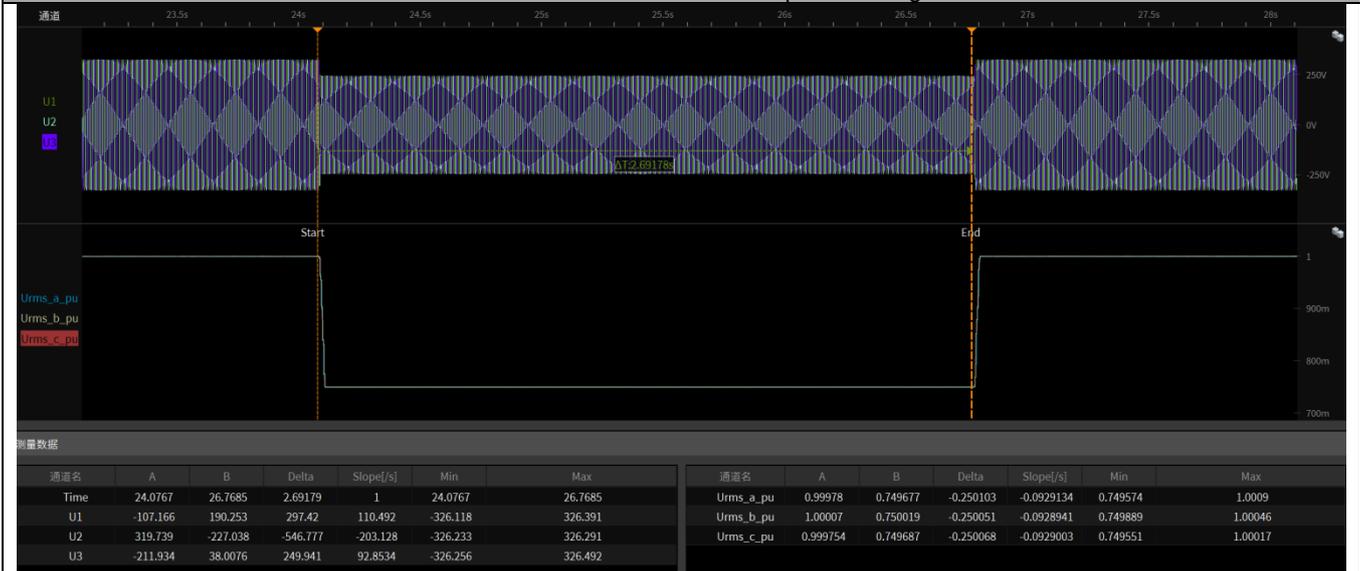
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	4.1	4.2
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	18:14:13.8	18:16:12.4
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.75	0.75
	5	Setting dip duration	--	--	--	≥1800	≥1800
	6	Point of fault entry	Total	--	ms	24067	24067
	7	Point of fault clearance	Total	--	ms	26762	26762
	8	Fault duration in empty load test	Total	--	ms	2695	2695
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.750	0.750
	10		Pos.			0.750	0.750
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	0.999
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.993	0.208
	14	Active power	Total	t1-10s to t1	p.u.	0.991	0.200
	15		Pos.			0.991	0.200
	16	Reactive power	Total	t1-10s to t1	p.u.	0.079	0.055
17	Pos.		0.079			0.055	
18	Cosφ	--	t1-10s to t1	--	0.996	0.960	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.750	0.749
			L2 to neutral			0.750	0.750
			L3 to neutral			0.750	0.750
			Pos.			0.750	0.750
	20					--	--
	21						
	22	Line current	Phase 1	t1+60ms	p.u.	1.312	0.268
	23		Phase 2			1.312	0.268
	24		Phase 3			1.309	0.067
	25	Line current	Phase 1	t1+100ms	p.u.	1.312	0.268
26	Phase 2		1.312			0.268	
27	Phase 3		1.309			0.067	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.981	0.198	
29		Pos.			0.981	0.198	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	0.999
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.991	0.200
	32		Pos.			0.991	0.200
	33	Active power rising time	Pos.	--	s	--	--
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.079	0.055
	35		Pos.			0.079	0.055
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

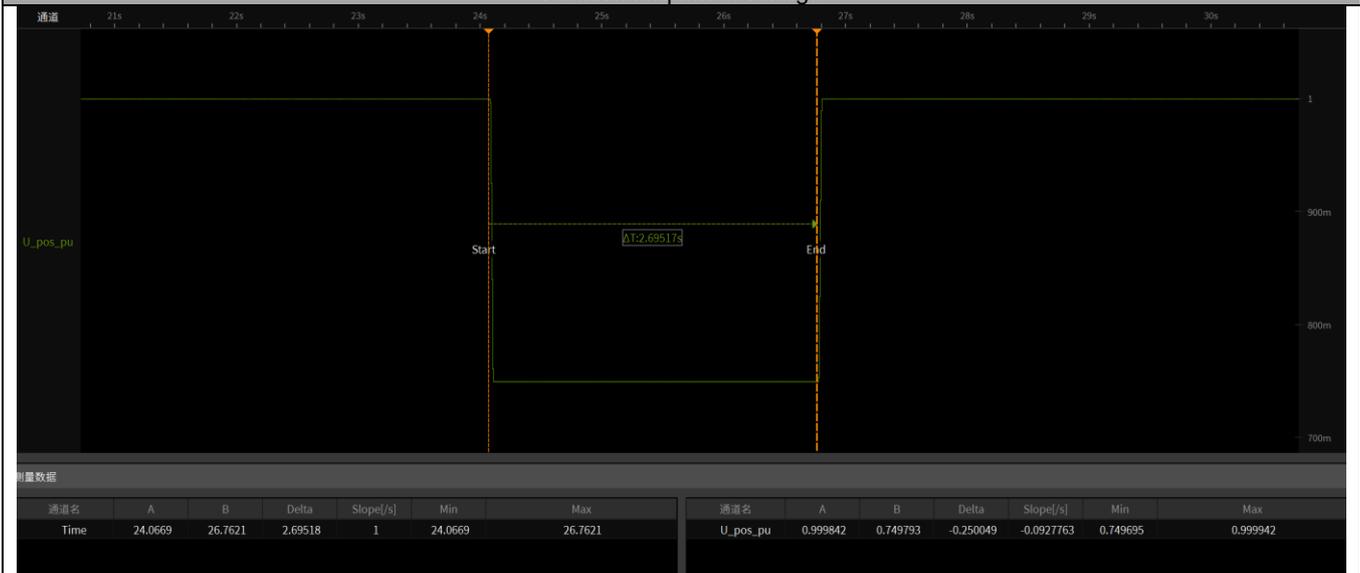
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.1&4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



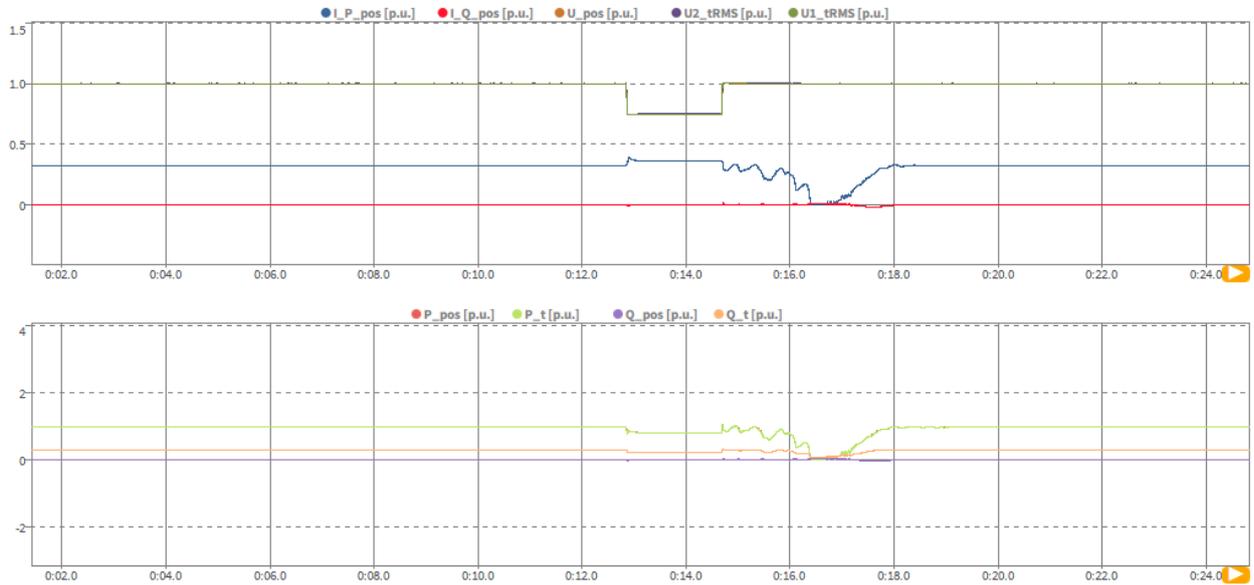
Test 4.1&4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), No load, Positive sequence voltage



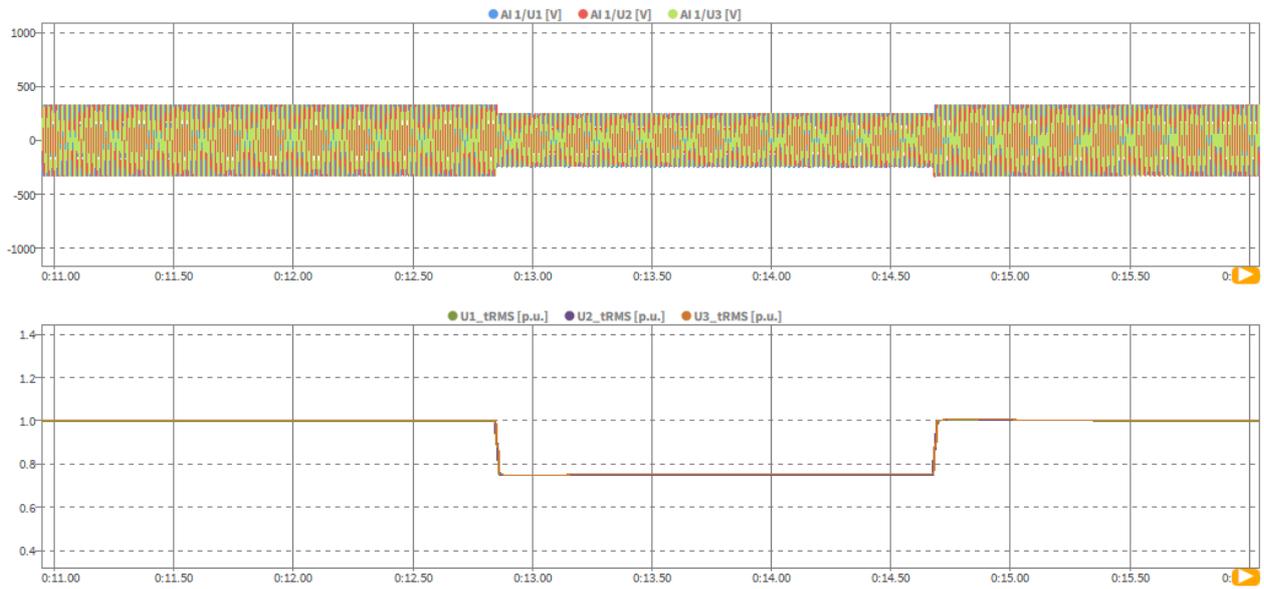
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



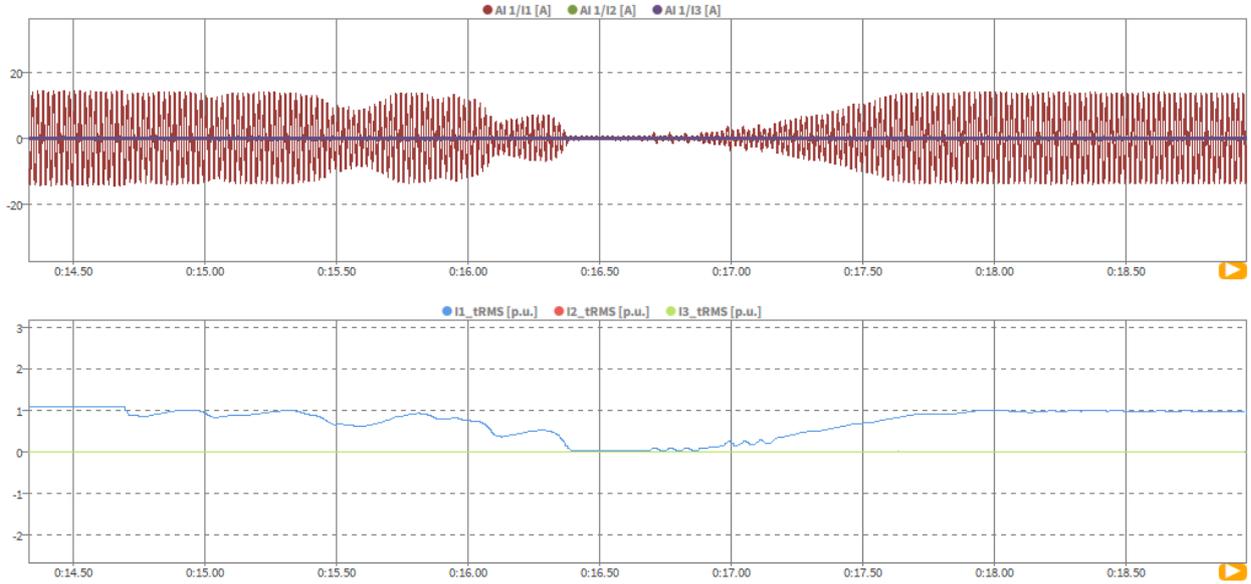
Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase voltages



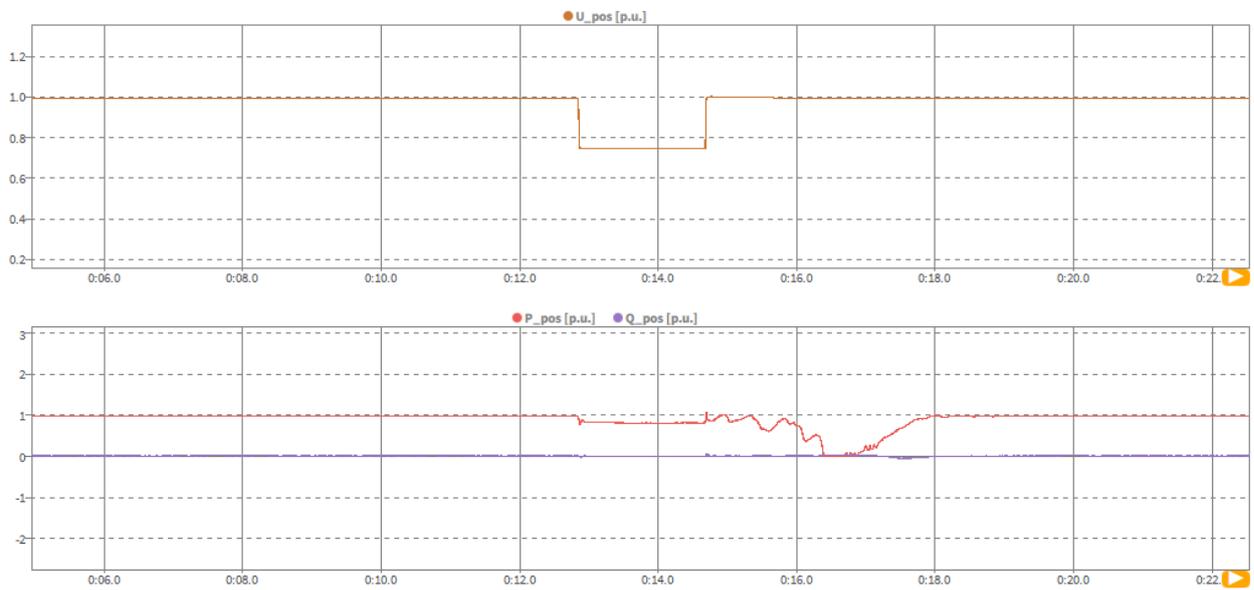
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



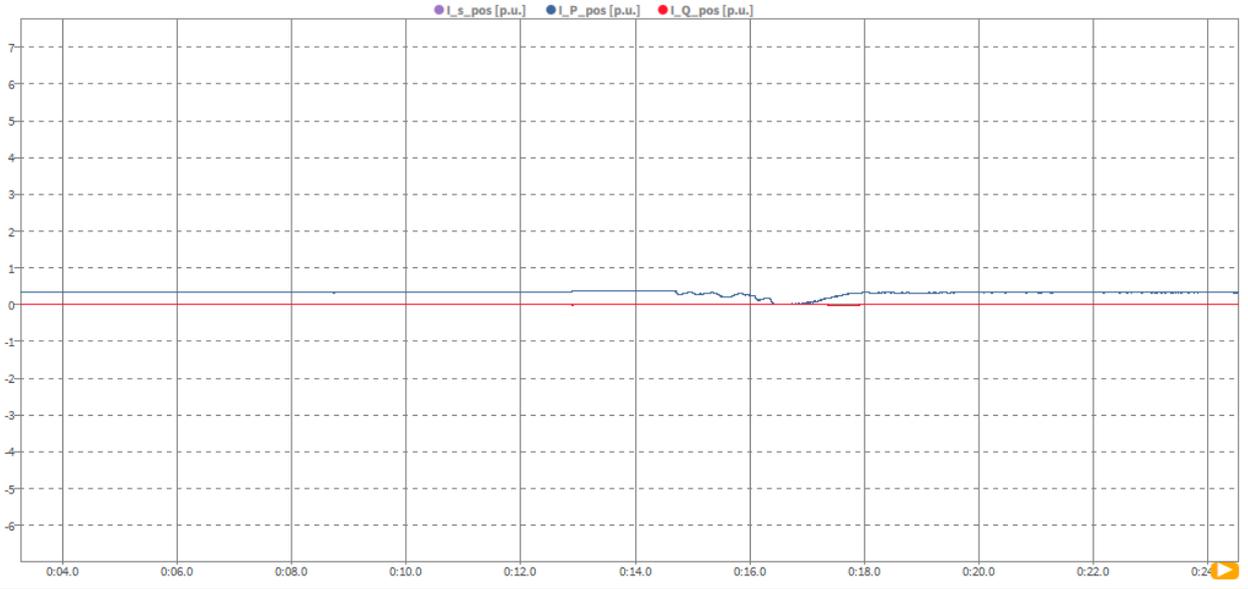
Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

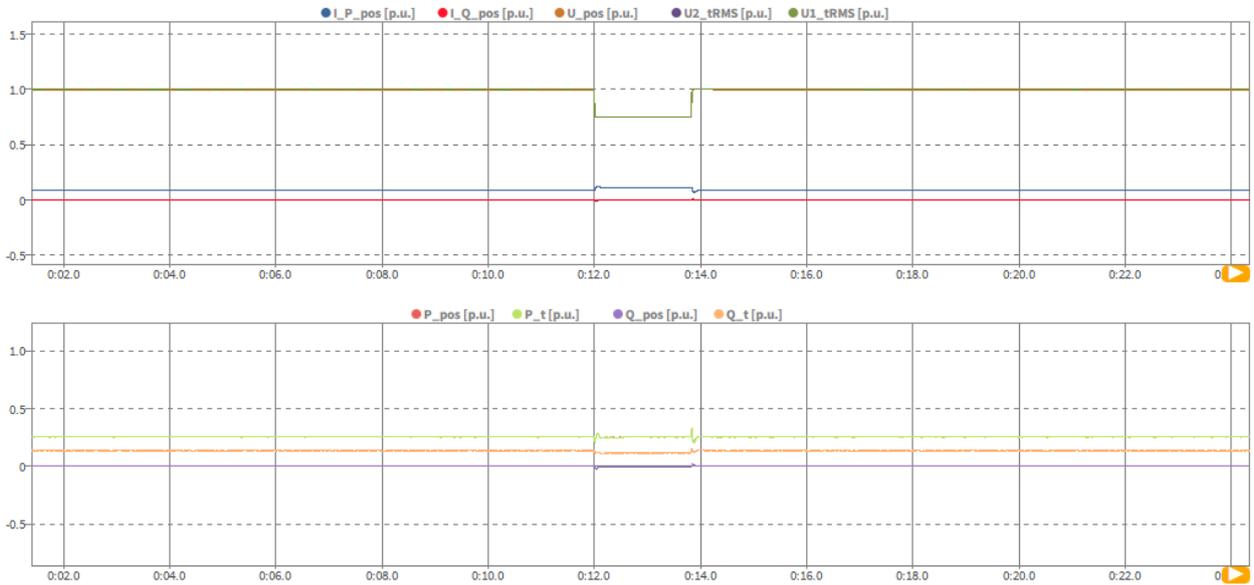
Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



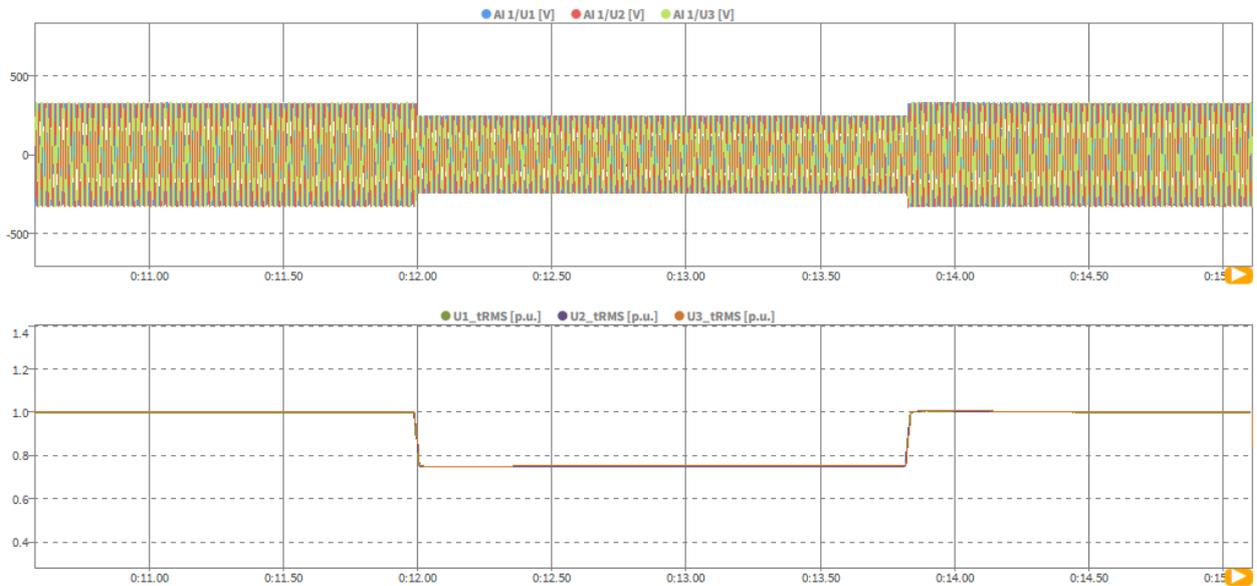
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 20% load, Test overview (voltage, current, active and reactive power positive sequence)



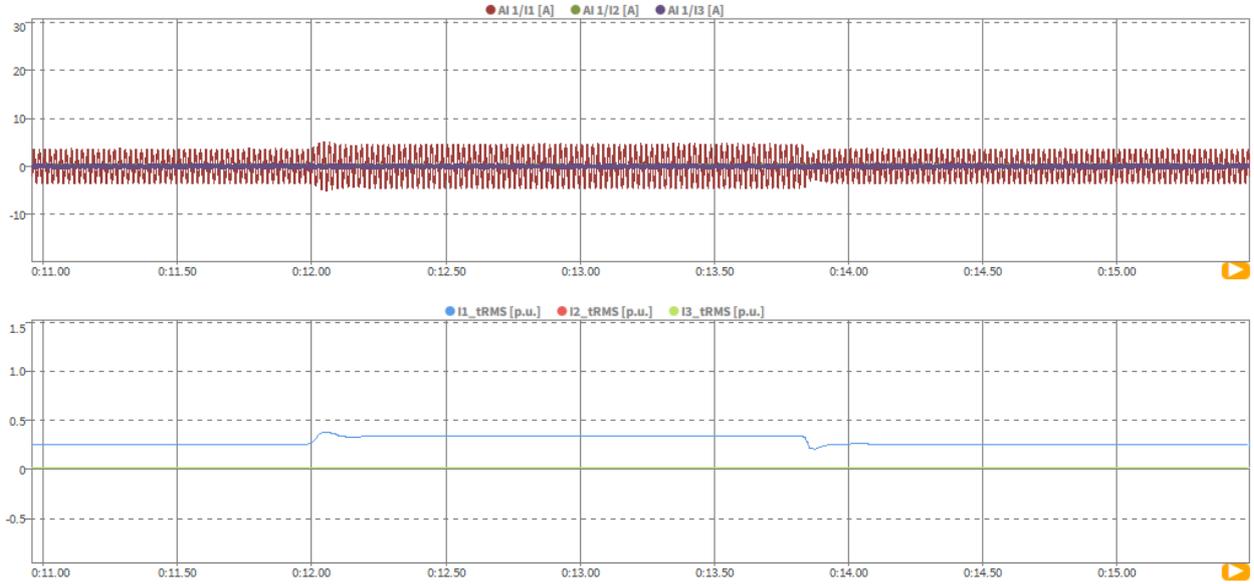
Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 20% load, Instantaneous and RMS values of phase voltages



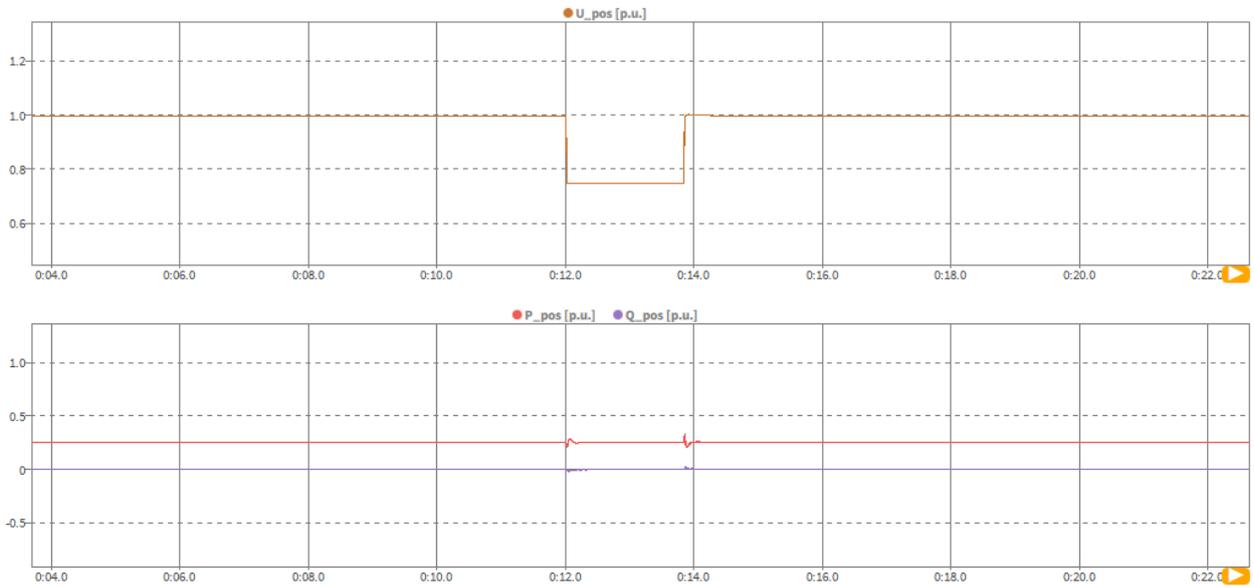
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

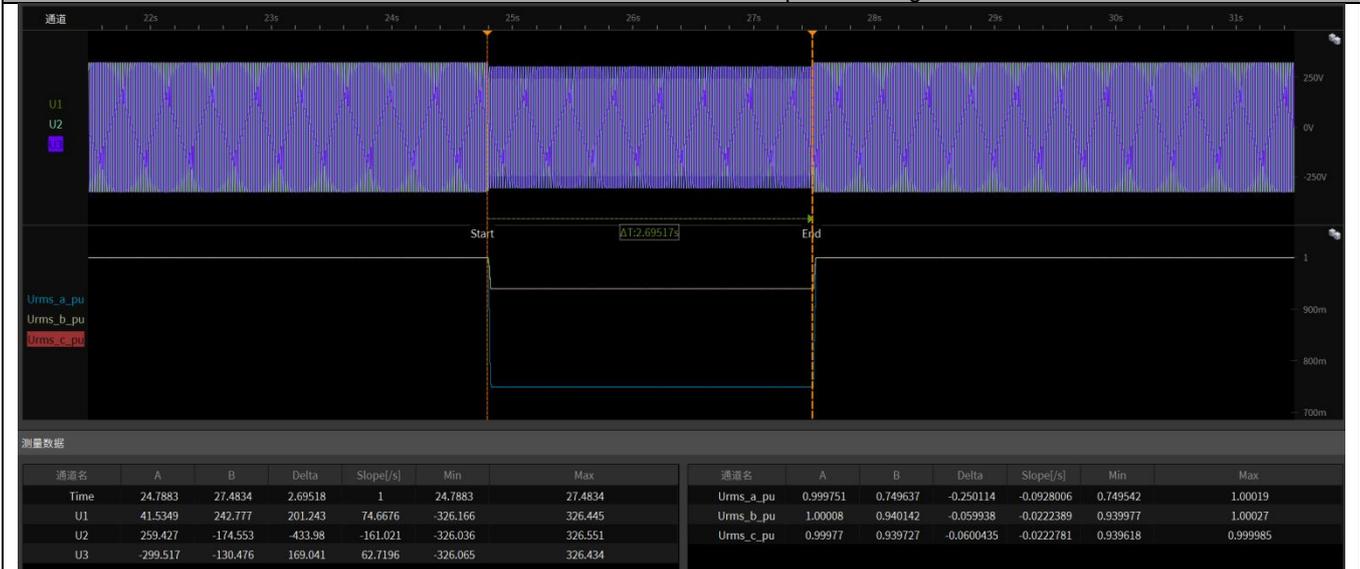
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	4.3	4.4
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	18:55:23.9	18:59:13.6
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.75	0.75
	5	Setting dip duration	--	--	--	≥1800	≥1800
	6	Point of fault entry	Total	--	ms	24782	24782
	7	Point of fault clearance	Total	--	ms	24477	24477
	8	Fault duration in empty load test	Total	--	ms	2695	2695
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.749	0.749
	10		Pos.			0.876	0.876
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	1.000
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.207
	14	Active power	Total	t1-10s to t1	p.u.	0.992	0.200
	15		Pos.			0.992	0.200
	16	Reactive power	Total	t1-10s to t1	p.u.	0.081	0.055
17	Pos.		0.081			0.055	
18	Cosφ	--	t1-10s to t1	--	0.996	0.961	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.750	0.750
			L2 to neutral			0.940	0.940
			L3 to neutral			0.940	0.940
			Pos.			0.877	0.876
	20	Line current	Phase 1	t1+60ms	p.u.	1.216	0.257
	21		Phase 2			1.059	0.222
	22		Phase 3			1.153	0.234
	23	Line current	Phase 1	t1+100ms	p.u.	1.216	0.257
	24		Phase 2			1.059	0.222
	25		Phase 3			1.153	0.234
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.986	0.199	
27		Pos.			0.991	0.200	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	1.000
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.992	0.200
	32		Pos.			0.992	0.200
	33	Active power rising time	Pos.	--	s	--	--
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.081	0.055
	35		Pos.			0.081	0.055
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

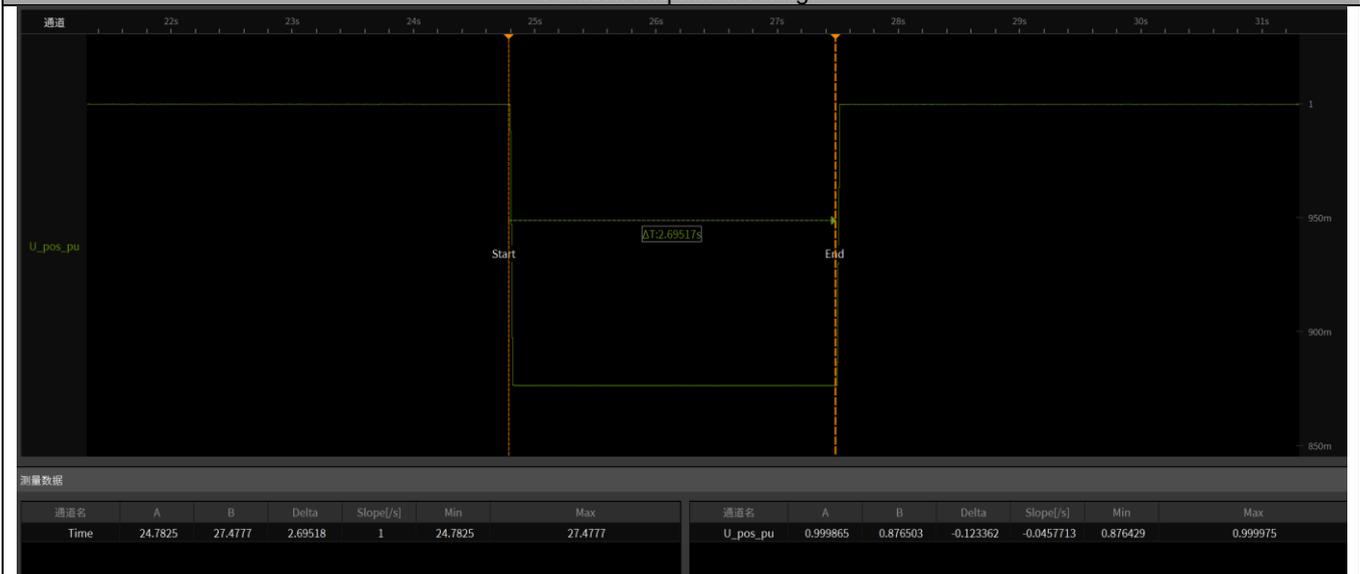
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.3&4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



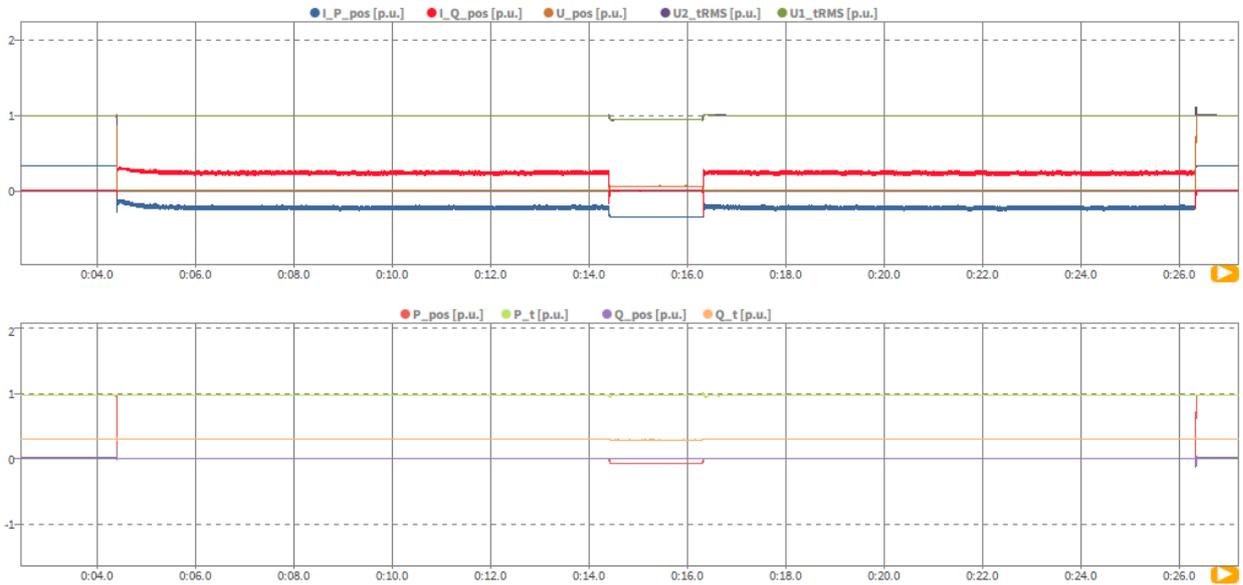
Test 4.3&4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), No load, Positive sequence voltage



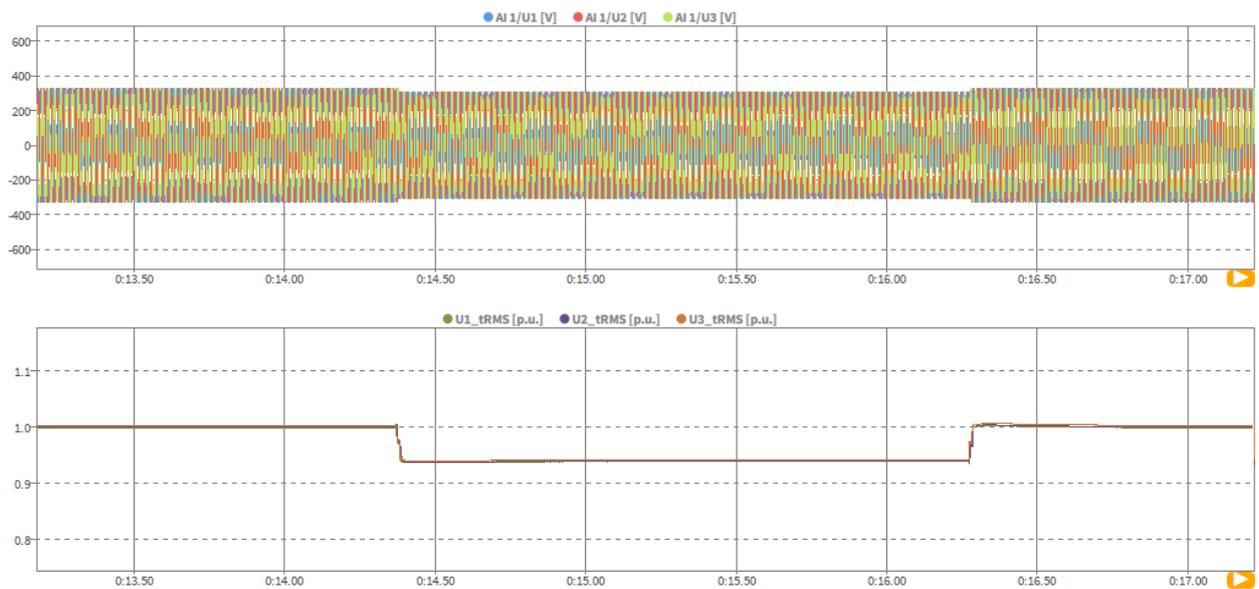
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.3 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



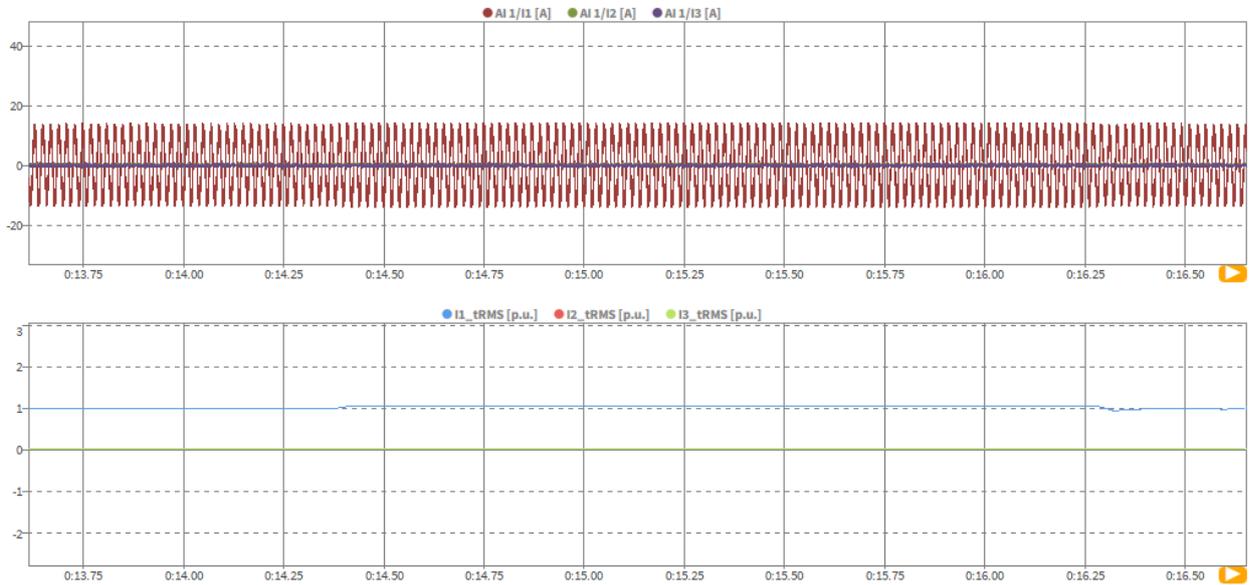
Test 4.3 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase voltages



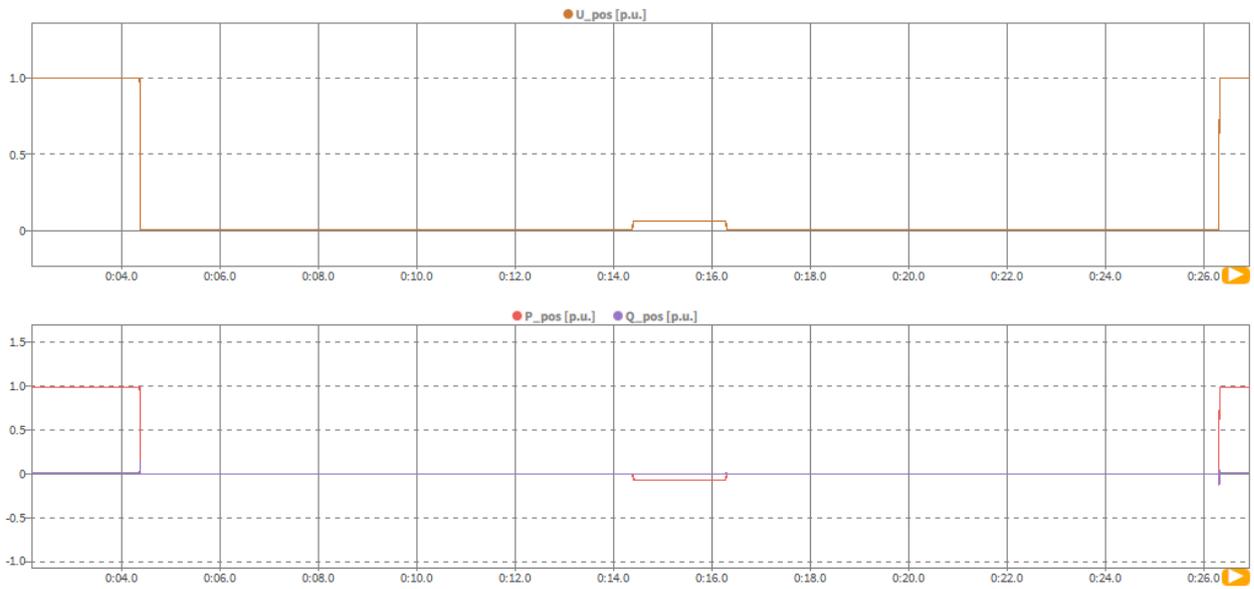
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.3 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase currents



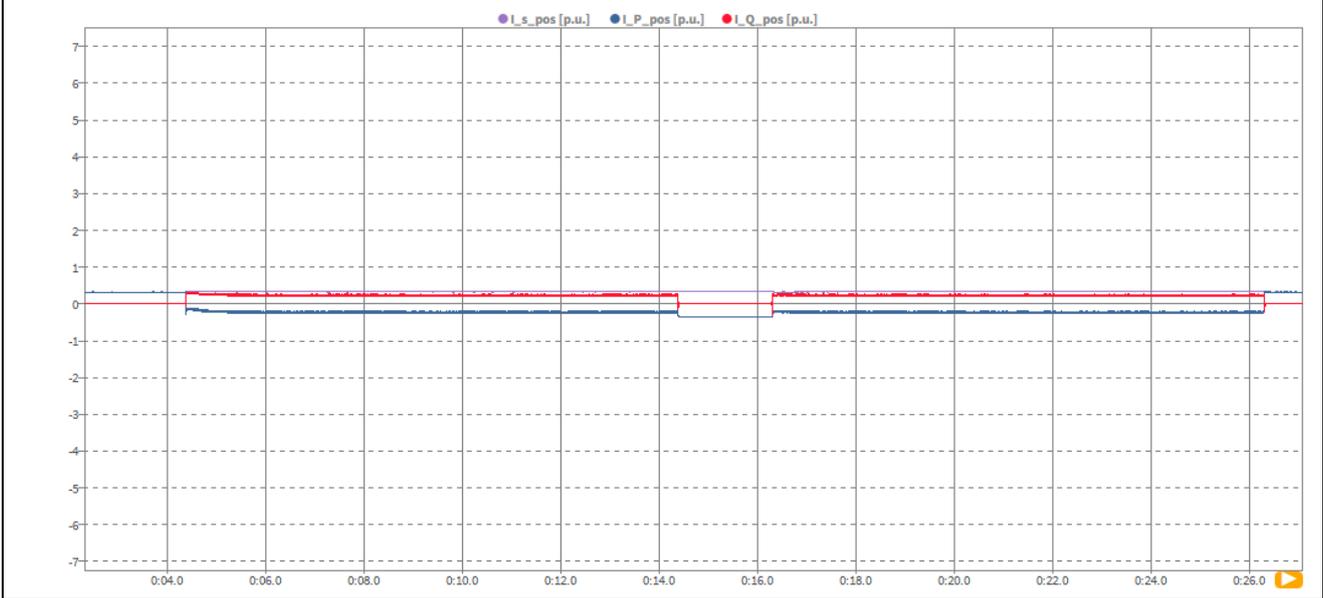
Test 4.3 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

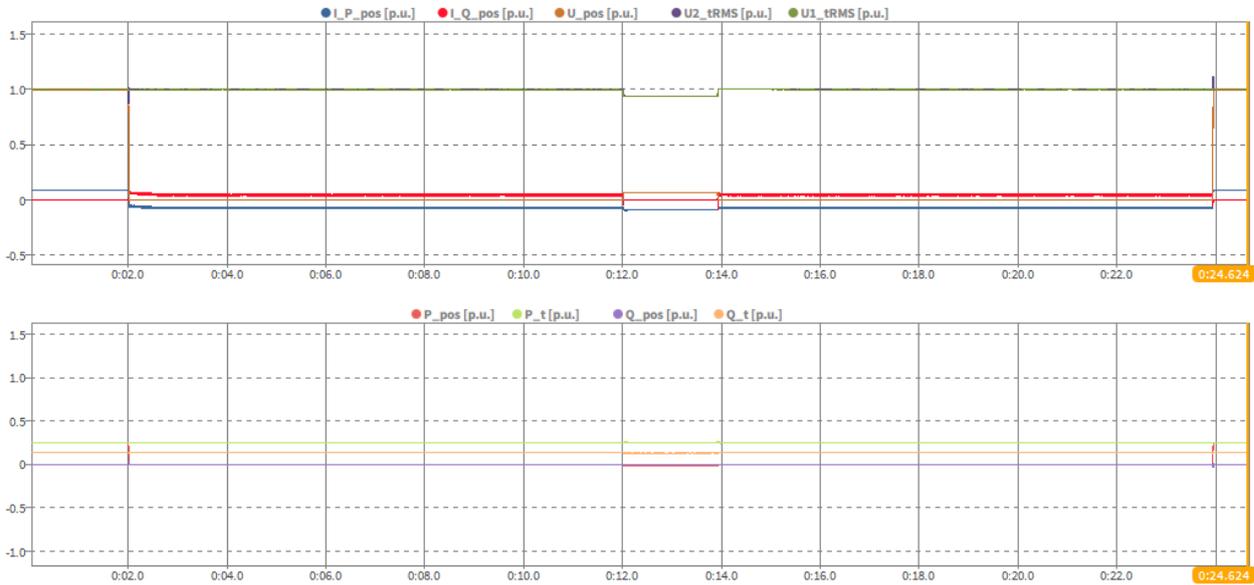
Test 4.3 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



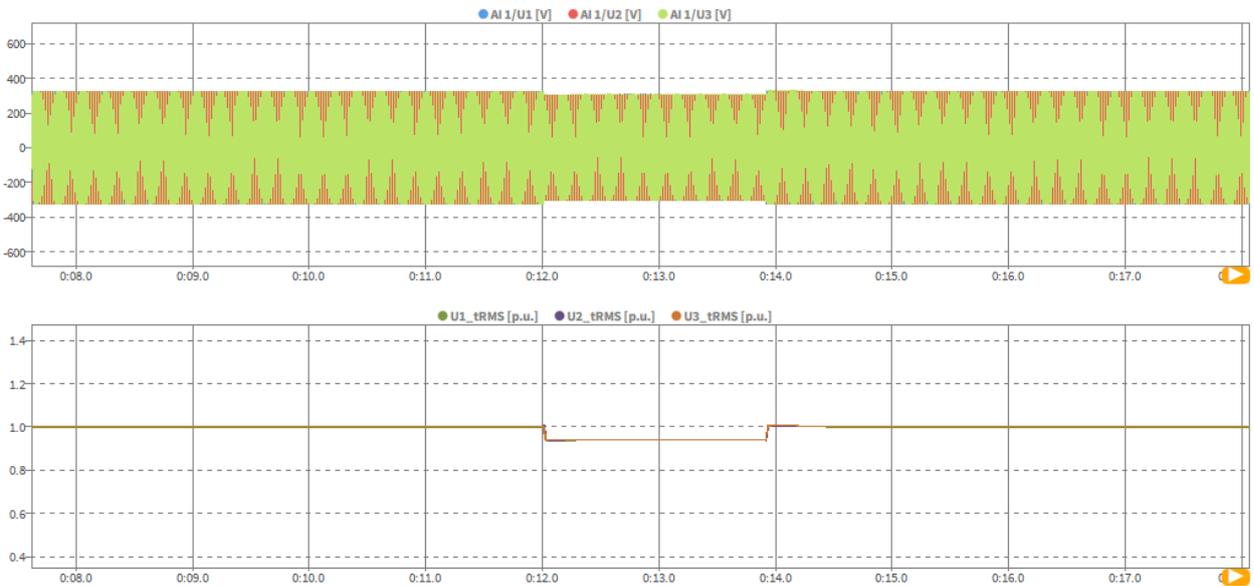
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



Test 4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 20% load,
Instantaneous and RMS values of phase voltages



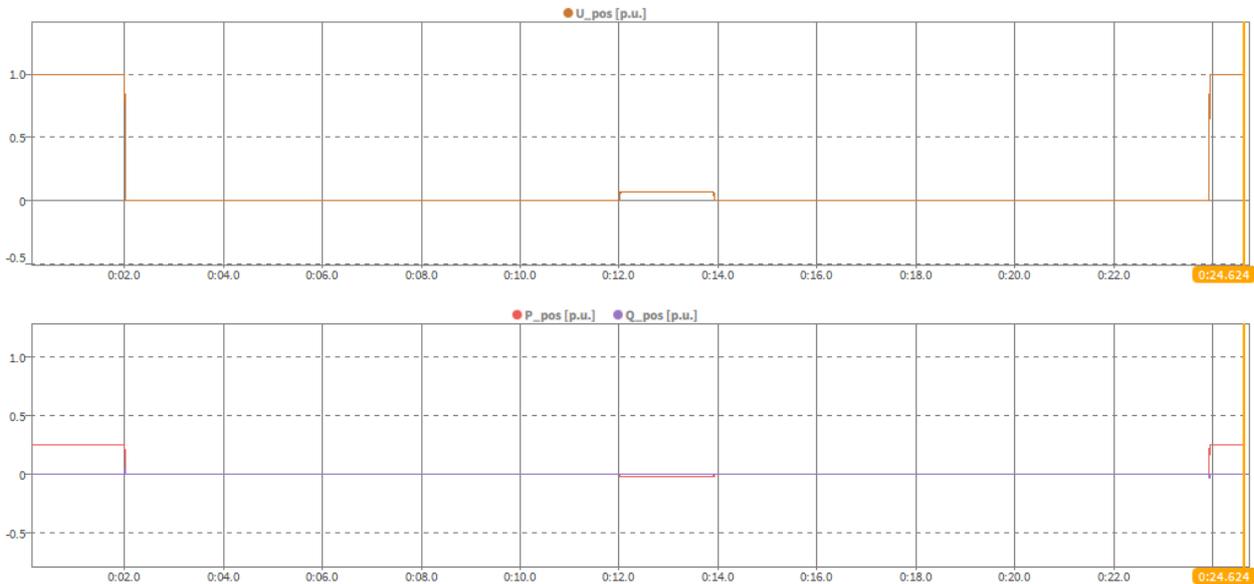
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 20% load, Instantaneous and RMS values of phase currents



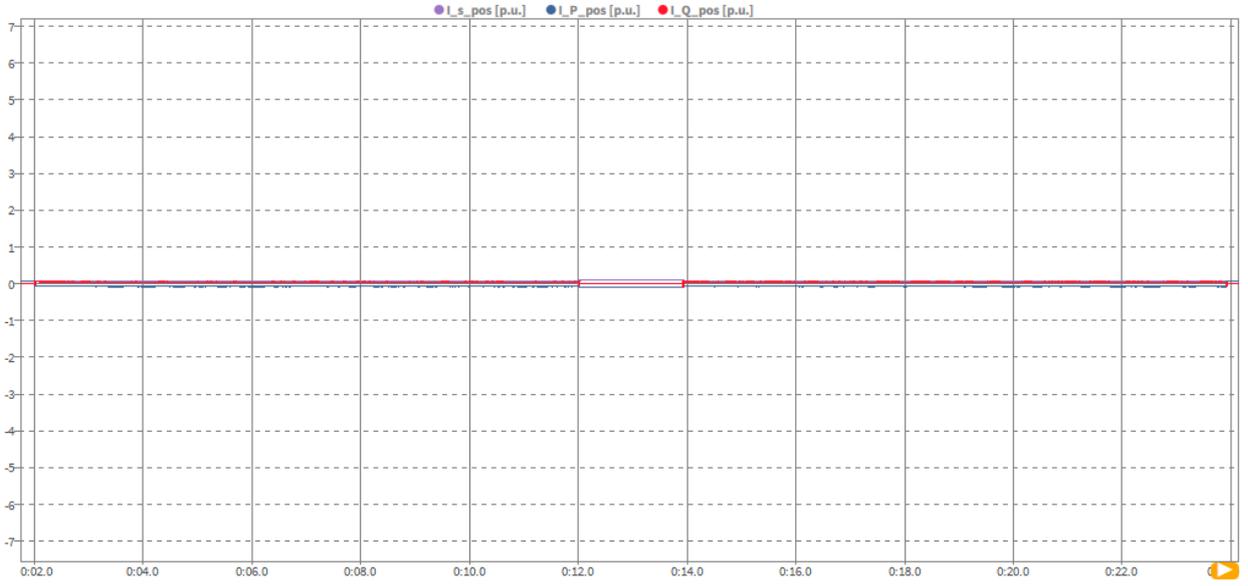
Test 4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 4.4 Depth of fault phase: 0.75 p.u., three-phase SC (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

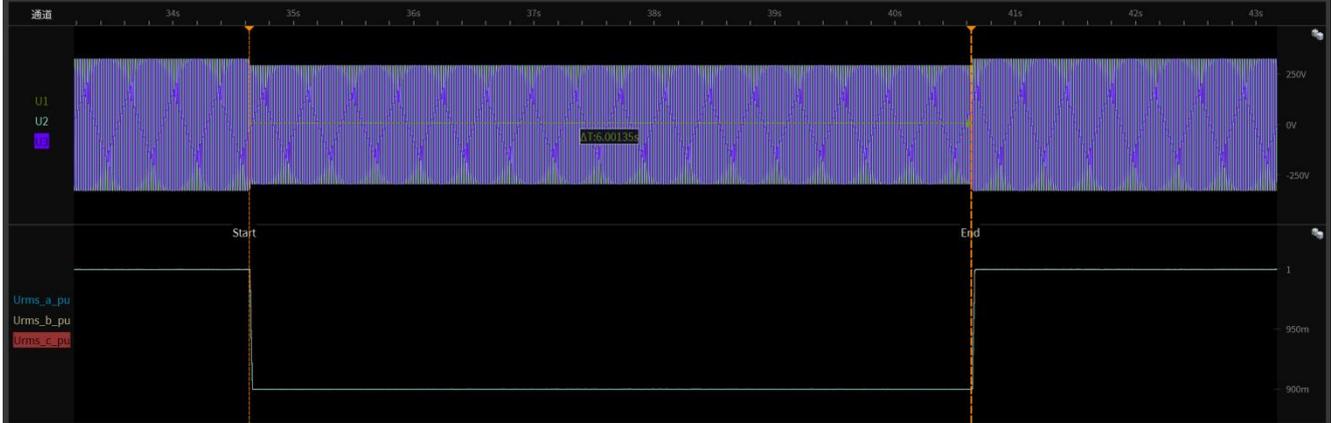
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	5.1	5.2
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	19:20:13.7	19:29:15.4
	3	Fault type (phase)	--	--	--	A	A
	4	Setting voltage depth	Line to line	--	p.u.	0.9	0.9
	5	Setting dip duration	--	--	--	≥6000	≥6000
	6	Point of fault entry	Total	--	ms	34548	34548
	7	Point of fault clearance	Total	--	ms	40556	40556
	8	Fault duration in empty load test	Total	--	ms	6008	6008
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.900	0.900
	10		Pos.			0.899	0.899
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	1.000
			L2 to neutral			1.000	1.001
			L3 to neutral			1.000	1.001
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.994	0.333
	14	Active power	Total	t1-10s to t1	p.u.	0.991	0.333
	15		Pos.			0.991	0.333
	16	Reactive power	Total	t1-10s to t1	p.u.	0.082	-0.011
17	Pos.		0.082			-0.011	
18	Cosφ	--	t1-10s to t1	--	0.995	0.960	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.900	0.900
			L2 to neutral			0.900	0.900
			L3 to neutral			0.900	0.900
	20		Pos.			0.900	0.900
	21		Neg.			--	--
	22	Line current	Phase 1	t1+60ms	p.u.	1.105	0.375
	23		Phase 2			1.102	0.367
	24		Phase 3			1.100	0.373
	25	Line current	Phase 1	t1+100ms	p.u.	1.105	0.375
	26		Phase 2			1.102	0.367
27	Phase 3		1.100			0.374	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.988	0.331	
29		Pos.			0.988	0.331	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	1.000
			L2 to neutral			1.000	1.001
			L3 to neutral			1.000	1.001
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.991	0.333
	32		Pos.			0.991	0.333
	33	Active power rising time	Pos.	--	s	--	--
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.082	-0.011
35	Pos.		0.082			-0.011	
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

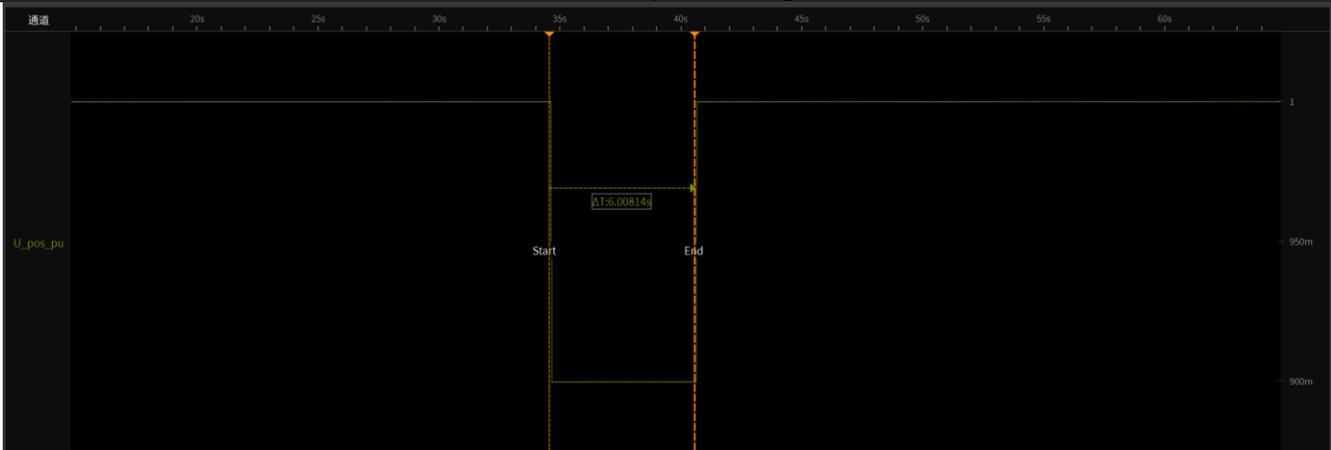
Test 5.1&5.2 Depth of fault phase: 0.90 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



通道名	A	B	Delta	Slope/s	Min	Max
Time	34.6293	40.6307	6.00136	1	34.6293	40.6307
U1	-259.03	-284.282	-25.252	-4.20771	-326.134	326.472
U2	300.244	202.797	-97.4471	-16.2375	-326.304	326.574
U3	-41.8139	81.2491	123.063	20.5059	-326.187	326.625

通道名	A	B	Delta	Slope/s	Min	Max
Urms_a_pu	0.999789	0.899743	-0.100045	-0.0166704	0.899627	1.00988
Urms_b_pu	1.00009	0.900085	-0.100008	-0.0166643	0.900014	1.00896
Urms_c_pu	0.999742	0.899633	-0.100109	-0.0166811	0.899595	1.00004

Test 5.1&5.2 Depth of fault phase: 0.90 p.u., three-phase SC (type A), No load, Positive sequence voltage



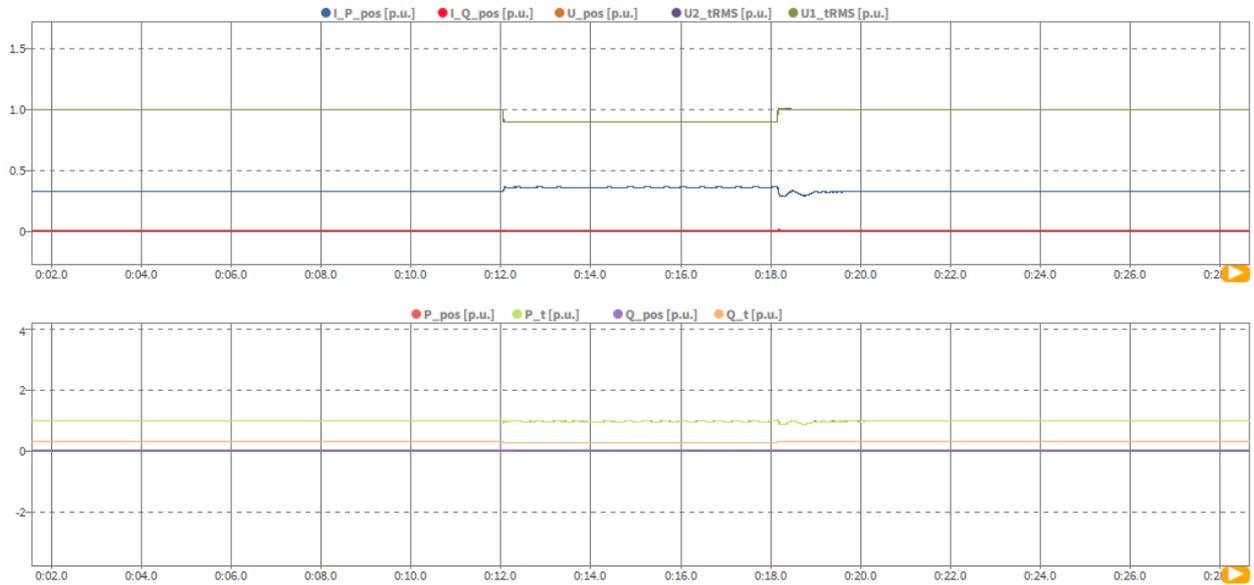
通道名	A	B	Delta	Slope/s	Min	Max
Time	34.5482	40.5563	6.00815	1	34.5482	40.5563

通道名	A	B	Delta	Slope/s	Min	Max
U_pos_pu	0.999892	0.899865	-0.100027	-0.0166486	0.899802	1.00002

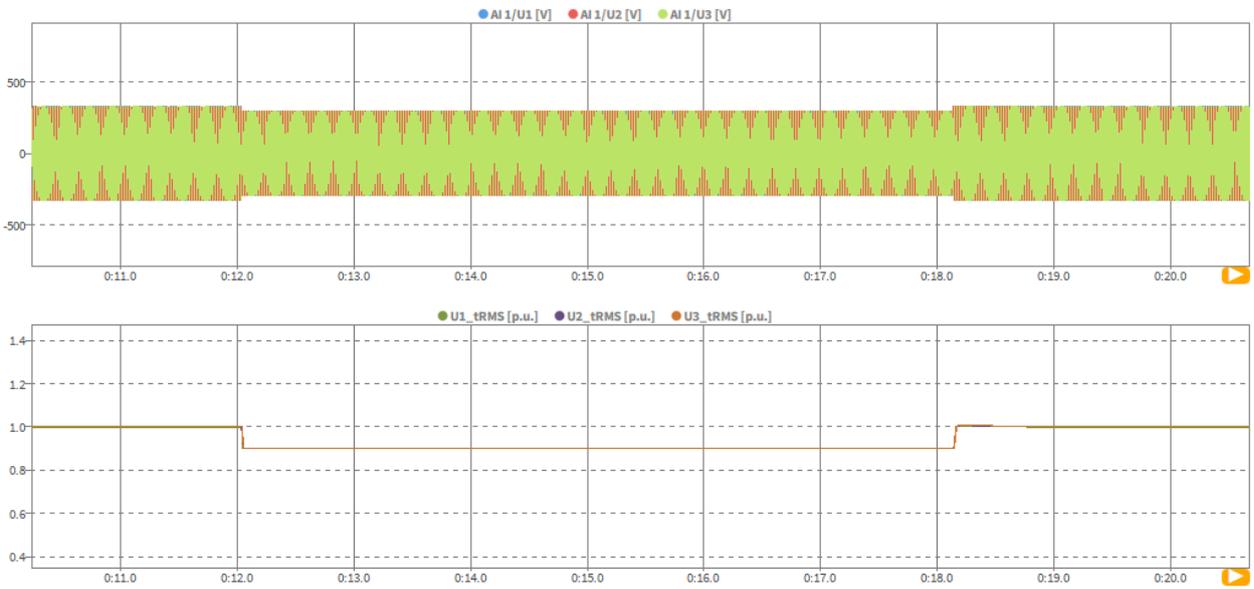
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Test overview (voltage, current, active and reactive power positive sequence)



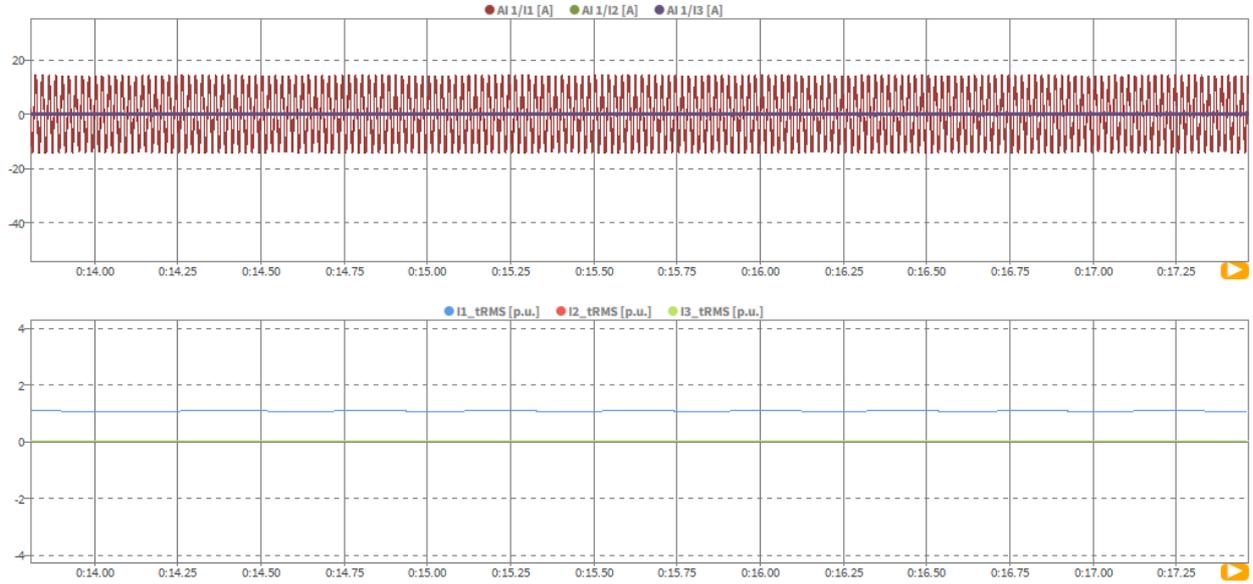
Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages



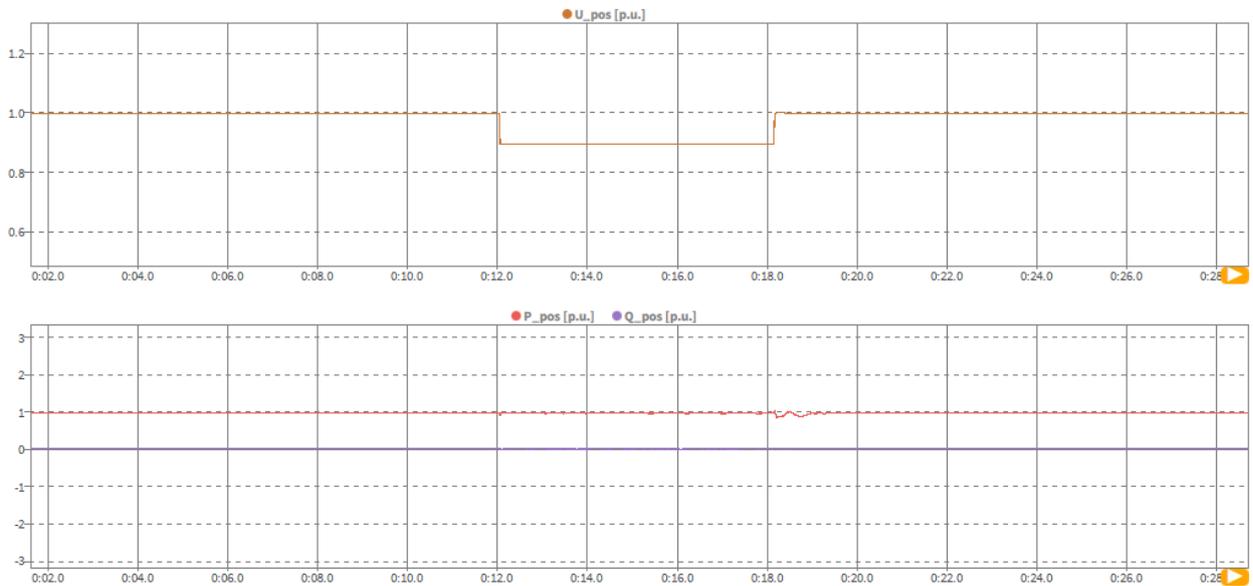
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase currents



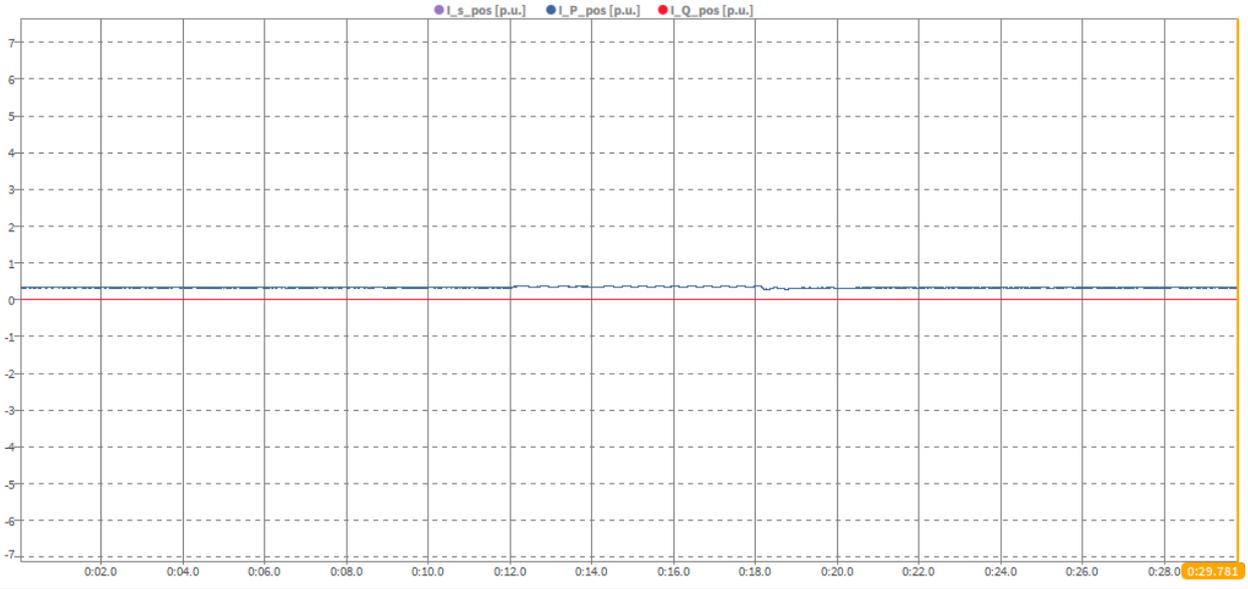
Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

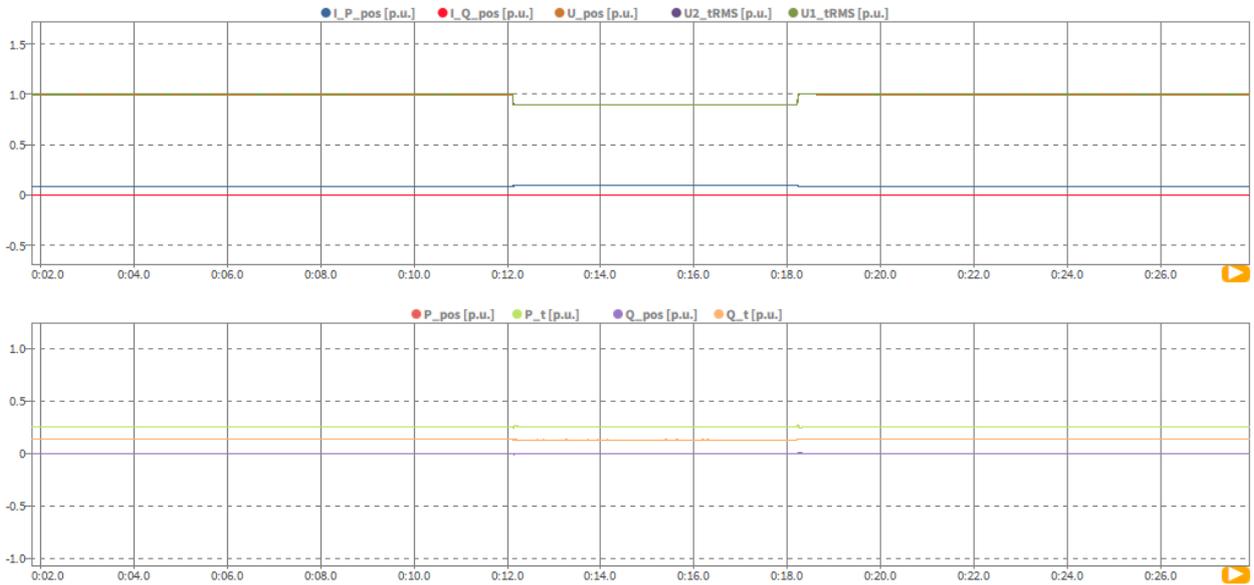
Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



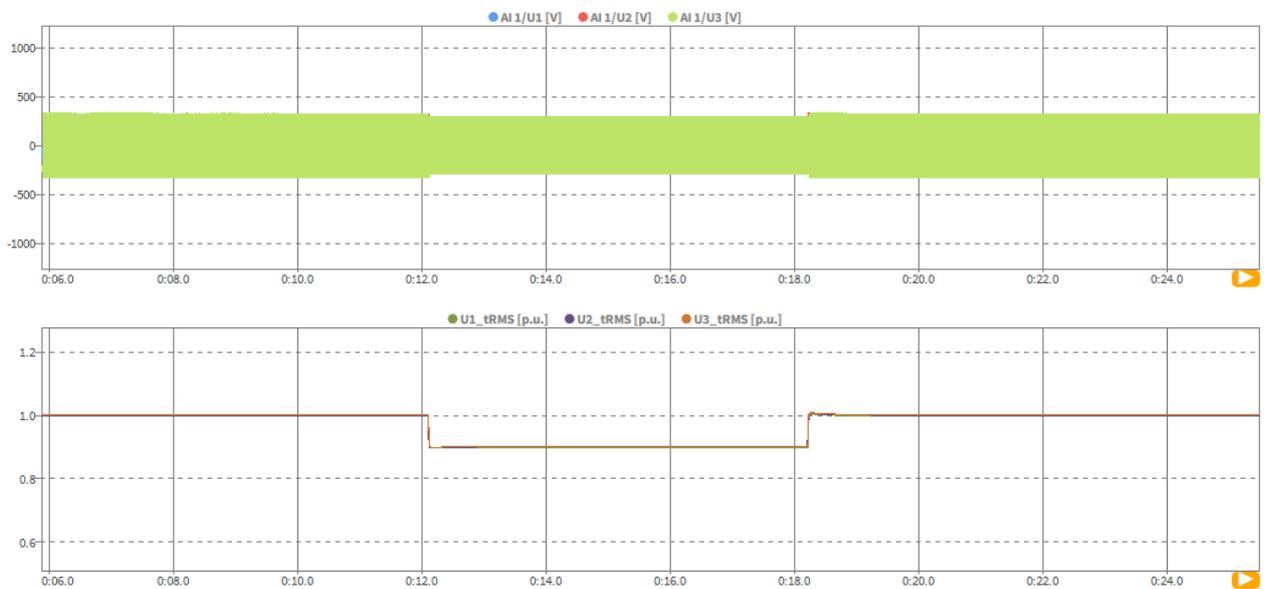
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



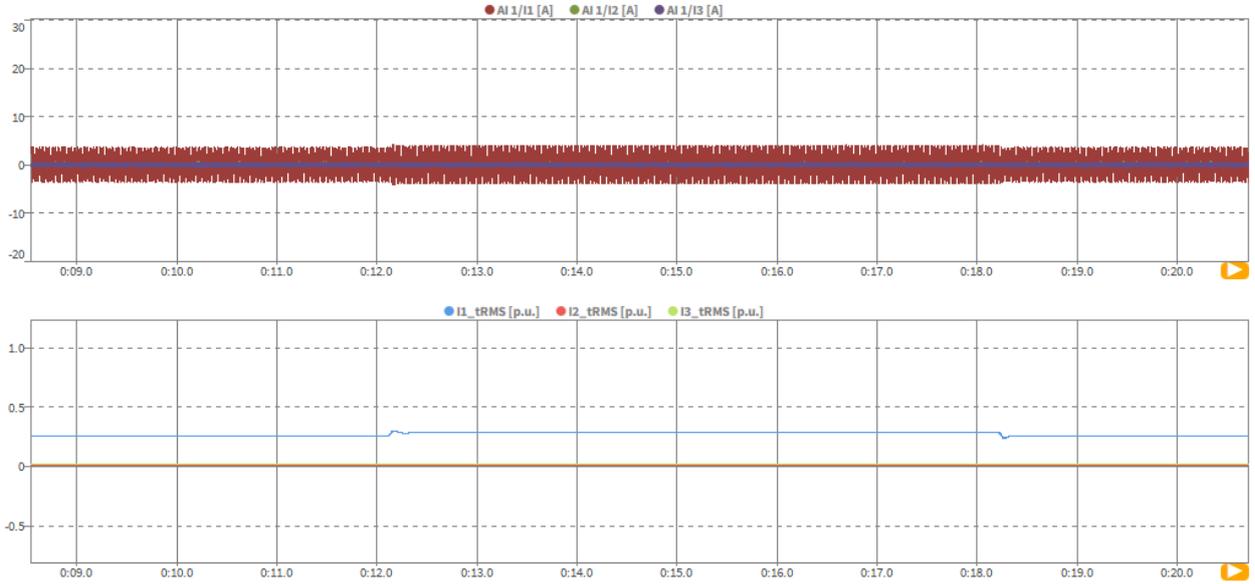
Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



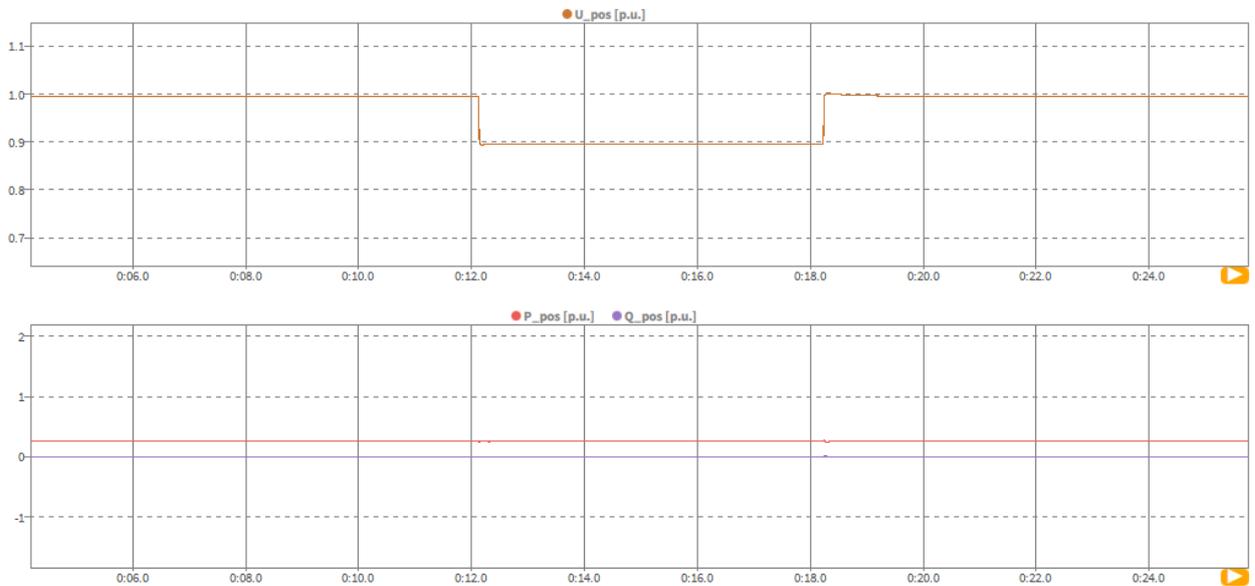
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.2 Depth of fault phase: 0.9 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase currents



Test 5.2 Depth of fault phase: 0.9 p.u, three-phase SC (type A), 20% load,
Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.2 Depth of fault phase: 0.9 p.u, three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

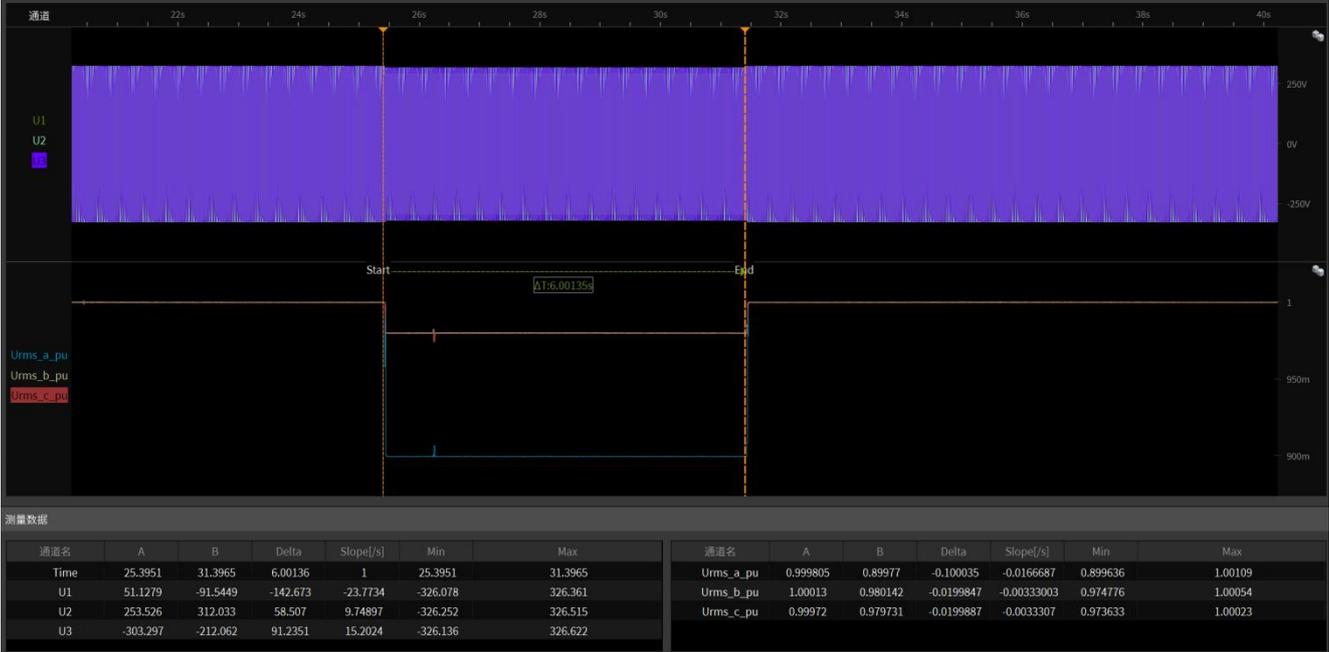
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General	0	Test number	--	--	--	5.3	5.4
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7
	2	Time (start of test)	--	--	hh:mm:ss.f	19:25:16.9	19:28:15.4
	3	Fault type (phase)	--	--	--	D1	D1
	4	Setting voltage depth	Line to line	--	p.u.	0.90	0.90
	5	Setting dip duration	--	--	--	≥6000	≥6000
	6	Point of fault entry	Total	--	ms	25412	25412
	7	Point of fault clearance	Total	--	ms	31413	31413
	8	Fault duration in empty load test	Total	--	ms	6001	6001
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	0.900	0.900
	10		Pos.			0.953	0.953
11	Neg.		--			--	
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	1.000
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.207
	14	Active power	Total	t1-10s to t1	p.u.	0.992	0.200
	15		Pos.			0.992	0.200
	16	Reactive power	Total	t1-10s to t1	p.u.	0.084	0.056
17	Pos.		0.084			0.056	
18	Cosφ	--	t1-10s to t1	--	0.996	0.959	
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	0.900	0.899
			L2 to neutral			0.980	0.979
			L3 to neutral			0.980	0.979
			Pos.			0.953	0.952
	20	Line current	Phase 1	t1+60ms	p.u.	1.079	0.227
	21		Phase 2			1.014	0.212
	22		Phase 3			1.041	0.215
	23	Line current	Phase 1	t1+100ms	p.u.	1.079	0.227
	24		Phase 2			1.014	0.212
	25		Phase 3			1.041	0.215
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.990	0.200	
27		Pos.			0.990	0.200	
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999
			L2 to neutral			1.000	1.000
			L3 to neutral			1.000	1.000
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.992	0.200
	32		Pos.			0.992	0.200
	33	Active power rising time	Pos.	--	s	--	--
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.084	0.056
35	Pos.		0.084			0.056	
36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes	

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.3&5.4 Depth of fault phase: 0.90 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



Test 5.3&5.4 Depth of fault phase: 0.90 p.u., three-phase SC (type D1), No load, Positive sequence voltage



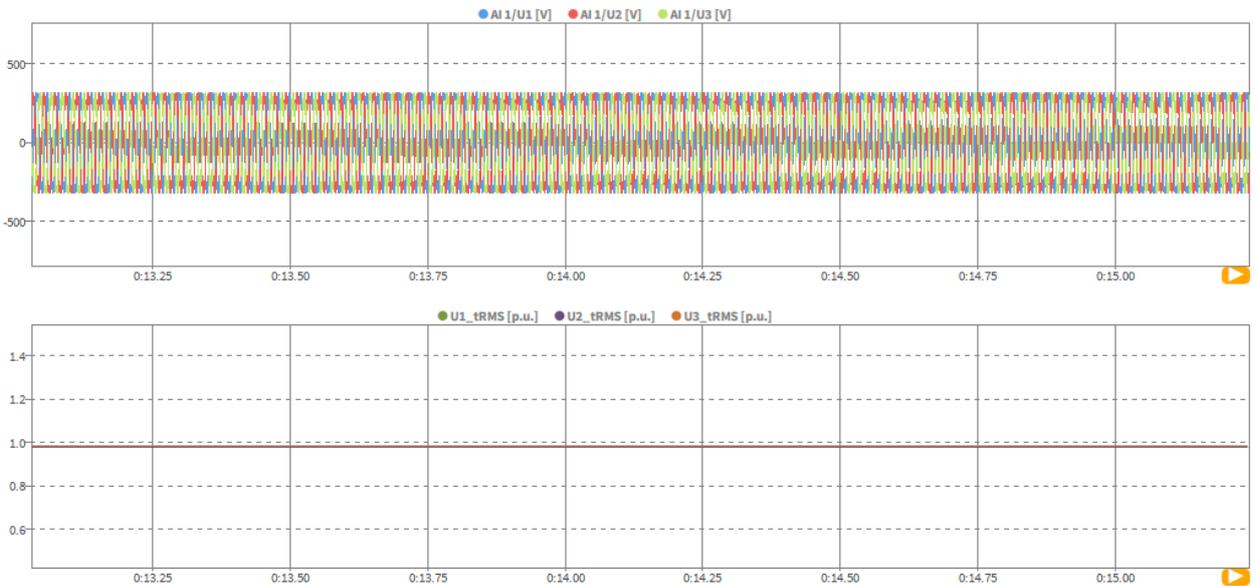
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.3 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 100% load,
Test overview (voltage, current, active and reactive power positive sequence)



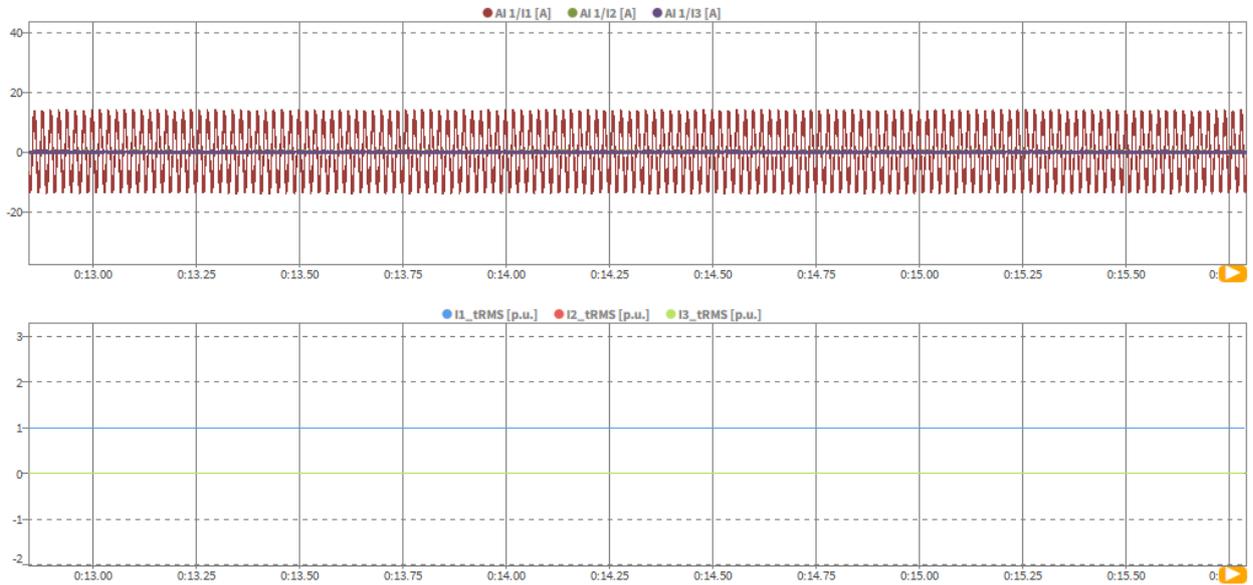
Test 5.3 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 100% load,
Instantaneous and RMS values of phase voltages



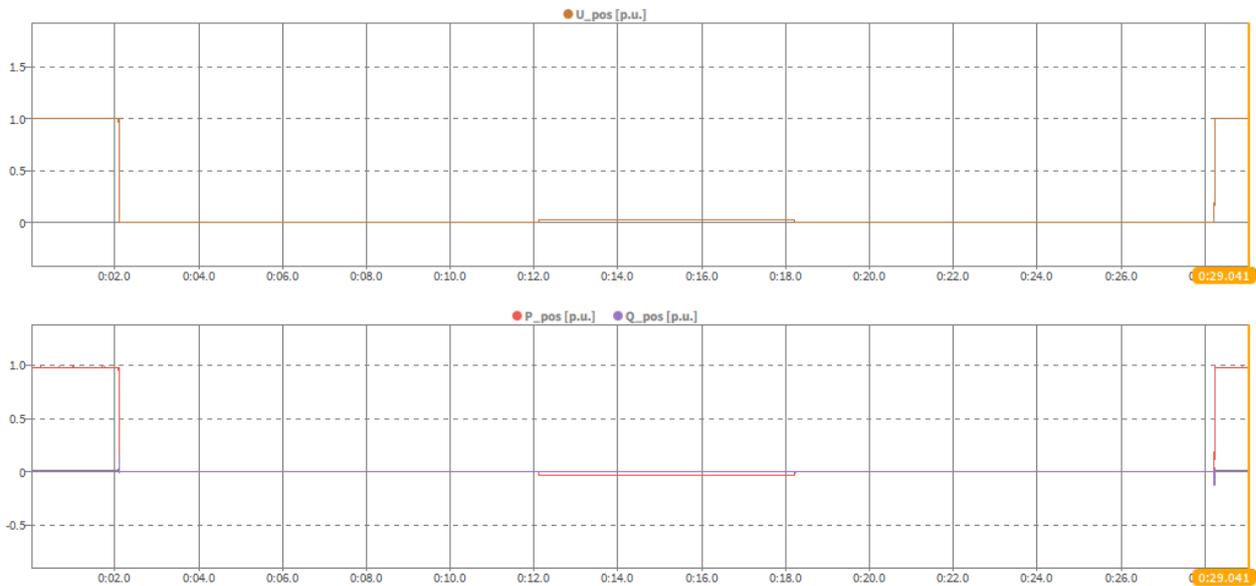
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.3 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 100% load,
Instantaneous and RMS values of phase currents



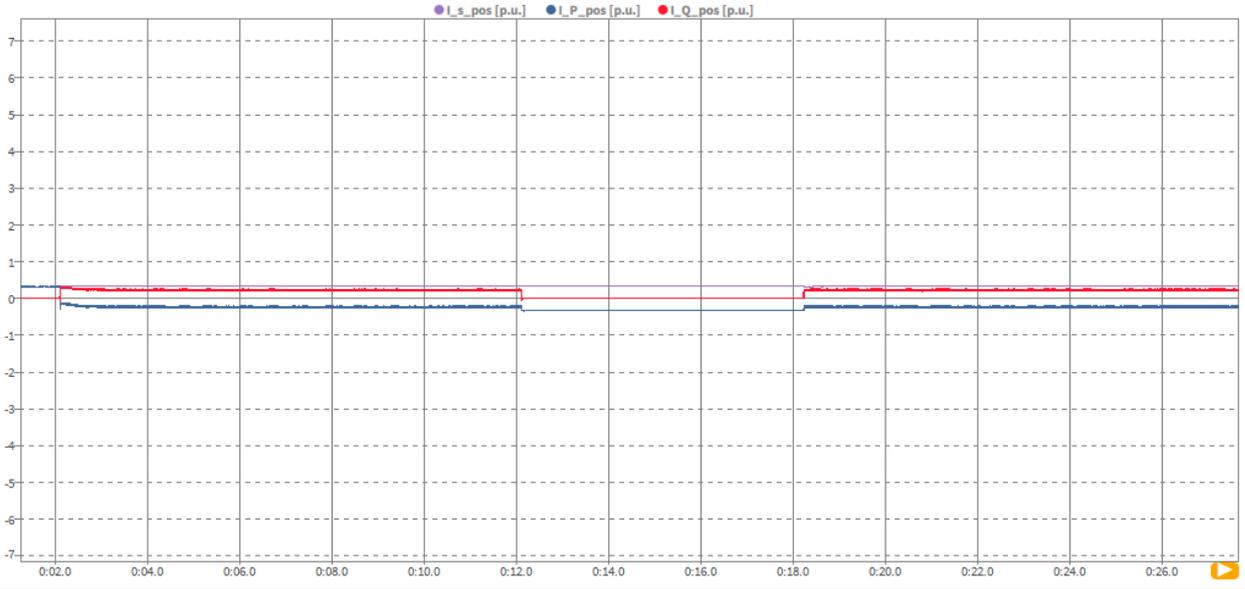
Test 5.3 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 100% load,
Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

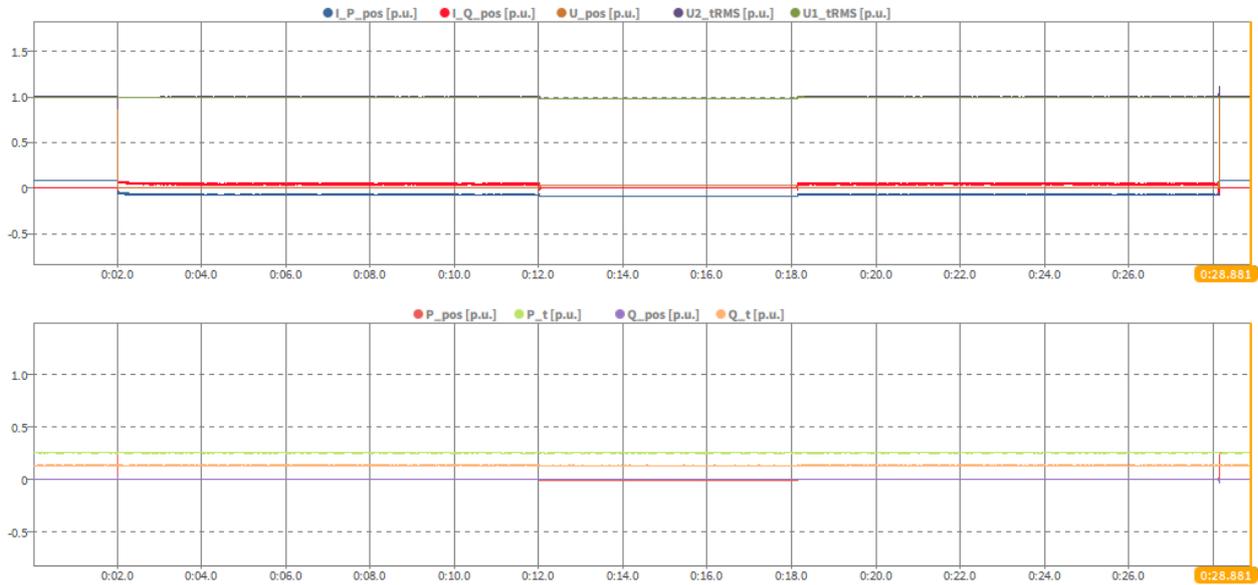
Test 5.3 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



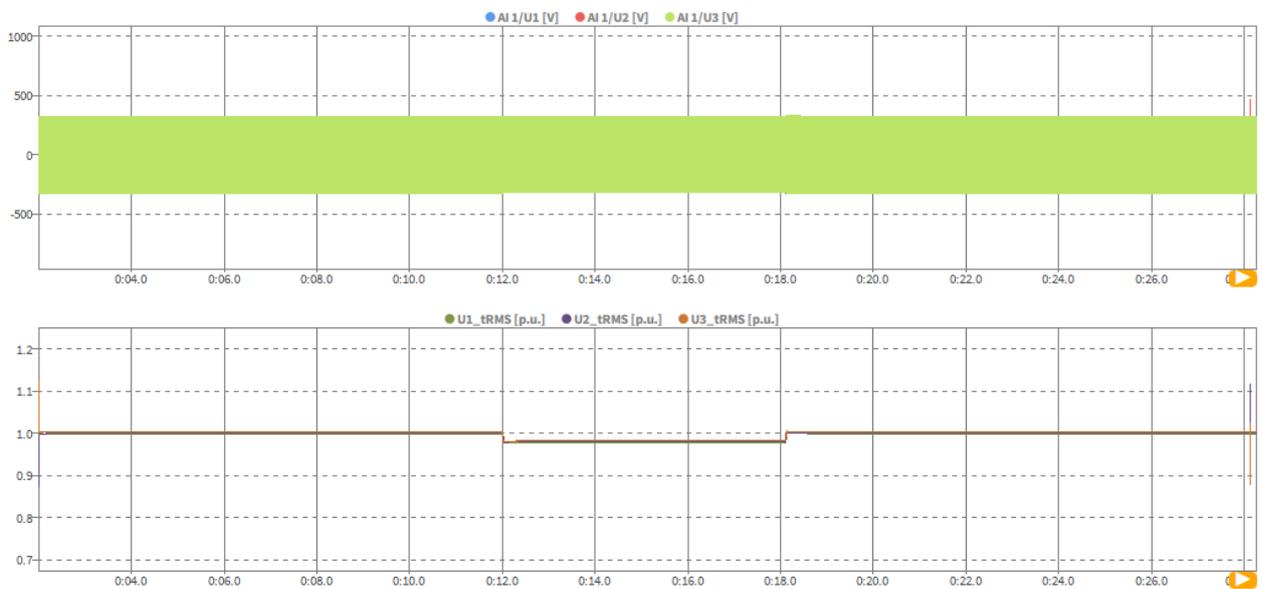
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.4 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



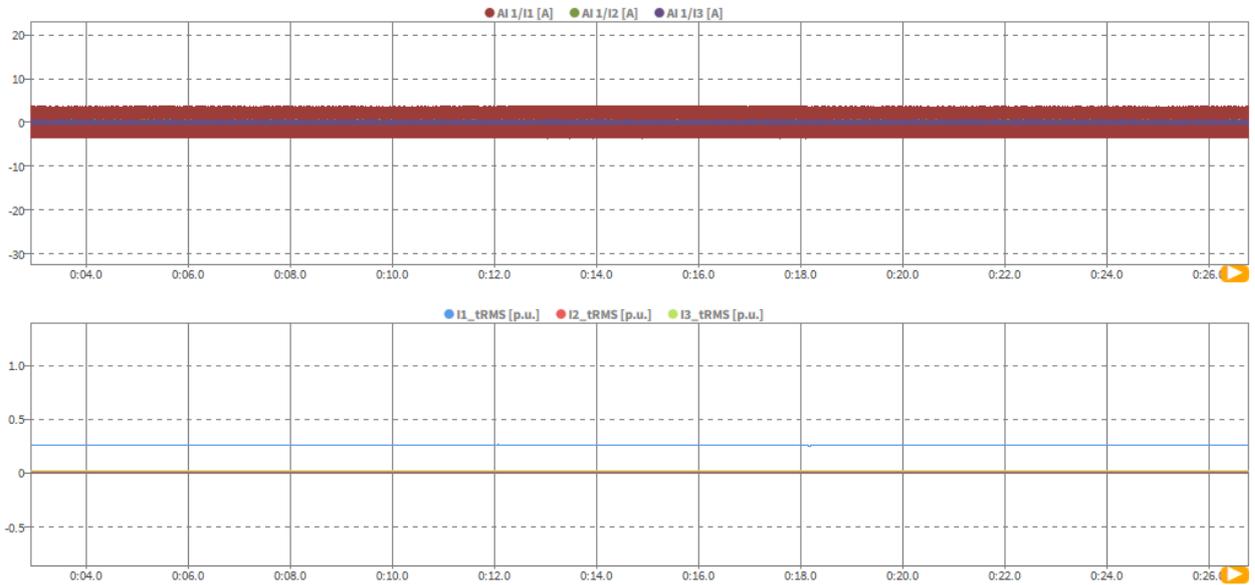
Test 5.4 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 20% load,
Instantaneous and RMS values of phase voltages



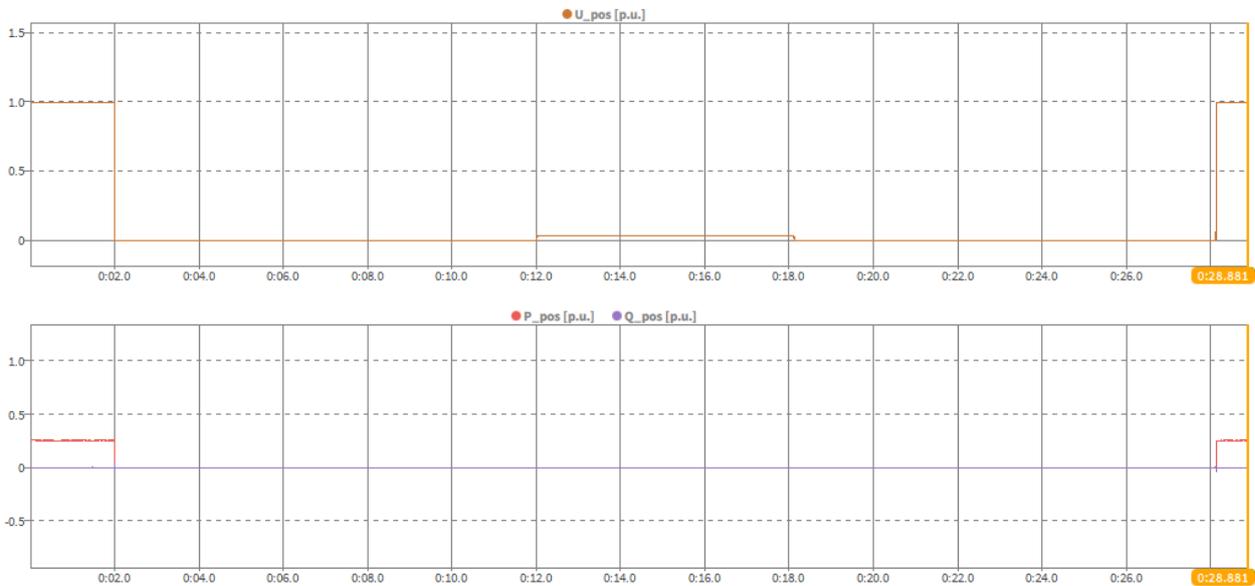
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.4 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 20% load, Instantaneous and RMS values of phase currents



Test 5.4 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 5.4 Depth of fault phase: 0.9 p.u, three-phase SC (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

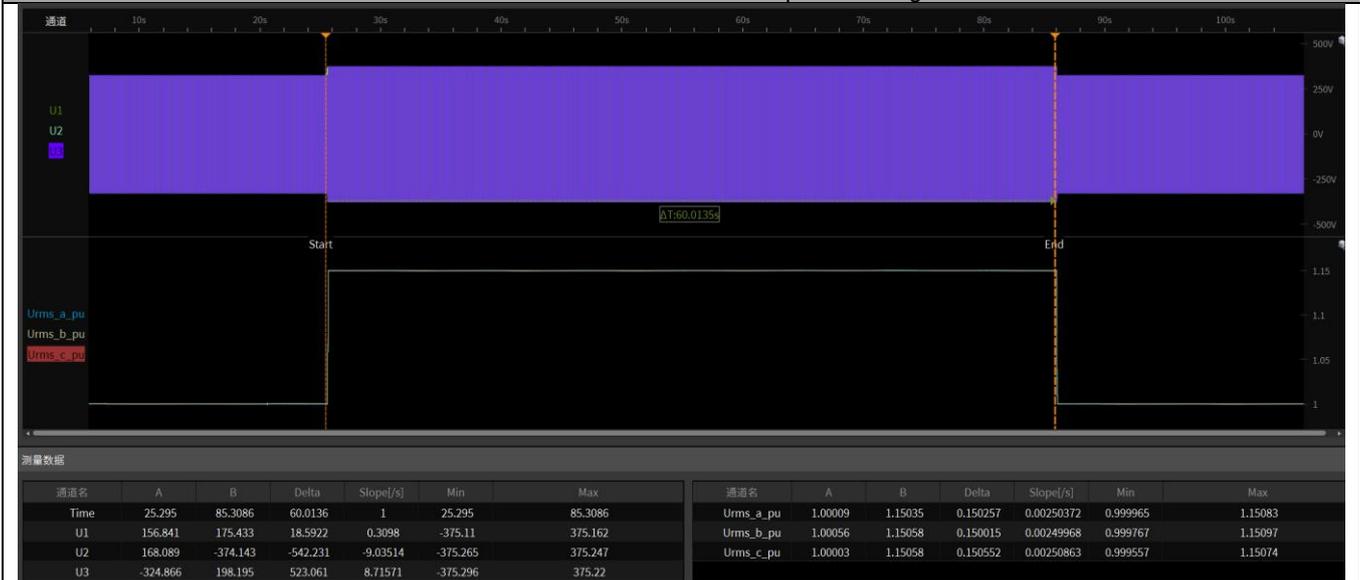
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	6.1	6.2	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	19:45:16.9	19:49:17.4	
	3	Fault type (phase)	--	--	--	A	A	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.15	1.15
	5	Setting dip duration	--	--	--	--	≥60000	≥60000
	6	Point of fault entry	Total	--	--	ms	25362	25362
	7	Point of fault clearance	Total	--	--	ms	85376	85376
	8	Fault duration in empty load test	Total	--	--	ms	60013	60013
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.150	1.150	
	10		Pos.			1.150	1.150	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.207	
	14	Active power	Total	t1-10s to t1	p.u.	0.991	0.199	
	15		Pos.			0.991	0.199	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.084	0.056	
17	Pos.		0.084			0.056		
18	Cosφ	--	t1-10s to t1	--	0.995	0.959		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.150	1.149	
			L2 to neutral			1.150	1.150	
			L3 to neutral			1.150	1.150	
			20			Pos.	1.150	1.150
			21			Neg.	--	--
	22	Line current	Phase 1	t1+60ms	p.u.	0.874	0.189	
	23		Phase 2			0.874	0.189	
	24		Phase 3			0.873	0.189	
	25	Line current	Phase 1	t1+100ms	p.u.	0.874	0.189	
	26		Phase 2			0.874	0.189	
	27		Phase 3			0.873	0.189	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.994	0.201		
29		Pos.			0.995	0.201		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.991	0.199	
	32		Pos.			0.991	0.199	
	33	Active power rising time	Pos.	--	s	--	--	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.084	0.056	
	35		Pos.			0.084	0.056	
	36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1&6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



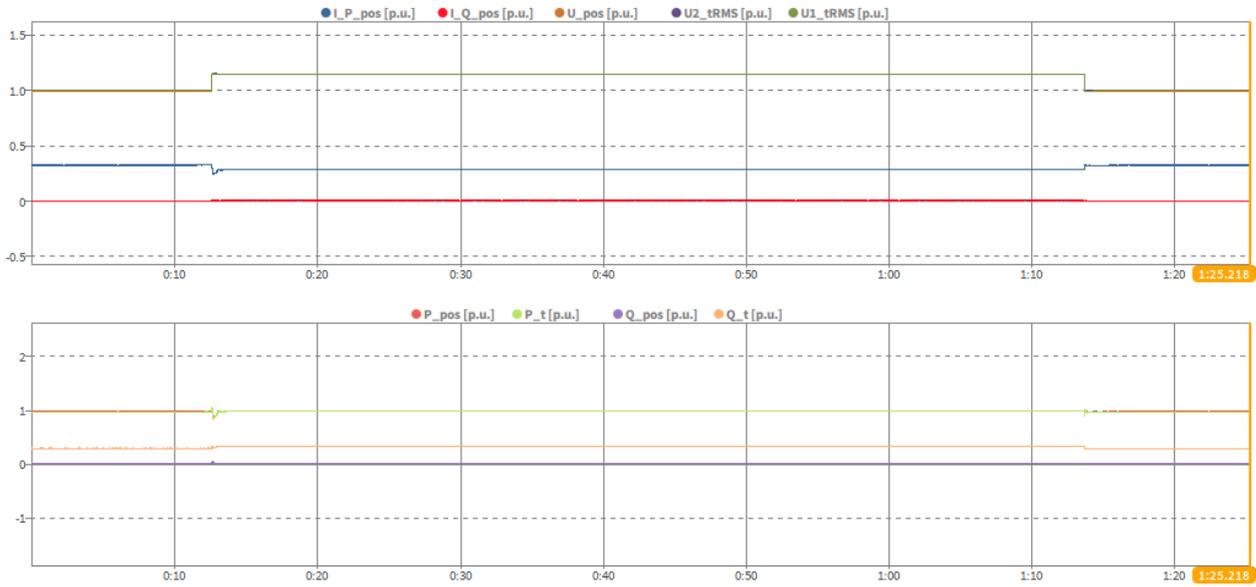
Test 6.1&6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), No load, Positive sequence voltage



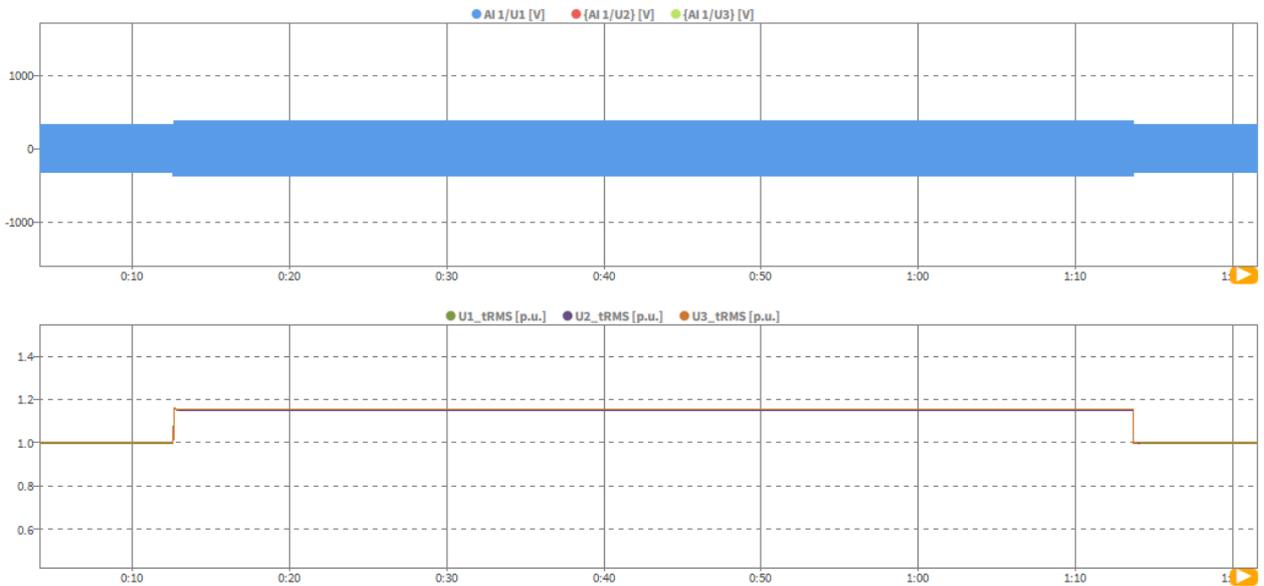
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 100% load,
Test overview (voltage, current, active and reactive power positive sequence)



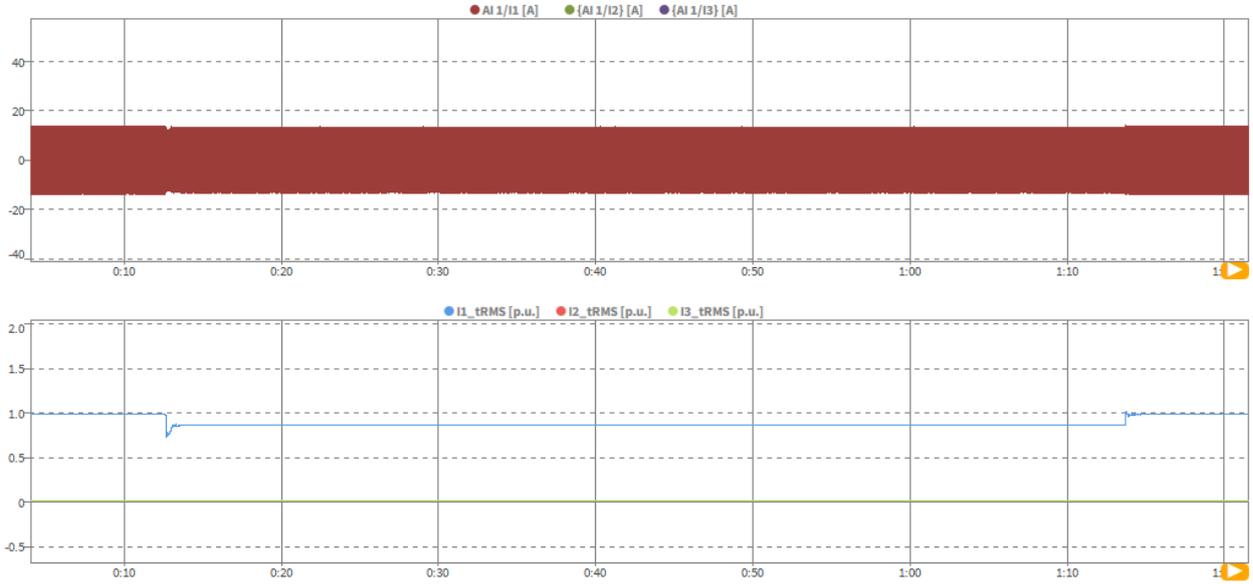
Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages



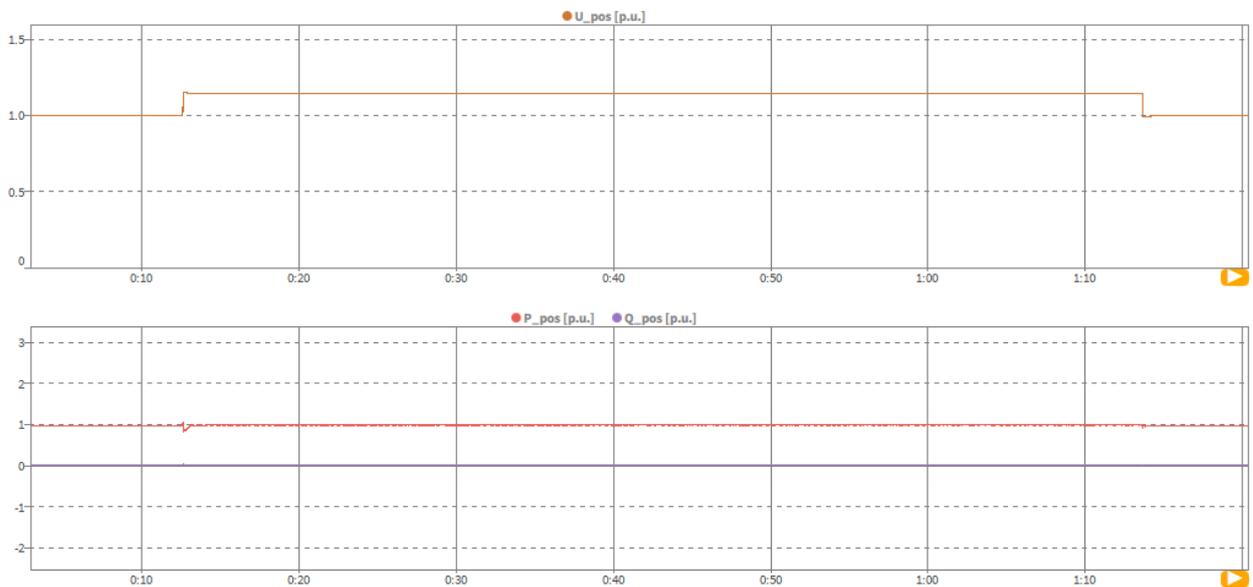
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



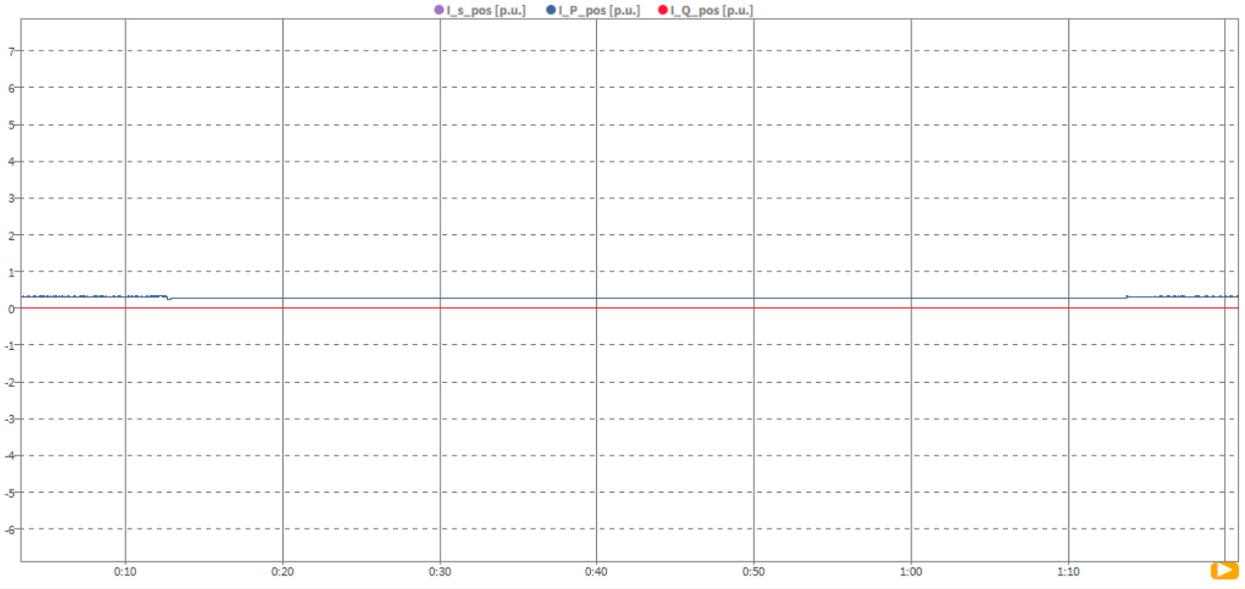
Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

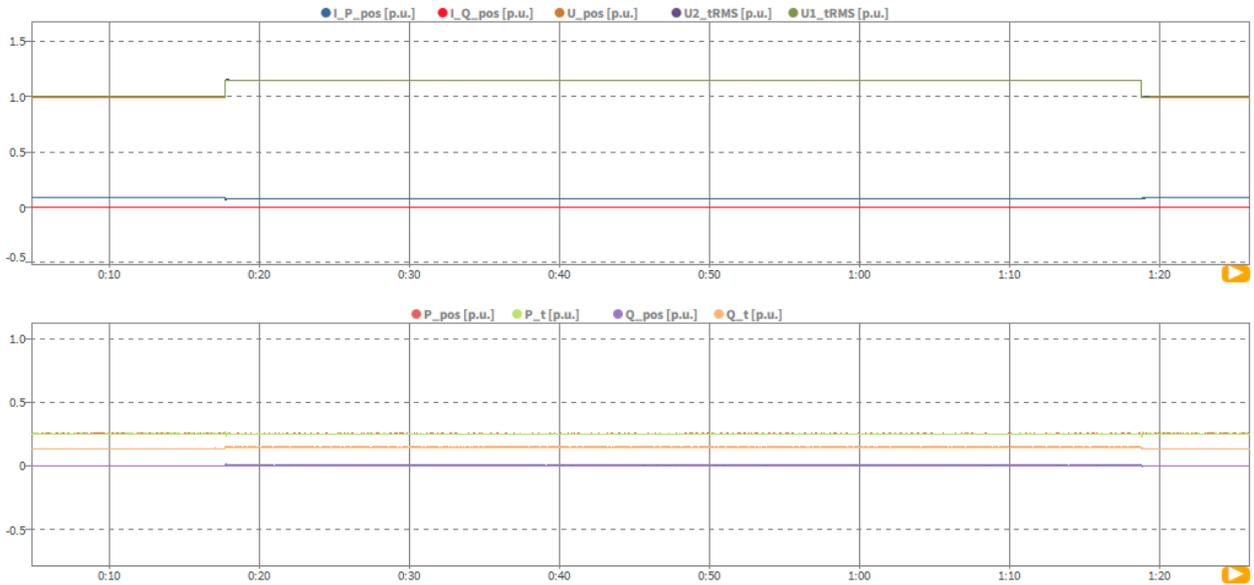
Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



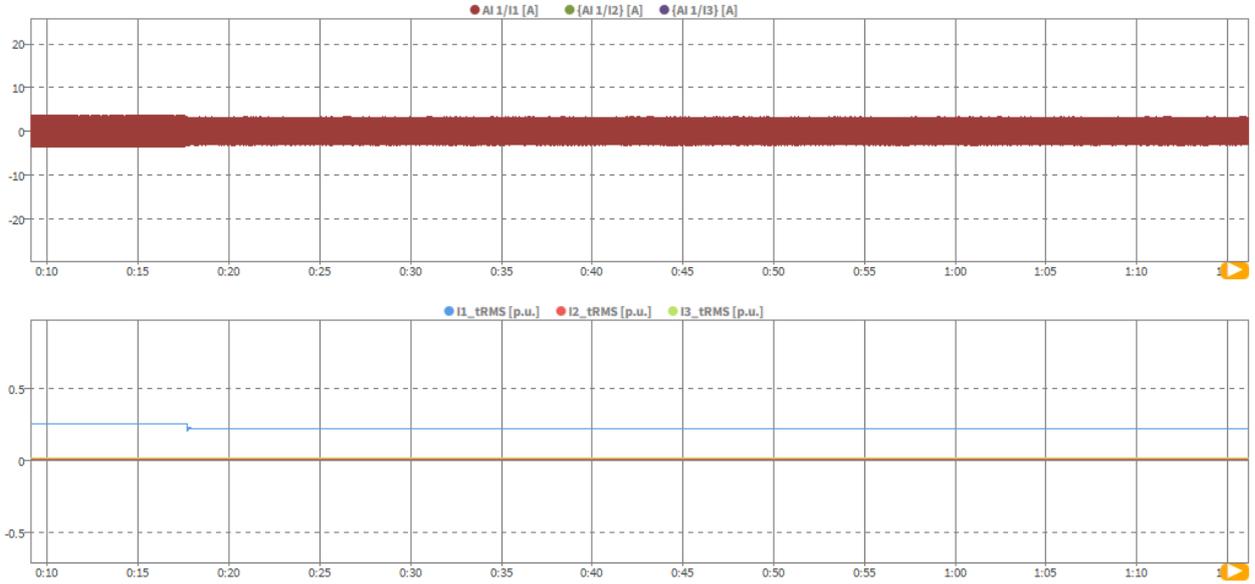
Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



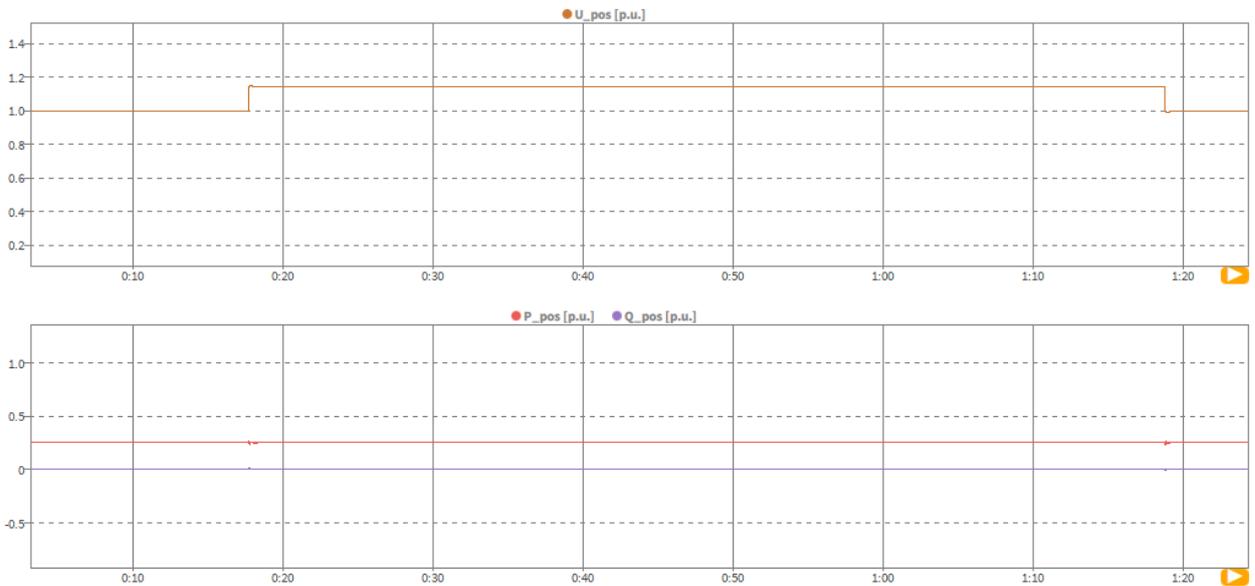
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



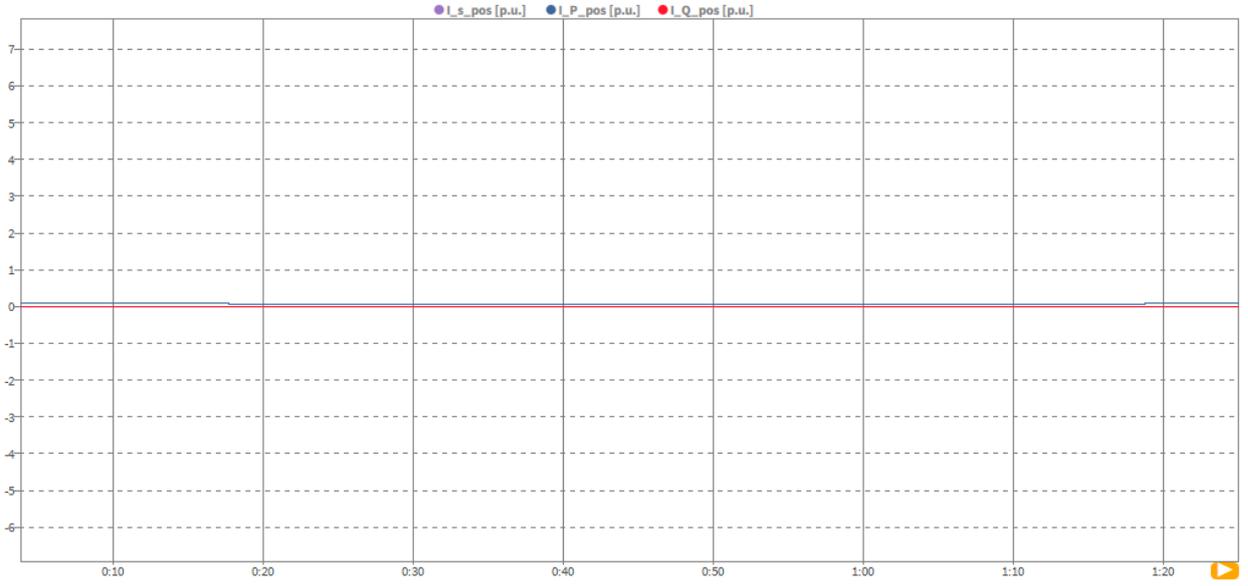
Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.1 Depth of fault phase: 1.15 p.u, three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

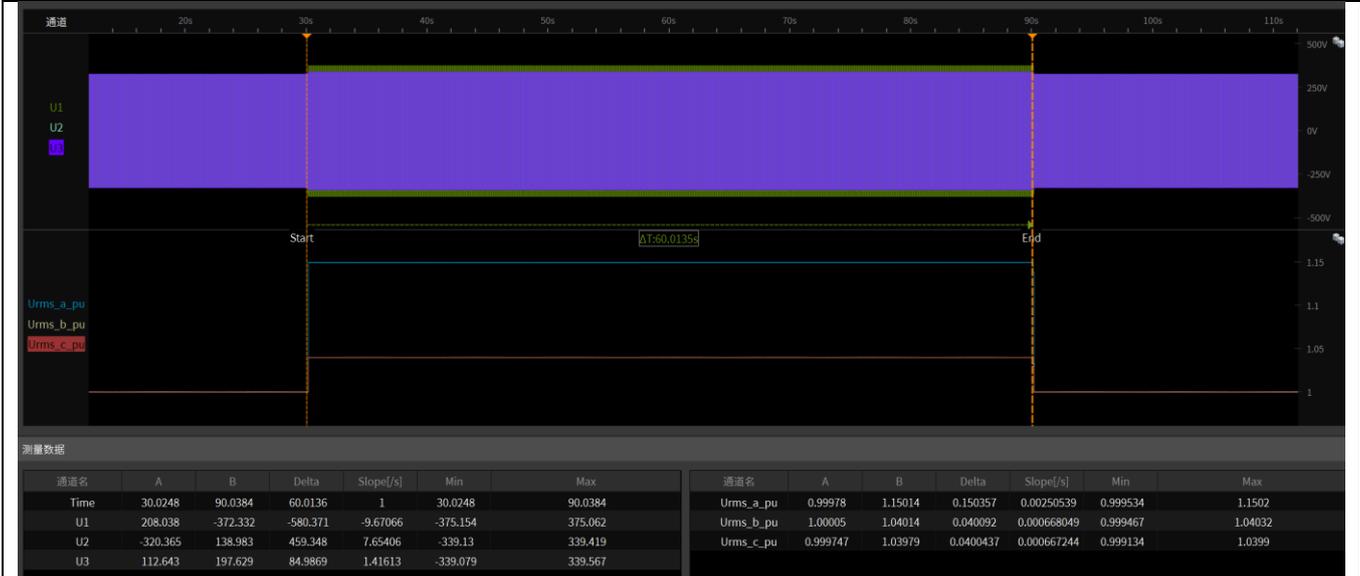
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	6.3	6.4	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	20:12:14.8	20:15:18.2	
	3	Fault type (phase)	--	--	--	D1	D1	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.15	1.15
	5	Setting dip duration	--	--	--	--	≥60000	≥60000
	6	Point of fault entry	Total	--	--	ms	29962	29962
	7	Point of fault clearance	Total	--	--	ms	89976	89976
	8	Fault duration in empty load test	Total	--	--	ms	60013	60013
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.150	1.150	
	10		Pos.			1.150	1.150	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	0.999	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.998	0.207	
	14	Active power	Total	t1-10s to t1	p.u.	0.996	0.199	
			Pos.			0.995	0.199	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.087	0.055	
			Pos.			0.087	0.055	
18	Cosφ	--	t1-10s to t1	--	0.996	0.962		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.150	1.149	
			L2 to neutral			1.040	1.040	
			L3 to neutral			1.040	1.040	
			Pos.			1.077	1.076	
			Neg.			--	--	
	20							
	22	Line current	Phase 1	t1+60ms	p.u.	0.876	0.180	
			Phase 2			0.970	0.203	
			Phase 3			0.940	0.203	
	25	Line current	Phase 1	t1+100ms	p.u.	0.876	0.180	
			Phase 2			0.970	0.203	
Phase 3			0.940			0.203		
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.995	0.200		
		Pos.			0.995	0.200		
29								
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	0.999	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.996	0.199	
			Pos.			0.995	0.199	
	32							
	33	Active power rising time	Pos.	--	s	--	--	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.087	0.055	
			Pos.			0.087	0.055	
	35							
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.3&6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



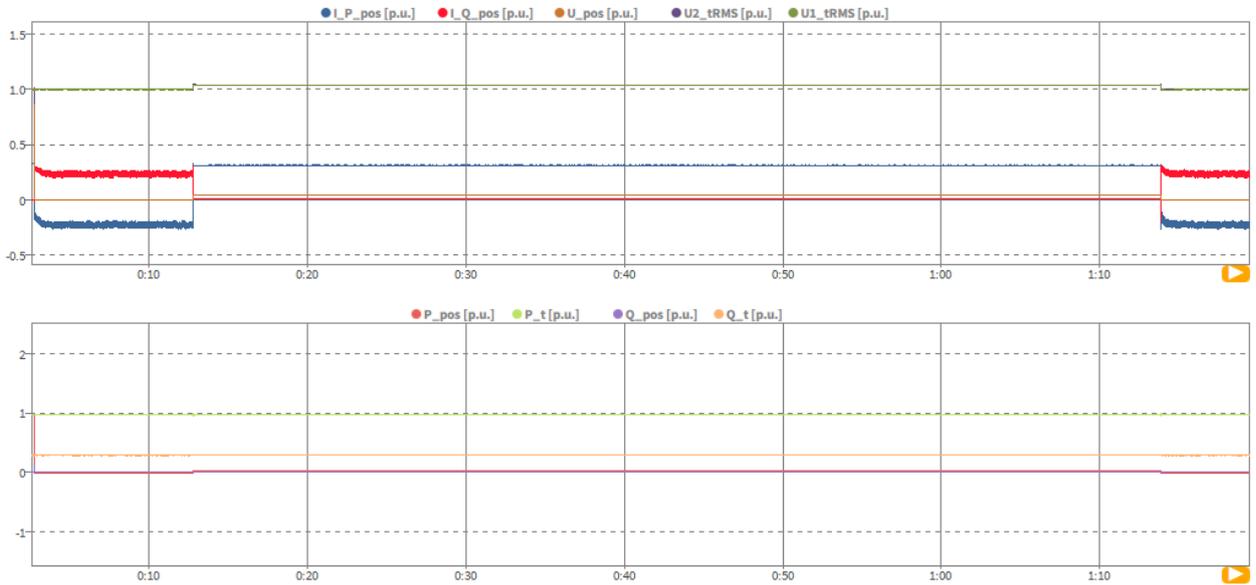
Test 6.3&6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), No load, Positive sequence voltage



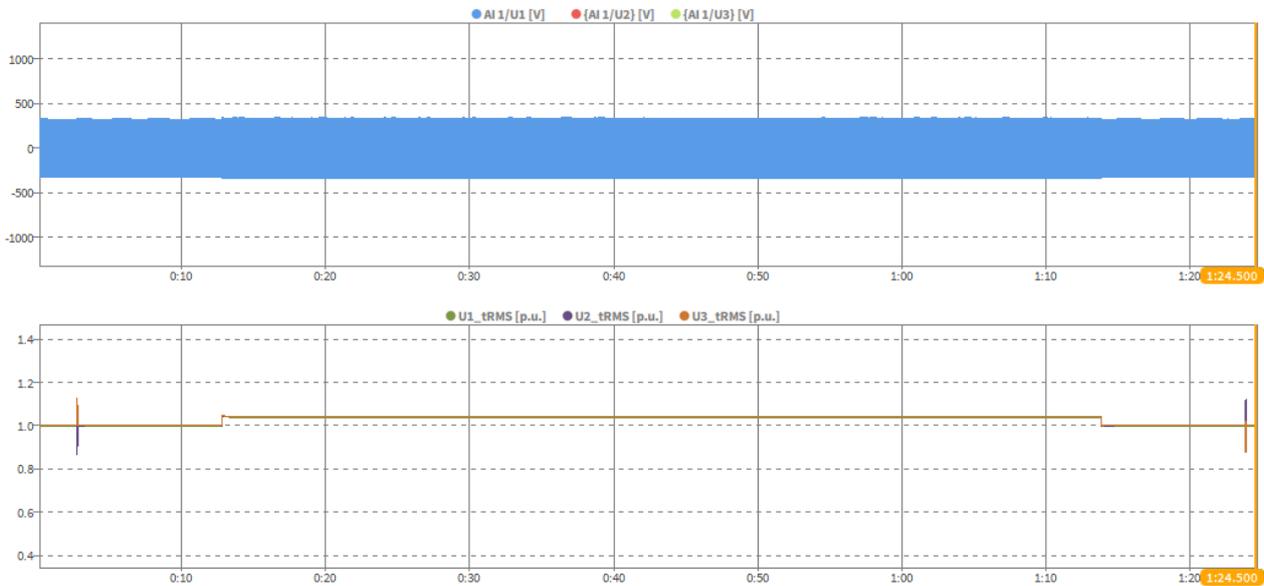
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.3 Depth of fault phase: 1.15 p.u, three-phase SC (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



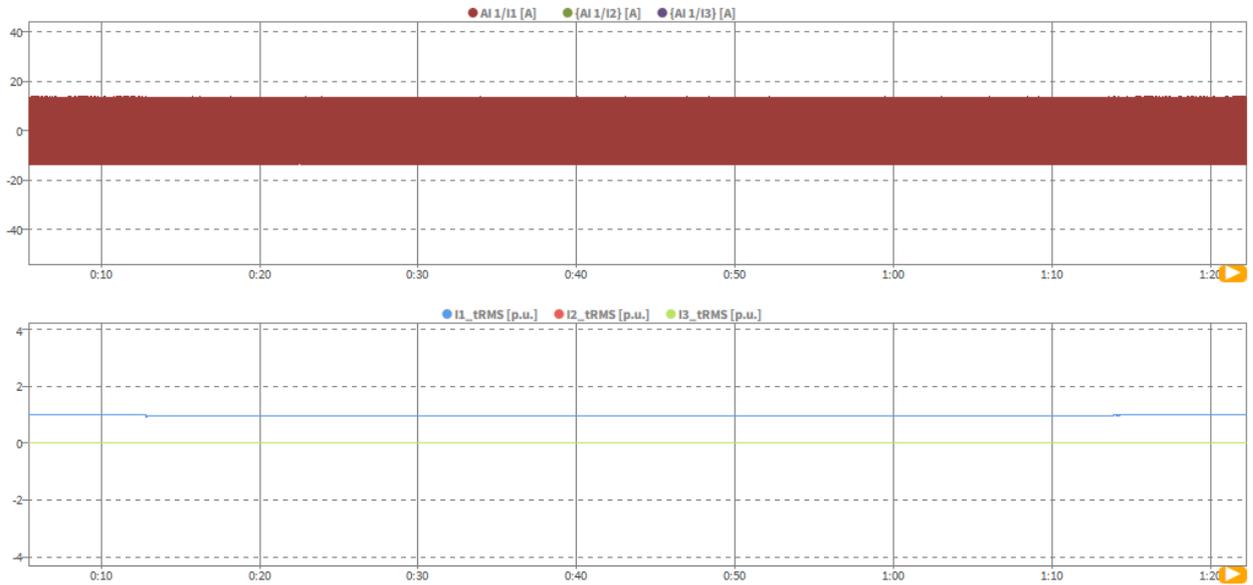
Test 6.3 Depth of fault phase: 1.15 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase voltages



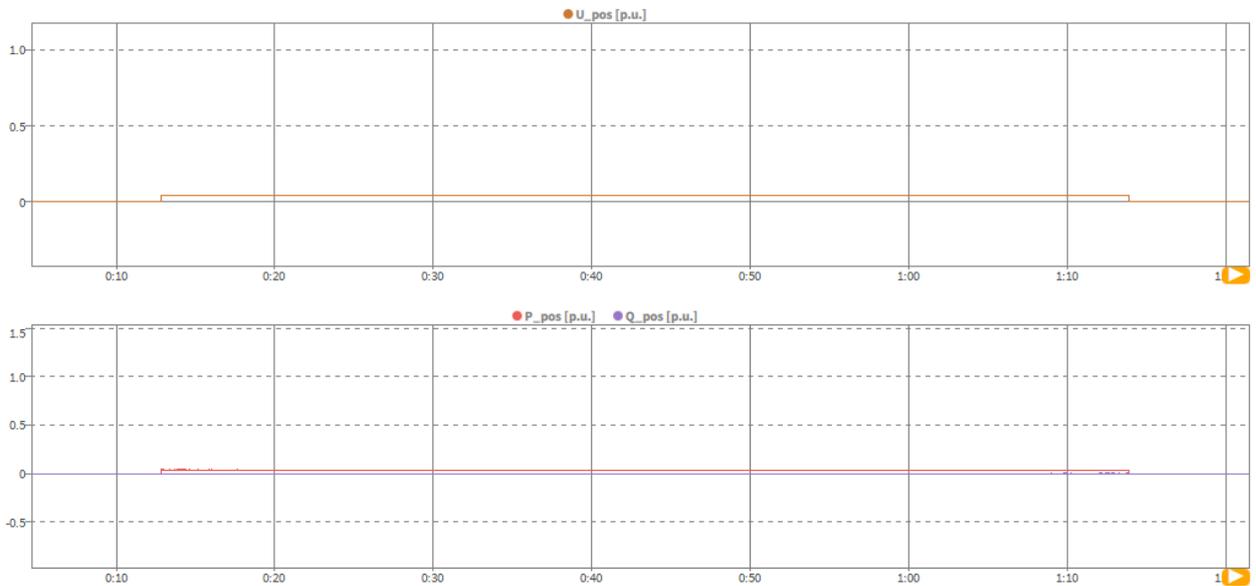
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.3 Depth of fault phase: 1.15 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase currents



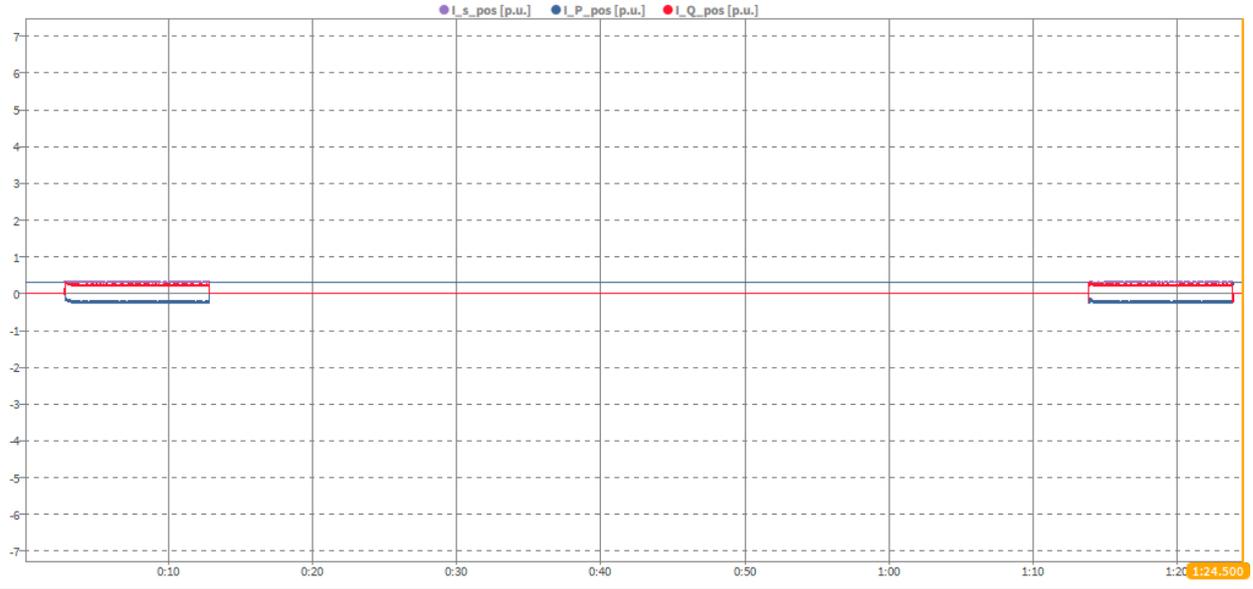
Test 6.3 Depth of fault phase: 1.15 p.u, three-phase SC (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

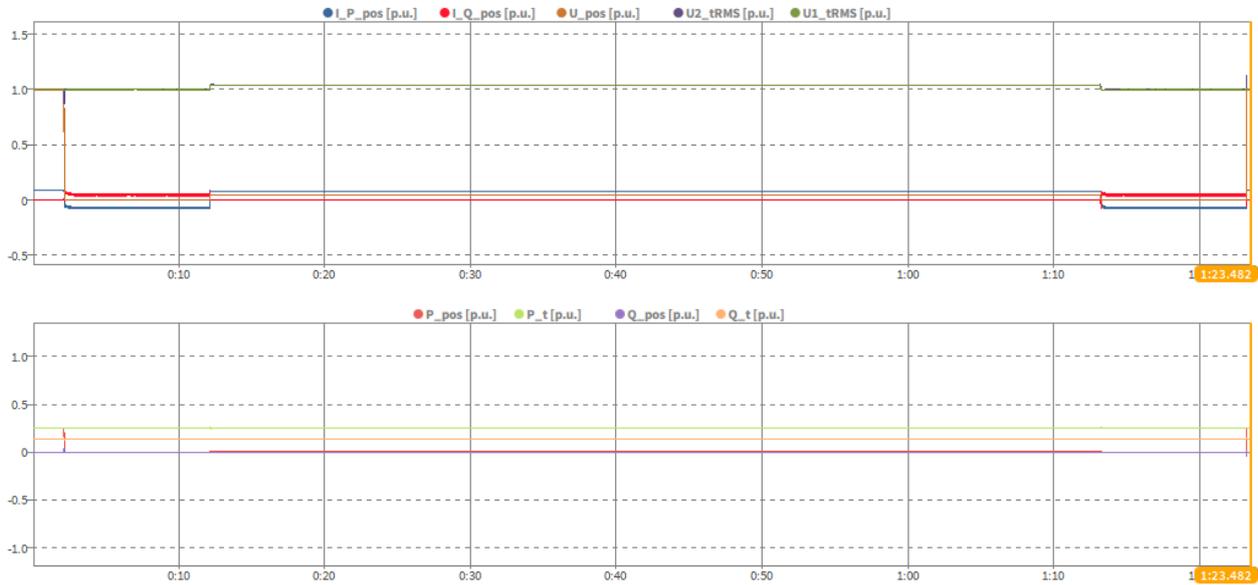
Test 6.3 Depth of fault phase: 1.15 p.u, three-phase SC (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



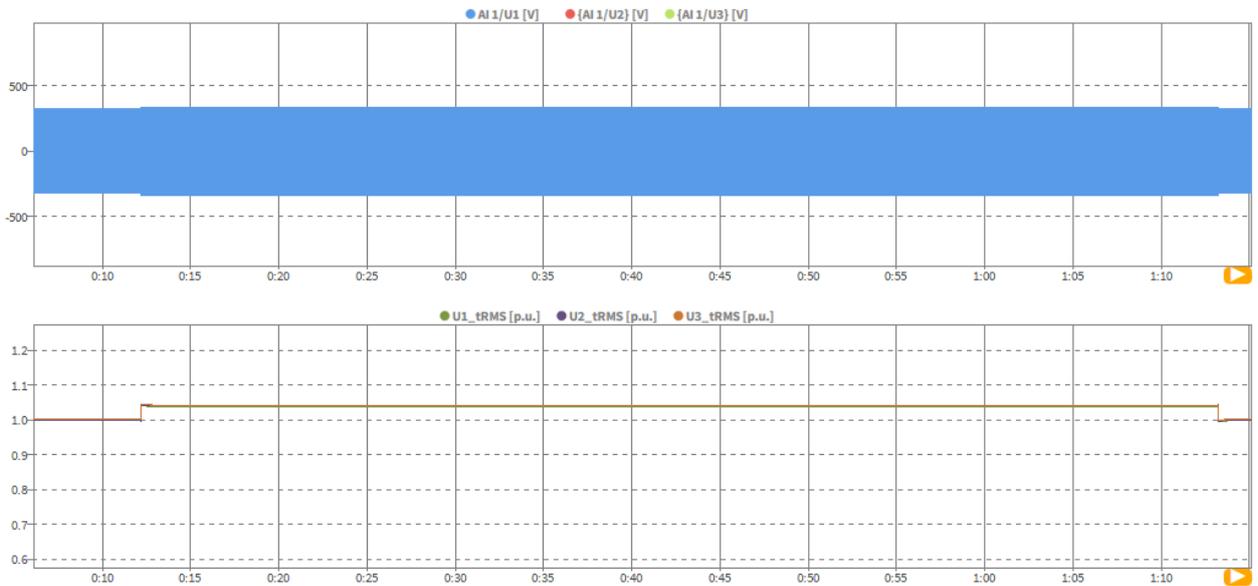
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



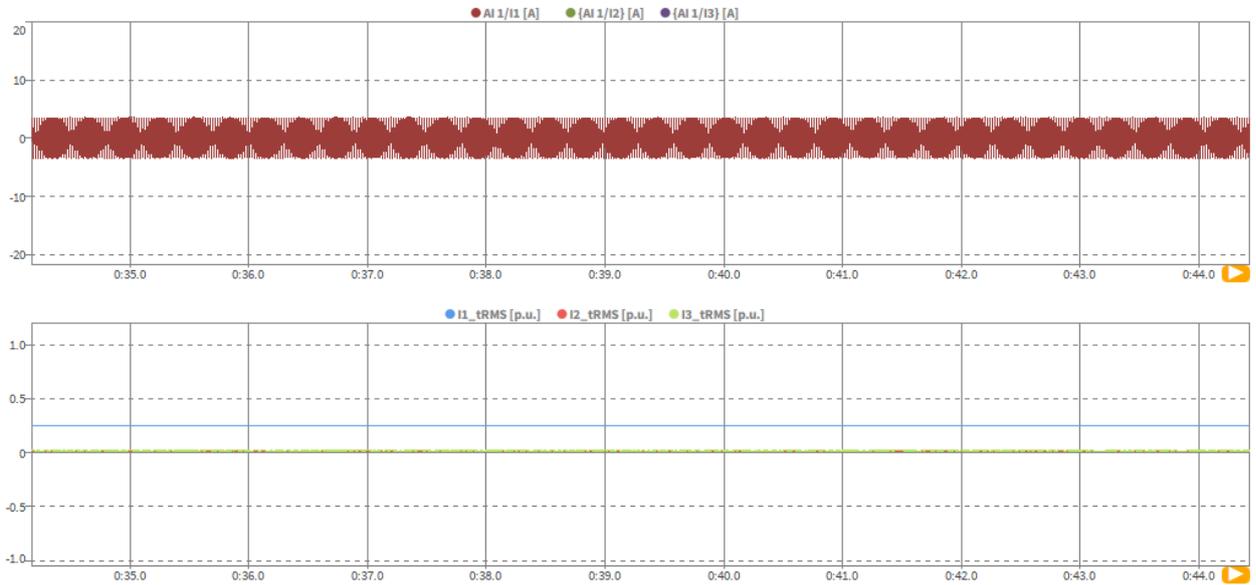
Test 6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), 20% load,
Instantaneous and RMS values of phase voltages



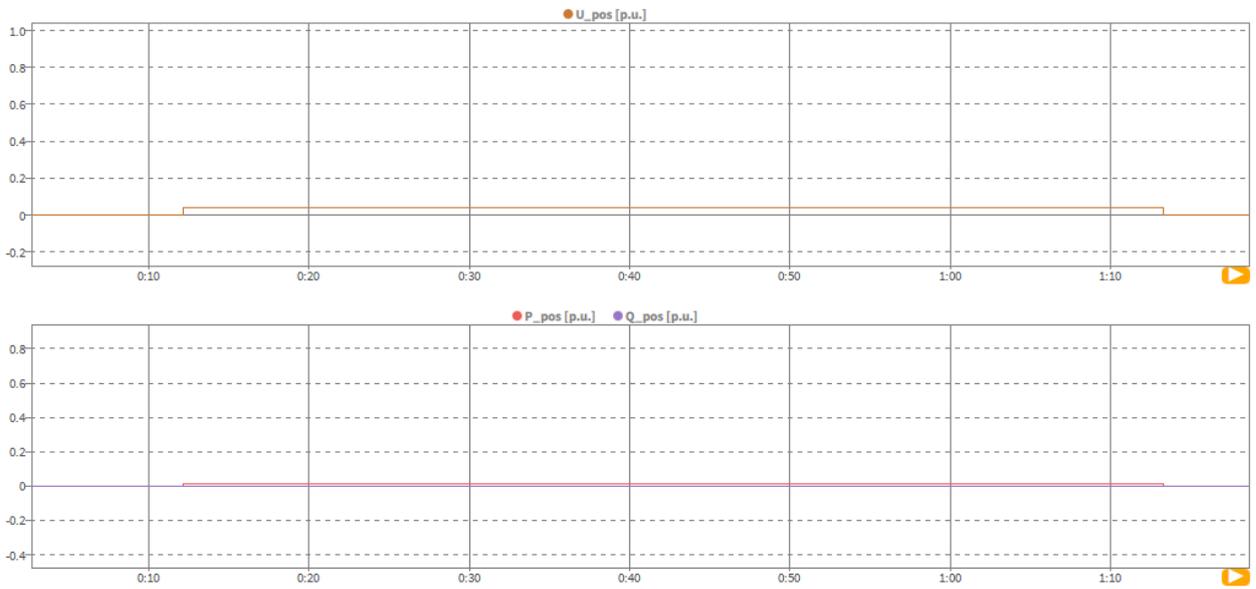
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), 20% load, Instantaneous and RMS values of phase currents



Test 6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 6.4 Depth of fault phase: 1.15 p.u., three-phase SC (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	7.1	7.2	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	20:45:18.9	20:47:15.4	
	3	Fault type (phase)	--	--	--	A	A	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.20	1.20
	5	Setting dip duration	--	--	--	--	≥5000	≥5000
	6	Point of fault entry	Total	--	--	ms	15874	15874
	7	Point of fault clearance	Total	--	--	ms	20877	20877
	8	Fault duration in empty load test	Total	--	--	ms	5003	5003
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.200	1.200	
	10		Pos.			1.200	1.200	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.208	
	14	Active power	Total	t1-10s to t1	p.u.	0.993	0.200	
	15		Pos.			0.993	0.200	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.084	0.055	
17	Pos.		0.084			0.055		
18	Cosφ	--	t1-10s to t1	--	0.996	0.960		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.199	1.199	
			L2 to neutral			1.199	1.199	
			L3 to neutral			1.199	1.199	
			Pos.			1.199	1.199	
			Neg.			--	--	
	20	Line current	Phase 1	t1+60ms	p.u.	0.060	0.060	
	21		Phase 2			0.062	0.062	
	22		Phase 3			0.061	0.061	
	23	Line current	Phase 1	t1+100ms	p.u.	0.060	0.060	
	24		Phase 2			0.062	0.062	
25	Phase 3		0.061			0.061		
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000		
27		Pos.			0.000	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.993	0.200	
	32		Pos.			0.993	0.200	
	33	Active power rising time	Pos.	--	s	0.837	0.423	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.084	0.055	
	35		Pos.			0.084	0.055	
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.1&7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



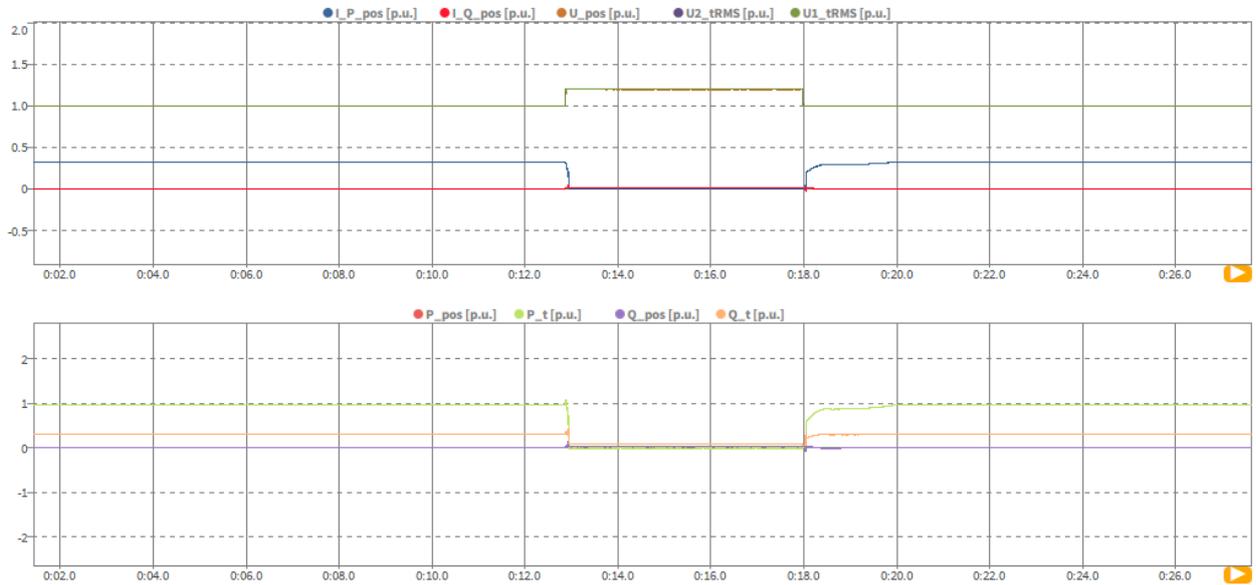
Test 7.1&7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), No load, Positive sequence voltage



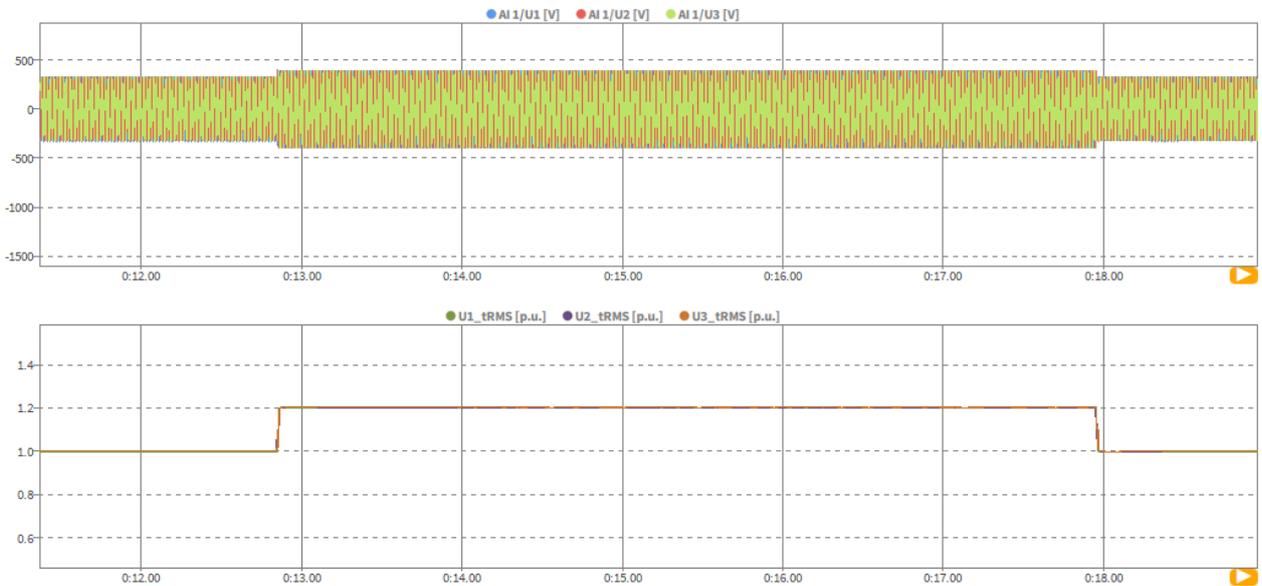
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



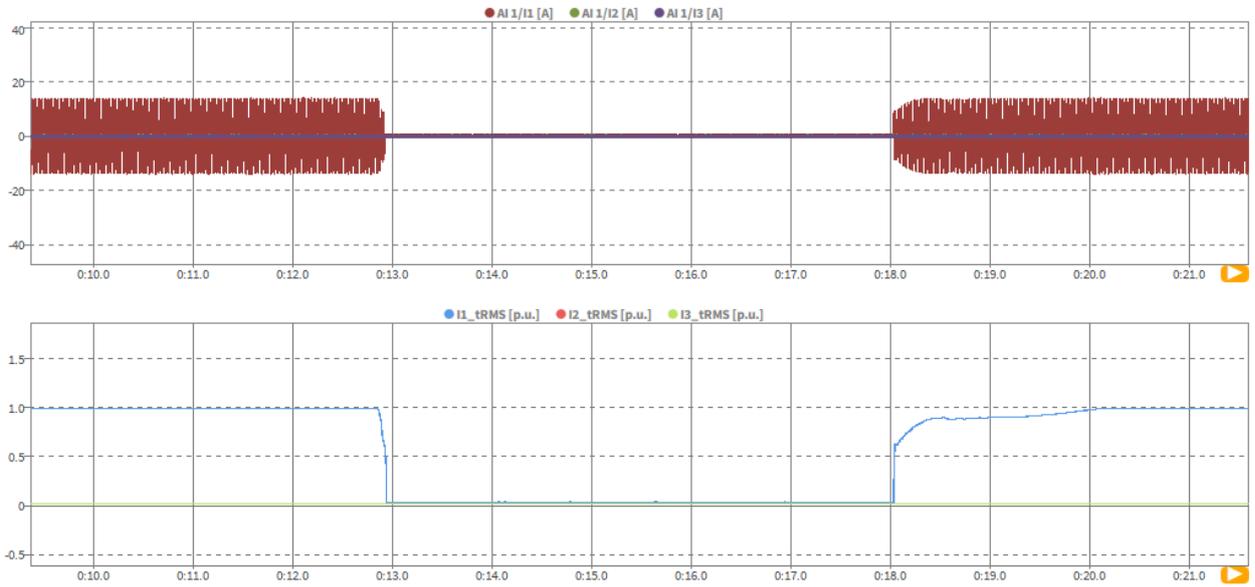
Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase voltages



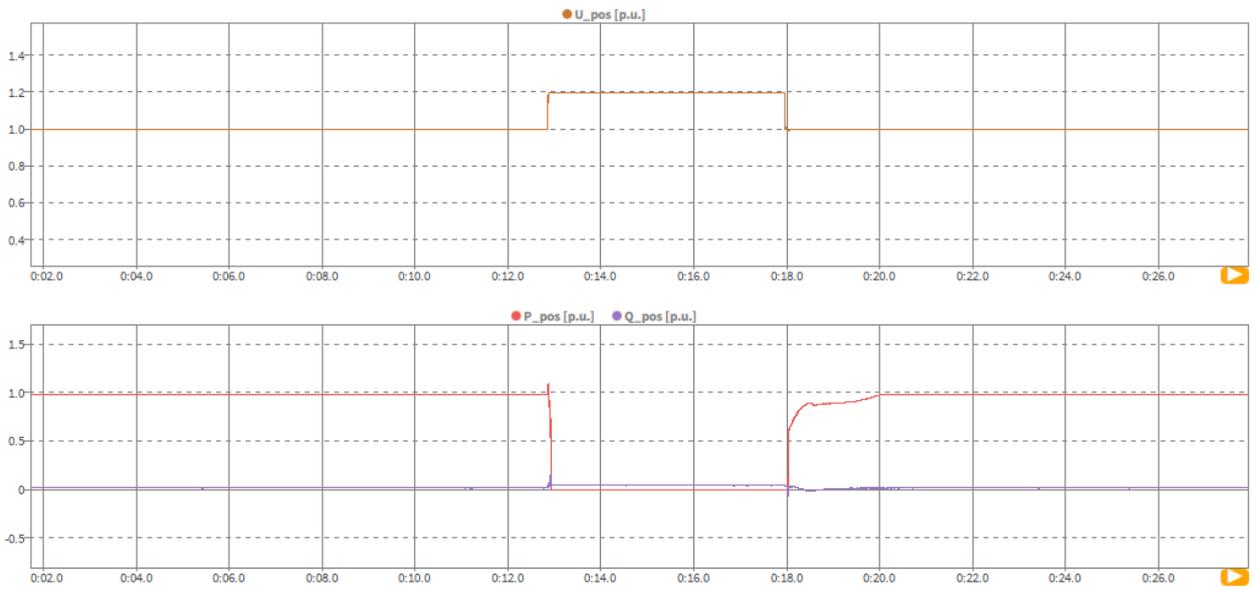
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.1 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



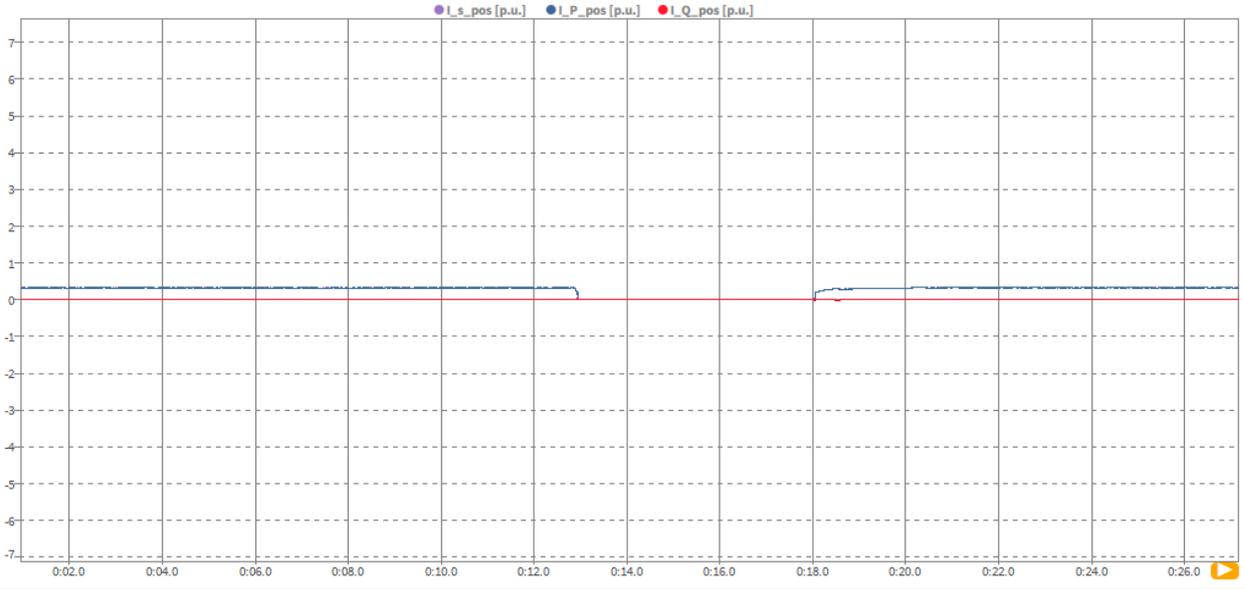
Test 7.1 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

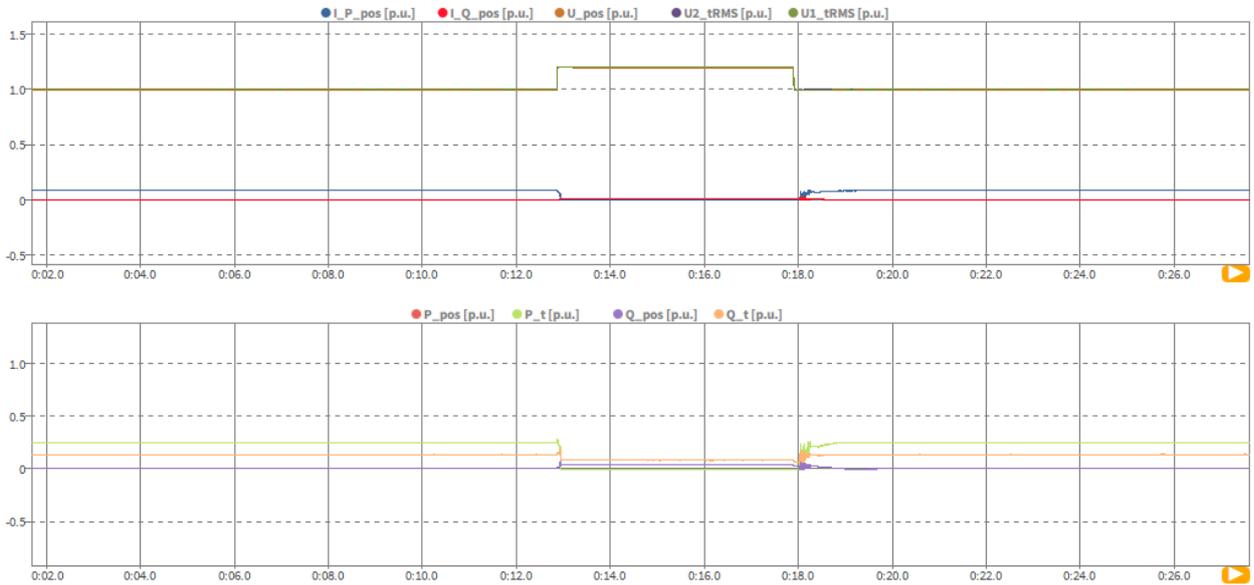
Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



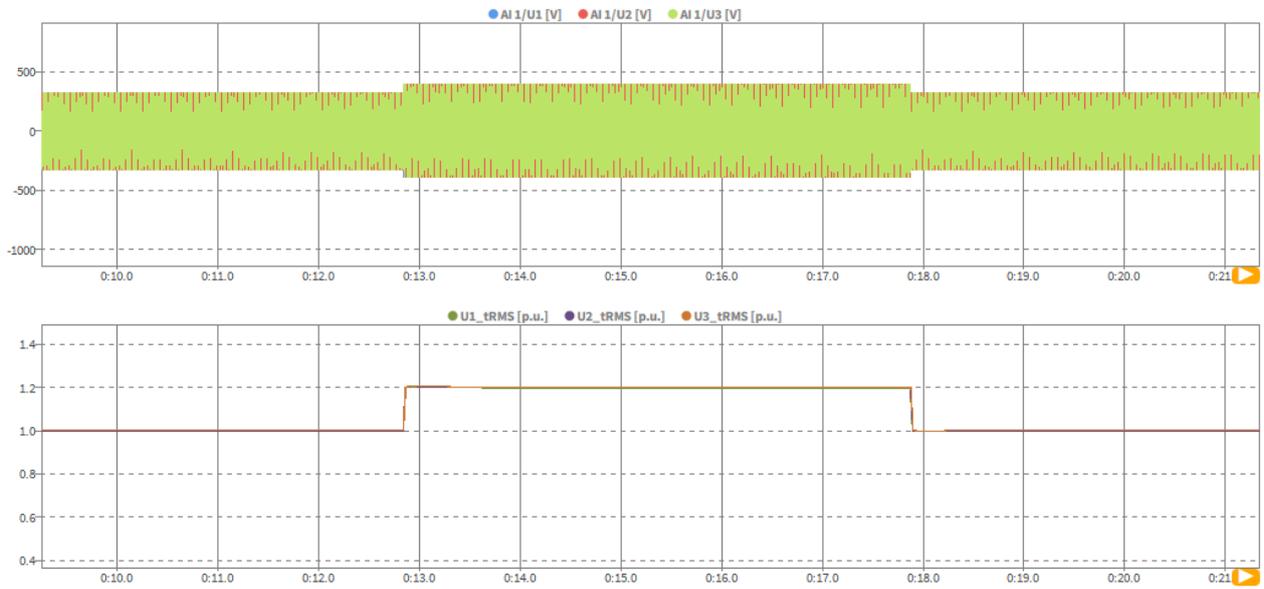
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.2 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



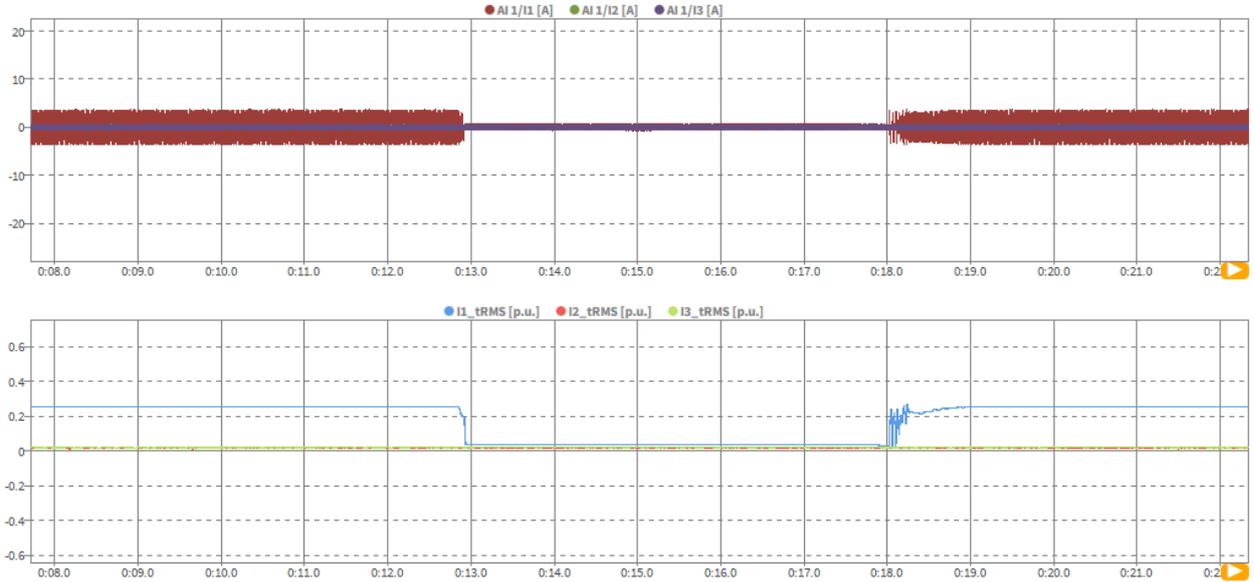
Test 7.2 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



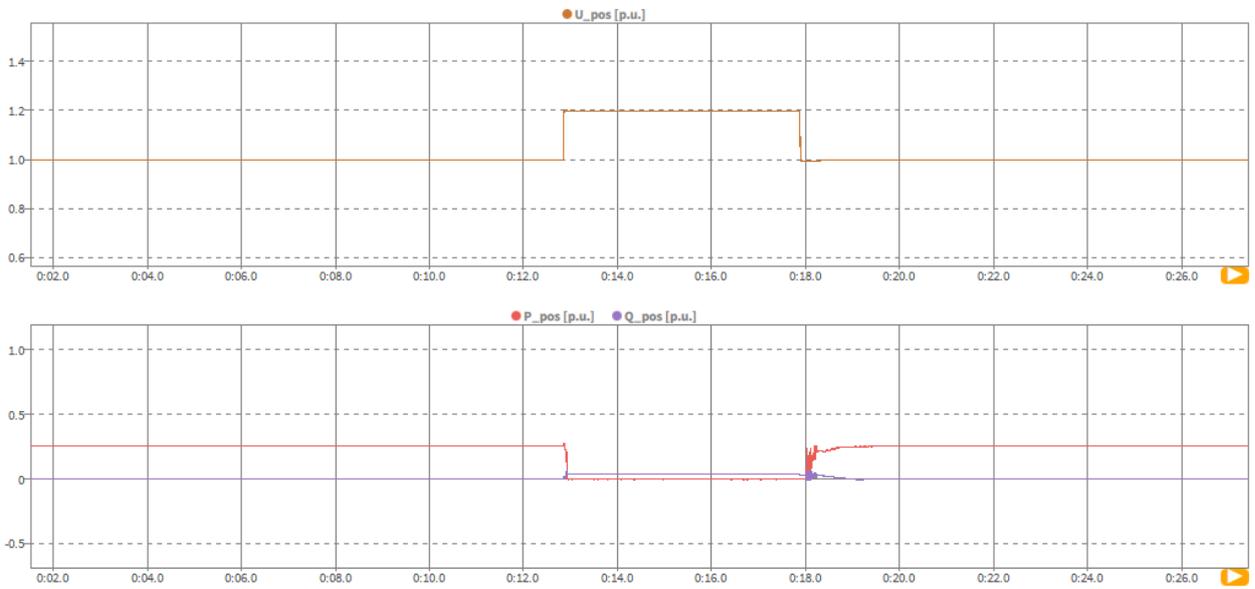
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.2 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



Test 7.2 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.2 Depth of fault phase: 1.20 p.u, three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	7.3	7.4	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	20:55:15.4	20:58:12.8	
	3	Fault type (phase)	--	--	--	D1	D1	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.20	1.20
	5	Setting dip duration	--	--	--	--	≥5000	≥5000
	6	Point of fault entry	Total	--	--	ms	21191	21191
	7	Point of fault clearance	Total	--	--	ms	26194	26194
	8	Fault duration in empty load test	Total	--	--	ms	5003	5003
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.200	1.200	
	10		Pos.			1.100	1.100	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	1.000	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	0.999	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.207	
	14	Active power	Total	t1-10s to t1	p.u.	0.992	0.200	
	15		Pos.			0.992	0.200	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.085	0.056	
17	Pos.		0.085			0.056		
18	Cosφ	--	t1-10s to t1	--	0.996	0.961		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.199	1.199	
			L2 to neutral			1.049	1.049	
			L3 to neutral			1.049	1.049	
			Pos.			1.099	1.099	
			Neg.			--	--	
	20	Line current	Phase 1	t1+60ms	p.u.	0.058	0.058	
	23		Phase 2			0.056	0.056	
	24		Phase 3			0.055	0.055	
	25	Line current	Phase 1	t1+100ms	p.u.	0.058	0.058	
	26		Phase 2			0.056	0.056	
	27		Phase 3			0.055	0.055	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.060	0.000		
29		Pos.			0.060	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	1.000	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	0.999	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.992	0.200	
	32		Pos.			0.992	0.200	
	33	Active power rising time	Pos.	--	s	0.635	0.426	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.085	0.056	
	35		Pos.			0.085	0.056	
	36	Reactive power rising time	Pos.	--	s	--	--	
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

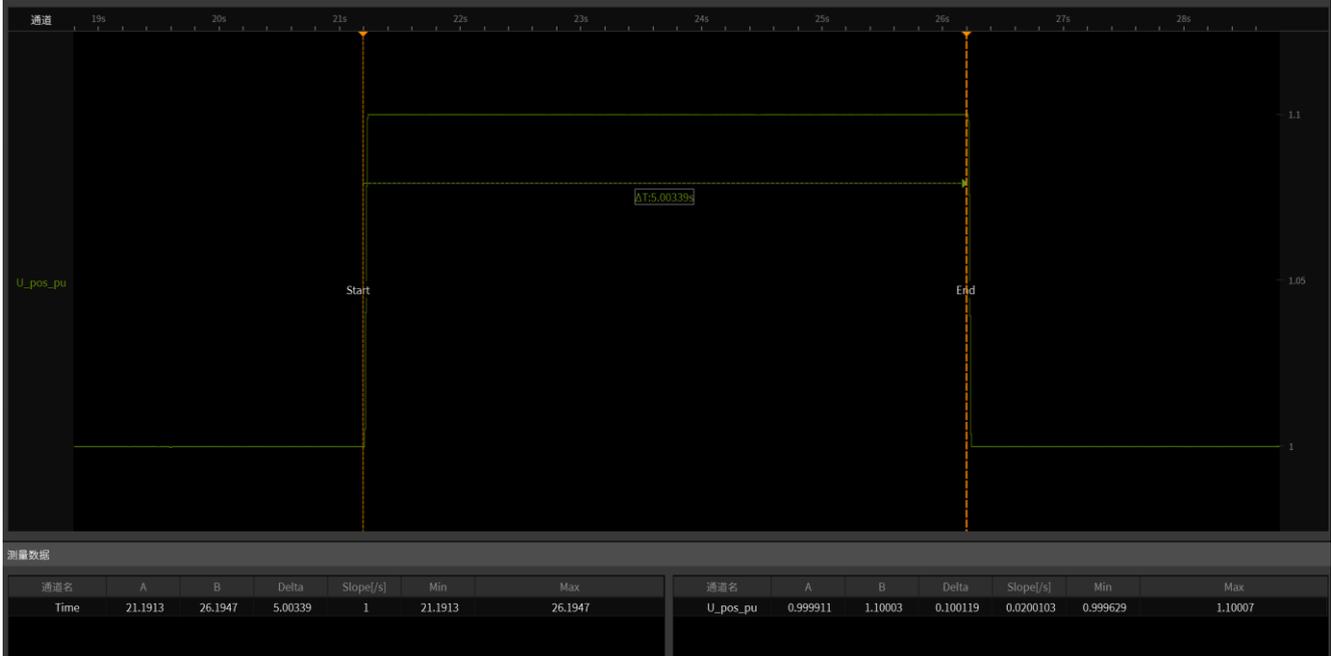
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.3&7.4 Depth of fault phase: 1.20 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



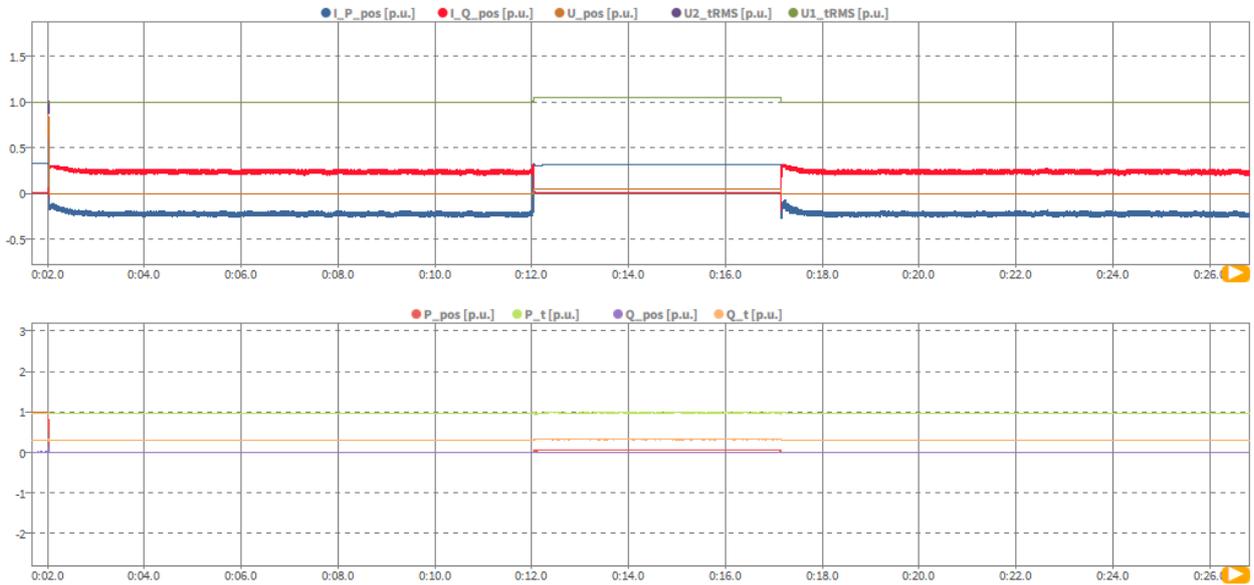
Test 7.3&7.4 Depth of fault phase: 1.20 p.u., three-phase SC (type D1), No load, Positive sequence voltage



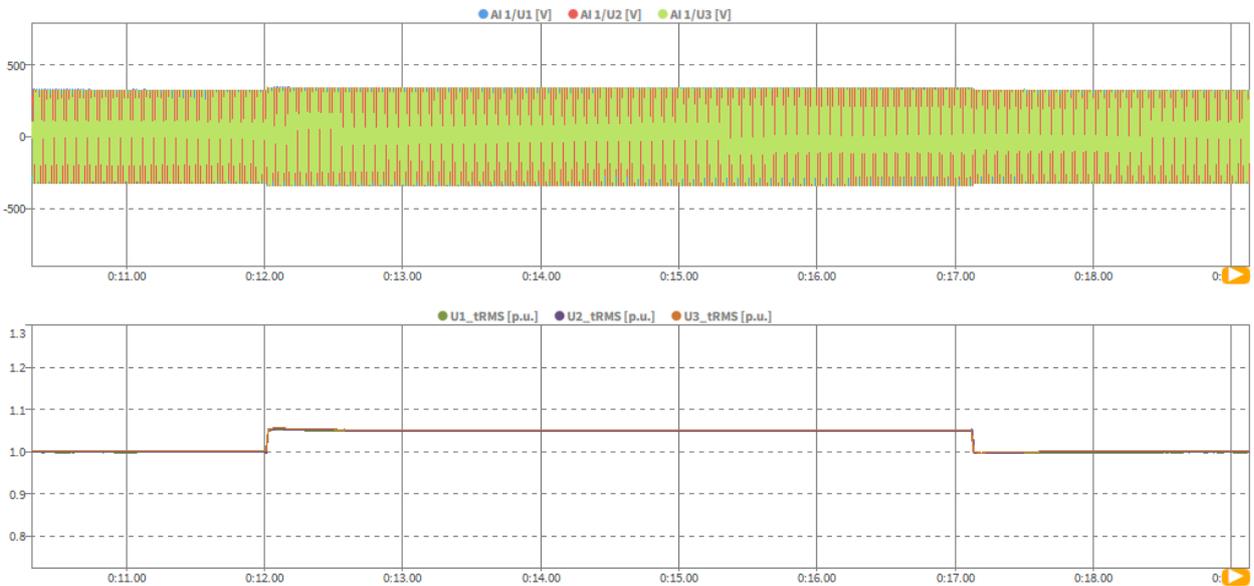
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.3 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



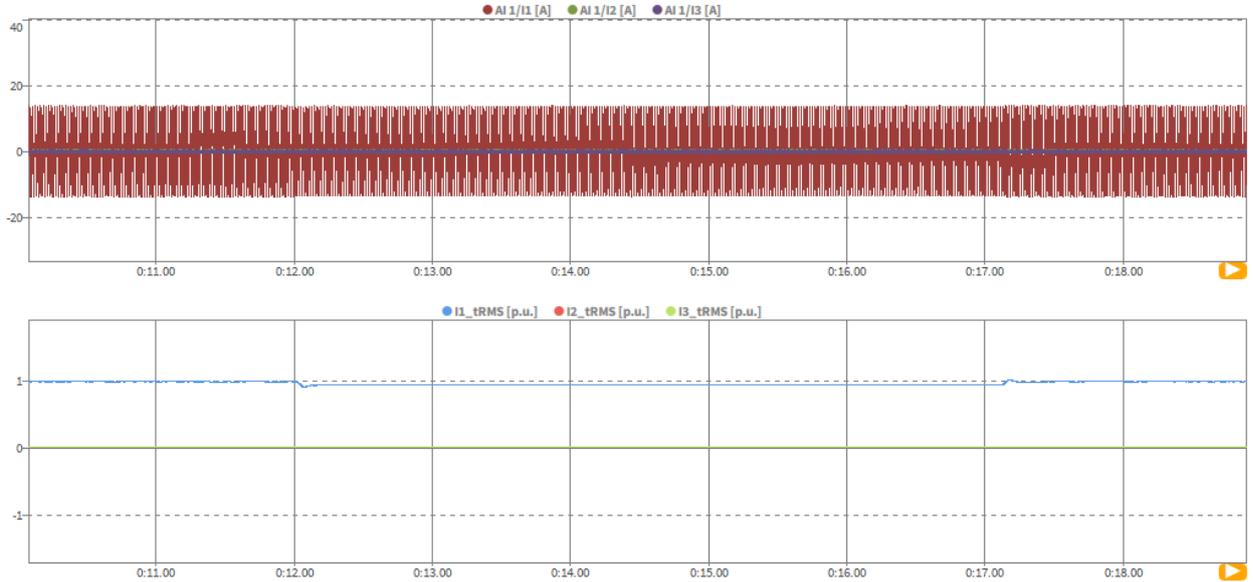
Test 7.3 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase voltages



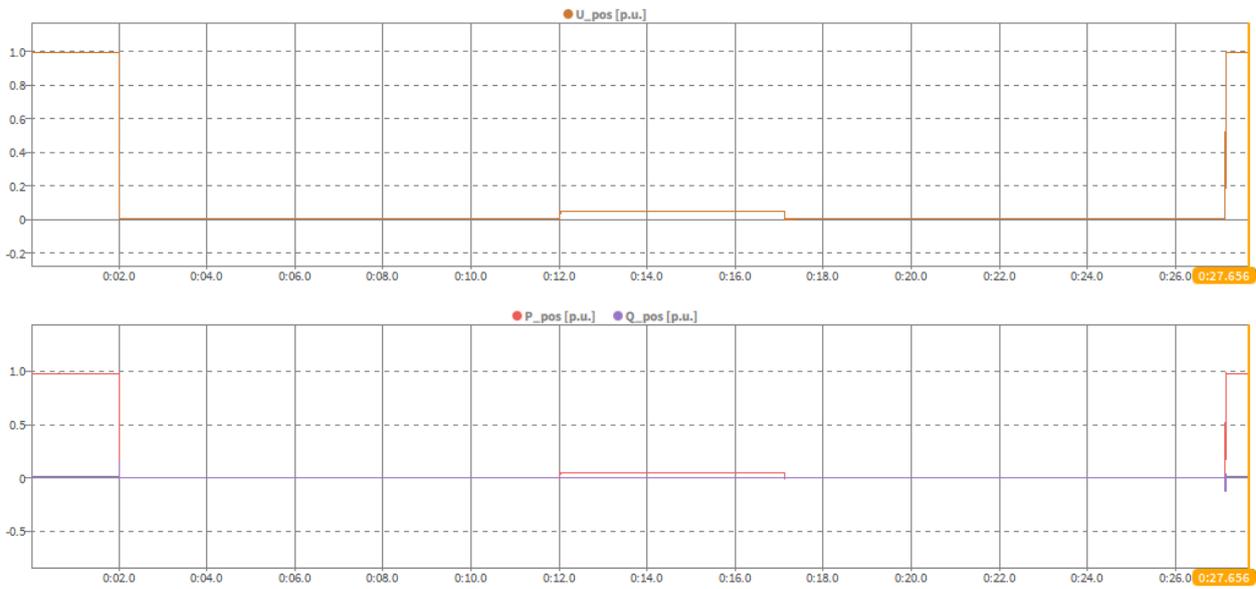
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.3 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase currents



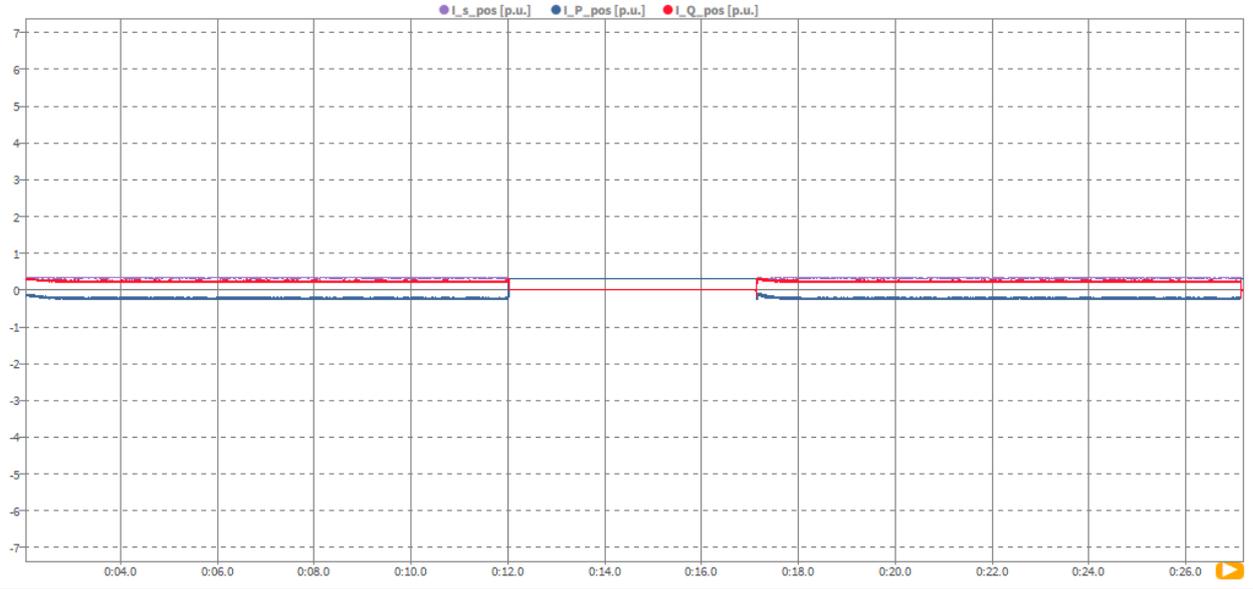
Test 7.3 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

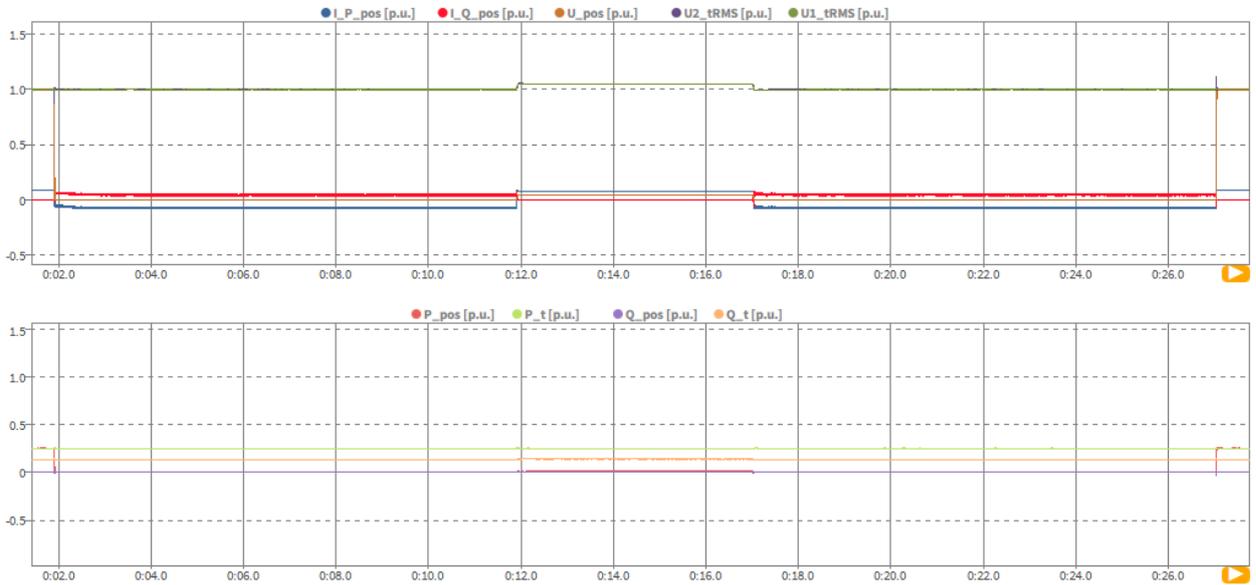
Test 7.3 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.4 Depth of fault phase: 1.20 p.u., three-phase SC (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



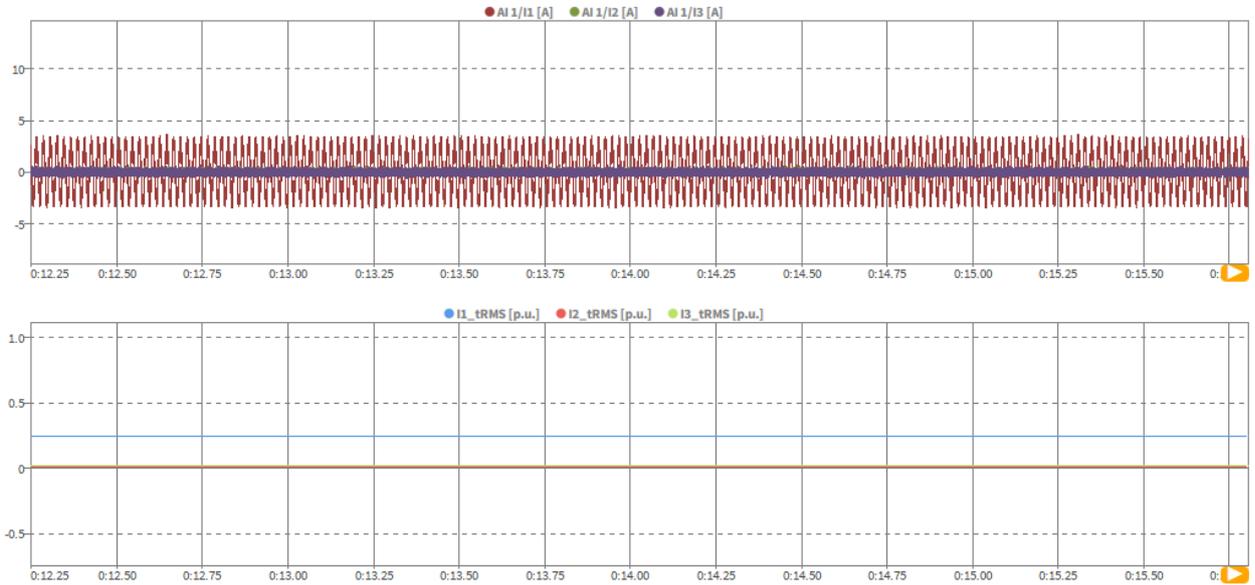
Test 7.4 Depth of fault phase: 1.20 p.u., three-phase SC (type D1), 20% load,
Instantaneous and RMS values of phase voltages



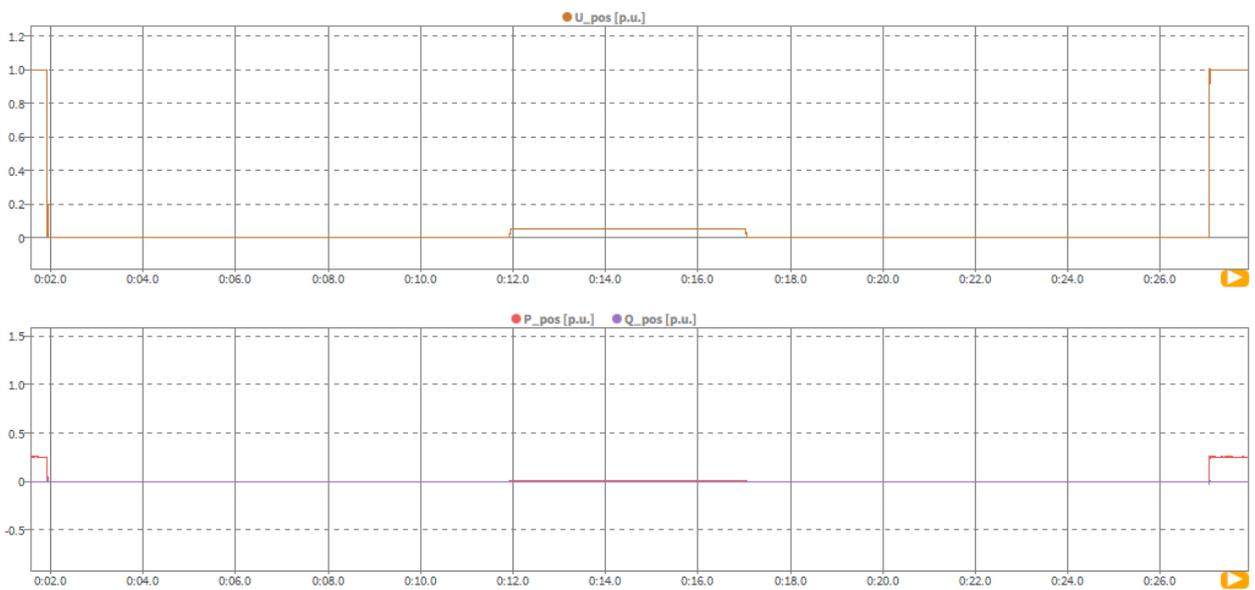
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.4 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 20% load, Instantaneous and RMS values of phase currents



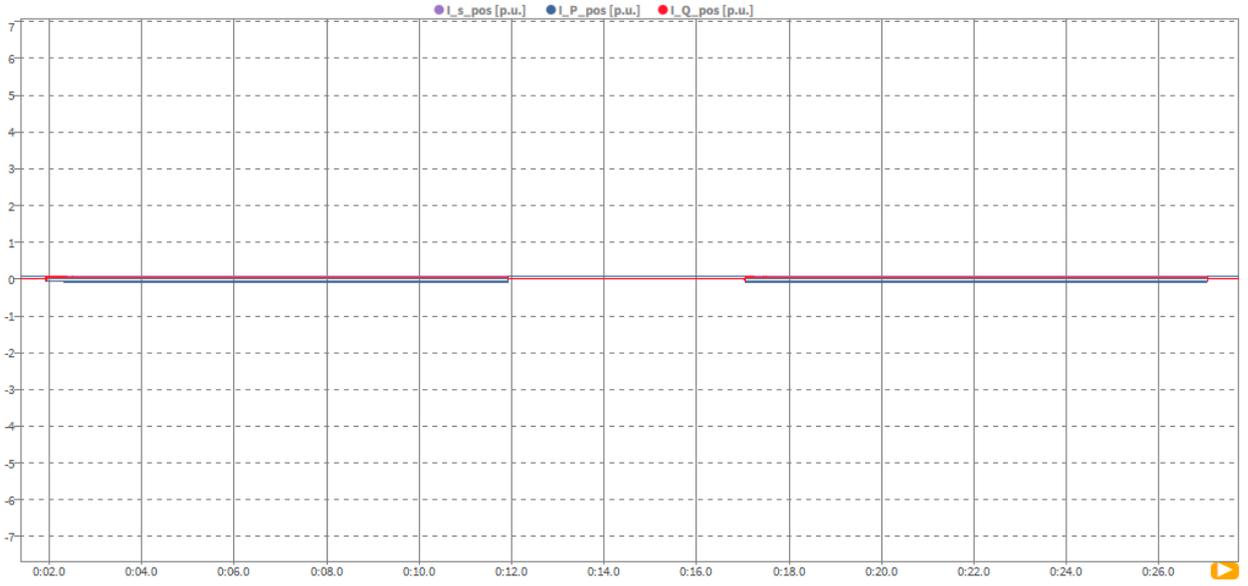
Test 7.4 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 7.4 Depth of fault phase: 1.20 p.u, three-phase SC (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	8.1	8.2	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	18:18:14.2	18:24:15.6	
	3	Fault type (phase)	--	--	--	A	A	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.25	1.25
	5	Setting dip duration	--	--	--	--	≥100	≥100
	6	Point of fault entry	Total	--	--	ms	26258	26258
	7	Point of fault clearance	Total	--	--	ms	26362	26362
	8	Fault duration in empty load test	Total	--	--	ms	104	104
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.25	1.25	
	10		Pos.			1.25	1.25	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	1.000	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.996	0.208	
	14	Active power	Total	t1-10s to t1	p.u.	0.993	0.200	
	15		Pos.			0.993	0.200	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.082	0.056	
17	Pos.		0.082			0.056		
18	Cosφ	--	t1-10s to t1	--	0.996	0.958		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.249	1.250	
			L2 to neutral			1.250	1.250	
			L3 to neutral			1.250	1.249	
			Pos.			1.250	1.250	
			Neg.			--	--	
	20	Line current	Phase 1	t1+60ms	p.u.	0.062	0.063	
	21		Phase 2			0.065	0.066	
	22		Phase 3			0.064	0.065	
	23	Line current	Phase 1	t1+100ms	p.u.	0.062	0.063	
	24		Phase 2			0.065	0.066	
25	Phase 3		0.064			0.065		
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	-0.004		
27		Pos.			0.000	-0.004		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	1.000	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.993	0.200	
	32		Pos.			0.993	0.200	
	33	Active power rising time	Pos.	--	s	0.732	0.256	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.082	0.056	
	35		Pos.			0.082	0.056	
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

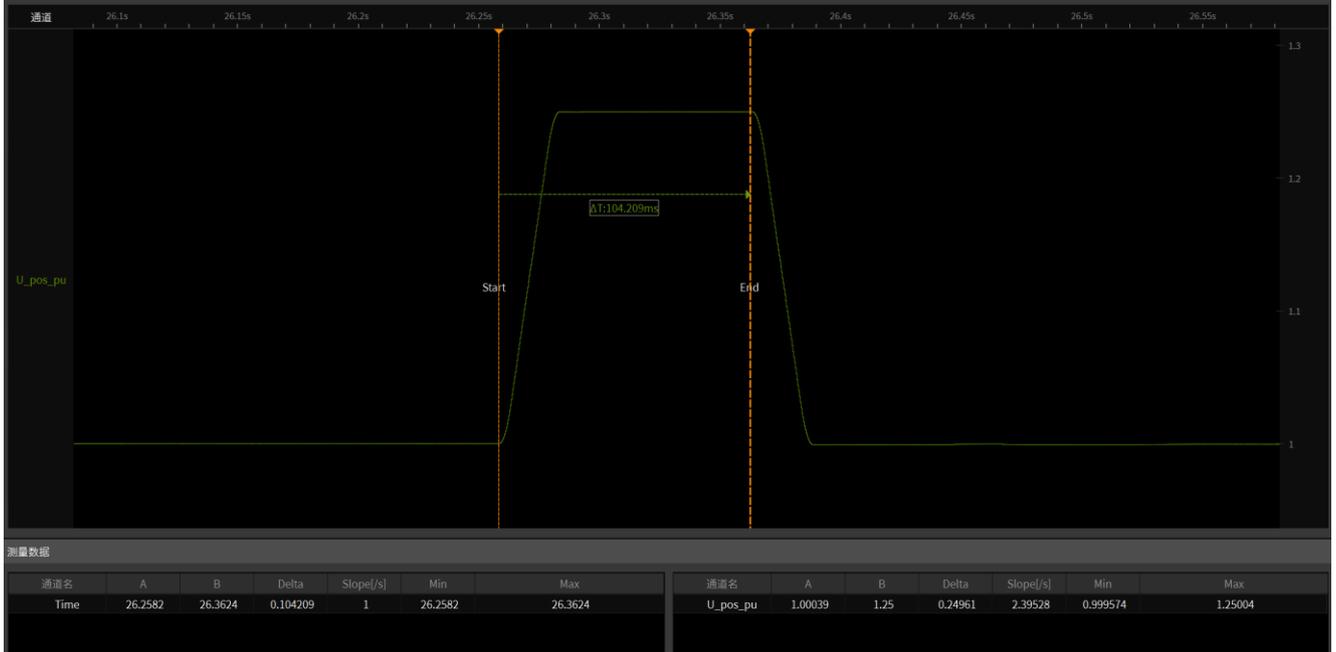
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.1&8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), No load, Instantaneous and RMS values of phase voltages



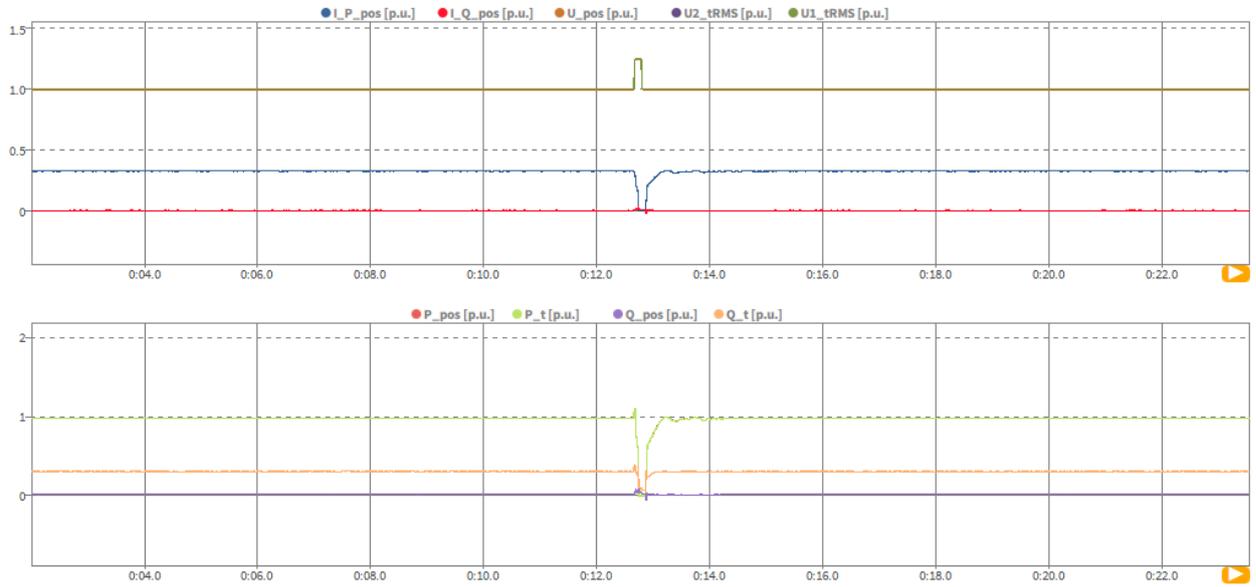
Test 8.1&8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), No load, Positive sequence voltage



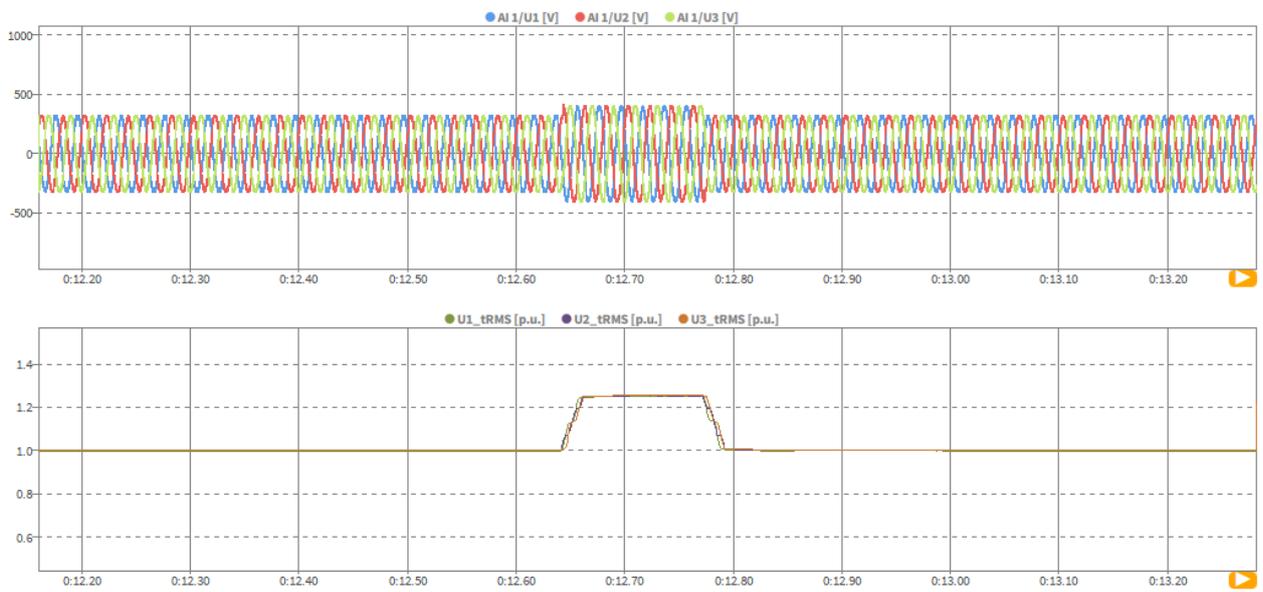
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.1 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



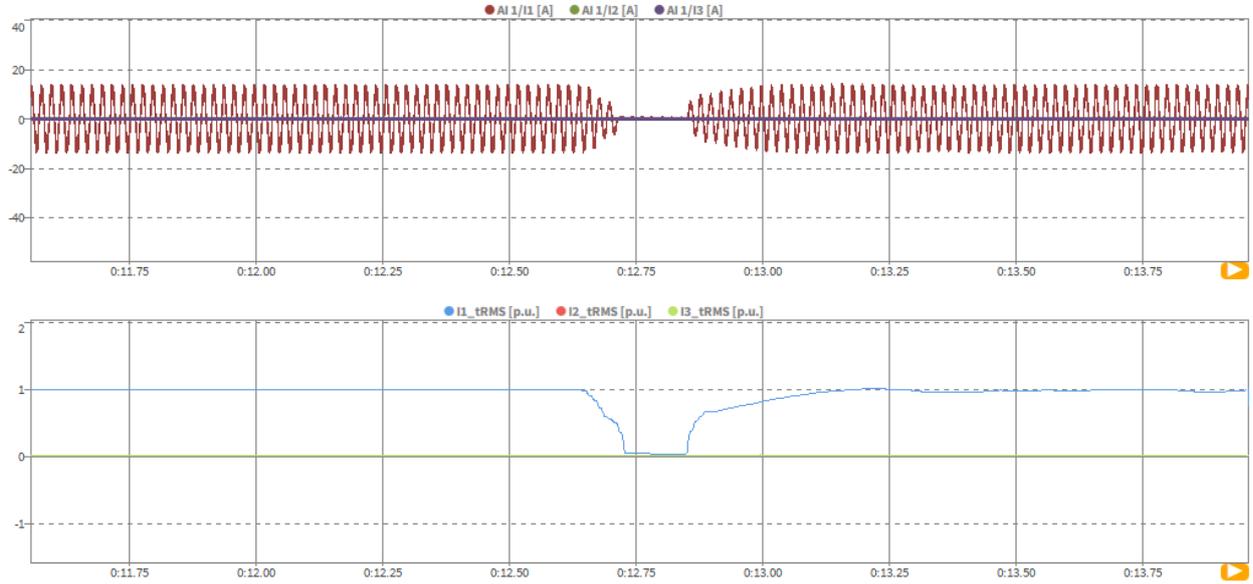
Test 8.1 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 100% load, Instantaneous and RMS values of phase voltages



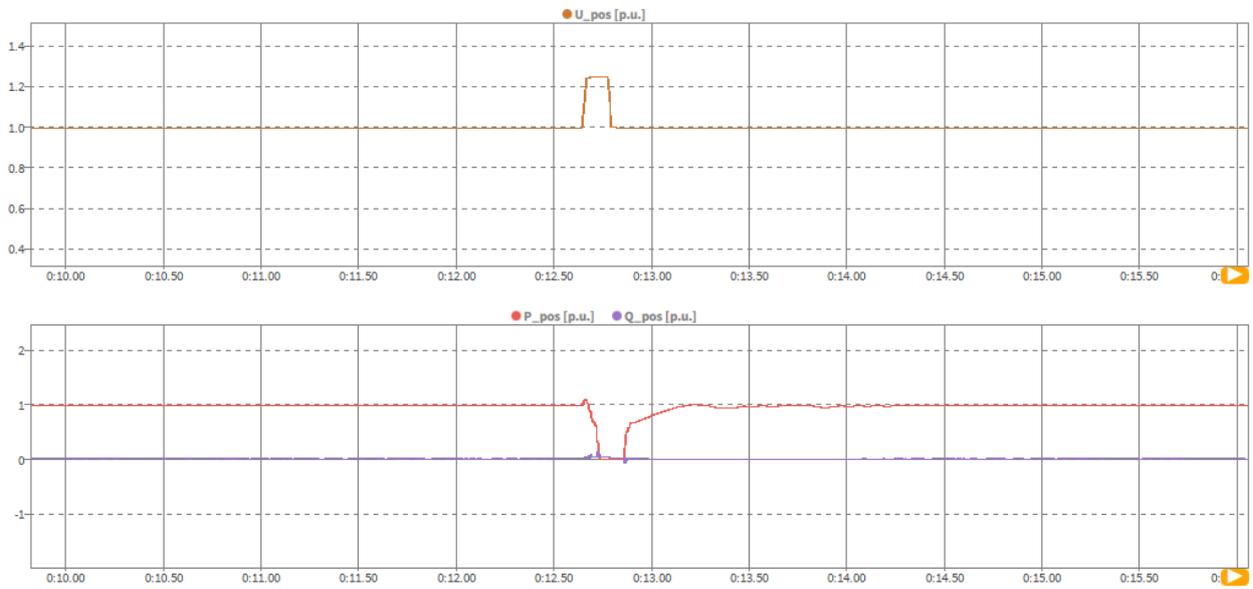
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load, Instantaneous and RMS values of phase currents



Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

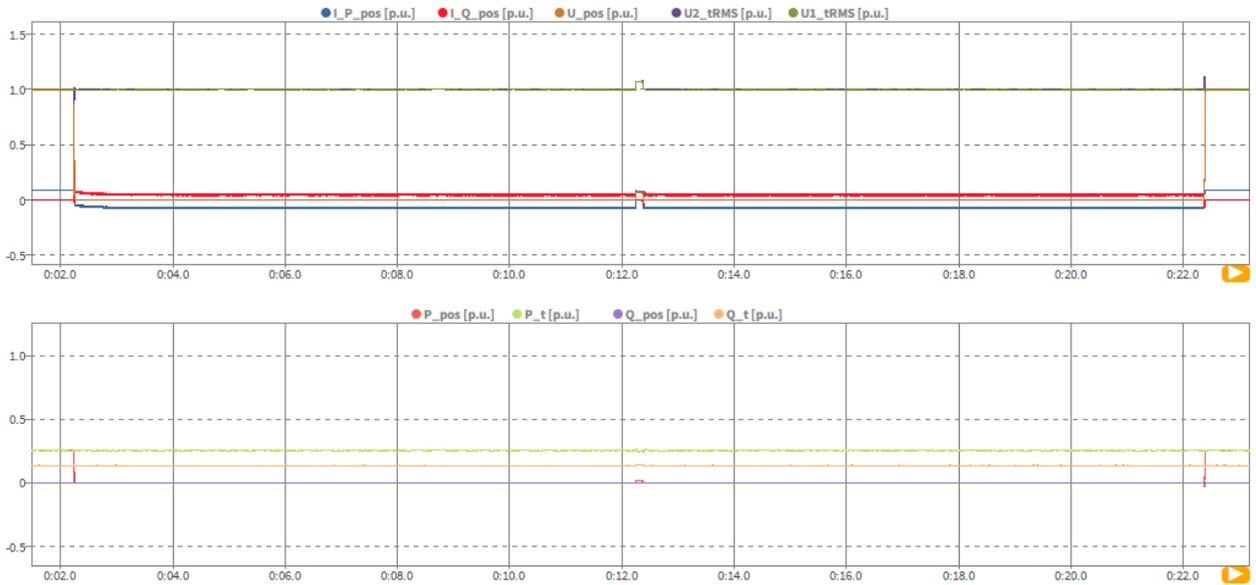
Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.2 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



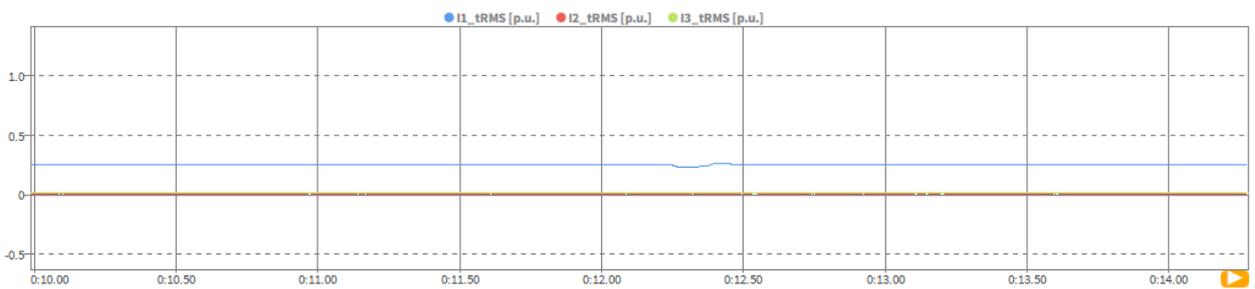
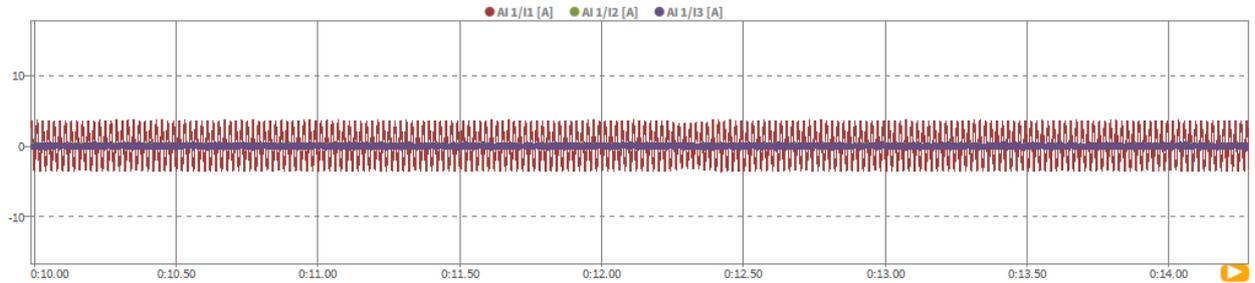
Test 8.2 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 20% load,
Instantaneous and RMS values of phase voltages



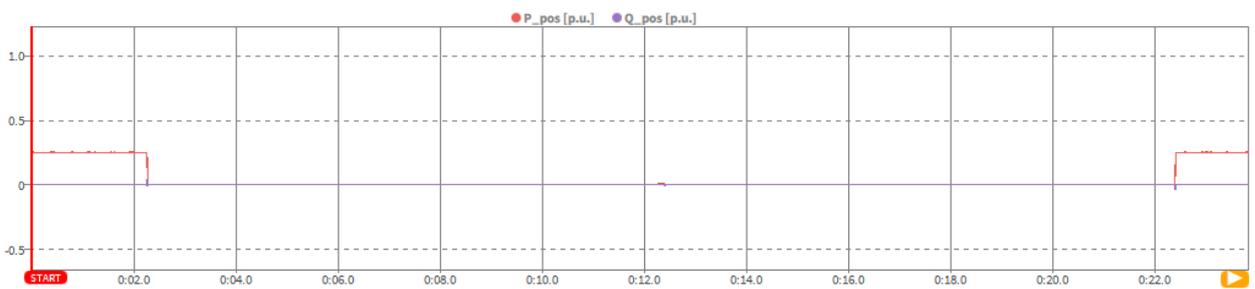
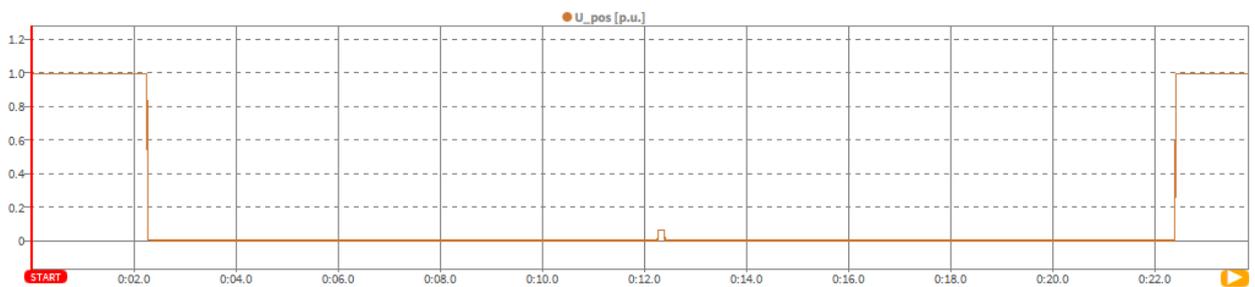
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.2 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 20% load, Instantaneous and RMS values of phase currents



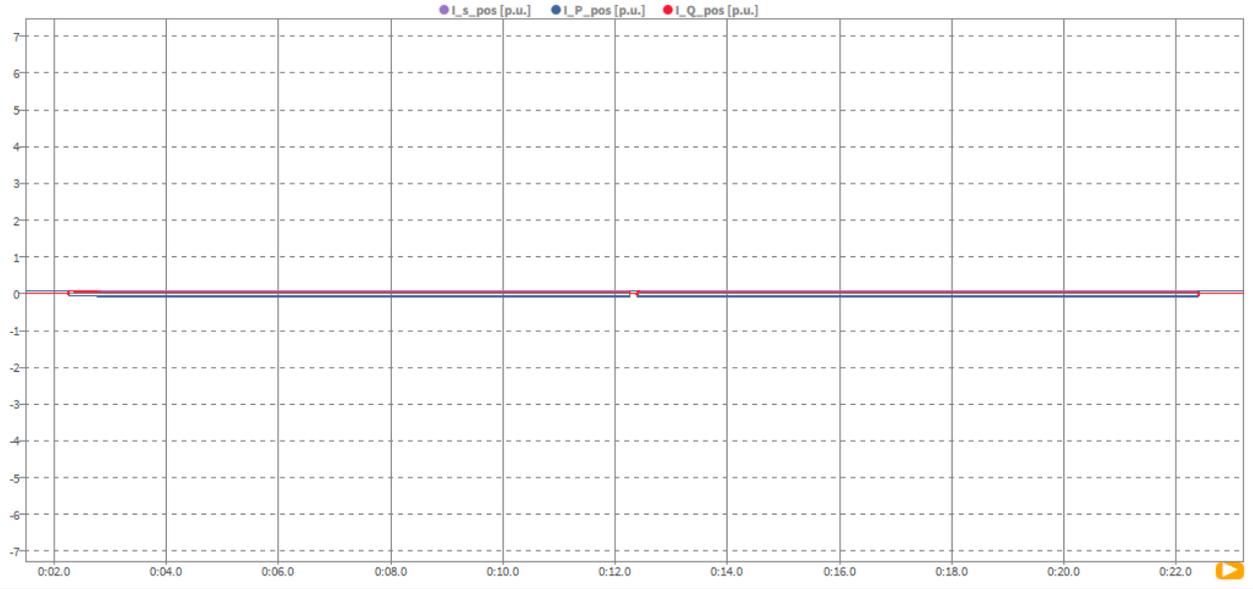
Test 8.2 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.2 Depth of fault phase: 1.25 p.u, three-phase SC (type A), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	8.3	8.4	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	18:46:15.8	18:53:19.4	
	3	Fault type (phase)	--	--	--	D1	D1	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.25	1.25
	5	Setting dip duration	--	--	--	--	≥ 100	≥ 100
	6	Point of fault entry	Total	--	--	ms	27793	27793
	7	Point of fault clearance	Total	--	--	ms	27898	27898
	8	Fault duration in empty load test	Total	--	--	ms	104	104
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.250	1.250	
	10		Pos.			1.129	1.129	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.207	
	14	Active power	Total	t1-10s to t1	p.u.	0.993	0.200	
			Pos.			0.993	0.200	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.078	0.055	
Pos.			0.078			0.055		
18	Cosφ	--	t1-10s to t1	--	0.996	0.961		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.250	1.249	
			L2 to neutral			1.069	1.069	
			L3 to neutral			1.069	1.068	
			Pos.			1.129	1.129	
			Neg.			--	--	
	22	Line current	Phase 1	t1+60ms	p.u.	0.059	0.059	
			Phase 2			0.058	0.058	
			Phase 3			0.057	0.057	
	25	Line current	Phase 1	t1+100ms	p.u.	0.059	0.059	
			Phase 2			0.058	0.058	
			Phase 3			0.057	0.057	
28	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000		
		Pos.			0.000	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.993	0.200	
			Pos.			0.993	0.200	
	33	Active power rising time	Pos.	--	s	--	--	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.078	0.055	
Pos.			0.078			0.055		
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

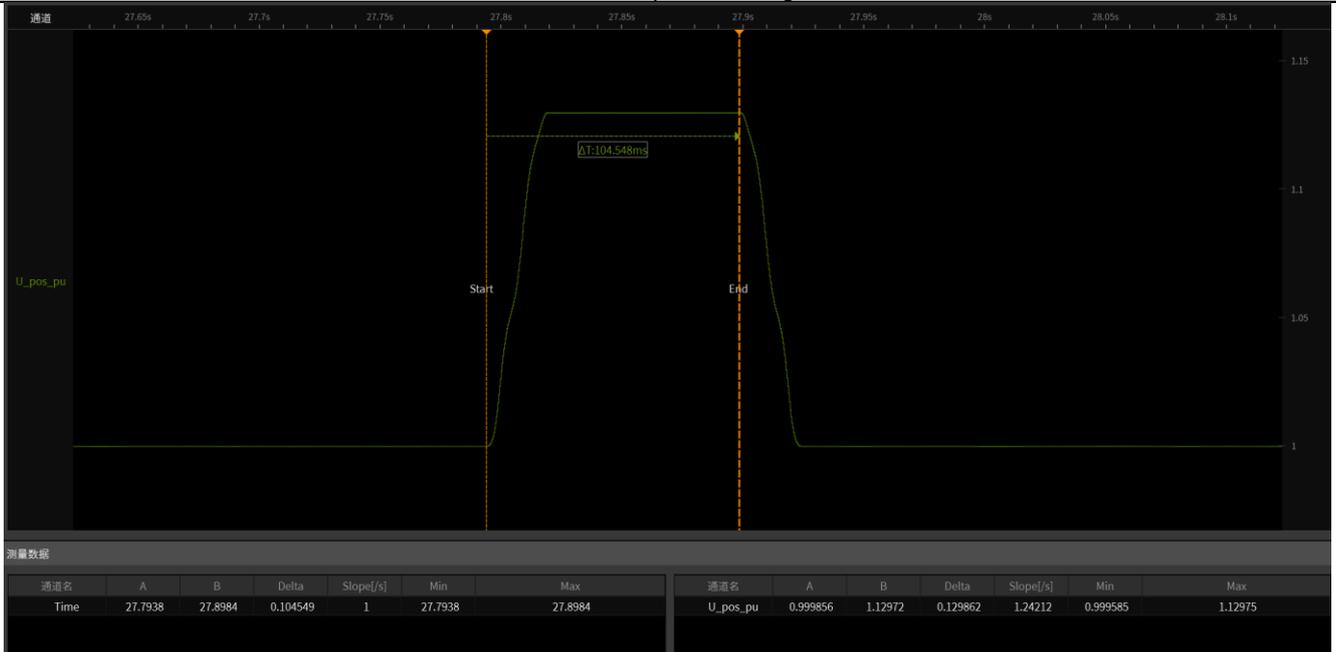
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.3&8.4 Depth of fault phase: 1.25 p.u., three-phase SC (type D1), No load, Instantaneous and RMS values of phase voltages



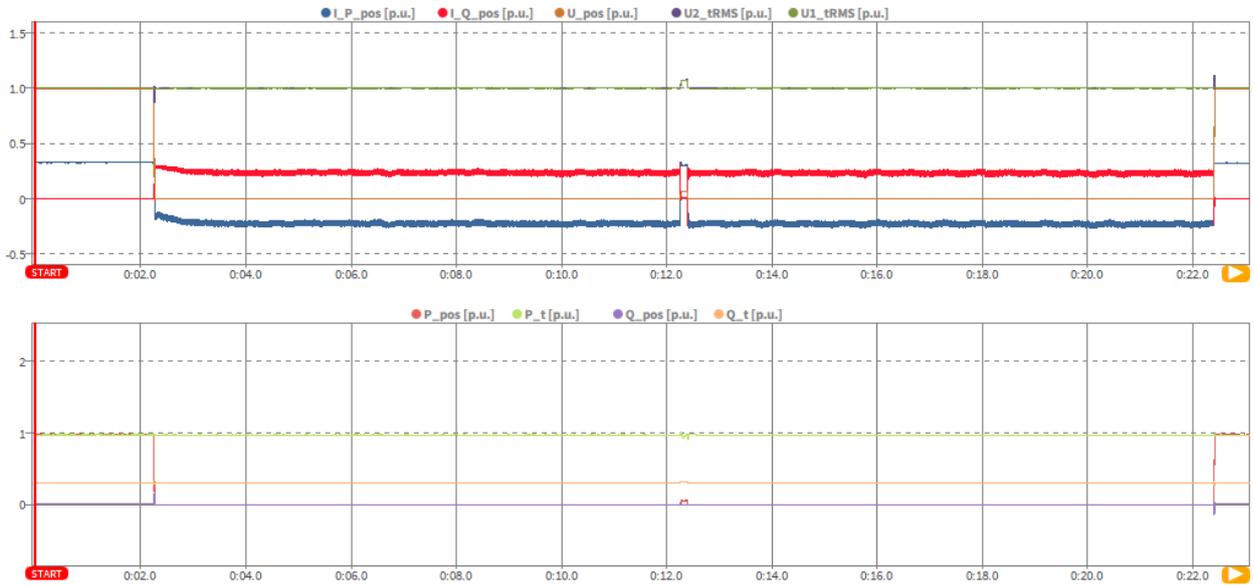
Test 8.3&8.4 Depth of fault phase: 1.25 p.u., three-phase SC (type D1), No load, Positive sequence voltage



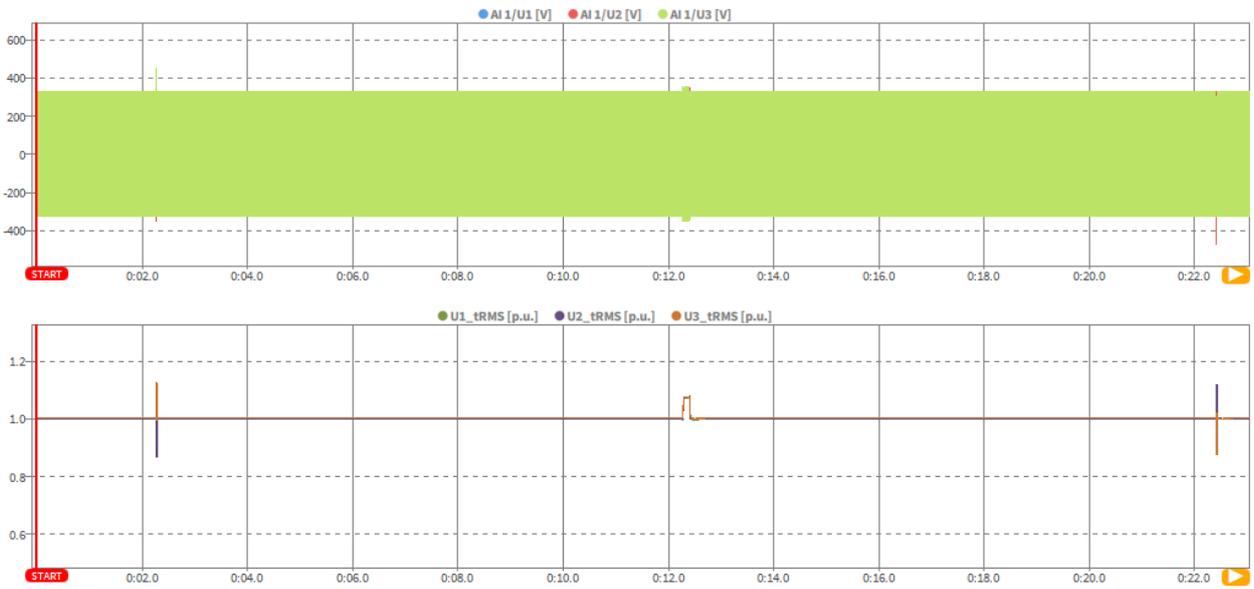
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.3 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



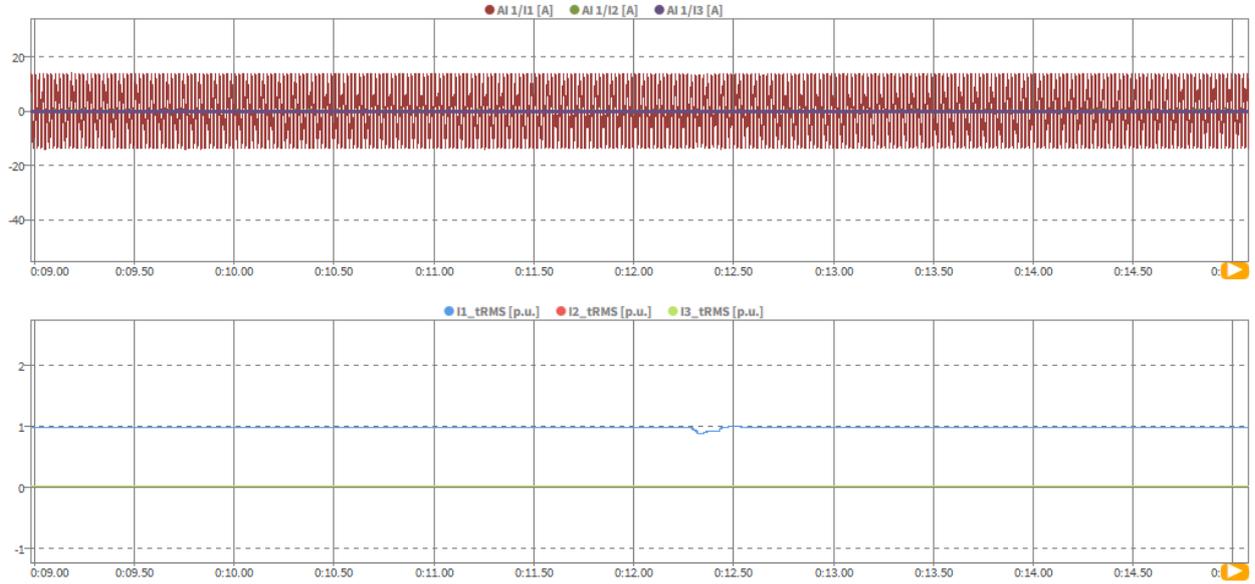
Test 8.3 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase voltages



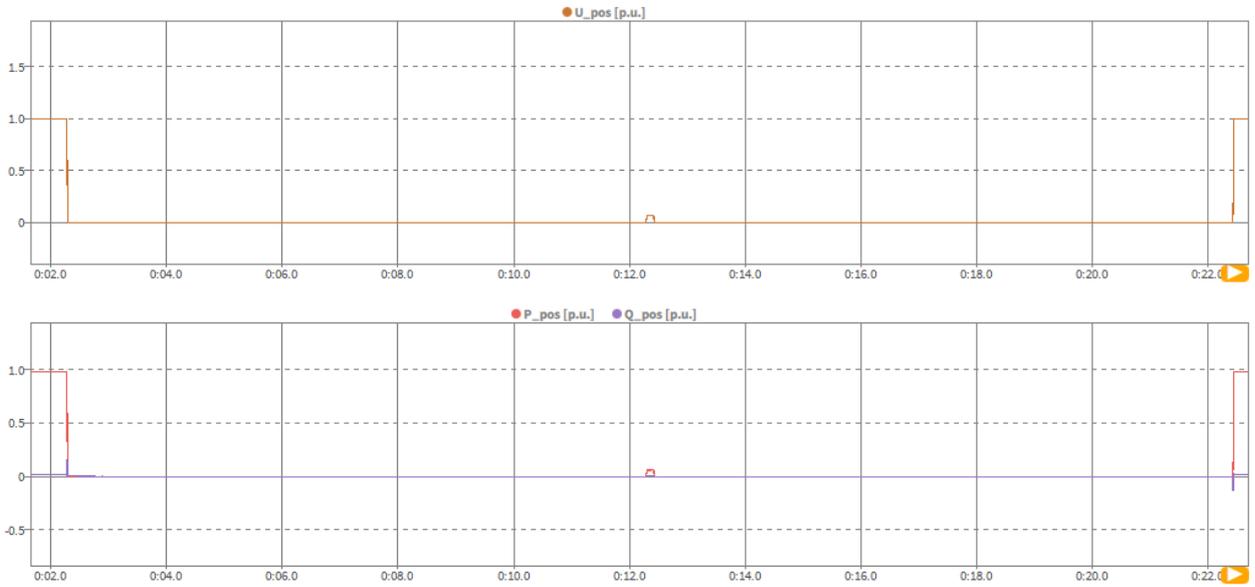
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.3 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 100% load, Instantaneous and RMS values of phase currents



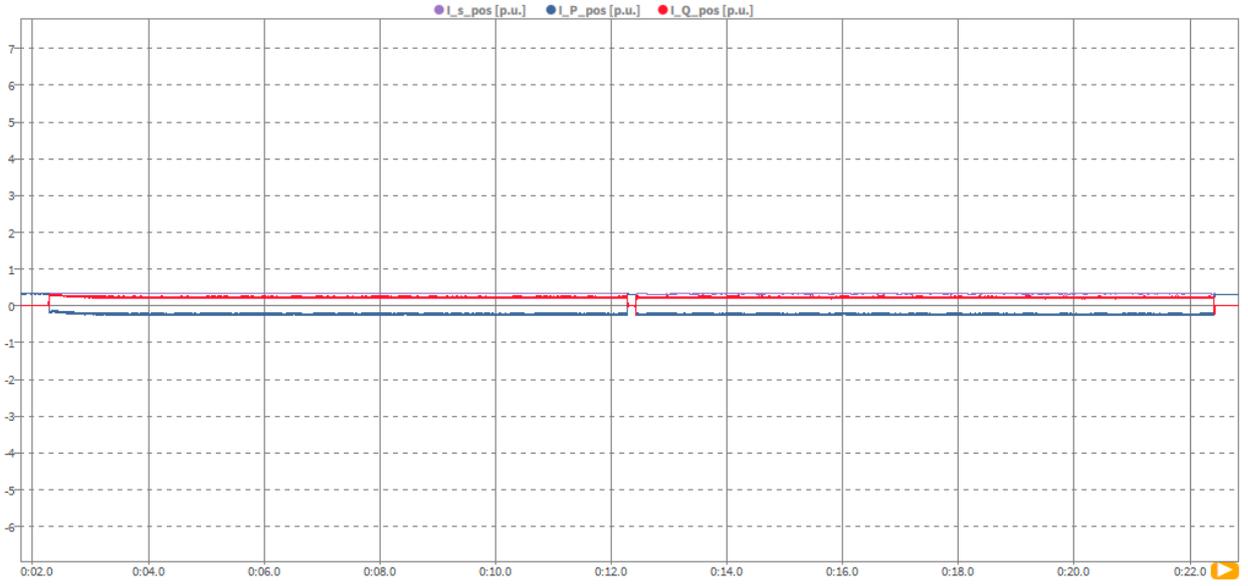
Test 8.3 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

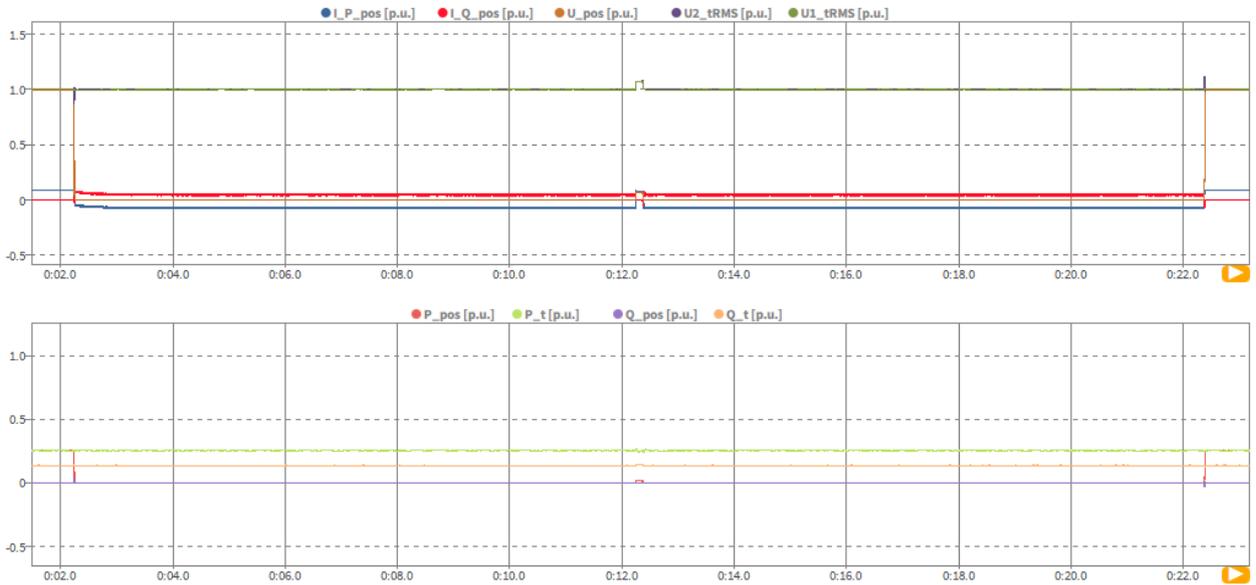
Test 8.3 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 100% load,
Positive and negative sequence active, reactive and apparent current



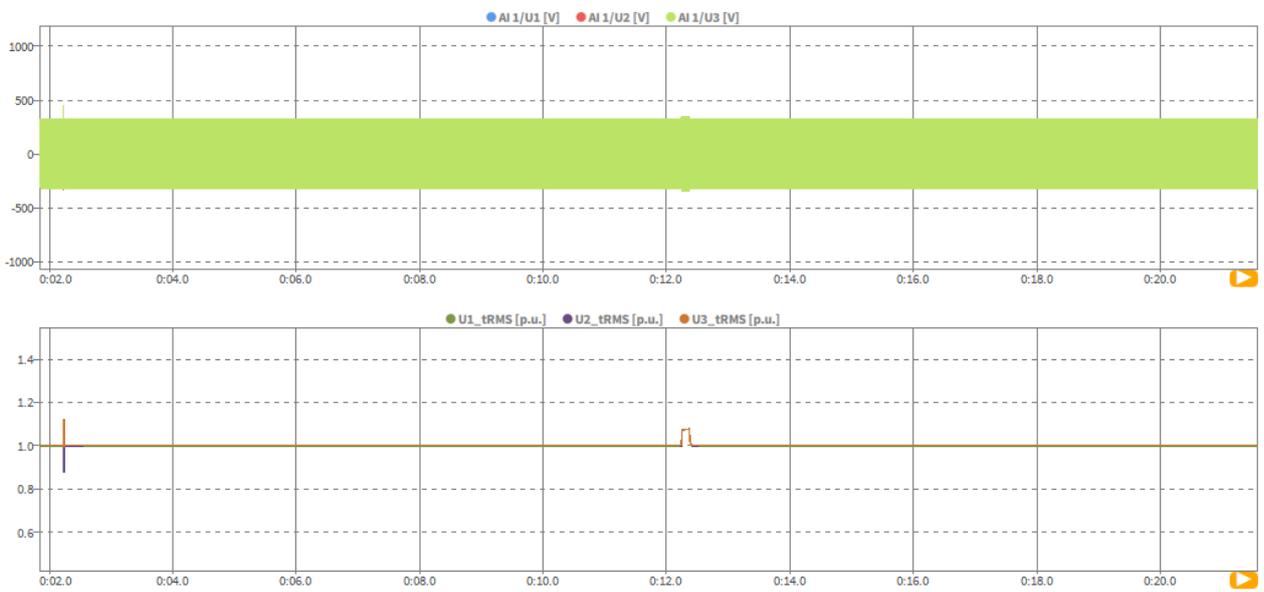
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.4 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 20% load,
Test overview (voltage, current, active and reactive power positive sequence)



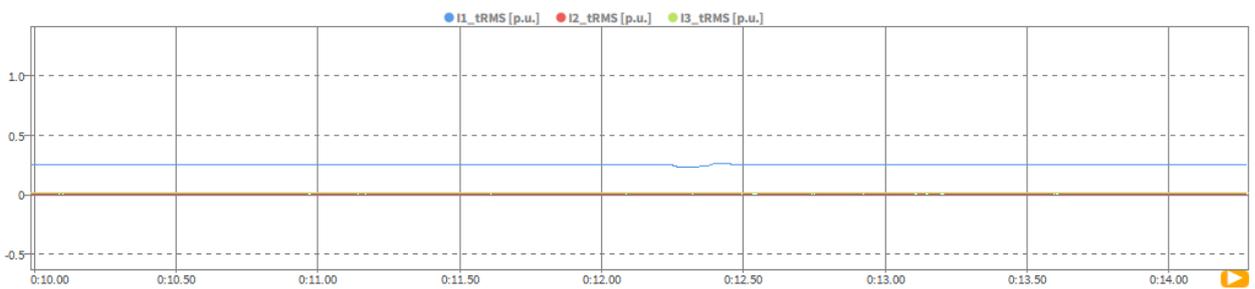
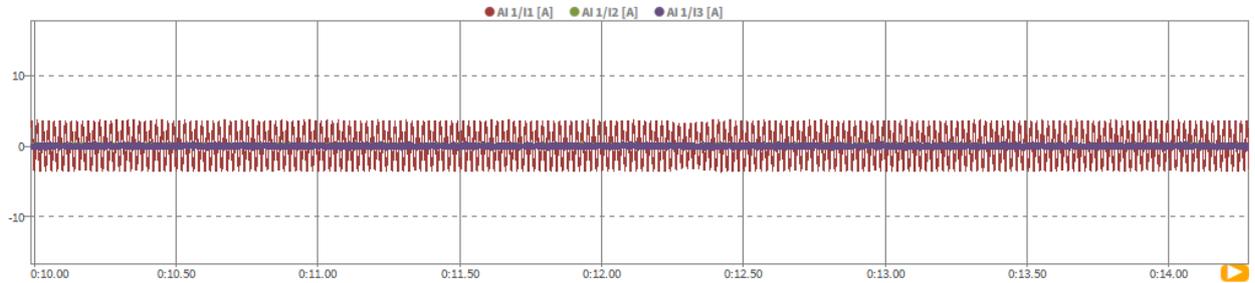
Test 8.4 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 20% load,
Instantaneous and RMS values of phase voltages



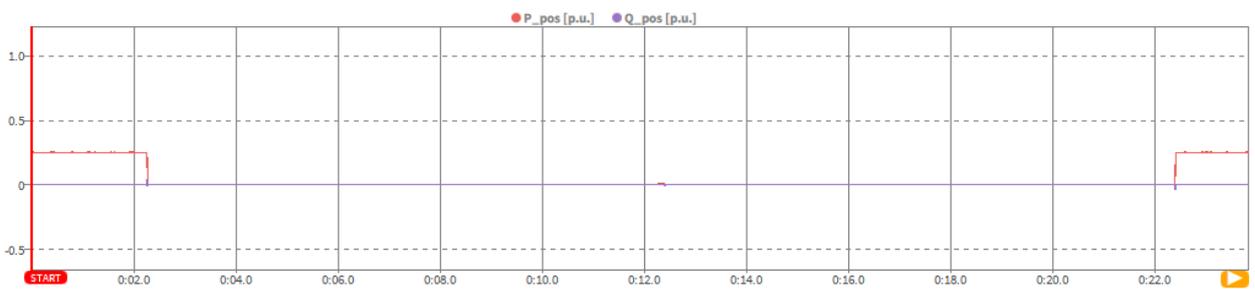
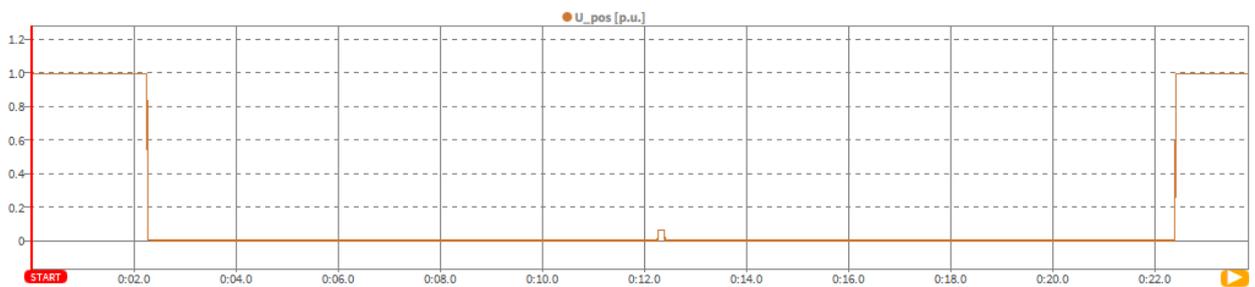
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.4 Depth of fault phase: 1.25 p.u., three-phase SC (type D1), 20% load, Instantaneous and RMS values of phase currents



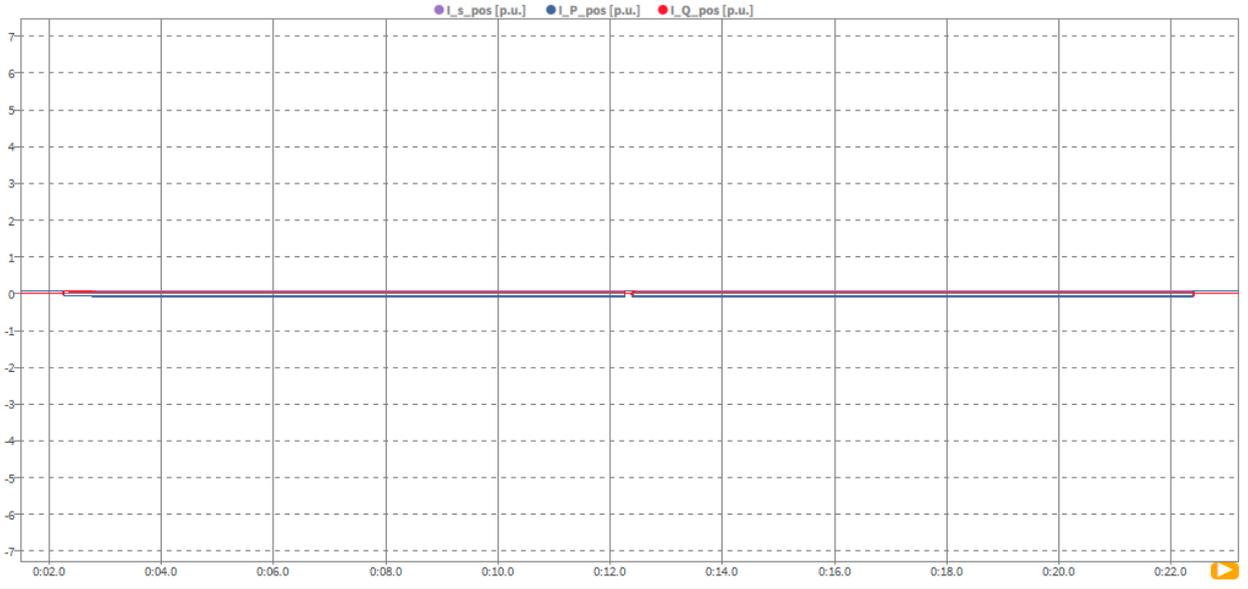
Test 8.4 Depth of fault phase: 1.25 p.u., three-phase SC (type D1), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.4 Depth of fault phase: 1.25 p.u, three-phase SC (type D1), 20% load,
Positive and negative sequence active, reactive and apparent current



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Condition						Measured value		
Item	No.	Parameter	Phase ref.	Time ref.	unit			
General	0	Test number	--	--	--	8.5	8.6	
	1	Date	--	--	yyyy.mm.dd	2024.12.7	2024.12.7	
	2	Time (start of test)	--	--	hh:mm:ss.f	18:46:15.8	18:53:19.4	
	3	Fault type (phase)	--	--	--	D2	D2	
	4	Setting voltage depth	Line to line	--	--	p.u.	1.25	1.25
	5	Setting dip duration	--	--	--	--	≥ 100	≥ 100
	6	Point of fault entry	Total	--	--	ms	27793	27793
	7	Point of fault clearance	Total	--	--	ms	27898	27898
	8	Fault duration in empty load test	Total	--	--	ms	104	104
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and	p.u.	1.250	1.250	
	10		Pos.			1.129	1.129	
11	Neg.		--			--		
Before dip <t1	12	Voltage	L1 to neutral	t1-10s to t1	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	13	Current	Pos.	t1-500ms to t1-100ms	p.u.	0.995	0.207	
	14	Active power	Total	t1-10s to t1	p.u.	0.993	0.200	
	15		Pos.			0.993	0.200	
	16	Reactive power	Total	t1-10s to t1	p.u.	0.078	0.055	
17	Pos.		0.078			0.055		
18	Cosφ	--	t1-10s to t1	--	0.996	0.961		
During dip t1 to t2	19	Voltage	L1 to neutral	t1+100ms to t2-20ms	p.u.	1.069	1.069	
			L2 to neutral			1.250	1.250	
			L3 to neutral			1.069	1.069	
			Pos.			1.129	1.129	
	20	Line current	Phase 1	t1+60ms	p.u.	0.059	0.059	
	21		Phase 2			0.058	0.058	
	22		Phase 3			0.057	0.057	
	23	Line current	Phase 1	t1+100ms	p.u.	0.059	0.059	
	24		Phase 2			0.058	0.058	
	25		Phase 3			0.057	0.057	
26	Active power	Total	t1+100ms to t2-20ms	p.u.	0.000	0.000		
27		Pos.			0.000	0.000		
After dip	30	Voltage	L1 to neutral	t2+3s to t2+10s	p.u.	1.000	0.999	
			L2 to neutral			1.000	1.000	
			L3 to neutral			1.000	1.000	
	31	Active power	Total	t2+3s to t2+10s	p.u.	0.993	0.200	
	32		Pos.			0.993	0.200	
	33	Active power rising time	Pos.	--	s	--	--	
	34	Reactive power	Total	t2+3s to t2+10s	p.u.	0.078	0.055	
	35		Pos.			0.078	0.055	
36	Reactive power rising time	Pos.	--	s	--	--		
37	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes	Yes		

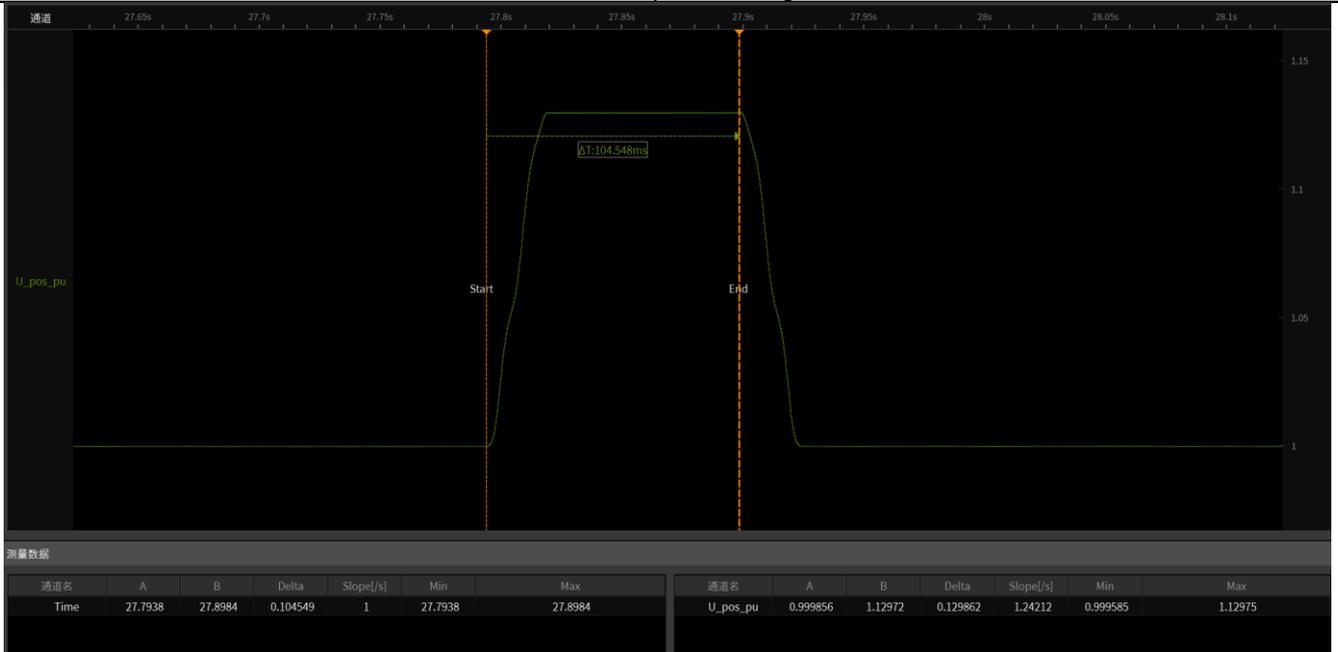
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.5&8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), No load, Instantaneous and RMS values of phase voltages



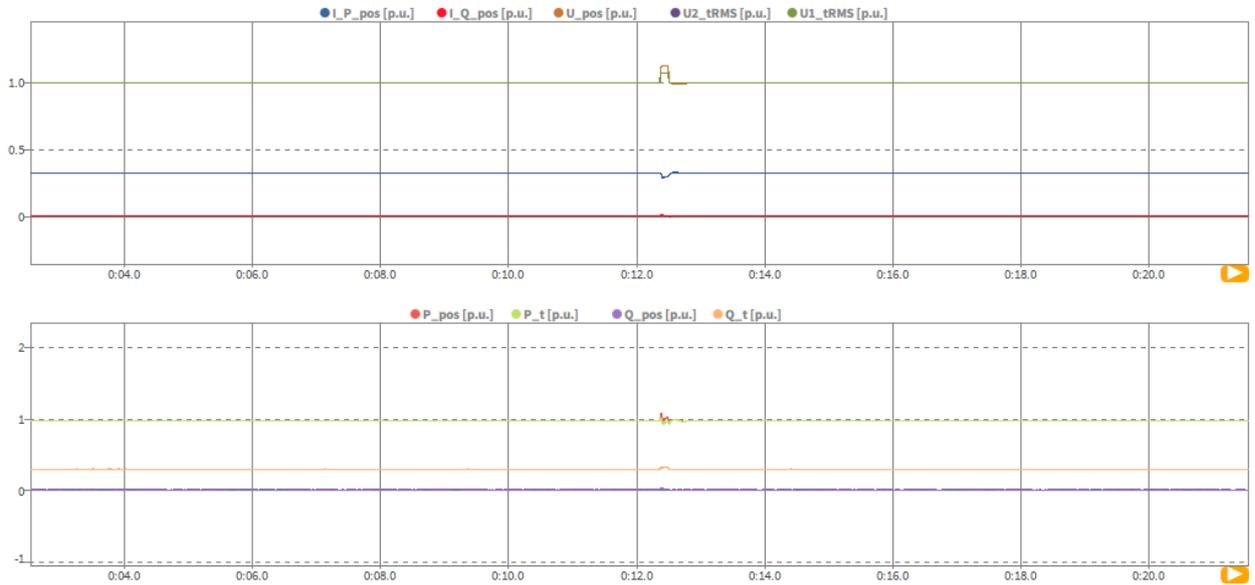
Test 8.5&8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), No load, Positive sequence voltage



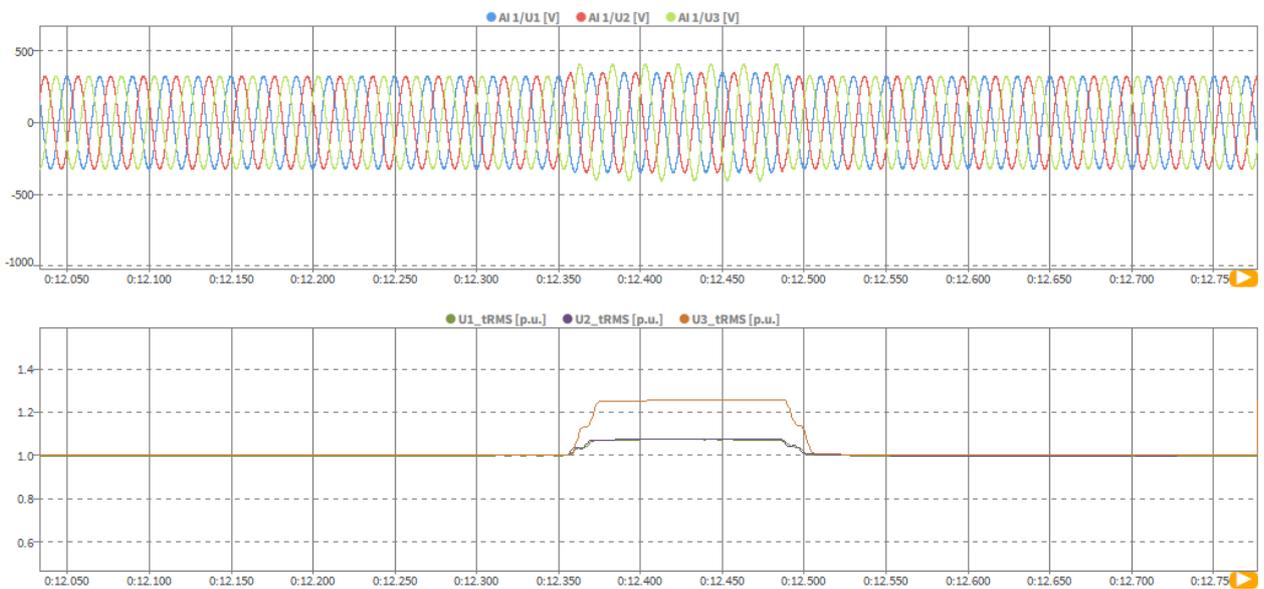
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.5 Depth of fault phase: 1.25 p.u, three-phase SC (type D2), 100% load, Test overview (voltage, current, active and reactive power positive sequence)



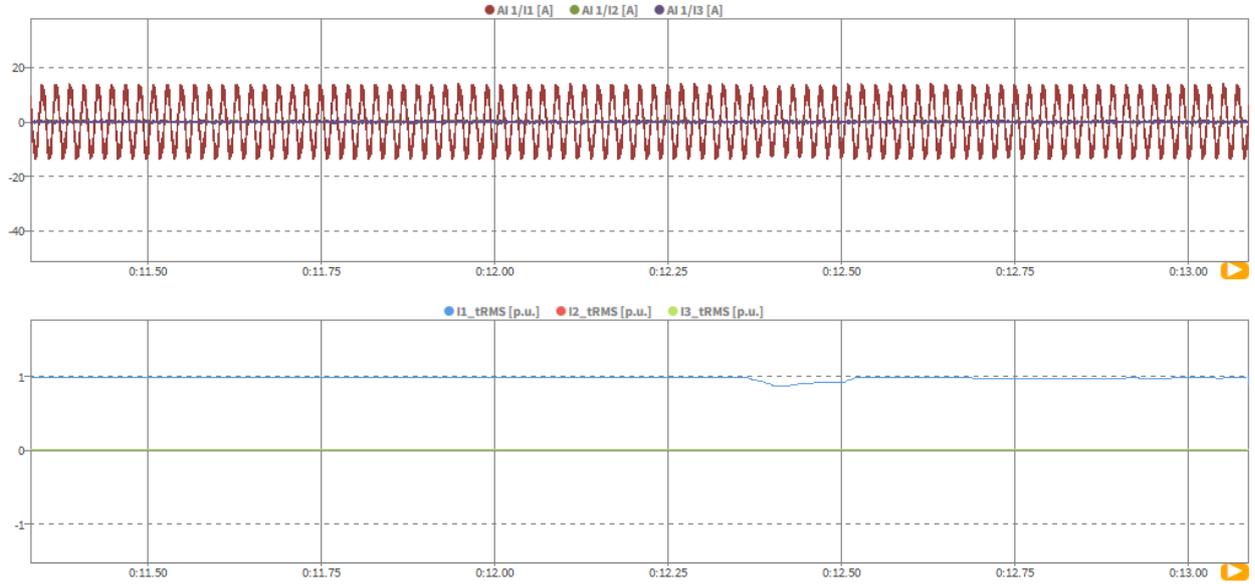
Test 8.5 Depth of fault phase: 1.25 p.u, three-phase SC (type D2), 100% load, Instantaneous and RMS values of phase voltages



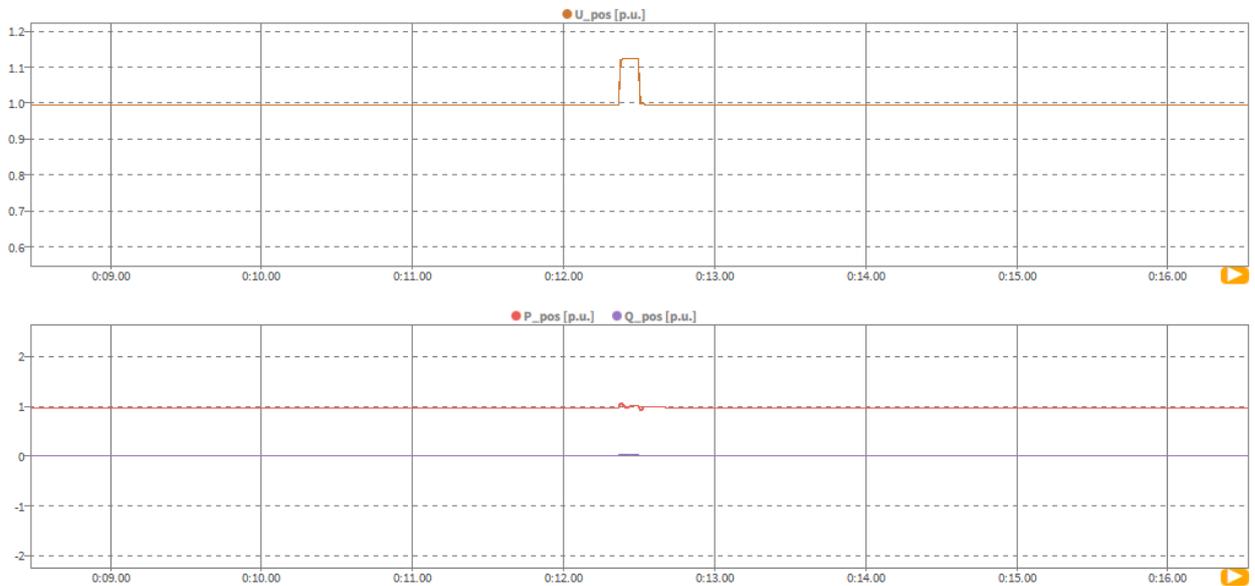
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.5 Depth of fault phase: 1.25 p.u, three-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents



Test 8.5 Depth of fault phase: 1.25 p.u, three-phase SC (type D2), 100% load, Positive sequence voltage, active and reactive power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.5 Depth of fault phase: 1.25 p.u, three-phase SC (type D2), 100% load,
Positive and negative sequence active, reactive and apparent current



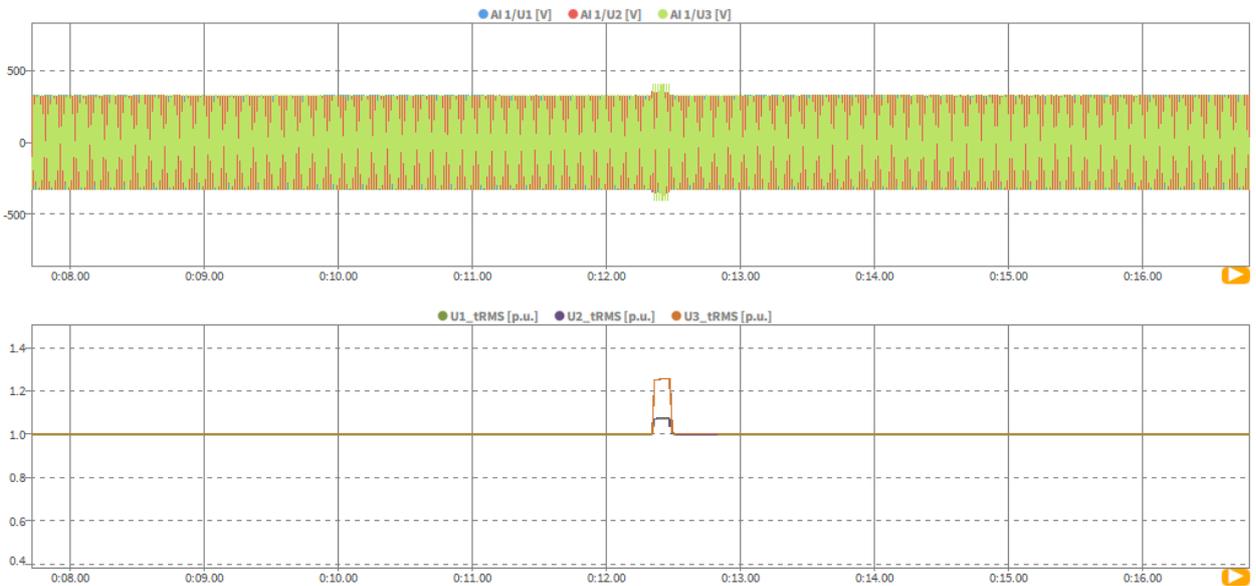
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test 8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), 20% load, Test overview (voltage, current, active and reactive power positive sequence)



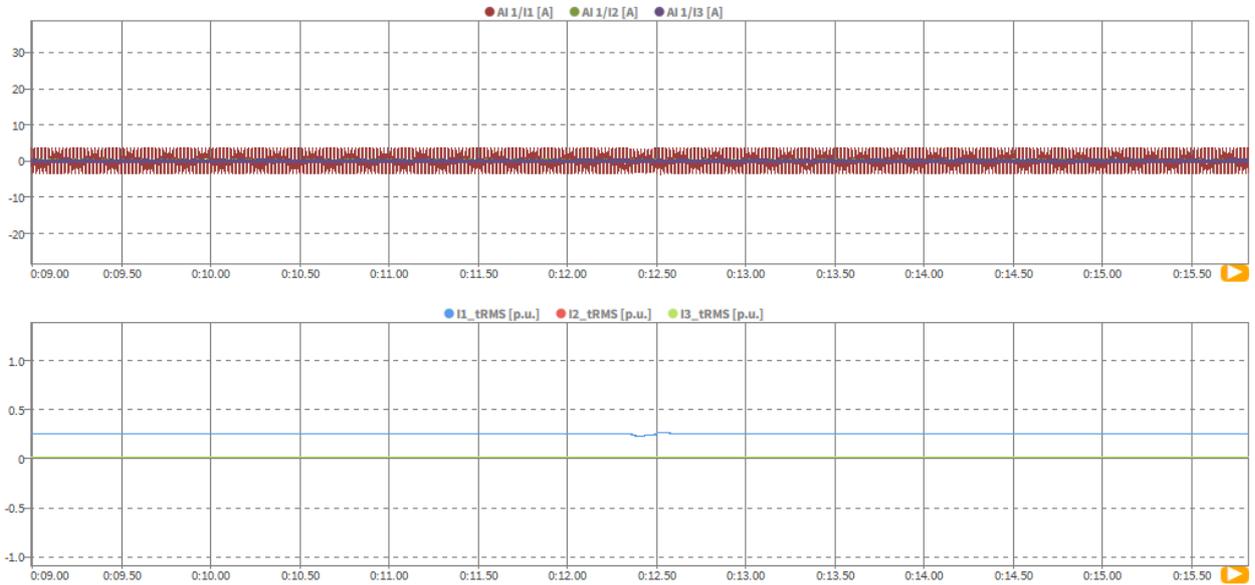
Test 8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), 20% load, Instantaneous and RMS values of phase voltages



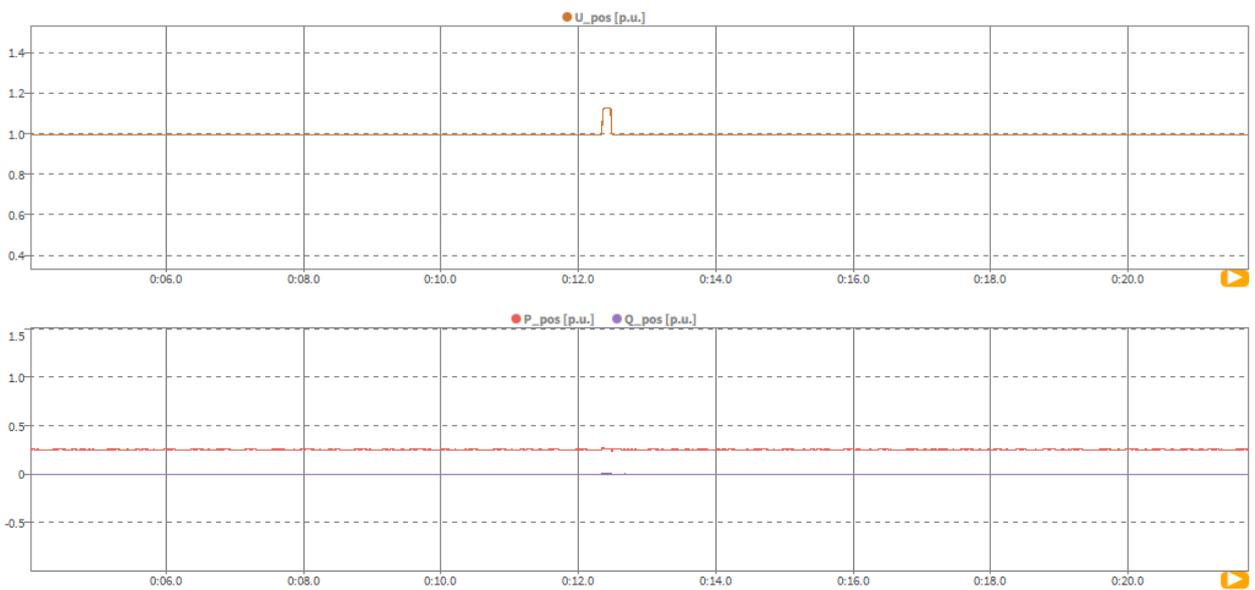
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

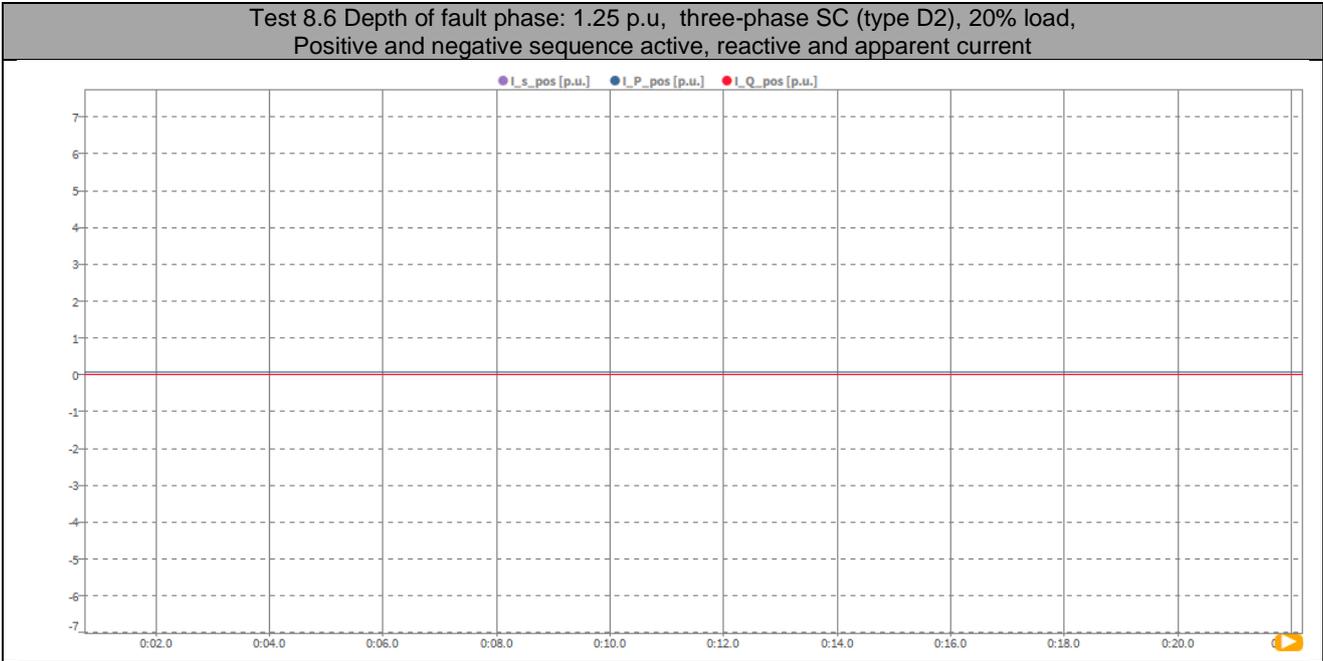
Test 8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), 20% load, Instantaneous and RMS values of phase currents



Test 8.6 Depth of fault phase: 1.25 p.u., three-phase SC (type D2), 20% load, Positive sequence voltage, active and reactive power



EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SG2000							
Available P adjust to follow droop during the over-frequency transient- For other generating unit Setting (a)								
Starting frequency f_{in} :	50.2Hz							
Deactivation threshold f_{stop} :	Deactivated							
Intentional delay [s]	0							
Droop:	5% (40% P_{ref} / Hz) $P_{ref} = P_M$							
Test No. 1:								
Power level at start of test	100% P_n							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	100%	50.00	99.05%	--	--	--	-0.95%	± 10%
50.10	100%	50.10	99.04%	--	--	0.5	-0.86%	
50.80	76%	50.80	76.51%	1.2	1.6	0.6	0.51%	
51.40	52%	51.40	52.06%	1.3	2.0	0.6	0.06%	
$f_{max}^a(52.0)$	28%	52.00	27.62%	1.3	1.9	0.6	-0.38%	
51.40	52%	51.40	52.07%	1.0	2.0	0.5	0.07%	
50.80	76%	50.80	76.55%	1.5	2.1	0.5	0.55%	
50.10	100%	50.10	99.14%	0.7	4.3	0.6	-0.86%	
50.00	100%	50.00	99.11%	--	--	--	-0.89%	
Test condition		Measurement					Limit	
50.80 to 50.10		Max. power gradient (% P_n /min):			--		≤10% P_n /min	
Test No. 2:								
Power level at start of test	50% P_n^b							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	50%	50.00	51.03%	--	--	--	1.03%	± 10%
50.10	50%	50.10	50.78%	0.3	0.3	0.3	0.78%	
50.80	38%	50.80	39.15%	0.7	1.3	0.6	1.15%	
51.40	26%	51.40	26.53%	1.3	1.6	0.4	0.53%	
$f_{max}^a(52.0)$	14%	52.00	18.01%	0.5	0.7	0.3	4.01%	
51.40	26%	51.40	26.55%	0.9	1.2	0.3	0.55%	
50.80	38%	50.80	39.18%	0.7	1.1	0.5	0.18%	
50.10	50%	50.10	50.82%	1.3	1.6	0.6	0.82%	
50.00	50%	50.00	50.77%	--	--	--	0.77%	
g) 50	50%	50.00	50.54%	--	--	--	0.54%	

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test condition	Measurement		Limit
50.80 to 50.10	Max. power gradient (%P _n /min):	--	≤10% P _n /min

Note(s):

^a f_{max} as maximum frequencies limits as specified in 5.2.1.

^b or minimum regulation level +35 % P_{max}, whichever is higher

Deactivate the frequency protection function if needed.

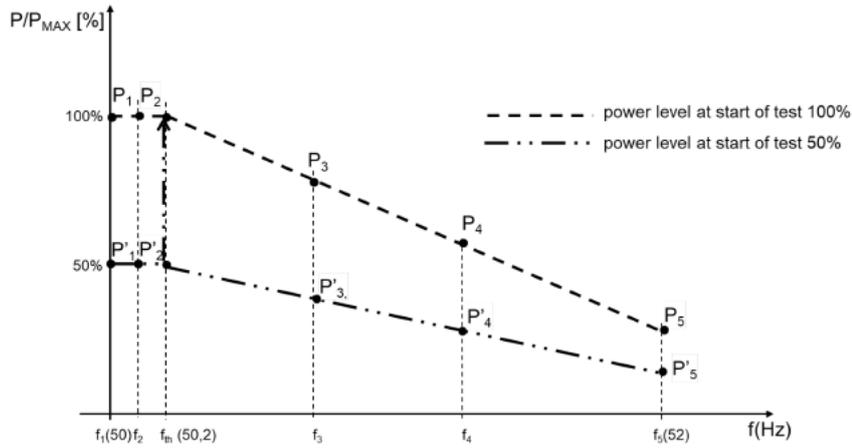
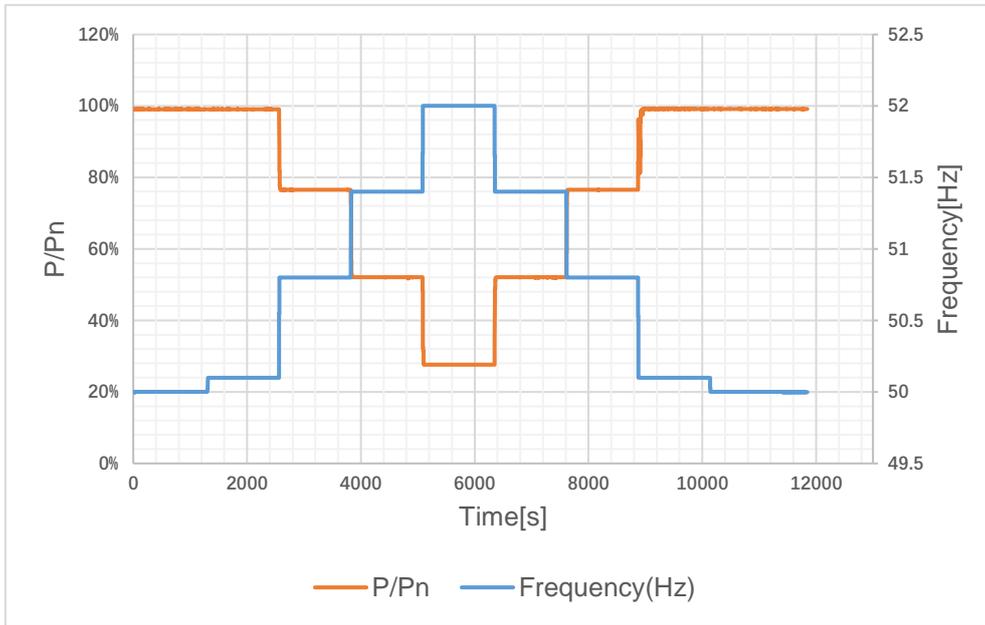


Figure 19 — Other non-synchronous generating technology ($P_{ref} = P_M$) without configured deactivation threshold, setting (a), example

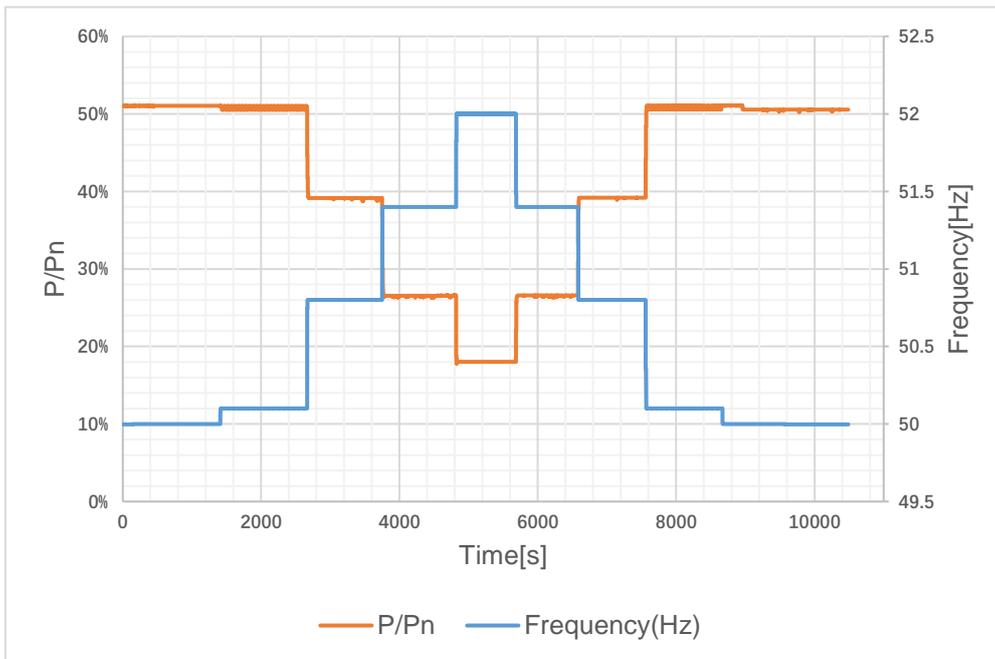
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement test 1



Graph of Measurement test 2



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)	P
----------------	---	----------

Model	SG2000
-------	--------

Available P adjust to follow droop during the over-frequency transient- For other generating unit **Setting (b)**

Starting frequency f_{th} :	50.5Hz
-------------------------------	--------

Deactivation threshold f_{stop} :	50.5/1s
-------------------------------------	---------

Intentional delay [s]	0
-----------------------	---

Droop:	2% (100% P_{ref} / Hz) $P_{ref} = P_M$
--------	--

Test No. 1

Power level at start of test	60% P_n^b
------------------------------	-------------

Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	$\Delta P/P_n$	
50.00	60%	50.00	61.29%	--	--	--	1.29%	± 10%
50.25	60%	50.25	61.05%	--	--	--	1.05%	
51.00	30%	51.00	30.46%	0.9	1.7	0.6	0.46%	
51.50	0%	51.50	2.33%	0.5	0.9	0.5	2.33%	
f_{max}^a (52.0)	0%	52.00	2.35%	0.6	0.1	0.6	2.35%	
51.50	0%	51.50	2.34%	0.1	0.2	0.1	2.34%	
51.00	0%	51.00	2.32%	0.6	0.7	0.6	2.32%	
50.25	60%	50.25	60%	--	--	0.5	0.00%	
50.00	60%	50.00	61.3%	--	--	--	1.30%	

Test condition	Measurement	Limit
51.00-50.25	Max. power gradient (% P_n /min):	9.87
		≤10% P_n /min

Note(s):
^a f_{max} as maximum frequencies limits as specified in 5.2.1.
^b or minimum regulation level +25 % P_{max} , whichever is higher
 Deactivate the frequency protection function if needed.

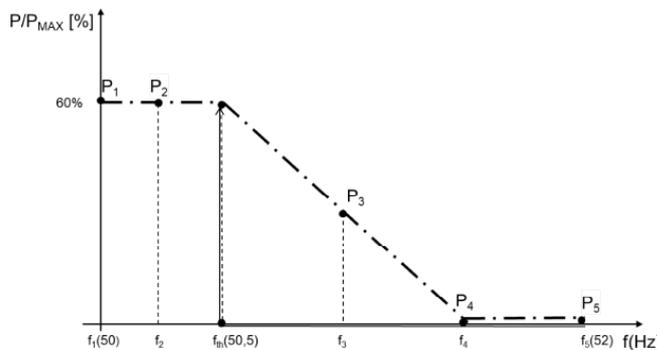
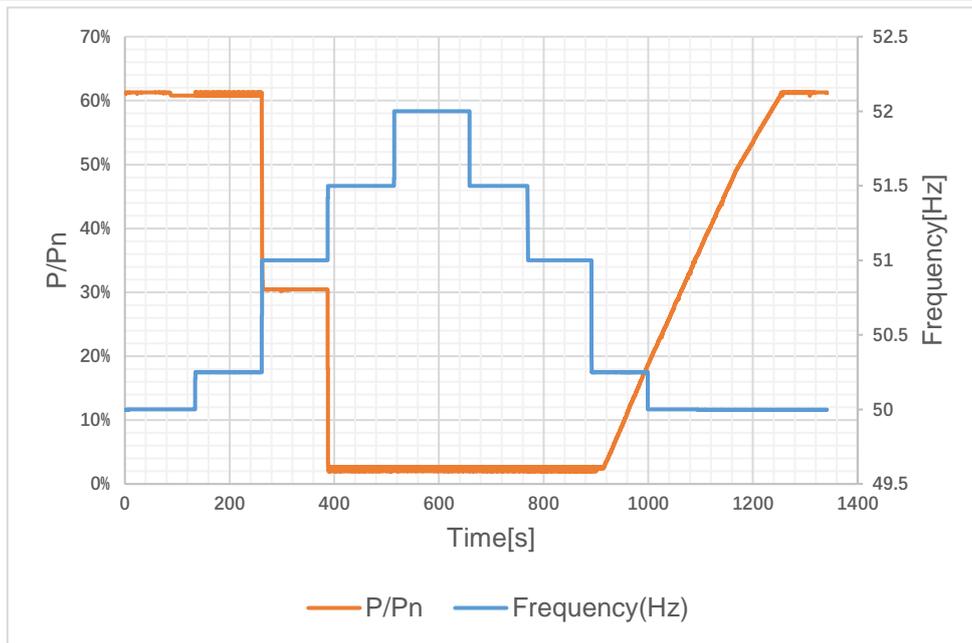


Figure 20 — Other non-synchronous generating technology ($P_{ref} = P_M$) with configured deactivation threshold, setting (b), example

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement Test No. 1



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.2		TABLE: Power response to over-frequencies (LFSM-O)						P
Model	SG2000							
Available P adjust to follow droop during the over-frequency transient- For other generating unit Setting (c)								
Starting frequency f_{th} :	50.2Hz							
Deactivation threshold f_{stop} :	50.05/600s							
Intentional delay [s]	2							
Droop:	12% (16.67% P_{ref} / Hz) $P_{ref} = P_M$							
Test No. 1								
Power level at start of test	40% P_n^b							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/ P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	40%	50.00	40.39%	--	--	--	0.39%	± 10%
50.10	40%	50.10	40.41%	1.4	2.0	0.6	0.41%	
50.80	36%	50.80	37.26%	1.6	2.1	0.5	1.26%	
51.40	32%	51.40	33.00%	1.0	1.6	0.6	1.00%	
f_{max}^a (52.0)	28%	52.00	28.76%	1.3	1.6	0.6	0.76%	
51.40	28%	51.40	28.72%	0.7	0.7	0.5	0.72%	
50.80	28%	50.80	28.80%	0.1	0.1	0.6	0.80%	
50.10	28%	50.10	28.76%	0.1	0.1	0.3	0.76%	
50.00	40%	50.00	40.16%	--	--	0.6	0.16%	
Test condition		Measurement				Limit		
50.10-50.00		Max. power gradient (% P_n /min):				7.92		$\leq 10\% P_n$ /min

Note(s):

^a f_{max} as maximum frequencies limits as specified in 5.2.1.

^b or minimum regulation level +25 % P_{max} , whichever is higher

Deactivate the frequency protection function if needed.

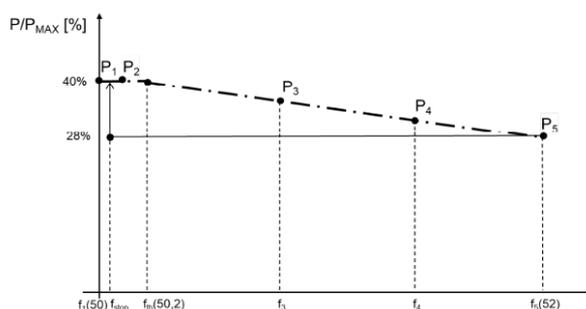
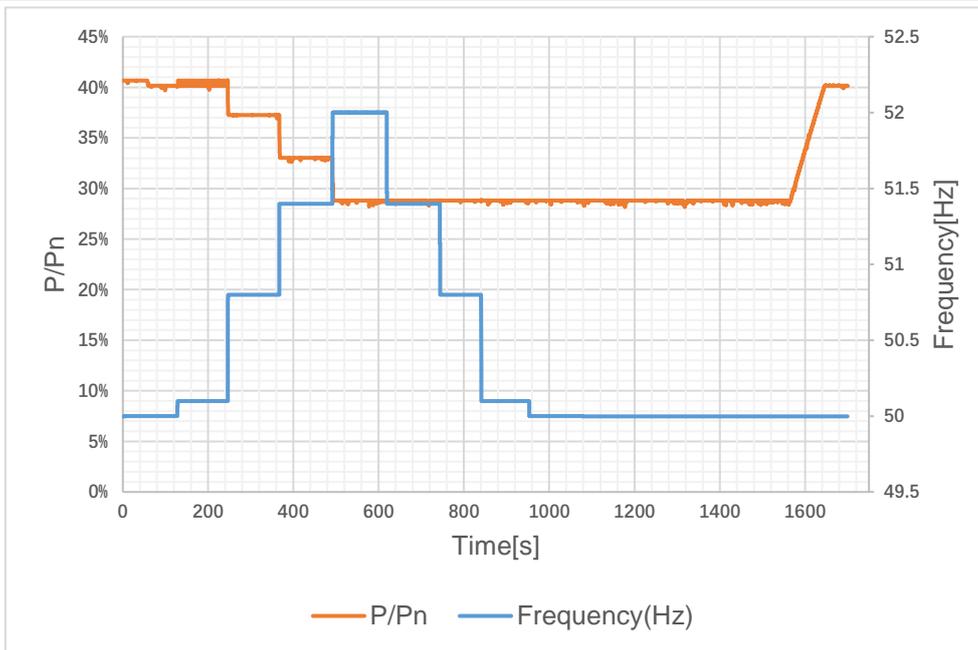


Figure 21 — Other non-synchronous generating technology ($P_{ref} = P_M$) with configured deactivation threshold, setting (c), example

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement Test No. 1



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.3		TABLE: Power response to under-frequency (LFSM-U)						P
Model	SG2000							
Available P adjust to follow droop during the over-frequency transient - For other generating unit Setting (a)								
Starting frequency f_{th} :	49.8Hz							
Deactivation threshold f_{stop} :	Deactivated							
Intentional delay [s]	0							
Droop:	5% (40% P_{ref} / Hz) $P_{ref} = P_{Max}$							
Test No. 1								
Power level at start of test	0% P_n^b							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/ P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	0%	50.00	1.86%	--	--	--	1.86%	± 10%
49.90	0%	49.90	1.93%	--	--	--	1.93%	
48.80	40%	48.80	42.52%	4.0	4.5	0.5	2.52%	
47.80	80%	47.80	83.88%	2.7	3.3	0.5	3.88%	
f_{min}^a (46.0)	100%	46.00	99.53%	1.7	3.6	0.6	-0.47%	
47.80	80%	47.80	83.84%	0.9	1.4	0.5	3.84%	
48.80	40%	48.80	42.78%	1.1	1.4	0.5	2.78%	
49.90	0%	49.90	2.25%	0.8	1.1	0.5	2.25%	
50.00	0%	50.00	2.25%	--	--	--	2.25%	

Note(s):

^a f_{min} as minimum frequencies limits as specified in 5.2.1.

^b or minimum regulation level, whichever is higher

Deactivate the frequency protection function if needed.

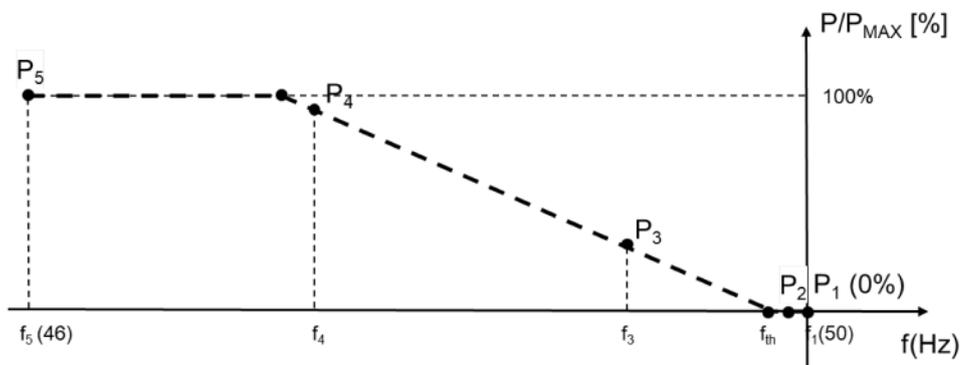
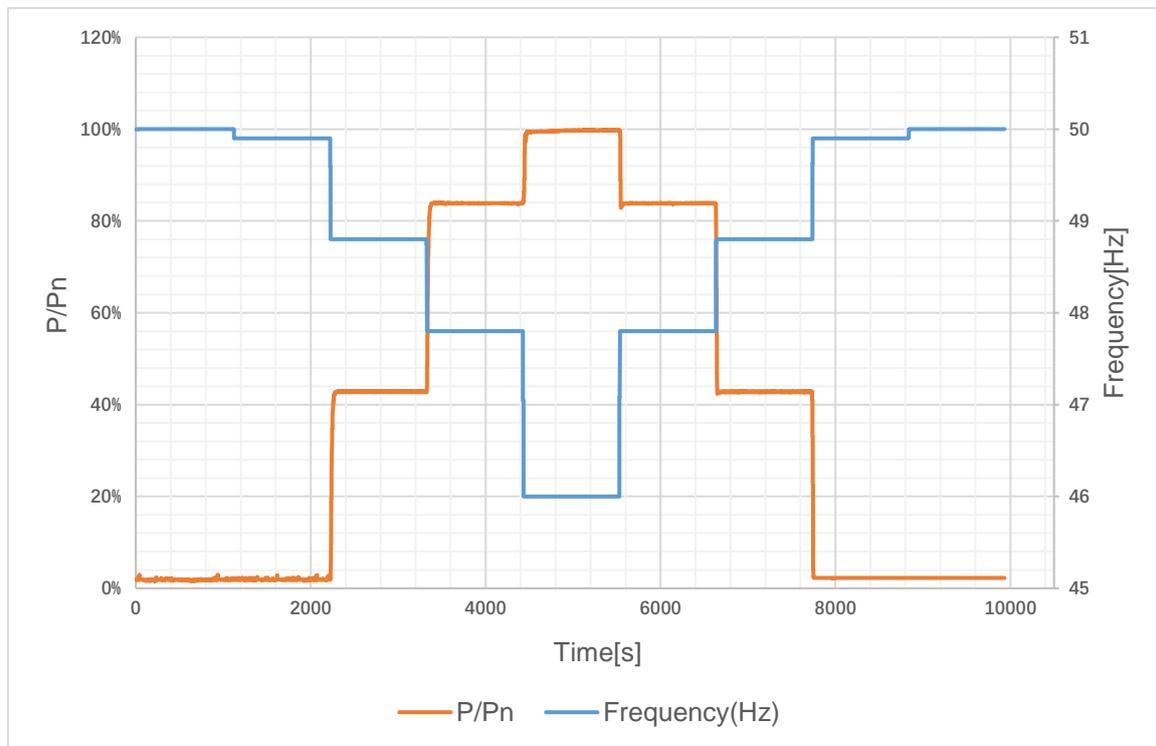


Figure 25 — Other generators: default values, example for interval frequency 46 – 50 Hz, setting (a)

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement Test No. 1



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.3		TABLE: Power response to under-frequency (LFSM-U)						P
Model	SG2000							
Available P adjust to follow droop during the over-frequency transient - For other generating unit Setting (b)								
Starting frequency f_{th} :	49.5Hz							
Deactivation threshold f_{stop} :	Deactivated							
Intentional delay [s]	0							
Droop:	2% (100% P_{ref} / Hz) $P_{ref} = P_{Max}$							
Test No. 1								
Power level at start of test	0% P_n ^b							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/ P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	0%	50.00	1.33%	--	--	--	1.33%	± 10%
49.75	0%	49.75	1.33%	--	--	--	1.33%	
49.25	25%	49.25	24.51%	4.8	5.1	0.5	-0.49%	
48.70	80%	48.70	81.21%	4.7	5.5	0.5	1.21%	
f_{min}^a (46.0)	100%	f_{min}^a (46.0)	99.61%	1.7	2.8	0.6	-0.49%	
48.70	80%	48.70	81.16%	2.1	2.6	0.5	1.16%	
49.25	25%	49.25	24.50%	1.7	1.9	0.3	-0.50%	
49.75	0%	49.75	1.33%	0.8	1.4	0.6	1.33%	
50.00	0%	50.00	1.33%	--	--	--	1.33%	

Note(s):

^a f_{min} as minimum frequencies limits as specified in 5.2.1.

^b or minimum regulation level, whichever is higher

Deactivate the frequency protection function if needed.

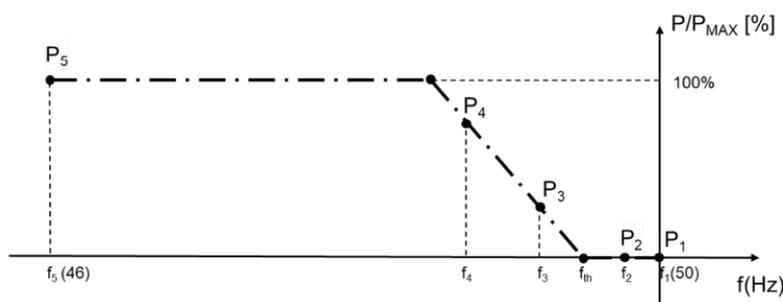
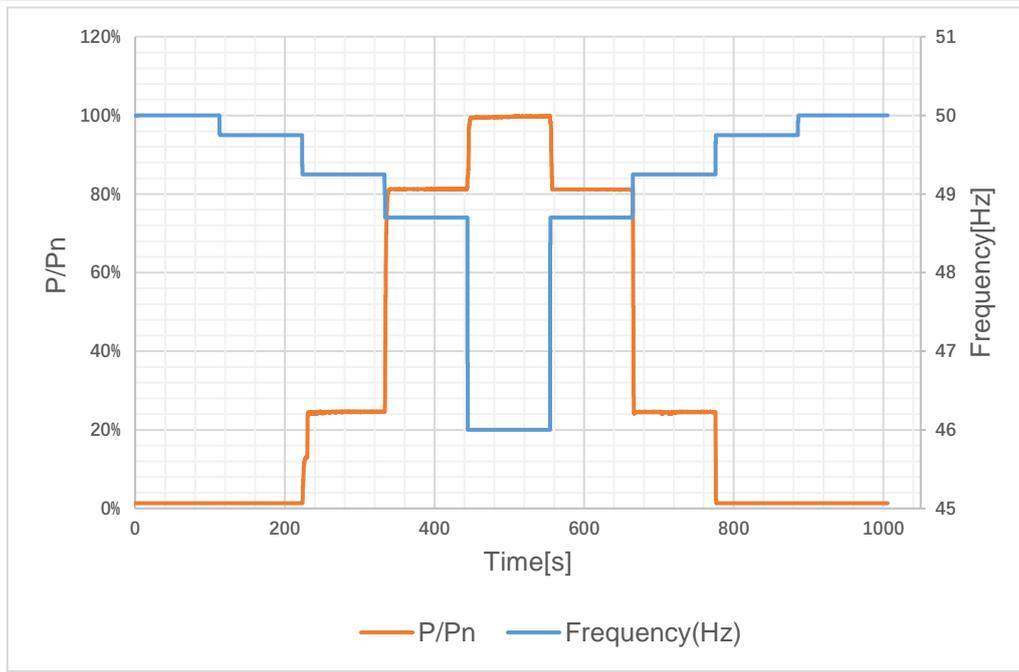


Figure 23 — $P_{ref} = P_{max}$, $s = 2\%$, $f_{th} = 49.5\text{Hz}$, example for interval frequency 46 – 50 Hz, setting (b)

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement Test No. 1



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.4.3.3		TABLE: Power response to under-frequency (LFSM-U)						P
Model	SG2000							
Available P adjust to follow droop during the over-frequency transient - For other generating unit Setting (c)								
Starting frequency f_{th} :	49.8Hz							
Deactivation threshold f_{stop} :	Deactivated							
Intentional delay [s]	2							
Droop:	12% (16.67% P_{ref} / Hz) $P_{ref} = P_{Max}$							
Test No. 1								
Power level at start of test	50% P_n							
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/ P_n	f [Hz]	P/ P_n	Tsr [s]	Ts [s]	Td [s]	$\Delta P/P_n$	
50.00	50%	50.00	50.56%	--	--	--	0.56%	± 10%
49.90	50%	49.90	50.87%	1.6	1.8	0.5	0.87%	
49.20	60%	49.20	61.81%	2.0	1.8	0.2	1.81%	
47.40	90%	47.40	92.58%	2.0	2.4	0.5	2.58%	
f_{min}^a (46.0)	100%	46.00	99.56%	1.6	3.5	0.5	0.56%	
47.40	90%	47.40	92.54%	1.7	2.3	0.5	2.54%	
49.20	60%	49.20	61.76%	1.8	2.4	0.5	1.76%	
49.90	50%	49.90	51.72%	1.7	2.3	0.5	1.72%	
50.00	50%	50.00	51.71%	--	--	--	1.71%	

Note(s):

^a f_{min} as minimum frequencies limits as specified in 5.2.1.

^b or minimum regulation level, whichever is higher
Deactivate the frequency protection function if needed.

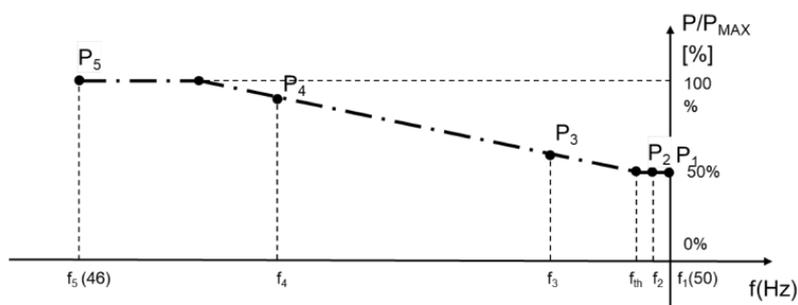
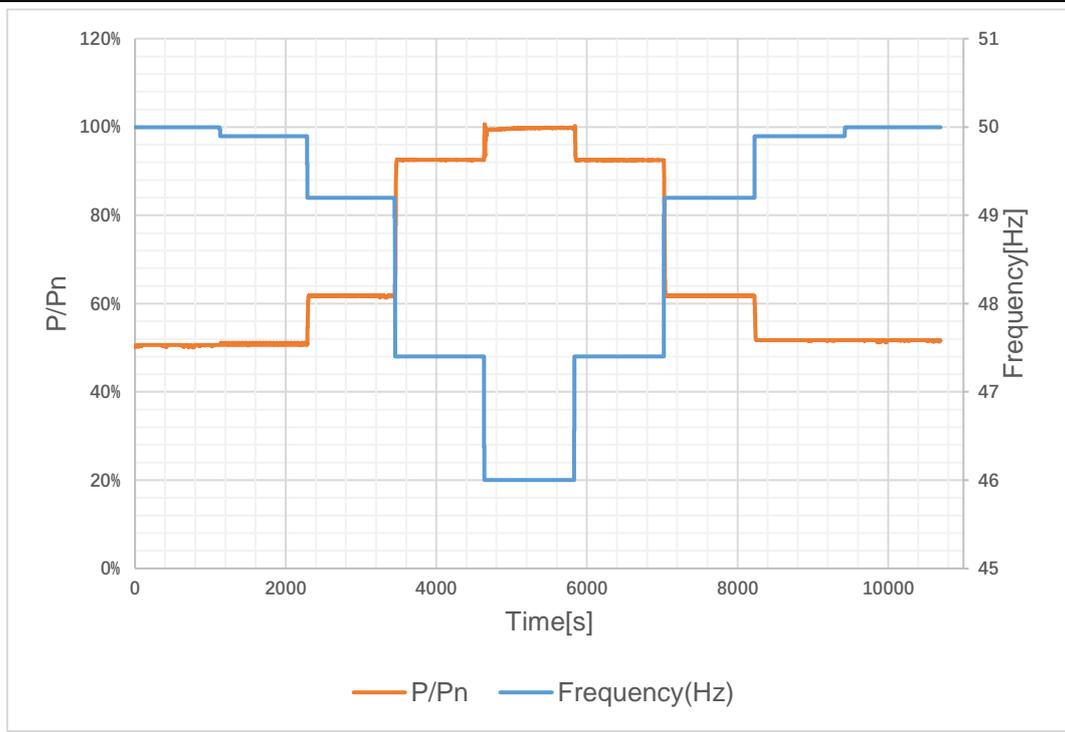


Figure 24 — $P_{ref} = P_{max}$, $s = 12\%$, $f_{th} = 49,8\text{Hz}$, example for interval frequency 46 – 50 Hz, setting (c)

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Measurement Test No. 1



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.5.1.3	TABLE: Verification procedure to determine the power capability (active, reactive, apparent) at nominal voltage						P
Model	SG2000						
setpoint for constant Q _{max}		under-excited			over-excited		
		-43.6			43.6		
Values at set point Q = 0 (Initial and final condition)							
P _n [%]	P		Q		cos(φ) [-]	U ₁	
	[W]	P.U.	[VAr]	P.U.		[V]	P.U.
0 ^a	-	-	-	-	-	-	-
10 ^a	203.36	0.10	23.50	0.01	0.99	229.99	0.99
20 ^a	397.57	0.19	25.49	0.01	0.99	229.99	0.99
30 ^a	610.33	0.30	25.05	0.01	0.99	229.99	0.99
40 ^a	815.36	0.40	29.30	0.01	0.99	229.99	0.99
50 ^a	1010.31	0.50	31.02	0.01	0.99	229.99	0.99
60 ^a	1214.58	0.60	35.55	0.01	0.99	229.99	0.99
70 ^a	1417.19	0.70	39.80	0.01	0.99	229.99	0.99
80 ^a	1616.85	0.80	35.68	0.01	0.99	229.99	0.99
90 ^a	1822.88	0.91	31.95	0.01	0.99	229.99	0.99
100 ^a	1988.73	0.99	39.13	0.01	0.99	229.99	0.99
Values at set point Q_{max} under							
P _n [%]	P		Q		cos(φ) [-]	U ₁	
	[W]	P.U.	[VAr]	P.U.		[V]	P.U.
0 ^a	-	-	-	-	-	-	-
10 ^a	187.59	0.09	-876.95	-0.43	0.21	229.99	0.99
20 ^a	402.75	0.20	-912.30	-0.45	0.40	229.99	0.99
30 ^a	599.83	0.29	-893.40	-0.44	0.55	229.99	0.99
40 ^a	806.34	0.40	-881.35	-0.44	0.67	229.99	0.99
50 ^a	1001.46	0.50	-876.42	-0.43	0.75	229.99	0.99
60 ^a	1205.31	0.60	-866.60	-0.43	0.81	229.99	0.99
70 ^a	1423.99	0.71	-863.29	-0.43	0.85	229.99	0.99
80 ^a	1628.17	0.81	-867.61	-0.43	0.88	229.99	0.99
90 ^a	1829.25	0.91	-869.62	-0.43	0.90	229.99	0.99
P _{max}	1945.31	0.97	-637.85	-0.31	0.95	229.99	0.99

EN 50549-10

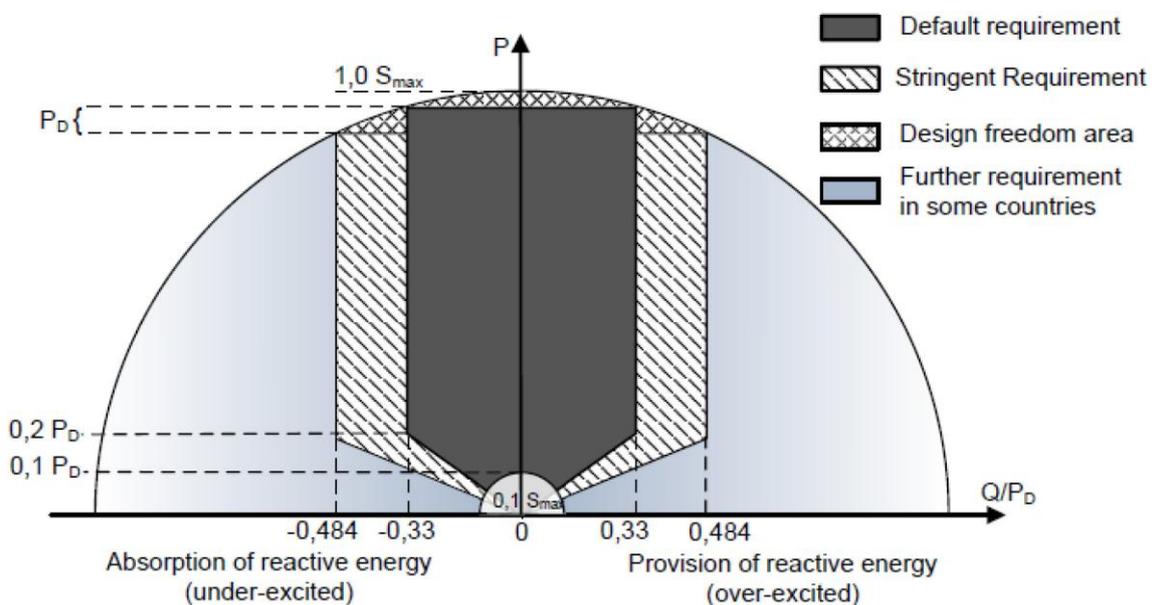
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Values at set point Q_{max} over

P_n [%]	P		Q		$\cos(\varphi)$ [-]	\underline{U}_1	
	[W]	P.U.	[VAr]	P.U.		[V]	P.U.
0 ^a	-	-	-	-	-	-	-
10 ^a	210.88	0.10	863.51	0.10	0.23	229.99	0.99
20 ^a	389.92	0.19	860.16	0.43	0.41	229.99	0.99
30 ^a	604.22	0.30	890.28	0.44	0.56	229.99	0.99
40 ^a	809.49	0.40	886.37	0.44	0.67	229.99	0.99
50 ^a	1005.66	0.50	881.87	0.44	0.75	229.99	0.99
60 ^a	1209.41	0.60	894.79	0.44	0.80	229.99	0.99
70 ^a	1429.91	0.71	880.46	0.44	0.85	229.99	0.99
80 ^a	1635.65	0.81	877.64	0.43	0.88	229.99	0.99
90 ^a	1813.72	0.90	879.74	0.43	0.89	229.99	0.99
Pmax	1933.20	0.96	596.48	0.29	0.95	229.99	0.99

NOTE

\underline{U}_1 refers to the positive sequence voltage as defined in EN 50549-1:2019 and EN 50549-2:2019.

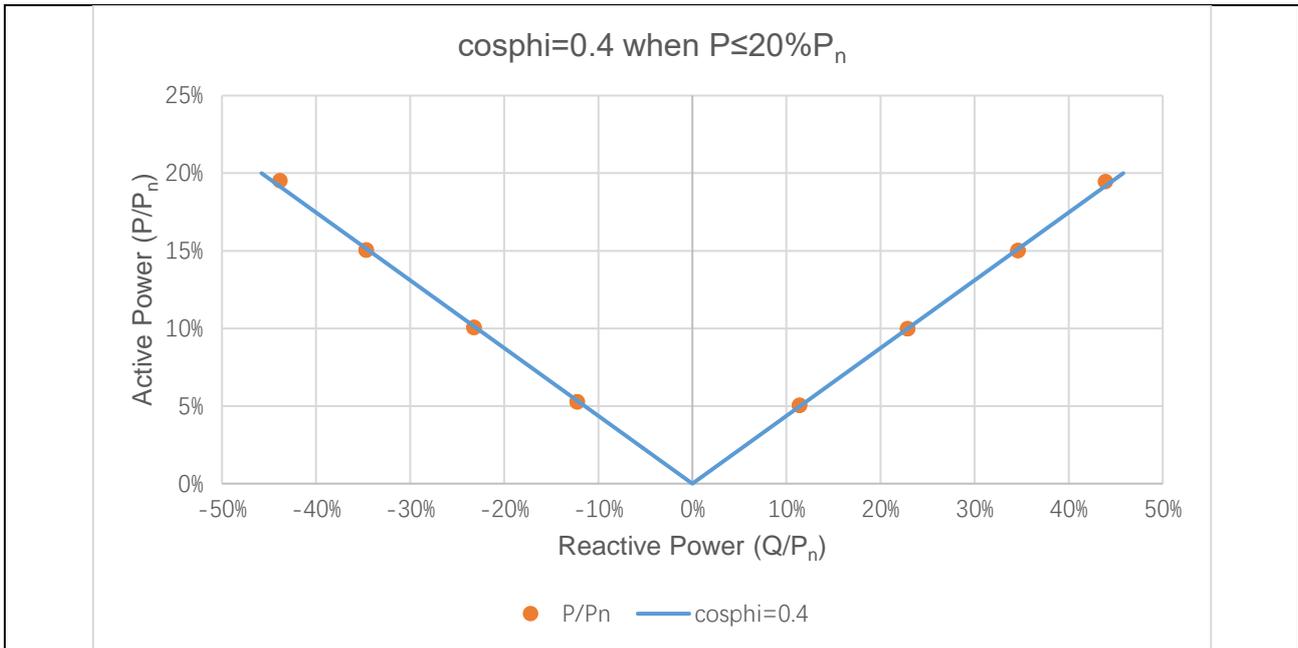


^a Only tested power levels according 5.3.1.3 to be documented.

Figure 26 — reactive power capability at nominal voltage

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------



EN 50549-10

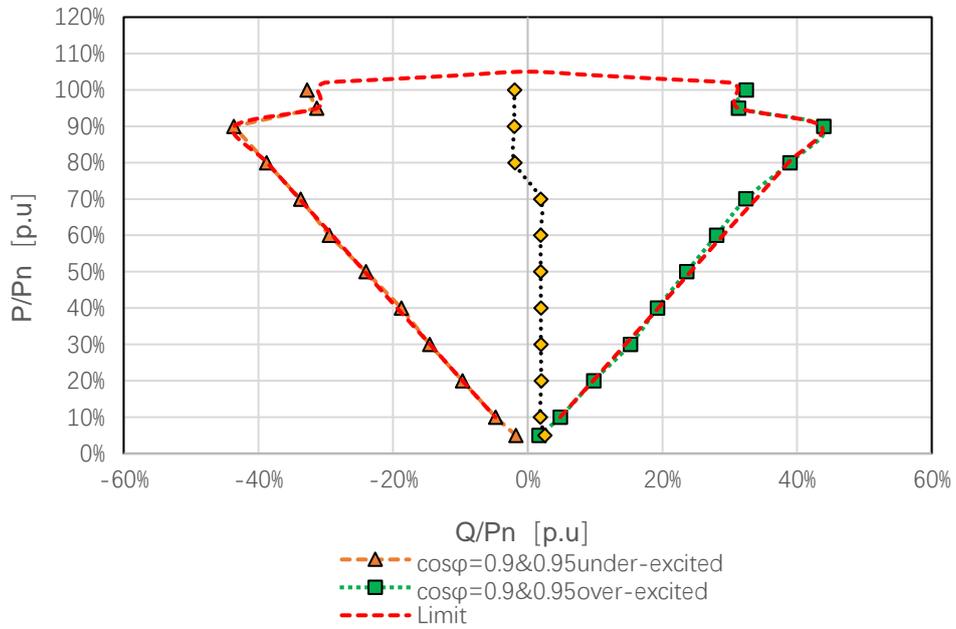
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Parameter	Pmax		Smax		Qmax over		Qmax under]	
	[W]	P.U.	[VAr]	P.U.	[VAr]	P.U.	[VAr]	P.U.
cos(φ)=1	2029.45	1.01	2030.12	1.01	N/A	N/A	N/A	N/A
cos(φ)=max under	1784.21	0.89	1983.71	0.99	N/A	N/A	-867.00	-0.43
cos(φ)=max over	1847.12	0.92	2044.63	1.02	876.74	0.43	N/A	N/A

NOTE

The values Pmax, Smax and Qmax over and Qmax under shall be measured over a period of 10 min.

diagram



EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

5.5.1.6		TABLE: Verification procedure for reactive power capability considering voltage range							P	
Model		SG2000								
setpoint for constant Q		under-excited				over-excited				
		-43.6%				43.6%				
Test Conditions		Measurements						Target value	Δ Limit	
U/Un	Q/Pn [%]	P/Pn	Q/Pn	S/Sn	I/In	U/Un	Δ Q/Pn	Q/Pn	Δ Q/Pn	
85%	0	97.52%	-1.71%	97.56%	114.98%	84.99%	-1.71%	--	--	
90%		98.20%	-1.77%	98.24%	109.35%	89.99%	-1.77%	--		
95%		98.73%	-1.44%	98.76%	104.14%	94.99%	-1.44%	--		
100%		98.94%	-1.44%	98.97%	99.15%	99.99%	-1.44%	--		
105%		99.00%	-1.39%	99.03%	94.49%	104.99%	-1.39%	--		
110%		99.32%	-1.48%	99.35%	90.48%	109.99%	-1.48%	--		
85%	Q _{max} under	90.15%	-42.51%	99.68%	117.48%	84.99%	1.08%	-43.6%	--	
90%		90.22%	-43.02%	99.95%	111.26%	89.99%	-0.58%	-43.6%		
95%		90.13%	-43.53%	100.10%	105.56%	94.99%	-0.20%	-43.6%		
100%		90.10%	-44.06%	100.29%	100.48%	99.99%	-0.46%	-43.6%		
105%		89.90%	-44.53%	100.33%	95.72%	104.99%	-0.93%	-43.6%		
110%		89.70%	-45.07%	100.38%	91.42%	109.99%	1.47%	-43.6%		
85%	Q _{max} over	91.11%	45.49%	101.93%	120.14%	84.99%	1.89%	43.6%	≥ - 2%	
90%		91.44%	43.68%	102.34%	113.92%	89.99%	1.09%	43.6%		
95%		91.79%	43.17%	102.76%	108.36%	94.99%	0.43%	43.6%		
100%		92.16%	43.35%	103.15%	103.34%	99.99%	0.25%	43.6%		
105%		92.54%	43.42%	103.53%	98.78%	104.99%	-0.18%	43.6%		
110%		92.96%	43.38%	103.89%	94.62%	109.99%	0.22%	43.6%		

Note(s): The diagrams show the operative limits.

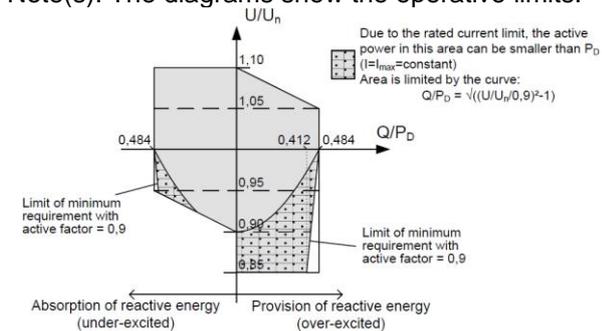


Figure 30 — Example: U-Q normalized diagram taken from the EN 50549-1

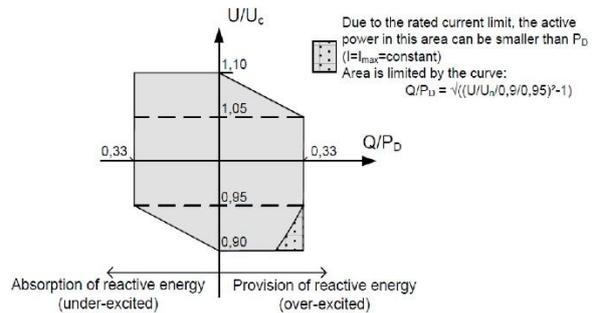
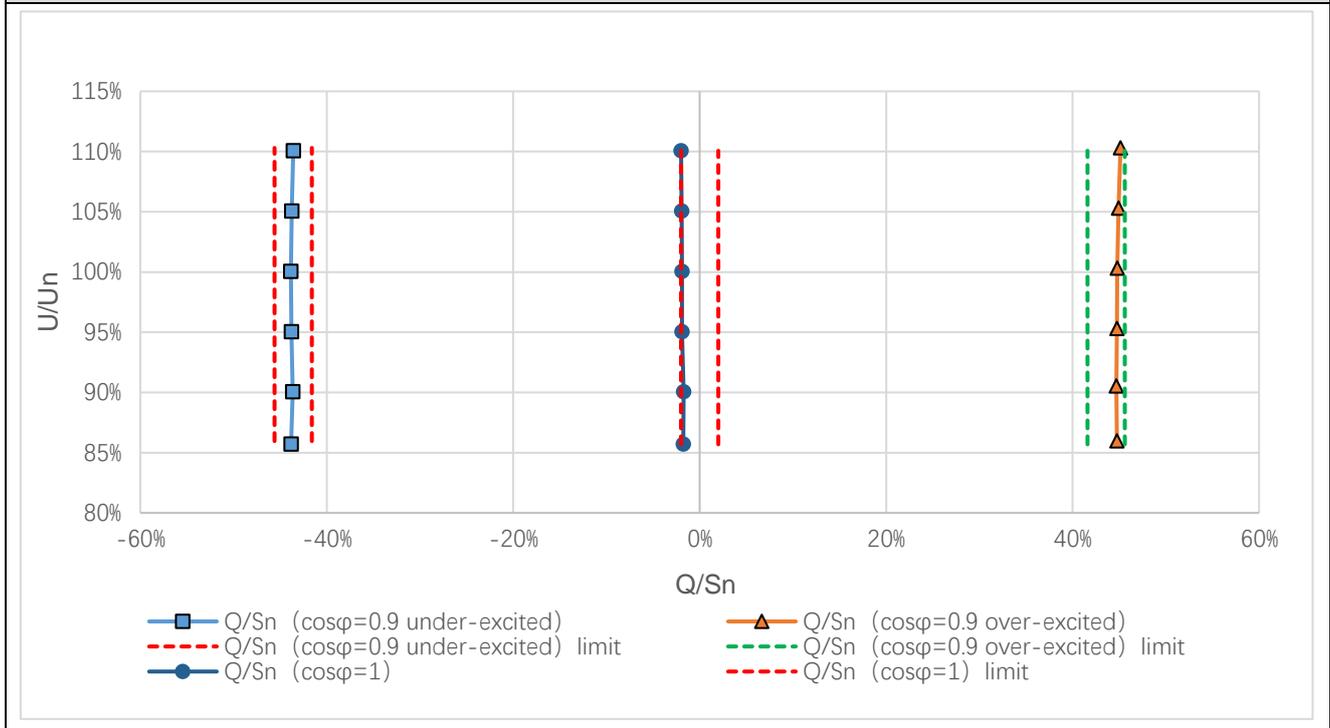


Figure 31 — Example of U-Q normalized diagram taken from the EN 50549-2

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram:



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.5.2.3	TABLE: Verification procedure for Set point control	P
----------------	--	---

Model	SG2000
-------	--------

Test no.1: Test for reactive power set point control accuracy

P=50%P_n

Reactive power step	Voltage		Set point value		Measured value (1-min average)		Deviation (Measured value - Set point)		Δ Limit
	V	p.u.	VAr	p.u.	VAr	p.u.	VAr	p.u.	
Q=0	229.99	0.99	0.0	0.0	12.07	0.011	12.07	0.011	$\pm 2\%S_{\max}$
Q max (over excited)	229.99	0.99	436	0.436	430.42	0.43	5.58	0.005	
Q max (under excited)	229.99	0.99	-436	-0.436	-422.06	0.42	13.94	0.013	
Q=0	229.99	0.99	0.0	0.0	-12.07	0.011	12.07	0.011	

Test no.2: Test for dynamic response

Tau= shortest time constant (not longer than 3s) 3s

Reactive power set point step p.u.	Generating unit response time setting	Measured response behaviour	
		dead time	response time / settling time
Q=0 \rightarrow 80% Q _{max} over	9s	0.1s	9.3s
80% Q _{max} over \rightarrow 80% Q _{max} under	9s	0.1s	9.9s
80% Q _{max} under \rightarrow Q=0	9s	0.1s	9.4s

Tau= longest time (if longest time > 60s, then test 60s) 60s

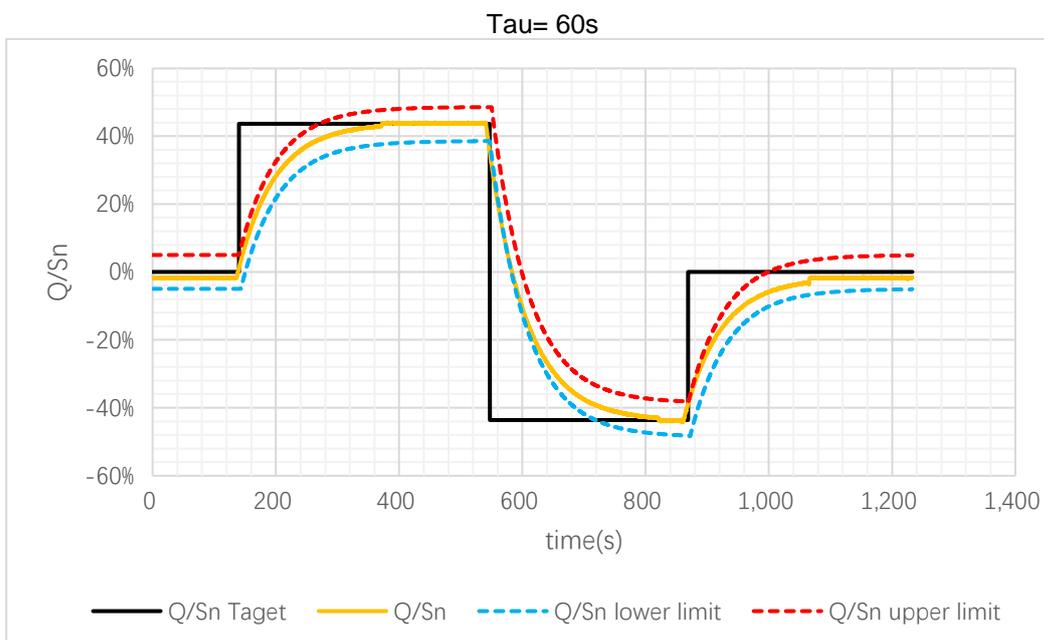
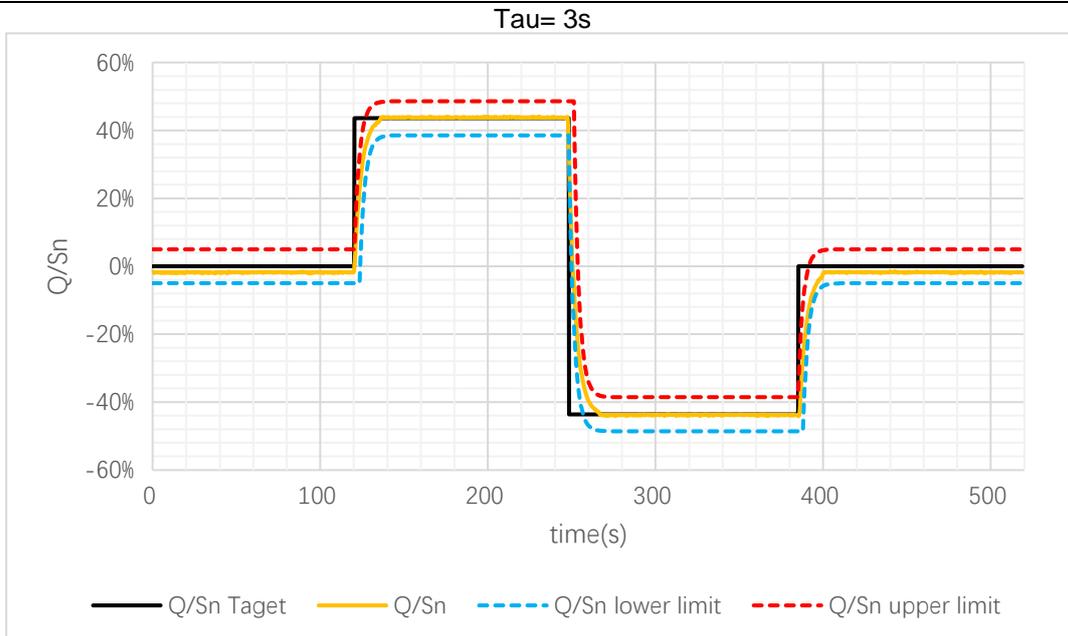
Reactive power set point step p.u.	Generating unit response time setting	Measured response behaviour	
		dead time	response time / settling time a
Q=0 \rightarrow 80% Q _{max} over	180s	0.2s	187.5 s
80% Q _{max} over \rightarrow 80% Q _{max} under	180s	0.2s	190.7s
80% Q _{max} under \rightarrow Q=0	180s	0.2s	181.5s

^a Due to the definition of dynamic accuracy as first order filter step response time and settling time are identical if the specified tolerance band is maintained.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.5.2.4	TABLE: Verification procedure for voltage related control mode for reactive power Q(U)							P	
Model	SG2000								
Test procedure for Q(U) -Setting (a)									
Set points	X1	X2	X3	X4	Time constant	Min cos ϕ	P Lock-in	P Lock-out	
U/Un	93%	94%	106%	108%	3 s	0.4	deactivated	deactivated	
Q/Qmax	100%	0	0	-100%					
Test procedure for accuracy									
Test Conditions		Measurements					Target value	Δ Limits	
U/Un	P/Pn	P/Pn	Q/Pn	U/Un	Cos ϕ	$\Delta Q/S_{max}$	Q/Pn*	$\Delta Q/S_{max}$	Cos ϕ
100%	100%	101.44%	0.90%	99.99%	0.999	0.90%	0%	$\leq \pm 2 S_{max}\%$	≥ 0.4
103%	100%	101.50%	0.60%	102.99%	0.999	0.60%	0%		
105%	100%	101.42%	0.61%	104.99%	0.999	0.61%	0%		
107%	100%	98.62%	-21.85%	106.73%	0.976	-0.05%	-21.80%		
108%	100%	89.06%	-43.87%	107.99%	0.897	-0.27%	-43.60%		
111%	100%	89.07%	-44.14%	110.99%	0.896	-0.54%	-43.60%		
114%	100%	89.09%	-44.36%	113.99%	0.895	-0.76%	-43.60%		
115%	100%	89.09%	-44.45%	114.99%	0.894	0.85%	-43.60%		
114%	100%	89.08%	-44.35%	113.99%	0.895	-0.75%	-43.60%		
111%	100%	89.07%	-44.14%	111.00%	0.896	-0.54%	-43.60%		
108%	100%	89.06%	-43.88%	107.99%	0.897	-0.28%	-43.60%		
107%	100%	98.41%	-22.19%	106.73%	0.975	-0.39%	-21.80%		
105%	100%	100.04%	0.60%	104.99%	0.999	0.60%	0%		
103%	100%	99.83%	0.54%	102.99%	0.999	0.54%	0%		
100%	100%	99.63%	0.90%	99.99%	0.999	0.90%	0%		
97%	100%	99.40%	0.84%	96.99%	0.999	0.84%	0%		
94%	100%	99.22%	0.87%	93.99%	0.999	0.87%	0%		
93%	100%	91.16%	41.99%	92.73%	0.908	-1.61%	43.60%		
90%	100%	90.00%	43.81%	89.95%	0.899	0.21%	43.60%		
87%	100%	89.68%	43.56%	86.99%	0.899	-0.04%	43.60%		
85%	100%	89.45%	43.39%	84.99%	0.899	-0.21%	43.60%		
87%	100%	89.61%	43.52%	86.99%	0.899	-0.08%	43.60%		
90%	100%	89.39%	43.36%	84.99%	0.899	-0.24%	43.60%		
93%	100%	91.16%	41.99%	92.73%	0.908	-1.61%	43.60%		
94%	100%	99.46%	0.89%	93.99%	0.999	0.89%	0%		
97%	100%	99.40%	0.84%	96.99%	0.999	0.84%	0%		
100%	100%	99.63%	0.90%	99.99%	0.999	0.90%	0%		
100%	20%	20.19%	0.91%	93.99%	0.993	0.91%	0%		
103%	20%	20.18%	1.33%	102.99%	0.997	1.33%	0%		
105%	20%	19.99%	1.38%	104.99%	0.997	1.38%	0%		
107%	20%	20.01%	-22.76%	107.21%	0.584	-0.96%	-21.80%		
108%	20%	19.57%	-42.64%	108.17%	0.417	0.96%	-43.60%		
111%	20%	19.52%	-42.70%	110.99%	0.415	0.90%	-43.60%		
114%	20%	19.76%	-44.02%	113.99%	0.409	-0.42%	-43.60%		
115%	20%	19.53%	-43.91%	114.99%	0.406	-0.31%	-43.60%		
114%	20%	20.06%	-44.17%	113.99%	0.413	-0.57%	-43.60%		
111%	20%	19.88%	-44.01%	110.99%	0.411	-0.41%	-43.60%		

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

108%	20%	19.89%	-43.24%	107.99%	0.417	0.36%	-43.60%
107%	20%	20.07%	-22.86%	107.21%	0.584	-1.06%	-21.80%
105%	20%	19.73%	1.39%	104.99%	0.997	1.39%	0%
103%	20%	20.19%	1.34%	102.99%	0.997	1.34%	0%
100%	20%	19.84%	1.30%	99.99%	0.997	1.30%	0%
97%	20%	19.70%	1.25%	96.99%	0.997	1.25%	0%
94%	20%	20.21%	1.21%	93.99%	0.998	1.21%	0%
93%	20%	19.62%	43.32%	92.99%	0.412	-0.28%	43.60%
90%	20%	19.09%	43.11%	89.99%	0.404	-0.49%	43.60%
87%	20%	19.55%	42.82%	86.99%	0.415	-0.78%	43.60%
85%	20%	19.55%	42.63%	84.99%	0.416	-0.97%	43.60%
87%	20%	19.06%	42.80%	86.99%	0.406	-0.80%	43.60%
90%	20%	19.40%	44.19%	89.99%	0.402	0.56%	43.60%
93%	20%	19.55%	44.47%	92.99%	0.402	0.87%	43.60%
94%	20%	20.20%	1.21%	93.99%	0.998	1.21%	0%
97%	20%	20.25%	1.24%	96.99%	0.998	1.24%	0%
100%	20%	19.82%	1.29%	99.99%	0.997	1.29%	0%

Note(s):

Time constant: as fast as possible but not slower as 3 s.

*: The accuracy exceeding 2% Smax is due to prioritizing the requirement of Min cos φ: 0.4.

Deactivate the voltage protection function if needed.

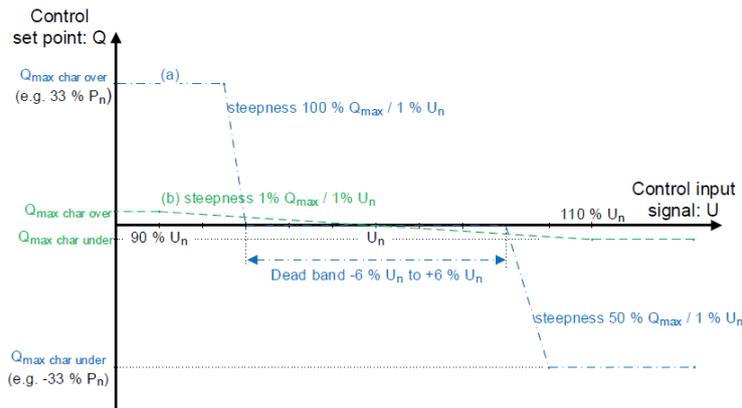
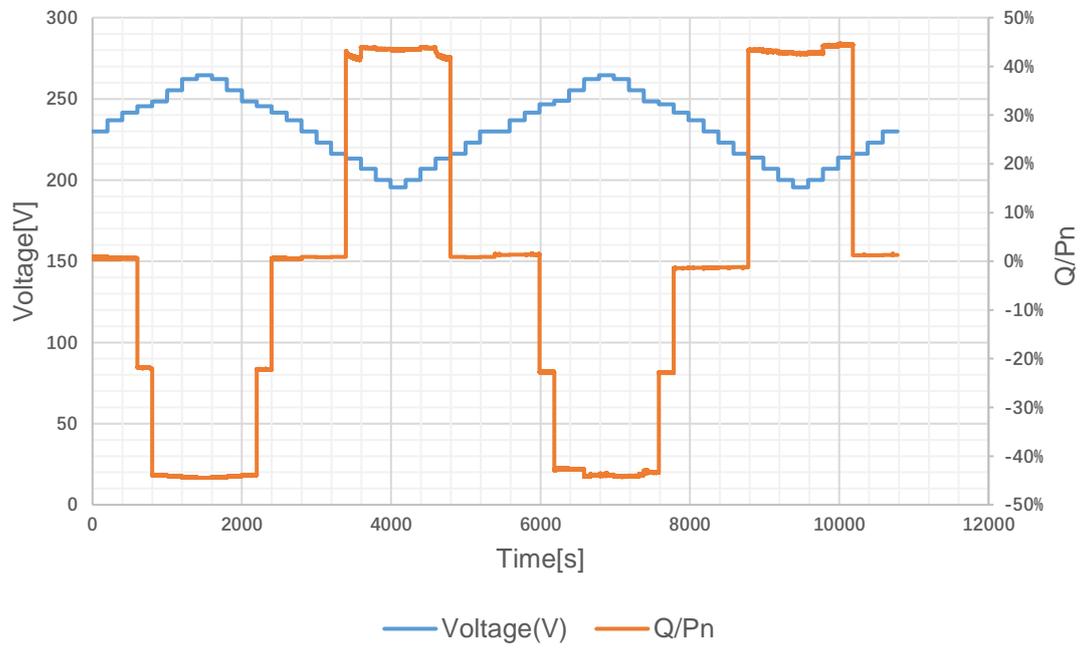


Figure 33 — Q(U) example characteristics for setting (a) and (b) for the test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram



EN 50549-10

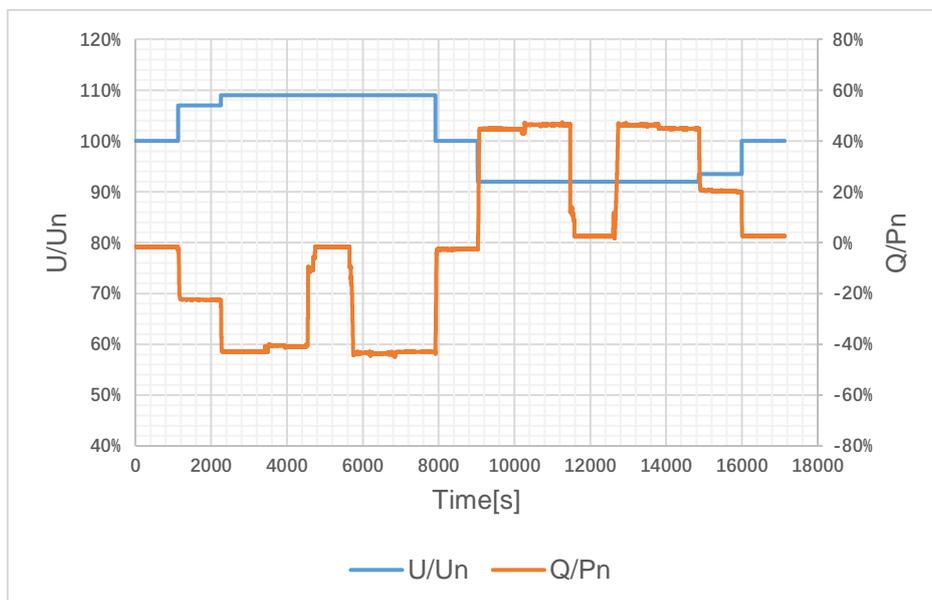
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test procedure for dynamic behaviour								
Test Conditions		Measurements			Deviation	Target value	Compliance to the PT-1 curve	Δ Limits
U/Un	P/Pn	Q/Pn [%]	P/Pn [%]	U/Un [%]	Δ Q/Pn [%]	Q/Pn*	Yes/No	Δ Q/Pn
100%	100%	-1.59%	99.50%	99.99%	-1.59%	0%	N/A	$\leq \pm 5\%$
107%	100%	-22.31%	98.34%	106.99%	-0.51%	-21.80%	Yes	
109%	100%	-42.93%	89.62%	108.99%	0.67%	-43.60%	Yes	
109%	18%	-40.43%	16.98%	108.99%	3.17%	-43.60%	N/A	
109%	3%	-0.67%	2.63%	108.99%	-0.67%	0%	Yes	
109%	22%	-43.51%	22.17%	108.99%	0.09%	-43.60%	Yes	
109%	100%	-42.98%	89.76%	108.99%	0.62%	-43.60%	N/A	
100%	100%	-2.67%	99.28%	99.99%	-2.67%	0%	Yes	
92%	100%	44.79%	91.70%	91.99%	1.30%	43.60%	Yes	
92%	18%	46.36%	18.86%	91.99%	2.76%	43.60%	N/A	
92%	3%	2.47%	1.85%	91.99%	2.47%	0%	Yes	
92%	22%	44.22%	21.99%	91.99%	0.62%	43.60%	Yes	
92%	100%	44.86%	91.84%	91.99%	1.26%	43.60%	N/A	
93.5%	100%	20.25%	98.70%	93.49%	1.55%	21.80%	Yes	
100%	100%	2.59%	99.33%	99.99%	2.59%	0%	Yes	

Note(s):

P lock-in: 20%Pn; P lock-out: 5%Pn.

Diagram



EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

5.5.2.4	TABLE: Verification procedure for voltage related control mode for reactive power Q(U)							P	
Model	SG2000								
Test procedure for Q(U) -Setting (b)									
Set points	X1	X2	X3	Time constant	Min cos φ	P Lock-in	P Lock-out		
U/Un	90%	100%	110%	20	deactivated	20%Pn	5%Pn		
Q/Qmax	10%	0%	-10%						
Test procedure for accuracy									
Test Conditions		Measurements					Target value	Δ Limits	
U/Un	P/Pn	P/Pn	Q/Pn	U/Un	Cosφ	ΔQ/ Smax	Q/Pn*	ΔQ/ Smax	Cosφ
100%	100%	99.89%	1.78%	99.99%	0.999	1.78%	0.00%	≤ ±2 Smax%	≥0.4
103%	100%	99.48%	-1.28%	102.99%	0.991	0.03%	-1.31%		
106%	100%	97.63%	-2.59%	105.99%	0.996	0.03%	-2.62%		
109%	100%	91.94%	-3.95%	108.99%	0.998	-0.03%	-3.92%		
112%	100%	88.89%	-4.51%	111.99%	0.991	-0.15%	-4.36%		
115%	100%	88.70%	-4.55%	114.99%	0.989	-0.19%	-4.36%		
112%	100%	88.92%	-4.51%	111.99%	0.991	-0.15%	-4.36%		
109%	100%	92.03%	-3.94%	108.99%	0.999	-0.02%	-3.92%		
106%	100%	97.66%	-2.60%	105.99%	0.996	0.02%	-2.62%		
103%	100%	99.55%	-1.30%	102.99%	0.991	0.01%	-1.31%		
100%	100%	99.98%	0.56%	99.99%	0.999	0.56%	0.00%		
97%	100%	99.75%	1.50%	97.17%	0.988	0.19%	1.31%		
94%	100%	98.81%	2.80%	94.24%	0.991	0.18%	2.62%		
91%	100%	94.06%	4.08%	91.21%	0.997	0.16%	3.92%		
88%	100%	91.56%	4.54%	87.99%	0.995	0.18%	4.36%		
85%	100%	91.33%	4.52%	84.99%	0.995	0.16%	4.36%		
88%	100%	91.55%	4.54%	87.99%	0.995	0.18%	4.36%		
91%	100%	94.11%	4.07%	91.21%	0.997	0.15%	3.92%		
94%	100%	98.86%	2.78%	94.25%	0.993	0.16%	2.62%		
97%	100%	99.55%	1.47%	97.21%	0.989	0.16%	1.31%		
100%	100%	99.96%	0.27%	99.99%	0.999	0.27%	0.00%		
100%	20%	19.83%	0.37%	99.99%	0.982	0.37%	0.00%		
103%	20%	19.70%	-1.41%	102.99%	0.812	0.10%	-1.31%		
106%	20%	19.44%	-2.65%	105.99%	0.973	0.03%	-2.62%		
109%	20%	19.51%	-3.89%	108.99%	0.448	-0.03%	-3.92%		
112%	20%	19.60%	-4.38%	111.99%	0.408	0.02%	-4.36%		
115%	20%	19.56%	-4.37%	114.99%	0.407	0.01%	-4.36%		
112%	20%	19.64%	-4.38%	111.99%	0.408	0.02%	-4.36%		
109%	20%	19.69%	-3.90%	108.99%	0.450	-0.02%	-3.92%		
106%	20%	19.67%	-2.66%	105.99%	0.594	0.04%	-2.62%		
103%	20%	19.59%	-1.42%	102.99%	0.808	0.11%	-1.31%		
100%	20%	19.78%	0.36%	99.99%	0.983	0.36%	0.00%		
97%	20%	19.62%	1.34%	96.99%	0.825	0.03%	1.31%		
94%	20%	19.45%	2.77%	94.12%	0.574	0.15%	2.62%		
91%	20%	19.27%	4.30%	91.21%	0.408	0.08%	3.92%		
88%	20%	19.17%	4.71%	87.99%	0.473	0.35%	4.36%		

EN 50549-10

Clause	Requirement - Test		Result - Remark					Verdict
85%	20%	19.21%	4.67%	84.99%	0.483	0.31%	4.36%	
88%	20%	19.22%	4.71%	87.99%	0.480	0.35%	4.36%	
91%	20%	19.28%	4.28%	91.25%	0.410	0.36%	3.92%	
94%	20%	19.45%	2.76%	94.12%	0.575	0.14%	2.62%	
97%	20%	19.69%	1.33%	96.99%	0.827	0.02%	1.31%	
100%	20%	19.74%	0.36%	99.99%	0.983	0.36%	0.00%	

Note(s):
 Time constant: as slow as possible but not slower as 20 s.
 Deactivate the voltage protection function if needed.

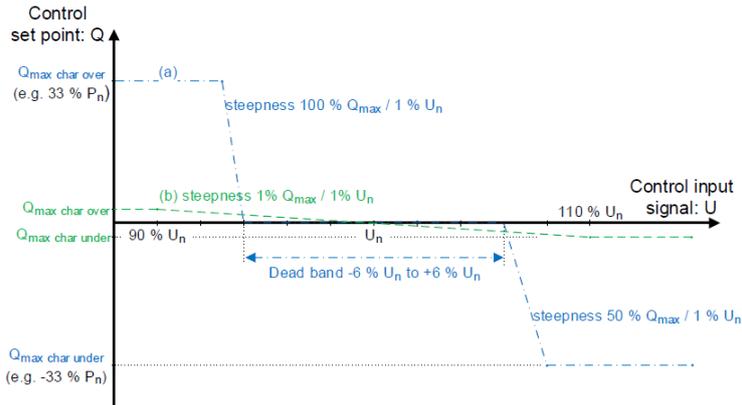
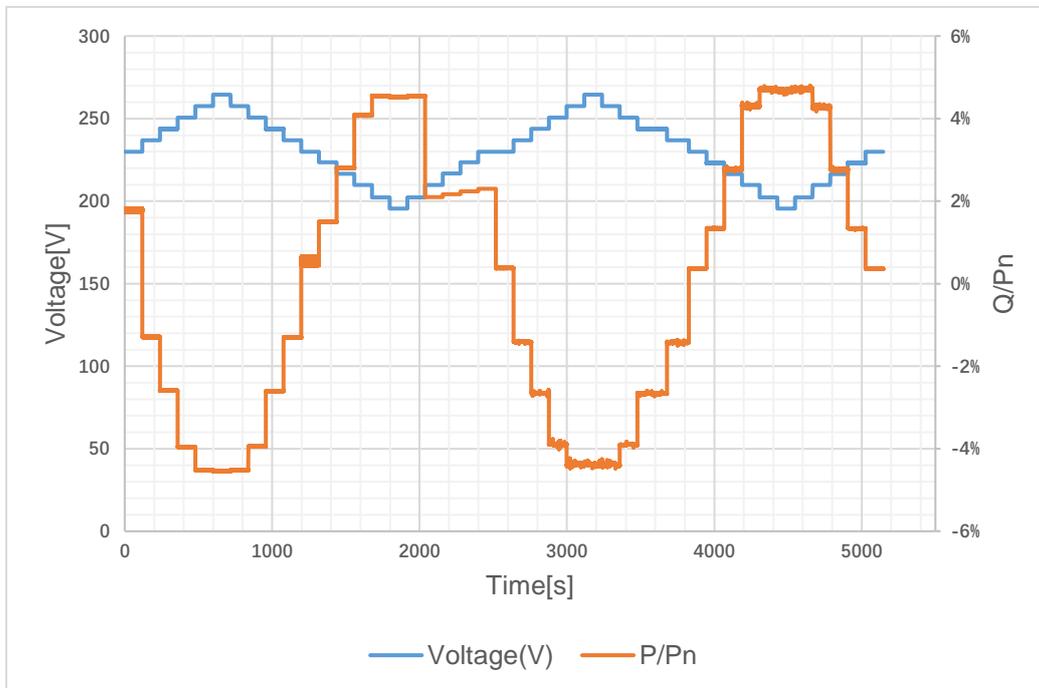


Figure 33 — Q(U) example characteristics for setting (a) and (b) for the test

Diagram

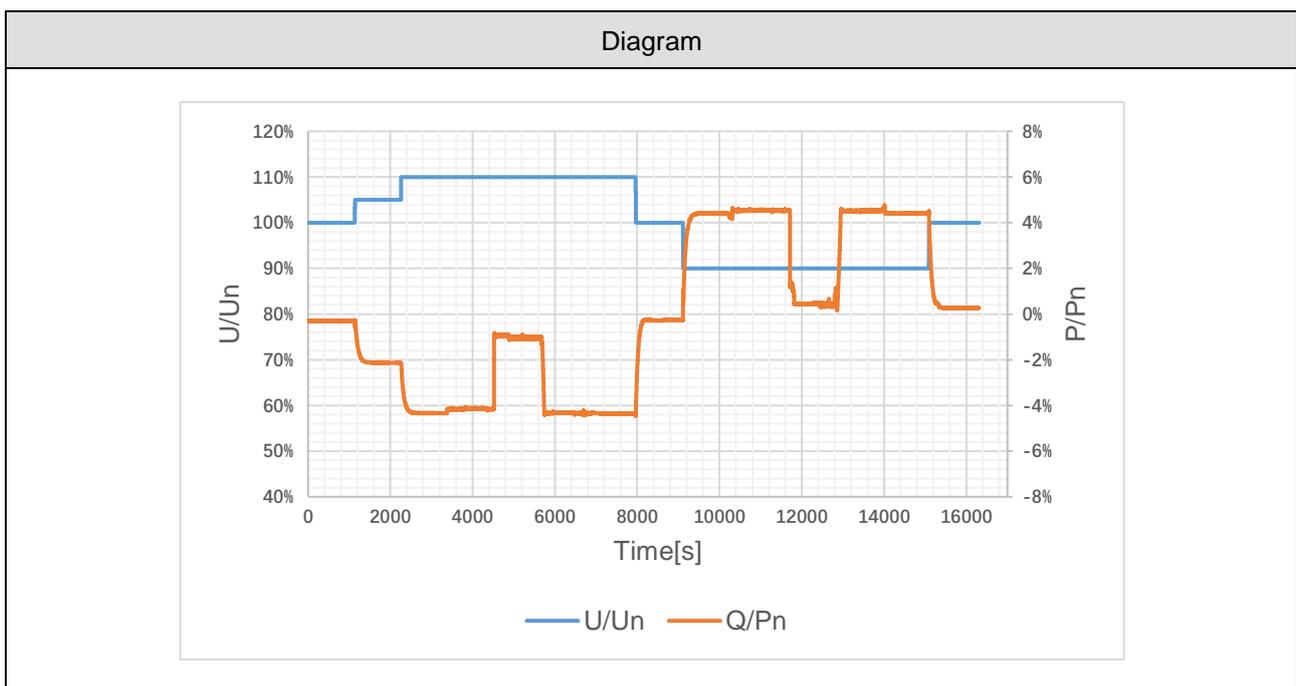


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test procedure for dynamic behaviour								
Test Conditions		Measurements			Deviation	Target value	Compliance to the PT-1 curve?	Δ Limits
U/Un	P/Pn	Q/Pn [%]	P/Pn [%]	U/Un [%]	ΔQ/Pn [%]	Q/Pn*	Yes/No	ΔQ/Pn
100%	100%	-0.29%	99.69%	99.99%	-0.29%	0.0%	N/A	≤ ±5%
105%	100%	-2.13%	99.05%	104.99%	0.05%	-2.18%	Yes	
110%	100%	-4.34%	99.01%	109.99%	0.02%	-4.36%	Yes	
110%	18%	-4.13%	18.79%	109.99%	0.23%	-4.36%	N/A	
110%	3%	-1.03%	3.50%	109.99%	-1.03%	0.0%	Yes	
110%	22%	-4.33%	22.45%	109.99%	0.03%	-4.36%	Yes	
110%	100%	-4.34%	99.84%	109.99%	0.02%	-4.36%	N/A	
100%	100%	-0.26%	99.65%	99.99%	-0.26%	0.0%	Yes	
90%	100%	4.39%	92.36%	89.99%	0.03%	4.36%	Yes	
90%	18%	4.54%	17.83%	89.99%	0.18%	4.36%	N/A	
90%	3%	0.61%	3.57%	89.99%	0.10%	0.61%	Yes	
90%	22%	4.51%	22.58%	89.99%	0.15%	4.36%	Yes	
90%	100%	4.40%	92.42%	89.99%	0.04%	4.36%	N/A	
100%	100%	0.27%	99.75%	99.99%	0.27%	0.0%	Yes	

Note(s):
P lock-in: 20%Pn; P lock-out: 5%Pn.



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.5.2.5	TABLE: Verification procedure for power related control modes for reactive power							P
Model	SG2000							
Test procedure for $\cos\phi$ (P) -Setting (a)								
$\cos\phi$ (P) curve settings:	Set points	1	2	3	4			
	P/Pn	15%	20%	80%	90%			
	Q	100%Q max over	0	0	100%Q max under			
Test procedure for accuracy								
Test Conditions		Measurements					Target vlaue	Δ Limits
P / Pn	U / Un	P / Pn	Q / Pn	U/Un	$\cos\phi$	$\Delta Q / S_{max}$	Q / Pn	$\Delta Q / S_{max}$
10%	100%	10.86%	43.46%	99.99%	0.243	-0.14%	43.60%	±2%
15%	100%	15.69%	43.26%	99.99%	0.343	-0.34%	43.60%	
20%	100%	19.74%	1.64%	99.99%	0.982	1.64%	0%	
30%	100%	30.17%	1.31%	99.99%	0.993	1.31%	0%	
40%	100%	40.49%	0.76%	99.99%	0.997	0.76%	0%	
50%	100%	50.71%	0.39%	99.99%	0.998	0.39%	0%	
60%	100%	61.22%	1.26%	99.99%	0.999	1.26%	0%	
70%	100%	71.43%	1.17%	99.99%	0.999	1.17%	0%	
80%	100%	81.58%	1.18%	99.99%	0.999	1.18%	0%	
85%	100%	86.59%	-23.13%	99.99%	0.966	-1.33%	-21.80%	
90%	100%	89.76%	-43.02%	99.99%	0.901	0.58%	-43.60%	
100%	100%	89.72%	-43.00%	99.99%	0.901	0.60%	-43.60%	
90%	100%	89.67%	-42.99%	99.99%	0.901	0.61%	-43.60%	
85%	100%	86.46%	-23.13%	99.99%	0.965	-1.33%	-21.80%	
80%	100%	81.47%	1.17%	99.99%	0.999	1.17%	0%	
70%	100%	71.61%	1.12%	99.99%	0.999	1.12%	0%	
60%	100%	60.95%	1.29%	99.99%	0.999	1.29%	0%	
50%	100%	53.53%	1.42%	99.99%	0.998	1.42%	0%	
40%	100%	40.39%	1.76%	99.99%	0.997	1.76%	0%	
30%	100%	30.06%	1.33%	99.99%	0.993	1.33%	0%	
20%	100%	19.74%	1.65%	99.99%	0.983	1.64%	0%	
15%	100%	15.15%	43.52%	99.99%	0.990	-0.08%	43.60%	
10%	100%	10.26%	44.00%	99.99%	0.226	0.40%	43.60%	
Note:								

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

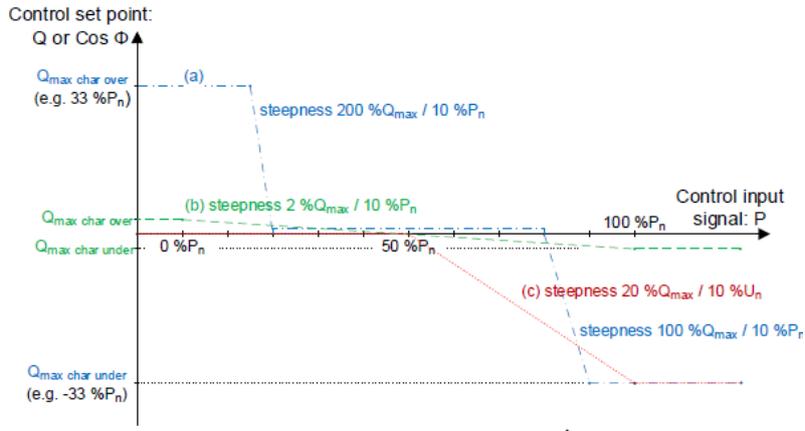
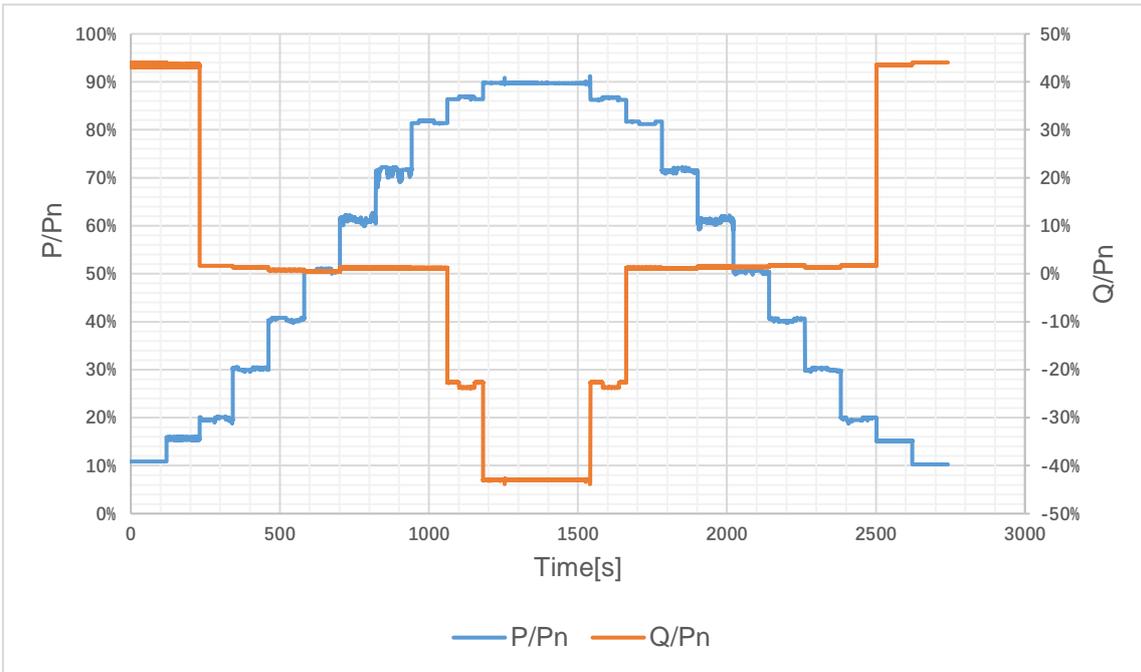


Figure 36 — Q (P) and cos φ (P) and example characteristics for setting (a), (b) and (c) for the test

Diagram



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

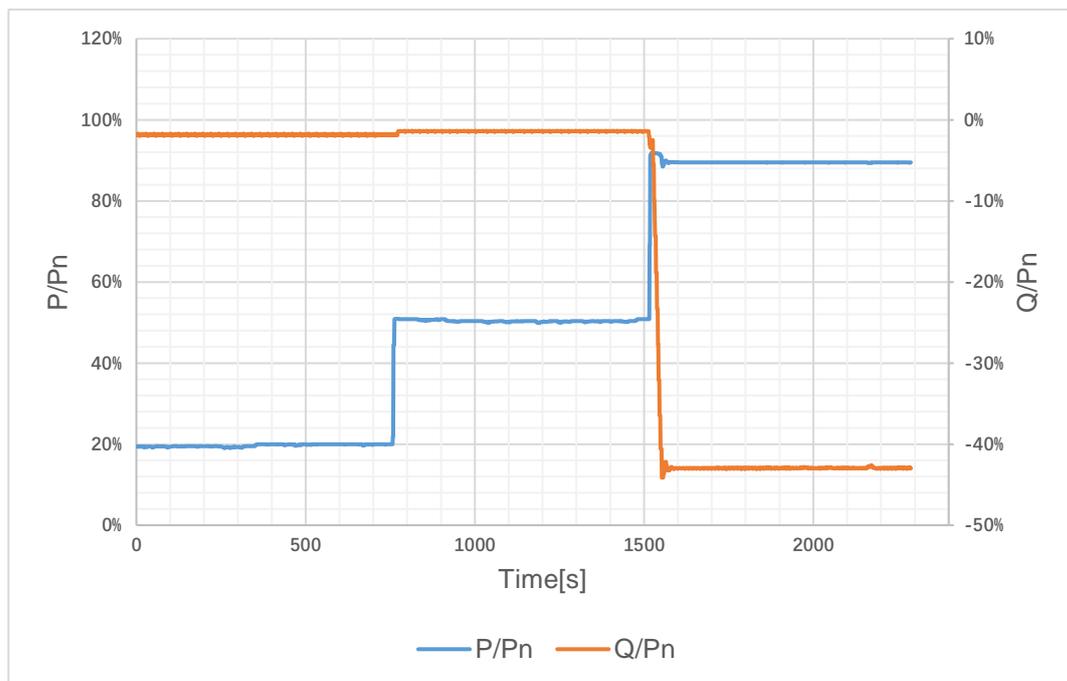
Test procedure for dynamic behaviour

Time constant: 3 s

Test Conditions	Measurements					
	Tsr [s]	Ts [s]	Td [s]	Reactive power/Pn [%]	Active power/Pn [%]	Grid voltage/Un [%]
20%Pn	--	--	--	-1.85%	19.94%	99.99%
20%Pn -> 50%Pn	--	--	--	-1.40%	50.31%	99.99%
50%Pn -> 90%Pn	5.4	6.1	0.4	-42.97%	89.50%	99.99%
90%Pn -> 50%Pn	4.3	4.5	0.7	-1.41%	50.33%	99.99%
50%Pn -> 20%Pn	--	--	--	-1.65%	19.55%	99.99%

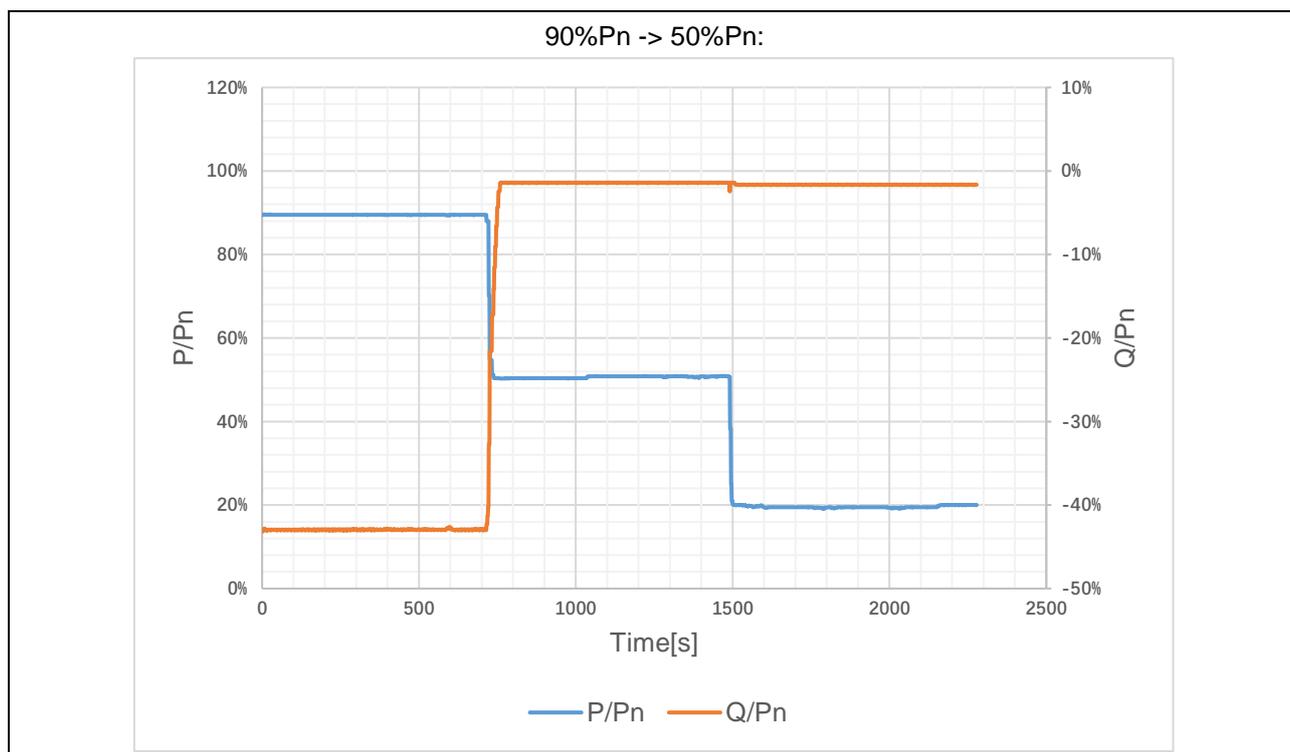
Diagram

50%Pn -> 90%Pn:



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------



Time constant: 60 s

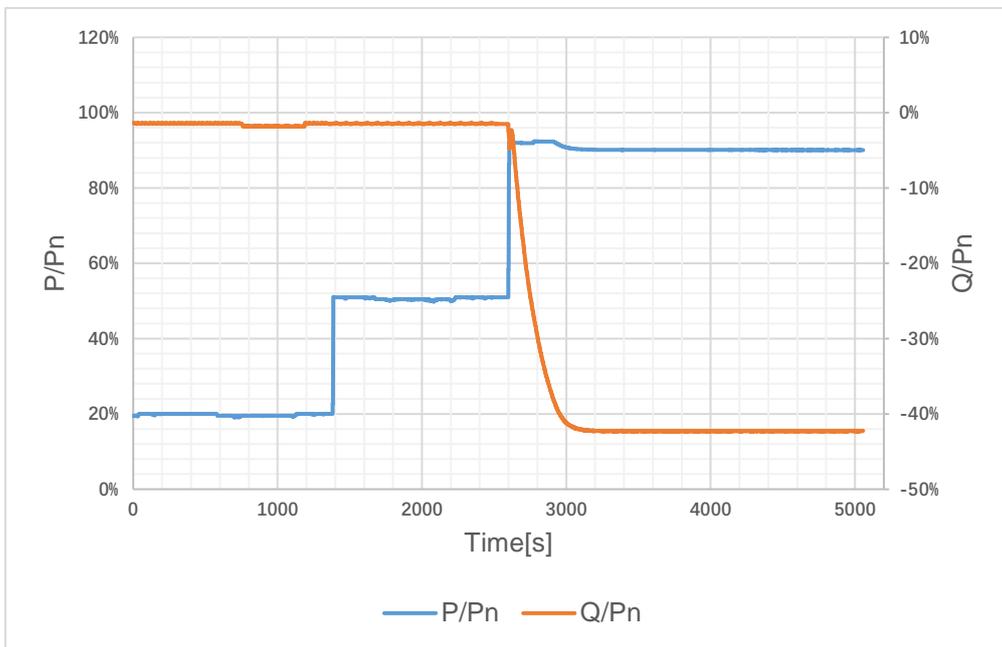
Test Conditions	Measurements					
	Tsr [s]	Ts [s]	Td [s]	Reactive power/Pn [%]	Active power/Pn [%]	Grid voltage/Un [%]
20%Pn	--	--	--	-1.46%	19.63%	99.99%
20%Pn -> 50%Pn	--	--	--	-1.48%	50.70%	99.99%
50%Pn -> 90%Pn	33.9	58.8	0.6	-42.27%	90.13%	99.99%
90%Pn -> 50%Pn	31.7	60.5	0.8	-1.20%	50.30%	99.99%
50%Pn -> 20%Pn	--	--	--	-1.19%	19.89%	99.99%

EN 50549-10

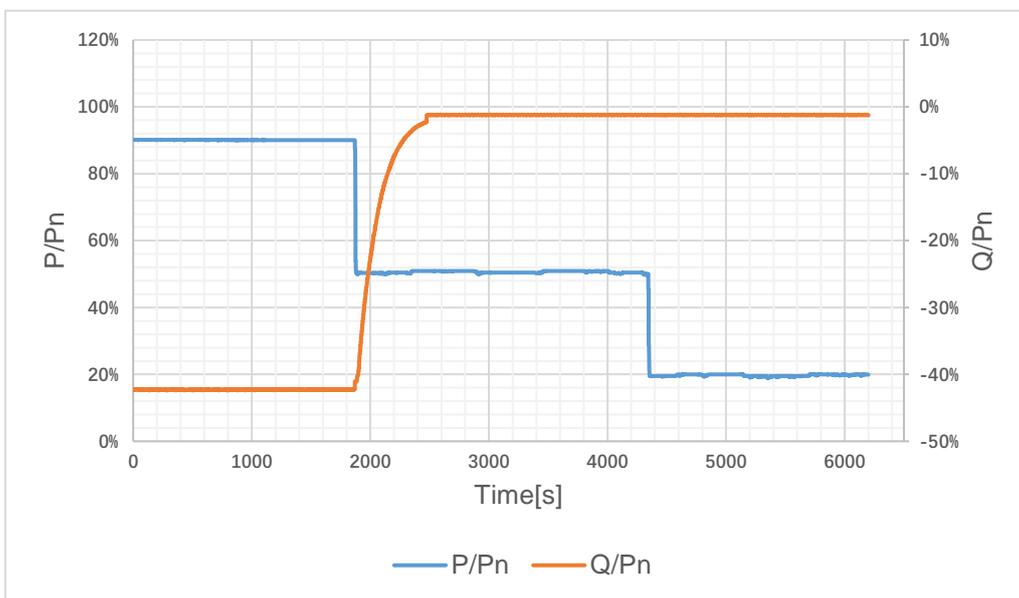
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram

50%Pn -> 90%Pn:



90%Pn -> 50%Pn:



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.5.2.5	TABLE: Verification procedure for power related control modes for reactive power					P		
Model	SG2000							
Test procedure for $\cos\phi$ (P) -Setting (c)								
$\cos\phi$ (P) curve settings:	Set points	1	2	3	4			
	P/Pn	20%	40%	50%	100%			
	Q	0	0	0	-Qmax			
Test procedure for accuracy								
Test Conditions		Measurements					Target value	Δ Limits
P / Pn	U / Un	P / Pn	Q / Pn	U/Un	$\cos\phi$	$\Delta Q / S_{max}$	Q / Pn	$\Delta Q / S_{max}$
10%	100%	10.68%	1.51%	99.99%	0.991	1.51%	0.00%	±2%
20%	100%	19.74%	1.65%	99.99%	0.983	1.65%	0.00%	
30%	100%	30.07%	1.33%	99.99%	0.993	1.33%	0.00%	
40%	100%	40.46%	1.76%	99.99%	0.997	1.76%	0.00%	
50%	100%	50.64%	1.61%	99.99%	0.997	1.61%	0.00%	
60%	100%	61.10%	-10.42%	99.99%	0.985	-1.70%	-8.72%	
70%	100%	71.60%	-16.26%	99.99%	0.975	1.18%	-17.44%	
80%	100%	81.44%	-25.79%	99.99%	0.953	0.37%	-26.16%	
90%	100%	92.09%	-33.30%	99.99%	0.940	1.56%	-34.88%	
100%	100%	89.90%	-42.61%	99.99%	0.903	0.99%	-43.60%	
90%	100%	92.01%	-33.27%	99.99%	0.940	1.61%	-34.88%	
80%	100%	81.32%	-25.75%	99.99%	0.953	0.41%	-26.16%	
70%	100%	71.45%	-16.22%	99.99%	0.975	1.22%	-17.44%	
60%	100%	60.97%	-8.31%	99.99%	0.990	0.41%	-8.72%	
50%	100%	50.63%	1.39%	99.99%	0.998	1.39%	0.00%	
40%	100%	40.35%	1.78%	99.99%	0.997	1.78%	0.00%	
30%	100%	30.07%	1.22%	99.99%	0.994	1.22%	0.00%	
20%	100%	19.68%	1.66%	99.99%	0.983	1.66%	0.00%	
10%	100%	10.37%	1.65%	99.99%	0.985	1.65%	0.00%	
30%	100%	30.09%	1.32%	99.99%	0.993	1.32%	0.00%	
20%	100%	19.69%	1.66%	99.99%	0.983	1.66%	0.00%	
15%	100%	14.76%	1.75%	99.99%	0.983	1.75%	0.00%	
10%	100%	10.92%	1.73%	99.99%	0.976	1.73%	0.00%	

EN 50549-10

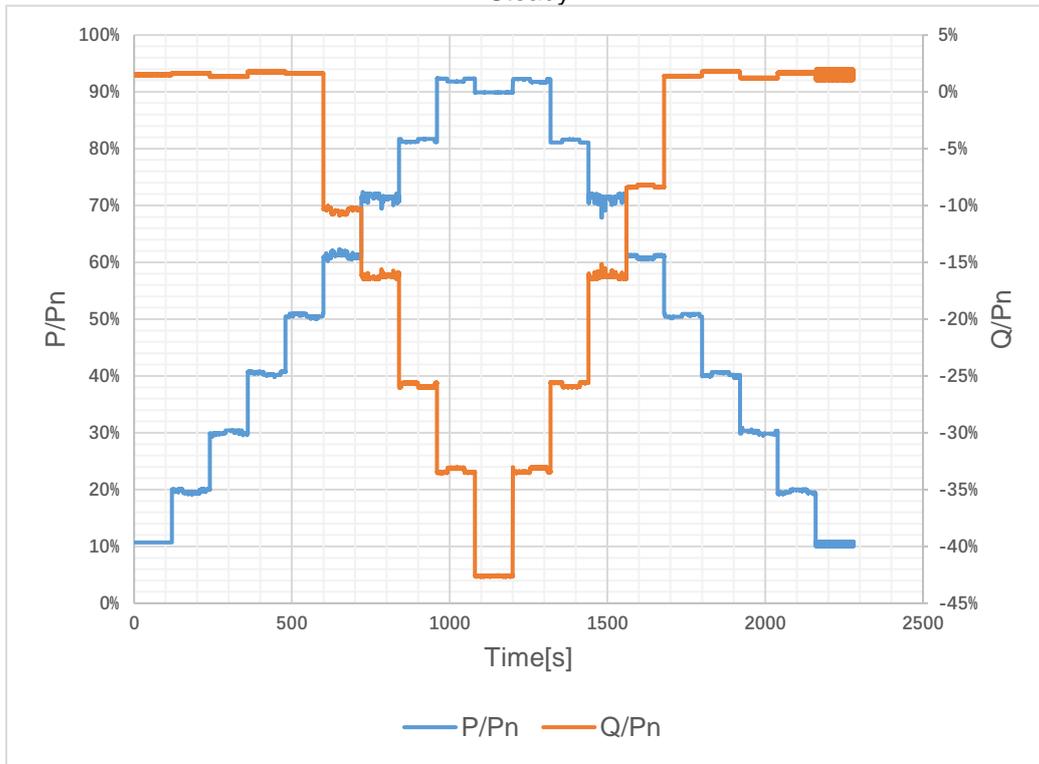
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test procedure for dynamic behaviour							
Time constant: 3.33s							
Test Conditions		Measurements					
P	U/Un	Tsr [s]	Ts [s]	Td [s]	Reactive power [var]	Active power [W]	Grid voltage [V]
20%Pn	107%	--	--	--	-1.19%	20.11%	106.99%
20%Pn -> 50%Pn	107%	--	--	--	-1.34%	51.12%	106.99%
50%Pn -> 90%Pn	107%	3.9	5.5	0.5	-33.99%	92.22%	106.99%
90%	103%	--	--	--	-34.09%	92.58%	102.99%
90%	98%	3.0	3.4	0.3	1.60%	92.56%	97.99%
90%	107%	4.4	5.8	0.5	-34.34%	92.64%	106.99%
90%	100%	3.5	4.0	0.3	-1.07%	92.11%	99.99%
90%Pn -> 50%Pn	100%	--	--	--	-1.08%	51.08%	99.99%
50%Pn -> 20%Pn	100%	--	--	--	-1.09%	19.95%	99.99%
Note: Lock-in voltage: 105%Un Lock out voltage: 100%Un							

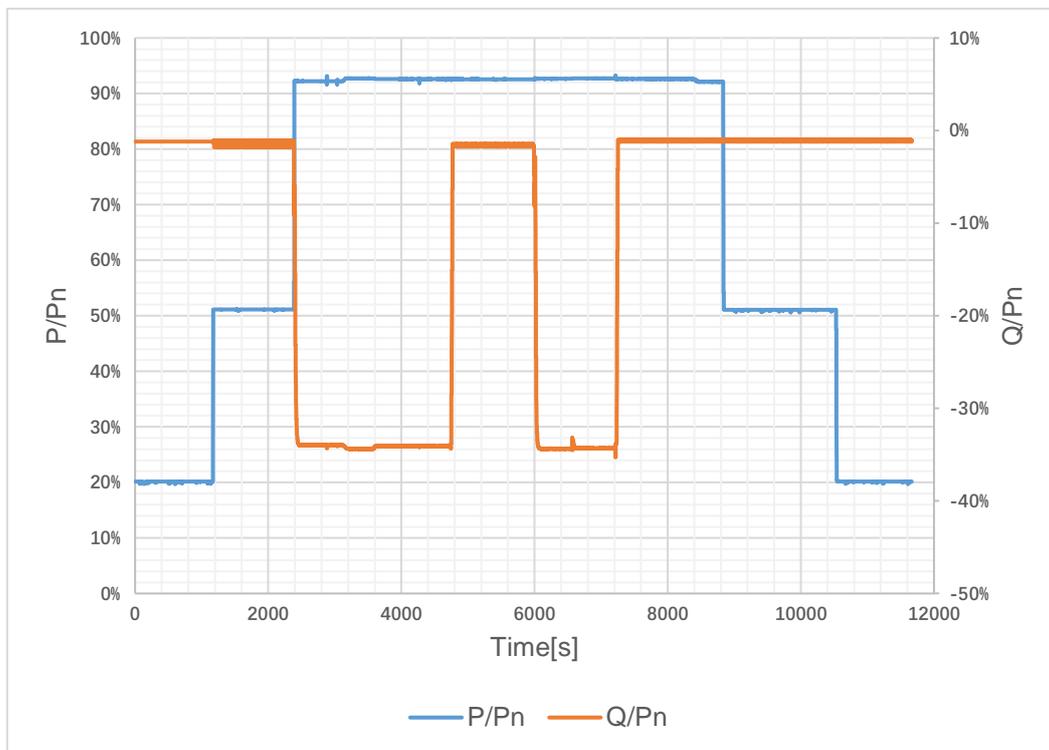
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram
Steady



Dynamic



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.6	TABLE: Voltage related active power reduction - P(U)	P
------------	---	---

Model	SG2000
-------	--------

P(U) curve settings:	Set points	1	2			
	U/Un	110%	115%			
	P/Pn	100%	0%			
	Q(U) function activated and configured the QU function to setting (a) .					
	Set points	X1	X2	X3	X4	Tau
	U/Un	93%	94%	106%	108%	3 s
	Q/Qmax	100%	0	0	-100%	

Test procedure for steady-state behaviour

Test Conditions		Measurements					Target value		Δ Limits	
U/Un	P/Pn	U/Un	P/Pn	Q/Pn	$\Delta P/S_{max}$	$\Delta Q/S_{max}$	P/Pn	Q	$\Delta P/S_{max}$	$\Delta Q/S_{max}$
100%	100%	99.99%	99.85%	-1.61%	-0.15%	-1.61%	100%	0%	$\leq \pm 2\%$	$\leq \pm 2\%$
103%		102.99%	99.95%	-1.64%	-0.05%	-1.64%	100%	0%		
106%		105.99%	100.02%	-1.65%	0.02%	-1.65%	100%	0%		
109%		108.99%	88.82%	-44.65%	-1.18%	-1.05%	90%	- Qmax		
112%		111.99%	60.33%	-44.64%	-0.33%	-1.06%	60%	- Qmax		
115%		115.21%	1.08%	-44.66%	1.08%	-1.06%	0%	- Qmax		
112%		111.99%	60.74%	-44.40%	0.74%	-0.80%	60%	- Qmax		
109%		108.99%	88.85%	-44.66%	-1.15%	-1.06%	90%	- Qmax		
106%		105.99%	99.66%	-1.88%	-0.34%	-1.88%	100%	0%		
103%		102.99%	99.92%	-1.66%	-0.08%	-1.66%	100%	0%		
100%		99.99%	99.80%	-1.65%	-0.20%	-1.65%	100%	0%		

Note:

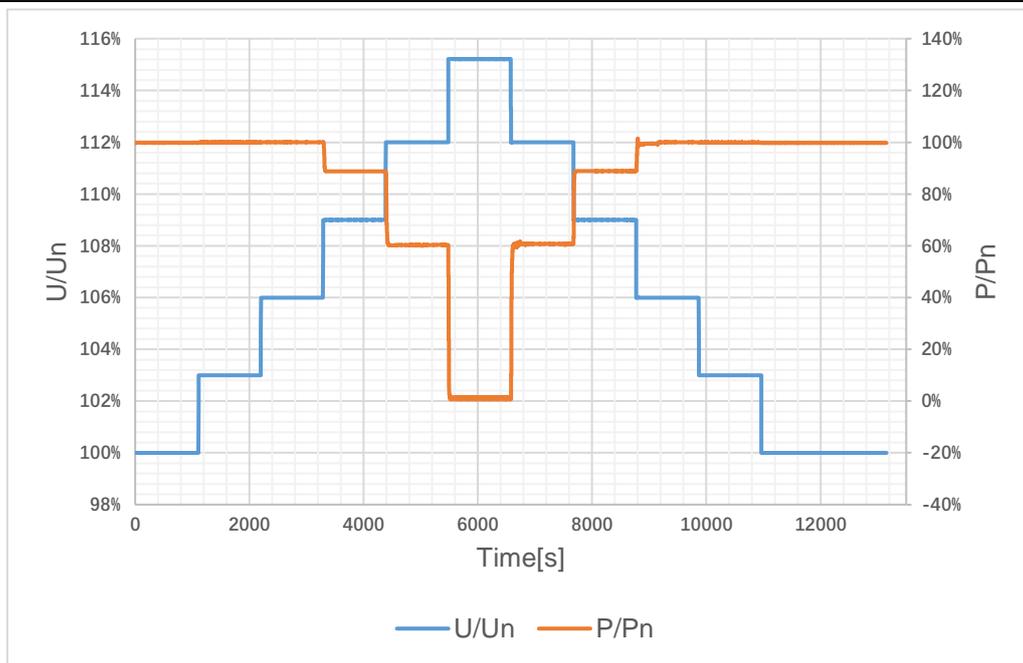
*: Due to the influence of the maximum current limit, it is allowed to reduce the active power under the condition that I reaches I_{max}.

** : the reactive power is continuity with min Cos ϕ =0.4.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram



EN 50549-10

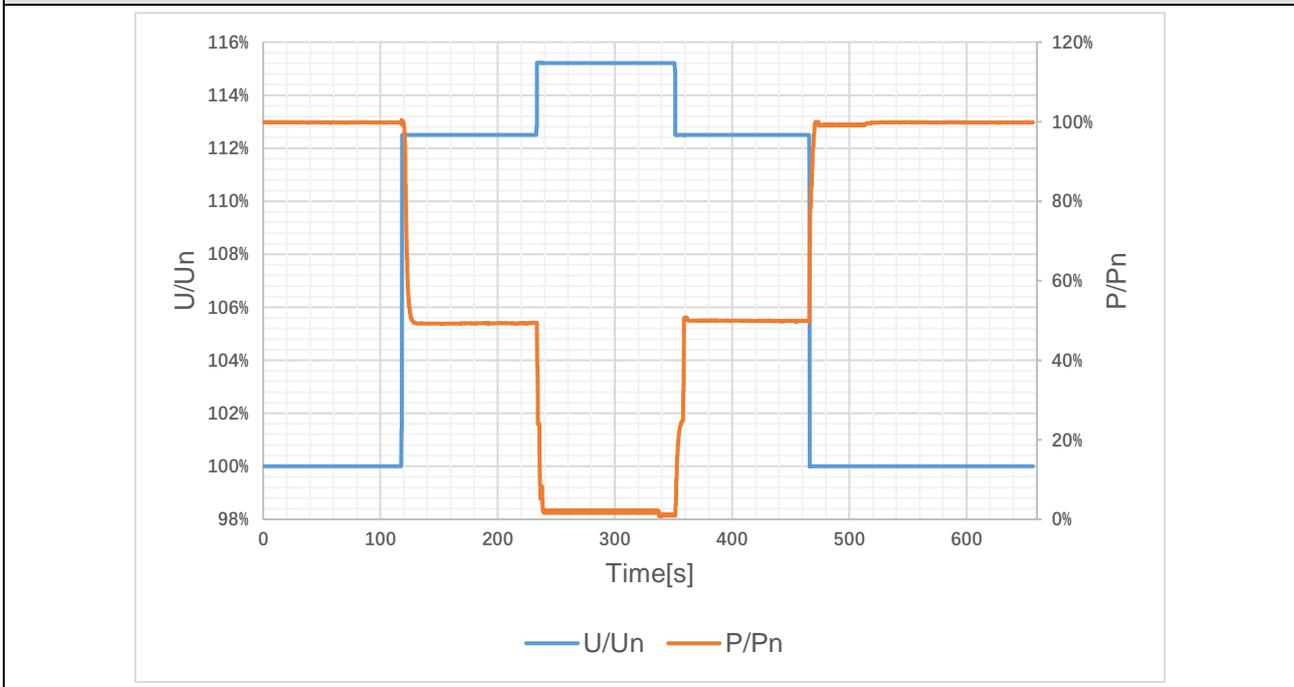
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test procedure for dynamic behaviour-Tau ≥3s (eg.5s)

P=100%P_n; Q(U) function activated and configured the QU function to **setting (a)**.

Test Conditions		Measurements				Target value		Limits	
U/U _n	P/P _n	U/U _n	P/P _n	Q/P _n	T _{sr_90%}	P/P _n	Q	ΔP/P _n	T _{sr_90%}
100%U _n -> 112.5%U _n	100%	112.49%	49.31%	-43.49%	7.6	50%	- Q _{max}	≤ ±5%	≥ 3s
112.5%U _n -> 115%U _n		115.21%	1.89%	-43.47%	7.0	0	- Q _{max}		
115%U _n -> 112.5%U _n		112.49%	48.91%	-44.47%	7.8	50%	- Q _{max}		
112.5%U _n -> 100%U _n		99.99%	99.66%	-1.82%	5.6	100%	0		

Diagram



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.7.2.2	TABLE: Power quality - Harmonic emission	P	
Model	SG2000		

Opinion 1: Power generating unit (individual device) and power generating system which is $I_n \leq 75A$

Test: Each phase output current $\leq 16A$, it shall be complied with EN 61000-3-2.

Measurements

Parameter	U (V)	f (Hz)	I (A)	P (W)	S (VA)	Power Factor THD (%)
Phase L1	229.9	50	4.31	988.9	989.2	3.74%
Phase L2	--	--	--	--	--	--
Phase L3	--	--	--	--	--	--

Harmonic odd no.	Current Magnitude (%)			Harmonic Current Limits (%)
	Phase L1	Phase L2	Phase L3	
1	0.17	--	--	--
2	1.01	--	--	8
3	0.10	--	--	21.6
4	0.04	--	--	4
5	0.02	--	--	10.7
6	0.02	--	--	2.7
7	0.09	--	--	7.2
8	0.10	--	--	2
9	0.07	--	--	3.8
10	0.10	--	--	1.6
11	0.06	--	--	3.1
12	0.11	--	--	1.3
13	0.06	--	--	2
14	0.10	--	--	--
15	0.05	--	--	--
16	0.10	--	--	--
17	0.05	--	--	--
18	0.10	--	--	--
19	0.04	--	--	--
20	0.11	--	--	--
21	0.04	--	--	--
22	0.12	--	--	--
23	0.04	--	--	--
24	0.10	--	--	--
25	0.03	--	--	--
26	0.07	--	--	--
27	0.03	--	--	--
28	0.07	--	--	--
29	0.03	--	--	--
30	0.12	--	--	--
31	0.03	--	--	--
32	0.08	--	--	--
33	0.03	--	--	--
34	0.11	--	--	--
35	0.04	--	--	--
36	0.12	--	--	--
37	0.04	--	--	--
38	0.03	--	--	--
39	0.06	--	--	--
40	0.08	--	--	--
THDi	2.469	--	--	--

Note(s):

EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

5.7.2.3	TABLE: Power quality - Flicker	P
----------------	---------------------------------------	---

Model	SG2000
-------	--------

Opinion 1: Generation units with a rated current $\leq 75A$

Test:

Measurements												
Parameter	P _{st}			d(t) (%)			d _c (%)			d _{max} (%)		
	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
1	0.128	--	--	0	--	--	0.044	--	--	0.286	--	--
2	0.128	--	--	0	--	--	0.037	--	--	0.255	--	--
3	0.126	--	--	0	--	--	0.048	--	--	0.289	--	--
4	0.125	--	--	0	--	--	0.093	--	--	0.281	--	--
5	0.124	--	--	0	--	--	0.045	--	--	0.26	--	--
6	0.124	--	--	0	--	--	0.041	--	--	0.267	--	--
7	0.123	--	--	0	--	--	0	--	--	0	--	--
8	0.122	--	--	0	--	--	0	--	--	0	--	--
9	0.119	--	--	0	--	--	0	--	--	0	--	--
10	0.12	--	--	0	--	--	0	--	--	0	--	--
11	0.129	--	--	0	--	--	0.143	--	--	0.307	--	--
12	0.131	--	--	0	--	--	0	--	--	0	--	--

Parameter	Measurements					Limit				
	P _{st}	P _{lt}	d(t) (%)	d _c (%)	d _{max} (%)	P _{st}	P _{lt}	d(t) (%)	d _c (%)	d _{max} (%)
L1	0.131	0.125	0	0.143	0.307	≤ 1.0	≤ 0.65	≤ 3.3	≤ 3.3	≤ 4.0
L2	--	--	--	--	--					
L3	--	--	--	--	--					

Note(s):

Each phase output current $\leq 16A$, it shall be complied with EN 61000-3-3.

Each phase output current $> 16A$ and $\leq 75A$, it shall be complied with EN 61000-3-11.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.7.2.3.5	TABLE: Power quality - Rapid voltage changes		P
Model	SG2000		

Each phase output current < 75A									
Switch-on for any capacity (10% PEmax)									
Phase	L1			L2			L3		
Single period effective values of the current [A]	0.61	1.18	1.05	--	--	--	--	--	--
Single period effective values of the voltage [V]	229.9	230.0	230.0	--	--	--	--	--	--
k _i value [1]	0.070	0.135	0.120	--	--	--	--	--	--
k _{imax} value [1]	0.036								

Unfavorable case when switching the generator step (not necessary for electronic inverter)									
Phase	L1			L2			L3		
Single period effective values of the current [A]	N/A								
Single period effective values of the voltage [V]	N/A								
k _i value [1]	N/A								
k _{imax} value [1]	N/A								

Switch-on for nominal capacity									
Phase	L1			L2			L3		
Single period effective values of the current [A]	0.46	0.68	0.46	--	--	--	--	--	--
Single period effective values of the voltage [V]	230.0	229.9	229.9	--	--	--	--	--	--
k _i value [1]	0.052	0.078	0.052	--	--	--	--	--	--
k _{imax} value [1]	0.117								
Switch-off for nominal capacity									
Phase	L1			L2			L3		
Single period effective values of the current [A]	4.86	8.10	7.77	--	--	--	--	--	--
Single period effective values of the voltage [V]	229.9	229.9	230.1	--	--	--	--	--	--
k _i value [1]	0.559	0.932	0.894	--	--	--	--	--	--
k _{imax} value [1]	0.997								

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Grid Frequency [Hz]	50		
Grid voltage [V]	230		
Rated current I_r [A]	8.69A		
Highest k_{imax} value for all switching operations [1]	0.932		
<p>Note: Limits: $k_{imax} = 1,2$ for synchronous generators with fine synchronization, converter; (electronic inverter) $k_{imax} = 4$ for asynchronous generators, which are switched on at 95% to 105% of their synchronous speed, if no further details are available regarding the type of current limitation, With regard to short-term compensation processes, the condition mentioned below for very short voltage changes must also be observed, $k_{imax} = 8$ for asynchronous generators that are powered up by the network if I_a is unknown, (I_a = starting current)</p>			
<p>Environmental condition (ambient) Temperature (°C) :25,0 Humidity (%rh):47,1 Pressure (hPa) : 1018</p>			

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict						
5.7.2.4	TABLE: Power quality - DC Injection		P						
Model	SG2000								
Test Conditions	Measurements						Target value	Limits	
P/P _n	U/U _n	I/I _n	P/P _n	cos φ	I _{dc} /I _n			I _{dc} /I _n	I _{dc} /I _n
					L1	L2	L3		
30-40%	99.99%	36.33%	36.18%	0.995	0.00%	--	--	0%	≤ ±0.5% or 20 mA
60-70%	99.99%	64.96%	64.95%	0.999	0.00%	--	--	0%	
≥ 95%	99.99%	98.84%	98.86%	0.999	0.00%	--	--	0%	
Note(s):									

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)			P		
Model	SG2000					
Accuracy of the setting values:						
Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L1-N	L2-N	L3-N	
U<	20%Un	--	46.12	--	--	± 1% of Un
		--	46.19	--	--	
		--	45.99	--	--	
U<	45%Un	--	103.59	--	--	
		--	103.58	--	--	
		--	103.58	--	--	
U<	65%Un	--	149.69	--	--	
		--	149.69	--	--	
		--	149.68	--	--	
U<	100%Un	--	229.99	--	--	
		--	228.99	--	--	
		--	228.99	--	--	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L1		
U<	20%Un	--	--	--	± 1% of Un	
		--	--	--		
		--	--	--		
U<	45%Un	--	--	--		
		--	--	--		
		--	--	--		
U<	65%Un	--	--	--		
		--	--	--		
		--	--	--		
U<	100%Un	--	--	--		
		--	--	--		
		--	--	--		
Notes: Ramp signal test						

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)		P
---------	--	--	---

Model	SG2000
-------	--------

Accuracy of the setting values:

Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L1-N	L2-N	L3-N	
U<<	20%Un	--	46.19	--	--	± 1% of Un
		--	46.19	--	--	
		--	46.20	--	--	
U<<	45%Un	--	103.59	--	--	
		--	103.48	--	--	
		--	103.59	--	--	
U<<	65%Un	--	149.67	--	--	
		--	149.58	--	--	
		--	149.58	--	--	
U<<	100%Un	--	230.99	--	--	
		--	230.89	--	--	
		--	230.88	--	--	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L4		
U<<	20%Un	--	--	--	± 1% of Un	
		--	--	--		
		--	--	--		
U<<	45%Un	--	--	--		
		--	--	--		
		--	--	--		
U<<	65%Un	--	--	--		
		--	--	--		
		--	--	--		
U<<	100%Un	--	--	--		
		--	--	--		
		--	--	--		

Notes: Ramp signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)		P
---------	--	--	---

Model	SG2000
-------	--------

Accuracy of the setting values:

Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L1-N	L2-N	L3-N	
U>	100%Un	--	229.99	--	--	± 1% of Un
		--	228.99	--	--	
		--	228.99	--	--	
U>	106%Un	--	243.98	--	--	
		--	243.97	--	--	
		--	243.98	--	--	
U>	112%Un	--	258.08	--	--	
		--	257.98	--	--	
		--	257.98	--	--	
U>	120%Un	--	276.19	--	--	
		--	276.18	--	--	
		--	276.18	--	--	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L4		
U>	100%Un	--	--	--	± 1% of Un	
		--	--	--		
		--	--	--		
U>	106%Un	--	--	--		
		--	--	--		
		--	--	--		
U>	112%Un	--	--	--		
		--	--	--		
		--	--	--		
U>	120%Un	--	--	--		
		--	--	--		
		--	--	--		

Notes: Ramp signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)		P
---------	--	--	---

Model	SG2000
-------	--------

Accuracy of the setting values:

Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L1-N	L2-N	L3-N	
U>>	100%Un	--	230.19	--	--	± 1% of Un
		--	229.79	--	--	
		--	229.88	--	--	
U>>	109%Un	--	250.58	--	--	
		--	250.57	--	--	
		--	250.59	--	--	
U>>	118%Un	--	271.88	--	--	
		--	271.87	--	--	
		--	271.88	--	--	
U>>	130%Un	--	299.69	--	--	
		--	299.59	--	--	
		--	299.49	--	--	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L1		
U>>	100%Un	--	--	--	± 1% of Un	
		--	--	--		
		--	--	--		
U>>	109%Un	--	--	--		
		--	--	--		
		--	--	--		
U>>	118%Un	--	--	--		
		--	--	--		
		--	--	--		
U>>	130%Un	--	--	--		
		--	--	--		
		--	--	--		

Notes: Ramp signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)				P	
Model	SG2000					
Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U<	100	--	125	--	--	100-200
		--	134	--	--	
		--	133	--	--	
U<	30000	--	30060	--	--	30000-30100
		--	30080	--	--	
		--	30080	--	--	
U<	60000	--	60040	--	--	60000-60100
		--	60041	--	--	
		--	60040	--	--	
U<	100000	--	100040	--	--	100000-100100
		--	100041	--	--	
		--	100042	--	--	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U<	100	--	--	--	100-200	
		--	--	--		
		--	--	--		
U<	30000	--	--	--	30000-30100	
		--	--	--		
		--	--	--		
U<	60000	--	--	--	60000-60100	
		--	--	--		
		--	--	--		
U<	100000	--	--	--	100000-100100	
		--	--	--		
		--	--	--		
Note(s): Jump signal test						

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)	P
---------	--	---

Model	SG2000
-------	--------

Time measurements:

Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U<<	100	--	136	--	--	100-200
		--	128	--	--	
		--	105	--	--	
U<<	1500	--	1552	--	--	1500-1600
		--	1544	--	--	
		--	1538	--	--	
U<<	3000	--	3020	--	--	3000-3100
		--	3040	--	--	
		--	3030	--	--	
U<<	5000	--	5050	--	--	5000-5100
		--	5040	--	--	
		--	5040	--	--	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U<<	100	--	--	--	100-200	
		--	--	--		
		--	--	--		
U<<	1500	--	--	--	1500-1600	
		--	--	--		
		--	--	--		
U<<	3000	--	--	--	3000-3100	
		--	--	--		
		--	--	--		
U<<	5000	--	--	--	5000-5100	
		--	--	--		
		--	--	--		

Note(s): Jump signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)	P
---------	--	---

Model	SG2000
-------	--------

Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U>	100	--	121	--	--	100-200
		--	124	--	--	
		--	125	--	--	
U>	30000	--	30060	--	--	30000-30100
		--	30040	--	--	
		--	30060	--	--	
U>	60000	--	60020	--	--	60000-60100
		--	60040	--	--	
		--	60040	--	--	
U>	100000	--	100080	--	--	100000-100100
		--	100020	--	--	
		--	100020	--	--	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U>	100	--	--	--	100-200	
		--	--	--		
		--	--	--		
U>	30000	--	--	--	30000-30100	
		--	--	--		
		--	--	--		
U>	60000	--	--	--	60000-60100	
		--	--	--		
		--	--	--		
U>	100000	--	--	--	100000-100100	
		--	--	--		
		--	--	--		

Note(s): Jump signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Voltage protection)		P
---------	--	--	---

Model	SG2000
-------	--------

Time measurements:

Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U>>	100	--	132	--	--	100-200
		--	122	--	--	
		--	132	--	--	
U>>	1500	--	1548	--	--	1500-1600
		--	1536	--	--	
		--	1548	--	--	
U>>	3000	--	3030	--	--	3000-3100
		--	3040	--	--	
		--	3040	--	--	
U>>	5000	--	5040	--	--	5000-5100
		--	5040	--	--	
		--	5034	--	--	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U>>	100	--	--	--	100-200	
		--	--	--		
		--	--	--		
U>>	1500	--	--	--	1500-1600	
		--	--	--		
		--	--	--		
U>>	3000	--	--	--	3000-3100	
		--	--	--		
		--	--	--		
U>>	5000	--	--	--	5000-5100	
		--	--	--		
		--	--	--		

Note(s): Jump signal test

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.	TABLE: Interface protection (Frequency protection)		P
Model	SG2000		
Accuracy of the setting values:			
Condition	Setting	Measurement Trip value [Hz]	Limitation
F>	50Hz	49.99	± 0.1% of fn
		49.99	
		49.98	
F>	50.5Hz	50.49	
		50.49	
		50.49	
F>	51.5Hz	51.49	
		51.49	
		51.49	
F>	52Hz	52.00	
		51.99	
		51.99	
Condition	Setting	Measurement Trip value [Hz]	Limitation
F>>	50Hz	49.99	± 0.1% of fn
		49.99	
		49.99	
F>>	50.5Hz	50.49	
		50.49	
		50.49	
F>>	51.5Hz	51.49	
		51.49	
		51.49	
F>>	52Hz	51.99	
		51.99	
		51.99	
Note(s): Ramp signal test			

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2	TABLE: Interface protection (Frequency protection)		P
Model	SG2000		
Accuracy of the setting values:			
Condition	Setting	Measurement Trip value [Hz]	Limitation
F<	47Hz	46.99	± 0.1% of fn
		46.99	
		46.99	
F<	48Hz	47.99	
		47.99	
		47.99	
F<	49Hz	48.98	
		48.99	
		48.99	
F<	50Hz	49.99	
		49.98	
		49.98	
Condition	Setting	Measurement Trip value [Hz]	Limitation
F<<	47Hz	46.98	± 0.1% of fn
		46.99	
		46.99	
F<<	48Hz	47.99	
		47.99	
		47.99	
F<<	49Hz	48.99	
		48.99	
		48.98	
F<<	50Hz	49.89	
		49.98	
		49.99	
Note(s): Ramp signal test			

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
5.8.3.2	TABLE: Interface protection (Frequency protection)		P
Model	SG2000		
Time measurements:			
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
F>	100	139	100-200
		149	
		149	
F>	30000	30040	30000-30100
		30040	
		30060	
F>	60000	60080	60000-60100
		60040	
		60040	
F>	100000	100040	100000-100100
		100010	
		100040	
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
F>>	100	154	100-200
		141	
		143	
F>>	1500	1532	1500-1600
		1532	
		1528	
F>>	3000	3050	3000-3100
		3060	
		3040	
F>>	5000	5090	5000-5100
		5090	
		5080	
Note(s): Jump signal test			

EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict
5.8.3.2	TABLE: Interface protection (Frequency protection)		P
Model	SG2000		
Time measurements:			
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
F<	100	141	100-200
		138	
		144	
F<	30000	30060	30000-30100
		30080	
		30060	
F<	60000	60080	60000-60100
		60080	
		60040	
F<	100000	100040	100000-100100
		100040	
		100020	
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
F<<	100	154	100-200
		148	
		131	
F<<	1500	1530	1500-1600
		1532	
		1528	
F<<	3000	3050	3000-3100
		3060	
		3060	
F<<	5000	5040	5000-5100
		5050	
		5040	
Note(s): Jump signal test			

EN 50549-10							
Clause	Requirement - Test	Result - Remark			Verdict		
5.8.3.2.4	TABLE: Interface protection (Reset time and reset ratio)				P		
Model	SG2000						
Condition	Setting U/Un [ms]	Measurement		Limitation			
		UL1-N, UL2-N, UL3-N		Reset time	Result		
		Reset time	Result			Reset time	Result
U> Un- 1.13Un(2940ms) - 1.08Un(3200ms) -Un	1.1Un/ 3000	2984	Trip	≤50ms	No trip		
		3277	No trip				
U>> Un- 1.23Un(40ms)- 1.18Un(300ms)- Un	1.2Un/ 100	43.6	Trip				
		310	No trip				
U< Un- 0.87Un(2940ms) - 0.92Un(3200ms) -Un	0.9Un/ 3000	2950	Trip				
		3200	No trip				
U<< Un- 0.77Un(40ms)- 0.82Un(300ms)- Un	0.8Un/ 100	55.6	Trip				
		320	No trip				
Condition	Setting HZ/ [ms]	Measurement				Limitation	
		Reset time	Result			Reset time	Result
F< 50HZ- 49.2HZ(2940ms) - 49.7HZ(3200ms) -50HZ	49.5/ 3000	2970	Trip	≤50ms	No trip		
		3200	No trip				
F<< 50HZ- 48.2HZ(40MS)- 48.7HZ(300ms)- 50HZ	48.5/ 100	77.6	Trip				
		320	No trip				
F> 50HZ- 50.8HZ(2940ms) - 50.3HZ(3200ms) -50HZ	50.5/ 3000	3020	Trip				
		3200	No trip				
F>> 50HZ- 51.8HZ(40ms)- 51.3HZ(300ms)- 50HZ	51.5 100	50.0	Trip				
		320	No trip				

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.2.6	TABLE: Interface protection (Immunity to voltage harmonics)		P
Model	SG2000		
The test item $f < 1$ shall be repeated under the voltage conditions as described in EN IEC 60255-181: 2019, Table 26			
Condition	Setting	Measurement Trip value [Hz]	Limitation
F>	50Hz	49.99	$\pm 0.1\%$ of f_n
		49.99	
		49.99	
F>	50.5Hz	50.49	
		50.49	
		50.49	
F>	51.5Hz	51.49	
		51.49	
		51.49	
F>	52Hz	51.99	
		52.00	
		51.99	

The test item $U < 1$ shall be repeated under the voltage conditions as described in EN IEC 60255-181: 2019, Table 26			
Condition	Setting	Measurement Trip value [Hz]	Limitation
U<	20%Un	46.09	$\pm 0.1\%$ of f_n
		46.09	
		45.98	
U<	45%Un	103.56	
		103.64	
		103.58	
U<	65%Un	149.86	
		149.87	
		149.88	
U<	100%Un	230.73	
		230.66	
		230.67	

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.3	Table: Overvoltage 10 min mean protection (OV)		P
Model	SG2000		
Setting values: U > (59 >)	Setting U > (V) :		
	Setting Tdisconnection (s) :		
Parameter	Measurement (V)	Limit:	
Phase 1	253.38	110% Un	
Phase 2	--		
Phase 3	--		
Parameter	Disconnection time:	Limit:	
a)	The voltage is set to 100% Un and held for 600 s. Thereafter the voltage is set to 112% Un. Disconnection must take place within 600 s.		
	UL1-N, UL2-N, UL3-N	476 s /--/--	450-550s
b)	The voltage is set to Un for 600 s and then to 108% Un for 600 s. No disconnection should take place.		
	UL1-N, UL2-N, UL3-N	600/--/--	Disconnection should not take place.
c)	The voltage is set to 106% Un and held for 600 s. Thereafter the voltage is set to 114% Un. Disconnection must take place within 300 s or about 50% of the disconnection time measured in point a).*		
	UL1-N	293.2 s	The disconnection time should be about 50% of the value measured in a). *
	UL2-N	--	
	UL3-N	--	
Note(s): *If the setting value is set to 600 s, then the disconnection time can be in the range between 225 s and 375 s.			

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.3.4		Table: ROCOF protection						P
Model		SG2000						
Setting values:		Setting ROCOF(Hz/s):				2		
		Setting $T_{operate}$ time (s):				1		
Test item	ROCOF direction	Test signal start frequency (Hz)	ROCOF of the test (Hz/s)	Test signal end frequency (Hz)	Step remain times	Disconnection time:	Limit:	
RVAL POS ₁	Increase	$f_n - ROCOF \times 0,5 s$	$G_S + 2 \times A_r$	$f_n + ROCOF \times 0,5 s$	1s+200ms	No Disconnection	Disconnection should not take place.	
RVAL POS ₂	Increase	$f_n - ROCOF \times 0,5 s$	$G_S - 2 \times A_r$	$f_n - ROCOF \times 0,5 s$	1s+200ms	0.034 s	<1s	
RVAL NEG ₁	Decrease	$f_n + ROCOF \times 0,5 s$	$G_S + 2 \times A_r$	$f_n + ROCOF \times 0,5 s$	1s+200ms	No Disconnection	Disconnection should not take place.	
RVAI NEG ₂	Decrease	$f_n + ROCOF \times 0,5 s$	$G_S - 2 \times A_r$	$f_n - ROCOF \times 0,5 s$	1s+200ms	0.031 s	<1s	

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.8.6	Table: Islanding detection (According to EN 62116)	P
Model	SG2000	

Test condition A (EUT output P/P_n = 100%)

No.	P _{EUT} (% of EUT rating) ^{a)}	Reactive load (% of normal (BL*))	P _{AC} ^{b)}	Q _{AC} ^{b)}	Run-on time (ms)	P _{EUT} (W)	Actual Q _f	V _{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	100	100	0	0	406	2000	1.000	48	BL ^{d)}
2	100	100	-5	-5	352	2000	0.98	48	IB ^{d)} /
3	100	100	-5	0	344	2000	1.05	48	IB ^{d)} /
4	100	100	-5	+5	480	2000	1.02	48	IB ^{d)} /
5	100	100	0	-5	396	2000	1.01	48	IB ^{d)} /
6	100	100	0	+5	333	2000	0.97	48	IB ^{d)} /
7	100	100	+5	-5	451	2000	0.92	48	IB ^{d)} /
8	100	100	+5	0	431	2000	1.05	48	IB ^{d)} /
9	100	100	+5	+5	348	2000	1.08	48	IB ^{d)} /
10	100	100	-10	+10	346	2000	1.02	48	IB ^{d)} /
11	100	100	-5	+10	326	2000	1.06	48	IB ^{d)} /
12	100	100	0	+10	332	2000	1.10	48	IB ^{d)} /
13	100	100	+10	+10	338	2000	1.09	48	IB ^{d)} /
14	100	100	+10	+5	359	2000	1.06	48	IB ^{d)} /
15	100	100	+10	0	408	2000	1.02	48	IB ^{d)} /
16	100	100	+10	-5	354	2000	1.12	48	IB ^{d)} /
17	100	100	+10	-10	323	2000	1.10	48	IB ^{d)} /
18	100	100	+5	-10	326	2000	1.06	48	IB ^{d)} /
19	100	100	0	-10	309	2000	1.00	48	IB ^{d)} /
20	100	100	-5	-10	328	2000	0.95	48	IB ^{d)} /
21	100	100	-10	-10	306	2000	0.90	48	IB ^{d)} /
22	100	100	-10	-5	348	2000	0.94	48	IB ^{d)} /
23	100	100	-10	0	382	2000	0.96	48	IB ^{d)} /
24	100	100	-10	+5	357	2000	1.02	48	IB ^{d)} /
25	100	100	-10	+10	342	2000	1.08	48	IB ^{d)} /

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Test condition B (EUT output P/P_n = 50 to 66%)

No.	P _{EUT} (% of EUT rating)	Reactive load (% of normal (BL*))	P _{AC}	Q _{AC}	Run-on time (ms)	P _{EUT} (W)	Actual Q _f	V _{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	66	66	0	- 5	343	1320	0.99	42	IB ^{d)} /
2	66	66	0	- 4	347	1320	0.99	42	IB ^{d)} /
3	66	66	0	- 3	351	1320	1.00	42	IB ^{d)} /
4	66	66	0	- 2	362	1320	1.01	42	IB ^{d)} /
5	66	66	0	- 1	385	1320	0.99	42	IB ^{d)} /
6	66	66	0	0	429	1320	1.03	42	BL ^{d)}
7	66	66	0	+ 1	349	1320	1.04	42	IB ^{d)} /
8	66	66	0	+ 2	342	1320	1.02	42	IB ^{d)} /
9	66	66	0	+ 3	321	1320	1.01	42	IB ^{d)} /
10	66	66	0	+ 4	315	1320	1.00	42	IB ^{d)} /
11	66	66	0	+ 5	269	1320	0.99	42	IB ^{d)} /

Test condition C (EUT output P/P_n = 25 to 33%)

No.	P _{EUT} (% of EUT rating)	Reactive load (% of normal (BL*))	P _{AC}	Q _{AC}	Run-on time (ms)	P _{EUT} (W)	Actual Q _f	V _{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	33	33	0	- 5	36	660	1.10	36	IB ^{d)} /
2	33	33	0	- 4	43	660	1.08	36	IB ^{d)} /
3	33	33	0	- 3	46	660	1.07	36	IB ^{d)} /
4	33	33	0	- 2	204	660	1.05	36	IB ^{d)} /
5	33	33	0	- 1	243	660	1.03	36	IB ^{d)} /
6	33	33	0	0	264	660	1.07	36	BL ^{d)}
7	33	33	0	+ 1	38.4	660	1.04	36	IB ^{d)} /
8	33	33	0	+ 2	37.8	660	1.06	36	IB ^{d)} /
9	33	33	0	+ 3	35.2	660	1.07	36	IB ^{d)} /
10	33	33	0	+ 4	35	660	1.05	36	IB ^{d)} /
11	33	33	0	+ 5	29.8	660	1.04	36	IB ^{d)} /

Note:

a) P_{EUT}: EUT output powerb) P_{ac}: Active power. Positive means power from EUT to utility. Nominal is the 0 % test condition value.c) Q_{ac}: Reactive power Positive means power from EUT to utility. Nominal is the 0 % test condition value.

d) BL: Balance condition, IB: Imbalance condition.

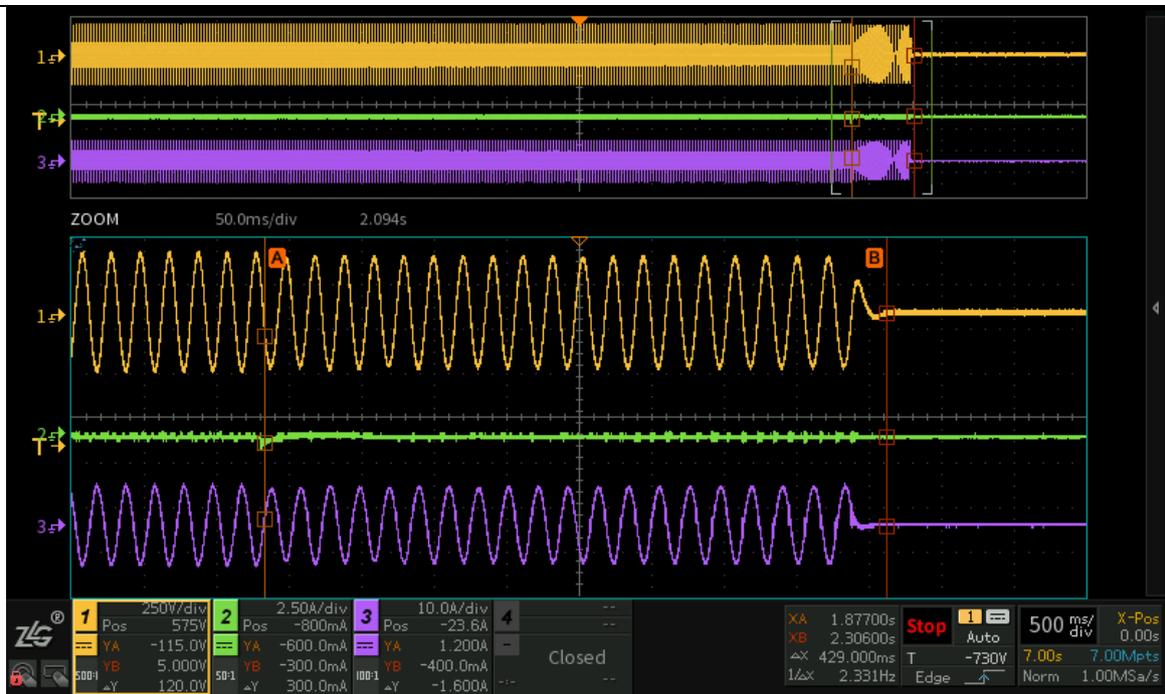
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



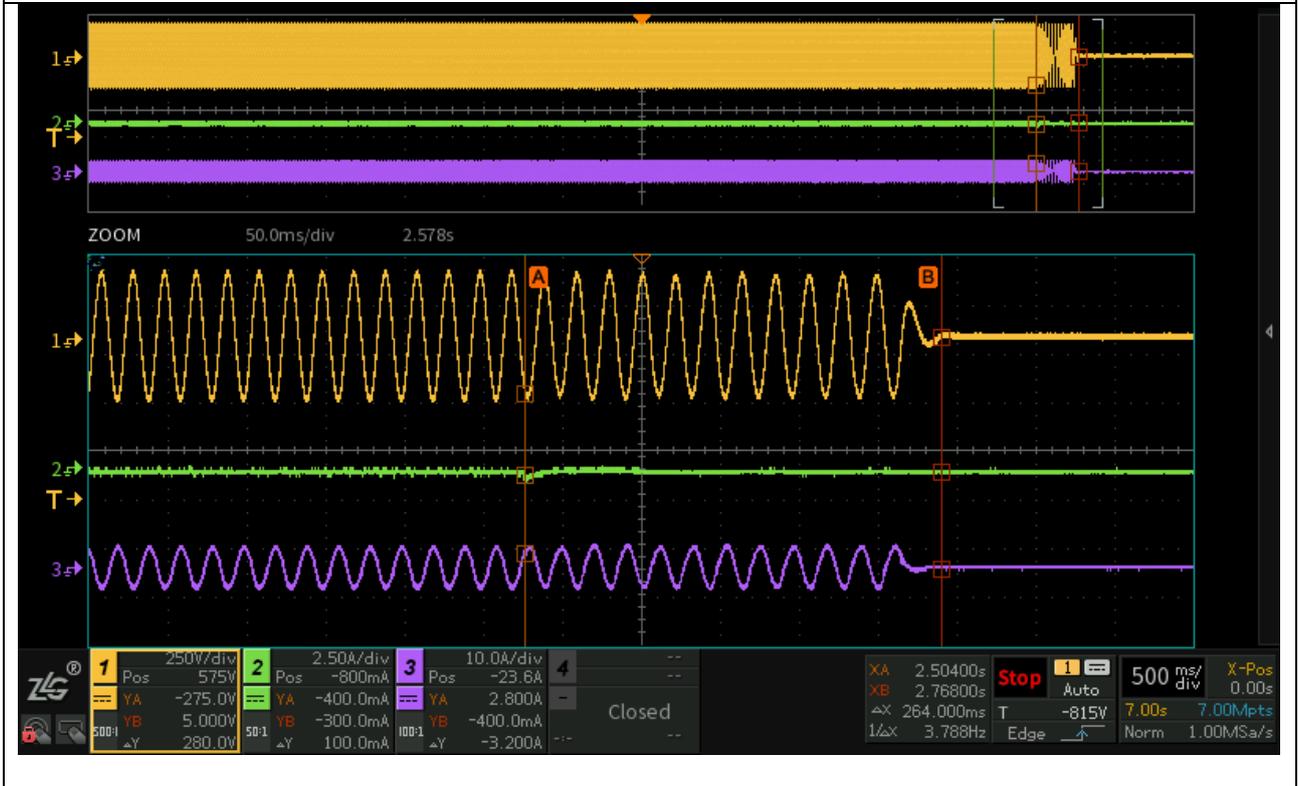
Graph of disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 66% nominal power



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 33% nominal power



EN 50549-10

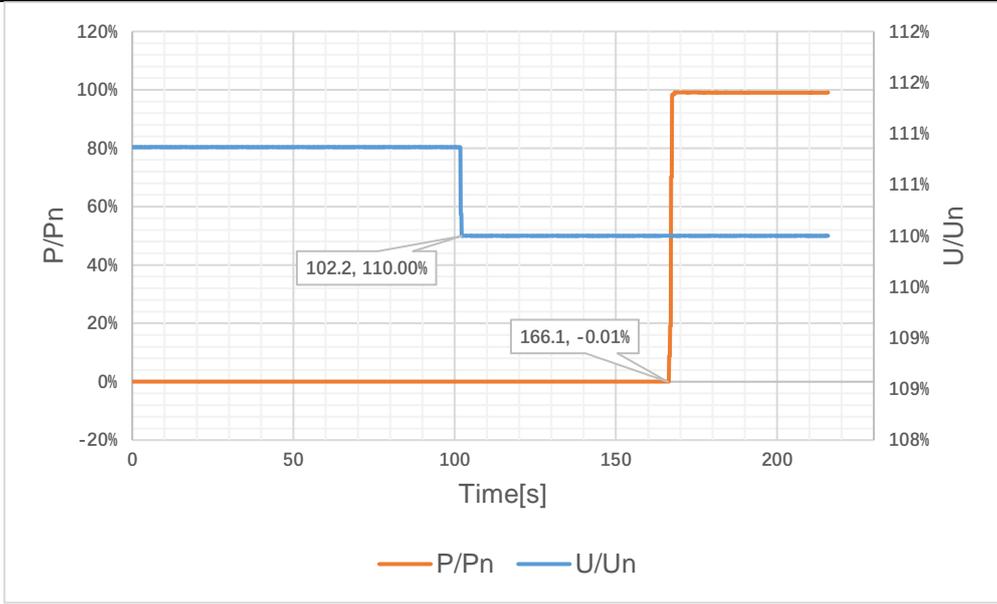
Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.9	TABLE: Connection and starting			P
Model	SG2000			
Setting values	Parameter	Range	Default setting	
			Starting connection	Reconnection
	Lower frequency	47,0Hz – 50,0 Hz	49,5 Hz	49,5 Hz
	Upper frequency	50,0 Hz – 52,0 Hz	50,1 Hz	50,2 Hz
	Lower voltage	50 %U _n – 100 %U _n	85 % U _n ^a / 90 % U _c ^b	85 % U _n ^a / 90 % U _c ^b
	Upper voltage	100 % – 120 % U _n	110 %U _n / 110 %U _c	110 %U _n / 110 %U _c
	Observation time	10 s – 600 s	60 s	60 s
Active power increase gradient:	6% – 3000%/min	disabled	10%/min	
Test condition	Measurement		Limitation	
	Observation time [s]	Power gradient [P/P _n per minute]	Observation time	Power gradient
Starting connection:				
U>	63.9	--	60s	--
U<	61.3	--		
f>	60.6	--		
f<	61.9	--		
Reconnection:				
U>	80.8	9.49	60s	≤ 10%P _n / minutes
U<	80.4	9.51		
f>	64.9	9.36		
f<	82.8	9.72		
Note(s):				
a In case of EN 50549-1:2019				
b In case of EN 50549-2:2019				

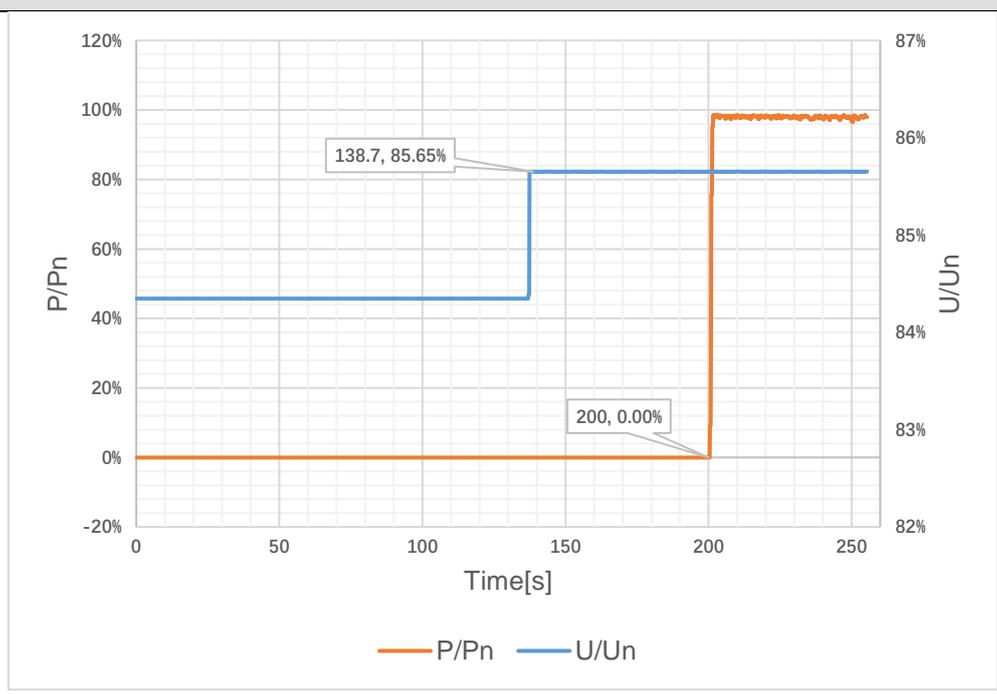
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Starting connection for U>



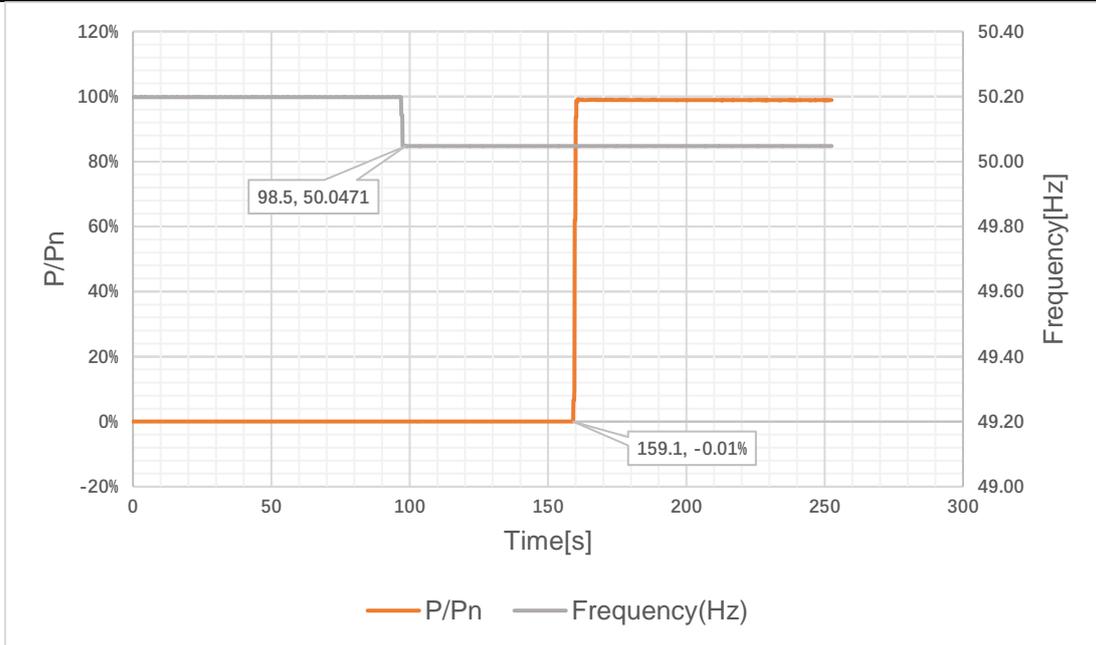
Graph of Starting connection for U<



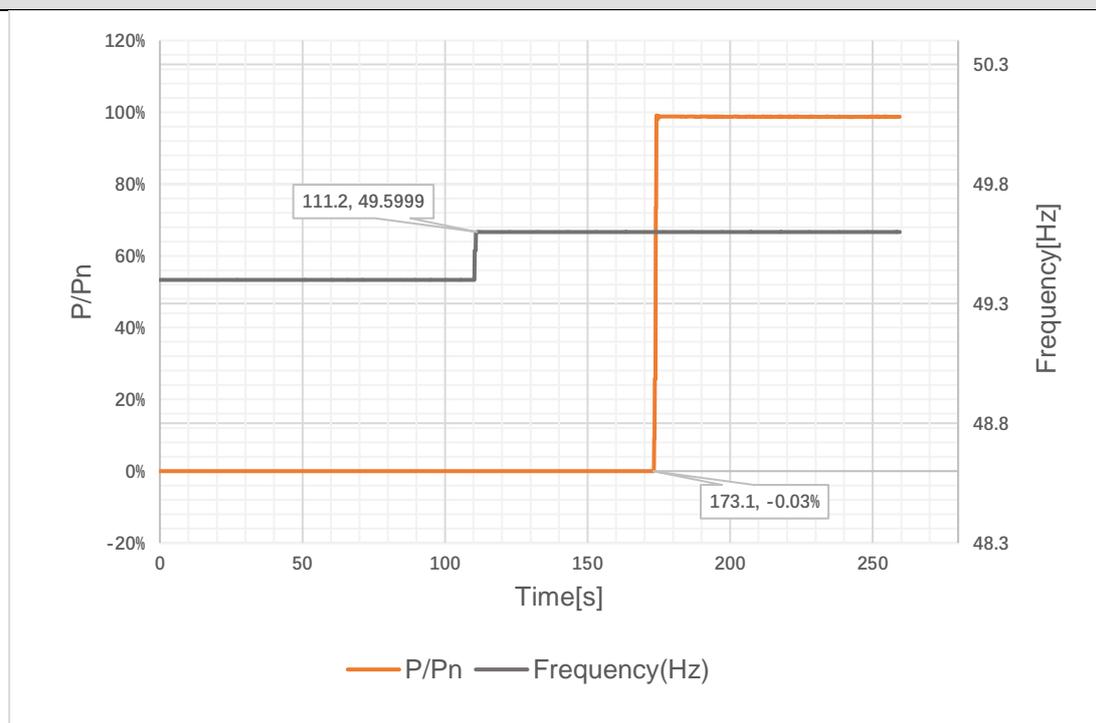
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Starting connection for f>



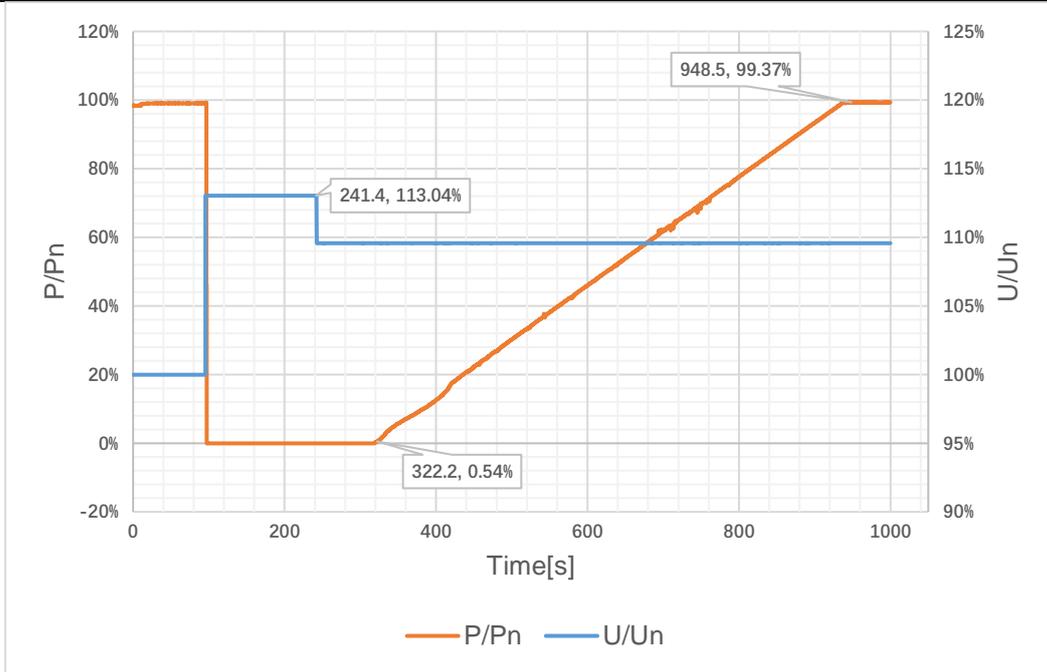
Graph of Starting connection for f<



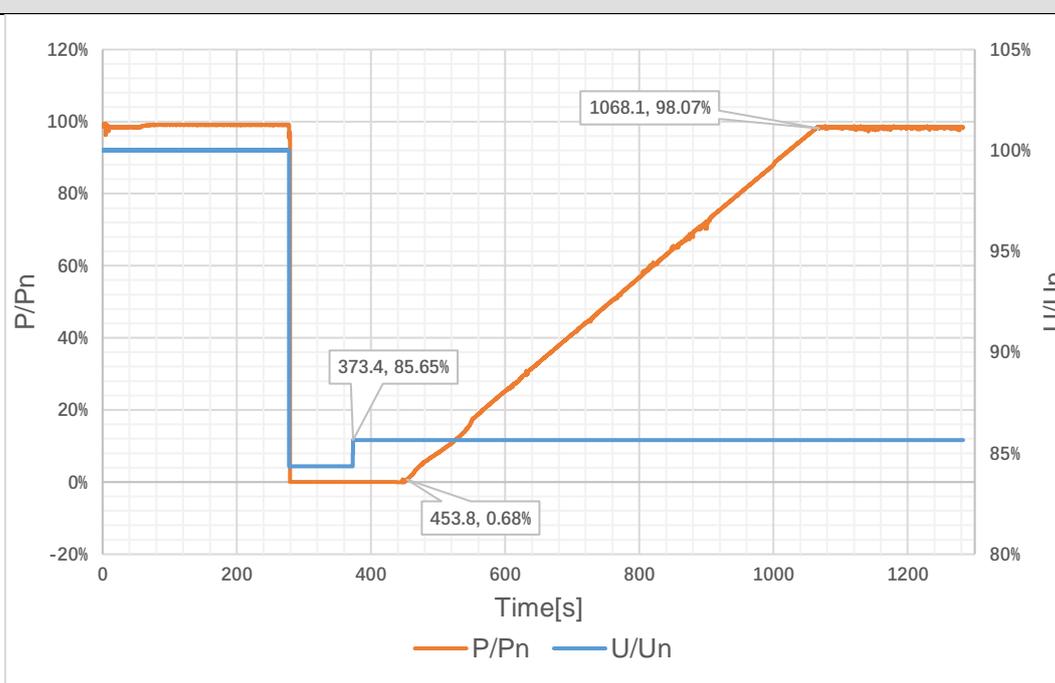
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Reconnection for U>



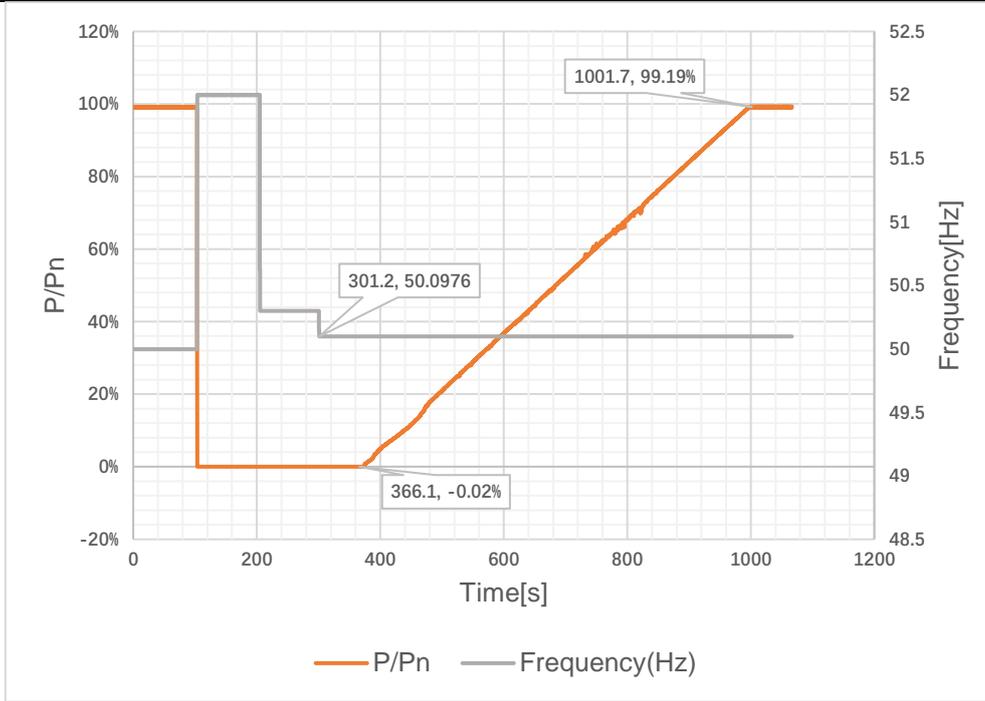
Graph of Reconnection for U<



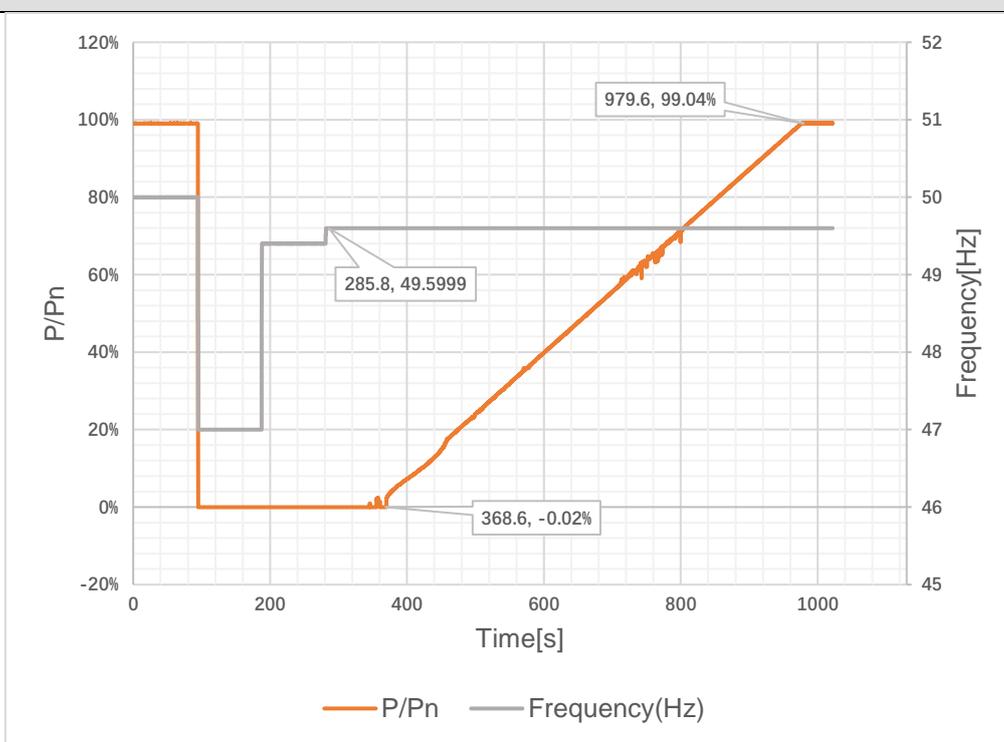
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Graph of Reconnection for f>



Graph of Reconnection for f<



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.10	TABLE: Active power reduction on set point	P
-------------	---	---

Model	SG2000
-------	--------

Test 1: Verification of the accuracy

Active power step [p.u. of P _n]	Requested set point value		Actual value		accuracy Actual value - Set point		Limit P/P _n [p.u.]
	W	P/P _n [p.u.]	W	P/P _n [p.u.]	W	P/P _n [p.u.]	
0.9	1800	0.9	1815.5	0.907	15.5	0.007	± 0.05
0.8	1600	0.8	1619.2	0.809	19.2	0.009	
0.7	1400	0.7	1420.7	0.709	20.7	0.010	
0.6	1200	0.6	1218.7	0.607	18.7	0.009	
0.5	1000	0.5	1005.3	0.502	5.3	0.002	
0.4	800	0.4	804.8	0.402	4.8	0.002	
0.3	600	0.3	600.5	0.294	0.5	0.000	
0.2	400	0.2	391.9	0.196	-8.1	-0.004	
0.1	200	0.1	201.6	0.100	1.6	-0.000	
0.3	600	0.3	593.7	0.297	-6.3	-0.003	
0.6	1200	0.6	1210.4	0.605	10.4	0.005	
1	2000	1	1969.2	0.984	-30.8	-0.015	

Test 2: Verification of the dynamic behaviour

Test Conditions	Measurements	Limit
P/P _n	Gradient	Gradient
90% to 10%	0.49% P _n / s	0.33-0.66%P _n /s

Note(s):

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

Diagram for test 1

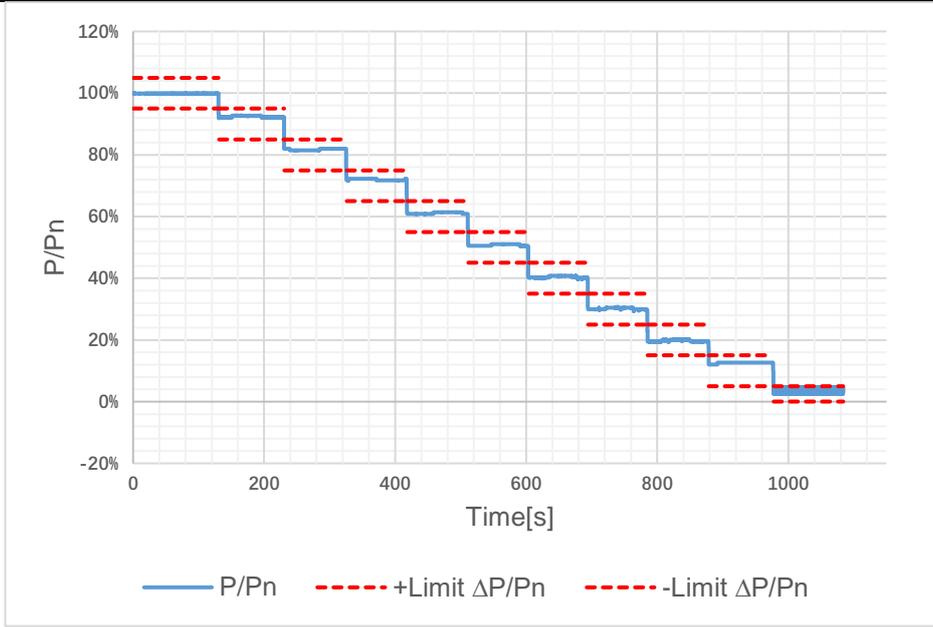
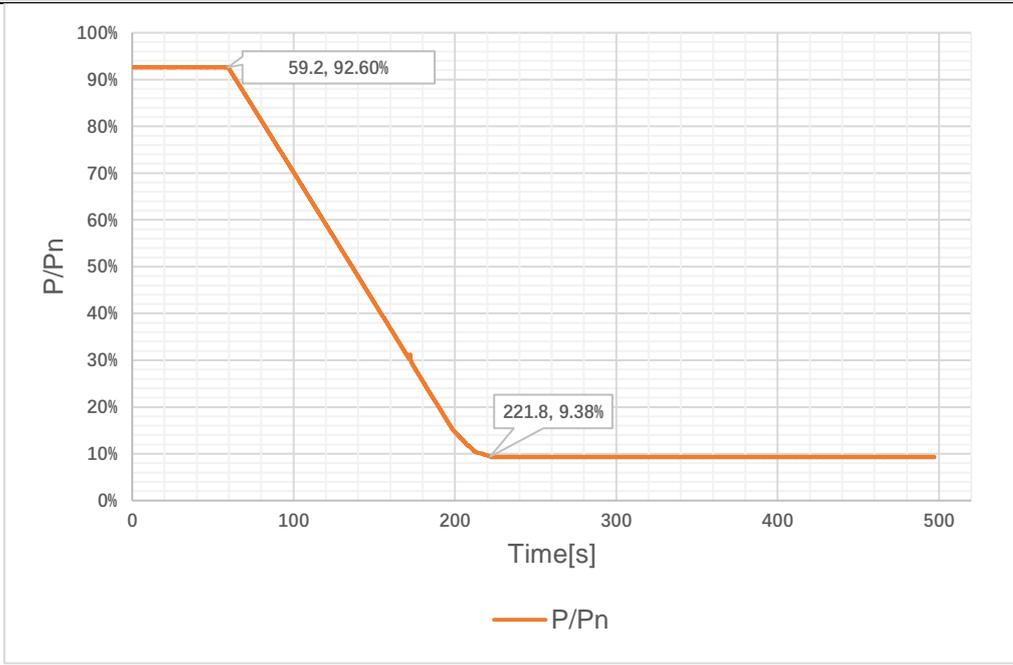


Diagram for test 2

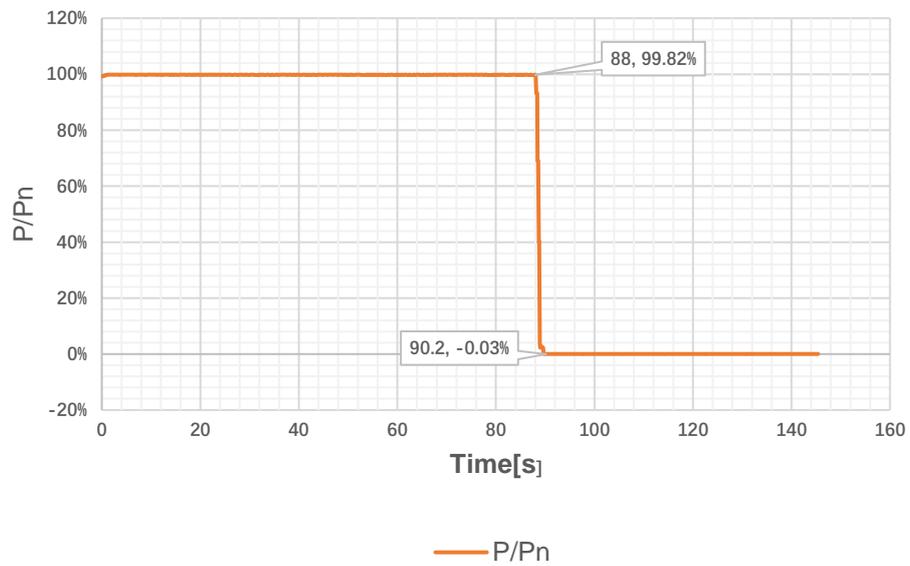


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

5.11	TABLE: Remote information exchange			P
Model	SG2000			
Reducing the active power form 100% P_{Amax} to 0				
Measured max power [W]	Ceasing power [W]	Ceasing time [s]	Limit [s]	
2000	2000	2.2	≤ 5	
Note:				

Graph for test



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

4.13	TABLE: Requirements regarding single fault tolerance of interface protection system							P
Model	SG2000							
	ambient temperature (°C)					25	--	
Component No.	Fault	test voltage (V)		Test time	fuse No.	fuse current (A)		Result
		AC	DC			AC	DC	
R158	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
C124	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
U18 (14)	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
U27 (13)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
R132	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
R130	Open	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
R131	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
C178	Open	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
C119	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
R154	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
R154	Open	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
R161	Open	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
C195	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
C195	Open	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
--------	--------------------	-----------------	---------

M1	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
M3	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
K1 (2,3)	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
K1 (4,5)	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
K1 (1,6)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
U12 (12)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
U12 (78)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
U14 (12)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
U14 (34)	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
T1 pin 9-10	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
T1 pin 3-5	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
T2 pin 3-4	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
L、N	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
L、PE	Short	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire
N、PE	Short	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
PE	Open	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire
DC	DCEP	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire

EN 50549-10

Clause	Requirement - Test							Result - Remark	Verdict
AC	ACEP	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire	
DC side feedback current	AC short circuit	230V	30V	10min	--	--	--	EUT can't be connected to the grid, no damage, no danger, no fire, Breaker, F1, F2 damaged	
AC side feedback current	DC short circuit	230V	30V	10min	--	--	--	EUT operates normally, without damage, danger or fire	
Supplementary information:									
Tests performed under abnormal or fault conditions shall be tested with a source capable of 1,25 to 1,5 times the PCE rated maximum input current (Isc PV) for that input.									

Appendix 1: Datasheet of the relay

顾客 Customer: 浙江万胜智能科技股份有限公司

1 品种 Type Model

1.1 种类 Type: 电磁继电器 Electromagnetic Relay

1.2 型号 Part NO.: HF115F/012-2HS4

1.3 外形尺寸 Outline dimensions: 29mm×12.7mm×15.7mm

1.4 触点形式 Contact Form: 2组常开 2 Form A

1.5 触点材料 Contact Material: AgSnO₂

2 安全认证 Safety Approvals

认证机构 Certification Agency	认证号 File No.
UL/CUL	E134517
VDE	116934
CQC	CQC17002168381

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

3 线圈额定参数 Coil Rating

at 23 °C

额定电压 Rated Voltage Vd. c.	动作电压 (1) Operate Voltage Vd. c.	释放电压 (1) Release Voltage Vd. c.	允许最大线圈电压 (2) Max Allowable Coil Voltage Vd. c.	线圈电阻 Coil Resistance Ω	线圈功耗 Coil Power 大约 Approx. W
12	≤8.4	≥1.2	18	360×(1±10%)	0.4

备注: (1) 上述值为初始值。

(2) 允许最大线圈电压是指继电器线圈在短时间内能够承受的最大电压值。

Note: (1) The data shown above are initial values

(2) Maximum allowable coil voltage refers to the maximum voltage which relay coil could endure in a short period of time.

4 触点参数 Contact Parameters

4.1 触点额定负载 Contact Rating: 8 A 250 Va. c.

4.2 最大切换电流 Max Switching Current: 8 A

4.3 最大切换电压 Max Switching Voltage: 250 Va. c.

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

5 性能 Performance

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

5.2 动作时间 Operate Time: ≤ 15 ms。

5.3 释放时间 Release Time: ≤ 8 ms。

5.4 耐久性 Endurance

5.4.1 电耐久性 Electrical Endurance

结构型式 Version	触点材料 Contact Material	触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 ON: OFF	电耐久性 Electrical Endurance
4 型 type 4	AgSnO ₂	阻性负载 Resistive Load 8 A 250 Va.c.	常温 Room Temperature	1 s: 9 s	NO 端: 5×10 ⁴ 次 (ops)

注: 塑封型规格在电耐久性测试时需要打开外壳透气孔/For plastic sealed type, the venting-hole should be excised.

5.4.2 机械耐久性 Mechanical Endurance

结构型式 Version	触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 ON: OFF	机械耐久性 Mechanical Endurance
4 型 type 4	无负载 No load	常温 Room Temperature	0.1s: 0.1s	1×10 ⁷ 次 (ops)

5.5 介质耐电压 Dielectric Strength (漏电流 Leakage Current: 1 mA)

5.5.1 断开触点电路的各引出端之间 Between terminals of each opened contact circuit: 1000 Va.c. (50/60 Hz 1 min)。

5.5.2 所有线圈引出端与所有触点电路引出端之间 Between all coil terminals and all contact circuit terminals: 5000 Va.c. (50/60 Hz 1 min)。

5.5.3 各独立的触点电路的引出端之间 Between terminals of separate contact circuits: 2500 Va.c. (50/60 Hz 1 min)。

5.6 绝缘电阻 Insulation Resistance

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

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

5.6.3 各独立的触点电路的引出端之间 Between terminals of separate contact circuits: 1000 MΩ (500 Vd.c.)。

5.7 线圈温升 Coil Temperature Rise: 55 K max.

以 110% 额定电压激励, 触点负载 8 A. 环境温度: 85 ℃。

Coil voltage: 110% of the rated coil voltage, Contact load: 8 A. Environmental temperature is 85 ℃.

5.8 振动 Vibration

非励磁状态: 继电器长度垂直于振动方向, 频率 10 Hz~150 Hz 加速度 49 m/s²;

继电器长度平行于振动方向, 频率 10 Hz~150 Hz 加速度 14.7 m/s²。

No energized: Vibration direction vertical to the relay length, frequency

10 Hz~150 Hz acceleration 49 m/s²;

Vibration direction parallel to the relay length, frequency

10 Hz~150 Hz acceleration 14.7 m/s²。

励磁状态: 频率 10 Hz~150 Hz 加速度 98 m/s²。

Energized: Frequency 10 Hz~150 Hz acceleration 98 m/s²。

继电器外观、结构和性能不应有异常。It shall be no abnormalities in appearance, construction and performance.

5.9 冲击 Shock

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

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

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

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

5.10 引出脚强度 Terminal Strength

PCB 引出脚: 在 PCB 引出脚轴线方向上施加 5 N 拉力或压力, 持续时间 6 s, 继电器应无异常。

PCB Terminals: No damage on the relay when applying 5 N tension or pressure for 6 s on the axis direction of terminals.

5.11 耐焊接热 Soldering Heat Resistance

5.11.1 焊接温度 Soldering Temperature: (260±5) °C

5.11.2 焊接时间 Soldering Time: (3~5) s

5.12 焊接性能 Solderability

继电器引出端在焊锡温度 (250±3) °C 下, 浸锡时间 (3±0.3) s 之后, 被浸锡部分应有 90% 以上连续覆盖一层锡层

Terminals dipped into the soldering bath should be 90% tin plated at (250±3) °C for (3±0.3) s.

5.13 耐温性 Temperature Resistance

5.13.1 耐热 Heat Resistance

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

At (85±2) °C for 16h storage follow by 2 hours at room temperature, no damage on internal structure, all parameters conform.

5.13.2 耐寒 Cold Resistance

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

At (-40±2) °C for 16h storage follow by 2 hours at room temperature, no damage on internal structure, all parameters conform.

5.14 耐湿性 Moisture Resistance

在温度 (40±2) °C 湿度 90%~95% RH 中放置 16 h, 恢复常温 2 h 后, 继电器的结构及性能应无异常。且绝缘电阻应不小于 10 MΩ (500 Vd.c.)。

The humidity was 90%~95% RH at (40±2) °C for 16h storage follow by 2 hours at room temperature, no damage on internal structure, all parameters conform. Insulation resistance should be not less than 10 MΩ (500 Vd.c.).

6 产品标识 Marking

6.1 外壳颜色 Case Color: 黑色 Black

6.2 印字位置 Marking Position: 顶面 Top Face

6.3 印字颜色 Ink Color: 激光 Laser

6.4 印字图



7 标准测试条件 Standard Test Conditions

7.1 温度 Temperature: 23°C ±5°C

7.2 湿度 Humidity: 25%~75% RH

7.3 方向 Direction of Measurement: 任意 Free

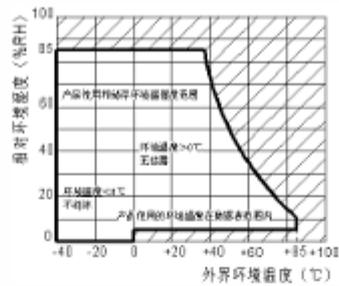
8 使用环境条件 Operate Ambient Conditions

8.1 环境温度 Ambient Temperature: -40 °C ~ 85 °C

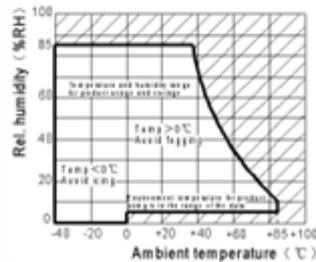
8.2 环境湿度 Ambient Humidity: 5%~85% RH

8.3 安装方向 Mounting Direction: 任意 Free

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



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



9 贮存条件 Storage Conditions

9.1 温度 Temperature: 0 ℃ ~ 40 ℃

9.2 湿度 Humidity: 20%~80% RH

9.3 环境 Environment

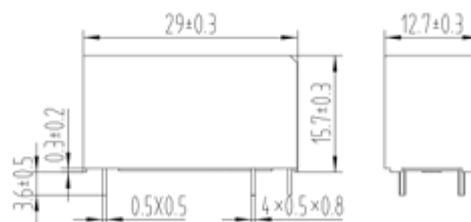
9.3.1 产品贮存场地不能有腐蚀性气体 Store in locations where the product is not exposed to corrosive gas.

9.3.2 贮存中应避免阳光直照产品 Avoid sunshine during storage.

9.3.3 堆码高度 Stacking Height: ≤ 7 层 layers

10 产品结构 Configuration

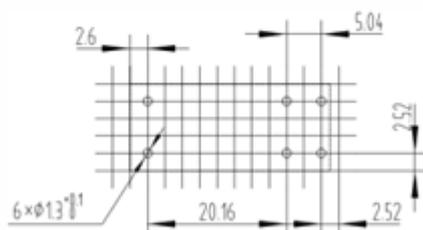
10.1 外形图 Outline Dimensions



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



10.3 安装孔尺寸图 (底视图) PCB Layout (Bottom View)



注：产品外形尺寸未注尺寸公差及 PCB 板未注尺寸公差按下表执行。

Note: All unspecified tolerance (including outline dimensions and PC board dimensions) please refer to the following table.

产品外形尺寸未注尺寸公差 Outline dimensions with no tolerance specified mm		PCB 板未注尺寸公差 PC board dimensions with no tolerance specified mm
外形尺寸 Outline Dimensions	公差 Tolerance	±0.1
≤1	±0.2	
>1~5	±0.3	
>5	±0.4	

11 订货标记 Ordering Information

HF115F / 012 - 2H S 4

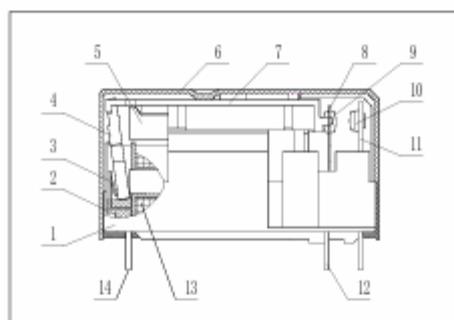
① ② ③ ④ ⑤

① 产品型号 Product part NO.	HF115F
② 线圈电压 Coil voltage	012:12 Vd.c.
③ 触点形式 Contact form	2H: 两组常开 (2 Form A)
④ 封装形式 Construction	S: 塑封型 (Plastic sealed)
⑤ 结构形式 Version	4: 5.0mm 两组 8A (5.0mm 2 pole 8A)

12 主要零部件 Important Parts And Components

序号 Serial No.	零部件名称 Parts And Components Name	材料名称 Material Name	备注 Remark
1	底座 Base	工程塑料 plastic	
2	线圈架 Bobbin	工程塑料 plastic	
3	压簧片 Hing spring	铜合金 Copper alloy	
4	衔铁 Armature	纯铁 Fe	
5	轭铁 Yoke	纯铁 Fe	
6	外壳 Cover	工程塑料 plastic	
7	推动块 Card	工程塑料 plastic	
8	动簧片 Mov. spring	铜合金 Copper alloy	
9	动触点 Mov. contact	银氧化锡 AgSnO ₂	
10	静触点 Stat. contact	银氧化锡 AgSnO ₂	
11	静簧片 Stat. spring	纯铜 Copper	
12	焊片 Terminal	纯铜 Copper	
13	漆包线 Coil wire	纯铜 Copper	
14	线圈引出脚 Coil Terminal	铜合金 Copper alloy	

结构图 Construction Schematic



13 其他说明 Others

13.1 对于塑封型产品,在焊接完成后,如果要进行清洗,请与宏发技术中心联系。Regarding the plastic sealed relay, if cleaning is necessary after soldering, please contact Hongfa R&D center.

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

13.3 对宏发而言,不可能评定继电器在每个应用领域、应用环境的所有性能参数要求,因而,客户应根据具体的使用条件选择与之相匹配的产品,若有疑问,请与宏发联系获得更多的技术支持。但产品的选型责任仅由客户负责。We could not evaluate all the performance and all the parameters for every possible application field and environment. Thus

the user should be in a right position to choose the suitable produce for their own application. If there is any query, please contact Hongfa for the technical service. However, it is the use' s responsibility to determine which product should be used only.

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

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

13.6 本产品规格书供客户使用时参考, 其中, 未明确规定的要求条件, 参考“继电器术语解释及使用指南”(见 <https://source.cn.hongfa.com/pdf/web/viewer.html?file=\Uploads\Down\PDF\GR1001.pdf>)。The specification is for reference only. See to “Terminology and Guidelines”(see <https://source.cn.hongfa.com/pdf/web/viewer.html?file=\Uploads\Down\PDF\GR1005.pdf>) for more information.

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

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

13.9 请避免让继电器在含有机硅的环境下使用，否则有机硅进入继电器内部后，有可能会
导致继电器触点加速失效。使用环境气体中，如果含有水汽及 H₂S、SO₂、NO₂、Cl、P、粉尘
等以及目前未知的有害物质、元素，可能会导致继电器使用过程中，触点发生电阻变大、接
触不良等。以上情况下，请对产生有害物质、元素的物料进行管控或使用塑封继电器规格，
并进行相关试验验证，确认是满足使用要求。Please avoid using the relay in an
environment containing organic silicon, otherwise the entry of organic silicon into
the relay may acceleration contact failure. If there are harmful substances and
elements such as water vapor, H₂S, SO₂, NO₂, Cl, P, dust, etc. , as well as unknown harmful
substances and elements, In the use of environmental gases, it may lead to increased
contact resistance and poor contact during the use of relays. In the above
situations, please control the materials that produce harmful substances and elements
or use plastic sealed type, and arrange relevant tests to confirm that it meet the
requirements for actual use.

13.10 环保措施 Environmental Protection

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

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

13.12 事前协议事项 Priority Consultation

无

Appendix 2: Evaluated protection function and operational capabilities

Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	applicable Clause(s) / subclause(s) of this document	Remarks, optional modes and constraints	Verdict
4.4.2 Operating frequency range	5.2.1 Frequency operating range		P
4.4.3 Minimal requirement for active power delivery at underfrequency	5.2.1 Frequency operating range		P
4.4.4 Continuous operating voltage range	5.2.2 Voltage operating range		P
4.5.2 Rate of change of frequency (ROCOF) immunity	5.3.1 Immunity to disturbances - Rate of change of frequency (ROCOF)		P
4.5.3.2 Generating plant with non-synchronous generating technology	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)		P
4.5.3.3 Generating plant with synchronous generating technology	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)		P
4.5.4 Over-voltage ride through (OVRT)	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)		P
4.6.1 Power response to overfrequency	5.4 Active response to frequency deviation		P
4.6.2 Power response to underfrequency	5.4 Active response to frequency deviation		P
4.7.2.2 Voltage support by reactive power, Capabilities	5.5.1 Power capabilities assessment		P
4.7.2.3 Voltage support by reactive power, Control modes	5.5.2 Voltage support by reactive power - test to determine the reactive power control modes	list available Modes here	P
4.7.2.3.2 Set point control modes	5.5.2.3 Verification procedure for Set point control		P
4.7.2.3.3 Voltage related control modes	5.5.2.5 Verification procedure for power related control modes for reactive power		P
4.7.2.3.4 Power related control mode	5.5.2.5 Verification procedure for power related control modes for reactive power		P
NOTE 1 EN 50549-2:2019 evaluates reactive power delivery of generating plants above a defined power threshold at the POC. In this case, the accuracy chain for reactive power delivery for a specific generating plant is excluded from the scope of this conformity assessment but must be considered during design and tested during commissioning of a specific plant.			
only EN 50549-2:2019 4.7.4.2.1.1 Voltage support during faults and voltage steps – General	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)		P
only EN 50549-2:2019 4.7.4.2.1.2 Voltage support during faults and voltage steps - Optional Modes	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)	list available optional modes here	P
4.7.4.2.2 Zero current mode for converter connected generating technology	5.3.3 Immunity to disturbances - Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)		P
only EN 50549-1:2019 4.9.3 Requirements on voltage and frequency protection	5.8.3 Verification procedure for generating plants to be connected to a LV distribution network with Interface protection as internal	if not all functions are tested: list available	P

Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	applicable Clause(s) / subclause(s) of this document	Remarks, optional modes and constraints	Verdict
	device 5.8.4 or Verification procedure for generating plants to be connected to a LV distribution network with Interface protection as dedicated device	protection functions here	
only EN 50549-2:2019, 4.9.3. Requirements on voltage and frequency protection	5.8.5 Verification procedure for generating plants to be connected to a MV distribution network	if not all functions are tested: list available protection functions here	P
NOTE 2 If the interface protection is designed as dedicated device, the disconnection chain and the accuracy of the measuring chain including voltage transformers for a specific generating plant is excluded from the scope of this conformity assessment but must be considered during design and tested during commissioning of a specific plant.			
4.9.4 Means to detect island situation	Islanding detection	indicate applied method here	P
4.10.2 Automatic reconnection after tripping	5.9.3 Automatic reconnection after tripping		P
4.10.3 Starting to generate electrical power	5.9.4 Starting to generate electrical power		P
4.11.1 Ceasing active power	5.10 Active power reduction on set point		P
4.11.2 Reduction of active power on set point	5.10 Active power reduction on set point		P
4.12 Remote information exchange	5.11 Remote information exchange	indicate applied standard here	P
only EN 50549-1:2019, 4.13 single fault tolerance of interface protection system and interface switch	5.12 Requirements regarding single fault tolerance of interface protection system and interface switch		P
	5.13 Model definition and model validation for generating units of synchronous generating technology	Indicate model identification when model is used (generating unit model, component model)	P

Appendix 3: Evaluated parameter and parameter range

Name of parameter set		indicate name of parameter set here			
specific technical requirement (e.g. grid codes)		indicate additional applicable requirement documents here			
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter a	Remarks/ additional information b	configurable value range	default value	
4.4.2 Operating frequency range	47,0 – 47,5 Hz Duration		0 – 20 s	0s	
	47,5 – 48,5 Hz Duration		30 – 90 min	30 min	
	48,5 – 49,0 Hz Duration		30 – 90 min	30 min	
	49,0 – 51,0 Hz Duration		not configurable	unlimited	
	51,0 – 51,5 Hz Duration		30 – 90 min	30 min	
	51,5 – 52 Hz Duration		0 – 15 min	0 s	
4.4.3 Minimal requirement for active power delivery at underfrequency	Reduction threshold		not configurable	49,5 Hz	
	Maximum reduction rate		not configurable	10 % PM/Hz	
4.4.4 Continuous operating voltage range	Upper limit		not configurable	110 % Un	
	Lower limit		not configurable	85 % Un, 90 % Uc	
4.5.2 Rate of change of frequency (ROCOF) immunity	ROCOF withstand capability (defined with a sliding measurement window of 500 ms) non-synchronous generating technology: synchronous generating technology:		not configurable	2 Hz/s 1 Hz/s	
4.5.3.2 Under-voltage ride through (UVRT) Generating plant with non-synchronous generating technology	Maximum power resumption time		not configurable	1 s	
	Voltage-Time-Diagram		see Figure 6 of EN 50549-1:2019 and EN 50549-2:2019	Time [s]	U [p.u.]
				0,0	0,2
				0,15	0,2
				1,5	0,85
				180	0,85
180	0,9				
4.5.3.3 Under-voltage ride through (UVRT)	Maximum power resumption time		not configurable	3 s	
Generating plant with synchronous generating technology	Voltage-Time-Diagram		see Figure 7 of EN 50549-1:2019 and EN 50549-2:2019	Time [s]	U [p.u.]
				0,0	0,3
				0,15	0,3
				0,15	0,7
				0,7	0,7
				1,5	0,85

Name of parameter set		indicate name of parameter set here			
specific technical requirement (e.g. grid codes)		indicate additional applicable requirement documents here			
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter a	Remarks/ additional information b	configurable value range	default value	
				180	0,85
				180	0,9
4.5.4 Over-voltage ride through (OVRT)	Voltage-Time-Diagram		not configurable see Figure 8 of EN 50549-1:2019 and EN 50549-2:2019	Time [s]	U [p.u.]
				0,0	1,25
				0,1	1,25
				0,1	1,20
				5,0	1,20
				5,0	1,15
				60	1,15
				60	1,10
4.6.1 Power response to overfrequency	Threshold frequency f1		50,2 Hz – 52 Hz	50,2 Hz	
	Droop		2 % – 12 %	5 %	
	Power reference		PM Pmax	Pmax, for synchronous generating technology and EESS PM for other non-synchronous generating technology	
	Intentional delay		0 – 2 s	0s	
	Deactivation threshold fstop		50,0 Hz – f1	deactivated	
	Deactivation time tstop		0 – 600 s	-	
	Acceptance of staged disconnection		yes no	yes	
4.6.2 Power response to underfrequency	Threshold frequency f1		49,8 Hz – 46 Hz	49,8 Hz	
	Droop		2 – 12 %	5 %	
	Power reference		PM Pmax	Pmax	
	Intentional delay		0 – 2 s	0 s	
4.7.2.2 voltage support by reactive power - Capabilities	Active factor / Reactive power (%Pd) range overexcited		0,9 – 1 / 48 %Pd - 0 0,95 – 1 / 33 %Pd - 0	0,95–1 / 33 %Pd-0	
	Active factor / Reactive power (%Pd) range underexcited		0,9 – 1 / 48 %Pd - 0 0,95 – 1 / 33 %Pd - 0	0,95–1 / 33 %Pd-0	

Name of parameter set		indicate name of parameter set here		
specific technical requirement (e.g. grid codes)		indicate additional applicable requirement documents here		
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter a	Remarks/ additional information b	configurable value range	default value
4.7.2.3 voltage support by reactive power - Control modes	Enabled control mode		Q setp. Q(U) Q(P) cos φ setp. cos φ (P)	Q set point
4.7.2.3.2 voltage support by reactive power - Set point control modes	Q set point and excitation		0 – 48 % P _D , 0 – 33 % P _D	0
	cos φ set point and excitation		1 – 0,9	1
4.7.2.3.3 voltage support by reactive power - Voltage related control modes	Characteristic curve			indicate default characteristic
	Time constant		3 s – 60 s	10 s
	Min cos φ		0,0 – 1	0,9
	Lock-in power		0 % – 20 %	deactivated
	Lock-out power		0 % – 20 %	deactivated
4.7.2.3.4 voltage support by reactive power - Power related control mode	Characteristic curve			indicate default characteristic
only EN 50549-2:2019, 4.7.4.2.1 Voltage support during faults and voltage steps – General / Generating Plant with non-synchronous generator	Enabling		enable disable	disabled
	Static voltage range overvoltage		100 % U _C – 120 % U _C	110 % U _C
	Static voltage range undervoltage		80 % U _C – 100 % U _C	90 % U _C
	Insensitivity range of ΔU _{50per}		0 % – 15 %	5 %
	Gradient k1		0 – 6	2
	Gradient k2		0 – 6	2
only EN 50549-2:2019, 4.7.4.2.1.2 Optional Modes / Generating Plant with non-synchronous generator	Active power priority		enable disable	disable
	Reactive current limitation [% rated current]		0 %–100 %	disable
	Zero current threshold		20 % U _C – 100 % U _C	disable
4.7.4.2.2 Zero current mode for converter connected generating technology / Generating Plant with non-synchronous generator	Enabling		enable disable	disable
	Static voltage range overvoltage		100 % U _n – 120 % U _n	120 % U _n
	Static voltage range undervoltage		20 % U _n – 100 % U _n	50 % U _n

Name of parameter set		indicate name of parameter set here		
specific technical requirement (e.g. grid codes)		indicate additional applicable requirement documents here		
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter a	Remarks/ additional information b	configurable value range	default value
4.9.3 Requirements on voltage and frequency protection	Threshold for protection as dedicated device [in A or kW, kVA]		16 A – 250 kVA	250 kVA
	Undervoltage threshold stage 1		$0,2 U_n - 1 U_n$	$1 U_n$
	Undervoltage operate time stage 1		0,1 s – 100 s	100 s
	Undervoltage threshold stage 2		$0,2 U_n - 1 U_n$	$1 U_n$
	Undervoltage operate time stage 2		0,1 s – 5 s	5 s
	Oversvoltage threshold stage 1		$1,0 U_n - 1,2 U_n$	$1,2 U_n$
	Oversvoltage operate time stage 1		0,1 s – 100 s	100 s
	Oversvoltage threshold stage 2		$1,0 U_n - 1,3 U_n$	$1,3 U_n$
	Oversvoltage operate time stage 2		0,1 s – 5 s	5 s
	Oversvoltage threshold 10 min mean protection		$1,0 U_n - 1,15 U_n$	$1,15 U_n$
	Underfrequency threshold stage 1		47,0 Hz – 50,0 Hz	50,0 Hz
	Underfrequency operate time stage 1		0,1 s – 100 s	100 s
	Underfrequency threshold stage 2		47,0 Hz – 50,0 Hz	50,0 Hz
	Underfrequency operate time stage 2		0,1 s – 5 s	5 s
	Overfrequency threshold stage 1		50,0 Hz – 52,0 Hz	52,0 Hz
	Overfrequency operate time stage 1		0,1 s – 100 s	100 s
	Overfrequency threshold stage 2		50,0 Hz – 52,0 Hz	52,0 Hz
	Overfrequency operate time stage 2		0,1 s – 5 s	5 s
only EN 50549-2:2019, 4.9.3 Requirements on voltage and frequency protection	Positive sequence under-voltage protection threshold		20 % – 100 %	100 %
	Positive sequence under-voltage protection operate time		0,2 s – 100 s	100s
	Negative sequence over-voltage protection threshold		1 % – 100 %	100 %
	Negative sequence over-voltage protection operate time		0,2 s – 100 s	100s

Name of parameter set		indicate name of parameter set here		
specific technical requirement (e.g. grid codes)		indicate additional applicable requirement documents here		
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter ^a	Remarks/ additional information ^b	configurable value range	default value
	Zero sequence over-voltage protection threshold		1 % – 100 %	100 %
	Zero sequence over-voltage protection operate time		0,2 s – 100 s	100s
4.10.2 Automatic reconnection after tripping	Lower frequency		47,0 Hz – 50,0 Hz	49,5 Hz
	Upper frequency		50,0 Hz – 52,0 Hz	50,2 Hz
	Lower voltage		50 % U_n – 100 % U_n	85 % U_n , 90 % U_c
	Upper voltage		100 % U_n – 120 % U_n	110 % U_n
	Observation time		10 s – 600 s	60 s
	Active power increase gradient		6 % – 3000 %/min	10 % /min
4.10.3 Starting to generate electrical power	Lower frequency		47,0 Hz – 50,0 Hz	49,5 Hz
	Upper frequency		50,0 Hz – 52,0 Hz	50,1 Hz
	Lower voltage		50 % – 100 % U_n	85 % U_n 90 % U_c
	Upper voltage		100 % – 120 % U_n	110 % U_n
	Observation time		10 s – 600 s	60 s
	Active power increase gradient		6 % – 3000 %/min	disabled
4.11.1 Ceasing active power	activation option		e.g. digital input, IEC 61850, sunspec	
4.11.2 Reduction of active power on set point	activation option		e.g. digital input, IEC 61850, sunspec	
4.12 Remote information exchange	available communication standards		e.g. IEC 61850, sunspec	
Note:				
^a If additional parameters have been evaluated during the test, these shall be added as additional lines in the table.				
^b This column should be used for manufacturer specific parameter descriptions.				

Appendix 4: Pictures of the products

Enclosure – Front View



Enclosure – Rear View



Enclosure – Left side view



Enclosure – Right side view



Enclosure – Top View



Internal view



--- End of test report---