

TEST REPORT EN 50549-1 Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network -Generating plants up to and including Type B EN 50549-10 Requirements for generating plants to be connected in parallel with distribution networks - Part 10: Tests for conformity assessment of generating units	
Report	
Report Number.....	6260989.50
Date of issue	2026-03-18
Total number of pages	385
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	Jiangsu Essis New Energy Technology Co., Ltd.
Address	No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province 226376, China
Test specification:	
Standard	EN 50549-1:2019; EN 50549-1:2019/A1:2023 EN 50549-10:2022
Test procedure	Type test
Non-standard test method.....	N/A
Test Report Form No.	EN 50549-1_V3.0
Test Report Form(s) Originator	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Master TRF	Dated 2024-07-28
Test item description	Hybrid Inverter
Trade Mark	
Manufacturer	Jiangsu Essis New Energy Technology Co., Ltd. No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province 226376, China
Model/Type reference	SUN-8K-H, SUN-7.5K-H, SUN-6K-H, SUN-5K-H SUN-4.6K-H, SUN-4K-H, SUN-3.6K-H, SUN-3K-H

Ratings:

Operating temperature range: - 25°C to + 60°C
 Protective class: I, Ingress protection rating: IP66
 Power factor range (adjustable): 0.8 leading ~0.8 lagging
 Altitude (m): 3000

SUN-3K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20 A, Isc PV current: 25 A,
 Number of MPPT channel: 1
 Battery Voltage Range 40-60 Vdc
 Max. Charge Current 80 A, Max. Discharge Current 80 A
 AC output: L/N/PE, 230 Vac, 50/60 Hz
 Rated output power 3000 W, Max apparent power 3300 VA
 Rated output current 13 A, Max. AC current 15 A

SUN-3.6K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20 A, Isc PV current: 25 A,
 Number of MPPT channel: 1
 Battery Voltage Range 40-60 Vdc
 Max. Charge Current 80 A, Max. Discharge Current 80 A
 AC output: L/N/PE, 230 Vac, 50/60 Hz
 Rated output power 3680 W, Max apparent power 3680 VA
 Rated output current 16 A, Max. AC current 16 A

SUN-4K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
 Number of MPPT channel: 2
 Battery Voltage Range 40-60 Vdc
 Max. Charge Current 100 A, Max. Discharge Current 100 A
 AC output: L/N/PE, 230 Vac, 50/60 Hz
 Rated output power 4000 W, Max apparent power 4400 VA
 Rated output current 17.4 A, Max. AC current 20 A

SUN-4.6K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
 Number of MPPT channel: 2
 Battery Voltage Range 40-60 Vdc
 Max. Charge Current 100 A, Max. Discharge Current 100 A
 AC output: L/N/PE, 230 Vac, 50/60 Hz
 Rated output power 4600 W, Max apparent power 5060 VA
 Rated output current 20 A, Max. AC current 23 A

SUN-5K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
 Number of MPPT channel: 2
 Battery Voltage Range 40-60 Vdc
 Max. Charge Current 120 A, Max. Discharge Current 120 A
 AC output: L/N/PE, 230 Vac, 50/60 Hz
 Rated output power 5000 W, Max apparent power 5500 VA
 Rated output current 21.7 A, Max. AC current 25 A

SUN-6K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
 Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
 Number of MPPT channel: 2

Battery Voltage Range 40-60 Vdc
Max. Charge Current 120 A, Max. Discharge Current 120 A
AC output: L/N/PE, 230 Vac, 50/60 Hz
Rated output power 6000 W, Max apparent power 6600 VA
Rated output current 26.1 A, Max. AC current 30 A

SUN-7.5K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
Number of MPPT channel: 2
Battery Voltage Range 40-60 Vdc
Max. Charge Current 160 A, Max. Discharge Current 160 A
AC output: L/N/PE, 230 Vac, 50/60 Hz
Rated output power 7500 W, Max apparent power 8250 VA
Rated output current 32.6 A, Max. AC current 37.5 A

SUN-8K-H:

PV input: Max.600 Vdc, MPPT voltage range: 80-550 Vdc,
Max. Input Current: 20/20 A, Isc PV current: 25/25 A,
Number of MPPT channel: 2
Battery Voltage Range 40-60 Vdc
Max. Charge Current 160 A, Max. Discharge Current 160 A
AC output: L/N/PE, 230 Vac, 50/60 Hz
Rated output power 8000 W, Max apparent power 8800 VA
Rated output current 34.8 A, Max. AC current 40 A

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

List of Attachments (including a total number of pages in each attachment): Appendix 1: Datasheet of the relay (3 pages) Appendix 2: Evaluated protection function and operational capabilities (2 pages) Appendix 3: Evaluated parameter and parameter range (5 pages) Appendix 4: Pictures of the products (4 pages)	
Summary of testing:	
Tests performed (name of test and test clause):	Testing location:
All applicable tests were performed. (Except EMC test)	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
5.7.1 EMC test (The EMC test report provided by the customer) EMC Test report No.: 6260988.50, Issued by DEKRA Testing and Certification (Shanghai) Ltd.	DEKRA Testing and Certification (Shanghai) Ltd. No.250, Jiangchangsan Road, Jing'an District, Shanghai, China

Copy of marking plate:

The artwork below may be only a draft.

essiss **Model:SUN-3K-H**
Name:HYBRID INVERTER

PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20A Isc PV: 25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 80 / 80 A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LNPE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 27.3A A.C. Input Max. Apparent Power: 6000VA
A.C. Output Port	A.C. Output Rated Power: 3000W A.C. Output Rated Apparent Power: 3000VA A.C. Output Max. Apparent Power: 3300VA A.C. Output Max. Current: 15A A.C. Output Rated Current: 13A A.C. Output Nominal Voltage: LNPE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ...0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LNPE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 3000W Back-up Output Rated Apparent Power: 3000VA Back-up Output Max. Apparent Power: 3300VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)








Manufacturer: Jiangsu Essiss New Energy Technology Co., Ltd.
Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China

essiss **Model:SUN-3.6K-H**
Name:HYBRID INVERTER

PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20A Isc PV: 25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 80 / 80 A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LNPE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 32.7A A.C. Input Max. Apparent Power: 7200VA
A.C. Output Port	A.C. Output Rated Power: 3680W A.C. Output Rated Apparent Power: 3680VA A.C. Output Max. Apparent Power: 3680VA A.C. Output Max. Current: 16A A.C. Output Rated Current: 16A A.C. Output Nominal Voltage: LNPE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ...0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LNPE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 3680W Back-up Output Rated Apparent Power: 3680VA Back-up Output Max. Apparent Power: 3680VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)








Manufacturer: Jiangsu Essiss New Energy Technology Co., Ltd.
Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China

essiss **Model:SUN-4K-H**
Name:HYBRID INVERTER

PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 100/100A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LNPE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 36.4A A.C. Input Max. Apparent Power: 8000VA
A.C. Output Port	A.C. Output Rated Power: 4000W A.C. Output Rated Apparent Power: 4000VA A.C. Output Max. Apparent Power: 4400VA A.C. Output Max. Current: 20A A.C. Output Rated Current: 17.4A A.C. Output Nominal Voltage: LNPE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ...0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LNPE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 4000W Back-up Output Rated Apparent Power: 4000VA Back-up Output Max. Apparent Power: 4400VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)








Manufacturer: Jiangsu Essiss New Energy Technology Co., Ltd.
Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China

essiss **Model:SUN-4.6K-H**
Name:HYBRID INVERTER

PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 100/100A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LNPE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 41.8A A.C. Input Max. Apparent Power: 9200VA
A.C. Output Port	A.C. Output Rated Power: 4600W A.C. Output Rated Apparent Power: 4600VA A.C. Output Max. Apparent Power: 5060VA A.C. Output Max. Current: 23A A.C. Output Rated Current: 20A A.C. Output Nominal Voltage: LNPE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ...0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LNPE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 4600W Back-up Output Rated Apparent Power: 4600VA Back-up Output Max. Apparent Power: 5060VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)








Manufacturer: Jiangsu Essiss New Energy Technology Co., Ltd.
Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China

 Model:SUN-5K-H Name:HYBRID INVERTER	
PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 120/120A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LN/PE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 43A A.C. Input Max. Apparent Power: 10000VA
A.C. Output Port	A.C. Output Rated Power: 5000W A.C. Output Rated Apparent Power: 5000VA A.C. Output Max. Apparent Power: 5500VA A.C. Output Max. Current: 25A A.C. Output Rated Current: 21.7A A.C. Output Nominal Voltage: LN/PE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ... 0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LN/PE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 5000W Back-up Output Rated Apparent Power: 5000VA Back-up Output Max. Apparent Power: 5500VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)
 Made in China Manufacturer: Jiangsu Essis New Energy Technology Co., Ltd. Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China	

 Model:SUN-6K-H Name:HYBRID INVERTER	
PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 120/120A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LN/PE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 43A A.C. Input Max. Apparent Power: 10000VA
A.C. Output Port	A.C. Output Rated Power: 6000W A.C. Output Rated Apparent Power: 6000VA A.C. Output Max. Apparent Power: 6600VA A.C. Output Max. Current: 30A A.C. Output Rated Current: 26.1A A.C. Output Nominal Voltage: LN/PE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ... 0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LN/PE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 6000W Back-up Output Rated Apparent Power: 6000VA Back-up Output Max. Apparent Power: 6600VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)
 Made in China Manufacturer: Jiangsu Essis New Energy Technology Co., Ltd. Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China	

 Model:SUN-7.5K-H Name:HYBRID INVERTER	
PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 160/160A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LN/PE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 43A A.C. Input Max. Apparent Power: 10000VA
A.C. Output Port	A.C. Output Rated Power: 7500W A.C. Output Rated Apparent Power: 7500VA A.C. Output Max. Apparent Power: 8250VA A.C. Output Max. Current: 37.5A A.C. Output Rated Current: 32.6A A.C. Output Nominal Voltage: LN/PE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ... 0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LN/PE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 7500W Back-up Output Rated Apparent Power: 7500VA Back-up Output Max. Apparent Power: 8250VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)
 Made in China Manufacturer: Jiangsu Essis New Energy Technology Co., Ltd. Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China	

 Model:SUN-8K-H Name:HYBRID INVERTER	
PV Port	D.C. Max. Input Voltage: 600Vd.c. D.C. Max. Input Current: 20/20A Isc PV: 25/25A D.C. MPPT Voltage Range: 80...550Vd.c.
Battery Port	Battery Voltage Range: 40-60Vd.c. Battery Max. charge/discharge Current: 160/160A Battery Type: Li-Ion/Lead Acid
A.C. Input Port	A.C. Input Nominal Voltage: LN/PE, 220/230V A.C. Input Nominal Frequency: 50/60Hz A.C. Input Max. Current: 43A A.C. Input Max. Apparent Power: 10000VA
A.C. Output Port	A.C. Output Rated Power: 8000W A.C. Output Rated Apparent Power: 8000VA A.C. Output Max. Apparent Power: 8800VA A.C. Output Max. Current: 40A A.C. Output Rated Current: 34.8A A.C. Output Nominal Voltage: LN/PE, 220/230V A.C. Output Nominal Frequency: 50/60Hz Power Factor: 0.8 leading ... 0.8 lagging
Back-up Output Port	Back-up Output Nominal Voltage: LN/PE, 220/230V Back-up Output Nominal Frequency: 50/60Hz Back-up Output Rated Power: 8000W Back-up Output Rated Apparent Power: 8000VA Back-up Output Max. Apparent Power: 8800VA
General Data	Operating Temperature Range: -25...+60 °C Enclosure: IP66 Protection Class: I Operating Altitude: 3000m Communication: WiFi/LAN(Optional) Inverter Topology: Non-isolated Over Voltage Category: II(PV), III(MAINS)
 Made in China Manufacturer: Jiangsu Essis New Energy Technology Co., Ltd. Address: No.029 Yangxing Road, Tongzhou District, Nantong City, Jiangsu Province, China	

Remark: According to customer's and market requirement, these models were evaluated under the grid voltage 230 Vac 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	
Enviromental 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 (%)	:-90 / +110 %			
Tested for power systems	: TN, TT			
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)	: SUN-8K-H, SUN-7.5K-H, SUN-6K-H, SUN-5K-H SUN-4.6K-H, SUN-4K-H, SUN-3.6K-H, SUN-3K-H			
Pollution degree	: Outside PD3; Inside PD2			
IP protection class.....	: IP66			
Possible test case verdicts:				
- test case does not apply to the test object..... : N/A				
- test object does meet the requirement				
: P (Pass)				
- test object does not meet the requirement				
: F (Fail)				
- this clause is information reference for installation.... : Info.				
Testing:				
Date of receipt of test item.....	: 2025-10-30 (samples provided by applicant) No samples (Amendment 1 report)			
Date (s) of performance of tests	: 2025-10-31 to 2025-12-11 No tests (Amendment 1 report)			

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.

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

The information provided by the customer in this report may affect the validity of the results, the test lab is not responsible for it.

This report is not used for social proof function in China market.

"(see Enclosure #)" refers to additional information appended to the report.

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

The clause 5.7.1 of EN50549-10(4.8 of EN 50549-1) EMC test is not in the IAS scope of DEKRA Testing and Certification (Suzhou) Co., Ltd.

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

Use of uncertainty of measurement for decisions on conformity (decision rule):

No decision rule is specified by this standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

Use of uncertainty of measurement for decisions on conformity (decision rule):

No decision rule is specified by this standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

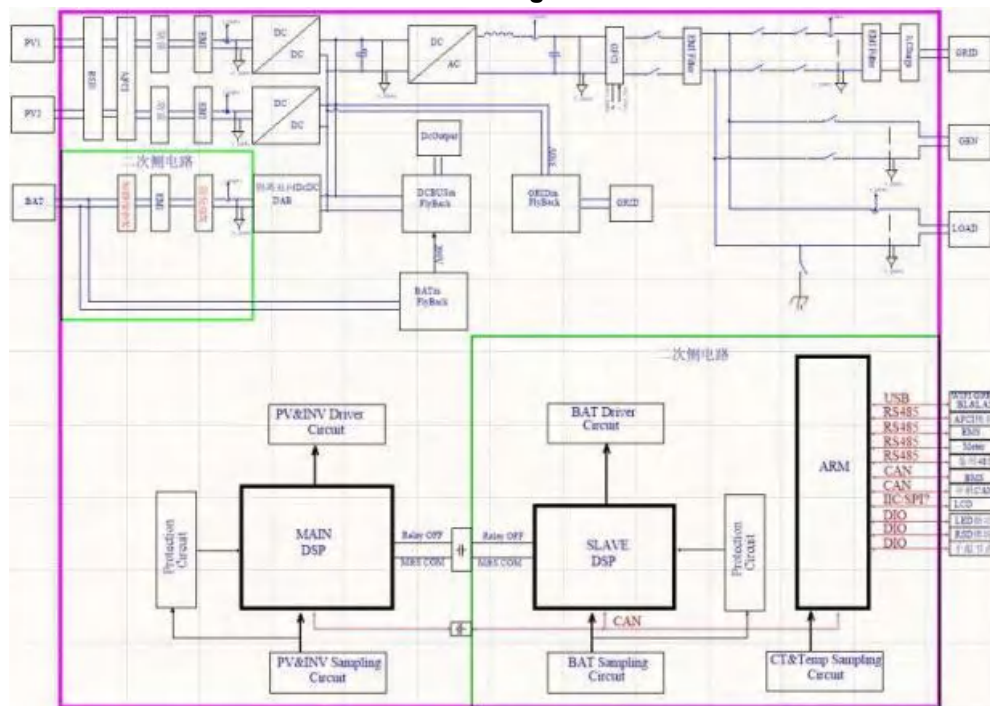
Name and address of factory (ies):

Factory code: 54853

General product information:

This product is single-phase hybrid inverter, which converts the DC voltage from solar panels into single-phase AC voltage and also converts the DC voltage from low-voltage batteries into single-phase AC voltage to connect to the household grid for power generation. It can also control and dispatch power among GRID, BAT, LOAD and GEN. Inverter can dispatch AC power from GRID or GEN to LOAD side, can also rectify AC power into DC power to charge the BAT, the PV can also charge BAT, the BAT can be discharged to the GRID and LOAD side and the inverter can also dispatch AC power from GEN to GRID side. There is an auxiliary power supply inside the product.

The product is equipped with an auxiliary power supply. There are 4 relays on the Grid side, which are redundant and can be disconnected to ensure the safety and reliability of the system. The product can achieve full power output at an ambient temperature of 45 °C. When the temperature exceeds 45 °C, the output power will linearly decrease until the ambient temperature reaches a maximum of 60 °C.

Block Diagram:**Model difference:**

1. SUN-8K-H, SUN-7.5K-H, SUN-6K-H, SUN-5K-H, SUN-4.6K-H, SUN-4K-H, SUN-3.6K-H and SUN-3K-H are completely the same models, with only the rated output power controlled by software being different.
2. SUN-3K-H, SUN-3.6K-H have 1 MPPT tracker, SUN-4K-H, SUN-4.6K-H, SUN-5K-H, SUN-6K-H, SUN-7.5K-H and SUN-8K-H have 2 MPPT trackers.

The product was tested on:

Unless otherwise specified, all tests were performed on the representative model of SUN-8K-H applicable for other models since it is identical in hardware and just power derating by software.

Hardware version: V01

Software version: V1.00

Amendment 1 report:

The report 6260989.50 was based on the report 6234686.50 issued by DEKRA Testing and Certification (Suzhou) Co., Ltd., issued on 2025-12-30, and COC No.: 6234686.01 issued by DEKRA Testing and Certification (Shanghai) Ltd., issued on 2025-12-30. It was issued due to the modifications below:

- Changed the applicant and manufacturer information and updated address accordingly.
- Update the marking plate and pictures of the product.

After technical review, tests were not considered necessary.

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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. 6234683.50 issued by DEKRA Testing and Certification (Shanghai) Ltd.	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		N/A
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

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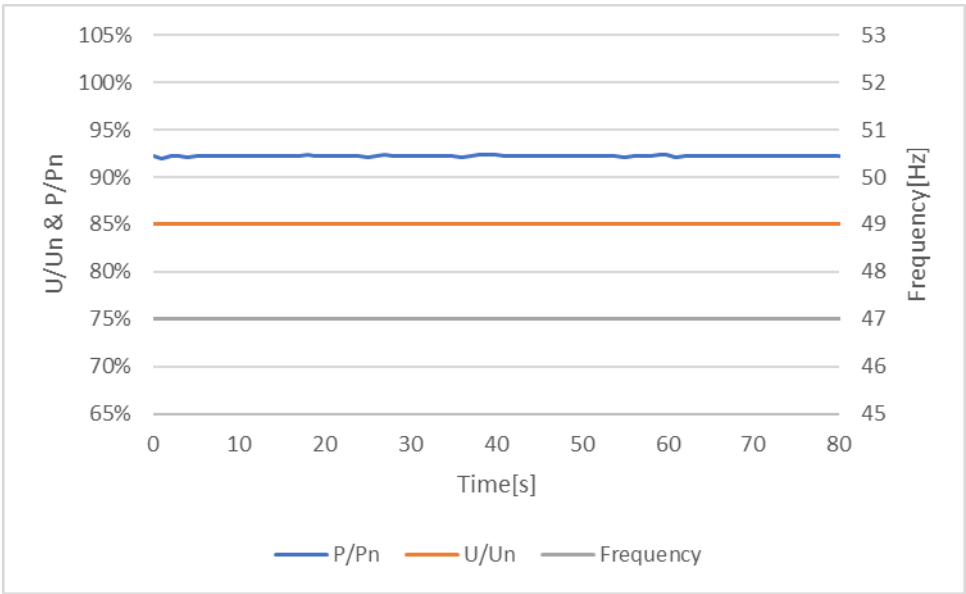
Clause	Requirement - Test	Result - Remark	Verdict
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5.2.1	TABLE: Frequency operating range							P
Model	SUN-8K-H							
☐ Opinion 1: Minimum requirement								
Test sequence	Test condition		Measurement					Limits
	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ	Duration T (s)	Cont. T
1	85%	47.0	-	-	-	-	-	≥ 300s
2	85%	48.5	-	-	-	-	-	≥ 1800s
3	110%	51.0	-	-	-	-	-	≥ 1800s
4	110%	51.5	-	-	-	-	-	≥ 300s
Note: * Function of interface protection and activating active power response to over/under frequency and voltage shall be disable. Remark: Due to current limit, when the voltage is 85% Un, the output power P/P _n is less than 95%.								
☒ 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	85.00%	47.00	92.23%	0.9962	79	≥ 20 s
2	85%	47.5	85.02%	47.50	92.41%	0.9960	5441	≥ 5400s
3	110%	51.5	110.02%	51.50	99.16%	0.9978	5459	≥ 5400s
4	110%	52.0	110.02%	52.00	99.13%	0.9978	311	≥ 300 s
Note: * Function of interface protection and activating active power response to over/under frequency and voltage shall be disable. Remark: Due to current limit, when the voltage is 85% Un, the output power P/P _n is less than 95%.								

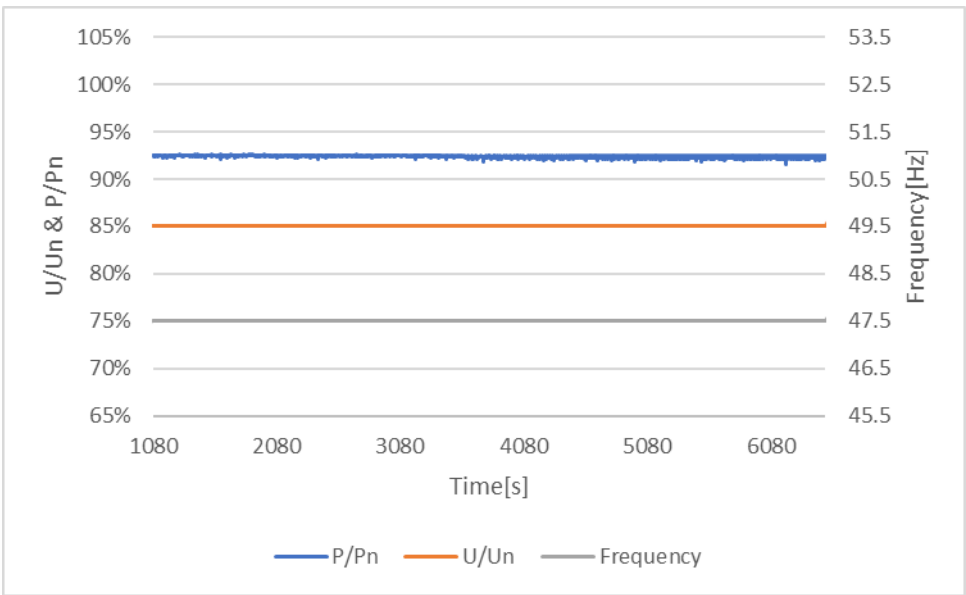
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Opinion 2: Stringent requirement

Test sequence 1



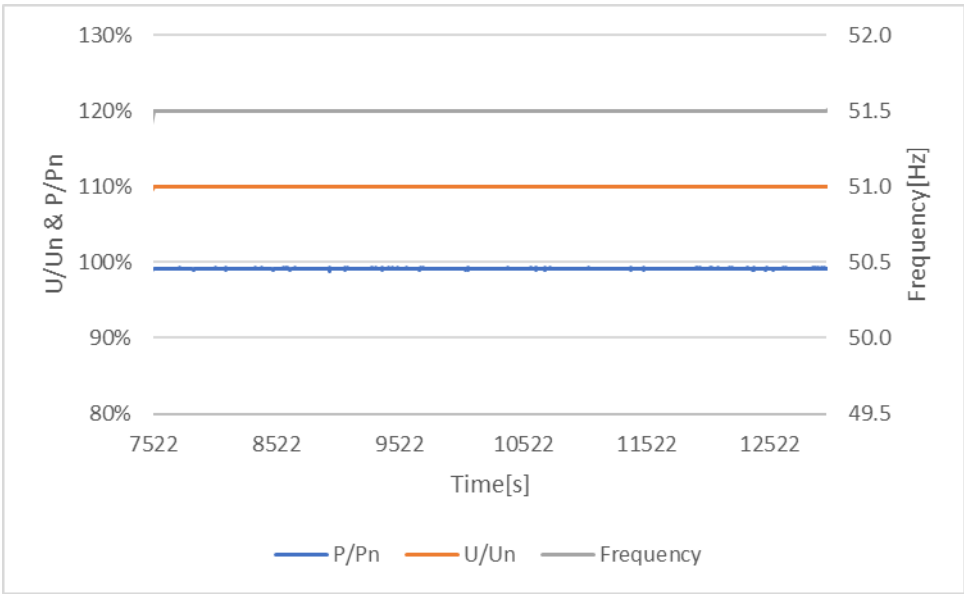
Test sequence 2



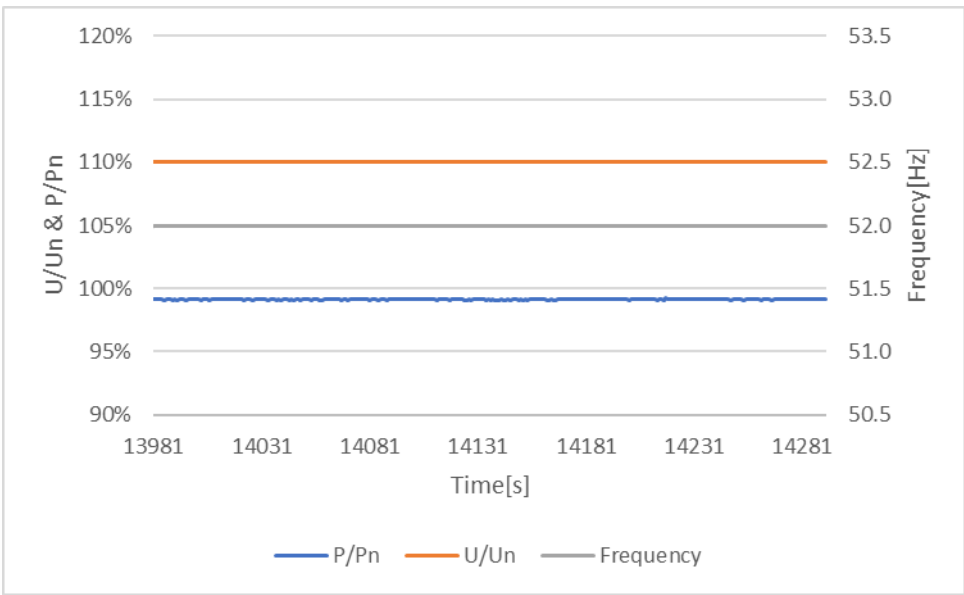
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Opinion 2: Stringent requirement

Test sequence 3



Test sequence 4

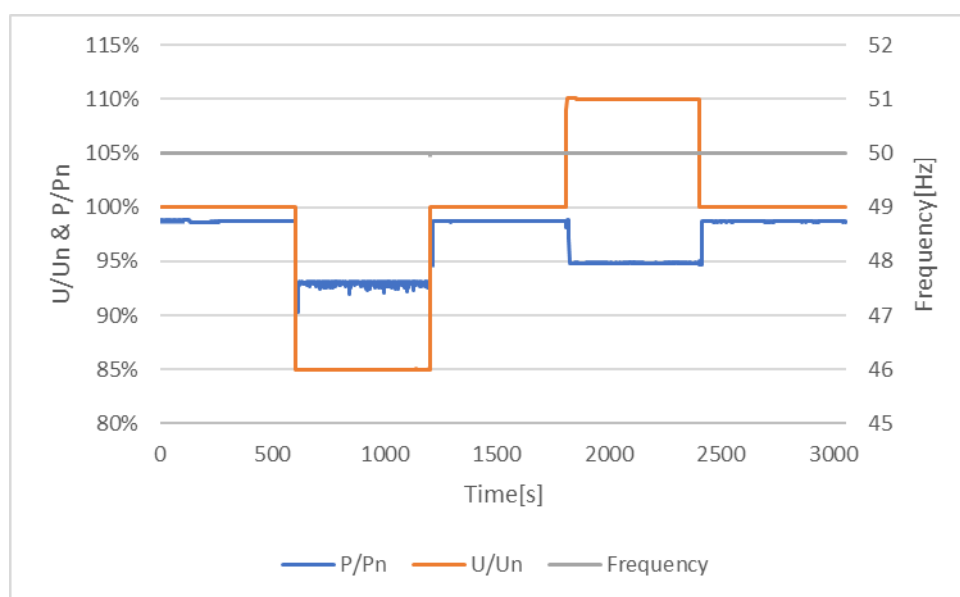


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.2.2	TABLE: Voltage operating range							P
Model	SUN-8K-H							
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	100.02%	50.00	98.72%	0.9988	603
2	85%	50.0	600	85.04%	50.00	92.96%	0.9961	600
3	100%	50.0	600	100.03%	50.00	98.64%	0.9988	606
4	110%	50.0	600	109.82%	50.00	95.00%	0.9988	603
5	100%	50.0	600	100.03%	50.00	98.69%	0.9988	640
Note: Due to current limit, when the voltage is 85% Un, the output power P/Pn is less than 95%.								

Graph of Test



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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4.4.3	TABLE: Minimal requirement for active power delivery at under-frequency	P
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Model	SUN-8K-H
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☒ 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	-	-	-	-	-	0	≥ -10%
3	100%	49.0	-	-	-	-	-	0	
4	100%	47.5	-	-	-	-	-	0	

☒ Opinion 2: Stringent requirement

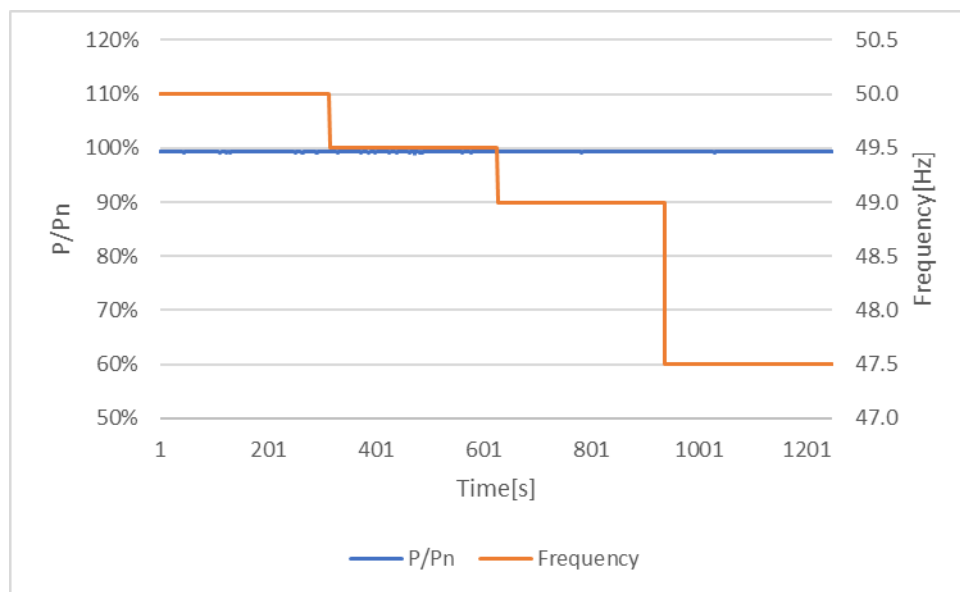
Test sequence	Test condition		Measurement						Limits
	U/U _n	f (Hz)	U/U _n	f (Hz)	P/P _n	Cosφ (PF)	ΔP/P _n	ΔP/P _n per 1 Hz	ΔP/P _n per 1 Hz
1	100%	50.0	100.03%	50.00	99.28%	0.9976	-0.72%	--	--
2	100%	49.5	100.03%	49.50	99.27%	0.9976	-0.73%	-1.45%	≥ -2%*
3	100%	49.0	100.03%	49.00	99.28%	0.9977	-0.72%	-0.72%	
4	100%	47.5	100.03%	47.50	99.29%	0.9977	-0.71%	-0.28%	

Note:

* Stringent requirement

P-f Diagram

Opinion 2: Stringent requirement



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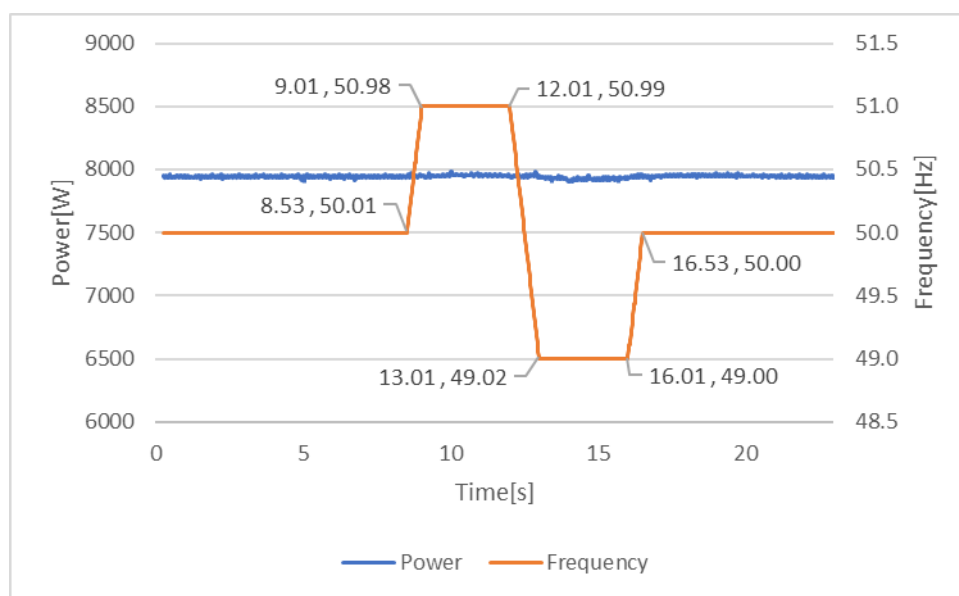
Clause	Requirement - Test	Result - Remark	Verdict
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5.3.1	TABLE: Rate of change of frequency (ROCOF) immunity					P
Model	SUN-8K-H					
Voltage (Vac)		230.06				
Active power (W)		7944.46				
Test sequence	Test condition				Result	Limits
	Ramp	From	To	Time [s]		
1	0	50.0 Hz	50.0 Hz	3	No disconnection	No disconnection
2	+2Hz/s	50.0 Hz	51.0 Hz	0.5	No disconnection	
3	0	51.0 Hz	51.0 Hz	3.0	No disconnection	
4	-2Hz/s	51.0 Hz	49.0 Hz	1.0	No disconnection	
5	0	49.0 Hz	49.0 Hz	3.0	No disconnection	
6	+2Hz/s	49.0 Hz	50.0 Hz	0.5	No disconnection	
7	0	50.0 Hz	50.0 Hz	3	No disconnection	

Note:

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

Graph of Test

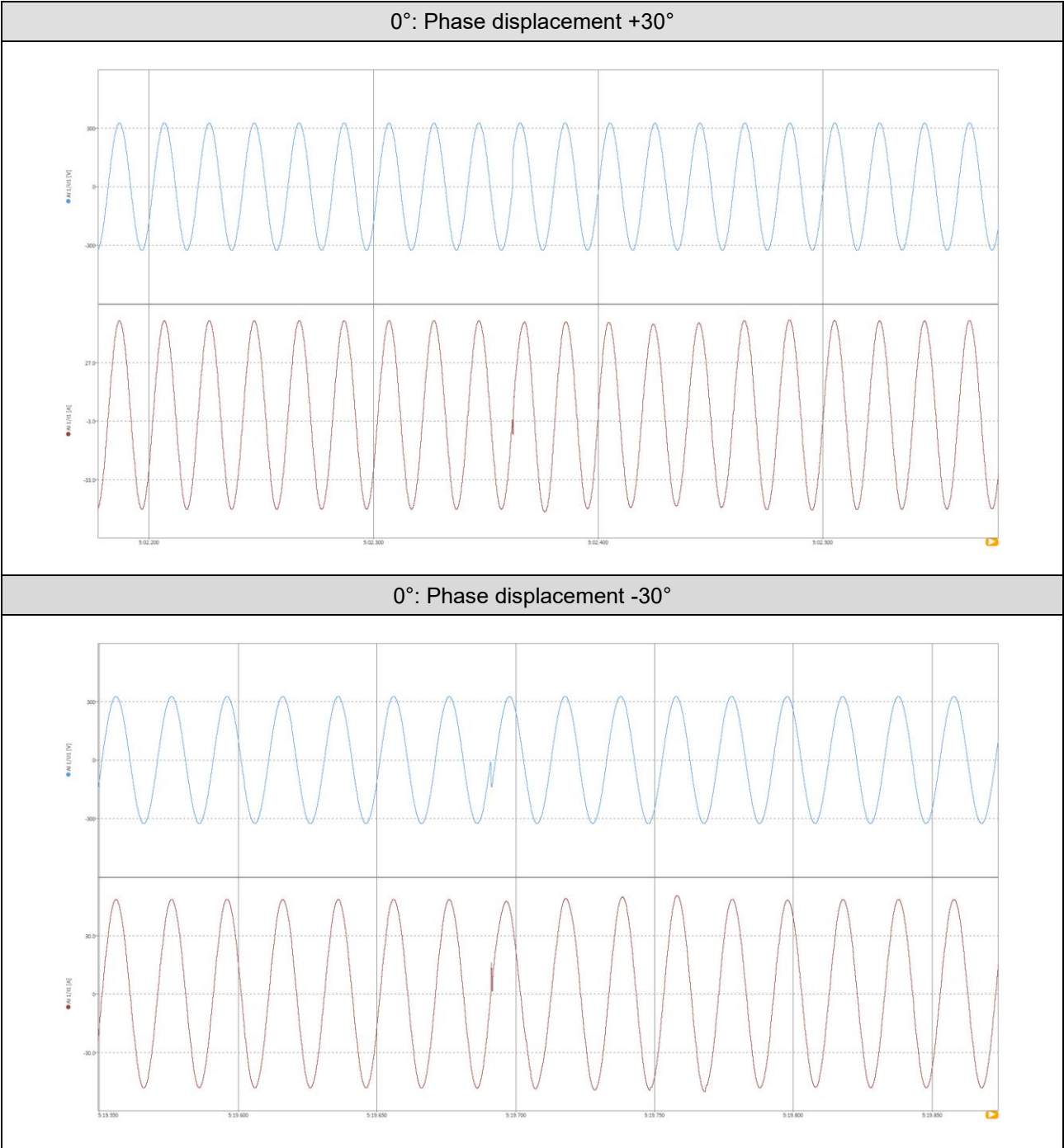


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.3.2	TABLE: Phase jump				P
Model	SUN-8K-H				
a phase jump at the voltage zero crossing (0°) of the sinewave					
Test Condition				Result	Limit
P/Pn	Cosφ (PF)	Time	Phase displacement [°]		
> 90%	1	5min	+(20°~50°)	No disconnection	After the phase jump, 90 % of pre-fault power or available power whichever is the smallest shall be resumed asfast as possible, but at the latest within 3 s
> 90%	1	5min	-(20°~50°)	No disconnection	
> 90%	1	5min	+180°*	No damage	No damage inverter
> 90%	1	5min	-180°*	No damage	
> 90%	1	5min	+90°*	No damage	
> 90%	1	5min	-90°*	No damage	
a phase jump at the voltage zero crossing (90°) of the sinewave					
Test Condition				Result	Limit
P/Pn	Cosφ (PF)	Time	Phase displacement [°]		
> 90%	1	5min	+(20°~50°)	No disconnection	After the phase jump, 90 % of pre-fault power or available power whichever is the smallest shall be resumed asfast as possible, but at the latest within 3 s
> 90%	1	5min	-(20°~50°)	No disconnection	
> 90%	1	5min	+180°*	No damage	No damage inverter
> 90%	1	5min	-180°*	No damage	
> 90%	1	5min	+90°*	No damage	
> 90%	1	5min	-90°*	No damage	
NOTE: The test shall be conducted to validate this declaration with a phase jump of at least the declared angle. EXAMPLE 90°and 180°are often considered as the most unfavourable cases.					

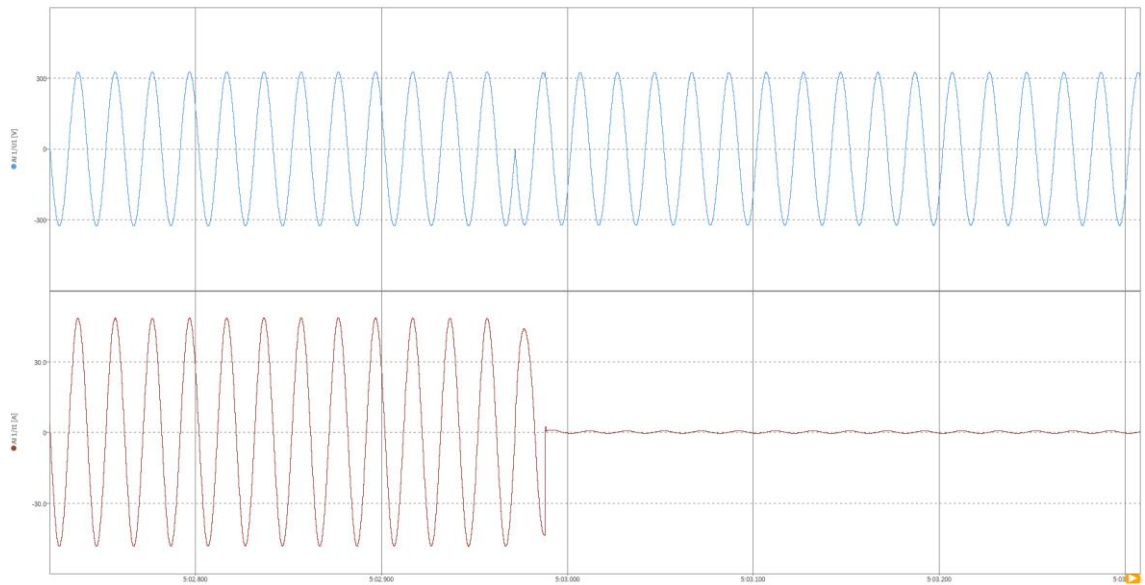
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict



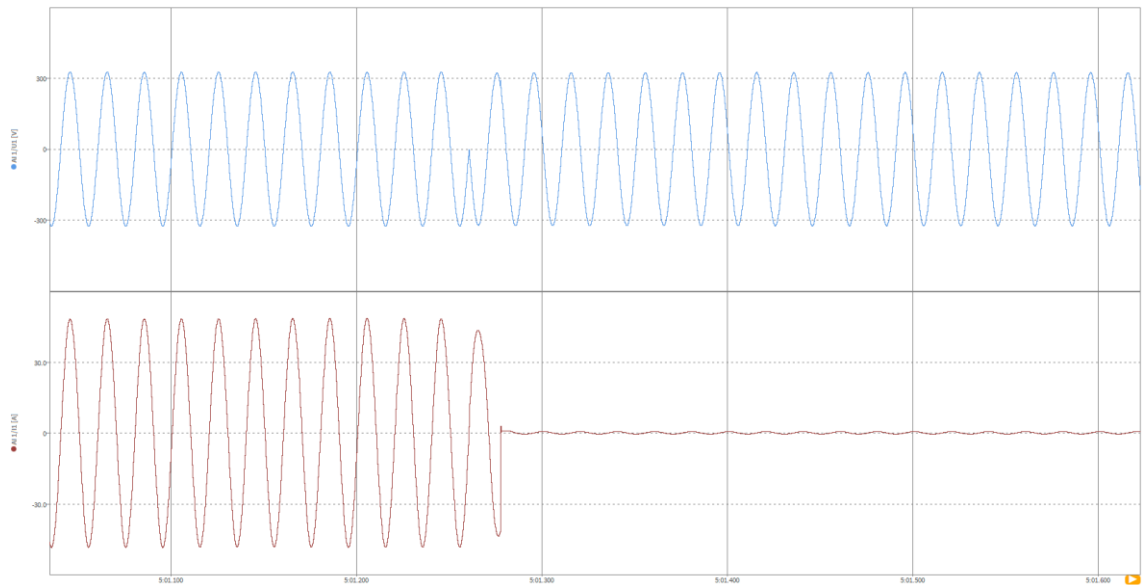
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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0°: Phase displacement +180°



0°: Phase displacement -180°



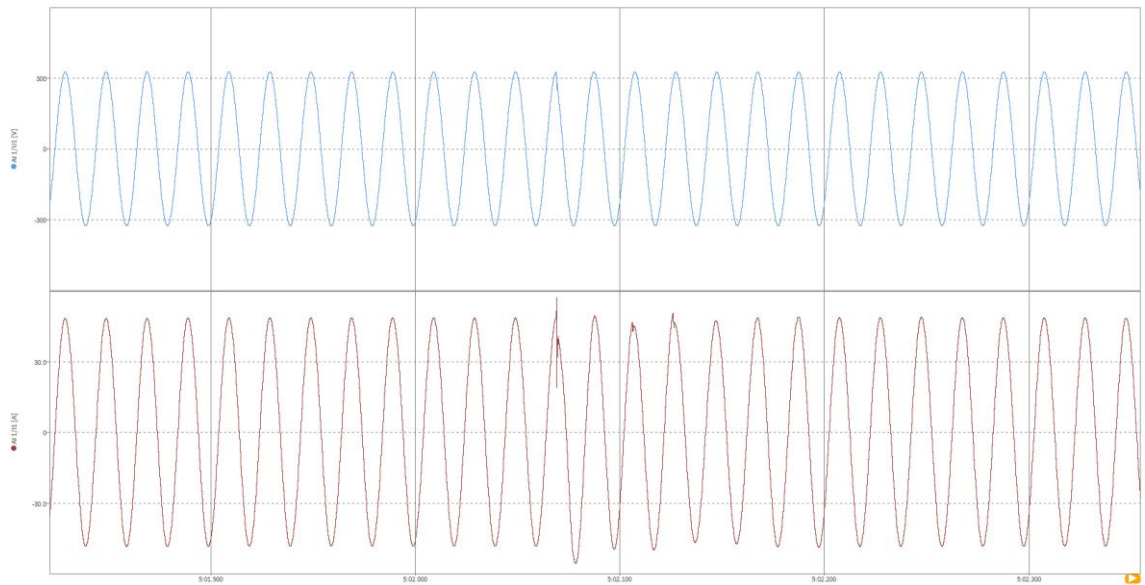
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict



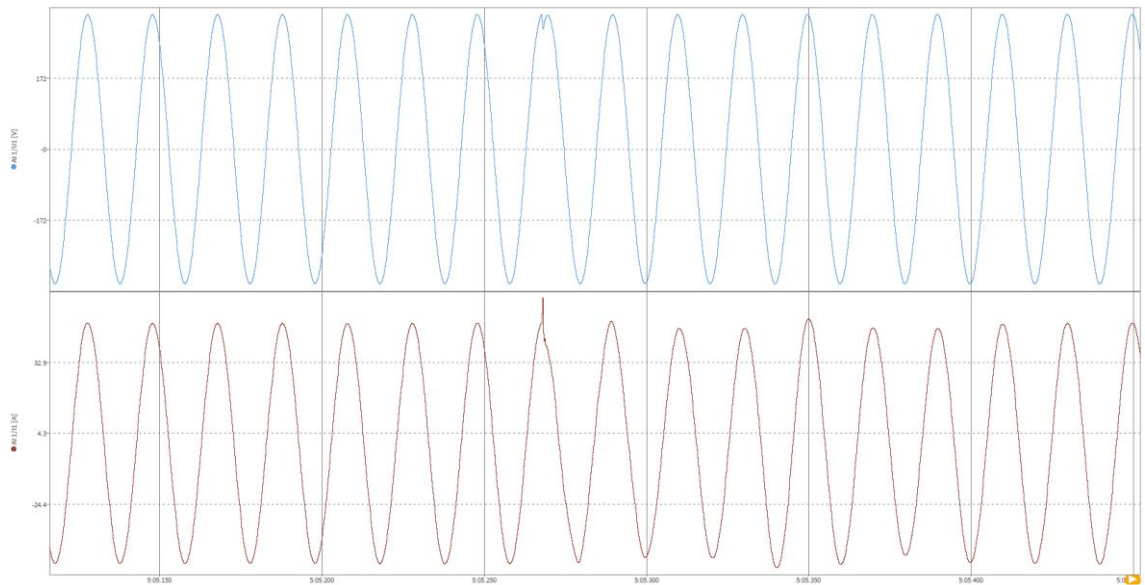
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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90°: Phase displacement +30°

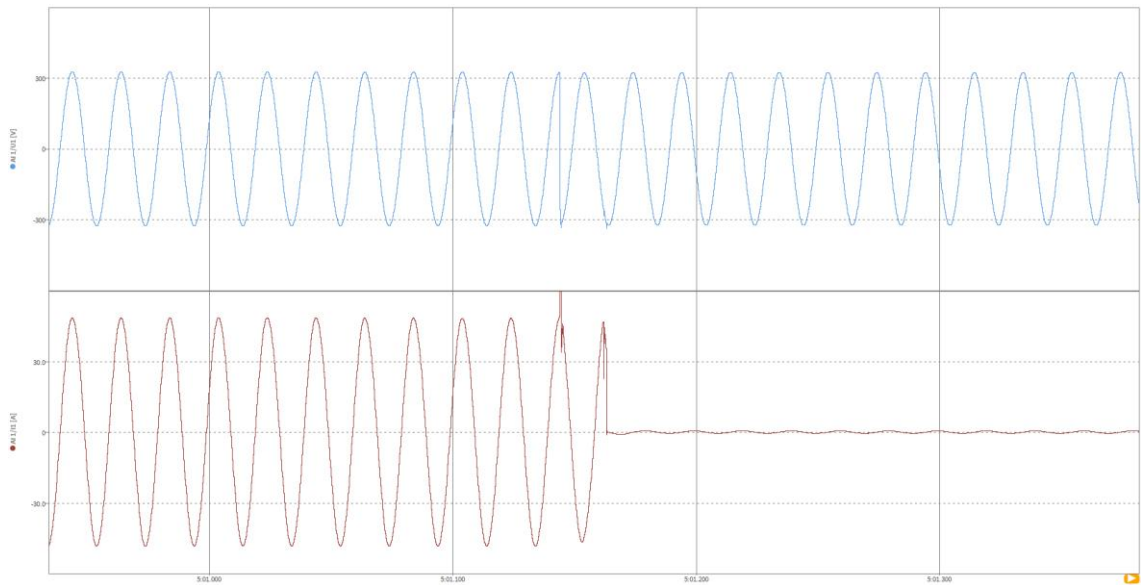


90°: Phase displacement -30°

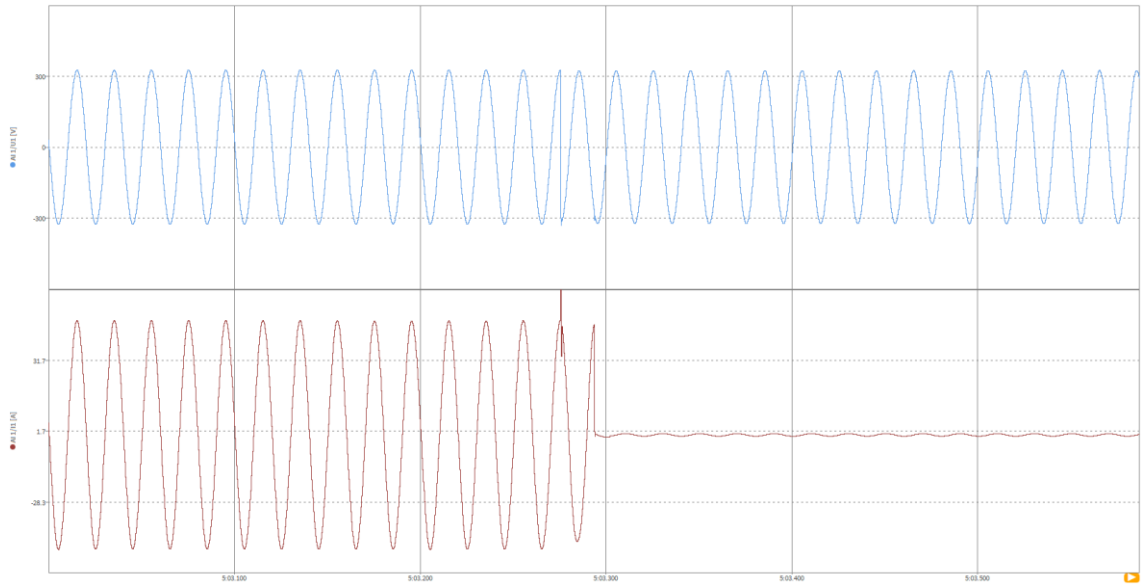


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

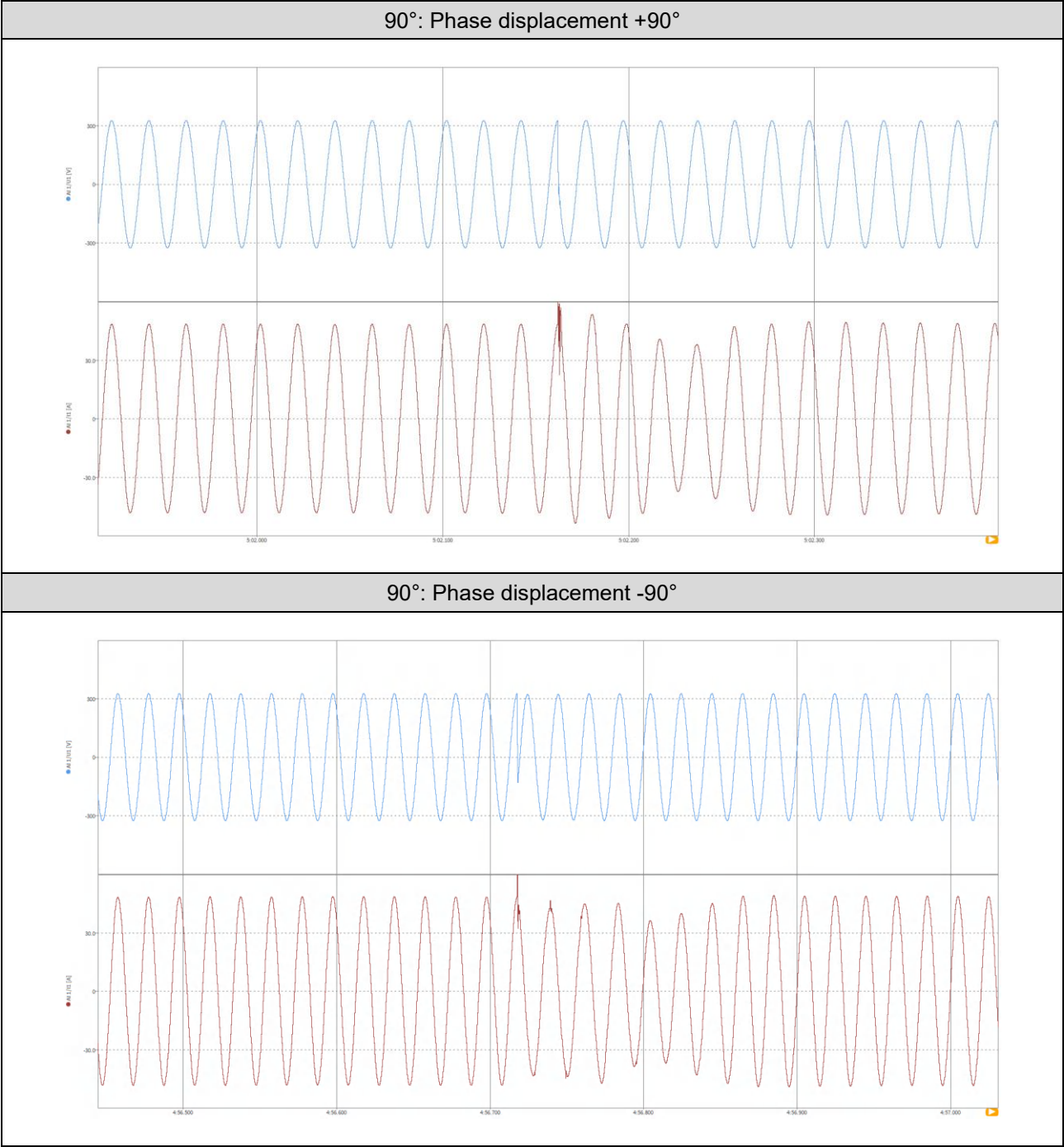
90°: Phase displacement +180°



90°: Phase displacement -180°



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



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.3.3	TABLE: Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)					P
Model	SUN-8K-H					
For EN 50549-1 type A(DC voltage=206 V)						
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
				0.1 to 0.5		8.4
		D2 (VS3)		0.98 to 1.02		8.5
				0.1 to 0.5		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 8.x) and VRT fault types (A/D1/D2).						
Each case two consecutive tests must be completed successfully.						

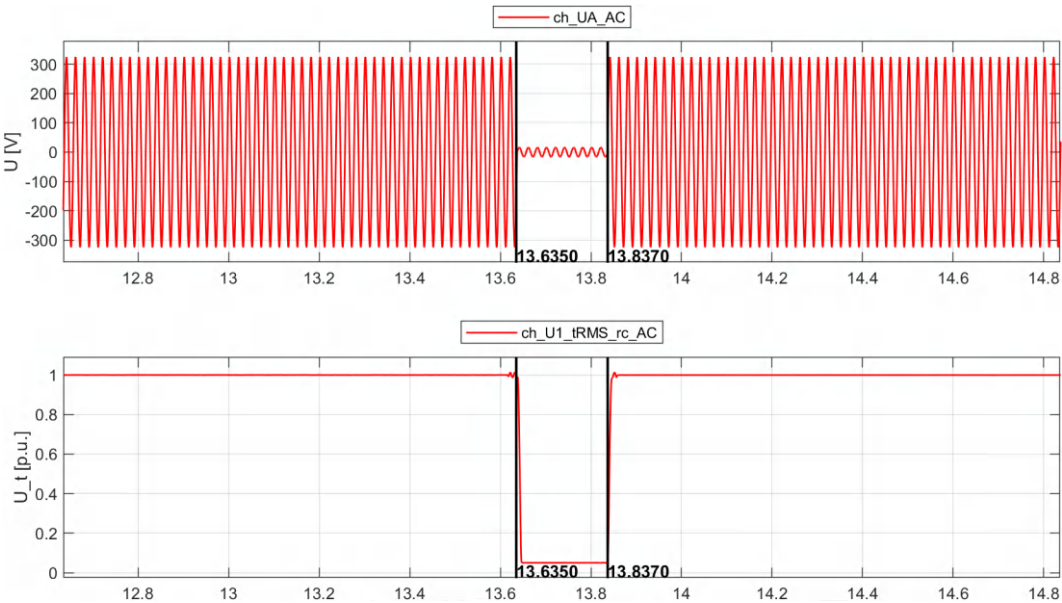
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.1	1.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	17:58:35.0	09:33:02.5
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	13818	13246
	7	Point of fault clearance(t_2)	Total	--	ms	14018	13448
	8	Fault duration in empty load test	Total	--	ms	202	202
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.050	0.050
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.986	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.990	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.050	0.050
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.031	0.022
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.030	0.025
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.001	0.001
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.990	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.183	0.227
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

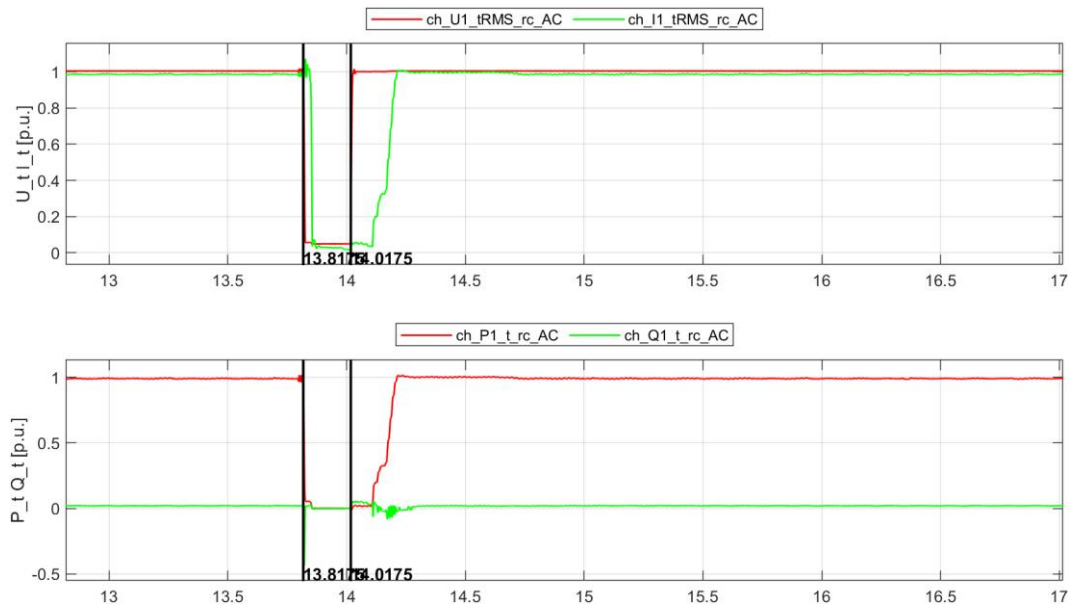
**Test 1.0a Depth of fault phase: 0.05 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



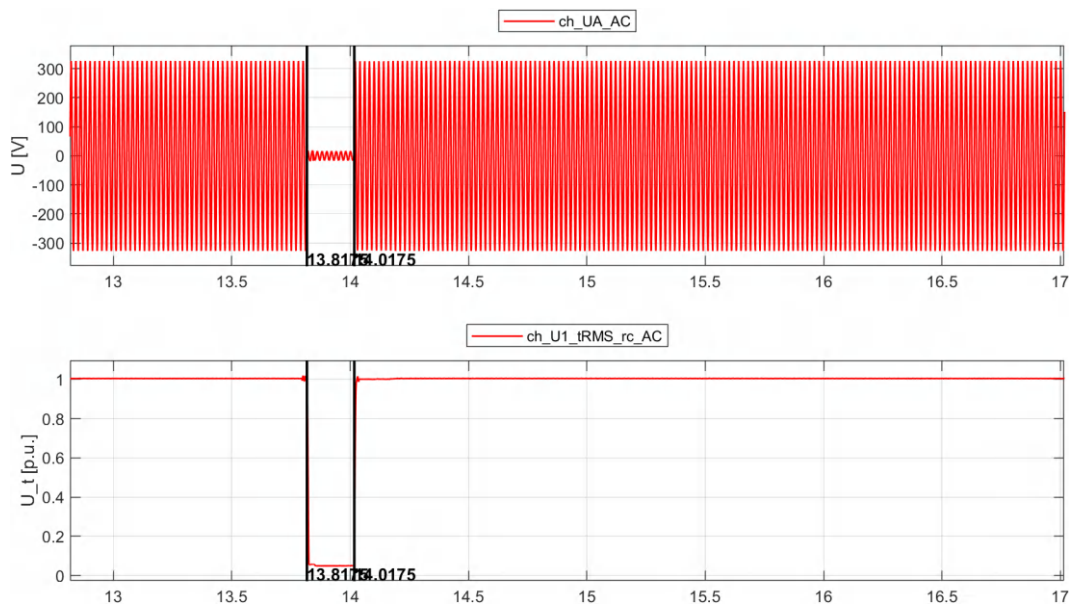
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Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Test overview (voltage, current, active and reactive power)**



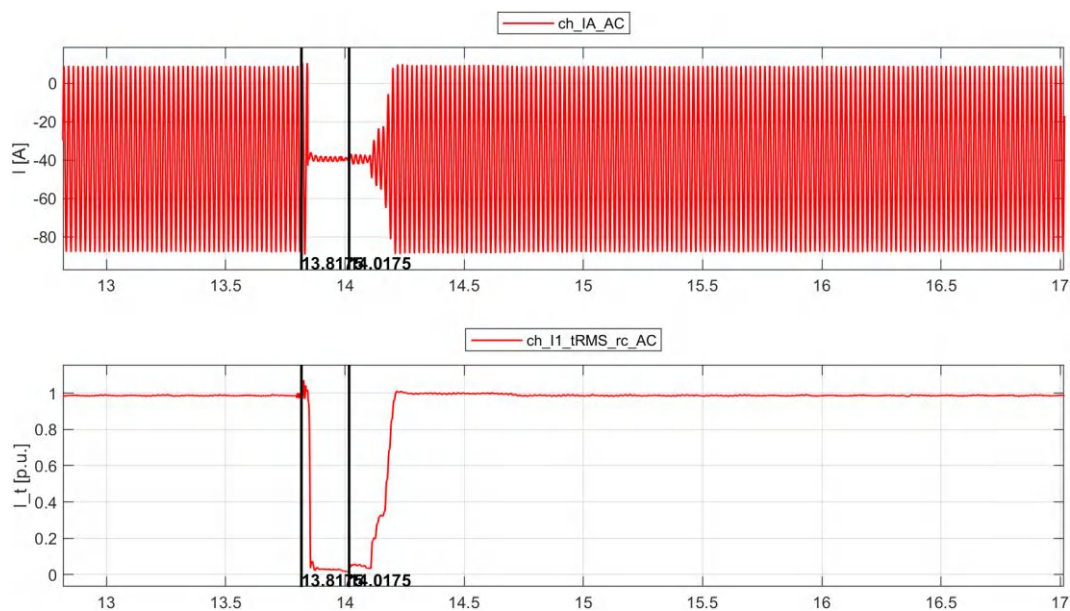
**Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



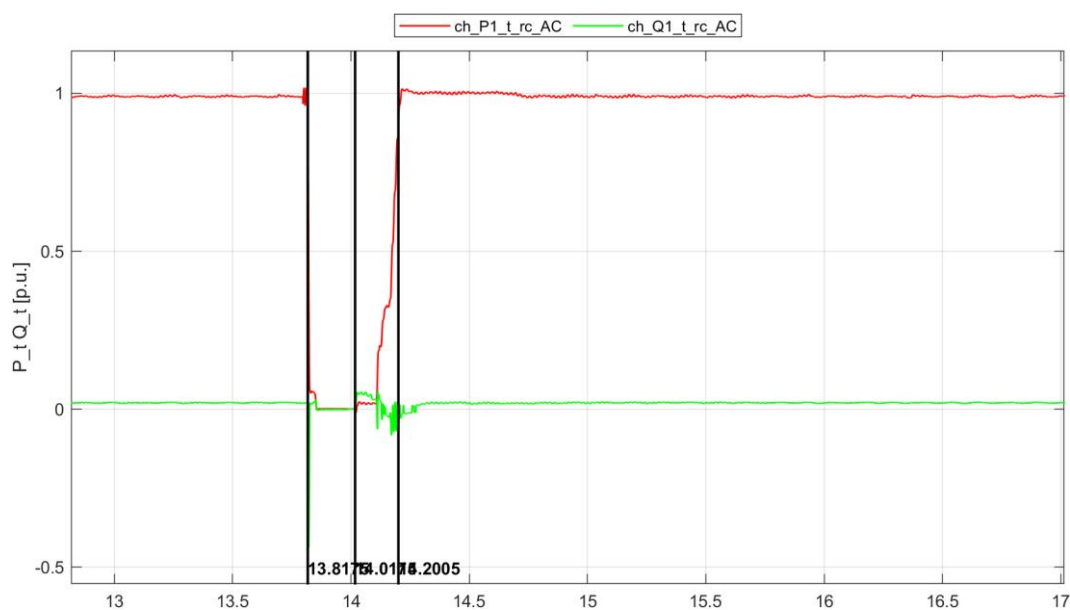
EN 50549-10

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



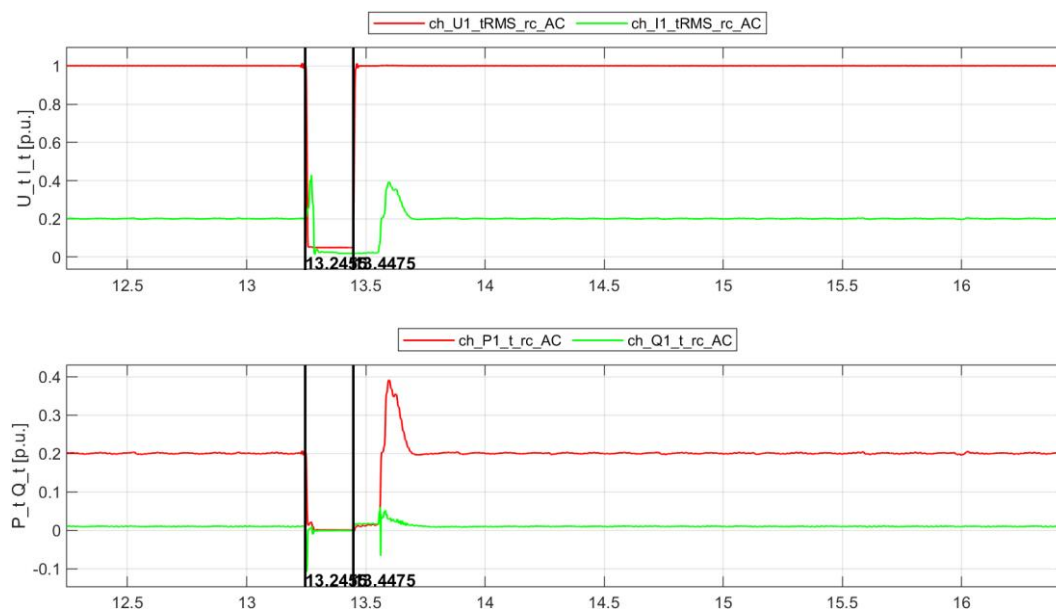
**Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Power restore**



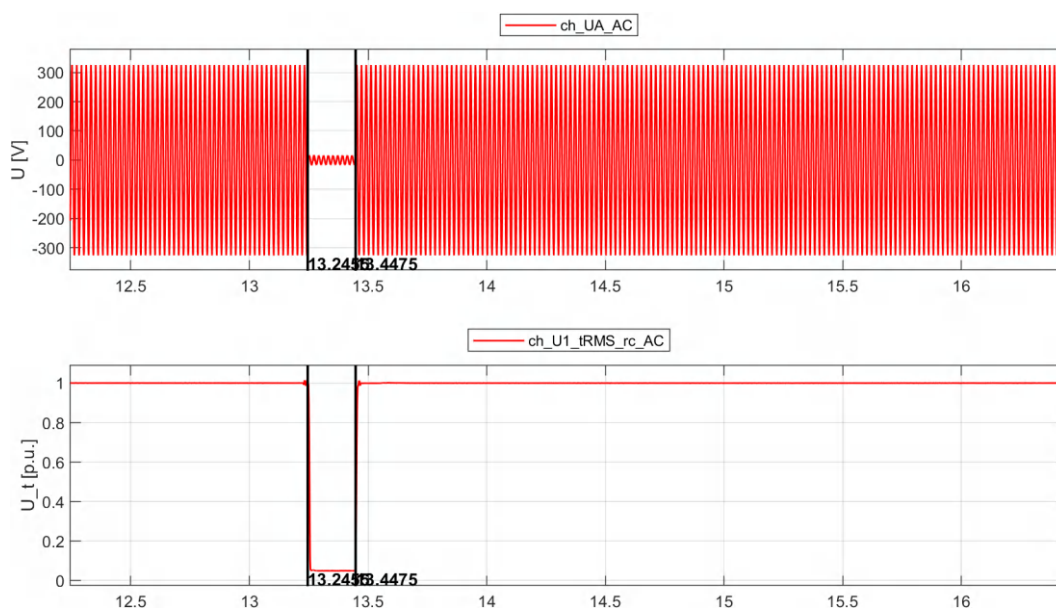
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

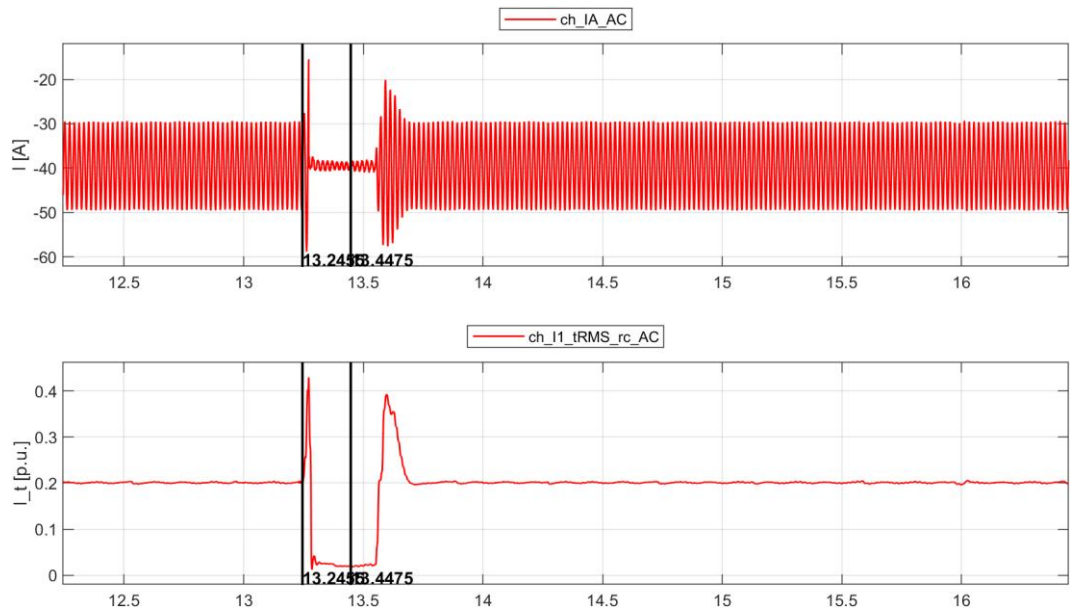


**Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

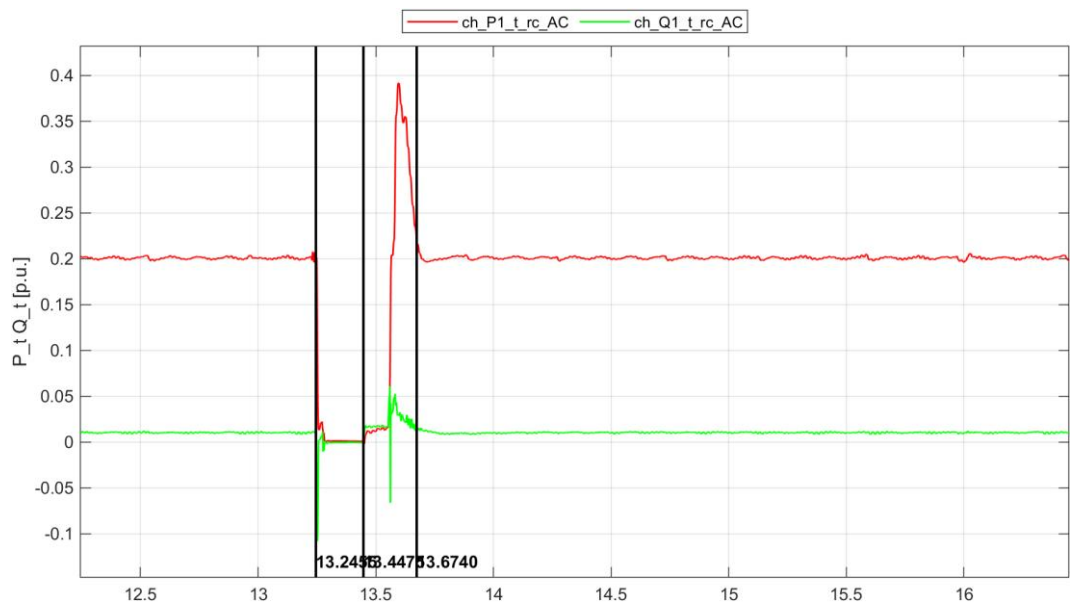


Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load, Power restore



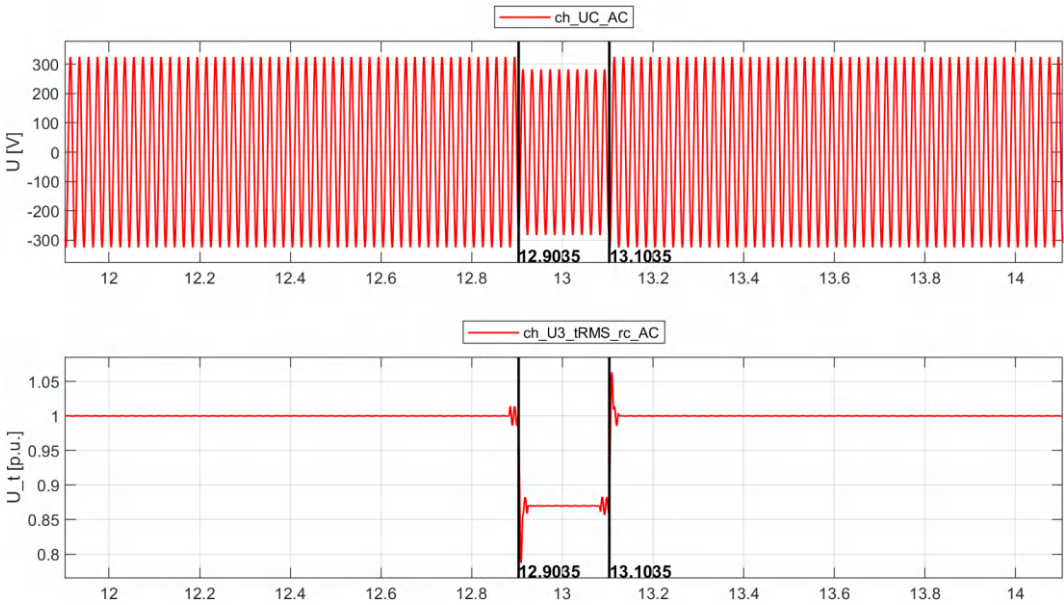
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.3	1.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	09:33:31.4	09:36:28.3
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	13262	13688
	7	Point of fault clearance(t_2)	Total	--	ms	13462	13888
	8	Fault duration in empty load test	Total	--	ms	200	200
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.870	0.870
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.977	0.198
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.980	0.198
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.868	0.869
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.055	0.018
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.067	0.019
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.013	0.011
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.980	0.197
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.183	0.164
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

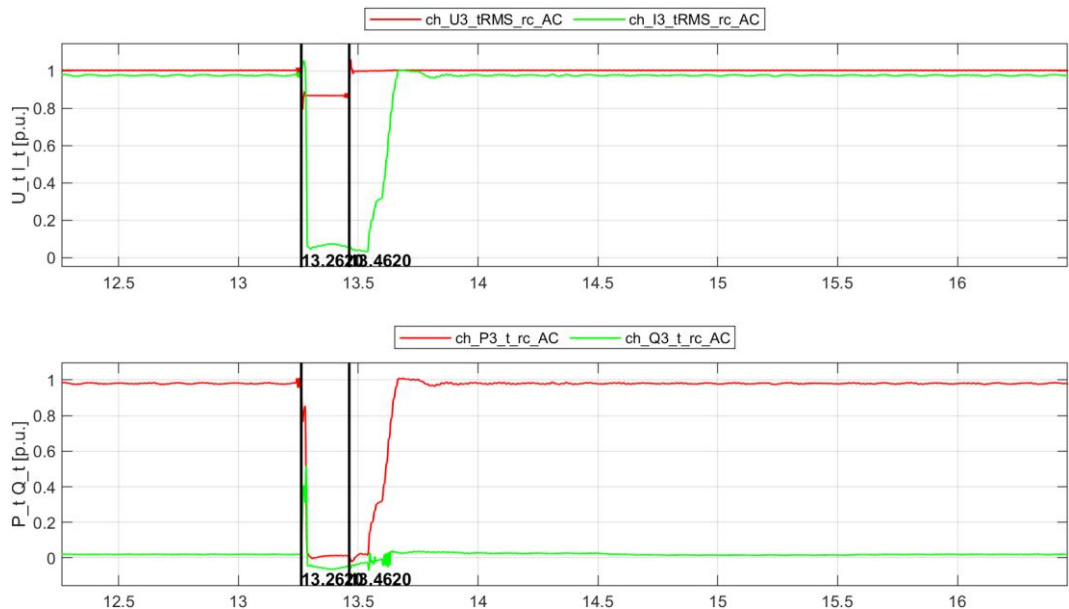
Test 1.0d1 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



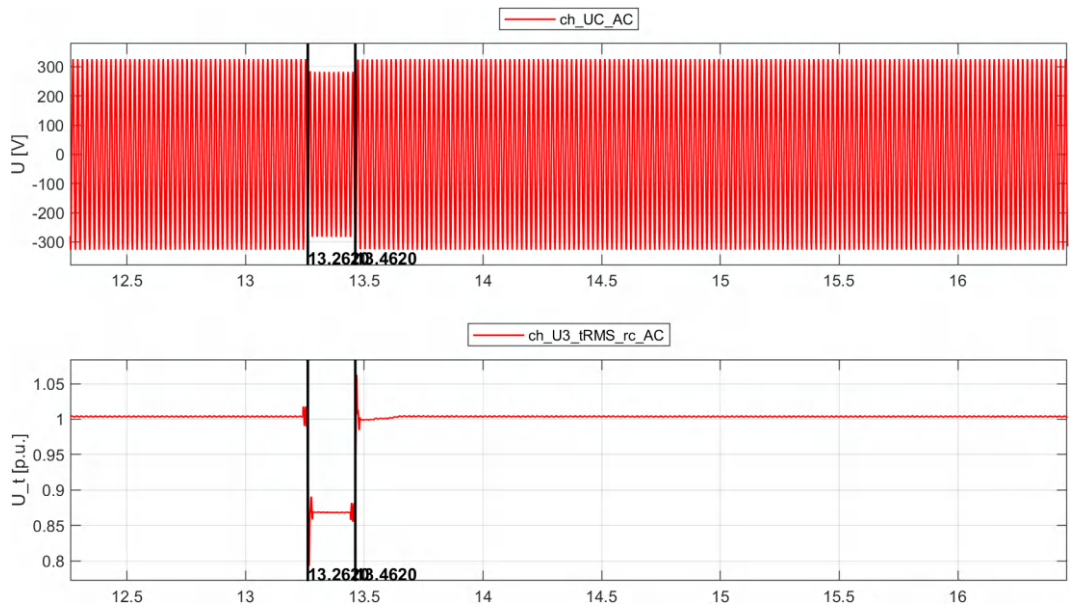
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



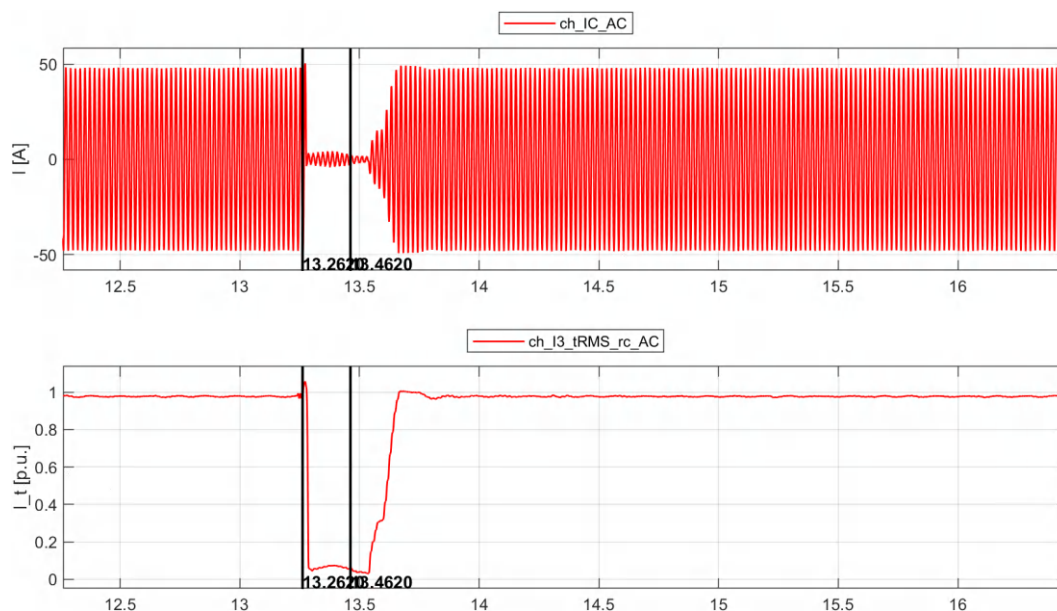
**Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



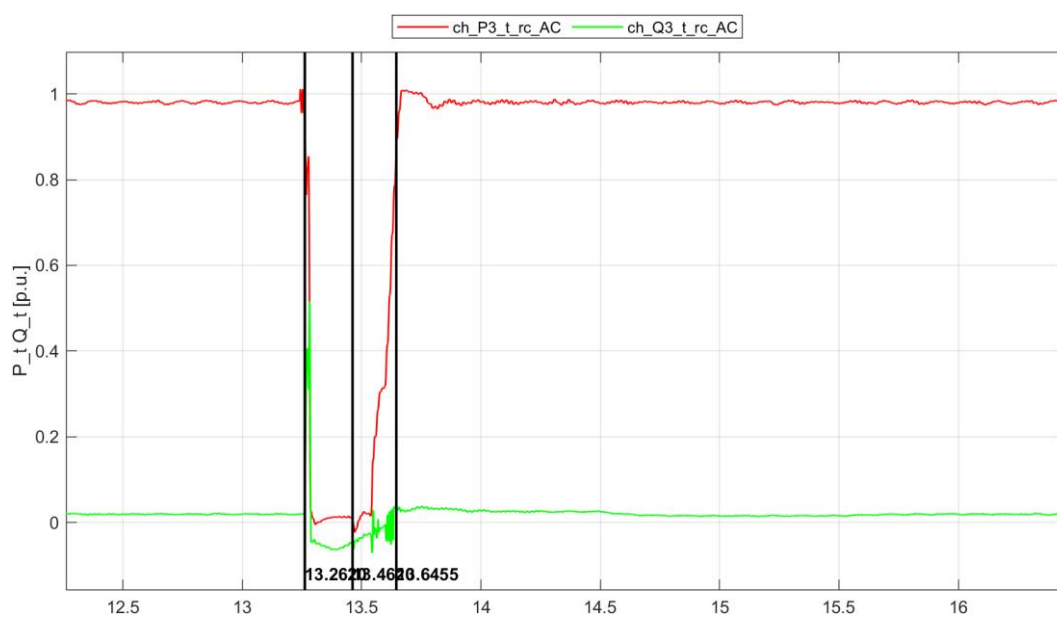
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents

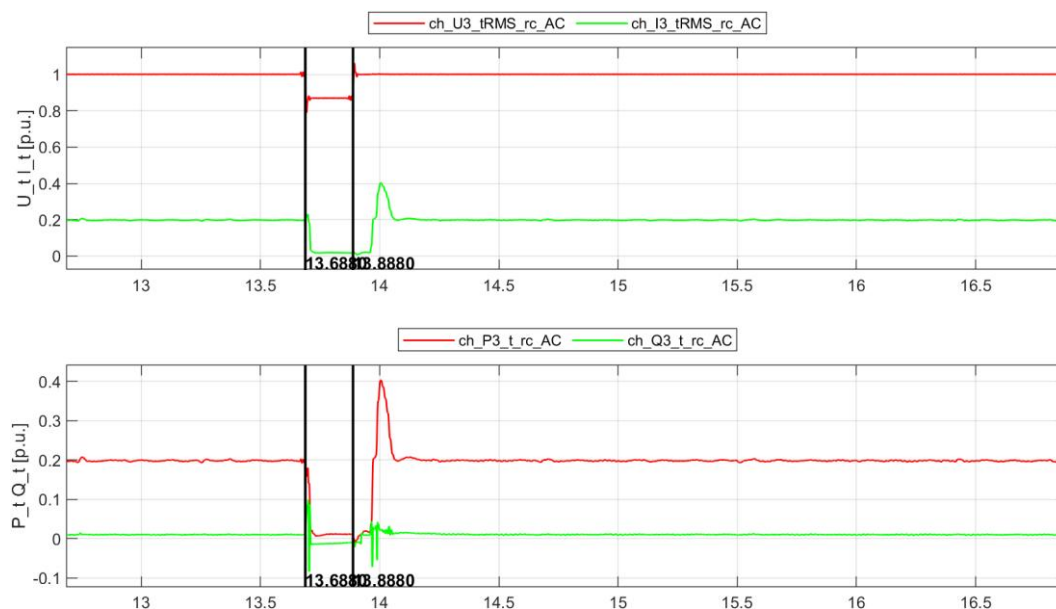


Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load, Power restore

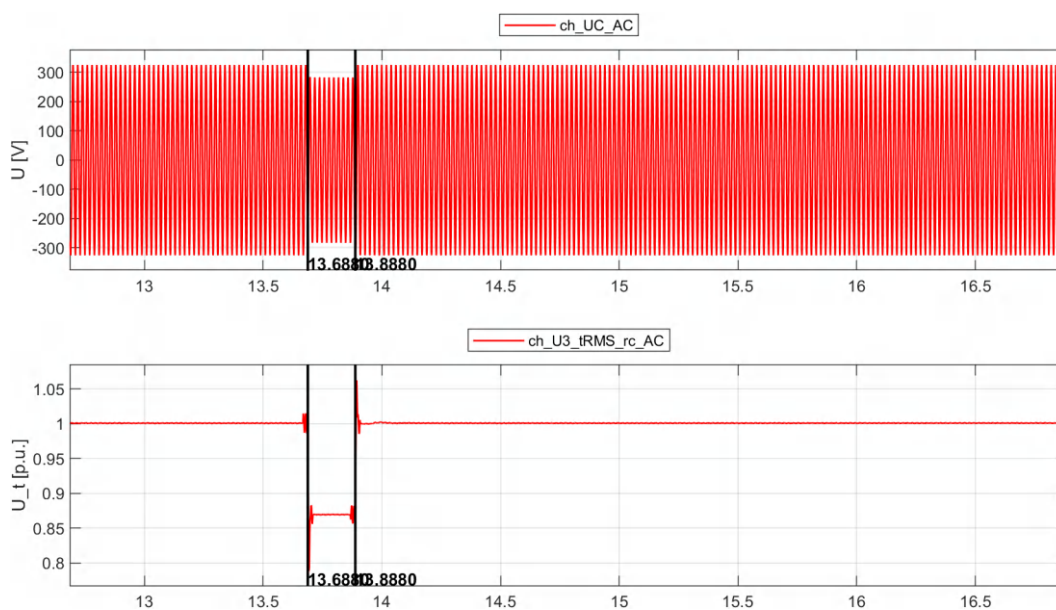


Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

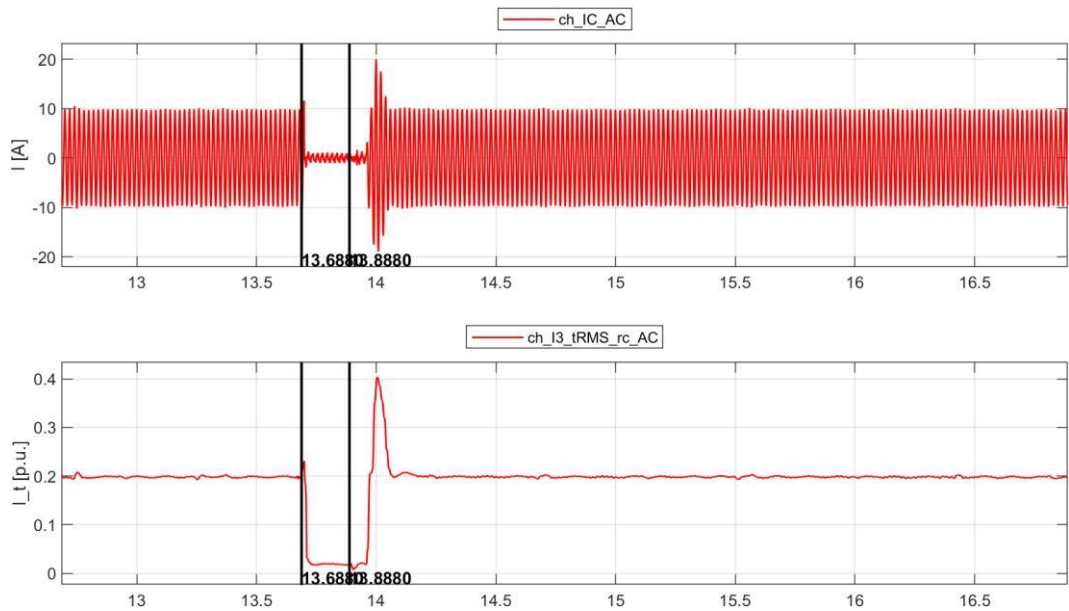


**Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

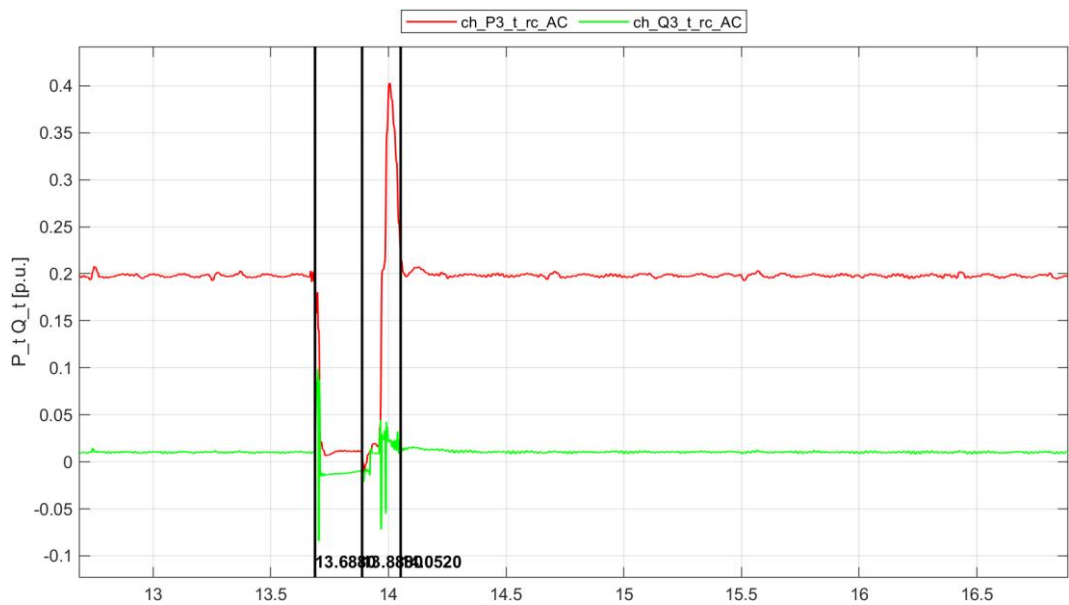


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load, Power restore



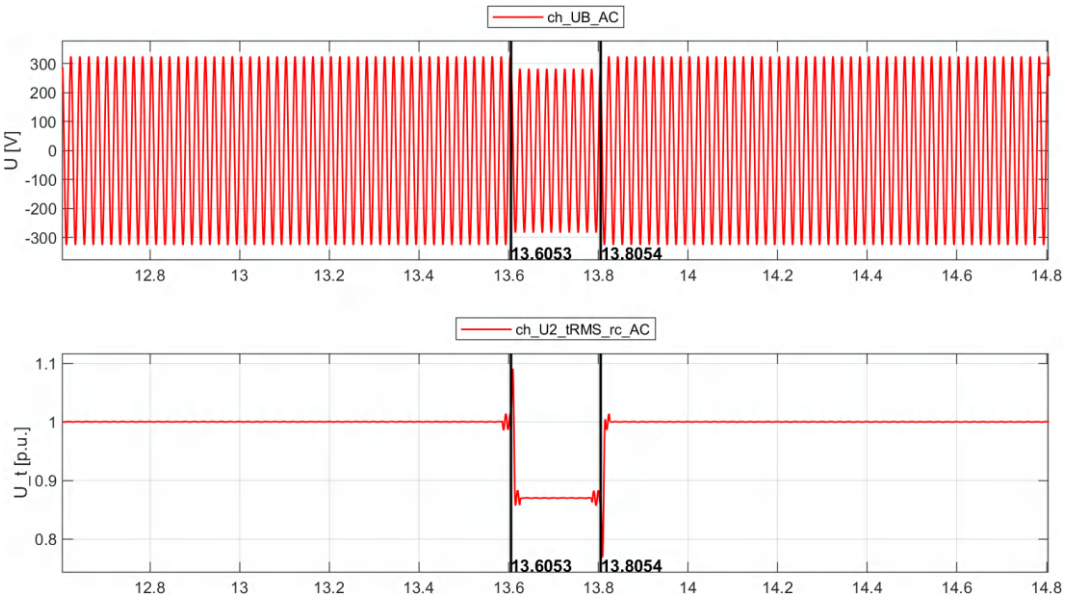
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.5	1.6
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	11:25:06.8	11:22:31.2
	3	Fault type (phase)	--	--	--	Type D2	Type D2
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	13072	12710
	7	Point of fault clearance(t_2)	Total	--	ms	13273	12911
	8	Fault duration in empty load test	Total	--	ms	200	200
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.870	0.870
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.870	0.870
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.031	0.026
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.030	0.019
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.014	0.013
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.989	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.197	0.187
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

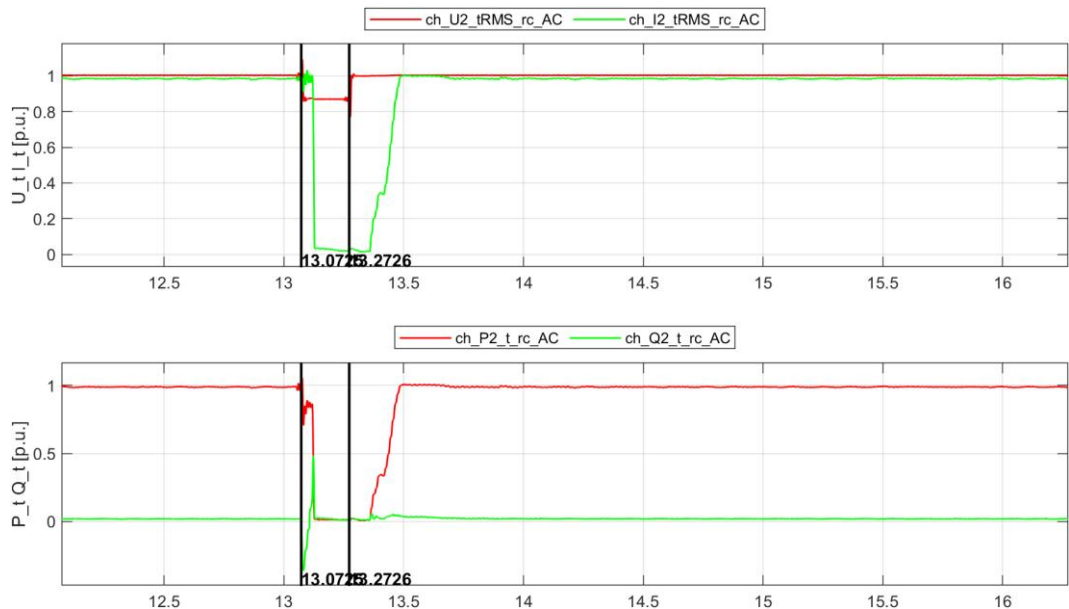
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

**Test 1.0d2 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 0% load,
Instantaneous and RMS values of phase voltages**

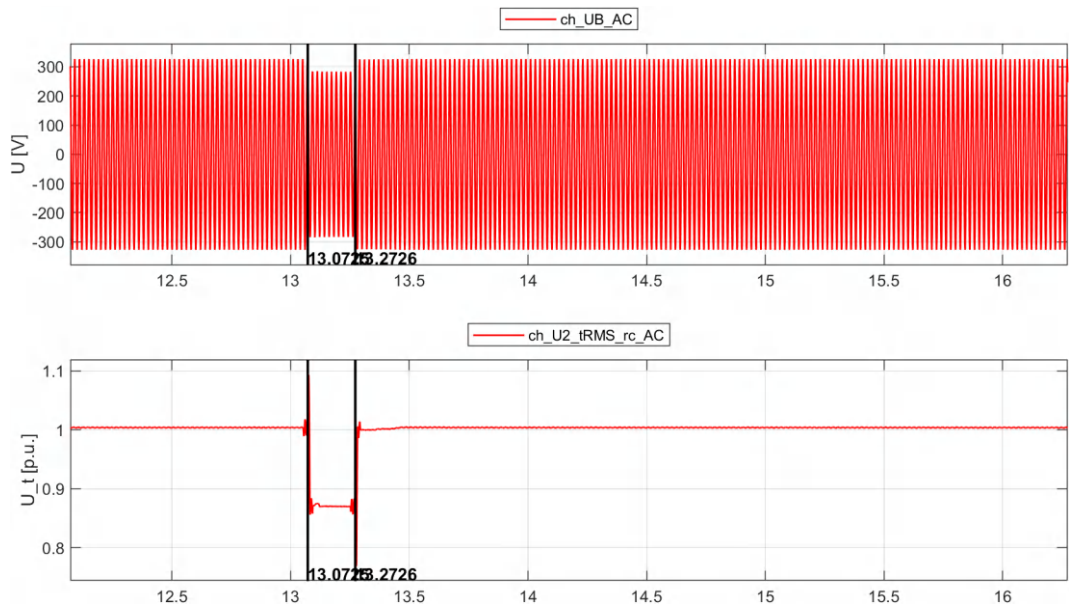


Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load,
Test overview (voltage, current, active and reactive power)**



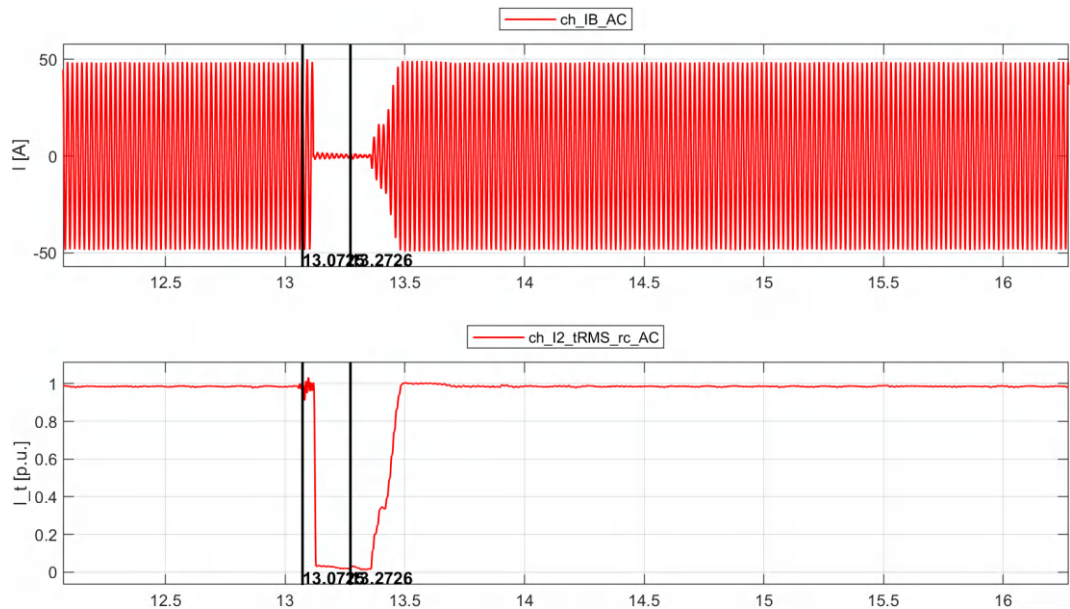
**Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load,
Instantaneous and RMS values of phase voltages**



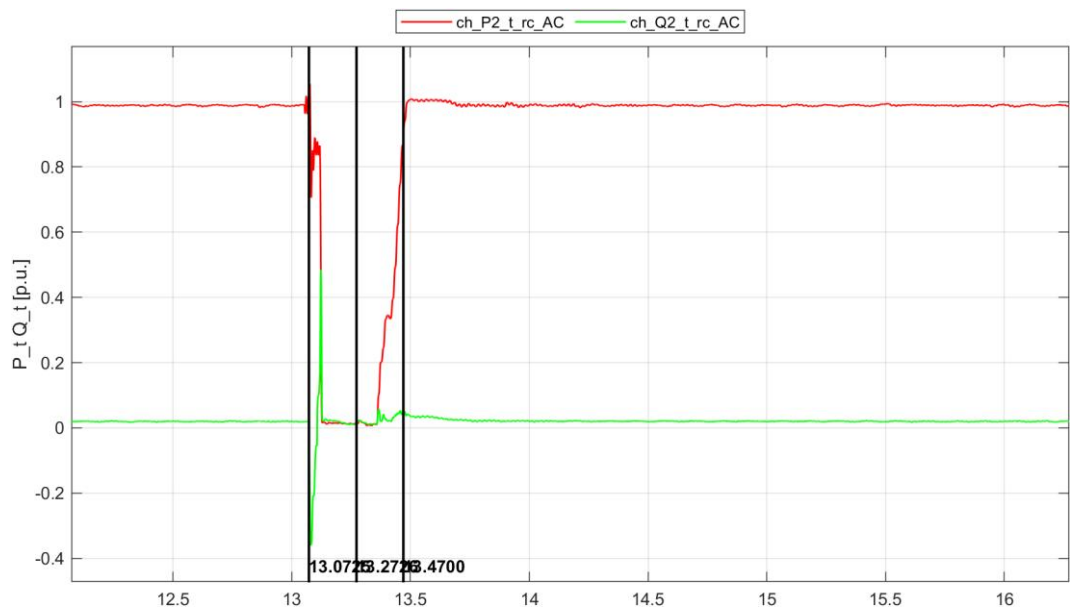
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents



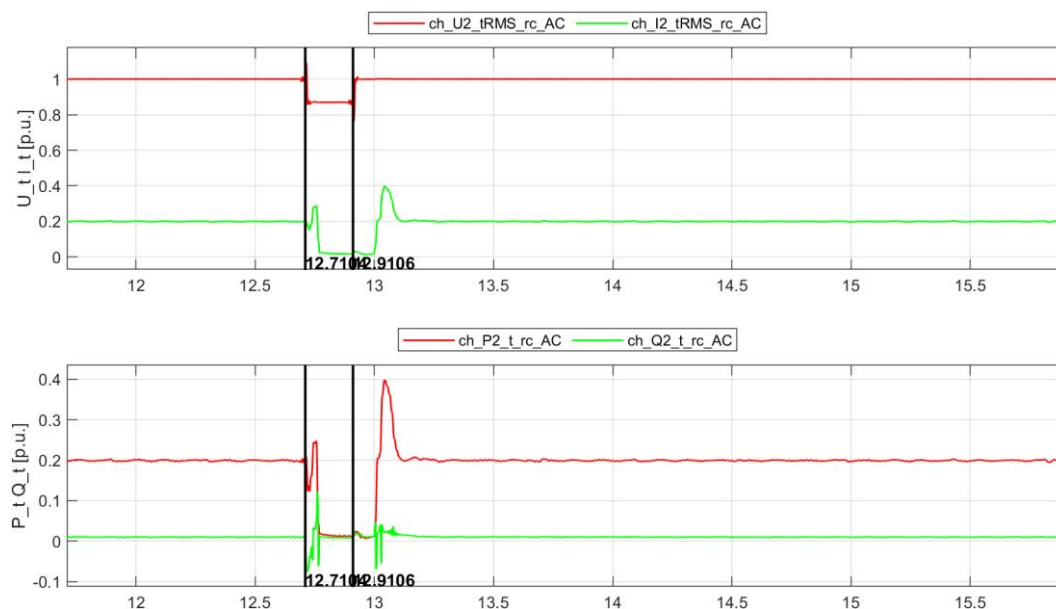
Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load, Power restore



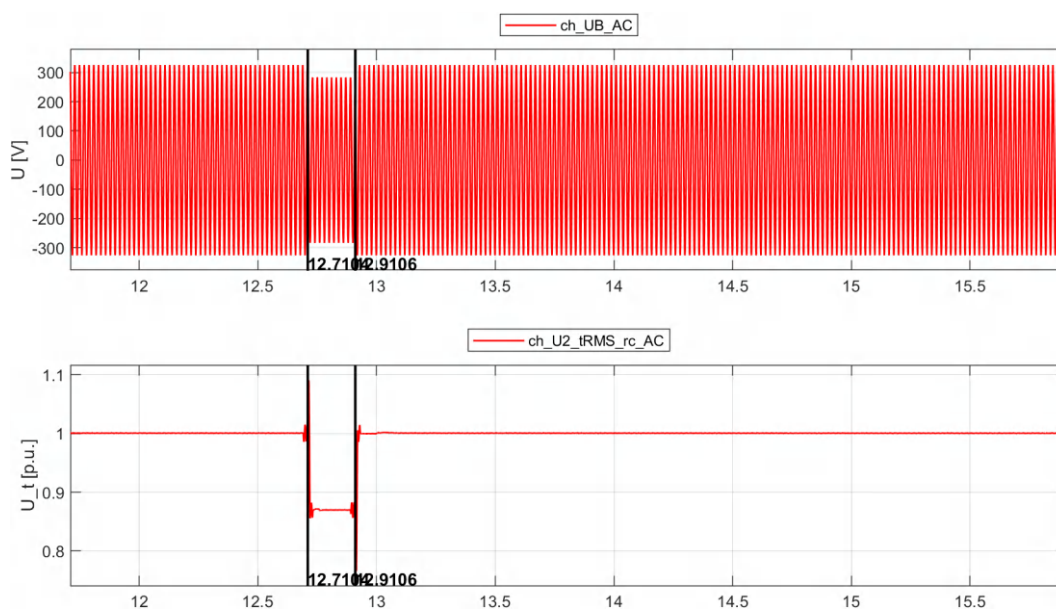
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load,
Test overview (voltage, current, active and reactive power)**



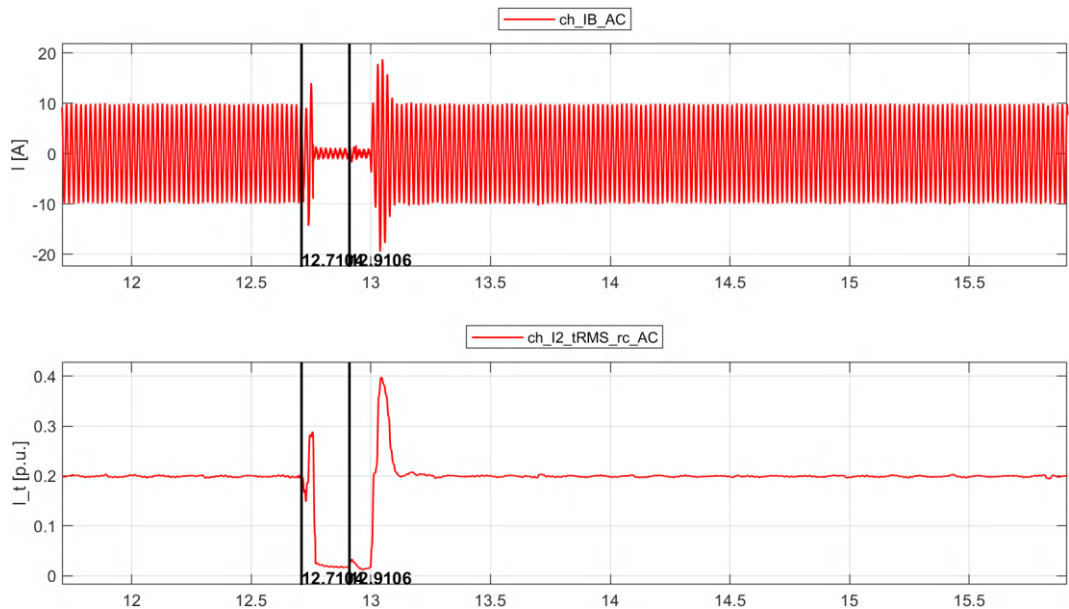
**Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load,
Instantaneous and RMS values of phase voltages**



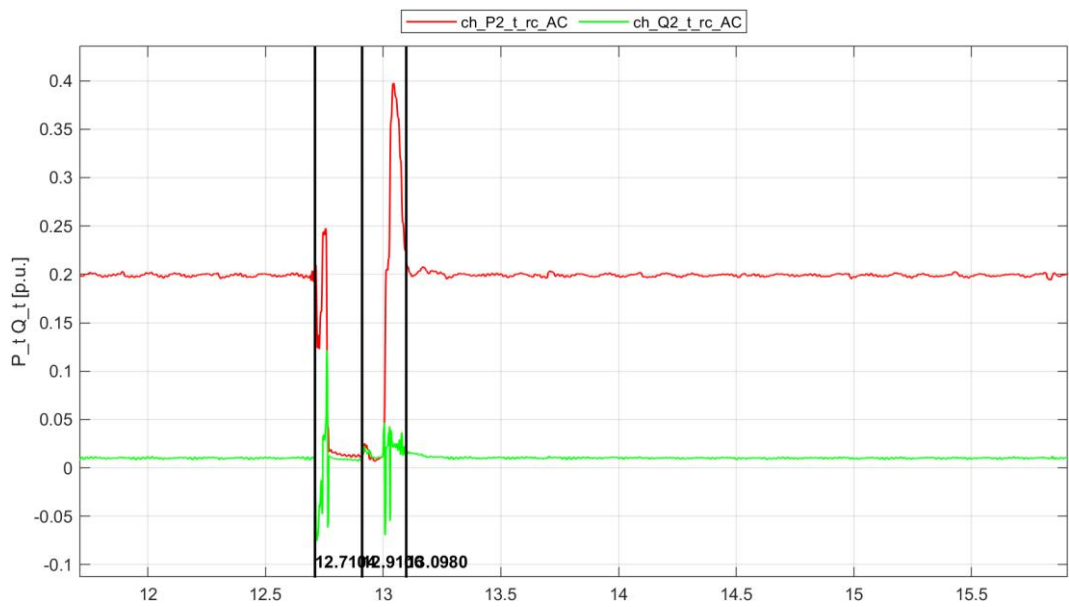
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load, Instantaneous and RMS values of phase currents



Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load, Power restore



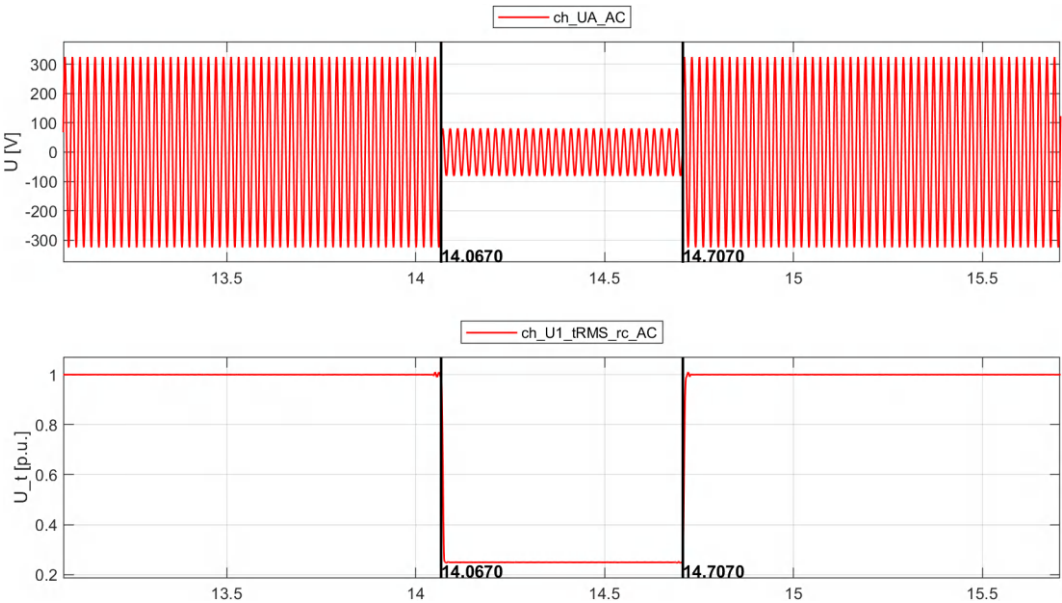
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2.1	2.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	18:50:04.1	09:39:56.5
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.25	0.25
	5	Setting dip duration		--	--	630	630
	6	Point of fault entry(t_1)	Total	--	ms	13492	14211
	7	Point of fault clearance(t_2)	Total	--	ms	14132	14850
	8	Fault duration in empty load test	Total	--	ms	640	640
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.250	0.250
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.249	0.250
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.048	0.027
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.047	0.023
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.003	0.003
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.989	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.192	0.223
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

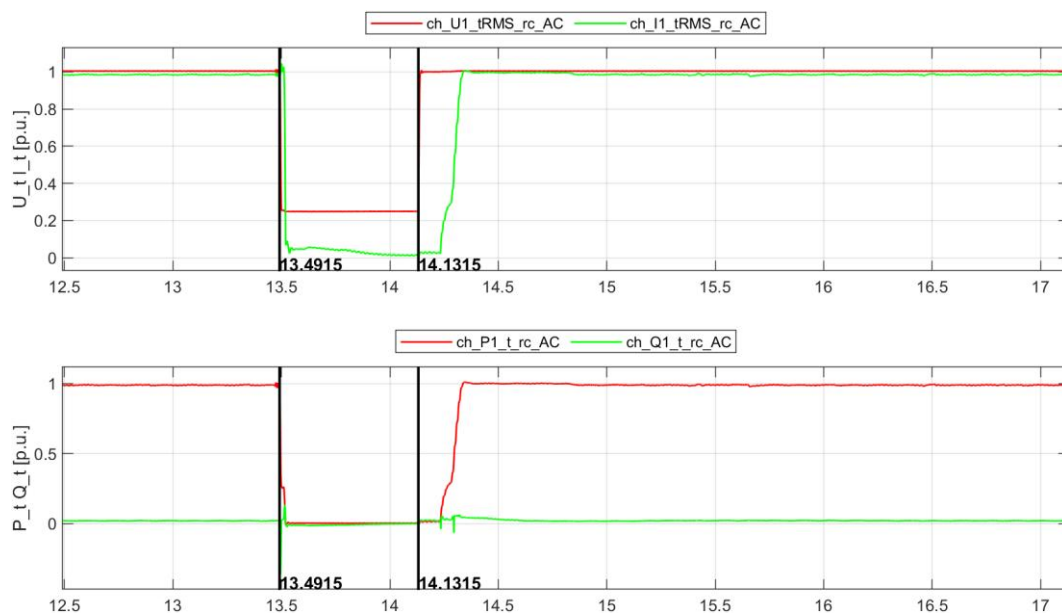
**Test 2.0a Depth of fault phase: 0.25 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



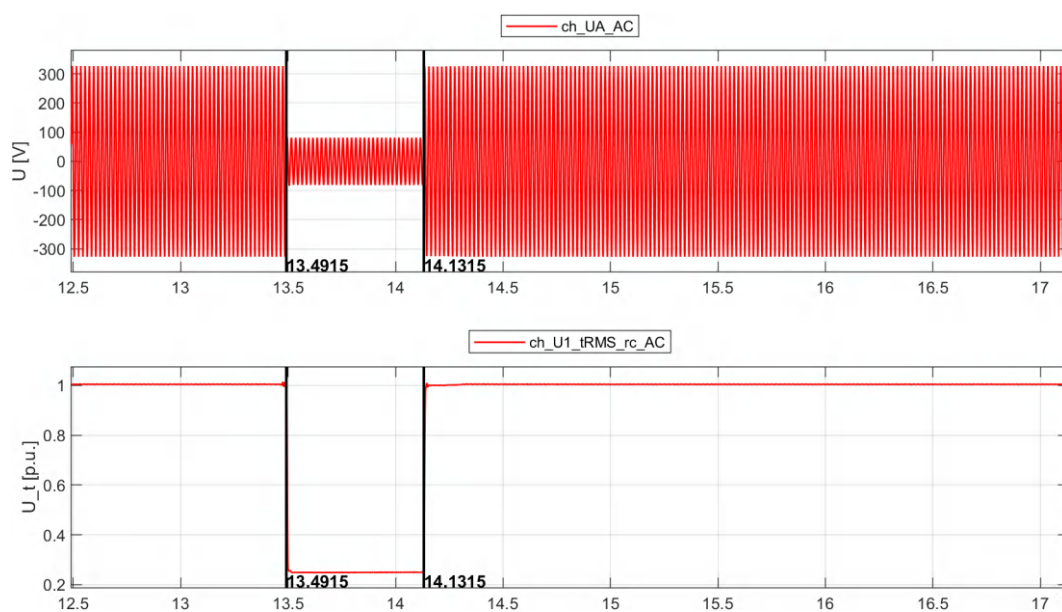
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



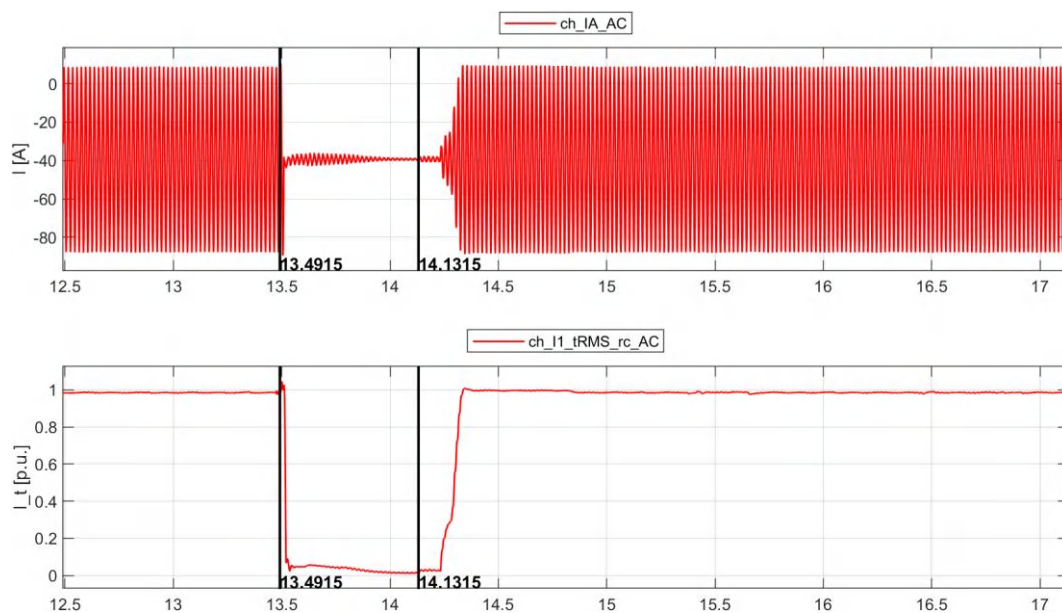
**Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



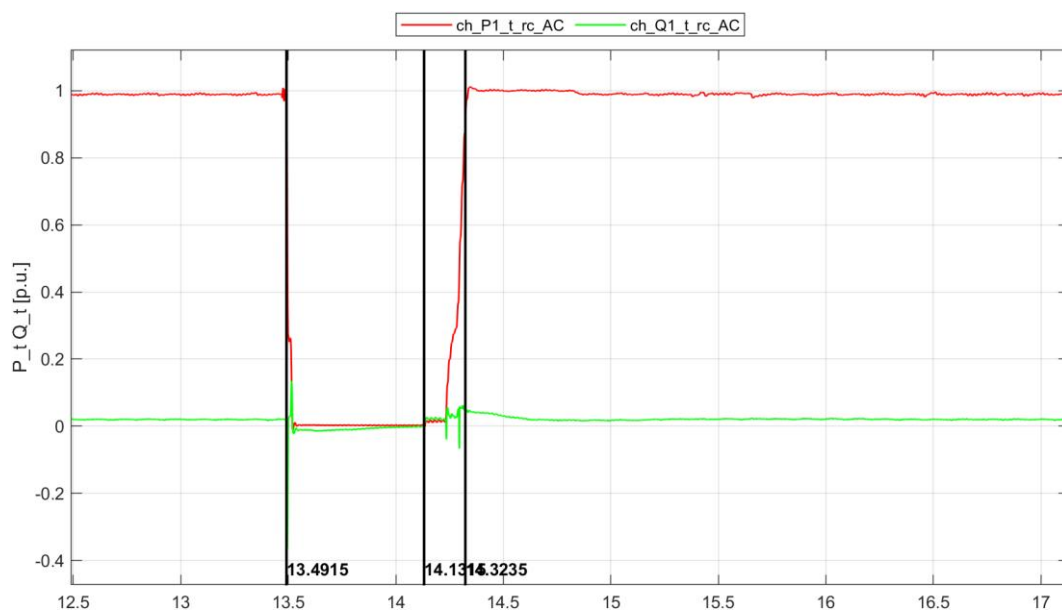
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



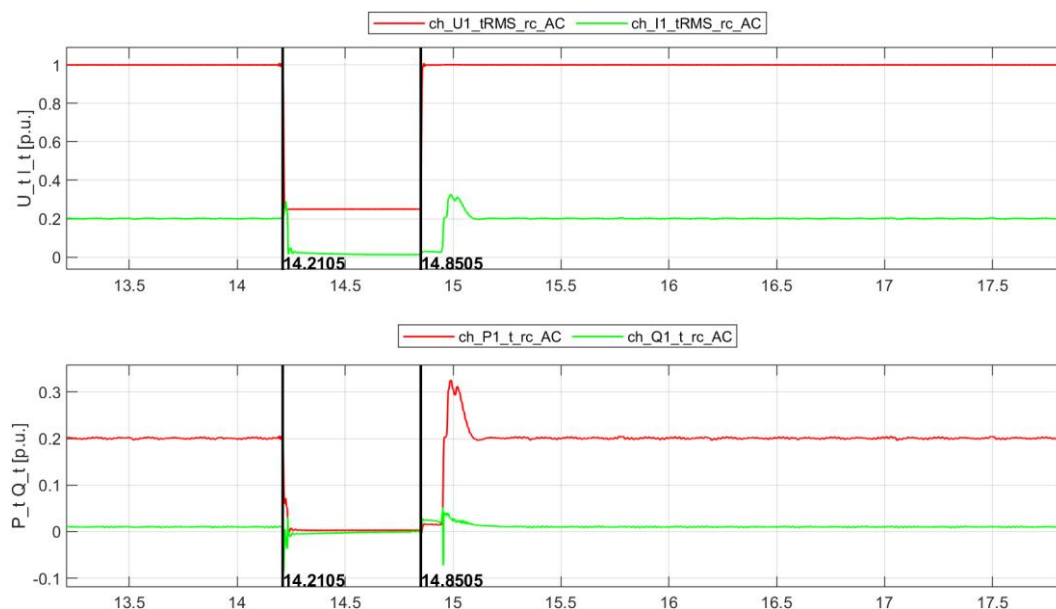
Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Power restore



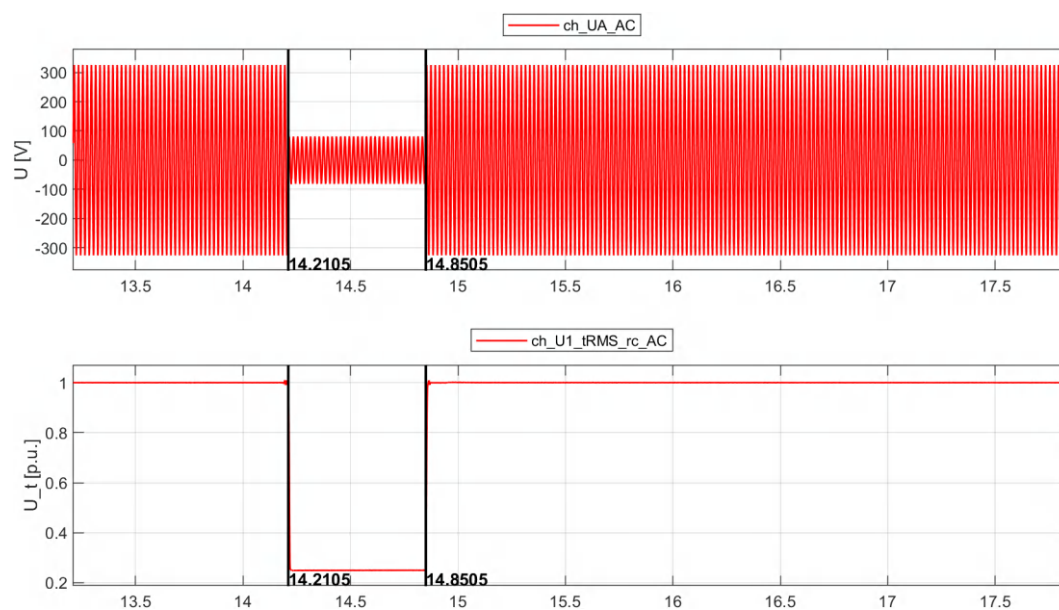
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

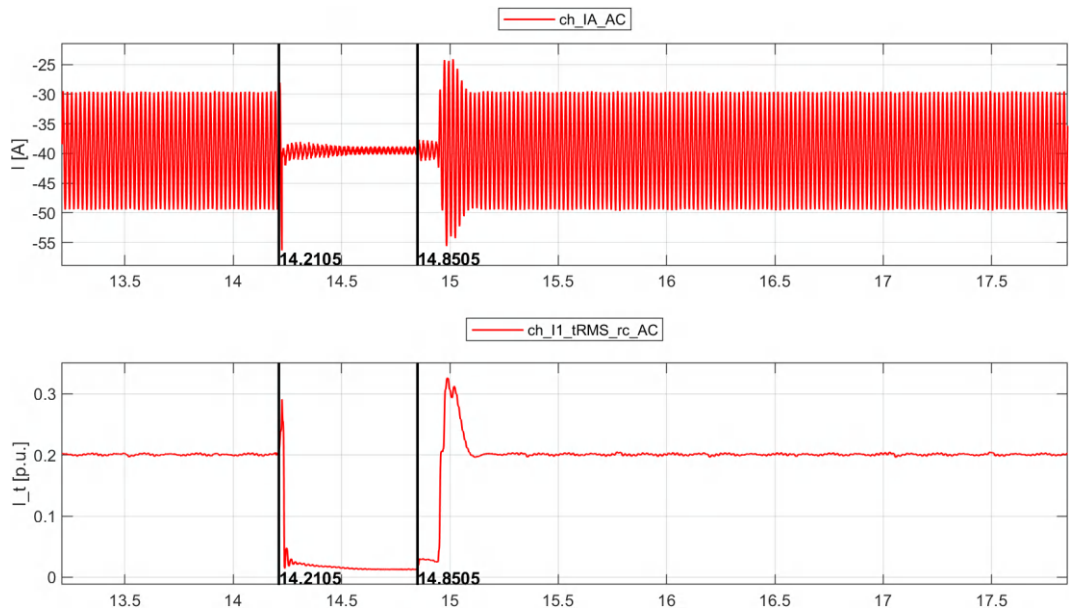


**Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

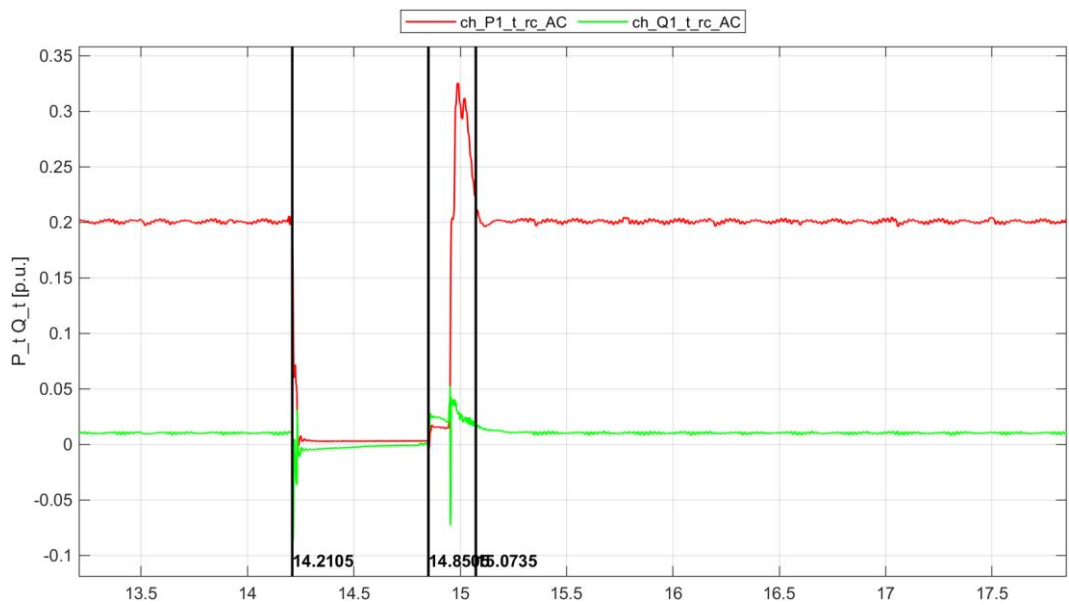


Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load, Power restore



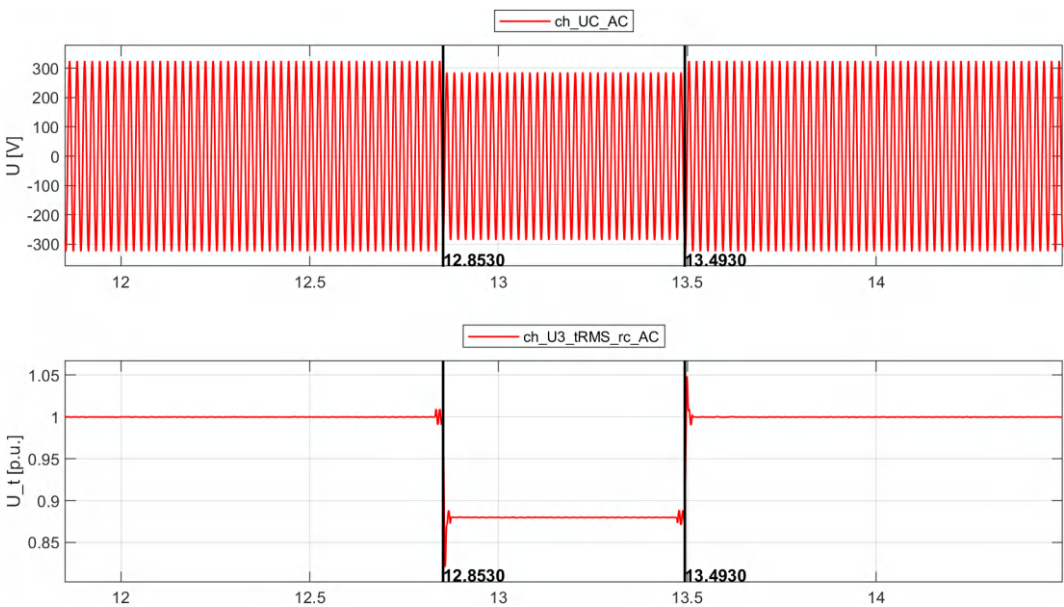
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2.3	2.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	09:49:46.8	09:47:45.8
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.25	0.25
	5	Setting dip duration		--	--	630	630
	6	Point of fault entry(t_1)	Total	--	ms	13226	13330
	7	Point of fault clearance(t_2)	Total	--	ms	13866	13970
	8	Fault duration in empty load test	Total	--	ms	640	640
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms}$ to t_2 and $t_1-10\text{s}$ to t_1	p.u.	0.880	0.880
	10		Pos.			N/A	N/A
Before dip $< t_1$	11	Voltage	Line to neutral	$t_1-100\text{s}$ to t_1	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms}$ to $t_1-100\text{ms}$	p.u.	0.987	0.200
	13	Active power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.990	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s}$ to t_1	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.879	0.880
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.043	0.017
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.056	0.018
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.011	0.012
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	1.004	1.001
After dip $> t_2$	28	Active power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.991	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.168	0.152
	31	Reactive power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

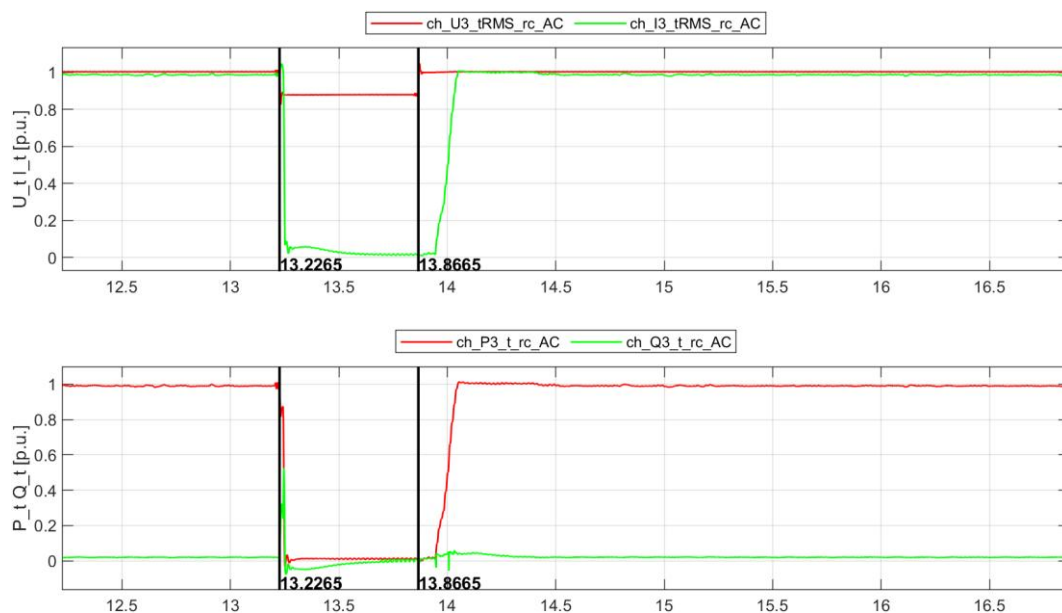
Test 2.0d1 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



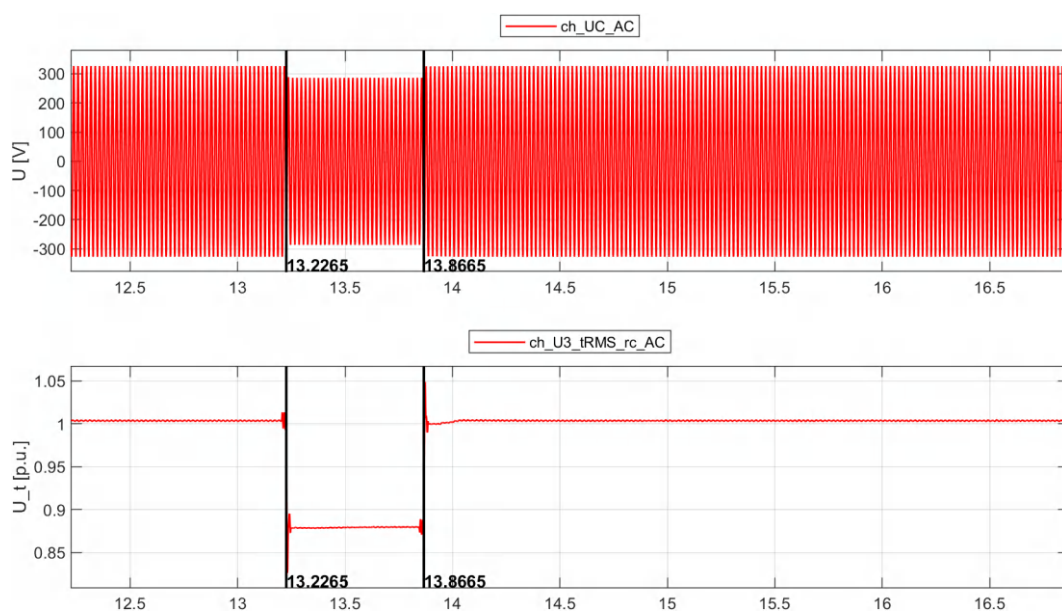
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**

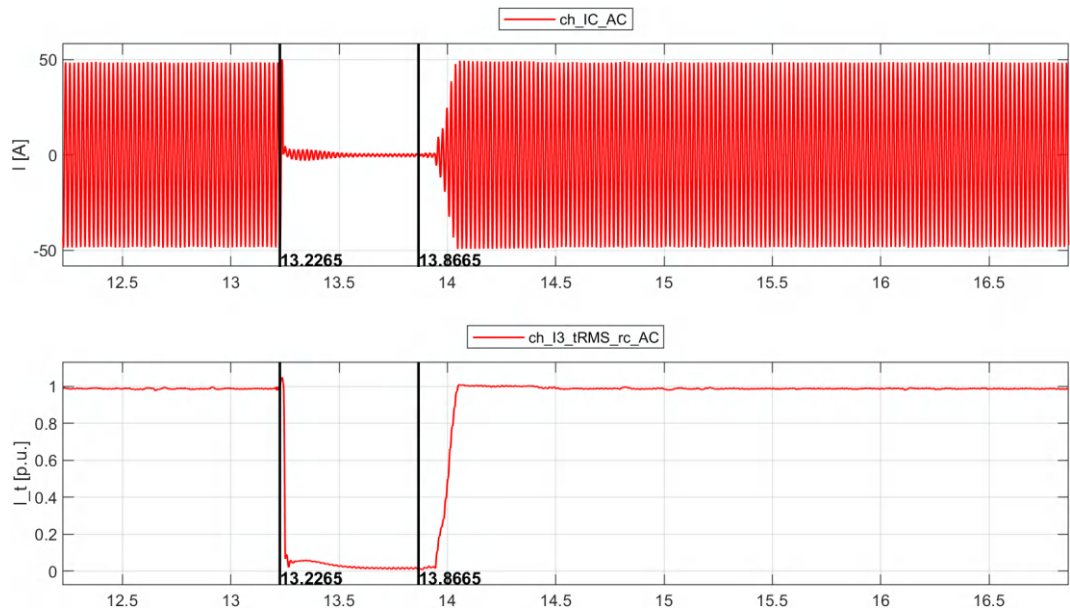


**Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**

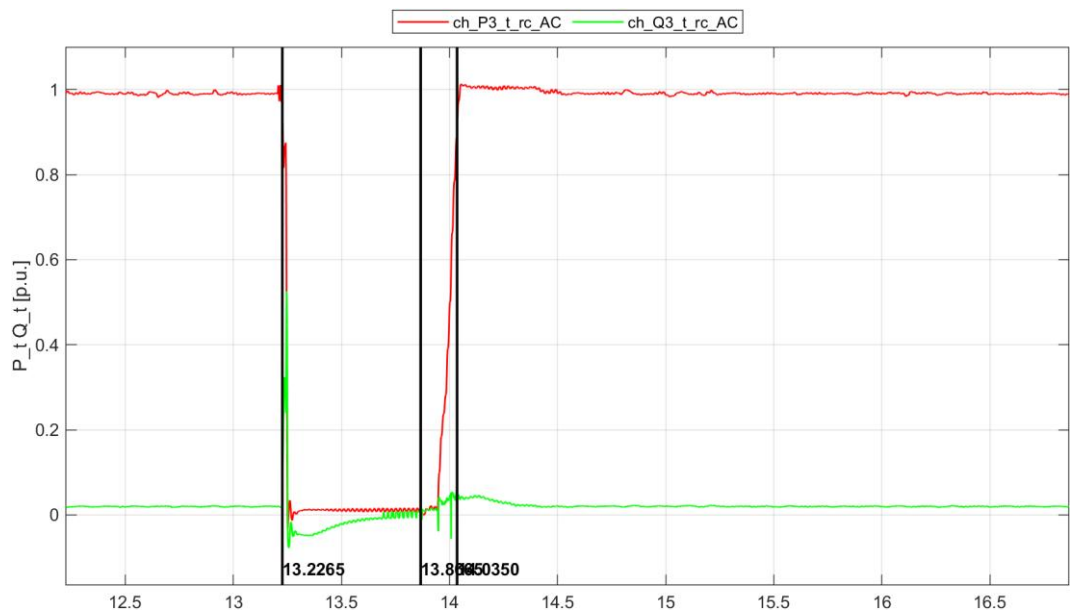


Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents

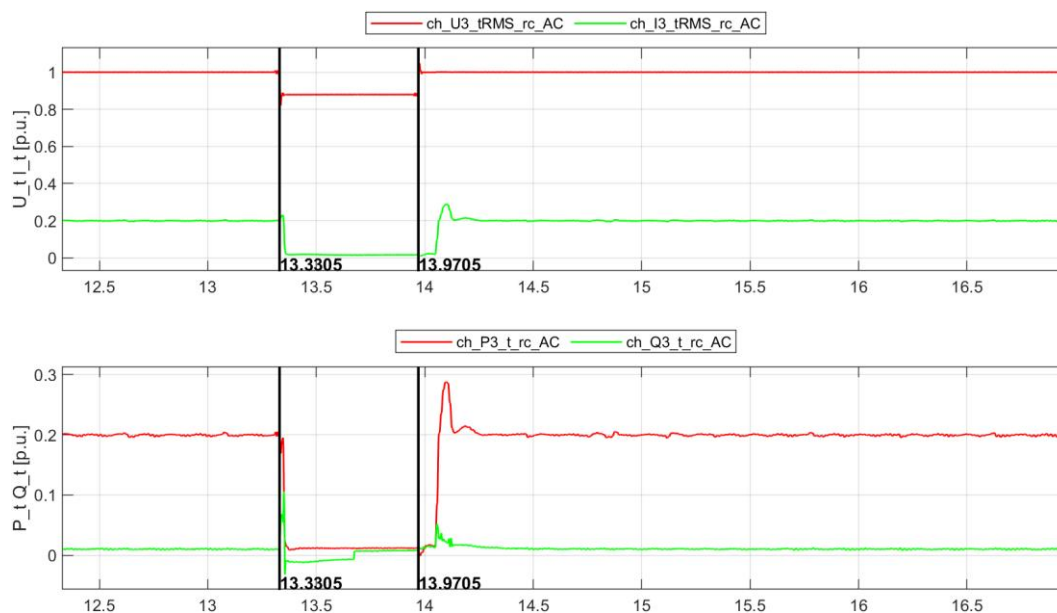


Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load, Power restore

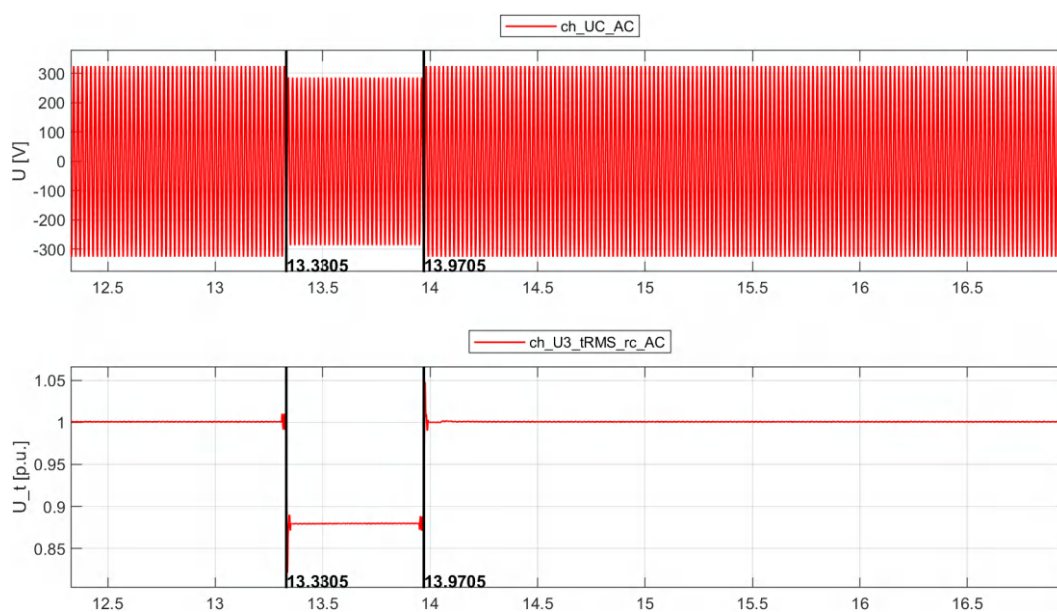


Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

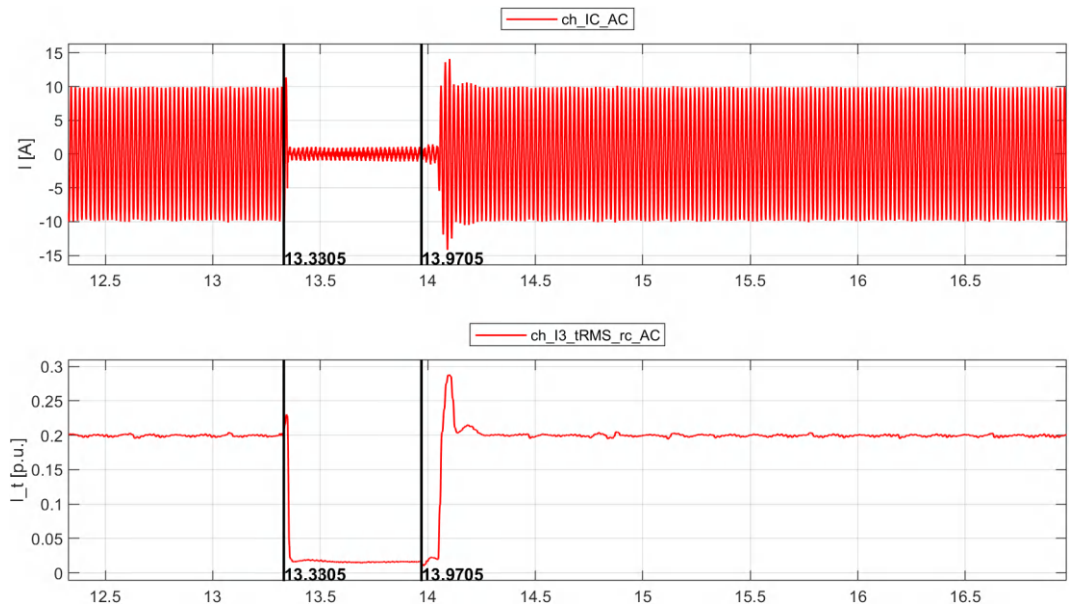


**Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

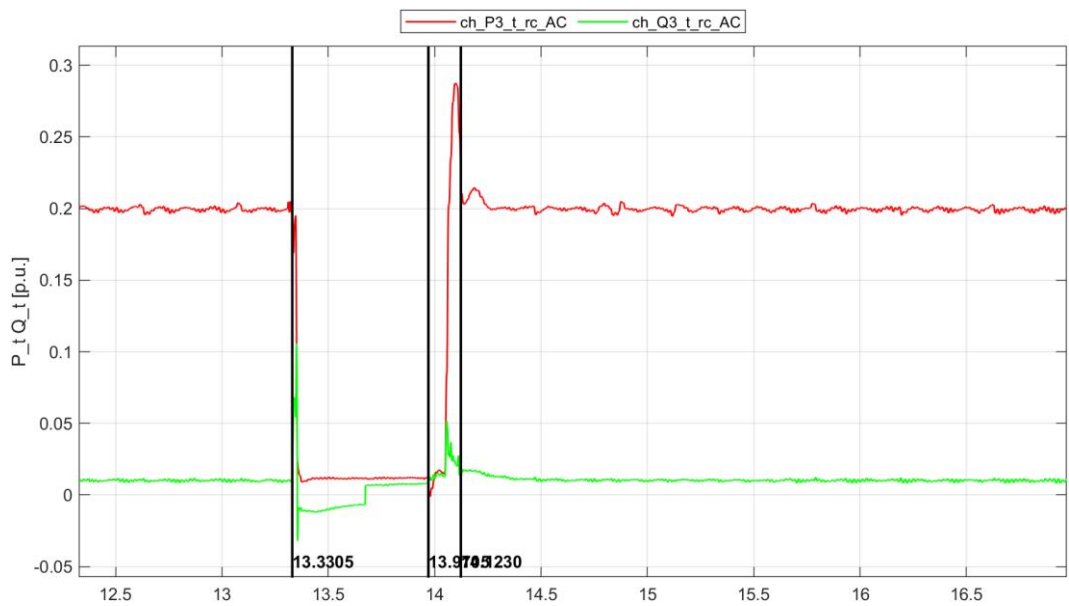


Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load, Power restore



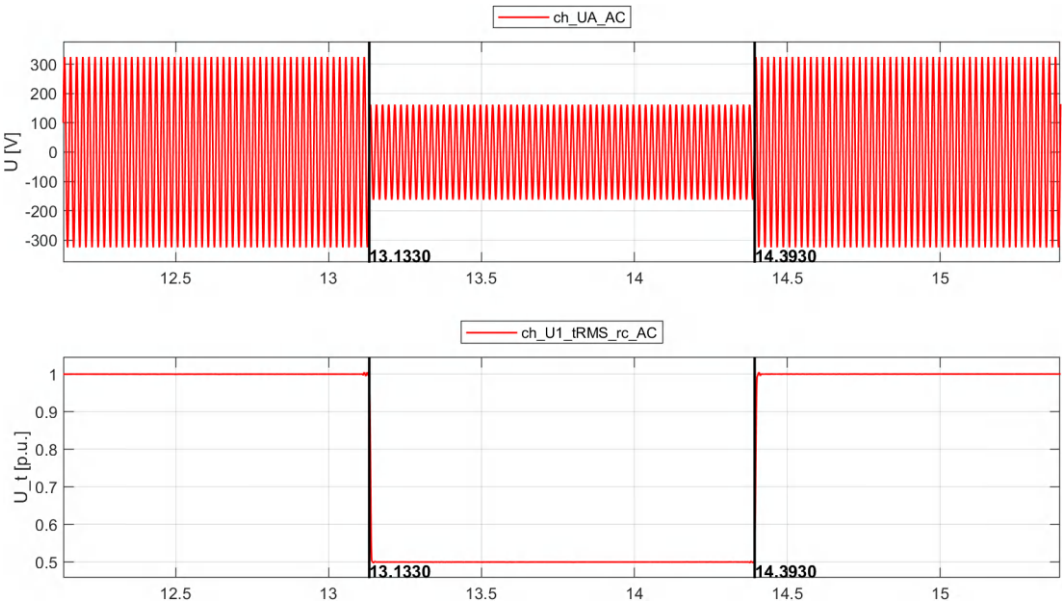
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3.1	3.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:00:36.6	09:43:09.7
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.50	0.50
	5	Setting dip duration		--	--	1260	1260
	6	Point of fault entry(t_1)	Total	--	ms	13089	13306
	7	Point of fault clearance(t_2)	Total	--	ms	14349	14566
	8	Fault duration in empty load test	Total	--	ms	1260	1260
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.500	0.500
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.986	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.990	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.499	0.500
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.026	0.021
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.026	0.020
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.007	0.007
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.990	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.185	0.204
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

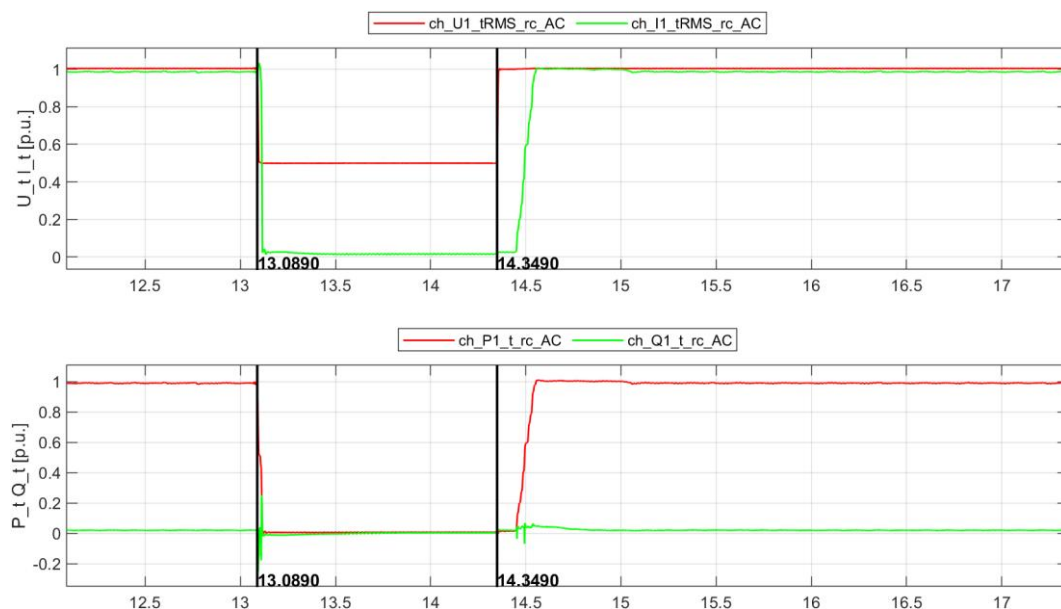
**Test 3.0a Depth of fault phase: 0.50 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



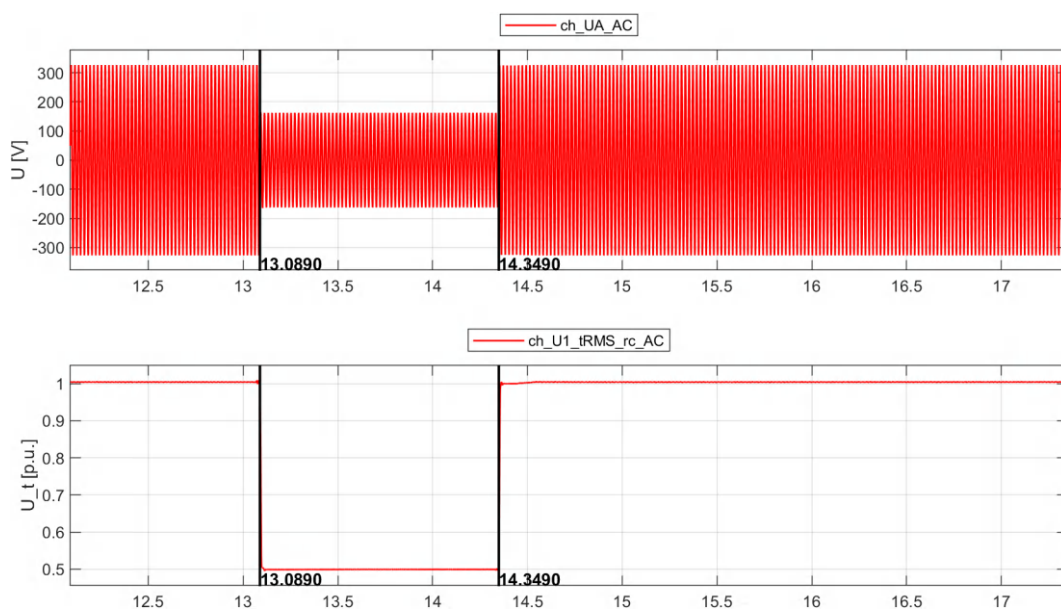
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



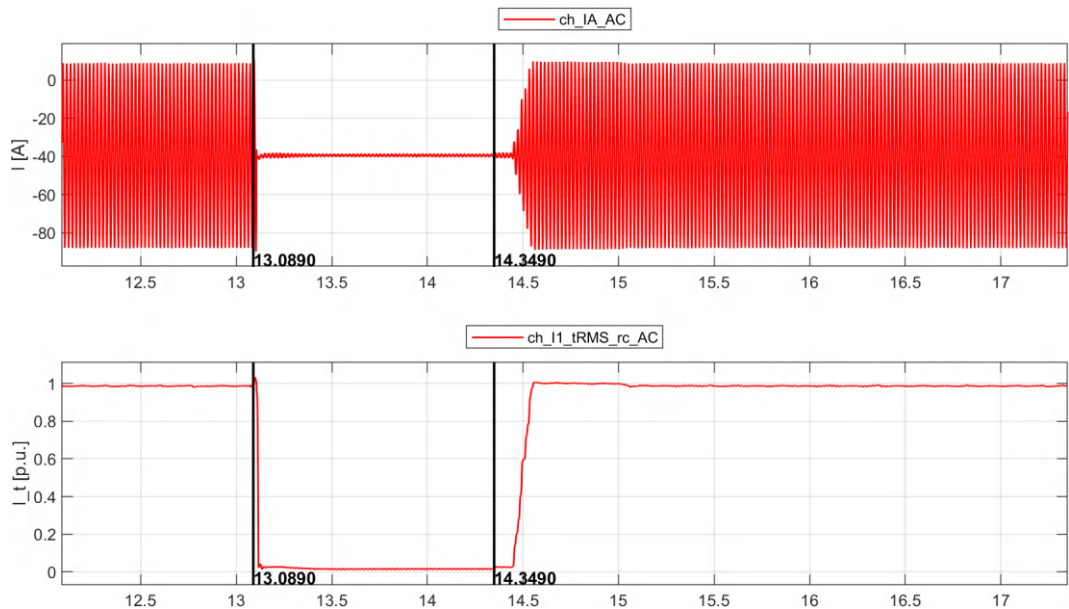
**Test 3.1 Depth of fault phase: 0.50 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



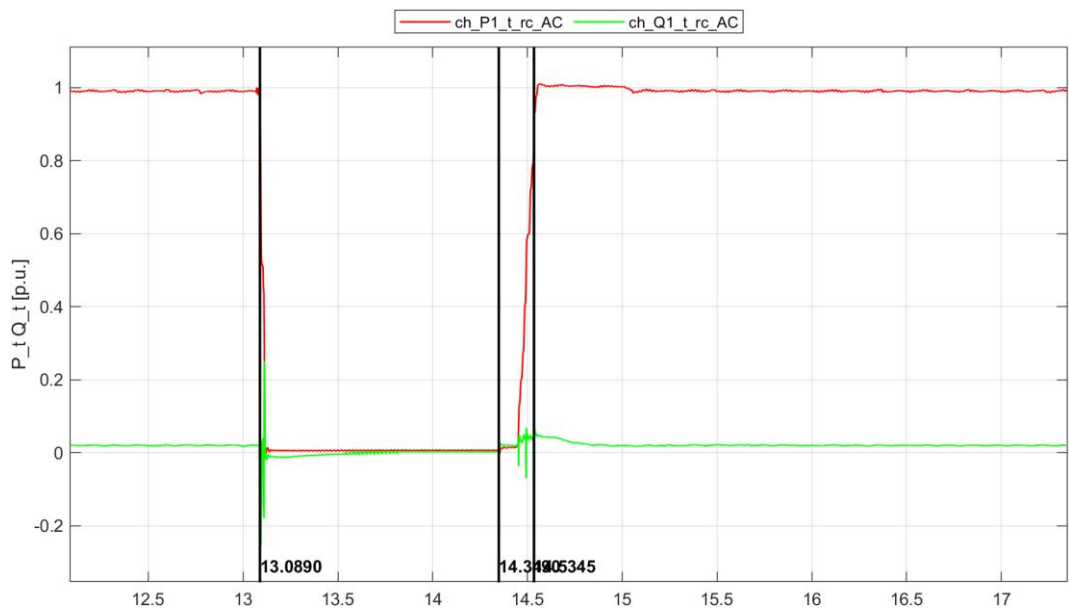
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



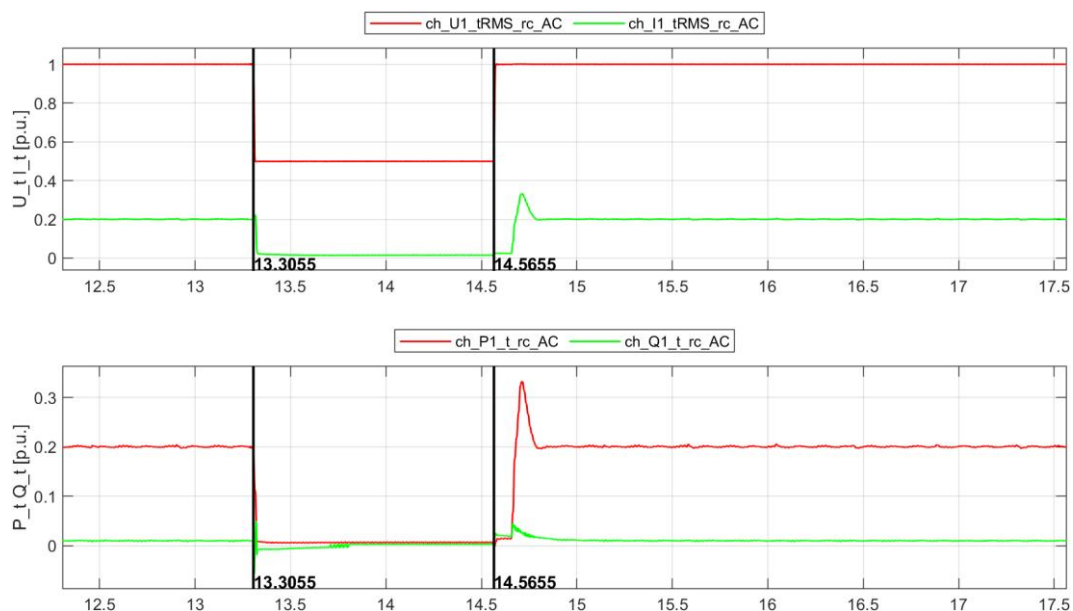
Test 3.1 Depth of fault phase: 0.50 p.u., three-phase SC (type A), 100% load, Power restore



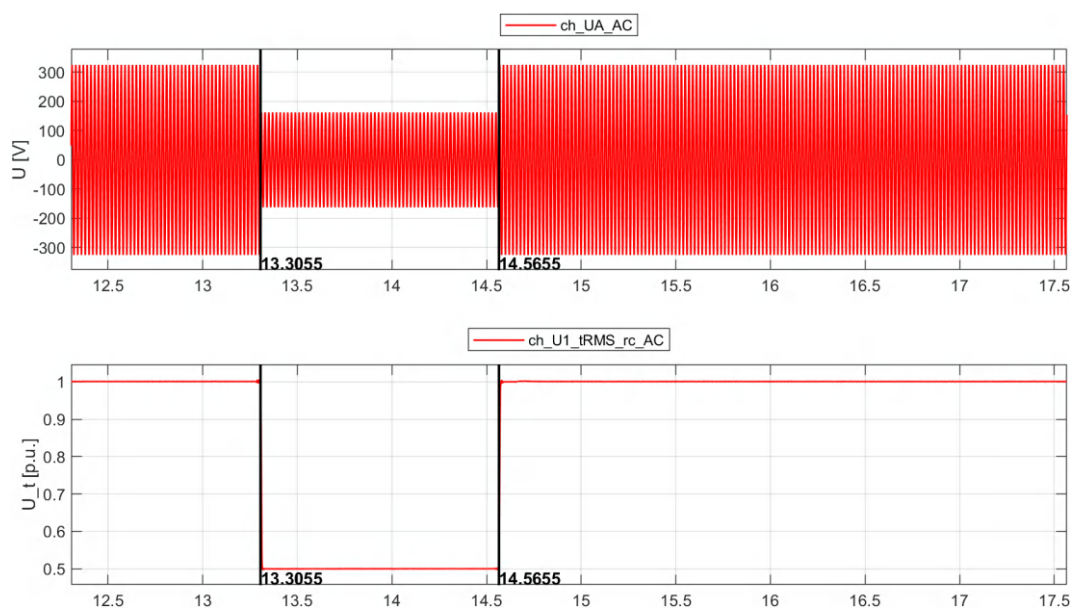
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

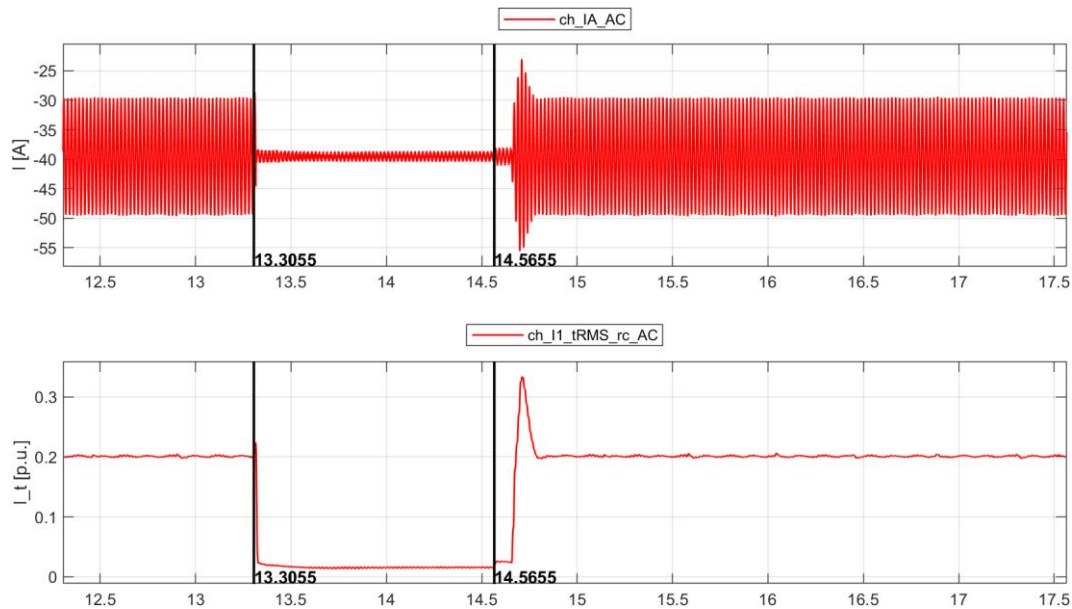


**Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

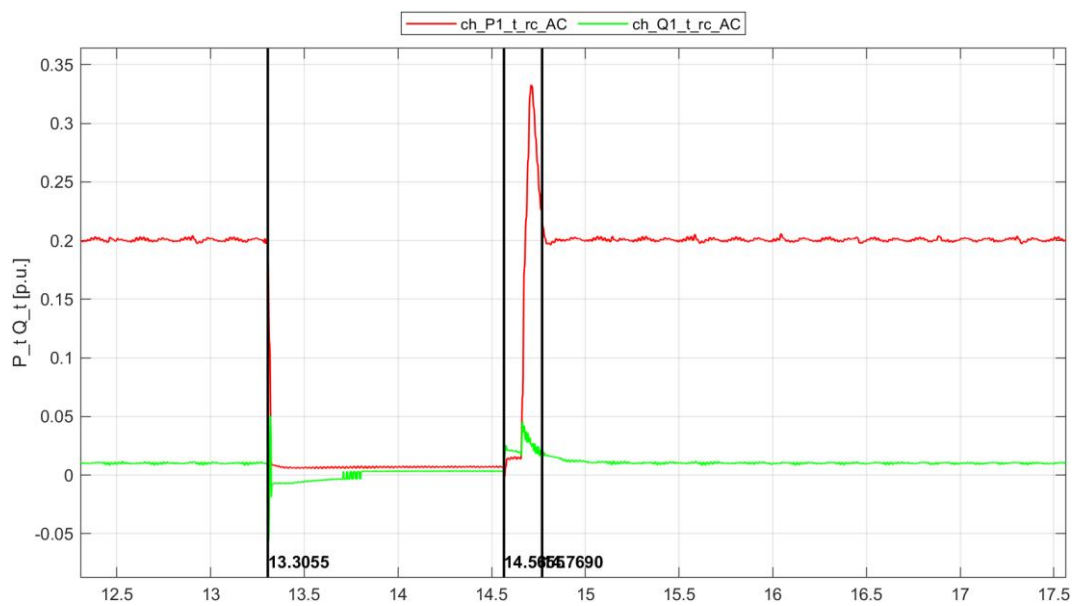


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load, Power restore



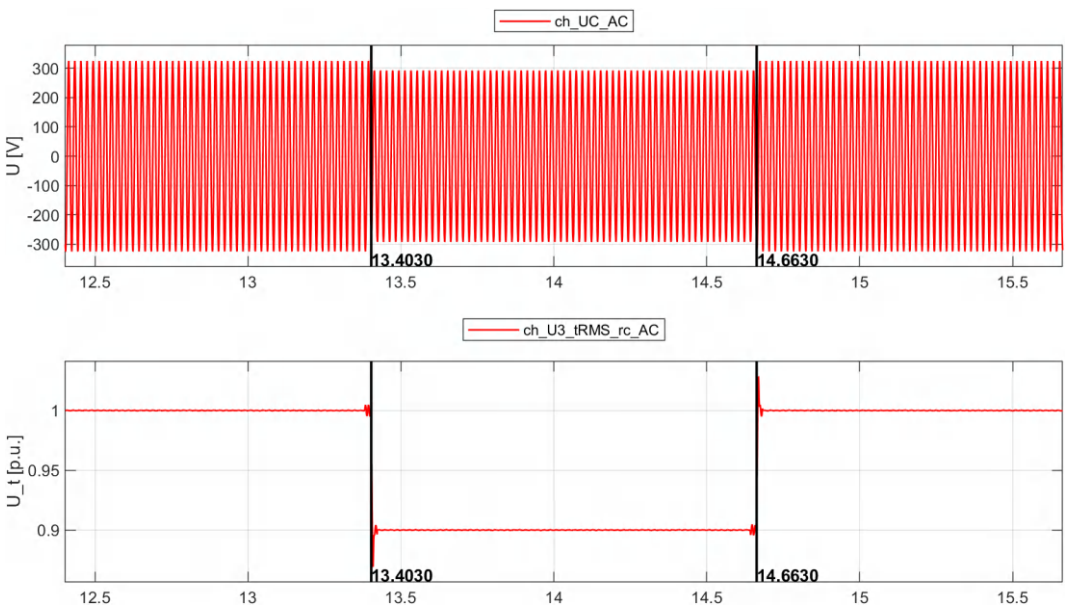
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3.3	3.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	09:54:31.0	09:56:38.4
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.50	0.50
	5	Setting dip duration		--	--	1260	1260
	6	Point of fault entry(t_1)	Total	--	ms	12762	13518
	7	Point of fault clearance(t_2)	Total	--	ms	14022	14779
	8	Fault duration in empty load test	Total	--	ms	1260	1260
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.900	0.900
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.900	0.901
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.037	0.016
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.044	0.017
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.012	0.204
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.989	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.120	0.042
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

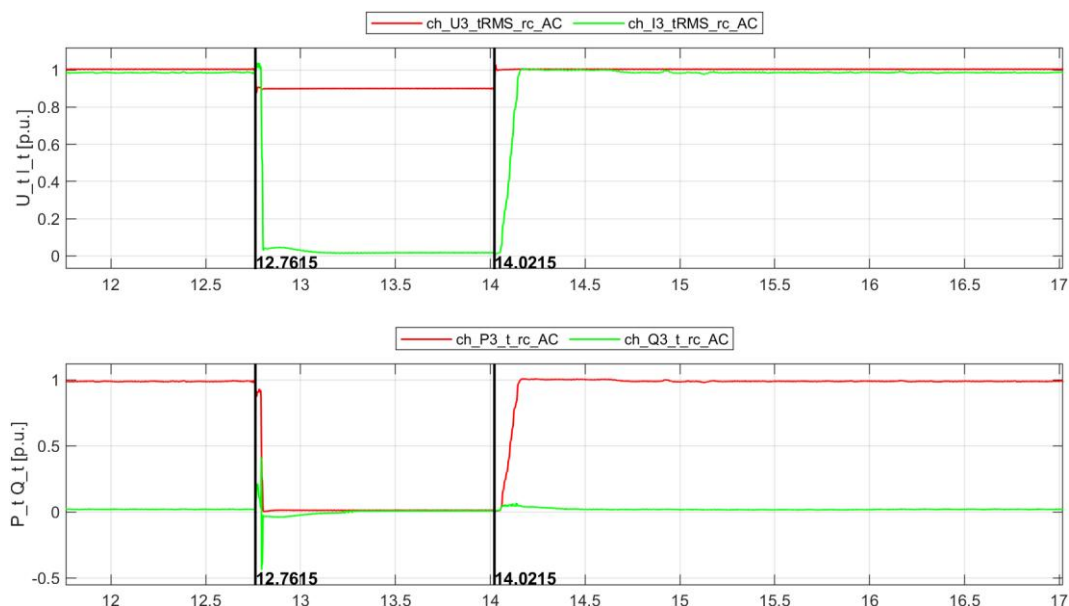
Test 3.0d1 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



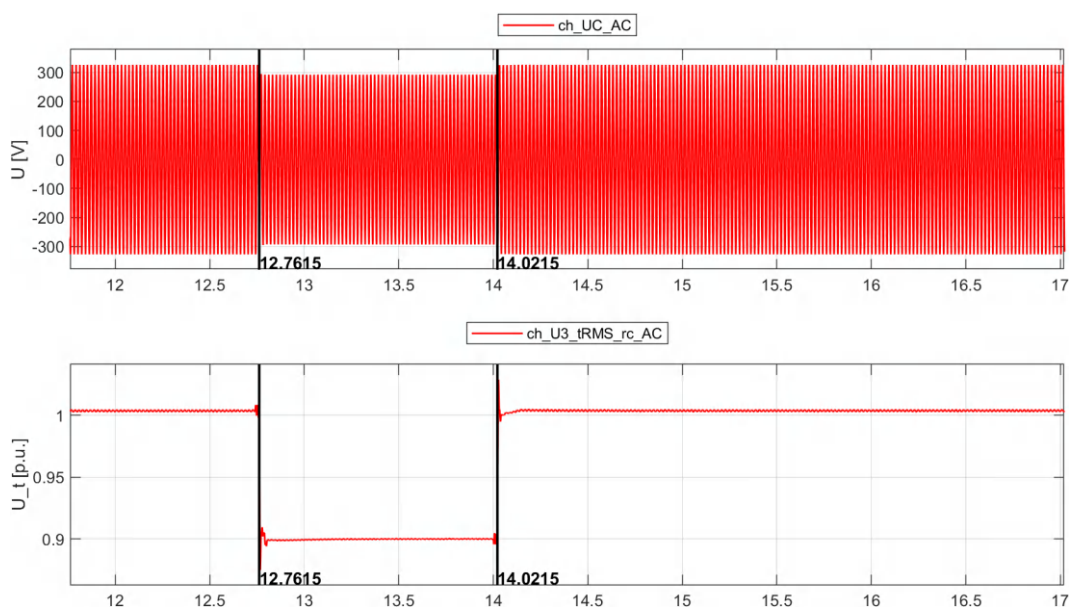
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**

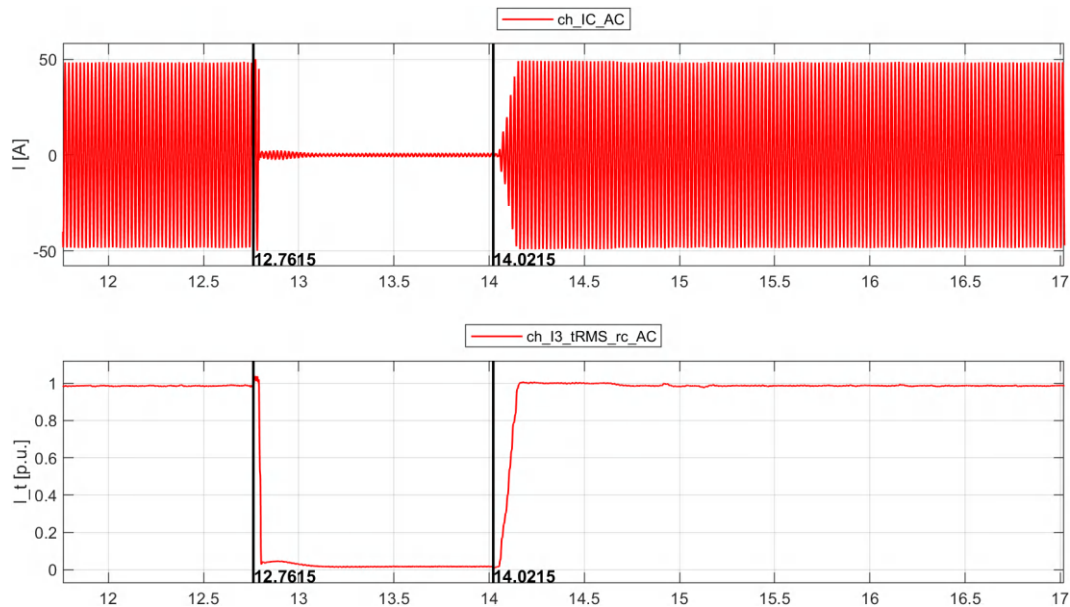


**Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**

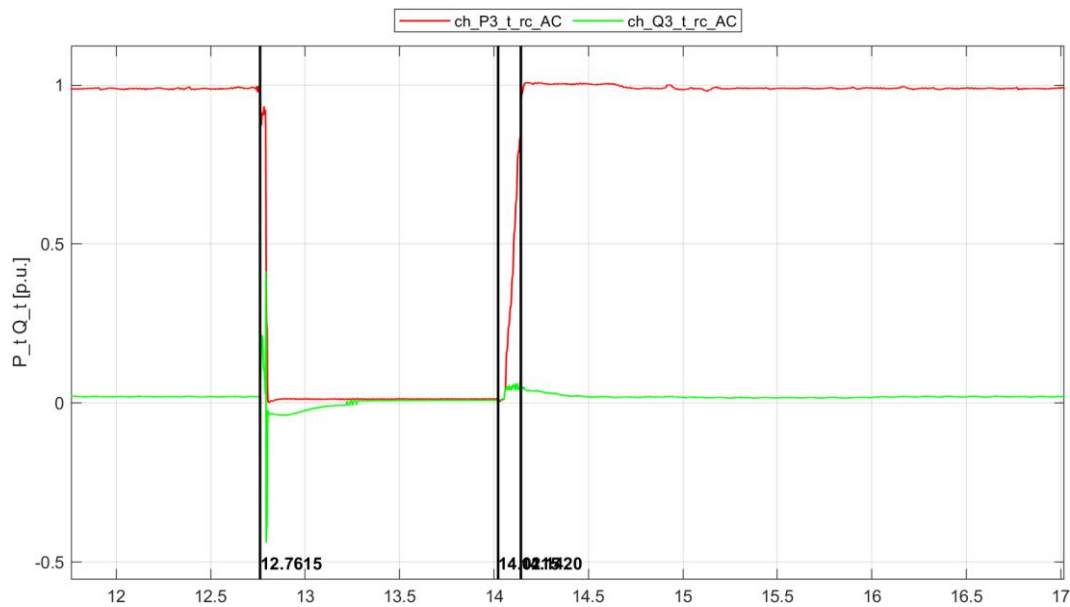


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



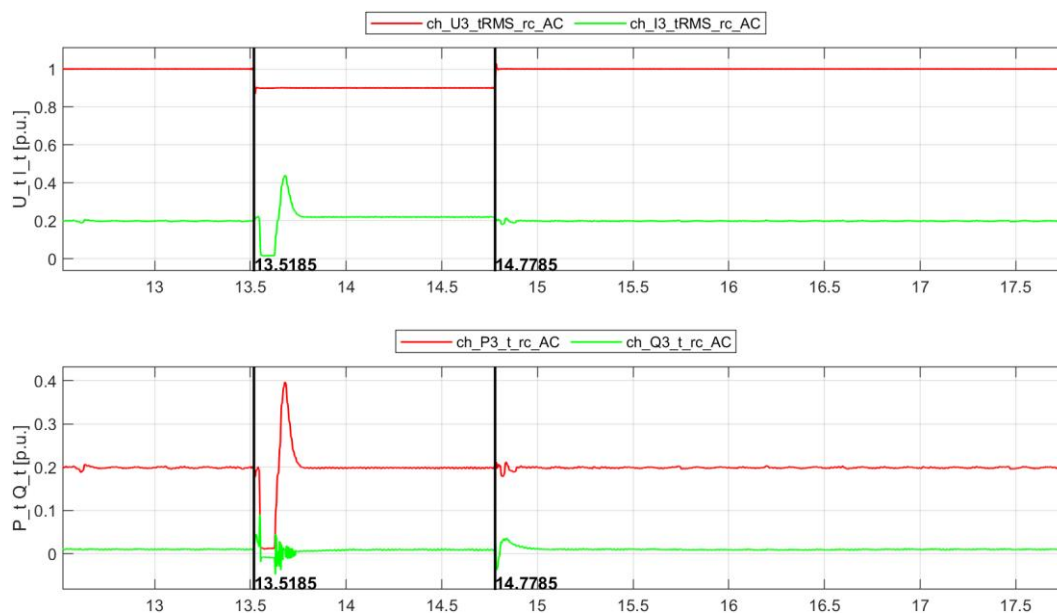
Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load, Power restore



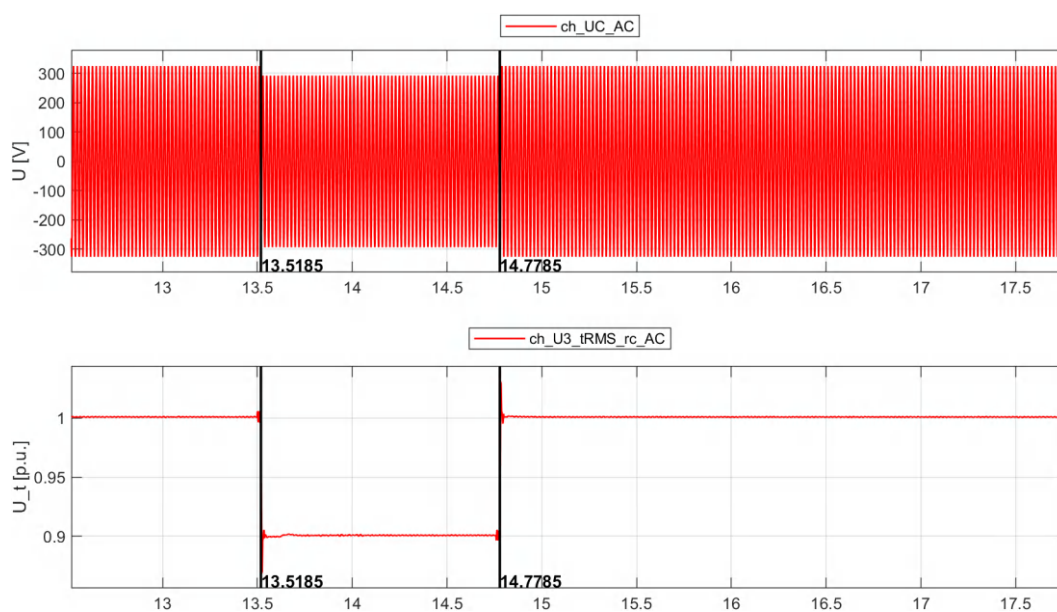
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

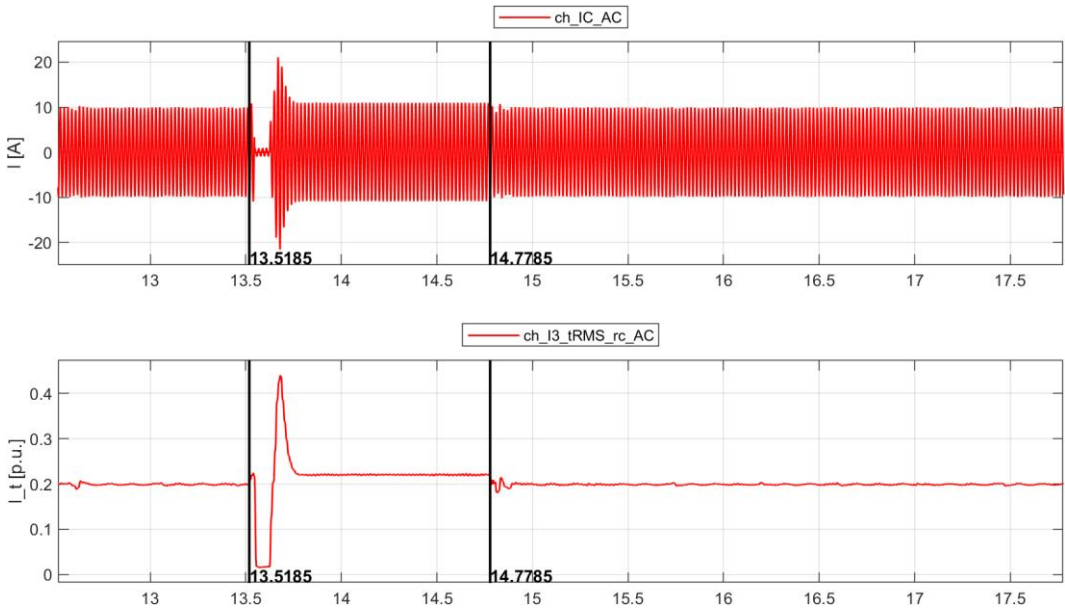


**Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

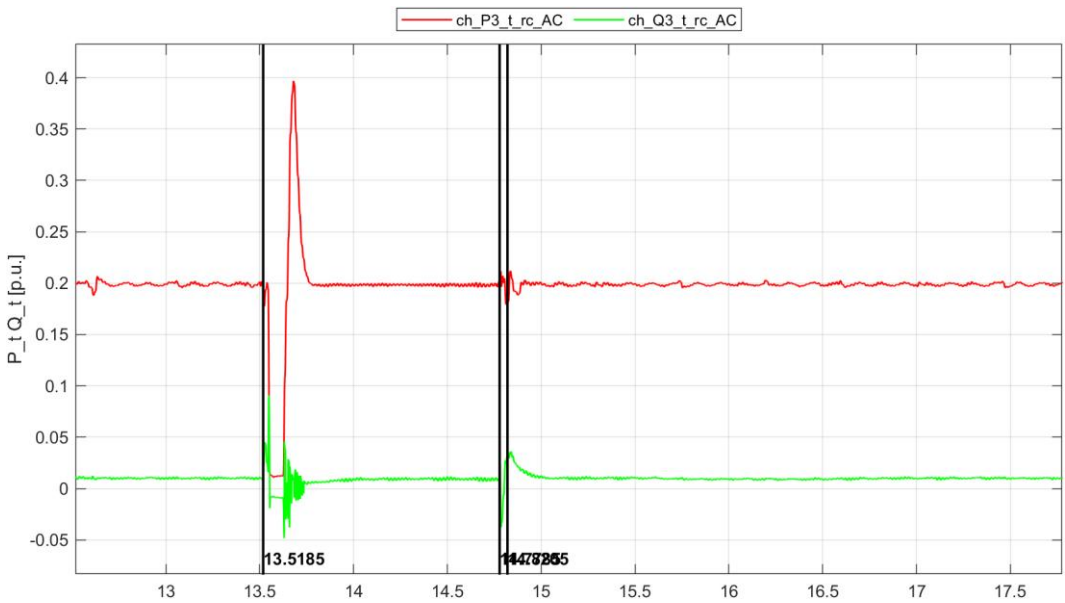


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load, Power restore



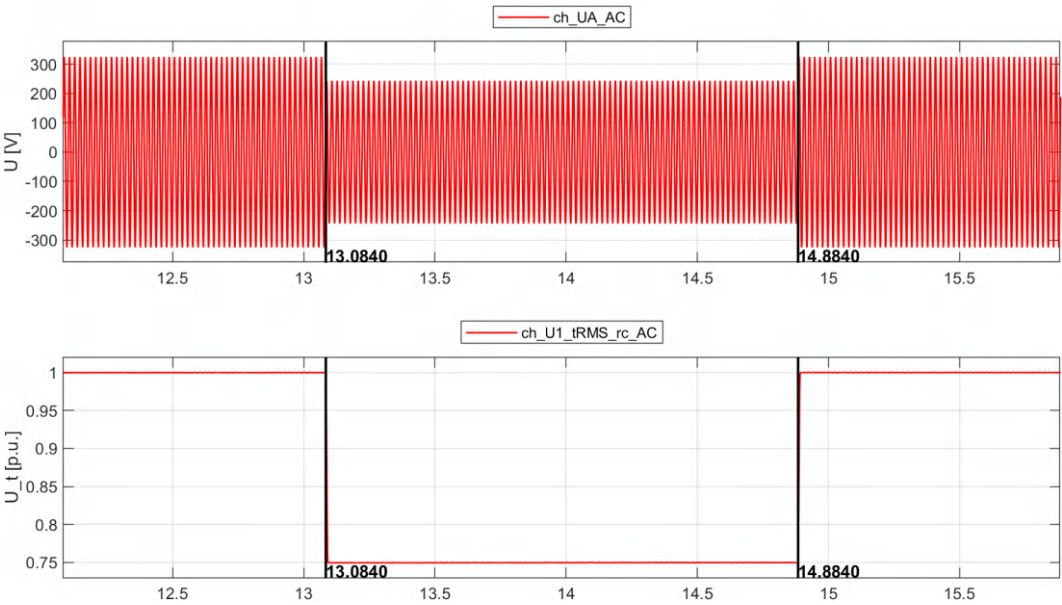
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	4.1	4.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:04:21.6	09:47:03.5
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.75	0.75
	5	Setting dip duration		--	--	1800	1800
	6	Point of fault entry(t_1)	Total	--	ms	13824	13270
	7	Point of fault clearance(t_2)	Total	--	ms	15624	15070
	8	Fault duration in empty load test	Total	--	ms	1800	1800
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.750	0.750
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.750	0.750
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.022	0.019
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.022	0.016
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.011	0.010
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.989	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.163	0.194
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

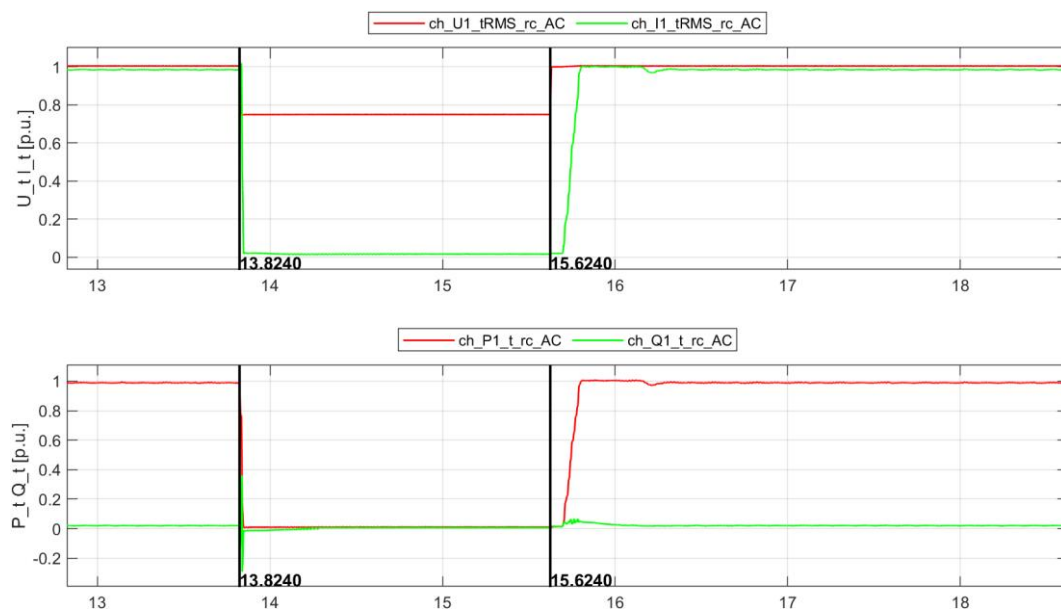
**Test 4.0a Depth of fault phase: 0.75 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



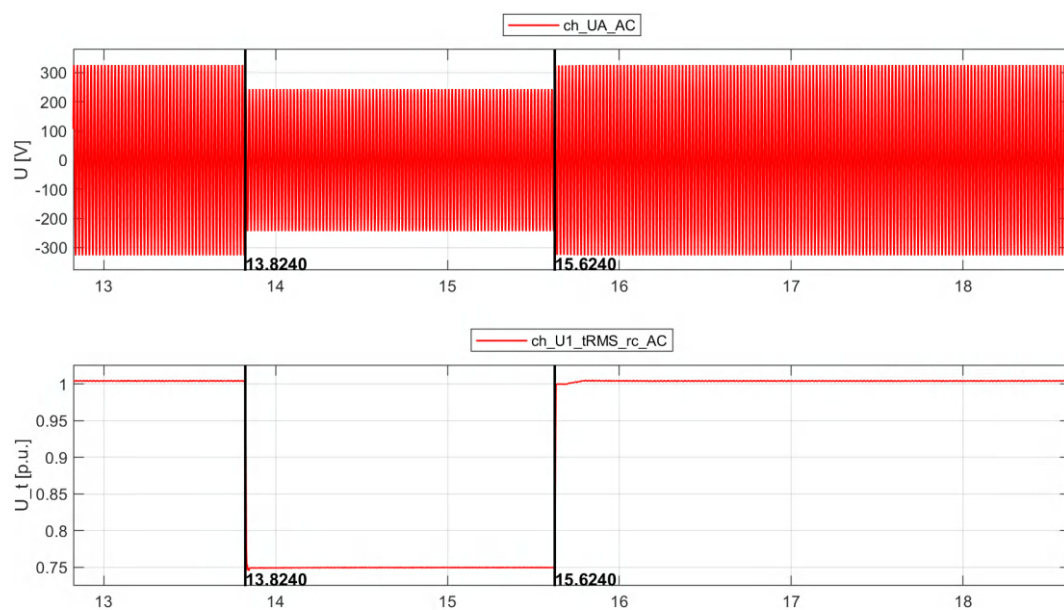
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**

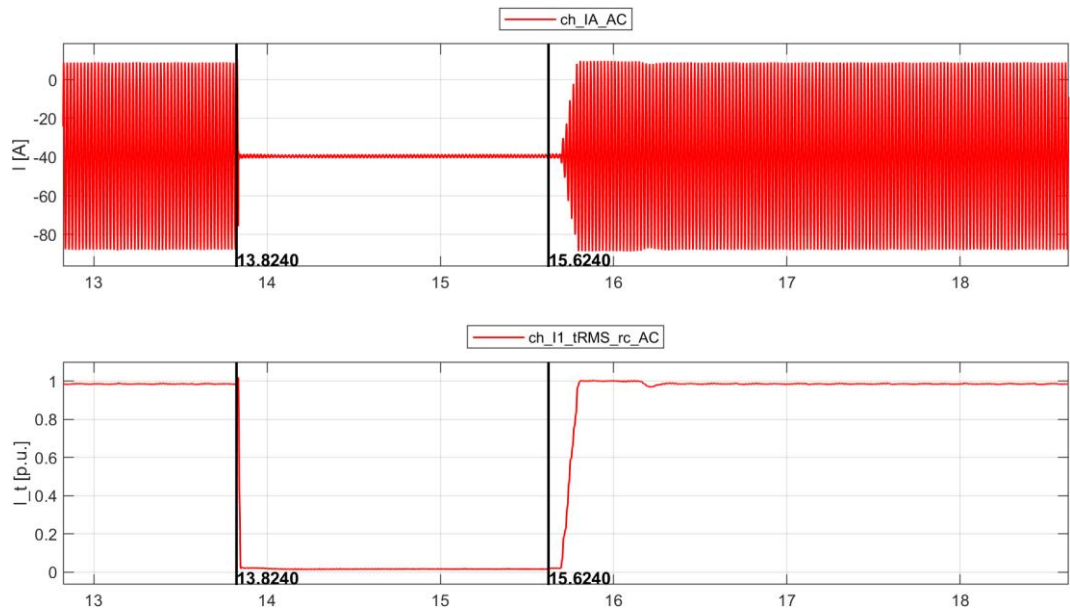


**Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**

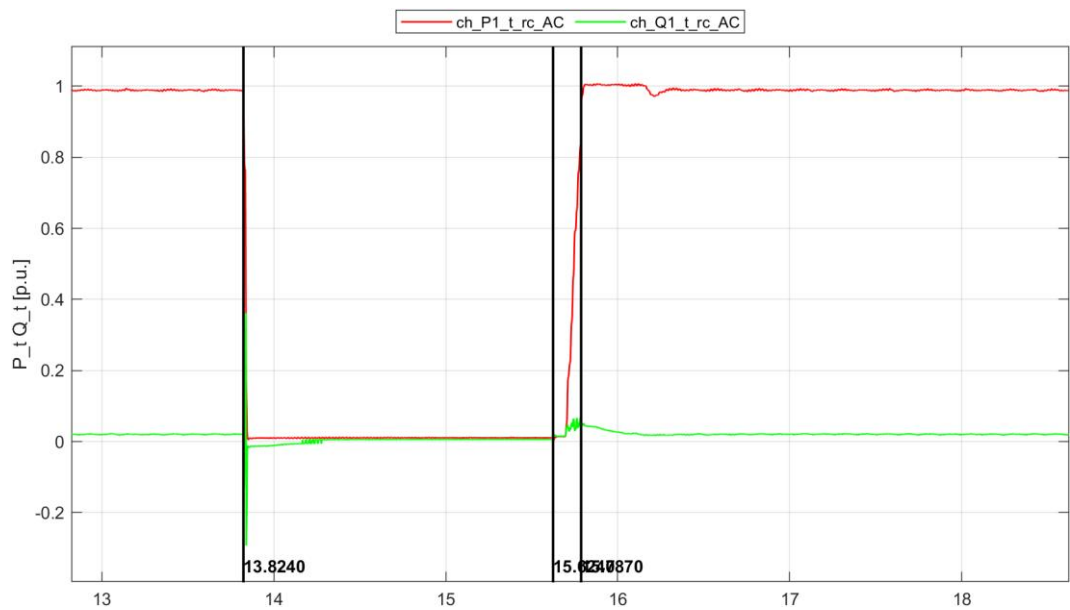


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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

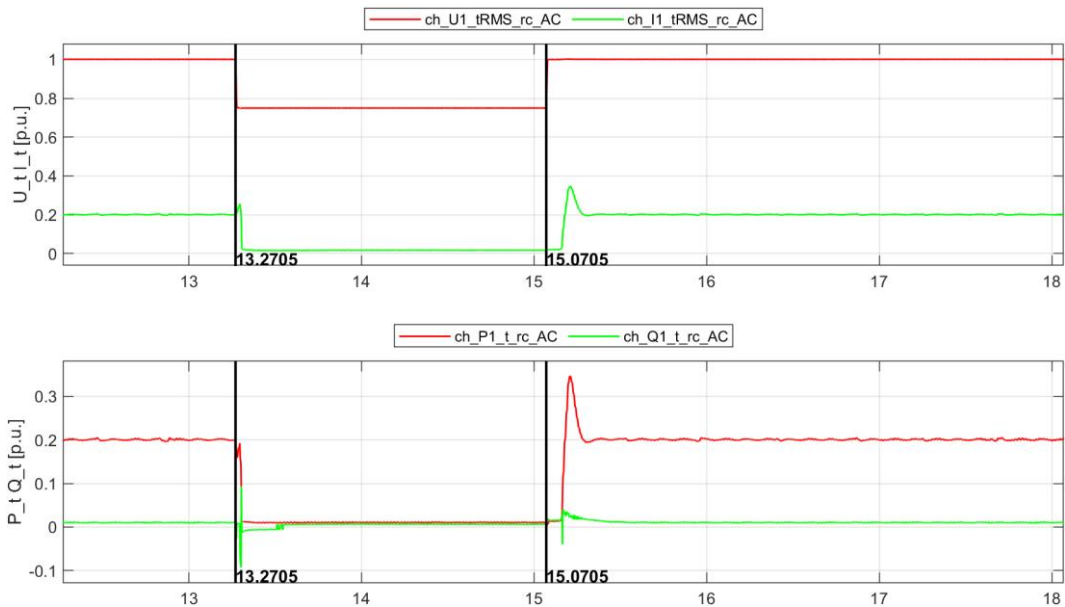


Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Power restore

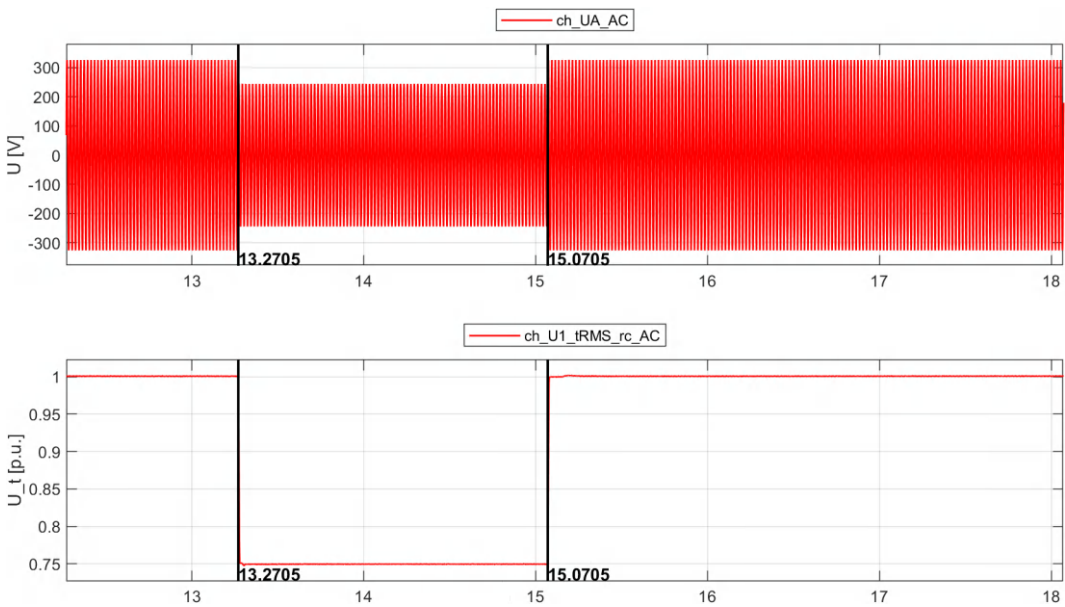


Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

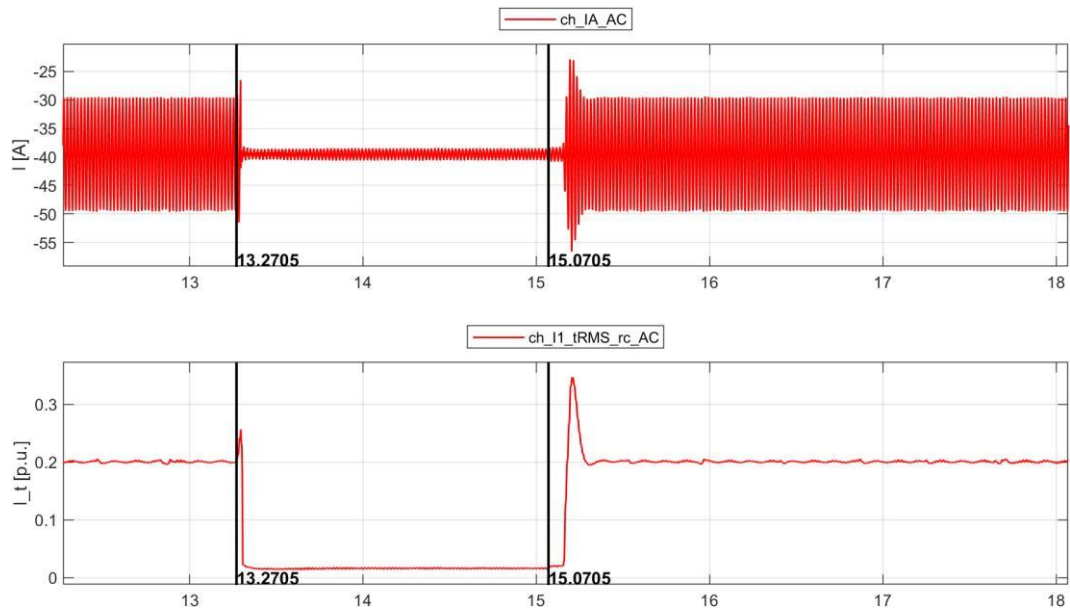


**Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

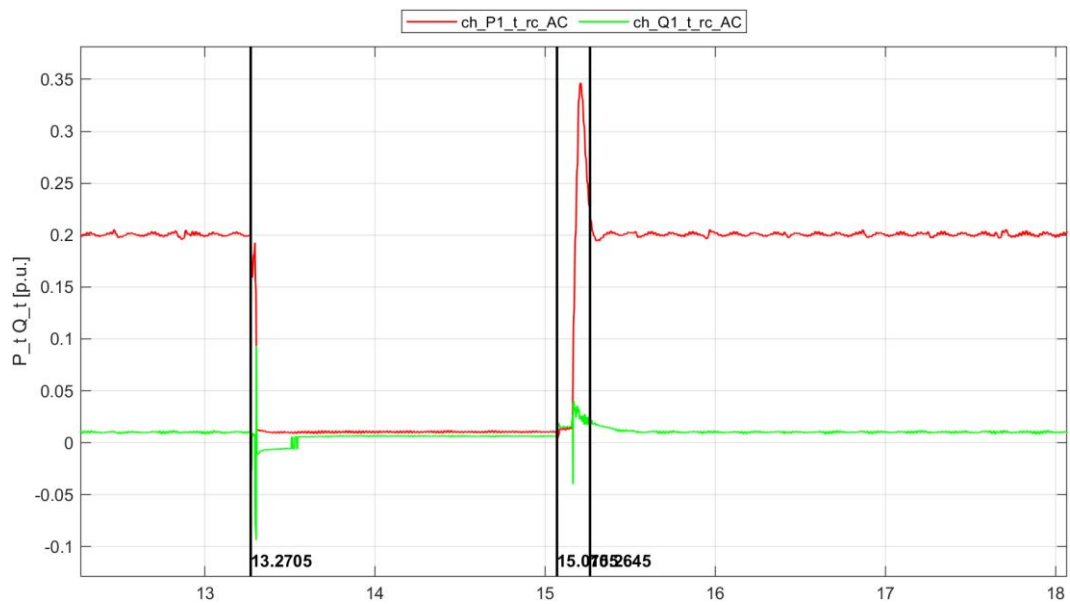


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load, Power restore



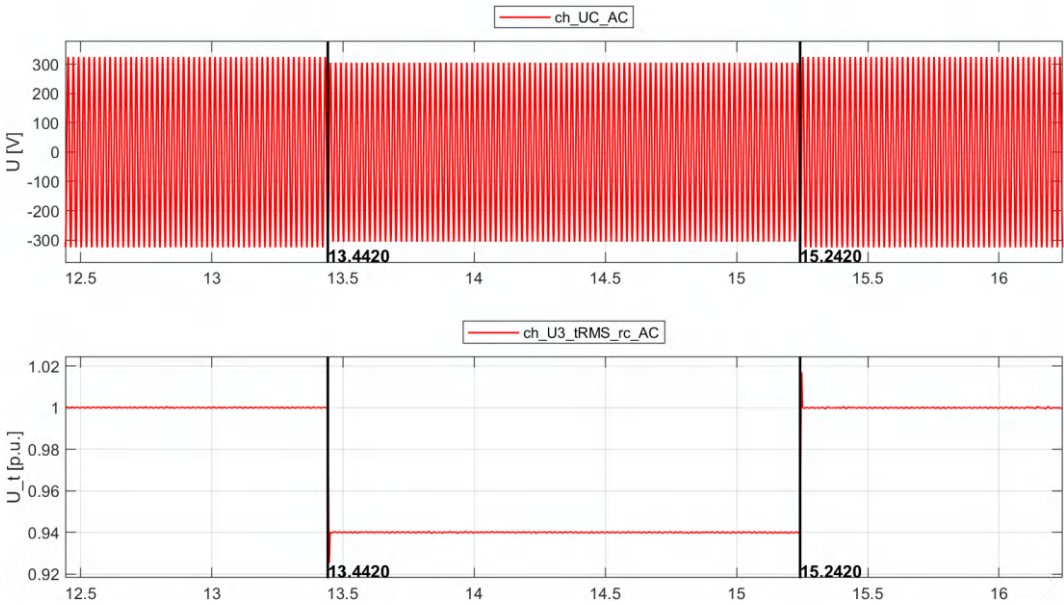
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	4.3	4.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	10:09:45.3	10:07:09.0
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.75	0.75
	5	Setting dip duration		--	--	1800	1800
	6	Point of fault entry(t_1)	Total	--	ms	13171	13016
	7	Point of fault clearance(t_2)	Total	--	ms	14971	14816
	8	Fault duration in empty load test	Total	--	ms	1800	1800
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.940	0.940
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.987	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.991	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.944	0.941
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	1.041	0.218
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	1.056	0.211
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.988	0.199
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.991	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

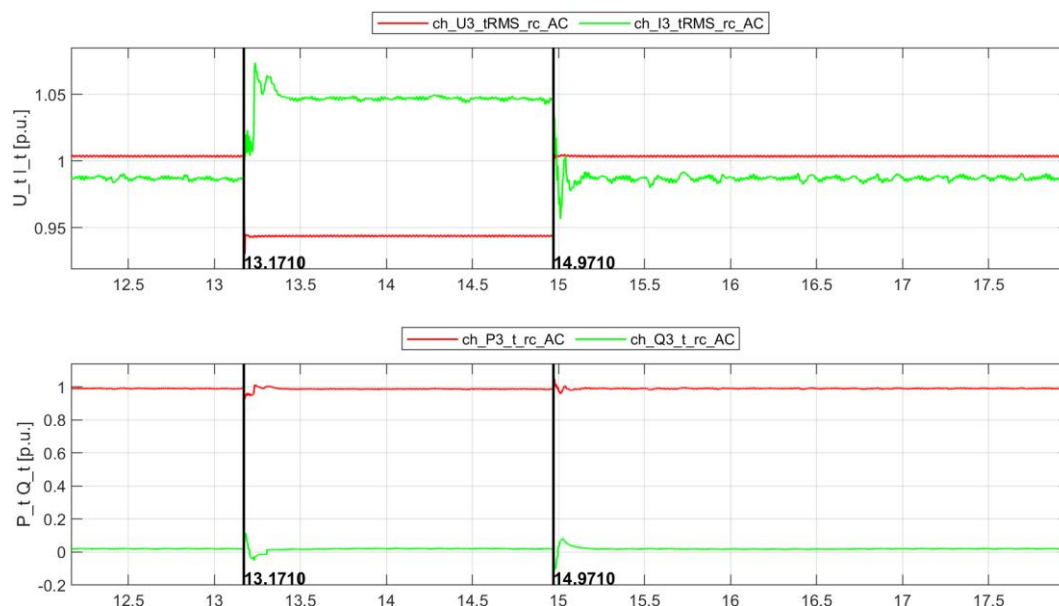
**Test 4.0d1 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 0% load,
Instantaneous and RMS values of phase voltages**



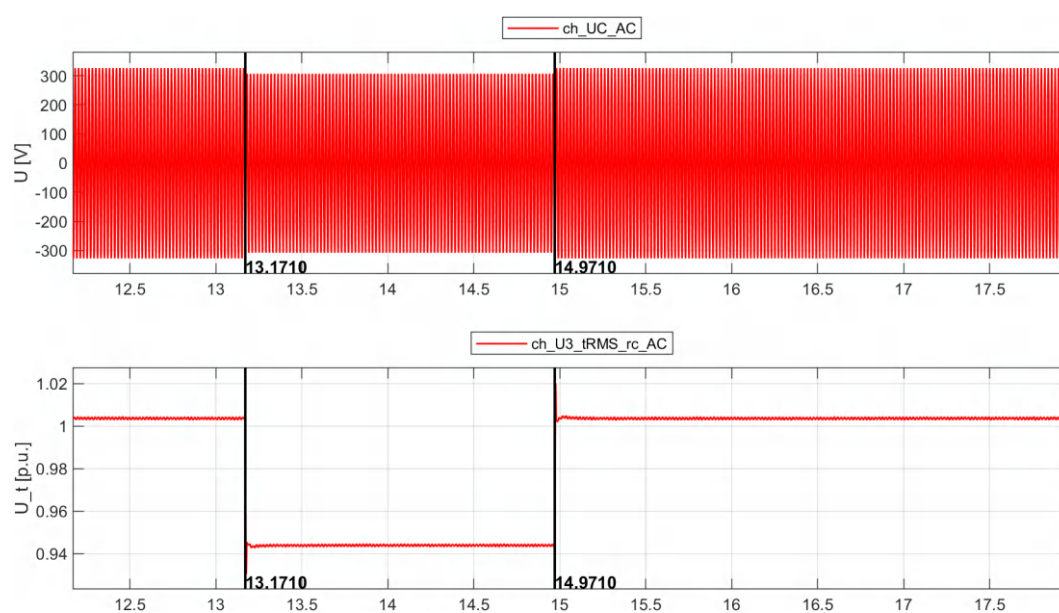
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



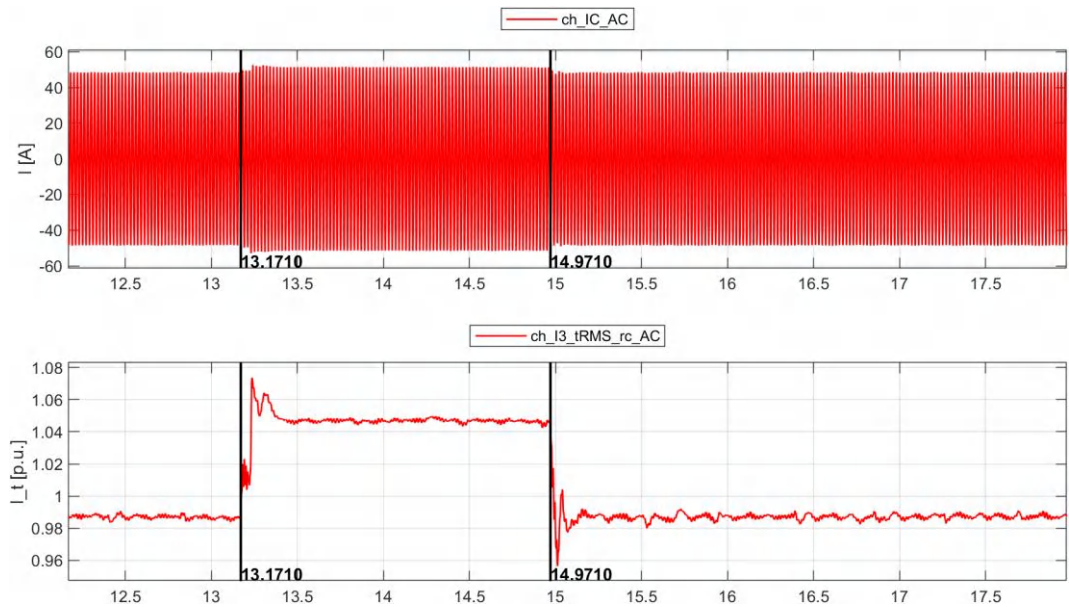
**Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



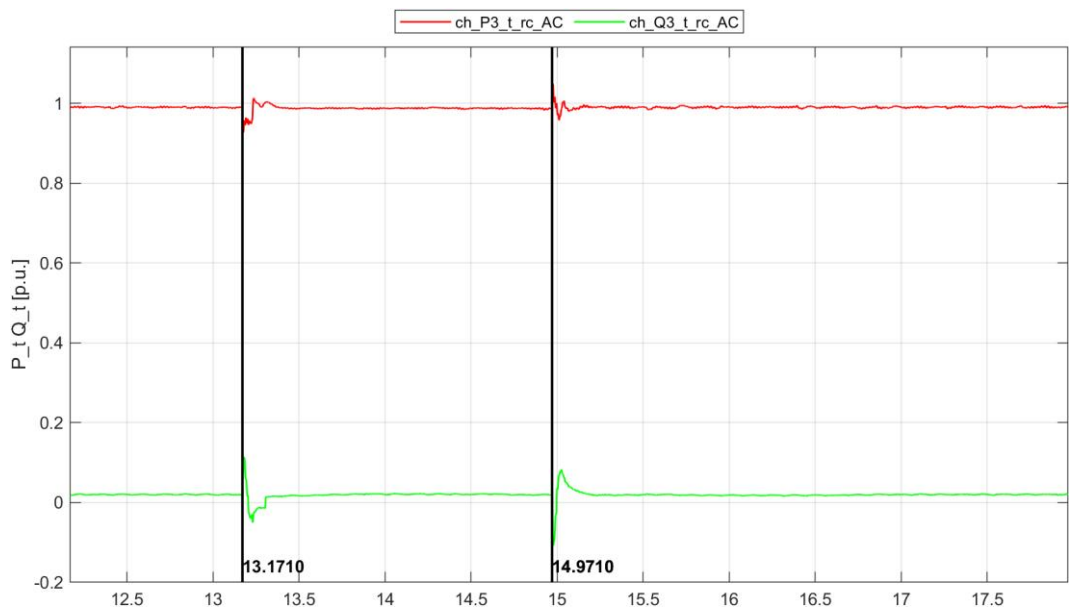
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



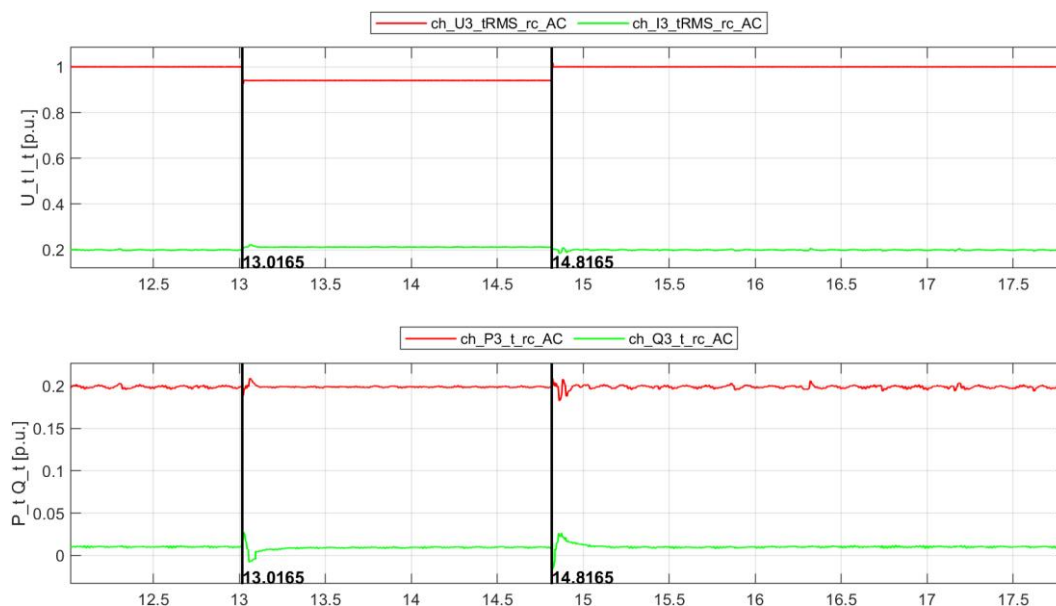
Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load, Power restore



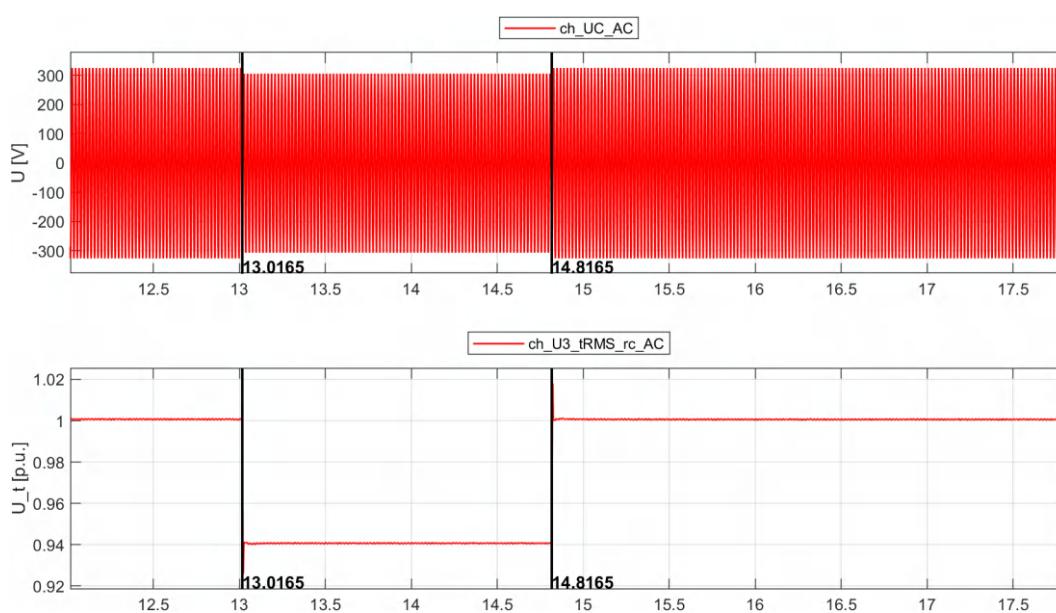
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



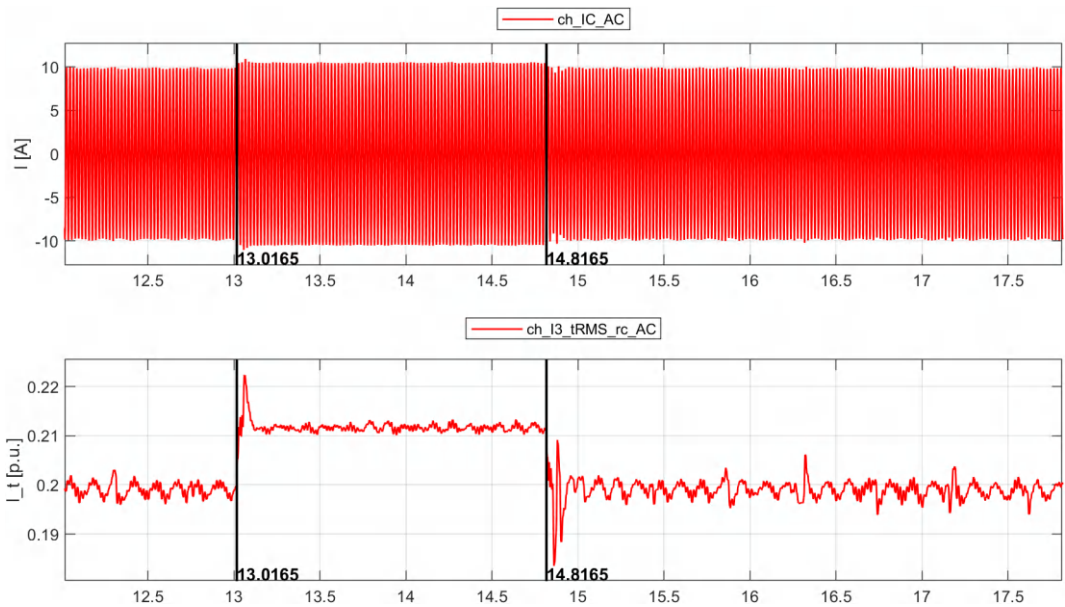
**Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



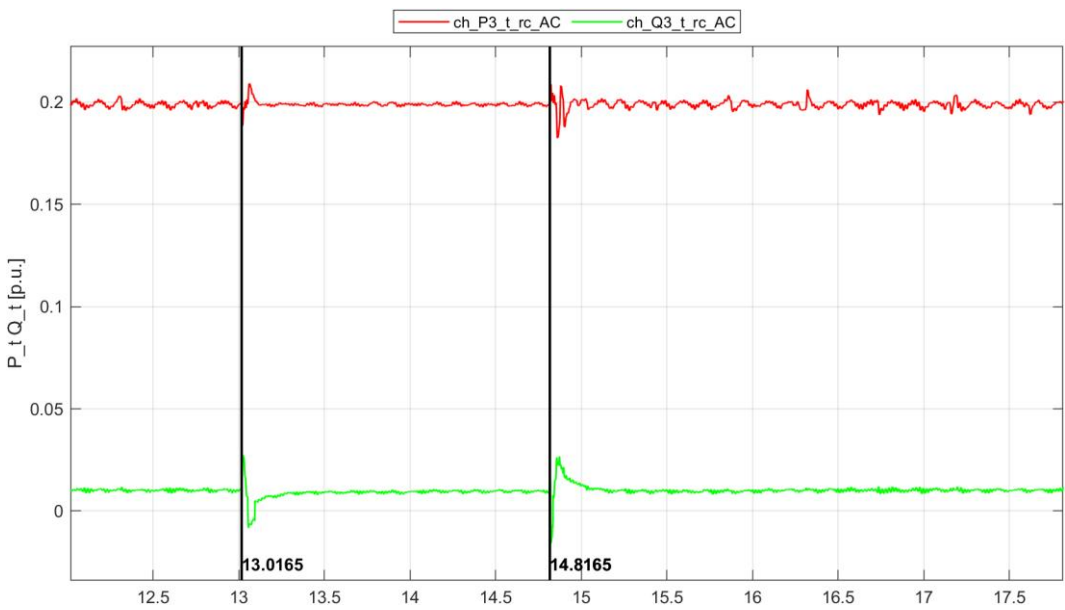
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load, Power restore



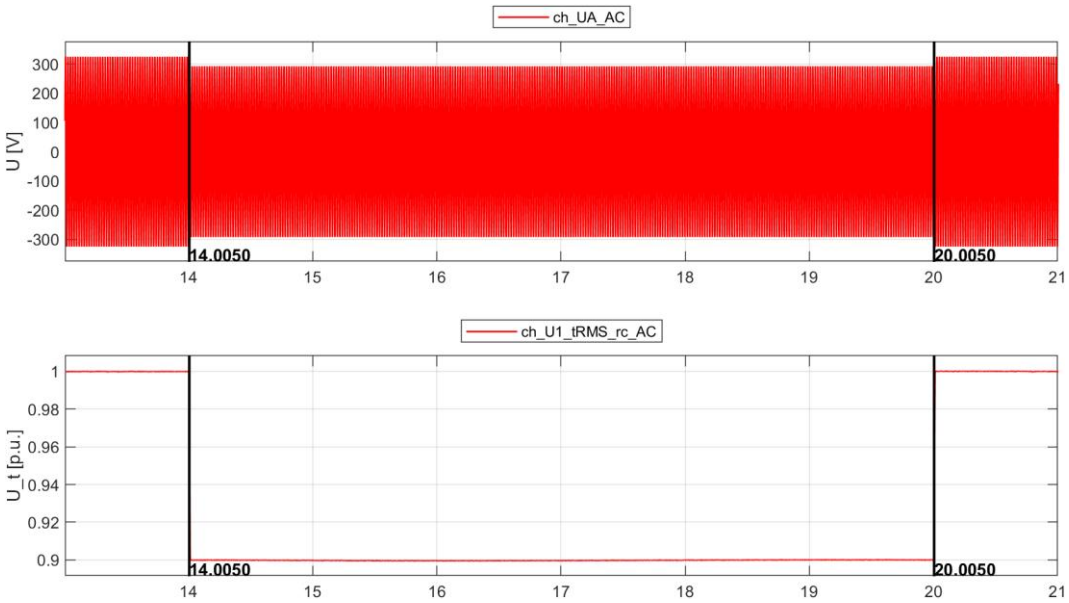
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	5.1	5.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:17:17.3	09:49:54.5
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.90	0.90
	5	Setting dip duration		--	--	6000	6000
	6	Point of fault entry(t_1)	Total	--	ms	13474	13536
	7	Point of fault clearance(t_2)	Total	--	ms	19474	19536
	8	Fault duration in empty load test	Total	--	ms	6000	6000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.900	0.900
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.987	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.991	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.905	0.900
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	1.065	0.230
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	1.101	0.224
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.986	0.016
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.990	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.172
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

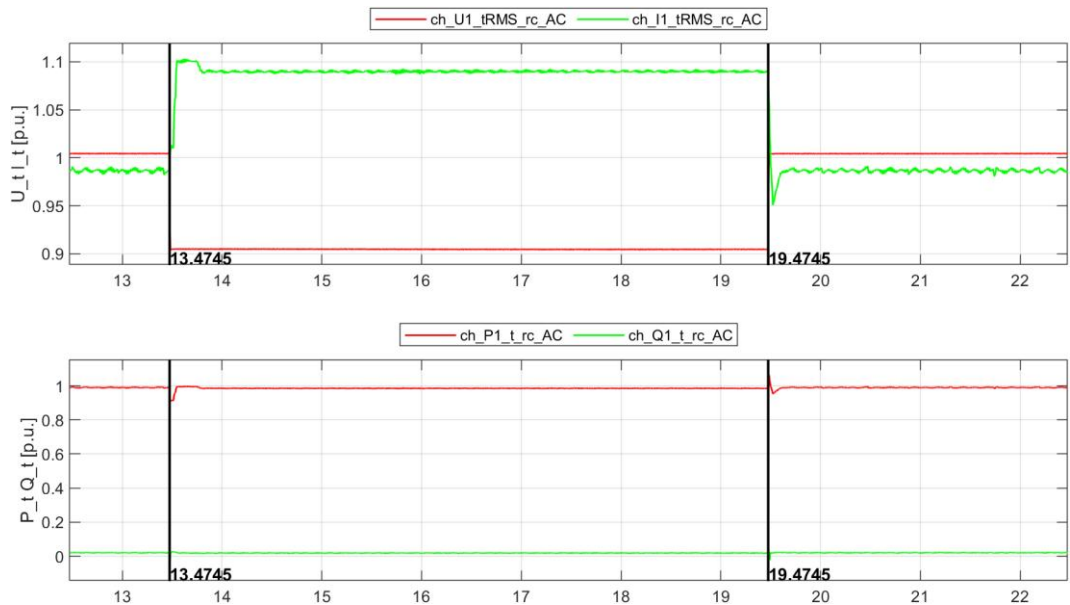
**Test 5.0a Depth of fault phase: 0.9 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



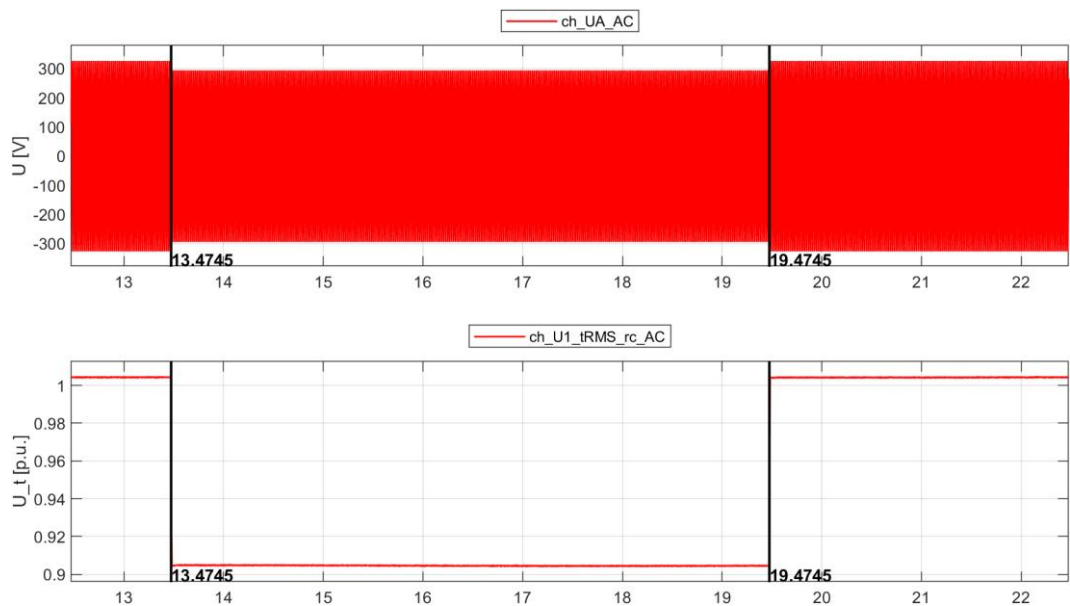
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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)

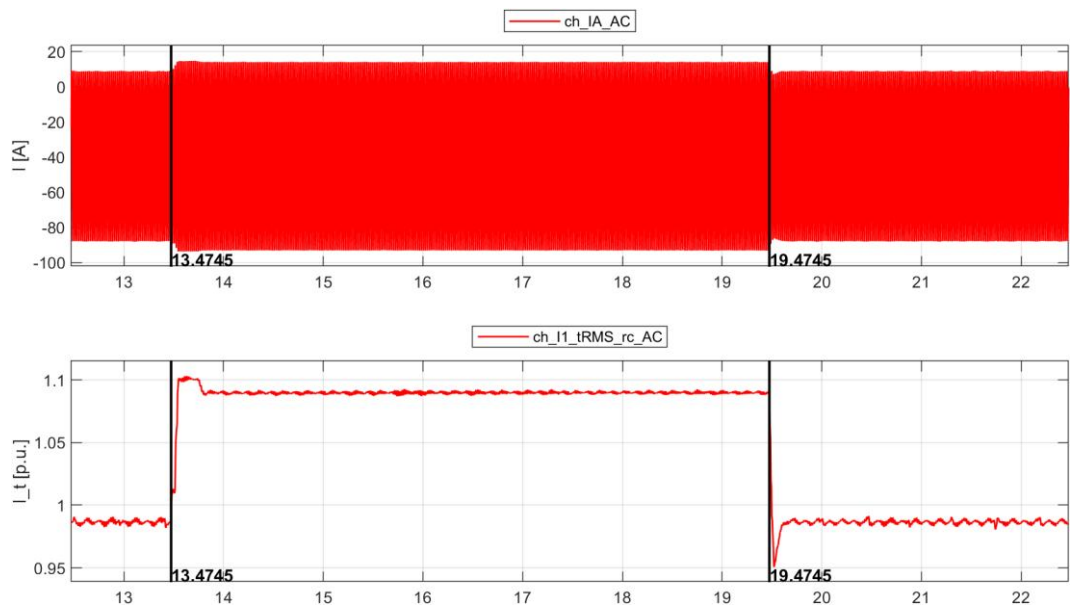


Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages

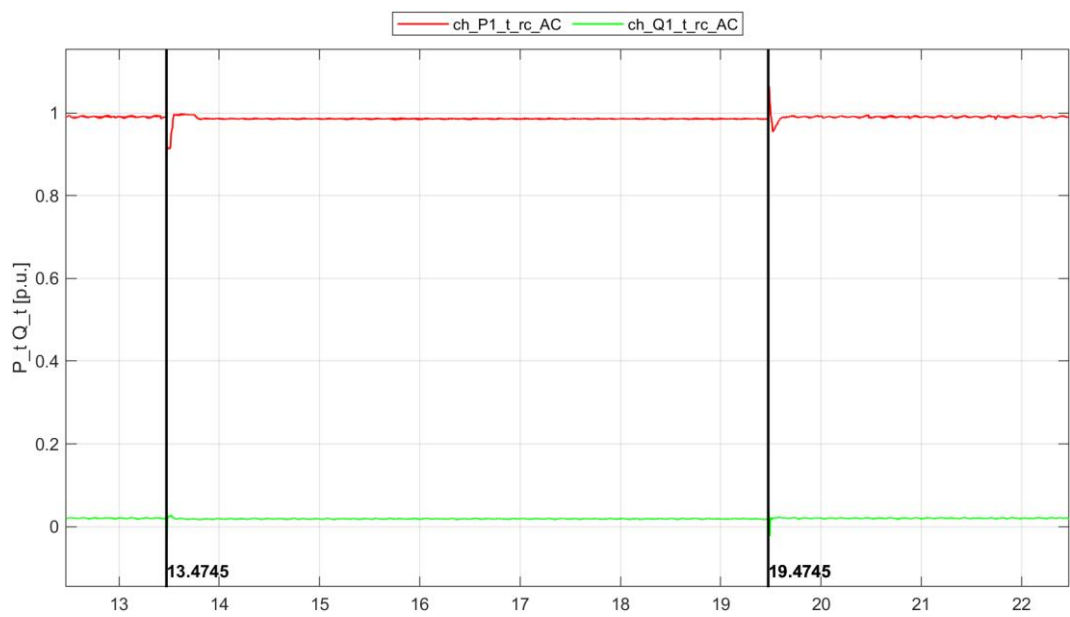


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



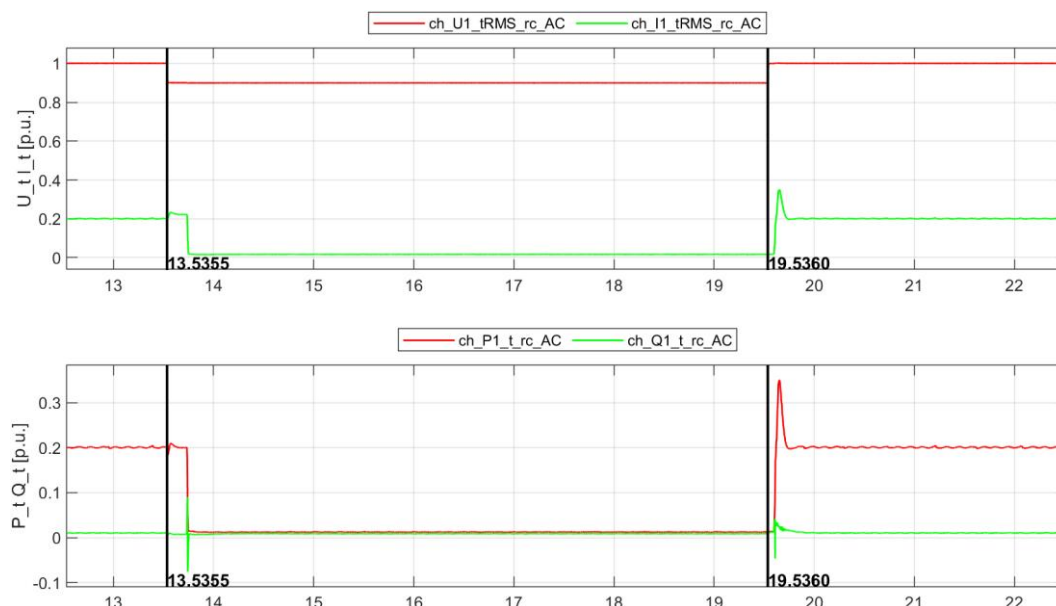
Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load, Power restore



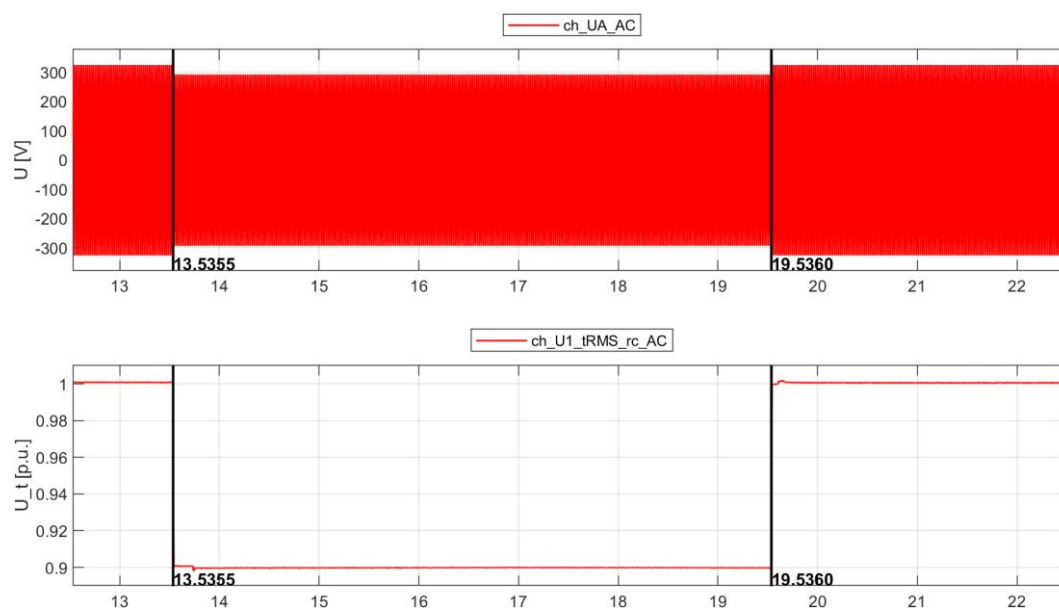
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

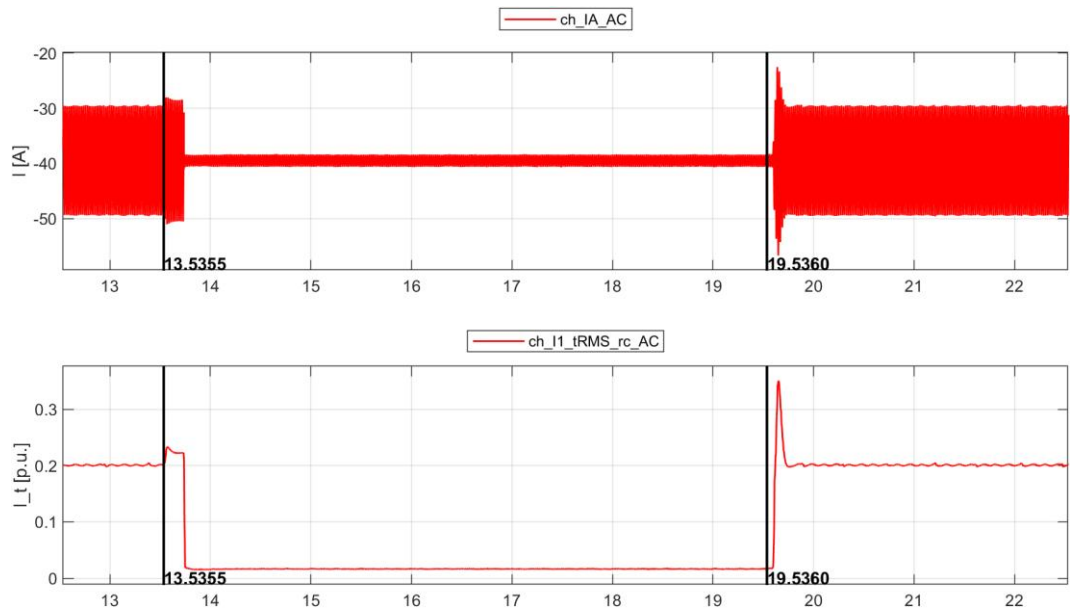


**Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

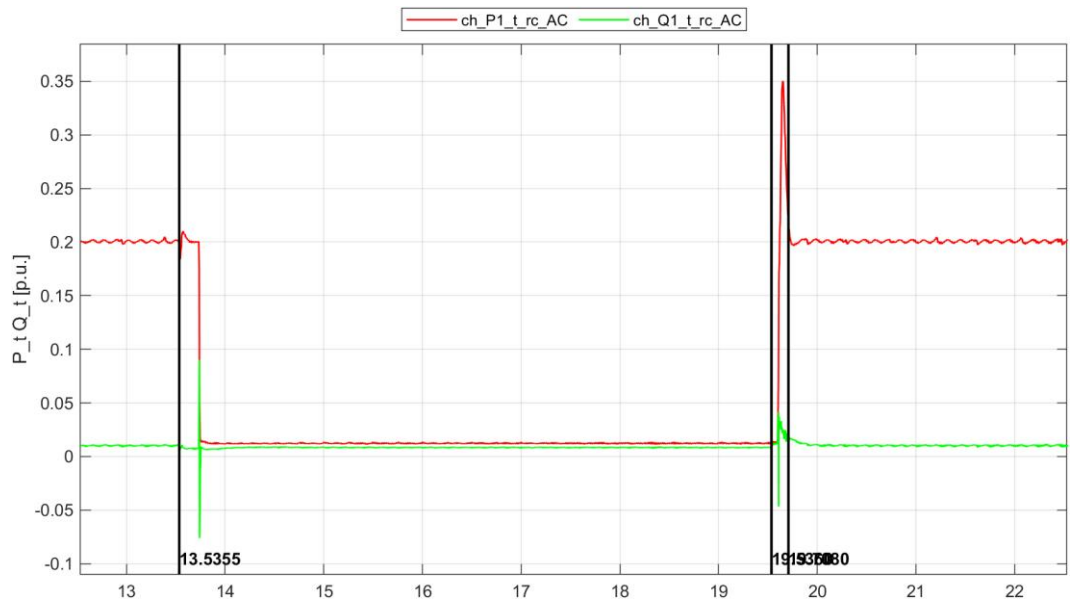


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load, Power restore



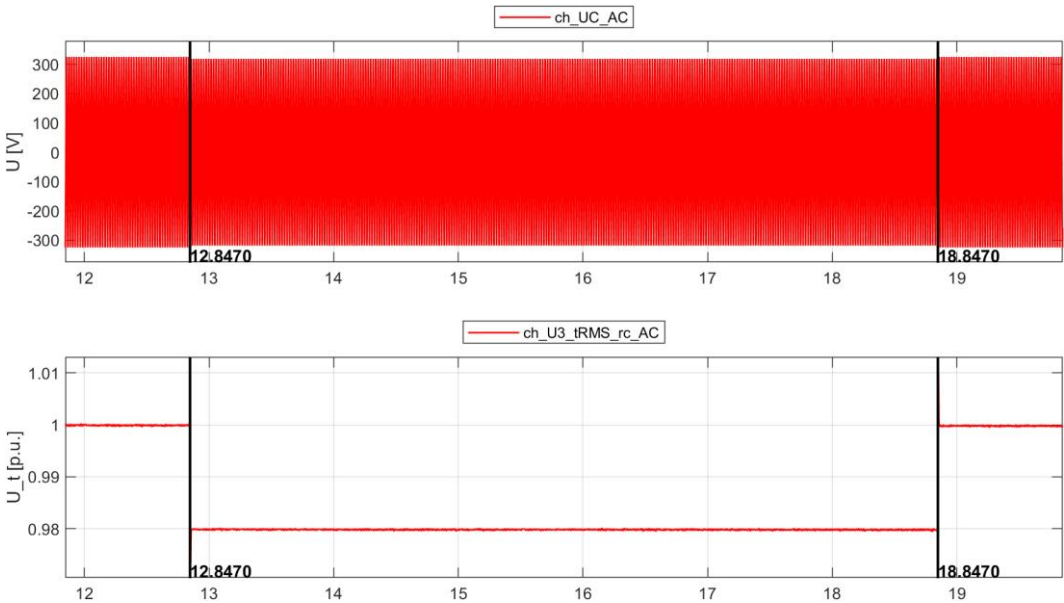
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	5.3	5.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	10:14:11.2	10:17:34.6
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.90	0.90
	5	Setting dip duration		--	--	6000	6000
	6	Point of fault entry(t_1)	Total	--	ms	13464	12961
	7	Point of fault clearance(t_2)	Total	--	ms	19464	18961
	8	Fault duration in empty load test	Total	--	ms	6000	6000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.980	0.980
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.984	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.987	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.984	0.981
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	1.013	0.206
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.996	0.203
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.987	0.199
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.987	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

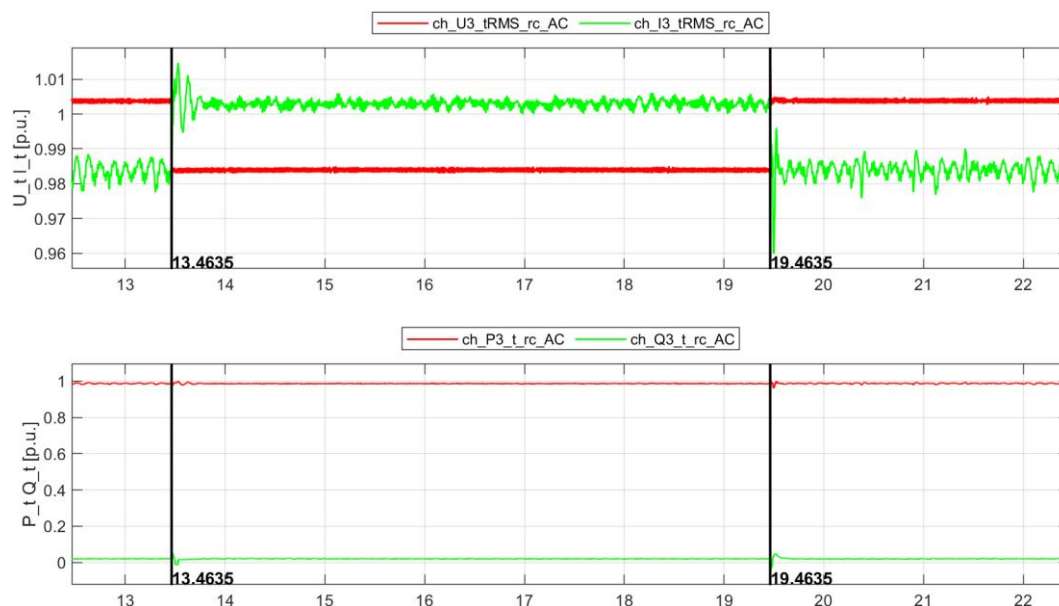
**Test 5.0d1 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 0% load,
Instantaneous and RMS values of phase voltages**



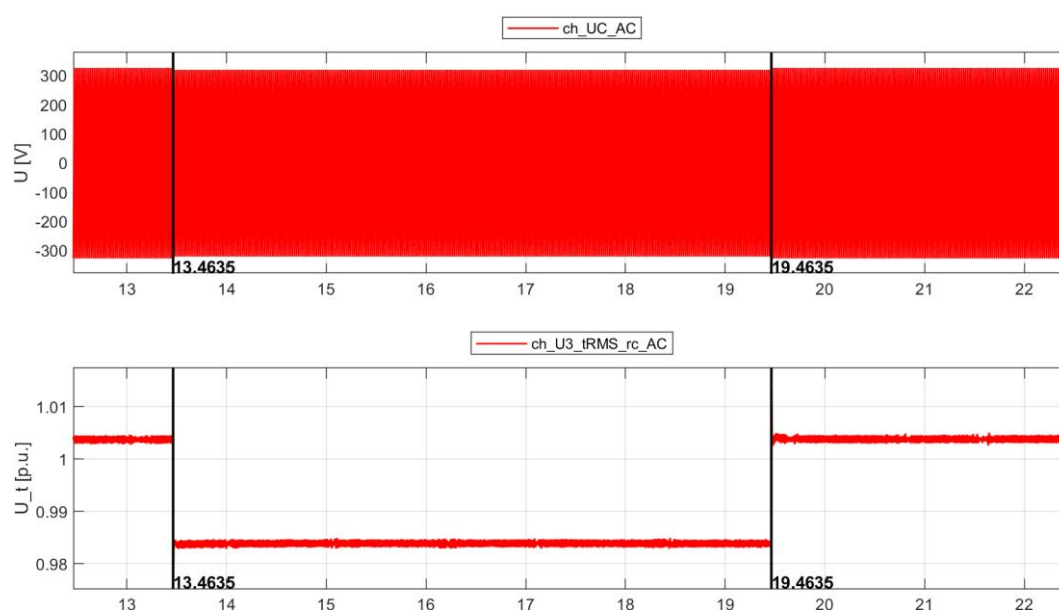
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



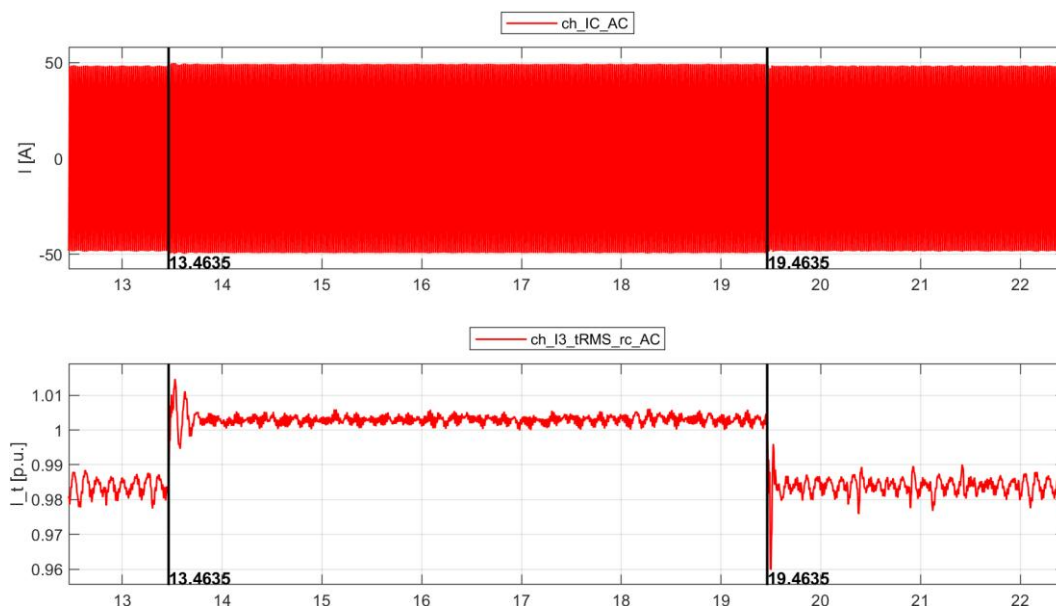
**Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



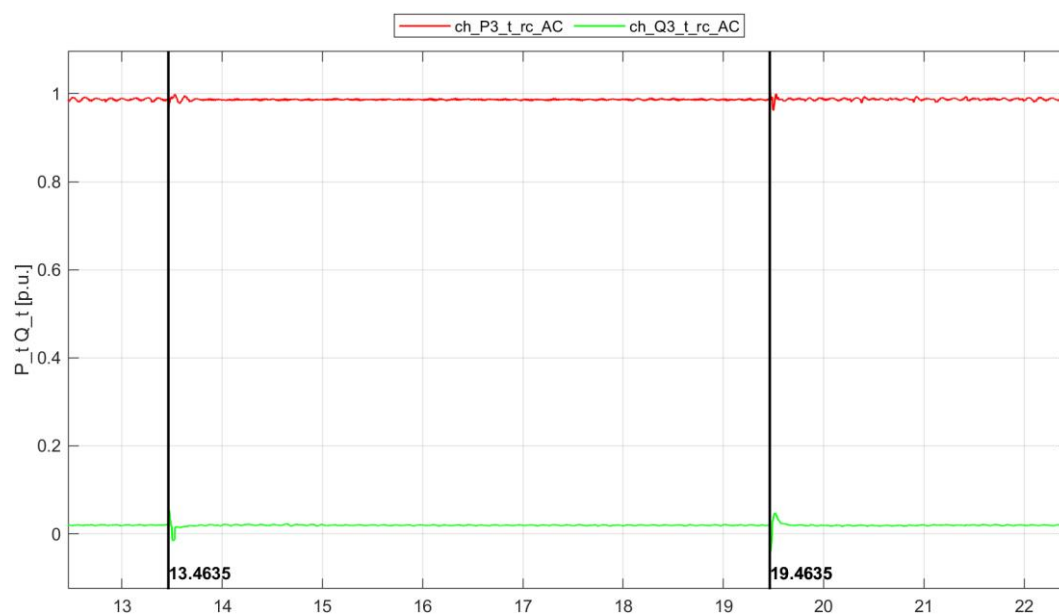
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



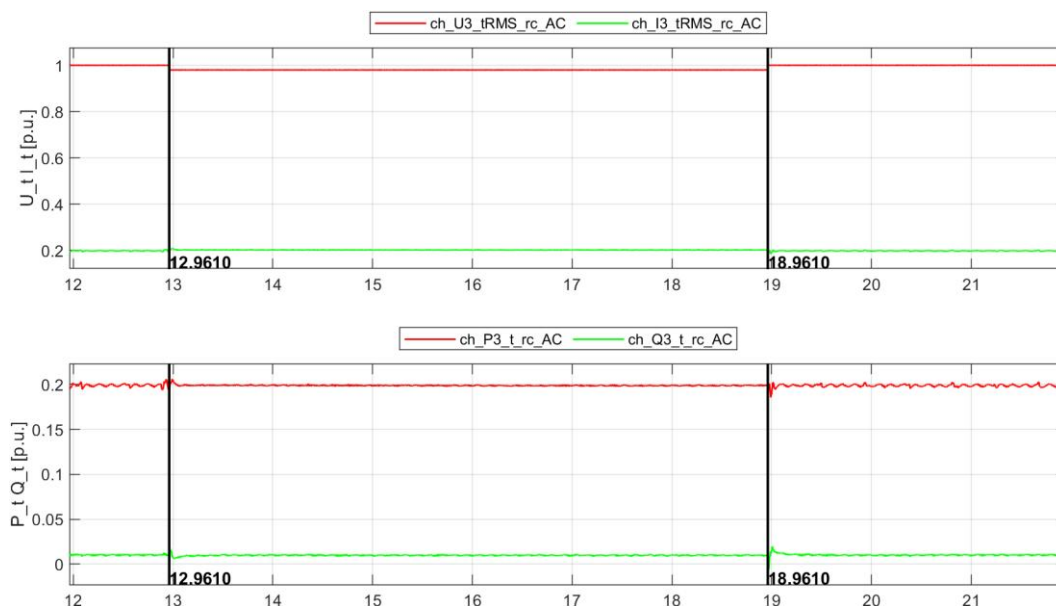
Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load, Power restore



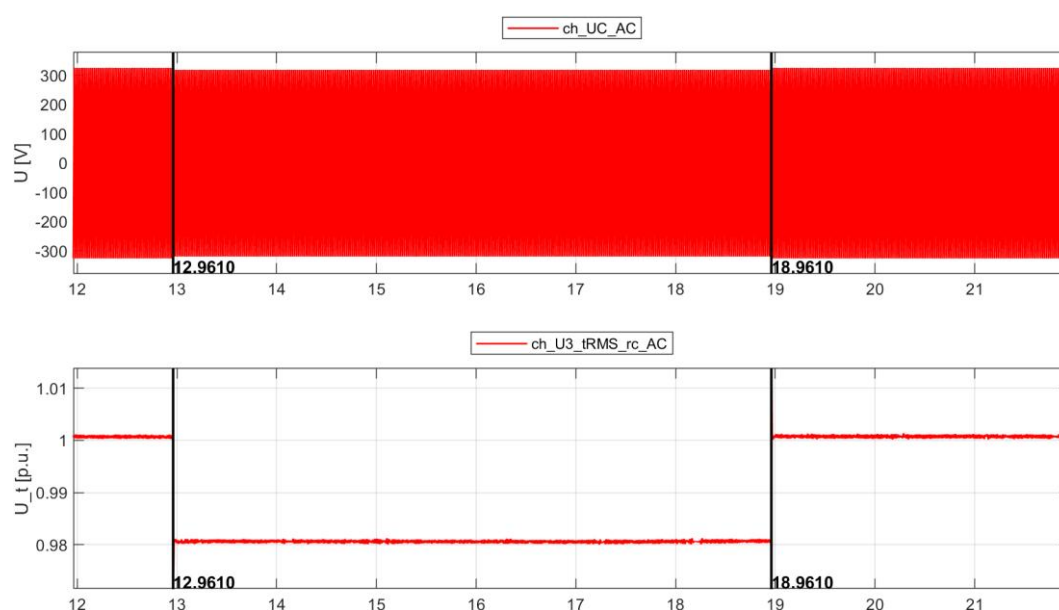
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

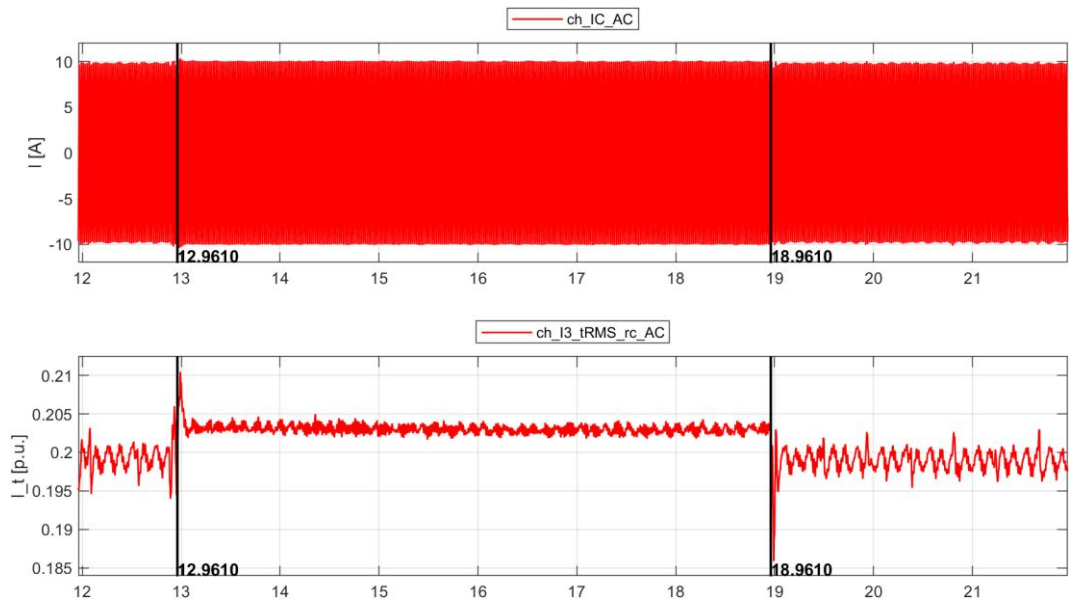


**Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

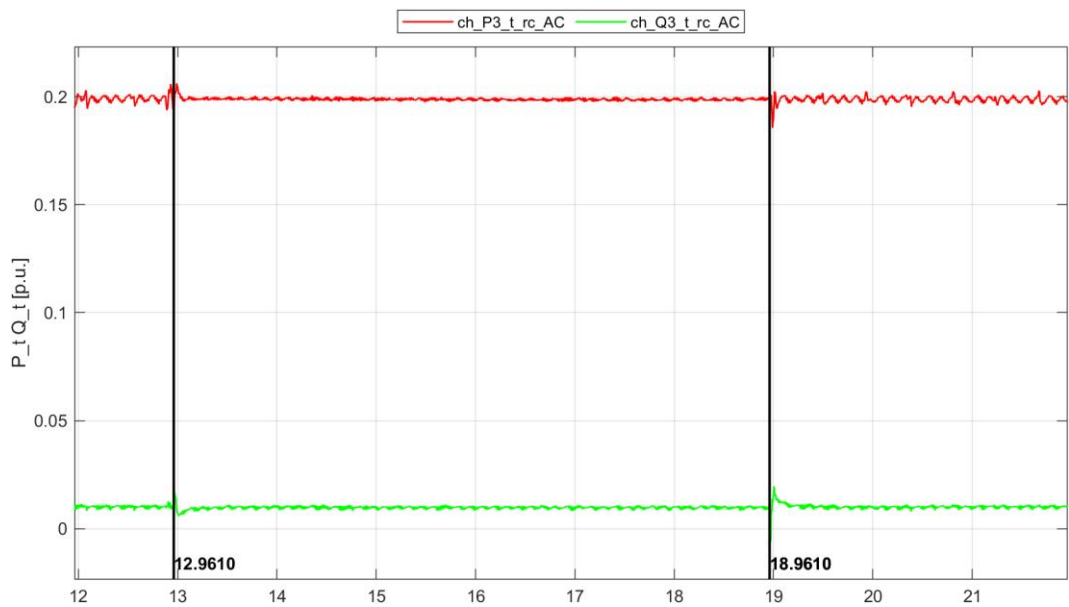


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load, Power restore



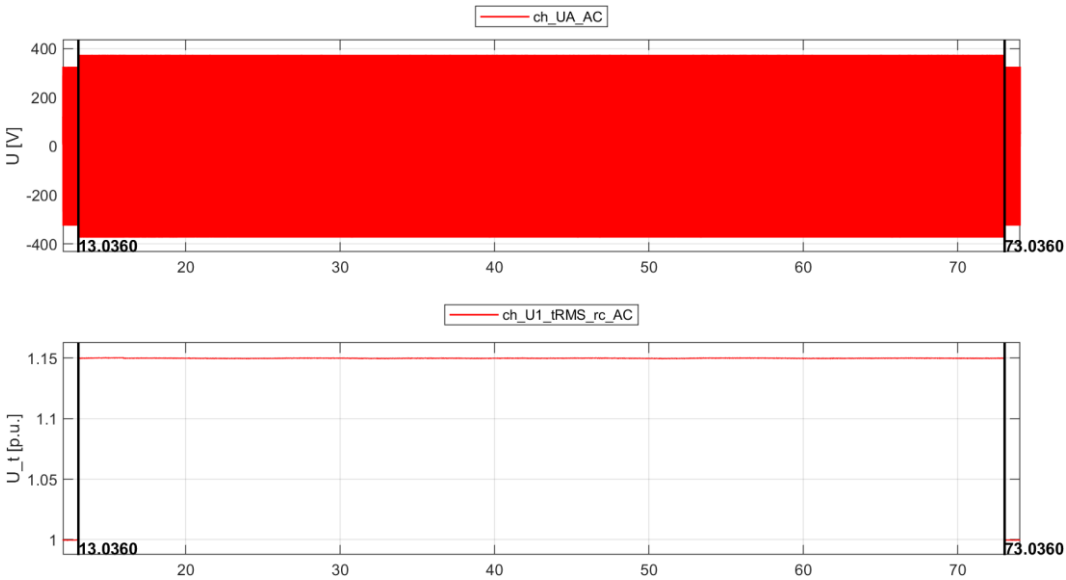
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	6.1	6.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:20:32.9	09:52:54.2
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.15	1.15
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry(t_1)	Total	--	ms	14236	13063
	7	Point of fault clearance(t_2)	Total	--	ms	74236	73063
	8	Fault duration in empty load test	Total	--	ms	60000	60000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.150	1.150
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.150	1.150
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.023	0.019
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.020	0.016
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.014	0.014
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.951	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.143	0.144
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

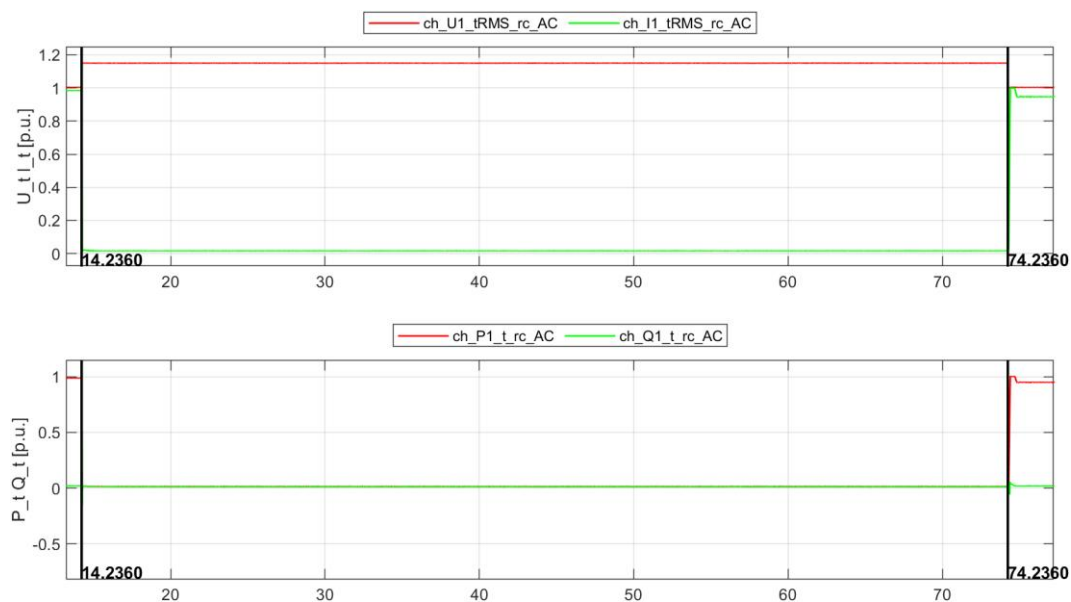
**Test 6.0a Depth of fault phase: 1.15 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



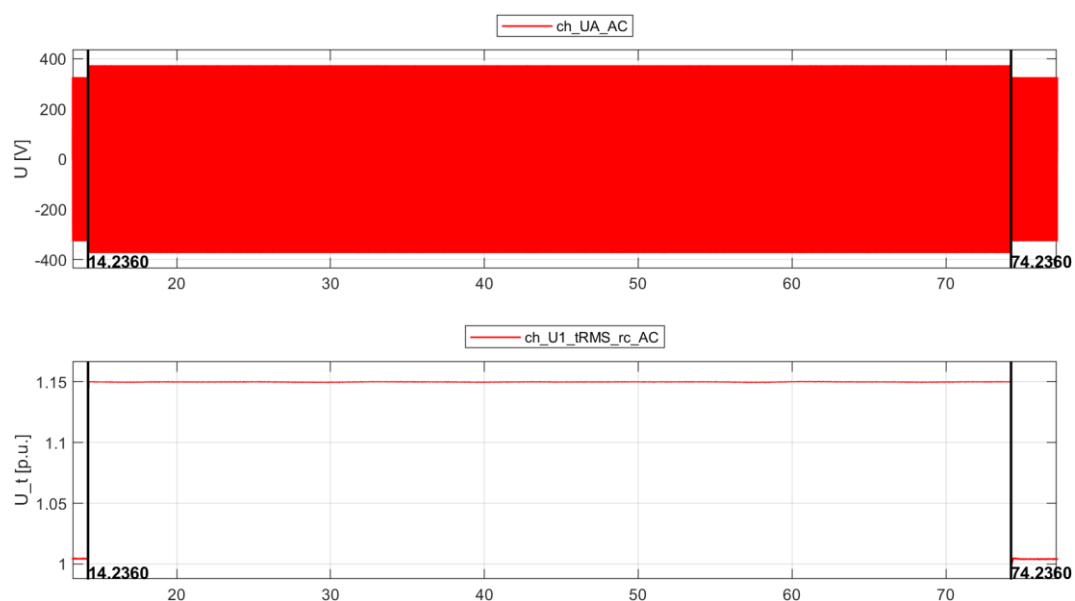
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**

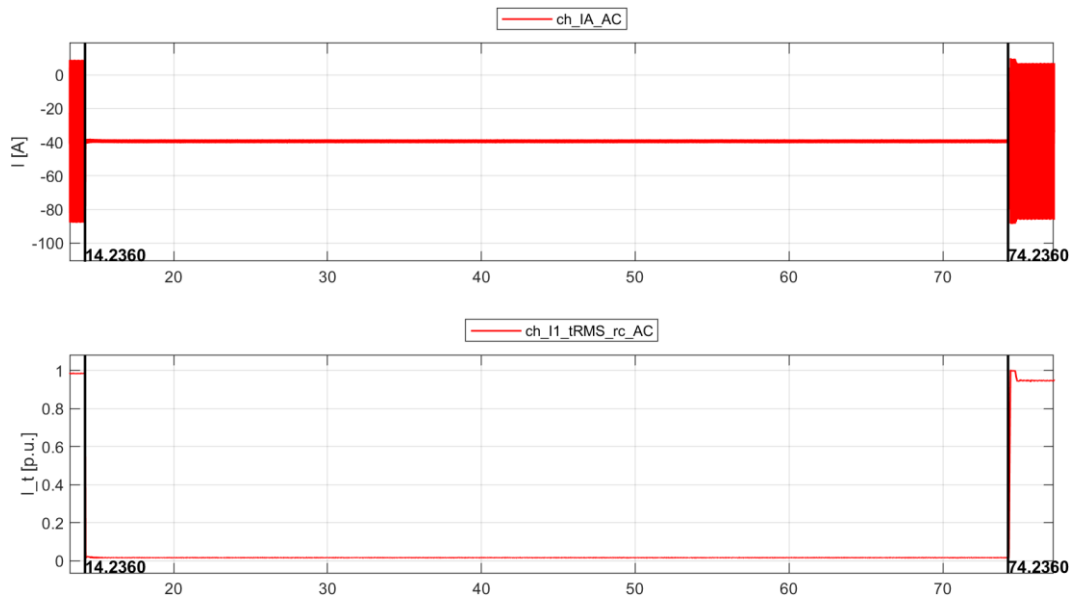


**Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**

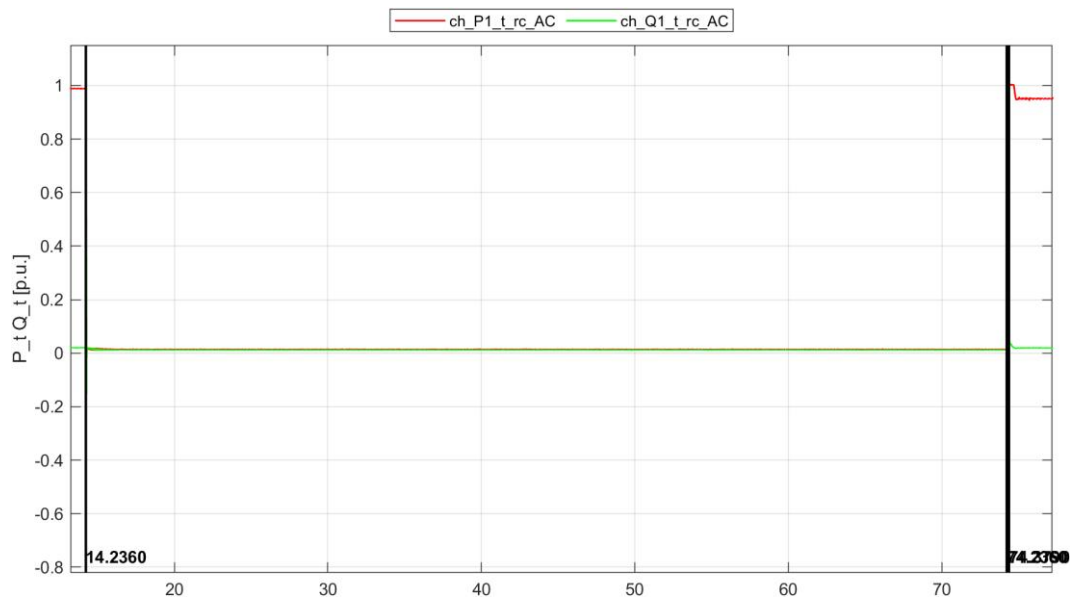


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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

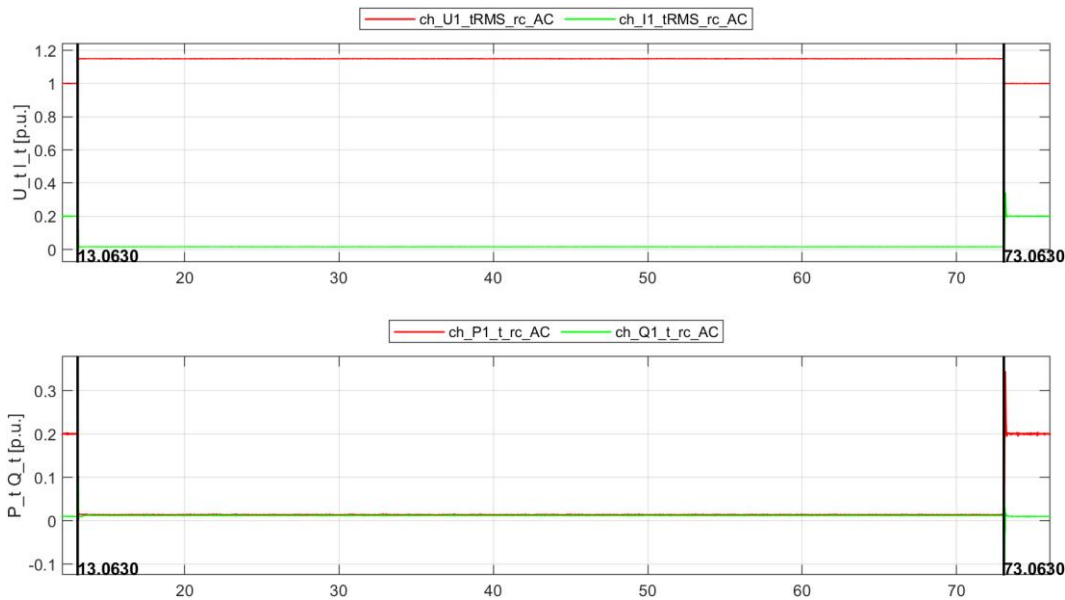


Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load, Power restore

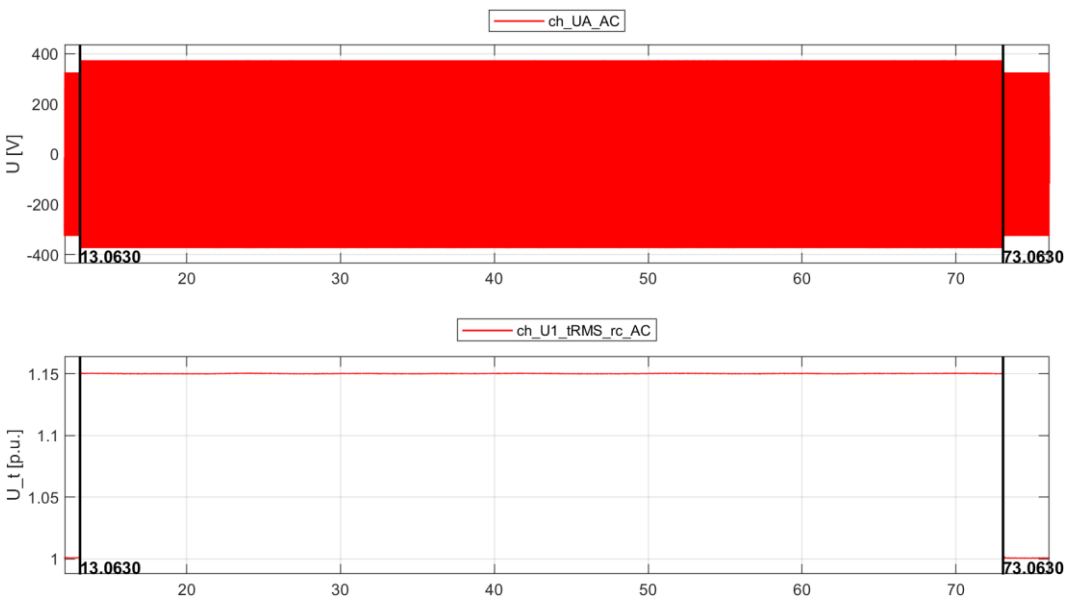


Clause	Requirement - Test	Result - Remark	Verdict
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**Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

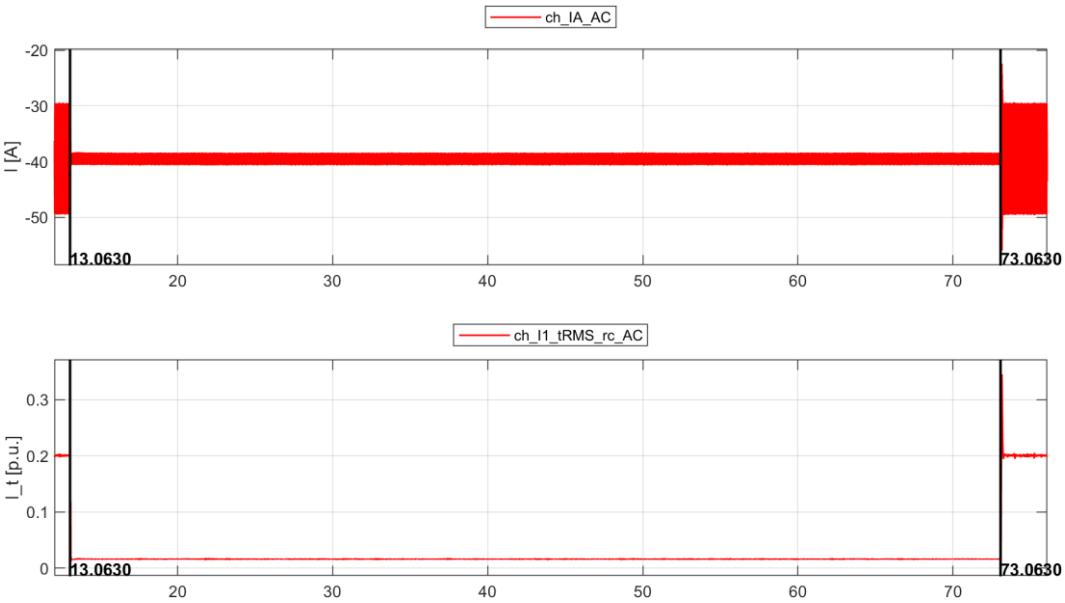


**Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

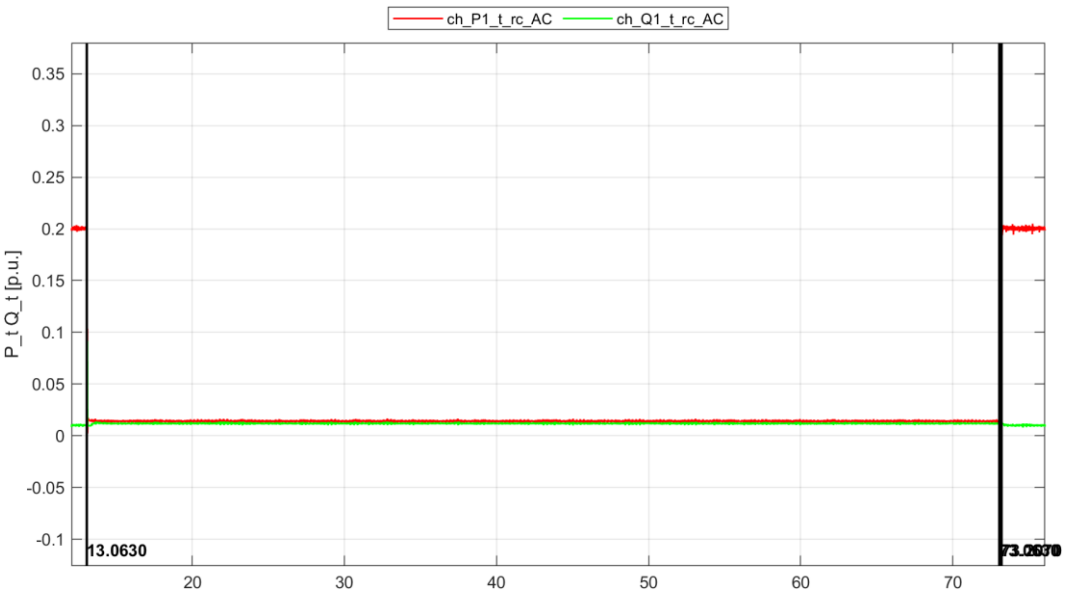


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load, Power restore



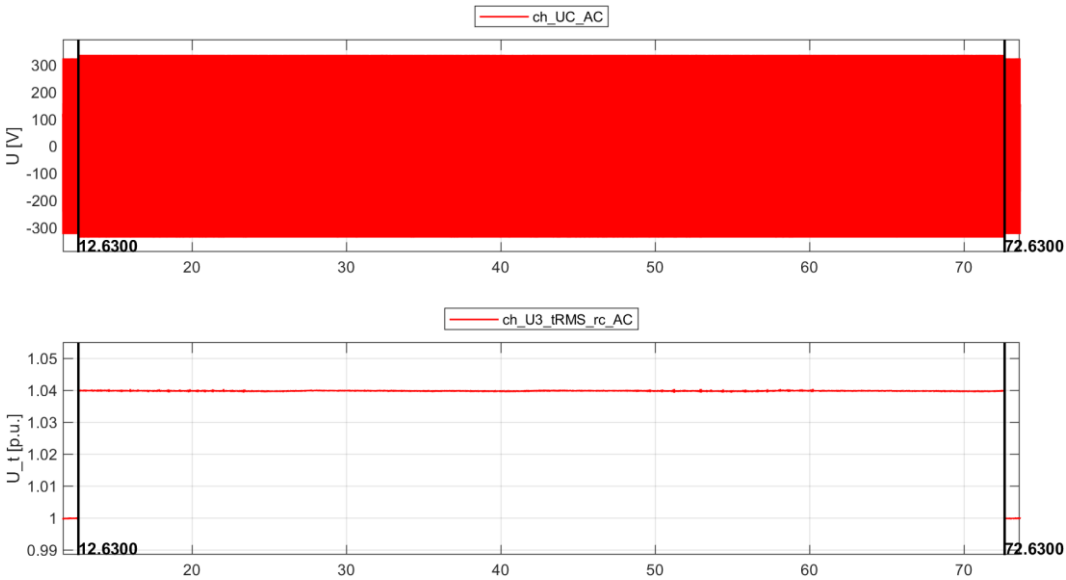
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	6.3	6.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	10:34:33.3	10:30:28.7
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.15	1.15
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry(t_1)	Total	--	ms	12752	12970
	7	Point of fault clearance(t_2)	Total	--	ms	72752	72970
	8	Fault duration in empty load test	Total	--	ms	60000	60000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.040	1.040
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.988	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.043	1.041
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.931	0.187
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.953	0.190
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.973	0.198
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.968	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.052
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.019	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

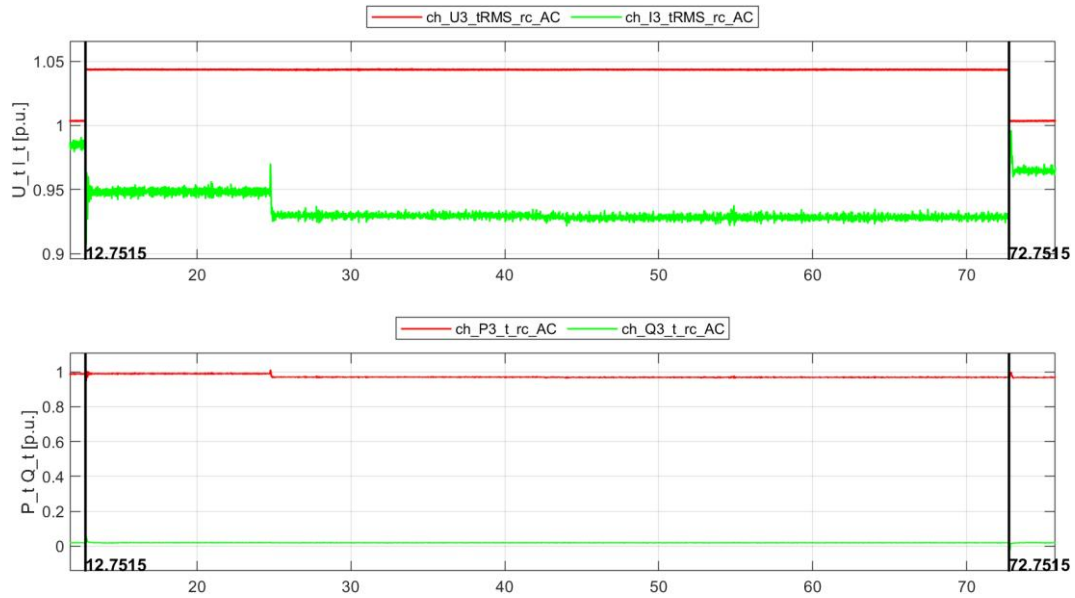
Test 6.0d1 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 0% load,
Instantaneous and RMS values of phase voltages



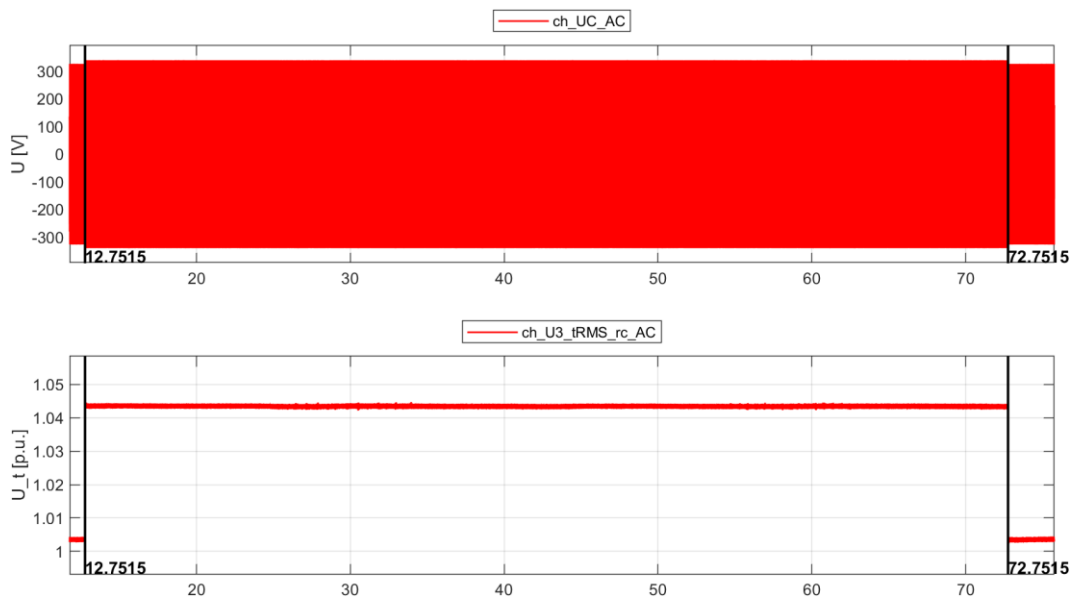
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**

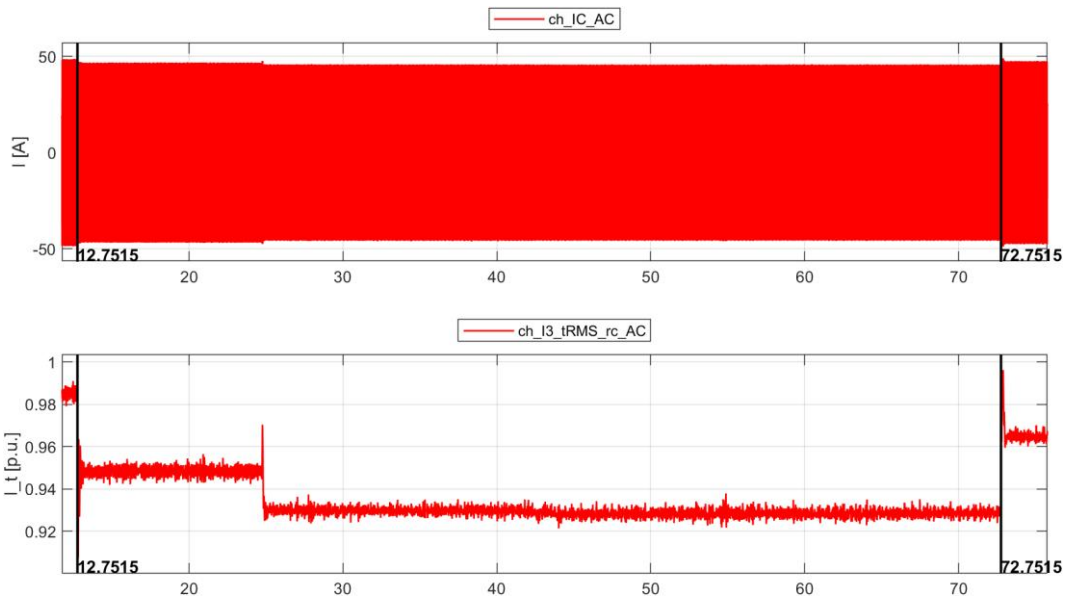


**Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**

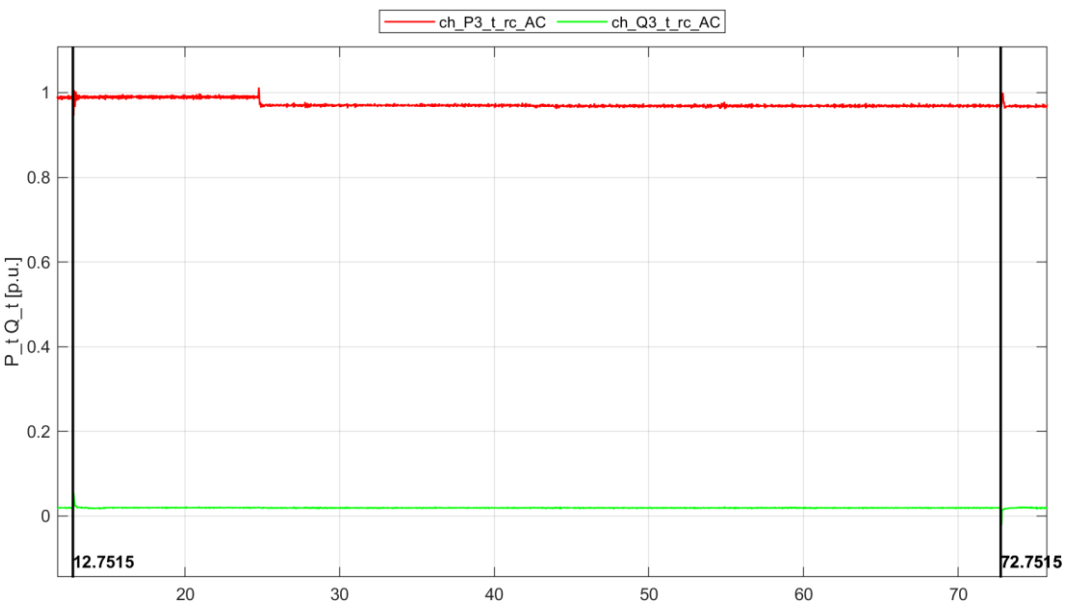


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



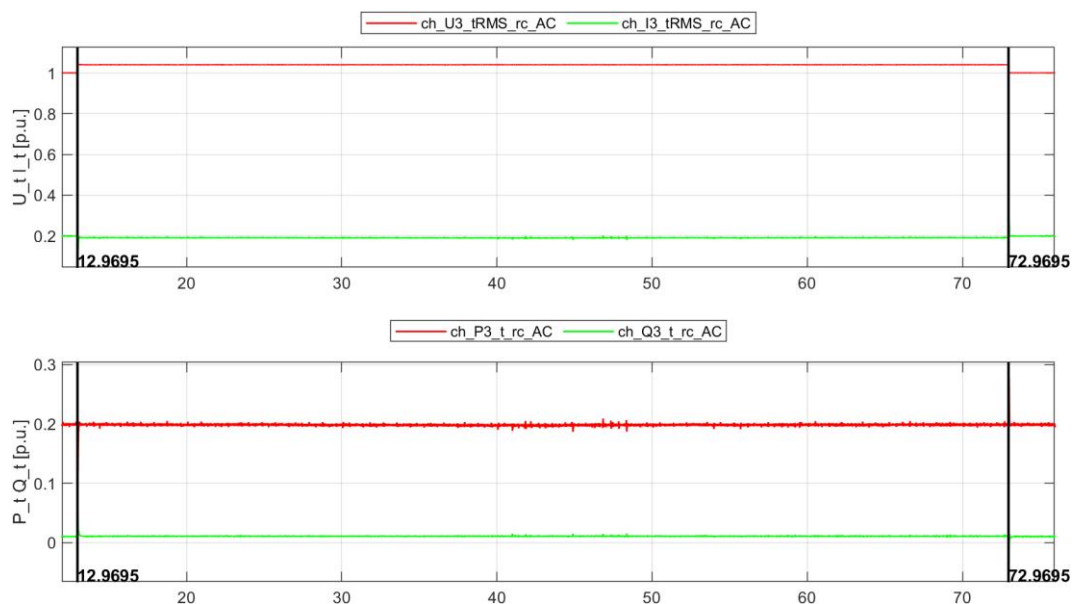
Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load, Power restore



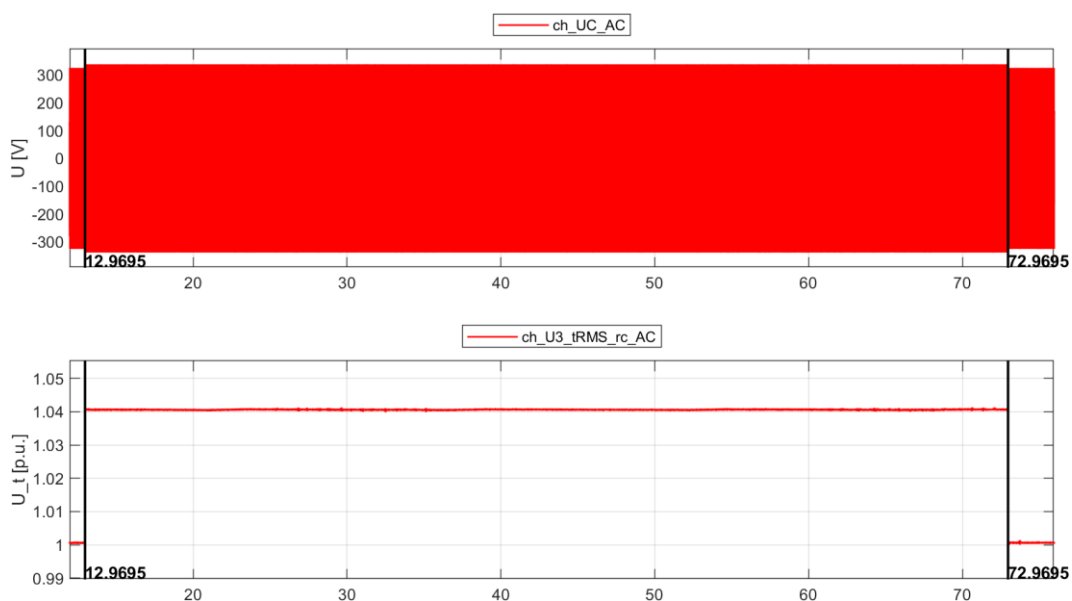
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

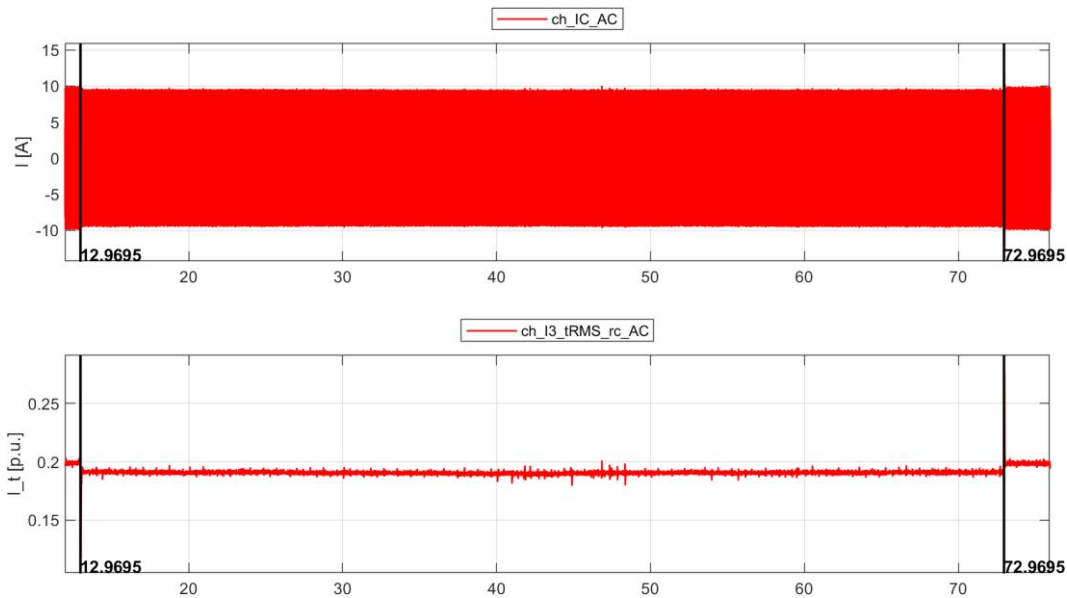


**Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

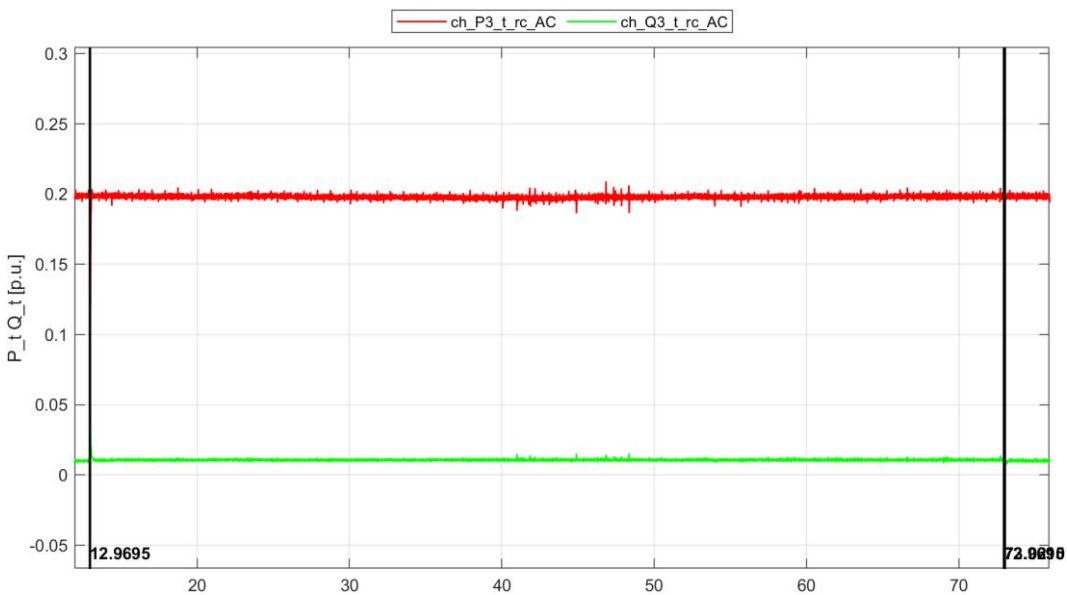


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load, Power restore



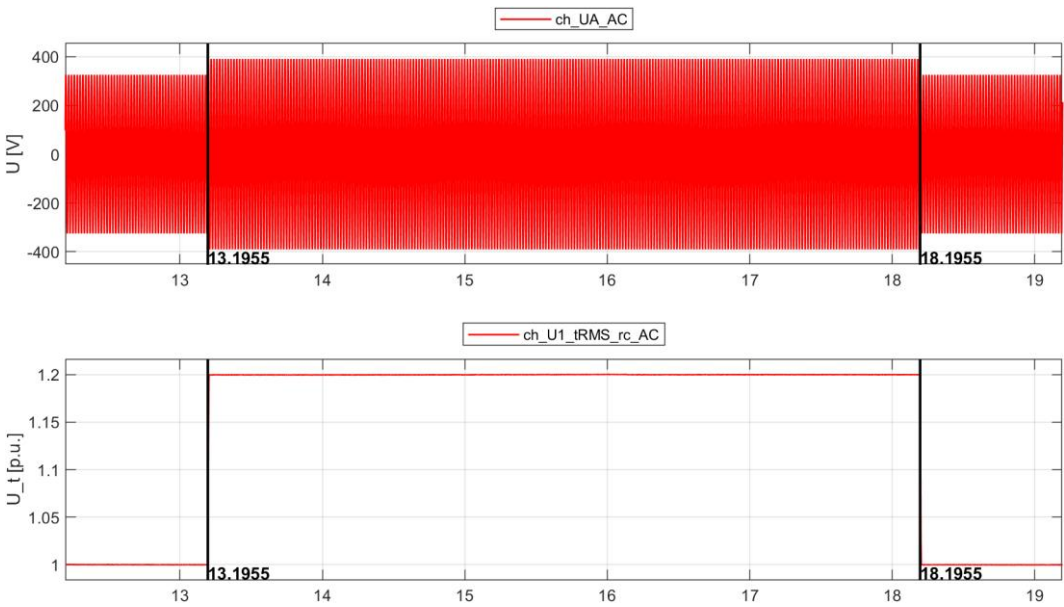
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	7.1	7.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:35:28.1	09:57:44.2
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.20	1.20
	5	Setting dip duration		--	--	5000	5000
	6	Point of fault entry(t_1)	Total	--	ms	13120	13190
	7	Point of fault clearance(t_2)	Total	--	ms	18120	18190
	8	Fault duration in empty load test	Total	--	ms	5000	5000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.200	1.200
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.986	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.990	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.200	1.200
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.017	0.022
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.019	0.018
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.010	0.010
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.990	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.130	0.164
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

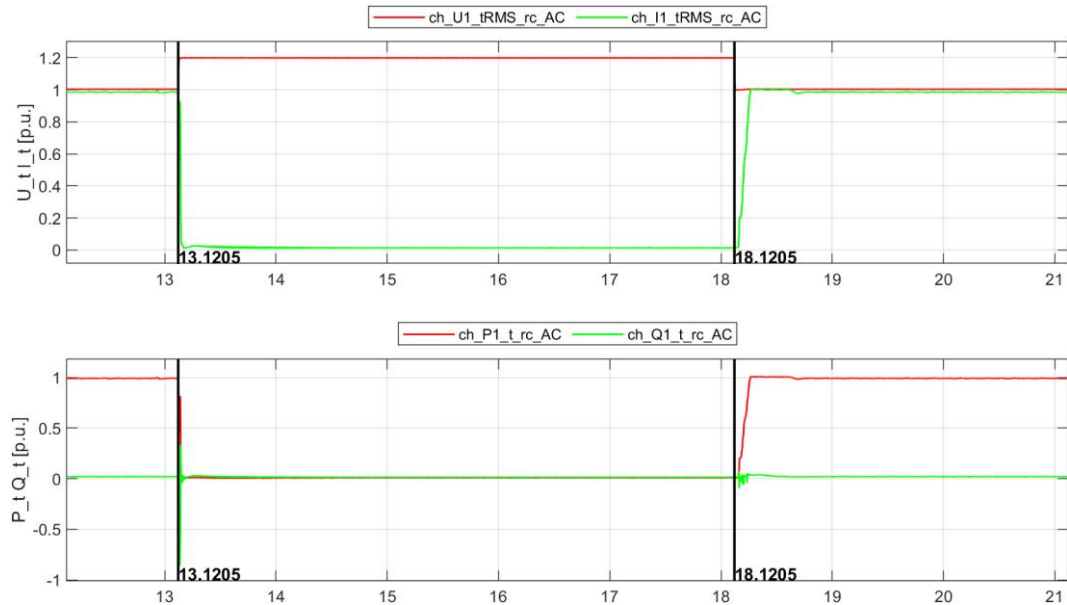
**Test 7.0a Depth of fault phase: 1.20 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



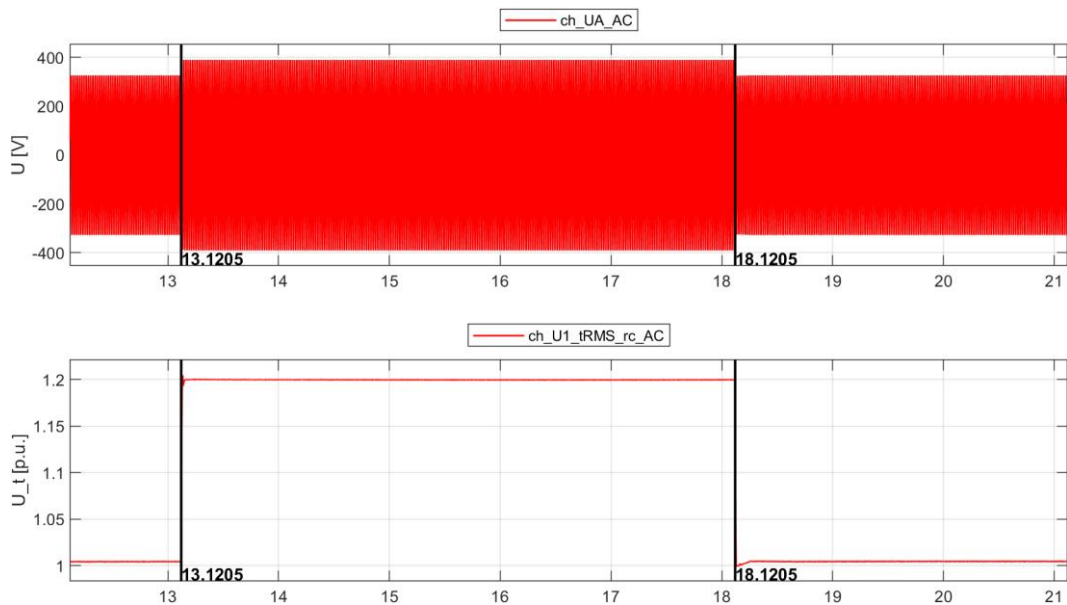
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



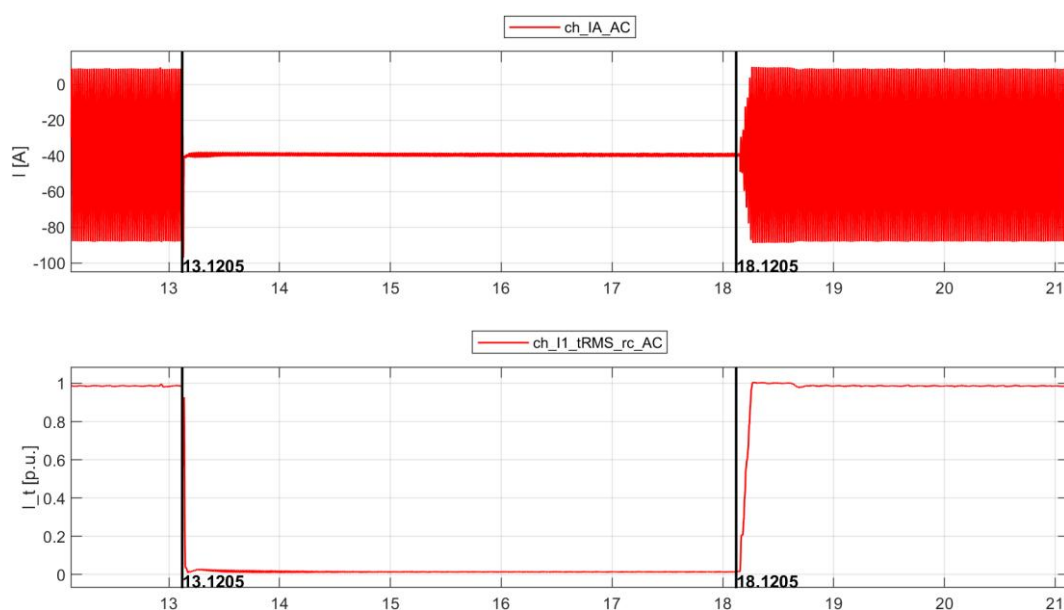
**Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



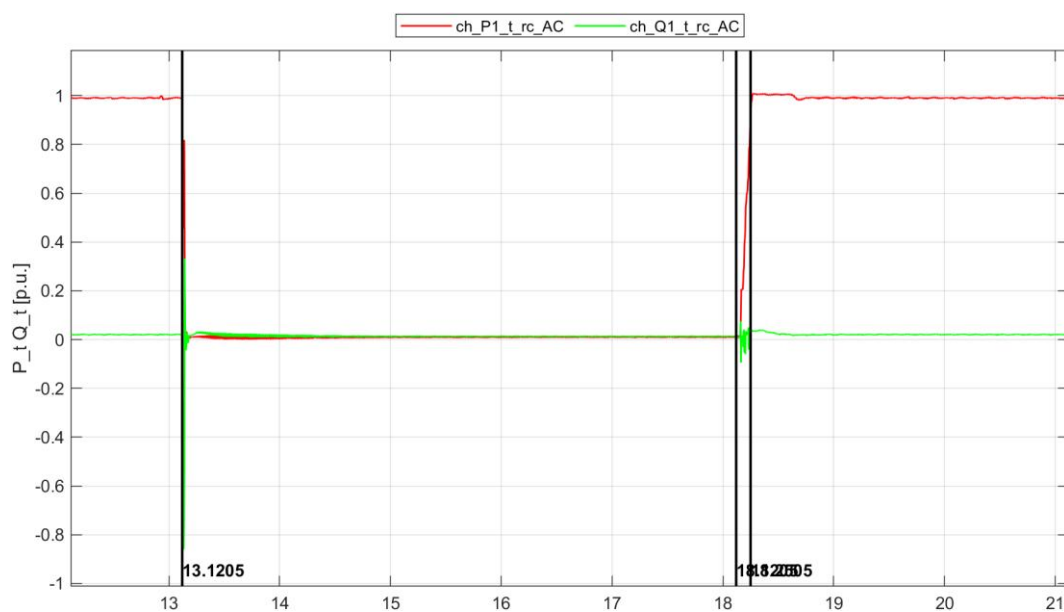
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



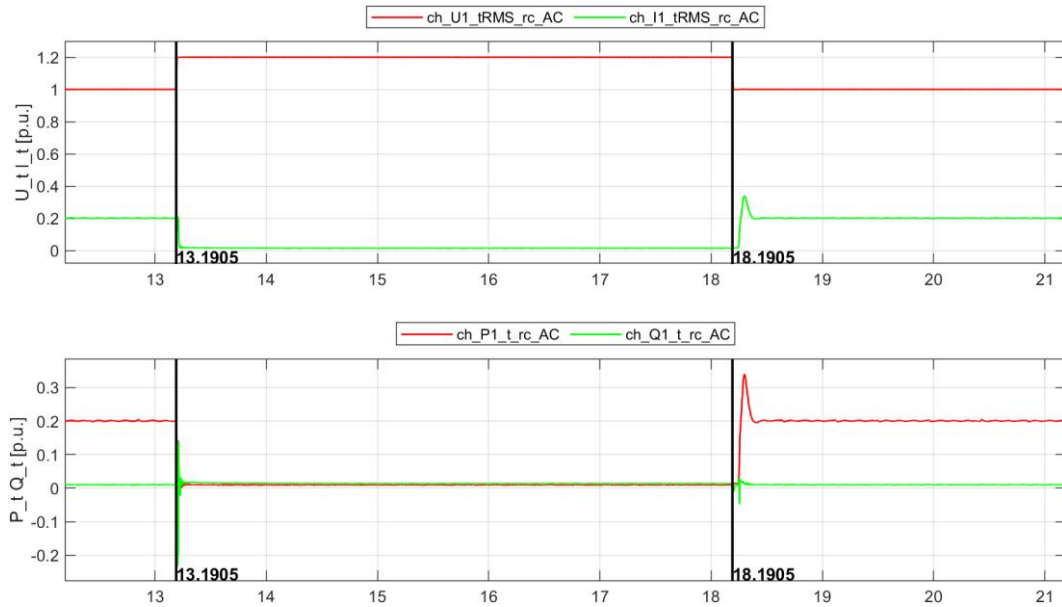
Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load, Power restore



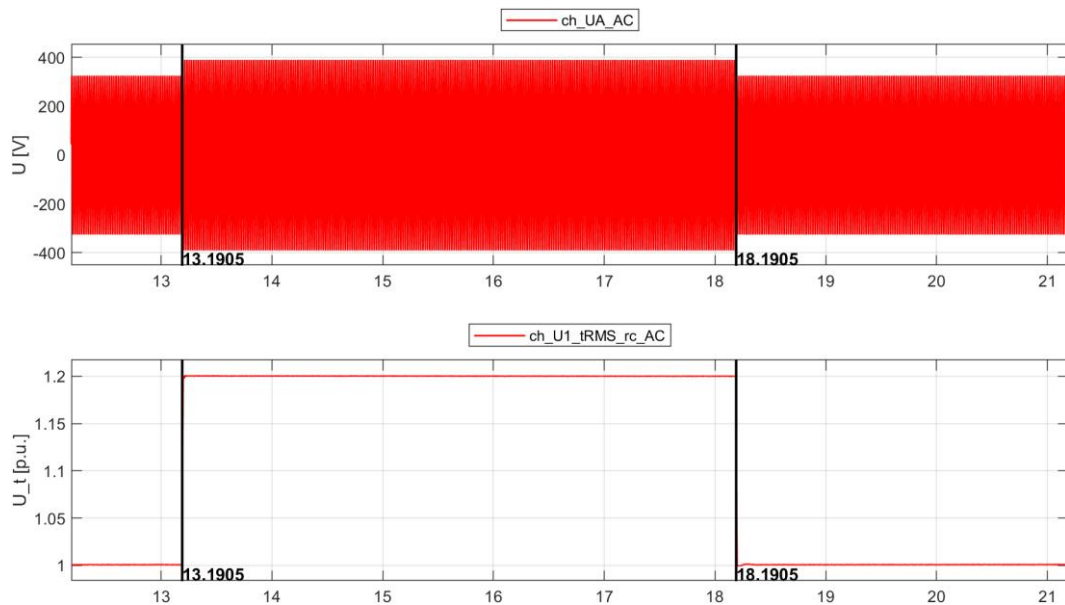
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**

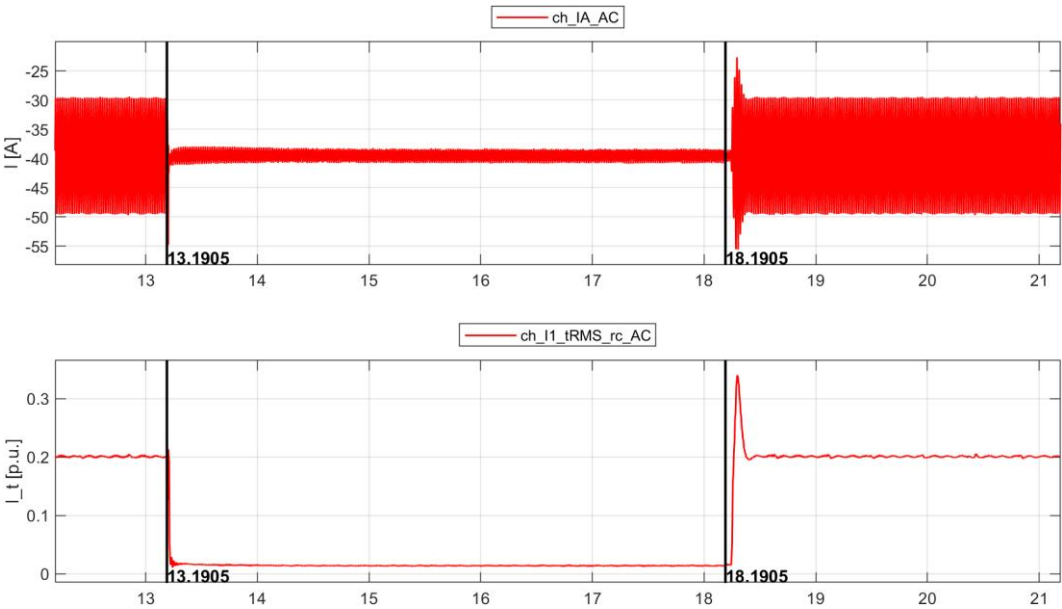


**Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**

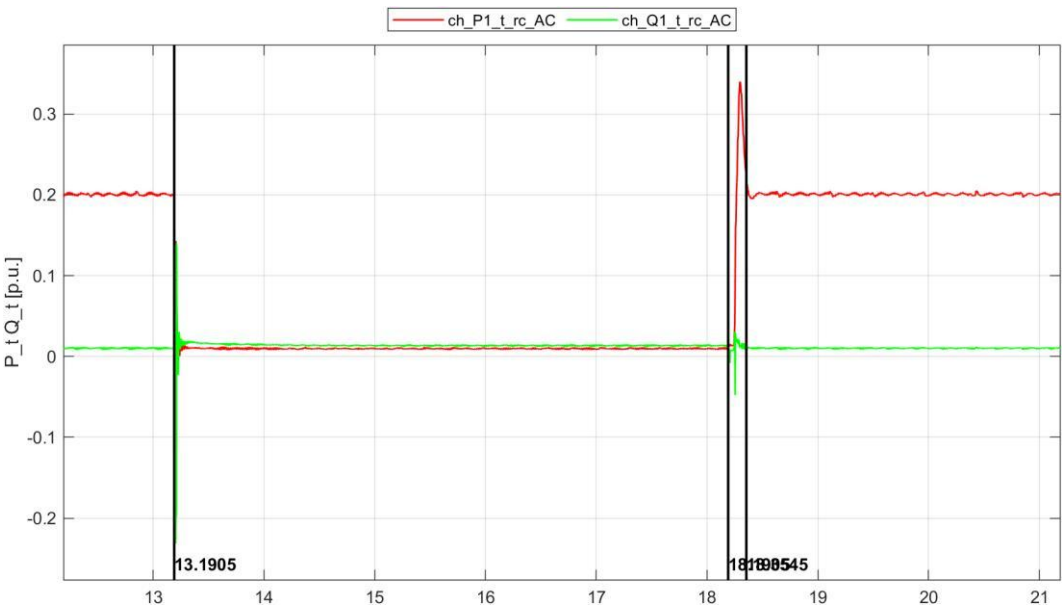


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load, Power restore



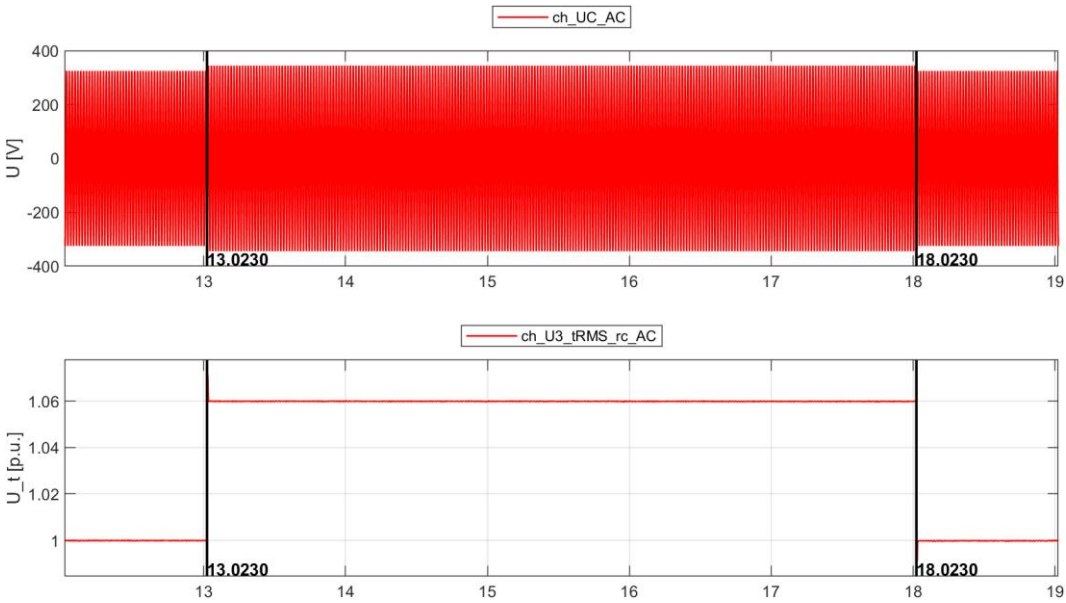
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	7.3	7.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	10:40:46.3	10:43:27.7
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.20	1.20
	5	Setting dip duration		--	--	5000	5000
	6	Point of fault entry(t_1)	Total	--	ms	14130	13022
	7	Point of fault clearance(t_2)	Total	--	ms	19130	18022
	8	Fault duration in empty load test	Total	--	ms	5000	5000
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.060	1.060
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.984	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.988	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.064	1.061
	19	Line current	Phase 1	t1+60ms	p.u.	0.913	0.160
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.930	0.192
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.989	0.199
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.988	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.063
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

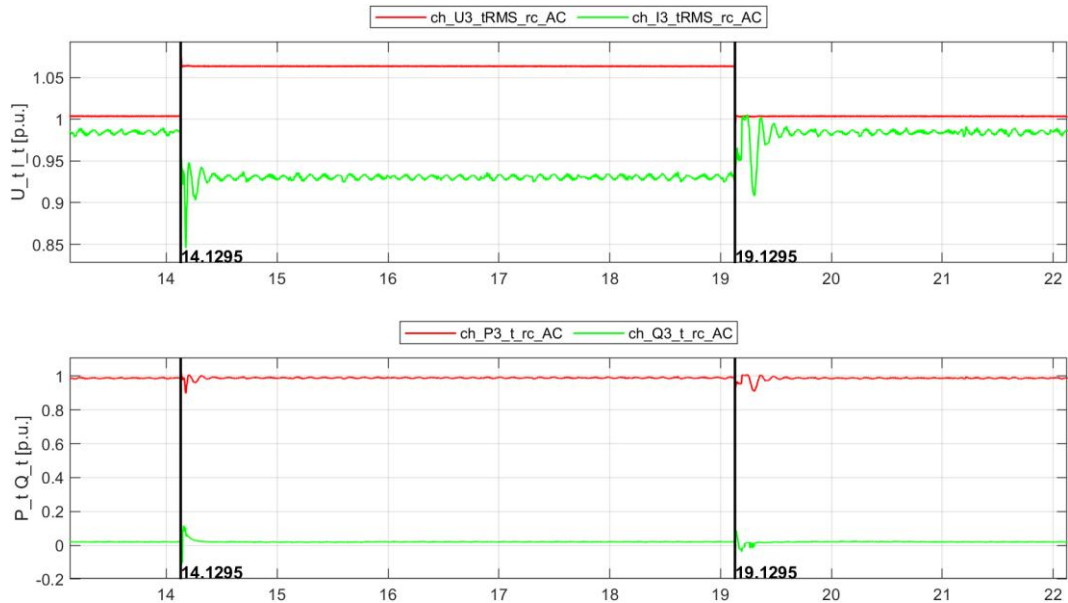
Test 7.0d1 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



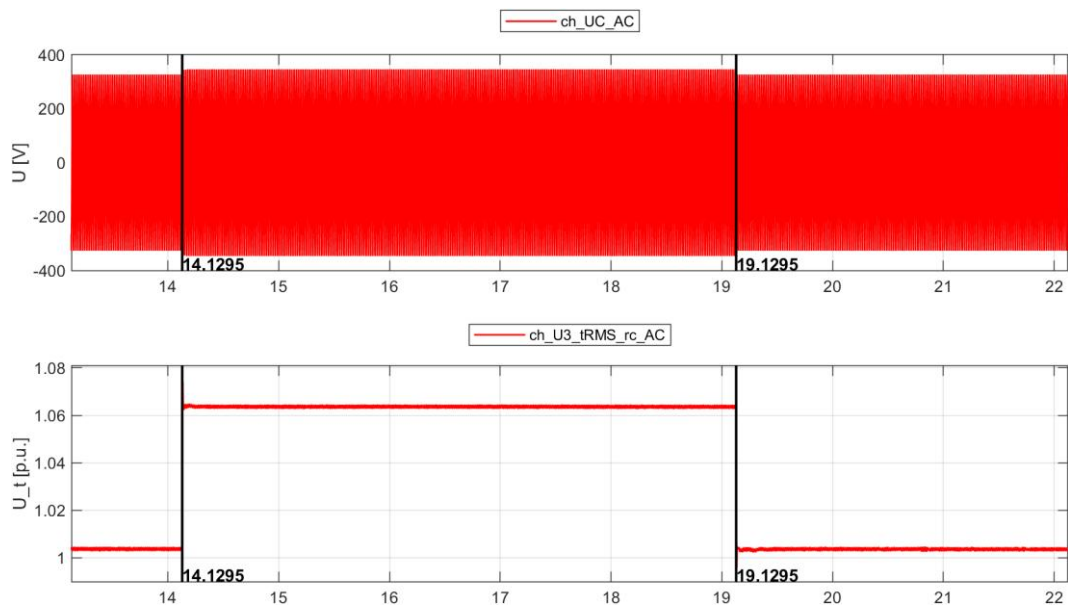
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



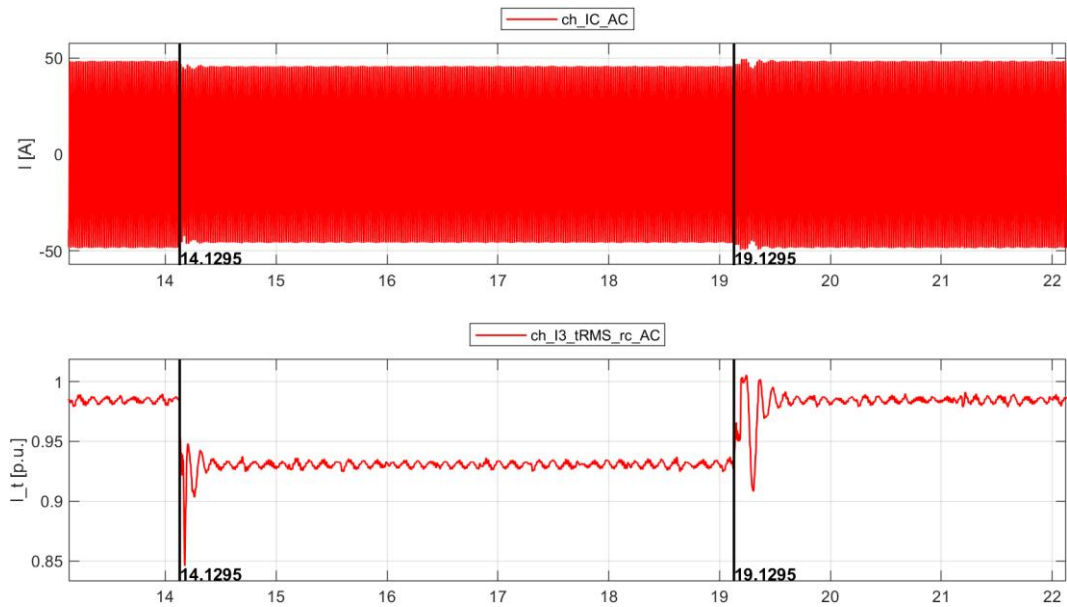
**Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



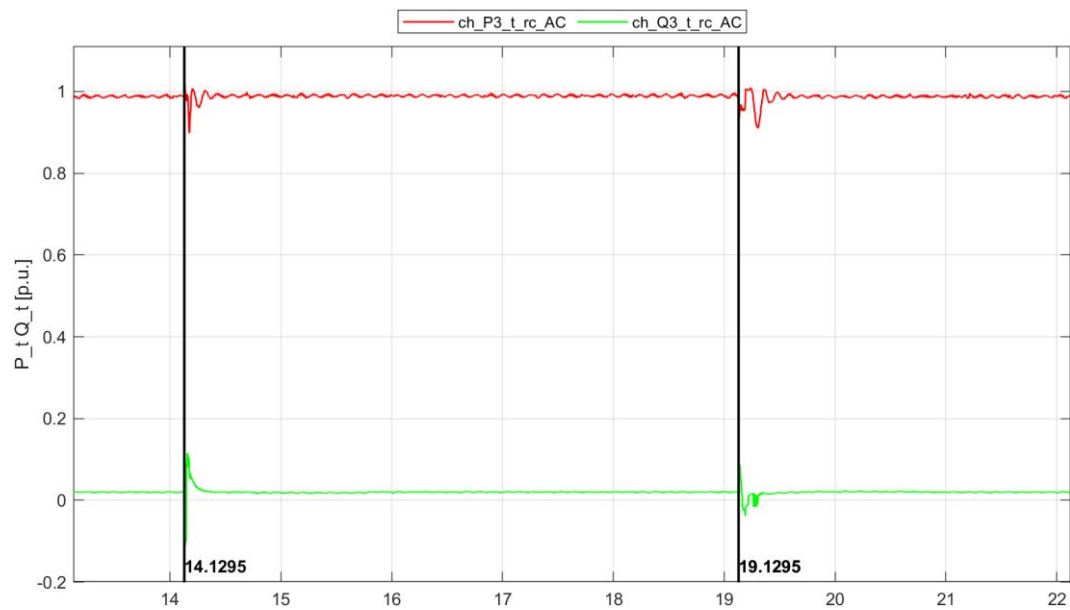
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



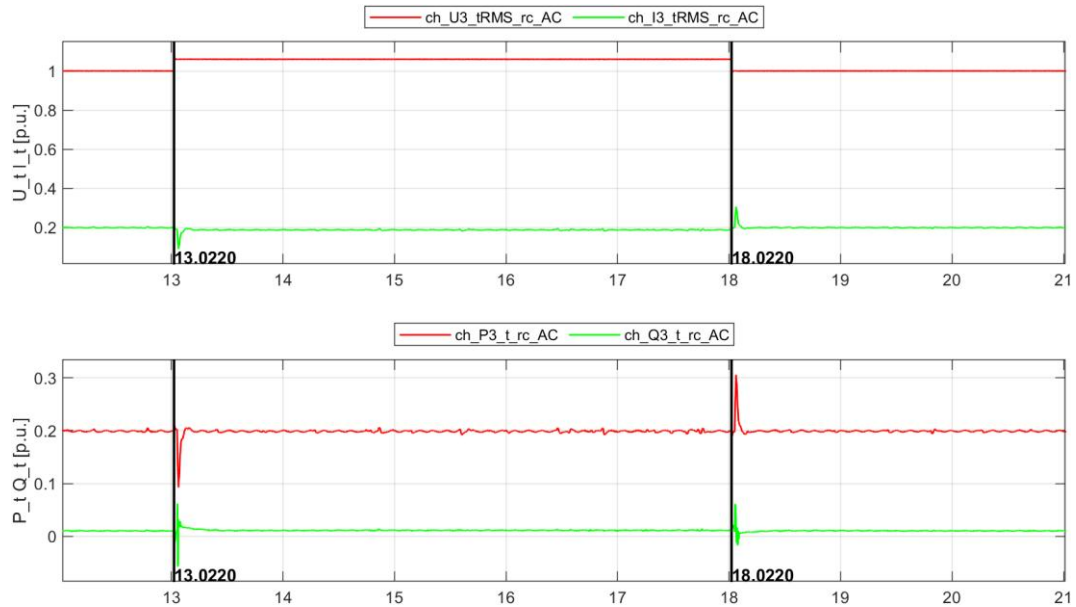
Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load, Power restore



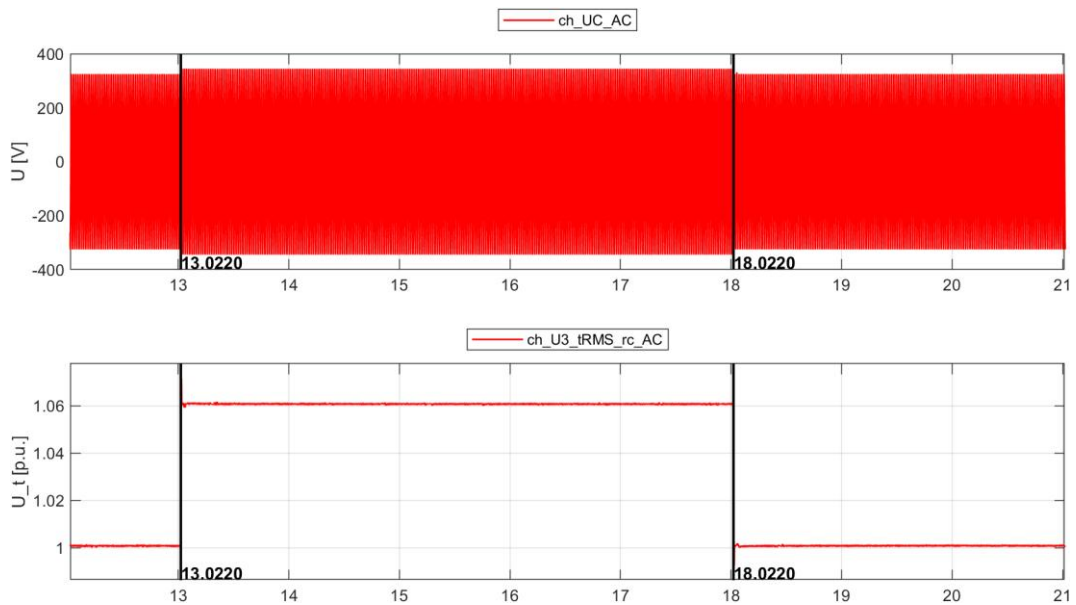
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

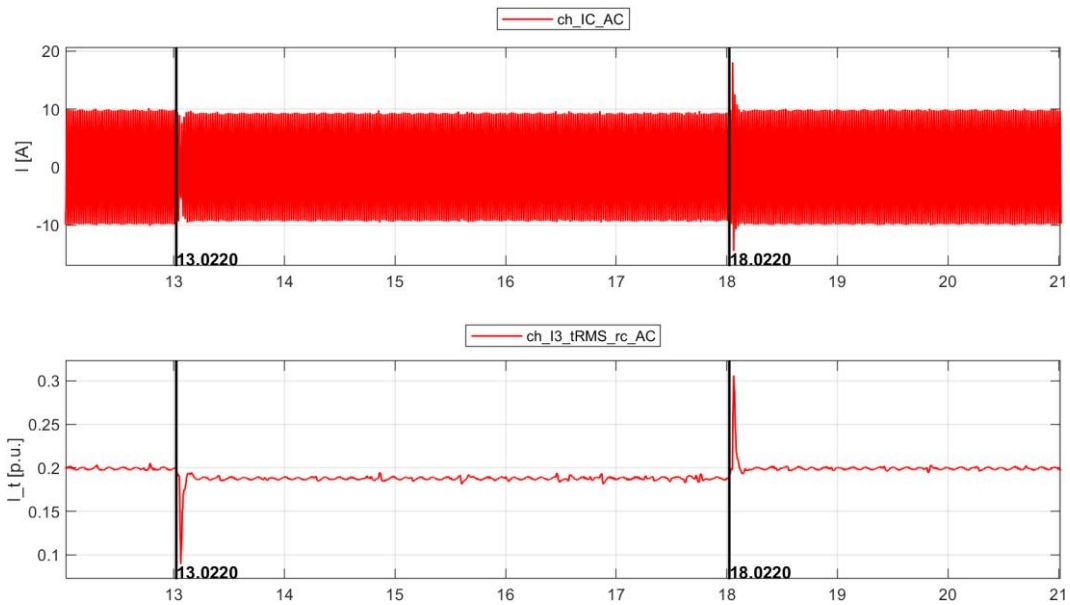


**Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

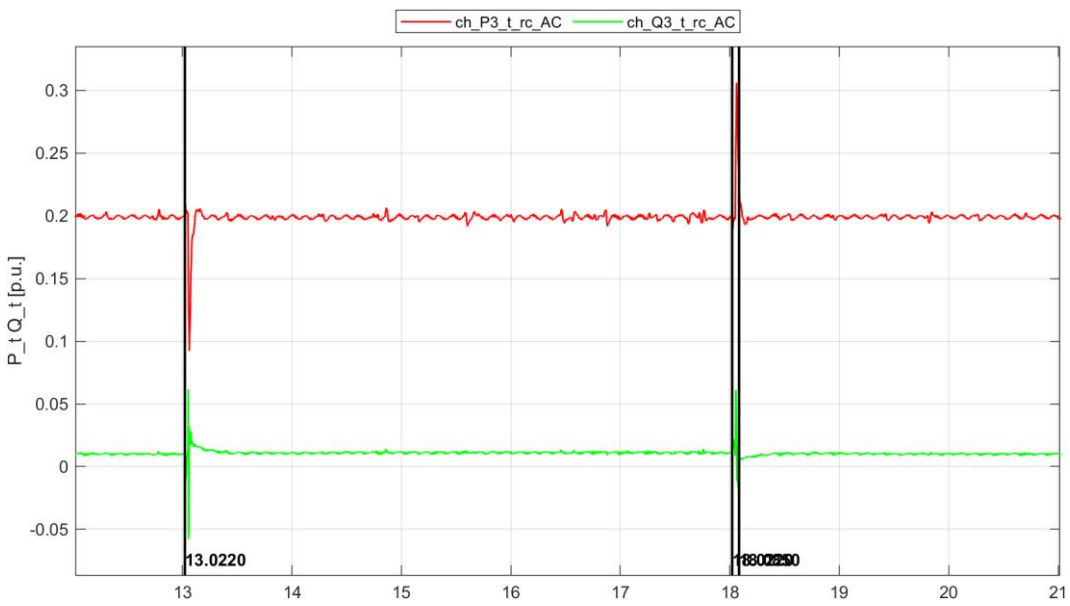


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load, Power restore



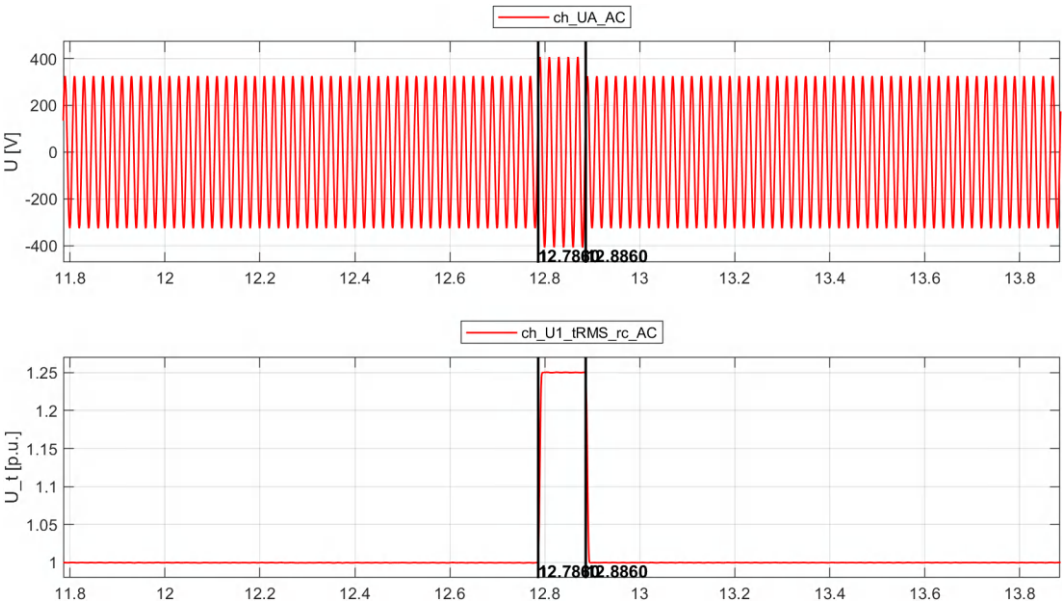
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.1	8.2
	1	Date	--	--	yyyy.mm.dd	2025.12.02	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:38:42.1	10:00:39.2
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t_1)	Total	--	ms	13968	13207
	7	Point of fault clearance(t_2)	Total	--	ms	14068	13308
	8	Fault duration in empty load test	Total	--	ms	100	100
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.245	1.245
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.985	0.201
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.989	0.201
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.250	1.250
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.022	0.019
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.027	0.019
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.006	0.005
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.989	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.144	0.166
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

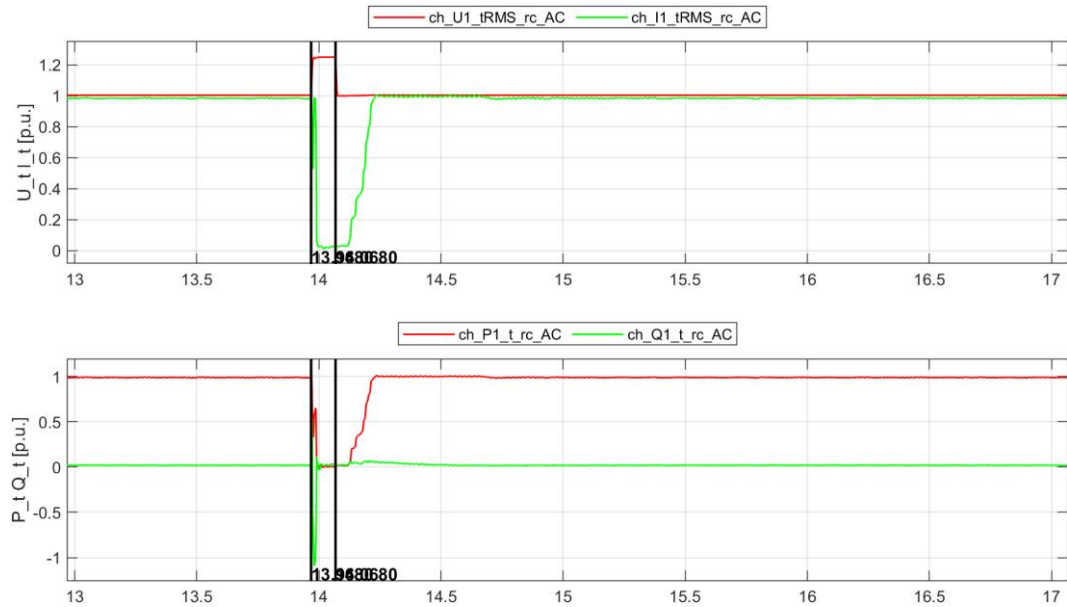
**Test 8.0a Depth of fault phase: 1.25 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



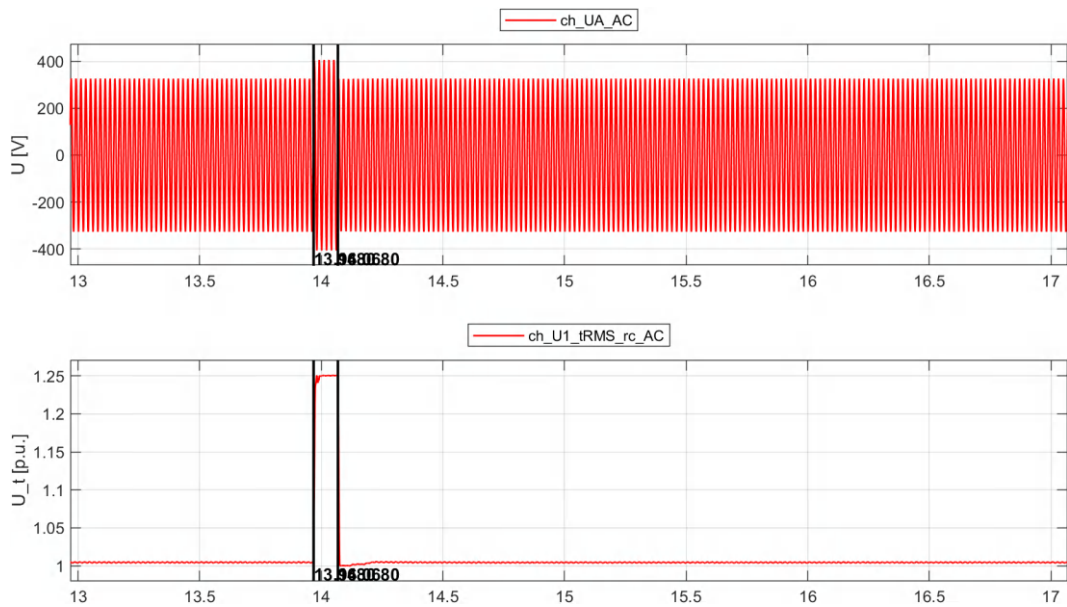
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



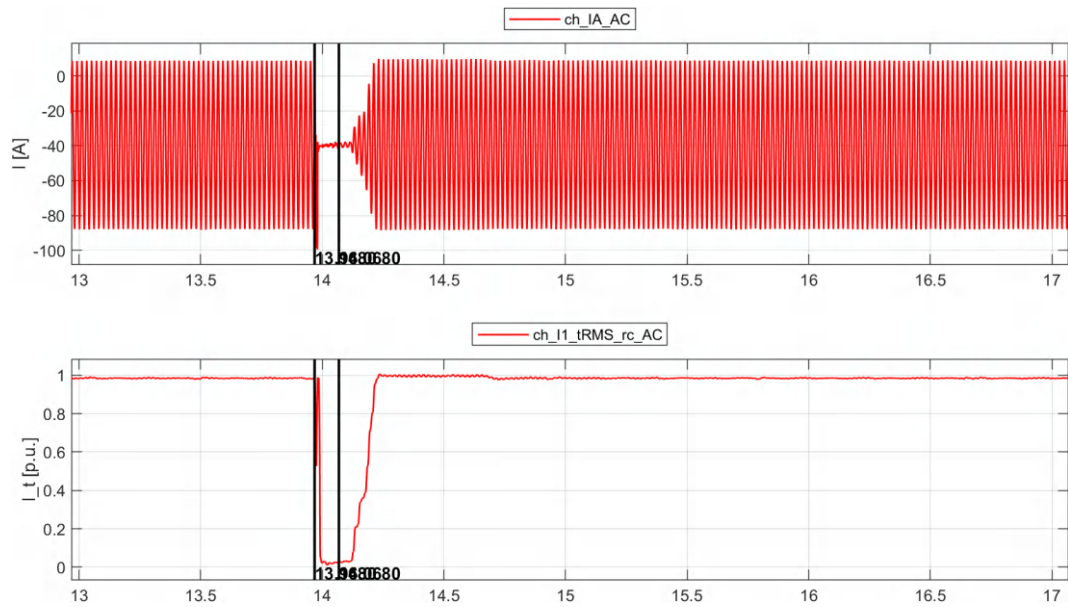
**Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



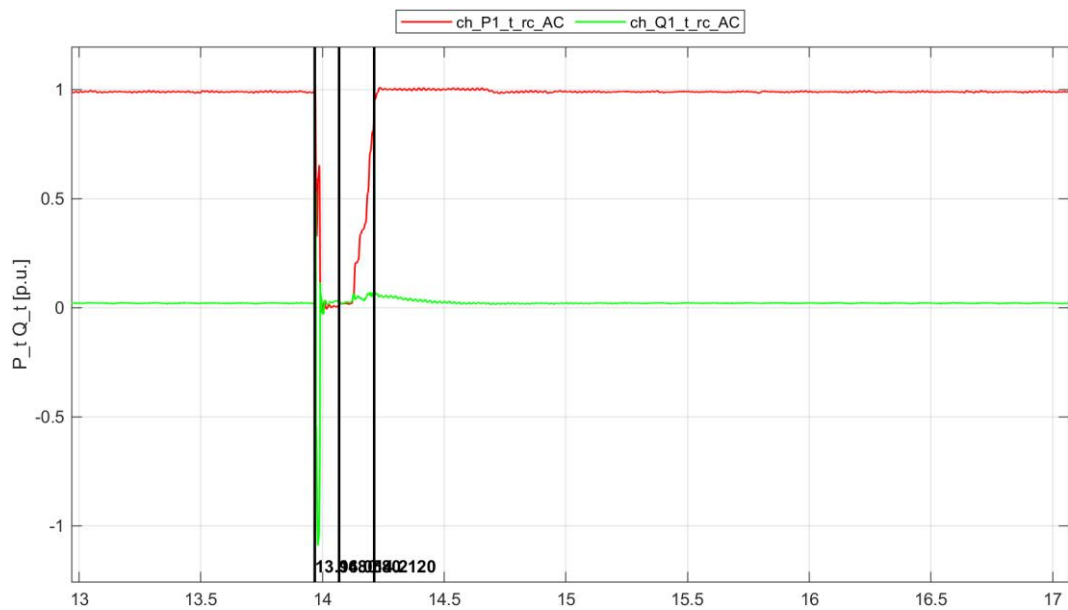
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



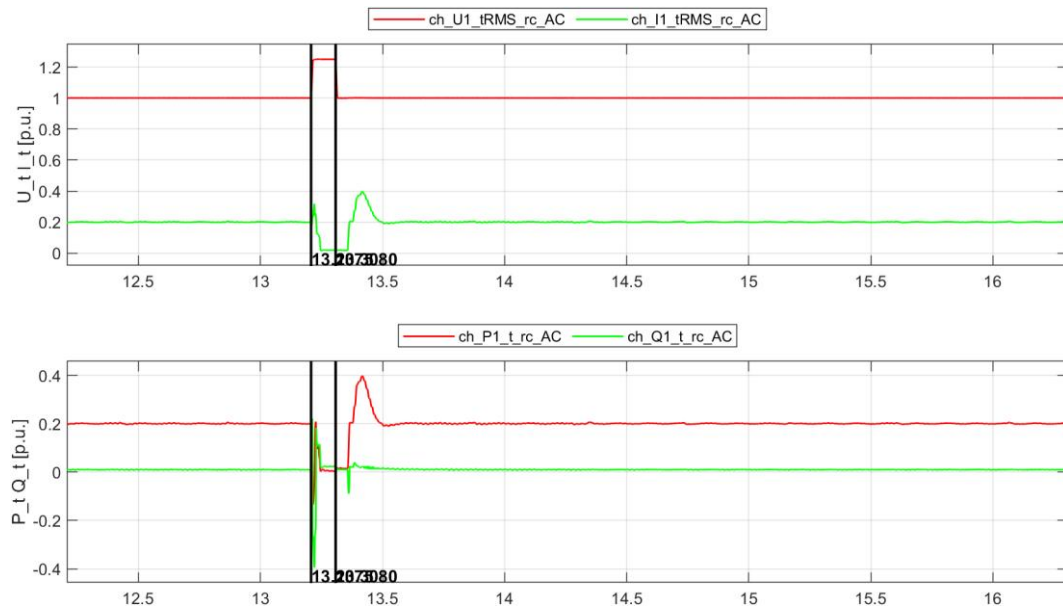
Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load, Power restore



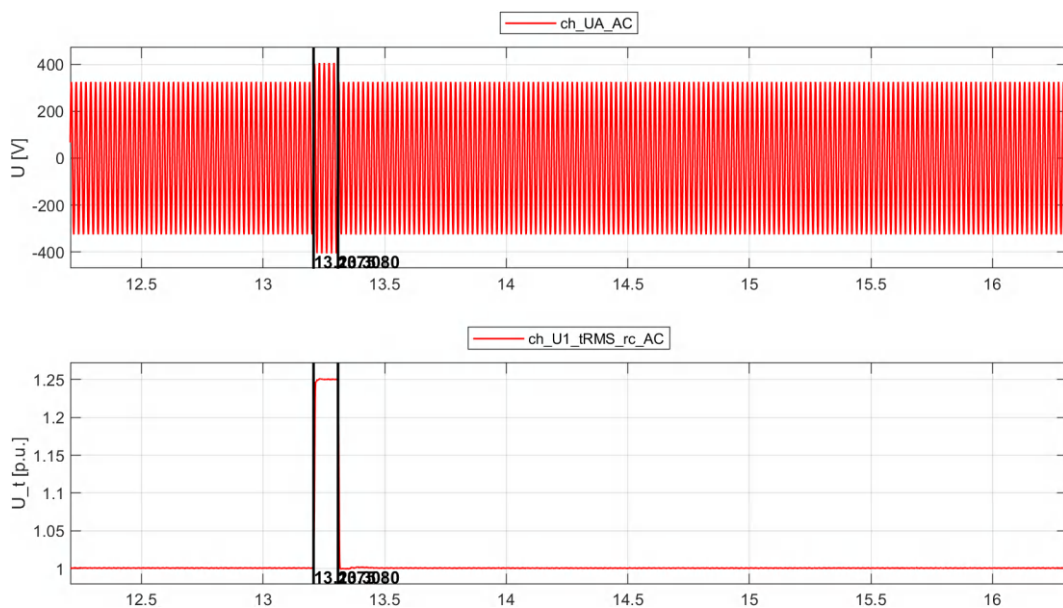
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



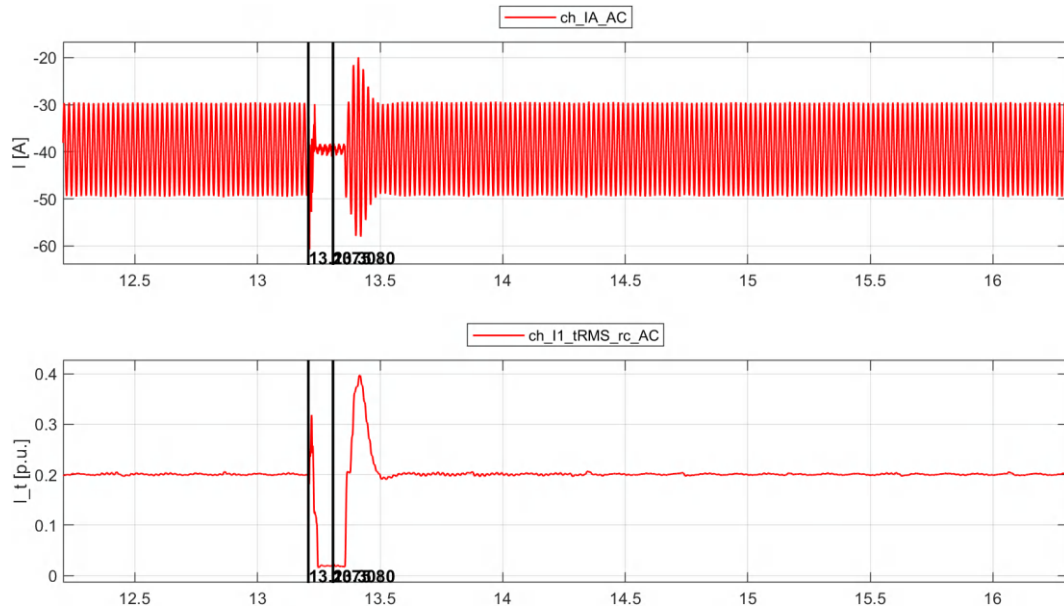
**Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



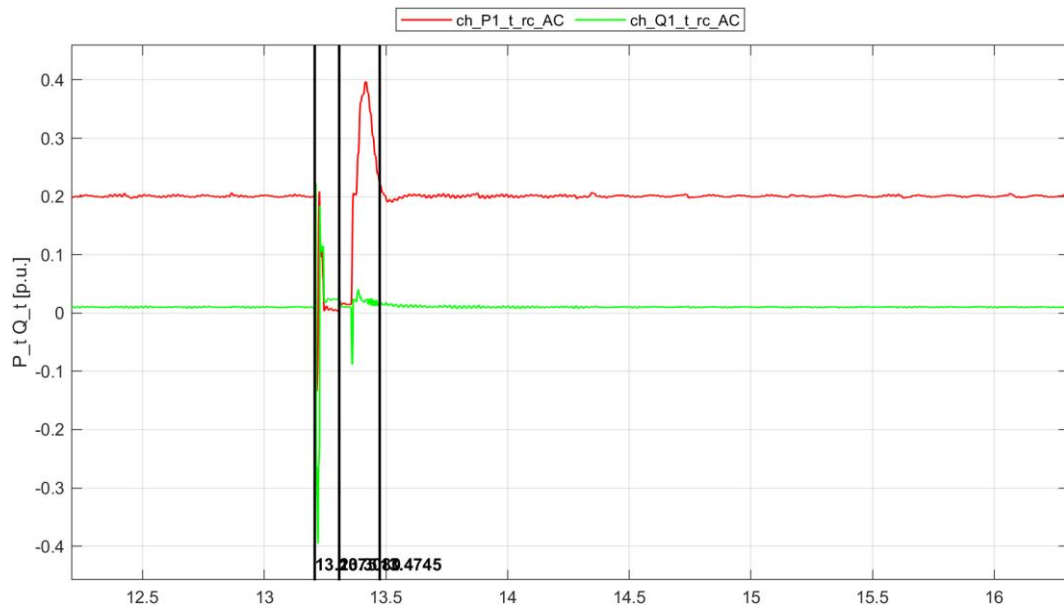
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load, Power restore



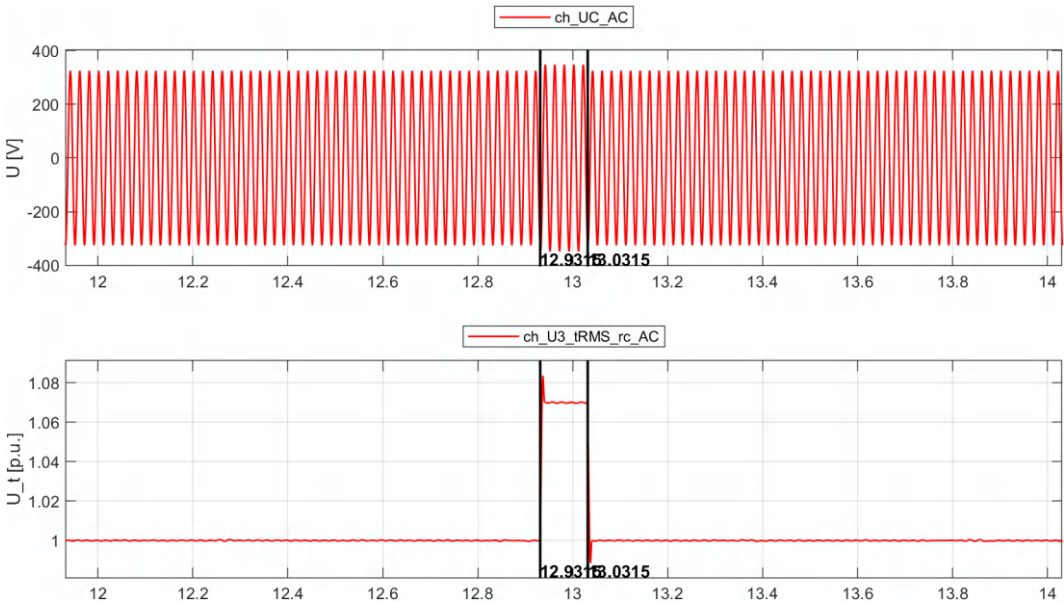
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.3	8.4
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	10:56:34.0	10:53:58.3
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t ₁)	Total	--	ms	12512	12750
	7	Point of fault clearance(t ₂)	Total	--	ms	12612	12850
	8	Fault duration in empty load test	Total	--	ms	100	100
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.069	1.069
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.987	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.990	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.073	1.071
	19	Line current	Phase 1	t1+60ms	p.u.	0.897	0.174
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.908	0.193
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	1.002	0.193
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.991	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.053
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

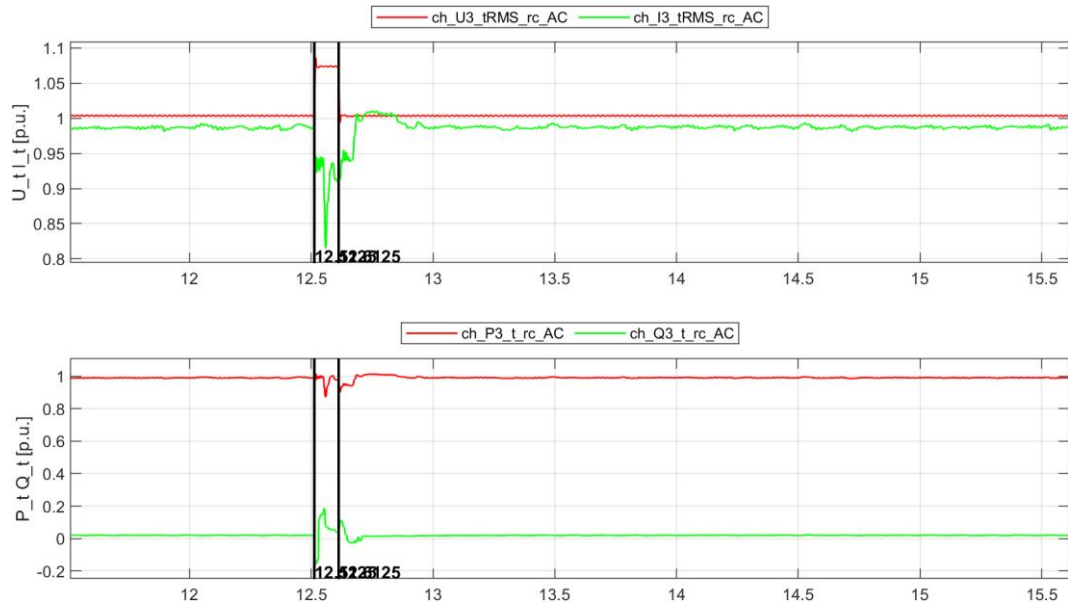
Test 8.0d1 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



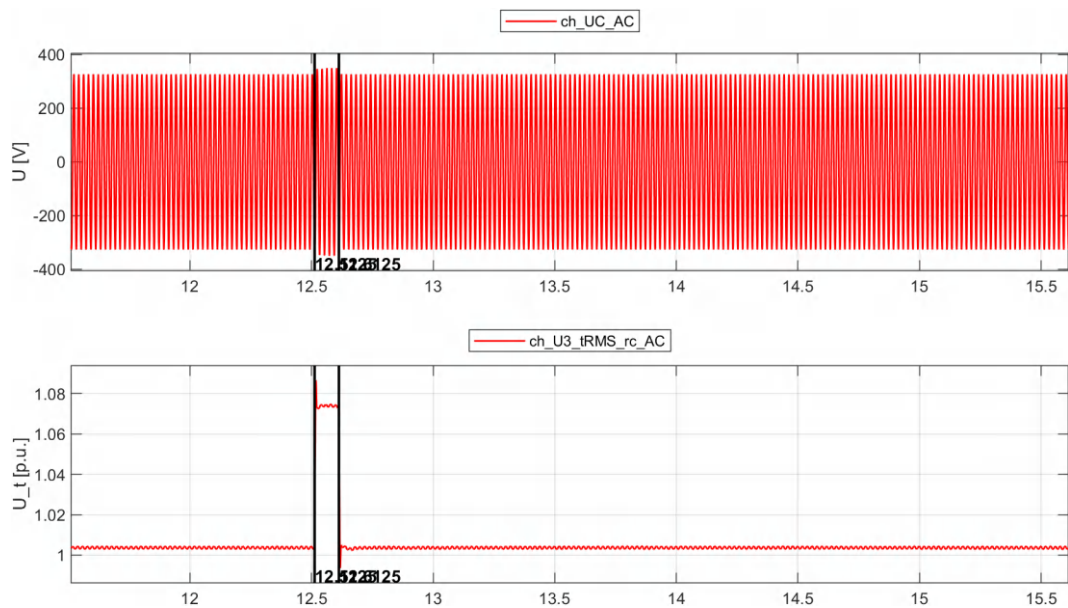
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



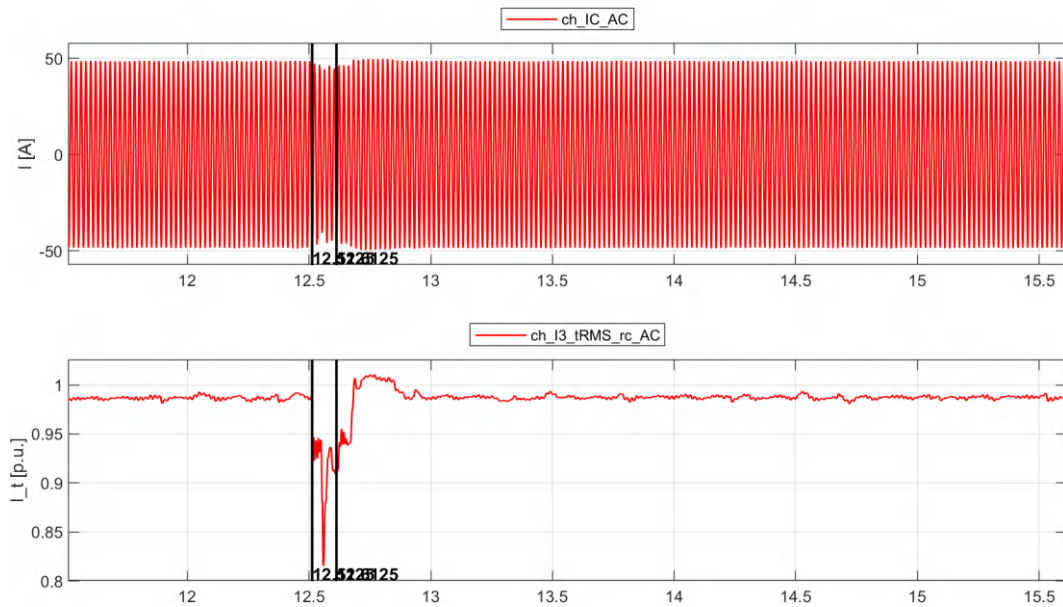
**Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



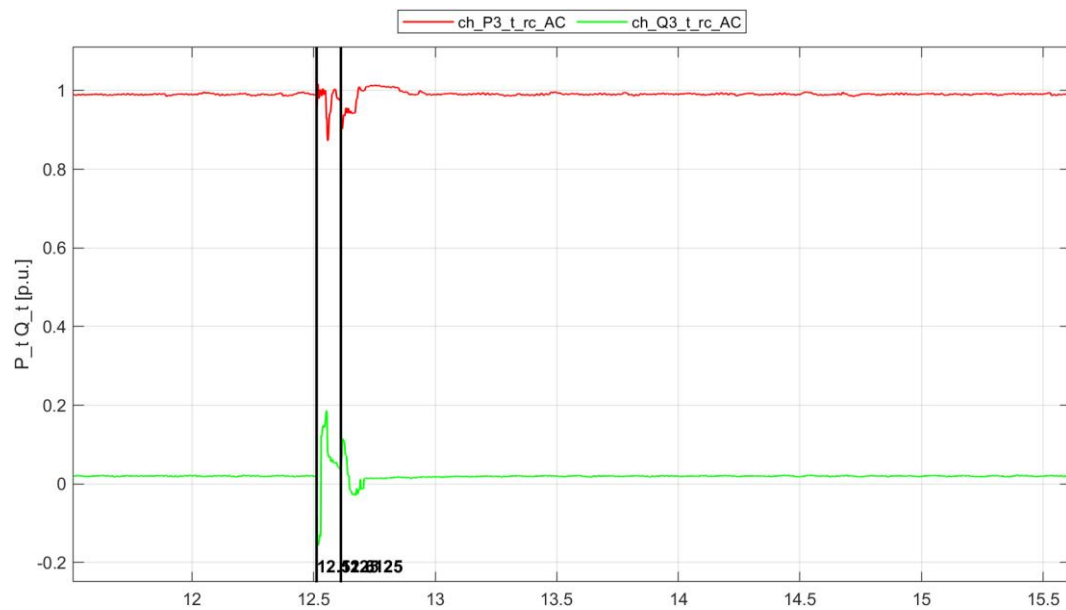
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



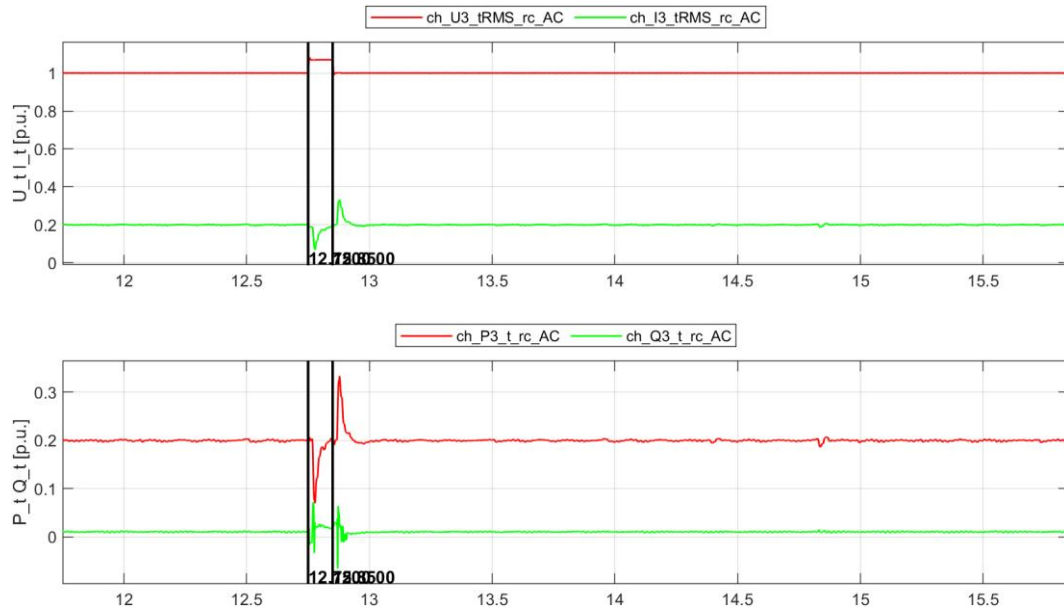
Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load, Power restore



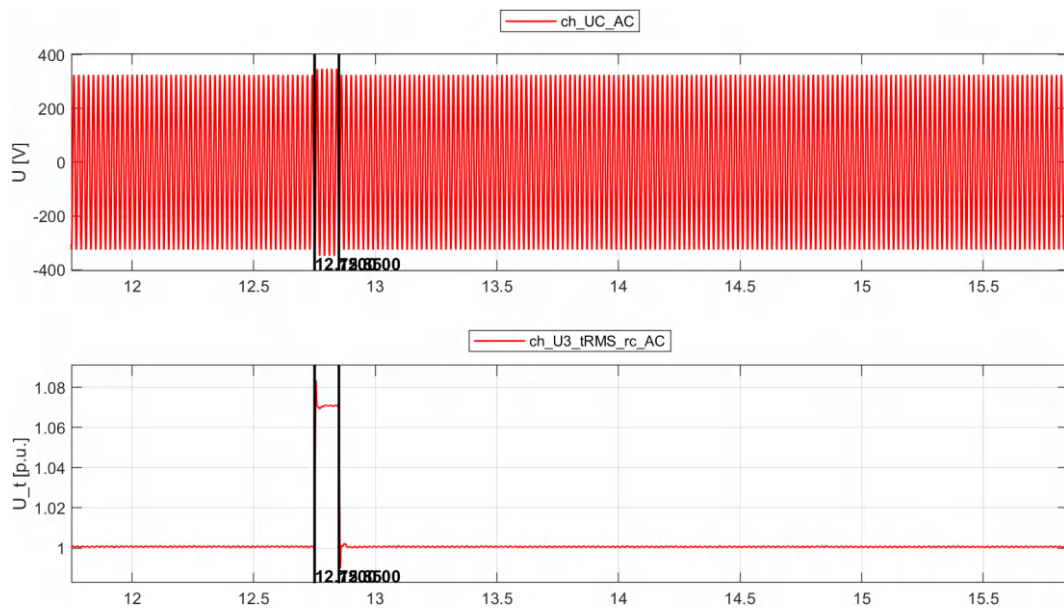
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



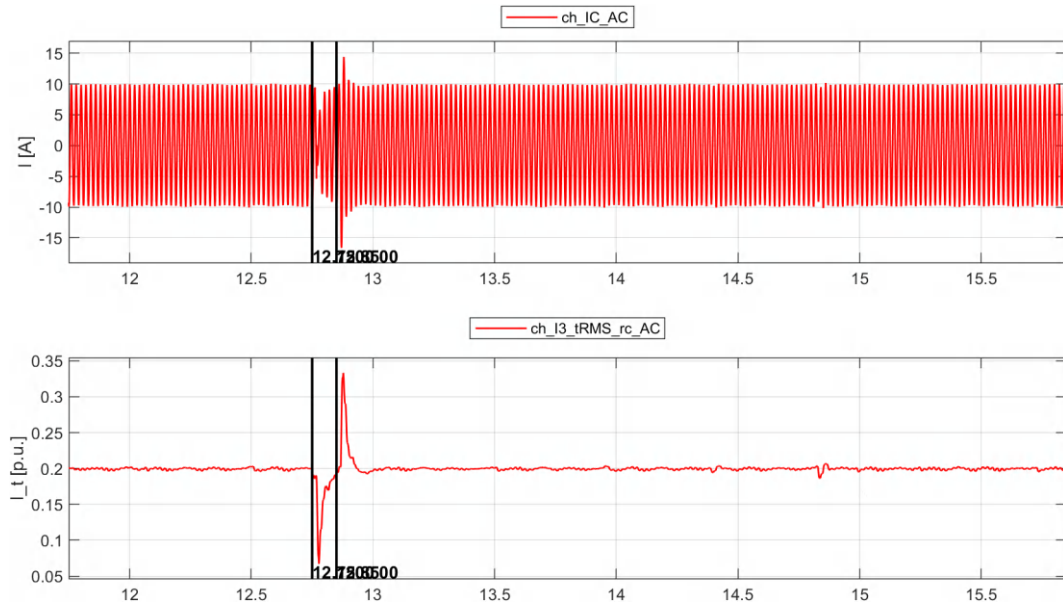
**Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



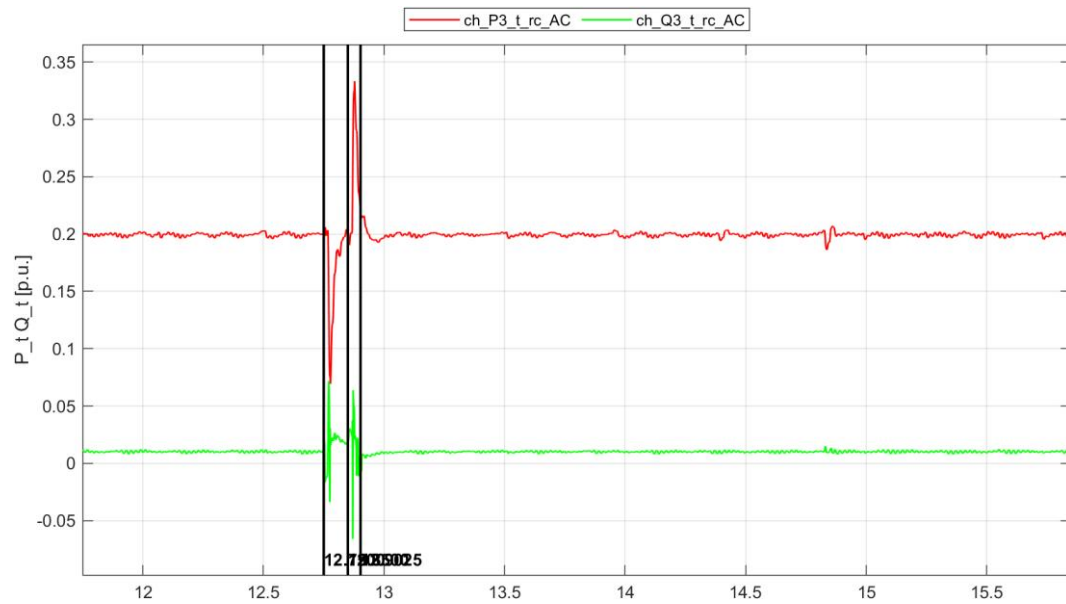
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load, Power restore



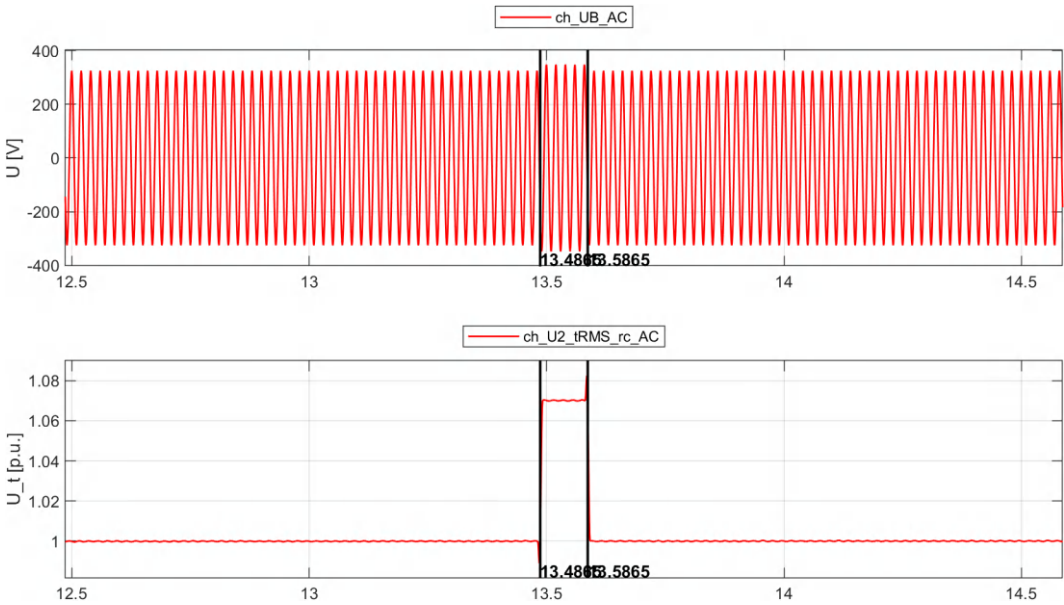
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.5	8.6
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	11:49:52.4	11:52:12.7
	3	Fault type (phase)	--	--	--	Type D2	Type D2
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t ₁)	Total	--	ms	12872	13284
	7	Point of fault clearance(t ₂)	Total	--	ms	12972	13384
	8	Fault duration in empty load test	Total	--	ms	100	100
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.073	1.073
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.984	0.198
	13	Active power	Total	t1-10s to t1	p.u.	0.987	0.198
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.020	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.073	1.071
	19	Line current	Phase 1	t1+60ms	p.u.	0.898	0.141
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.870	0.194
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.975	0.193
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.987	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.007	0.072
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.020	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	YES	YES

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Clause	Requirement - Test	Result - Remark	Verdict

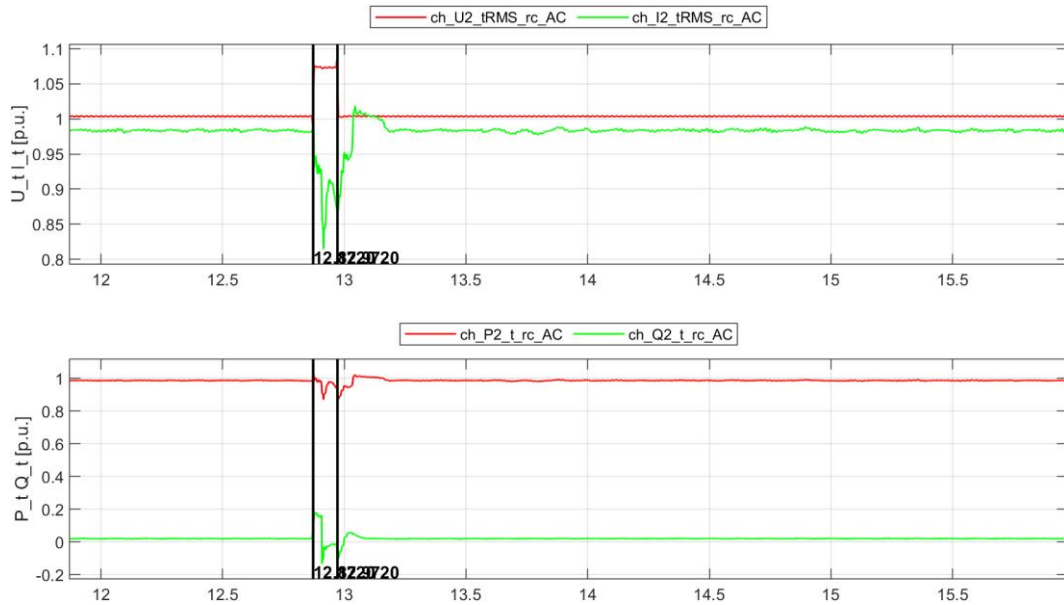
**Test 8.0d2 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 0% load,
Instantaneous and RMS values of phase voltages**



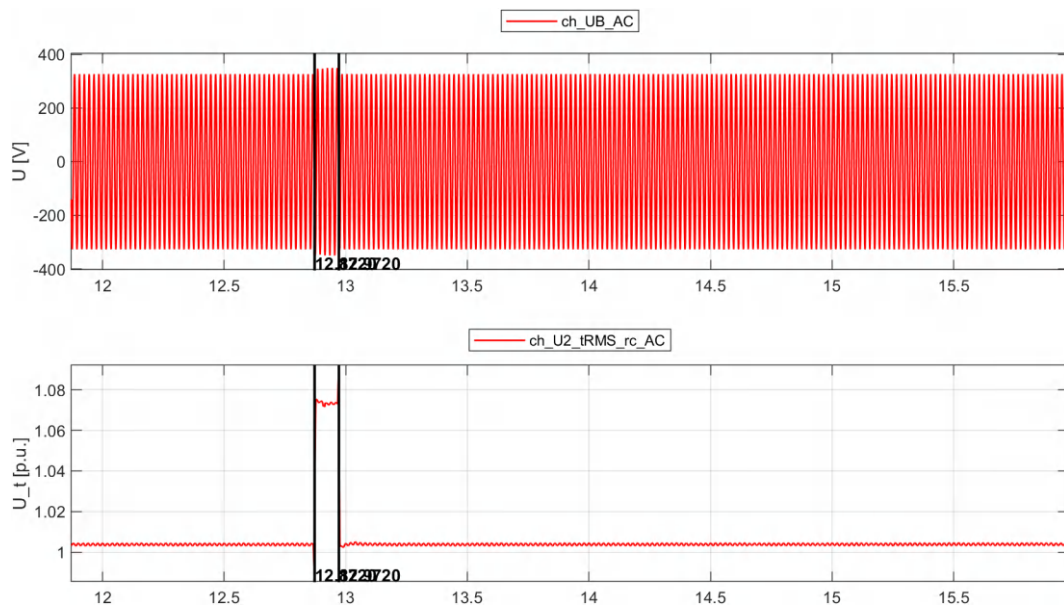
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load,
Test overview (voltage, current, active and reactive power)**



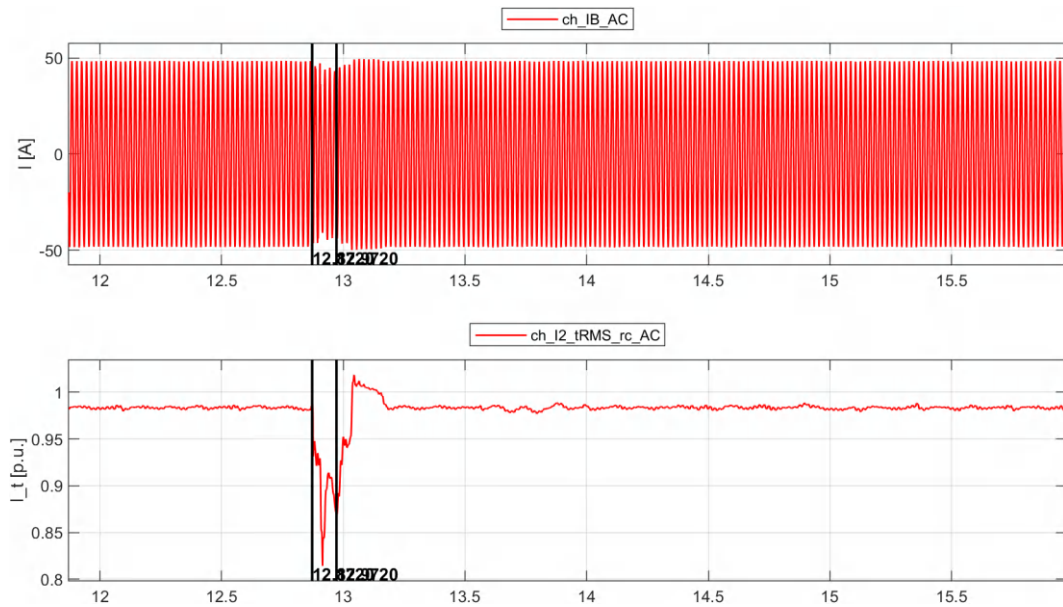
**Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load,
Instantaneous and RMS values of phase voltages**



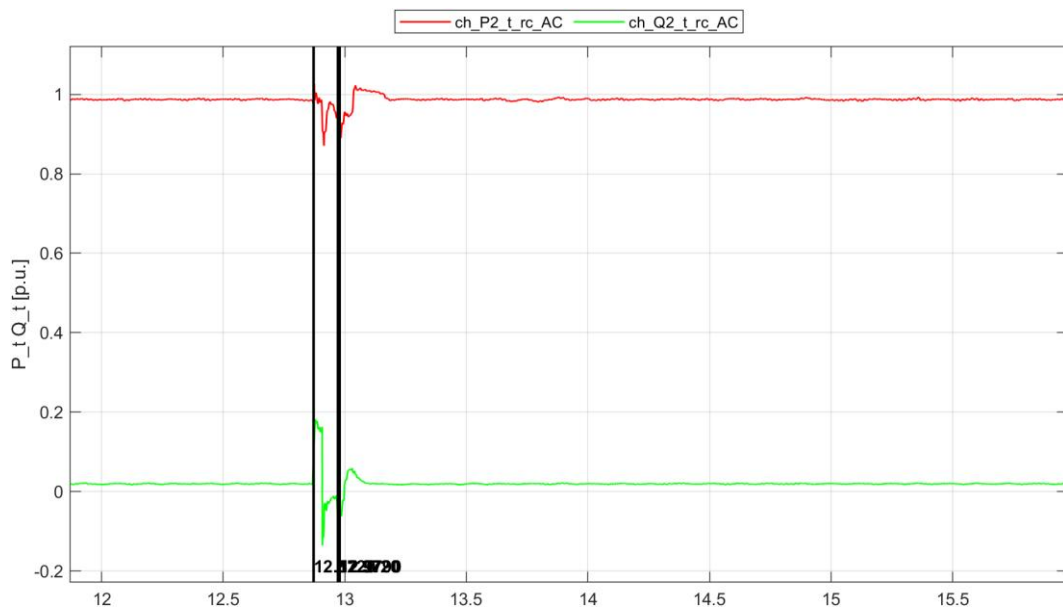
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents

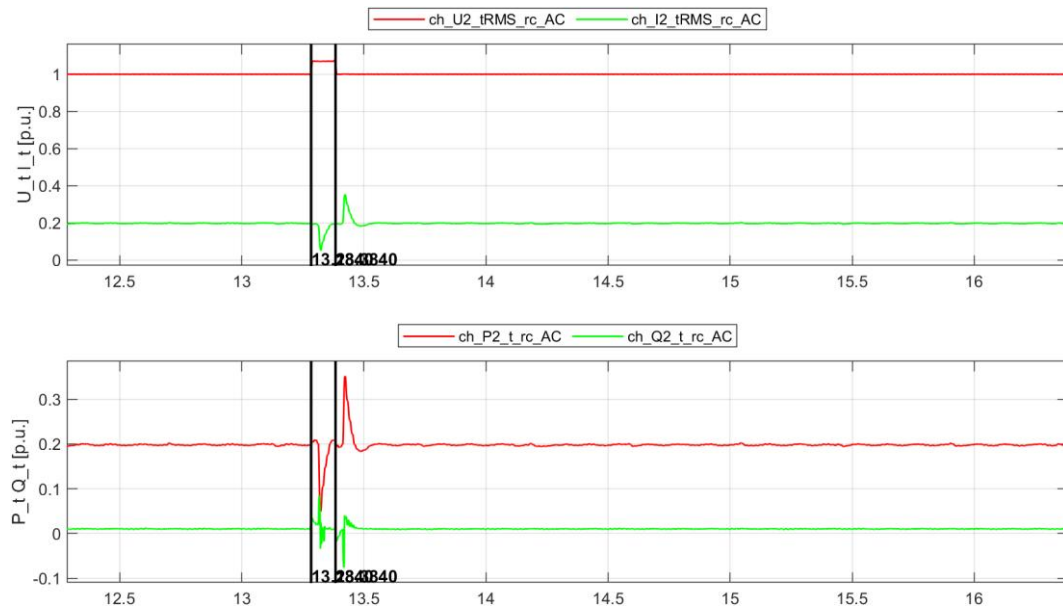
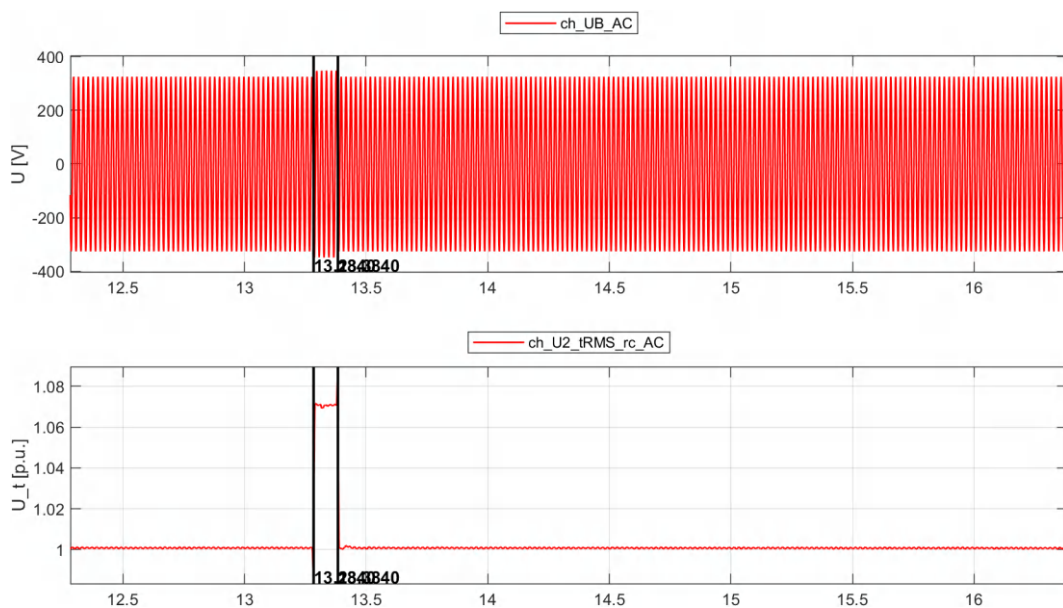


Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load, Power restore



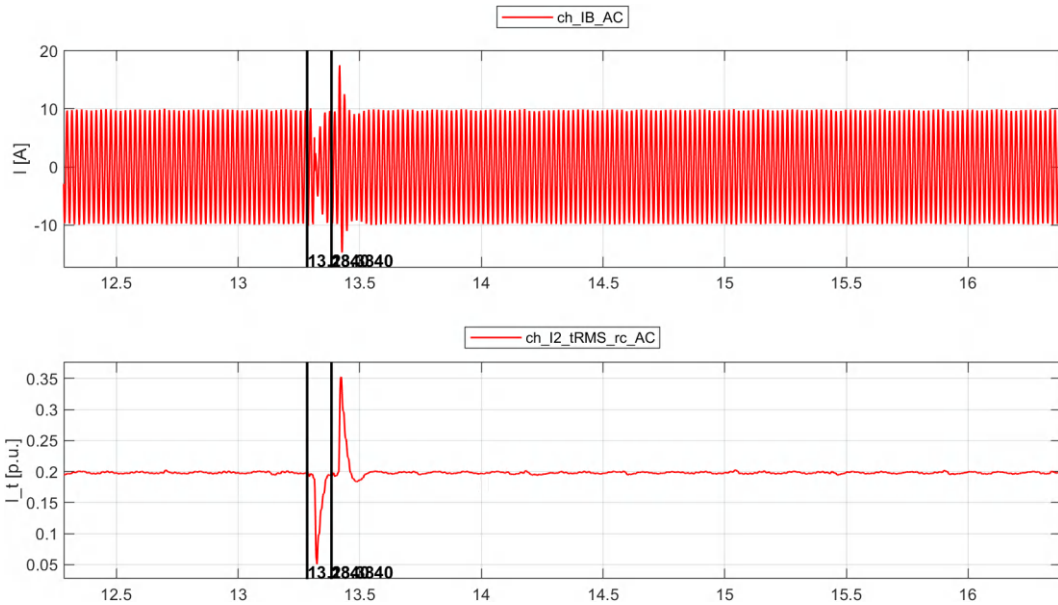
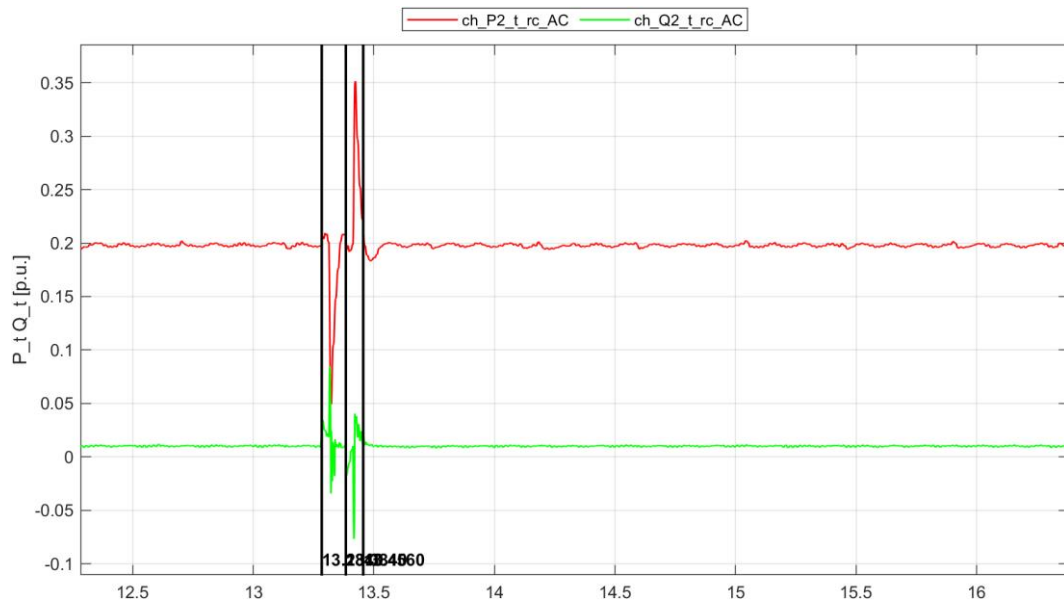
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load,
Test overview (voltage, current, active and reactive power)**

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


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Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load, Instantaneous and RMS values of phase currents

Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load, Power restore


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.3.3	TABLE: Fault ride through, over-voltage (OVRT) and under-voltage (UVRT)					P
Model	SUN-8K-H					
For EN 50549-1 type A (DC voltage=456 V)						
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
				0.1 to 0.5		8.4
		D2 (VS3)		0.98 to 1.02		8.5
				0.1 to 0.5		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.

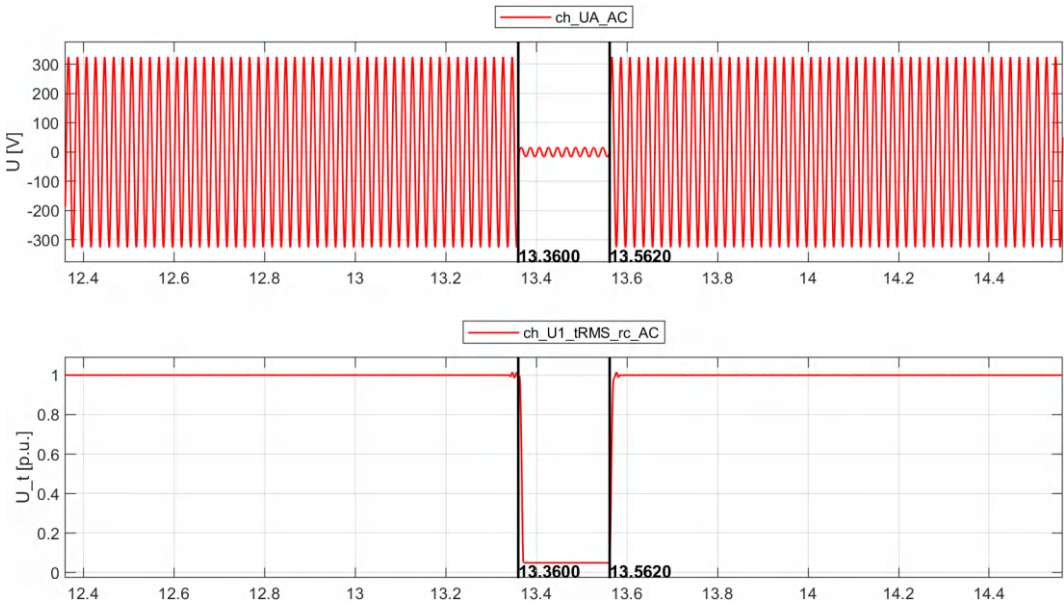
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.1	1.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	11:13:37.9	11:16:23.9
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	12848	14694
	7	Point of fault clearance(t_2)	Total	--	ms	13048	14894
	8	Fault duration in empty load test	Total	--	ms	202	202
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.050	0.050
	10		Pos.			N/A	N/A
Before dip $<t_1$	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.198
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.198
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	$\text{Cos}\phi$	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.050	0.050
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.044	0.028
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.035	0.025
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.001	0.001
	26		Pos.			N/A	N/A
After dip $>t_2$	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.998	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.263	0.171
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

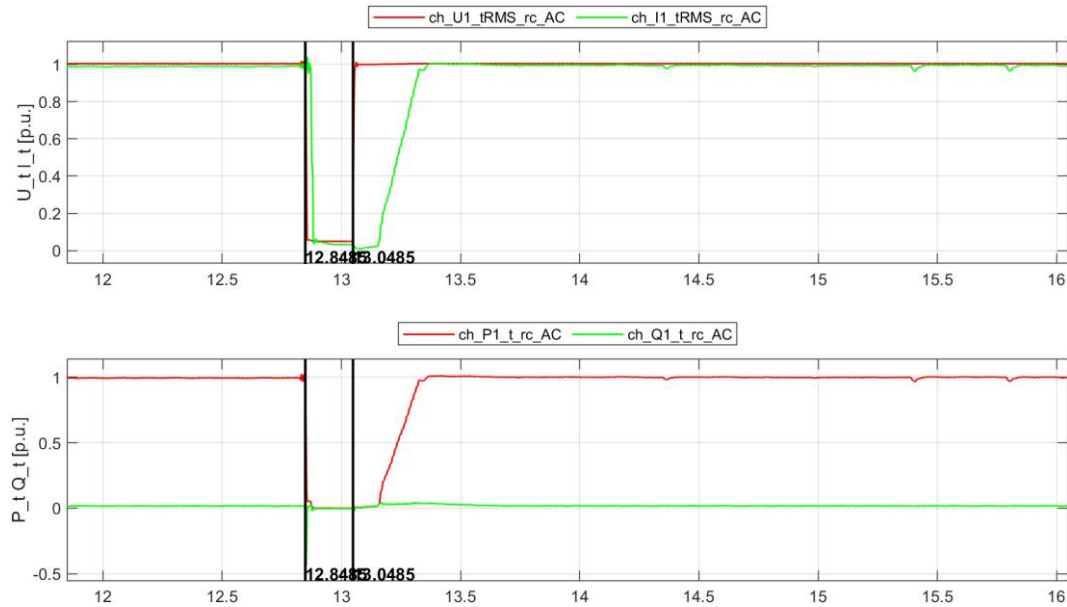
**Test 1.0a Depth of fault phase: 0.05 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



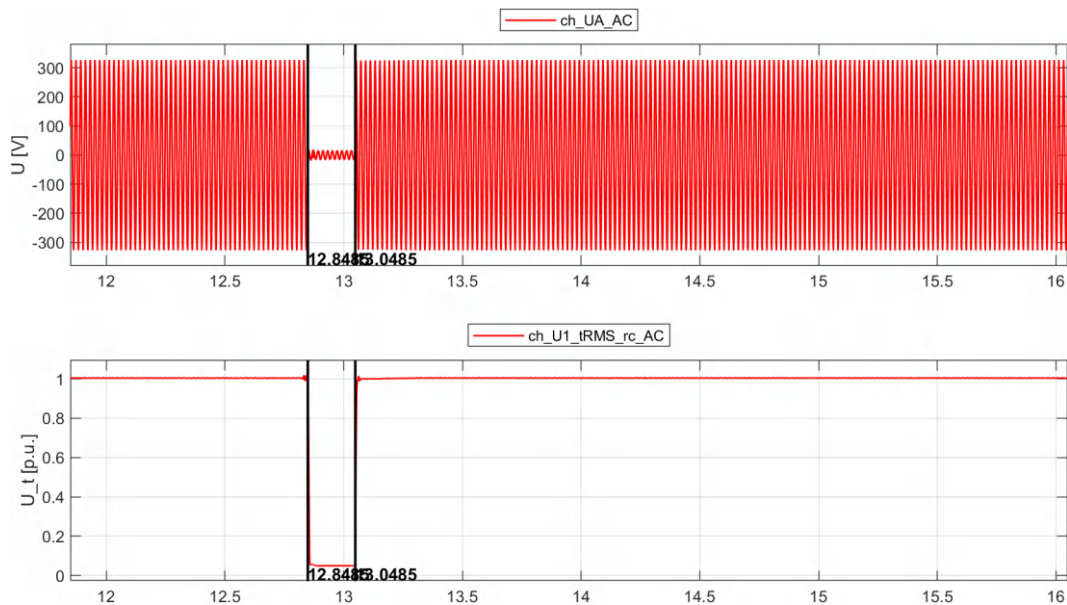
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



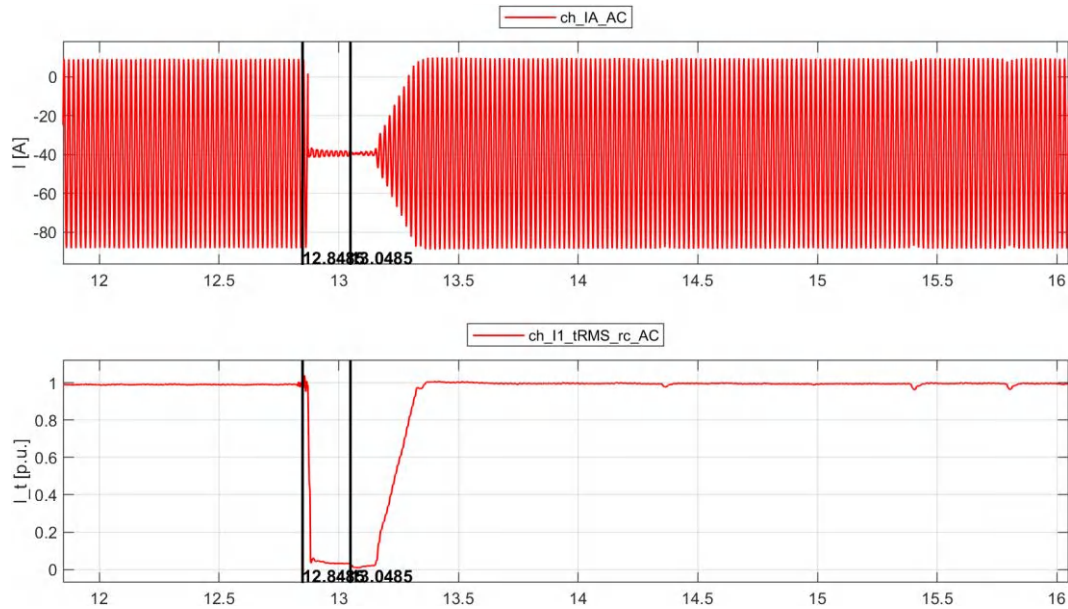
**Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



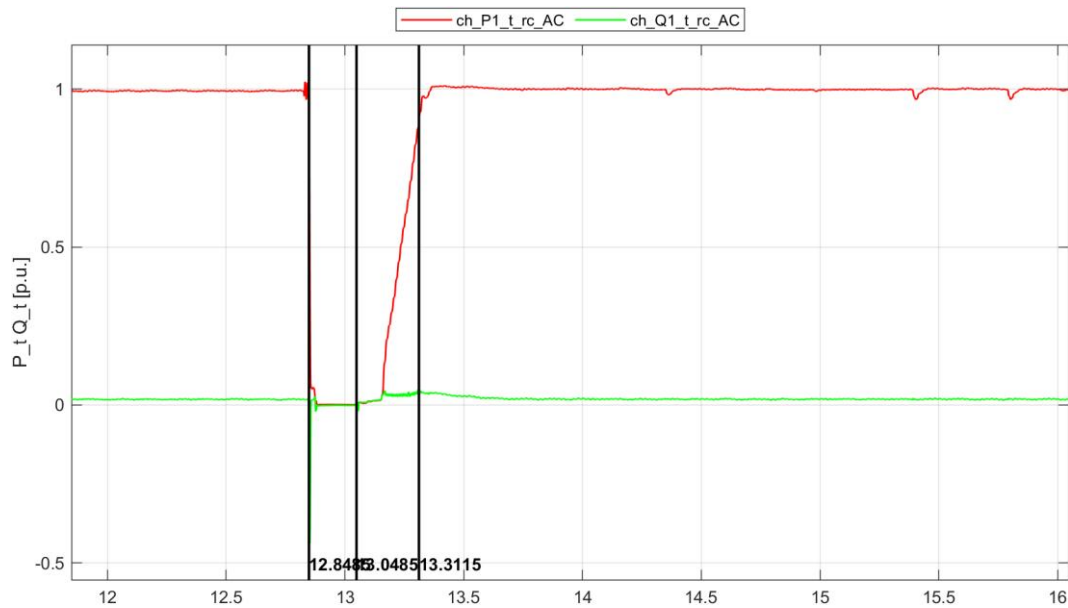
EN 50549-10

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



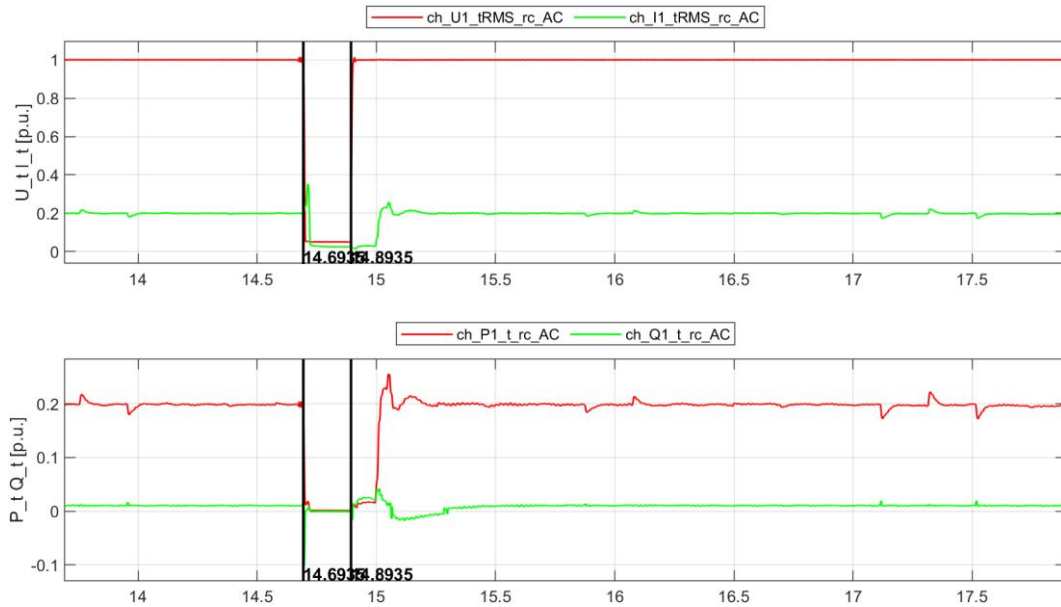
**Test 1.1 Depth of fault phase: 0.05 p.u., three-phase SC (type A), 100% load,
Power restore**



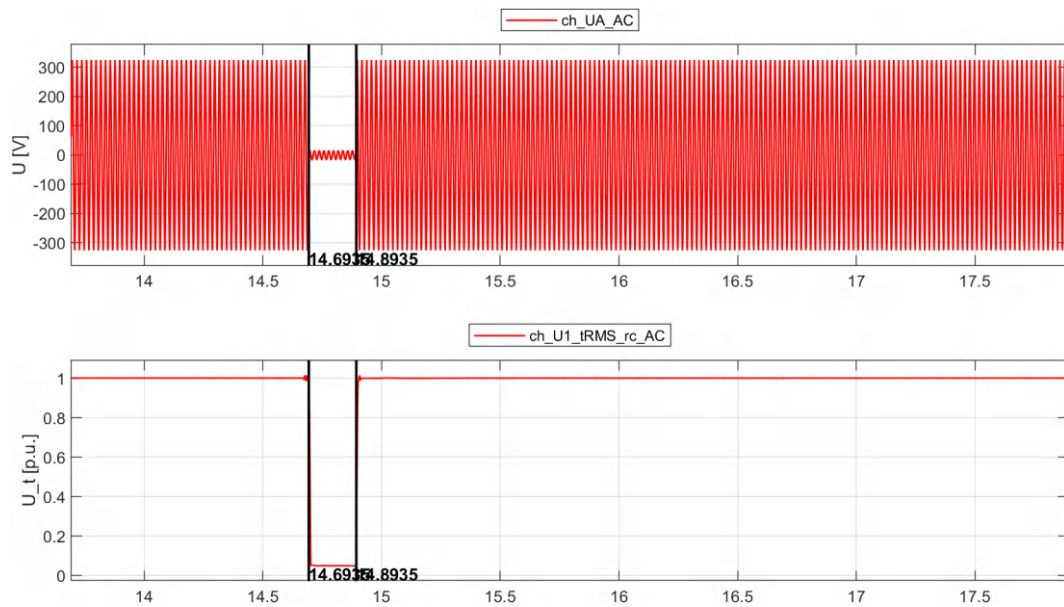
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



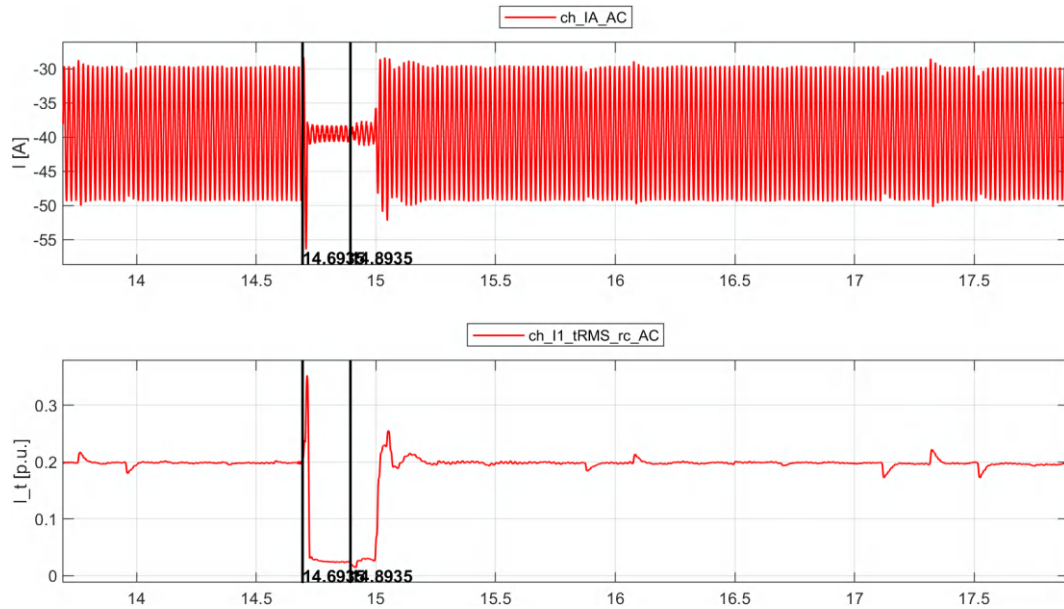
**Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



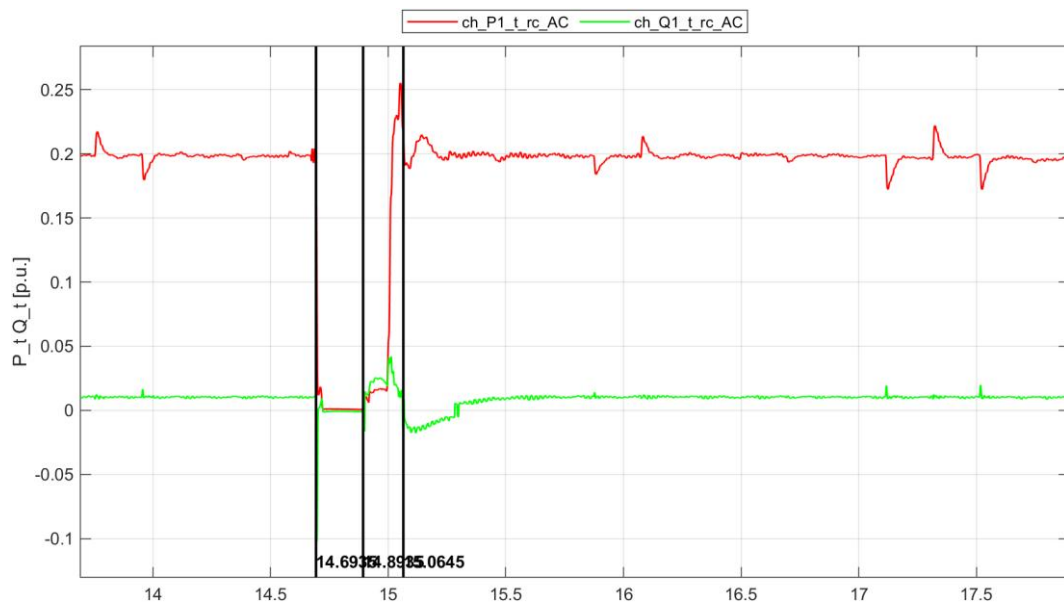
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 1.2 Depth of fault phase: 0.05 p.u., three-phase SC (type A), partial load, Power restore



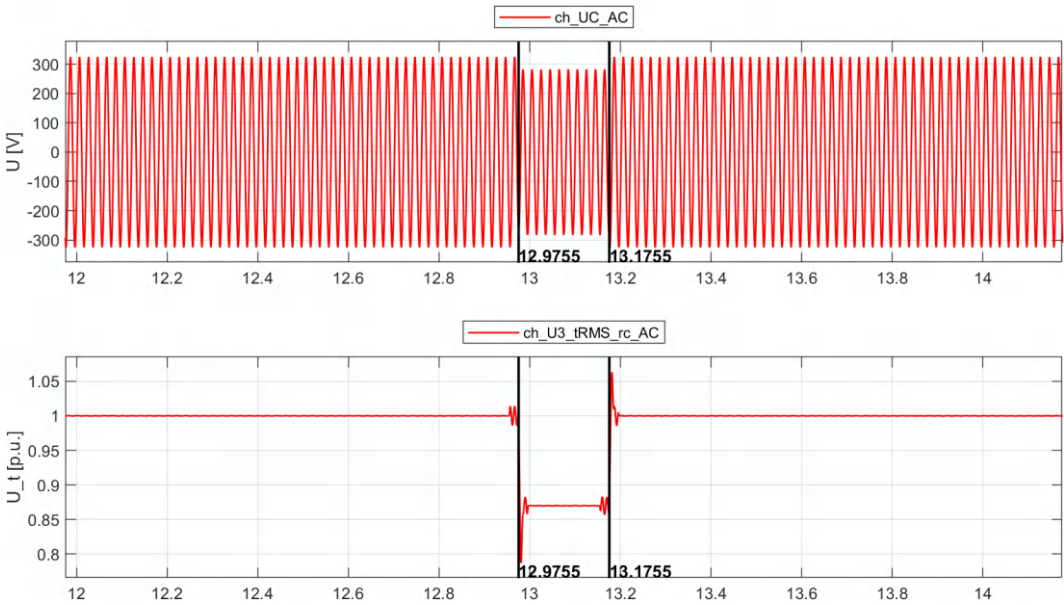
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.3	1.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	18:52:47.2	17:41:19.9
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	12632	12839
	7	Point of fault clearance(t_2)	Total	--	ms	12832	13039
	8	Fault duration in empty load test	Total	--	ms	200	200
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.870	0.870
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.868	0.869
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.067	0.019
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.073	0.020
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.013	0.011
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.997	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.220	0.132
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

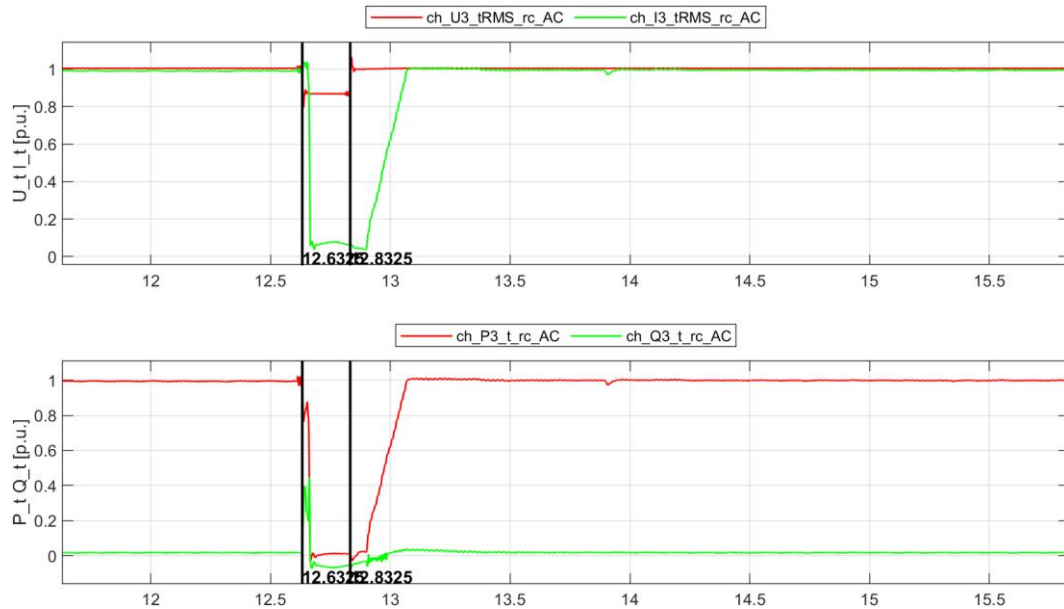
Test 1.0d1 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



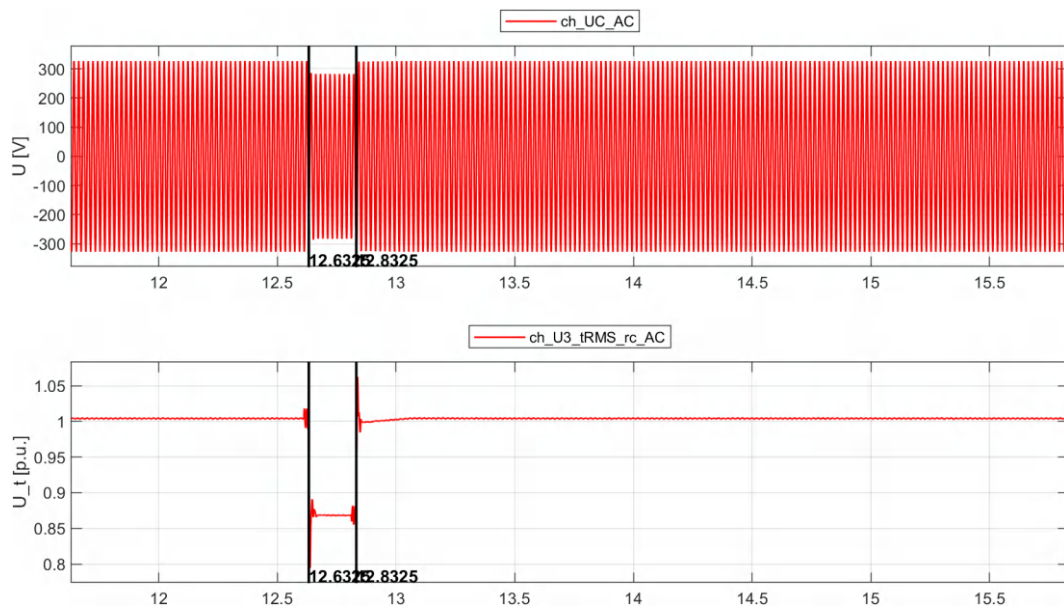
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**

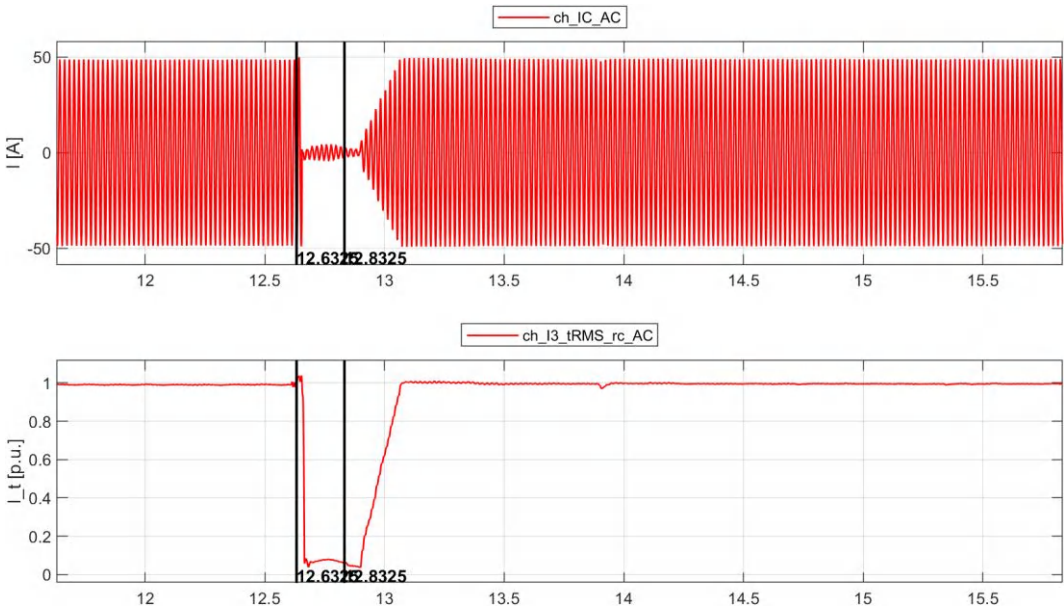


**Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**

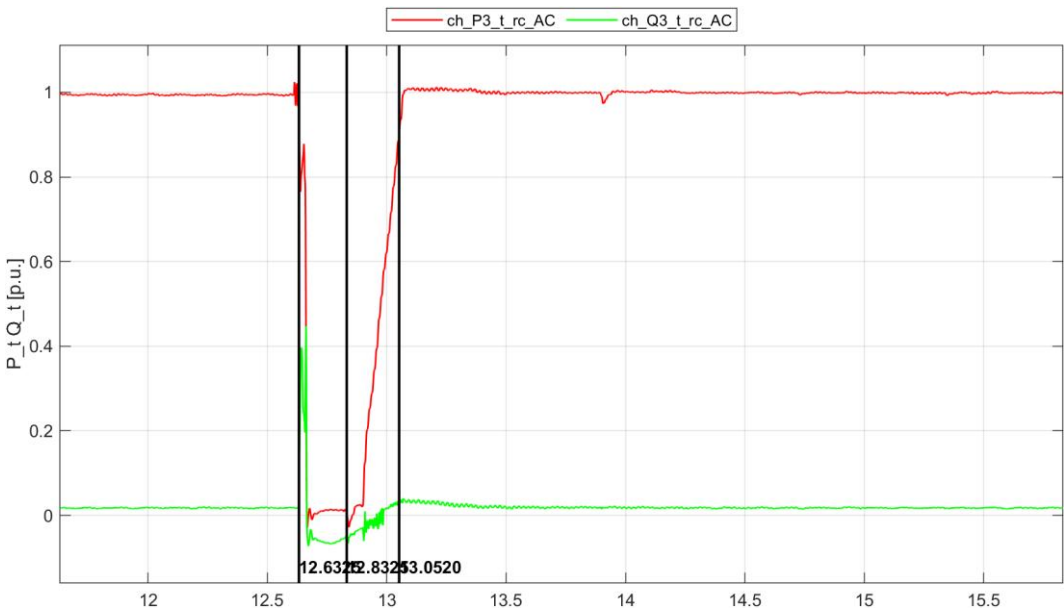


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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



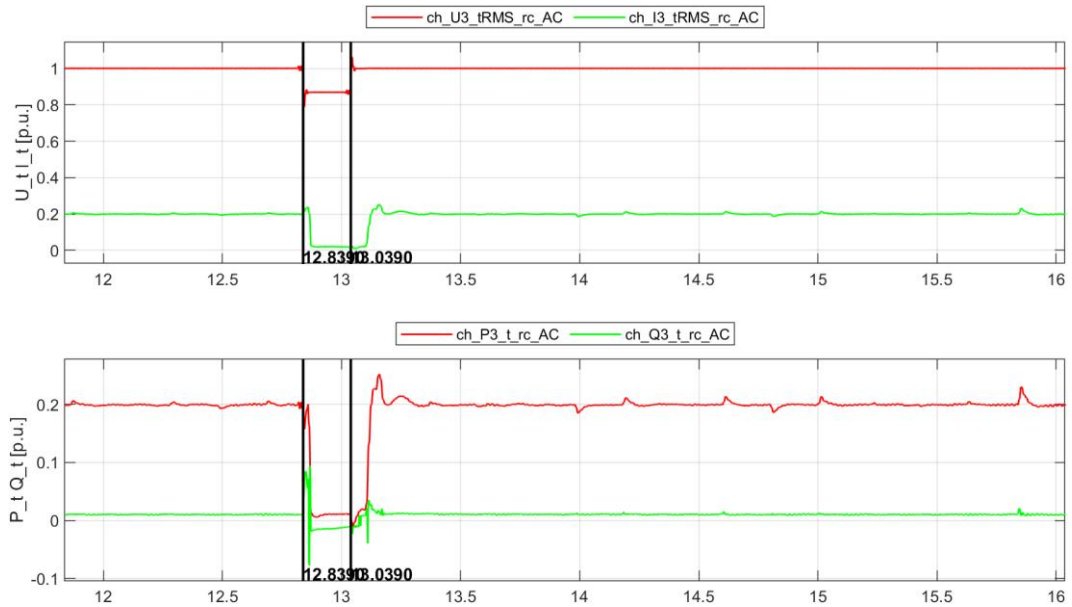
Test 1.3 Depth of fault phase: 0.05 p.u., two-phase SC (type D), 100% load, Power restore



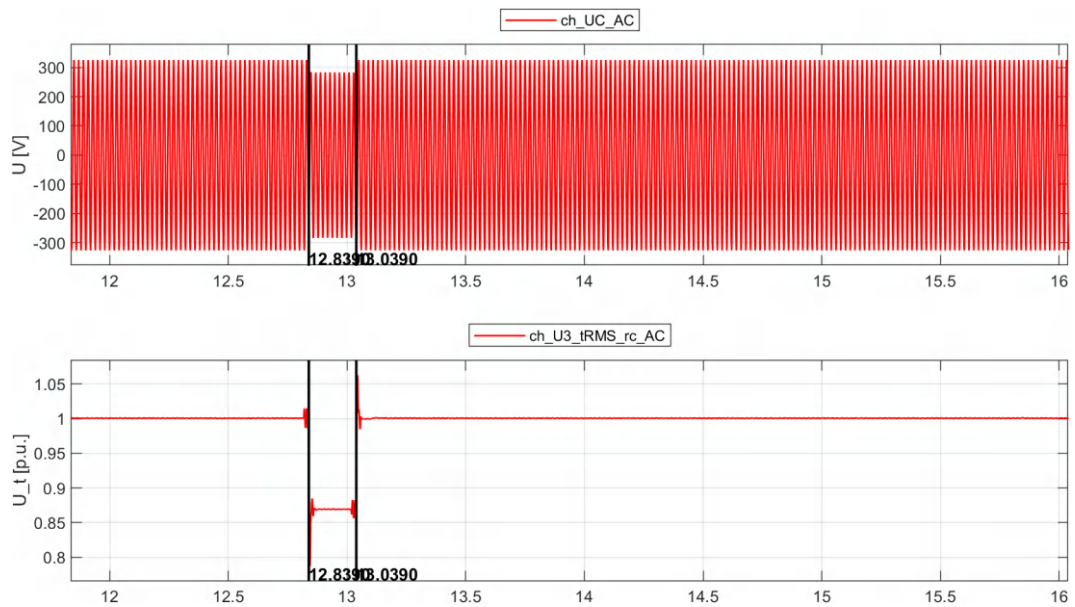
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



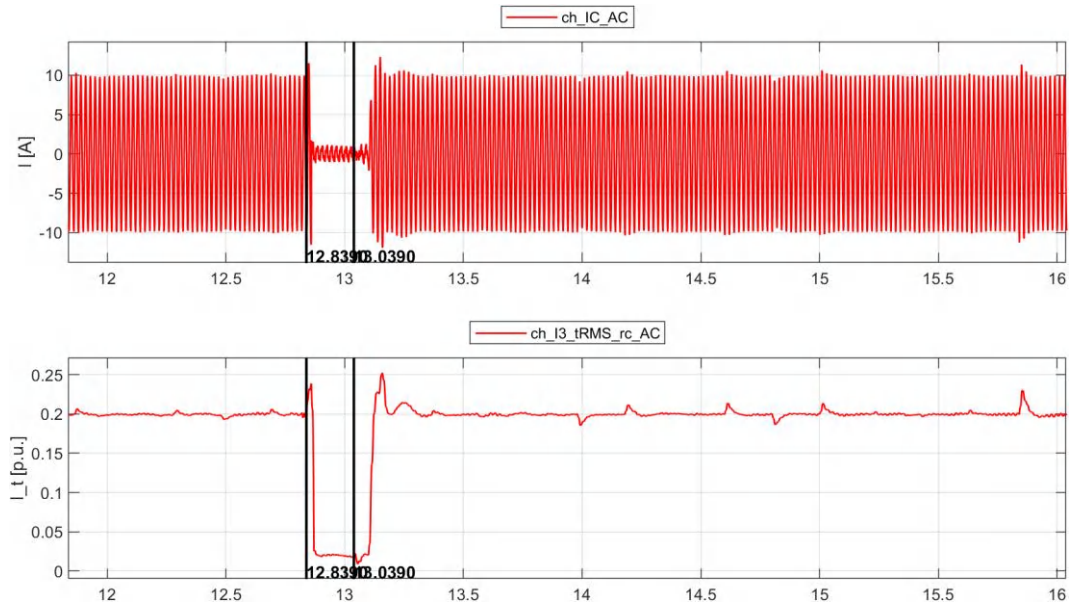
**Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



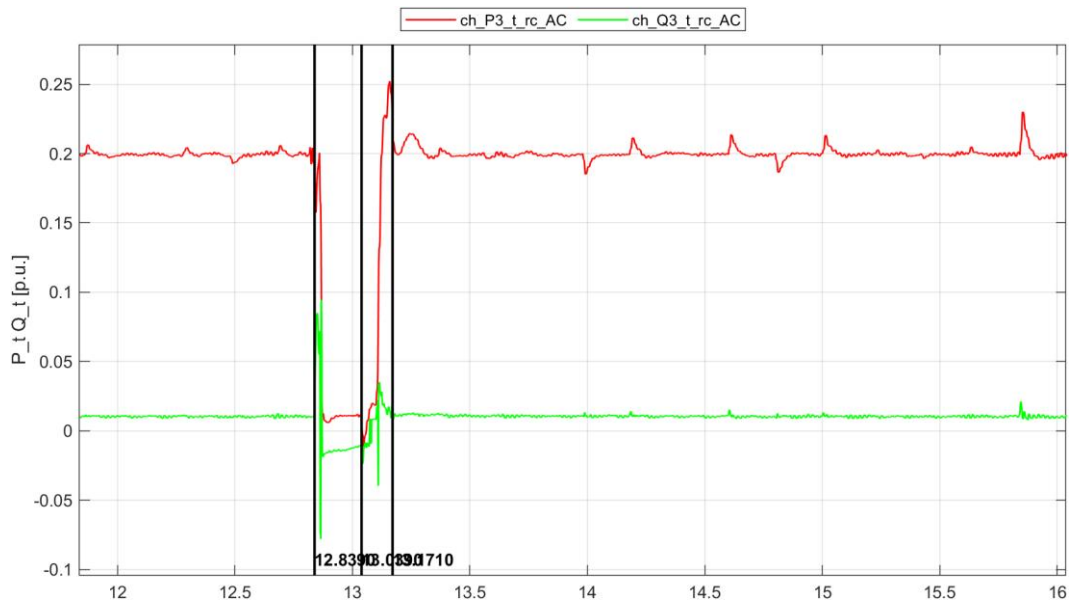
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 1.4 Depth of fault phase: 0.05 p.u., two-phase SC (type D), partial load, Power restore

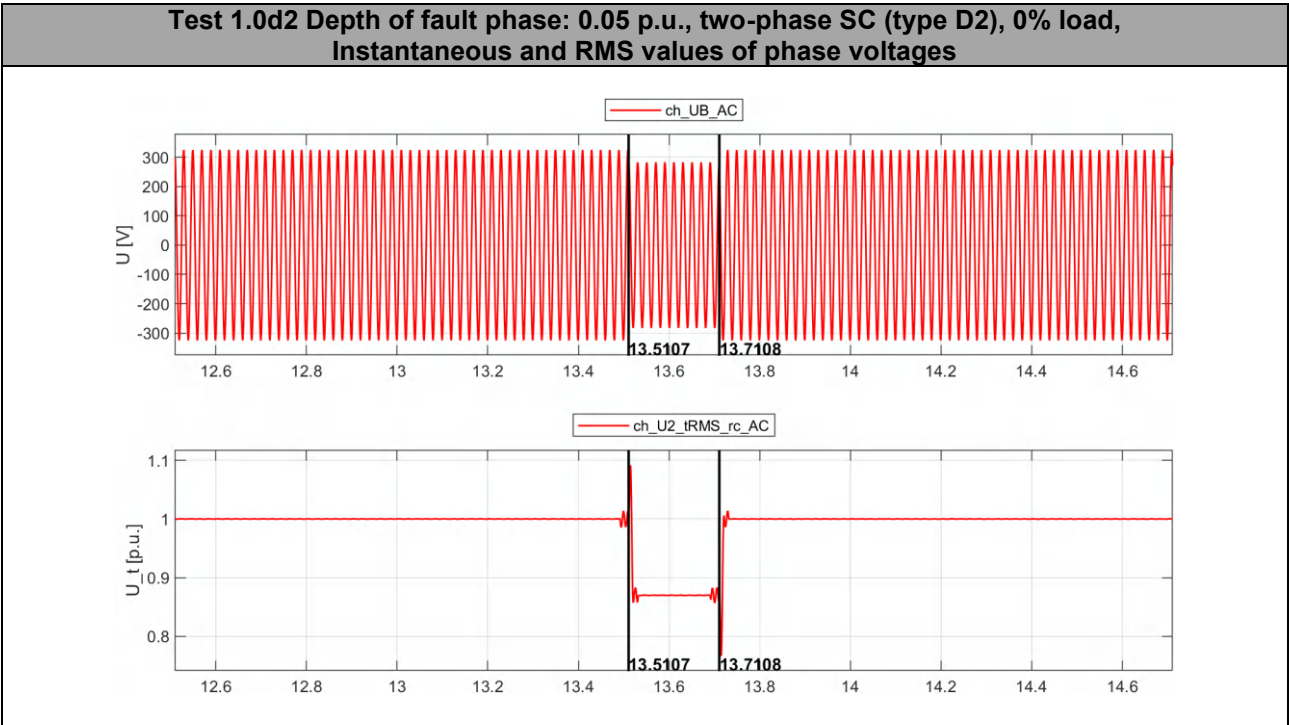


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	1.5	1.6
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	11:32:43.7	11:34:28.6
	3	Fault type (phase)	--	--	--	Type D2	Type D2
	4	Setting voltage depth	Phase conductor	--	p.u.	0.05	0.05
	5	Setting dip duration		--	--	200	200
	6	Point of fault entry(t_1)	Total	--	ms	12769	13182
	7	Point of fault clearance(t_2)	Total	--	ms	12969	13382
	8	Fault duration in empty load test	Total	--	ms	200	200
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.870	0.870
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.991	0.203
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.203
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.870	0.870
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.779	0.187
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.018	0.019
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.011	0.013
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.996	0.201
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.219	0.200
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

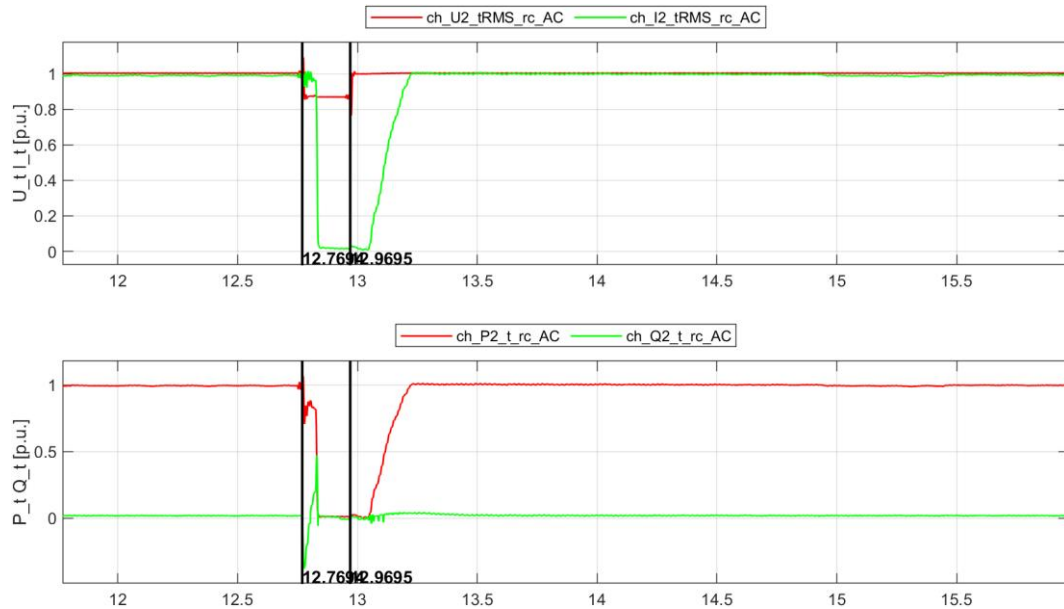
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict



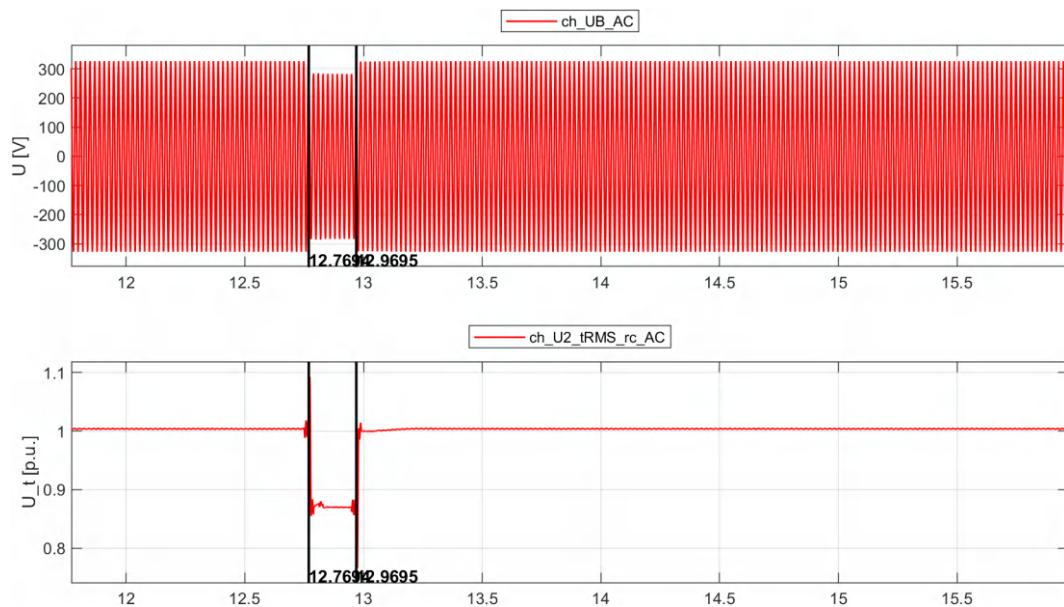
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load,
Test overview (voltage, current, active and reactive power)**



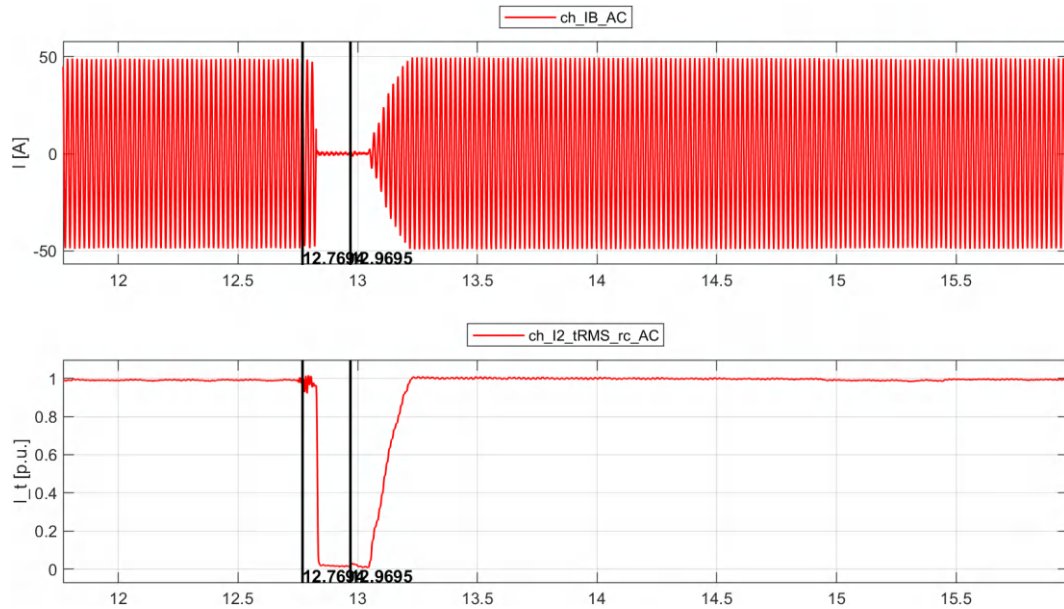
**Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load,
Instantaneous and RMS values of phase voltages**



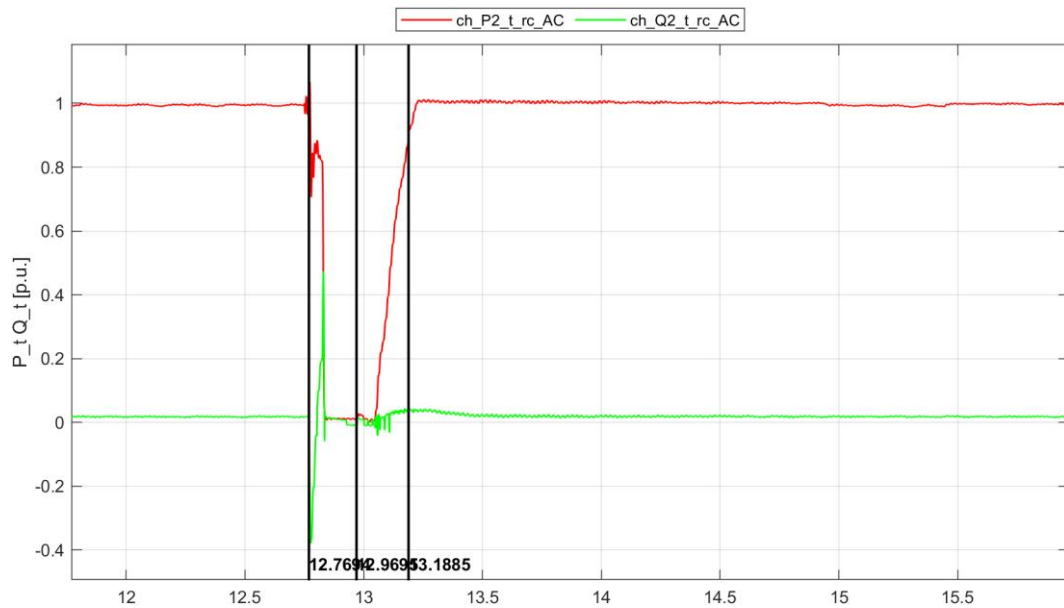
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents



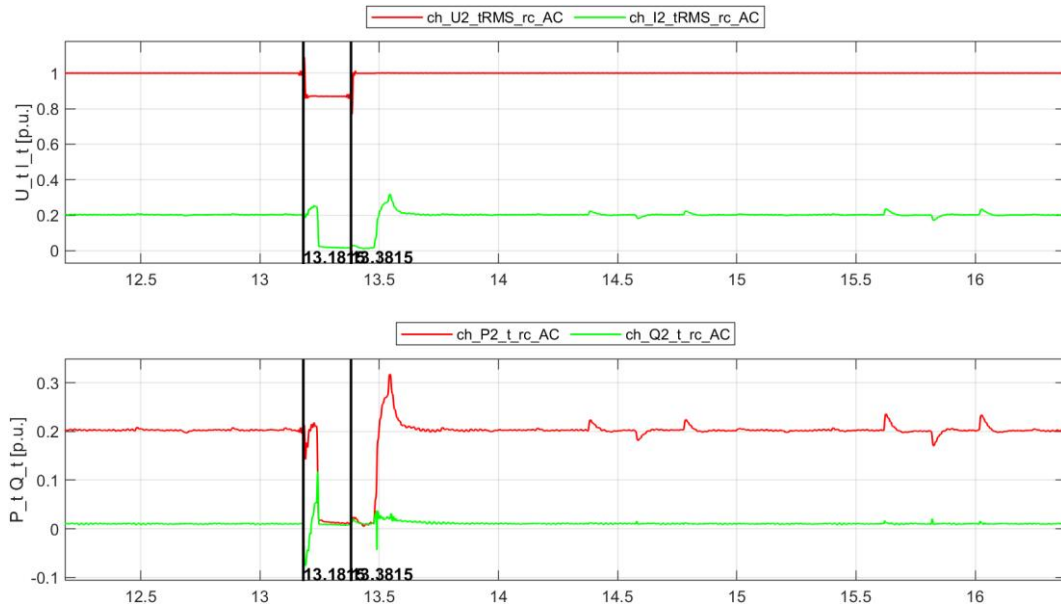
Test 1.5 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), 100% load, Power restore



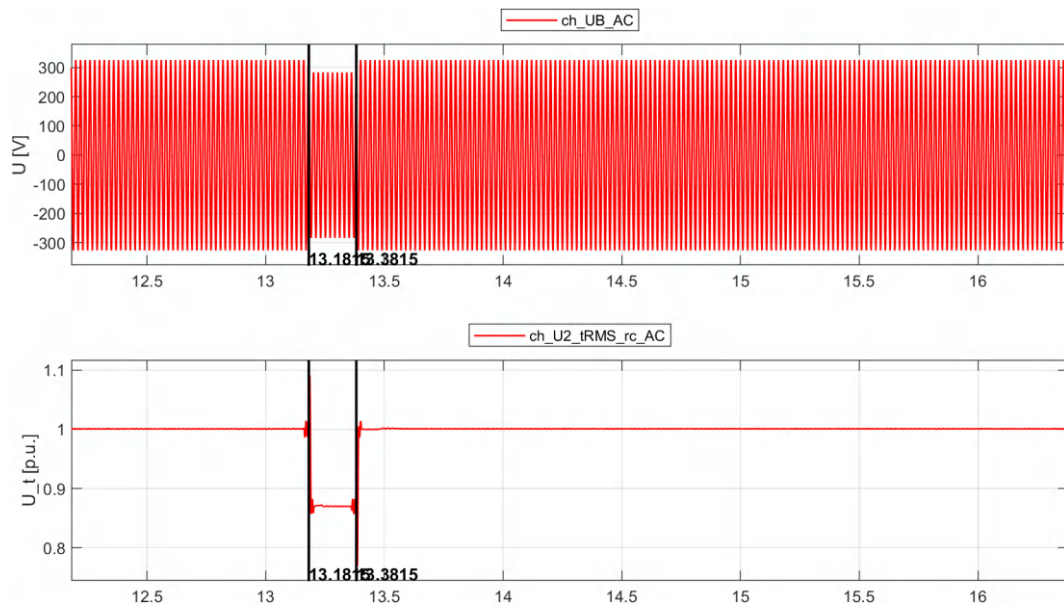
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load,
Test overview (voltage, current, active and reactive power)**



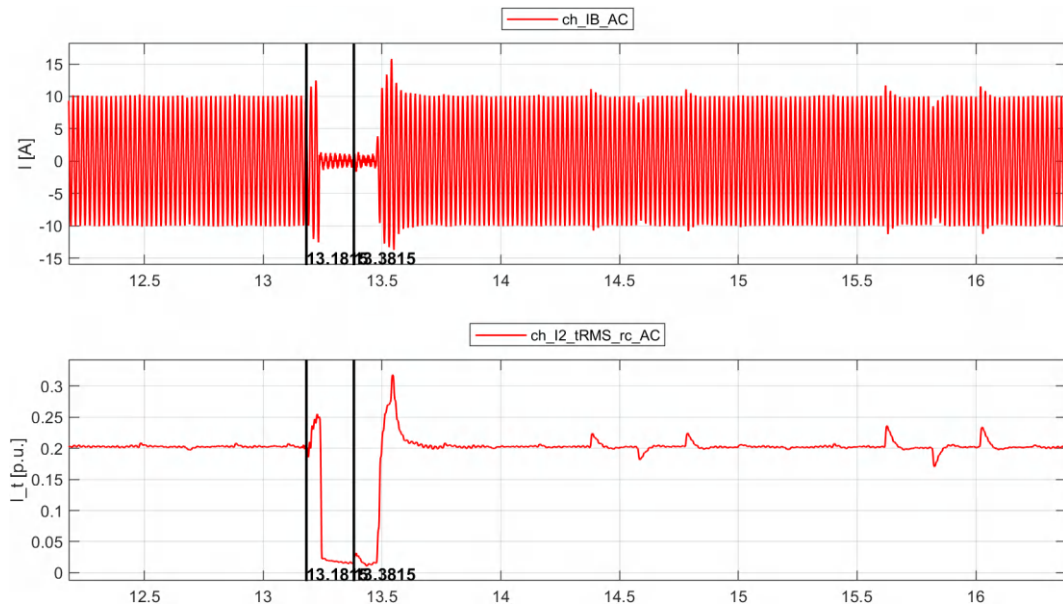
**Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load,
Instantaneous and RMS values of phase voltages**



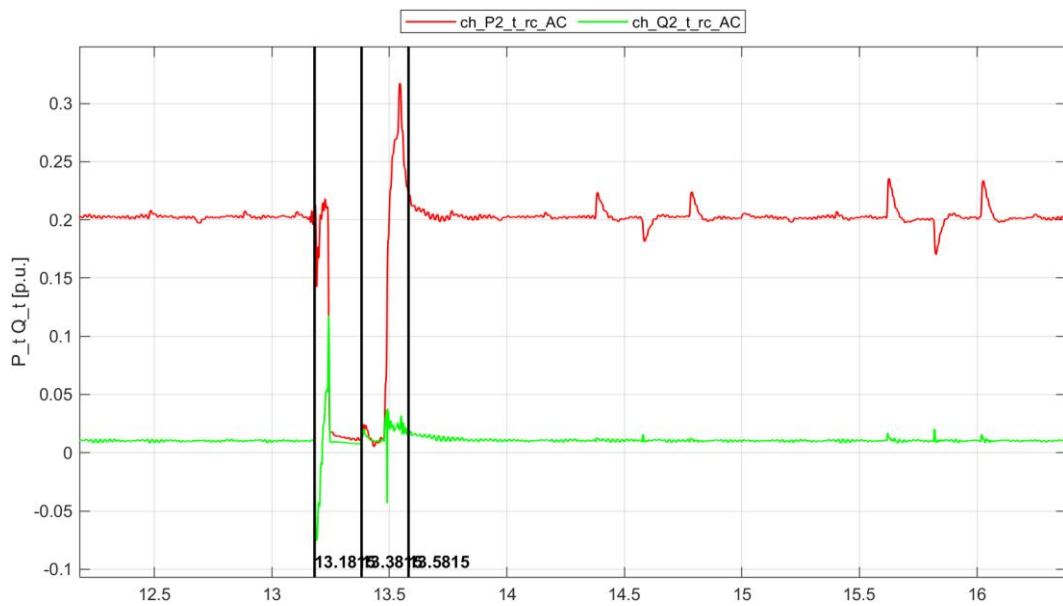
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load, Instantaneous and RMS values of phase currents



Test 1.6 Depth of fault phase: 0.05 p.u., two-phase SC (type D2), partial load, Power restore



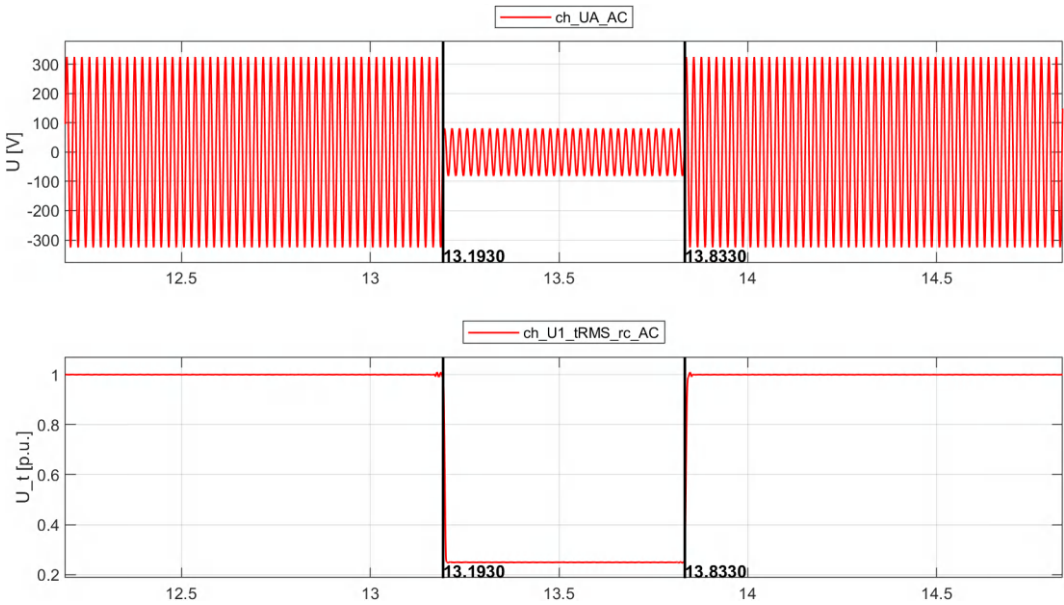
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2.1	2.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	11:05:43.8	11:18:59.2
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.25	0.25
	5	Setting dip duration		--	--	630	630
	6	Point of fault entry(t ₁)	Total	--	ms	14295	13746
	7	Point of fault clearance(t ₂)	Total	--	ms	14935	14386
	8	Fault duration in empty load test	Total	--	ms	640	640
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.250	0.250
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.200
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.249	0.250
	19	Line current	Phase 1	t1+60ms	p.u.	0.044	0.027
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.040	0.024
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.003	0.003
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.998	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.252	0.176
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

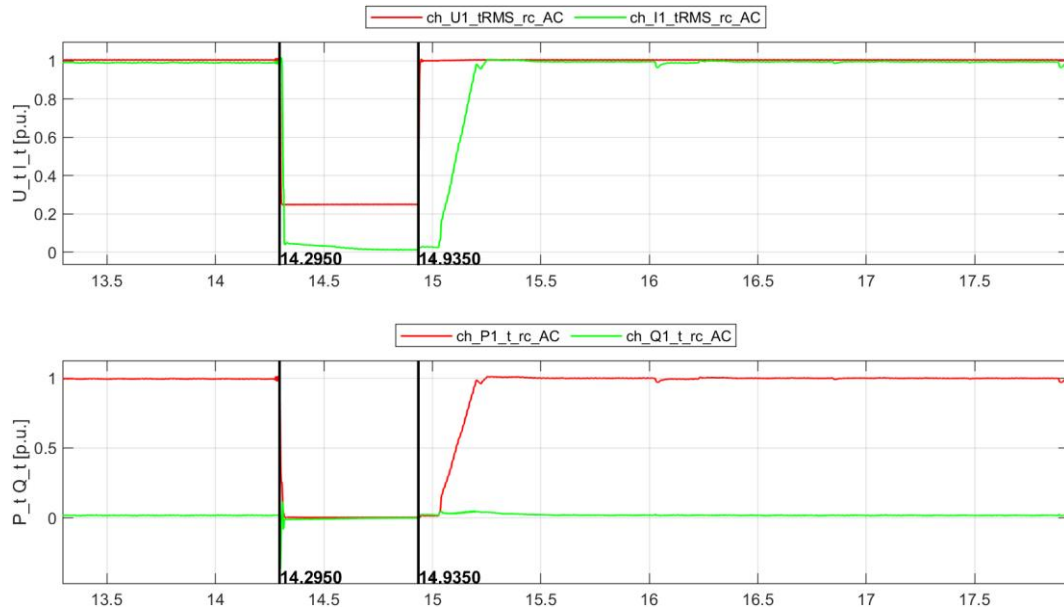
**Test 2.0a Depth of fault phase: 0.25 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



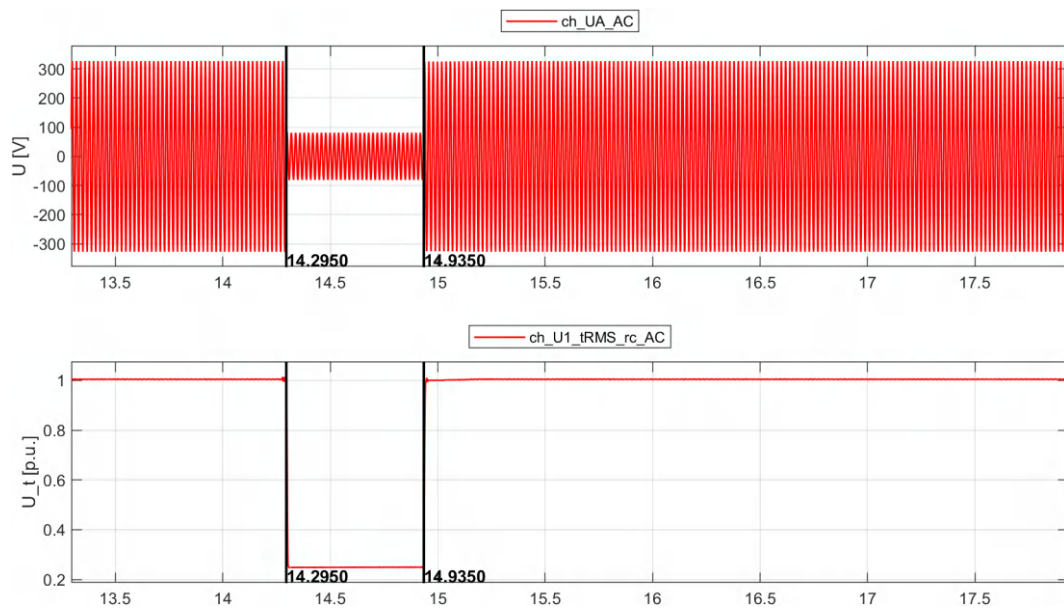
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



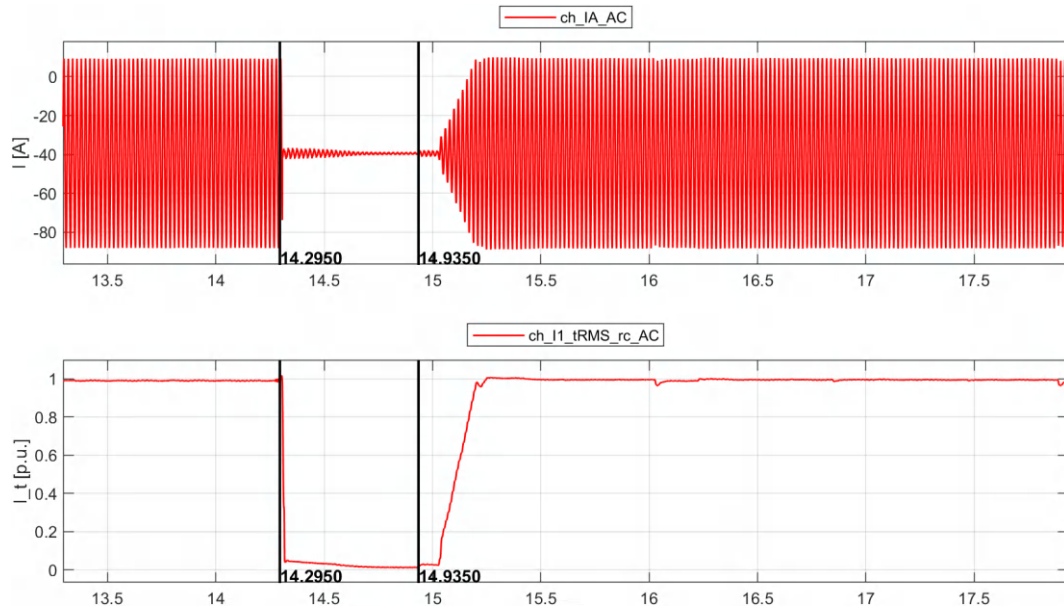
**Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



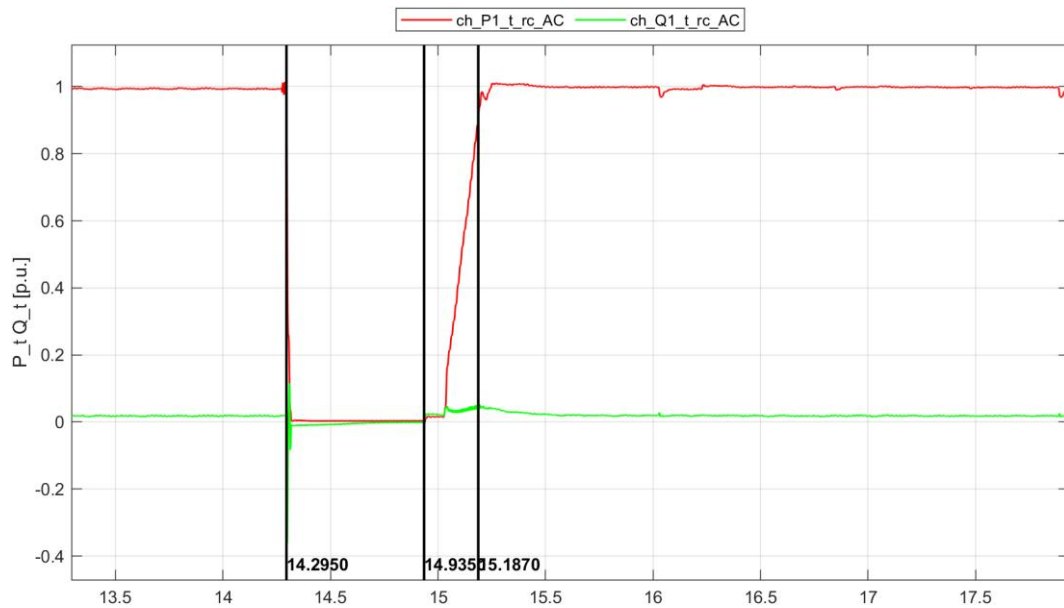
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



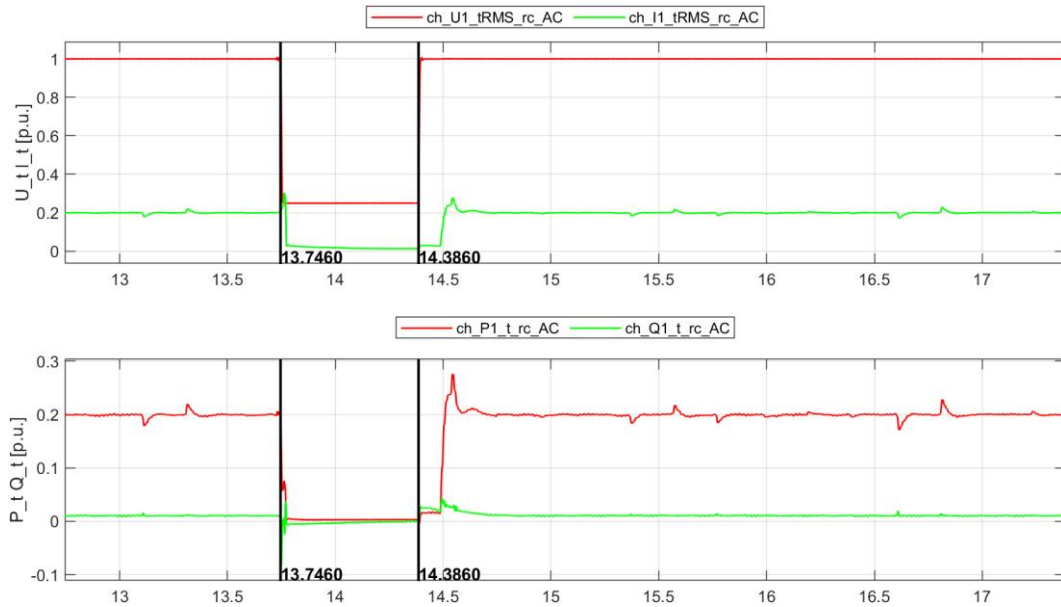
Test 2.1 Depth of fault phase: 0.25 p.u., three-phase SC (type A), 100% load, Power restore



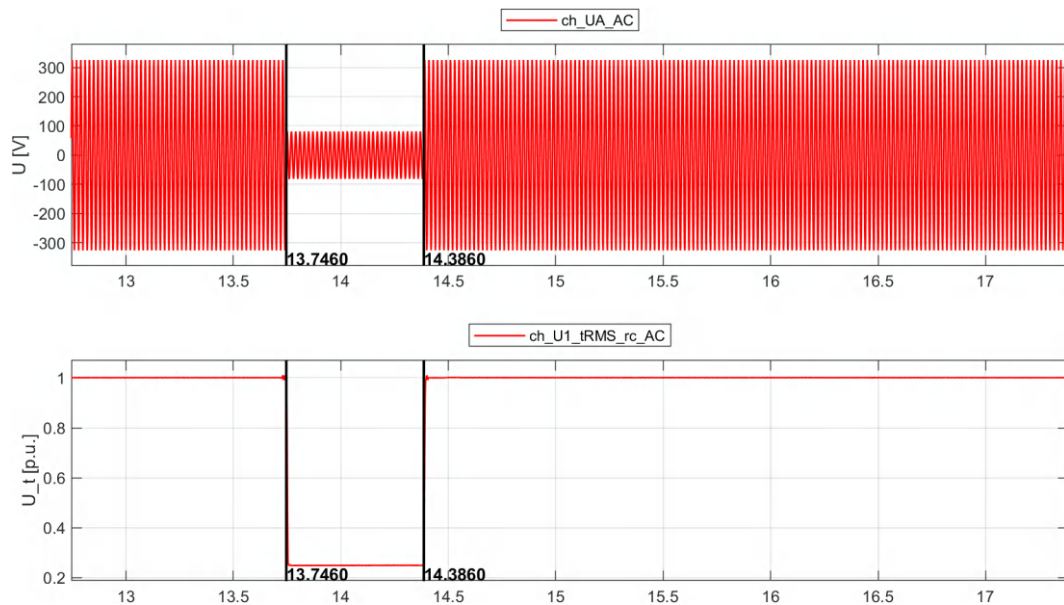
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



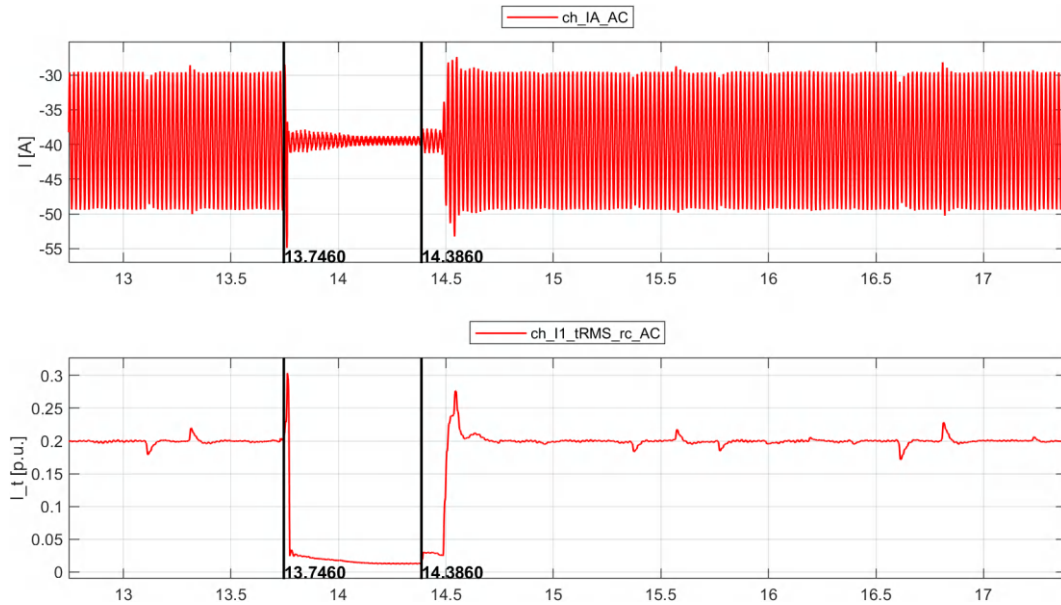
**Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



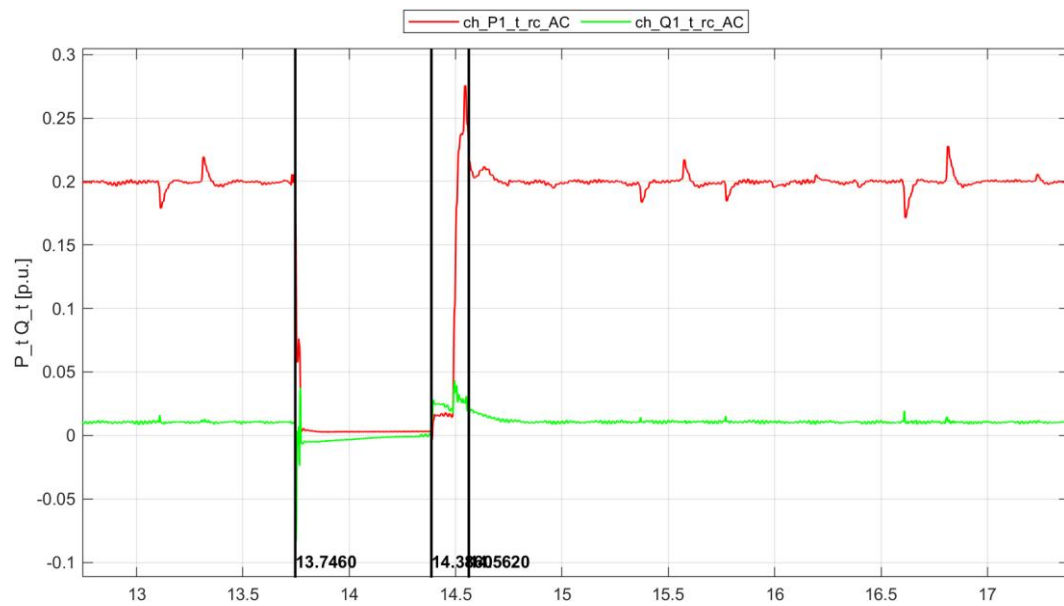
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 2.2 Depth of fault phase: 0.25 p.u., three-phase SC (type A), partial load, Power restore



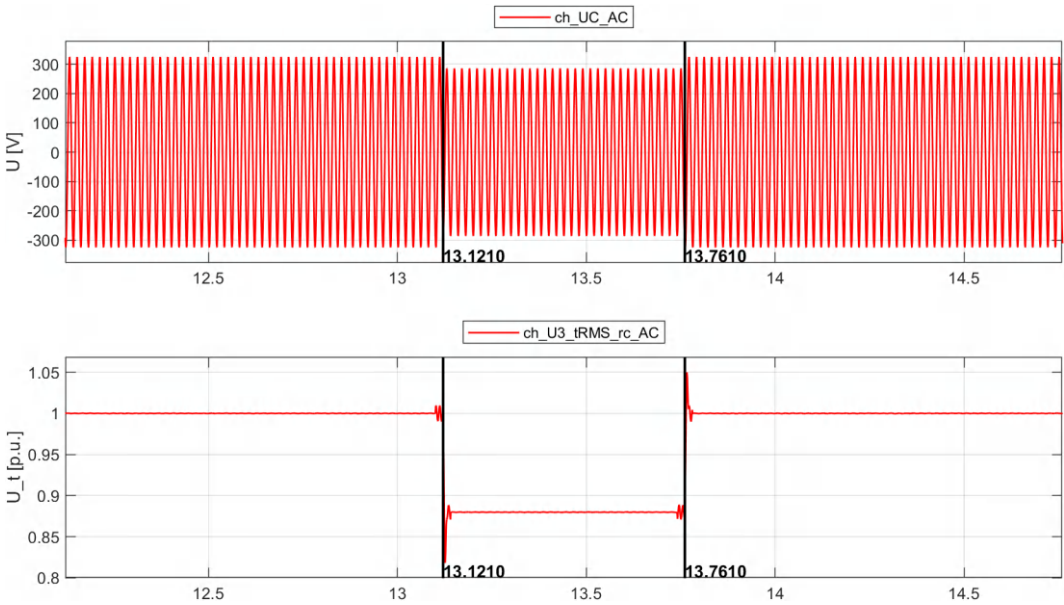
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	2.3	2.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	18:58:15.6	17:24:35.1
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.25	0.25
	5	Setting dip duration		--	--	630	630
	6	Point of fault entry(t ₁)	Total	--	ms	13763	12723
	7	Point of fault clearance(t ₂)	Total	--	ms	14403	13363
	8	Fault duration in empty load test	Total	--	ms	640	640
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.880	0.880
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.991	0.201
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.879	0.880
	19	Line current	Phase 1	t1+60ms	p.u.	0.065	0.016
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.073	0.018
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.012	0.012
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.997	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.233	0.140
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

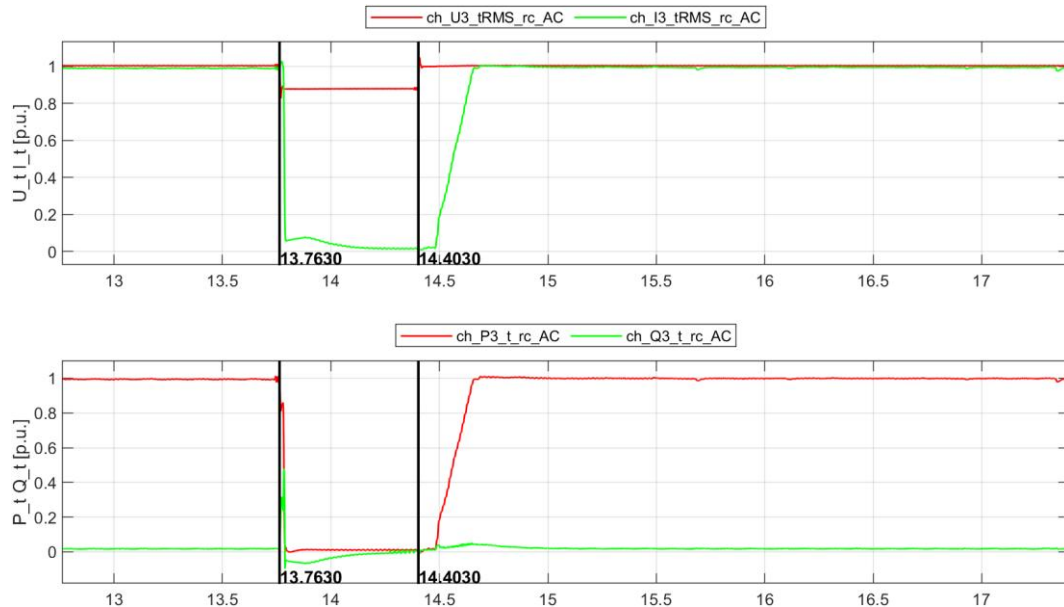
Test 2.0d1 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



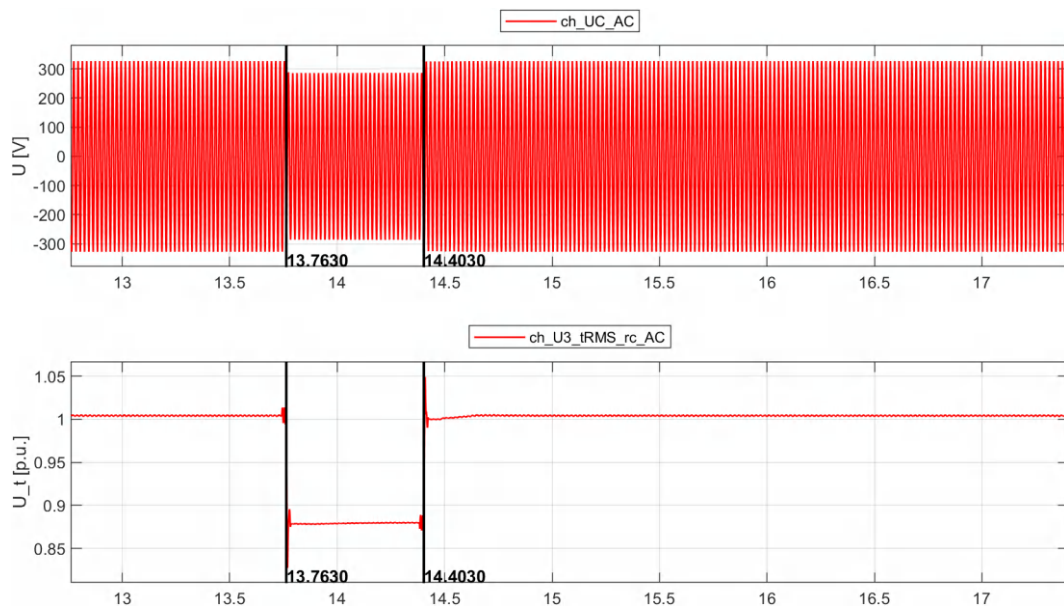
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



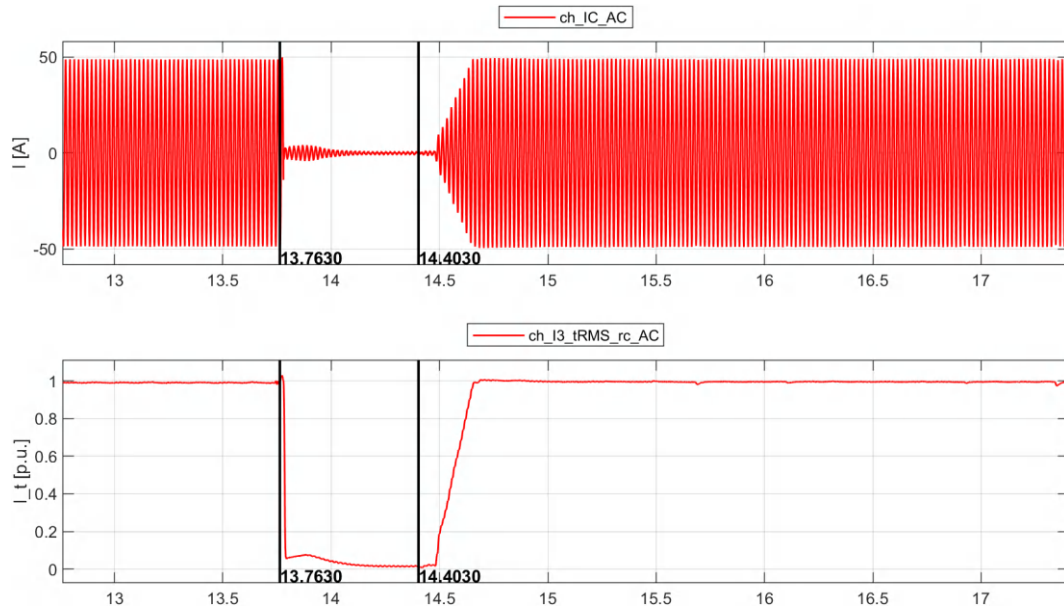
**Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



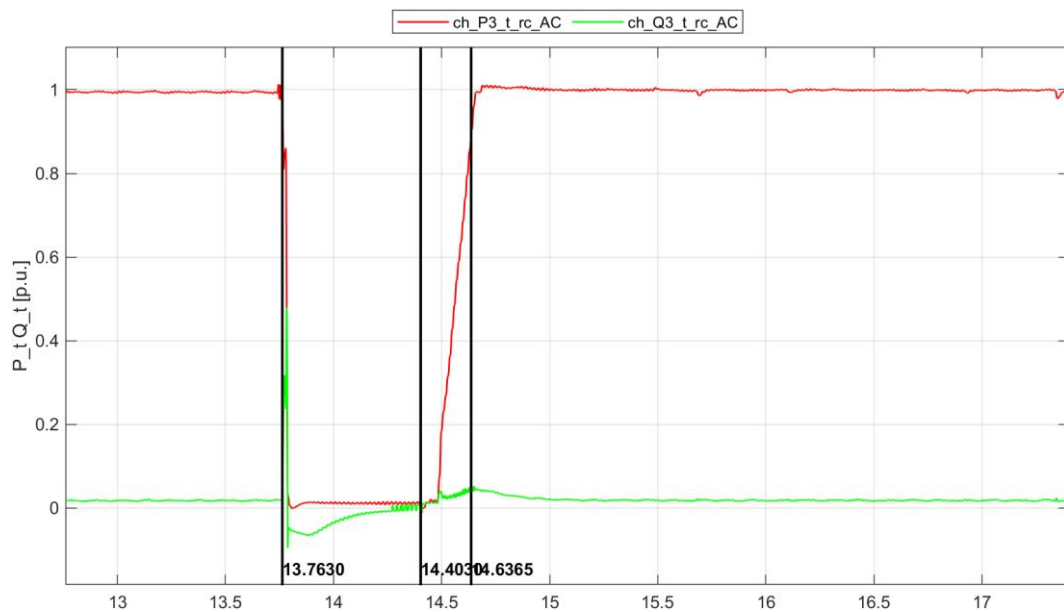
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



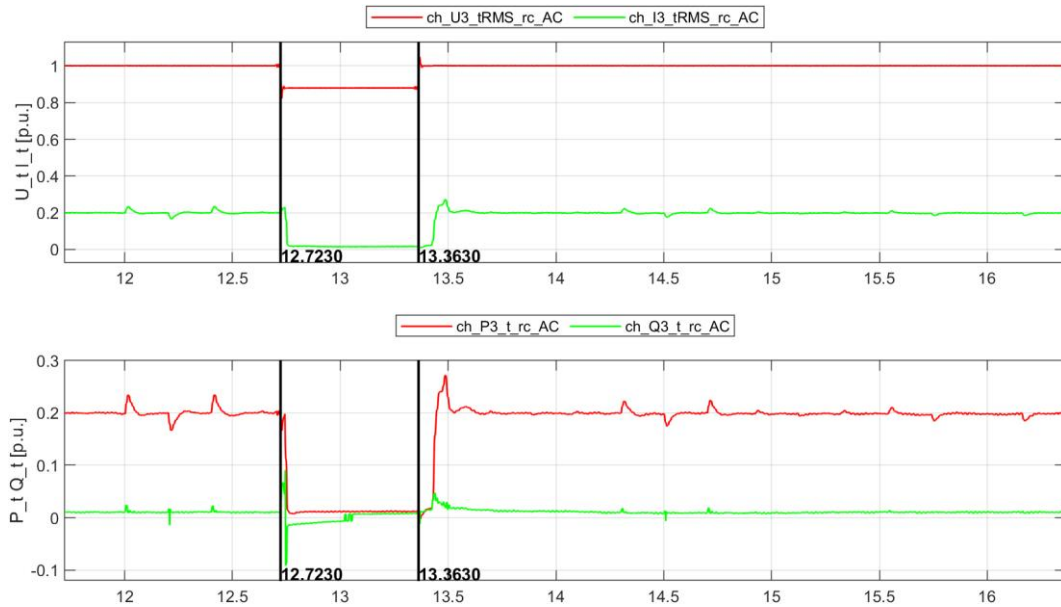
Test 2.3 Depth of fault phase: 0.25 p.u., two-phase SC (type D), 100% load, Power restore



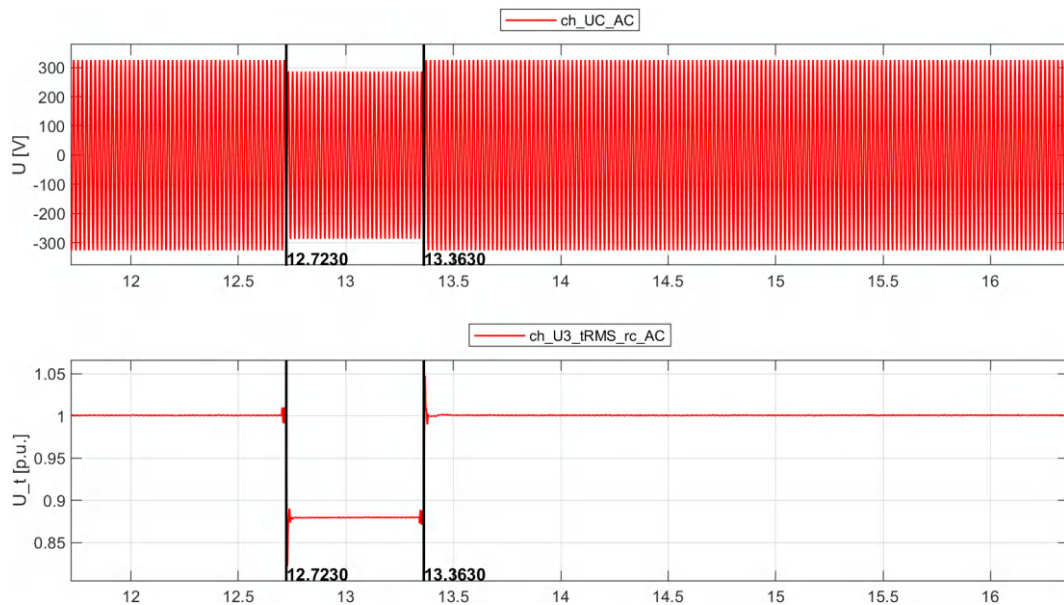
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



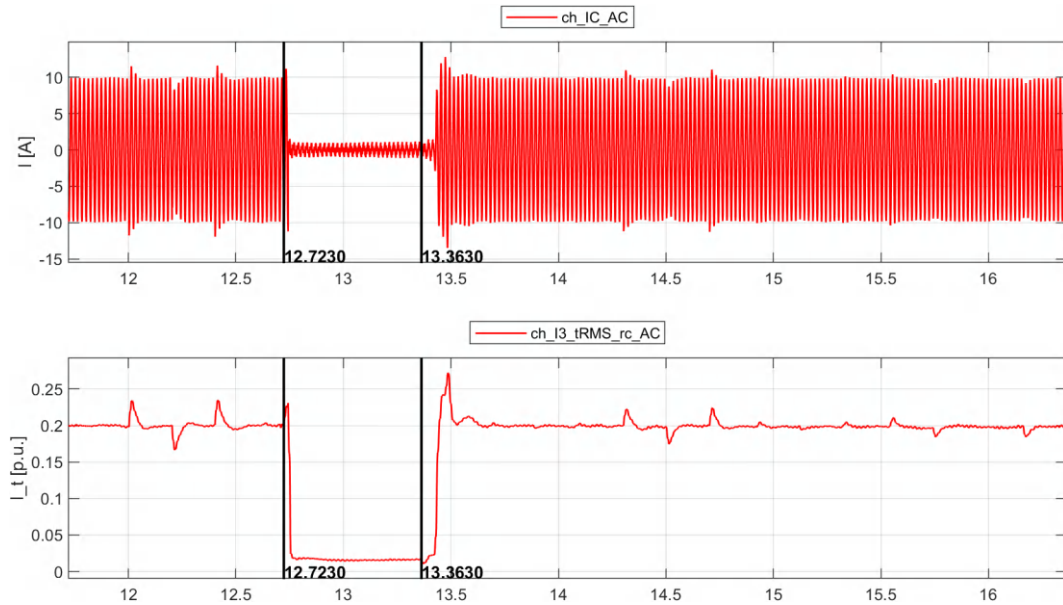
**Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



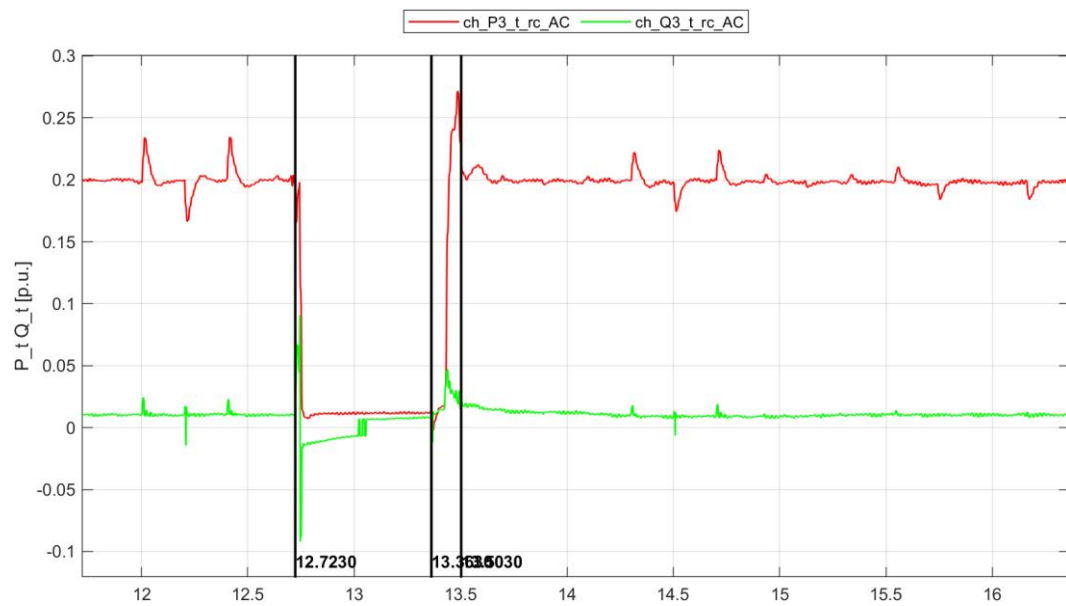
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 2.4 Depth of fault phase: 0.25 p.u., two-phase SC (type D), partial load, Power restore



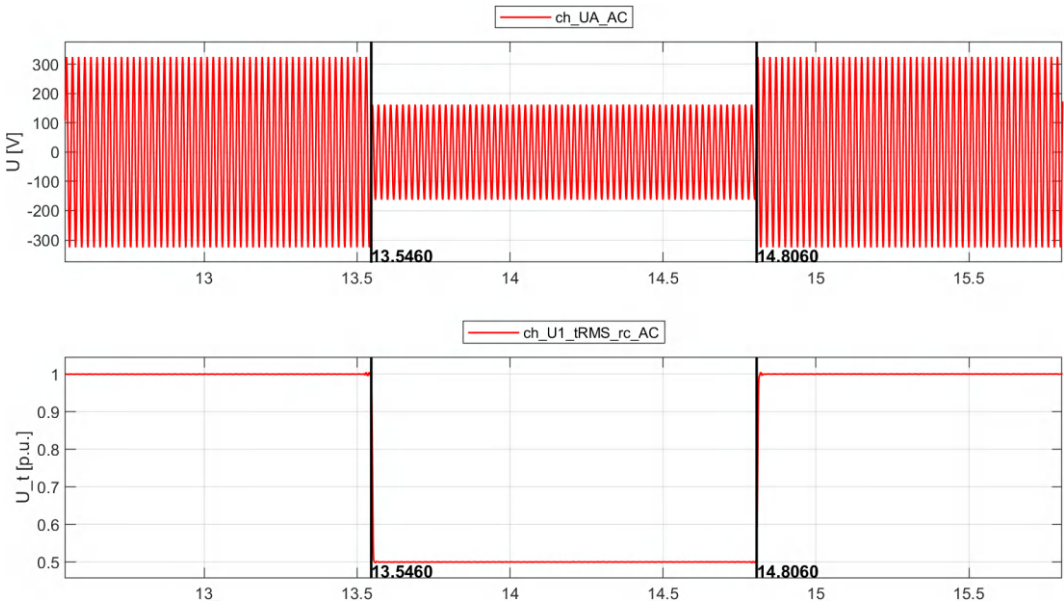
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3.1	3.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	11:03:23.1	11:20:18.5
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.50	0.50
	5	Setting dip duration		--	--	1260	1260
	6	Point of fault entry(t ₁)	Total	--	ms	13245	13157
	7	Point of fault clearance(t ₂)	Total	--	ms	14505	14418
	8	Fault duration in empty load test	Total	--	ms	1260	1260
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.500	0.500
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.201
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.500	0.500
	19	Line current	Phase 1	t1+60ms	p.u.	0.034	0.021
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.029	0.018
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.007	0.007
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.997	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.251	0.176
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

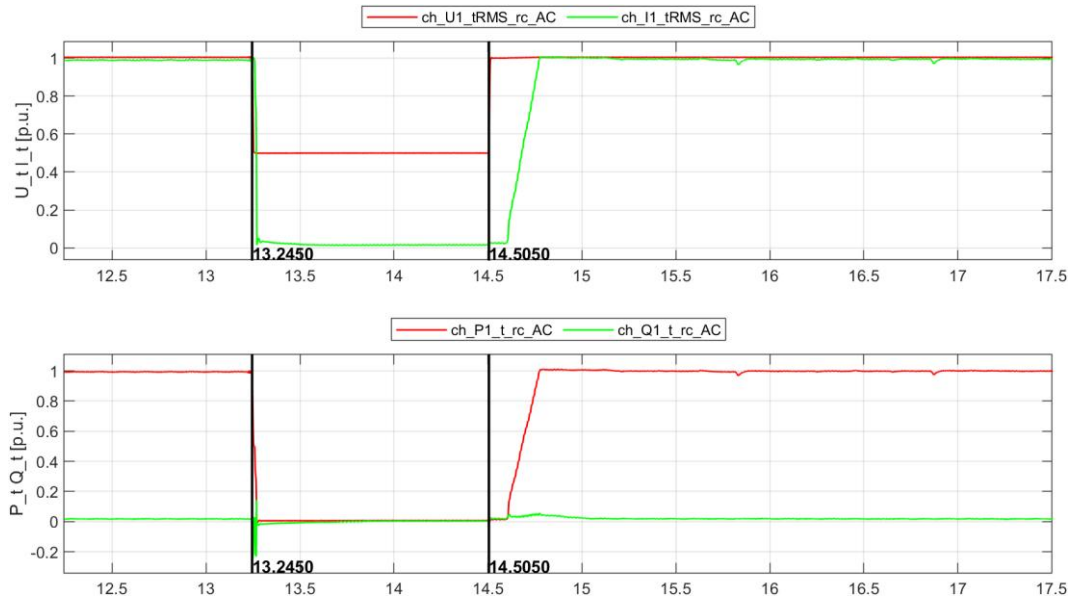
**Test 3.0a Depth of fault phase: 0.50 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



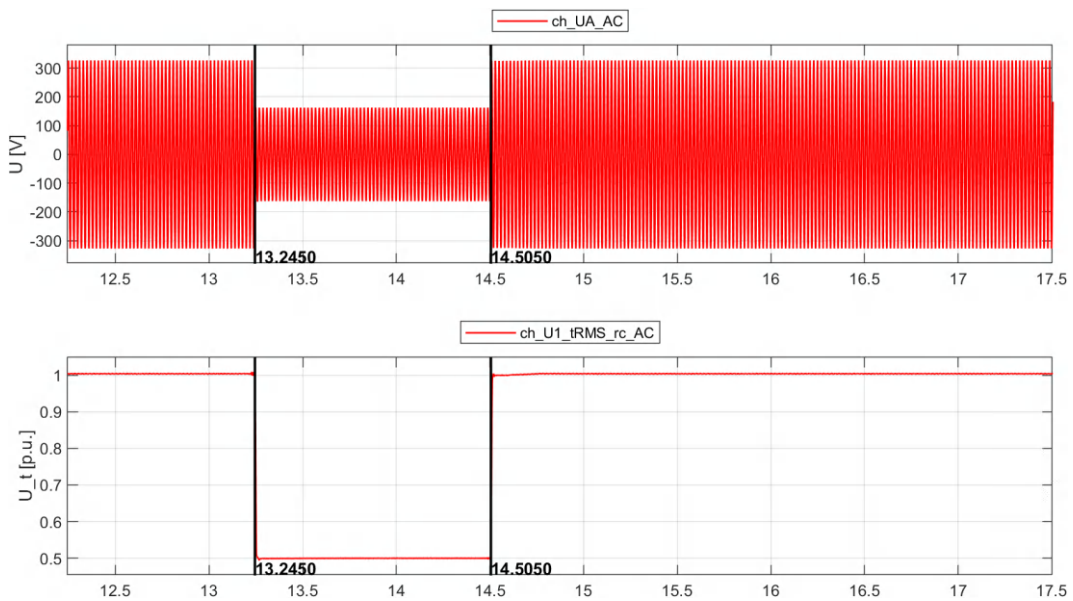
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



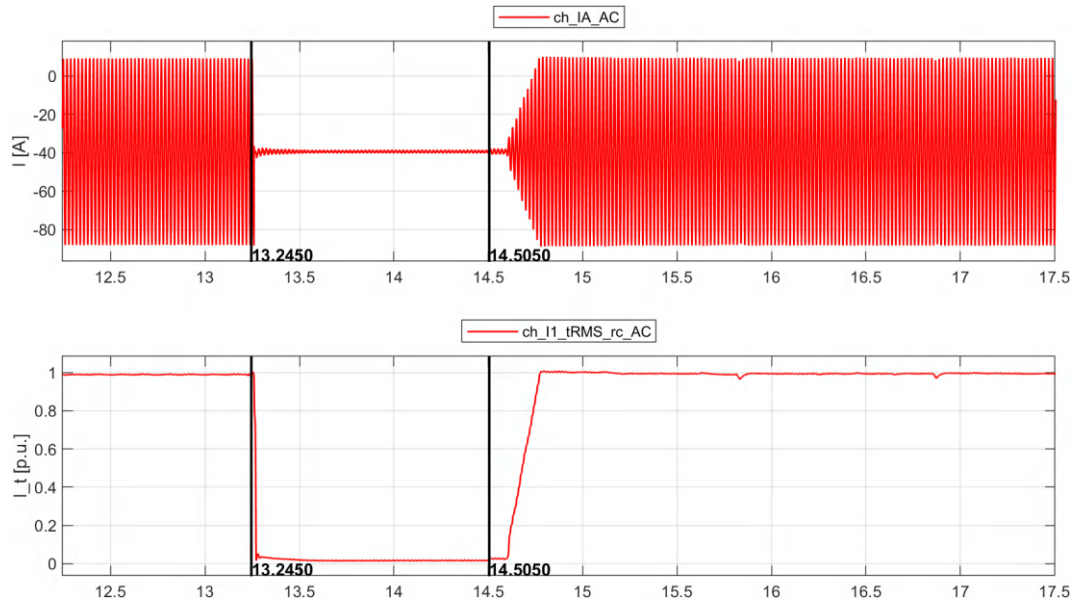
**Test 3.1 Depth of fault phase: 0.50 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



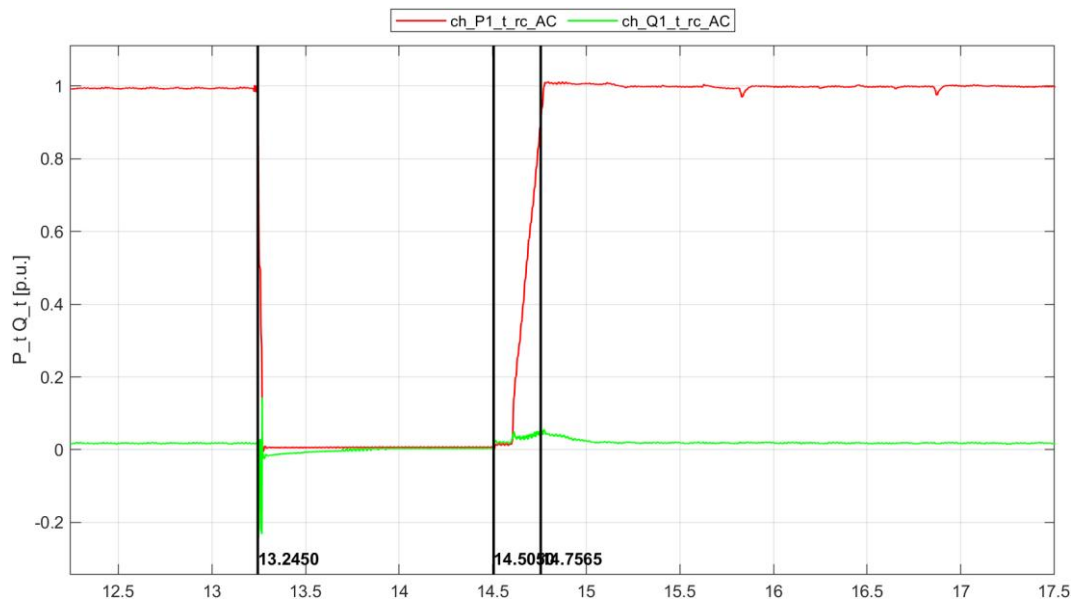
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



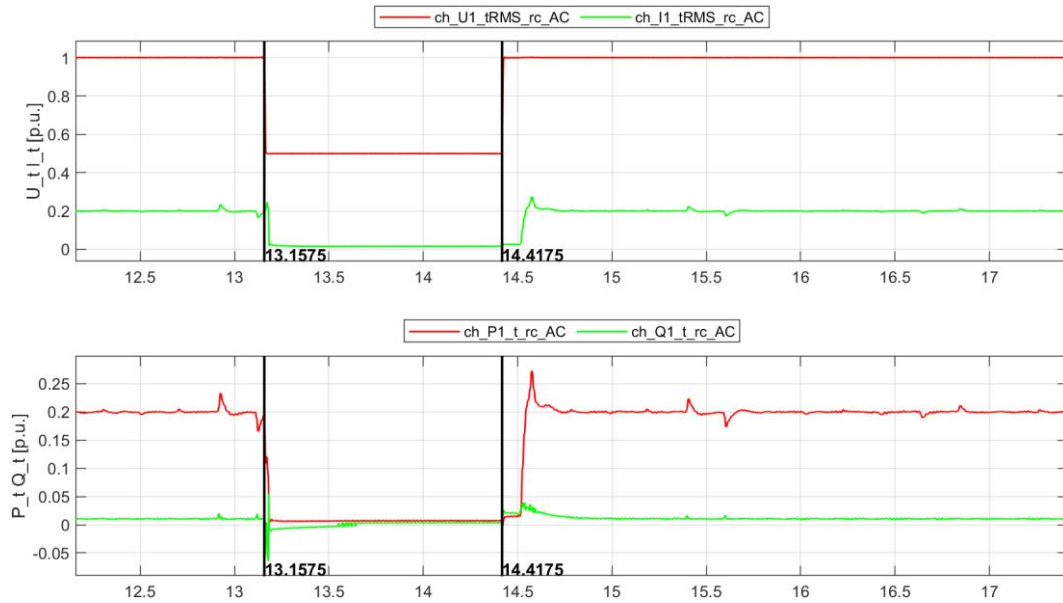
Test 3.1 Depth of fault phase: 0.50 p.u., three-phase SC (type A), 100% load, Power restore



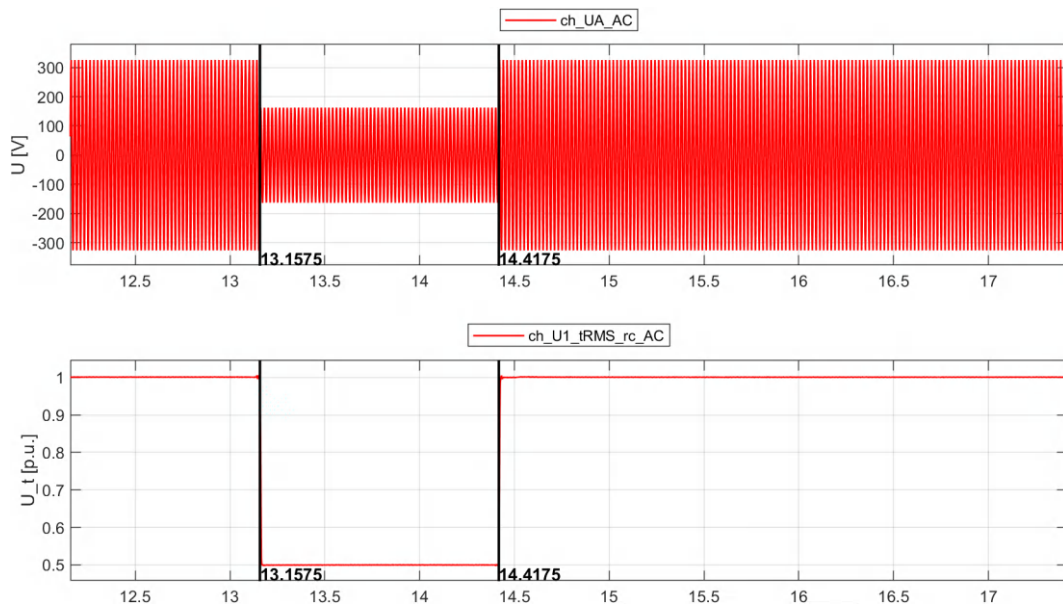
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



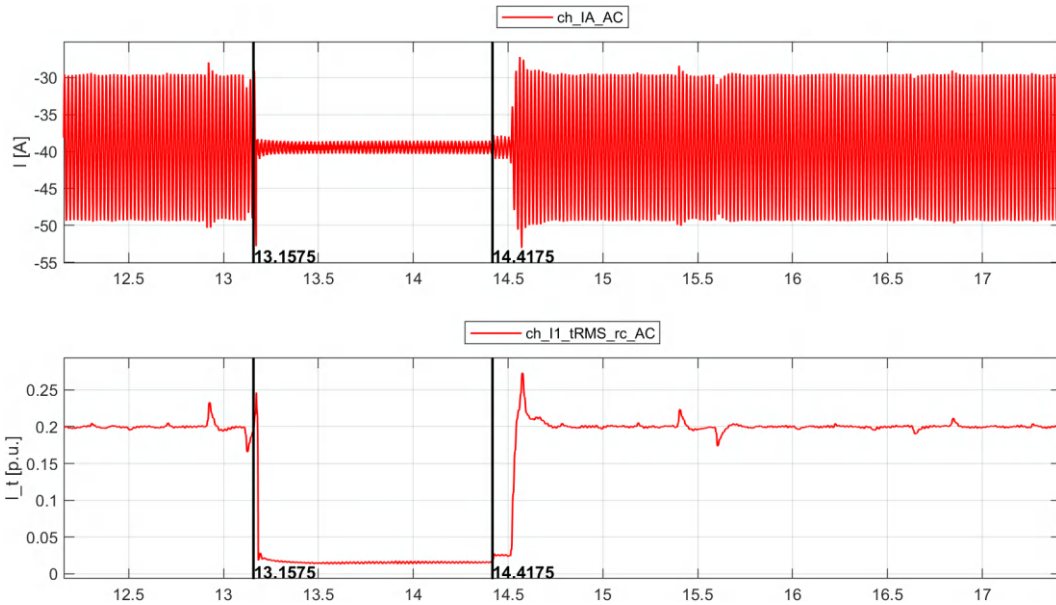
**Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



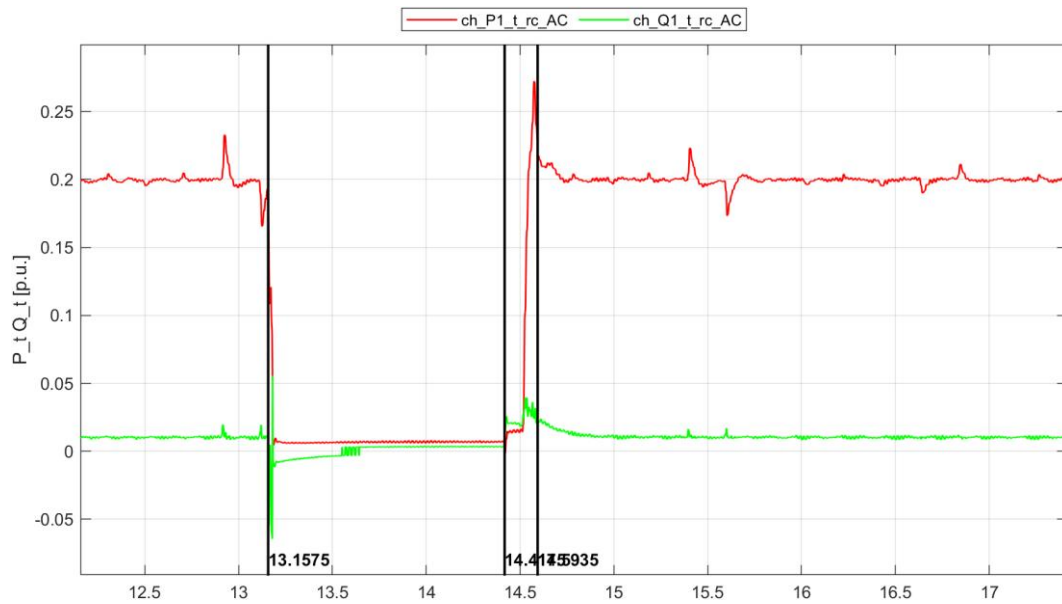
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 3.2 Depth of fault phase: 0.50 p.u., three-phase SC (type A), partial load, Power restore



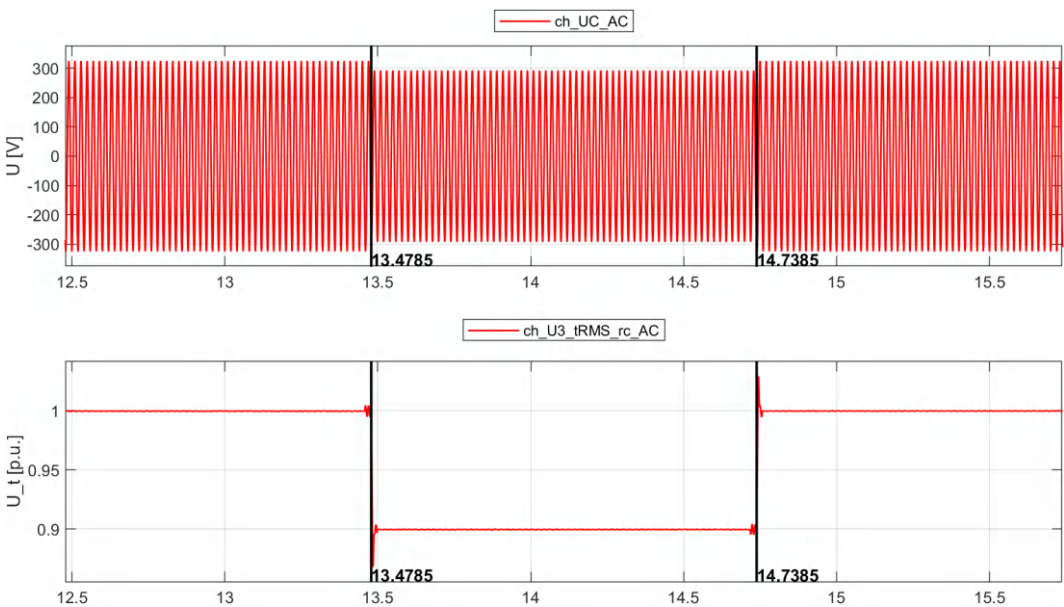
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	3.3	3.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:02:15.0	17:02:13.7
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.50	0.50
	5	Setting dip duration		--	--	1260	1260
	6	Point of fault entry(t_1)	Total	--	ms	12752	13248
	7	Point of fault clearance(t_2)	Total	--	ms	14012	14507
	8	Fault duration in empty load test	Total	--	ms	1260	1260
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.900	0.900
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.197
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.198
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.900	0.900
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.038	0.017
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.055	0.017
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.012	0.012
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.997	0.197
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.191	0.115
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

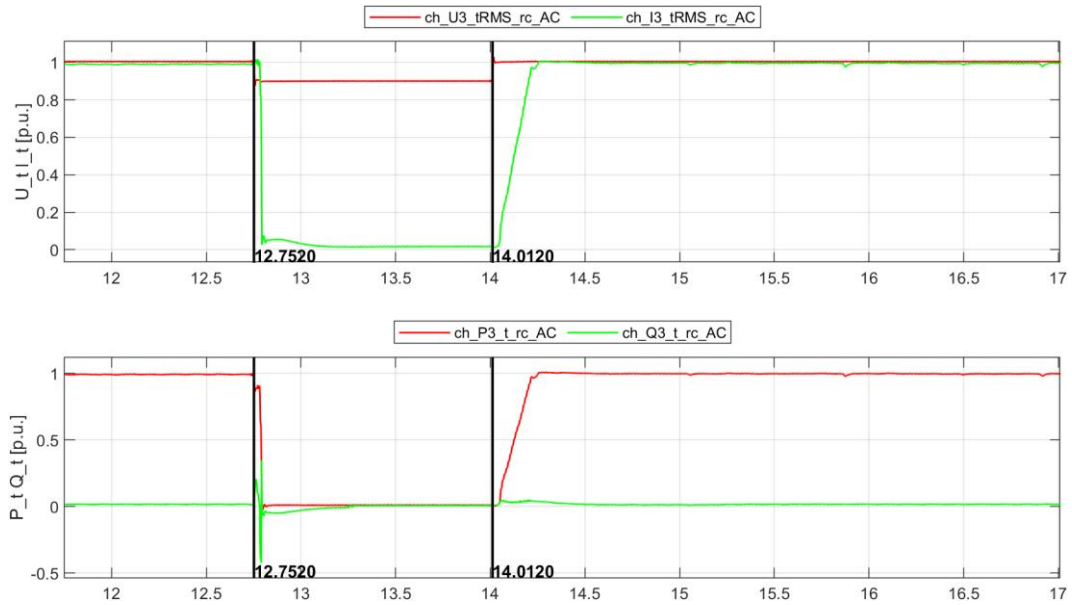
Test 3.0d1 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



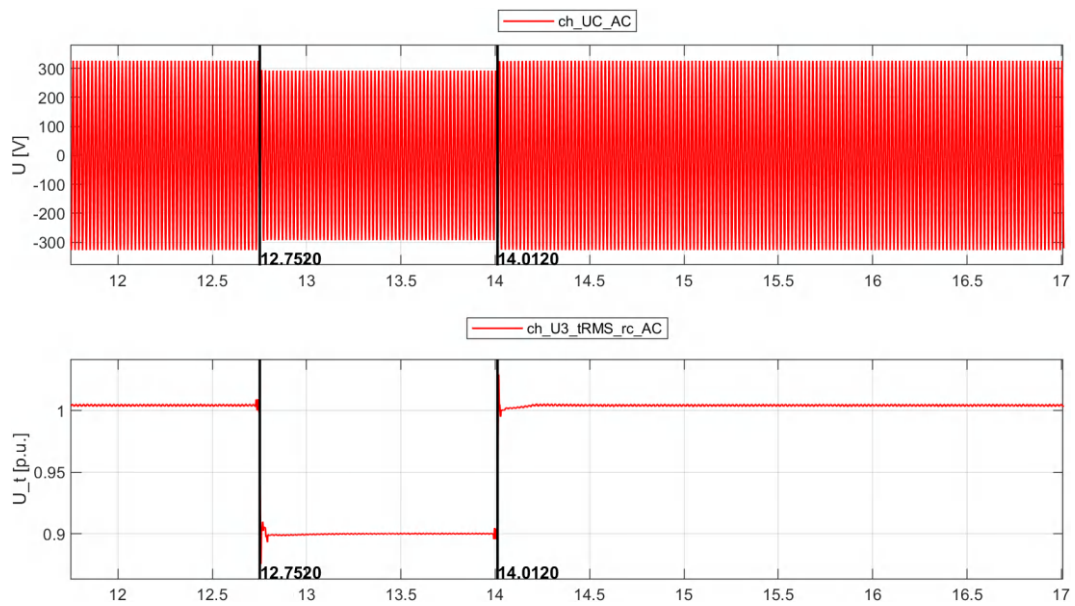
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



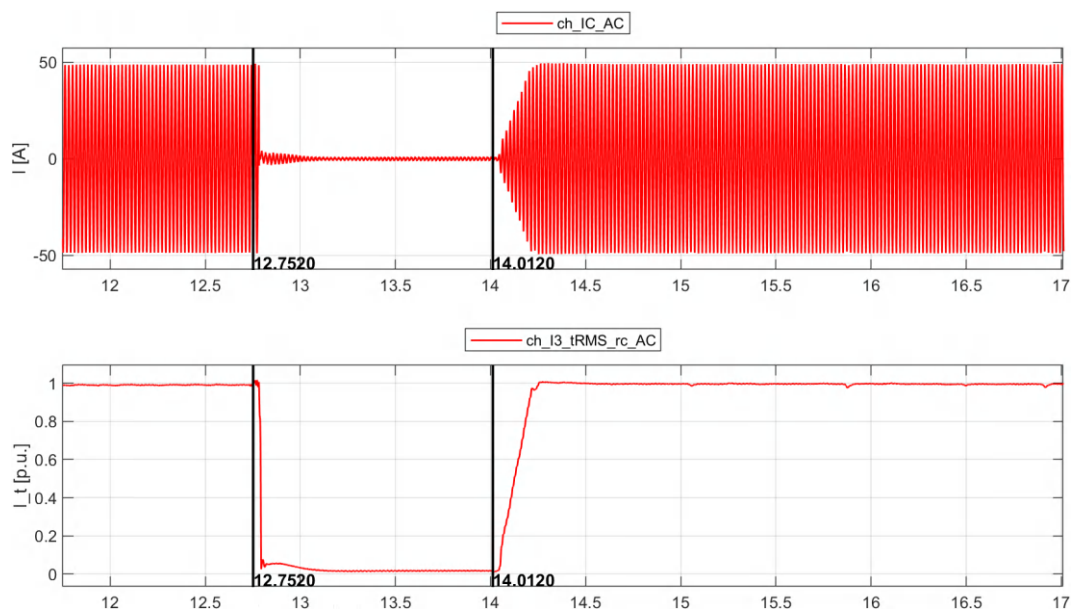
**Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



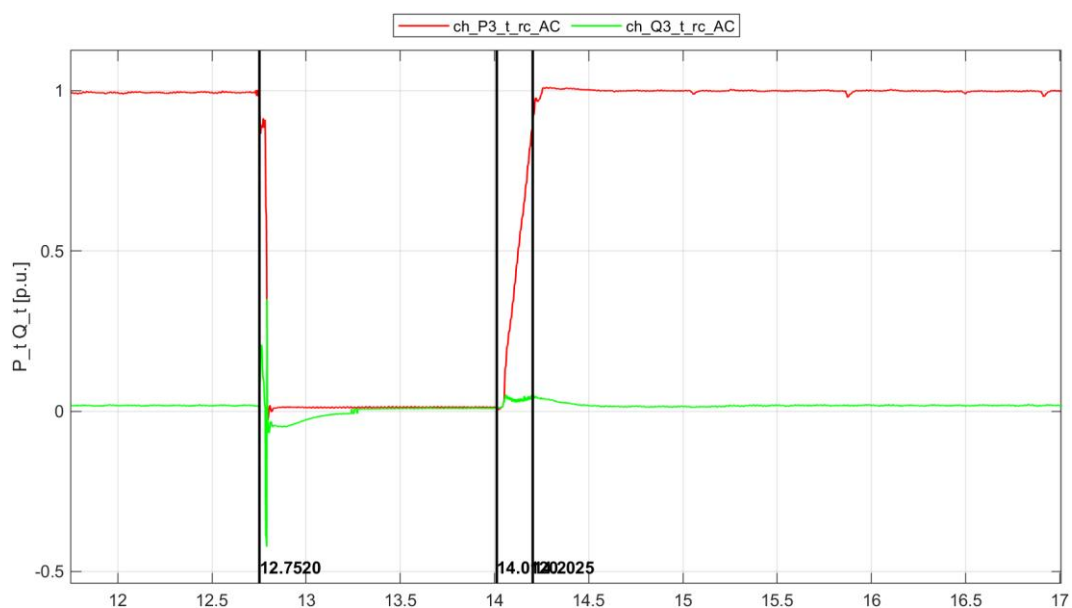
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



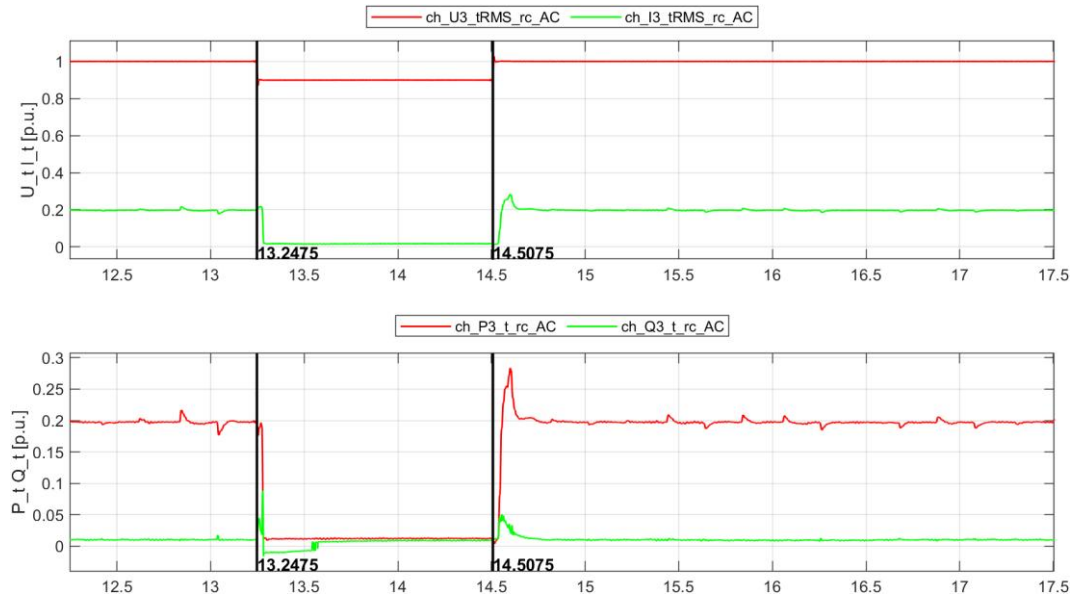
Test 3.3 Depth of fault phase: 0.50 p.u., two-phase SC (type D), 100% load, Power restore



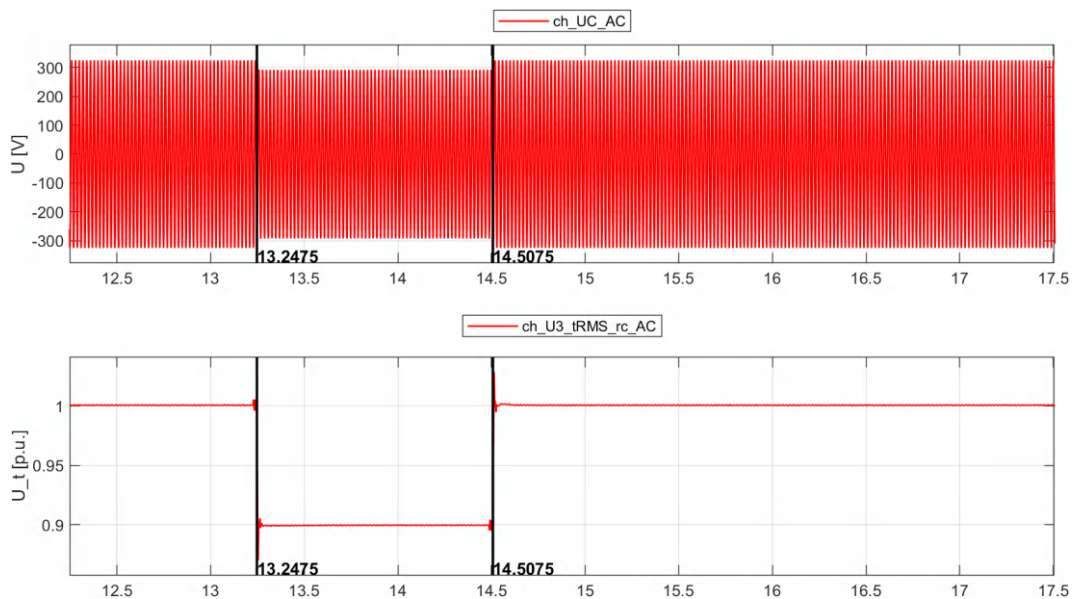
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



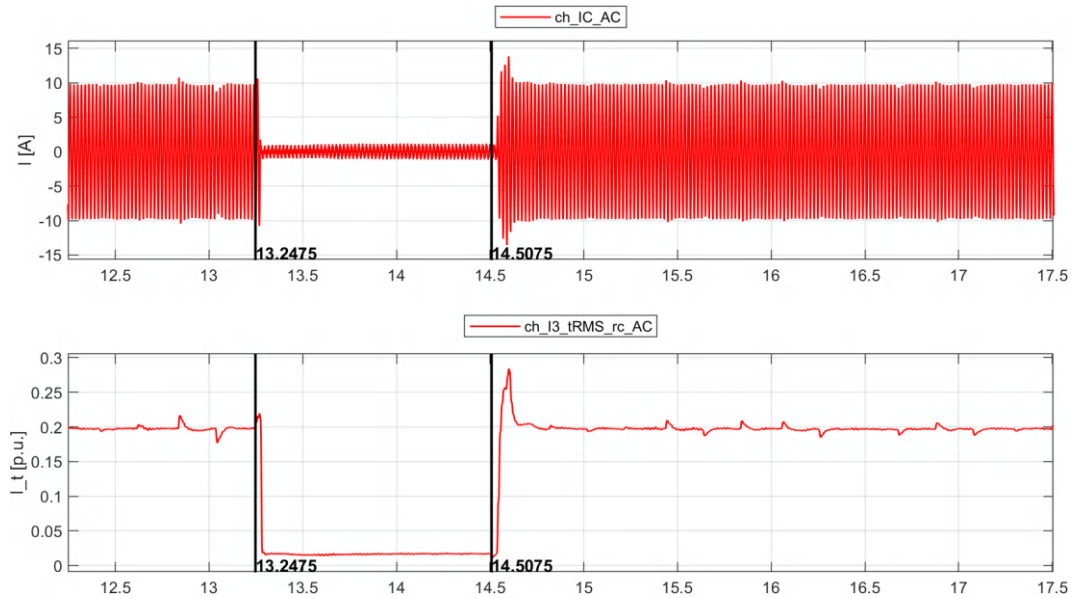
**Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



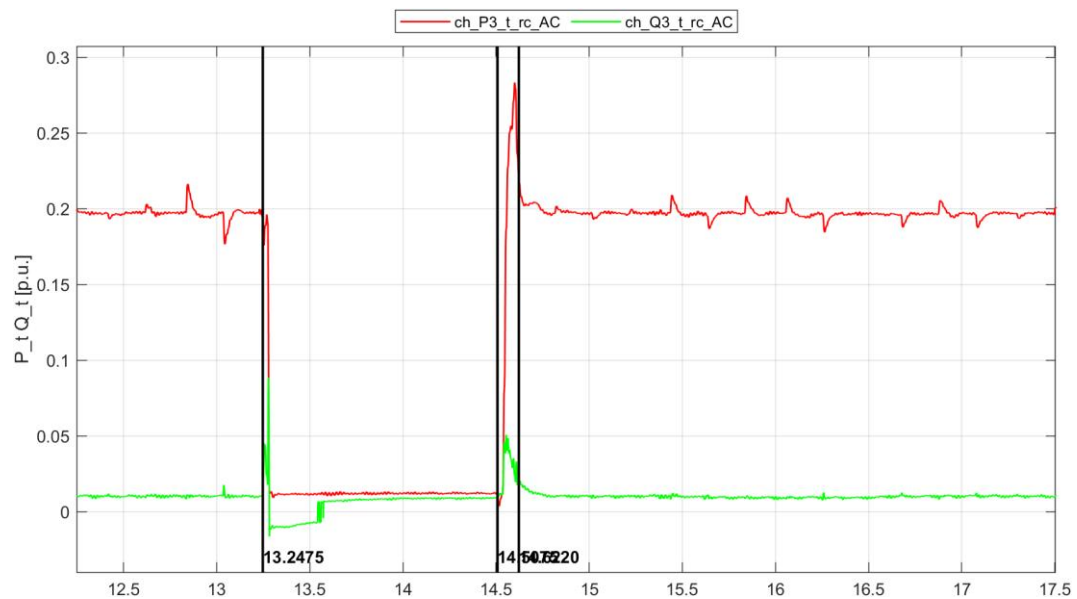
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 3.4 Depth of fault phase: 0.50 p.u., two-phase SC (type D), partial load, Power restore



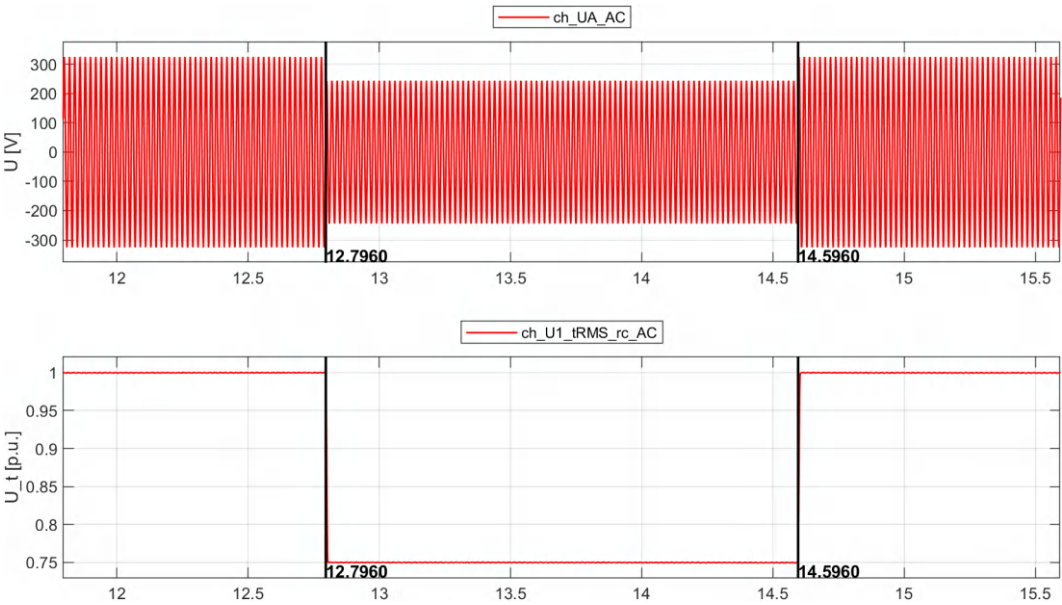
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	4.1	4.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	10:55:59.8	11:21:48.6
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.75	0.75
	5	Setting dip duration		--	--	1800	1800
	6	Point of fault entry(t ₁)	Total	--	ms	13312	12785
	7	Point of fault clearance(t ₂)	Total	--	ms	15112	14584
	8	Fault duration in empty load test	Total	--	ms	1800	1800
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.750	0.750
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	0.750	0.750
	19	Line current	Phase 1	t1+60ms	p.u.	0.027	0.016
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.028	0.015
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.010	0.010
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.996	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.242	0.145
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

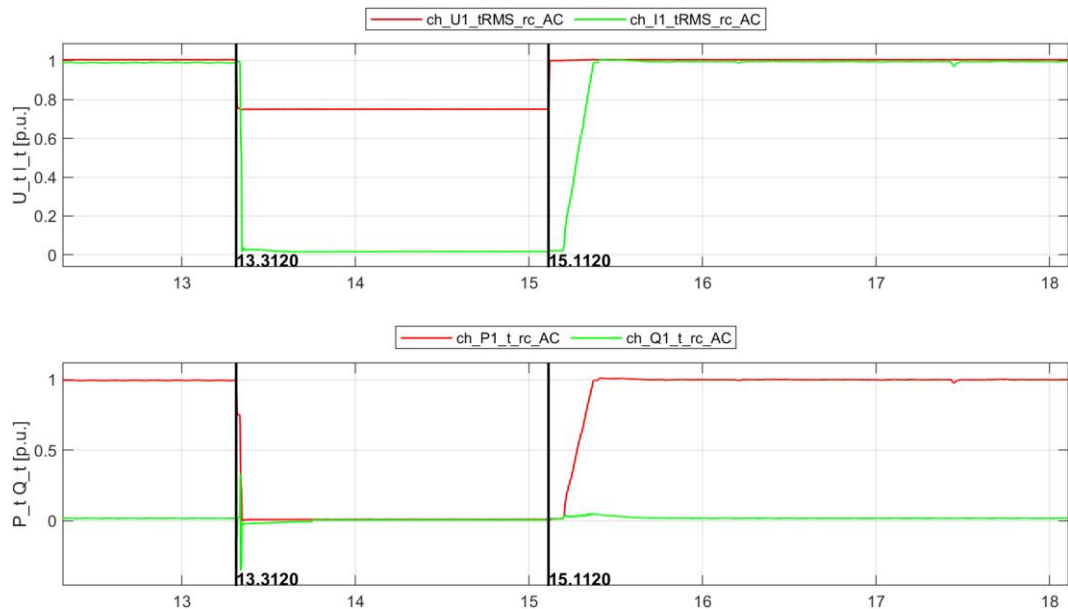
**Test 4.0a Depth of fault phase: 0.75 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



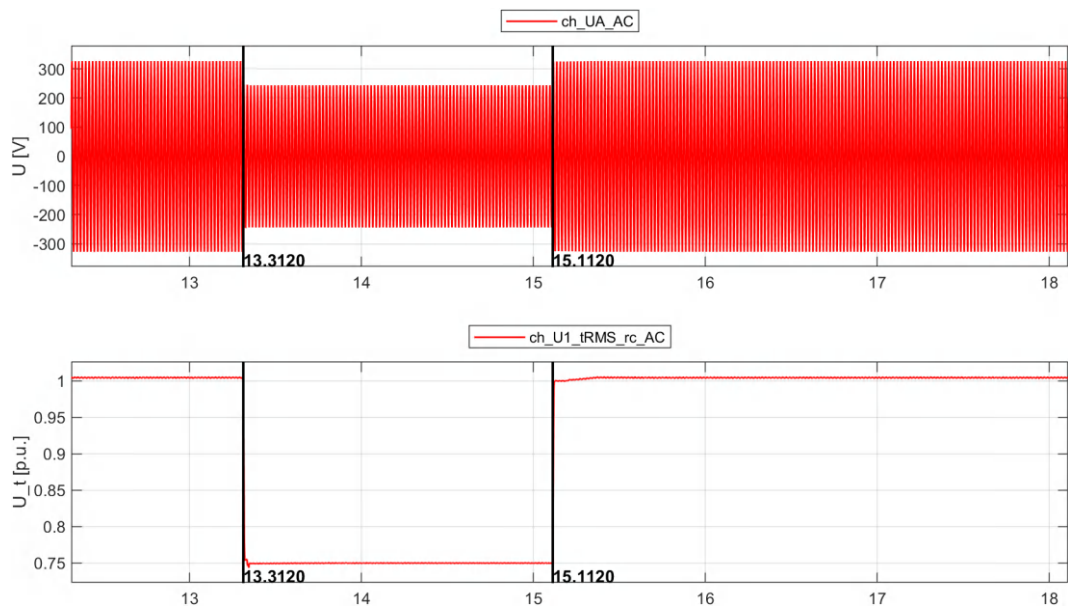
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



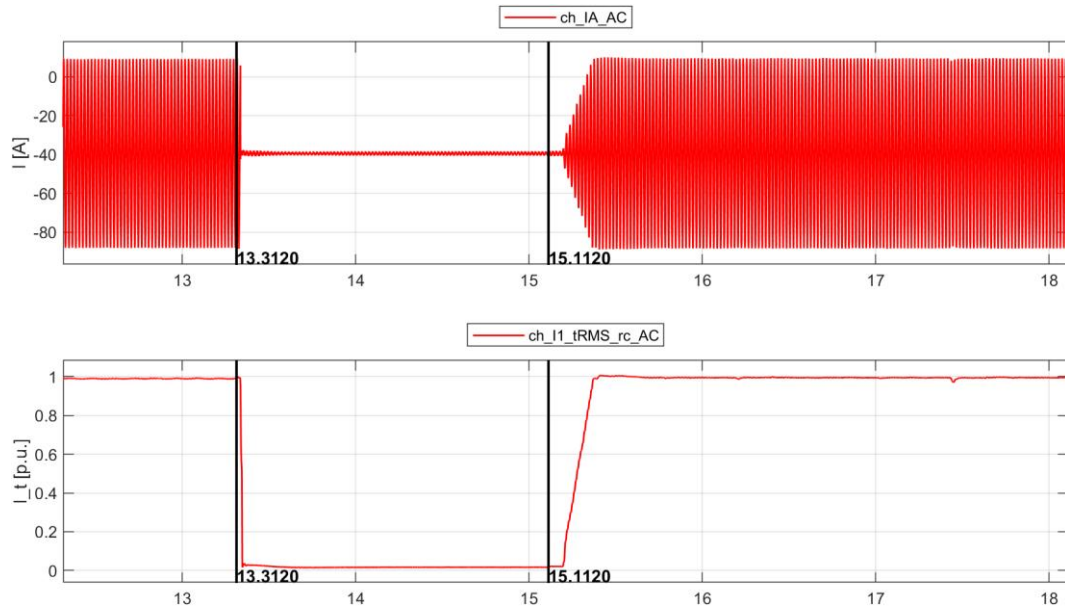
**Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



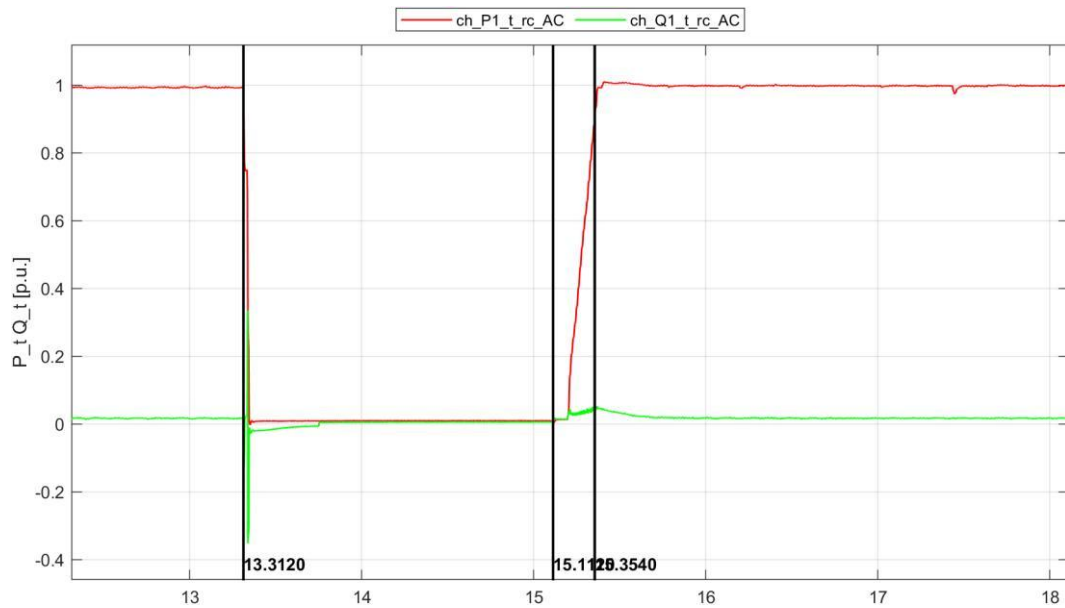
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



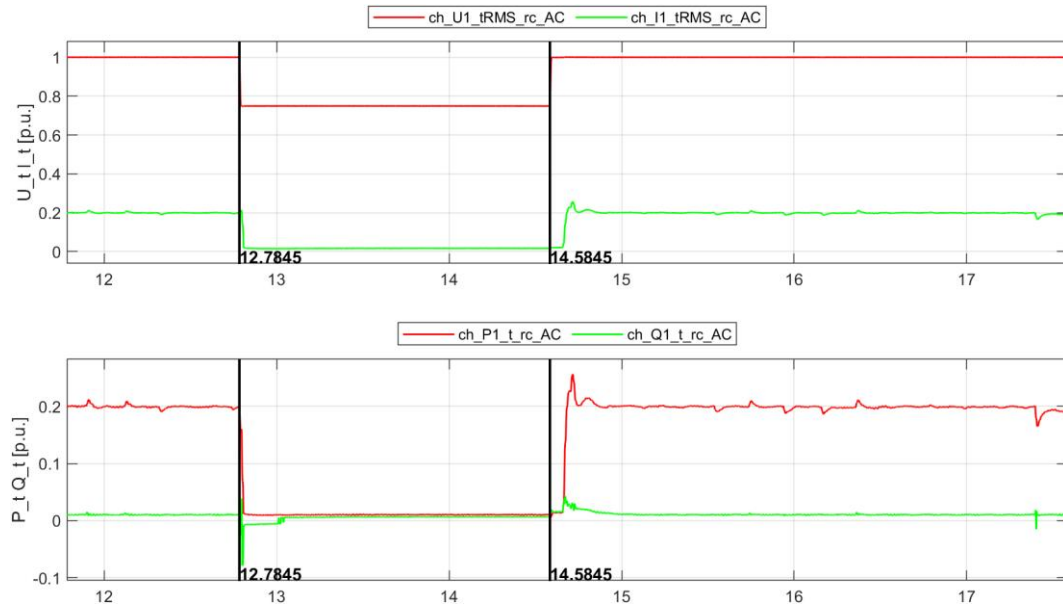
Test 4.1 Depth of fault phase: 0.75 p.u., three-phase SC (type A), 100% load, Power restore



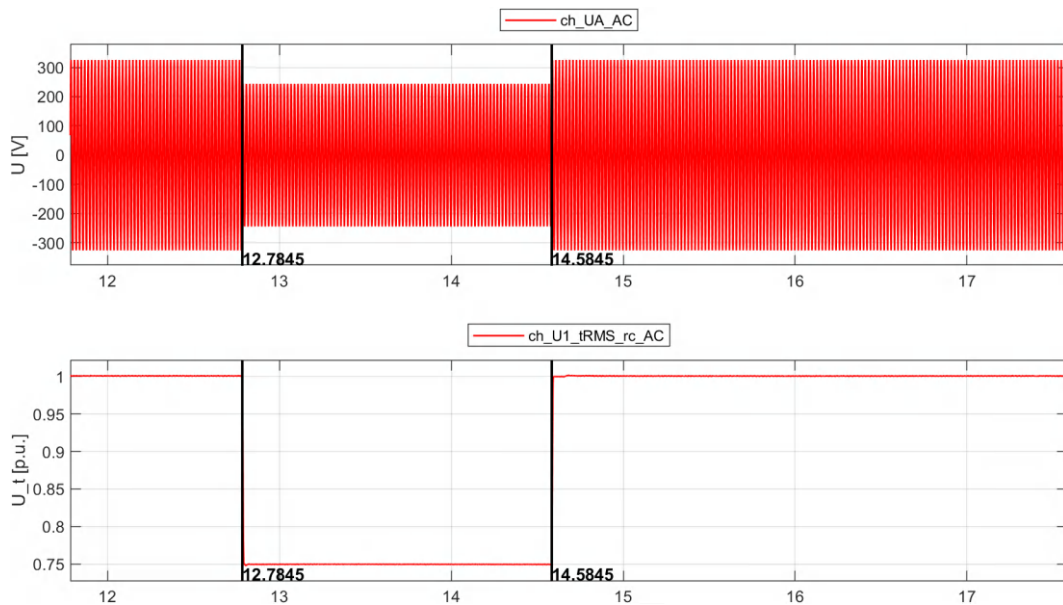
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



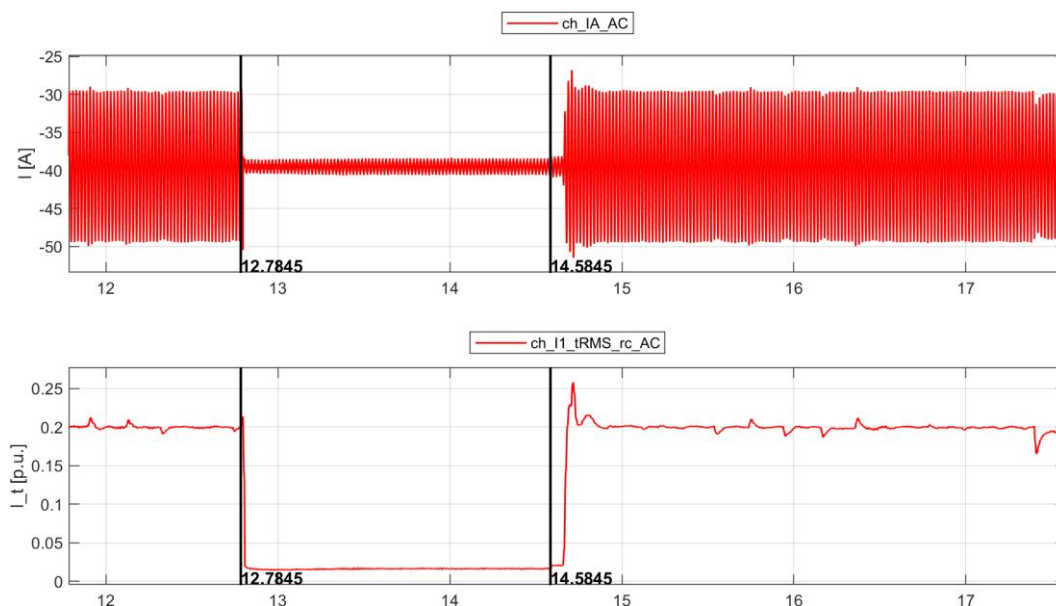
**Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



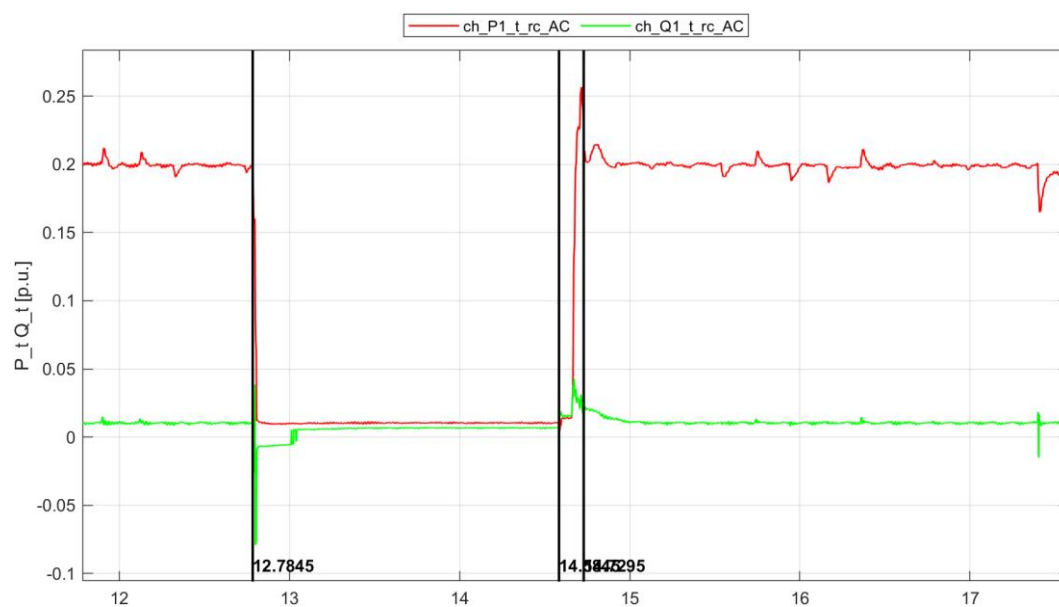
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 4.2 Depth of fault phase: 0.75 p.u., three-phase SC (type A), partial load, Power restore



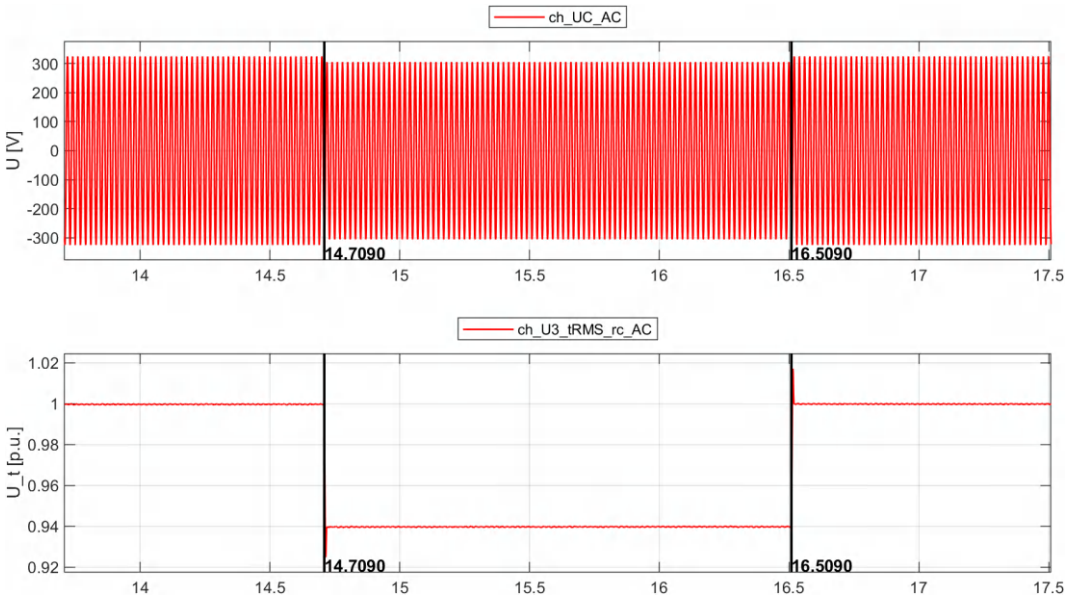
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	4.3	4.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:06:13.3	16:50:53.9
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.75	0.75
	5	Setting dip duration		--	--	1800	1800
	6	Point of fault entry(t_1)	Total	--	ms	12806	13416
	7	Point of fault clearance(t_2)	Total	--	ms	14606	15216
	8	Fault duration in empty load test	Total	--	ms	1800	1800
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms}$ to t_2 and $t_1-10\text{s}$ to t_1	p.u.	0.940	0.940
	10		Pos.			N/A	N/A
Before dip $< t_1$	11	Voltage	Line to neutral	$t_1-100\text{s}$ to t_1	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms}$ to $t_1-100\text{ms}$	p.u.	0.990	0.198
	13	Active power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	$\text{Cos}\phi$	--	$t_1-10\text{s}$ to t_1	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.944	0.941
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.971	0.215
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	1.049	0.214
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.996	0.199
	26		Pos.			N/A	N/A
After dip $> t_2$	27	Voltage	Line to neutral	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.995	0.196
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.421
	31	Reactive power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

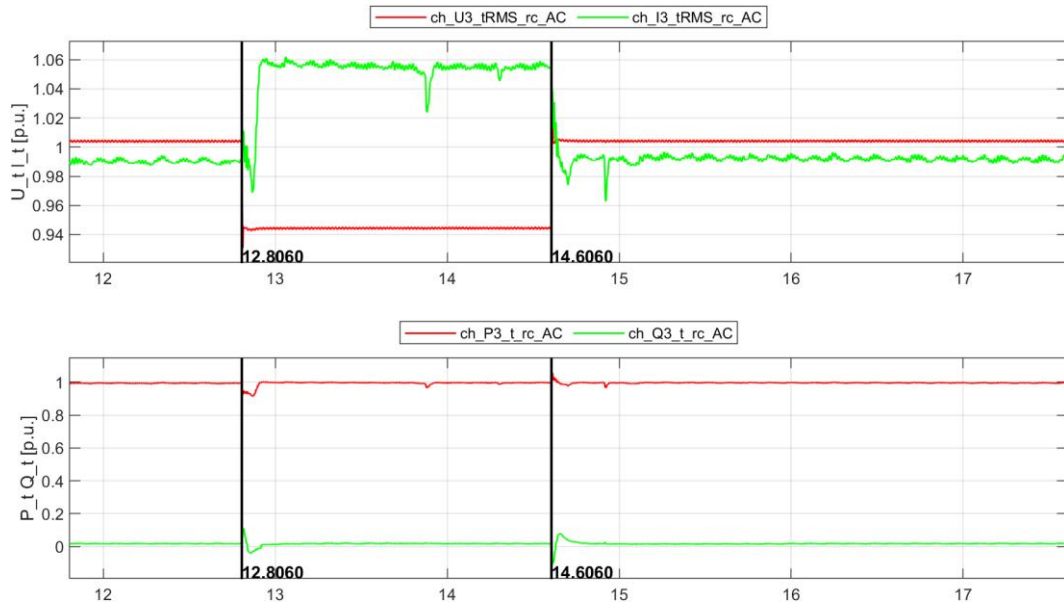
Test 4.0d1 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



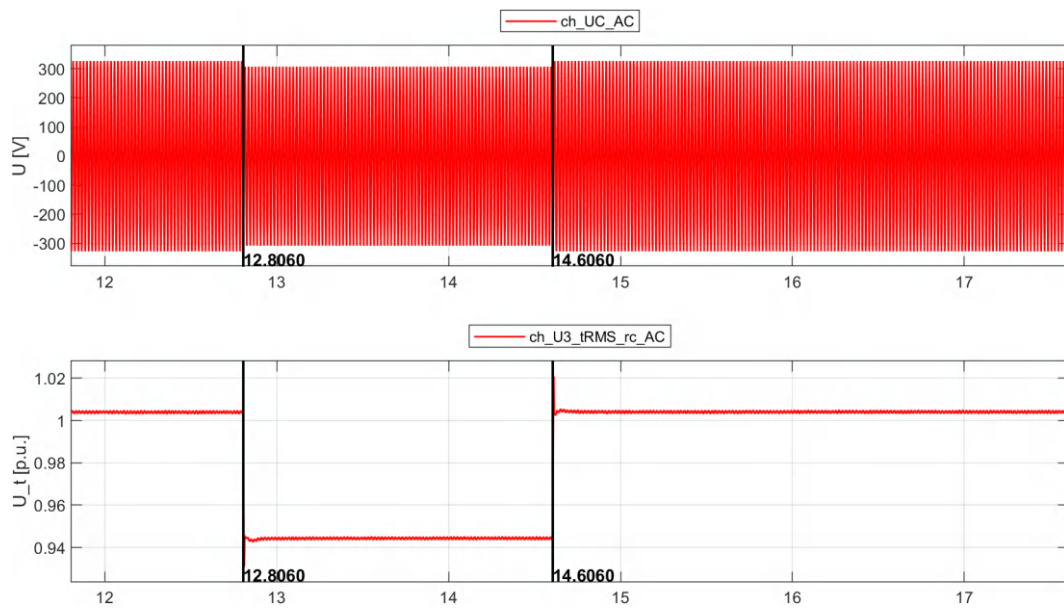
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



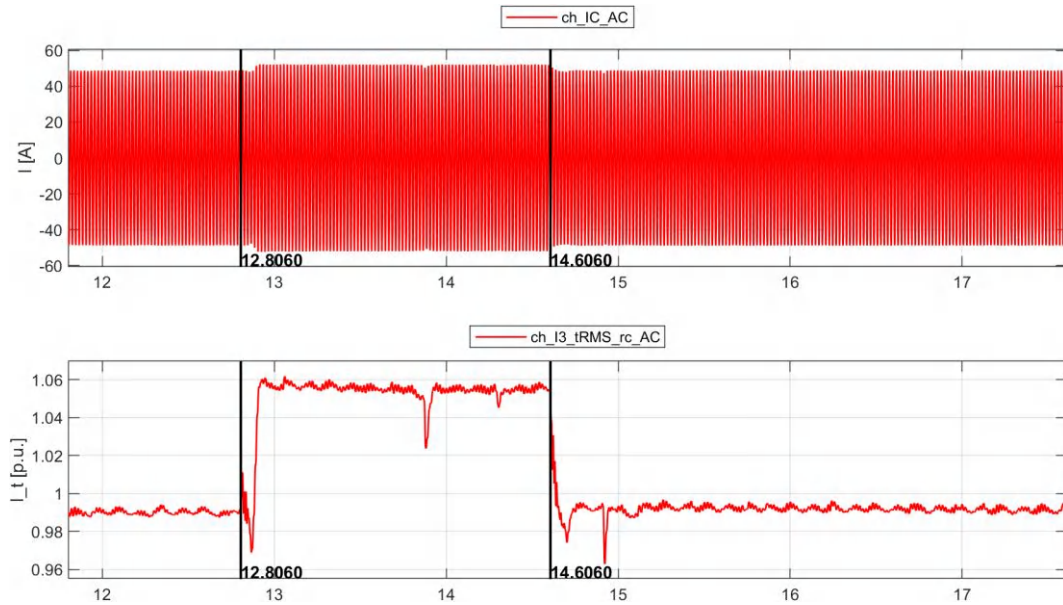
**Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



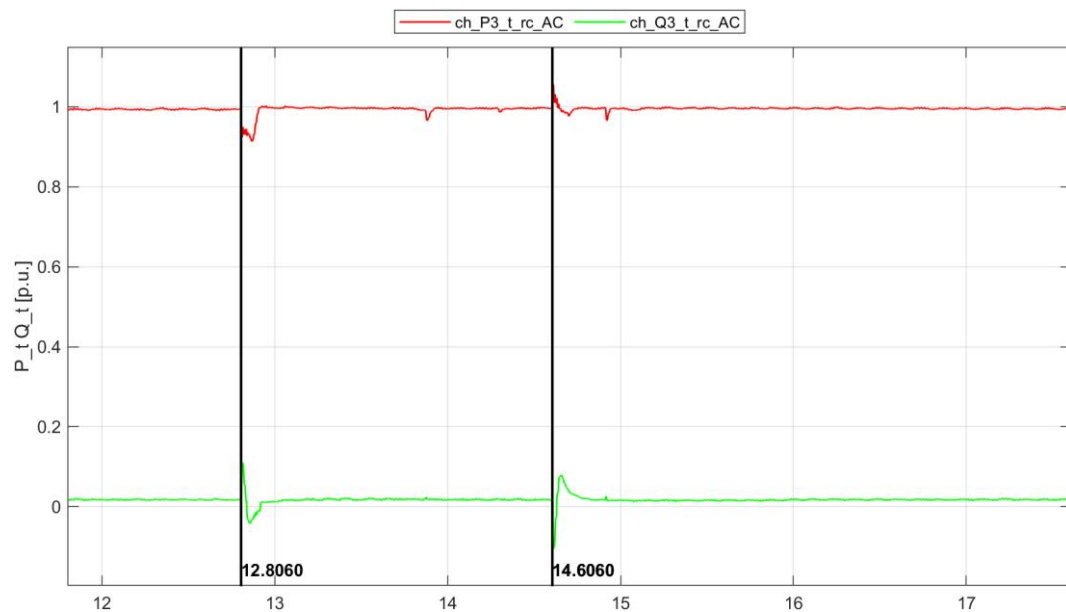
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



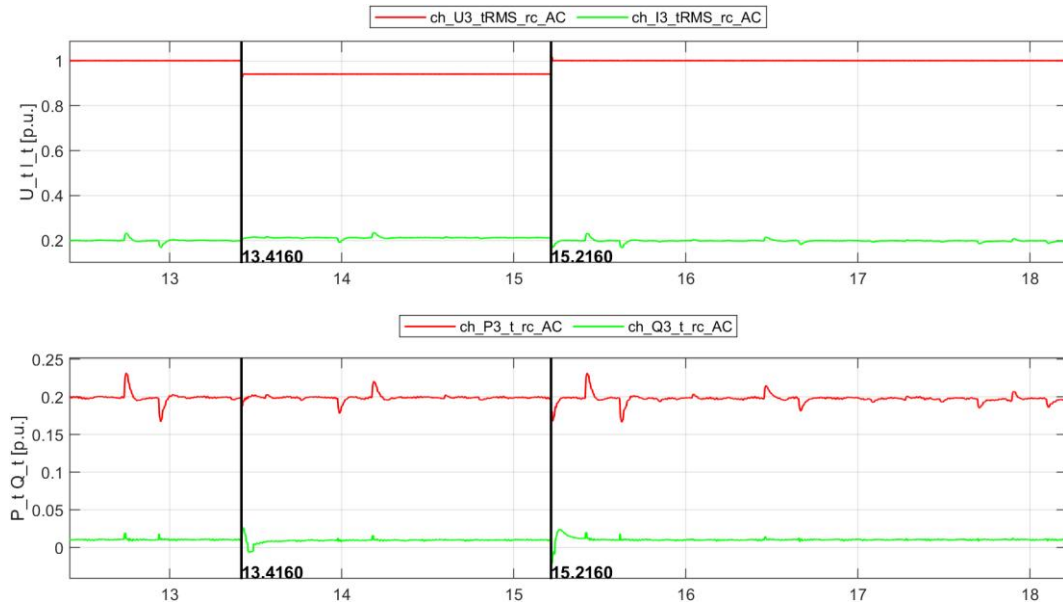
Test 4.3 Depth of fault phase: 0.75 p.u., two-phase SC (type D), 100% load, Power restore



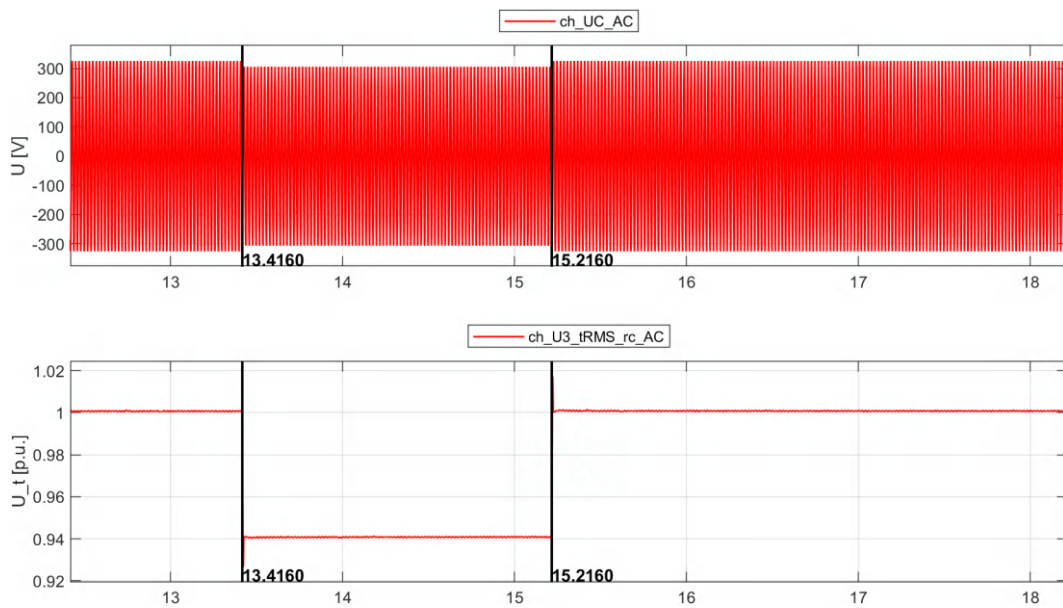
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



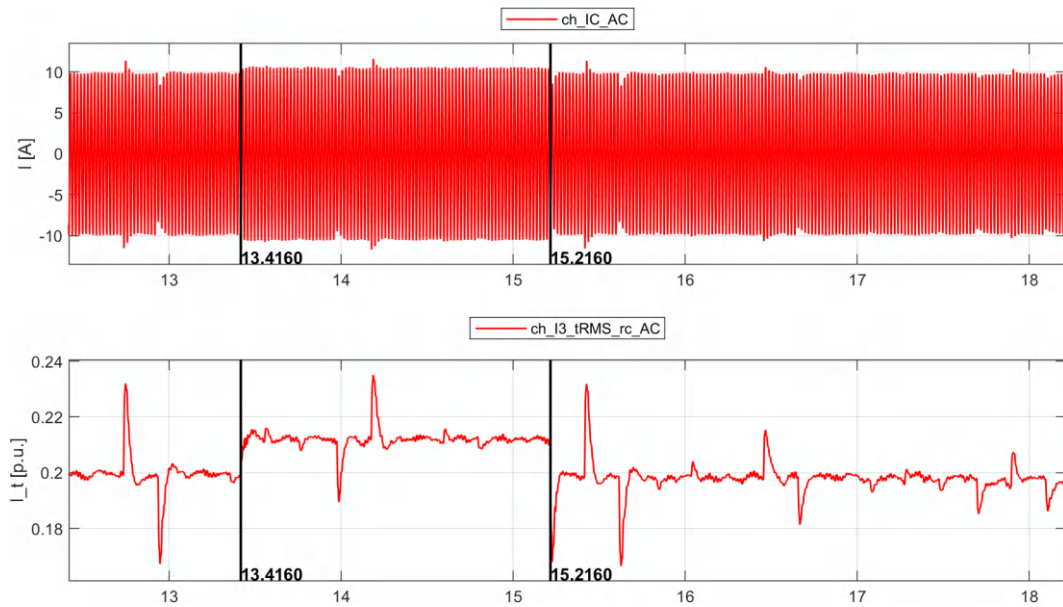
**Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



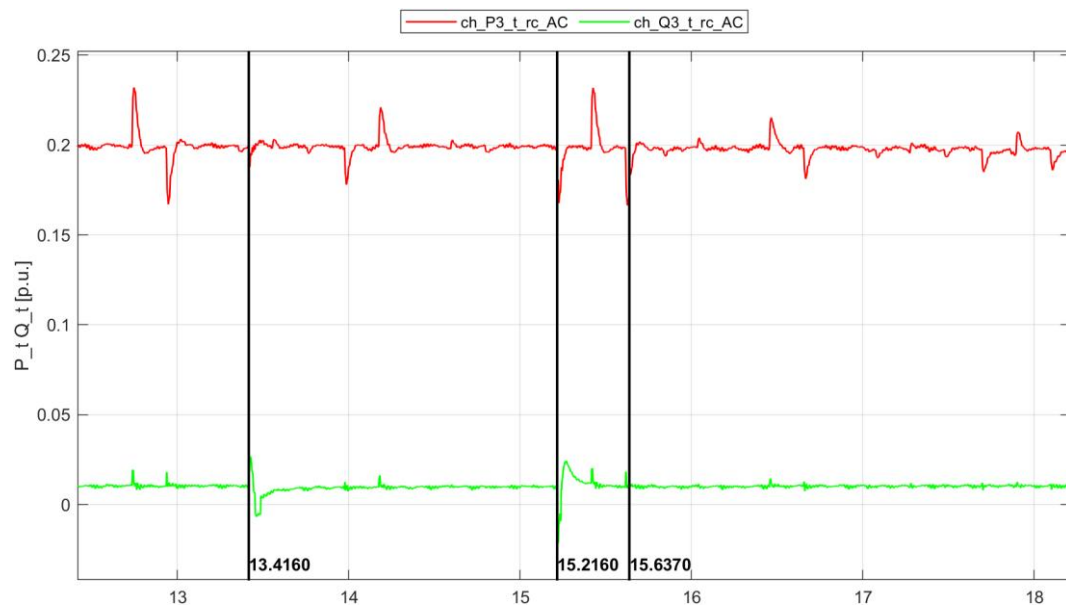
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 4.4 Depth of fault phase: 0.75 p.u., two-phase SC (type D), partial load, Power restore



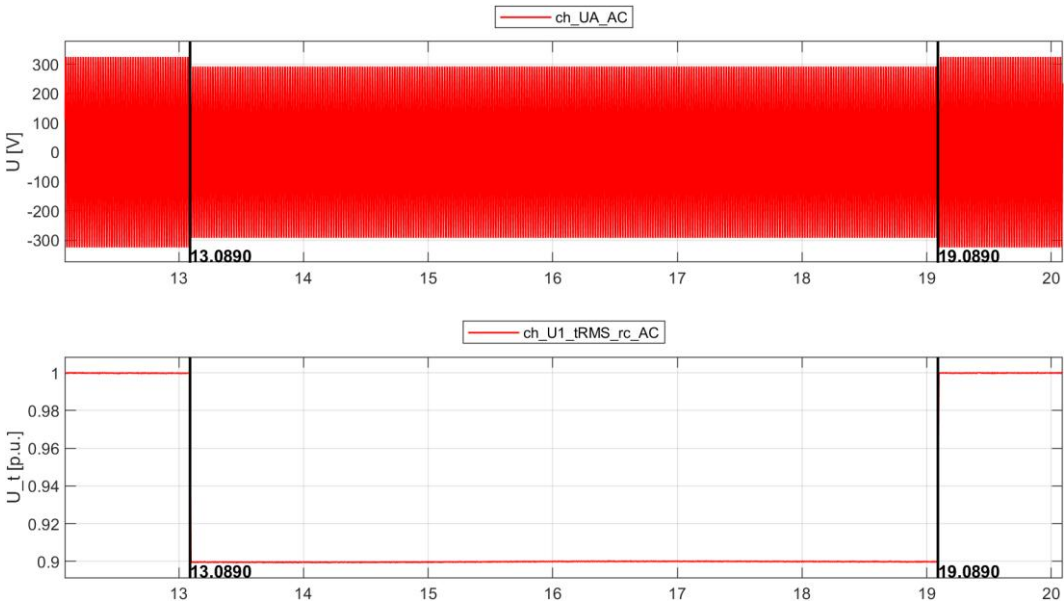
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	5.1	5.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	10:53:04.9	11:23:13.0
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	0.90	0.90
	5	Setting dip duration		--	--	6000	6000
	6	Point of fault entry(t_1)	Total	--	ms	12846	13676
	7	Point of fault clearance(t_2)	Total	--	ms	18846	19676
	8	Fault duration in empty load test	Total	--	ms	6000	6000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	0.900	0.900
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.200
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.905	0.901
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.971	0.226
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	1.082	0.223
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.993	0.199
	26		Pos.			N/A	N/A
After dip > t_2	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.998	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

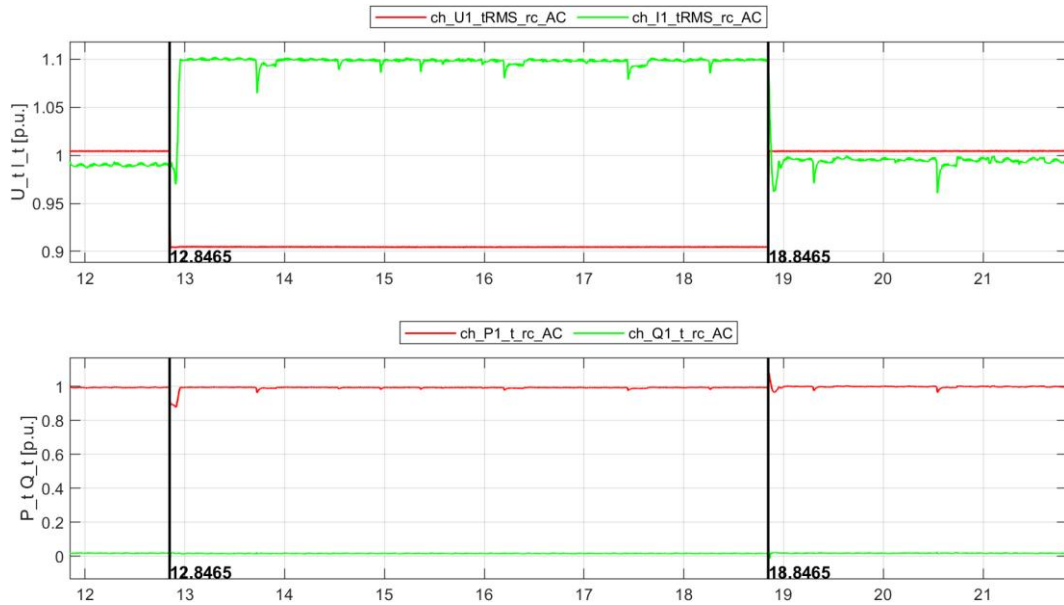
**Test 5.0a Depth of fault phase: 0.9 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



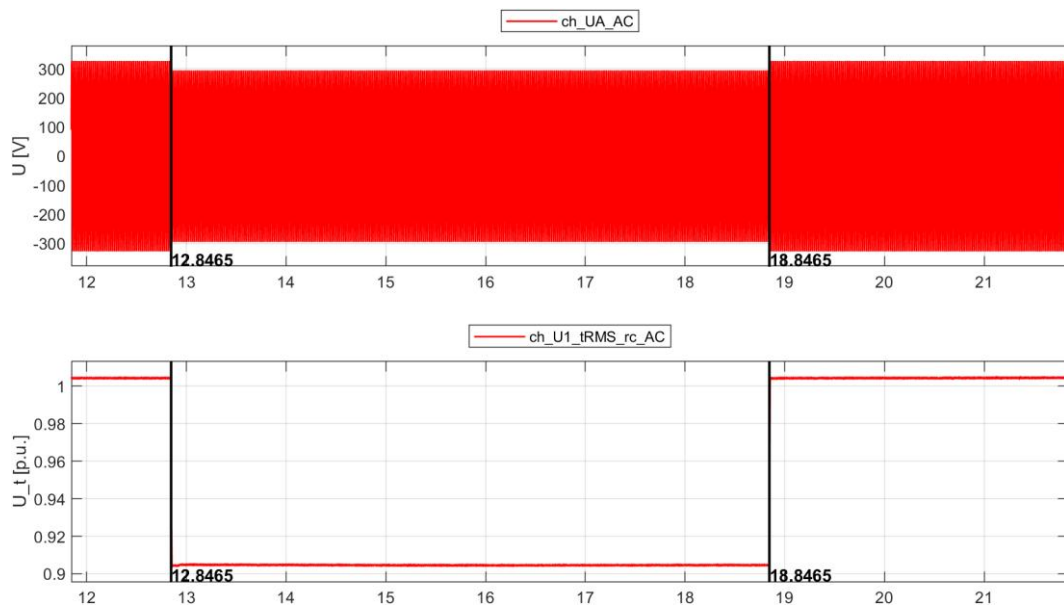
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



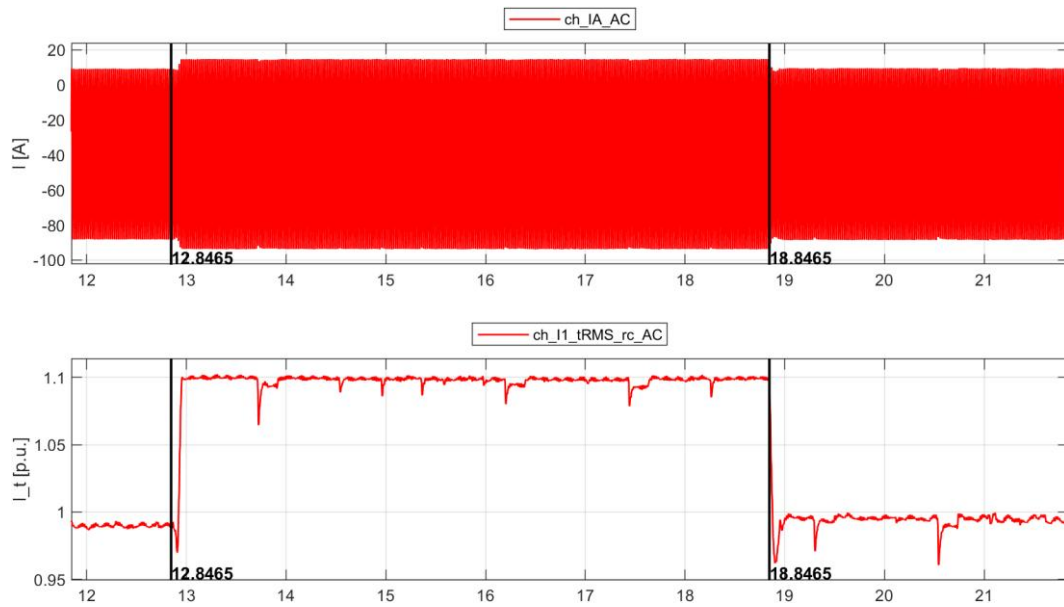
**Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



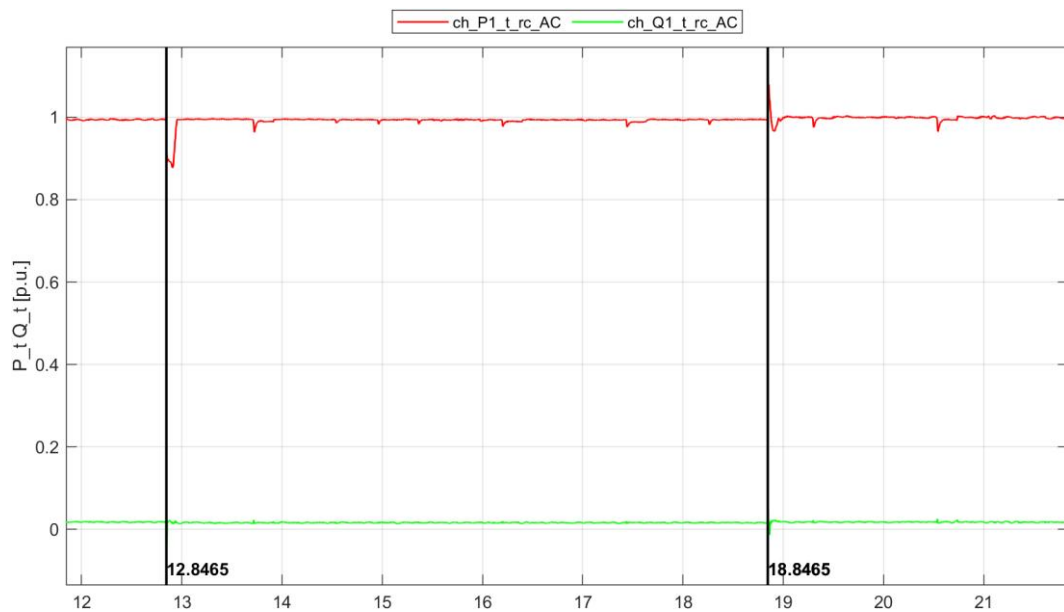
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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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



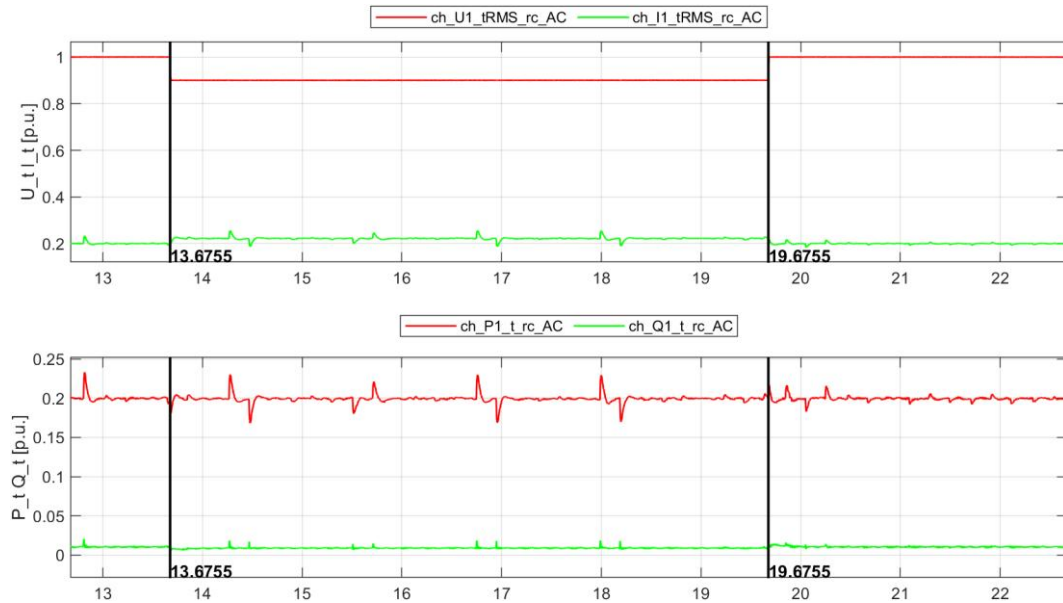
Test 5.1 Depth of fault phase: 0.9 p.u., three-phase SC (type A), 100% load, Power restore



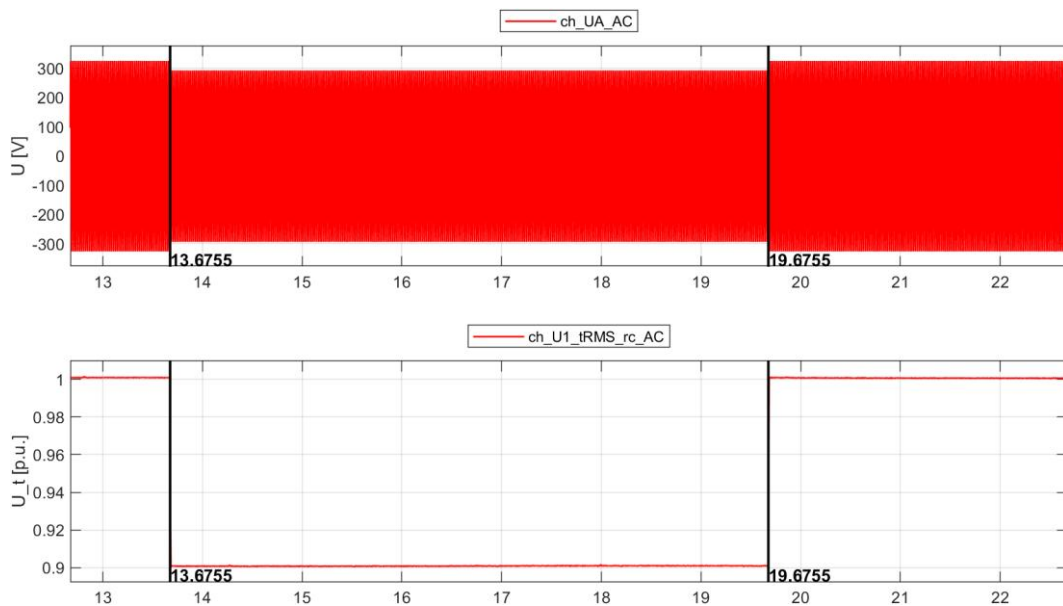
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



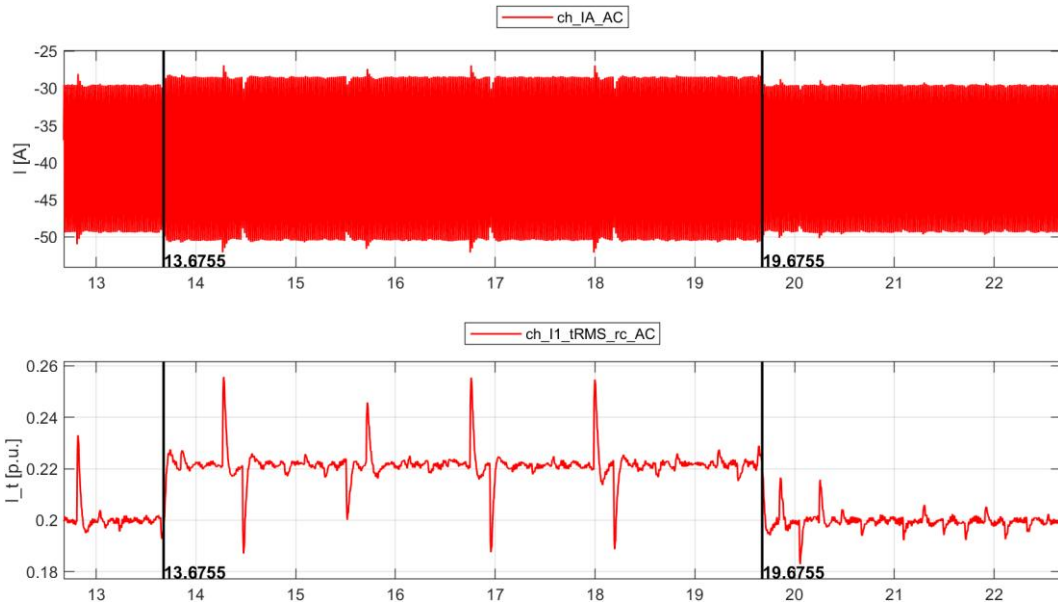
**Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



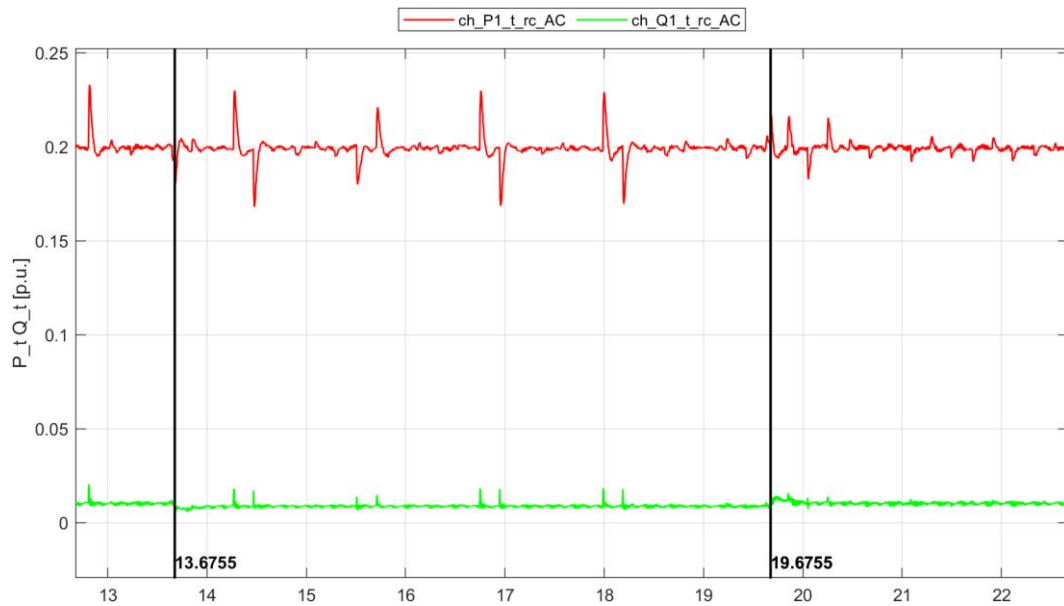
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 5.2 Depth of fault phase: 0.9 p.u., three-phase SC (type A), partial load, Power restore



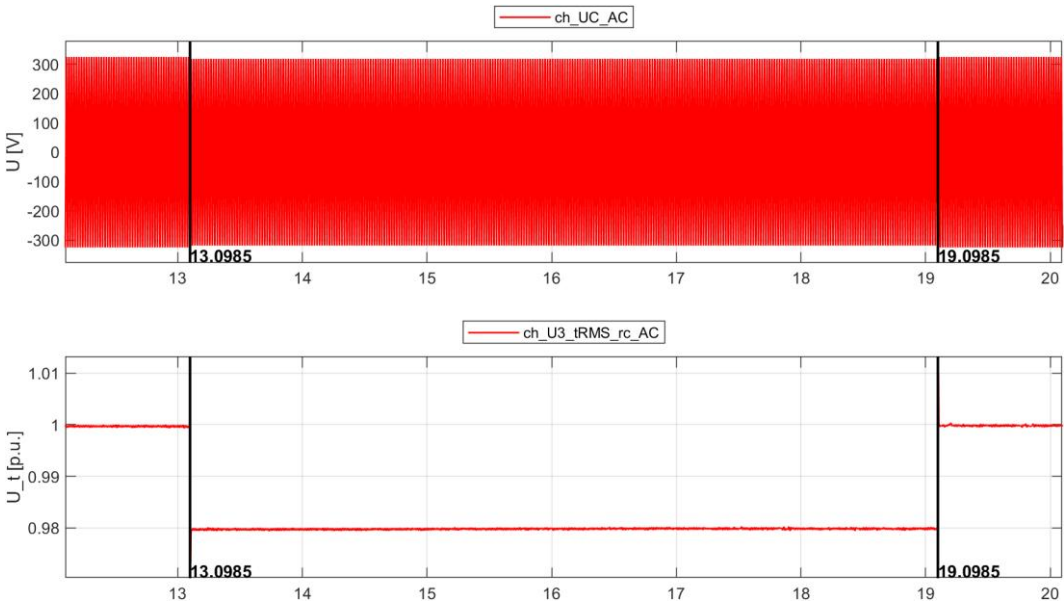
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	5.3	5.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:10:19.0	16:44:59.2
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	0.90	0.90
	5	Setting dip duration		--	--	6000	6000
	6	Point of fault entry(t_1)	Total	--	ms	13448	13063
	7	Point of fault clearance(t_2)	Total	--	ms	19448	19063
	8	Fault duration in empty load test	Total	--	ms	6000	6000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms}$ to t_2 and $t_1-10\text{s}$ to t_1	p.u.	0.980	0.980
	10		Pos.			N/A	N/A
Before dip $< t_1$	11	Voltage	Line to neutral	$t_1-100\text{s}$ to t_1	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms}$ to $t_1-100\text{ms}$	p.u.	0.990	0.198
	13	Active power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s}$ to t_1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	$\text{Cos}\phi$	--	$t_1-10\text{s}$ to t_1	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.984	0.981
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	1.005	0.201
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	1.014	0.203
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms}$ to $t_2-20\text{ms}$	p.u.	0.995	0.199
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	1.004	1.001
After dip $> t_2$	28	Active power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.994	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	$t_2+3\text{s}$ to $t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

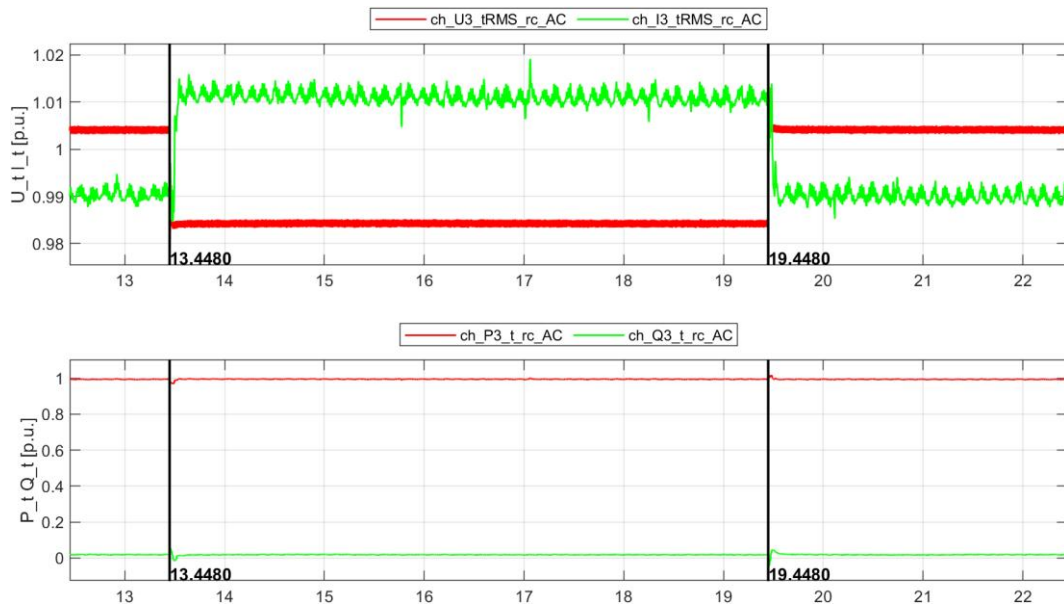
**Test 5.0d1 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 0% load,
Instantaneous and RMS values of phase voltages**



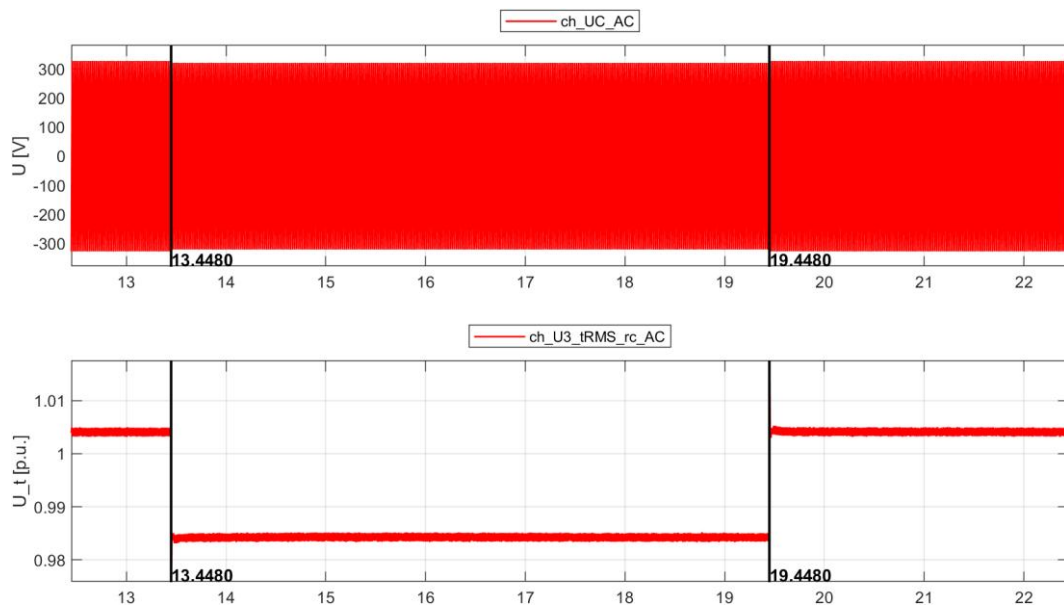
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



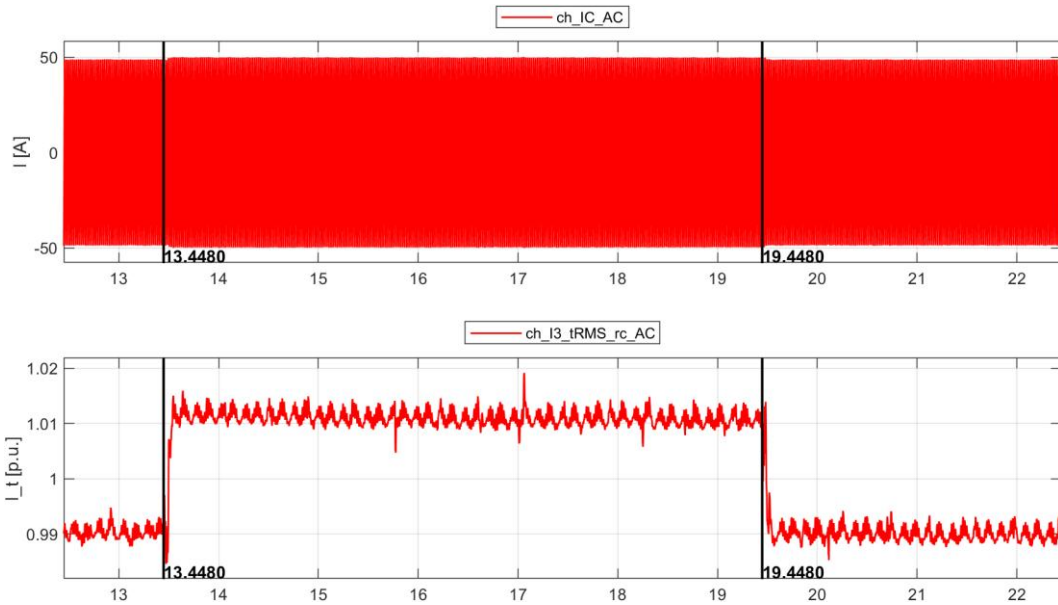
**Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



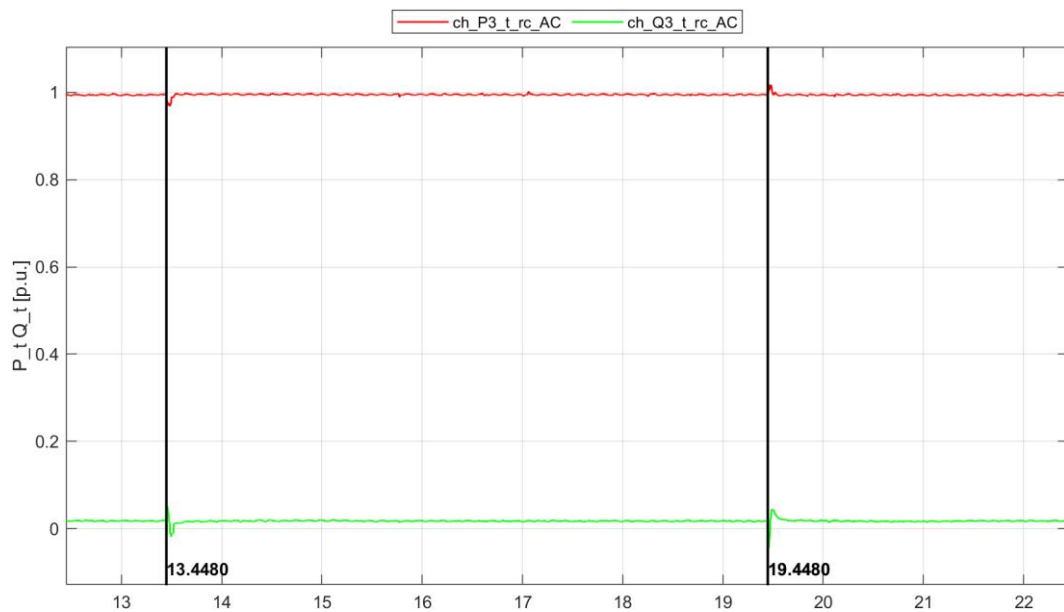
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



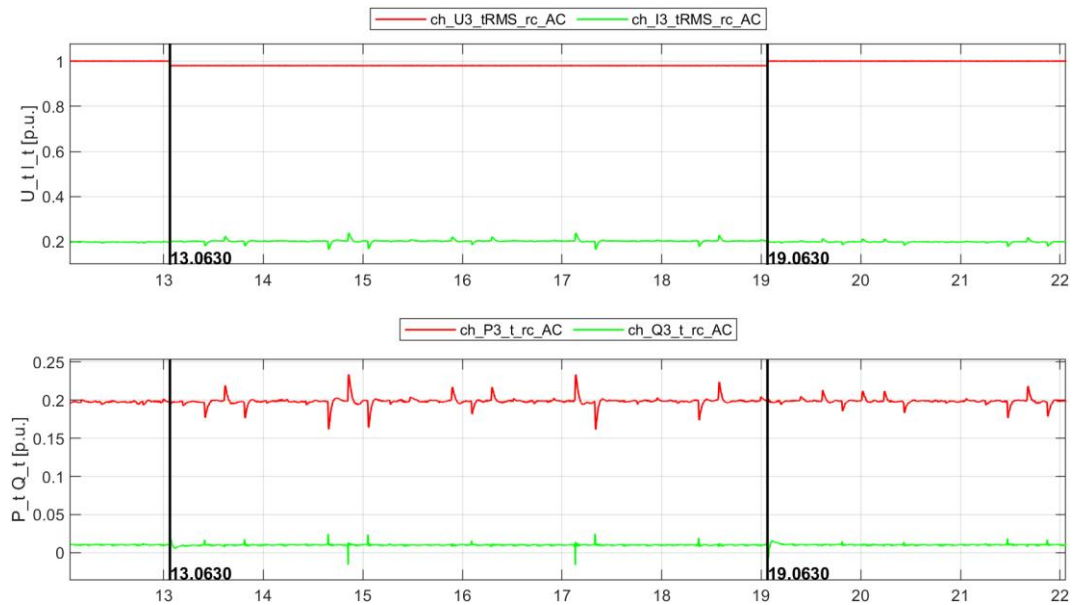
Test 5.3 Depth of fault phase: 0.9 p.u., two-phase SC (type D), 100% load, Power restore



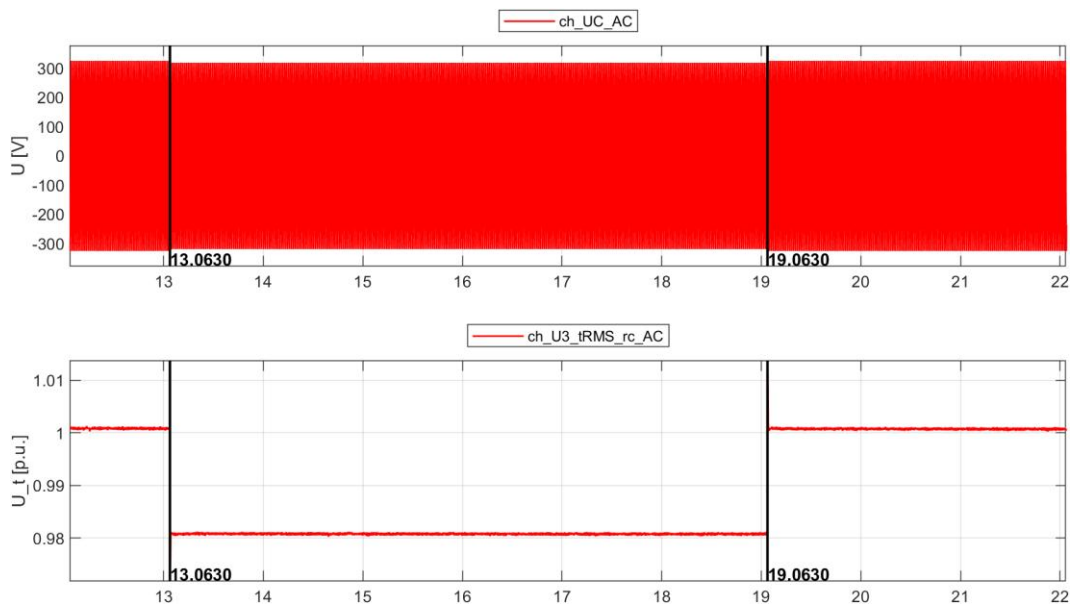
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**

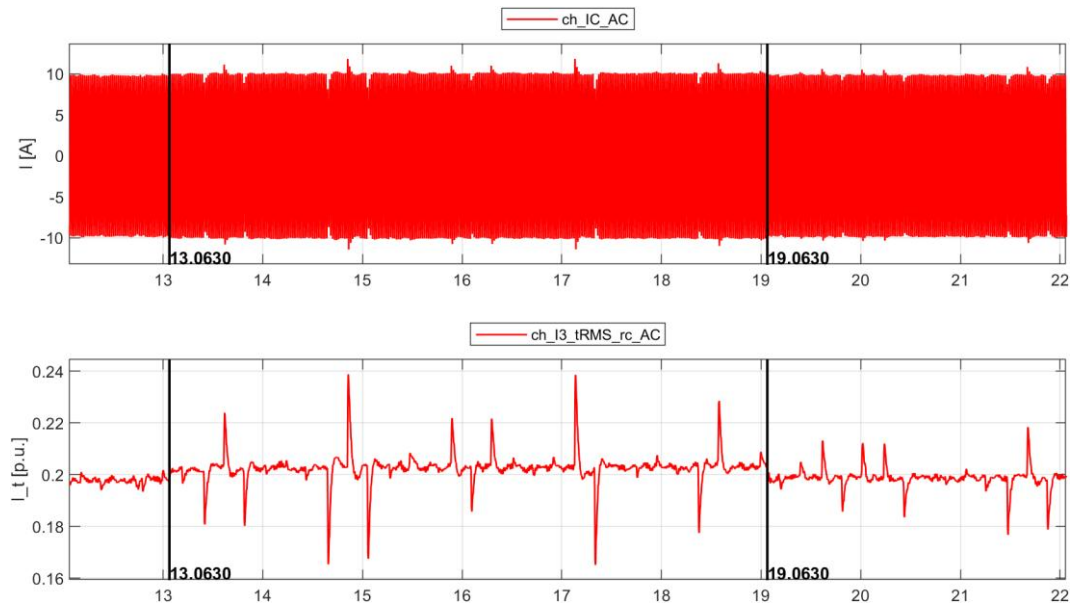


**Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**

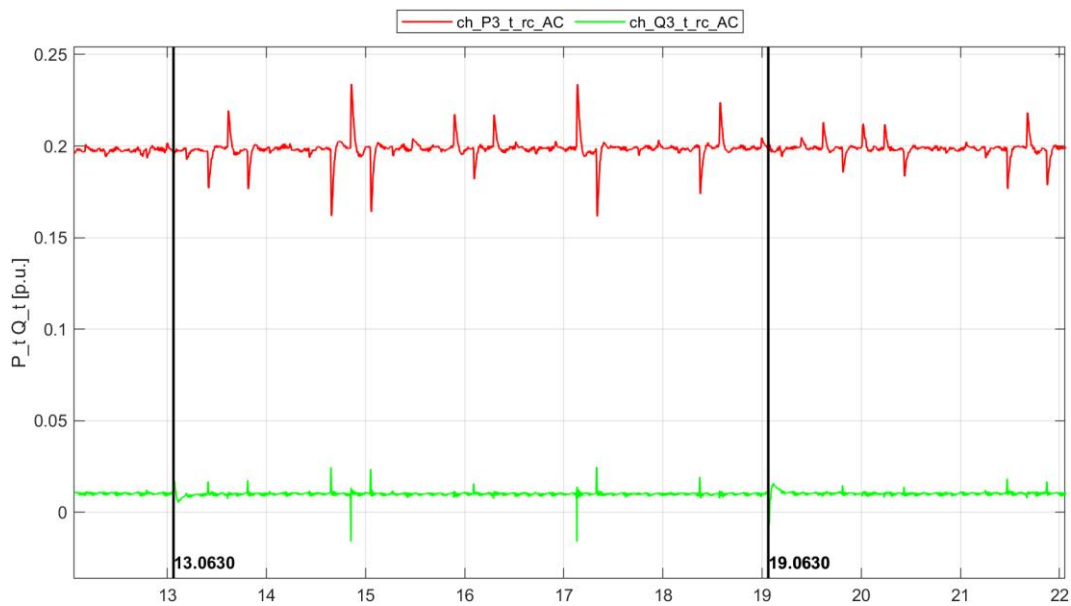


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 5.4 Depth of fault phase: 0.9 p.u., two-phase SC (type D), partial load, Power restore



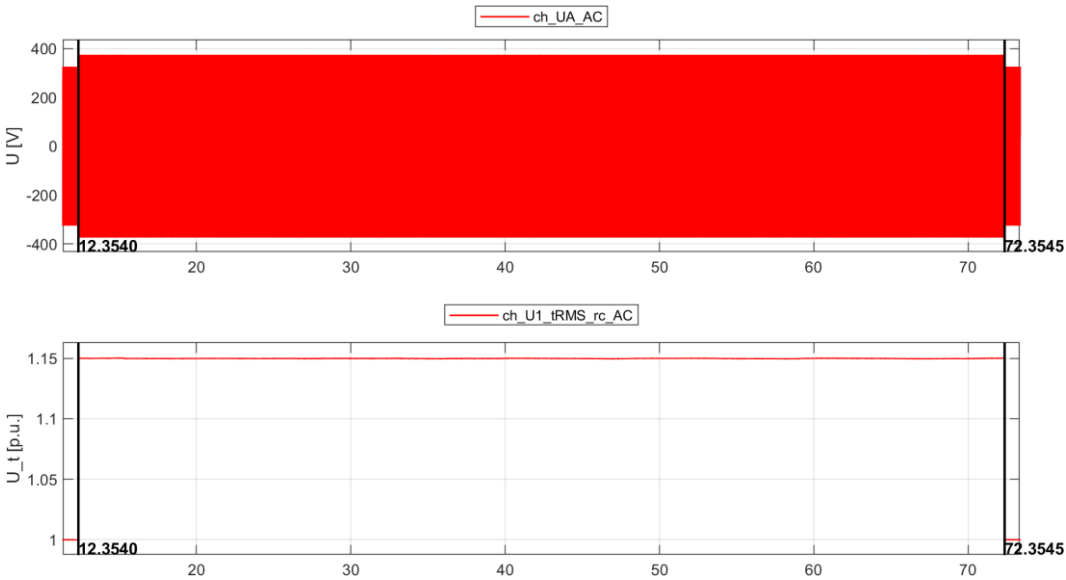
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	6.1	6.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	10:40:33.8	11:24:47.0
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.15	1.15
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry(t ₁)	Total	--	ms	13232	13824
	7	Point of fault clearance(t ₂)	Total	--	ms	73232	73824
	8	Fault duration in empty load test	Total	--	ms	60000	60000
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.150	1.150
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.200
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.150	1.150
	19	Line current	Phase 1	t1+60ms	p.u.	0.018	0.016
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.021	0.016
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.015	0.015
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.997	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.200	0.114
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

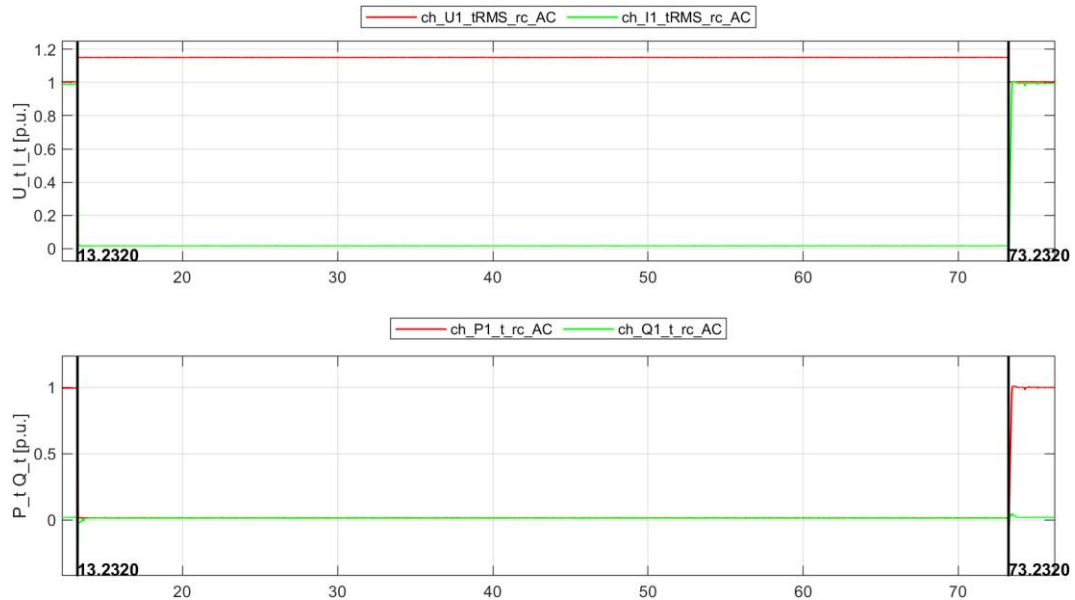
Test 6.0a Depth of fault phase: 1.15 p.u., three-phase SC (type A), 0% load, Instantaneous and RMS values of phase voltages



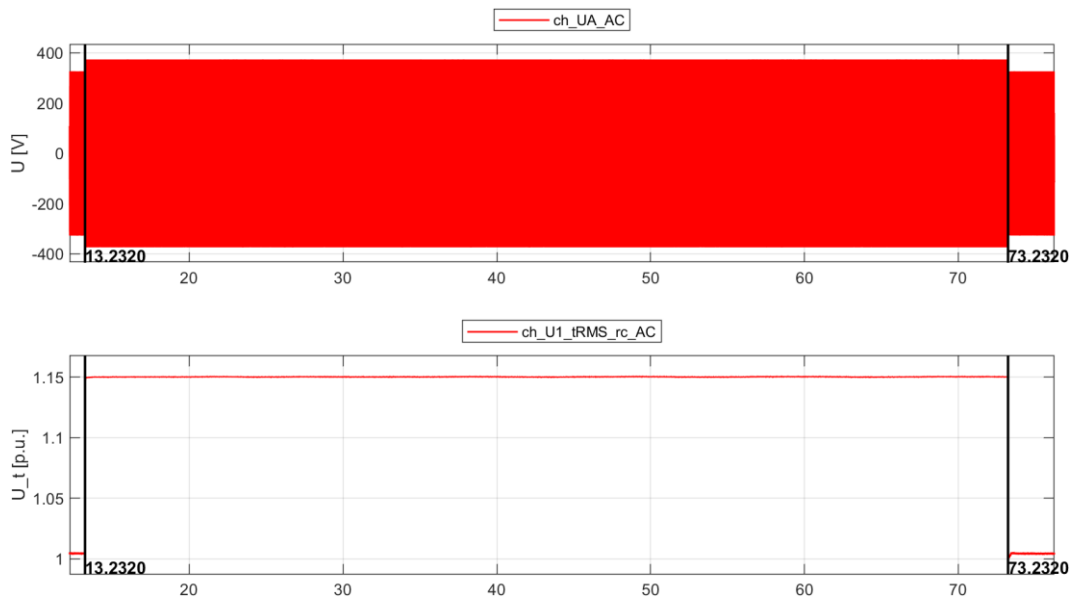
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**

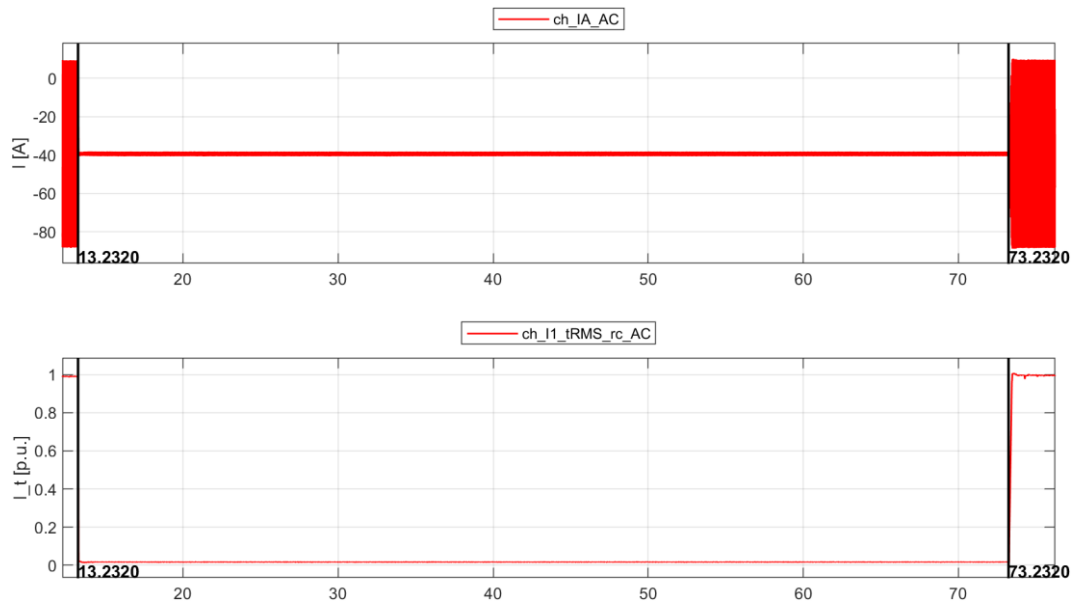


**Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**

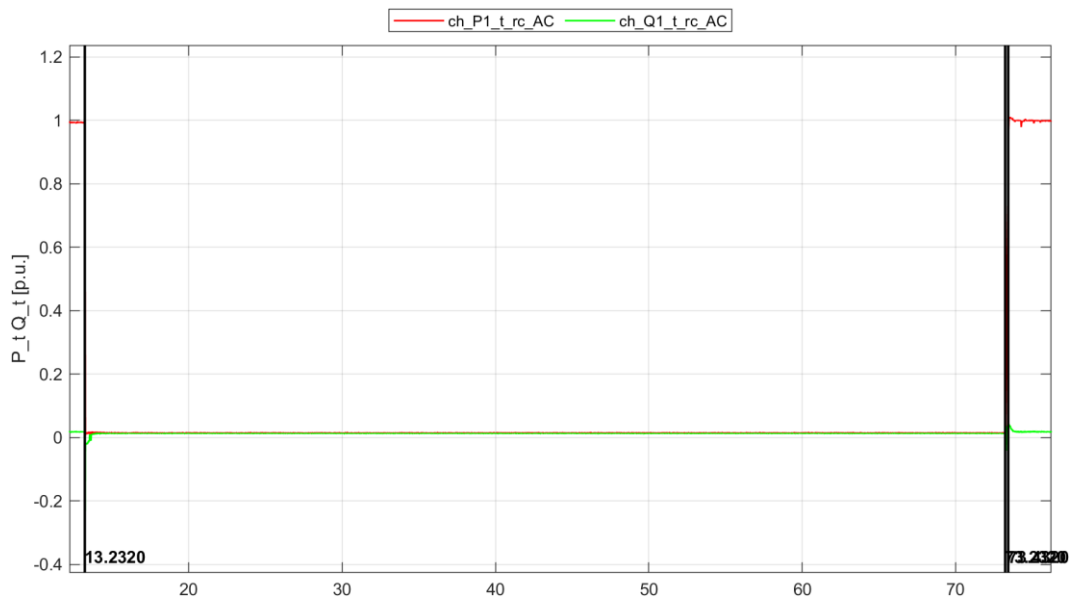


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

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

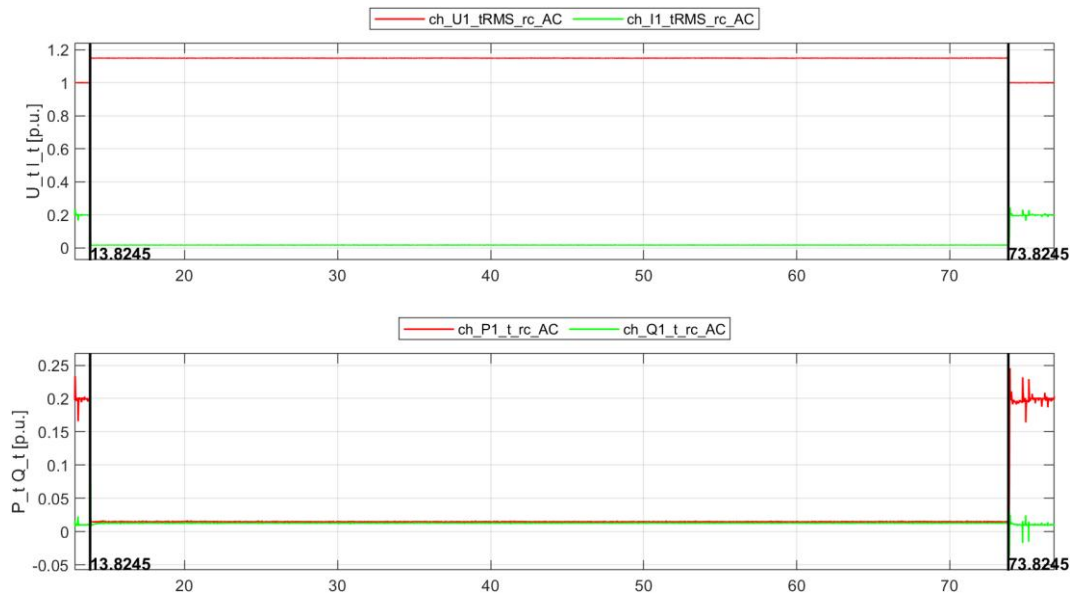


Test 6.1 Depth of fault phase: 1.15 p.u., three-phase SC (type A), 100% load, Power restore

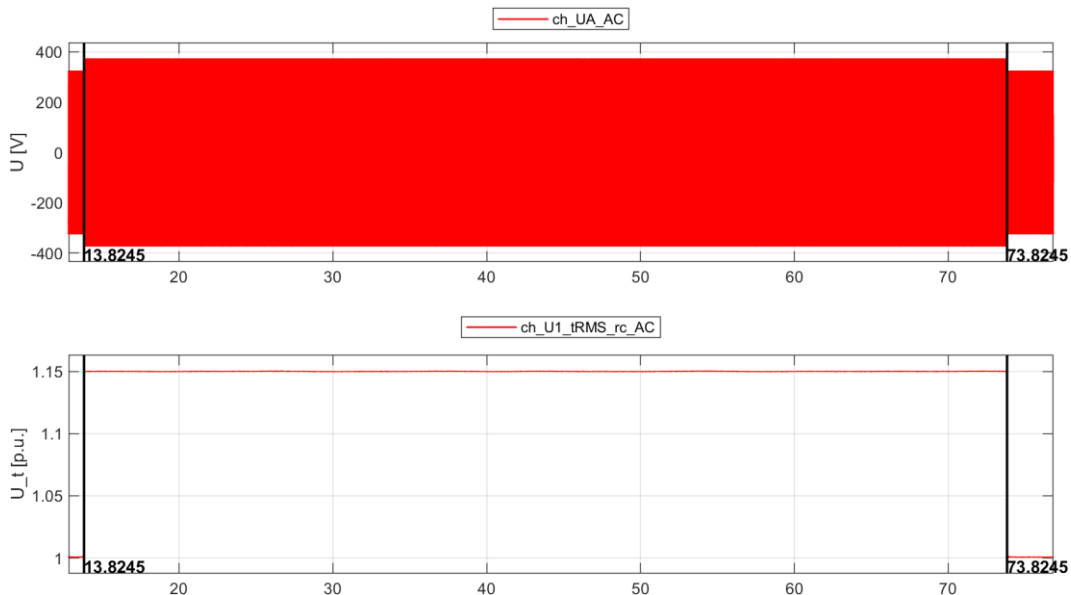


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)

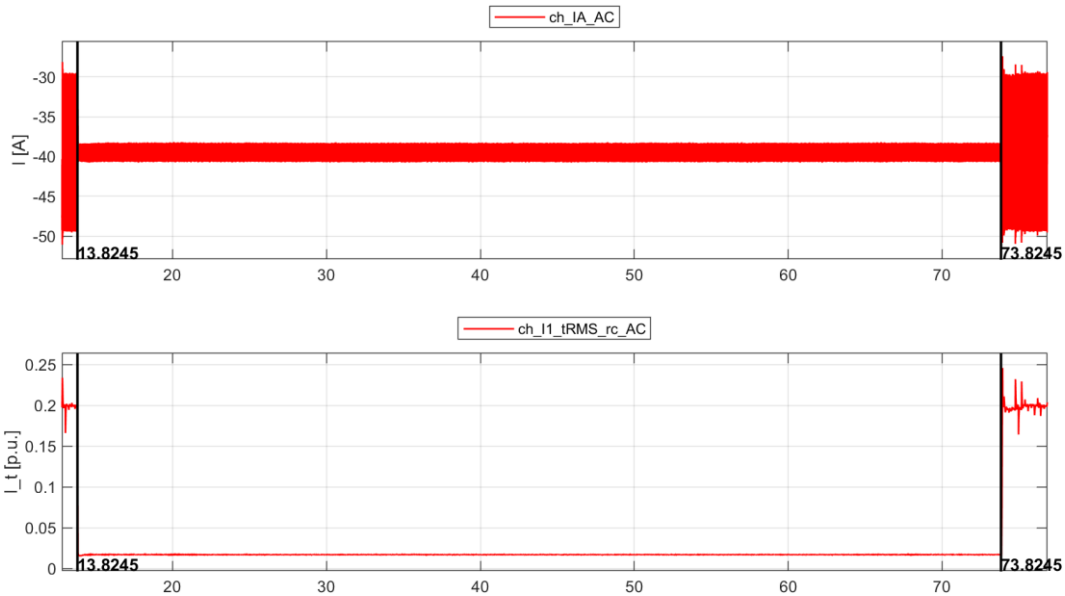


Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages

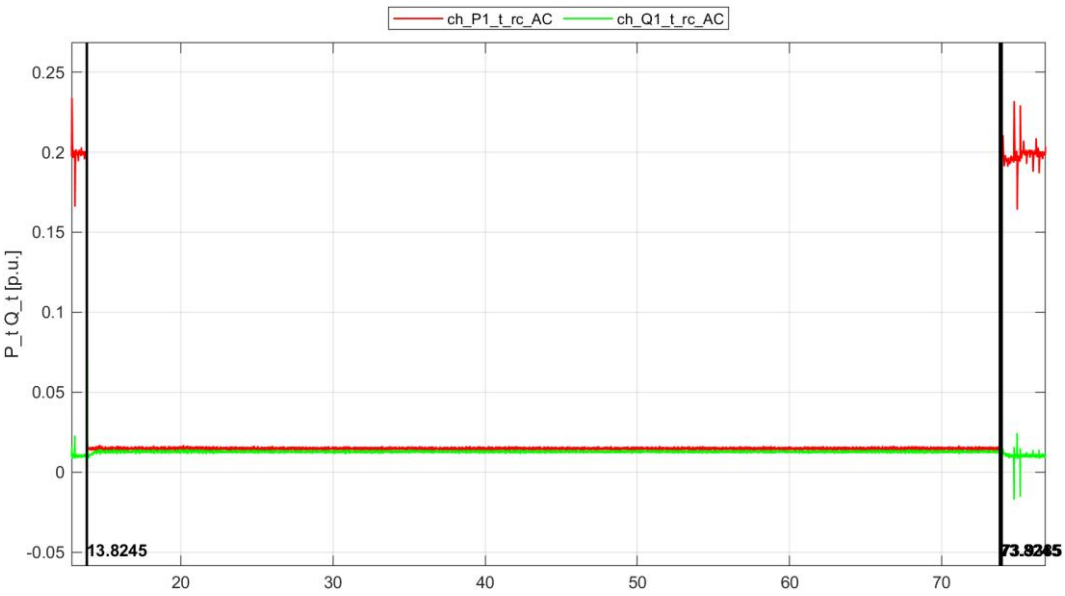


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 6.2 Depth of fault phase: 1.15 p.u., three-phase SC (type A), partial load, Power restore



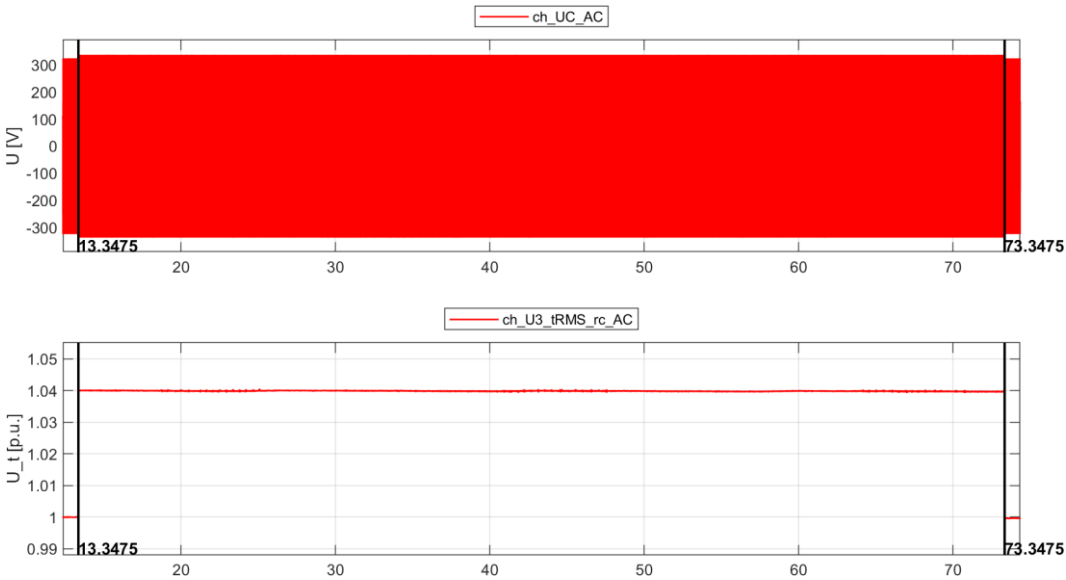
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	6.3	6.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:15:00.6	16:25:41.3
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.15	1.15
	5	Setting dip duration		--	--	60000	60000
	6	Point of fault entry(t_1)	Total	--	ms	13691	13248
	7	Point of fault clearance(t_2)	Total	--	ms	73691	73248
	8	Fault duration in empty load test	Total	--	ms	60000	60000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.040	1.040
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.991	0.198
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.044	1.041
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.974	0.191
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.952	0.193
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.994	0.199
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.995	0.197
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

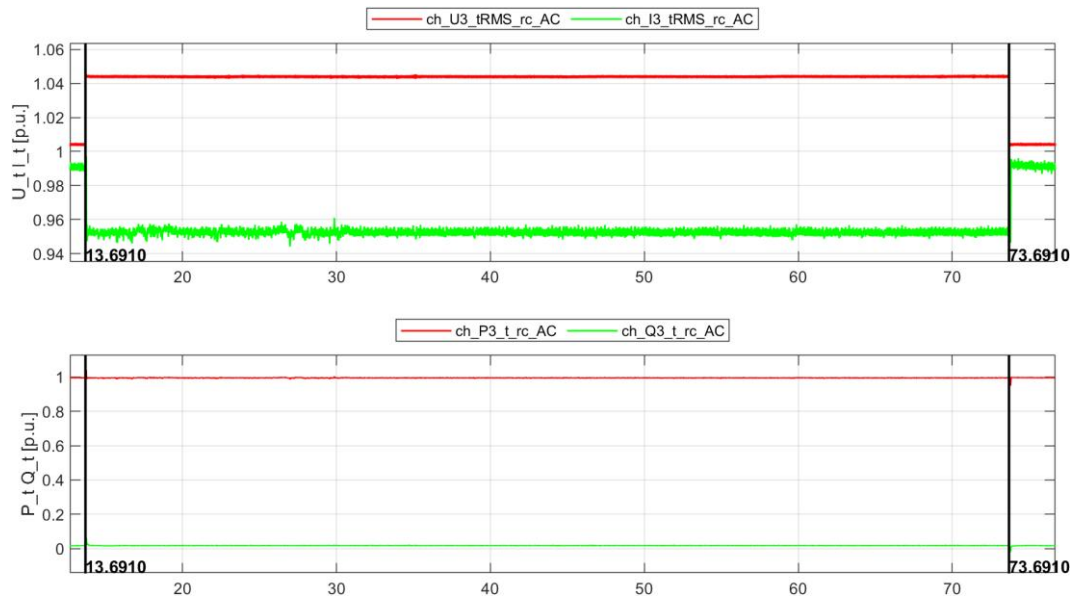
Test 6.0d1 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 0% load,
Instantaneous and RMS values of phase voltages



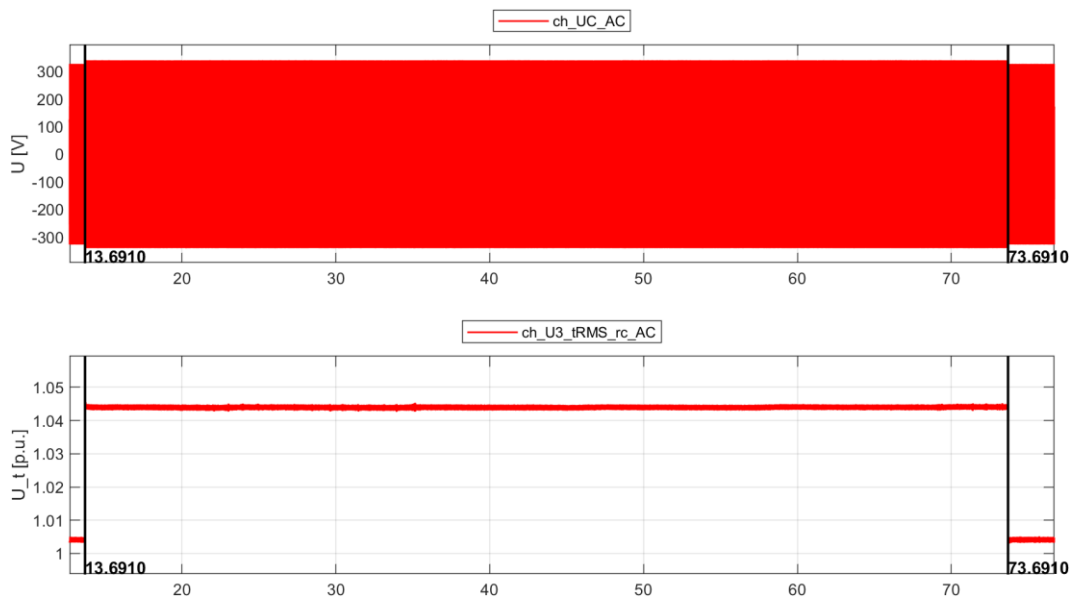
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)



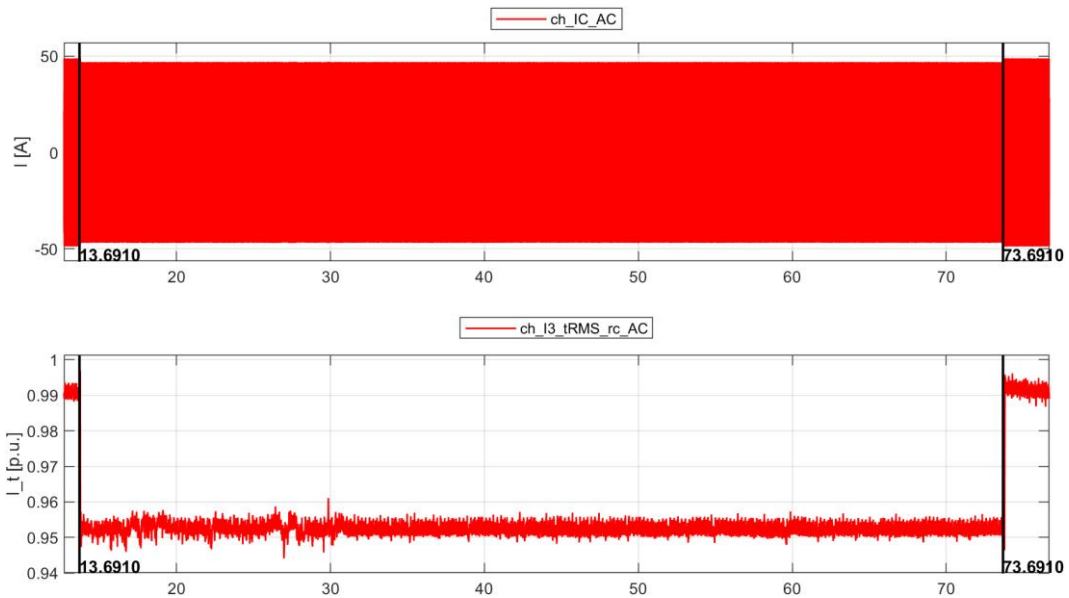
Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages



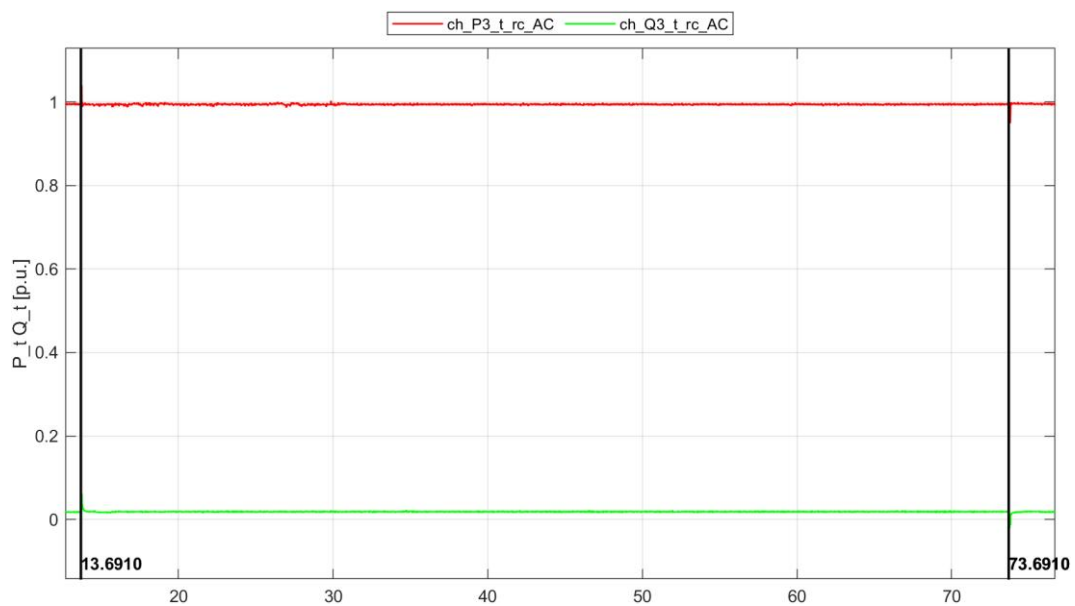
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



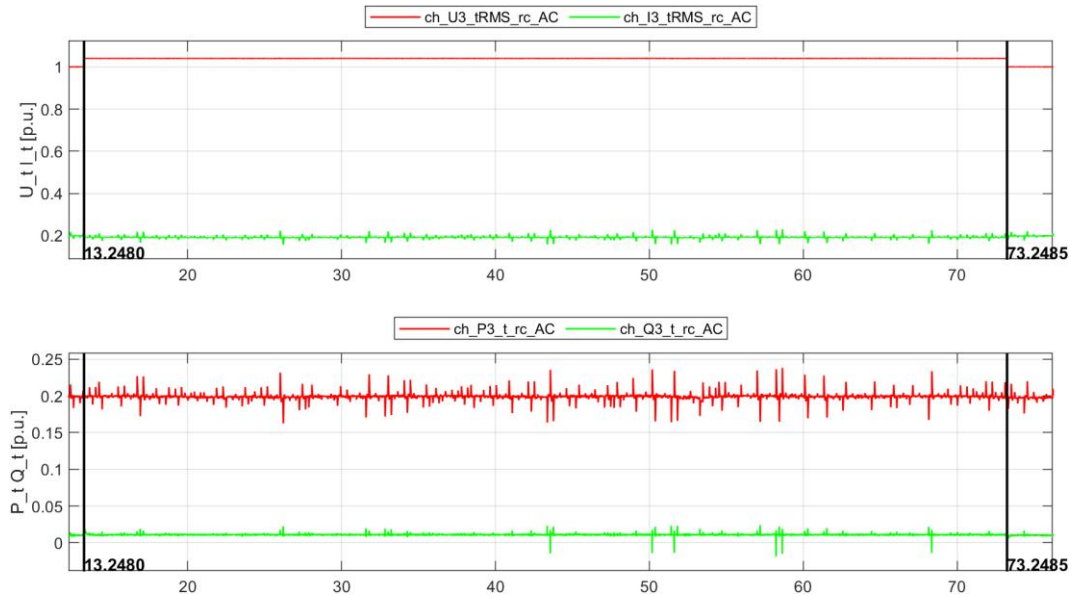
Test 6.3 Depth of fault phase: 1.15 p.u., two-phase SC (type D), 100% load, Power restore



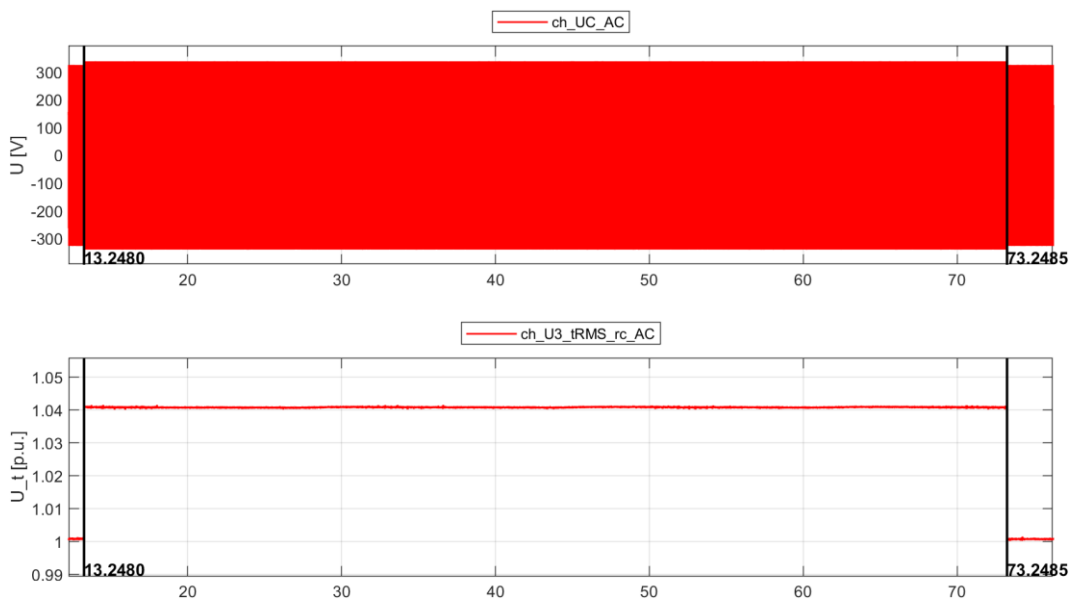
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



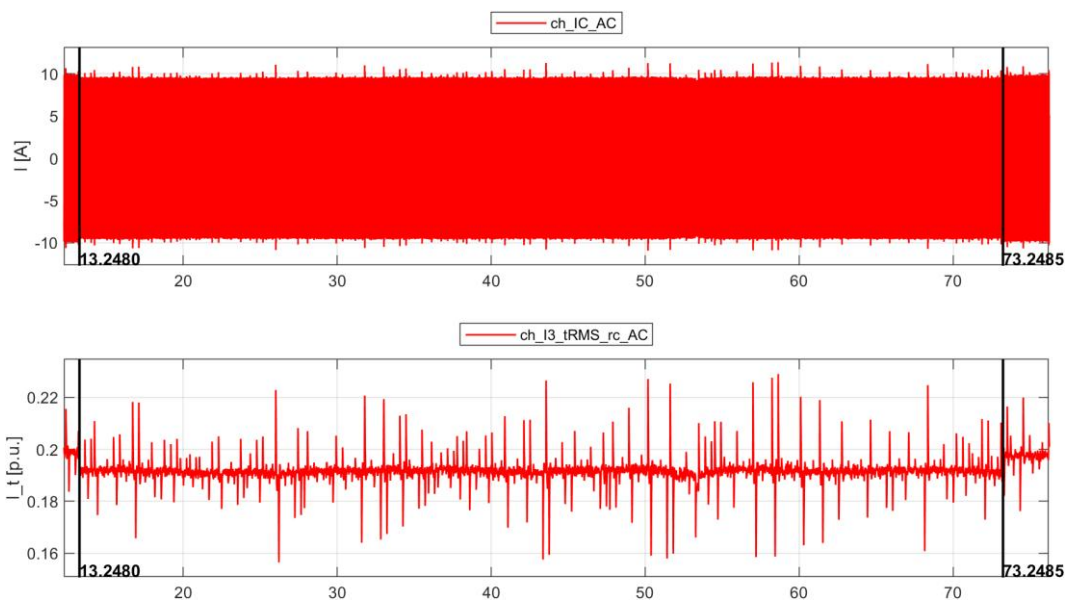
**Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



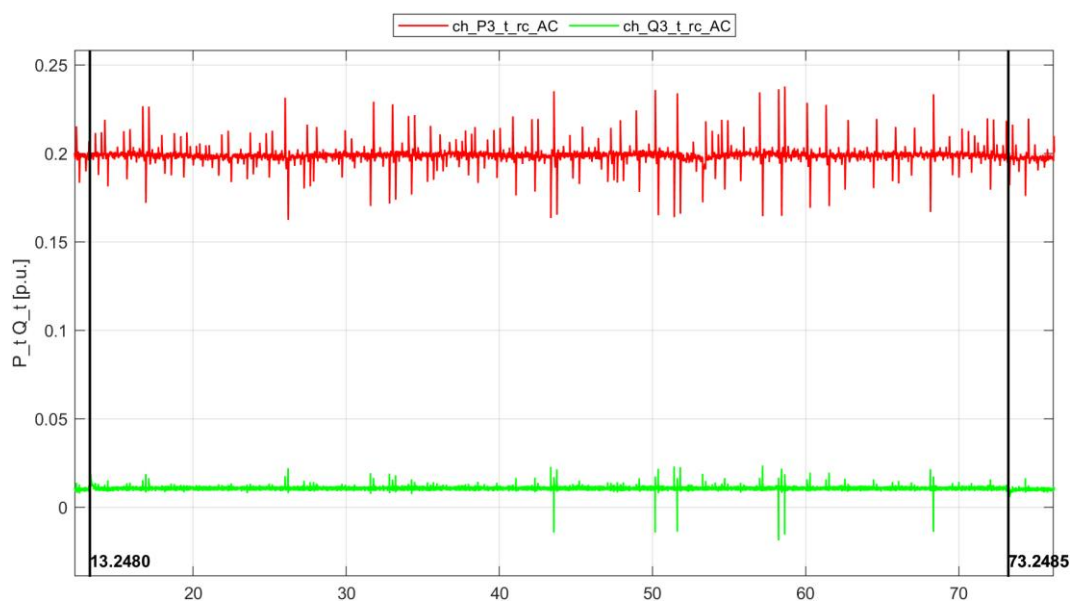
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 6.4 Depth of fault phase: 1.15 p.u., two-phase SC (type D), partial load, Power restore



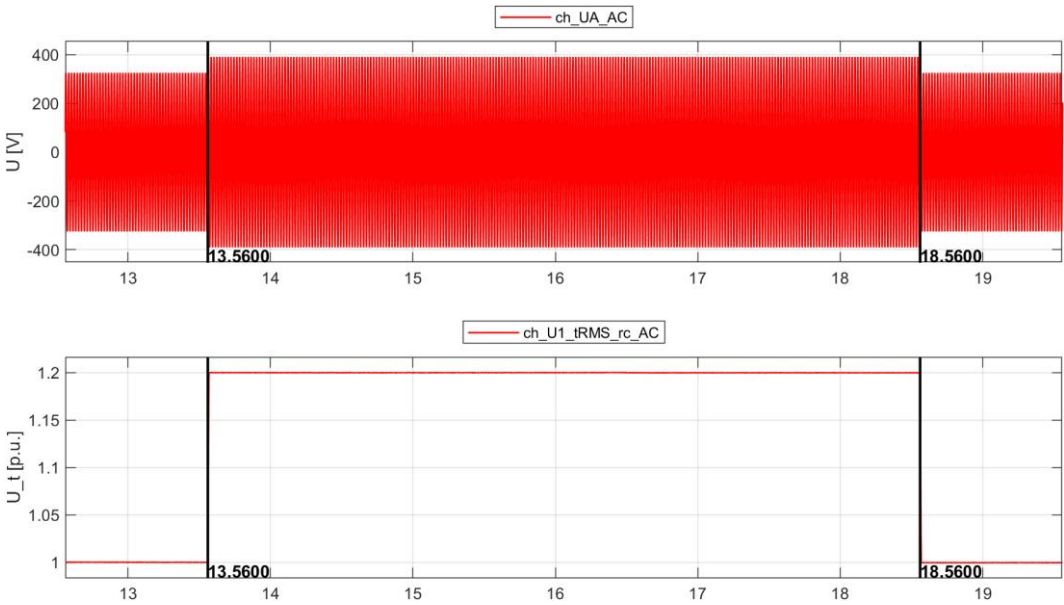
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	7.1	7.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	10:38:44.4	11:27:03.8
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.20	1.20
	5	Setting dip duration		--	--	5000	5000
	6	Point of fault entry(t_1)	Total	--	ms	12666	14388
	7	Point of fault clearance(t_2)	Total	--	ms	17666	19388
	8	Fault duration in empty load test	Total	--	ms	5000	5000
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.200	1.200
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.200
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.200	1.200
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.011	0.013
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.013	0.014
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.010	0.010
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.998	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.204	0.133
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

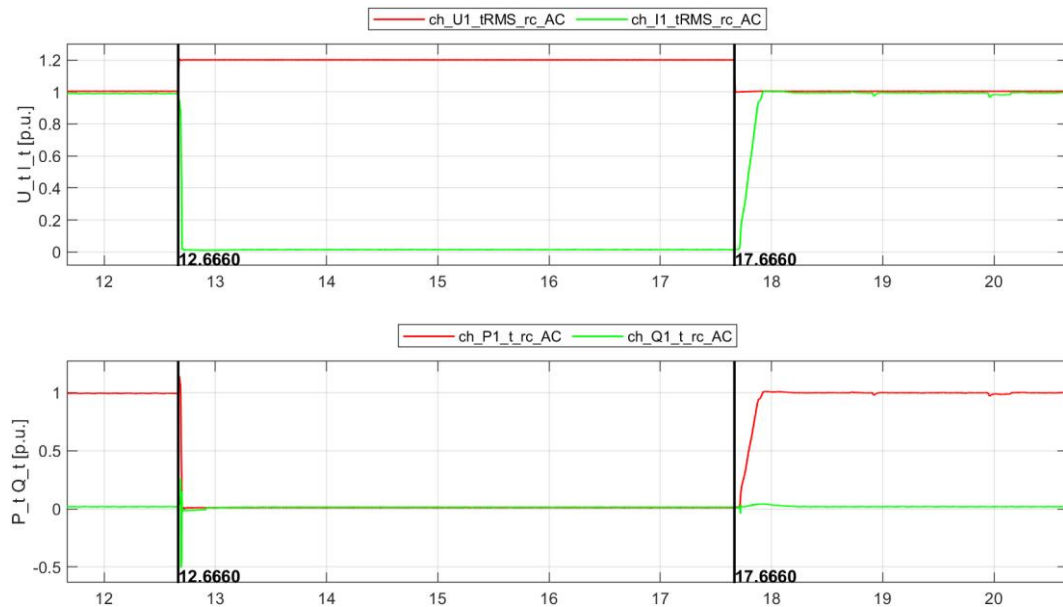
**Test 7.0a Depth of fault phase: 1.20 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



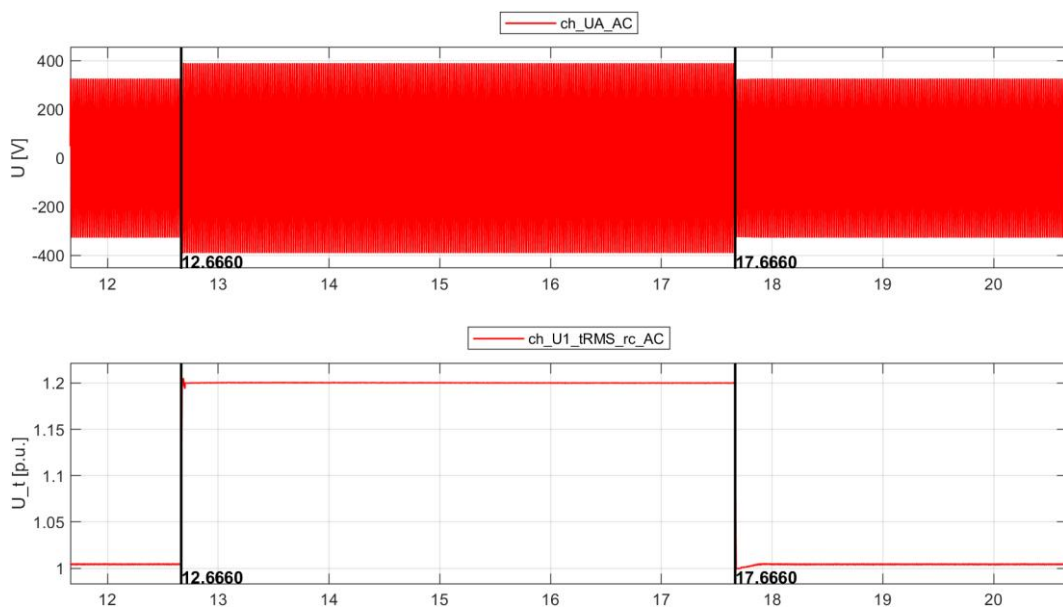
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



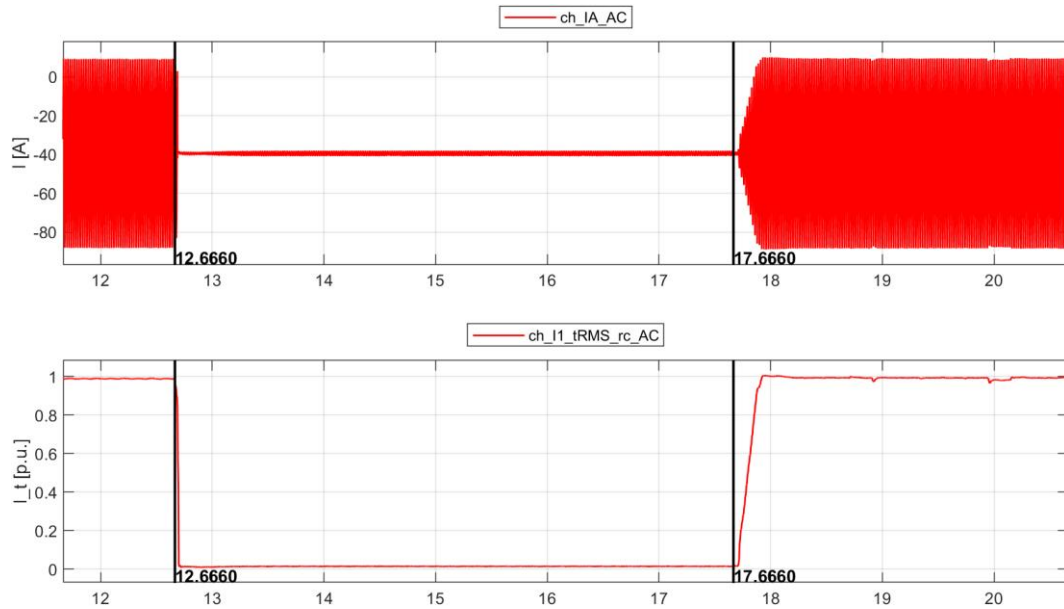
**Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



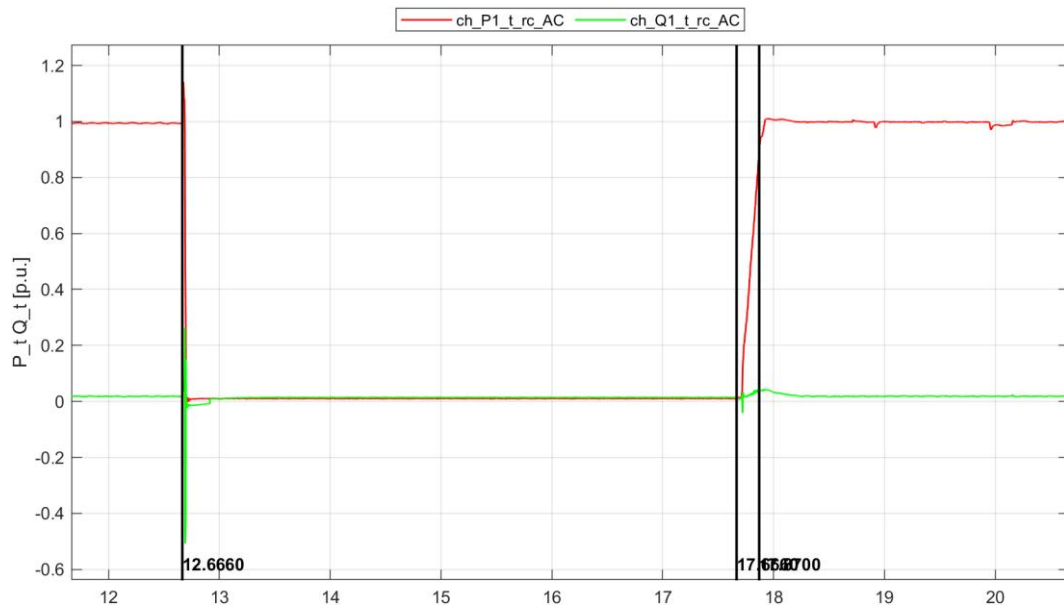
EN 50549-10

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



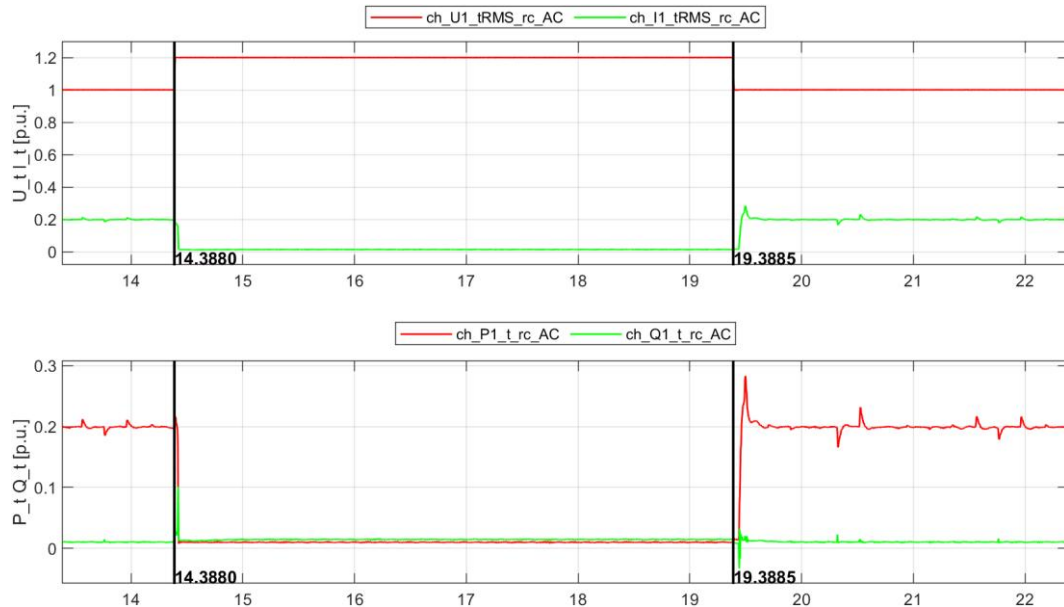
**Test 7.1 Depth of fault phase: 1.20 p.u., three-phase SC (type A), 100% load,
Power restore**



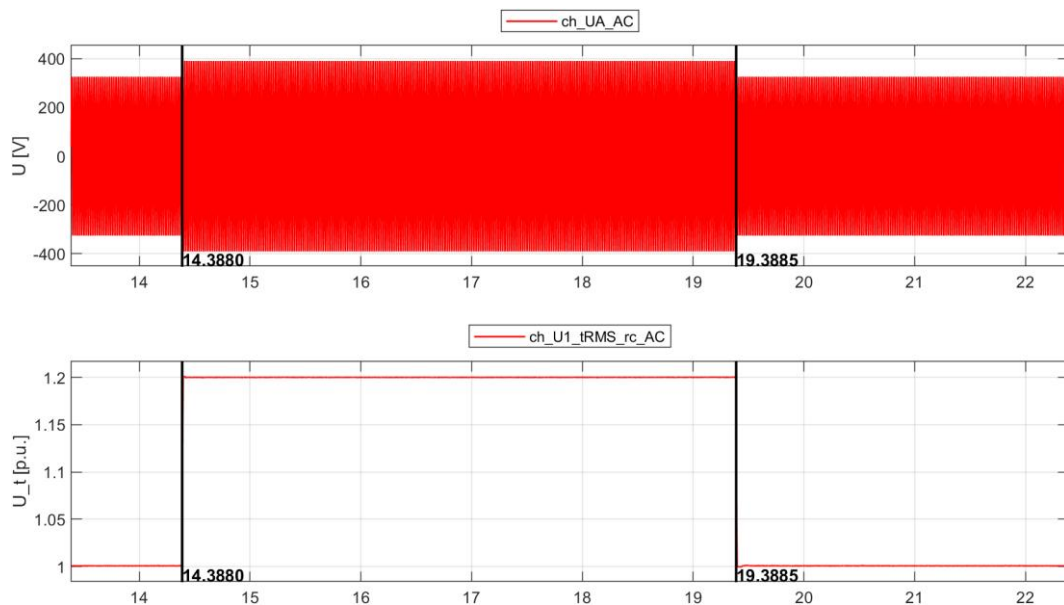
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



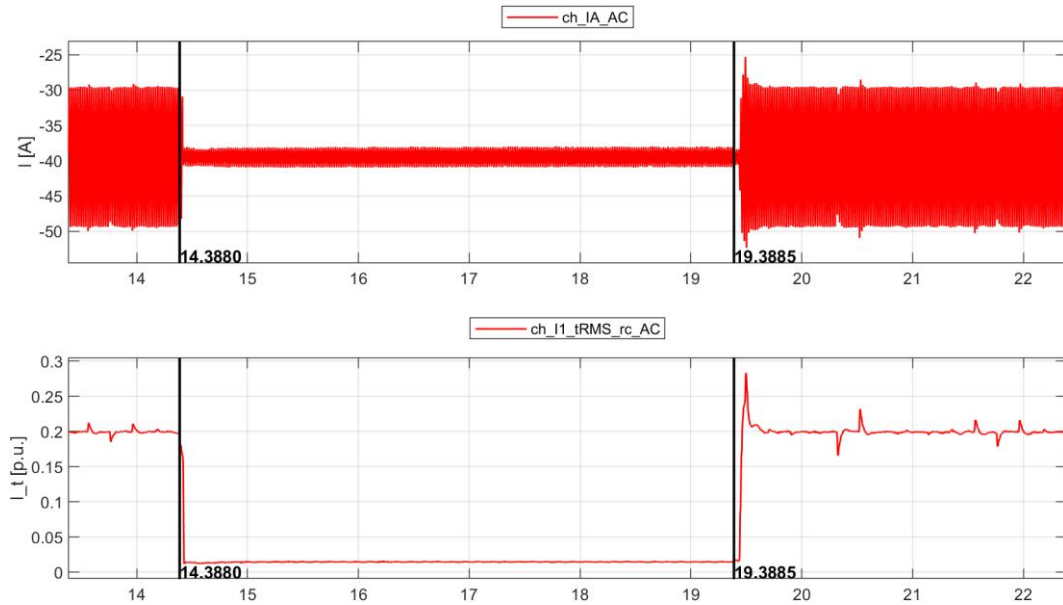
**Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



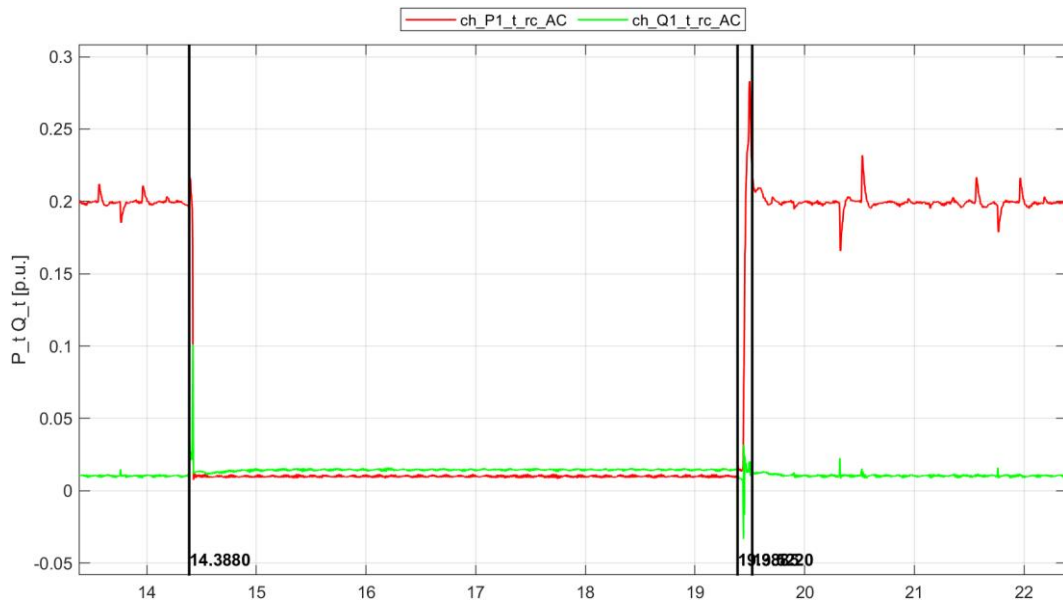
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 7.2 Depth of fault phase: 1.20 p.u., three-phase SC (type A), partial load, Power restore



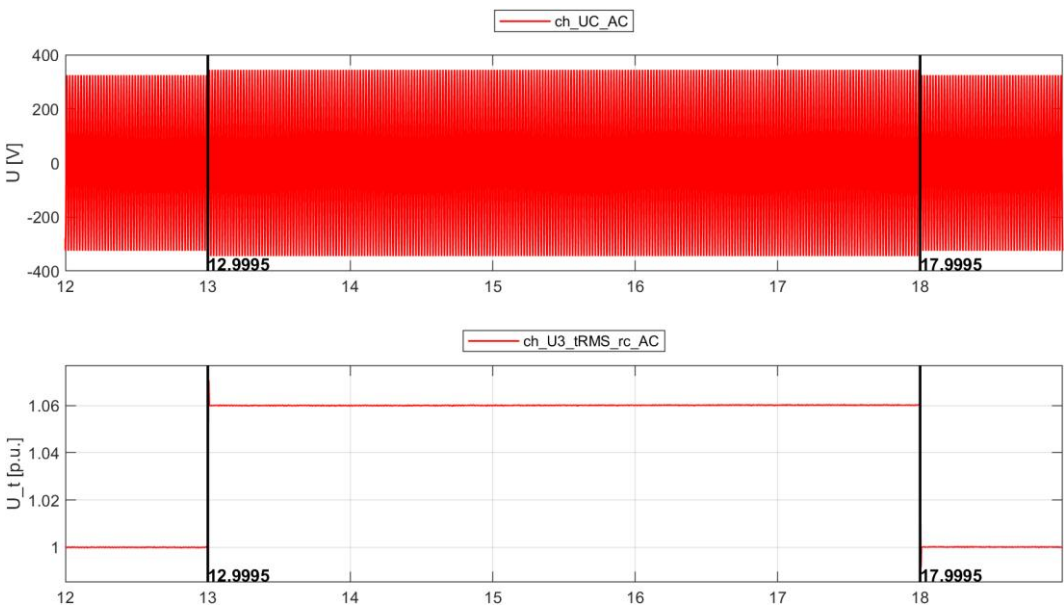
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	7.3	7.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:20:28.5	16:17:34.0
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.20	1.20
	5	Setting dip duration		--	--	5000	5000
	6	Point of fault entry(t_1)	Total	--	ms	13315	13442
	7	Point of fault clearance(t_2)	Total	--	ms	18315	18442
	8	Fault duration in empty load test	Total	--	ms	5000	5000
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.060	1.060
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.064	1.061
	19	Line current	Phase 1	t1+60ms	p.u.	0.936	0.185
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.934	0.187
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	0.993	0.199
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.994	0.198
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

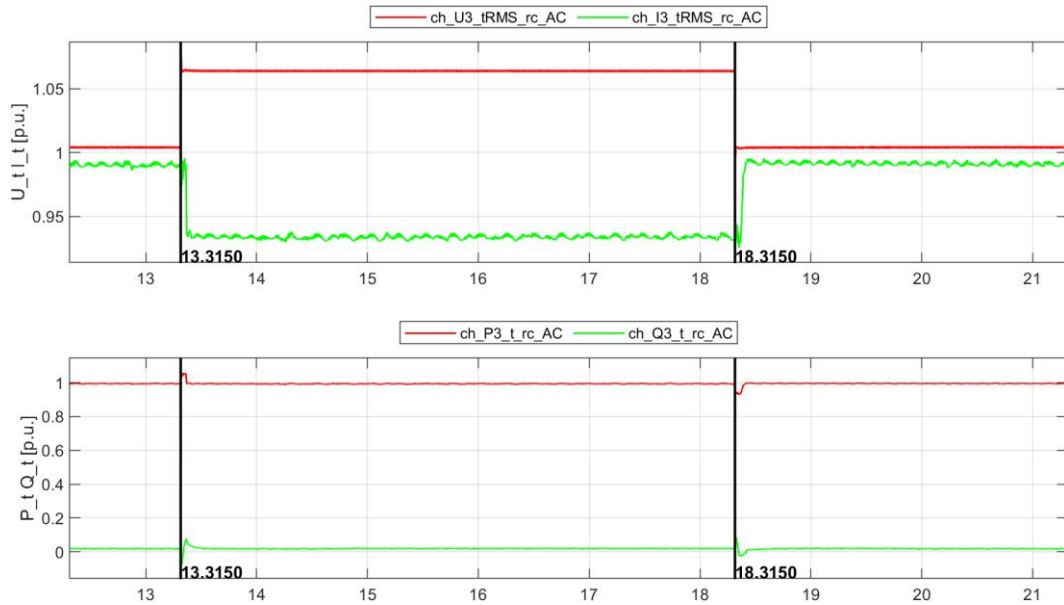
Test 7.0d1 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



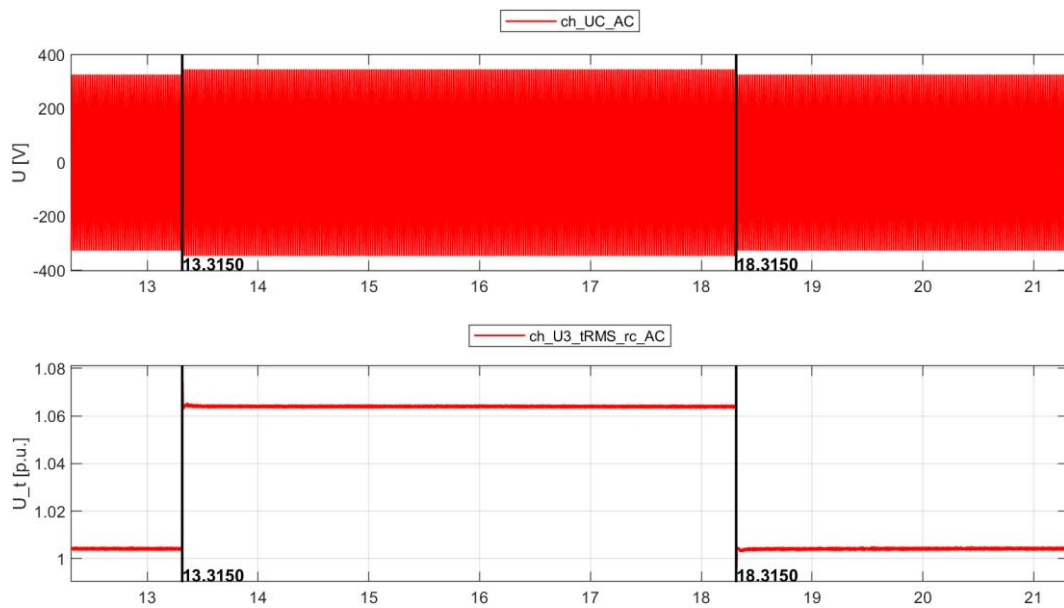
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



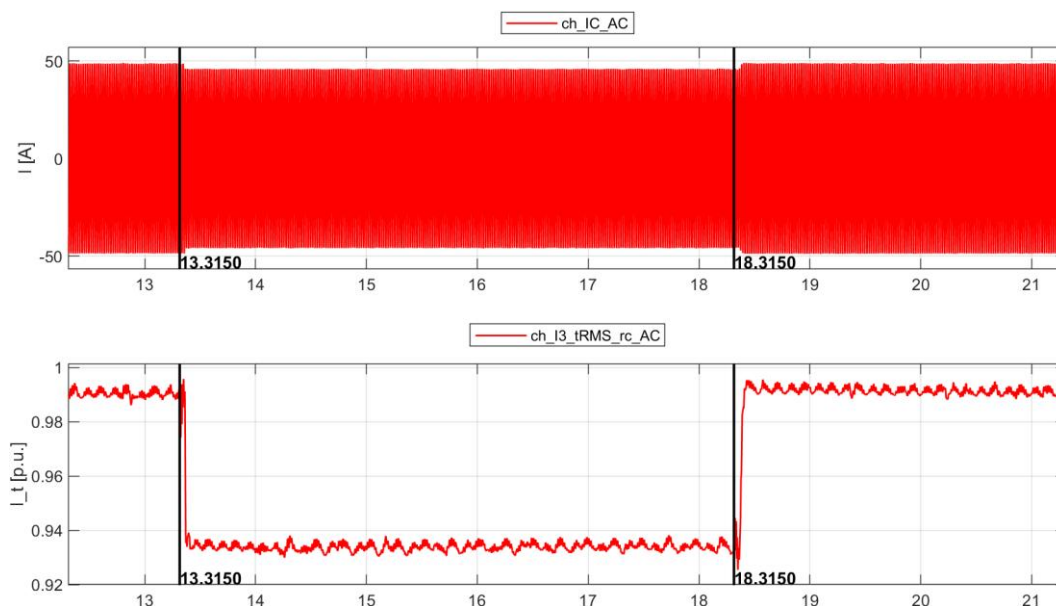
**Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



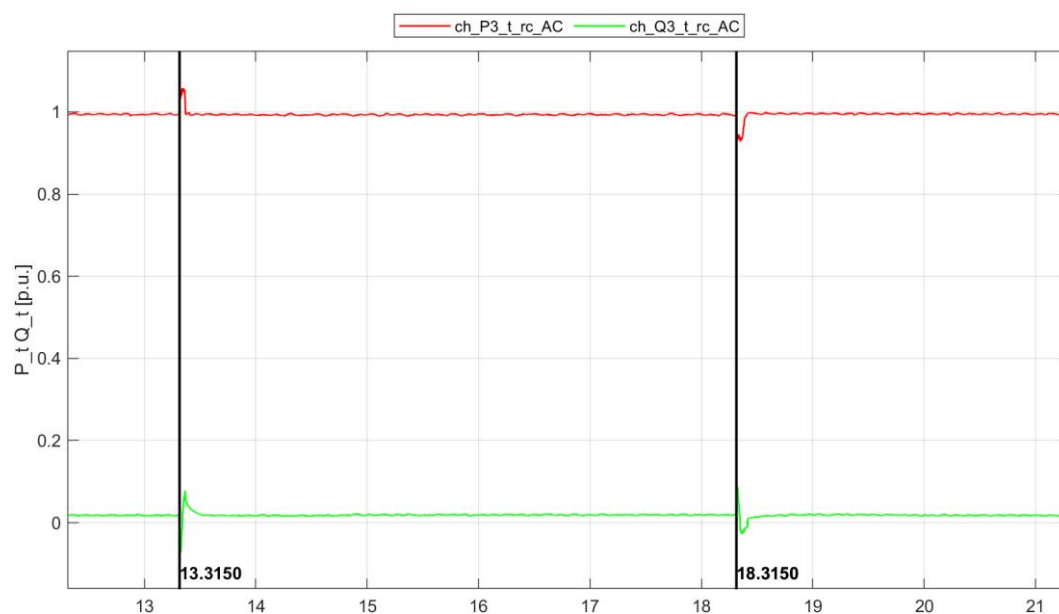
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



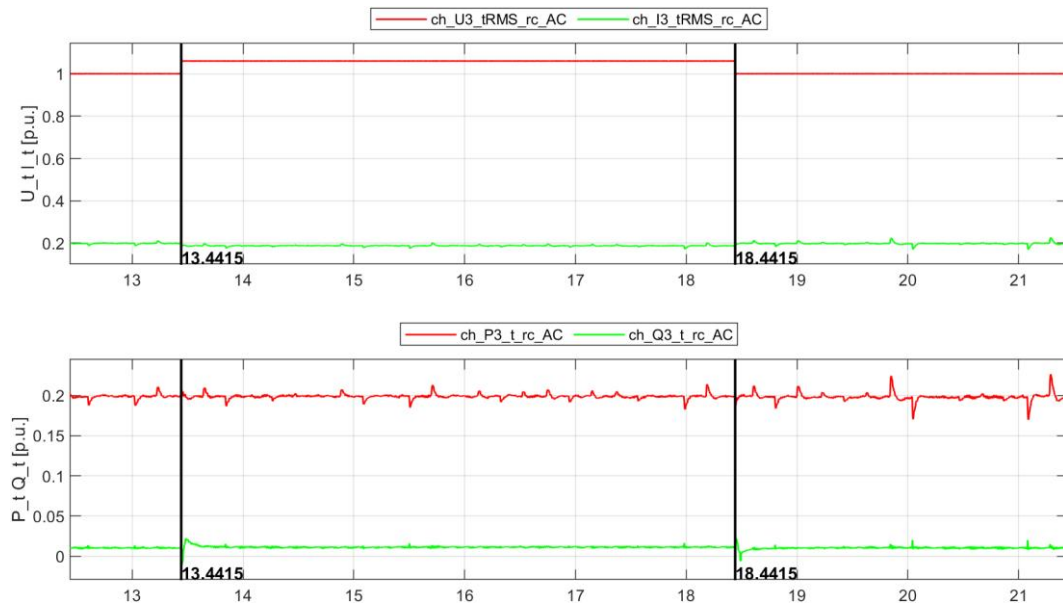
Test 7.3 Depth of fault phase: 1.20 p.u., two-phase SC (type D), 100% load, Power restore



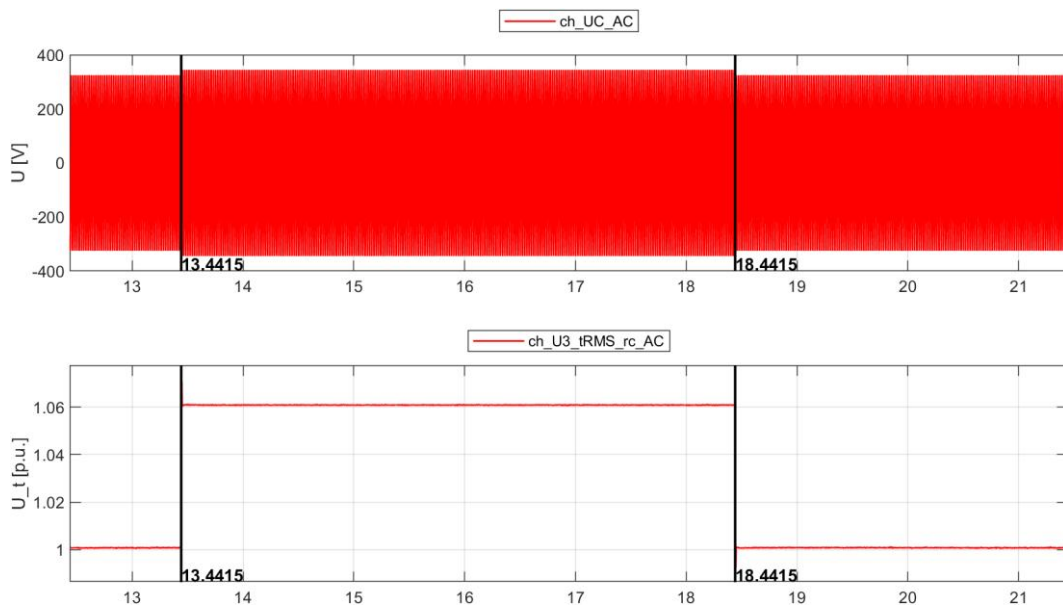
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



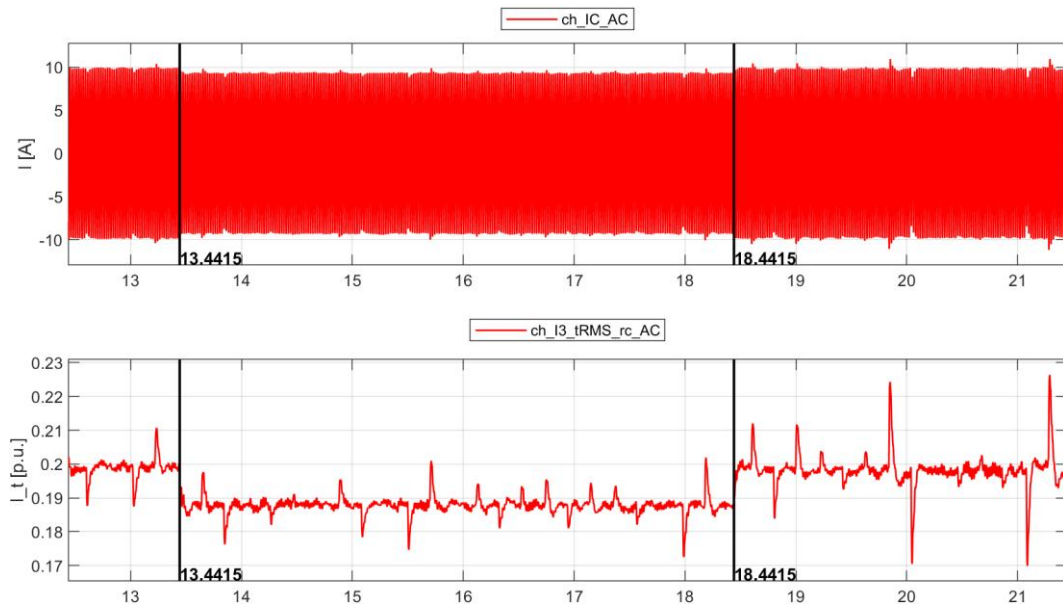
**Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



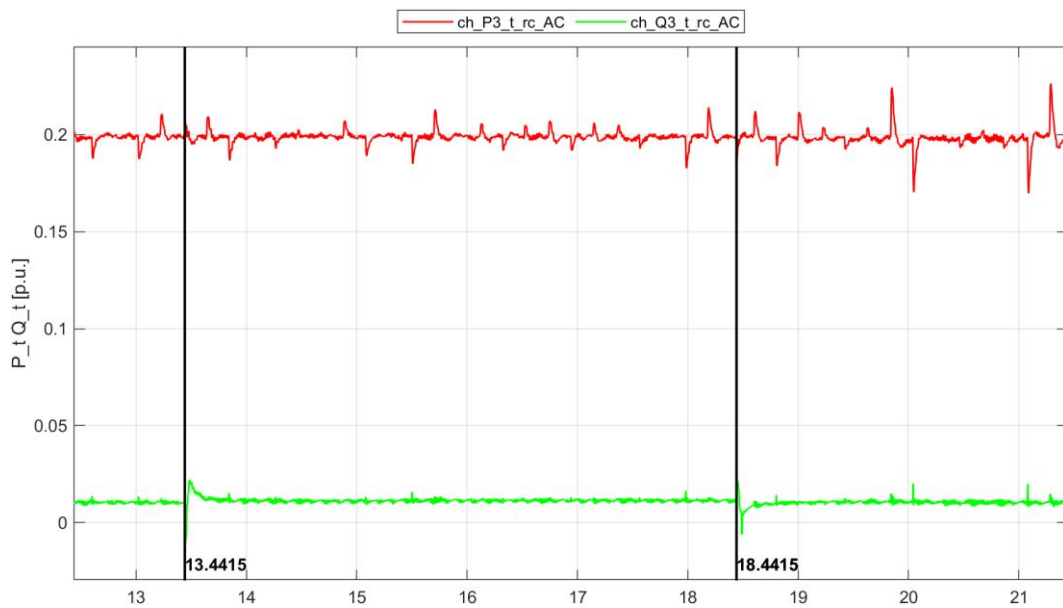
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 7.4 Depth of fault phase: 1.20 p.u., two-phase SC (type D), partial load, Power restore



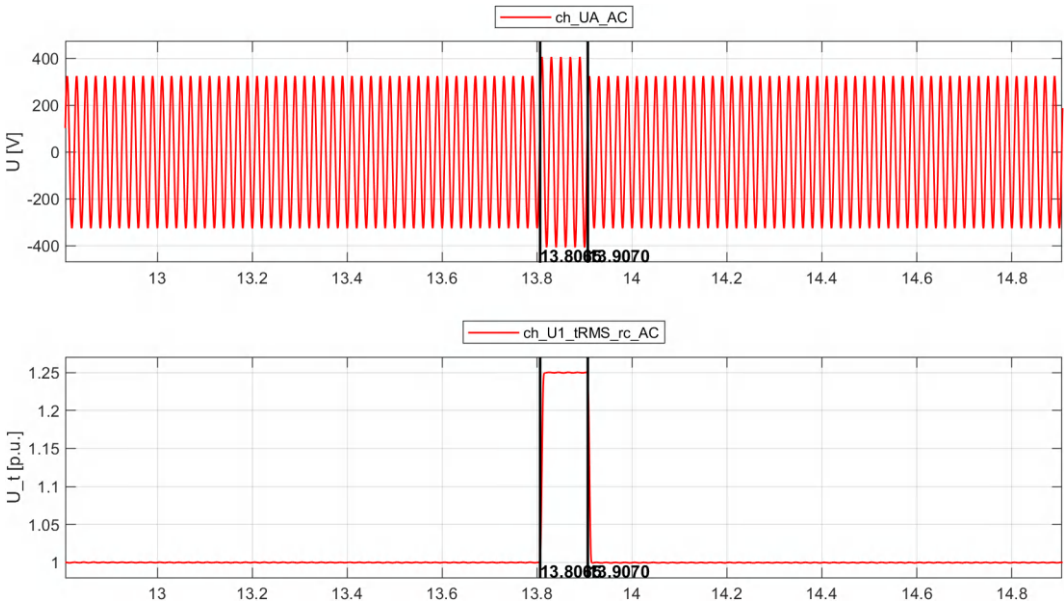
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.1	8.2
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	10:21:53.3	11:28:35.1
	3	Fault type (phase)	--	--	--	Type A	Type A
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t_1)	Total	--	ms	13263	12832
	7	Point of fault clearance(t_2)	Total	--	ms	13363	12932
	8	Fault duration in empty load test	Total	--	ms	101	101
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.244	1.244
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.990	0.199
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.250	1.250
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.014	0.017
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.017	0.016
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	-0.001	0.002
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.997	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.204	0.127
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

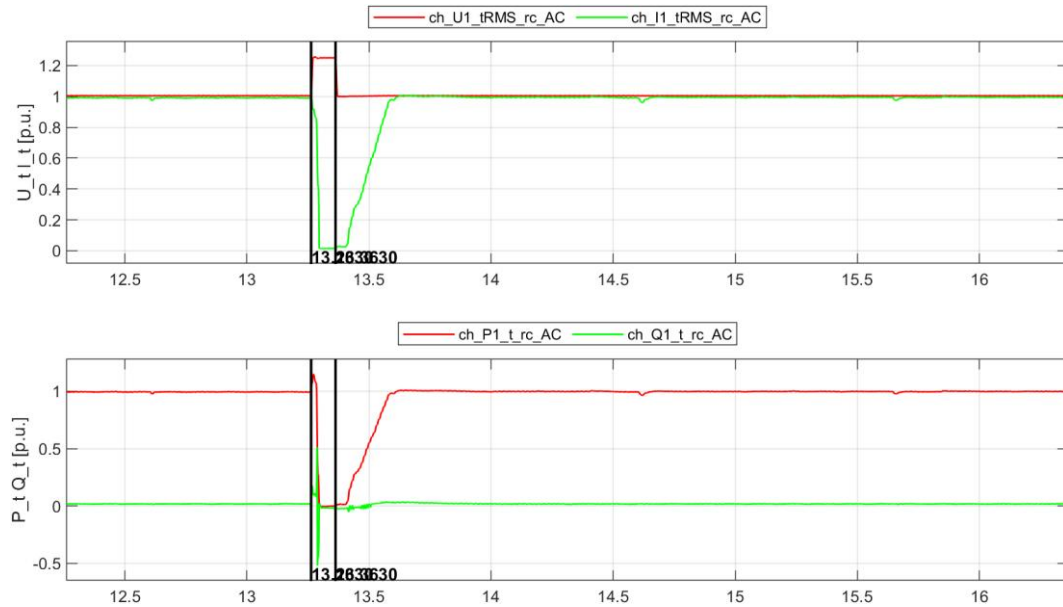
**Test 8.0a Depth of fault phase: 1.25 p.u., three-phase SC (type A), 0% load,
Instantaneous and RMS values of phase voltages**



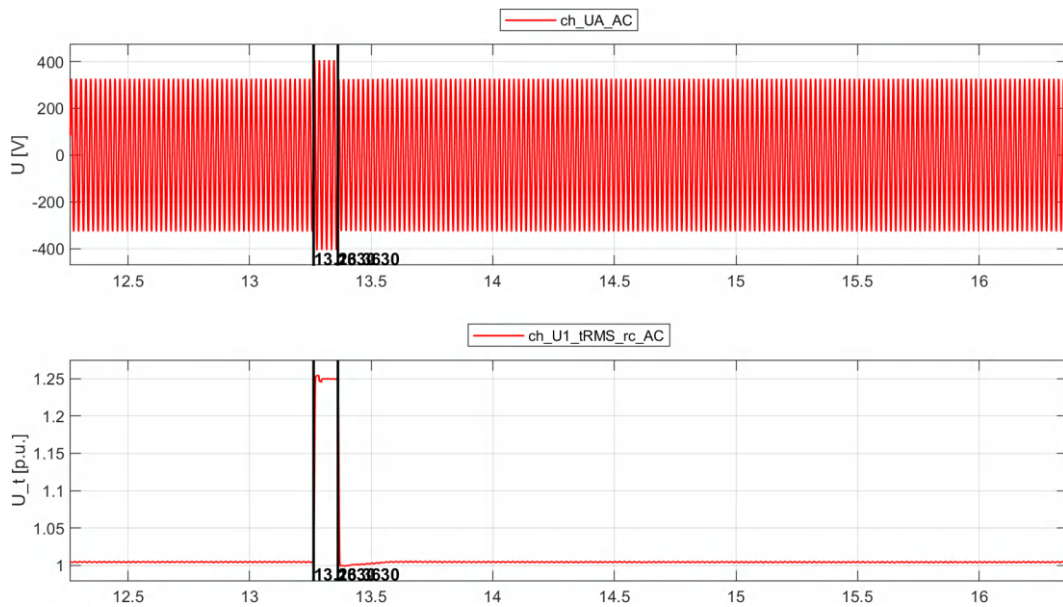
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**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)**



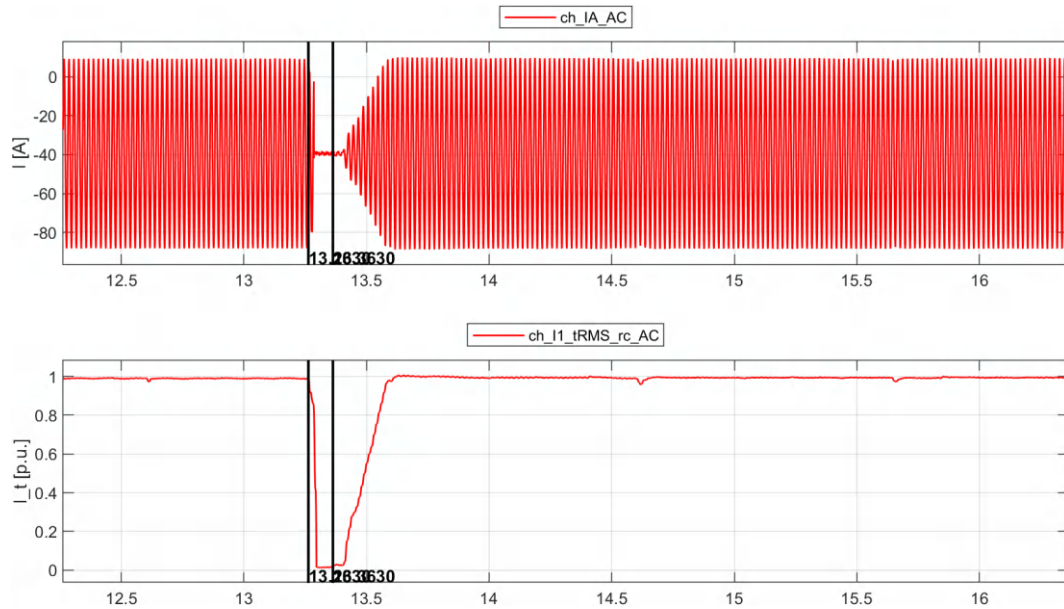
**Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load,
Instantaneous and RMS values of phase voltages**



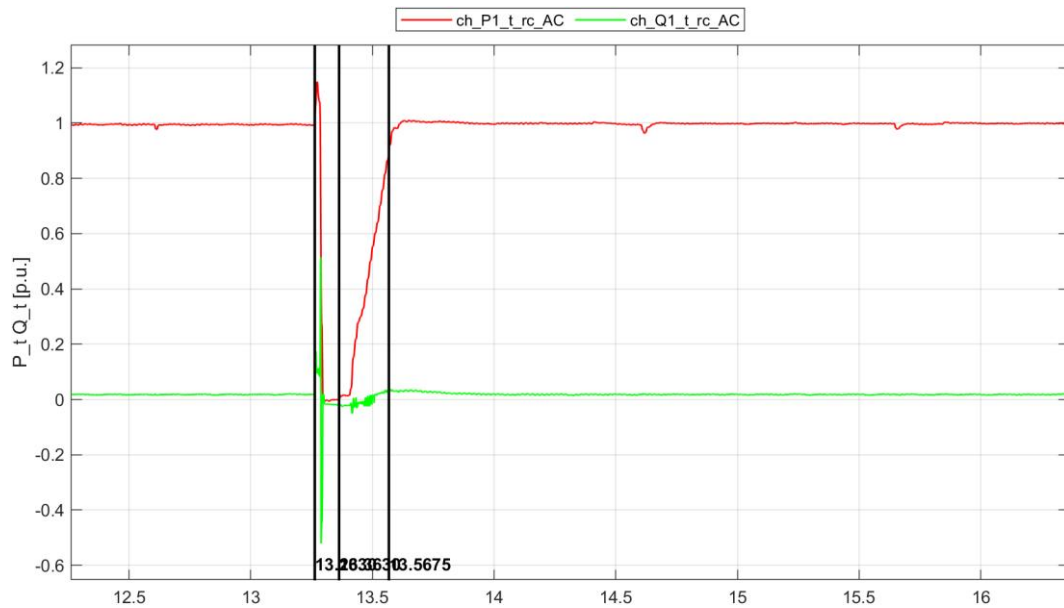
EN 50549-10

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



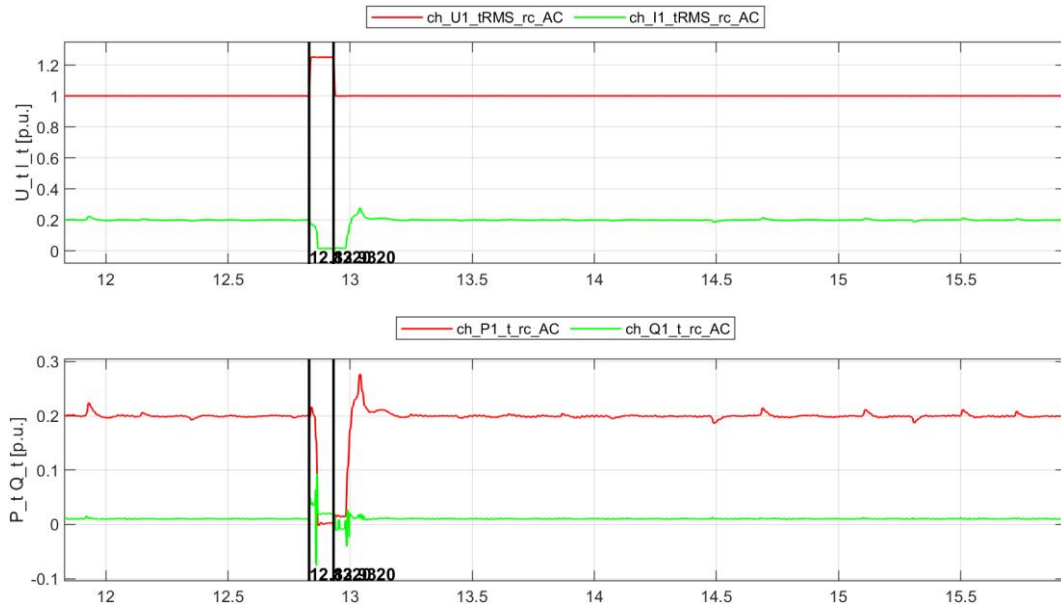
**Test 8.1 Depth of fault phase: 1.25 p.u., three-phase SC (type A), 100% load,
Power restore**



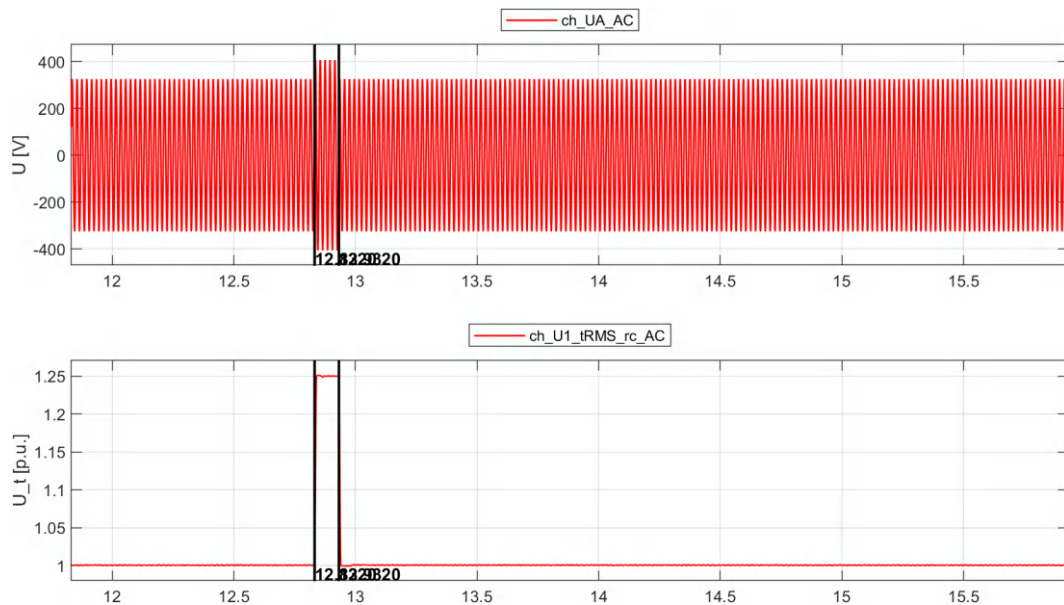
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load,
Test overview (voltage, current, active and reactive power)**



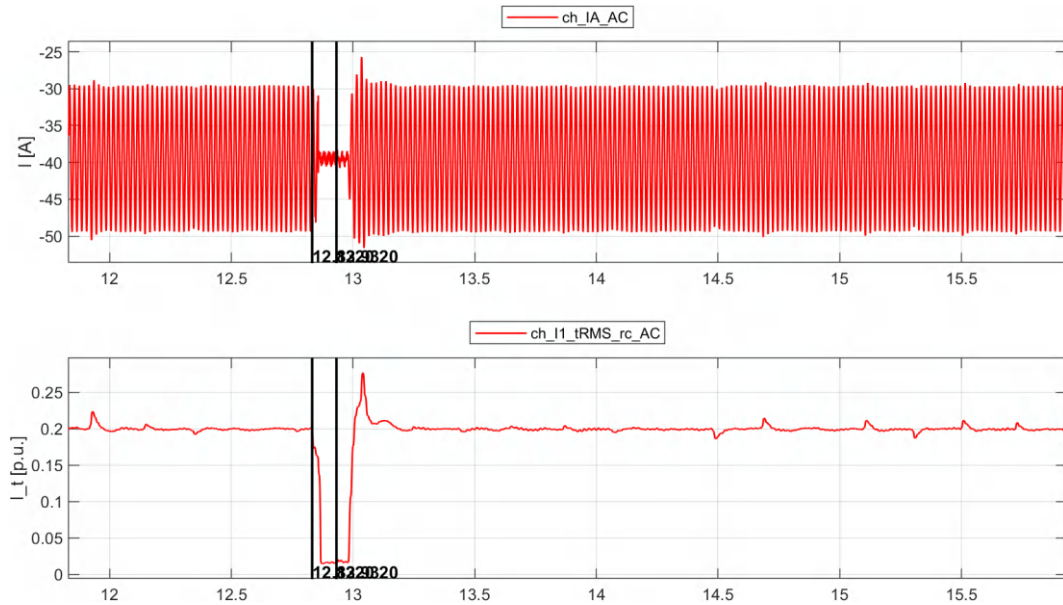
**Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load,
Instantaneous and RMS values of phase voltages**



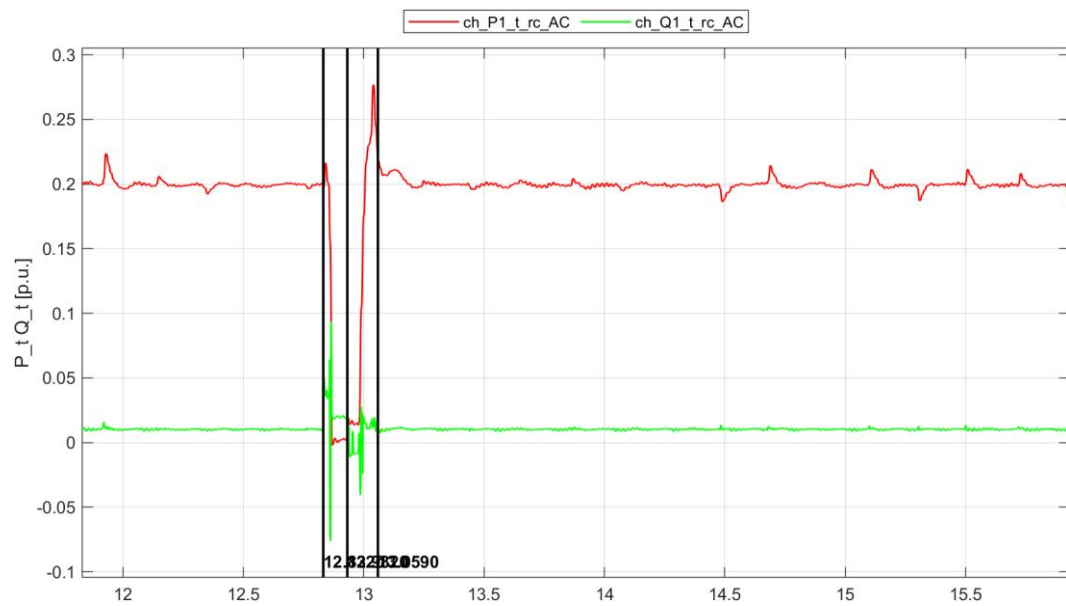
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load, Instantaneous and RMS values of phase currents



Test 8.2 Depth of fault phase: 1.25 p.u., three-phase SC (type A), partial load, Power restore



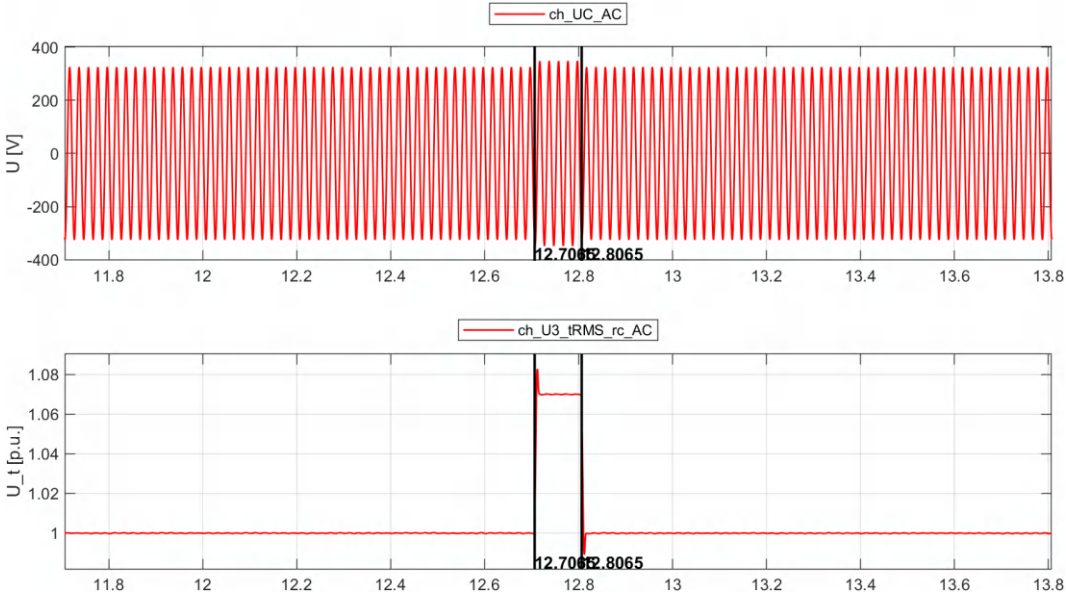
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.3	8.4
	1	Date	--	--	yyyy.mm.dd	2025.12.03	2025.12.03
	2	Time (start of test)	--	--	hh:mm:ss.f	19:24:59.0	15:27:02.8
	3	Fault type (phase)	--	--	--	Type D1	Type D1
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t ₁)	Total	--	ms	13446	12750
	7	Point of fault clearance(t ₂)	Total	--	ms	13546	12850
	8	Fault duration in empty load test	Total	--	ms	100	100
	9	Voltage depth/height in empty load test	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.070	1.070
	10		Pos.			N/A	N/A
Before dip <t1	11	Voltage	Line to neutral	t1-100s to t1	p.u.	1.004	1.001
	12	Current	Total	t1-500ms to t1-100ms	p.u.	0.990	0.199
	13	Active power	Total	t1-10s to t1	p.u.	0.994	0.199
	14		Pos.			N/A	N/A
	15	Reactive power	Total	t1-10s to t1	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cosφ	--	t1-10s to t1	--	1.000	0.999
During dip t1 to t2	18	Voltage	Line to neutral	t1+100ms to t2-20ms	p.u.	1.074	1.071
	19	Line current	Phase 1	t1+60ms	p.u.	0.930	0.187
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	t1+100ms	p.u.	0.929	0.187
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	t1+100ms to t2-20ms	p.u.	1.003	0.198
	26		Pos.			N/A	N/A
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.004	1.001
	28	Active power	Total	t2+3s to t2+10s	p.u.	0.994	0.199
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.001
	31	Reactive power	Total	t2+3s to t2+10s	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	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

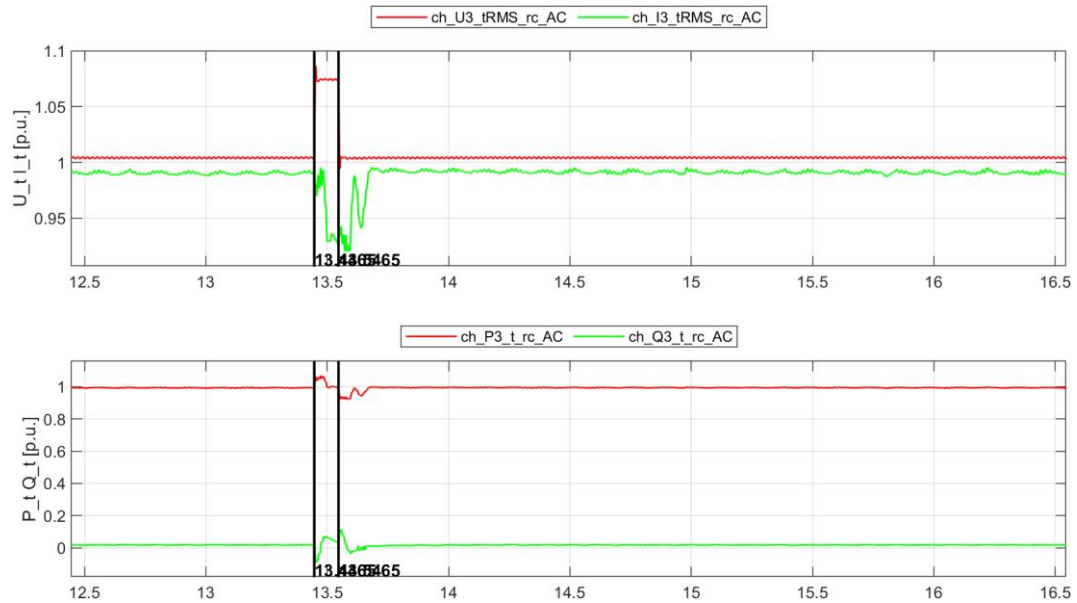
Test 8.0d1 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 0% load, Instantaneous and RMS values of phase voltages



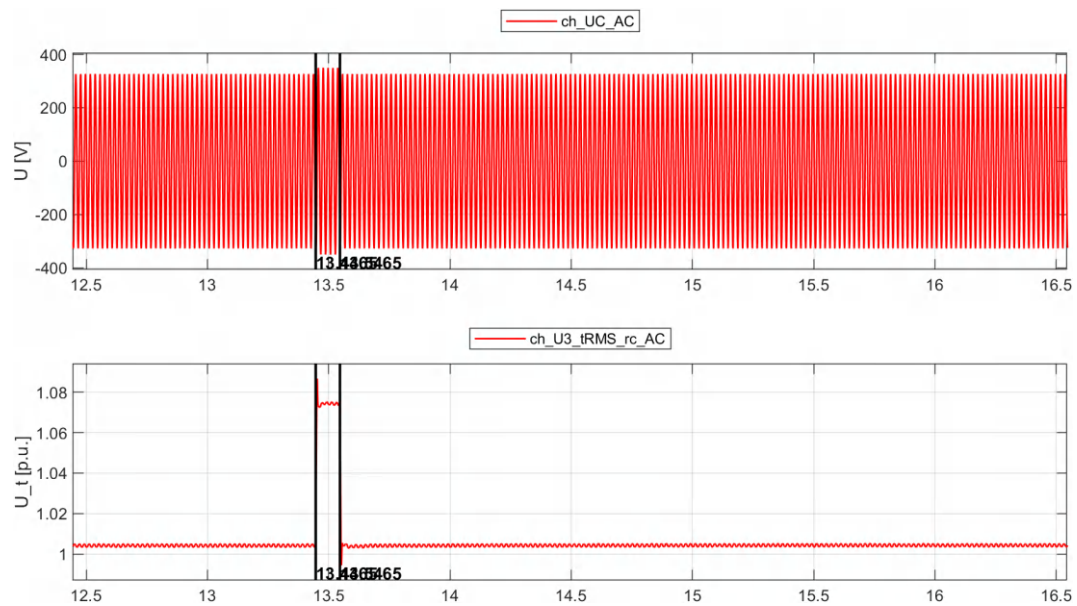
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load,
Test overview (voltage, current, active and reactive power)**



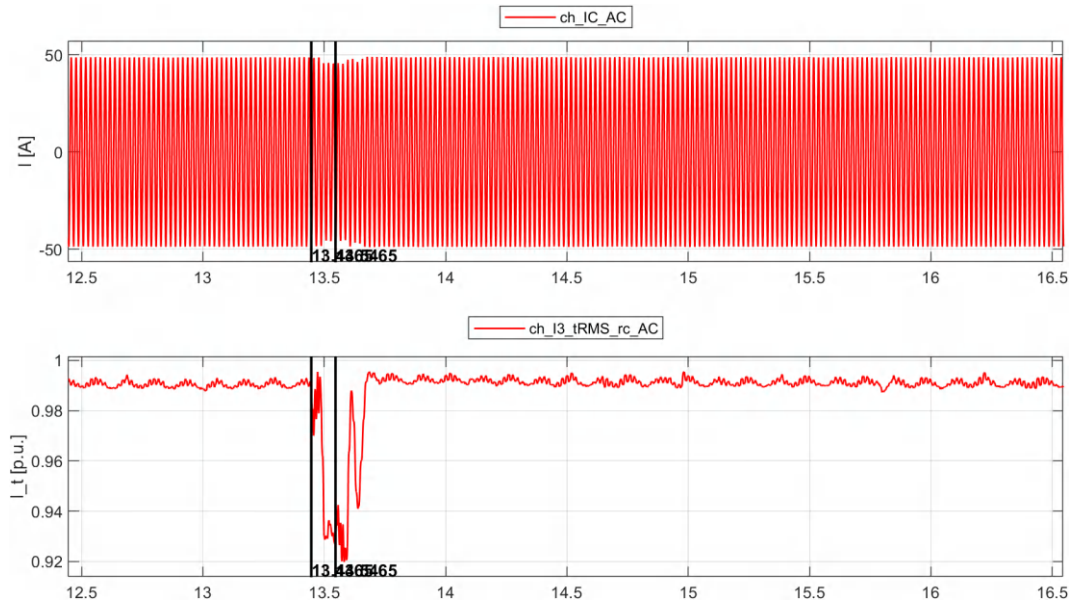
**Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load,
Instantaneous and RMS values of phase voltages**



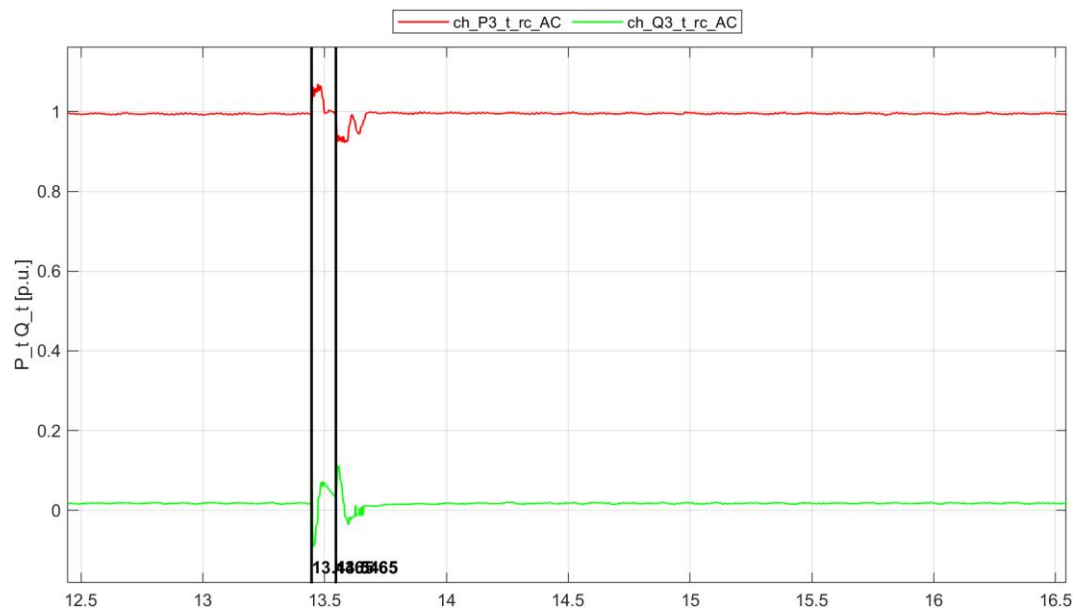
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load, Instantaneous and RMS values of phase currents



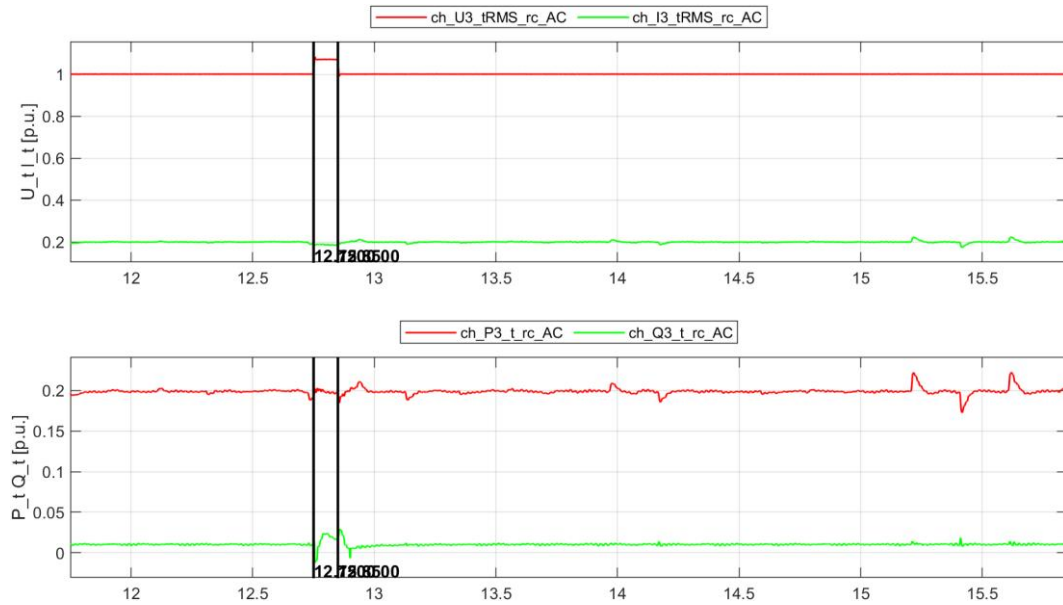
Test 8.3 Depth of fault phase: 1.25 p.u., two-phase SC (type D), 100% load, Power restore



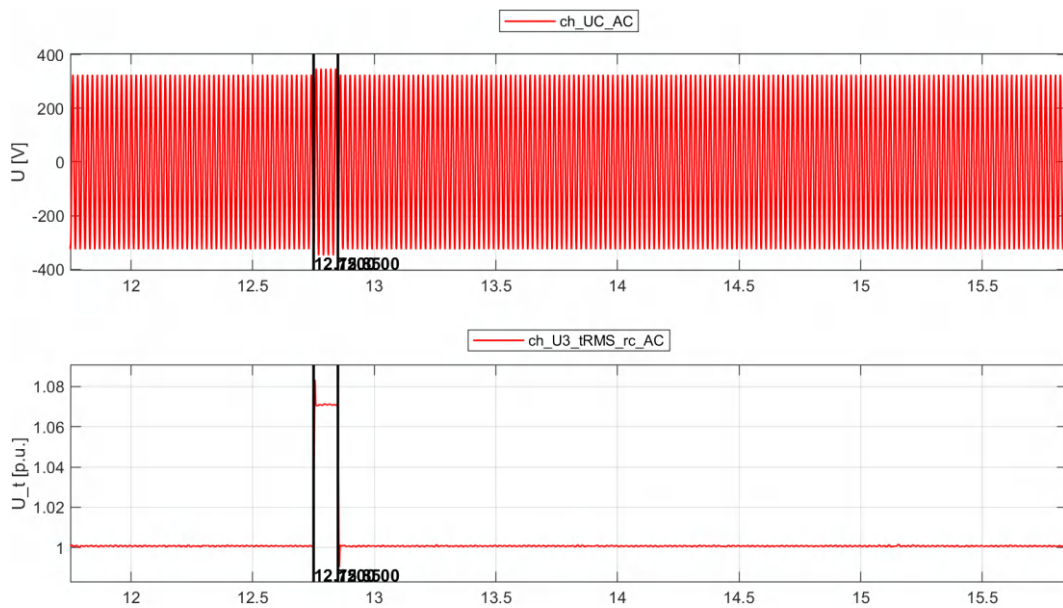
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load,
Test overview (voltage, current, active and reactive power)**



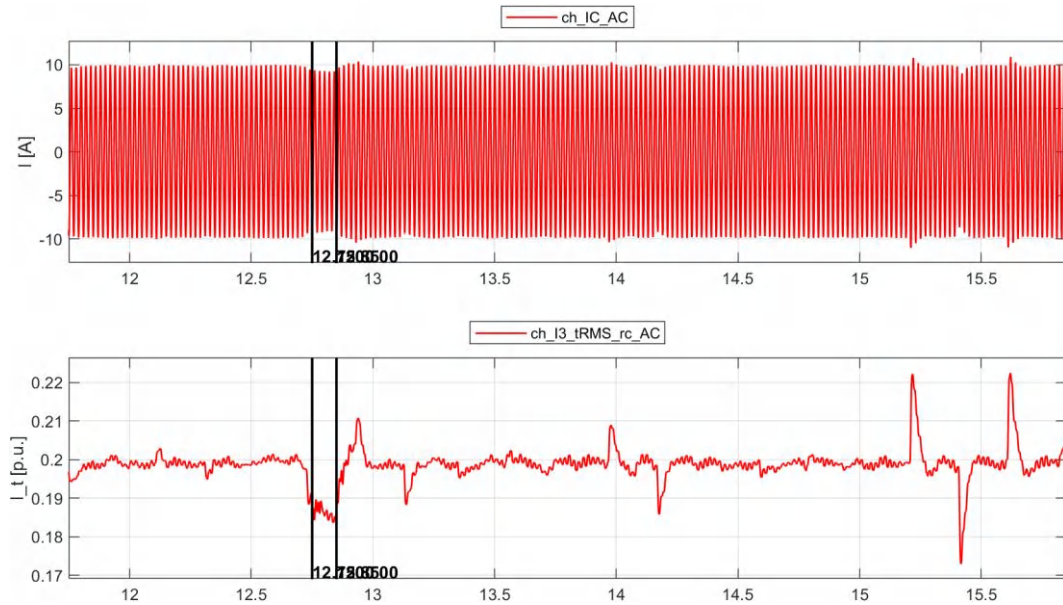
**Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load,
Instantaneous and RMS values of phase voltages**



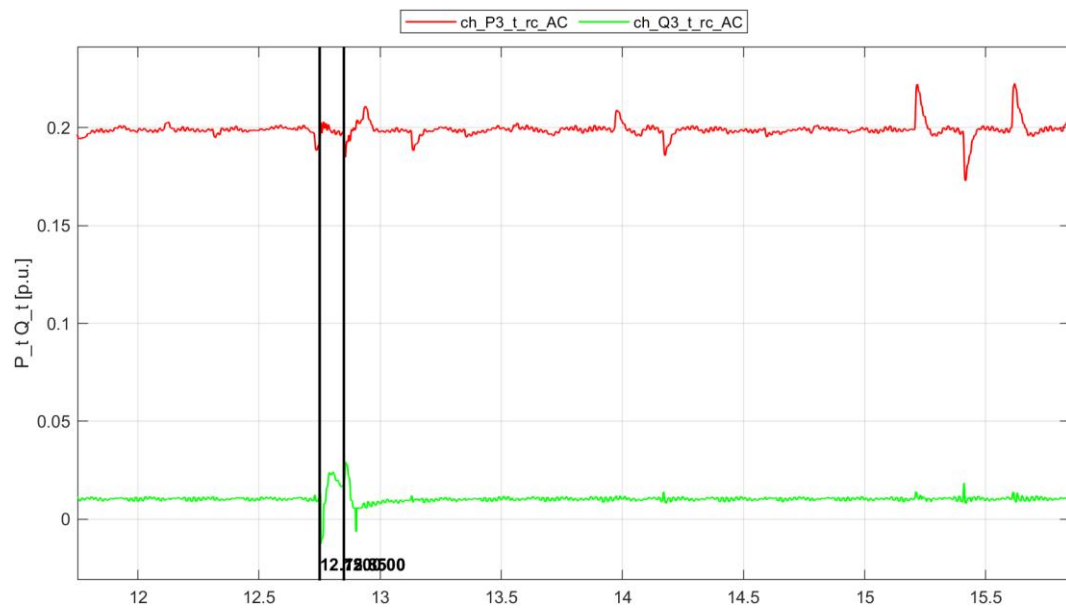
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load, Instantaneous and RMS values of phase currents



Test 8.4 Depth of fault phase: 1.25 p.u., two-phase SC (type D), partial load, Power restore



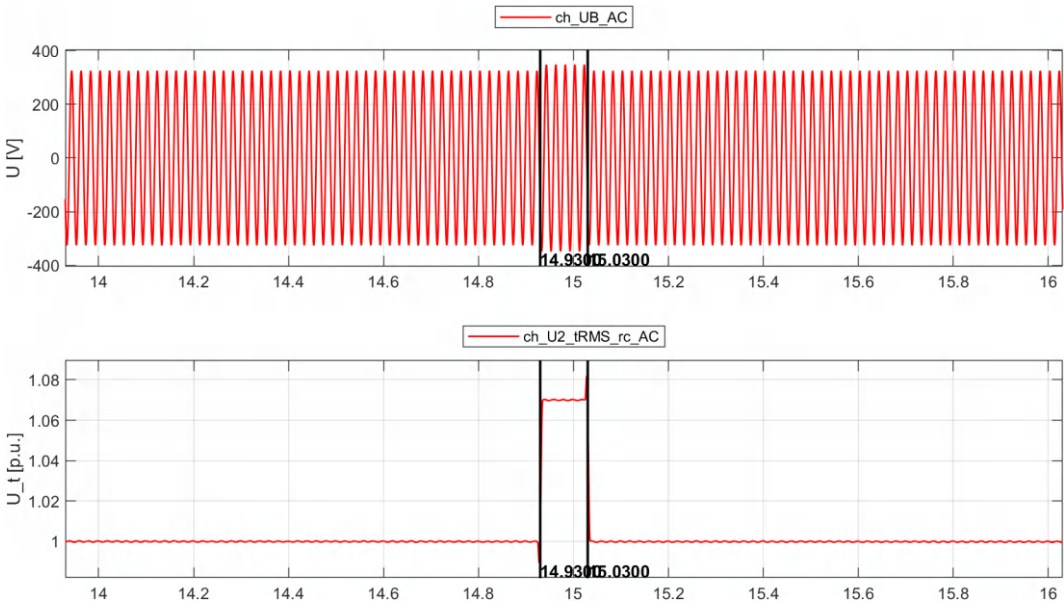
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Condition						Measured value	
Item	No.	Parameter	Phase ref.	Time ref.	unit		
General Info.	0	Test number	--	--	--	8.5	8.6
	1	Date	--	--	yyyy.mm.dd	2025.12.04	2025.12.04
	2	Time (start of test)	--	--	hh:mm:ss.f	11:41:53.3	11:39:35.7
	3	Fault type (phase)	--	--	--	Type D2	Type D2
	4	Setting voltage depth	Phase conductor	--	p.u.	1.25	1.25
	5	Setting dip duration		--	--	100	100
	6	Point of fault entry(t_1)	Total	--	ms	13375	13015
	7	Point of fault clearance(t_2)	Total	--	ms	13475	13115
	8	Fault duration in empty load test	Total	--	ms	100	100
	9	Voltage depth/height in empty load test	Total	$t_1+100\text{ms to }t_2$ and $t_1-10\text{s to }t_1$	p.u.	1.073	1.073
	10		Pos.			N/A	N/A
Before dip < t_1	11	Voltage	Line to neutral	$t_1-100\text{s to }t_1$	p.u.	1.004	1.001
	12	Current	Total	$t_1-500\text{ms to }t_1-100\text{ms}$	p.u.	0.991	0.203
	13	Active power	Total	$t_1-10\text{s to }t_1$	p.u.	0.994	0.203
	14		Pos.			N/A	N/A
	15	Reactive power	Total	$t_1-10\text{s to }t_1$	p.u.	0.018	0.010
	16		Pos.			N/A	N/A
	17	Cos ϕ	--	$t_1-10\text{s to }t_1$	--	1.000	0.999
During dip t_1 to t_2	18	Voltage	Line to neutral	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	1.073	1.071
	19	Line current	Phase 1	$t_1+60\text{ms}$	p.u.	0.917	0.190
	20		Phase 2			N/A	N/A
	21		Phase 3			N/A	N/A
	22	Line current	Phase 1	$t_1+100\text{ms}$	p.u.	0.923	0.188
	23		Phase 2			N/A	N/A
	24		Phase 3			N/A	N/A
	25	Active power	Total	$t_1+100\text{ms to }t_2-20\text{ms}$	p.u.	0.990	0.203
	26		Pos.			N/A	N/A
	27	Voltage	Line to neutral	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	1.004	1.001
After dip > t_2	28	Active power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.994	0.203
	29		Pos.			N/A	N/A
	30	Response time active power	Total	--	s	0.001	0.264
	31	Reactive power	Total	$t_2+3\text{s to }t_2+10\text{s}$	p.u.	0.018	0.010
	32		Pos.			N/A	N/A
	33	Reactive power rising time	Total	--	s	N/A	N/A
	34	PGU does not disconnect from grid till 60s after fault	--	t_2 to $t_2+60\text{s}$	Yes / No	YES	YES

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

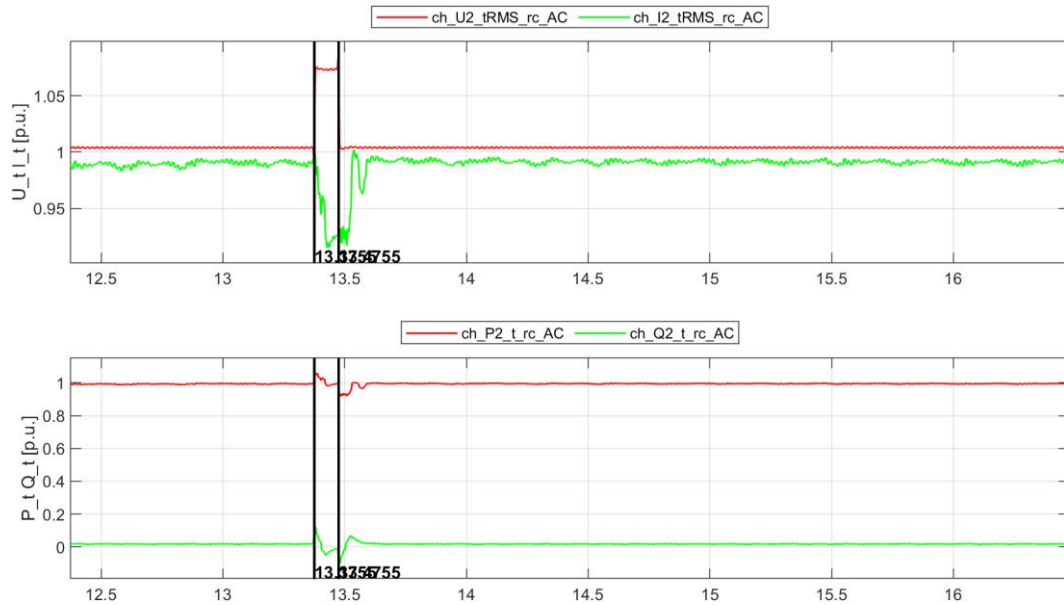
Test 8.0d2 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 0% load,
Instantaneous and RMS values of phase voltages



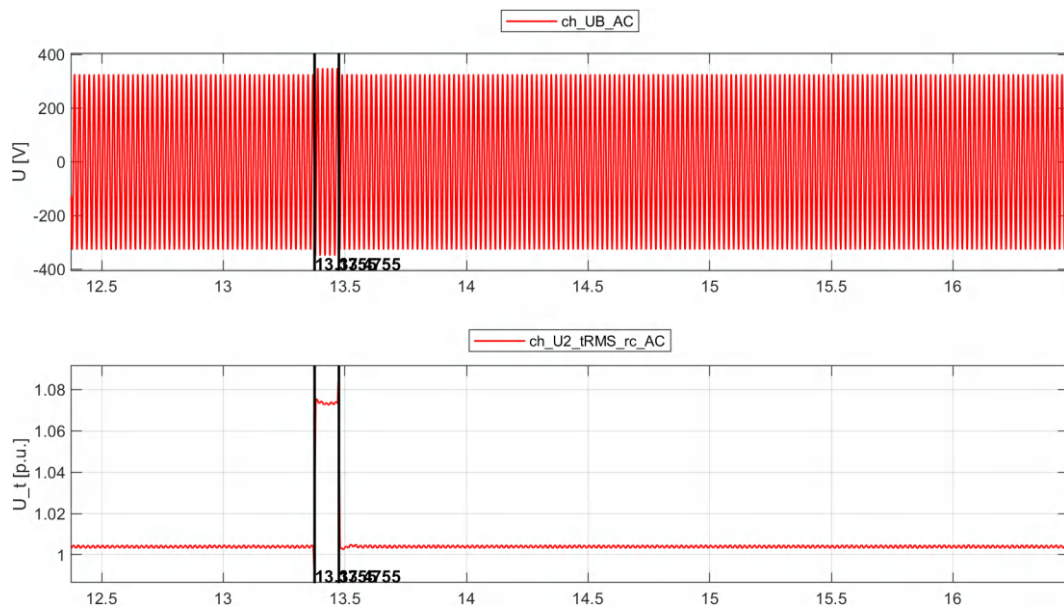
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load,
Test overview (voltage, current, active and reactive power)**



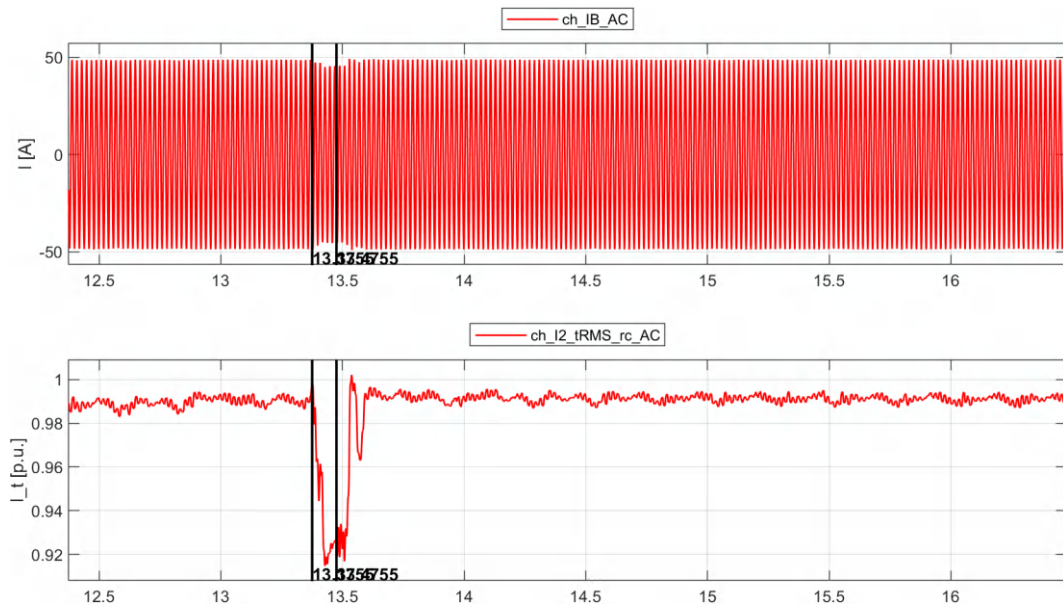
**Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load,
Instantaneous and RMS values of phase voltages**



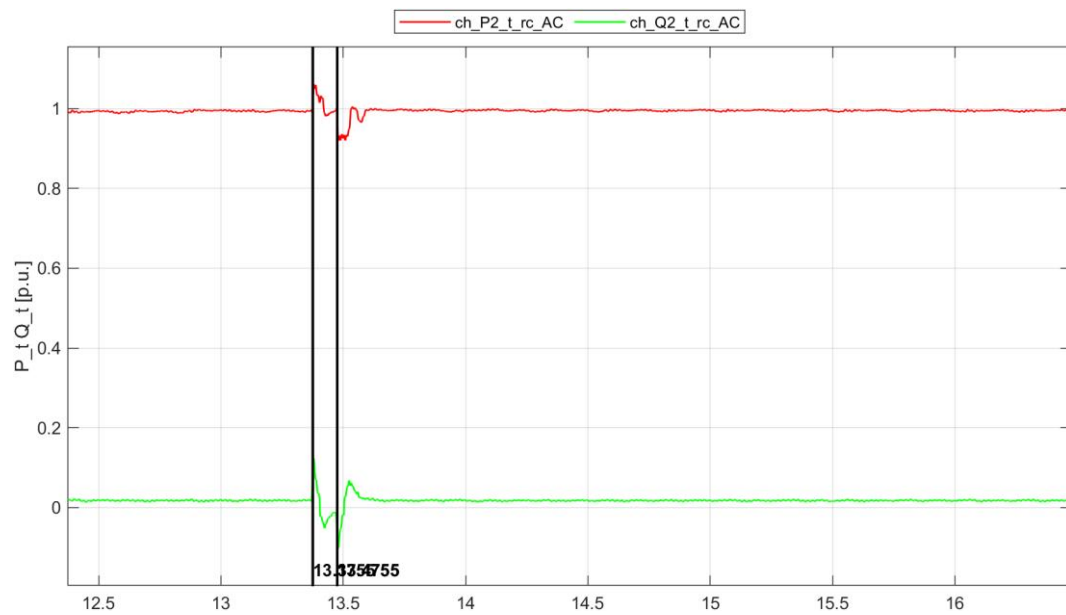
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load, Instantaneous and RMS values of phase currents



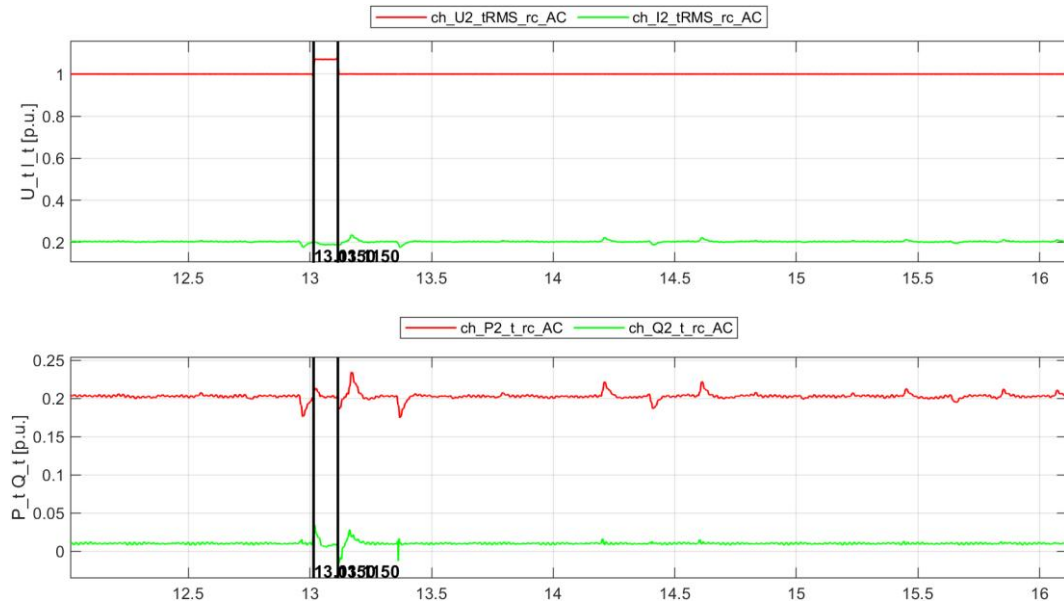
Test 8.5 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), 100% load, Power restore



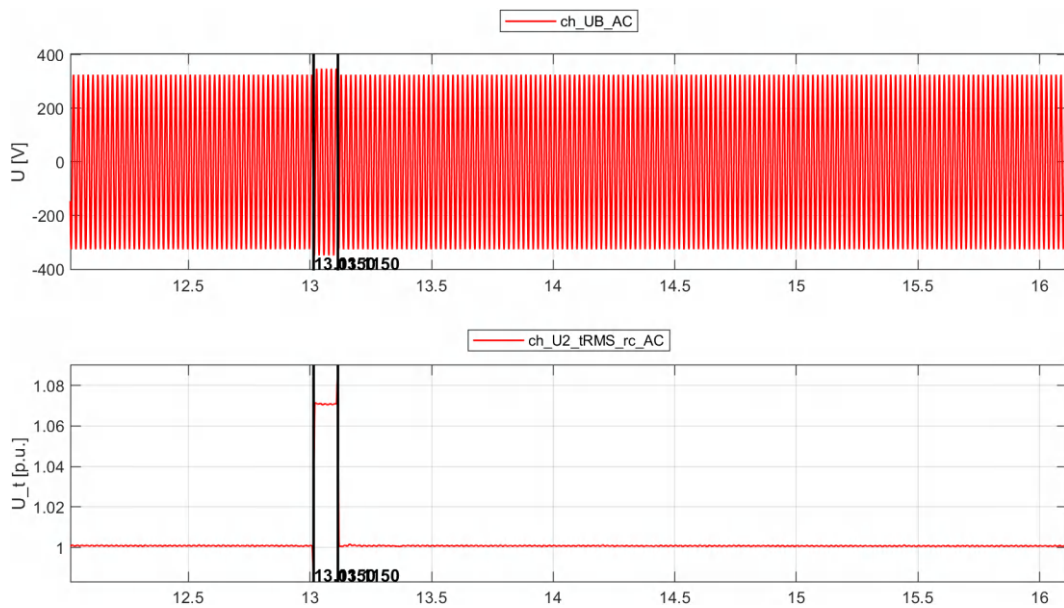
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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**Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load,
Test overview (voltage, current, active and reactive power)**

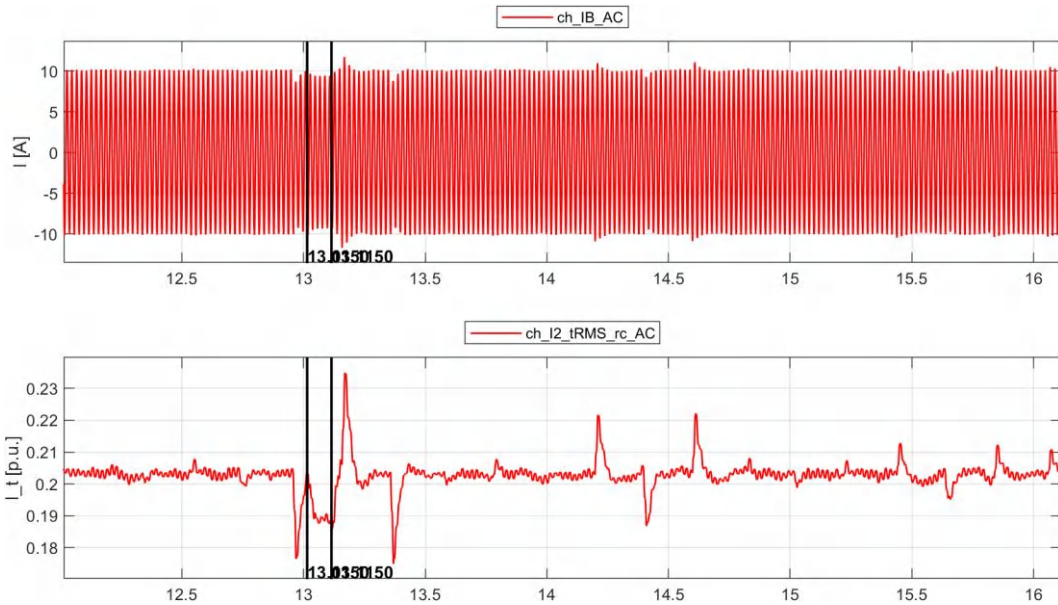
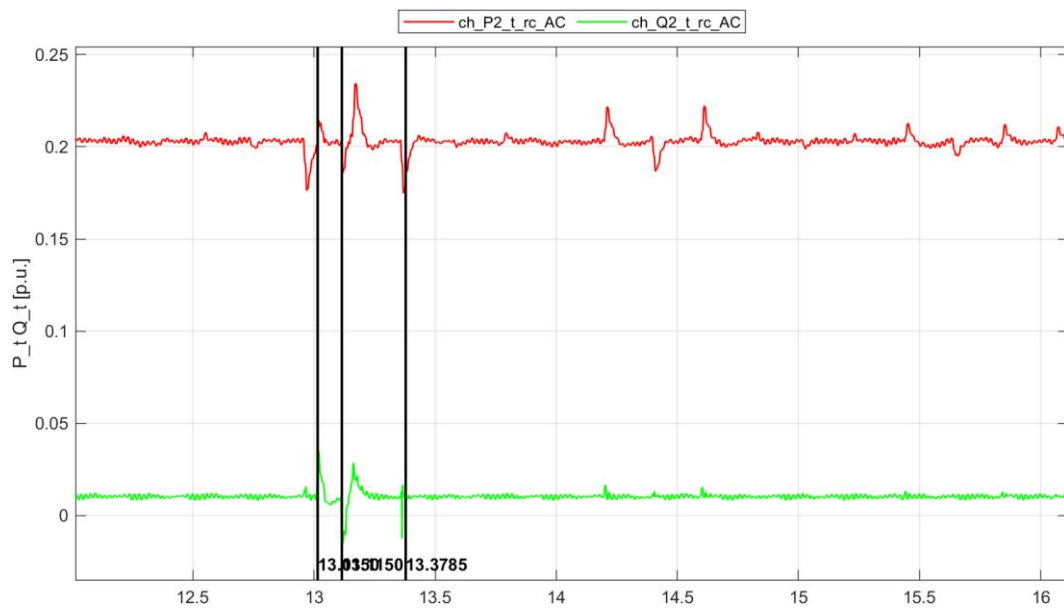


**Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load,
Instantaneous and RMS values of phase voltages**



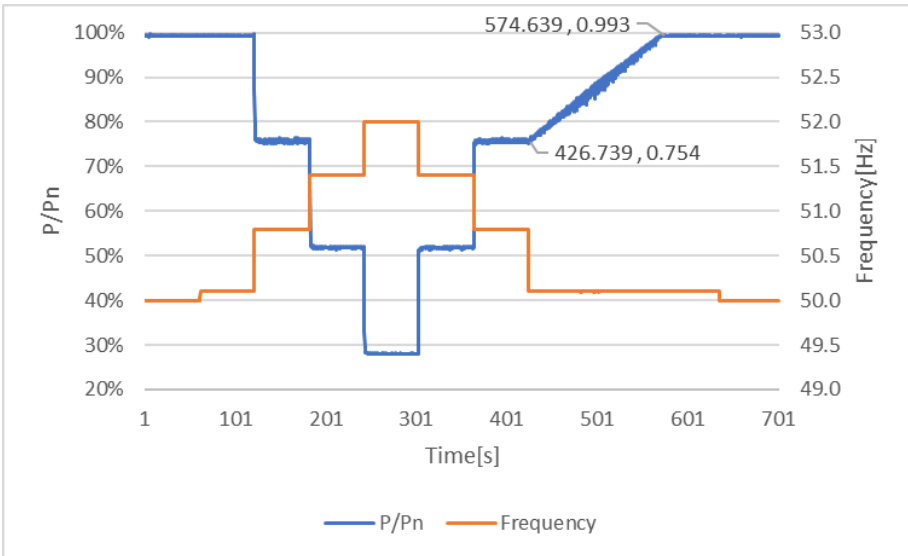
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load, Instantaneous and RMS values of phase currents

Test 8.6 Depth of fault phase: 1.25 p.u., two-phase SC (type D2), partial load, Power restore


EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient- For other generating unit Setting (a)								
Starting frequency f_{th} :		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	99.32%	--	--	--	-0.68%	$\pm 10\%$
50.10	100%	50.10	99.31%	--	--	--	-0.69%	
50.80	76%	50.80	75.77%	0.4	0.4	0.2	-0.23%	
51.40	52%	51.40	51.86%	0.4	0.4	0.2	-0.14%	
f_{max}^a (52.0)	28%	52.00	28.05%	0.4	0.4	0.2	0.05%	
51.40	52%	51.40	51.82%	0.3	0.3	<0.1	-0.18%	
50.80	76%	50.80	75.72%	0.5	0.5	0.2	-0.28%	
50.10	100%	50.10	98.70%	--	--	1.1	-1.30%	
50.00	100%	50.00	99.30%	--	--	--	-0.70%	
Test condition		Measurement					Limit	
50.80 to 50.10		Max. power gradient (% P_{max}/min):				9.70	$\leq 10\%$ P_{max}/min	
Graph of Measurement test 1								
								

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test No. 2:

Power level at start of test 50% P_n^b

Test condition		Measurement						Limit ΔP/P _n
f (Hz)	Target P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	
50.00	50%	50.00	49.53%	--	--	--	-0.47%	± 10%
50.10	50%	50.10	49.53%	--	--	--	-0.47%	
50.80	38%	50.80	37.81%	0.3	0.3	0.2	-0.19%	
51.40	26%	51.40	25.87%	0.3	0.3	0.1	-0.13%	
f _{max} ^a (52.0)	14%	52.00	13.95%	0.3	0.3	0.2	-0.05%	
51.40	26%	51.40	25.86%	0.4	0.4	0.1	-0.14%	
50.80	38%	50.80	37.80%	0.3	0.3	0.2	-0.20%	
50.10	50% to 100%	50.10	99.28%	--	--	0.9	-0.72%	
50.00	100%	50.00	99.30%	--	--	--	-0.70%	
Test condition		Measurement						Limit
50.80 to 50.10		Max. power gradient (%P _n /min):				9.70		≤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.

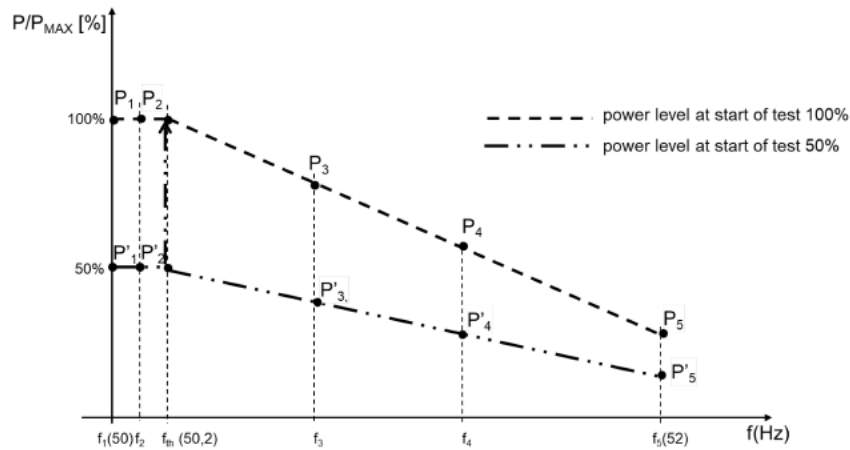
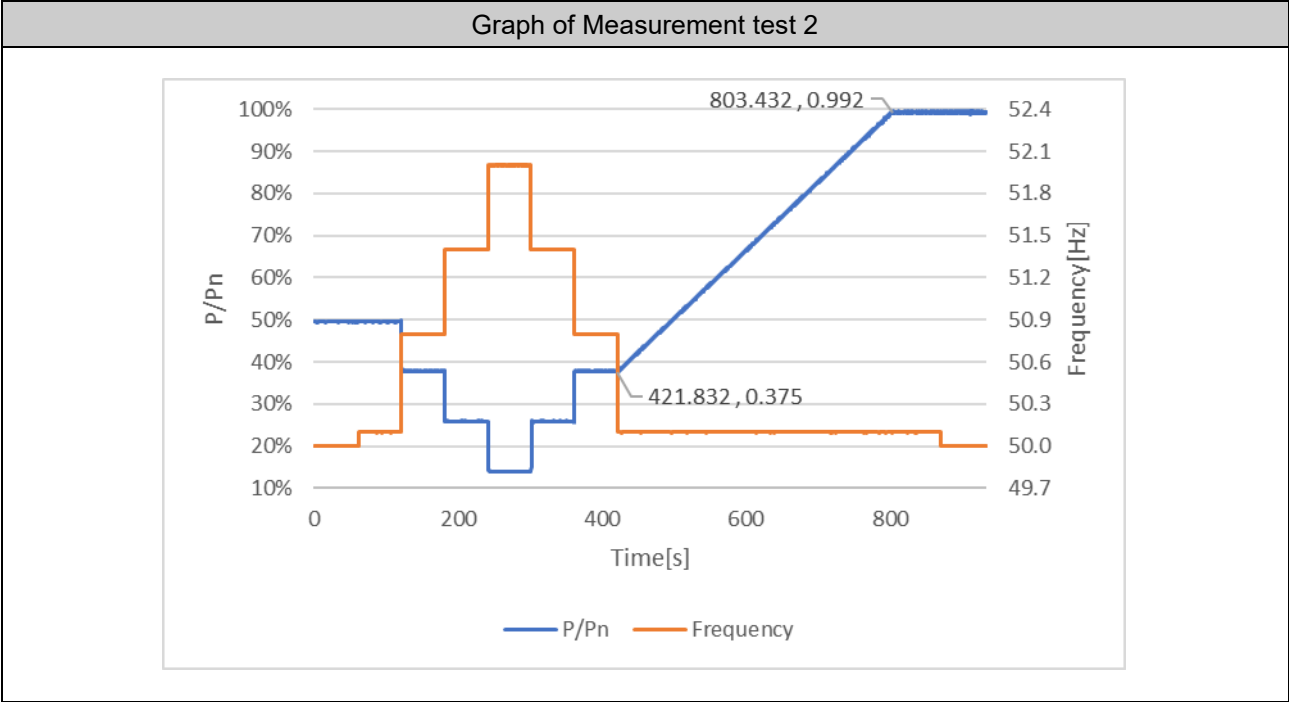


Figure 19 — Other non-synchronous generating technology ($P_{\text{ref}} = P_M$) without configured deactivation threshold, setting (a), example

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



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient- For ESS Setting (a)								
Starting frequency f_{th} :		50.2Hz						
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		100% P_n						
Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/P_n^c	f [Hz]	P/P_n	T_{sr} [s]	T_s [s]	T_d [s]	$\Delta P/P_n$	$\Delta P/P_n$
50.00	91.5%	50.00	91.46%	--	--	--	-0.04%	$\pm 10\%$
50.10	91.5%	50.10	91.23%	--	--	--	-0.27%	
50.80	67.5%	50.80	67.66%	1.2	1.2	1.1	0.16%	
51.40	43.5%	51.40	43.80%	0.3	0.3	0.2	0.30%	
f_{max}^a (52.0)	19.5%	52.00	19.99%	0.4	0.4	0.2	0.49%	
51.40	43.5%	51.40	43.78%	0.4	0.4	0.2	0.28%	
50.80	67.5%	50.80	67.64%	0.5	0.5	0.2	0.14%	
50.25	91.5%	50.10	91.65%	0.5	0.5	0.2	0.15%	
50.00	91.5%	50.00	91.32%	--	--	--	-0.18%	
Graph of Measurement test 1								
Time[s] — P/Pn — Frequency								

EN 50549-10

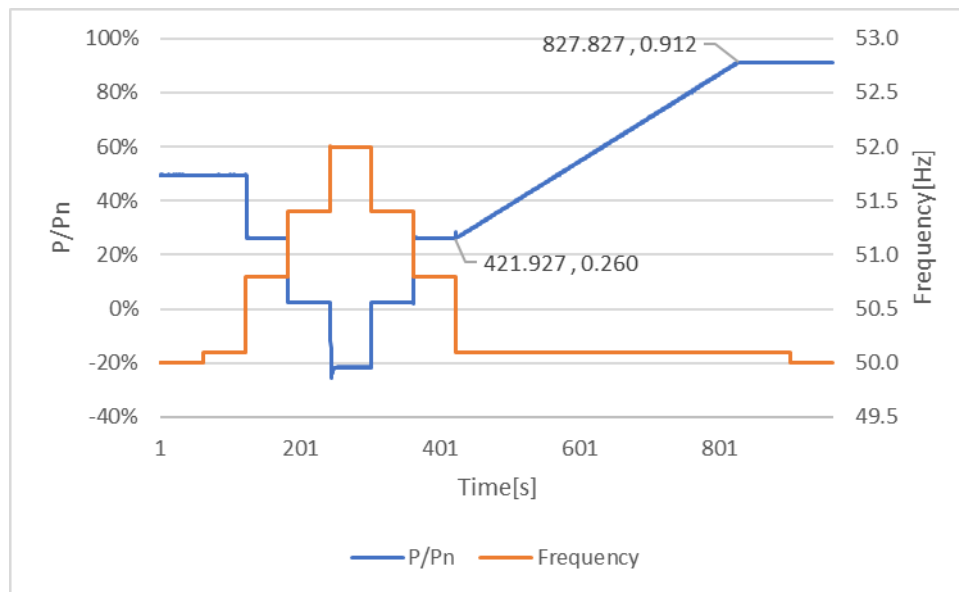
Clause	Requirement - Test	Result - Remark	Verdict
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Test No. 2

Power level at start of test 50% P_n^b

Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/Pn ^c	f [Hz]	P/Pn	Tsr [s]	Ts [s]	Td [s]	Δ P/Pn	Δ P/Pn
50.00	50%	50.00	49.49%	--	--	--	-0.51%	± 10%
50.10	50.0%	50.10	49.49%	--	--	--	-0.51%	
50.80	26.0%	50.80	26.05%	1.3	1.3	1.2	0.05%	
51.40	2.0%	51.40	2.22%	0.4	0.4	<0.1	0.22%	
f _{max} ^a (52.0)	-22.0%	52.00	-21.58%	1.7	1.7	0.1	0.42%	
51.40	2.0%	51.40	2.23%	0.4	0.4	0.2	0.23%	
50.80	26.0%	50.80	26.09%	0.4	0.4	<0.1	0.09%	
50.25	91.5%	50.10	90.30%	--	--	0.1	-1.20%	
50.00	91.5%	50.00	90.92%	--	--	--	-0.58%	
Test condition		Measurement					Limit	
50.80 to 50.10		Max. power gradient (%Pmax/min):			9.64		≤10% Pmax/min	

Graph of Measurement test 2



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Test No. 3

Power level at start of test -50% P_n

Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	Δ P/P _n
50.00	-50.0%	50.00	-49.76%	--	--	--	0.24%	± 10%
50.10	-50.0%	50.10	-49.76%	--	--	--	0.24%	
50.80	-74.0%	50.80	-73.20%	2.4	2.4	2.2	0.80%	
51.40	-98.0%	51.40	-97.08%	0.5	0.5	0.2	0.92%	
f _{max} ^a (52.0)	-100.0%	52.00	-99.48%	0.3	0.3	0.2	0.52%	
51.40	-98.0%	51.40	-97.11%	0.5	0.5	0.1	0.89%	
50.80	-74.0%	50.80	-73.22%	0.5	0.5	0.2	0.78%	
50.10	-50.0%	50.10	-49.76%	0.3	0.3	<0.1	0.24%	
50.00	-50.0%	50.00	-49.76%	--	--	--	0.24%	

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^c the maximum discharge power in battery operation is 7320W.

Deactivate the frequency protection function if needed.

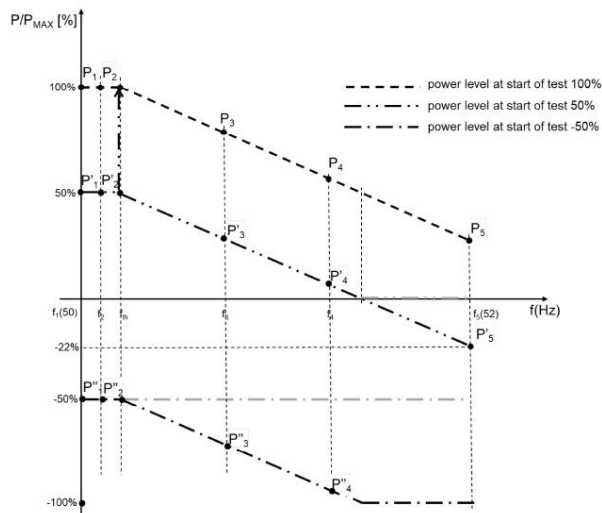
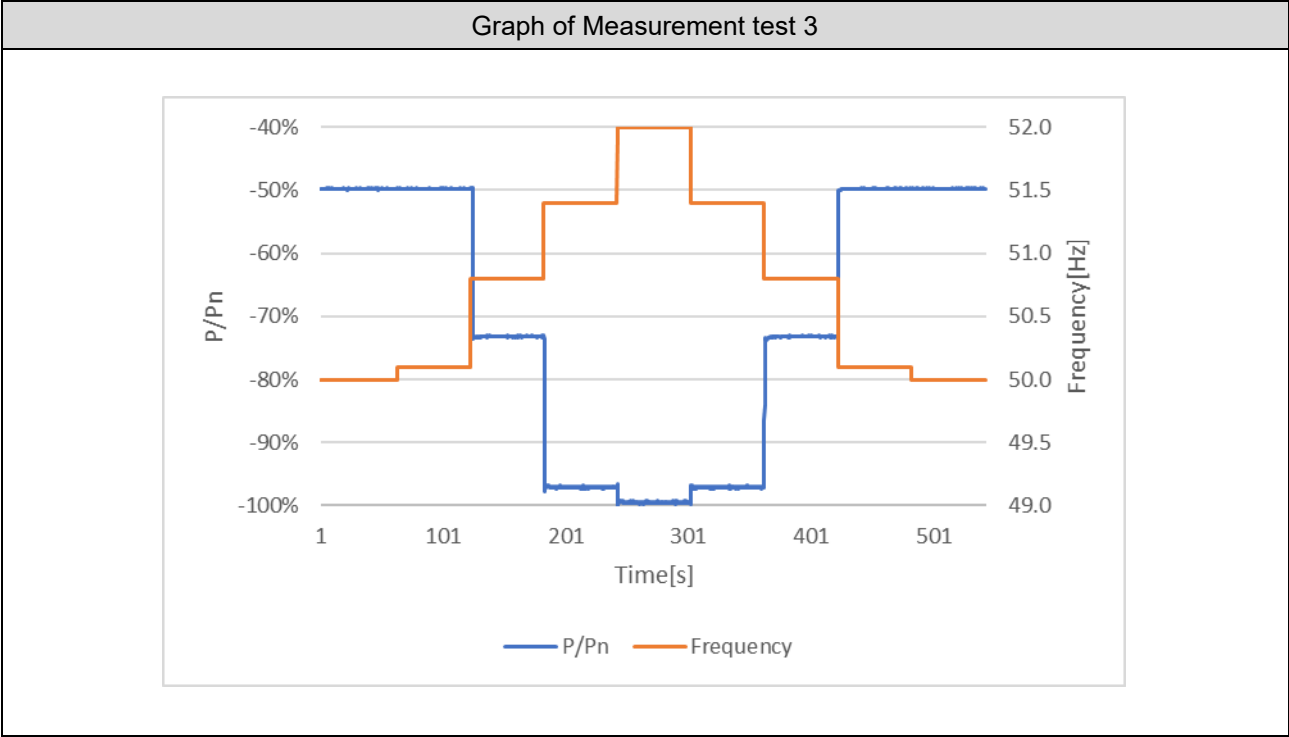


Figure 16 — Electrical energy storage systems ($P_{ref} = P_{max}$) without configured deactivation threshold, setting (a), example

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



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
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						
Power level at start of test			60% P _n ^b					
Test condition		Measurement						Limit ΔP/P _n
f (Hz)	Target P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	
50.00	60%	50.00	59.44%	--	--	--	-0.56%	± 10%
50.25	60%	50.25	59.44%	--	--	--	-0.56%	
51.00	30%	51.00	29.66%	1.3	1.3	1.1	-0.34%	
51.50	0%	51.50	0.53%	0.4	0.4	0.2	0.53%	
f _{max} ^a (52.0)	0%	52.00	-0.08%	--	--	--	-0.08%	
51.50	0%	51.50	-0.12%	--	--	--	-0.12%	
51.00	0%	51.00	-0.16%	--	--	--	-0.16%	
50.25	60%	50.25	59.45%	--	--	1.6	-0.55%	
50.00	60%	50.00	59.46%	--	--	--	-0.54%	
Test condition		Measurement					Limit	
51.00-50.25		Max. power gradient (%P _n /min):			9.69		≤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.

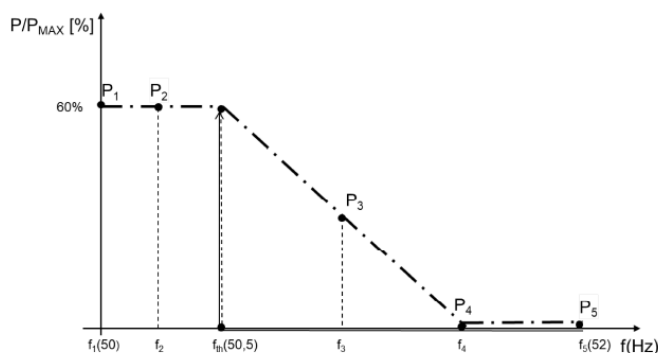
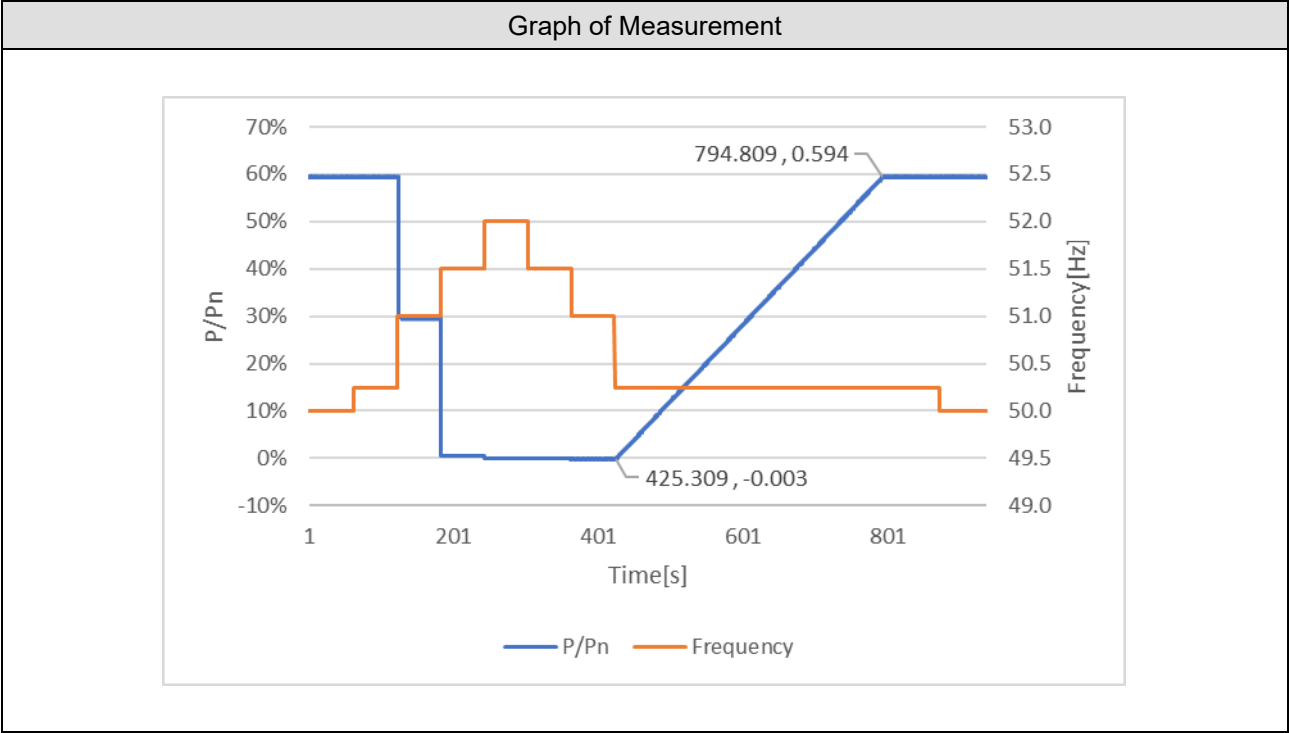


Figure 20 — Other non-synchronous generating technology ($P_{ref} = P_M$) with configured deactivation threshold, setting (b), example

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



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient- For ESS 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 _{MAX}						
Test No. 1								
Power level at start of test		60% P _n ^b						
Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	Δ P/P _n
50.00	60%	50.00	60.06%	--	--	--	0.06%	± 10%
50.25	60%	50.25	60.04%	--	--	--	0.04%	
51.00	10%	51.00	10.40%	1.4	1.4	1.3	0.40%	
51.50	-40%	51.50	-38.23%	2.1	2.1	0.2	1.77%	
f _{max} ^a (52.0)	-90%	52.00	-87.94%	0.5	0.5	0.1	2.06%	
51.50	-90%	51.50	-87.94%	--	--	--	2.06%	
51.00	-90%	51.00	-87.97%	--	--	--	2.03%	
50.25	60%	50.25	59.60%	--	--	0.1	-0.40%	
50.00	60%	50.00	60.06%	--	--	--	0.06%	
Test Condition	Measurement					Limitation		
51.00-50.25	Observation time			0.1		1s		
	Max. power gradient (%P _{max} /min):			9.67		≤ 10% P _{max} /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.								

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

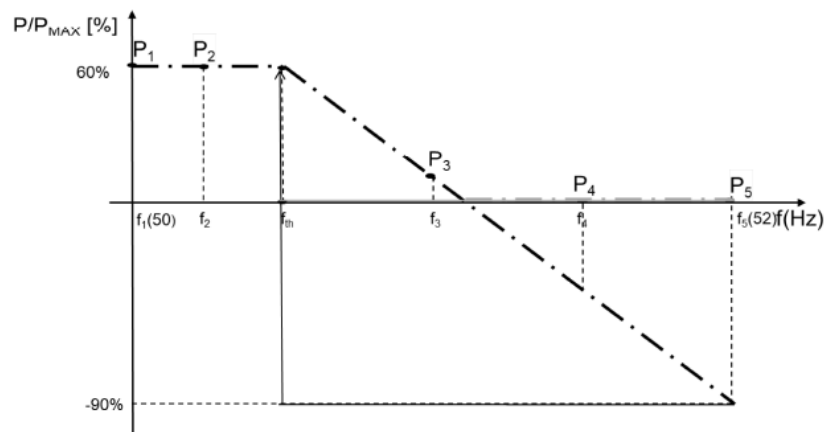
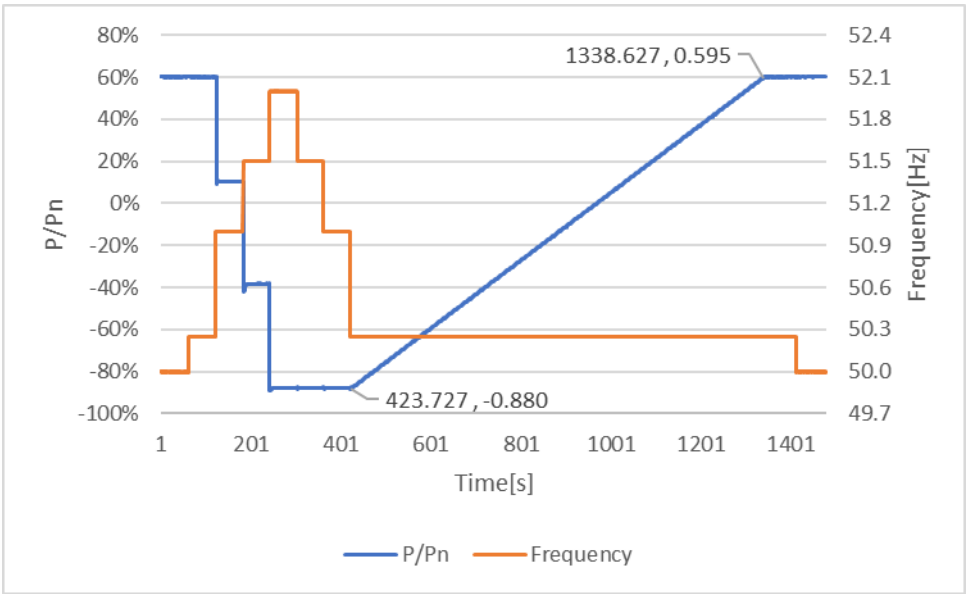


Figure 17 — Electrical energy storage systems ($P_{ref} = P_{max}$) with configured deactivation threshold, setting (b), example

Graph of Measurement



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
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						
Power level at start of test			40% P _n ^b					
Test condition		Measurement						Limit ΔP/P _n
f (Hz)	Target P/P _n	f [Hz]	P/P _n	Tsr [s]	Ts [s]	Td [s]	Δ P/P _n	
50.00	40%	50.00	40.10%	--	--	--	0.10%	± 10%
50.10	40%	50.10	40.10%	--	--	--	0.10%	
50.80	36%	50.80	36.46%	2.4	2.4	2.3	0.46%	
51.40	32%	51.40	32.67%	0.3	0.3	0.2	0.67%	
f _{max} ^a (52.0)	28%	52.00	28.99%	0.3	0.3	0.2	0.99%	
51.40	28%	51.40	28.99%	--	--	--	0.99%	
50.80	28%	50.80	28.99%	--	--	--	0.99%	
50.10	28%	50.10	28.99%	--	--	--	0.99%	
50.00	40%	50.00	40.16%	--	--	--	0.16%	
Test condition		Measurement					Limit	
50.10-50.00		Max. power gradient (%P _n /min):			9.80		≤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.

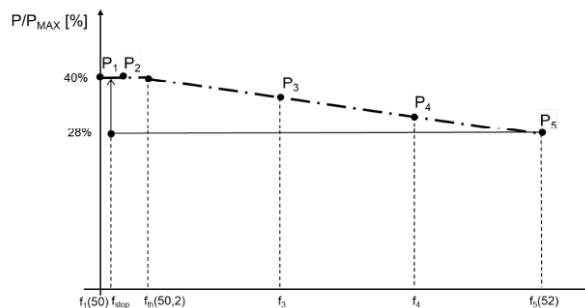
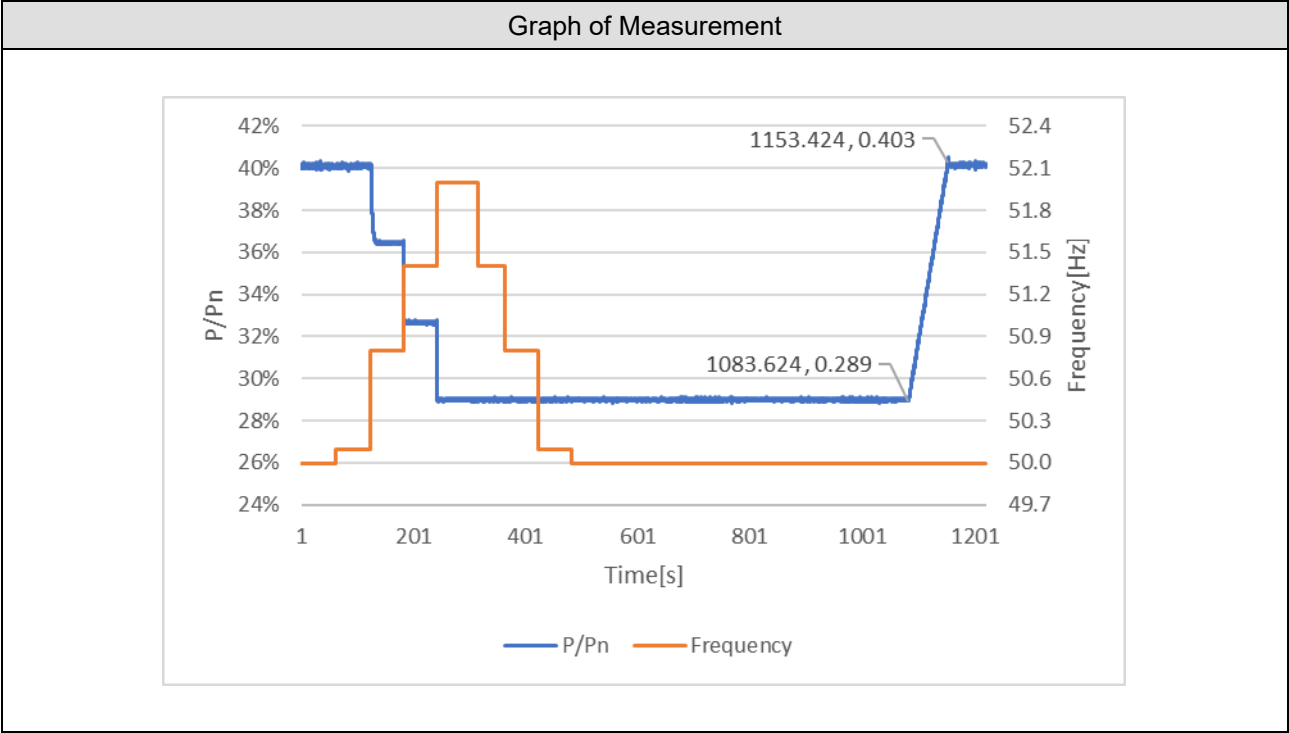


Figure 21 — Other non-synchronous generating technology ($P_{ref} = P_M$) with configured deactivation threshold, setting (c), example

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



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.2	TABLE: Power response to over-frequencies (LFSM-O)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient- For ESS 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 _{Max}						
Test No. 1								
Power level at start of test		40% P _n ^b						
Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	Δ P/P _n
50.00	40%	50.00	39.59%	--	--	--	-0.41%	± 10%
50.10	40%	50.10	39.58%	--	--	--	-0.42%	
50.80	30%	50.80	30.06%	0.3	0.3	0.2	0.06%	
51.40	20%	51.40	20.38%	0.2	0.2	0.1	0.38%	
f _{max} ^a (52.0)	10%	52.00	10.68%	0.3	0.3	0.2	0.68%	
51.40	10%	51.40	10.68%	--	--	--	0.68%	
50.80	10%	50.80	10.69%	--	--	--	0.69%	
50.10	10%	50.10	10.69%	--	--	--	0.69%	
50.00	40%	50.00	39.44%	--	--	--	-0.56%	
Test Condition	Measurement					Limitation		
50.10-50.00	Observation time			600.0		600 s		
	Max. power gradient (%P _{max} /min):			9.61		≤ 10% P _{max} /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.								

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

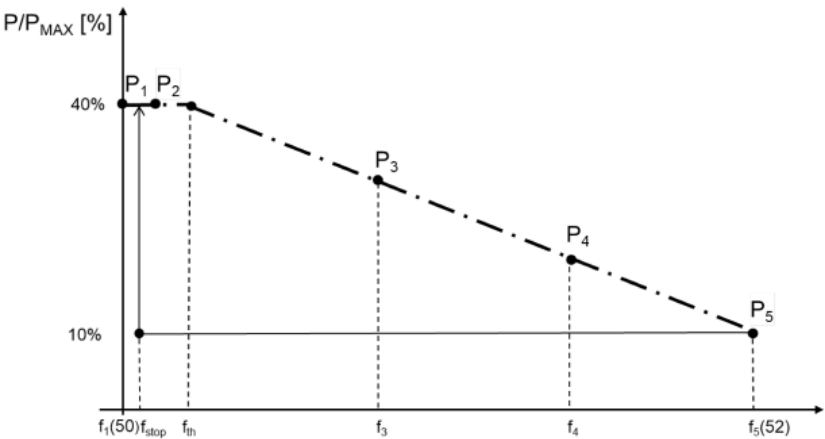
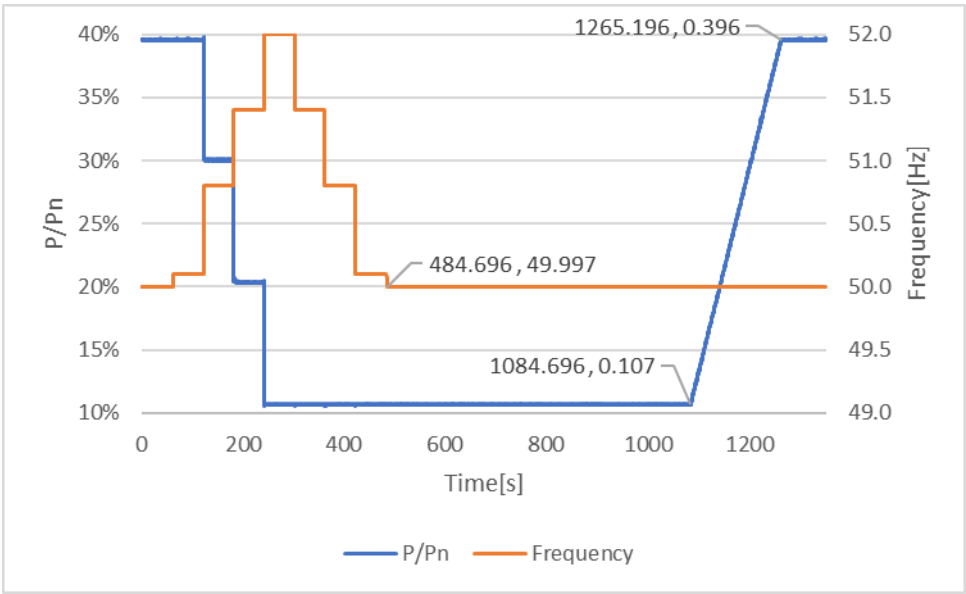


Figure 18 — Electrical energy storage systems ($P_{ref} = P_{max}$) with configured deactivation threshold, setting (c), example

Graph of Measurement



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the under-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}						
Power level at start of test			0% P _n ^b					
Test condition		Measurement						Limit ΔP/P _n
f (Hz)	Target P/P _n	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	
50.00	0%	50.00	-0.24%	--	--	--	-0.24%	± 10%
49.90	0%	49.90	-0.24%	--	--	--	-0.24%	
48.80	40%	48.80	39.64%	0.3	0.3	0.2	-0.36%	
47.80	80%	47.80	79.57%	0.4	0.4	0.1	-0.43%	
f _{min} ^a (46.0)	100%	46.00	99.30%	0.3	0.3	0.2	-0.70%	
47.80	80%	47.80	79.67%	0.5	0.5	0.3	-0.33%	
48.80	40%	48.80	39.65%	0.4	0.4	0.2	-0.35%	
49.90	0%	49.90	-0.25%	0.4	0.4	0.1	-0.25%	
50.00	0%	50.00	-0.24%	--	--	--	-0.24%	

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.

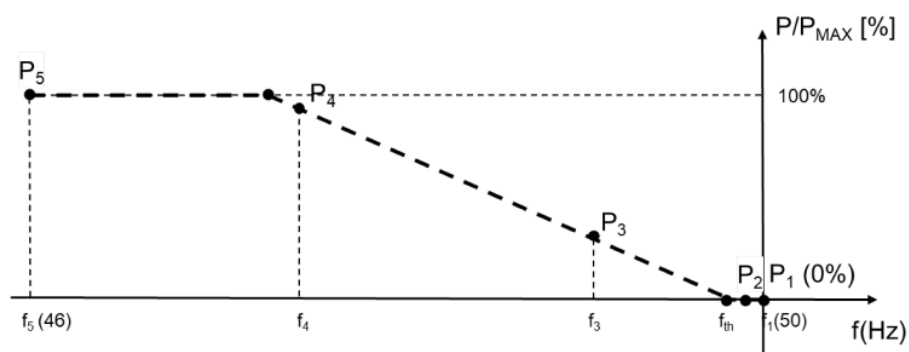
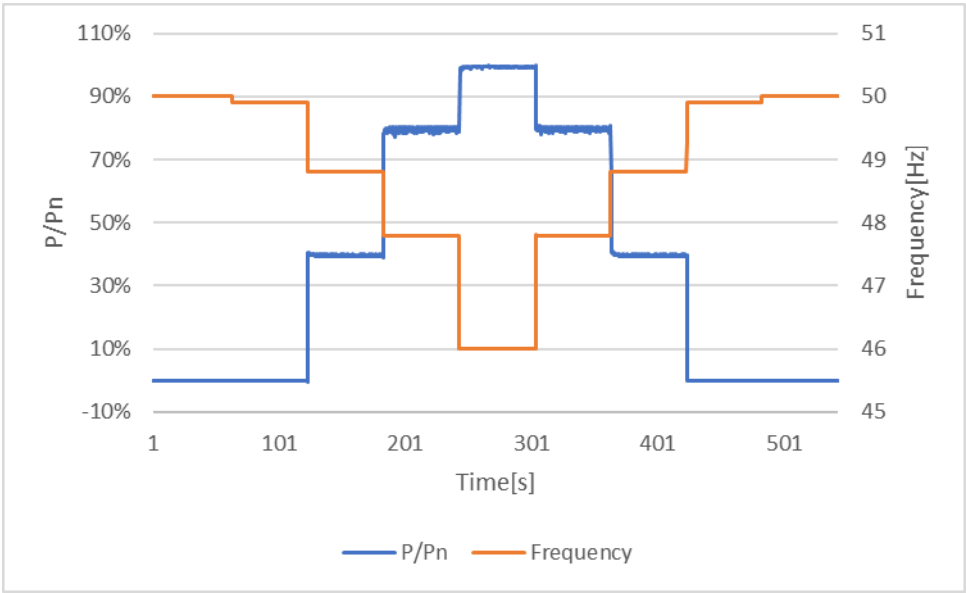


Figure 25 — Other generators: default values, example for interval frequency 46 – 50 Hz, setting (a)

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

Graph of Measurement for other generating unit Setting (a)



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient - For ESS 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		-50% Pn						
Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/Pn ^a	f [Hz]	P/Pn	Tsr [s]	Ts [s]	Td [s]	Δ P/Pn	Δ P/Pn
50.0	-50%	50.00	-49.78%	--	--	--	0.22%	± 10%
49.9	-50%	49.90	-49.78%	--	--	--	0.22%	
48.8	-10%	48.80	-9.92%	0.4	0.4	0.2	0.08%	
47.8	30%	47.80	30.06%	0.6	0.6	0.1	0.06%	
46.05	91.5%	46.05	91.73%	1.5	1.5	0.1	0.23%	
47.8	30%	47.80	30.06%	0.5	0.4	0.3	0.06%	
48.80	-10%	48.80	-10.11%	0.5	0.5	0.1	-0.11%	
49.9	-50%	49.90	-49.79%	0.5	0.5	0.2	0.21%	
50.0	-50%	50.00	-49.78%	--	--	--	0.22%	

Note(s):

Deactivate the frequency protection function if needed.

^a The maximum discharge power in battery operation is 7320W.

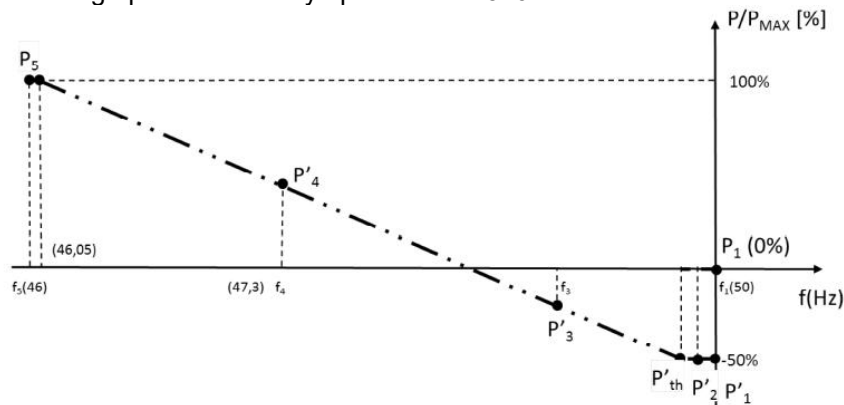
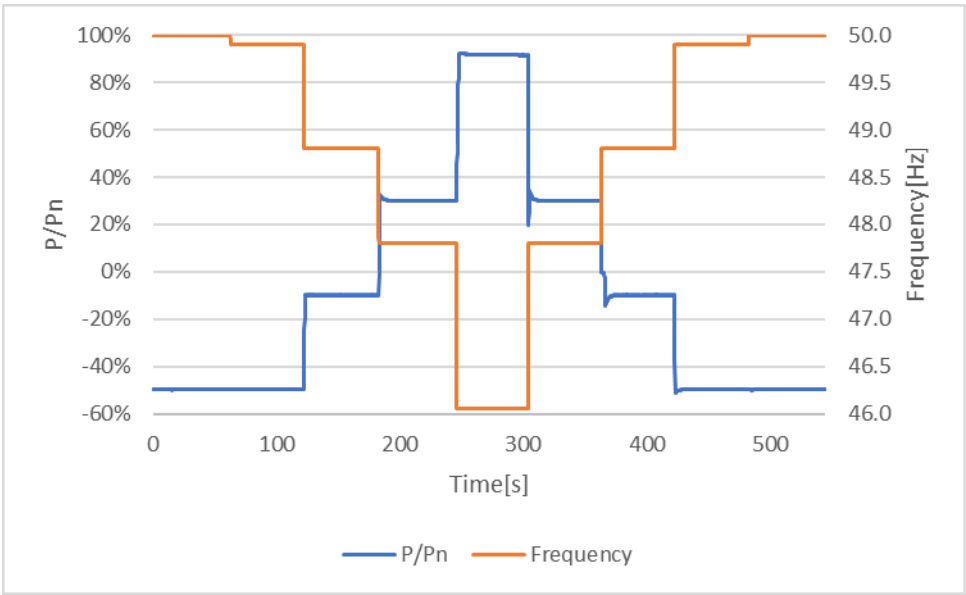


Figure 22 — default values, example for interval frequency 46 – 50 Hz, setting (a)

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

Graph of Measurement for ESS Setting (a)



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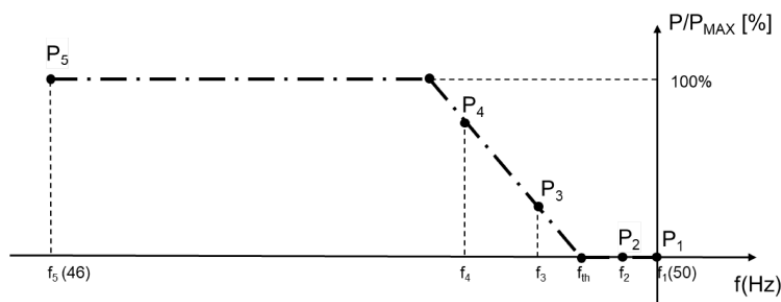
Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the under-frequency transient - For other generating unit Setting (b)								
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}						
Power level at start of test			0% P _n ^b					
Test condition		Measurement						Limit ΔP/P _n
f (Hz)	Target P/P _n	f [Hz]	P/P _n	Tsr [s]	Ts [s]	Td [s]	Δ P/P _n	
50.00	0%	50.00	-0.23%	--	--	--	-0.23%	± 10%
49.75	0%	49.75	-0.25%	--	--	--	-0.25%	
49.25	25%	49.25	25.57%	0.5	0.5	0.2	0.57%	
48.70	80%	48.70	80.14%	0.5	0.5	0.2	0.14%	
f _{min} ^a (46.0)	100%	46.00	99.33%	0.3	0.3	0.1	-0.67%	
48.70	80%	48.70	80.23%	0.4	0.4	0.3	0.23%	
49.25	25%	49.25	25.57%	0.3	0.3	0.2	0.57%	
49.75	0%	49.75	-0.26%	0.3	0.3	0.2	-0.26%	
50.00	0%	50.00	-0.24%	--	--	--	-0.24%	

Note(s):

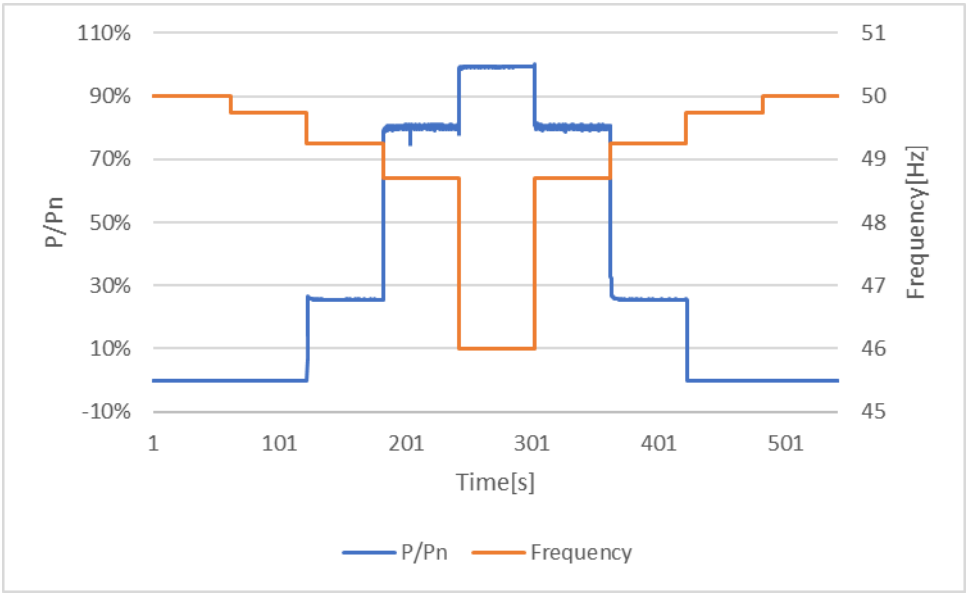
^a f_{min} as minimum frequencies limits as specified in 5.2.1.^b or minimum regulation level, whichever is higher

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 for other generating unit Setting (b)



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient - For ESS 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 Conditions	Target value	Measurements						Limitation
f [Hz]	P/P _n ^c	f [Hz]	P/P _n	T _{sr} [s]	T _s [s]	T _d [s]	Δ P/P _n	Δ P/P _n
50.00	0%	50.00	-0.18%	--	--	--	-0.18%	± 10%
49.75	0%	49.75	-0.20%	--	--	--	-0.20%	
49.25	25%	49.25	25.62%	0.5	0.5	0.2	0.62%	
48.70	80%	48.70	80.25%	1.3	1.3	0.2	0.25%	
f _{min} ^a (46.0)	91.5%	46.00	91.47%	0.2	0.2	<0.1	-0.03%	
48.70	80%	48.70	80.26%	0.5	0.5	0.1	0.26%	
49.25	25%	49.25	25.62%	0.4	0.4	0.1	0.62%	
49.75	0%	49.75	-0.19%	0.3	0.3	<0.1	-0.19%	
50.00	0%	50.00	-0.17%	--	--	--	-0.17%	

Note(s):

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

^b or minimum regulation level, whichever is higher

^c The maximum discharge power in battery operation is 7320W.

Deactivate the frequency protection function if needed.

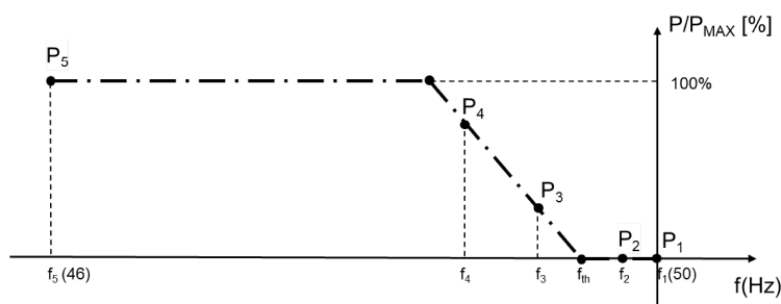
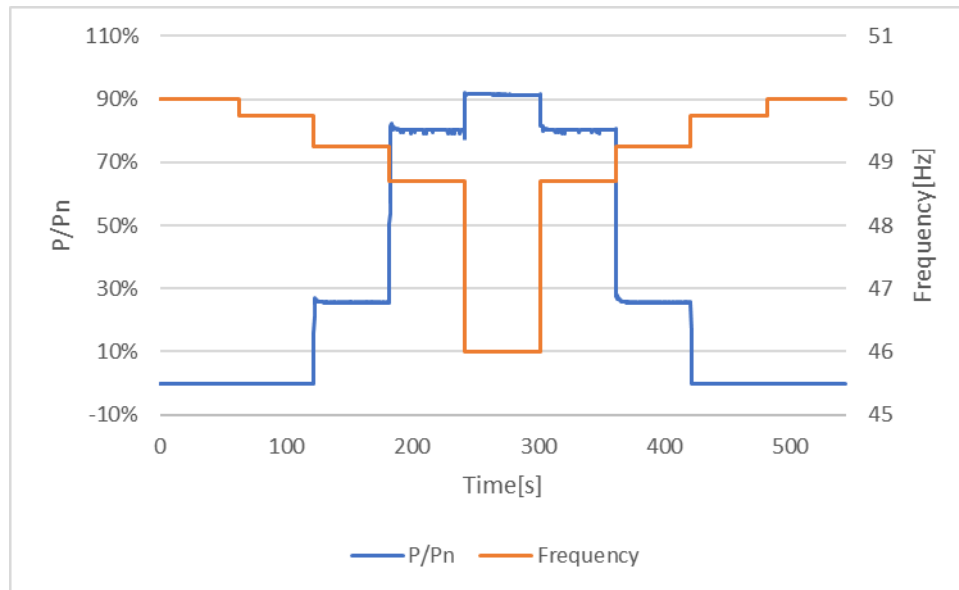


Figure 23 — $P_{ref} = P_{max}$, $s = 2\%$, $f_{th} = 49.5\text{Hz}$, example for interval frequency 46 – 50 Hz, setting (b)

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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of Measurement for ESS Setting (b)

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the under-frequency transient - For other generating unit Setting (c)								
Starting frequency f_{th} :		49.8Hz						
Deactivation threshold f_{stop} :		Deactivated						
Intentional delay [s]		0						
Droop:		12% (16.67% P_{ref} / Hz) $P_{ref} = P_{Max}$						
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	49.50%	--	--	--	-0.50%	$\pm 10\%$
49.90	50%	49.90	49.51%	--	--	--	-0.49%	
49.20	60%	49.20	59.35%	2.2	2.2	2.1	-0.65%	
47.40	90%	47.40	88.45%	0.3	0.3	<0.1	-1.55%	
f_{min}^a (46.0)	100%	46.00	99.34%	0.3	0.3	<0.1	-0.66%	
47.40	90%	47.40	88.50%	0.3	0.3	<0.1	-1.50%	
49.20	60%	49.20	59.38%	0.4	0.4	0.1	-0.62%	
49.90	50%	49.90	49.52%	0.2	0.2	0.1	-0.48%	
50.00	50%	50.00	49.50%	--	--	--	-0.50%	

Note(s):

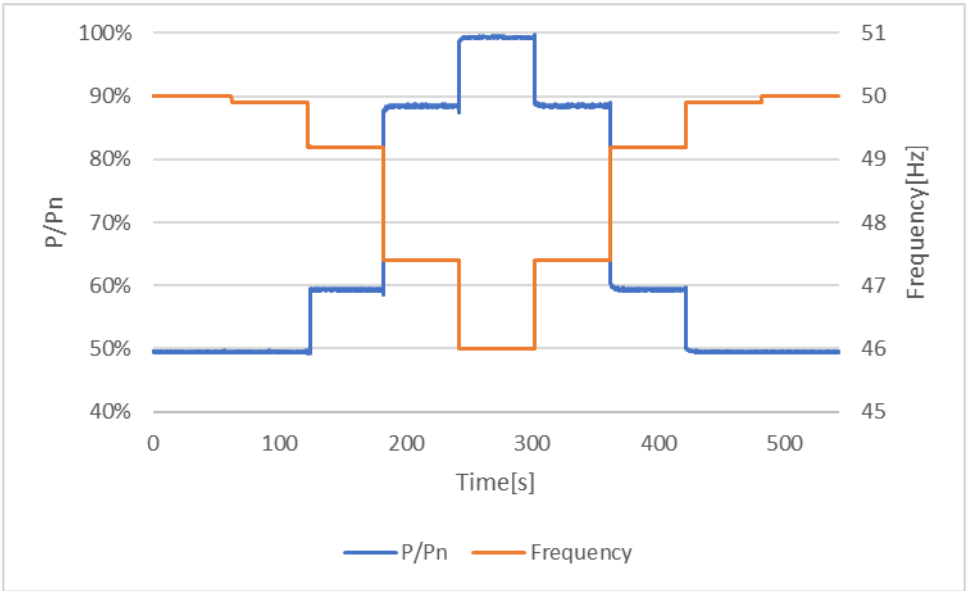
f_{min}^a as minimum frequencies limits as specified in 5.2.1.
b or minimum regulation level, whichever is higher
Deactivate the frequency protection function if needed.

The graph shows a power response curve for under-frequency. The y-axis is labeled P/P_{MAX} [%] and ranges from 0% to 100%. The x-axis is labeled $f(Hz)$ and has marked points $f_5(46)$, f_4 , f_3 , f_m , f_2 , and $f_1(50)$. A dashed line represents the power response, starting at P_5 (100% at $f_5(46)$) and decreasing to P_1 (50% at $f_1(50)$). Points P_4 , P_3 , and P_2 are also marked on the curve at frequencies f_4 , f_3 , and f_m respectively.

Figure 24 — $P_{ref} = P_{max}$, $s = 12\%$, $f_{th} = 49.8Hz$, example for interval frequency 46 – 50 Hz, setting (c)

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

Graph of Measurement for other generating unit Setting (c)



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.4.3.3	TABLE: Power response to under-frequency (LFSM-U)							P
Model	SUN-8K-H							
Available P adjust to follow droop during the over-frequency transient - For ESS 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% Pn						
Test Conditions	Target value	Measurements						Limitation
f [Hz]	P/Pn ^b	f [Hz]	P/Pn	Tsr [s]	Ts [s]	Td [s]	Δ P/Pmax	Δ P/Pn
50.00	50%	50.00	49.50%	--	--	--	-0.50%	± 10%
49.90	50%	49.90	49.50%	--	--	--	-0.50%	
49.20	60%	49.20	59.34%	2.2	2.2	2.1	-0.66%	
47.40	90%	47.40	88.47%	0.6	0.6	<0.1	-1.53%	
f _{min} ^a (46.0)	91.5%	46.00	91.14%	0.4	0.4	0.3	-0.36%	
47.40	90%	47.40	88.49%	0.5	0.5	0.3	-1.51%	
49.20	60%	49.20	59.33%	0.4	0.4	0.3	-0.67%	
49.90	50%	49.90	49.50%	0.3	0.3	0.2	-0.50%	
50.00	50%	50.00	49.49%	--	--	--	-0.51%	

Note(s):

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

^b The maximum discharge power in battery operation is 7320W.

Deactivate the frequency protection function if needed.

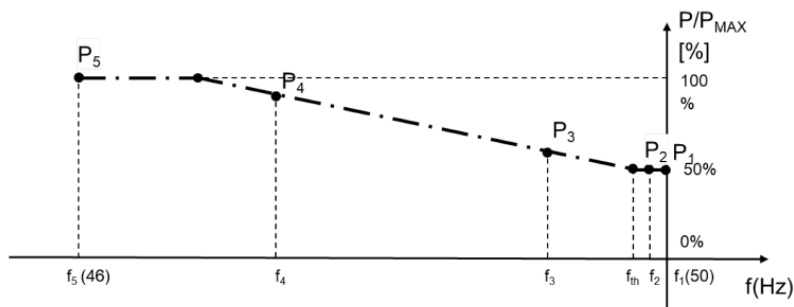
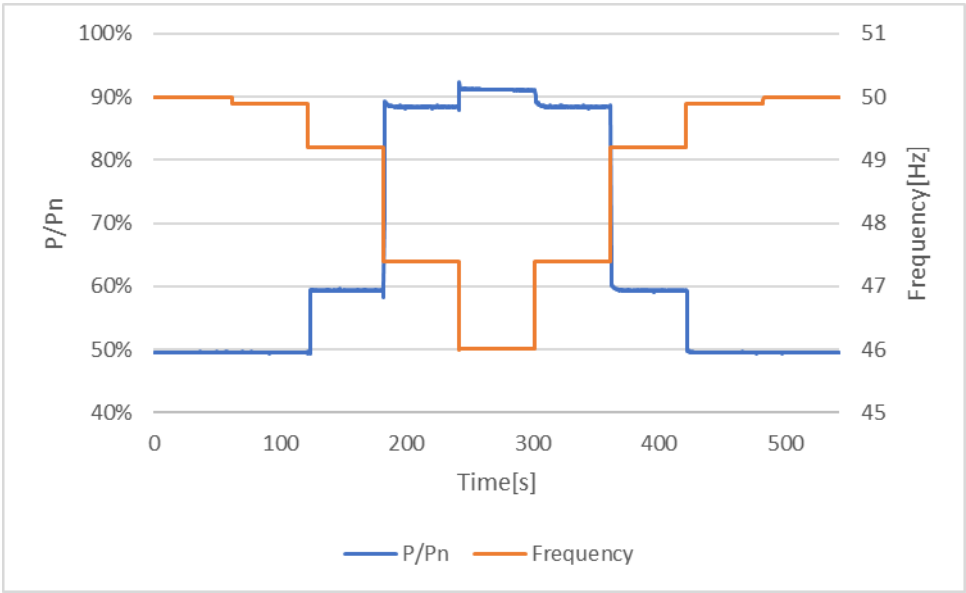


Figure 24 — $P_{ref} = P_{max}$, $s = 12\%$, $f_{th} = 49.8\text{Hz}$, example for interval frequency 46 – 50 Hz, setting (c)

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

Graph of Measurement for ESS Setting (c)



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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.1.3	TABLE: Verification procedure to determine the power capability (active, reactive, apparent) at nominal voltage						P
Model	SUN-8K-H						
setpoint for constant Qmax			under-excited		over-excited		
			-0.484		0.484		
Values at set point Q = 0 (Initial and final condition)							
P _n [%]	P		Q		cos(φ) [-]	U	
	[W]	p.u.	[VAr]	p.u.		[V]	p.u.
0 ^a	62.37	0.008	60.51	0.008	0.4251	230.02	1.000
10 ^a	792.86	0.099	65.38	0.008	0.9844	230.03	1.000
20 ^a	1613.18	0.202	71.08	0.009	0.9958	230.01	1.000
30 ^a	2426.92	0.303	77.05	0.010	0.9978	229.98	1.000
40 ^a	3222.44	0.403	82.48	0.010	0.9985	230.00	1.000
50 ^a	4028.48	0.504	87.74	0.011	0.9988	230.03	1.000
60 ^a	4832.54	0.604	92.81	0.012	0.9990	230.06	1.000
70 ^a	5627.55	0.703	97.19	0.012	0.9990	229.99	1.000
80 ^a	6424.57	0.803	101.34	0.013	0.9990	230.02	1.000
90 ^a	7208.12	0.901	106.27	0.013	0.9989	230.05	1.000
100 ^a	7943.92	0.993	110.15	0.014	0.9971	229.99	1.000
Values at set point Q _{max} under							
P _n [%]	P		Q		cos(φ) [-]	U	
	[W]	p.u.	[VAr]	p.u.		[V]	p.u.
0 ^a	20.07	0.003	-3807.52	-0.476	0.0053	229.96	1.000
10 ^a	738.60	0.092	-3801.70	-0.475	0.1904	230.07	1.000
20 ^a	1551.96	0.194	-3796.34	-0.475	0.3779	230.00	1.000
30 ^a	2370.55	0.296	-3791.27	-0.474	0.5295	230.02	1.000
40 ^a	3170.29	0.396	-3786.59	-0.473	0.6411	230.05	1.000
50 ^a	3983.60	0.498	-3782.00	-0.473	0.7243	229.98	1.000
60 ^a	4787.58	0.598	-3778.43	-0.472	0.7839	230.00	1.000
70 ^a	5579.88	0.697	-3774.33	-0.472	0.8271	230.00	1.000
80 ^a	6375.88	0.797	-3770.99	-0.471	0.8594	230.00	1.000
90 ^a	7166.03	0.896	-3768.47	-0.471	0.8836	230.00	1.000
Pmax	7939.90	0.992	-3766.04	-0.471	0.9018	230.01	1.000

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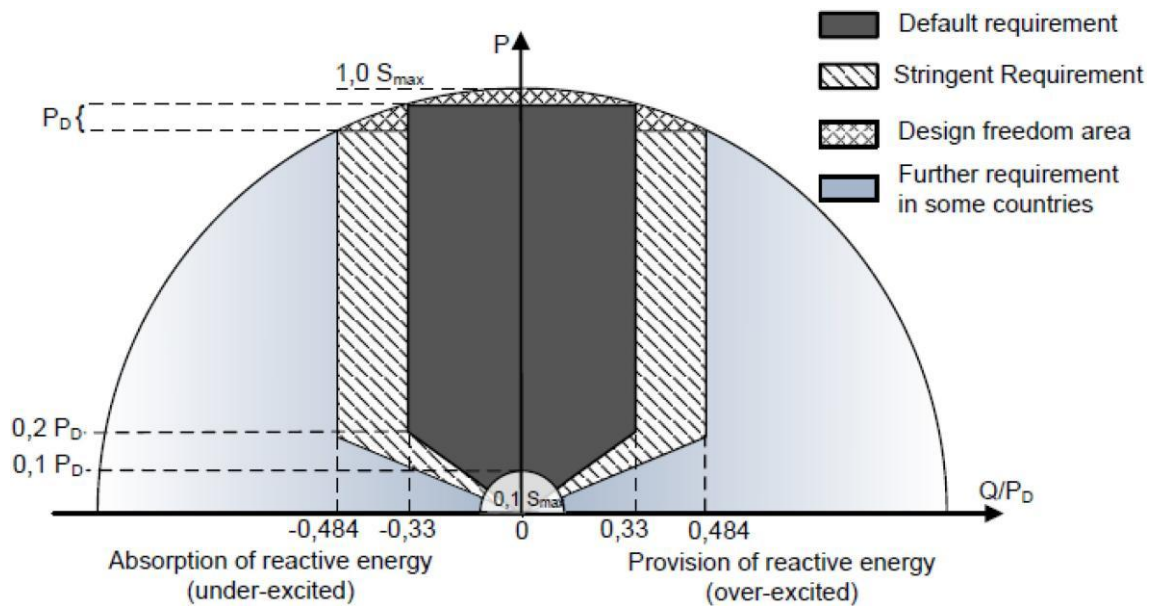
Clause	Requirement - Test	Result - Remark	Verdict
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Values at set point $Q_{\max}$ over

P_n [%]	P		Q		$\cos(\varphi)$ [-]	U	
	[W]	p.u.	[VAr]	p.u.		[V]	p.u.
0 ^a	22.23	0.003	3926.46	0.491	0.0057	229.89	1.000
10 ^a	740.71	0.093	3931.26	0.491	0.1849	230.00	1.000
20 ^a	1556.17	0.195	3936.84	0.492	0.3672	230.00	1.000
30 ^a	2370.37	0.296	3942.64	0.493	0.5147	230.00	1.000
40 ^a	3172.04	0.397	3948.45	0.494	0.6256	230.00	1.000
50 ^a	3978.19	0.497	3953.62	0.494	0.7086	230.00	1.000
60 ^a	4780.55	0.598	3959.92	0.495	0.7693	230.01	1.000
70 ^a	5578.14	0.697	3965.41	0.496	0.8141	230.03	1.000
80 ^a	6370.98	0.796	3970.93	0.496	0.8476	230.05	1.000
90 ^a	7167.36	0.896	3976.03	0.497	0.8733	230.00	1.000
Pmax	7921.65	0.990	3983.24	0.498	0.8916	230.02	1.000

NOTE

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

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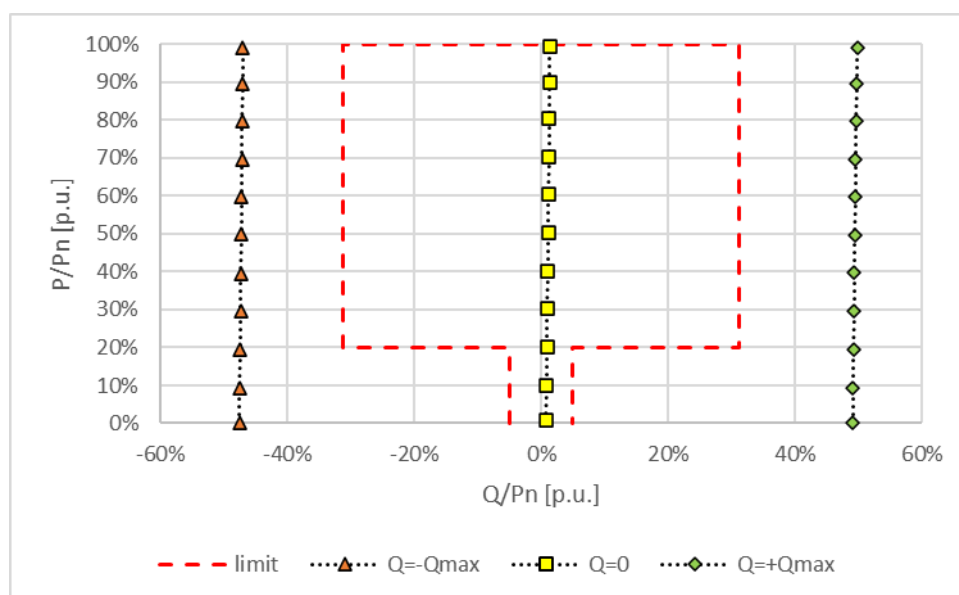
Clause	Requirement - Test	Result - Remark	Verdict
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Parameter	Pmax		Smax		Qmax over		Qmax under]	
	[W]	p.u.	[VA]	p.u.	[VAr]	p.u.	[VAr]	p.u.
$\cos(\varphi)=1$	7942.07	0.993	7965.34	0.996	N/A	N/A	N/A	N/A
$\cos(\varphi)=\text{max under}$	7934.94	0.992	8803.39	1.100	N/A	N/A	-3774.05	-0.472
$\cos(\varphi)=\text{max over}$	7920.95	0.990	8866.94	1.108	3939.44	0.492	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



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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.1.6	TABLE: Verification procedure for reactive power capability considering voltage range								P
Model	SUN-8K-H								
setpoint for constant Q			under-excited			over-excited			
			-0.484			0.484			
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	83.31	1.06	83.60	98.36	84.99	--	--	--
90%		88.34	1.16	88.63	98.49	89.99	--	--	
95%		99.02	1.29	99.18	104.39	95.01	--	--	
100%		99.32	1.38	99.50	99.51	99.99	--	--	
105%		99.23	1.45	99.47	94.73	105.01	--	--	
110%		99.19	1.54	99.41	90.35	110.02	--	--	
85%	Q _{max} under	73.61	-47.41	87.92	103.53	84.92	--	--	--
90%		79.70	-47.31	93.06	103.48	89.93	--	--	
95%		86.68	-47.20	99.12	104.40	94.94	1.24	-48.4	≤ 2%
100%		98.89	-47.07	109.74	109.76	99.98	1.37	-48.4	
105%		99.07	-46.97	109.85	104.62	104.99	1.48	-48.4	
110%		99.19	-46.87	109.92	99.91	110.02	1.57	-48.4	
85%	Q _{max} over	73.09	49.37	88.53	104.21	84.96	0.93	48.4	≥ - 2%
90%		79.17	49.49	93.70	104.15	89.97	1.04	48.4	
95%		97.70	49.72	110.08	115.80	95.05	1.27	48.4	
100%		98.82	49.79	110.82	110.81	100.02	1.35	48.4	
105%		99.00	49.86	111.02	105.70	105.03	1.42	48.4	
110%		98.97	49.92	111.10	100.95	110.06	--	--	--

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

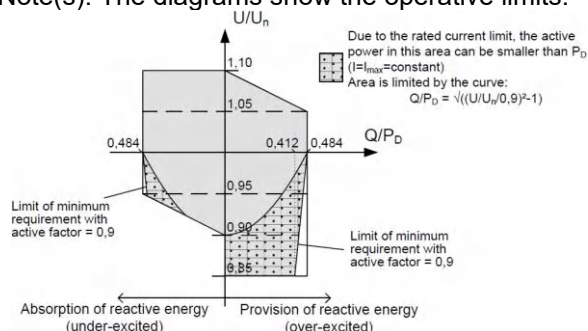


Figure 30 — Example: U-Q normalized diagram taken from the EN 50549-1

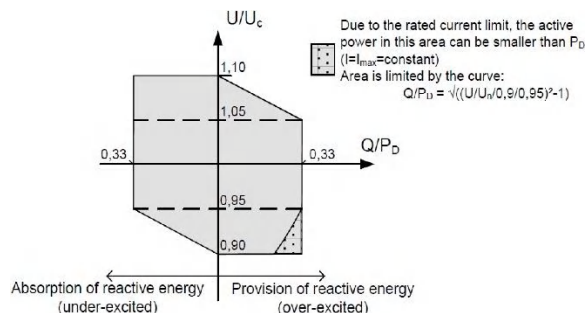
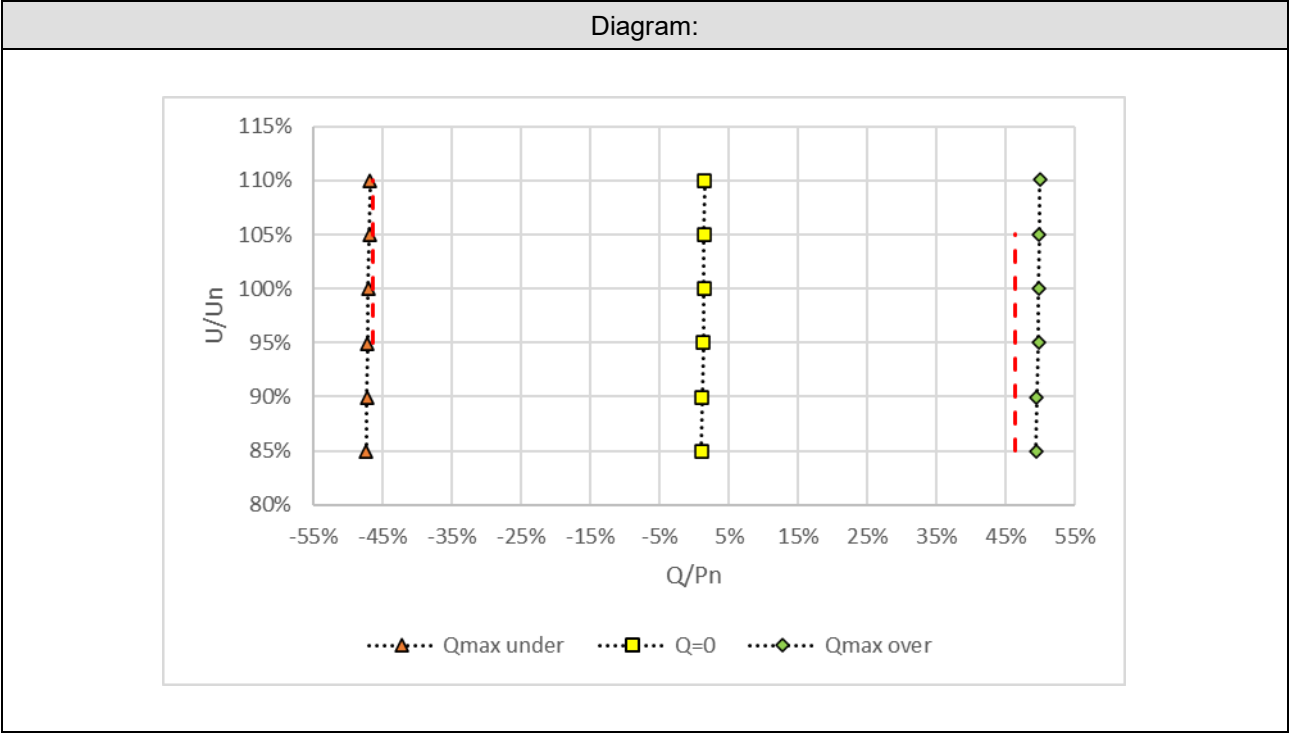


Figure 31 — Example of U-Q normalized diagram taken from the EN 50549-2

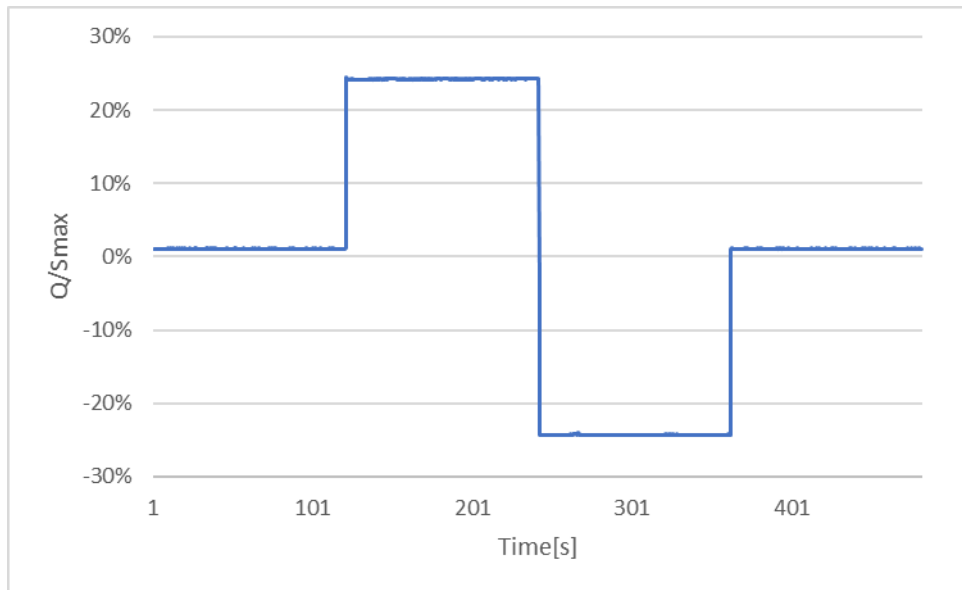
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict



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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.2.3	TABLE: Verification procedure for Set point control								P
Model	SUN-8K-H								
Test no.1: Test for reactive power set point control accuracy									
P=50%P _n									
Reactive power step Q/P _n (p.u.)	Voltage		Set point value		Measured value (1-min average)		Deviation (Measured value - Set point)		Δ Limit
	V	p.u.	kVAr	Q/P _n p.u.	kVAr	Q/P _n p.u.	kVAr	Q/P _n p.u.	± 2%S _{max}
Q=0	230.02	1.000	0	0	87.47	0.011	87.47	0.011	
50% Q _{max} (over excited)	230.05	1.000	1937	0.242	1937.76	0.242	0.56	0.000	
50% Q _{max} (under excited)	229.99	1.000	-1937	-0.242	-1944.33	-0.243	-7.13	-0.001	
Q=0	230.02	1.000	0	0	87.51	0.011	87.51	0.011	



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Clause	Requirement - Test	Result - Remark	Verdict
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Test no.2: Test for dynamic response			
Tau= shortest time constant (not longer than 3 s) 3 s			
Reactive power set point step p.u.	Generating unit response time setting	Measured response behaviour	
		dead time	response time / settling time
Q=0 → 80% Q _{max} over	9 s	0.11 s	6.51 s
80% Q _{max} over → 80% Q _{max} under	9 s	0.12 s	8.72 s
80% Q _{max} under → Q=0	9 s	0.13 s	6.73 s
Tau= longest time (if longest time>60s, then test 60 s) 60 s			
Reactive power set point step p.u.	Generating unit response time setting	Measured response behaviour	
		dead time	response time / settling time
Q=0 → 80% Q _{max} over	180 s	0.13 s	162.93 s
80% Q _{max} over → 80% Q _{max} under	180 s	0.08 s	124.08 s
80% Q _{max} under → Q=0	180 s	1.95 s	146.75 s
^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.			

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Clause	Requirement - Test	Result - Remark	Verdict
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Diagram Tau= 3 s

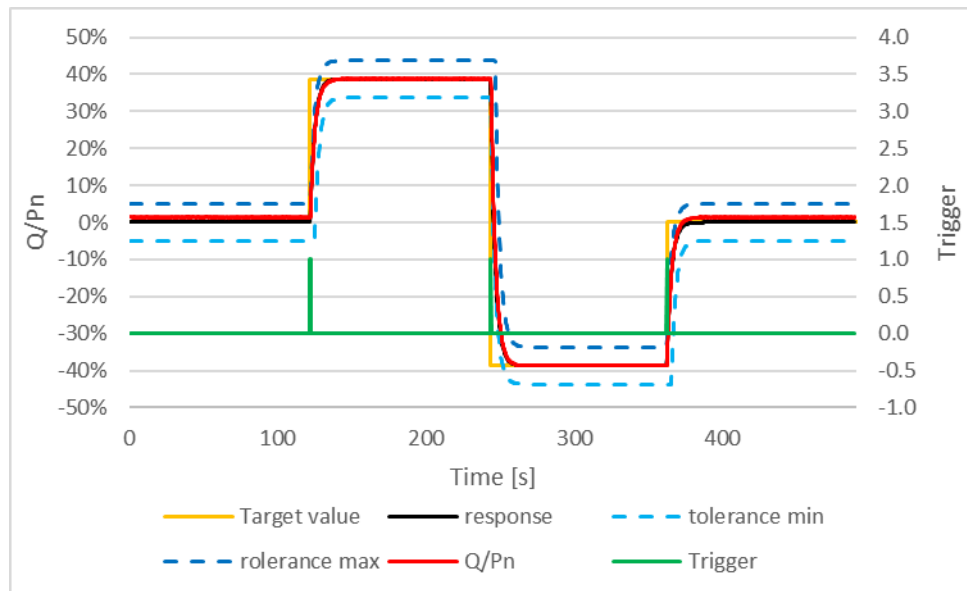
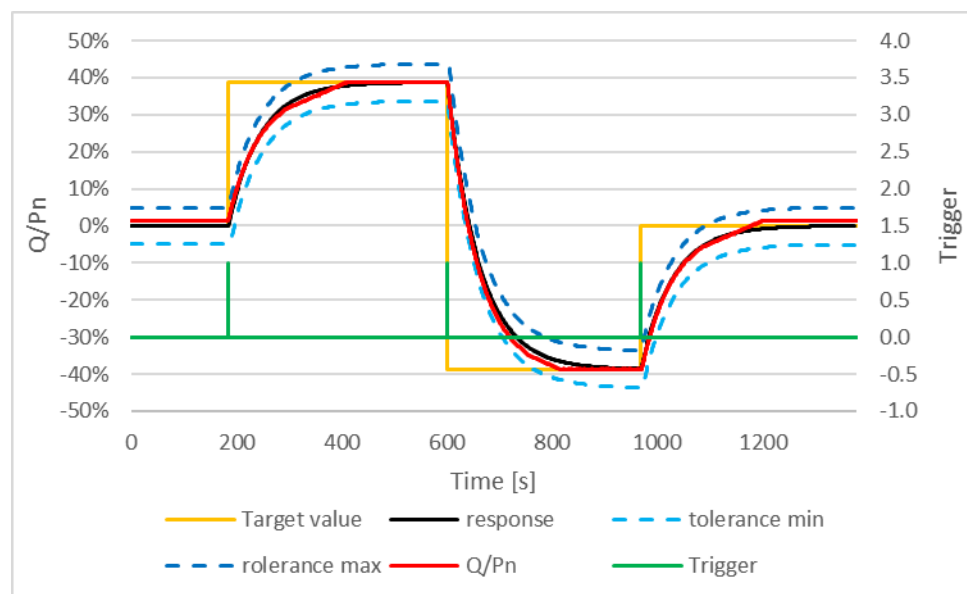


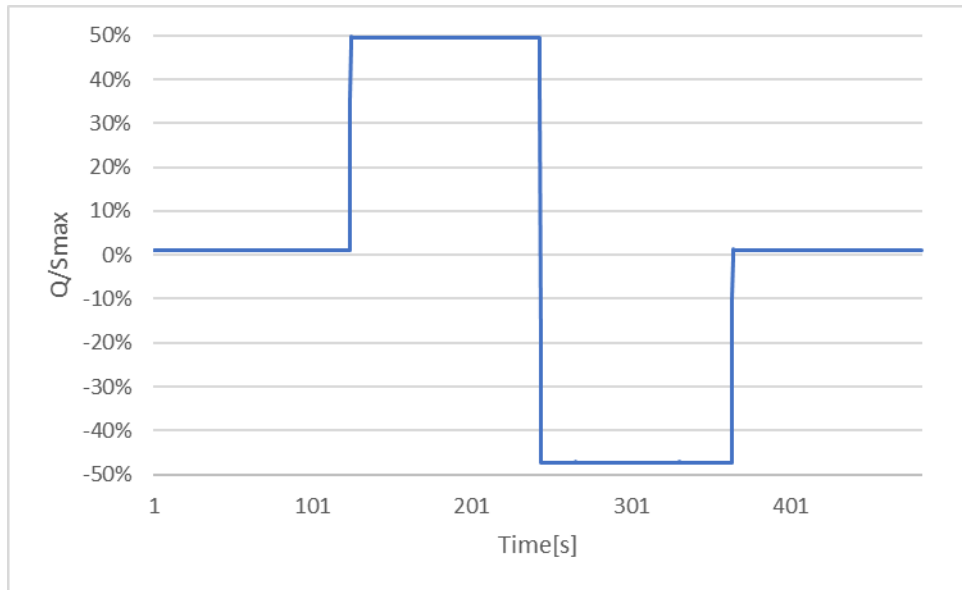
Diagram Tau= 60 s



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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.2.3	TABLE: Verification procedure for Set point control- cos ϕ setpoint mode								P
Model	SUN-8K-H								
setpoint for constant cos ϕ			under-excited				over-excited		
			0.9				0.9		
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	230.03	1.000	0	0	87.29	0.011	87.29	0.011	$\pm 2\% S_{\max}$
Q max (over excited)	230.09	1.000	3874	0.484	3952.60	0.494	78.20	0.010	
Q max (under excited)	229.98	1.000	-3874	-0.484	-3781.54	-0.473	92.86	0.012	
Q=0	230.04	1.000	0	0	87.08	0.011	87.08	0.011	



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Clause	Requirement - Test	Result - Remark	Verdict
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Test no.2: Test for dynamic response			
P>90%P _n			
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
$Q=0 \rightarrow Q_{\max \text{ over}}$	9s	1.17 s	8.57 s
$Q_{\max \text{ over}} \rightarrow Q_{\max \text{ under}}$	9s	1.05 s	8.45 s
$Q_{\max \text{ under}} \rightarrow Q=0$	9s	1.07 s	7.66 s
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
$Q=0 \rightarrow Q_{\max \text{ over}}$	180s	0.94 s	164.74 s
$Q_{\max \text{ over}} \rightarrow Q_{\max \text{ under}}$	180s	0.87 s	126.87 s
$Q_{\max \text{ under}} \rightarrow Q=0$	180s	0.66 s	143.66 s
^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 Tau= 3 s

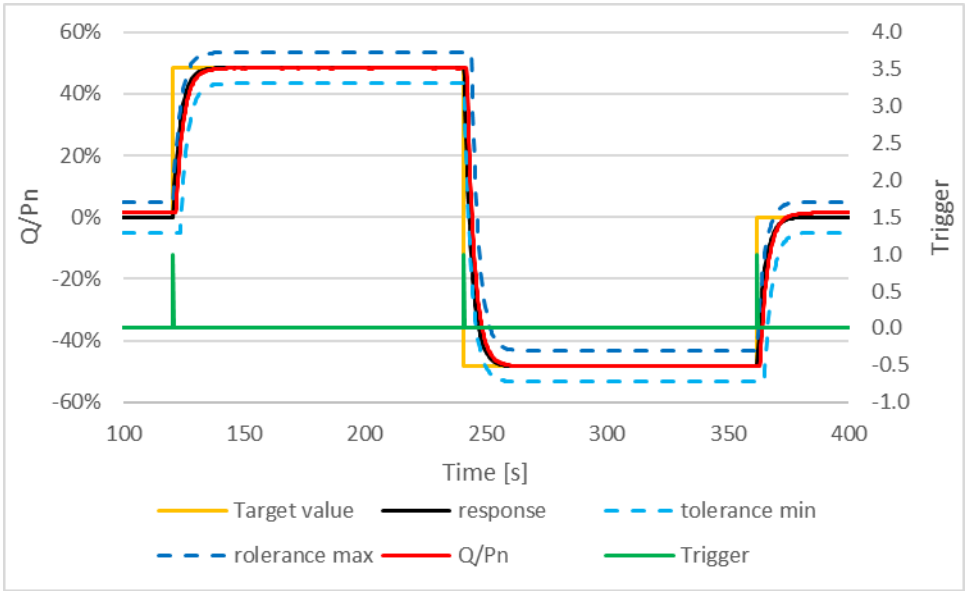
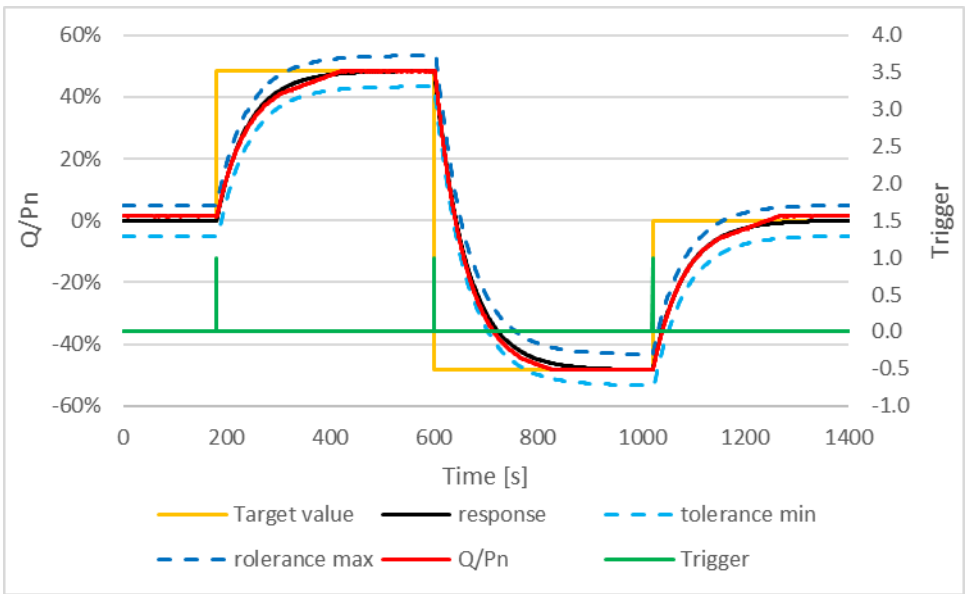


Diagram Tau= 60 s



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.5.2.4	TABLE: Verification procedure for voltage related control mode for reactive power Q(U)								P
Model	SUN-8K-H								
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	deactivate d	
Q/Qmax	100%	0	0	-100%					
Test procedure for accuracy									
Test Conditions		Measurements					Target vlaue	Δ Limits	
U/Un	P/Pn	P/Pn [%]	Q/Pn [%]	U/Un [%]	Cosφ	ΔQ/ Smax	Q/Pn* [%]	ΔQ/ Smax	Cosφ
100%	100%	99.26	1.38	100.04	0.9969	1.38%	0.00	≤ ±2 Smax%	≥0.4
103%	100%	99.23	1.43	103.02	0.9972	1.43%	0.00		
105%	100%	99.21	1.46	105.01	0.9974	1.46%	0.00		
107%	100%	99.37	-24.14	107.03	0.9693	0.07%	-24.22		
108%	100%	99.56	-46.87	108.02	0.9020	1.56%	-48.43		
111%	100%	99.53	-46.83	111.01	0.9021	1.60%	-48.43		
114%	100%	99.49	-46.77	114.04	0.9025	1.66%	-48.43		
115%	100%	99.49	-46.76	115.04	0.9026	1.67%	-48.43		
114%	100%	99.51	-46.78	114.04	0.9025	1.65%	-48.43		
111%	100%	99.56	-46.84	111.01	0.9021	1.59%	-48.43		
108%	100%	99.58	-46.84	108.03	0.9018	1.59%	-48.43		
107%	100%	99.39	-24.10	107.04	0.9688	0.12%	-24.22		
105%	100%	99.23	1.46	105.01	0.9973	1.46%	0.00		
103%	100%	99.24	1.43	103.02	0.9972	1.43%	0.00		
100%	100%	99.27	1.38	100.04	0.9968	1.38%	0.00		
97%	100%	99.30	1.34	97.02	0.9965	1.34%	0.00		
94%	100%	97.10	1.29	94.02	0.9966	1.29%	0.00		
93%	100%	84.00	47.58	93.02	0.8674	-0.85%	48.43		
90%	100%	79.17	49.58	90.01	0.8443	1.15%	48.43		
87%	100%	75.52	49.51	87.01	0.8330	1.08%	48.43		
85%	100%	73.06	49.46	85.01	0.8247	1.03%	48.43		
87%	100%	75.53	49.51	87.01	0.8330	1.08%	48.43		
90%	100%	79.17	49.58	90.01	0.8443	1.15%	48.43		
93%	100%	84.12	47.27	93.02	0.8686	-1.16%	48.43		
94%	100%	97.09	1.37	94.03	0.9965	1.37%	0.00		
97%	100%	99.30	1.34	97.02	0.9965	1.34%	0.00		
100%	100%	99.27	1.38	100.04	0.9968	1.38%	0.00		
100%	20%	20.21	0.90	100.02	0.9924	0.90%	0.00		
103%	20%	20.20	0.94	103.02	0.9921	0.94%	0.00		
105%	20%	20.20	0.97	105.02	0.9920	0.97%	0.00		
107%	20%	20.37	-22.36	107.01	0.6721	1.86%	-24.22*		
108%	20%	20.50	-41.95	108.00	0.4389	6.48%	-48.43*		
111%	20%	20.49	-41.89	111.00	0.4382	6.54%	-48.43*		
114%	20%	20.48	-41.85	114.04	0.4385	6.58%	-48.43*		
115%	20%	20.48	-41.83	115.04	0.4386	6.60%	-48.43*		
114%	20%	20.48	-41.85	114.04	0.4385	6.58%	-48.43*		
111%	20%	20.49	-41.90	111.00	0.4383	6.53%	-48.43*		

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Clause	Requirement - Test	Result - Remark	Verdict
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108%	20%	20.50	-41.94	108.00	0.4381	6.49%	-48.43*
107%	20%	20.37	-22.36	107.01	0.6698	1.85%	-24.22*
105%	20%	20.20	0.97	105.02	0.9920	0.97%	0.00
103%	20%	20.21	0.94	103.02	0.9921	0.94%	0.00
100%	20%	20.22	0.90	100.02	0.9924	0.90%	0.00
97%	20%	20.23	0.85	97.07	0.9926	0.85%	0.00
94%	20%	20.23	1.34	94.03	0.9905	1.34%	0.00
93%	20%	19.94	43.77	93.01	0.4137	-4.66%	48.43*
90%	20%	19.94	43.71	90.02	0.4142	-4.72%	48.43*
87%	20%	19.95	43.67	87.02	0.4146	-4.76%	48.43*
85%	20%	19.95	43.65	85.02	0.4149	-4.78%	48.43*
87%	20%	19.95	43.67	87.02	0.4146	-4.76%	48.43*
90%	20%	19.94	43.70	90.02	0.4142	-4.73%	48.43*
93%	20%	19.93	43.74	93.01	0.4138	-4.69%	48.43*
94%	20%	20.22	1.19	94.03	0.9882	1.19%	0.00
97%	20%	20.22	0.87	97.07	0.9925	0.87%	0.00
100%	20%	20.21	0.89	100.02	0.9924	0.89%	0.00

Note(s):

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

*: The accuracy exceeding 2% S_{max} is due to prioritizing the requirement of Min cos φ: 0.4.

Deactivate the voltage protection function if needed.

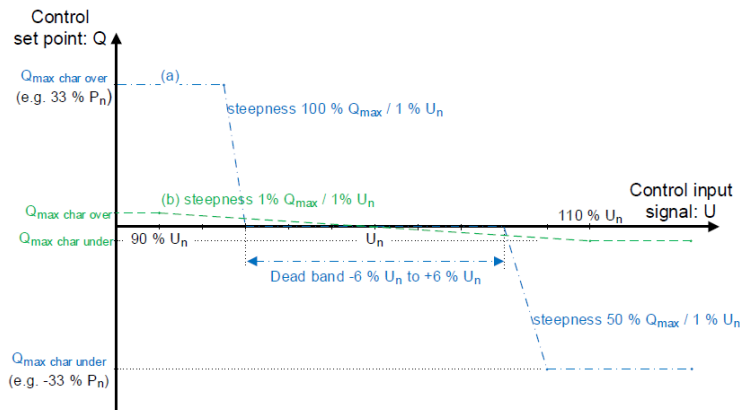
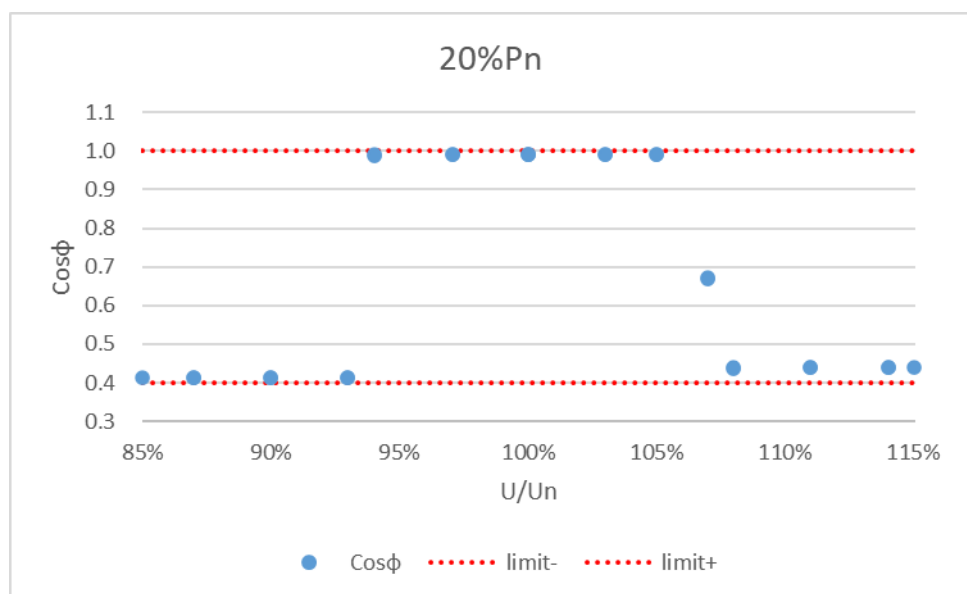
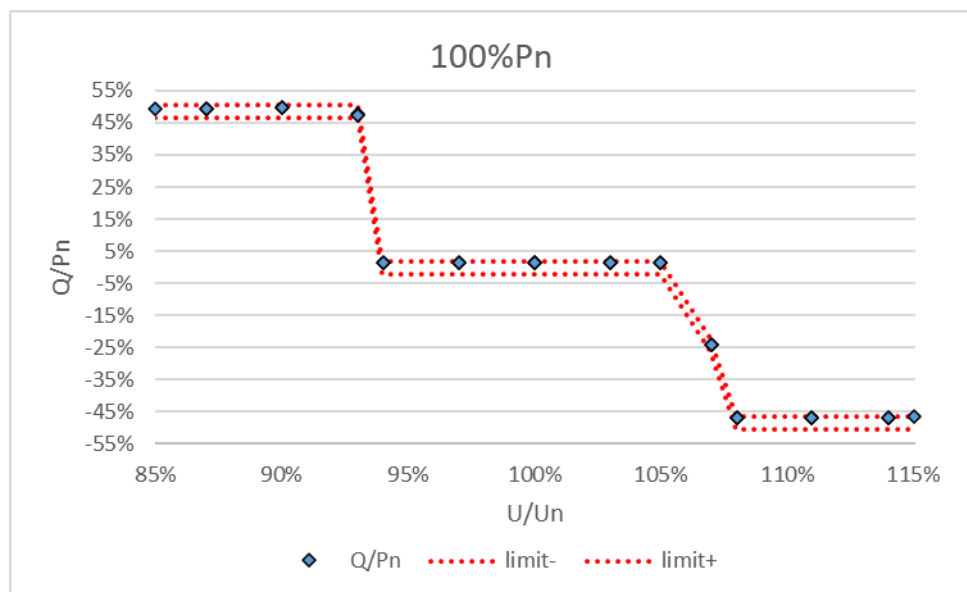


Figure 33 — Q(U) example characteristics for setting (a) and (b) for the test

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Clause	Requirement - Test	Result - Remark	Verdict
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Clause	Requirement - Test	Result - Remark	Verdict
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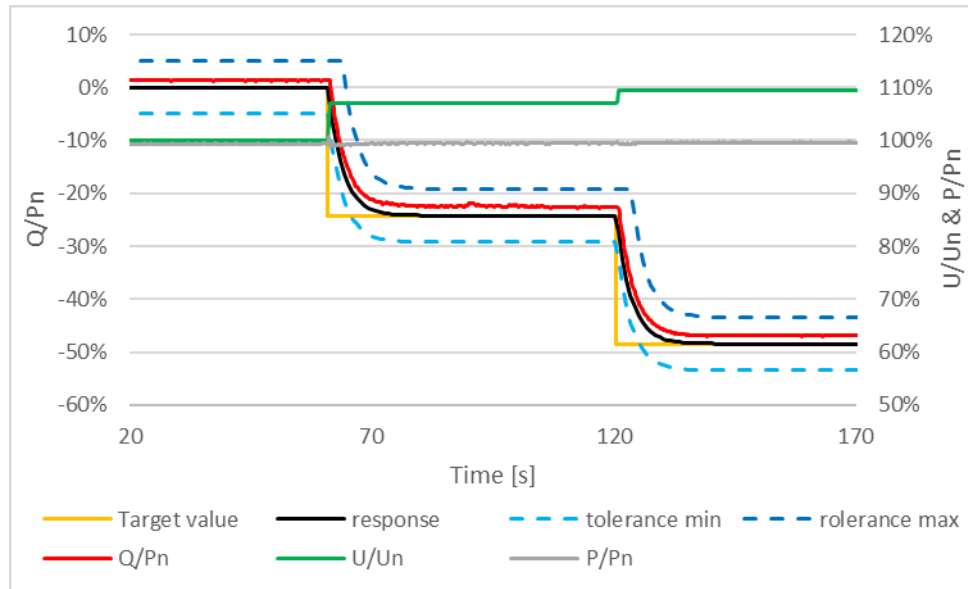
Test procedure for dynamic behaviour								
Test Conditions		Measurements			Deviation	Target vlaue	Compliance to the PT-1 curve?	Δ Limits
U/Un	P/Pn	Q/Pn [%]	P/Pn [%]	U/Un [%]	ΔQ/Pn [%]	Q/Pn* [%]	Yes/No	ΔQ/Pn
100%	100%	1.38	99.33	100.03	1.38	0	N/A	≤ ±5%
107%	100%	-22.41	99.41	107.03	1.81	-24.22	Yes	
109%	100%	-46.89	99.57	109.40	1.54	-48.43	Yes	
109%	18%	-36.71	17.99	108.99	*	*	N/A	
109%	3%	-5.32	2.84	108.93	*	*	N/A	
109%	22%	-45.06	22.00	109.01	*	*	N/A	
109%	100%	-46.86	99.51	109.39	1.57	-48.43	N/A	
100%	100%	1.36	99.34	100.03	1.36	0	Yes	
92%	100%	49.54	81.79	92.09	1.11	48.43	Yes	
92%	18%	32.73	17.53	91.69	*	*	N/A	
92%	3%	5.94	2.82	91.59	*	*	N/A	
92%	22%	39.85	21.45	91.72	*	*	N/A	
92%	100%	49.52	81.75	92.09	1.09	48.43	N/A	
93.5%	100%	25.55	93.28	93.48	1.33	24.22	Yes	
100%	100%	1.39	99.27	100.03	1.39	0	Yes	
Note(s): P lock-in: 20%Pn; P lock-out: 5%Pn.								

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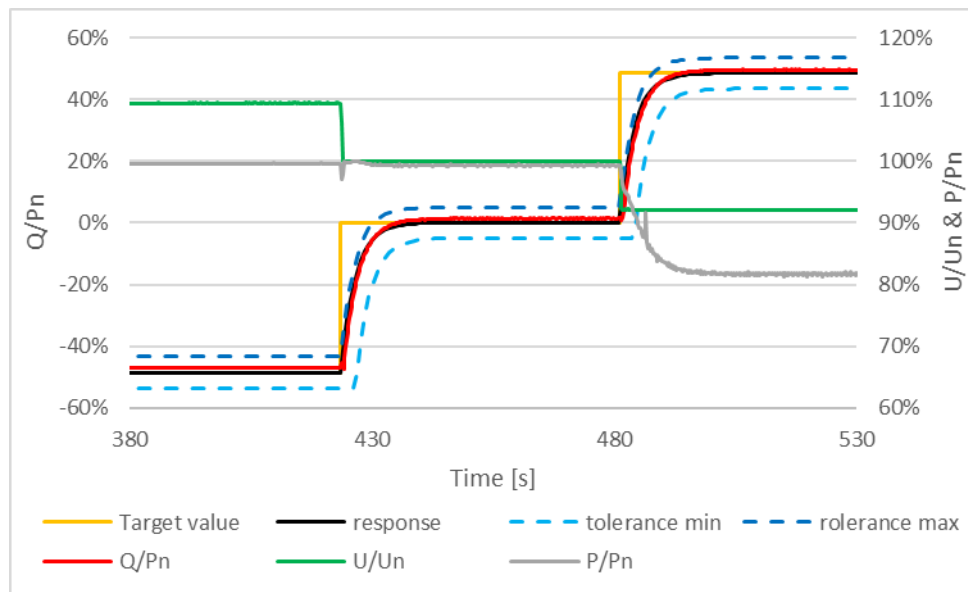
Clause	Requirement - Test	Result - Remark	Verdict
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Diagram

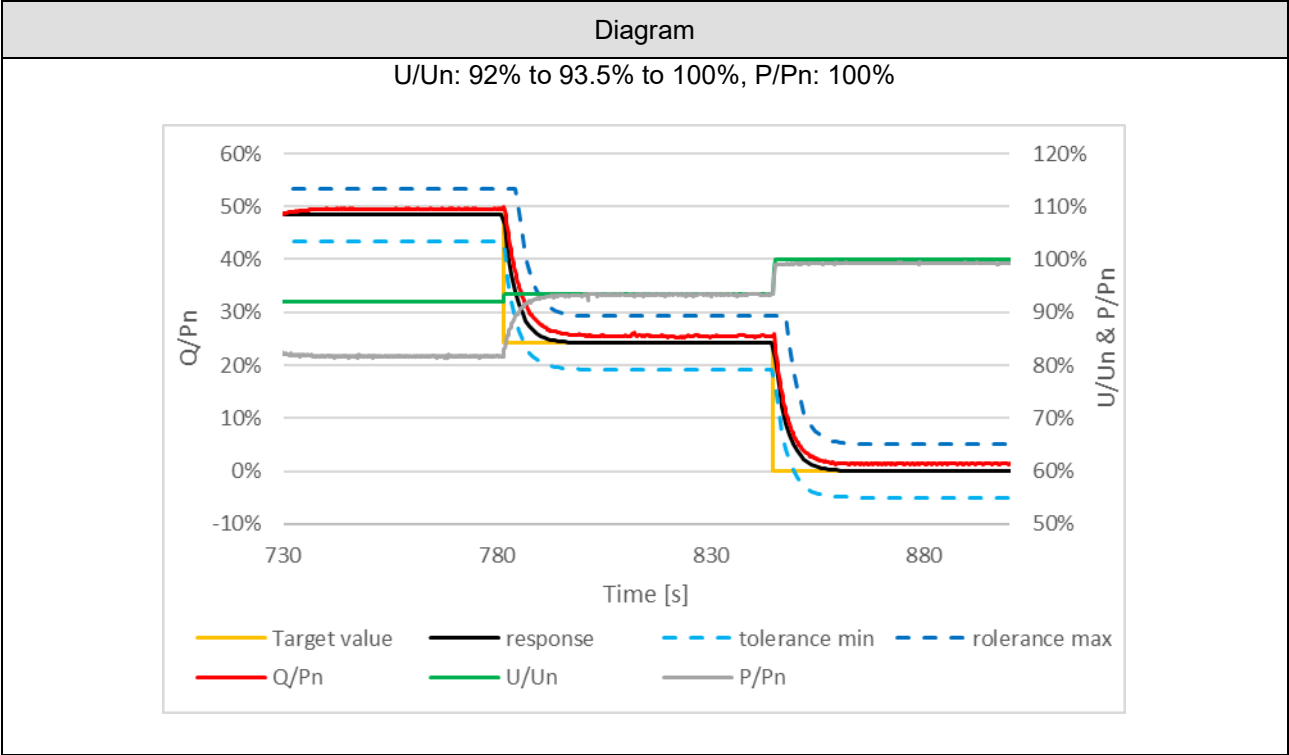
U/Un: 100% to 107% to 109%, P/Pn: 100%



U/Un: 109% to 100% to 92%, P/Pn: 100%



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Clause	Requirement - Test	Result - Remark	Verdict



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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.2.4	TABLE: Verification procedure for voltage related control mode for reactive power Q(U)							P	
Model	SUN-8K-H								
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/Pn	10%	0%	-10%						
Test procedure for accuracy									
Test Conditions		Measurements					Target vlaue	Δ Limits	
U/Un	P/Pn	Q/Pn [%]	P/Pn [%]	U/Un [%]	Cosφ	ΔQ/ Smax	Q/Pn* [%]	ΔQ/ Smax	Cosφ
100%	100%	1.38	99.27	100.04	0.9967	1.38%	0.00	≤ ±2 Smax%	≥0.4
103%	100%	-0.27	99.26	103.02	0.9971	1.19%	-1.45		
106%	100%	-1.99	99.23	106.00	0.9973	0.92%	-2.91		
109%	100%	-3.67	99.22	109.03	0.9971	0.69%	-4.36		
112%	100%	-4.21	99.19	112.02	0.9971	0.63%	-4.84		
115%	100%	-4.16	99.17	115.00	0.9972	0.68%	-4.84		
112%	100%	-4.21	99.21	112.01	0.9971	0.63%	-4.84		
109%	100%	-3.67	99.22	109.03	0.9971	0.69%	-4.36		
106%	100%	-1.99	99.23	106.00	0.9973	0.91%	-2.91		
103%	100%	-0.27	99.25	103.02	0.9972	1.18%	-1.45		
100%	100%	1.38	99.28	100.04	0.9967	1.38%	0.00		
97%	100%	2.53	99.31	97.02	0.9960	1.08%	1.45		
94%	100%	3.57	97.06	94.02	0.9959	0.67%	2.91		
91%	100%	4.70	93.92	91.02	0.9953	0.34%	4.36		
88%	100%	4.95	90.82	88.03	0.9949	0.11%	4.84		
85%	100%	4.89	87.74	85.03	0.9947	0.05%	4.84		
88%	100%	4.95	90.82	88.03	0.9950	0.11%	4.84		
91%	100%	4.70	93.94	91.03	0.9954	0.34%	4.36		
94%	100%	3.58	97.07	94.02	0.9961	0.67%	2.91		
97%	100%	2.54	99.31	97.02	0.9962	1.08%	1.45		
100%	100%	1.38	99.28	100.04	0.9967	1.38%	0.00		
100%	20%	0.90	20.22	100.03	0.9923	0.90%	0.00		
103%	20%	-0.76	20.22	103.02	0.9924	0.70%	-1.45		
106%	20%	-2.43	20.21	106.02	0.9860	0.48%	-2.91		
109%	20%	-4.14	20.22	109.02	0.9730	0.22%	-4.36		
112%	20%	-4.70	20.22	112.01	0.9673	0.14%	-4.84		
115%	20%	-4.65	20.21	115.01	0.9677	0.19%	-4.84		
112%	20%	-4.71	20.22	112.01	0.9672	0.14%	-4.84		
109%	20%	-4.15	20.23	109.02	0.9728	0.21%	-4.36		
106%	20%	-2.42	20.23	106.02	0.9859	0.48%	-2.91		
103%	20%	-0.76	20.23	103.02	0.9924	0.70%	-1.45		
100%	20%	0.90	20.22	100.03	0.9923	0.90%	0.00		
97%	20%	2.05	20.22	97.03	0.9884	0.59%	1.45*		
94%	20%	3.10	20.22	94.03	0.9824	0.20%	2.91*		
91%	20%	4.26	20.22	91.04	0.9728	-0.10%	4.36*		
88%	20%	4.52	20.23	88.00	0.9705	-0.33%	4.84*		
85%	20%	4.48	20.23	85.00	0.9711	-0.36%	4.84*		

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Clause	Requirement - Test	Result - Remark	Verdict
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88%	20%	4.52	20.22	88.00	0.9705	-0.33%	4.84*		
91%	20%	4.26	20.22	91.04	0.9728	-0.10%	4.36		
94%	20%	3.10	20.22	94.03	0.9823	0.20%	2.91		
97%	20%	2.04	20.22	97.03	0.9884	0.59%	1.45		
100%	20%	0.90	20.22	100.03	0.9923	0.90%	0.00		

Note(s):

Time constant: as slow as possible but not slower as 20 s.

Deactivate the voltage protection function if needed.

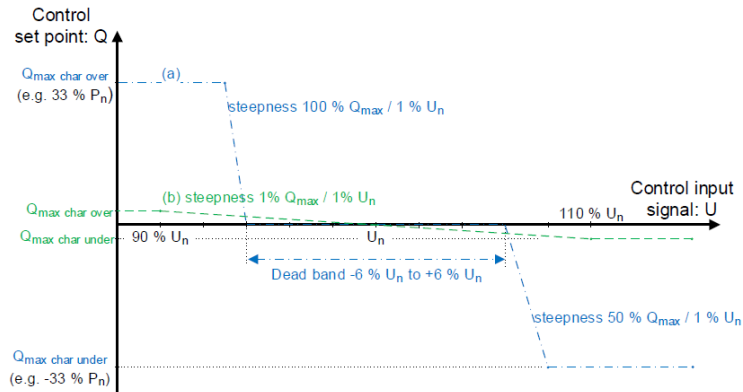
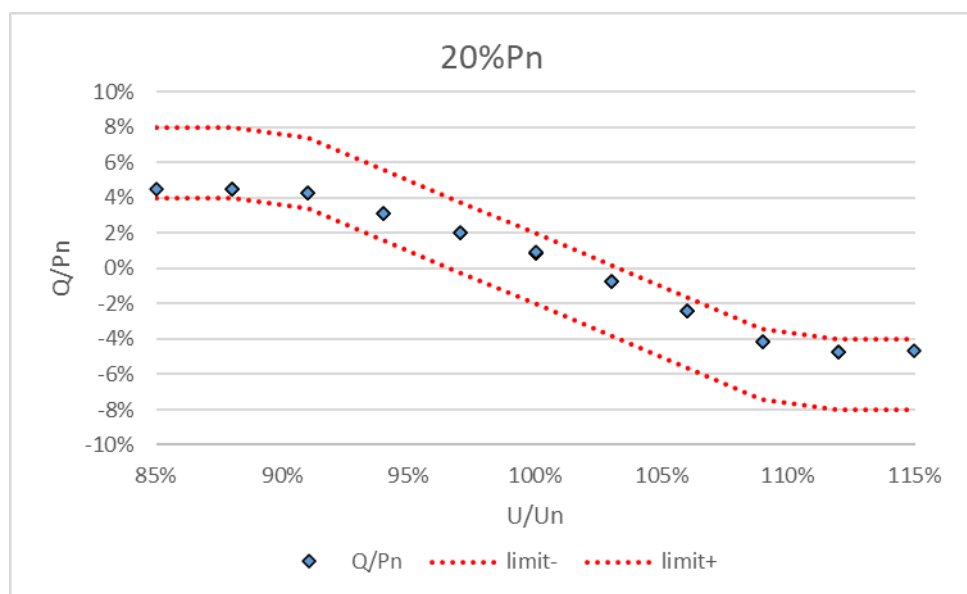
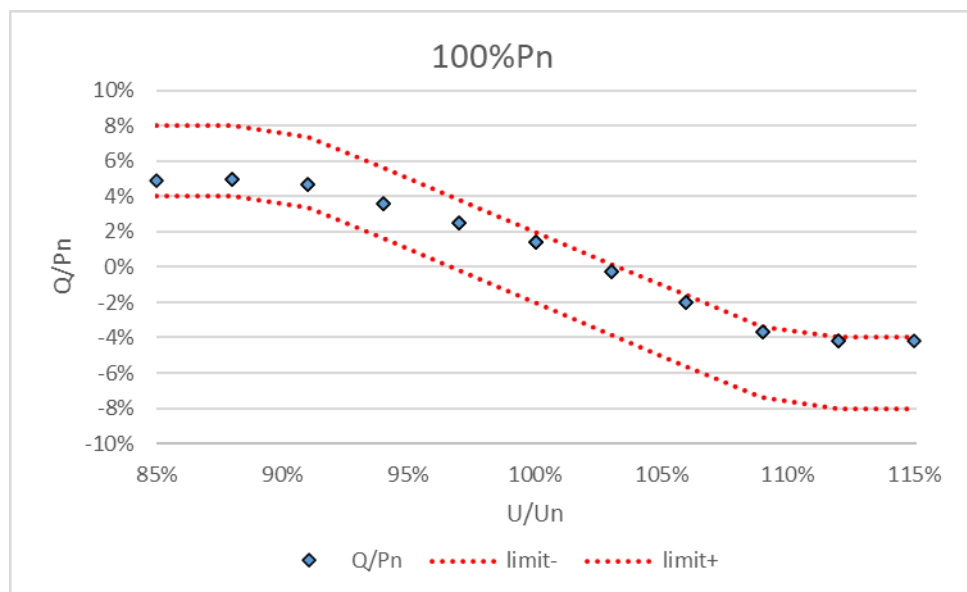


Figure 33 — Q(U) example characteristics for setting (a) and (b) for the test

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Clause	Requirement - Test	Result - Remark	Verdict
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Clause	Requirement - Test	Result - Remark	Verdict
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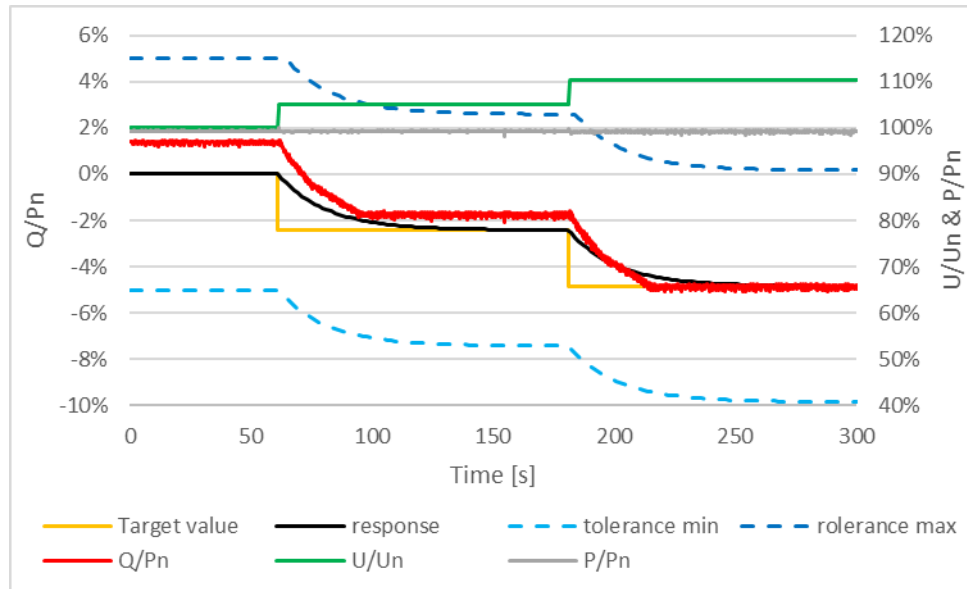
Test procedure for dynamic behaviour								
Test Conditions		Measurements			Deviation	Target vlaue	Compliance to the PT-1 curve?	Δ Limits
U/Un	P/Pn	Q/Pn [%]	P/Pn [%]	U/Un [%]	ΔQ/Pn [%]	Q/Pn* [%]	Yes/No	ΔQ/Pn
100%	100%	1.38	99.30	100.00	1.38	0.00	N/A	≤ ±5%
105%	100%	-1.53	99.26	105.01	0.89	-2.42	Yes	
110%	100%	-4.61	99.24	110.28	0.23	-4.84	Yes	
110%	18%	-5.16	17.75	109.87	-0.32	-4.84	N/A	
110%	3%	0.77	2.81	109.80	0.77	0.00	N/A	
110%	22%	-5.00	21.71	109.89	-0.15	-4.84	N/A	
110%	100%	-4.84	99.23	110.27	0.00	-4.84	N/A	
100%	100%	1.28	99.33	99.99	1.28	0.00	Yes	
90%	100%	4.88	93.05	90.15	0.03	4.84	Yes	
90%	18%	4.52	17.73	89.68	-0.32	4.84	N/A	
90%	3%	0.82	2.86	89.59	0.82	0.00	N/A	
90%	22%	4.53	21.71	89.70	-0.32	4.84	N/A	
90%	100%	4.99	92.99	90.14	0.15	4.84	N/A	
95%	100%	3.21	99.30	95.02	0.79	2.42	Yes	
100%	100%	1.54	99.30	99.99	1.54	0.00	Yes	
Note(s): P lock-in: 20%Pn; P lock-out: 5%Pn.								

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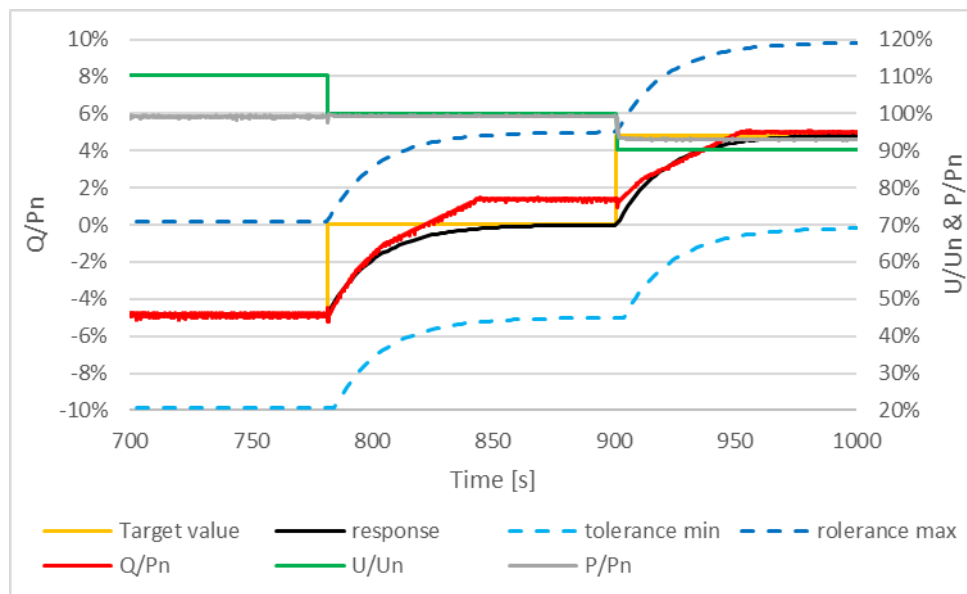
Clause	Requirement - Test	Result - Remark	Verdict
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Diagram

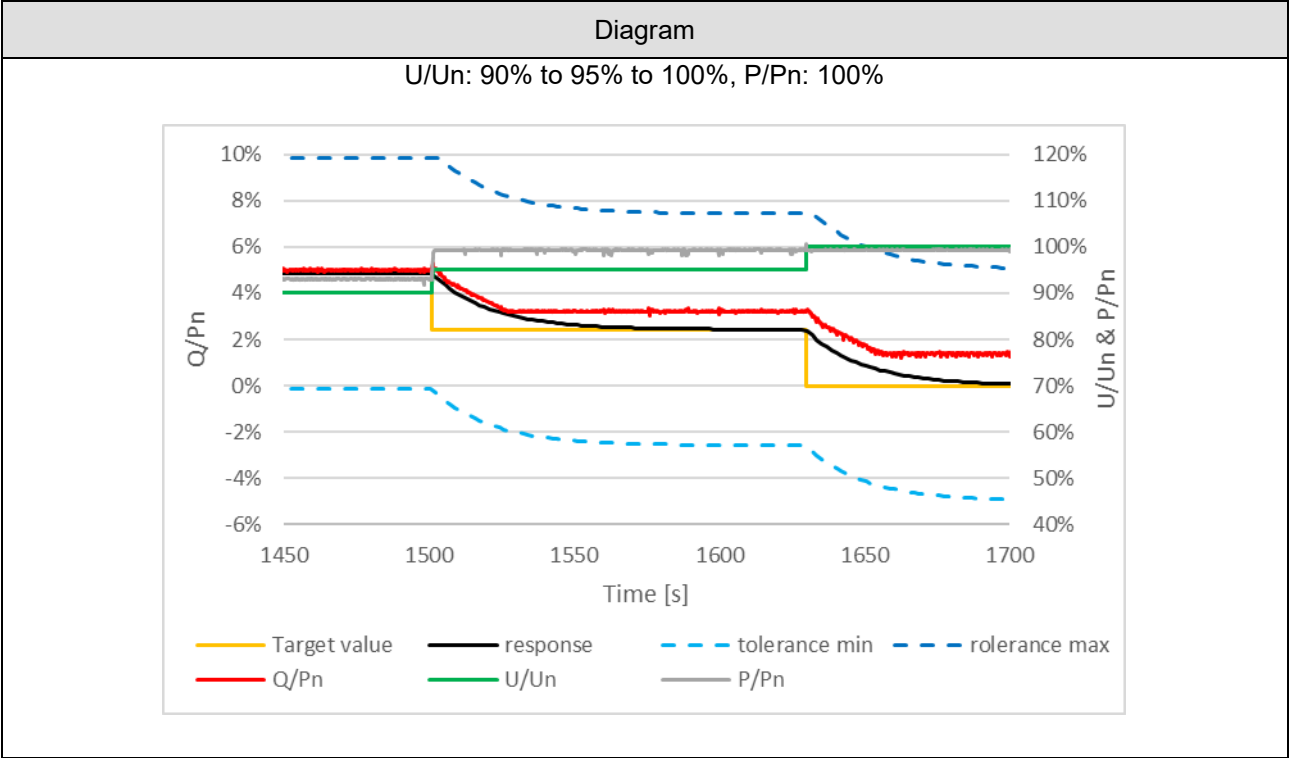
U/Un: 100% to 105% to 110%, P/Pn: 100%



U/Un: 110% to 100% to 90%, P/Pn: 100%



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Clause	Requirement - Test	Result - Remark	Verdict



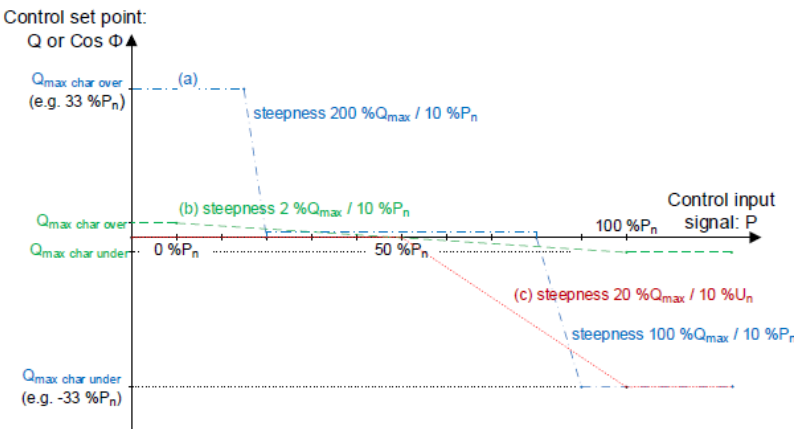
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Clause	Requirement - Test	Result - Remark	Verdict
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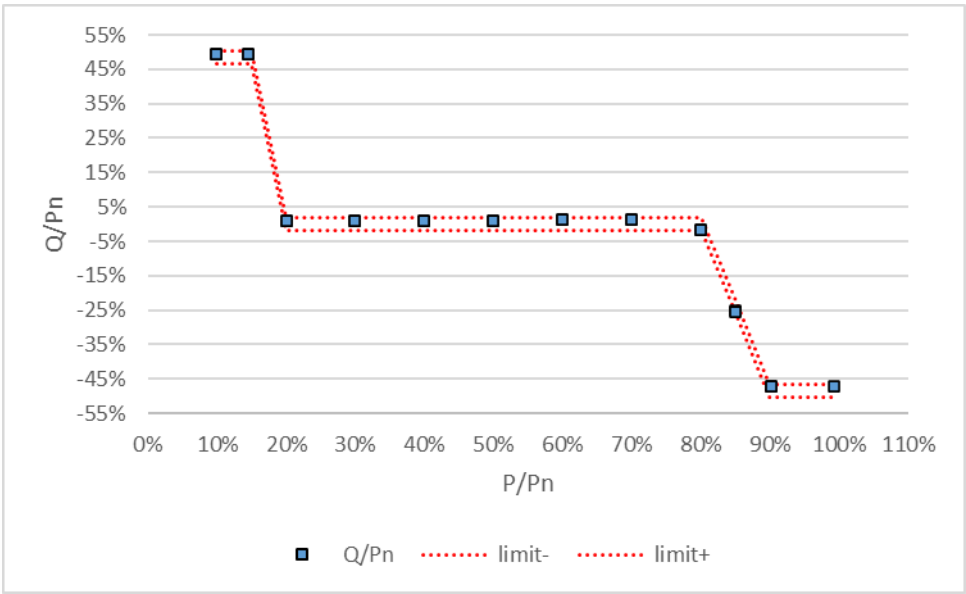
5.5.2.5	TABLE: Verification procedure for power related control modes for reactive power							P		
Model	SUN-8K-H									
Test procedure for cosφ (P) -Setting (a)										
cosφ (P) curve settings:	Set points		1		2		3		4	
	P/Pn		15%		20%		80%		90%	
	Q		100%Q max over		0		0		100%Q max under	
Test procedure for accuracy										
Test Conditions		Measurements					Target vlaue	Δ Limits		
P / Pn	U / Un	P / Pn [%]	Q / Pn [%]	U/Un [%]	cosφ	Δ Q / Smax [%]	Q / Pn [%]	Δ Q / Smax		
10%	100%	9.94	49.24	99.87	0.1975	0.80	48.4	±2%		
15%	100%	14.41	49.27	99.89	0.2802	0.82	48.4			
20%	100%	20.01	0.89	99.89	0.9922	0.89	0.0			
30%	100%	29.95	0.97	99.95	0.9955	0.97	0.0			
40%	100%	39.98	1.03	100.00	0.9968	1.03	0.0			
50%	100%	50.00	1.10	100.05	0.9972	1.10	0.0			
60%	100%	60.03	1.16	100.11	0.9974	1.16	0.0			
70%	100%	69.97	1.22	100.16	0.9975	1.22	0.0			
80%	100%	79.94	-1.52	100.22	0.9975	-1.52	0.0			
85%	100%	84.98	-25.17	100.23	0.9571	-0.95	-24.2			
90%	100%	90.15	-47.18	100.26	0.8844	1.26	-48.4			
100%	100%	99.38	-47.17	100.30	0.9017	1.28	-48.4			
90%	100%	90.19	-47.18	100.26	0.8831	1.26	-48.4			
85%	100%	85.01	-25.33	100.24	0.9542	-1.11	-24.2			
80%	100%	79.96	-1.62	100.22	0.9967	-1.62	0.0			
70%	100%	69.97	1.21	100.17	0.9975	1.21	0.0			
60%	100%	60.03	1.15	100.11	0.9974	1.15	0.0			
50%	100%	50.00	1.09	100.06	0.9972	1.09	0.0			
40%	100%	39.98	1.03	100.00	0.9967	1.03	0.0			
30%	100%	29.95	0.96	99.95	0.9955	0.96	0.0			
20%	100%	20.02	0.89	99.89	0.9922	0.89	0.0			
15%	100%	14.42	49.27	99.89	0.2804	0.82	48.4			
10%	100%	9.95	49.24	99.87	0.1976	0.79	48.4			

Clause	Requirement - Test	Result - Remark	Verdict
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Note:



Diagram



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Clause	Requirement - Test	Result - Remark	Verdict
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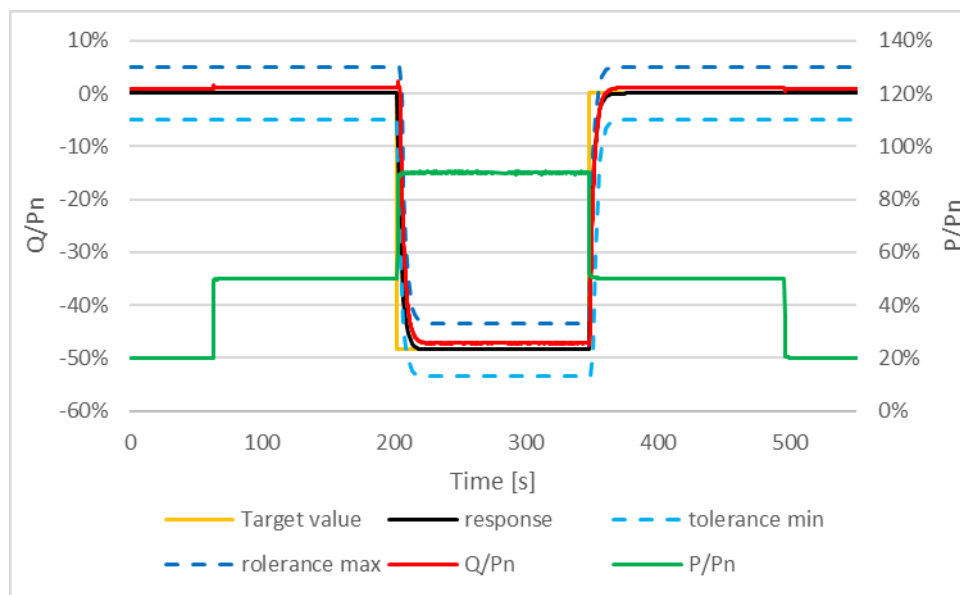
Test procedure for dynamic behaviour

Time constant: 3 s

Test Conditions	Measurements					
	Tsr [s]	Ts [s]	Td [s]	Reactive power/Pn [%]	Active power/Pn [%]	Grid voltage/Un [%]
20%Pn	--	--	--	0.89	20.02	99.89
20%Pn -> 50%Pn	--	--	--	1.10	50.00	100.05
50%Pn -> 90%Pn	10.2	10.2	2.0	-47.19	90.14	100.26
90%Pn -> 50%Pn	7.4	7.4	0.6	1.07	50.01	100.06
50%Pn -> 20%Pn	--	--	--	0.89	20.02	99.90

Diagram

50%Pn -> 90%Pn -> 50%Pn:



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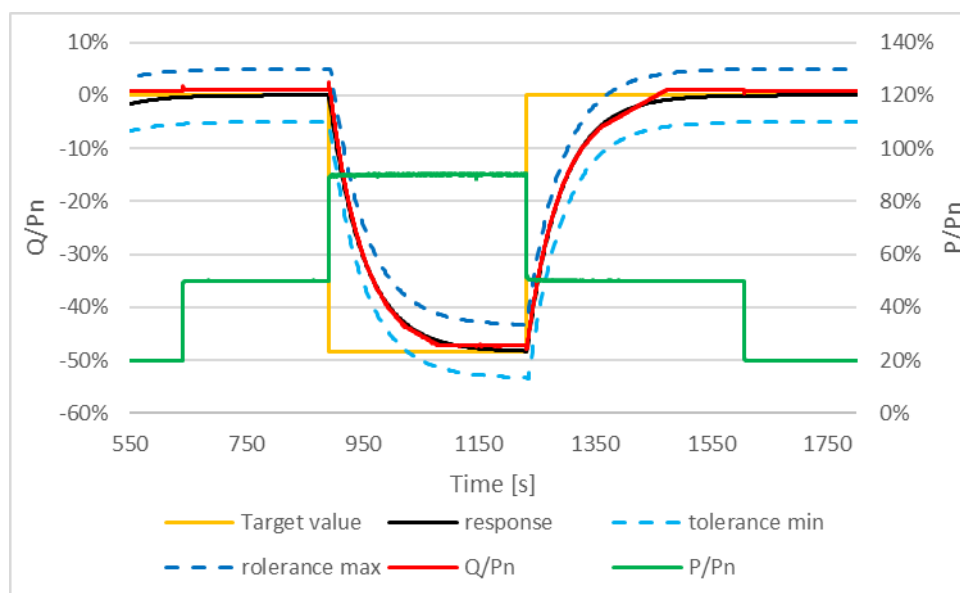
Clause	Requirement - Test	Result - Remark	Verdict
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Time constant: 60 s

Test Conditions	Measurements					
	Tsr [s]	Ts [s]	Td [s]	Reactive power/Pn [%]	Active power/Pn [%]	Grid voltage/Un [%]
20%Pn	--	--	--	0.89	20.02	99.89
20%Pn -> 50%Pn	--	--	--	1.10	50.00	100.05
50%Pn -> 90%Pn	131.0	131.0	1.8	-47.18	90.10	100.26
90%Pn -> 50%Pn	145.8	145.8	0.8	1.07	50.06	100.05
50%Pn -> 20%Pn	--	--	--	0.89	20.02	99.89

Diagram

50%Pn -> 90%Pn -> 50%Pn:

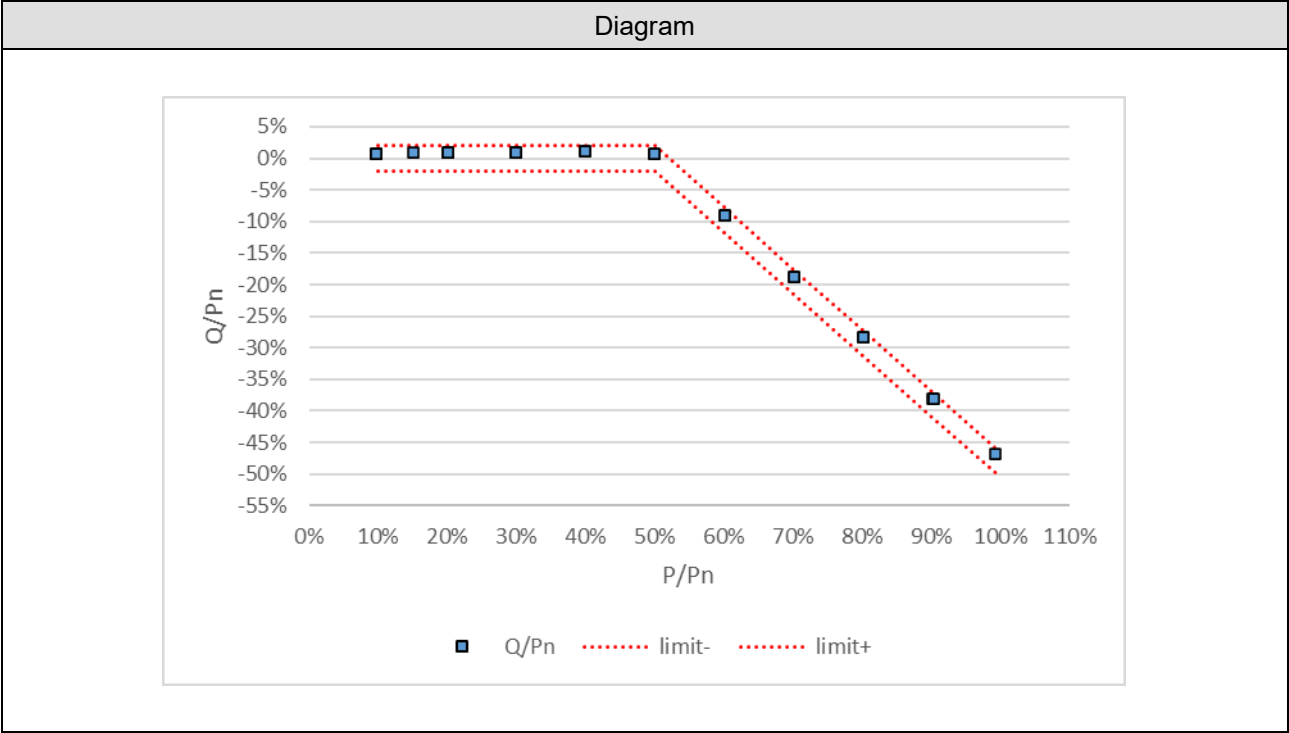


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Clause	Requirement - Test	Result - Remark	Verdict
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5.5.2.5	TABLE: Verification procedure for power related control modes for reactive power							P
Model	SUN-8K-H							
Test procedure for cosφ (P) -Setting (c)								
cosφ (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 vlaue	Δ Limits
P / Pn	U / Un	P / Pn [%]	Q / Pn [%]	U/Un [%]	cosφ	Δ Q / Smax [%]	Q / Pn [%]	Δ Q / Smax
10%	100%	9.79	0.82	99.84	0.9742	0.82	0.0	±2%
20%	100%	20.03	0.89	99.89	0.9924	0.89	0.0	
30%	100%	29.97	0.96	99.95	0.9956	0.96	0.0	
40%	100%	39.99	1.03	100.00	0.9968	1.03	0.0	
50%	100%	49.92	0.81	100.05	0.9974	0.81	0.0	
60%	100%	60.12	-9.03	100.10	0.9868	0.66	-9.7	
70%	100%	70.23	-18.77	100.15	0.9643	0.61	-19.4	
80%	100%	80.25	-28.41	100.20	0.9408	0.66	-29.1	
90%	100%	90.31	-38.08	100.26	0.9194	0.68	-38.8	
100%	100%	99.38	-46.82	100.30	0.9034	1.63	-48.4	
90%	100%	90.37	-38.12	100.26	0.9180	0.64	-38.8	
80%	100%	80.28	-28.44	100.21	0.9394	0.63	-29.1	
70%	100%	70.24	-18.78	100.16	0.9632	0.60	-19.4	
60%	100%	60.14	-9.05	100.11	0.9859	0.64	-9.7	
50%	100%	49.93	0.78	100.06	0.9973	0.78	0.0	
40%	100%	39.99	1.03	100.00	0.9968	1.03	0.0	
30%	100%	29.96	0.96	99.95	0.9956	0.96	0.0	
20%	100%	20.03	0.89	99.89	0.9923	0.89	0.0	
10%	100%	9.78	0.82	99.84	0.9740	0.82	0.0	
30%	100%	29.97	0.96	99.95	0.9956	0.96	0.0	
20%	100%	20.03	0.89	99.89	0.9923	0.89	0.0	
15%	100%	15.05	0.85	99.87	0.9879	0.85	0.0	
10%	100%	9.78	0.82	99.84	0.9740	0.82	0.0	

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Clause	Requirement - Test	Result - Remark	Verdict



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Clause	Requirement - Test	Result - Remark	Verdict
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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%	--	--	--	80.05	1599.69	246.05
20%Pn -> 50%Pn	107%	--	--	--	81.85	3982.02	246.39
50%Pn -> 90%Pn	107%	9.4	9.4	0.4	-3033.62	7213.33	246.83
90%	103%	--	--	--	-3041.46	7220.96	236.98
90%	98%	8.4	8.4	0.4	96.32	7204.35	225.47
90%	107%	8.6	8.6	0.4	-3033.49	7216.16	246.84
90%	100%	--	--	--	-3045.78	7223.41	230.62
90%Pn -> 50%Pn	100%	9.4	9.4	0.8	75.10	3985.12	230.13
50%Pn -> 20%Pn	100%	--	--	--	71.26	1601.38	229.76

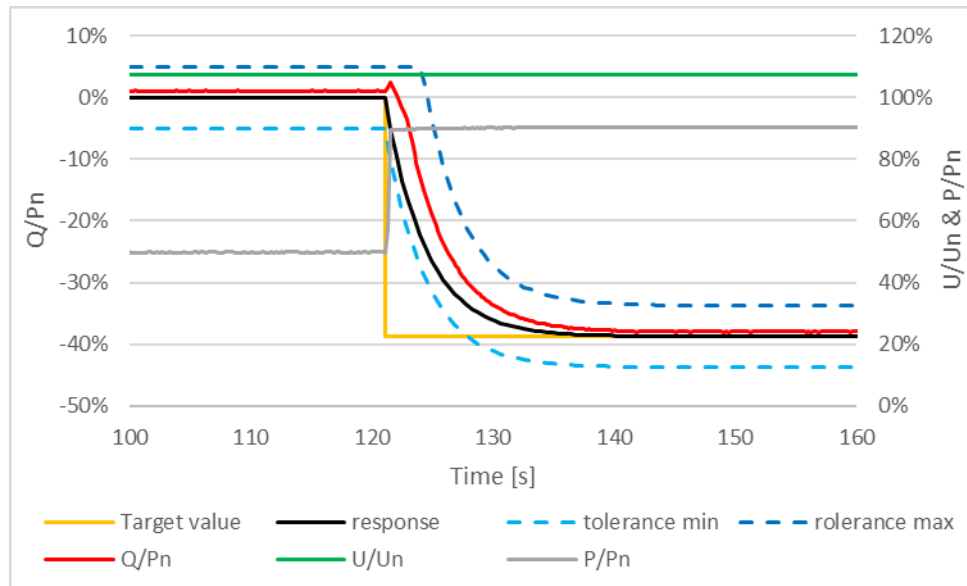
Note:

Lock-in voltage: 105%Un

Lock out voltage: 100%Un

Diagram

P/Pn: 50% to 90%, U/Un: 107%

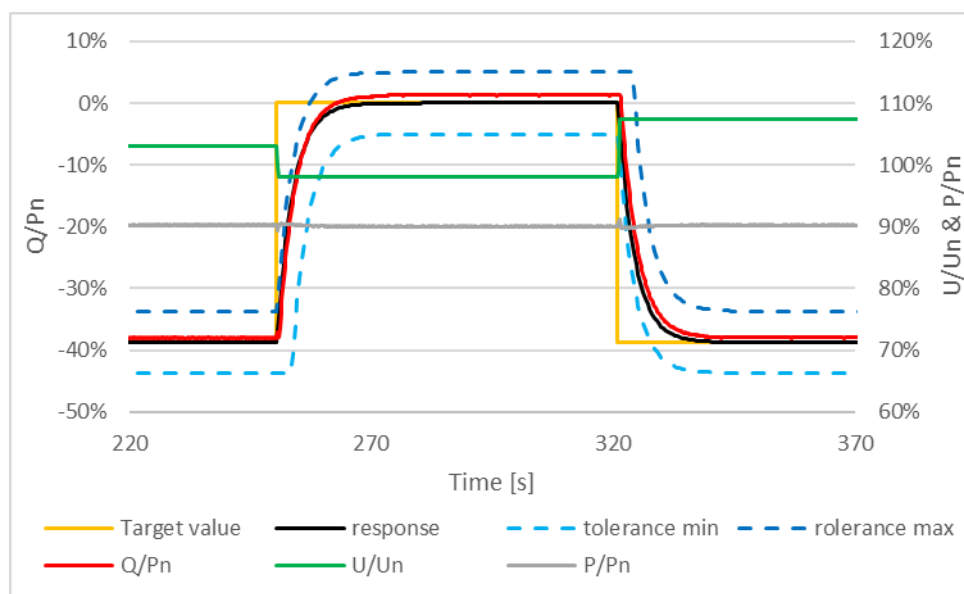


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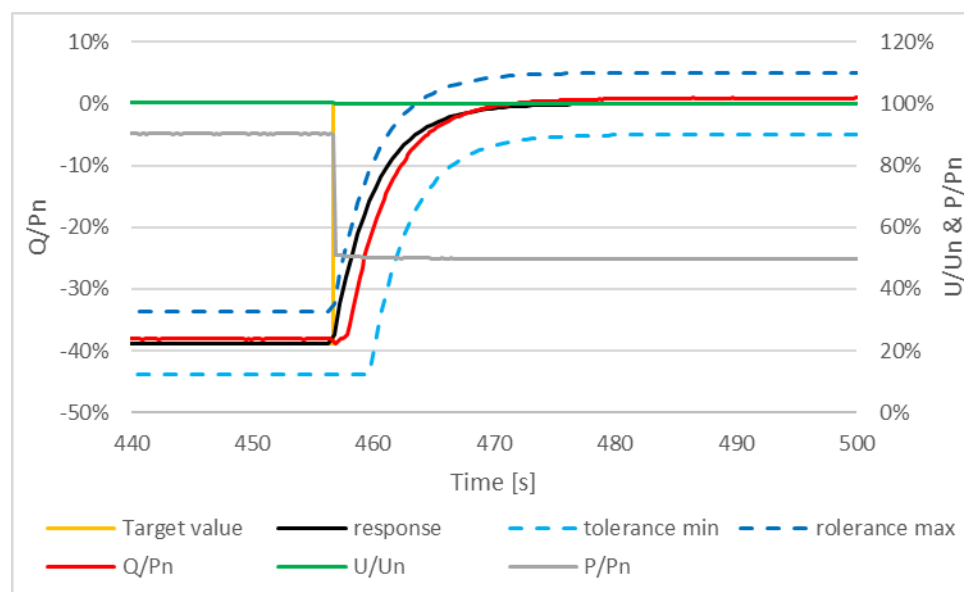
Clause	Requirement - Test	Result - Remark	Verdict
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Diagram

P/Pn: 90%, U/Un: 103 % to 98% to 107%



90%Pn -> 50%Pn, U/Un: 100%



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Clause	Requirement - Test	Result - Remark	Verdict
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5.6	TABLE: Voltage related active power reduction - P(U)					P
Model	SUN-8K-H					
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 vlaue		Δ Limits	
U/Un	P/Pn	U/Un [%]	P/Pn [%]	Q/Pn [%]	$\Delta P/S_{max}$ [%]	$\Delta Q/S_{max}$ [%]	P/Pn [%]	Q/Pn [%]	$\Delta P/S_{max}$	$\Delta Q/S_{max}$
100%	100%	100.03	99.30	1.38	-0.70	1.38	100	0	$\leq \pm 2\%$	$\leq \pm 2\%$
103%		103.01	99.28	1.42	-0.72	1.42	100	0		
106%		106.00	99.27	1.07	-0.73	1.07	100	0		
109%		109.01	99.55	-46.89	-0.45	1.51	100*	-48.4		
112%		112.02	59.83	-47.00	-0.17	1.40	60	-48.4		
115%		115.05	0.04	0.50	0.04	0.50	0	0		
112%		112.02	59.77	-46.99	-0.23	1.41	60	-48.4		
109%		109.01	99.59	-46.89	-0.41	1.51	100*	-48.4		
106%		106.00	99.29	0.81	-0.71	0.81	100	0		
103%		103.02	99.29	1.39	-0.71	1.39	100	0		
100%		100.04	99.32	1.38	-0.68	1.38	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 Cosφ=0.4.

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Clause	Requirement - Test	Result - Remark	Verdict
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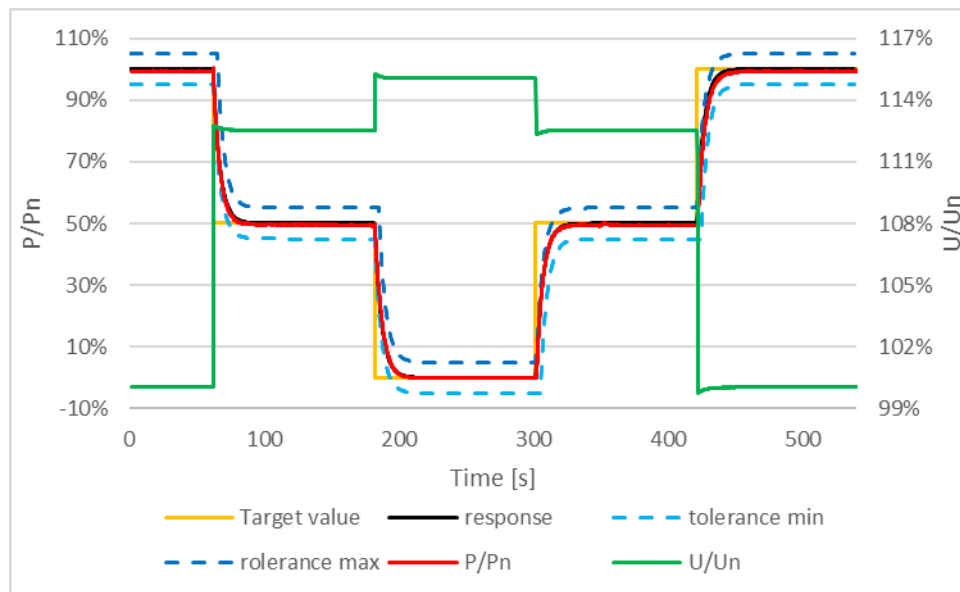
Test procedure for dynamic behaviour-Tau $\geq 3s$ (eg.5s)

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

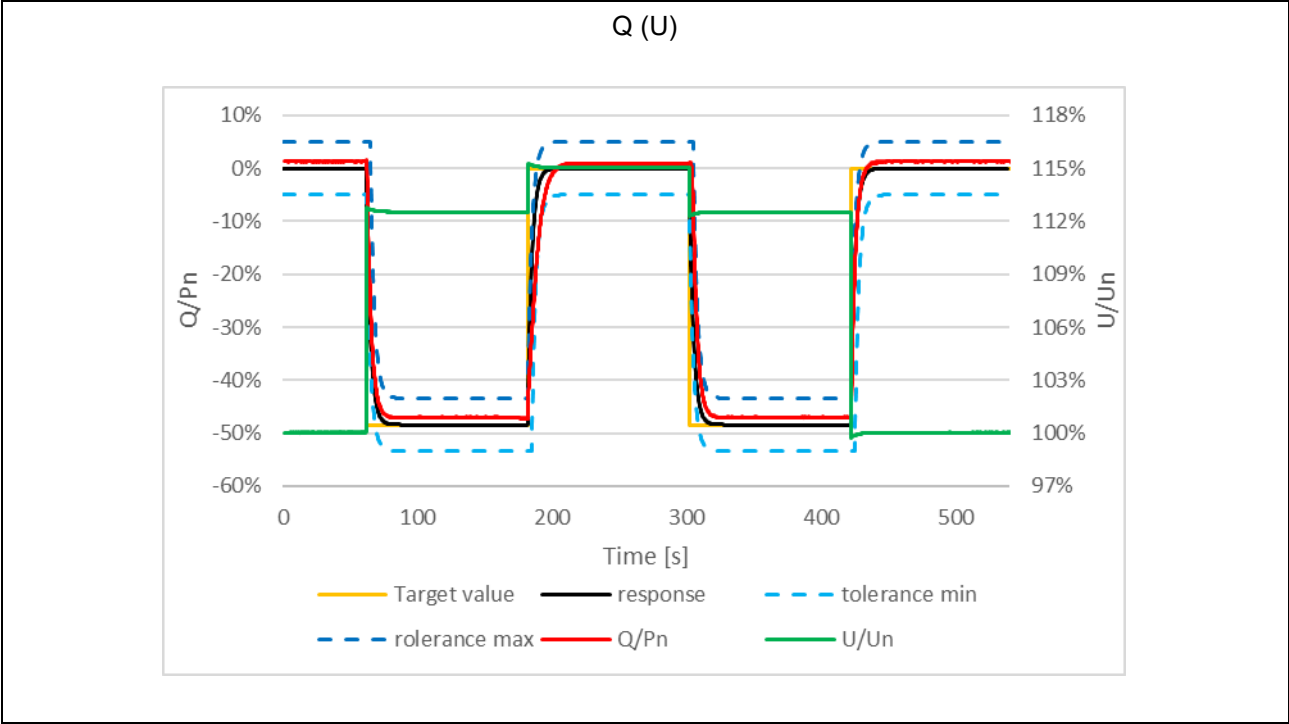
Test Conditions		Measurements				Target value		Limits	
U/U _n	P/P _n	U/U _n [%]	P/P _n [%]	Q/P _n [%]	T _{sr_90%}	P/P _n [%]	Q/P _n [%]	Δ P/P _n [%]	T _{sr_90%}
100%U _n -> 112.5%U _n	100%	112.54	49.59	-47.05	10.8	50	- 48.4	$\leq \pm 5$	$\geq 3s$
112.5%U _n -> 115%U _n		115.06	-0.20	0.90	12.2	0	0		
115%U _n -> 112.5%U _n		112.52	49.43	-47.05	11.8	50	- 48.4		
112.5%U _n -> 100%U _n		100.02	99.30	1.38	13.2	100	0		

Diagram

P (U)



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Clause	Requirement - Test	Result - Remark	Verdict



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Clause	Requirement - Test	Result - Remark	Verdict
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5.7.2.2	TABLE: Power quality - Harmonic emission						P
Model	SUN-3K-H						
☒ 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	230.08	50.00	13.12	3012.66	3017.78	0.9983	1.647
Phase L2	--	--	--	--	--	--	--
Phase L3	--	--	--	--	--	--	--
Harmonic odd no.	Current Magnitude (A)					Harmonic Current Limits (A)	
	Phase L1	Phase L2		Phase L3			
1	13.098	--		--		--	
2	0.013	--		--		1.080	
3	0.146	--		--		2.300	
4	0.002	--		--		0.430	
5	0.080	--		--		1.140	
6	0.002	--		--		0.300	
7	0.044	--		--		0.770	
8	0.002	--		--		0.230	
9	0.052	--		--		0.400	
10	0.003	--		--		0.184	
11	0.042	--		--		0.330	
12	0.002	--		--		0.153	
13	0.041	--		--		0.210	
14	0.002	--		--		0.131	
15	0.030	--		--		0.150	
16	0.002	--		--		0.115	
17	0.032	--		--		0.132	
18	0.002	--		--		0.102	
19	0.029	--		--		0.118	
20	0.001	--		--		0.092	
21	0.030	--		--		0.107	
22	0.002	--		--		0.084	
23	0.026	--		--		0.098	
24	0.002	--		--		0.077	
25	0.029	--		--		0.090	
26	0.002	--		--		0.071	
27	0.027	--		--		0.083	
28	0.002	--		--		0.066	
29	0.026	--		--		0.078	
30	0.002	--		--		0.061	
31	0.024	--		--		0.073	
32	0.002	--		--		0.058	
33	0.024	--		--		0.068	
34	0.002	--		--		0.054	

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Clause	Requirement - Test		Result - Remark	Verdict
35	0.020	--	--	0.064
36	0.002	--	--	0.051
37	0.020	--	--	0.061
38	0.002	--	--	0.048
39	0.019	--	--	0.058
40	0.001	--	--	0.046
41	0.016	--	--	--
42	0.001	--	--	--
43	0.016	--	--	--
44	0.001	--	--	--
45	0.016	--	--	--
46	0.001	--	--	--
47	0.015	--	--	--
48	0.001	--	--	--
49	0.015	--	--	--
50	0.001	--	--	--
THC	0.215	--	--	--
Note(s):				

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Clause	Requirement - Test	Result - Remark	Verdict
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5.7.2.2	TABLE: Power quality - Harmonic emission						P
Model	SUN-8K-H						
☒ Opinion 1: Power generating unit (individual device) and power generating system which is $I_n \leq 75A$							
Test: Each phase output current > 16A and $\leq 75A$, it shall be complied with EN 61000-3-12.							
Measurements							
Parameter	U (V)	f (Hz)	I (A)	P (W)	S (VA)	Power Factor	
Phase L1	230.10	50.00	34.61	7940.25	7964.44	0.9970	
Phase L2	--	--	--	--	--	--	
Phase L3	--	--	--	--	--	--	
Order No.	Measurement						Harmonic Current Limits
	Phase L1		Phase L2		Phase L3		
	[A]	[%]	[A]	[%]	[A]	[%]	[A]
1	34.491	--	--	--	--	--	--
2	0.016	0.047	--	--	--	--	8.00
3	0.055	0.159	--	--	--	--	N/A
4	0.003	0.010	--	--	--	--	4.00
5	0.147	0.423	--	--	--	--	10.70
6	0.003	0.009	--	--	--	--	2.67
7	0.016	0.047	--	--	--	--	7.20
8	0.002	0.005	--	--	--	--	2.00
9	0.147	0.424	--	--	--	--	N/A
10	0.002	0.006	--	--	--	--	1.60
11	0.182	0.523	--	--	--	--	3.10
12	0.002	0.006	--	--	--	--	1.33
13	0.124	0.355	--	--	--	--	2.00
14	0.002	0.005	--	--	--	--	N/A
15	0.055	0.159	--	--	--	--	N/A
16	0.002	0.005	--	--	--	--	N/A
17	0.050	0.143	--	--	--	--	N/A
18	0.002	0.006	--	--	--	--	N/A
19	0.036	0.104	--	--	--	--	N/A
20	0.002	0.005	--	--	--	--	N/A
21	0.038	0.108	--	--	--	--	N/A
22	0.002	0.007	--	--	--	--	N/A
23	0.055	0.157	--	--	--	--	N/A
24	0.002	0.006	--	--	--	--	N/A
25	0.047	0.136	--	--	--	--	N/A
26	0.003	0.008	--	--	--	--	N/A
27	0.015	0.043	--	--	--	--	N/A
28	0.003	0.008	--	--	--	--	N/A
29	0.009	0.027	--	--	--	--	N/A
30	0.002	0.006	--	--	--	--	N/A
31	0.019	0.054	--	--	--	--	N/A
32	0.002	0.006	--	--	--	--	N/A
33	0.028	0.080	--	--	--	--	N/A
34	0.002	0.006	--	--	--	--	N/A

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Clause	Requirement - Test				Result - Remark		Verdict
35	0.030	0.087	--	--	--	--	N/A
36	0.002	0.004	--	--	--	--	N/A
37	0.024	0.070	--	--	--	--	N/A
38	0.002	0.005	--	--	--	--	N/A
39	0.015	0.042	--	--	--	--	N/A
40	0.001	0.004	--	--	--	--	N/A
41	0.009	0.025	--	--	--	--	N/A
42	0.001	0.004	--	--	--	--	N/A
43	0.004	0.012	--	--	--	--	N/A
44	0.001	0.004	--	--	--	--	N/A
45	0.007	0.019	--	--	--	--	N/A
46	0.001	0.004	--	--	--	--	N/A
47	0.010	0.029	--	--	--	--	N/A
48	0.001	0.003	--	--	--	--	N/A
49	0.011	0.031	--	--	--	--	N/A
50	0.001	0.003	--	--	--	--	N/A
THDi	0.964		--		--		13
PWHD	1.804		--		--		22
Note(s):							

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Clause	Requirement - Test	Result - Remark	Verdict
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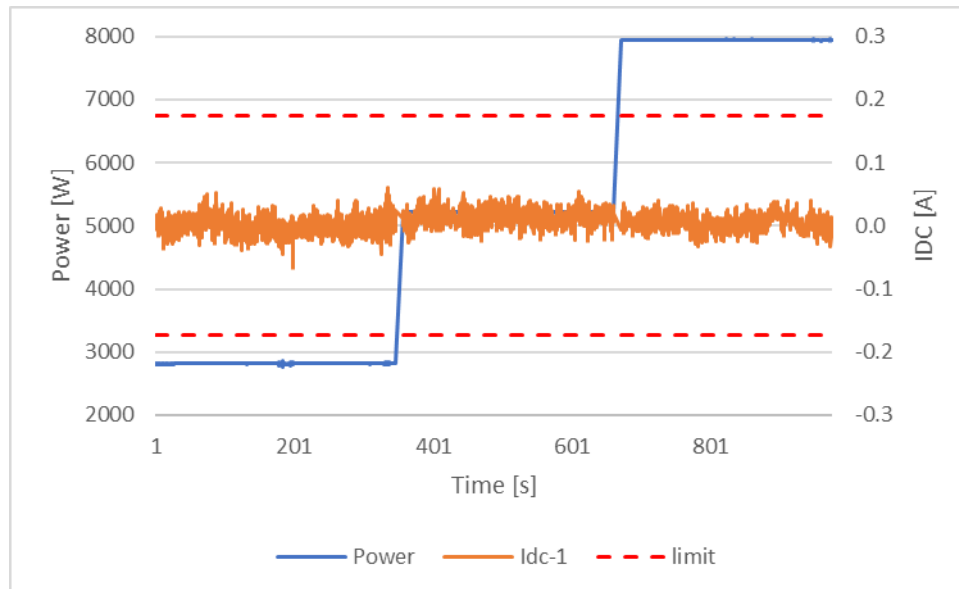
5.7.2.3	TABLE: Power quality - Flicker											P
Model	SUN-8K-H											
☒ Opinion 1: Generation units with a rated current ≤ 75A												
Test:												
Measurements												
Parameter	P _{st}			d(t) (%)			d _c (%)			d _{max} (%)		
	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
1	0.262	-	-	0.0	-	-	0.435	-	-	0.663	-	-
2	0.275	-	-	0.0	-	-	0.435	-	-	0.752	-	-
3	0.253	-	-	0.0	-	-	0.434	-	-	0.690	-	-
4	0.252	-	-	0.0	-	-	0.437	-	-	0.654	-	-
5	0.256	-	-	0.0	-	-	0.435	-	-	0.663	-	-
6	0.256	-	-	0.0	-	-	0.434	-	-	0.746	-	-
7	0.255	-	-	0.0	-	-	0.435	-	-	0.647	-	-
8	0.276	-	-	0.0	-	-	0.435	-	-	0.712	-	-
9	0.248	-	-	0.0	-	-	0.433	-	-	0.733	-	-
10	0.257	-	-	0.0	-	-	0.436	-	-	0.691	-	-
11	0.247	-	-	0.0	-	-	0.435	-	-	0.649	-	-
12	0.257	-	-	0.0	-	-	0.433	-	-	0.755	-	-
Parameter	Measurements					Limit						
	P _{st}	P _{lt}	d(t) (%)	d _c (%)	d _{max} (%)	P _{st}	P _{lt}	d(t) (%)	d _c (%)	d _{max} (%)		
L1	0.276	0.258	0.0	0.437	0.755	≤ 1.0	≤ 0.65	≤ 3.3	≤ 3.3	≤ 4.0		
L2	-	-	-	-	-							
L3	-	-	-	-	-							
Note(s):												
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-3.												
Each phase output current > 16A and ≤ 75A, it shall be complied with EN 61000-3-11.												

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Clause	Requirement - Test	Result - Remark	Verdict
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5.7.2.4	TABLE: Power quality - DC Injection						P
Model	SUN-8K-H						
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
30-40%	100.02%	35.31%	35.25%	0.9982	0.187%	0%	≤ ±0.5% or 20 mA
60-70%	100.01%	65.35%	65.29%	0.9990	0.169%	0%	
≥ 95%	100.03%	99.53%	99.29%	0.9972	0.117%	0%	

Note(s):

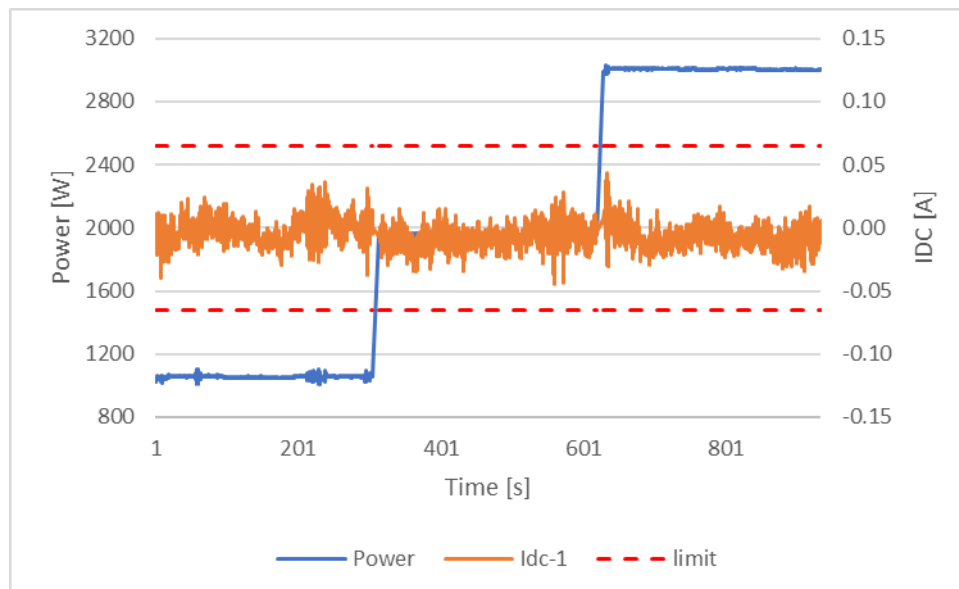


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Clause	Requirement - Test	Result - Remark	Verdict
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5.7.2.4	TABLE: Power quality - DC Injection						P
Model	SUN-3K-H						
Test Conditions	Measurements					Target value	Limits
P/P _n	U/U _n	I/I _n	P/P _n	cos φ	I _{dc} /I _n	I _{dc} /I _n	I _{dc} /I _n
30-40%	100.03%	35.48%	35.18%	0.9911	0.303%	0%	≤ ±0.5% or 20 mA
60-70%	100.00%	65.43%	65.24%	0.9969	0.335%	0%	
≥ 95%	100.03%	100.32%	100.19%	0.9983	0.337%	0%	

Note(s):



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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3	Table: Interface protection								P
Model	SUN-8K-H								
All thresholds must be adjustable									
Voltage values									
Threshold	(27<)	tmin (27<)	(27<<)	tmin (27<<)	59>	tmax (59>)	59>>	tmax (59.S1)	59 10 min- mean
Range	0.2-1.0 U _n	0.1- 100s	0.2-1.0 U _n	0.1-5s	1.0-1.2 U _n	0.1- 100s	1.0-1.3 U _n	0.1-5s	1.0- 1.15 U _n
Adjustable in Step	0.01 U _n	0.1s	0.01 U _n	0.05s	0.01 U _n	0.1s	0.01 U _n	0.05s	0.01 U _n
Frequency values									
Threshold	81<	tmin (81<)	81<<	tmin (81<<)	81>	tmax (81>)	81>>	tmax (81>>)	
Range	47.0- 50.0Hz	0.1-100s	47.0- 50.0Hz	0.1-5s	50.0- 52.0Hz	0.1-100s	50.0- 52.0Hz	0.1-5s	
Steps	0.1 Hz	0.1s	0.1 Hz	0.05s	0.1 Hz	0.1s	0.1 Hz	0.05s	
Note 1:	External SPI stays in operation conditions for 5s after disconnecting the mains voltage								
Note 2:	The frequency protection shall function correctly in the input voltage range between 20% U _n and 120% U _n and shall be inhibited for input voltages of less than 20% U _n . Under 20% U _n the frequency protection is inhibited. Disconnection may only happen based on undervoltage protection.								

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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Accuracy of the setting values:						
Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L-N	L2-N	L3-N	
U<	20%Un	N/A	44.75	N/A	N/A	± 1% of Un
		N/A	44.70	N/A	N/A	
		N/A	44.31	N/A	N/A	
U<	45%Un	N/A	103.18	N/A	N/A	
		N/A	102.48	N/A	N/A	
		N/A	101.69	N/A	N/A	
U<	65%Un	N/A	148.33	N/A	N/A	
		N/A	149.32	N/A	N/A	
		N/A	148.82	N/A	N/A	
U<	100%Un	N/A	228.18	N/A	N/A	
		N/A	228.20	N/A	N/A	
		N/A	227.90	N/A	N/A	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L1		
U<	20%Un	N/A	N/A	N/A	± 1% of Un	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	45%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	65%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	100%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Notes: Ramp signal test						

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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Accuracy of the setting values:						
Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L-N	L2-N	L3-N	
U<<	20%Un	N/A	44.85	N/A	N/A	± 1% of U _n
		N/A	43.99	N/A	N/A	
		N/A	44.53	N/A	N/A	
U<<	45%Un	N/A	102.46	N/A	N/A	
		N/A	103.27	N/A	N/A	
		N/A	102.45	N/A	N/A	
U<<	65%Un	N/A	147.87	N/A	N/A	
		N/A	148.33	N/A	N/A	
		N/A	148.28	N/A	N/A	
U<<	100%Un	N/A	228.89	N/A	N/A	
		N/A	229.20	N/A	N/A	
		N/A	229.04	N/A	N/A	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L4		
U<<	20%Un	N/A	N/A	N/A	± 1% of U _n	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	45%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	65%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	100%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Notes: Ramp signal test						

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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Accuracy of the setting values:						
Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L-N	L2-N	L3-N	
U>	100%Un	N/A	231.31	N/A	N/A	± 1% of U _n
		N/A	231.33	N/A	N/A	
		N/A	231.21	N/A	N/A	
U>	106%Un	N/A	245.17	N/A	N/A	
		N/A	244.96	N/A	N/A	
		N/A	245.19	N/A	N/A	
U>	112%Un	N/A	257.94	N/A	N/A	
		N/A	258.49	N/A	N/A	
		N/A	258.00	N/A	N/A	
U>	120%Un	N/A	276.95	N/A	N/A	
		N/A	277.92	N/A	N/A	
		N/A	278.00	N/A	N/A	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L4		
U>	100%Un	N/A	N/A	N/A	± 1% of U _n	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	106%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	112%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	120%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Notes: Ramp signal test						

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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Accuracy of the setting values:						
Condition	Setting	Measurement Trip value [V]				Limitation
		L123	L1-N	L2-N	L3-N	
U>>	100%Un	N/A	230.02	N/A	N/A	± 1% of U _n
		N/A	230.61	N/A	N/A	
		N/A	230.09	N/A	N/A	
U>>	109%Un	N/A	251.29	N/A	N/A	
		N/A	251.02	N/A	N/A	
		N/A	251.19	N/A	N/A	
U>>	118%Un	N/A	272.16	N/A	N/A	
		N/A	272.44	N/A	N/A	
		N/A	272.00	N/A	N/A	
U>>	130%Un	N/A	300.05	N/A	N/A	
		N/A	300.17	N/A	N/A	
		N/A	300.14	N/A	N/A	
Condition	Setting	Measurement Trip value [V]			Limitation	
		L1-L2	L2-L3	L3-L1		
U>>	100%Un	N/A	N/A	N/A	± 1% of U _n	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	109%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	118%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	130%Un	N/A	N/A	N/A		
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Notes: Ramp signal test						

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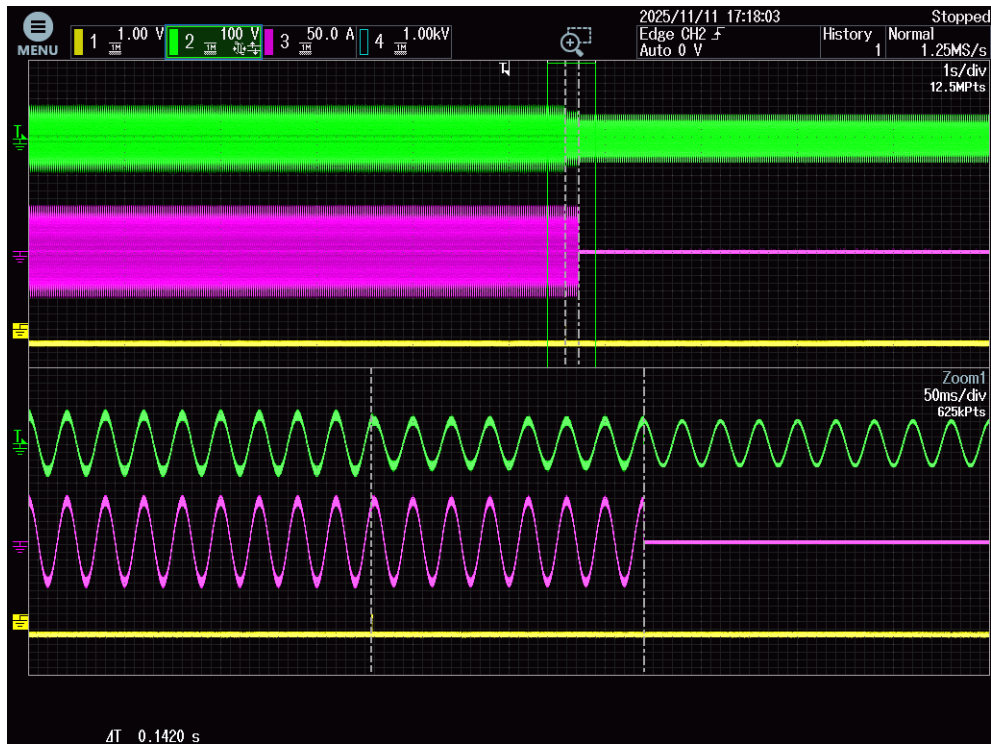
Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.3	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U<	100	N/A	142	N/A	N/A	100-200
		N/A	141	N/A	N/A	
		N/A	105	N/A	N/A	
U<	30000	N/A	30040	N/A	N/A	30000-30100
		N/A	30080	N/A	N/A	
		N/A	30040	N/A	N/A	
U<	60000	N/A	60040	N/A	N/A	60000-60100
		N/A	60040	N/A	N/A	
		N/A	60040	N/A	N/A	
U<	100000	N/A	100050	N/A	N/A	100000-100100
		N/A	100050	N/A	N/A	
		N/A	100050	N/A	N/A	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U<	100	N/A	N/A	N/A	100-200	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	30000	N/A	N/A	N/A	30000-30100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	60000	N/A	N/A	N/A	60000-60100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<	100000	N/A	N/A	N/A	100000-100100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Note(s): Jump signal test						

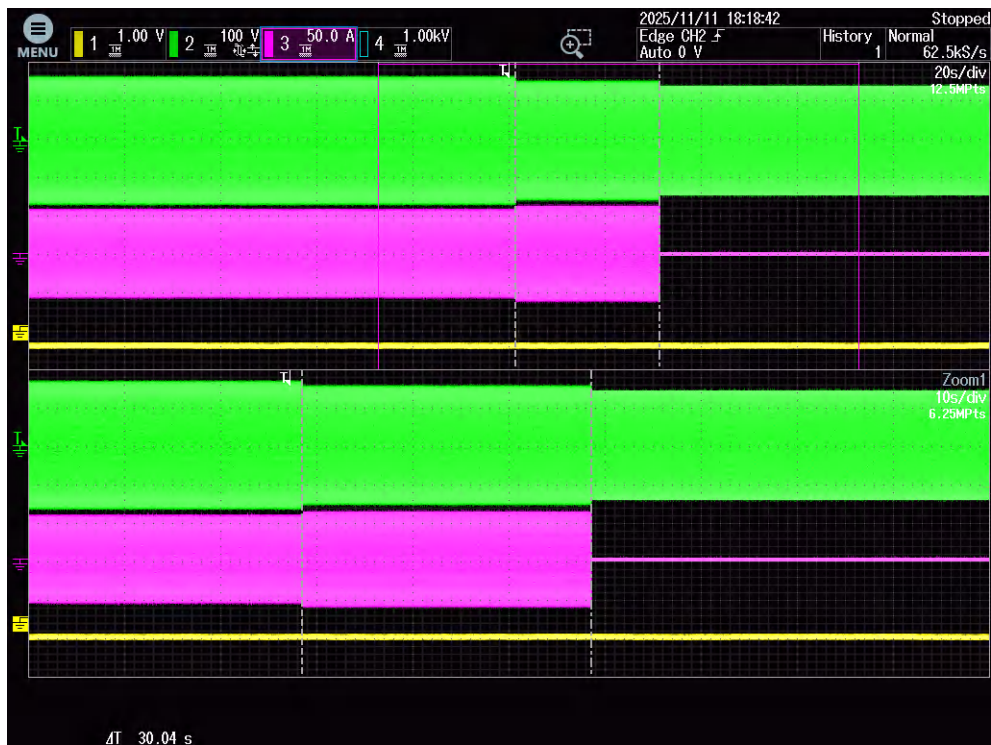
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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 100 ms

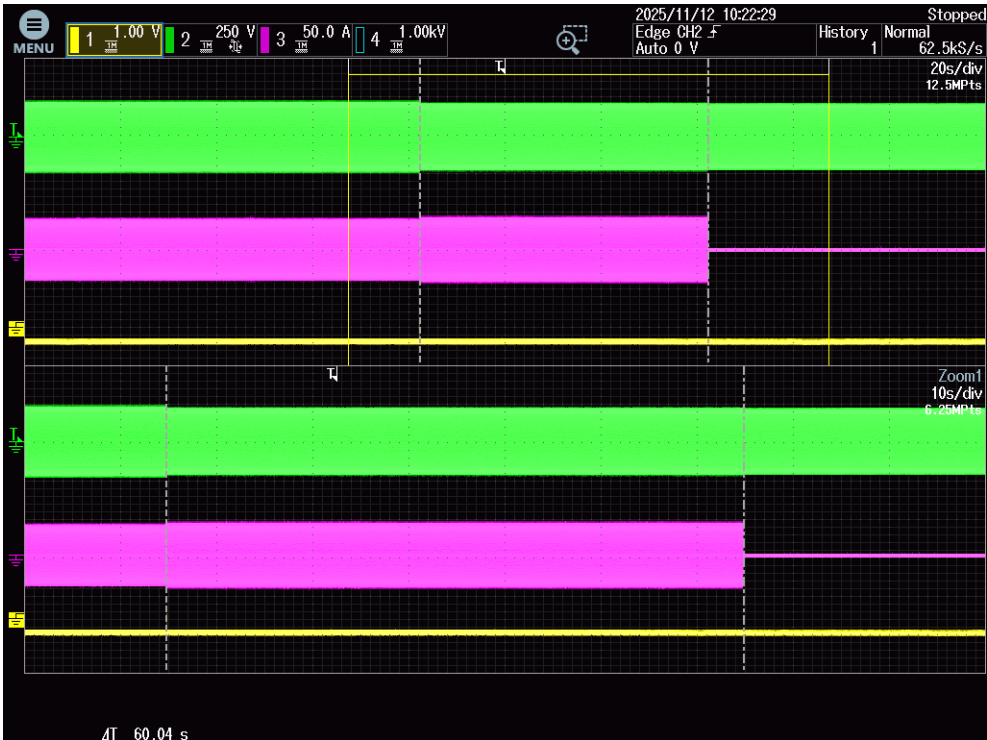


Graph of trip time of 30000 ms

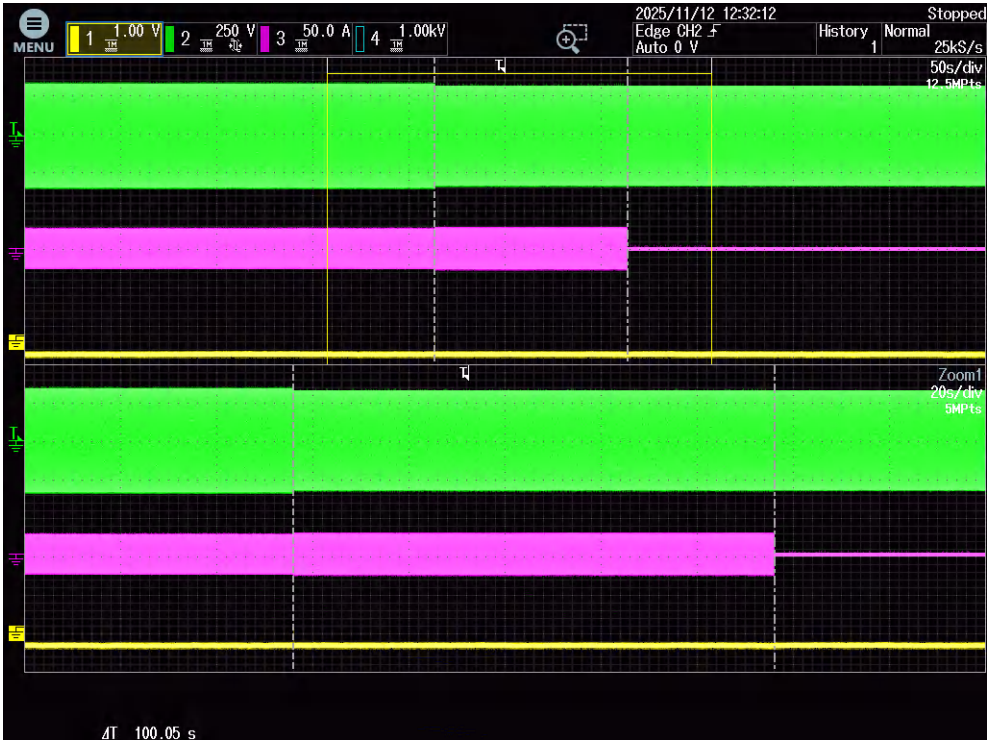


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Clause	Requirement - Test	Result - Remark	Verdict

Graph of trip time of 60000 ms



Graph of trip time of 100000 ms



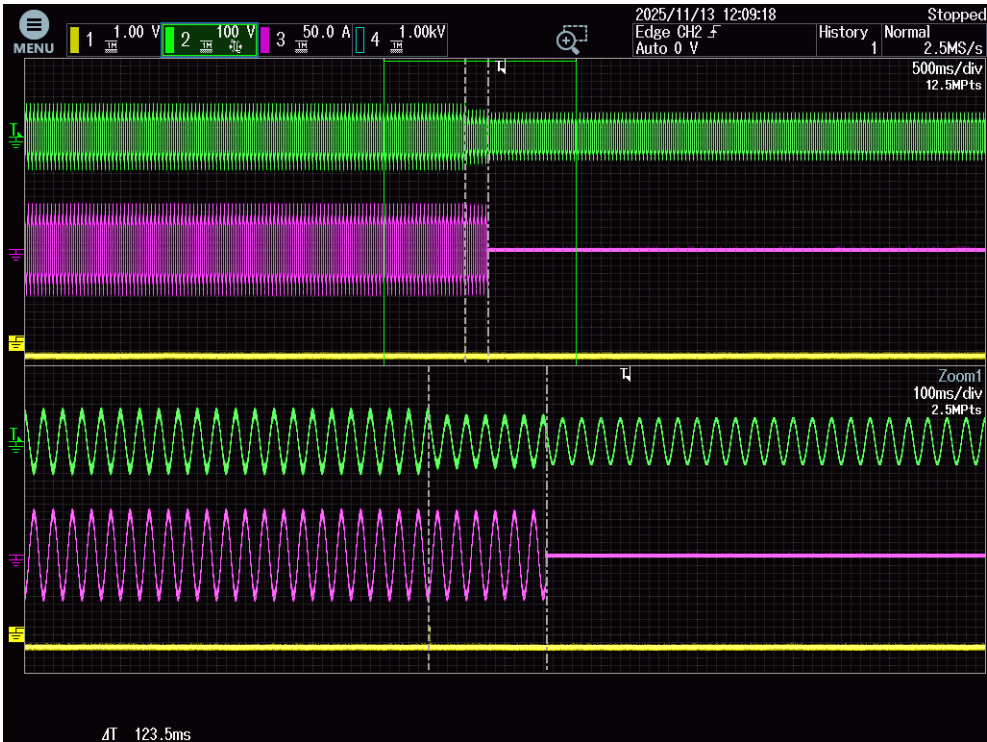
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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.3	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U<<	100	N/A	124	N/A	N/A	100-200
		N/A	136	N/A	N/A	
		N/A	118	N/A	N/A	
U<<	1500	N/A	1535	N/A	N/A	1500-1600
		N/A	1537	N/A	N/A	
		N/A	1532	N/A	N/A	
U<<	3000	N/A	3032	N/A	N/A	3000-3100
		N/A	3032	N/A	N/A	
		N/A	3040	N/A	N/A	
U<<	5000	N/A	5042	N/A	N/A	5000-5100
		N/A	5030	N/A	N/A	
		N/A	5052	N/A	N/A	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U<<	100	N/A	N/A	N/A	100-200	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	1500	N/A	N/A	N/A	1500-1600	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	3000	N/A	N/A	N/A	3000-3100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U<<	5000	N/A	N/A	N/A	5000-5100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Note(s): Jump signal test						

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Clause	Requirement - Test	Result - Remark	Verdict

Graph of trip time of 100 ms



Graph of trip time of 1500 ms



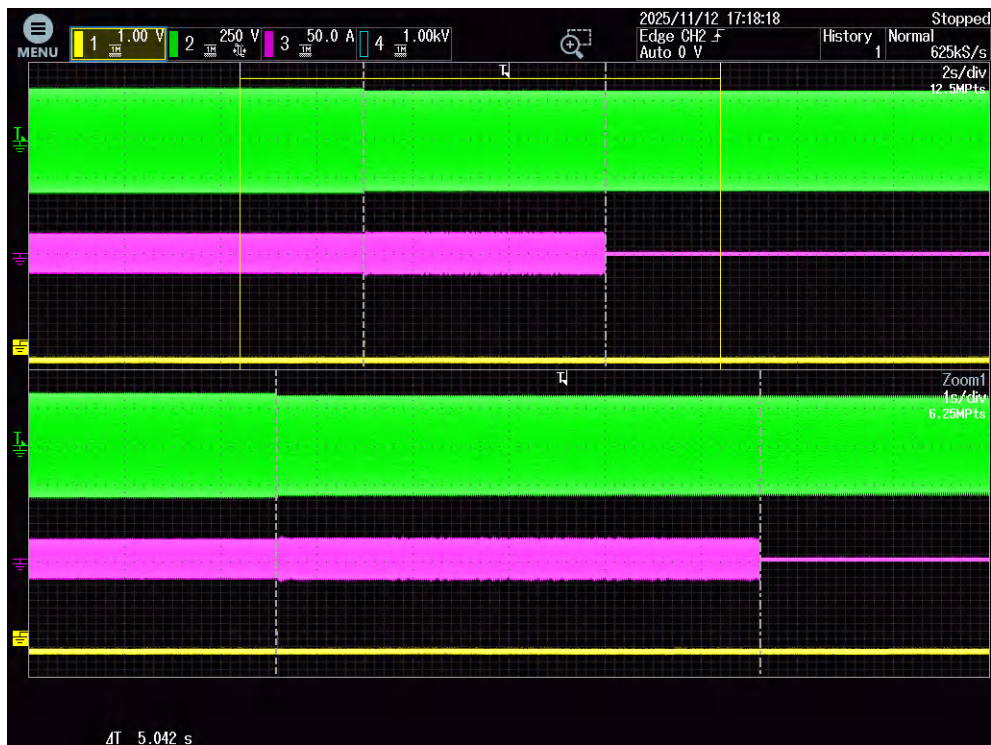
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 3000 ms



Graph of trip time of 5000 ms



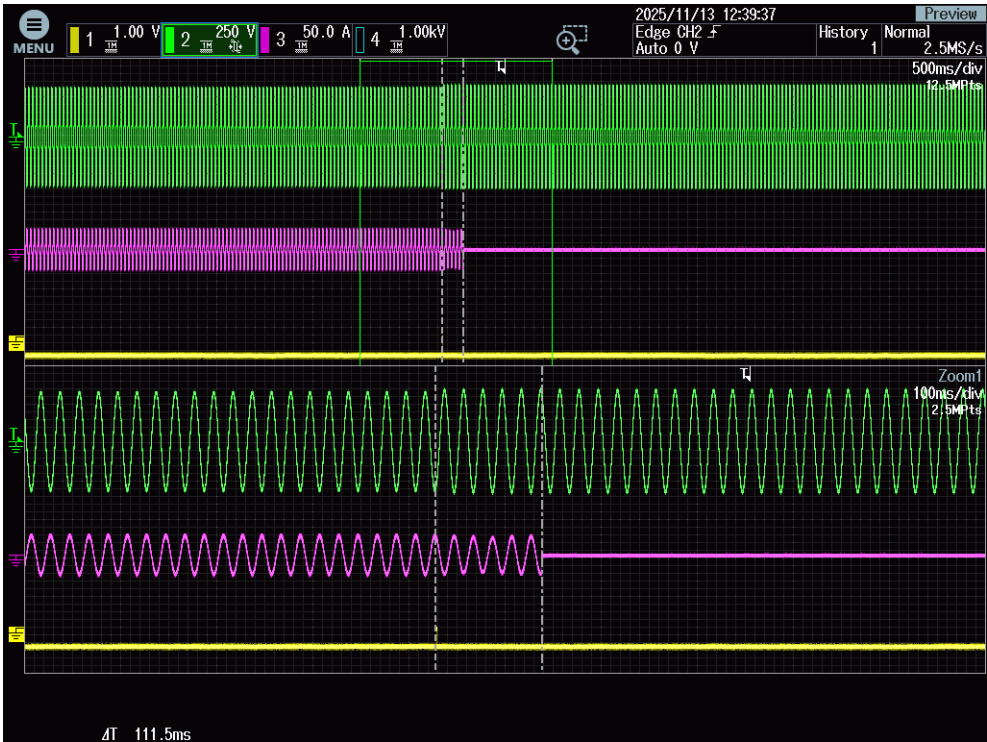
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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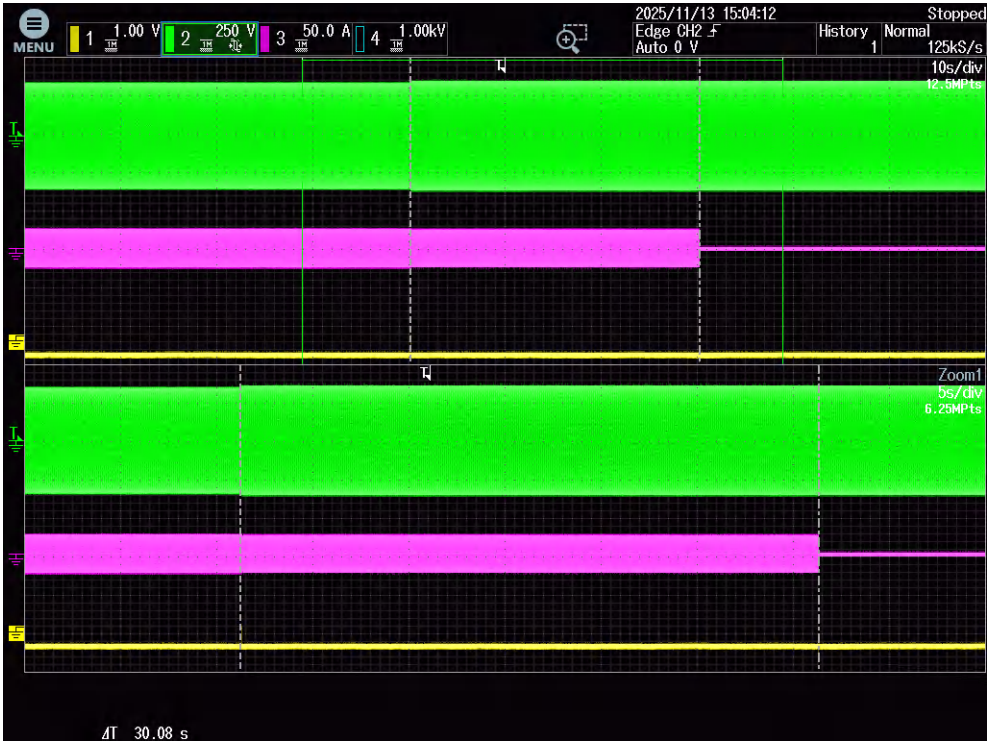
5.8.3.2.3	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U>	100	N/A	112	N/A	N/A	100-200
		N/A	110	N/A	N/A	
		N/A	115	N/A	N/A	
U>	30000	N/A	30080	N/A	N/A	30000-30100
		N/A	30070	N/A	N/A	
		N/A	30050	N/A	N/A	
U>	60000	N/A	60040	N/A	N/A	60000-60100
		N/A	60070	N/A	N/A	
		N/A	60080	N/A	N/A	
U>	100000	N/A	100040	N/A	N/A	100000-100100
		N/A	100030	N/A	N/A	
		N/A	100050	N/A	N/A	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U>	100	N/A	N/A	N/A	100-200	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	30000	N/A	N/A	N/A	30000-30100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	60000	N/A	N/A	N/A	60000-60100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>	100000	N/A	N/A	N/A	100000-100100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Note(s): Jump signal test						

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

Graph of trip time of 100 ms



Graph of trip time of 30000 ms



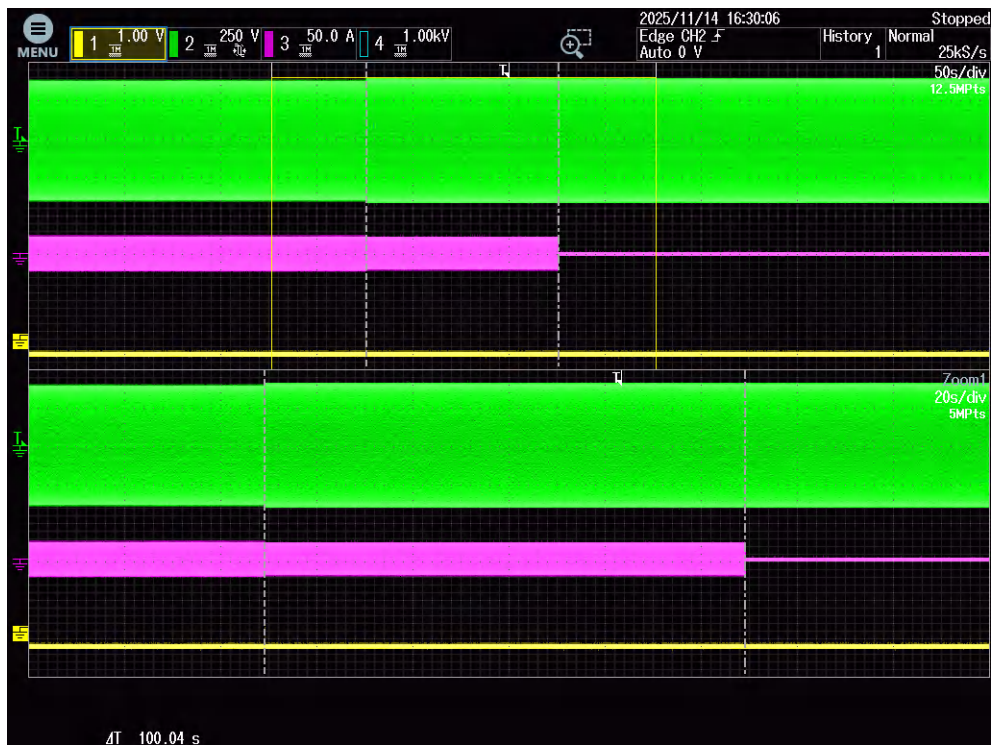
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 60000 ms



Graph of trip time of 100000 ms



EN 50549-10

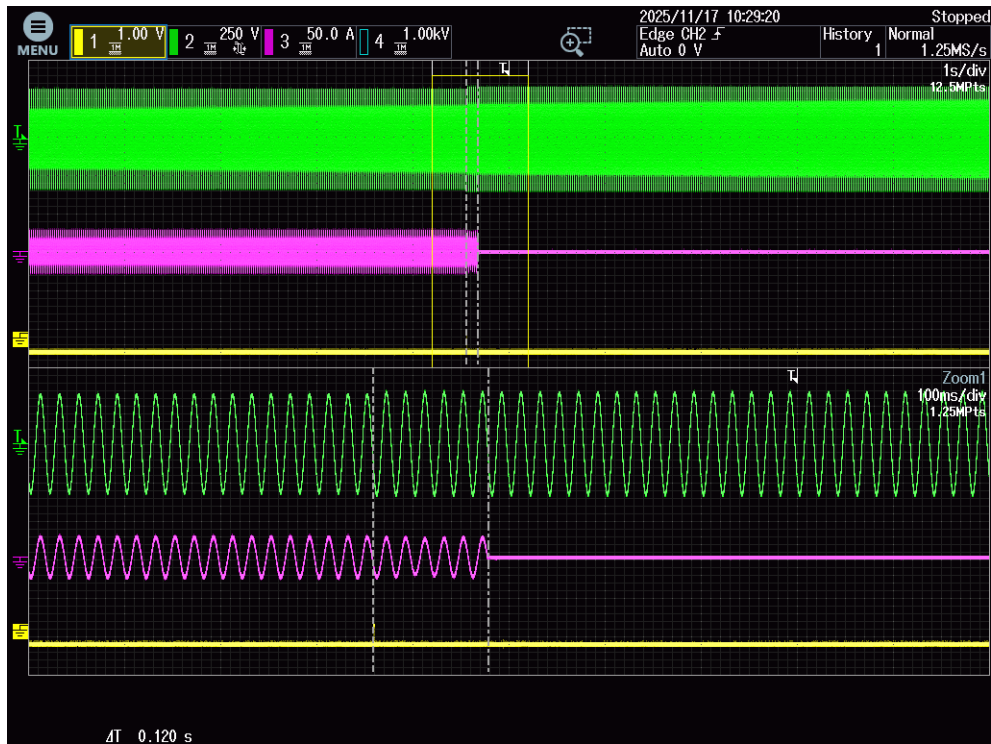
Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.3	TABLE: Interface protection (Voltage protection)					P
Model	SUN-8K-H					
Time measurements:						
Condition	Setting [ms]	Measurement Trip time [ms]				Limitation [ms]
		L123	L1-N	L2-N	L3-N	
U>>	100	N/A	120	N/A	N/A	100-200
		N/A	119	N/A	N/A	
		N/A	117	N/A	N/A	
U>>	1500	N/A	1527	N/A	N/A	1500-1600
		N/A	1537	N/A	N/A	
		N/A	1532	N/A	N/A	
U>>	3000	N/A	3044	N/A	N/A	3000-3100
		N/A	3034	N/A	N/A	
		N/A	3054	N/A	N/A	
U>>	5000	N/A	5044	N/A	N/A	5000-5100
		N/A	5064	N/A	N/A	
		N/A	5034	N/A	N/A	
Condition	Setting [ms]	Measurement Trip time [ms]			Limitation [ms]	
		L1-L2	L2-L3	L3-L1		
U>>	100	N/A	N/A	N/A	100-200	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	1500	N/A	N/A	N/A	1500-1600	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	3000	N/A	N/A	N/A	3000-3100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
U>>	5000	N/A	N/A	N/A	5000-5100	
		N/A	N/A	N/A		
		N/A	N/A	N/A		
Note(s): Jump signal test						

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 100 ms

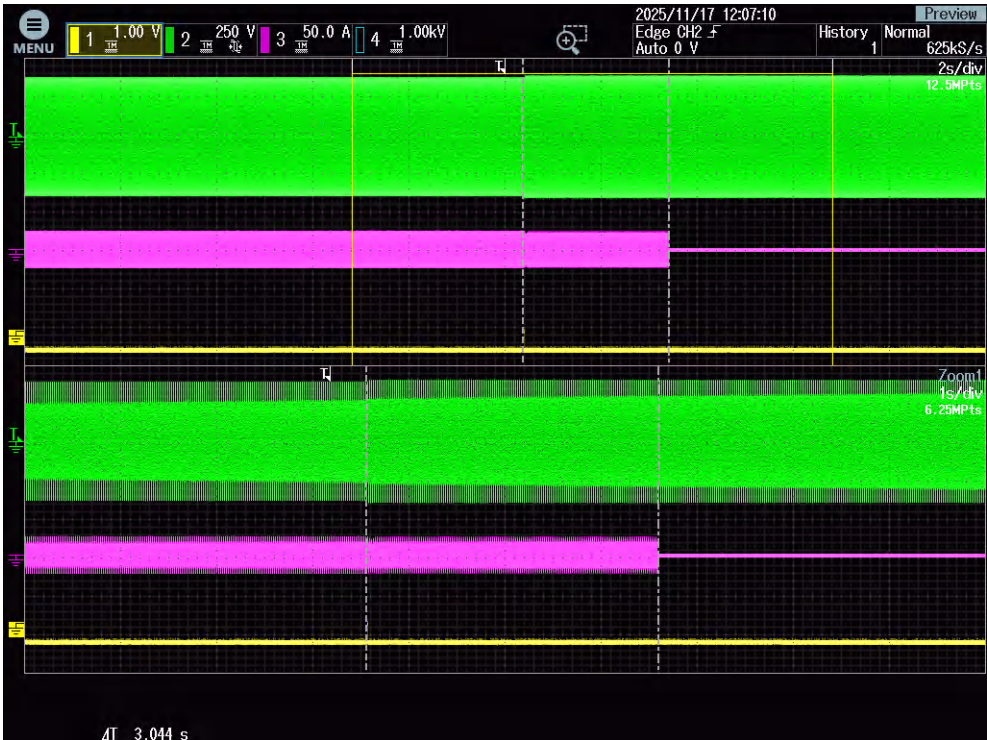


Graph of trip time of 1500 ms

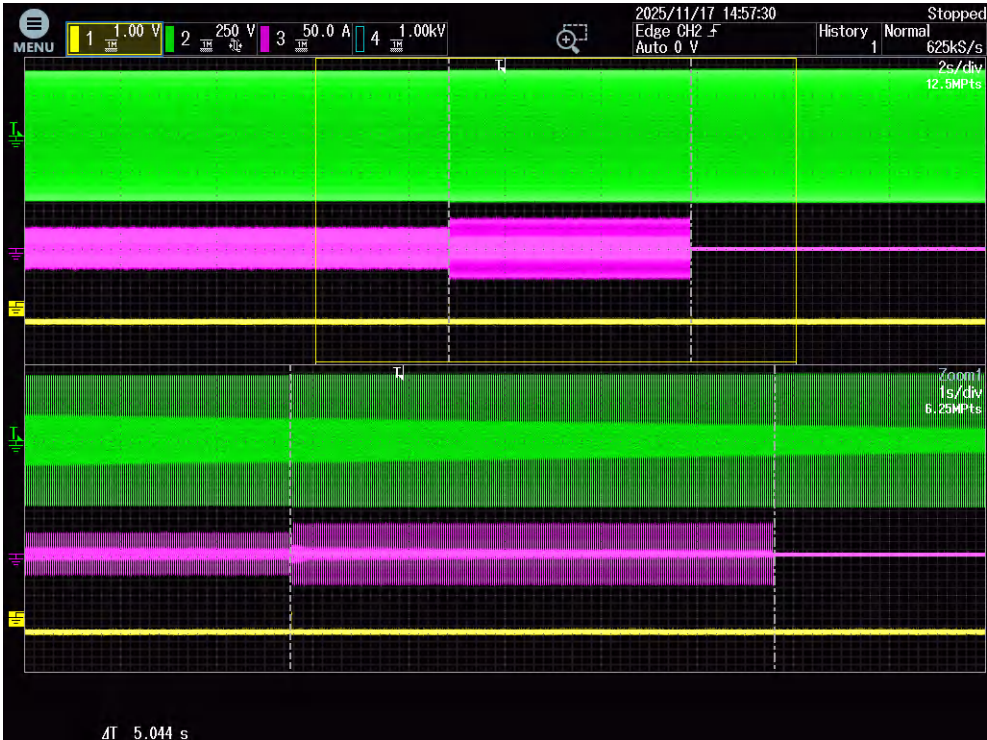


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of trip time of 3000 ms



Graph of trip time of 5000 ms



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Frequency protection)			P
Model	SUN-8K-H			
Accuracy of the setting values:				
Condition	Setting	Measurement Trip value [Hz]		Limitation
F>	50Hz	50.01		± 0.1% of f _n
		50.01		
		50.01		
F>	50.5Hz	50.52		
		50.52		
		50.52		
F>	51.5Hz	51.52		
		51.53		
		51.52		
F>	52Hz	52.02		
		52.02		
		52.03		
Condition	Setting	Measurement Trip value [Hz]		Limitation
F>>	50Hz	50.01		± 0.1% of f _n
		50.01		
		50.01		
F>>	50.5Hz	50.51		
		50.51		
		50.52		
F>>	51.5Hz	51.52		
		51.53		
		51.52		
F>>	52Hz	52.02		
		52.02		
		52.03		
Note(s): Ramp signal test				

EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.2	TABLE: Interface protection (Frequency protection)			P
Model	SUN-8K-H			
Accuracy of the setting values:				
Condition	Setting	Measurement Trip value [Hz]		Limitation
F<	47Hz	47.00		± 0.1% of f _n
		47.00		
		47.00		
F<	48Hz	47.98		
		47.97		
		47.97		
F<	49Hz	48.98		
		48.98		
		48.97		
F<	50Hz	49.98		
		49.97		
		49.97		
Condition	Setting	Measurement Trip value [Hz]		Limitation
F<<	47Hz	46.99		± 0.1% of f _n
		46.98		
		46.99		
F<<	48Hz	47.98		
		47.97		
		47.98		
F<<	49Hz	48.97		
		48.98		
		48.98		
F<<	50Hz	49.97		
		49.97		
		49.97		
Note(s): Ramp signal test				

EN 50549-10

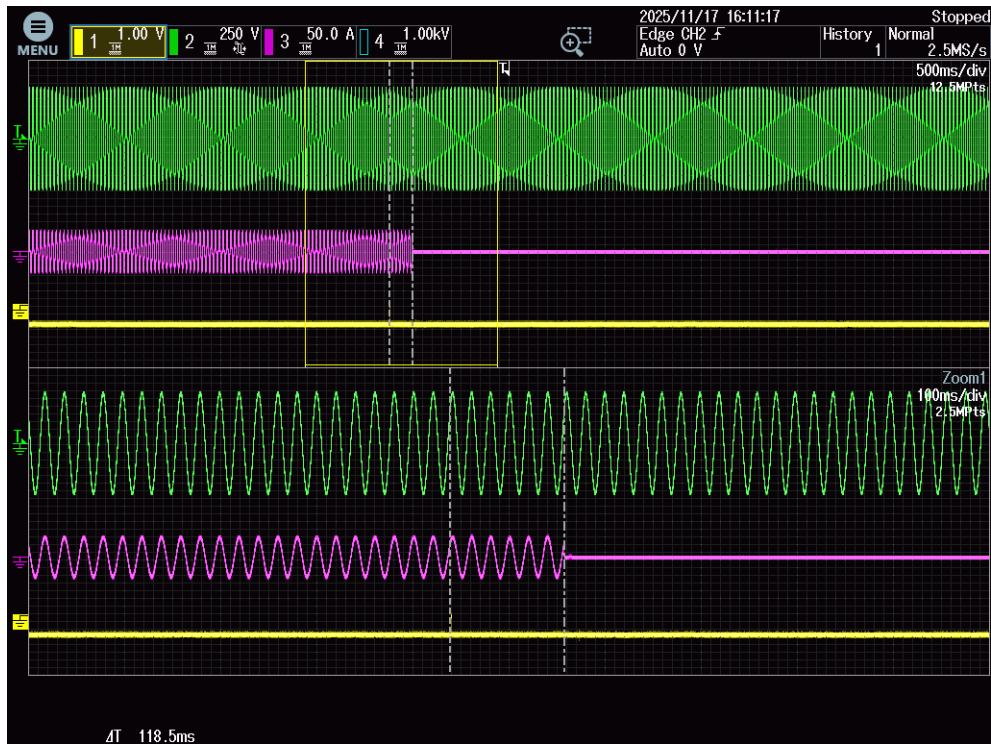
Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.3	TABLE: Interface protection (Frequency protection)			P
Model	SUN-8K-H			
Time measurements:				
Condition	Setting [ms]	Measurement Trip time [ms]		Limitation [ms]
F>	100	119		100-200
		125		
		122		
F>	30000	30080		30000-30100
		30090		
		30050		
F>	60000	60040		60000-60100
		60030		
		60020		
F>	100000	100050		100000-100100
		100080		
		100030		
Condition	Setting [ms]	Measurement Trip time [ms]		Limitation [ms]
F>>	100	173		100-200
		138		
		143		
F>>	1500	1571		1500-1600
		1581		
		1576		
F>>	3000	3040		3000-3100
		3050		
		3041		
F>>	5000	5056		5000-5100
		5076		
		5051		
Note(s): Jump signal test				

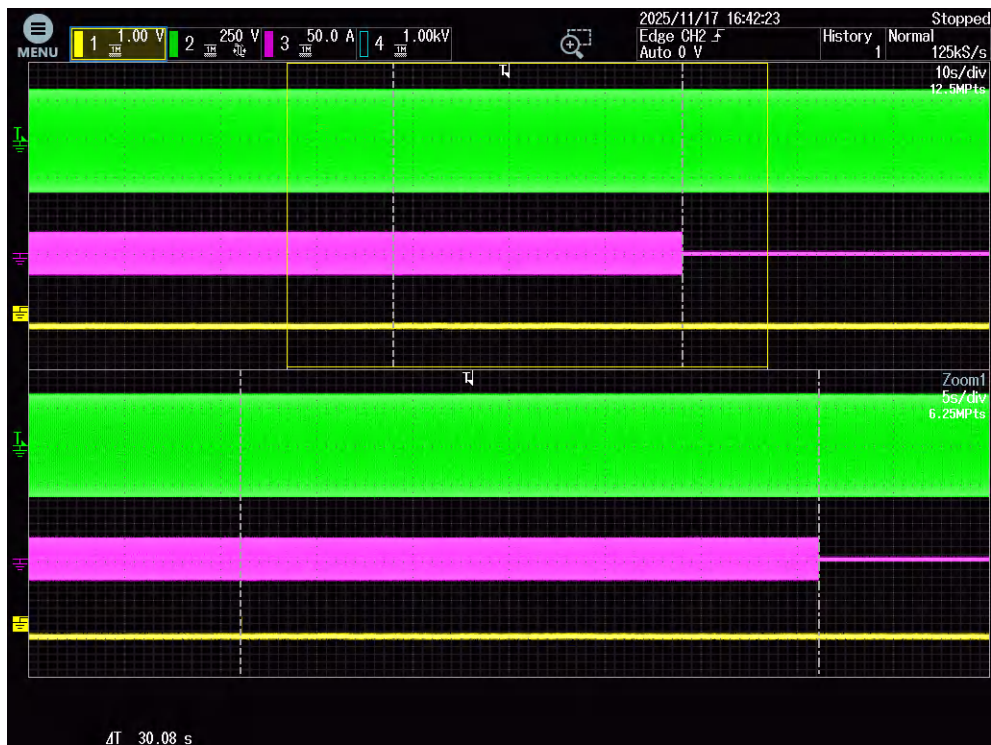
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 100 ms



Graph of trip time of 30000 ms



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

Graph of trip time of 60000 ms



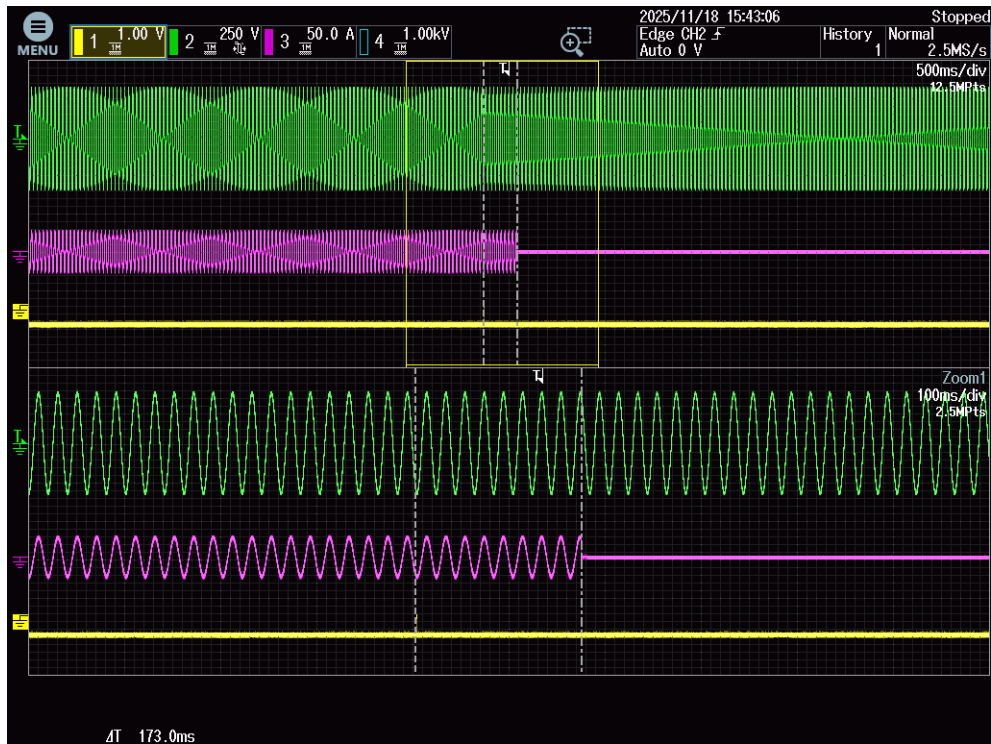
Graph of trip time of 100000 ms



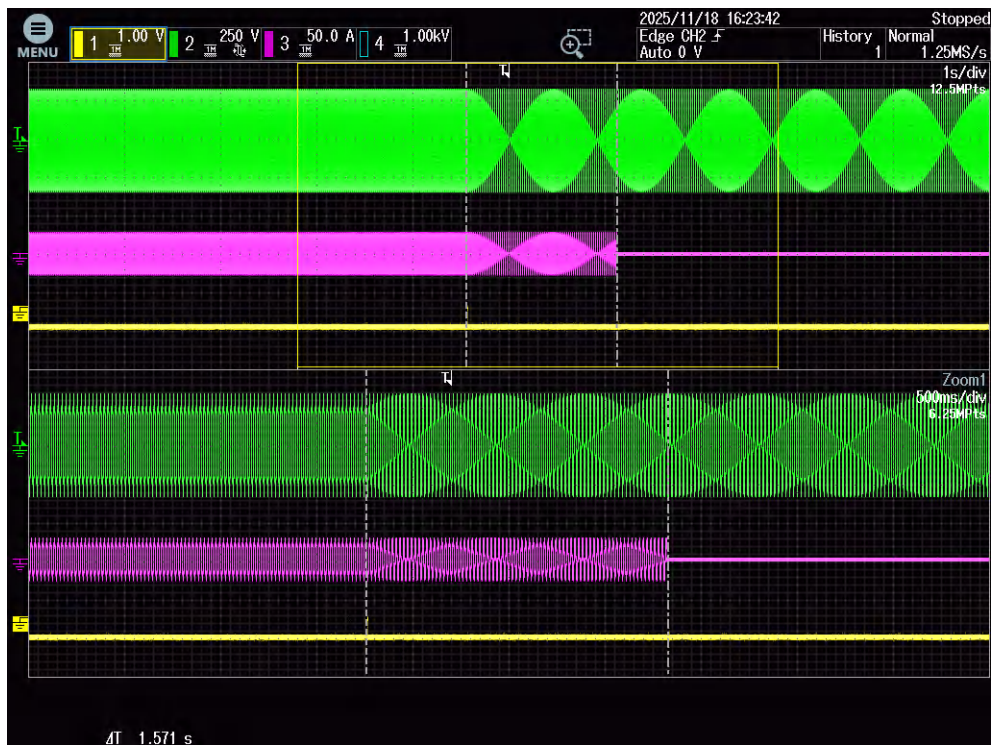
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 100 ms



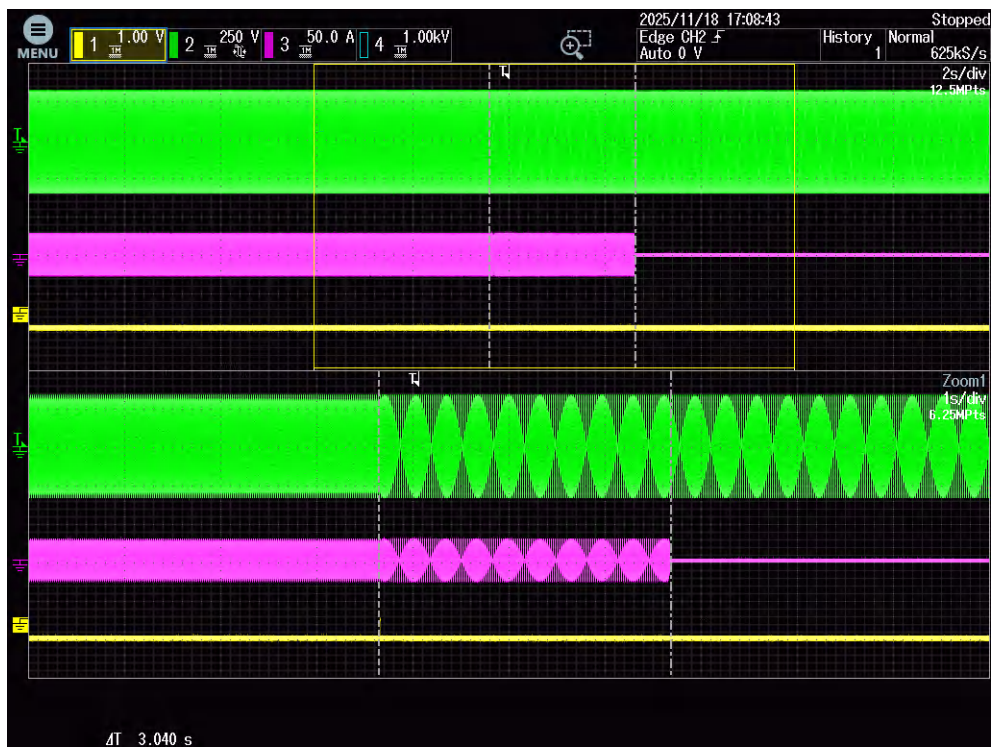
Graph of trip time of 1500 ms



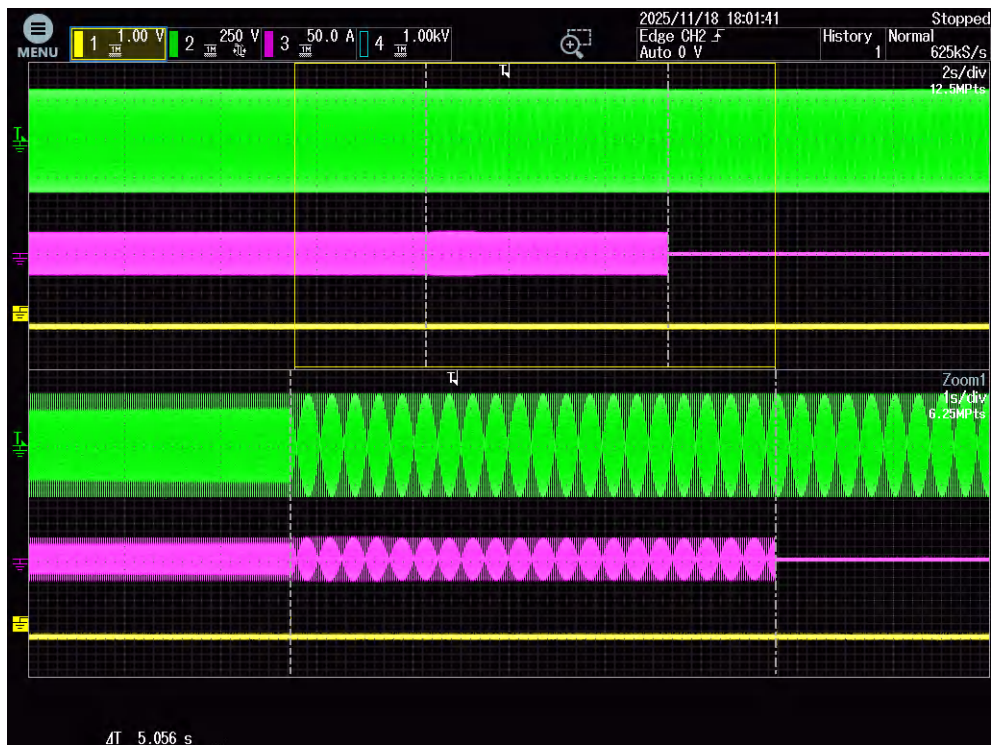
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 3000 ms



Graph of trip time of 5000 ms



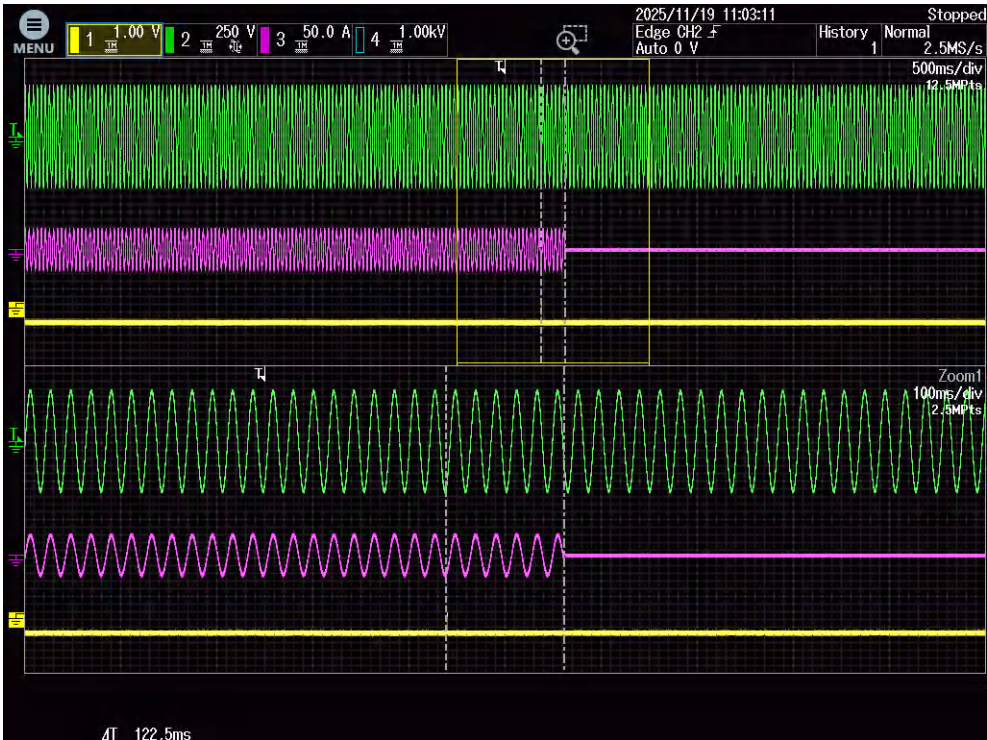
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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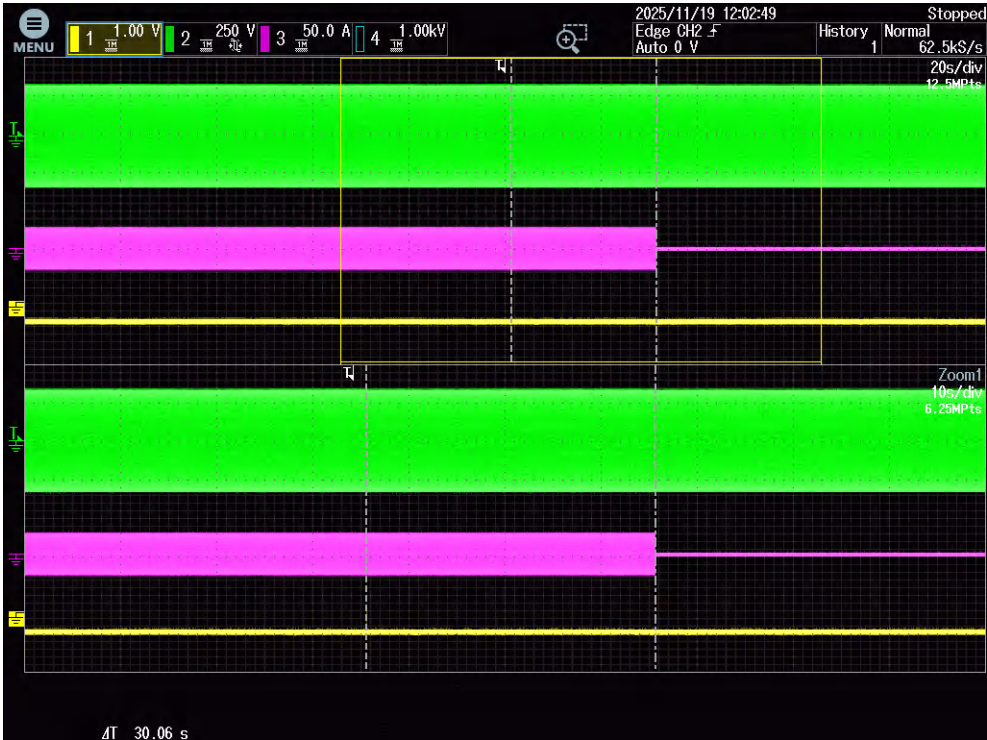
5.8.3.2.3	TABLE: Interface protection (Frequency protection)			P
Model	SUN-8K-H			
Time measurements:				
Condition	Setting [ms]	Measurement Trip time [ms]		Limitation [ms]
F<	100	123		100-200
		124		
		143		
F<	30000	30060		30000-30100
		30070		
		30060		
F<	60000	60060		60000-60100
		60070		
		60050		
F<	100000	100030		100000-100100
		100020		
		100030		
Condition	Setting [ms]	Measurement Trip time [ms]		Limitation [ms]
F<<	100	133		100-200
		131		
		137		
F<<	1500	1535		1500-1600
		1530		
		1540		
F<<	3000	3030		3000-3100
		3035		
		3020		
F<<	5000	5041		5000-5100
		5051		
		5040		
Note(s): Jump signal test				

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

Graph of trip time of 100 ms



Graph of trip time of 30000 ms

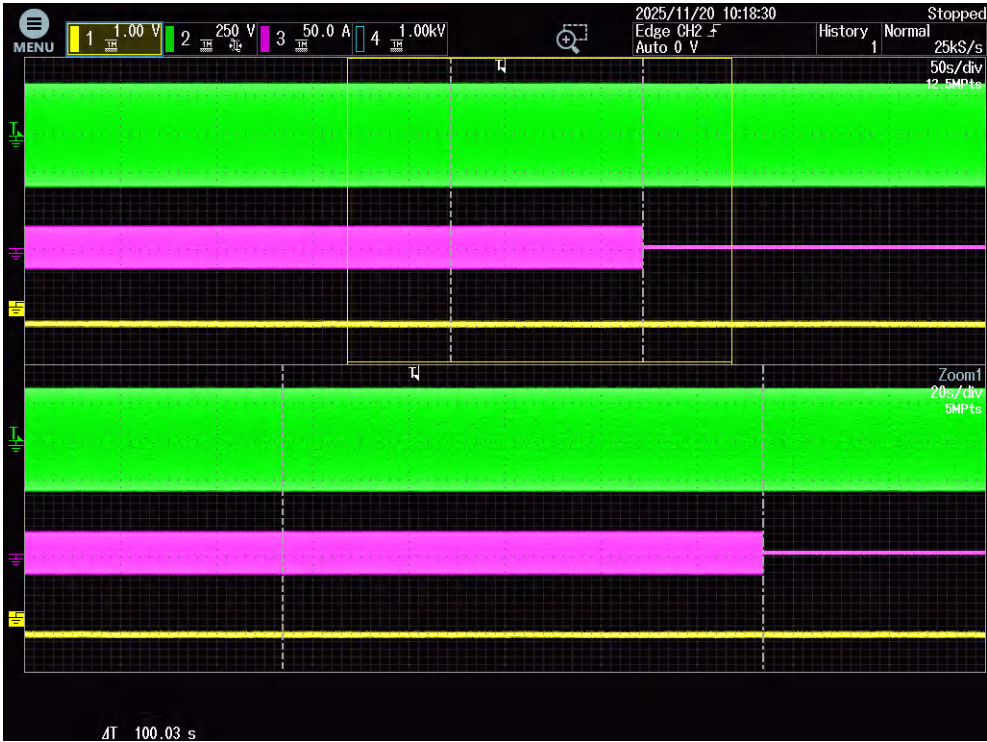


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of trip time of 60000 ms



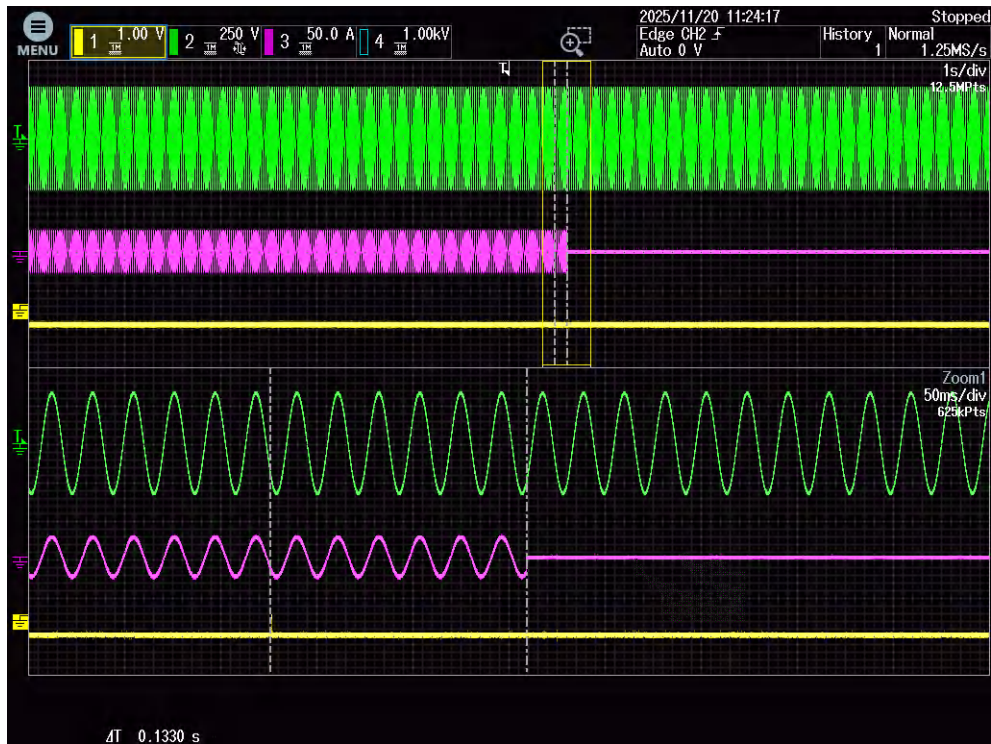
Graph of trip time of 100000 ms



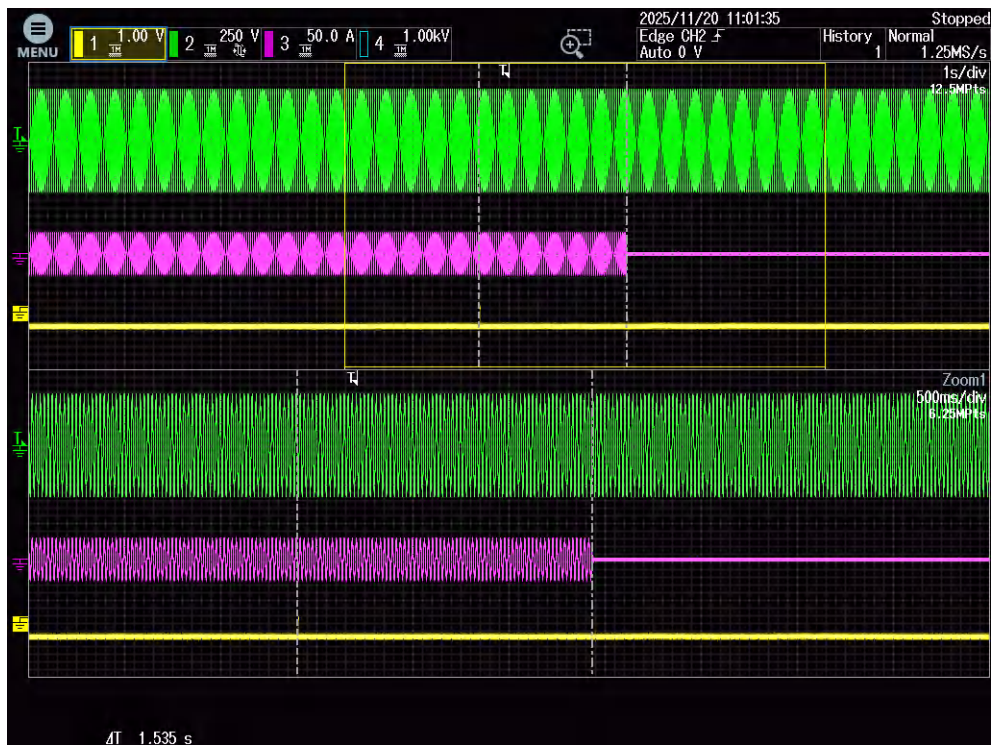
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of trip time of 100 ms

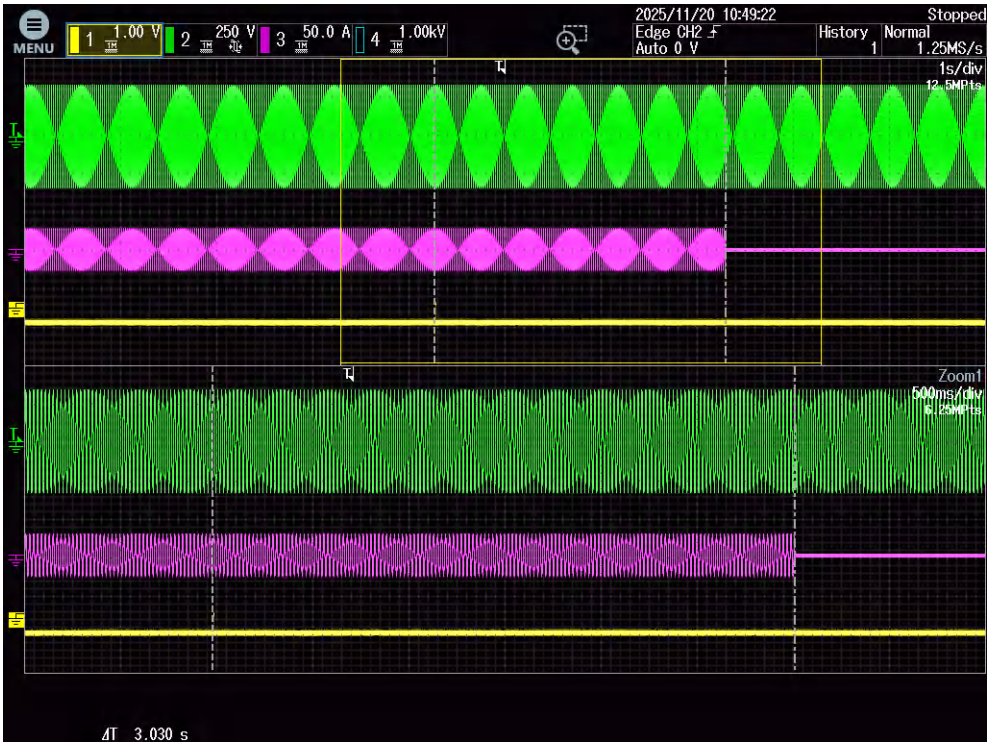


Graph of trip time of 1500 ms

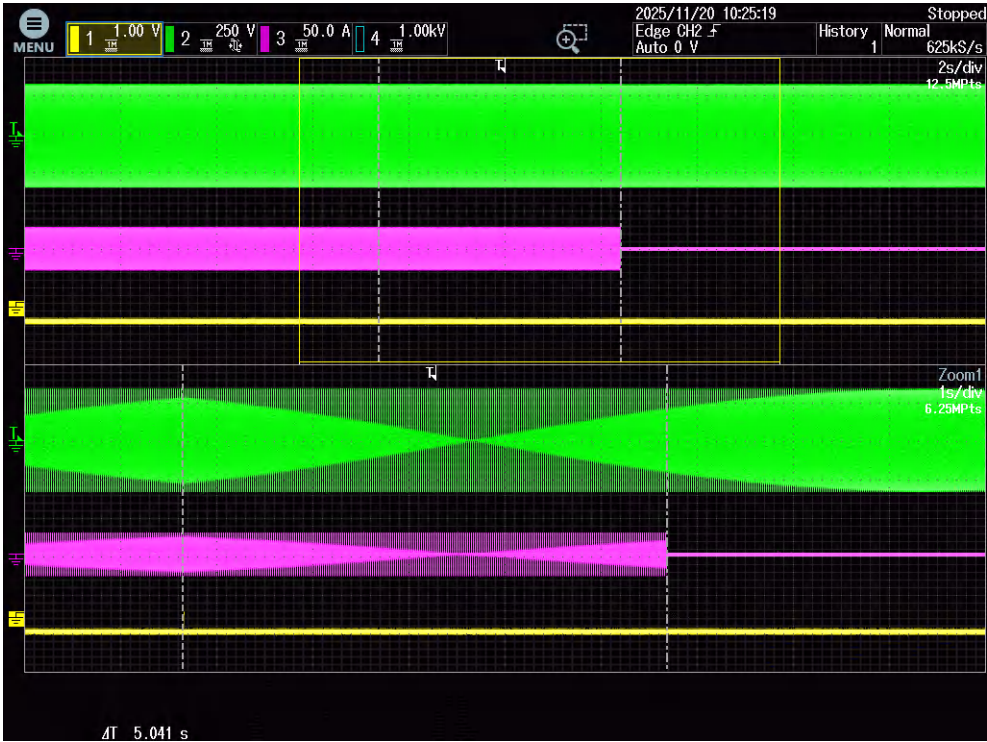


EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of trip time of 3000 ms



Graph of trip time of 5000 ms



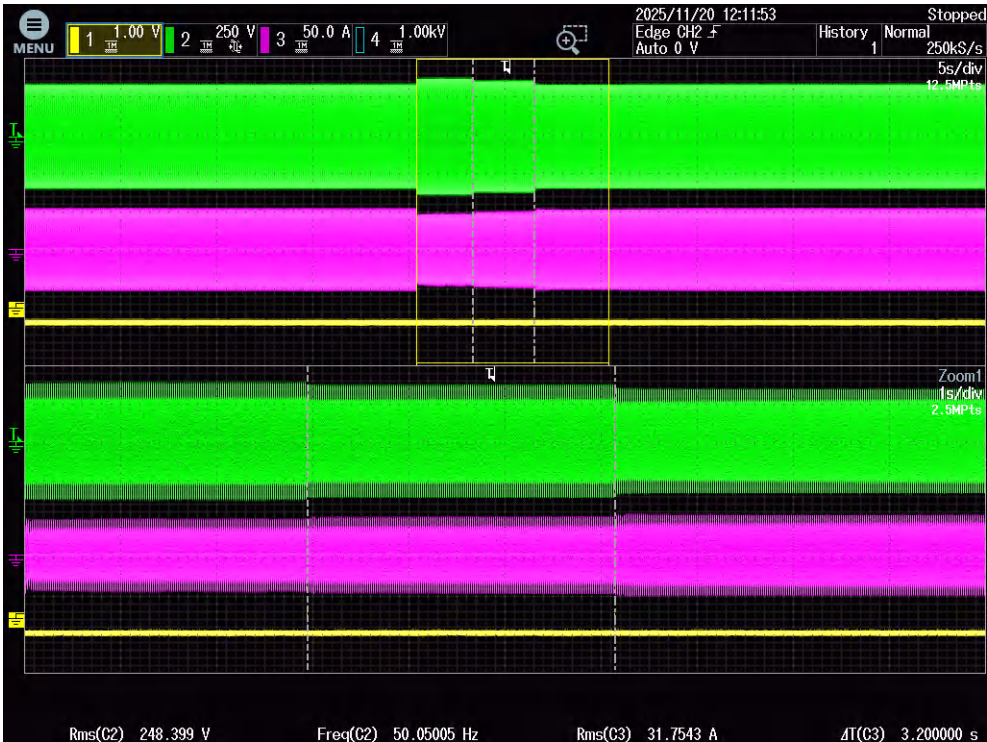
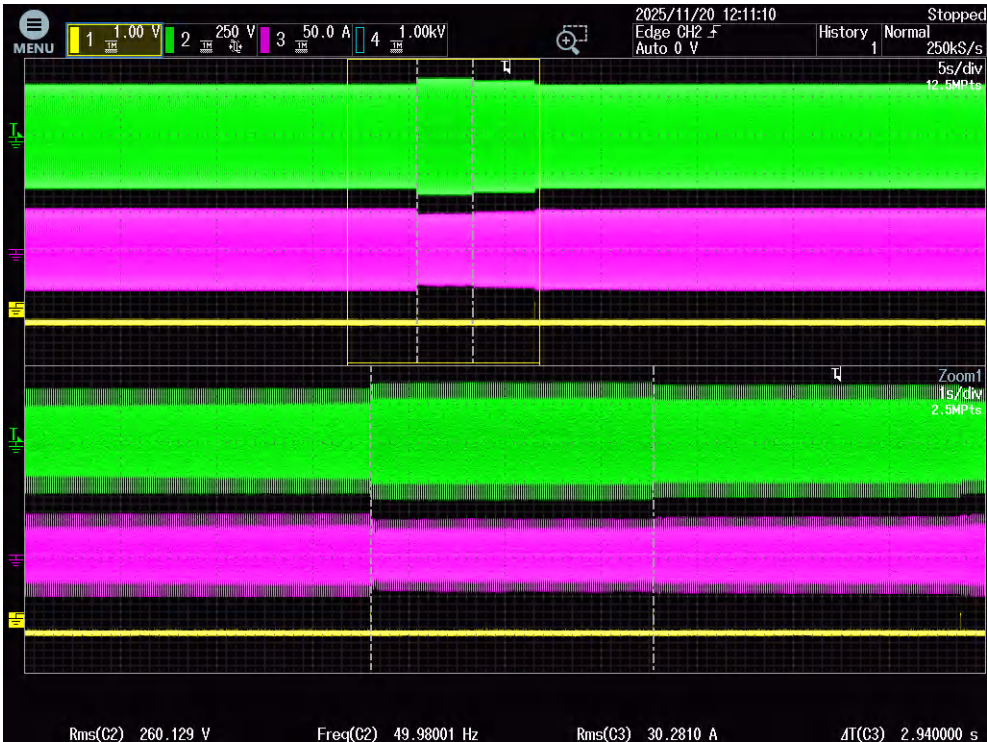
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.2.4	TABLE: Interface protection (Reset time and reset ratio)					P
Model	SUN-8K-H					
Condition	Setting U/Un [ms]	Measurement		Limitation		
		UL-N				
		Reset time	Result	Reset time	Result	
U> Un-1.13Un(2940ms)- 1.08Un(3200ms)-Un	1.1Un/ 3000	50 ms	No trip	≤50ms	No trip	
		50 ms	No trip			
		50 ms	No trip			
U>> Un-1.23Un(40ms)- 1.18Un(300ms)-Un	1.2Un/ 100	50 ms	No trip			
		50 ms	No trip			
		50 ms	No trip			
U< Un-0.87Un(2940ms)- 0.92Un(3200ms)-Un	0.9Un/ 3000	50 ms	No trip			
		50 ms	No trip			
		50 ms	No trip			
U<< Un-0.77Un(40ms)- 0.82Un(300ms)-Un	0.8Un/ 100	50 ms	No trip			
		50 ms	No trip			
		50 ms	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	50 ms	No trip	≤50ms	No trip	
		50 ms	No trip			
		50 ms	No trip			
F<< 50Hz- 48.2Hz(40 ms)- 48.7Hz(300ms)- 50Hz	48.5/ 100	50 ms	No trip			
		50 ms	No trip			
		50 ms	No trip			
F> 50Hz- 50.8Hz(2940ms)- 50.3Hz(3200ms)- 50Hz	50.5/ 3000	50 ms	No trip			
		50 ms	No trip			
		50 ms	No trip			
F>> 50Hz- 51.8Hz(40ms)- 51.3Hz(300ms)- 50Hz	51.5 100	50 ms	No trip			
		50 ms	No trip			
		50 ms	No trip			

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

1.1 Un no trip



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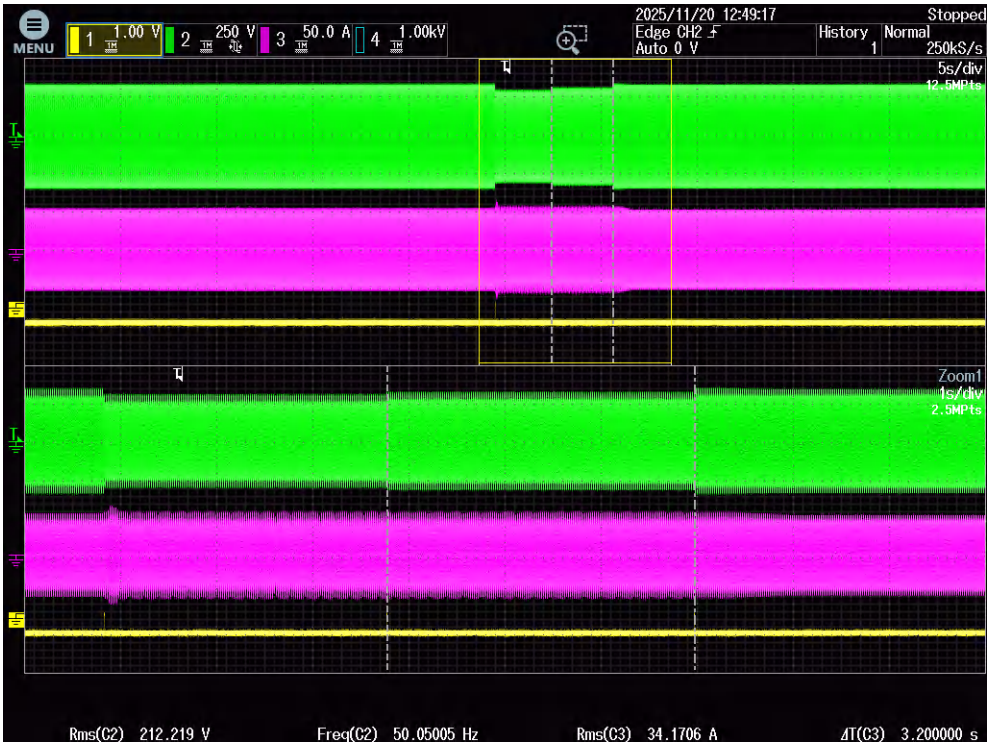
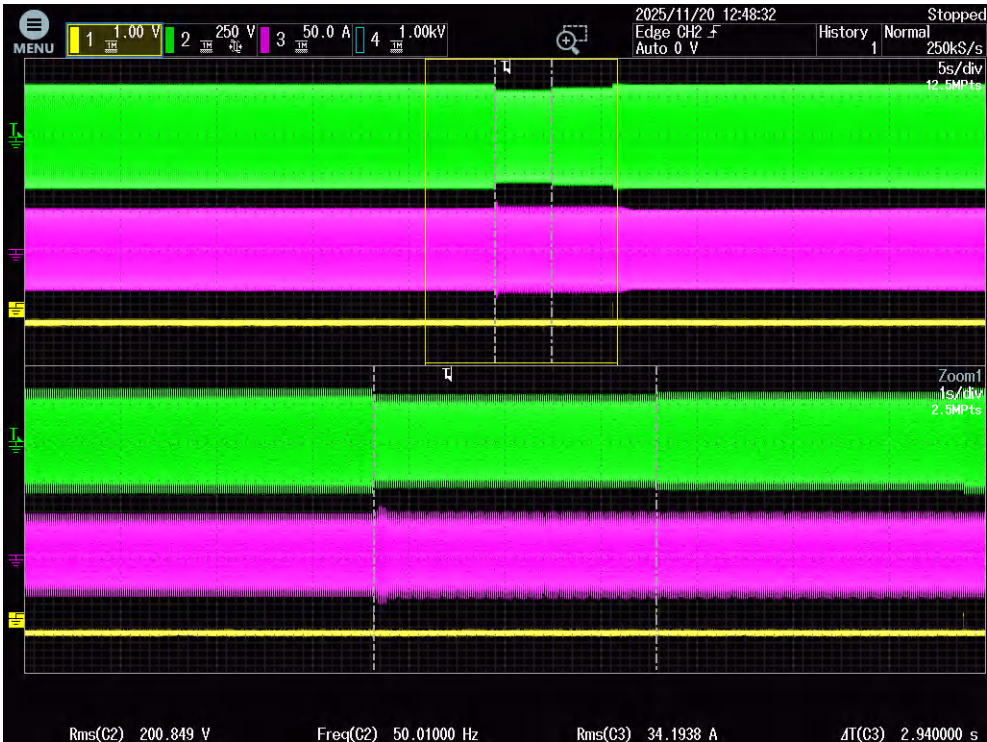
Clause	Requirement - Test	Result - Remark	Verdict
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1.2 Un no trip



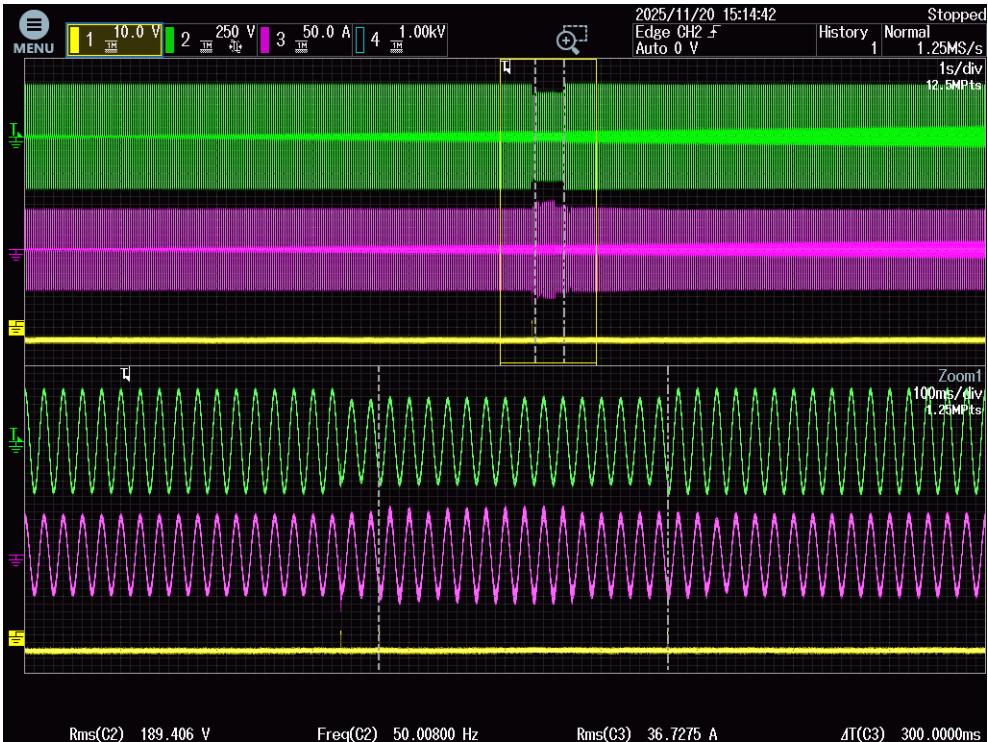
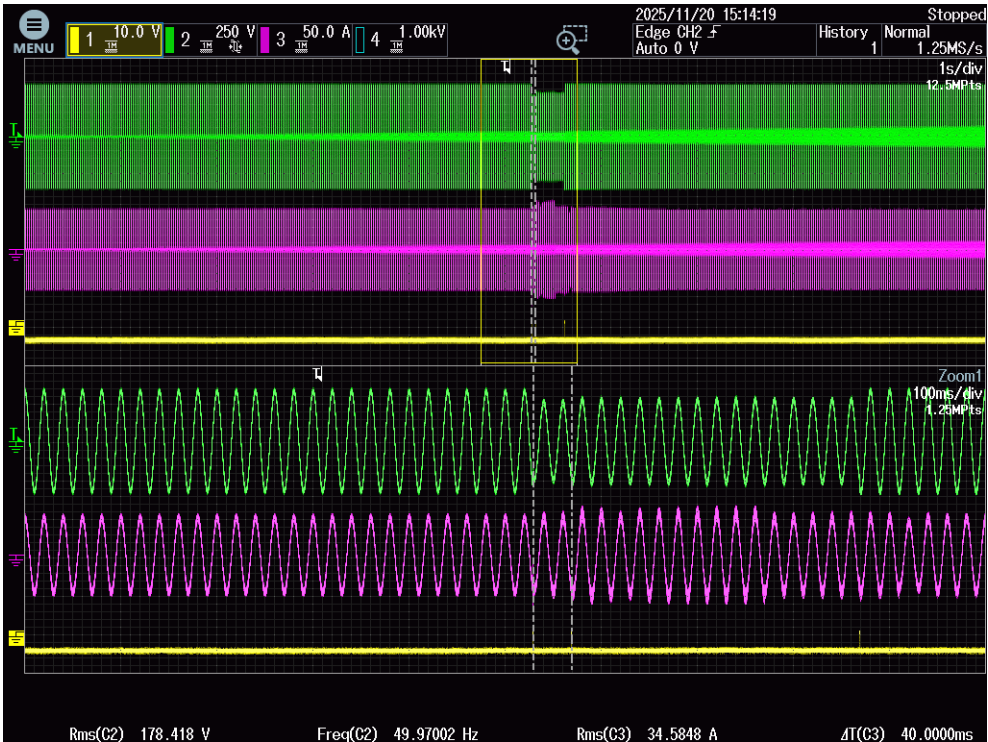
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

0.9 Un no trip



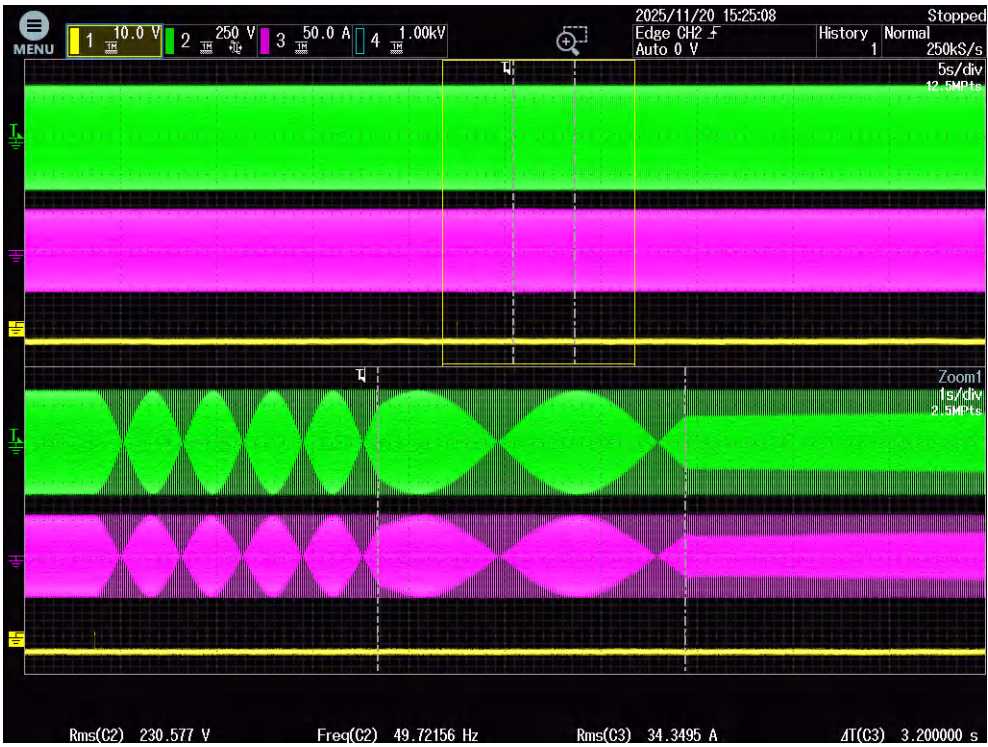
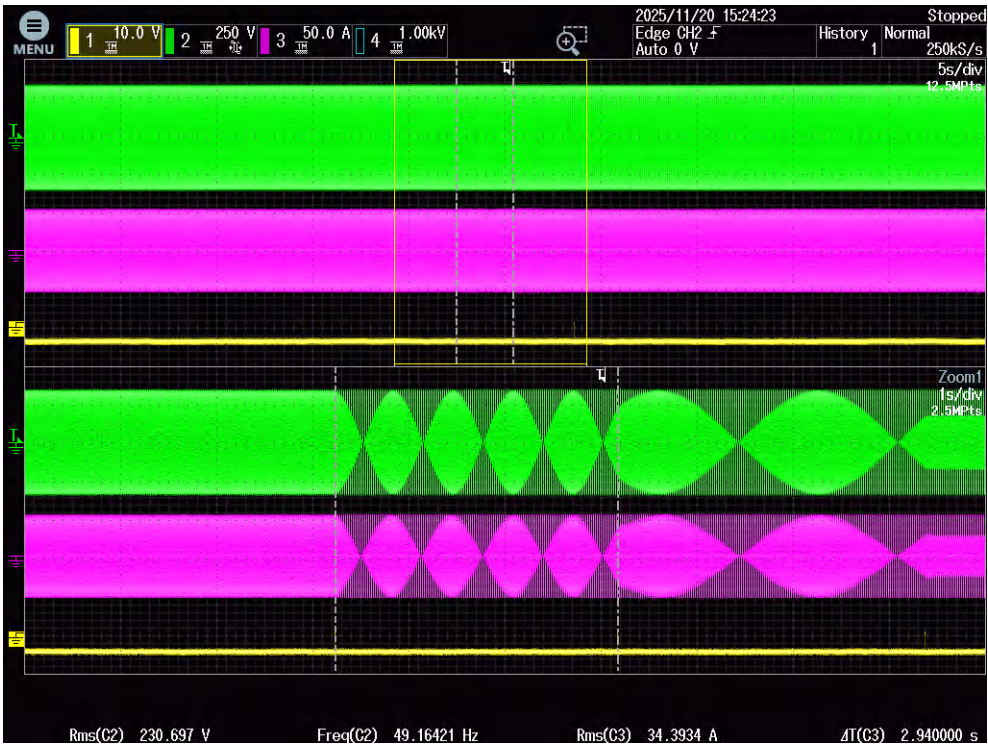
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

0.8 Un no trip



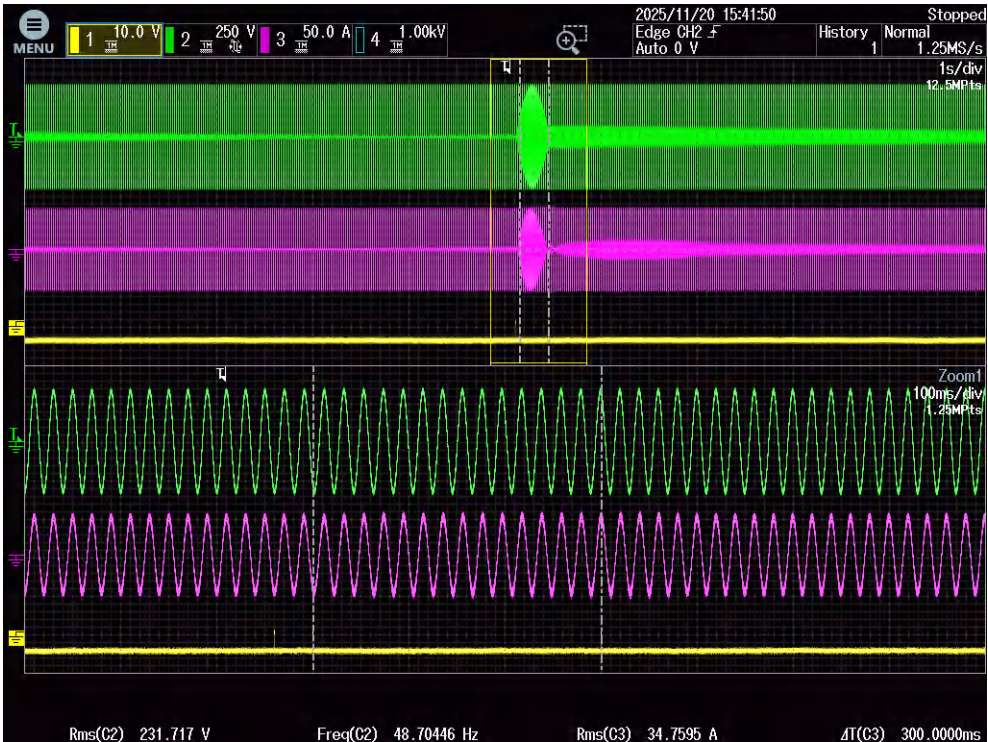
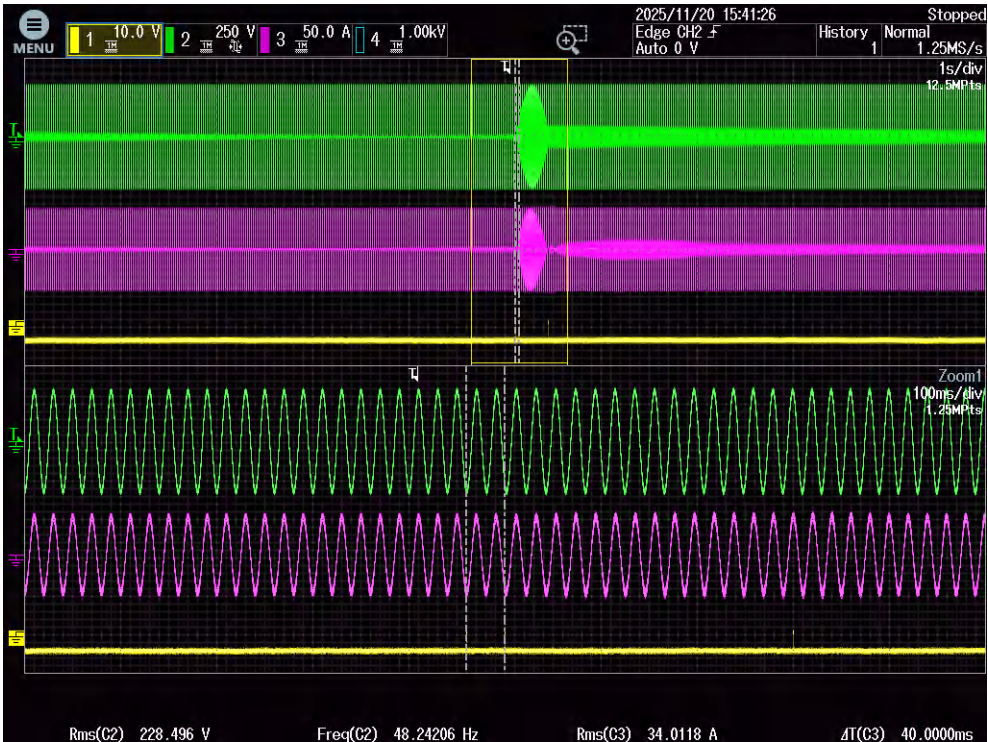
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

49.5 Hz no trip



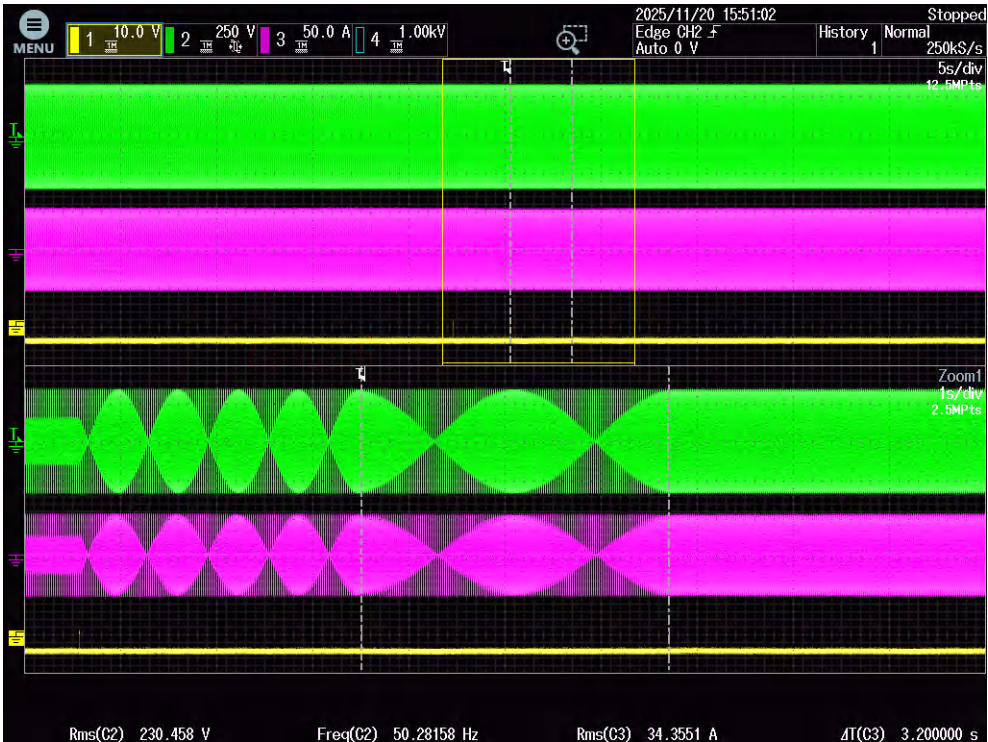
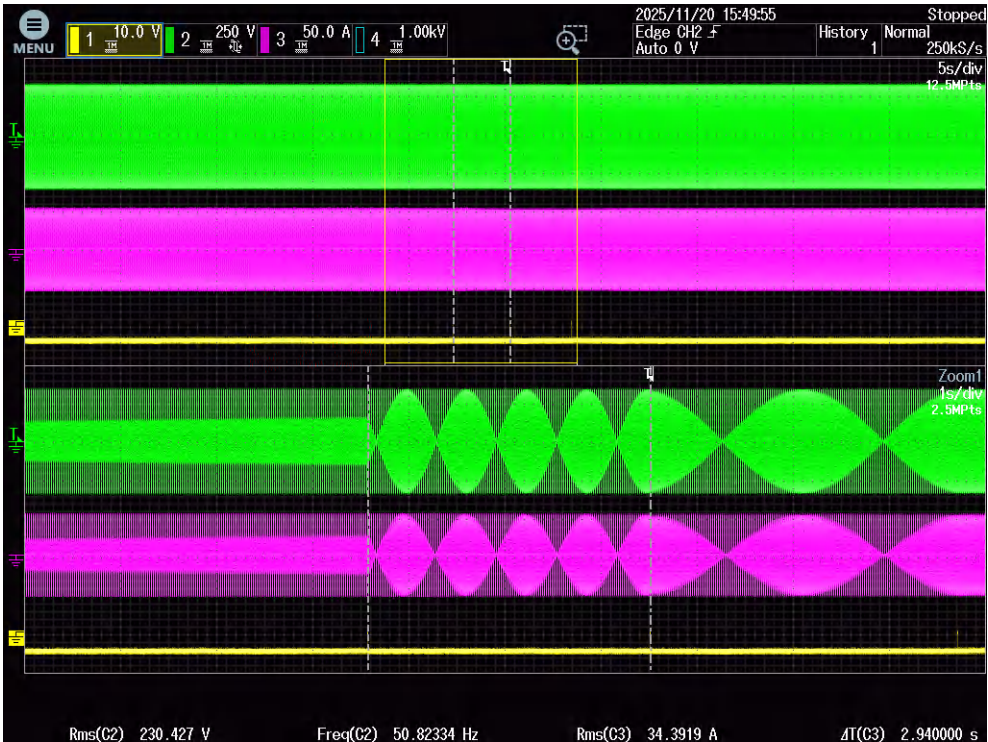
EN 50549-10			
Clause	Requirement - Test	Result - Remark	Verdict

48.5 Hz no trip



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

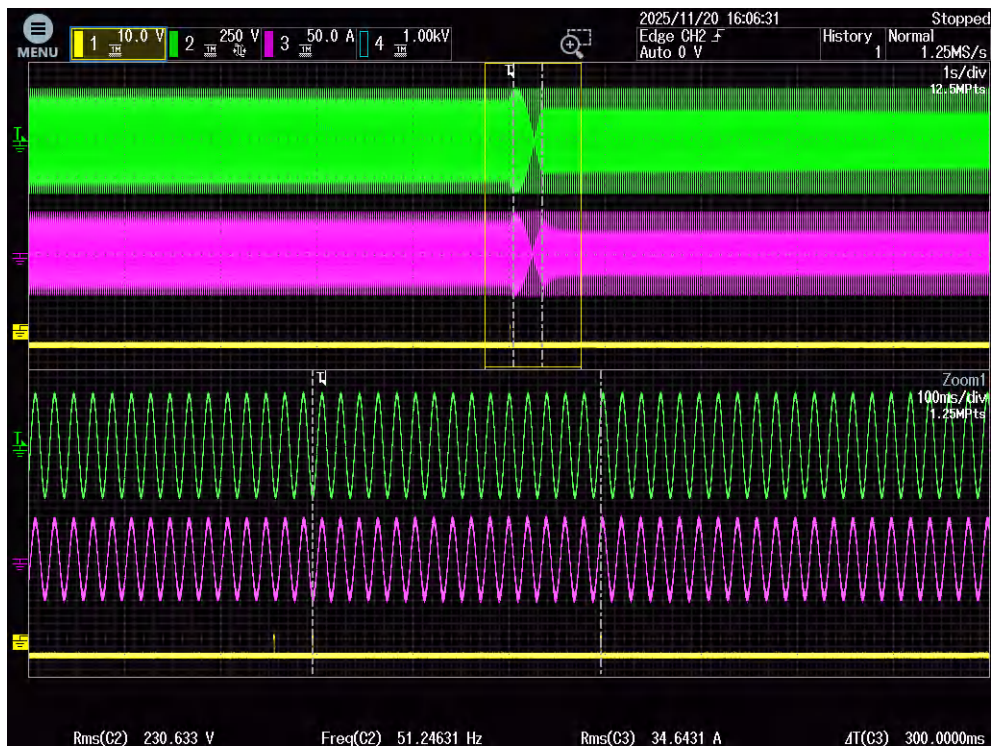
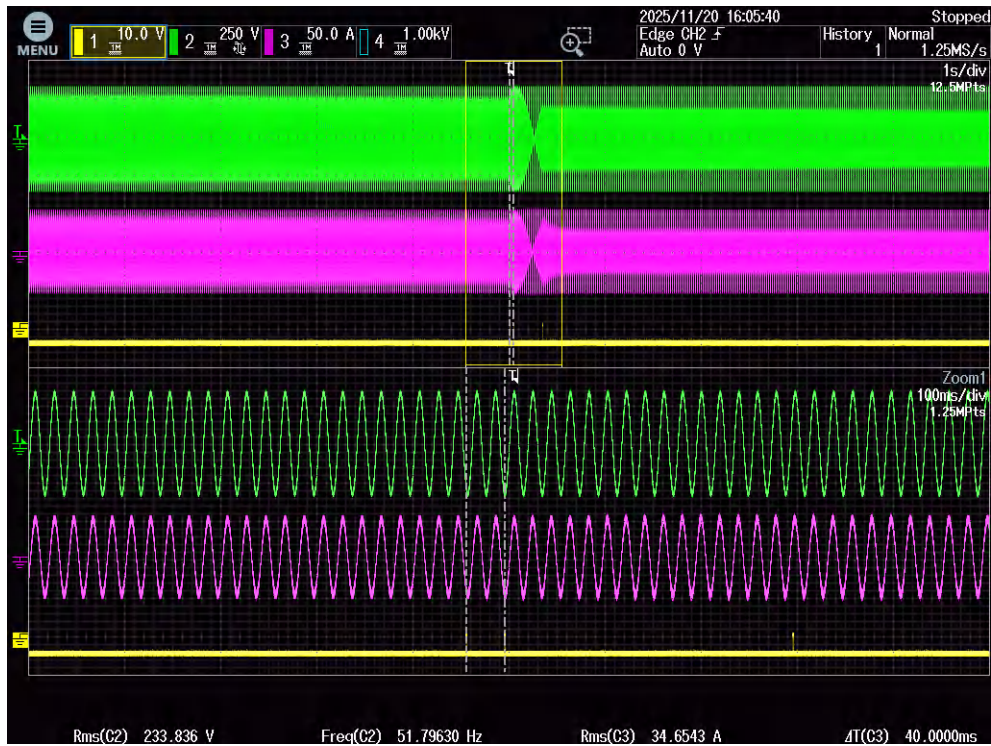
50.5 Hz no trip



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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51.5 Hz no trip



EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.4	TABLE: Interface protection (Immunity to voltage harmonics)			P
Model	SUN-8K-H			
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	50.01		± 0.1% of f _n
		50.01		
		50.01		
F>	50.5Hz	50.52		
		50.52		
		50.52		
F>	51.5Hz	51.52		
		51.53		
		51.52		
F>	52Hz	52.02		
		52.02		
		52.03		
The test item U < 1 shall be repeated under the voltage conditions as described in EN 61000-4-13:20023, Table 8 class 3.				
Condition	Setting	Measurement Trip value [V]		Limitation
U<	20%Un	44.75		± 1% of U _n
		44.70		
		44.31		
U<	45%Un	103.18		
		102.48		
		101.69		
U<	65%Un	148.33		
		149.32		
		148.82		
U<	100%Un	228.18		
		228.20		
		227.90		

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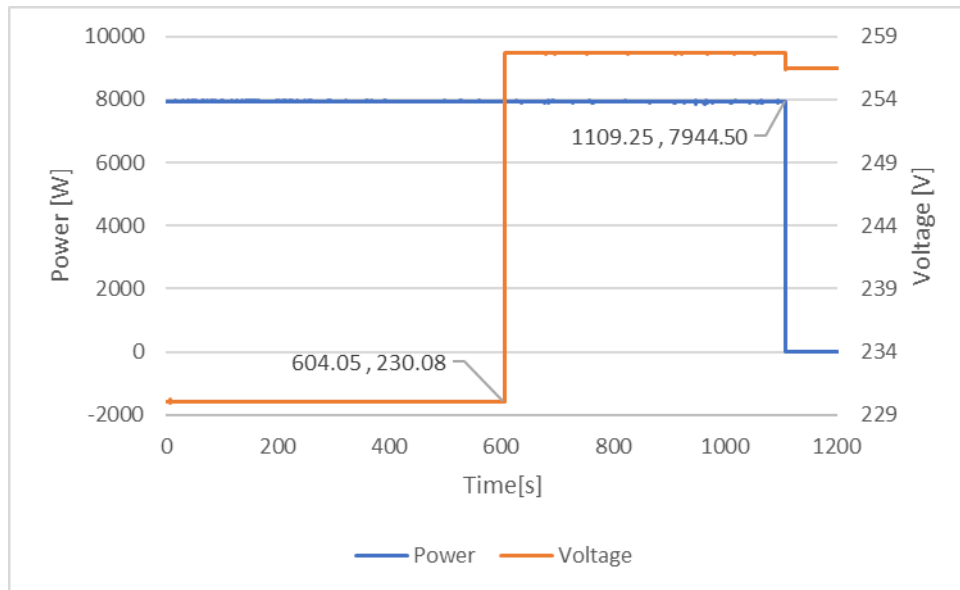
Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.3		Table: Overvoltage 10 min mean protection (OV)		P
Model		SUN-8K-H		
Setting values: U > (59 >)		Setting U > (V):	253	
		Setting T _{disconnection} (s):	600	
Parameter		Measurement (V)	Limit:	
Phase 1		253	110% U _n	
Phase 2		N/A		
Phase 3		N/A		
Parameter		Disconnection time:	Limit:	
a)	The voltage is set to 100% U _n and held for 600 s. Thereafter the voltage is set to 112% U _n . Disconnection must take place within 600 s.			
	UL-N	505.2	450-550s	
b)	The voltage is set to U _n for 600 s and then to 108% U _n for 600 s. No disconnection should take place.			
	UL-N	No disconnection.	Disconnection should not take place.	
c)	The voltage is set to 106% U _n and held for 600 s. Thereafter the voltage is set to 114% U _n . Disconnection must take place within 300 s or about 50% of the disconnection time measured in point a)*			
	UL1-N	275.2	The disconnection time should be about 50% of the value measured in a). *	
	UL2-N	N/A		
	UL3-N	N/A		
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.				

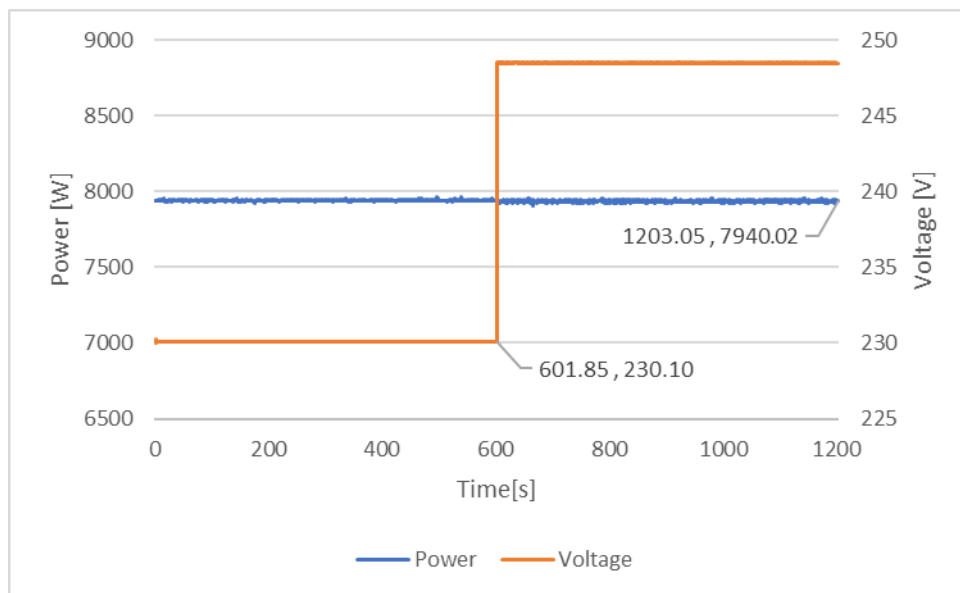
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of disconnection at (a)



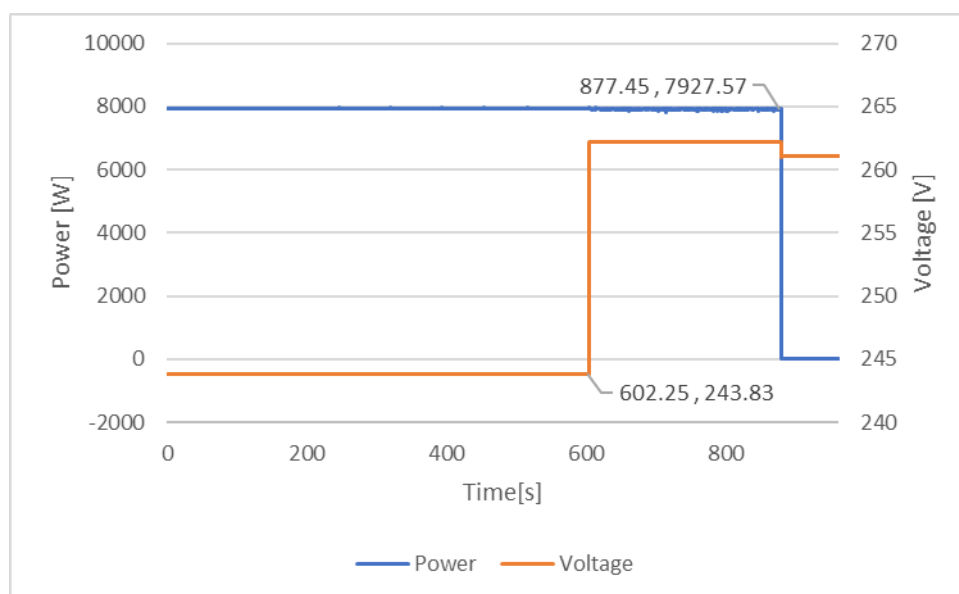
Graph of disconnection at (b)



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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of disconnection at (c)



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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.3.4	Table: ROCOF protection						P
Model	SUN-8K-H						
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	49.05	1.9	50.95	1.0 s	No Disconnection	Disconnection should not take place.
RVAL POS 2	Increase	48.95	2.1	51.05	1.0 s	0.62 s	<1s
RVAL NEG 1	Decrease	50.95	1.9	49.05	1.0 s	No Disconnection	Disconnection should not take place.
RVAI NEG 2	Decrease	51.05	2.1	48.95	1.0 s	0.62 s	<1s

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Clause	Requirement - Test	Result - Remark	Verdict
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5.8.6		Table: Islanding detection (According to EN 62116)							P
Model		SUN-8K-H							
Test condtion 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} (kW)	Actual Q _f	V _{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	100	100	0	0	237	8.0	1.002	450	BL ^{d)}
2	100	100	-5	-5	143	8.0	0.976	450	IB ^{d)} /
3	100	100	-5	0	204	8.0	0.952	450	IB ^{d)} /
4	100	100	-5	+5	148	8.0	0.935	450	IB ^{d)} /
5	100	100	0	-5	150	8.0	1.024	450	IB ^{d)} /
6	100	100	0	+5	168	8.0	0.974	450	IB ^{d)} /
7	100	100	+5	-5	167	8.0	1.080	450	IB ^{d)} /
8	100	100	+5	0	188	8.0	1.060	450	IB ^{d)} /
9	100	100	+5	+5	140	8.0	1.027	450	IB ^{d)} /
10	100	100	5	+10	237	8.0	1.002	450	IB ^{d)} /
11	100	100	-5	+10	143	8.0	0.976	450	IB ^{d)} /
12	100	100	0	+10	204	8.0	0.952	450	IB ^{d)} /
13	100	100	+10	+10	--	--	--	--	IB ^{d)} /
14	100	100	+10	+5	--	--	--	--	IB ^{d)} /
15	100	100	+10	0	--	--	--	--	IB ^{d)} /
16	100	100	+10	-5	--	--	--	--	IB ^{d)} /
17	100	100	+10	-10	--	--	--	--	IB ^{d)} /
18	100	100	+5	-10	--	--	--	--	IB ^{d)} /
19	100	100	0	-10	--	--	--	--	IB ^{d)} /
20	100	100	-5	-10	--	--	--	--	IB ^{d)} /
21	100	100	-10	-10	--	--	--	--	IB ^{d)} /
22	100	100	-10	-5	--	--	--	--	IB ^{d)} /
23	100	100	-10	0	--	--	--	--	IB ^{d)} /
24	100	100	-10	+5	--	--	--	--	IB ^{d)} /
25	100	100	-10	+10	--	--	--	--	IB ^{d)} /

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Clause	Requirement - Test	Result - Remark	Verdict
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Test condition B (EUT output $P/P_n = 50$ to 66%)

No.	P_{EUT} (% of EUT rating)	Reactive load (% of nominal (BL*))	P_{AC}	Q_{AC}	Run-on time (ms)	P_{EUT} (kW)	Actual Q_f	V_{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	66	66	0	- 5	134	5.3	1.027	300	IB ^{d)} /
2	66	66	0	- 4	156	5.3	1.020	300	IB ^{d)} /
3	66	66	0	- 3	158	5.3	1.018	300	IB ^{d)} /
4	66	66	0	- 2	169	5.3	1.007	300	IB ^{d)} /
5	66	66	0	- 1	170	5.3	1.000	300	IB ^{d)} /
6	66	66	0	0	276	5.3	1.000	300	BL ^{d)}
7	66	66	0	+ 1	222	5.3	0.997	300	IB ^{d)} /
8	66	66	0	+ 2	221	5.3	0.990	300	IB ^{d)} /
9	66	66	0	+ 3	190	5.3	0.986	300	IB ^{d)} /
10	66	66	0	+ 4	160	5.3	0.950	300	IB ^{d)} /
11	66	66	0	+ 5	142	5.3	0.973	300	IB ^{d)} /

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

No.	P_{EUT} (% of EUT rating)	Reactive load (% of nominal (BL*))	P_{AC}	Q_{AC}	Run-on time (ms)	P_{EUT} (kW)	Actual Q_f	V_{DC} (V)	Which load is selected to be adjusted (R, L, or C)
1	33	33	0	- 5	144	2.6	1.031	170	IB ^{d)} /
2	33	33	0	- 4	156	2.6	1.014	170	IB ^{d)} /
3	33	33	0	- 3	168	2.6	1.014	170	IB ^{d)} /
4	33	33	0	- 2	167	2.6	1.011	170	IB ^{d)} /
5	33	33	0	- 1	177	2.6	0.994	170	IB ^{d)} /
6	33	33	0	0	377	2.6	1.000	170	BL ^{d)}
7	33	33	0	+ 1	211	2.6	0.994	170	IB ^{d)} /
8	33	33	0	+ 2	210	2.6	0.991	170	IB ^{d)} /
9	33	33	0	+ 3	195	2.6	0.983	170	IB ^{d)} /
10	33	33	0	+ 4	193	2.6	0.980	170	IB ^{d)} /
11	33	33	0	+ 5	149	2.6	0.974	170	IB ^{d)} /

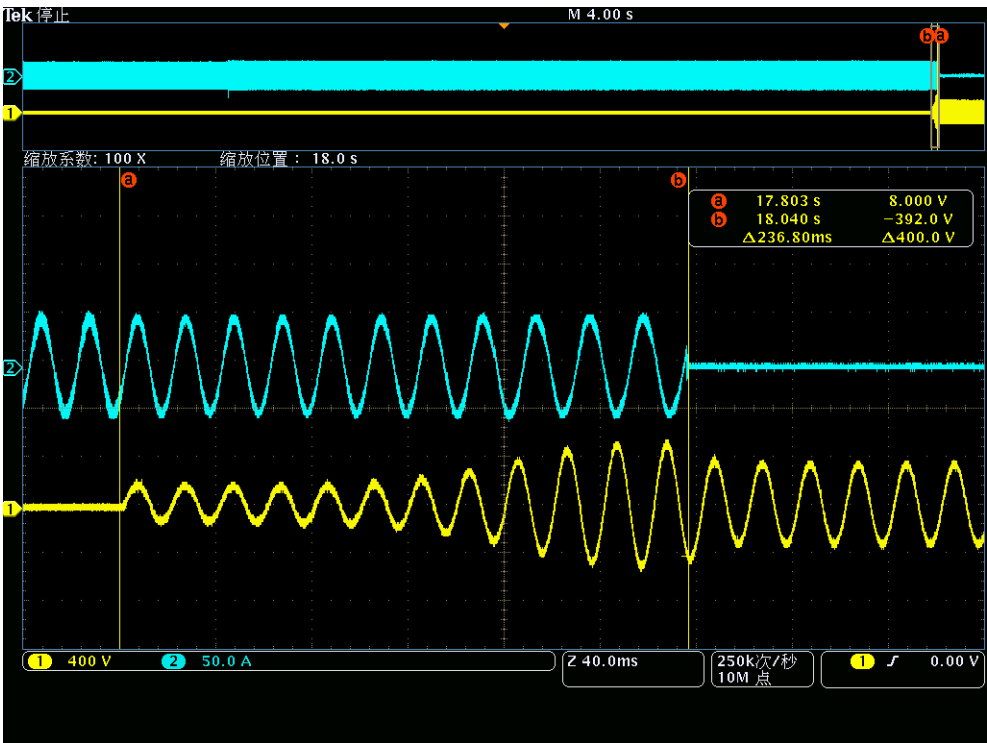
Note:

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.

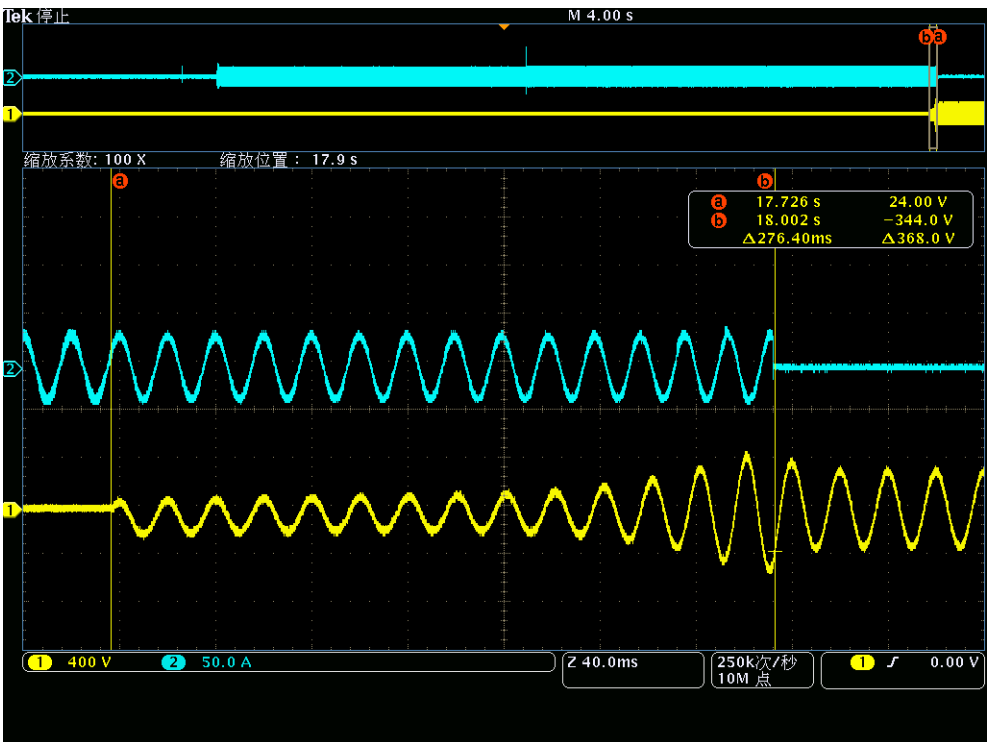
d) BL: Balance condition, IB: Imbalance condition.

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Clause	Requirement - Test	Result - Remark	Verdict

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

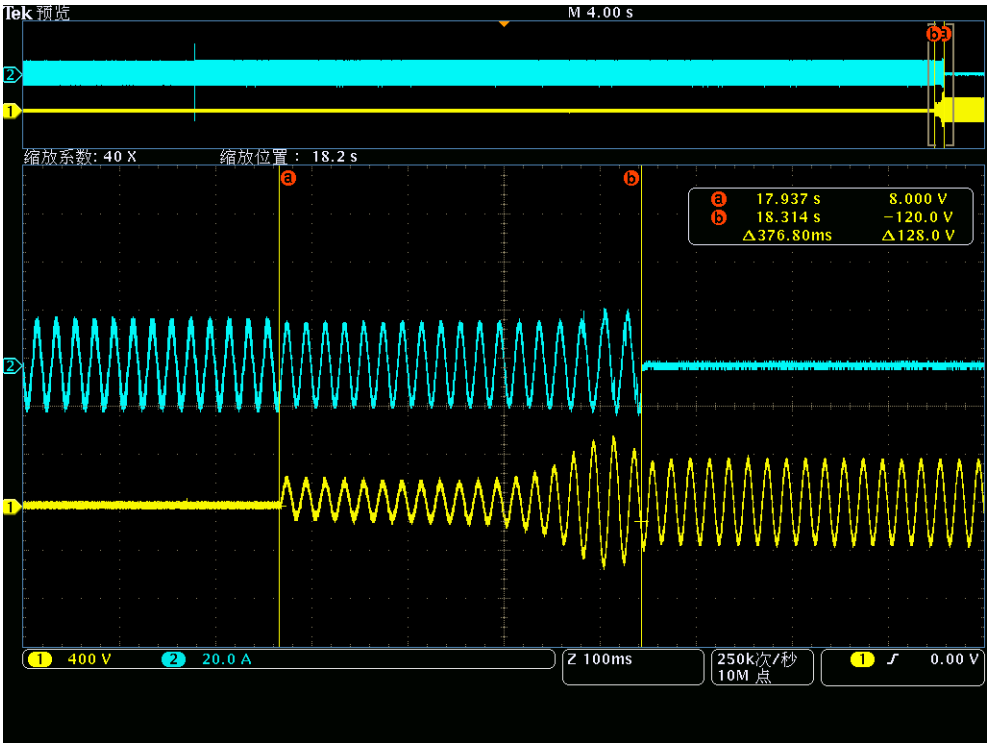


Graph of disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 50 to 66% nominal power



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Clause	Requirement - Test	Result - Remark	Verdict

Graph of disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 25 to 33% nominal power



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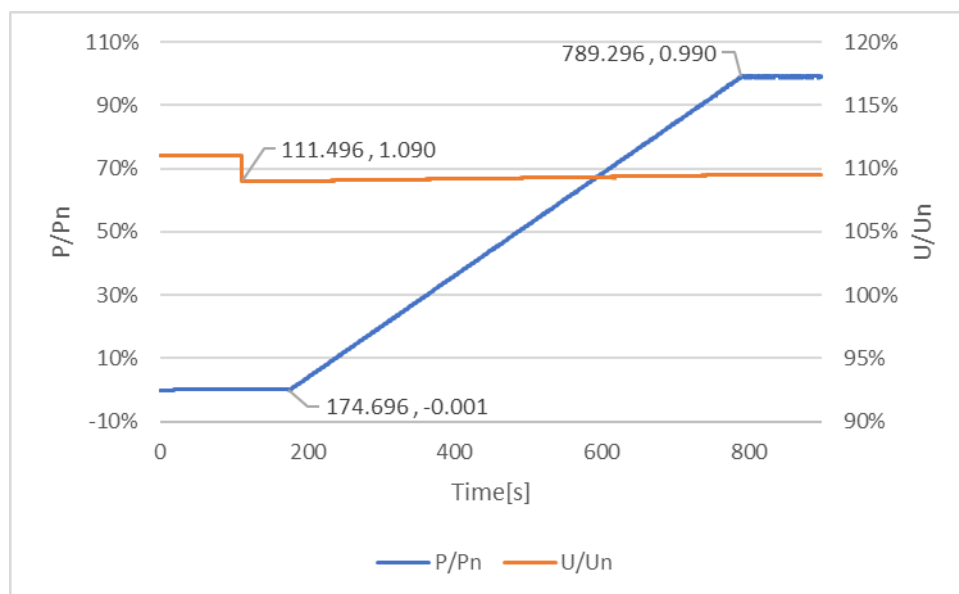
Clause	Requirement - Test	Result - Remark	Verdict
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5.9	TABLE: Connection and starting				P
Model	SUN-8K-H				
Setting values	Parameter	Range	Default setting		
			Starting connection	Reconnection	
	Lower frequency	47,0Hz – 50,0 Hz	49,5 Hz	49,5 Hz	
	Upper 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>	63.2	--	60s	--	
U<	73.2	--			
f>	70.6	--			
f<	73.0	--			
Reconnection:					
U>	73.6	9.70	60s	≤ 10%P _n / minutes	
U<	74.2	9.69			
f>	74.0	9.72			
f<	73.6	9.70			
Note(s):					
a In case of EN 50549-1:2019					
b In case of EN 50549-2:2019					

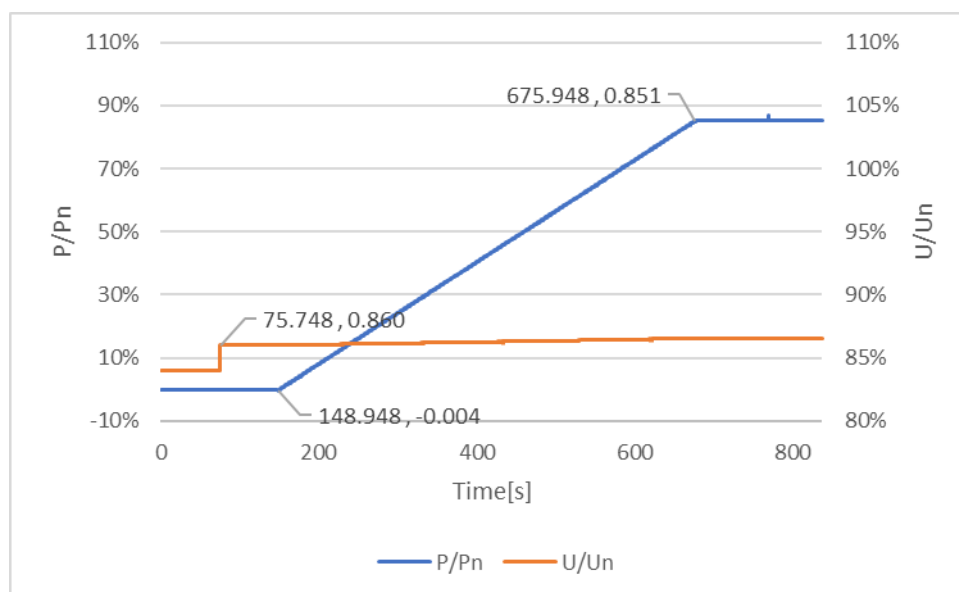
EN 50549-10

Clause	Requirement - Test	Result - Remark	Verdict
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Graph of Starting connection for U>

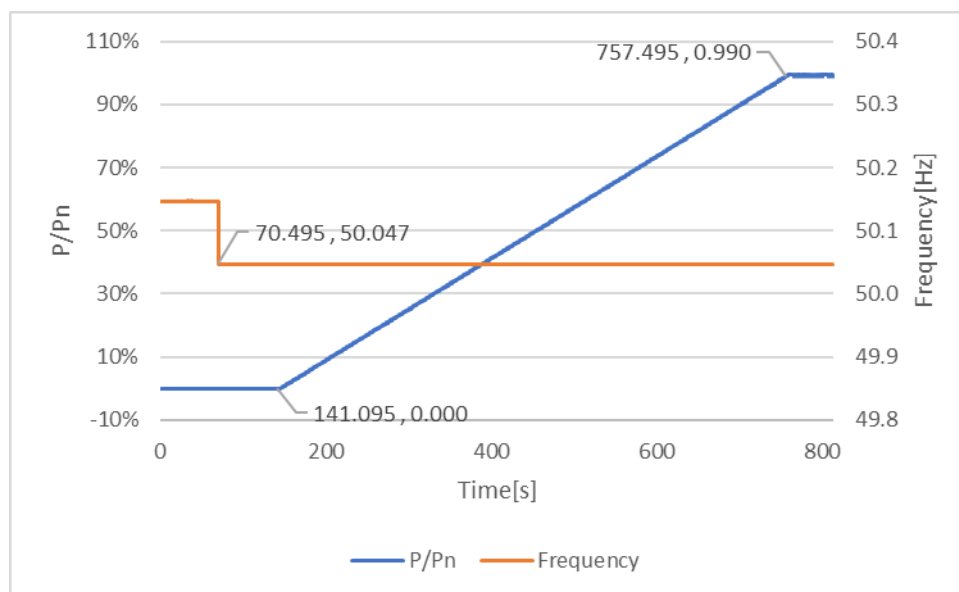
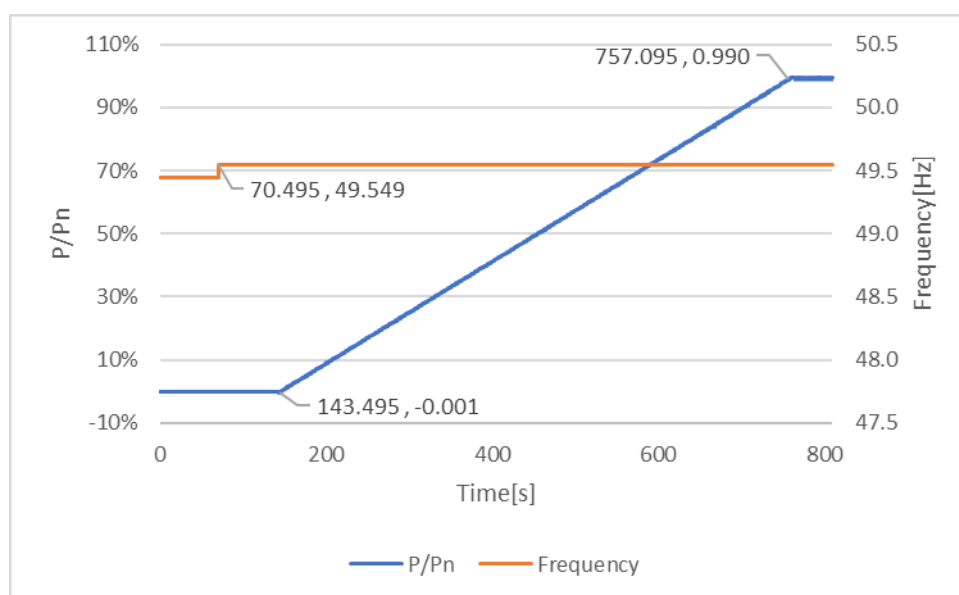


Graph of Starting connection for U<



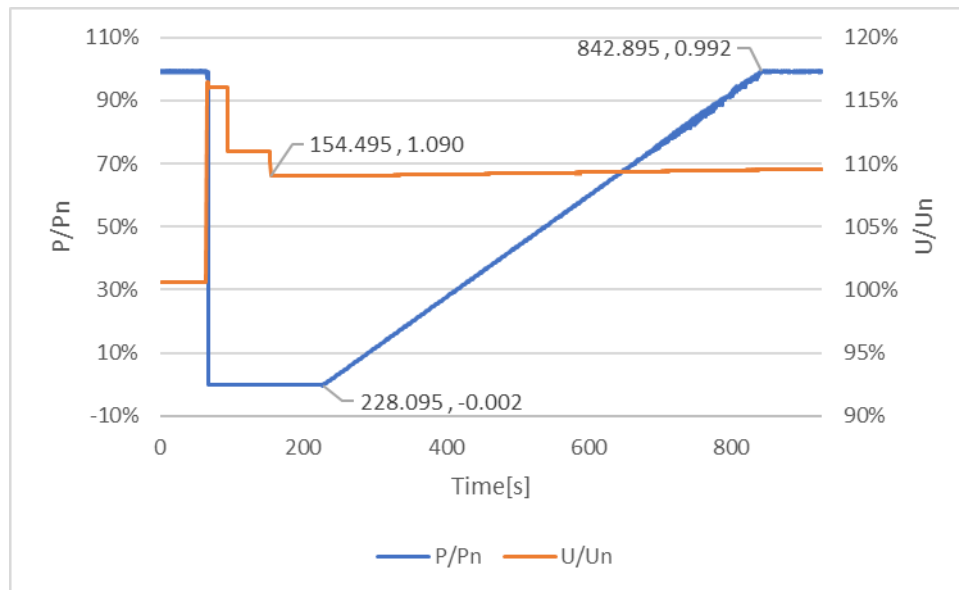
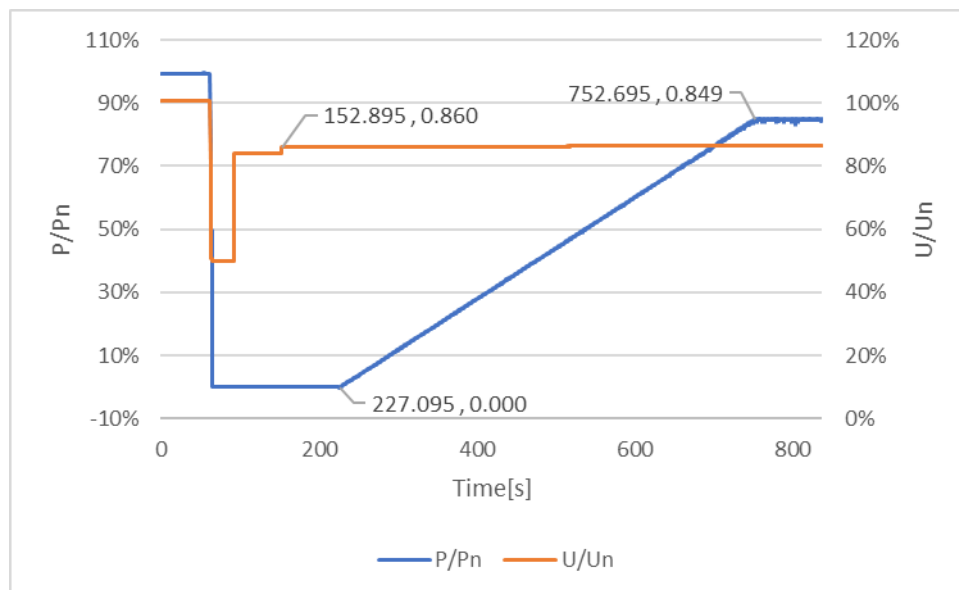
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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of Starting connection for $f >$ Graph of Starting connection for $f <$ 

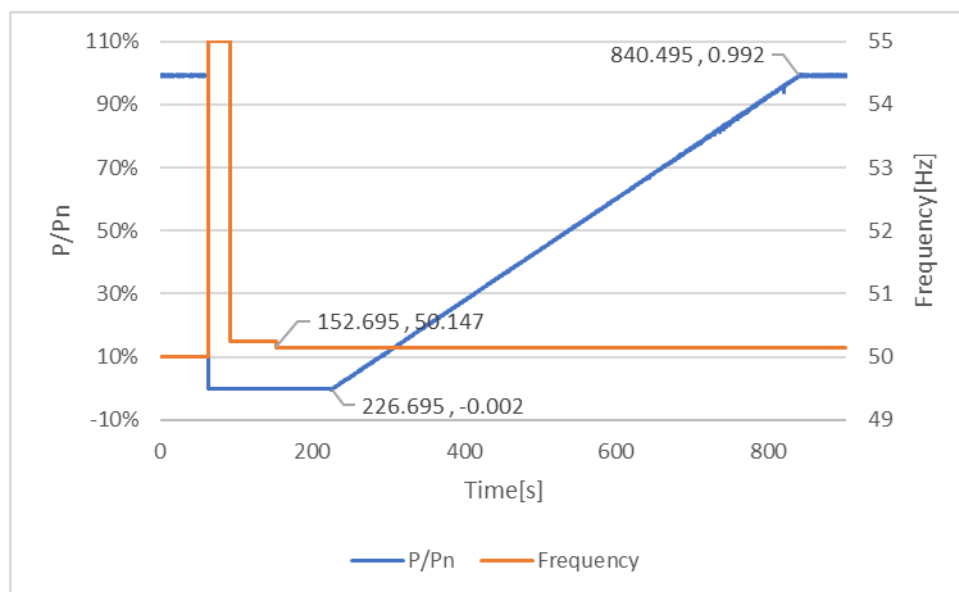
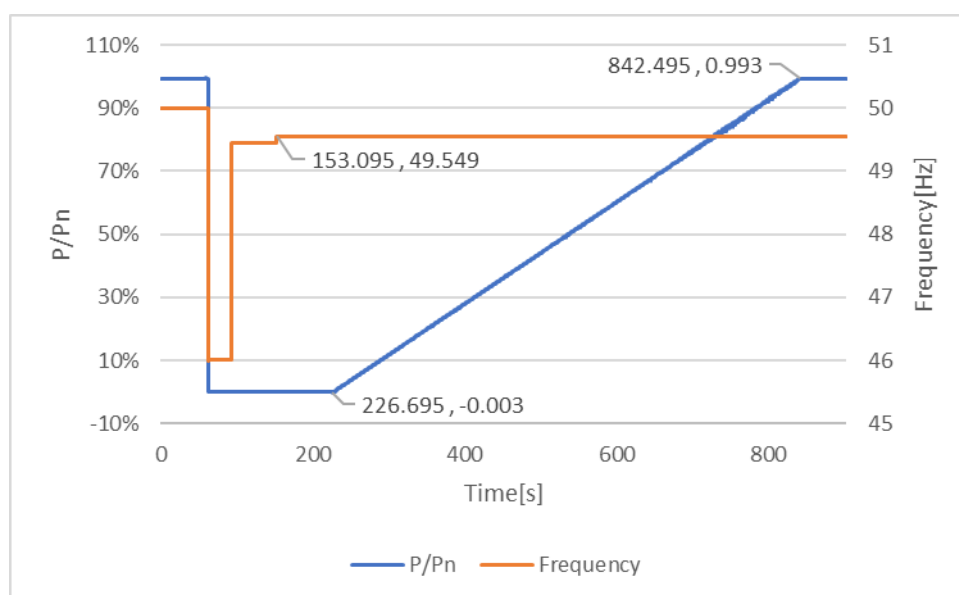
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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of Reconnection for $U >$ Graph of Reconnection for $U <$ 

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Clause	Requirement - Test	Result - Remark	Verdict
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Graph of Reconnection for $f >$ Graph of Reconnection for $f <$ 

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Clause	Requirement - Test	Result - Remark	Verdict
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5.10	TABLE: Active power reduction on set point						P
Model	SUN-8K-H						
Test 1: Verification of the accuracy							
Active power step [p.u. of Pn]	Requested set point value		Actual value		accuracy Actual value - Set point		Limit
	W	P/Pn [p.u.]	W	P/Pn [p.u.]	W	P/Pn [p.u.]	P/Pn [p.u.]
0.9	7200	0.9	7199.09	0.900	-0.91	0.000	± 0.05
0.8	6400	0.8	6385.35	0.798	-14.65	-0.002	
0.7	5600	0.7	5593.66	0.699	-6.34	-0.001	
0.6	4800	0.6	4801.76	0.600	1.76	0.000	
0.5	4000	0.5	4007.86	0.501	7.86	0.001	
0.4	3200	0.4	3206.61	0.401	6.61	0.001	
0.3	2400	0.3	2404.25	0.301	4.25	0.001	
0.2	1600	0.2	1601.53	0.200	1.53	0.000	
0.1	800	0.1	805.91	0.101	5.91	0.001	
0.3	2400	0.3	2404.19	0.301	4.19	0.001	
0.6	4800	0.6	4802.06	0.600	2.06	0.000	
1	8000	1.0	7941.67	0.993	-58.33	-0.007	
Test 2: Verification of the dynamic behaviour							
Test Conditions		Measurements		Limit			
P/Pn		Gradient		Gradient			
90% to 10%		0.494 %Pn/s		0.33-0.66%Pn/s			
Note(s): N/A							

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Clause	Requirement - Test	Result - Remark	Verdict
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Diagram for test 1

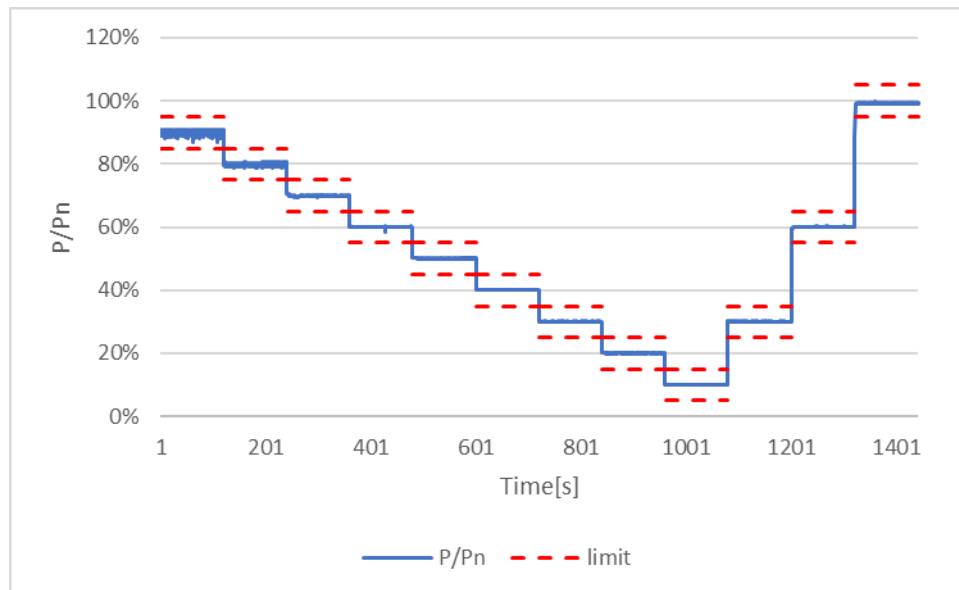
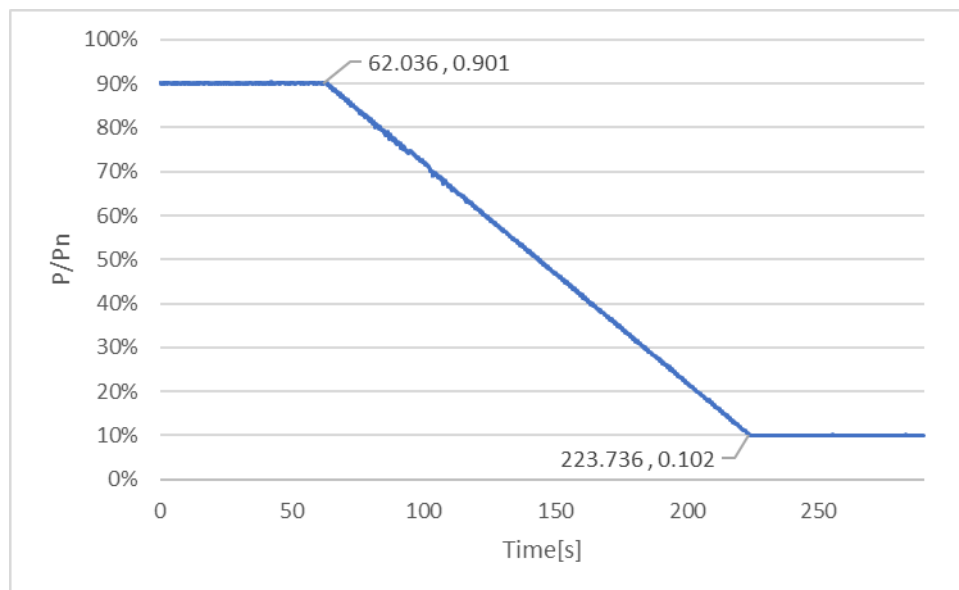


Diagram for test 2



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Clause	Requirement - Test	Result - Remark	Verdict
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5.11	TABLE: Remote information exchange	P
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Model	SUN-8K-H
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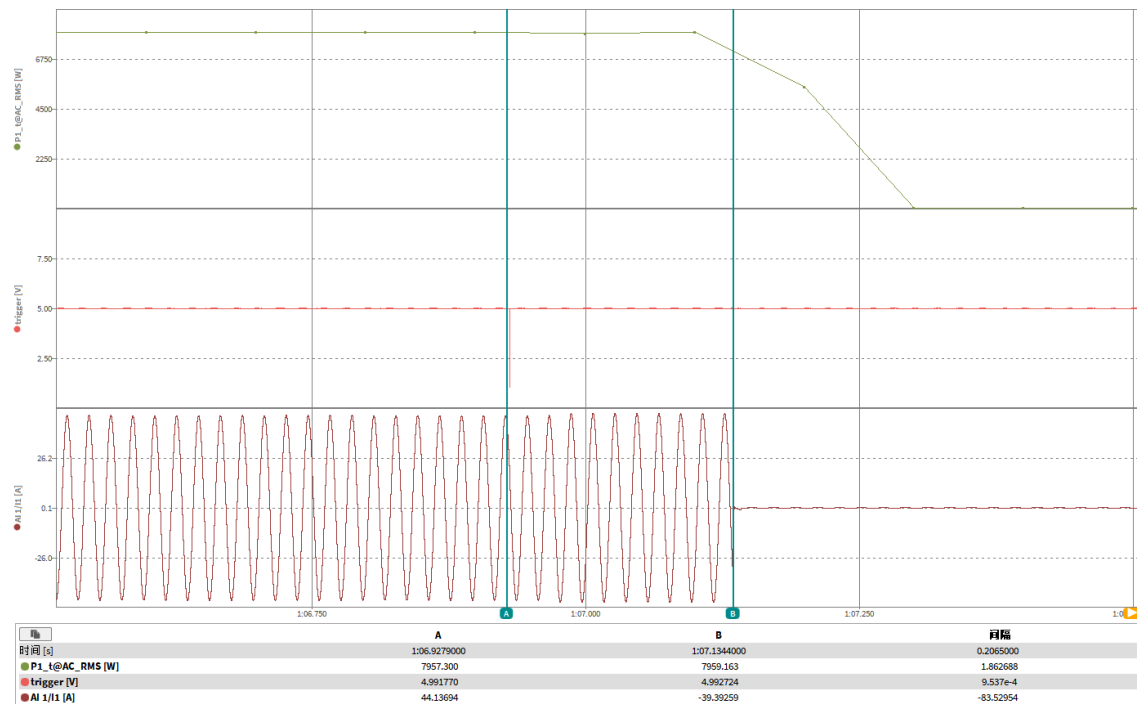
Reducing the active power form 100% P_{Amax} to 0

Measured max power [W]	Ceasing power [W]	Ceasing time [s]	Limit [s]
7957.3	0.0	0.21	5

Note:

N/A

Graph for test



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Clause	Requirement - Test	Result - Remark	Verdict
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5.12	TABLE: Requirements regarding single fault tolerance of interface protection system and interface switch					P
Ambient temperature (°C).....:					25	
Component No.	Fault	Test voltage (V)	Test time	fuse No.	fuse current (A)	Result
R165, R166, R167, R168, R169	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
R165, R166, R167, R168, R169	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
HCT5, Pin 11-12	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "over current" error, no damage, no hazard, no fire
R149	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "over current" error, no damage, no hazard, no fire
R165, R166, R167, R168, R169	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "grid frequency" error, no damage, no hazard, no fire
R165, R166, R167, R168, R169	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "grid frequency" error, no damage, no hazard, no fire
R4, R5, R6, R7, R8	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
R4, R5, R6, R7, R8	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
HCT2,12-13 HCT4,12-13	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "over current" error, no damage, no hazard, no fire
R77, R88	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "over current" error, no damage, no hazard, no fire
R509, R510, R511, R512, R513	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "bus voltage" error, no damage, no hazard, no fire
R509, R510, R511, R512, R513	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "bus voltage" error, no damage, no hazard, no fire
C435	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire

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Clause	Requirement - Test					Result - Remark	Verdict
R187	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "GFCI error" error, no damage, no hazard, no fire	
HCT7, Pin 1-5	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "GFCI error" error, no damage, no hazard, no fire	
R49	Open Before Start Up	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "GFCI error" error, no damage, no hazard, no fire	
Q77, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q77, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q80, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q80, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
D66	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
D70	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q59, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q59, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q61, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q61, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q62, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q62, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q64, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	

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Clause	Requirement - Test					Result - Remark	Verdict
Q64, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q20, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q20, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q23, B-E	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q23, E-C	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q1, G-S	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q1, D-S	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q4, G-S	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
Q4, D-S	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
RY2 pin3-pin4	Short Before Start Up	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "relay fault" error, no damage, no hazard, no fire	
RY3 Pin3-pin4	Short Before Start Up	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "relay fault" error, no damage, no hazard, no fire	
RY3 Pin3-pin4	Short Before Start Up	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "relay fault" error, no damage, no hazard, no fire	
RY8 Pin2-pin5	Short Before Start Up	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "relay fault" error, no damage, no hazard, no fire	
R245, R246, R247, R248, R249	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, "ISO" error, no damage, no hazard, no fire	
U10 Pin14-pin16	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	

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Clause	Requirement - Test				Result - Remark	
U10 Pin14-pin16	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U14 Pin4-pin6	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U14 Pin4-pin6	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U37 Pin4-pin6	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U37 Pin4-pin6	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U33 Pin4-pin6	Open	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
U33 Pin4-pin6	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX1 Pin6-10	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX2 Pin 2-3	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX2 Pin 4-5	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX2 Pin 12-15	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX2 Pin 19-20	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX2 Pin 21-22	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX3 Pin 1-2	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX3 Pin 8-9	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire
TX3 Pin 10-11	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire

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Clause	Requirement - Test					Result - Remark	Verdict
TX3 Pin 13-14	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 16-17	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 18-19	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 21-22	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 25-26	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 32-33	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
TX3 Pin 33-34	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
L to N	Short	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire Pk-Pk: 70 AAC rms:50,2 A Duration: 60,4 ms	
L to PE	Short		10 min	-	-	EUT shut down, no damage, no hazard, no fire Pk-Pk: 70 AAC rms:50,2 A Duration: 60,4 ms	
N to PE	Short		10 min	-	-	EUT shut down, no damage, no hazard, no fire Pk-Pk: 70 AAC rms:50,2 A Duration: 60,4 ms	
No PE	Short		10 min	-	-	ETU working normally, no damage, no hazard, no fire	
DC side feedback current	Short	PV:360 AC:230 BAT:50	10 min	-	-	No feedback current	
AC side feedback current	Short	PV:360 AC:230 BAT:50	10 min	-	-	No feedback current	
AC output	Overload 44 A	PV:360 AC:230 BAT:50	1 h	-	-	EUT protected when the current is more than 45 A, EUT normal operation at Overload 44 A, no error, no damage, no hazard, no fire.	
External FAN	Disconnected	PV:360 AC:230 BAT:50	10 min	-	-	EUT cannot start, "Fan Speed fault" error, no damage, no hazard, no fire	
External FAN	Stopped	PV:360 AC:230 BAT:50	10 min	-	-	EUT cannot start, "Fan Speed fault" error, no damage, no hazard, no fire	

EN 50549-10

Clause	Requirement - Test					Result - Remark	Verdict
Internal Fan	Disconnected	PV:360 AC:230 BAT:50	10 min	-	-	EUT cannot start, "Fan Speed fault" error, no damage, no hazard, no fire	
Internal Fan	Stopped	PV:360 AC:230 BAT:50	10 min	-	-	EUT cannot start, "Fan Speed fault" error, no damage, no hazard, no fire	
PV+/PV-	Reverse	PV:360 AC:230 BAT:50	10 min	-	-	EUT shut down, no damage, no hazard, no fire	
L/N	Reverse	PV:360 AC:230 BAT:50	10 min	-	-	ETU working normally, no damage, no hazard, no fire	
supplementary information: Working condition: PV-Grid & BAT							

Appendix 1: Datasheet of the relay

HF161F-40W

MINIATURE HIGH POWER RELAY

cULus

File No.:E134517



File No.:R 50475730



File No.:20002246447



Features

- Applicable to inverter used for photovoltaic power generation systems
- Ideal for UPS
- 43 A 277 VAC switching capability
- Contact gap 2.1 mm, 2.0 mm, 1.8 mm is optional
- Low coil holding voltage contributes to saving energy of equipment.
- Class F insulation system
- Outline Dimensions:(30.4×15.9×23.3)mm

RoHS compliant

CONTACT DATA

Contact arrangement	1A
Contact resistance ⁽¹⁾	10mΩ max.(6VDC 20A)
Contact material	AgSnO ₂
Contact rating (Res. load)	Making 20A, loading 40A,breaking 20A 277VAC
Max. switching voltage	277VAC
Max. switching current	43A
Max. switching power	11911VA
Mechanical endurance	1×10 ⁵ Ops
Electrical endurance	Min. 5×10 ⁴ Ops (85°C,1s on 9s off,Making20A, loading 40 A breaking 20 A, 277VAC,Res. load)

Notes: 1) The data shown above are initial values.

COIL

Coil power	Standard:Approx. 3.8W (967):Approx. 1.6W
Holding voltage (Standards)	40% to 70%U _N (temperature 23°C) 40% to 55%U _N (temperature 85°C)
Holding voltage (967)	50% to 100%U _N (temperature 23°C) 55% to 70%U _N (temperature 85°C)

Notes: 1) The coil holding voltage is the voltage applied to coil 100ms after the rated voltage.
2) To avoid overheating and burning,the coil can not be consistently applied to with voltage larger than maximum holding voltage.

CHARACTERISTICS

Insulation resistance		1000MΩ(500VDC)
Dielectric strength	Between open contacts	2500VAC 1min
	Between coil & contacts	4500VAC 1min
Surge Voltage		10kV(1.2/50μs)
Operate time (at rated. volt.)		20ms max.
Release time (at rated. volt.)		10ms max.
Temperature rise		70K max. (Contact load current 43A, Applied voltage of coil 100% rated voltage for 100ms holding voltage of coil 55% rated voltage, at 85°C)
Shock resistance	Functional	196m/s ²
	Destructive	980m/s ²
Vibration resistance		10Hz to 55Hz 1.5mm DA
Humidity		5% to 85%RH
Ambient temperature		-40°C to 85°C (Apply holding voltage to coil)
Termination		PCB
Unit weight		Approx. 25g
Construction		Flux proofed

Notes: 1) The data shown above are initial values.

SAFETY APPROVAL RATINGS

UL/CUL	Making 20 A loading 40 A breaking 20 A, 277 VAC, Resistive 85°C
TÜV	40 A, 277 VAC, Resistive 85°C
CQC	43 A, 277 VAC, Resistive 85°C
	Making 10 A loading 43 A breaking 10 A, 277 VAC, Resistive 85°C

Notes: 1) All values unspecified are at room temperature.
2) Only typical loads are listed above. Other load specifications can be available upon request.



HONGFA RELAY

ISO9001, IATF16949, ISO14001, ISO45001, IECQ QC 080000, ISO/IEC 27001 CERTIFIED

2025 Rev. 1.00

COIL DATA

at 23°C

Standard

Nominal Voltage VDC	Pick-up Voltage VDC max.	Drop-out Voltage VDC min.	Max. Voltage VDC	Coil Resistance Ω
6	4.2	0.3	6.6	$9.5 \times (1\pm10\%)$
9	6.3	0.45	9.9	$21.3 \times (1\pm10\%)$
12	8.4	0.6	13.2	$38 \times (1\pm10\%)$
24	16.8	1.2	26.4	$152 \times (1\pm10\%)$

(967)

Nominal Voltage VDC	Pick-up Voltage VDC max.	Drop-out Voltage VDC min.	Max. Voltage VDC	Coil Resistance Ω
6	4.5	0.3	6.6	$22.5 \times (1\pm10\%)$
9	6.75	0.45	9.9	$50.6 \times (1\pm10\%)$
12	9.0	0.6	13.2	$90 \times (1\pm10\%)$
24	18	1.2	26.4	$360 \times (1\pm10\%)$

Notes: *Maximum voltage refers to the maximum voltage which relay coil could endure in a short period of time.

ORDERING INFORMATION

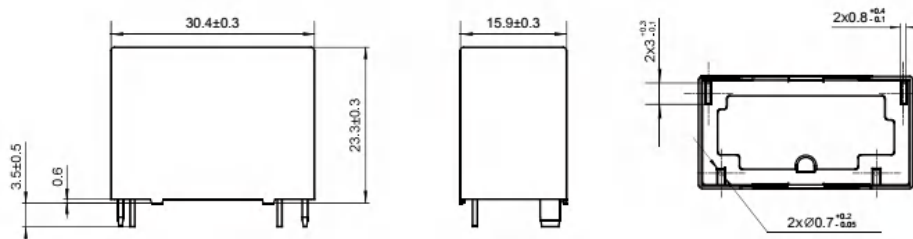
Type	HF161F-40W /12 -H T F (XXX)
Coil voltage	6,9,12,24VDC
Contact arrangement	H: 1 Form A
Contact material	T: AgSnO ₂
Insulation standard	F: Class F
Special code ⁽¹⁾	(967) stands for the coil power 1.6W and contact gap ≥ 1.8 mm (912) stands for contact gap ≥ 2.1 mm

Notes: 1) 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 meets the requirements for actual use.
2) Water clearing or surface process is not suggested after the flux-proofed relays are assembled on PCB.
3) The customer special requirement express as special code after evaluating by Hongfa.

OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

Unit: mm

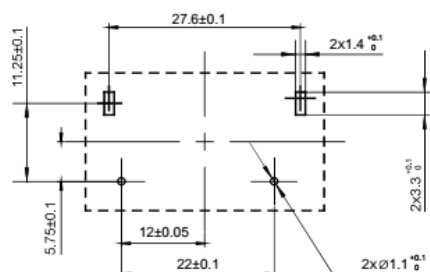
Outline Dimensions



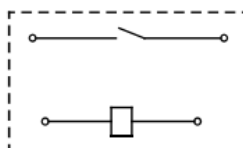
OUTLINE DIMENSIONS, WIRING DIAGRAM AND PC BOARD LAYOUT

Unit: mm

PCB Layout
(Bottom view)



Wiring Diagram
(Bottom view)



Remark: 1) In case of no tolerance shown in outline dimension: outline dimension $\leq 1\text{mm}$, tolerance should be $\pm 0.2\text{mm}$; outline dimension $> 1\text{mm}$ and $\leq 5\text{mm}$, tolerance should be $\pm 0.3\text{mm}$; outline dimension $> 5\text{mm}$, tolerance should be $\pm 0.4\text{mm}$.
2) The tolerance without indicating for PCB layout is always $\pm 0.1\text{mm}$.

Disclaimer

The specification is for reference only. See to "Terminology and Guidelines" for more information. Specifications subject to change without notice. We could not evaluate all the performance and all the parameters for every possible application. Thus the user should be in a right position to choose the suitable product for their own application. If there is any query, please contact Hongfa for the technical service. However, it is the user's responsibility to determine which product should be used only.

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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)		N/A
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		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
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)		N/A
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)		N/A
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 device 5.8.4 or Verification procedure for generating plants to be connected to a LV distribution network with		N/A

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
	Interface protection as dedicated device		
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		N/A
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	IEC 62116:2014	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		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)	N/A

Appendix 3: Evaluated parameter and parameter range

Name of parameter set		IEC 50549-1			
specific technical requirement (e.g. grid codes)		N/A			
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	N/A	0 – 20 s	0s	
	47,5 – 48,5 Hz Duration	N/A	30 – 90 min	30 min	
	48,5 – 49,0 Hz Duration	N/A	30 – 90 min	30 min	
	49,0 – 51,0 Hz Duration	N/A	not configurable	unlimited	
	51,0 – 51,5 Hz Duration	N/A	30 – 90 min	30 min	
	51, 5 – 52 Hz Duration	N/A	0 – 15 min	0 s	
4.4.3 Minimal requirement for active power delivery at underfrequency	Reduction threshold	N/A	not configurable	49.5 Hz	
	Maximum reduction rate	N/A	not configurable	10 % PM/Hz	
4.4.4 Continuous operating voltage range	Upper limit	N/A	not configurable	110 % Un	
	Lower limit	N/A	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:	N/A	not configurable	2 Hz/s 4 Hz/s	
4.5.3.2 Under-voltage ride through (UVRT) Generating plant with non-synchronous generating technology	Maximum power resumption time	N/A	not configurable	1 s	
	Voltage-Time-Diagram	N/A	see Figure 6 of EN 50549-1:2019 and EN 50549-2:2019	Time [s]	U [p.u.]
		N/A		0.0	0.2
		N/A		0.15	0.2
		N/A		1.5	0.85
		N/A		180	0.85
		N/A		180	0.9
4.5.3.3 Under-voltage ride through (UVRT)	Maximum power resumption time	N/A	not configurable	3s	
Generating plant with synchronous generating technology	Voltage-Time-Diagram	N/A	see Figure 7 of EN 50549-1:2019	Time [s]	U [p.u.]
		N/A		0.0	0.3
		N/A		0.15	0.3
		N/A		0.15	0.7
		N/A		0.7	0.7
		N/A		1.5	0.85

Name of parameter set		IEC 50549-1			
specific technical requirement (e.g. grid codes)		N/A			
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	
		N/A		180	0.85
		N/A		180	0.9
4.5.4 Over-voltage ride through (OVRT)	Voltage-Time-Diagram	N/A	not configurable see Figure 8 of EN 50549-1:2019	Time [s]	U [p.u.]
		N/A		0.0	1.25
		N/A		0.1	1.25
		N/A		0.1	1.20
		N/A		5.0	1.20
		N/A		5.0	1.15
		N/A		60	1.15
		N/A		60	1.10
4.6.1 Power response to overfrequency	Threshold frequency f ₁	N/A	50.2 Hz – 52 Hz	50.2 Hz	
	Droop	N/A	2 % – 12 %	5 %	
	Power reference	N/A	PM P _{max}	PM for other non-synchronous generating technology	
	Intentional delay	N/A	0 – 2 s	0s	
	Deactivation threshold f _{stop}	N/A	50.0 Hz – f ₁	deactivated	
	Deactivation time t _{stop}	N/A	0 – 600 s	-	
	Acceptance of staged disconnection	N/A	yes no	yes	
4.6.2 Power response to underfrequency	Threshold frequency f ₁	N/A	49.8 Hz – 46 Hz	49.8 Hz	
	Droop	N/A	2 – 12 %	5 %	
	Power reference	N/A	PM P _{max}	P _{max}	
	Intentional delay	N/A	0 – 2 s	0 s	
4.7.2.2 voltage support by reactive power - Capabilities	Active factor / Reactive power (%P _d) range overexcited	N/A	0.9 – 1 / 48 %P _d - 0 0.95 – 1 / 33 %P _d - 0	0.90–1 / 48 %P _d -0	
	Active factor / Reactive power (%P _d) range underexcited	N/A	0.9 – 1 / 48 %P _d - 0 0.95 – 1 / 33 %P _d - 0	0.90–1 / 48 %P _d -0	
4.7.2.3 voltage support by reactive power - Control modes	Enabled control mode	N/A	Q setp. Q(U) Q(P) cos φ setp. cos φ (P)	Q set point	
4.7.2.3.2 voltage support by	Q set point and excitation	N/A	0 – 48 % P _D . 0 –	0	

Name of parameter set		IEC 50549-1		
specific technical requirement (e.g. grid codes)		N/A		
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
reactive power - Set point control modes			33 %P _D	
	cos φ set point and excitation	N/A	1 – 0.9	1
4.7.2.3.3 voltage support by reactive power - Voltage related control modes	Characteristic curve	N/A		Q(U)
	Time constant	N/A	3 s – 60 s	10 s
	Min cos φ	N/A	0.0 – 1	0.9
	Lock-in power	N/A	0 % – 20 %	deactivated
	Lock-out power	N/A	0 % – 20 %	deactivated
4.7.2.3.4 voltage support by reactive power - Power related control mode	Characteristic curve	N/A		P(U)
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	N/A	enable disable	N/A
	Static voltage range overvoltage	N/A	100 % U_G – 120 % U_G	110 % U_G
	Static voltage range undervoltage	N/A	80 % U_G – 100 % U_G	90 % U_G
	Insensitivity range of ΔU50per	N/A	0 % – 15 %	5 %
	Gradient k1	N/A	0 – 6	2
	Gradient k2	N/A	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	N/A	enable disable	disable
	Reactive current limitation [% rated current]	N/A	0 % – 100 %	disable
	Zero current threshold	N/A	20 % U_G – 100 % U_G	disable
4.7.4.2.2 Zero current mode for converter connected generating technology / Generating Plant with non-synchronous generator	Enabling	N/A	enable disable	disable
	Static voltage range overvoltage	N/A	100 % U _N – 120 % U _N	120 % U _N
	Static voltage range undervoltage	N/A	20 % U _N – 100 % U _N	50 % U _N
4.9.3 Requirements on voltage and frequency protection	Threshold for protection as dedicated device [in A or kW, kVA]	N/A	16 A – 250 kVA	16 A – 250 kVA
	Undervoltage threshold stage 1	N/A	0.2 U _N – 1 U _N	0.2 U _N – 1 U _N
	Undervoltage operate time stage 1	N/A	0.1 s – 100 s	0.1 s – 100 s
	Undervoltage threshold stage 2	N/A	0.2 U _N – 1 U _N	0.2 U _N – 1 U _N
	Undervoltage operate time stage 2	N/A	0.1 s – 5 s	0.1 s – 5 s

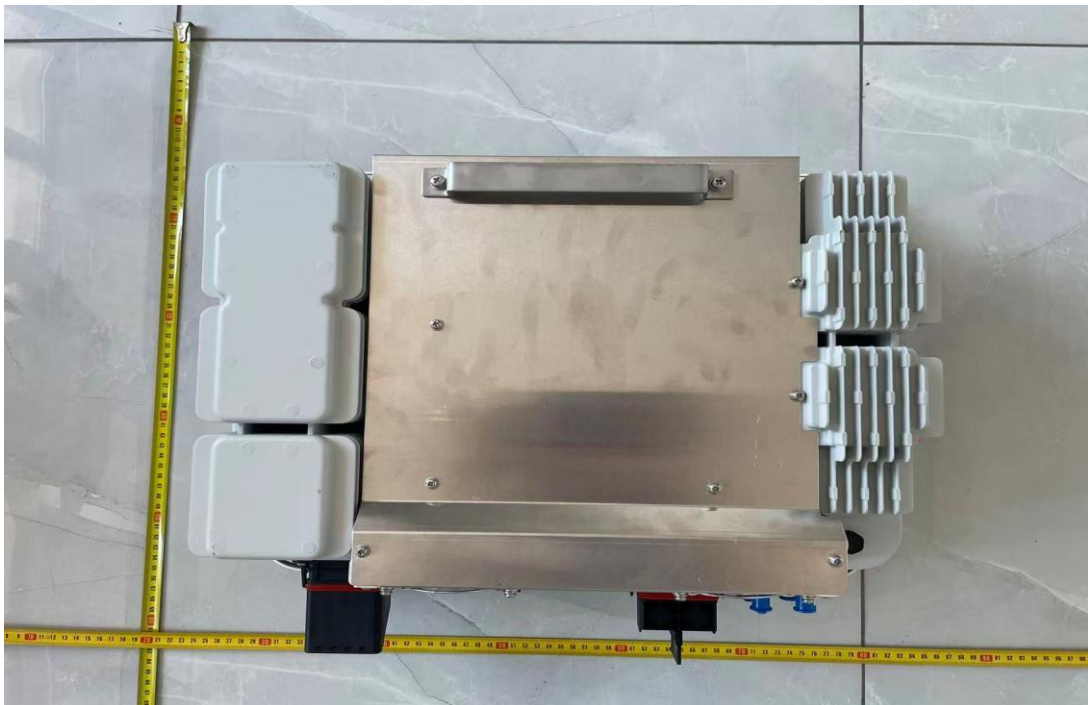
Name of parameter set		IEC 50549-1		
specific technical requirement (e.g. grid codes)		N/A		
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter ^a	Remarks/ additional information ^b	configurable value range	default value
	Overvoltage threshold stage 1	N/A	$1.0 U_n - 1.2 U_n$	$1.0 U_n - 1.2 U_n$
	Overvoltage operate time stage 1	N/A	0.1 s – 100 s	0.1 s – 100 s
	Overvoltage threshold stage 2	N/A	$1.0 U_n - 1.3 U_n$	$1.0 U_n - 1.3 U_n$
	Overvoltage operate time stage 2	N/A	0.1 s – 5 s	0.1 s – 5 s
	Overvoltage threshold 10 min mean protection	N/A	$1.0 U_n - 1.15 U_n$	$1.0 U_n - 1.15 U_n$
	Underfrequency threshold stage 1	N/A	47.0 Hz – 50.0 Hz	47.0 Hz – 50.0 Hz
	Underfrequency operate time stage 1	N/A	0.1 s – 100 s	0.1 s – 100 s
	Underfrequency threshold stage 2	N/A	47.0 Hz – 50.0 Hz	47.0 Hz – 50.0 Hz
	Underfrequency operate time stage 2	N/A	0.1 s – 5 s	0.1 s – 5 s
	Overfrequency threshold stage 1	N/A	50.0 Hz – 52.0 Hz	50.0 Hz – 52.0 Hz
	Overfrequency operate time stage 1	N/A	0.1 s – 100 s	0.1 s – 100 s
	Overfrequency threshold stage 2	N/A	50.0 Hz – 52.0 Hz	50.0 Hz – 52.0 Hz
	Overfrequency operate time stage 2	N/A	0.1 s – 5 s	0.1 s – 5 s
only EN 50549-2:2019, 4.9.3 Requirements on voltage and frequency protection	Positive sequence under voltage protection threshold	N/A	20 % – 100 %	N/A
	Positive sequence under voltage protection operate time	N/A	0.2 s – 100 s	N/A
	Negative sequence over-voltage protection threshold	N/A	1 % – 100 %	N/A
	Negative sequence over-voltage protection operate time	N/A	0.2 s – 100 s	N/A
	Zero sequence over-voltage protection threshold	N/A	1 % – 100 %	N/A
	Zero sequence over-voltage protection operate time	N/A	N/A	N/A
4.10.2 Automatic reconnection after tripping	Lower frequency	N/A	47.0 Hz – 50.0 Hz	49.5 Hz
	Upper frequency	N/A	50.0 Hz – 52.0 Hz	50.2 Hz
	Lower voltage	N/A	50 % U_n – 100 % U_n	85 % U_n , 90 % U_c

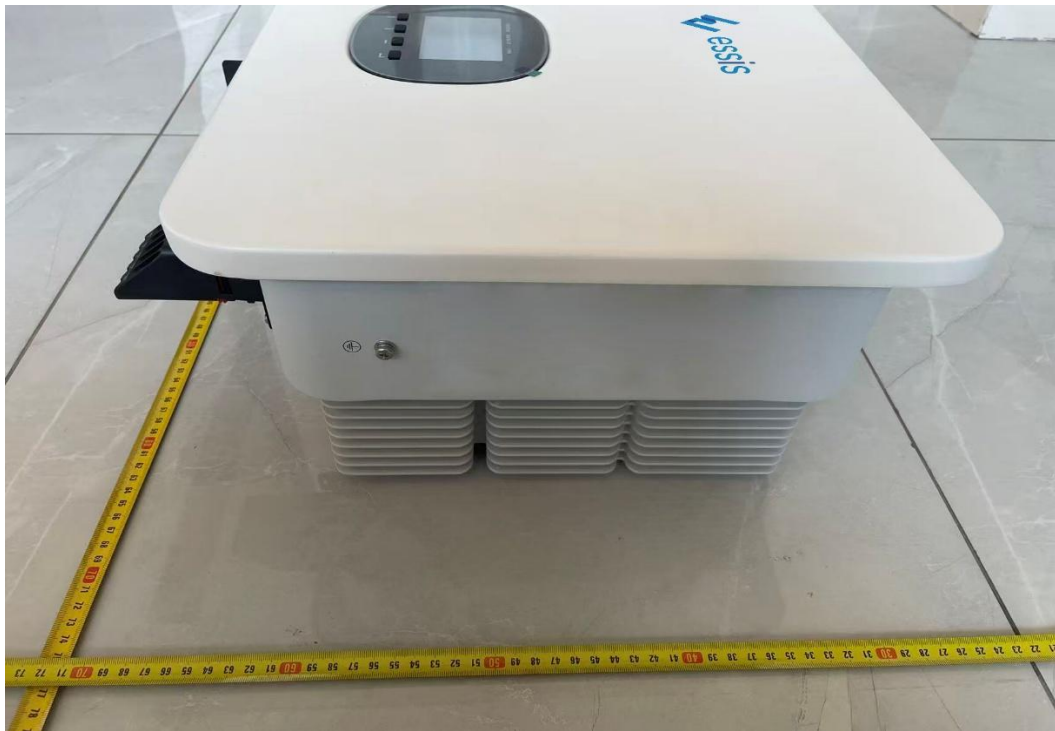
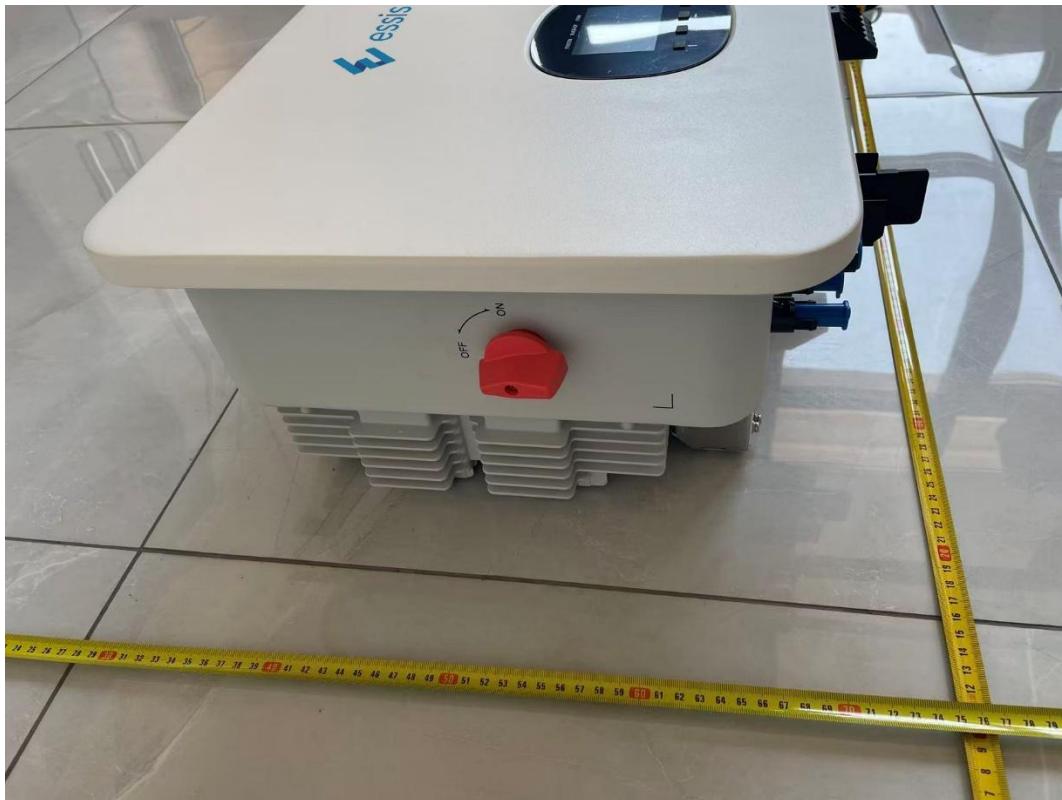
Name of parameter set		IEC 50549-1		
specific technical requirement (e.g. grid codes)		N/A		
Clause(s) / subclause(s) of EN 50549-1:2019 or EN 50549-2:2019	Parameter ^a	Remarks/ additional information ^b	configurable value range	default value
	Upper voltage	N/A	100 % U _n – 120 % U _n	110 % U _n
	Observation time	N/A	10 s – 600 s	60 s
	Active power increase gradient	N/A	6 % – 3000 %/min	10 % /min
4.10.3 Starting to generate electrical power	Lower frequency	N/A	47.0 Hz – 50.0 Hz	49.5 Hz
	Upper frequency	N/A	50.0 Hz – 52.0 Hz	50.1 Hz
	Lower voltage	N/A	50 % – 100 % U _n	85 % U _n , 90 % U _c
	Upper voltage	N/A	100 % – 120 % U _n	110 % U _n
	Observation time	N/A	10 s – 600 s	60 s
	Active power increase gradient	N/A	6 % – 3000 %/min	disabled
4.11.1 Ceasing active power	activation option	N/A	e.g. digital input, IEC 61850, sunspec	
4.11.2 Reduction of active power on set point	activation option	N/A	e.g. digital input, IEC 61850, sunspec	
4.12 Remote information exchange	available communication standards	N/A	e.g. IEC 61850, sunspec	

Note:

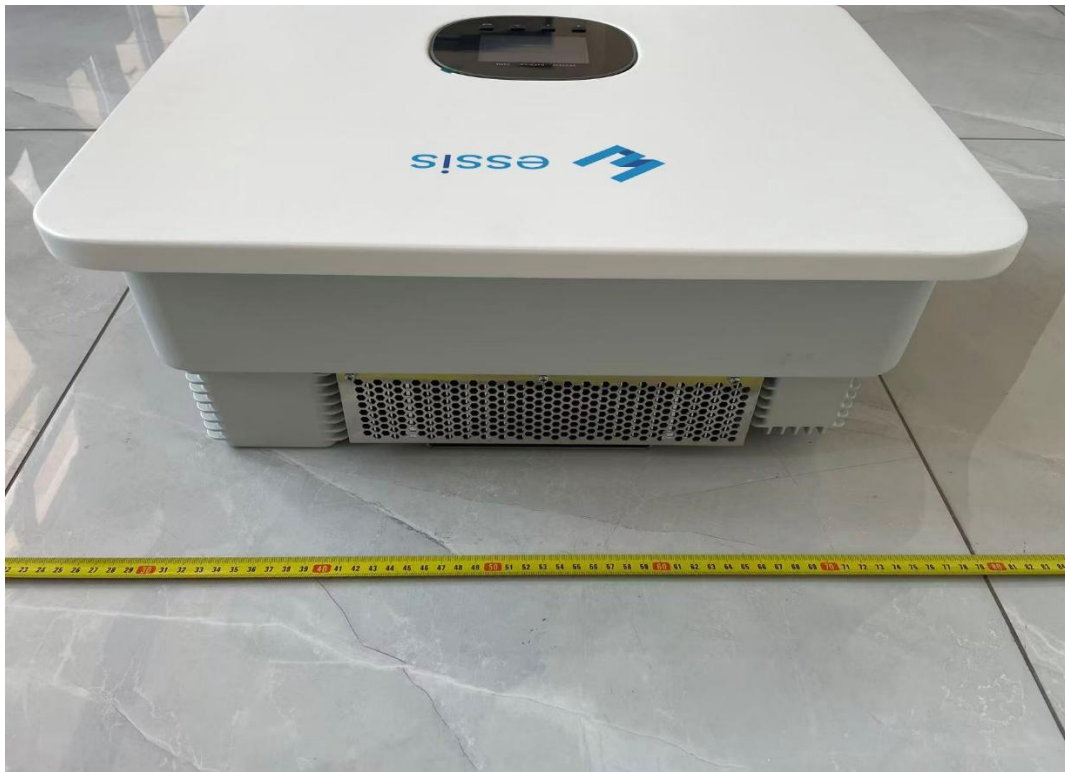
^a If additional parameters have been evaluated during the test, these shall be added as additional lines in the table.

^b This column should be used for manufacturer specific parameter descriptions.

Appendix 4: Pictures of the products**Enclosure Front View****Enclosure Rear View**

Enclosure Right Side View**Enclosure Left Side View**

Enclosure Top Side View



Enclosure Bottom Side View



Internal View



--- End of test report---