TEST REPORT

DIN VDE V 0124-100

Test requirements for generation units to be connected and operated parallel with the low voltage distribution networks

Report No, ...:	**BWDO-ESH-P25110858**
Date of issue .....:	2026-03-25
Total number of pages.....:	215
Testing laboratory name.....:	**Bureau Veritas Consumer Products Services Germany GmbH**
Address .....:	Businesspark A96 86842 Türkheim Germany
Accreditation.....:	ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12024-03-00
Applicant's name.....:	**Marstek energy Co.,Ltd.**
Address .....:	1-4F, BLDG#9, 1/F, BLDG#5, West Industrial Park, South of the Intersection of Ma'anshan Tunnel and Zhangshe Avenue, Xiangxi High-tech Zone, Hunan Province, China
Test specification	
Standard.....:	VDE AR-N 4105:2018-11 DIN VDE V 0124-100:2020-06
Certificate.....:	**Certificate of compliance**
Template number standard .....:	TRF_VDE0124-100_26
Master TRF originator.....:	Bureau Veritas Consumer Products Services Germany GmbH
Test item description .....:	**Energy Storage System**
Trademark.....:	MARSTEK
Model / Type.....:	Inverter: MST-HI-2200 Energy Meter: SPEM-002CEBEU50

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Ratings .....:	**MST-HI-2200**
MPP DC voltage range [V] .....:	16-55
Input DC voltage range [V] .....:	16-60
Input DC current [A].....:	32*4
Output AC voltage .....:	L/N/PE, 230/400 Va.c., 50Hz
Output AC current [A] .....:	9,57
Initial short-circuit AC current $I_{k''}$[A].....:	11,5
Output power [VA] .....:	2200

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Testing Location.....:	**LCIE China Company Limited**
Address .....:	Building 4, No, 518, Xinzhuan Road, Caohejing, Songjiang High-Tech Park, Shanghai, P,R, China (201612)

Tested by (name, function and signature).....:	Joell Qin	Joell Qin Test Engineer	Digitally signed by Joell Qin DN: cn=Joell Qin, o=LCIE CHINA COMPANY LIMITED, ou=New energy, email=joell.qin@bureauveritas.com, c=CN Date: 2026.05.19 16:24:06 +08'00'
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Manufacturer's name .....:	**Hamedata Technology Co.,Limited**
Factory address.....:	1-3F; 6-8F, BLDG#A, Changfang industrial Park, No.2 Guihua 5th Road,pingshan District, shenzhen, Guangdong, China

Document History

Date	Internal reference	Modification / Change / Status	Revision
2026-03-25	Joell Qin	Initial report was written	0

Supplementary information:

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Test items particulars

Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment..... :	Class I
Protection against ingress of water..... :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	17,1

Test case verdicts

Test case does not apply to the test object ..... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)

Testing

Date of receipt of test item..... :	2025-11-02
Date(s) of performance of test..... :	2025-11-02 to 2025-12-25

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General remarks:

The test result presented in this report relate only to the object(s) tested,

The report shall state compliance of the tested objects with the requirements of VDE-AR-N 4105 / DIN VDE V 0124-100,

All information in this test report limited to the type label, warning markings, trademark, block diagram, manual and datasheets are provided by the customer,

Conformity statements are decided in accordance with IEC GUIDE 115:2021 Procedure 2 (accuracy method), unless otherwise normatively specified or contractually agreed, The measurement result is considered as "pass" according to the requirement if it is within the prescribed limit or exactly on the limit,

”(see Annex #)" refers to additional information appended to the report,
"(see appended table)" refers to a table appended to the report,

Throughout this report a comma is used as the decimal separator,

- “P_{rE}” for the rated active power:

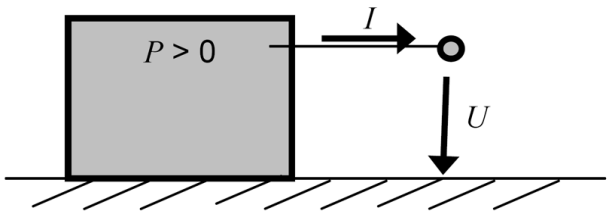
  $P_{rE} = U_n \times I_r \times \cos \varphi$ (single-Phase); $P_{rE} = \sqrt{3}\ U_n \times I_r \times \cos \varphi$ (three-Phase)
- “P_{ref}” for the momentary power
- “ΔP_{E60}” in [%] = $(P_{Setpoint} – P_{E60}) / P_{rE}$
- “ΔQ_{E60}” in [%] = $(Q_{expected} – Q_{E60}) / P_{Emax}$
- “$_{E0,2}$” for gliding average values over 200 milliseconds
- “$_{E60}$” for gliding average values over 60 seconds
- “$_{E600}$” for gliding average values over 10 minutes
- “(c)” for over-excited
- “(i)” for under-excited

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Active and reactive power:

The regarded system of the voltage and current vectors is the producer view (Figure 2):

- if the inverter feeds to the grid the active power is measured with positive sign,



For the representation in quadrants, a power circle is chosen whose representation is compatible with mathematical representations of trigonometry and complex numbers (see Figure 2), Angles are counted positively counter-clockwise as in mathematics, The phase angle is defined as the angle from the current pointer to the voltage pointer, The current pointer is always in the real axis; the position of the voltage pointer corresponds to the apparent power and the phase angle,

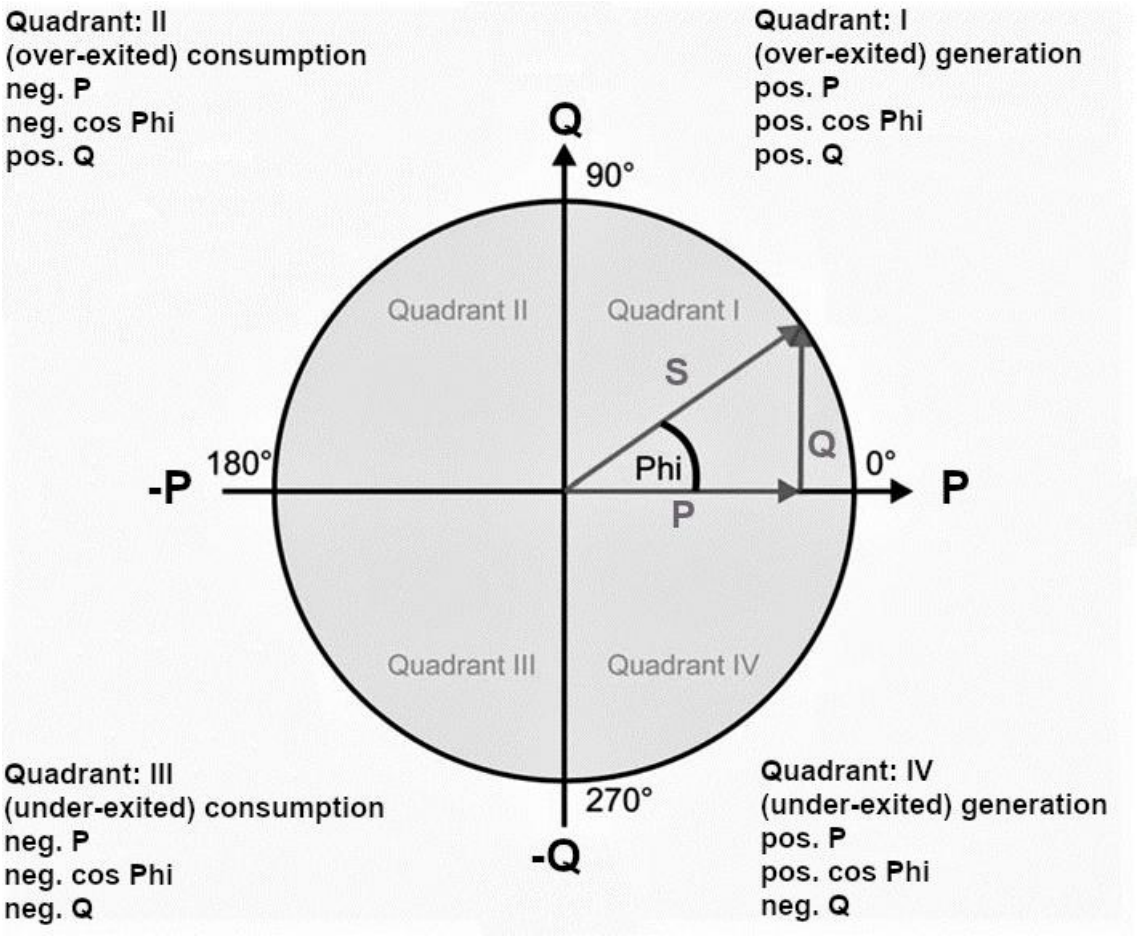


Figure 2

The different operating states can be represented in quadrants I to quadrant IV, The quadrants are named in a counter-clockwise direction,

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This Test Report consists of the following documents:

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Annex No, 1 Pictures of the unit 208
Annex No, 2 Test Equipment list 213
End of Test Report 215

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Copy of marking plate

MARSTEK

MARSTEK VENUS-D

Model:		MST-HI-2200
DC: PV Input	MPPT Voltage Range:	16V-55V
	Max. Input Voltage:	60V
	Max. Input Current (per string):	32A
	Max. Input Short-Circuit Current (per string):	40A
AC: Grid Connection	Rated Input Power:	2.2kVA
	Rated Grid Voltage:	230V
	Rated Grid Frequency:	50Hz
	Rated Grid Input Current:	9.57Aac
	Nominal Output Power:	0.8kVA(Default)/2.2kVA(*Premium)
	Nominal Output Current:	3.48Aac(Default)/9.57Aac(*Premium)
	Power Factor:	>0.99(Default)

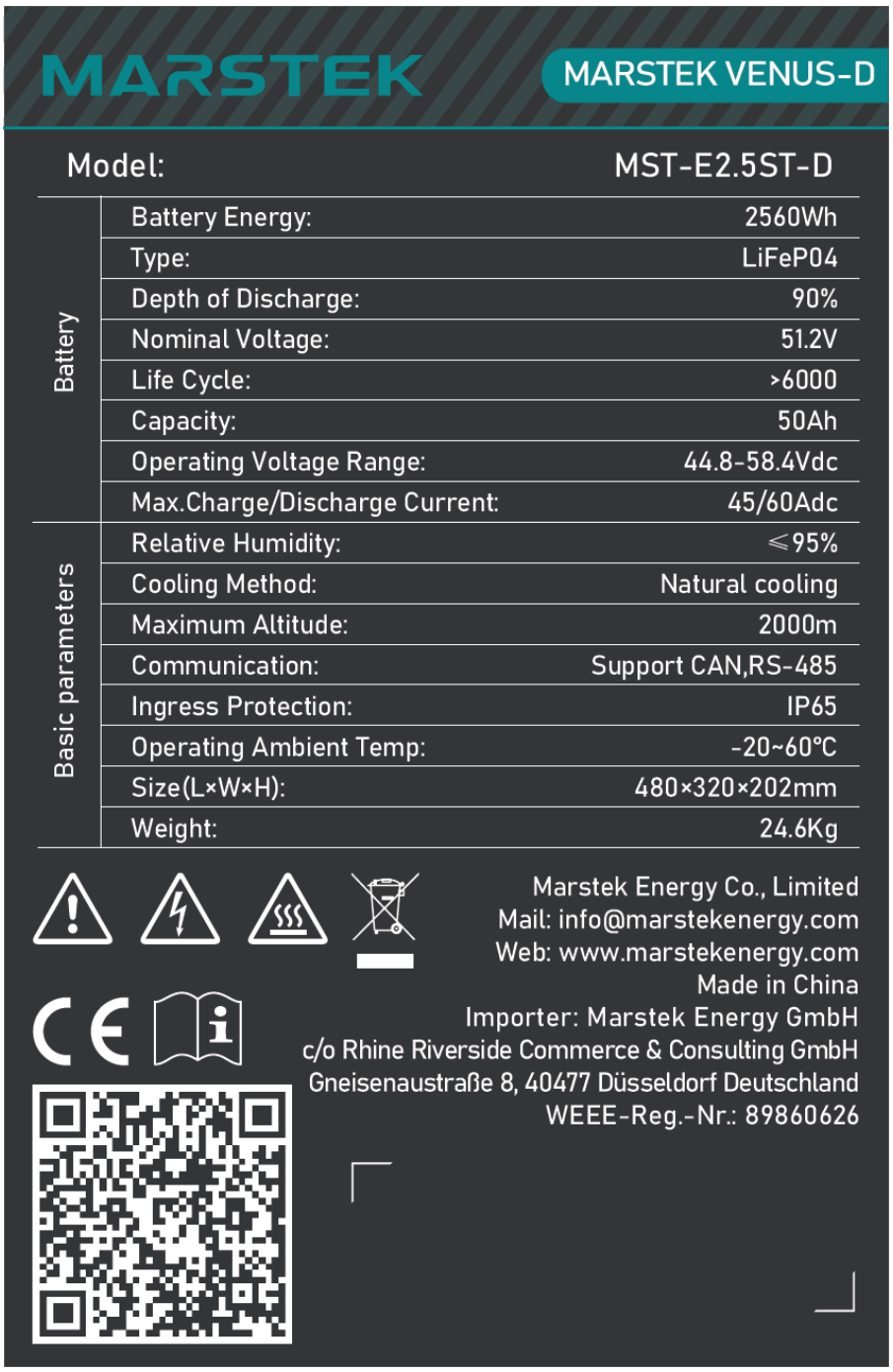
AC: Off-Grid Output	Max. Output Power:	2.5kVA
	Nominal Output Power:	2.2kVA
	Nominal Output Current:	9.57A
	Nominal output Voltage:	230V
	Nominal Frequency:	50Hz
System	Protection Class:	I
	Over Voltage Category:	DC II / AC III
	Operating Ambient Temp:	-20-60°C
	Relative Humidity:	0-95%
	Ingress Protection	IP65
	Cooling Method:	Natural cooling
	Size(L×W×H):	480×385×135mm
	Weight:	17.1Kg

Marstek Energy Co., Limited
Mail: info@marstekenergy.com
Web: www.marstekenergy.com
Made in China

Importer: Marstek Energy GmbH
c/o Rhine Riverside Commerce & Consulting GmbH
Gneisenaustraße 8, 40477 Düsseldorf Deutschland

*Enabling this function must comply with local regulations and must be performed by professional technicians!

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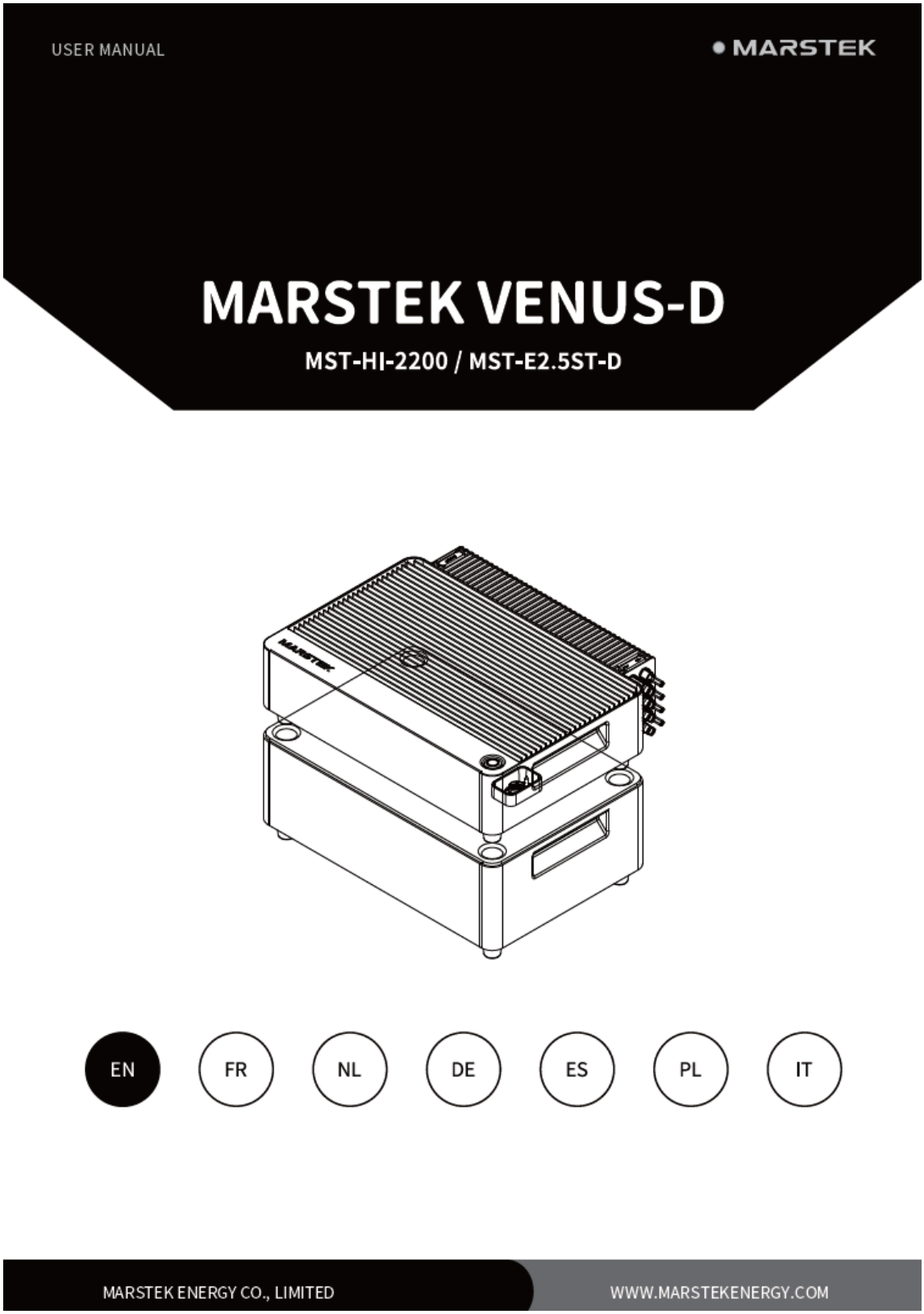
Note:

Example of marking plate

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General product information

Datasheet Manufacturer example:



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5. Technical Specifications

The Power Module Parameters:MST-HI-2200	
DC: PV Input	
Maximum Input Power	4000W
MPPT Voltage Range	16V ~ 55V
Startup Voltage	22V
Operating Voltage Range	16V ~ 60V
Maximum Input Voltage	60V
Maximum Input Current (Single Channel)	32A
Maximum Input Short-Circuit Current (Single Channel)	40A
Number of PV Input Channels	4
Number of MPPT Trackers	4
AC: Grid-Tied Input	
Max. Input Power	2.42kVA
Operating Phase Number	L/N/PE
Rated Grid Voltage	230V
Rated Grid Frequency	50Hz
Max. Input Current	10.5A
AC: Grid-Tied Output	
Rated Output Power	2200VA
Operating Phase Number	L/N/PE
Rated Grid Voltage	230V
Rated Grid Frequency	50Hz
Rated Grid Output Current	9.57A
Power Factor	0.8 ahead - 0.8 behind
THDI	< 3%
Max. Output apparent power	2.42kVA
Max. Output Current:	10.9Aac
AC :Off-Grid Output	
Rated Output Power	2200VA
Peak Output Power	2500VA
Rated Output Current	9.57A
Rated Output Voltage	230V
Rated Output Voltage Frequency	50Hz

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Max. Ouput Current:	10.9Aac
Extra Battery Module (EBM) Parameters	
Rated Voltage	51.2V (16S)
Capacity	2.56 kWh
Lifespan	> 6000 Cycles (25°C)
Battery Type	LiFePO4
Depth of Discharge (DOD)	90%
Rated Current	50A
Max battery stack quantity	6 PCS
Protection	
Protection Class	Class I
Overvoltage Withstand Class	DC II / AC III
Basic Parameters	
Charging Temperature:	0-55°C
Discharging Temperature:	-20-60°C
Relative Humidity	0 - 95%
Ingress Protection (IP) Rating	IP65
Cooling Method	Natural Cooling
Maximum Altitude	2000m
Others	
Grid-Tied AC Connection	Three-wire Household Plug(Euro16A)
Display	LED Strip Display
Communication Method	Bluetooth, WIFI, RS-485 (RJ45), Ethernet Port (RJ45)

Note 1: Rated voltage/frequency range can be changed according to the requirements of the local power department.
Note 2: Please refer to local electrical regulations to determine the number of the MARSTEKVENUS units that can be connected to each branch circuit.
*Enabling this function must comply with local regulations and should only be performed by authorized personnel!

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The Extra Moudule(EBM) Parameters:MST-E2.5ST-D	
Battery Parameters	
Rated Voltage	51.2V（16S）
Battery Level	2.56kWh
Lifecycle	>6000(25°C)
Battery Type	LiFePO4
Depth of Discharge	90%
Battery Capacity	50Ah
Basic Parameters	
Ambient Temperature Range	-20 ~+ 60℃(Storage-30 ~+ 85℃)
Relative Humidity	≤95%
Protection Level	IP65
Cooling Method	Natural Cooling
Maximum Altitude	2000m

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Block diagram of the utility interactive inverter

This inverter converts the DC power from the battery and photovoltaic panel to AC power, with single-phase output and output have varistors grounding protection. It adopts the isolation transformer topology.

The control system adopts a master-slave DSP architecture: U37 is the main DSP responsible for communicating with slave DSP-U57, U12, and BMS by CAN. It also communicates with external devices by 485 and RF module. U57 is responsible for relay control (K1, K2, K3 are controlled separately), 400V bus voltage, grid voltage and frequency, AC current (including DC injection) monitoring, and calibration of current sensors before startup; U12 is responsible for monitoring the voltage, current and isolation resistance of the PV. If the resistance is too low, the PV side won't work.

The output part achieves dual protection through isolation transformers and relays: even if a single relay fails the isolation transformer can still maintain insulation and disconnect, When the svstemdetects an abnormalily in the relay, it wil sound an alarm and display an error code. All relays undergo self inspection before starting up.

The current signal is collected by sensors, and both AC and DC components are sent to U57 for analysis. The battery voltage and temperature are monitored by BMS and interact with the power board through CAN to manage charging and discharging.

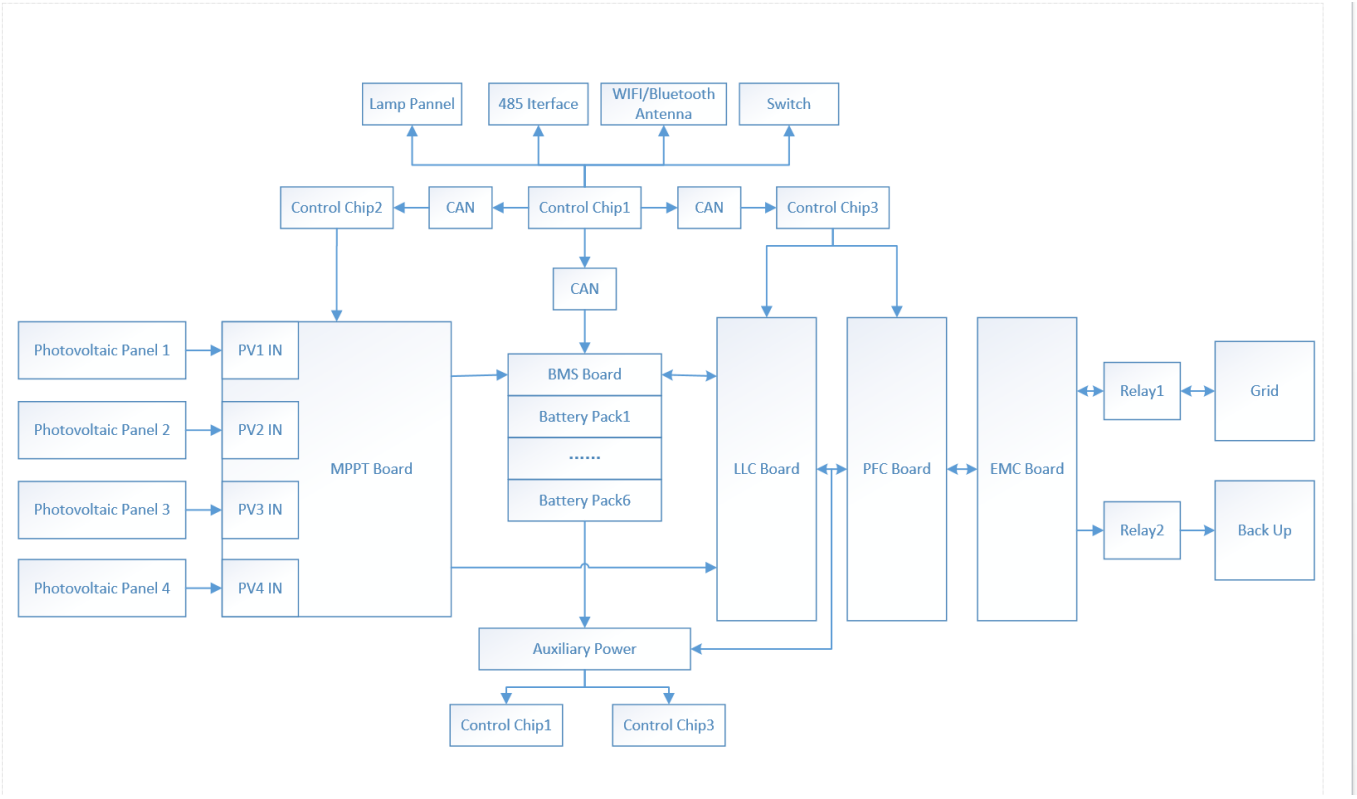
Working mode:

Grid connected mode: Close relay K2, which can charge the battery or feed power to the grid, with a rated power of 2200W;

Back-up mode: Close relay K3 and supply power to the load through the Backup interface, with a rated power of 2200W.

PV charging mode: Relay K2 and K3 are open. PVs only charge the battery.

In the event of a malfunction, the master-slave DSP collaboratively triggers protection, and if necessary, a relay or isolation transformer is used for secondary disconnection to ensure basic insulation between PV, the battery, and the grid.



Differences of the models in the series

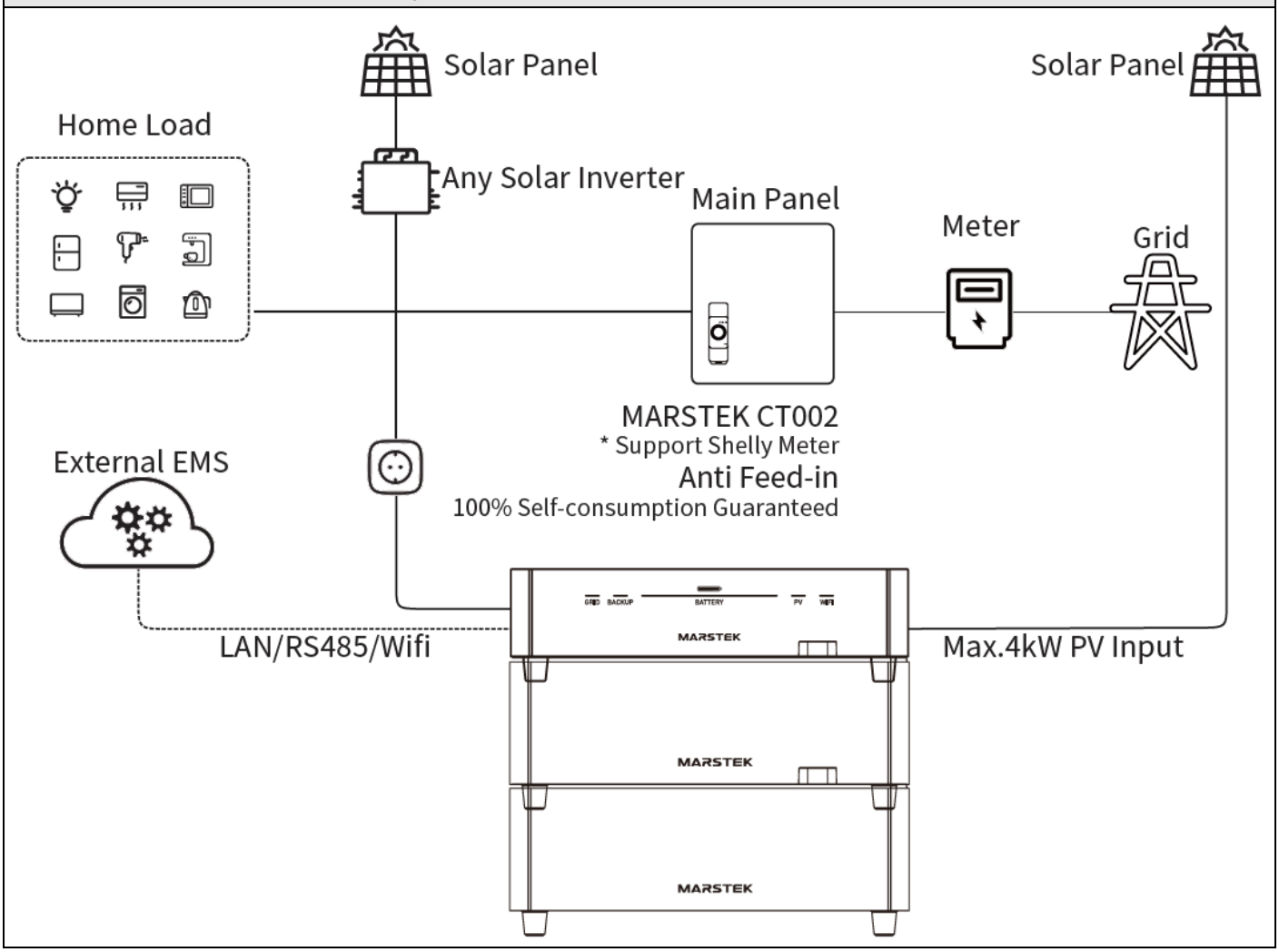
None.

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The product was tested on
The products with serial number HVD101251800001 was tested on. Hardware: HAME-POWER-HI2200 V3.1 Software: 0113 All tests were performed on EUT MST-HI-2200.

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Description of the remote control in a typical installation



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Test Results

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DIN VDE V 0124-100		
Clause	**Requirement – Test**	**Verdict**
5,2	Evidence of permissible network perturbations	**P**
5,3	Evidence of symmetry behaviour of inverters	**P**
5,4	Evidence of the behaviour of the generating unit on the network	**P**
5,5	NS-protection	**P**
5,6	Connecting conditions and synchronization	**P**
5,7	Evidence of $P_{AV,E}$-Control	**P**
5,8	Evidence dynamic grid support	**P**
5,9	Test of Ancillary Unit	**N/A**

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DIN VDE V 0124-100		
Clause	**Requirement – Test**	**Verdict**
5,2	**Evidence of permissible network perturbations**	
5,2,1	General	**P**
5,2,2	Rapid voltage changes	**P**
5,2,3	Flicker	**P**
5,2,4	Harmonics and interharmonics	**P**
5,2,4,1 a)	Test Harmonics DIN EN 61000-3-2 (≤ 16 A per Phase)	**P**
5,2,4,1 a)	Test Harmonics DIN EN 61000-3-12 (≥ 16 A and ≤ 75 A per Phase)	**N/A**
5,2,4,1 b)	Test Harmonics and interharmonics DIN EN 61000-4-7 (≥ 75 A per Phase)	**P**
5,2,5	Commutation	**N/A**
5,2,6	Feed in of DC current	**P**

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5,2,1	General	P

The electrical installations of the customer system shall be planned, constructed and operated so that reactions to the network operator's network and to the systems of other customers are permanently reduced to a permissible minimum, Should interfering reactions on the network operator's network occur nonetheless, the customer shall apply measures to his system that are to be coordinated with the network operator, The network operator is entitled to disconnect the power generation system concerned from the network until the deficiencies are corrected,

System perturbations are defined as:

- Rapid voltage changes

- Flicker

- Harmonics, interharmonics and higher frequencies (up to 9 kHz)

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5,2,2	Rapid voltage changes	P

The purpose of the test is to determine k_i and k_{imax},

The following three cases must be tested (where applicable),

- Switch-on for any capacity
- Unfavourable case when switching the generator step
- Switch-on for nominal capacity

Note: For PV-plants the inverter is the generator

- Switch-off for nominal capacity (no emergency shutdown, but operative shutdown)

If the manufacturer knows more critical cases (e,g, different cos φ parameters) then these additional have to be tested

Test conditions:

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

Test: MST-HI-2200

Switch-on for any capacity (10% PEmax)

Phase	L1			L2			L3		
Single period effective values of the current [A]	0,624	0,646	0,584	NA	NA	NA	NA	NA	NA
Single period effective values of the voltage [V]	229,9	230,1	230,2	NA	NA	NA	NA	NA	NA
k_i value [1]	0,065	0,068	0,061	NA	NA	NA	NA	NA	NA
k_{imax} value [1]	0,068			NA			NA		

Unfavourable case when switching the generator step (not necessary for electronic inverter)

Phase	L1			L2			L3		
Single period effective values of the current [A]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Single period effective values of the voltage [V]	NA	NA	NA	NA	NA	NA	NA	NA	NA
k_i value [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA
k_{imax} value [1]	NA			NA			NA		

Switch-on for nominal capacity

Phase	L1			L2			L3		
Single period effective values of the current [A]	0,577	0,558	0,634	NA	NA	NA	NA	NA	NA
Single period effective values of the voltage [V]	230,1	230,1	229,8	NA	NA	NA	NA	NA	NA
k_i value [1]	0,060	0,058	0,066	NA	NA	NA	NA	NA	NA
k_{imax} value [1]	0,066			NA			NA		

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5,2,2	Rapid voltage changes	P

Switch-off for nominal capacity

Phase	L1			L2			L3		
Single period effective values of the current [A]	0,584	0,713	0,805	NA	NA	NA	NA	NA	NA
Single period effective values of the voltage [V]	228,4	229,1	229,5	NA	NA	NA	NA	NA	NA
k_i value [1]	0,061	0,075	0,084	NA	NA	NA	NA	NA	NA
k_{imax} value [1]	0,084			NA			NA		

Grid Frequency [Hz]	50
Grid voltage [V]	230
Rated current I_r [A]	9,57
Highest k_{imax} value for all switching operations [1]	0,084

Note:

Limits:

k_{imax} = 1,2 for synchronous generators with fine synchronization, converter; (electronic inverter)

k_{imax} = 4 for asynchronous generators, which are switched on at 95% to 105% of their synchronous speed, if no further details are available regarding the type of current limitation, With regard to short-term compensation processes, the condition mentioned below for very short voltage changes must also be observed,

K_{imax} = 8 for asynchronous generators that are powered up by the network if I_a is unknown,

(I_a = starting current)

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5,2,3	**Flicker** These tests are designed to provide evidence that the requirements of VDE-AR-N 4100:2109-04 are met,	**P**

Adherence to the thresholds for flicker must be verified as followed:

- For nominal currents ≤ 16 A per conductor to DIN EN 61000-3-3 (VDE 0838-3)
- For nominal currents > 16 A and ≤ 75 A per conductor to DIN EN 61000-3-11 (VDE 0838-11)

Test conditions:

Voltage: 86% U_n to 109% U_n

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rise of the PGU at 100% P_{Emax}: ≤ 3 %

Test:

MST-HI-2200

Flicker to DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 (VDE 0838-11) for generator units ≤ 75 A

Grid impedance DIN EN 61000-3-3 (VDE 0838-3) [Ω]:	R_A = 0,24Ω jX_A = 0,15Ω / R_N = 0,16Ω jX_N = 0,10Ω (Rn and jXn only for single-phase units used!)
Output voltage of the impedance network [V]	230 V

Flicker to:	Result:		
	P_{lt}	P_{st}	dc%
DIN EN 61000-3-3	0,013	0,014	0,031

Assessment criterion:

Long-term flicker strength Plt to DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 must be ≤ 0,5,

Determination of the flicker coefficient:

$$c_{\psi k} = P_{st} \times (S_k / P_n)$$

where S_k is the short-circuit power of the network standby element (during the determination of the appropriate P_{st} values)

The value for the network standby element must be determined separately with measurements for rated currents > 75 A,

Flicker for rated currents ≤75A to DIN EN 61000-3-3 (VDE 0838-3)

Grid impedance angle ψ_k	32°
Flicker coefficient c(ψ_k)	2,635

Assessment criterion:

Long-term flicker strength: P_{lt}≤ 0,5

Note:

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5,2,4,1 a)	Test Harmonics DIN EN 61000-3-2 (≤16 A per Phase)						P
MST-HI-2200							
Phase	**L1**		**L2**		**L3**		
Power Level	**100%**		**100%**		**100%**		
AC Power [W]	2202,3		N/A		N/A		
AC Voltage [V]	229,9		N/A		N/A		
AC Current [A]	9,577		N/A		N/A		
Frequency [Hz]	50,00		N/A		N/A		
THD [%][50]	1,963		N/A		N/A		
Harmonic	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Current Magnitude (A)**	**% of Funda-mental**	**Harmonic Current Limits (A)**
1st	9,577	-	N/A	N/A	N/A	N/A	--
2nd	0,013	0,132	N/A	N/A	N/A	N/A	1,080
3rd	0,072	0,754	N/A	N/A	N/A	N/A	2,300
4th	0,002	0,024	N/A	N/A	N/A	N/A	0,430
5th	0,060	0,628	N/A	N/A	N/A	N/A	1,140
6th	0,004	0,038	N/A	N/A	N/A	N/A	0,300
7th	0,054	0,564	N/A	N/A	N/A	N/A	0,770
8th	0,003	0,035	N/A	N/A	N/A	N/A	0,263
9th	0,052	0,541	N/A	N/A	N/A	N/A	0,400
10th	0,004	0,043	N/A	N/A	N/A	N/A	0,184
11th	0,050	0,522	N/A	N/A	N/A	N/A	0,330
12th	0,005	0,055	N/A	N/A	N/A	N/A	0,153
13th	0,046	0,476	N/A	N/A	N/A	N/A	0,210
14th	0,004	0,041	N/A	N/A	N/A	N/A	0,131
15th	0,037	0,389	N/A	N/A	N/A	N/A	0,150
16th	0,004	0,038	N/A	N/A	N/A	N/A	0,115
17th	0,028	0,295	N/A	N/A	N/A	N/A	0,132
18th	0,003	0,035	N/A	N/A	N/A	N/A	0,102
19th	0,019	0,194	N/A	N/A	N/A	N/A	0,188
20th	0,002	0,026	N/A	N/A	N/A	N/A	0,092
21th	0,013	0,132	N/A	N/A	N/A	N/A	0,107
22th	0,003	0,034	N/A	N/A	N/A	N/A	0,084
23th	0,011	0,110	N/A	N/A	N/A	N/A	0,098
24th	0,003	0,029	N/A	N/A	N/A	N/A	0,077
25th	0,004	0,041	N/A	N/A	N/A	N/A	0,090
26th	0,002	0,023	N/A	N/A	N/A	N/A	0,071
27th	0,007	0,075	N/A	N/A	N/A	N/A	0,080
28th	0,002	0,020	N/A	N/A	N/A	N/A	0,066
29th	0,002	0,023	N/A	N/A	N/A	N/A	0,078
30th	0,002	0,025	N/A	N/A	N/A	N/A	0,061
31th	0,005	0,047	N/A	N/A	N/A	N/A	0,073
32th	0,002	0,019	N/A	N/A	N/A	N/A	0,057

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5,2,4,1 a)	Test Harmonics DIN EN 61000-3-2 (≤16 A per Phase)						P
MST-HI-2200							
33th	0,003	0,035	N/A	N/A	N/A	N/A	0,068
34th	0,002	0,024	N/A	N/A	N/A	N/A	0,054
35th	0,002	0,026	N/A	N/A	N/A	N/A	0,064
36th	0,002	0,025	N/A	N/A	N/A	N/A	0,051
37th	0,004	0,043	N/A	N/A	N/A	N/A	0,061
38th	0,002	0,026	N/A	N/A	N/A	N/A	0,048
39th	0,003	0,028	N/A	N/A	N/A	N/A	0,058
40th	0,002	0,025	N/A	N/A	N/A	N/A	0,046
41th	0,003	0,035	N/A	N/A	N/A	N/A	N/A
42th	0,002	0,024	N/A	N/A	N/A	N/A	N/A
43th	0,003	0,029	N/A	N/A	N/A	N/A	N/A
44th	0,003	0,028	N/A	N/A	N/A	N/A	N/A
45th	0,002	0,021	N/A	N/A	N/A	N/A	N/A
46th	0,002	0,021	N/A	N/A	N/A	N/A	N/A
47th	0,003	0,035	N/A	N/A	N/A	N/A	N/A
48th	0,002	0,019	N/A	N/A	N/A	N/A	N/A
49th	0,003	0,036	N/A	N/A	N/A	N/A	N/A
50th	0,002	0,017	N/A	N/A	N/A	N/A	N/A

Impedance [Ω]	
Line	$R_A = 0,24\ jX_A = 0,15$
Neutral	$R_N = 0,16\ jX_N = 0,10$

Note:

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5.2.4.1 b)	Test Harmonics DIN EN 61000-4-7											P
MST-HI-2200												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
Order	I_h [%]											
1	4,922	9,756	19,789	29,913	39,942	50,004	60,047	70,081	80,098	90,093	100,069	100,069
2	0,073	0,090	0,079	0,057	0,084	0,084	0,102	0,093	0,112	0,103	0,132	0,132
3	0,605	0,510	0,390	0,414	0,459	0,509	0,549	0,596	0,646	0,701	0,754	0,754
4	0,065	0,074	0,064	0,049	0,043	0,040	0,039	0,046	0,035	0,037	0,024	0,024
5	0,389	0,482	0,424	0,398	0,421	0,462	0,504	0,536	0,574	0,600	0,628	0,628
6	0,024	0,038	0,045	0,040	0,039	0,036	0,030	0,037	0,042	0,040	0,038	0,038
7	0,238	0,254	0,278	0,267	0,300	0,364	0,421	0,471	0,509	0,542	0,564	0,564
8	0,015	0,017	0,039	0,035	0,031	0,036	0,037	0,036	0,036	0,035	0,035	0,035
9	0,120	0,114	0,173	0,217	0,260	0,308	0,370	0,432	0,478	0,515	0,541	0,541
10	0,024	0,018	0,021	0,038	0,032	0,028	0,043	0,038	0,038	0,047	0,043	0,043
11	0,057	0,058	0,048	0,142	0,219	0,281	0,336	0,388	0,445	0,484	0,522	0,522
12	0,037	0,035	0,024	0,025	0,037	0,029	0,037	0,037	0,045	0,045	0,055	0,055
13	0,123	0,125	0,068	0,036	0,131	0,210	0,272	0,326	0,381	0,442	0,476	0,476
14	0,034	0,039	0,030	0,018	0,032	0,033	0,034	0,032	0,036	0,037	0,041	0,041
15	0,099	0,106	0,100	0,061	0,058	0,123	0,185	0,239	0,296	0,347	0,389	0,389
16	0,030	0,025	0,026	0,026	0,025	0,026	0,024	0,025	0,024	0,036	0,038	0,038
17	0,057	0,072	0,063	0,058	0,036	0,063	0,116	0,159	0,200	0,244	0,295	0,295
18	0,021	0,029	0,026	0,025	0,017	0,019	0,026	0,025	0,019	0,027	0,035	0,035
19	0,066	0,090	0,077	0,070	0,041	0,027	0,050	0,086	0,125	0,162	0,194	0,194
20	0,023	0,028	0,032	0,025	0,023	0,026	0,030	0,025	0,028	0,029	0,026	0,026
21	0,039	0,070	0,104	0,112	0,105	0,090	0,074	0,070	0,089	0,110	0,132	0,132
22	0,020	0,025	0,030	0,027	0,028	0,023	0,023	0,024	0,021	0,024	0,034	0,034
23	0,028	0,024	0,053	0,062	0,066	0,059	0,057	0,059	0,075	0,088	0,110	0,110
24	0,018	0,019	0,019	0,018	0,020	0,020	0,024	0,026	0,029	0,025	0,029	0,029
25	0,050	0,056	0,059	0,051	0,066	0,064	0,064	0,054	0,049	0,041	0,041	0,041
26	0,018	0,018	0,016	0,020	0,016	0,020	0,017	0,016	0,017	0,020	0,023	0,023
27	0,032	0,050	0,066	0,061	0,071	0,068	0,078	0,079	0,072	0,068	0,075	0,075
28	0,017	0,022	0,020	0,021	0,023	0,018	0,015	0,025	0,019	0,017	0,020	0,020
29	0,064	0,038	0,032	0,031	0,037	0,031	0,030	0,027	0,030	0,031	0,023	0,023
30	0,015	0,018	0,019	0,019	0,023	0,026	0,024	0,026	0,022	0,026	0,025	0,025
31	0,049	0,059	0,090	0,076	0,086	0,070	0,065	0,067	0,060	0,056	0,047	0,047
32	0,014	0,018	0,019	0,021	0,020	0,017	0,018	0,018	0,017	0,020	0,019	0,019
33	0,073	0,060	0,078	0,072	0,066	0,066	0,065	0,055	0,052	0,042	0,035	0,035
34	0,015	0,016	0,017	0,016	0,018	0,022	0,016	0,016	0,015	0,016	0,024	0,024
35	0,071	0,069	0,066	0,062	0,048	0,034	0,016	0,018	0,015	0,013	0,026	0,026
36	0,016	0,016	0,012	0,021	0,015	0,021	0,017	0,020	0,023	0,018	0,025	0,025
37	0,056	0,045	0,050	0,048	0,033	0,027	0,027	0,027	0,037	0,035	0,043	0,043
38	0,016	0,019	0,022	0,024	0,024	0,020	0,019	0,024	0,029	0,022	0,026	0,026
39	0,049	0,046	0,035	0,025	0,017	0,013	0,014	0,015	0,021	0,021	0,028	0,028
40	0,017	0,022	0,018	0,017	0,019	0,018	0,019	0,017	0,018	0,019	0,025	0,025
41	0,030	0,025	0,024	0,032	0,030	0,028	0,023	0,028	0,027	0,033	0,035	0,035
42	0,017	0,017	0,018	0,024	0,020	0,022	0,019	0,019	0,021	0,017	0,024	0,024
43	0,036	0,036	0,031	0,033	0,025	0,019	0,013	0,014	0,017	0,019	0,029	0,029

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5.2.4.1 b)	Test Harmonics DIN EN 61000-4-7											P
MST-HI-2200												
Harmonics												
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
44	0,015	0,022	0,024	0,020	0,022	0,017	0,016	0,015	0,016	0,022	0,028	0,028
45	0,033	0,032	0,026	0,017	0,008	0,008	0,008	0,011	0,020	0,021	0,021	0,021
46	0,017	0,020	0,014	0,019	0,016	0,021	0,017	0,014	0,013	0,020	0,021	0,021
47	0,026	0,029	0,021	0,020	0,014	0,014	0,014	0,015	0,015	0,027	0,035	0,035
48	0,017	0,017	0,022	0,017	0,018	0,016	0,014	0,015	0,018	0,017	0,019	0,019
49	0,033	0,034	0,024	0,025	0,023	0,015	0,014	0,021	0,024	0,030	0,036	0,036
50	0,020	0,021	0,015	0,016	0,015	0,014	0,013	0,011	0,012	0,019	0,017	0,017

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5.2.4.1 b)	Interharmonics											P
MST-HI-2200												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [Hz]	I_h [%]											
75	0,019	0,024	0,044	0,055	0,085	0,096	0,122	0,131	0,146	0,175	0,194	0,194
125	0,017	0,018	0,020	0,022	0,025	0,026	0,028	0,032	0,034	0,041	0,048	0,048
175	0,021	0,020	0,021	0,021	0,024	0,026	0,029	0,030	0,031	0,038	0,038	0,038
225	0,018	0,019	0,021	0,022	0,028	0,025	0,030	0,032	0,031	0,034	0,035	0,035
275	0,024	0,022	0,024	0,024	0,032	0,029	0,030	0,031	0,033	0,035	0,036	0,036
325	0,034	0,035	0,036	0,039	0,037	0,040	0,042	0,040	0,039	0,045	0,046	0,046
375	0,028	0,026	0,026	0,030	0,031	0,032	0,034	0,034	0,039	0,039	0,040	0,040
425	0,030	0,027	0,027	0,032	0,033	0,039	0,041	0,037	0,040	0,040	0,042	0,042
475	0,029	0,028	0,029	0,032	0,038	0,037	0,037	0,042	0,039	0,042	0,042	0,042
525	0,029	0,029	0,030	0,031	0,038	0,040	0,041	0,041	0,045	0,042	0,043	0,043
575	0,031	0,032	0,034	0,039	0,038	0,043	0,044	0,044	0,044	0,047	0,050	0,050
625	0,032	0,036	0,040	0,039	0,043	0,045	0,045	0,045	0,043	0,045	0,042	0,042
675	0,032	0,038	0,040	0,049	0,046	0,054	0,053	0,055	0,061	0,062	0,067	0,067
725	0,033	0,037	0,033	0,041	0,042	0,040	0,045	0,045	0,042	0,042	0,047	0,047
775	0,034	0,035	0,035	0,040	0,043	0,045	0,050	0,056	0,057	0,064	0,063	0,063
825	0,037	0,035	0,037	0,043	0,041	0,047	0,050	0,050	0,050	0,051	0,052	0,052
875	0,038	0,034	0,037	0,040	0,047	0,052	0,055	0,064	0,069	0,084	0,090	0,090
925	0,041	0,042	0,047	0,048	0,053	0,050	0,055	0,059	0,051	0,053	0,054	0,054
975	0,036	0,035	0,038	0,044	0,045	0,054	0,057	0,066	0,072	0,078	0,085	0,085
1025	0,034	0,036	0,036	0,037	0,042	0,046	0,053	0,049	0,051	0,050	0,058	0,058
1075	0,035	0,033	0,036	0,042	0,042	0,045	0,058	0,057	0,065	0,070	0,072	0,072
1125	0,034	0,036	0,037	0,042	0,044	0,047	0,049	0,049	0,055	0,054	0,057	0,057
1175	0,035	0,038	0,037	0,044	0,045	0,053	0,055	0,057	0,061	0,059	0,070	0,070
1225	0,041	0,045	0,050	0,052	0,055	0,061	0,064	0,065	0,057	0,066	0,067	0,067
1275	0,033	0,034	0,034	0,037	0,041	0,043	0,045	0,047	0,052	0,056	0,058	0,058
1325	0,035	0,037	0,038	0,036	0,044	0,045	0,049	0,053	0,055	0,054	0,056	0,056
1375	0,033	0,033	0,035	0,038	0,043	0,044	0,045	0,051	0,054	0,058	0,060	0,060
1425	0,034	0,036	0,034	0,037	0,041	0,051	0,052	0,053	0,051	0,058	0,059	0,059
1475	0,029	0,034	0,032	0,035	0,041	0,045	0,049	0,053	0,065	0,064	0,060	0,060
1525	0,028	0,039	0,032	0,039	0,039	0,041	0,043	0,049	0,047	0,055	0,054	0,054
1575	0,026	0,029	0,031	0,034	0,037	0,038	0,043	0,045	0,050	0,054	0,060	0,060
1625	0,029	0,034	0,032	0,033	0,045	0,038	0,046	0,049	0,055	0,055	0,060	0,060
1675	0,027	0,029	0,029	0,033	0,037	0,038	0,041	0,048	0,049	0,058	0,067	0,067
1725	0,028	0,033	0,029	0,032	0,035	0,039	0,041	0,043	0,049	0,051	0,069	0,069
1775	0,036	0,031	0,026	0,026	0,034	0,042	0,056	0,064	0,086	0,100	0,122	0,122
1825	0,030	0,037	0,035	0,037	0,036	0,050	0,048	0,055	0,061	0,071	0,078	0,078
1875	0,111	0,118	0,137	0,146	0,158	0,169	0,196	0,210	0,242	0,256	0,294	0,294
1925	0,027	0,029	0,029	0,032	0,031	0,041	0,041	0,047	0,054	0,060	0,070	0,070
1975	0,026	0,029	0,032	0,033	0,039	0,042	0,056	0,067	0,082	0,113	0,132	0,132

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5.2.4.1 b)	Higher Frequencies											P
MST-HI-2200												
P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100	Max
f [kHz]	I_h [%]											
2,1	0,070	0,074	0,079	0,082	0,083	0,083	0,089	0,099	0,108	0,136	0,158	0,158
2,3	0,066	0,072	0,066	0,065	0,066	0,071	0,078	0,088	0,101	0,124	0,144	0,144
2,5	0,073	0,079	0,063	0,066	0,065	0,062	0,071	0,082	0,091	0,104	0,123	0,123
2,7	0,059	0,060	0,055	0,064	0,081	0,097	0,111	0,118	0,127	0,137	0,148	0,148
2,9	0,065	0,065	0,074	0,087	0,098	0,101	0,101	0,104	0,104	0,114	0,114	0,114
3,1	0,082	0,087	0,090	0,096	0,100	0,099	0,097	0,094	0,094	0,106	0,102	0,102
3,3	0,101	0,090	0,080	0,082	0,090	0,094	0,095	0,094	0,097	0,107	0,105	0,105
3,5	0,071	0,079	0,091	0,094	0,092	0,088	0,083	0,080	0,083	0,084	0,088	0,088
3,7	0,081	0,082	0,079	0,073	0,075	0,077	0,081	0,080	0,083	0,090	0,090	0,090
3,9	0,090	0,081	0,068	0,065	0,067	0,072	0,077	0,083	0,088	0,094	0,117	0,117
4,1	0,083	0,079	0,078	0,084	0,087	0,096	0,101	0,112	0,116	0,118	0,114	0,114
4,3	0,059	0,065	0,070	0,077	0,085	0,093	0,098	0,107	0,109	0,123	0,124	0,124
4,5	0,137	0,116	0,089	0,100	0,132	0,164	0,197	0,226	0,249	0,270	0,272	0,272
4,7	0,320	0,373	0,442	0,540	0,642	0,733	0,825	0,895	0,932	0,975	0,956	0,956
4,9	0,072	0,075	0,066	0,067	0,073	0,093	0,112	0,140	0,171	0,217	0,230	0,230
5,1	0,043	0,044	0,047	0,051	0,053	0,059	0,065	0,066	0,078	0,084	0,089	0,089
5,3	0,047	0,049	0,048	0,049	0,047	0,047	0,049	0,048	0,051	0,056	0,062	0,062
5,5	0,054	0,051	0,067	0,058	0,051	0,054	0,053	0,056	0,050	0,059	0,059	0,059
5,7	0,168	0,175	0,193	0,205	0,221	0,233	0,245	0,255	0,261	0,262	0,063	0,063
5,9	0,075	0,071	0,042	0,044	0,045	0,043	0,056	0,059	0,060	0,099	0,266	0,266
6,1	0,041	0,053	0,054	0,058	0,066	0,052	0,076	0,070	0,058	0,119	0,123	0,123
6,3	0,029	0,027	0,026	0,025	0,026	0,027	0,030	0,029	0,032	0,034	0,034	0,034
6,5	0,024	0,025	0,024	0,023	0,023	0,023	0,026	0,025	0,027	0,029	0,031	0,031
6,7	0,021	0,022	0,022	0,023	0,024	0,022	0,024	0,022	0,024	0,025	0,026	0,026
6,9	0,020	0,021	0,019	0,021	0,021	0,020	0,022	0,021	0,021	0,022	0,023	0,023
7,1	0,018	0,020	0,018	0,019	0,021	0,018	0,020	0,020	0,020	0,020	0,021	0,021
7,3	0,018	0,020	0,019	0,020	0,021	0,020	0,021	0,021	0,021	0,022	0,022	0,022
7,5	0,026	0,026	0,026	0,026	0,027	0,026	0,027	0,027	0,027	0,028	0,027	0,027
7,7	0,017	0,017	0,016	0,017	0,017	0,017	0,017	0,017	0,017	0,017	0,022	0,022
7,9	0,016	0,017	0,015	0,015	0,015	0,015	0,016	0,016	0,015	0,015	0,039	0,039
8,1	0,017	0,015	0,015	0,048	0,049	0,049	0,049	0,050	0,016	0,015	0,022	0,022
8,3	0,025	0,051	0,049	0,015	0,014	0,014	0,014	0,014	0,052	0,032	0,032	0,032
8,5	0,051	0,024	0,025	0,019	0,017	0,019	0,020	0,017	0,028	0,055	0,013	0,013
8,7	0,021	0,021	0,023	0,026	0,027	0,024	0,025	0,027	0,021	0,026	0,013	0,013
8,9	0,021	0,023	0,021	0,018	0,016	0,016	0,016	0,015	0,024	0,022	0,058	0,058
Impedance [Ω]												
					Line	$R_A = 0,24$ $jX_A = 0,15$						
					Neutral	$R_N = 0,16$ $jX_N = 0,10$						

Note:

The normalization current is 9,57 A.

The harmonics, interharmonics and higher frequencies are maximum values of all three phases.

The currents of the interharmonics to 2 kHz must be measured in accordance with DIN EN 61000-4-7 (VDE 0817-4-7), Annex A. The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with DIN EN 61000-4-7 (VDE 0847-4-7), Annex B.

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5,2,6	Feed in of DC current	P

Test:

Phase1

Power Level [% of VA_r]	30% S_{Emax} to 40% S_{Emax}	60% S_{Emax} to 70% S_{Emax}	>95% S_{Emax}
AC Power [VA]	722,4	1432,4	2205,2
AC Voltage [V]	229,9	229,9	229,9
AC Current [A]	3,148	6,238	9,601
DC Current in AC [A]	0,009	0,022	0,018
DC Current in AC [% of I_r]	0,089	0,228	0,185

Test:

The inverter must be used in the adjustment range Test 1, Test 2 and Test 3, Each test point shall be held for min 5 minutes and I_{AC}, U_{AC}, $I_{dc\ in\ AC}$ of each phase has to be recorded, Measurement of $I_{dc\ in\ AC}$ must be done according to VDE AR-N 4100:2020-06 based on DIN EN 61000-4-7 (VDE-0847-4-7) over 10 fundamental periods,

Assessment criterion:

An inverter must not feed more than 0,5% of its rated current I_r or a maximum of 20 mA (the higher value is to be selected) as direct current,

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DIN VDE V 0124-100		
Clause	**Requirement – Test**	**Verdict**
5,4	**Evidence of the behaviour of the generating unit on the network**	
5,4,1	General	**P**
5,4,2	Measurement of the active and reactive power range	**P**
5,4,3,2 **5,4,3,3**	Measurement of setting accuracy	**P**
5,4,3,4	Measurement of the power gradient	**P**
5,4,3,5	Measurement Priority Interfaces / Energy Management	**P**
5,4,4	Active power feed-in for PGUs at overfrequency	**N/A**
5,4,5	Active power feed-in of Storage systems for overfrequency	**P**
5,4,6	Active power feed-in for PGUs at underfrequency	**N/A**
5,4,7	Active power feed-in for storage systems at underfrequency	**P**
5,4,8	Static voltage stability / reactive power supply	**P**
5,4,8,2	Tests of the Reactive power / cos φ setting accuracy	**P**
	The regulating and control behaviour of the reactive power	**P**
5,4,8,3	Test of the displacement factor/active power characteristic curve cos φ (P)	**P**
	Test 1) for conducted PGUs - Accuracy (characteristic)	**N/A**
	Test 2) for conducted PGUs - dynamics	**N/A**
	Test 3) supply-dependent PGUs - Accuracy (characteristic curve)	**P**
	Test 4) supply-dependent PGUs - Dynamic	**P**
5,4,8,4,1	Test of the accuracy of the Q(U) regulation	**N/A**
5,4,8,4,2	Test of the dynamics of the Q(U) regulation	**N/A**

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5,4,1	**General** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11, 5,7,2,2 are met and to determine the values for S_{Emax} and P_{Emax})	**P**
Test Condition:	The measurements were performed in the testing laboratory at the grid-simulator, Test voltage between 0,9 Un and 1,09 Un with ±2% Un until the test Test frequency: 50,0 Hz ± 0,5%	
Note: If an examination is required for any other requirements, these apply to this test,		

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5,4,2	**Measurement of the active power and reactive power range** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11, 5,7,2,2 are met and to determine the values for S_{Emax} and P_{Emax})	**P**

Test:

MST-HI-2200

600 s mean value	U [V]	$P_{Emax600\ c)}$ [W]	$S_{Emax600\ c)}$ [VA]	cos $\varphi_{Emax600}$ [1]
0,90 U_n at 100% P_{Emax}				
cos φ = 1	206,9	2217,7	2220,0	0,9990
cos φ max, over-excited	206,9	2225,0	2350,0	0,9468
0,95 U_n at 100% P_{Emax}				
cos φ max, under-excited	218,9	2204,9	2320,9	0,9500
1,0 U_n at 100% P_{Emax}				
cos φ = 1	229,9	2205,2	2207,0	0,9992
cos φ max, under-excited	229,9	2199,7	2312,8	0,9511
cos φ max, over-excited	229,9	2213,2	2344,6	0,9439
1,05 U_n at 100% P_{Emax}				
cos φ max, over-excited	241,9	2207,5	2343,1	0,9421
1,09 U_n at 100% P_{Emax}				
cos φ = 1	250,8	2196,6	2197,9	0,9994
cos φ max, under-excited	250,8	2190,2	2296,1	0,9539

$S_{Emax600}$ and $P_{Emax\ 600}$	
$S_{Emax600}$= max ($S_{Emax600\ a)}$, $S_{Emax600\ b)}$, $S_{Emax600\ c)}$) [VA]	2344,6
$P_{Emax\ 600}$= max ($P_{Emax600\ a)}$, $P_{Emax600\ b)}$, $P_{Emax600\ c)}$) [W]	2225,0

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5,4,3 **5,4,3,2** **5,4,3,3**	**Measurement of setting accuracy**	**P**

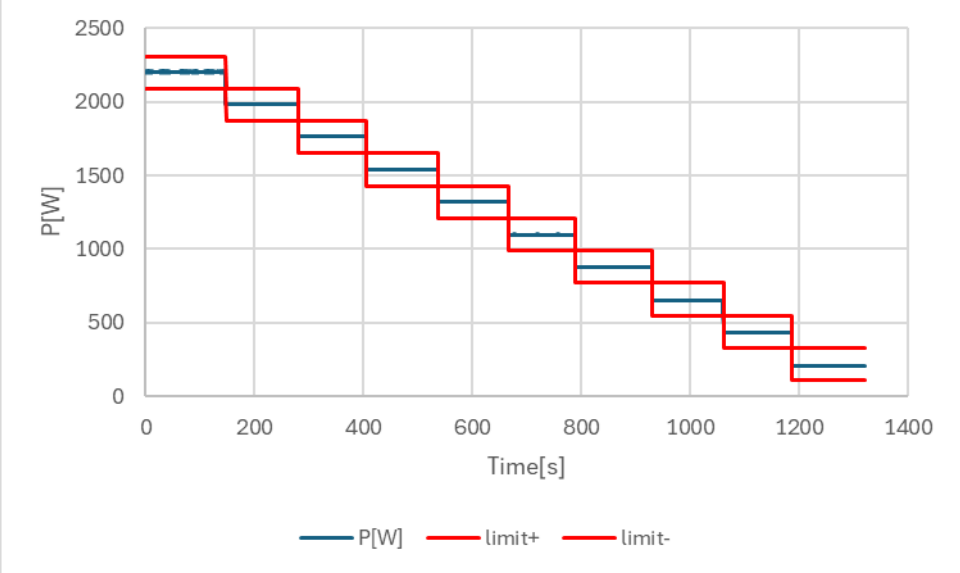
Test:

1-min mean value P/P_{rE} [%]	100	90	80	70	60	50	40	30	20	10
$P_{Setpoint}$ [W]	2200	1980	1760	1540	1320	1100	880	660	440	220
P_{E60} [W]	2205	1984	1763	1543	1321	1098	877	655	431	208
ΔP_{E60} [%]	0,23	0,18	0,14	0,14	0,05	-0,09	-0,14	-0,23	-0,41	-0,55

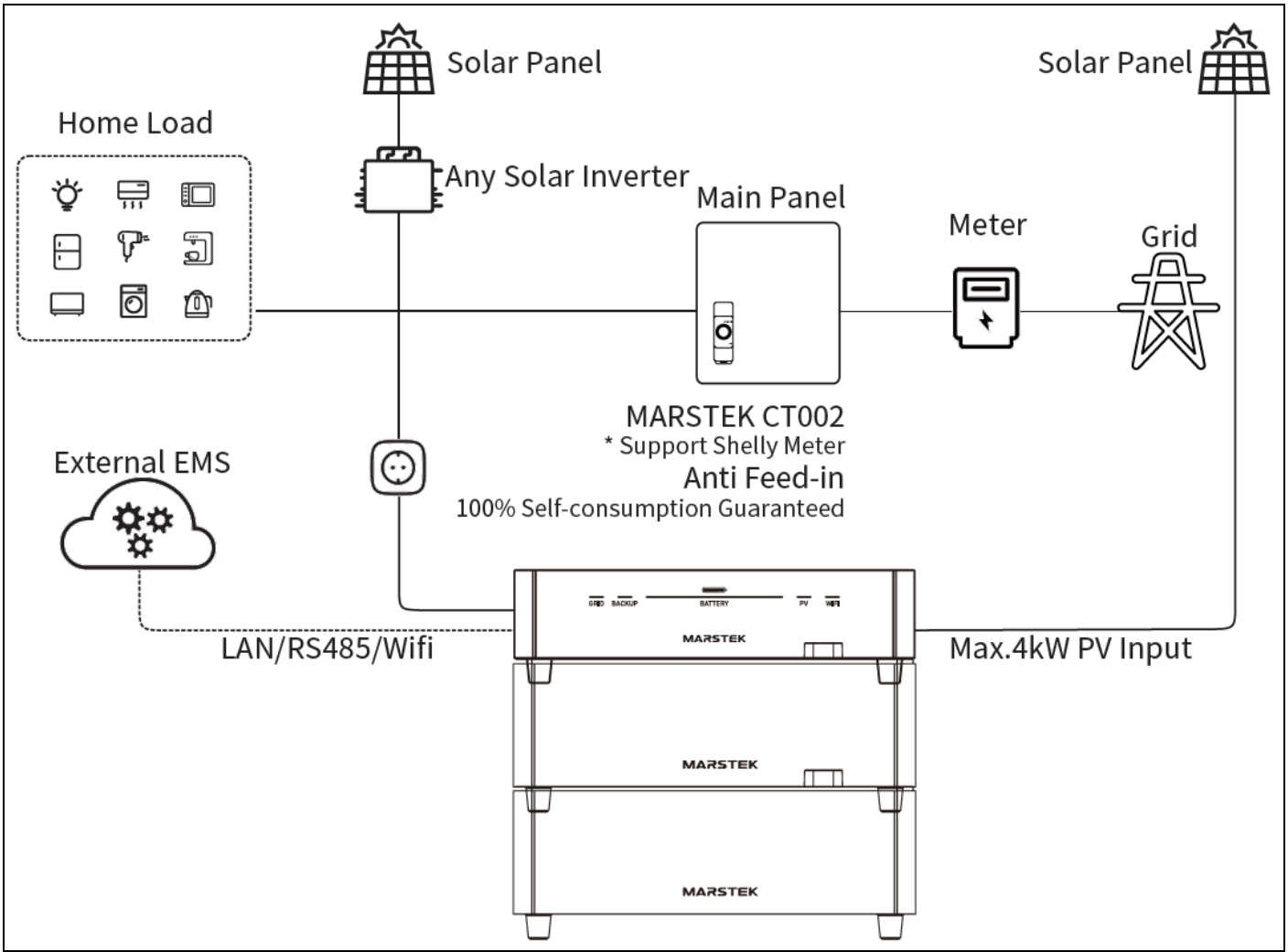
Limit

ΔP_{E60} in %	≤ ±5% of P_{rE}	P

Graph of the setting accuracy:



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Test:

The setpoint signal must be reduced from 100% to 10% P_{rE}:

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

Assessment criterion:

a) for adjustable PGUs:

- no network disconnection
- the active power value does not exceed the setpoint by more than ±5% P_{rE}
- the setting time determined this way is ≤1 min

Note:

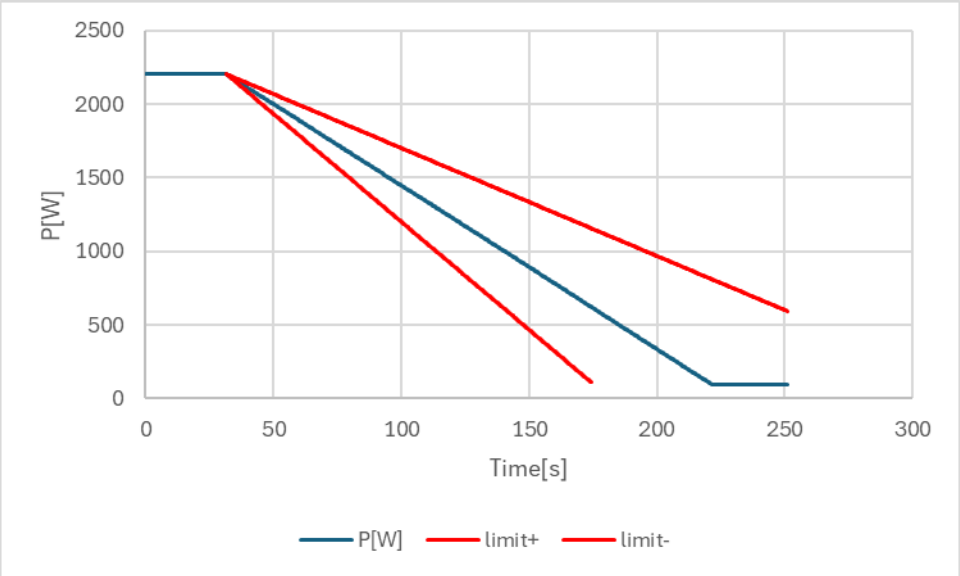
The setting time is ≤ 1min, See below “Graph of the setting accuracy”,

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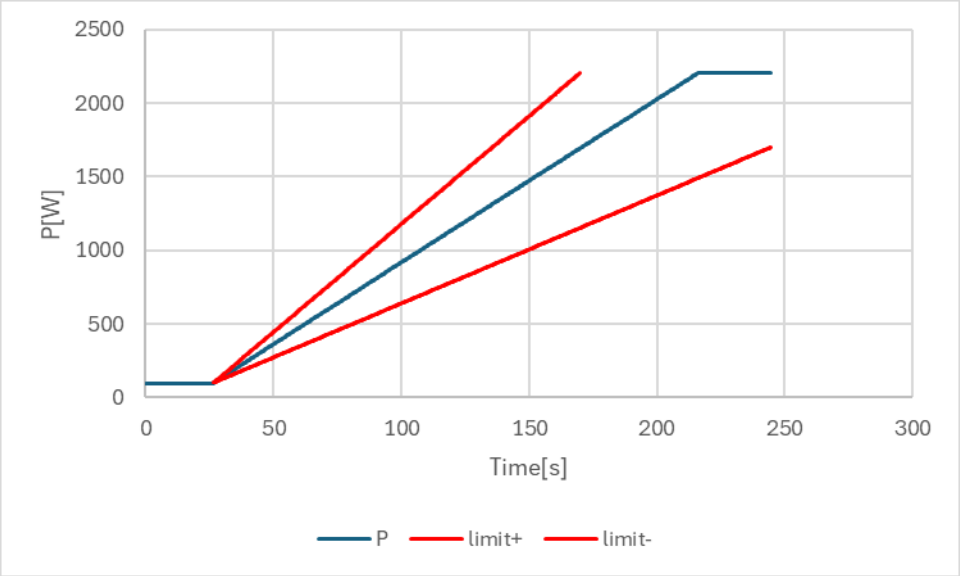
5,4,3,4	Measurement of the power gradient	P

Test:

Graph of the gradient <5% to 100% P_{rE}



Graph of the gradient 100% to <5% P_{rE}



Test:

The measurement of the power gradient takes place :

- Via a setpoint change from 100% to 5% of the rated effective power P_{rE} at time t_0, If the technical performance is >5%, this should be specified,

- Via a setpoint change from 5% to 100% of the rated effective power P_{rE} at time t_0, Is the technical Performance >5%, this should be specified,

Assessment criterion:

for adjustable PGUs:

- no network disconnection

- the active power value does not exceed the setpoint by more than 5% P_{rE}

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- the power gradient determined according 5,4,3,4 not be less than 0,33% P_{rE}/s and not more than 0,66% P_{rE}/s, The first gradient is to be created 30 s after the setpoint jump has been set,

The formation of gradients is ended 30 s before the static end value is reached,

NOTE These times were determined by the maximum or minimum prescribed gradients and with a performance delta of ±10% P_{rE} around the target value,

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5,4,3,5	Measurement priority interfaces / energy management system	P

Test:

a) The lowest setpoint is always given priority
b) the setpoint at the interface programmed for the NSM is never exceeded

		$P/P_{rE\ Setpoint}$	$P/P_{rE\ Measured}$
Test 1	Interface NSM (Digital inputs)	0,7	0,71
	Interface low Priority Modbus, TCP IP etc, (Software)	0,9	
Test 2	Interface NSM (Digital inputs)	0,9	0,52
	Interface low Priority Modbus, TCP IP etc, (Software)	0,5	

Note:

a) Software to set setpoint at the interface with low priority is Modbus etc, The interface NSM (Digital Inputs) have always priority,
b) The setpoint at the interface programmed for the NSM is never exceeded,

Assessment criterion:

for measurements 5,4,3,5 either

a) the lowest setpoint is always given priority

or

b) the setpoint at the interface programmed for the NSM is never exceeded

- When the logical interface (input port) was tested, the active power feed-in of the PGU was completely terminated within a maximum of 5 s after the change in status of the logical signal,

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5,4,4	**Active power feed-in of Storage systems for overfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)	**P**

Test cycle for adjustable PGUs:										
Test 1:										
1-min mean value:	50,00	50,25	50,70	51,40	50,70	50,25	50,00	51,65	50,15	50,00
Expected active power output [% of P_{Emax}]	100	98	80	52	80	98	100	0	0	100
Measurement: 100% P_{Emax}; start frequency 50,20Hz; droop setting s = 5% (40% P_{ref}/Hz)										
Frequency [Hz]	50,00	50,25	50,70	51,40	50,70	50,25	50,00	51,65	50,15	50,00
$P_{setpoint}$ [W]	2200	2156	1760	1144	1760	2156	2200	0	0	2200
P_{E60} [W]	2202	2159	1761	1146	1762	2158	2201	-12	-12	2202
ΔP_{E60} [%]	0,09	0,14	0,05	0,09	0,09	0,09	0,05	-0,55	-0,55	0.09
Available DC-power [%]	100									

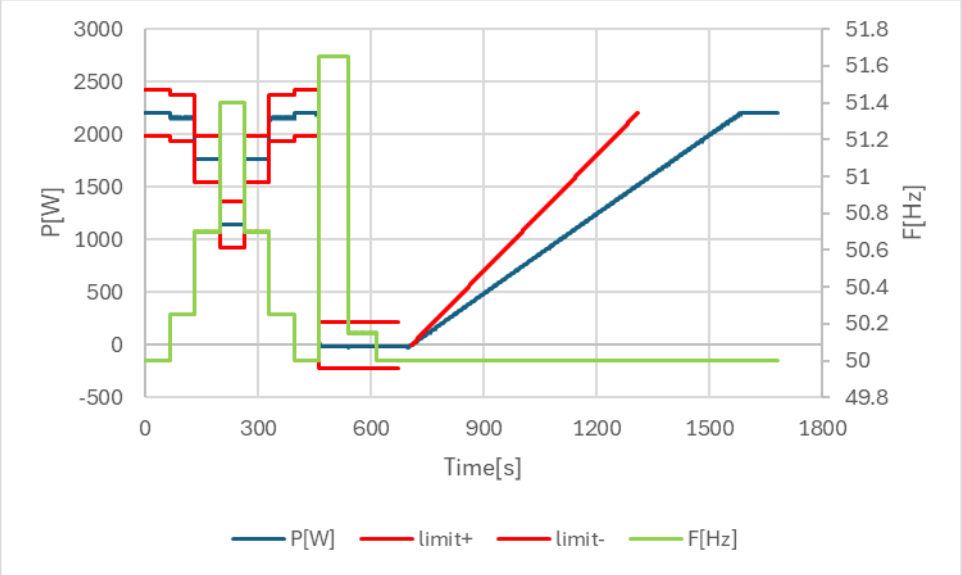
Test 2:							
1-min mean value:	50,00	50,40	50,70	51,40	50,70	50,40	50,00
Expected active power output [% of P_{Emax}]	60	60	52	24	52	60 - 100	100
Measurement: 60% P_{Emax}; start frequency 50,50Hz; droop setting s = 12% (16,67% P_{ref}/Hz)							
Frequency [Hz]	50,00	50,40	50,70	51,40	50,70	50,40	50,00
$P_{setpoint}$ [W]	1320	1320	1144	528	1144	2200	2200
P_{E60} [W]	1321	1321	1141	521	1143	2205	2205
ΔP_{E60} [%]	0,05	0,05	-0,14	-0,32	-0,05	0,23	0,23
Available DC-power [%]	60		100				

Limit		
ΔP_{E60} in %	≤ ±10% of P_{Emax}	P

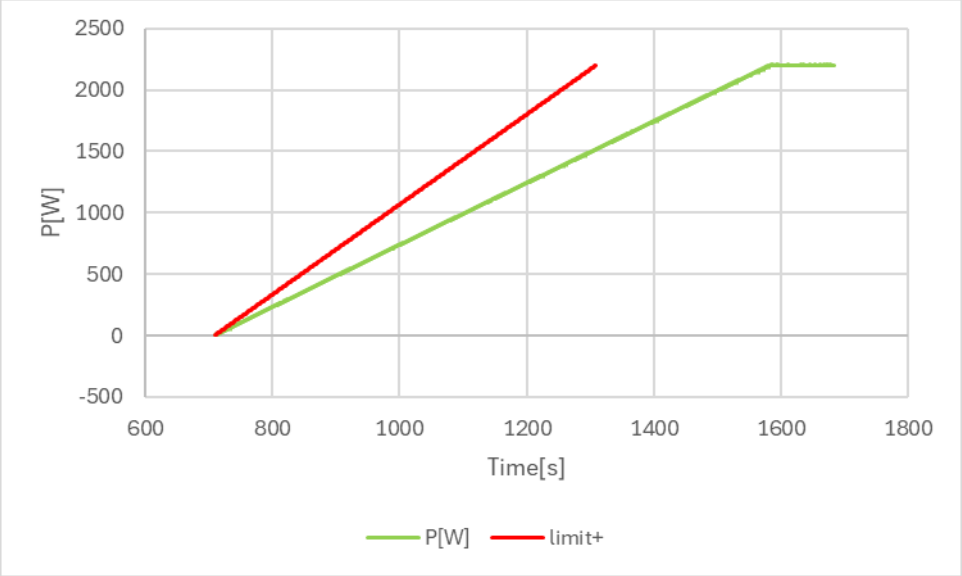
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5,4,4	**Active power feed-in of Storage systems for overfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)	**P**

Graph Test 1@ 100% P_{Emax}



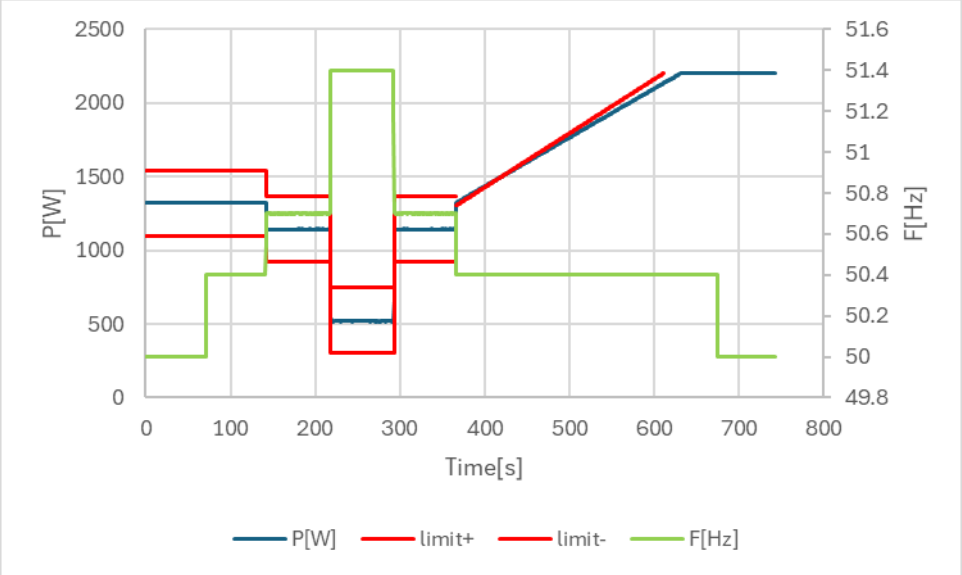
Gradient Test 1



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5,4,4	**Active power feed-in of Storage systems for overfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)	**P**

Graph Test2 @ 60% P_{Emax}



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5,4,4	**Active power feed-in of Storage systems for overfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)	**P**

Assessment criterion:

The test is regarded as passed:

a) for controllable PGU if:

- The active power reduces between measuring points 5,4,4,1 a) to g) and j), the expected active power output, after settling, adjusts with a deviation ≤ ±10% P_{Emax},

In the measurement points h) and i) shall no active power be given,

- The initial time delay T_V of the frequency-dependent adaptation of the active power output ≤ 2 s,

- The response time of the adaptation of the active power output is a maximum of 8 s (type 1 units and type 2 units with rotating machines) or 2 s (all other type 2 units)

- the settling time of the adaptation of the active power output is a maximum time of 30 s (for type 1 units and for type 2 units with rotating machines) or respectively a maximum time of 20 s (for all other generation units type 2) and

- The connection time at point j) is at least 60 s and the power is then increased with a gradient of ≤ 10% P_{Emax}/min,

- In the case of generating units with combustion engines or gas turbines, if the criteria for response time and settling time are not met, the test shall be passed, even if the adaptation of active power output occurs with a power gradient of at least 66% P_{Emax} per min (corresponding to 1,11% P_{Emax} per s),

b) for conditionally adjustable PGU, if:

- they behave as described in a) inside their control range and

- outside the control range, the power supplied when leaving the control range remains constant until it is switched off

- the connection time in j) and where appropriate in g) corresponds to the manufacturer's information on the random number generator;

NOTE: The Uniform distribution of the disconnection frequency in maximum increments of 0,1 Hz between the end of the control range (at least 50,2 Hz) and 51,5 Hz shall be proofed by a manufacturer's declaration,

c) for non-adjustable PGU, if

- a disconnection takes place between 50,2 Hz and 51,5 Hz;

- the connection time in j) and where appropriate in g) corresponds to the manufacturer's information on the random number generator;

NOTE The Uniform distribution of the disconnection frequency in maximum increments of 0,1 Hz between 50,2 Hz and 51,5 Hz shall be proofed by a manufacturer's declaration,

d) for linear generators with S_{Emax} ≤ 4,6 kVA,

- if they disconnect from the mains at a frequency ≥ 50,2 Hz and their maximum upper frequency limit (as specified by the manufacturer), but at the latest when they exceed 51,5 Hz,

- the connection time in j) and where appropriate in g) corresponds to the manufacturer's information on the random number generator;

Subsequently no more resynchronisation/active power feed-in is permitted, also while the frequency 5,4,4,1 i) is maintained (i,e, no running on the characteristic curve as previously tested in a) at g),

Note:

*At this point, a gradient is run from 60% to 100%, so an exact value cannot be determined

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5,4,6	**Active power feed-in for Storage systems at underfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5,7,4,3, and VDE-AR-N 4105:2018-11 8,3,1, are met)	**P**

Test cycle for adjustable PGUs:										
Test 1:										
1-min mean value:	50,00	49,75	48,80	47,60	48,80	49,85	50,00	47,35	47,60	50,00
Expected active power output [% of P_{Emax}]:	-100	-95	0	100	0	-100	-100	0	0	-100
Measurement: -100% P_{Emax}; start frequency 49,80Hz; droop setting s = 5% (40% P_{ref}/Hz)										
Frequency [Hz]:	50,00	49,75	48,80	47,60	48,80	49,75	50,00	47,35	47,60	50,00
$P_{setpoint}$ [W]:	-2200	-2090	0	2200	0	-2200	-2200	0	0	-2200
P_{E60} [W]:	-2201	-2091	-15	2203	-15	-2202	-2202	-14	-14	-2203
ΔP_{E60} [%]	-0,05	-0,05	-0,68	0,14	-0,68	-0,09	-0,09	-0,64	-0,64	-0,14
Available DC-power [%]:	-100%									

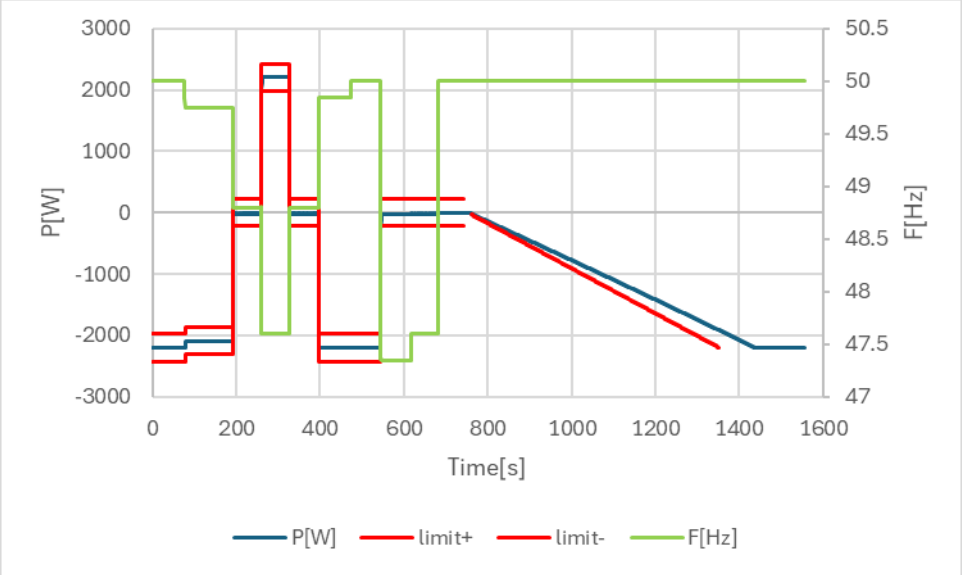
Test 2:							
1-min mean value:	50,00	49,75	48,80	47,60	48,80	49,85	50,00
Expected active power output [% of P_{Emax}]:	10	15	100	100	100	10	10
Measurement: 10% P_{Emax}; start frequency 49,80Hz; droop setting s = 5% (40% P_{ref}/Hz)							
Frequency [Hz]:	50,00	49,75	49,20	48,80	49,20	49,85	50,00
$P_{setpoint}$ [W]:	220	330	2200	2200	2200	220	220
P_{E60} [W]:	218	329	2202	2202	2203	218	218
ΔP_{E60} [%]	-0,09	-0,05	0,09	0,09	0,14	-0,09	-0,09
Available DC-power [%]:	10%						

Limit:		
ΔP_{E60} in %	≤ ±10% of P_{Emax}	P

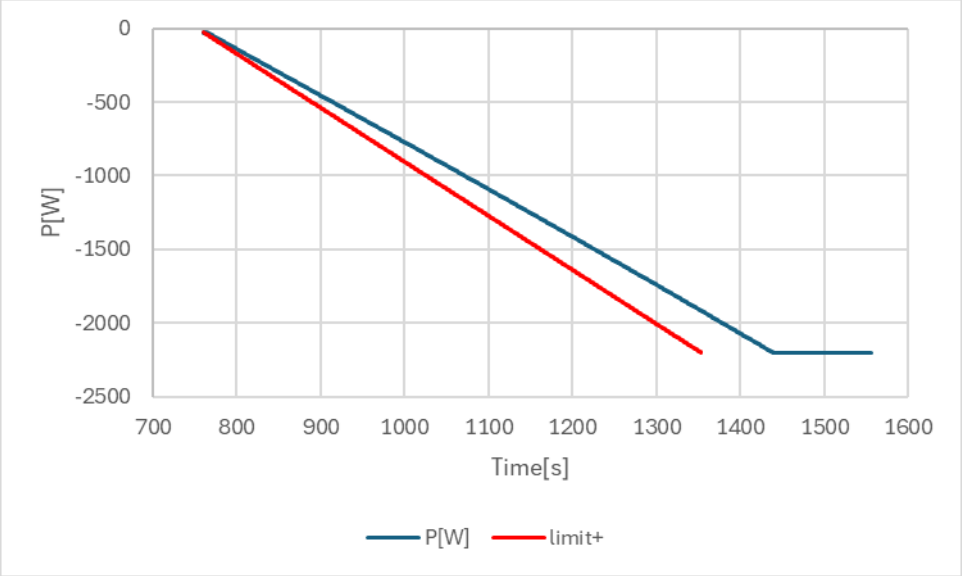
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5,4,6	**Active power feed-in for Storage systems at underfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5,7,4,3, and VDE-AR-N 4105:2018-11 8,3,1, are met)	**P**

Graph Test 1@ 100% P_{Emax}



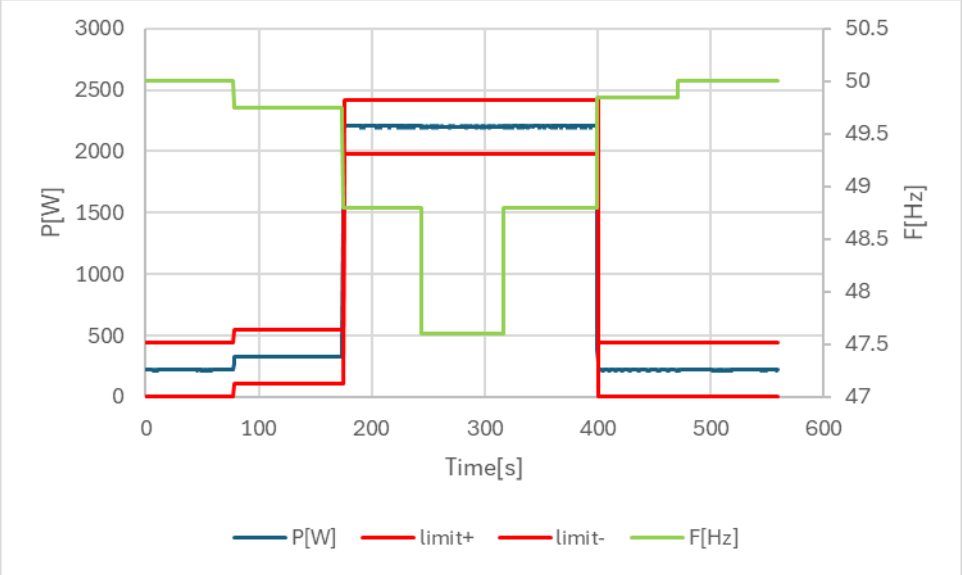
Gradient Test 1



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5,4,6	**Active power feed-in for Storage systems at underfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5,7,4,3, and VDE-AR-N 4105:2018-11 8,3,1, are met)	**P**

Graph Test2 @ 60% P_{Emax}



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5,4,6	**Active power feed-in for Storage systems at underfrequency** (these tests are designed to provide evidence that the requirements of VDE-AR-N 4105:2018-11 5,7,4,3, and VDE-AR-N 4105:2018-11 8,3,1, are met)	**P**

Assessment criterion:

The test is regarded as passed:

a) for controllable PGU if:

- The active power reduces between measuring points 5,4,4,1 a) to g) and j), the expected active power output, after settling, adjusts with a deviation ≤ ±10% P_{Emax}, Deviations according to VDE-AR-N 4105: 2018-11, 5,7,4,3, Figure 13 and due to the technical restrictions described are permissible, In the measuring points h) and i) no active power may be delivered,

- The initial time delay T_V of the frequency-dependent adaptation of the active power output ≤ 2 s,

- The response time of the adaptation of the active power output is a maximum of 8 s (type 1 units and type 2 units with rotating machines) or 2 s (all other type 2 units)

- the settling time of the adaptation of the active power output is a maximum time of 30 s (for type 1 units and for type 2 units with rotating machines) or respectively a maximum time of 20 s (for all other generation units type 2) and

- The connection time at point j) is at least 60 s and the power is then increased with a gradient of ≤ 10% P_{Emax} / min,

- In the case of generating units with combustion engines or gas turbines, if the criteria for response time and settling time are not met, the test shall be passed, even if the adaptation of active power output occurs with a power gradient of at least 66% P_{Emax} per min (corresponding to 1,11% P_{Emax} per s),

b) for conditionally adjustable PGU, if:

- they behave as descripted in a) inside their control range and

- no disconnection takes place between 49,8 Hz and 47,5 Hz;

- the connection time in j) corresponds to the manufacturer's information on the random number generator;

NOTE: The Uniform distribution of the disconnection frequency in maximum increments of 0,1 Hz between the end of the control range (at least 50,2 Hz) and 51,5 Hz shall be proofed by a manufacturer's declaration,

c) for non-adjustable PGU, if

- no disconnection takes place between 49,8 Hz and 47,5 Hz;

- the connection time in j) corresponds to the manufacturer's information on the random number generator;

NOTE The Uniform distribution of the disconnection frequency in maximum increments of 0,1 Hz between 50,2 Hz and 51,5 Hz shall be proofed by a manufacturer's declaration,

d) for linear generators with S_{Emax} ≤ 4,6 kVA,

- if they disconnect from the mains at a frequency ≤ 49,8 Hz and their maximum upper frequency limit (as specified by the manufacturer), but at the latest when they exceed 47,5 Hz,

- the connection time in j) corresponds to the manufacturer's information on the random number generator;

Subsequently no more resynchronization/active power feed-in is permitted, also while the frequency 5,4,4,1 i) is maintained (i,e no running on the characteristic curve as previously tested in a) at g),

Note:

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5,4,8	**Static voltage stability / reactive power supply** The test serves as verification of the reactive power mode according to VD-AR-N 4105: 2018-11, 5,7,2 of the PGU in normal operation,	
5,4,8,2	**Tests of the Reactive power / cos φ setting accuracy**	**P**

Test:

60 s mean value	0,9 U_n		U_n		1,1 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}
cos φ 0,95 over-excited						
U [V]	206,9	207,0	229,9	230,0	252,8	253,0
P_{E60} [W]	1108,9	2201,3	1103,1	2201,6	1096,0	2201,5
Q_{E60} [VAr]	352,7	711,9	373,3	737,4	394,9	767,8
S_{E60} [VA]	1163,6	2313,6	1164,6	2321,8	1165,0	2331,5
cos $\varphi_{E60\ over\text{-}excited}$	0,9530	0,9515	0,9472	0,9482	0,9408	0,9442
$Q_{expected}$ [VA]	361,6	723,1	361,6	723,1	361,6	723,1
ΔQ_{E60} [%]	-0,40	-0,51	0,53	0,65	1,51	2,03
cos φ 0,95 under-excited						
U [V]	206,9	207,0	229,9	230,0	252,9	257,0
P_{E60} [W]	1100,3	2197,4	1096,5	2199,2	1090,0	2198,6
Q_{E60} [VAr]	-391,0	-762,0	-369,6	-731,9	-346,7	-696,5
S_{E60} [VA]	1167,7	2325,8	1157,1	2317,8	1143,8	2306,3
cos $\varphi_{E60\ under\text{-}excited}$	0,9423	0,9448	0,9476	0,9488	0,9529	0,9533
$Q_{expected}$ [VA]	-361,6	-723,1	-361,6	-723,1	-361,6	-723,1
ΔQ_{E60} [%]	-1,34	-1,77	-0,36	-0,40	0,68	1,21
cos φ 0,98 over-excited						
U [V]	206,9	207,0	229,9	230,0	252,9	253,0
P_{E60} [W]	1106,4	2201,7	1102,5	2201,8	1095,4	2201,8
Q_{E60} [Var]	211,1	432,0	232,1	459,2	253,6	487,4
S_{E60} [VA]	1126,4	2243,7	1126,7	2249,1	1124,3	2255,2
cos $\varphi_{E60\ over\text{-}excited}$	0,9823	0,9813	0,9786	0,9789	0,9742	0,9764
$Q_{expected}$ [VA]	223,4	446,7	223,4	446,7	223,4	446,7
ΔQ_{E60} [%]	-0,56	-0,67	0,40	0,57	1,37	1,85

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5,4,8	**Static voltage stability / reactive power supply** The test serves as verification of the reactive power mode according to VD-AR-N 4105: 2018-11, 5,7,2 of the PGU in normal operation,	
5,4,8,2	**Tests of the Reactive power / cos φ setting accuracy**	**P**

Test:						
60 s mean value	0,9 U_n		U_n		1,1 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}
cos φ 0,98 under-excited						
U [V]	206,9	207,0	229,9	230,0	252,9	253,0
P_{E60} [W]	1103,1	2199,8	1096,8	2199,7	1090,8	2199,5
Q_{E60} [Var]	-247,4	-480,4	-228,4	-453,1	-206,7	-424,5
S_{E60} [VA]	1130,5	2251,7	1120,3	2245,9	1110,3	2240,1
cos $\varphi_{E60\ under\text{-}excited}$	0,9758	0,9770	0,9790	0,9794	0,9825	0,9819
$Q_{expected}$ [VA]	-223,4	-446,7	-223,4	-446,7	-223,4	-446,7
ΔQ_{E60} [%]	-1,09	-1,53	-0,23	-0,29	0,76	1,01

Limit		
cos φ_{E60}	cos φ = 0,94 to 0,96 I and cos φ = 0,94 to 0,96 (i) cos φ = 0,97 to 0,99 I and cos φ = 0,97 to 0,99 (i)	P
cos φ settling steps	≤ 0,01	P
ΔQ_{E60} in %	≤ ±4% P_{Emax}	P

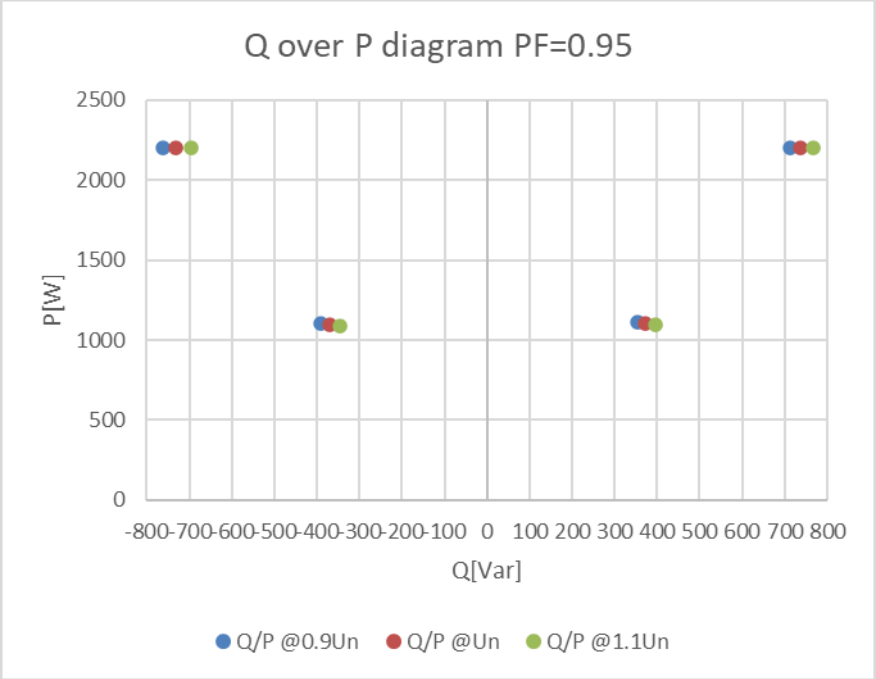
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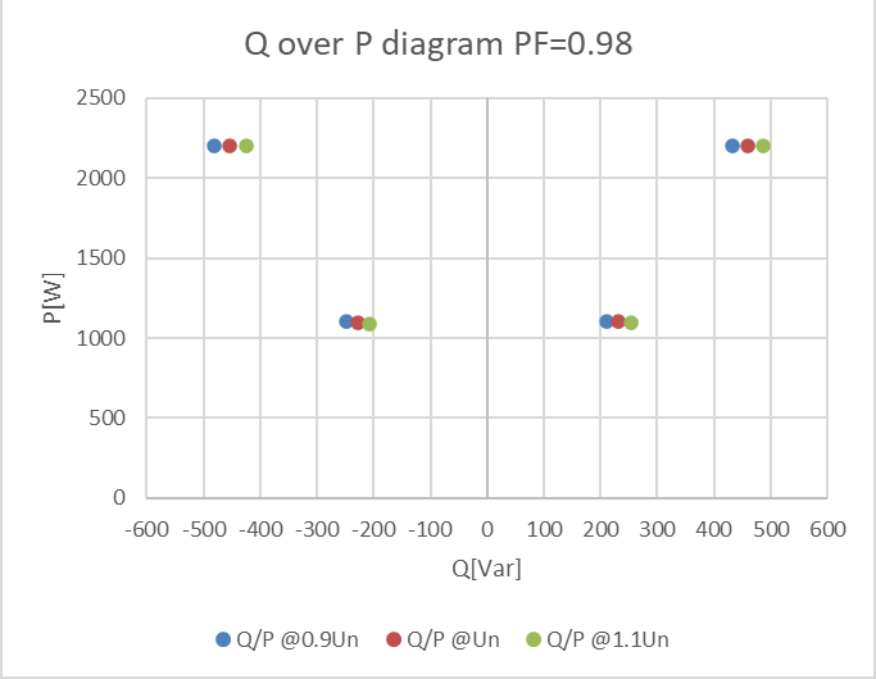
5,4,8	**Static voltage stability / reactive power supply** The test serves as verification of the reactive power mode according to VD-AR-N 4105: 2018-11, 5,7,2 of the PGU in normal operation,	
5,4,8,2	**Tests of the Reactive power / cos φ setting accuracy**	**P**

Test:

60 s mean value	0,9 U_n		U_n		1,1 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}

Graph: Q/P diagram





Test:

applies for PGUs Type 2 - only inverter $\Sigma S_{Emax} \leq 4{,}6$ kVA

a) and b) For cos φ 0,95 over-excited and φ 0,95 under-excited, the active power will be measured at value between 40% P_{Emax} and 60% and S_{Emax} and a second time,

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5,4,8	**Static voltage stability / reactive power supply** The test serves as verification of the reactive power mode according to VD-AR-N 4105: 2018-11, 5,7,2 of the PGU in normal operation,	
5,4,8,2	**Tests of the Reactive power / cos φ setting accuracy**	**P**

Test:

60 s mean value	0,9 U_n		U_n		1,1 U_n	
Active power	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}	40 – 60% P_{Emax}	S_{Emax}

for cos φ 0,98 over-excited and φ 0,98 under-excited, the active power will be measured at a value between 40% P_{Emax} and 60% and S_{Emax}

applies for PGUs Type 2 - only inverter $\Sigma S_{Emax} \geq 4{,}6$ kVA

c) and d) For cos φ 0,90 over-excited and φ 0,90 under-excited, the active power will be measured at value between 40% P_{Emax} and 60% and S_{Emax} and a second time,

for cos φ 0,95 over-excited and φ 0,95 under-excited, the active power will be measured at a value between 40% P_{Emax} and 60% and S_{Emax}

applies PGUs Type 1 as well as for type 2 plants with Stirling generators and fuel cells $\Sigma S_{Emax} \leq 4{,}6$ kVA

e) without specification of the cos φ the active power will be measured at value between 40% P_{Emax} and 60% and S_{Emax},

applies for PGUs Type 1 as well as for type 2 plants with Stirling generators and fuel cells $\Sigma S_{Emax} > 4{,}6$ kVA

f) and g) For cos φ 0,95 over-excited and cos φ 0,95 under-excited, the active power will be measured at value between 40% P_{Emax} and 60% and S_{Emax} and a second time,

for cos φ 0,98 over-excited and φ 0,98 under-excited, the active power will be measured at a value between 40% P_{Emax} and 60% and S_{Emax}

applies for PGUs Type 2 Asynchronous generators:

h) without specification of the cos φ the active power will be measured at value $S_{Emax,}$ The test is performed only at U_n,

Assessment criterion:

applies for PGUs Type 2 - only inverter $\Sigma S_{Emax} \leq 4{,}6$ kVA

The Q setpoint is calculated by using the required cos φ setpoint one time at 0,95 and one time at 0,98 and the measured apparent power of the fundamental, The test is passed if all the Q 60 s mean values of the fundamental component for a) are in the range of Q set point ± 4% P_{Emax} overexcited and for b) in the range of Q set point ± 4% P_{Emax} under-excited, In addition, a setting of the cos φ must be possible within a step size of at least 0,01,

applies for PGUs Type 2 - only inverter $\Sigma S_{Emax} \geq 4{,}6$ kVA

The Q setpoint is calculated by using the required cos φ setpoint one time at 0,90 and one time at 0,95 and the measured apparent power of the fundamental, The test is passed if all the Q 60 s mean values of the fundamental component for a) are in the range of Q set point ± 4% P_{Emax} overexcited and for c) in the range of Q set point ± 4% P_{Emax} under-excited, In addition, a setting of the cos φ must be possible within a step size of at least 0,01,

applies for PGUs Type 1 as well as for type 2 plants with Stirling generators and fuel cells $\Sigma S_{Emax} \leq 4{,}6$ kVA

The Q setpoint is calculated by using the required cos φ setpoint one time at 0,95 and one time at 0,98 and the measured apparent power of the fundamental, The test is passed if all the Q 60 s mean values of the fundamental from e) are in the range Q maximal overexcited till Q minimal under-excited,

applies for PGUs Type 1 as well as for type 2 plants with Stirling generators and fuel cells $\Sigma S_{Emax} \geq 4{,}6$ kVA

The Q setpoint is calculated by using the required cos φ setpoint one time at 0,95 and one time at 0,98 and the measured apparent power of the fundamental, The test is passed if all the Q 60 s mean values of the fundamental component for a) are in the range of Q set point ± 4% P_{Emax} overexcited and for f) in the range of Q set point ± 4% P_{Emax} under-excited, In addition, a setting of the cos φ must be possible within a step size of at least 0,01,

applies for PGUs Type 1 Asynchronous generators:

The test is passed if the cos φ Q 60 s mean values of h) is in the range cos φ = 0,95 under excited ±0,02,

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	The regulating and control behavior of the reactive power	P

The regulating or control behaviour of the reactive power is based on the PT-1 behaviour shown in Figure 10, Each reactive power value, which results from the control behaviour specified by the network operator, can be set between 6s and 60s (for Type 1 between 10 s and 60 s), The signal runtime includes the detection of the mains voltage or the active and reactive power,

Step response with the tolerances relevant for the evaluation

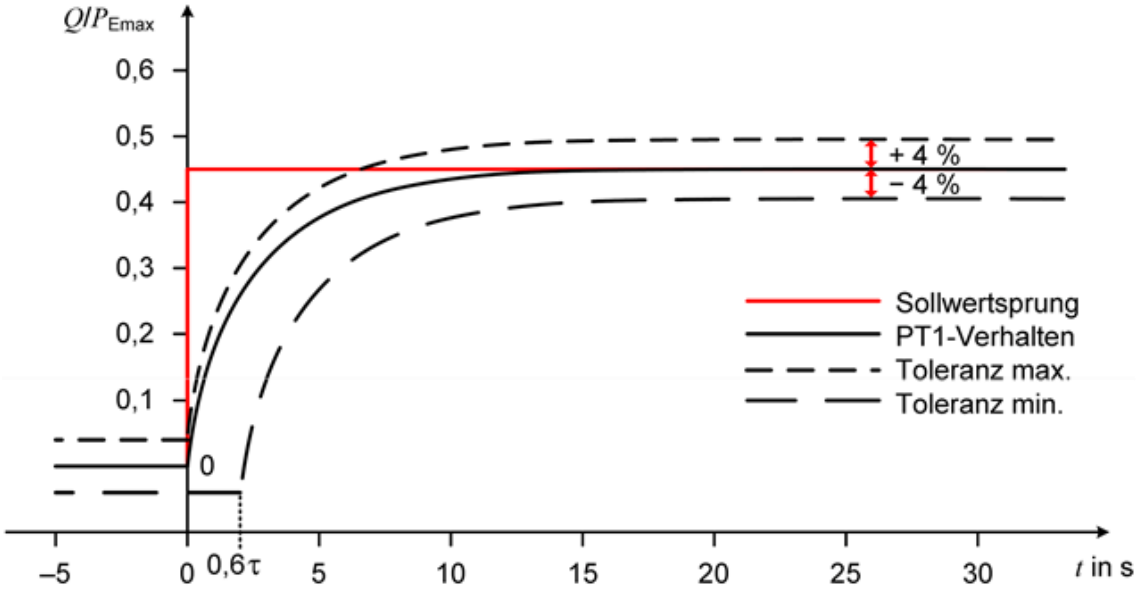


Figure 10 - Illustration at 3 tau = 10 s

Comment:

The regulation and control behaviour according to PT-1 is implemented and checked for all reactive power control modes,

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5.4.8.3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5.7.2.4.	**P**

Test 1) for conducted PGUs - Accuracy (characteristic) (must be used for battery inverter)

Measurement: 20-100-20% P_{Emax}

P_{Emax}/P [%]	20	100	20
U [V]	229,9	229,9	229,9
P_{E30} [W]	430,3	2200,7	430,2
P_{E30} of P_{Emax} [%]	19,6	100,0	19,6
Q_{E30} [VAr]	-0,8	-721,0	-5,4
$Q_{expected}$	0	-723,1	0
ΔQ_{E30} [%]	-0,04	0,10	-0,25
cos φ_{E30}	0,9980	0,9503	0,9980
cos $\varphi_{setpoint}$ of P_{E30}	1,0000	0,9500	1,0000
P gradient [% of P_{rE}/s]	-	0,500	0,498

Limit

ΔQ_{E30} in %	≤ ± 4,0% relative to P_{Emax}	P

Assessment criterion:

Test 5.4.8.3 (1) and (3) are passed if, for all calculated reactive power values, the maximum deviation between the reactive power setpoint (calculated from the characteristic curve to be verified) and the reactive power actual value at the generator terminals is a maximum of ± 4,0% based on P_{Emax}.

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5,4,8,3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5,7,2,4,	**P**

Test c) supply-dependent PGUs - Accuracy (characteristic curve)

Measurement: 20-100% P_{Emax}									
P_{Emax}/P [%]	20	30	40	50	60	70	80	90	100
U [V]	229,9	229,9	229,9	229,9	229,9	229,9	229,9	229,9	229,9
P_{E30} [W]	433,2	655,8	878,3	1099,7	1319,3	1539,3	1758,1	1977,4	2196,1
P_{E30} of P_{Emax} [%]	19,7	29,8	39,9	50,0	60,0	70,0	79,9	89,9	99,8
Q_{E30} [VAr]	-38,4	-44,4	-50,9	-56,2	-186,3	-307,6	-431,7	-567,6	-712,2
cos φ_{E30}	0,9961	0,9977	0,9983	0,9987	0,9902	0,9806	0,9712	0,9612	0,9512
cos $\varphi_{setpoint}$ of P_{E30}	1,0000	1,0000	1,0000	1,0000	0,9900	0,9800	0,9700	0,9600	0,9500
Measurement: 100-20% P_{Emax}									
P_{Emax}/P [%]	100	90	80	70	60	50	40	30	20
U [V]	229,9	229,9	229,9	229,9	229,9	229,9	229,9	229,9	229,9
P_{E30} [W]	2197,5	1977,8	1759,2	1538,7	1318,5	1099,8	876,7	654,0	431,6
P_{E30} of P_{Emax} [%]	99,9	89,9	80,0	69,9	59,9	50,0	39,9	29,7	19,6
Q_{E30} [VAr]	-712,6	-567,4	-432,0	-308,1	-187,9	-55,4	-50,2	-44,5	-39,1
cos φ_{E30}	0,9512	0,9612	0,9712	0,9805	0,9900	0,9987	0,9984	0,9977	0,9959
cos $\varphi_{setpoint}$ of P_{E30}	0,9500	0,9600	0,9700	0,9800	0,9900	1,0000	1,0000	1,0000	1,0000
Limit									
ΔQ_{E30} in %	≤ ±4,0% relative to P_{Emax}						P		

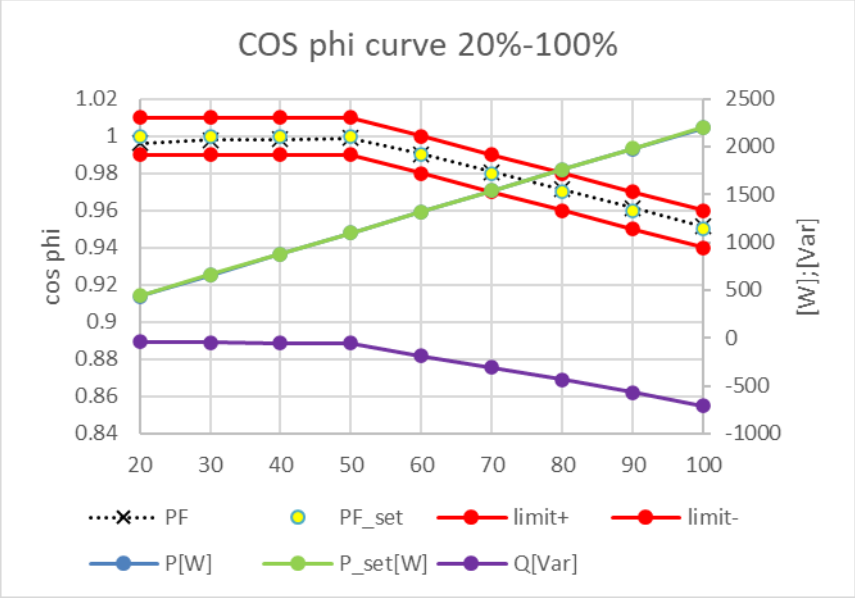
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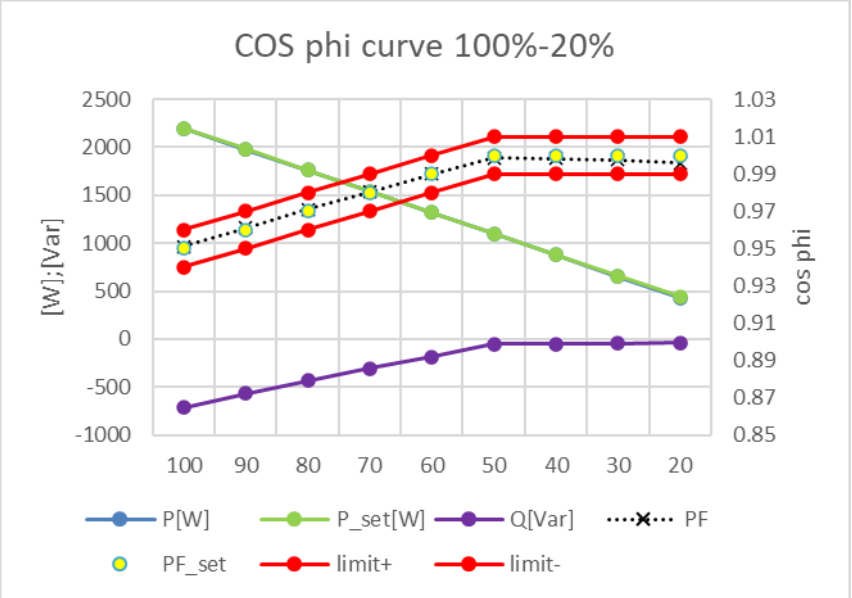
5,4,8,3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5,7,2,4,				**P**
Test d): supply-dependent PGUs - Dynamic					
P_{Emax}/P_n [%]	100	40	100	75	
U [V]	229,9	229,9	229,9	229,9	
P_{E30} [W]	2201,5	878,2	2200,7	1651,9	
P_{E30} of P_{Emax} [%]	100,1	39,9	100,0	75,1	
Q_{E30} [VAr]	-720,1	-42,6	-720,7	-378,5	
$Q_{expected}$	-723,1	0	-723,1	-376,0	
ΔQ_{E30} [%]	0,14	-1,94	0,11	-0,11	
cos φ_{E30}	0,9504	0,9988	0,9503	0,9747	
cos $\varphi_{setpoint}$ of P_{E30}	0,9500	1,0000	0,9500	0,9750	
Limit					
ΔQ_{E30} in %	≤ ± 4,0% relative to P_{Emax}			P	

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5,4,8,3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5,7,2,4,	**P**

Graph of Test c)

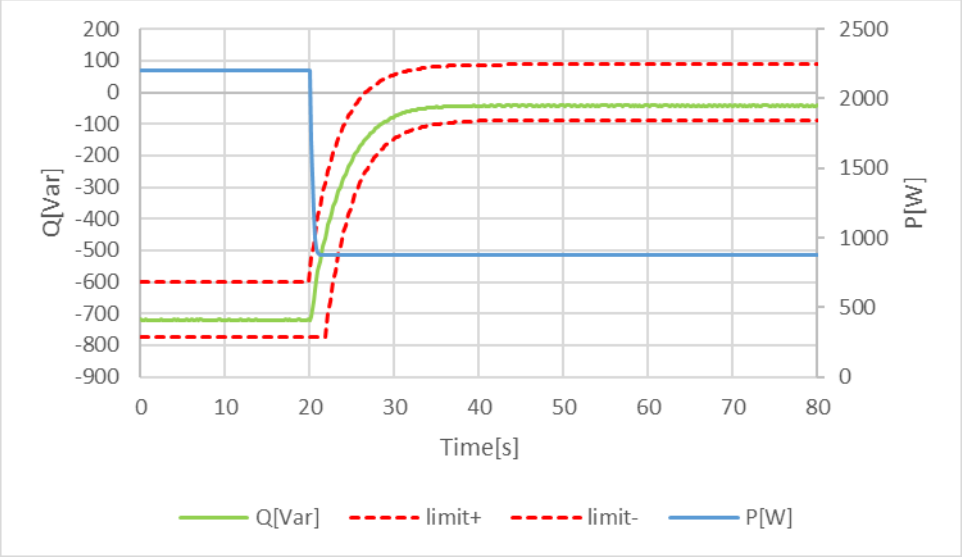


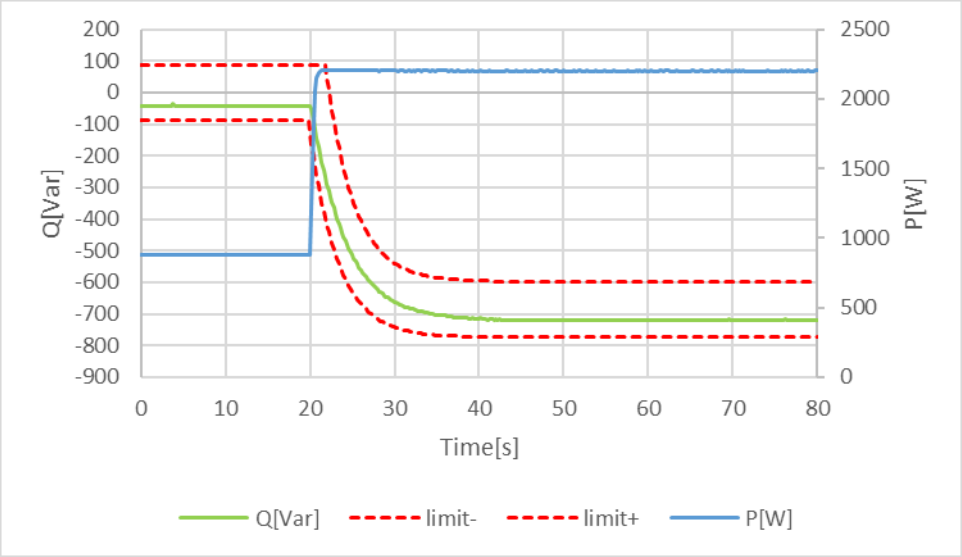


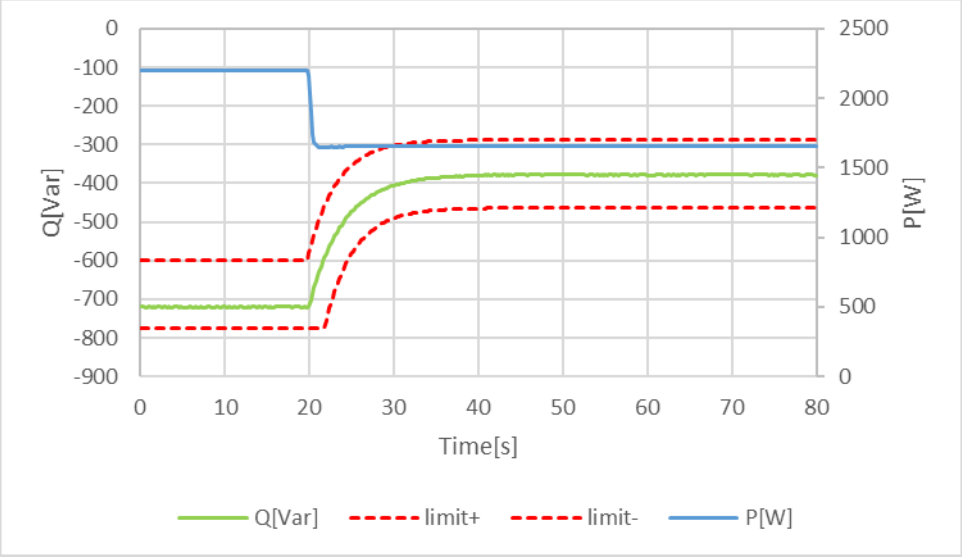
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5,4,8,3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5,7,2,4,	**P**

Graph of Test d)







Assessment criterion:

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5,4,8,3	**Test of the displacement factor/active power characteristic curve cos φ (P)** The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5,7,2,4,	**P**
Test 5,4,8,3 (2) is considered to have been passed if the PGU meets the requirements for the performance gradient in VDE AR-N 4105: 2018-11, 5,7,4,2, Test 5,4,8,3 (4) is passed if the step response of the reactive power in test steps c) and e) shows PT-1 behaviour according to VDE-AR-N 4105: 2018-11, 5,7,2,5 and for test step d) optionally the power gradient lies between the limits defined in VDE AR-N 4105: 2018-11, 5,7,4,1 or the step response of the reactive power also has PT-1 behaviour according to VDE-AR-N 4105: 2018-11, 5,7,2,5,		

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DIN VDE 0124-100		
Clause	**Requirement – Test**	**Verdict**
5,5	**Testing of NS protection**	
5,5,2	NS protection	**P**
5,5,2,1	Functional safety	**P**
5,5,3	Central NS-protection	**N/A**
5,5,4	Integrated NS-protection	**P**
5,5,6	Interface switch	**P**
5,5,6,2	Central interface switch	**N/A**
5,5,6,3	Integrated interface switch	**P**
5,5,7,2	Check of setting values	**P**
5,5,7,3	Wiring check	**P**
5,5,7,4	Voltage and frequency control	**P**
5,5,7,4,1	Voltage and frequency control – Single Phase	**P**
	Voltage and frequency control – Multi Phase (Phase to N)	**N/A**
	Voltage and frequency control – Multi Phase (Phase to Phase)	**N/A**
	Voltage and frequency control – Measuring the rise-in voltage protection as a running 10-minute mean value	**P**
	Voltage and frequency control – Frequency measurement	**P**
5,5,7,5	Reporting of NS protection	**P**
5,5,9	Constructional characteristics of NS protection	**P**
5,5,10,1	General	**P**
5,5,10,2	Passive Islanding Protection	**P**
5,5,10,3	Islanding protection according table 6 – Load imbalance (real, reactive load) for test condition A (PGU output = 100%)	**P**
	Islanding protection according table 6 – Load imbalance (real, reactive load) for test condition A (PGUT output = 66%)	**P**
	Islanding protection according table 6 – Load imbalance (real, reactive load) for test condition A (PGU output = 33%)	**P**

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5,5,2	NS protection	P

The test for error detection with subsequent shutdown is carried out by means of error simulation, if necessary with additional error tests (see VDE-AR-N 4105: 2018-11, 6,1),

5,5,2,1	Functional safety	P

Component No.	Fault	Test condition		Test time	fuse no. (AC)	Fault condition		Result
		AC [V/A]	DC [V/A]			AC [V/A]	DC [V/A]	
PV EMC capacitor-C1	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	36V/0 A	The insulation impedance detection of MPPT circuit is abnormal, MPPT cannot operate normally, and the PV indicator light flashes; The grid and backup mode can operate normally. There is no other damage, no danger.
PV EMC capacitor-C17	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	0V/40 A	The PV corresponding to the fault in the MPPT circuit cannot operate normally, while the grid and backup mode can operate normally. There is no other damage, no danger.
MOSFET-Q1	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	0V/40 A	The PV corresponding to the fault in the MPPT circuit cannot operate normally, while the grid and backup mode can operate normally. There is no other damage, no danger.
MOSFET-Q9	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	0V/40 A	The PV corresponding to the fault in the MPPT circuit cannot operate normally, while the grid and backup mode can operate normally. There is no other damage, no danger.
PV voltage sampling resistor-R12	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/9 5.7A	The voltage sampling of the corresponding faulty PV in the MPPT circuit is abnormal and cannot operate normally, with the PV indicator light flashing; The grid and backup mode can operate normally. There is no other damage, no danger.
PV current sampling resistor-R13	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/9 5.7A	The current sampling of the corresponding faulty PV in the MPPT circuit is abnormal and cannot operate normally, with the PV indicator light flashing; The grid and backup mode can operate normally. There is no other damage, no danger.
60V bus voltage sampling resistor-R34	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	36V/0. 0A	The sampling of the 60V bus voltage in the MPPT circuit is abnormal, causing the PV to malfunction and the PV indicator light to flash; The grid and backup mode can operate normally. There is no other damage, no danger.
60V bus current sampling resistor-R38	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.76 A	The MPPT circuit can operate normally, and both the grid and backup mode can operate normally. There is no other damage, no danger.
PE voltage sampling resistor - R9	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	36V/0. 0A	The insulation impedance detection of MPPT circuit is abnormal, MPPT cannot operate normally, and the PV indicator light flashes; The grid and backup mode can operate normally. There is no other damage, no danger.

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EMC X capacitor-C188	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/126.73A	The MPPT circuit can operate normally, and backup mode can operate normally.The grid mode will trigger the overcurrent protection of the power grid simulator. There is no other damage, no danger.
EMC Y Capacitor-C182	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/126.71A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Grid relay -K2	Short	230V/9.57A	36V/128A	5min	FU1	230V/0.0A	33V/78.46A	The MPPT circuit and backup mode can operate normally, but the grid mode cannot operate. There is no other damage, no danger.
Backup relay -K3	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/126.71A	The MPPT circuit and grid mode can operate normally, but the backup mode cannot operate. There is no other damage, no danger.
EMC X capacitor-C196	Short	230V/9.57A	36V/128A	5min	FU1	230V/0A	33V/78.33A	The MPPT circuit can operate normally, but the grid and backup mode cannot operate normally, and the GRID indicator light flashes. There is no other damage, no danger.
EMC Y capacitor-C202	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/126.71A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
EMC X capacitor-C213	Short	230V/9.57A	36V/128A	5min	FU1	230V/0.0A	33V/78.34A	The MPPT circuit can operate normally, but the grid and backup mode cannot operate normally, and the GRID indicator light flashes. There is no other damage, no danger.
EMC Y capacitor-C217	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/126.75A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
EMC X capacitor-C185	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/127.05A	The MPPT circuit and grid mode can operate normally, but the backup mode cannot operate. There is no other damage, no danger.
EMC Y capacitor-C180	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/127.61A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Backup current transformer-T1	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/127.58A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Closed-loop Hall Sensor-H1	Short	230V/9.57A	36V/128A	5min	FU1	230V/0.0A	33V/78.41A	The MPPT circuit can operate normally, but the grid and backup mode cannot operate normally, and the GRID indicator light flashes. There is no other damage, no danger.
Start-up auxiliary power relay-K4	Short	230V/9.57A	36V/128A	5min	FU1	230V/9.57A	33V/127.58A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.

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Start-up auxiliary power MOSFET-Q52	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.76 A	The current sampling resistors R619/R625/R627 of the flyback auxiliary source are damaged, and there is no output voltage from the flyback auxiliary source. The MPPT circuit and grid mode can operate normally, while the backup mode cannot operate normally when the GRID cable is not connected to the power grid.
Start-up auxiliary power flyback transformer secondary side-T12	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.85 A	The current sampling resistors R619/R625/R627 and mos-Q52 of the flyback auxiliary source are damaged, and there is no output voltage from the flyback auxiliary source. The MPPT circuit and grid mode can operate normally, while the backup mode cannot operate normally when the GRID cable is not connected to the power grid.
Start-up auxiliary power diode-D105	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.53 A	The current sampling resistors R619/R625/R627 and mos-Q52 of the flyback auxiliary source are damaged, and there is no output voltage from the flyback auxiliary source. The MPPT circuit and grid mode can operate normally, while the backup mode cannot operate normally when the GRID cable is not connected to the power grid.
Bus pre-charging relay-K1	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.46 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Rectifier Bridge-D50	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.36 A	Fuse FU1 is blown. MPPT circuit can operate normally; Although the grid and backup modes can operate normally, the bus voltage cannot be pre charged.
Main auxiliary power MOSFET-Q38	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.28A	Cement resistors R590/R591 and MOS-Q38 are damaged. The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The inverter control part cannot be powered on normally.
Optical coupler-U63	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.22A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The inverter control part cannot be powered on normally.
Battery-side electrolytic capacitor-C694	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	36V/0. 0A	A short circuit between the positive and negative terminals of the battery will trigger the short-circuit protection of the external battery pack. The MPPT circuit, grid and backup mode cannot operate normally, and the battery indicator light is flashing.
Battery-side MOSFET-Q32	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	36V/0. 0A	MOS-Q33/Q35 is damaged, causing a short circuit between the positive and negative terminals of the battery, which will trigger the short-circuit protection of the external battery pack. The MPPT circuit， grid and backup mode cannot operate normally, and the battery indicator light is flashing.

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Battery-side MOSFET-Q33	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	36V/0. 0A	MOS-Q32/Q34 is damaged, causing a short circuit between the positive and negative terminals of the battery, which will trigger the short-circuit protection of the external battery pack. The MPPT circuit， grid and backup mode cannot operate normally, and the battery indicator light is flashing.
Bus side electrolytic capacitor-C230	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.87A	Cement resistors R590/R591 are damaged.The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The inverter control part cannot be powered on normally.
Bus side MOSFET-Q28	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.84A	Cement resistors R590/R591 and MOS-Q28/Q29 are damaged. The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light flashes and there are no other hazards.
Bus side MOSFET-Q29	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.05A	Cement resistors R590/R591 and MOS-Q28/Q29 are damaged. The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light flashes and there are no other hazards.
Inverter bridge IGBT-Q22	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.18A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light flashes, and there is no other damage or danger.
Inverter bridge IGBT-Q23	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.28A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light flashes, and there is no other damage or danger.
Inverter bridge IGBT-Q26	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.24A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light flashes, and there is no other damage or danger.
Battary current sampling resistor-R191	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.84A	The current sampling on the battery side is abnormal, the MPPT circuit can operate normally, but the grid and backup mode cannot operate normally. The GRID indicator light is flashing, and there is no other damage or danger.
Battary voltage sampling resistor-R209	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.83A	The voltage sampling on the battery side is abnormal, the MPPT circuit can operate normally, but the grid and backup mode cannot operate normally. The GRID indicator light is flashing, and there is no other damage or danger.
Battary voltage sampling resistor-R197	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.49A	The voltage sampling on the battery side is abnormal, the MPPT circuit can operate normally, but the grid and backup mode cannot operate normally. The GRID indicator light is flashing, and there is no other damage or danger.
Bus voltage sampling resistor-R158	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.05A	The voltage sampling of the bus is abnormal,the MPPT circuit can operate normally, but the grid and backup mode cannot operate normally. The GRID indicator light is flashing, and there is no other damage or danger.

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Grid voltage sampling resistor-R180	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.23A	The voltage sampling of the grid is abnormal,the MPPT circuit and backup mode can operate normally, but the grid mode cannot operate normally. The GRID indicator light is flashing, and there is no other damage or danger.
Backup voltage sampling resistor-R161	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.61 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Inverter voltage sampling resistor-R210	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.49 A	The MPPT circuit and grid mode can operate normally,but the backup mode cannot operate normally. There is no other damage, no danger.
Inverter voltage DC component sampling resistor-R207	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.48 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Input Reverse-PV1	Reversed	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/9 5.88A	The voltage at both ends of PV1 in the MPPT circuit will be pulled low, PV2-PV4 in the MPPT circuit can operate normally, and both grid and backup modes can operate normally. There is no other damage, no danger.
Input short -PV1	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/9 5.95A	The voltage at both ends of PV1 in the MPPT circuit will be pulled low, PV2-PV4 in the MPPT circuit can operate normally, and both grid and backup modes can operate normally. There is no other damage, no danger.
GRID_L/N terminals-J6/J8	Reversed	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.85 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
GRID_L/N terminals-J6/J8	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 7.63A	The MPPT circuit and backup mode can operate normally; Power on in grid mode will trigger the overcurrent protection of the grid simulator. There is no other damage, no danger.
NTC temperature sampling resistor-J12	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.57 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
NTC temperature sampling resistor-J21	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.93 A	The MPPT circuit can operate normally, both grid and backup mode can operate normally. There is no other damage, no danger.
Transformer output port-T6	Short	230V/ 9.57A	36V/ 128 A	2min	FU1	230V/ 0.0A	33V/7 7.52A	The Q41/Q42 transistors are damaged, the MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.
Transformer output port-T7	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.22A	The Q41/Q42 transistors are damaged, the MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.
Transformer output port-T3	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.05A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.

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Transformer output port-T8	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.64A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.
Transformer output port-T9	Short	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.19A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.
Output current sampling resistor-R492	open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 0.0A	33V/7 8.41A	The MPPT circuit can operate normally, but the grid and backup modes cannot operate normally. The GRID light is flashing, and there are no other hazards.
Output current DC component sampling resistor-R491	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.79 A	The MPPT circuit can operate normally, both grid and backup modes can operate normally. There is no other damage, no danger.
Backup current sampling resistor-R511	Open	230V/ 9.57A	36V/ 128 A	5min	FU1	230V/ 9.57A	33V/1 27.68	The MPPT circuit can operate normally, both grid and backup modes can operate normally. There is no other damage, no danger.

supplementary information:

S-C: short circuit, O-C: open circuit, O-L: overload, R: reversed

Note:

The errors in the control circuit simulate that the safety is even ensured during a single fault,

Assessment criterion:

The NS protection must send a shutdown command to the coupling switch,

If the error is detected, the device is switched off within 10 s after error detection,

If the auxiliary voltage fails with the central NS protection or if the control fails with the integrated NS protection, the switch-off command must be given immediately,

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5,5,4	Integrated NS protection	P
The integrated NS protection is tested in 5,5,7 and in connection with the examination of the entire NS protection chain and switch,		
Note: For test results see 5,5,2,1 Functional safety,		

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5,5,6,3	**Integrated interface switch**	**P**
5,5,6,3,1	**Test (functional chain integrated NS-protection and integrated interface switch)**	**P**
Following monitoring options of an interface switch are valid (a) or (b) or (c):		
(a) Use of a interface switch in which a control voltage must be constantly applied when switched on and which switches off automatically when this voltage is not present, The operational switch-on and switch-off processes is monitored		
The disconnection of the control voltage leads to the instantaneous disconnection of the interface switch,		N/A
A simulated defect during the closing and opening of the interface switch leads to an instantaneous shutdown of the PGU, A restart is not possible,		N/A
A simulated defect of the interface switch after the NS protection as operated leads to an instantaneous shutdown of the PGU, A restart is not possible,		N/A
The switch-off time of the whole reaction chain is within 0,2s,		N/A
(b) The interface switch is switched on and off at least once a day by the NS protection and the proper functioning of the coupling switch is monitored,		
A simulated defect of the interface switch during the daily test leads to an instantaneous shutdown of the PGU, A restart is not possible,		N/A
A simulated defect of the interface switch after the NS protection has operated leads to an instantaneous shutdown of the PGU, A restart is not possible,		N/A
A function for daily switching on and off is available and explained by a manufacturer's declaration,		N/A
(c) Use of the integrated coupling switch and the integrated NA protection for PV and battery converters according to DIN EN 62109 (VDE 0126-14-1),		
The integrated interface switch and NS protection is comply with DIN EN 62109 (VDE 0126-14-1), See IEC 62109-2 test report BWDO-ESH-P24011134-2,		P
Note: See test results 5,5,2,1 functional safety,		
The inverter has a galvanic separating break device, The interface switch is short-circuit proof for the maximum short-circuit current of the power generation unit,		
Max, initial short-circuit current of the PGU (power generation unit)	= 11,5 A, 230 Vac	
Max, switching current relay	= 12 A, 250 Vac	
Relay type used	HF140FF	

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Datasheet of the relay (interface protection relay / Interface switch):

HF140FF(NEW) MINIATURE INTERMEDIATE POWER RELAY

c UL us
File No.:E134517

File No.:R50149131

File No.:CQC10002046173



Features

- 12A switching capability
- 5kV dielectric strength (between coil and contacts)
- 1.5mm/2.0mm contact gap available
- Plastic sealed and flux proofed types available
- Sockets available
- UL insulation system:Class F

RoHS compliant

CONTACT DATA

Contact arrangement	2A, 2C
Contact resistance	100mΩ max.(at 1A 6VDC)
Contact material	$AgSnO_2$
Contact rating (Res. load)	12A/10A 250VAC, 8A 30VDC
Max. switching voltage	250VAC / 30VDC
Max. switching current	12A
Max. switching power	3000VA / 360W
Mechanical endurance	W(456) type: 3 x 10^5OPS W type: 5 x10^5OPS
Electrical endurance	NO 3 x 10^4OPS, NC 1 x 10^4OPS (12A 250VAC,1s on 9s off) 3 x10^4ops (8A 30VDC, 1s on 9s off)

Notes: 1) The data shown above are initial values.
2) For plastic sealed type, the venting-hole should be excised in electrical endurance test.

CHARACTERISTICS

Insulation resistance		1000MΩ (at 500VDC)
Dielectric strength	Between coil & contacts	5000VAC 1min
	Between contacts sets	3000VAC 1min
	Between open contacts	2500VAC 1min
Surge voltage (between coil & contacts)		10kV (1.2/50 μs)
Operate time (at nomi. volt.)		20ms max.
Release time (at nomi. volt.)		5ms max.
Humidity		5% to 85% RH
Ambient temperature		-40°C to 85°C
Shock resistance	Functional	98m/s²
	Destructive	980m/s²
Vibration resistance		10Hz to 55Hz 1.5mmDA
Termination		PCB
Unit weight		Approx. 19g
Construction		Plastic sealed, Flux proofed

Notes: 1) The data shown above are initial values.
2) Z type product Operate time ≤ 20ms.

SAFETY APPROVAL RATINGS

UL	12A 250VAC AC Resistive load 85°C 1/3HP 125VAC NO/NC,40°C 3/4HP 250/240VAC,NO,40°C TV-5, 125VAC,40°C
TÜV	12A 250VAC AC Resistive load 85°C
CQC	12A 250VAC AC Resistive load 85°C

Notes: Only typical loads are listed above. Other load specifications can be available upon request.

COIL

Coil power	W type(1.5mm): Approx. 0.8W W type(2.0mm): Approx. 1.4W

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5,5,7,2	Check of setting values				P
5,5,7,2,1	Test				P
Inverter name					
Setting values:					
PGU type	Description	Parameter name	Set value in p,u,	Set value L-N	Set value L-L *2)
	nominal voltage	U_n	1	230,0 V	400,0 V
	Nominal frequency	f_n	1	50,0 Hz	50,0 Hz
a) name set of parameter (Parameter setup name in manual or software)					
Stirling generators, fuel cells, coupled directly or via a converter Synchronous and asynchronous generators with $P_n \leq 50$ kW	Excitation threshold U>>	AU>>	1,15	264,5 V	460,0 V
	Delay time U>>	tU>>	-	0,100 s	0,100 s
	Excitation threshold U>	AU>	1,10	253,0 V	440,0 V
	Delay time U> * 1)	tU>	-	0,100 s *1)	0,100 s *1)
	Excitation threshold U<	AU<	0,8	184,0 V	320,0 V
	Delay time U<	tU<	-	0,100 s	0,100 s
	Excitation threshold U<<	AU<<	deactivated	-	-
	Delay time U<<	tU<<	deactivated	-	-
	Excitation threshold f>	Af>	1,03	51,5 Hz	51,5 Hz
	Delay time f>	tf>	-	0,100 s	0,100 s
	Excitation threshold f<	Af<	0,95	47,5 Hz	47,5 Hz
	Delay time f<	tf<	-	0,100 s	0,100 s
b) name set of parameter (Parameter setup name in manual or software)					
directly coupled synchronous and asynchronous generators with $P_n > 50$ kW	Excitation threshold U>>	AU>>	1,25	287,5 V	500,0 V
	Delay time U>>	tU>>	-	0,100 s	0,100 s
	Excitation threshold U>	AU>	1,10	253,0 V	440,0 V
	Delay time U> * 1)	tU>	-	0,100 s *1)	0,100 s *1)
	Excitation threshold U<	AU<	0,8	184,0 V	320,0 V
	Delay time U<	tU<	-	1,0 s	1,0 s
	Excitation threshold U<<	AU<<	0,45	103,5 V	180,0 V
	Delay time U<<	tU<<	-	0,300 s	0,300 s
	Excitation threshold f>	Af>	1,03	51,5 Hz	51,5 Hz
	Delay time f>	tf>	-	0,100 s	0,100 s
	Excitation threshold f<	Af<	0,95	47,5 Hz	47,5 Hz
	Delay time f<	tf<	-	0,100 s	0,100 s
c) name set of parameter (Parameter setup name in manual or software)					
Inverter	Excitation threshold U>>	AU>>	1,25	287,5 V	500,0 V
	Delay time U>>	tU>>	-	0,100 s	0,100 s
	Excitation threshold U>	AU>	1,10	253,0 V	440,0 V
	Delay time U> * 1)	tU>	-	0,100 s *1)	0,100 s *1)
	Excitation threshold U<	AU<	0,8	184,0 V	320,0 V
	Delay time U<	tU<	-	3,0 s	3,0 s
	Excitation threshold U<<	AU<<	0,45	103,5 V	180,0 V
	Delay time U<<	tU<<	-	0,300 s	0,300 s
	Excitation threshold f>	Af>	1,03	51,5 Hz	51,5 Hz

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	Delay time f>	tf>	-	0,100 s	0,100 s
	Excitation threshold f<	Af<	0,95	47,5 Hz	47,5 Hz
	Delay time f<	tf<	-	0,100 s	0,100 s

*1) 10-min mean value

*2) testing of external NS-protection

Factory settings correspond to the values in Table 36	Yes
There are no factory settings, The information on the setting values in the instructions manual correspond to those in Table 36,	No
External NS protection: settings and delay times are password protected settable	N/A
External NS protection: It is possible to read the setting values without a tool	N/A
Integrated NS protection: the setting values are visible via a data interface or display	Yes
The limit values for U> can be set between 110% and 115% and, in the case of directly coupled synchronous and asynchronous generators with P_{rE} >50kW, the time delay for U< and U<< can be set, All other limit values are protected against unauthorized access,	Yes

Assessment criterion:

The exam is passed if the following points are met:

The factory setting values correspond

a) With integrated NA protection of VDE-AR-N 4105: 2018-11, 6,5,2 Table 2 (see also Table 36),
b) With central NA protection, either the factory settings of VDE-AR-N 4105: 2018-11, 6,5,2, Table 2 (see also Table 36) or these values can be set,

- In the event of an operator input, the test object only goes into operation after settings have been selected,

The setting values that can be changed according to 4105: 2018-11, 6,5,1 and 6,5,2 can be set within the specified limits and are protected against unauthorized access,

The setting values that cannot be changed according to VDE-AR-N 4105: 2018-11, 6,5,1 and 6,5,2 cannot be changed or are protected from unauthorized access by an additional separate protection system

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5,5,7,3	**Wiring check**			**P**
5,5,7,3,1	**Test**			**P**
Setting values:				
U L1-E	219,4 V	0°	50,0 Hz	
U L2-E	N/A	-120°	50,0 Hz	
U L3-E	N/A	120°	50,00 Hz	
Measured values:				
U L1-E	219,7 V	0°	50,0 Hz	
U L2-E	N/A	-120°	50,0 Hz	
U L3-E	N/A	120°	50,0 Hz	
Evaluation criterion				
This test is not assessed, If a phase shift is found, it must be corrected and the test repeated				

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5,5,7,4	**Voltage and frequency control**	**P**
5,5,7,4,1	**Voltage and frequency control – Single Phase**	**P**

Integrated NS protection single phase ≤ 30 kVA

Operating time of the monitoring device:

MST-HI-2200

L1 to N:	**Under voltage 1 (4,2):**	**Over voltage 1 (1,2):**
Ramp [start V to stop V]	>188,6 → <179,4	<282,9 → >292,1
Step size [V]	<1,15	<1,15
Step length [s]	>3,200	>0,400
Limit [V]	184,0 ± 1% U_n	287,5 ± 1% U_n
Measurement [V]	183,5	288,0

L1 to N:	**Under voltage 1 (5,2):**	**Over voltage 1 (2,2):**
Jump [start V to stop V]	>200,1 → <179,4	<282,9 → >292,1
Step size [V]	>9,2	>9,2
Step length [s]	>3,200	>0,400
Limit [s]	3,000 ± 0,100	0,100 ± 0,100
Measurement [s]	3,057	0,149

L1 to N:	**Under voltage 2 (6,2):**
Ramp [start V to stop V]:	>108,1 → <98,9
Step size [V]	<1,15
Step length [s]	>0,500
Limit [V]:	103,5 ± 1% U_n
Measurement [V:]	102,9

L1 to N:	**Under voltage 2 (7,2):**
Jump [start V to stop V]:	>108,1 → <98,9
Step size [V]	>9,2
Step length [s]	>0,500
Limit [s]:	0,300 ± 0,100
Measurement [s]:	0,315

Note:

The disconnection time includes disconnect time + operate time of the integrated relay, Therefore limit is give with +0,1 s according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2018,

The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of U_n ,

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5,5,7,4	**Voltage and frequency control**	**P**
5,5,7,4,1	**Voltage and frequency control – Measuring the rise-in voltage protection as a running 10-minute mean value**	**P**

MST-HI-2200	
L-N:	**Over voltage 10-minute mean value (3,1):**
Ramp [start V to stop V]	230,0 → 257,6
Step size [V]	27,6
Step length [s]	>600,2
Limit for disconnection [s]	450 – 550
Measurement [s]	517,8
L-N:	**Over voltage 10-minute mean value (3,2):**
Ramp [start V to stop V]	230,0 → >248,4
Step size [V]	18,4
Step length [s]	>600,2
Limit for reconnection [s]	no disconnection (also after 600 s)
Measurement [s]	no disconnection
L-N:	**Over voltage 10-minute mean value (3,3):**
Ramp [start V to stop V]	243,8 → >262,2
Step size [V]	18,4
Step length [s]	>600,2
Limit for disconnection[s]	225 – 375
Measurement [s]	299,2
Note:	

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5,5,7,4	**Voltage and frequency control**	**P**
5,5,7,4,1	**Voltage and frequency control – Frequency measurement**	**P**

Operating time of the monitoring device:

MST-HI-2200

	Under frequency (10,1):	**Over frequency (8,1):**
Ramp [start Hz to stop Hz]	47,60 → 47,40	51,40 → 51,60
Step size [Hz]	<0,025	<0,025
Step length [s]	>0,4	>0,4
Limit [Hz]	47,50 ± 1% f_n	51,50 ± 1% f_n
Measurement [Hz]	47,49	51,51

	Under frequency (11,1):	**Over frequency (9,1):**
Jump [start Hz to stop Hz]	47,60 → 47,40	51,40 → 51,60
Step size [Hz]	>0,2	>0,2
Step length [s]	>0,4	>0,4
Limit [s]	0,100 ± 0,100	0,100 ± 0,100
Disconnection time [s]	0,175	0,186

Note:

The setting value and the trip value of the frequency may not vary by more than ± 0,1 % f_n,

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5,5,7,5	Reporting NS protection	P

The last 5 dated failure reports on the NS protection can be read, An interruption in the supply voltage of ≤ 3 s does not result in any loss of failure reports,

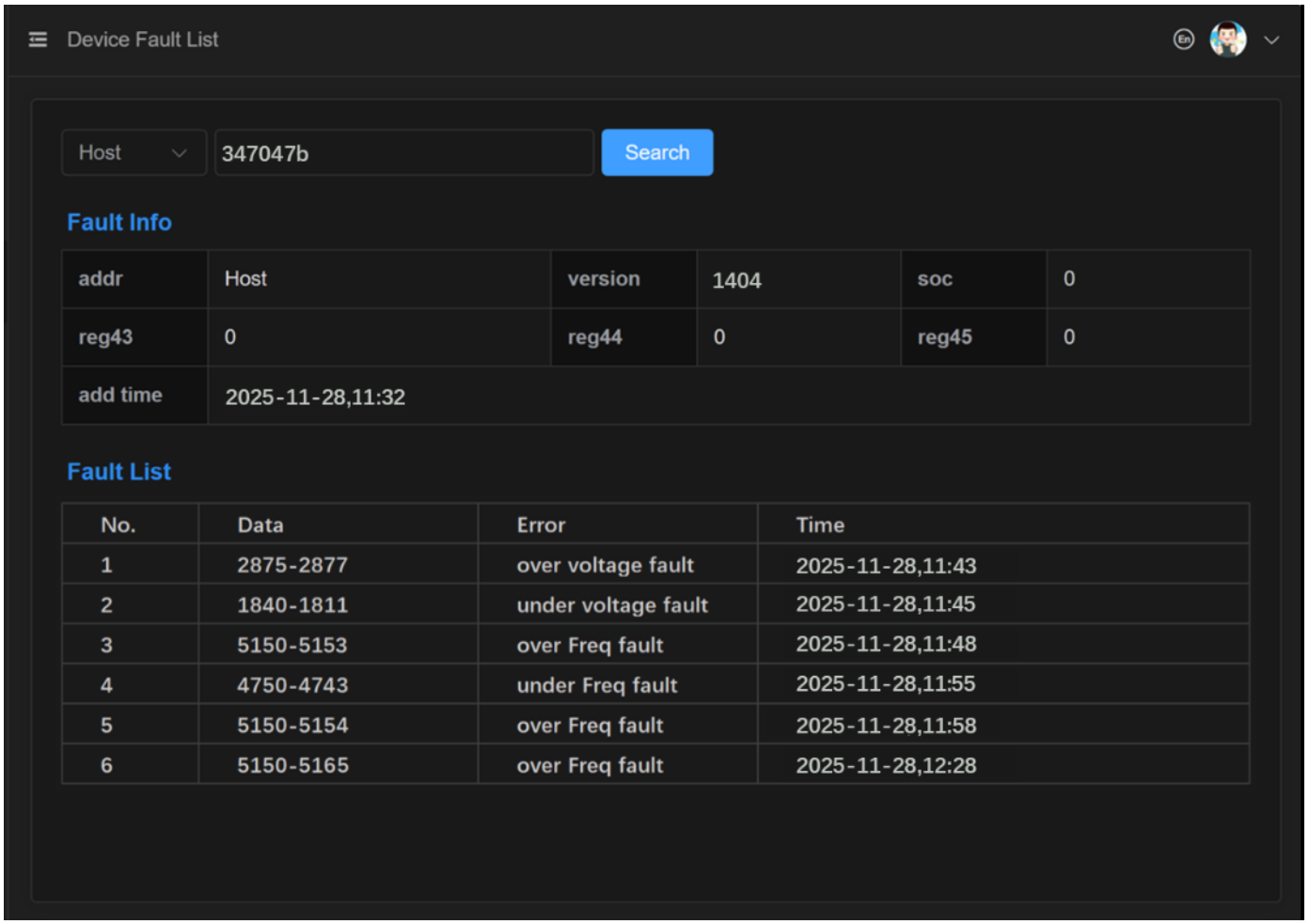
Central NS protection:

It is possible to read the setting values and the failure reports of the NS protection independently of the operational state and without any additional aids,

Integrated NS protection:

It is possible to read out the values of the NS protection via the data interface, if the values are not directly readable,

Picture of 5 last dated failure:



Assessment criterion:

At least the last 5 error messages including time stamps that were recorded before the voltage interruption and at least 5 error messages including time stamps that were recorded after the voltage interruption must be documented,

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5,5,9	**Constructional characteristics of NS protection**	**P**
5,5,9,1	**General**	**P**
These tests serve to demonstrate the requirements of VDE-AR-N 4105: 2018-11, 6,5,2,		
5,5,9,2	**Test**	**P**
Type of NS protection: Internal		
NS-protection is sealed or a password protection is used (or both)		P
adjustability of U> and the time delays for U< and U<< is given		P
All other protective functions are either permanently protected or protected from unauthorized access by additional, separate protection (example password)		P

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5,5,10	**Islanding detection**	**P**
For power generation systems, islanding detection must be carried out using one of the following processes: a) active method, e,g, by means of frequency – shift process (oscillating circuit) b) passive method by means of the three-phase voltage monitoring (possible only for power generation systems without inverters or for single-phase power generation units with inverters), (see 5,5,7,4 3-phase voltage control) With the passive process, it is important to provide evidence that the power generation unit can be set not equal to 120°,		
5,5,10,1	**General**	**P**
These tests serve as proof of the requirements of VDE-AR-N 4105: 2018-11, 6,5,3, The maximum switch-off time is 9 s,		

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5,5,10,2	**Passive Islanding detection**	**P**
The passive procedure is implemented by the voltage increase and voltage decrease protection of the NS protection,		
Note: A passive procedure is possible with the help of three-phase voltage monitoring (only for generating units without converter or for single-phase generating units with converter) The three-phase voltage monitoring is also permissible with the structural integration of several single-phase generating units that feed into different external conductors, as long as the currents of these generating units are regulated independently of each other so that any phase positions can be set,		

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5,5,10,3	Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (PGU output = 100%)	P

Test conditions	Frequency: 50,00 Hz ± 1% f_n U_n = 230,0 V ± 1% U_n Distortion factor of chokes ≤ 2%
Disconnection limit	2 s (IEC 62116)

MST-HI-2200

No	P_{PGU} [1] [% of PGU rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	I_{AC} [4] [A]			P_{PGU} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Re-marks[5]
					L1	L2	L3					
1	100	100	0	0	0,07	-	-	2200	49	1,00	858	BL
4	100	100	-5	-5	-	-	-	2200	49	1,02	255	IB
5	100	100	-5	0	-	-	-	2200	49	1,06	614	IB
6	100	100	-5	+5	-	-	-	2200	49	1,09	346	IB
7	100	100	0	-5	-	-	-	2200	49	0,98	248	IB
8	100	100	0	+5	-	-	-	2200	49	1,03	338	IB
9	100	100	+5	-5	-	-	-	2200	49	0,94	263	IB
10	100	100	+5	0	-	-	-	2200	49	0,97	642	IB
11	100	100	+5	+5	-	-	-	2200	49	0,99	318	IB

Parameter at 0% per phase	L= 76,58 mH	R= 24,05 Ω	C= 132,45 µF

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5,5,10,3	**Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (PGU output = 100%)**	**P**

Note:

RLC is adjusted to min, +/-1% of the inverter rated output power

[1] P_{PGU}: PGU output power

[2] P_{AC}: Real power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[3] Q_{AC}: Reactive power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition,

Condition A:

PGU output power P_{PGU} = Maximum [6]

PGU input voltage [6] ≥ 75% of rated input voltage range

[6] Maximum PGU output power condition should be achieved using the maximum allowable input power, Actual output power may exceed nominal rated output,

[7] Based on PGU rated input operating range, For example, If range is between X volts and Y volts, 75 % of range =X + 0,75 × (Y – X), Y shall not exceed 0,8 × PGU maximum system voltage (i,e,, maximum allowable array open circuit voltage), In any case, the PGU should not be operated outside of its allowable input voltage range,

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5,5,10,3	Islanding protection according Table 7 – Load imbalance (reactive load) for test condition B (PGU output = 50 % – 66 %)	P

Test conditions	Frequency: 50,00 Hz ± 1% f_n U_n = 230,0 V ± 1% U_n Distortion factor of chokes ≤ 2%
Disconnection limit	2 s (IEC 62116)

No	P_{PGU} [1] [% of PGU rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	I_{AC} [4] [A]			P_{PGU} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [s]	Re-marks [5]
					L1	L2	L3					
12	66	66	0	-5	0,06	-	-	1400	38	0,96	217	IB
13	66	66	0	-4	-	-	-	1400	38	0,97	252	IB
14	66	66	0	-3	-	-	-	1400	38	0,98	305	IB
15	66	66	0	-2	-	-	-	1400	38	0,99	349	IB
16	66	66	0	-1	-	-	-	1400	38	0,99	466	IB
2	66	66	0	0	-	-	-	1400	38	1,00	780	BL
17	66	66	0	1	-	-	-	1400	38	1,01	506	IB
18	66	66	0	2	-	-	-	1400	38	1,02	414	IB
19	66	66	0	3	-	-	-	1400	38	1,03	350	IB
20	66	66	0	4	-	-	-	1400	38	1,04	307	IB
21	66	66	0	5	-	-	-	1400	38	1,04	278	IB

Parameter at 0% per phase	L= 120,34 mH	R= 37,79 Ω	C= 84,28 µF

Note:

RLC is adjusted to min, +/-1% of the inverter rated output power

[1] P_{PGU}: PGU output power

[2] P_{AC}: Real power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[3] Q_{AC}: Reactive power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition,

Condition B:

PGU output power P_{PGU} = 50 % – 66 % of maximum

PGU input voltage [6] = 50 % of rated input voltage range, ±10 %

[6] Based on PGU rated input operating range, For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X), Y shall not exceed 0,8 × PGU maximum system voltage (i,e,, maximum allowable array open circuit voltage), In any case, the PGU should not be operated outside of its allowable input voltage range,

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5,5,10	Islanding protection according Table 7 – Load imbalance (reactive load) for test condition C (PGU output = 25 % – 33 %)	P

Test conditions	Frequency: 50,00 Hz ± 1% f_n U_n = 230,0 V ± 1% U_n Distortion factor of chokes ≤ 2%
Disconnection limit	2s (IEC 62116)

No	P_{PGU} [1] [% of PGU rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	I_{AC} [4] [A]			P_{PGU} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [s]	Re-marks [5]
					L1	L2	L3					
22	33	33	0	-5	0,05	-	-	700	24	0,96	157	IB
23	33	33	0	-4	-	-	-	700	24	0,96	180	IB
24	33	33	0	-3	-	-	-	700	24	0,97	212	IB
25	33	33	0	-2	-	-	-	700	24	0,98	257	IB
26	33	33	0	-1	-	-	-	700	24	0,99	348	IB
3	33	33	0	0	-	-	-	700	24	1,00	689	BL
27	33	33	0	1	-	-	-	700	24	1,01	434	IB
28	33	33	0	2	-	-	-	700	24	1,02	332	IB
29	33	33	0	3	-	-	-	700	24	1,03	270	IB
30	33	33	0	4	-	-	-	700	24	1,04	231	IB
31	33	33	0	5	-	-	-	700	24	1,04	188	IB

Parameter at 0% per phase	L= 240,67 mH	R= 75,57 Ω	C= 42,14 µF

Note:

RLC is adjusted to min, +/-1% of the inverter rated output power

[1] P_{PGU}: PGU output power

[2] P_{AC}: Real power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[3] Q_{AC}: Reactive power flow at S1 in Figure 1, Positive means power from PGU to utility, Nominal is the 0 % test condition value,

[4] Fundamental of I_{AC} when RLC is adjusted

[5] BL: Balance condition, IB: Imbalance condition,

Condition B:

PGU output power P_{PGU} = 25 % – 33 % [6] of maximum

PGU input voltage [7] < 20 % of rated input voltage range

[6] Or minimum allowable PGU output level if greater than 33 %,

[7] Based on PGU rated input operating range, For example, If range is between X volts and Y volts, 20 % of range =X + 0,2 × (Y – X), Y shall not exceed 0,8 × PGU maximum system voltage (i,e,, maximum allowable array open circuit voltage), In any case, the PGU should not be operated outside of its allowable input voltage range,

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DIN VDE 0124-100		
Clause	**Requirement – Test**	**Verdict**
5,6	**Testing of connecting conditions and synchronisation**	
5,6,1	General	**P**
5,6,2	Connecting conditions and synchronisation	**P**

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5,6	**Testing of connecting conditions and synchronisation**	**P**
5,6,1	**General**	**P**
These tests serve to demonstrate the requirements of VDE-AR-N 4105: 2018-11, 8,3		

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5,6,2,	Connecting conditions and synchronisation		P
Test:			
	f_{ist}	**Reset time:**	**Limit:**
Connecting conditions for frequencies:			
a)	< 47,45 Hz	No reconnection	No resetting allowed
	Switch to:		
b)	≥ 47,55 Hz	62,8	≥ 60 s
c)	> 50,15 Hz	No reconnection	No resetting allowed
	Switch to:		
d)	≤ 50,05 Hz	60,6	≥ 60 s
Connecting conditions for voltages:			
e)	84% U_n	No reconnection	No resetting allowed
	Switch to:		
f)	≥ 86% U_n	66,8	≥ 60 s
g)	111% U_n	No reconnection	No resetting allowed
	Switch to:		
h)	≤ 109% U_n	65,2	≥ 60 s

Test:

see points a) to h) for the test process,

The measurement was carried out with a programmable AC source,

e,g, connecting conditions for frequencies: Point a) and b), The AC source was programmed in such a way that the first step of 230 V / 50,0 Hz to 200 V / 47,0 Hz resulted in a disconnection, Thereafter the voltage and frequency for 100 s is set to 215 V / 47,45 Hz, Switching on again is not permitted, After a lapse of 100 s the voltage is set to 230 V / 47,55 Hz, Setting again after 60 s is permitted,

Assessment criterion:

After actuating the NS protection it should be checked that the system can only be switched within the tolerance ranges ((80% U_n ≤ U ≤110% U_n) and (47,50 Hz ≤ f ≤ 50,10 Hz)) at the earliest after 60 s after voltage and frequency has remained within the tolerance ranges,

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5,7	Evidence of $P_{AV,E}$ –Control	
Clause	**Requirement – Test**	**Verdict**
5,7,1	General	**P**
5,7,2,1	Test control dynamic	**P**
5,7,2,2	Test disconnection function	**N/A**

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5.7.	Evidence of $P_{AV,E}$ -Control	
5.7.1	General	P

The test serves to prove the requirements of VDE-AR-N 4105: 2018 - 11, 5.5.2. The $P_{AV,E}$-monitoring may, but does not have to be, integrated into the PGU. If the $P_{AV,E}$-monitoring is not as a unit built, but distributed over several devices, the entire impact chain is analogous to the examination of NA protection including the communicative Check coupling.

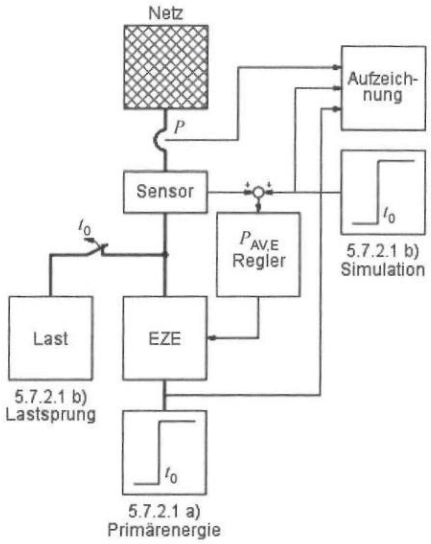


Bild 8 – Skizze des Prüfaufbaus zur Prüfung der Regeldynamik

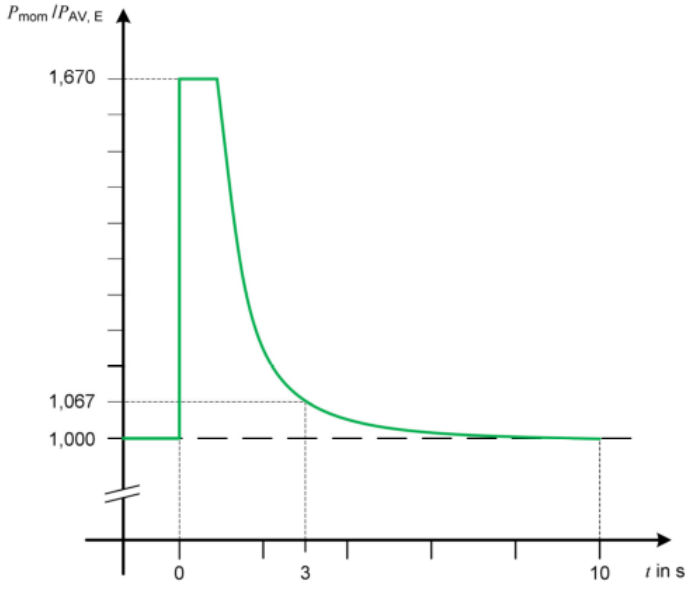


Bild 1 – Wirkleistungs-Grenzkurve für Erzeugungsanlagen

The PGU with any necessary additional components is installed according to the manufacturer's instructions and parameterized so that the feed limitation $P_{AV,E}$ is activated at ≥ 60% P_{rE}. The power jump can be simulated either by a jump in the primary energy supply or by the fall of a load become:

a) Primary energy supply jump: The primary energy supply is adjusted so that the PGU supplies the power $P_{AV,E}$ = 60% P_{rE} with a tolerance of -2%. At the time t0, the primary energy supply is to be suddenly increased so that the PGU can provide the rated output.

b) Loss of load: The PGU is operated at nominal power. Via a load which is to be connected symmetrically to all feeding phases parallel to the PGU, the power at the grid connection point is set to $P_{AV,E}$ with a tolerance of -2%. At time t0, the load is switched off. The elimination of the load can also be simulated by an appropriate offset on the power measurement signal.

The closed loop must not be disconnected. Here, the sum of the effective active values of all 3 phases at the grid connection point must be recorded for at least 15 s from the power jump.

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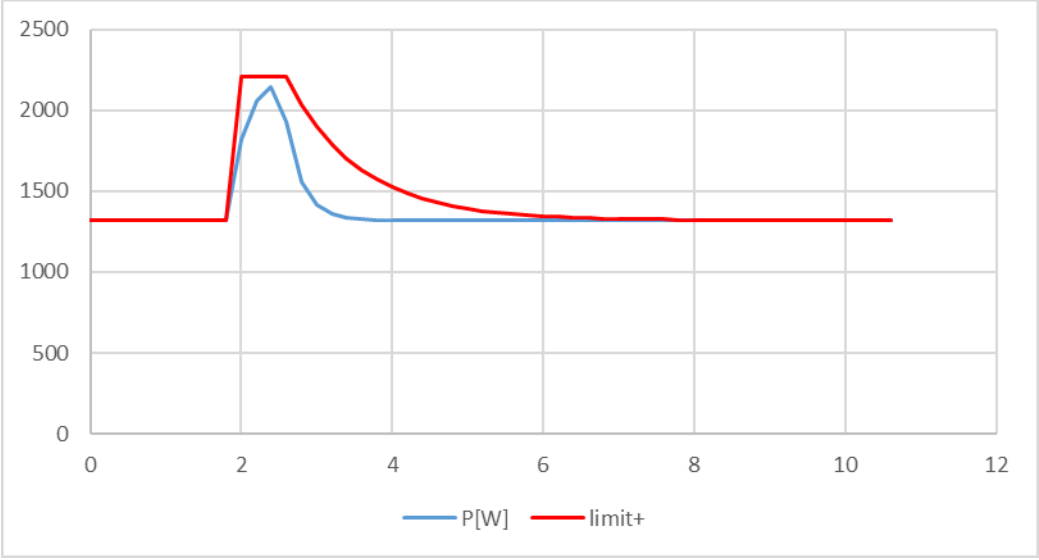
5.7.2.1	Test of control the dynamic	
5.7.2.1	Test a): Primary energy supply jump	P

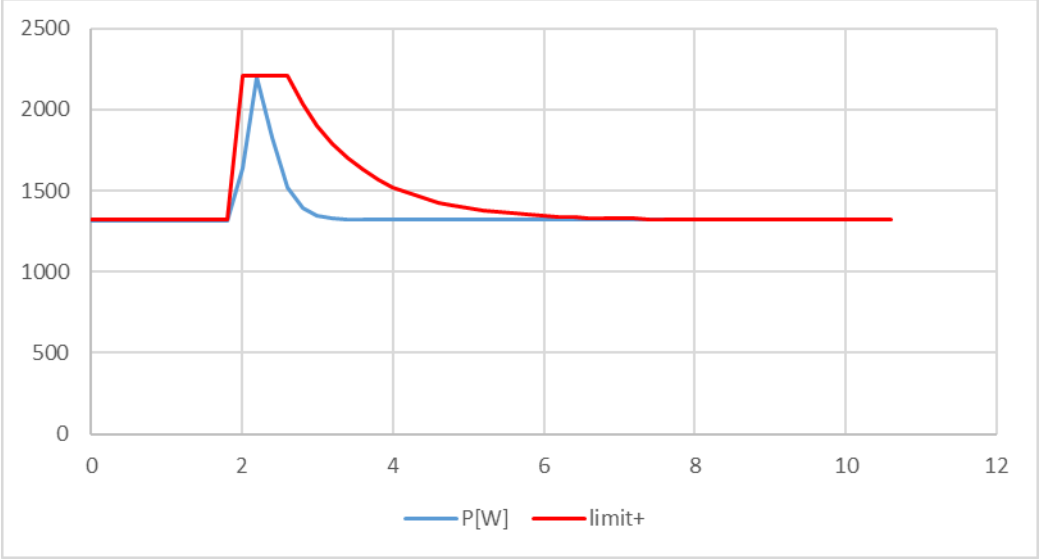
P_{SUM} before energy jump [W]	P_{SUM} after energy jump [W]	P_{DC} before energy jump [W]	Available P_{DC} after energy jump [W]	Settling time [s]
1321,1	1320,3	1408,2	1406,9	1,2

5.7.2.1	Test b): Loss of load	

P_{SUM} inverter [W]	P_{SUM} load [W]	Settling time [s]
1317,2	887,7	1,0

Diagram:

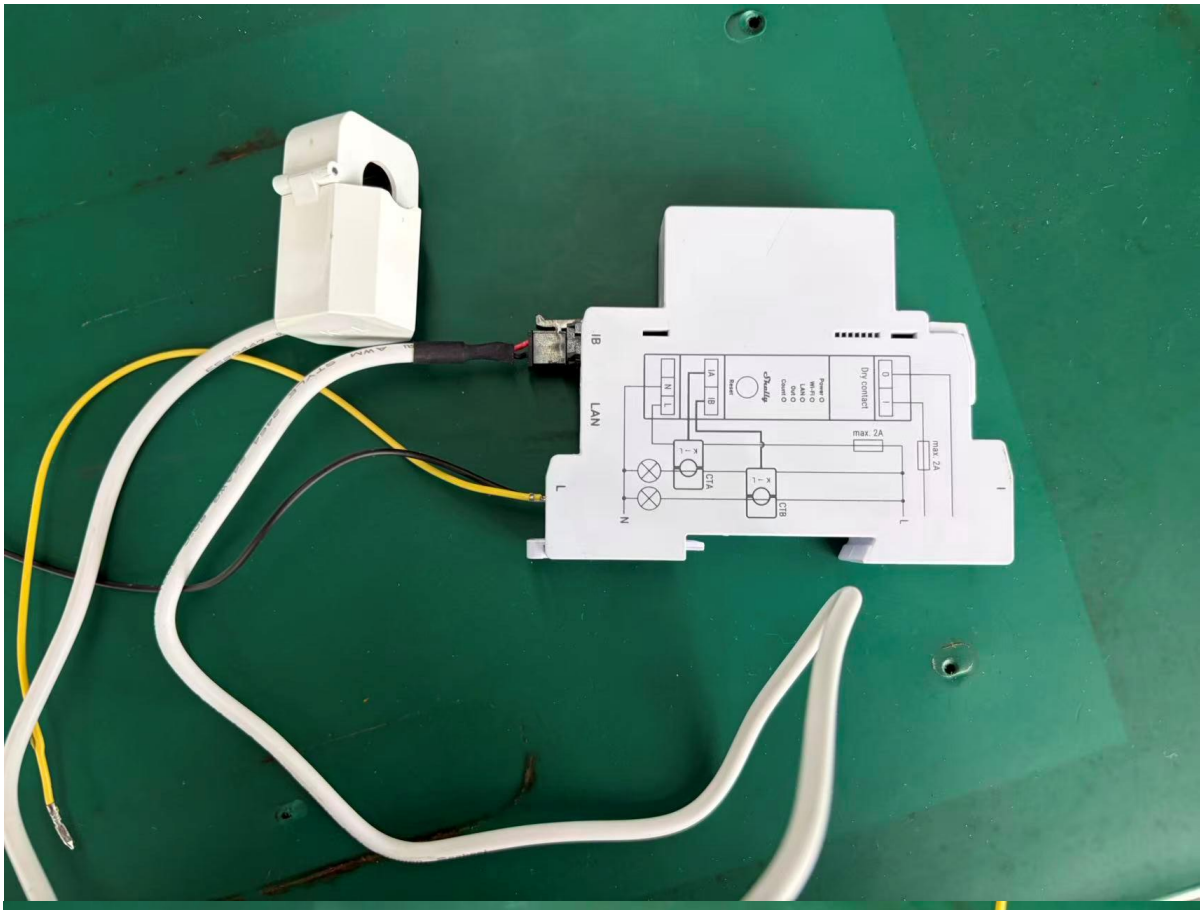




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Meter Information:
Device Name: Shelly Pro EM-50

Device Model: SPEM-002CEBEU50





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Description:

Use the Shelly Pro EM-50 meter to perform anti-reverse power flow testing, monitor the power direction on the grid side in real time, determine whether reverse power is being fed back to the grid, and provide data to the inverter to verify whether the inverter meets requirements when limiting output. Connect the Shelly meter's L terminal to the live wire, N terminal to the neutral wire, and the CT current transformer IA to the live wire with the direction from the grid side to the load side. Then configure the Shelly meter for testing.

Assessment criterion:

The test in accordance with 5.7.2.1 is considered passed if the active power measured at the grid connection point does not exceed the limit curve in VDE-AR-N 4105:2018-11, 5.5.2, Figure 1.

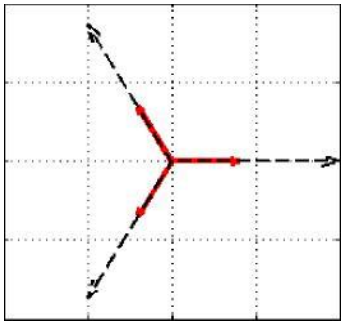
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5.8	Evidence dynamic grid support	
Clause	**Requirement – Test**	**Verdict**
5.8.1	General	**P**
5.8.3	Testing of the dynamic grid support PGU Type 1	**N/A**
5.8.3	Testing of the dynamic grid support PGU Type 2	**P**

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5.8.1	General	

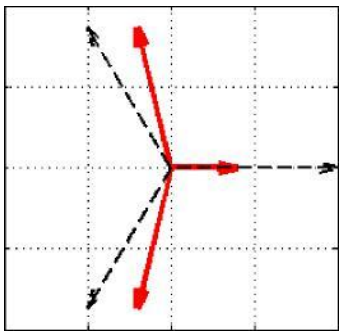
FRT test for three-phase symmetrical (Test ref no. x.1.x)



Typ-A

LVRT test for two-phase asymmetrical fault (Test ref no. 1.2.x to 5.2.x)

Test No.	V/V_{nom}	Phase-to-earth voltages			Phase angles		
		$u_1/u_{1,nom}$	$u_2/u_{2,nom}$	$u_3/u_{3,nom}$	φ_{u1}	φ_{u2}	φ_{u3}
1.2.x	0,1-0,15	0,1-0,15	0,87 ± 0,05	0,87 ± 0,05	0°	-94°	94°
2.2.x	0,20-0,25	0,20-0,25	0,87 ± 0,05	0,87 ± 0,05	0°	-97°	97°
3.2.x	0,50 ± 0,05	0,50 ± 0,05	0,90 ± 0,05	0,90 ± 0,05	0°	-106°	106°
4.2.x	0,75 ± 0,05	0,75 ± 0,05	0,94 ± 0,05	0,94 ± 0,05	0°	-113°	113°
5.2.x	0,92 ± 0,05	0,92 ± 0,05	0,98 ± 0,05	0,98 ± 0,05	0°	-118°	118°
Normal condition	1	1	1	1	0°	-120°	120°



Typ-D

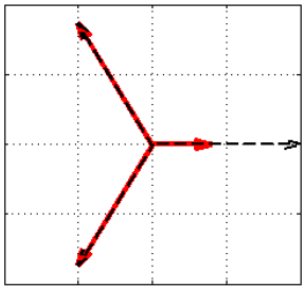
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5.8.1	General	

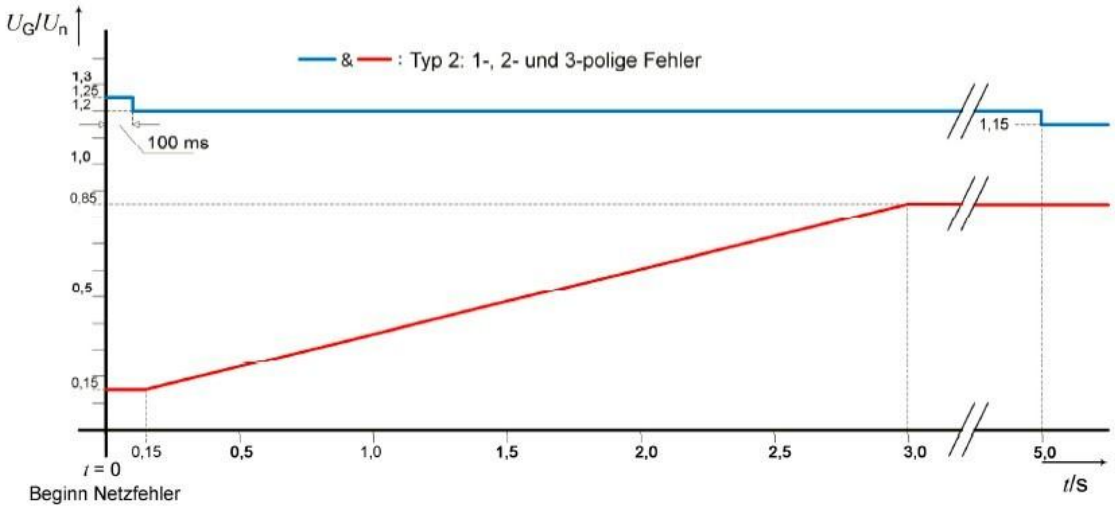
FRT test for two-phase asymmetrical fault (Test ref no. 6.2.x to 7.2.x)

Test No.	V/V_{nom}	Phase-to-earth voltages			Phase angles		
		$u_1/u_{1,nom}$	$u_2/u_{2,nom}$	$u_3/u_{3,nom}$	φ_{u1}	φ_{u2}	φ_{u3}
6.2.x	1,25-1,30	1,25-1,30	1,25-1,30	1,00 ± 0,05	0°	-120°	120°
7.2.x	1,20 ± 0,05	1,20 ± 0,05	1,20 ± 0,05	1,00 ± 0,05	0°	-120°	120°
Normal condition	1	1	1	1	0°	-120°	120°

FRT test for two-phase asymmetrical fault (Test ref no. x.3.x)



Typ-B



Legende

& FRT-Kurve für 1-, 2- und 3-polige Netzfehler

UG Effektivwert der aktuellen Spannung an den Generatorklemmen

Bild 12 – Fault-Ride-Through-Grenzkurve für den Spannungsverlauf an den Generatorklemmen für eine Erzeugungseinheit vom Typ 2 und für Speicher

Figure 12 - Fault ride-through limit curve for the voltage curve at the generator terminals for a **type 2** generation unit and for storage

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5.8.3	Testing of the dynamic grid support	P
	For PGUs Type 2 and storage systems	P
	1 and 3-phase systems	

Test	Voltage dip to (U_n / p.u.)	Dip type	duration (s)	P set point (P_{rE} / p.u.)	Q set point (Q / p.u.)	Comment	Test ref. No.	R recovery response time [s]
1	0,15 to 0,25	A	for 0,15 ≥0,150 / for 0,25 ≥0,500	1	0 to ± 0,1	Symmetric	1.1	0,442
				0,2 to 0,6			1.2	0,242
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	1.3	0,506
				0,2 to 0,6			1.4	0,282
		D2		1			1.5	0,500
2	0,50 to 0,60	A	for 0,50 ≥1,5 / for 0,60 ≥2,000	1	Max. over excited	Symmetric	2.1	0,423
				0,2 to 0,6			2.2	0,242
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	2.3	0,520
				0,2 to 0,6			2.4	0,451
3	0,50 to 0,60	A	for 0,50 ≥1,500 / for 0,60 ≥2,000	1	Max. under excited	Symmetric	3.1	0,466
				0,2 to 0,6			3.2	0,298
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	3.3	0,496
				0,2 to 0,6			3.4	0,398
4	0,85 to 0,90	A	≥60,000	1	0 to ± 0,1	Symmetric	4.1	N/A
				0,2 to 0,6			4.2	N/A
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	4.3	N/A
				0,2 to 0,6			4.4	N/A
5	1,20 to 1,25	A	≥0,100	1	0 to ± 0,1	Symmetric	5.1	0,435
				0,2 to 0,6			5.2	0,309
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	5.3	N/A
				0,2 to 0,6			5.4	N/A
		D2		1			5.5	0,434
6	1,15 to 1,20	A	≥5,000	1	0 to ± 0,1	Symmetric	6.1	0,499
				0,2 to 0,6			6.2	0,501
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	6.3	N/A
				0,2 to 0,6			6.4	N/A
7	1,10 to 1,15	A	≥60,000	1	0 to ± 0,1	Symmetric	7.1	N/A
				0,2 to 0,6			7.2	N/A
		D1		1		Asymmetric (ph-2ph + Dy5-Trafo)	7.3	N/A
				0,2 to 0,6			7.4	N/A

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5.8.3	Testing of the dynamic grid support	P

Note:

At lease The recording must begin at least 10 s before the error occurs. After a faulty declaration (Voltage in the range 0,85 U_n ≤ U ≤ 1,1 U_n), the recording must continue for at least another 60 s.

Behaviour during the network error:

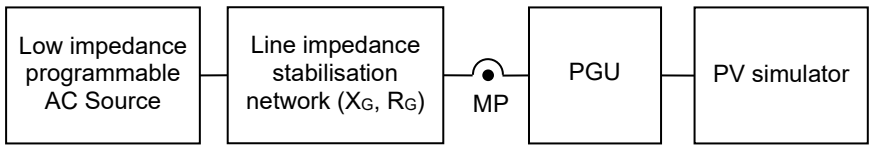
No disconnection of the PGU during the voltage drops the grid. If the PGU disconnects from the grid, the time of disconnection must be documented.

- Type 2 units and storage systems are not allowed to inject either active or reactive current during a line voltage at the PGUs terminals below 0,8 Un and above 1,15 Un. This requirement is met if, in the event of a under-/ under voltage dip, the injected current of the generating unit and / or the storage systems does not exceed 20% of the rated current Ir and no more than 10% Ir after 0,06 s after the occurrence of this under-/ under voltage dip in any phase.

Behaviour after the end of the error:

- Not disconnection of the PGU within 60s after the end of the fault.
- Type 2 units and storage systems: Reaction time of active power up to 1 s, Reaction time of reactive power according to PT-1 behaviour with 3 tau = 10 s in accordance with VDE-AR-N 4105: 2018-11, 5.7.2.5

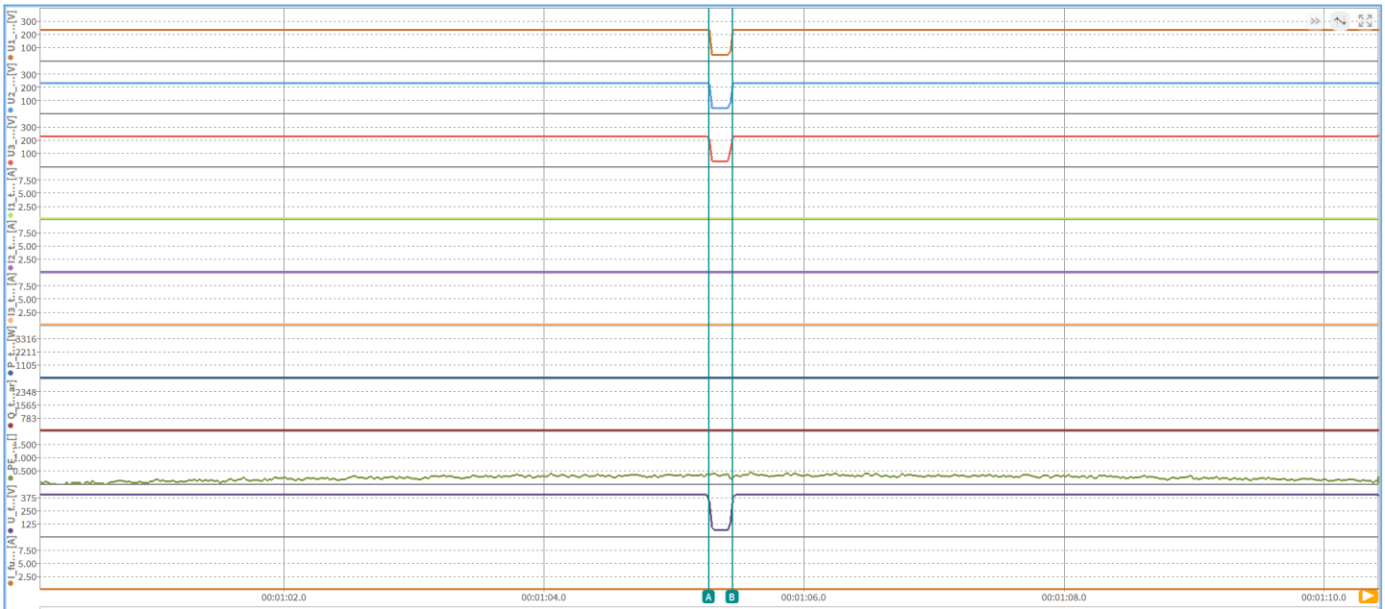
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Test setup	
Grid simulator (grid conditions varied)	☒
Test bench	☐
Identifier of test setup	See Annex 2 – Test equipment list
Schematic of test setup:  	Note on test setup: Instead of an LVRT test bench a low-voltage AC simulator was used.
Note: Evaluation of data measured at MP. Used sample rate: 10 kHz	
Grid parameters at MP1	
Nominal voltage PCC // U_G [V]	230 V (P-N) / 400 V (P-P)
Nominal apparent power of test setup // S_n [kVA]	30
Short-circuit power of the test setup // S_{sc} [kVA]	≥ 3x$S_{n,PGU}$
Grid reactance X_G [Ω]	0,39
Grid impedance R_G [Ω]	0,15

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5.8.3	For PGUs Type 2 and storage systems – no load	P

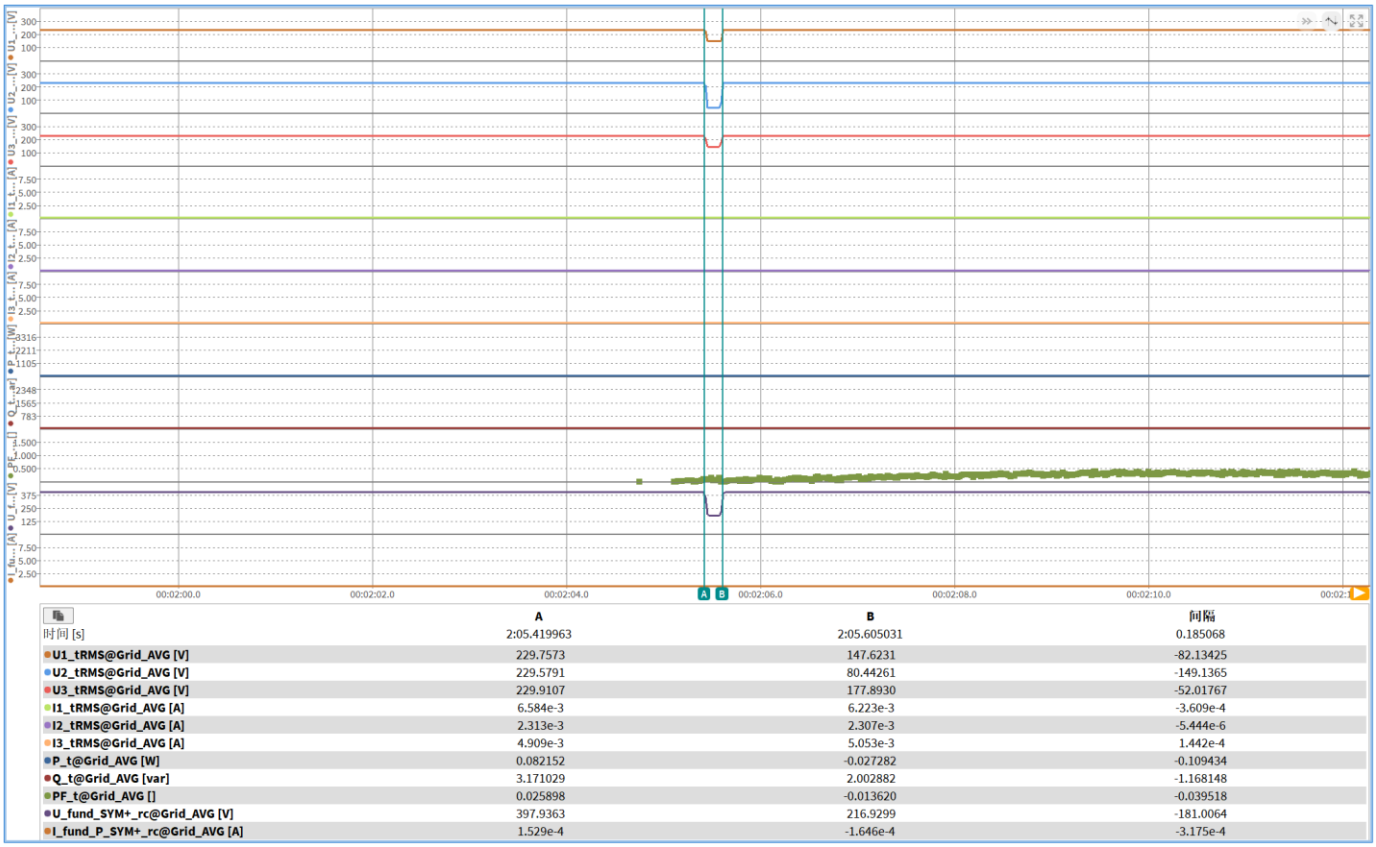
1.1



时间 [s]	A 1:05.27011	B 1:05.45173	间隔 0.18162
U1_tRMS@Grid_AVG [V]	229.7412	66.23406	-163.5071
U2_tRMS@Grid_AVG [V]	229.5830	81.04279	-148.5402
U3_tRMS@Grid_AVG [V]	229.9272	122.0297	-107.8975
I1_tRMS@Grid_AVG [A]	6.532e-3	6.307e-3	-2.248e-4
I2_tRMS@Grid_AVG [A]	2.397e-3	2.459e-3	6.201e-5
I3_tRMS@Grid_AVG [A]	4.429e-3	4.406e-3	-2.254e-5
P_t@Grid_AVG [W]	1.057691	0.178567	-0.879123
Q_t@Grid_AVG [var]	2.881154	1.140795	-1.740358
PF_t@Grid_AVG []	0.344619	0.154646	-0.189973
U_fund_SYM+_rc@Grid_AVG [V]	397.1980	131.2894	-265.9086
I_fund_P_SYM+_rc@Grid_AVG [A]	1.469e-3	1.423e-3	-4.602e-5

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5.8.3	For PGUs Type 2 and storage systems – no load	P
	1.3	

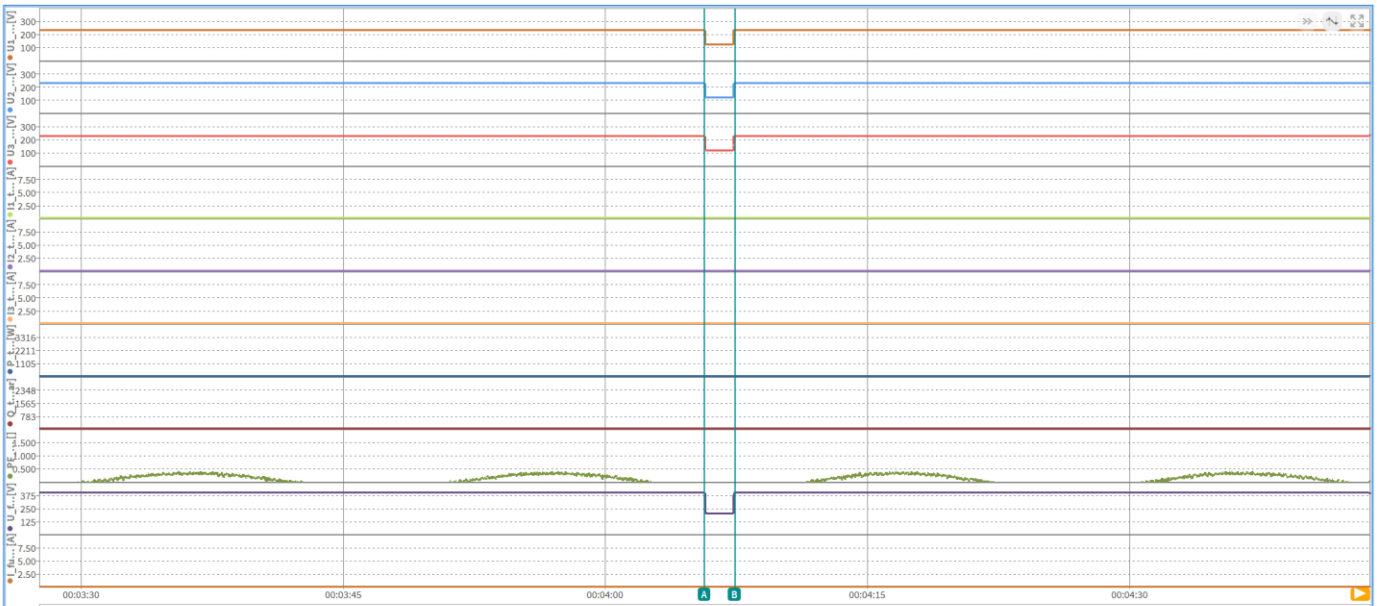


	A	B	间隔
时间 [s]	2:05.419963	2:05.605031	0.185068
U1_tRMS@Grid_AVG [V]	229.7573	147.6231	-82.13425
U2_tRMS@Grid_AVG [V]	229.5791	80.44261	-149.1365
U3_tRMS@Grid_AVG [V]	229.9107	177.8930	-52.01767
I1_tRMS@Grid_AVG [A]	6.584e-3	6.223e-3	-3.609e-4
I2_tRMS@Grid_AVG [A]	2.313e-3	2.307e-3	-5.444e-6
I3_tRMS@Grid_AVG [A]	4.909e-3	5.053e-3	1.442e-4
P_t@Grid_AVG [W]	0.082152	-0.027282	-0.109434
Q_t@Grid_AVG [var]	3.171029	2.002882	-1.168148
PF_t@Grid_AVG []	0.025898	-0.013620	-0.039518
U_fund_SYM+_rc@Grid_AVG [V]	397.9363	216.9299	-181.0064
I_fund_P_SYM+_rc@Grid_AVG [A]	1.529e-4	-1.646e-4	-3.175e-4

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5.8.3	For PGUs Type 2 and storage systems – no load	P

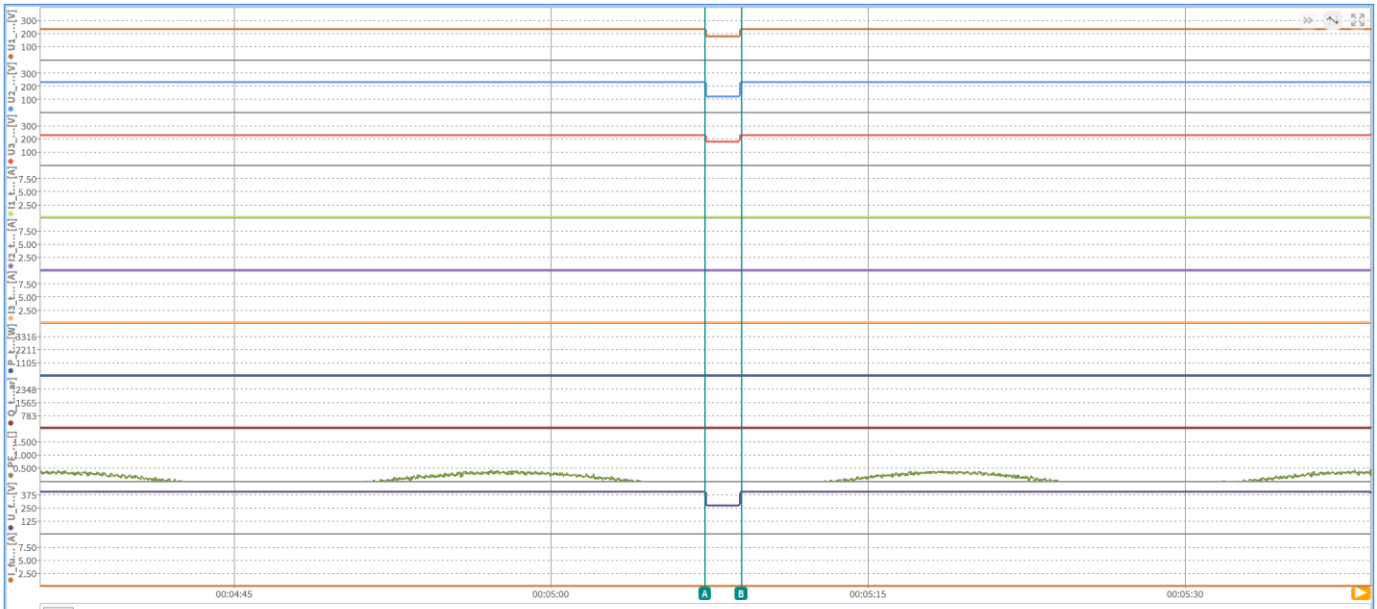
2.1



时间 [s]	A 4:05.673549	B 4:07.403261	间隔 1.729712
U1_tRMS@Grid_AVG [V]	229.7610	229.9307	0.169693
U2_tRMS@Grid_AVG [V]	229.5818	229.6431	0.061249
U3_tRMS@Grid_AVG [V]	229.9126	229.8446	-0.067963
I1_tRMS@Grid_AVG [A]	6.130e-3	5.867e-3	-2.627e-4
I2_tRMS@Grid_AVG [A]	2.494e-3	2.682e-3	1.881e-4
I3_tRMS@Grid_AVG [A]	5.157e-3	4.744e-3	-4.122e-4
P_t@Grid_AVG [W]	-0.873360	-0.975290	-0.101930
Q_t@Grid_AVG [var]	-3.043704	-2.895600	0.148103
PF_t@Grid_AVG []	-0.275810	-0.319198	-0.043388
U_fund_SYM+_rc@Grid_AVG [V]	397.9416	398.0462	0.104593
I_fund_P_SYM+_rc@Grid_AVG [A]	-1.383e-3	-1.465e-3	-8.233e-5

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5.8.3	For PGUs Type 2 and storage systems – no load	P
	2.3	

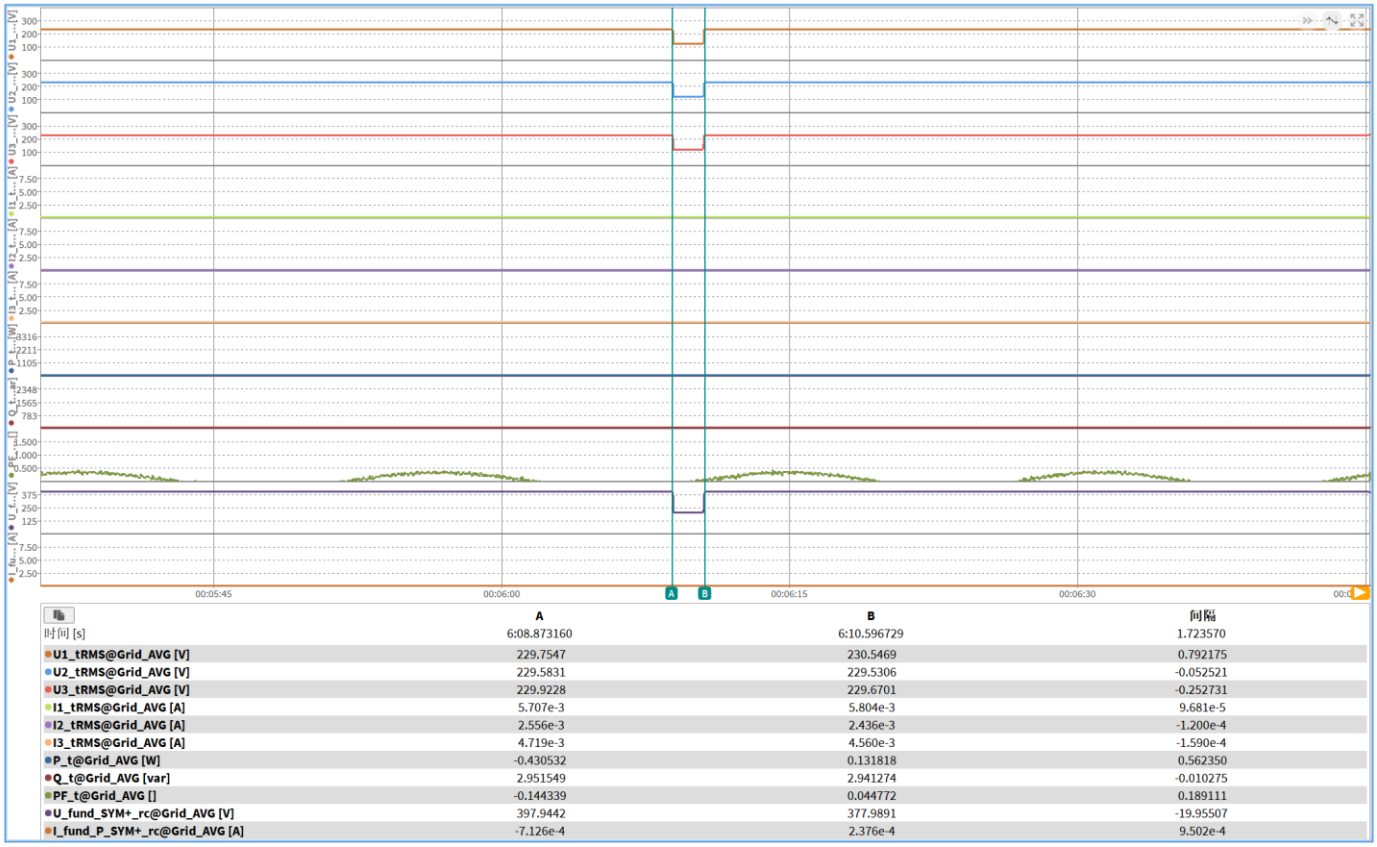


	A	B	间隔
时间 [s]	5:07.28975	5:09.00750	1.71775
U1_tRMS@Grid_AVG [V]	229.7545	229.8717	0.117172
U2_tRMS@Grid_AVG [V]	229.5797	229.6342	0.054443
U3_tRMS@Grid_AVG [V]	229.9122	229.8791	-0.033173
I1_tRMS@Grid_AVG [A]	6.288e-3	6.256e-3	-3.176e-5
I2_tRMS@Grid_AVG [A]	2.222e-3	2.464e-3	2.427e-4
I3_tRMS@Grid_AVG [A]	4.957e-3	5.210e-3	2.528e-4
P_t@Grid_AVG [W]	-1.016878	-0.818573	0.198306
Q_t@Grid_AVG [var]	-2.922548	3.095238	6.017786
PF_t@Grid_AVG []	-0.328619	-0.255672	0.072946
U_fund_SYM+_rc@Grid_AVG [V]	397.9370	398.0176	0.080568
I_fund_P_SYM+_rc@Grid_AVG [A]	-1.403e-3	-1.252e-3	1.511e-4

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5.8.3	For PGUs Type 2 and storage systems – no load	P

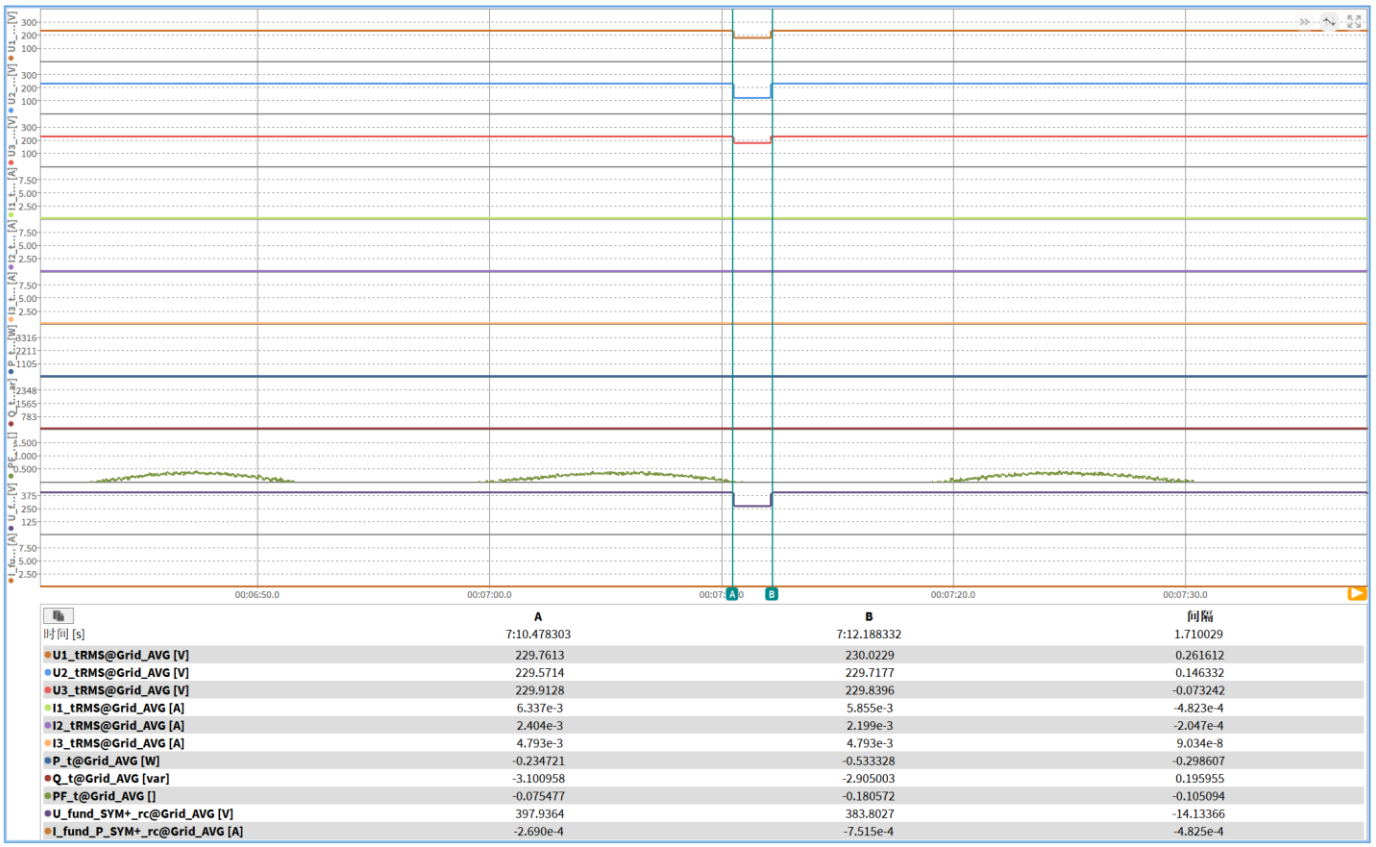
3.1



时间 [s]	A 6:08.873160	B 6:10.596729	间隔 1.723570
U1_tRMS@Grid_AVG [V]	229.7547	230.5469	0.792175
U2_tRMS@Grid_AVG [V]	229.5831	229.5306	-0.052521
U3_tRMS@Grid_AVG [V]	229.9228	229.6701	-0.252731
I1_tRMS@Grid_AVG [A]	5.707e-3	5.804e-3	9.681e-5
I2_tRMS@Grid_AVG [A]	2.556e-3	2.436e-3	-1.200e-4
I3_tRMS@Grid_AVG [A]	4.719e-3	4.560e-3	-1.590e-4
P_t@Grid_AVG [W]	-0.430532	0.131818	0.562350
Q_t@Grid_AVG [var]	2.951549	2.941274	-0.010275
PF_t@Grid_AVG []	-0.144339	0.044772	0.189111
U_fund_SYM+_rc@Grid_AVG [V]	397.9442	377.9891	-19.95507
I_fund_P_SYM+_rc@Grid_AVG [A]	-7.126e-4	2.376e-4	9.502e-4

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5.8.3	For PGUs Type 2 and storage systems – no load	P
	3.3	

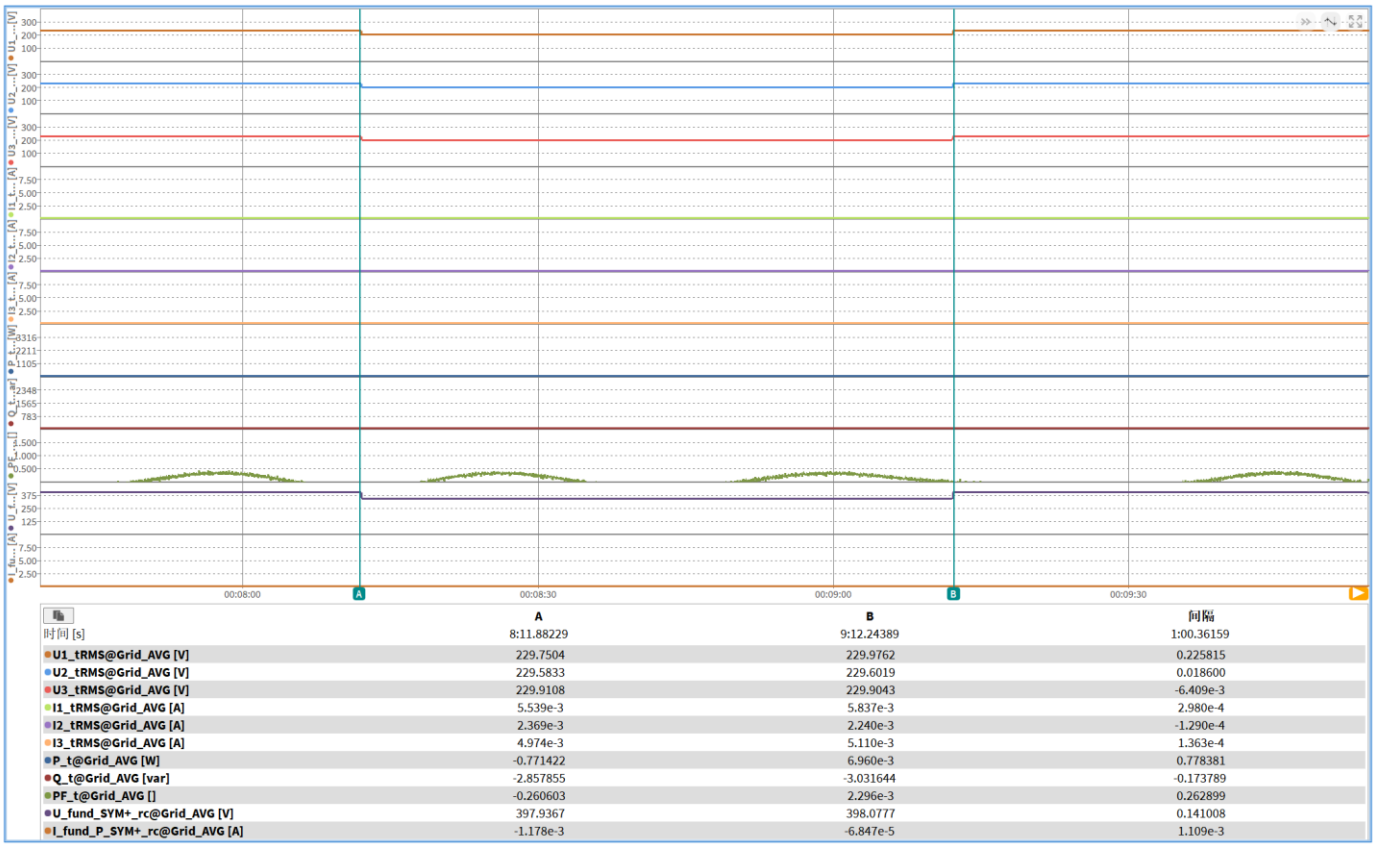


时间 [s]	A 7:10.478303	B 7:12.188332	间隔 1.710029
U1_tRMS@Grid_AVG [V]	229.7613	230.0229	0.261612
U2_tRMS@Grid_AVG [V]	229.5714	229.7177	0.146332
U3_tRMS@Grid_AVG [V]	229.9128	229.8396	-0.073242
I1_tRMS@Grid_AVG [A]	6.337e-3	5.855e-3	-4.823e-4
I2_tRMS@Grid_AVG [A]	2.404e-3	2.199e-3	-2.047e-4
I3_tRMS@Grid_AVG [A]	4.793e-3	4.793e-3	9.034e-8
P_t@Grid_AVG [W]	-0.234721	-0.533328	-0.298607
Q_t@Grid_AVG [var]	-3.100958	-2.905003	0.195955
PF_t@Grid_AVG []	-0.075477	-0.180572	-0.105094
U_fund_SYM+_rc@Grid_AVG [V]	397.9364	383.8027	-14.13366
I_fund_P_SYM+_rc@Grid_AVG [A]	-2.690e-4	-7.515e-4	-4.825e-4

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5.8.3	For PGUs Type 2 and storage systems – no load	P

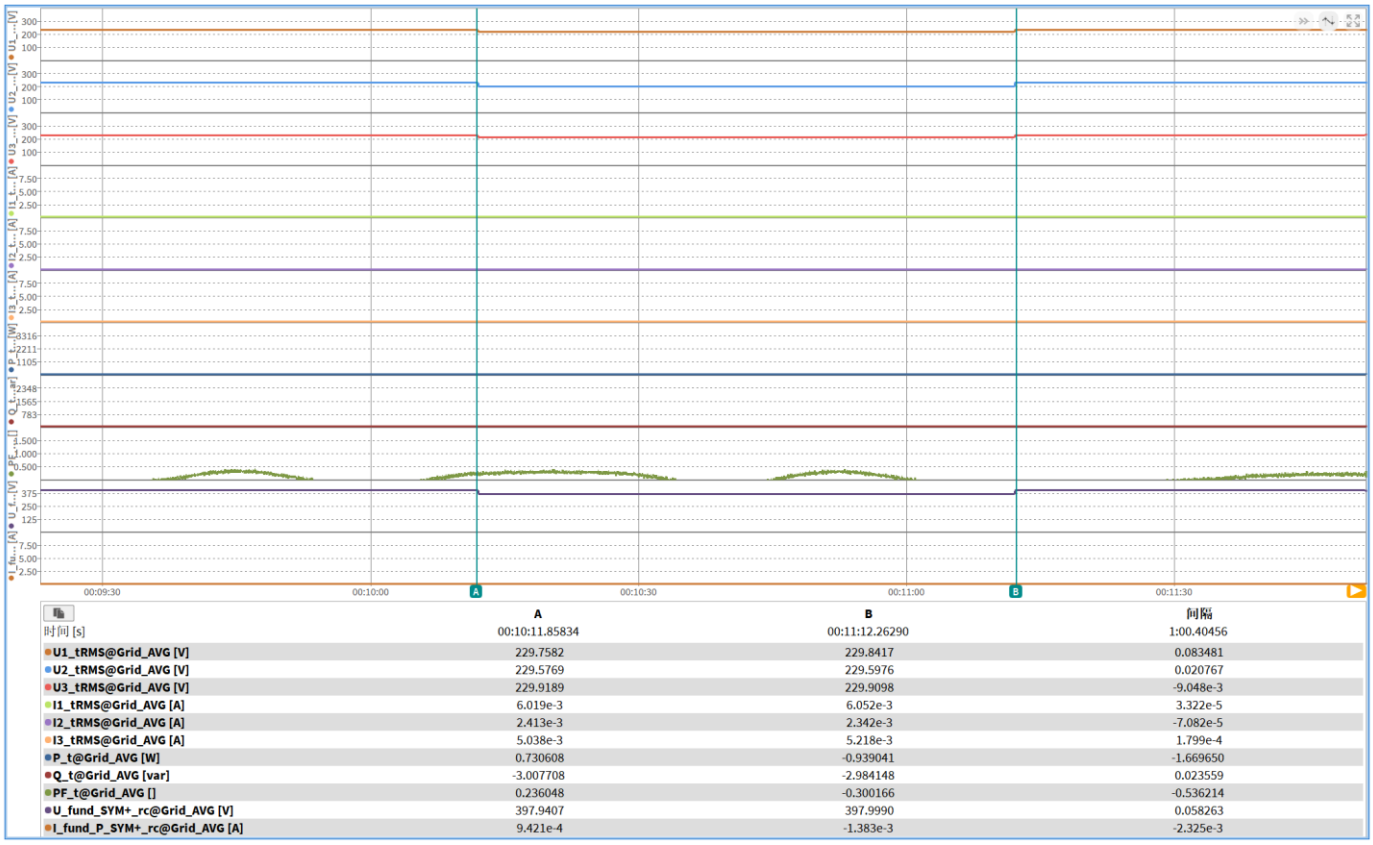
4.1



时间 [s]	A 8:11.88229	B 9:12.24389	间隔 1:00.36159
U1_tRMS@Grid_AVG [V]	229.7504	229.9762	0.225815
U2_tRMS@Grid_AVG [V]	229.5833	229.6019	0.018600
U3_tRMS@Grid_AVG [V]	229.9108	229.9043	-6.409e-3
I1_tRMS@Grid_AVG [A]	5.539e-3	5.837e-3	2.980e-4
I2_tRMS@Grid_AVG [A]	2.369e-3	2.240e-3	-1.290e-4
I3_tRMS@Grid_AVG [A]	4.974e-3	5.110e-3	1.363e-4
P_t@Grid_AVG [W]	-0.771422	6.960e-3	0.778381
Q_t@Grid_AVG [var]	-2.857855	-3.031644	-0.173789
PF_t@Grid_AVG []	-0.260603	2.296e-3	0.262899
U_fund_SYM+_rc@Grid_AVG [V]	397.9367	398.0777	0.141008
I_fund_P_SYM+_rc@Grid_AVG [A]	-1.178e-3	-6.847e-5	1.109e-3

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5.8.3	For PGUs Type 2 and storage systems – no load	P
	4.3	

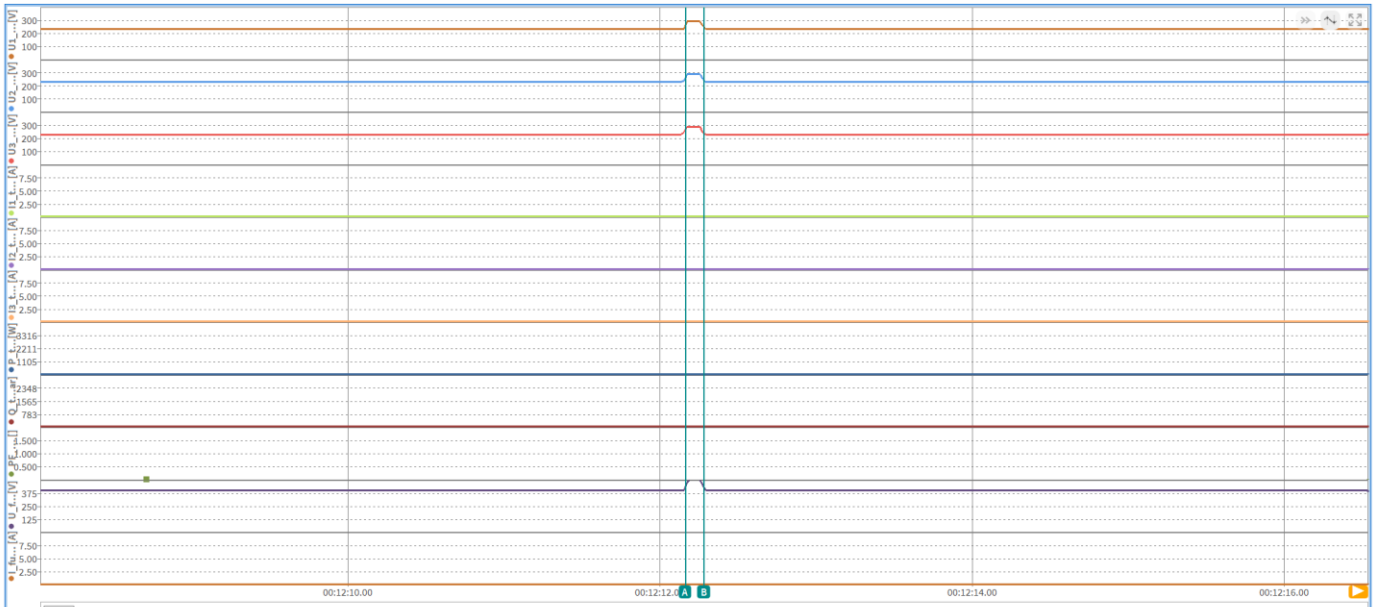


时间 [s]	A 00:10:11.85834	B 00:11:12.26290	间隔 1:00.40456
U1_tRMS@Grid_AVG [V]	229.7582	229.8417	0.083481
U2_tRMS@Grid_AVG [V]	229.5769	229.5976	0.020767
U3_tRMS@Grid_AVG [V]	229.9189	229.9098	-9.048e-3
I1_tRMS@Grid_AVG [A]	6.019e-3	6.052e-3	3.322e-5
I2_tRMS@Grid_AVG [A]	2.413e-3	2.342e-3	-7.082e-5
I3_tRMS@Grid_AVG [A]	5.038e-3	5.218e-3	1.799e-4
P_t@Grid_AVG [W]	0.730608	-0.939041	-1.669650
Q_t@Grid_AVG [var]	-3.007708	-2.984148	0.023559
PF_t@Grid_AVG []	0.236048	-0.300166	-0.536214
U_fund_SYM+_rc@Grid_AVG [V]	397.9407	397.9990	0.058263
I_fund_P_SYM+_rc@Grid_AVG [A]	9.421e-4	-1.383e-3	-2.325e-3

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5.8.3	For PGUs Type 2 and storage systems – no load	P

5.1

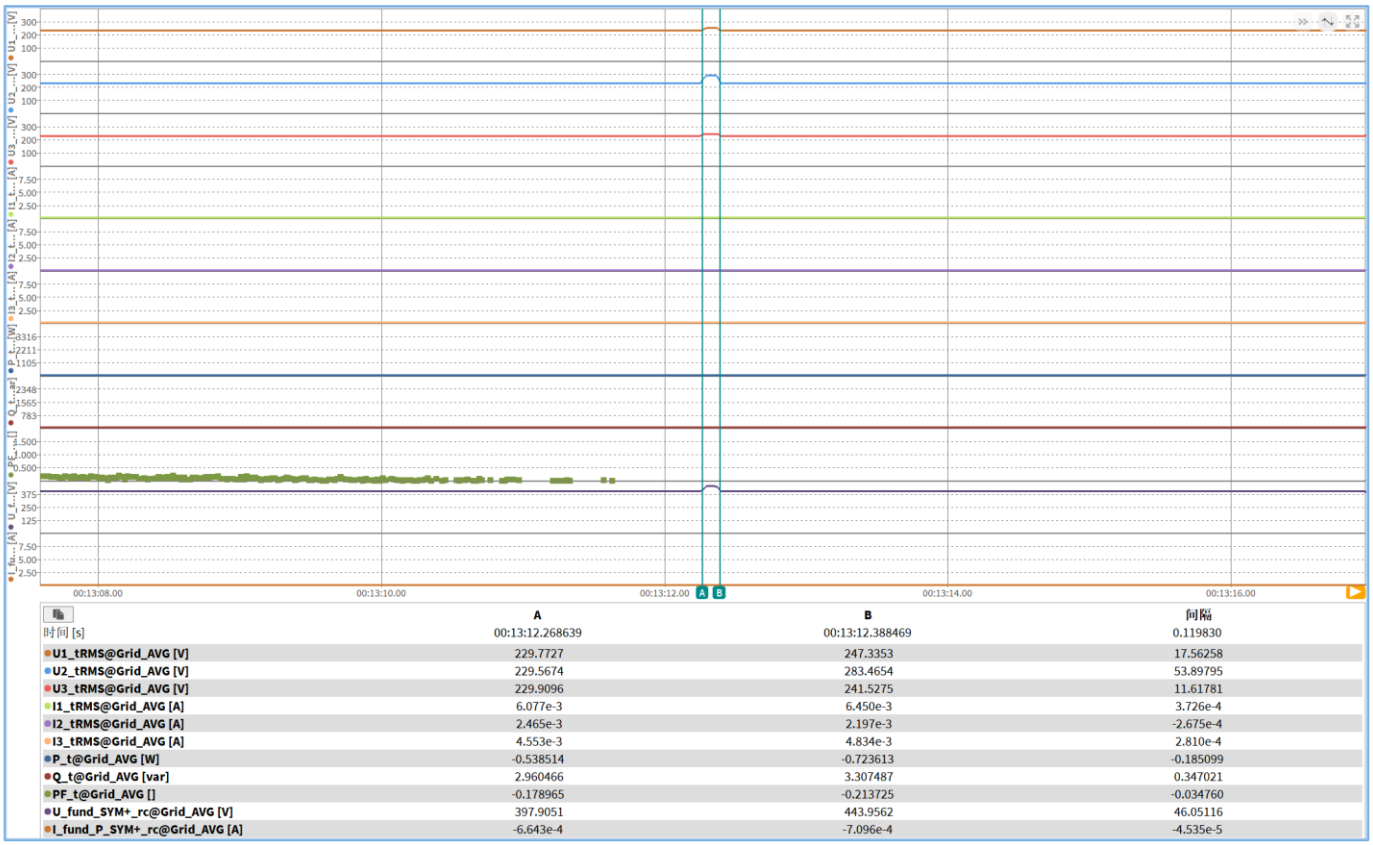


时间 [s]	A 00:12:12.163335	B 00:12:12.282893	间隔 0.119558
U1_tRMS@Grid_AVG [V]	234.0416	255.9315	21.88995
U2_tRMS@Grid_AVG [V]	235.8414	254.4385	18.59709
U3_tRMS@Grid_AVG [V]	246.9224	244.3459	-2.576538
I1_tRMS@Grid_AVG [A]	5.948e-3	5.956e-3	7.913e-6
I2_tRMS@Grid_AVG [A]	2.452e-3	2.246e-3	-2.061e-4
I3_tRMS@Grid_AVG [A]	5.009e-3	4.728e-3	-2.816e-4
P_t@Grid_AVG [W]	-0.807052	-0.882953	-0.075900
Q_t@Grid_AVG [var]	3.104004	3.128682	0.024679
PF_t@Grid_AVG []	-0.251637	-0.271604	-0.019966
U_fund_SYM+_rc@Grid_AVG [V]	406.7625	455.1900	48.42755
I_fund_P_SYM+_rc@Grid_AVG [A]	-9.085e-4	-1.073e-3	-1.644e-4

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5.8.3	For PGUs Type 2 and storage systems – no load	P

5.3

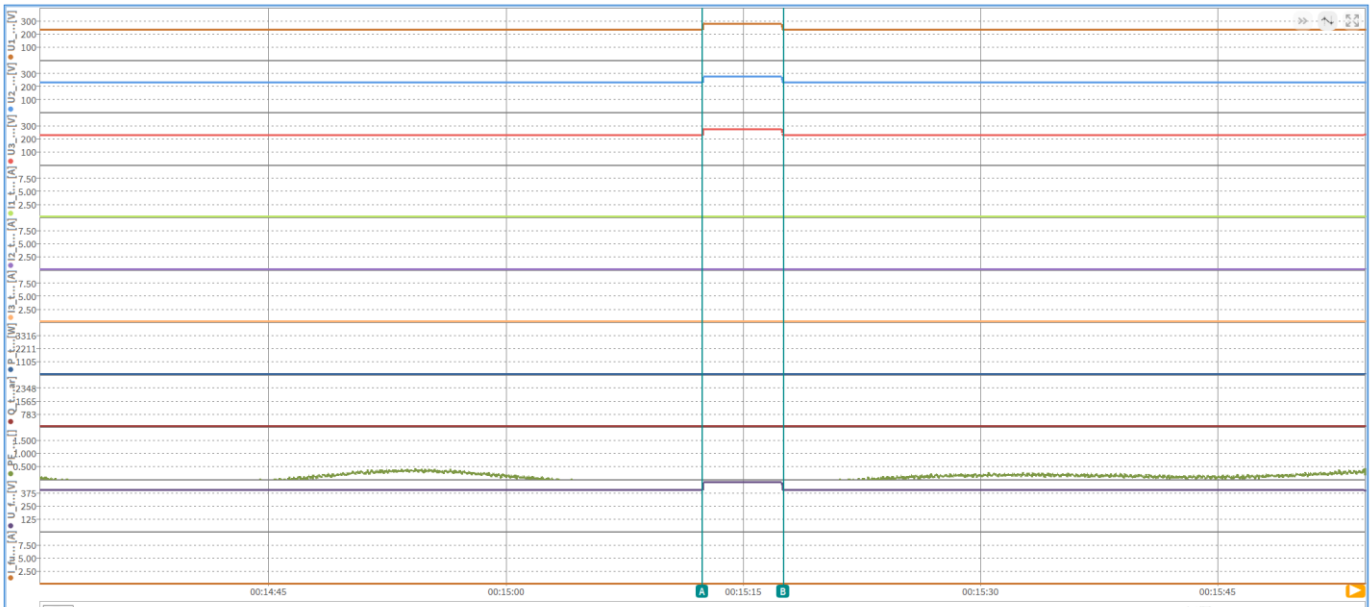


时间 [s]	A 00:13:12.268639	B 00:13:12.388469	间隔 0.119830
U1_tRMS@Grid_AVG [V]	229.7727	247.3353	17.56258
U2_tRMS@Grid_AVG [V]	229.5674	283.4654	53.89795
U3_tRMS@Grid_AVG [V]	229.9096	241.5275	11.61781
I1_tRMS@Grid_AVG [A]	6.077e-3	6.450e-3	3.726e-4
I2_tRMS@Grid_AVG [A]	2.465e-3	2.197e-3	-2.675e-4
I3_tRMS@Grid_AVG [A]	4.553e-3	4.834e-3	2.810e-4
P_t@Grid_AVG [W]	-0.538514	-0.723613	-0.185099
Q_t@Grid_AVG [var]	2.960466	3.307487	0.347021
PF_t@Grid_AVG []	-0.178965	-0.213725	-0.034760
U_fund_SYM+_rc@Grid_AVG [V]	397.9051	443.9562	46.05116
I_fund_P_SYM+_rc@Grid_AVG [A]	-6.643e-4	-7.096e-4	-4.535e-5

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5.8.3	For PGUs Type 2 and storage systems – no load	P

6.1

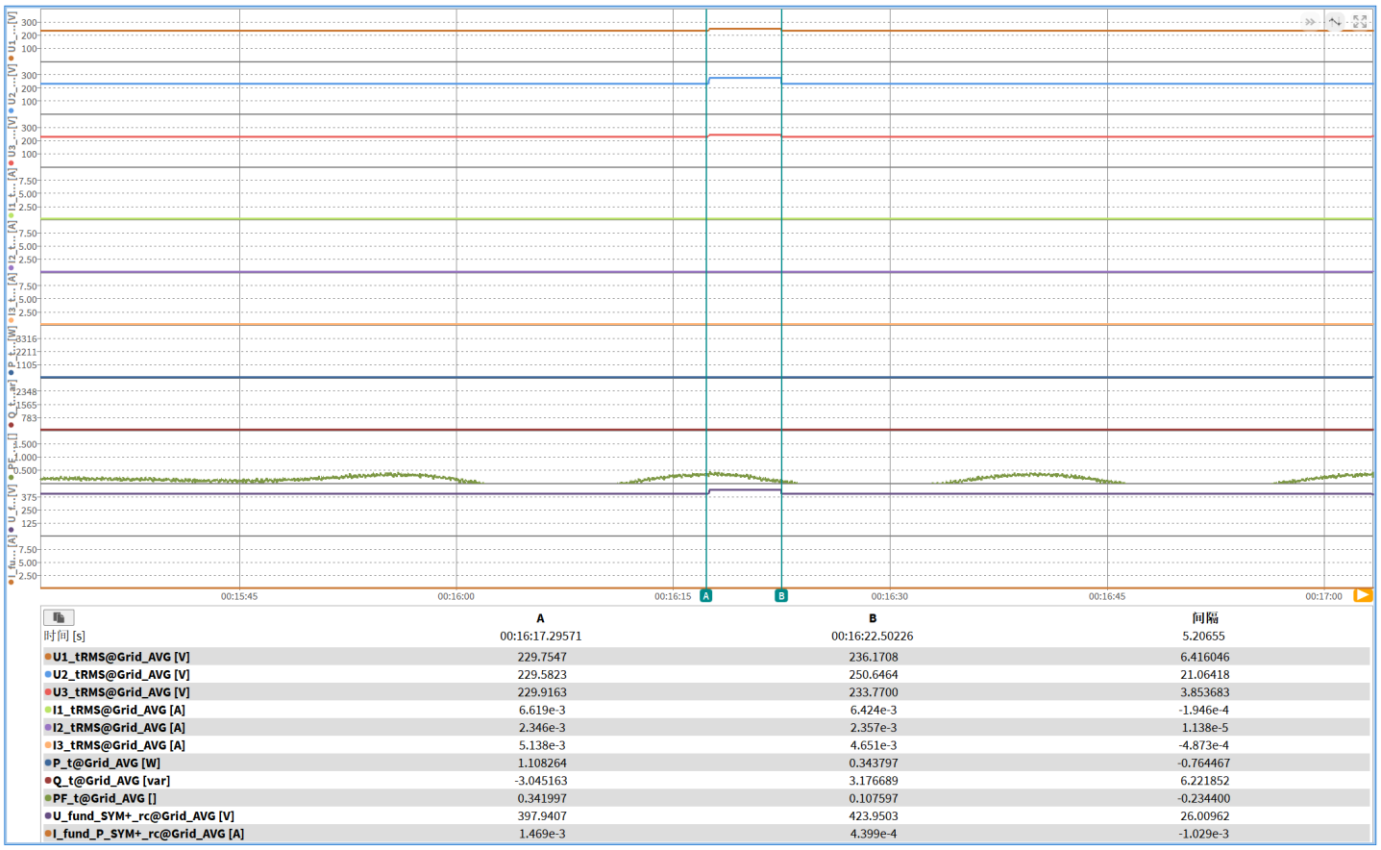


时间 [s]	A 00:15:12.41280	B 00:15:17.52410	Δ 5.11130
U1_tRMS@Grid_AVG [V]	229.7580	229.4806	-0.277359
U2_tRMS@Grid_AVG [V]	229.5810	229.5209	-0.060089
U3_tRMS@Grid_AVG [V]	229.9156	229.9054	-0.010193
I1_tRMS@Grid_AVG [A]	6.112e-3	6.402e-3	2.897e-4
I2_tRMS@Grid_AVG [A]	2.312e-3	2.555e-3	2.432e-4
I3_tRMS@Grid_AVG [A]	4.644e-3	4.889e-3	2.444e-4
P_t@Grid_AVG [W]	-0.853685	-0.932617	-0.078932
Q_t@Grid_AVG [var]	2.878838	-3.039480	-5.918318
PF_t@Grid_AVG []	-0.284301	-0.293337	-9.035e-3
U_fund_SYM+_rc@Grid_AVG [V]	397.9410	398.5264	0.585361
I_fund_P_SYM+_rc@Grid_AVG [A]	-1.297e-3	-1.215e-3	8.204e-5

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5.8.3	For PGUs Type 2 and storage systems – no load	P

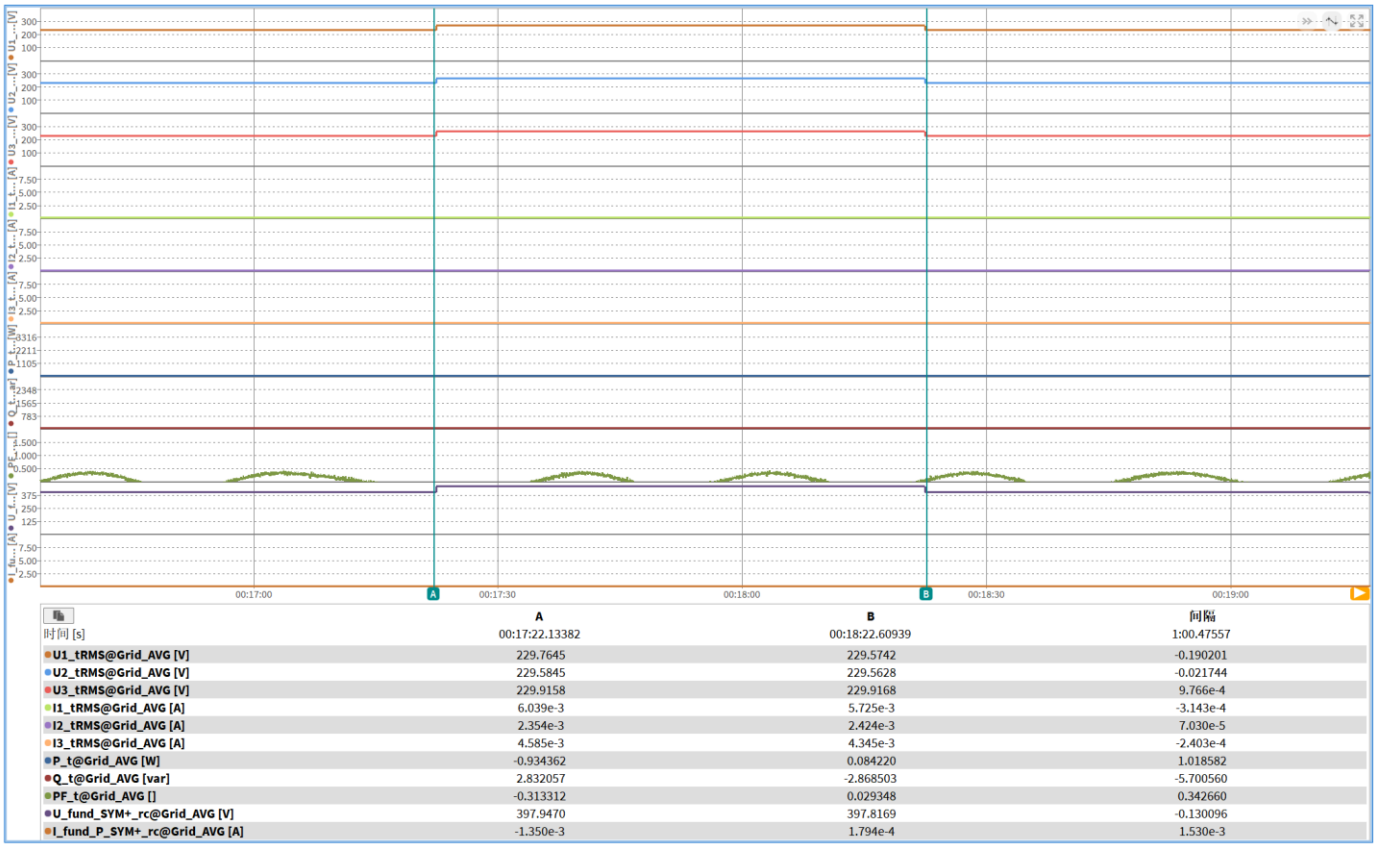
6.3



时间 [s]	A 00:16:17.29571	B 00:16:22.50226	间隔 5.20655
U1_tRMS@Grid_AVG [V]	229.7547	236.1708	6.416046
U2_tRMS@Grid_AVG [V]	229.5823	250.6464	21.06418
U3_tRMS@Grid_AVG [V]	229.9163	233.7700	3.853683
I1_tRMS@Grid_AVG [A]	6.619e-3	6.424e-3	-1.946e-4
I2_tRMS@Grid_AVG [A]	2.346e-3	2.357e-3	1.138e-5
I3_tRMS@Grid_AVG [A]	5.138e-3	4.651e-3	-4.873e-4
P_t@Grid_AVG [W]	1.108264	0.343797	-0.764467
Q_t@Grid_AVG [var]	-3.045163	3.176689	6.221852
PF_t@Grid_AVG []	0.341997	0.107597	-0.234400
U_fund_SYM+_rc@Grid_AVG [V]	397.9407	423.9503	26.00962
I_fund_P_SYM+_rc@Grid_AVG [A]	1.469e-3	4.399e-4	-1.029e-3

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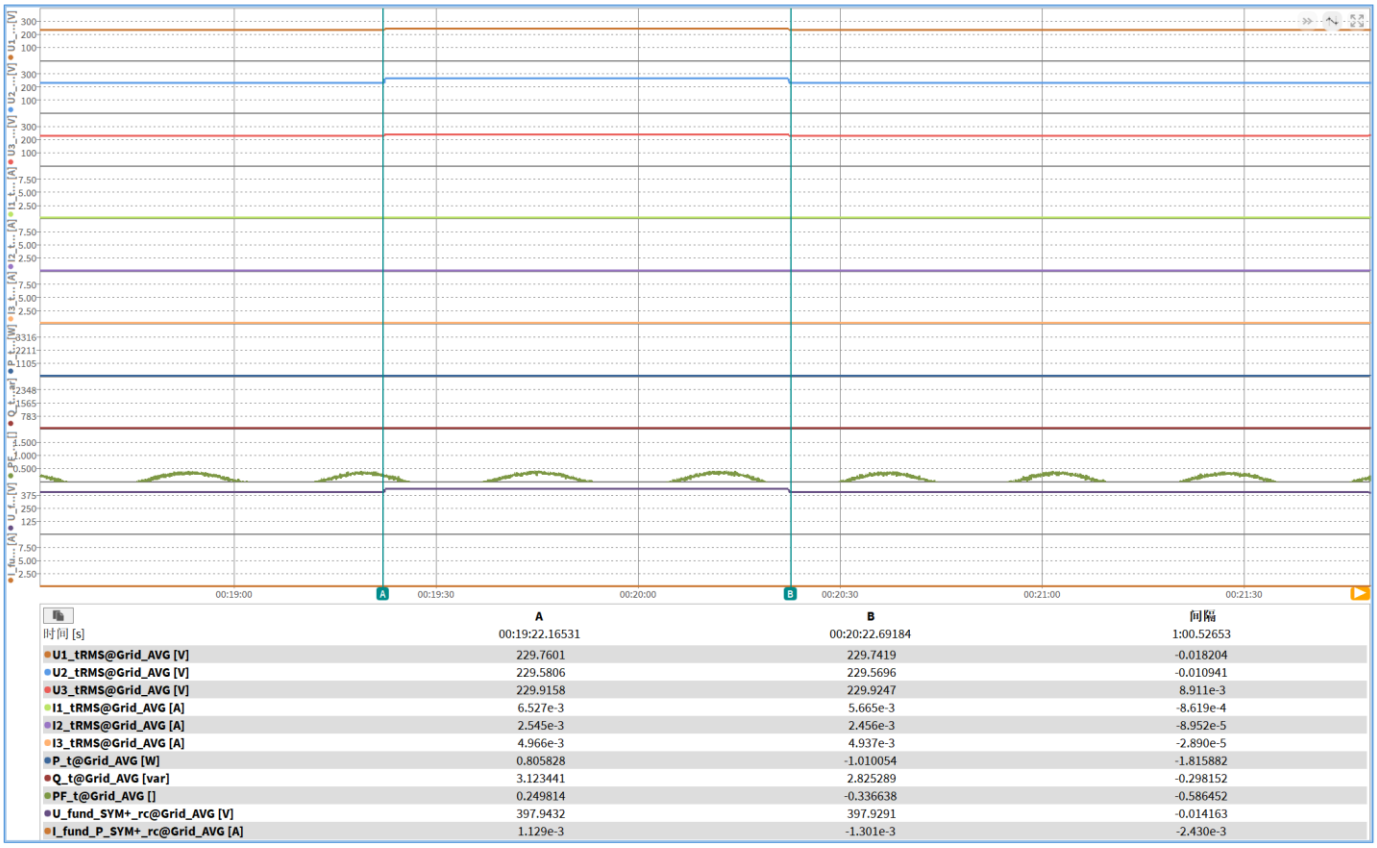
5.8.3	For PGUs Type 2 and storage systems – no load	P
	7.1	



时间 [s]	A 00:17:22.13382	B 00:18:22.60939	Δ 1:00.47557
U1_tRMS@Grid_AVG [V]	229.7645	229.5742	-0.190201
U2_tRMS@Grid_AVG [V]	229.5845	229.5628	-0.021744
U3_tRMS@Grid_AVG [V]	229.9158	229.9168	9.766e-4
I1_tRMS@Grid_AVG [A]	6.039e-3	5.725e-3	-3.143e-4
I2_tRMS@Grid_AVG [A]	2.354e-3	2.424e-3	7.030e-5
I3_tRMS@Grid_AVG [A]	4.585e-3	4.345e-3	-2.403e-4
P_t@Grid_AVG [W]	-0.934362	0.084220	1.018582
Q_t@Grid_AVG [var]	2.832057	-2.868503	-5.700560
PF_t@Grid_AVG []	-0.313312	0.029348	0.342660
U_fund_SYM+_rc@Grid_AVG [V]	397.9470	397.8169	-0.130096
I_fund_P_SYM+_rc@Grid_AVG [A]	-1.350e-3	1.794e-4	1.530e-3

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5.8.3	For PGUs Type 2 and storage systems – no load	P
	7.3	



时间 [s]	A 00:19:22.16531	B 00:20:22.69184	间隔 1:00.52653
U1_tRMS@Grid_AVG [V]	229.7601	229.7419	-0.018204
U2_tRMS@Grid_AVG [V]	229.5806	229.5696	-0.010941
U3_tRMS@Grid_AVG [V]	229.9158	229.9247	8.911e-3
I1_tRMS@Grid_AVG [A]	6.527e-3	5.665e-3	-8.619e-4
I2_tRMS@Grid_AVG [A]	2.545e-3	2.456e-3	-8.952e-5
I3_tRMS@Grid_AVG [A]	4.966e-3	4.937e-3	-2.890e-5
P_t@Grid_AVG [W]	0.805828	-1.010054	-1.815882
Q_t@Grid_AVG [var]	3.123441	2.825289	-0.298152
PF_t@Grid_AVG []	0.249814	-0.336638	-0.586452
U_fund_SYM+_rc@Grid_AVG [V]	397.9432	397.9291	-0.014163
I_fund_P_SYM+_rc@Grid_AVG [A]	1.129e-3	-1.301e-3	-2.430e-3

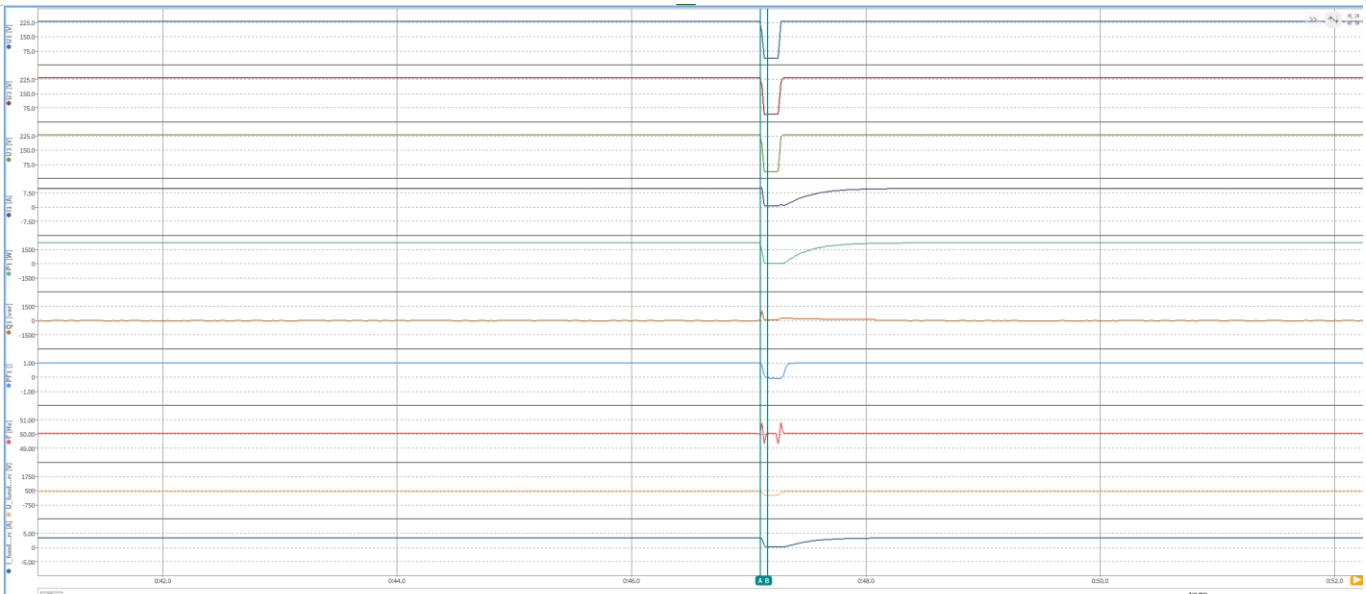
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Load tests 1.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	1.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0.15
	5	Drop duration setpoint	Total	–	[ms]	150
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	149
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,850
	10		Positive sequence			0,850
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,040
	16		Total	t_1-10 s to t_1	[p.u.]	0,040
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9992
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,150
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,043
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,016
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,998
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,970
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,970
	30	Response time active power	Positive sequence	-	[s]	0,569
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,026
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,026
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

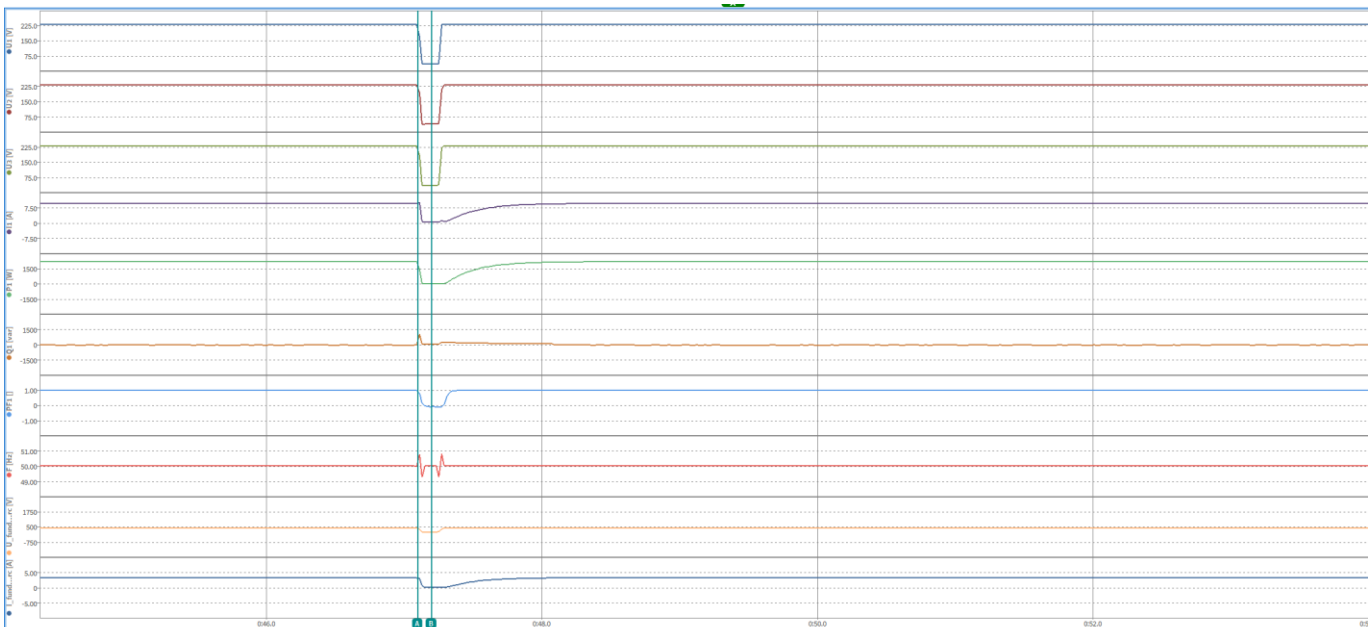
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0-60ms



	A	B	间隔
时间 [s]	0:47.1006524	0:47.1606841	0.0600317
U1 [V]	229.9219	34.46251	-195.4594
U2 [V]	230.0032	34.54060	-195.4626
U3 [V]	229.9804	34.44840	-195.5320
I1 [A]	9.611876	0.155645	-9.456231
P1 [W]	2208.268	-0.116044	-2208.384
Q1 [var]	-87.00698	5.362647	92.36963
PF1 []	0.999225	-0.021634	-1.020859
F [Hz]	49.97438	50.00285	0.028469
U_fund_SYM+_rc [V]	398.3154	59.71102	-338.6044
I_fund_P_SYM+_rc [A]	3.203140	-6.639e-3	-3.209779

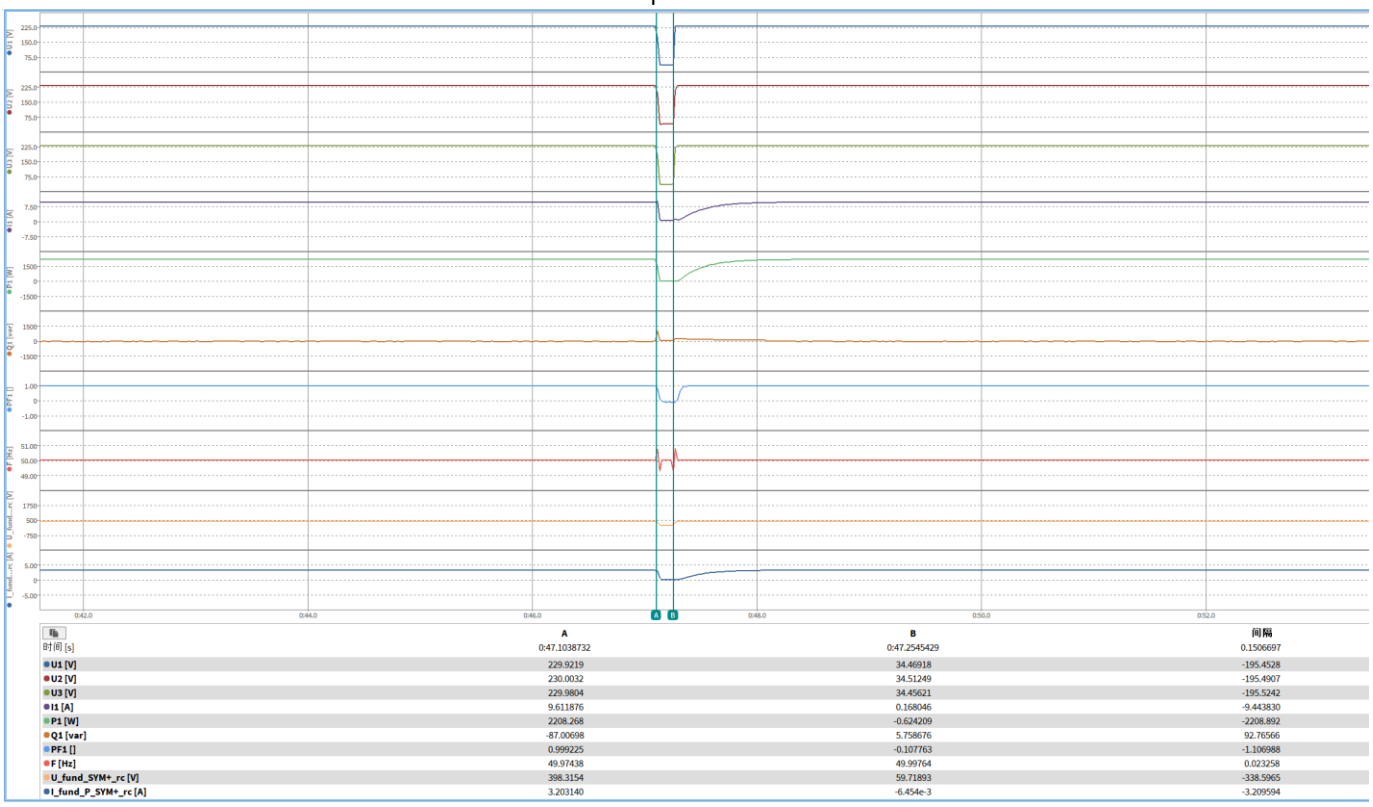
0-100ms



	A	B	间隔
时间 [s]	0:47.1006524	0:47.2006888	0.1000364
U1 [V]	229.9219	34.46308	-195.4589
U2 [V]	230.0032	34.53655	-195.4667
U3 [V]	229.9804	34.45107	-195.5293
I1 [A]	9.611876	0.172881	-9.438994
P1 [W]	2208.268	-0.633085	-2208.901
Q1 [var]	-87.00698	5.924285	92.93127
PF1 []	0.999225	-0.106258	-1.105482
F [Hz]	49.97438	49.99511	0.020729
U_fund_SYM+_rc [V]	398.3154	59.72514	-338.5903
I_fund_P_SYM+_rc [A]	3.203140	-6.893e-3	-3.210033

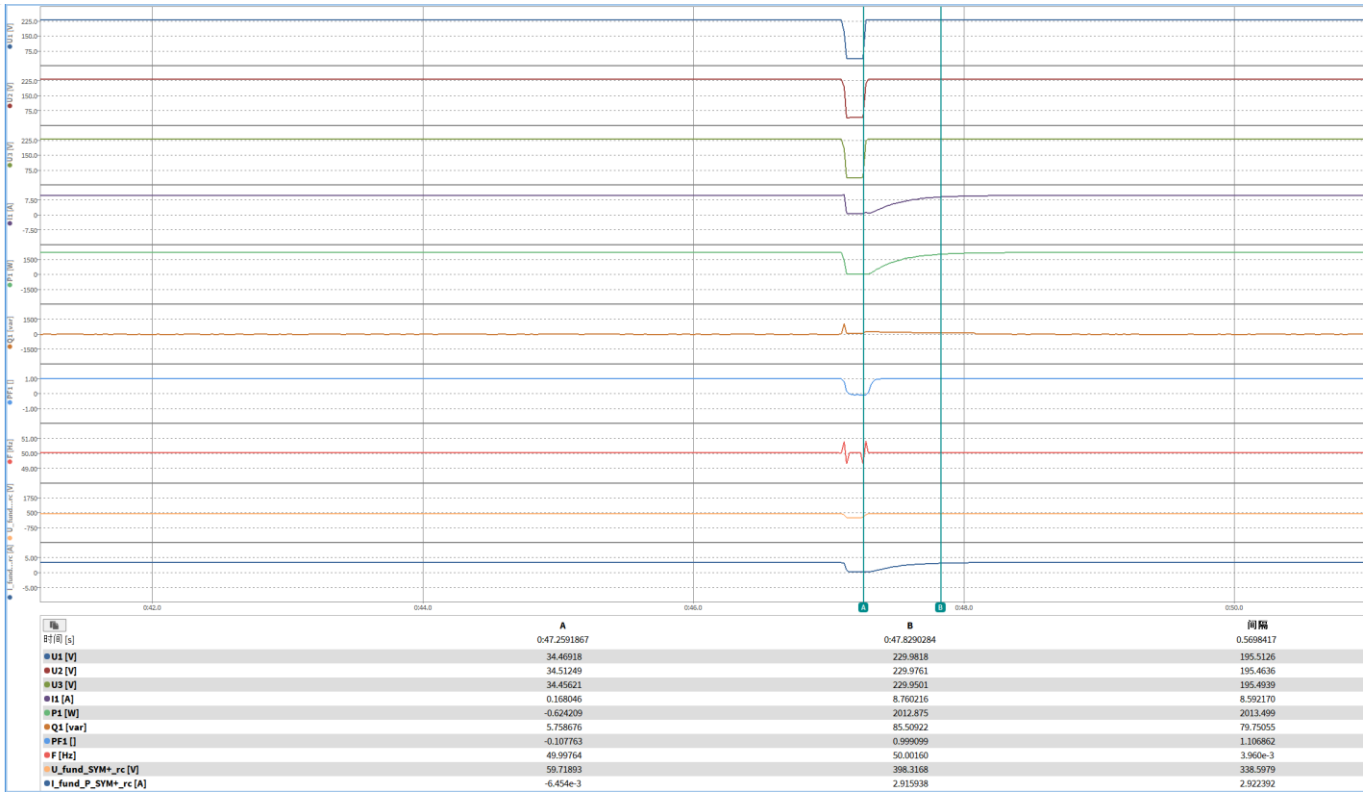
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Drop duration



时间 [s]	A 0:47.1038732	B 0:47.2545429	间隔 0.1506697
U1 [V]	229.9219	34.46918	-195.4528
U2 [V]	230.0032	34.51249	-195.4907
U3 [V]	229.9804	34.45621	-195.5242
I1 [A]	9.611876	0.168046	-9.443830
P1 [W]	2208.268	-0.624209	-2208.892
Q1 [var]	-87.00698	5.758676	92.76566
PF1 []	0.999225	-0.107763	-1.106988
F [Hz]	49.97438	49.99764	0.023258
U_fund_SYM+_rc [V]	398.3154	59.71893	-338.5965
I_fund_P_SYM+_rc [A]	3.203140	-6.454e-3	-3.209594

Recover time



时间 [s]	A 0:47.2591867	B 0:47.8290284	间隔 0.5698417
U1 [V]	34.46918	229.9818	195.5126
U2 [V]	34.51249	229.9761	195.4636
U3 [V]	34.45621	229.9501	195.4939
I1 [A]	0.168046	8.760216	8.592170
P1 [W]	-0.624209	2012.875	2013.499
Q1 [var]	5.758676	85.50922	79.75055
PF1 []	-0.107763	0.999099	1.106862
F [Hz]	49.99764	50.00160	3.960e-3
U_fund_SYM+_rc [V]	59.71893	398.3168	338.5979
I_fund_P_SYM+_rc [A]	-6.454e-3	2.915938	2.922392

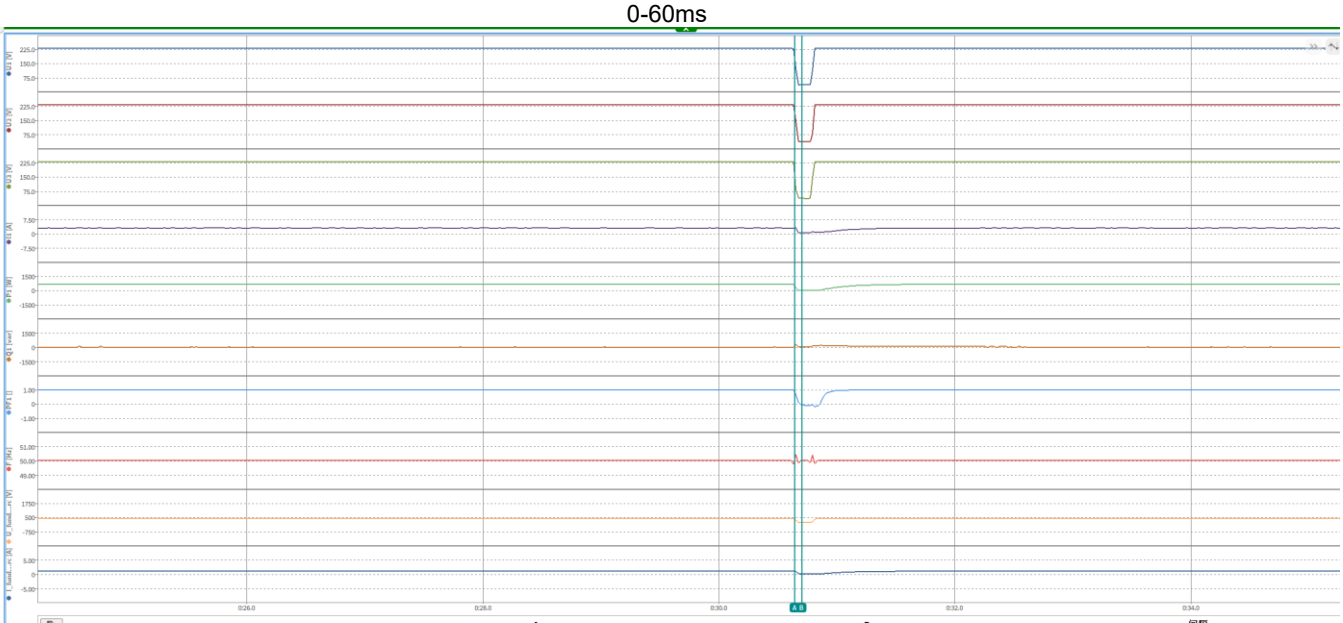
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Load tests 1.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	1.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0.15
	5	Drop duration setpoint	Total	–	[ms]	150
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	149
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,850
	10		Positive sequence			0,850
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,392
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,391
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,391
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,032
	16		Total	t_1-10 s to t_1	[p.u.]	0,032
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9980
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,150
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,998
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,371
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,371
	30	Response time active power	Positive sequence	-	[s]	0,639
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,002
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,002
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

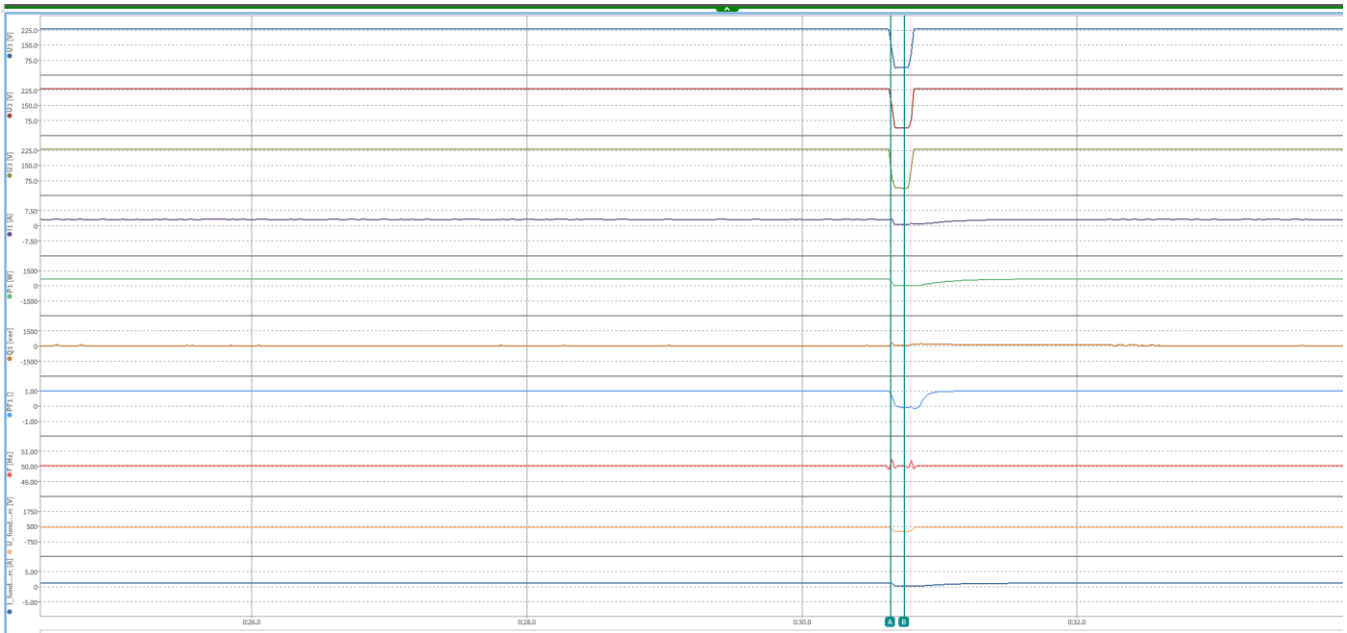
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0-60ms



时间 [s]	A 0:30.6430262	B 0:30.7030549	间隔 0.0600286
U1 [V]	229.3741	34.60867	-194.7654
U2 [V]	230.2987	34.48470	-195.8140
U3 [V]	230.2721	34.51365	-195.7584
I1 [A]	2.839581	0.154651	-2.684930
P1 [W]	649.9966	-0.165117	-650.1617
Q1 [var]	-41.59831	5.349725	46.94803
PF1 []	0.997958	-0.030850	-1.028808
F [Hz]	49.72131	49.99759	0.276279
U_fund_SYM+_rc [V]	398.3393	59.80841	-338.5309
I_fund_P_SYM+_rc [A]	0.947639	-6.693e-3	-0.954331

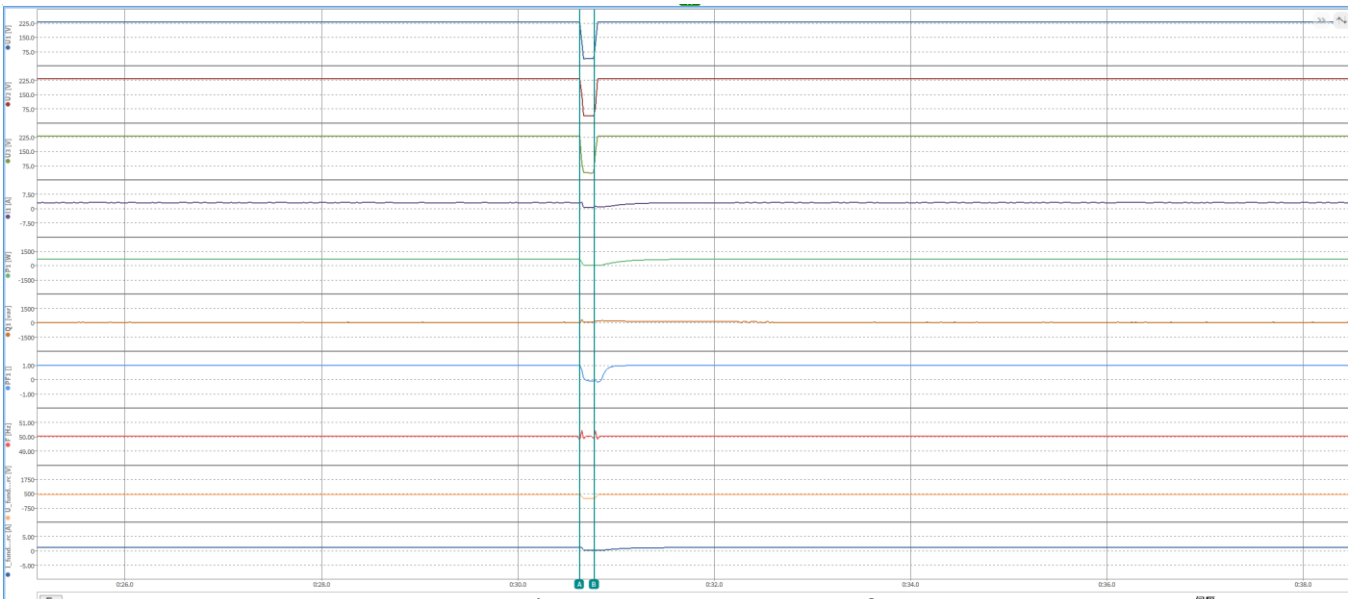
0-100ms



时间 [s]	A 0:30.6430262	B 0:30.7434944	间隔 0.1004681
U1 [V]	229.3741	34.58464	-194.7894
U2 [V]	230.2987	34.47483	-195.8238
U3 [V]	230.2721	34.49770	-195.7744
I1 [A]	2.839581	0.153252	-2.686329
P1 [W]	649.9966	-0.556832	-650.5534
Q1 [var]	-41.59831	5.270851	46.86916
PF1 []	0.997958	-0.105059	-1.103017
F [Hz]	49.72131	50.00565	0.284340
U_fund_SYM+_rc [V]	398.3393	59.79098	-338.5484
I_fund_P_SYM+_rc [A]	0.947639	-6.041e-3	-0.953679

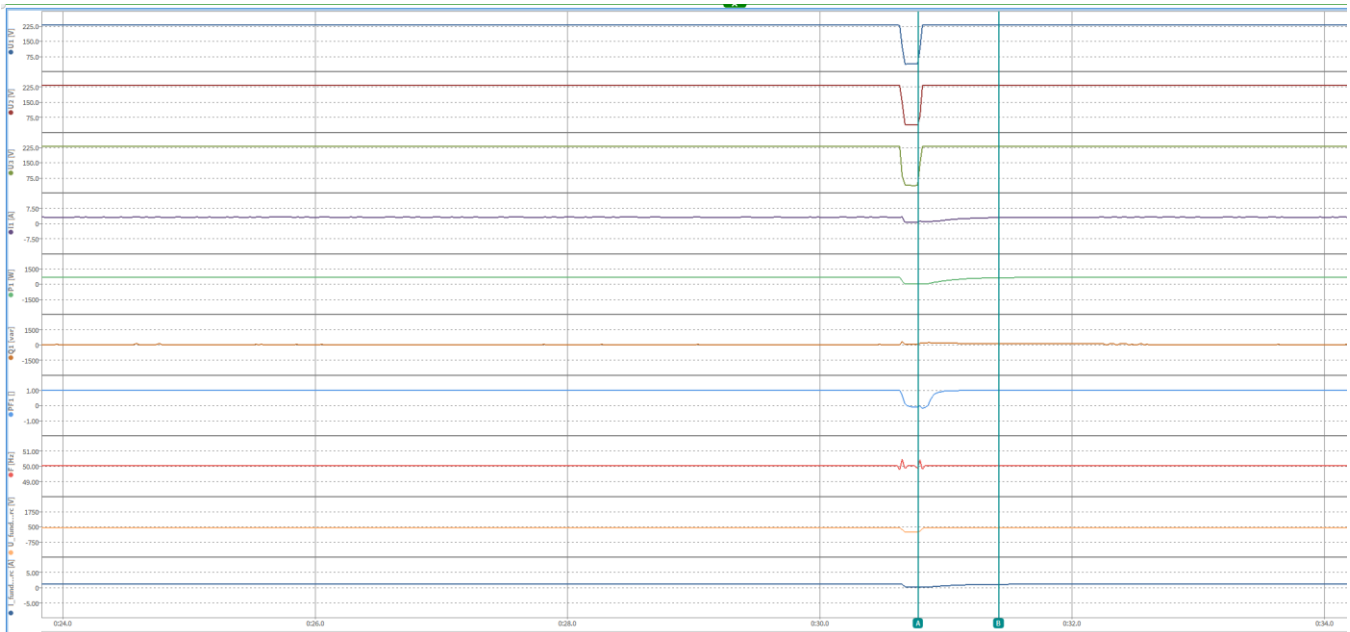
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Drop duration



时间 [s]	A 0:30.6299570	B 0:30.7808473	间隔 0.1508903
U1 [V]	230.0169	34.50837	-195.5085
U2 [V]	229.9780	34.49627	-195.4818
U3 [V]	229.9520	34.51451	-195.4375
I1 [A]	2.849427	0.160268	-2.689159
P1 [W]	653.8491	-0.563306	-654.4124
Q1 [var]	-45.29717	5.501822	50.79899
PF1 []	0.997609	-0.101853	-1.099462
F [Hz]	50.00021	49.85305	-0.147160
U_fund_SYM+_rc [V]	398.3411	59.76877	-338.5723
I_fund_P_SYM+_rc [A]	0.947793	-5.687e-3	-0.953479

Recover time



时间 [s]	A 0:30.7804173	B 0:31.4202342	间隔 0.6398169
U1 [V]	34.50837	230.0104	195.5021
U2 [V]	34.49627	229.9772	195.4809
U3 [V]	34.51451	229.9505	195.4360
I1 [A]	0.160268	2.657063	2.496796
P1 [W]	-0.563306	608.7079	609.2712
Q1 [var]	5.501822	54.60620	49.10438
PF1 []	-0.101853	0.996000	1.097853
F [Hz]	49.85305	50.00049	0.147438
U_fund_SYM+_rc [V]	59.76877	398.3359	338.5671
I_fund_P_SYM+_rc [A]	-5.687e-3	0.880591	0.886278

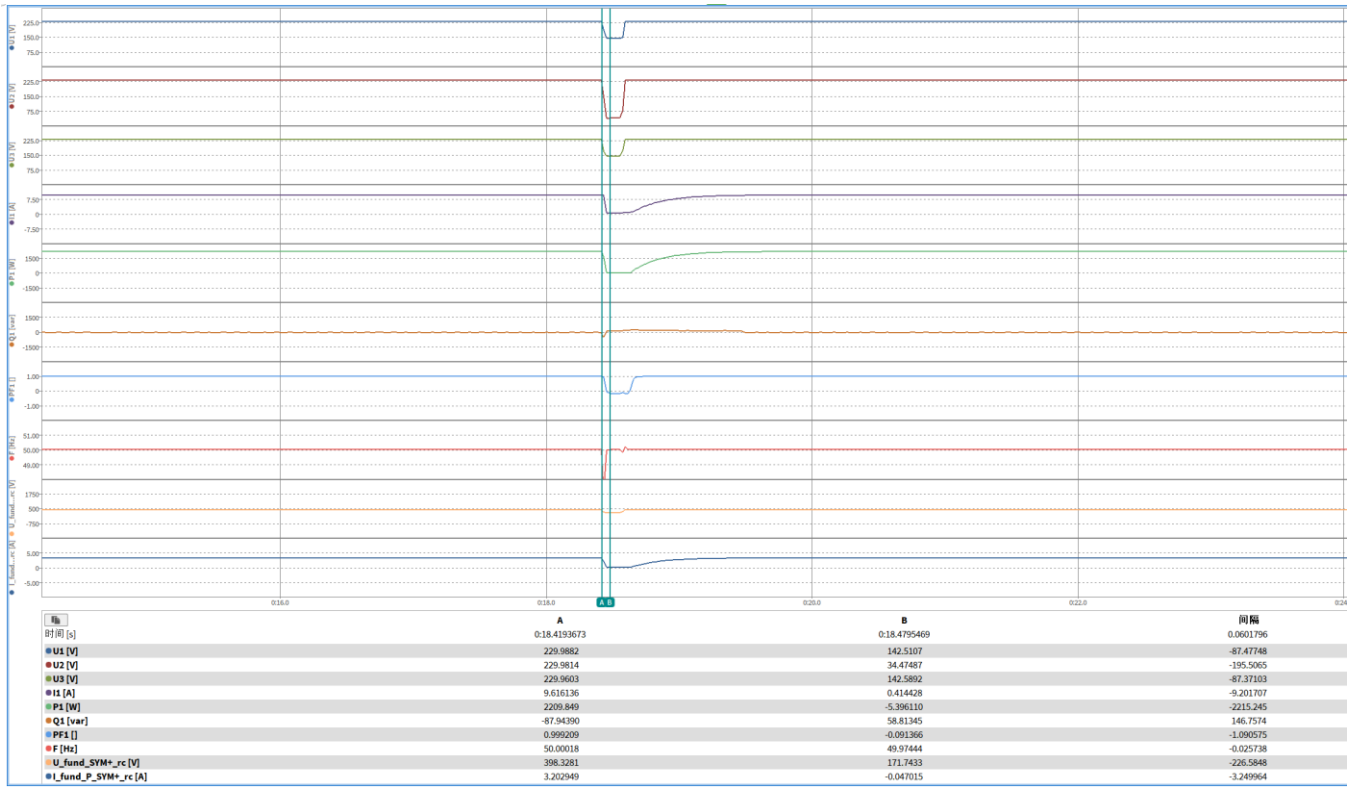
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Load tests 1.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	1.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0.15
	5	Drop duration setpoint	Total	–	[ms]	150
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	151
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,380
	10		Positive sequence			0,380
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,999
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,998
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,998
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,032
	16		Total	t_1-10 s to t_1	[p.u.]	0,032
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,620
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,014
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,045
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,921
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,921
	30	Response time active power	Positive sequence	-	[s]	0,585
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,002
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,002
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

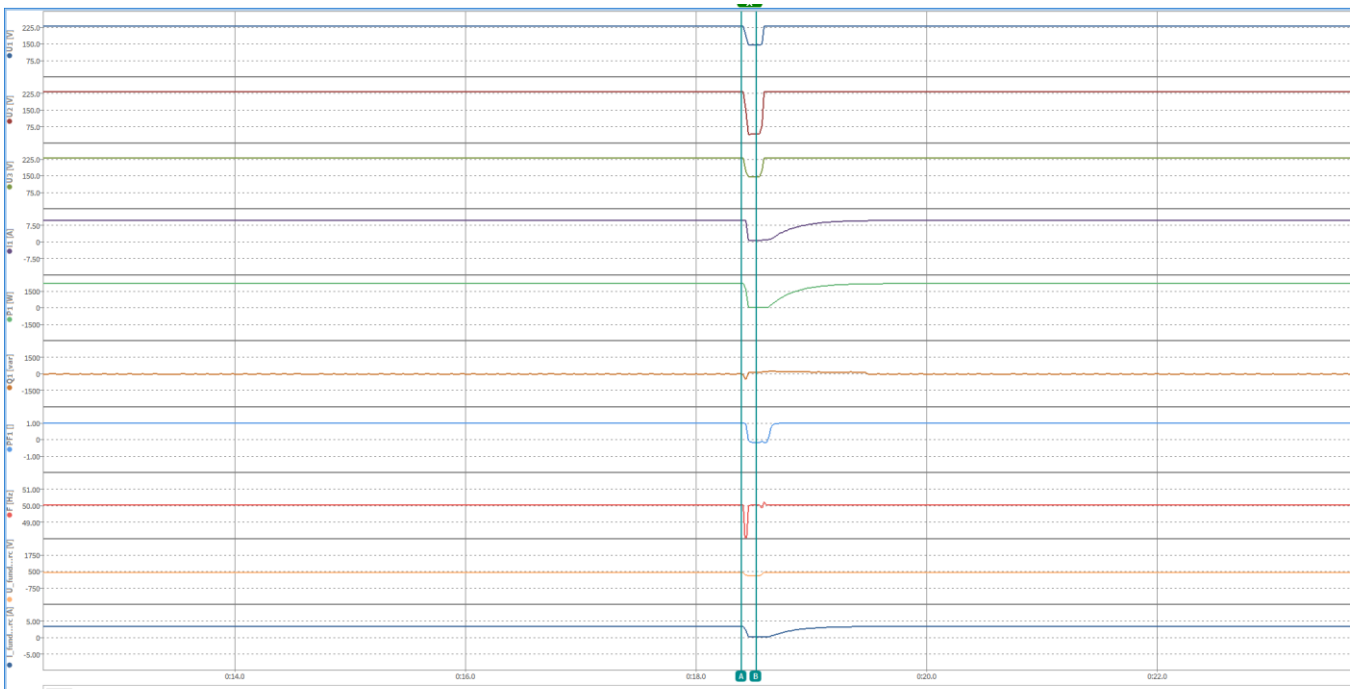
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0-60ms



时间 [s]	A 0:18.4193673	B 0:18.4795469	间隔 0.0601796
U1 [V]	229.9882	142.5107	-87.47748
U2 [V]	229.9814	34.47487	-195.5065
U3 [V]	229.9603	142.5892	-87.37103
I1 [A]	9.616136	0.414428	-9.201707
P1 [W]	2209.849	-5.396110	-2215.245
Q1 [var]	-87.94390	58.81345	146.7574
PF1 []	0.999209	-0.091366	-1.090575
F [Hz]	50.00018	49.97444	-0.025738
U_fund_SYM+_rc [V]	398.3281	171.7433	-226.5848
I_fund_P_SYM+_rc [A]	3.202949	-0.047015	-3.249964

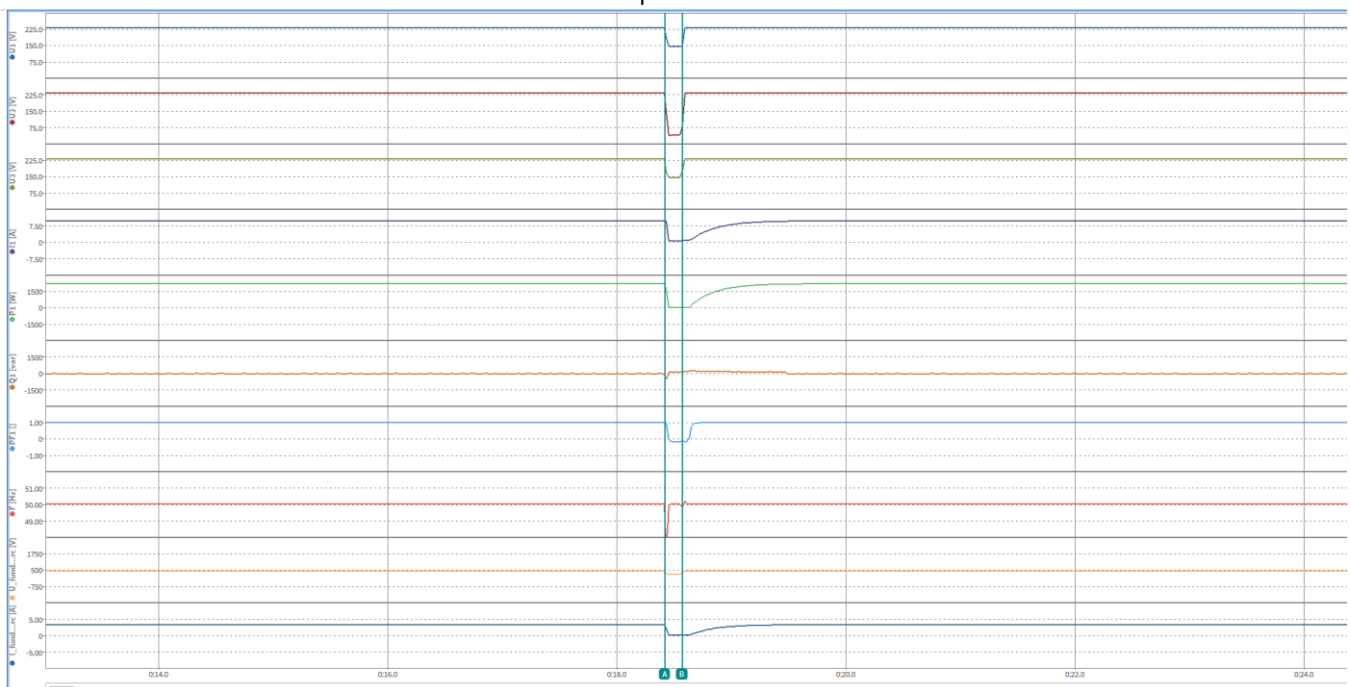
0-100ms



时间 [s]	A 0:18.3943136	B 0:18.5199580	间隔 0.1256444
U1 [V]	229.9848	142.5498	-87.43506
U2 [V]	229.9843	34.54691	-195.4374
U3 [V]	229.9615	142.6031	-87.35837
I1 [A]	9.615037	0.413663	-9.201374
P1 [W]	2209.732	-11.24064	-2220.973
Q1 [var]	-83.58094	57.88634	141.4673
PF1 []	0.999285	-0.190624	-1.189909
F [Hz]	50.00015	50.00048	3.319e-4
U_fund_SYM+_rc [V]	398.3305	171.7654	-226.5651
I_fund_P_SYM+_rc [A]	3.202578	-0.074497	-3.277075

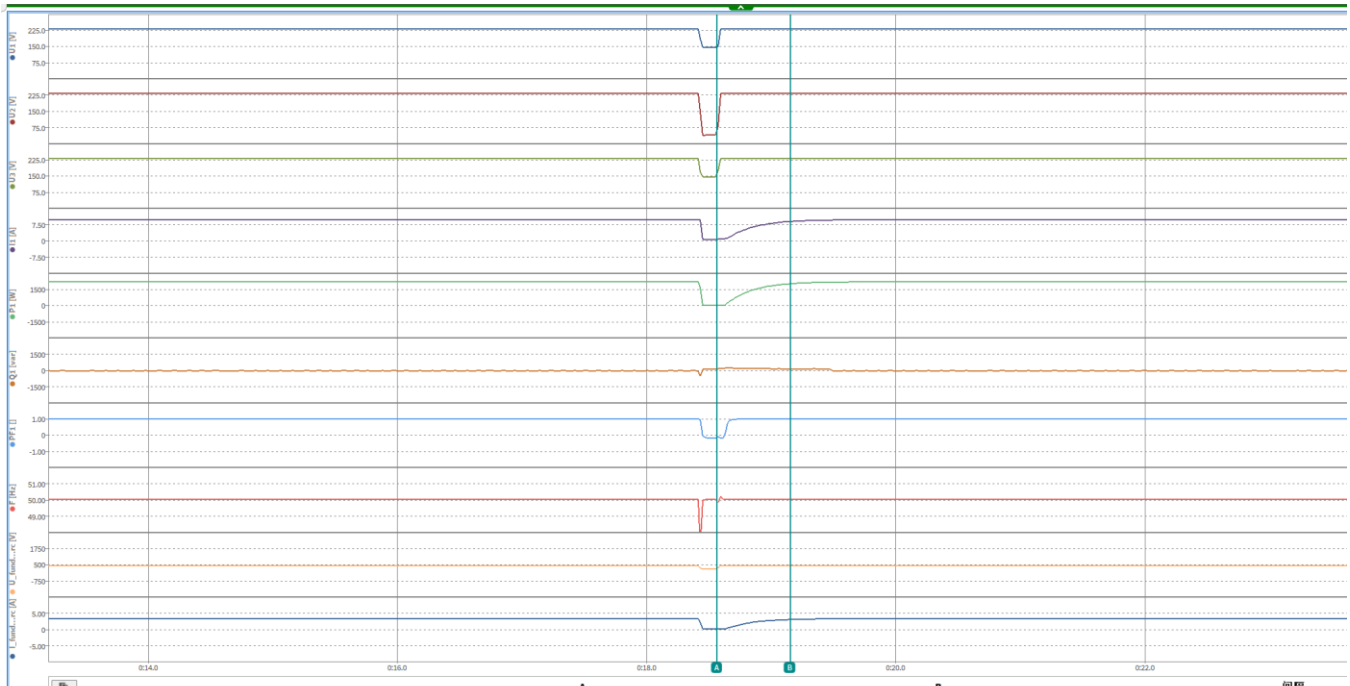
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Drop duration



	A	B	间隔
时间 [s]	0:18.4204196	0:18.5716780	0.1512584
U1 [V]	230.0214	142.5712	-87.45020
U2 [V]	229.9650	34.51363	-195.4514
U3 [V]	229.9384	142.5889	-87.34943
I1 [A]	9.614378	0.401219	-9.213159
P1 [W]	2209.540	-11.81448	-2221.355
Q1 [var]	-93.38671	55.96899	149.3557
PF1 []	0.999108	-0.206538	-1.205646
F [Hz]	50.01653	50.00350	-0.013027
U_fund_SYM+_rc [V]	375.2512	171.7480	-203.5032
I_fund_P_SYM+_rc [A]	3.196320	-0.074710	-3.271030

Recover time



	A	B	间隔
时间 [s]	0:18.5653225	0:19.1512160	0.5858936
U1 [V]	142.5712	229.9891	87.41789
U2 [V]	34.51363	229.9847	195.4711
U3 [V]	142.5889	229.9586	87.36963
I1 [A]	0.401219	8.741000	8.339781
P1 [W]	-11.81448	2008.414	2020.229
Q1 [var]	55.96899	87.86193	31.89294
PF1 []	-0.206538	0.999044	1.205583
F [Hz]	50.00350	50.00103	-2.472e-3
U_fund_SYM+_rc [V]	171.7480	398.3316	226.5836
I_fund_P_SYM+_rc [A]	-0.074710	2.918671	2.993381

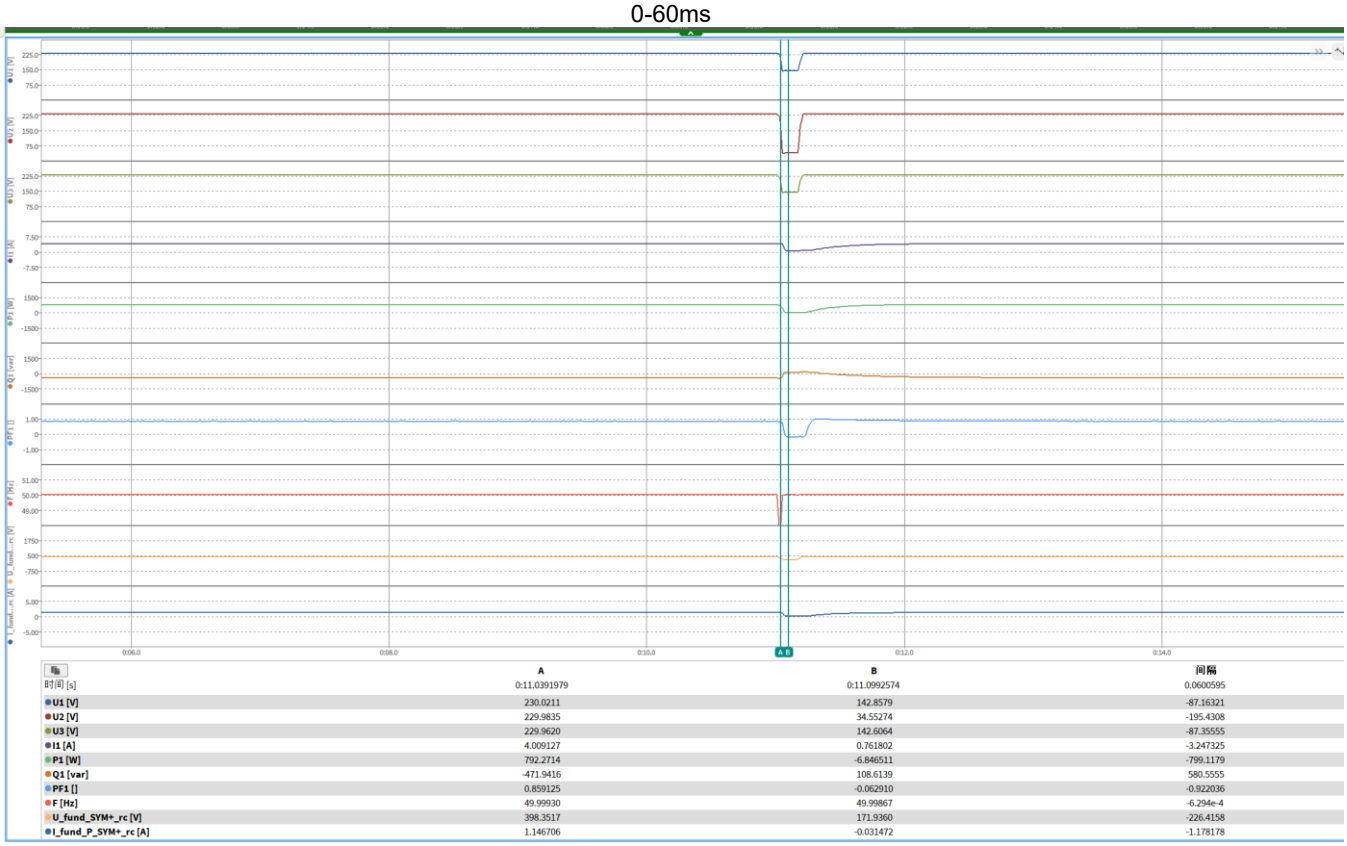
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Load tests 1.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	1.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0,15
	5	Drop duration setpoint	Total	–	[ms]	150
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	149
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,380
	10		Positive sequence			0,380
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,391
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,391
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,391
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,027
	16		Total	t_1-10 s to t_1	[p.u.]	-0,027
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9985
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,620
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,072
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,061
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	30	Response time active power	Positive sequence	-	[s]	0,572
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,001
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,001
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

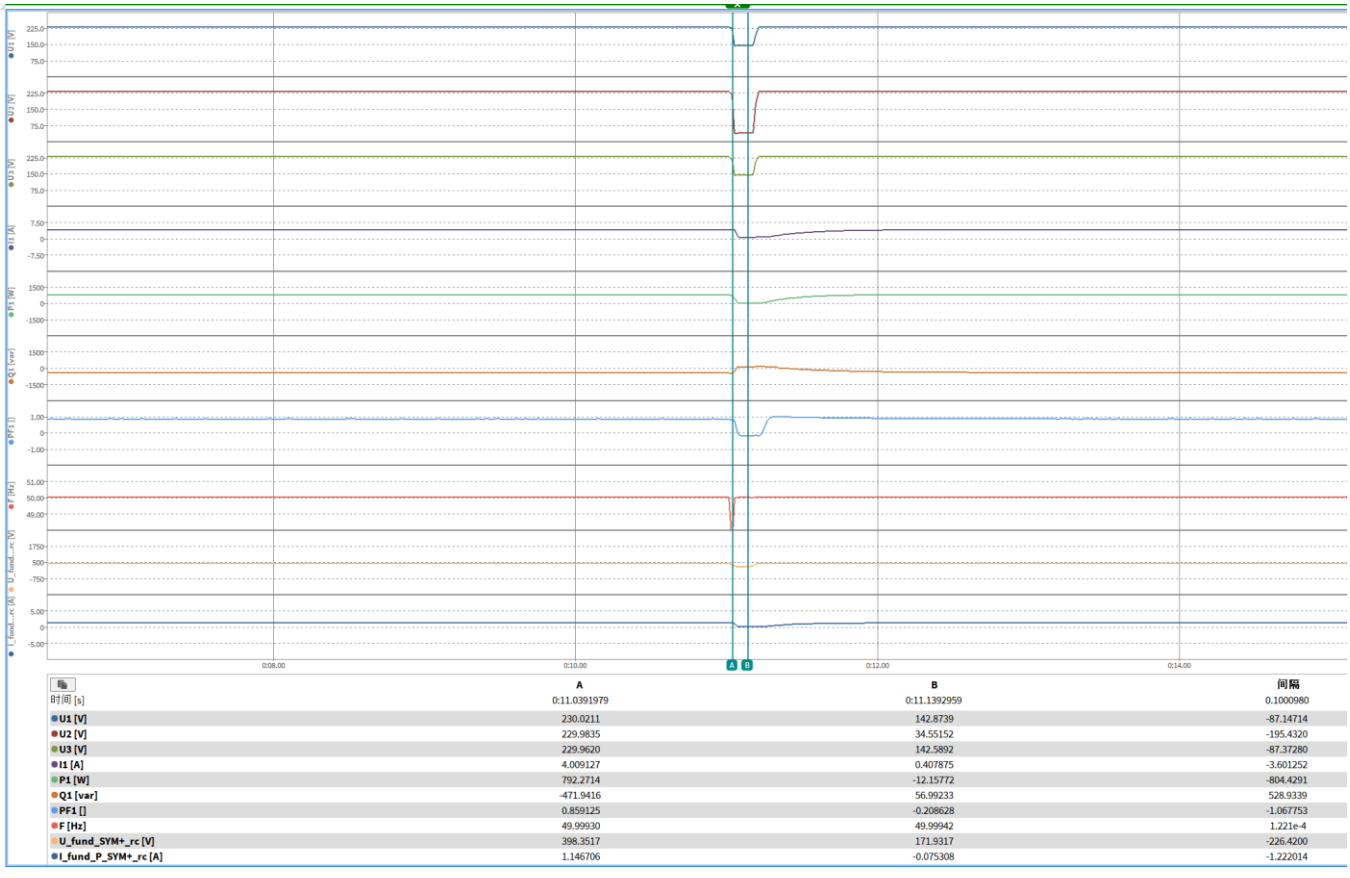
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0-60ms



时间 [s]	A 0:11.0391979	B 0:11.0992574	间隔 0.0600595
U1 [V]	230.0211	142.8579	-87.16321
U2 [V]	229.9835	34.55274	-195.4308
U3 [V]	229.9620	142.6064	-87.35555
I1 [A]	4.009127	0.761802	-3.247325
P1 [W]	792.2714	-6.846511	-799.1179
Q1 [var]	-471.9416	108.6139	580.5555
PF1 []	0.859125	-0.062910	-0.922036
F [Hz]	49.99930	49.99867	-6.294e-4
U_fund_SYM+_rc [V]	398.3517	171.9360	-226.4158
I_fund_P_SYM+_rc [A]	1.146706	-0.031472	-1.178178

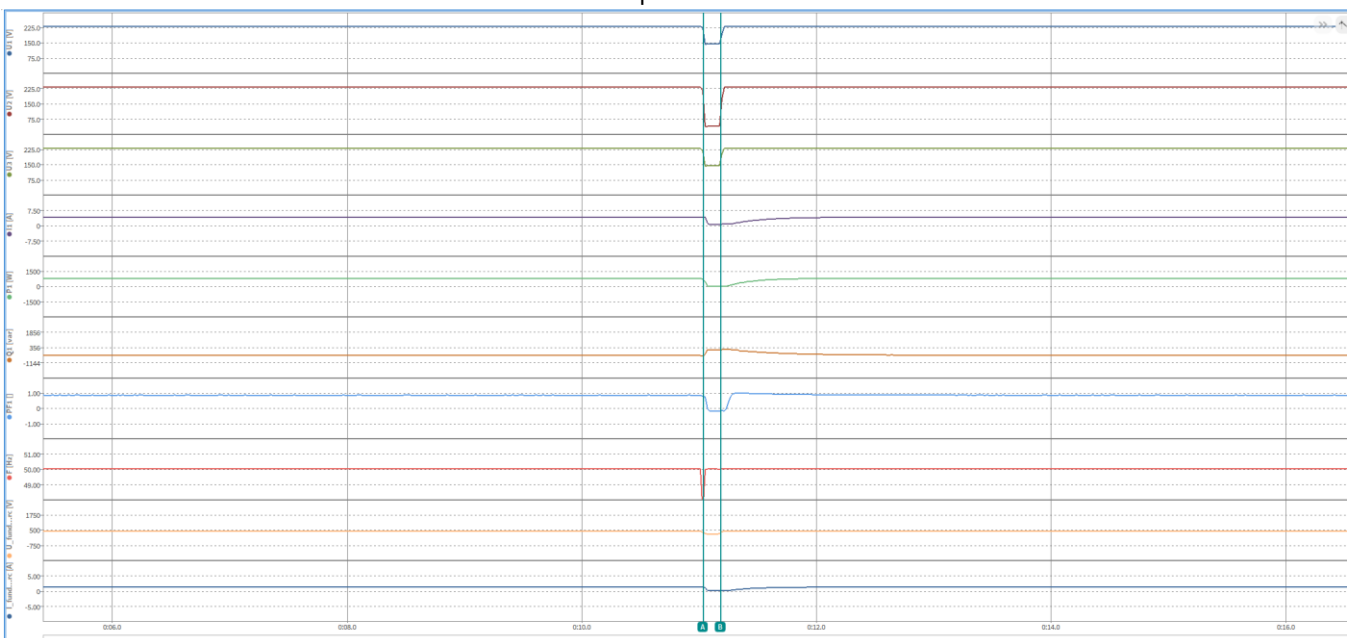
0-100ms



时间 [s]	A 0:11.0391979	B 0:11.1392959	间隔 0.1000980
U1 [V]	230.0211	142.8739	-87.14714
U2 [V]	229.9835	34.55152	-195.4320
U3 [V]	229.9620	142.5892	-87.37280
I1 [A]	4.009127	0.407875	-3.601252
P1 [W]	792.2714	-12.15772	-804.4291
Q1 [var]	-471.9416	56.99233	528.9339
PF1 []	0.859125	-0.208628	-1.067753
F [Hz]	49.99930	49.99942	1.221e-4
U_fund_SYM+_rc [V]	398.3517	171.9317	-226.4200
I_fund_P_SYM+_rc [A]	1.146706	-0.075308	-1.222014

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Drop duration



	A	B	间隔
时间 [s]	0:11.0339000	0:11.1840689	0.1501689
U1 [V]	230.0211	142.7709	-87.25023
U2 [V]	229.9835	34.52530	-195.4582
U3 [V]	229.9620	142.5471	-87.41487
I1 [A]	4.009127	0.402105	-3.607022
P1 [W]	792.2714	-12.02240	-804.2938
Q1 [var]	-471.9416	56.13588	528.0775
PF1 []	0.859125	-0.209417	-1.068543
F [Hz]	49.99930	49.97425	-0.025047
U_fund_SYM+_rc [V]	398.3517	179.2457	-219.1061
I_fund_P_SYM+_rc [A]	1.146706	-0.074763	-1.221468

Recover time



	A	B	间隔
时间 [s]	0:11.1800090	0:11.7528683	0.5728593
U1 [V]	142.7709	229.9814	87.21057
U2 [V]	34.52530	229.9867	195.4614
U3 [V]	142.5471	229.9619	87.41483
I1 [A]	0.402105	3.375524	2.973419
P1 [W]	-12.02240	720.2283	732.2507
Q1 [var]	56.13588	-289.6979	-345.8338
PF1 []	-0.209417	0.927761	1.137179
F [Hz]	49.97425	50.00109	0.026840
U_fund_SYM+_rc [V]	179.2457	398.3301	219.0845
I_fund_P_SYM+_rc [A]	-0.074763	1.045430	1.120193

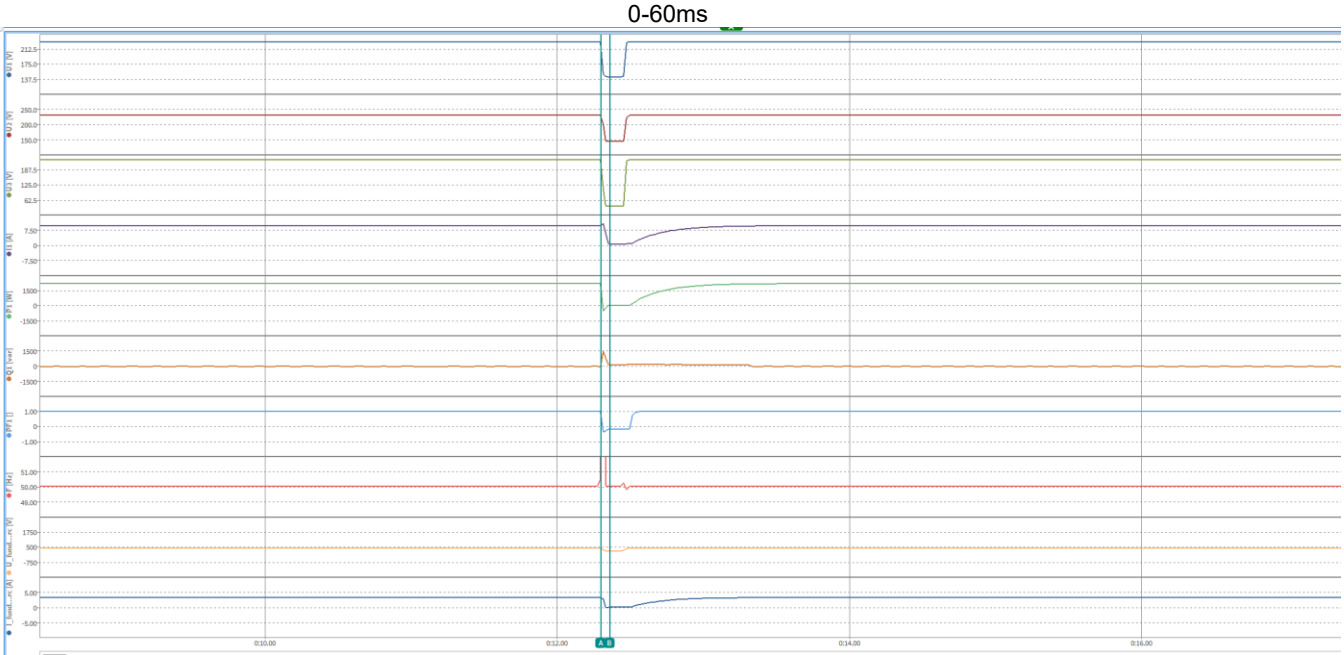
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Load tests 1.5

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	1.5
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D2
	4	Drop depth setpoint	Phase	–	[p.u]	0,15
	5	Drop duration setpoint	Total	–	[ms]	150
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	150
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,851
	10		Positive sequence			0,851
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,999
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,999
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,012
	16		Total	t_1-10 s to t_1	[p.u.]	0,012
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,149
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	0,003
	21		Phase 3	t_1+60 ms	[p.u.]	N/A
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	0,006
	24		Phase 3	t_1 +100 ms	[p.u.]	N/A
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,922
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,922
	30	Response time active power	Positive sequence	-	[s]	0,539
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,001
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,001
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

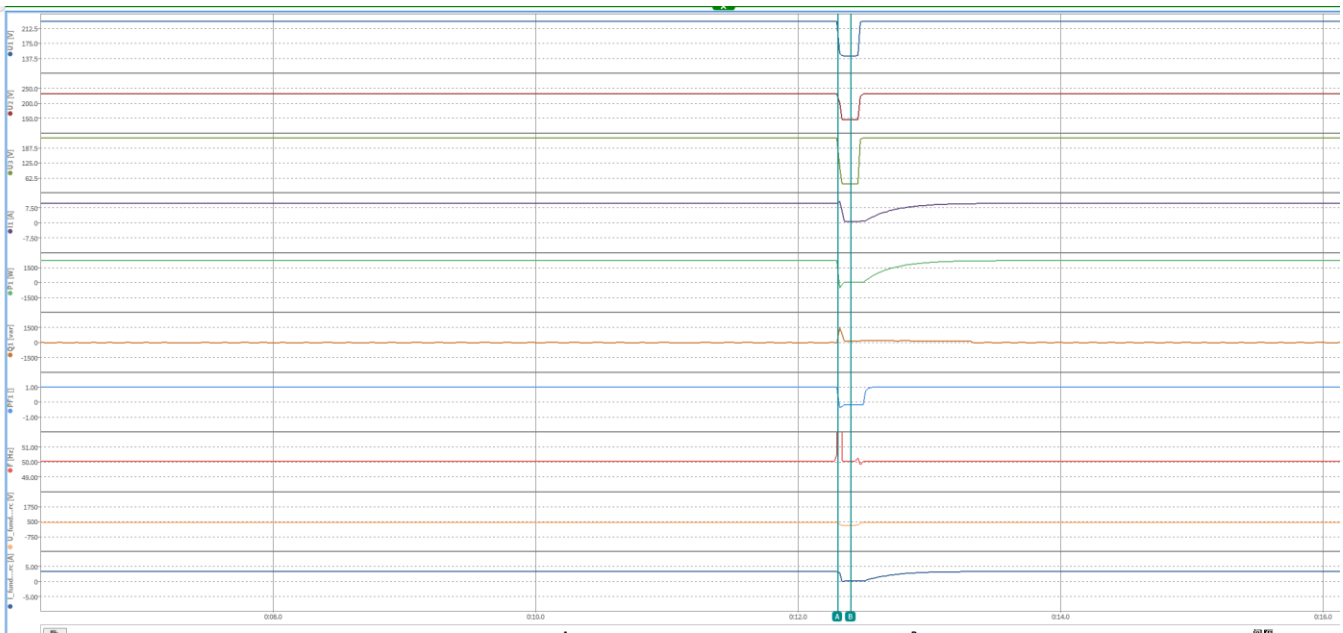
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0-60ms



时间 [s]	A 0:12.2995940	B 0:12.3600084	间隔 0.0604144
U1 [V]	229.9845	142.5355	-87.44896
U2 [V]	229.9810	142.6360	-87.34492
U3 [V]	229.9540	34.48096	-195.4730
I1 [A]	9.608547	0.412485	-9.196063
P1 [W]	2208.174	-11.94139	-2220.115
Q1 [var]	-85.20589	57.56827	142.7742
PF1 []	0.999256	-0.203107	-1.202363
F [Hz]	50.00037	49.99987	-4.997e-4
U_fund_SYM+_rc [V]	398.3259	171.2308	-227.0951
I_fund_P_SYM+_rc [A]	3.201929	0.023884	-3.178045

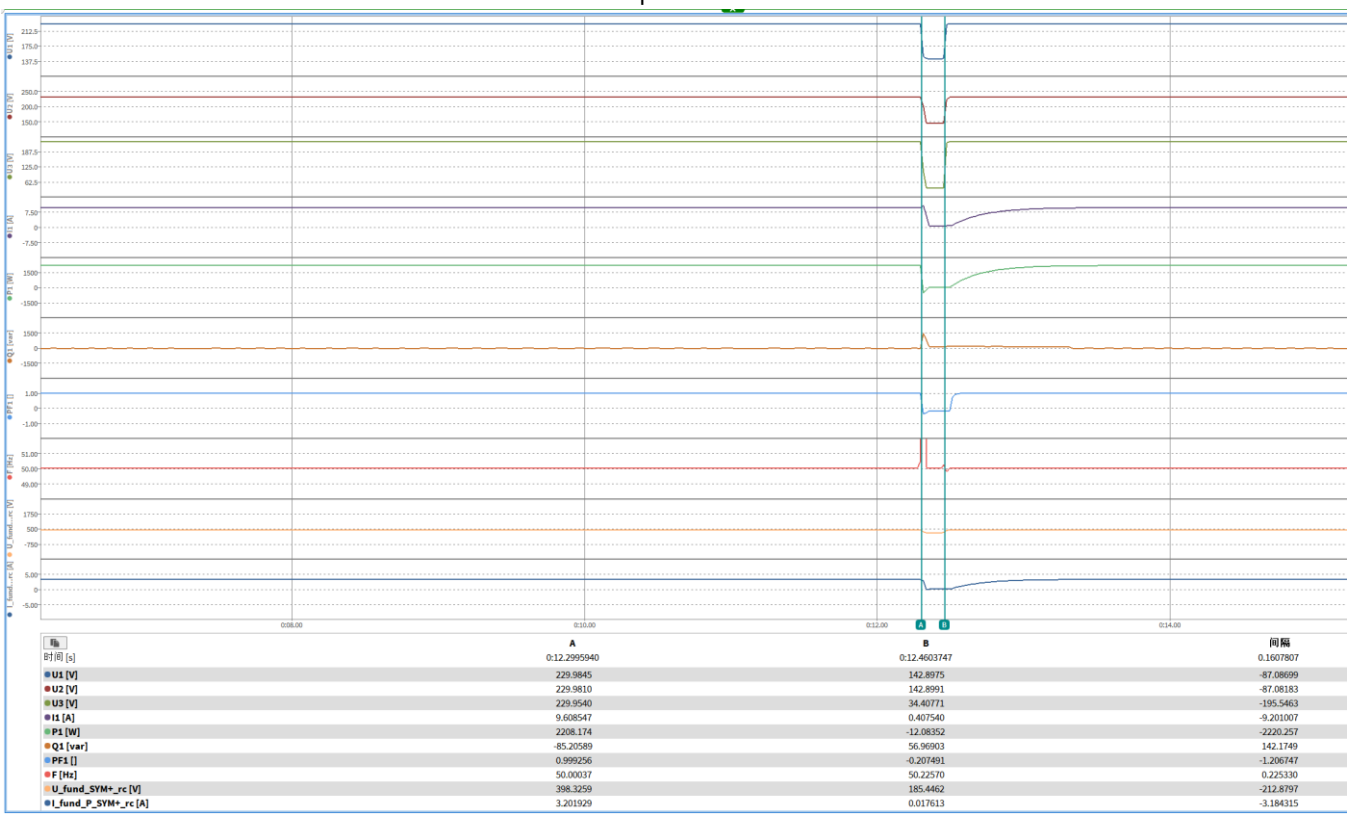
0-100ms



时间 [s]	A 0:12.2995940	B 0:12.4004374	间隔 0.1008434
U1 [V]	229.9845	142.5549	-87.42955
U2 [V]	229.9810	142.6140	-87.36691
U3 [V]	229.9540	34.48927	-195.4647
I1 [A]	9.608547	0.410345	-9.198202
P1 [W]	2208.174	-12.01042	-2220.184
Q1 [var]	-85.20589	57.25050	142.4564
PF1 []	0.999256	-0.205318	-1.204574
F [Hz]	50.00037	49.99982	-5.493e-4
U_fund_SYM+_rc [V]	398.3259	171.2374	-227.0885
I_fund_P_SYM+_rc [A]	3.201929	0.024161	-3.177768

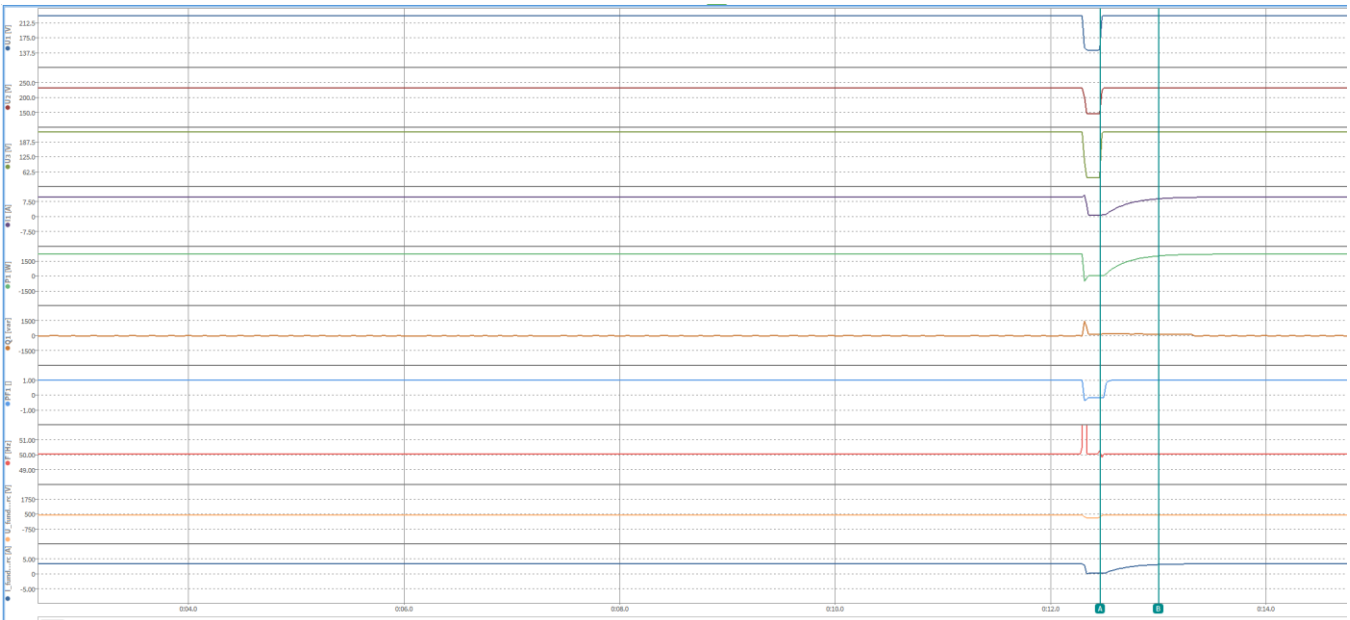
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Drop duration



时间 [s]	A 0:12.2995940	B 0:12.4603747	间隔 0.1607807
U1 [V]	229.9845	142.8975	-87.08699
U2 [V]	229.9810	142.8991	-87.08183
U3 [V]	229.9540	34.40771	-195.5463
I1 [A]	9.608547	0.407540	-9.201007
P1 [W]	2208.174	-12.08352	-2220.257
Q1 [var]	-85.20589	56.96903	142.1749
PF1 []	0.999256	-0.207491	-1.206747
F [Hz]	50.00037	50.22570	0.225330
U_fund_SYM+_rc [V]	398.3259	185.4462	-212.8797
I_fund_P_SYM+_rc [A]	3.201929	0.017613	-3.184315

Recover time



时间 [s]	A 0:12.4606790	B 0:13.0006541	间隔 0.5399752
U1 [V]	142.8975	229.9877	87.09016
U2 [V]	142.8991	229.9828	87.08369
U3 [V]	34.40771	229.9581	195.5504
I1 [A]	0.407540	8.732352	8.324812
P1 [W]	-12.08352	2006.473	2018.556
Q1 [var]	56.96903	86.43564	29.46661
PF1 []	-0.207491	0.999073	1.206564
F [Hz]	50.22570	50.00100	-0.224701
U_fund_SYM+_rc [V]	185.4462	398.3296	212.8835
I_fund_P_SYM+_rc [A]	0.017613	2.905450	2.887837

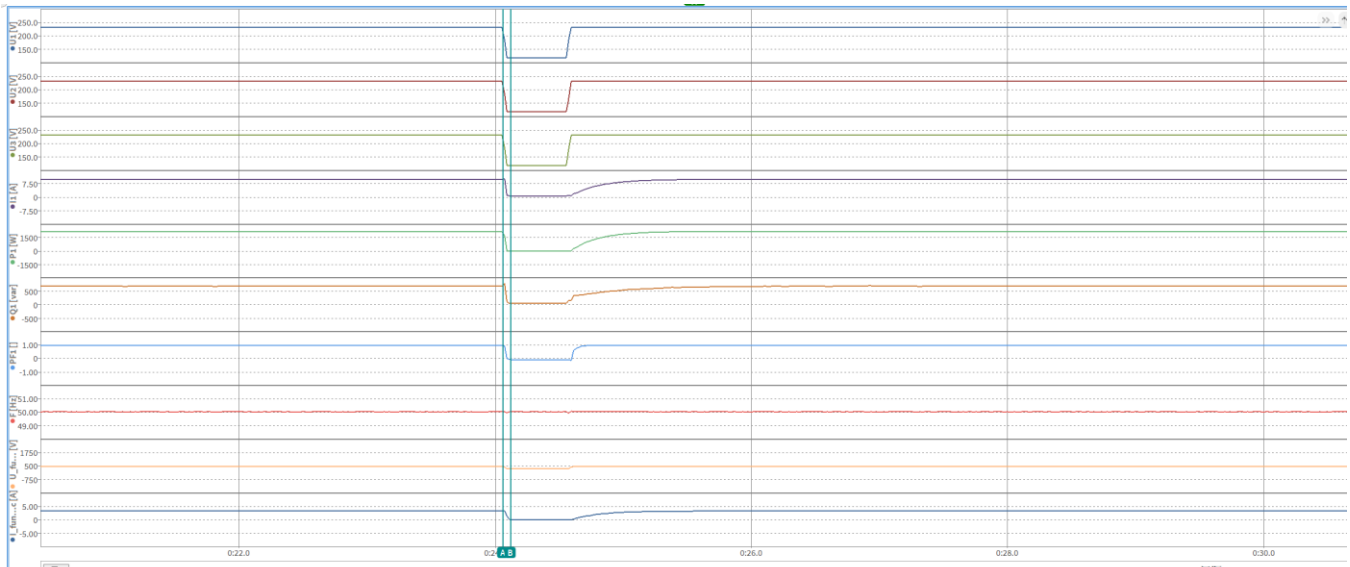
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Load tests 2.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	2.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1582
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,501
	10		Positive sequence			0,501
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,999
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,003
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,003
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,313
	16		Total	t_1-10 s to t_1	[p.u.]	0,313
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9501
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,499
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,076
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,022
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,922
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,922
	30	Response time active power	Positive sequence	-	[s]	0,566
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,311
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,311
	33	Response time reactive power	Positive sequence	–	[s]	1,874
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

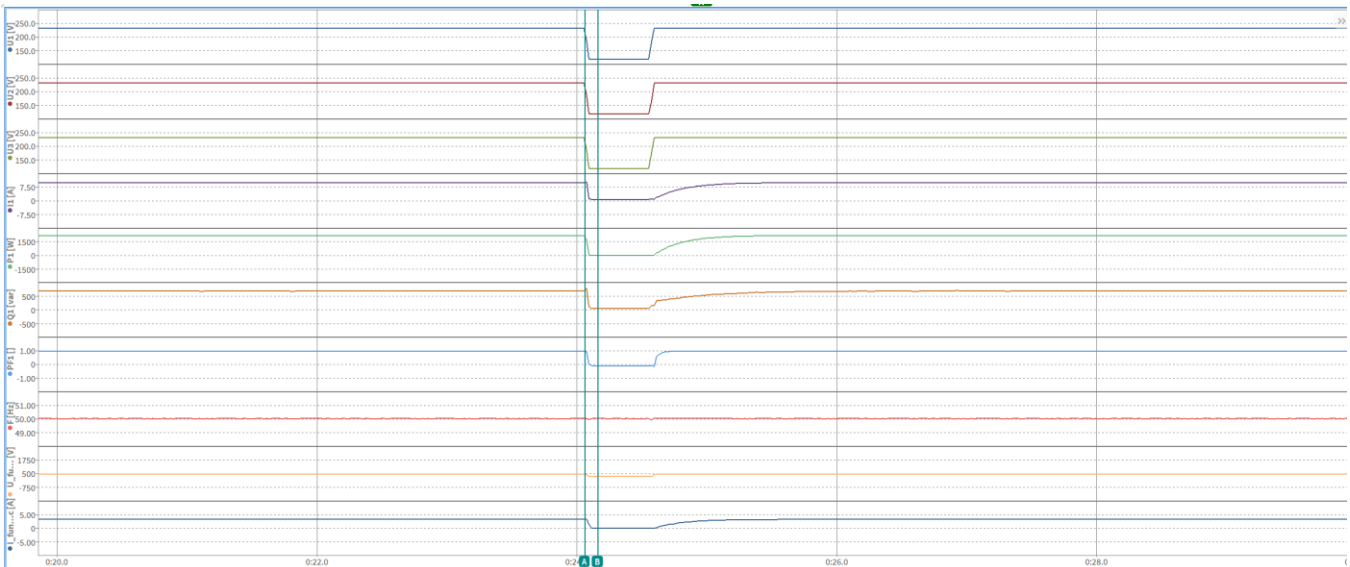
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0-60ms



时间 [s]	A 0:24.0612389	B 0:24.1212727	间隔 0.0600338
U1 [V]	229.9990	114.7302	-115.2688
U2 [V]	229.9839	115.0395	-114.9444
U3 [V]	229.9564	115.0038	-114.9527
I1 [A]	10.02080	0.318581	-9.702214
P1 [W]	2201.199	-4.533207	-2205.732
Q1 [var]	683.1570	36.26870	-646.8883
PF1 []	0.955061	-0.124024	-1.079085
F [Hz]	50.00514	50.00016	-4.978e-3
U_fund_SYM+_rc [V]	398.3358	199.0402	-199.2956
I_fund_P_SYM+_rc [A]	3.194472	-0.016395	-3.210867

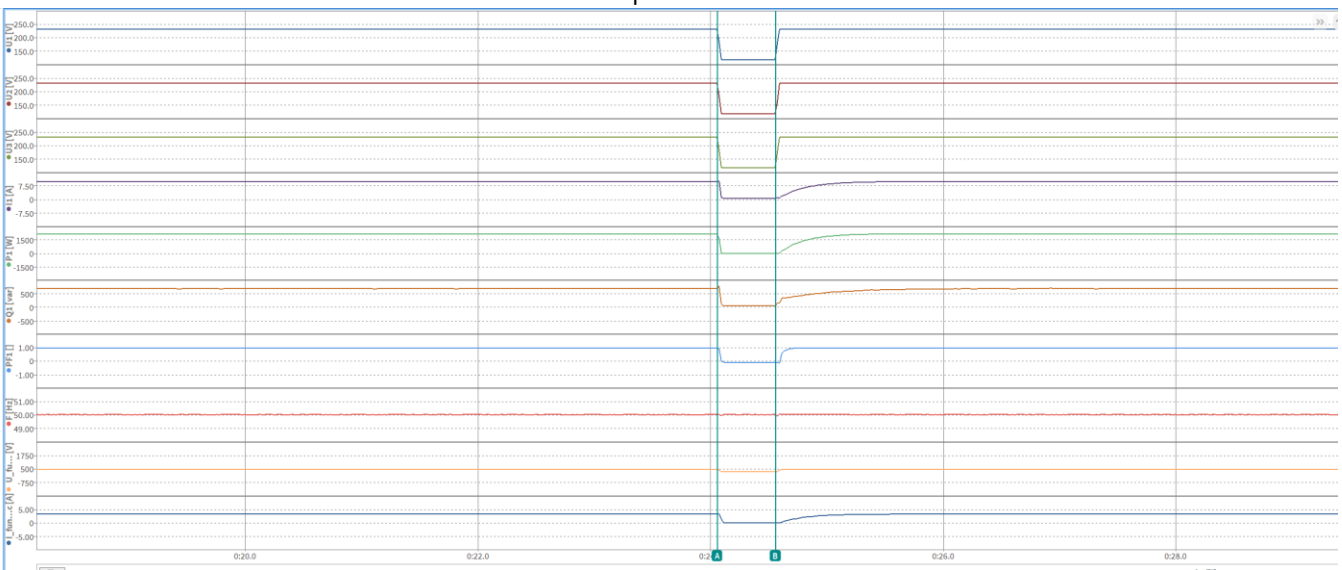
0-100ms



时间 [s]	A 0:24.0612389	B 0:24.1613955	间隔 0.1001567
U1 [V]	229.9990	114.8035	-115.1955
U2 [V]	229.9839	115.0276	-114.9563
U3 [V]	229.9564	114.9940	-114.9624
I1 [A]	10.02080	0.317867	-9.702928
P1 [W]	2201.199	-5.645891	-2206.845
Q1 [var]	683.1570	36.05288	-647.1042
PF1 []	0.955061	-0.154715	-1.109776
F [Hz]	50.00514	50.00027	-4.868e-3
U_fund_SYM+_rc [V]	398.3358	199.0771	-199.2587
I_fund_P_SYM+_rc [A]	3.194472	-0.015984	-3.210457

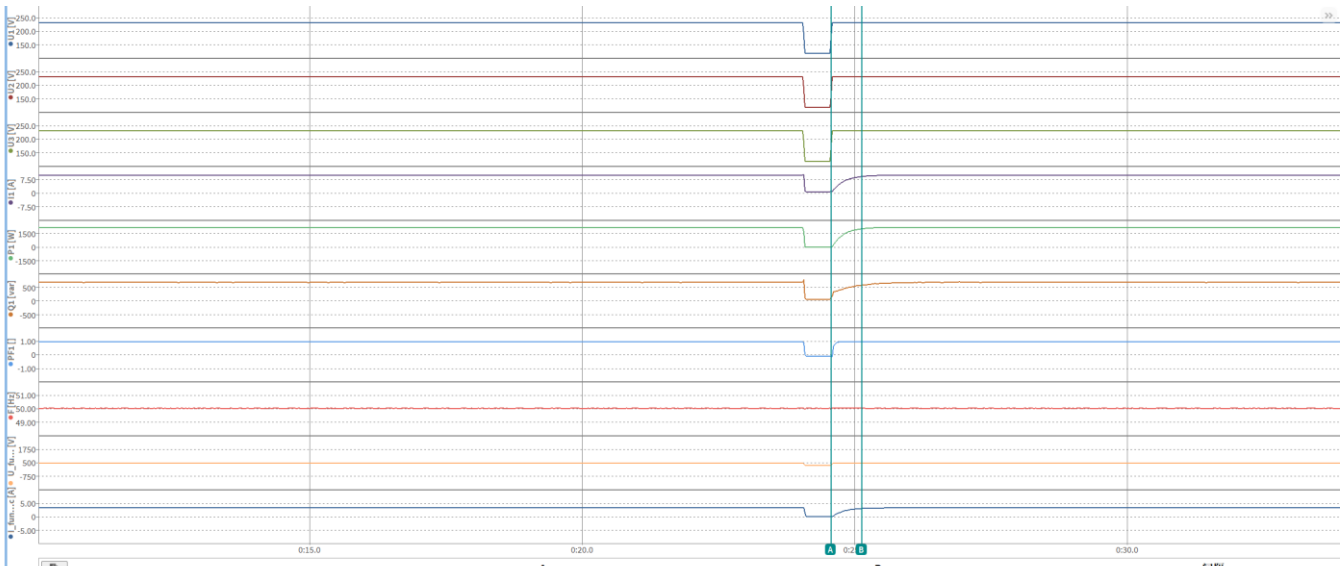
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Drop duration



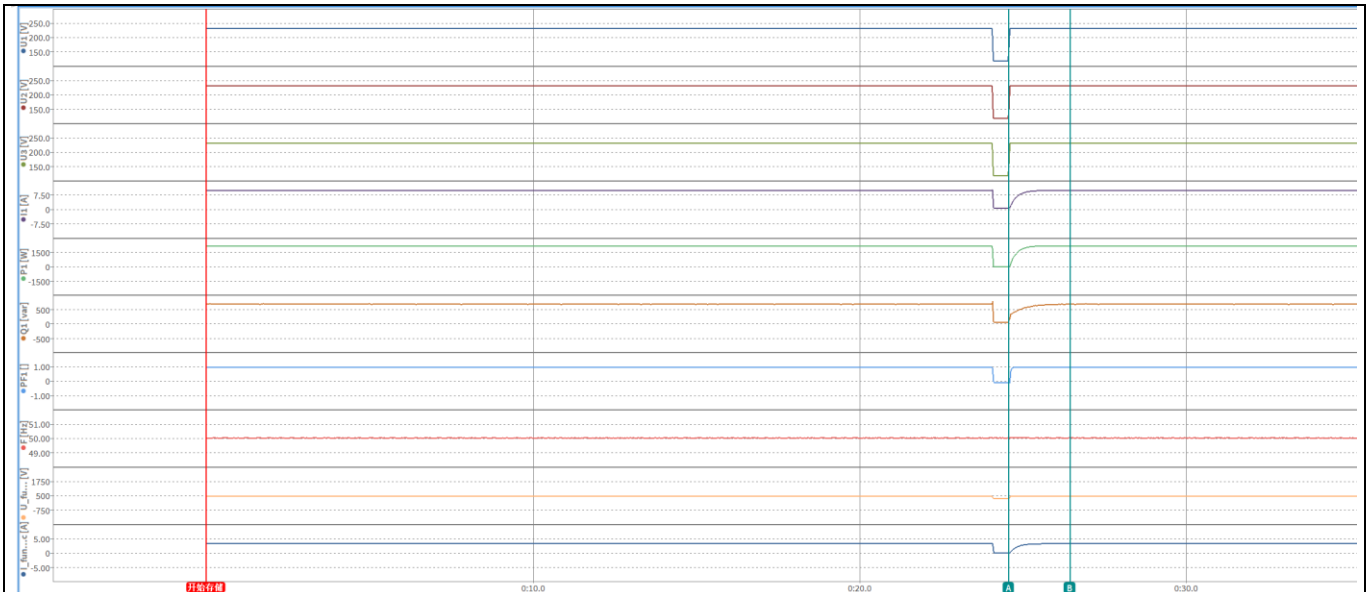
时间 [s]	A 0:24.0586566	B 0:24.5604069	间隔 0.5017503
U1 [V]	229.9874	115.0503	-114.9371
U2 [V]	229.9895	114.9731	-115.0164
U3 [V]	229.9626	114.9483	-115.0143
I1 [A]	10.02699	0.319426	-9.707565
P1 [W]	2202.982	-5.636372	-2208.619
Q1 [var]	681.8195	36.31524	-645.5042
PF1 []	0.955293	-0.153371	-1.108663
F [Hz]	50.00013	50.03625	0.036121
U_fund_SYM+_rc [V]	398.3351	199.1694	-199.1657
I_fund_P_SYM+_rc [A]	3.195968	-0.016097	-3.212066

Recover time



时间 [s]	A 0:24.5602939	B 0:25.1267424	间隔 0.5664486
U1 [V]	115.0503	230.0114	114.9611
U2 [V]	114.9731	229.9896	115.0165
U3 [V]	114.9483	229.9636	115.0153
I1 [A]	0.319426	9.109783	8.790357
P1 [W]	-5.636372	2016.800	2022.436
Q1 [var]	36.31524	568.3540	532.0388
PF1 []	-0.153371	0.962510	1.115881
F [Hz]	50.03625	50.00047	-0.035782
U_fund_SYM+_rc [V]	199.1694	398.3503	199.1809
I_fund_P_SYM+_rc [A]	-0.016097	2.913702	2.929799

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时间 [s]	A 0:24.5602939	B 0:26.4349161	间隔 1.8746222
U1 [V]	115.0503	229.9888	114.9385
U2 [V]	114.9731	229.9902	115.0171
U3 [V]	114.9483	229.9669	115.0186
I1 [A]	0.319426	10.02410	9.704678
P1 [W]	-5.636372	2202.868	2208.504
Q1 [var]	36.31524	679.9924	643.6771
PF1 []	-0.153371	0.955512	1.108883
F [Hz]	50.03625	50.00050	-0.035751
U_fund_SYM+_rc [V]	199.1694	398.3376	199.1682
I_fund_P_SYM+_rc [A]	-0.016097	3.195780	3.211877

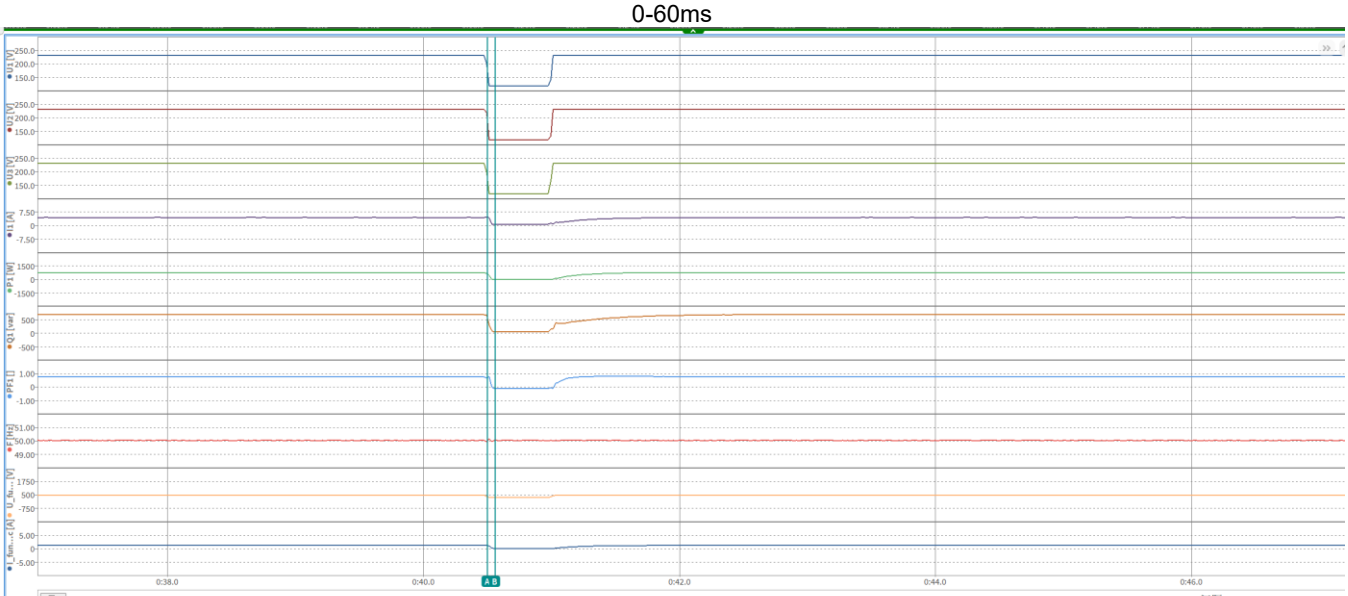
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Load tests 2.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	2.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1541
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,501
	10		Positive sequence			0,501
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,391
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,382
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,382
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,154
	16		Total	t_1-10 s to t_1	[p.u.]	0,154
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9521
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,499
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,024
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,022
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,392
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,392
	30	Response time active power	Positive sequence	-	[s]	0,658
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,285
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,285
	33	Response time reactive power	Positive sequence	–	[s]	1,956
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

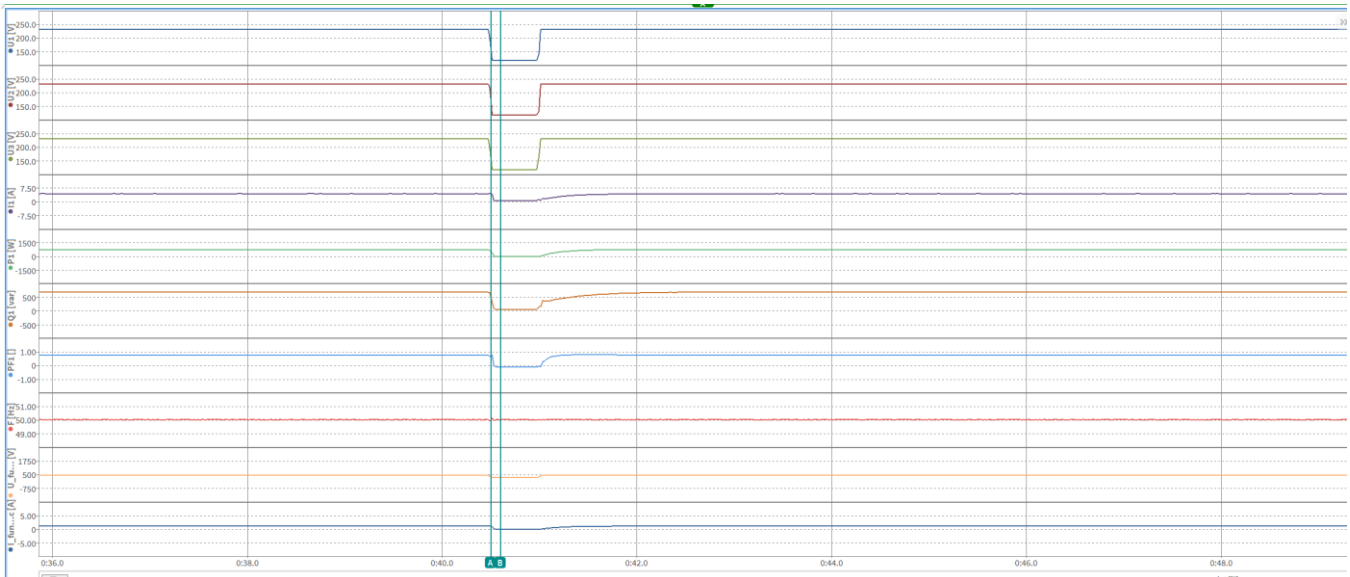
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0-60ms



时间 [s]	A 0:40.4996186	B 0:40.5601456	间隔 0.0605270
U1 [V]	230.0300	114.6652	-115.3648
U2 [V]	229.9851	115.0263	-114.9589
U3 [V]	229.9622	114.9976	-114.9645
I1 [A]	4.418949	0.317156	-4.101792
P1 [W]	748.2885	-4.978154	-753.2666
Q1 [var]	687.9811	36.02447	-651.9566
PF1 []	0.736149	-0.136887	-0.873036
F [Hz]	50.00302	50.00057	-2.453e-3
U_fund_SYM+_rc [V]	398.3577	199.0087	-199.3490
I_fund_P_SYM+_rc [A]	1.085766	-0.016348	-1.102115

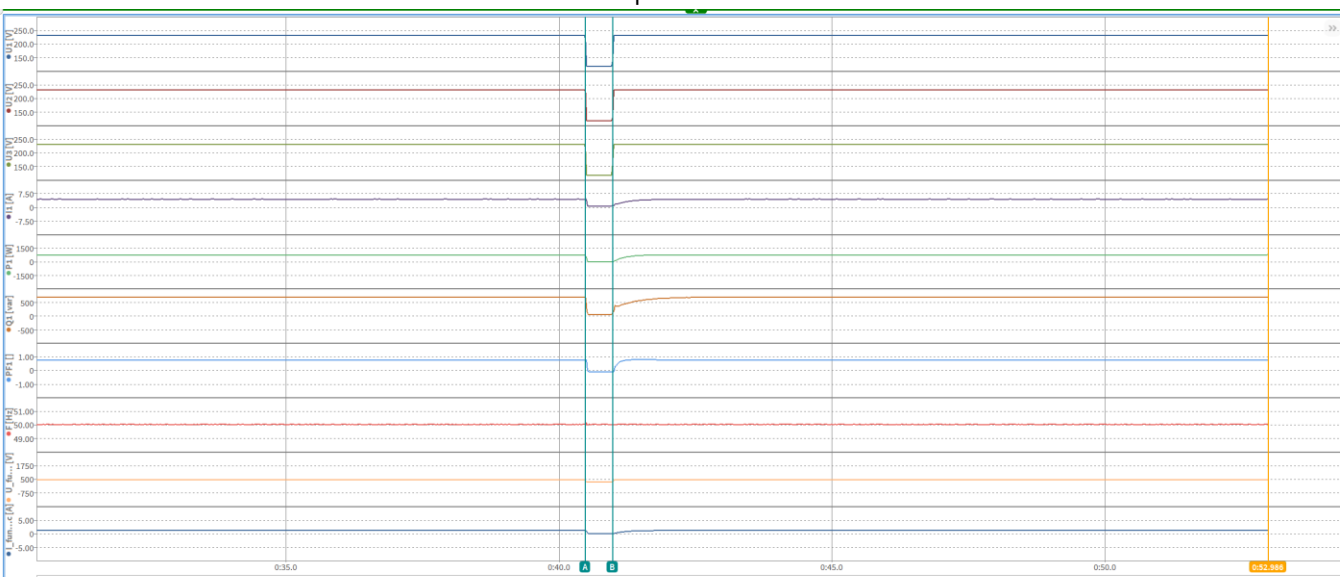
0-100ms



时间 [s]	A 0:40.4996186	B 0:40.6001870	间隔 0.1005684
U1 [V]	230.0300	114.7718	-115.2583
U2 [V]	229.9851	115.0171	-114.9680
U3 [V]	229.9622	114.9895	-114.9727
I1 [A]	4.418949	0.317349	-4.101600
P1 [W]	748.2885	-5.486928	-753.7754
Q1 [var]	687.9811	36.00699	-651.9741
PF1 []	0.736149	-0.150646	-0.886795
F [Hz]	50.00302	49.99826	-4.761e-3
U_fund_SYM+_rc [V]	398.3577	199.0582	-199.2995
I_fund_P_SYM+_rc [A]	1.085766	-0.016231	-1.101998

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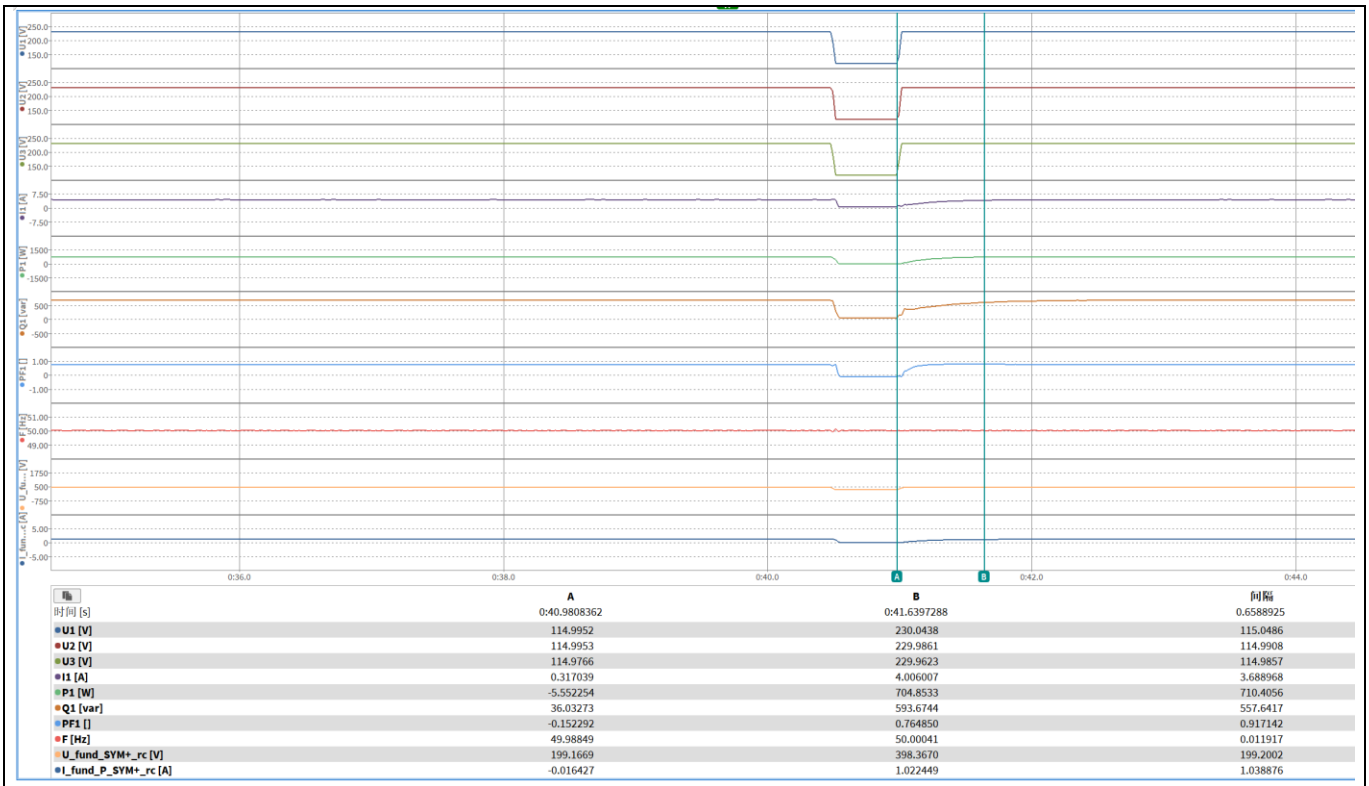
Drop duration



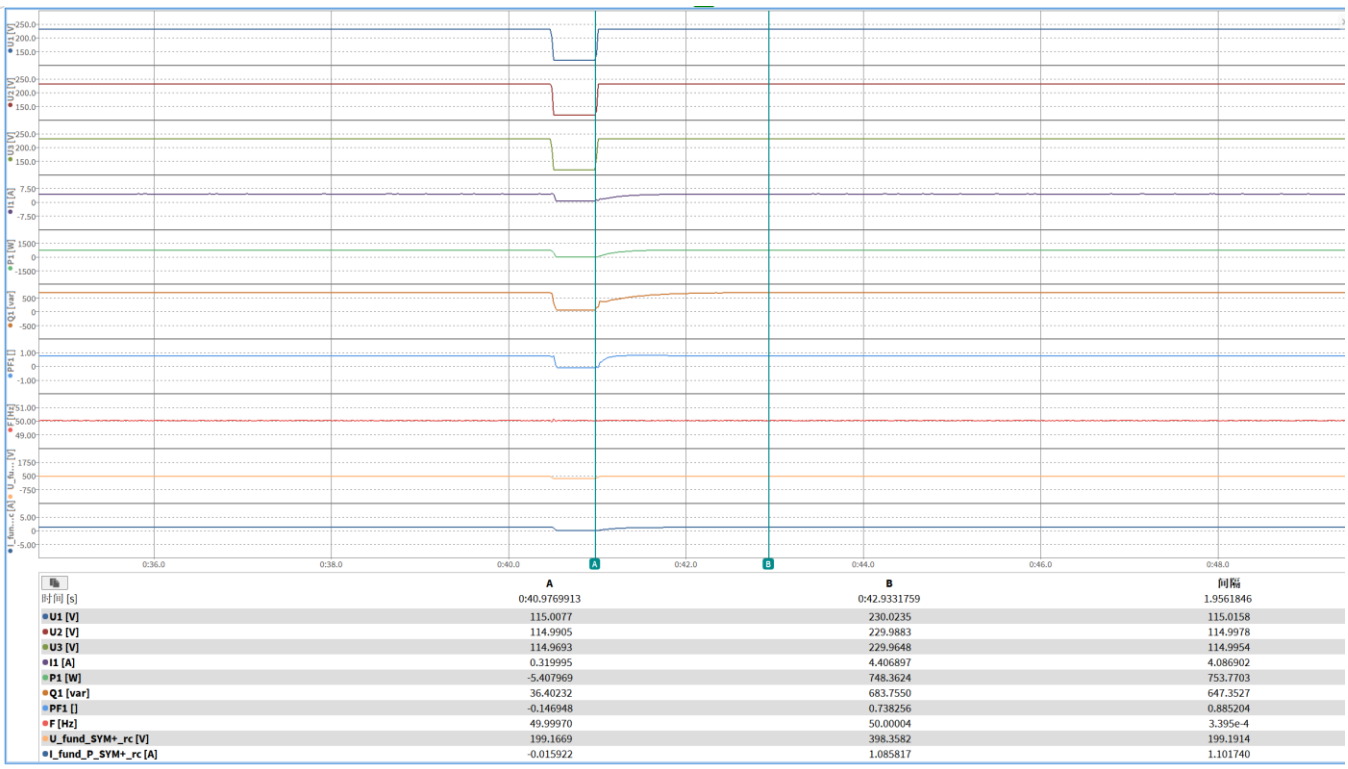
	A	B	间隔
时间 [s]	0:40.4798106	0:40.9813613	0.5015506
U1 [V]	230.0246	114.9952	-115.0294
U2 [V]	229.9878	114.9953	-114.9925
U3 [V]	229.9645	114.9766	-114.9879
I1 [A]	4.414659	0.317039	-4.097620
P1 [W]	747.7267	-5.552254	-753.2790
Q1 [var]	687.0991	36.03273	-651.0663
PF1 []	0.736328	-0.152292	-0.888620
F [Hz]	50.00065	49.98849	-0.012157
U_fund_SYM+_rc [V]	398.3576	199.1669	-199.1907
I_fund_P_SYM+_rc [A]	1.085070	-0.016427	-1.101497

Recover time

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	A	B	间隔
时间 [s]	0:40.9808362	0:41.6397288	0.6588925
U1 [V]	114.9952	230.0438	115.0486
U2 [V]	114.9953	229.9861	114.9908
U3 [V]	114.9766	229.9623	114.9857
I1 [A]	0.317039	4.006007	3.688968
P1 [W]	-5.552254	704.8533	710.4056
Q1 [var]	36.03273	593.6744	557.6417
PF1 []	-0.152292	0.764850	0.917142
F [Hz]	49.98849	50.00041	0.011917
U_fund_SYM+_rc [V]	199.1669	398.3670	199.2002
I_fund_P_SYM+_rc [A]	-0.016427	1.022449	1.038876



	A	B	间隔
时间 [s]	0:40.9769913	0:42.9331759	1.9561846
U1 [V]	115.0077	230.0235	115.0158
U2 [V]	114.9905	229.9883	114.9978
U3 [V]	114.9693	229.9648	114.9954
I1 [A]	0.319995	4.406897	4.086902
P1 [W]	-5.407969	748.3624	753.7703
Q1 [var]	36.40232	683.7550	647.3527
PF1 []	-0.146948	0.738256	0.885204
F [Hz]	49.99970	50.00004	3.395e-4
U_fund_SYM+_rc [V]	199.1669	398.3582	199.1914
I_fund_P_SYM+_rc [A]	-0.015922	1.085817	1.101740

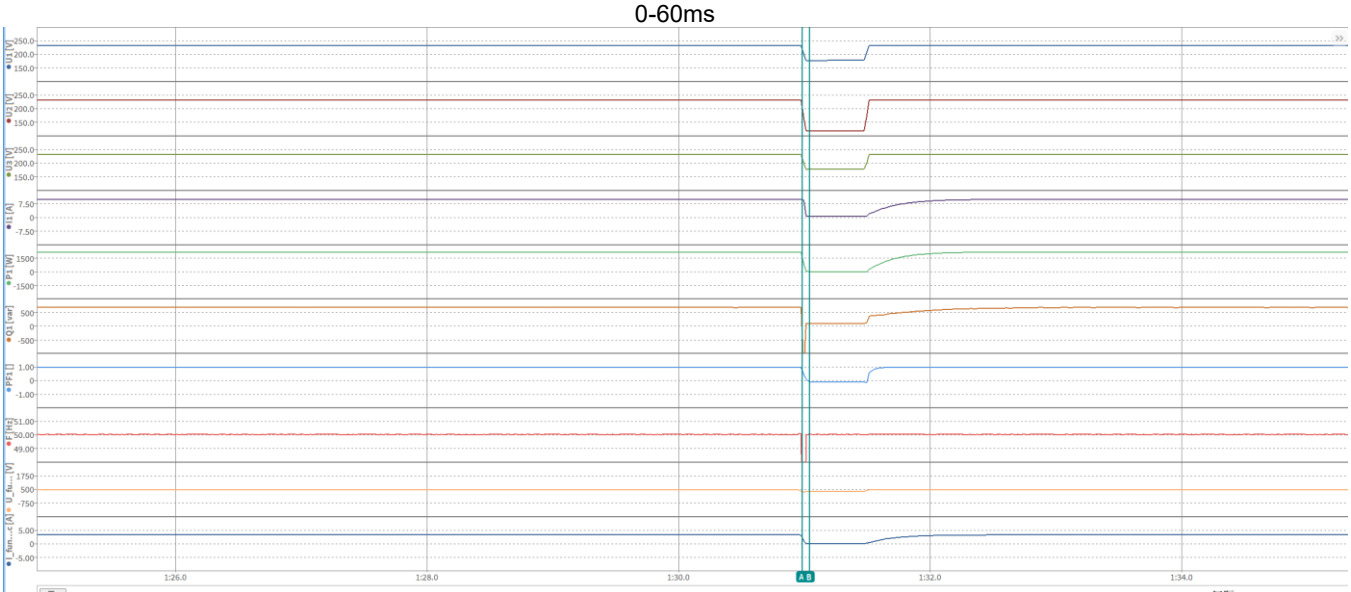
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Load tests 2.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	2.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0.50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1576
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,242
	10		Positive sequence			0,242
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,992
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,017
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,946
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,946
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,322
	16		Total	t_1-10 s to t_1	[p.u.]	0,322
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9465
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,758
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,063
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,061
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	30	Response time active power	Positive sequence	-	[s]	0,572
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,290
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,290
	33	Response time reactive power	Positive sequence	–	[s]	1,292
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

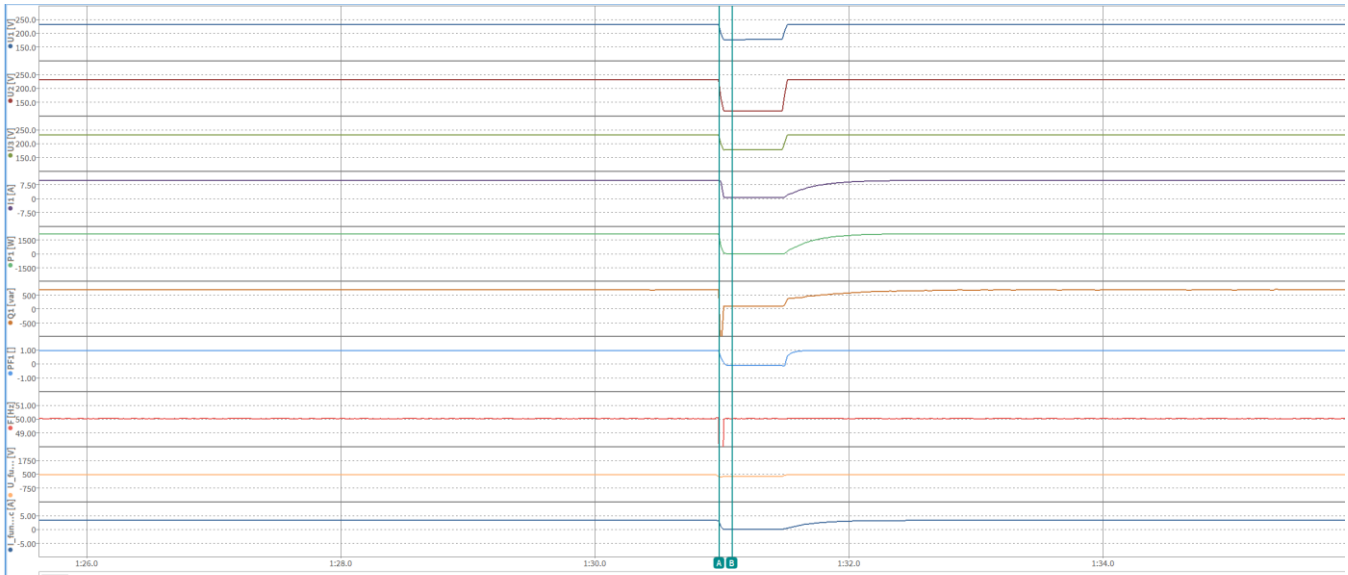
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0-60ms



时间 [s]	A 1:30.9800408	B 1:31.0404099	间隔 0.0603691
U1 [V]	230.0859	174.4821	-55.60379
U2 [V]	229.9388	115.0226	-114.9161
U3 [V]	229.9084	174.7596	-55.14877
I1 [A]	10.04001	0.481831	-9.558180
P1 [W]	2204.813	-9.418464	-2214.231
Q1 [var]	689.3474	83.54165	-605.8058
PF1 []	0.954438	-0.112030	-1.066468
F [Hz]	50.04275	50.00063	-0.042122
U_fund_SYM+_rc [V]	272.2371	264.3426	-7.894491
I_fund_P_SYM+_rc [A]	3.080183	-0.053347	-3.133530

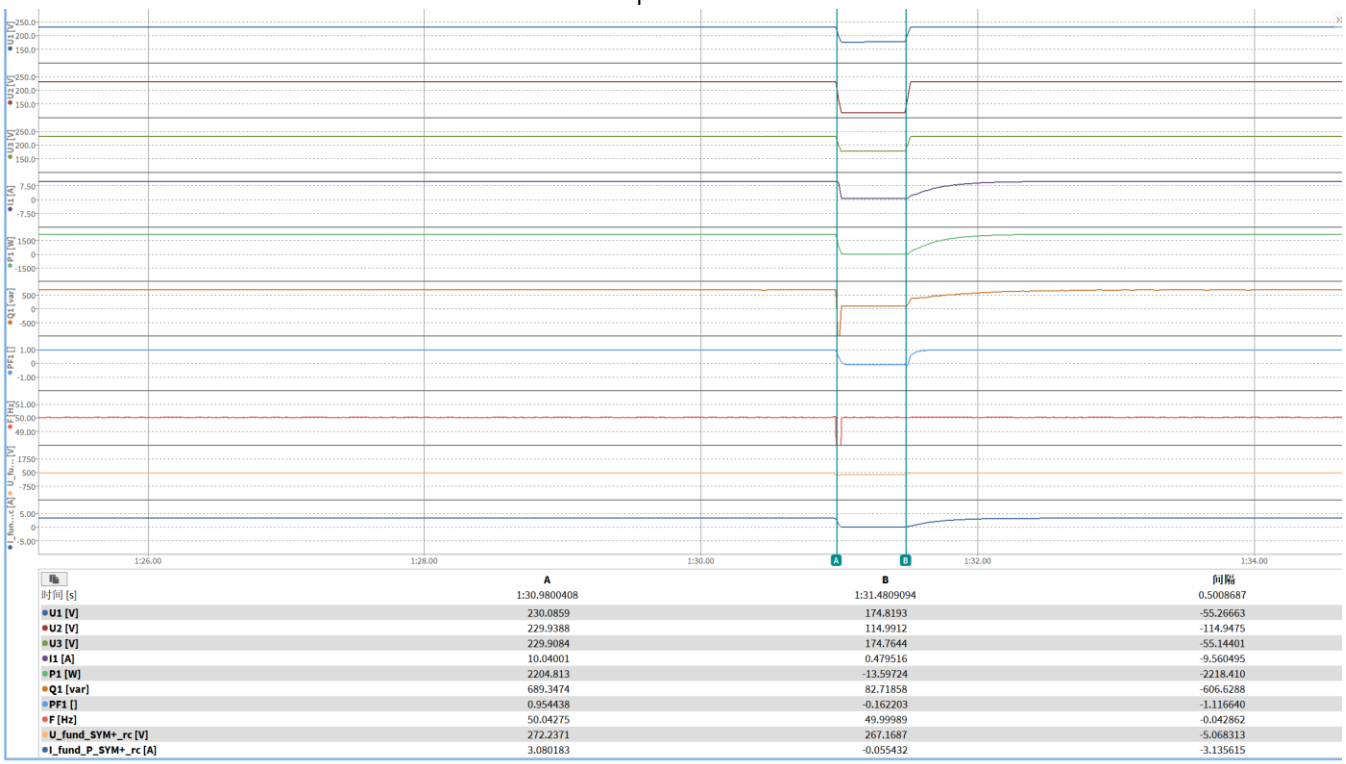
0-100ms



时间 [s]	A 1:30.9800408	B 1:31.0809316	间隔 0.1008908
U1 [V]	230.0859	174.5838	-55.50214
U2 [V]	229.9388	115.0166	-114.9222
U3 [V]	229.9084	174.7613	-55.14706
I1 [A]	10.04001	0.475881	-9.564130
P1 [W]	2204.813	-13.05437	-2217.867
Q1 [var]	689.3474	82.04915	-607.2983
PF1 []	0.954438	-0.157128	-1.111566
F [Hz]	50.04275	49.99993	-0.042820
U_fund_SYM+_rc [V]	272.2371	264.3979	-7.839204
I_fund_P_SYM+_rc [A]	3.080183	-0.054327	-3.134509

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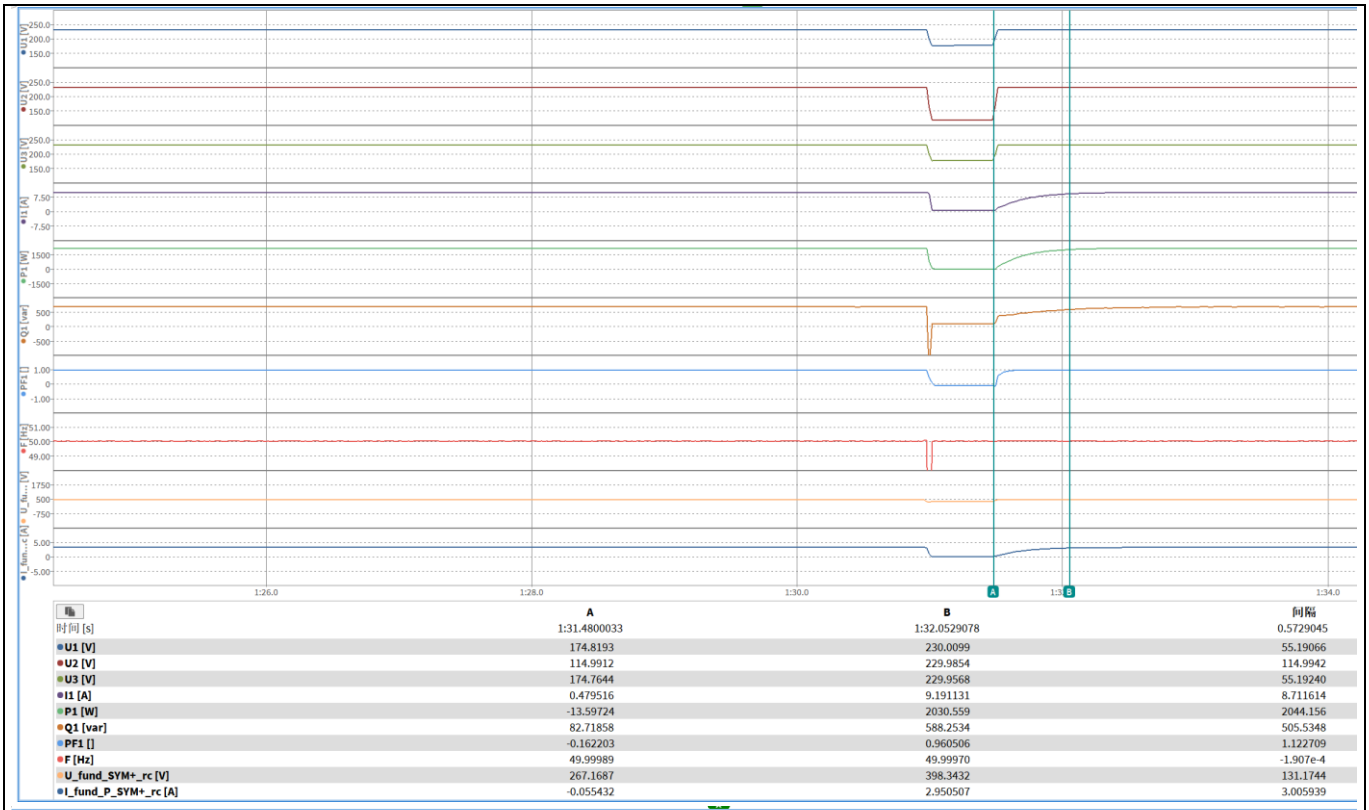
Drop duration



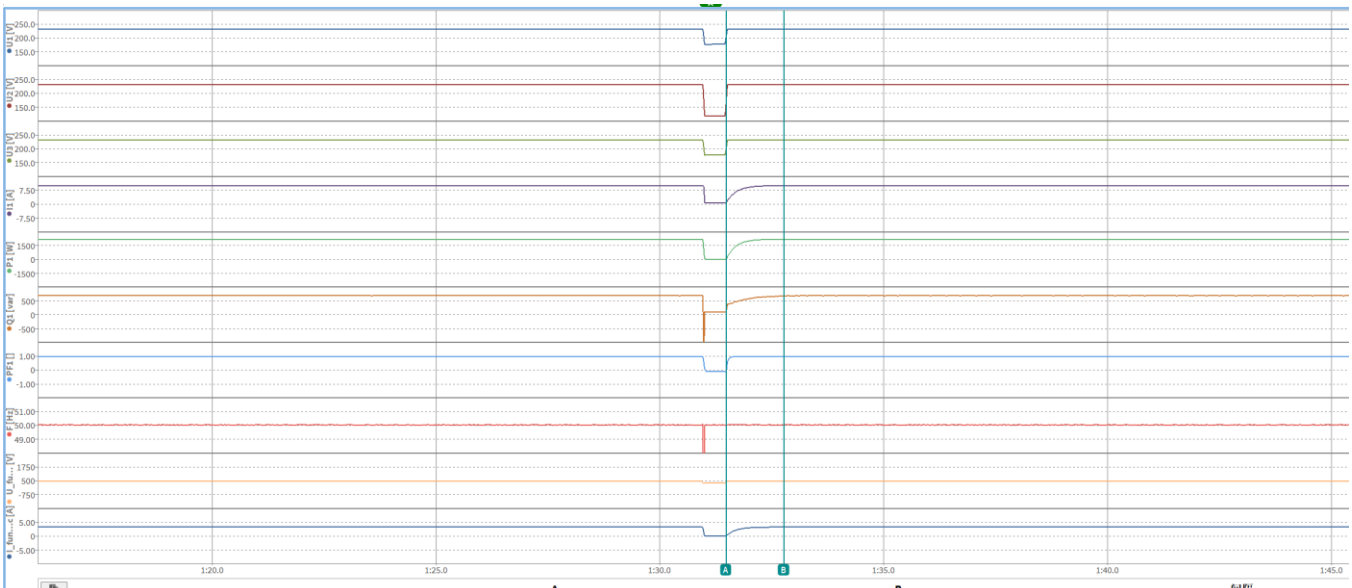
	A	B	间隔
时间 [s]	1:30.9800408	1:31.4809094	0.5008687
U1 [V]	230.0859	174.8193	-55.26663
U2 [V]	229.9388	114.9912	-114.9475
U3 [V]	229.9084	174.7644	-55.14401
I1 [A]	10.04001	0.479516	-9.560495
P1 [W]	2204.813	-13.59724	-2218.410
Q1 [var]	689.3474	82.71858	-606.6288
PF1 []	0.954438	-0.162203	-1.116640
F [Hz]	50.04275	49.99989	-0.042862
U_fund_SYM+_rc [V]	272.2371	267.1687	-5.068313
I_fund_P_SYM+_rc [A]	3.080183	-0.055432	-3.135615

Recover time

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时间 [s]	A 1:31.4800033	B 1:32.0529078	间隔 0.5729045
U1 [V]	174.8193	230.0099	55.19066
U2 [V]	114.9912	229.9854	114.9942
U3 [V]	174.7644	229.9568	55.19240
I1 [A]	0.479516	9.191131	8.711614
P1 [W]	-13.59724	2030.559	2044.156
Q1 [var]	82.71858	588.2534	505.5348
PF1 []	-0.162203	0.960506	1.122709
F [Hz]	49.99989	49.99970	-1.907e-4
U_fund_SYM+_rc [V]	267.1687	398.3432	131.1744
I_fund_P_SYM+_rc [A]	-0.055432	2.950507	3.005939



时间 [s]	A 1:31.4800033	B 1:32.7720147	间隔 1.2920114
U1 [V]	174.8193	229.9912	55.17189
U2 [V]	114.9912	229.9837	114.9925
U3 [V]	174.7644	229.9587	55.19432
I1 [A]	0.479516	9.987396	9.507880
P1 [W]	-13.59724	2197.598	2211.195
Q1 [var]	82.71858	668.4531	585.7345
PF1 []	-0.162203	0.956720	1.118923
F [Hz]	49.99989	50.00053	6.409e-4
U_fund_SYM+_rc [V]	267.1687	398.3319	131.1631
I_fund_P_SYM+_rc [A]	-0.055432	3.189064	3.244496

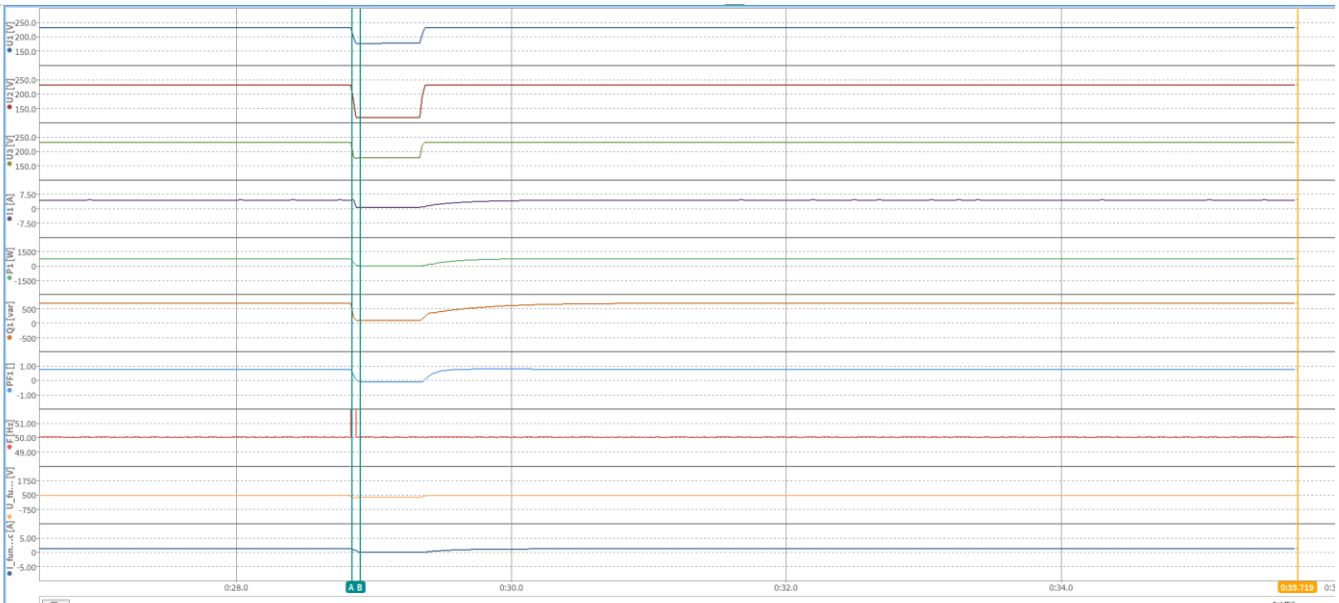
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Load tests 2.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	2.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0.50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1596
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,241
	10		Positive sequence			0,241
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,970
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,399
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,395
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,395
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,297
	16		Total	t_1-10 s to t_1	[p.u.]	0,297
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9506
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,759
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,068
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,065
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,000
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	30	Response time active power	Positive sequence	-	[s]	0,635
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,298
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,298
	33	Response time reactive power	Positive sequence	–	[s]	1,686
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

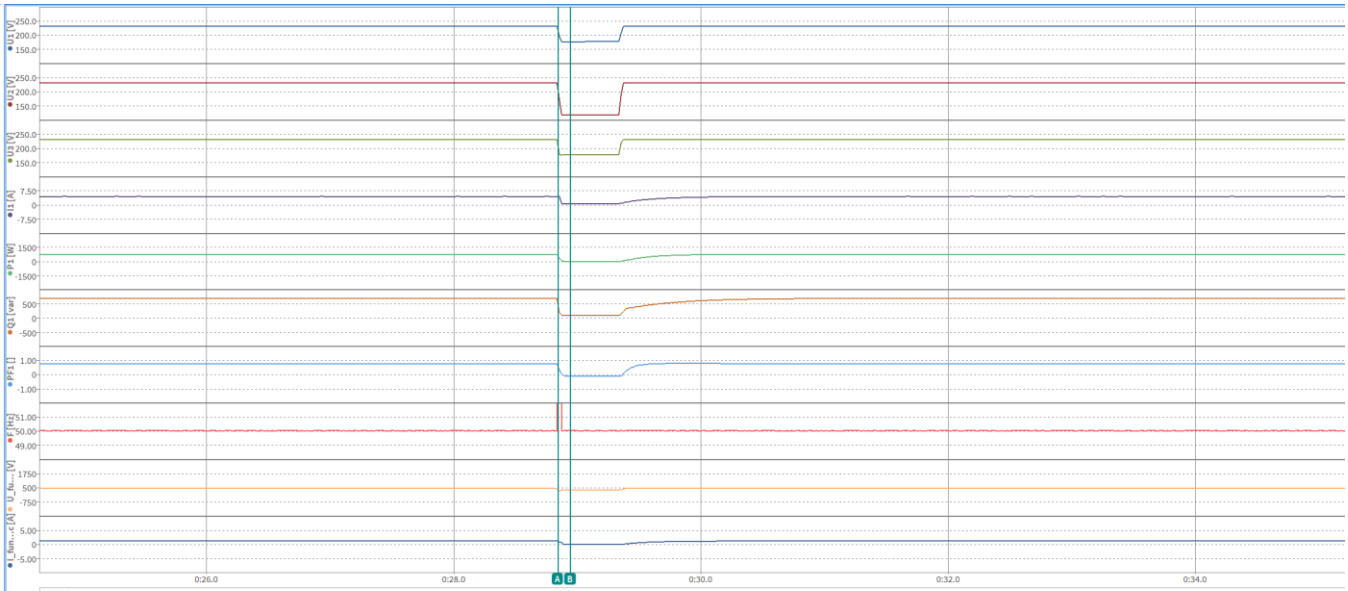
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0-60ms



时间 [s]	A 0:28.841880	B 0:28.902095	间隔 0.060215
U1 [V]	229.9781	174.3834	-55.59471
U2 [V]	230.0051	115.0081	-114.9970
U3 [V]	229.9808	174.7680	-55.21274
I1 [A]	4.415003	0.478595	-3.936407
P1 [W]	747.4092	-9.849472	-757.2587
Q1 [var]	687.2578	82.87588	-604.3819
PF1 []	0.736107	-0.118016	-0.854123
F [Hz]	49.98199	50.00028	0.018288
U_fund_SYM+_rc [V]	394.1620	264.2405	-129.9215
I_fund_P_SYM+_rc [A]	1.092352	-0.053265	-1.145617

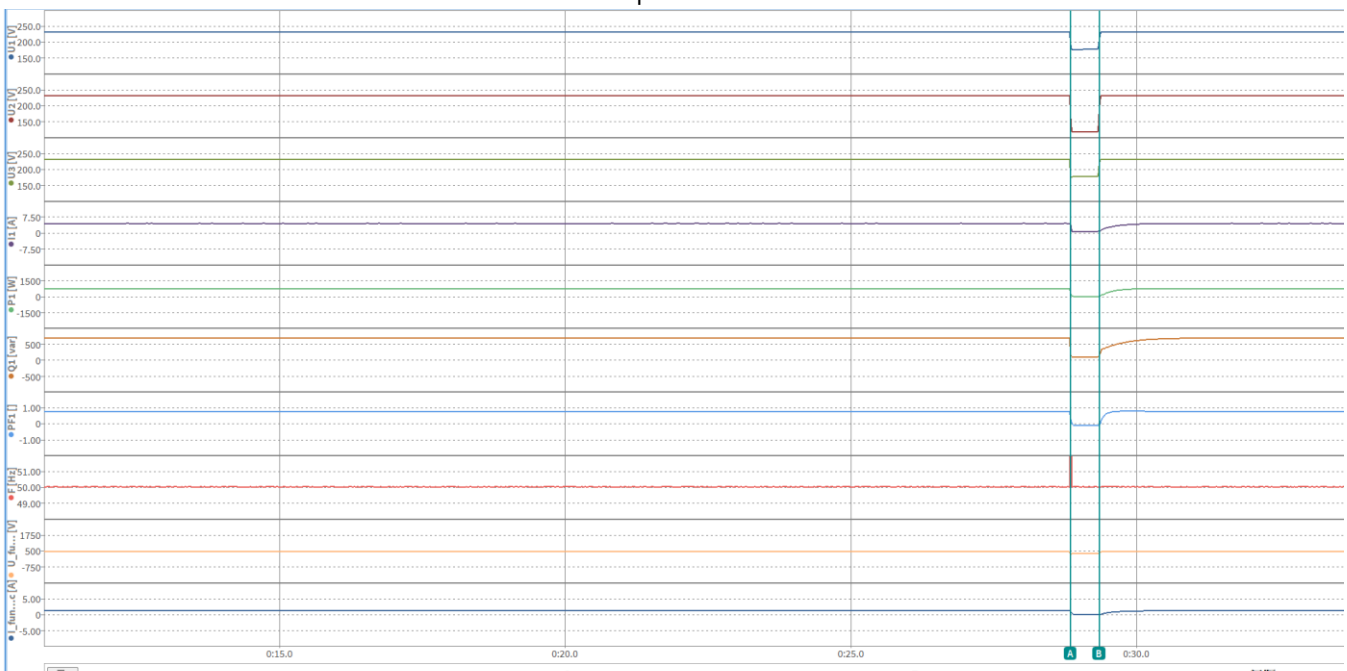
0-100ms



时间 [s]	A 0:28.841880	B 0:28.944602	间隔 0.102722
U1 [V]	229.9781	174.5149	-55.46321
U2 [V]	230.0051	115.0038	-115.0013
U3 [V]	229.9808	174.7665	-55.21423
I1 [A]	4.415003	0.475819	-3.939184
P1 [W]	747.4092	-13.17604	-760.5853
Q1 [var]	687.2578	81.98549	-605.2723
PF1 []	0.736107	-0.158676	-0.894783
F [Hz]	49.98199	50.00048	0.018490
U_fund_SYM+_rc [V]	394.1620	264.3326	-129.8294
I_fund_P_SYM+_rc [A]	1.092352	-0.054405	-1.146757

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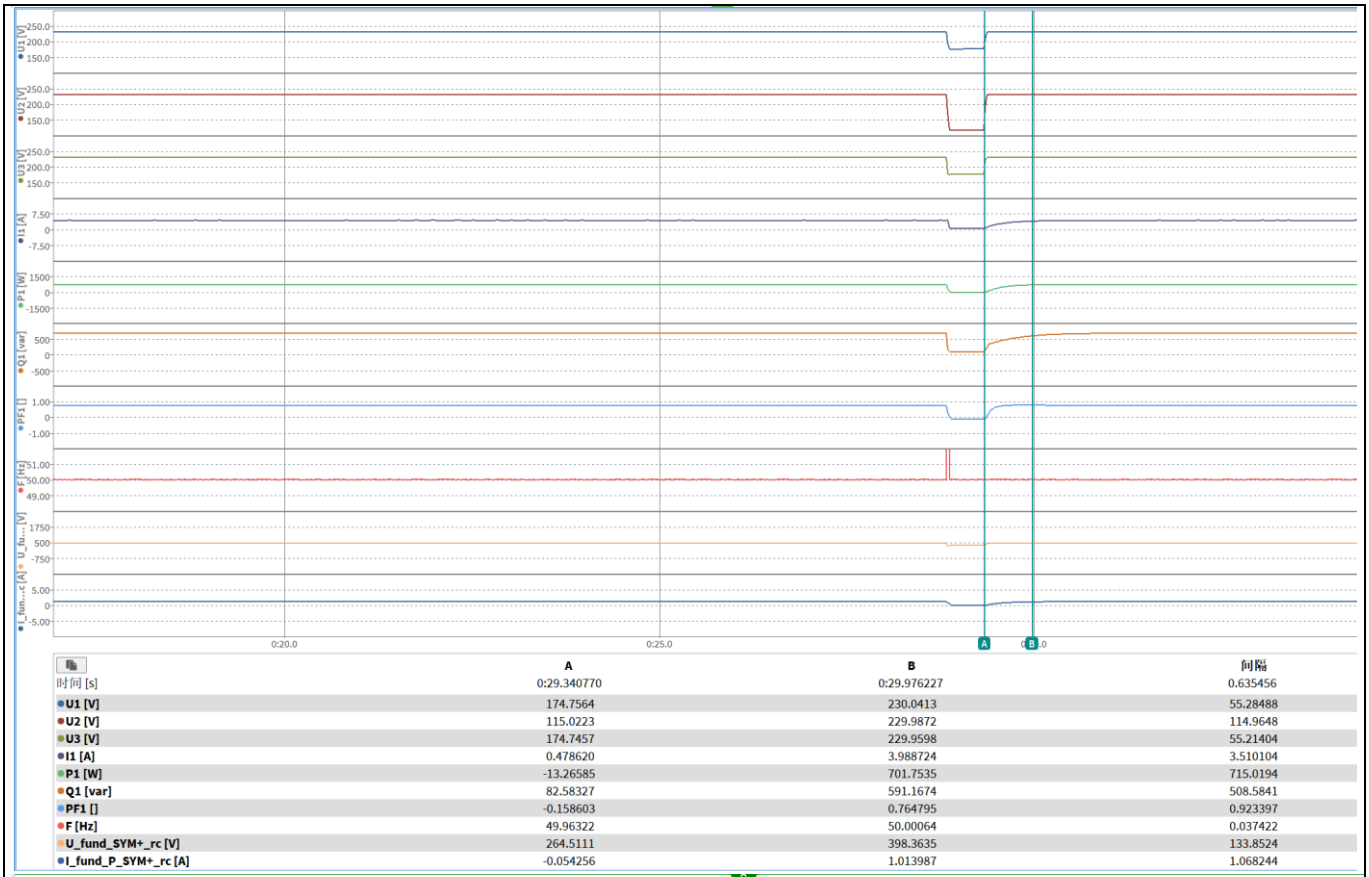
Drop duration



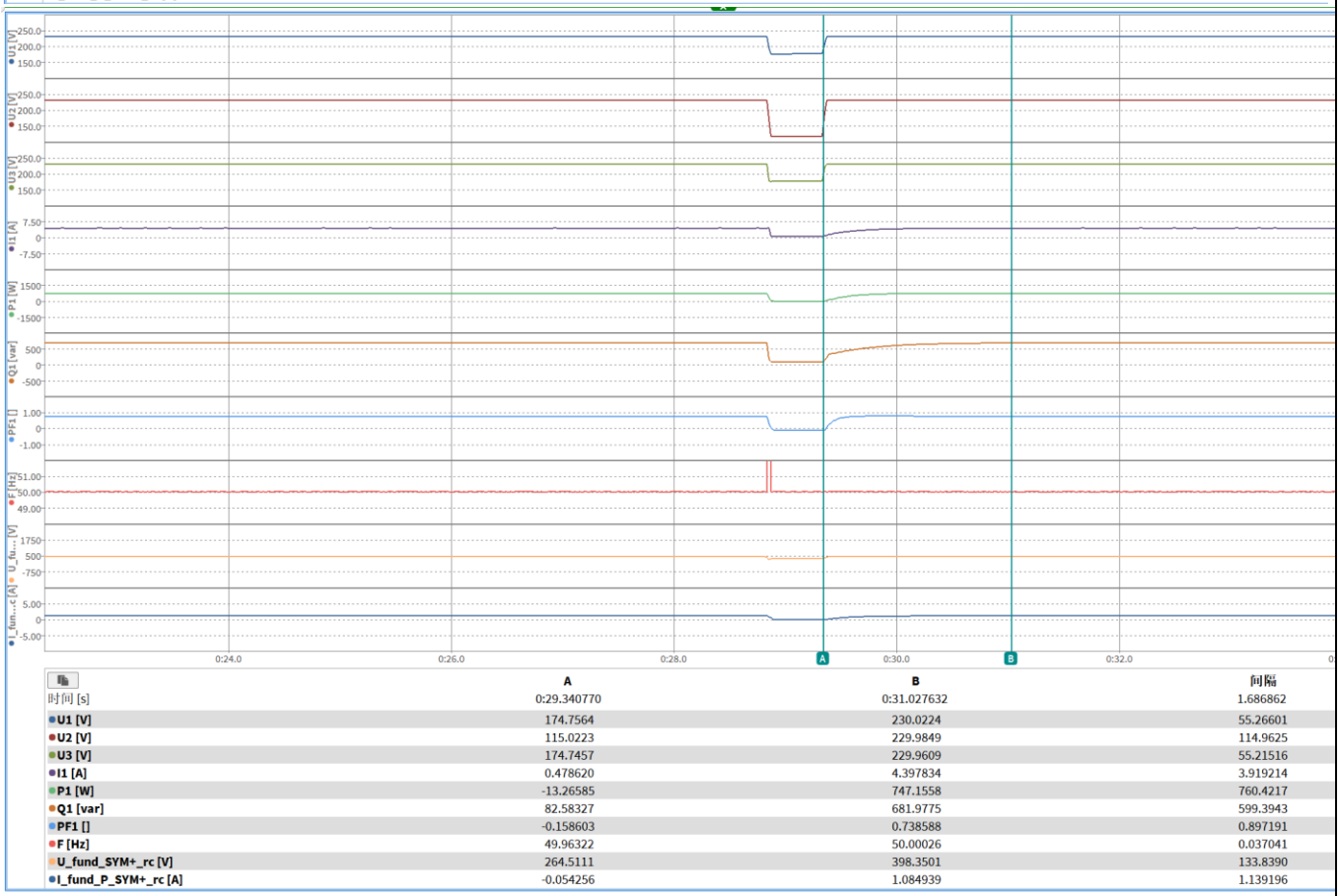
时间 [s]	A 0:28.841880	B 0:29.345568	Δ 0.503688
U1 [V]	229.9781	174.7564	-55.22176
U2 [V]	230.0051	115.0223	-114.9827
U3 [V]	229.9808	174.7457	-55.23503
I1 [A]	4.415003	0.478620	-3.936382
P1 [W]	747.4092	-13.26585	-760.6751
Q1 [var]	687.2578	82.58327	-604.6745
PF1 []	0.736107	-0.158603	-0.894710
F [Hz]	49.98199	49.96322	-0.018772
U_fund_SYM+_rc [V]	394.1620	264.5111	-129.6509
I_fund_P_SYM+_rc [A]	1.092352	-0.054256	-1.146608

Recover time

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	A	B	间隔
时间 [s]	0:29.340770	0:29.976227	0.635456
U1 [V]	174.7564	230.0413	55.28488
U2 [V]	115.0223	229.9872	114.9648
U3 [V]	174.7457	229.9598	55.21404
I1 [A]	0.478620	3.988724	3.510104
P1 [W]	-13.26585	701.7535	715.0194
Q1 [var]	82.58327	591.1674	508.5841
PF1 []	-0.158603	0.764795	0.923397
F [Hz]	49.96322	50.00064	0.037422
U_fund_SYM+_rc [V]	264.5111	398.3635	133.8524
I_fund_P_SYM+_rc [A]	-0.054256	1.013987	1.068244



	A	B	间隔
时间 [s]	0:29.340770	0:31.027632	1.686862
U1 [V]	174.7564	230.0224	55.26601
U2 [V]	115.0223	229.9849	114.9625
U3 [V]	174.7457	229.9609	55.21516
I1 [A]	0.478620	4.397834	3.919214
P1 [W]	-13.26585	747.1558	760.4217
Q1 [var]	82.58327	681.9775	599.3943
PF1 []	-0.158603	0.738588	0.897191
F [Hz]	49.96322	50.00026	0.037041
U_fund_SYM+_rc [V]	264.5111	398.3501	133.8390
I_fund_P_SYM+_rc [A]	-0.054256	1.084939	1.139196

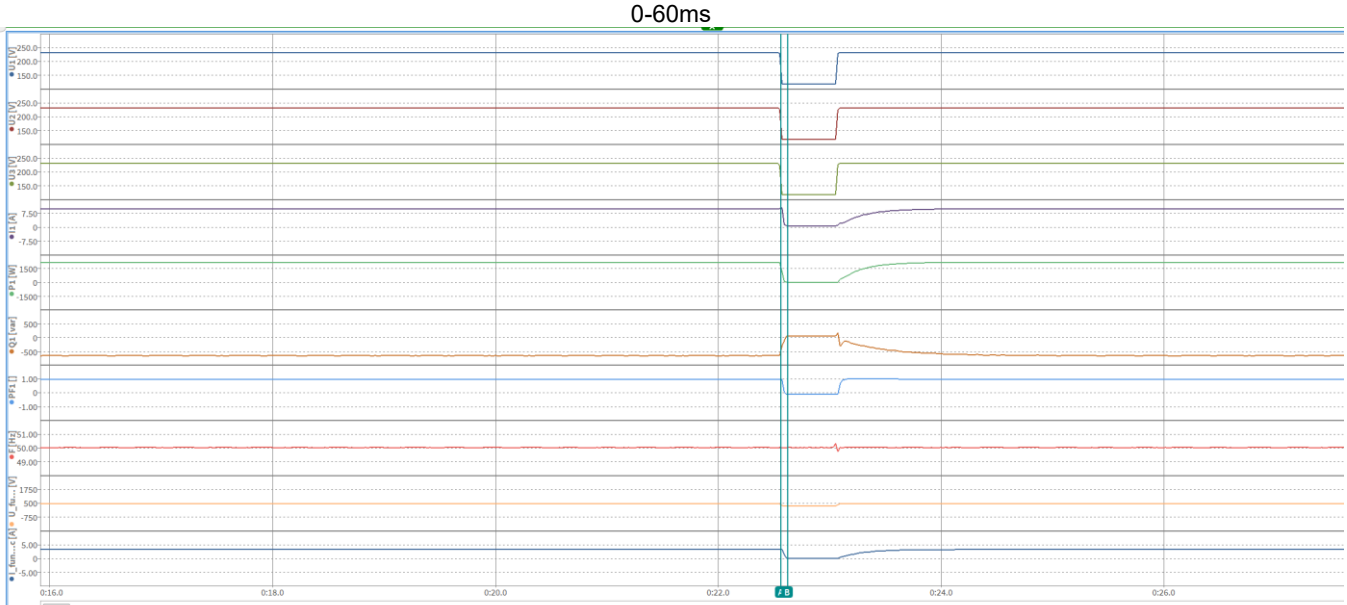
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Load tests 3.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	3.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1652
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,499
	10		Positive sequence			0,499
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,993
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,943
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,943
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,312
	16		Total	t_1-10 s to t_1	[p.u.]	-0,312
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9494
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,501
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,078
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,078
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	30	Response time active power	Positive sequence	-	[s]	0,562
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,279
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,279
	33	Response time reactive power	Positive sequence	–	[s]	1,349
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

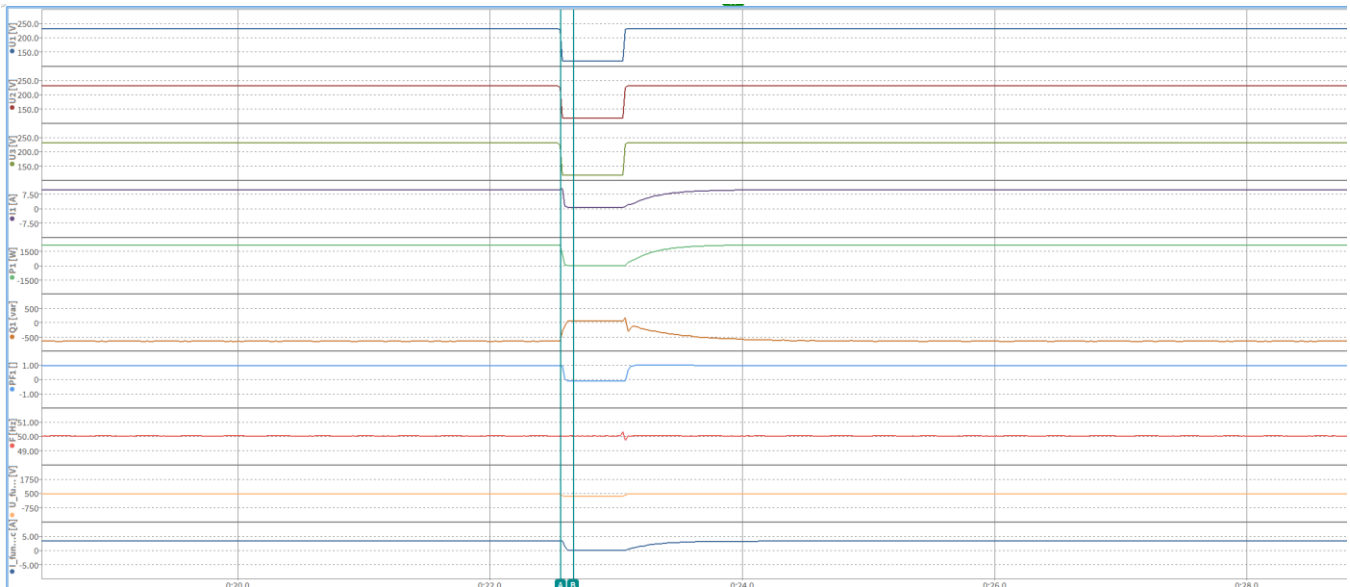
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0-60ms



时间 [s]	A 0:22.5615650	B 0:22.6217810	间隔 0.0602160
U1 [V]	229.4014	115.3188	-114.0826
U2 [V]	224.0533	115.0340	-109.0194
U3 [V]	220.2804	114.9969	-105.2835
I1 [A]	10.03641	0.317857	-9.718549
P1 [W]	2200.457	-4.934409	-2205.392
Q1 [var]	-677.4030	36.32121	713.7242
PF1 []	0.955738	-0.134618	-1.090356
F [Hz]	50.02233	49.99896	-0.023373
U_fund_SYM+_rc [V]	395.7547	199.3952	-196.3595
I_fund_P_SYM+_rc [A]	3.183495	-0.016507	-3.200002

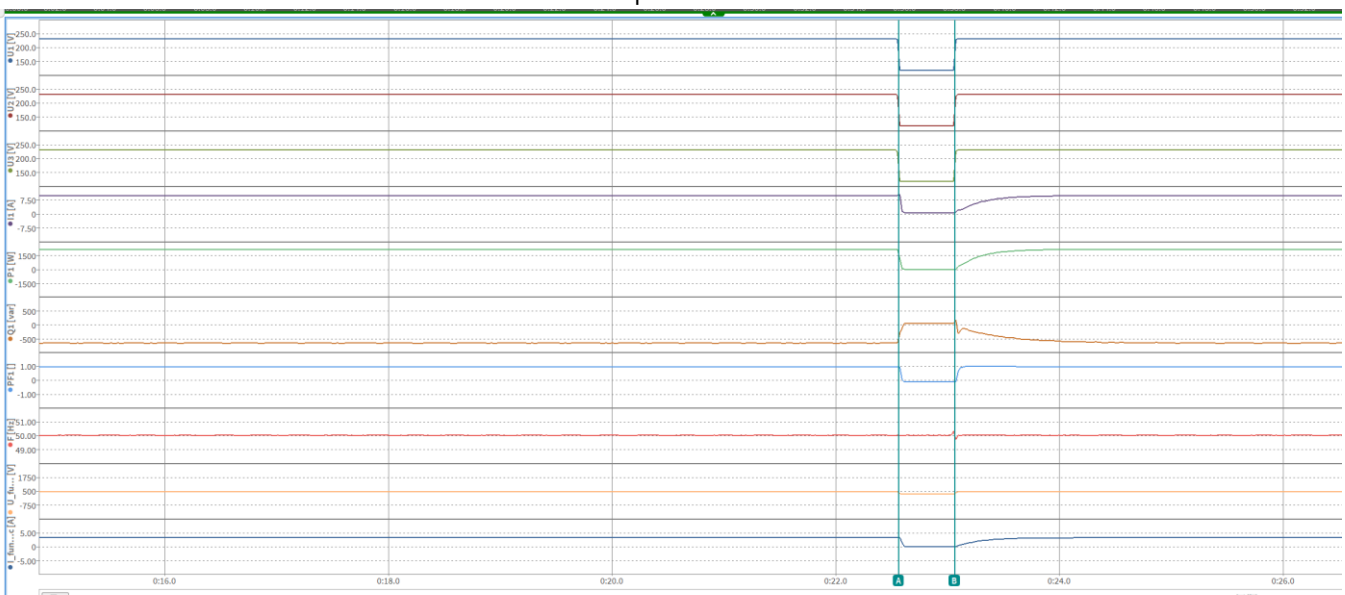
0-100ms



时间 [s]	A 0:22.5615650	B 0:22.6617335	间隔 0.1001685
U1 [V]	229.4014	115.2236	-114.1778
U2 [V]	224.0533	115.0213	-109.0320
U3 [V]	220.2804	114.9868	-105.2936
I1 [A]	10.03641	0.318072	-9.718333
P1 [W]	2200.457	-5.584752	-2206.042
Q1 [var]	-677.4030	36.22144	713.6244
PF1 []	0.955738	-0.152383	-1.108121
F [Hz]	50.02233	50.00031	-0.022022
U_fund_SYM+_rc [V]	395.7547	199.3327	-196.4221
I_fund_P_SYM+_rc [A]	3.183495	-0.016389	-3.199884

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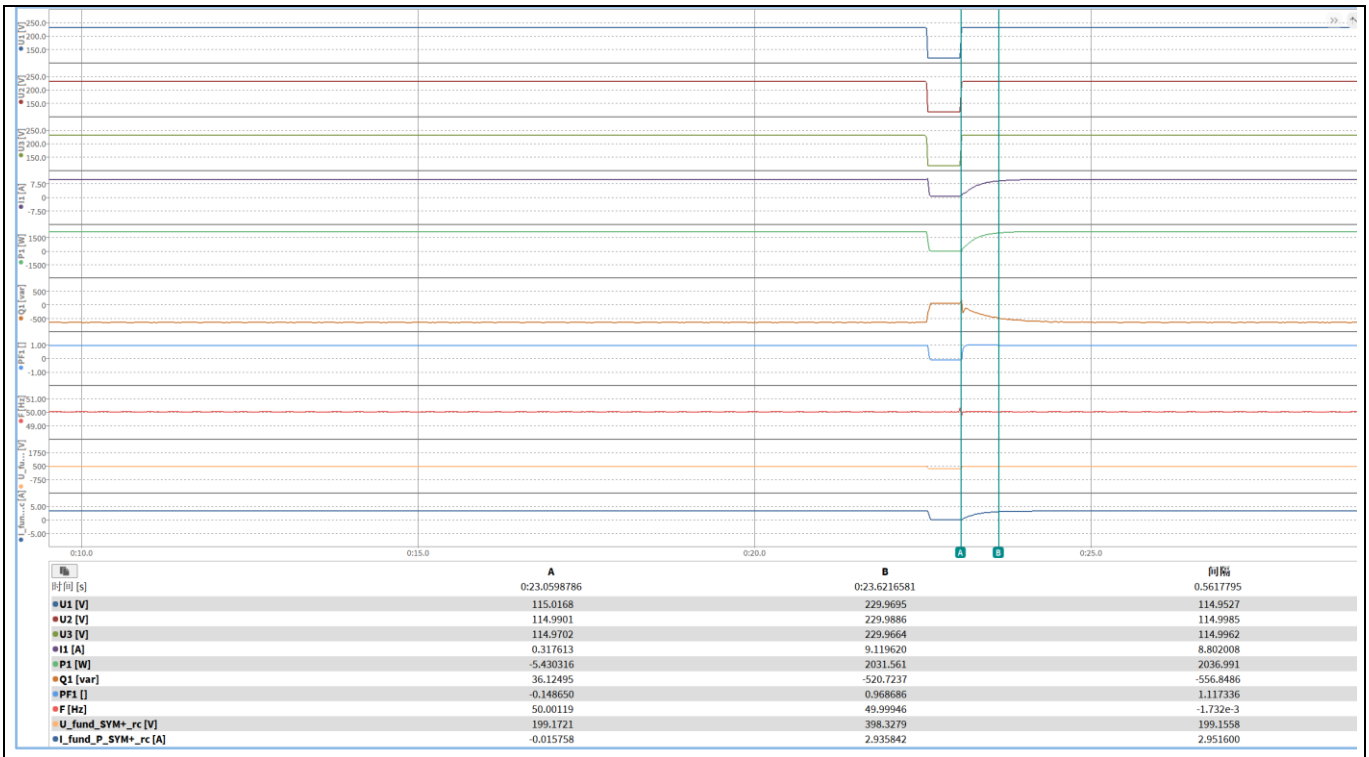
Drop duration



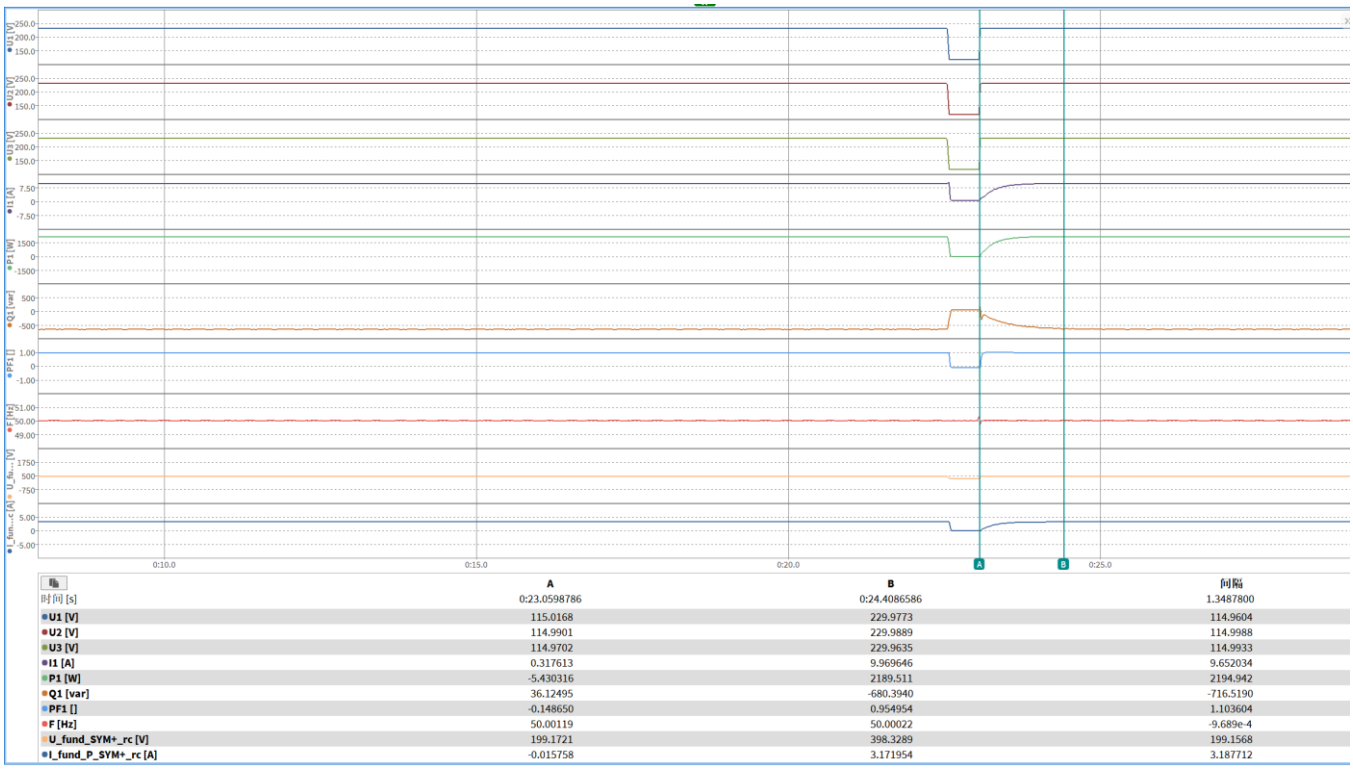
	A	B	间隔
时间 [s]	0:22.5615650	0:23.0621259	0.5005609
U1 [V]	229.4014	115.3690	-114.0324
U2 [V]	224.0533	114.8353	-109.2180
U3 [V]	220.2804	114.7716	-105.5088
I1 [A]	10.03641	0.320131	-9.716275
P1 [W]	2200.457	-5.469044	-2205.926
Q1 [var]	-677.4030	36.52599	713.9289
PF1 []	0.955738	-0.148079	-1.103817
F [Hz]	50.02233	50.30750	0.285168
U_fund_SYM+_rc [V]	395.7547	199.5328	-196.2220
I_fund_P_SYM+_rc [A]	3.183495	-0.016150	-3.199645

Recover time

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	A	B	间隔
时间 [s]	0:23.0598786	0:23.6216581	0.5617795
U1 [V]	115.0168	229.9695	114.9527
U2 [V]	114.9901	229.9886	114.9985
U3 [V]	114.9702	229.9664	114.9962
I1 [A]	0.317613	9.119620	8.802008
P1 [W]	-5.430316	2031.561	2036.991
Q1 [var]	36.12495	-520.7237	-556.8486
PF1 []	-0.148650	0.968686	1.117336
F [Hz]	50.00119	49.99946	-1.732e-3
U_fund_SYM+_rc [V]	199.1721	398.3279	199.1558
I_fund_P_SYM+_rc [A]	-0.015758	2.935842	2.951600



	A	B	间隔
时间 [s]	0:23.0598786	0:24.4086586	1.3487800
U1 [V]	115.0168	229.9773	114.9604
U2 [V]	114.9901	229.9889	114.9988
U3 [V]	114.9702	229.9635	114.9933
I1 [A]	0.317613	9.969646	9.652034
P1 [W]	-5.430316	2189.511	2194.942
Q1 [var]	36.12495	-680.3940	-716.5190
PF1 []	-0.148650	0.954954	1.103604
F [Hz]	50.00119	50.00022	-9.689e-4
U_fund_SYM+_rc [V]	199.1721	398.3289	199.1568
I_fund_P_SYM+_rc [A]	-0.015758	3.171954	3.187712

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Load tests 3.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	3.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1631
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,500
	10		Positive sequence			0,500
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,494
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,468
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,468
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,161
	16		Total	t_1-10 s to t_1	[p.u.]	-0,161
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9452
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,500
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,171
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,038
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,002
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,002
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	30	Response time active power	Positive sequence	-	[s]	0,657
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,311
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,311
	33	Response time reactive power	Positive sequence	–	[s]	1,907
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

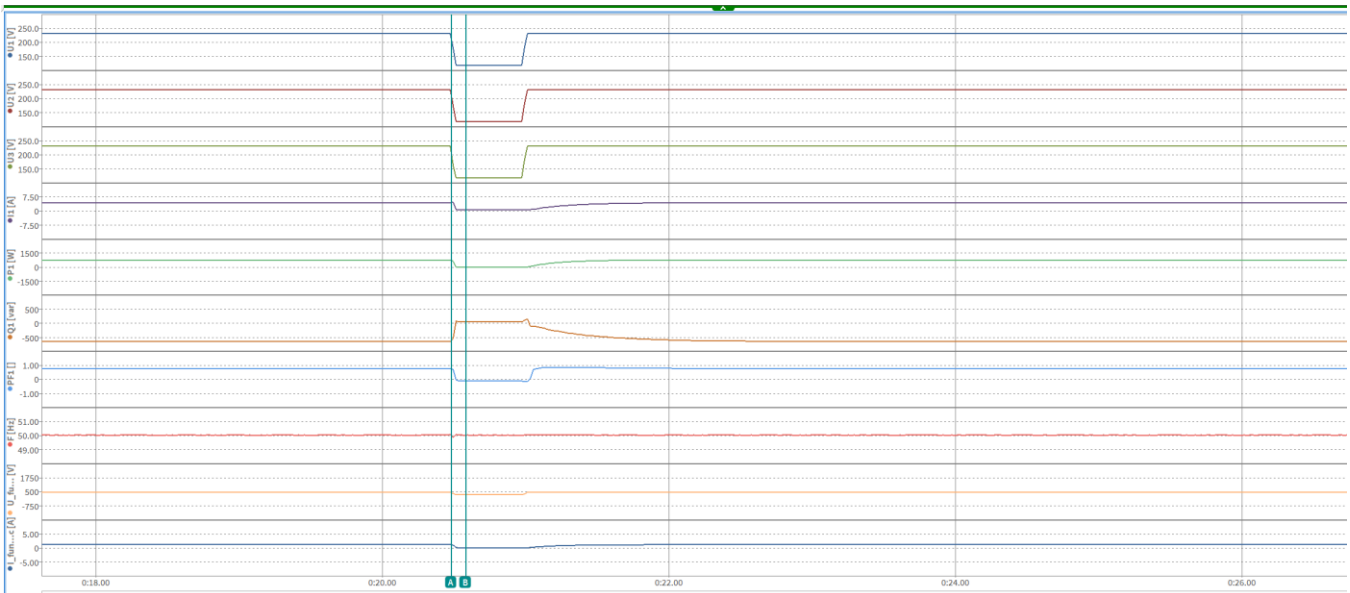
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0-60ms



时间 [s]	A 0:20.4804077	B 0:20.5405519	间隔 0.0601442
U1 [V]	230.1497	115.5181	-114.6316
U2 [V]	229.9243	115.0326	-114.8918
U3 [V]	229.8979	114.9930	-114.9049
I1 [A]	4.409548	0.319276	-4.090272
P1 [W]	744.8251	-5.095930	-749.9210
Q1 [var]	-689.3250	36.52847	725.8534
PF1 []	0.733922	-0.138168	-0.872089
F [Hz]	50.05572	50.00042	-0.055302
U_fund_SYM+_rc [V]	398.3539	199.4990	-198.8549
I_fund_P_SYM+_rc [A]	1.076753	-0.016650	-1.093404

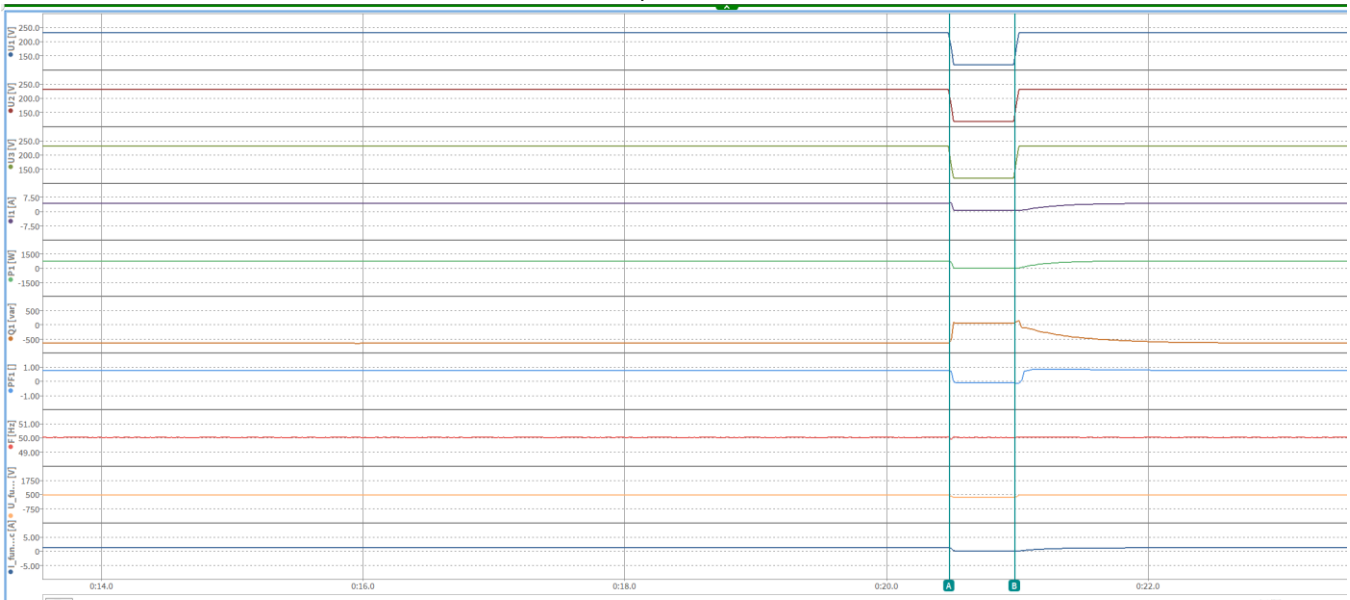
0-100ms



时间 [s]	A 0:20.4804077	B 0:20.5810086	间隔 0.1006009
U1 [V]	230.1497	115.3617	-114.7880
U2 [V]	229.9243	115.0195	-114.9049
U3 [V]	229.8979	114.9859	-114.9119
I1 [A]	4.409548	0.317688	-4.091861
P1 [W]	744.8251	-5.507841	-750.3329
Q1 [var]	-689.3250	36.23275	725.5577
PF1 []	0.733922	-0.150286	-0.884208
F [Hz]	50.05572	49.99987	-0.055851
U_fund_SYM+_rc [V]	398.3539	199.4039	-198.9501
I_fund_P_SYM+_rc [A]	1.076753	-0.015931	-1.092685

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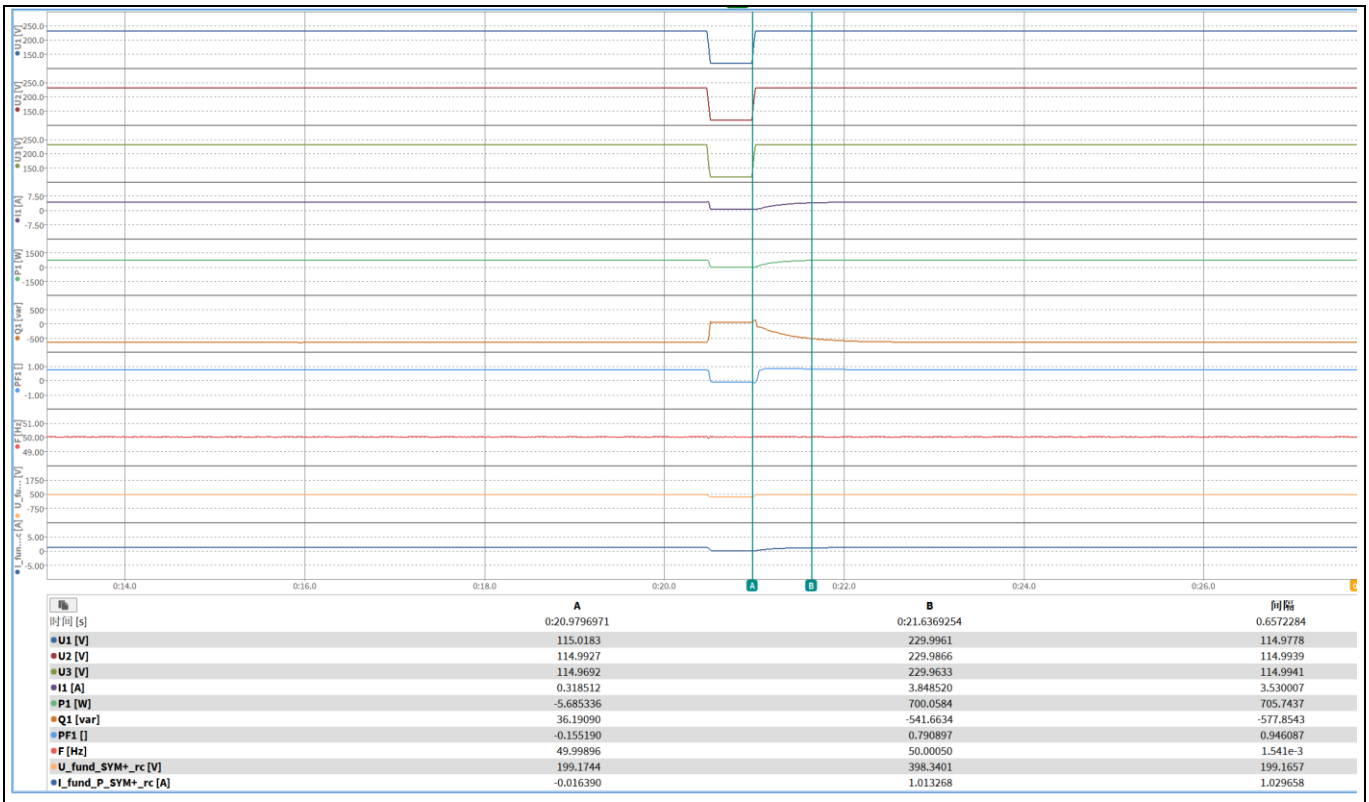
Drop duration



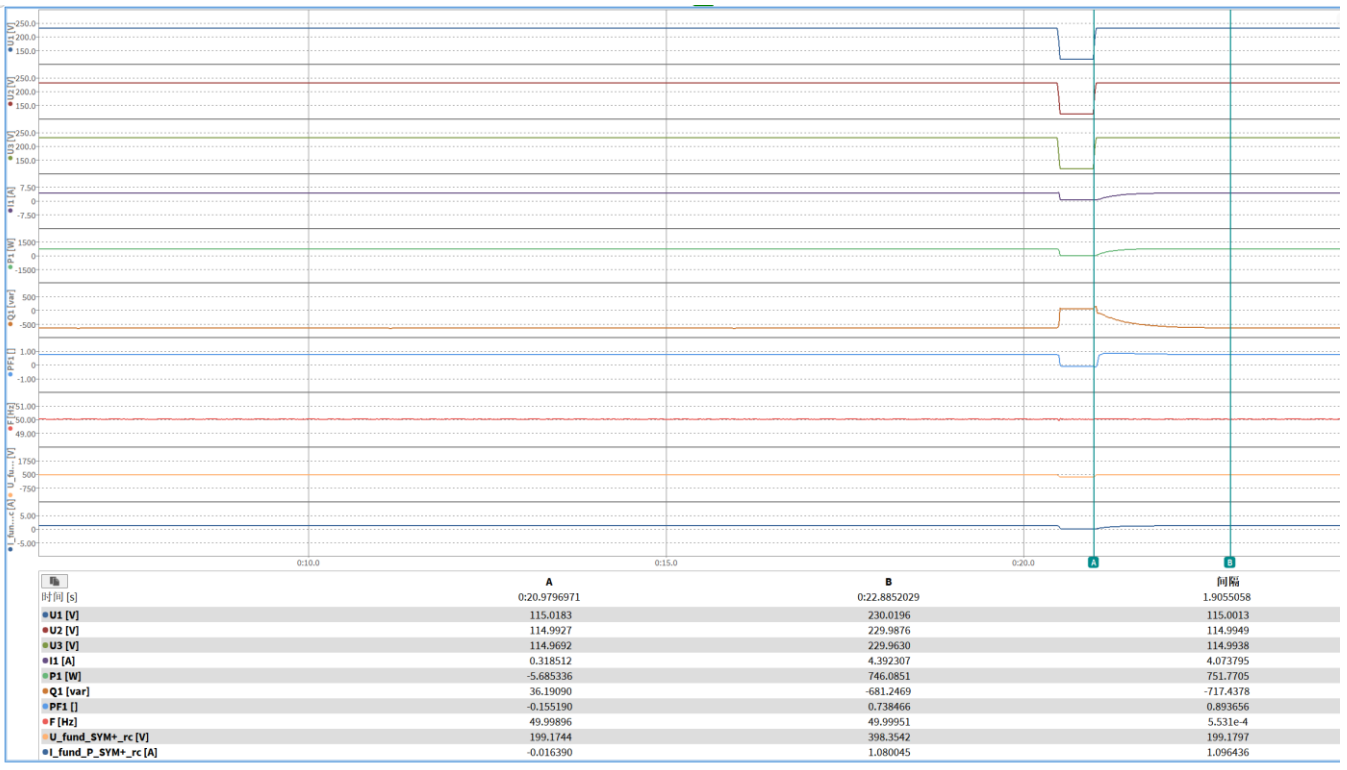
时间 [s]	A 0:20.4804077	B 0:20.9810034	间隔 0.5005957
U1 [V]	230.1497	115.0075	-115.1423
U2 [V]	229.9243	114.9942	-114.9302
U3 [V]	229.8979	114.9740	-114.9238
I1 [A]	4.409548	0.318421	-4.091127
P1 [W]	744.8251	-5.545946	-750.3710
Q1 [var]	-689.3250	36.19844	725.5234
PF1 []	0.733922	-0.151442	-0.885364
F [Hz]	50.05572	49.99138	-0.064342
U_fund_SYM+_rc [V]	398.3539	199.1715	-199.1825
I_fund_P_SYM+_rc [A]	1.076753	-0.015842	-1.092595

Recover time

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时间 [s]	A 0:20.9796971	B 0:21.6369254	间隔 0.6572284
U1 [V]	115.0183	229.9961	114.9778
U2 [V]	114.9927	229.9866	114.9939
U3 [V]	114.9692	229.9633	114.9941
I1 [A]	0.318512	3.848520	3.530007
P1 [W]	-5.685336	700.0584	705.7437
Q1 [var]	36.19090	-541.6634	-577.8543
PF1 []	-0.155190	0.790897	0.946087
F [Hz]	49.99896	50.00050	1.541e-3
U_fund_SYM+_rc [V]	199.1744	398.3401	199.1657
I_fund_P_SYM+_rc [A]	-0.016390	1.013268	1.029658



时间 [s]	A 0:20.9796971	B 0:22.8852029	间隔 1.9055058
U1 [V]	115.0183	230.0196	115.0013
U2 [V]	114.9927	229.9876	114.9949
U3 [V]	114.9692	229.9630	114.9938
I1 [A]	0.318512	4.392307	4.073795
P1 [W]	-5.685336	746.0851	751.7705
Q1 [var]	36.19090	-681.2469	-717.4378
PF1 []	-0.155190	0.738466	0.893656
F [Hz]	49.99896	49.99951	5.531e-4
U_fund_SYM+_rc [V]	199.1744	398.3542	199.1797
I_fund_P_SYM+_rc [A]	-0.016390	1.080045	1.096436

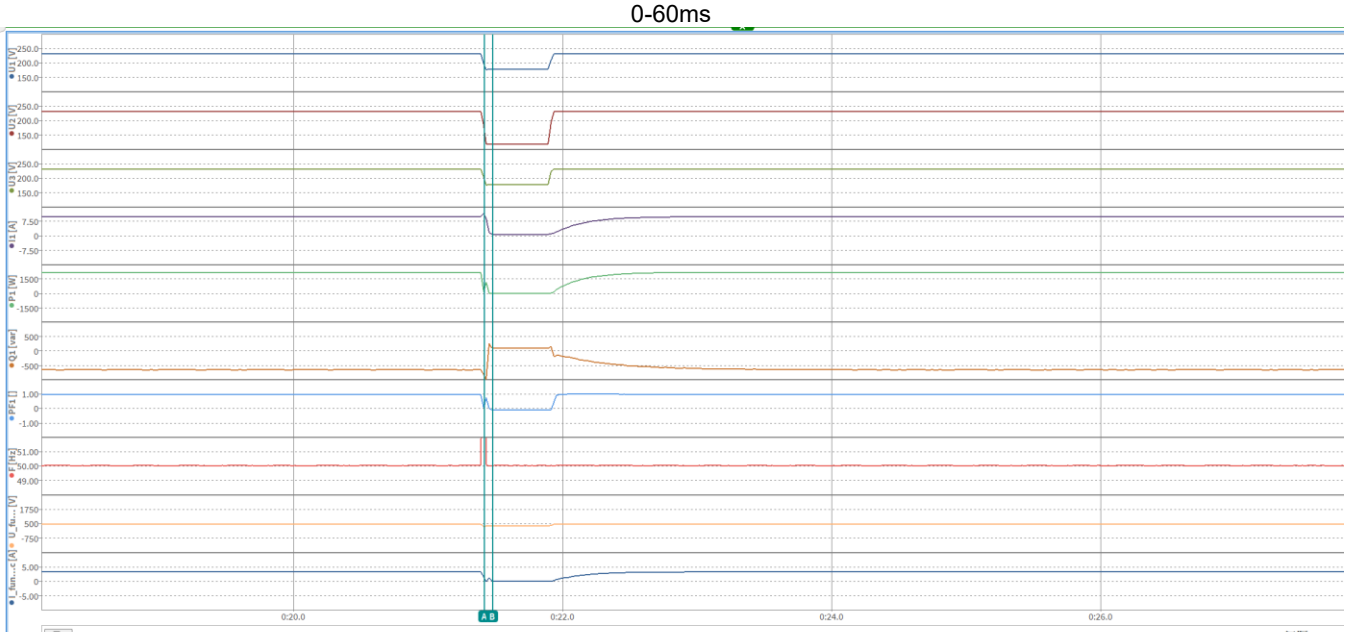
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Load tests 3.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	3.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0.50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1581
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,239
	10		Positive sequence			0,239
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,922
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,993
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,883
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,883
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,253
	16		Total	t_1-10 s to t_1	[p.u.]	-0,253
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9614
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,761
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,035
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,030
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,001
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,001
	30	Response time active power	Positive sequence	-	[s]	0,554
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,312
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,312
	33	Response time reactive power	Positive sequence	–	[s]	1,588
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

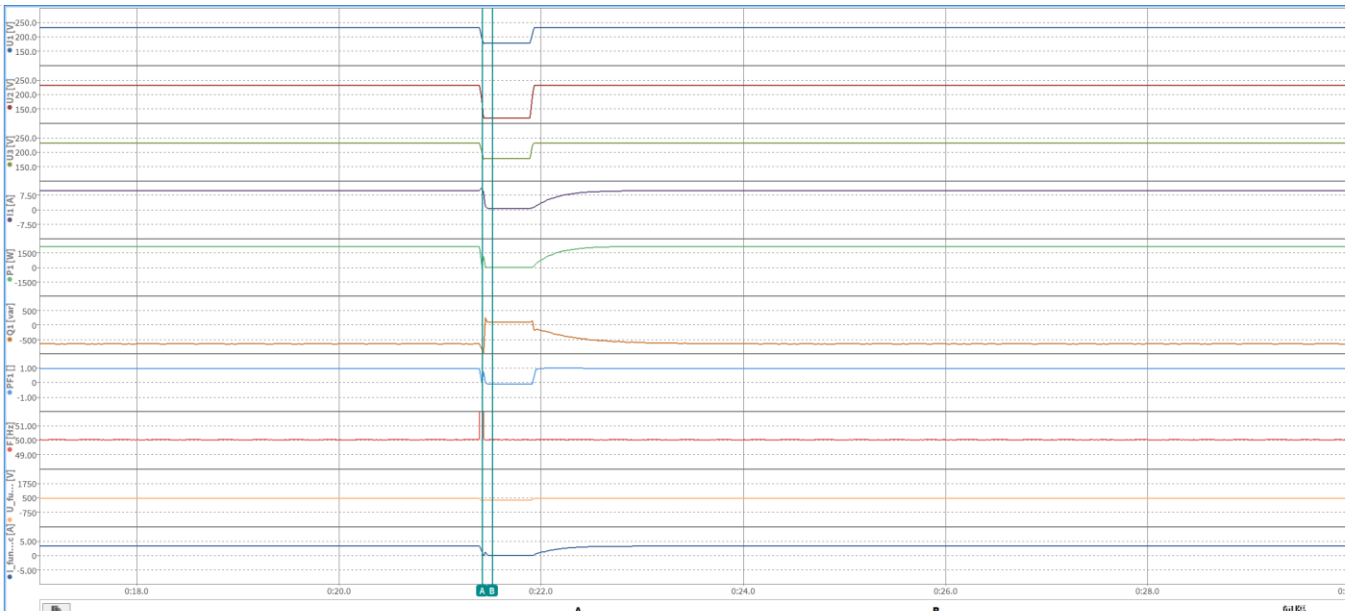
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0-60ms



时间 [s]	A 0:21.4191929	B 0:21.4800014	间隔 0.0608085
U1 [V]	230.0366	175.1694	-54.86722
U2 [V]	229.9609	114.9979	-114.9630
U3 [V]	229.9309	174.7623	-55.16864
I1 [A]	10.02676	0.479912	-9.546845
P1 [W]	2200.482	-12.91635	-2213.399
Q1 [var]	-691.3149	83.06770	774.3826
PF1 []	0.954027	-0.153646	-1.107672
F [Hz]	50.02197	49.99979	-0.022179
U_fund_SYM+_rc [V]	398.3293	264.7234	-133.6059
I_fund_P_SYM+_rc [A]	3.184465	-0.055368	-3.239833

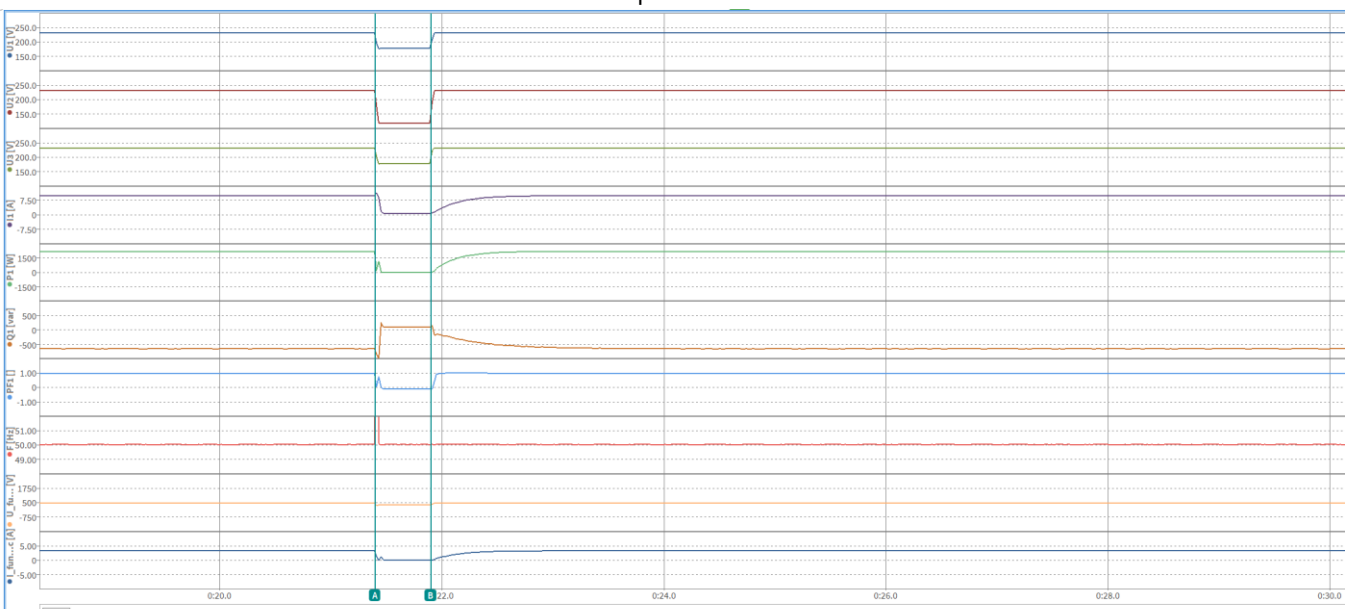
0-100ms



时间 [s]	A 0:21.4191929	B 0:21.5191956	间隔 0.1000027
U1 [V]	230.0366	175.1113	-54.92531
U2 [V]	229.9609	114.9969	-114.9641
U3 [V]	229.9309	174.7634	-55.16756
I1 [A]	10.02676	0.479899	-9.546858
P1 [W]	2200.482	-13.45562	-2213.938
Q1 [var]	-691.3149	82.95145	774.2663
PF1 []	0.954027	-0.160118	-1.114145
F [Hz]	50.02197	50.00028	-0.021690
U_fund_SYM+_rc [V]	398.3293	264.6952	-133.6341
I_fund_P_SYM+_rc [A]	3.184465	-0.055193	-3.239659

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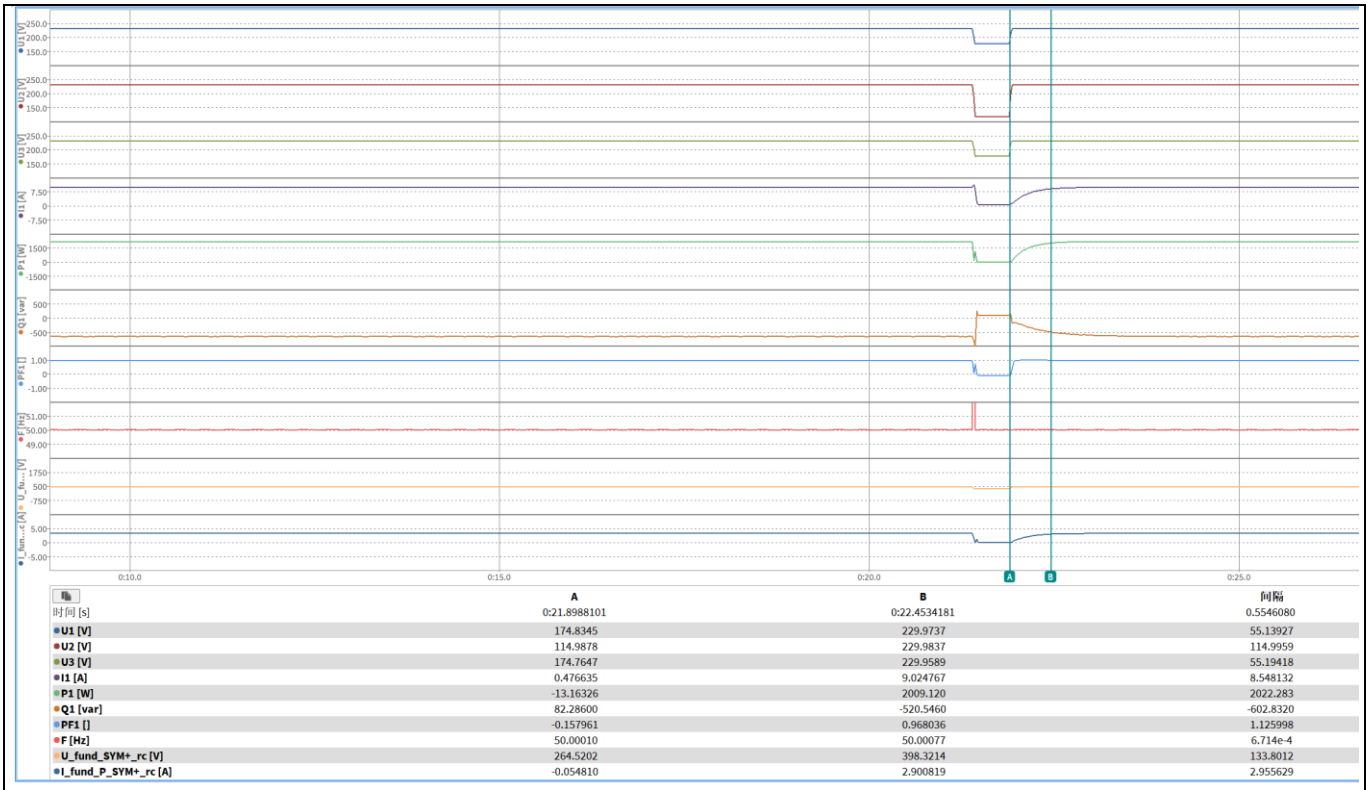
Drop duration



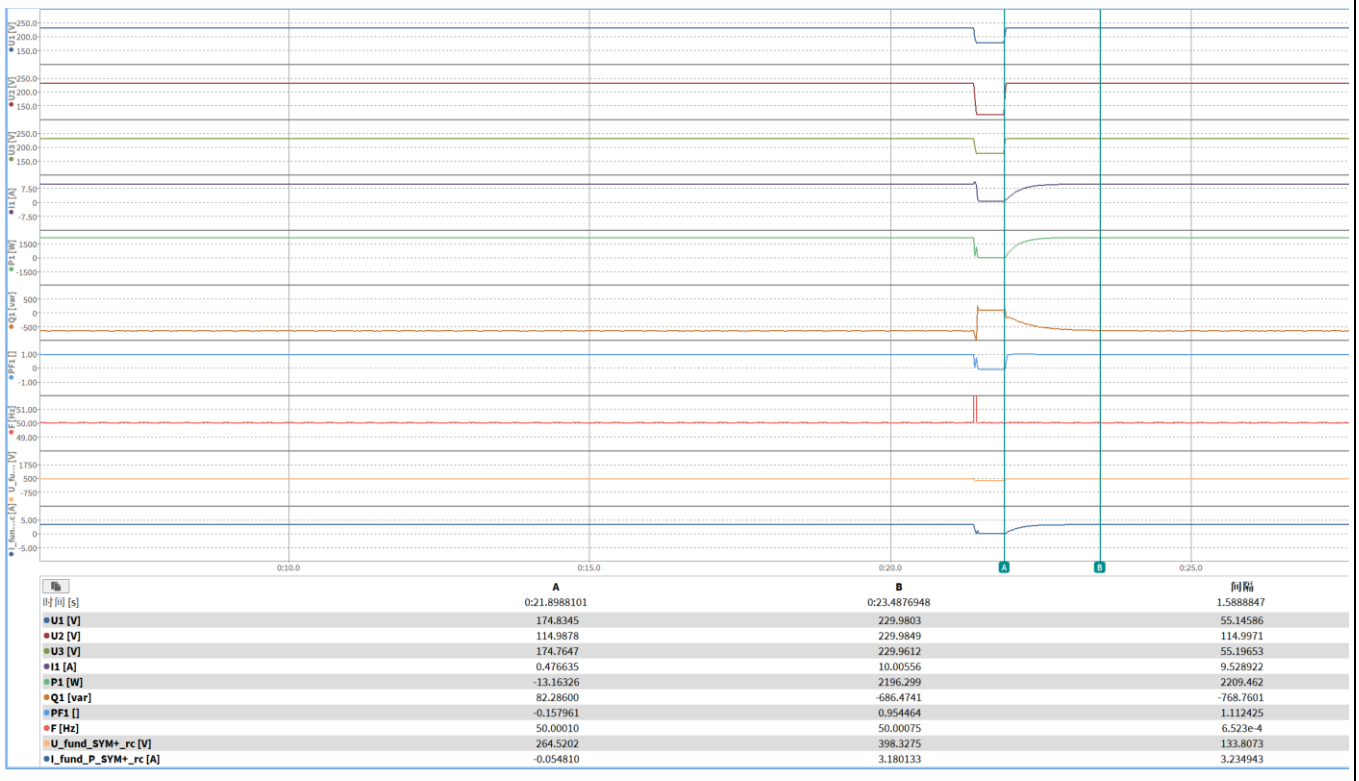
时间 [s]	A 0:21.3996828	B 0:21.9019465	间隔 0.5022637
U1 [V]	229.9884	174.7803	-55.20811
U2 [V]	229.9846	115.0150	-114.9697
U3 [V]	229.9609	174.7540	-55.20692
I1 [A]	10.02055	0.475554	-9.544991
P1 [W]	2198.743	-13.24829	-2211.991
Q1 [var]	-690.4749	82.05485	772.5297
PF1 []	0.954063	-0.159392	-1.113455
F [Hz]	50.00093	49.97109	-0.029842
U_fund_SYM+_rc [V]	398.3317	264.5198	-133.8119
I_fund_P_SYM+_rc [A]	3.183760	-0.054469	-3.238229

Recover time

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时间 [s]	A	B	间隔
	0:21.8988101	0:22.4534181	0.5546080
U1 [V]	174.8345	229.9737	55.13927
U2 [V]	114.9878	229.9837	114.9959
U3 [V]	174.7647	229.9589	55.19418
I1 [A]	0.476635	9.024767	8.548132
P1 [W]	-13.16326	2009.120	2022.283
Q1 [var]	82.28600	-520.5460	-602.8320
PF1 []	-0.157961	0.968036	1.125998
F [Hz]	50.00010	50.00077	6.714e-4
U_fund_SYM+_rc [V]	264.5202	398.3214	133.8012
I_fund_P_SYM+_rc [A]	-0.054810	2.900819	2.955629



时间 [s]	A	B	间隔
	0:21.8988101	0:23.4876948	1.5888847
U1 [V]	174.8345	229.9803	55.14586
U2 [V]	114.9878	229.9849	114.9971
U3 [V]	174.7647	229.9612	55.19653
I1 [A]	0.476635	10.00556	9.528922
P1 [W]	-13.16326	2196.299	2209.462
Q1 [var]	82.28600	-686.4741	-768.7601
PF1 []	-0.157961	0.954464	1.112425
F [Hz]	50.00010	50.00075	6.523e-4
U_fund_SYM+_rc [V]	264.5202	398.3275	133.8073
I_fund_P_SYM+_rc [A]	-0.054810	3.180133	3.234943

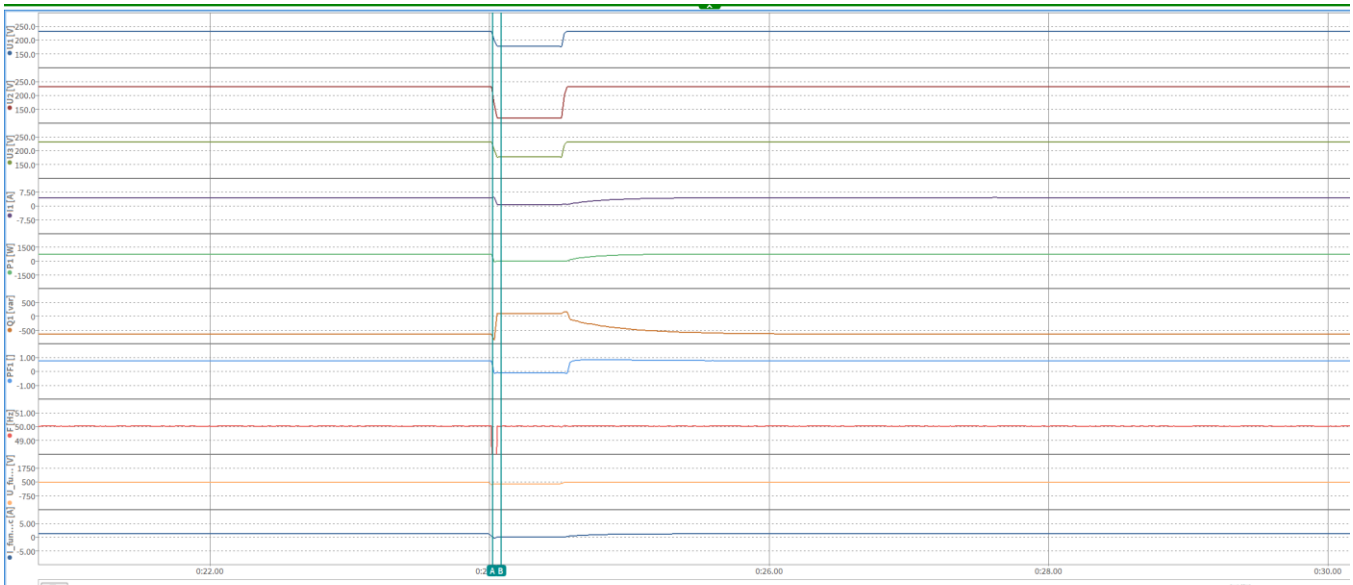
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Load tests 3.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	3.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0,50
	5	Drop duration setpoint	Total	–	[ms]	1500
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	1610
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,240
	10		Positive sequence			0,240
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,987
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,397
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,397
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,397
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,322
	16		Total	t_1-10 s to t_1	[p.u.]	0,322
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9452
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,760
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,183
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,028
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	30	Response time active power	Positive sequence	-	[s]	0,627
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,313
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,313
	33	Response time reactive power	Positive sequence	–	[s]	1,555
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

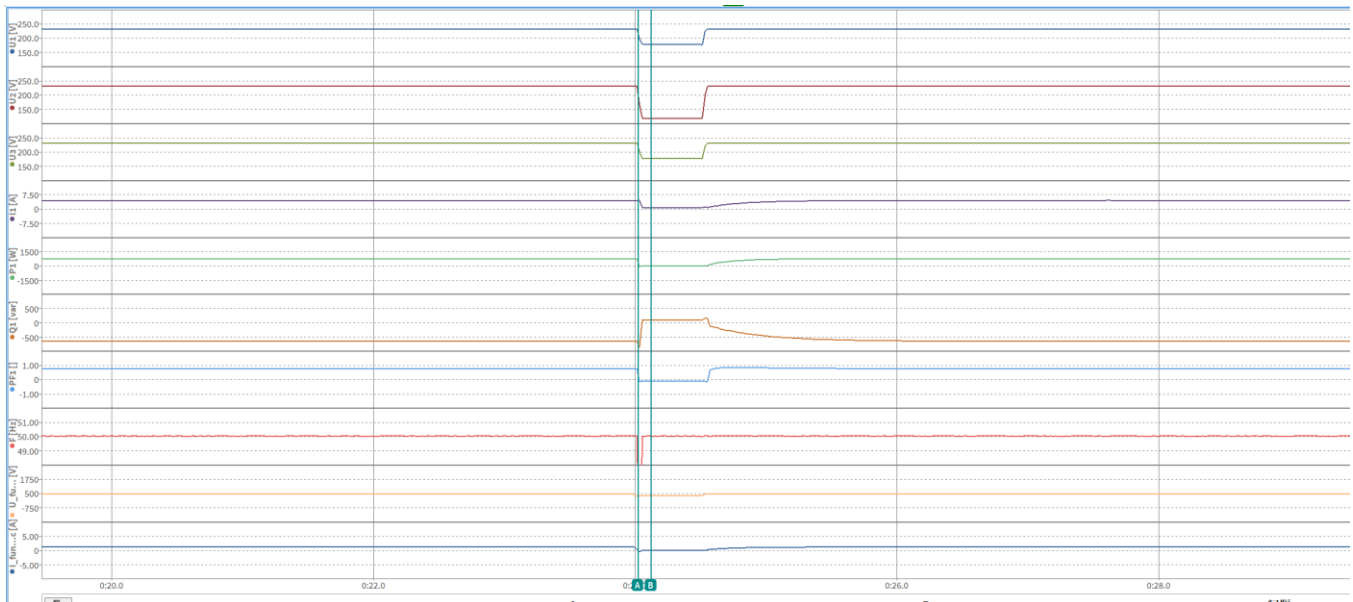
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0-60ms



时间 [s]	A 0:24.0223070	B 0:24.0824639	间隔 0.0601569
U1 [V]	230.1001	175.3007	-54.79945
U2 [V]	229.9508	115.0228	-114.9280
U3 [V]	229.9136	174.7421	-55.17149
I1 [A]	4.409402	0.477562	-3.931841
P1 [W]	745.7845	-12.55899	-758.3435
Q1 [var]	-687.9150	82.76950	770.6845
PF1 []	0.735050	-0.150017	-0.885067
F [Hz]	50.03581	49.99996	-0.035847
U_fund_SYM+_rc [V]	208.8175	264.7731	55.95563
I_fund_P_SYM+_rc [A]	0.334936	-0.054830	-0.389765

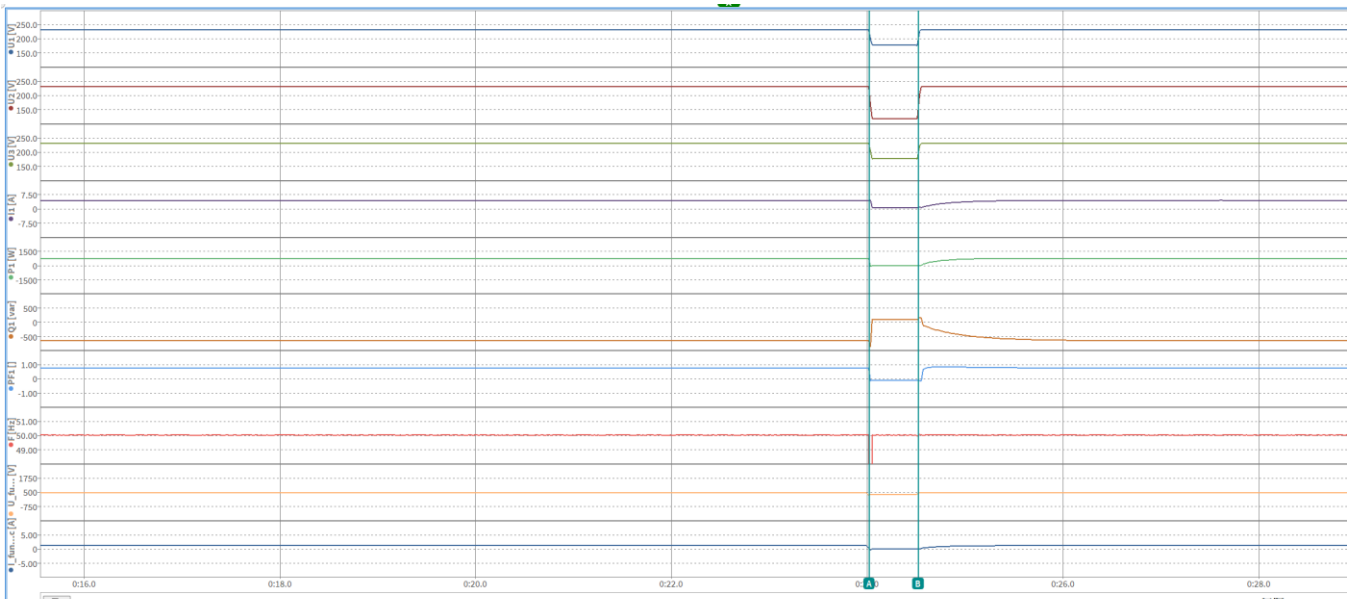
0-100ms



时间 [s]	A 0:24.0223070	B 0:24.1227364	间隔 0.1004294
U1 [V]	230.1001	175.1556	-54.94452
U2 [V]	229.9508	115.0161	-114.9347
U3 [V]	229.9136	174.7526	-55.16096
I1 [A]	4.409402	0.478259	-3.931143
P1 [W]	745.7845	-12.99732	-758.7819
Q1 [var]	-687.9150	82.75539	770.6704
PF1 []	0.735050	-0.155155	-0.890205
F [Hz]	50.03581	50.00093	-0.034878
U_fund_SYM+_rc [V]	208.8175	264.6936	55.87607
I_fund_P_SYM+_rc [A]	0.334936	-0.054816	-0.389752

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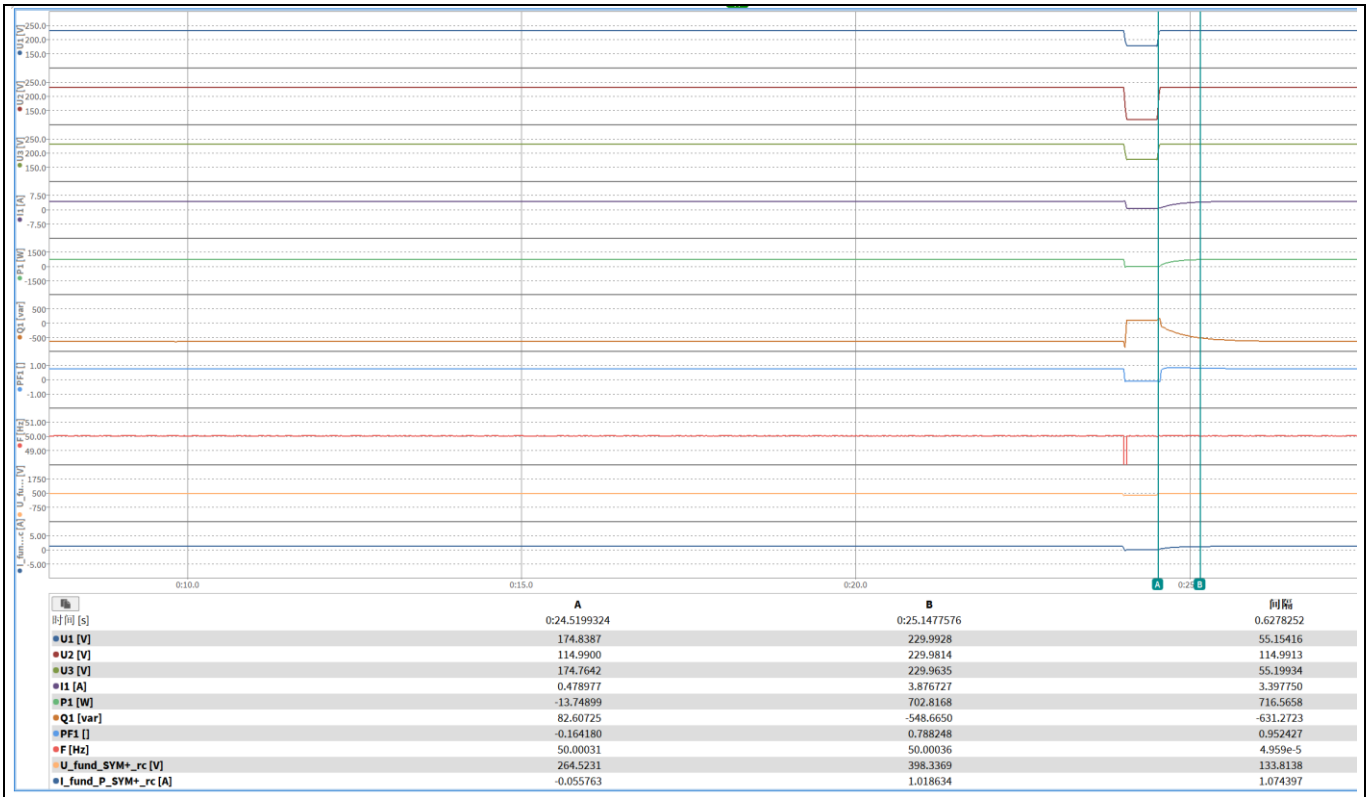
Drop duration



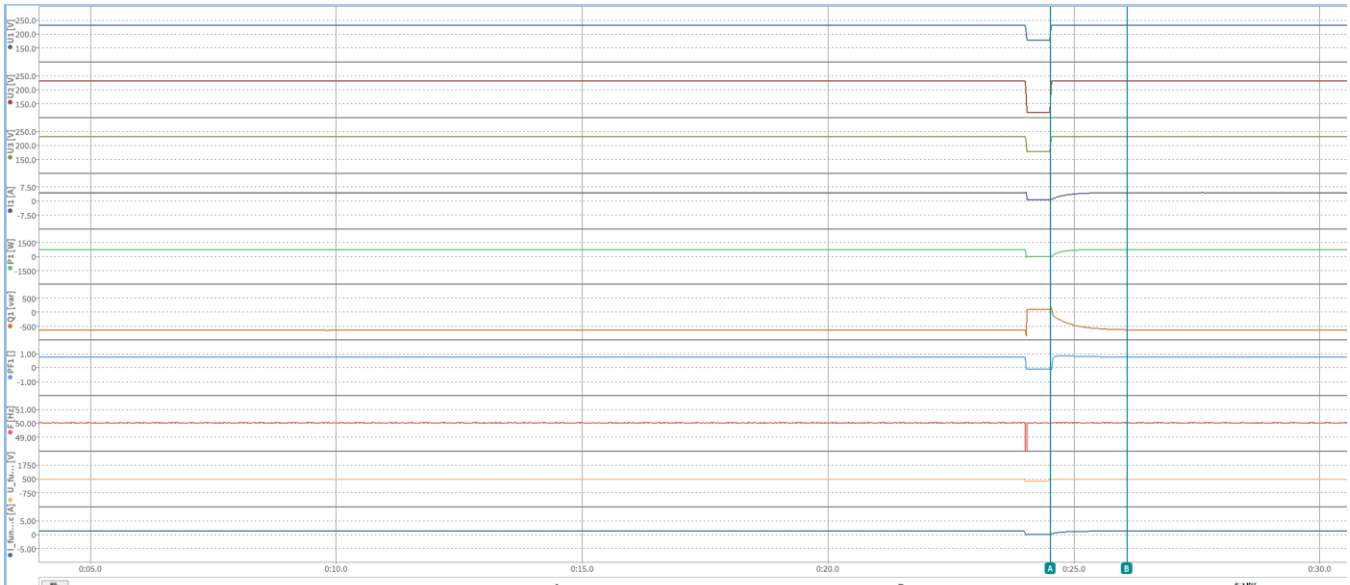
	A	B	间隔
时间 [s]	0:24.0223070	0:24.5230391	0.5007321
U1 [V]	230.1001	174.6933	-55.40683
U2 [V]	229.9508	115.0637	-114.8871
U3 [V]	229.9136	174.7285	-55.18512
I1 [A]	4.409402	0.477828	-3.931575
P1 [W]	745.7845	-13.73540	-759.5199
Q1 [var]	-687.9150	82.33549	770.2505
PF1 []	0.735050	-0.164548	-0.899598
F [Hz]	50.03581	49.91826	-0.117550
U_fund_SYM+_rc [V]	208.8175	305.8097	96.99223
I_fund_P_SYM+_rc [A]	0.334936	-0.057240	-0.392176

Recover time

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时间 [s]	A 0:24.5199324	B 0:25.1477576	间隔 0.6278252
U1 [V]	174.8387	229.9928	55.15416
U2 [V]	114.9900	229.9814	114.9913
U3 [V]	174.7642	229.9635	55.19934
I1 [A]	0.478977	3.876727	3.397750
P1 [W]	-13.74899	702.8168	716.5658
Q1 [var]	82.60725	-548.6650	-631.2723
PF1 []	-0.164180	0.788248	0.952427
F [Hz]	50.00031	50.00036	4.959e-5
U_fund_SYM+_rc [V]	264.5231	398.3369	133.8138
I_fund_P_SYM+_rc [A]	-0.055763	1.018634	1.074397



时间 [s]	A 0:24.5199324	B 0:26.0749351	间隔 1.5550027
U1 [V]	174.8387	230.0177	55.17902
U2 [V]	114.9900	229.9833	114.9933
U3 [V]	174.7642	229.9682	55.20406
I1 [A]	0.478977	4.369144	3.890167
P1 [W]	-13.74899	743.1917	756.9407
Q1 [var]	82.60725	-676.4995	-759.1067
PF1 []	-0.164180	0.739509	0.903688
F [Hz]	50.00031	50.00057	2.594e-4
U_fund_SYM+_rc [V]	264.5231	398.3532	133.8301
I_fund_P_SYM+_rc [A]	-0.055763	1.074809	1.130572

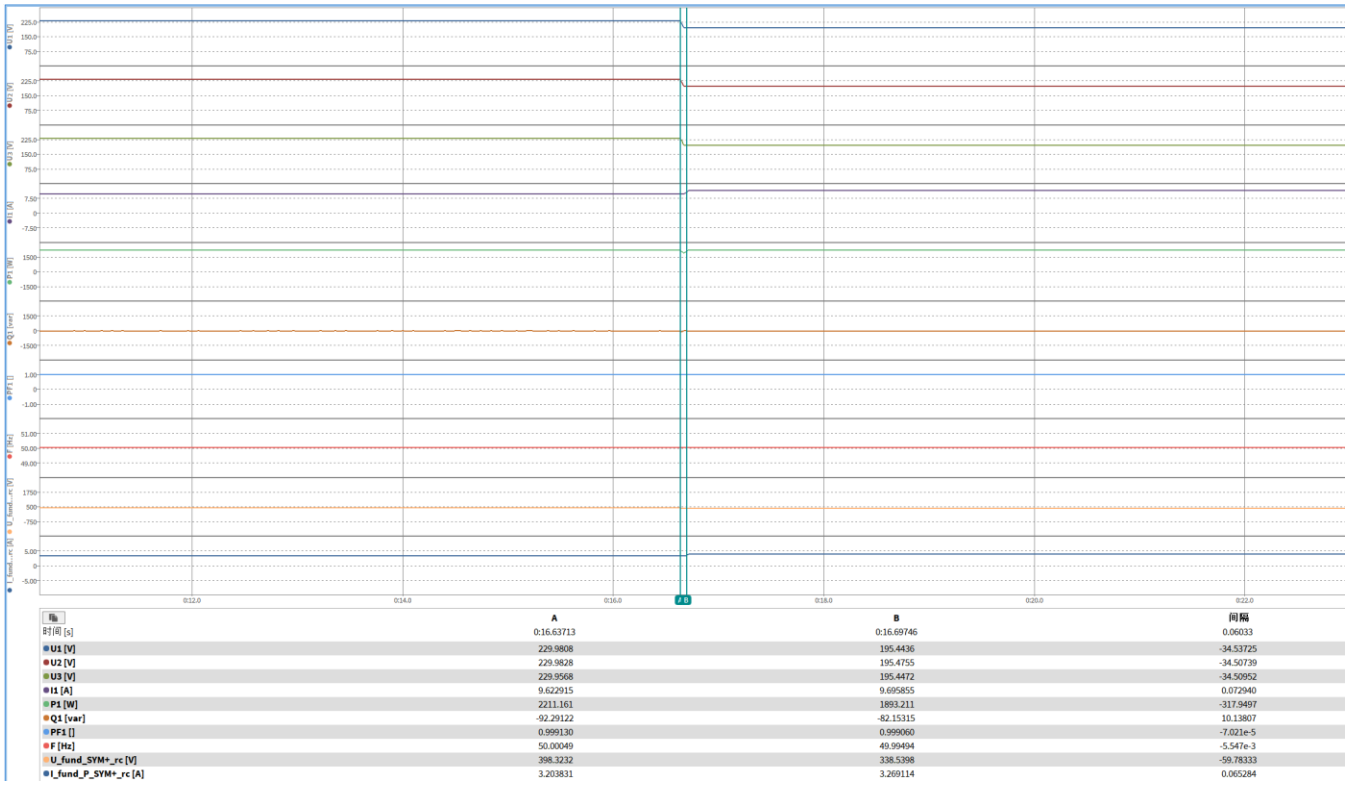
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Load tests 4.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	4.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,85
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	65205
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,249
	10		Positive sequence			0,249
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,000
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,000
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,030
	16		Total	t_1-10 s to t_1	[p.u.]	-0,030
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,851
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	1,107
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	1,186
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,998
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,998
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,002
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,002
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

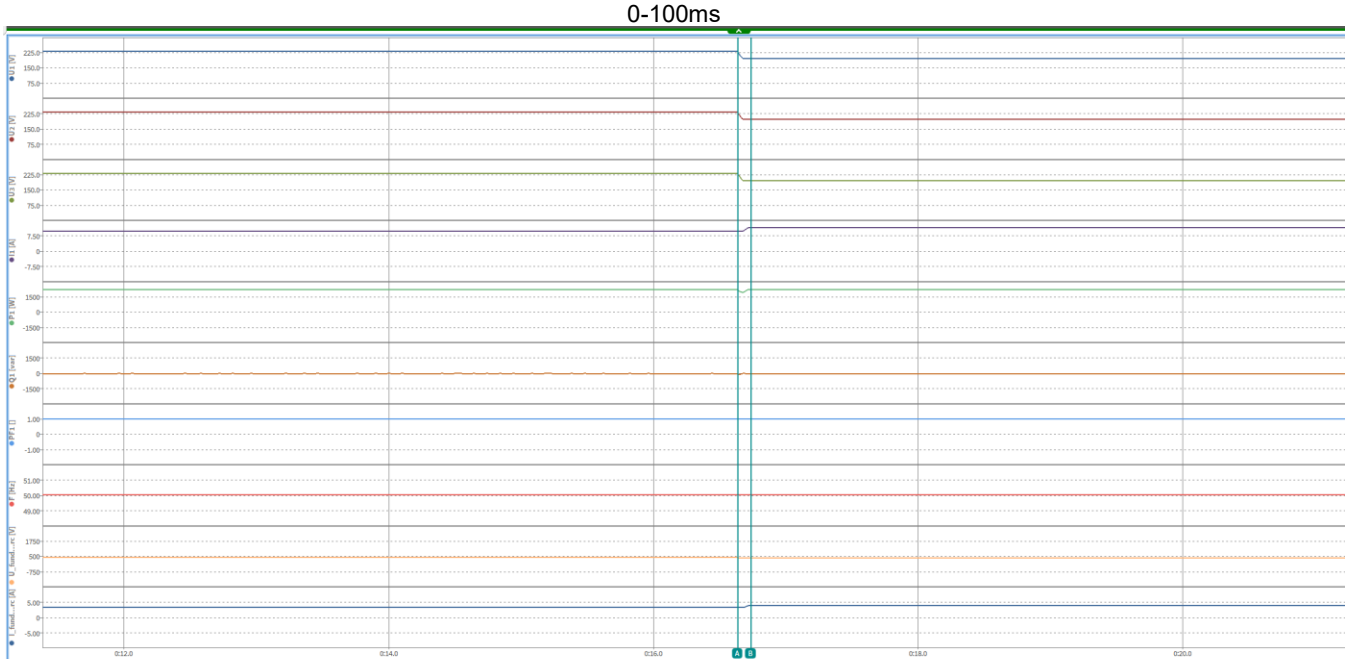
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0-60ms



时间 [s]	A	B	间隔
U1 [V]	0:16.63713	0:16.69746	0.06033
U2 [V]	229.9808	195.4436	-34.53725
U3 [V]	229.9828	195.4755	-34.50739
I1 [A]	229.9568	195.4472	-34.50952
P1 [W]	9.622915	9.695855	0.072940
Q1 [var]	2211.161	1893.211	-317.9497
PF1 []	-92.29122	-82.15315	10.13807
F [Hz]	0.999130	0.999060	-7.021e-5
U_fund_SYM+_rc [V]	50.00049	49.99494	-5.547e-3
I_fund_P_SYM+_rc [A]	398.3232	338.5398	-59.78333
	3.203831	3.269114	0.065284

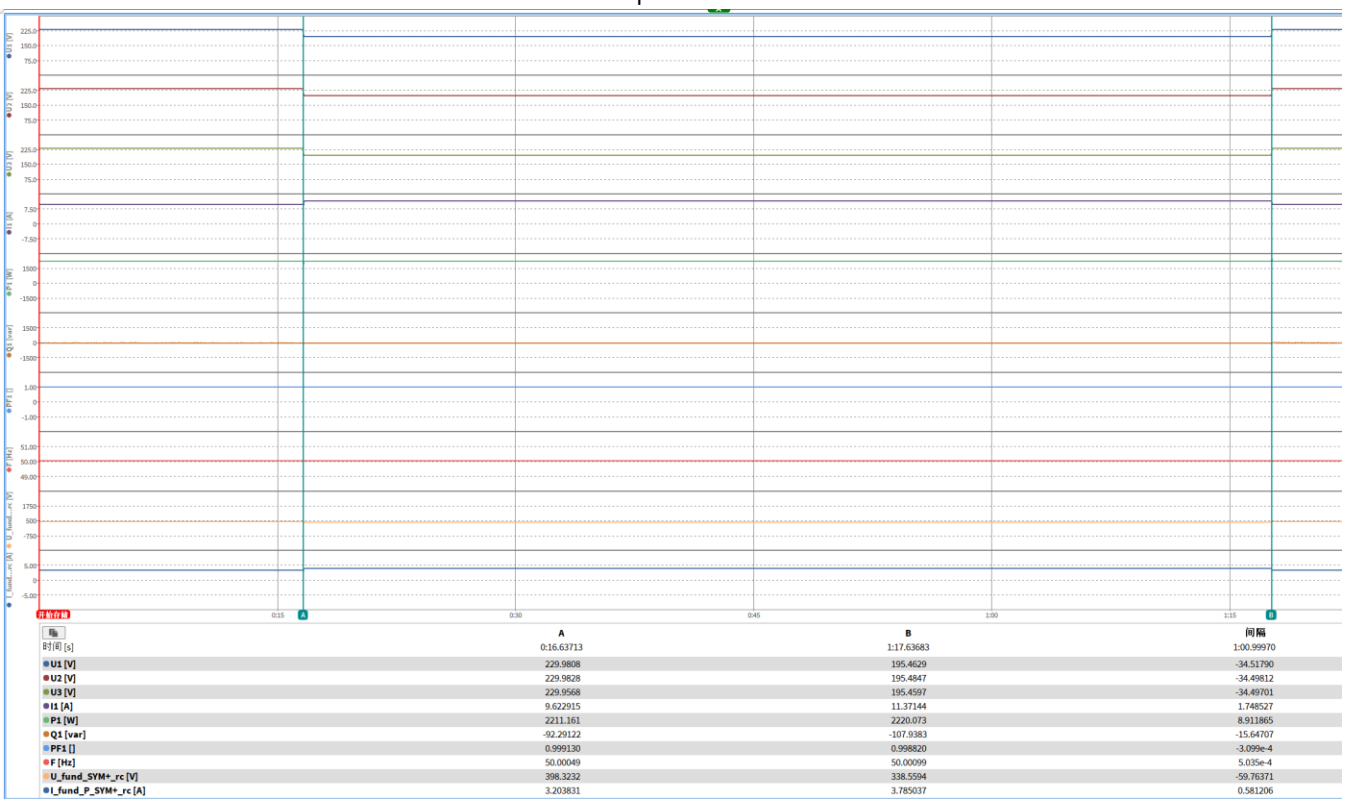
0-100ms



时间 [s]	A	B	间隔
U1 [V]	0:16.63713	0:16.73713	0.10000
U2 [V]	229.9808	195.4548	-34.52602
U3 [V]	229.9828	195.4892	-34.49361
I1 [A]	229.9568	195.4565	-34.50029
P1 [W]	9.622915	11.39059	1.767677
Q1 [var]	2211.161	2223.741	12.57983
PF1 []	-92.29122	-107.6747	-15.38351
F [Hz]	0.999130	0.998830	-3.003e-4
U_fund_SYM+_rc [V]	50.00049	50.00150	1.011e-3
I_fund_P_SYM+_rc [A]	398.3232	338.5574	-59.76579
	3.203831	3.760339	0.556508

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Drop duration



	A	B	间隔
时间 [s]	0:16.63713	1:17.63683	1:00.99970
U1 [V]	229.9808	195.4629	-34.51790
U2 [V]	229.9828	195.4847	-34.49812
U3 [V]	229.9568	195.4597	-34.49701
I1 [A]	9.622915	11.37144	1.748527
P1 [W]	2211.161	2220.073	8.911865
Q1 [var]	-92.29122	-107.9383	-15.64707
PF1 []	0.999130	0.998820	-3.099e-4
F [Hz]	50.00049	50.00099	5.035e-4
U_fund_SYM+_rc [V]	398.3232	338.5594	-59.76371
I_fund_P_SYM+_rc [A]	3.203831	3.785037	0.581206

Recover time

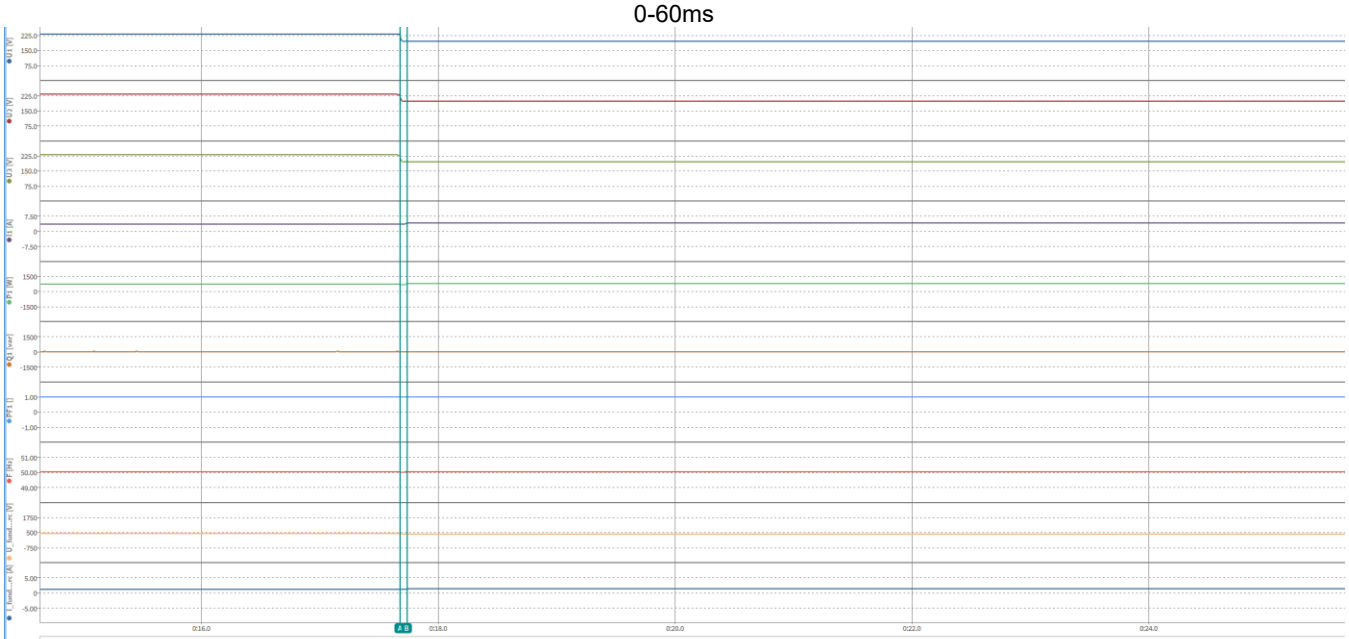
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Load tests 4.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	4.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	0,85
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	65097
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,259
	10		Positive sequence			0,259
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,391
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,390
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,390
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,025
	16		Total	t_1-10 s to t_1	[p.u.]	-0,025
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9987
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,841
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,431
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,483
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,398
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,398
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	-0,026
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	-0,026
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

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0-60ms



时间 [s]	A 0:17.67650	B 0:17.73652	间隔 0.06003
U1 [V]	230.0219	195.2507	-34.77122
U2 [V]	229.9815	195.4964	-34.48506
U3 [V]	229.9537	195.4552	-34.49847
I1 [A]	3.252616	3.281236	0.028620
P1 [W]	746.4989	639.3405	-107.1584
Q1 [var]	50.02137	-41.15131	-91.17268
PF1 []	0.997763	0.997935	1.725e-4
F [Hz]	50.00083	49.99886	-1.972e-3
U_fund_SYM+_rc [V]	398.3454	338.4393	-59.90609
I_fund_P_SYM+_rc [A]	1.081911	1.098091	0.016180

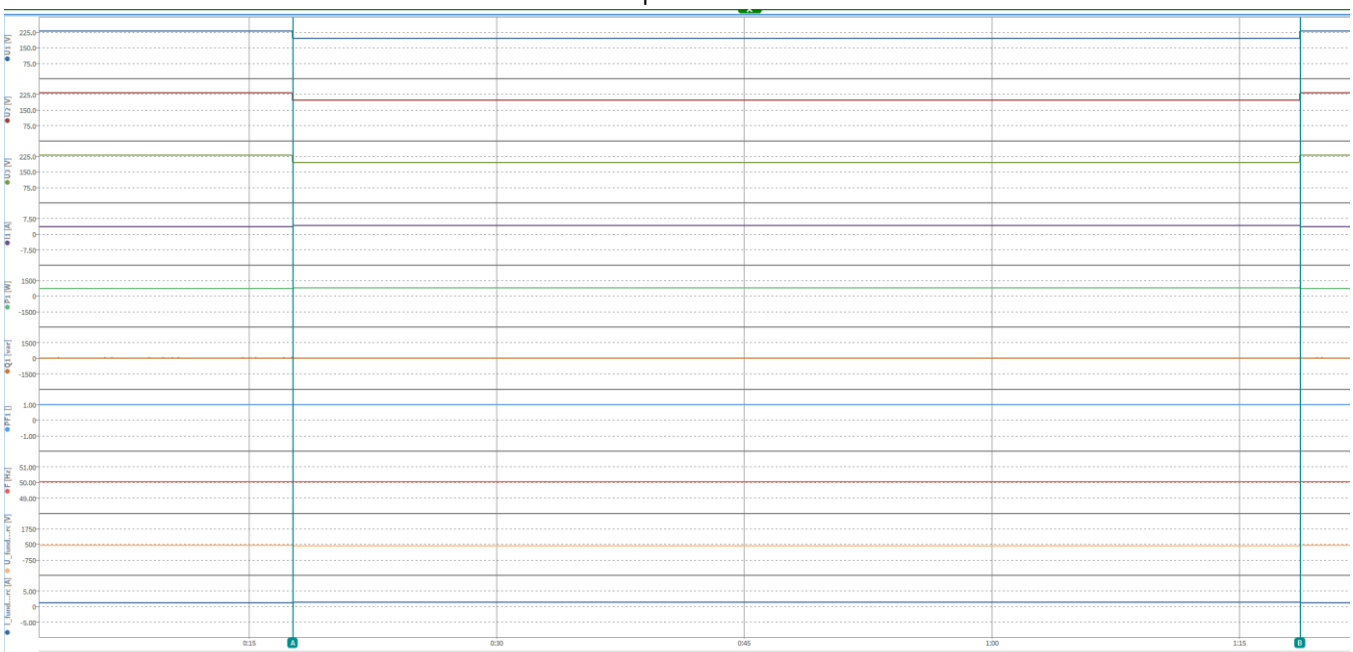
0-100ms



时间 [s]	A 0:17.67650	B 0:17.77701	间隔 0.10052
U1 [V]	230.0219	195.2792	-34.74272
U2 [V]	229.9815	195.4910	-34.49052
U3 [V]	229.9537	195.4540	-34.49969
I1 [A]	3.252616	3.873862	0.621246
P1 [W]	746.4989	753.9000	7.401062
Q1 [var]	50.02137	-62.47978	-112.5011
PF1 []	0.997763	0.996583	-1.179e-3
F [Hz]	50.00083	50.00031	-5.226e-4
U_fund_SYM+_rc [V]	398.3454	338.4541	-59.89135
I_fund_P_SYM+_rc [A]	1.081911	1.286985	0.205075

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Drop duration



	A	B	间隔
时间 [s]	0:17.67650	1:18.67865	1:01.00216
U1 [V]	230.0219	195.5124	-34.50949
U2 [V]	229.9815	195.4839	-34.49759
U3 [V]	229.9537	195.4578	-34.49583
I1 [A]	3.252616	3.869462	0.616846
P1 [W]	746.4989	754.2481	7.749207
Q1 [var]	50.02137	-58.68825	-108.7096
PF1 []	0.997763	0.996986	-7.761e-4
F [Hz]	50.00083	50.00096	1.297e-4
U_fund_SYM+_rc [V]	398.3454	338.5878	-59.75759
I_fund_P_SYM+_rc [A]	1.081911	1.285548	0.203637

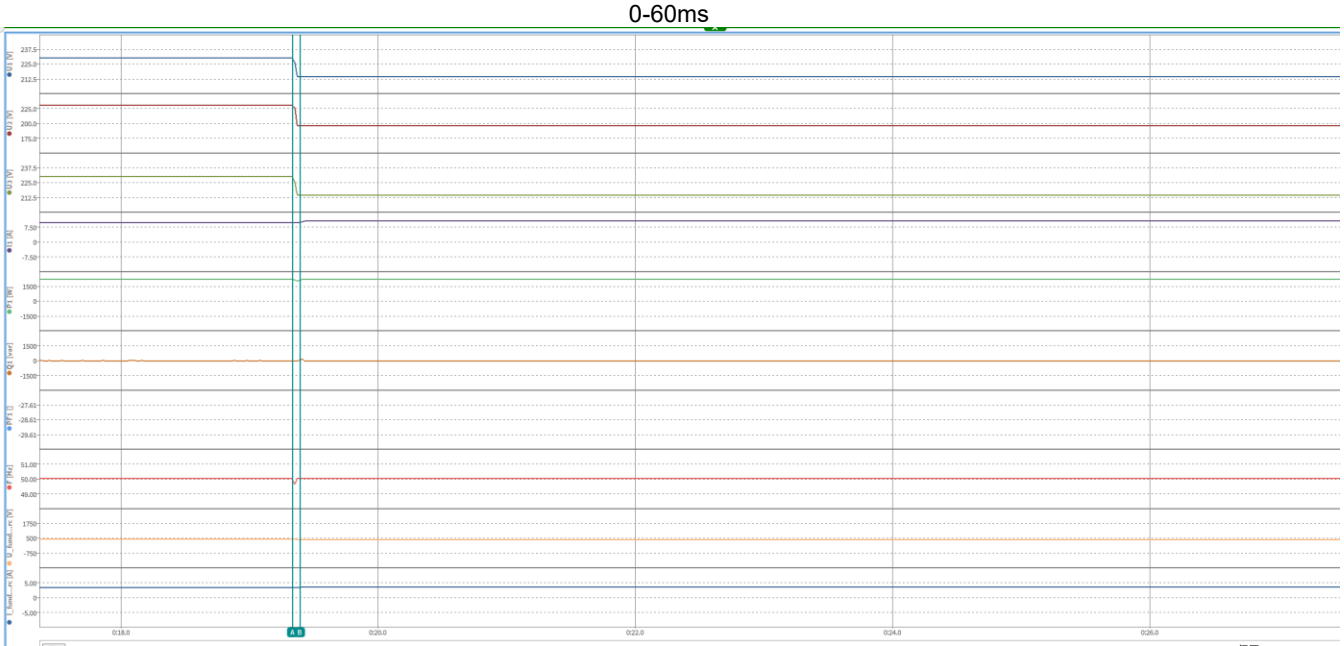
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Load tests 4.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	4.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0,85
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	65231
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,070
	10		Positive sequence			0,070
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,002
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,033
	16		Total	t_1-10 s to t_1	[p.u.]	0,033
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,930
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	1,011
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	1,011
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	1,001
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	1,001
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,001
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,001
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,033
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,033
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

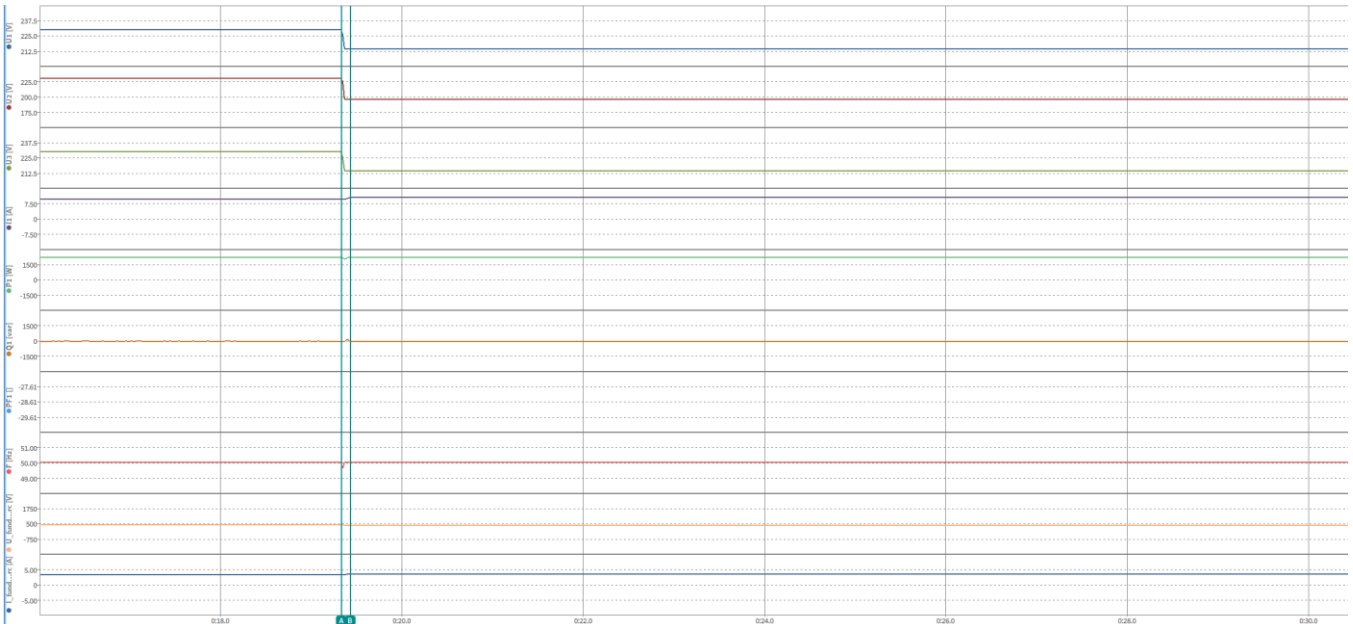
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0-60ms



	A	B	间隔
时间 [s]	0:19.33633	0:19.39636	0.06003
U1 [V]	229.9829	213.8586	-16.12434
U2 [V]	229.9837	195.4181	-34.56561
U3 [V]	229.9596	213.8383	-16.12132
I1 [A]	9.616255	9.679554	0.063299
P1 [W]	2209.648	2067.051	-142.5972
Q1 [var]	-92.29513	-111.5020	-19.20688
PF1 []	0.999129	0.998548	-5.805e-4
F [Hz]	49.99987	50.02088	0.021011
U_fund_SYM+_rc [V]	398.3274	359.5315	-38.79590
I_fund_P_SYM+_rc [A]	3.202547	3.222084	0.019537

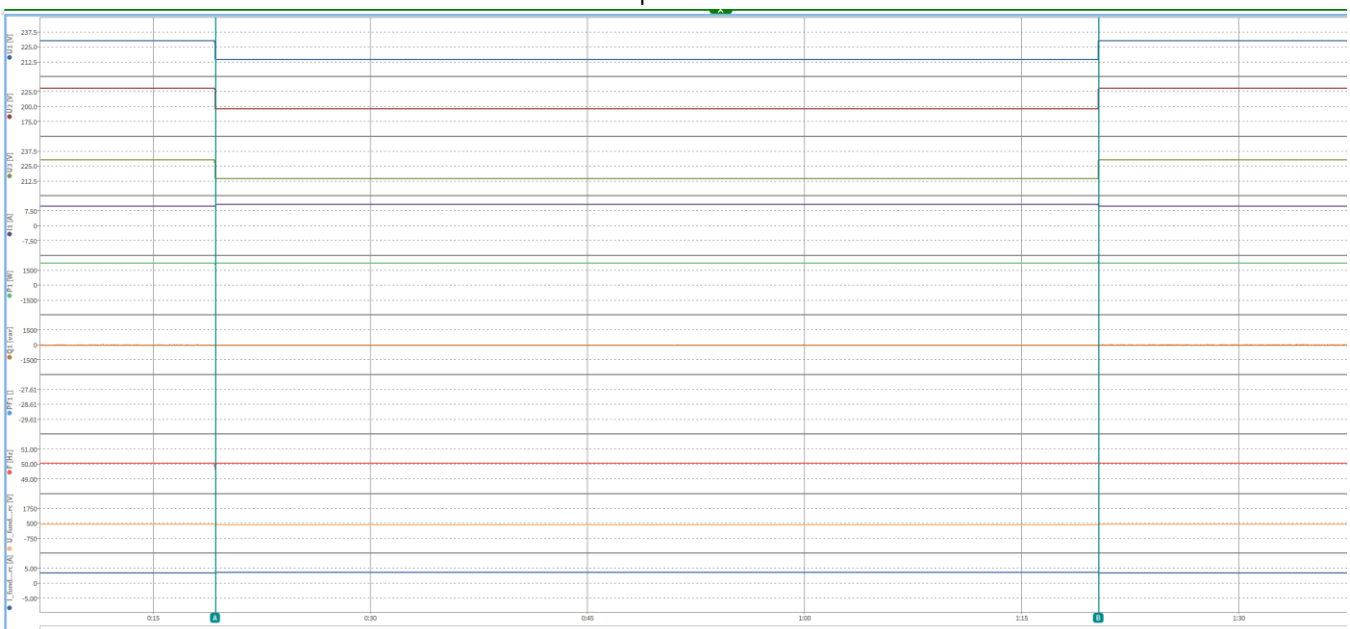
0-100ms



	A	B	间隔
时间 [s]	0:19.33633	0:19.43668	0.10035
U1 [V]	229.9829	213.8489	-16.13405
U2 [V]	229.9837	195.4782	-34.50554
U3 [V]	229.9596	213.8607	-16.09883
I1 [A]	9.616255	10.30625	0.689994
P1 [W]	2209.648	2202.061	-7.587158
Q1 [var]	-92.29513	91.95514	184.2503
PF1 []	0.999129	0.999129	4.172e-7
F [Hz]	49.99987	50.00364	3.769e-3
U_fund_SYM+_rc [V]	398.3274	359.5479	-38.77955
I_fund_P_SYM+_rc [A]	3.202547	3.457813	0.255266

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Drop duration



时间 [s]	A	B	间隔
U1 [V]	229.9829	213.8781	-16.10484
U2 [V]	229.9837	195.4856	-34.49815
U3 [V]	229.9596	213.8583	-16.10127
I1 [A]	9.616255	10.36849	0.752236
P1 [W]	2209.648	2215.493	5.845703
Q1 [var]	-92.29513	-96.47565	-4.180527
PF1 []	0.999129	0.999053	-7.558e-5
F [Hz]	49.99987	50.00077	9.003e-4
U_fund_SYM+_rc [V]	398.3274	359.5727	-38.75466
I_fund_P_SYM+_rc [A]	3.202547	3.452791	0.250244

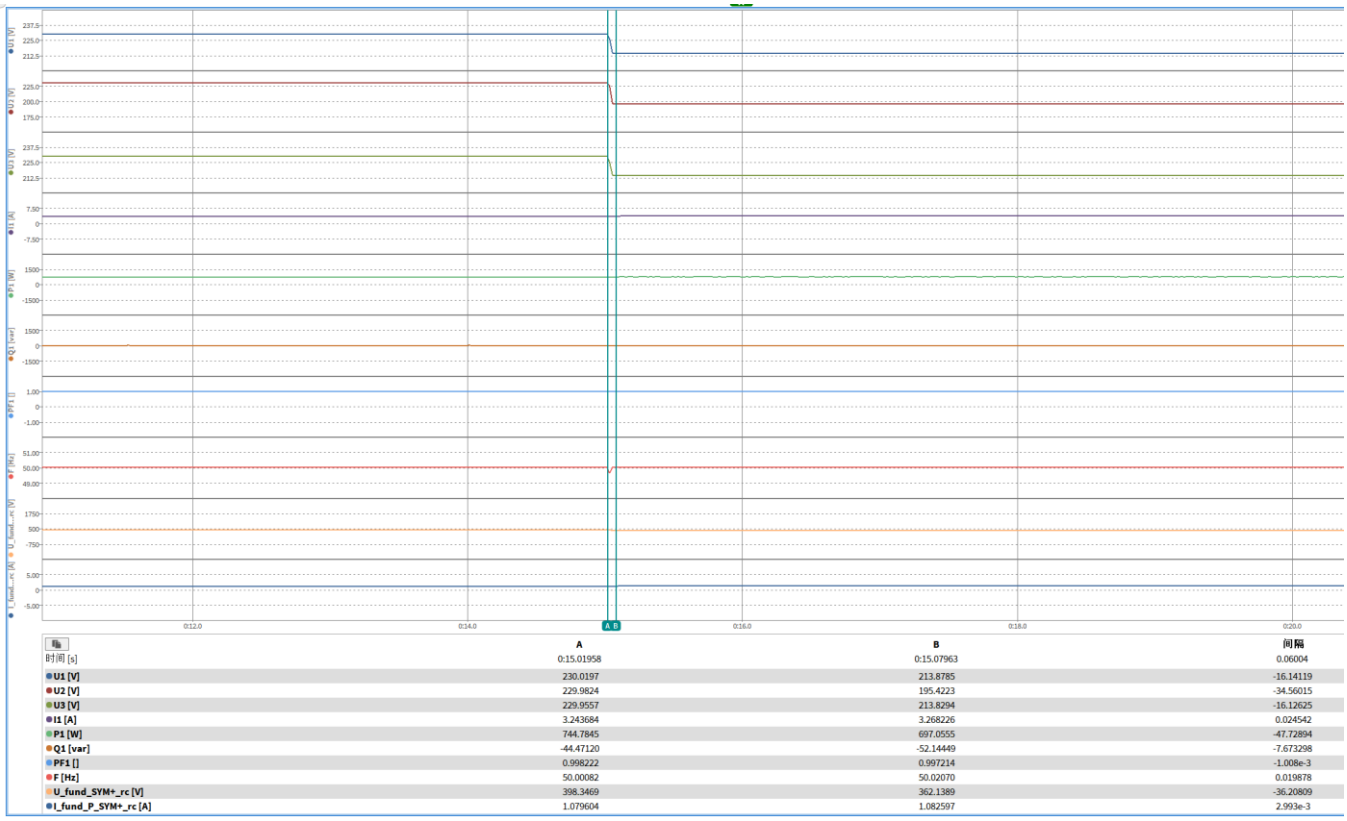
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Load tests 4.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	4.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	0,85
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	64877
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,070
	10		Positive sequence			0,070
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,399
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,398
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,398
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,029
	16		Total	t_1-10 s to t_1	[p.u.]	-0,029
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9983
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	0,930
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,530
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,535
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,497
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,497
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	-0,028
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	-0,028
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

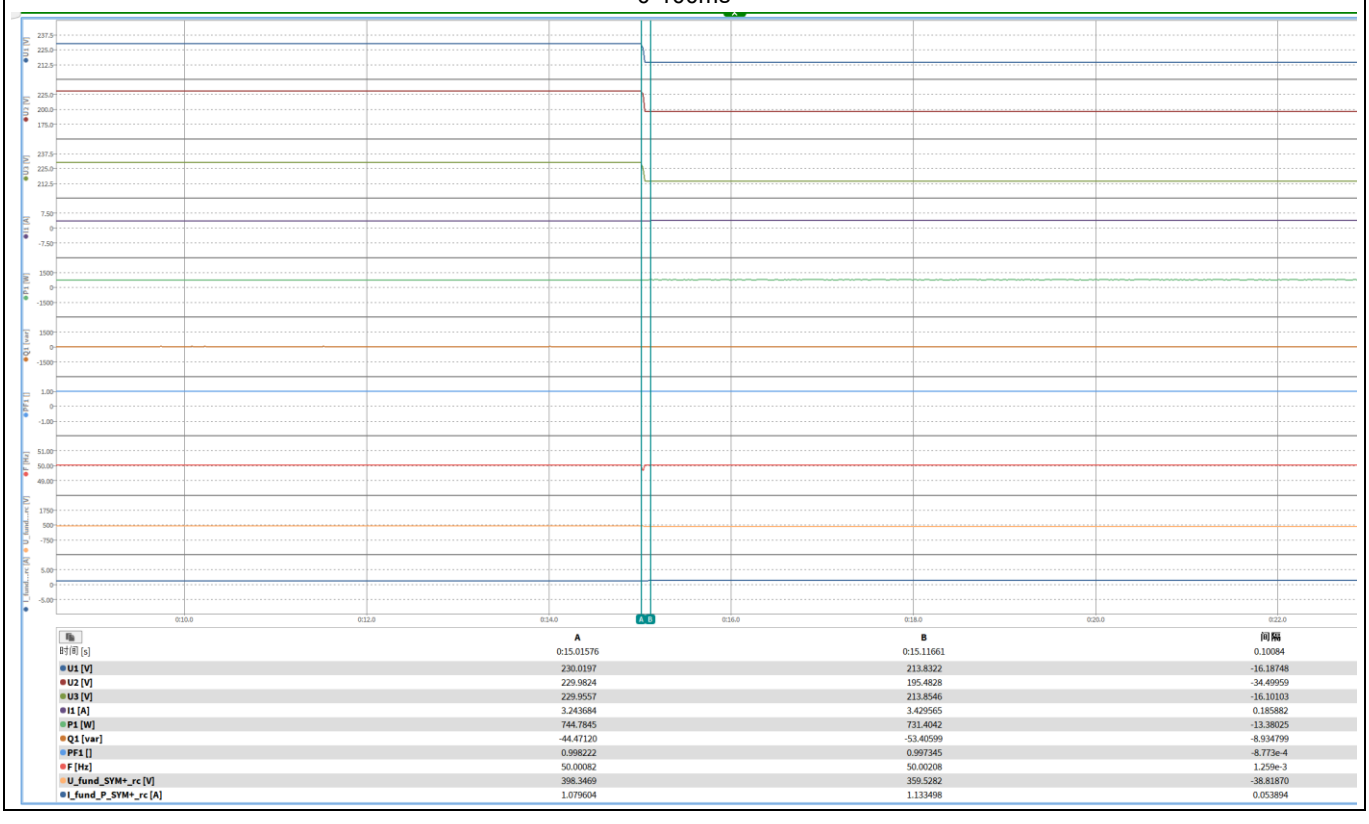
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0-60ms



时间 [s]	A 0:15.01958	B 0:15.07963	间隔 0.06004
U1 [V]	230.0197	213.8785	-16.14119
U2 [V]	229.9824	195.4223	-34.56015
U3 [V]	229.9557	213.8294	-16.12625
I1 [A]	3.243684	3.268226	0.024542
P1 [W]	744.7845	697.0555	-47.72894
Q1 [var]	-44.47120	-52.14449	-7.673298
PF1 []	0.998222	0.997214	-1.008e-3
F [Hz]	50.00082	50.02070	0.019878
U_fund_SYM+_rc [V]	398.3469	362.1389	-36.20809
I_fund_P_SYM+_rc [A]	1.079604	1.082597	2.993e-3

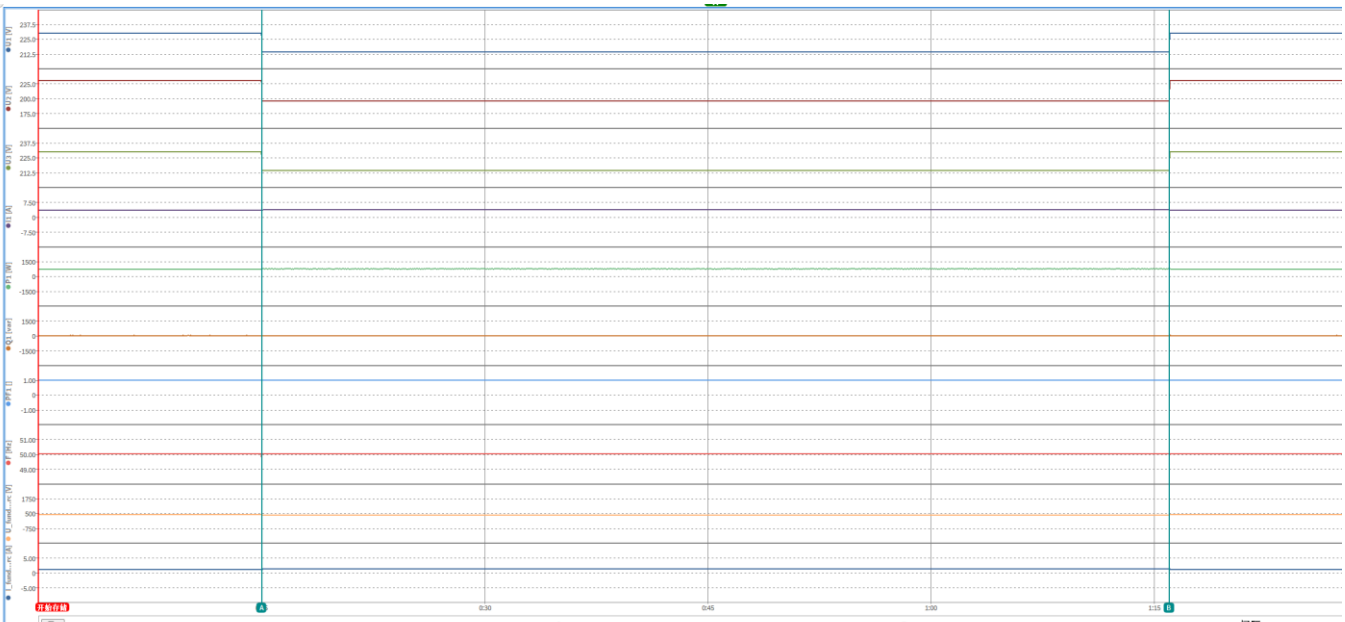
0-100ms



时间 [s]	A 0:15.01576	B 0:15.11661	间隔 0.10084
U1 [V]	230.0197	213.8322	-16.18748
U2 [V]	229.9824	195.4828	-34.49959
U3 [V]	229.9557	213.8546	-16.10103
I1 [A]	3.243684	3.429565	0.185882
P1 [W]	744.7845	731.4042	-13.38025
Q1 [var]	-44.47120	-53.40599	-8.934799
PF1 []	0.998222	0.997345	-8.773e-4
F [Hz]	50.00082	50.00208	1.259e-3
U_fund_SYM+_rc [V]	398.3469	359.5282	-38.81870
I_fund_P_SYM+_rc [A]	1.079604	1.133498	0.053894

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Drop duration



时间 [s]	A 0:15.01576	B 1:16.01969	间隔 1:01.00393
U1 [V]	230.0197	213.9135	-16.10612
U2 [V]	229.9824	195.4851	-34.49734
U3 [V]	229.9557	213.8563	-16.09938
I1 [A]	3.243684	3.516164	0.272481
P1 [W]	744.7845	750.2454	5.460876
Q1 [var]	-44.47120	-53.56599	-9.094795
PF1 []	0.998222	0.997461	-7.613e-4
F [Hz]	50.00082	49.99968	-1.141e-3
U_fund_SYM+_rc [V]	398.3469	359.5793	-38.76768
I_fund_P_SYM+_rc [A]	1.079604	1.170021	0.090416

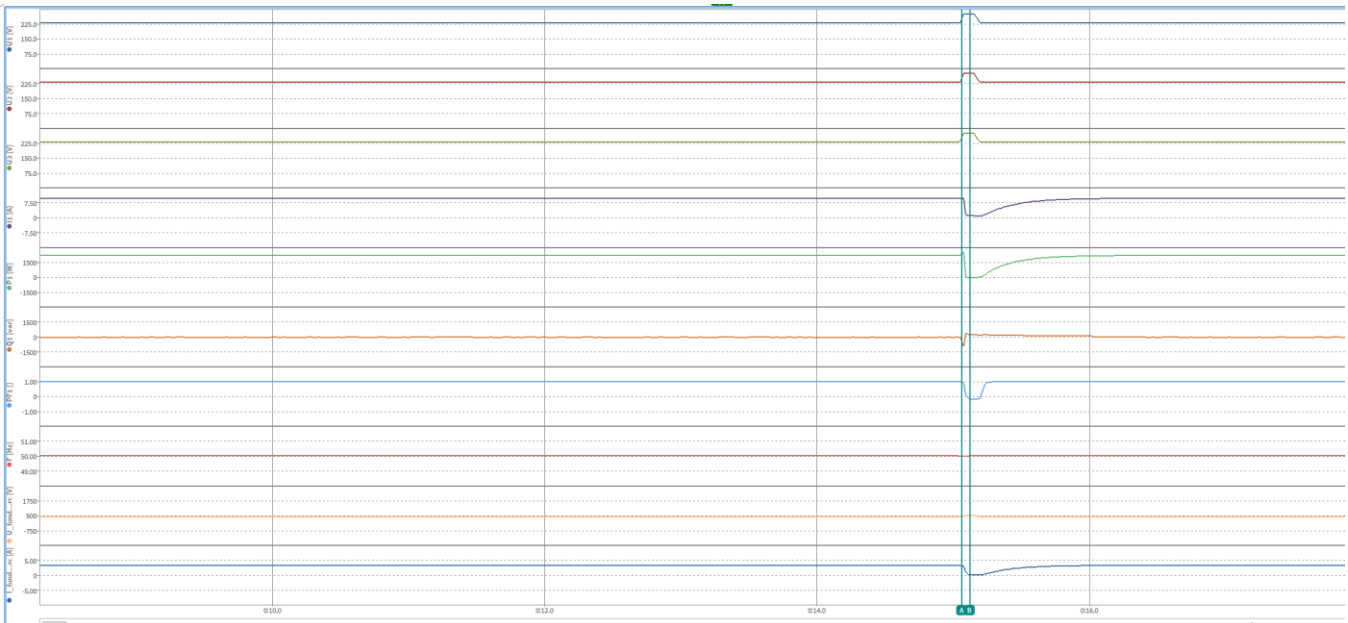
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Load tests 5.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	5.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,25
	5	Drop duration setpoint	Total	–	[ms]	100
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	100
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,249
	10		Positive sequence			0,249
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,001
	16		Total	t_1-10 s to t_1	[p.u.]	-0,001
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9994
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,249
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,047
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,049
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,001
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,001
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	1,001
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	30	Response time active power	Positive sequence	-	[s]	0,557
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,003
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,003
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

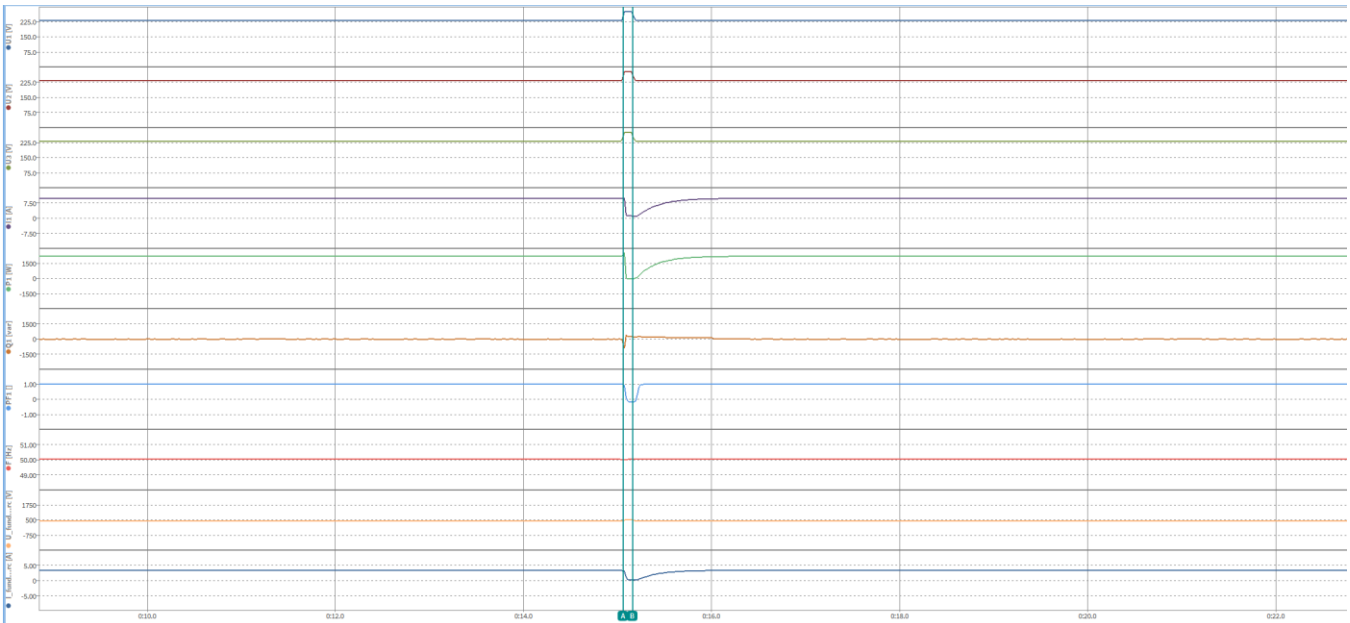
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0-60ms



时间 [s]	A 0:15.0616873	B 0:15.1216900	间隔 0.0600028
U1 [V]	230.4147	276.3174	45.90266
U2 [V]	233.6460	275.9665	42.32045
U3 [V]	236.1721	275.9677	39.79552
I1 [A]	9.605524	0.758533	-8.846991
P1 [W]	2210.379	-31.14138	-2241.521
Q1 [var]	-112.7662	207.2695	320.0357
PF1 []	0.998701	-0.148578	-1.147279
F [Hz]	49.97844	50.00069	0.022251
U_fund_SYM+_rc [V]	401.6612	478.1938	76.53257
I_fund_P_SYM+_rc [A]	3.200081	-0.058046	-3.258127

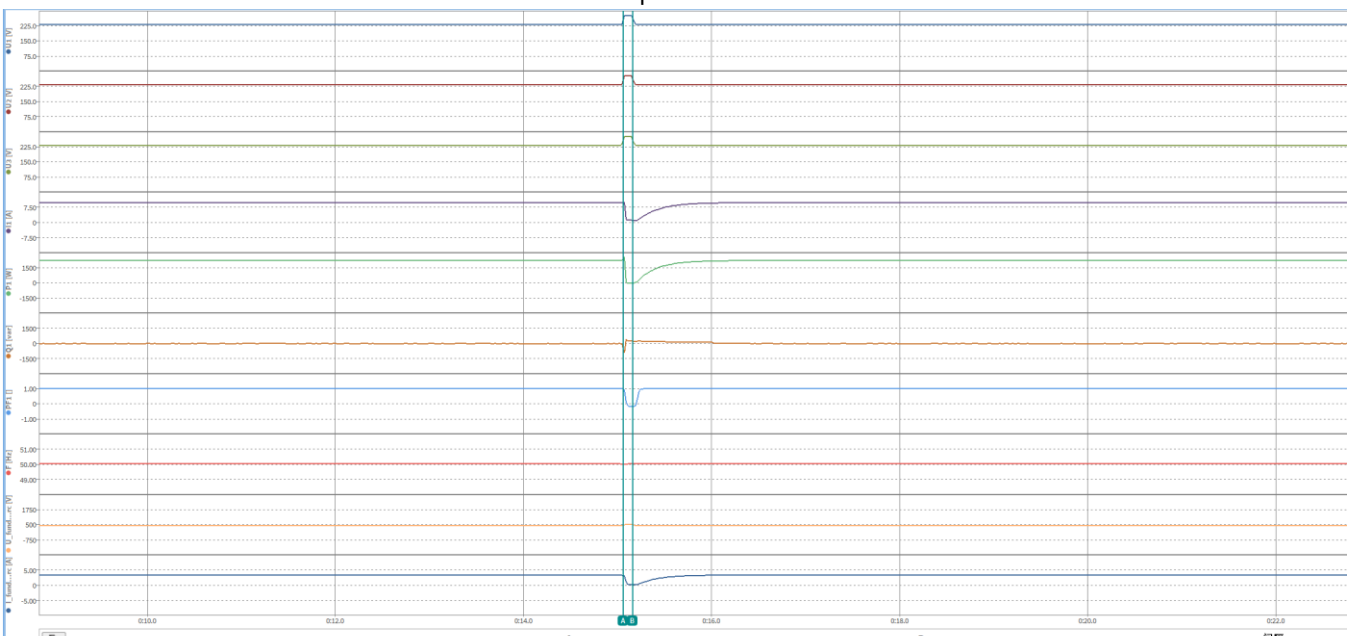
0-100ms



时间 [s]	A 0:15.0616873	B 0:15.1617240	间隔 0.1000368
U1 [V]	230.4147	276.2742	45.85948
U2 [V]	233.6460	275.9587	42.31270
U3 [V]	236.1721	275.9491	39.77693
I1 [A]	9.605524	0.753895	-8.851629
P1 [W]	2210.379	-42.82642	-2253.206
Q1 [var]	-112.7662	203.8314	316.5976
PF1 []	0.998701	-0.205618	-1.204319
F [Hz]	49.97844	50.00950	0.031059
U_fund_SYM+_rc [V]	401.6612	478.1574	76.49619
I_fund_P_SYM+_rc [A]	3.200081	-0.052123	-3.252204

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Drop duration



	A	B	间隔
时间 [s]	0:15.0616873	0:15.1617240	0.1000368
U1 [V]	230.4147	276.2742	45.85948
U2 [V]	233.6460	275.9587	42.31270
U3 [V]	236.1721	275.9491	39.77693
I1 [A]	9.605524	0.753895	-8.851629
P1 [W]	2210.379	-42.82642	-2253.206
Q1 [var]	-112.7662	203.8314	316.5976
PF1 []	0.998701	-0.205618	-1.204319
F [Hz]	49.97844	50.00950	0.031059
U_fund_SYM+_rc [V]	401.6612	478.1574	76.49619
I_fund_P_SYM+_rc [A]	3.200081	-0.052123	-3.252204

Recover time



	A	B	间隔
时间 [s]	0:15.1654003	0:15.7227782	0.5573779
U1 [V]	276.2742	229.9745	-46.29970
U2 [V]	275.9587	229.9848	-45.97388
U3 [V]	275.9491	229.9577	-45.99135
I1 [A]	0.753895	8.772994	8.019099
P1 [W]	-42.82642	2016.063	2058.890
Q1 [var]	203.8314	77.83665	-125.9947
PF1 []	-0.205618	0.999256	1.204873
F [Hz]	50.00950	49.99959	-9.907e-3
U_fund_SYM+_rc [V]	478.1574	398.3218	-79.83562
I_fund_P_SYM+_rc [A]	-0.052123	2.914347	2.966470

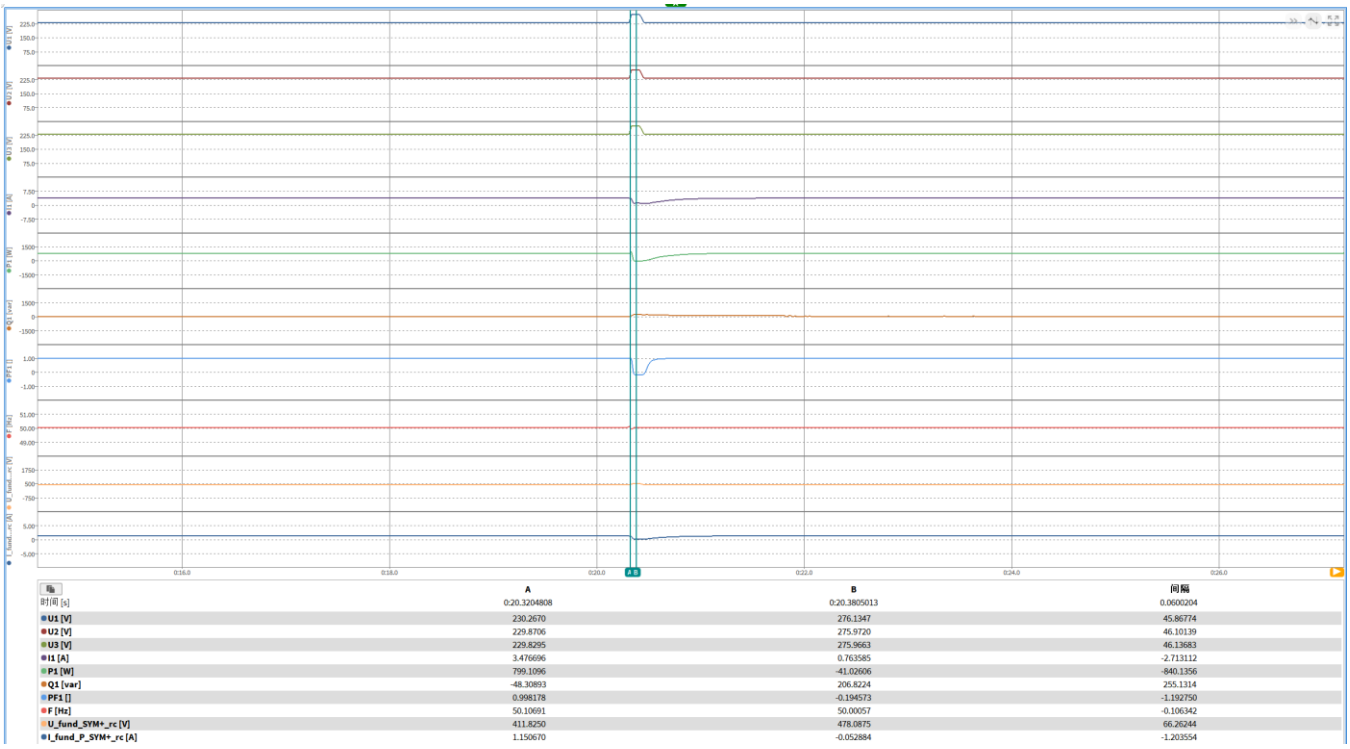
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Load tests 5.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	5.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,25
	5	Drop duration setpoint	Total	–	[ms]	100
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	100
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,250
	10		Positive sequence			0,250
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,998
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,392
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,399
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,399
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,029
	16		Total	t_1-10 s to t_1	[p.u.]	-0,029
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9984
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,250
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,051
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,051
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,001
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,001
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,397
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,397
	30	Response time active power	Positive sequence	-	[s]	0,599
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,012
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,012
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

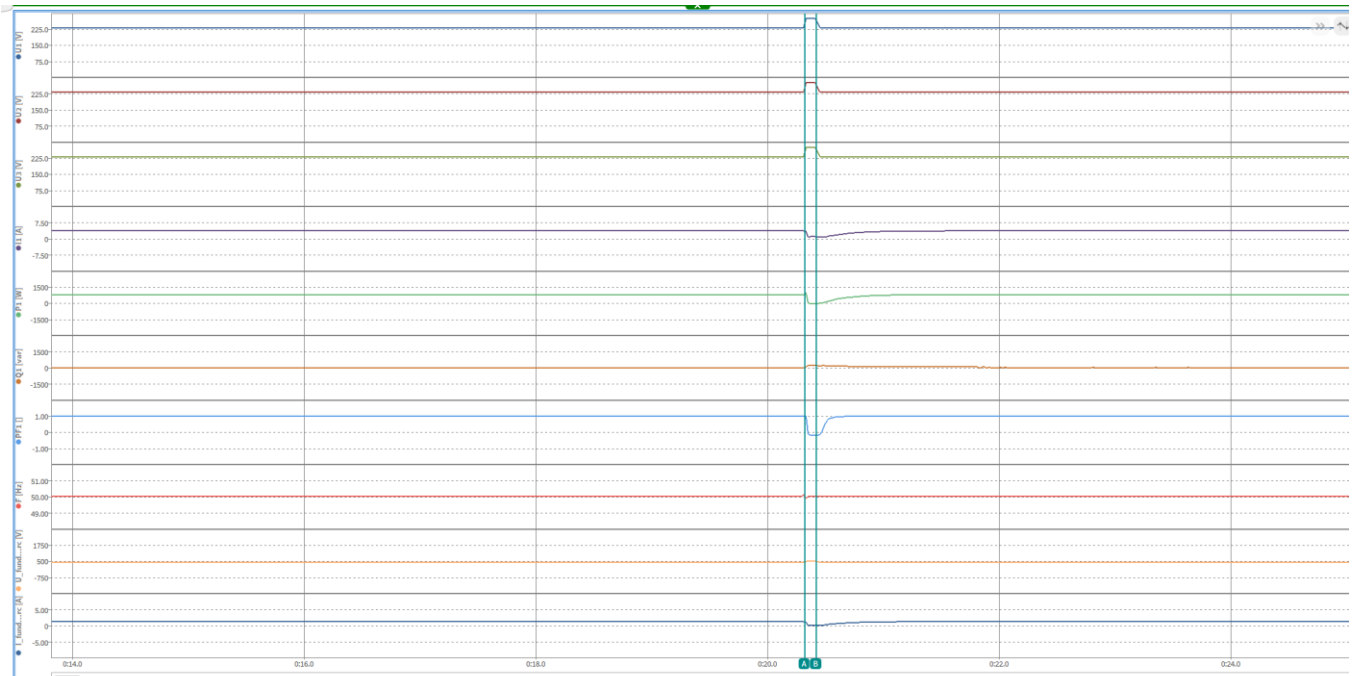
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0-60ms



时间 [s]	A 0:20.3204808	B 0:20.3805013	间隔 0.0600204
U1 [V]	230.2670	276.1347	45.86774
U2 [V]	229.8706	275.9720	46.10139
U3 [V]	229.8295	275.9663	46.13683
I1 [A]	3.476696	0.763585	-2.713112
P1 [W]	799.1096	-41.02606	-840.1356
Q1 [var]	-48.30893	206.8224	255.1314
PF1 []	0.998178	-0.194573	-1.192750
F [Hz]	50.10691	50.00057	-0.106342
U_fund_SYM+_rc [V]	411.8250	478.0875	66.26244
I_fund_P_SYM+_rc [A]	1.150670	-0.052884	-1.203554

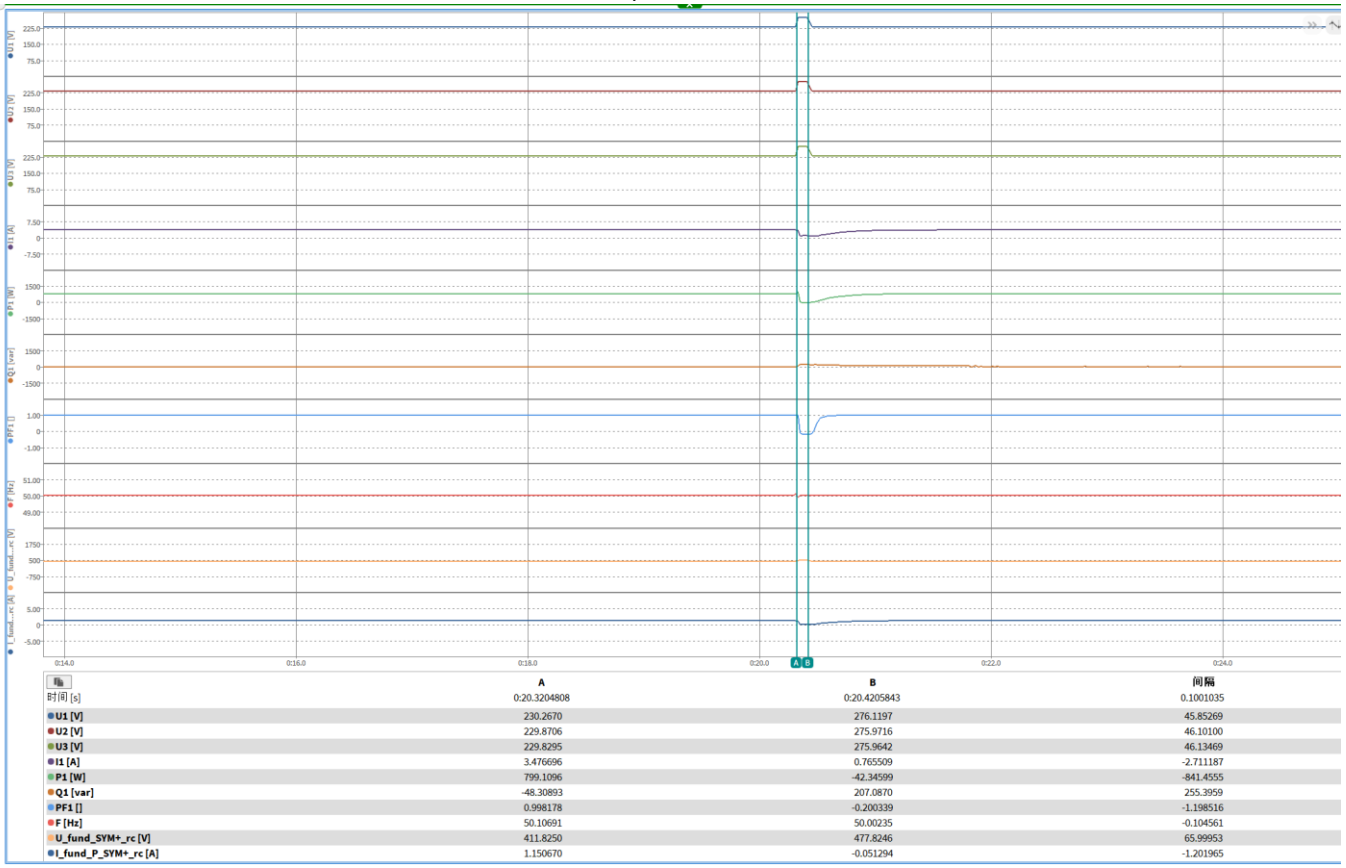
0-100ms



时间 [s]	A 0:20.3204808	B 0:20.4205843	间隔 0.1001035
U1 [V]	230.2670	276.1197	45.85269
U2 [V]	229.8706	275.9716	46.10100
U3 [V]	229.8295	275.9642	46.13469
I1 [A]	3.476696	0.765509	-2.711187
P1 [W]	799.1096	-42.34599	-841.4555
Q1 [var]	-48.30893	207.0870	255.3959
PF1 []	0.998178	-0.200339	-1.198516
F [Hz]	50.10691	50.00235	-0.104561
U_fund_SYM+_rc [V]	411.8250	477.8246	65.99953
I_fund_P_SYM+_rc [A]	1.150670	-0.051294	-1.201965

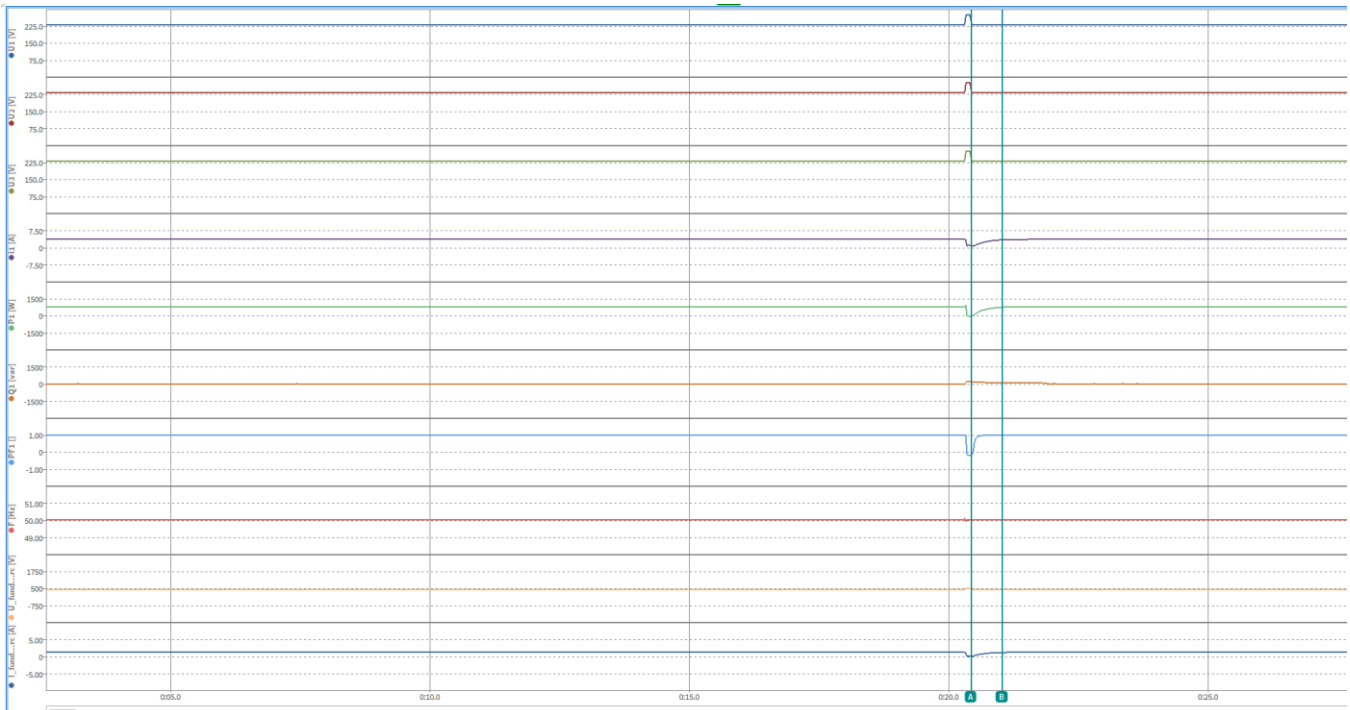
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Drop duration



时间 [s]	A	B	间隔
	0:20.3204808	0:20.4205843	0.1001035
U1 [V]	230.2670	276.1197	45.85269
U2 [V]	229.8706	275.9716	46.10100
U3 [V]	229.8295	275.9642	46.13469
I1 [A]	3.476696	0.765509	-2.711187
P1 [W]	799.1096	-42.34599	-841.4555
Q1 [var]	-48.30893	207.0870	255.3959
PF1 []	0.998178	-0.200339	-1.198516
F [Hz]	50.10691	50.00235	-0.104561
U_fund_SYM+_rc [V]	411.8250	477.8246	65.99953
I_fund_P_SYM+_rc [A]	1.150670	-0.051294	-1.201965

Recover time



时间 [s]	A	B	间隔
	0:20.4240812	0:21.0234862	0.5994050
U1 [V]	276.1197	230.0110	-46.10864
U2 [V]	275.9716	229.9846	-45.98691
U3 [V]	275.9642	229.9585	-46.00571
I1 [A]	0.765509	3.217201	2.451692
P1 [W]	-42.34599	737.3335	779.6795
Q1 [var]	207.0870	62.66778	-144.4192
PF1 []	-0.200339	0.996408	1.196746
F [Hz]	50.00235	50.00084	-1.511e-3
U_fund_SYM+_rc [V]	477.8246	398.3431	-79.48150
I_fund_P_SYM+_rc [A]	-0.051294	1.069617	1.120912

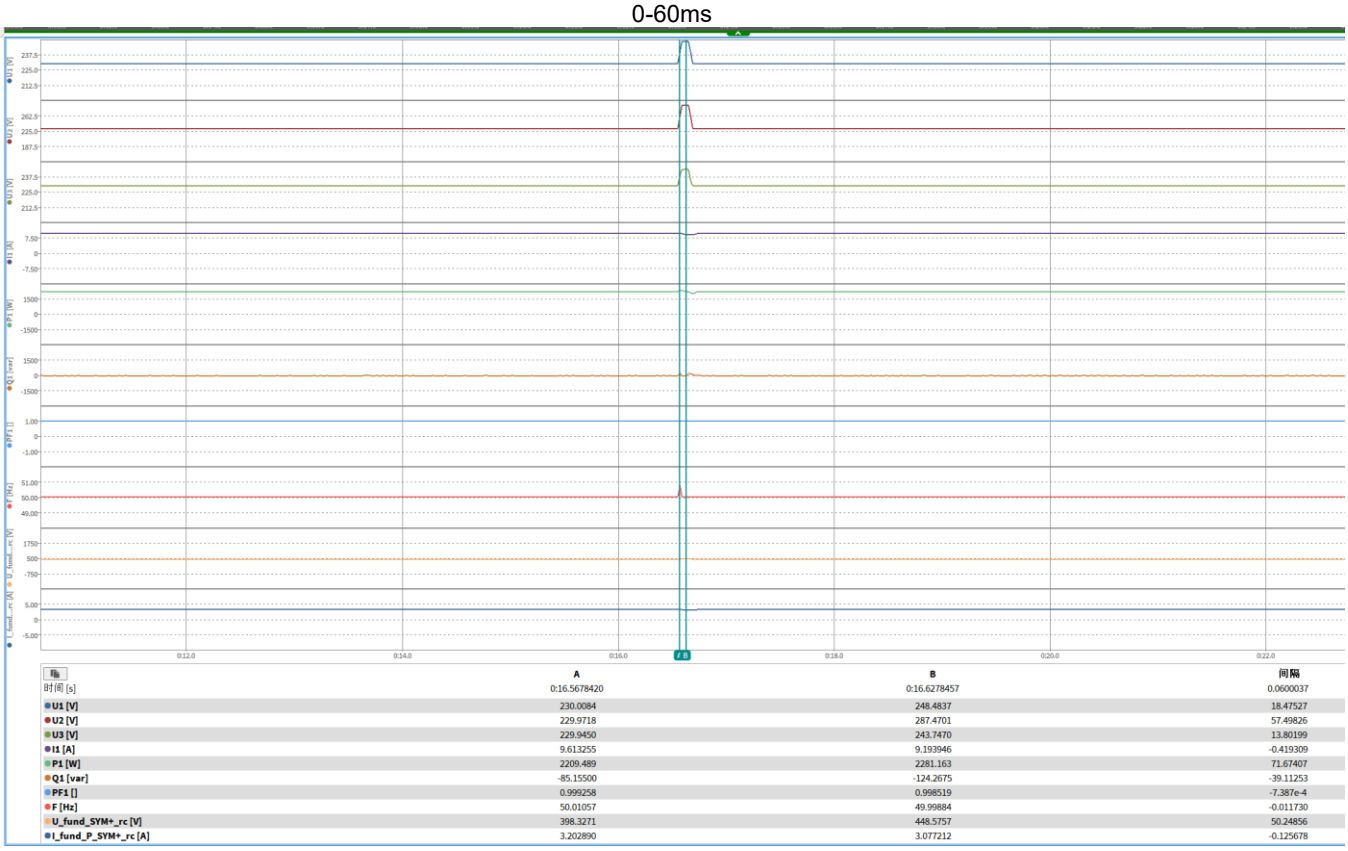
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Load tests 5.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	5.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,25
	5	Drop duration setpoint	Total	–	[ms]	100
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	100
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,060
	10		Positive sequence			0,060
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,003
	16		Total	t_1-10 s to t_1	[p.u.]	-0,003
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9989
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,060
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,953
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,951
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,999
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,999
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,003
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,003
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

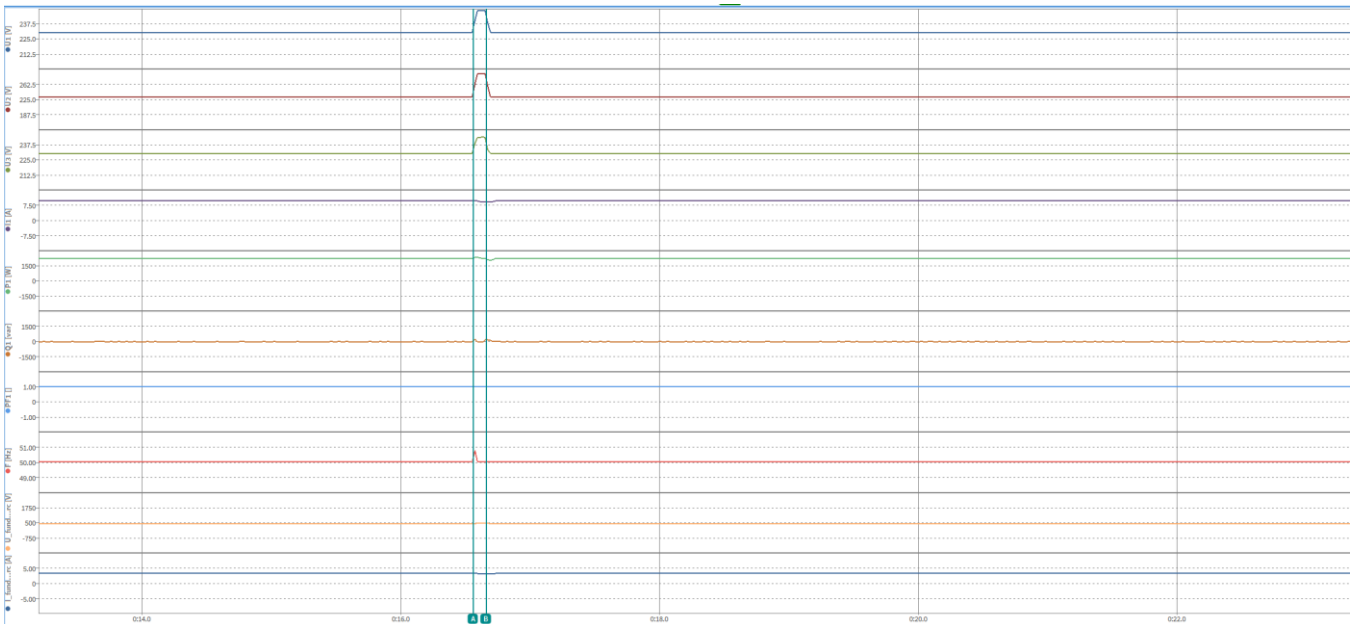
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0-60ms



时间 [s]	A	B	间隔
	0:16.5678420	0:16.6278457	0.0600037
U1 [V]	230.0084	248.4837	18.47527
U2 [V]	229.9718	287.4701	57.49826
U3 [V]	229.9450	243.7470	13.80199
I1 [A]	9.613255	9.193946	-0.419309
P1 [W]	2209.489	2281.163	71.67407
Q1 [var]	-85.15500	-124.2675	-39.11253
PF1 []	0.999258	0.998519	-7.387e-4
F [Hz]	50.01057	49.99884	-0.011730
U_fund_SYM+_rc [V]	398.3271	448.5757	50.24856
I_fund_P_SYM+_rc [A]	3.202890	3.077212	-0.125678

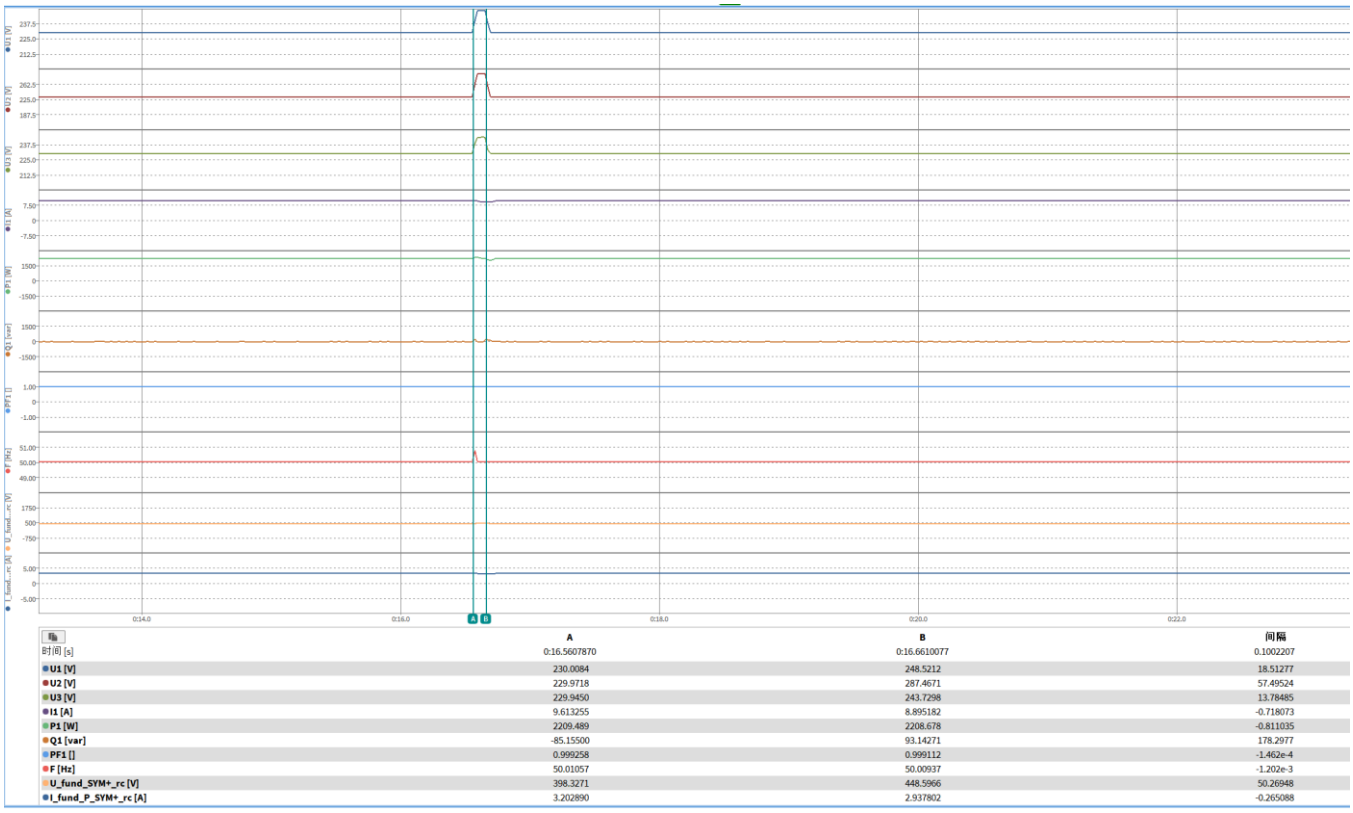
0-100ms



时间 [s]	A	B	间隔
	0:16.5607870	0:16.6610077	0.1002207
U1 [V]	230.0084	248.5212	18.51277
U2 [V]	229.9718	287.4671	57.49524
U3 [V]	229.9450	243.7298	13.78485
I1 [A]	9.613255	8.895182	-0.718073
P1 [W]	2209.489	2208.678	-0.811035
Q1 [var]	-85.15500	93.14271	178.2977
PF1 []	0.999258	0.999112	-1.462e-4
F [Hz]	50.01057	50.00937	-1.202e-3
U_fund_SYM+_rc [V]	398.3271	448.5966	50.26948
I_fund_P_SYM+_rc [A]	3.202890	2.937802	-0.265088

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Drop duration



时间 [s]	A 0:16.5607870	B 0:16.6610077	间隔 0.1002207
U1 [V]	230.0084	248.5212	18.51277
U2 [V]	229.9718	287.4671	57.49524
U3 [V]	229.9450	243.7298	13.78485
I1 [A]	9.613255	8.895182	-0.718073
P1 [W]	2209.489	2208.678	-0.811035
Q1 [var]	-85.15500	93.14271	178.2977
PF1 []	0.999258	0.999112	-1.462e-4
F [Hz]	50.01057	50.00937	-1.202e-3
U_fund_SYM+_rc [V]	398.3271	448.5966	50.26948
I_fund_P_SYM+_rc [A]	3.202890	2.937802	-0.265088

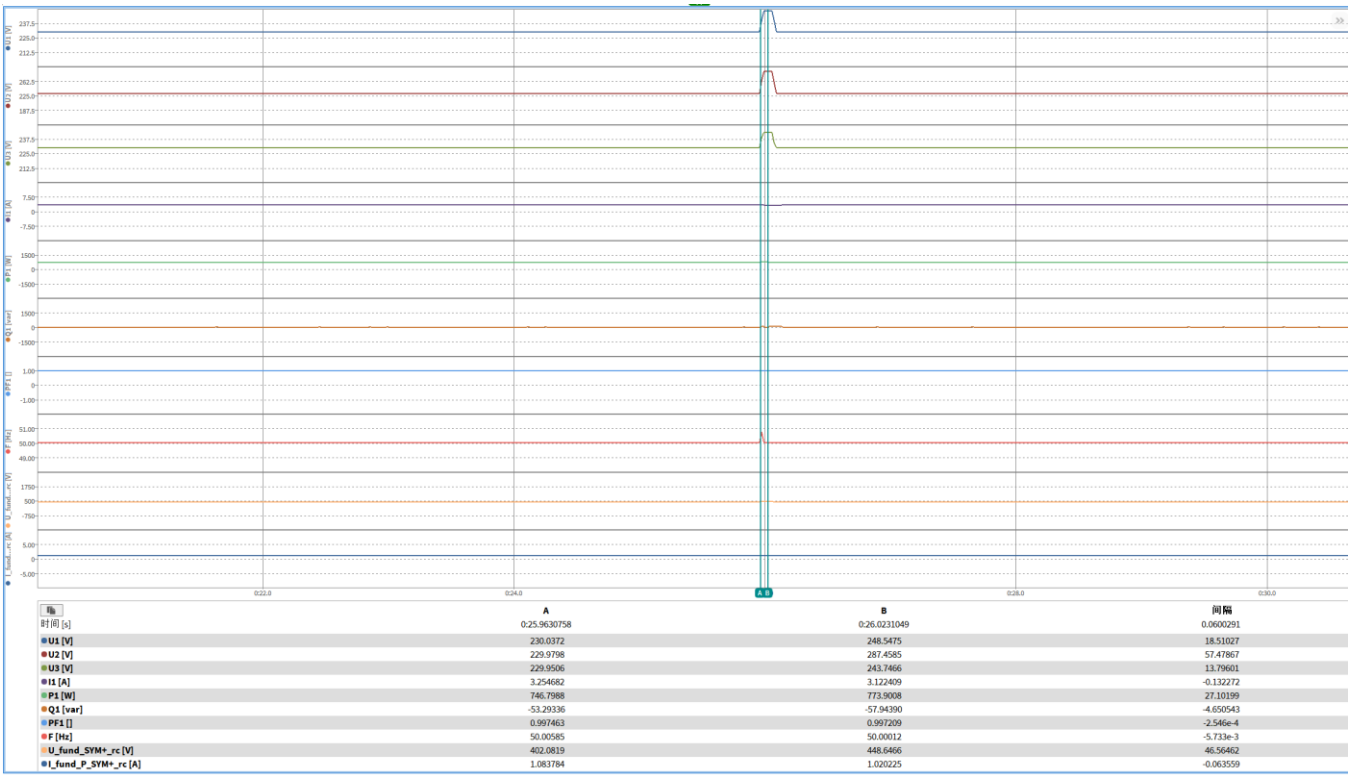
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Load tests 5.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	5.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,25
	5	Drop duration setpoint	Total	–	[ms]	100
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	100
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,060
	10		Positive sequence			0,060
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,998
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,399
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,398
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,398
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,001
	16		Total	t_1-10 s to t_1	[p.u.]	-0,001
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,060
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,389
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,389
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,399
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,399
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,998
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,402
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,402
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,009
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,009
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

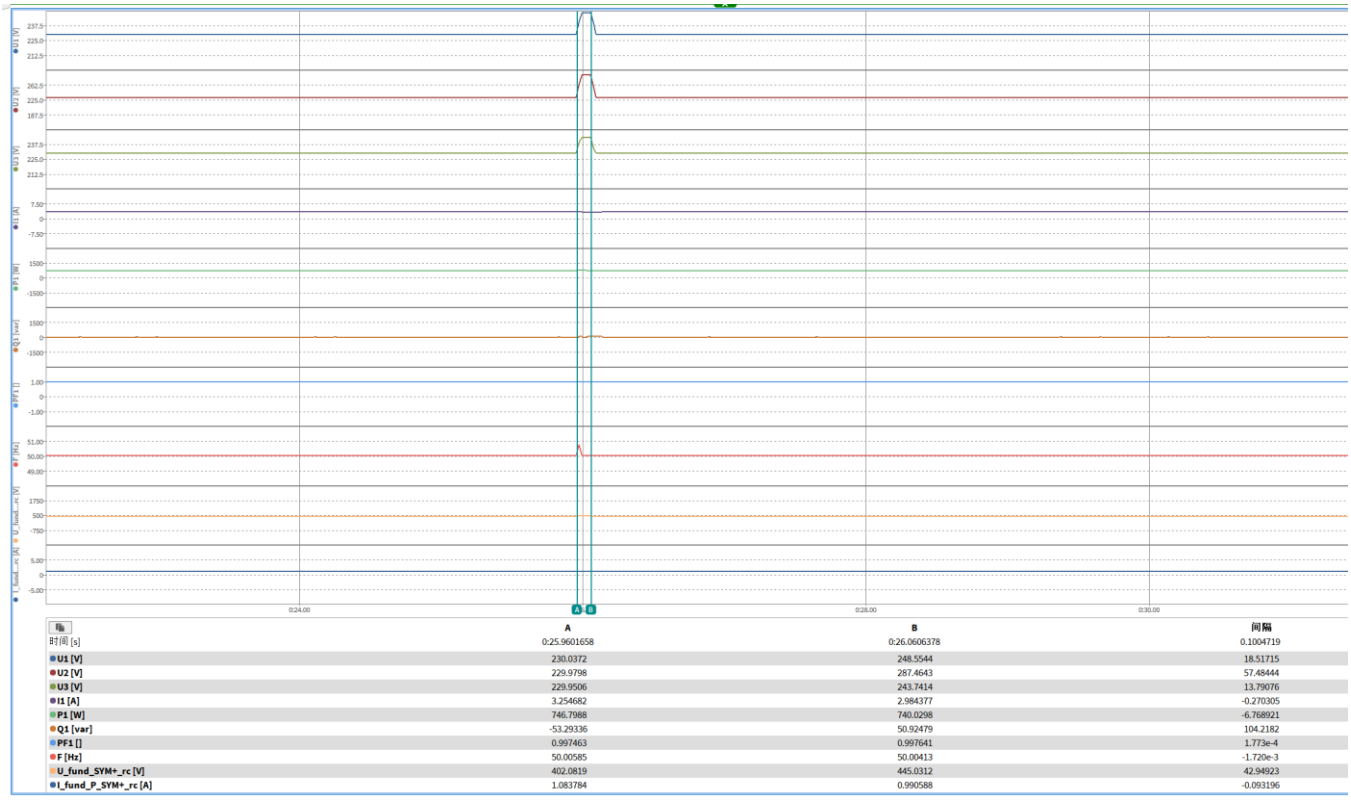
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0-60ms



时间 [s]	A 0:25.9630758	B 0:26.0231049	间隔 0.0600291
U1 [V]	230.0372	248.5475	18.51027
U2 [V]	229.9798	287.4585	57.47867
U3 [V]	229.9506	243.7466	13.79601
I1 [A]	3.254682	3.122409	-0.132272
P1 [W]	746.7988	773.9008	27.10199
Q1 [var]	-53.29336	-57.94390	-4.650543
PF1 []	0.997463	0.997209	-2.546e-4
F [Hz]	50.00585	50.00012	-5.733e-3
U_fund_SYM+_rc [V]	402.0819	448.6466	46.56462
I_fund_P_SYM+_rc [A]	1.083784	1.020225	-0.063559

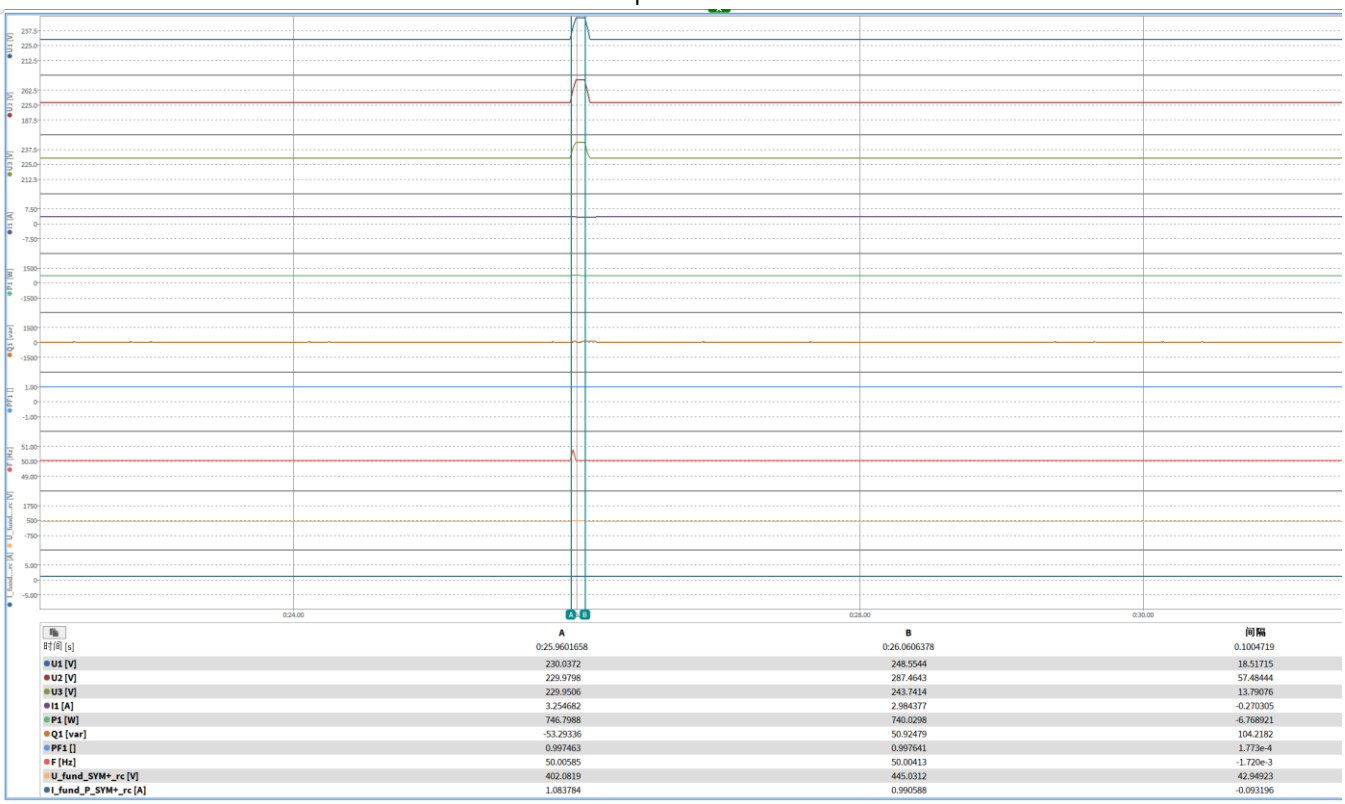
0-100ms



时间 [s]	A 0:25.9601658	B 0:26.0606378	间隔 0.1004719
U1 [V]	230.0372	248.5544	18.51715
U2 [V]	229.9798	287.4643	57.48444
U3 [V]	229.9506	243.7414	13.79076
I1 [A]	3.254682	2.984377	-0.270305
P1 [W]	746.7988	740.0298	-6.768921
Q1 [var]	-53.29336	50.92479	104.2182
PF1 []	0.997463	0.997641	1.773e-4
F [Hz]	50.00585	50.00413	-1.720e-3
U_fund_SYM+_rc [V]	402.0819	445.0312	42.94923
I_fund_P_SYM+_rc [A]	1.083784	0.990588	-0.093196

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Drop duration



时间 [s]	A 0:25.9601658	B 0:26.0606378	间隔 0.1004719
U1 [V]	230.0372	248.5544	18.51715
U2 [V]	229.9798	287.4643	57.48444
U3 [V]	229.9506	243.7414	13.79076
I1 [A]	3.254682	2.984377	-0.270305
P1 [W]	746.7988	740.0298	-6.768921
Q1 [var]	-53.29336	50.92479	104.2182
PF1 []	0.997463	0.997641	1.773e-4
F [Hz]	50.00585	50.00413	-1.720e-3
U_fund_SYM+_rc [V]	402.0819	445.0312	42.94923
I_fund_P_SYM+_rc [A]	1.083784	0.990588	-0.093196

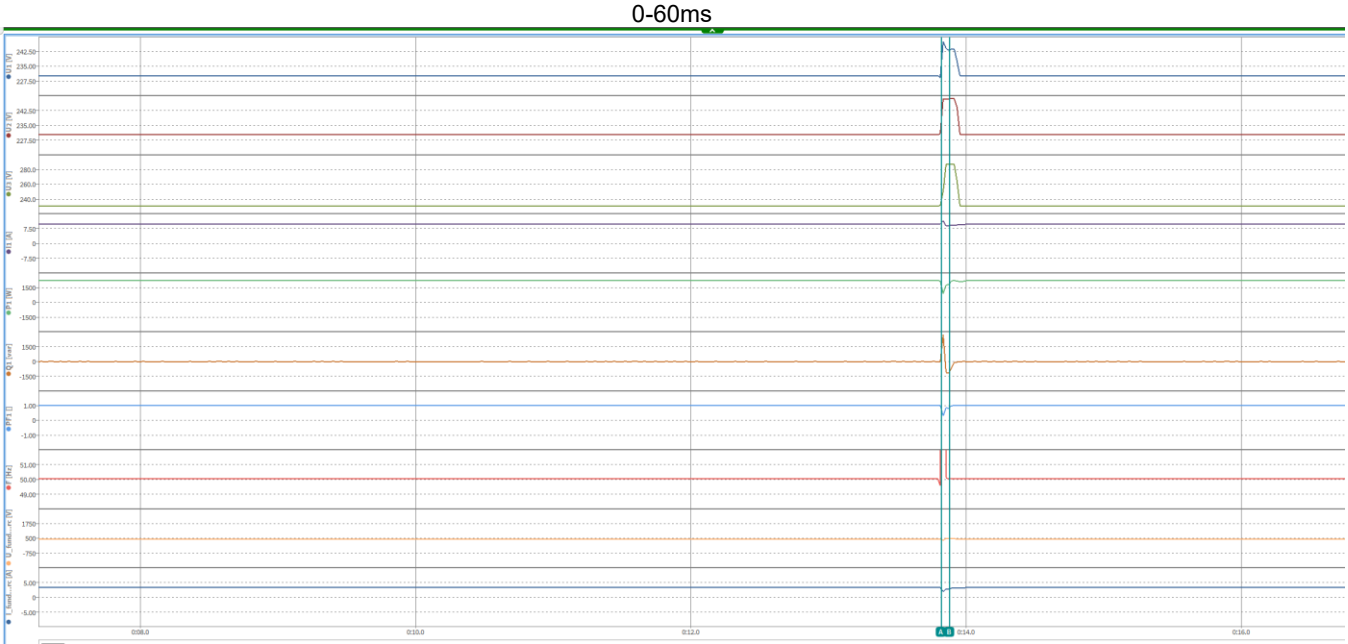
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Load tests 5.5

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	5.5
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D2
	4	Drop depth setpoint	Phase	–	[p.u]	1,25
	5	Drop duration setpoint	Total	–	[ms]	100
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	100
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,248
	10		Positive sequence			0,248
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,002
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,000
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,000
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,043
	16		Total	t_1-10 s to t_1	[p.u.]	0,043
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9991
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,248
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	0,001
	21		Phase 3	t_1+60 ms	[p.u.]	N/A
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	0,001
	24		Phase 3	t_1 +100 ms	[p.u.]	N/A
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,0
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,011
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,011
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

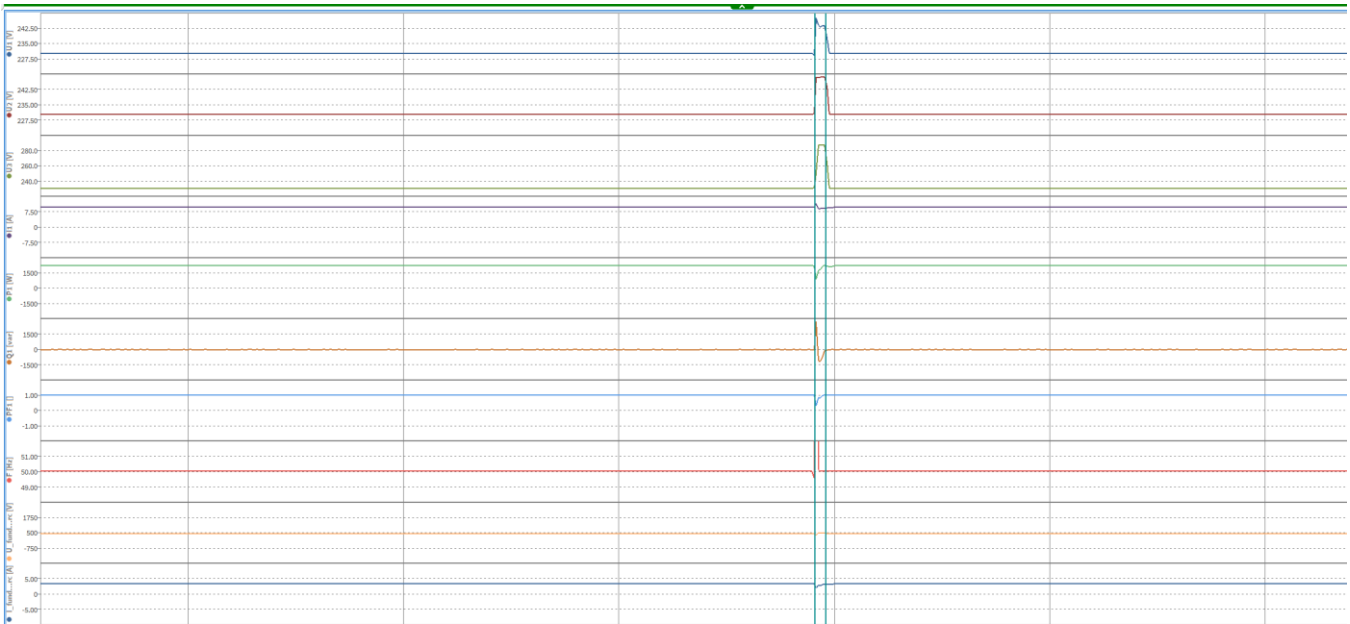
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0-60ms



时间 [s]	A	B	间隔
	0:13.8197075	0:13.8798000	0.0600925
U1 [V]	229.9857	243.9698	13.98413
U2 [V]	229.9824	248.3045	18.32210
U3 [V]	229.9549	287.4636	57.50868
I1 [A]	9.614490	8.728455	-0.886035
P1 [W]	2209.263	1758.390	-450.8726
Q1 [var]	-92.42906	-1201.145	-1108.716
PF1 []	0.999126	0.825737	-0.173389
F [Hz]	50.00057	50.06981	0.069241
U_fund_SYM+_rc [V]	398.3261	448.5821	50.25595
I_fund_P_SYM+_rc [A]	3.202416	2.728784	-0.473631

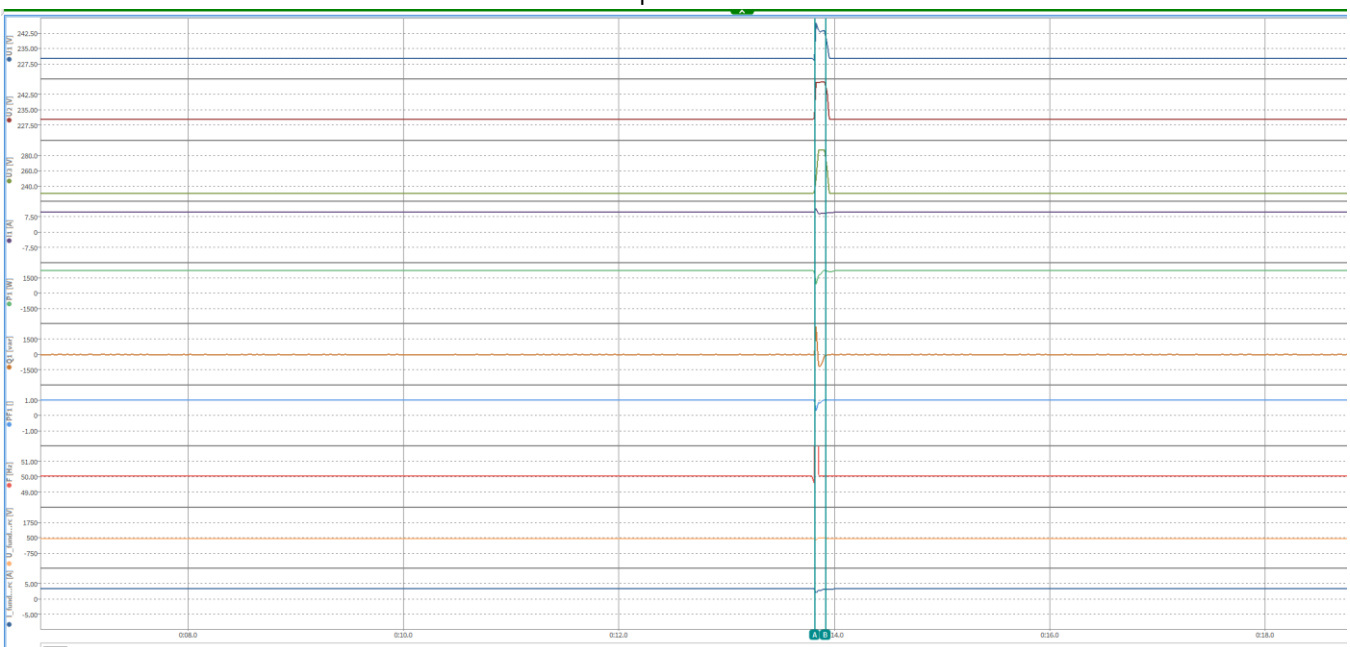
0-100ms



时间 [s]	A	B	间隔
	0:13.8197075	0:13.9202313	0.1005238
U1 [V]	229.9857	243.7929	13.80714
U2 [V]	229.9824	248.3810	18.39862
U3 [V]	229.9549	287.4599	57.50505
I1 [A]	9.614490	9.029761	-0.584728
P1 [W]	2209.263	2195.968	-13.29443
Q1 [var]	-92.42906	-154.4258	-61.99675
PF1 []	0.999126	0.997537	-1.589e-3
F [Hz]	50.00057	49.99891	-1.659e-3
U_fund_SYM+_rc [V]	398.3261	448.5921	50.26598
I_fund_P_SYM+_rc [A]	3.202416	2.991423	-0.210993

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Drop duration



	A	B	间隔
时间 [s]	0:13.8197075	0:13.9202313	0.1005238
U1 [V]	229.9857	243.7929	13.80714
U2 [V]	229.9824	248.3810	18.39862
U3 [V]	229.9549	287.4599	57.50505
I1 [A]	9.614490	9.029761	-0.584728
P1 [W]	2209.263	2195.968	-13.29443
Q1 [var]	-92.42906	-154.4258	-61.99675
PF1 []	0.999126	0.997537	-1.589e-3
F [Hz]	50.00057	49.99891	-1.659e-3
U_fund_SYM+_rc [V]	398.3261	448.5921	50.26598
I_fund_P_SYM+_rc [A]	3.202416	2.991423	-0.210993

Recover time

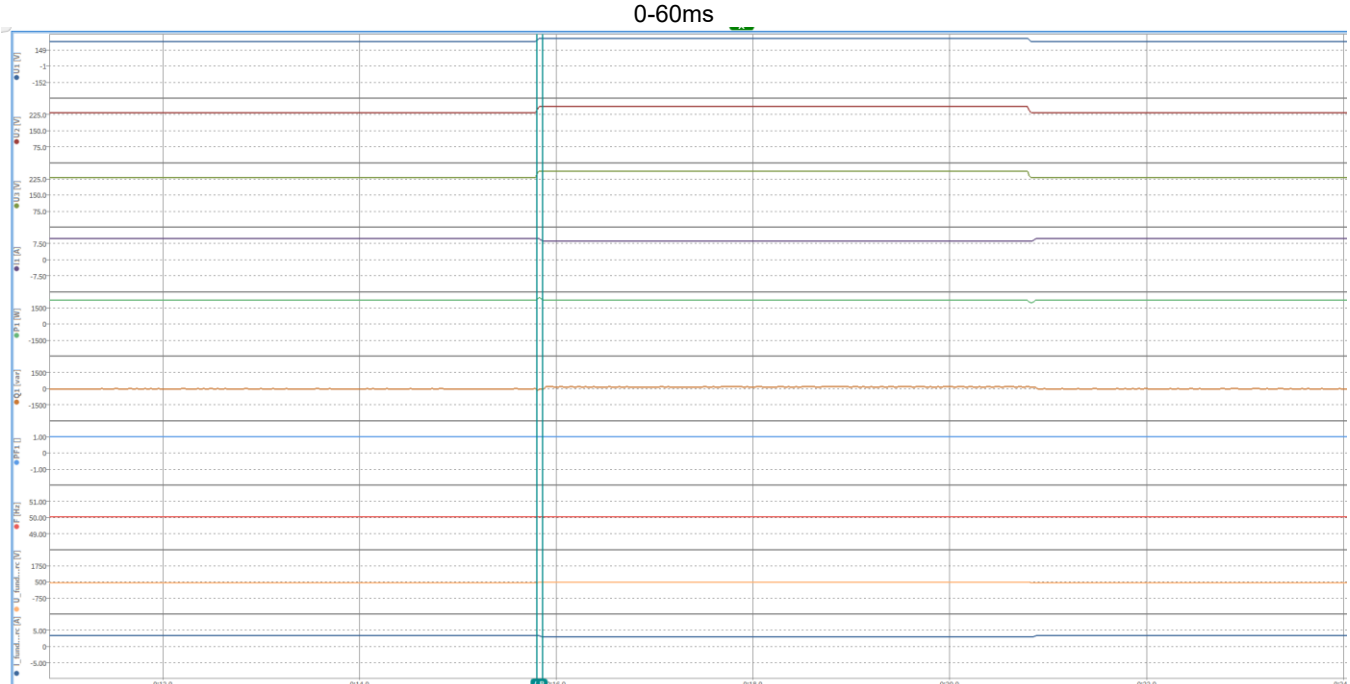
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Load tests 6.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	6.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,20
	5	Drop duration setpoint	Total	–	[ms]	5000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	5591
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,200
	10		Positive sequence			0,200
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	1,039
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,002
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,041
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,041
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,064
	16		Total	t_1-10 s to t_1	[p.u.]	0,064
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9981
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,200
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,039
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,049
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,998
	30	Response time active power	Positive sequence	-	[s]	0,781
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,031
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,031
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

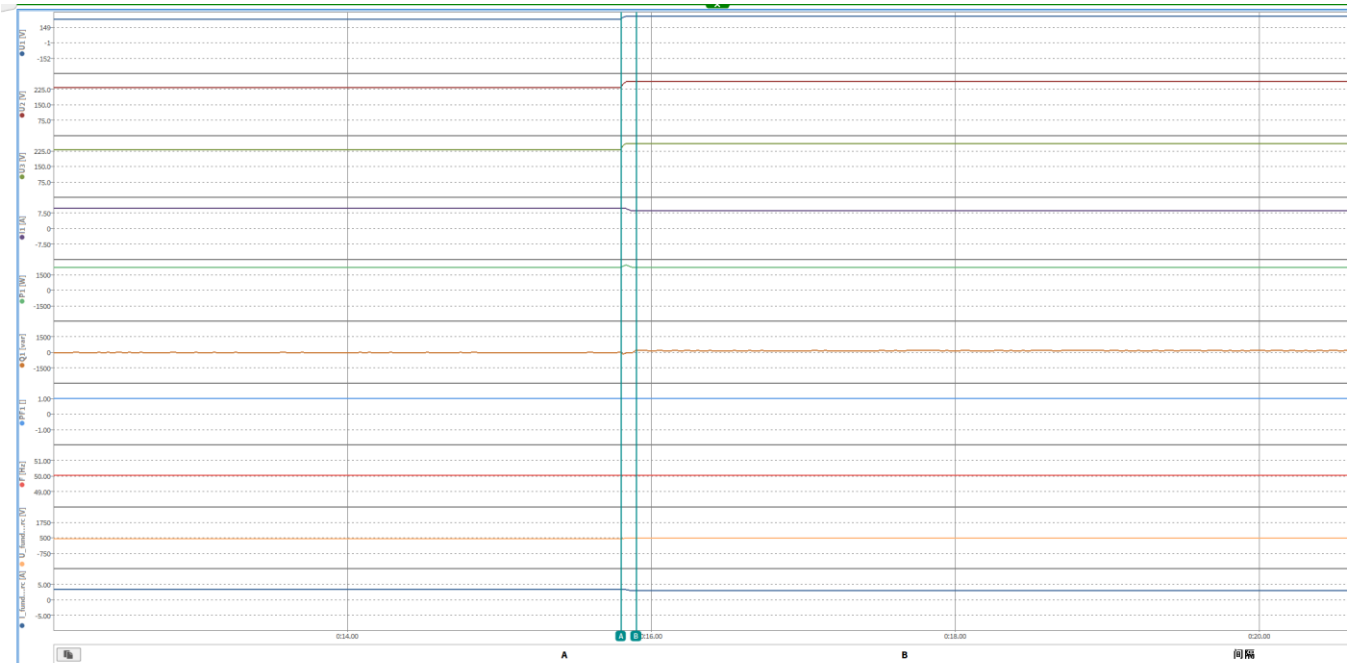
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0-60ms



时间 [s]	A	B	间隔
	0:15.80033	0:15.86071	0.06038
U1 [V]	229.9536	260.1090	30.15541
U2 [V]	229.9992	259.8834	29.88420
U3 [V]	229.9727	259.8594	29.88673
I1 [A]	9.611365	9.003798	-0.607567
P1 [W]	2208.485	2338.787	130.3020
Q1 [var]	-86.22955	-122.0408	-35.81126
PF1 []	0.999239	0.998641	-5.973e-4
F [Hz]	49.98635	49.99712	0.010769
U_fund_SYM+_rc [V]	398.3279	450.2429	51.91494
I_fund_P_SYM+_rc [A]	3.202193	3.066787	-0.135406

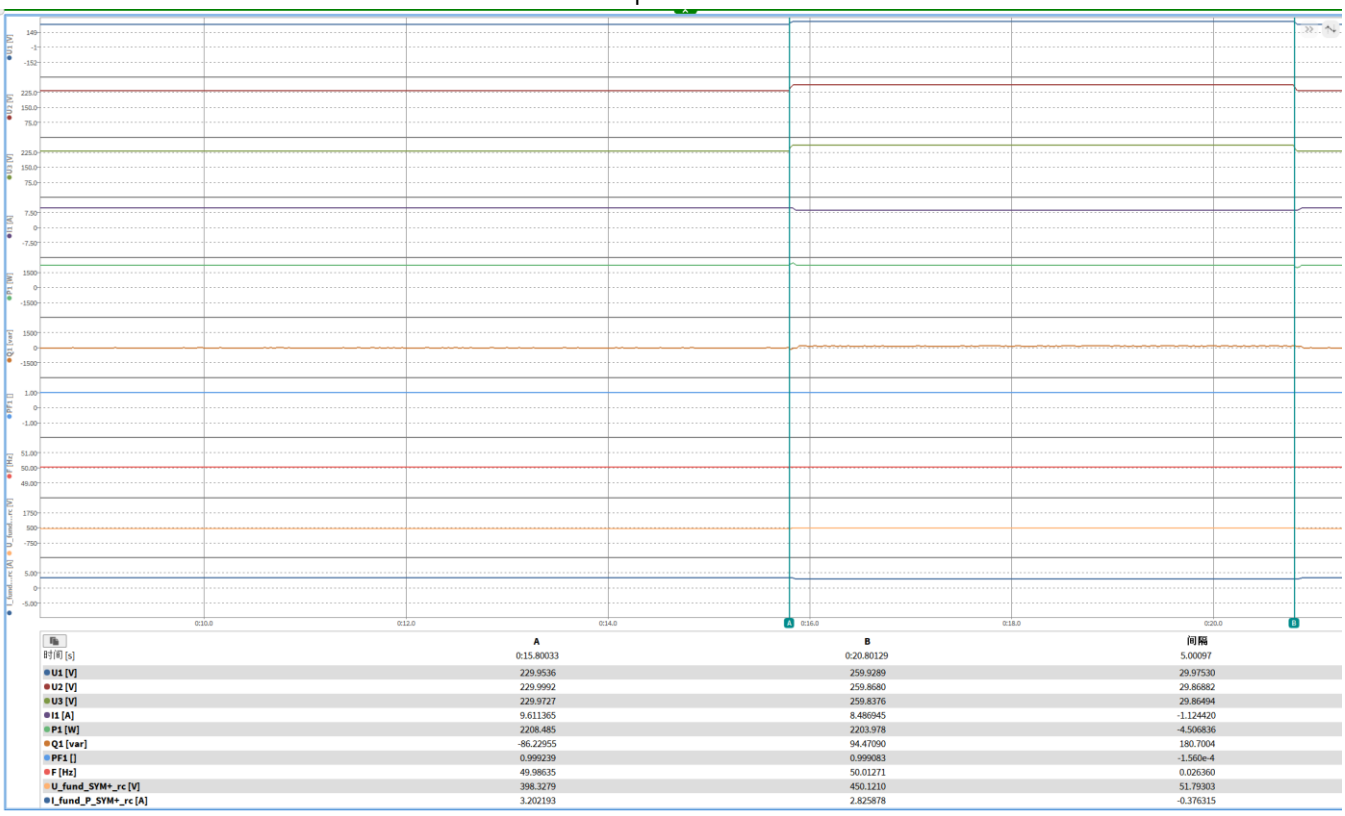
0-100ms



时间 [s]	A	B	间隔
	0:15.80033	0:15.90044	0.10012
U1 [V]	229.9536	260.0917	30.13814
U2 [V]	229.9992	259.8808	29.88161
U3 [V]	229.9727	259.8564	29.88374
I1 [A]	9.611365	8.473403	-1.137962
P1 [W]	2208.485	2201.925	-6.560547
Q1 [var]	-86.22955	92.39436	178.6239
PF1 []	0.999239	0.999121	-1.178e-4
F [Hz]	49.98635	50.00017	0.013821
U_fund_SYM+_rc [V]	398.3279	450.2364	51.90844
I_fund_P_SYM+_rc [A]	3.202193	2.820956	-0.381237

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Drop duration



	A	B	(B)差
时间 [s]	0:15.80033	0:20.80129	5.00097
U1 [V]	229.9536	259.9289	29.97530
U2 [V]	229.9992	259.8680	29.86882
U3 [V]	229.9727	259.8376	29.86494
I1 [A]	9.611365	8.486945	-1.124420
P1 [W]	2208.485	2203.978	-4.506836
Q1 [var]	-86.22955	94.47090	180.7004
PF1 []	0.999239	0.999083	-1.560e-4
F [Hz]	49.98635	50.01271	0.026360
U_fund_SYM+_rc [V]	398.3279	450.1210	51.79303
I_fund_P_SYM+_rc [A]	3.202193	2.825878	-0.376315

Recover time

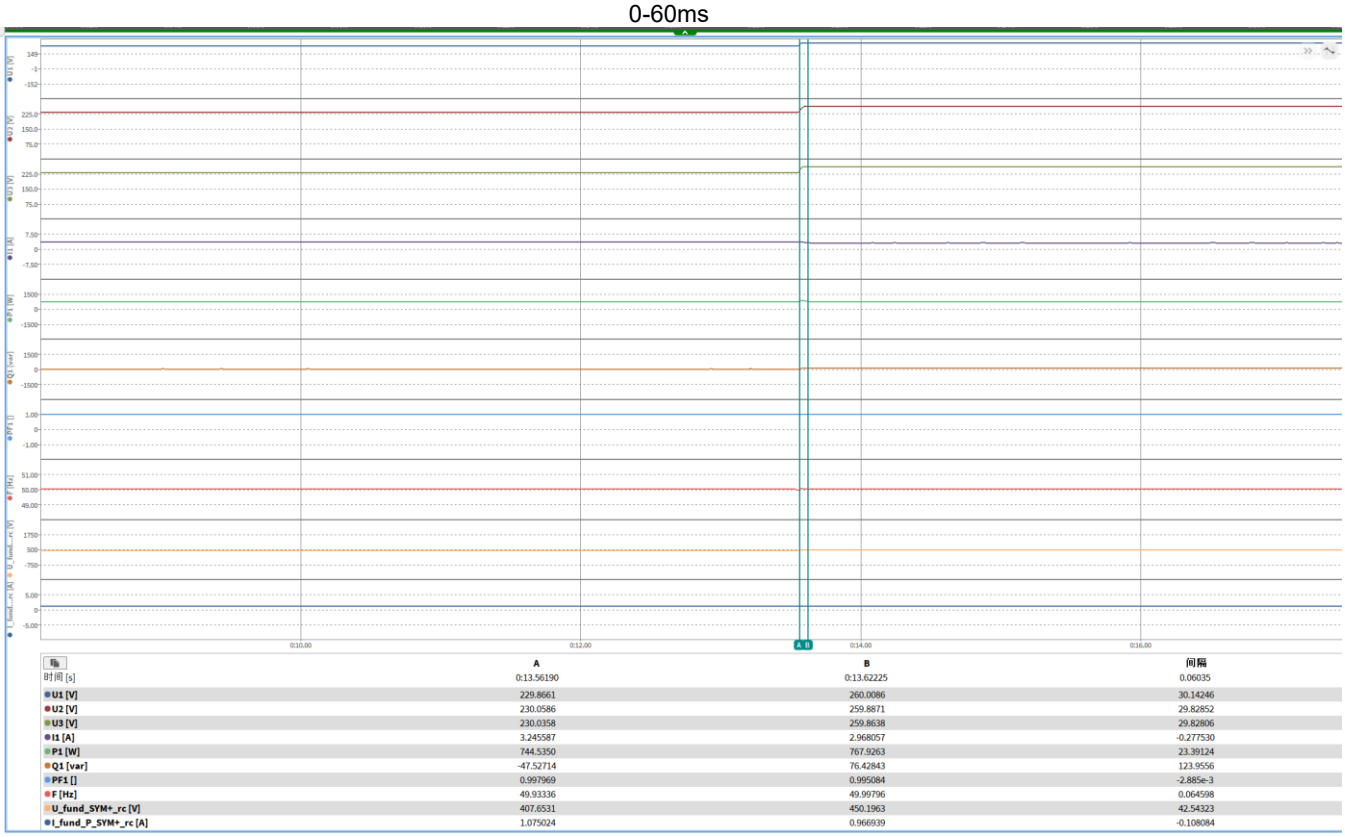
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Load tests 6.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	6.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,20
	5	Drop duration setpoint	Total	–	[ms]	5000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	5552
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,199
	10		Positive sequence			0,199
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,399
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,398
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,398
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,029
	16		Total	t_1-10 s to t_1	[p.u.]	0,029
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9985
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,199
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,049
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,049
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,003
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,003
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,399
	30	Response time active power	Positive sequence	-	[s]	0,798
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,031
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,031
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

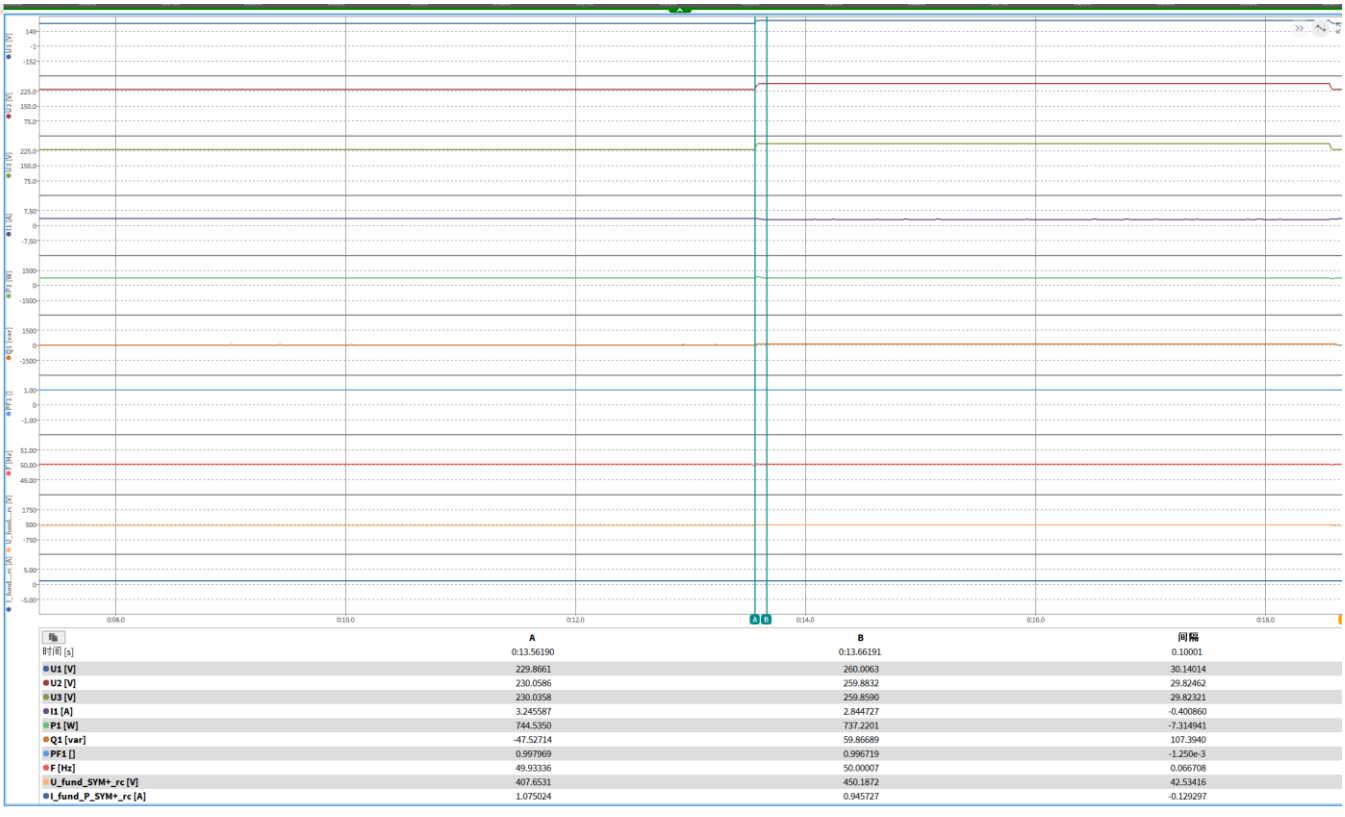
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0-60ms



	A	B	间隔
时间 [s]	0:13.56190	0:13.62225	0.06035
U1 [V]	229.8661	260.0086	30.14246
U2 [V]	230.0586	259.8871	29.82852
U3 [V]	230.0358	259.8638	29.82806
I1 [A]	3.245587	2.968057	-0.277530
P1 [W]	744.5350	767.9263	23.39124
Q1 [var]	-47.52714	76.42843	123.9556
PF1 []	0.997969	0.995084	-2.885e-3
F [Hz]	49.93336	49.99796	0.064598
U_fund_SYM+_rc [V]	407.6531	450.1963	42.54323
I_fund_P_SYM+_rc [A]	1.075024	0.966939	-0.108084

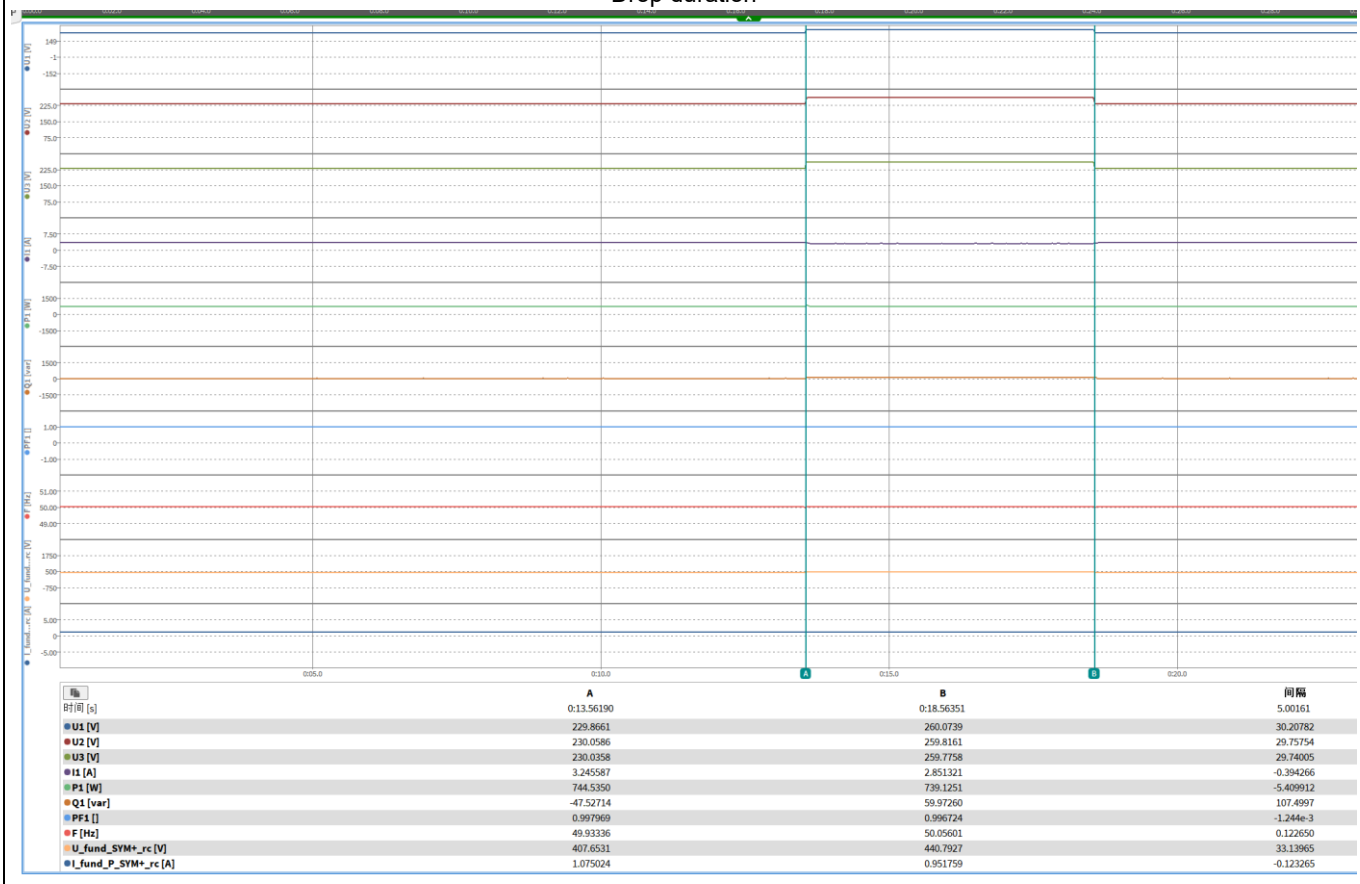
0-100ms



	A	B	间隔
时间 [s]	0:13.56190	0:13.66191	0.10001
U1 [V]	229.8661	260.0063	30.14014
U2 [V]	230.0586	259.8832	29.82462
U3 [V]	230.0358	259.8590	29.82321
I1 [A]	3.245587	2.844727	-0.400860
P1 [W]	744.5350	737.2201	-7.314941
Q1 [var]	-47.52714	59.86689	107.3940
PF1 []	0.997969	0.996719	-1.250e-3
F [Hz]	49.93336	50.00007	0.066708
U_fund_SYM+_rc [V]	407.6531	450.1872	42.53416
I_fund_P_SYM+_rc [A]	1.075024	0.945727	-0.129297

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Drop duration



	A	B	间隔
时间 [s]	0:13.56190	0:18.56351	5.00161
U1 [V]	229.8661	260.0739	30.20782
U2 [V]	230.0586	259.8161	29.75754
U3 [V]	230.0358	259.7758	29.74005
I1 [A]	3.245587	2.851321	-0.394266
P1 [W]	744.5350	739.1251	-5.409912
Q1 [var]	-47.52714	59.97260	107.4997
PF1 []	0.997969	0.996724	-1.244e-3
F [Hz]	49.93336	50.05601	0.122650
U_fund_SYM+_rc [V]	407.6531	440.7927	33.13965
I_fund_P_SYM+_rc [A]	1.075024	0.951759	-0.123265

Recover time

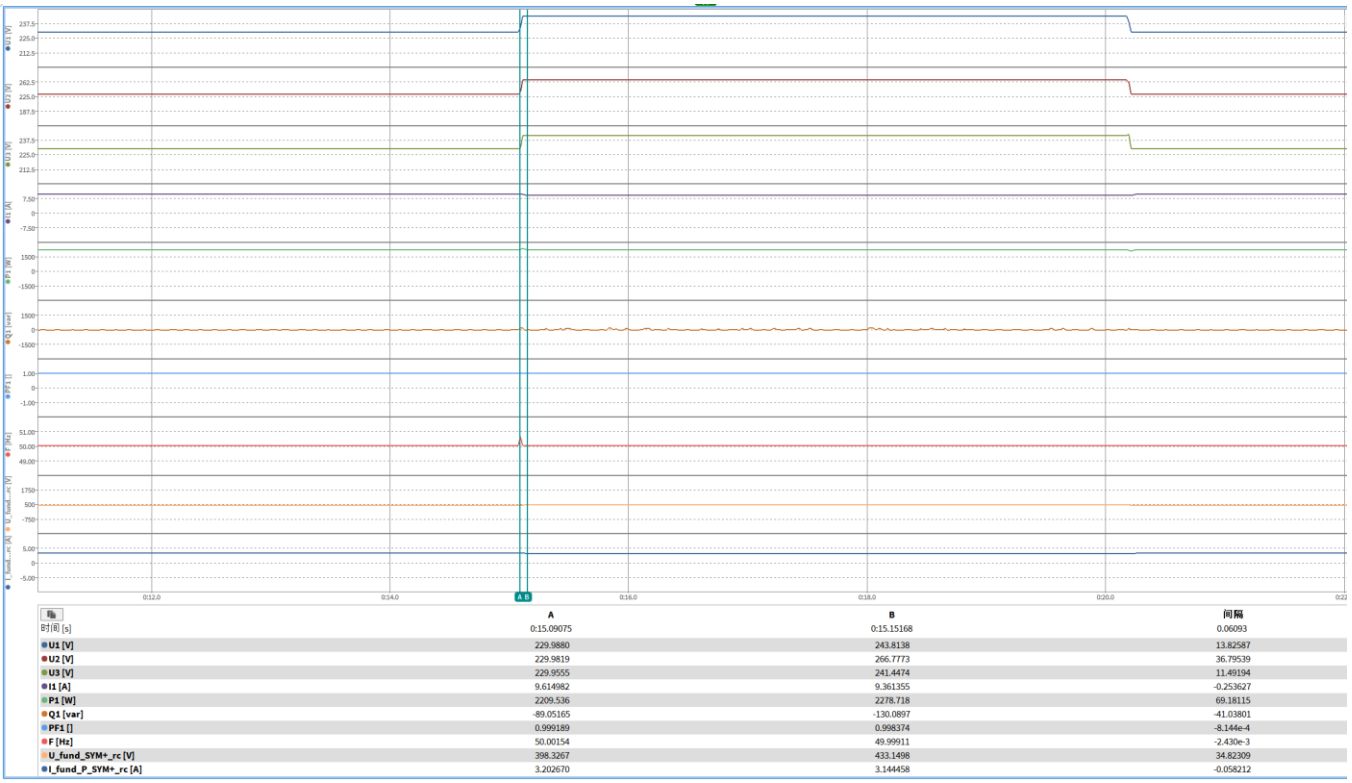
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Load tests 6.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	6.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,20
	5	Drop duration setpoint	Total	–	[ms]	5000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	5585
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,050
	10		Positive sequence			0,050
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,998
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,998
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,998
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,033
	16		Total	t_1-10 s to t_1	[p.u.]	0,033
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9994
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,050
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,980
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,954
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	1,002
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	1,002
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,002
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,002
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,035
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,035
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

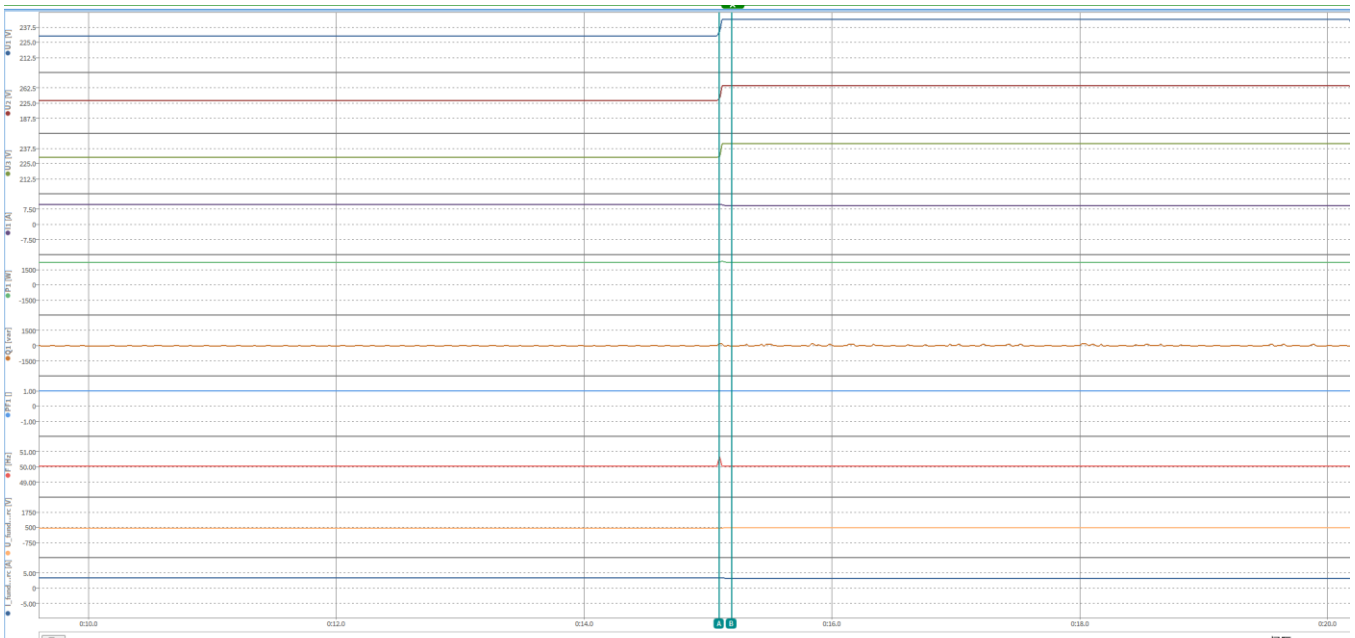
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0-60ms



	A	B	间隔
时间 [s]	0:15.09075	0:15.15168	0.06093
U1 [V]	229.9880	243.8138	13.82587
U2 [V]	229.9819	266.7773	36.79539
U3 [V]	229.9555	241.4474	11.49194
I1 [A]	9.614982	9.361355	-0.253627
P1 [W]	2209.536	2278.718	69.18115
Q1 [var]	-89.05165	-130.0897	-41.03801
PF1 []	0.999189	0.998374	-8.144e-4
F [Hz]	50.00154	49.99911	-2.430e-3
U_fund_SYM+_rc [V]	398.3267	433.1498	34.82309
I_fund_P_SYM+_rc [A]	3.202670	3.144458	-0.058212

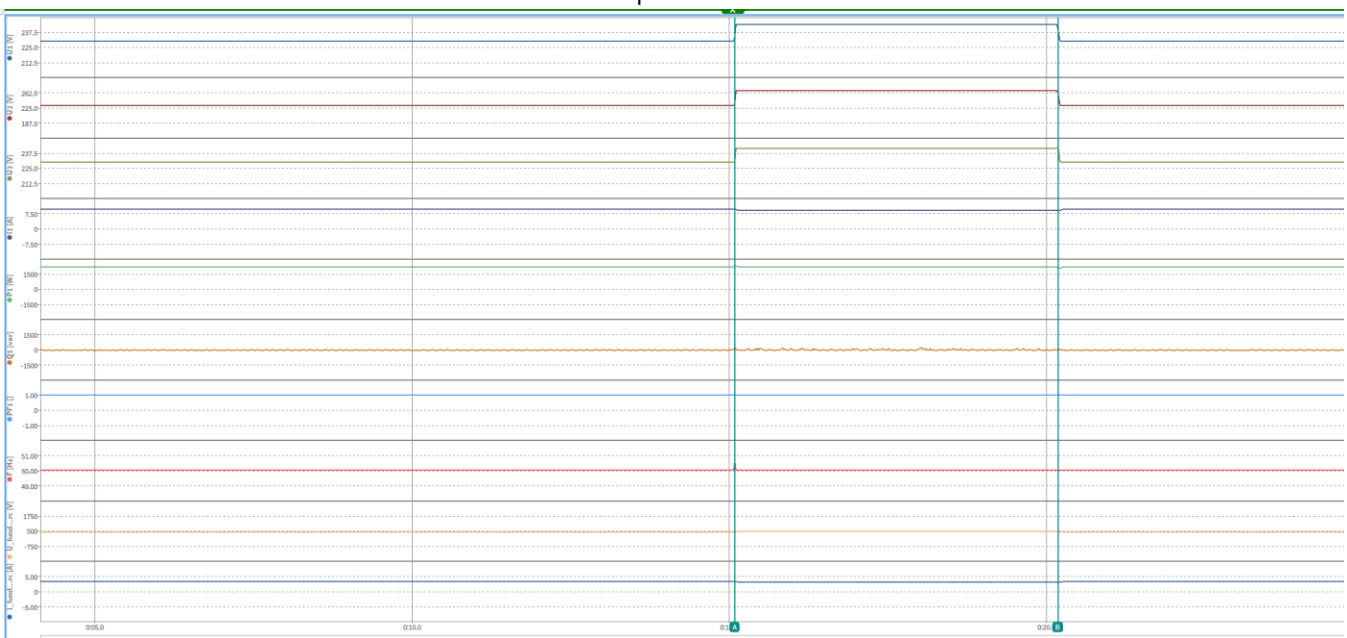
0-100ms



	A	B	间隔
时间 [s]	0:15.09075	0:15.19111	0.10036
U1 [V]	229.9880	243.8355	13.84756
U2 [V]	229.9819	266.7830	36.80107
U3 [V]	229.9555	241.4508	11.49530
I1 [A]	9.614982	9.043578	-0.571404
P1 [W]	2209.536	2203.521	-6.015381
Q1 [var]	-89.05165	-84.63039	4.421257
PF1 []	0.999189	0.999263	7.451e-5
F [Hz]	50.00154	50.00095	-5.913e-4
U_fund_SYM+_rc [V]	398.3267	433.1628	34.83610
I_fund_P_SYM+_rc [A]	3.202670	2.988122	-0.214548

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Drop duration



时间 [s]	A 0:15.09075	B 0:20.18295	间隔 5.09220
U1 [V]	229.9880	243.7908	13.80287
U2 [V]	229.9819	266.7786	36.79665
U3 [V]	229.9555	241.4549	11.49947
I1 [A]	9.614982	9.055408	-0.559573
P1 [W]	2209.536	2205.705	-3.831543
Q1 [var]	-89.05165	-92.06703	-3.015381
PF1 []	0.999189	0.999130	-5.877e-5
F [Hz]	50.00154	50.00143	-1.106e-4
U_fund_SYM+_rc [V]	398.3267	433.1391	34.81239
I_fund_P_SYM+_rc [A]	3.202670	3.003319	-0.199350

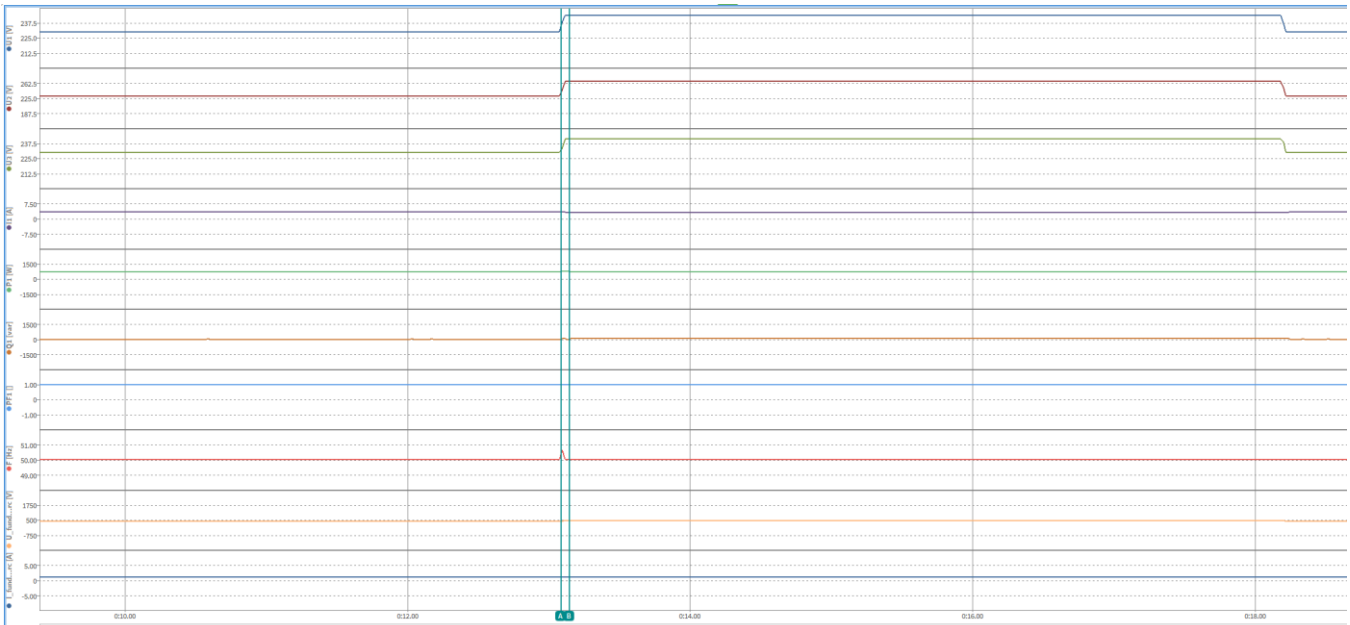
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Load tests 6.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	6.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,20
	5	Drop duration setpoint	Total	–	[ms]	5000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	5572
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,050
	10		Positive sequence			0,050
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	0,500
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,399
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,399
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,027
	16		Total	t_1-10 s to t_1	[p.u.]	-0,027
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9985
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,050
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,492
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,479
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,399
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,399
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

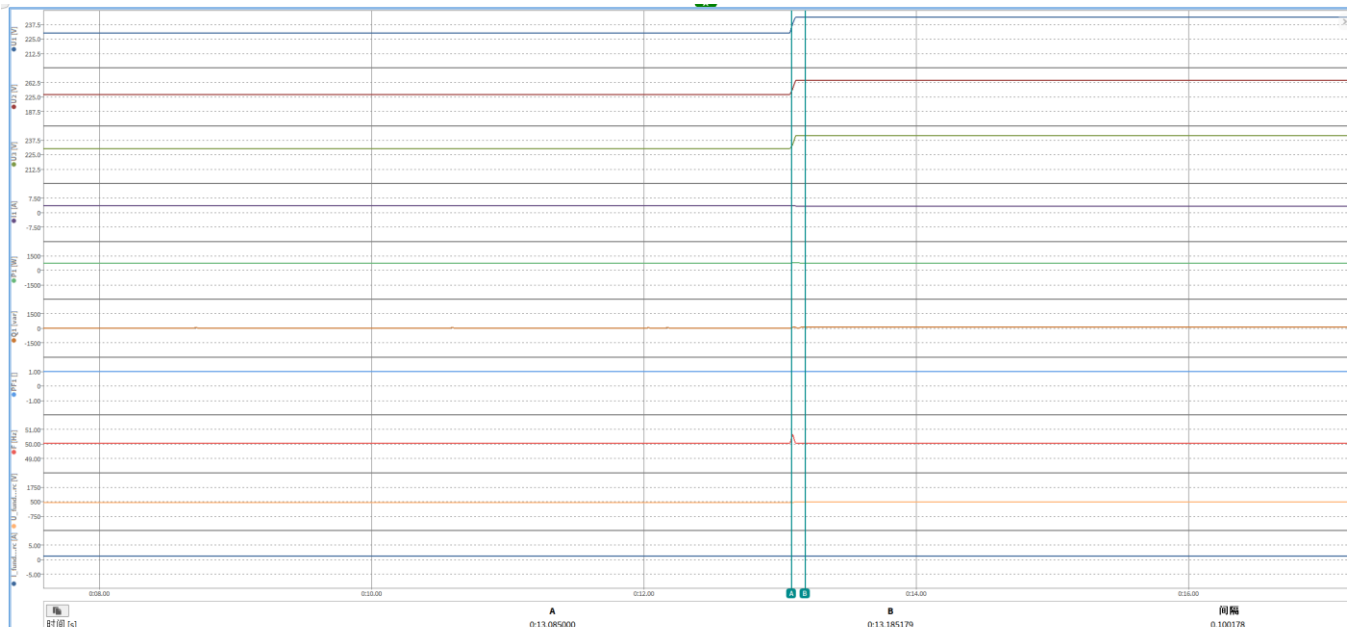
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0-60ms



时间 [s]	A 0:13.085000	B 0:13.145164	间隔 0.060164
U1 [V]	229.9978	243.8174	13.81963
U2 [V]	229.9867	266.7738	36.78711
U3 [V]	229.9612	241.4465	11.48532
I1 [A]	3.246704	3.114263	-0.132441
P1 [W]	745.3820	758.0549	12.67297
Q1 [var]	-44.92805	-43.66580	1.262249
PF1 []	0.998188	0.998345	1.567e-4
F [Hz]	49.99290	49.99956	6.660e-3
U_fund_SYM+_rc [V]	398.3406	433.1756	34.83501
I_fund_P_SYM+_rc [A]	1.080550	1.047624	-0.032926

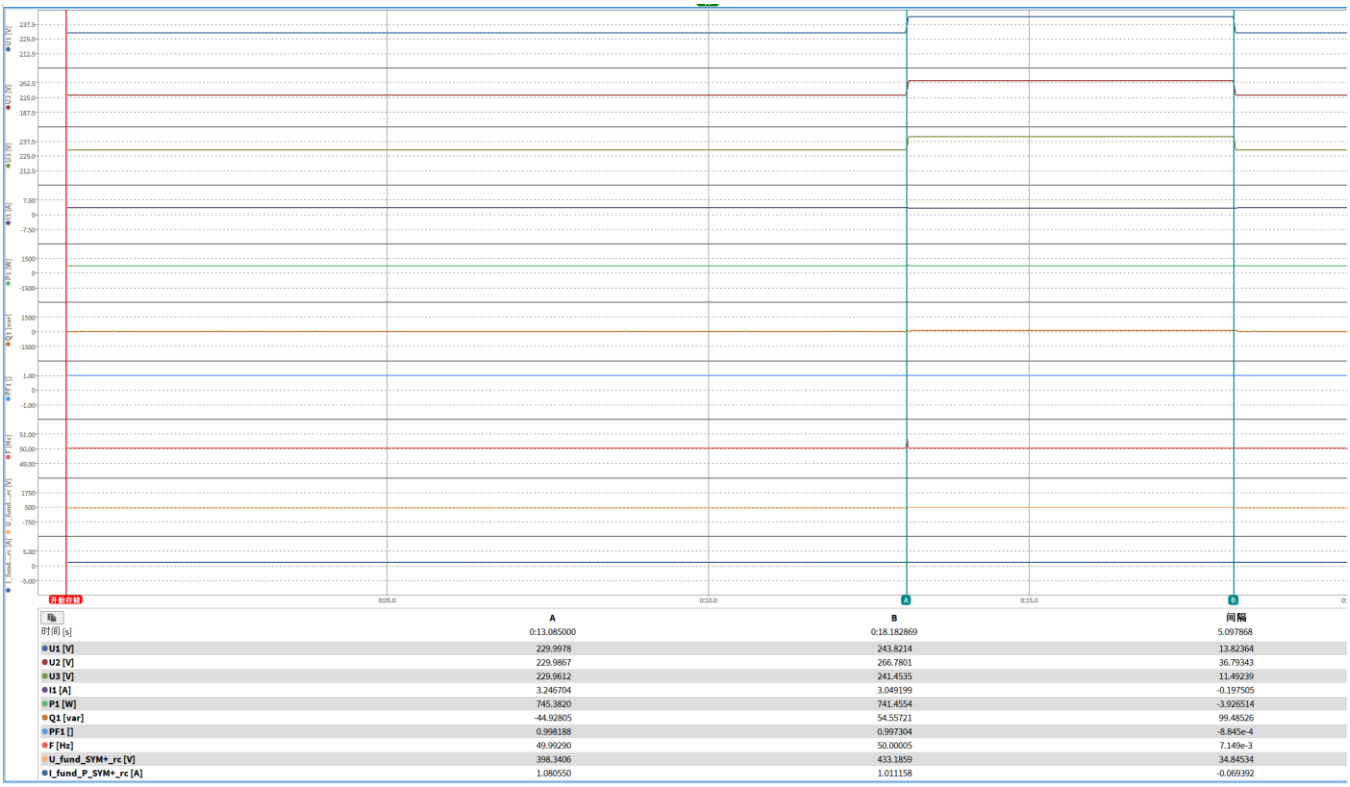
0-100ms



时间 [s]	A 0:13.085000	B 0:13.185179	间隔 0.100178
U1 [V]	229.9978	243.8323	13.83455
U2 [V]	229.9867	266.7748	36.78809
U3 [V]	229.9612	241.4473	11.48613
I1 [A]	3.246704	3.048336	-0.198369
P1 [W]	745.3820	741.9855	-3.396484
Q1 [var]	-44.92805	43.89594	88.82399
PF1 []	0.998188	0.998255	6.622e-5
F [Hz]	49.99290	50.00088	7.980e-3
U_fund_SYM+_rc [V]	398.3406	433.1836	34.84303
I_fund_P_SYM+_rc [A]	1.080550	1.008008	-0.072542

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Drop duration



	A	B	间隔
时间 [s]	0:13.085000	0:18.182869	5.097868
U1 [V]	229.9978	243.8214	13.82364
U2 [V]	229.9867	266.7801	36.79343
U3 [V]	229.9612	241.4535	11.49239
I1 [A]	3.246704	3.049199	-0.197505
P1 [W]	745.3820	741.4554	-3.926514
Q1 [var]	-44.92805	54.55721	99.48526
PF1 []	0.998188	0.997304	-8.845e-4
F [Hz]	49.99290	50.00005	7.149e-3
U_fund_SYM+_rc [V]	398.3406	433.1859	34.84534
I_fund_P_SYM+_rc [A]	1.080550	1.011158	-0.069392

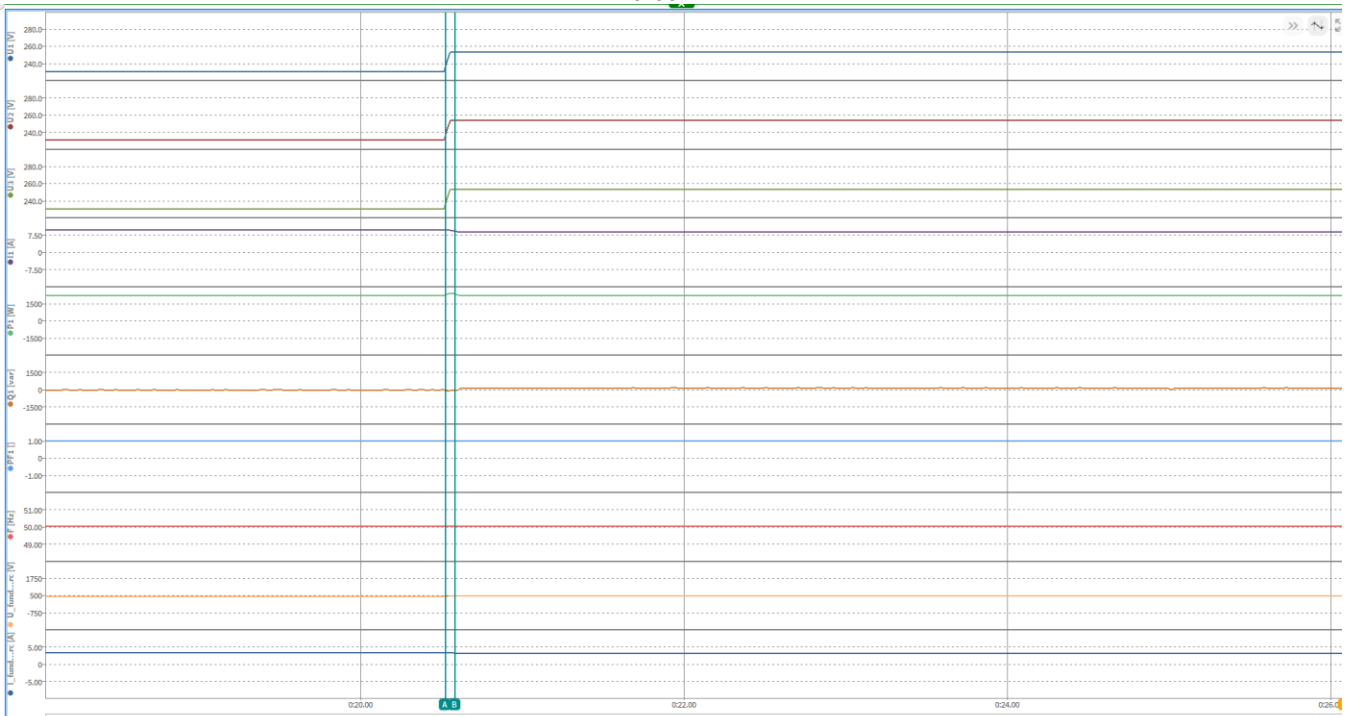
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Load tests 7.1

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	7.1
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,15
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	60304
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,149
	10		Positive sequence			0,149
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,002
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	0,034
	16		Total	t_1-10 s to t_1	[p.u.]	0,034
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9994
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,149
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,977
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,977
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	1,004
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	1,004
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	1,000
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,033
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,033
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

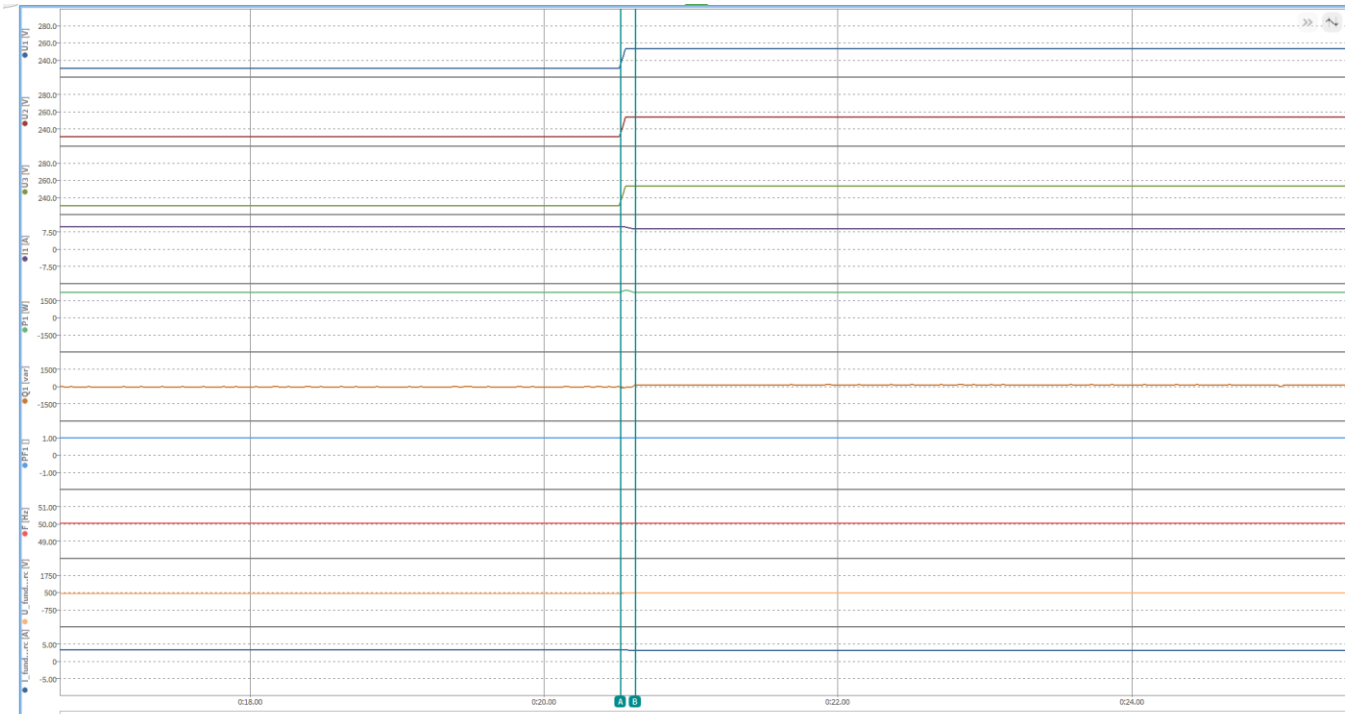
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0-60ms



时间 [s]	A 0:20.52226	B 0:20.58236	间隔 0.06010
U1 [V]	229.9845	253.1053	23.12086
U2 [V]	229.9853	252.9818	22.99654
U3 [V]	229.9597	252.9613	23.00159
I1 [A]	9.616800	9.434942	-0.181858
P1 [W]	2209.927	2384.861	174.9341
Q1 [var]	-88.90269	-123.0588	-34.15608
PF1 []	0.999192	0.998671	-5.205e-4
F [Hz]	49.99960	49.99892	-6.790e-4
U_fund_SYM+_rc [V]	398.7467	438.2343	39.48756
I_fund_P_SYM+_rc [A]	3.203128	3.112781	-0.090347

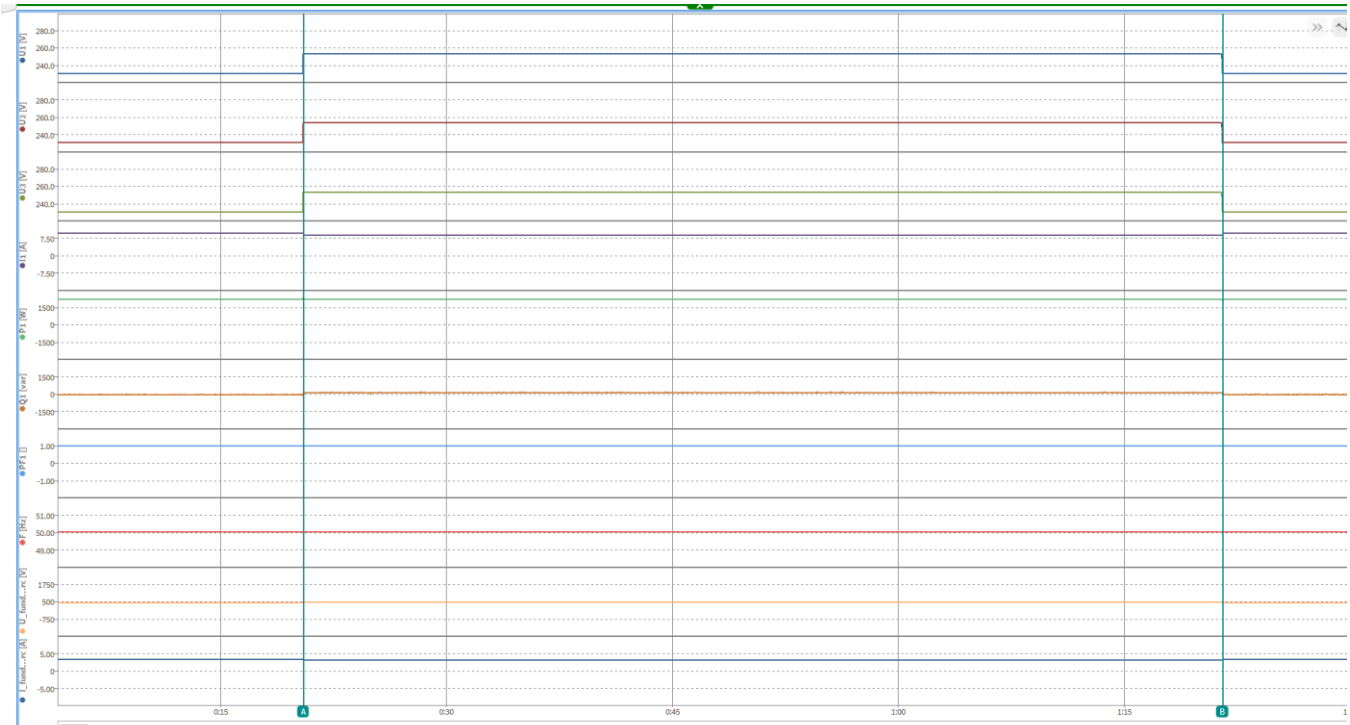
0-100ms



时间 [s]	A 0:20.52226	B 0:20.62258	间隔 0.10031
U1 [V]	229.9845	253.0986	23.11412
U2 [V]	229.9853	252.9835	22.99823
U3 [V]	229.9597	252.9617	23.00203
I1 [A]	9.616800	8.710165	-0.906635
P1 [W]	2209.927	2202.785	-7.142334
Q1 [var]	-88.90269	87.71532	176.6180
PF1 []	0.999192	0.999208	1.627e-5
F [Hz]	49.99960	50.00006	4.616e-4
U_fund_SYM+_rc [V]	398.7467	438.2315	39.48471
I_fund_P_SYM+_rc [A]	3.203128	2.902013	-0.301115

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Drop duration



	A	B	间隔
时间 [s]	0:20.52226	1:21.51446	1:00.99219
U1 [V]	229.9845	252.9961	23.01166
U2 [V]	229.9853	252.9818	22.99651
U3 [V]	229.9597	252.9522	22.99252
I1 [A]	9.616800	8.713148	-0.903652
P1 [W]	2209.927	2202.501	-7.425781
Q1 [var]	-88.90269	91.29514	180.1978
PF1 []	0.999192	0.999142	-4.977e-5
F [Hz]	49.99960	50.00072	1.122e-3
U_fund_SYM+_rc [V]	398.7467	438.1662	39.41948
I_fund_P_SYM+_rc [A]	3.203128	2.902056	-0.301071

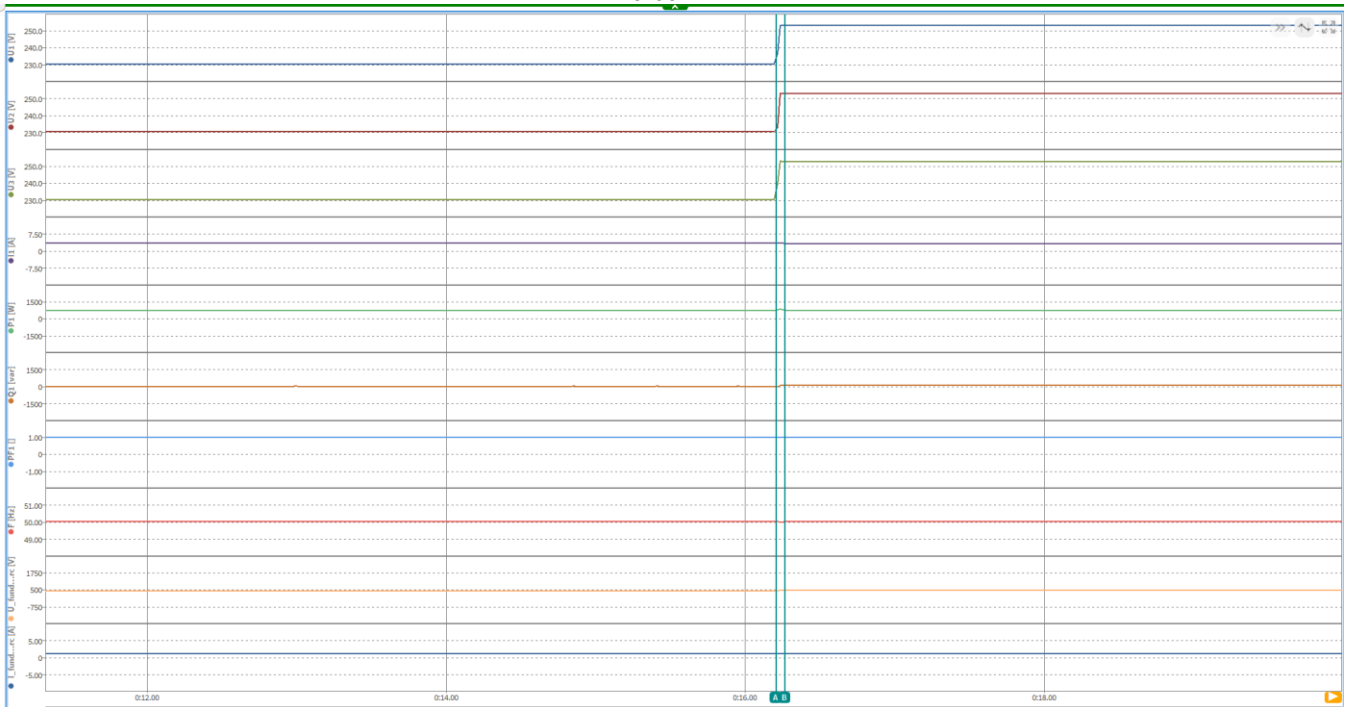
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Load tests 7.2

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	7.2
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	A
	4	Drop depth setpoint	Phase	–	[p.u]	1,15
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	60216
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,149
	10		Positive sequence			0,149
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,003
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,392
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,392
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,027
	16		Total	t_1-10 s to t_1	[p.u.]	-0,027
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9986
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,149
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,381
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,381
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,391
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,391
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,391
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

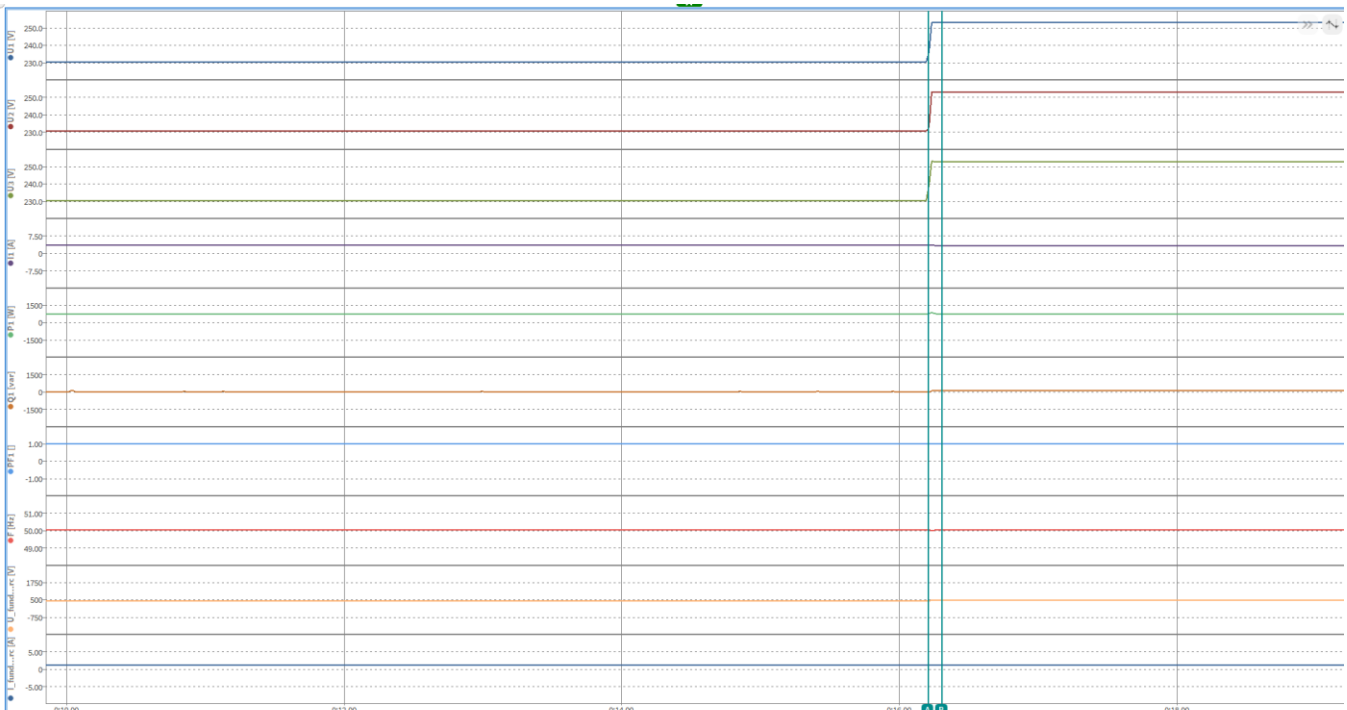
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0-60ms



时间 [s]	A 0:16.20420785	B 0:16.26428281	间隔 0.06007496
U1 [V]	230.0119	253.1712	23.15927
U2 [V]	229.9839	252.9878	23.00388
U3 [V]	229.9542	252.9477	22.99350
I1 [A]	3.250692	3.151521	-0.099171
P1 [W]	746.4163	796.0429	49.62659
Q1 [var]	-43.75908	54.02935	97.78843
PF1 []	0.998286	0.997705	-5.814e-4
F [Hz]	49.99805	49.99972	1.671e-3
U_fund_SYM+_rc [V]	398.3436	438.2709	39.92739
I_fund_P_SYM+_rc [A]	1.081105	1.041799	-0.039306

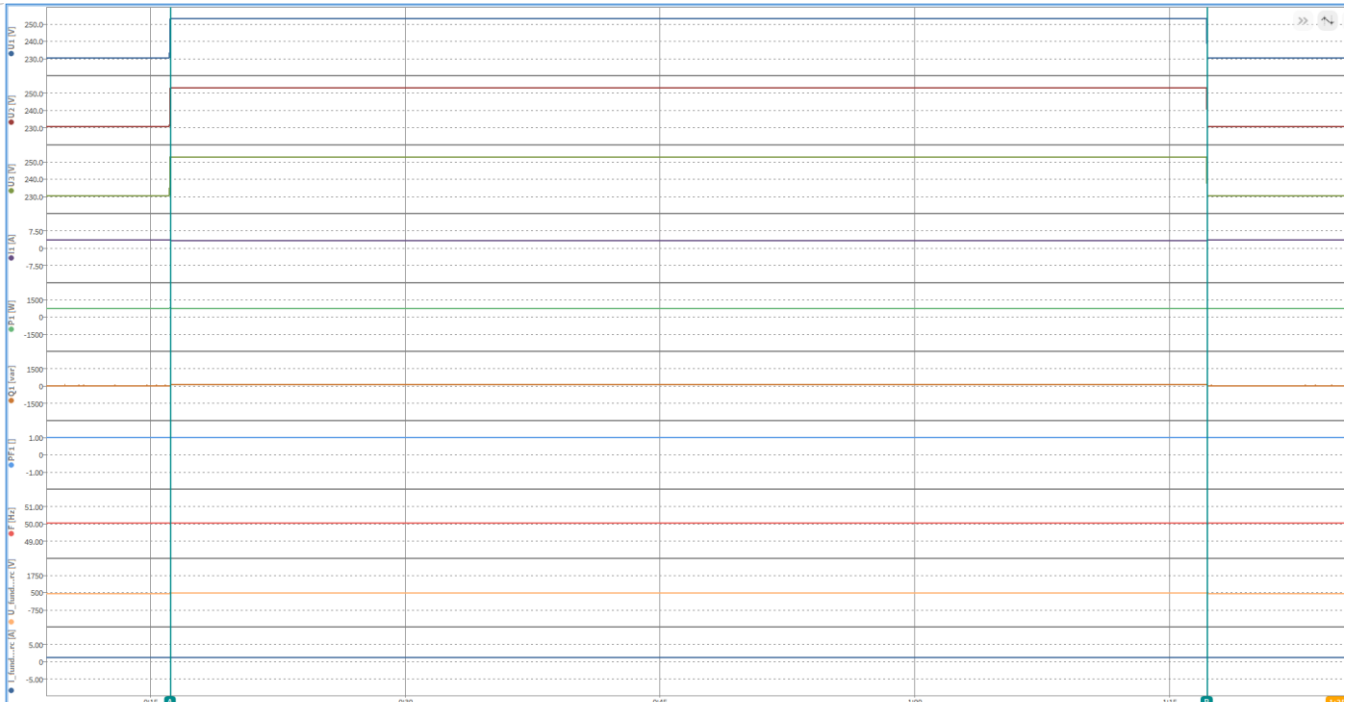
0-100ms



时间 [s]	A 0:16.20420785	B 0:16.30483528	间隔 0.10062743
U1 [V]	230.0119	253.1488	23.13684
U2 [V]	229.9839	252.9896	23.00569
U3 [V]	229.9542	252.9534	22.99918
I1 [A]	3.250692	2.928771	-0.321921
P1 [W]	746.4163	739.5424	-6.873962
Q1 [var]	-43.75908	52.66038	96.41945
PF1 []	0.998286	0.997474	-8.115e-4
F [Hz]	49.99805	49.99923	1.179e-3
U_fund_SYM+_rc [V]	398.3436	438.2610	39.91741
I_fund_P_SYM+_rc [A]	1.081105	0.974042	-0.107064

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Drop duration



	A	B	间隔
时间 [s]	0:16.20420785	1:17.19964094	1:00.99543309
U1 [V]	230.0119	253.0264	23.01442
U2 [V]	229.9839	252.9845	23.00055
U3 [V]	229.9542	252.9481	22.99388
I1 [A]	3.250692	2.931515	-0.319177
P1 [W]	746.4163	739.6516	-6.764709
Q1 [var]	-43.75908	55.76156	99.52063
PF1 []	0.998286	0.997170	-1.116e-3
F [Hz]	49.99805	50.00064	2.590e-3
U_fund_SYM+_rc [V]	398.3436	438.1837	39.84019
I_fund_P_SYM+_rc [A]	1.081105	0.974918	-0.106187

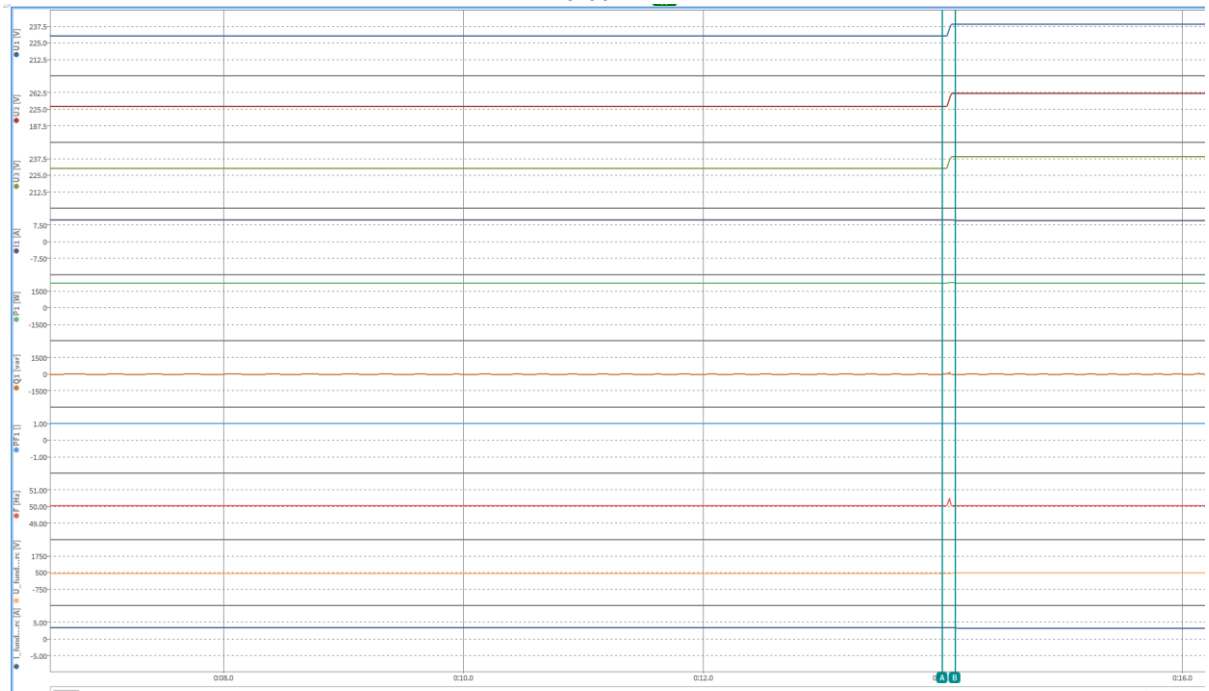
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Load tests 7.3

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	7.3
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,15
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	60217
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,039
	10		Positive sequence			0,039
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,001
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	1,001
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	1,001
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,033
	16		Total	t_1-10 s to t_1	[p.u.]	-0,033
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9995
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,039
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,985
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,973
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	1,001
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	1,001
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,999
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	0,033
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	0,033
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

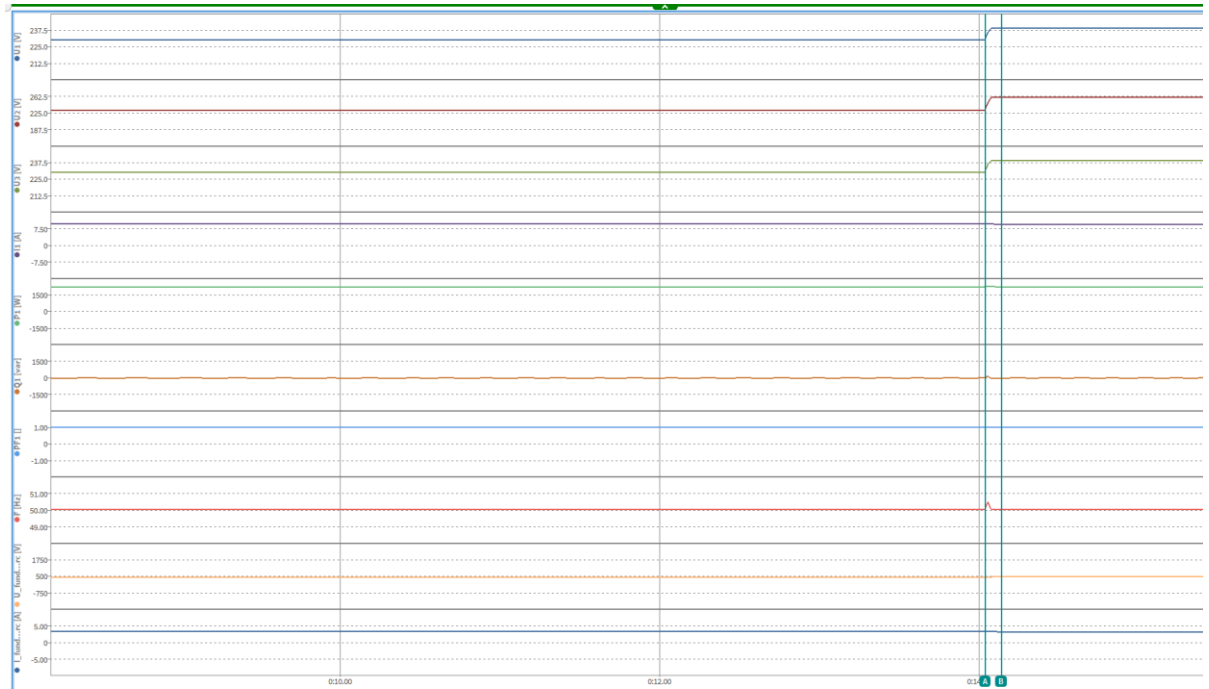
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0-60ms



时间 [s]	A 0:13.99569	B 0:14.10115	间隔 0.10546
U1 [V]	229.9845	239.2057	9.221191
U2 [V]	229.9792	259.8850	29.90581
U3 [V]	229.9555	239.1407	9.185196
I1 [A]	9.606471	9.473356	-0.133115
P1 [W]	2207.467	2263.435	55.96777
Q1 [var]	-90.93232	-109.4743	-18.54197
PF1 []	0.999153	0.998832	-3.203e-4
F [Hz]	50.00064	49.99947	-1.171e-3
U_fund_SYM+_rc [V]	398.3236	425.6118	27.28813
I_fund_P_SYM+_rc [A]	3.201220	3.169188	-0.032032

0-100ms



时间 [s]	A 0:14.04019	B 0:14.14090	间隔 0.10071
U1 [V]	230.0082	239.2171	9.208878
U2 [V]	229.9726	259.8813	29.90866
U3 [V]	229.9445	239.1463	9.201843
I1 [A]	9.611626	9.222418	-0.389208
P1 [W]	2209.131	2204.219	-4.911621
Q1 [var]	-84.67756	-92.52339	-7.845833
PF1 []	0.999266	0.999120	-1.460e-4
F [Hz]	50.00976	50.00059	-9.171e-3
U_fund_SYM+_rc [V]	398.3256	425.6189	27.29335
I_fund_P_SYM+_rc [A]	3.202674	3.062975	-0.139698

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Drop duration



	A	B	间隔
时间 [s]	0:14.04019	1:15.03804	1:00.99784
U1 [V]	230.0082	239.1842	9.175934
U2 [V]	229.9726	259.8748	29.90219
U3 [V]	229.9445	239.1511	9.206619
I1 [A]	9.611626	9.240021	-0.371605
P1 [W]	2209.131	2208.532	-0.598633
Q1 [var]	-84.67756	-82.34133	2.336227
PF1 []	0.999266	0.999306	3.952e-5
F [Hz]	50.00976	49.99950	-0.010262
U_fund_SYM+_rc [V]	398.3256	425.6008	27.27525
I_fund_P_SYM+_rc [A]	3.202674	3.068690	-0.133984

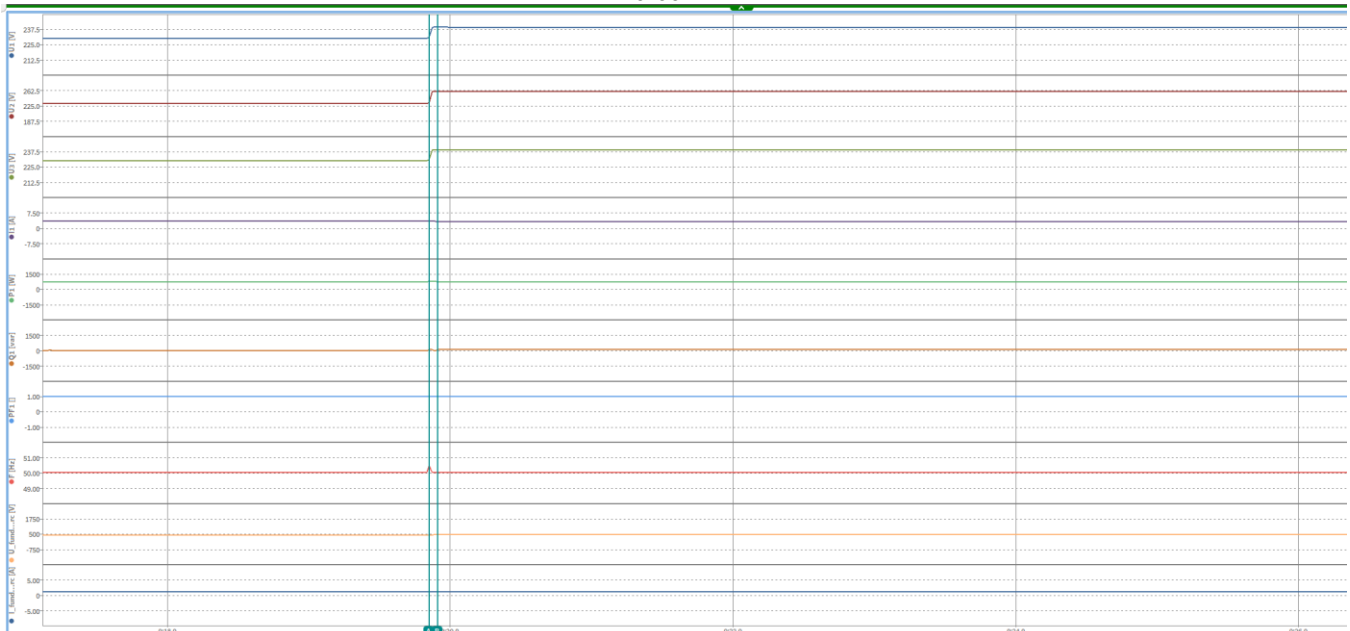
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Load tests 7.4

	No.	Parameter	Phase reference	Reference time	Value (unit)	Value
General information	0	Test no.	–	–	–	7.4
	1	Date	–	–	[dd.mm.yyyy]	17.01.2026
	2	Time (Start of test)	–	–	[hh:mm:ss.f]	-
	3	Type of fault (number of affected phases)	–	–	–	D1
	4	Drop depth setpoint	Phase	–	[p.u]	1,15
	5	Drop duration setpoint	Total	–	[ms]	60000
	6	Fault occurrence (*t*1)	Total	–	[ms]	-
	7	Fault clearance (*t*2)	Total	–	[ms]	-
	8	Fault duration determined from test	Total	–	[ms]	60253
	9	Measeured value of voltage drop / increase	Total	t_1+100ms to $t_2$and t_1-10 s to t_1	[p.u.]	0,040
	10		Positive sequence			0,040
Before t_1	11	Voltage	Phase to Neutral	t_1-10s to t_1	[p.u.]	0,999
	12	Current	Positive sequence	t_1-500 ms to t_1-100 ms	[p.u.]	1,002
	13	Active power	Total	t_1-10 s to t_1	[p.u.]	0,399
	14		Positive sequence	t_1-10 s to t_1	[p.u.]	0,399
	15	Reactive power	Positive sequence	t_1-10 s to t_1	[p.u.]	-0,025
	16		Total	t_1-10 s to t_1	[p.u.]	-0,025
	17	cos φ	-	t_1-10 s to t_1	[p.u.]	0,9987
t_1 till t_2	18	Voltage	Phase to Neutral	t_1+100 ms to t_2-20 ms	[p.u.]	1,040
	19	Phase current	Phase 1	t_1+60 ms	[p.u.]	N/A
	20		Phase 2	t_1+60 ms	[p.u.]	N/A
	21		Phase 3	t_1+60 ms	[p.u.]	0,393
	22	Phase current	Phase 1	t_1 +100 ms	[p.u.]	N/A
	23		Phase 2	t_1 +100 ms	[p.u.]	N/A
	24		Phase 3	t_1 +100 ms	[p.u.]	0,393
	25	Active power	Total	t_1+100 ms to t_2-20 ms	[p.u.]	0,398
	26		Positive sequence	t_1+100 ms to t_2-20 ms	[p.u.]	0,398
After t_2	27	Voltage	Phase to Neutral	t_2+3 s to t_2+10 s	[p.u.]	0,999
	28	Active power	Positive sequence	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	29		Total	t_2+3 s to *t*2+10 s	[p.u.]	0,398
	30	Response time active power	Positive sequence	-	[s]	N/A
	31	Reactive power	Positive sequence	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	32		Total	t_2+3 s to t_2+10 s	[p.u.]	-0,027
	33	Response time reactive power	Positive sequence	–	[s]	N/A
	34	EZE didn´t disconnect from grid within 60s after fault ended yes/no?	–	t_2 to t_2+60s	–	Yes

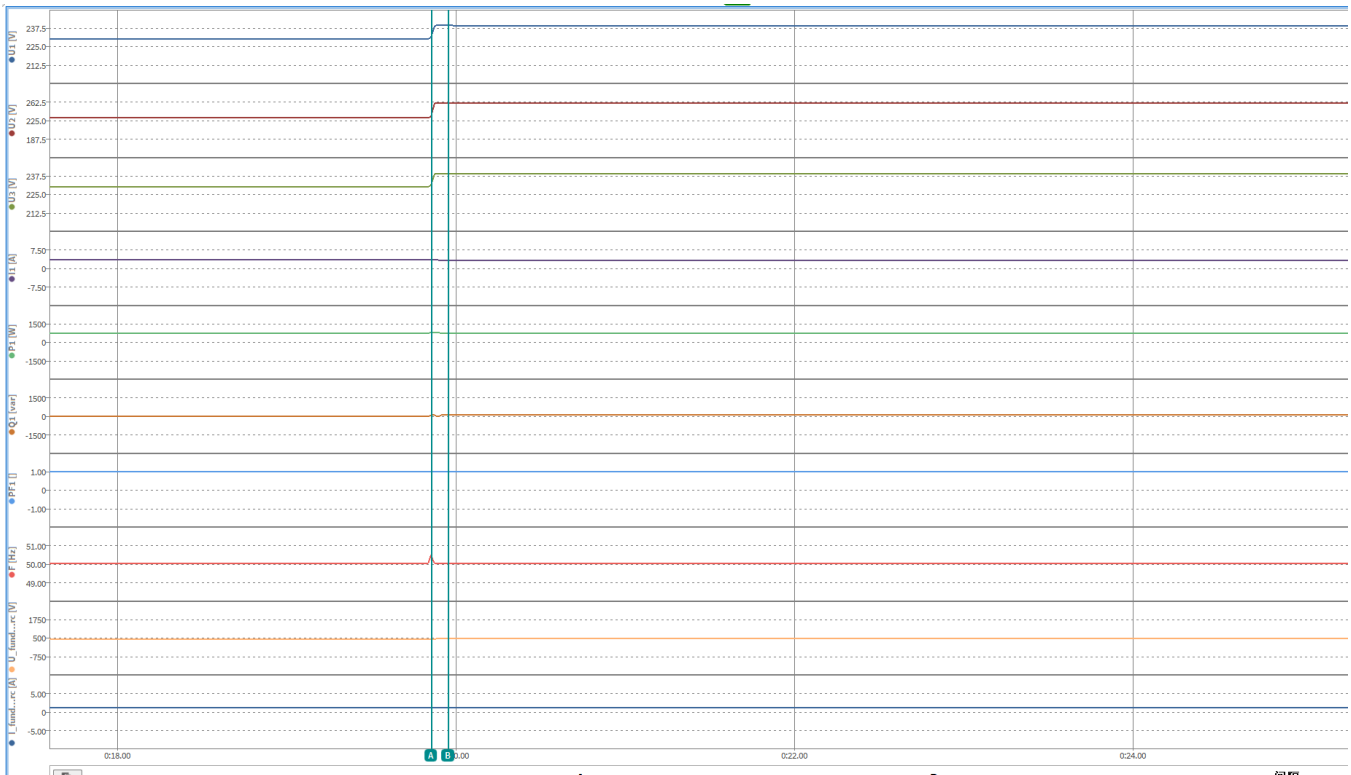
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0-60ms



	A	B	间隔
时间 [s]	0:19.85159	0:19.91171	0.06013
U1 [V]	230.0166	239.2580	9.241440
U2 [V]	229.9808	259.8751	29.89430
U3 [V]	229.9581	239.1412	9.183167
I1 [A]	3.253586	3.189481	-0.064105
P1 [W]	746.6667	761.5308	14.86414
Q1 [var]	-50.59277	-49.05309	1.539680
PF1 []	0.997712	0.997932	2.195e-4
F [Hz]	49.99888	49.99866	-2.174e-4
U_fund_SYM+_rc [V]	398.3455	425.6630	27.31753
I_fund_P_SYM+_rc [A]	1.081559	1.069348	-0.012211

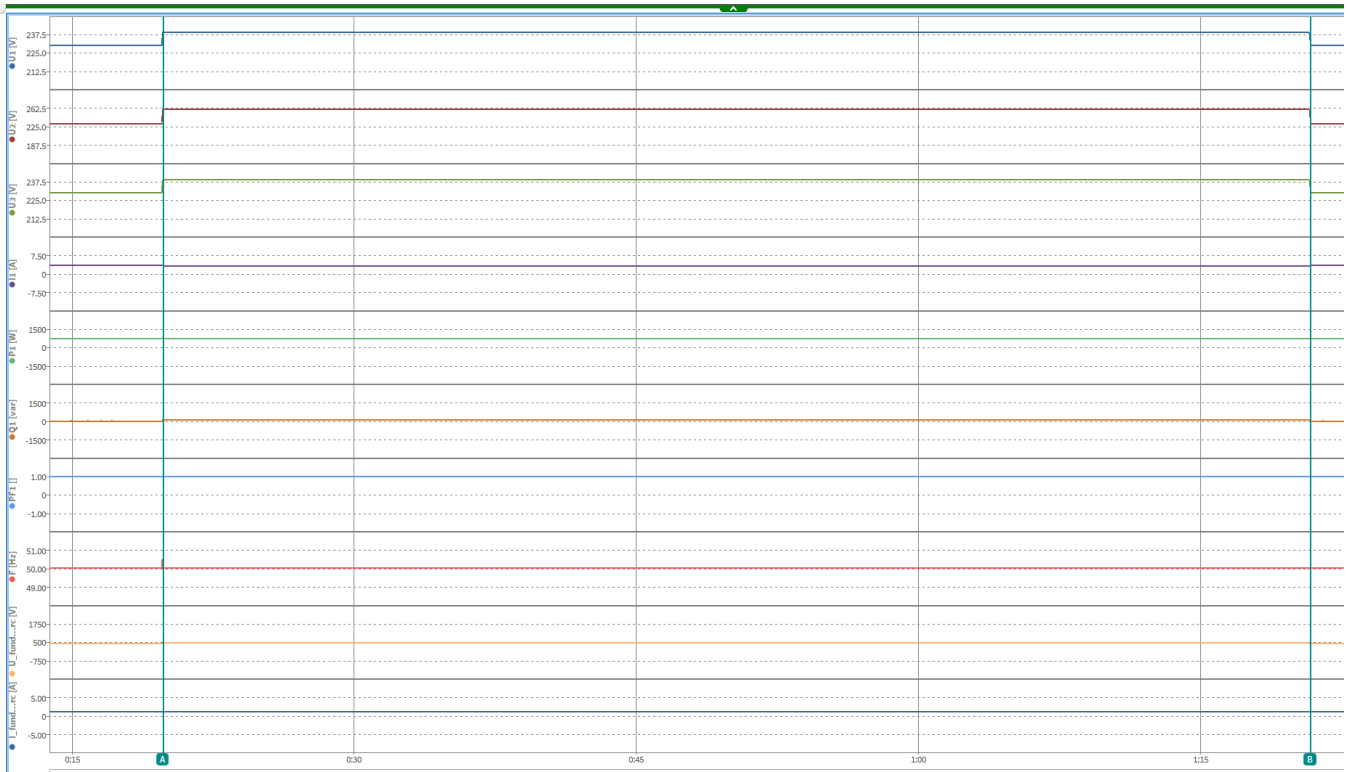
0-100ms



	A	B	间隔
时间 [s]	0:19.85431	0:19.95493	0.10062
U1 [V]	230.0166	239.2579	9.241333
U2 [V]	229.9808	259.8802	29.89946
U3 [V]	229.9581	239.1455	9.187485
I1 [A]	3.253586	3.109879	-0.143707
P1 [W]	746.6667	742.8846	-3.782104
Q1 [var]	-50.59277	41.86296	92.45574
PF1 []	0.997712	0.998416	7.037e-4
F [Hz]	49.99888	49.99882	-5.722e-5
U_fund_SYM+_rc [V]	398.3455	425.6648	27.31936
I_fund_P_SYM+_rc [A]	1.081559	1.030857	-0.050702

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Drop duration



	A	B	间隔
时间 [s]	0:19.85431	1:20.84426	1:00.98994
U1 [V]	230.0166	239.2251	9.208496
U2 [V]	229.9808	259.8741	29.89326
U3 [V]	229.9581	239.1546	9.196503
I1 [A]	3.253586	3.113612	-0.139975
P1 [W]	746.6667	743.6473	-3.019348
Q1 [var]	-50.59277	42.38072	92.97349
PF1 []	0.997712	0.998380	6.677e-4
F [Hz]	49.99888	50.00157	2.693e-3
U_fund_SYM+_rc [V]	398.3455	425.6477	27.30228
I_fund_P_SYM+_rc [A]	1.081559	1.034377	-0.047182

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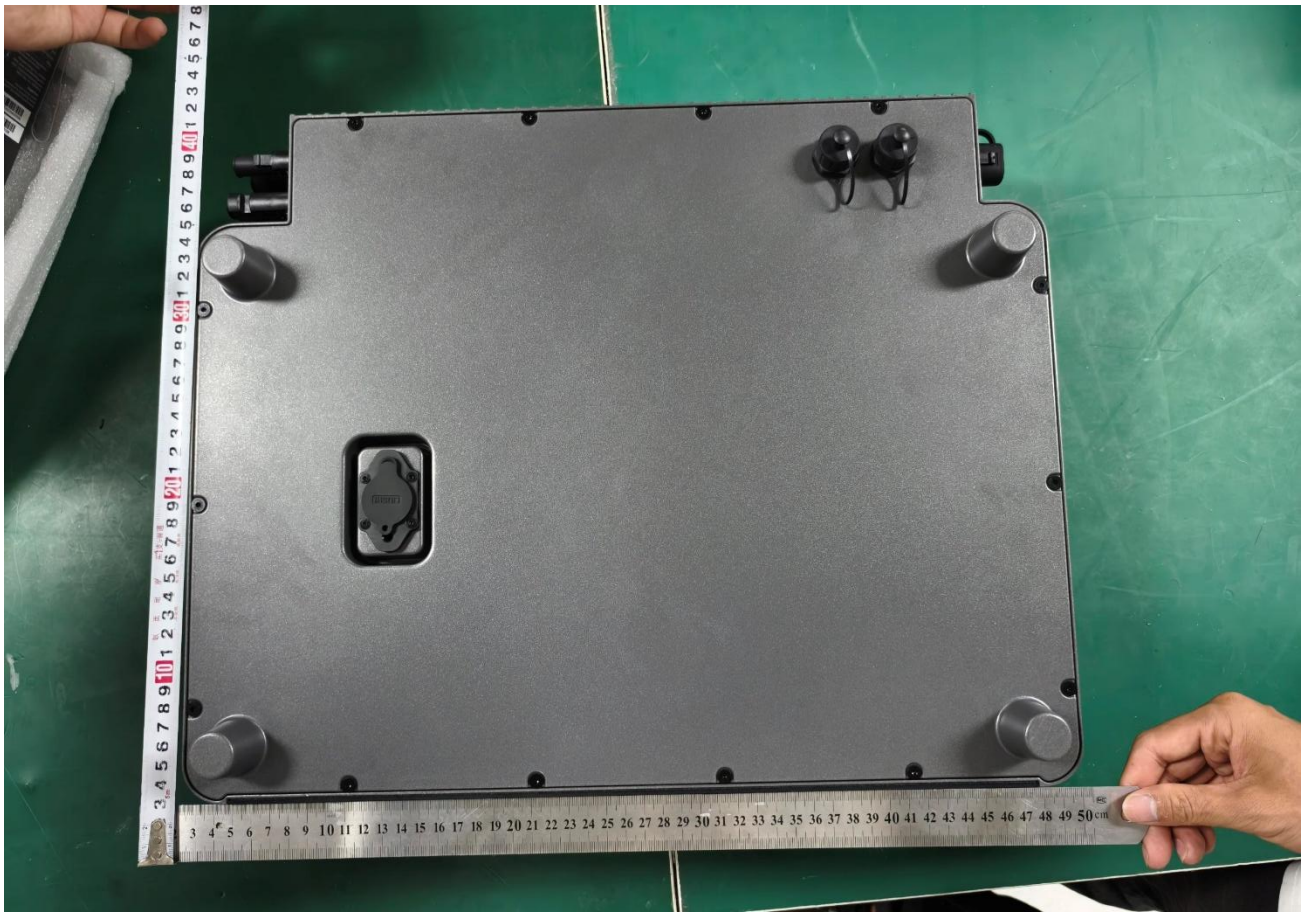
Annex No, 1
Pictures of the unit

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Enclosure front

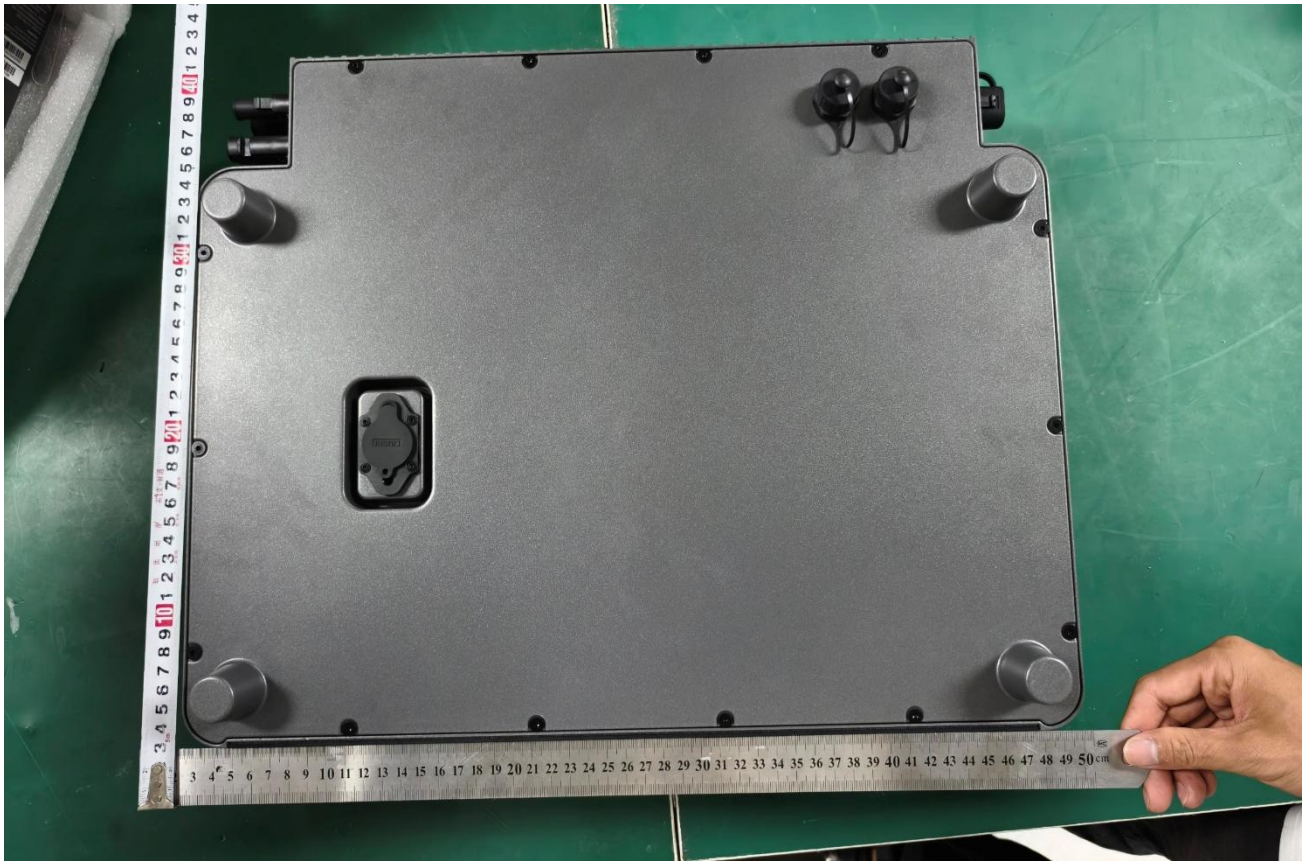


Enclosure back



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Enclosure bottom



Enclosure top side



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Enclosure left side

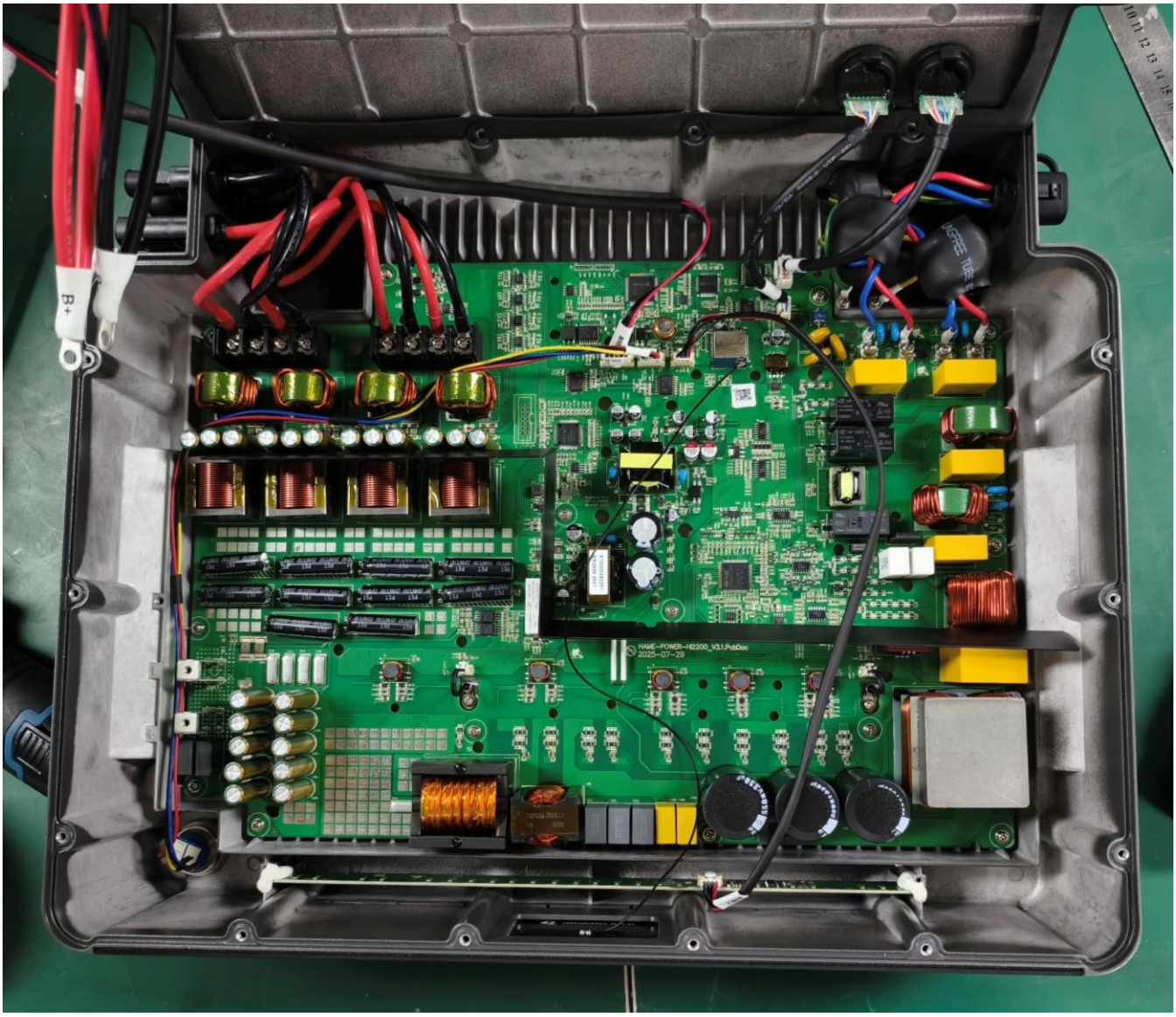


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Annex No, 2
Test Equipment list

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No.	Equipment	Internal No.	Type	Manufacturer	Last Calibration	Due Date
1	Oscilloscope	A4089036SH	DL850	YOKOGAWA	7/May/25	6/May/26
2	Oscilloscope	A4089058SH	ZDS30244Plus	ZLG	5/Jun/25	4/Jun/26
3	Voltage probe	A4089059SH	DP6150A	CYBERTEK	5/Jun/25	4/Jun/26
4	Voltage probe	A4089060SH	DP6150A	CYBERTEK	5/Jun/25	4/Jun/26
5	Voltage probe	A4089063SH	DP6150A	CYBERTEK	5/Jun/25	4/Jun/26
6	Current probe	A4089061SH	CPL8100A	CYBERTEK	5/Jun/25	4/Jun/26
7	Current probe	A4089062SH	CPL8100A	CYBERTEK	5/Jun/25	4/Jun/26
8	Current probe	A4089064SH	CPL8100A	CYBERTEK	5/Jun/25	4/Jun/26
9	Bidirectional AC power source	A7040135SH	AGS-40-7006	ACTION	5/Jun/25	4/Jun/26
10	Bidirectional DC power source	A7040136SH	ABS-E40-2006	ACTION	5/Jun/25	4/Jun/26
11	Power Analyzer	A1240096SH	WT3000	YOKOGAWA	7/May/25	6/May/26
12	Power Analyzer	A1240097SH	WT3000	YOKOGAWA	7/May/25	6/May/26
13	Temperature & humidity meter	B4200079SH	314	center	10/May/25	9/May/26
14	Power Analyzer	A1240132SH	DEWE2-A4	DEWETRON	9/May/25	8/May/26

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End of Test Report

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