Test Report issued under the responsibility of:

LYNS-TCi

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 Number.	**HC2411280272GC02**
Total pages	231
Tested by (name + signature)	Leslie He / Test engineer
Approved by (name + signature)	Lukes Lin / Project Manager
Date of issue	2025-02-20

Applicant's name	Anker Innovations Limited
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Manufacturer	Same as Applicant
Address	Same as Applicant

Testing laboratory name	Lyns-tci Technology Guangdong Co., Ltd.
Address	Room 1201, Unit 2, Building 18, No. 7, Science and Technology Boulevard, Houjie Town, Dongguan City, Guangdong, 523960 P.R.C
Testing Location	As above
Address	As above

Test specification:	
Standard	VDE AR-N 4105:2018-11 DIN VDE V 0124-100:2020-06
Test Report Form No.	VDE0124-100 VER.1.1

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Product name ..... :	Anker SOLIX Solarbank 3 E2700 Pro
Trade Mark ..... :	ANKER SOLIX
Factory's name ..... :	Huizhou Blueway Electronics Co., Ltd
Factory address ..... :	No. 101, West hechang 5th Road, Zhongkai High-Tech Development Zone, Huizhou, Guangdong, P.R. China

Model/Type reference ..... :	**A17C53Z1**	**A17C53Z1-20**
Expansion Models ..... :	**A17C53Z1-1**	**A17C53Z1-20-1**
	A17C53Z1-2	**A17C53Z1-20-2**
	A17C53Z1-3	**A17C53Z1-20-3**
	A17C53Z1-4	**A17C53Z1-20-4**
	A17C53Z1-5	**A17C53Z1-20-5**
Ratings:		
DC input (PV)		
Max. DC input voltage [V] ..... :	60	
Max. PV Input Current [A] ..... :	32*4	
Max.Isc PV [A] ..... :	40*4	
Max. PV Input Power [W] ..... :	3600	
Battery connection		
Brand ..... :	Anker innovations Limited	
Technology ..... :	Rechargeable Li-ion Battery	
Battery Model ..... :	A17C53Z1-85	
Total Energy Capacity ..... :	105Ah, 2688Wh	
Firmware version of the BMS ..... :	0.3.2.0	
Number of expansion modules ..... :	1-5	
Battery voltage [V] ..... :	25,6 Vd.c.	
Battery charging current [A] ..... :	max. 70	
Battery discharging current [A] ..... :	max. 75	
Rated Power (Single device) [W] ..... :	1800	
AC connection (On-grid terminal)		
Nominal output AC voltage [V] ..... :	220/230 (L + N + PE, 50Hz) *	
Output AC current [A] ..... :	max. 3,5	max. 5,3
Nominal active output power P_n [W]:	800	1200
Max. apparent power [VA] ..... :	800	1200
AC connection (Off-grid terminal)		
Nominal output AC voltage [V] ..... :	220/230 (L + N + PE, 50Hz)	
Nominal active output power P_n [W]:	1200	

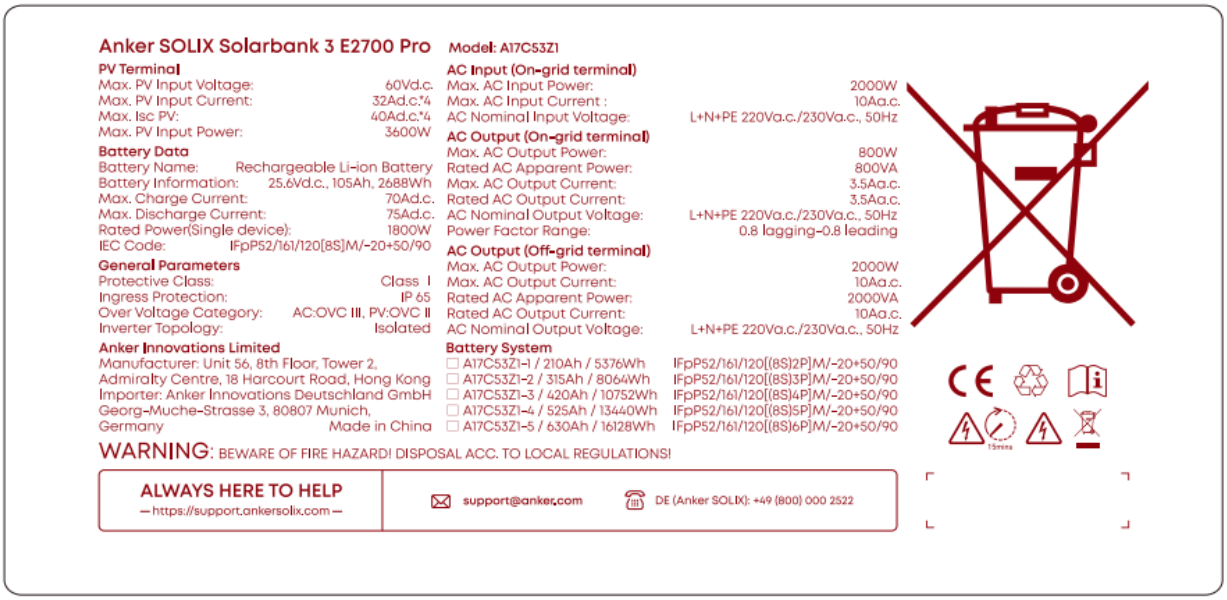
Max. AC Output current [A] .....:	max. 5,3
Max. AC Bypass Output Power [W] .:	2000
Max. AC Bypass Output Current [A] :	max. 10
Software version.....:	V1.0
Note: * All tests are performed at 230V, 50Hz.	

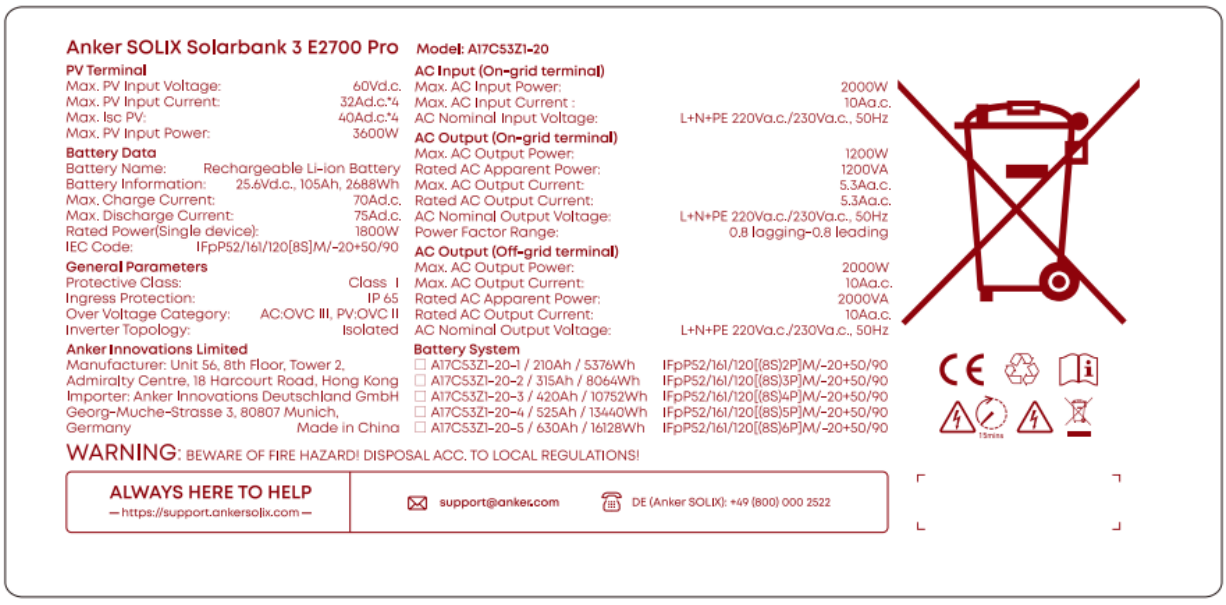
Contents

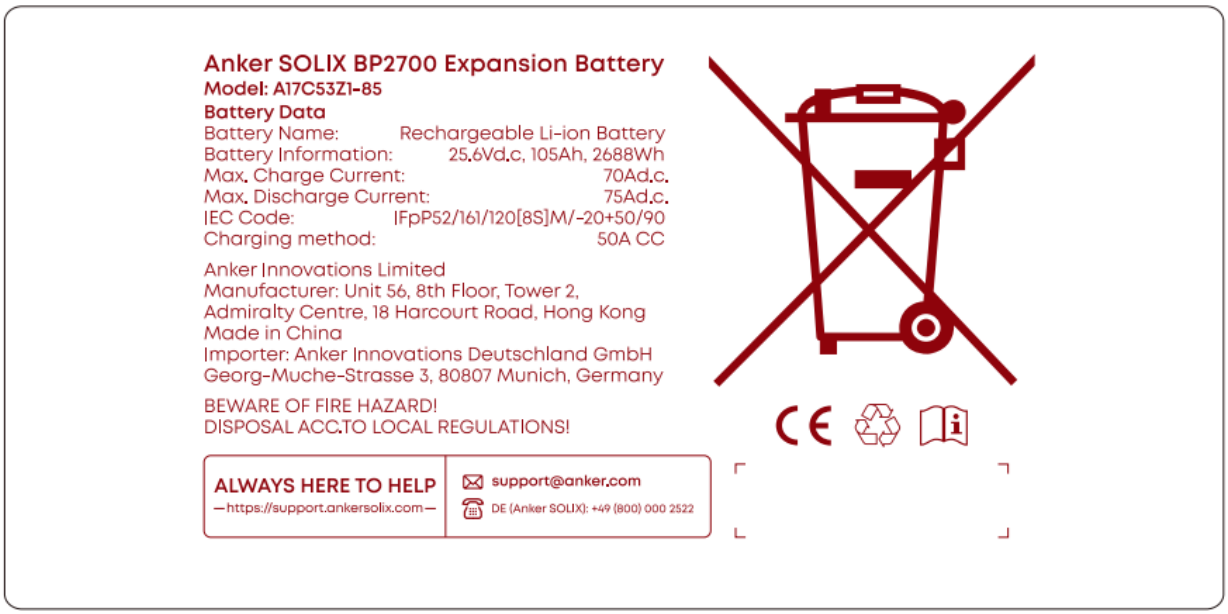
Revision history of test report

Issued Date	Description	Report Number
2025-02-20	Initial issue.	HC2411280272GC02

Copy of marking plate







Note:

The marking plates shown above may be only a draft. The use of certification marks on products must be approved by the respective NCBs to which these marks belong.

The marking plate is attached to the side surface or the back of the enclosure and is visible after installation.

General remarks - documentation

Possible test case verdicts

Test case does not apply to the test object ...: N/A

Test case is not rated .....: N/R

Test item does meet the requirement .....: P (Pass)

Test item does not meet the requirement ....: F (Fail)

Testing

Date of receipt of test items .....: 2024-12-06

Date(s) of performance of tests .....: 2024-12-06 to 2025-01-18

General remarks:

The test result presented in this report relate only to the object(s) tested. This report shall not be reproduced in part or in full without the written approval of the issuing testing laboratory.

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

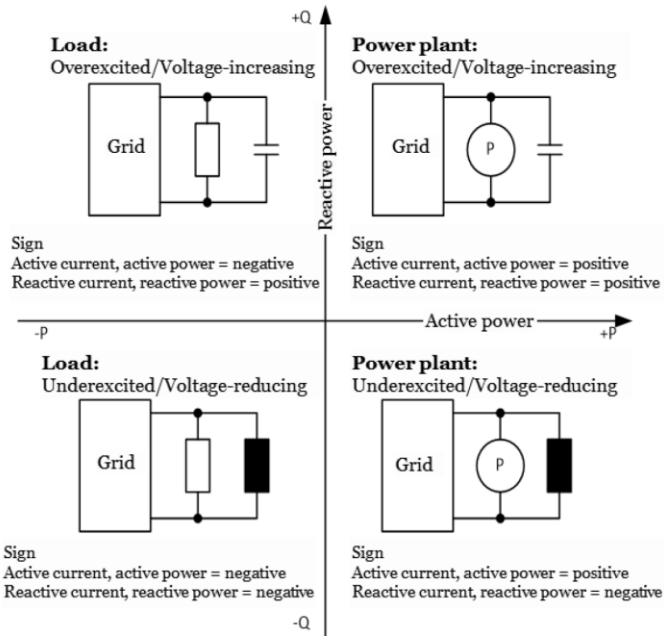
Throughout this report a ☒comma / ☐point is used as the decimal separator.

Conformity statements are decided in accordance with ILAC-G8:09/2019 Binary Statement for Simple Acceptance Rule, unless otherwise normatively specified or contractually agreed.

Direction definition of P and Q:

in this test report, the regarded system of the voltage and current vectors is the active sign convention system:

- If the inverter feeds to the grid the active power is measured with positive sign.
- If the inverter injects reactive power / current with leading power factor the reactive power / current is marked “leading” or “inductive” (under-excited) or has a negative sign.
- If the inverter injects reactive power / current with lagging power factor the reactive power / current is marked “lagging” or “capacitive” (over-excited) or has a positive sign.



General remarks for testing

Test setup:

For the testing 2 test setups were used:

a) *Test setup 1:* used for tests except islanding prevention testing.

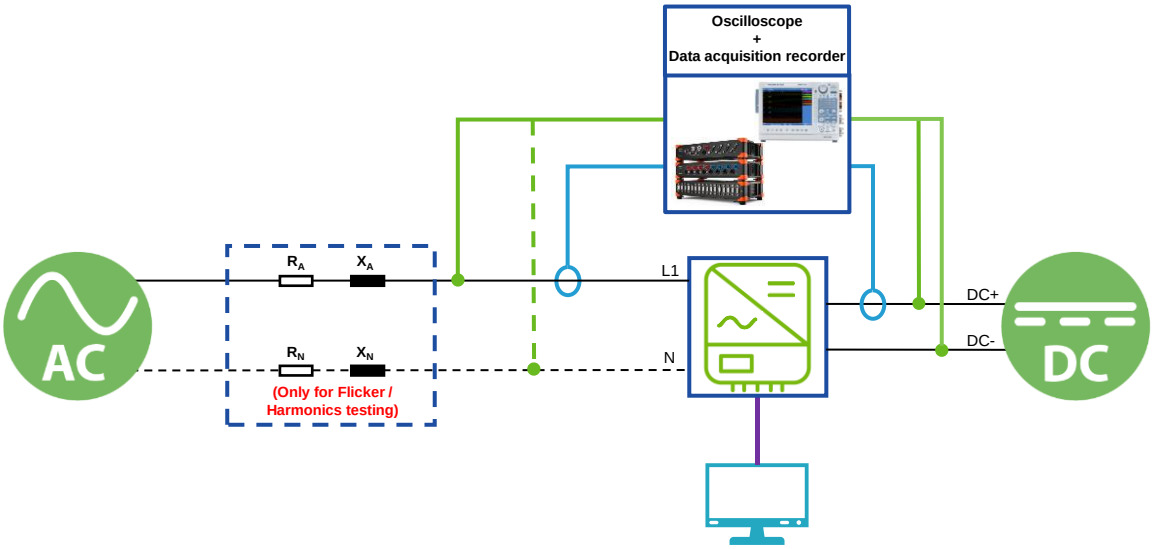


Figure 1 – Test setup 1

b) Test setup 2: Basic test configuration for islanding detection function

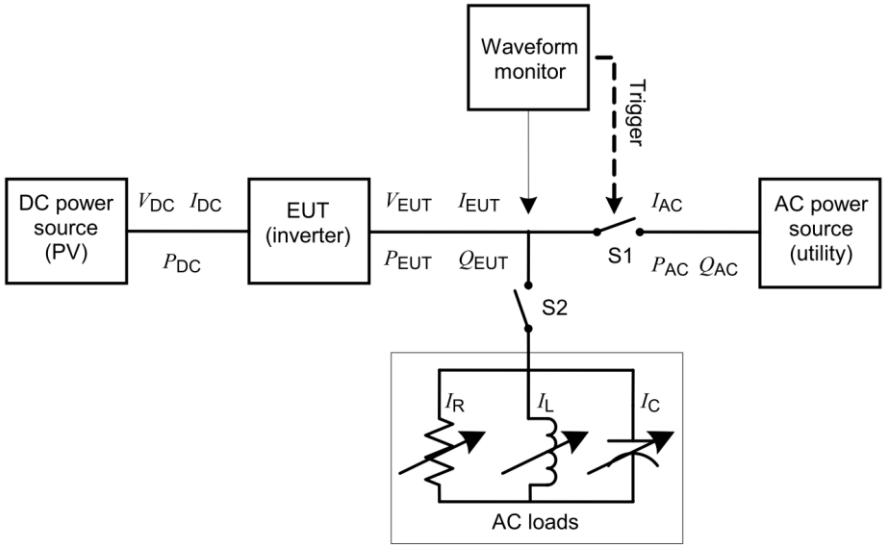


Figure 2 – Test circuit for islanding detection function in a power conditioner (inverter) from IEC 62116:2014

General product information

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]	:	Approximately 29,2kg

General product information

The Hybrid Inverter is a single-phase type, The inverter input voltage supply can be supplied DC voltage by PV array and battery, and the output can connect to the grid. (See Figure 3)

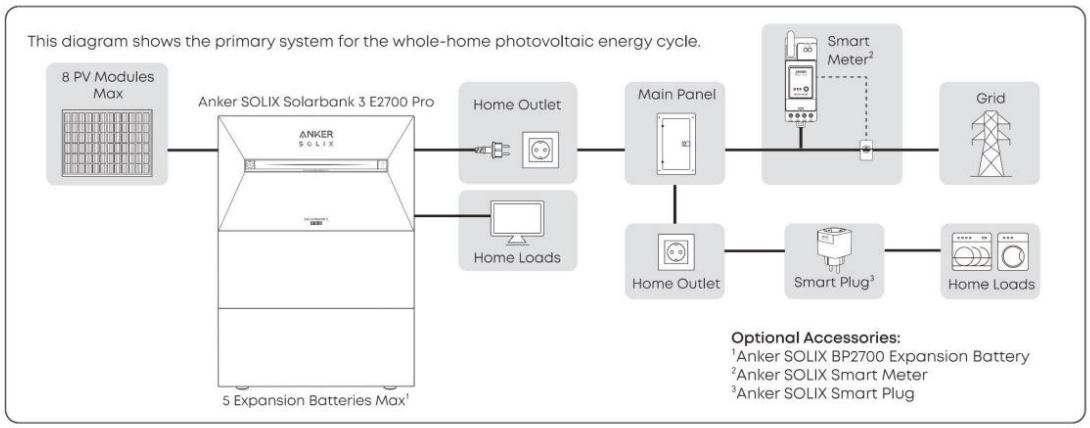


Figure 3 – Scheme of an installation

The product was tested on the EUT **A17C53Z1-20**.

Hardware Version: HVDSP Board: V0.4

LVDSP Board: V0.2

Software Version: V1.0

Model Difference:

The units in the product series:

- sharing the same control electronics.
- with the same firmware.
- with the same construction solutions including the power part.
- with the same number of phases.
- with the same power electronics, filters and transducers.

General product information

Description of the power circuit (Figure 4):

The inverter converts DC voltage, generated by photovoltaic modules and battery, into AC voltage.
The units are single-phase.
The device uses 4 sets of MPPT units. The unit provides galvanic isolation of the primary and secondary sides (with transformer). The output is composed of an H-bridge circuit and an on-grid and off-grid relay. They control the state of on-grid and off-grid state respectively. The PCS and the battery are connected after voltage conversion through DC/DC.
The battery uses 8 strings together.
The battery can obtain energy not only from PV, but also from the grid, that is to say, the battery to the inverter is a unit that supports the two-way flow of energy.
The device uses two DSP chips, one on each of the primary and secondary sides, to control the power modules and Sample voltage and current signals on the low-voltage side and the high-voltage side respectively, and the two DSPs communicate with each other through CAN.

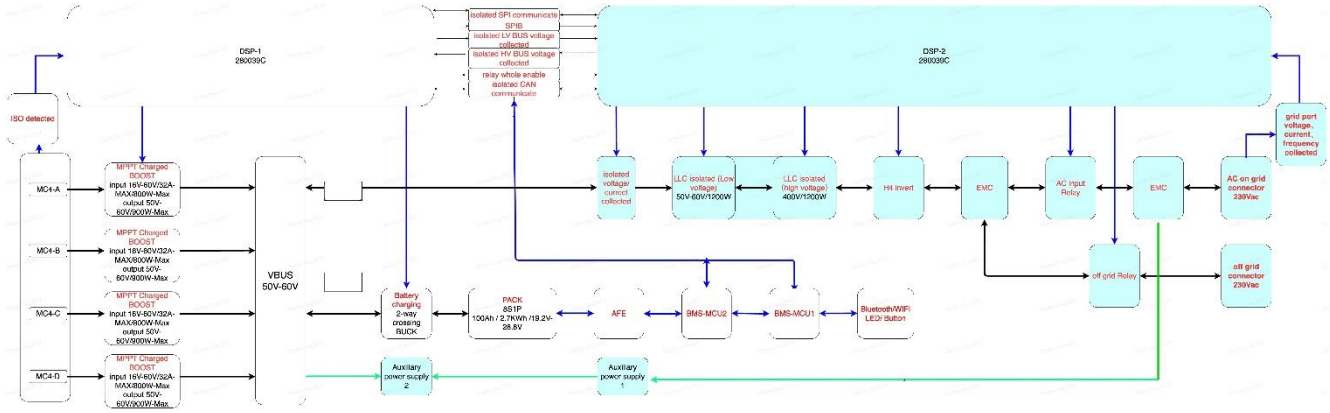


Figure 4 – Block diagram

Assessment

Clause/§	Requirement	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)	**N/A**
5.2.5	Commutation	**N/A**
5.2.6	Feed in of DC current	**P**
5.3	**Evidence of symmetry behaviour of inverters**	
5.3.1	General	**N/A**
5.3.2.1	Calculation of the asymmetry of three-phase inverters	**N/A**
5.3.2.2.1	Failure of single inverter modules	**N/A**
5.3.2.2.2	Power drop of single inverter modules	**N/A**
5.3.2.3.2	Symmetrical operation with a symmetry device	**N/A**
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**
5.4.3.3	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 over-frequency	**P**
5.4.5	Active power feed-in of Storage systems for over-frequency	**P**
5.4.6	Active power feed-in for PGUs at underfrequency	**P**
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)	**P**
	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**

Assessment

Clause/§	Requirement	Verdict
5.4.8.4.2	Test of the dynamics of the Q(U) regulation	**N/A**
5.5	**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	**N/A**
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	**N/A**
5.5.10.3	Islanding protection according to table 6 – Load imbalance (real, reactive load) for test condition A (PGU output = 100%)	**P**
	Islanding protection according to table 7 – Load imbalance (real, reactive load) for test condition B (PGUT output = 66%)	**P**
	Islanding protection according to table 8 – Load imbalance (real, reactive load) for test condition C (PGU output = 33%)	**P**
5.6	**Connecting conditions and synchronization**	
5.6.1	General	**P**
5.6.2	Connecting conditions and synchronisation	**P**
5.7	**Evidence of $P_{AV,E}$ - Control**	
5.7.1	General	**P**
5.7.2.1	Test control dynamic	**P**
5.7.2.2	Test disconnection function	**N/A**
5.8	**Evidence dynamic grid support**	
5.8.1	General	**P**

Assessment

Clause/§	Requirement	Verdict
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**
5.9	**Test of Ancillary Unit**	

Annex 1– Test Results

5.2	Evidence of permissible network perturbations	
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)		

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

Assessment criterion:

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)

A17C53Z1-20

Switch-on for any capacity (10% P_{Emax})

Phase	L1			L2			L3		
Single period effective values of the current [A]	0,176	0,177	0,178	--	--	--	--	--	--
Single period effective values of the voltage [V]	229,89	229,91	229,89	--	--	--	--	--	--
k_i value [1]	0,101	0,102	0,103	--	--	--	--	--	--
k_{imax} value [1]	0,103			--			--		

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

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

Switch-on for nominal capacity

Phase	L1			L2			L3		
Single period effective values of the current [A]	0,583	0,580	0,610	--	--	--	--	--	--
Single period effective	229,92	229,94	229,93	--	--	--	--	--	--

values of the voltage [V]									
k_i value [1]	0,335	0,334	0,351	--	--	--	--	--	--
k_{imax} value [1]	0,351			--			--		
Switch-off for nominal capacity									
Phase	**L1**			**L2**			**L3**		
Single period effective values of the current [A]	0,160	0,159	0,160	--	--	--	--	--	--
Single period effective values of the voltage [V]	229,76	229,99	229,72	--	--	--	--	--	--
k_i value [1]	0,092	0,092	0,092	--	--	--	--	--	--
k_{imax} value [1]	0,092			--			--		

Grid Frequency [Hz]	50
Grid voltage [V]	230
Rated current I_r [A]	1,739
Highest k_{imax} value for all switching operations [1]	0,351

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.2.3 Flicker **These tests are designed to provide evidence that the requirements of VDE-AR-N 4100:2019-04 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 rises of the PGU at 100% P_{Emax}: ≤ 3 %

Assessment criterion:

Long-term flicker strength Plt to DIN EN 61000-3-3 (VDE 0838-3) 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.

Note:

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!)
Grid impedance DIN EN 61000-3-11 (VDE 0838-11) [Ω]:	R_A = 0,24Ω jX_A = 0,15Ω / R_N = 0,16Ω jX_N = 0,10Ω (Rn and jXn only for line to neutral single-phase or three units used!) R_A = 0,15Ω jX_A= 0,15Ω / R_N = 0,01Ω jX_N= 0,01Ω (Rn and jXn only for line to line three-phase units used!)

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Test result:

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

EUT		**Selection of limits**				
☒ **1- phase**	☐ **3-phase**	☒ Equipment with rated current ≤16 A per phase		☐ Equipment with rated current ≤75 A per phase		
A17C53Z1-20		*IEC EN 61000-3-3*		*IEC EN 61000-3-11*		
		d_{max}	d_c	T_{max}	P_{st}	P_{lt}
Phase L1		0,433	0,394	0	0,497	0,495
Phase L2		--	--	--	--	--
Phase L3		--	--	--	--	--
Output voltage of the impedance network [V]				230,0		

Reference impedance according the standard:

☒ 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!)

☐	Grid impedance DIN EN 61000-3-11 (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 line to neutral single-phase or three units used!)
☐	Grid impedance DIN EN 61000-3-11 (VDE 0838-3) [Ω]:	R_A = 0,15Ω jX_A= 0,15Ω / R_N = 0,01Ω jX_N= 0,01Ω (Rn and jXn only for line to line three-phase units used!)

Flicker for rated currents ≤75A to DIN EN 61000-3-11 (VDE 0838-3)					
Assessment criterion: Long-term flicker strength: P_{lt}≤0,5					
Grid impedance angle ψ_k	☒ 32° or ☐ 45				
Flicker coefficient c(ψ_k)	7,741				
b) Flicker to DIN EN 61000-3-3 (VDE 0838-3) for generator units > 75 A					**N/A**
Adherence to the thresholds for flicker must be verified as followed: - For PGUs (power generation units) and PSUs (power supply units) intended for PGSs (power generation systems) with nominal currents > 75 A, the measurements must be conducted as in 5.2.3.2.					
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 %					
Assessment criterion: Long-term flicker strength: P_{lt}≤0,5					
Test result :					
Flicker for rated currents >75A (at SCR = 20) (Calculation Flickermeter according to TG3)					
Rated Output voltage [V]	--				
Grid impedance angle ψ_k [°]	30	50	70	85	
Flicker coefficient c(ψ_k) [1]	--	--	--	--	
Short-term Flicker P_{st} [1]	--	--	--	--	
Flicker step factor k(fψ_k) [1]	--	--	--	--	
Voltage change factor k(uψ_k) [1]	--	--	--	--	

5.2.4	Harmonics and interharmonics	P

5.2.4.1 a)	Harmonics test	P

EUT		Selection of limits		
☒	☐	☒	☐	☐
1-phase	*3-phase*	Class A equipment with input current ≤16 A per phase	Equipment with input current >16 A and ≤75 A per phase	Equipment with input current >75 A per phase
A17C53Z1-20		***IEC EN 61000-3-2***	***IEC EN 61000-3-12***	

Phase	**L1**	**L2**	**L3**
Power Level	**30%**	**30%**	**30%**
AC Power [W]	360	--	--
AC Voltage [V]	230,29	--	--
AC Current [A]	1,565	--	--
Frequency [Hz]	50,00	--	--

Harmonic	**Measured value I_h [A]**			**Measured value I_h [%I_1]**			**Limits [A]** IEC EN 61000-3-2
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	
1st	1,565	--	--	--	--	--	--
2nd	0,001	--	--	0,034	--	--	1,080
3rd	0,017	--	--	1,085	--	--	2,300
4th	0,000	--	--	0,025	--	--	0,430
5th	0,037	--	--	2,348	--	--	1,140
6th	0,000	--	--	0,017	--	--	0,300
7th	0,020	--	--	1,255	--	--	0,770
8th	0,000	--	--	0,018	--	--	0,263
9th	0,010	--	--	0,634	--	--	0,400
10th	0,000	--	--	0,017	--	--	0,184
11th	0,004	--	--	0,262	--	--	0,330
12th	0,000	--	--	0,019	--	--	0,153
13th	0,001	--	--	0,071	--	--	0,210
14th	0,000	--	--	0,017	--	--	0,131
15th	0,002	--	--	0,139	--	--	0,150
16th	0,000	--	--	0,017	--	--	0,115
17th	0,004	--	--	0,238	--	--	0,132
18th	0,000	--	--	0,017	--	--	0,102
19th	0,005	--	--	0,296	--	--	0,188
20th	0,000	--	--	0,018	--	--	0,092
21th	0,005	--	--	0,316	--	--	0,107
22th	0,000	--	--	0,018	--	--	0,084
23th	0,005	--	--	0,312	--	--	0,098
24th	0,000	--	--	0,018	--	--	0,077
25th	0,005	--	--	0,309	--	--	0,090

26th	0,000	--	--	0,018	--	--	0,071
27th	0,004	--	--	0,284	--	--	0,080
28th	0,000	--	--	0,022	--	--	0,066
29th	0,004	--	--	0,272	--	--	0,078
30th	0,000	--	--	0,020	--	--	0,061
31th	0,004	--	--	0,264	--	--	0,073
32th	0,000	--	--	0,021	--	--	0,057
33th	0,004	--	--	0,261	--	--	0,068
34th	0,000	--	--	0,023	--	--	0,054
35th	0,004	--	--	0,251	--	--	0,064
36th	0,000	--	--	0,022	--	--	0,051
37th	0,004	--	--	0,275	--	--	0,061
38th	0,000	--	--	0,022	--	--	0,048
39th	0,007	--	--	0,416	--	--	0,058
40th	0,001	--	--	0,032	--	--	0,046
THD [%]	--	--	--	3,139	--	--	--

Phase	**L1**	**L2**	**L3**
Power Level	**60%**	**60%**	**60%**
AC Power [W]	728	--	--
AC Voltage [V]	230,39	--	--
AC Current [A]	3,161	--	--
Frequency [Hz]	50,00	--	--

Harmonic	**Measured value I_h [A]**			**Measured value I_h [%I_1]**			**Limits [A]** IEC EN 61000-3-2
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	
1st	3,160	--	--	--	--	--	--
2nd	0,001	--	--	0,044	--	--	1,080
3rd	0,029	--	--	0,928	--	--	2,300
4th	0,001	--	--	0,017	--	--	0,430
5th	0,057	--	--	1,803	--	--	1,140
6th	0,000	--	--	0,013	--	--	0,300
7th	0,030	--	--	0,934	--	--	0,770
8th	0,000	--	--	0,013	--	--	0,263
9th	0,013	--	--	0,406	--	--	0,400
10th	0,000	--	--	0,013	--	--	0,184
11th	0,007	--	--	0,212	--	--	0,330
12th	0,000	--	--	0,013	--	--	0,153
13th	0,006	--	--	0,192	--	--	0,210
14th	0,000	--	--	0,013	--	--	0,131
15th	0,006	--	--	0,200	--	--	0,150
16th	0,000	--	--	0,013	--	--	0,115

17th	0,007	--	--	0,216	--	--	0,132
18th	0,000	--	--	0,013	--	--	0,102
19th	0,006	--	--	0,185	--	--	0,188
20th	0,000	--	--	0,013	--	--	0,092
21th	0,005	--	--	0,157	--	--	0,107
22th	0,000	--	--	0,013	--	--	0,084
23th	0,004	--	--	0,134	--	--	0,098
24th	0,000	--	--	0,014	--	--	0,077
25th	0,004	--	--	0,131	--	--	0,090
26th	0,000	--	--	0,014	--	--	0,071
27th	0,004	--	--	0,126	--	--	0,080
28th	0,001	--	--	0,016	--	--	0,066
29th	0,004	--	--	0,137	--	--	0,078
30th	0,000	--	--	0,016	--	--	0,061
31th	0,005	--	--	0,158	--	--	0,073
32th	0,001	--	--	0,016	--	--	0,057
33th	0,005	--	--	0,171	--	--	0,068
34th	0,001	--	--	0,017	--	--	0,054
35th	0,006	--	--	0,178	--	--	0,064
36th	0,001	--	--	0,020	--	--	0,051
37th	0,007	--	--	0,209	--	--	0,061
38th	0,001	--	--	0,017	--	--	0,048
39th	0,010	--	--	0,325	--	--	0,058
40th	0,001	--	--	0,025	--	--	0,046
THD [%]	--	--	--	2,391	--	--	--

Phase	**L1**	**L2**	**L3**
Power Level	**100%**	**100%**	**100%**
AC Power [W]	1195	--	--
AC Voltage [V]	230,52	--	--
AC Current [A]	5,185	--	--
Frequency [Hz]	50,00	--	--

Harmonic	**Measured value I_h [A]**			**Measured value I_h [%I_1]**			**Limits [A]** IEC EN 61000-3-2
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	
1st	5,184	--	--	--	--	--	--
2nd	0,002	--	--	0,043	--	--	1,080
3rd	0,042	--	--	0,809	--	--	2,300
4th	0,001	--	--	0,013	--	--	0,430
5th	0,073	--	--	1,400	--	--	1,140
6th	0,001	--	--	0,010	--	--	0,300
7th	0,037	--	--	0,708	--	--	0,770

8th	0,001	--	--	0,011	--	--	0,263
9th	0,015	--	--	0,280	--	--	0,400
10th	0,000	--	--	0,010	--	--	0,184
11th	0,009	--	--	0,173	--	--	0,330
12th	0,001	--	--	0,010	--	--	0,153
13th	0,010	--	--	0,201	--	--	0,210
14th	0,000	--	--	0,010	--	--	0,131
15th	0,012	--	--	0,222	--	--	0,150
16th	0,000	--	--	0,009	--	--	0,115
17th	0,012	--	--	0,235	--	--	0,132
18th	0,001	--	--	0,010	--	--	0,102
19th	0,011	--	--	0,204	--	--	0,188
20th	0,001	--	--	0,010	--	--	0,092
21th	0,009	--	--	0,180	--	--	0,107
22th	0,001	--	--	0,011	--	--	0,084
23th	0,008	--	--	0,152	--	--	0,098
24th	0,001	--	--	0,011	--	--	0,077
25th	0,006	--	--	0,114	--	--	0,090
26th	0,001	--	--	0,011	--	--	0,071
27th	0,004	--	--	0,077	--	--	0,080
28th	0,001	--	--	0,013	--	--	0,066
29th	0,003	--	--	0,061	--	--	0,078
30th	0,001	--	--	0,012	--	--	0,061
31th	0,002	--	--	0,043	--	--	0,073
32th	0,001	--	--	0,012	--	--	0,057
33th	0,002	--	--	0,039	--	--	0,068
34th	0,001	--	--	0,013	--	--	0,054
35th	0,002	--	--	0,036	--	--	0,064
36th	0,001	--	--	0,014	--	--	0,051
37th	0,004	--	--	0,086	--	--	0,061
38th	0,001	--	--	0,013	--	--	0,048
39th	0,012	--	--	0,230	--	--	0,058
40th	0,001	--	--	0,020	--	--	0,046
THD [%]	--	--	--	1,888	--	--	--

PV-curve simulated according to	
Voltage of defined MPP [V]	44
Current of defined MPP [A]	40
FFU of PV curve [1]	1
Impedance [Ω]	
Line	R_A = 0,24 jX_A = 0,15
Neutral	R_N = 0,16 jX_N = 0,10
Note:	

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.2.4.1 b)	Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)	N/A

Harmonics											
L1 phase											
P/ P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100
Order	I_h [%]										
1	--	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	--
9	--	--	--	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--	--
13	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--
25	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	--	--	--	--	--	--
29	--	--	--	--	--	--	--	--	--	--	--
30	--	--	--	--	--	--	--	--	--	--	--
31	--	--	--	--	--	--	--	--	--	--	--
32	--	--	--	--	--	--	--	--	--	--	--
33	--	--	--	--	--	--	--	--	--	--	--
34	--	--	--	--	--	--	--	--	--	--	--
35	--	--	--	--	--	--	--	--	--	--	--
36	--	--	--	--	--	--	--	--	--	--	--
37	--	--	--	--	--	--	--	--	--	--	--
38	--	--	--	--	--	--	--	--	--	--	--
39	--	--	--	--	--	--	--	--	--	--	--
40	--	--	--	--	--	--	--	--	--	--	--
THC [%]	--	--	--	--	--	--	--	--	--	--	--
THDU40 [%]	--	--	--	--	--	--	--	--	--	--	--

5.2.4.1 b)	Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)	N/A

Interharmonics

Test result:

P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I_h [%]										
75	--	--	--	--	--	--	--	--	--	--	--
125	--	--	--	--	--	--	--	--	--	--	--
175	--	--	--	--	--	--	--	--	--	--	--
225	--	--	--	--	--	--	--	--	--	--	--
275	--	--	--	--	--	--	--	--	--	--	--
325	--	--	--	--	--	--	--	--	--	--	--
375	--	--	--	--	--	--	--	--	--	--	--
425	--	--	--	--	--	--	--	--	--	--	--
475	--	--	--	--	--	--	--	--	--	--	--
525	--	--	--	--	--	--	--	--	--	--	--
575	--	--	--	--	--	--	--	--	--	--	--
625	--	--	--	--	--	--	--	--	--	--	--
675	--	--	--	--	--	--	--	--	--	--	--
725	--	--	--	--	--	--	--	--	--	--	--
775	--	--	--	--	--	--	--	--	--	--	--
825	--	--	--	--	--	--	--	--	--	--	--
875	--	--	--	--	--	--	--	--	--	--	--
925	--	--	--	--	--	--	--	--	--	--	--
975	--	--	--	--	--	--	--	--	--	--	--
1025	--	--	--	--	--	--	--	--	--	--	--
1075	--	--	--	--	--	--	--	--	--	--	--
1125	--	--	--	--	--	--	--	--	--	--	--
1175	--	--	--	--	--	--	--	--	--	--	--
1225	--	--	--	--	--	--	--	--	--	--	--
1275	--	--	--	--	--	--	--	--	--	--	--
1325	--	--	--	--	--	--	--	--	--	--	--
1375	--	--	--	--	--	--	--	--	--	--	--
1425	--	--	--	--	--	--	--	--	--	--	--
1475	--	--	--	--	--	--	--	--	--	--	--
1525	--	--	--	--	--	--	--	--	--	--	--
1575	--	--	--	--	--	--	--	--	--	--	--
1625	--	--	--	--	--	--	--	--	--	--	--
1675	--	--	--	--	--	--	--	--	--	--	--
1725	--	--	--	--	--	--	--	--	--	--	--
1775	--	--	--	--	--	--	--	--	--	--	--
1825	--	--	--	--	--	--	--	--	--	--	--
1875	--	--	--	--	--	--	--	--	--	--	--
1925	--	--	--	--	--	--	--	--	--	--	--
1975	--	--	--	--	--	--	--	--	--	--	--

5.2.4.1 b)	Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)	N/A

Higher Frequencies

Test result:

P/P_{rE} [%]	5	10	20	30	40	50	60	70	80	90	100
f [kHz]	I_h [%]										
2,1	--	--	--	--	--	--	--	--	--	--	--
2,3	--	--	--	--	--	--	--	--	--	--	--
2,5	--	--	--	--	--	--	--	--	--	--	--
2,7	--	--	--	--	--	--	--	--	--	--	--
2,9	--	--	--	--	--	--	--	--	--	--	--
3,1	--	--	--	--	--	--	--	--	--	--	--
3,3	--	--	--	--	--	--	--	--	--	--	--
3,5	--	--	--	--	--	--	--	--	--	--	--
3,7	--	--	--	--	--	--	--	--	--	--	--
3,9	--	--	--	--	--	--	--	--	--	--	--
4,1	--	--	--	--	--	--	--	--	--	--	--
4,3	--	--	--	--	--	--	--	--	--	--	--
4,5	--	--	--	--	--	--	--	--	--	--	--
4,7	--	--	--	--	--	--	--	--	--	--	--
4,9	--	--	--	--	--	--	--	--	--	--	--
5,1	--	--	--	--	--	--	--	--	--	--	--
5,3	--	--	--	--	--	--	--	--	--	--	--
5,5	--	--	--	--	--	--	--	--	--	--	--
5,7	--	--	--	--	--	--	--	--	--	--	--
5,9	--	--	--	--	--	--	--	--	--	--	--
6,1	--	--	--	--	--	--	--	--	--	--	--
6,3	--	--	--	--	--	--	--	--	--	--	--
6,5	--	--	--	--	--	--	--	--	--	--	--
6,7	--	--	--	--	--	--	--	--	--	--	--
6,9	--	--	--	--	--	--	--	--	--	--	--
7,1	--	--	--	--	--	--	--	--	--	--	--
7,3	--	--	--	--	--	--	--	--	--	--	--
7,5	--	--	--	--	--	--	--	--	--	--	--
7,7	--	--	--	--	--	--	--	--	--	--	--
7,9	--	--	--	--	--	--	--	--	--	--	--
8,1	--	--	--	--	--	--	--	--	--	--	--
8,3	--	--	--	--	--	--	--	--	--	--	--
8,5	--	--	--	--	--	--	--	--	--	--	--
8,7	--	--	--	--	--	--	--	--	--	--	--
8,9	--	--	--	--	--	--	--	--	--	--	--

5.2.4.1 b) Test Harmonics DIN EN 61000-4-7 (≥75 A per Phase)	N/A

PV-curve simulated according to	
Voltage of defined MPP [V]	--
Current of defined MPP [A]	--
FFU of PV curve [1]	--
Impedance [Ω] Line Neutral	 R_A = 0,24 jX_A = 0,15 R_N = 0,16 jX_N = 0,10

5.2.5	Commutation	N/A

This test serves to determine the commutation currents, the project - specific identification and assessment of the

Commutation voltage dips according to VDE-AR-N 4100: 2020-06, 5.4.4.5 is required taking into account the short-circuit power at the point of connection.

- This check is only required for mains-controlled inverters.

5.2.6 Feed in of DC current	P

Test procedural:

The inverter must be used in the adjustment range Test1, Test2 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.

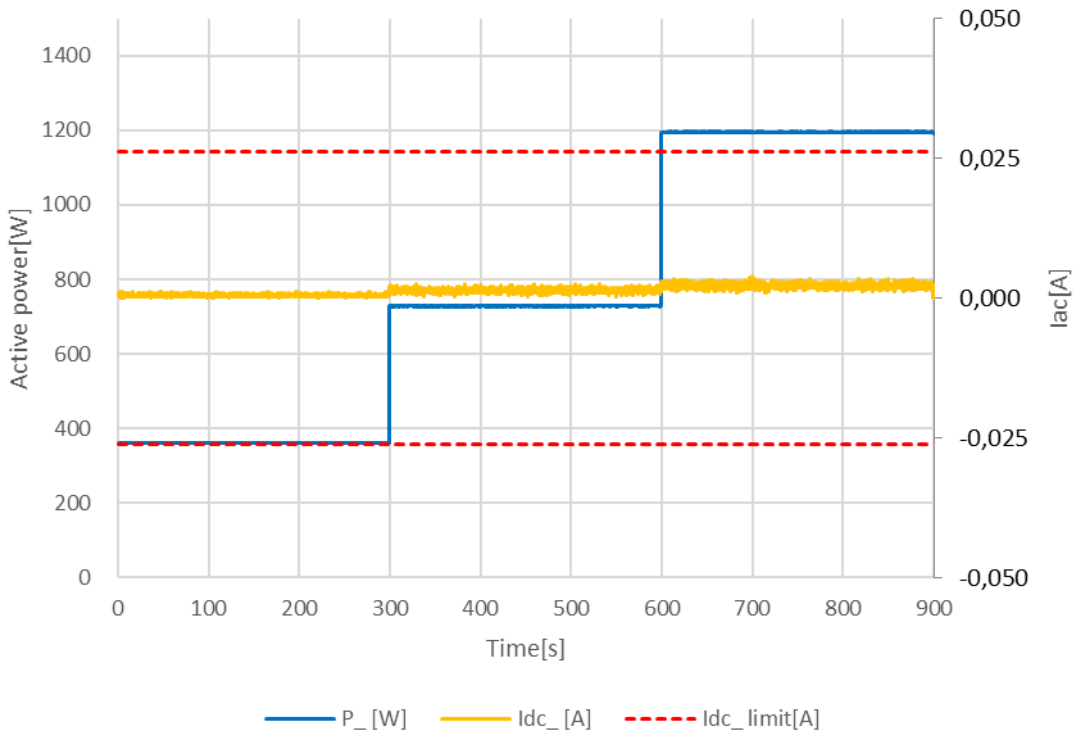
Assessment criterion:

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.

A17C53Z1-20

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]	360	728	1195
AC Voltage [V]	230,3	230,4	230,5
AC Current [A]	1,565	3,161	5,185
Max. DC Current in AC [mA]	3	6	7
Max. DC Current in AC [% of Ir]	0,058	0,115	0,134
Average. DC Current in AC [mA]	2	4	5
Average. DC Current in AC [% of Ir]	0,038	0,077	0,096

Graphs for A17C53Z1-20



Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.3	Evidence of symmetry behaviour of inverters	N/A

5.3.1	General	N/A
These tests serve to prove the requirements according to VDE-AR-N 4100: 2020-06, 5.5: These tests are not applicable for direct connected rotating machines! This test is necessary only for electronic inverters!		
Note: The tests of the “symmetry characteristics of three-phase inverter modules” were performed on the unit with the highest output power. Here is the maximum asymmetry given.		

5.3.2.1	Calculation of asymmetry	N/A

Test procedural:

The maximum absolute difference between the apparent powers of the three phases is determined for each of the five measurements (1-min means) in the respective operating point.

The maximum of these five values is again determined.

Assessment criterion:

The test is passed if the maximum value from the above measurements does not exceed 5 % S_{Emax} and ≤ 4600 VA.

Note:

The maximum inductive and capacitive values are specified by the manufacturer.

Setting values	cos φ = 1	--
	cos φ over-excited	--
	cos φ under-excited	--

Test:

1-min mean value	L1	L2	L3	|L1 – L2|	|L2 – L3|	|L3 – L1|
a) cos φ = 1 at 100 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}	--					
max. asymmetry [VA]	--					
b) maximum under-excited (i) at 100 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}	--					
max. asymmetry [VA]	--					

c) maximum over-excited (c) at 100 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}	--					
max. asymmetry [VA]	--					
d) cos φ = 1 at 50 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}	--					
max. asymmetry [VA]	--					
e) maximum under-excited (i) at 50 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}	--					
max. asymmetry [VA]	--					
f) maximum over-excited (c) at 50 % P_{rE} ± 5 % P_{Emax}						
S_{E60} [VA]	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
cos φ_{E60}:	--					
max. asymmetry [VA]	--					
Limit:	≤5% S_{Emax} and ≤4600VA					

5.4	Evidence of the behaviour of the generating unit on the network

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: 50Hz ± 0,5%		
Note: If an examination is required for any other requirements, these apply to this test.		

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)	**P**

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 ≤1min

Note:

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

The maximum inductive and capacitive values are specified by the manufacturer.

Setting values	cos φ = 1	1,0
	cos φ over-excited:	0,95
	cos φ under-excited:	0,95

A17C53Z1-20				
600s mean value	U [V]	$P_{Emax600\ c)}$ [W]	$S_{Emax600\ c)}$ [VA]	cos $\varphi_{Emax600}$ [-]
0,90 U_n at 100% P_{Emax}				
cos φ = 1	207,37	1079	1080	1,000
cos φ max. over-excited	207,87	1027	1081	0,950
0,95 U_n at 100% P_{Emax}				
cos φ max. under-excited	218,90	1082	1139	0,950
1,0 U_n at 100% P_{Emax}				
cos φ = 1	230,31	1200	1201	0,999
cos φ max. under-excited	230,85	1143	1200	0,952
cos φ max. over-excited	230,86	1139	1197	0,951
1,05 U_n at 100% P_{Emax}				
cos φ max. over-excited	241,81	1141	1205	0,947
1,09 U_n at 100% P_{Emax}				
cos φ = 1	250,97	1199	1199	1,000
cos φ max. under-excited	251,49	1141	1200	0,951

$S_{Emax600}$ and $P_{Emax\ 600}$	
$S_{Emax600}$= max($S_{Emax600\ a)}$, $S_{Emax600\ b)}$, $S_{Emax600\ c)}$) [VA]	1205
$P_{Emax\ 600}$= max($P_{Emax600\ a)}$, $P_{Emax600\ b)}$, $P_{Emax600\ c)}$) [W]	1200

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.4.3 Measurement of setting accuracy	P

Test procedural:

The P setpoint was set by WiFi port.

(The active power can be set between 100%Pn and 10%Pn with a step size of 10%Pn)

Assessment:

- no network disconnection occurs and
- the active power value does not deviate by more than 5% P_{rE} from the target value.

Note:

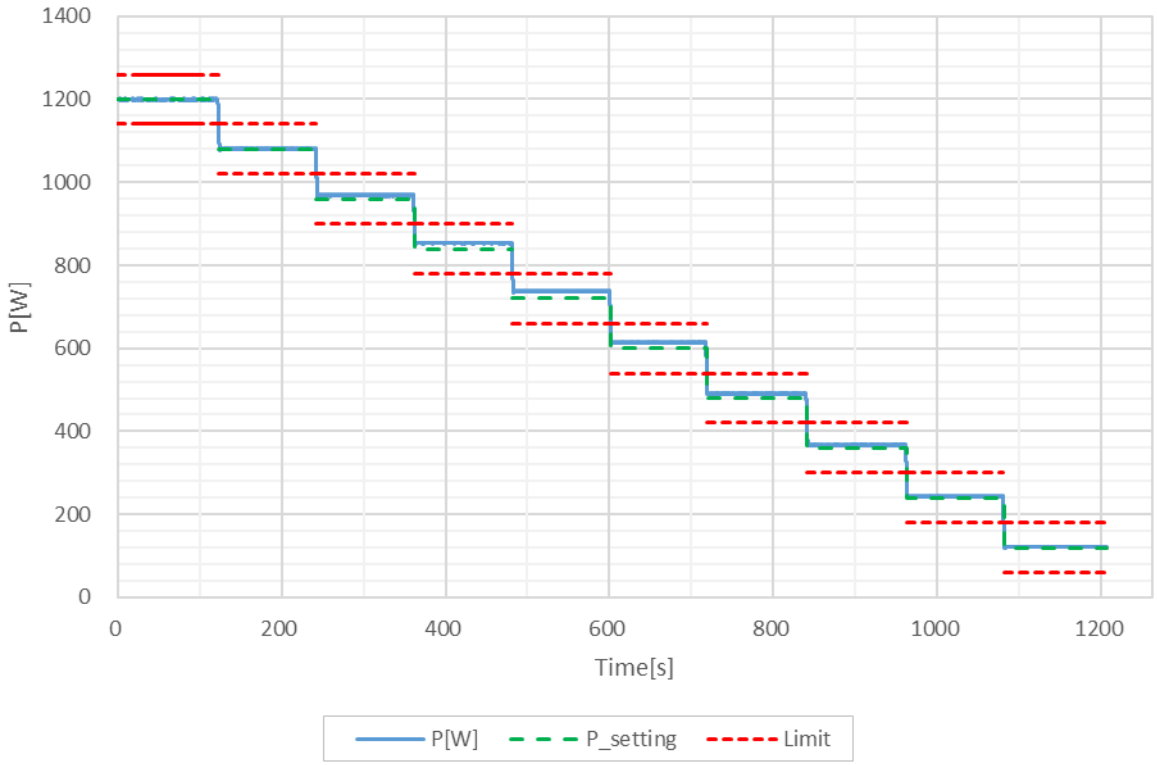
The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

A17C53Z1-20

% of rated capability	Setpoint		Measured value		Deviation (P_{meas} - P_{set})		Limit ΔP_{E60} in %
	[W]	[%P_n]	[W]	[%Pn]	[W]	[%P_n]	
100	1200	100,0	1199	99,94	-1	-0,06	≤ ±5% of P_{rE}
90	1080	90,0	1081	90,08	1	0,08	
80	960	80,0	968	80,68	8	0,68	
70	840	70,0	848	70,63	8	0,63	
60	720	60,0	720	60,00	0	0,00	
50	600	50,0	602	50,18	2	0,18	
40	480	40,0	491	40,92	11	0,92	
30	360	30,0	367	30,62	7	0,62	
20	240	20,0	244	20,30	4	0,30	
10	120	10,0	122	10,14	2	0,14	

Overall maximum active power deviation to set point [%P_n]:	0,92

Graph of the setting accuracy: A17C53Z1-20



5.4.3.4 Measurement of the power gradient	P

Test procedural:

The P setpoint was set by WiFi port.
The measurement of the power gradient takes place:

- Via a setpoint change from 100% to 5% of the rated effective power PrE at time t0. If the technical performance is >5%, this should be specified.
- Via a setpoint change from 5% to 100% of the rated effective power PrE at time t0. Is the technical Performance >5%, this should be specified.

Assessment:

- no network disconnection occurs and
- the power gradients determined in accordance with 5.4.3.4 shall not fall below 0.33 % P_{rE} and shall not exceed 0.66 % P_{rE}.
- The first gradient is to be formed 30 s after setting the setpoint jump.
- The formation of gradients is terminated 30 s before reaching the stationary final value.

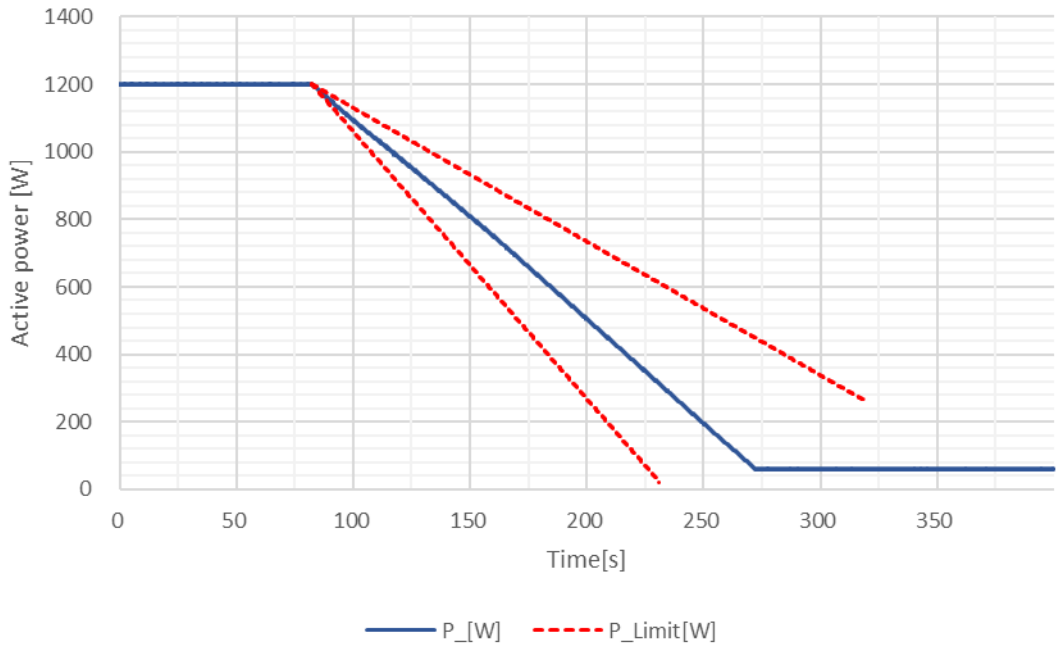
Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

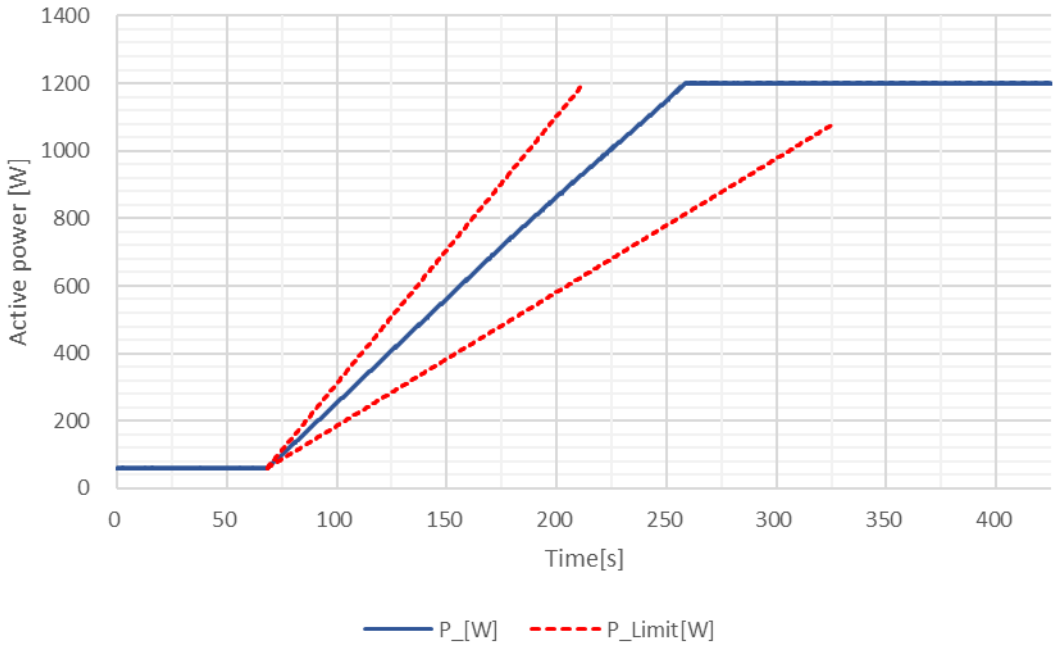
Verification the setting Power gradient change from 100%$P_{rE\ to}$ 5%P_{rE} at A17C53Z1-20

$P_{\_setting}$ point step	Setting value	Measured value
$P_{before\ power\ change}$ = 100% P_{rE} ± 5% P_{rE}	100,0% P_{rE}	100,02% P_{rE}
Power gradient (during power change):	0,5 %P_{rE} / s	0,50 %P_{rE} / s
$P_{after\ power\ change}$ = 5% P_{rE} ± 5% P_{rE}	5,0% P_{rE}	5,01 % P_{rE}

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



5.4.3.4 Measurement of the power gradient		P
Verification the setting Power gradient change from 5% to 100% at A17C53Z1-20		
$P_{\_setting}$ point step	Setting value	Measured value
$P_{before\ power\ change}$ = 5% P_{rE} ± 5% P_{rE}	5,0% P_{rE}	5,01% P_{rE}
Power gradient (during power change):	0,5 %P_{rE} / s	0,50%P_{rE} / s
$P_{after\ power\ change}$ = 100% P_{rE} ± 5% P_{rE}	100,0 % P_{rE}	100,04 % P_{rE}
Limit of power gradient [%P_{rE} / s]:	0,33 to 0,66	
Inverter remains in operation?	☒ yes	
	☐ no	
Graph of the gradient 5% to 100% PrE		



5.4.3.5 Measurement priority interfaces / energy management system	P

Test procedural:

Test 1 (Measurement priority interfaces)

Test 2 (logical interface):

Test steps

a) the PGU is operated with no less than 90% P_{rE};
b) the change of state of the logic signal.

Assessment:

Test 1:

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

Test 2:

c) during the examination of the logical interface (input port), the active power feed of the EZE was completely terminated within a maximum of 5 s after the state change of the logical signal.

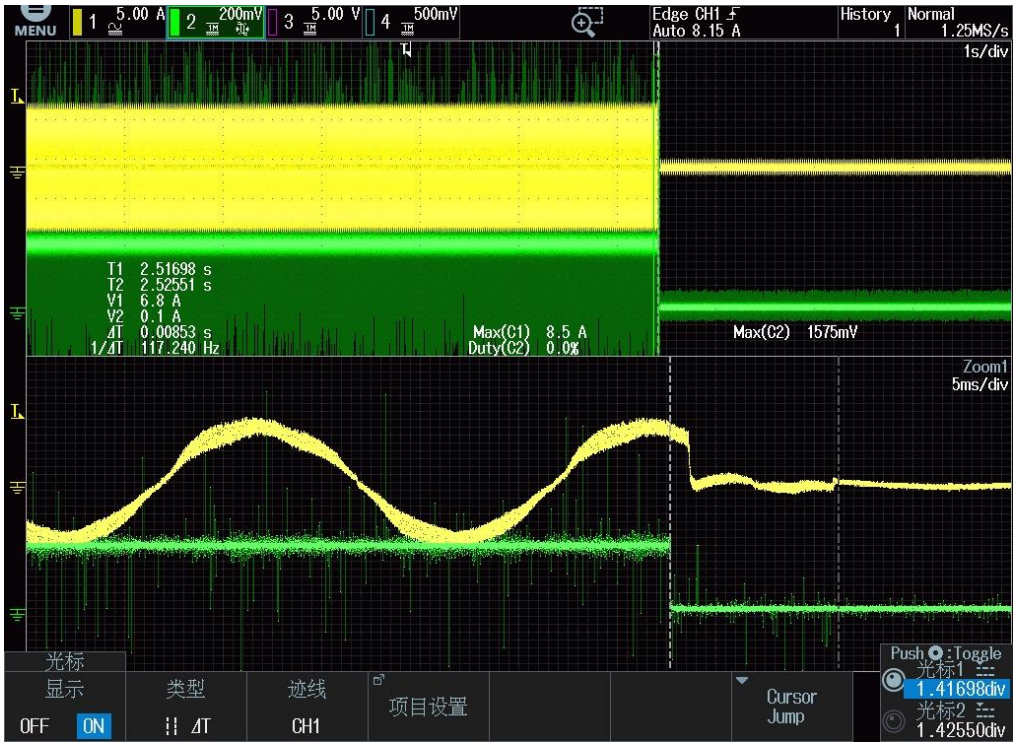
Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Test results:

Test1: The unit only provides one interfaces (WiFi port) for active power reduction, so the Test1 can N/A.

Test 2: Use logical interface to test the result of stopping active power output.



High level description of logic interface:

The PGU does not provide logic interface for terminating active power output (active power output can only beterminated via APP / PC software). This needs to be considered on the plant level (e.g. using an additional energy monitoring / communication unit with logic interface)

5.4.4 Active power feed-in for PGU´s at 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: A17C53Z1-20

Test point: No.	Test point: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** ΔP_{E60} in %	Available DC-power [%]:
Measurement: 100% P_{Emax}; start frequency 50,20Hz; droop s setting = 5% (40% P_{ref}/Hz)									
a)	50,00	100	50,00	1200	1197	99,79	-0,21	≤ ±10% of P_{Emax}	100
b)	50,25	98	50,25	1176	1171	97,59	-0,41		
c)	50,70	80	50,70	960	957	79,71	-0,29		
d)	51,40	52	51,40	624	621	51,74	-0,26		
e)	50,70	80	50,70	960	957	79,72	-0,28		
f)	50,25	98	50,25	1176	1170	97,53	-0,47		
g)	50,00	100	50,00	1200	1197	99,76	-0,24		
h)	51,65	0	51,65	0	1	0,06	0,06		
i)	50,15	0	50,15	0	0	0,00	0,00		
j)	50,00	100	50,00	1200	1198	99,86	-0,14		

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,2	0,4
c) → d)	0,2	0,4
d) → e)	0,2	0,4
e) → f)	0,2	0,4

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

Test 2: A17C53Z1-20

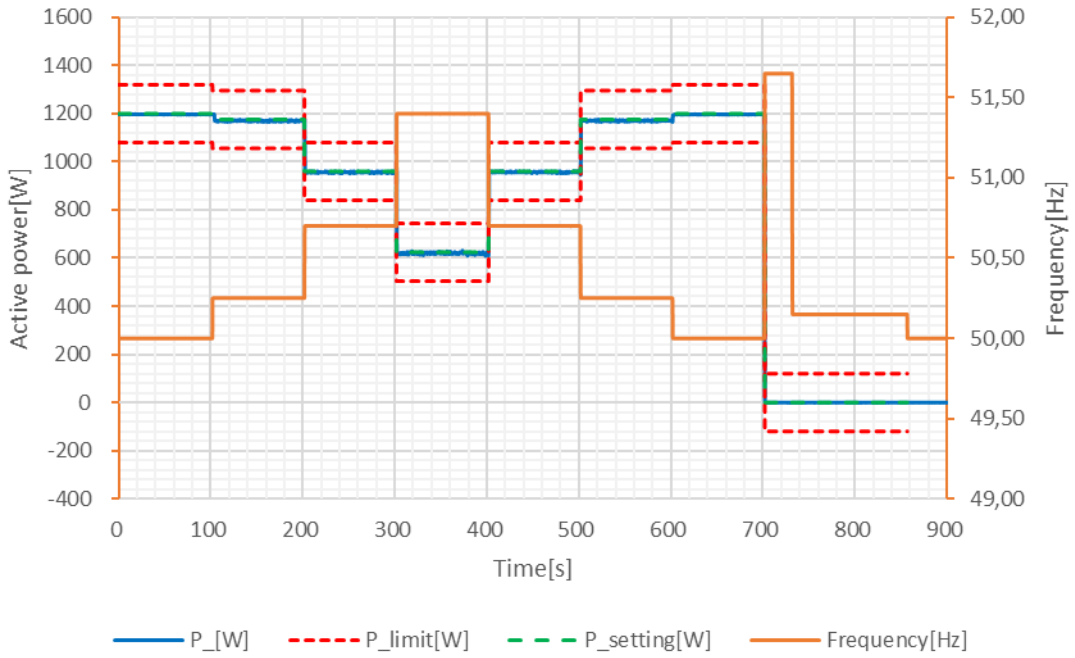
1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60}[% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** ΔP_{E60} in %	Available DC-power [%]:
Measurement: 60% P_{Emax}; start frequency 50,50Hz; droop s setting = 12% (16,67% P_{ref}/Hz)									
a)	50,00	60	50,00	720	720	59,97	-0,03	≤ ±10% of P_{Emax}	100
b)	50,40	60	50,40	720	720	59,97	-0,03		
c)	50,70	58	50,70	696	694	57,84	-0,16		
d)	51,40	51	51,40	612	609	50,78	-0,22		
e)	50,70	58	50,70	696	694	57,80	-0,20		
f)	50,40	60 – 100	50,40	--	1198	99,83	-0,17		
g)	50,00	100	50,00	1200	1198	99,82	-0,18		

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,2	0,4
c) → d)	0,2	0,4
d) → e)	0,2	0,4
e) → f)	0,2	0,4

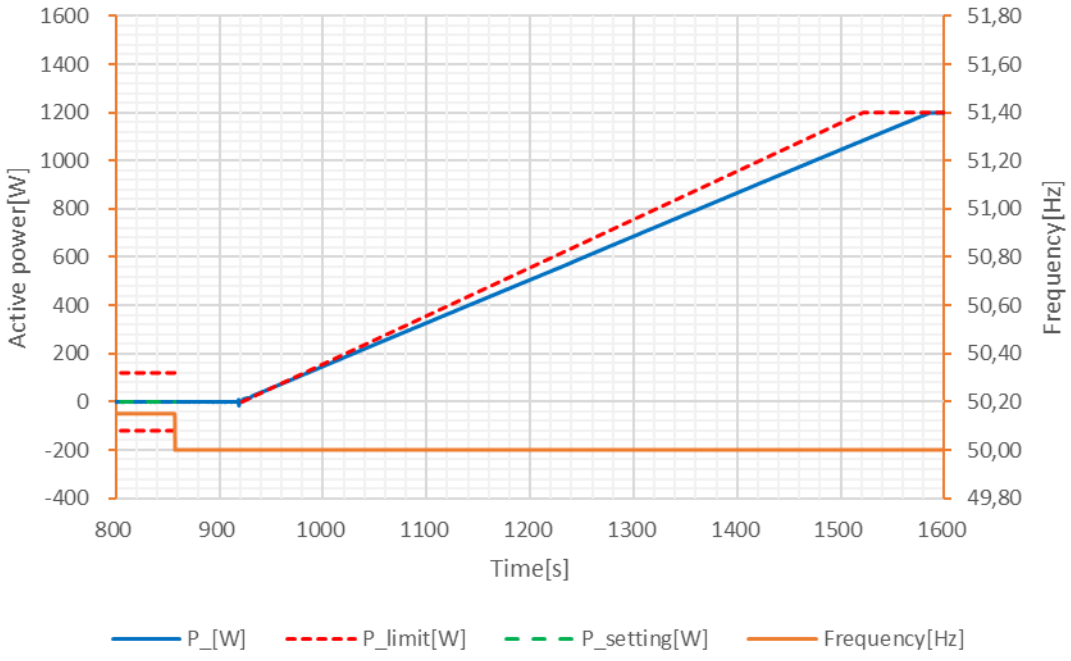
Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	0,5

DC setting values:	
PV-curve simulated according to	
Voltage of defined MPP [V]	44
Current of defined MPP [A]	40
FFU of PV curve [1]	1
P_{DC} [W]	1800

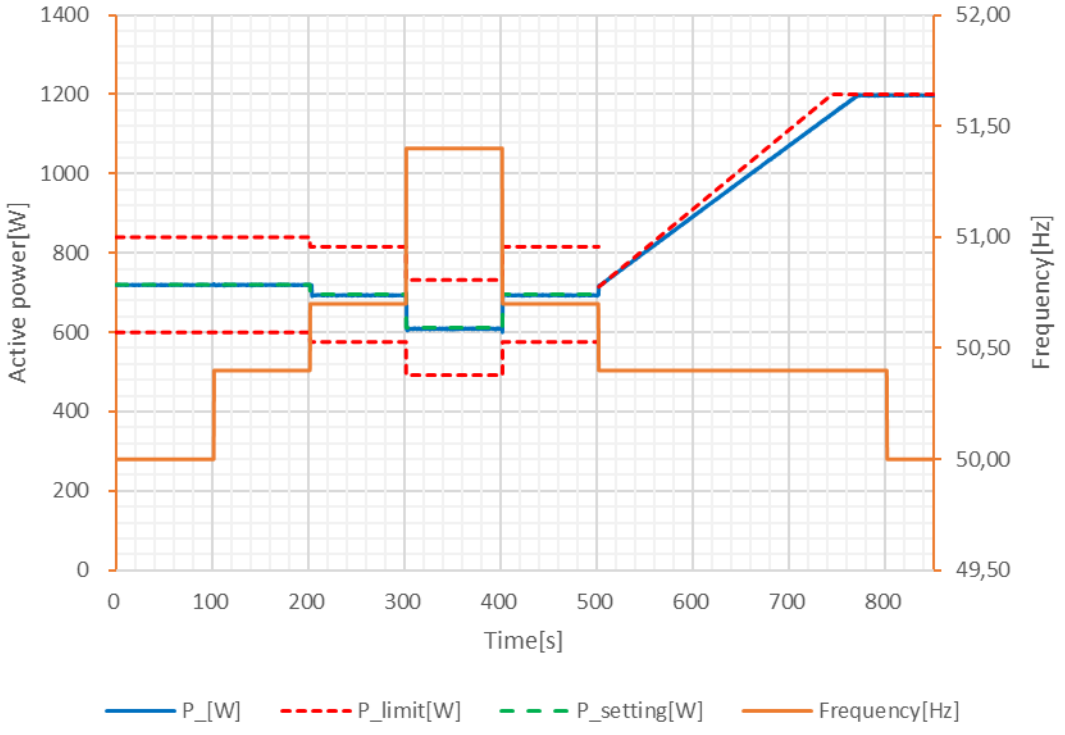
Graph Test 1@ 100% P_{Emax}



Gradient Test 1



Graph Test2 @ 60% P_{Emax}



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}.

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 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).

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:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.4.5	**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: A17C53Z1-20

1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** $\lvert\Delta P_{E60}\rvert$ [%P_{Emax}]	SOC [%]*
Measurement: 100% P_{Emax}; start frequency 50,20Hz; droop s setting = 5% (40% P_{Emax}/Hz)									
a)	50,00	100	50,00	1200	1197	99,79	-0,21	≤ 10	35
b)	50,25	98	50,25	1176	1173	97,74	-0,26		34
c)	50,70	80	50,70	960	958	79,86	-0,14		33
d)	51,40	52	51,40	624	621	51,78	-0,22		32
e)	50,70	80	50,70	960	958	79,83	-0,17		31
f)	50,25	98	50,25	1176	1172	97,69	-0,31		30
g)	50,00	100	50,00	1200	1197	99,75	-0,25		29
h)	51,65	0	51,65	0	0	0,00	0,00		27
i)	50,15	0	50,15	0	0	0,00	0,00		27
j)	50,00	100	50,00	1200	1198	99,82	-0,18		27

Frequency Step	**Response time [s]**	**Settling time [s]**
b) → c)	0,5	0,6
c) → d)	0,3	0,4
d) → e)	0,4	0,4
e) → f)	0,3	0,4

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

Test 2: A17C53Z1-20

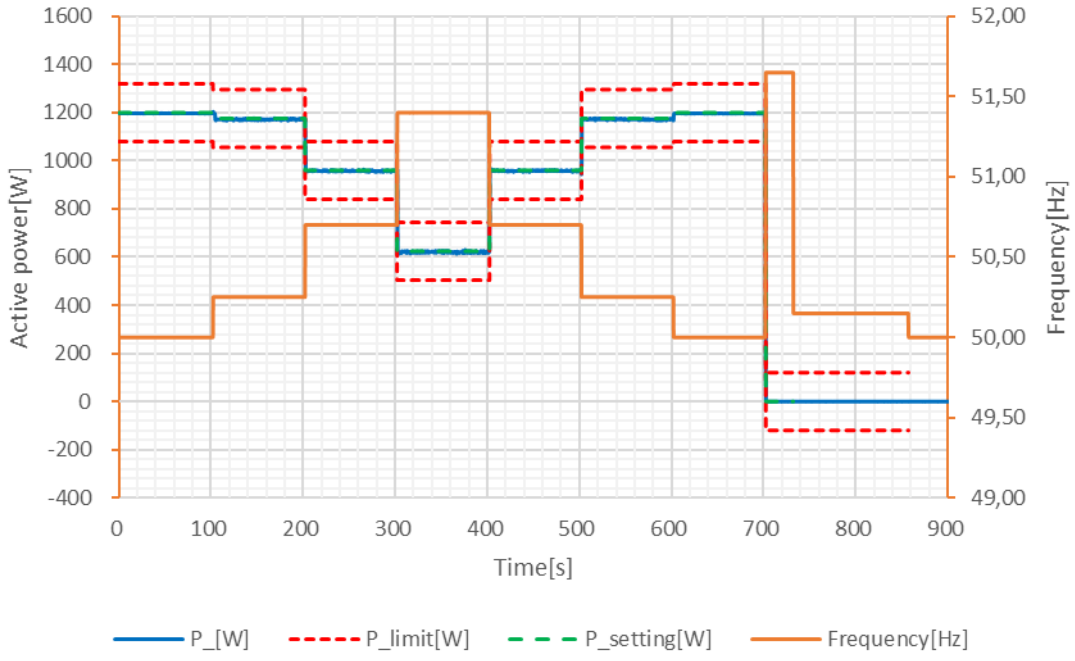
1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** $\lvert\Delta P_{E60}\rvert$ [%P_{Emax}]	SOC [%]*
Measurement: 60% P_{Emax}; start frequency 50,50Hz; droop s setting = 5%(40% P_{Emax}/Hz)									
a)	50,00	60	50,00	720	719	59,94	-0,06	≤ 10	67
b)	50,40	60	50,40	720	719	59,95	-0,05		66
c)	50,70	52	50,70	624	625	52,12	0,12		66
d)	51,40	24	51,40	288	289	24,12	0,12		65
e)	50,70	52	50,70	624	623	51,93	-0,07		64
f)	50,40	60 - 100	50,40	--	1197	99,78	-0,22		64
g)	50,00	100	50,00	1200	1197	99,76	-0,24		60

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,2	0,4
c) → d)	0,3	0,4
d) → e)	0,2	0,4
e) → f)	0,2	0,4

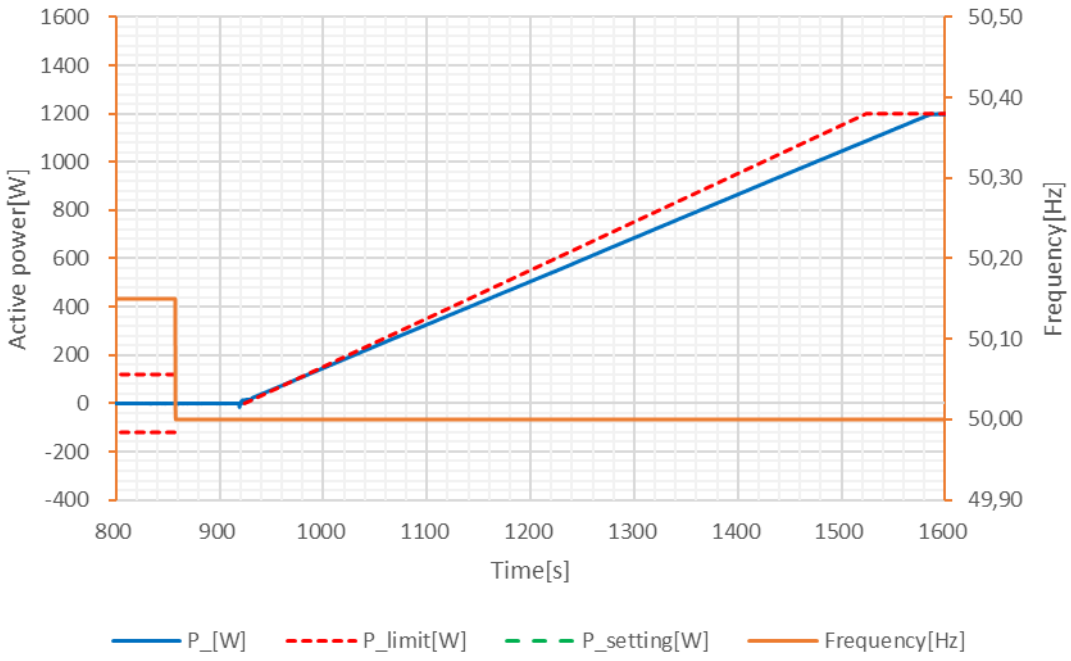
Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	0,5

DC setting values:	
PV-curve simulated according to	
Voltage of defined MPP [V]	--
Current of defined MPP [A]	--
FFU of PV curve [1]	--
DC Battery (Source) input current	69A
DC Battery (Source) input voltage	26V
$P_{DC\text{-}Sum}$ [W]	1800W

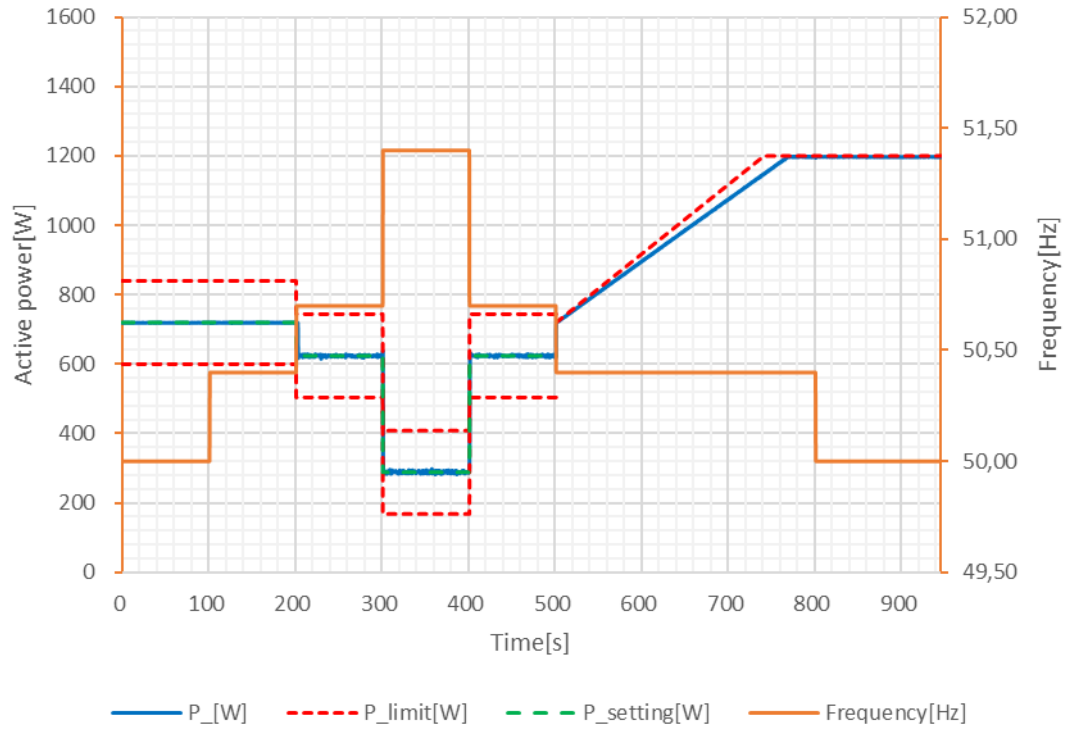
Graph Test 1@ 100% P_{Emax}



Gradient Test 1



Graph Test2 @ 60% P_{Ema}



Assessment criterion:

The test is regarded as passed:

The active power reduces between measuring points in clause 5.4.5.1 a) to g) and j), the expected active power output, after settling, adjusts with a deviation ≤ ±10% P_{Emax}. Deviations arising from the fact that the maximum discharge capacity is less than P_{Emax} 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 1s

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

- 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.

Note:

* Results recorded at 1 minute after the transient process of power change completed.

The default LFSM-O curve setting of the **A17C53Z1** to **A17C53Z1-20** series complies with the requirements for storage units according to VDE-AR-N 4105.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.4.6	**Active power feed-in for PGUs 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) (Not for DC-coupled Storage systems)	**P**

Test cycle for adjustable PGUs:

Test 1:A17C53Z1-20

1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** ΔP_{E60} in %	Available DC-power [%]:
Measurement: 10% P_{Emax}; start frequency 49,80Hz; droop s setting = 5% (40% P_{ref}/Hz)									
a)	50,00	10	50,00	120	121	10,05	0,05	≤ ±10% of P_{Emax}	100
b)	49,75	12	49,75	144	145	12,09	0,09		
c)	48,80	50	48,80	600	600	50,03	0,03		
d)	47,60	98	47,60	1176	1175	97,91	-0,09		
e)	48,80	50	48,80	600	601	50,09	0,09		
f)	49,75	12	49,87	144	150	12,53	0,53		
g)	50,00	10	50,00	120	121	10,05	0,05		
h)	47,35	0	47,35	0	0	0,00	0,00		
i)	47,40	0	47,40	0	0	0,00	0,00		
j)	50,00	10	50,00	120	121	10,10	0,10		

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,4	0,4
c) → d)	0,4	0,4
d) → e)	0,4	0,5
e) → f)	0,4	0,5

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

Test 2: A17C53Z1-20

1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_{Emax}]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_{Emax}]:	ΔP_{E60} [%]	**Limit** ΔP_{E60} in %	Available DC-power [%]:
Measurement: 60% P_{Emax}; start frequency 49,80Hz; droop s setting = 5% (40% P_{ref}/Hz)									
a)	50,00	60	50,00	720	718	59,82	-0,18	≤ ±10% of P_{Emax}	100
b)	49,75	62	49,75	744	744	61,99	-0,01		
c)	49,20	84	49,20	1008	1006	83,84	-0,16		
d)	48,80	100	48,80	1200	1194	99,49	-0,51		
e)	49,20	84	49,20	1008	1007	83,91	-0,09		
f)	49,85	60	49,85	720	718	59,87	-0,13		

5.4.6	Active power feed-in for PGUs 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) (Not for DC-coupled Storage systems)	P

g)	50,00	60	50,00	720	718	59,87	-0,13		

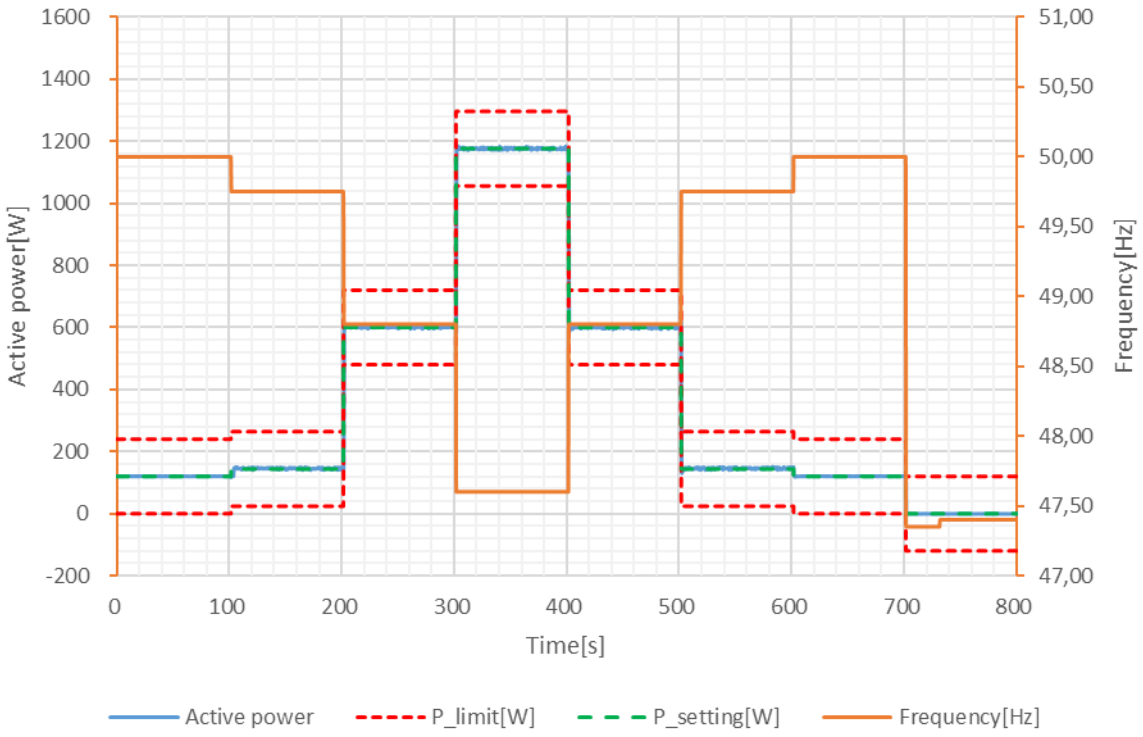
Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,4	0,4
c) → d)	0,6	0,6
d) → e)	0,4	0,4
e) → f)	0,4	0,4

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

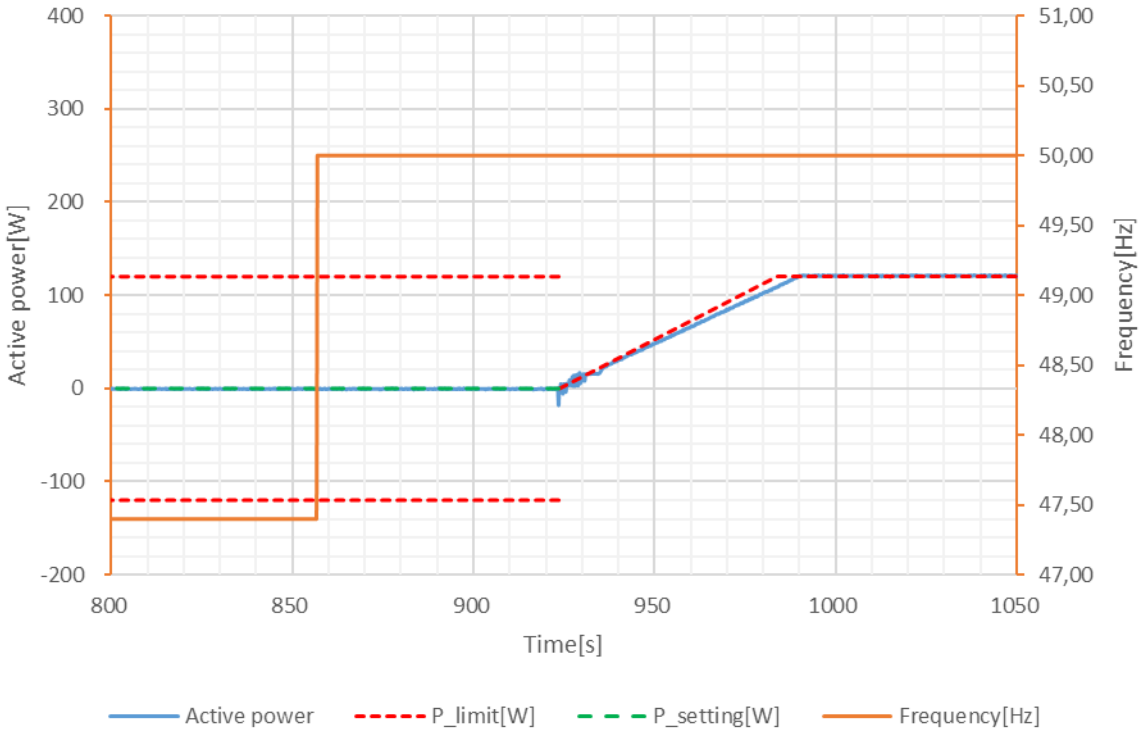
DC setting values:	
PV-curve simulated according to	
Voltage of defined MPP [V]	44
Current of defined MPP [A]	40
FFU of PV curve [1]	1
P_{DC} [W]	1800

5.4.6	**Active power feed-in for PGUs 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) (Not for DC-coupled Storage systems)	**P**

Graph Test 1@ 10% P_{Emax}

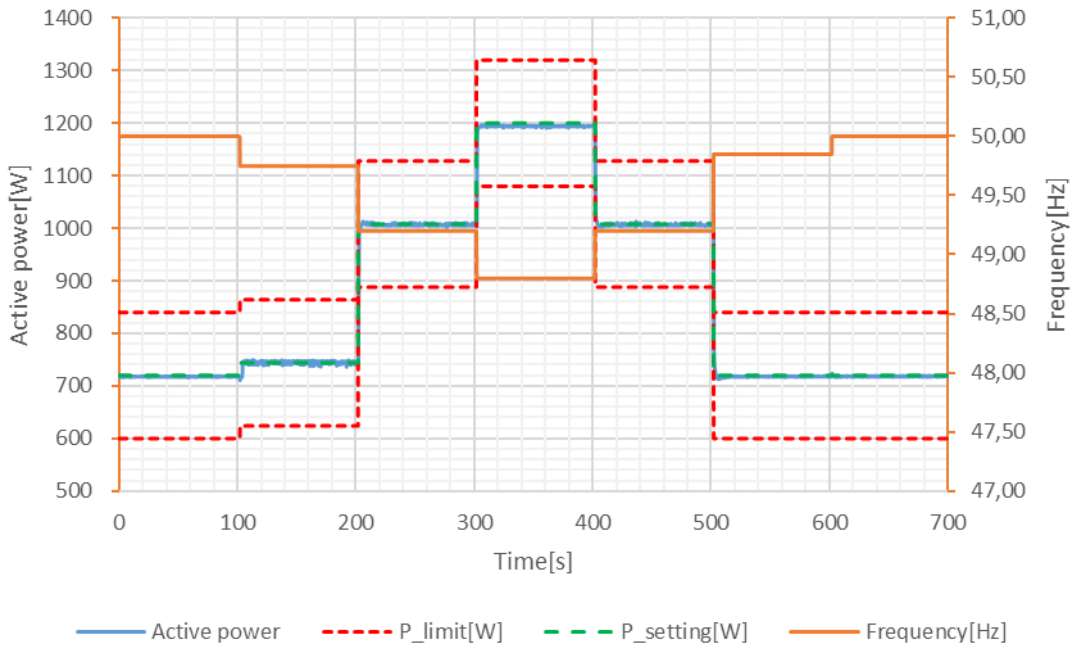


Gradient Test 1



5.4.6	**Active power feed-in for PGUs 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) (Not for DC-coupled Storage systems)	**P**

Graph Test2 @ 60% P_{Emax}



5.4.6	**Active power feed-in for PGUs 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) (Not for DC-coupled Storage systems)	**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:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.4.7	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: A17C53Z1-20

1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_n]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_n]:	ΔP_{E60} [%]	**Limit $\lvert\Delta P_{E60}\rvert$ [%P_n]**	SOC [%] *	Available active power in charging or discharging mode [%Pn]
Measurement: -100% P_{Emax}; start frequency 49,80Hz; droop s setting = 2% (100% P_{Emax}/Hz)										
a)	50,00	-100	50,00	-1200	-1198	-99,83	0,17	≤ 10	51	-110
b)	49,75	-95	49,75	-1140	-1130	-94,17	0,83		52	-110
c)	48,80	0	48,80	0	8	0,67	0,67		53	+110
d)	47,60	100	47,60	1200	1196	99,67	-0,33		53	+110
e)	48,80	0	48,80	0	11	0,92	0,92		51	+110
f)	49,85	-100	49,85	-1200	-1195	-99,58	0,42		51	-110
g)	50,00	-100	50,00	-1200	-1200	-100,00	0,00		52	-110
h)	47,35	0	47,35	0	0	0,00	0,00		53	+110
i)	47,40	0	47,40	0	0	0,00	0,00		53	+110
j)	50,00	-100	50,00	-1200	-1200	-100,00	0,00		53	-110

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,7	1,0
c) → d)	0,8	1,0
d) → e)	0,7	1,0
e) → f)	0,6	1,0

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

Test 2: A17C53Z1-20

1-min mean value: No.	1-min mean value: [Hz]	Expected active power output [% of P_n]:	Frequency [Hz]:	$P_{setpoint}$ [W]:	P_{E60} [W]:	P_{E60} [% of P_n]:	ΔP_{E60} [%]	**Limit $\lvert\Delta P_{E60}\rvert$ [%P_n]**	SOC [%] *	Available active power in charging or discharging mode [%Pn]
Measurement: 10% P_{Emax}; start frequency 49,80Hz; droop s setting = 2% (100% P_{Emax}/Hz)										
a)	50,00	10	50,00	120	118	9,83	-0,17	≤ 10	93	+110
b)	49,75	15	49,75	180	184	15,33	0,33		93	+110
c)	48,80	100	48,80	1200	1194	99,50	-0,50		92	+110
d)	47,60	100	47,60	1200	1196	99,67	-0,33		91	+110

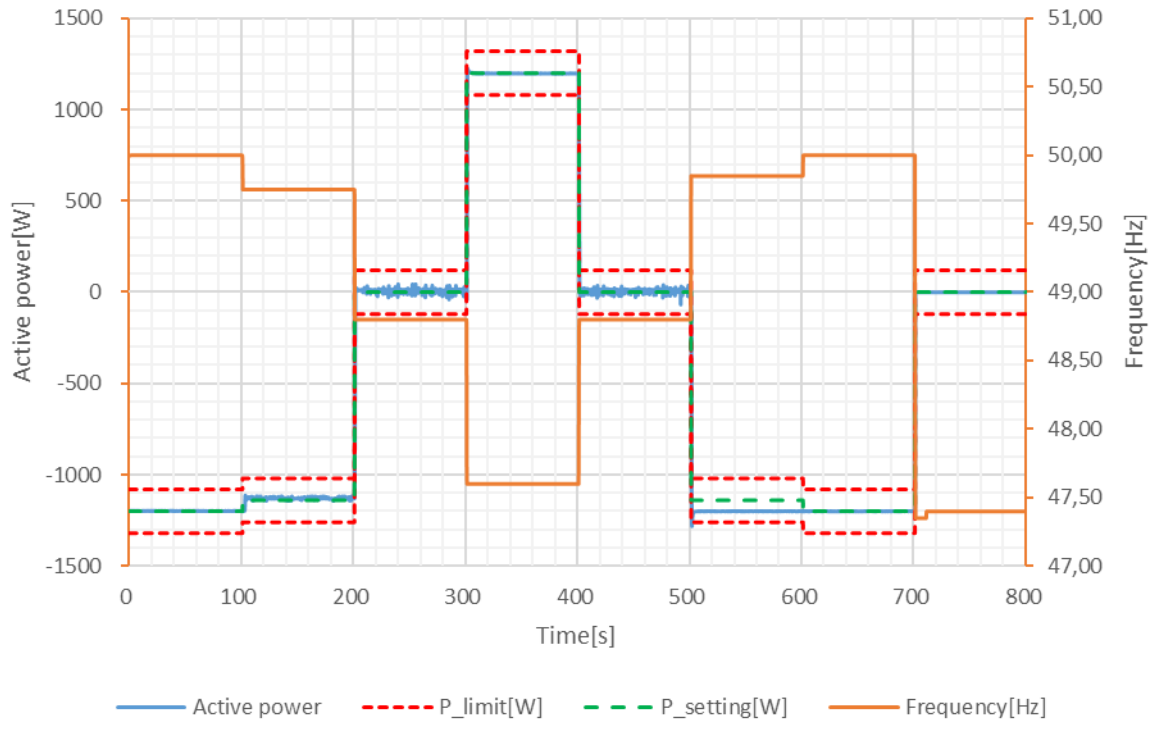
5.4.7	Active power feed-in for Storage systems at underfrequency (These tests are designed to provide evidence that the requirements of VDE-AR-N: 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)									P
e)	48,80	100	48,80	1200	1195	99,58	-0,42		90	+110
f)	49,85	10	49,85	120	120	10,00	0,00		88	+110
g)	50,00	10	50,00	120	118	9,83	-0,17		88	+110

Frequency Step	Response time [s]	Settling time [s]
b) → c)	0,7	0,8
c) → d)	0,6	0,6
d) → e)	0,6	0,6
e) → f)	0,6	0,6

Initial time delay T_V setting value [s]:	Initial time delay T_V measured value (Determined during frequency step a) → b)) [s]:
2,0	1,0

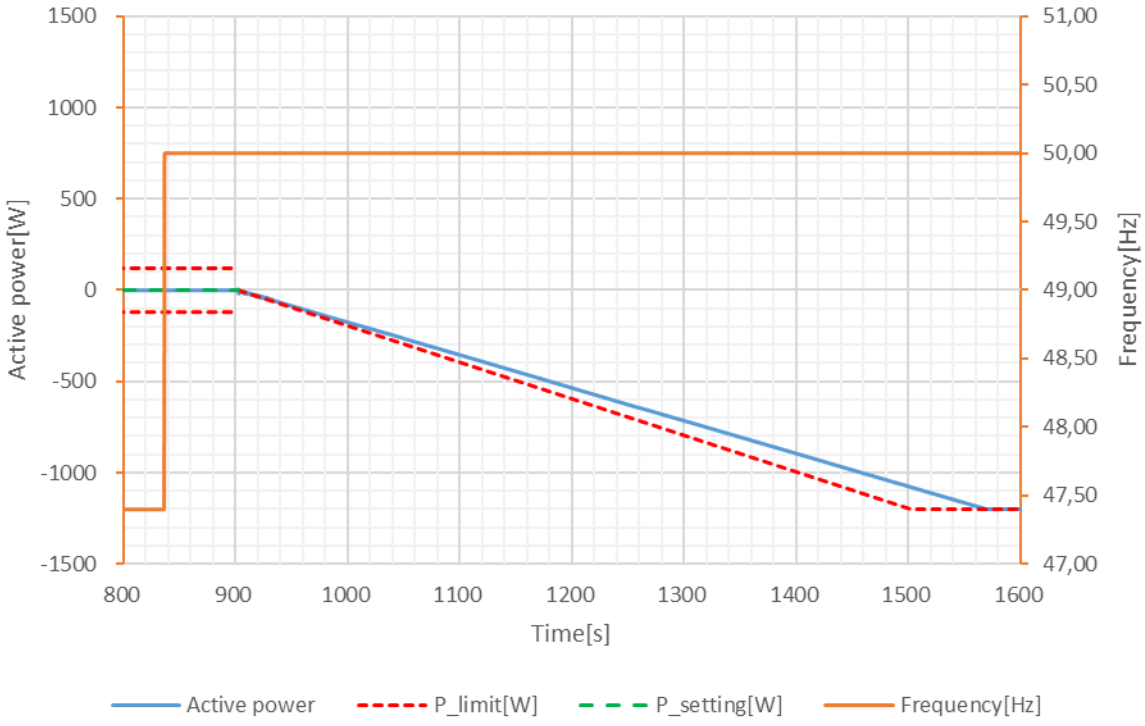
DC setting values:	
PV-curve simulated according to	
Voltage of defined MPP [V]	--
Current of defined MPP [A]	--
FFU of PV curve [1]	--
DC Battery (Source) input current	69A
DC Battery (Source) input voltage	26V
$P_{DC\text{-}Sum}$ [W]	1800W

Graph Test 1@ -100% P_{Emax}

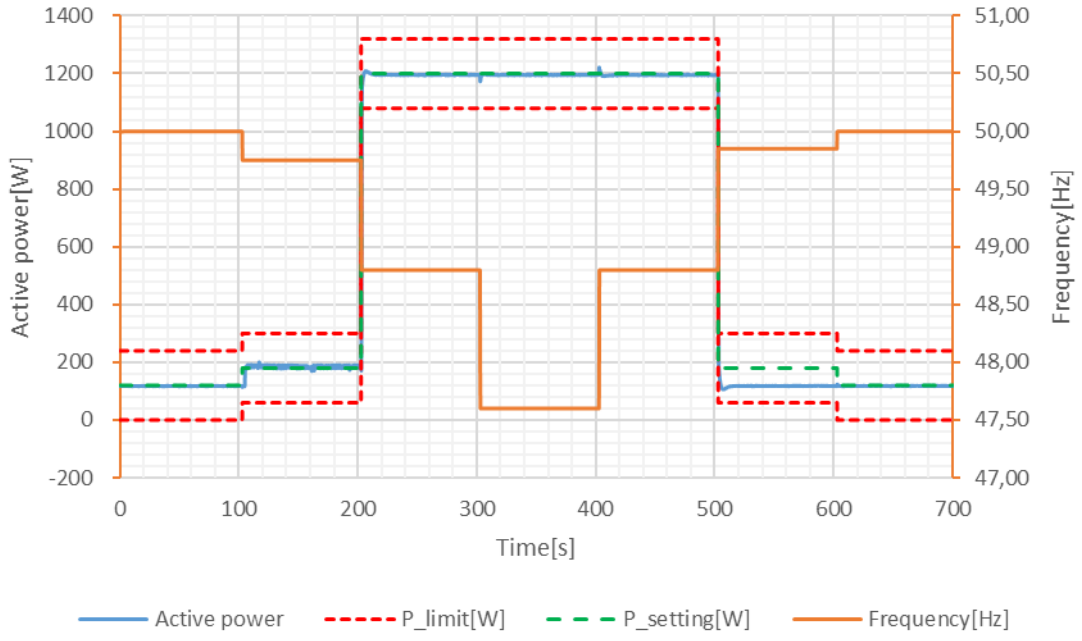


5.4.7	**Active power feed-in for Storage systems at underfrequency** (These tests are designed to provide evidence that the requirements of VDE-AR-N: 4105:2018-11 5.7.4.3. and VDE-AR-N 4105:2018-11 8.3.1. are met)	**P**

Gradient Test 1



Graph Test2 @ 10% P_{Emax}



Assessment criterion:

The test is regarded as passed if the Storage system:

- The active power reduces between measuring points 5.4.7.1 a) and j), the expected active power output, after settling, adjusts with a deviation ≤ ±10% P_{Emax}. Deviations arising from the fact that the maximum discharge

5.4.7	**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**

capacity is less than P_{Emax} 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 ≤2s.
- The response time of the adaptation of the active power output /-consumption is a maximum of 1s and;
- the settling time of the adaptation of the active power output /-consumption is a maximum time of 20s
- The connection time at point j) is at least 60s and the power is then increased with a gradient of ≤ ±10% P_{Emax}/min.

Note:

* Results recorded at 1 minute after the transient process of power change completed.

The default LFSM-U curve setting of the **A17C53Z1** series complies with the requirements for storage units according to VDE-AR-N 4105.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

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**

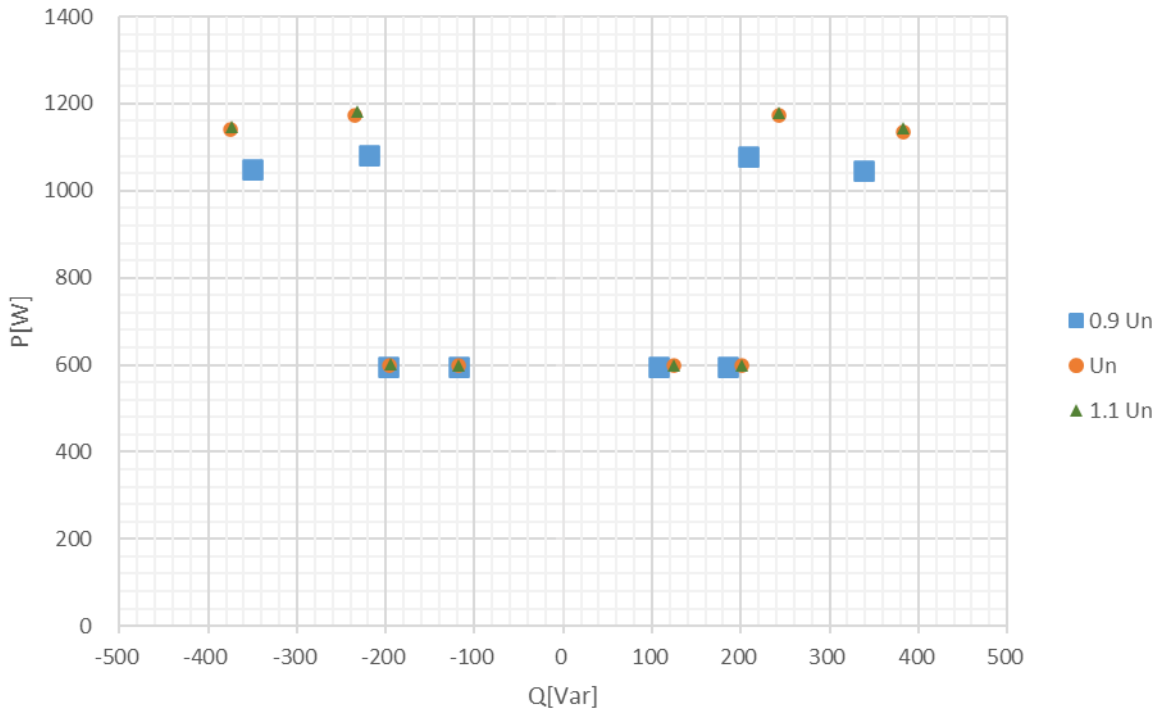
Setting values	cos φ under-excited	0,95	0,98
	cos φ over-excited	0,95	0,98

Test: A17C53Z1-20

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]	207,17	207,32	230,11	230,27	253,09	253,23
P_{E60} [W]	594	1047	599	1136	599	1144
Q_{E60} [Var]	185	338	202	383	201	382
S_{E60} [VA]	632	1113	642	1211	642	1215
cos $\varphi_{E60\ over\text{-}excited}$	0,955	0,952	0,948	0,948	0,948	0,948
$Q_{expected}$ [Var]	197	348	200	378	200	379
ΔQ_{E60} [%]	-0,10	-0,08	0,01	0,04	0,01	0,03
cos φ 0,95 under-excited						
U [V]	207,17	207,32	230,11	230,27	253,08	253,23
P_{E60} [W]	596	1049	600	1140	600	1147
Q_{E60} [Var]	-197	-351	-195	-375	-195	-373
S_{E60} [VA]	639	1122	643	1214	643	1218
cos $\varphi_{E60\ under\text{-}excited}$	0,949	0,948	0,951	0,950	0,951	0,951
$Q_{expected}$ [Var]	-199	-350	-201	-379	-201	-380
ΔQ_{E60} [%]	0,02	0,00	0,04	0,04	0,05	0,06
cos φ 0,98 over-excited						
U [V]	207,17	207,33	230,11	230,28	253,09	253,24
P_{E60} [W]	594	1080	598	1172	600	1181
Q_{E60} [Var]	107	208	124	243	124	243
S_{E60} [VA]	613	1113	622	1209	622	1214
cos $\varphi_{E60\ over\text{-}excited}$	0,984	0,982	0,979	0,979	0,979	0,979
$Q_{expected}$ [Var]	122	221	124	241	124	242
ΔQ_{E60} [%]	-0,13	-0,12	0,01	0,02	0,00	0,01

cos φ 0,98 under-excited						
U [V]	207,17	207,33	230,11	230,28	253,08	253,24
P_{E60} [W]	595	1082	600	1175	600	1182
Q_{E60} [Var]	-119	-220	-118	-234	-118	-233
S_{E60} [VA]	617	1119	622	1211	622	1215
cos $\varphi_{E60\ under\text{-}excited}$	0,981	0,980	0,981	0,981	0,981	0,981
$Q_{expected}$ [Var]	-123	-223	-124	-241	-124	-242
ΔQ_{E60} [%]	0,04	0,02	0,05	0,06	0,05	0,08

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,

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.

Note:

cos φ Minimum step size: 0,001.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

	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 10s and 60s). 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

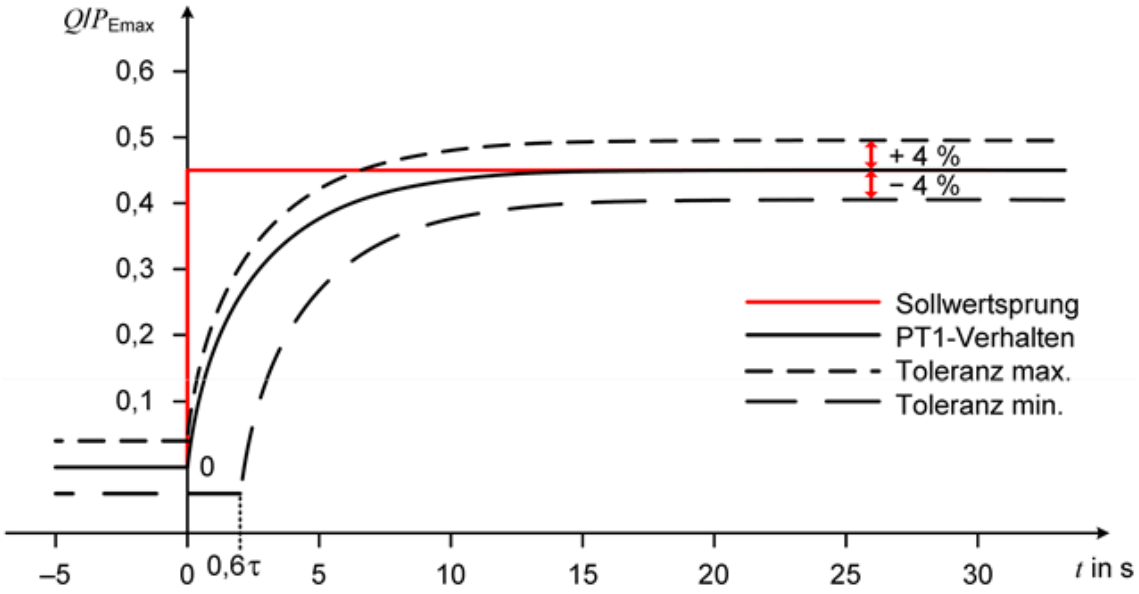


Figure 10 - Illustration at 3 tau = 10 s

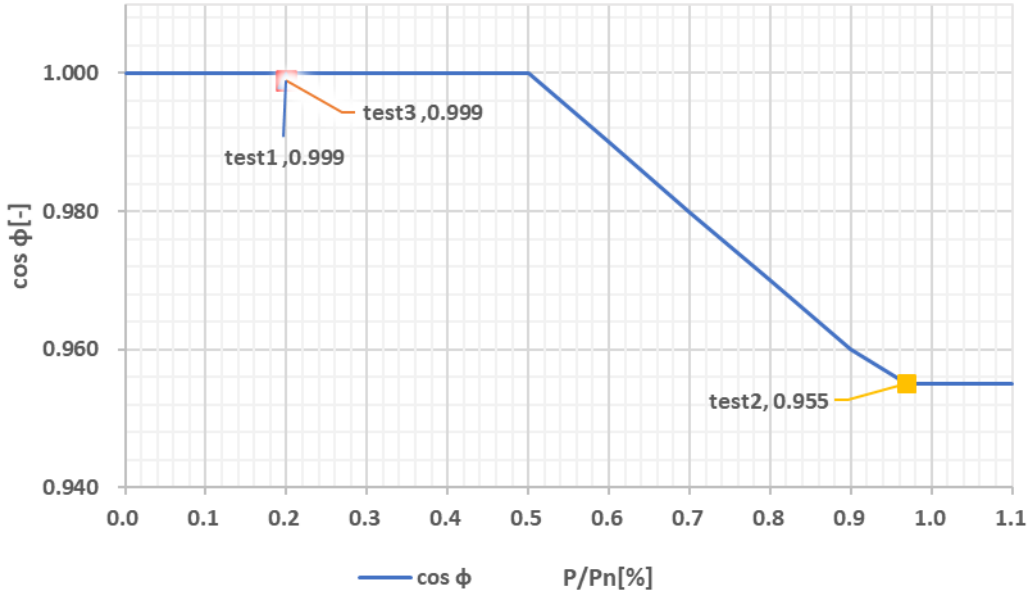
Comment:

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

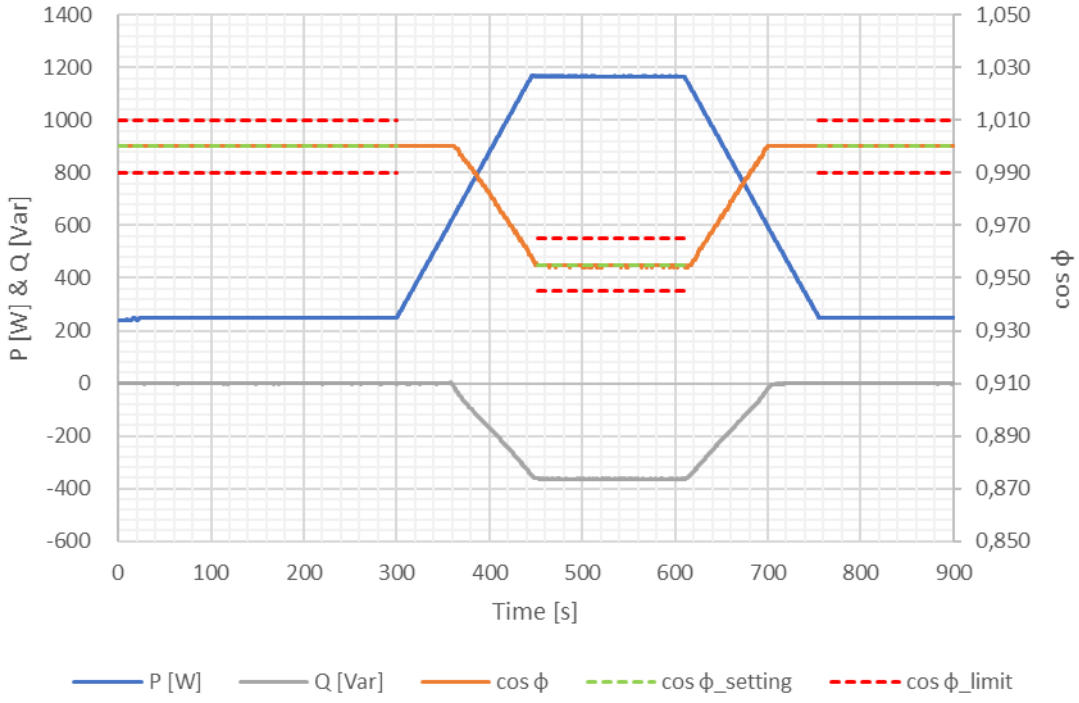
5.4.8.3 Test of the displacement factor/active power characteristic curve cos φ (P) The test serves as verification of the standard cos φ (P) curve according to VDE-AR-N 4105:2018-11, 5.7.2.4.	P

A17C53Z1-20			
Test 1) for conducted PGUs(Battery) - Accuracy (characteristic)			
Measurement: 20-100-20% P_n			
P_E/P [%]	20	100	20
U [V]	230,01	230,28	230,01
P_{E30} [W]	249	1167	250
P_{E30} of P_E [%]	20,75	97,23	20,82
Q_{E30} [VAr]	-1	-363	-1
$Q_{expected}$	0	-362	0
ΔQ_{E30} [%]	-0,08	-0,06	-0,09
cos φ_{E30}	0,999	0,955	0,999
cos $\varphi_{setpoint}$ of P_{E30}	1,000	0,955	1,000
Limit			
ΔQ_{E30} in %	≤ ±4,0% relative to P_{Emax}		P
DC setting values:			
DC Battery (Source) input current [A]	40		
DC Battery (Source) input voltage [V]	44		
P_{DC} [W]	1800		

Graph of Test 1)



Graph of Test 1)



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}.

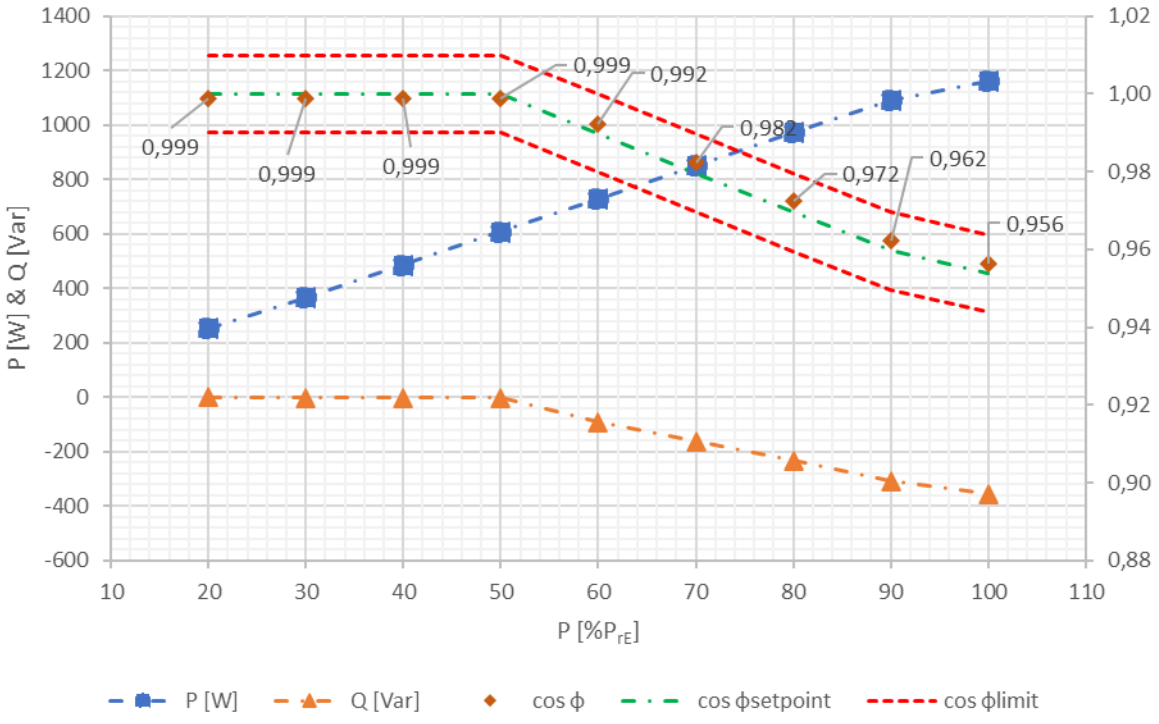
Test 3) supply-dependent PGUs - Accuracy (characteristic curve)									
A17C53Z1-20									
Measurement: 20-100% P_n									
P_{Emax}/P [%]	U [V]	P_{E30} [W]	P_{E30} of P_n [%]	Q_{E30} [VAr]	$Q_{expected}$	ΔQ_{E30} [%]	cos φ_{E30}	cos $\varphi_{setpoint}$ of P_{E30}	P_{DC}[W]
20	230,00	253	21,12	-1	0	-0,01	0,999	1,000	293
30	230,04	367	30,59	-1	0	-0,01	0,999	1,000	411
40	230,07	488	40,63	-1	0	-0,01	0,999	1,000	531
50	230,11	608	50,71	-3	0	-0,03	0,999	1,000	656
60	230,14	730	60,86	-91	-105	0,11	0,992	0,990	782
70	230,18	852	71,00	-162	-174	0,10	0,982	0,980	910
80	230,22	973	81,10	-234	-246	0,10	0,972	0,970	1038
90	230,25	1092	91,00	-309	-320	0,09	0,962	0,960	1163
100	230,27	1162	96,80	-356	-365	0,08	0,956	0,954	1237
Measurement: 100-20% P_n									
P_{Emax}/P [%]	U [V]	P_{E30} [W]	P_{E30} of P_n [%]	Q_{E30} [VAr]	$Q_{expected}$	ΔQ_{E30} [%]	cos φ_{E30}	cos $\varphi_{setpoint}$ of P_{E30}	P_{DC}[W]
100	230,27	1161	96,77	-362	-365	0,03	0,955	0,954	1237
90	230,25	1092	90,98	-317	-320	0,02	0,960	0,960	1163
80	230,22	973	81,07	-242	-245	0,02	0,970	0,970	1038
70	230,18	852	70,99	-170	-174	0,03	0,981	0,980	910
60	230,15	730	60,85	-101	-105	0,04	0,991	0,990	783
50	230,11	608	50,69	-10	0	-0,08	0,999	1,000	656
40	230,07	488	40,63	-1	0	-0,01	0,999	1,000	531
30	230,04	367	30,60	-1	0	-0,01	0,999	1,000	407
20	230,00	253	21,11	-1	0	-0,01	0,999	1,000	291
Limit									
ΔQ_{E30} in %	≤ ±4,0% relative to P_{Emax}							P	

Test 4): supply-dependent PGUs - Dynamic				
A17C53Z1-20				
P_{Emax}/P_n [%]	100	40	100	75
U [V]	230,31	230,11	230,31	230,24
P_{E30} [W]	1145	479	1145	901
P_{E30} of P_n [%]	95,42	39,92	95,42	75,08
Q_{E30} [Var]	-363	-21	-363	-207
$Q_{expected}$	-357	0	-357	-297
ΔQ_{E30} [%]	-0,05	-0,18	-0,05	0,75

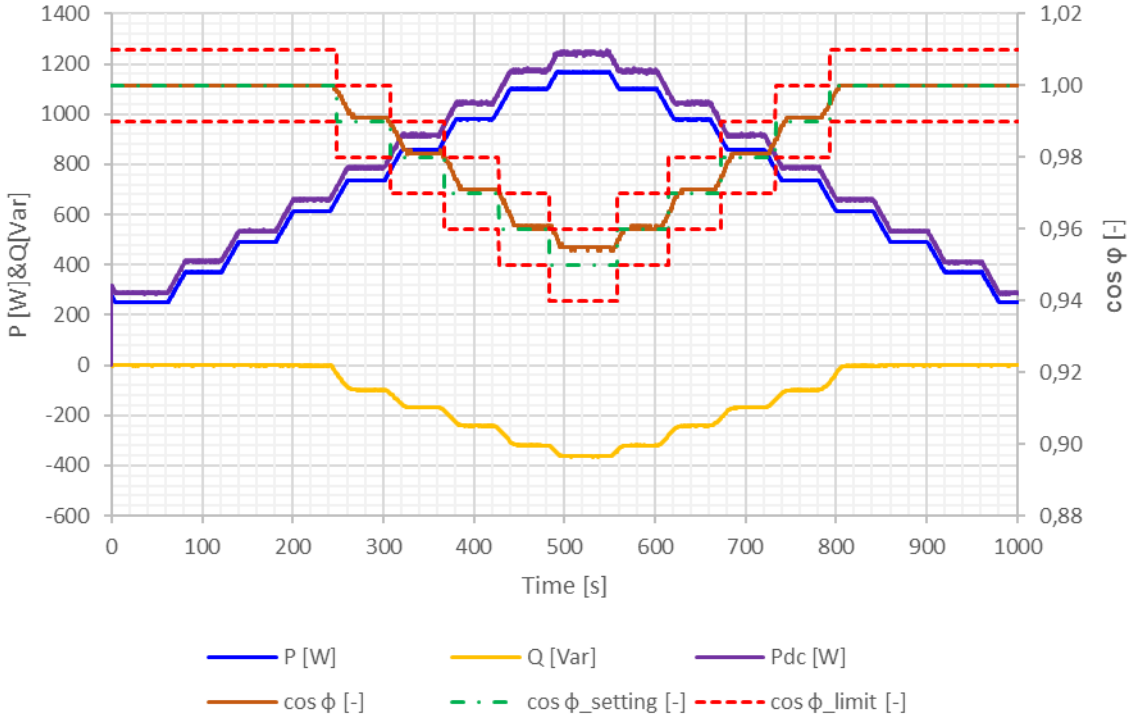
cos φ $_{E30}$	0,953	0,999	0,953	0,975
cos φ$_{setpoint}$ of P$_{E30}$	0,955	1,000	0,955	0,975
T [s]	--	10,2	10,6	9,4
Limit				
ΔQ$_{E30}$ in %	≤ ±4,0% relative to P$_{Emax}$			P
DC setting values:				

PV-curve simulated according to	
Voltage of defined MPP [V]	44
Current of defined MPP [A]	40
FFU of PV curve [1]	1
P$_{DC}$ [W]	1800

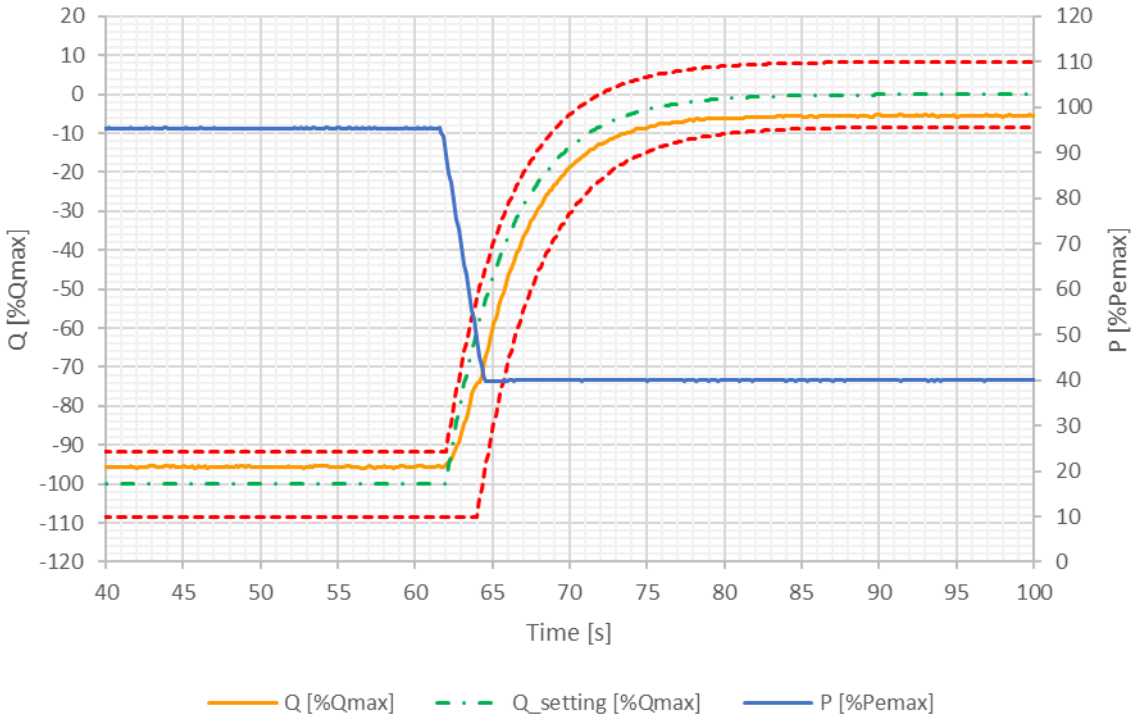
Graph of Test 3)



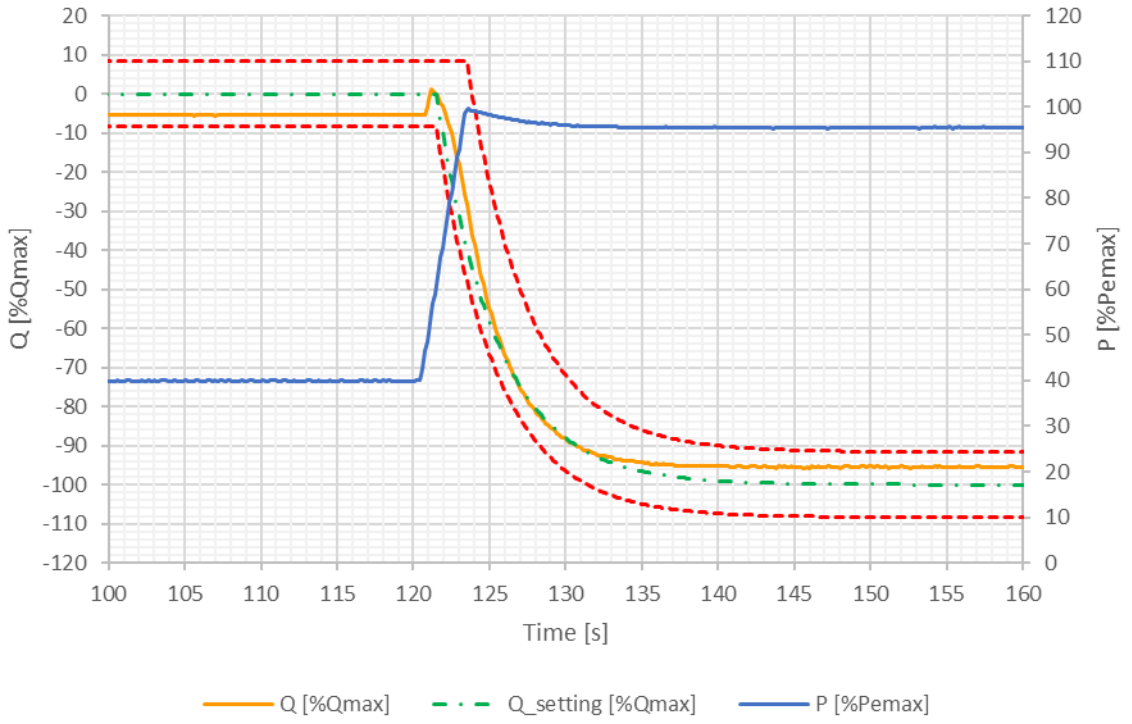
Graph of Test 3): 20% to 100% to 20%



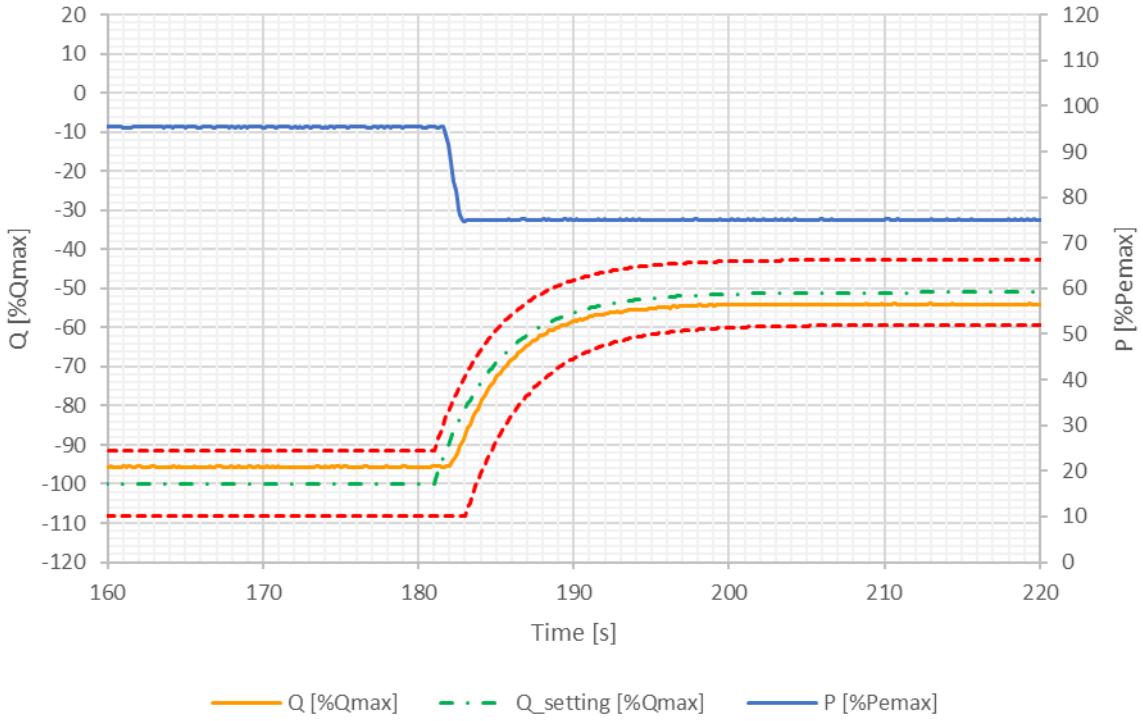
Graph of Test 4): 100% to 40%



Graph of Test 4): 40% to 100%



Graph of Test d): 100% to 75%



Assessment criterion:

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 PT1 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 PT1 behaviour according to VDE-AR-N 4105: 2018-11, 5.7.2.5.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.4.8.4	Test the reactive power-voltage characteristic Q(U)	
	The validation of the Q (U) regulation according to VDE-AR-N 4105: 2018-05, 5.7.2.4 is divided into two partial tests, so that on the one hand the accuracy and on the other hand the dynamics of the Q (U) control is checked. For all inverter-coupled systems, only the inverter must be tested.	
5.4.8.4.1	Test of the reactive power-voltage characteristic Q(U)	N/A

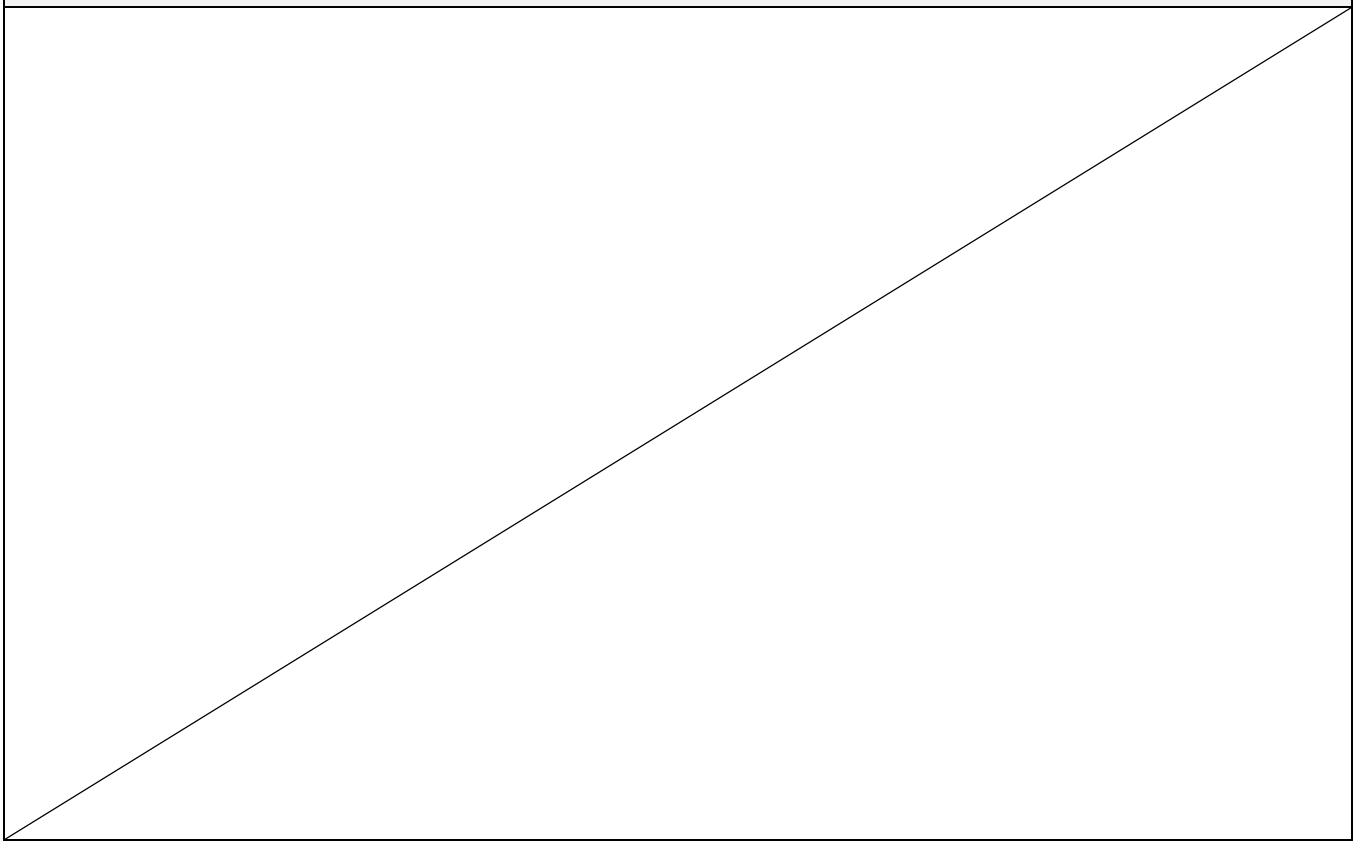
Voltage steps	[Vac] L1	[Vac] L2	[Vac] L3	P_{start} [W]	$Q_{measured}$ [VAr]	$Q_{setting}$ [VAr]	ΔQ [%Pn]
100	--	--	--	--	--	--	--
99	--	--	--	--	--	--	--
98	--	--	--	--	--	--	--
97	--	--	--	--	--	--	--
96	--	--	--	--	--	--	--
95	--	--	--	--	--	--	--
94	--	--	--	--	--	--	--
93	--	--	--	--	--	--	--
92	--	--	--	--	--	--	--
91	--	--	--	--	--	--	--
90	--	--	--	--	--	--	--
91	--	--	--	--	--	--	--
92	--	--	--	--	--	--	--
93	--	--	--	--	--	--	--
94	--	--	--	--	--	--	--
95	--	--	--	--	--	--	--
96	--	--	--	--	--	--	--
97	--	--	--	--	--	--	--
98	--	--	--	--	--	--	--
99	--	--	--	--	--	--	--
100	--	--	--	--	--	--	--
101	--	--	--	--	--	--	--
102	--	--	--	--	--	--	--
103	--	--	--	--	--	--	--
104	--	--	--	--	--	--	--
105	--	--	--	--	--	--	--
106	--	--	--	--	--	--	--
107	--	--	--	--	--	--	--
108	--	--	--	--	--	--	--
109	--	--	--	--	--	--	--

110	--	--	--	--	--	--	--
109	--	--	--	--	--	--	--
108	--	--	--	--	--	--	--
107	--	--	--	--	--	--	--
106	--	--	--	--	--	--	--
105	--	--	--	--	--	--	--
104	--	--	--	--	--	--	--
103	--	--	--	--	--	--	--
102	--	--	--	--	--	--	--
101	--	--	--	--	--	--	--
100	--	--	--	--	--	--	--

Assessment criterion:

To pass the Q (U) accuracy test, the measured stationary value pairs U_{PGU} and Q_{PGU}, taking account to the correct sign in the consumer metering system, must be within VDE-AR-N 4105: 2018-11, in 5.7.2.4, Figure 7 Q (U) shown characteristic. The stationary value pairs U_{PGU} and Q_{PGU} are determined by averaging over 30 seconds at the end of the respective measuring section analogously to Chapter 5.4.3.2. The permissible deviations are with the maximum measuring error of the voltage of 1% U_n stated in VDE-AR-N 4105: 2018-11 and a setting accuracy of 4% P_{EMax}.

$$Q_{EZE,tol} = \pm(\,0.01 \cdot \mathrm{U_{N,Y}} \cdot \mathrm{k_{QU}} + 0.04 \cdot P_{EMax}) = \pm 0{,}25 \cdot P_{EMax} \cdot (\sin(\arccos(\varphi_{min})) + 0.16).$$

Graph of Q(U) curve


5.4.8.4.2 Test of the dynamics of the Q(U) regulation	N/A

Setting values	Qmax [var]	kQU	X_{Netz}	$\Delta U_{ind,Y}$ [V]	$\Delta U_{kap,Y}$ [V]	Tau
	--	--	--	--	--	3Tau = 10s

Voltage steps	U_{start} [V] L1	U_{start} [V] L2	U_{start} [V] L3	U_{end} [V] L1	U_{end} [V] L2	U_{end} [V] L3	Q_{start} [Var]	Q_{end} [Var]	Settling time[s]
Test1:100→106,4	--	--	--	--	--	--	--	--	--
Test2:100→106,4	--	--	--	--	--	--	--	--	--
Test3:100→106,4	--	--	--	--	--	--	--	--	--
Test1:100→93,6	--	--	--	--	--	--	--	--	--
Test2:100→93,6	--	--	--	--	--	--	--	--	--
Test3:100→93,6	--	--	--	--	--	--	--	--	--

PV-curve simulated according to	
Voltage of defined MPP [V]	--
Current of defined MPP [A]	--
FFU of PV curve [1]	--
P_{DC} [W]	--

Assessment criterion:

For passing the test on the dynamics of the Q (U) control, the measured, time profiles of the reactive power have to be determined in the “positive sequence” Q_{PGU} during the entire measuring period in the PT1-like tolerances according to VDE-AR-N 4105: 2018-11, 5.7.2.5. For this purpose, the tolerance bands are entered into the diagram of the respective measurement according to the formulas below. It should be distinguished according to the expected PGU behavior (inductive, capacitive). An exemplary representation of the tolerance bands for the capacitive case is shown in Figure 6. Physically caused compensation processes (for example with type 1 PGU) are to be excluded from the evaluation, if they decay in a time range smaller than one third of the Q (U) - set time.

The variable T corresponds to the set - up time of the generating plant and three times the parameterized PT1 time constant Tau (T = 3Tau). The measurement of the time starts at the time of the excitation in 5. 4.8.3.2a) or the manipulation in 5.4.8.3.2 b).

Since the increase or decrease of the voltage according to the formula given in 5.4.8.3.2 represents only an approximation to the real behavior of the closed control loop, the steady-state final value Qset is determined from the measurement. For this purpose, a 10 - second mean value is formed at the end of the one - minute measurement period via the three - phase reactive power in the positive sequence system. Likewise, the starting value of the reactive power (positive sequence) Qstart (= offset) before the respective voltage change is determined over a 10-second averaging.

The response time of the overall system to be evaluated is measured starting from the excitation according to 5.4.8.3.2 a) or the manipulation according to 5.4.8.3.2 b) until reaching 95% of the steady end value in the positive sequence Qsoll and is with the factor 5/3 to multiply. This factor takes into account the effect of the feedback on the control dynamics of the Q (U) control and is strongly related to the formula of the net replacement reactance.

5.5	Testing of NS protection	
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

Test procedural:

- It should be checked that a single error does not result in the loss of the security function.
- Typical errors must be checked, where applicable:
  - a) Error of an AD converter or measuring card for voltage measurement;
  - b) malfunction or freezing of a microprocessor or PLC;
  - c) merging or clamping the contacts of the switching output;
  - d) Overvoltage of the supply voltage;
  - e) Breakage of the line in connecting lines between the measuring input and the control output to the dome switch;
  - f) Failure of the supply voltage (auxiliary voltage).

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

Note:

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

No.	Component No.	Fault	Test voltage	Test time	Fuse No.	Fuse current	Result
A17C5_MainBoard-V0.2(SCH)							
1.	PV voltage sampling R11	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PV1 cannot run normally. No damage. No hazard.
2.	PV voltage sampling R12	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PV1 cannot run normally. No damage. No hazard.
3.	PV voltage sampling R14	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PV1 cannot run normally. No damage. No hazard.
4.	PV voltage sampling R15	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PV1 cannot run normally. No damage. No hazard.
5.	ISO detection sampling R5	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: ISOcircuit No damage. No hazard.
6.	ISO detection sampling R8	Open before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.

7.	ISO detection sampling R9	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
8.	ISO detection sampling R13	Open before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
9.	INV voltage sampling R316	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Overvoltage No damage. No hazard.
10.	INV voltage sampling R318	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Undervoltage No damage. No hazard.
11.	INV voltage sampling R319	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Overvoltage No damage. No hazard.
12.	INV voltage sampling R330	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Undervoltage No damage. No hazard.
13.	Grid voltage sampling R357	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Grid voltage fault No damage. No hazard.
14.	Grid voltage sampling R359	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Grid voltage fault No damage. No hazard.
15.	Grid voltage sampling R360	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Grid voltage fault No damage. No hazard.
16.	BUS voltage sampling R366	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: faultLBusOver No damage. No hazard.
17.	Grid voltage sampling R368	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Udervoltage No damage. No hazard.
18.	BUS voltage sampling R369	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: faultLBusOver No damage. No hazard.
19.	BUS voltage sampling R371	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: Busunder No damage. No hazard.
A17C5_AC EMC Board_V0.2(SCH)							
20.	ISO detection sampling R2	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
21.	ISO detection sampling R11	Open before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.

22.	ISO detection sampling R12	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
23.	ISO detection sampling R18	Open before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
24.	Grid voltage sampling R19	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridOverVoltage No damage. No hazard.
25.	Grid voltage sampling R21	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridUnderVoltage No damage. No hazard.
26.	Grid voltage sampling R22	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridOverVoltage No damage. No hazard.
27.	Grid voltage sampling R24	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridUnderVoltage No damage. No hazard.
28.	Relay fault RY2 pin2 to pin3	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: GridRlyshort No damage. No hazard.
29.	Relay fault RY2 pin4 to pin5	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: GridRlyshort No damage. No hazard.
30.	Relay fault RY3 pin2 to pin3	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: OffgridRlyshort No damage. No hazard.
31.	Relay fault RY3 pin4 to pin5	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: OffgridRlyshort No damage. No hazard.
A17C5_HVDSP Board-V0.2(SCH)							
32.	Communication fault U7 pin7	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
33.	Communication fault U7 pin8	Open	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
34.	Communication fault XT2 pin1 to pin2	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
35.	Communication fault U7 pin67 to GND (VCC3.3_DSP 2 to GND)	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
36.	Grid voltage sampling D72	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridoverVoltage No damage. No hazard.

37.	Grid voltage sampling R446	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridoverVoltage No damage. No hazard.
38.	Grid voltage sampling U17 pin7 to pin5	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridoverVoltage No damage. No hazard.
39.	Grid voltage sampling U17 pin7 to pin6	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: GridoverVoltage No damage. No hazard.
40.	DCI sampling U29 pin14 to pin12	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: OverCurrent No damage. No hazard.
41.	DCI sampling U29 pin8 to pin10	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: OverCurrent No damage. No hazard.
42.	DCI sampling U29 pin8 to pin9	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: OverCurrent No damage. No hazard.
43.	DCI sampling C600	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: OverCurrent No damage. No hazard.
44.	DCI sampling R59	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: OverCurrent No damage. No hazard.
45.	ISO detection sampling R424	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
46.	ISO detection sampling U26 pin1 to pin3	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
47.	ISO detection sampling U26 pin1 to pin2	Short before start-up	230Vac 550Vdc	10ming	--	--	The inverter cannot start-up. Error message: ISOcircuit No damage. No hazard.
A17C5_LVDSP Board_V0.2(SCH)							
48.	Communication fault XT1 pin1 to pin2	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
49.	Communication fault U3 pin94 to GND (+3.3_LV to GND)	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: The product not working and Abnormal communication No damage. No hazard.
50.	BUS voltage sampling R164	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: BusuOver No damage. No hazard.
51.	BUS voltage sampling U204 pin14 to pin12	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: BusuOver No damage. No hazard.

52.	BUS voltage sampling U204 pin14 to pin13	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: BusuOver No damage. No hazard.
53.	BUS voltage sampling U206 pin2 to pin5	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: BusuOver No damage. No hazard.
54.	BUS voltage sampling U206 pin2 to pin6	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: BusuOver No damage. No hazard.
55.	PV voltage sampling R218	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PVOverVoltage No damage. No hazard.
56.	PV voltage sampling U203 pin14 to pin12	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PVOverVoltage No damage. No hazard.
57.	PV voltage sampling U203 pin14 to pin13	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PVOverVoltage No damage. No hazard.
58.	PV voltage sampling C183	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: PVOverVoltage No damage. No hazard.
59.	HV BUS R366	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: HBUS over voltage No damage. No hazard.
60.	HV BUS R371	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message: HBUS over No damage. No hazard.
61.	LV BUS R439	Short	230Vac 550Vdc	10ming	--	--	The inverter immediately disconnection from grid. Error message:LBUS over No damage. No hazard.

supplementary information:
S-C: short circuit, O-C: open circuit, O-L: overload, R: reversed
The errors in the control circuit simulate that the safety is even under one error ensured.

.5.3 Central NS-protection	N/A
5.5.3.1 Test	**N/A**
- The auxiliary voltage of the NS protection is switched off	**N/A**
- The test facility on the NS protection is actuated	**N/A**
Assessment criterion: The test is considered to have been passed if a signal for the immediate shutdown is generated.	
Note: The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.	

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.	

5.5.6 Interface switch	
5.5.6.1 General	**P**
These tests serve to demonstrate the requirements of VDE-AR-N 4105: 2018-11, 6.4	
5.5.6.2 Documentation for the design of the central interface switch	**N/A**
Some details of the central NS protection and the PGU are necessary for the design of a central interface switch. The manufacturer's documentation must therefore contain the following information.	
- maximum operating time of the central interface switch (manufacturer NS protection)	**N/A**
- Operating time of the protective device (manufacturer NA protection)	**N/A**
- maximum initial short-circuit alternating current (manufacturer PGU)	**N/A**
- maximum AC circuit breaker / grid fuse for the PGU (manufacturer PGU)	**N/A**
- circuit diagram / connection diagram (NS protection / coupling switch) contains the required control and feedback signals (manufacturer NS protection)	**N/A**
Assessment criterion: The test is considered as pass when the documentation of the manufacturer included the necessary information.	
Note: Information checked in the manual and datasheet for the external NS protection and coupling switch used in the PGU.	

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.	P
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.	P
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.	P
The switch-off time of the whole reaction chain is within 0,2s.	P
(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 complied with DIN EN 62109 (VDE 0126-14-1).	N/A
Note: See test results 5.5.2.1 functional safety.	
Relay model: HF140FF-G-012-2HSWTF(456)	
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)	= 10 A, 230 Vac
Max. switching current relay	= 16 A, 250 Vac
Response time of interface switch for integrated NS protection	≤ 15 ms

Datasheet of the relay (Interface switch):

Relay model: HF140FF-G-012-2HSWTF(456)

产品规格书Product Specification FM-M0608-002 Rev1.7

宁波金海电子有限公司

Ningbo Jinhai Electronic Co., Ltd

电话 Tel：（86）-592-6106688
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产品规格书

Product Specification

文件编号 File No.：4528773GGS072

顾客 Customer: _____

顾客产品名称 Customer Product Name: _____

顾客零件号 Customer Part No.: _____

宏发产品名称 Hongfa Product Name: 继电器 RELAY

宏发产品型号 Hongfa Product Part No.: HF140FF-G/012-2HSWTF(456)

发布日期 Release Date: 2023 年 4 月 24 日

生产工厂 Production Plant: 宁波金海电子有限公司
Ningbo Jinhai Electronic Co., Ltd

版本 Version: a 更改单号 Number of Modification: _____

宁波金海电子有限公司 技术中心

宏发审批签字 Signature by Hongfa			顾客确认 Customer Approval
拟制 Released by	审核 Checked by	批准 Approved by	负责人 By:
吴城富	周干善/安倩倩	温启洪	日期 Date:

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- 1 - 保存期限:长期 保存部门:技术系统

产品规格书 Product Specification

产品规格书 Relay Specification

顾客 Customer:_____

1 品种 Type Model

1.1 种类 Type: 电磁继电器 Electromagnetic Relay

1.2 型号 Part NO.: HF140FF-G/012-2HSWTF(456)

1.3 外形尺寸 Outline dimensions : 29.0 mm×12.7 mm×26.0 mm

1.4 触点形式 Contact Form: 两组常开 2Form A

1.5 触点材料 Contact Material: $AgSnO_2$

1.6 触点间隙 Contact Gap: ≥2.0mm

2 安全认证 Safety Approvals

认证机构 Certification Agency	认证号 File No.
UL/CUL	E134517
TüV	R 50149131
CQC	CQC10002046173

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

3 线圈额定参数 Coil Rating

at 23 ℃

额定电压 Rated Voltage Vd.c.	动作电压 (1) Operate Voltage Vd.c.	释放电压 (1) Release Voltage Vd.c.	允许最大线圈电压 (2) Max Allowable Coil Voltage Vd.c.	线圈电阻 Coil Resistance Ω	线圈功耗 Coil Power 大约 Approx. W
12	≤9.6	≥0.6	13.2	102×(1±10%)	1.4

备注：（1）上述值为初始值。
（2）允许最大线圈电压是指继电器线圈在短时间内能够承受的最大电压值。
Note:(1)The data shown above are initial values
(2) Maximun allowable coil voltage refers to the maximun voltage which relay coil could endure in a short period of time.

4 触点参数 Contact Parameters

4.1 触点额定负载 Contact Rating: 16 A 250 Va.c.

4.2 最大切换电流 Max Switching Current: 16 A

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

4.4 最小适用负载 Min Applicable Load: 6 Vd.c. 1 A

5 性能 Performance

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

5.2 动作时间 Operate Time: ≤ 20 ms 。

5.3 释放时间 Release Time: ≤ 15 ms 。

5.4 耐久性 Endurance

5.4.1 电耐久性 Electrical Endurance

结构型式 Version	触点材料 Contact Material	触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 Ratio	电耐久性 Electrical Endurance
2H 型	$AgSnO_2$	阻性负载 Resistive Load 16 A 250 Va.c. 2NO 串联	室温 Room Temperature	1s: 9s	3×10^4 次(ops)

5.4.2 机械耐久性 Mechanical Endurance

结构型式 Version	触点负载 Contact Rating	环境温度 Ambient Temperature	通断比 Ratio	机械耐久性 Mechanical Endurance
2H 型	无负载 No load	室温 Room Temperature	0.5s：0.5s	1×10^7 次 （ops）

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

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

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

5.5.3 各独立的触点电路的引出端之间 Between terminals of separate contact circuits: 3000 Va.c. (50/60 Hz 1 min) 。

5.6 绝缘电阻 Insulation Resistance

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

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

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

5.7 线圈温升 Coil Temperature Rise: 80 K max
以 110%额定电压激励，触点负载 16 A 250 Va.c.。环境温度：75 ℃。
Applied voltage of coil 110% rated voltage, Carry current of contact 16 A 250 Va.c.. Environmental temperature is 75 ℃.

5.8 振动 Vibration

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

Functional:10 Hz～55 Hz, 1.5 mm double amplitude, 1 hour for each axe.No opening or closing of any closed or opened contact circuit respectively shall exceed 10 μs.

5.9 冲击 Shock

稳定性: 98 m/s^2（脉冲持续时间 11 ms），6 次(三个相互垂直轴线的每一个方向 6 次，总共 36 次),闭合回路的断开或开路回路的闭合时间应不超过 10 μs。

Functional: 98 m/s^2(Duration 11ms), 6 shocks (six ops in both directions of each of the three mutually perpendicular axes, totally 36 ops), No opening or closing of any closed or opened contact circuit respectively shall exceed 10 μs.

强度: 980 m/s^2（脉冲持续时间 6 ms），6 次(三个相互垂直轴线的每一个方向 6 次，总共 36 次）继电器外观、结构和性能不应有异常。

Destructive: 980 m/s^2(Duration 6 ms), 6 shocks (six ops in both directions of each of the three mutually perpendicular axes, totally 36 ops) There should be no abnormalities in appearance, construction and performance.

5.10 引出脚强度 Terminal Strength

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

PCB Terminals: No damage on the relay when applying 10 N tension or pressure for 10 s on the axis direction of terminals。

5.11 耐焊接热 Soldering Heat Resistance

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

5.11.2 焊接时间 Soldering Time：(5±1) s

5.12 焊接性能 Solderbility

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

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

5.13 耐温性 Temperature Resistance

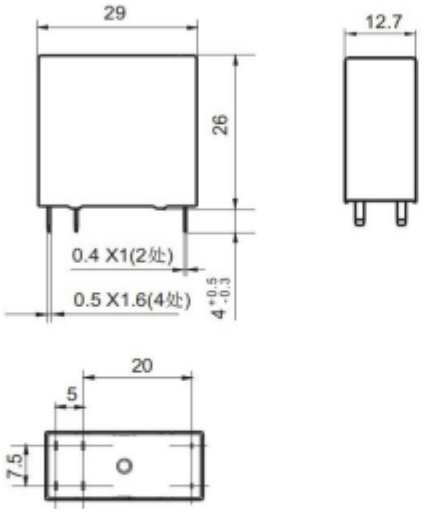
5.13.1 耐热 Heat Resistance

(75±2) ℃温度中放置 16 h,恢复常温 2 h 后，继电器的结构及性能应无异常。

At (75±2) ℃ for 16h storage follow by 2 hours at room temperature, no damage on internal structure, all parameters conform.

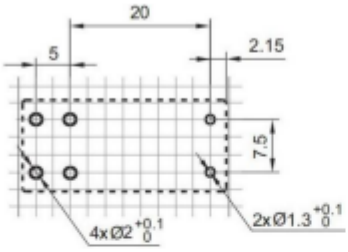
5.13.2 耐寒 Cold Resistance

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



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

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



注：产品外形尺寸未注尺寸公差及 PCB 板未注尺寸公差按下表执行。

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

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

5.5.7.2 Check of setting values	P
5.5.7.2.1 Test	P

Test procedural:

- Before the further tests begin, the factory setting values of the test object must be checked.
- The test object must be reset to factory settings.
- The test object must be put into operation according to the user manual. If an operator input is required, the setting for VDE-ARN 4105:2018 must be selected.

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

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	230,0V	400V
	Nominal frequency	f_n	1	50Hz	50Hz
a) name set of parameters (Parameter setup name in manual or software)					
☐ Synchronous and asynchronous generators with $P_n \leq 50$ kW coupled directly or via a converter Stirling generators, fuel cells,	Excitation threshold U>>	N/A	N/A	N/A	N/A
	Delay time U>>	N/A	N/A	N/A	N/A
	Excitation threshold U>	N/A	N/A	N/A	N/A
	Delay time U> * 1)	N/A	N/A	N/A	N/A
	Excitation threshold U<	N/A	N/A	N/A	N/A
	Delay time U<	N/A	N/A	N/A	N/A
	Excitation threshold U<<	N/A	N/A	N/A	N/A
	Delay time U<<	N/A	N/A	N/A	N/A
	Excitation threshold f>	N/A	N/A	N/A	N/A
	Delay time f>	N/A	N/A	N/A	N/A
	Excitation threshold f<	N/A	N/A	N/A	N/A
	Delay time f<	N/A	N/A	N/A	N/A
b) name set of parameters (Parameter setup name in manual or software)					
☐ directly coupled synchronous and asynchronous generators with $P_n > 50$ kW	Excitation threshold U>>	N/A	N/A	N/A	N/A
	Delay time U>>	N/A	N/A	N/A	N/A
	Excitation threshold U>	N/A	N/A	N/A	N/A
	Delay time U> * 1)	N/A	N/A	N/A	N/A
	Excitation threshold U<	N/A	N/A	N/A	N/A
	Delay time U<	N/A	N/A	N/A	N/A

	Excitation threshold U<<	N/A	N/A	N/A	N/A
	Delay time U<<	N/A	N/A	N/A	N/A
	Excitation threshold f>	N/A	N/A	N/A	N/A
	Delay time f>	N/A	N/A	N/A	N/A
	Excitation threshold f<	N/A	N/A	N/A	N/A
	Delay time f<	N/A	N/A	N/A	N/A
c) name set of parameters (Parameter setup name in manual or software)					
☒ Inverter	Excitation threshold U>>	GridOVP2Threshold	--	287,5	N/A
	Delay time U>>	GridOVP2Time	--	100	N/A
	Excitation threshold U>	GridOVP1Threshold	--	253,0	N/A
	Delay time U> * 1)	GridOVP1Time	--	100 *1)	N/A
	Excitation threshold U<	GridUVP1Threshold	--	184,0	N/A
	Delay time U<	GridUVP1Time	--	3000	N/A
	Excitation threshold U<<	GridUVP2Threshold	--	103,5	N/A
	Delay time U<<	GridUVP2Time	--	300	N/A
	Excitation threshold f>	GridOFP1Threshold	--	51,5	N/A
	Delay time f>	GridOFP1Time	--	100	N/A
	Excitation threshold f<	GridUFP1Threshold	--	47,5	N/A
	Delay time f<	GridUFP1Time	--	100	N/A
*1) 10-min mean value *2) testing of external NS-protection					

Factory settings correspond to the values according the Inverter of Table 36 of VDE 0124	P
There are no factory settings. The information on the setting values in the instruction manual correspond to those in Inverter of Table 36 of VDE 0124.	N/A
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	P
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.	P

5.5.7.3 Wiring check	N/A
5.5.7.3.1 Test	N/A

Test procedural:

- The wiring of the test object must be checked by applying the test voltages.
- For single-phase EZE, the wiring test is adapted, only the feed-in phase is to be evaluated.
- It must be checked that the test object correctly evaluates line to line voltages and line to neutral conductor voltages. This test step is not applicable for single-phase EZE.

Assessment criterion:

This check is not evaluated. If a phase rotation is detected, it shall be corrected and the test repeated.

Note:

Wiring Test Voltage Monitoring and Frequency Monitoring

Setting values:

Phase	Voltage [Vac]	Phase angle [°]	Frequency [Hz]
U L1-E	--	--	--
U L2-E	--	--	--
U L3-E	--	--	--

Measured values:

Phase	Voltage [Vac]	Phase angle [°]	Frequency [Hz]
U L1-E	--	--	--
U L2-E	--	--	--
U L3-E	--	--	--

Checking Voltage Reference Voltage Monitoring and Frequency Monitoring

Setting values:

Phase	Voltage [Vac]	Phase angle [°]	Frequency [Hz]
U L1-E	--	--	--
U L2-E	--	--	--
U L3-E	--	--	--

Measured values:

Phase	Voltage [Vac]	Phase angle [°]	Frequency [Hz]
U L1-E	--	--	--
U L2-E	--	--	--
U L3-E	--	--	--

5.5.7.4	Voltage and frequency control	P
5.5.7.4.1	Voltage and frequency control – Single Phase	P

Test procedural:

- For a single-phase EZE, only the feed-in phase needs to be checked.
- Before each test step, the EZE must be operated symmetrically with rated voltage and rated frequency for at least 10 s in feed-in mode.
- The P setpoint was set by WiFi port.

Assessment criterion:

- The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of Un.
- The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, limit is given with +0,100s according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2018.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Integrated NS protection single-phase ≤30kVA

	Setting	Value [V]	Time [s]	Setting	Value [V]	Time [s]
Setting values of the NS protection:	U>>	287,5	0,1			
	U<	184,0	3,0	U<<	103,5	0,3

Operating time of the monitoring device:

A17C53Z1-20

L to N:	**Under voltage AU< (4.4):**			**Over voltage AU>> (1.4):**		
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]	183,55	183,43	183,42	287,56	287,47	287,50

L to N:	**Under voltage tU< (5.4):**			**Over voltage tU>> (2.4):**		
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 ≤t ≤3,100			0,100 ≤t ≤0,200		
Measurement [s]	3,076	3,056	3,068	0,166	0,163	0,166

L to N:	**Under voltage AU<< (6.4):**		
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]	103,09	103,05	103,02

L to N:	**Under voltage tU<< (7.4):**
Jump [start V to stop V]	>108,1 → <98,9
Step size [V]	>9,2

5.5.7.4	Voltage and frequency control	P
5.5.7.4.1	Voltage and frequency control – Single Phase	P

Test procedural:

- For a single-phase EZE, only the feed-in phase needs to be checked.
- Before each test step, the EZE must be operated symmetrically with rated voltage and rated frequency for at least 10 s in feed-in mode.
- The P setpoint was set by WiFi port.

Assessment criterion:

- The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of Un.
- The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, limit is given with +0,100s according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2018.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Integrated NS protection single-phase ≤30kVA

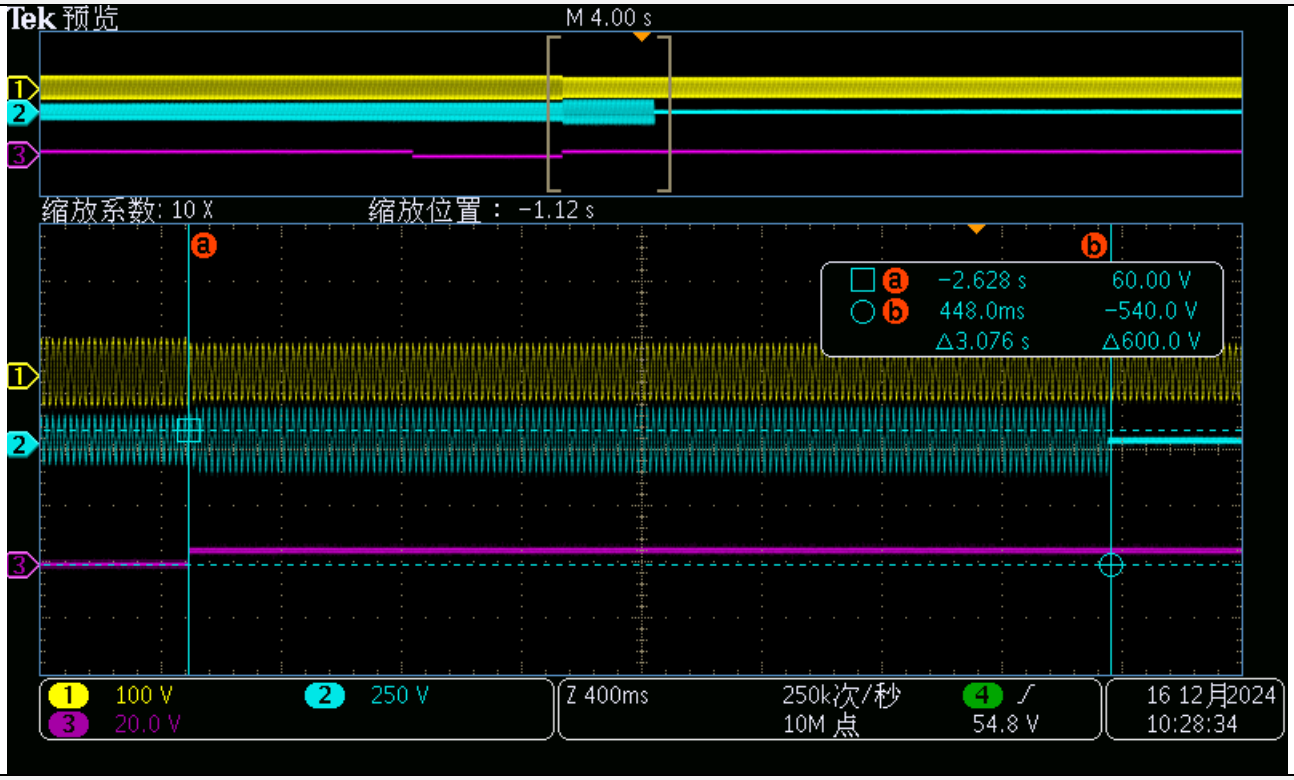
	Setting	Value [V]	Time [s]	Setting	Value [V]	Time [s]
Setting values of the NS protection:	U>>	287,5	0,1			
	U<	184,0	3,0	U<<	103,5	0,3

Operating time of the monitoring device:

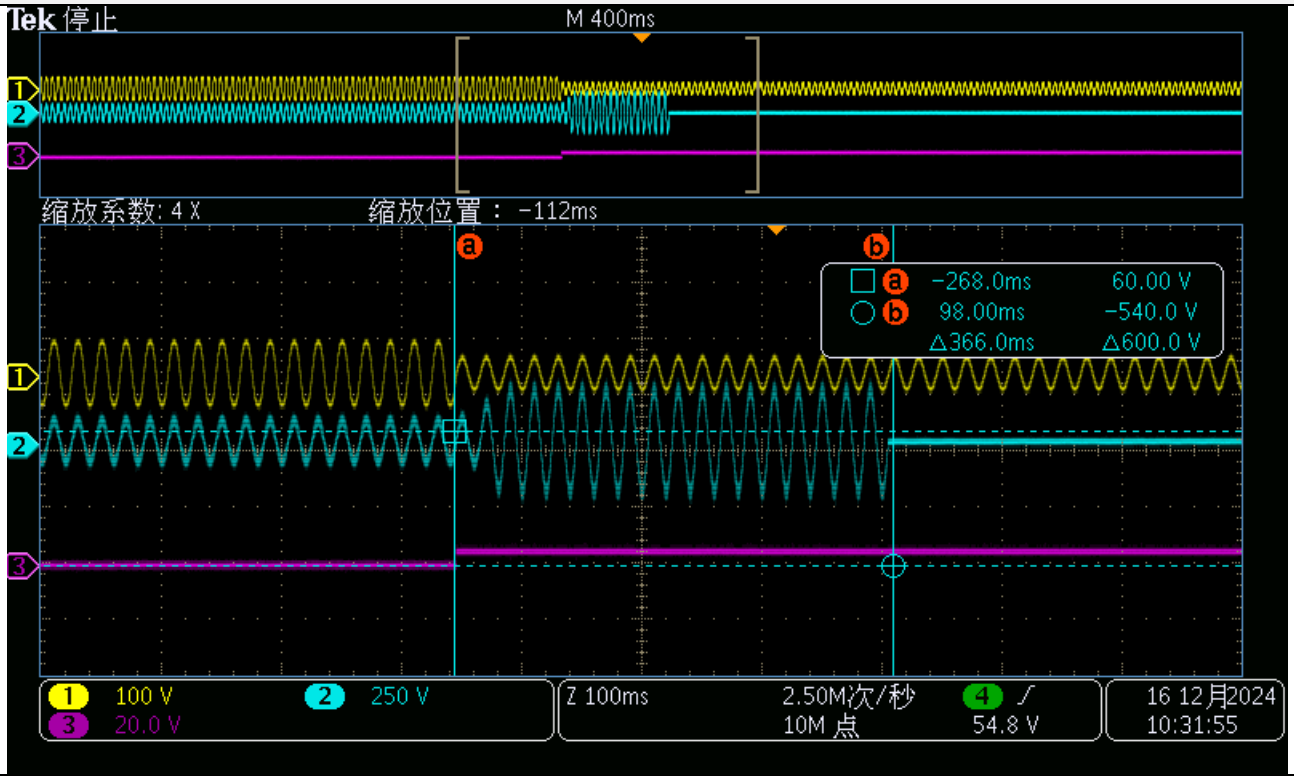
A17C53Z1-20

Step length [s]	>0,500			
Limit [s]	0,300 ≤t ≤0,400			
Measurement [s]	0,364	0,366	0,362	

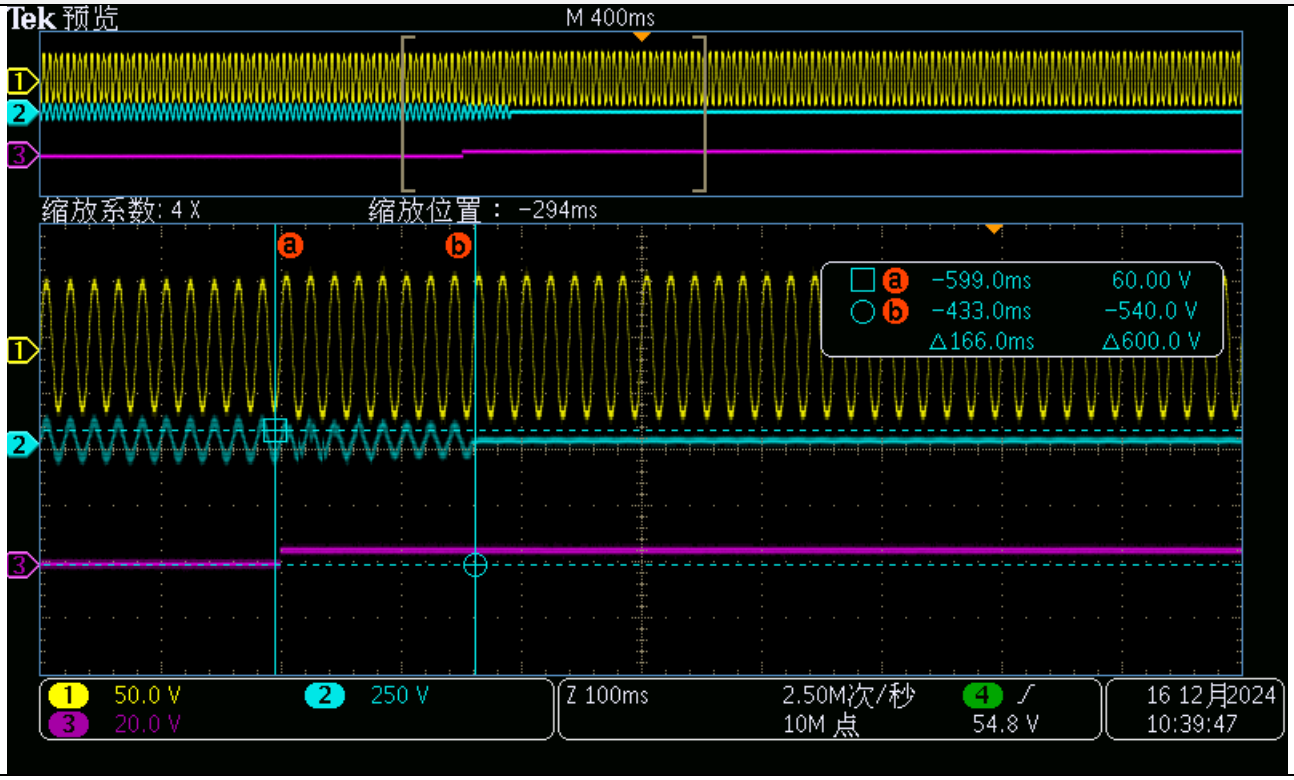
Under voltage AU<: L to N:



Under voltage AU<<: L to N:

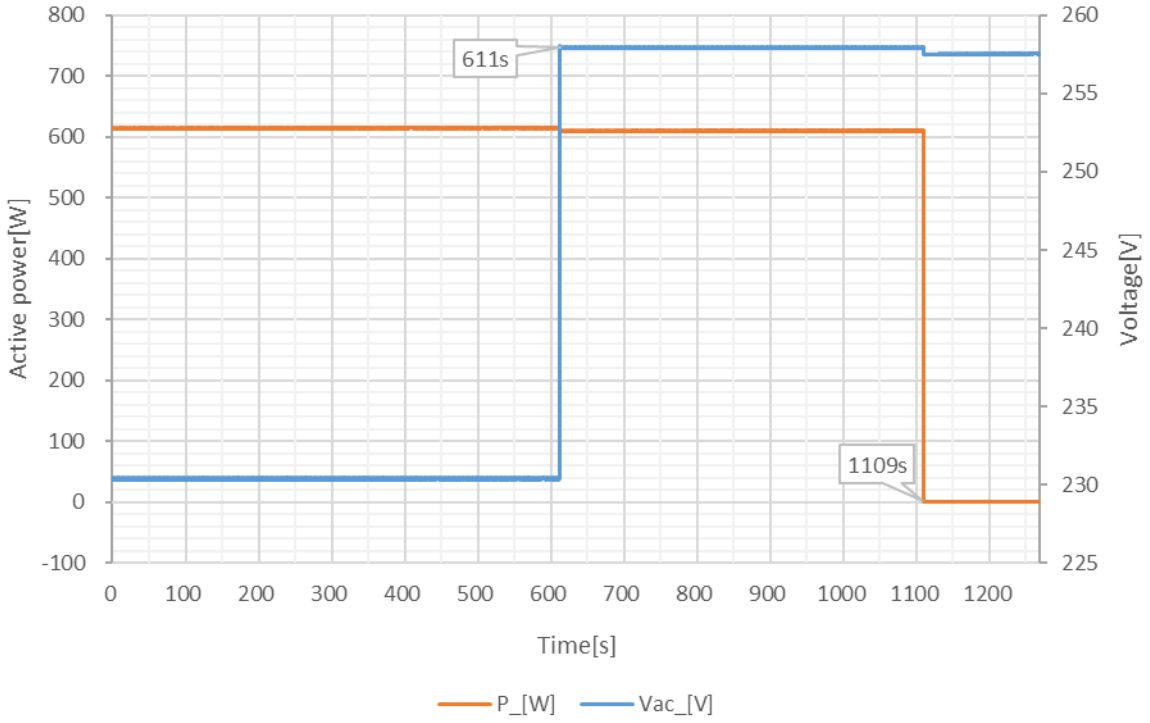


Over voltage AU>>: L to N:

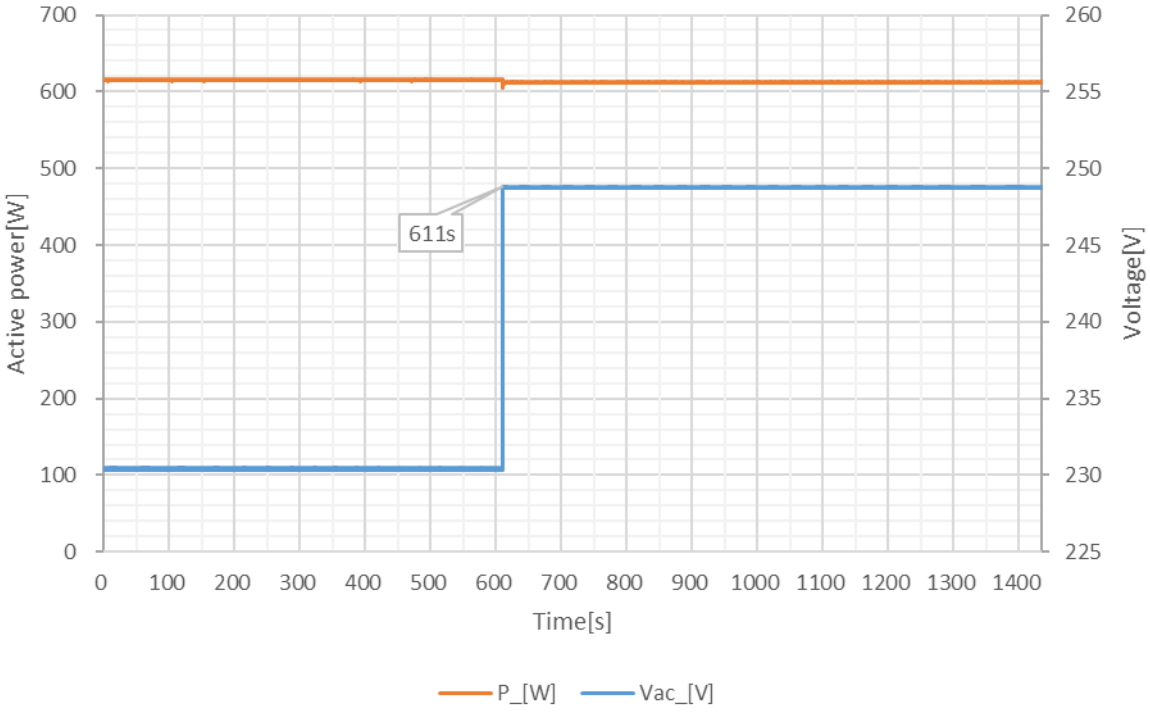


5.5.7.4 Voltage and frequency control			**P**
5.5.7.4.1 Measuring the rise-in voltage protection as a running 10-minute mean value			**P**
Setting values of the NS protection:	Setting U> [V]	253,0	
	Setting $T_{disconnection\ U>}$ [s]	600	
Note: The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.			
Operating time of the monitoring device:			
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 to 550		
Measurement [s]	498s		
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 600s)		
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]	225s to 375		
Measurement [s]	296 s		

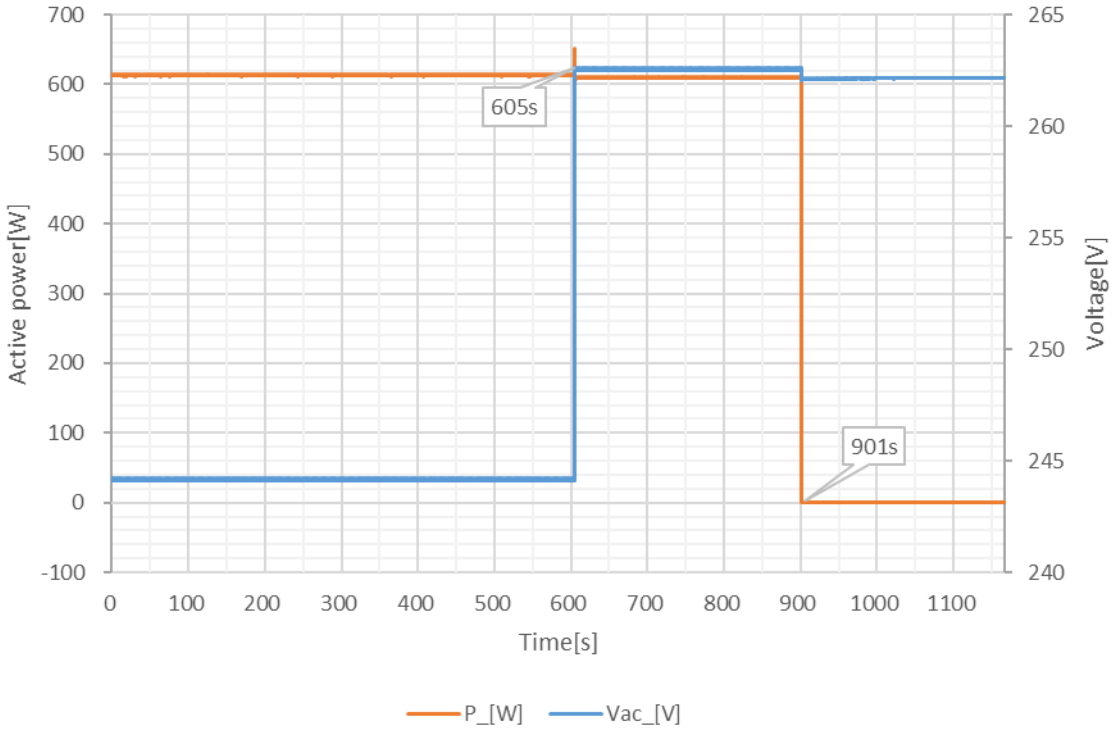
Over voltage 10-minute mean value (3.1):



Over voltage 10-minute mean value (3.2):



Over voltage 10-minute mean value (3.3):



5.5.7.4 Voltage and frequency control	P
5.5.7.4.1 Voltage and frequency control – Frequency measurement	**P**

Test procedural:

- For a single-phase EZE, only the feed-in phase needs to be checked.
- Before each test step, the EZE must be operated symmetrically with rated voltage and rated frequency for at least 10 s in feed-in mode.
- The P setpoint was set by WiFi port.

Assessment criterion:

- The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1% of f_n.
- The disconnection time includes disconnect time + operate time of the integrated relay. Therefore, limit is given with +0,100s according to Table 2 set values of the NS-protection according to VDE AR-N 4105:2018.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

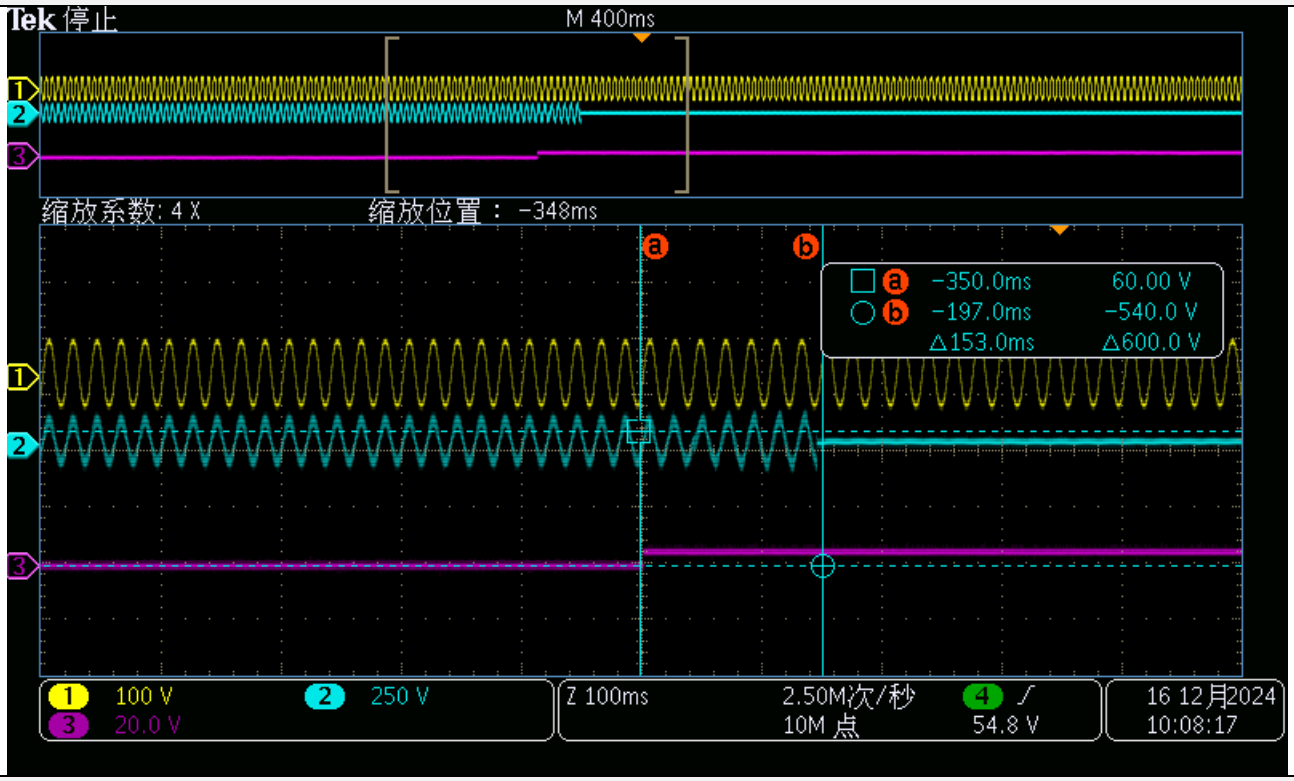
	Setting	Value [Hz]	Time [s]
Setting values of the NS protection:	f<	47,5	0,1
	f>	51,5	0,1

Operating time of the monitoring device:

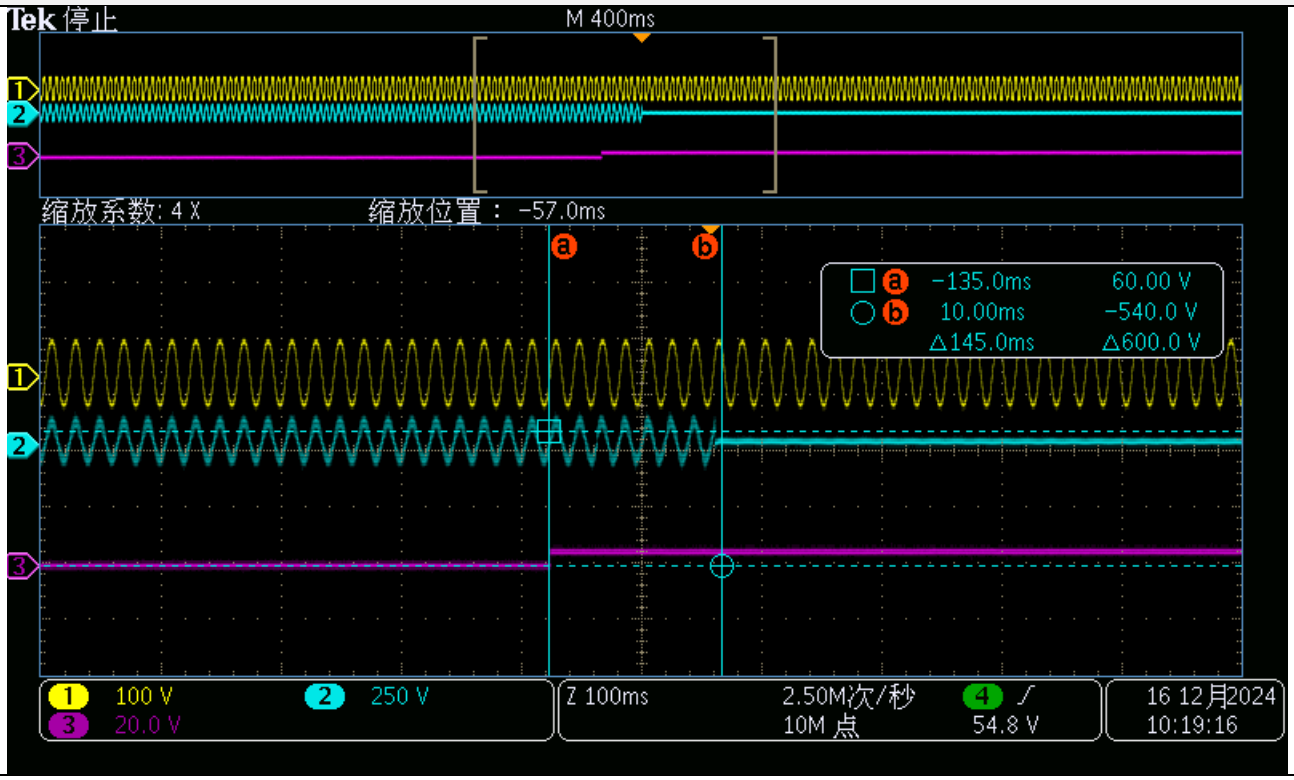
	Under frequency Af< (10.1):			**Over frequency Af>(8.1):**		
Ramp [start Hz to stop Hz]	47,60 → 47,40			51,40 → 51,60		
Step size [Hz]	<0,025			<0,025		
Step length [s]	>0,4			>0,4		
Limit [Hz]	47,50 ±1% f_n			51,50 ±1% f_n		
Measurement [Hz]	47,51	47,50	47,50	51,50	51,50	51,50

	Under frequency Tf< (11.1):			**Over frequency Tf> (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 ≤t ≤0,200			0,100 ≤t ≤0,200		
Disconnection time [s]	0,147	0,152	0,153	0,145	0,143	0,142

Under frequency Af< (11.1):



Over frequency Af> (9.1):



5.5.7.5 Reporting NS protection	P

Test procedural:

- At least the last 5 error messages can be read at the EZE or the external NA protection.
- The supply voltage must then be interrupted for 3 s.
- The error messages must then be read out again.

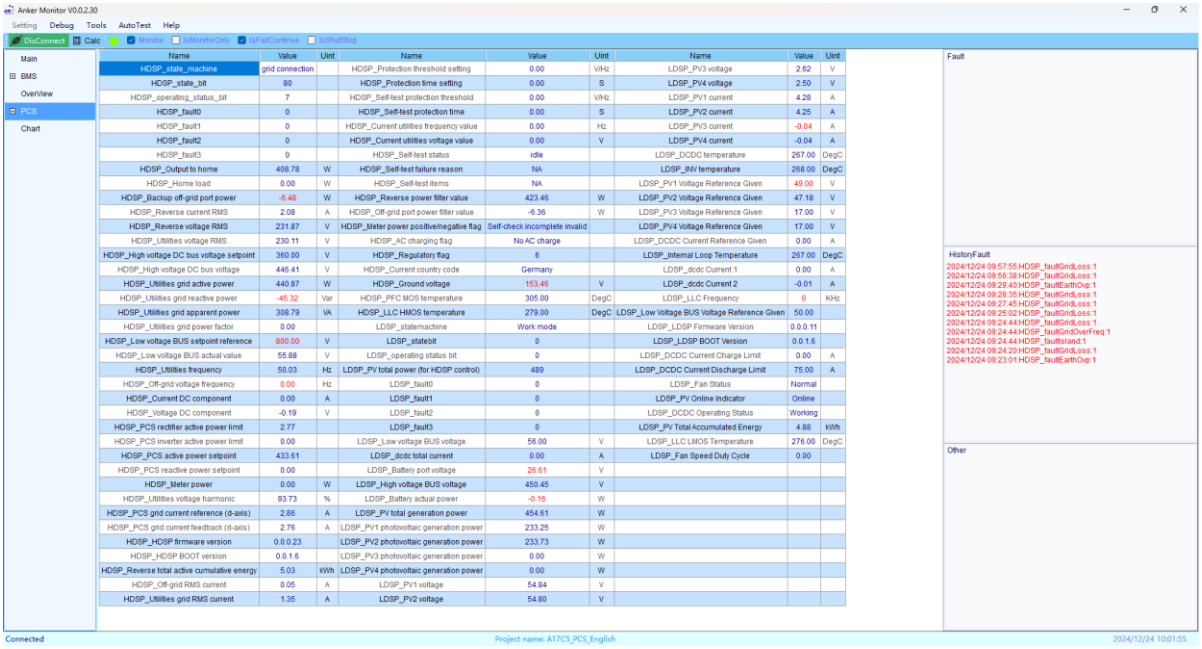
Assessment criterion:

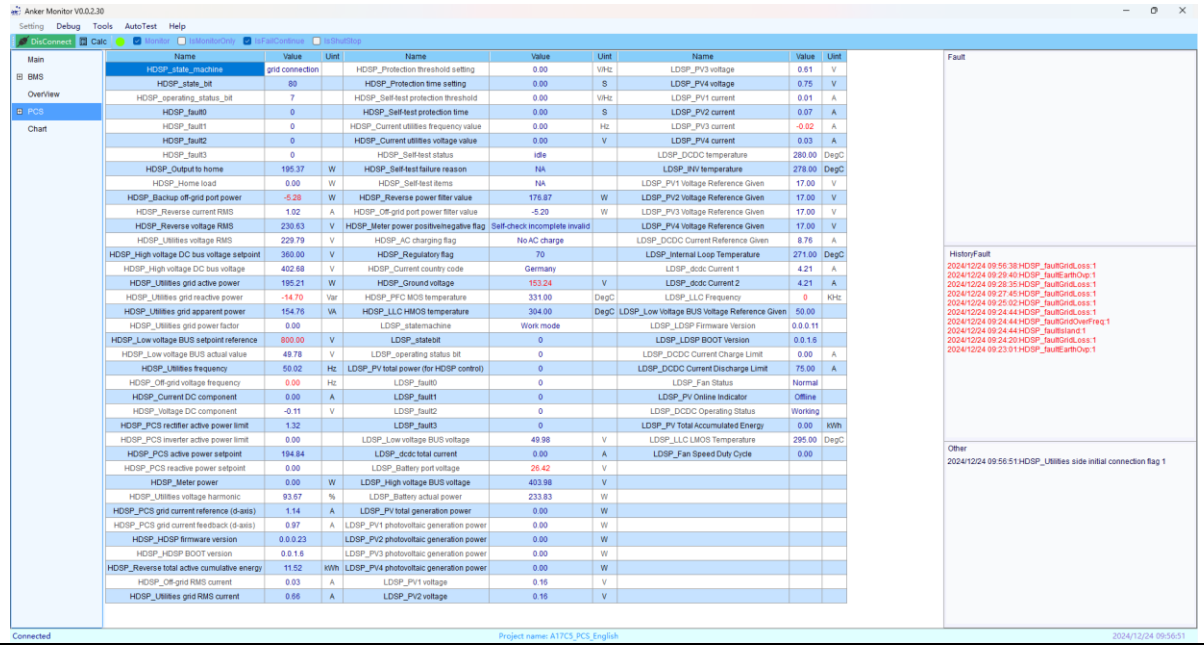
At least the last 5 error messages including time stamps that were recorded before the voltage interruption and at least 5 error messages including time stamps that were recorded after the voltage interruption must be documented.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Picture of 5 last dated failure:





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 / ☐external	
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

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 5.4.5.3 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.	

5.5.10.2 Passive Islanding detection	N/A
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.	

5.5.10.3 Islanding protection according to table 6 - Load imbalance (real, reactive load) for test condition A (PGU output = 100%)	P
Test conditions	Frequency: 50 ±1% f_n U_n = 230 ±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]	P_{PGU} [W]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Re-marks5)
1	100	100	0	0	1200	49	0,998	148	Test A at BL
2	100	100	-10	-10	1200	49	1,083	193	Test A at IB
3	100	100	-10	-5	1200	49	1,095	167	Test A at IB
4	100	100	-10	0	1200	49	1,120	151	Test A at IB
5	100	100	-10	+5	1200	49	1,128	138	Test A at IB
6	100	100	-10	+10	1200	49	1,152	105	Test A at IB
7	100	100	-5	-10	1200	49	1,032	183	Test A at IB
8	100	100	-5	-5	1200	49	1,043	150	Test A at IB
9	100	100	-5	0	1200	49	1,061	132	Test A at IB
10	100	100	-5	+5	1200	49	1,076	140	Test A at IB
11	100	100	-5	+10	1200	49	1,085	108	Test A at IB
12	100	100	0	-10	1200	49	0,969	190	Test A at IB
13	100	100	0	-5	1200	49	0,979	161	Test A at IB
14	100	100	0	+5	1200	49	1,010	134	Test A at IB
15	100	100	0	+10	1200	49	1,037	116	Test A at IB
16	100	100	+5	-10	1200	49	0,934	184	Test A at IB
17	100	100	+5	-5	1200	49	0,949	143	Test A at IB
18	100	100	+5	0	1200	49	0,959	129	Test A at IB
19	100	100	+5	+5	1200	49	0,973	120	Test A at IB
20	100	100	+5	+10	1200	49	0,988	134	Test A at IB
21	100	100	+10	-10	1200	49	0,887	190	Test A at IB
22	100	100	+10	-5	1200	49	0,901	142	Test A at IB
23	100	100	+10	0	1200	49	0,916	130	Test A at IB
24	100	100	+10	+5	1200	49	0,929	133	Test A at IB
25	100	100	+10	+10	1200	49	0,943	120	Test A at IB

Parameter at 0%	L= 2140,32 mH	R= 44,08 Ω	C= 72,21 µF
I_{AC} 4)[A]	0,030		

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)

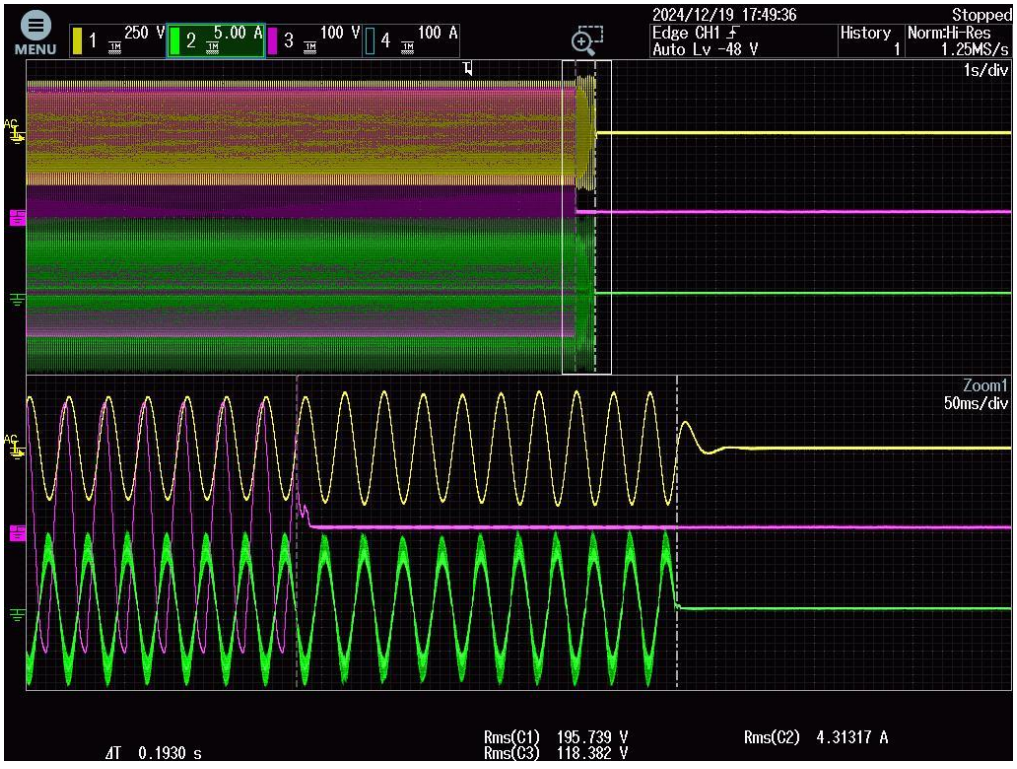
PGU input voltage 6) ≥ 75% of rated input voltage range

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.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Disconnection at P_{AC} -10% & Q_{AC} -10%



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 ±1% f_n U_n = 230 ±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]	P_{PGU} [W]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Re-marks[5)]
26	66	66	0	-5	792	37	0,977	187	Test B at IB
27	66	66	0	-5	792	37	0,981	190	Test B at IB
28	66	66	0	-4	792	37	0,985	156	Test B at IB
29	66	66	0	-3	792	37	0,988	164	Test B at IB
30	66	66	0	-2	792	37	0,994	167	Test B at IB
31	66	66	0	-1	792	37	0,998	142	Test B at IB
32	66	66	0	0	792	37	1,001	135	Test B at BL
33	66	66	0	1	792	37	1,005	143	Test B at IB
34	66	66	0	2	792	37	1,007	132	Test B at IB
35	66	66	0	3	792	37	1,011	132	Test B at IB
36	66	66	0	4	792	37	1,017	129	Test B at IB
37	66	66	0	5	792	37	1,018	118	Test B at IB

Parameter at 0%	L= 212,62 mH	R= 66,79 Ω	C= 47,66µF
I_{AC} [4)][A]	0,020		

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:

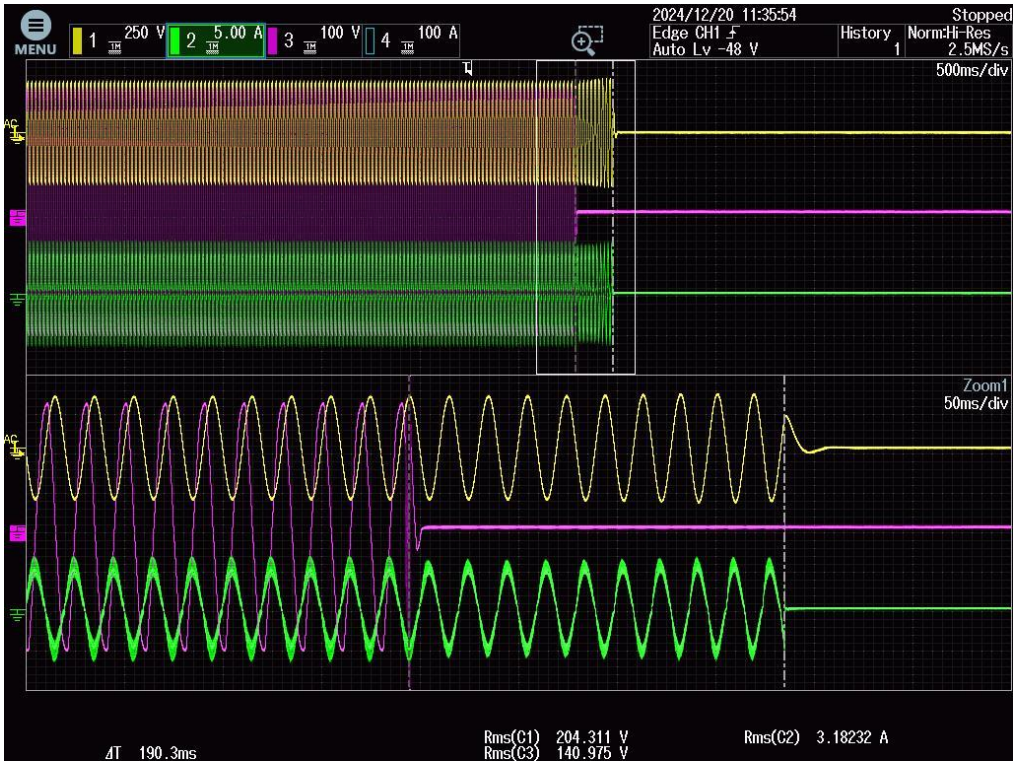
PGU output power P_{PGU} = 50 % – 66 % of maximum

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.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Disconnection time at P_{AC} 0% and Q_{AC} -5%



5.5.10.3 Islanding protection according Table 8 – Load imbalance (reactive load) for test condition C (PGU output = 25 % – 33 %)									**P**
Test conditions			Frequency: 50 ±1% f_n U_n = 230 ±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]	P_{PGU} [W]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Re-marks[5]
38	33	33	0	-5	396	24	0,945	255	Test C at IB
39	33	33	0	-5	396	24	0,952	287	Test C at IB
40	33	33	0	-4	396	24	0,959	246	Test C at IB
41	33	33	0	-3	396	24	0,965	201	Test C at IB
42	33	33	0	-2	396	24	0,975	187	Test C at IB
43	33	33	0	-1	396	24	0,980	164	Test C at IB
44	33	33	0	0	396	24	1,000	146	Test C at BL
45	33	33	0	1	396	24	1,009	142	Test C at IB
46	33	33	0	2	396	24	1,012	137	Test C at IB
47	33	33	0	3	396	24	1,019	145	Test C at IB
48	33	33	0	4	396	24	1,028	119	Test C at IB
49	33	33	0	5	396	24	1,036	109	Test C at IB

Parameter at 0%	L= 425,22 mH	R= 133,58 Ω	C= 23,83µF
I_{AC} [4][A]	0,020		

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 C:

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

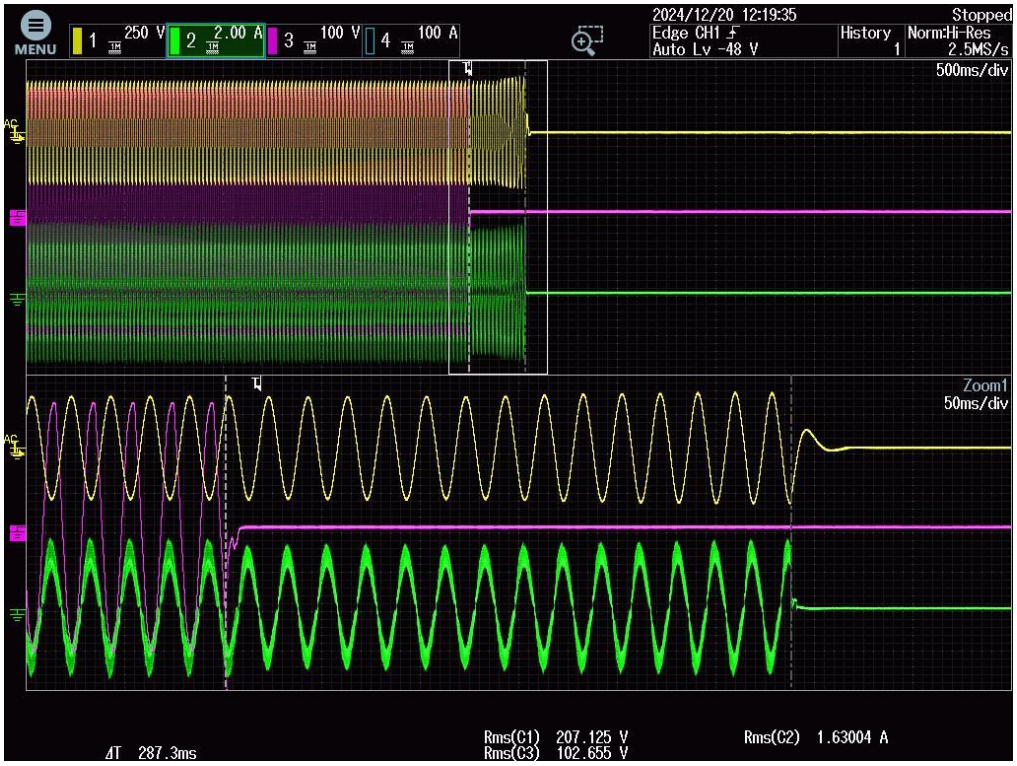
PGU input voltage [7] < 20 % of rated input voltage range

[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.

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

Disconnection time at P_{AC} 0% and Q_{AC} -5



5.6.2. Connecting conditions and synchronisation				P
Test: A17C53Z1-20				
	f_{ist}	**Reset time:**	**Limit:**	
Connecting conditions for frequencies:				
a)	<47,45Hz	No reconnection	No resetting allowed	
	Switch to:			
b)	≥47,55Hz	75 s	≥60s	
c)	>50,15Hz	No reconnection	No resetting allowed	
	Switch to:			
d)	≤50,05Hz	72 s	≥60s	
Connecting conditions for voltages:				
e)	84%	No reconnection	No resetting allowed	
	Switch to:			
f)	≥86%	70 s	≥60s	
g)	111%	No reconnection	No resetting allowed	
	Switch to:			
h)	≤109%	76 s	≥60s	

Test:

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

The measurement was carried out with a programmable AC source.

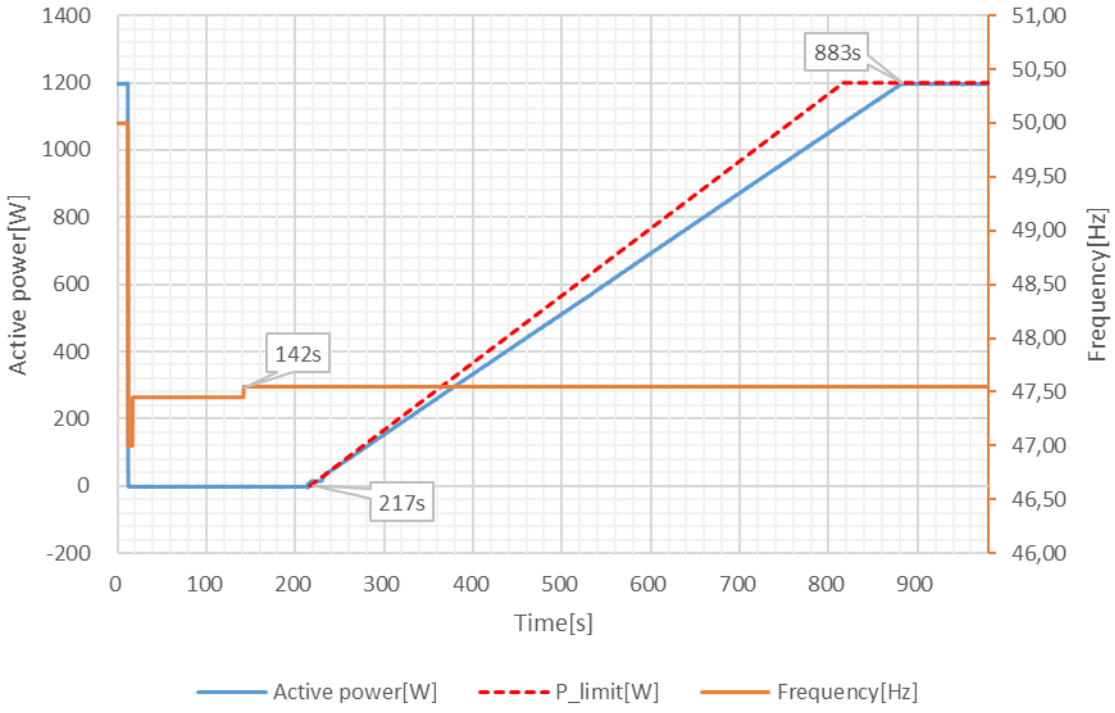
e.g. connecting conditions for frequencies: Point a) and b). The AC source was programmed in such a way that the first step of 230V/50Hz to 230V/47,0Hz resulted in a faulty disconnection. Thereafter the voltage and frequency for 100s is set to 230V/47,45Hz. Switching on again is not permitted. After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

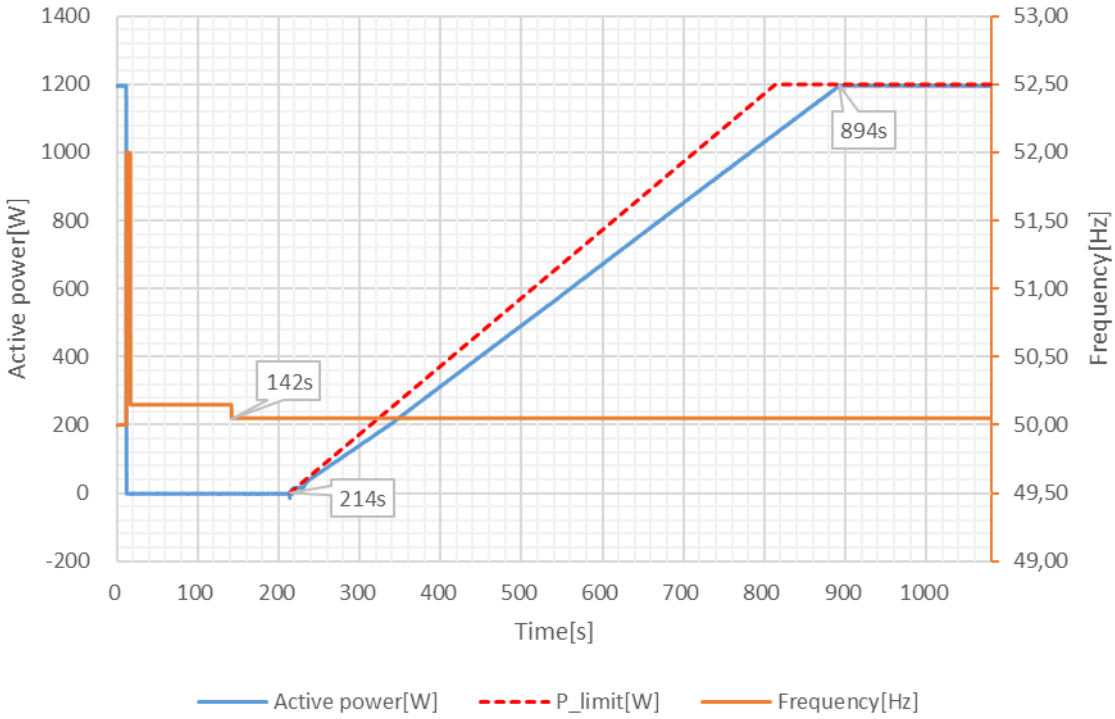
Assessment criterion:

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 (47,50Hz ≤f ≤50,10Hz)) at the earliest after 60s after voltage and frequency has remained within the tolerance ranges.

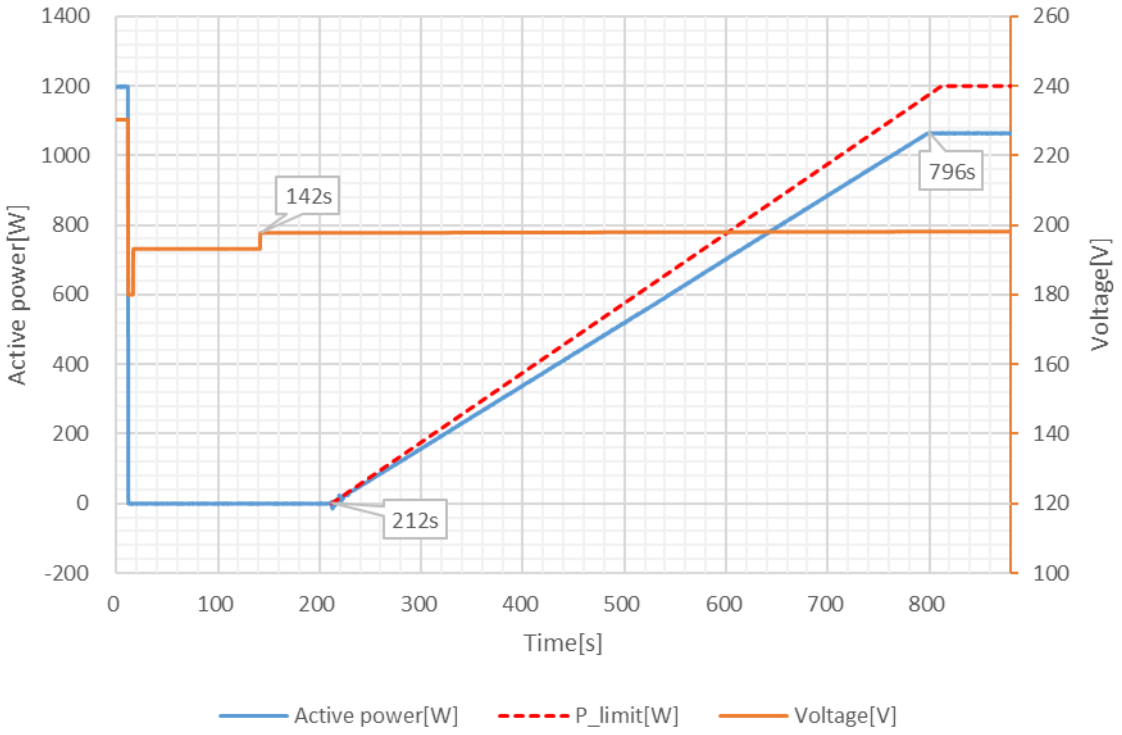
Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

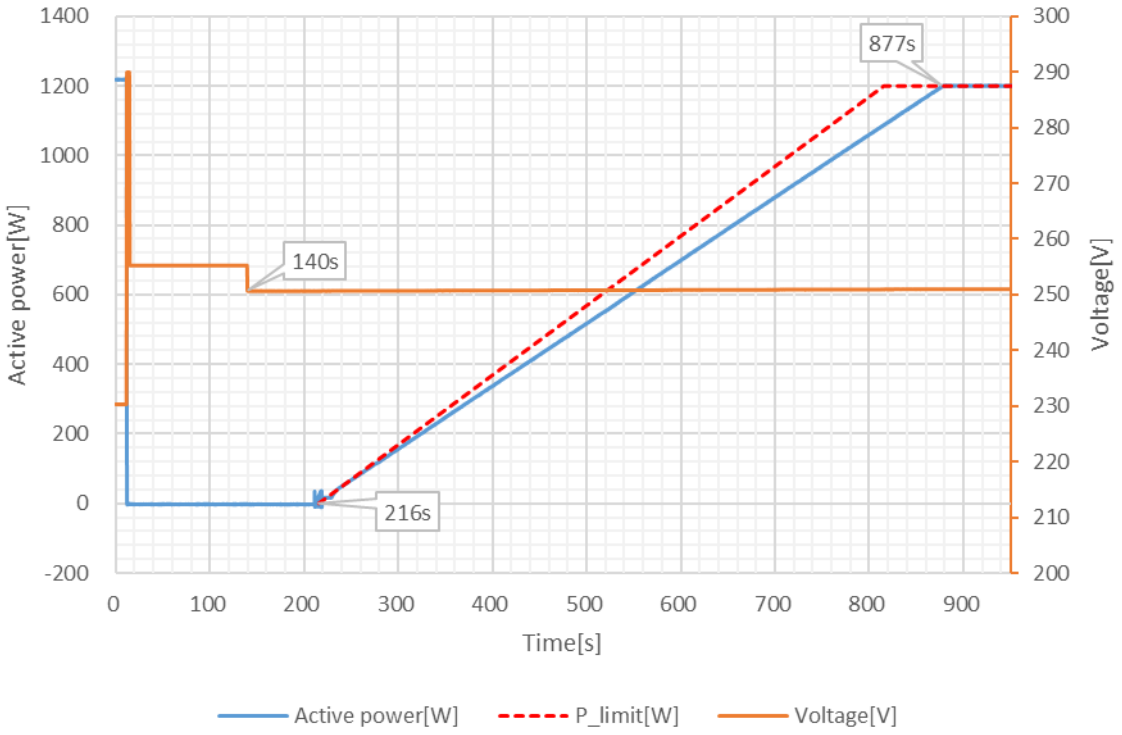
Connecting conditions for frequencies: 47,55Hz


Connecting conditions for frequencies: 50,05Hz


Connecting conditions for voltages: 86%Un



Connecting conditions for voltages: 109%Un



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.

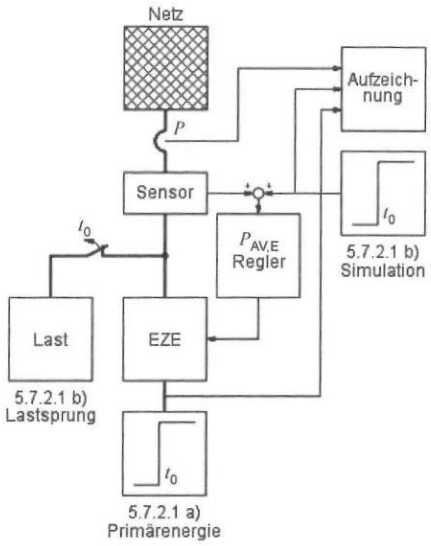


Bild 8 – Skizze des Prüfaufbaus zur Prüfung der Regeldynamik

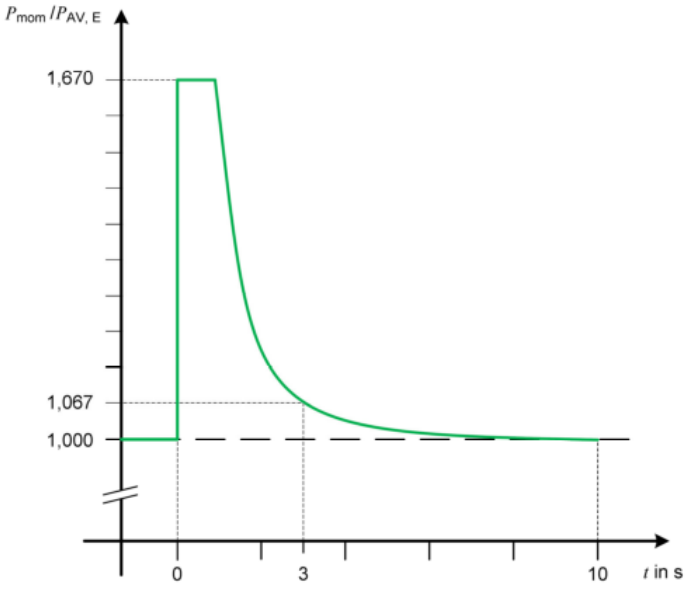


Bild 1 – Wirkleistungs-Grenzkurve für Erzeugungsanlagen

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 15s from the power jump.

5.7.2.1 Test of control the dynamic

Parameter setting for testing
The $P_{AV, E}$ -control power was setting to 60%PrE through the parameter settling limitation feed power of maximum total system power of smart power meter.

For step descripted of testing
Test a): Primary energy supply jump

a) The primary energy supply is set so that the EZE feeds the power $P_{AV, E}$ = 60% P_{rE} with a tolerance of −2%.
b) At time t0, the primary energy supply has to be increased by leaps and bounds so that the EZE can provide the nominal output.
c) Waiting for the output power were stabilizing (keep at lease 60s) then sudden added the primary supply to nominal power of EZE.

Test b): Loss of load setting:

d) Adjust load with 40%PrE at least with a tolerance of +2% to make the active power at the meter position to be $P_{AV, E}$ =60%PrE with a tolerance of −2%.
e) e) Waiting for the output power were stabilizing (keep at lease 60s) then sudden disconnected the load.

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.

Note:

The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.7.2.1 Test a): Primary energy supply jump **P**

The primary energy supply is set so that the EZE feeds the power PAV, E = 60% PrE with a tolerance of −2%.		Setting the primary supply allows the EZE to reach nominal power		response time [s]
P_{DC} [W]	P_{SUM} [W]	P_{DC} [W]	P_{SUM} [W]	
759	706	769	716	0,2

5.7.2.1 Test b): Loss of load **P**

P_{load} [W]	P_{SUM} before disconnect the load [W]	P_{SUM} after disconnect the load [W]	response time [s]
464	1257	715	0,2

Note:

P_{DC}: setting value of the primary supply power

P_{SUM}: active power at the meter position

P_{load}: setting value of the load power

Datasheet of the meter:

Meter model: A17X7

Specifications- Smart Meter

Product Model

PN	A17X7
Model Name	Smart meter

Smart Meter Info

Voltage AC(Un)	3x230/400V
Rated Input	50/60Hz, CT 40mA, 2W CATIII
Operating Temperature	-25~+55°C
DIN Rail	35mm
Ingress Protection	IP51
Warranty	2 years

Transportation

Product Weight	0.40kg
Packaging Weight	0.50kg
Product Dimension	95x70x35mm
Packaging Dimension	220x165x65mm

product		A17X7	remark
picture			
dimension		72x100x66	
application		three phase	
supply	network type	3P4W	
	input voltage Vac	230+/-10%	
	Energy consumption W	2	
measure range	Line voltage	400 V	
	phase voltage	100 ~ 260V	
	frequency	50/60HZ	
	current	0-120	
accuracy	voltage	class 1	
	current	class 1	
	power	class 1	
Communication mode		wifi/ bluetooth/485	
Baud rate		9600	
temp. range		-25-55°C	
storage range		-30-60°C	
Humidity		<95%	
Altitude		2000m	

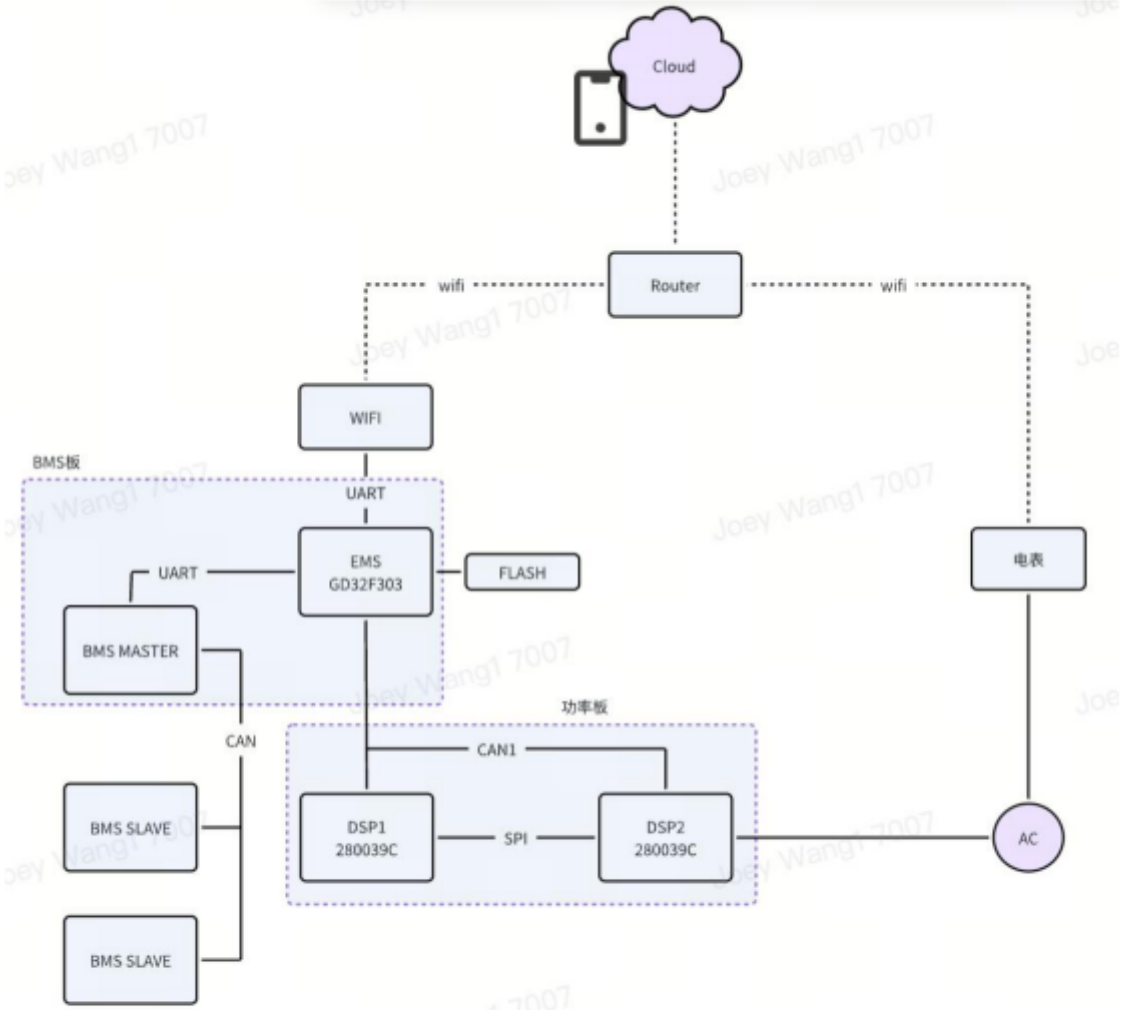
IP degree	IP20	
certificate	CE-LVD, CE-RED, Rohs, EMC	
CT range A	0-120	
CT dimension mm	36x47x32	

Sampling accuracy: Reference standard IEC 62053, meet the Class 2 accuracy

Table 3 – Acceptable percentage error limits (single-phase meters and poly-phase meters with balanced loads or single-phase loads)

Value of current		Power factor cos φ	Acceptable percentage error limits for meters of class		
for directly connected meters	for transformer operated meters		0,5	1	2
$I_{min} \le I < 0{,}1\ I_n$	$I_{min} \le I < 0{,}05\ I_n$	1	±1,0	±1,5	±2,5
$0{,}1\ I_n \le I \le I_{max}$	$0{,}05\ I_n \le I \le I_{max}$	1	±0,5	±1,0	±2,0
$0{,}1\ I_n \le I < 0{,}2\ I_n$	$0{,}05\ I_n \le I < 0{,}1\ I_n$	0,5 inductive 0,8 capacitive	±1,0 ±1,0	±1,5 ±1,5	±2,5 -
$0{,}2\ I_n \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,5 inductive 0,8 capacitive	±0,6 ±0,6	±1,0 ±1,0	±2,0 -------
$0{,}2\ I_n \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,25 inductive 0,5 capacitive 0,25 capacitive	±1,0 [a] ±1,0 [a] ----------	±3,5 [a] ±2,5 [a] -------	 ------- -------
[a] When specially requested by the user.					
NOTE 1 The current transformers under IEC 61869-2 have a lowest load point at 0,05 I_n.					
NOTE 2 See Annex A for an informative comparison of percentage error limits for classes 0,5, 1 and 2.					

Meter system scheme:



Fault management:

1.Network configuration failure: internal module self-processing
2.The power supply to the meter is abnormal
3.Meter communication anomaly: C1 self-identification handle
4.OTA upgrade failed: An error message is displayed indicating that the upgrade failed

Diagram: Test a): Primary energy supply jump

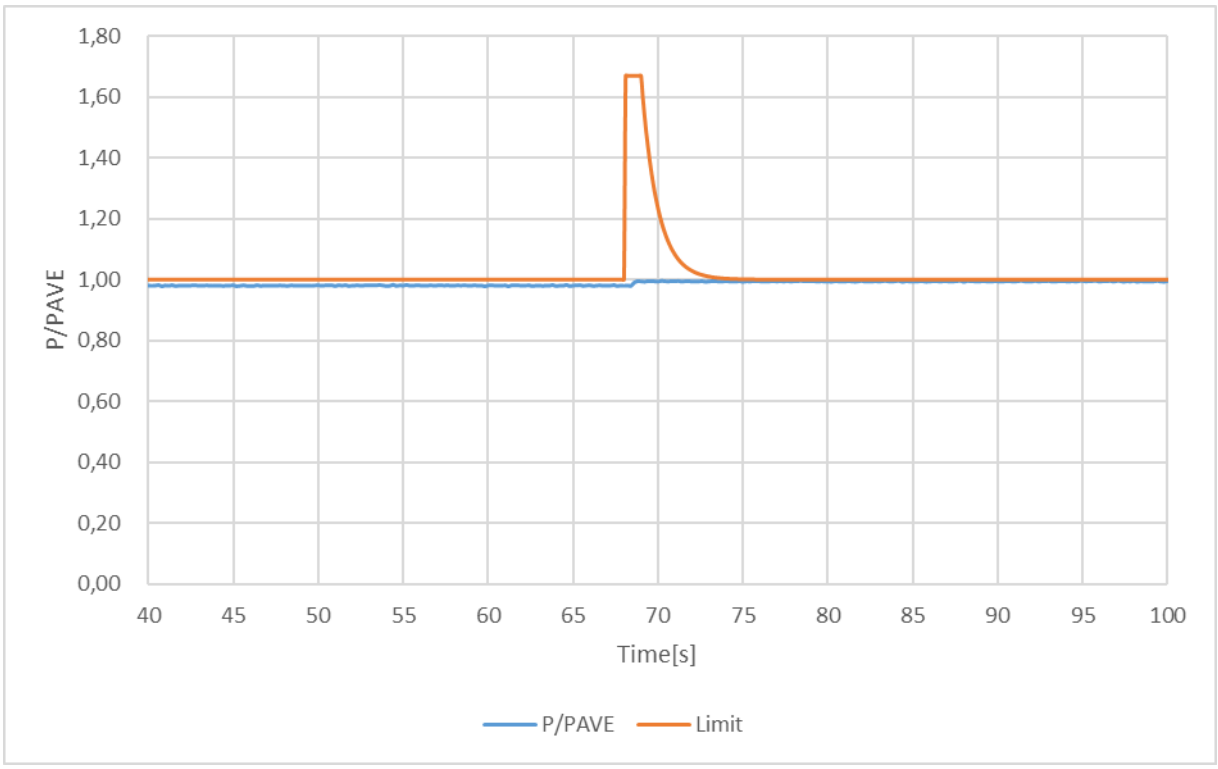
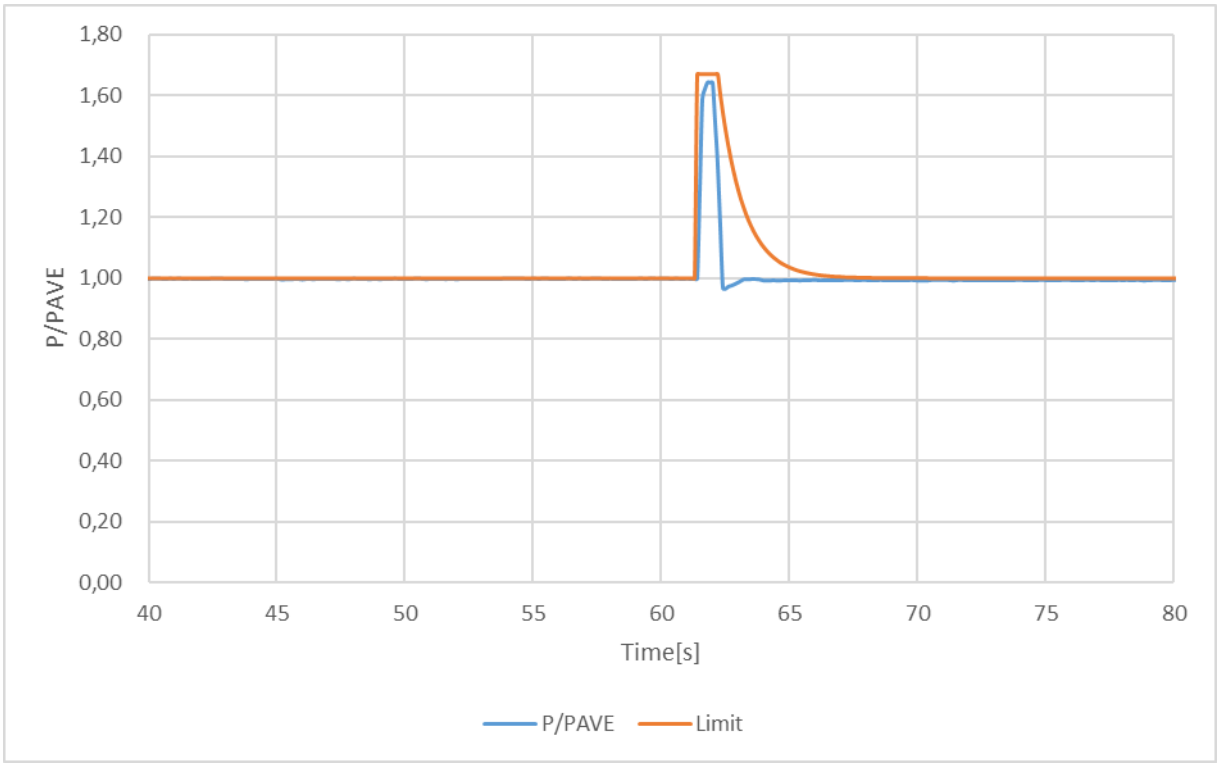
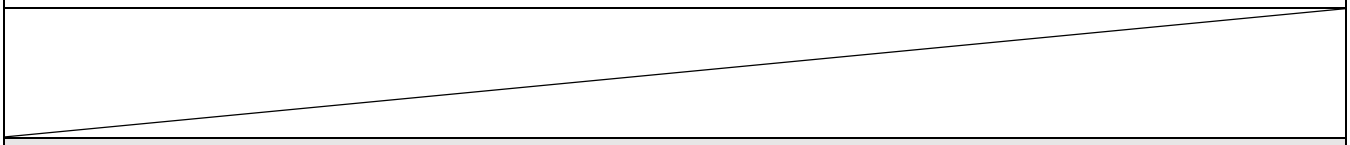


Diagram: Test b): Loss of load



5.7.2.2 Test disconnection function			N/A
Test:	**P_{SUM} before energy jump [W]**	**Required energy jump [W]**	**Disconnection time [s]**
a)	--	--	--
b)	--	--	--
c)	--	--	--
d)	--	--	--

Diagram:



Assessment criterion:

The test according to 5.7.2.2 shall be deemed to have been passed if, in the case of a), there were no shutdowns and, in the case of b), c) and d), a shutdown after the time t defined in Table 16.

Table 16

Test	Rated Power	Limit Disconnect time t
a)	$0,98*P_{AV,E}$	No disconnection
b)	$1,02*P_{AV,E} – 1,067*P_{AV,E}$	t < 10s + 0,2s
c)	$1,067*P_{AV,E} – 1,670*P_{AV,E}$	t < 3s + 0,2s
d)	$1,690*P_{AV,E}$	t < 0,2s

Note:

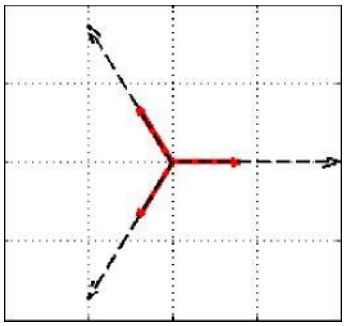
The EUT evaluated and tested the examination of regular dynamics used the P calculation check with a real EZE according to requirement of VDE-AR-N 4105, 5.5.2.

The nominal output power of EZE declared by manufacture.

5.8 Evidence dynamic grid support			
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**

5.8.1 General	P

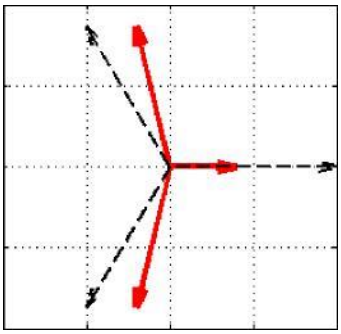
FRT test for three-phase symmetrical (Test ref no. x.1.x)



Typ-A

LVRT test for two-phase asymmetrical fault (Test ref no. 1.3.x to 4.3.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}
1.3, 1.4, 1.5	0,15 ± 0,05	0,62 ± 0,05	0,15 ± 0,05	0,62 ± 0,05	-143°	120°	23°
2.3, 2.4, 3.3, 3.4	0,50 ± 0,05	0,76 ± 0,05	0,50 ± 0,05	0,76 ± 0,05	-131°	120°	11°
4.3, 4.4	0,50 ± 0,05	0,93 ± 0,05	0,85 ± 0,05	0,93 ± 0,05	-123°	120°	3°
Normal condition	1	1	1	1	-120°	120°	0°



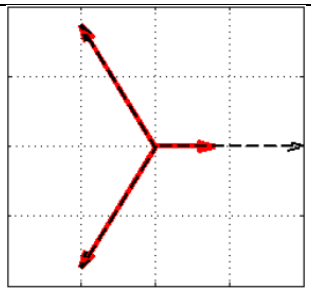
Typ-D

FRT test for two-phase asymmetrical fault (Test ref no. 5.3.x to 7.3.x)

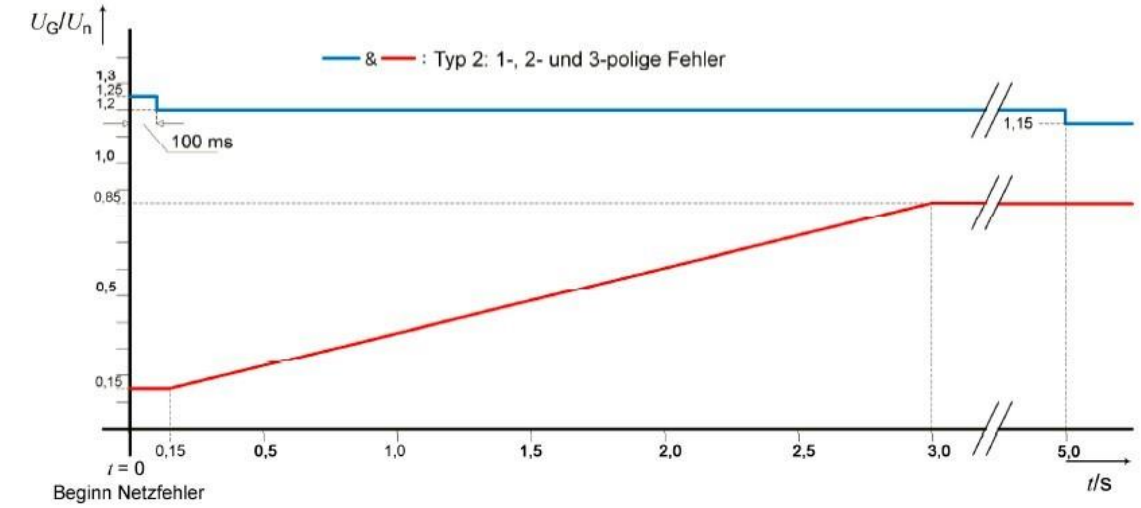
Test No.	V/V_{nom}	Phase-to-earth voltages			Phase angles		
		$u_1/u_{1,nom}$	$u_2/u_{2,nom}$	$u_3/u_{3,nom}$	φ_{u1}	φ_{u2}	φ_{u3}
5.3, 5.4	1,25 ± 0,05	1,08 ± 0,05	1,25 ± 0,05	1,06 ± 0,05	-115°	-120°	6°
6.3,6.4	1,20 ± 0,05	1,06 ± 0,05	1,20 ± 0,05	1,05 ± 0,05	-116°	-120°	5°
7.3,7,4	1,15 ± 0,05	1,04 ± 0,05	1,15 ± 0,05	1,04 ± 0,05	-117°	-120°	4°
Normal condition	1	1	1	1	-120°	120°	0°

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

5.8.1 General	P



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

5.8.3	Testing of the dynamic grid support	P
For PGUs Type 2 and storage systems		P
1-phase systems		
A17C53Z1-20		

Test	Voltage dip to [p.u.]	Dip type	duration [s]	P set point [p.u.]	Q set point [p.u.]	Comment	Recovery response time [s]		Test ref. No.*
							P	Q	
1	0,15 to 0,25	A	for 0,15 ≥0,150 / for 0,25 ≥0,500	1	0 to ± 0,1	Symmetric	0,595	--	1.1
				0,2 to 0,6			0,514	--	1.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,597	--	1.3
				0,2 to 0,6			0,503	--	1.4
		D2[2)]		1			0,574	--	1.5
2	0,50 to 0,60	A	for 0,50 ≥1,5 / for 0,60 ≥2,000	1	Max. over excited**	Symmetric	0,592	9,877	2.1
				0,2 to 0,6			0,380	9,731	2.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,693	9,882	2.3
				0,2 to 0,6			0,447	9,870	2.4
3	0,50 to 0,60	A	for 0,50 ≥1,500 / for 0,60 ≥2,000	1	Max. under excited**	Symmetric	0,574	9,895	3.1
				0,2 to 0,6			0,350	9,794	3.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,676	9,865	3.3
				0,2 to 0,6			0,517	9,934	3.4
4	0,85 to 0,90	A	≥60,000	1	0 to ± 0,1	Symmetric	0,210	--	4.1
				0,2 to 0,6			0,184	--	4.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,207	--	4.3
				0,2 to 0,6			0,143	--	4.4
5	1,20 to 1,25	A	≥0,100	1	0 to ± 0,1	Symmetric	0,576	--	5.1
				0,2 to 0,6			0,398	--	5.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,210	--	5.3
				0,2 to 0,6			0,193	--	5.4
		D2[2)]		1			0,550	--	5.5
6	1,15 to 1,20	A	≥5,000	1	0 to ± 0,1	Symmetric	0,648	--	6.1
				0,2 to 0,6			0,482	--	6.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,210	--	6.3
				0,2 to 0,6			0,185	--	6.4
7	1,10 to 1,15	A	≥60,000	1	0 to ± 0,1	Symmetric	0,187	--	7.1
				0,2 to 0,6			0,212	--	7.2
		D1[1)]		1		Asymmetric (ph-ph + Dy5-transformer)	0,175	--	7.3
				0,2 to 0,6			0,199	--	7.4

5.8.3	Testing of the dynamic grid support	P

Note:

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

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 an 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 0,06s 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 1s, Reaction time of reactive power according to PT1 behaviour with 3τ = 10s in accordance with VDE-AR-N 4105: 2018-11, 5.7.2.5

Table above shows test sequences for single-phase unit.

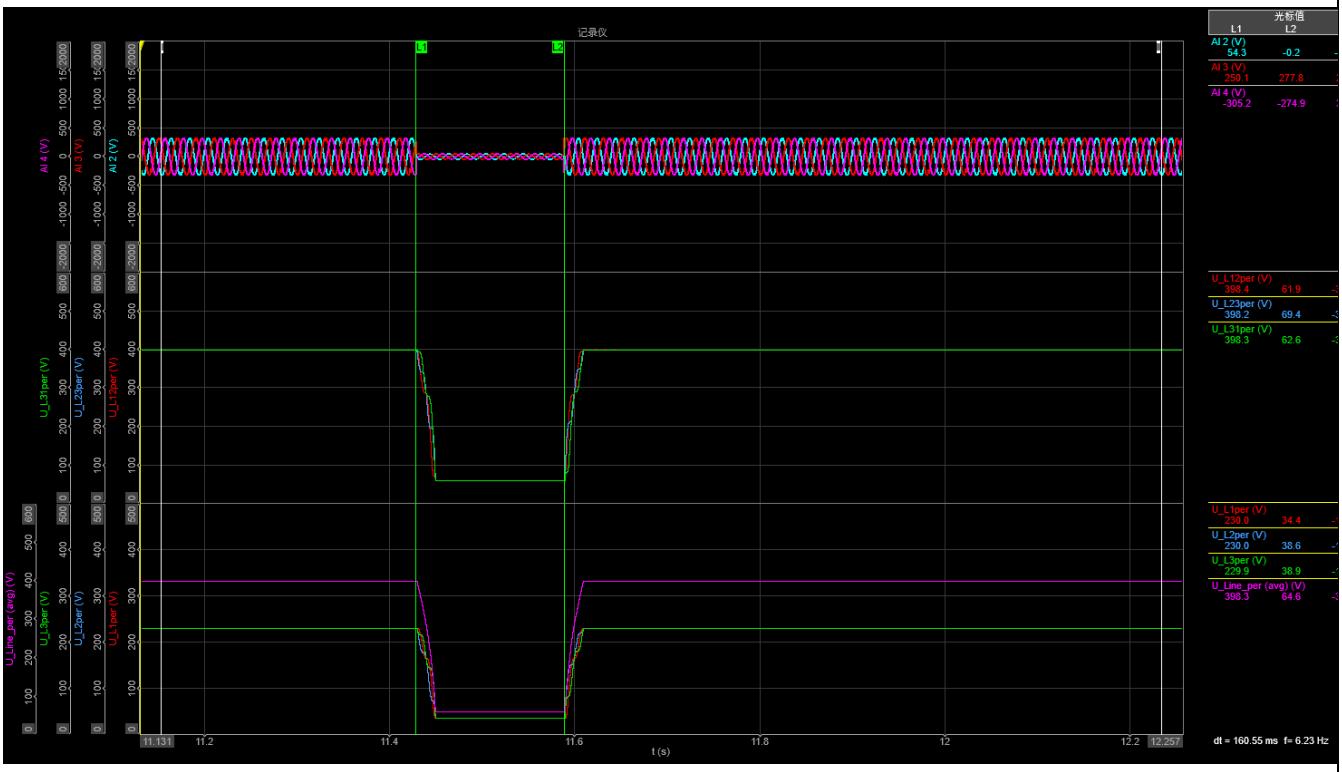
- [1)] One-phase EZE are connected to the phase W and N for error pattern D1
- [2)] One-phase EZE are connected to the phase V and N for error pattern D2

“*” The test has been performed twice and only show one times tested result in the test report.

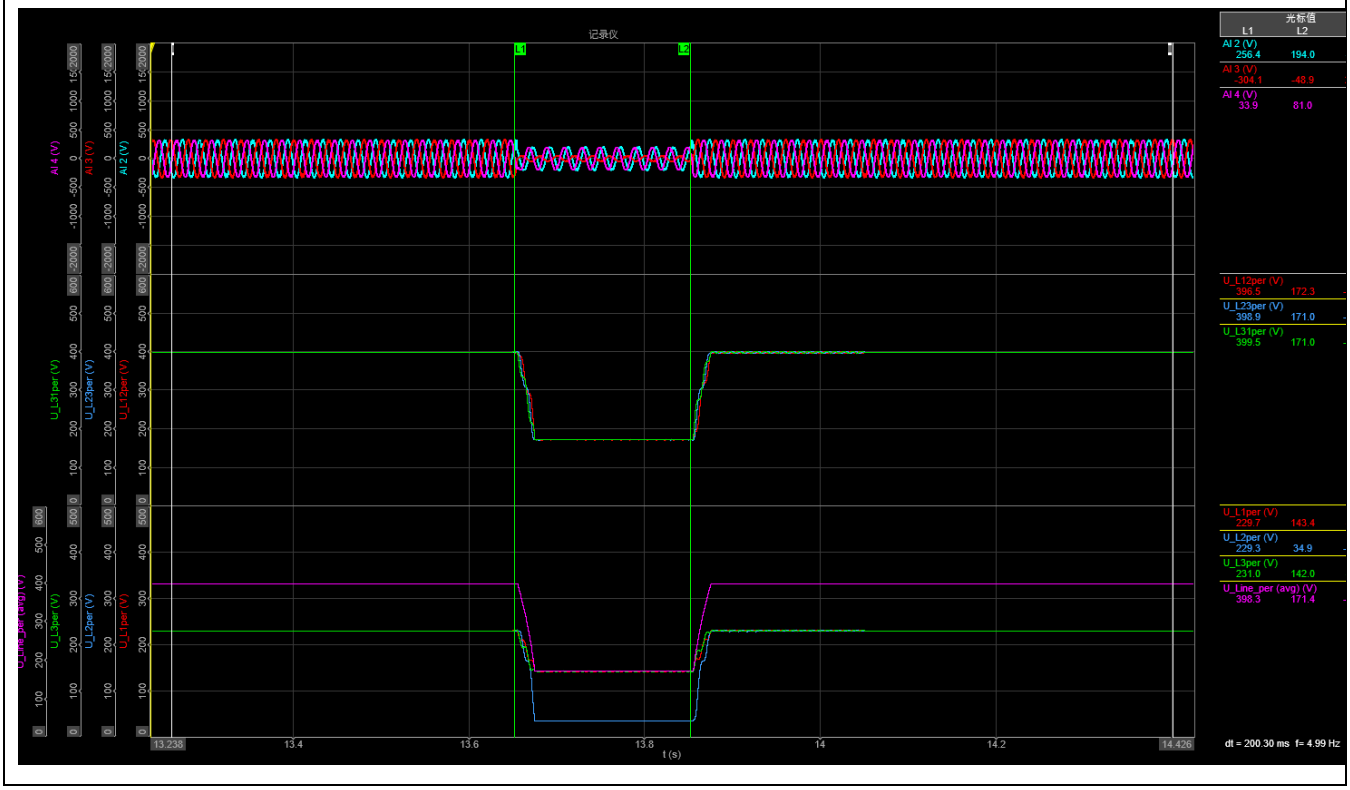
The test results of the **A17C53Z1-20** can be applied to other units in the product series directly, since it is identical in hardware and just power derated by software.

5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

1.1

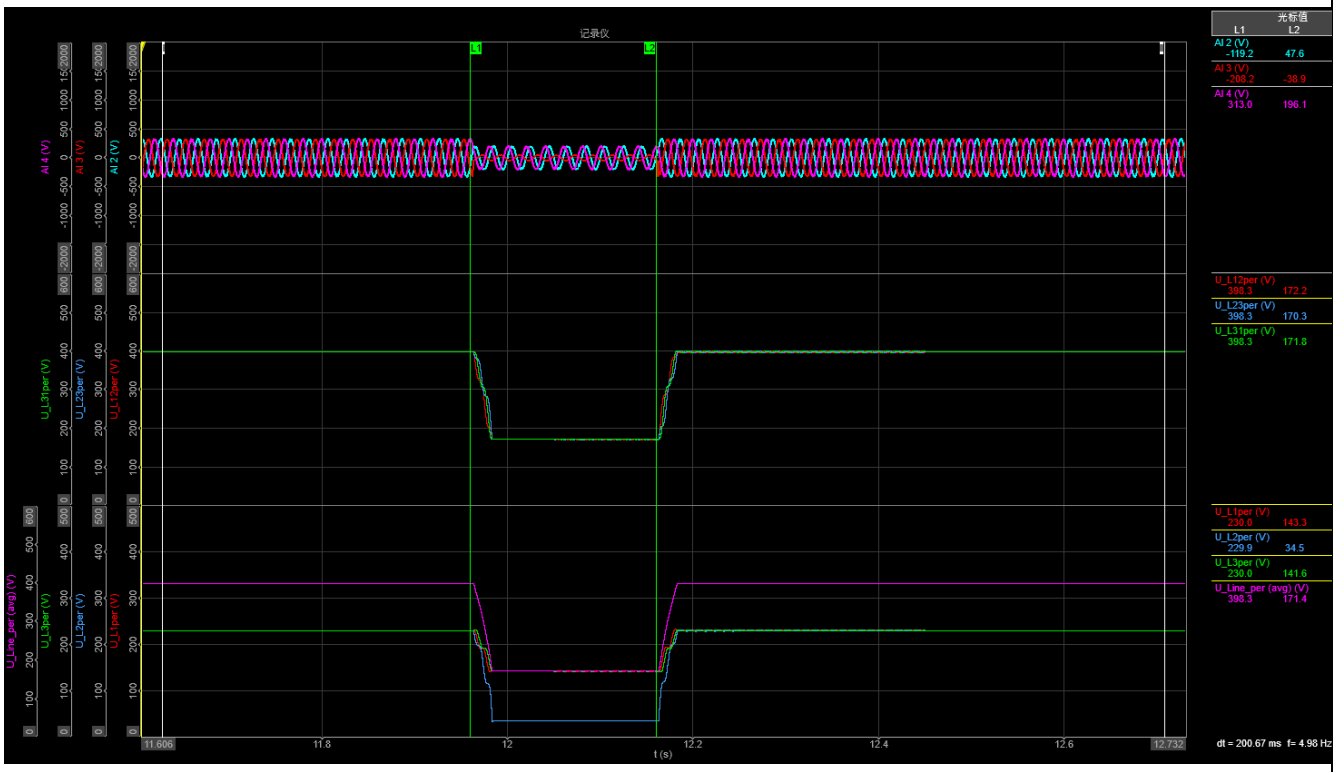


1.3

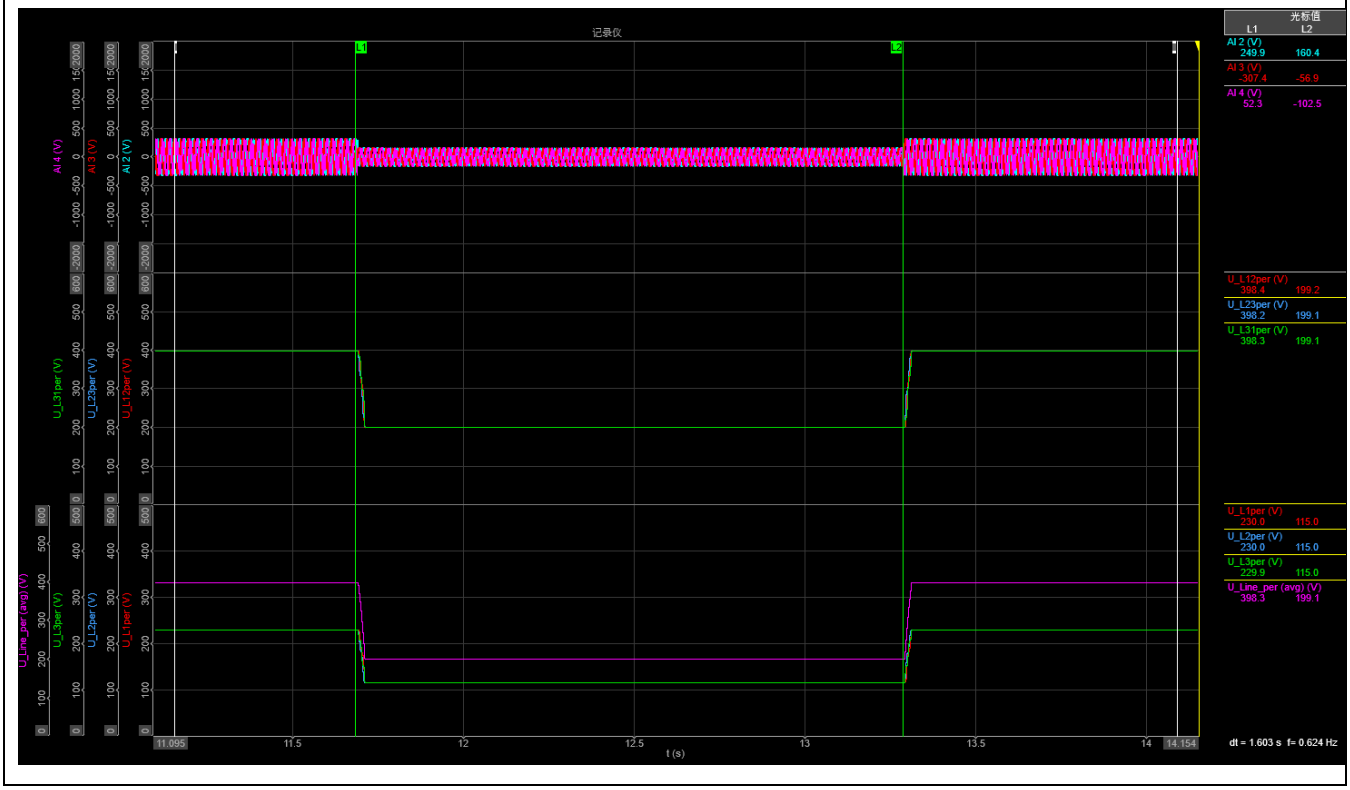


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

1.5

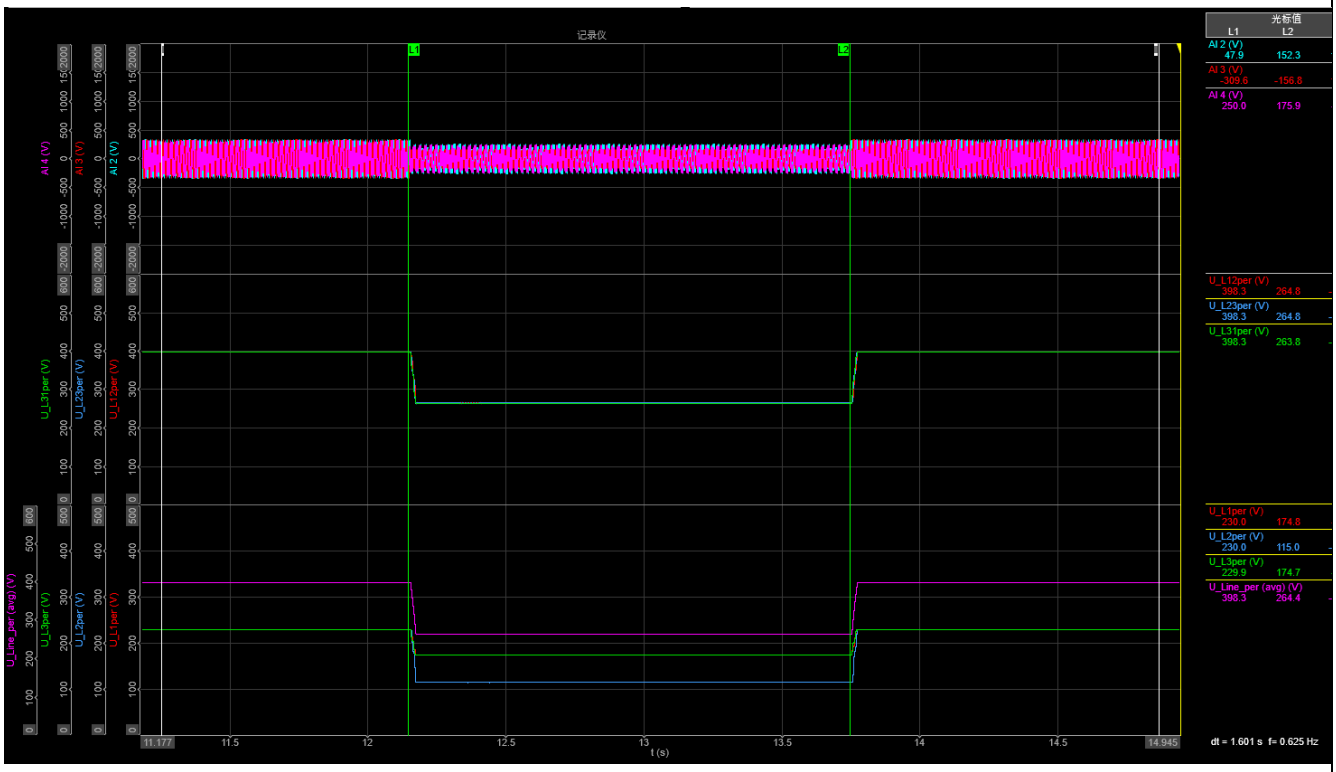


2.1

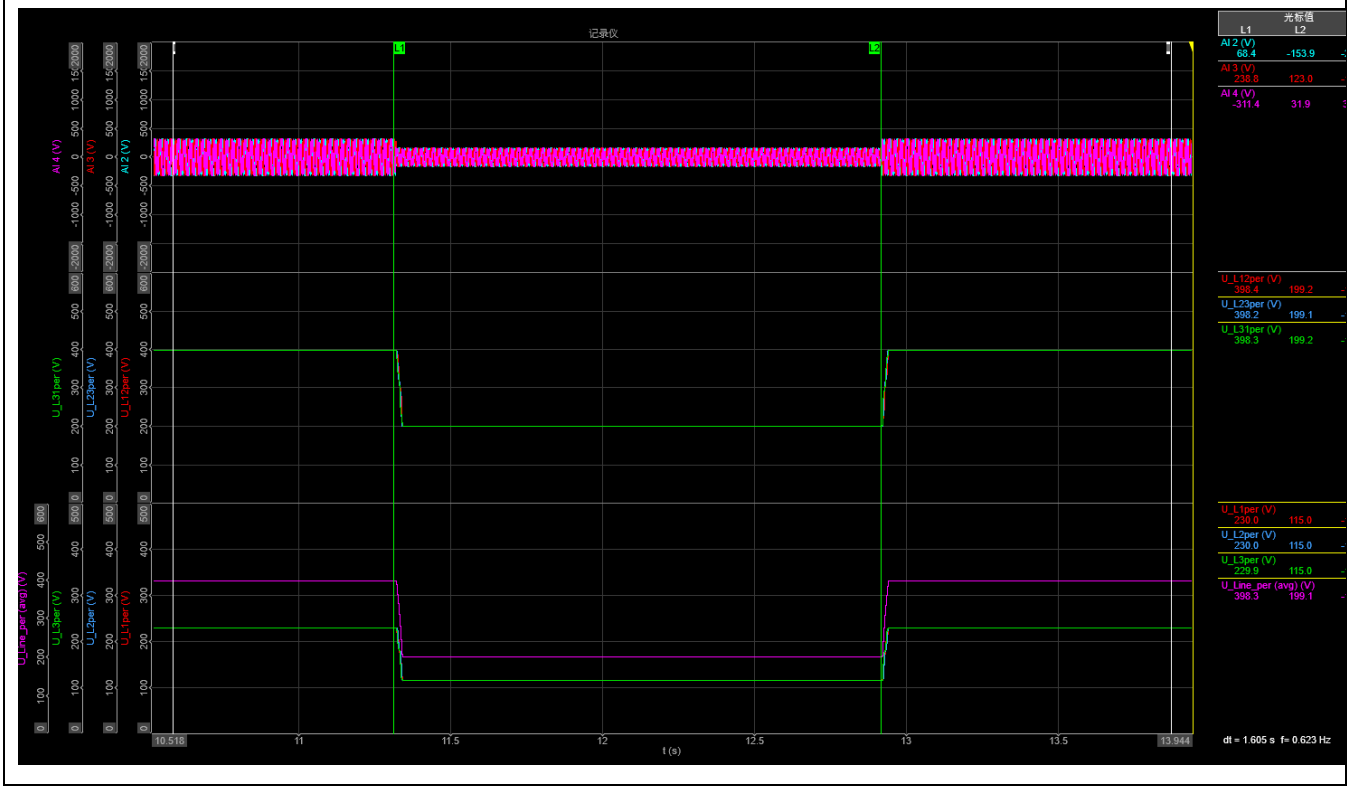


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

2.3

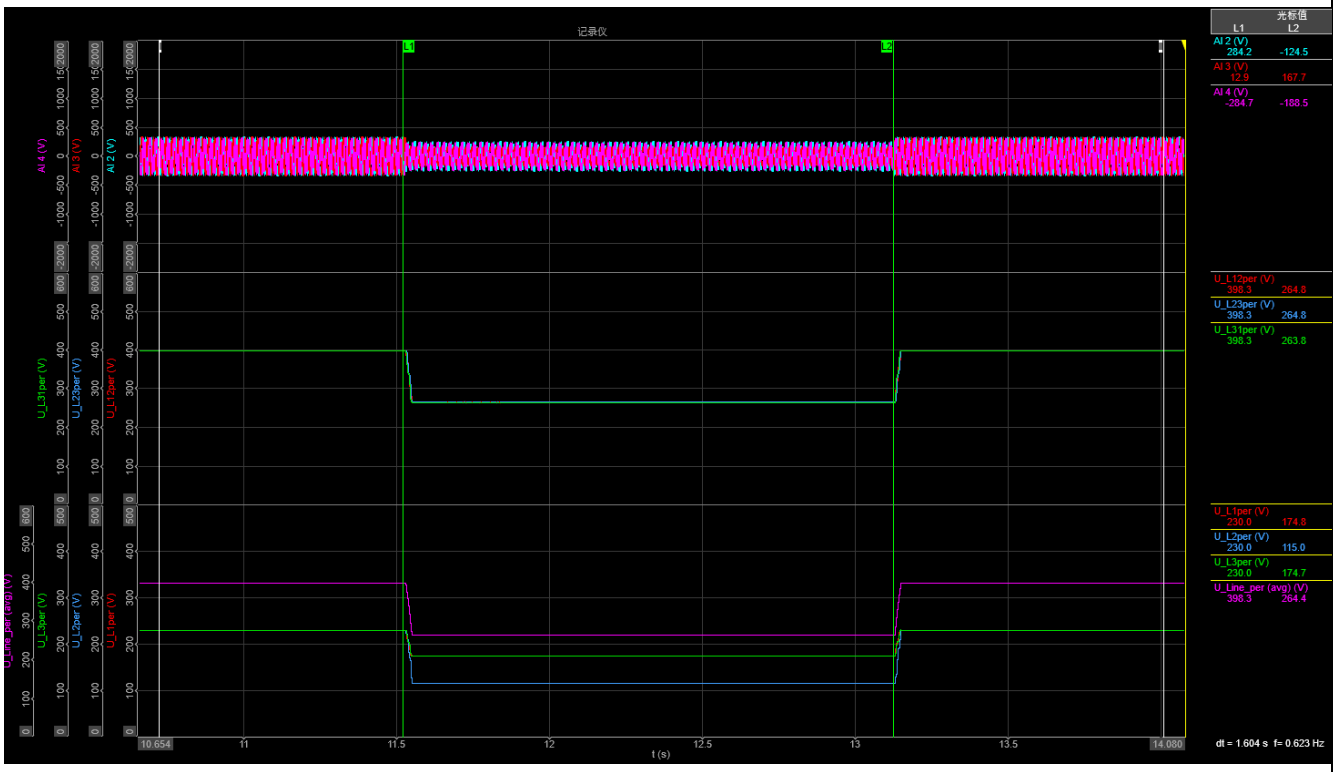


3.1

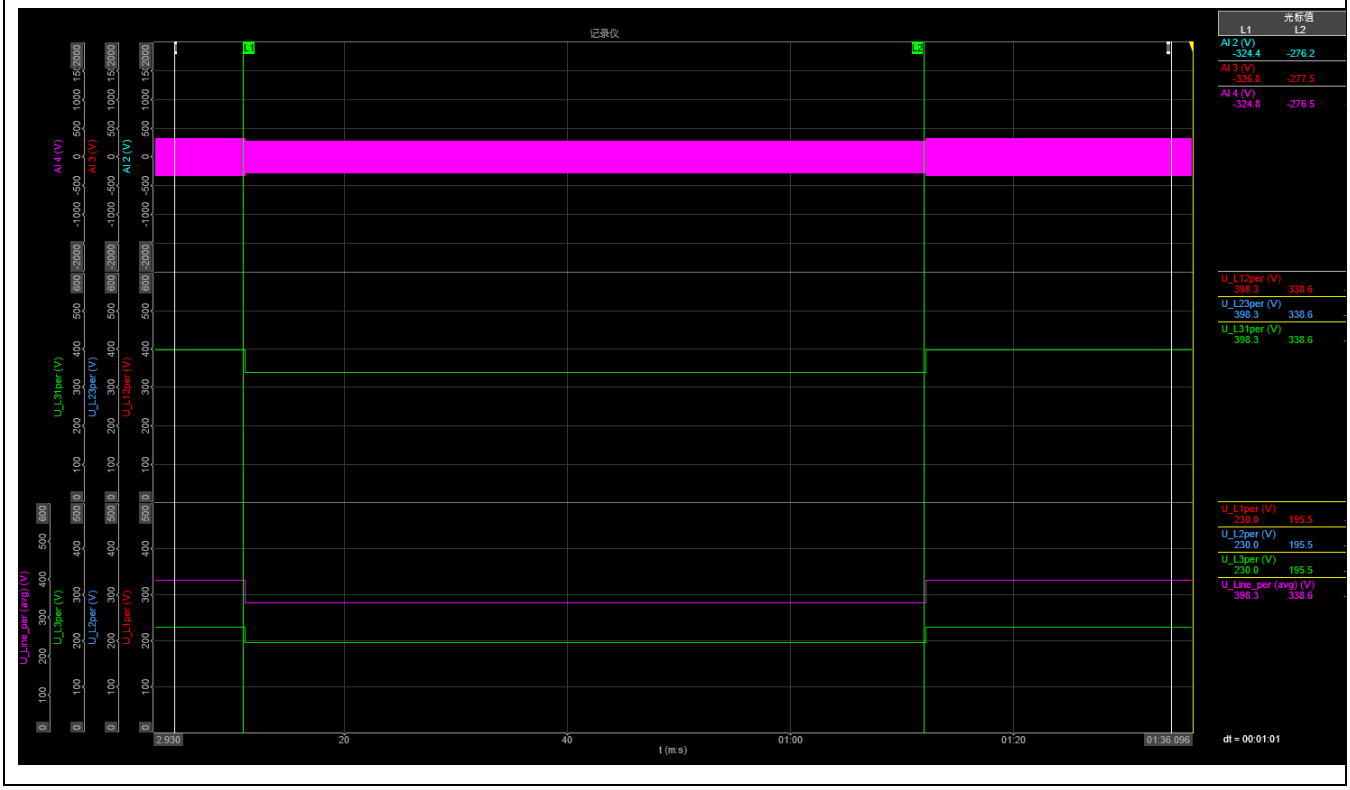


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

3.3

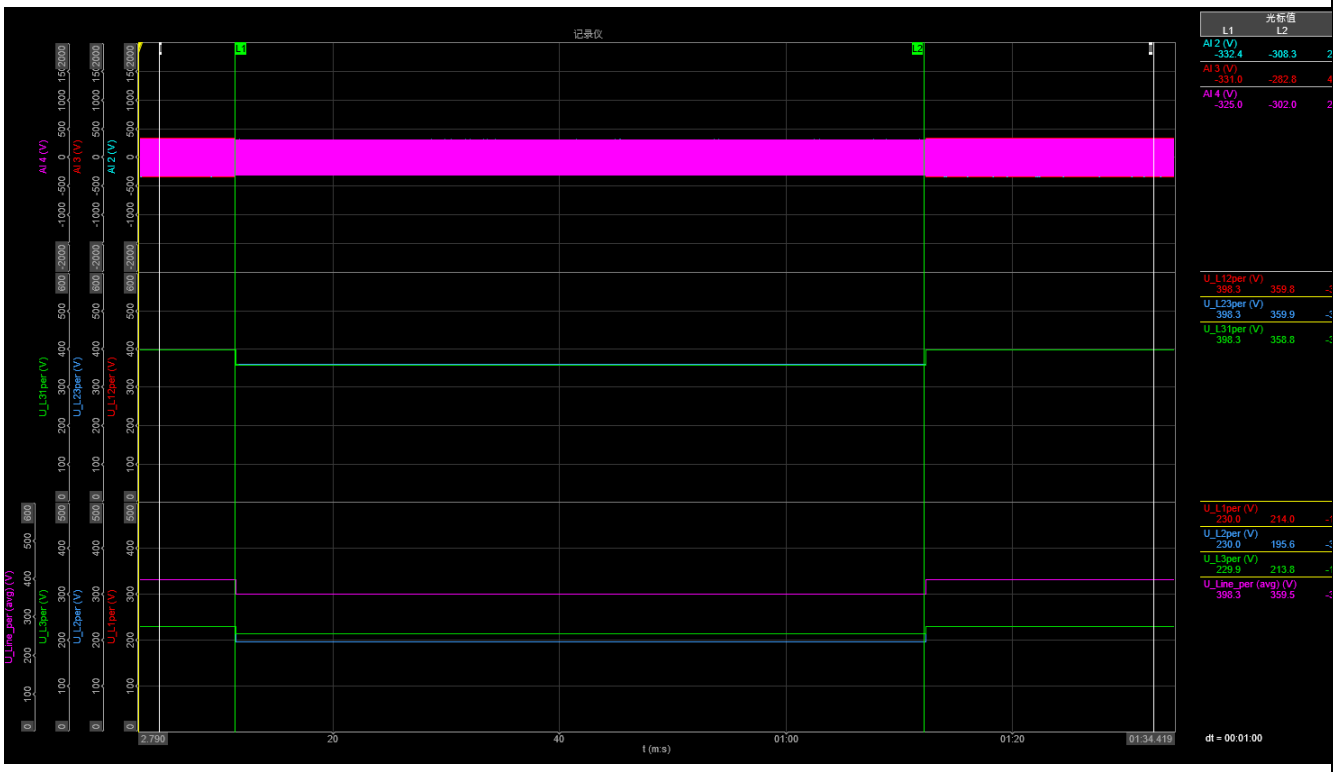


4.1

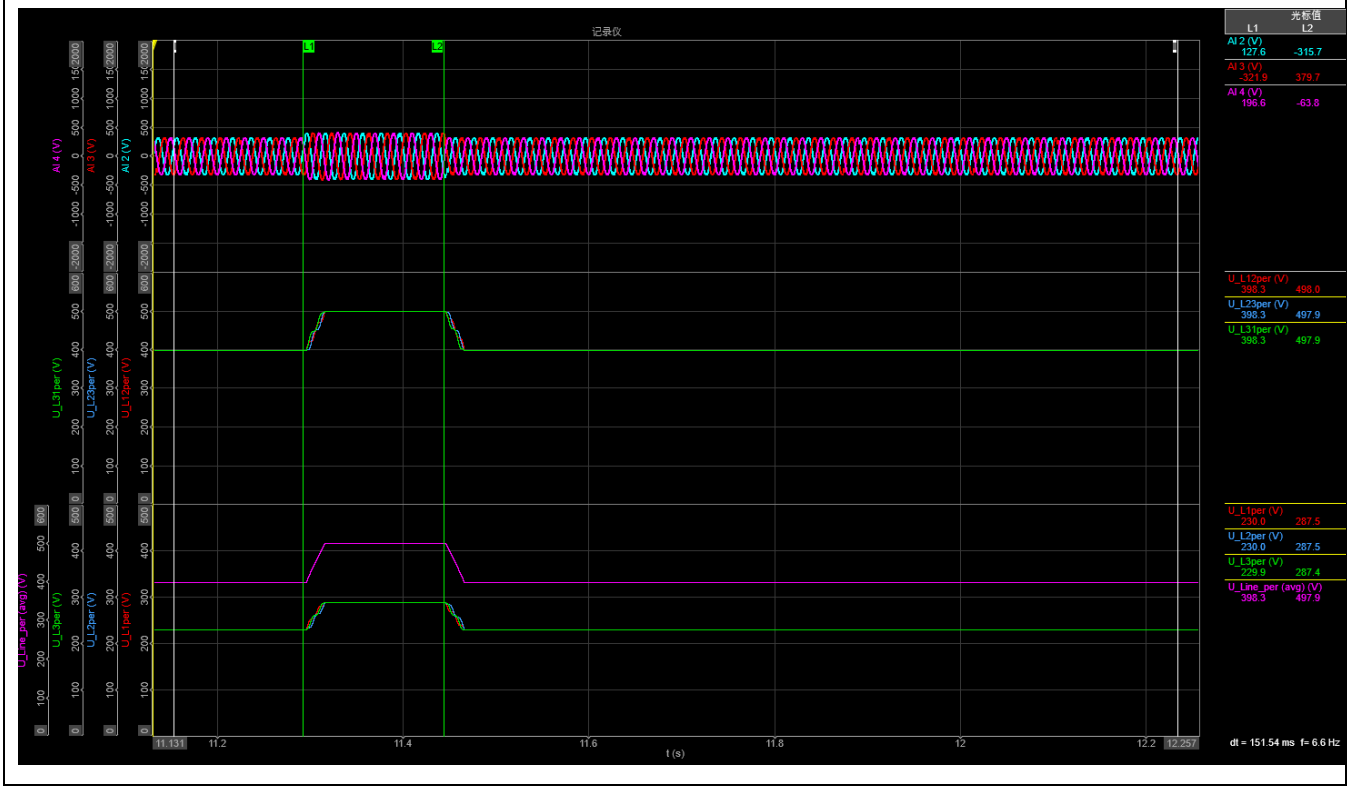


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

4.3

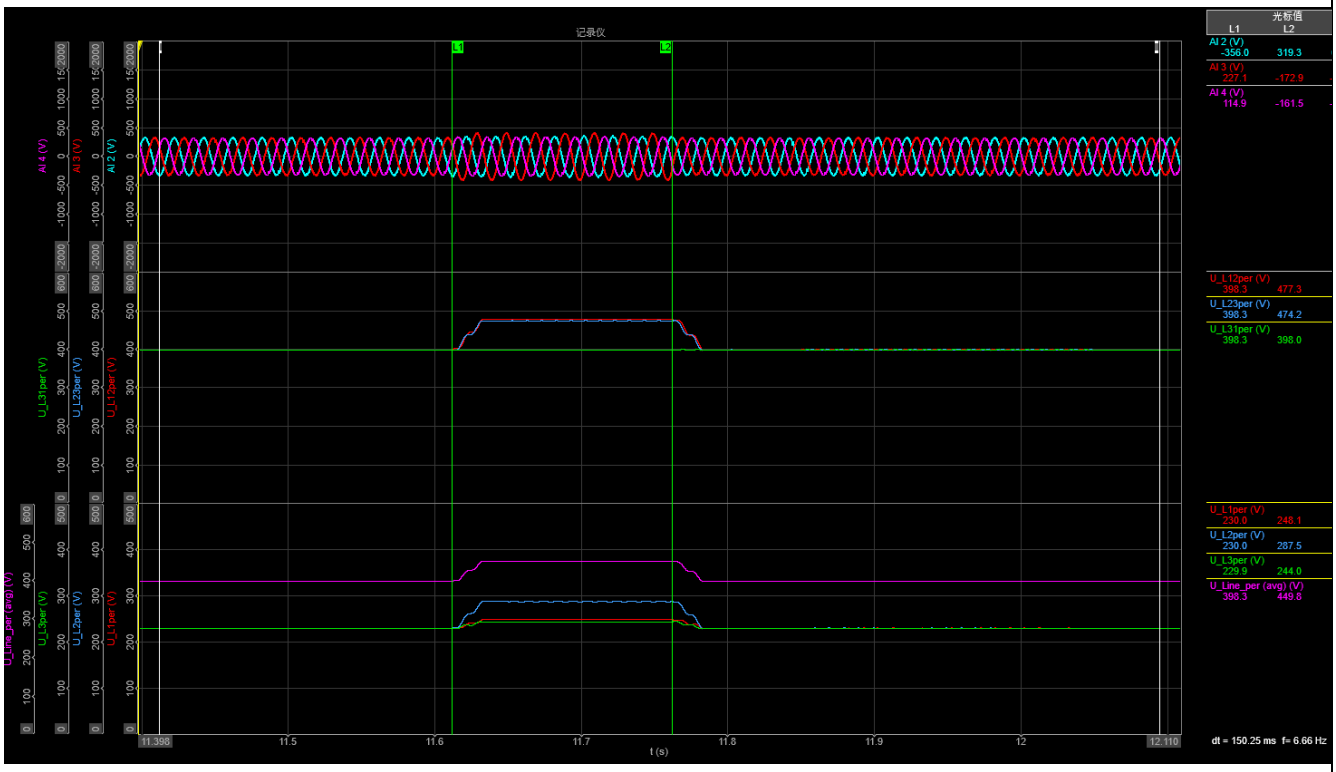


5.1

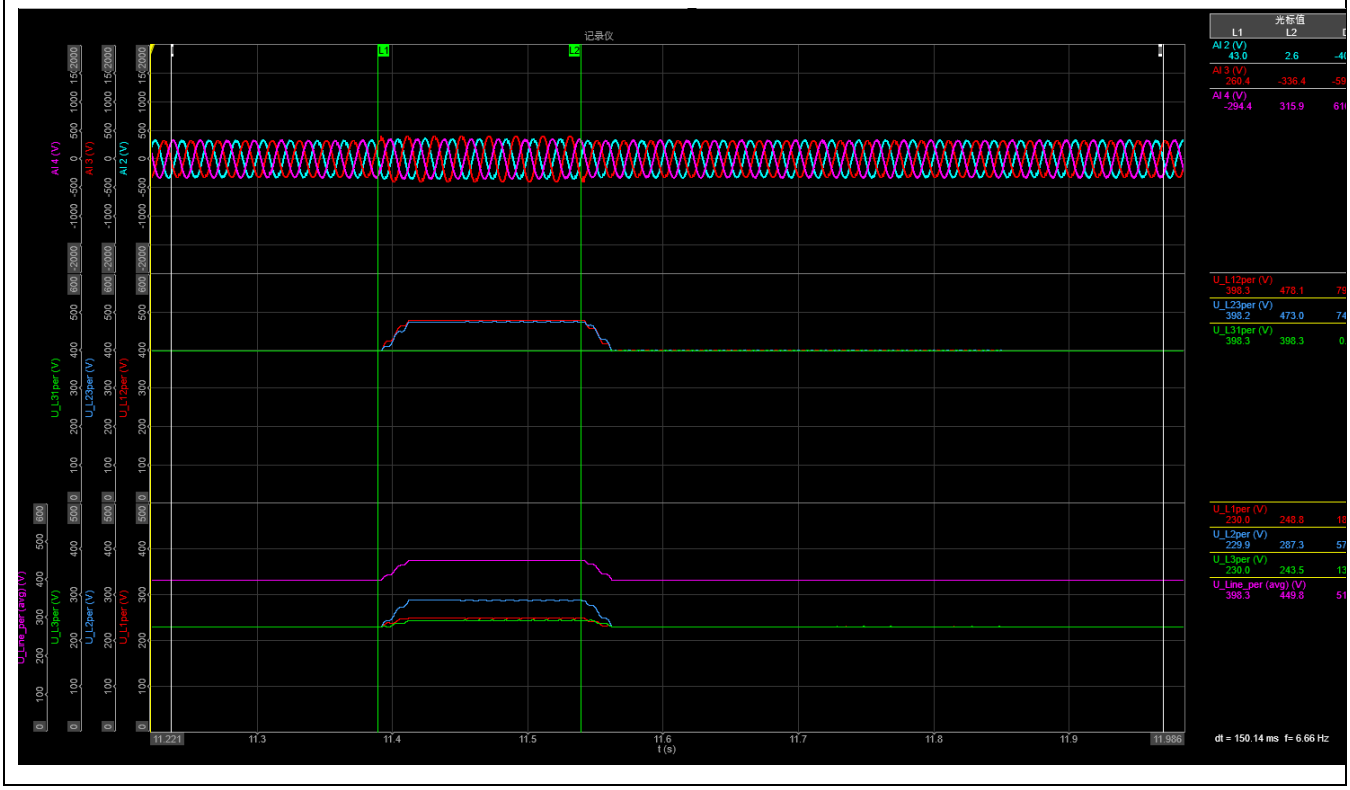


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

5.3

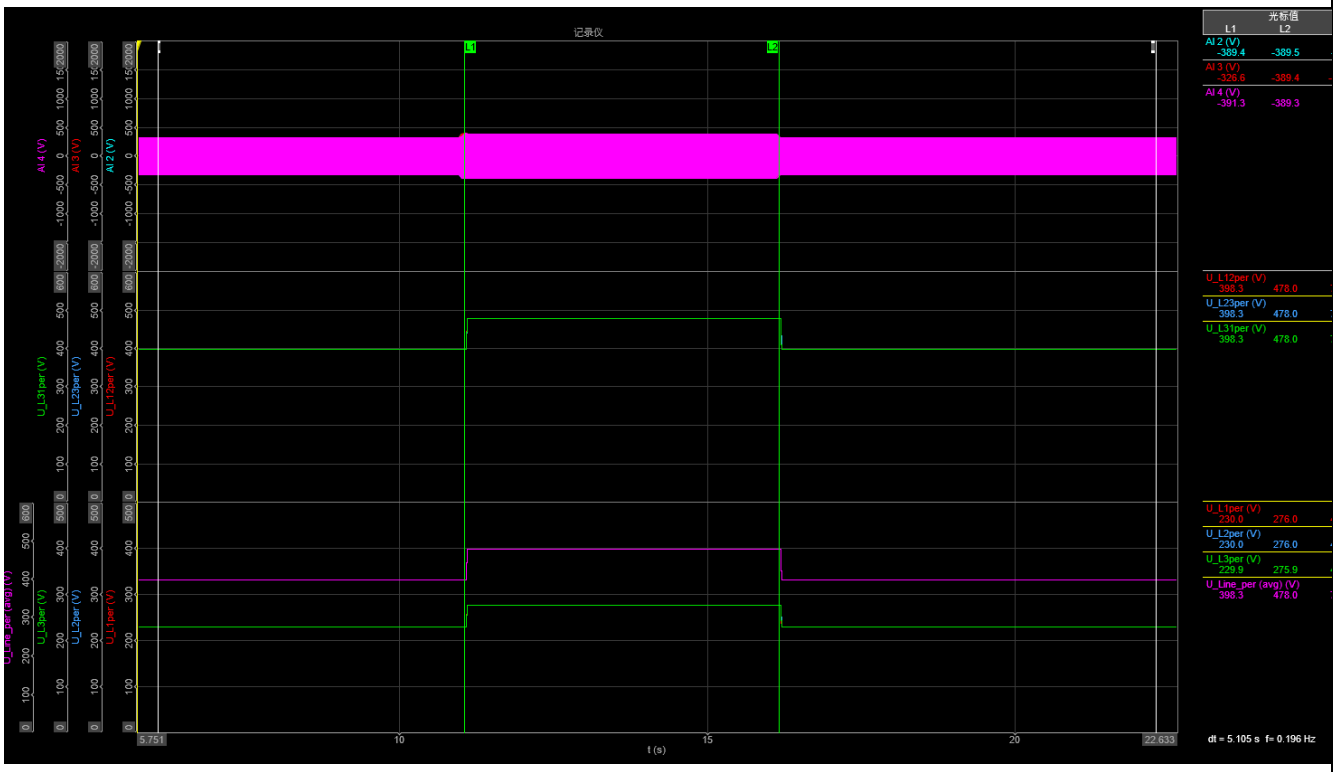


5.5

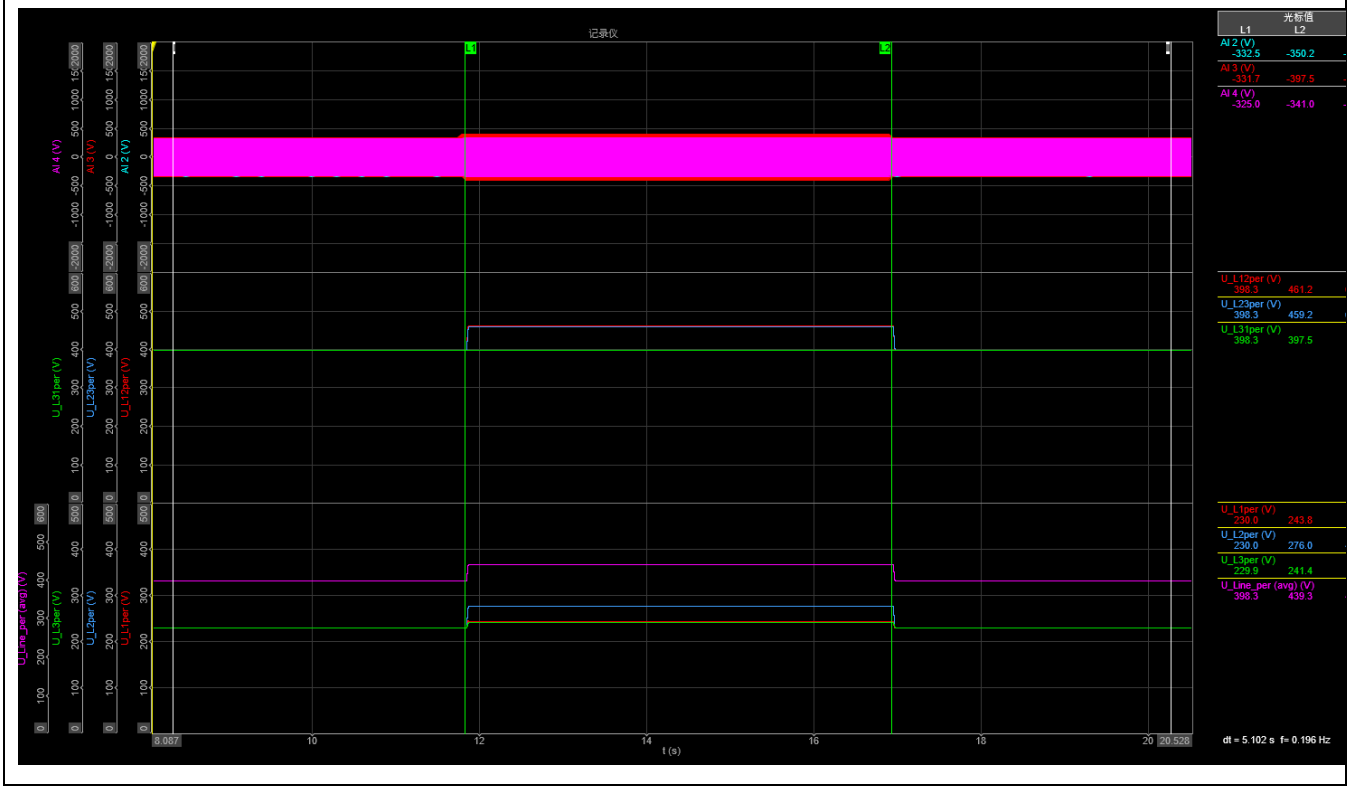


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

6.1

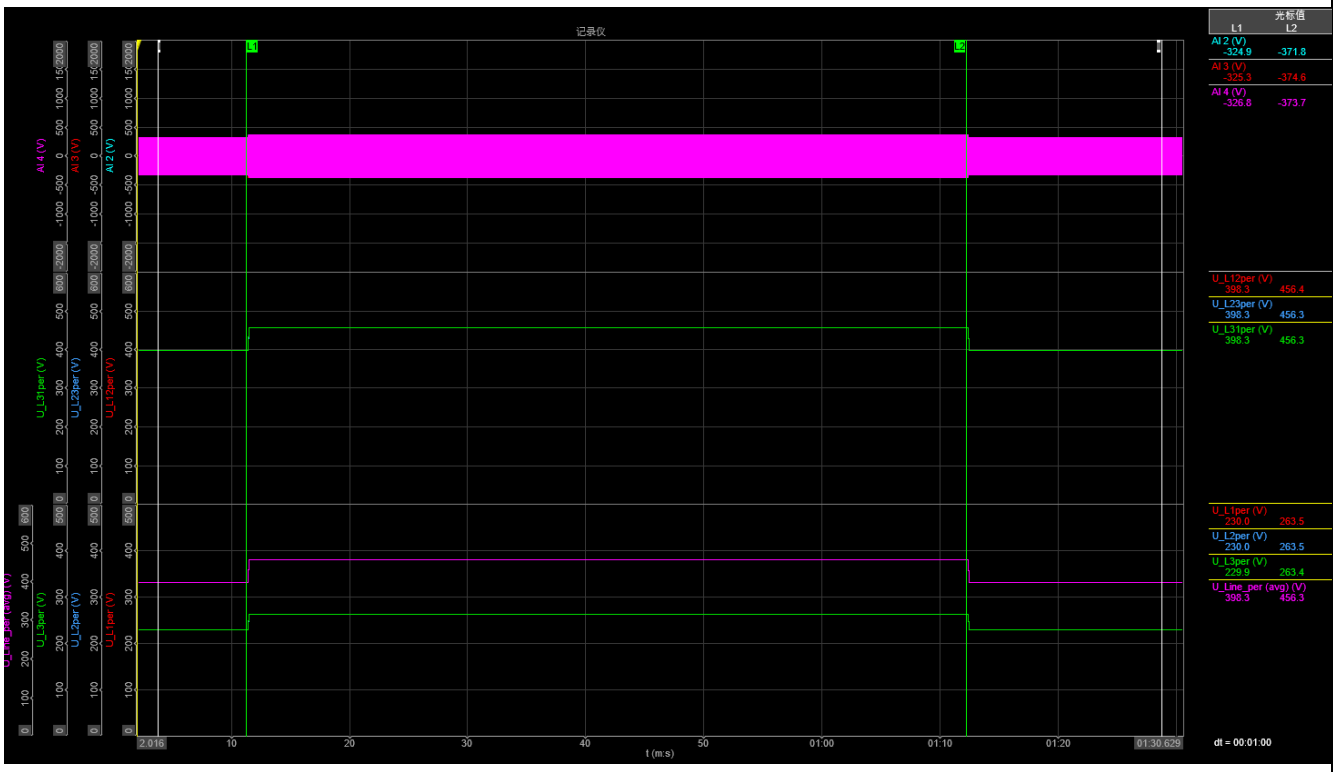


6.3

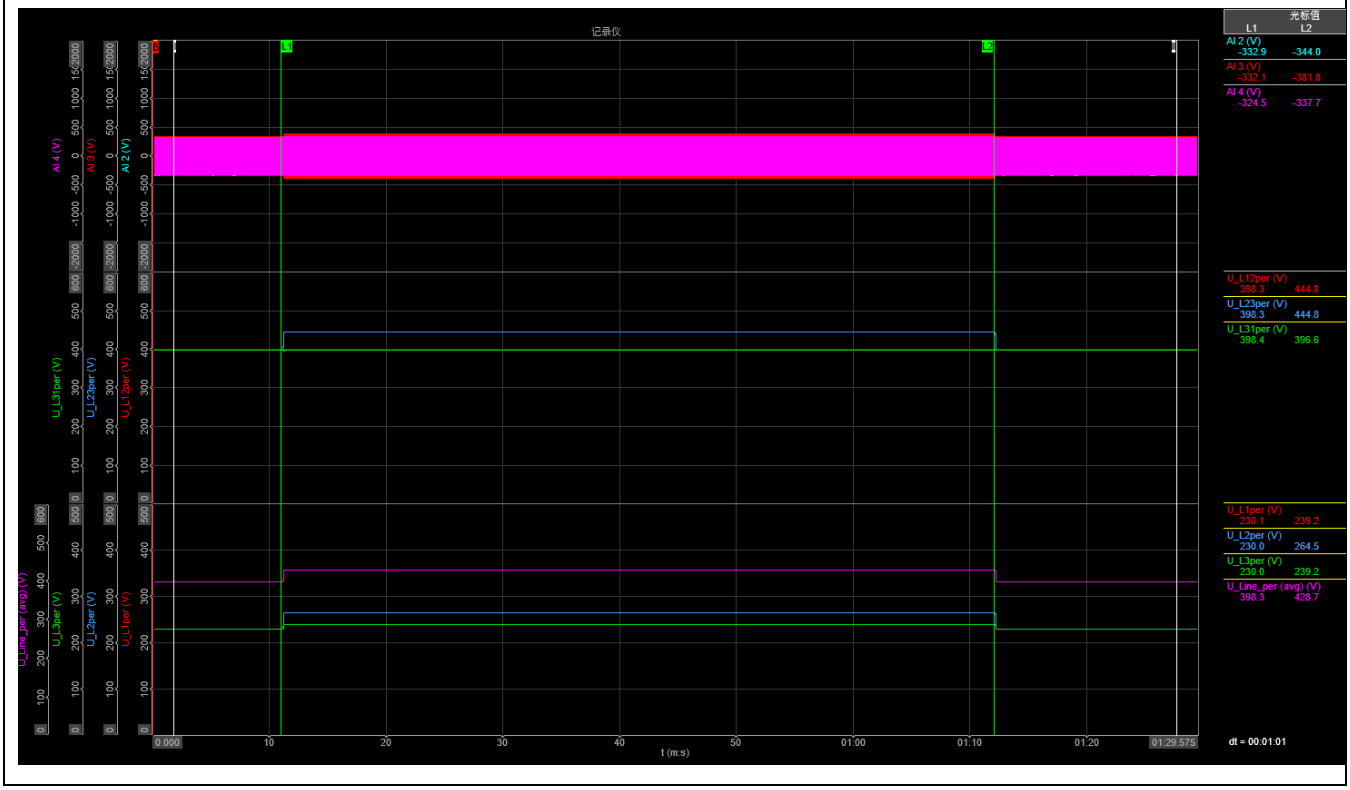


5.8.3	For PGUs Type 2 and storage systems – no load	P
A17C53Z1-20		

7.1



7.3



5.8.3	For PGUs Type 2 and storage systems	P

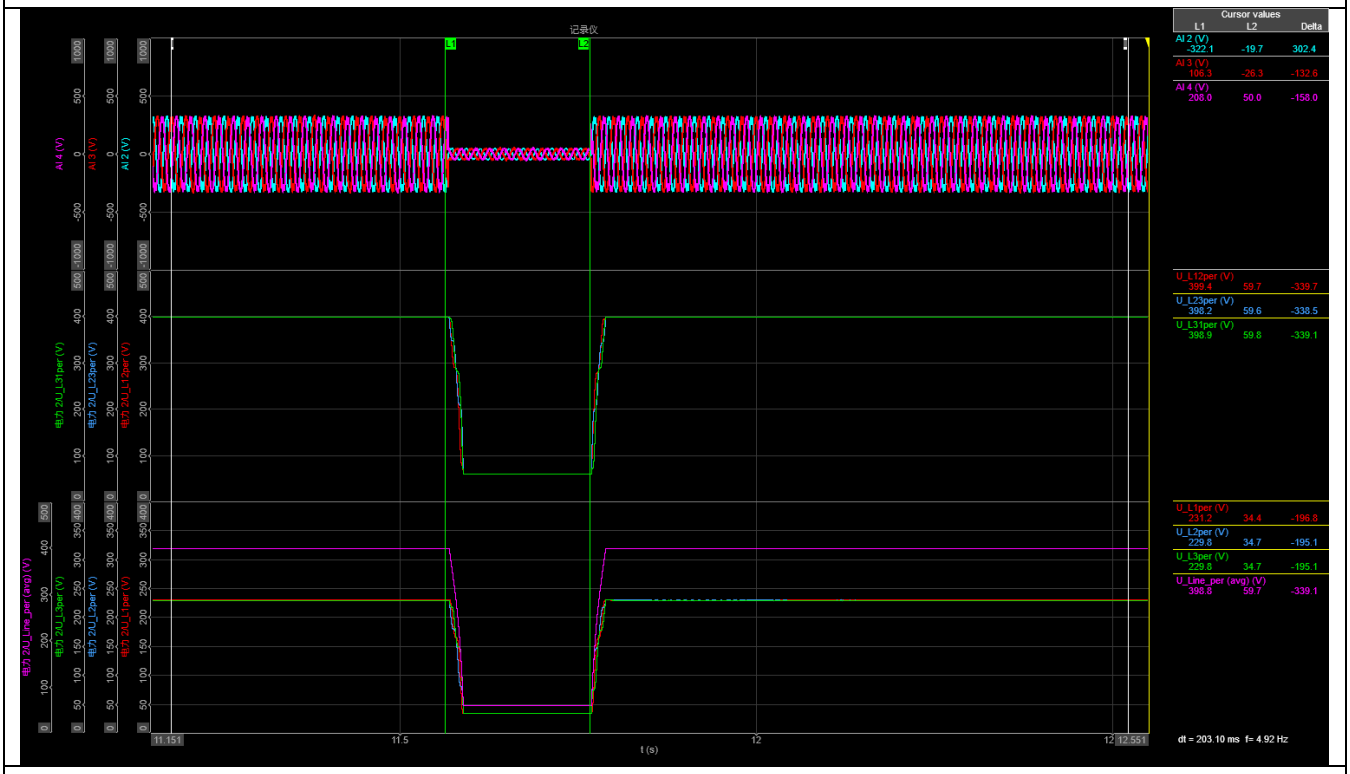
A17C53Z1-20

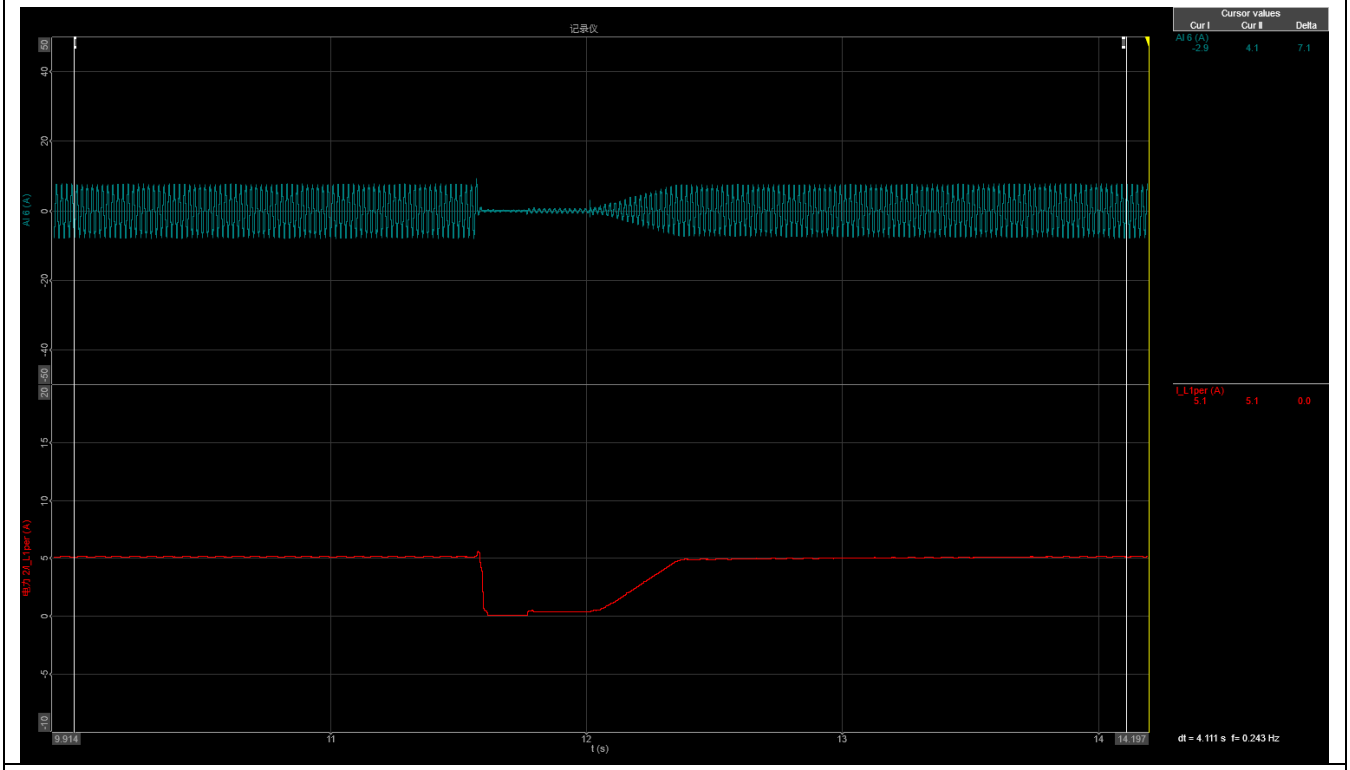
1.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.1
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	12:06:50
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,15
	5	Setting dip duration		--	--	200
	6	Point of fault entry	Total	--	ms	11565
	7	Point of fault clearance	Total	--	ms	11765
	8	Fault duration in empty load test	Total	--	ms	200
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,149
	10		Total (Phase 2)			0,151
	11		Total (Phase 3)			0,150
	12		Positive sequence			0,149
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,005
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,987
	17	Active power	Total	t1-10s to t1	p.u.	0,992
	18		Pos.			0,992
	19	Reactive power	Total	t1-10s to t1	p.u.	0,056
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,149
	23		Phase 2			0,151
	24		Phase 3			0,150
	25	Line current	Phase 1	t1+60ms	p.u.	0,019
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,019
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,005
	34		Phase 2			0,999
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,993
	37		Pos.			0,993
	38	Active power rising time	Total	--	s	0,595
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,056
	40		Pos.			0,008
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

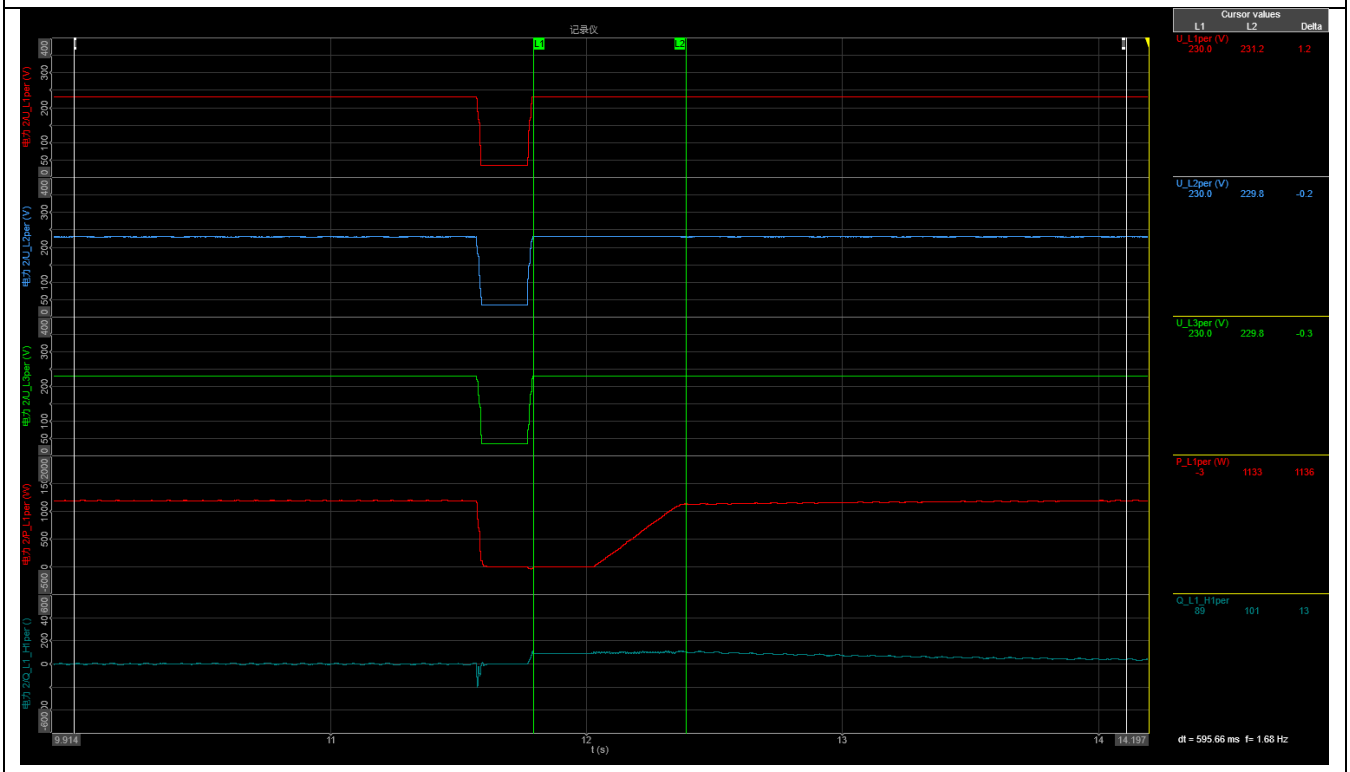
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

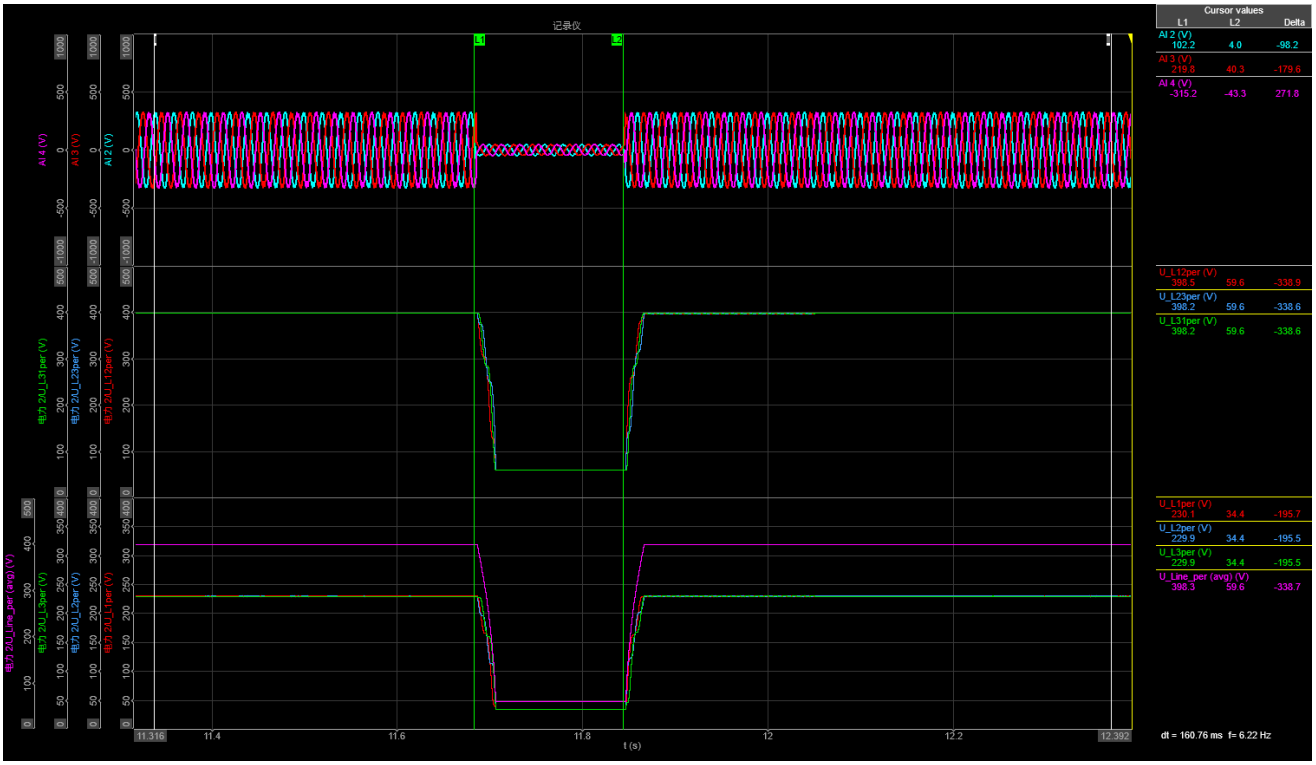
A17C53Z1-20

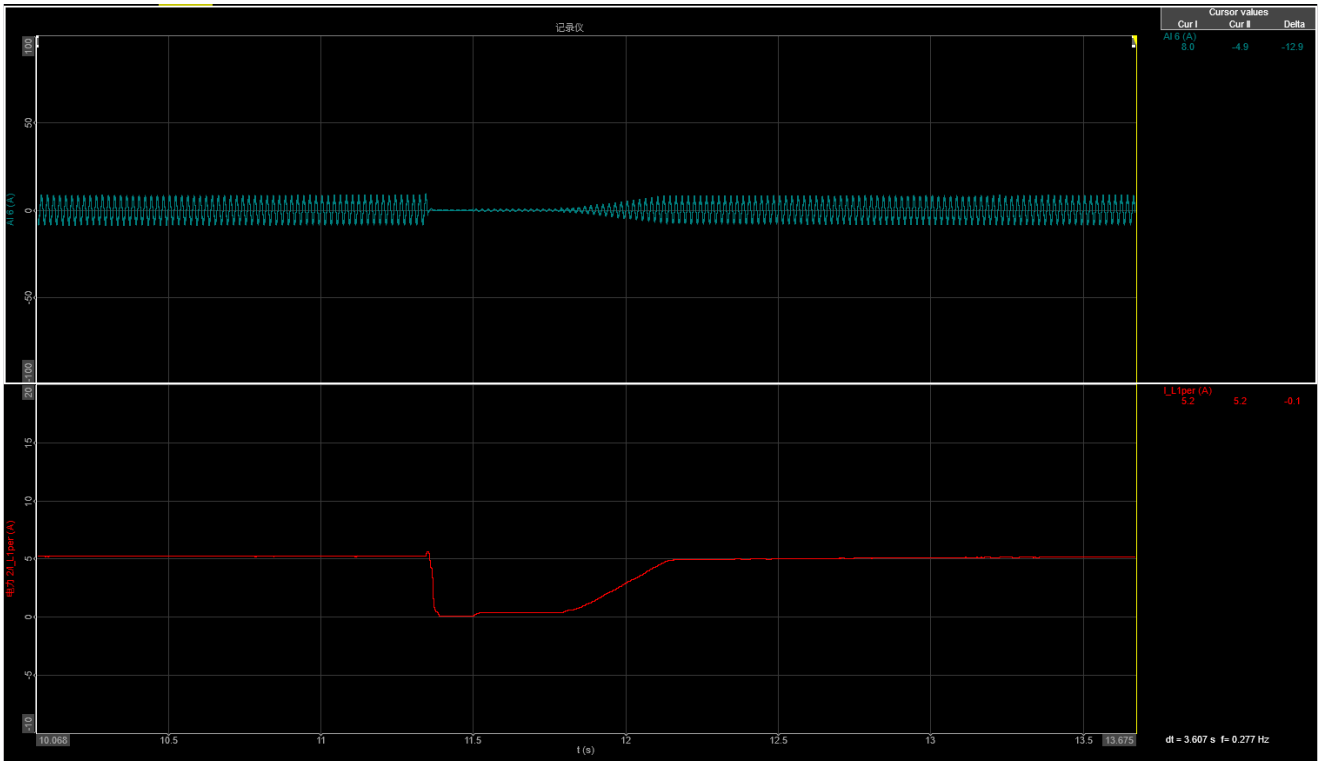
1.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.2
	1	Date	--	--	yyyy.mm.dd	2024/8/29
	2	Time (start of test)	--	--	hh:mm:ss.f	11:33:02
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,15
	5	Setting dip duration		--	--	160
	6	Point of fault entry	Total	--	ms	11684
	7	Point of fault clearance	Total	--	ms	11845
	8	Fault duration in empty load test	Total	--	ms	161
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,150
	10		Total (Phase 2)			0,150
	11		Total (Phase 3)			0,150
	12		Positive sequence			0,149
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,298
	18		Pos.			0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,070
	20		Pos.			0,012
	21	Cosφ	Total	t1-10s to t1	--	0,974
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,150
	23		Phase 2			0,150
	24		Phase 3			0,150
	25	Line current	Phase 1	t1+60ms	p.u.	0,019
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,019
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,300
	37		Pos.			0,300
	38	Active power rising time	Total	--	s	0,514
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,069
	40		Pos.			0,006
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

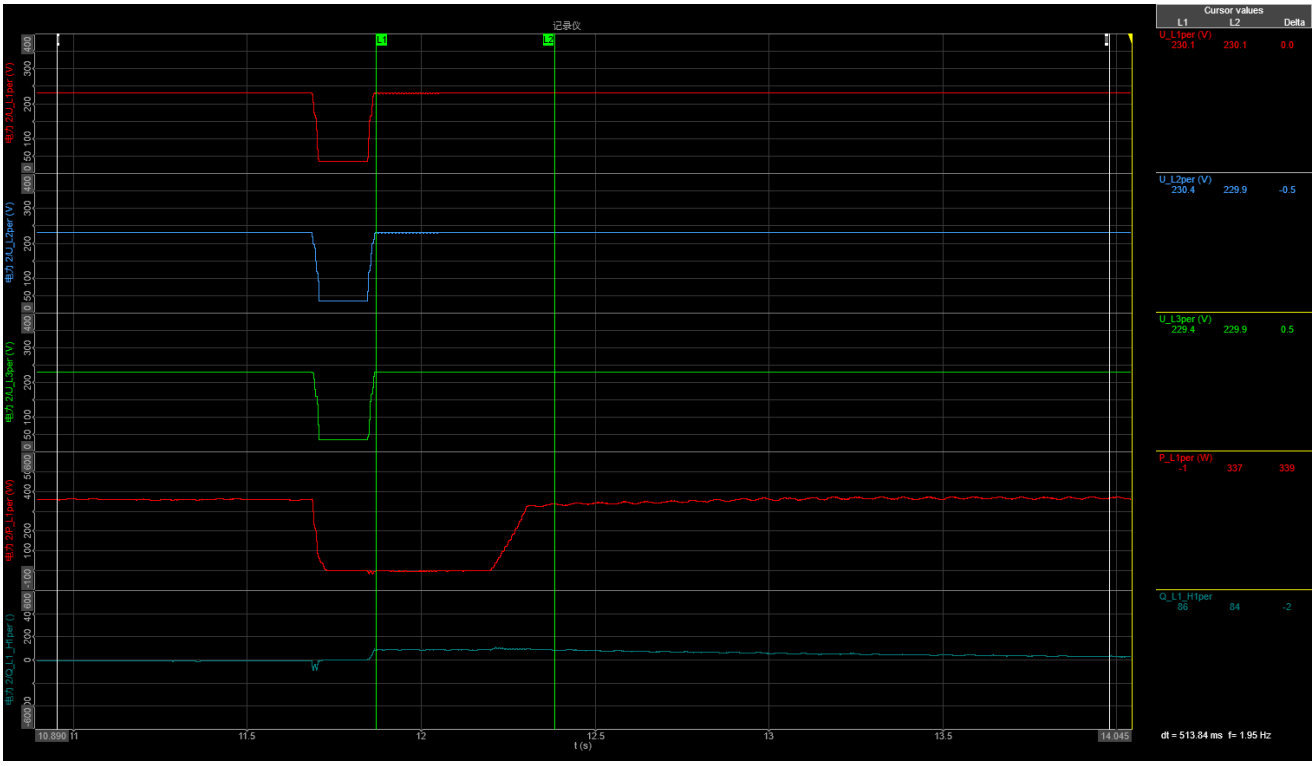
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

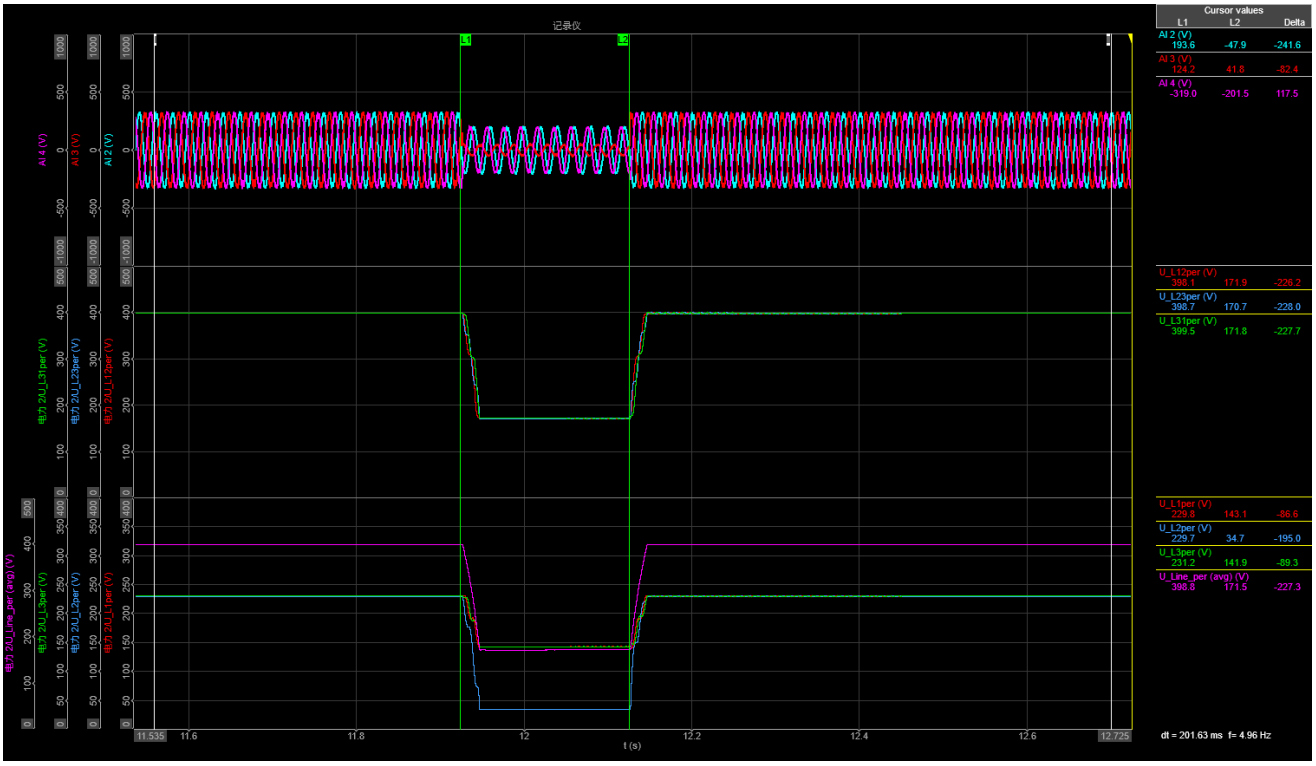
A17C53Z1-20

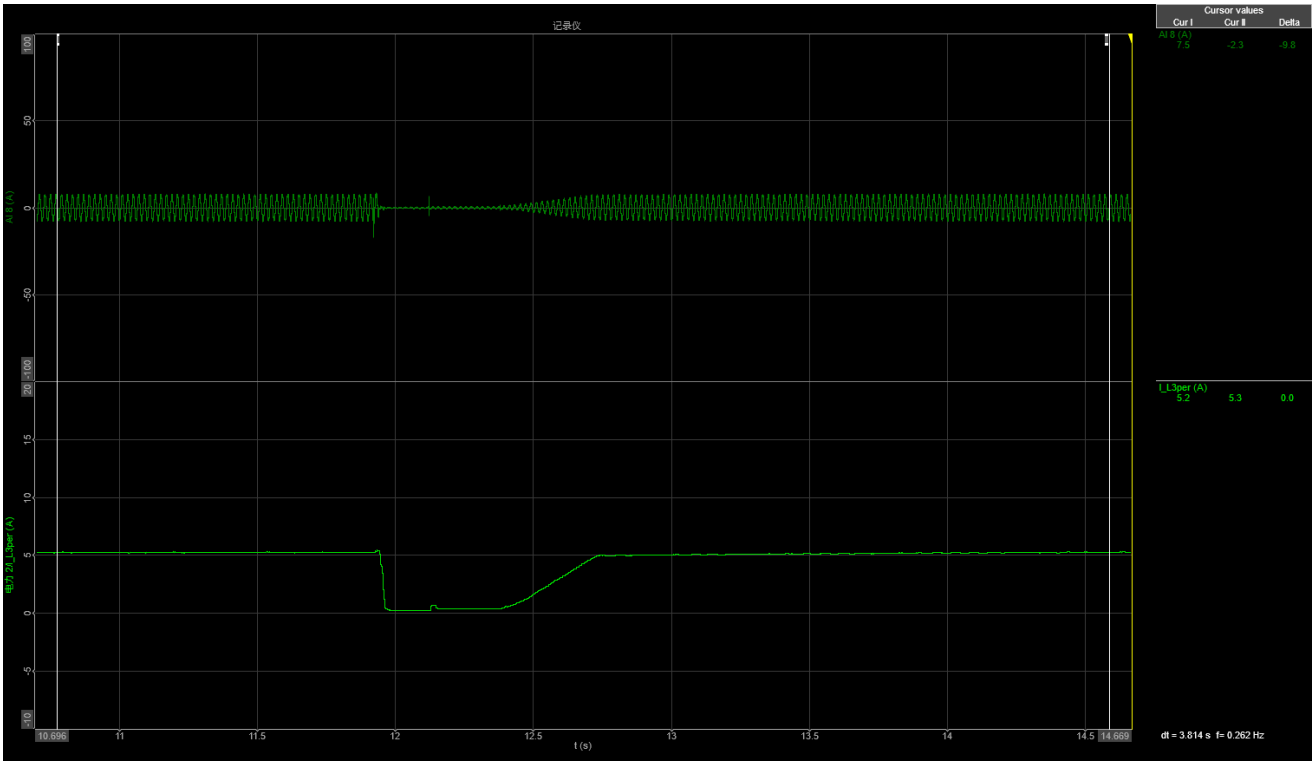
1.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.3
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	18:09:50
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,15
	5	Setting dip duration		--	--	200
	6	Point of fault entry	Total	--	ms	11922
	7	Point of fault clearance	Total	--	ms	12124
	8	Fault duration in empty load test	Total	--	ms	202
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,620
	10		Total (Phase 2)			0,151
	11		Total (Phase 3)			0,620
	12		Positive sequence			0,430
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,005
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,016
	17	Active power	Total	t1-10s to t1	p.u.	1,012
	18		Pos.			1,012
	19	Reactive power	Total	t1-10s to t1	p.u.	0,063
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,620
	23		Phase 2			0,151
	24		Phase 3			0,620
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,038
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,038
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			0,999
	35		Phase 3			1,005
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,013
	37		Pos.			1,013
	38	Active power rising time	Total	--	s	0,597
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,063
	40		Pos.			0,006
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

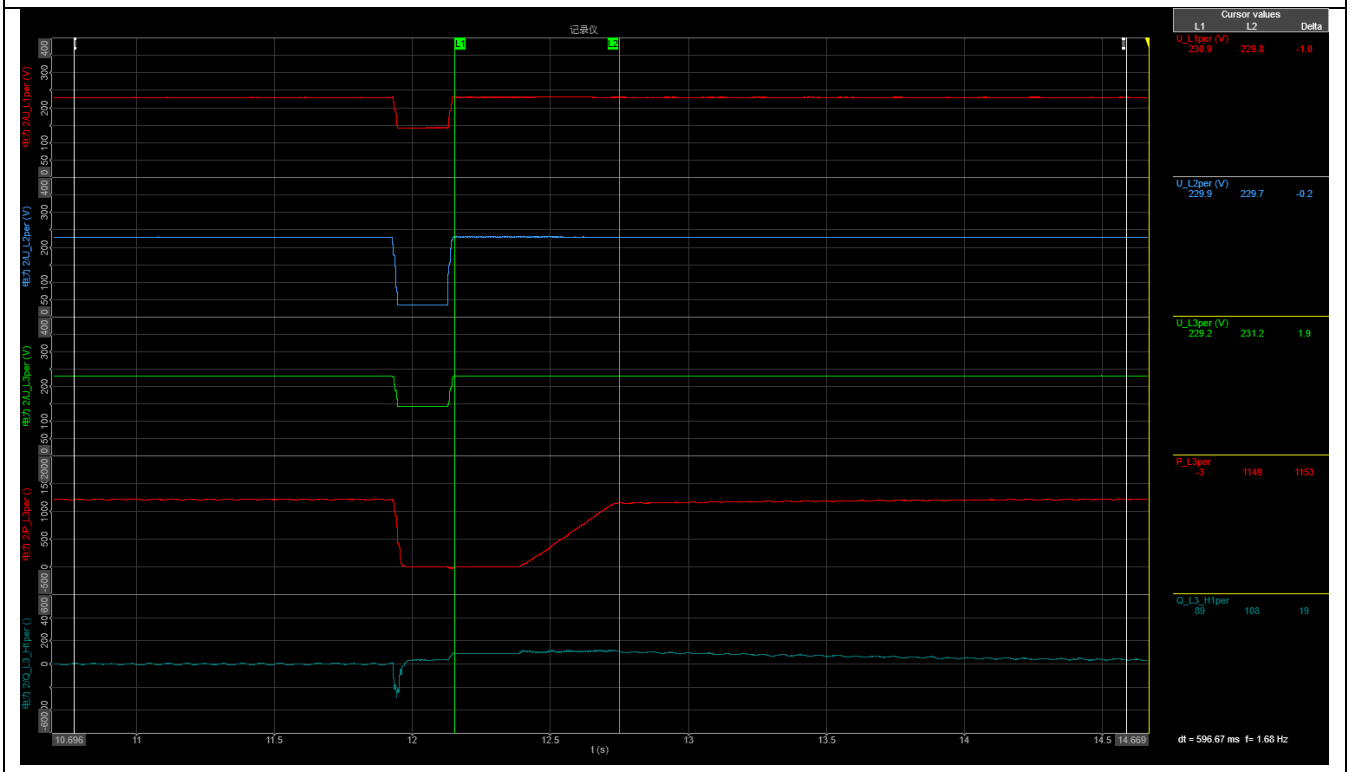
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

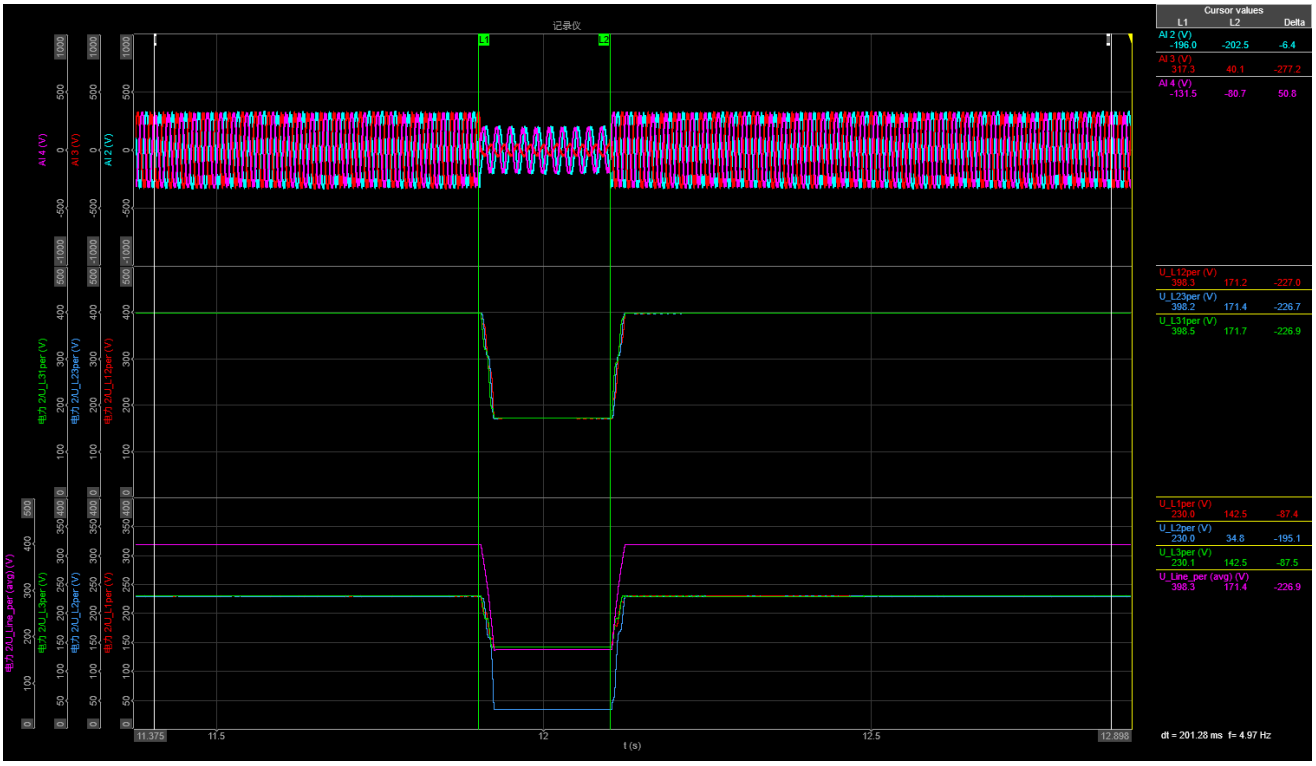
A17C53Z1-20

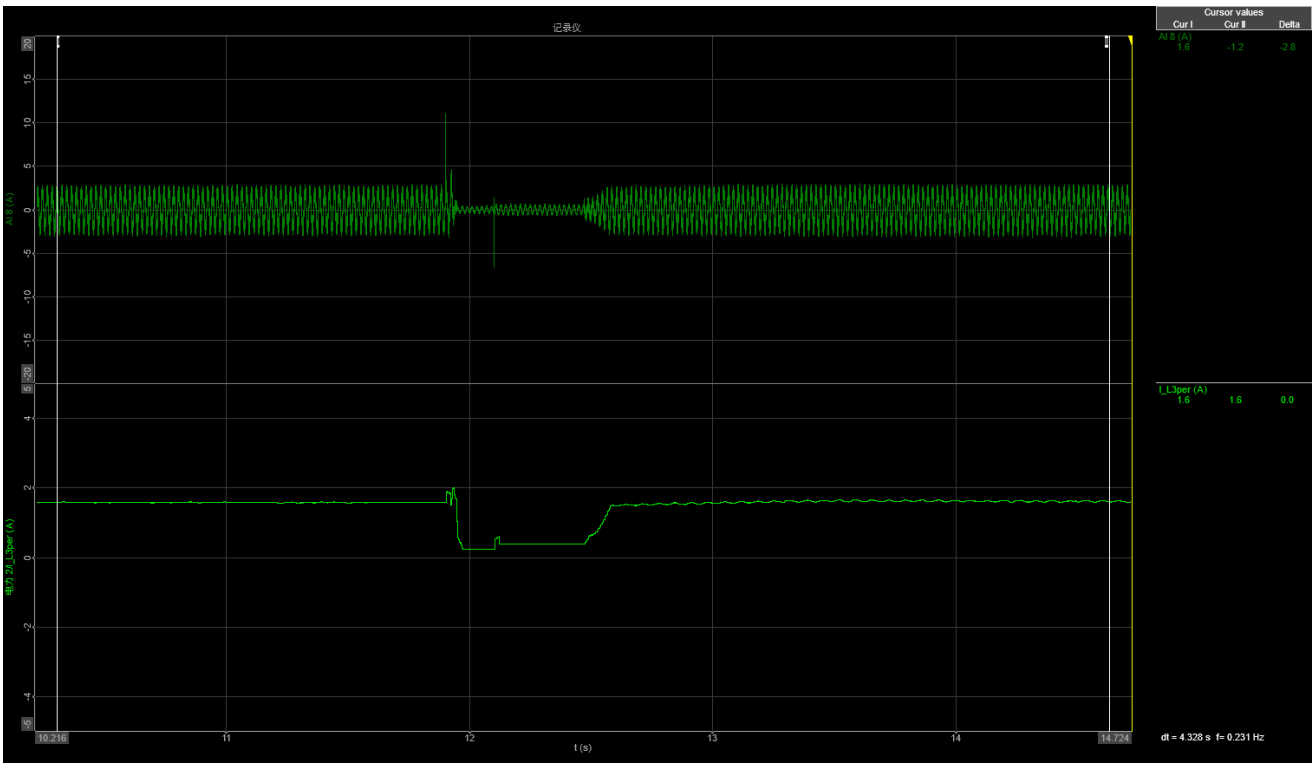
1.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.4
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	15:28:08
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,15
	5	Setting dip duration		--	--	200
	6	Point of fault entry	Total	--	ms	11903
	7	Point of fault clearance	Total	--	ms	12104
	8	Fault duration in empty load test	Total	--	ms	201
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,620
	10		Total (Phase 2)			0,152
	11		Total (Phase 3)			0,620
	12		Positive sequence			0,430
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,288
	17	Active power	Total	t1-10s to t1	p.u.	0,293
	18		Pos.			0,293
	19	Reactive power	Total	t1-10s to t1	p.u.	0,078
	20		Pos.			0,011
	21	Cosφ	Total	t1-10s to t1	--	0,967
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,620
	23		Phase 2			0,152
	24		Phase 3			0,620
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,096
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,096
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,294
	37		Pos.			0,294
	38	Active power rising time	Total	--	s	0,503
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,077
	40		Pos.			0,005
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

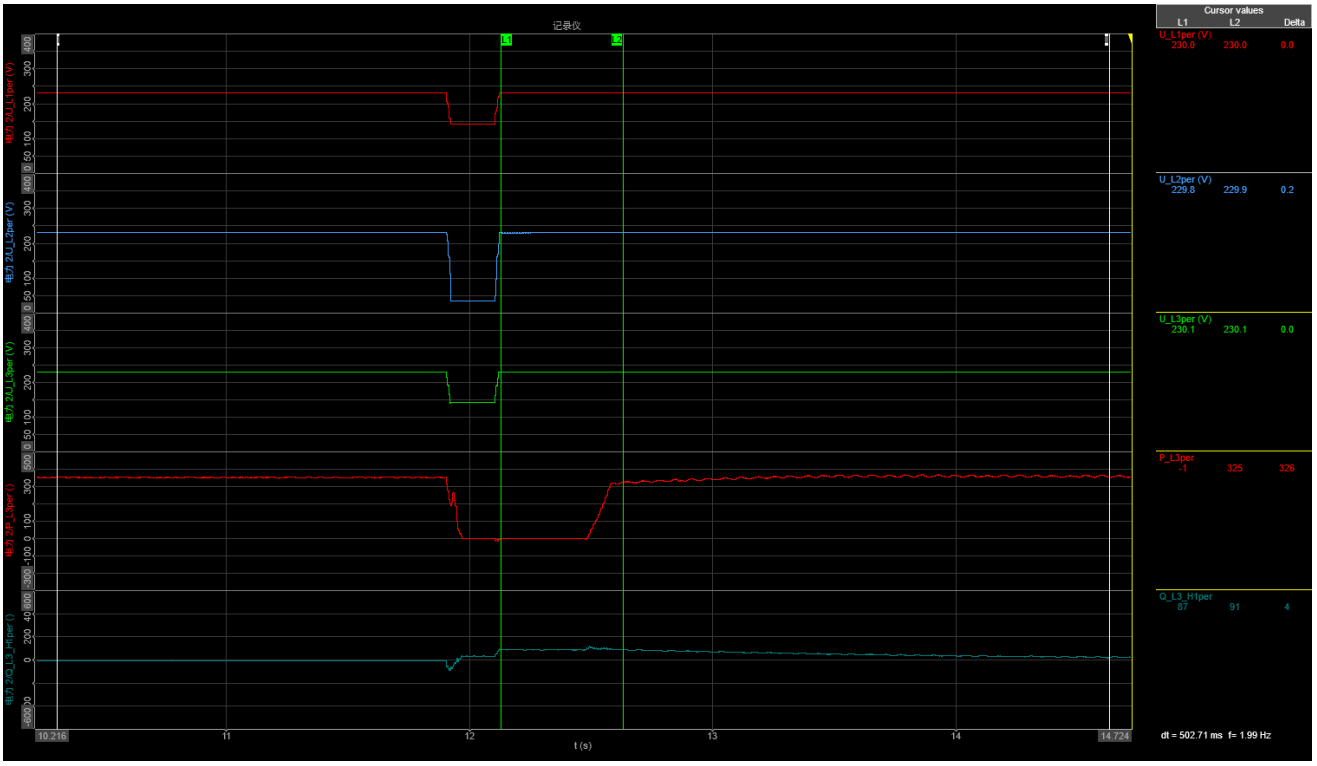
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

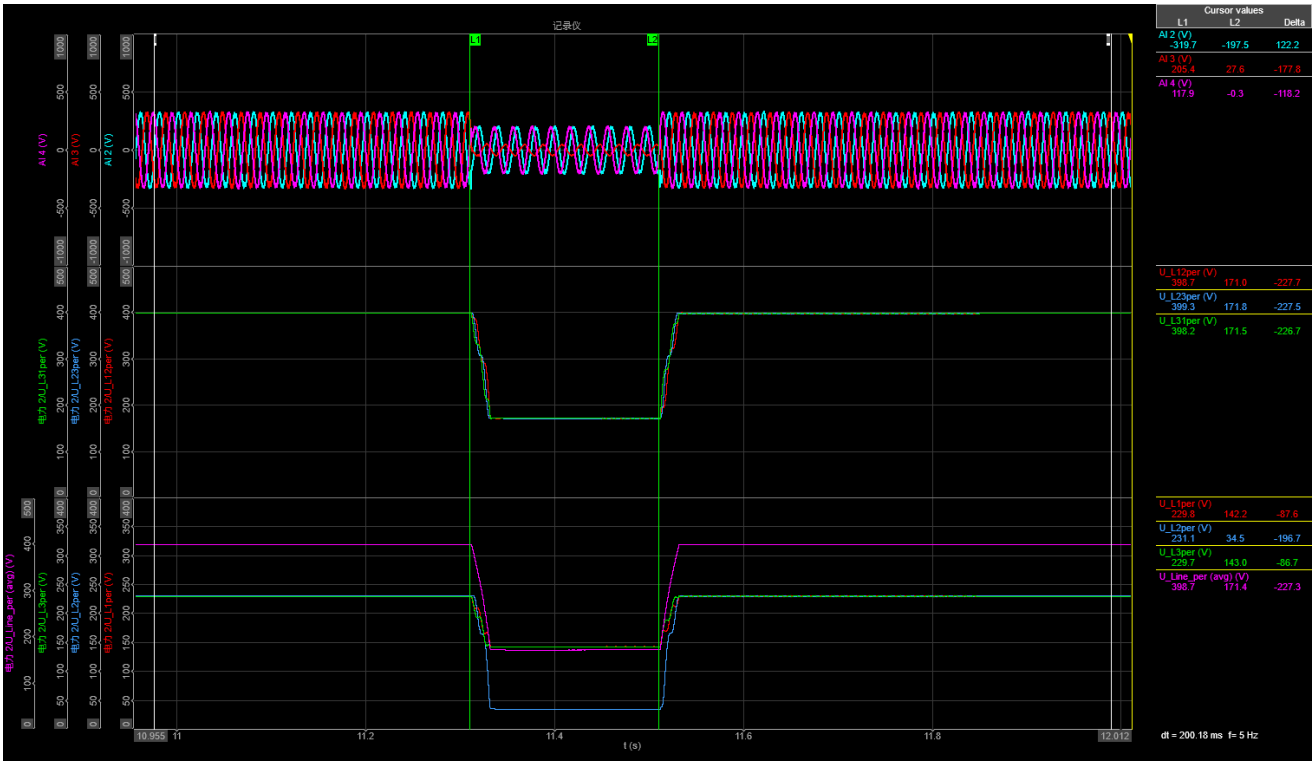
A17C53Z1-20

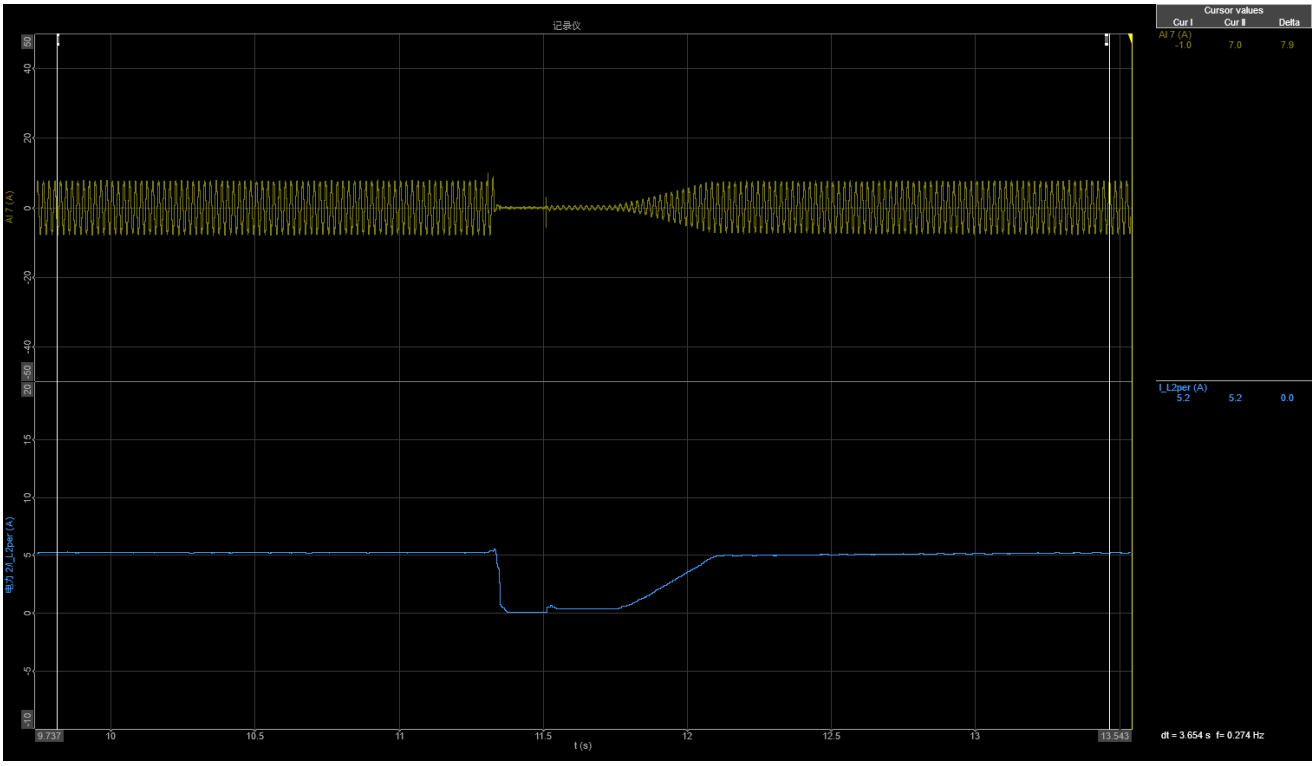
1.5

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	1.5
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	15:01:00
	3	Fault type (phase)	--	--	--	D2
	4	Setting voltage depth	Line to line	--	p.u.	0,15
	5	Setting dip duration		--	--	200
	6	Point of fault entry	Total	--	ms	11311
	7	Point of fault clearance	Total	--	ms	11511
	8	Fault duration in empty load test	Total	--	ms	200
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,620
	10		Total (Phase 2)			0,150
	11		Total (Phase 3)			0,620
	12		Positive sequence			0,429
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			1,005
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,004
	17	Active power	Total	t1-10s to t1	p.u.	1,010
	18		Pos.			1,010
	19	Reactive power	Total	t1-10s to t1	p.u.	0,061
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,620
	23		Phase 2			0,150
	24		Phase 3			0,620
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			0,000
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			0,019
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			1,005
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,012
	37		Pos.			1,012
	38	Active power rising time	Total	--	s	0,574
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,061
	40		Pos.			0,009
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

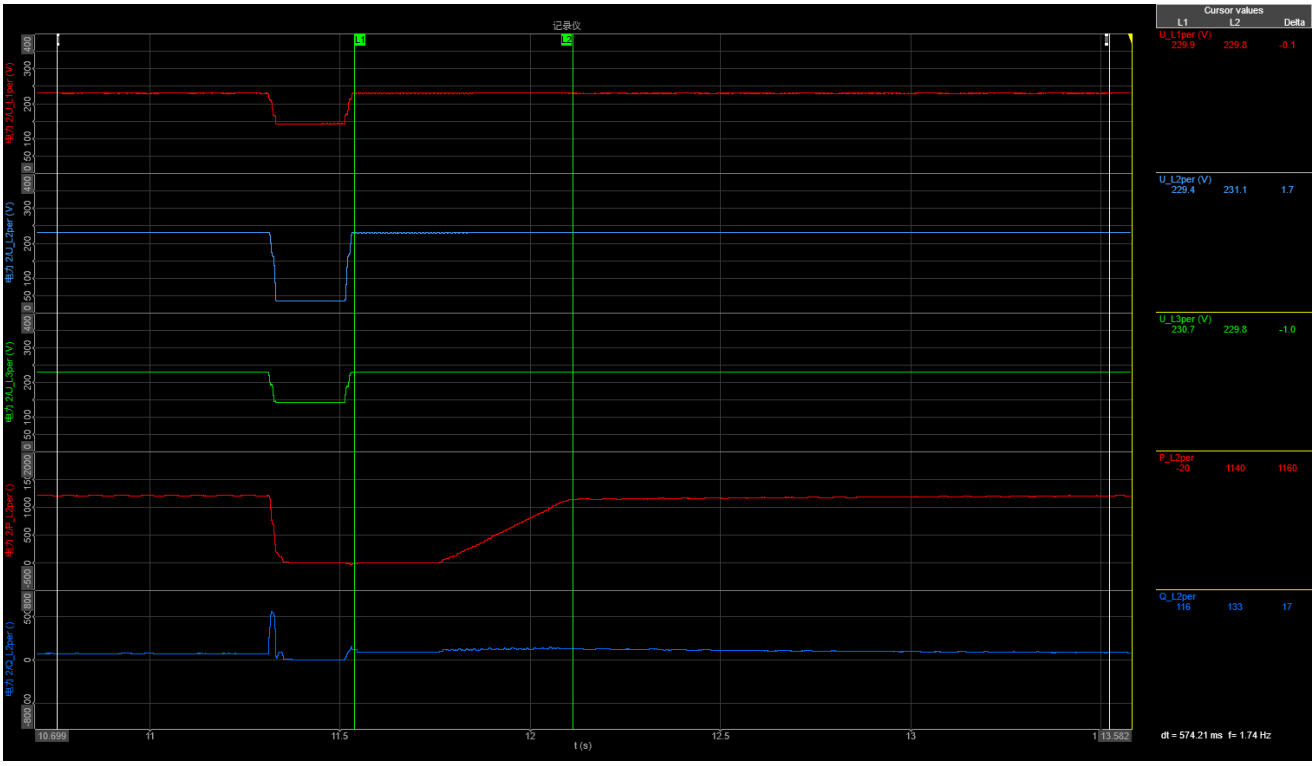
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

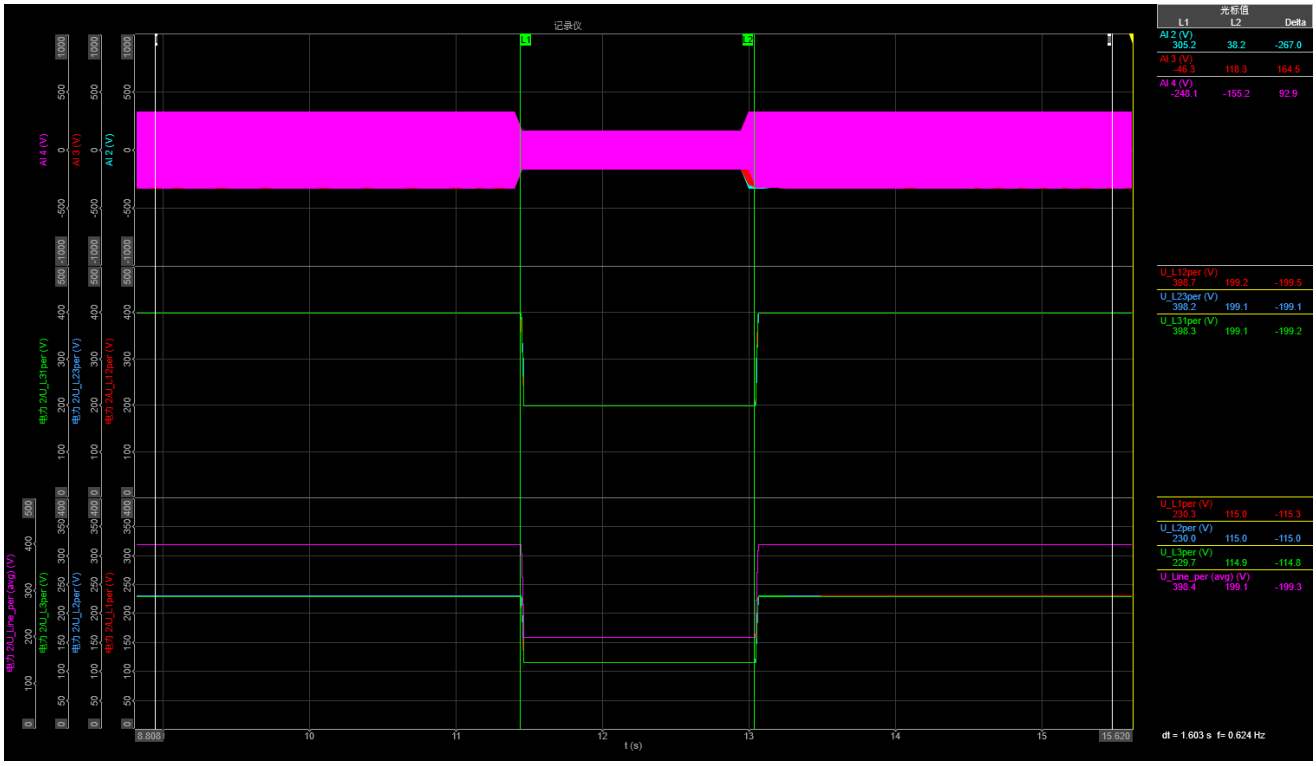
A17C53Z1-20

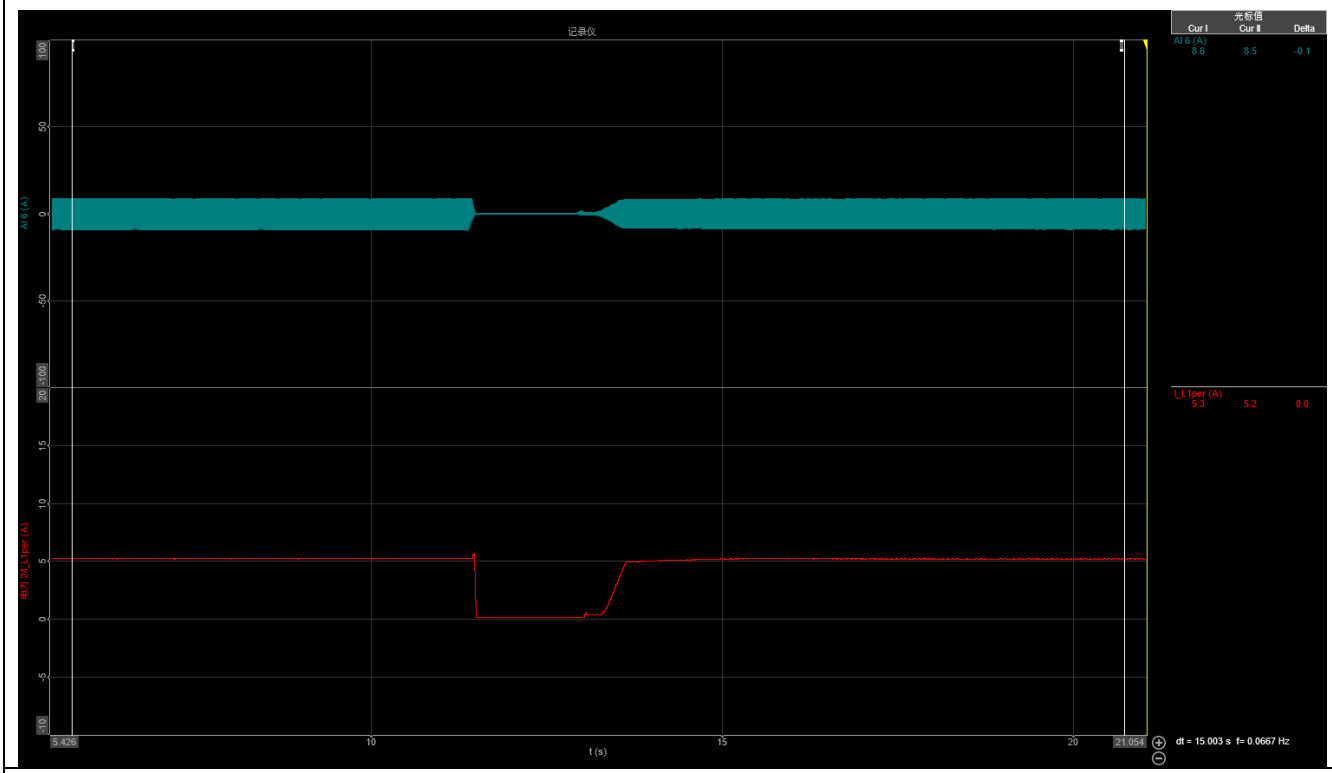
2.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.1
	1	Date	--	--	yyyy.mm.dd	2025/1/14
	2	Time (start of test)	--	--	hh:mm:ss.f	14:40:31
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11443
	7	Point of fault clearance	Total	--	ms	13046
	8	Fault duration in empty load test	Total	--	ms	1603
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,499
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,500
	12		Positive sequence			0,498
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,001
	14		Phase 2			1,000
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,801
	18		Pos.			0,800
	19	Reactive power	Total	t1-10s to t1	p.u.	0,613
	20		Pos.			0,598
	21	Cosφ	Total	t1-10s to t1	--	0,794
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,499
	23		Phase 2			0,500
	24		Phase 3			0,500
	25	Line current	Phase 1	t1+60ms	p.u.	0,038
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,038
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,002
	34		Phase 2			1,000
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,866
	37		Pos.			0,866
	38	Active power rising time	Total	--	s	0,592
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,506
	40		Pos.			0,488
	41	Reactive power rising time	total	--	s	9,877
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

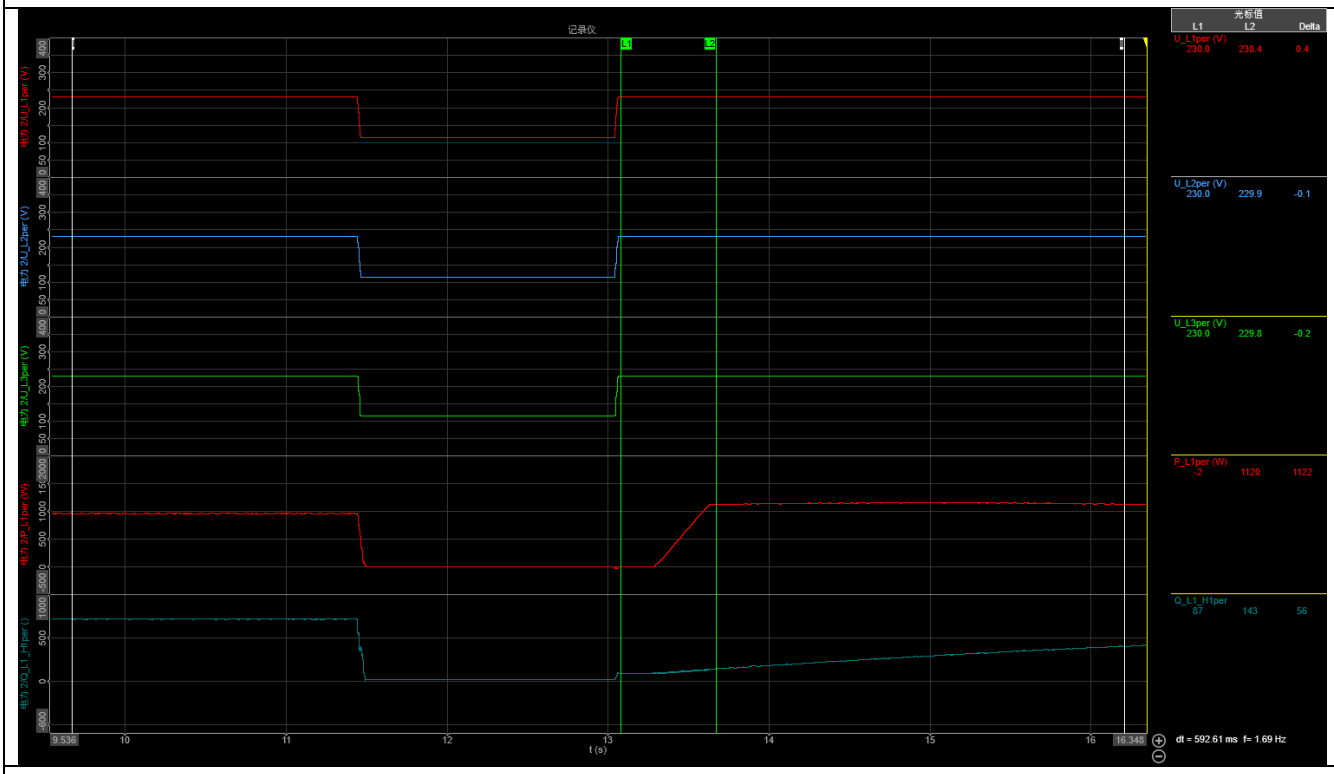
A17C53Z1-20

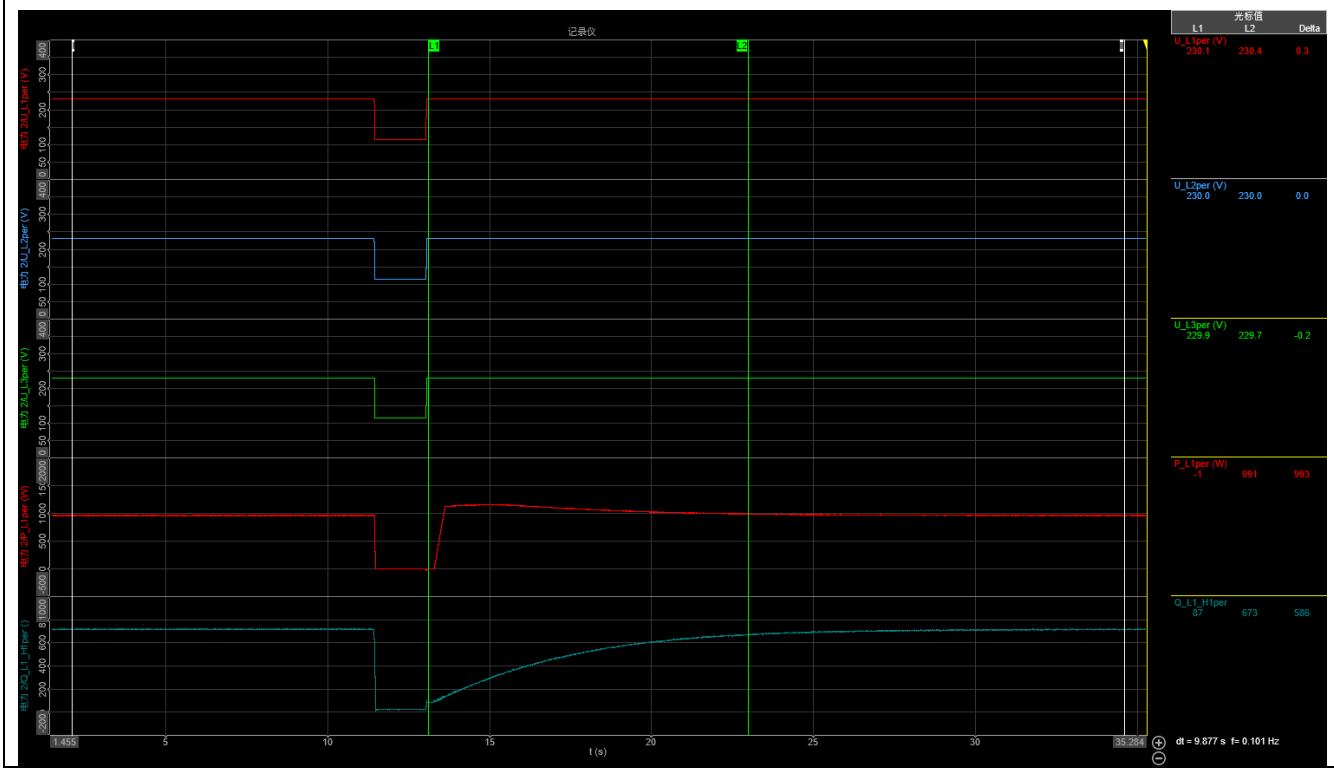




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

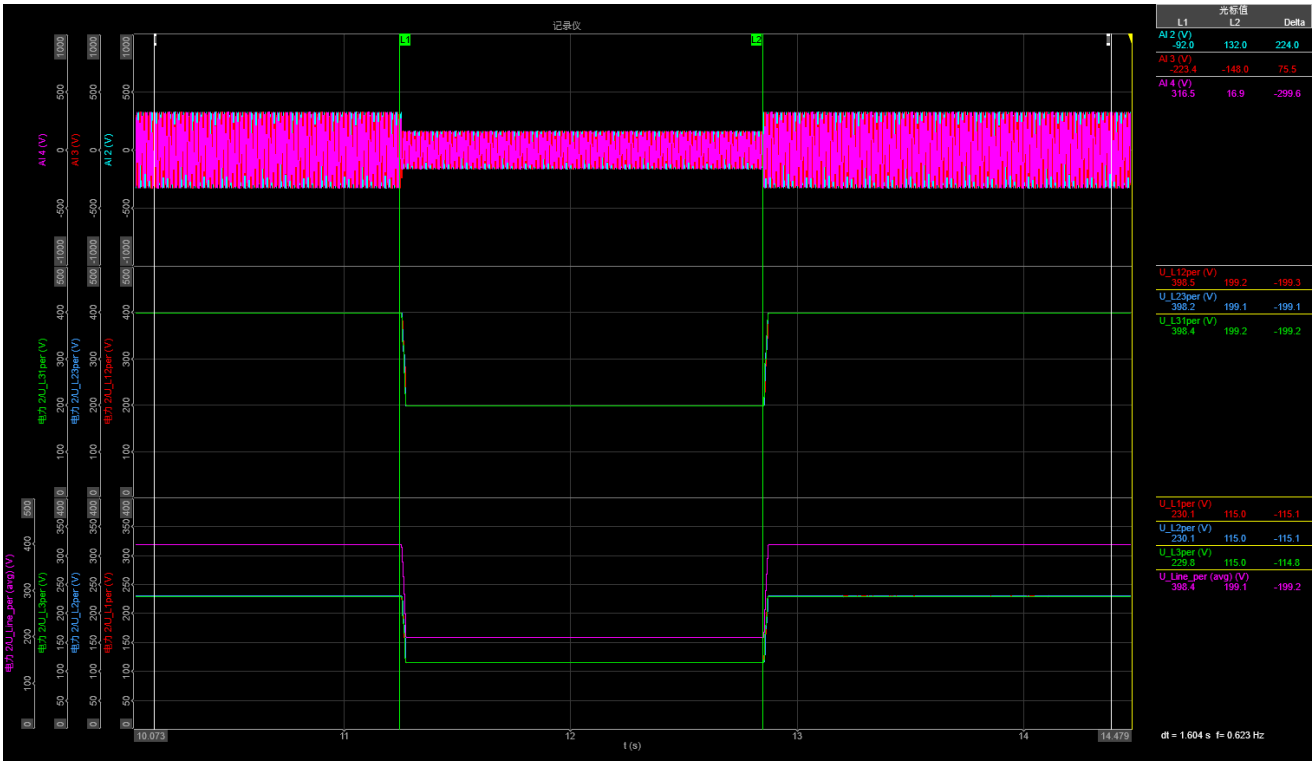
A17C53Z1-20

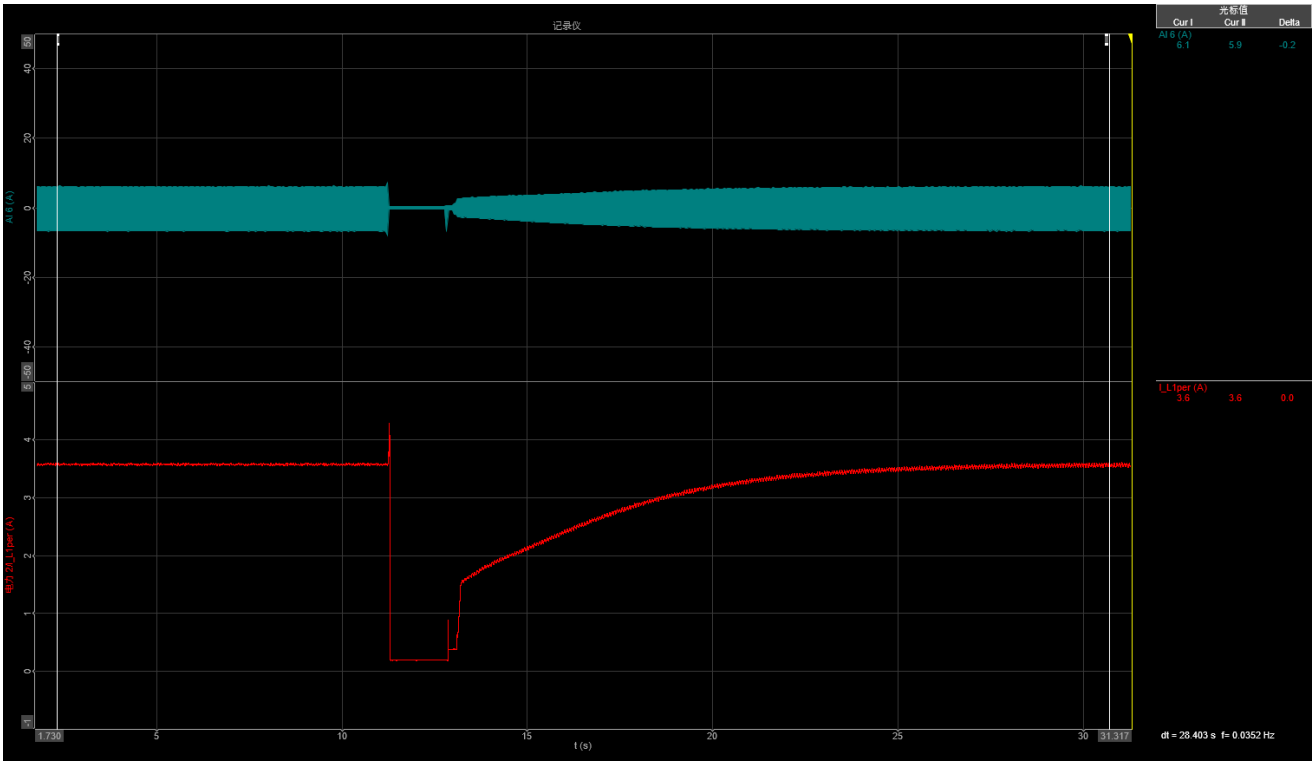
2.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.2
	1	Date	--	--	yyyy.mm.dd	2025/1/14
	2	Time (start of test)	--	--	hh:mm:ss.f	14:45:33
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11248
	7	Point of fault clearance	Total	--	ms	12852
	8	Fault duration in empty load test	Total	--	ms	1604
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,499
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,500
	12		Positive sequence			0,499
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,671
	17	Active power	Total	t1-10s to t1	p.u.	0,302
	18		Pos.			0,302
	19	Reactive power	Total	t1-10s to t1	p.u.	0,615
	20		Pos.			0,606
	21	Cosφ	Total	t1-10s to t1	--	0,441
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,499
	23		Phase 2			0,500
	24		Phase 3			0,500
	25	Line current	Phase 1	t1+60ms	p.u.	0,038
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,038
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,302
	37		Pos.			0,302
	38	Active power rising time	Total	--	s	0,387
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,514
	40		Pos.			0,505
	41	Reactive power rising time	total	--	s	9,731
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

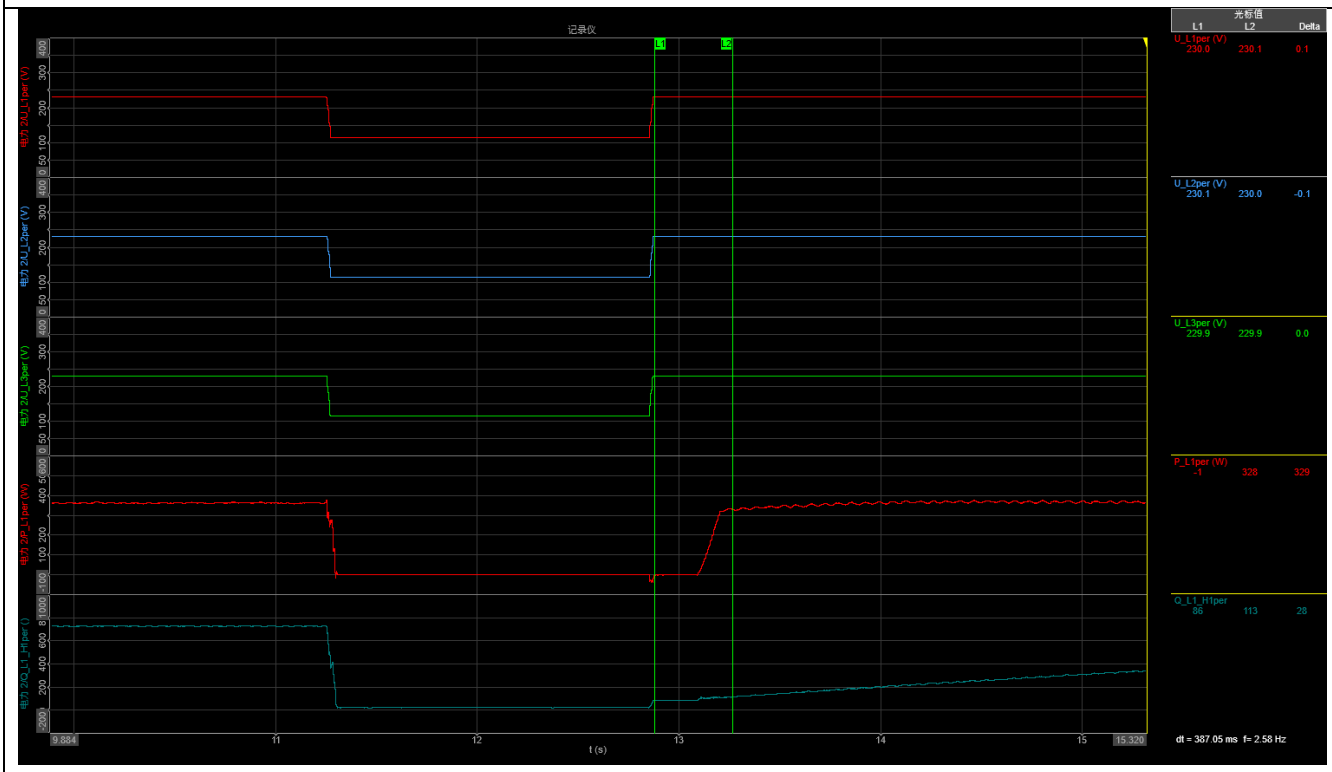
A17C53Z1-20

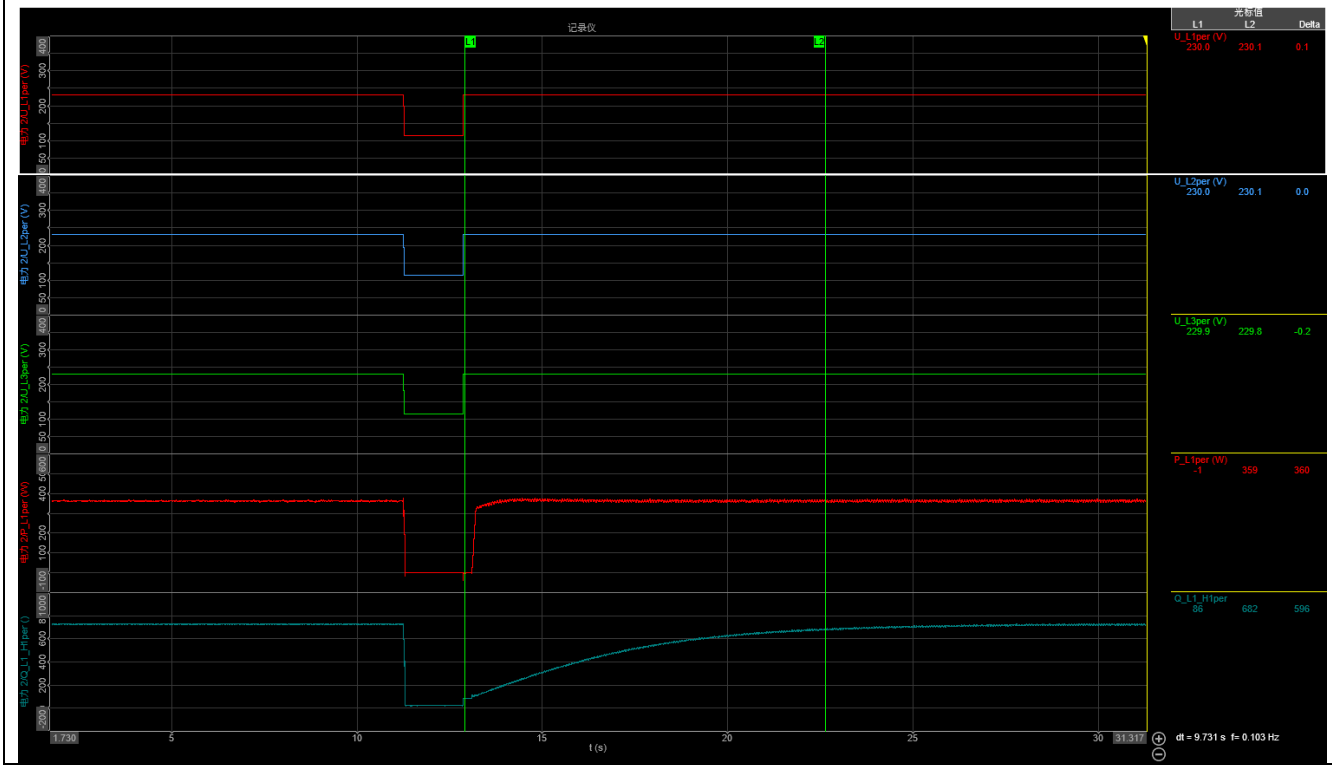




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

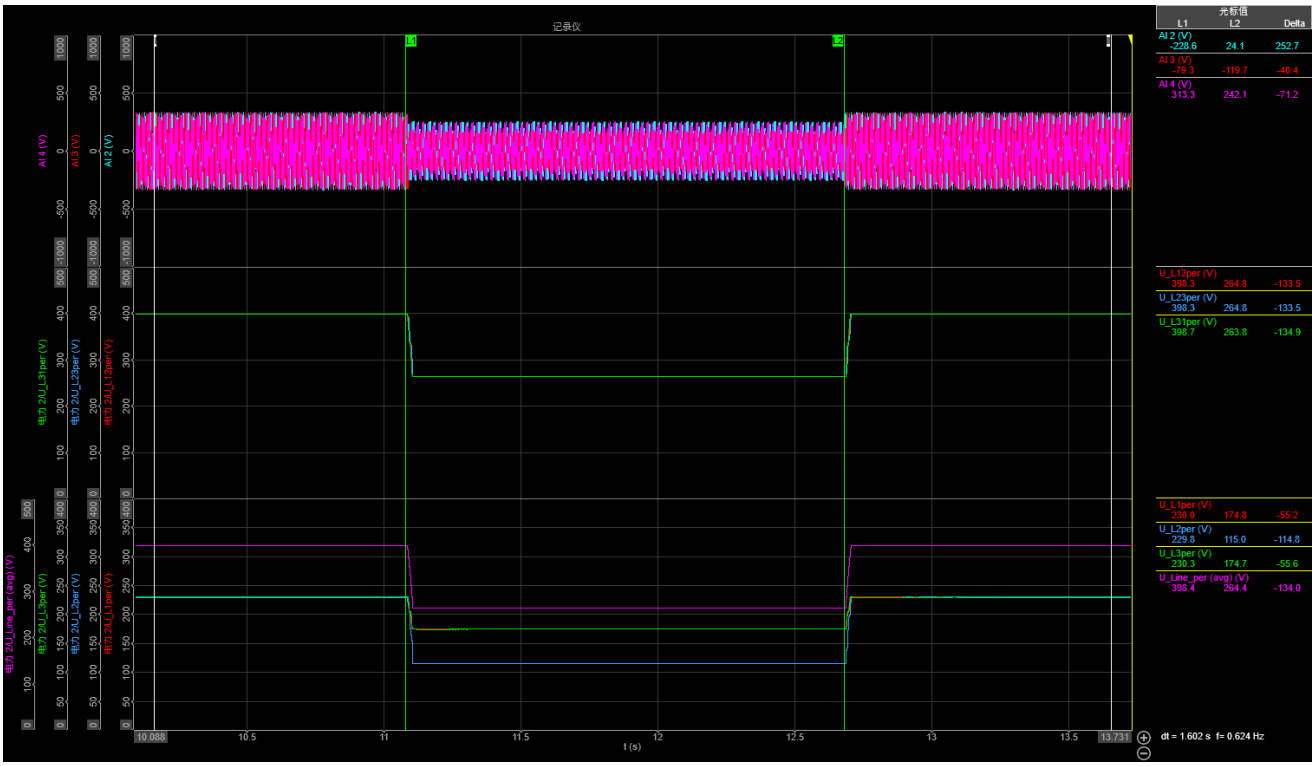
A17C53Z1-20

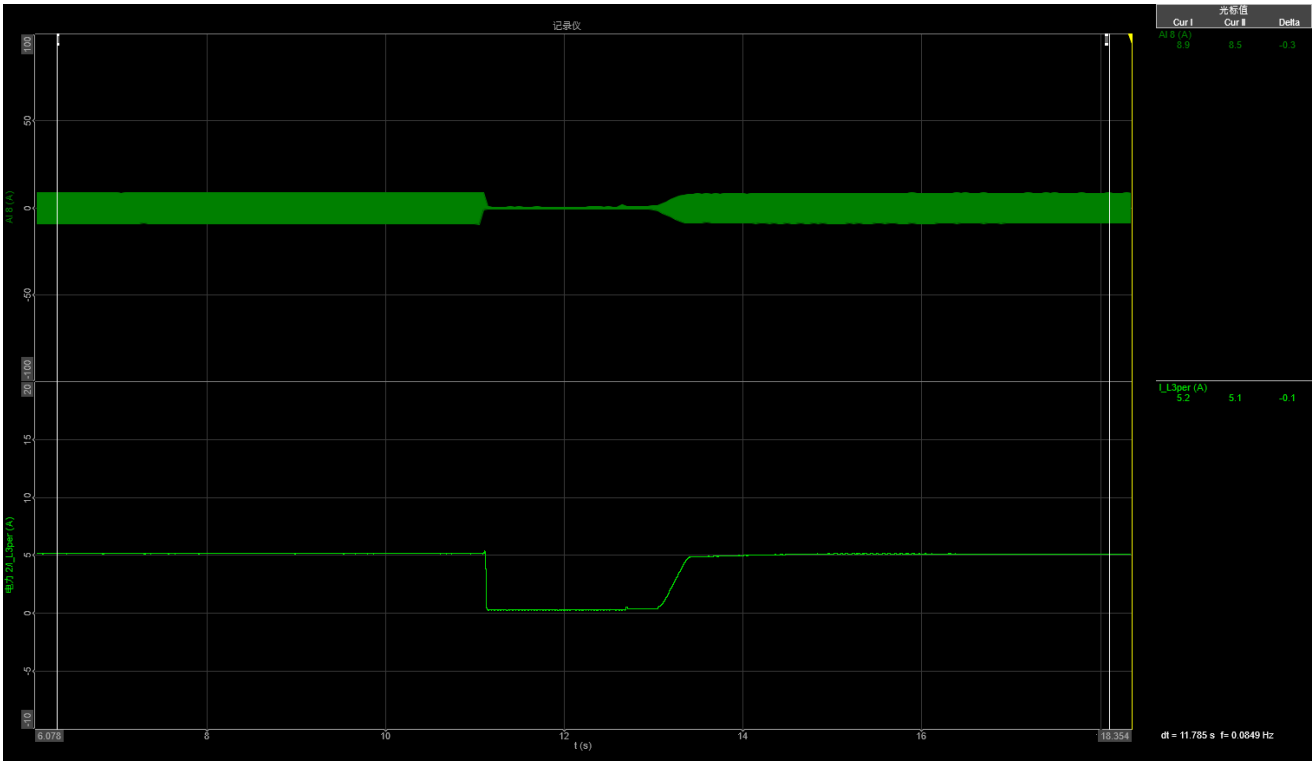
2.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.3
	1	Date	--	--	yyyy.mm.dd	2025/1/14
	2	Time (start of test)	--	--	hh:mm:ss.f	9:54:06
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11085
	7	Point of fault clearance	Total	--	ms	12687
	8	Fault duration in empty load test	Total	--	ms	1602
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,760
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,759
	12		Positive sequence			0,663
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			0,999
	15		Phase 3			1,001
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,779
	18		Pos.			0,778
	19	Reactive power	Total	t1-10s to t1	p.u.	0,614
	20		Pos.			0,598
	21	Cosφ	Total	t1-10s to t1	--	0,794
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,760
	23		Phase 2			0,500
	24		Phase 3			0,759
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,058
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,058
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			0,999
	35		Phase 3			1,001
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,848
	37		Pos.			0,848
	38	Active power rising time	Total	--	s	0,693
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,501
	40		Pos.			0,482
	41	Reactive power rising time	total	--	s	9,882
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

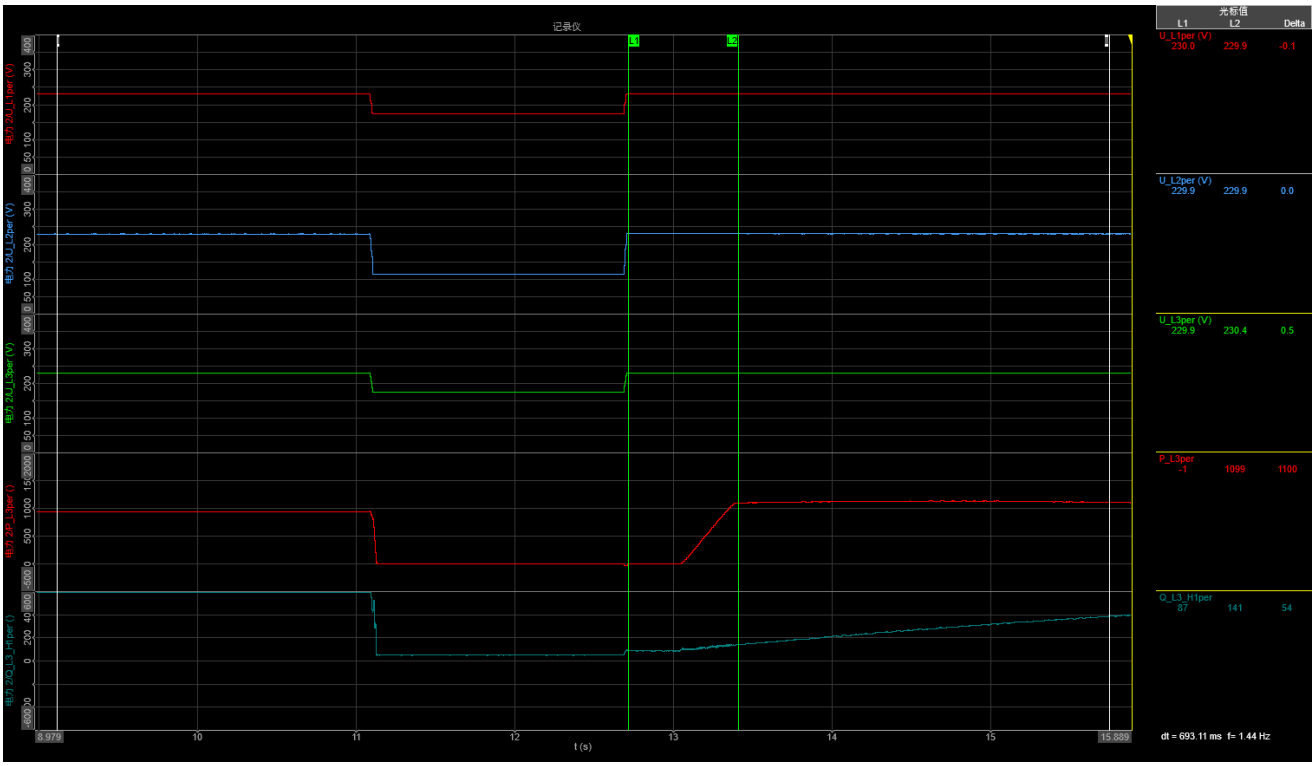
A17C53Z1-20

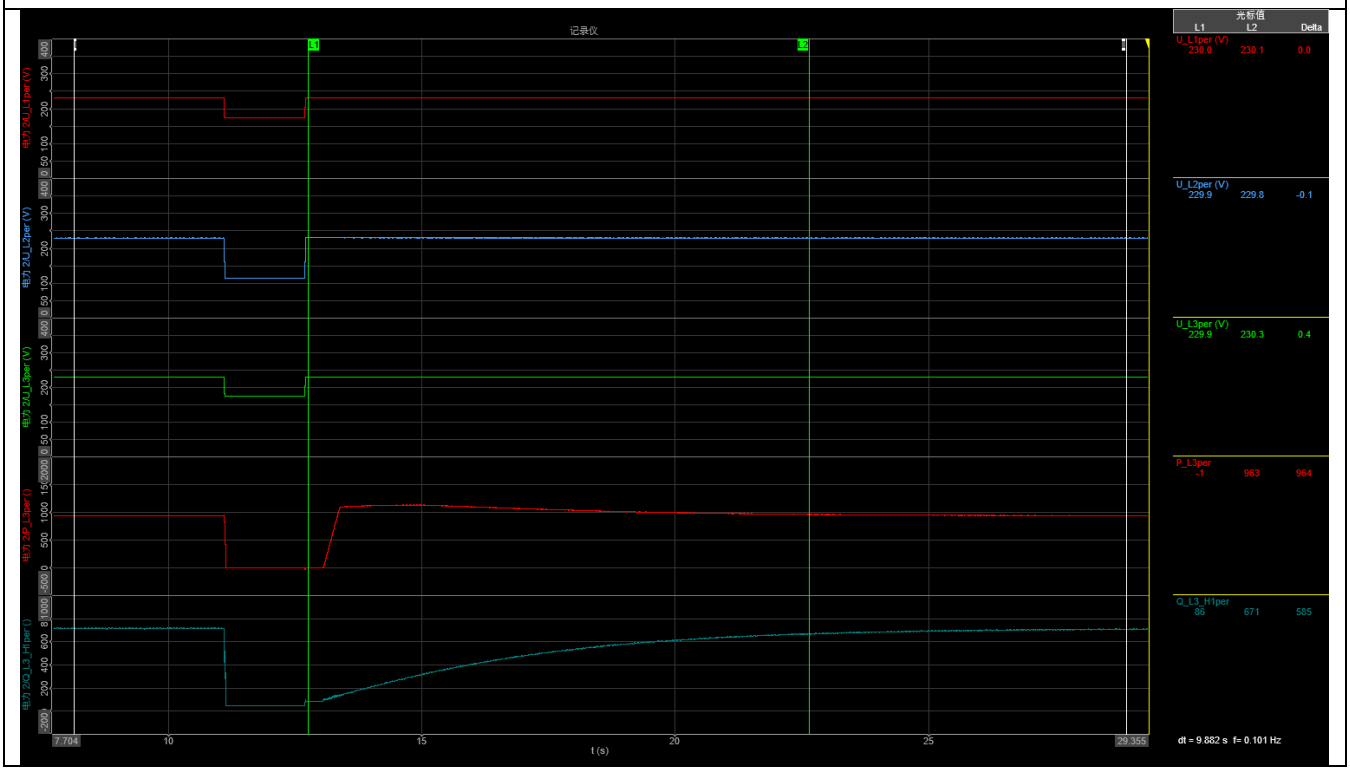




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

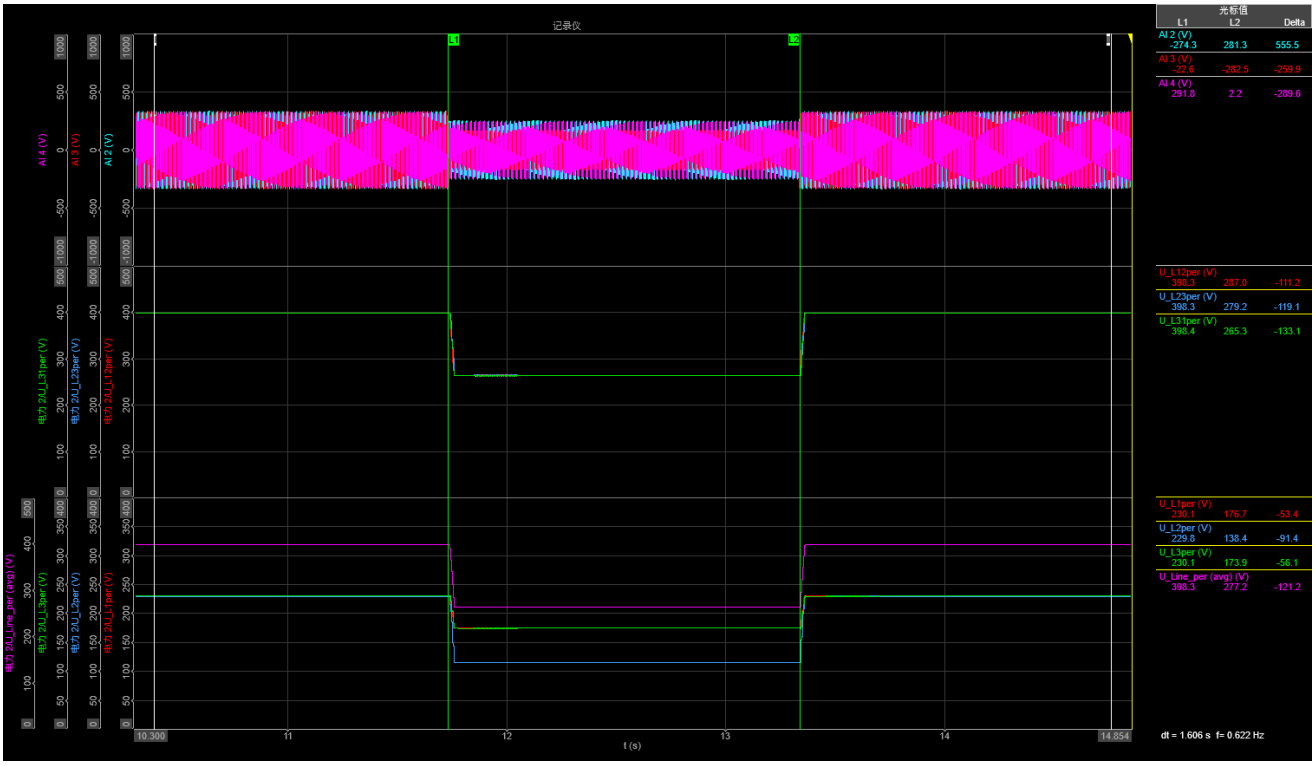
A17C53Z1-20

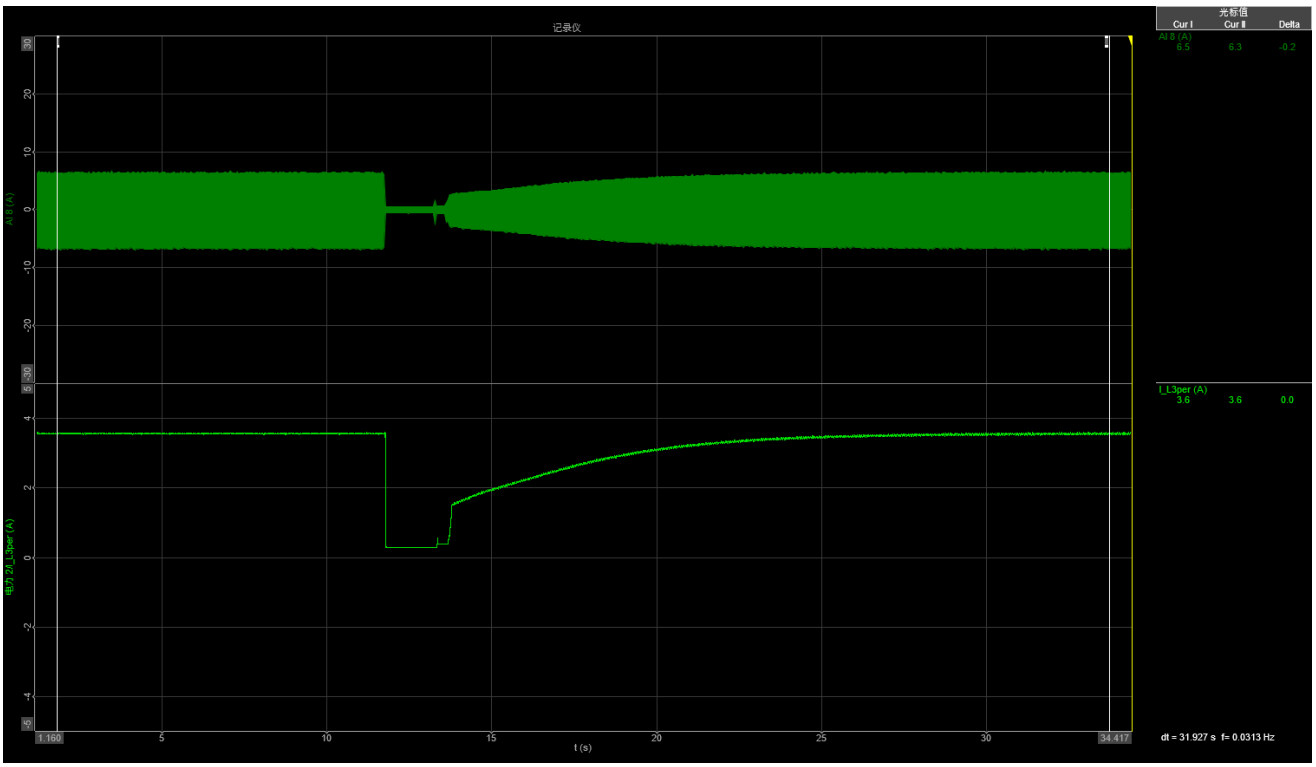
2.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	2.4
	1	Date	--	--	yyyy.mm.dd	2025/1/14
	2	Time (start of test)	--	--	hh:mm:ss.f	9:50:02
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11740
	7	Point of fault clearance	Total	--	ms	13346
	8	Fault duration in empty load test	Total	--	ms	1606
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,760
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,760
	12		Positive sequence			0,663
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			0,999
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,671
	17	Active power	Total	t1-10s to t1	p.u.	0,293
	18		Pos.			0,293
	19	Reactive power	Total	t1-10s to t1	p.u.	0,617
	20		Pos.			0,607
	21	Cosφ	Total	t1-10s to t1	--	0,430
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,760
	23		Phase 2			0,500
	24		Phase 3			0,760
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,058
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,058
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,294
	37		Pos.			0,294
	38	Active power rising time	Total	--	s	0,447
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,508
	40		Pos.			0,497
	41	Reactive power rising time	total	--	s	9,87
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

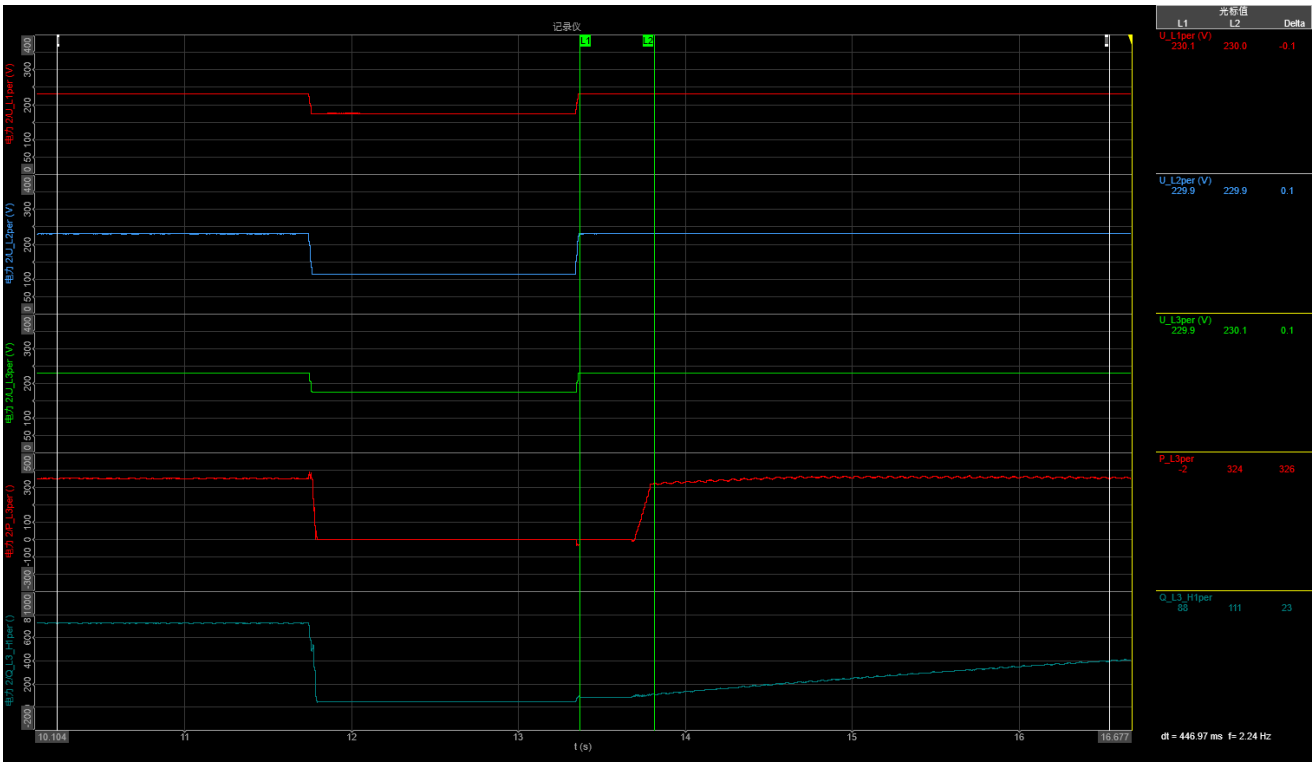
A17C53Z1-20

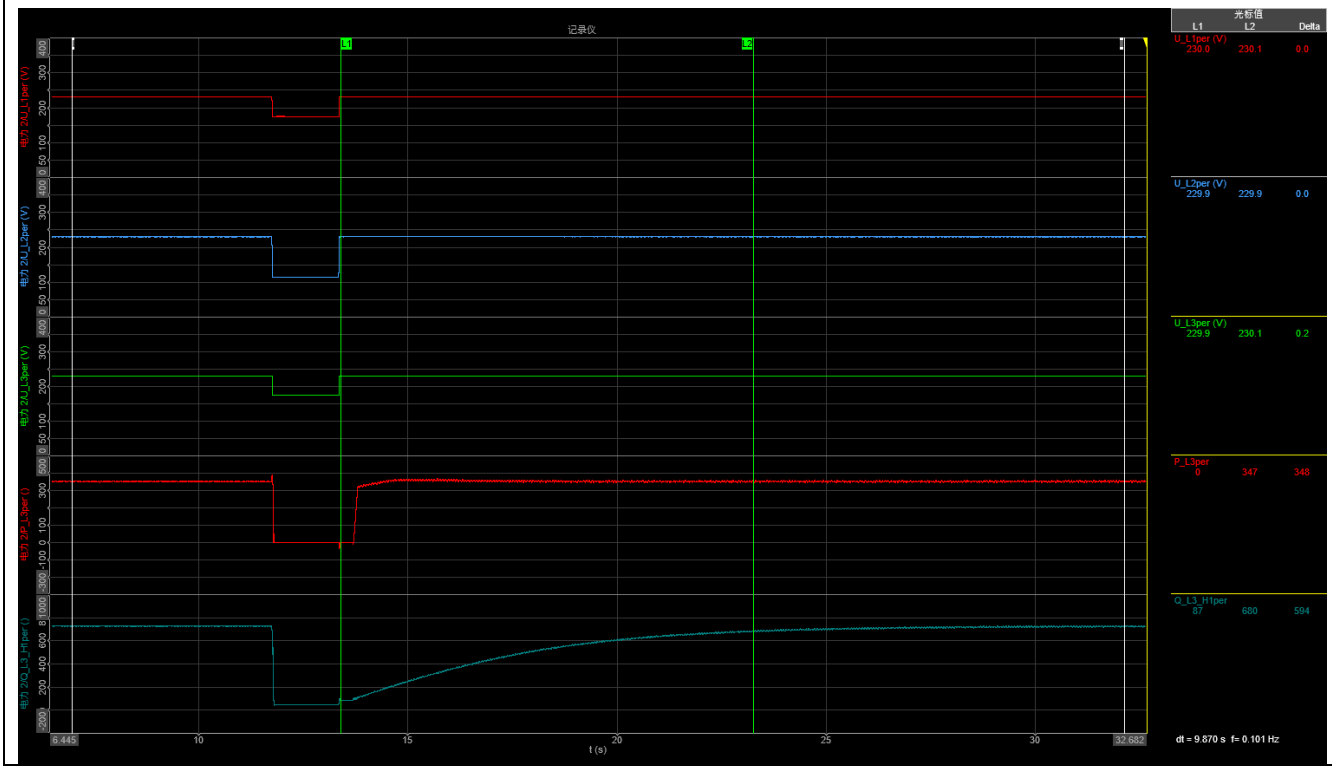




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





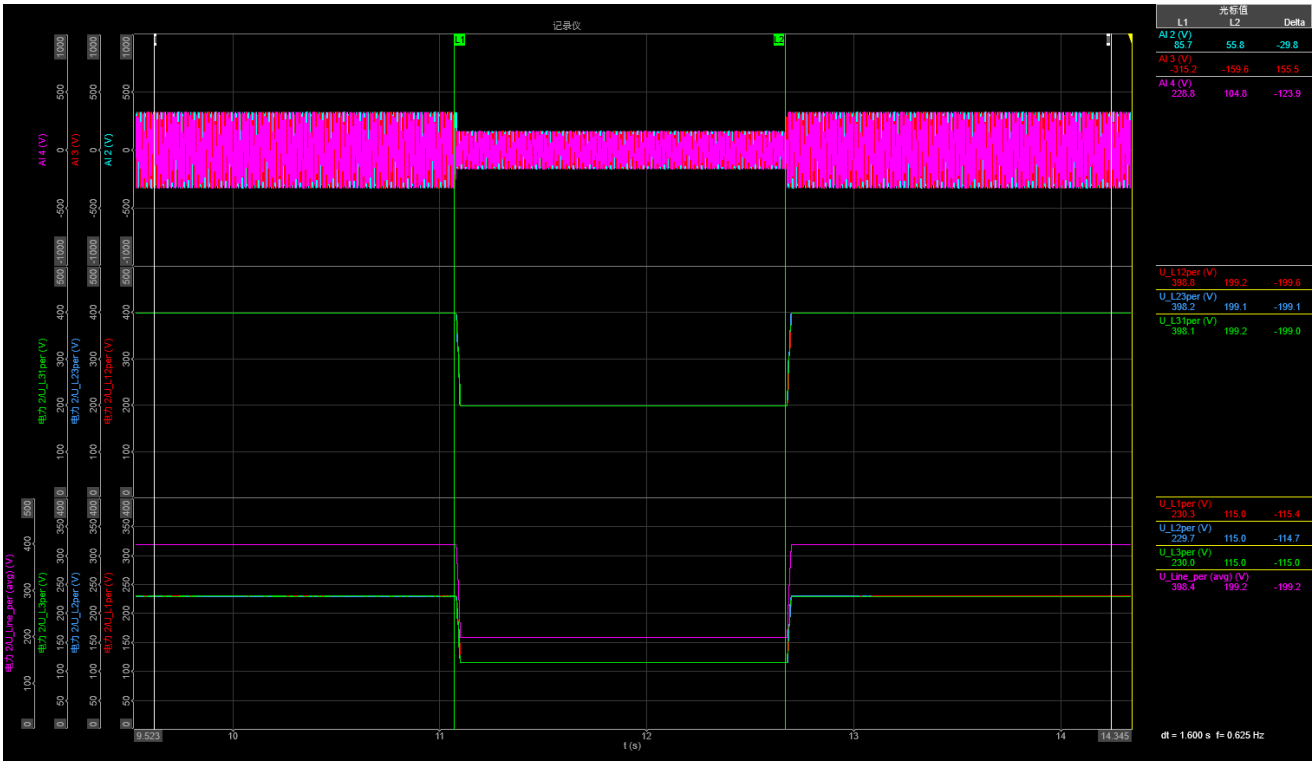
5.8.3	For PGUs Type 2 and storage systems	P

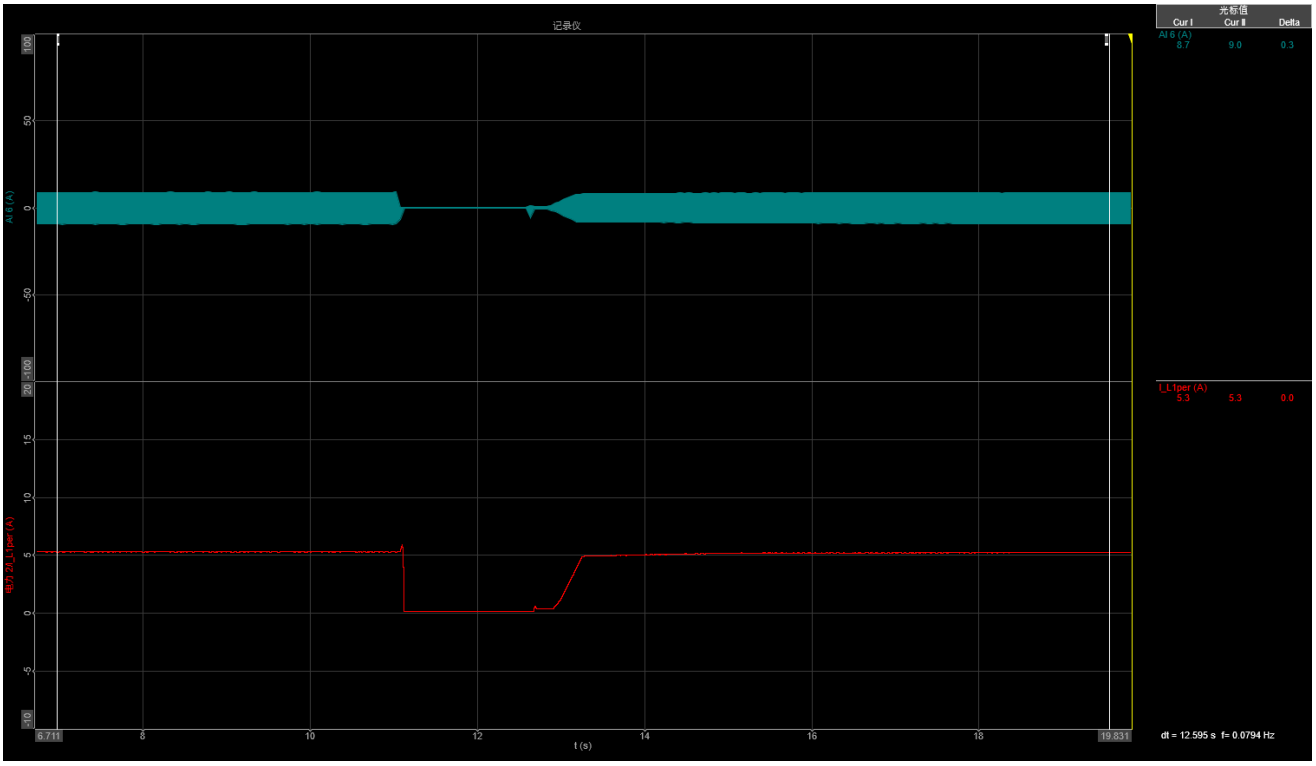
A17C53Z1-20

3.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.1
	1	Date	--	--	yyyy.mm.dd	2025/1/14
	2	Time (start of test)	--	--	hh:mm:ss.f	14:28:29
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11080
	7	Point of fault clearance	Total	--	ms	12680
	8	Fault duration in empty load test	Total	--	ms	1600
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,500
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,500
	12		Positive sequence			0,499
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,002
	14		Phase 2			0,999
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,806
	18		Pos.			0,805
	19	Reactive power	Total	t1-10s to t1	p.u.	-0,624
	20		Pos.			-0,605
	21	Cosφ	Total	t1-10s to t1	--	0,790
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,500
	23		Phase 2			0,500
	24		Phase 3			0,500
	25	Line current	Phase 1	t1+60ms	p.u.	0,038
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,038
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,002
	34		Phase 2			0,999
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,868
	37		Pos.			0,868
	38	Active power rising time	Total	--	s	0,574
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	-0,516
	40		Pos.			-0,493
	41	Reactive power rising time	total	--	s	9,895
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

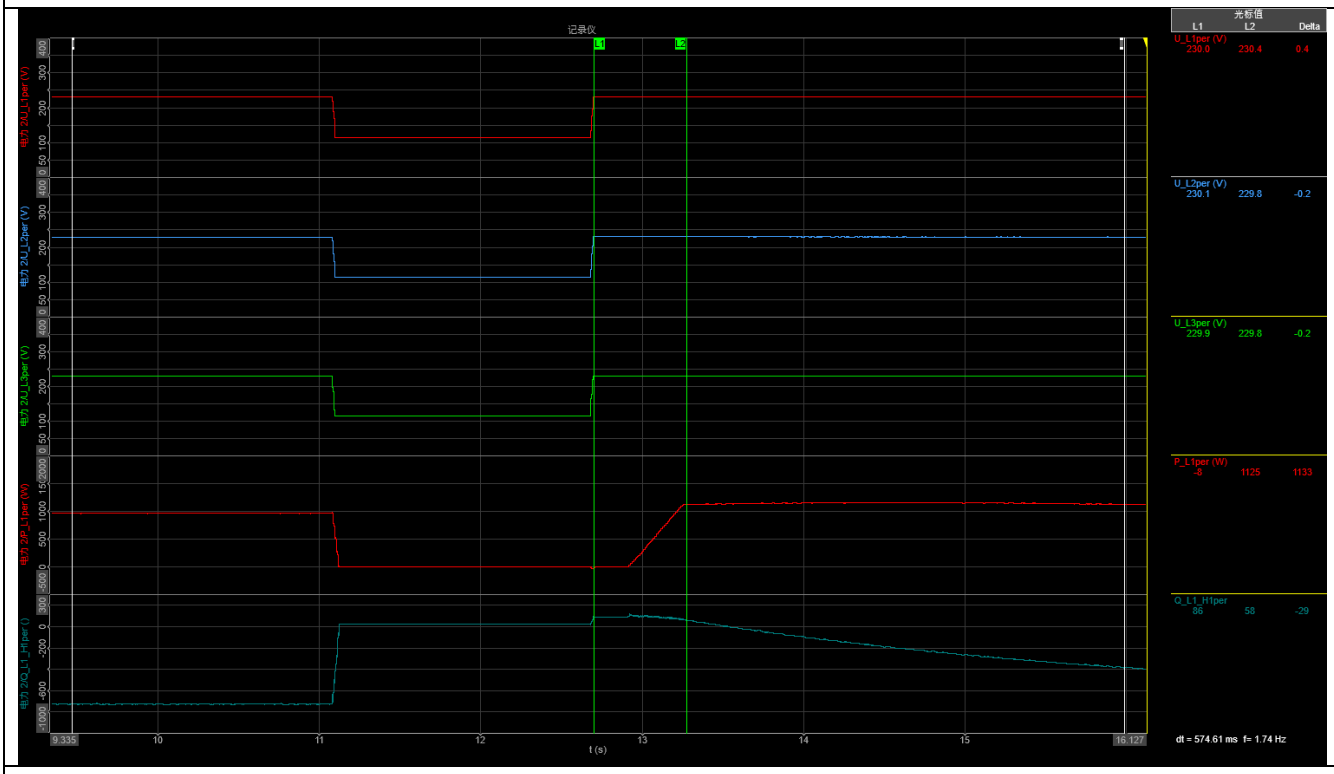
5.8.3	For PGUs Type 2 and storage systems	P
A17C53Z1-20		

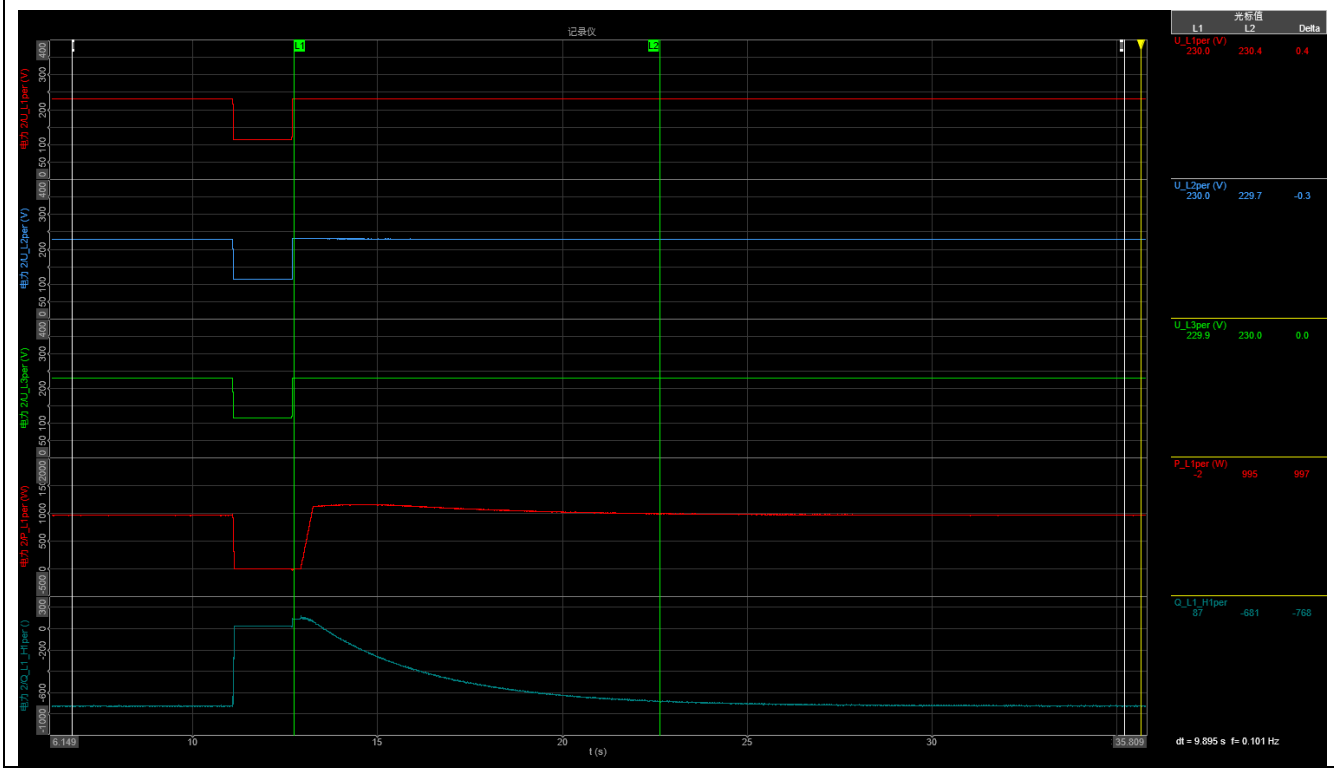




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

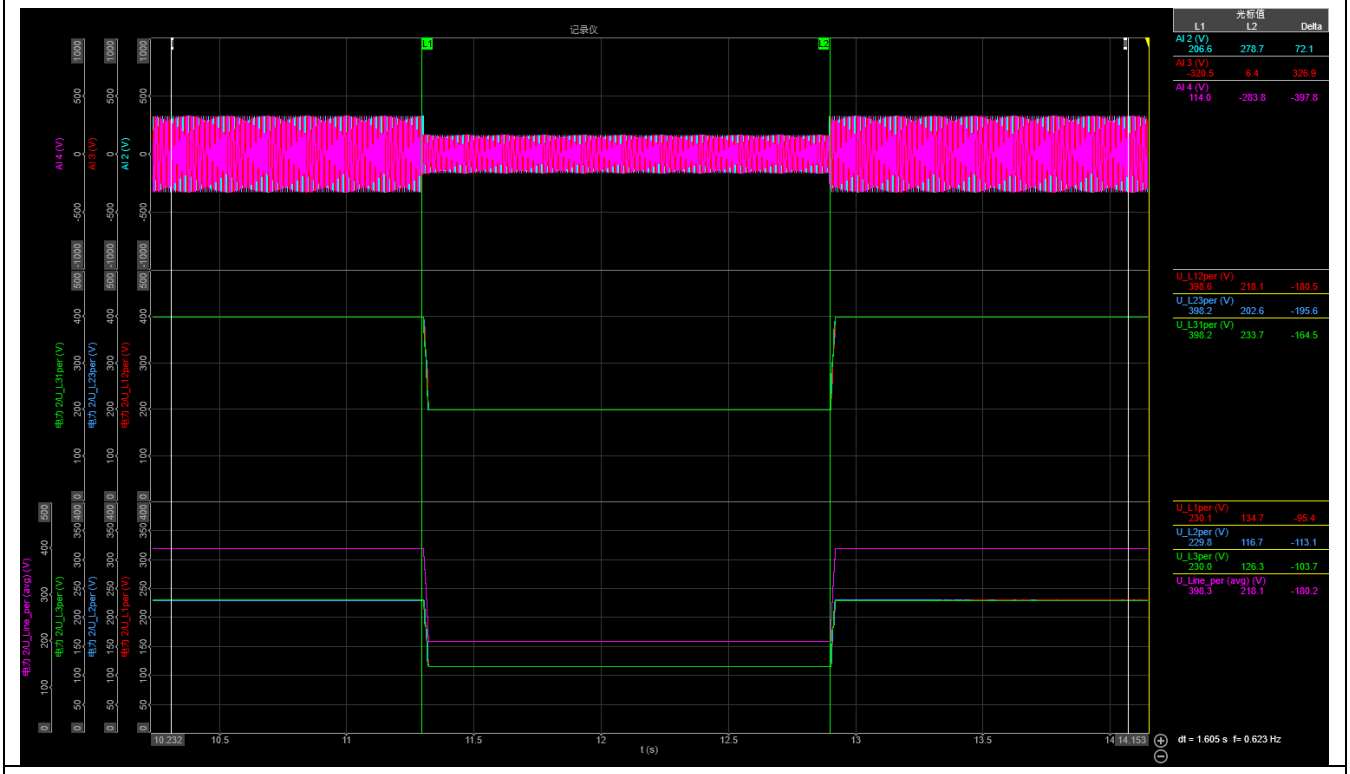
A17C53Z1-20

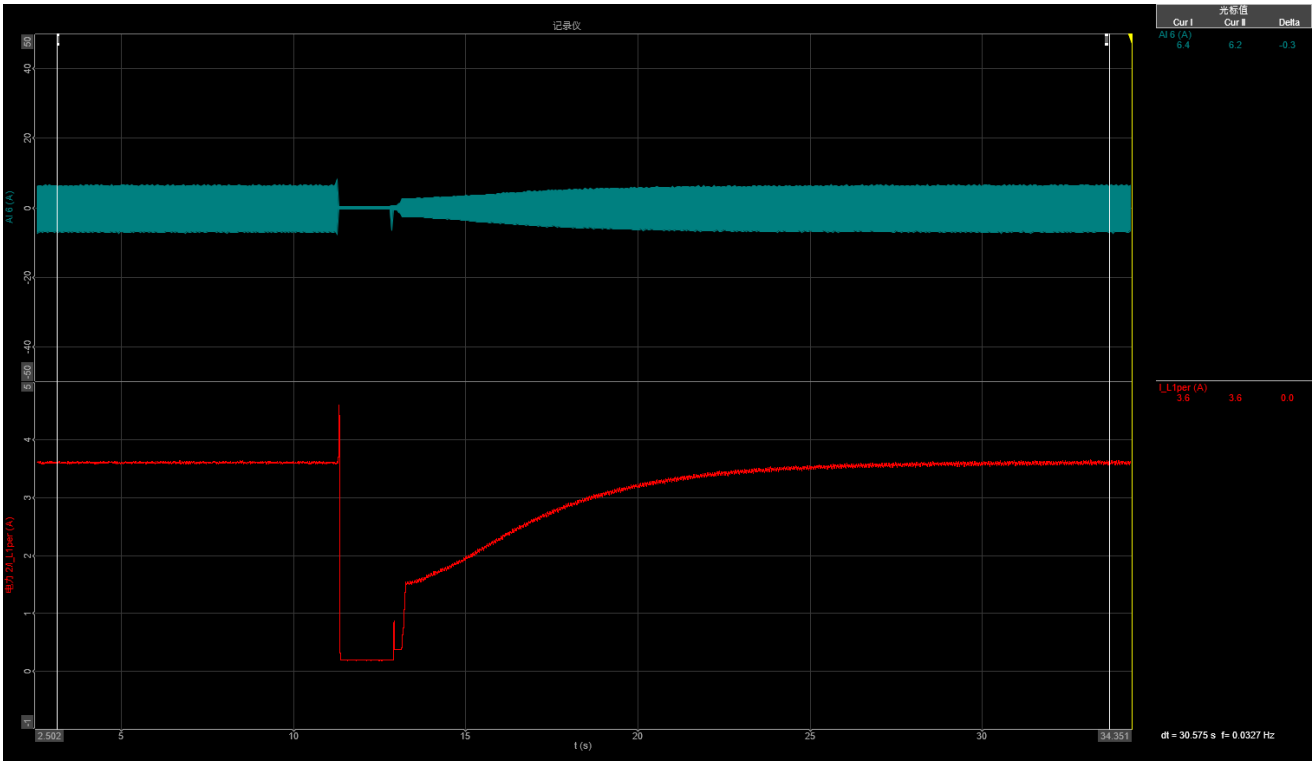
3.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.2
	1	Date	--	--	yyyy.mm.dd	2025/1/15
	2	Time (start of test)	--	--	hh:mm:ss.f	14:28:29
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11291
	7	Point of fault clearance	Total	--	ms	12896
	8	Fault duration in empty load test	Total	--	ms	1605
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,500
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,500
	12		Positive sequence			0,499
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			0,999
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,671
	17	Active power	Total	t1-10s to t1	p.u.	0,305
	18		Pos.			0,305
	19	Reactive power	Total	t1-10s to t1	p.u.	-0,620
	20		Pos.			-0,608
	21	Cosφ	Total	t1-10s to t1	--	0,442
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,500
	23		Phase 2			0,500
	24		Phase 3			0,500
	25	Line current	Phase 1	t1+60ms	p.u.	0,038
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,038
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			0,999
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,304
	37		Pos.			0,304
	38	Active power rising time	Total	--	s	0,350
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	-0,523
	40		Pos.			-0,511
	41	Reactive power rising time	total	--	s	9,794
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

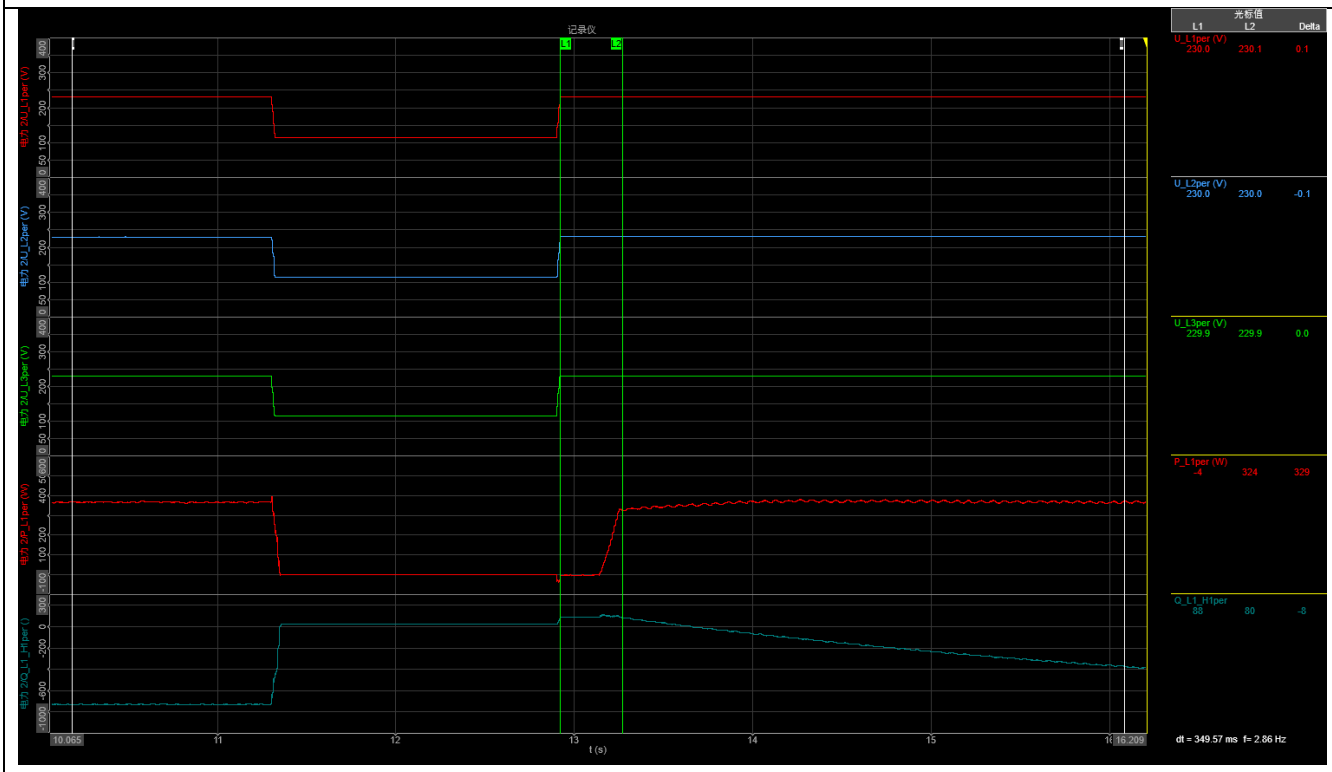
A17C53Z1-20

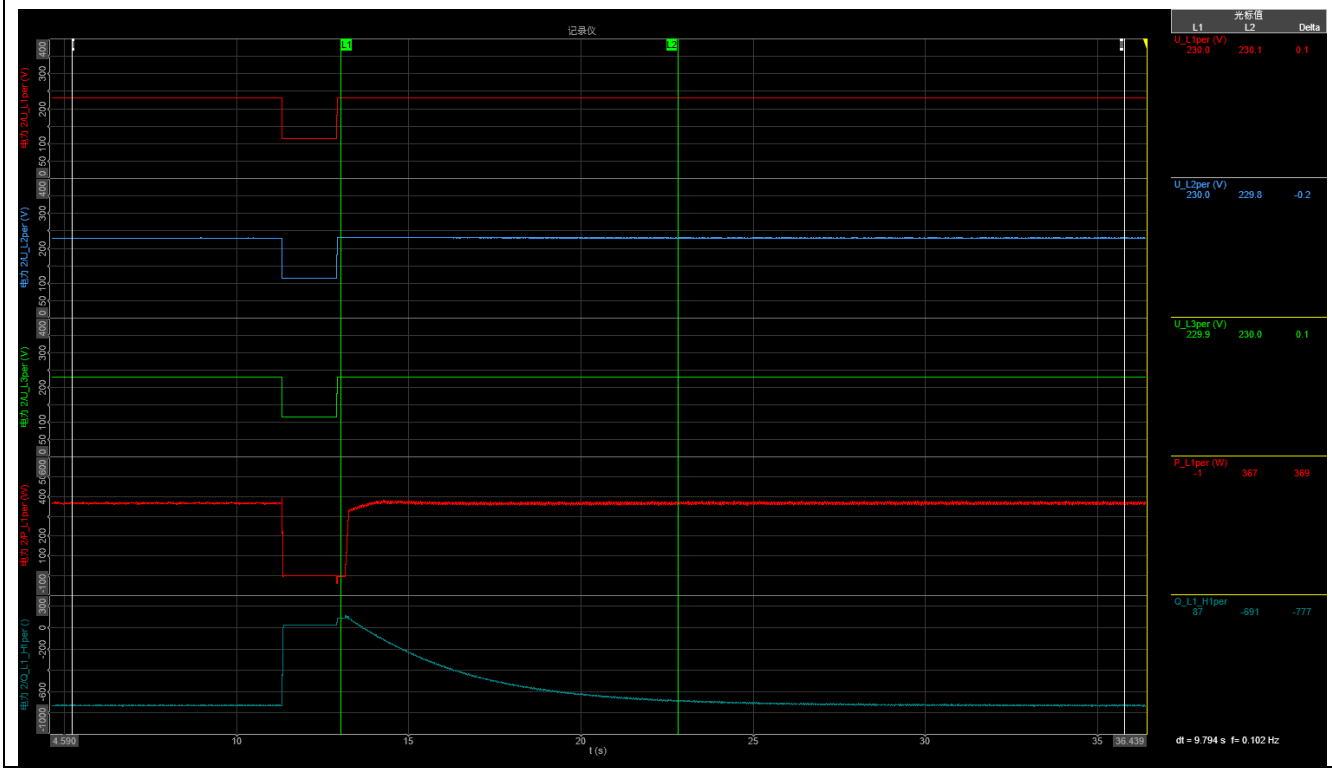




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

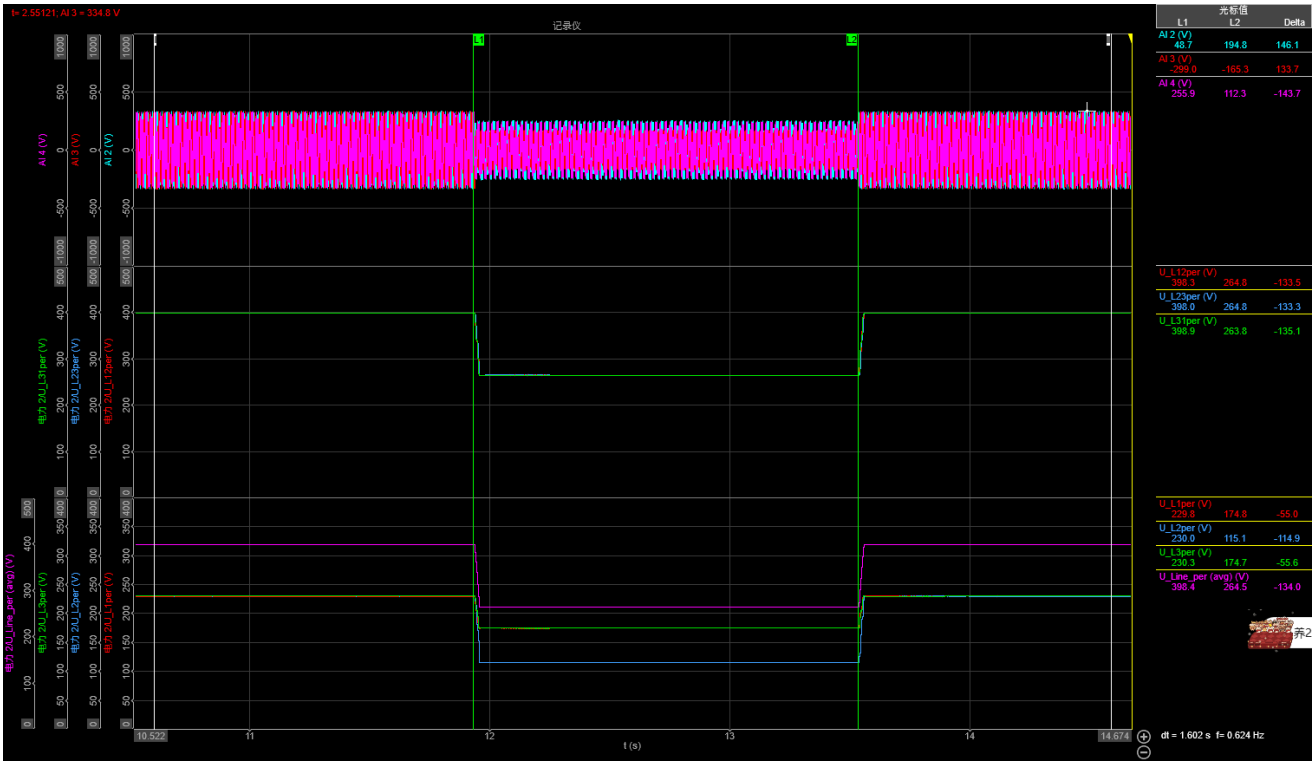
A17C53Z1-20

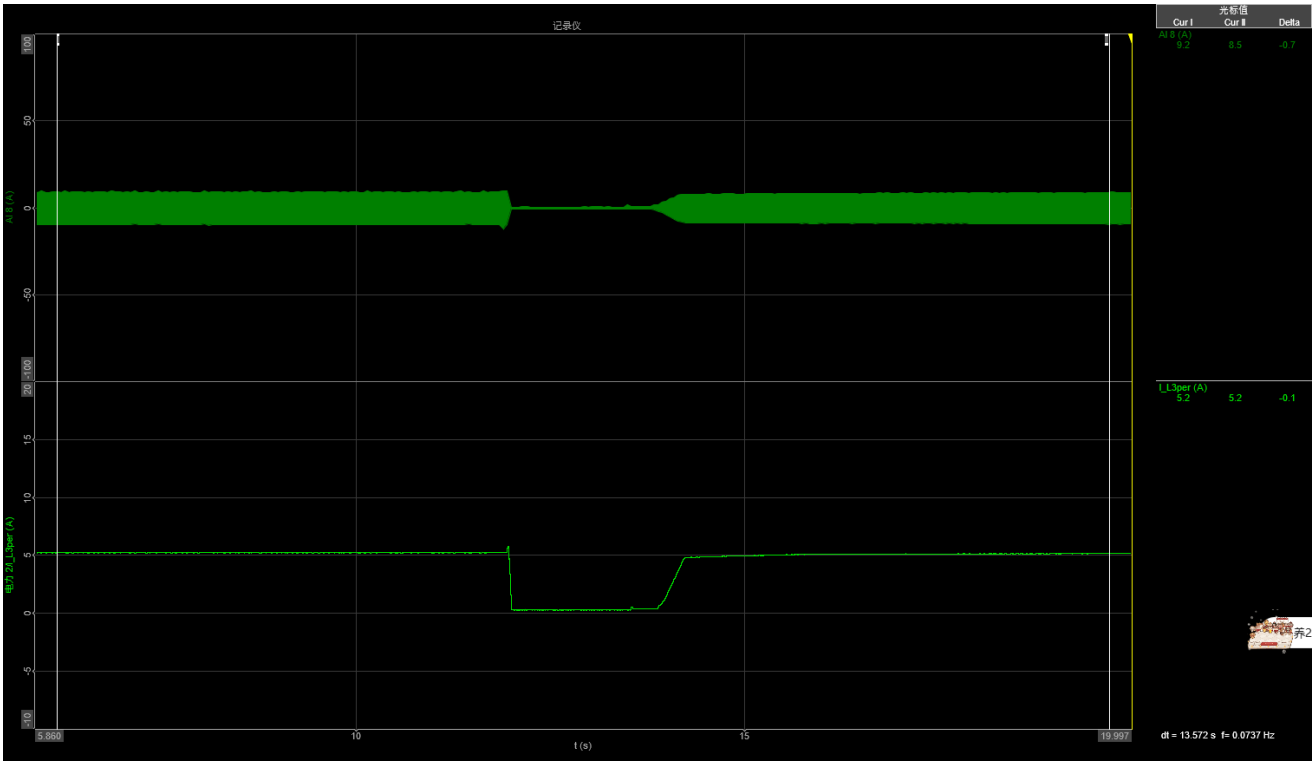
3.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.3
	1	Date	--	--	yyyy.mm.dd	2025/1/15
	2	Time (start of test)	--	--	hh:mm:ss.f	10:06:35
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11937
	7	Point of fault clearance	Total	--	ms	13539
	8	Fault duration in empty load test	Total	--	ms	1602
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,760
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,760
	12		Positive sequence			0,663
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			1,000
	15		Phase 3			1,001
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,788
	18		Pos.			0,787
	19	Reactive power	Total	t1-10s to t1	p.u.	-0,624
	20		Pos.			-0,603
	21	Cosφ	Total	t1-10s to t1	--	0,794
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,760
	23		Phase 2			0,500
	24		Phase 3			0,760
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,038
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,058
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			1,000
	35		Phase 3			1,001
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,855
	37		Pos.			0,854
	38	Active power rising time	Total	--	s	0,676
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	-0,504
	40		Pos.			-0,479
	41	Reactive power rising time	total	--	s	9,865
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

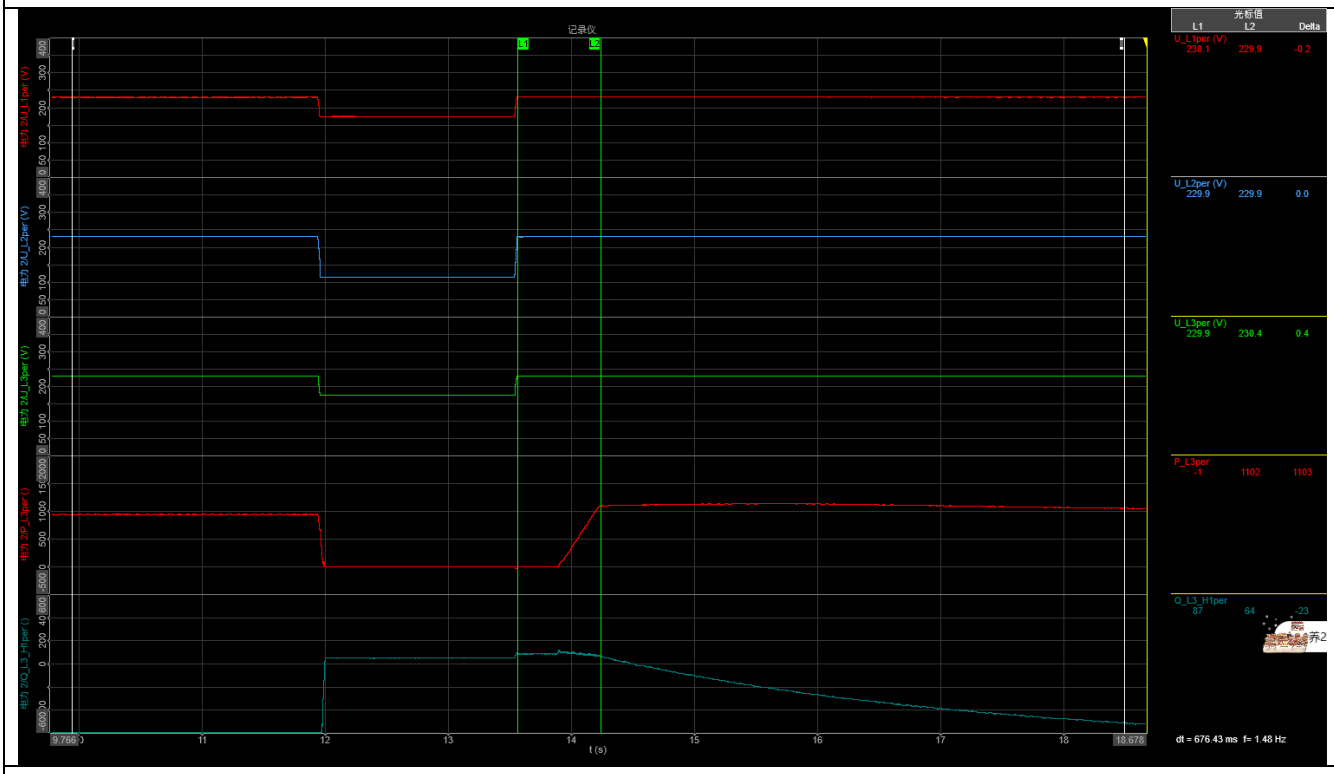
A17C53Z1-20

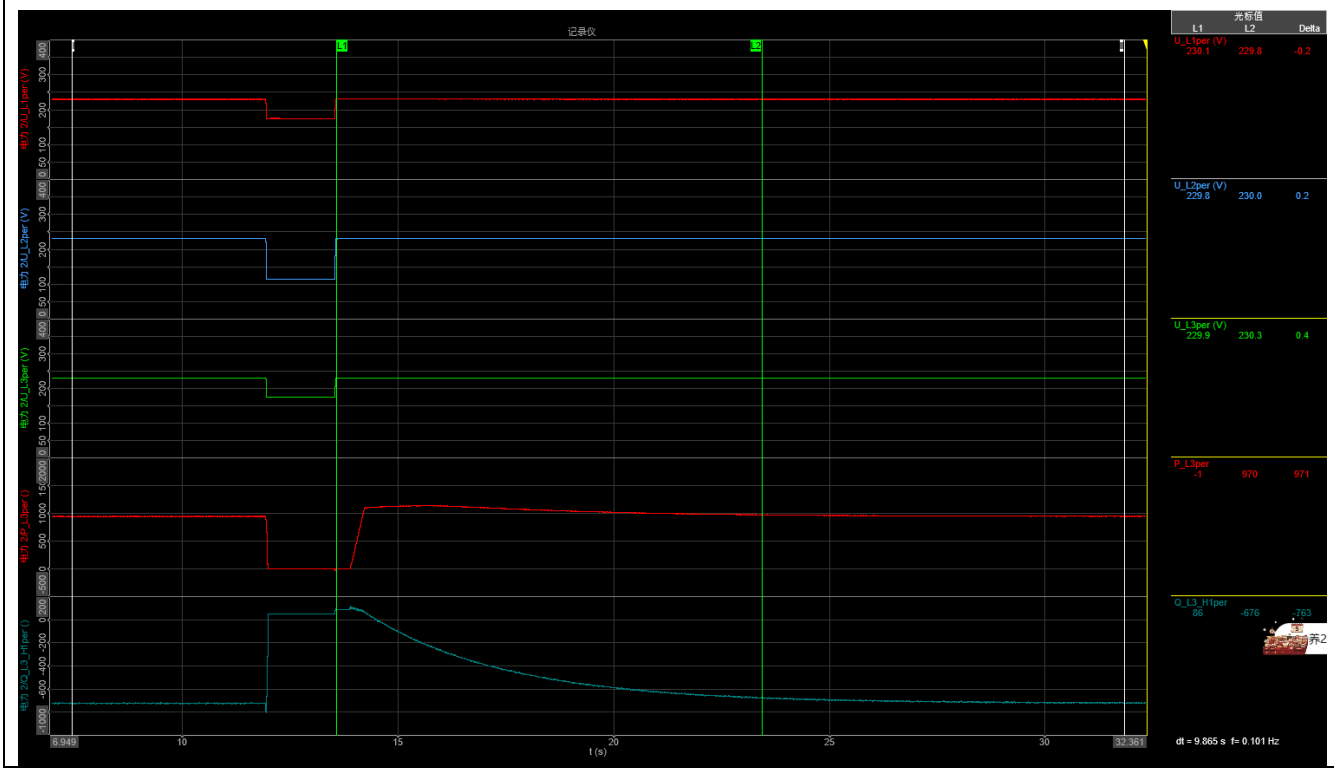




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

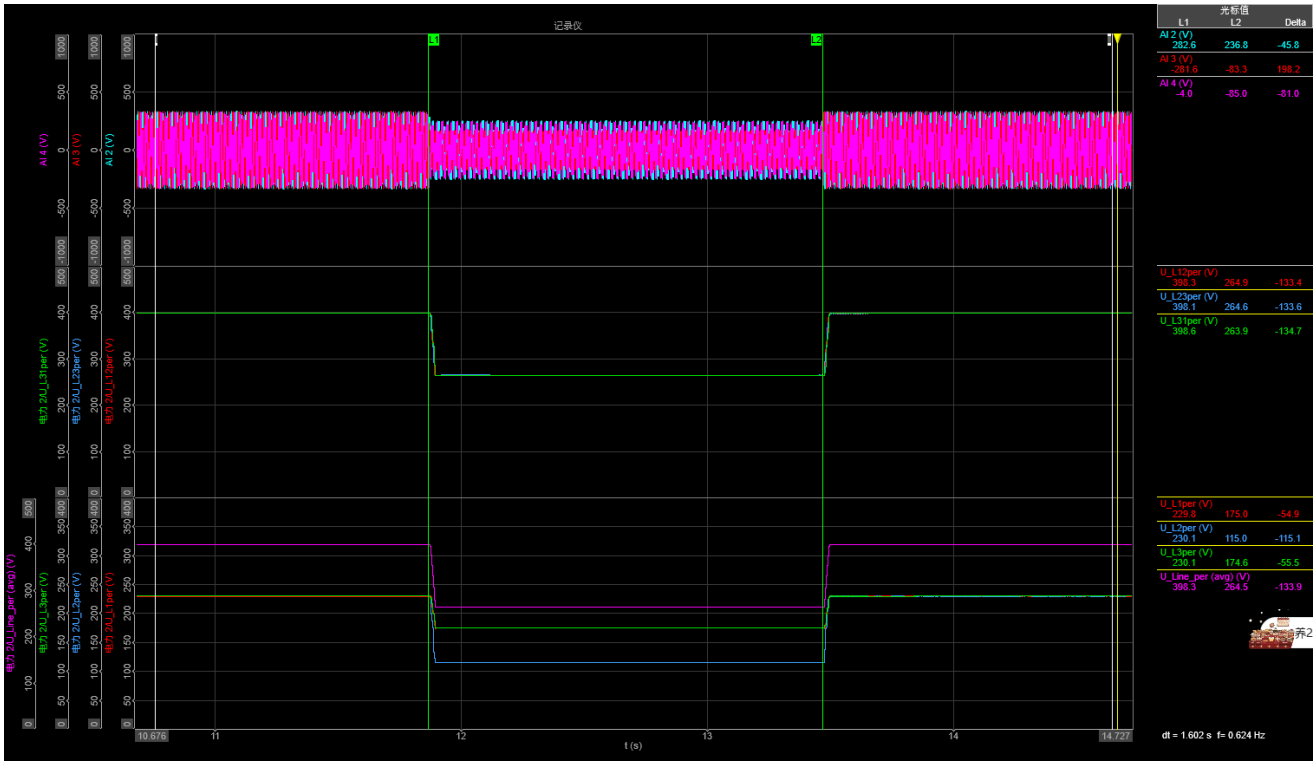
A17C53Z1-20

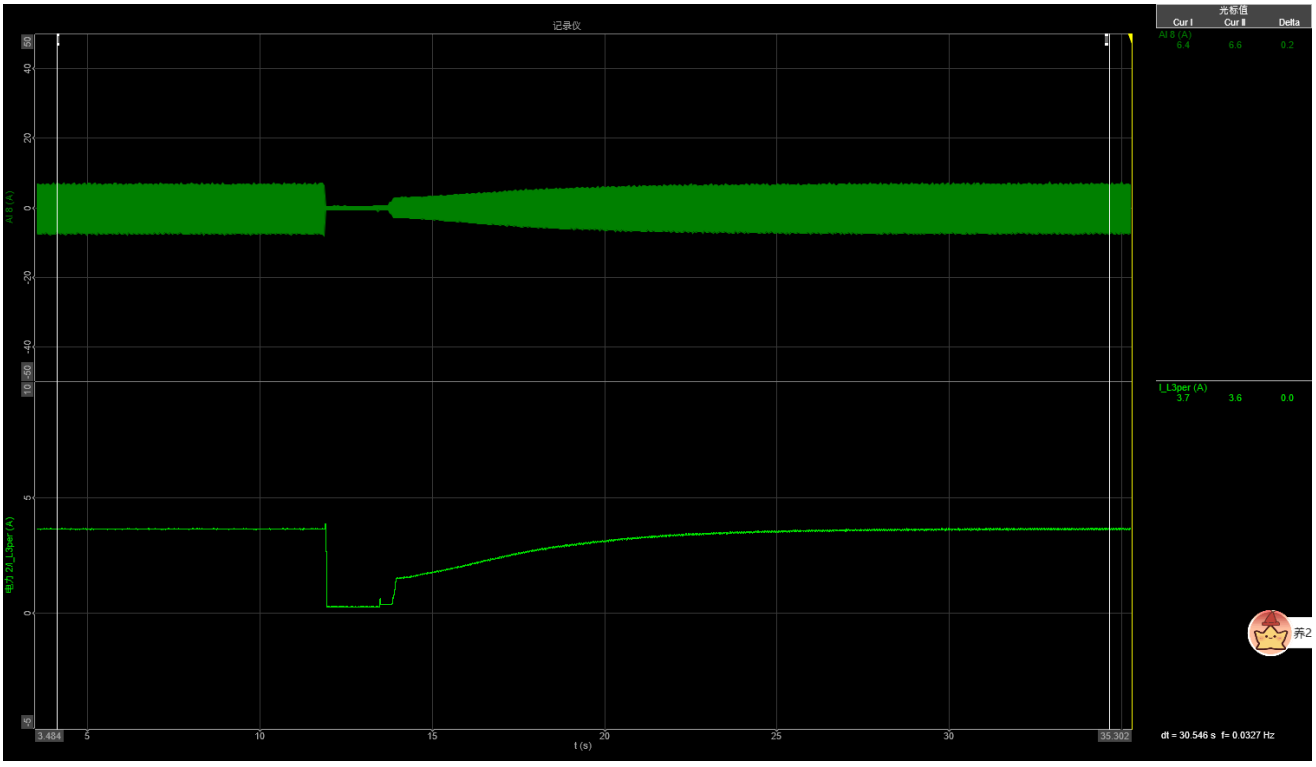
3.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	3.4
	1	Date	--	--	yyyy.mm.dd	2025/1/15
	2	Time (start of test)	--	--	hh:mm:ss.f	10:11:43
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,5
	5	Setting dip duration		--	--	1600
	6	Point of fault entry	Total	--	ms	11868
	7	Point of fault clearance	Total	--	ms	13470
	8	Fault duration in empty load test	Total	--	ms	1602
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,760
	10		Total (Phase 2)			0,500
	11		Total (Phase 3)			0,760
	12		Positive sequence			0,664
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,690
	17	Active power	Total	t1-10s to t1	p.u.	0,306
	18		Pos.			0,305
	19	Reactive power	Total	t1-10s to t1	p.u.	-0,628
	20		Pos.			-0,609
	21	Cosφ	Total	t1-10s to t1	--	0,438
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,760
	23		Phase 2			0,500
	24		Phase 3			0,760
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,058
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,058
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,000
	32		Pos.			0,000
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,303
	37		Pos.			0,303
	38	Active power rising time	Total	--	s	0,517
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	-0,513
	40		Pos.			-0,496
	41	Reactive power rising time	total	--	s	9,934
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

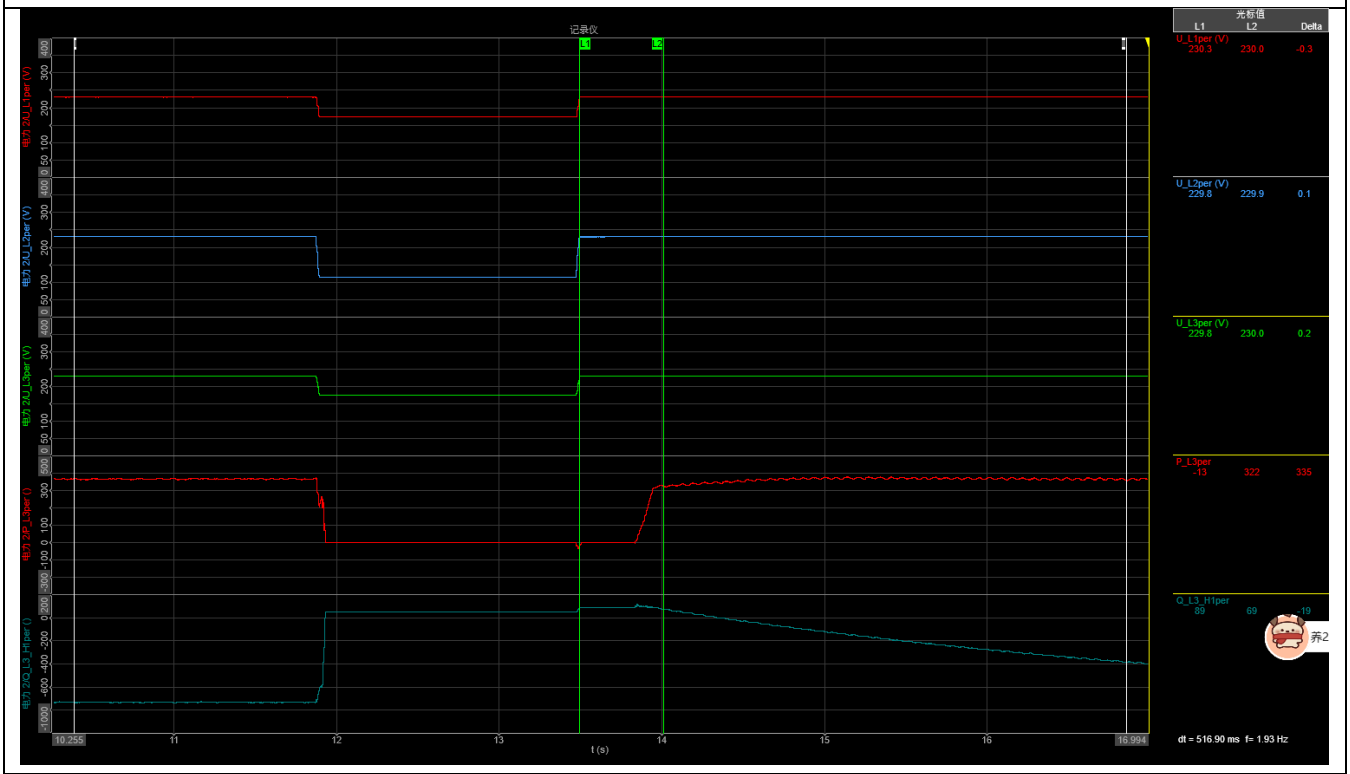
A17C53Z1-20

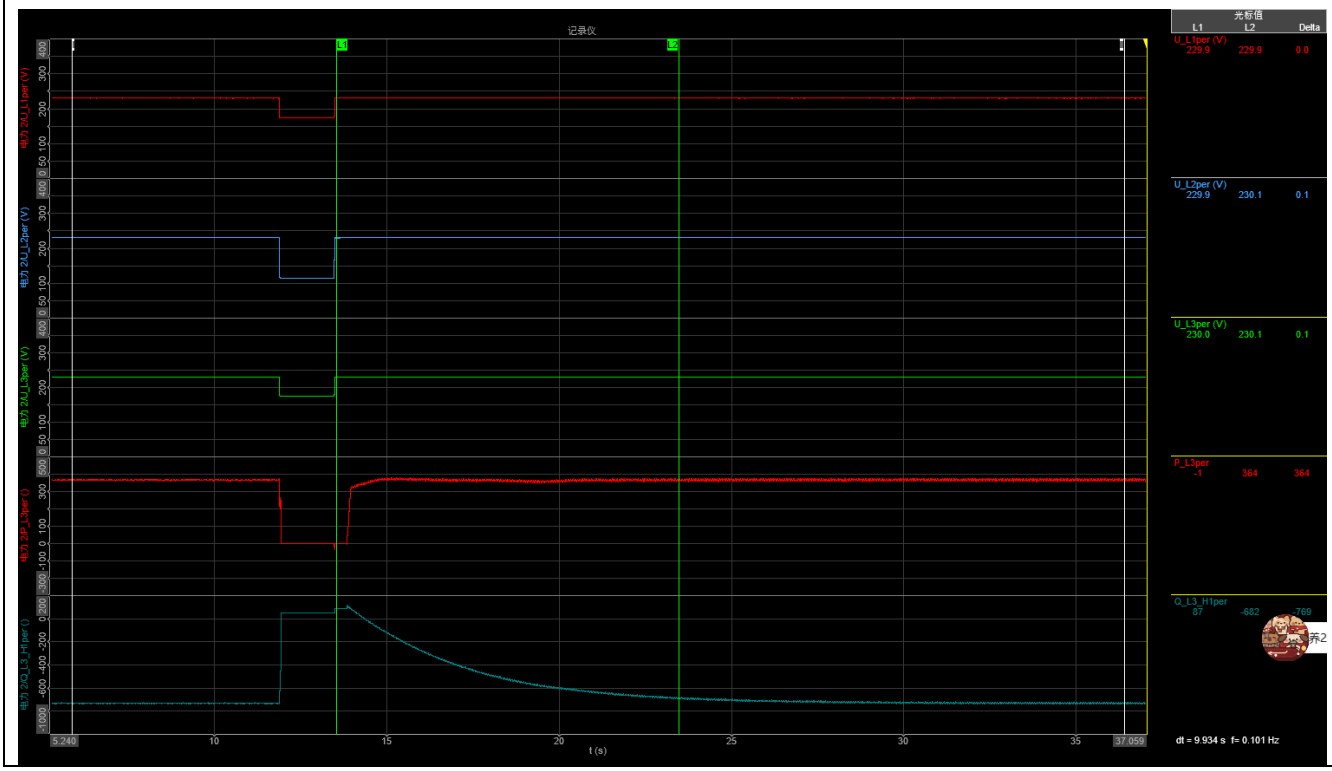




5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

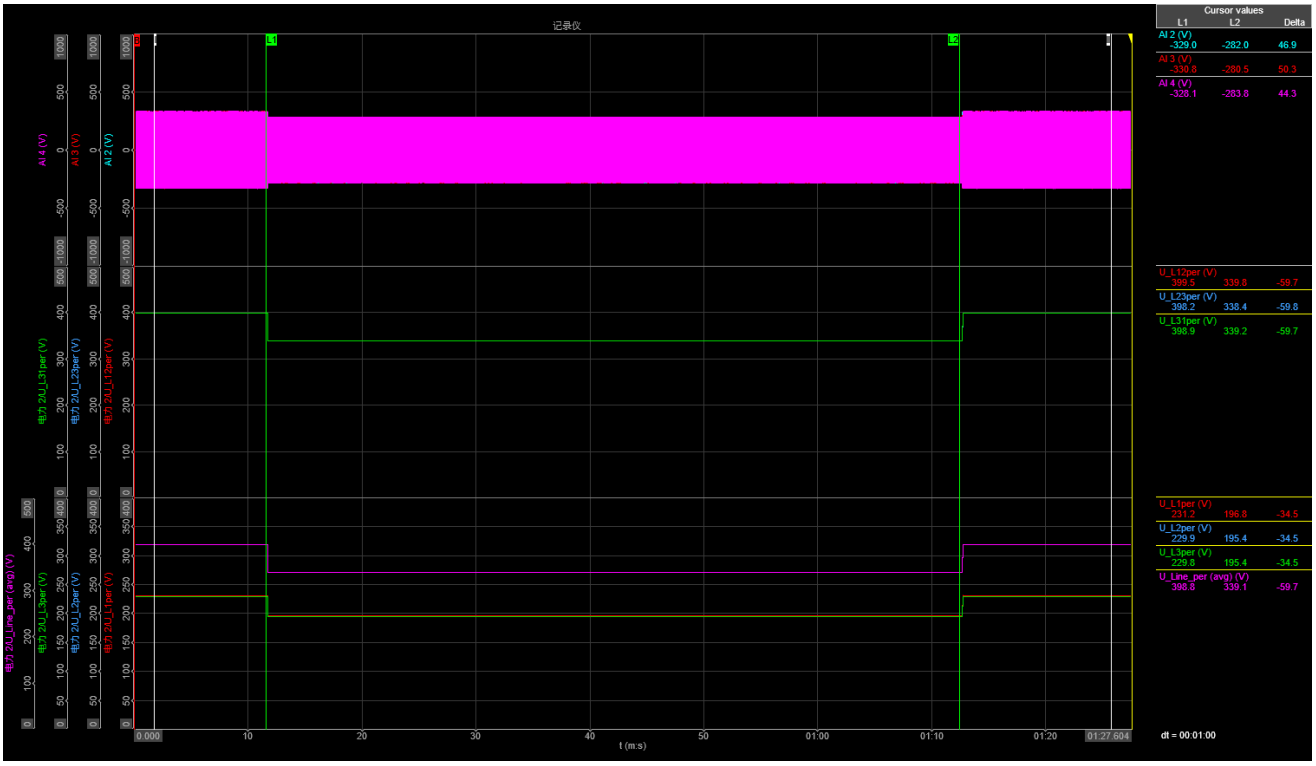
A17C53Z1-20

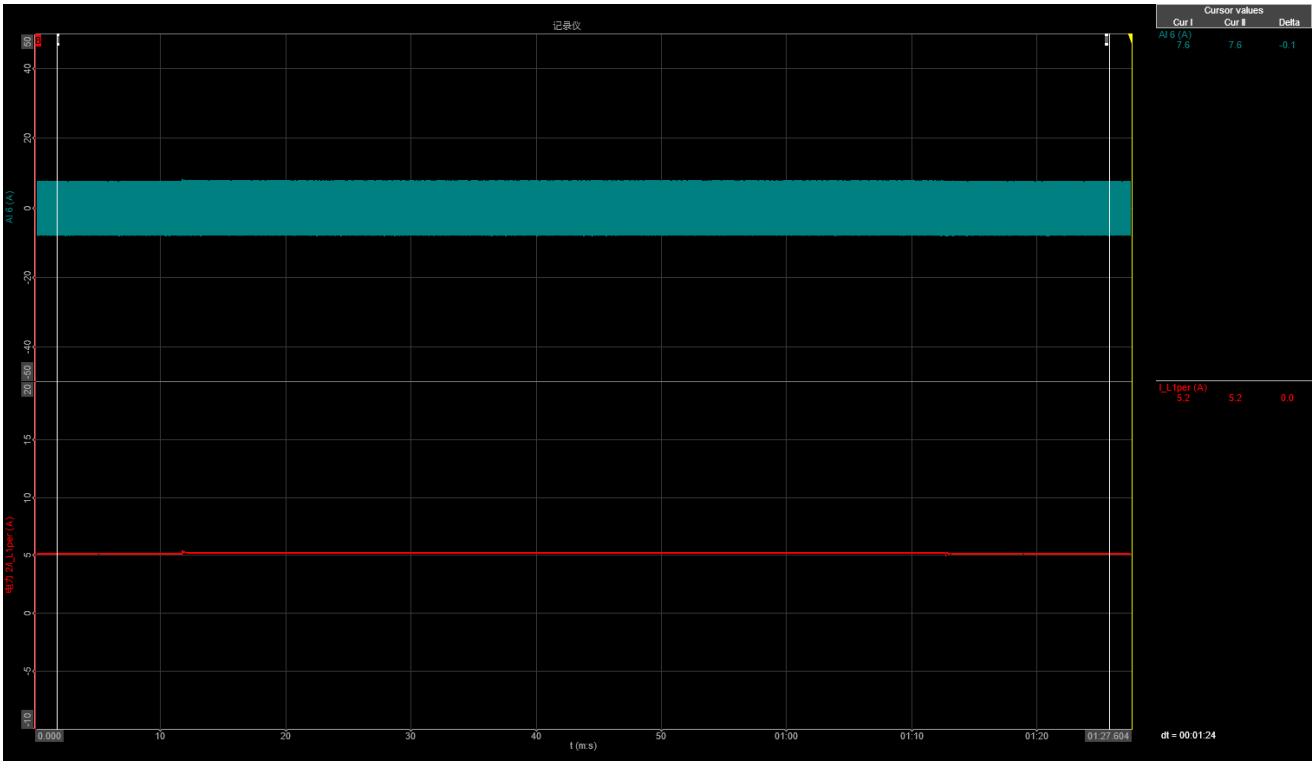
4.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.1
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	15:15:53
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,85
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11700
	7	Point of fault clearance	Total	--	ms	72700
	8	Fault duration in empty load test	Total	--	ms	61000
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,854
	10		Total (Phase 2)			0,849
	11		Total (Phase 3)			0,849
	12		Positive sequence			0,849
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,005
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,993
	18		Pos.			0,993
	19	Reactive power	Total	t1-10s to t1	p.u.	0,055
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,855
	23		Phase 2			0,849
	24		Phase 3			0,849
	25	Line current	Phase 1	t1+60ms	p.u.	1,008
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	1,008
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,857
	32		Pos.			0,857
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,005
	34		Phase 2			0,999
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,993
	37		Pos.			0,993
	38	Active power rising time	Total	--	s	0,210
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,055
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

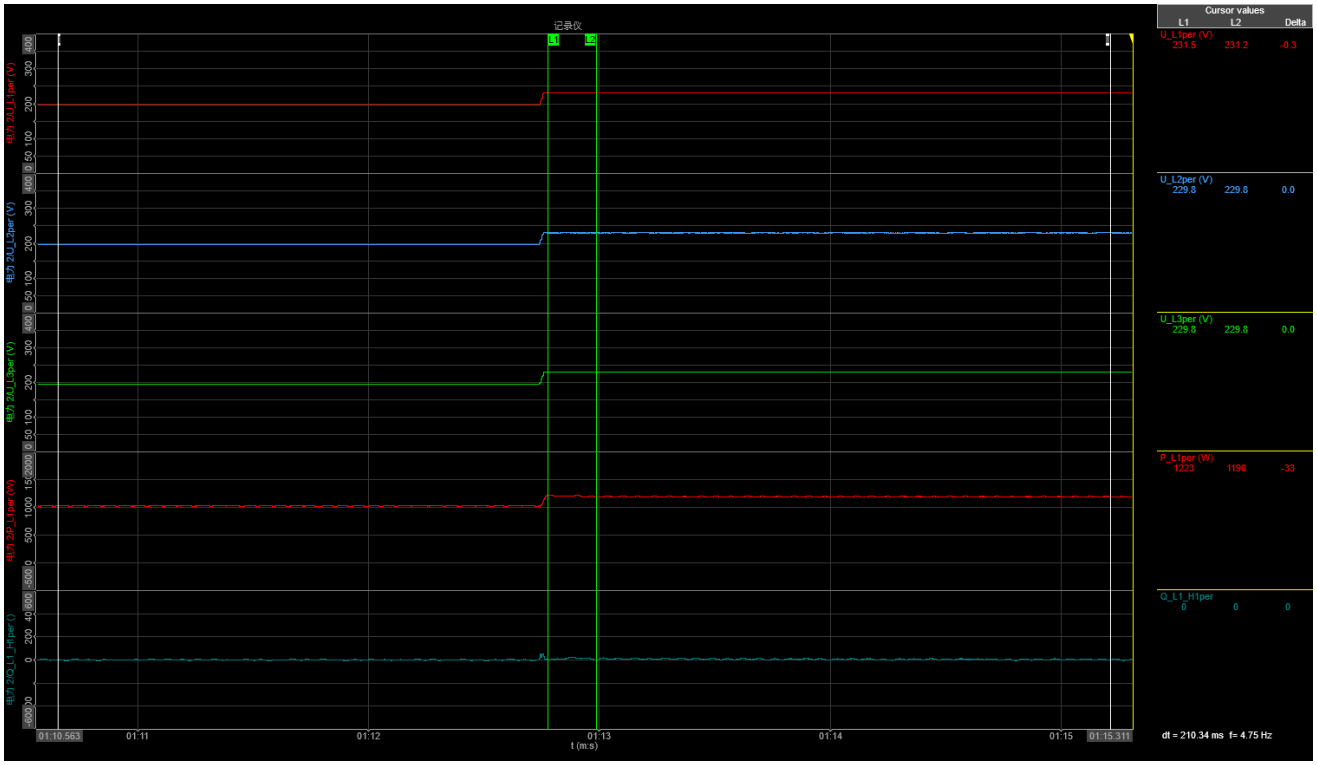
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

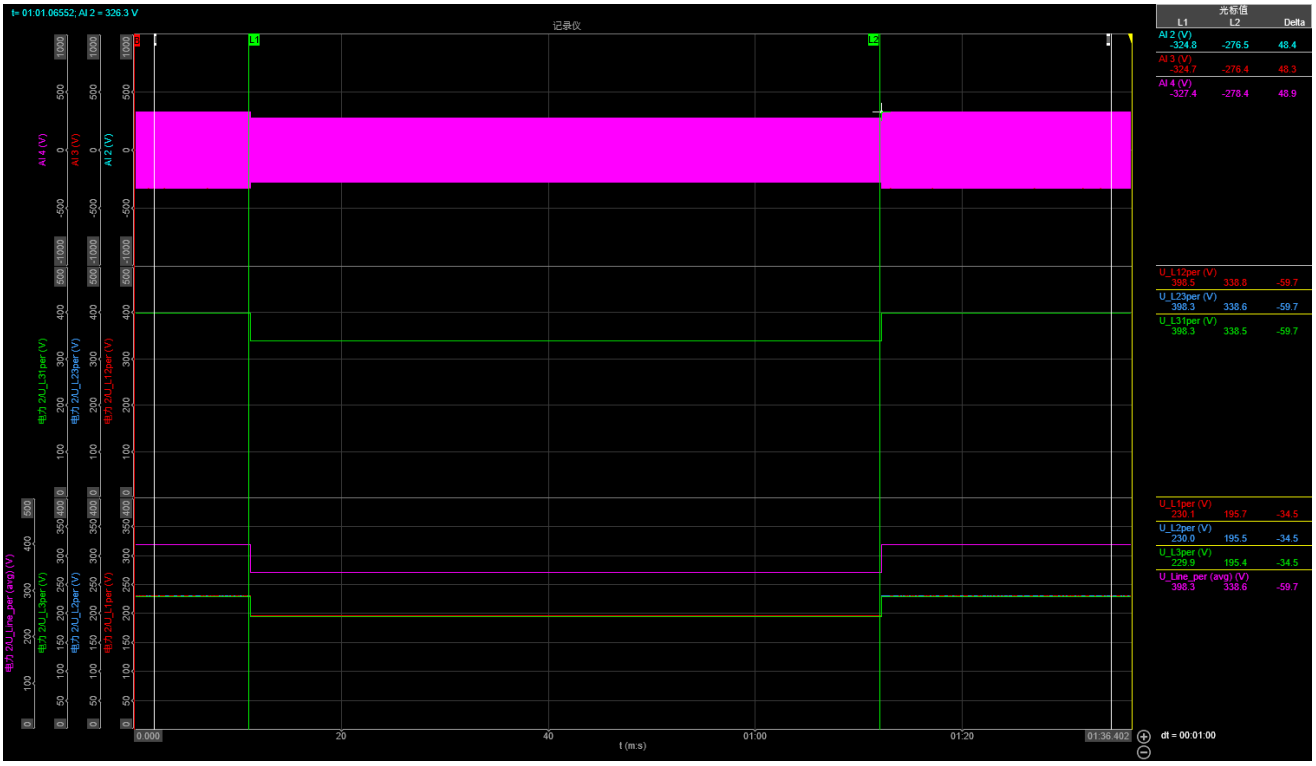
A17C53Z1-20

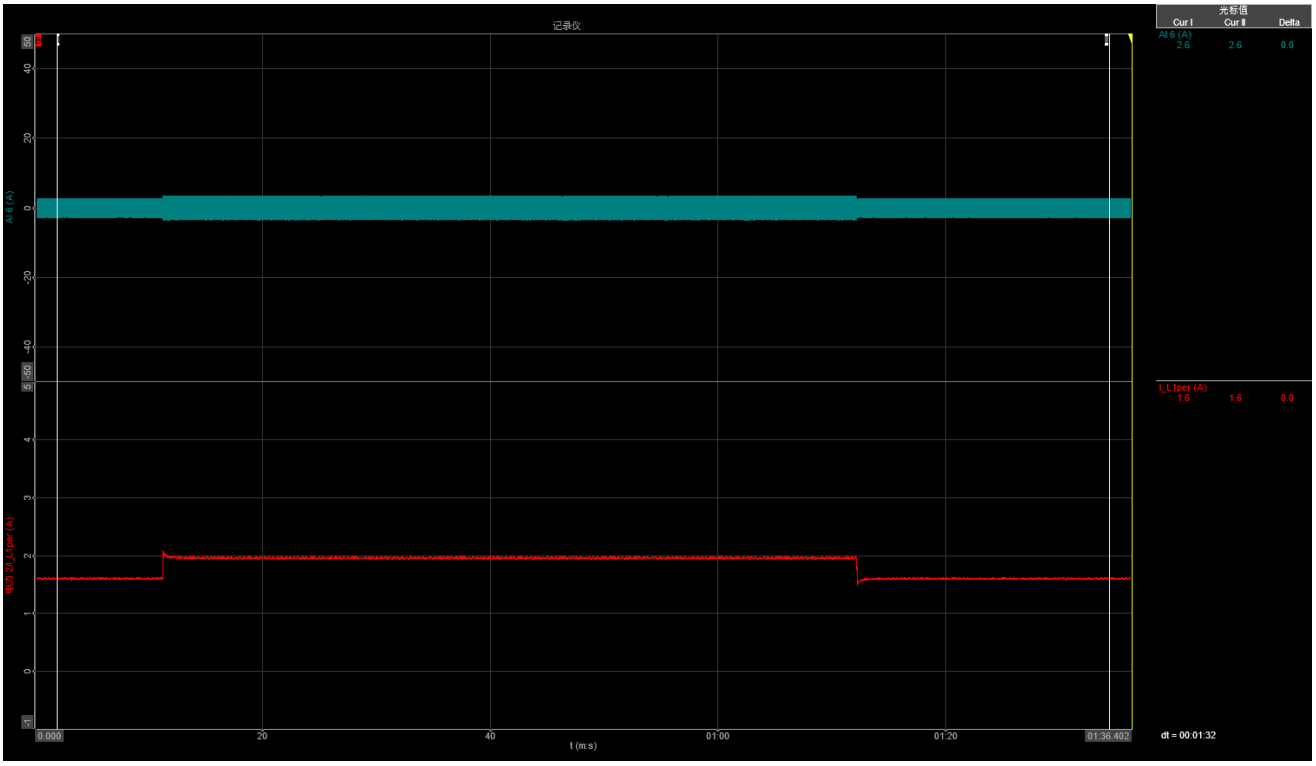
4.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.2
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:58:53
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	0,85
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11150
	7	Point of fault clearance	Total	--	ms	72150
	8	Fault duration in empty load test	Total	--	ms	61000
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,851
	10		Total (Phase 2)			0,850
	11		Total (Phase 3)			0,850
	12		Positive sequence			0,849
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,070
	20		Pos.			0,007
	21	Cosφ	Total	t1-10s to t1	--	0,974
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,851
	23		Phase 2			0,850
	24		Phase 3			0,850
	25	Line current	Phase 1	t1+60ms	p.u.	0,383
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,383
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,313
	32		Pos.			0,313
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,299
	38	Active power rising time	Total	--	s	0,184
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,069
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

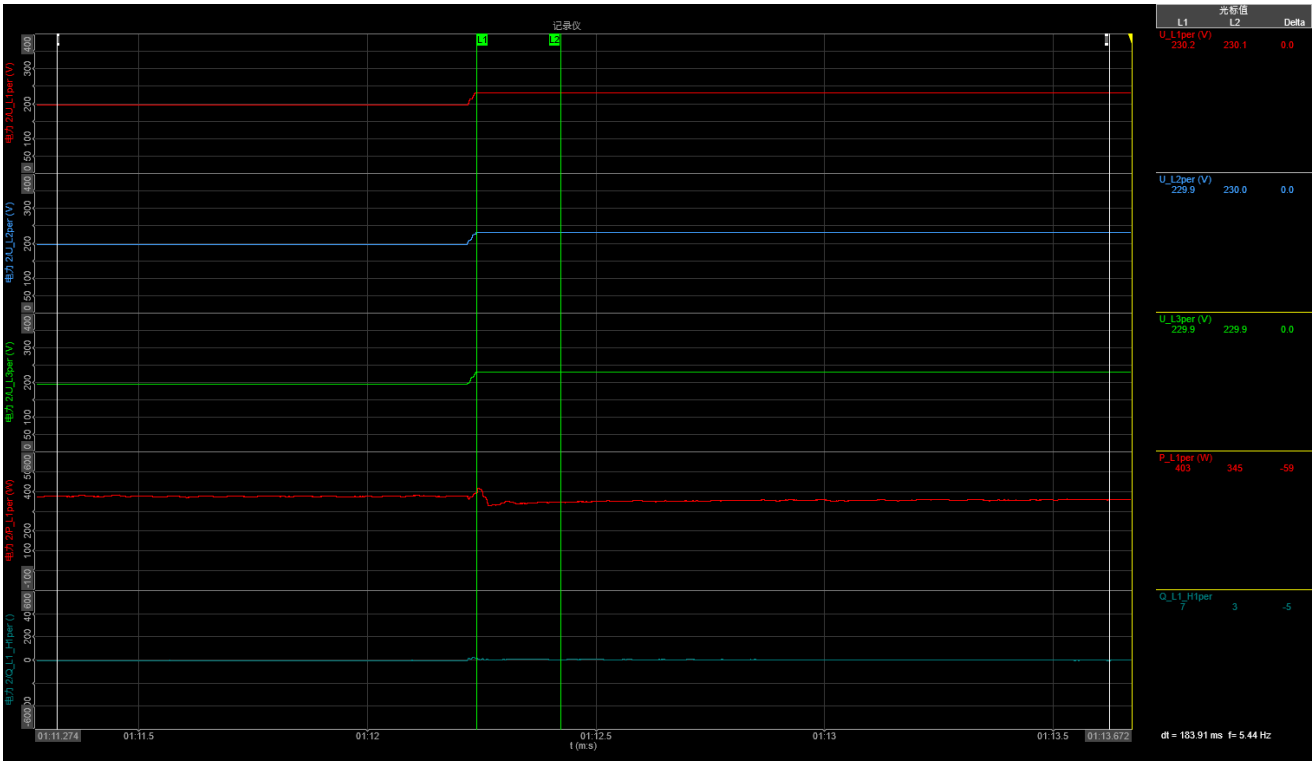
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

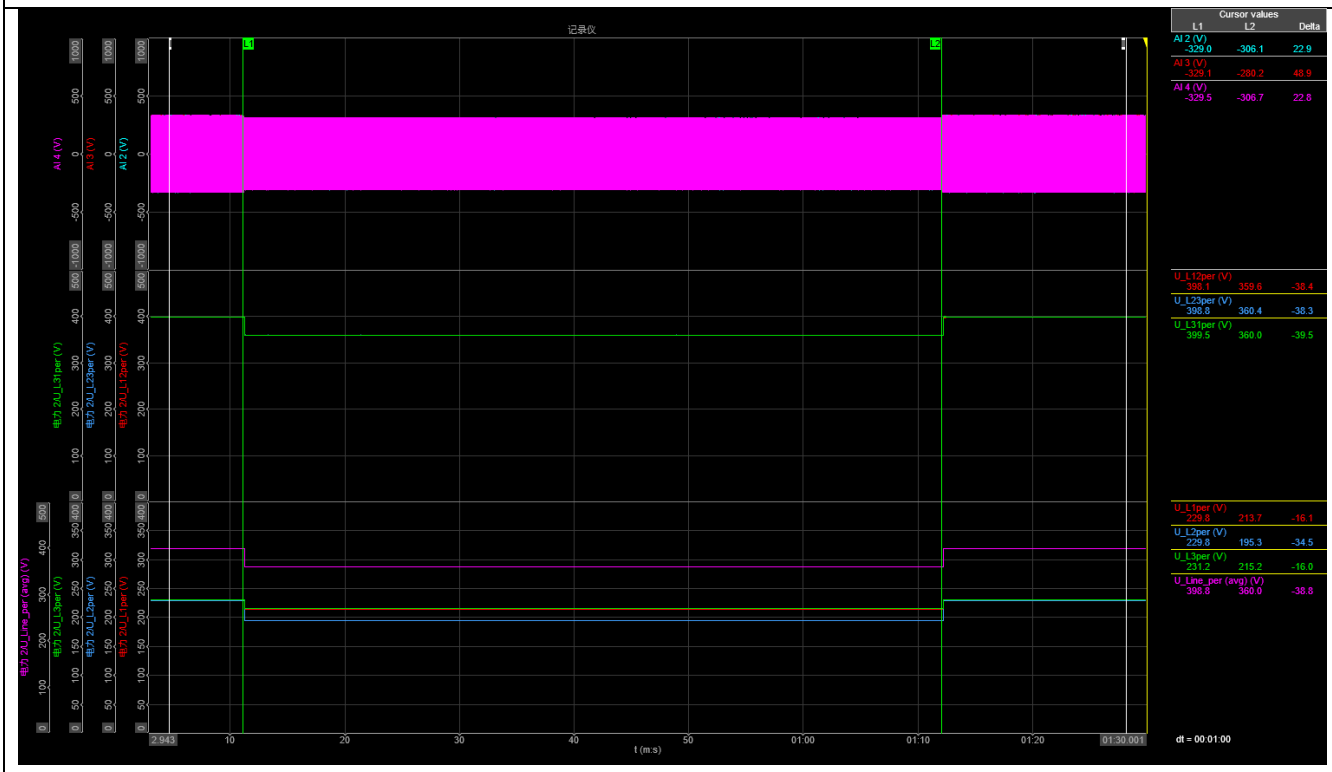
A17C53Z1-20

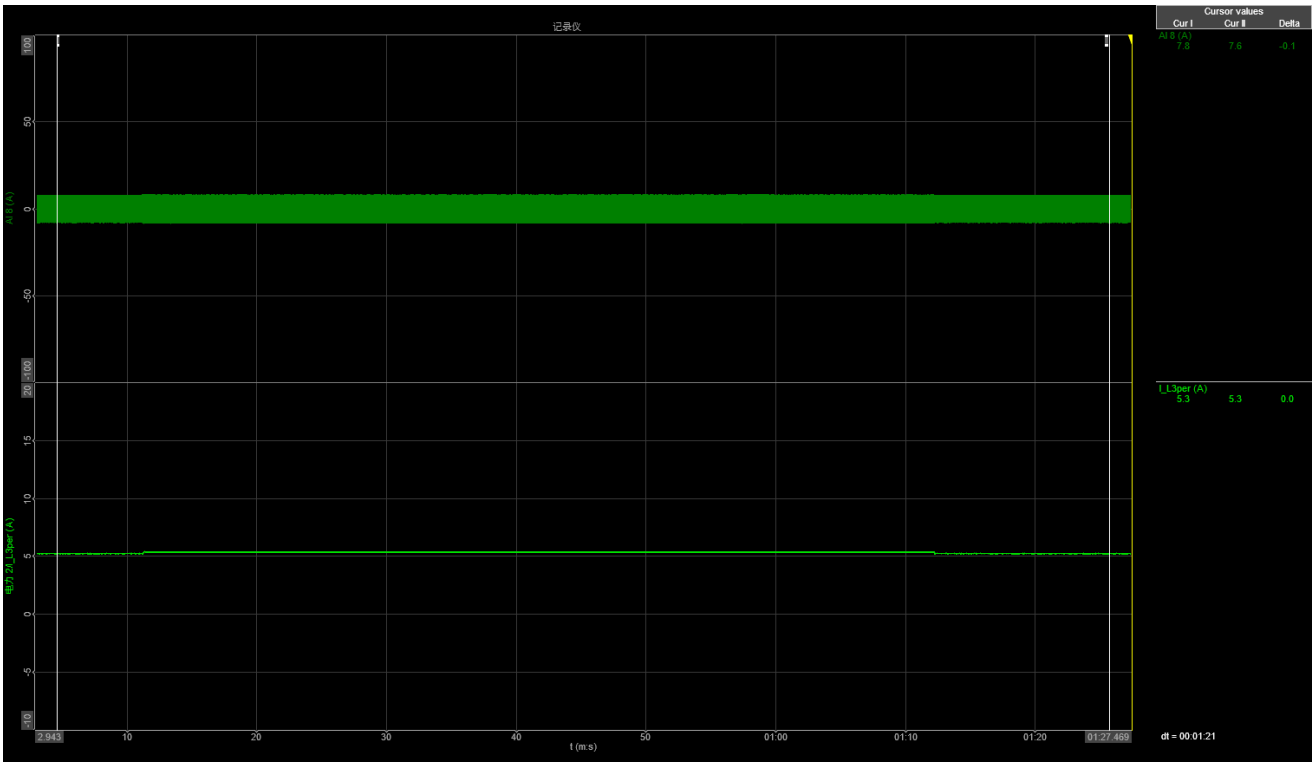
4.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.3
	1	Date	--	--	yyyy.mm.dd	2025/1/17
	2	Time (start of test)	--	--	hh:mm:ss.f	10:41:49
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,85
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11200
	7	Point of fault clearance	Total	--	ms	72200
	8	Fault duration in empty load test	Total	--	ms	61000
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,929
	10		Total (Phase 2)			0,849
	11		Total (Phase 3)			0,936
	12		Positive sequence			0,902
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,005
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	1,011
	18		Pos.			1,011
	19	Reactive power	Total	t1-10s to t1	p.u.	0,063
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,929
	23		Phase 2			0,849
	24		Phase 3			0,936
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			1,031
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			1,031
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,959
	32		Pos.			0,959
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			0,999
	35		Phase 3			1,005
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,011
	37		Pos.			1,011
	38	Active power rising time	Total	--	s	0,207
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,063
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

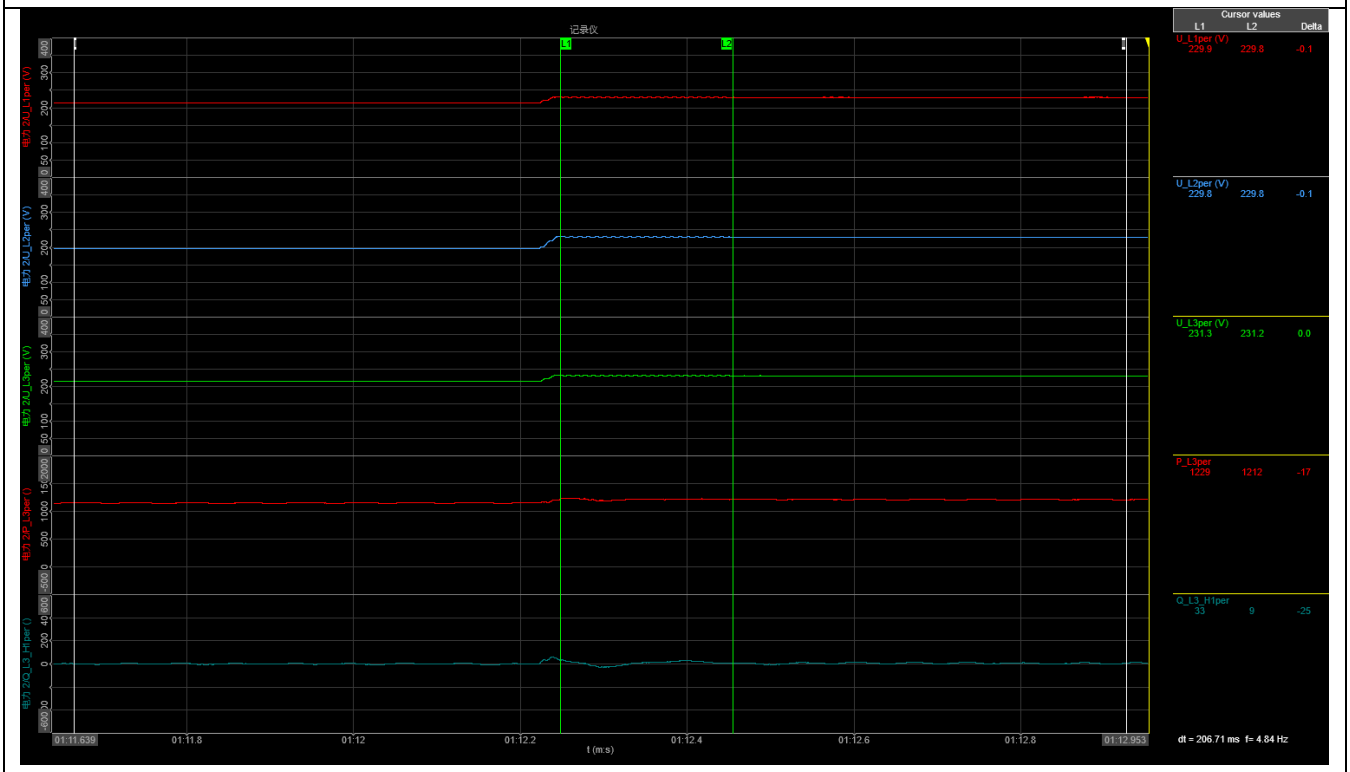
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

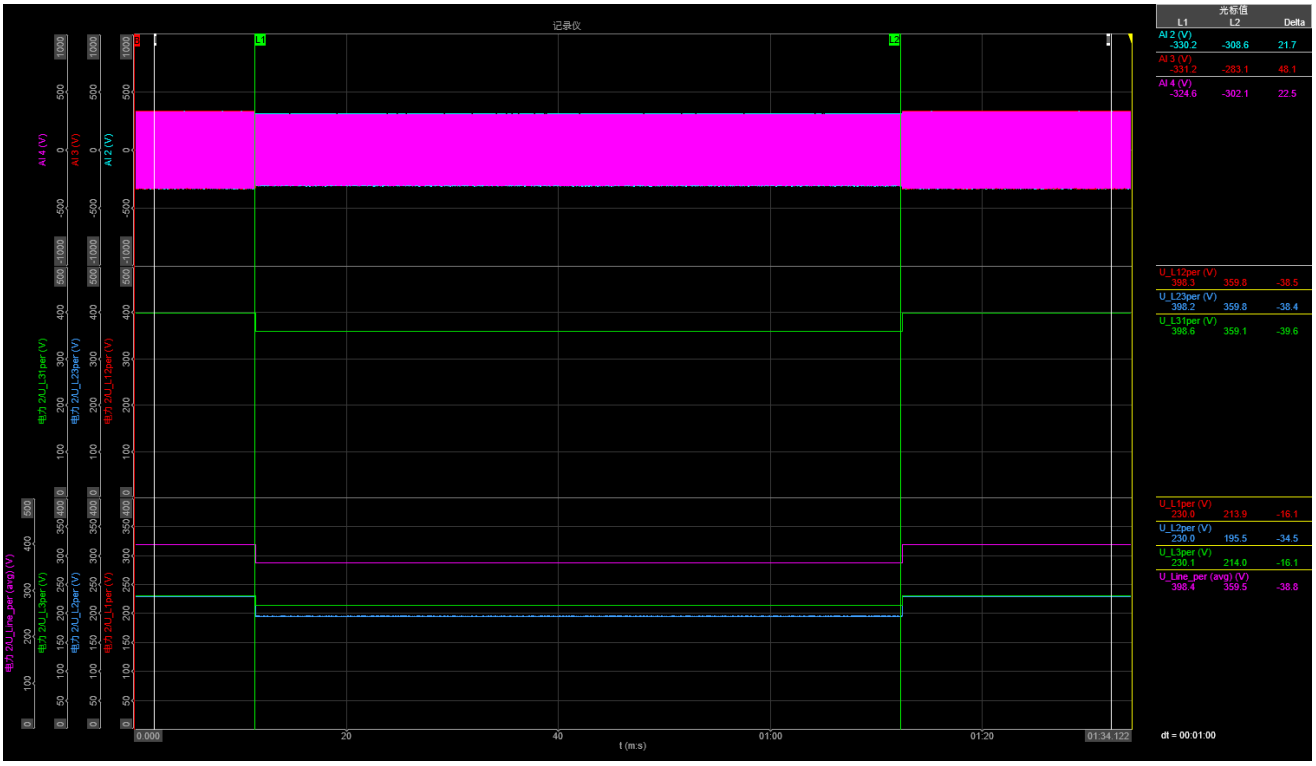
A17C53Z1-20

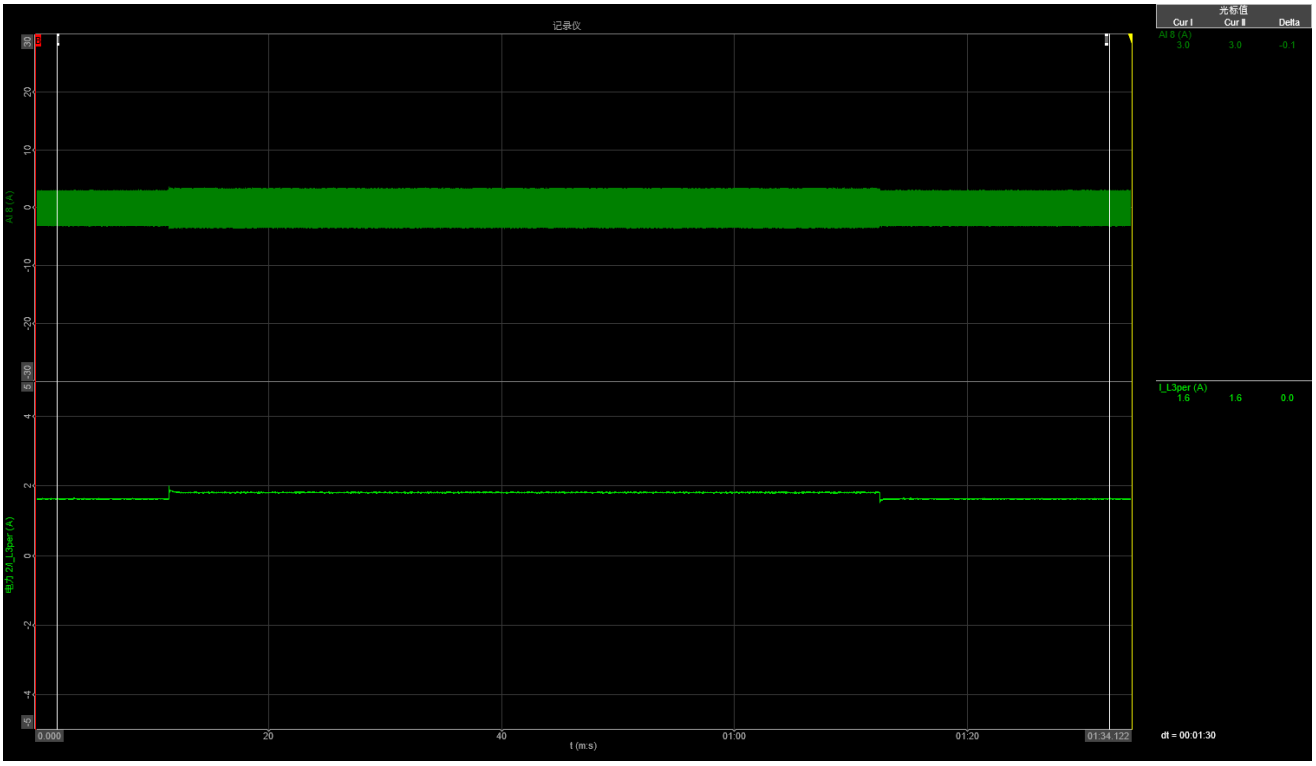
4.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	4.4
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	10:36:15
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	0,85
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11300
	7	Point of fault clearance	Total	--	ms	72300
	8	Fault duration in empty load test	Total	--	ms	61000
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	0,930
	10		Total (Phase 2)			0,850
	11		Total (Phase 3)			0,930
	12		Positive sequence			0,901
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,090
	20		Pos.			0,008
	21	Cosφ	Total	t1-10s to t1	--	0,958
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	0,930
	23		Phase 2			0,850
	24		Phase 3			0,930
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,364
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,345
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,311
	32		Pos.			0,311
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,143
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,090
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

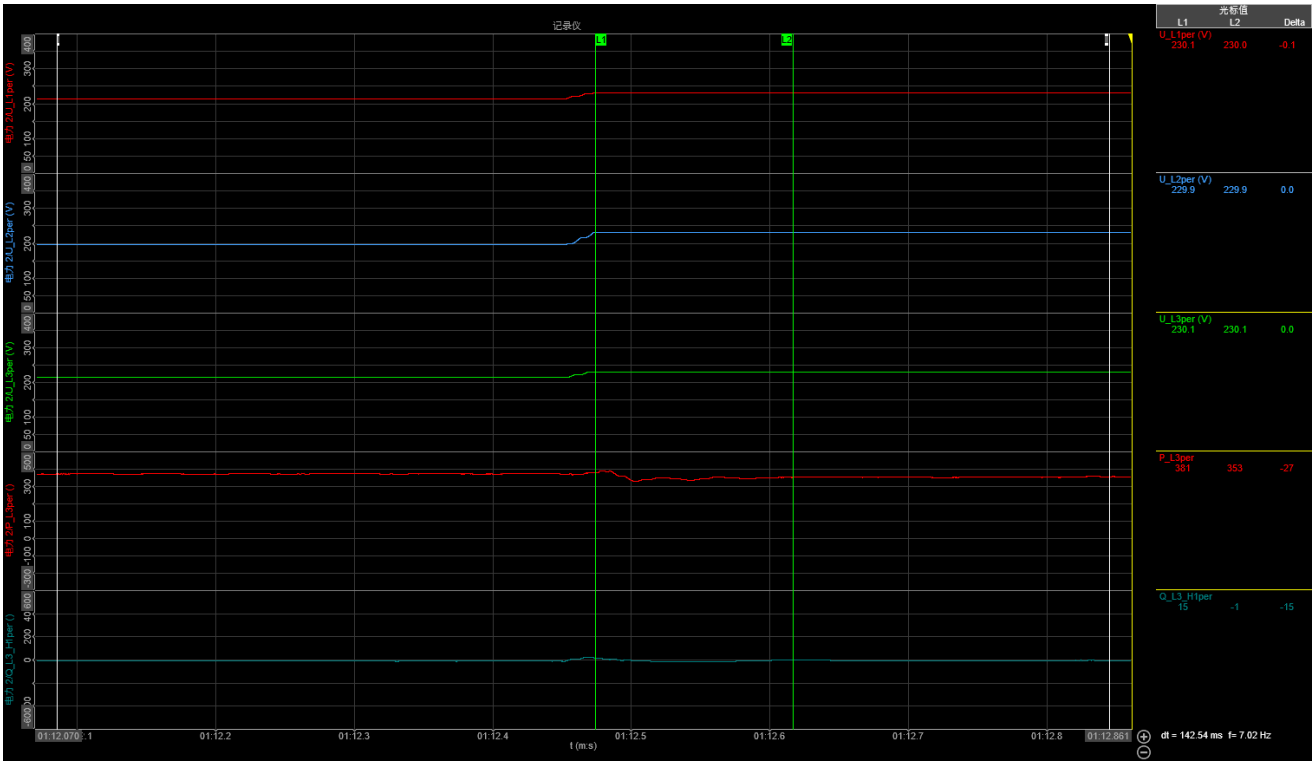
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

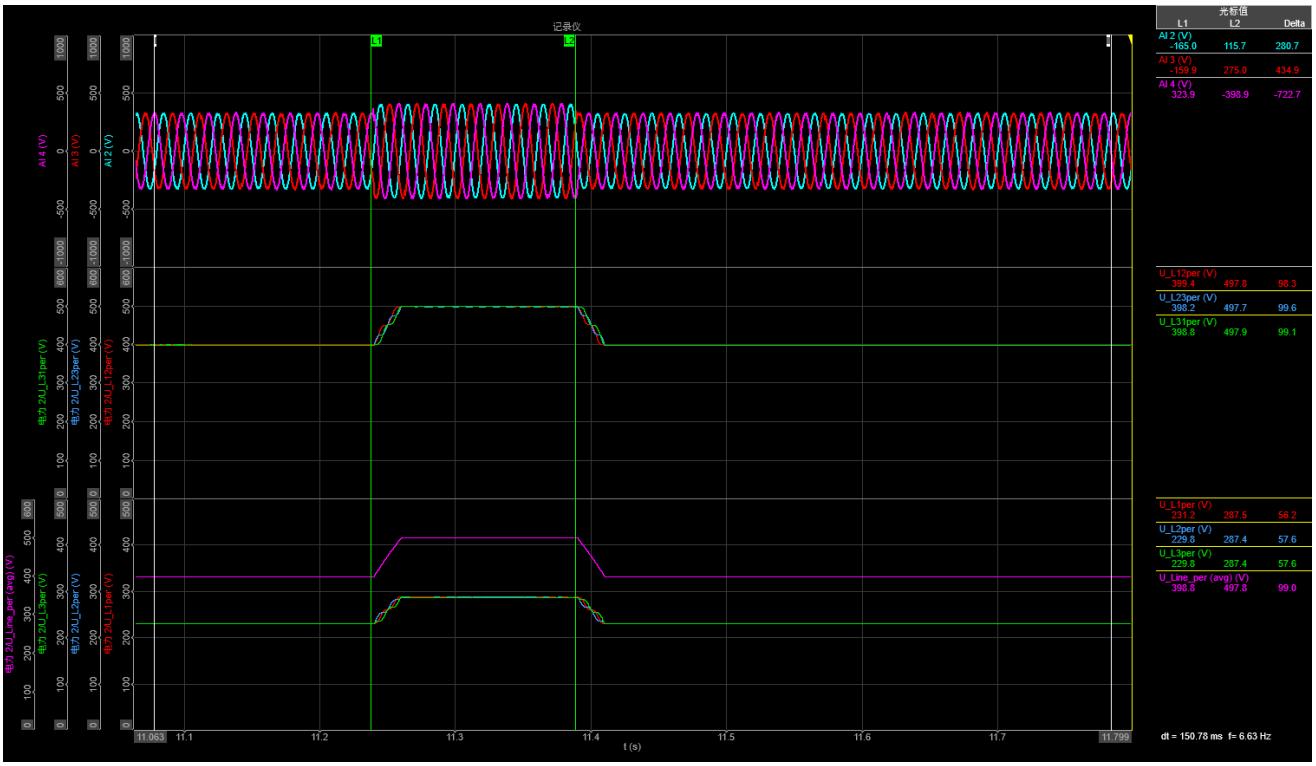
A17C53Z1-20

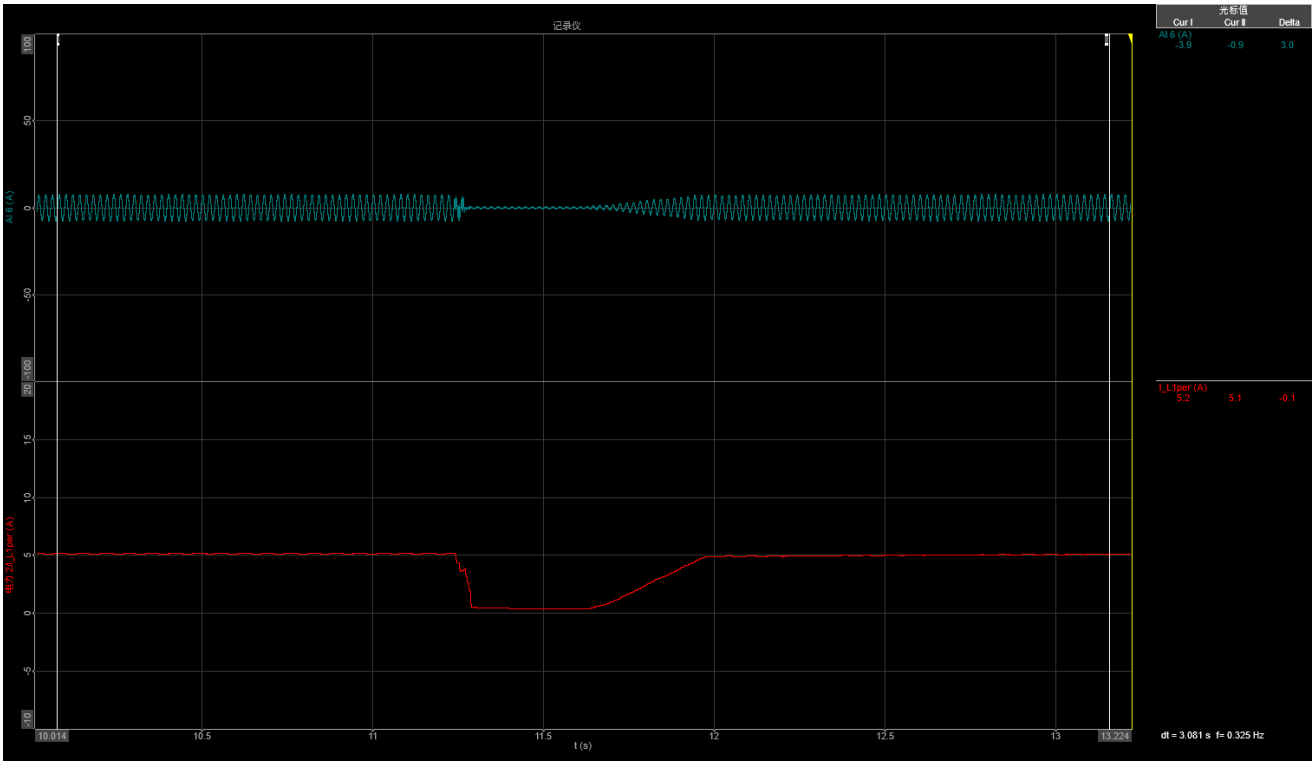
5.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.1
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:15:14
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,25
	5	Setting dip duration		--	--	150
	6	Point of fault entry	Total	--	ms	11238
	7	Point of fault clearance	Total	--	ms	11389
	8	Fault duration in empty load test	Total	--	ms	151
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,250
	10		Total (Phase 2)			1,250
	11		Total (Phase 3)			1,250
	12		Positive sequence			1,249
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,005
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,987
	17	Active power	Total	t1-10s to t1	p.u.	0,992
	18		Pos.			0,992
	19	Reactive power	Total	t1-10s to t1	p.u.	0,056
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,250
	23		Phase 2			1,250
	24		Phase 3			1,250
	25	Line current	Phase 1	t1+60ms	p.u.	0,077
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,096
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,003
	32		Pos.			0,003
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,005
	34		Phase 2			0,999
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,993
	37		Pos.			0,993
	38	Active power rising time	Total	--	s	0,576
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,056
	40		Pos.			0,008
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

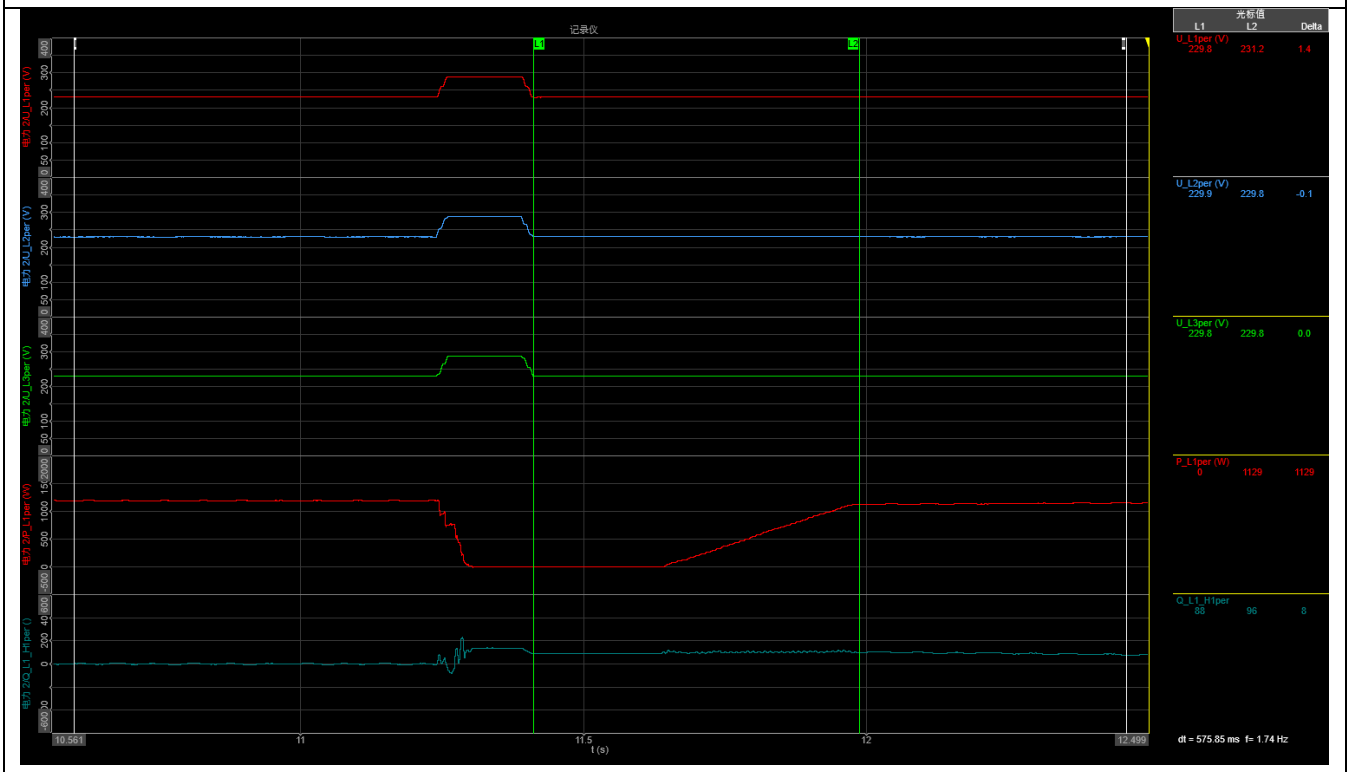
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

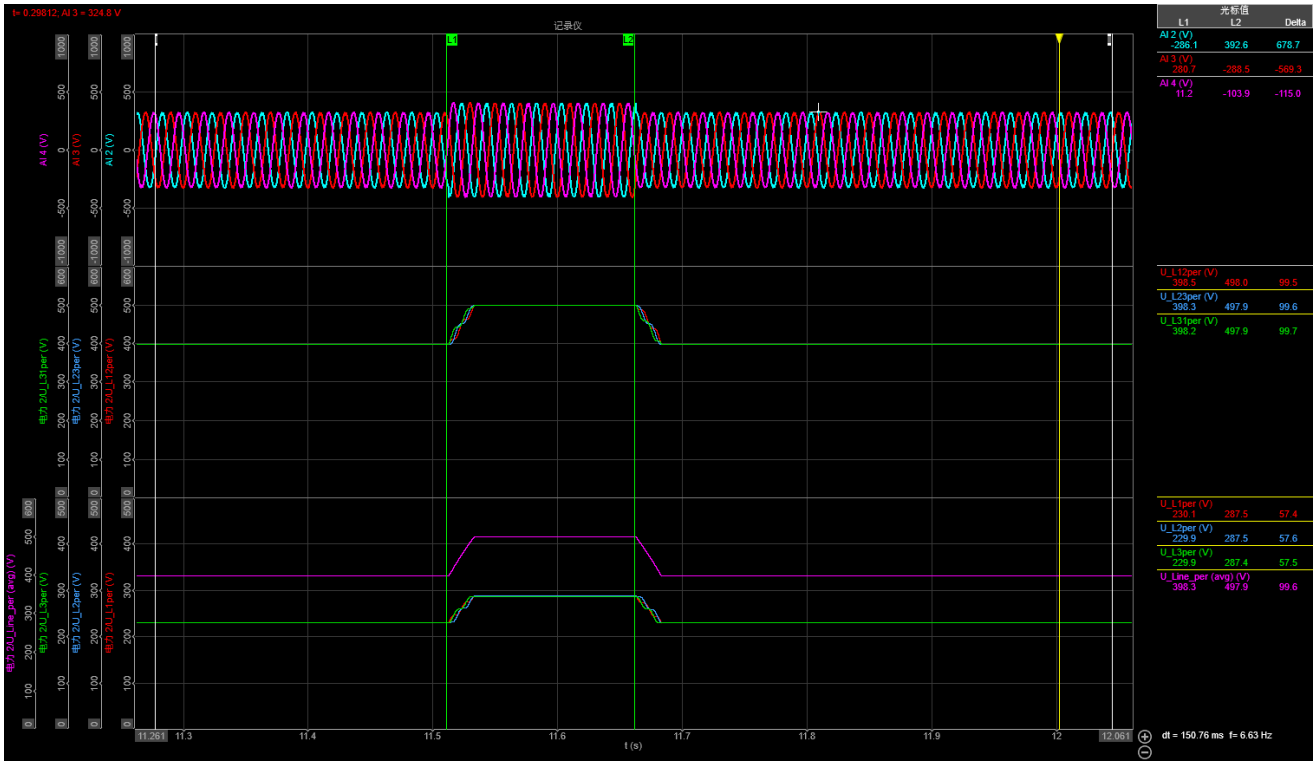
A17C53Z1-20

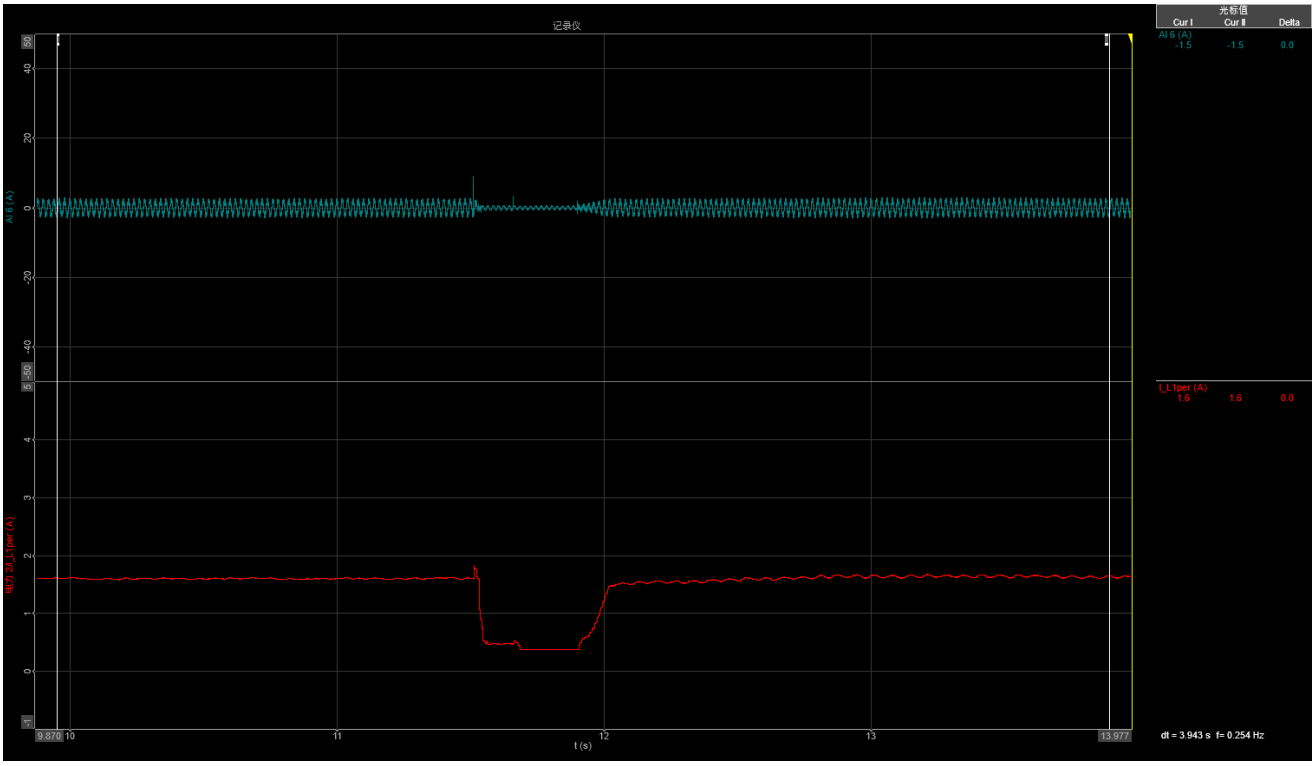
5.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.2
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:44:13
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,25
	5	Setting dip duration		--	--	150
	6	Point of fault entry	Total	--	ms	11511
	7	Point of fault clearance	Total	--	ms	11662
	8	Fault duration in empty load test	Total	--	ms	151
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,250
	10		Total (Phase 2)			1,250
	11		Total (Phase 3)			1,250
	12		Positive sequence			1,249
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,070
	20		Pos.			0,007
	21	Cosφ	Total	t1-10s to t1	--	0,974
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,250
	23		Phase 2			1,250
	24		Phase 3			1,250
	25	Line current	Phase 1	t1+60ms	p.u.	0,096
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,096
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,299
	38	Active power rising time	Total	--	s	0,398
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,069
	40		Pos.			0,006
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

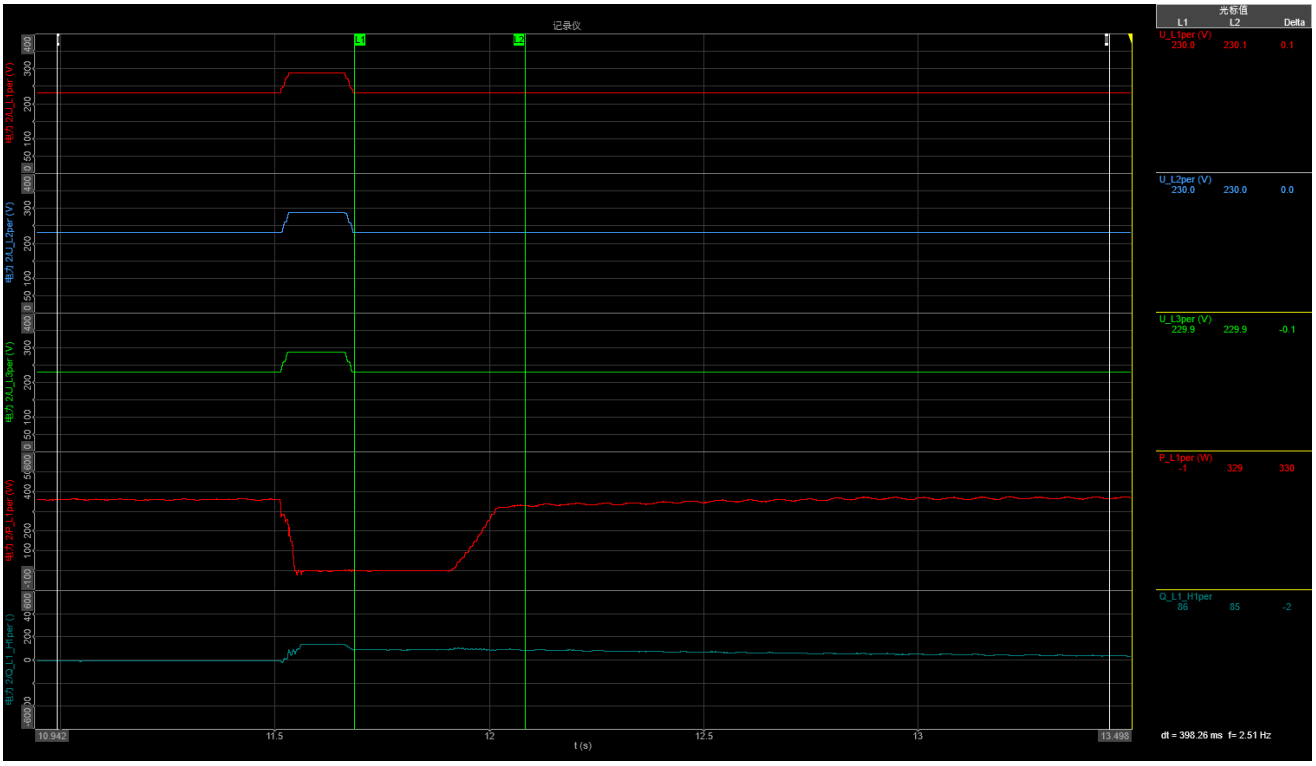
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

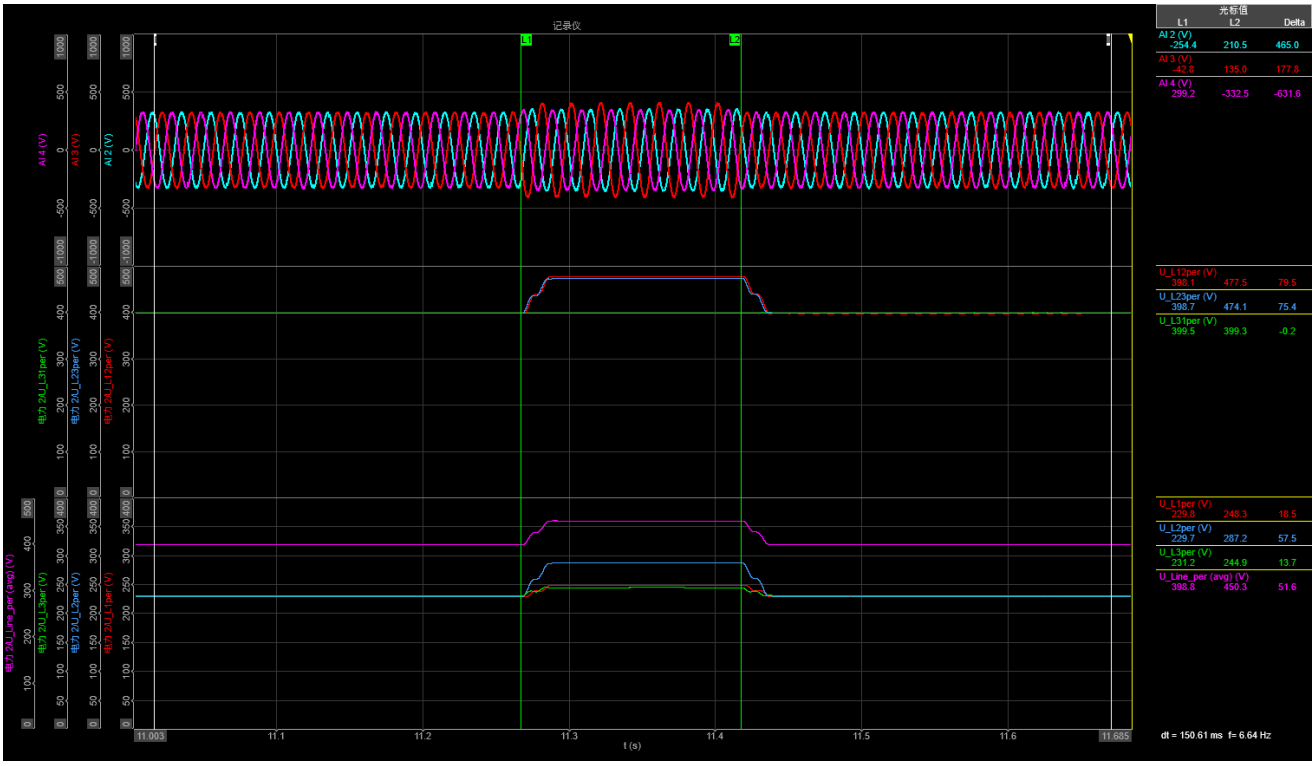
A17C53Z1-20

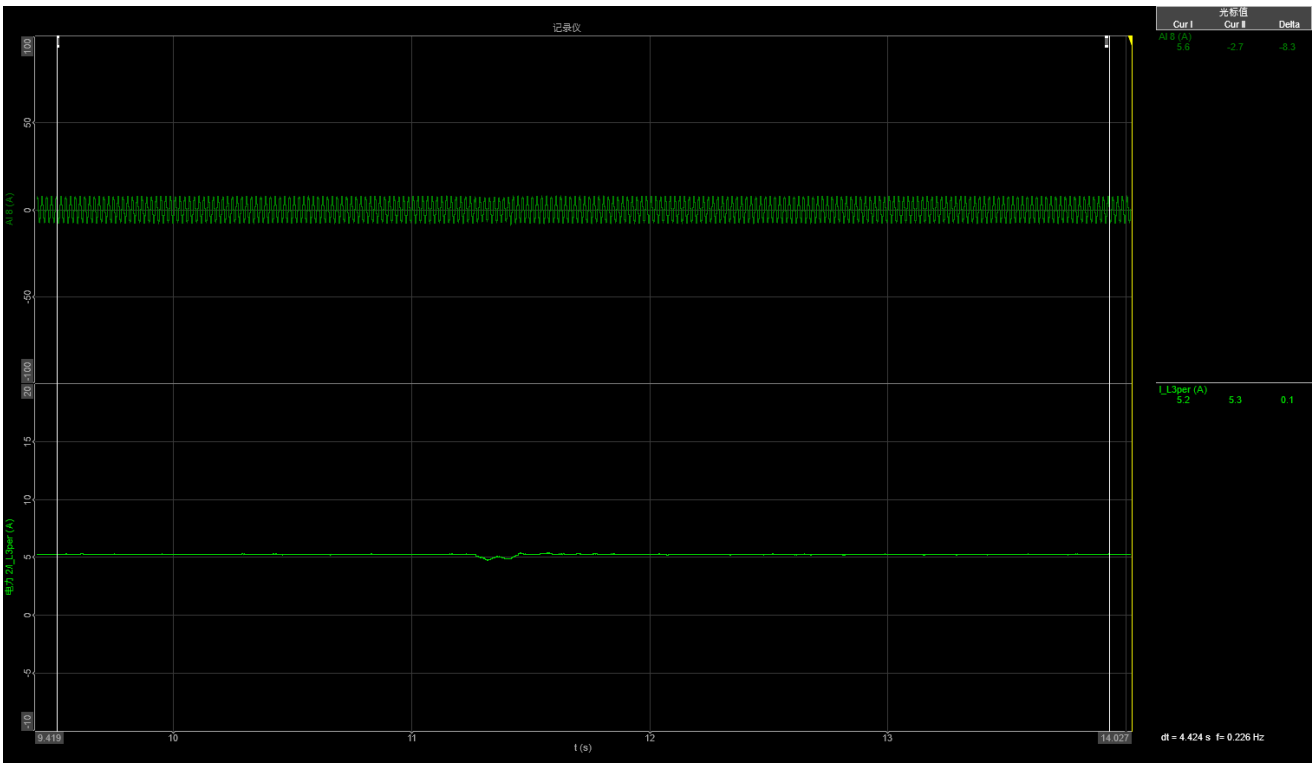
5.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.3
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	16:05:13
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,25
	5	Setting dip duration		--	--	150
	6	Point of fault entry	Total	--	ms	11267
	7	Point of fault clearance	Total	--	ms	11418
	8	Fault duration in empty load test	Total	--	ms	151
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,080
	10		Total (Phase 2)			1,249
	11		Total (Phase 3)			1,065
	12		Positive sequence			1,129
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,005
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,016
	17	Active power	Total	t1-10s to t1	p.u.	1,013
	18		Pos.			1,013
	19	Reactive power	Total	t1-10s to t1	p.u.	0,061
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,080
	23		Phase 2			1,249
	24		Phase 3			1,065
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,920
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,978
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	1,006
	32		Pos.			1,005
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			0,999
	35		Phase 3			1,005
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,013
	37		Pos.			1,013
	38	Active power rising time	Total	--	s	0,210
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,061
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

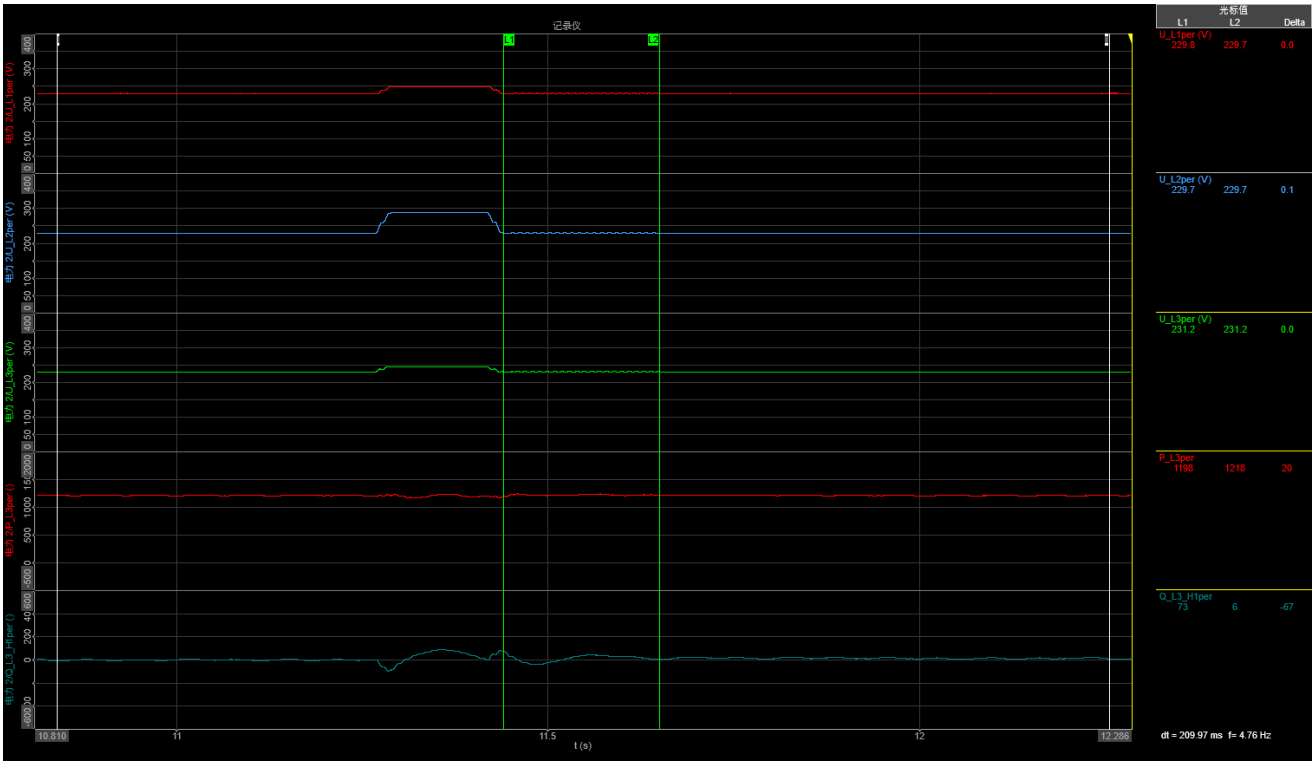
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

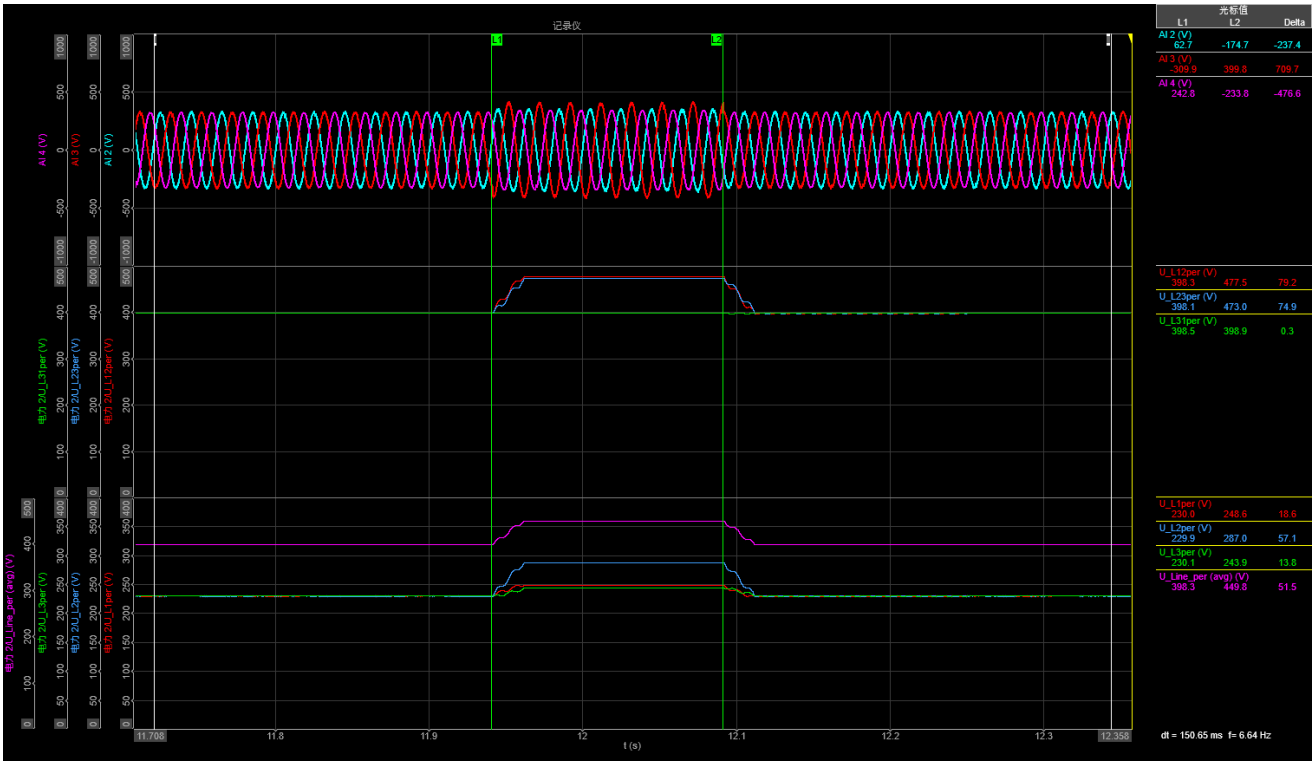
A17C53Z1-20

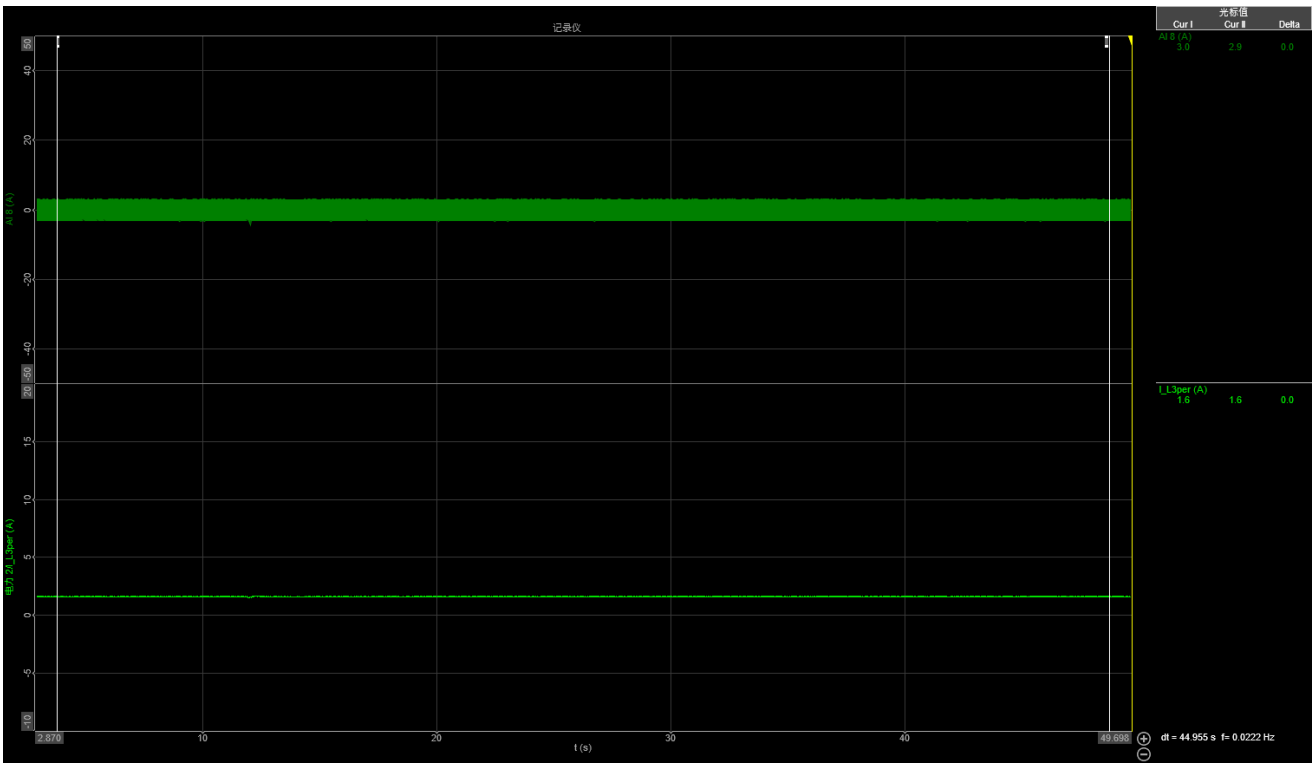
5.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.4
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	11:15:49
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,25
	5	Setting dip duration		--	--	150
	6	Point of fault entry	Total	--	ms	11940
	7	Point of fault clearance	Total	--	ms	12091
	8	Fault duration in empty load test	Total	--	ms	151
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,080
	10		Total (Phase 2)			1,249
	11		Total (Phase 3)			1,060
	12		Positive sequence			1,128
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,090
	20		Pos.			0,007
	21	Cosφ	Total	t1-10s to t1	--	0,958
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,080
	23		Phase 2			1,249
	24		Phase 3			1,060
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,268
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,288
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,304
	32		Pos.			0,304
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,193
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,090
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

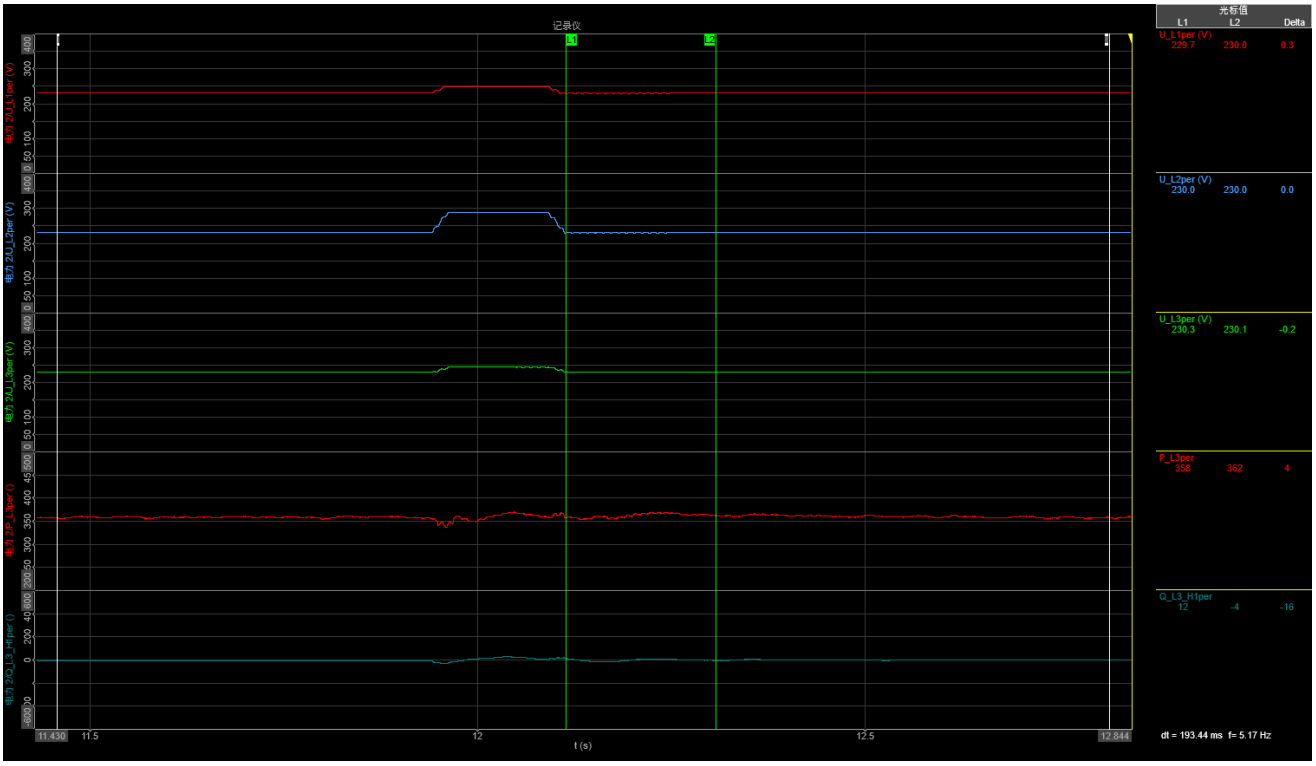
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

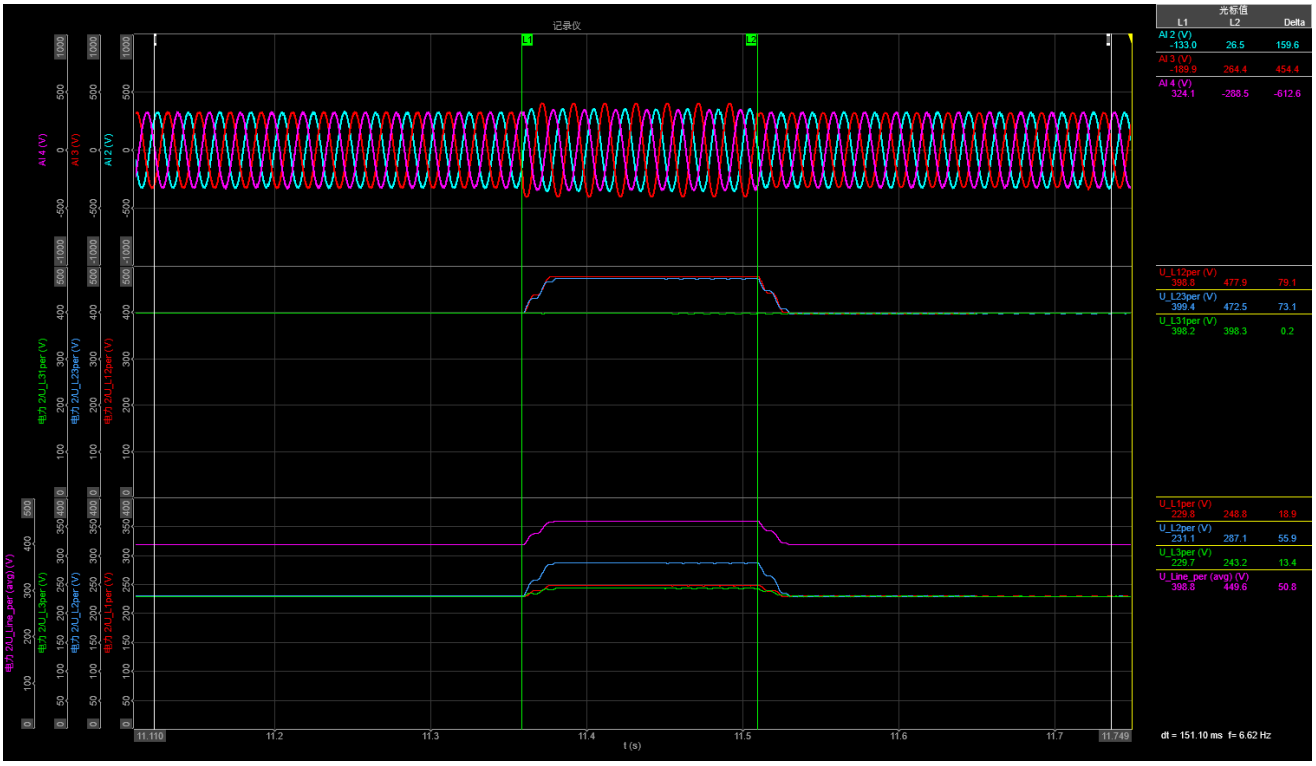
A17C53Z1-20

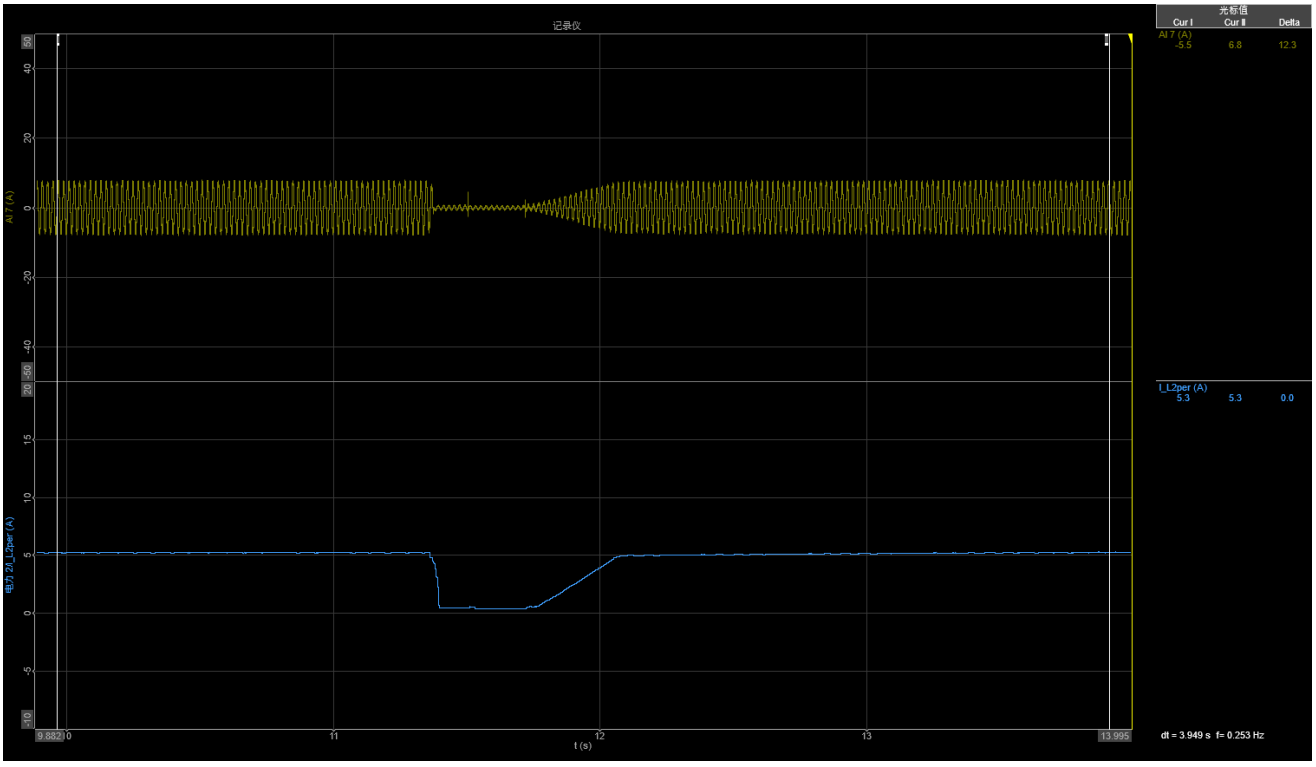
5.5

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	5.5
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	15:12:04
	3	Fault type (phase)	--	--	--	D2
	4	Setting voltage depth	Line to line	--	p.u.	1,25
	5	Setting dip duration		--	--	150
	6	Point of fault entry	Total	--	ms	11359
	7	Point of fault clearance	Total	--	ms	11510
	8	Fault duration in empty load test	Total	--	ms	151
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,080
	10		Total (Phase 2)			1,249
	11		Total (Phase 3)			1,059
	12		Positive sequence			1,127
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			1,005
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,004
	17	Active power	Total	t1-10s to t1	p.u.	1,009
	18		Pos.			1,009
	19	Reactive power	Total	t1-10s to t1	p.u.	0,061
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,080
	23		Phase 2			1,249
	24		Phase 3			1,059
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			0,096
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			0,096
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,003
	32		Pos.			0,003
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			1,005
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,011
	37		Pos.			1,011
	38	Active power rising time	Total	--	s	0,550
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,061
	40		Pos.			0,008
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

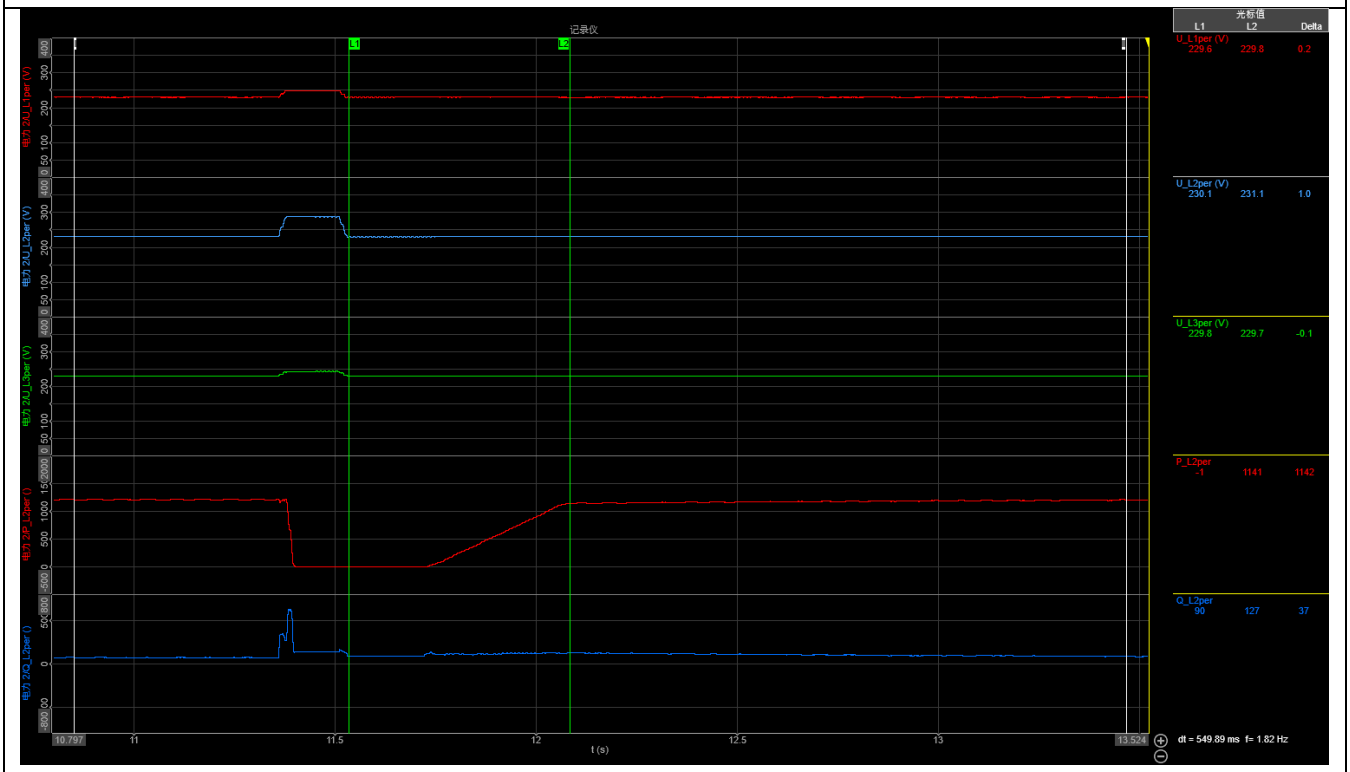
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

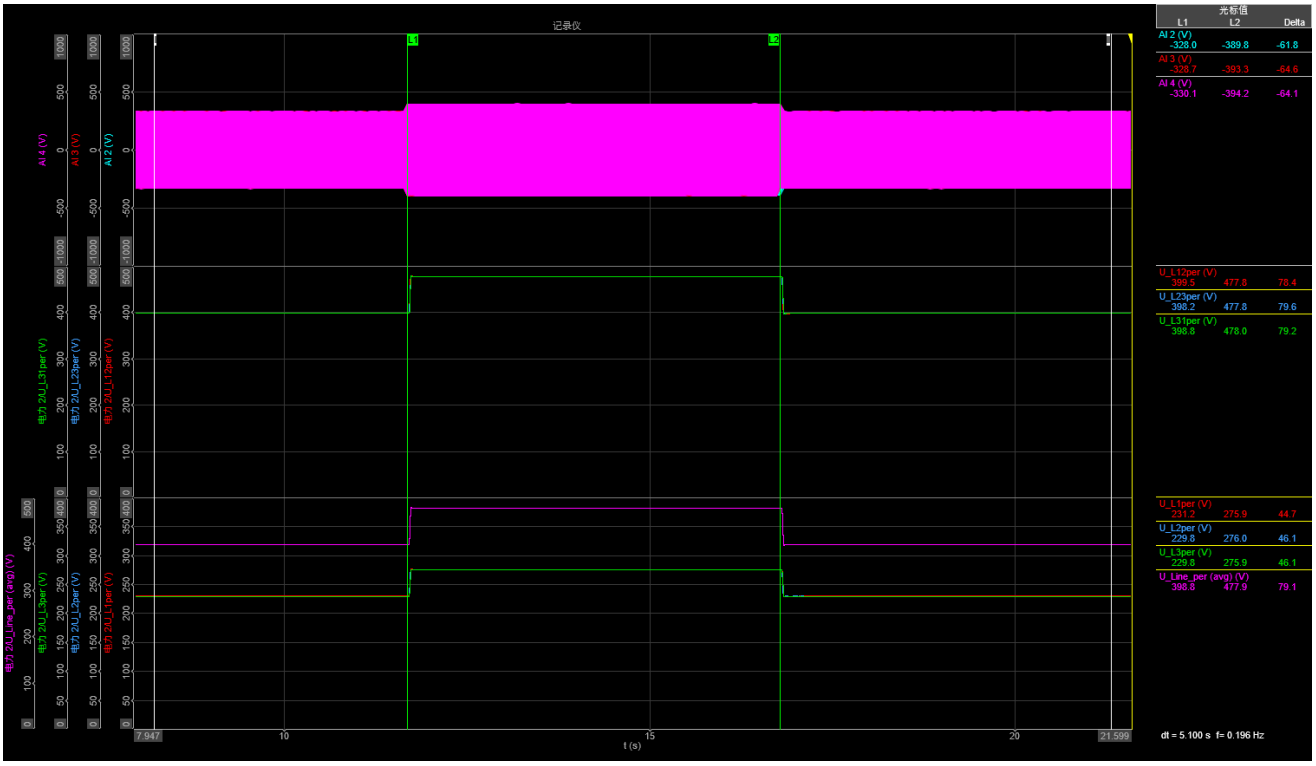
A17C53Z1-20

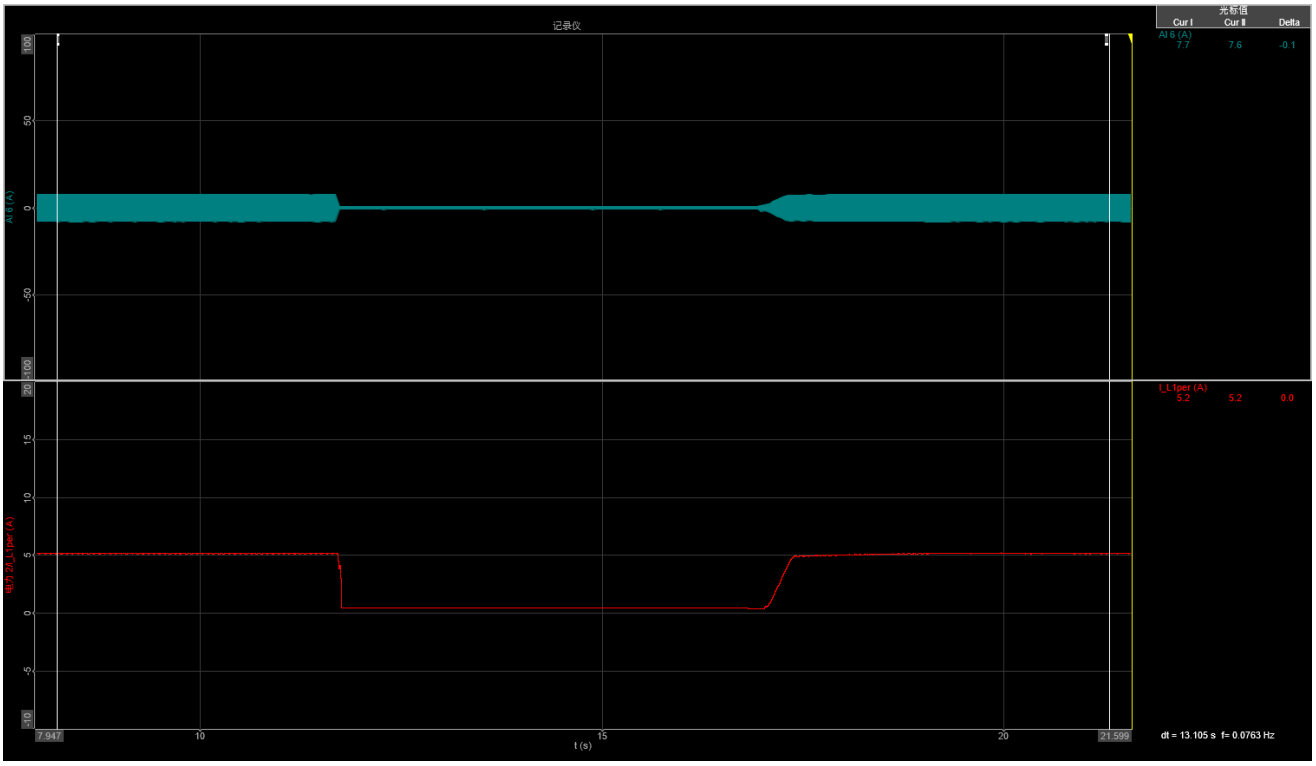
6.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.1
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:47:57
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,2
	5	Setting dip duration		--	--	5100
	6	Point of fault entry	Total	--	ms	11700
	7	Point of fault clearance	Total	--	ms	16800
	8	Fault duration in empty load test	Total	--	ms	5100
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,200
	10		Total (Phase 2)			1,200
	11		Total (Phase 3)			1,200
	12		Positive sequence			1,199
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,005
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,994
	18		Pos.			0,994
	19	Reactive power	Total	t1-10s to t1	p.u.	0,056
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,200
	23		Phase 2			1,200
	24		Phase 3			1,200
	25	Line current	Phase 1	t1+60ms	p.u.	0,096
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,096
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,003
	32		Pos.			0,003
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,005
	34		Phase 2			0,999
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,995
	37		Pos.			0,995
	38	Active power rising time	Total	--	s	0,648
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,056
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

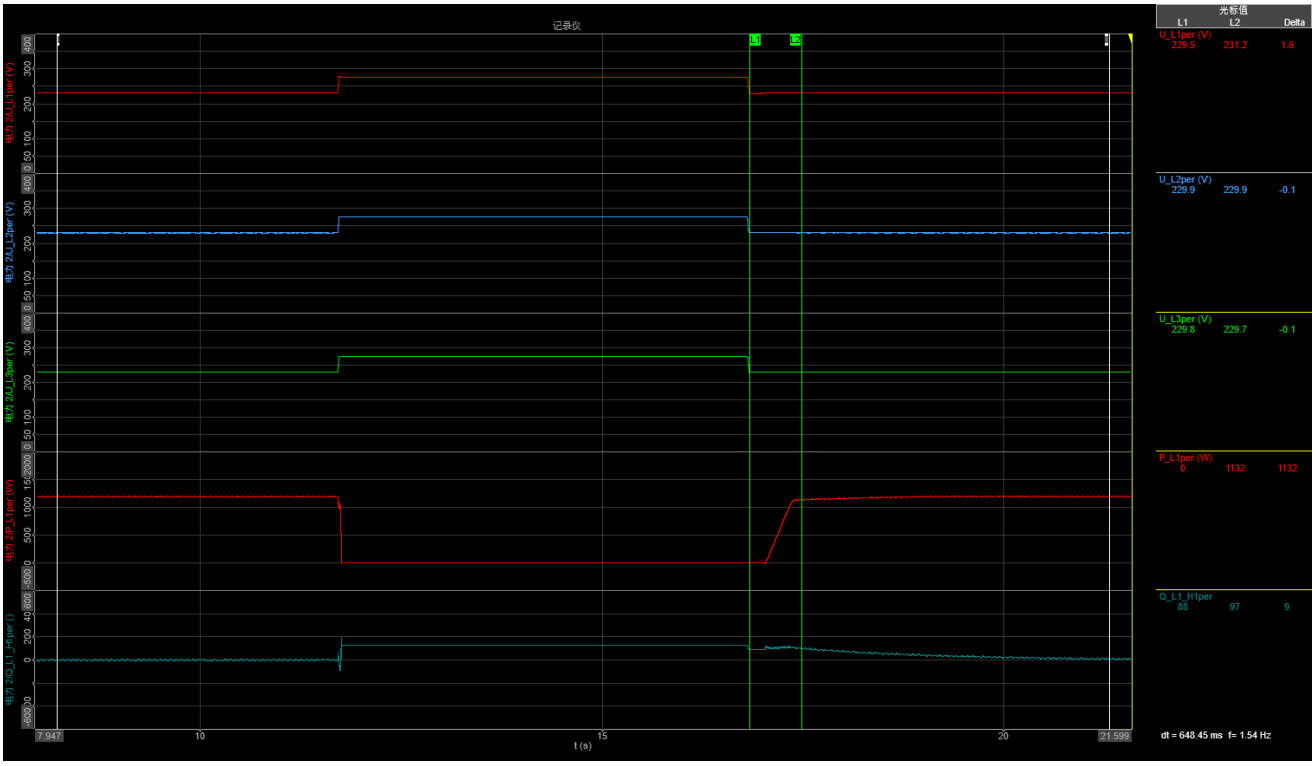
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

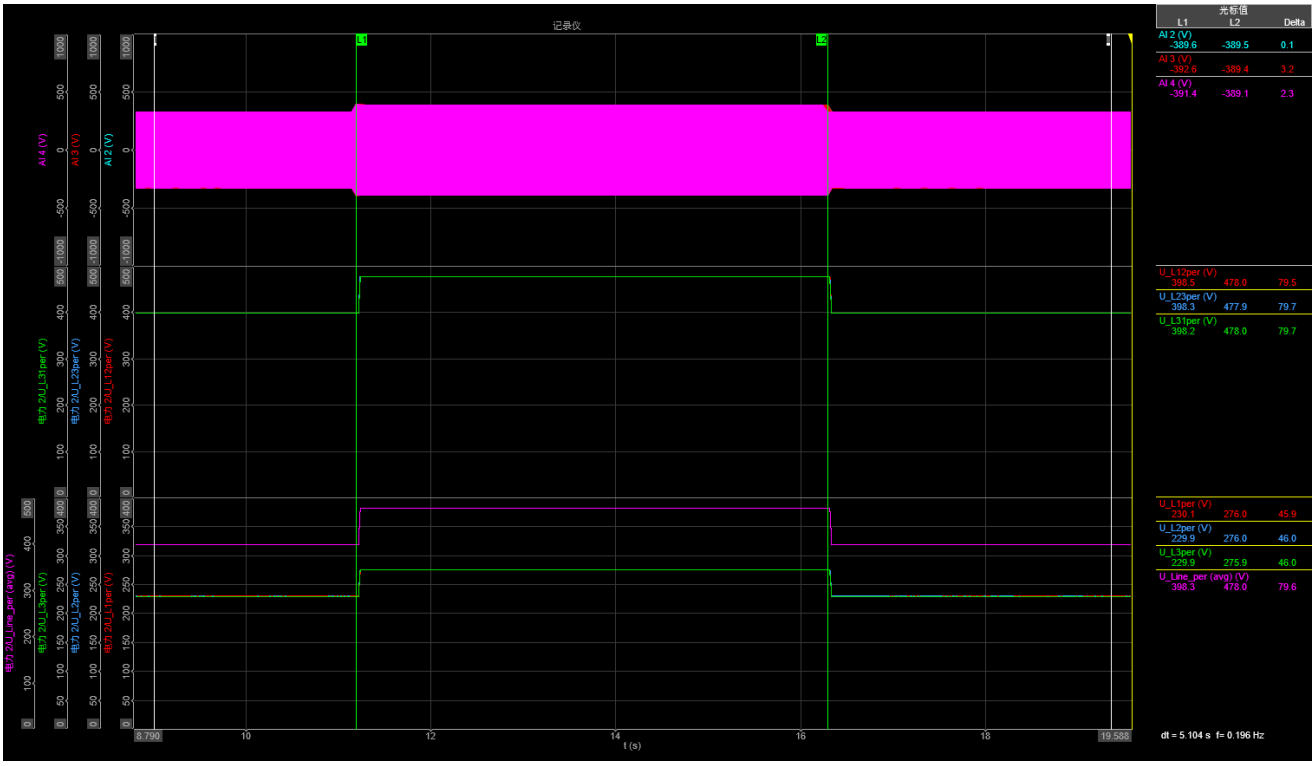
A17C53Z1-20

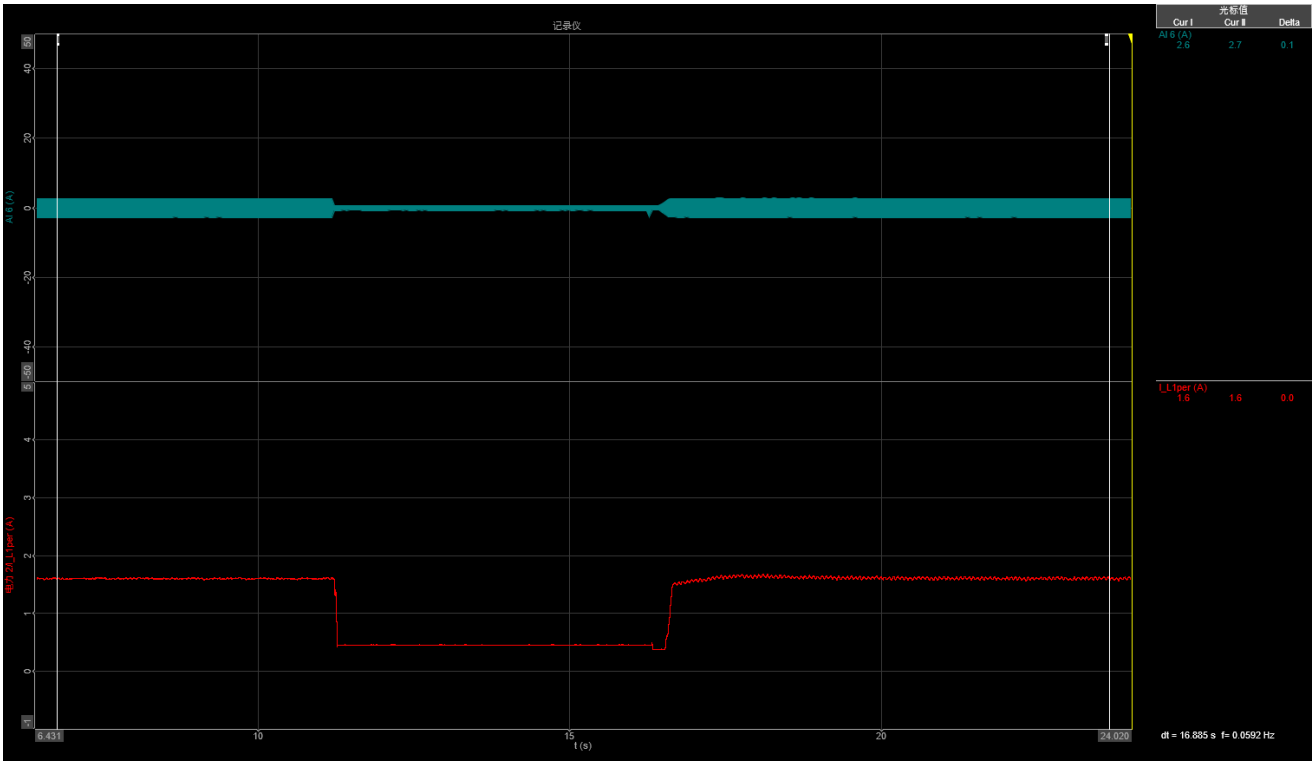
6.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.2
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:50:33
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,2
	5	Setting dip duration		--	--	5100
	6	Point of fault entry	Total	--	ms	11187
	7	Point of fault clearance	Total	--	ms	16291
	8	Fault duration in empty load test	Total	--	ms	5104
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,200
	10		Total (Phase 2)			1,200
	11		Total (Phase 3)			1,200
	12		Positive sequence			1,199
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,070
	20		Pos.			0,008
	21	Cosφ	Total	t1-10s to t1	--	0,974
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,200
	23		Phase 2			1,200
	24		Phase 3			1,200
	25	Line current	Phase 1	t1+60ms	p.u.	0,096
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,096
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,001
	32		Pos.			0,001
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,482
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,070
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

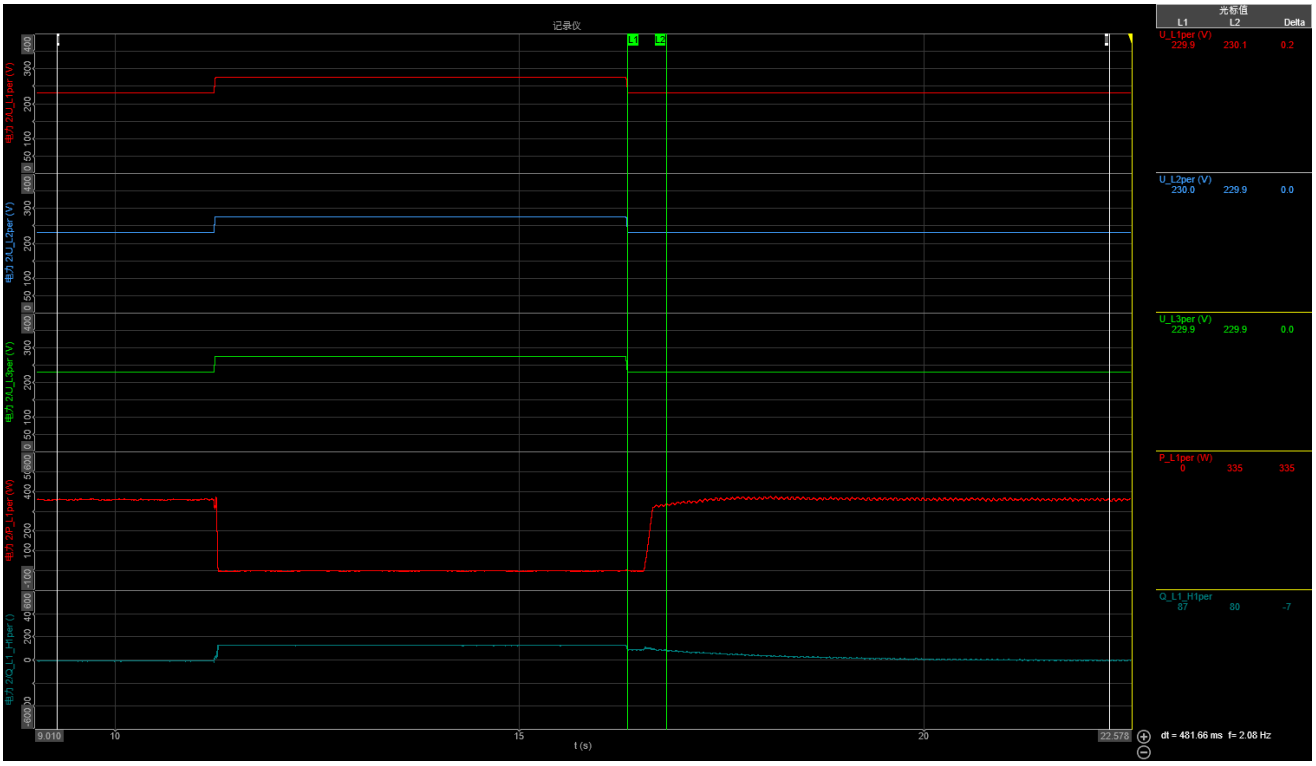
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

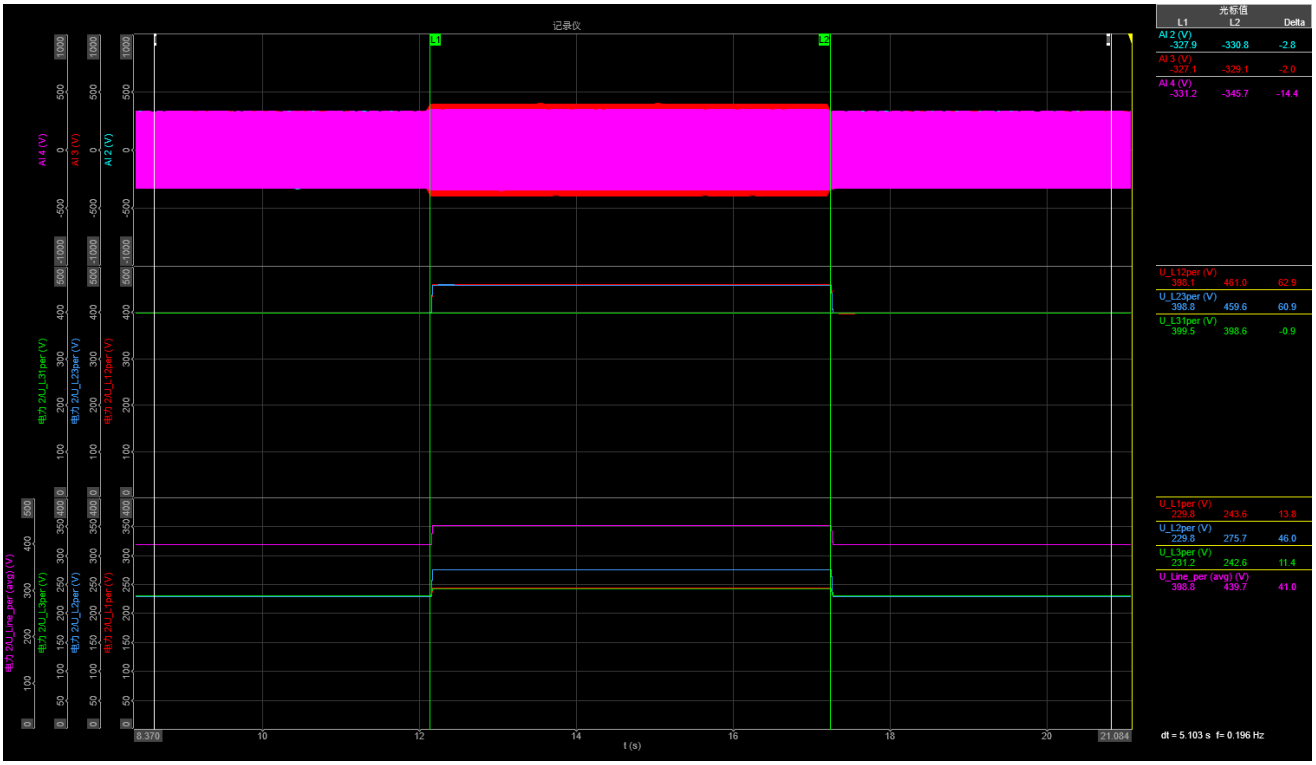
A17C53Z1-20

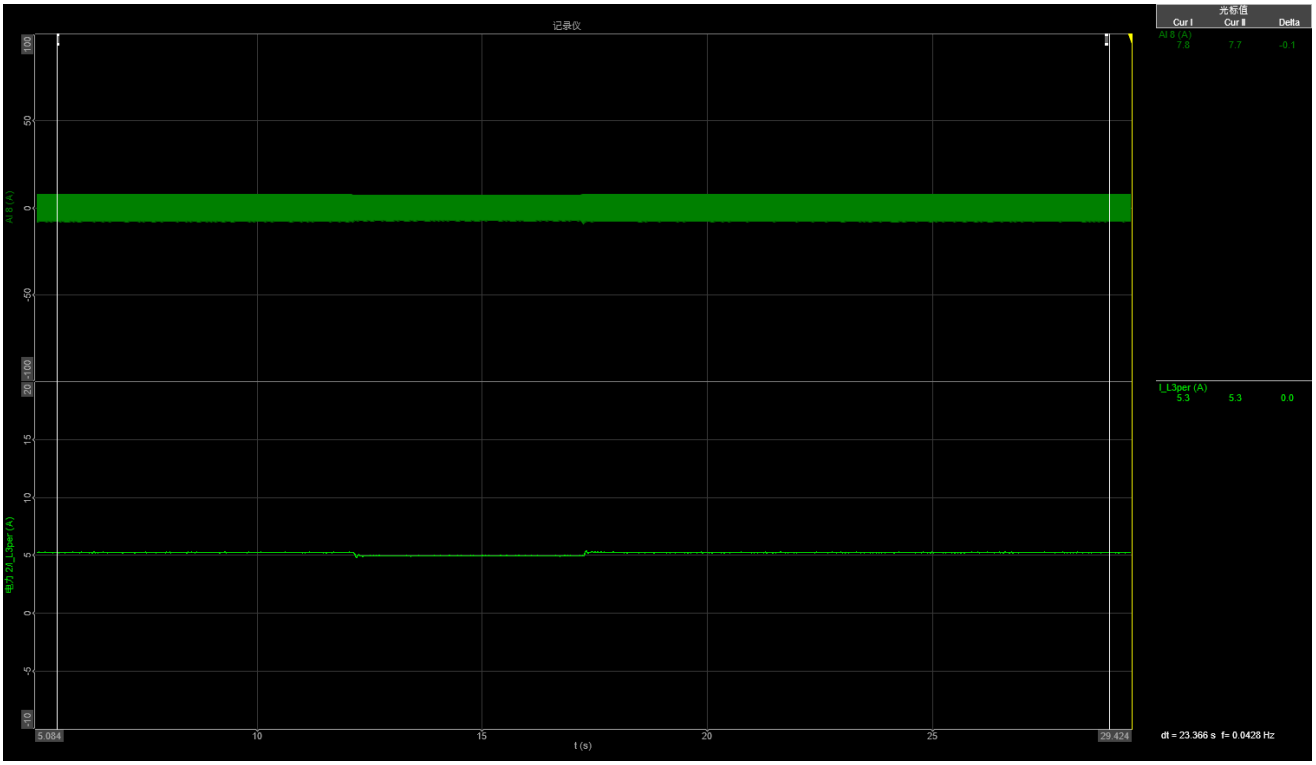
6.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.3
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	16:12:11
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,2
	5	Setting dip duration		--	--	5100
	6	Point of fault entry	Total	--	ms	12140
	7	Point of fault clearance	Total	--	ms	17243
	8	Fault duration in empty load test	Total	--	ms	5103
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,059
	10		Total (Phase 2)			1,199
	11		Total (Phase 3)			1,055
	12		Positive sequence			1,103
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,005
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	1,016
	17	Active power	Total	t1-10s to t1	p.u.	1,012
	18		Pos.			1,012
	19	Reactive power	Total	t1-10s to t1	p.u.	0,061
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,059
	23		Phase 2			1,199
	24		Phase 3			1,055
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,920
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,978
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	1,003
	32		Pos.			1,003
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			0,999
	35		Phase 3			1,005
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,011
	37		Pos.			1,011
	38	Active power rising time	Total	--	s	0,210
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,061
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

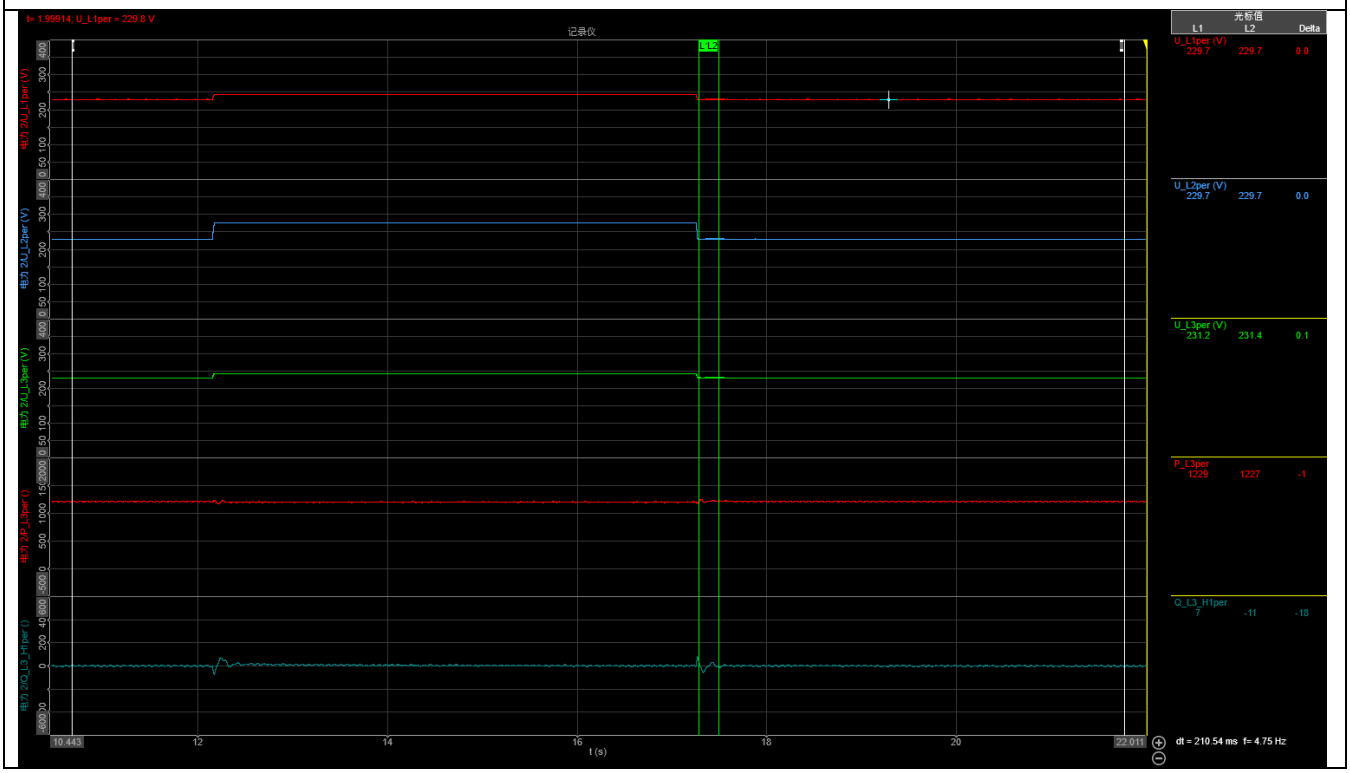
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

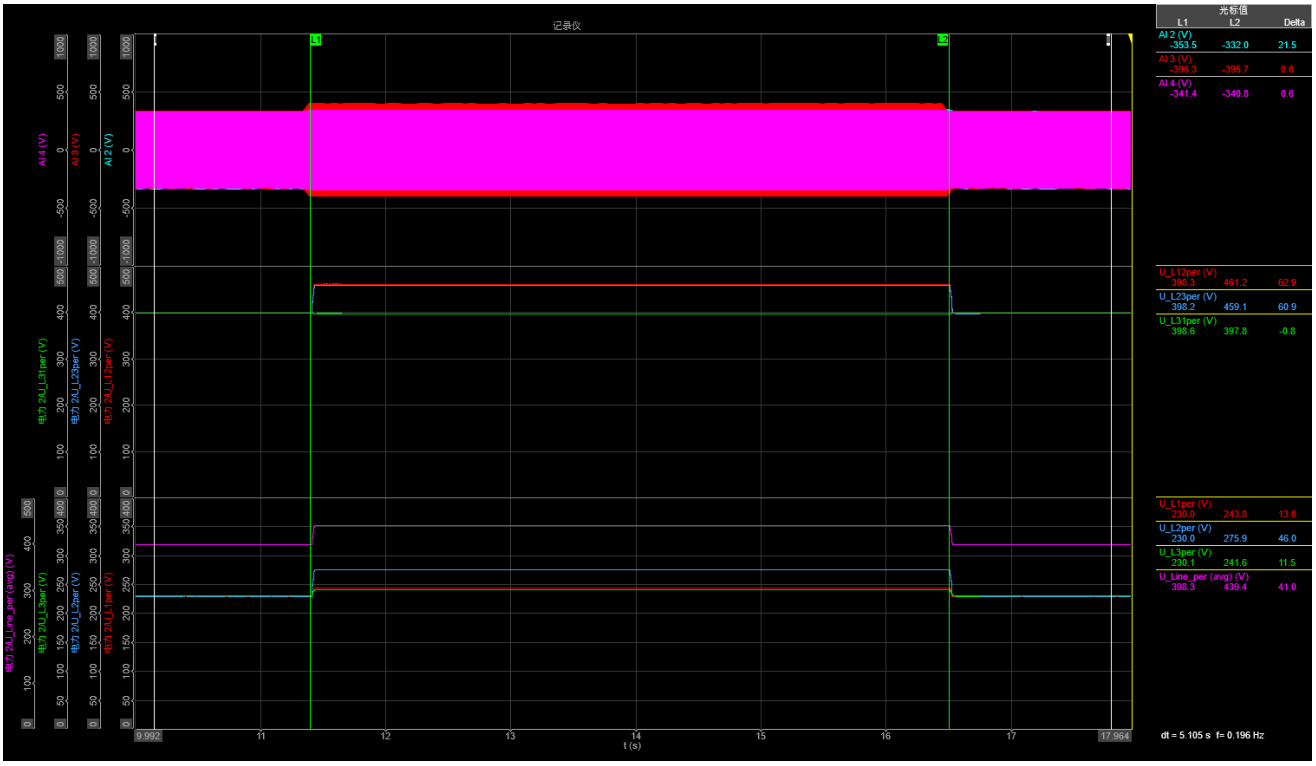
A17C53Z1-20

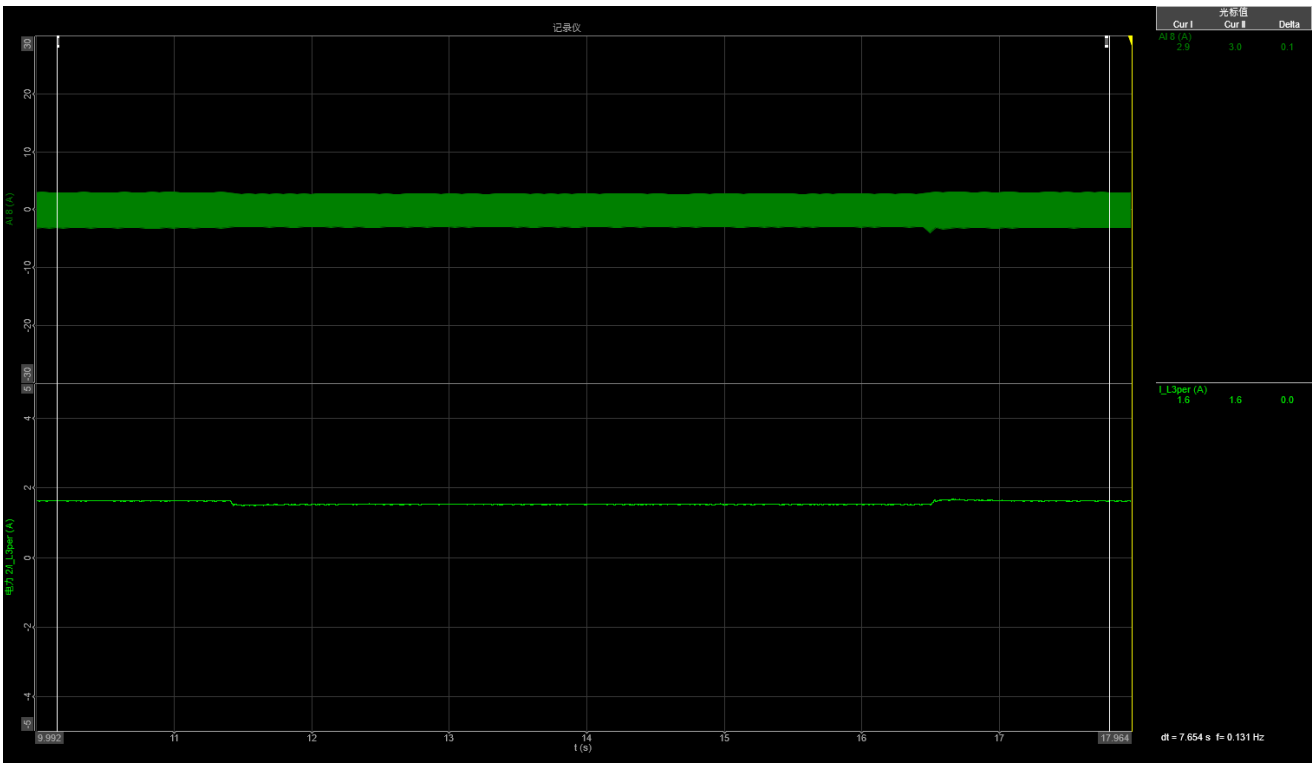
6.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	6.4
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	16:14:46
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,2
	5	Setting dip duration		--	--	5100
	6	Point of fault entry	Total	--	ms	11406
	7	Point of fault clearance	Total	--	ms	16511
	8	Fault duration in empty load test	Total	--	ms	5105
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,060
	10		Total (Phase 2)			1,200
	11		Total (Phase 3)			1,050
	12		Positive sequence			1,101
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,090
	20		Pos.			0,007
	21	Cosφ	Total	t1-10s to t1	--	0,958
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,060
	23		Phase 2			1,200
	24		Phase 3			1,050
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,268
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,268
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,293
	32		Pos.			0,293
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,299
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,185
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,090
	40		Pos.			0,007
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

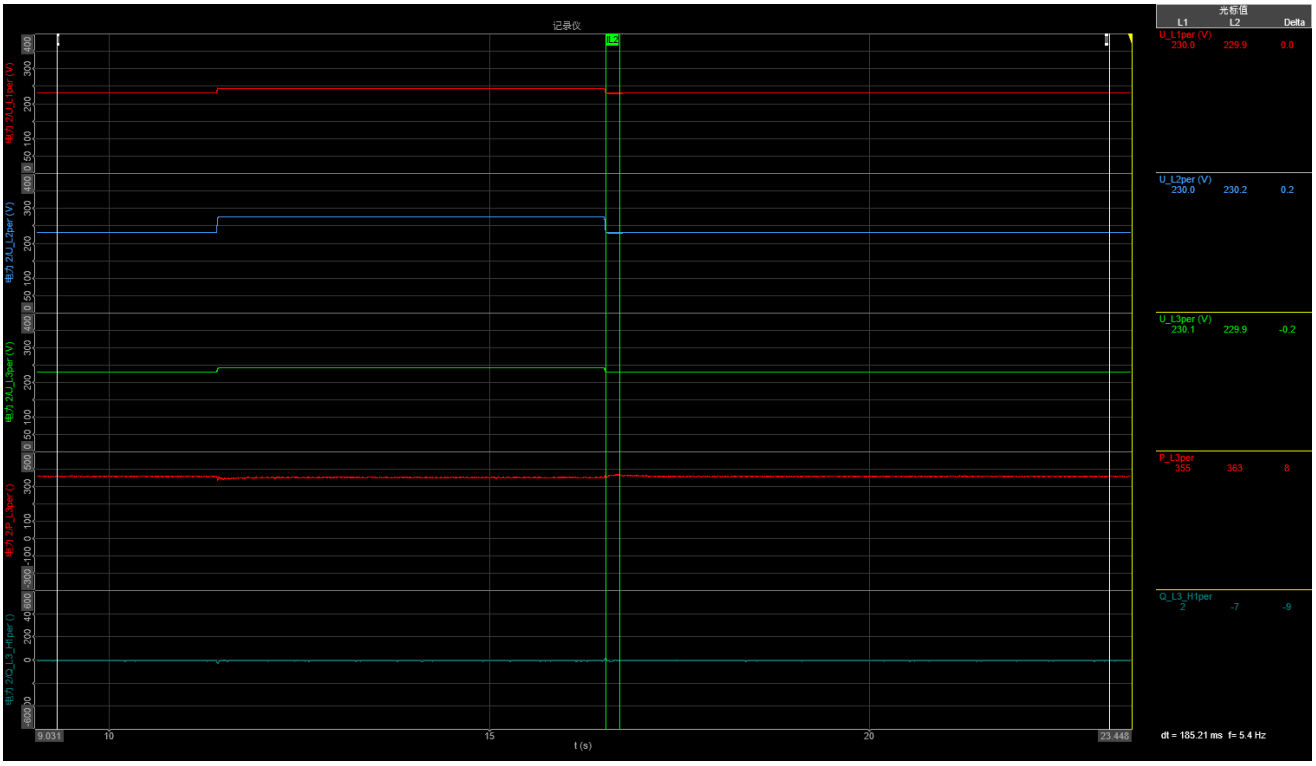
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

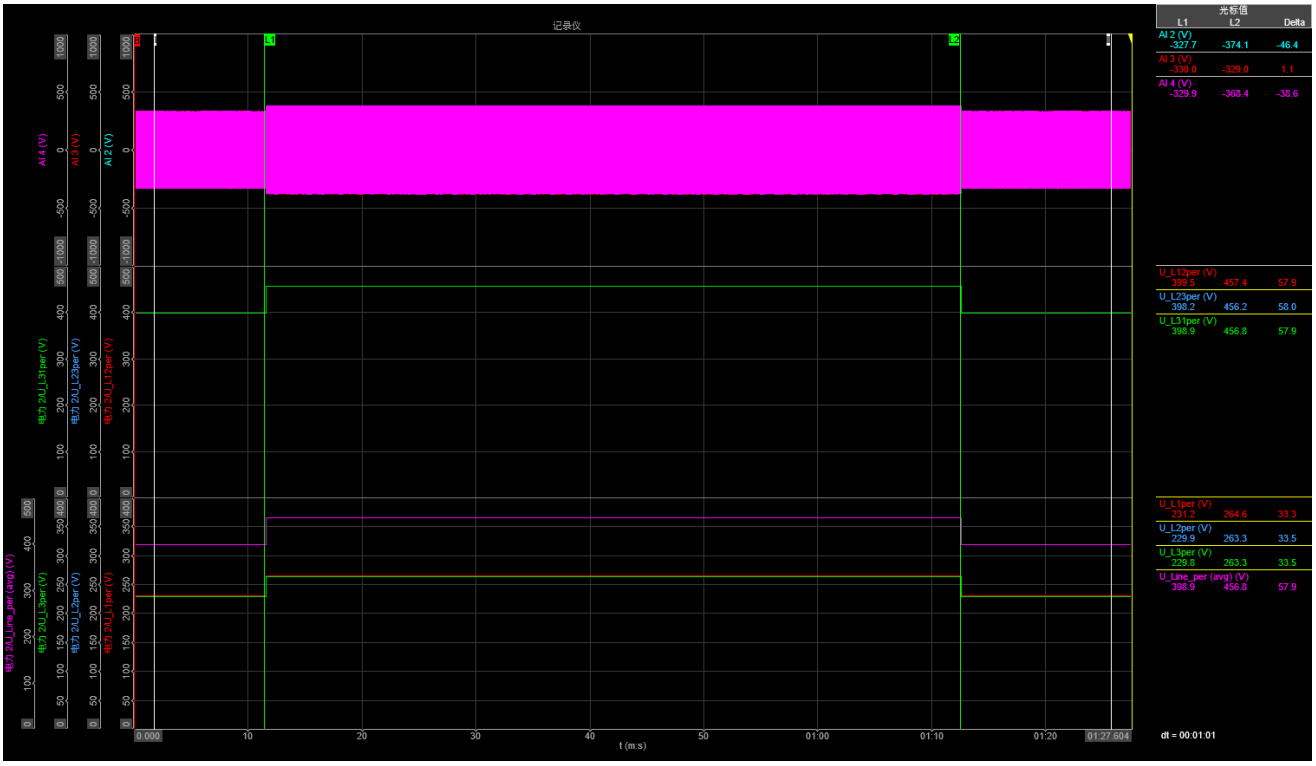
A17C53Z1-20

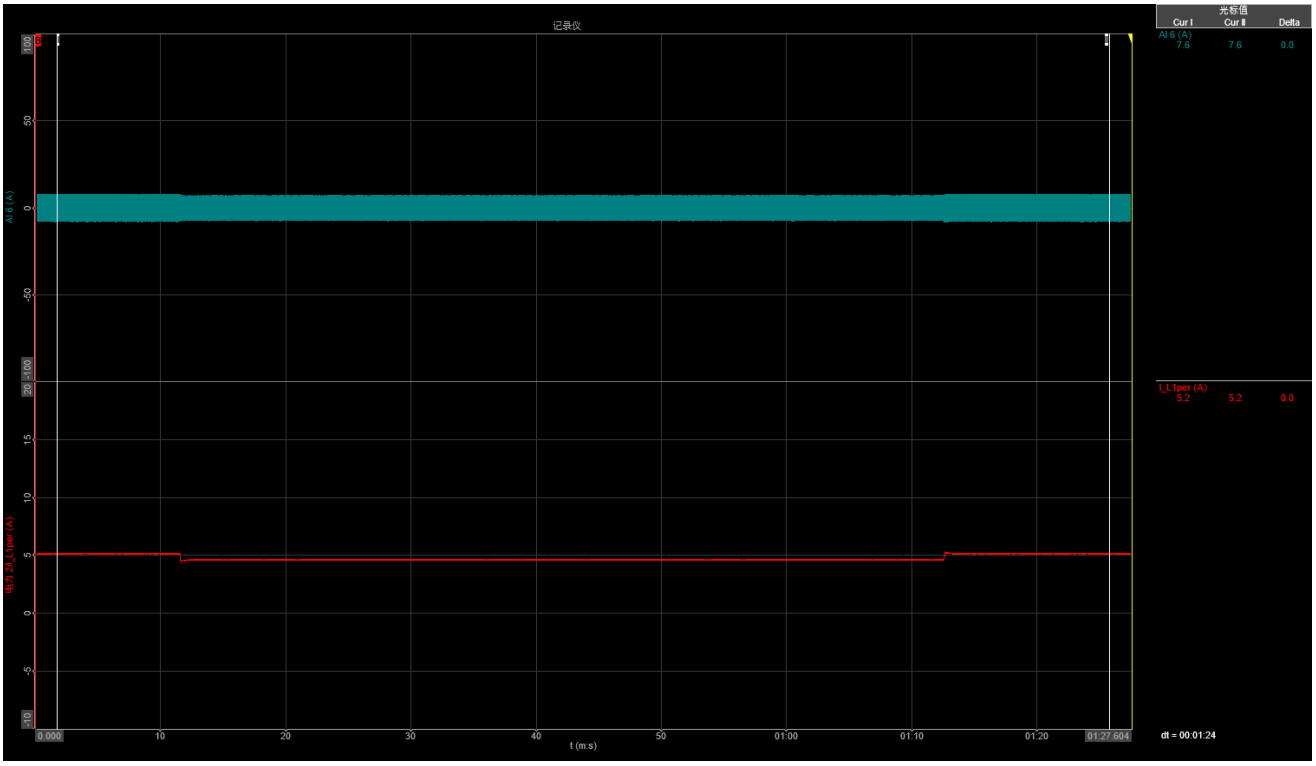
7.1

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.1
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:54:44
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,15
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11550
	7	Point of fault clearance	Total	--	ms	72551
	8	Fault duration in empty load test	Total	--	ms	61001
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,150
	10		Total (Phase 2)			1,145
	11		Total (Phase 3)			1,145
	12		Positive sequence			1,145
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,005
	14		Phase 2			0,999
	15		Phase 3			0,999
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	0,994
	18		Pos.			0,994
	19	Reactive power	Total	t1-10s to t1	p.u.	0,056
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,150
	23		Phase 2			1,145
	24		Phase 3			1,145
	25	Line current	Phase 1	t1+60ms	p.u.	0,843
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,882
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	1,013
	32		Pos.			1,013
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,005
	34		Phase 2			0,999
	35		Phase 3			0,999
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,994
	37		Pos.			0,994
	38	Active power rising time	Total	--	s	0,187
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,056
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

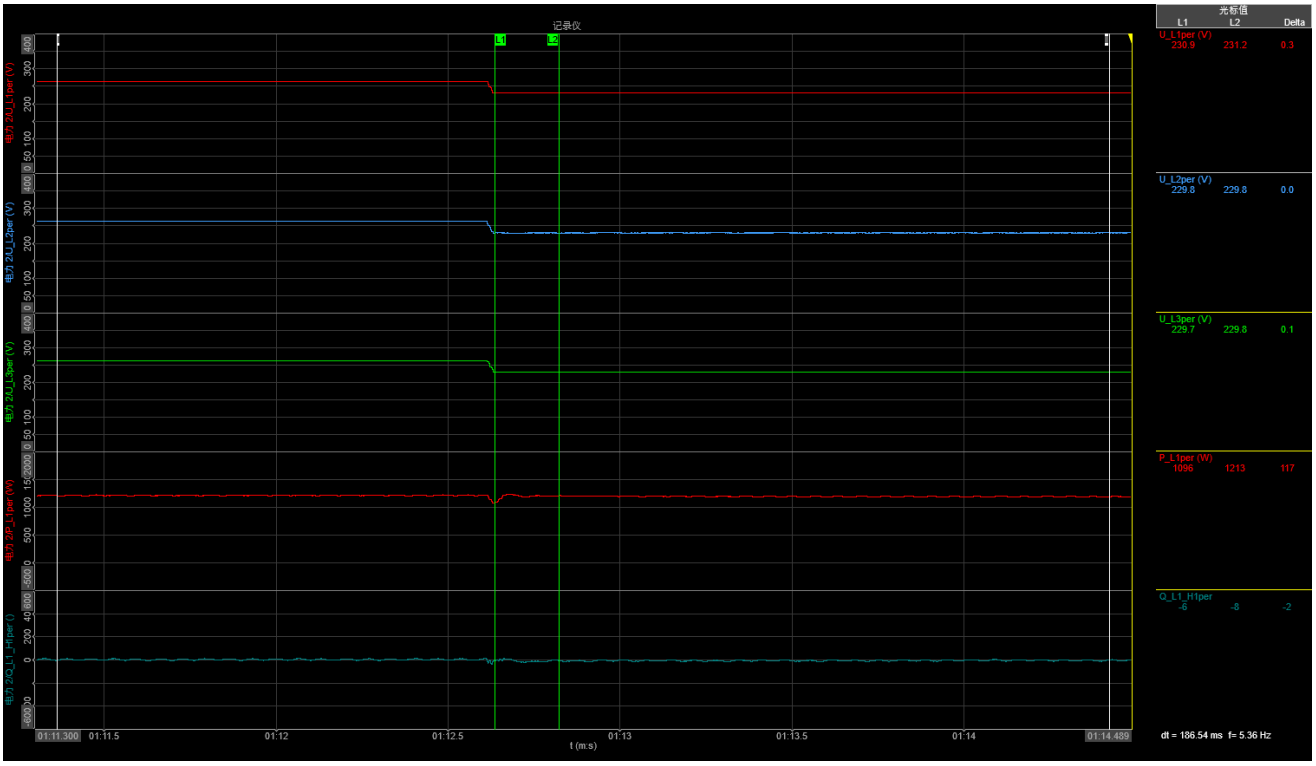
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

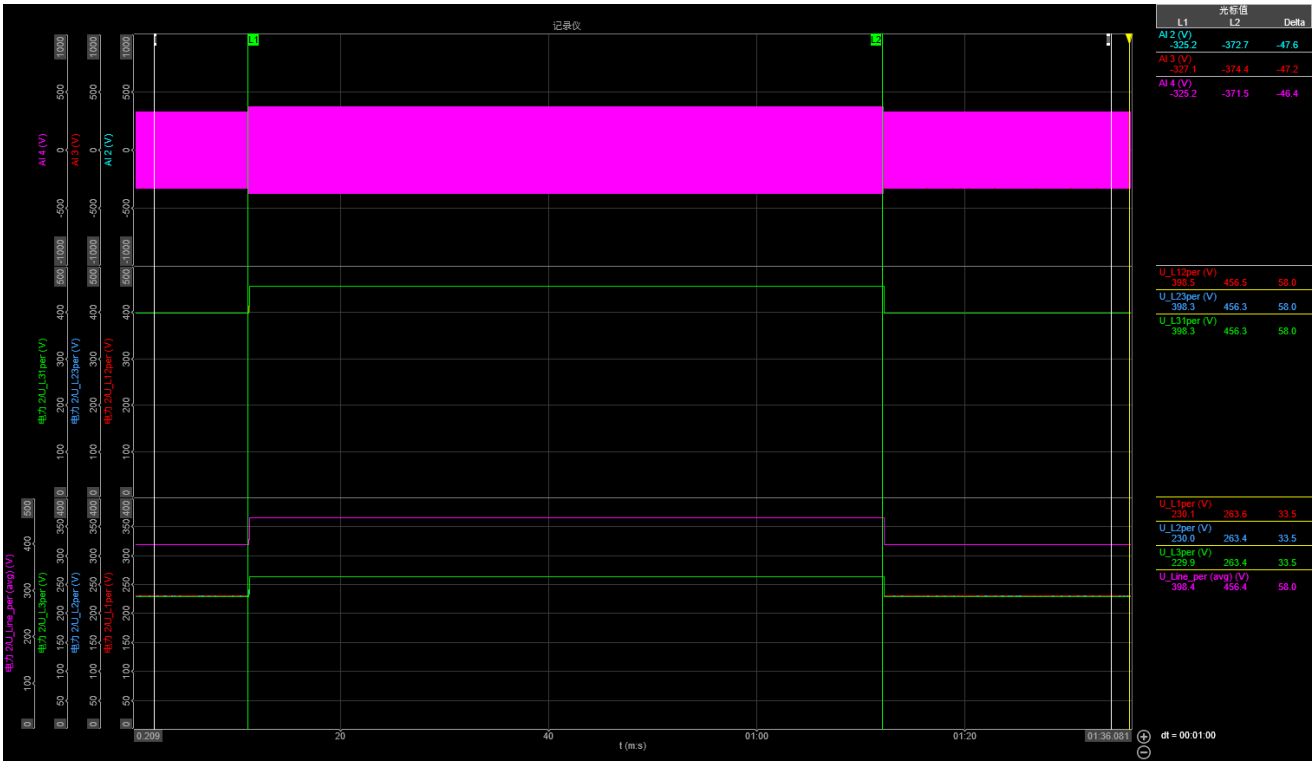
A17C53Z1-20

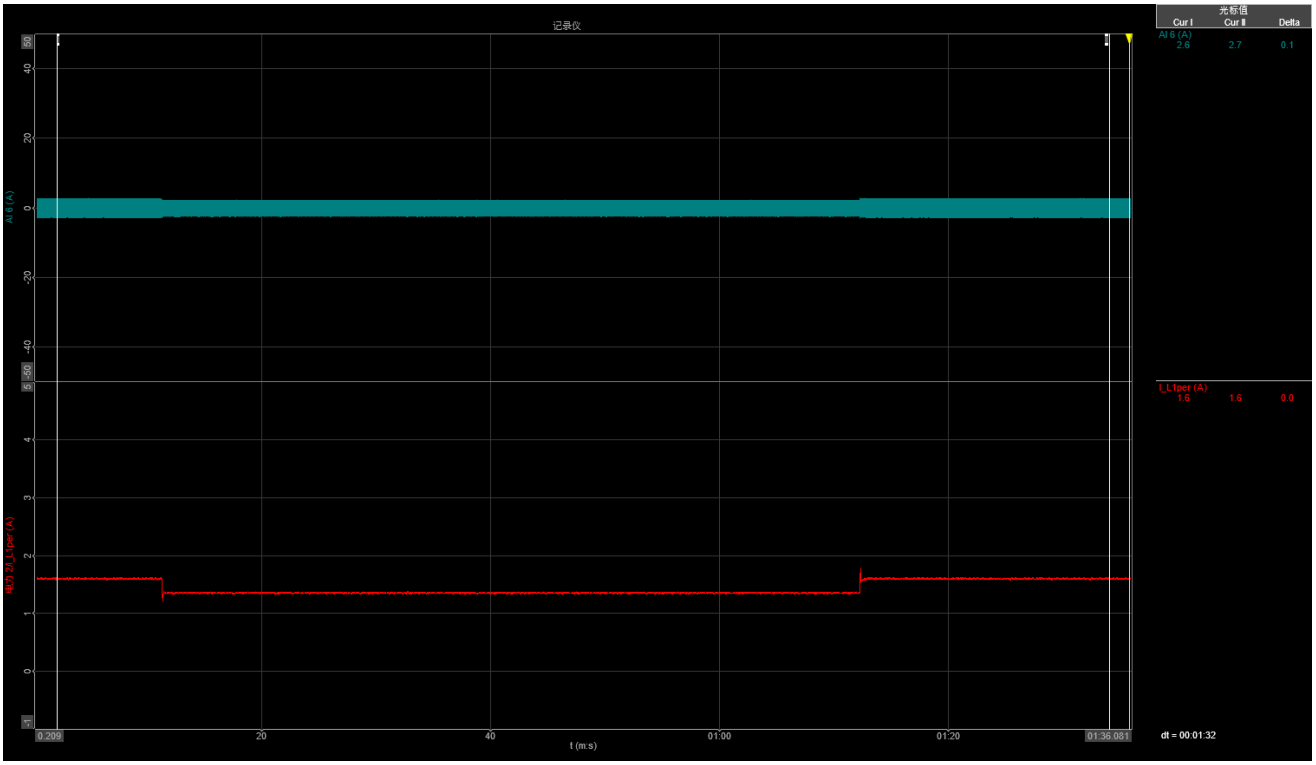
7.2

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.2
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	14:58:29
	3	Fault type (phase)	--	--	--	A
	4	Setting voltage depth	Line to line	--	p.u.	1,15
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	11100
	7	Point of fault clearance	Total	--	ms	72100
	8	Fault duration in empty load test	Total	--	ms	61000
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,146
	10		Total (Phase 2)			1,145
	11		Total (Phase 3)			1,145
	12		Positive sequence			1,144
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,299
	18		Pos.			0,299
	19	Reactive power	Total	t1-10s to t1	p.u.	0,070
	20		Pos.			0,008
	21	Cosφ	Total	t1-10s to t1	--	0,974
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,146
	23		Phase 2			1,145
	24		Phase 3			1,145
	25	Line current	Phase 1	t1+60ms	p.u.	0,230
	26		Phase 2			--
	27		Phase 3			--
	28	Line current	Phase 1	t1+100ms	p.u.	0,249
	29		Phase 2			--
	30		Phase 3			--
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,288
	32		Pos.			0,288
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			0,999
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,298
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,212
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,070
	40		Pos.			0,008
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

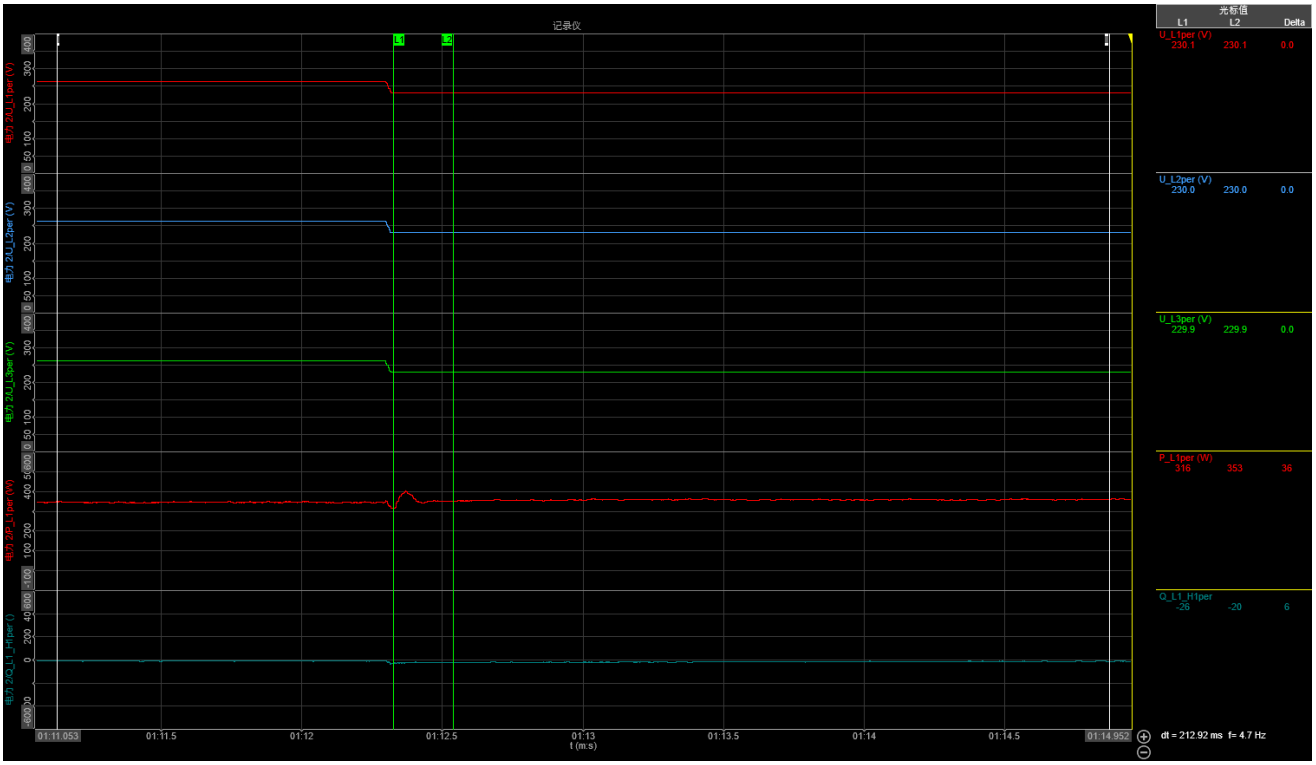
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

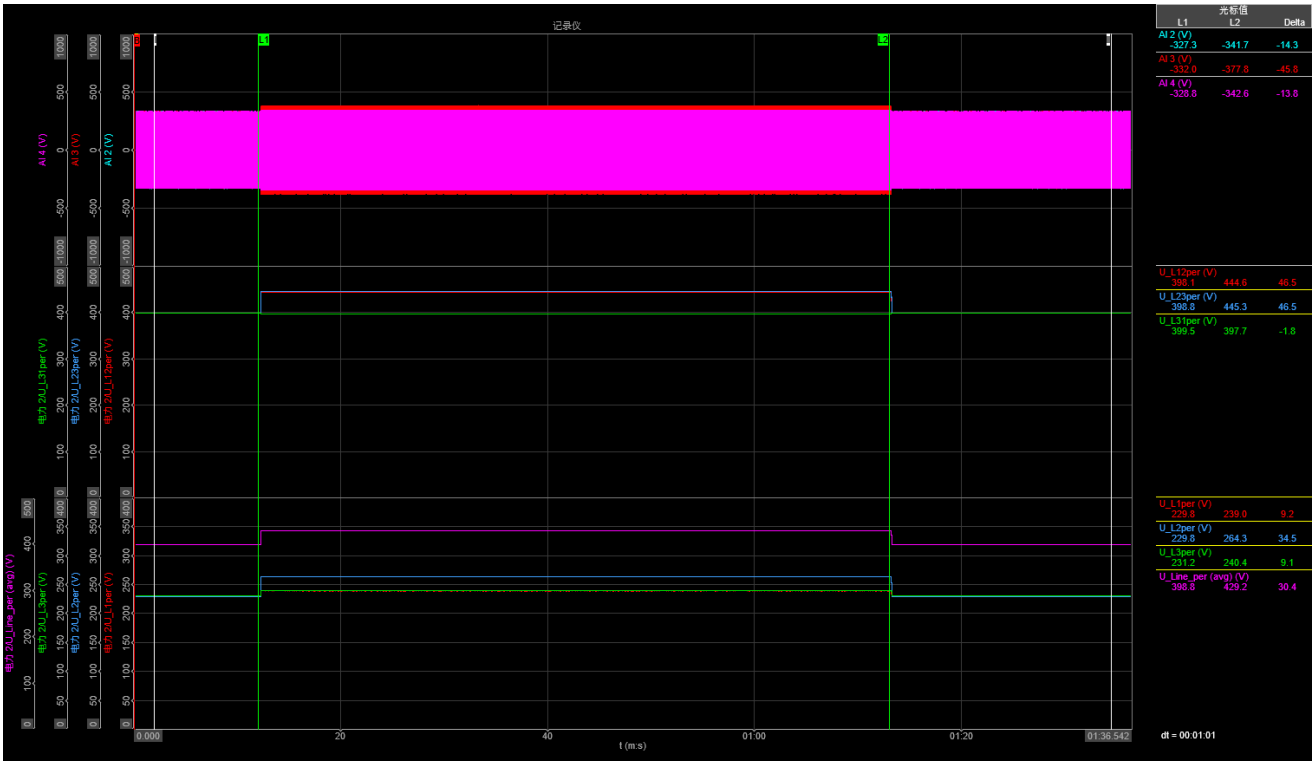
A17C53Z1-20

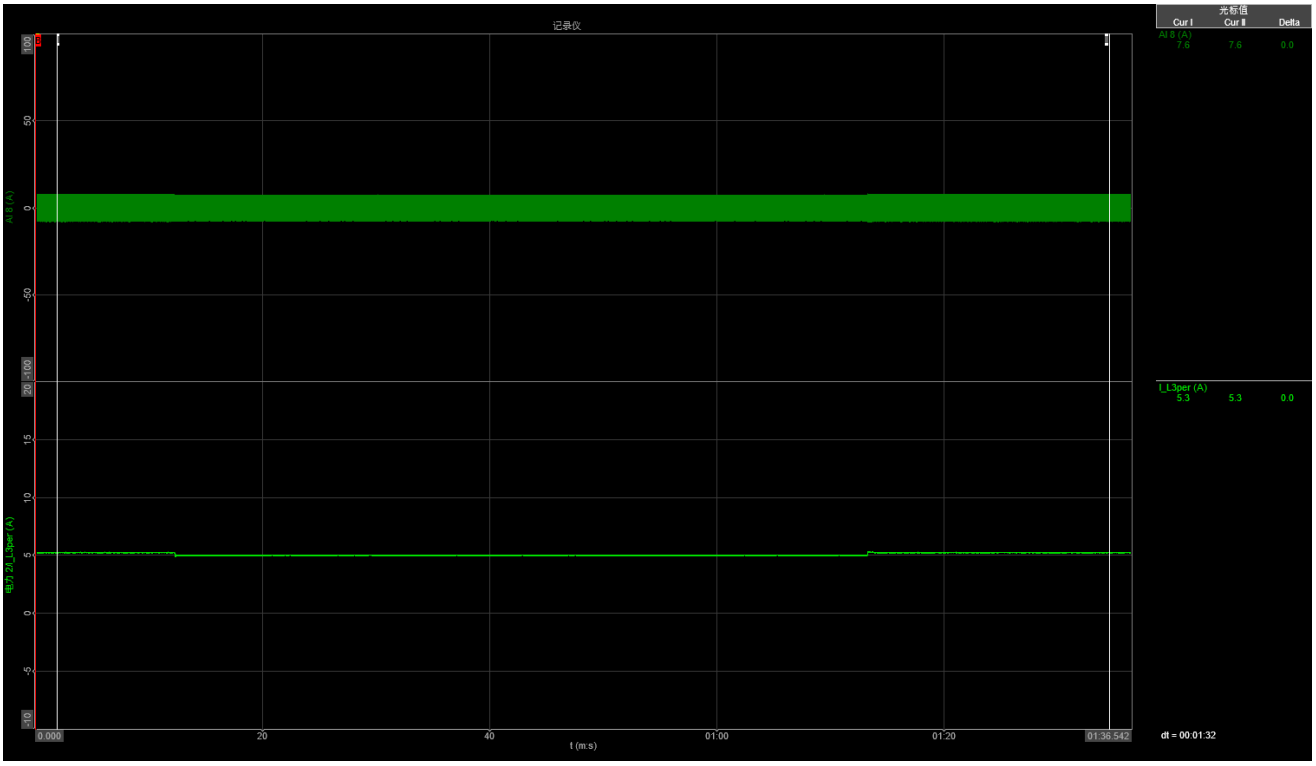
7.3

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.3
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	16:18:39
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,15
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	12150
	7	Point of fault clearance	Total	--	ms	73151
	8	Fault duration in empty load test	Total	--	ms	61001
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,039
	10		Total (Phase 2)			1,149
	11		Total (Phase 3)			1,045
	12		Positive sequence			1,076
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	0,999
	14		Phase 2			0,999
	15		Phase 3			1,005
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,997
	17	Active power	Total	t1-10s to t1	p.u.	1,011
	18		Pos.			1,011
	19	Reactive power	Total	t1-10s to t1	p.u.	0,061
	20		Pos.			0,003
	21	Cosφ	Total	t1-10s to t1	--	0,998
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,039
	23		Phase 2			1,149
	24		Phase 3			1,045
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,939
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,958
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	1,004
	32		Pos.			1,003
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	0,999
	34		Phase 2			0,999
	35		Phase 3			1,005
	36	Active power	Total	t2+3s to t2+10s	p.u.	1,010
	37		Pos.			1,010
	38	Active power rising time	Total	--	s	0,175
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,061
	40		Pos.			0,003
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

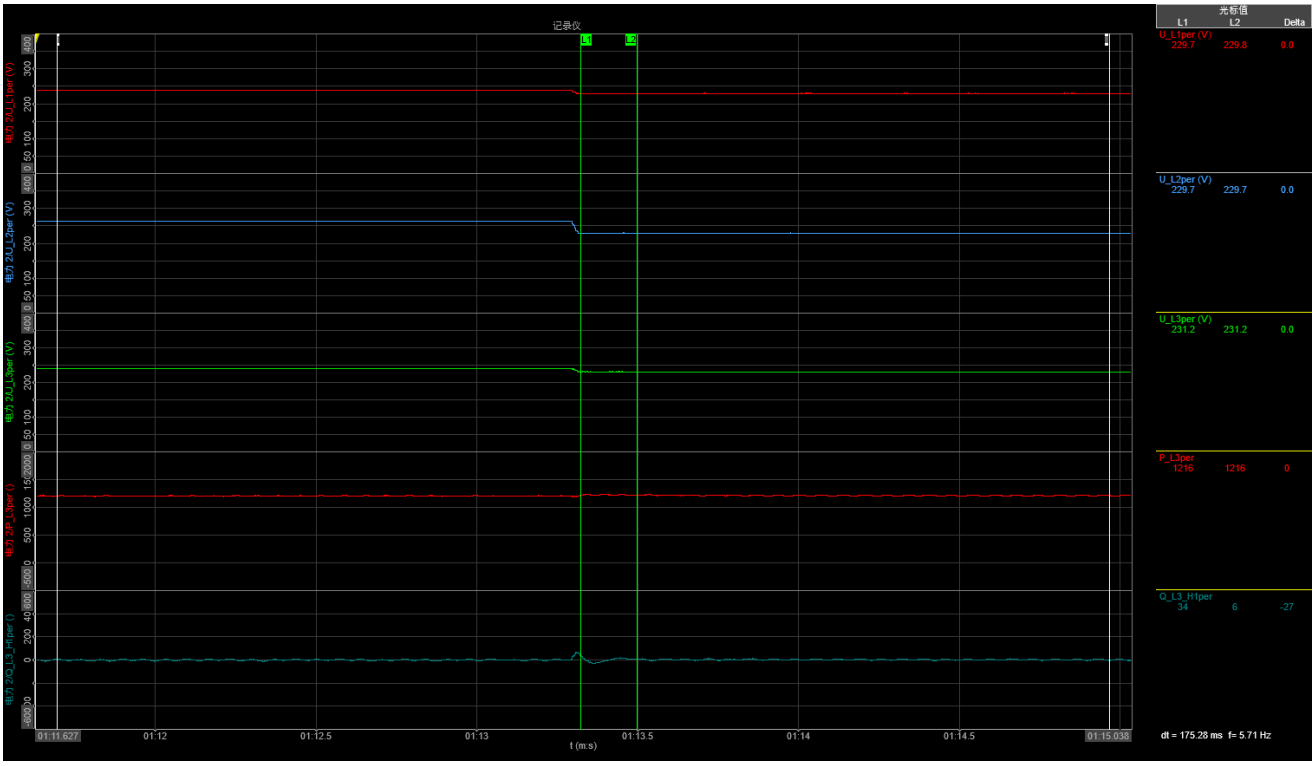
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

A17C53Z1-20



5.8.3	For PGUs Type 2 and storage systems	P

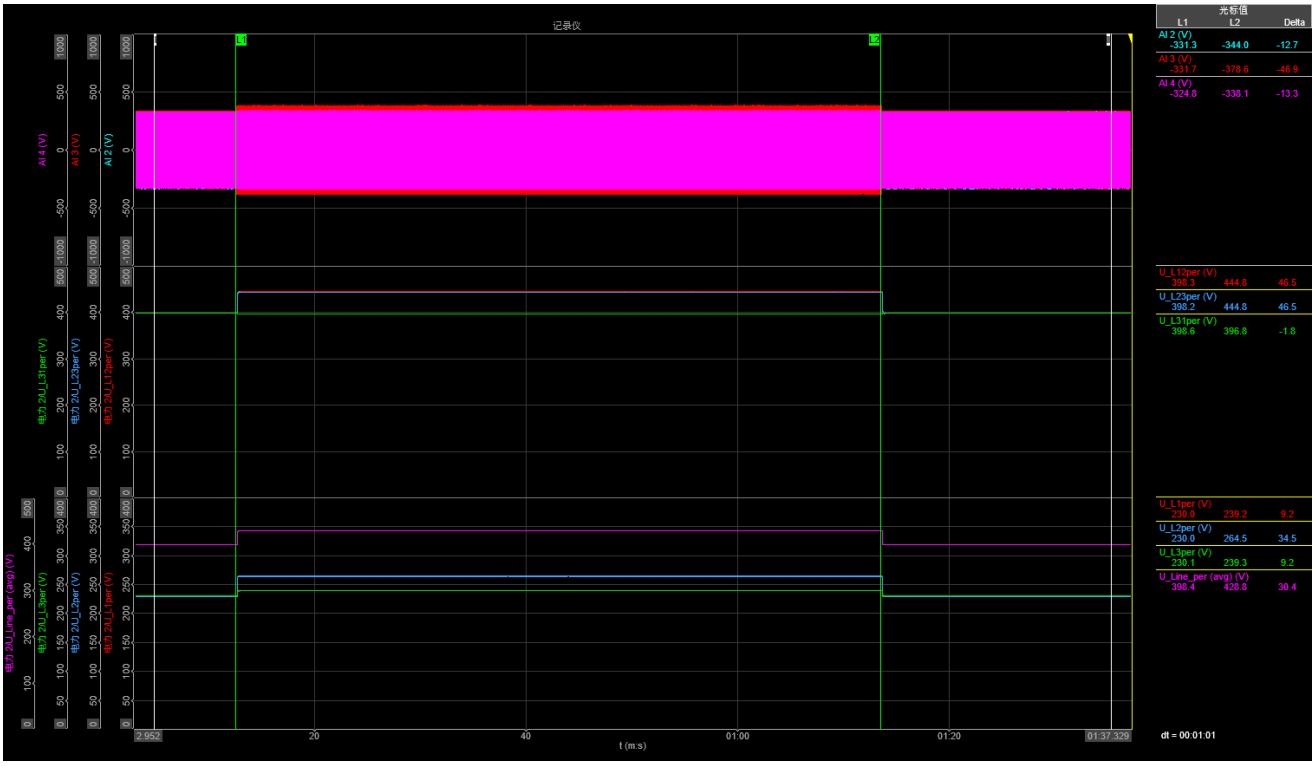
A17C53Z1-20

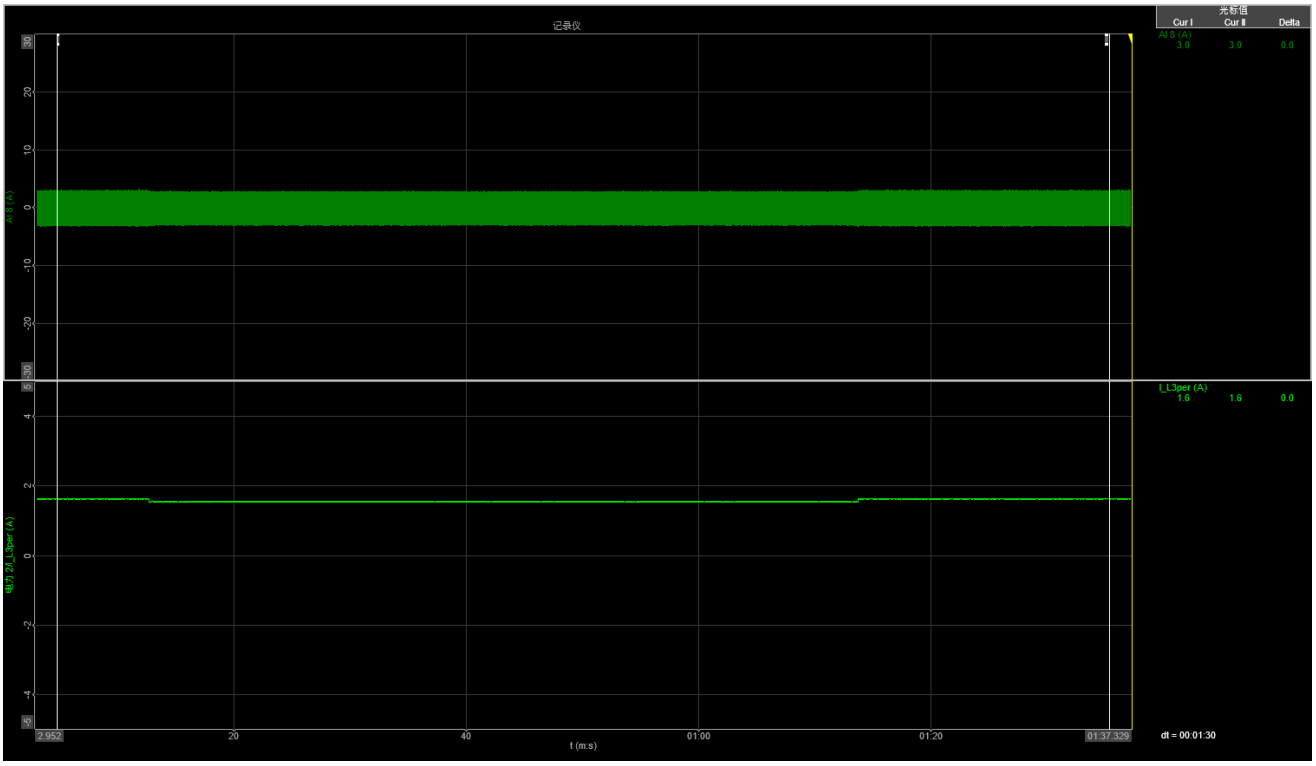
7.4

Condition						Measured value
Item	No.	Parameter	Phase ref.	Time ref.	unit	
General Info.	0	Test number	--	--	--	7.4
	1	Date	--	--	yyyy.mm.dd	2025/1/18
	2	Time (start of test)	--	--	hh:mm:ss.f	16:23:43
	3	Fault type (phase)	--	--	--	D1
	4	Setting voltage depth	Line to line	--	p.u.	1,15
	5	Setting dip duration		--	--	61000
	6	Point of fault entry	Total	--	ms	12650
	7	Point of fault clearance	Total	--	ms	73651
	8	Fault duration in empty load test	Total	--	ms	61001
	9	Voltage depth/height in empty load test	Total (Phase 1)	t1+100ms to t2 and t1-10s to t1	p.u.	1,040
	10		Total (Phase 2)			1,150
	11		Total (Phase 3)			1,040
	12		Positive sequence			1,075
Before dip <t1	13	Voltage	Phase 1	t1-10s to t1	p.u.	1,000
	14		Phase 2			1,000
	15		Phase 3			1,000
	16	Current	Pos.	t1-500ms to t1-100ms	p.u.	0,307
	17	Active power	Total	t1-10s to t1	p.u.	0,298
	18		Pos.			0,298
	19	Reactive power	Total	t1-10s to t1	p.u.	0,091
	20		Pos.			0,008
	21	Cosφ	Total	t1-10s to t1	--	0,957
During dip t1 to t2	22	Voltage	Phase 1	t1+100ms to t2-20ms	p.u.	1,040
	23		Phase 2			1,150
	24		Phase 3			1,040
	25	Line current	Phase 1	t1+60ms	p.u.	--
	26		Phase 2			--
	27		Phase 3			0,268
	28	Line current	Phase 1	t1+100ms	p.u.	--
	29		Phase 2			--
	30		Phase 3			0,288
	31	Active power	Total	t1+100ms to t2-20ms	p.u.	0,293
	32		Pos.			0,293
After dip > t2	33	Voltage	Phase 1	t2+3s to t2+10s	p.u.	1,000
	34		Phase 2			1,000
	35		Phase 3			1,000
	36	Active power	Total	t2+3s to t2+10s	p.u.	0,298
	37		Pos.			0,298
	38	Active power rising time	Total	--	s	0,199
	39	Reactive power	Total	t2+3s to t2+10s	p.u.	0,091
	40		Pos.			0,008
	41	Reactive power rising time	total	--	s	--
	42	PGU does not disconnect from grid till 60s after fault	--	t2 to t2+60s	Yes / No	Yes

5.8.3	For PGUs Type 2 and storage systems	P

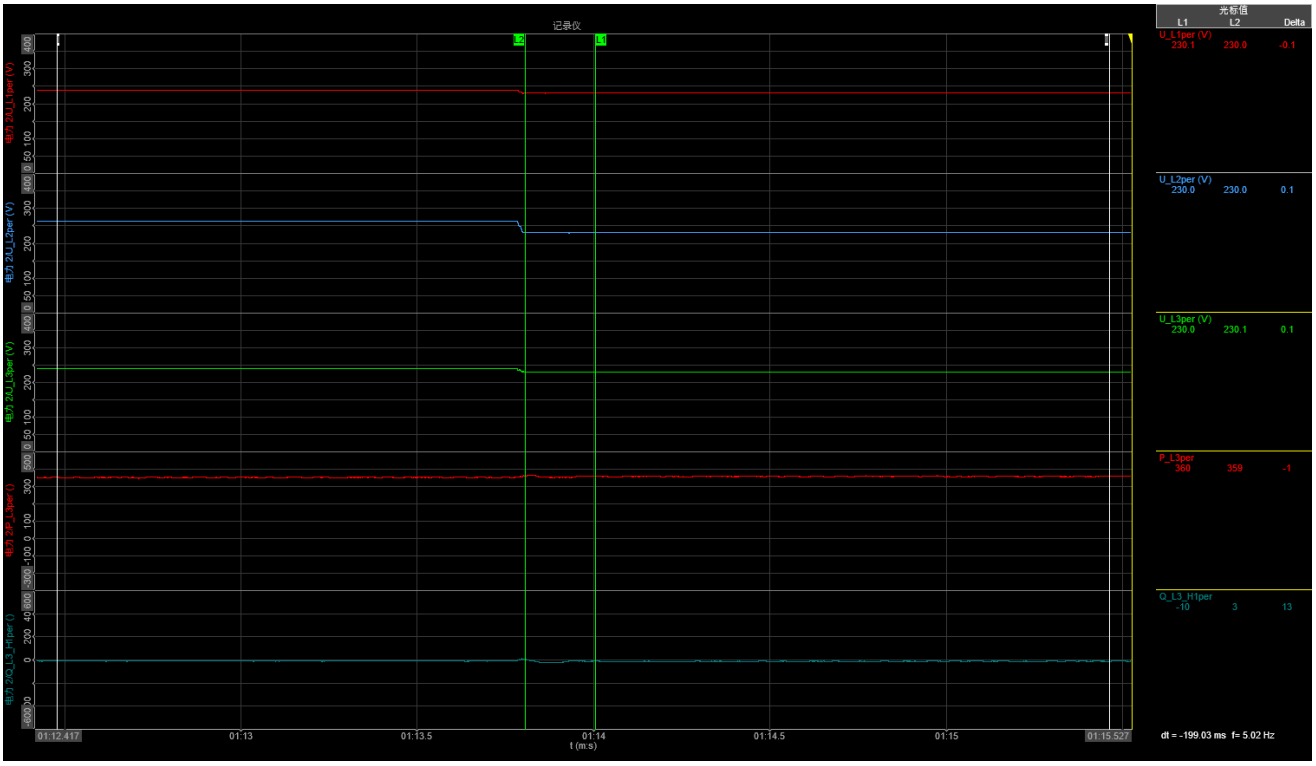
A17C53Z1-20





5.8.3	For PGUs Type 2 and storage systems	P

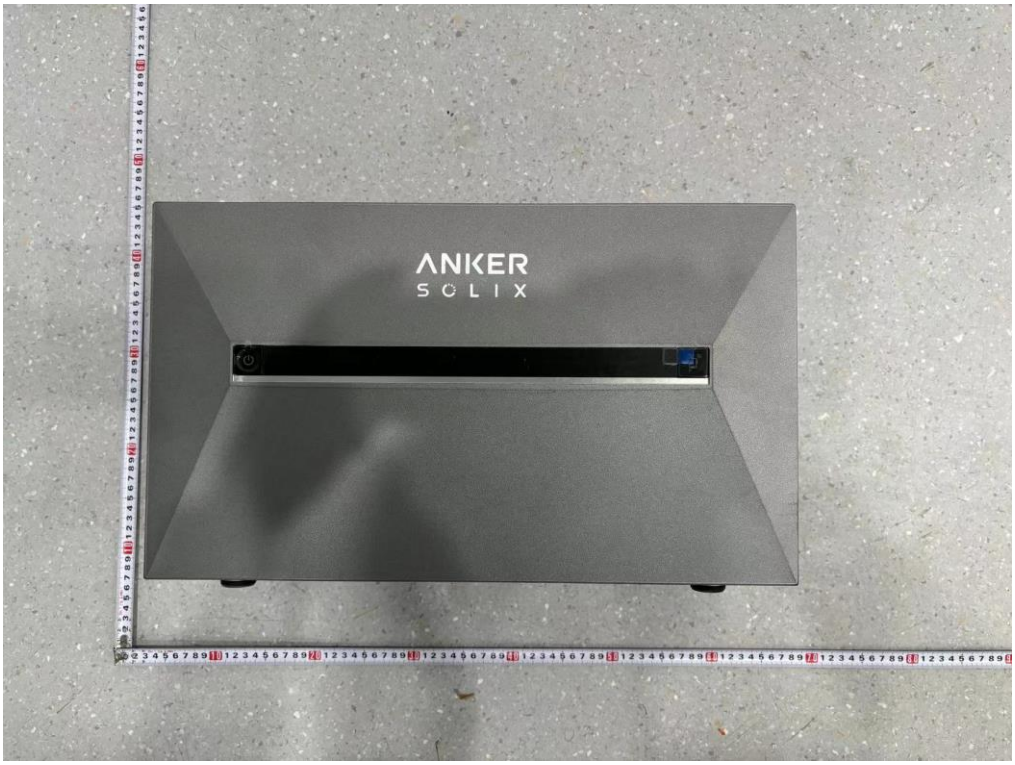
A17C53Z1-20



Annex 2 – Pictures of the unit

Photos of EUT

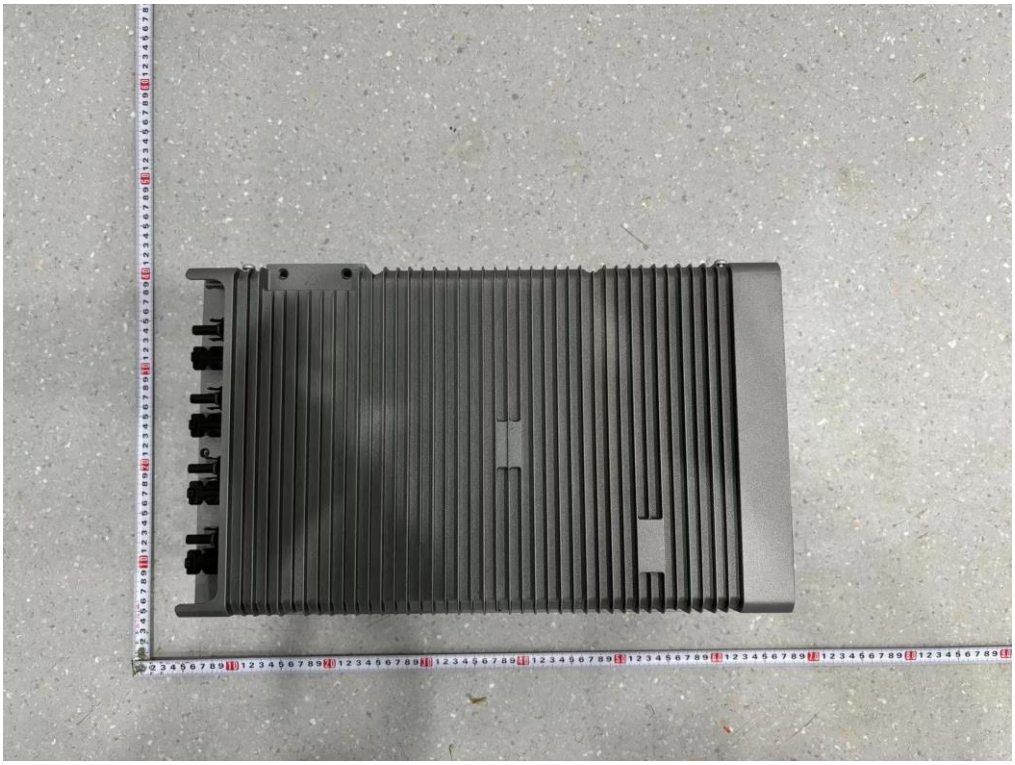
Enclosure front view of Inverter



Enclosure front view of (Inverter+5Battery)

Photos of EUT

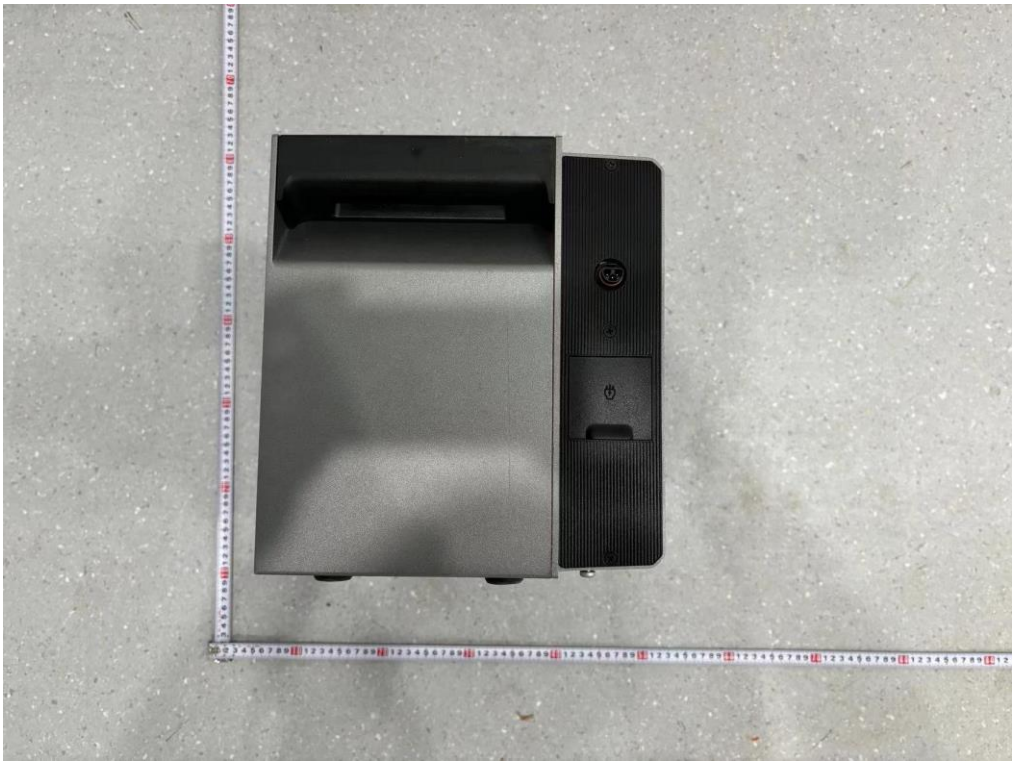
Rear view



Photos of EUT

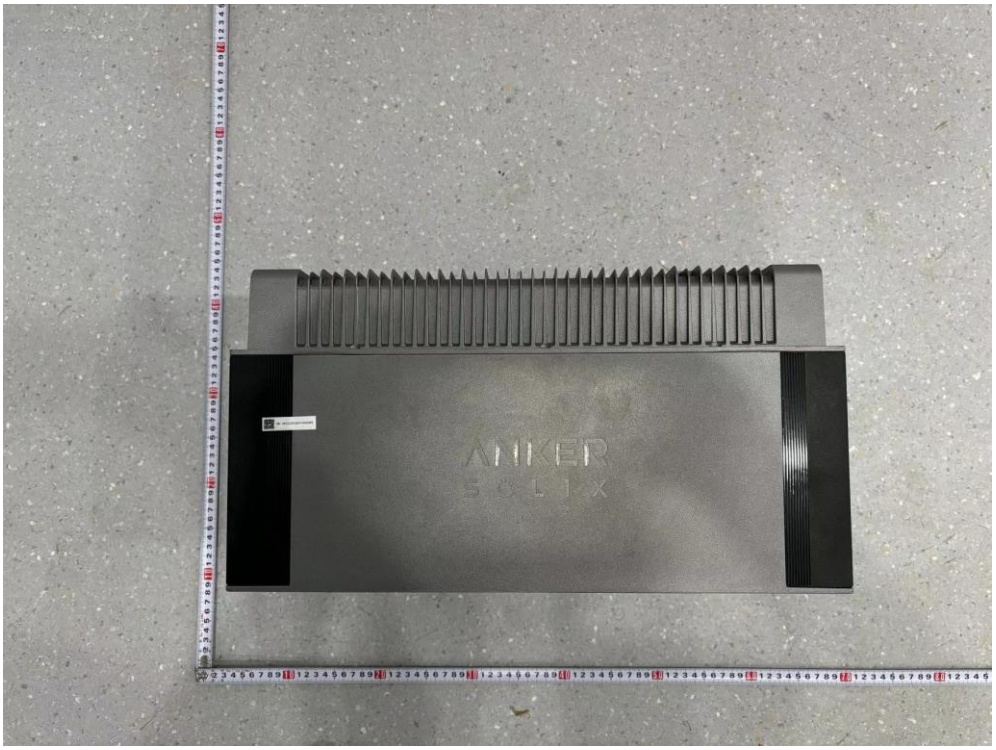
Side view-1

Side view-2



Photos of EUT

Top view

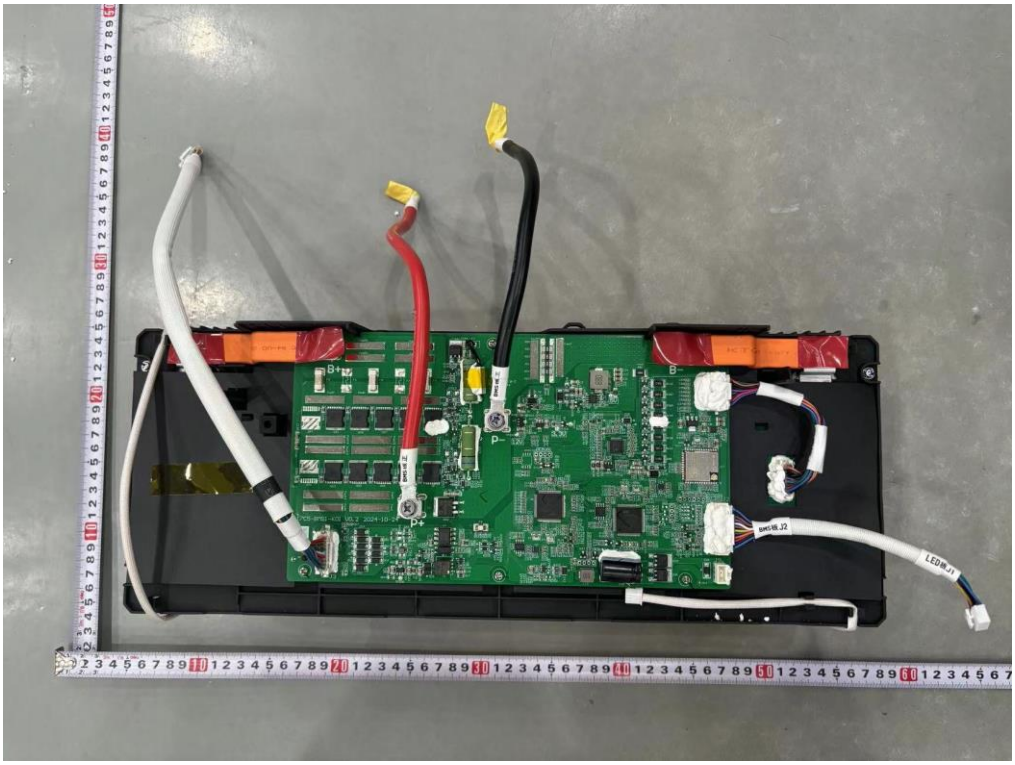


Bottom view

Photos of EUT

Internal view-1

Internal view-2



Annex 3 – Test equipment list

Date(s) of performance of tests: 2024-12-06 to 2025-01-18

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration
DC power supply	HC-ENG-052	KEWELL	S7000-21K-2000-0040	6018888220400696	Monitored by Power Analyzer
	HC-ENG-053	KEWELL	S7000-21K-2000-0040	6018888220501273	
AC simulator	HC-ENG-055	KEWELL	KAC-45-345-33	6018888220903254	
RLC Load	HC-ENG-058	Lyns-tci Technology Guangdong Co., Ltd.	IMAX3312-120KW	20230325002	
RL load bank	HC-ENG-068	EMAX	IMAX5005-RL	20211007	
Power analyser	HC-ENG-046	DEWEsoft	SIRIUSi-HS-4xHV-4xLV	DB20123915 DB20124350	2025-03-24
Current sensor		SIGNAL TEC	CT 400	1221300587	2025-03-24
		SIGNAL TEC	CT 400	1221300588	2025-03-24
		SIGNAL TEC	CT 400	1221300595	2025-03-24
		SIGNAL TEC	CT 400	1221300596	2025-03-24
Digital hygrometer	HC-ENG-002	Jiangsu Jingchuang Electric Co., Ltd.	GSP-8A	CMA215000031	2025-03-26
Digital phosphor Oscilloscope	--	YOKOGAWA	DLM3054	--	2025-04-28
	--	TEK	MD003034	--	2025-05-07

---End of test report--