Product Service

TEST REPORT

Standard VDE-AR-N 4105:2018

TUV SUD Test Report for Technical requirements for the connection of generator to and parallel operation with low-voltage distribution networks

Report No.:	64.290.22.30943.01
Date of issue:	2022-08-30
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Testing location:	as above
Client:	Myenergi Ltd
Client number:	117310
Address:	Pioneer Business Park, Faraday Way,Grimsby, DN41 8FF, UNITED KINGDOM
Contact person:	Louise McCormack
Standard:	This TUV SUD test report form is based on the following requirements: VDE-AR-N 4105:2018 and DIN VDE V 0124-100:2020.
TRF number and revision*:*	*T*RF VDE-AR-N 4105:2018 re*v.0/2018-11*
TRF originated by:	TUV SUD Product Service, Mr. Billy Qiu
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Scheme:	☐ TUV Mark ☒ Type verification of conformity ☐ GS Mark ☐ NRTL Mark ☐ EU-Directive
Non-standard test method:	☒ No ☐ Yes, see details under Summary of testing
National deviations:	N/A
Number of pages *(Report)*:	132
Number of pages *(Attachments)*:	N/A
Compiled by:	Wendy Zhao, Jenn Huang *(Printed Name and Signature)*
Approved by:	Kennen Wang *(Printed Name and Signature)*

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Test sample: Trademark: Model and/or type reference:	Hybrid inverter  LIBBI-HS3680, LIBBI-HS5000
Rating(s):	Refer to page 8
Manufacturer: Manufacturer number: Address:	Same as applicant Same as applicant Same as applicant
Sub-contractors/ tests (clause): Name:	N/A N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order: Date of receipt of test item: Date(s) of performance of test:	2021-01-15; 2022-06-07 2021-01-15 ; 2022-06-07 2021-01-15 to 2021-05-24; 2022-06-08 to 2022-08-30

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Test item particulars ..... :	
Equipment mobility ..... :	☐ movable ☐ hand-held ☒ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains ..... :	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category ..... :	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%) ..... :	+/- 10%
Tested for power systems ..... :	TN system
IT testing, phase-phase voltage (V) .....:	N/A
Class of equipment.....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .....:	30 kg (Approx.)
Pollution degree.....:	External: PD3, Internal: PD2
IP protection class .....:	IP 65
Possible test case verdicts:	
test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)
Possible suffixes to the verdicts:	
suffix for detailed information for the client:	C (Comment)
suffix for important information for factory inspection:	M (Manufacturing)

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Summary of testing:

Clause of DIN VDE V 0124-100	Requirement + Test
5.2.2	Rapid voltage change
5.2.3	Flicker
5.2.4&5.2.6	Harmonics and inter-harmonics& Feed-in of direct currents
5.4.2	Measurement of reactive and active power range
5.4.3	Reduction of active power by setpoint specification
5.4.4	Active power feed-in from EZE at overfrequency
5.4.6	Active power supply for EZE at underfrequency
5.4.8.3	Testing of the displacement factor/active power characteristic cos φ (P)
5.5.2 & 5.5.6.3	NA protection safety fault test
5.5.4 & 5.5.7.4	Integrated NA Protection and Protective devices and settings
5.5.7.2	Voltage monitoring (integrated protection and interface switch)-setting check
5.5.7.5	Reading the fault messages
5.5.9	Structural features of NA protection
5.5.10	Islanding detection
5.6	Connection conditions and synchronization
5.7	Proof of PAV,E monitoring
5.8	Proof of dynamic grid support

Remark: If no specification, all tests were conducted on model LIBBI-HS5000.

☐ deviation(s) found

☒ no deviations found

Additional information on Non-standard test method(s)

Sub clause: N/A

Page: N/A

Rational: N/A

If additional information is necessary, please provide

N/A

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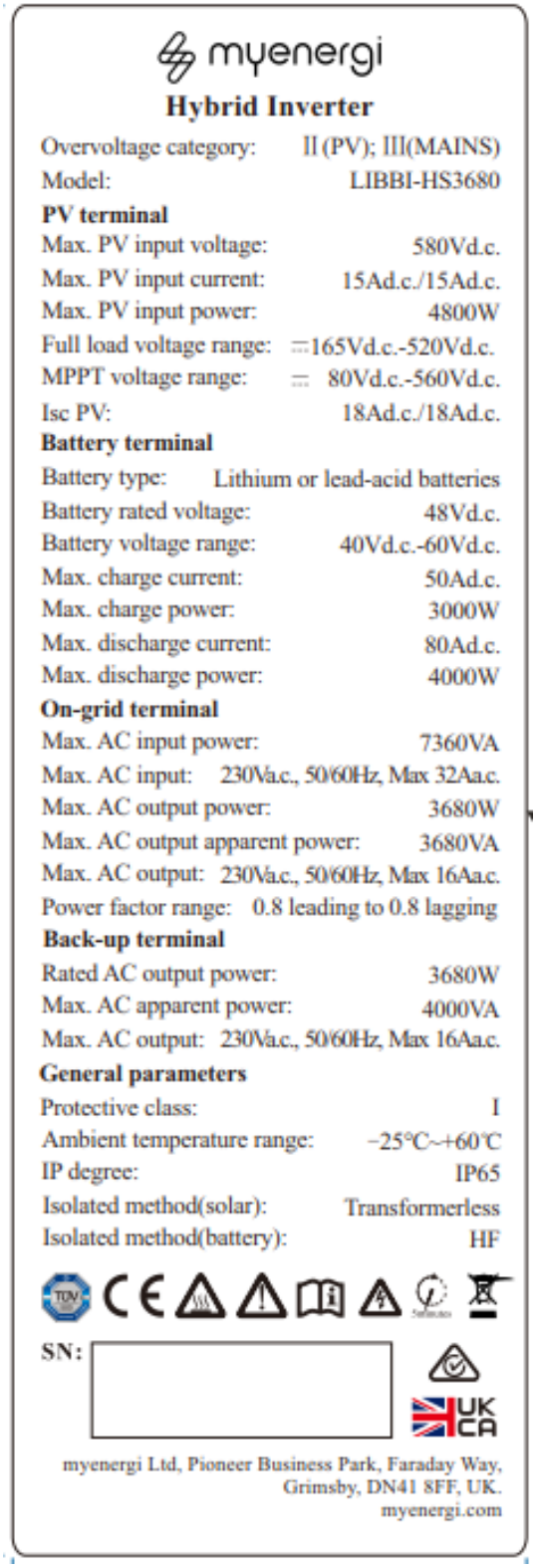
Copy of marking plate:



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Hybrid Inverter

Overvoltage category:	II (PV); III(MAINS)
Model:	LIBBI-HS3680
PV terminal	
Max. PV input voltage:	580Vd.c.
Max. PV input current:	15Ad.c./15Ad.c.
Max. PV input power:	4800W
Full load voltage range:	⎓165Vd.c.-520Vd.c.
MPPT voltage range:	⎓ 80Vd.c.-560Vd.c.
Isc PV:	18Ad.c./18Ad.c.
Battery terminal	
Battery type:	Lithium or lead-acid batteries
Battery rated voltage:	48Vd.c.
Battery voltage range:	40Vd.c.-60Vd.c.
Max. charge current:	50Ad.c.
Max. charge power:	3000W
Max. discharge current:	80Ad.c.
Max. discharge power:	4000W
On-grid terminal	
Max. AC input power:	7360VA
Max. AC input:	230Va.c., 50/60Hz, Max 32Aa.c.
Max. AC output power:	3680W
Max. AC output apparent power:	3680VA
Max. AC output:	230Va.c., 50/60Hz, Max 16Aa.c.
Power factor range:	0.8 leading to 0.8 lagging
Back-up terminal	
Rated AC output power:	3680W
Max. AC apparent power:	4000VA
Max. AC output:	230Va.c., 50/60Hz, Max 16Aa.c.
General parameters	
Protective class:	I
Ambient temperature range:	-25℃~+60℃
IP degree:	IP65
Isolated method(solar):	Transformerless
Isolated method(battery):	HF

SN:

myenergi Ltd, Pioneer Business Park, Faraday Way, Grimsby, DN41 8FF, UK.
myenergi.com

myenergi

Hybrid Inverter

Overvoltage category:	II (PV); III(MAINS)
Model:	LIBBI-HS5000
PV terminal	
Max. PV input voltage:	580Vd.c.
Max. PV input current:	15Ad.c./15Ad.c.
Max. PV input power:	6500W
Full load voltage range:	⎓210Vd.c.-520Vd.c.
MPPT voltage range:	⎓ 80Vd.c.-560Vd.c.
Isc PV:	18Ad.c./18Ad.c.
Battery terminal	
Battery type:	Lithium or lead-acid batteries
Battery rated voltage:	48Vd.c.
Battery voltage range:	40Vd.c.-60Vd.c.
Max. charge current:	100Ad.c.
Max. charge power:	4600W
Max. discharge current:	100Ad.c.
Max. discharge power:	5000W
On-grid terminal	
Max. AC input power:	7360VA
Max. AC input:	230Va.c., 50/60Hz, Max 32Aa.c.
Max. AC output power:	5000W
Max. AC output apparent power:	5000VA
Max. AC output:	230Va.c., 50/60Hz, Max 22Aa.c.
Power factor range:	0.8 leading to 0.8 lagging
Back-up terminal	
Rated AC output power:	4600W
Max. AC apparent power:	5000VA
Max. AC output:	230Va.c., 50/60Hz, Max 20Aa.c.
General parameters	
Protective class:	I
Ambient temperature range:	-25℃~+60℃
IP degree:	IP65
Isolated method(solar):	Transformerless
Isolated method(battery):	HF

SN:

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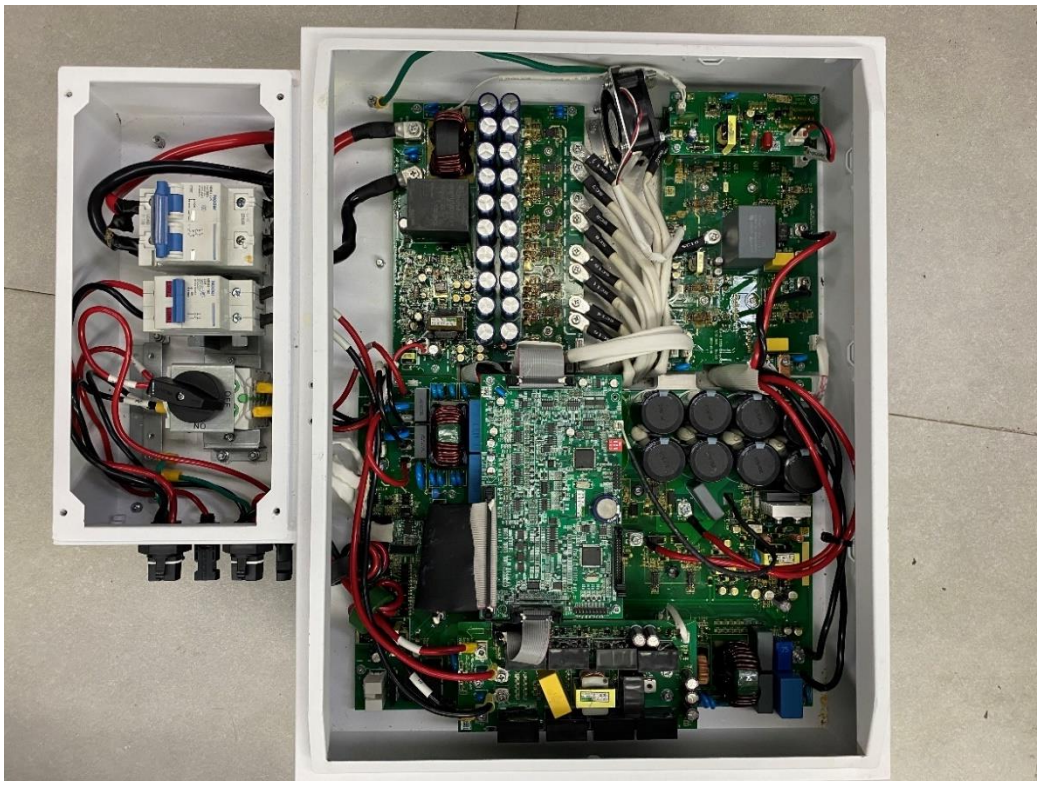
Picture of the product:



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Test item particulars:

1) The unit is non-isolated (transformerless) hybrid energy inverter for connection with public low voltage grid, for outdoor use. It has below operating modes:
   - PV to Grid mode;
   - PV to Load mode;
   - PV to Battery charge mode;
   - Grid to Battery charge mode;
   - Grid to Load bypass mode;
   - Battery to Grid discharge mode;
   - Battery to Load discharge mode.
2) The unit shall be used at specified ambient range. Temperature: -25 °C ~ +60 °C, Auto-derating at 45 °C; Humidity: 4% ~ 100%; Altitude: ≤ 2000 m; Overvoltage category: II (DC side), III (AC side).
3) The unit provides two relays in series on each phase between inverter output and grid terminal (L, N). The internal control is redundantly built. It contains a main DSP and a slave DSP. Both DSP can open relays independently and communicate with each other.
4) The battery circuit is not insulated from PV or grid circuit and considered as DVC-C circuit.
5) DVC-C terminal: backup load terminal, grid terminal, PV terminal, battery terminal, CAN terminal. DVC-A terminal: DRM terminal, COM terminal, CT/meter terminal.
6) The N wire of backup load will automatically disconnect from grid neutral when in stand-alone mode, if earth system is requirement, the setting of N line shall be changed.
7) This hybrid inverter is integrated with dedicated BESS as described in user manual.
8) Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the converter.
9) In order to protect the PCE, user and installer, external DC and AC circuit breaker shall be equipped at the end-use application.
10) Software version: ARMV1.0.2, DSPV1.0.3

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Characteristic data:

Model	LIBBI-HS3680	LIBBI-HS5000
PV terminal		
Vmax. PV	580Vd.c.	
Rate Voltage	400Vd.c.	
MPPT Voltage Range	80 ~ 560Vd.c.	
MPPT Voltage Range (full load)	165 ~ 520Vd.c.	210 ~ 520Vd.c.
MPPT Tracker number	2	
Max. continuous PV input current per tracker	15Ad.c.	
Isc PV per tracker	18Ad.c.	
Max. continuous PV input power	4800W	6500W
Battery terminal		
Battery type	Lithium or lead-acid batteries	
Voltage range	40 ~ 60Vd.c.	
Rated voltage	48Vd.c.	
Maximum charge/discharge current	50Ad.c./80Ad.c.	100Ad.c./100Ad.c.
Maximum charge/discharge power	3000W/4000W	4600W/4600W
Grid terminal parameter		
Rated voltage	230Va.c.	
Rated frequency	50Hz	
Rated input Current	20Aa.c.	
Maximum continuous input current	20Aa.c.	
Maximum continuous input power	4600VA	
Rated output Current	16Aa.c.	20Aa.c.
Maximum continuous output current	16Aa.c.	20Aa.c.
Power factor (Cos phi), adjustable	0.95 leading ~ 0.95 lagging	
Maximum continuous output power	3680VA	4600VA
PEmax, max. active power	3674W	4593W
SEmax, max apparent power	3676VA	4595VA
Back up load terminal parameter		
Rated voltage	230Va.c.	
Rated frequency	50Hz	
Rated output Current	16Aa.c.	20Aa.c.
Maximum continuous output current	16Aa.c.	20Aa.c.
Rated continuous output power	3680W	4600W
Maximum output apparent power	4000VA	4600VA

Model difference:
Model LIBBI-HS5000 is the basic model, LIBBI-HS3680 have the same PCB layout circuit, structure with LIBBI-HS5000, except the quantity of bus capacitor, and the power rating are limited by software.

Attachments:

N/A

General remarks:

"(see remark #)" refers to a remark appended to the report.
"(see appended table)" refers to a table appended to the report.
*Throughout this report **a dot** is used as the decimal separator.*
The test results presented in this report relate only to the object tested.
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Name and address of factory (ies) (only if certification is provided):

Shenzhen KSTAR Science & Technology Co., Ltd. Guangming Branch

Kstar High Tech Park, Guangming High Technology Town, Gongming Street, Baoan District 518107 Shenzhen City, Guangdong Province PEOPLE'S REPUBLIC OF CHINA

Possible test case verdicts:

test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

Possible suffixes to the verdicts:

suffix for detailed information for the client:	C (Comment)
suffix for important information for factory inspection:	M (Manufacturing)

Abbreviations used in the report:

Active power (P),
Reactive power (Q),
Apparent power (S),
Maximum apparent power of a power generation system (SAmax),
Maximum apparent power of a power generation unit (S_{EmaX}),
Maximum active power of a power generation system (P_{Amax}),
Maximum active power of a power generation unit (P_{EMax}),
Network short-circuit power (S_{kV}),
Point of common coupling (PCC),
Displacement factor (cos φ),
Power factor (λ),
Network impedance angle (ψ_k),
Short-term flicker strength (P_{st}),
Long-term flicker strength (P_{lt}),
Automatic reclosing (AR; geman: Automatische Widereinschaltung, AWE),
Power generation system (PGS; german: Erzeugungsanlage, EZA),
Power generation unit (PGU; german: Erzeugungseinheit, EZE),
Network and system protection (NS protection; german Netz- und Anlagenshutz, NA-Shutz),
Maximum switching current factor (K_{imax}),

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Clause	Requirement + Test	result – Remark	Verdict

VDE-AR-N 4105:2018			
5	Grid connection		P
5.1	Principles for determining the grid connection point	Considered for final PGS	N/A
5.2	Rating of grid operation equipment	Considered for final PGS	N/A
5.3	Permissible voltage change	Evaluated in 5.4	P
	For undisturbed operation of the network, the amount of the voltage change caused by all power generation systems with a network connection point in a low-voltage network shall at none of the PCCs in this network may a value of 3 % as compared with the voltage without power generation systems		P
5.4	Grid reaction		P
	The permissible limits for network repercussions are also described for generation plants and storage in VDE-AR-N 4100, 5.4. For the connection assessment of generation plants and storage, the connector provides the network operator with the completed preprints E.2 to E.5	Evaluated according to DIN VDE V 0124-100:2020, cl 5.2.2, see below table	P
5.5	Connection criteria		P
5.5.1	General		P
5.5.2	$P_{AV, E}$ monitoring (feed-in limitation)	Considered for final PGS	P
	The measurement of the feed-in limit described in this subsection must be carried out at the central meter panel according to VDE-AR-N 4100, 7.2		P
	If exceeding the PAV, E, the power of generation system and/or energy storage must be reduced within blue curve with specified time response according to Fig-1	Evaluated according to DIN VDE V 0124-100:2020, cl 5.7.2, see below table	P
5.5.3	Generation system ready for socket connection		N/A
5.6	Three-phase converter system		N/A
	In the case of three phase generation systems with grid feed-in via converters, the power must be fed three-phase symmetrically into the three outer conductors. The converter circuit is preferably to be built up as a rotary power unit. The positive sequence value must be used as a reference for the currents, even if the terminal voltages are not symmetrical.		N/A
5.7	Behaviour of the power generation system at the grid	See below table	P

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Clause	Requirement + Test	result – Remark	Verdict
5.7.1	General		P
	If the grid frequency is between 47.5Hz and 51.5Hz, disconnection from grid is not permitted. The active power output shall follow Cl. 5.7.4.3.		P
	The frequency/time requirement of operation of generation system are: 47.5Hz to 49.0Hz: >30 min; 49.0Hz to 51.0Hz: permanent; 51.0Hz to 51.5Hz: >30 min.	Declaration by manufacturer	P
	Generation unit must remain connection during rapid frequency change (RoCoF): +/- 2.0Hz/s for average time window of 0.5s; +/- 1.5Hz/s for average time window of 1s or +/-1.25Hz/s for average time window of 2s	Declaration by manufacturer	P
5.7.2	Static voltage supporting/Reactive power control		P
5.7.2.1	General range condition		P
	For static voltage supporting, the generation system should control reactive power to support slow (quasi-station) voltage change in distribution grid within agree limit		P
	The reactive power controlling process is described in Cl. 5.7.2.4 with 3 methods		P
	For energy storage system, during energy consumption from grid, the requirement should follow VDE-AR-N 4100		P
5.7.2.2	Reactive power control during S_{Emax}		P
	For type 2 system with only converter, the output displacement factor should cover the area described in Fig-2 or Fig-3	Evaluated according to DIN VDE V 0124-100:2020, cl 5.4.2, see below table	P
5.7.2.3	Reactive power control under P_{Emax}		P
	In addition, when active power is less than PEmax, the reactive power control should fulfil below requirement:		P
	The minimum reactive power control area shoul cover the red triangle P/Q diagram in Fig-5 or Fig-6. In the free operation area, a reduction of active power to facilitate reactive power is permitted		P
	The maximal deviation between setting value and actual value of the controlled reactive power should be 4.0% of S_{Emax}. In		P

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Clause	Requirement + Test	result – Remark	Verdict
	range of $0<P_{mom}/S_{Emax}<0.2$(or 0.1), the reactive power should be less than 10% of S_{Emax}.		
5.7.2.4	Behavior/process of reactive power control		P
	The static voltage supporting with reactive power control should not imfluence dynamic grid supporting. The generation system should control the reactive power within range described in Fig-5 or Fig-6 using one of below process of controlling reactive power. The selection of process is informed during plan of grid connection		P
	a) Reactive power-Voltage Q(U)		N/A
	The reference voltage UQ0 is 400V/1.732 and calculation method could be arithmetic average of RMS value of three L-N voltage or positive sequence voltage. The voltage measurement tolerance should be less than 1% of rated voltage		N/A
	The Q(U) control is only applicable to 3 phase generation unit and the requirement is performed on generation unit terminals		N/A
	b) Displacement factor-Active power cos phi (P)	Evaluated according to DIN VDE V 0124-100:2020, cl 5.4.8.3, see below table	P
	The displacement power factor is dependent on the actual active power output according to Fig-8 and Fig-9		P
	c) Fixed displacement factor cos phi		P
	The discplacement power factor is set as fixed value with minimal setting step value 0.01 and the maximal deviation between setting value and actual value of the controlled reactive power should be 4.0% of S_{Emax}.	Evaluated according to DIN VDE V 0124-100:2020, cl 5.4.8.2, see below table	P
5.7.2.5	Requirement for the reactive power process of Type 2 system and Type 1 system		P
	The control process of reactive power (process a, b and c) during setting value adjustment should follow PT-1 process of Fig-10. The PT-1 proecess 3 Tau should be settable between 6s and 60s for Type 2 system with default setting as 10s.		P
5.7.2.6	Particular requirement during extension of generation system	Considered for final PGS	N/A
5.7.3	Dynamic grid supporting		P
5.7.3.1	General		P

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Clause	Requirement + Test	result – Remark	Verdict
	A grid fault start if the voltage at generation unit terminals is under 0.85 Un or over 1.15Un.		P
	The grid fault ends when one of below two things happen in earlier: The voltage of generation unit recover to range -15% Un to +10% Un or 5s after the start of the fault		P
	Generation unit in mode “Energy supply” and Energy storage in mode “Energy supply” and “Energy consumption” should have dynamic grid support function	With battery terminal in “Energy supply” and “Energy consumption mode”	P
	During grid fault, the generation unit and energy storage should fulfil below requirements in both balanced and unbalanced grid fault:		P
	- No disconnection from the grid		P
	- Overvoltage upto 1.2Un for period of 5s		P
	- Type 2 unit and energy storage should not feed-in active or reactive current into grid during fault.		P
	- Generation unit and energy storage should endure multiple grid faults followed		P
	The FRT-Limit-Curve according to Fig-11 and Fig-12 is applicable to 1-, 2- and 3-phases fault		P
5.7.3.2	Dynamic grid supporting for Type 1 unit		N/A
5.7.3.3	Dynamic grid supporting for Type 2 unit and energy storage		P
	The output current at all terminals should be limited less than 20% of rated current in 60ms and 10% of rated current in 100ms		P
	Behavior after end of fault: Active current should recover back to normal value before fault within 1s after end of fault		P
5.7.4	Active power output	See below table	P
5.7.4.1	During active power remote control required by grid security management, the change should fulfil power gradient requirement. The adjustment of power gradient direct on generation unit or energy storage is sufficient to fulfil the requirement: Not faster than 0.66% P_{Amax}/s;	Evaluated according to VDE V 0124-100:2020, cl 5.4.3, see below table	P

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Clause	Requirement + Test	result – Remark	Verdict
	Not slower than 0.33% P_{Amax}/s. For genertation system not slower than 4% P_{Amax}/minute		
	The generation system and energy storage shoul have a logic interface to receive active power order within 5s after sending by grid operator.		P
5.7.4.2	Grid security management		P
5.7.4.2.1	Generation system and energy storage		P
	For PV system less than 30kWp, the certified technical control limited to 70% of installed module power of grid connection point or PV system is equiped with remote active power control for limitation	RS 485 comunication port provided	P
	For PV system large than 30kWp and less than 100kWp, it should be equipped with remote active power control for limitation		N/A
	For PV system large than 100kWp, it should be equipped with remote active power control for limitation and report feed-in power in real time.		N/A
	For Energy storage used in EEG or KWK-G system, if the PAmax>100kW, it should be equipped with remote active power control for limitation and report feed-in power in real time.		N/A
5.7.4.2.2	Implementation of network security management	See below table	P
	The generation system and energy storage should control its active power without grid disconnection to 100%/60%/30%/0% of P_{Amax}.		P
5.7.4.3	Active power adjustment during over and under frequency	See below table	P
	If the network frequency falls out of tolerance band of +/-200mHz from rated frequency of 50.0Hz, all generation unit and energy storage connected to the grid shall support grid stability by frequency regulation.		P
	The accuracy of frequency measurement must be <10mHz.		P
	For DC-coupling energy storage, type-2 unit is regarded.		P
	During frequency change, the active power output should fulfil Fig-13, Fig-14 and/or Fig-15	For overfrequency evaluated according to DIN VDE V 0124-100:2020, cl 5.4.4. For	P

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		underfrequency evaluated according to DIN VDE V 0124-100:2020, cl 5.4.6.	
5.7.4.4	Active power reduction depend on voltage is not required in this technical requirement		N/A
5.7.5	Short circuit contribution		P
6	Construction of the power generation system/network and system protection (NS-protection)		P
6.1	General requirements	The PGU include integrated interface switch and is type-tested in report.	P
6.2	Central NS protection		N/A
6.3	Integrated NS protection		P
6.4	Interface switch		P
6.4.1	The disconnection switch is used for NS protection can can be used as switch device in single generation unit (integratged interface switch)	Integrated power relay in the PGU. Each live conductor is constructed with two relays comply with A.6 requirement.	P
	The interface switch must be designed and rated for the conditional short-circuit current and taking into account the protective devices required by 6.5. The switching ability of the interface switch is to be measured according to the higher value from the rated current of the upstream fuse and maximum initial short-circuit current contribution of the generation plant. The function control of the interface switch is to be realized according to a) or b) or (c):		P
	a) Using a interface switch, that switch-on with control voltage and can automatic switch-off without voltage supply. The switch on-off state can be monitored		P
	b) Minimum once daily check of on-off switch with the NS protection and monitoring of normal functions of interface switch		P
	c) Using integrated interface switch and integrated NS protection for PV and ESS inverter according to DIN EN 62109	The interface switches fulfil DIN EN 62109, refer to related report.	P
	If a defect is detected, the generation system should not feed-in grid and not reconnect to grid	If a defect is detected, the device shut down.	P
	The interface switch should switch all line conductors. In TT system, all pole disconnection should be realized. In this	Interface switches switch all conductors.	P

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	condition, the interface switch as grid disconnection device during islanding operation, it should comply with VDE-AR-E 2510-2	VDE-AR-E 2510-2 should be consider in final installation.	
6.4.2	Central interface switch	Without central interface switch	N/A
6.4.3	Integrated interface switch		P
6.5	Protective devices for the interface switch		P
6.5.1	General		P
	The specification given in 6.5.2 do not refer to the short-circuit protection, overload protection, electric shock protection and all-phase separator. The protection function may have to be extended by the connection owner if applicable		P
	The protection function shall be implemented as follows: Voltage drop protection U< Rise-in-voltage protection U> Rise-in-voltage protection U>> Frequency decrease protection f< Frequency increase protection f> Islanding detection.	See below table	P
	Voltage protection devices should utilize the half-wave r.m.s value of 50Hz.		P
	The rise-in voltage protection U> shall be designed as 10 minute mean value as required in DIN EN 50160 (power quality). The formation of a new 10 minute mean value shall be at least every 3s.		P
	For PGS up to 30kVA, the voltage protection shall be measured between line and neutral	The voltage protection function in the PGU integrated NS protection is designed between line and neutral.	P
	For PGS more than 30kVA, the voltage protection shall be measured between line and neutral. The line to line voltage shall be determined or measured.	For use in PGS more than 30kVA, central NS protection is needed.	N/A
	Frequency protection may be designed as single-phase equipment		P
	The setting value of protection function and the last five dated failure report shall be readable at the NS protection. Interruption of supply shall not lead to loss of any failure report. Read-out shall be possible for central protection without any additional aid. For integrated NS protection read-out may use a data interface.		P

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6.5.2	The protection function setting should follow Table 2		P
	The rise-in-voltage protection U> can be 1.1 to 1.15 Un, if used for up to 30kVA with only integrated NS protection, 1.1Un setting shall not be changed.		P
	The tolerance of the setting value and trip value of voltage shall be maximum +/-1% and frequency +/-0.1%		P
6.5.3	Islanding detection		P
	The testing method is according to DIN EN 62116. Detection of an isolated network and disconnection of PGS shall be within 2s.	Evaluated according to DIN VDE V 0124-100:2020, cl 5.5.10, see below table	P
6.6	Other requirements for generation system		N/A
6.6.1	Ability to provide primary control power is not required in the technical requirement. If this function is included, reference to VDE-AR-N 4120, 10.5.3		N/A
6.6.2	Ability to provide secondary control and minute reserve is not required in the technical requirement. If this function is included, reference to VDE-AR-N 4120, 10.5.4		N/A
7	Metering for billing purpose		N/A
8	Operation of the system		P
8.1	General		P
8.2	Particular characteristics of the management of the network operator's network		N/A
8.3	Connection conditions and synchronisation	Evaluated according to DIN VDE V 0124-100:2020, cl 5.6, see below table	P
8.4	Particular requirement of plan, installation and in operation of generation system and energy storage with $P_{Amax} \geq 135kW$		N/A
9	Verification of electric features		P
Annex A	Explanation (informative)		P
Annex B	Measurement concepts (informative)		P
Annex C	Examples of meter panel configurations (informative)		P
Annex D	Example of connection assessment of generation plants – connection of a 20 kW photovoltaic plant (informative)		P
Annex E	Form (Normative)		P

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5.2.2	TABLE: Rapid voltage change							P
Nominal current of PGU I_n (A)			20		The k_{imax} value:			1.00
Test frequency (Hz)			50Hz		--			--
Switching action		Ia (A)			U(V)			ki
A	--	L1	L2	L3	L1	L2	L3	--
	#1	9.7	--	--	230.7	--	--	0.485
	#2	8.9	--	--	231.2	--	--	0.445
	#3	8.9	--	--	230.9	--	--	0.445
B	--	L1	L2	L3	L1	L2	L3	--
	#1	10.1	--	--	230.6	--	--	0.505
	#2	10.0	--	--	230.5	--	--	0.500
	#3	10.0	--	--	231.3	--	--	0.500
C	--	L1	L2	L3	L1	L2	L3	--
	#1	19.7	--	--	231.5	--	--	0.985
	#2	19.4	--	--	231.3	--	--	0.970
	#3	18.8	--	--	232.0	--	--	0.940
D	--	L1	L2	L3	L1	L2	L3	--
	#1	20.0	--	--	231.4	--	--	1.000
	#2	19.9	--	--	231.8	--	--	0.995
	#3	19.9	--	--	231.6	--	--	0.995
Supplementary information: Choose the applicable case for the tested EZE. Each case shall be measured for three times.								

5.2.3	TABLE: Flicker				P
Simulated network voltage (V)	L1 (P-N)	230Va.c.	Network impedance	L1	0.24+j0.15
	L2(P-N)	--		L2	--
	L3(P-N)	--		L3	--
	--	--		N	0.24+j0.15
EZE operating current (A)	L1	20A	EZE operating power (kVA)	L1	4.6kVA
	L2	--		L2	--
	L3	--		L3	--
Simulated network frequency (Hz)	50		Short circuit power Sk (VA)	187k	
Plt (Maximum measured	0.136		EZE nominal	4.6k	

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Pst)		powerPn (W)	
Maximum flicker coefficient Cφk	3.25	--	--

Pst	#1	#2	#3	#4	#5	#6
L1	0.176	0.180	0.144	0.182	0.110	0.098
L2	--	--	--	--	--	--
L3	--	--	--	--	--	--
Pst	#7	#8	#9	#10	#11	#12
L1	0.107	0.109	0.116	0.098	0.100	0.109
L2	--	--	--	--	--	--
L3	--	--	--	--	--	--

Supplementary information:
The table is only applied to EZE with nominal current less than 75A.

5.2.4 & 5.2.6	TABLE: Harmonics and inter-harmonics& Feed-in of direct currents	P

Harmon. Nr.	P/P_{Emax}											Limit (%)
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
0	0.00	0.00	0.12	0.15	0.07	0.08	0.04	0.02	0.05	0.13	0.03	0.5
1	99.93	99.93	99.94	99.98	99.98	99.99	99.99	99.99	99.99	99.99	99.98	-
2	0.64	0.94	0.30	0.31	0.35	0.20	0.13	0.12	0.09	0.07	0.20	8.0
3	0.65	3.04	2.07	1.36	1.28	1.15	1.21	1.25	1.25	1.30	1.41	-
4	0.24	0.37	0.06	0.03	0.09	0.03	0.03	0.01	0.01	0.03	0.12	4.0
5	0.92	1.70	1.68	0.83	0.74	0.57	0.61	0.48	0.49	0.51	0.67	10.7
6	0.52	0.24	0.05	0.03	0.08	0.05	0.04	0.05	0.02	0.03	0.11	2.67
7	0.37	0.88	1.41	0.65	0.57	0.50	0.54	0.40	0.43	0.35	0.44	7.2
8	0.36	0.23	0.14	0.06	0.11	0.03	0.06	0.06	0.04	0.04	0.10	2.0
9	0.20	0.73	1.27	0.42	0.48	0.47	0.49	0.39	0.45	0.36	0.43	-
10	0.29	0.12	0.05	0.11	0.19	0.13	0.10	0.05	0.09	0.02	0.13	1.6
11	0.61	0.52	0.94	0.26	0.40	0.39	0.39	0.26	0.40	0.34	0.41	3.1
12	0.32	0.08	0.09	0.07	0.11	0.05	0.05	0.03	0.03	0.02	0.09	0.33
13	0.13	0.36	0.72	0.32	0.29	0.30	0.31	0.18	0.29	0.26	0.35	2.0
14	0.16	0.04	0.04	0.05	0.09	0.03	0.02	0.02	0.06	0.03	0.05	-
15	0.50	0.34	0.52	0.20	0.19	0.12	0.18	0.14	0.21	0.19	0.23	-
16	0.33	0.05	0.06	0.03	0.06	0.03	0.02	0.03	0.03	0.02	0.06	-
17	0.12	0.27	0.37	0.16	0.09	0.09	0.08	0.10	0.14	0.14	0.10	-
18	0.14	0.07	0.04	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.03	-
19	0.18	0.18	0.28	0.09	0.05	0.06	0.05	0.07	0.08	0.07	0.05	-
20	0.48	0.07	0.03	0.05	0.02	0.00	0.03	0.02	0.02	0.03	0.05	-
21	0.54	0.13	0.22	0.04	0.00	0.02	0.04	0.04	0.04	0.03	0.02	-
22	0.61	0.01	0.02	0.02	0.03	0.01	0.00	0.02	0.00	0.01	0.01	-
23	0.28	0.15	0.12	0.04	0.03	0.03	0.03	0.02	0.01	0.02	0.02	-
24	0.65	0.01	0.01	0.02	0.03	0.00	0.01	0.01	0.02	0.02	0.01	-
25	0.37	0.10	0.09	0.02	0.05	0.03	0.02	0.02	0.01	0.02	0.00	-
26	0.88	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	-

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27	0.53	0.07	0.06	0.02	0.02	0.01	0.02	0.01	0.00	0.01	0.02	-
28	0.17	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	-
29	0.65	0.08	0.05	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	-
30	0.57	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	-
31	0.68	0.06	0.04	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	-
32	0.32	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	-
33	0.63	0.05	0.03	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	-
34	0.50	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
35	0.17	0.04	0.02	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.01	-
36	0.96	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
37	0.52	0.03	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	-
38	0.57	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
39	0.91	0.04	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	-
40	0.69	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
THD	3.04	3.60	3.30	1.73	1.66	1.44	1.51	1.39	1.46	2.04	2.36	13
PWHD	15.46	2.36	3.13	1.18	1.02	0.72	0.87	0.82	1.13	1.03	1.11	22

5.4.2 & 5.4.8.2	**TABLE: Measurement of reactive and active power range**	P

	$S_{Emax600}$ (VA)	$P_{Emax600}$(W)
LIBBI-HS3500	3676	3674
LIBBI-HS5000	4595	4593

5.4.2	Reactive and active power range, For S_{Emax}>4.6kVA Cosφ =0.90, other 0.95 (or max. under and over for manufacturer declares), test 10min

Model	LIBBI-HS3500							
Test voltage	Cosφ setting	P_{600} [W]	Q_{600} [Var]	S_{600} [VA]	Cosφ 600	U [V]		
						L1	L2	L3
0.90 Un	1.00	3306	-101	3308	0.9993	208.26	-	-
1.00 Un	1.00	3674	-49	3676	0.9994	231.24	-	-
1.09 Un	1.00	3674	43	3676	0.9996	251.90	-	-
0.95 Un	0.95 un	3321	1050	3483	0.9535	219.76	-	-
1.00 Un	0.95 un	3486	1134	3666	0.9509	231.15	-	-
1.09 Un	0.95 un	3475	1159	3663	0.9486	251.85	-	-
0.90 Un	0.95 ov	3127	-1065	3304	0.9466	208.26	-	-
1.00 Un	0.95 ov	3486	-1140	3668	0.9504	231.19	-	-
1.05 Un	0.95 ov	3497	-1108	3668	0.9533	242.59	-	-
Model	LIBBI-HS5000							
Test voltage	Cosφ setting	P_{600} [W]	Q_{600} [Var]	S_{600} [VA]	Cosφ 600	U [V]		
						L1	L2	L3
0.90 Un	1.00	4133	-132	4136	0.9993	208.29	-	-
1.00 Un	1.00	4589	-57	4592	0.9994	231.22	-	-
1.09 Un	1.00	4593	-55	4595	0.9996	251.89	-	-
0.95 Un	0.95 un	4150	1312	4352	0.9535	219.76	-	-

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1.00 Un	0.95 un	4355	1416	4579	0.9510	231.09	-	-
1.09 Un	0.95 un	4343	1447	4578	0.9487	251.87	-	-
0.90 Un	0.95 ov	3908	-1332	4129	0.9465	208.26	-	-
1.00 Un	0.95 ov	4355	-1421	4581	0.9507	231.18	-	-
1.05 Un	0.95 ov	4368	-1387	4583	0.9531	242.59	-	-

5.4.8.2	**Checking reactive power / displacement factor setting accuracy**				P
Case a) Tested at Nominal voltage 0.90 Un, test 1min					
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95un	0.95un	0.98un	0.98un
Cosφ 60		0.9556un	0.9539un	0.9828un	0.9795un
P_{60} (W)		2310	3932	2311	4060
Q_{60} (Var)		711	1236	432	835
S_{60} (VA)		2416	4122	2351	4145
U_{60} [V]	L1	207.65	208.25	207.62	208.27
	L2	-	-	-	-
	L3	-	-	-	-
Required Q (Var)		756	1361	467	841
Percentage of max Q ($\%P_{Emax}$)		0.98%	2.72%	0.76%	0.13%
Tolerance with 4% $P/_{Emax}$		Yes	Yes	Yes	Yes
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95ov	0.95ov	0.98ov	0.98ov
Cosφ 60		0.9483ov	0.9469ov	0.9800ov	0.9822ov
P_{60} (W)		2303	3910	2307	4052
Q_{60} (Var)		-770	-1328	-467	-774
S_{60} (VA)		2429	4130	2354	4125
U_{60} [V]	L1	207.61	208.21	207.64	208.28
	L2	-	-	-	-
	L3	-	-	-	-
Required Q (Var)		-756	-1361	-467	-841
Percentage of max Q ($\%P_{Emax}$)		0.30%	0.72%	0.00%	1.46%
Tolerance with 4% SEmax		Yes	Yes	Yes	Yes
Case b): Tested at Nominal voltage 1.0Un, test 1min					
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95un	0.95un	0.98un	0.98un
Cosφ 60		0.9506un	0.9514un	0.9799un	0.9807un
P_{60} (W)		2305	4357	2306	4496
Q_{60} (Var)		753	1410	469	895
S_{60} (VA)		2425	4581	2353	4584
U_{60} [V]	L1	230.81	231.21	230.73	231.21
	L2	-	-	-	-
	L3	-	-	-	-

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Required Q (Var)		718	1436	458	915
Percentage of max Q (%S_{Emax})		0.76%	0.57%	0.24%	0.43%
Tolerance with 4% S_{Emax}		Yes	Yes	Yes	Yes
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95ov	0.95ov	0.98ov	0.98ov
Cosφ $_{60}$		0.9533ov	0.9507ov	0.9830ov	0.9812ov
P_{60} (W)		2299	4358	2303	4500
Q_{60} (Var)		-727	-1421	-429	-885
S_{60} (VA)		2412	4584	2343	4587
U_{60} [V]	L1	230.77	231.13	230.73	231.18
	L2	-	-	-	-
	L3	-	-	-	-
Required Q (Var)		-718	-1436	-458	-915
Percentage of max Q (%S_{Emax})		0.20%	0.32%	0.63%	0.65%
Tolerance with 4% S_{Emax}		Yes	Yes	Yes	Yes
Case c): Tested at Nominal voltage 1.1Un, test 1min					
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95un	0.95un	0.98un	0.98un
Cosφ $_{60}$		0.9455un	0.9486un	0.9771un	0.9792un
P_{60} (W)		2305	4344	2305	4489
Q_{60} (Var)		793	1449	498	931
S_{60} (VA)		2438	4579	2359	4584
U_{60} [V]	L1	253.53	254.14	253.57	254.17
	L2	-	-		
	L3	-	-		
Required Q (Var)		718	1436	458	915
Percentage of max Q (%SEmax)		1.63%	0.28%	0.87%	0.35%
Tolerance with 4% S_{Emax}		Yes	Yes	Yes	Yes
P/S_{Emax} (%)		50	100	50	100
Cosφ setting		0.95ov	0.95ov	0.98ov	0.98ov
Cosφ $_{60}$		0.9572ov	0.9545ov	0.9853ov	0.9835ov
P_{60} (W)		2298	4372	2302	4509
Q_{60} (Var)		-693	-1367	-397	-828
S_{60} (VA)		2401	4581	2336	4585
U_{60} [V]	L1	253.56	254.13	253.53	254.13
	L2	-	-	-	-
	L3	-	-	-	-
Required Q (Var)		-718	-1436	-458	-915
Percentage of max Q (%S_{Emax})		0.54%	1.72%	1.33%	1.89%
Tolerance with 4% S_{Emax}		Yes	Yes	Yes	Yes

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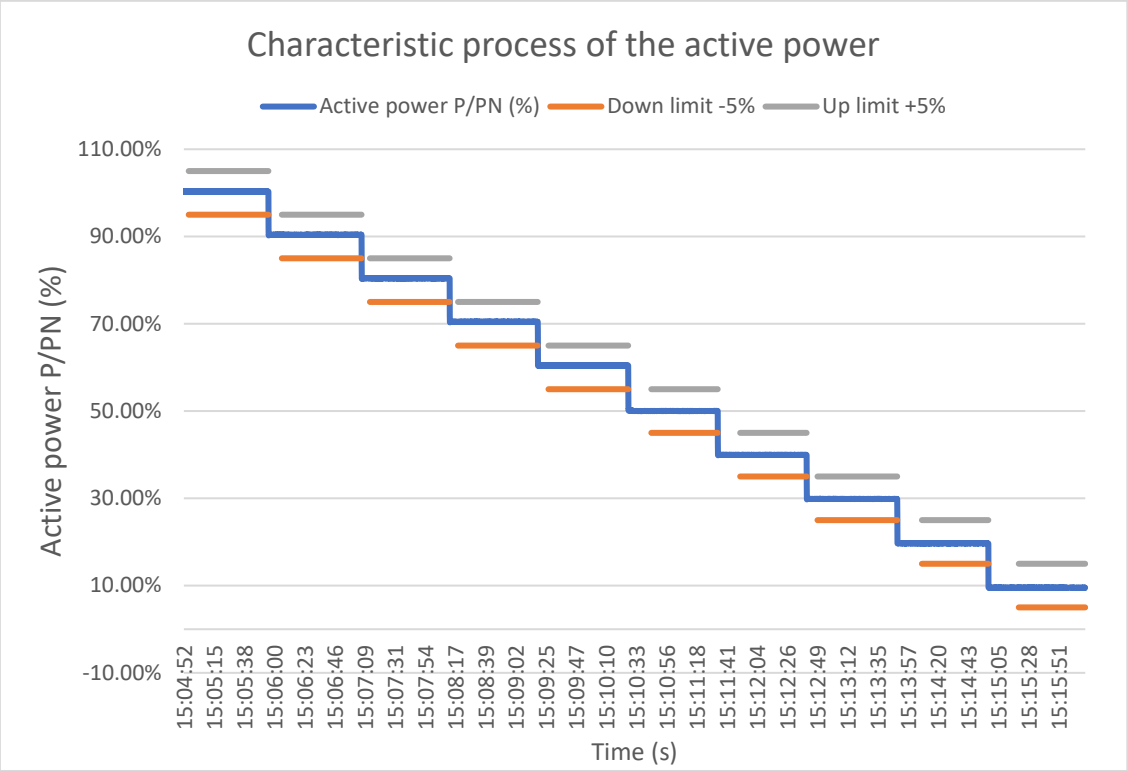
Clause	Requirement + Test	result – Remark	Verdict

5.4.3	TABLE: Reduction of active power by setpoint specification									P
Test 1										
P/P_{Emax} (%)	100	90	80	70	60	50	40	30	20	10
Setting value	4600	4140	3680	3220	2760	2300	1840	1380	920	460
Measured value	4588	4141	3683	3226	2765	2311	1842	1377	930	464
Deviation	0.26%	0.02%	0.07%	0.13%	0.11%	0.24%	0.04%	0.07%	0.22%	0.09%



Maximum active power gradient (0.66% Pn inst (or P controllable) per second)	
Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	146
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	153
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.65%/s
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.62%/s
Minimum active power gradient(0.33% Pn inst (or P controllable) per second)	
Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	293
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	294

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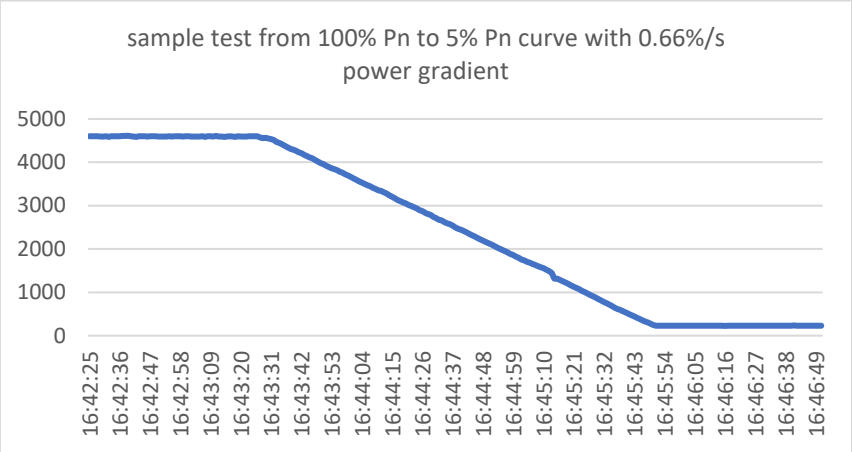
Clause	Requirement + Test	result – Remark	Verdict

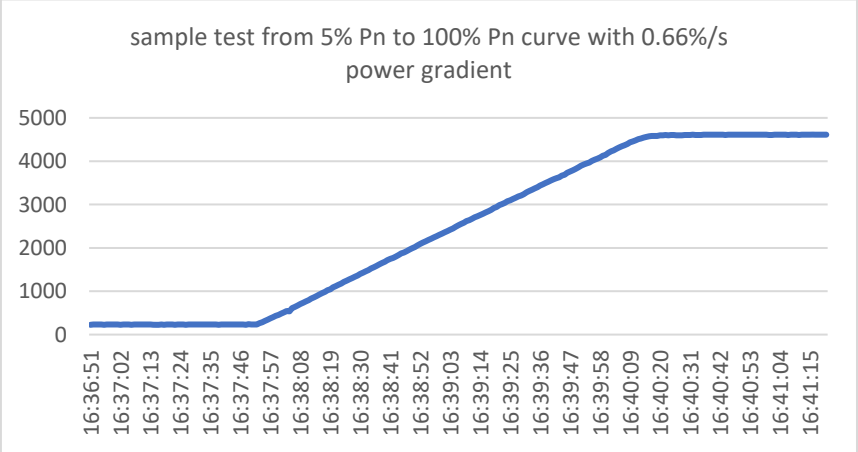
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.33%/s
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.33%/s
During the active power regulation, the PGU disconnect from the grid or not?	No

Response curve:

Graphic of change setpoint from 100% Pn to 5% Pn curve with 0.66%/s power gradient



Graphic of change setpoint from 5% Pn to 100% Pn curve with 0.66%/s power gradient



Graphic of change setpoint from 100% Pn to 5% Pn curve with 0.33%/s power gradient

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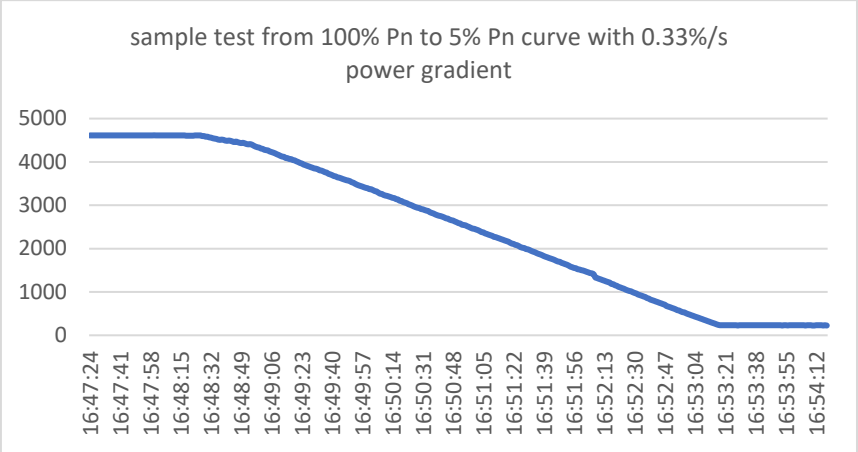
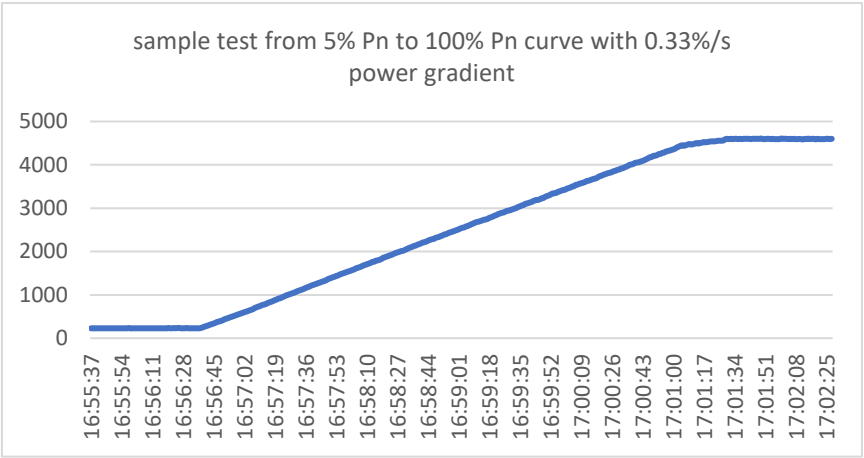


Graphic of change setpoint from 5% Pn to 100% Pn curve with 0.33%/s power gradient



Interface type	RS485
Expected signal type (e.g. AC, DC);	--
"High" and "Low" states	RS485 protocol
Confirm that an input port is provided and can be used to shut down the module within 5s	Yes

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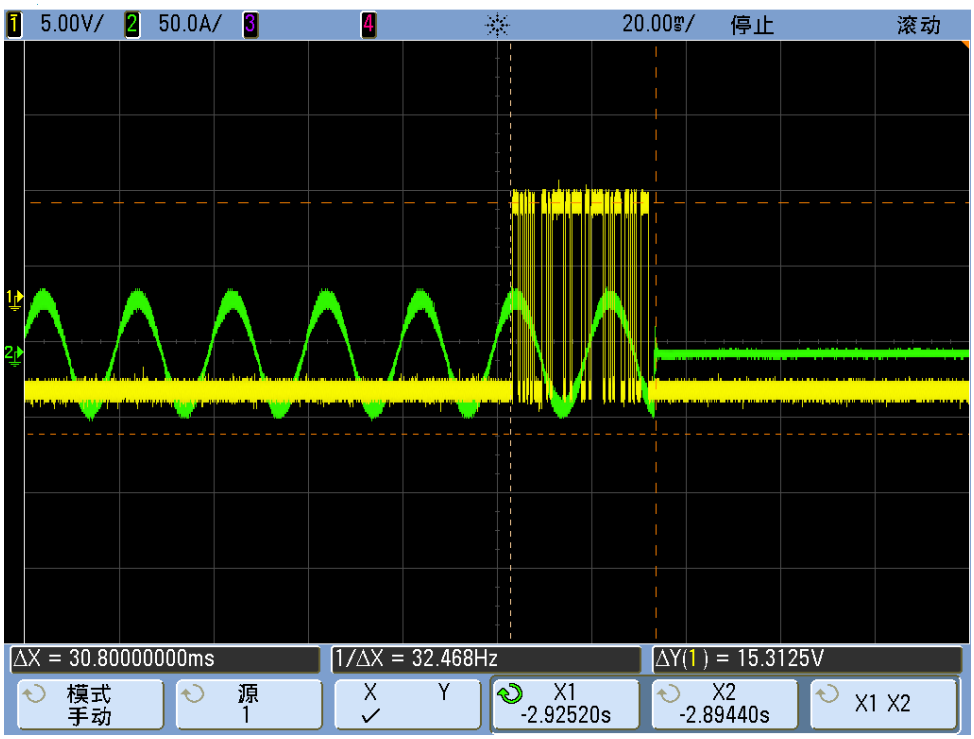

Supplementary information:

The measured active power is measured as mean value of a period of 1 min (60s);

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Clause	Requirement + Test	result – Remark	Verdict

5.4.4	**TABLE: Active power feed-in from EZE at overfrequency**	P

Test 1: generation unit (PV and ESS), over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient s=5% (40 % P_{ref}/Hz)

TYPE 2 inverter DC input power is set to 100% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve (a gradient of 40% of P_M per hertz) for more than 10% P_{Emax}.

P_M = 4608, 10% P_{Emax}= 460.

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
a)	50.00	4608	4600 (100%)	8	Yes
b)	50.25	4603	4516 (98% P_M)	87	Yes
c)	50.70	3744	3686 (80%P_M)	58	Yes
d)	51.40	2438	2396 (52% P_M)	42	Yes
e)	50.70	3744	3686 (80%P_M)	58	Yes
f)	50.25	4577	4516 (98% P_M)	61	Yes
g)	50.00	4500	4600 (100% P_M)	100	Yes
h)	51.65	Protection	Protection	-	-
i)	50.15	No reconnection	Maintain 149.0 s	-	-
j)	50.00	See below table	100% PM (waiting for 60s, then power rise up with gradient of <10 P_{Emax})	-	-

Test sequence	Frequency (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active output power P_{10} (W)	Arised active power ΔP during next 0,5 minute (W)	Gradient of arising active power ΔP/t (W/1 min.)	Gradient of arising active power ΔP/ Pn/t (%/1 min.)	Limit within 10% of Pn/min (Yes/No)
6	50.00	0.0 min	--	--	--	--	--
6	50.00	0.0 min	The time that the active power start increases after the frequency change to 50.00Hz (s)				76
7	50.00	0.5 min	--	--	--	--	--
8	50.00	1.0 min	43	43	43	0.9%	Yes
9	50.00	1.5 min	131	88	131	2.9%	Yes
10	50.00	2.0 min	285	153	241	5.2%	Yes
11	50.00	2.5 min	493	209	362	7.9%	Yes
12	50.00	3.0 min	715	222	431	9.4%	Yes
13	50.00	3.5 min	945	229	451	9.8%	Yes

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Clause	Requirement + Test	result – Remark	Verdict

14	50.00	4.0 min	1153	208	437	9.5%	Yes
15	50.00	4.5 min	1373	220	428	9.3%	Yes
16	50.00	5.0 min	1590	218	438	9.5%	Yes
17	50.00	5.5 min	1806	216	434	9.4%	Yes
18	50.00	6.0 min	2027	221	437	9.5%	Yes
19	50.00	6.5 min	2241	214	435	9.4%	Yes
20	50.00	7.0 min	2458	217	431	9.4%	Yes
21	50.00	7.5 min	2672	214	431	9.4%	Yes
22	50.00	8.0 min	2888	216	430	9.3%	Yes
23	50.00	8.5 min	3102	215	431	9.4%	Yes
24	50.00	9.0 min	3323	221	435	9.5%	Yes
25	50.00	9.5 min	3536	213	433	9.4%	Yes
26	50.00	10.0 min	3744	208	421	9.1%	Yes
27	50.00	10.5 min	3948	205	413	9.0%	Yes
28	50.00	11.0 min	4163	215	420	9.1%	Yes
29	50.00	11.5 min	4384	220	435	9.5%	Yes
30	50.00	12.0 min	4483	99	320	6.9%	Yes
31	50.00	12.5 min	4543	60	159	3.5%	Yes
32	50.00	13.0 min	4604	62	121	2.6%	Yes
Graphic of the active power change:							

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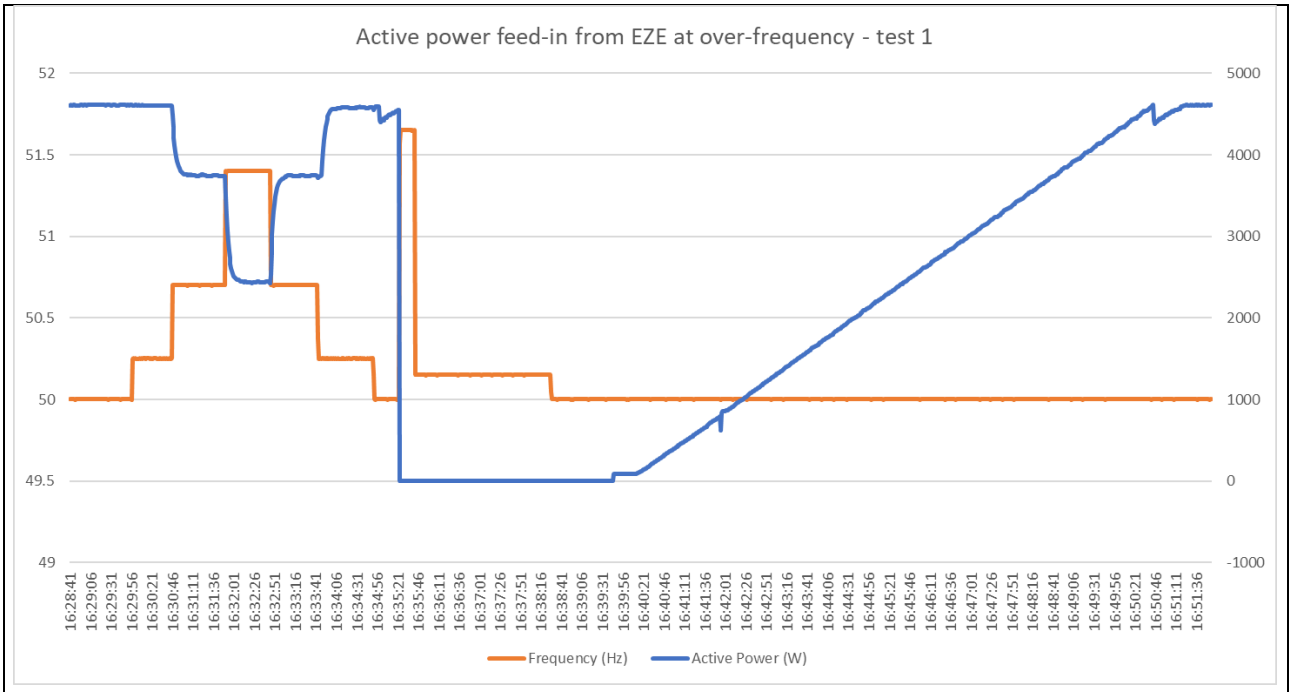

Max. and Mean active power gradient after returning from an overfrequency	
Max. active power gradient	9.8%
Mean active power gradient	8.0%
Defined active power gradient	10% Pn/min

Test 2: generation unit (PV and ESS), over-frequency regulation, with active power reduction frequency start point=50.5Hz, gradient s=12% (16.67 % P_{ref}/Hz)

inverter DC input power is set to 60% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve (a gradient of 16.7% of P_M per hertz) for more than 10% P_{Emax}., once the frequency rise above 50.5Hz, the DC input power shall immediately be set to a point to support 100% active output power.

P_M = 2768, 10% P_{Emax}= 460 ..

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
a)	50.00	2767	2760	7	Yes
b)	50.40	2767	2745	22	Yes
c)	50.70	2592	2537	55	Yes
d)	51.40	2267	2330	63	Yes
e)	50.70	2594	2537	57	Yes
f)	50.40	See below table	From 60% rise to 100%	--	--
g)	50.00	4603	4600	--	--

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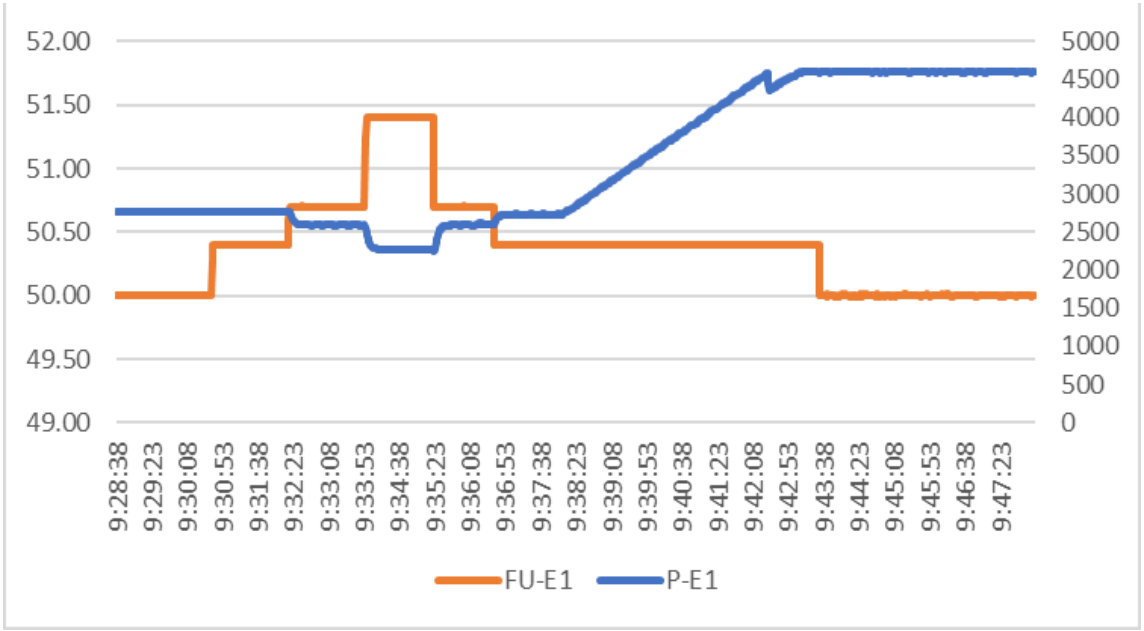
Clause	Requirement + Test	result – Remark	Verdict

Test sequence	Frequency (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active output power P_{10} (W)	Arised active power ΔP during next 0,5 minute (W)	Gradient of arising active power ΔP/t (W/1 min.)	Gradient of arising active power ΔP/ Pn/t (%/1min.)	Limit within 10% of Pn/min (Yes/No)
2	50.40	0.0 min	2664	-	-	-	-
3	50.40	0.5 min	2731	-	-	-	-
4	50.40	1.0 min	2742	11	78	1.7%	Yes
5	50.40	1.5 min	2856	114	125	2.7%	Yes
6	50.40	2.0 min	3067	211	326	7.1%	Yes
7	50.40	2.5 min	3284	217	428	9.3%	Yes
8	50.40	3.0 min	3494	210	427	9.3%	Yes
9	50.40	3.5 min	3704	210	420	9.1%	Yes
10	50.40	4.0 min	3911	207	417	9.1%	Yes
11	50.40	4.5 min	4128	217	424	9.2%	Yes
12	50.40	5.0 min	4339	211	428	9.3%	Yes
13	50.40	5.5 min	4439	100	311	6.8%	Yes
14	50.40	6.0 min	4514	76	176	3.8%	Yes
15	50.40	6.5 min	4592	78	154	3.3%	Yes



Active power reaction time

With active power reduction frequency start point=50.2Hz, gradient s=5%

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Clause	Requirement + Test	result – Remark	Verdict

Test Point	Frequenc y (Hz)	Measured active output power P_{10} (W)	Settling time (s)	Rise time (s)	--
1	50.00	4601	--	--	--
2	50.20	4603	--	--	--
3	51.40	2443	25s	1s	--

5.4.6	**TABLE: Active power supply for EZE at underfrequency**	P

Below test applies only to generator without storage

Inverter DC input power is set to 10% of maximum active output power first. After the TYPE 2 inverter step into frequency range under 49.8Hz, the TYPE 2 inverter available input power is set to 100% of maximum active output. The output active power should regulate the active power with gradient of 40% P_{Emax}/Hz till technical maximum power.

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
1	50.00	460	460	0	Yes
2	49.75	516	552	36	Yes
4	48.80	2293	2300	7	Yes
6	47.60	4461	4508	47	Yes
7	48.80	2316	2300	16	Yes
8	49.75	521	552	31	Yes
9	50.00	467	460	7	Yes
10	47.35	Protection	Protection	--	--
11	47.45	No reconnection	Maintain 120s	--	--
12	50.00	See below tabel	Wait for 60s without connection	--	--

Test sequence	Frequency (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active output power P_{10} (W)	Arised active power ΔP during next 0,5 minute (W)	Gradient of arising active power ΔP/t (W/1 min.)	Gradient of arising active power ΔP/ Pn/t (%/1 min.)	Limit within 10% of Pn/min (Yes/No)
13	50.00	0.0 min	0	--	--	--	--
13	50.00	0.0 min	The time that the active power start increases after the frequency change to 50.00Hz (s)				68
13	50.00	0.5 min	0	--	--	--	--
13	50.00	1.0 min	29	29	29	0.5%	Yes

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Clause	Requirement + Test	result – Remark	Verdict

13	50.00	1.5 min	154	125	154	2.6%	Yes
13	50.00	2.0 min	337	184	308	5.1%	Yes
13	50.00	2.5 min	544	207	390	6.5%	Yes
13	50.00	3.0 min	761	216	423	7.1%	Yes
13	50.00	3.5 min	987	226	442	7.4%	Yes
13	50.00	4.0 min	1207	220	446	7.4%	Yes
13	50.00	4.5 min	1426	219	439	7.3%	Yes
13	50.00	5.0 min	1678	252	471	7.8%	Yes
13	50.00	5.5 min	1892	214	466	7.8%	Yes
13	50.00	6.0 min	2104	212	427	7.1%	Yes
13	50.00	6.5 min	2312	208	420	7.0%	Yes
13	50.00	7.0 min	2514	202	410	6.8%	Yes
13	50.00	7.5 min	2719	205	407	6.8%	Yes
13	50.00	8.0 min	2954	235	440	7.3%	Yes
13	50.00	8.5 min	3170	215	451	7.5%	Yes
13	50.00	9.0 min	3347	178	393	6.6%	Yes
13	50.00	9.5 min	3556	208	386	6.4%	Yes
13	50.00	10.0 min	3763	207	416	6.9%	Yes
13	50.00	10.5 min	4040	277	485	8.1%	Yes
13	50.00	11.0 min	4224	184	461	7.7%	Yes
13	50.00	11.5 min	4408	184	367	6.1%	Yes
13	50.00	12.0 min	4552	144	328	5.5%	Yes
13	50.00	12.5 min	4597	45	190	3.2%	Yes

Max. and Mean active power gradient after returning from an underfrequency	
Max. active power gradient	8.1%
Mean active power gradient	6.1%
Defined active power gradient	10% Pn/min

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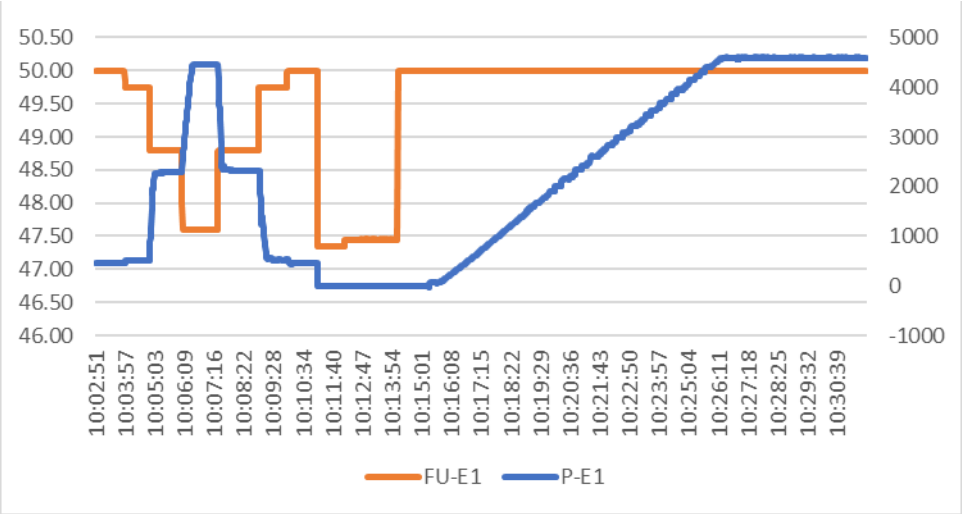

TYPE 2 inverter DC input power is set to 60% of maximum active output power or minimum opera table active power first. After the TYPE 2 inverter step into frequency range under 49.8Hz, the TYPE 2 inverter available input power is set to 100% of maximum active output. The output active power should regulate the active power with gradient of 40% P_{Emax}/Hz till technical maximum power.

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
1	50.00	2790	2760	30	2760
2	49.75	2852	2852	0	2852
3	49.20	3900	3864	36	3864
4	48.80	4610	4600	10	4600
5	49.20	3937	3864	73	3864
6	49.85	2816	2760	56	2760
7	50.00	2814	2760	54	2760

Active power reaction time					
Test Point	Frequency (Hz)	Measured active output power P_{10} (W)	Settling time (s)	Rise time (s)	--
1	50.00	2813	--	--	--
2	49.80	2883	--	--	--
3	47.60	4658	1s	1s	--

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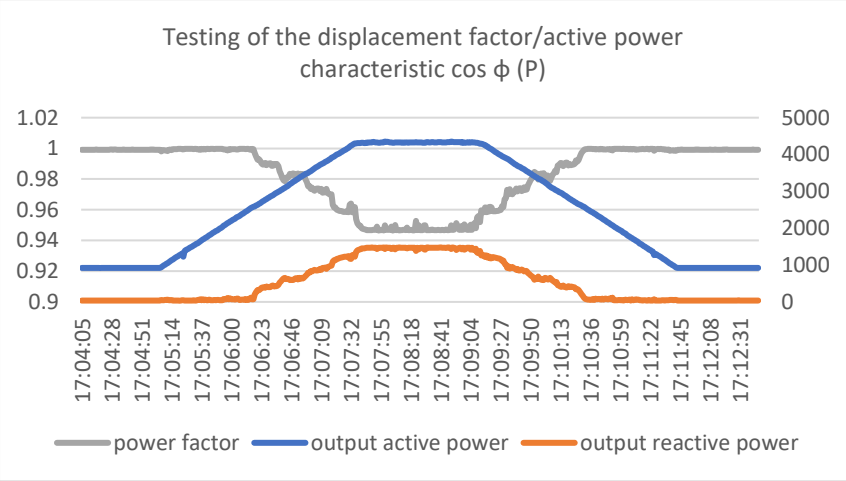
Clause	Requirement + Test	result – Remark	Verdict

5.4.8.3	**TABLE: Testing of the displacement factor/active power characteristic cos φ (P)**	P
Maximal active power P_{Emax} with the tested displacement factor (W)		4373

Trip #1

Percentage of output active power P/P_{Emax} (%)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(Var)	Displacement factor as to feature curve	Deviation of displacement reactive power
20%	921	922	0.9991	39	1.0000	39
100%	4352	4572	0.9474	1464	0.9500	28
20%	921	922	0.9991	39	1.0000	39



Trip #2- the active power gradient setting at 100% Pn/s

Percentage of output active power P/P_{Emax} (%)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(Var)	Displacement factor as to feature curve	Deviation of displacement reactive power
20%	917	919	0.9980	58	1.0000	58
100%	4373	4579	0.9549	1359	0.9500	77
20%	915	917	0.9977	60	1.0000	60

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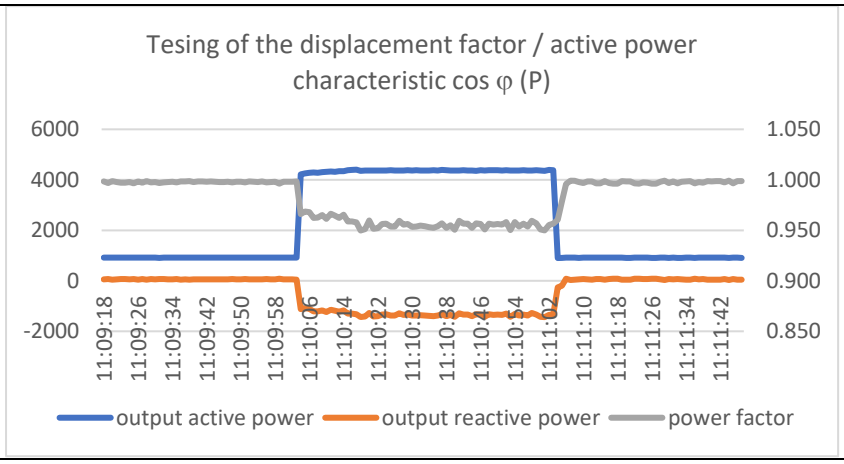
Clause	Requirement + Test	result – Remark	Verdict



5.5.2 & 5.5.6.3	**TABLE: NA protection safety fault test**	P
Ambient temperature (°C) .....:	25 °C	—
Power source for EUT: Manufacturer, model/type, output rating :	--	—

No.	Component	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
1.	Bypass grid relay K11, relay board	S-C	230	10 min	---	-	The fault applied before unit operate. After applied the fault, unit does not start and report "F19, Backup Relay Fail".
2.	Bypass grid relay K12, relay board						Same as above
3.	Bypass grid relay K13, relay board						Same as above
4.	Bypass grid relay K14, relay board						Same as above
5.	Load relay K5 and K8, relay board						Same as above
6.	Load relay K9 and K10, relay board						Same as above
7.	Grid relay K3 and K2, AC board (PSDR)						The fault applied before unit operate. After applied the fault, unit does not start and report "F14, Grid Relay Fail".
8.	Grid relay K4 and K8, AC board (PSDR)						Same as above
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.							Yes L distance: 1.8mm*2=3.6mm N distance: 1.8mm*2=3.6mm
Each active phase can be switched. (L and N)							Yes
Supplementary information: S-C: short circuit, O-C: open circuit							

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5.5.4 & 5.5.7.4	TABLE: Integrated NA Protection and Protective devices and settings					P
Test step	Size	Apply to	Jump height △U, △f	Step length △t	Measured value	Limit
1.1	U>>	L1-N	< 1.15 V	>400ms	287.57 V	287.5±2.3 V
					289.00 V	
					288.23 V	
2.1	U>>	L1-N	>9.2 V	>400 ms	165 ms	100-200ms
					162 ms	
					169 ms	
3.1	U>	L1-N	27.6 V	> 600.2 s	475 s	450-550 s
3.2	U>	L1-N	18.4 V	>400 ms	No	No disconnection
3.3	U>	L1-N	< 1.15 V	> 600.2 s	289 s	225-375s
4.1	U<	L1-N	< 1.15 V	>3.2 s	183.92 V	184±2.3 V
					184.39 V	
					183.78 V	
5.1	U<	L1-N	> 9.2 V	>3.2 s	3.075 s	3.0-3.1s
					3.074 s	
					3.067 s	
6.1	U<<	L1-N	<1.15 V	>3.2 s	102.25 V	103±2.3 V
					102.92 V	
					104.59 V	
7.1	U<<	L1-N	> 9.2 V	>500 ms	373 ms	300-400ms
					367 ms	
					367 ms	
8.1	f>	f	< 25 mHz	> 400 ms	51.470 Hz	51.5±0.05Hz
					51.505 Hz	
					51.516 Hz	
9.1	f>	f	> 0.2 Hz	> 400 ms	136 ms	100-200ms
					128 ms	
					130 ms	
10.1	f<	f	< 25 mHz	> 400 ms	47.485 Hz	47.5±0.05Hz
					47.461 Hz	
					47.468 Hz	
11.1	f<	f	> 0.2 Hz	> 400 ms	146 ms	100-200ms
					129 ms	
					126 ms	

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5.5.7.2	TABLE: Voltage monitoring (integrated protection and interface switch)-setting check				P
Description	Parameter name	Setting value in pu	Setting value N	Set value L-L	Check match (yes or not)
Excitation threshold U>>	AU>>	1,25	287.5 V	500 V	yes
Delay time U>>	tU>>	–	100 ms	100 ms	yes
Excitation threshold U>	AU>	1,10	253 V	440 V	yes
Delay time U>[a]	tU>	–	100 ms	100 ms	yes
Excitation threshold U<	AU<	0,8	184 V	320 V	yes
Delay time U<.	tU<	–	3 s	3 s	yes
Excitation threshold U<<	AU<<	0,45	103.5 V	180 V	yes
Delay time U<<	tU<<	–	300 ms	300 ms	yes
Excitation threshold f>	Af>	1,03	51,5 Hz	51,5 Hz	yes
Delay time f>	Tf>	–	100 ms	100 ms	yes
Excitation threshold f<	Af<	0,95	47,5 Hz	47,5 Hz	yes
Delay time f<	Tf<	–	100 ms	100 ms	yes

5.5.7.5	TABLE: Reading the fault messages	P	
	Pass	Fail	N/A
The last five date failure report readable	Pass	-	-
Interruptions of supply with duration of 3s or longer shall not lead to loss of any of the failure report	Pass	-	-
Read our shall be possible at the central NA protection irrespective of the operational state of the power generation system and without any additional aids	Pass	-	-
For a integrated NA protection, a read out may be carried out using data interface.	Pass	-	-

5.5.10	TABLE: Islanding detection								P
No.	P_{EUT} (% of EUT rating)	Reactive Load (% of Q_L)	P_{AC} (% of nominal)	Q_{AC} (% of nominal)	Run on time (ms)	P_{EUT} (kW)	Actual Q_f	V_{DC} (V)	Remarks
1	100	100	0	0	446.6	4.73	0.998	405	Test A at BL
2	66	66	0	0	109.6	3.31	1.008	352	Test B at BL
3	33	33	0	0	102.0	1.61	1.025	185	Test C at BL
4	100	100	-5	-5	322.8	4.49	--	405	Test A at IB

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Clause	Requirement + Test	result – Remark	Verdict

5	100	100	-5	0	280.2	4.50	--	405	Test A at IB
6	100	100	-5	5	223.2	4.93	--	405	Test A at IB
7	100	100	0	-5	355.6	4.73	--	405	Test A at IB
8	100	100	0	5	326.0	4.73	--	405	Test A at IB
9	100	100	5	-5	425.2	4.96	--	405	Test A at IB
10	100	100	5	0	334.8	4.87	--	405	Test A at IB
11	100	100	5	5	434.4	4.96	--	405	Test B at IB
12	66	66	0	-5	90.8	3.00	--	352	Test B at IB
13	66	66	0	-4	99.8	3.20	--	352	Test B at IB
14	66	66	0	-3	86.2	3.20	--	352	Test B at IB
15	66	66	0	-2	92.0	3.10	--	352	Test B at IB
16	66	66	0	-1	105.2	3.20	--	352	Test B at IB
17	66	66	0	1	100.0	3.10	--	352	Test B at IB
18	66	66	0	2	101.2	3.10	--	352	Test B at IB
19	66	66	0	3	100.8	3.10	--	352	Test B at IB
20	66	66	0	4	95.2	3.10	--	352	Test B at IB
21	66	66	0	5	95.0	3.10	--	352	Test B at IB
22	33	33	0	-5	93.6	1.40	--	185	Test C at IB
23	33	33	0	-4	104.8	1.40	--	185	Test C at IB
24	33	33	0	-3	106.2	1.40	--	185	Test C at IB
25	33	33	0	-2	107.0	1.40	--	185	Test C at IB
26	33	33	0	-1	89.6	1.40	--	185	Test C at IB
27	33	33	0	1	101.0	1.40	--	185	Test C at IB
28	33	33	0	2	85.5	1.40	--	185	Test C at IB
29	33	33	0	3	107.5	1.30	--	185	Test C at IB
30	33	33	0	4	102.5	1.40	--	185	Test C at IB
31	33	33	0	5	96.0	1.40	--	185	Test C at IB

Supplementary information:

The anti-islanding test is conducted with maximum output power of 5000VA according to IEC 62116:2014 independently. For VDE-AR-N 4105:2018, the program method of islanding is not changed, the output power is limited under 4600VA via firmware.

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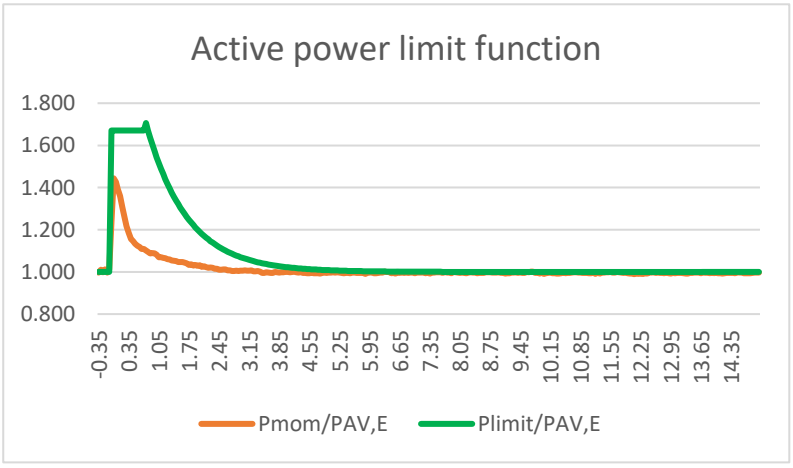
5.6	TABLE: Connection conditions and synchronization	P
Test procedure	a) f=47.45Hz, no reconnection allowed	Yes
	b) f=47.55Hz, reconnection allowed	Yes
	c) f=50.15Hz, no reconnection allowed	Yes
	d) f=50.05Hz, reconnection allowed	Yes
	e) U=84% Un, no reconnection allowed	Yes
	f) U=86% Un, reconnection allowed	Yes
	g) U=111% Un, no reconnection allowed	Yes
	h) U=109% Un, reconnection allowed	Yes

5.7	TABLE: Proof of $P_{AV,E}$ monitoring					P
Pn (W)	4600		$P_{AV,E}$ setting value (W)		2760	
Test a)	Maximum EZE output power before switch load			Maximum EZE output power after switch load for 10 s		
Phase	L1 (W)	L2(W)	L3 (W)	L1 (W)	L2(W)	L3 (W)
Measured power value	2787	-	-	2747	-	-
Pm/ $P_{AV,E}$	100.01%	-	-	99.5%	-	-
Tolerance(-2%)	0.01%	-	-	0.5%	-	-
Power cure (time for 1.067 Pav,e)						
Power cure (time for 1.67 Pav,e)						
Power cure (time for 1.69 Pav,e)						

Test b)	Maximum EZE output power before primary power jump			Maximum EZE output power after primary power jump for 10 s		
Phase	L1 (W)	L2(W)	L3 (W)	L1 (W)	L2(W)	L3 (W)
Measured power value	2734	-	-	2742	-	-
Pm/ $P_{AV,E}$	99.1%	-	-	99.3%	-	-
Tolerance (-2%)	0.9%	-	-	0.7%	-	-

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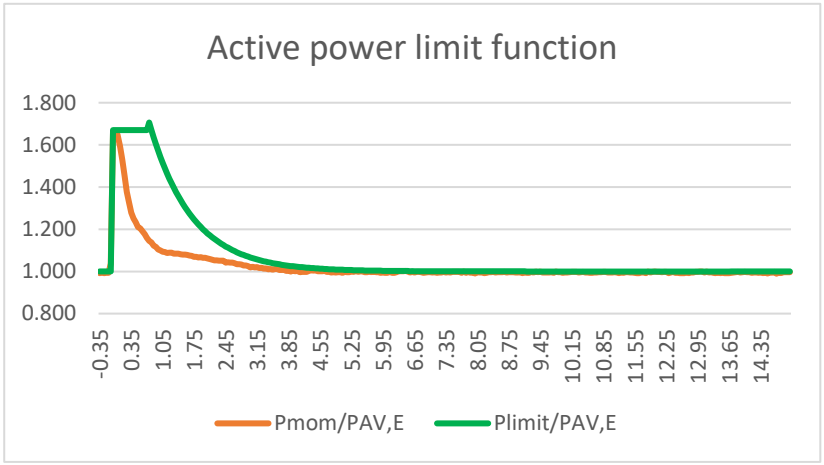
Clause	Requirement + Test	result – Remark	Verdict

Power cure (time for 1.067 Pav,e)	
Power cure (time for 1.67 Pav,e)	
Power cure (time for 1.69 Pav,e)	

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Clause	Requirement + Test	result – Remark	Verdict

5.8	**Proof of dynamic grid support**	P

For single phase inverter, 1 phase faults are included in below table

Single-phase EZE are connected to terminals W and N for fault pattern D1. For fault pattern D2, the connection is made to terminals V and N. During test, the voltage source change three phase voltage

Test	Voltage during fault	Phase fault type	Fault duration (ms)	Load	Cosφ setting	Test Number
1	0.15-0.25	1 phase	At 0.15pu> 150 At 0.25pu> 150	Full load	1	1.1
				Partial load		1.2
		1 phase D1		Full load		1.3
				Partial load		1.4
		1 phase D2		Full load		1.5
2	0.50-0.60	1 phase	at 0.50pu ≥1500 at 0.60pu ≥2000	Full load	maximum over-excited	2.1
				Partial load	maximum over-excited	2.2
		1 phase D1		Full load	maximum over-excited	2.3
				Partial load	maximum over-excited	2.4
3	0.50-0.60	1 phase	at 0.50pu ≥1500 at 0.60pu ≥2000	Full load	maximum under-excited	3.1
				Partial load	maximum under-excited	3.2
		1 phase D1		Full load	maximum under-excited	3.3
				Partial load	maximum under-excited	3.4
4	0.85-0.90	1 phase	≥ 60000	Full load	1	4.1
				Partial load		4.2
		1 phase D1		Full load		4.3
				Partial load		4.4
5	1.20 to 1.25	1 phase	≥ 100	Full load	1	5.1
				Partial load		5.2
		1 phase D1		Full load		5.3
				Partial load		5.4
		1 phase D2		Full load		5.5
6	1.15 to 1.20	1 phase	≥ 5000	Full load	1	6.1
				Partial load		6.2
		1 phase D1		Full load		6.3
				Partial load		6.4
7	1.10-1.15	1 phase	≥ 60000	Full load	1	7.1
				Partial load		7.2
		1 phase D1		Full load		7.3
				Partial load		7.4

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Clause	Requirement + Test	result – Remark	Verdict

Test Number	1.1					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	1.1	1.1
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	15:32:30
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint voltage increase determined from no load test	L1-N	-	[p.u.]	0.157
	5	Dip duration setpoint	-	-	[ms]	200
	6	Time of fault occurrence (t_1)	-	-	[ms]	12242
	7	Time of fault clearance (t_2)	-	-	[ms]	12452
	8	Fault duration determined from no load test	-	-	[ms]	190
	9	Voltage drop depth	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.843
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.987
	12	Active power	Total	t1-10s to t1	[p.u.]	0.987
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.047
	14	cos φ	Total	t1-10s to t1	-	0.999
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.157
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.011
	17		L1	t1+100ms	[p.u.]	0.011
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.011
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.000
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.985
	22		Total	t2+3s to t2+10s	[p.u.]	0.989
	23	Active power recover time	Total	-	ms	135
	24	Reactive power	Total	t2+10s	[p.u.]	0.036

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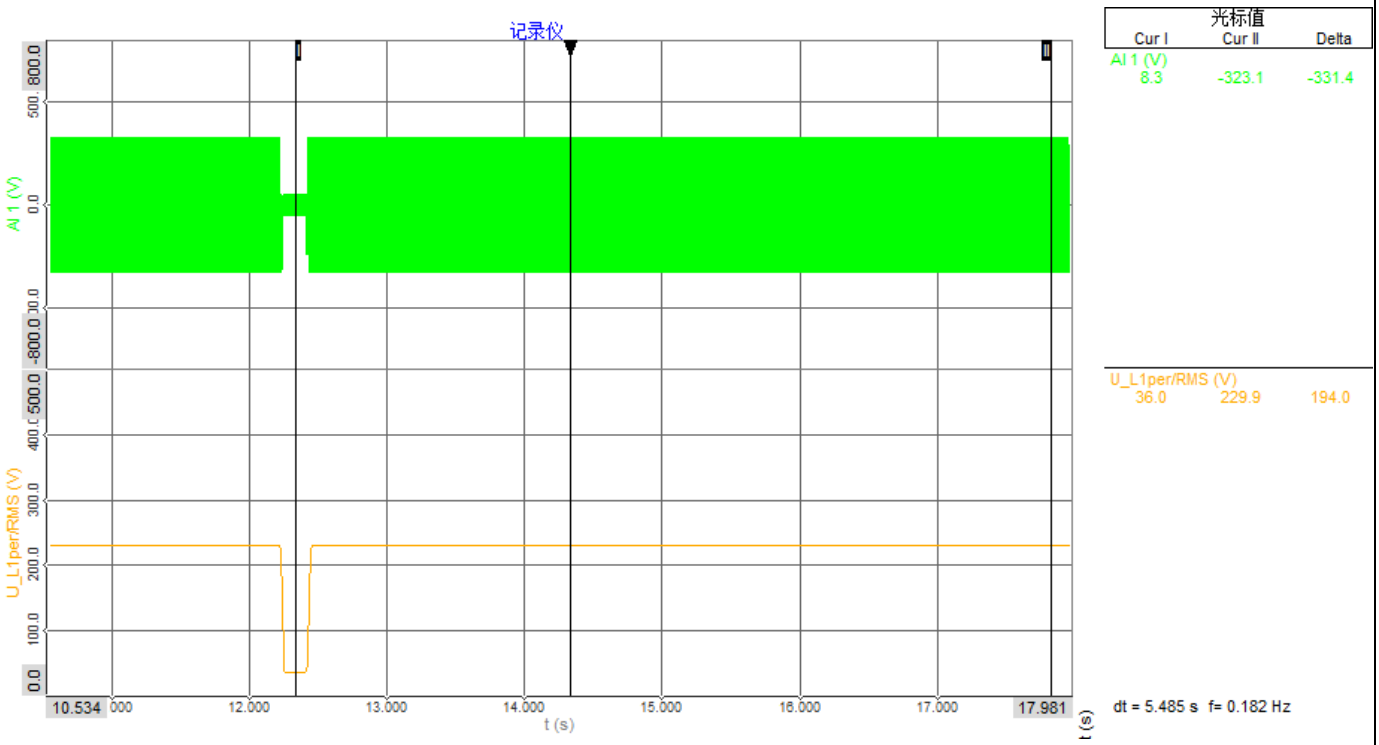
	25		Total	t2+3s to t2+10s	[p.u.]	0.046
	26	Reactive power recover time	Total	-	ms	0

Graphic:

Phase-to-neutral voltages (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms

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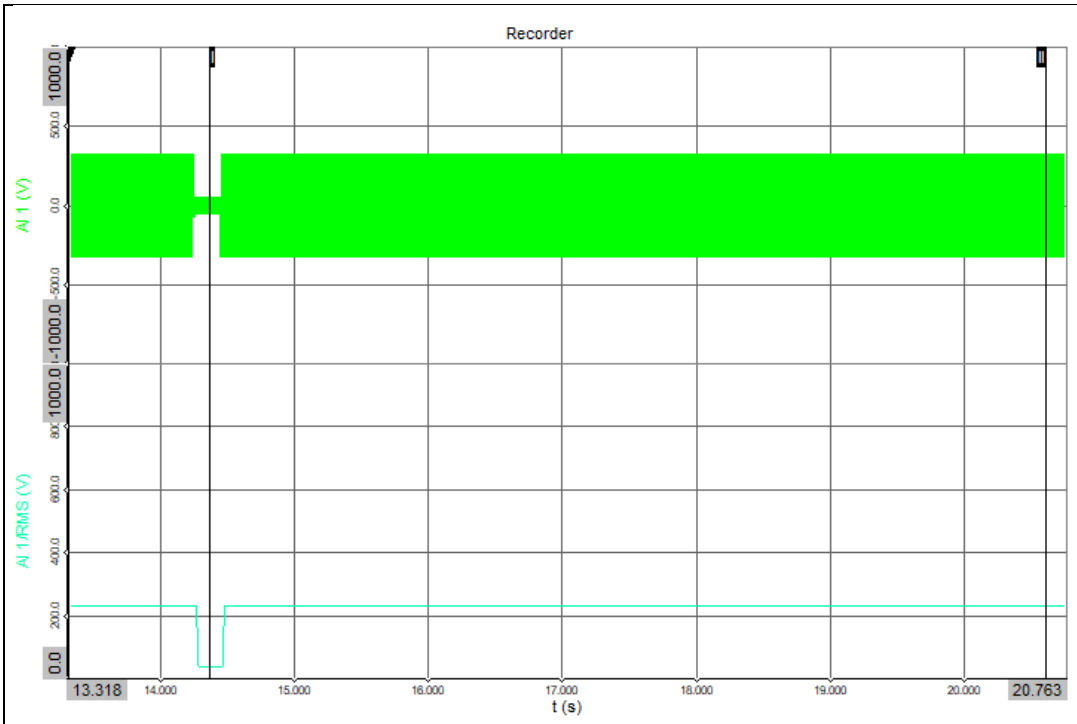
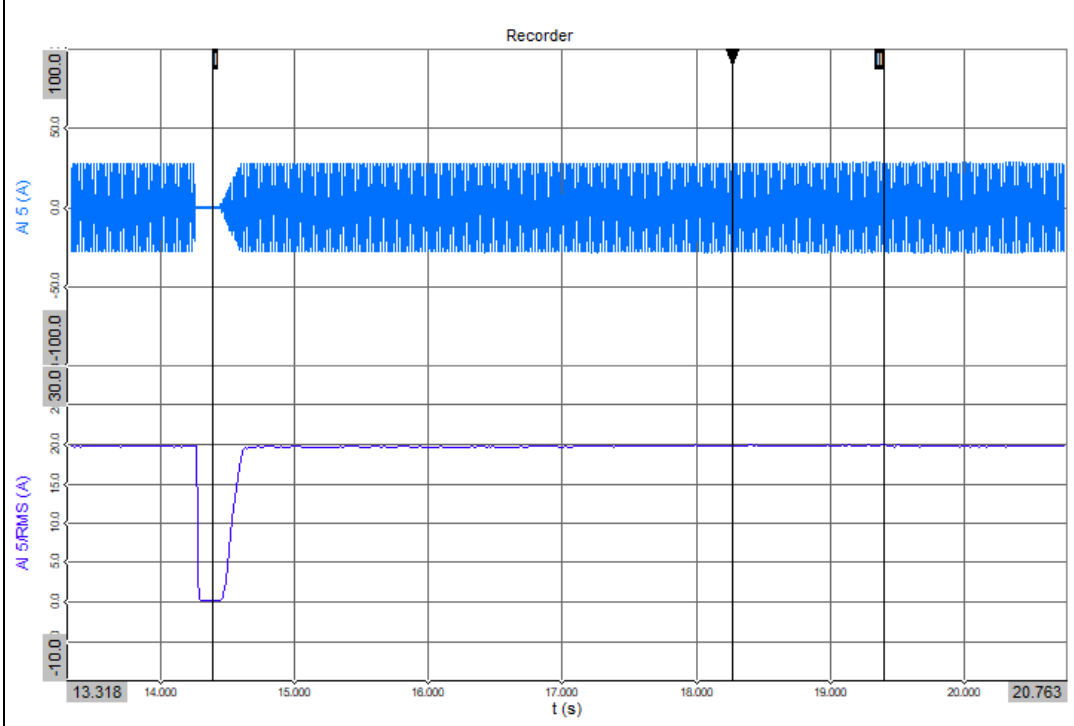


Phase currents

RMS phase currents as moving averages over 20 ms



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms

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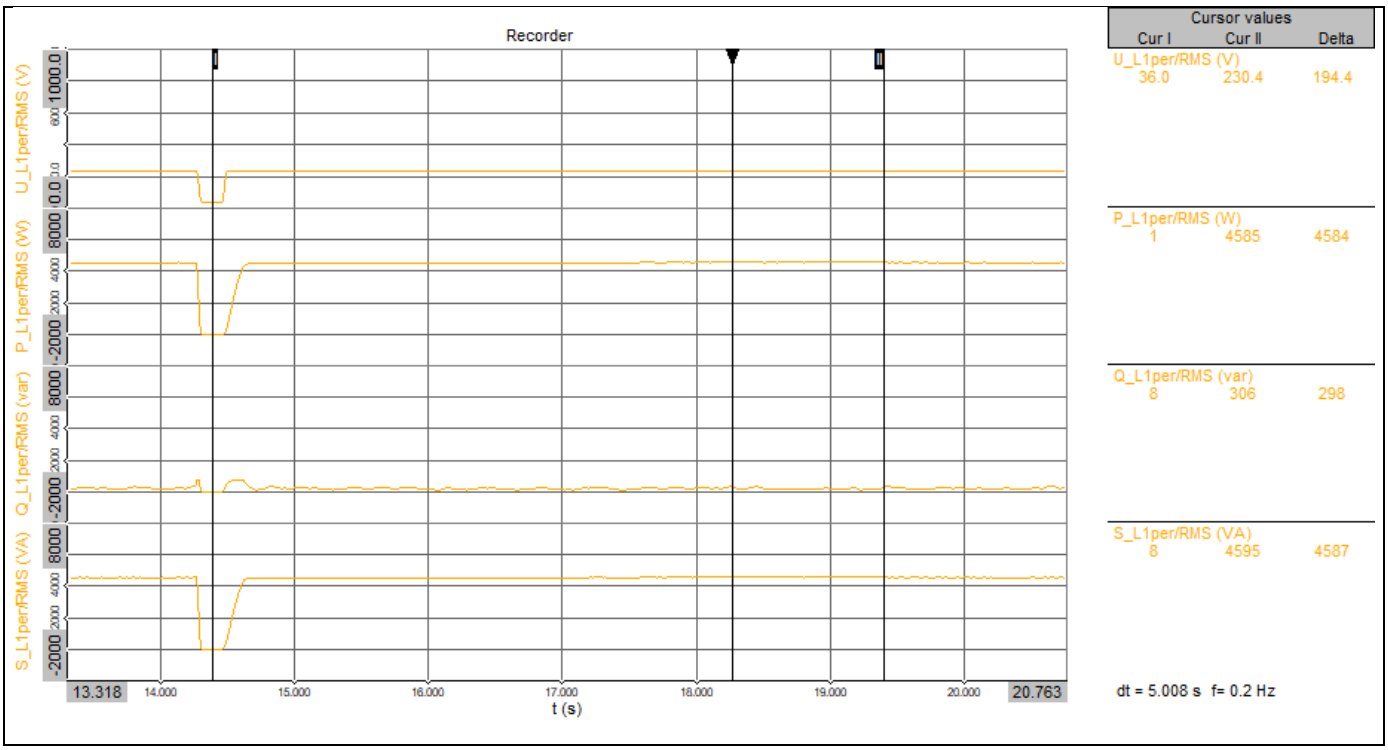

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Clause	Requirement + Test	result – Remark	Verdict

Test Number	1.2				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	1.2	1.2
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	15:38:10
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.157
	5	Dip duration setpoint	-	-	[ms]	200
	6	Time of fault occurrence (t_1)	-	-	[ms]	12242
	7	Time of fault clearance (t_2)	-	-	[ms]	12452
	8	Fault duration determined from no load test	-	-	[ms]	190
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.843
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.392
	12	Active power	Total	t1-10s to t1	[p.u.]	0.391
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.034
	14	cos φ	Total	t1-10s to t1	-	0.996
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.157
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.011
	17		L1	t1+100ms	[p.u.]	0.011
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.011
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.000
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.391
	22		Total	t2+3s to t2+10s	[p.u.]	0.391
	23	Active power recover time	Total	-	ms	50
	24	Reactive power	Total	t2+10s	[p.u.]	0.040
	25		Total	t2+3s to t2+10s	[p.u.]	0.034
	26	Reactive power recover time	Total	-	ms	0

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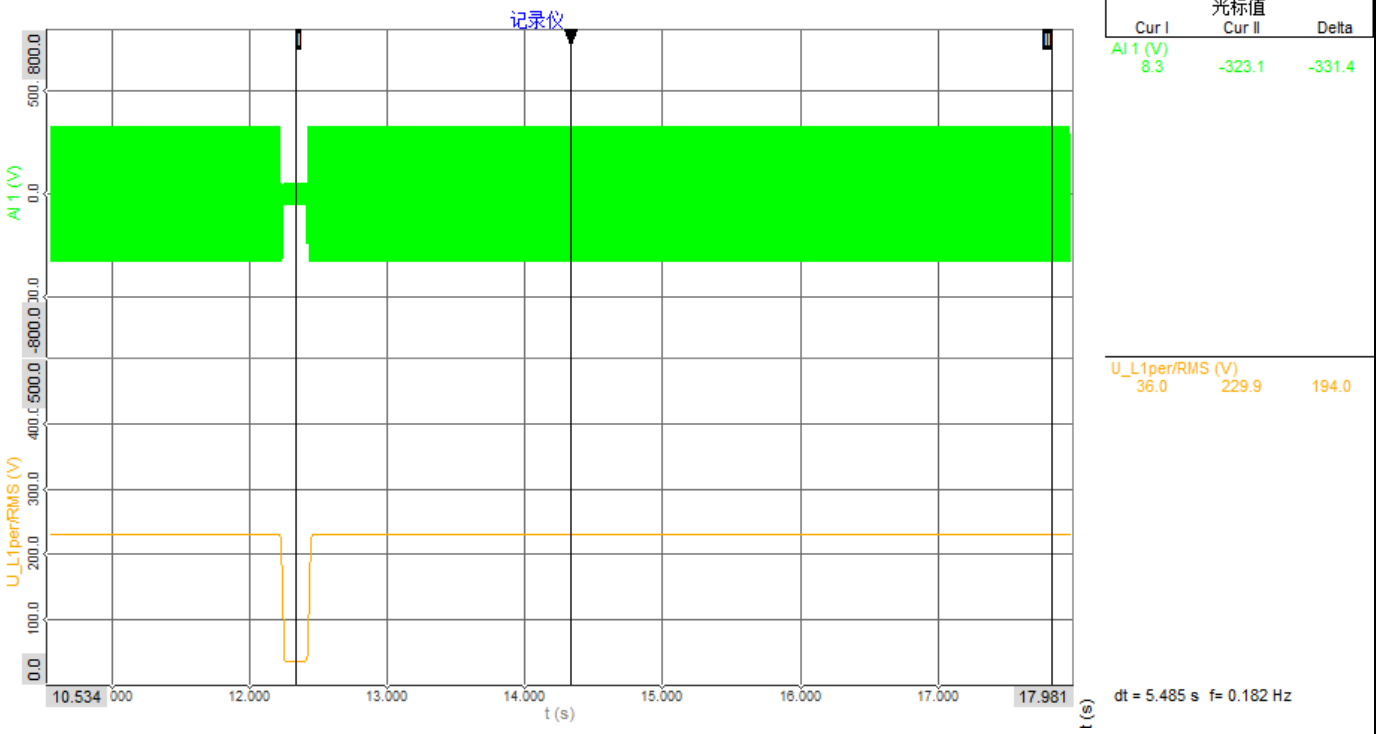
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

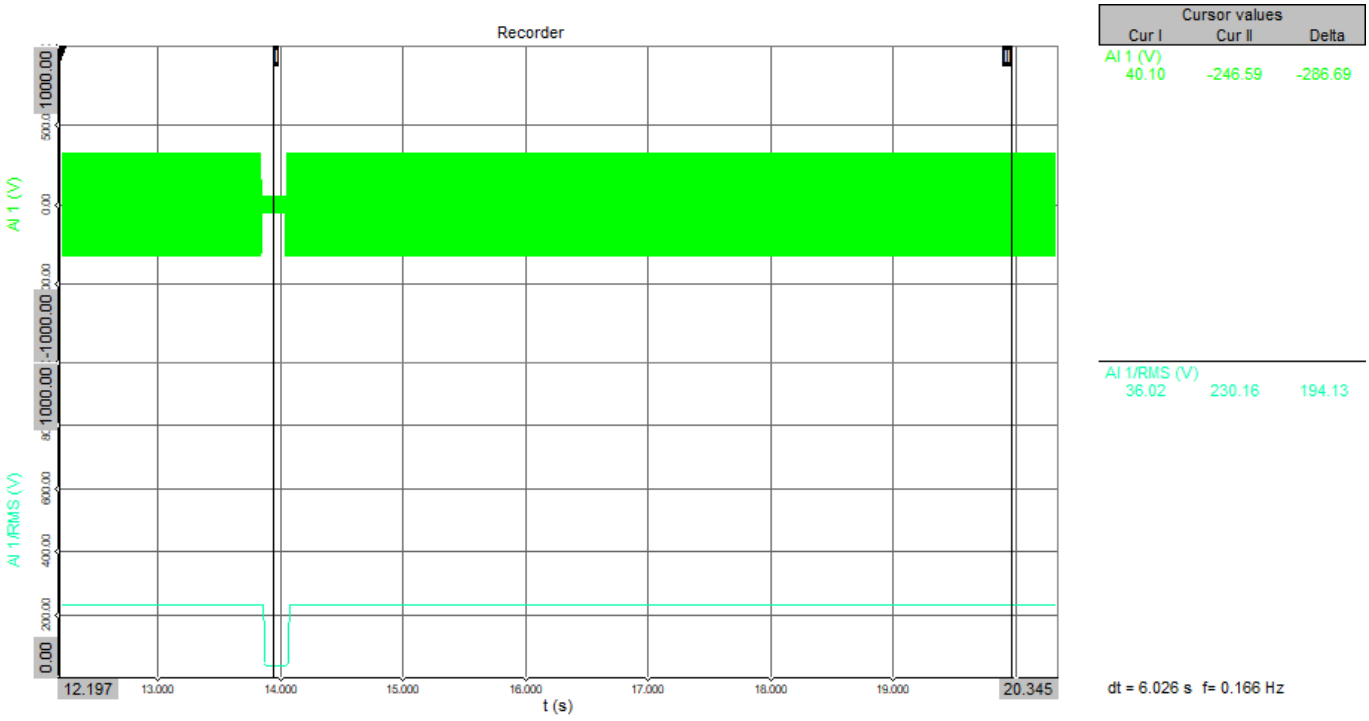
Phase-to-neutral voltages (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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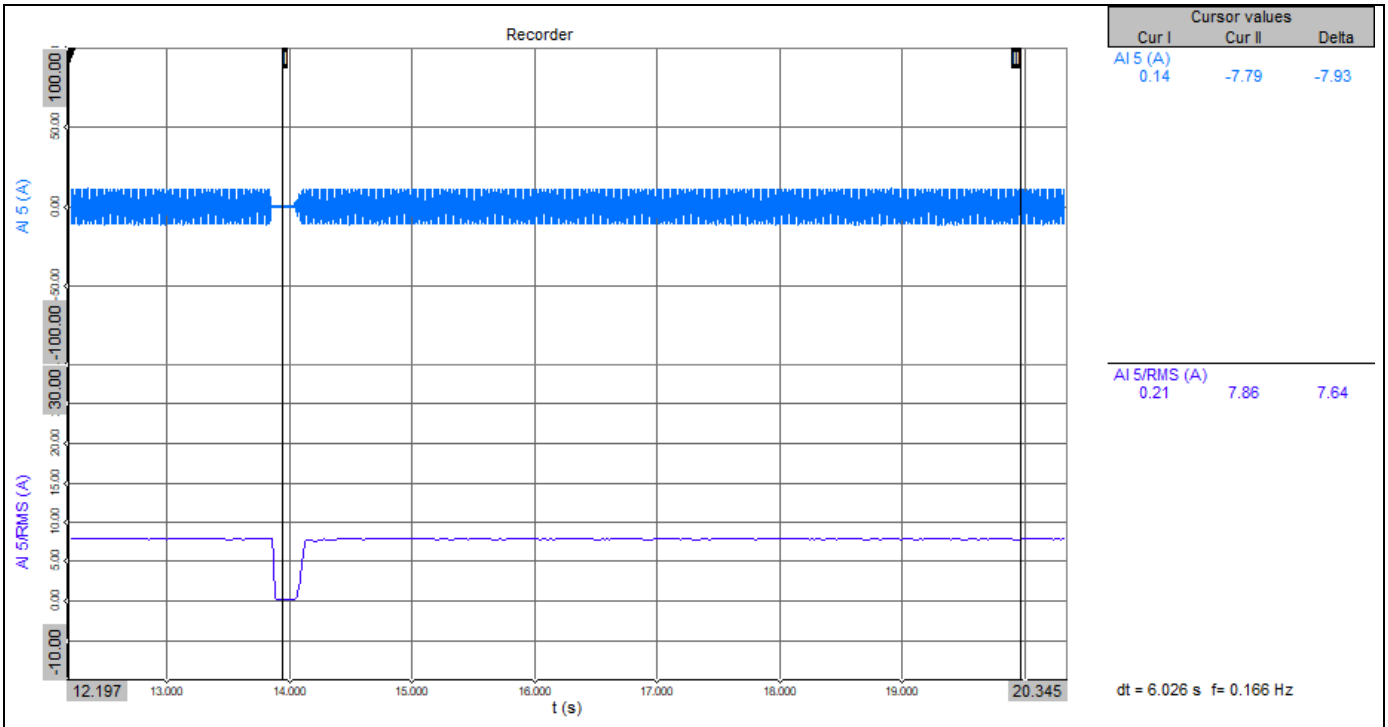
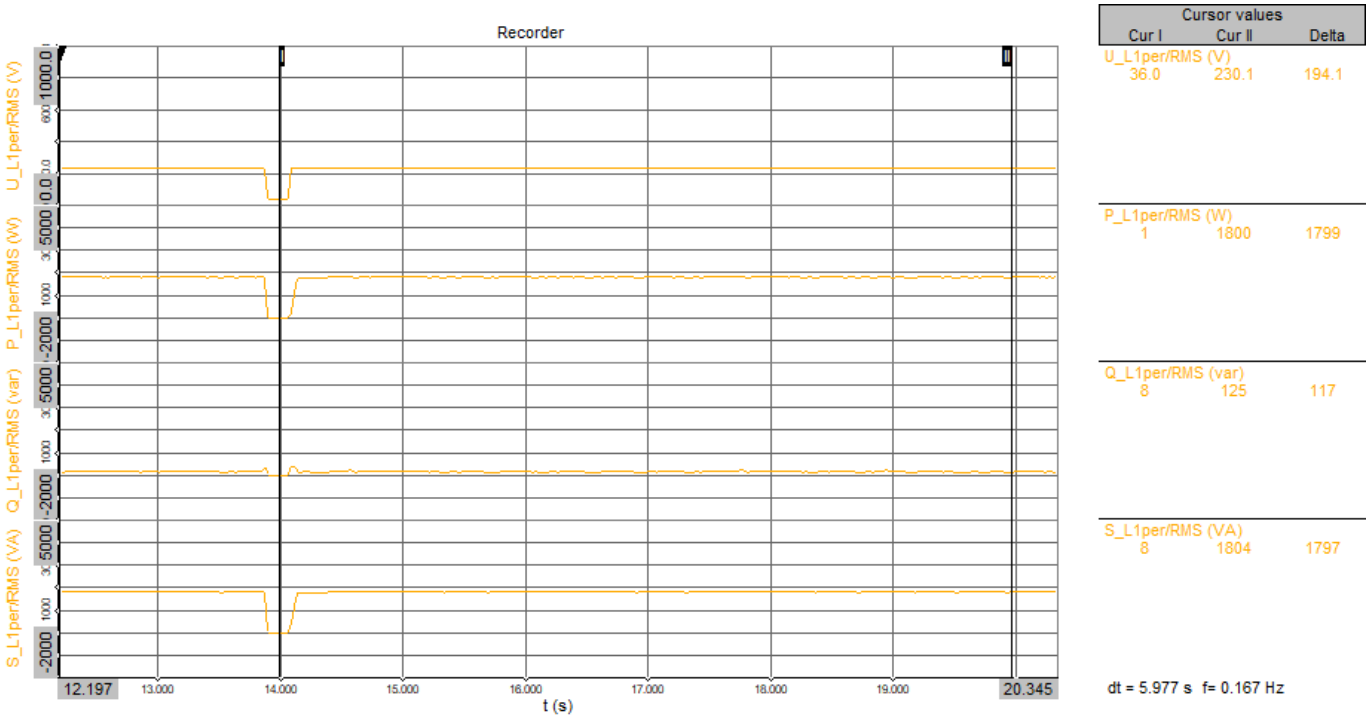
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	1.3					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	1.3	1.3
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:41:50
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.620
	5	Dip duration setpoint	-	-	[ms]	200
	6	Time of fault occurrence (t_1)	-	-	[ms]	12900
	7	Time of fault clearance (t_2)	-	-	[ms]	13102
	8	Fault duration determined from no load test	-	-	[ms]	182
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.380
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.991
	12	Active power	Total	t1-10s to t1	[p.u.]	0.991
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.031
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.621
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.050
	17		L1	t1+100ms	[p.u.]	0.049
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.049
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.003
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.991
	22		Total	t2+3s to t2+10s	[p.u.]	0.992
	23	Active power recover time	Total	-	ms	128
	24	Reactive power	Total	t2+10s	[p.u.]	0.025
	25		Total	t2+3s to t2+10s	[p.u.]	0.032

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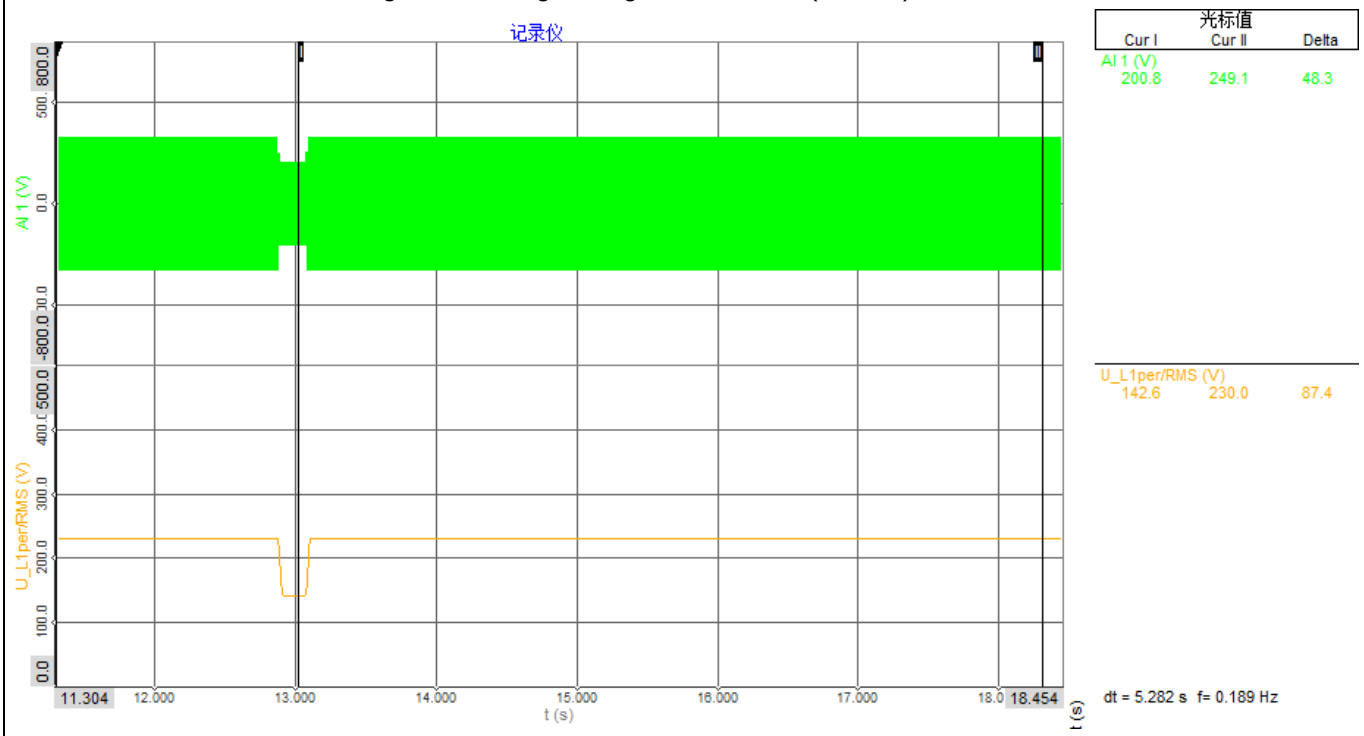
Clause	Requirement + Test	result – Remark	Verdict

	26	Reactive power recover time	Total	-	ms	0

Graphic:

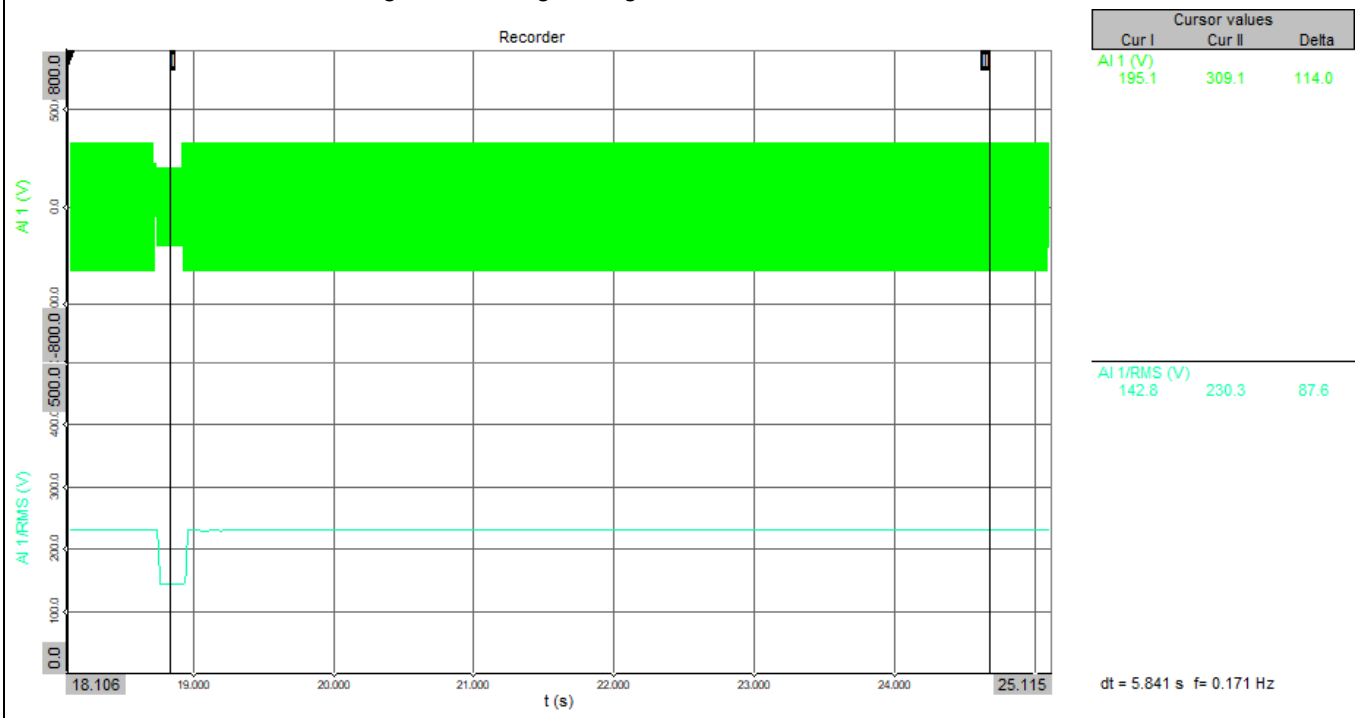
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

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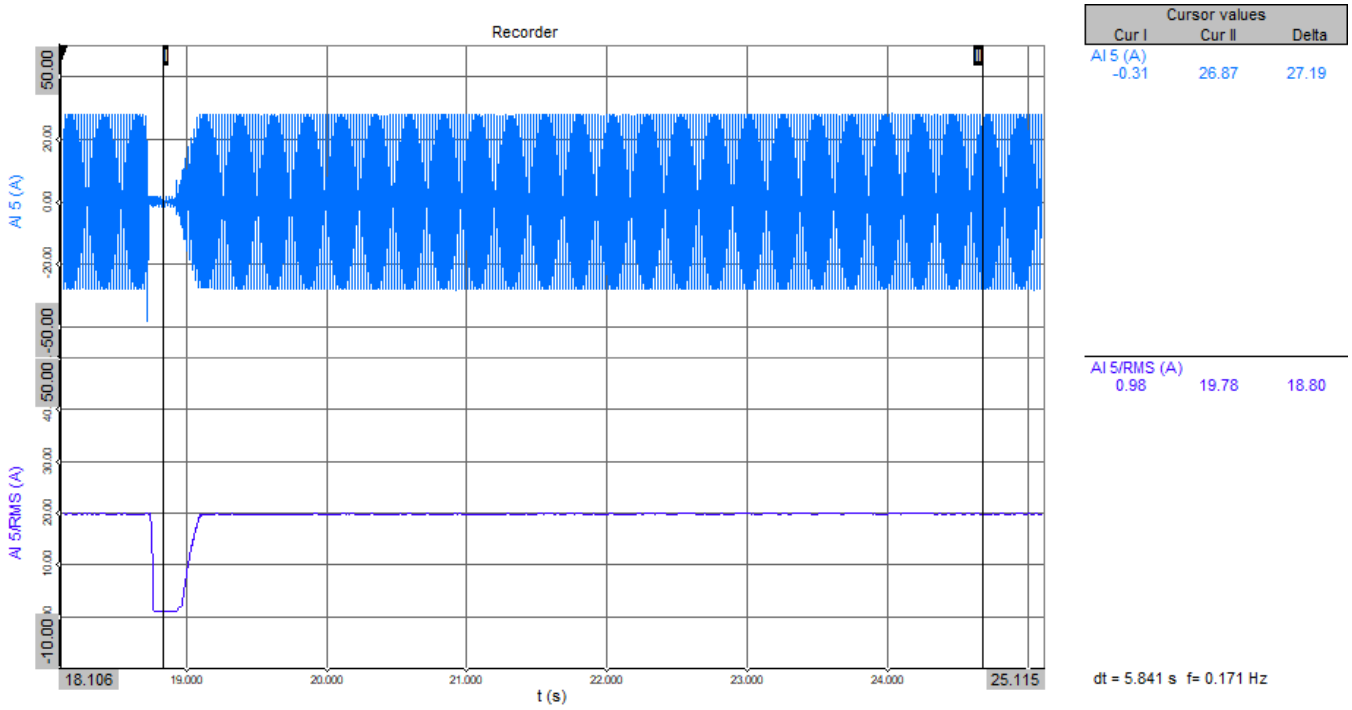
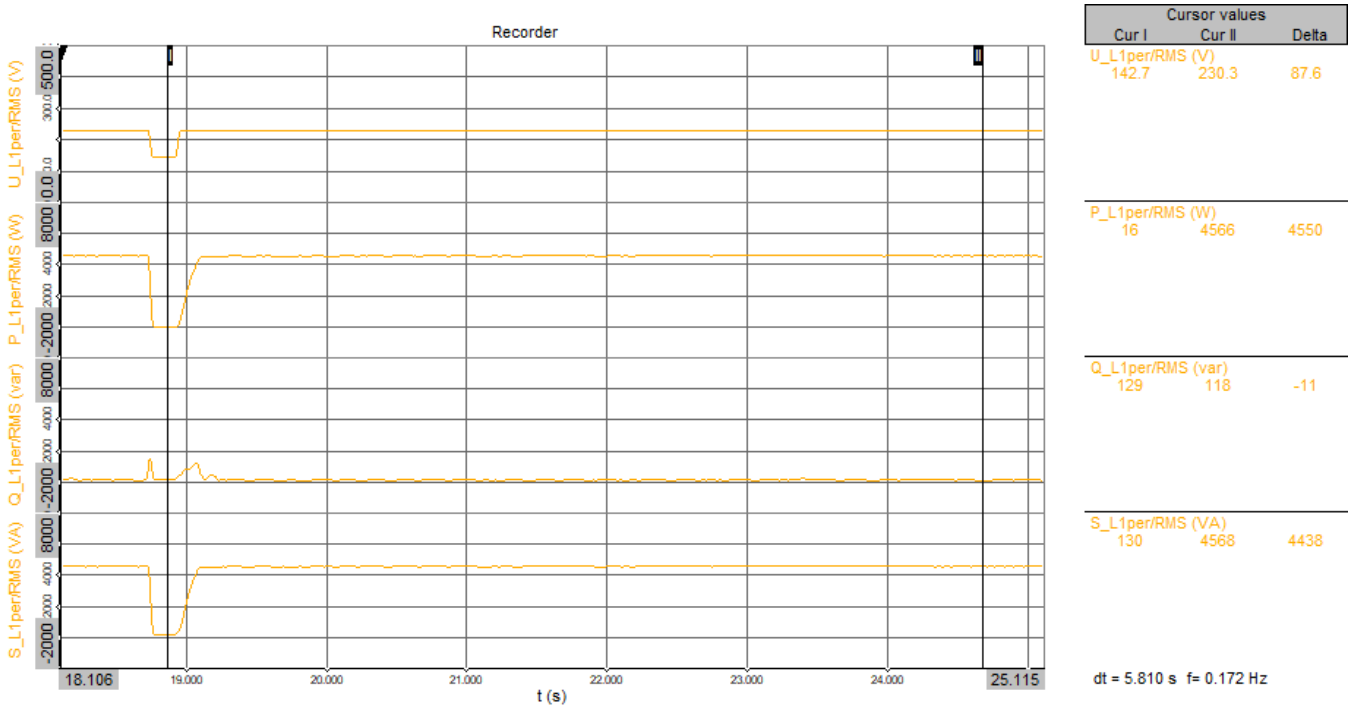
Clause	Requirement + Test	result – Remark	Verdict

RMS phase currents as moving averages over 20 ms



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	1.4					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	1.4	1.4
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:55:00
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.620
	5	Dip duration setpoint	-	-	[ms]	200
	6	Time of fault occurrence (t_1)	-	-	[ms]	12900
	7	Time of fault clearance (t_2)	-	-	[ms]	13102
	8	Fault duration determined from no load test	-	-	[ms]	182
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.380
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.396
	12	Active power	Total	t1-10s to t1	[p.u.]	0.395
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.026
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.621
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.047
	17		L1	t1+100ms	[p.u.]	0.048
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.048
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.003
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.395
	22		Total	t2+3s to t2+10s	[p.u.]	0.395
	23	Active power recover time	Total	-	ms	37
	24	Reactive power	Total	t2+10s	[p.u.]	0.016
	25		Total	t2+3s to t2+10s	[p.u.]	0.020
	26	Reactive power recover time	Total	-	ms	0

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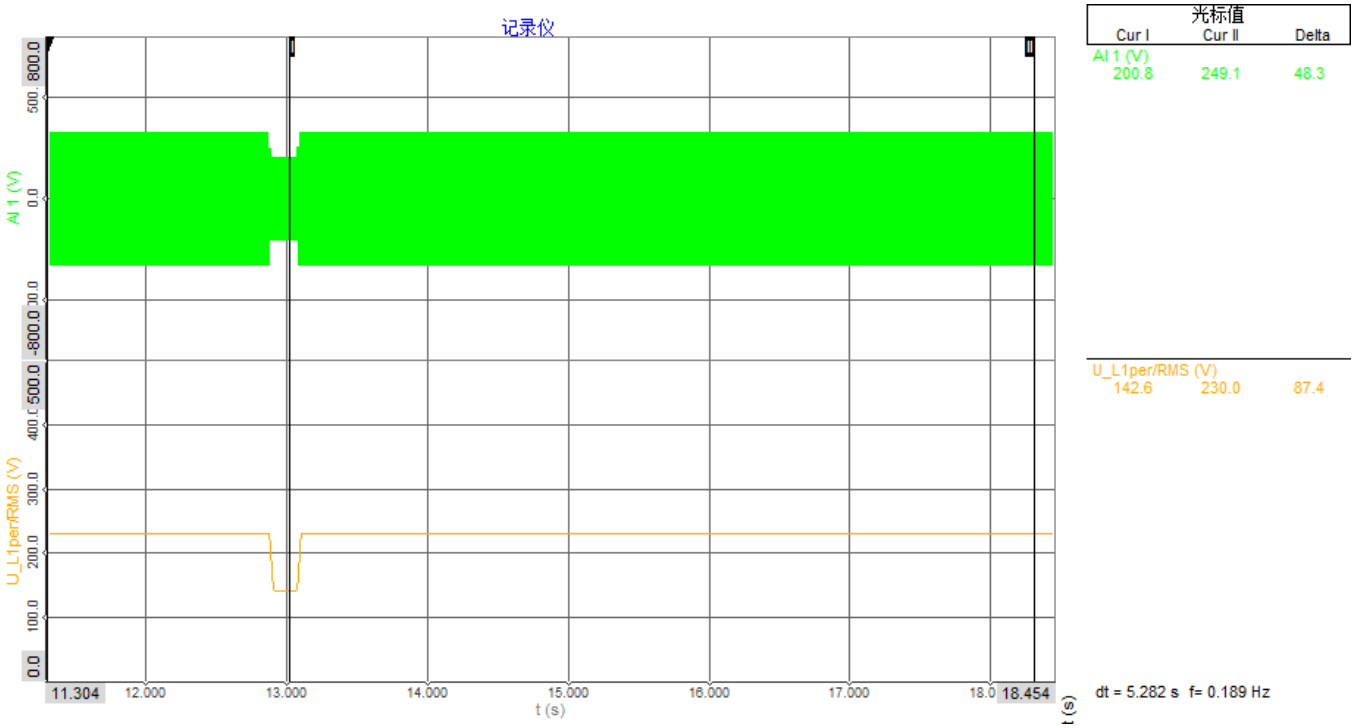
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

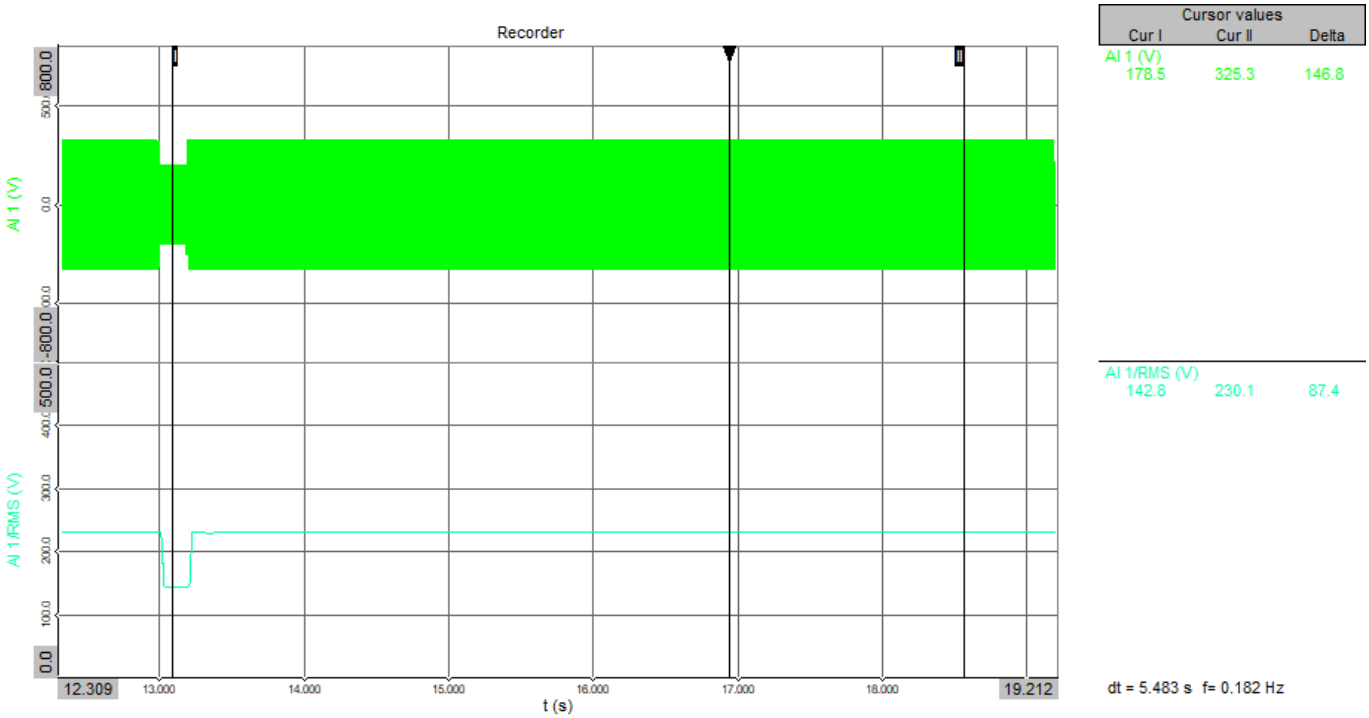
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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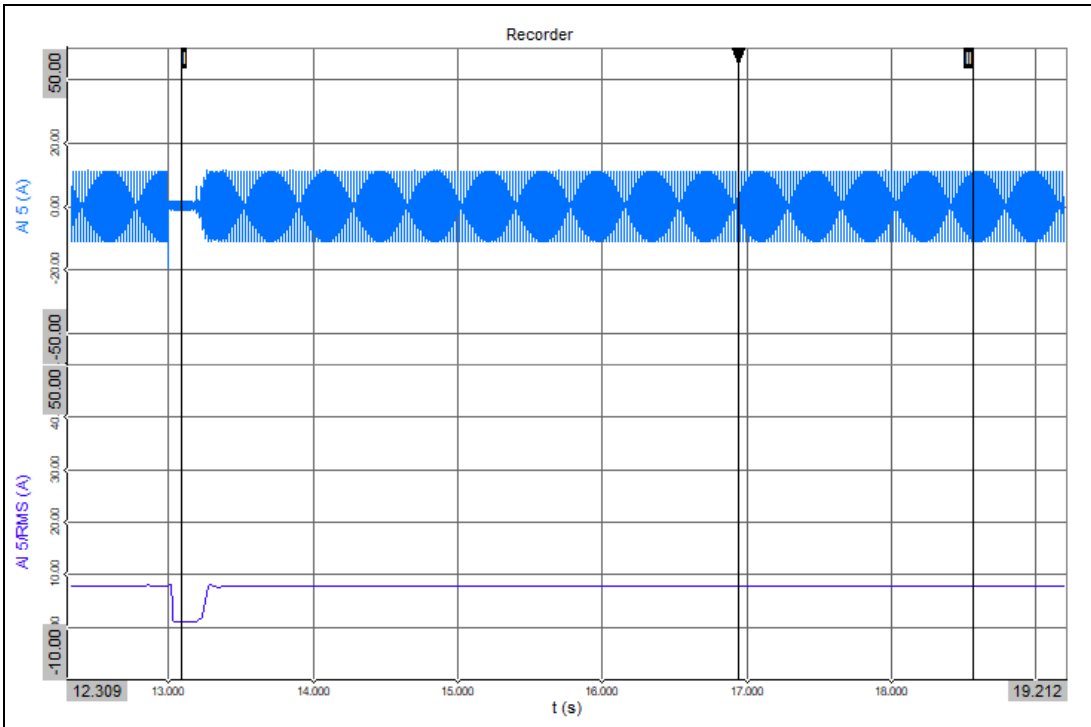
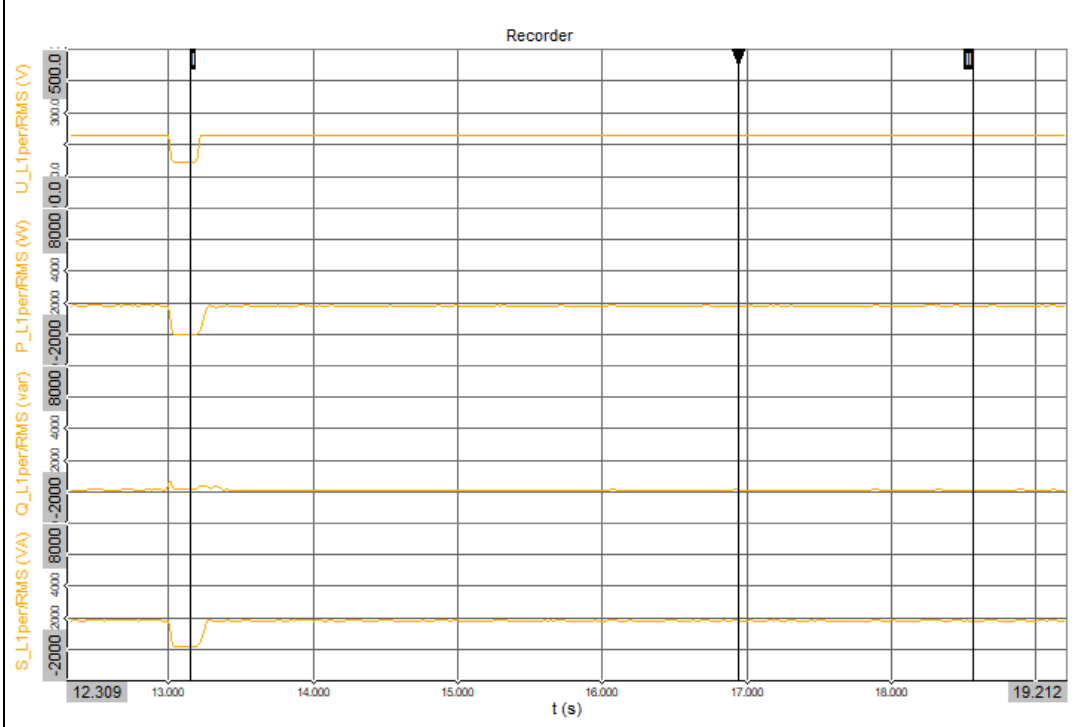
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		1.5				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	1.5	1.5
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:47:38
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.620
	5	Dip duration setpoint	-	-	[ms]	200
	6	Time of fault occurrence (t_1)	-	-	[ms]	12900
	7	Time of fault clearance (t_2)	-	-	[ms]	13102
	8	Fault duration determined from no load test	-	-	[ms]	182
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.380
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.991
	12	Active power	Total	t1-10s to t1	[p.u.]	0.991
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.031
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.621
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.052
	17		L1	t1+100ms	[p.u.]	0.051
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.051
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.004
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.002
	21	Active power	Total	t2+1s	[p.u.]	0.993
	22		Total	t2+3s to t2+10s	[p.u.]	0.984
	23	Active power recover time	Total	-	ms	126
	24	Reactive power	Total	t2+10s	[p.u.]	0.057
	25		Total	t2+3s to t2+10s	[p.u.]	0.076
	26	Reactive power recover time	Total	-	ms	0

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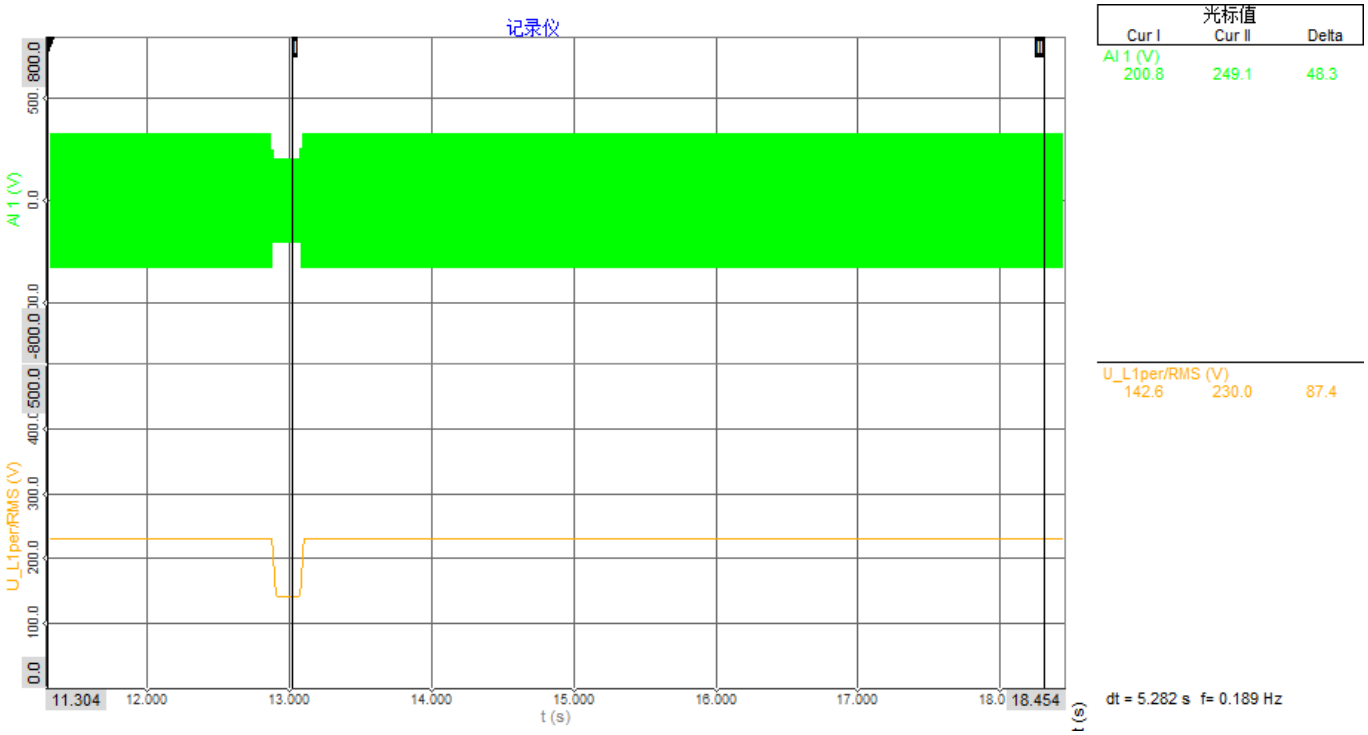
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

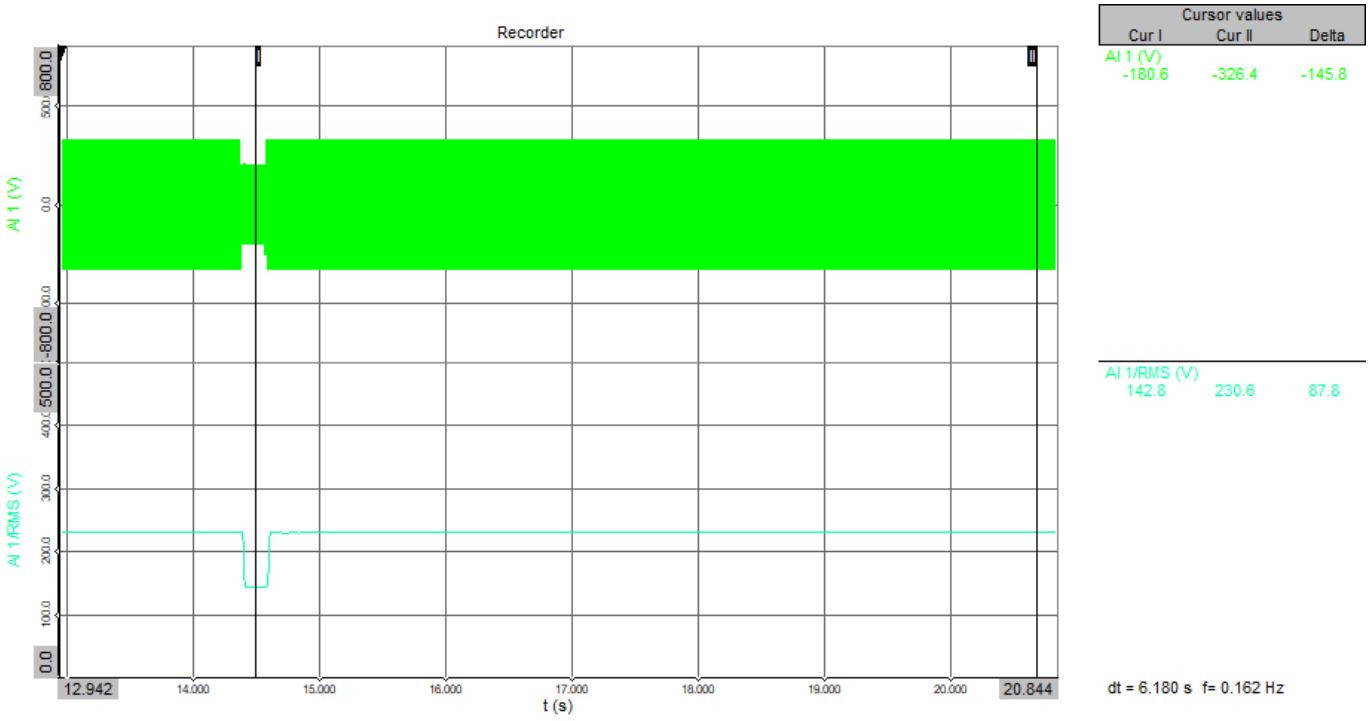
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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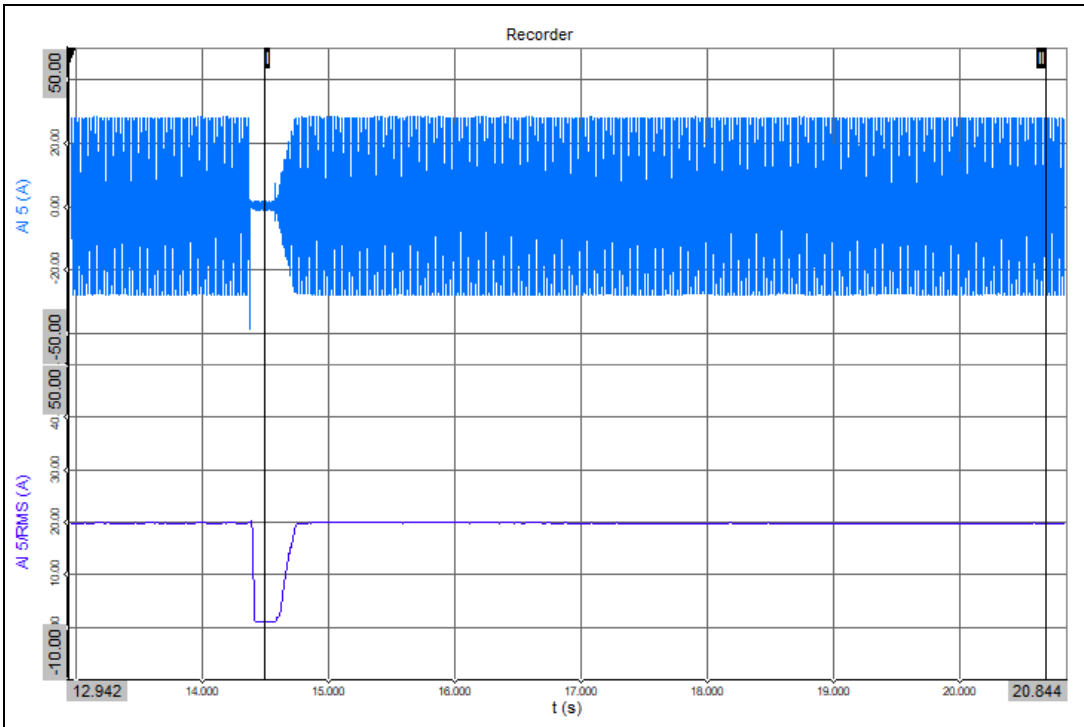
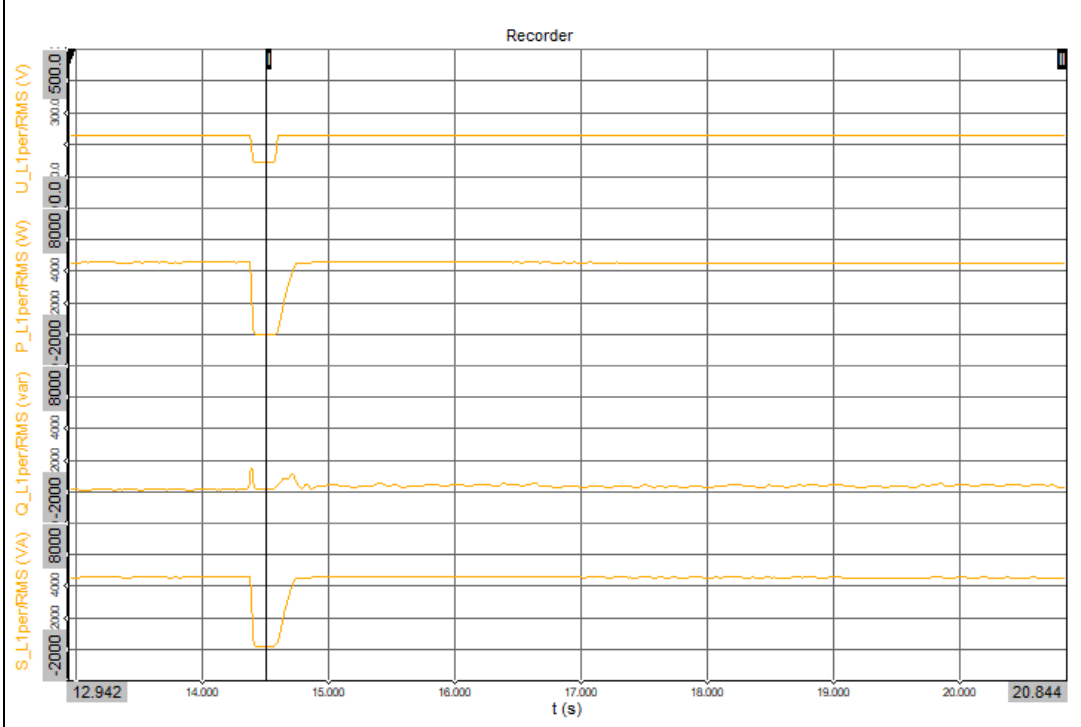
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		2.1				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	2.1	2.1
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:29:47
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.522
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13784
	7	Time of fault clearance (t_2)	-	-	[ms]	15341
	8	Fault duration determined from no load test	-	-	[ms]	1537
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.478
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.011
	11	Current	L1	t1-10s to t1	[p.u.]	0.985
	12	Active power	Total	t1-10s to t1	[p.u.]	0.791
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.605
	14	cos φ	Total	t1-10s to t1	-	0.794
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.522
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.041
	17		L1	t1+100ms	[p.u.]	0.041
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.041
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.002
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.011
	21	Active power	Total	t2+1s	[p.u.]	0.793
	22		Total	t2+3s to t2+10s	[p.u.]	0.792
	23	Active power recover time	Total	-	ms	108
	24	Reactive power	Total	t2+10s	[p.u.]	0.603
	25		Total	t2+3s to t2+10s	[p.u.]	0.606
	26	Reactive power recover time	Total	-	ms	149

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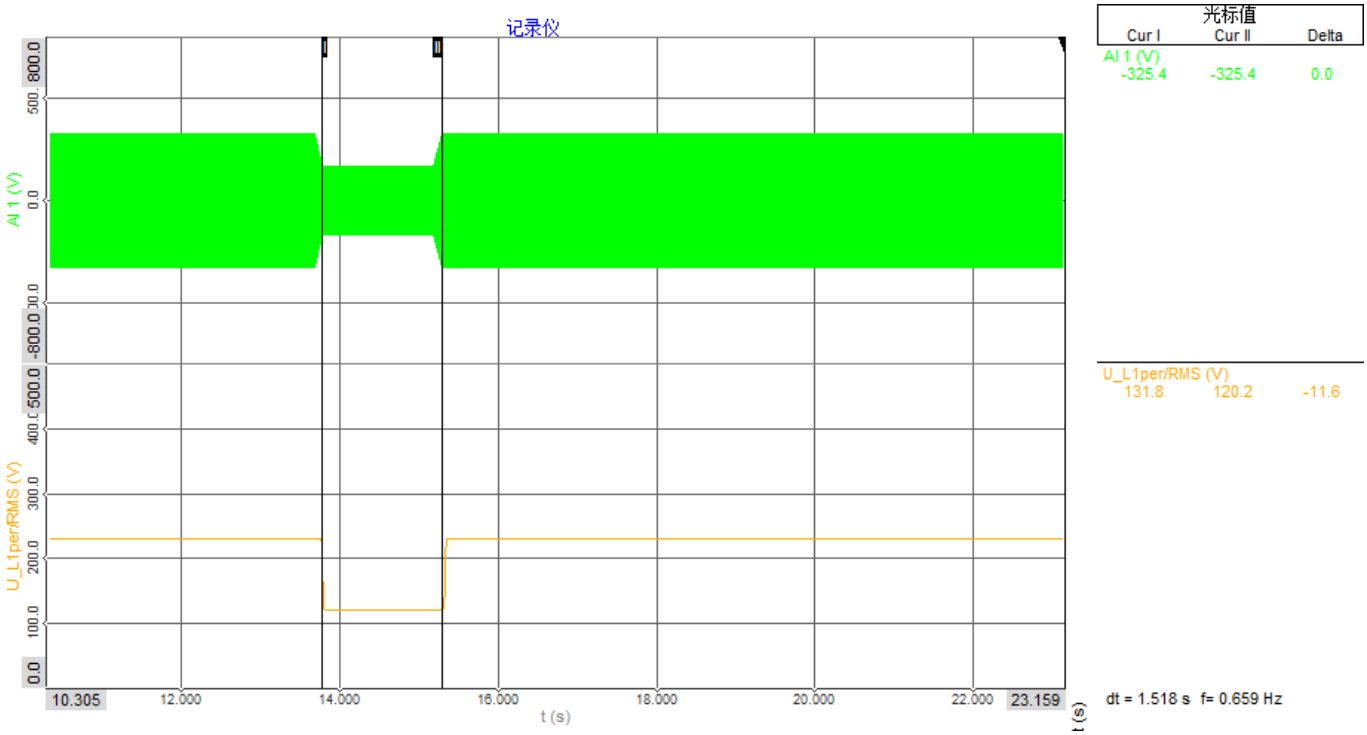
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

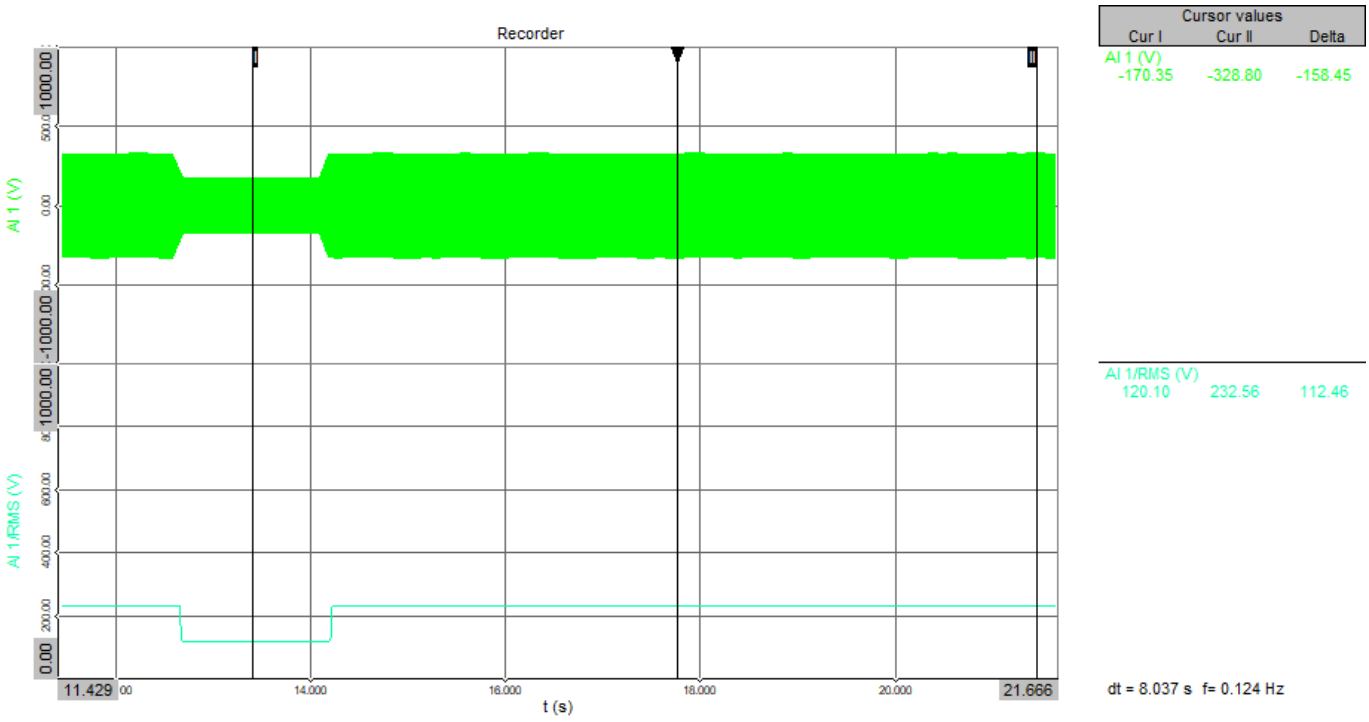
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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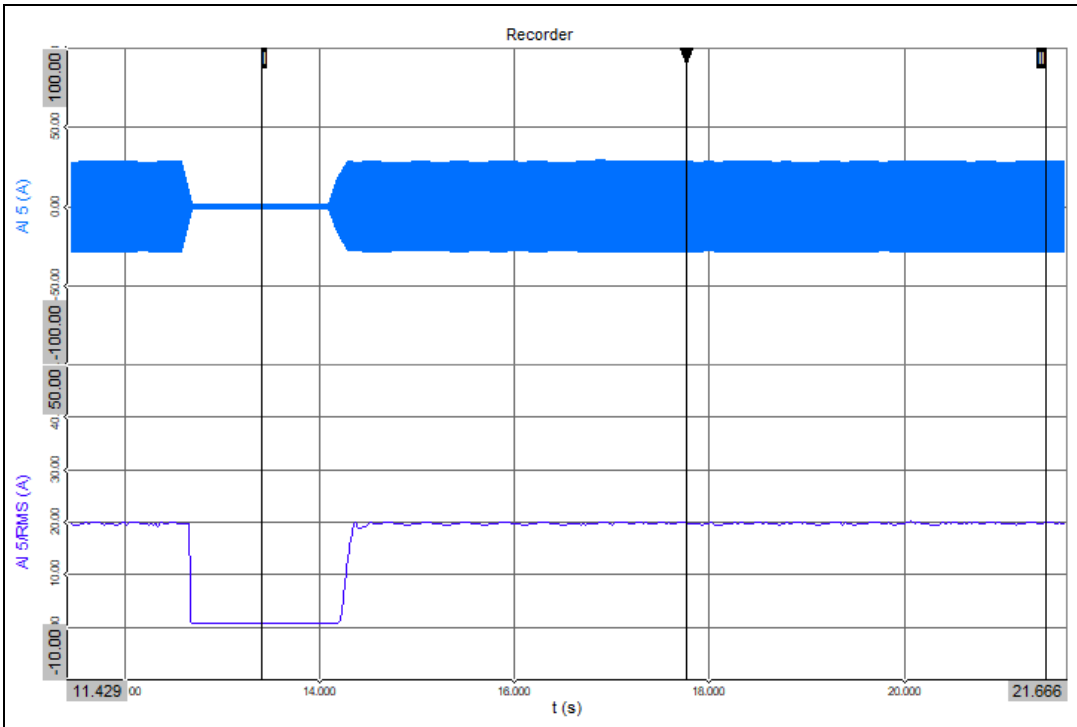
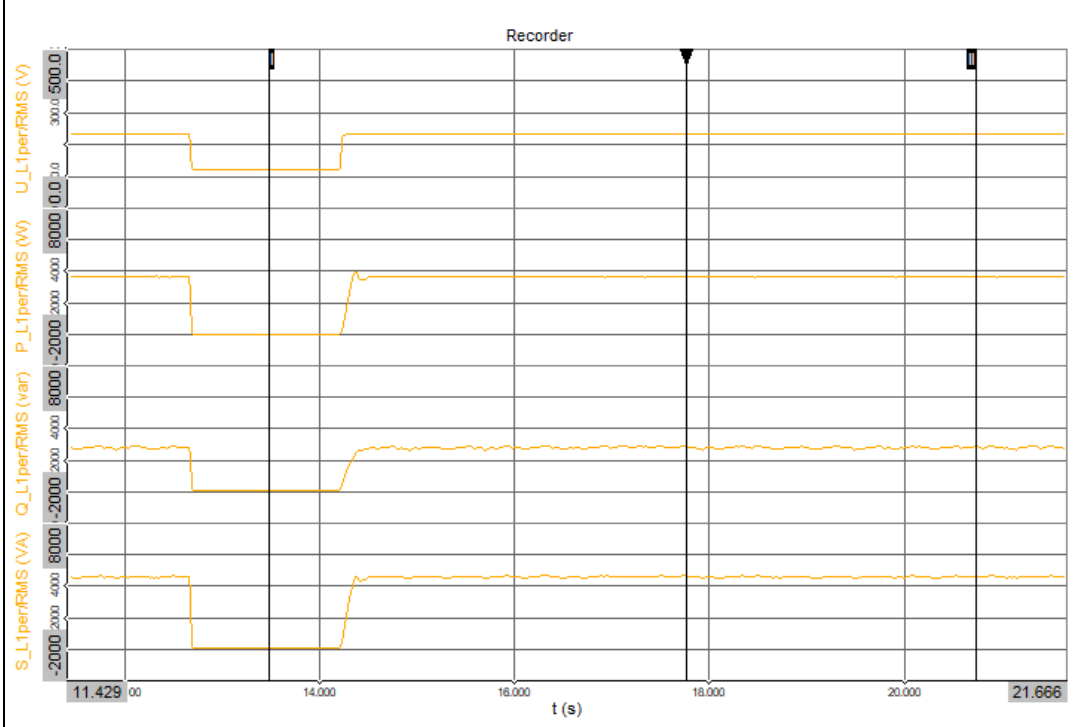
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	2.2					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	2.2	2.2
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:23:45
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.522
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13784
	7	Time of fault clearance (t_2)	-	-	[ms]	15341
	8	Fault duration determined from no load test	-	-	[ms]	1537
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.478
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.006
	11	Current	L1	t1-10s to t1	[p.u.]	0.505
	12	Active power	Total	t1-10s to t1	[p.u.]	0.404
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.308
	14	cos φ	Total	t1-10s to t1	-	0.795
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.522
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.039
	17		L1	t1+100ms	[p.u.]	0.039
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.040
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.001
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.006
	21	Active power	Total	t2+1s	[p.u.]	0.405
	22		Total	t2+3s to t2+10s	[p.u.]	0.404
	23	Active power recover time	Total	-	ms	54
	24	Reactive power	Total	t2+10s	[p.u.]	0.299
	25		Total	t2+3s to t2+10s	[p.u.]	0.308
	26	Reactive power recover time	Total	-	ms	47

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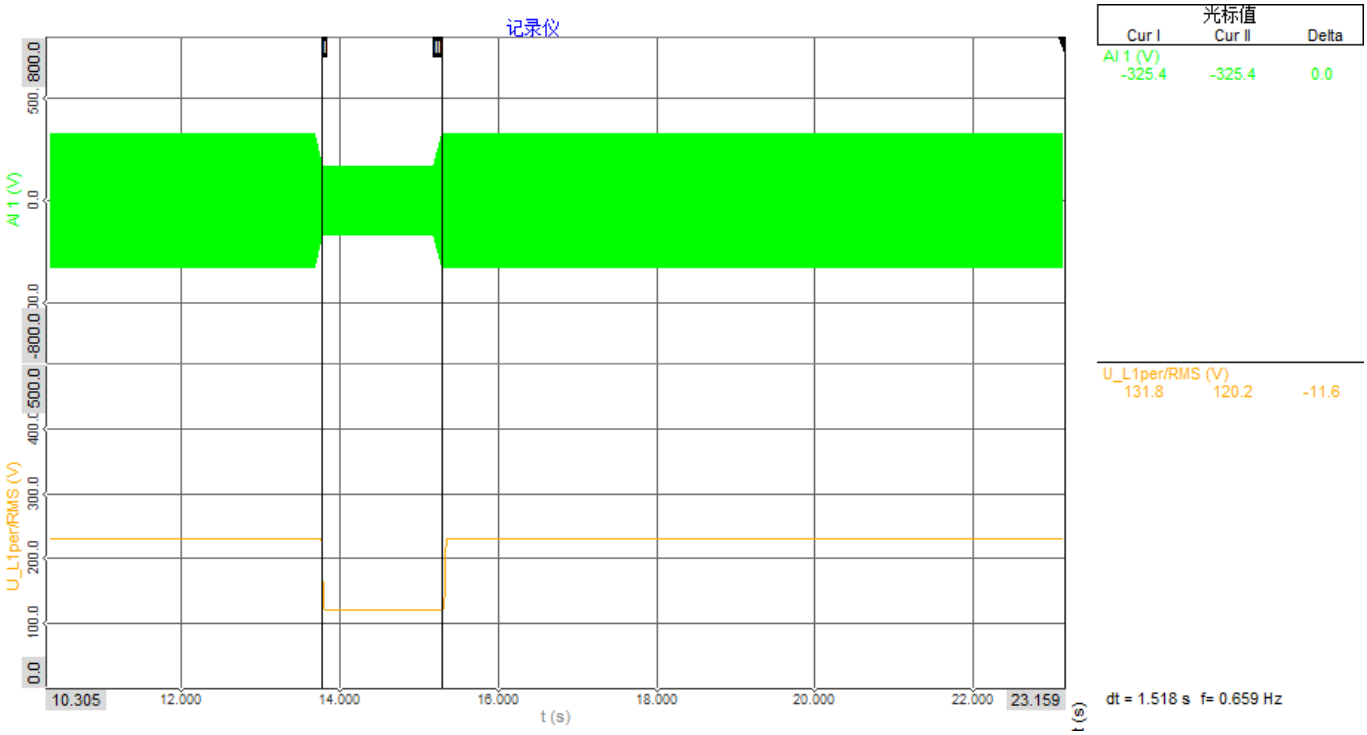
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

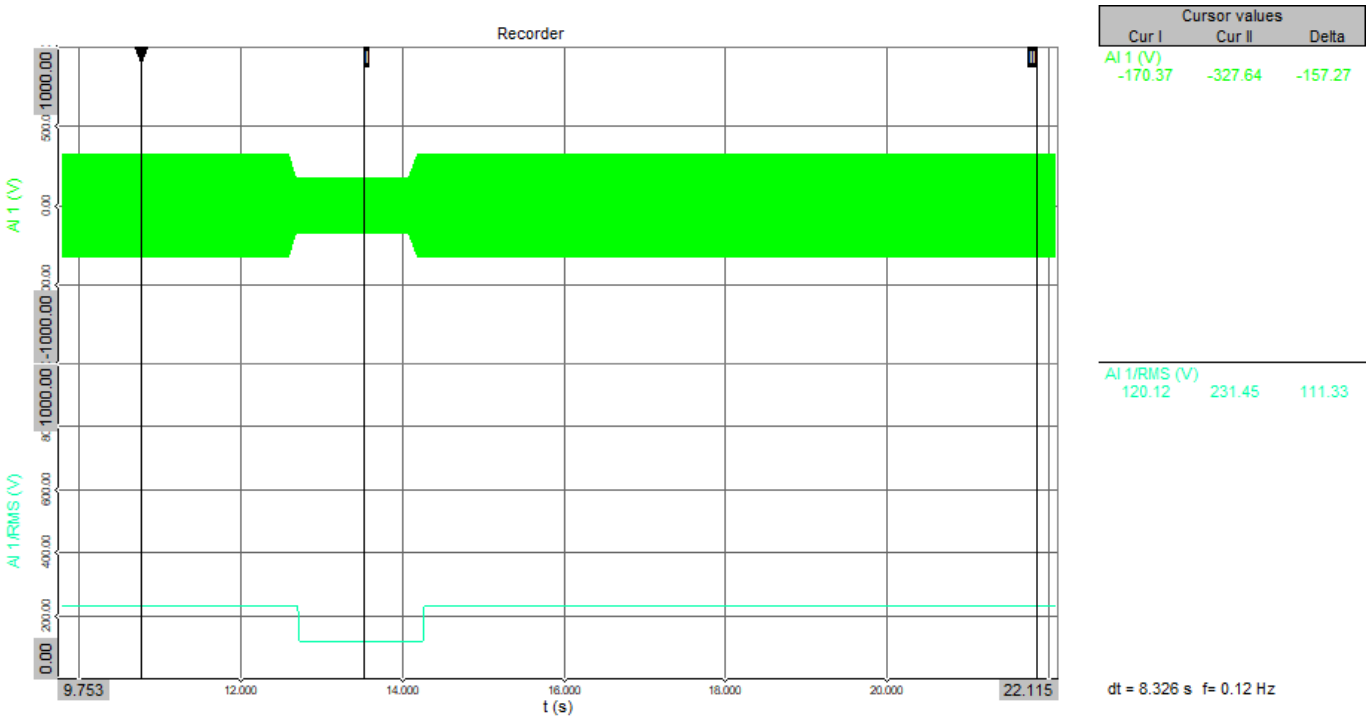
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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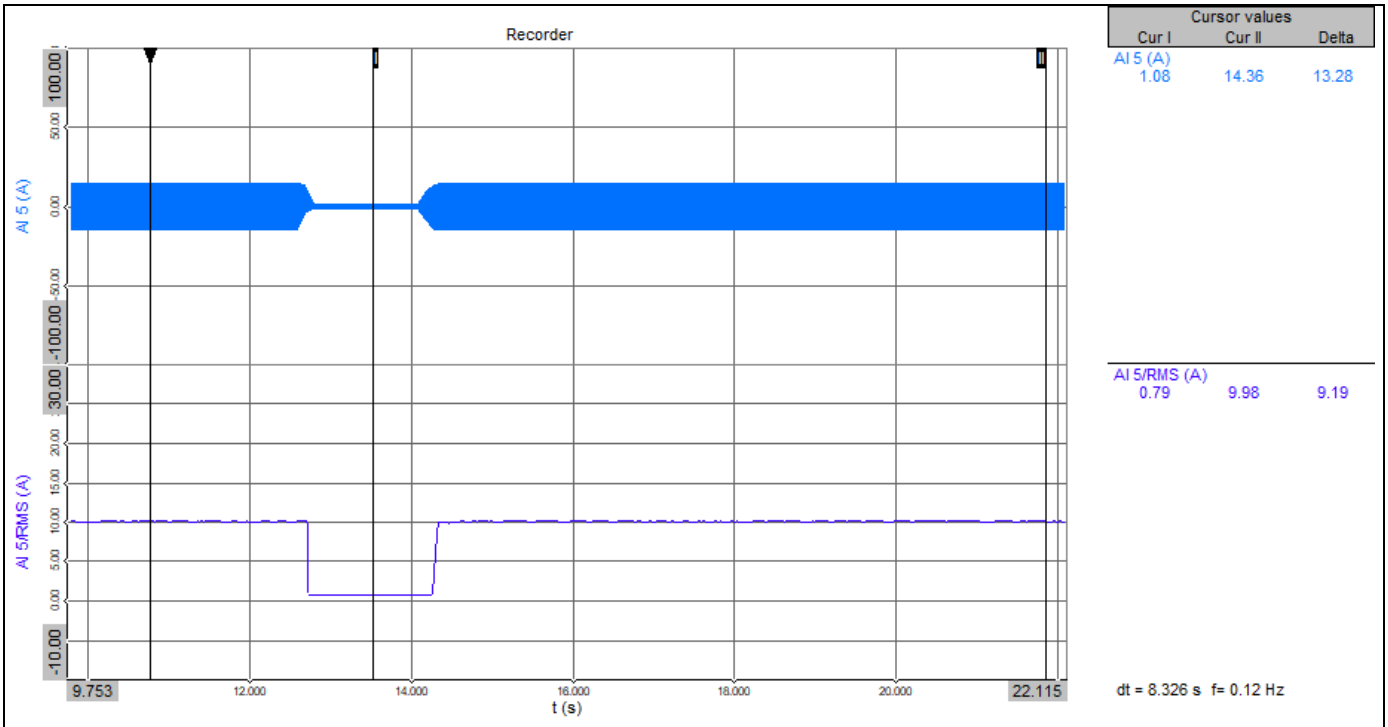
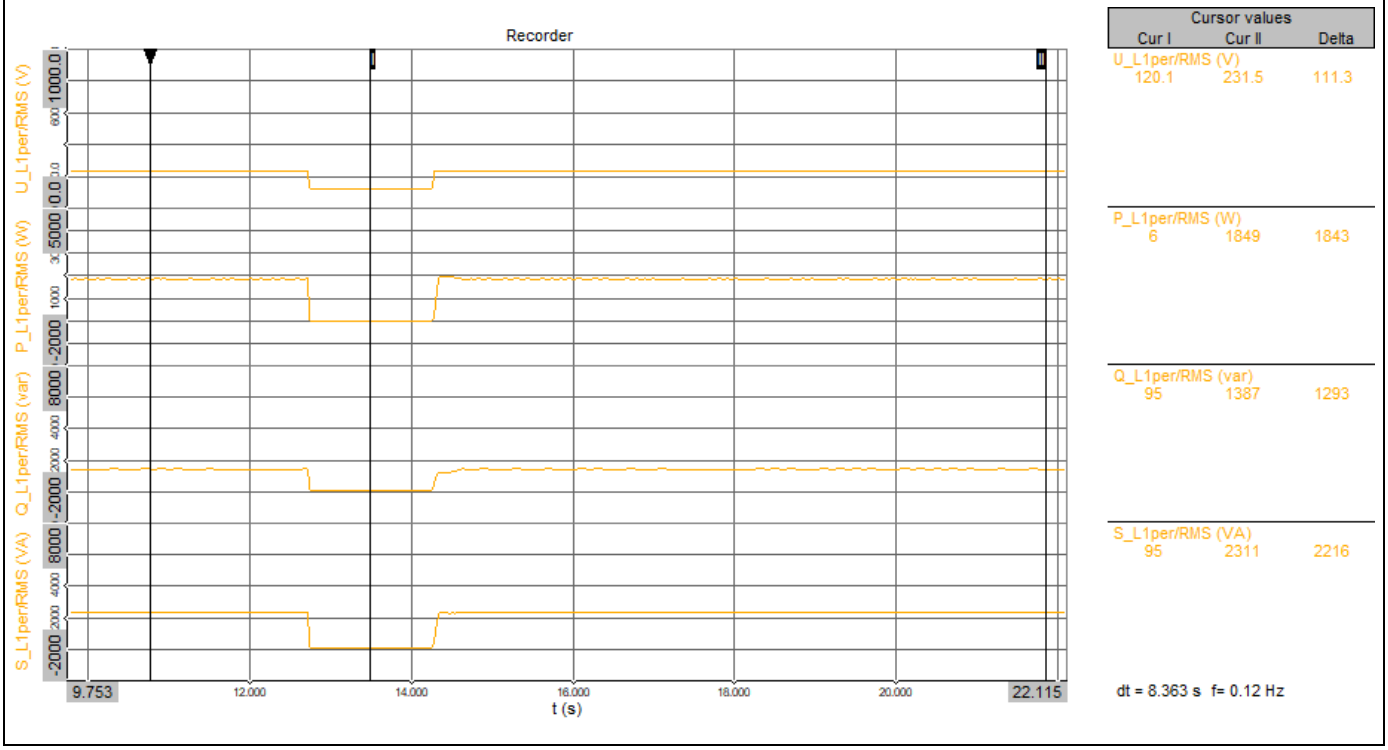
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	2.3					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	2.3	2.3
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:45:19
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.760
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13171
	7	Time of fault clearance (t_2)	-	-	[ms]	14719
	8	Fault duration determined from no load test	-	-	[ms]	1528
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.240
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.011
	11	Current	L1	t1-10s to t1	[p.u.]	0.988
	12	Active power	Total	t1-10s to t1	[p.u.]	0.809
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.585
	14	cos φ	Total	t1-10s to t1	-	0.810
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.761
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.058
	17		L1	t1+100ms	[p.u.]	0.058
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.060
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.004
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.011
	21	Active power	Total	t2+1s	[p.u.]	0.808
	22		Total	t2+3s to t2+10s	[p.u.]	0.810
	23	Active power recover time	Total	-	ms	89
	24	Reactive power	Total	t2+10s	[p.u.]	0.587
	25		Total	t2+3s to t2+10s	[p.u.]	0.587
	26	Reactive power recover time	Total	-	ms	132

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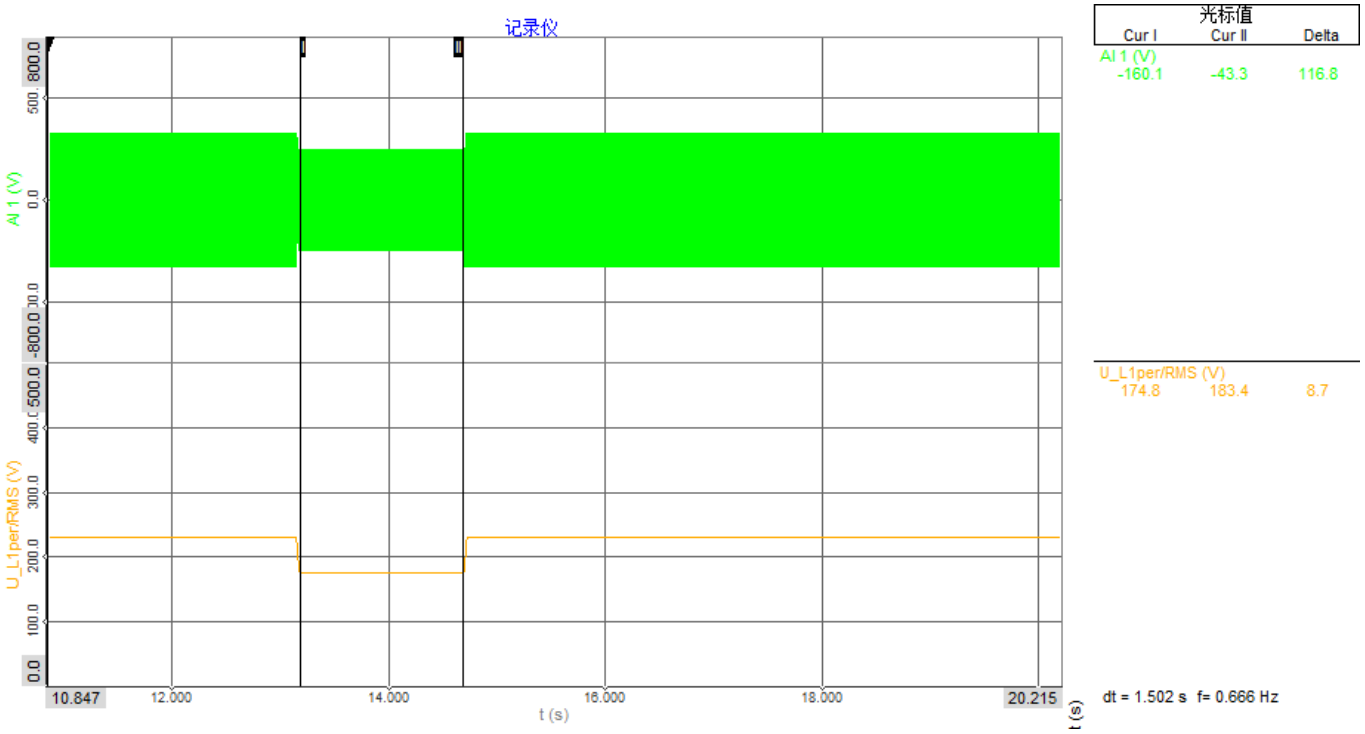
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

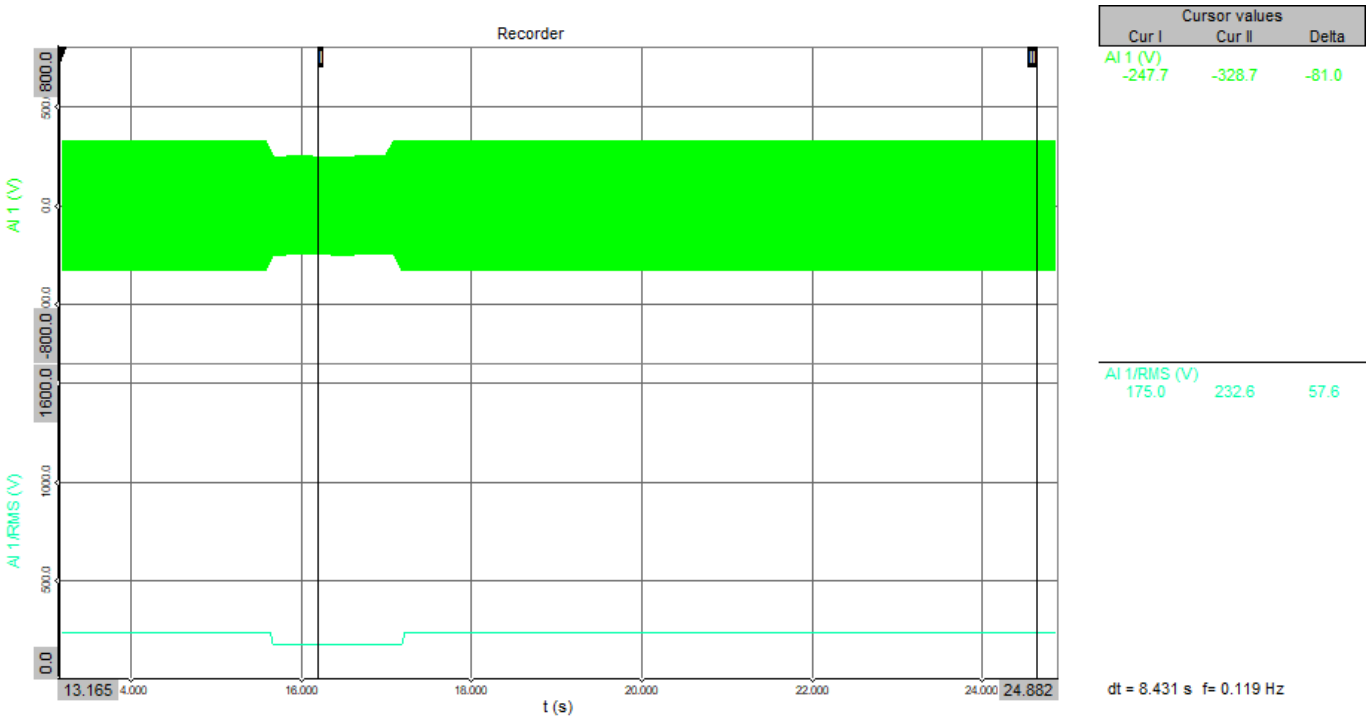
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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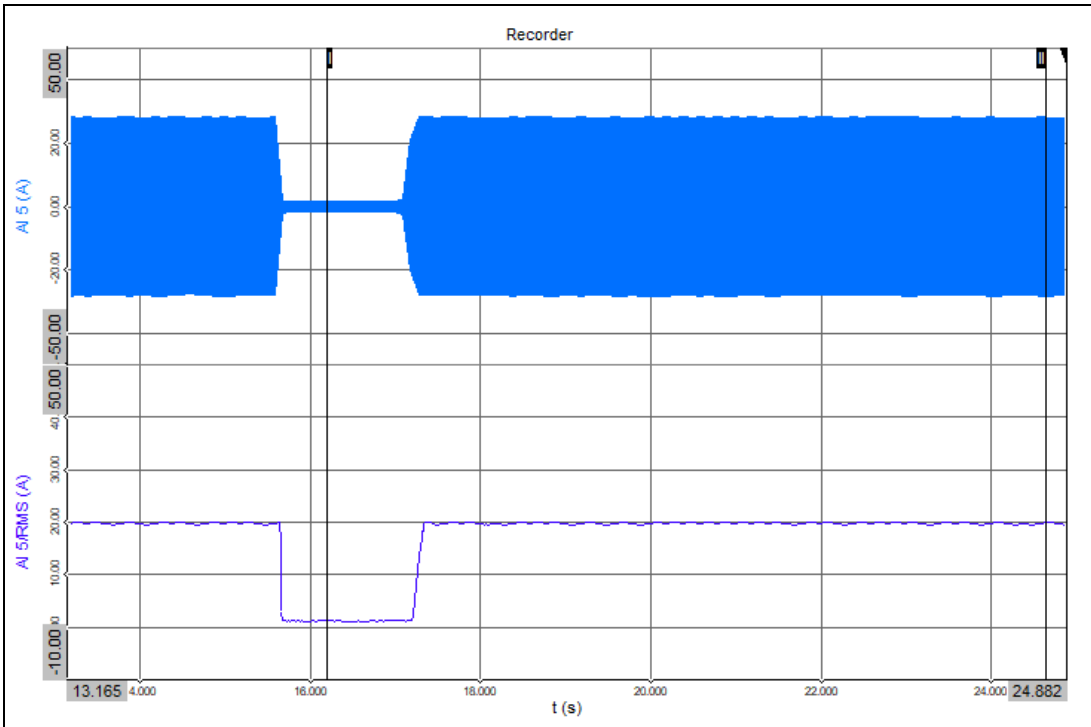
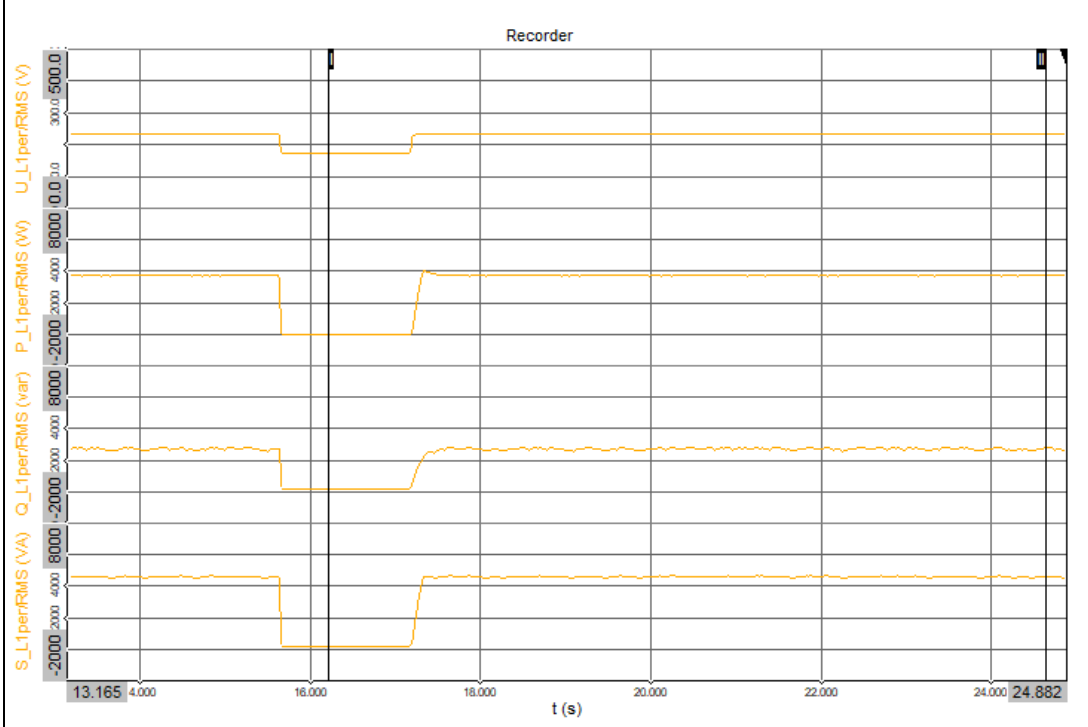
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		2.4				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	2.4	2.4
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:40:29
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.760
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13171
	7	Time of fault clearance (t_2)	-	-	[ms]	14719
	8	Fault duration determined from no load test	-	-	[ms]	1528
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.240
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.006
	11	Current	L1	t1-10s to t1	[p.u.]	0.487
	12	Active power	Total	t1-10s to t1	[p.u.]	0.395
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.290
	14	cos φ	Total	t1-10s to t1	-	0.807
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.761
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.058
	17		L1	t1+100ms	[p.u.]	0.058
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.060
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.003
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.006
	21	Active power	Total	t2+1s	[p.u.]	0.396
	22		Total	t2+3s to t2+10s	[p.u.]	0.396
	23	Active power recover time	Total	-	ms	31
	24	Reactive power	Total	t2+10s	[p.u.]	0.279
	25		Total	t2+3s to t2+10s	[p.u.]	0.291
	26	Reactive power recover time	Total	-	ms	23

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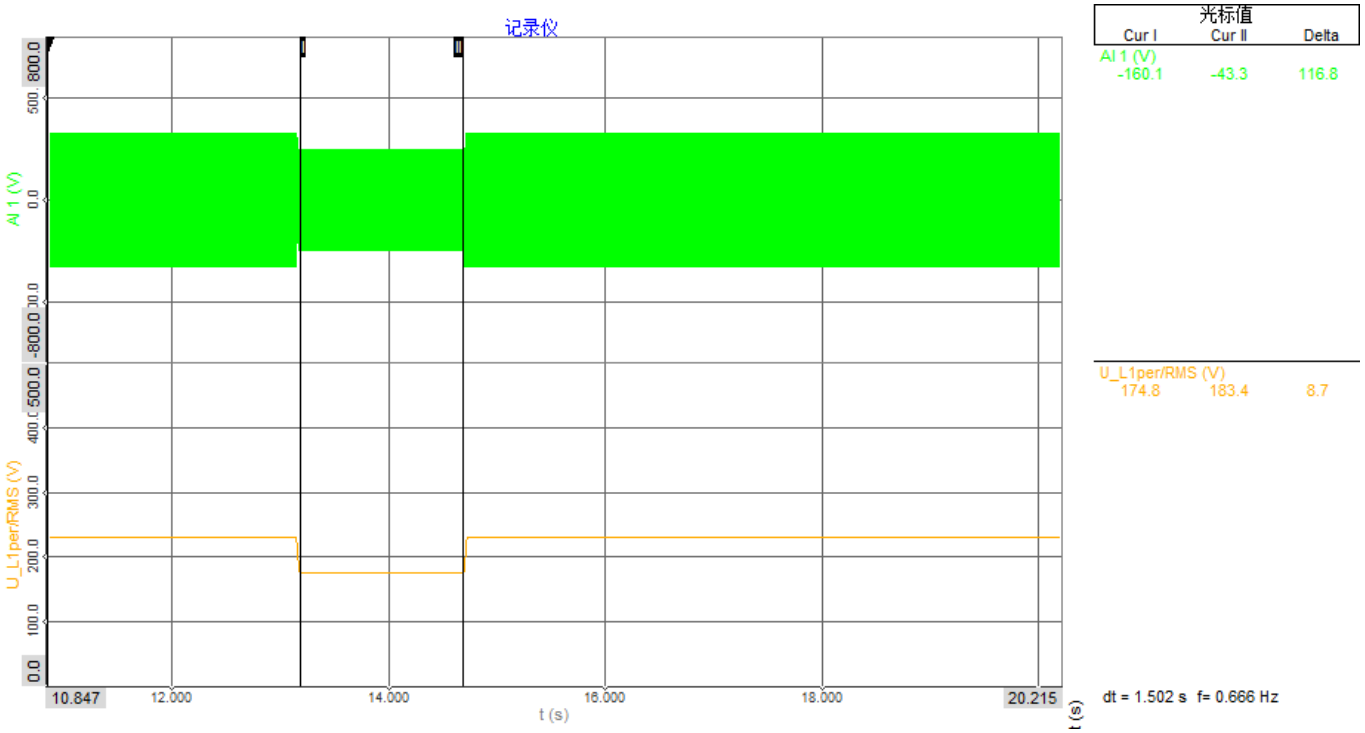
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

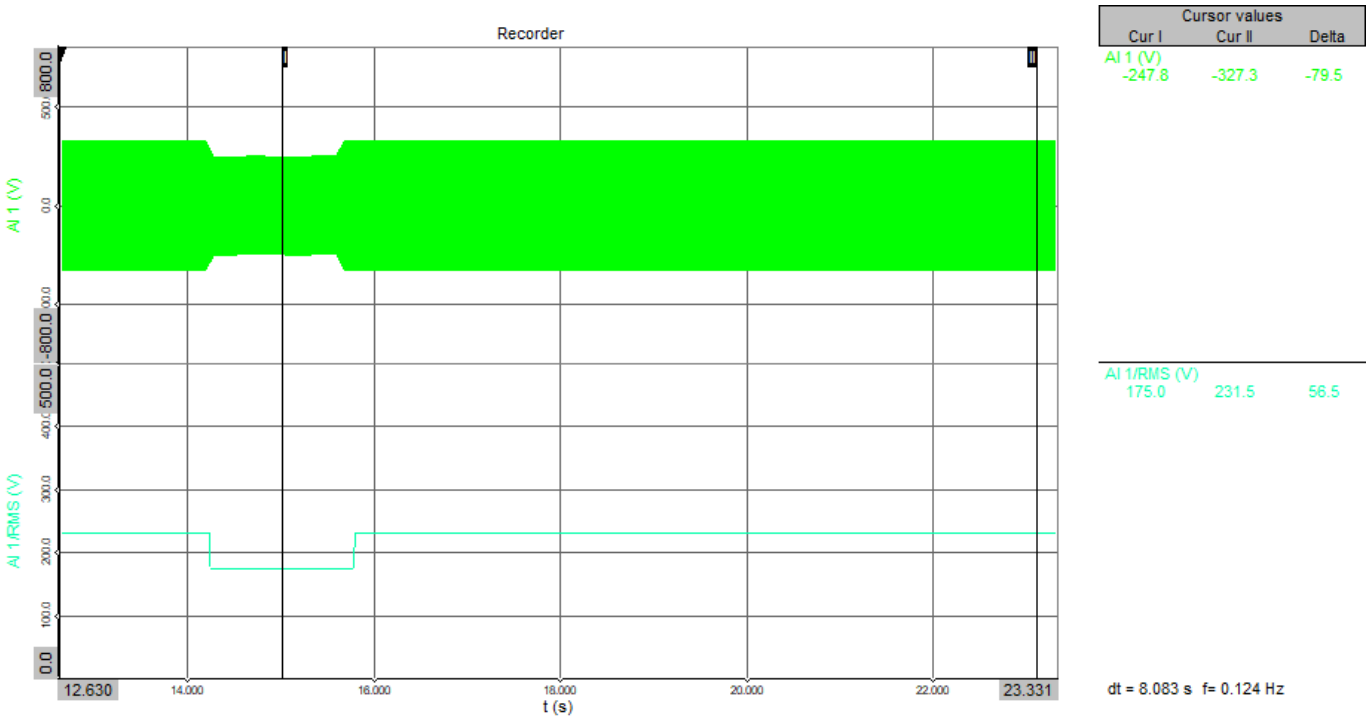
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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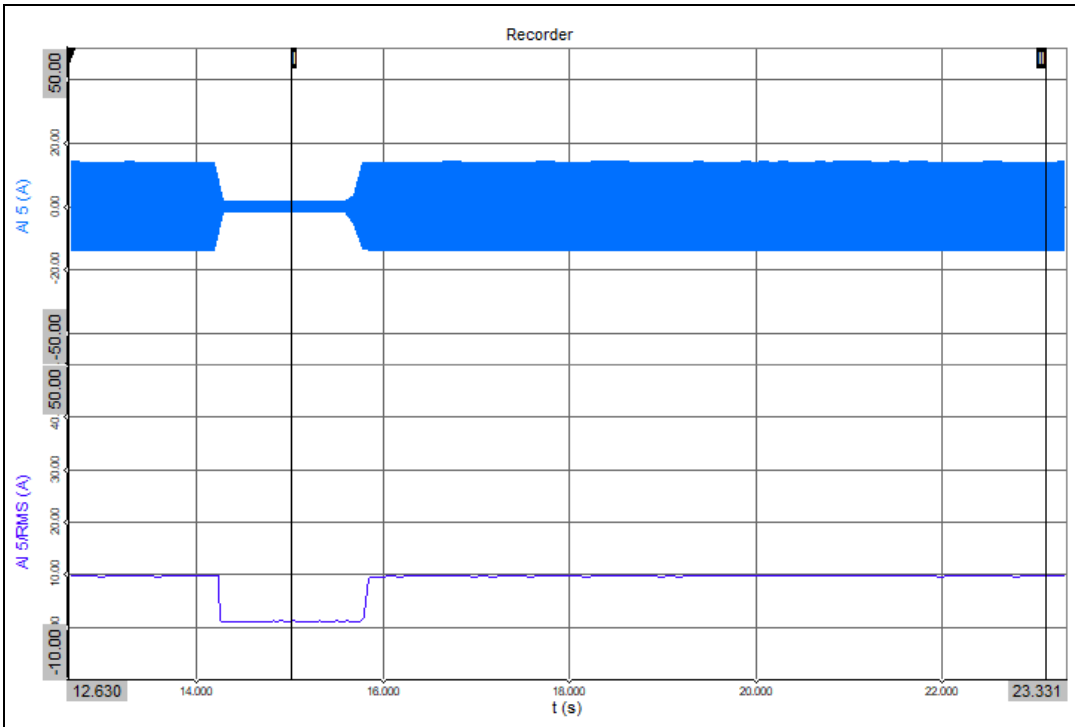
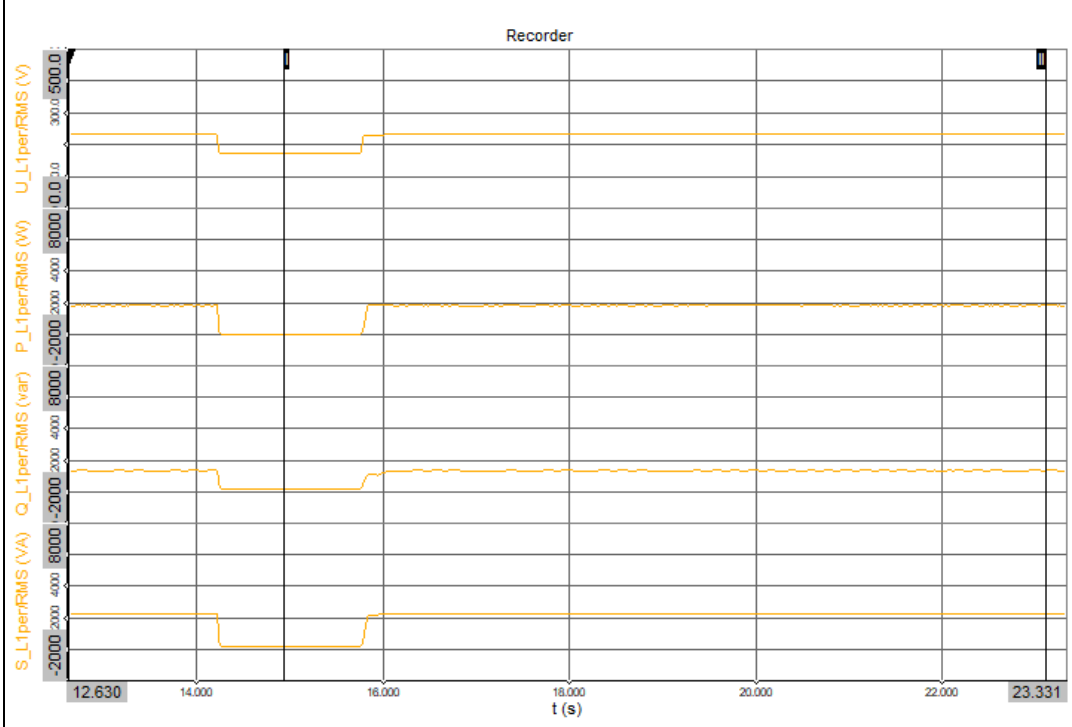
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		3.1				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	3.1	3.1
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:34:59
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.522
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13784
	7	Time of fault clearance (t_2)	-	-	[ms]	15341
	8	Fault duration determined from no load test	-	-	[ms]	1537
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.478
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	0.990
	11	Current	L1	t1-10s to t1	[p.u.]	0.988
	12	Active power	Total	t1-10s to t1	[p.u.]	0.797
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.568
	14	cos φ	Total	t1-10s to t1	-	0.814
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.522
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.041
	17		L1	t1+100ms	[p.u.]	0.041
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.041
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.002
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	0.990
	21	Active power	Total	t2+1s	[p.u.]	0.786
	22		Total	t2+3s to t2+10s	[p.u.]	0.798
	23	Active power recover time	Total	-	ms	176
	24	Reactive power	Total	t2+10s	[p.u.]	0.573
	25		Total	t2+3s to t2+10s	[p.u.]	0.573
	26	Reactive power recover time	Total	-	ms	103

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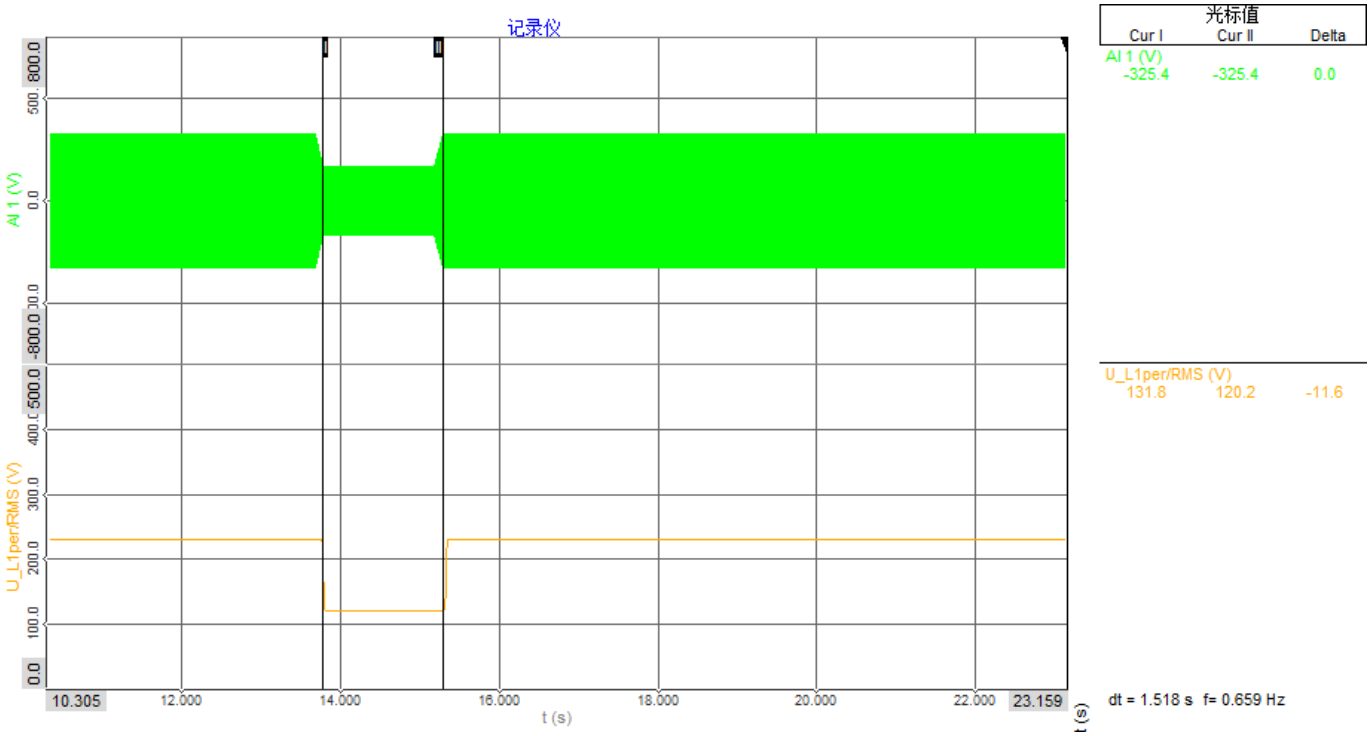
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

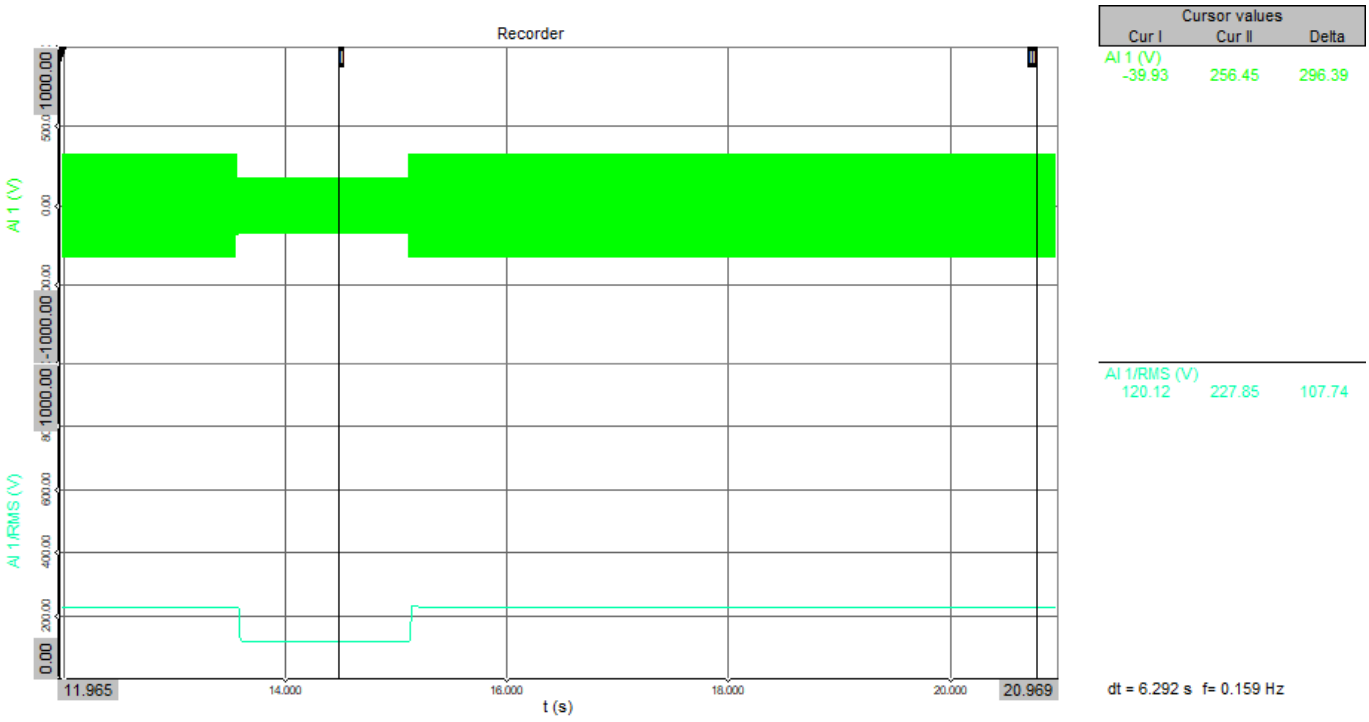
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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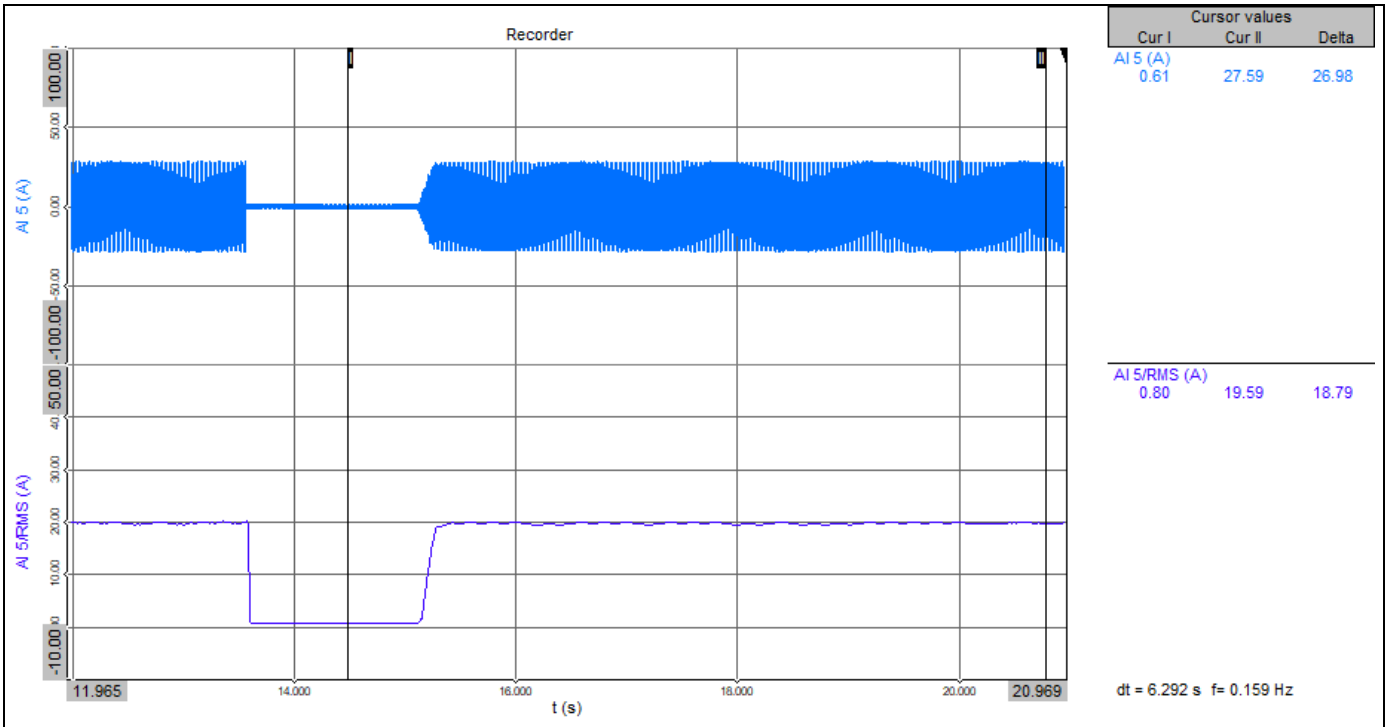
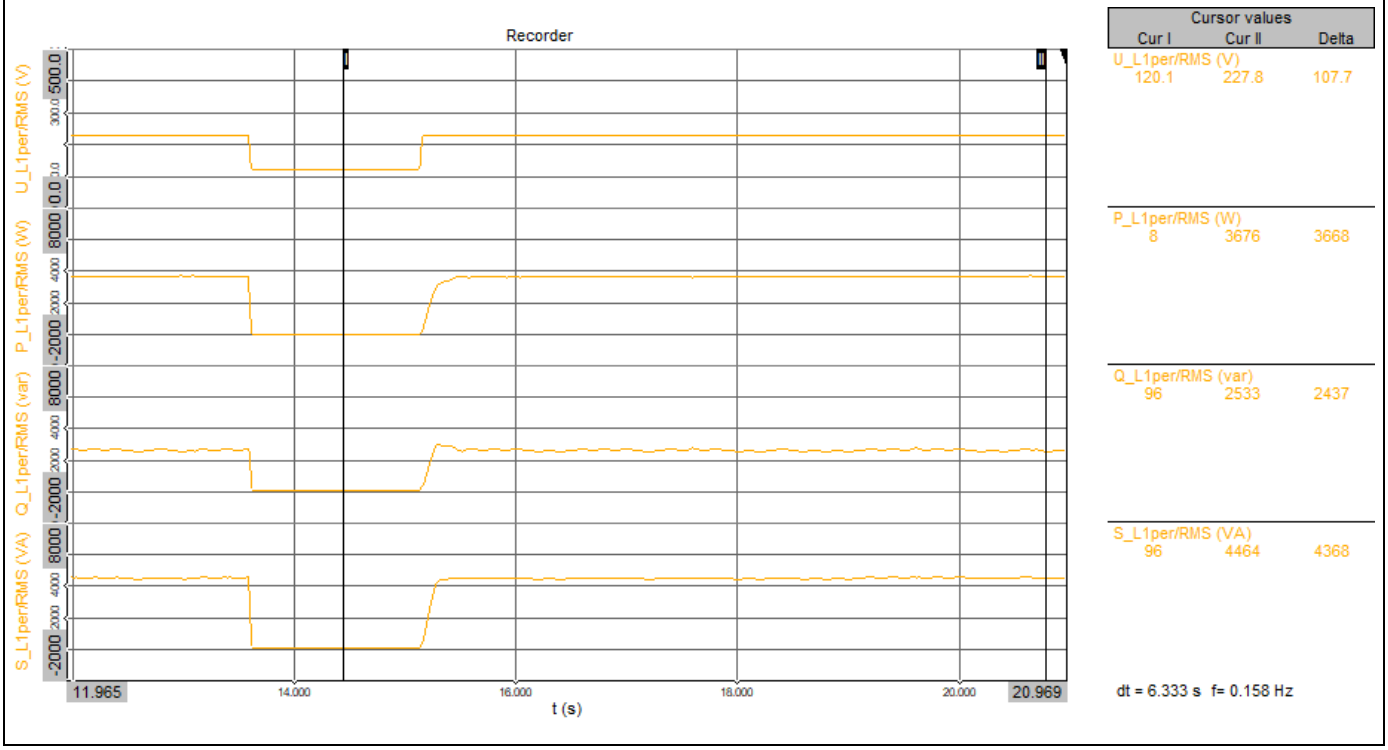
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		3.2				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	3.2	3.2
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:18:41
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.522
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13784
	7	Time of fault clearance (t_2)	-	-	[ms]	15341
	8	Fault duration determined from no load test	-	-	[ms]	1537
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.478
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	0.994
	11	Current	L1	t1-10s to t1	[p.u.]	0.466
	12	Active power	Total	t1-10s to t1	[p.u.]	0.378
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.268
	14	cos φ	Total	t1-10s to t1	-	0.816
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.522
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.039
	17		L1	t1+100ms	[p.u.]	0.039
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.040
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.001
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	0.994
	21	Active power	Total	t2+1s	[p.u.]	0.380
	22		Total	t2+3s to t2+10s	[p.u.]	0.379
	23	Active power recover time	Total	-	ms	69
	24	Reactive power	Total	t2+10s	[p.u.]	0.266
	25		Total	t2+3s to t2+10s	[p.u.]	0.268
	26	Reactive power recover time	Total	-	ms	49

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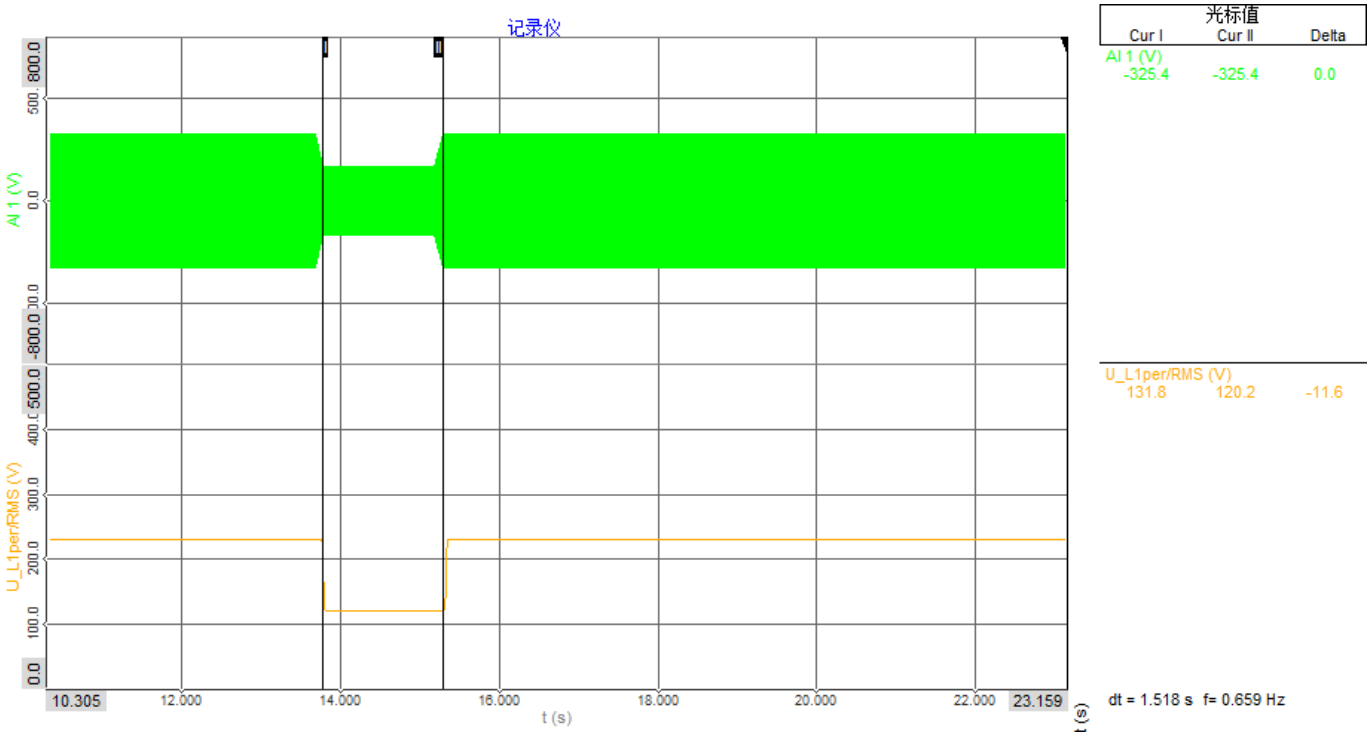
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

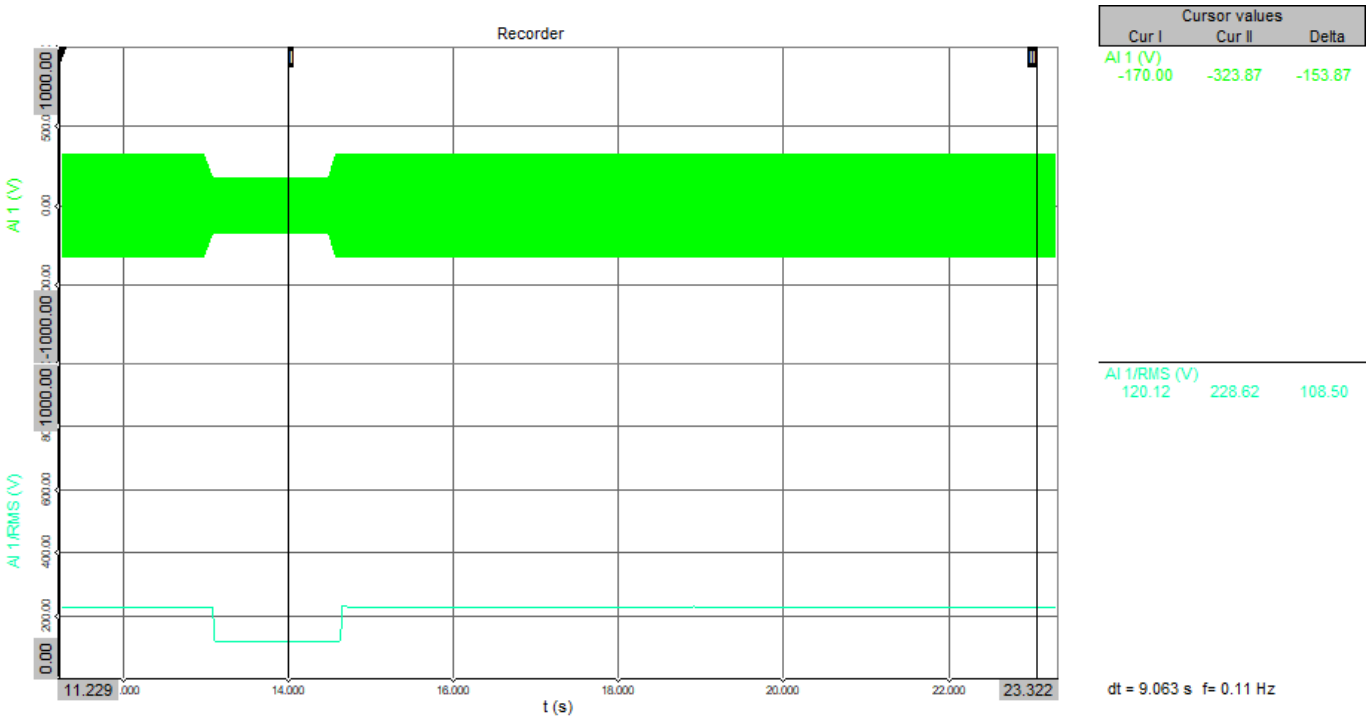
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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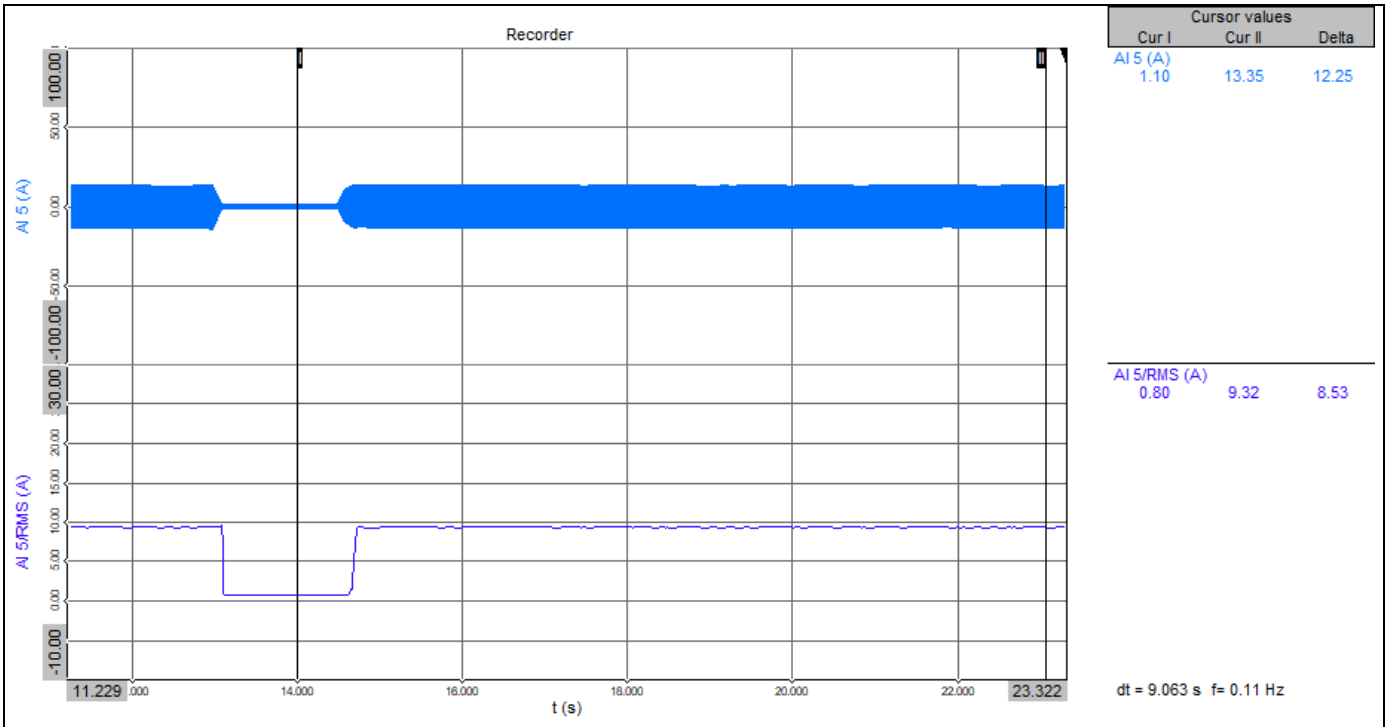
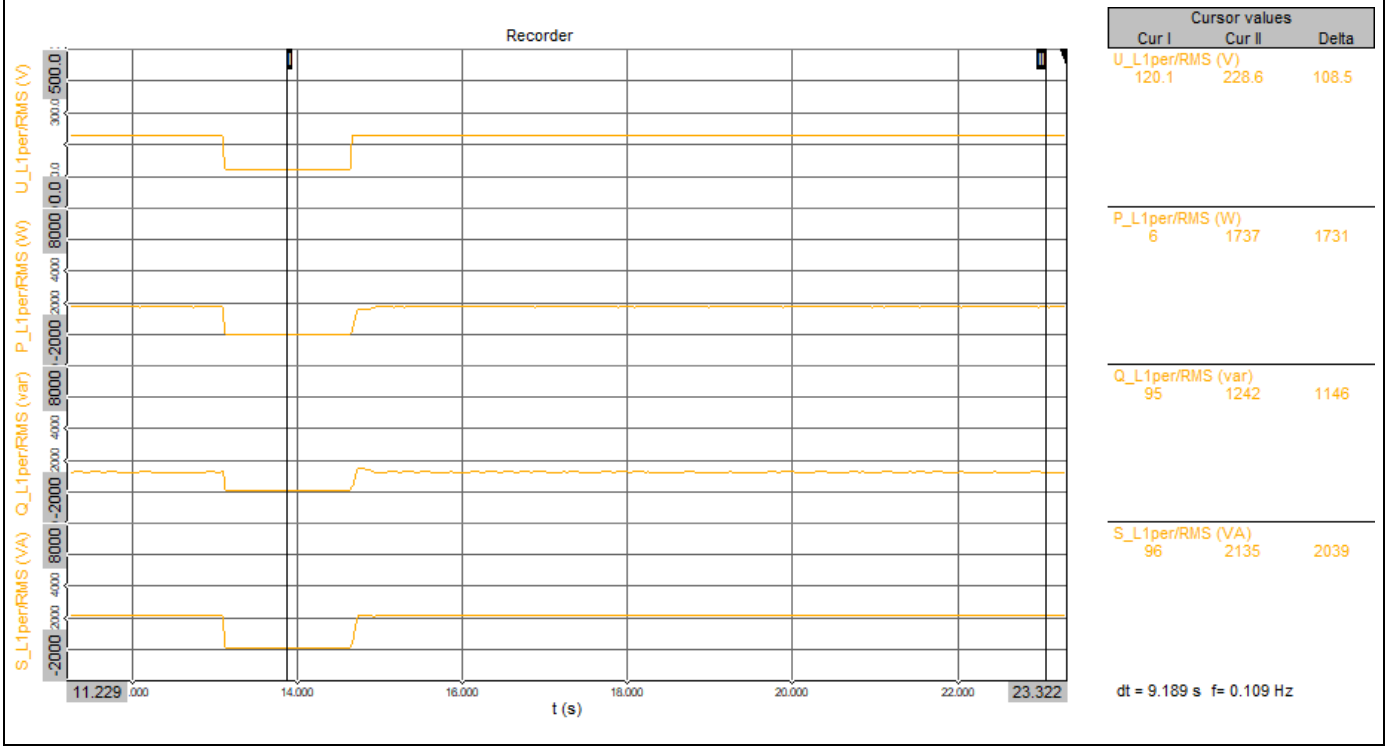
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		3.3				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	3.3	3.3
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:30:42
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.760
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13171
	7	Time of fault clearance (t_2)	-	-	[ms]	14719
	8	Fault duration determined from no load test	-	-	[ms]	1528
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.240
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	0.990
	11	Current	L1	t1-10s to t1	[p.u.]	0.985
	12	Active power	Total	t1-10s to t1	[p.u.]	0.773
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.592
	14	cos φ	Total	t1-10s to t1	-	0.794
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.761
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.060
	17		L1	t1+100ms	[p.u.]	0.061
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.061
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.004
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	0.990
	21	Active power	Total	t2+1s	[p.u.]	0.776
	22		Total	t2+3s to t2+10s	[p.u.]	0.777
	23	Active power recover time	Total	-	ms	162
	24	Reactive power	Total	t2+10s	[p.u.]	0.593
	25		Total	t2+3s to t2+10s	[p.u.]	0.591
	26	Reactive power recover time	Total	-	ms	82

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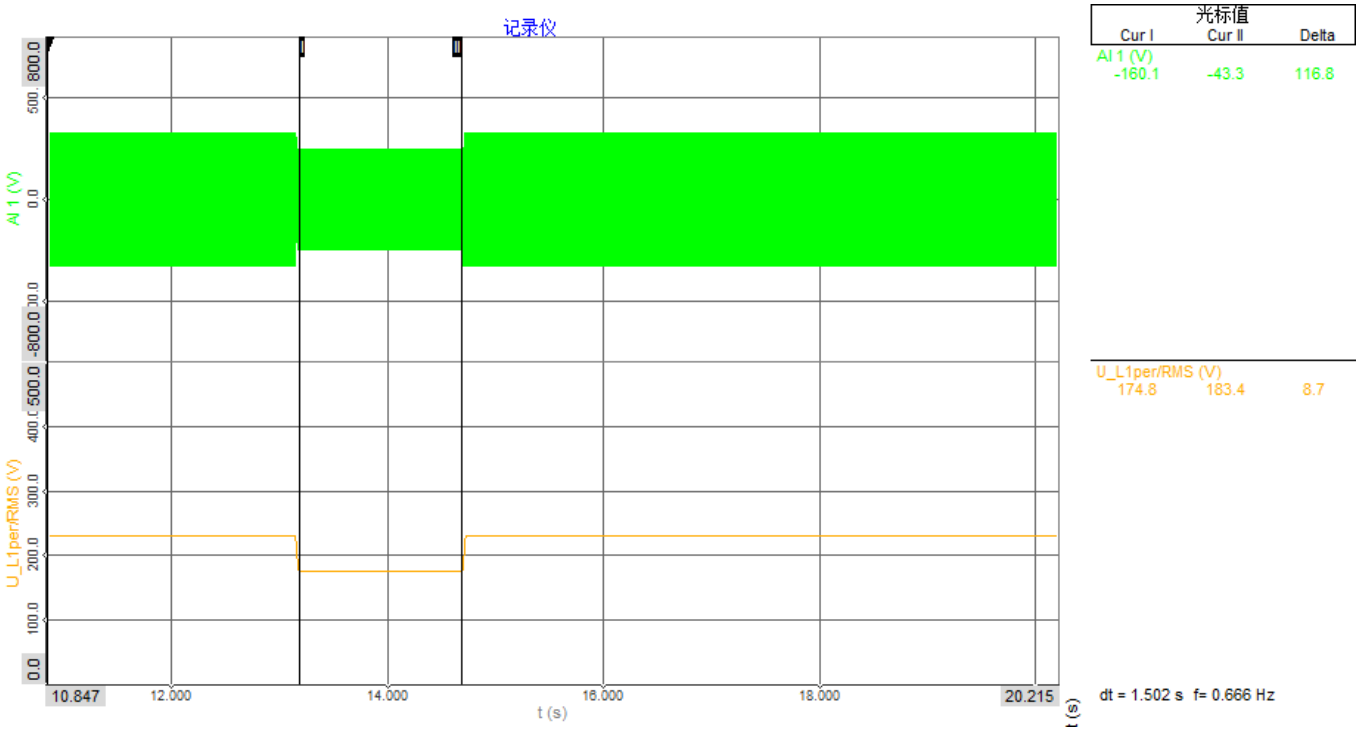
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

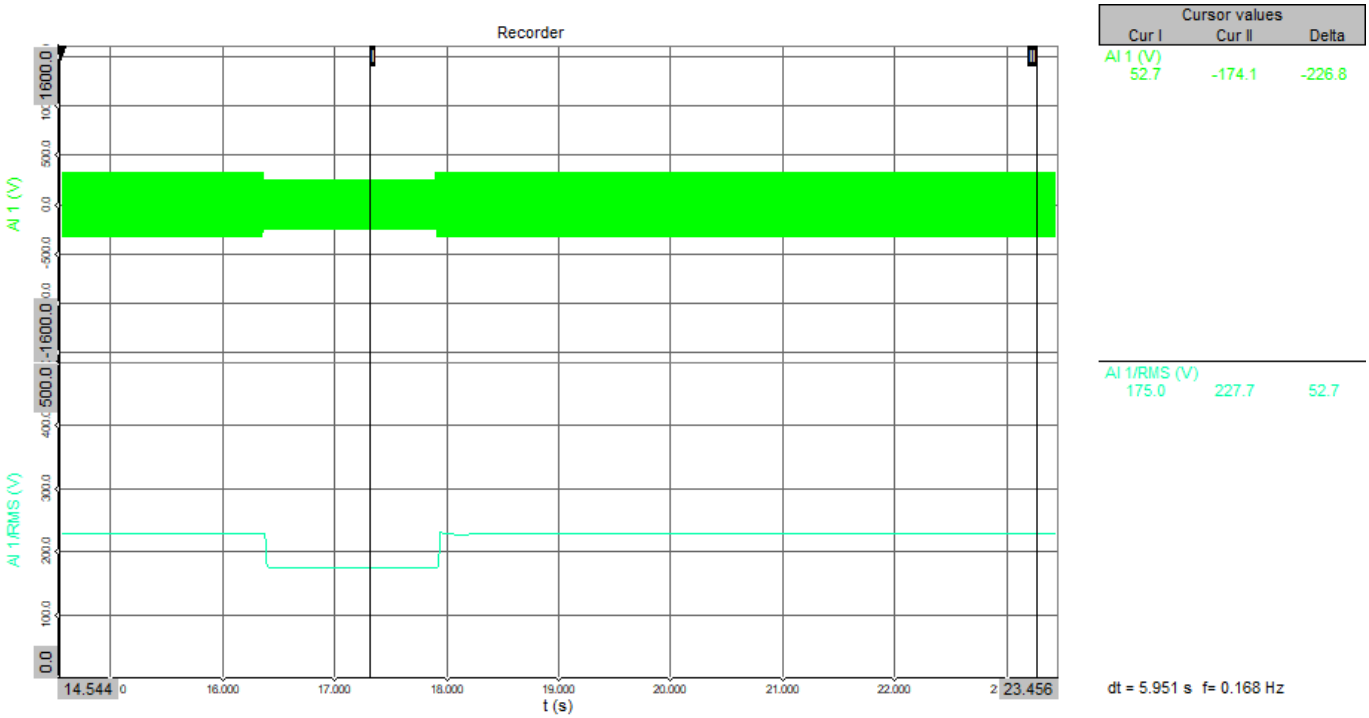
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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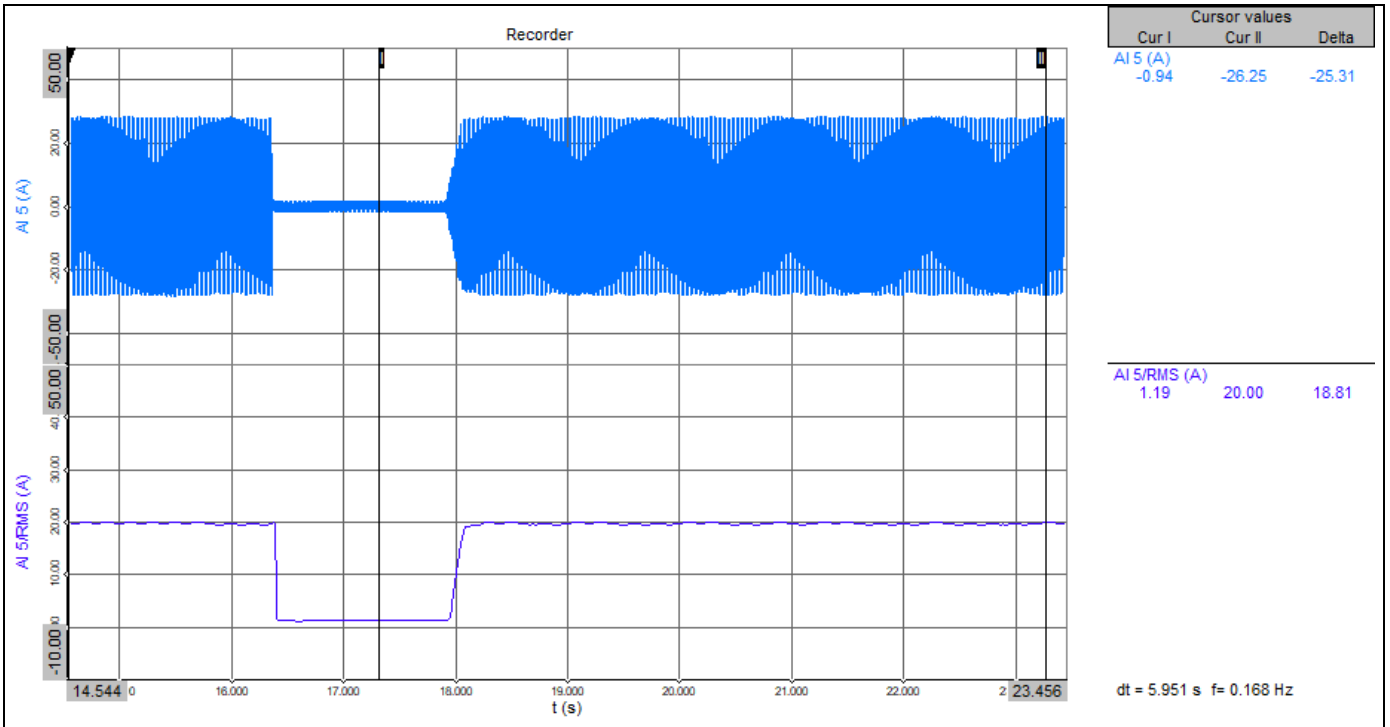
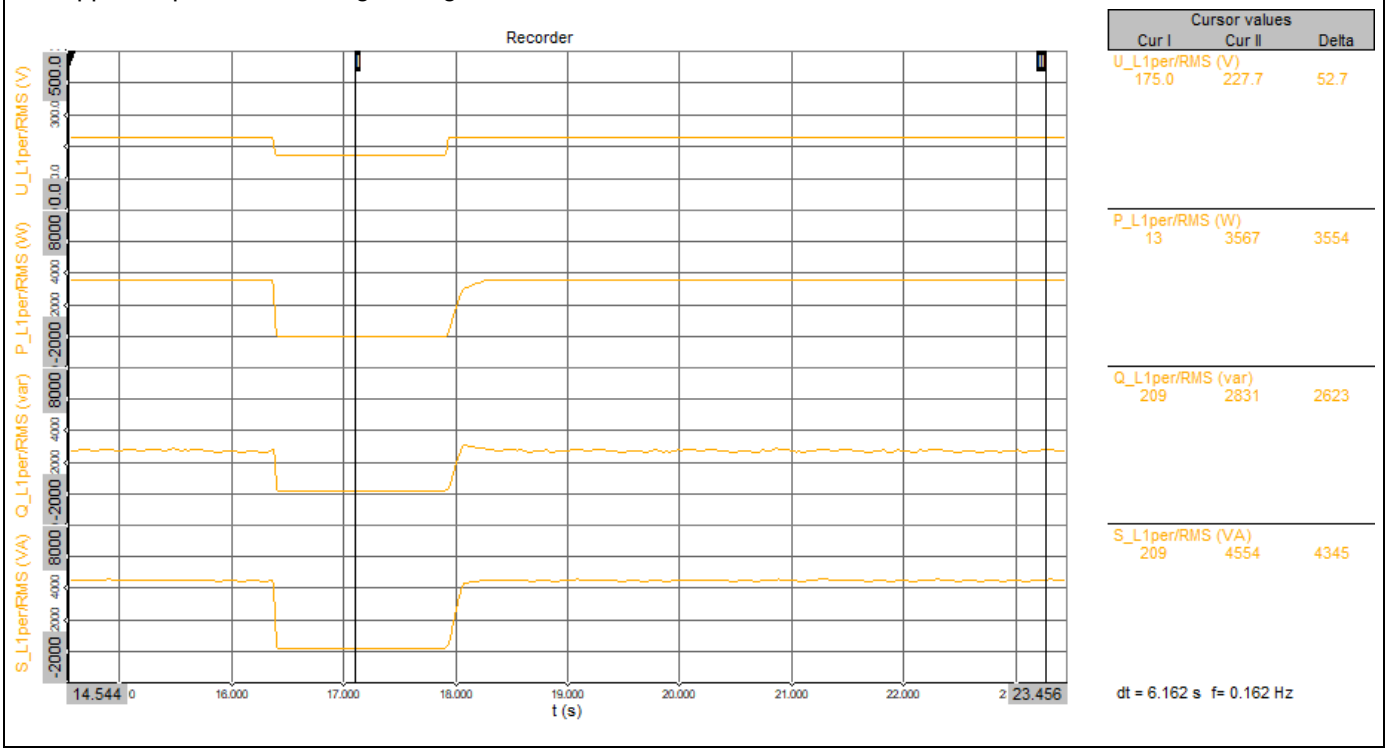
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		3.4				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	3.4	3.4
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:37:38
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.760
	5	Dip duration setpoint	-	-	[ms]	1550
	6	Time of fault occurrence (t_1)	-	-	[ms]	13171
	7	Time of fault clearance (t_2)	-	-	[ms]	14719
	8	Fault duration determined from no load test	-	-	[ms]	1528
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.240
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	0.994
	11	Current	L1	t1-10s to t1	[p.u.]	0.475
	12	Active power	Total	t1-10s to t1	[p.u.]	0.378
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.282
	14	cos φ	Total	t1-10s to t1	-	0.801
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.761
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.059
	17		L1	t1+100ms	[p.u.]	0.058
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.061
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.003
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	0.994
	21	Active power	Total	t2+1s	[p.u.]	0.379
	22		Total	t2+3s to t2+10s	[p.u.]	0.379
	23	Active power recover time	Total	-	ms	48
	24	Reactive power	Total	t2+10s	[p.u.]	0.272
	25		Total	t2+3s to t2+10s	[p.u.]	0.283
	26	Reactive power recover time	Total	-	ms	29

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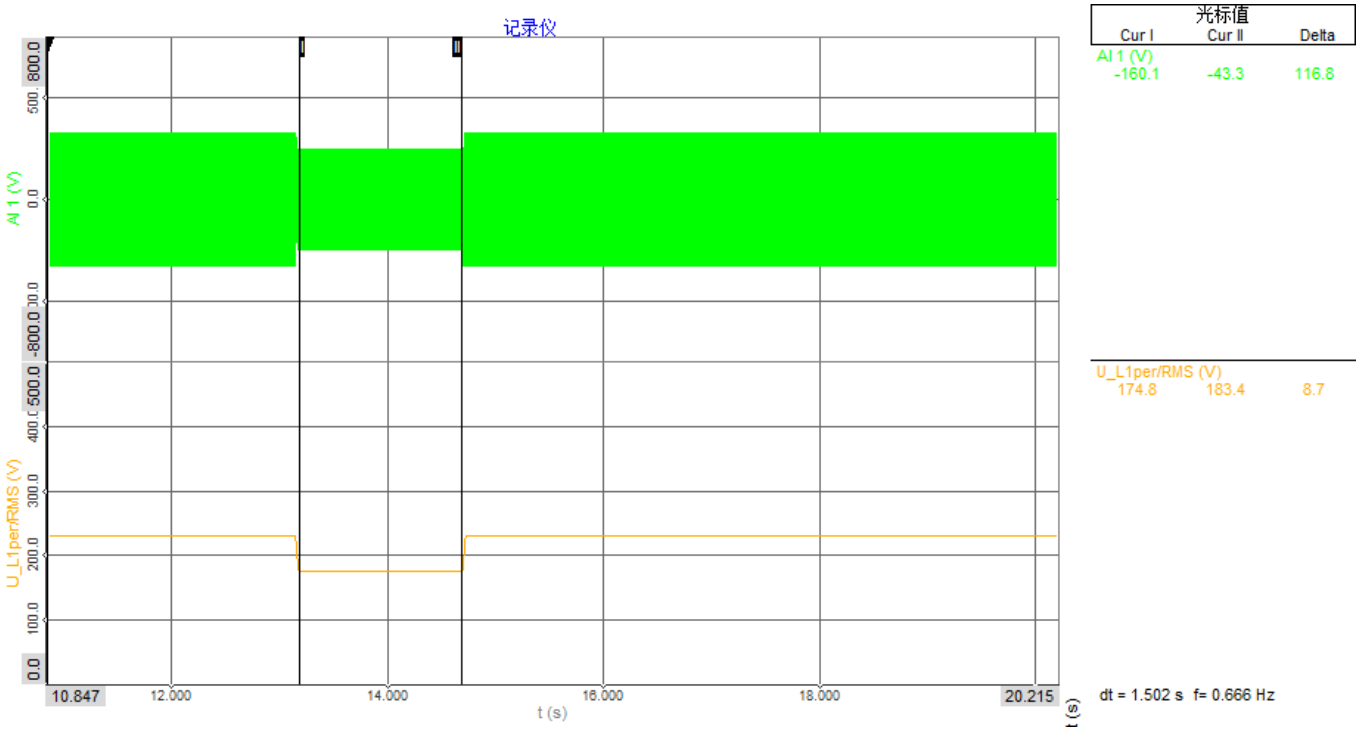
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

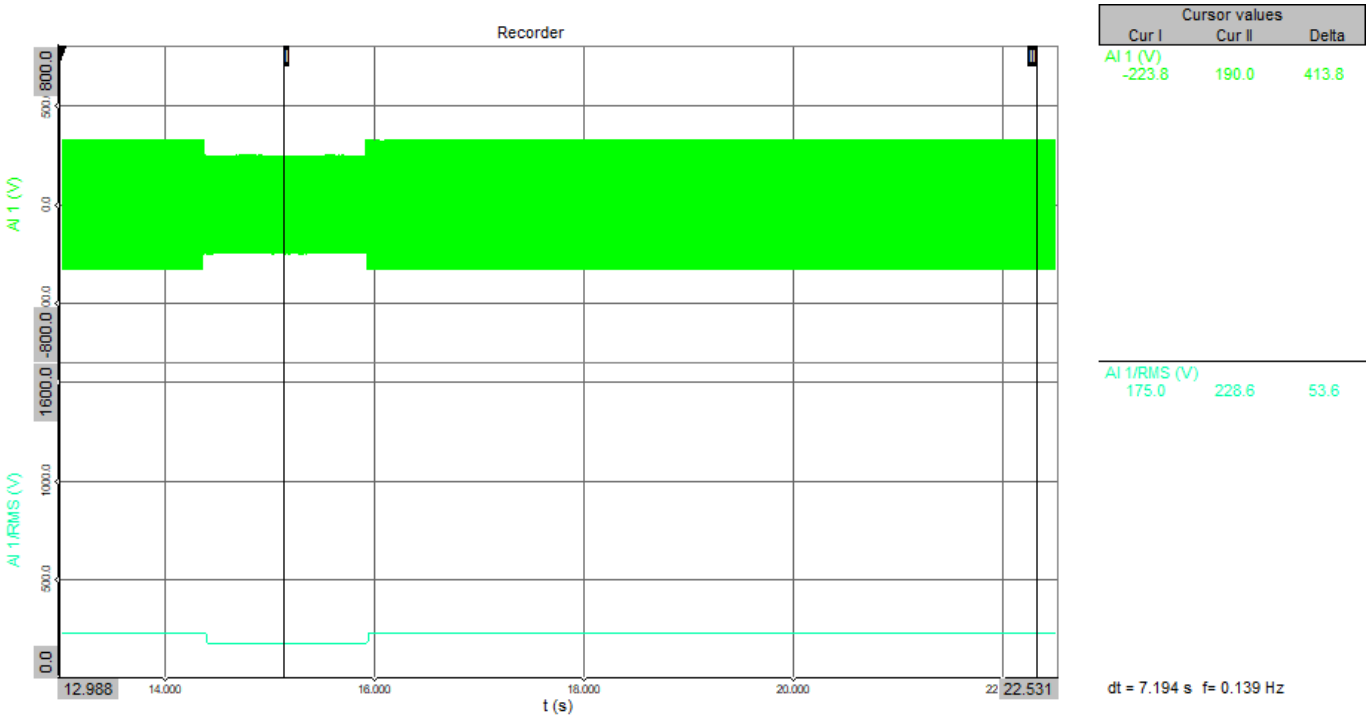
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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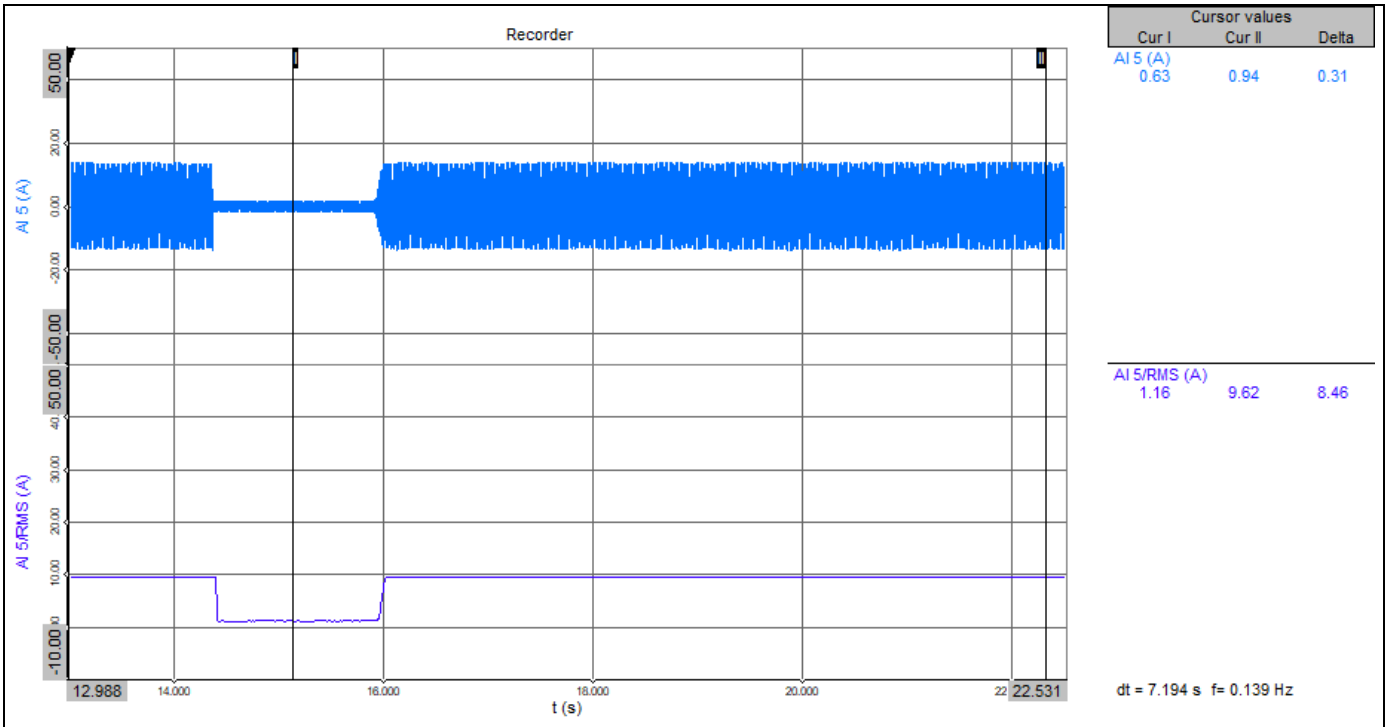
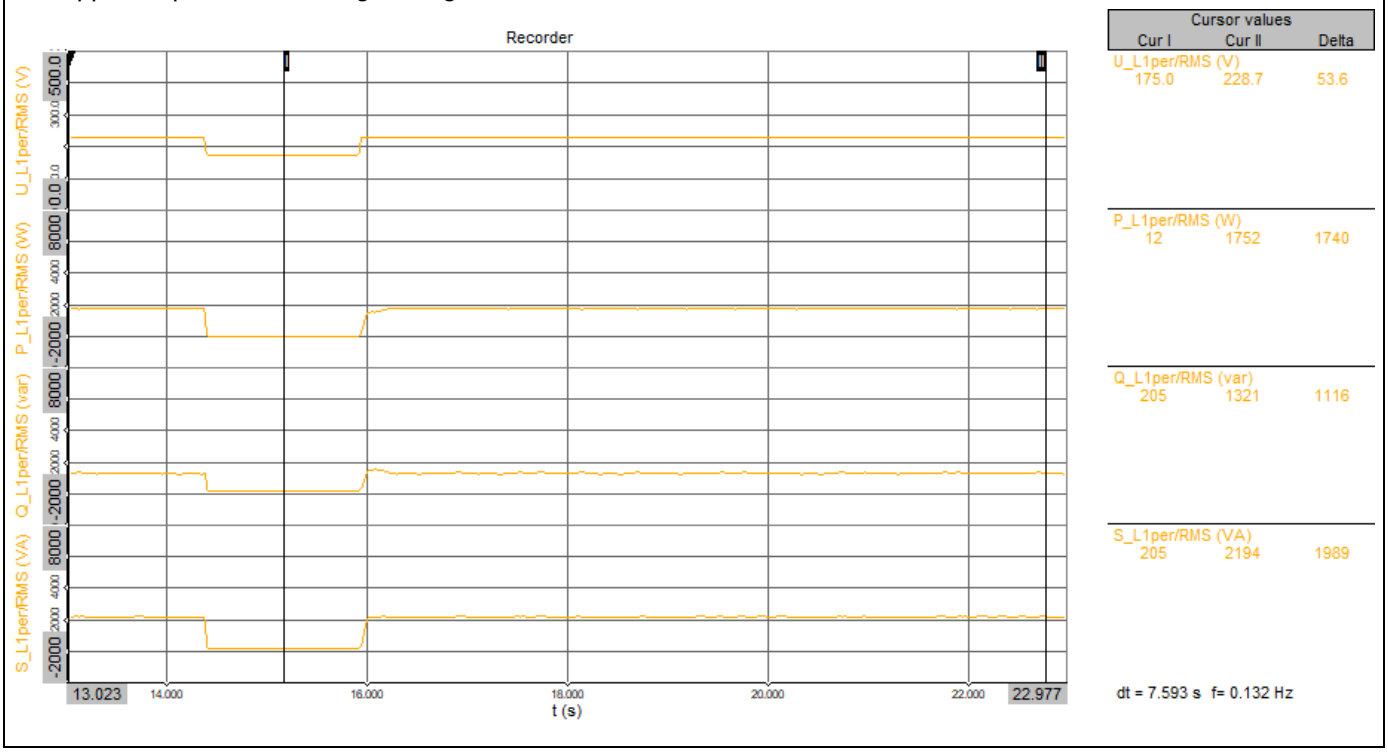
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	4.1					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	4.1	4.1
	1	Date	-	-	[dd.mm.yyyy]	11.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:18:09
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.860
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	12450
	7	Time of fault clearance (t_2)	-	-	[ms]	72500
	8	Fault duration determined from no load test	-	-	[ms]	60030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.143
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.986
	12	Active power	Total	t1-10s to t1	[p.u.]	0.985
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.056
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.858
	16	Momentary Current	L1	t1+60ms	[p.u.]	1.025
	17		L1	t1+100ms	[p.u.]	1.021
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	1.030
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.905
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.987
	22		Total	t2+3s to t2+10s	[p.u.]	0.986
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.070
	25		Total	t2+3s to t2+10s	[p.u.]	0.056
	26	Reactive power recover time	Total	-	ms	0

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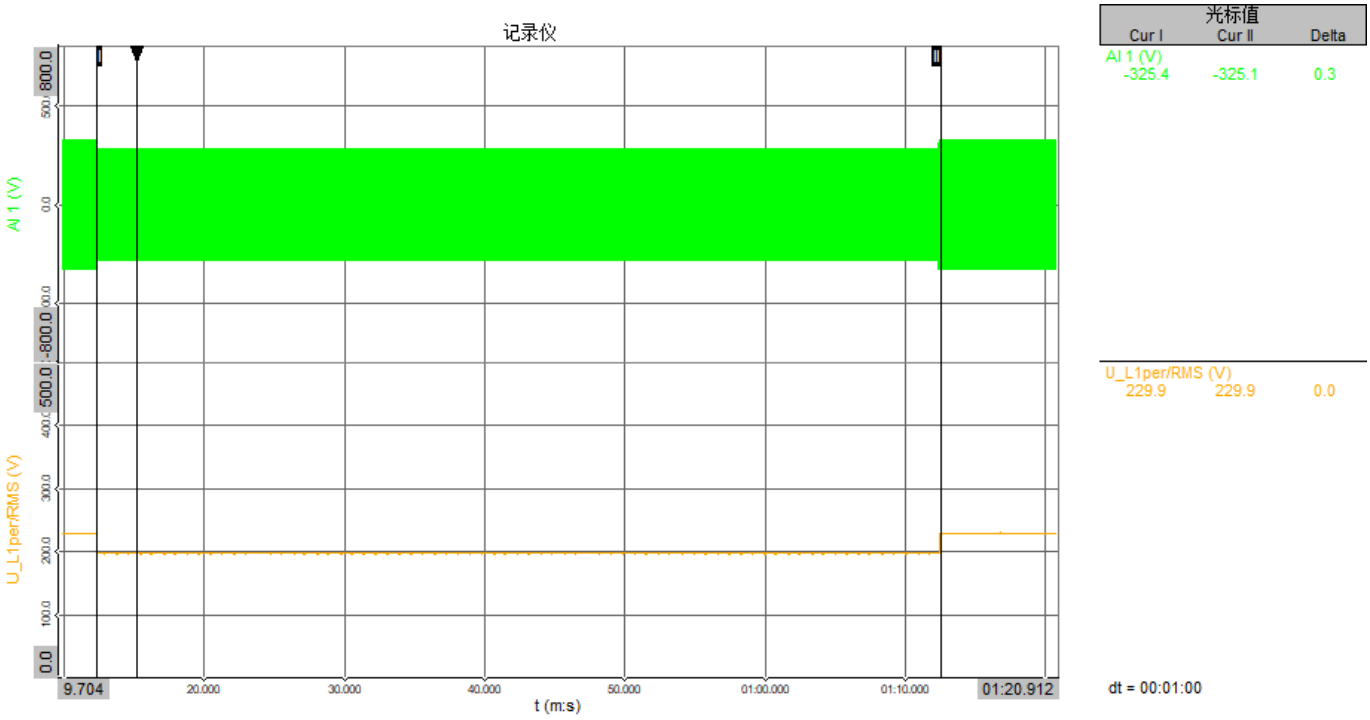
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

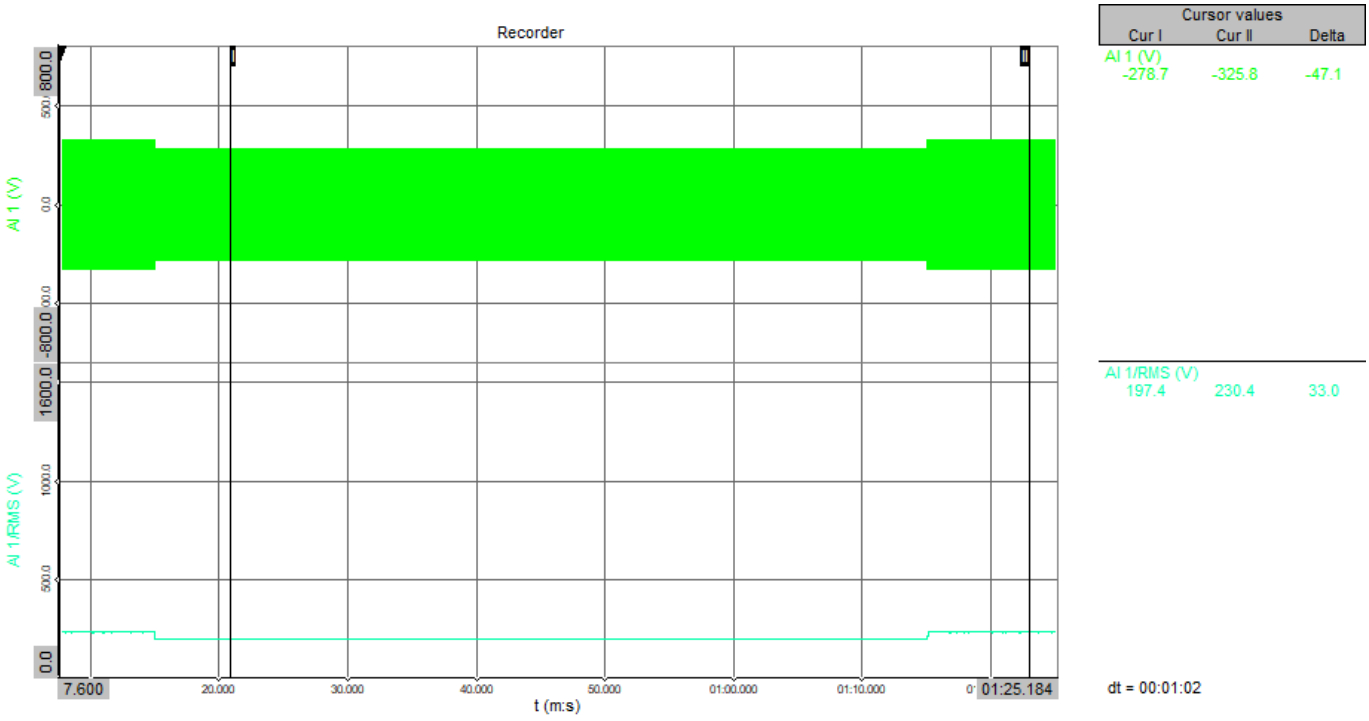
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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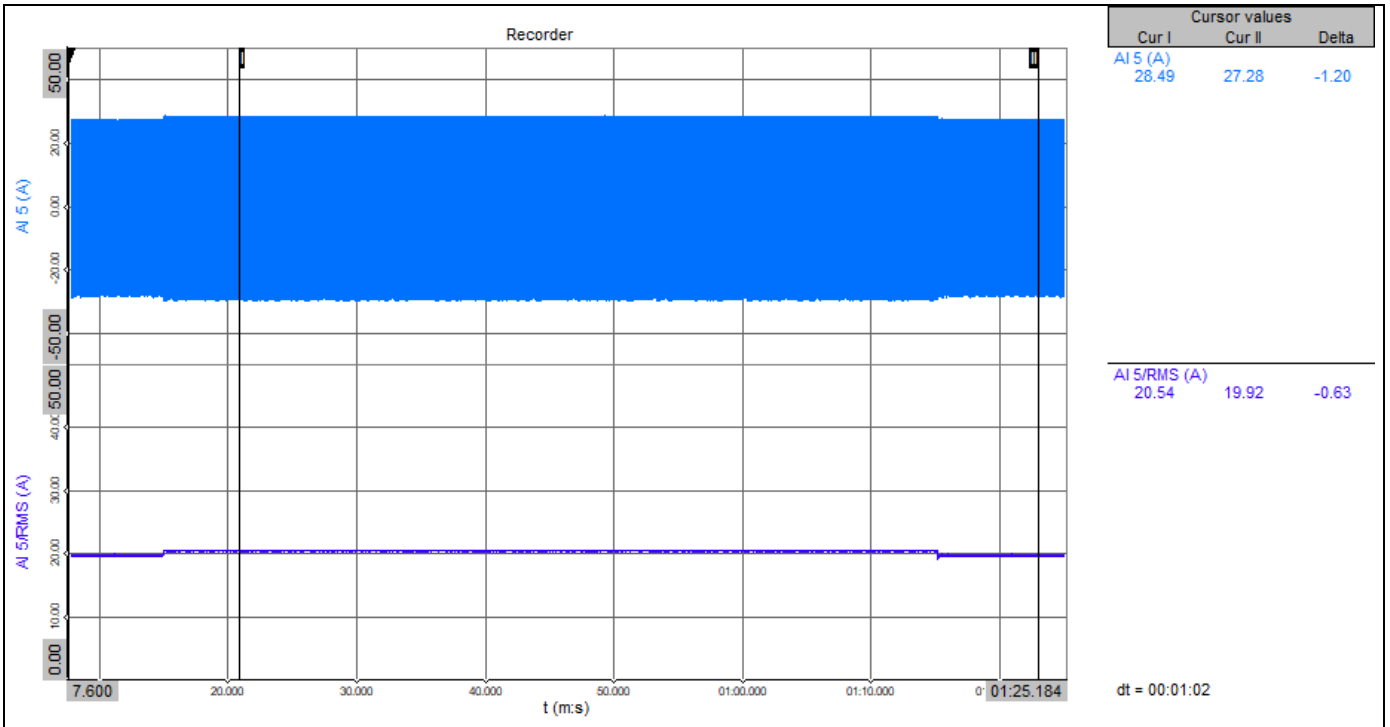
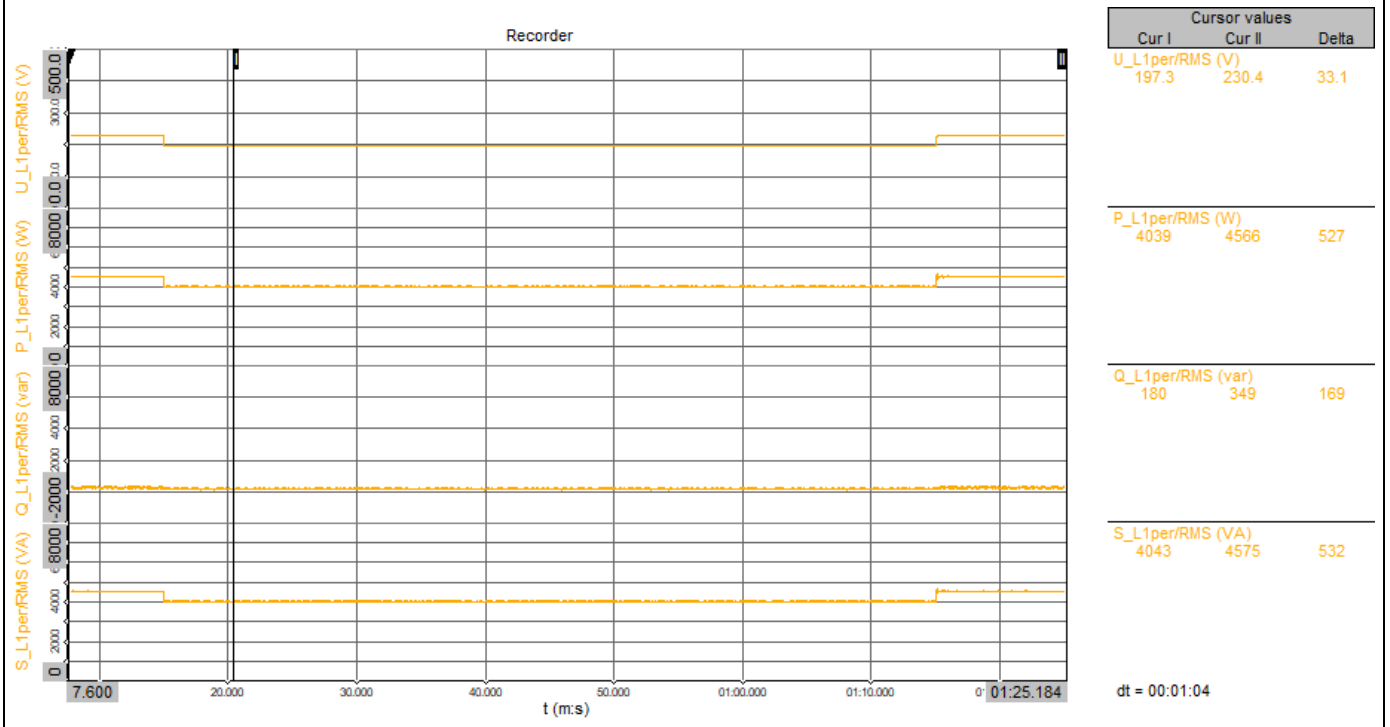
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		4.2				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	4.2	4.2
	1	Date	-	-	[dd.mm.yyyy]	11.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:07:15
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.860
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	12450
	7	Time of fault clearance (t_2)	-	-	[ms]	72500
	8	Fault duration determined from no load test	-	-	[ms]	60030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.143
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.402
	12	Active power	Total	t1-10s to t1	[p.u.]	0.399
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.054
	14	cos φ	Total	t1-10s to t1	-	0.991
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.857
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.403
	17		L1	t1+100ms	[p.u.]	0.401
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.477
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.417
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.454
	22		Total	t2+3s to t2+10s	[p.u.]	0.414
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.053
	25		Total	t2+3s to t2+10s	[p.u.]	0.052
	26	Reactive power recover time	Total	-	ms	0

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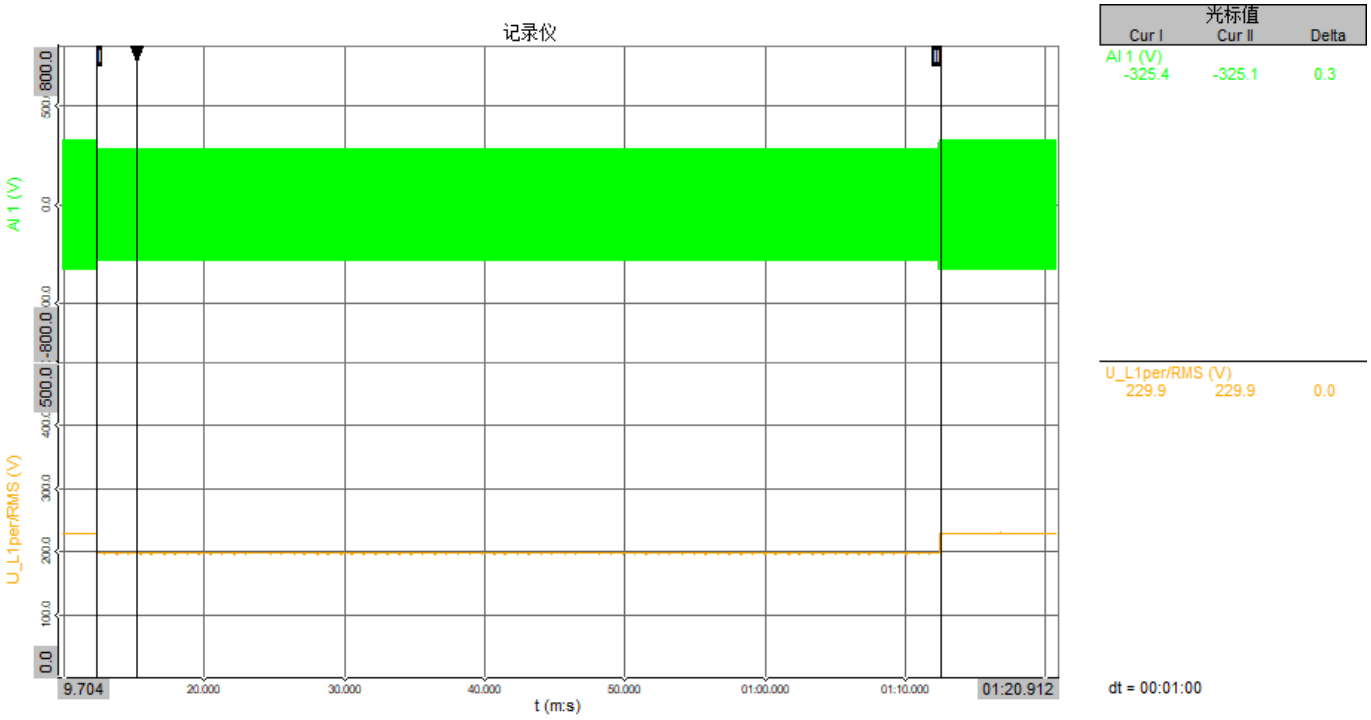
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

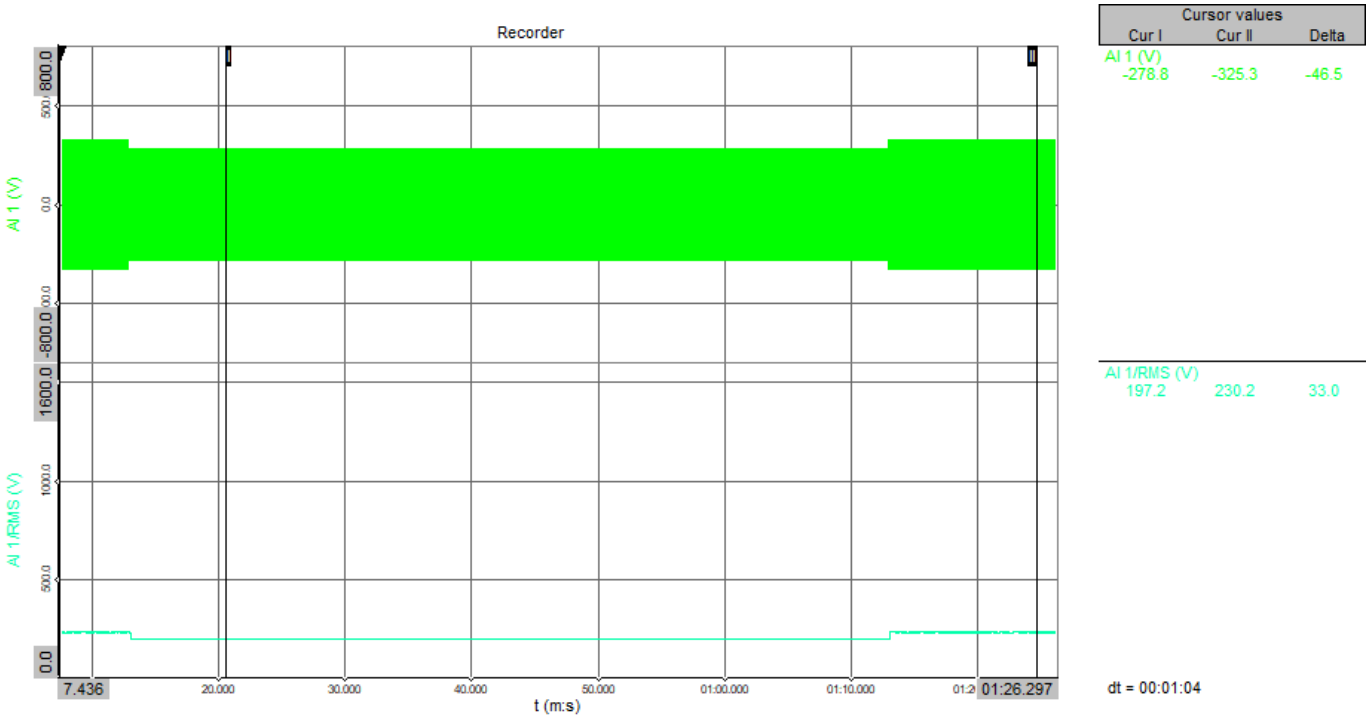
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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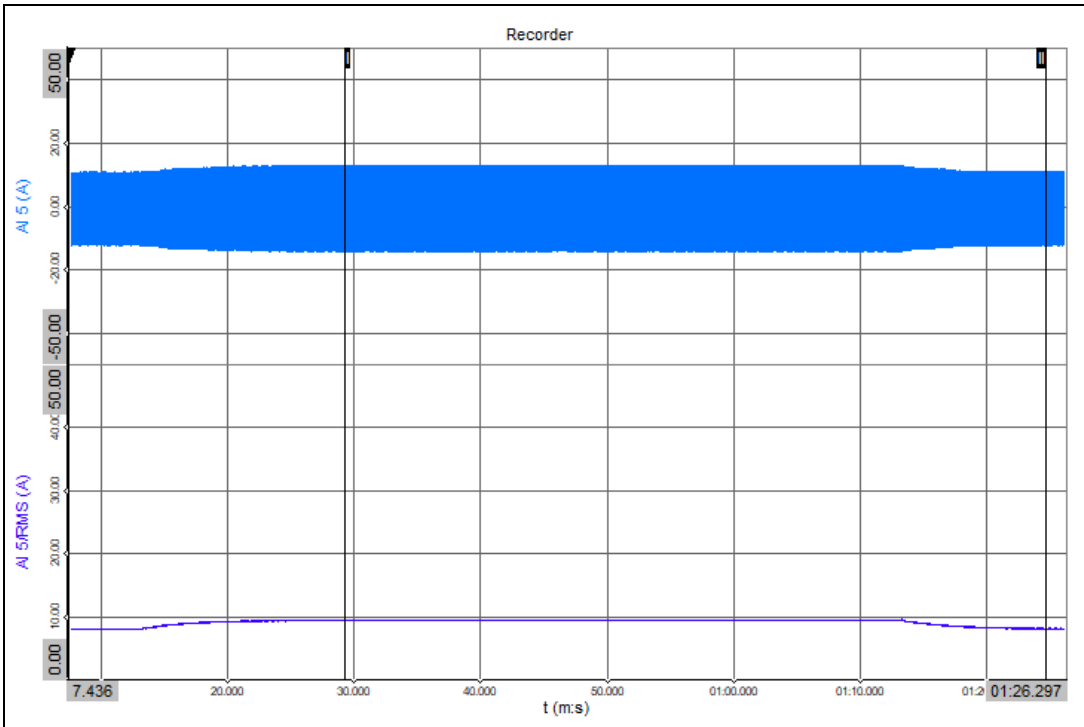
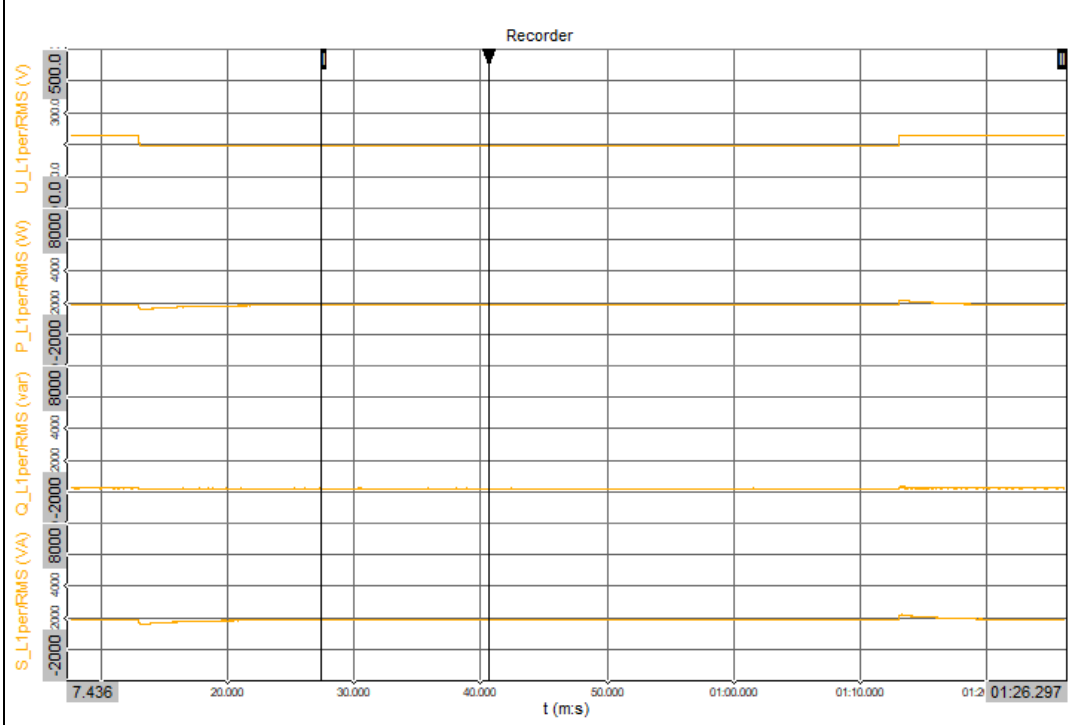
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		4.3				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	4.3	4.3
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:53:45
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.930
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	13777
	7	Time of fault clearance (t_2)	-	-	[ms]	73827
	8	Fault duration determined from no load test	-	-	[ms]	60030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.070
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.986
	12	Active power	Total	t1-10s to t1	[p.u.]	0.987
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.030
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.931
	16	Momentary Current	L1	t1+60ms	[p.u.]	1.004
	17		L1	t1+100ms	[p.u.]	1.007
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	1.012
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.951
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.986
	22		Total	t2+3s to t2+10s	[p.u.]	0.988
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.034
	25		Total	t2+3s to t2+10s	[p.u.]	0.031
	26	Reactive power recover time	Total	-	ms	0

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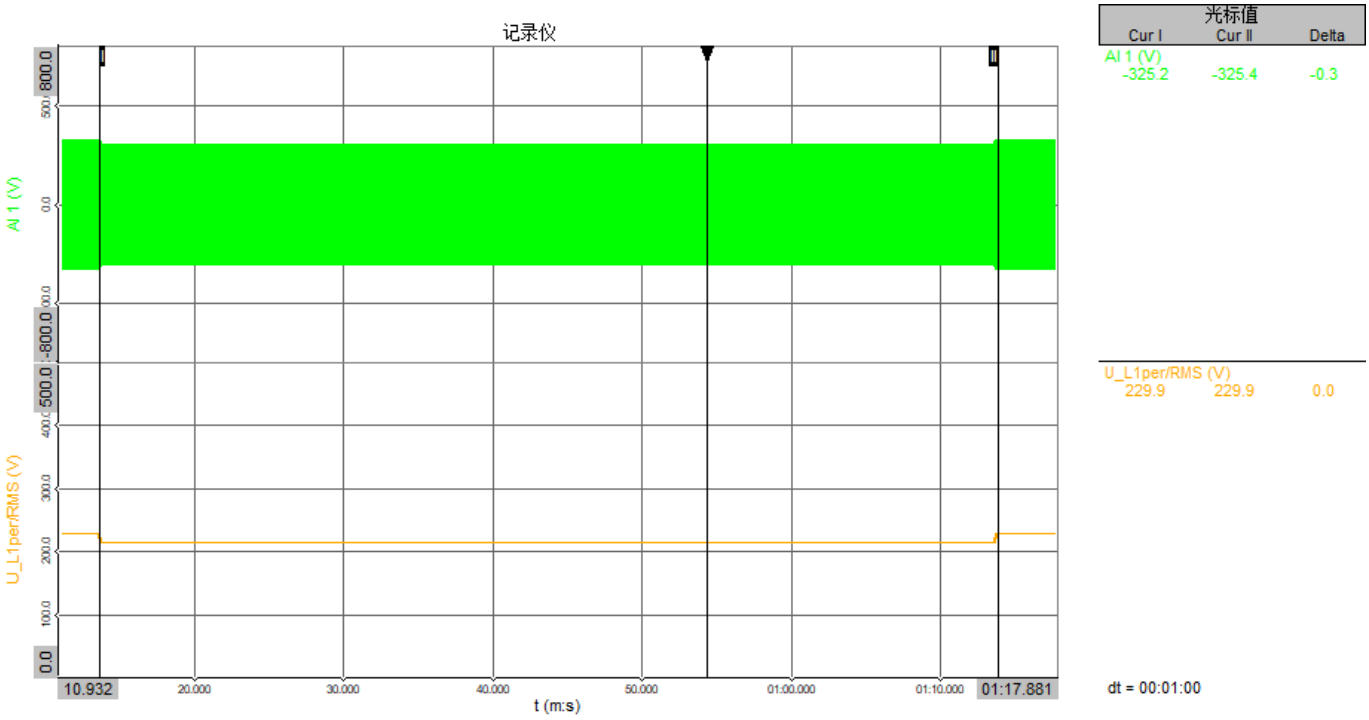
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

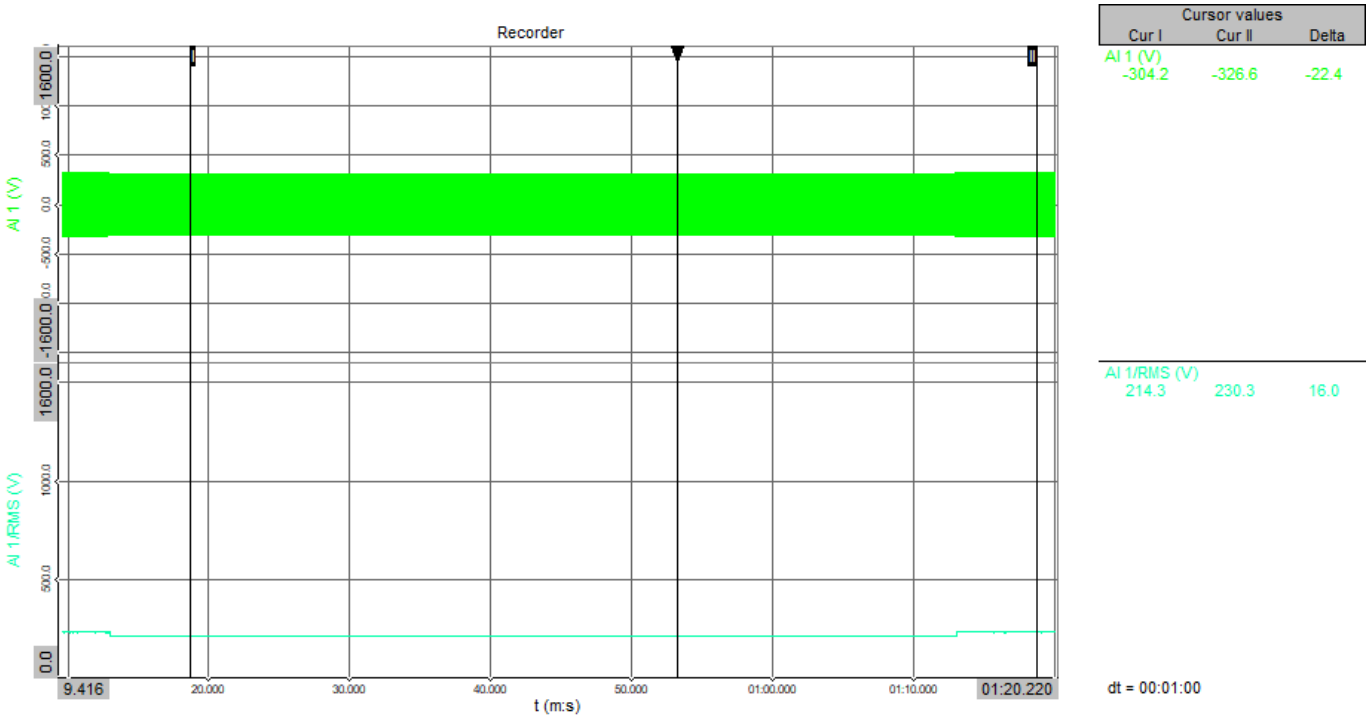
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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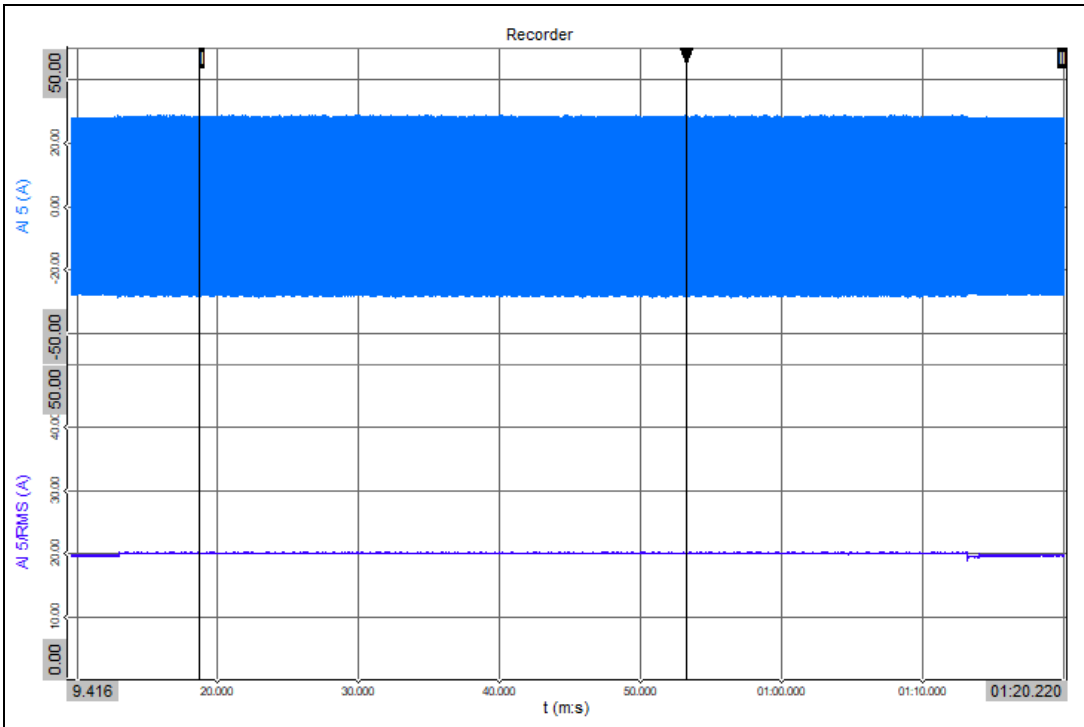
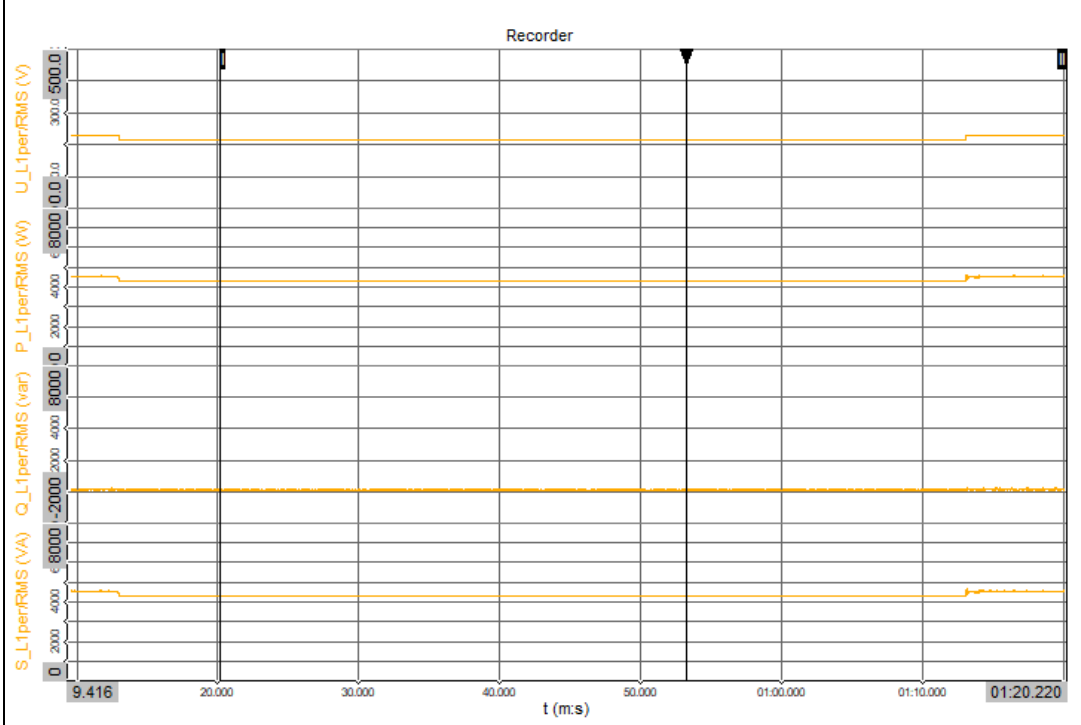
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		4.4				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	4.4	4.4
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	15:00:07
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	0.930
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	13777
	7	Time of fault clearance (t_2)	-	-	[ms]	73827
	8	Fault duration determined from no load test	-	-	[ms]	60030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.070
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.398
	12	Active power	Total	t1-10s to t1	[p.u.]	0.397
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.027
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	0.931
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.398
	17		L1	t1+100ms	[p.u.]	0.399
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.434
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.406
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.423
	22		Total	t2+3s to t2+10s	[p.u.]	0.405
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.018
	25		Total	t2+3s to t2+10s	[p.u.]	0.026
	26	Reactive power recover time	Total	-	ms	0

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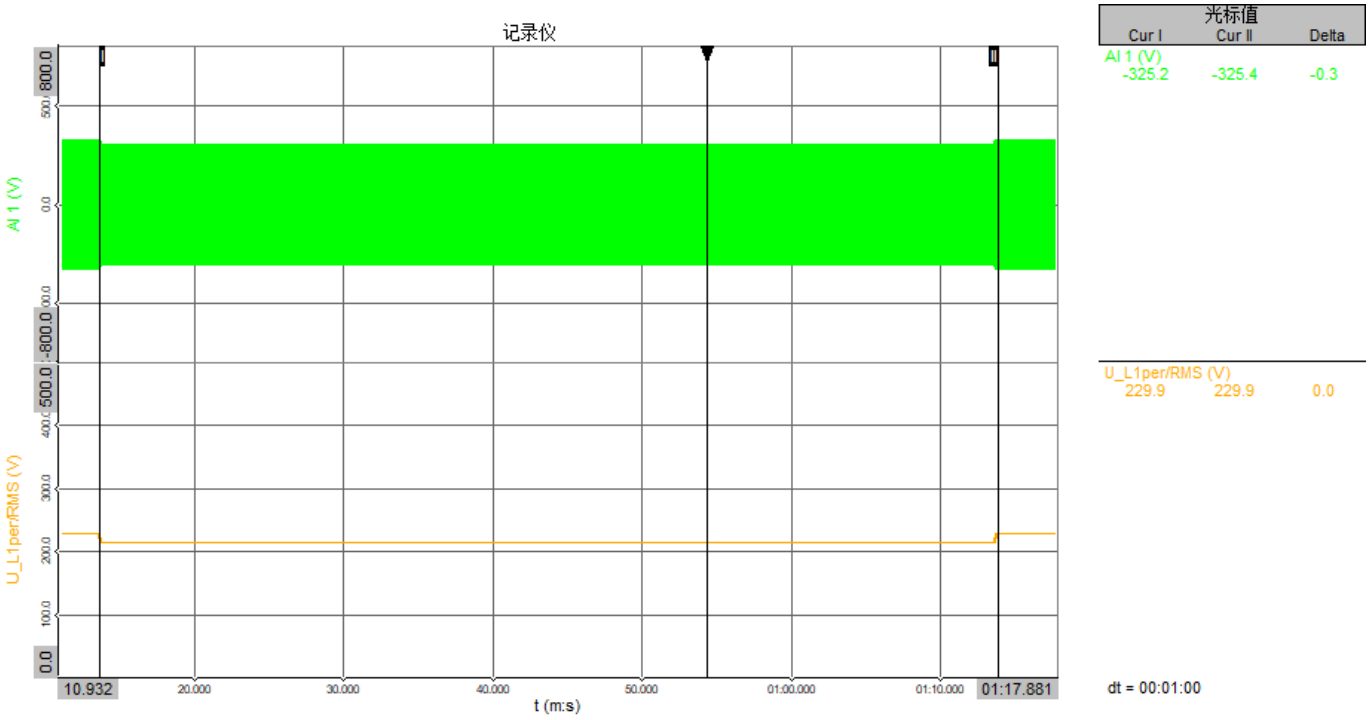
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

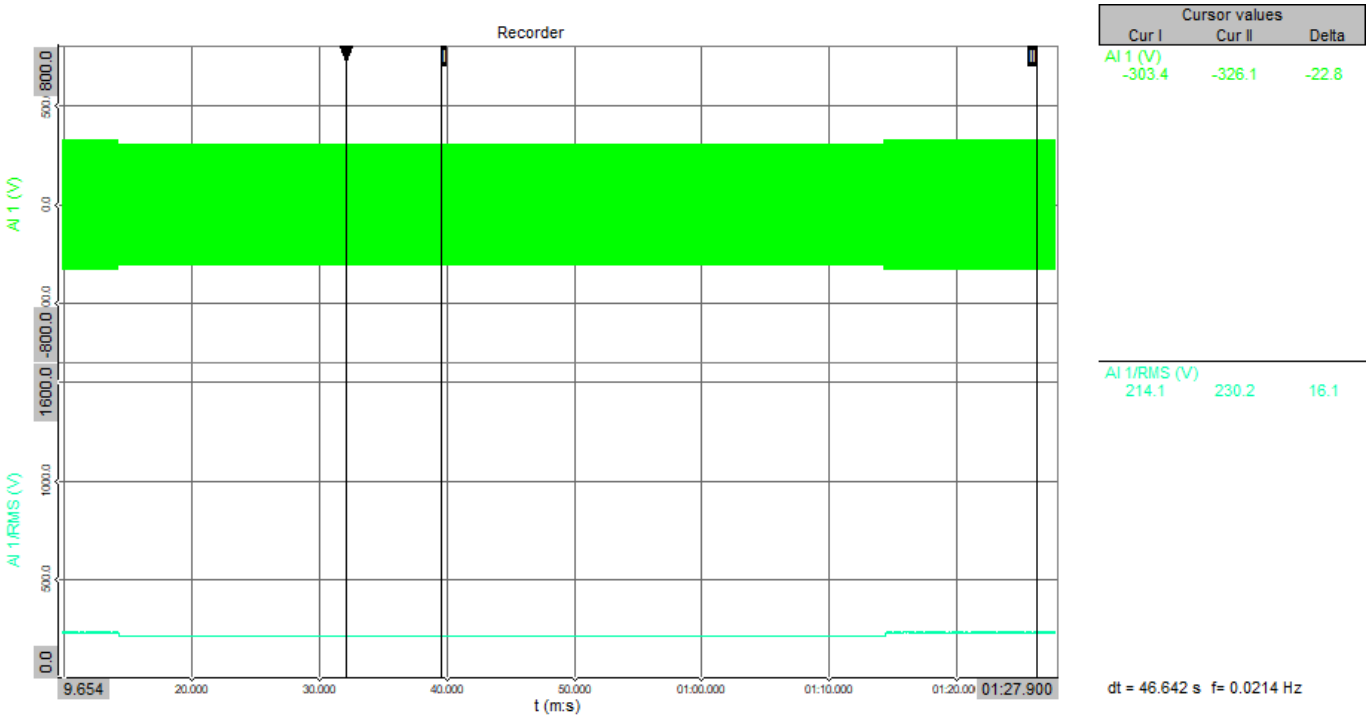
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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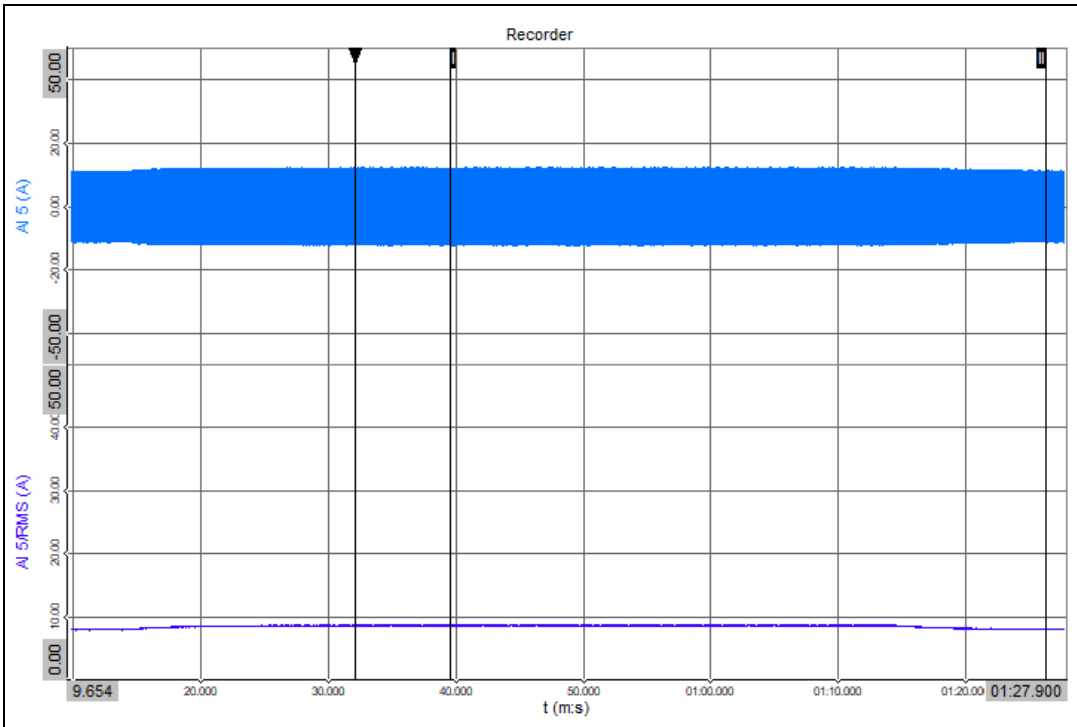
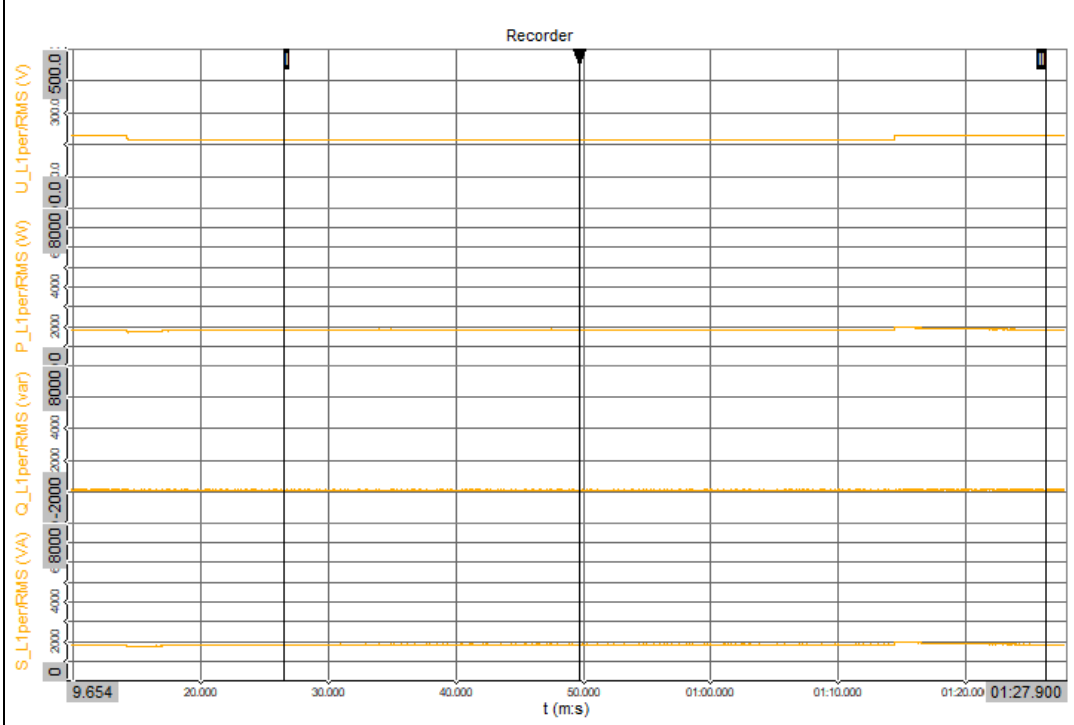
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		5.1				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	5.1	5.1
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:00:03
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.205
	5	Dip duration setpoint	-	-	[ms]	150
	6	Time of fault occurrence (t_1)	-	-	[ms]	12400
	7	Time of fault clearance (t_2)	-	-	[ms]	12550
	8	Fault duration determined from no load test	-	-	[ms]	130
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.208
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.987
	12	Active power	Total	t1-10s to t1	[p.u.]	0.987
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.045
	14	cos φ	Total	t1-10s to t1	-	0.999
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.210
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.091
	17		L1	t1+100ms	[p.u.]	0.093
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.094
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.002
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.987
	22		Total	t2+3s to t2+10s	[p.u.]	0.987
	23	Active power recover time	Total	-	ms	132
	24	Reactive power	Total	t2+10s	[p.u.]	0.048
	25		Total	t2+3s to t2+10s	[p.u.]	0.049
	26	Reactive power recover time	Total	-	ms	0

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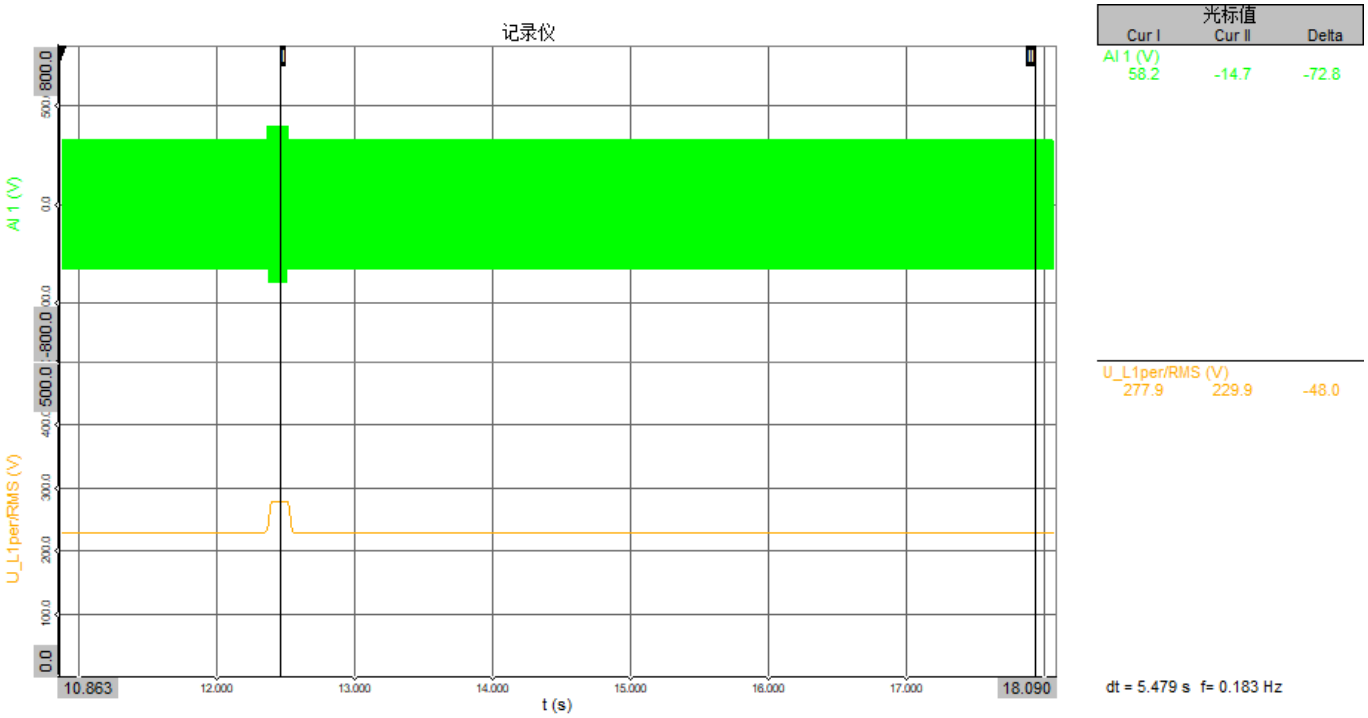
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

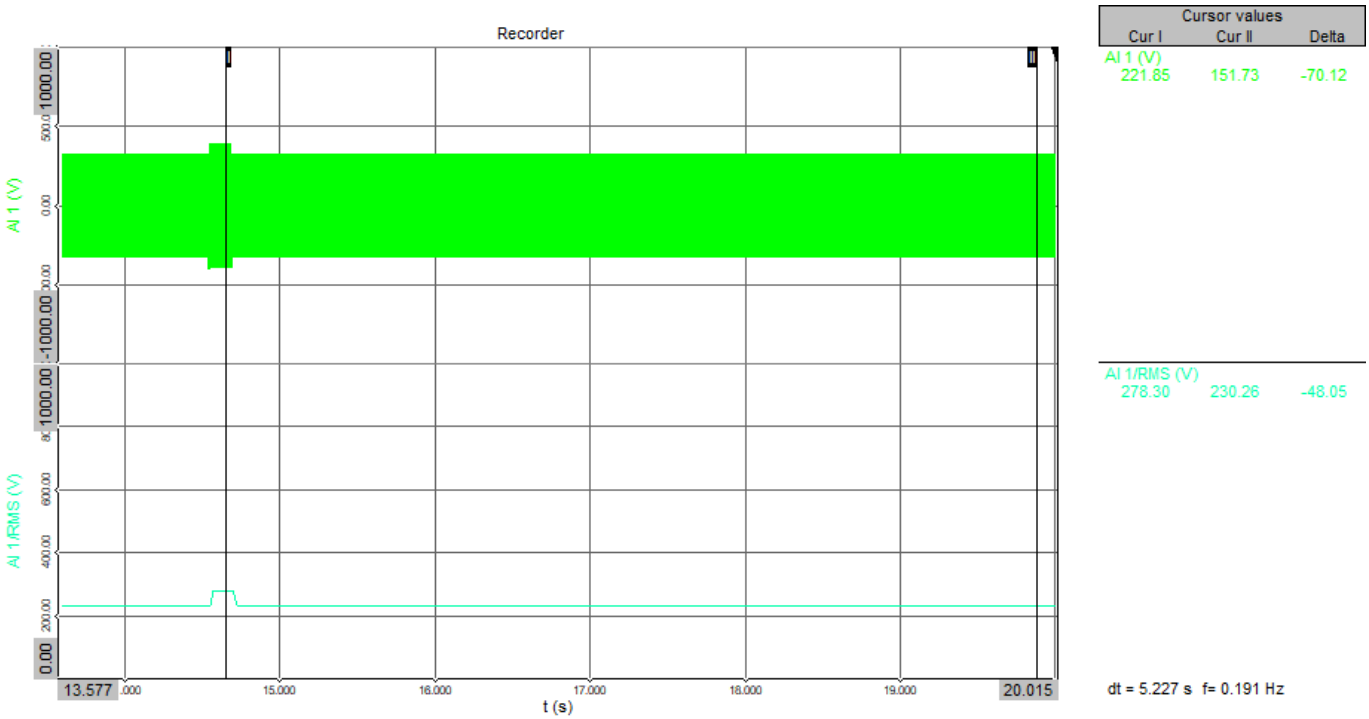
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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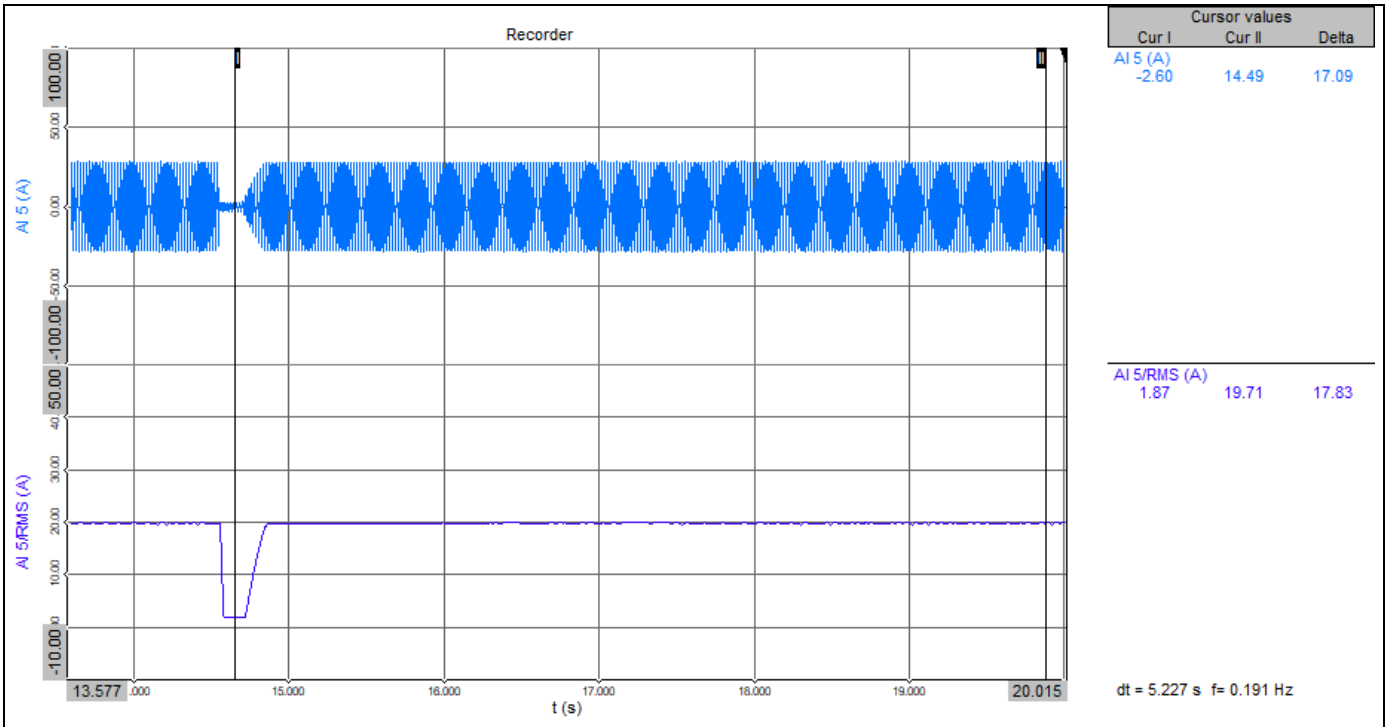
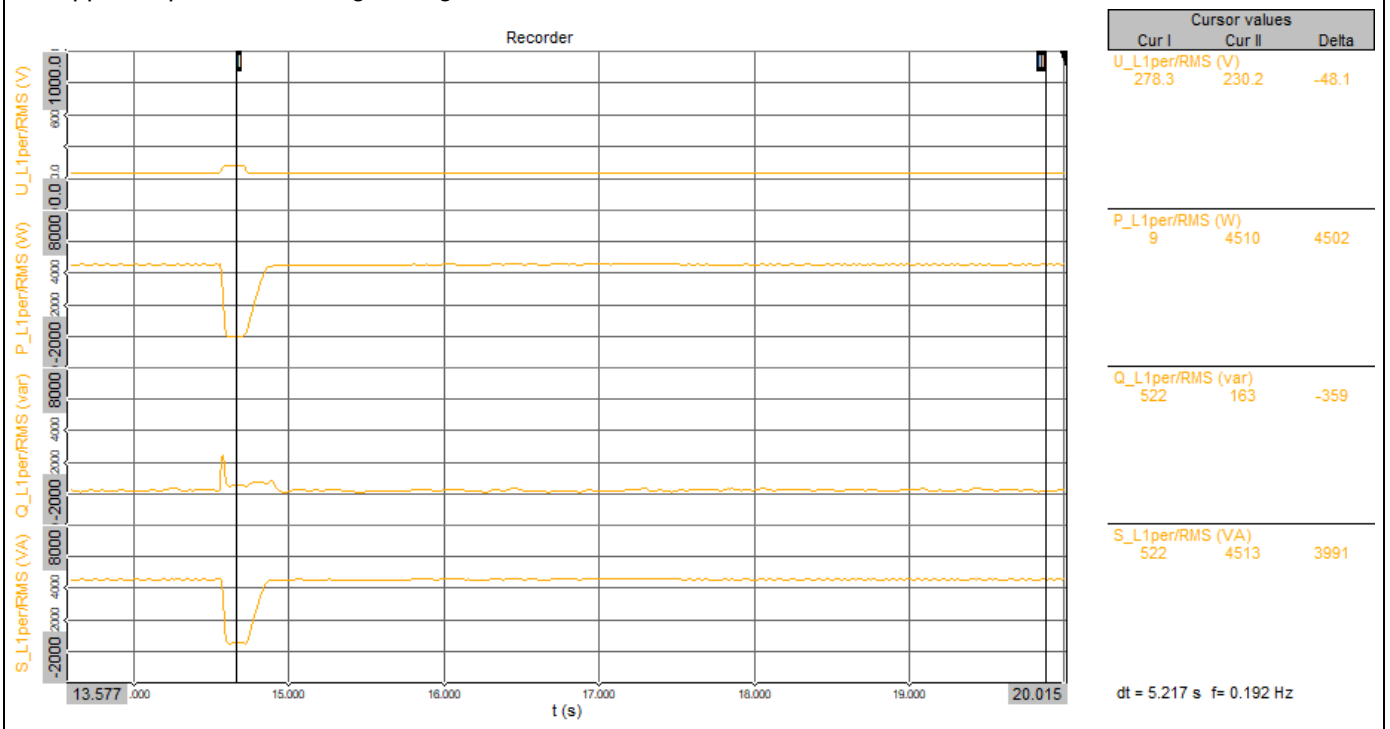
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		5.2				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	5.2	5.2
	1	Date	-	-	[dd.mm.yyyy]	04.27.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	15:55:10
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.205
	5	Dip duration setpoint	-	-	[ms]	150
	6	Time of fault occurrence (t_1)	-	-	[ms]	12400
	7	Time of fault clearance (t_2)	-	-	[ms]	12550
	8	Fault duration determined from no load test	-	-	[ms]	130
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.208
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.393
	12	Active power	Total	t1-10s to t1	[p.u.]	0.391
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.034
	14	cos φ	Total	t1-10s to t1	-	0.996
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.210
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.094
	17		L1	t1+100ms	[p.u.]	0.094
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.094
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.001
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.391
	22		Total	t2+3s to t2+10s	[p.u.]	0.391
	23	Active power recover time	Total	-	ms	48
	24	Reactive power	Total	t2+10s	[p.u.]	0.035
	25		Total	t2+3s to t2+10s	[p.u.]	0.034
	26	Reactive power recover time	Total	-	ms	0

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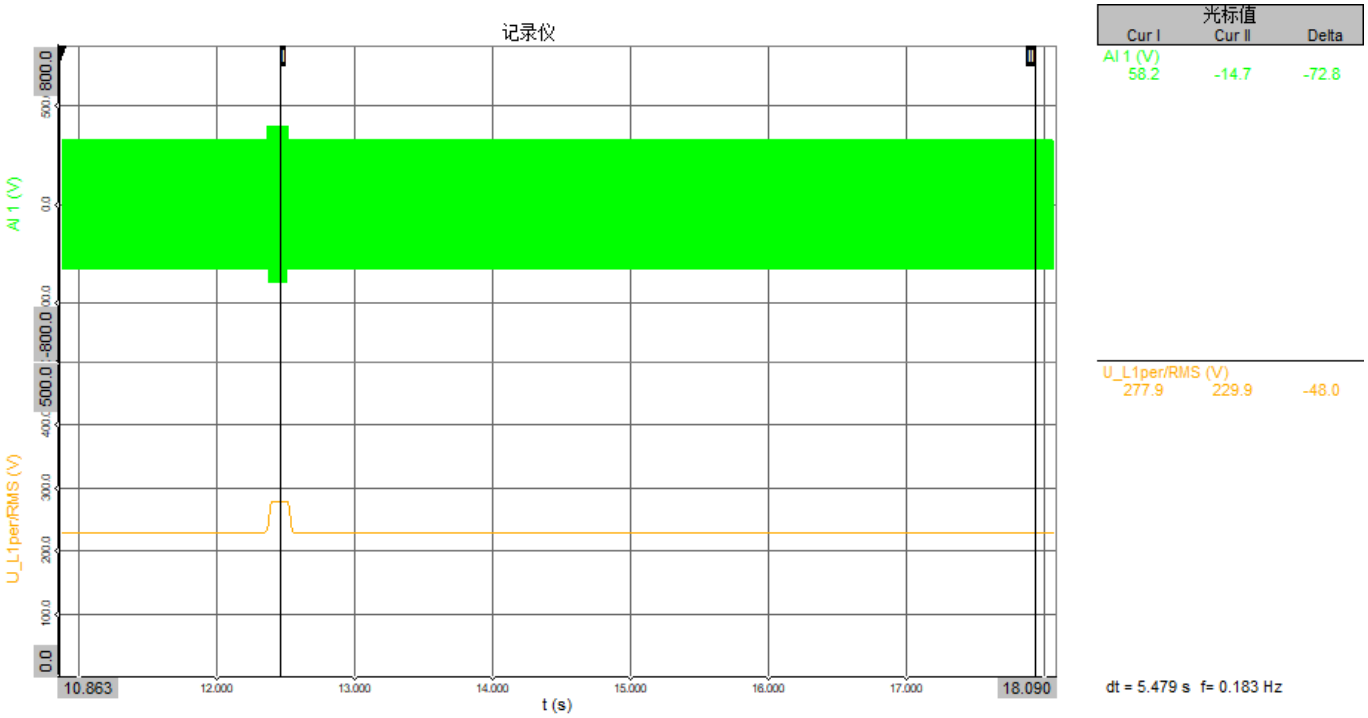
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

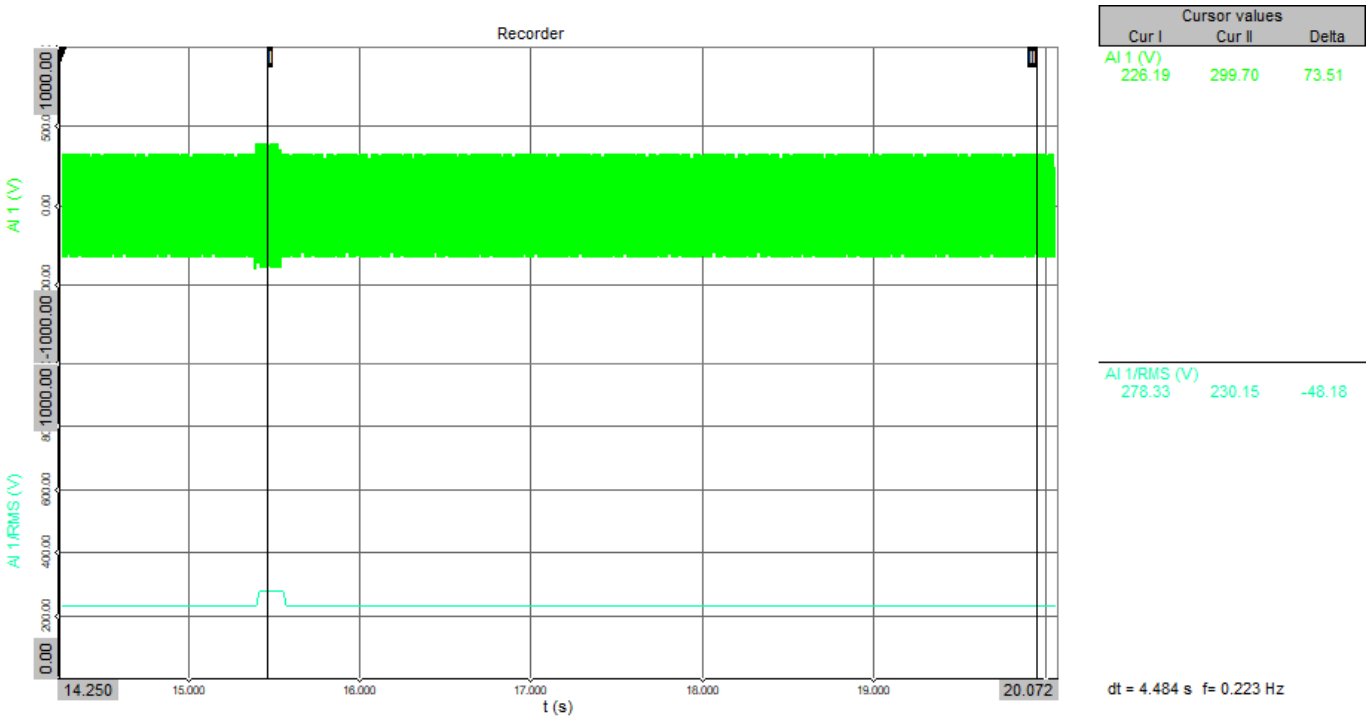
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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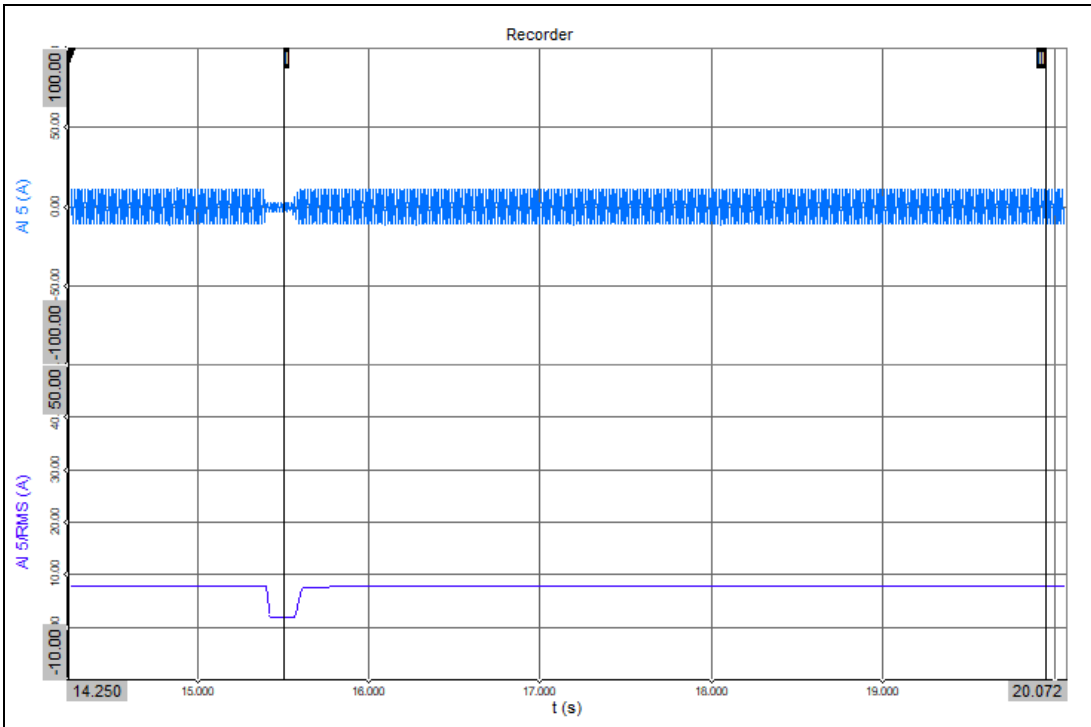
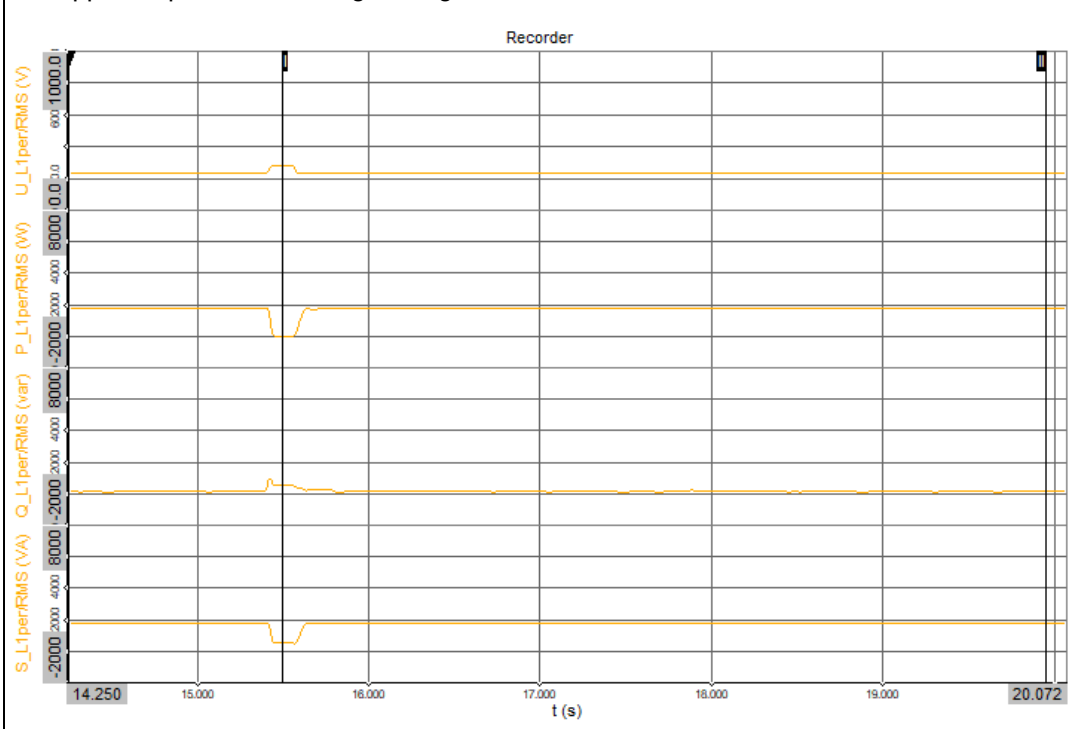
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		5.3				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	5.3	5.3
	1	Date	-	-	[dd.mm.yyyy]	20.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:28:16
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.060
	5	Dip duration setpoint	-	-	[ms]	150
	6	Time of fault occurrence (t_1)	-	-	[ms]	11875
	7	Time of fault clearance (t_2)	-	-	[ms]	12036
	8	Fault duration determined from no load test	-	-	[ms]	141
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.060
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.991
	12	Active power	Total	t1-10s to t1	[p.u.]	0.992
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.028
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.061
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.995
	17		L1	t1+100ms	[p.u.]	0.987
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.990
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	1.048
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.992
	22		Total	t2+3s to t2+10s	[p.u.]	0.991
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.030
	25		Total	t2+3s to t2+10s	[p.u.]	0.028
	26	Reactive power recover time	Total	-	ms	0

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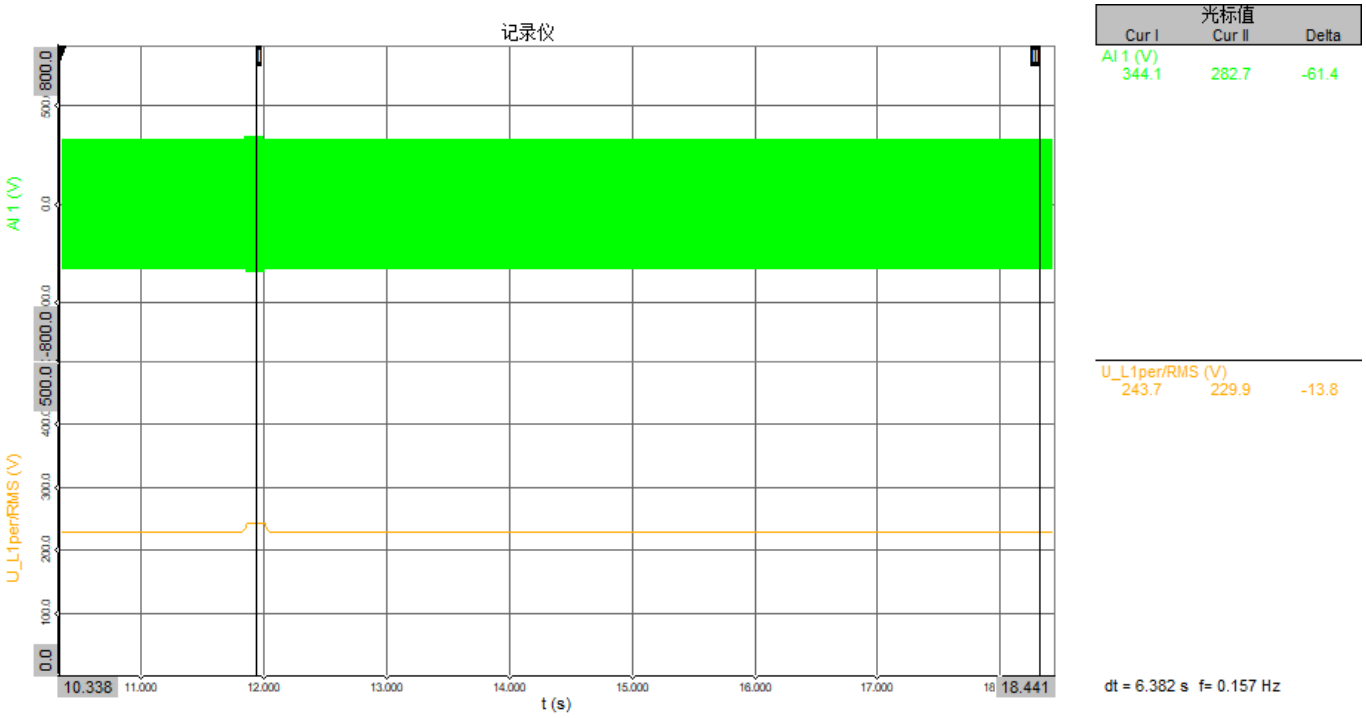
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

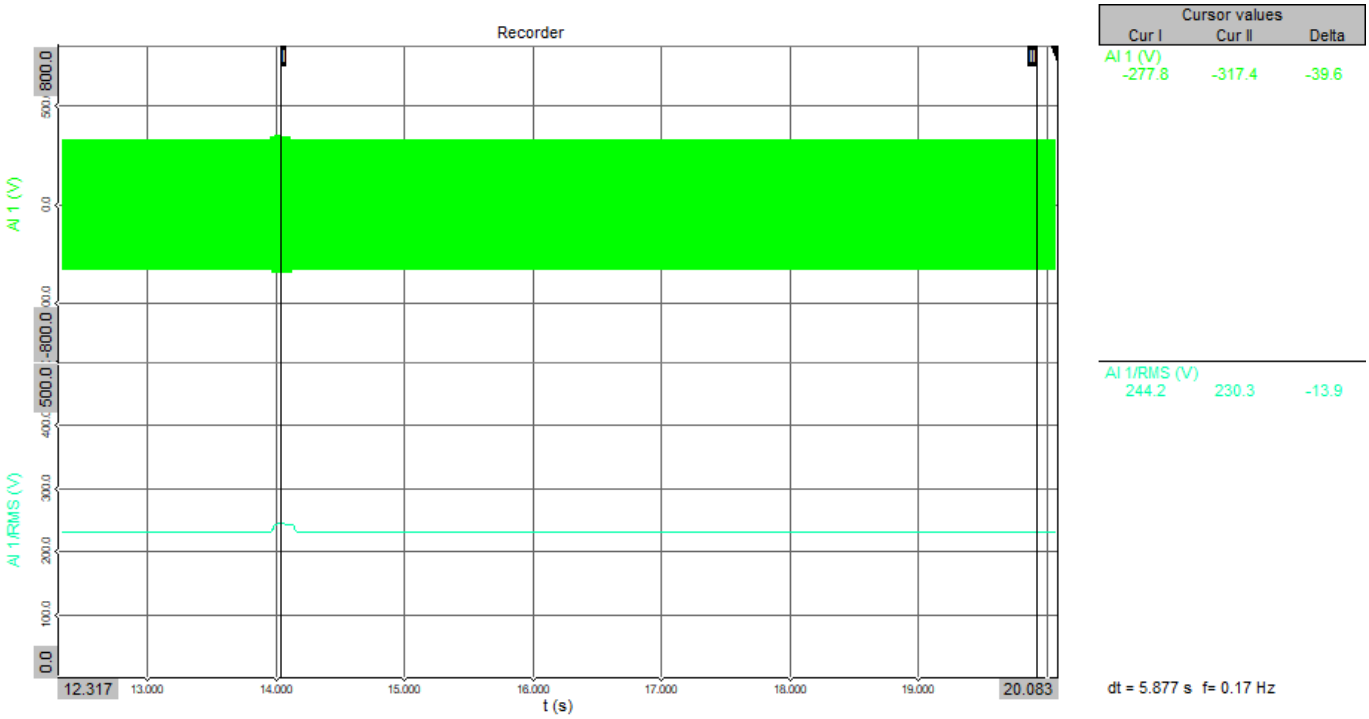
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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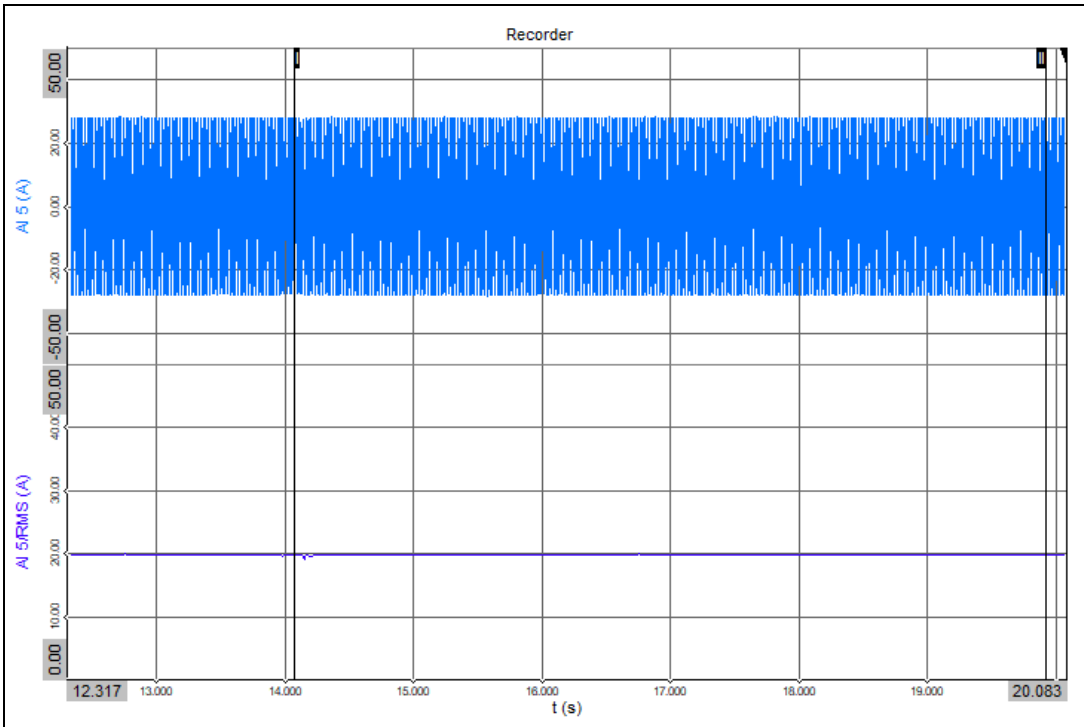
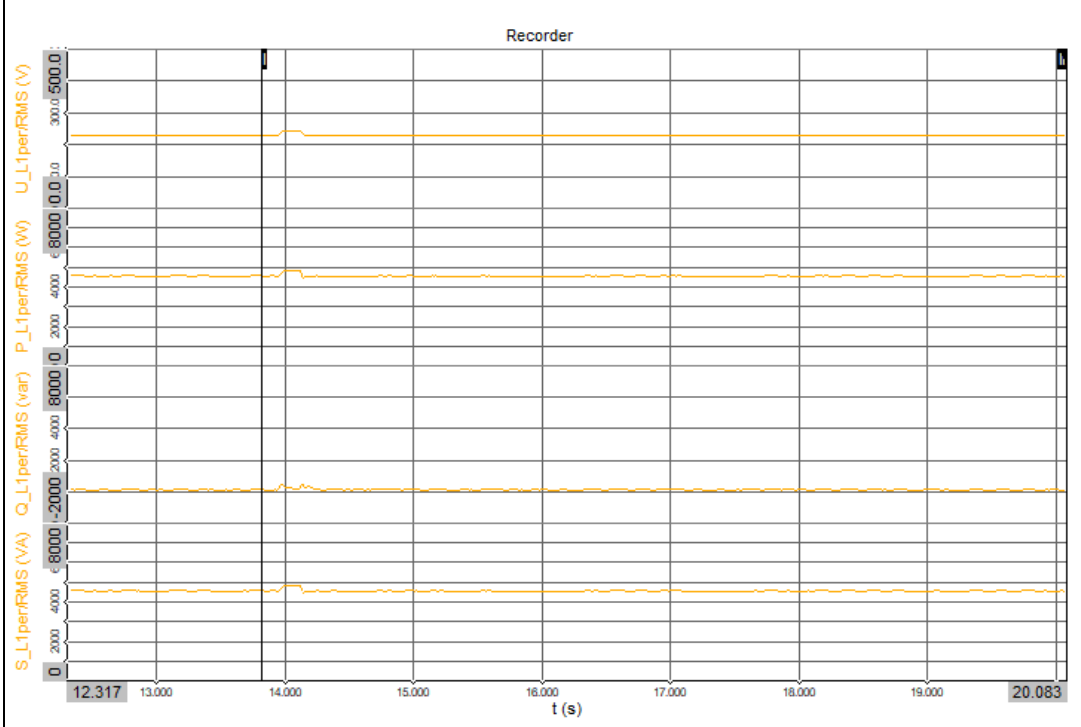
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	5.4				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	5.4	5.4
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:54:58
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.060
	5	Dip duration setpoint	-	-	[ms]	150
	6	Time of fault occurrence (t_1)	-	-	[ms]	11875
	7	Time of fault clearance (t_2)	-	-	[ms]	12036
	8	Fault duration determined from no load test	-	-	[ms]	141
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.060
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.396
	12	Active power	Total	t1-10s to t1	[p.u.]	0.395
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.024
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.061
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.403
	17		L1	t1+100ms	[p.u.]	0.393
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.395
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.417
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.395
	22		Total	t2+3s to t2+10s	[p.u.]	0.396
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.025
	25		Total	t2+3s to t2+10s	[p.u.]	0.025
	26	Reactive power recover time	Total	-	ms	0

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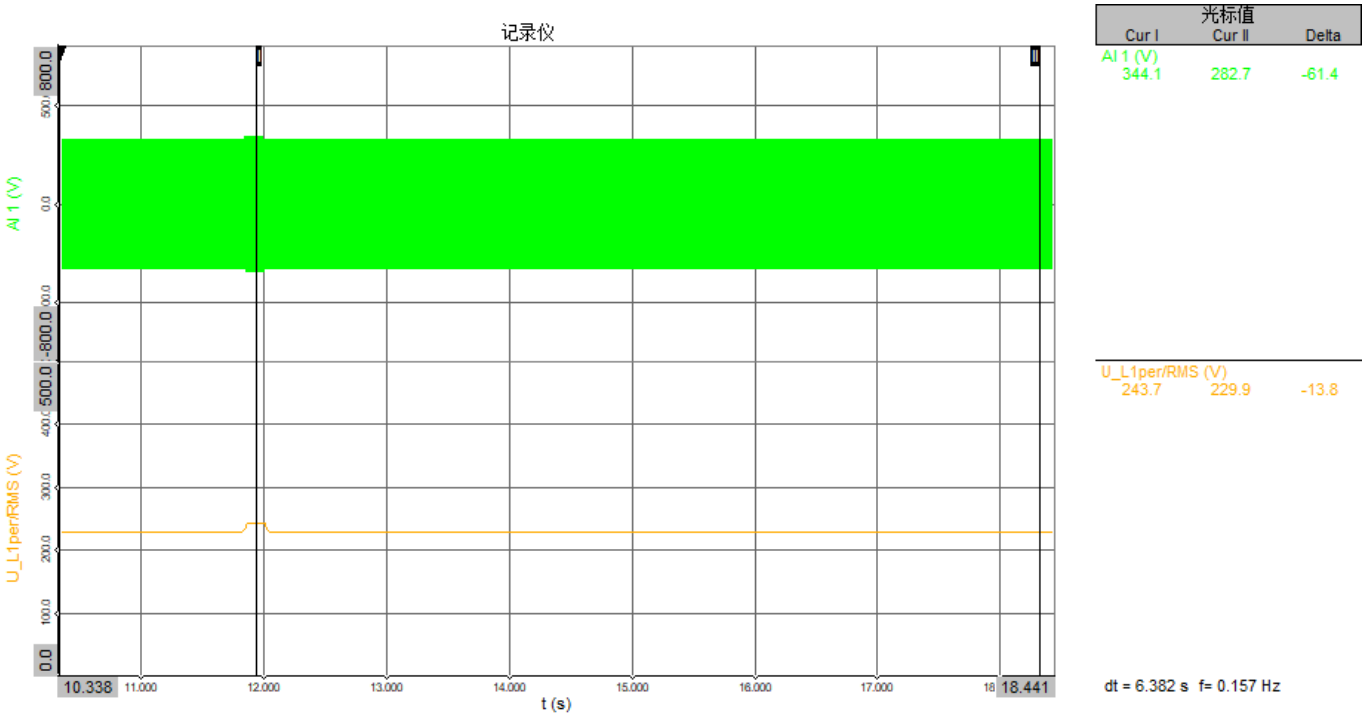
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

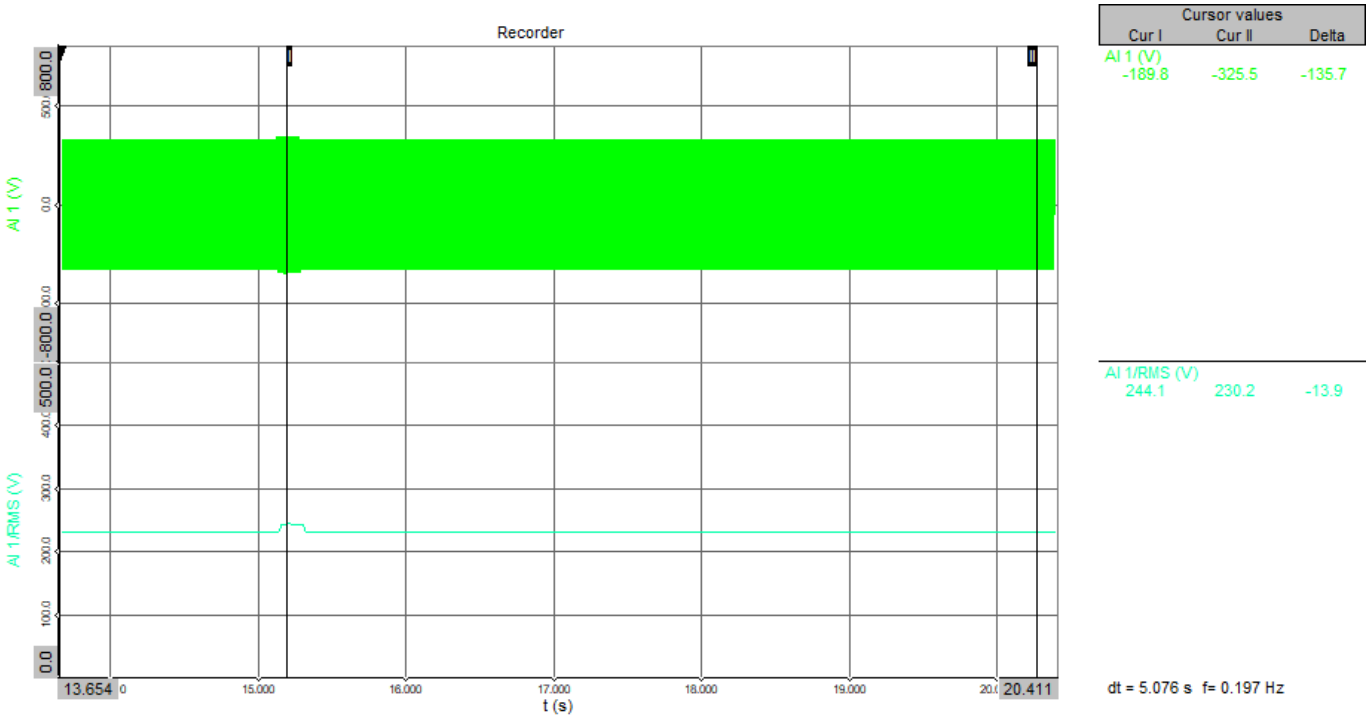
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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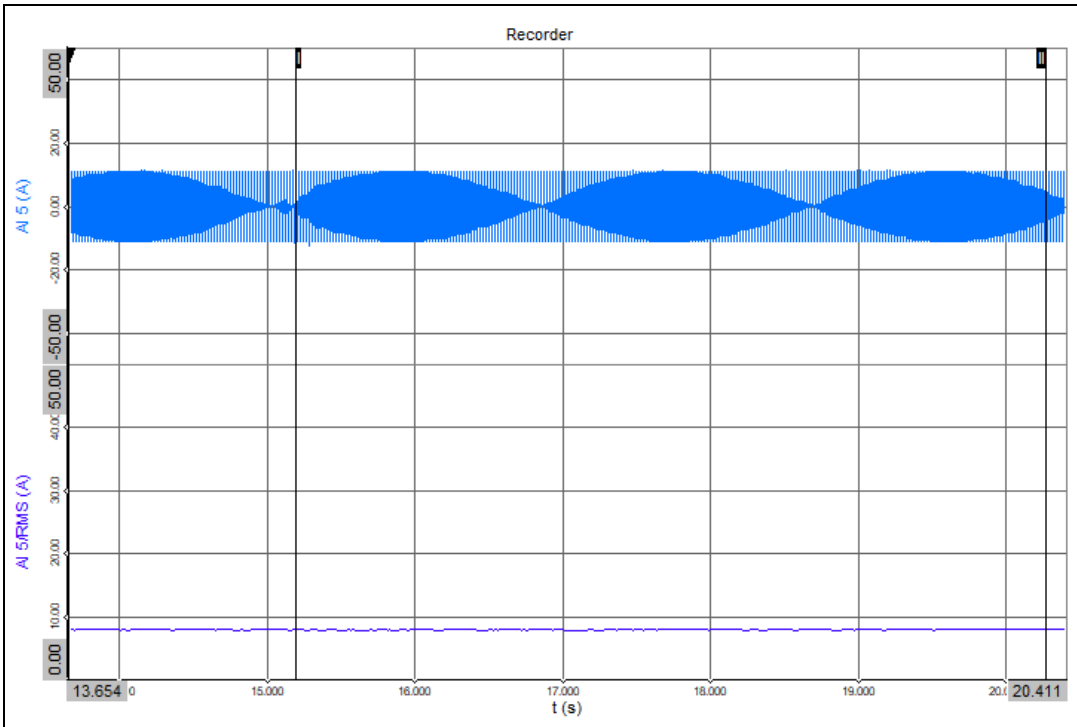
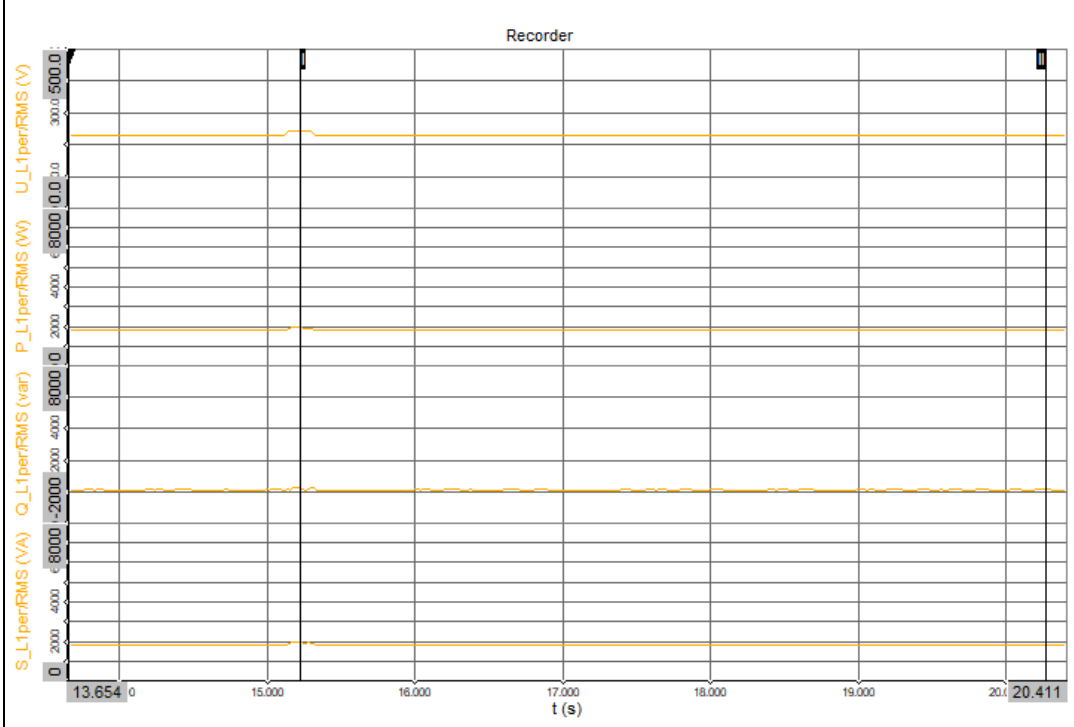
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		5.5				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	5.5	5.5
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	14:50:36
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.080
	5	Dip duration setpoint	-	-	[ms]	150
	6	Time of fault occurrence (t_1)	-	-	[ms]	13458
	7	Time of fault clearance (t_2)	-	-	[ms]	13618
	8	Fault duration determined from no load test	-	-	[ms]	140
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.080
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.991
	12	Active power	Total	t1-10s to t1	[p.u.]	0.992
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.030
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.082
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.942
	17		L1	t1+100ms	[p.u.]	0.944
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.944
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	1.002
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.993
	22		Total	t2+3s to t2+10s	[p.u.]	0.992
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.026
	25		Total	t2+3s to t2+10s	[p.u.]	0.030
	26	Reactive power recover time	Total	-	ms	0

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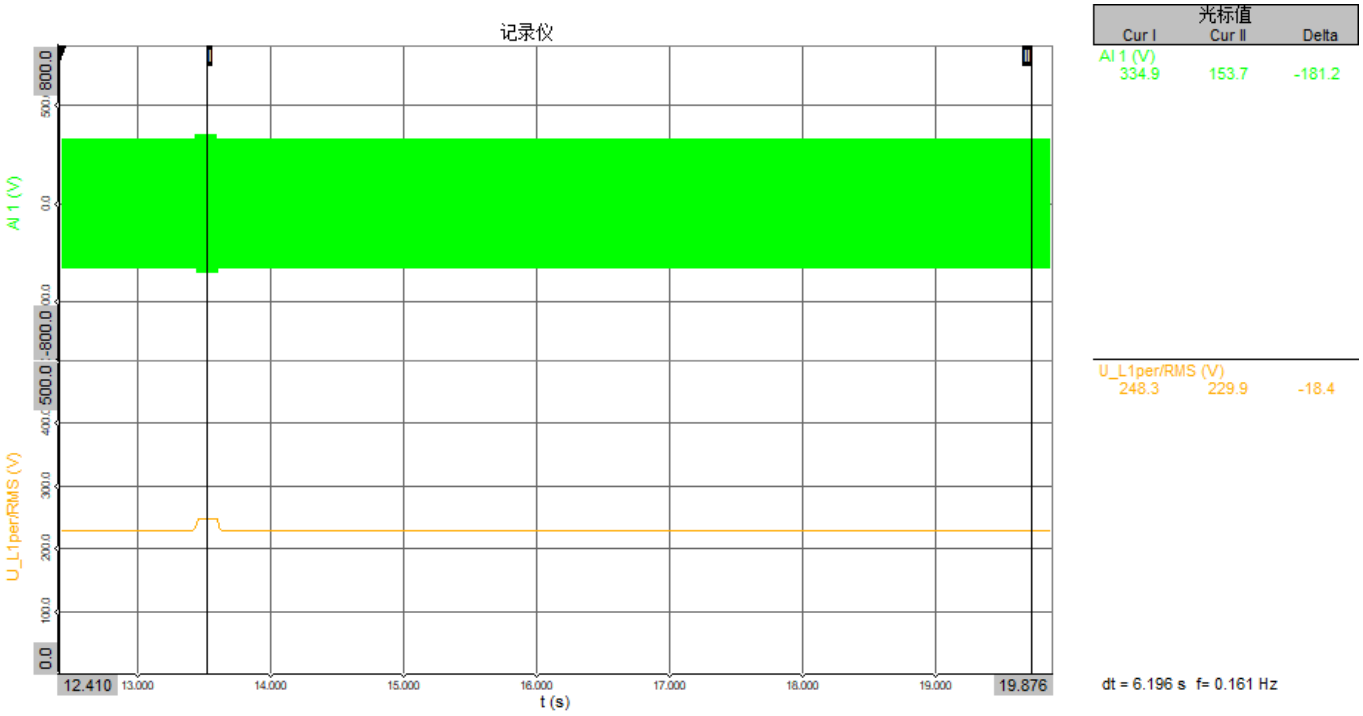
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

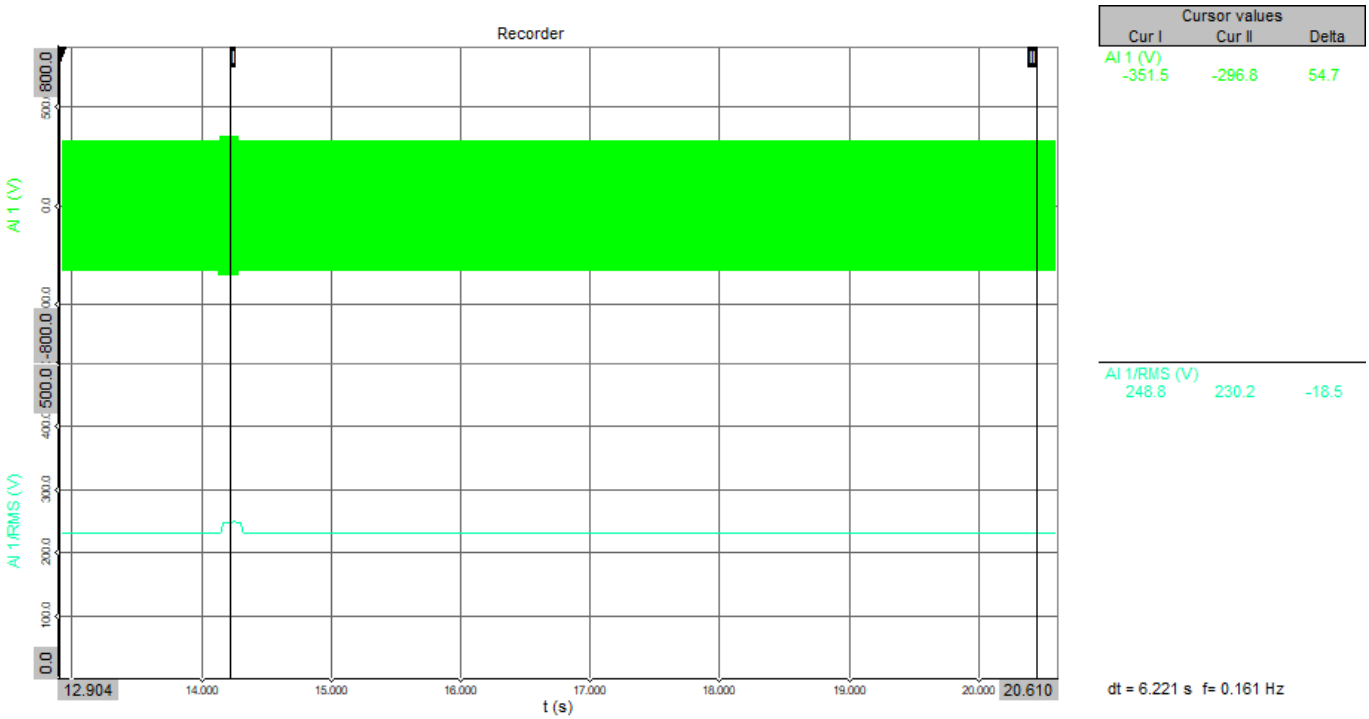
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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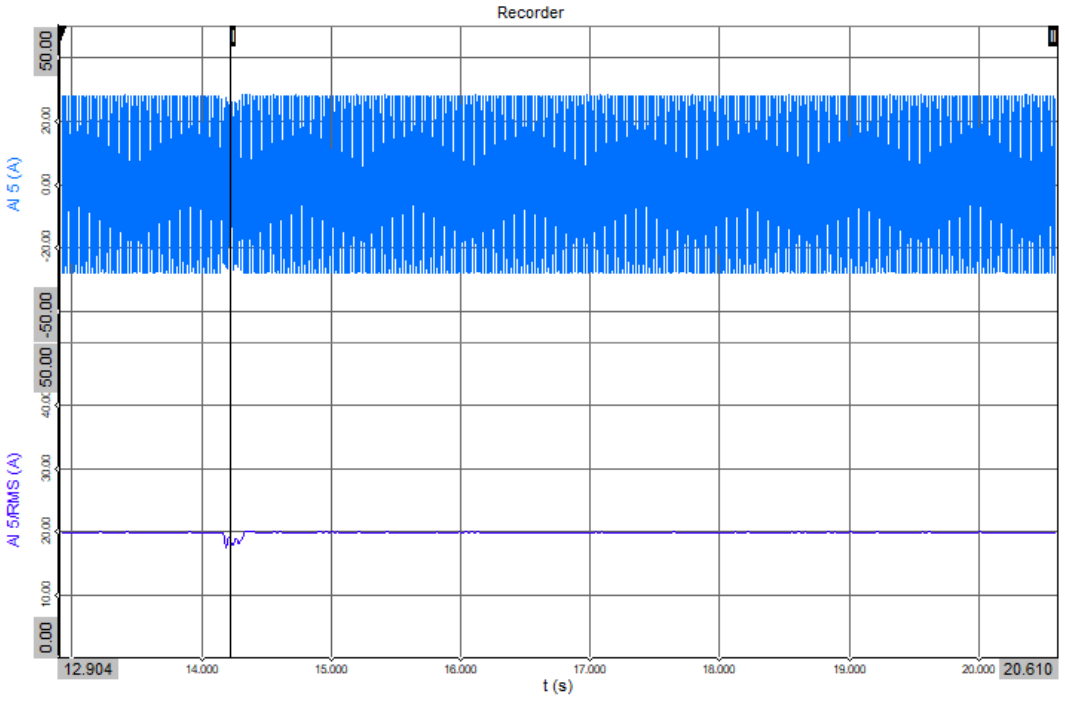
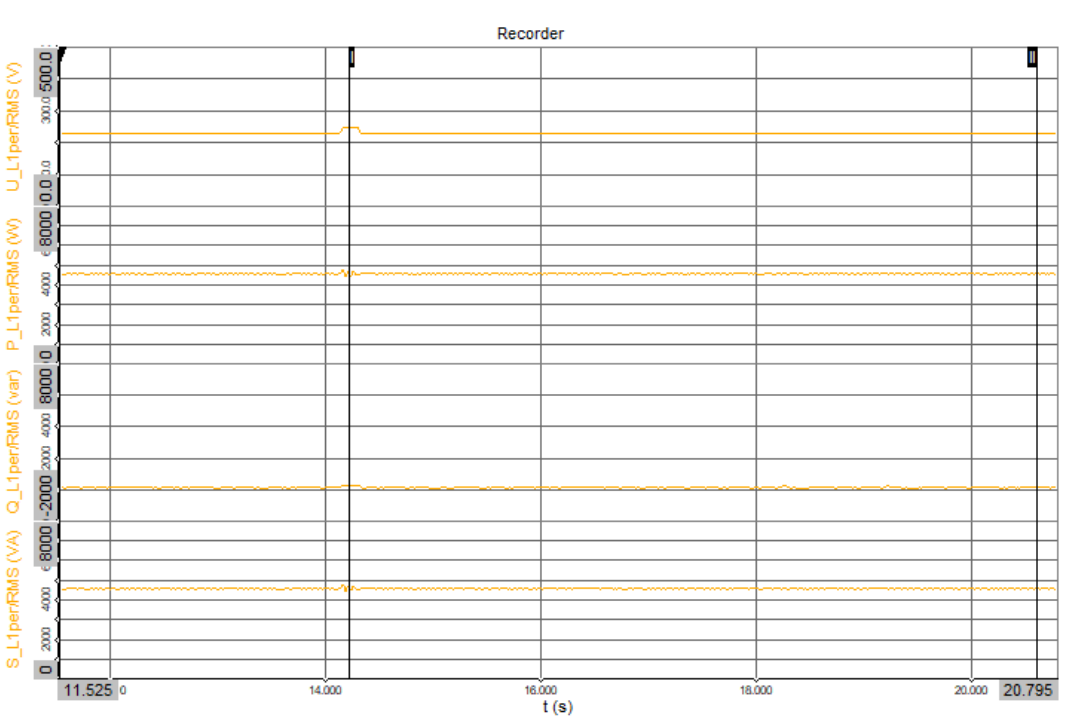
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		6.1				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	6.1	6.1
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:06:09
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.175
	5	Dip duration setpoint	-	-	[ms]	5070
	6	Time of fault occurrence (t_1)	-	-	[ms]	11548
	7	Time of fault clearance (t_2)	-	-	[ms]	16598
	8	Fault duration determined from no load test	-	-	[ms]	5030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.174
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.987
	12	Active power	Total	t1-10s to t1	[p.u.]	0.987
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.048
	14	cos φ	Total	t1-10s to t1	-	0.999
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.175
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.090
	17		L1	t1+100ms	[p.u.]	0.092
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.094
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.003
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.986
	22		Total	t2+3s to t2+10s	[p.u.]	0.987
	23	Active power recover time	Total	-	ms	130
	24	Reactive power	Total	t2+10s	[p.u.]	0.032
	25		Total	t2+3s to t2+10s	[p.u.]	0.047
	26	Reactive power recover time	Total	-	ms	0

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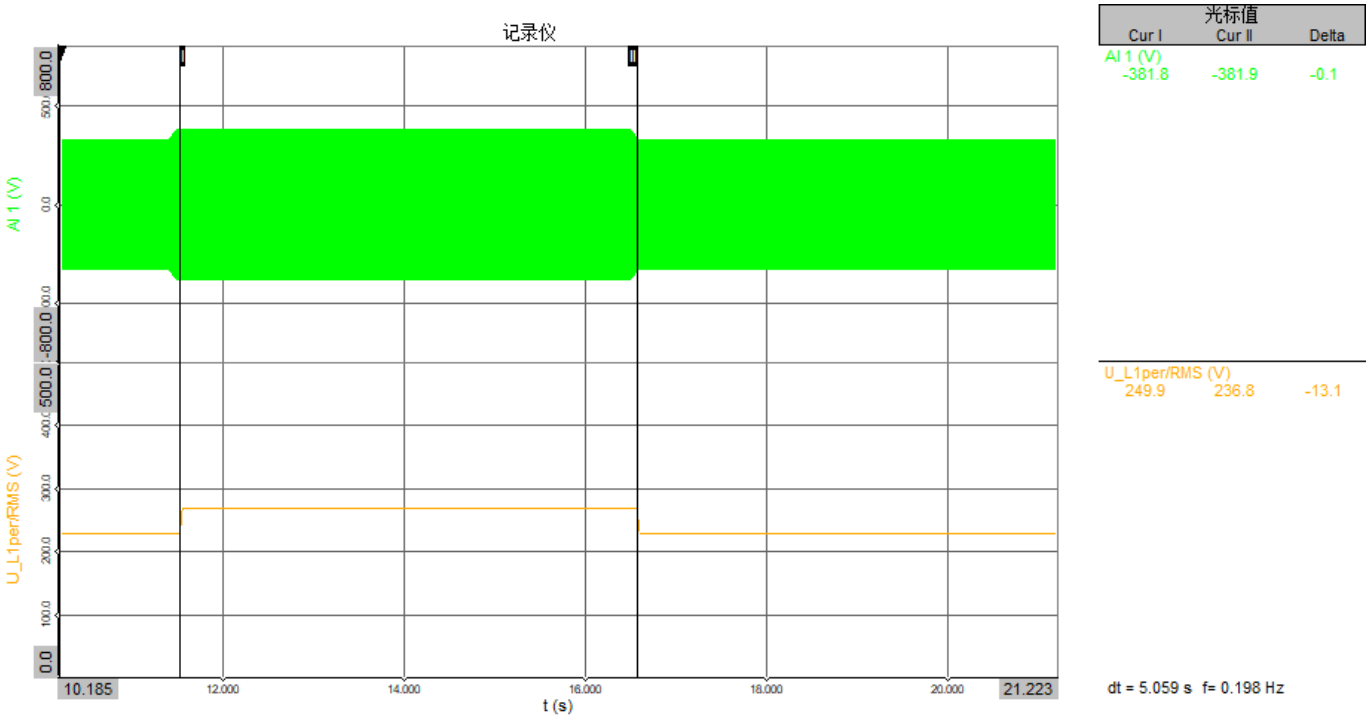
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

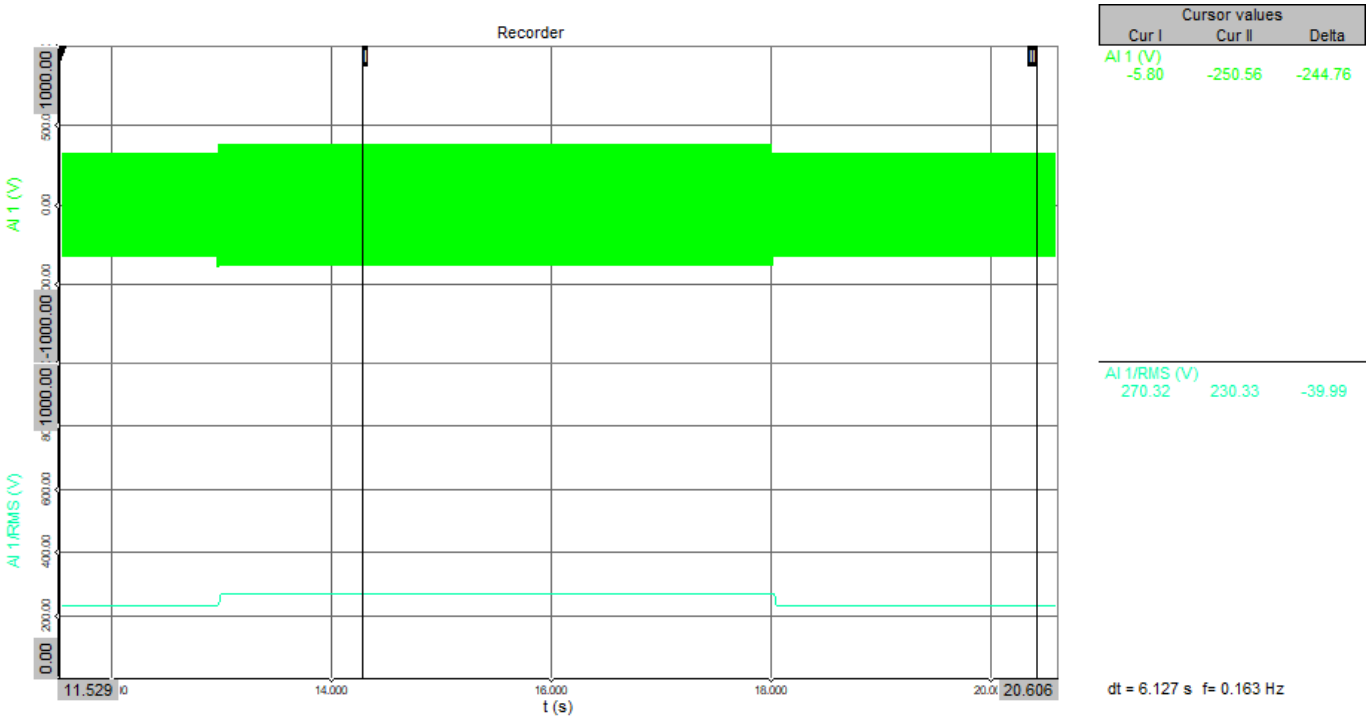
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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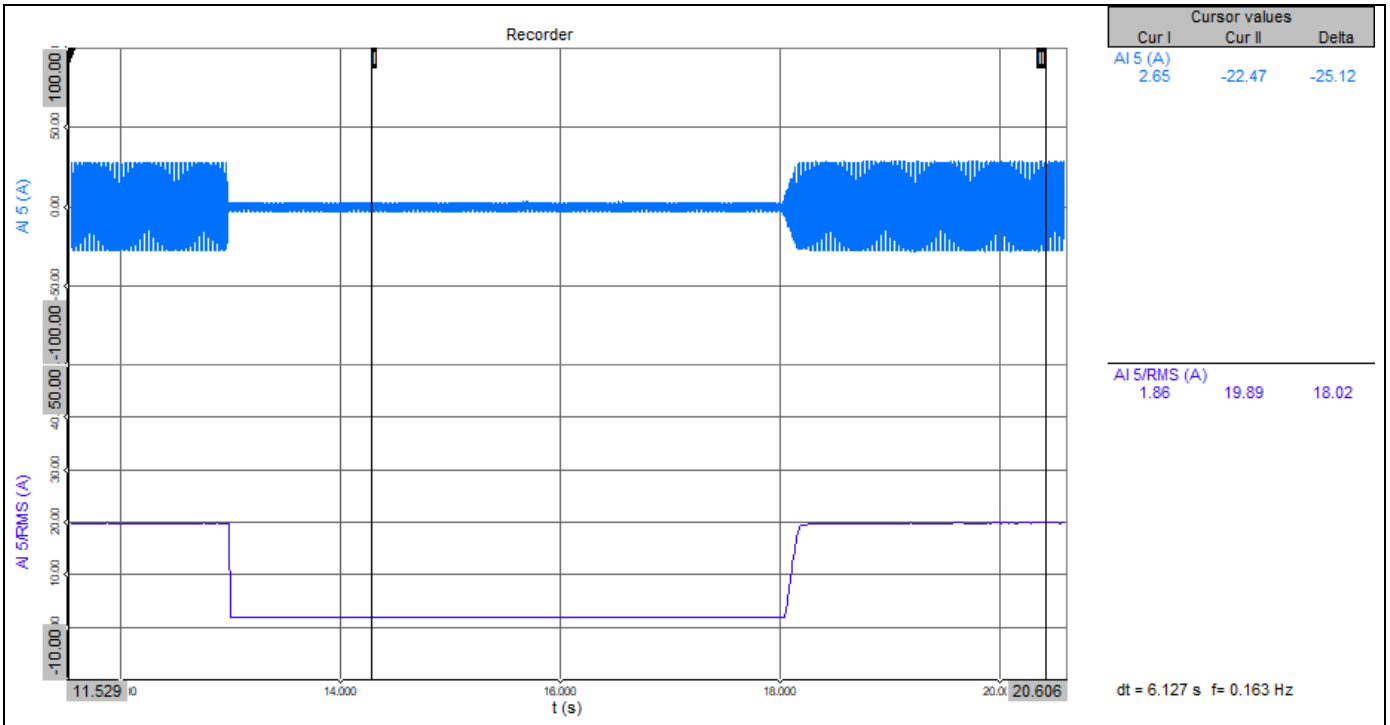
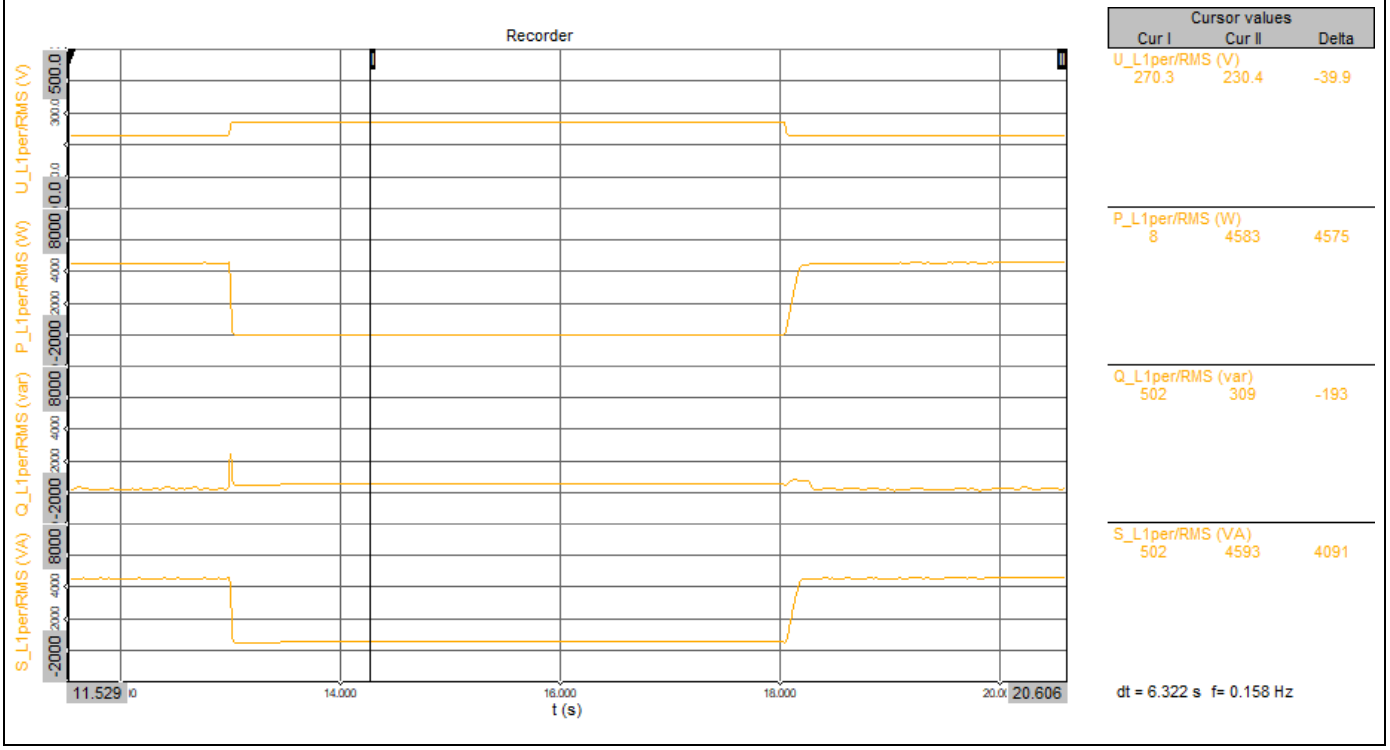
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		6.2				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	6.2	6.2
	1	Date	-	-	[dd.mm.yyyy]	27.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:11:13
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.175
	5	Dip duration setpoint	-	-	[ms]	5050
	6	Time of fault occurrence (t_1)	-	-	[ms]	11548
	7	Time of fault clearance (t_2)	-	-	[ms]	16598
	8	Fault duration determined from no load test	-	-	[ms]	5030
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.174
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.392
	12	Active power	Total	t1-10s to t1	[p.u.]	0.391
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.034
	14	cos φ	Total	t1-10s to t1	-	0.996
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.175
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.091
	17		L1	t1+100ms	[p.u.]	0.091
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.093
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.001
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.390
	22		Total	t2+3s to t2+10s	[p.u.]	0.391
	23	Active power recover time	Total	-	ms	47
	24	Reactive power	Total	t2+10s	[p.u.]	0.040
	25		Total	t2+3s to t2+10s	[p.u.]	0.034
	26	Reactive power recover time	Total	-	ms	0

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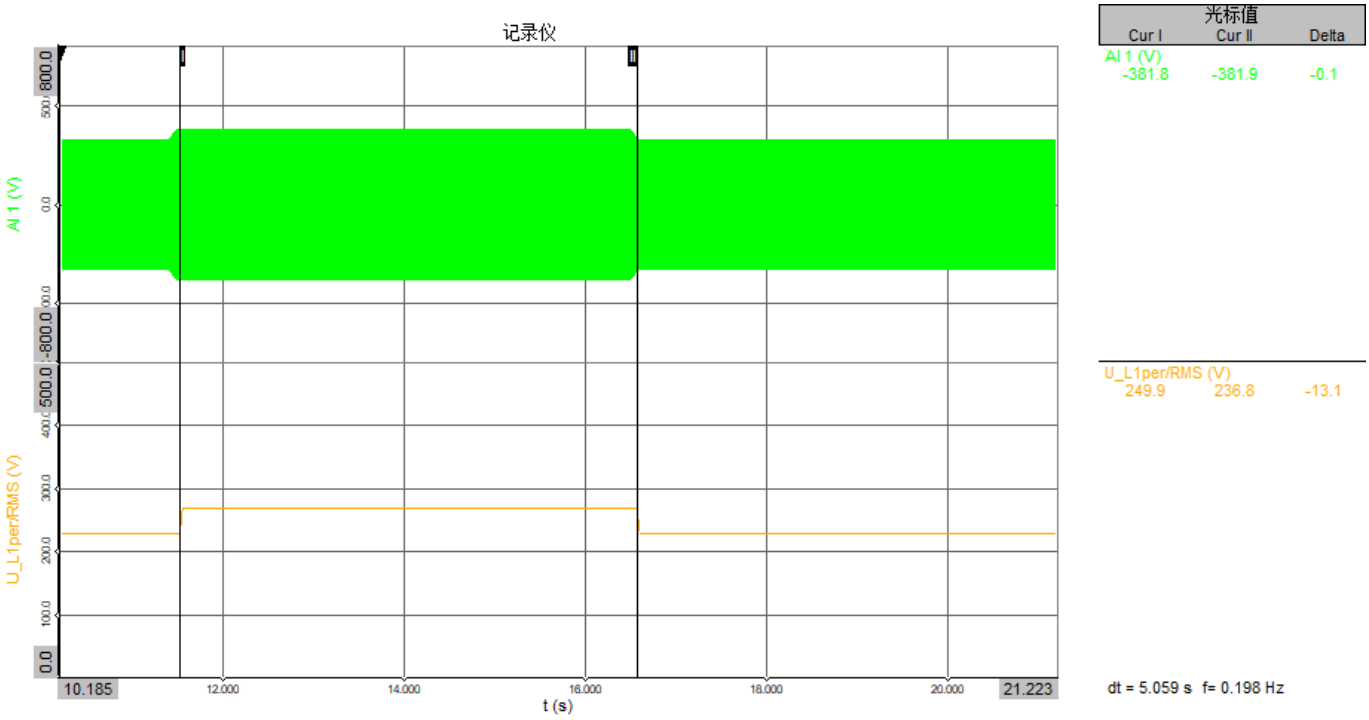
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

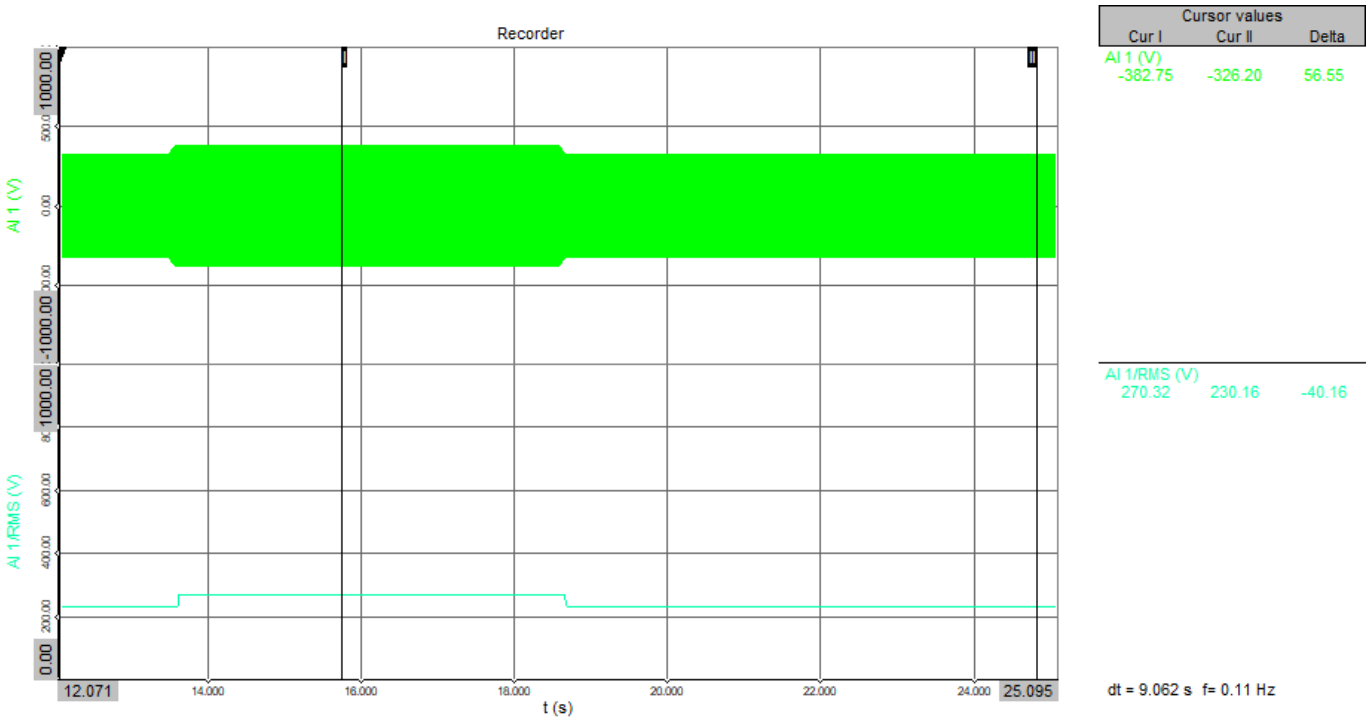
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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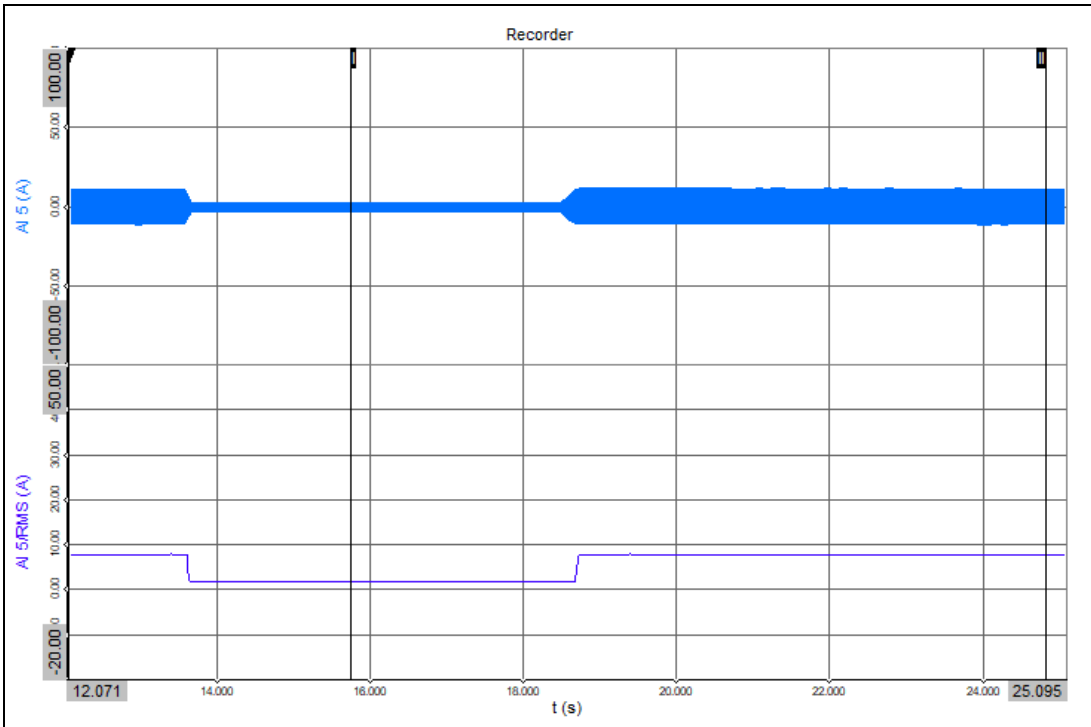
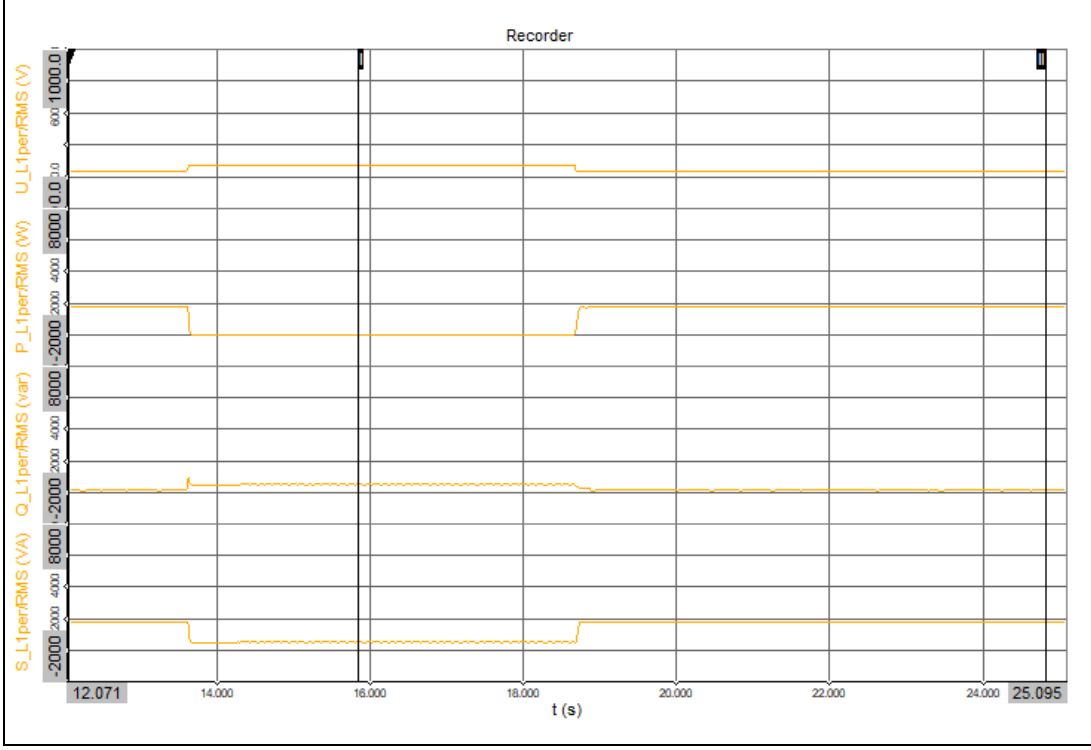
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		6.3				Pass
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	6.3	6.3
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	15:56:59
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.050
	5	Dip duration setpoint	-	-	[ms]	5050
	6	Time of fault occurrence (t_1)	-	-	[ms]	11808
	7	Time of fault clearance (t_2)	-	-	[ms]	16860
	8	Fault duration determined from no load test	-	-	[ms]	5032
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.05
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.995
	12	Active power	Total	t1-10s to t1	[p.u.]	0.995
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.029
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.051
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.995
	17		L1	t1+100ms	[p.u.]	0.995
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.996
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	1.046
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.996
	22		Total	t2+3s to t2+10s	[p.u.]	0.995
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.029
	25		Total	t2+3s to t2+10s	[p.u.]	0.029
	26	Reactive power recover time	Total	-	ms	--

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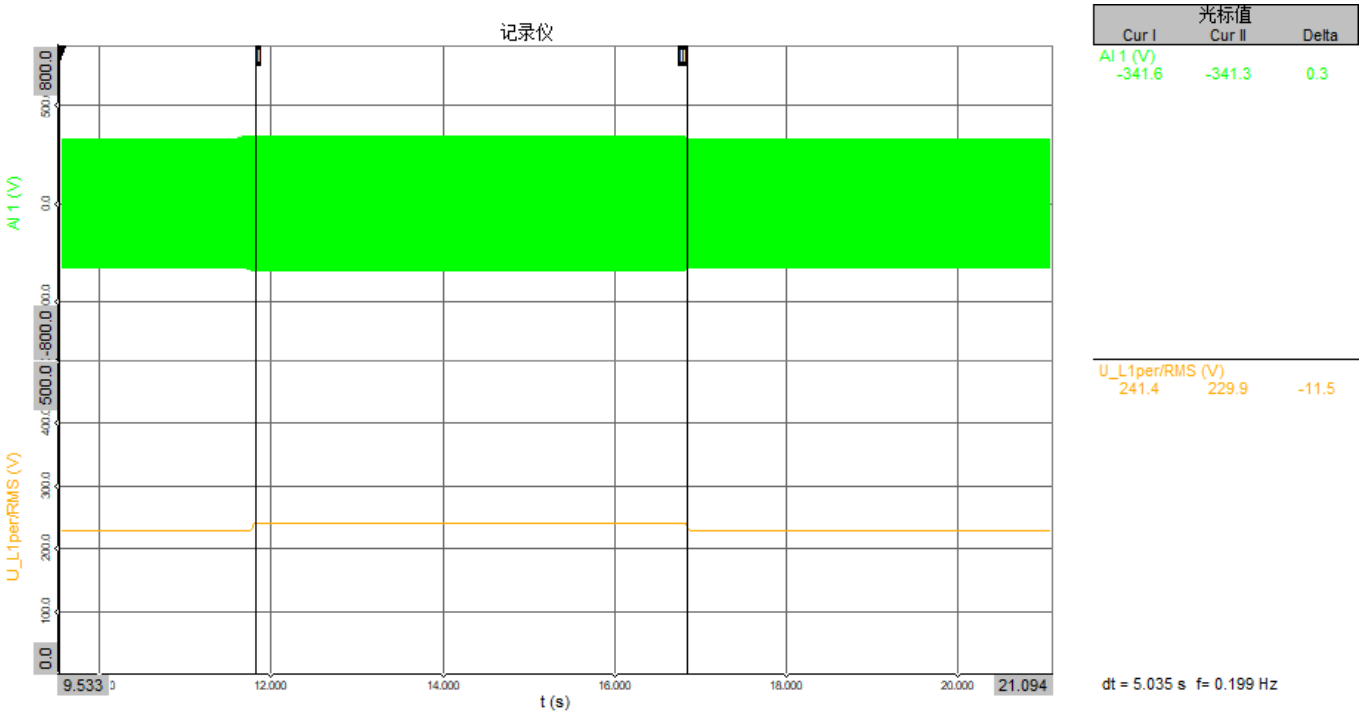
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

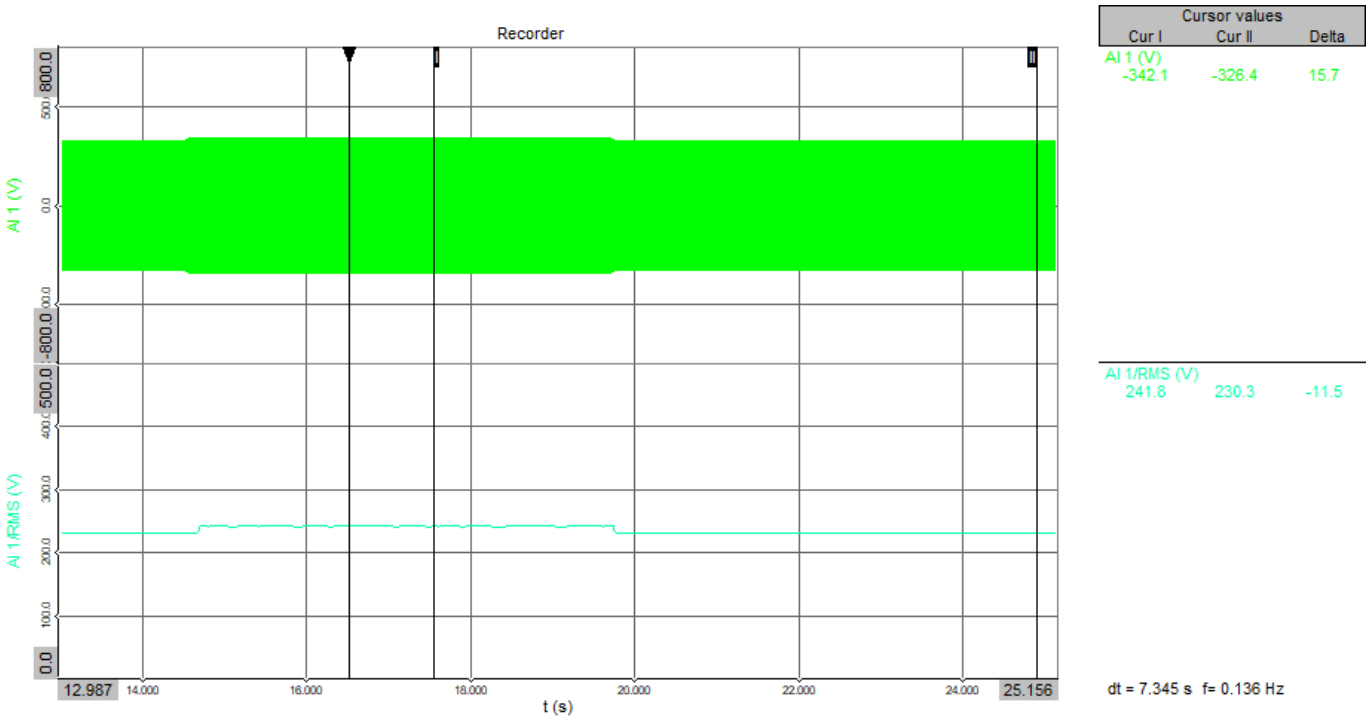
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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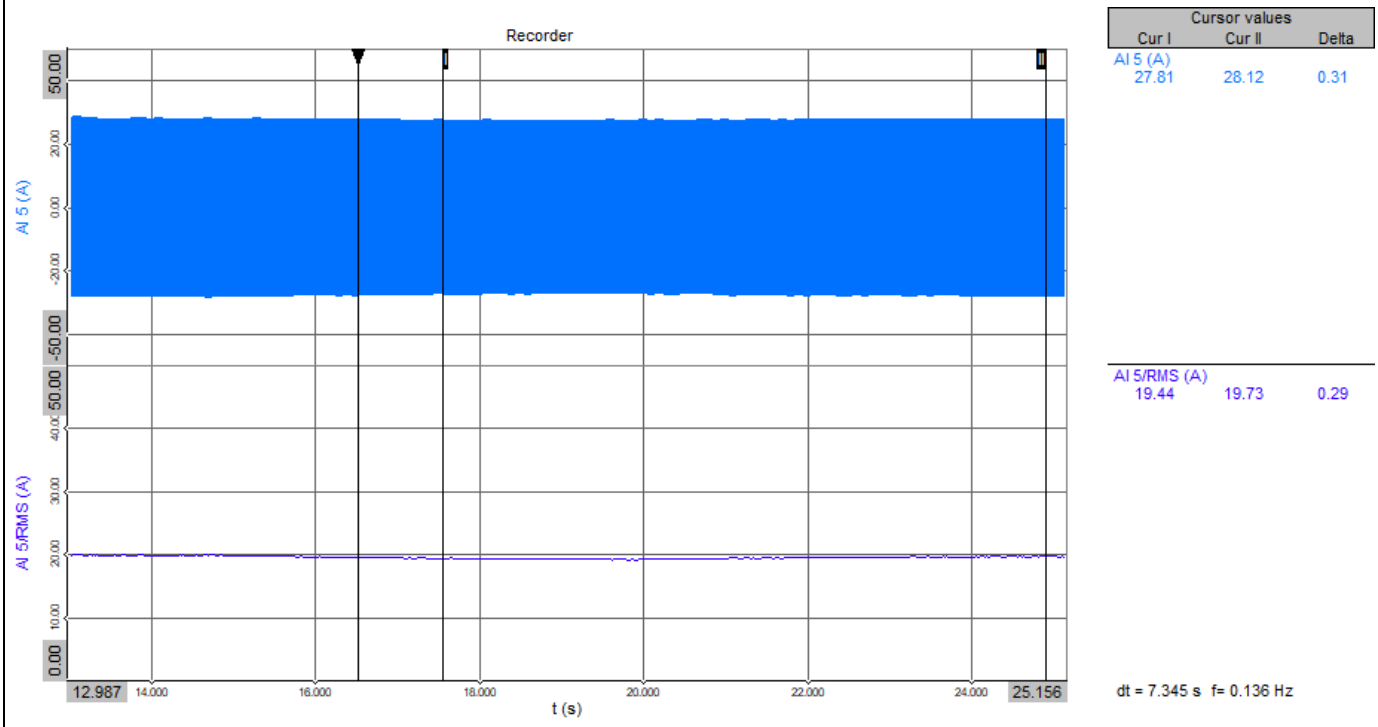
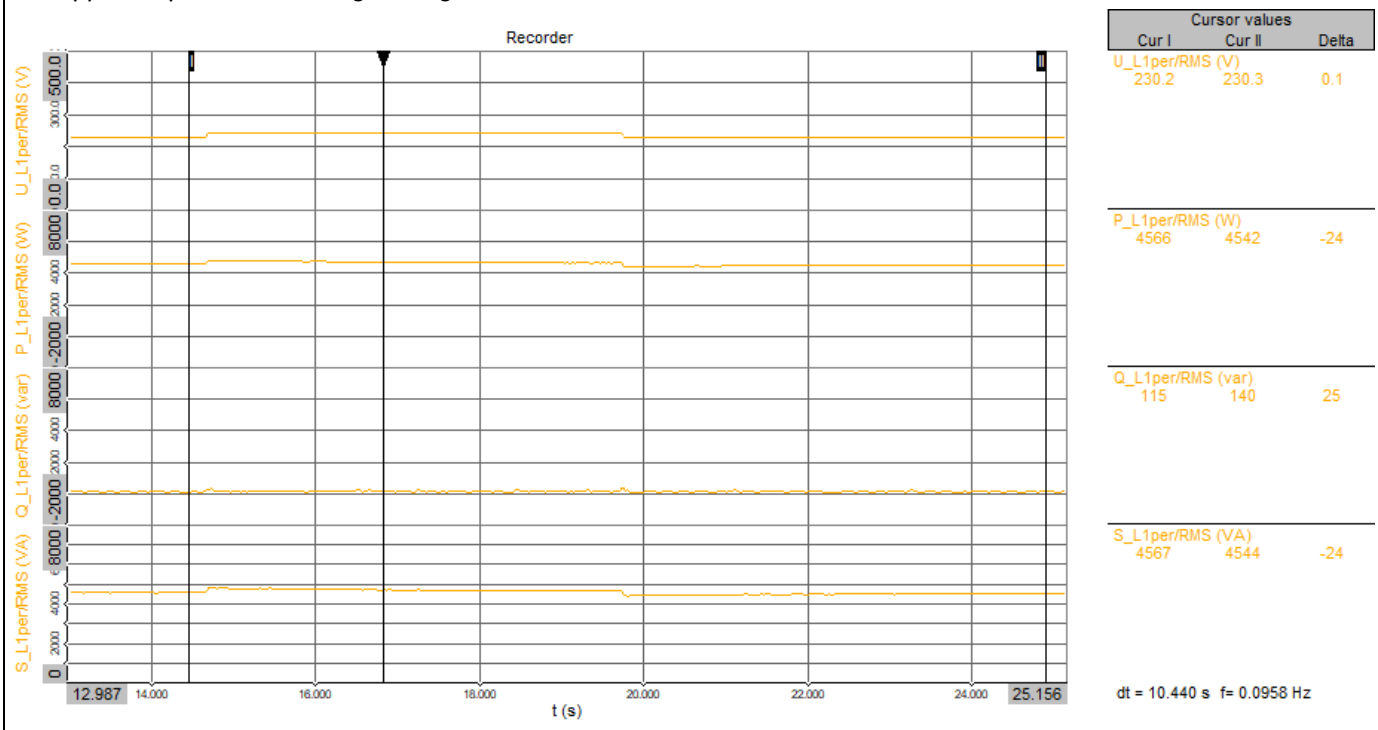
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms

Active and reactive power as moving average over 20 ms

Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		6.4				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	6.4	6.4
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:02:11
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.050
	5	Dip duration setpoint	-	-	[ms]	5070
	6	Time of fault occurrence (t_1)	-	-	[ms]	11808
	7	Time of fault clearance (t_2)	-	-	[ms]	16860
	8	Fault duration determined from no load test	-	-	[ms]	5032
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.05
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.000
	11	Current	L1	t1-10s to t1	[p.u.]	0.396
	12	Active power	Total	t1-10s to t1	[p.u.]	0.395
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.025
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.05
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.394
	17		L1	t1+100ms	[p.u.]	0.395
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.395
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.415
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.000
	21	Active power	Total	t2+1s	[p.u.]	0.414
	22		Total	t2+3s to t2+10s	[p.u.]	0.415
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.025
	25		Total	t2+3s to t2+10s	[p.u.]	0.025
	26	Reactive power recover time	Total	-	ms	--

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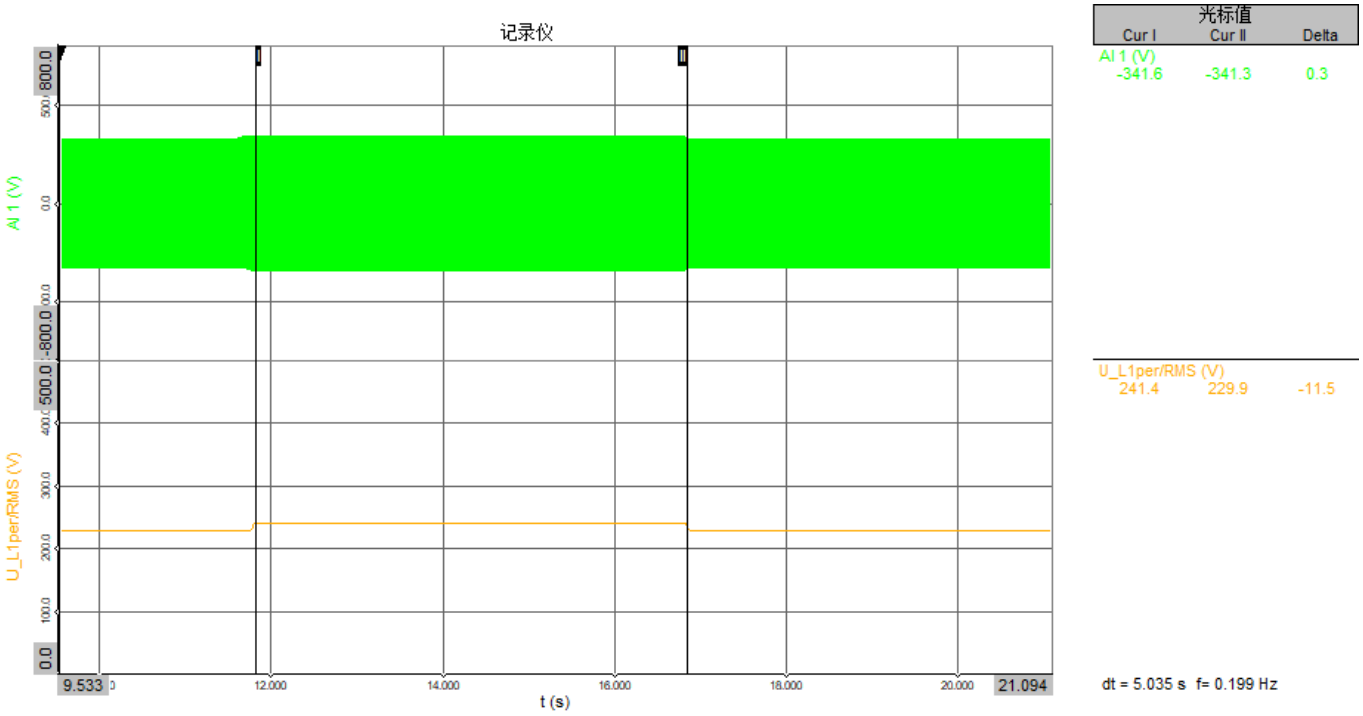
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

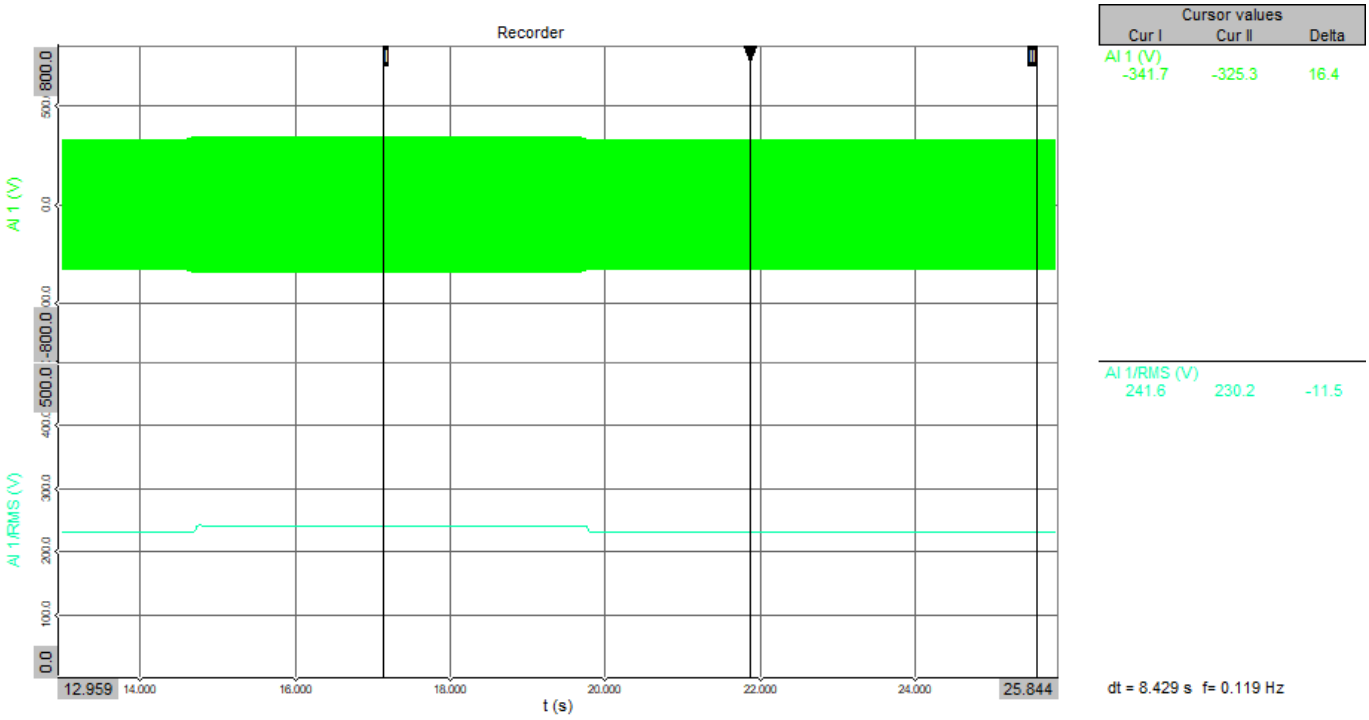
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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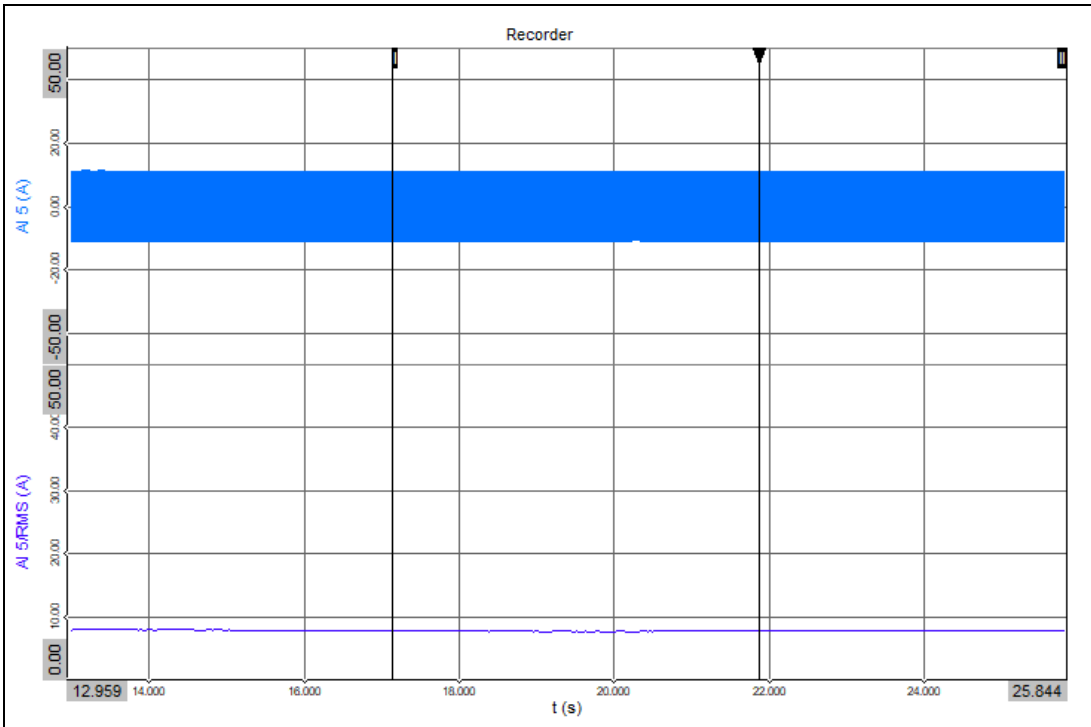
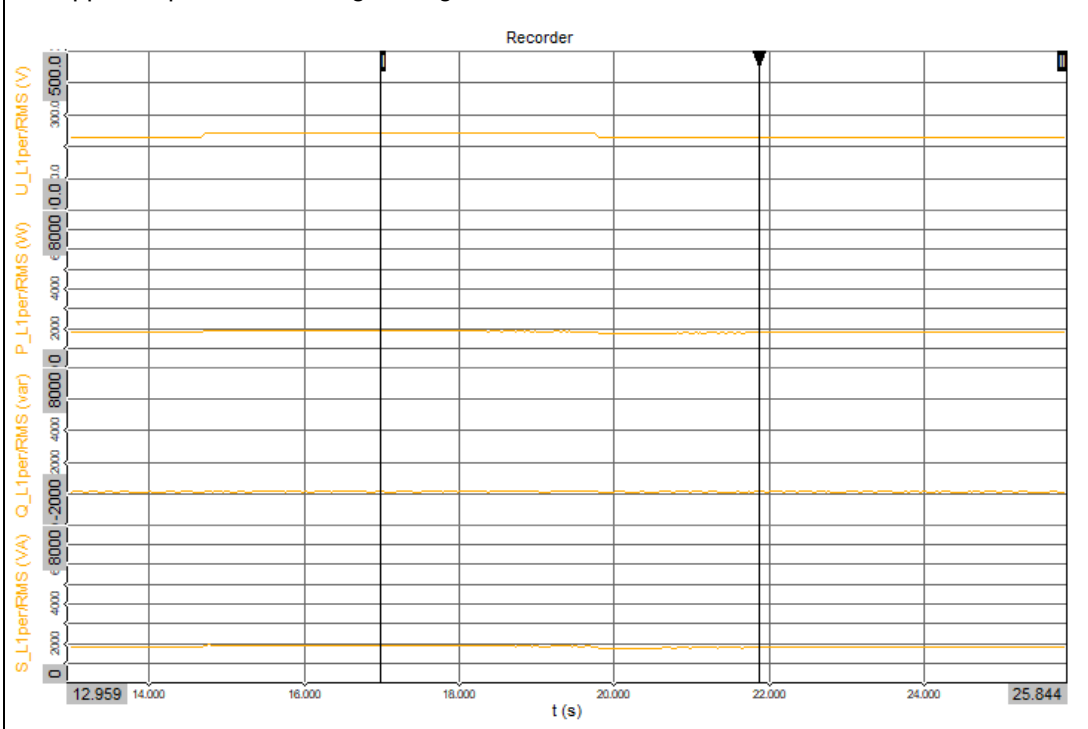
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		7.1				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	7.1	7.1
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	11:08:34
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.108
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	11969
	7	Time of fault clearance (t_2)	-	-	[ms]	72021
	8	Fault duration determined from no load test	-	-	[ms]	60032
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.109
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.986
	12	Active power	Total	t1-10s to t1	[p.u.]	0.986
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.044
	14	cos φ	Total	t1-10s to t1	-	0.999
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.110
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.985
	17		L1	t1+100ms	[p.u.]	0.848
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.984
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	1.077
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.907
	22		Total	t2+3s to t2+10s	[p.u.]	0.963
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.025
	25		Total	t2+3s to t2+10s	[p.u.]	0.029
	26	Reactive power recover time	Total	-	ms	0

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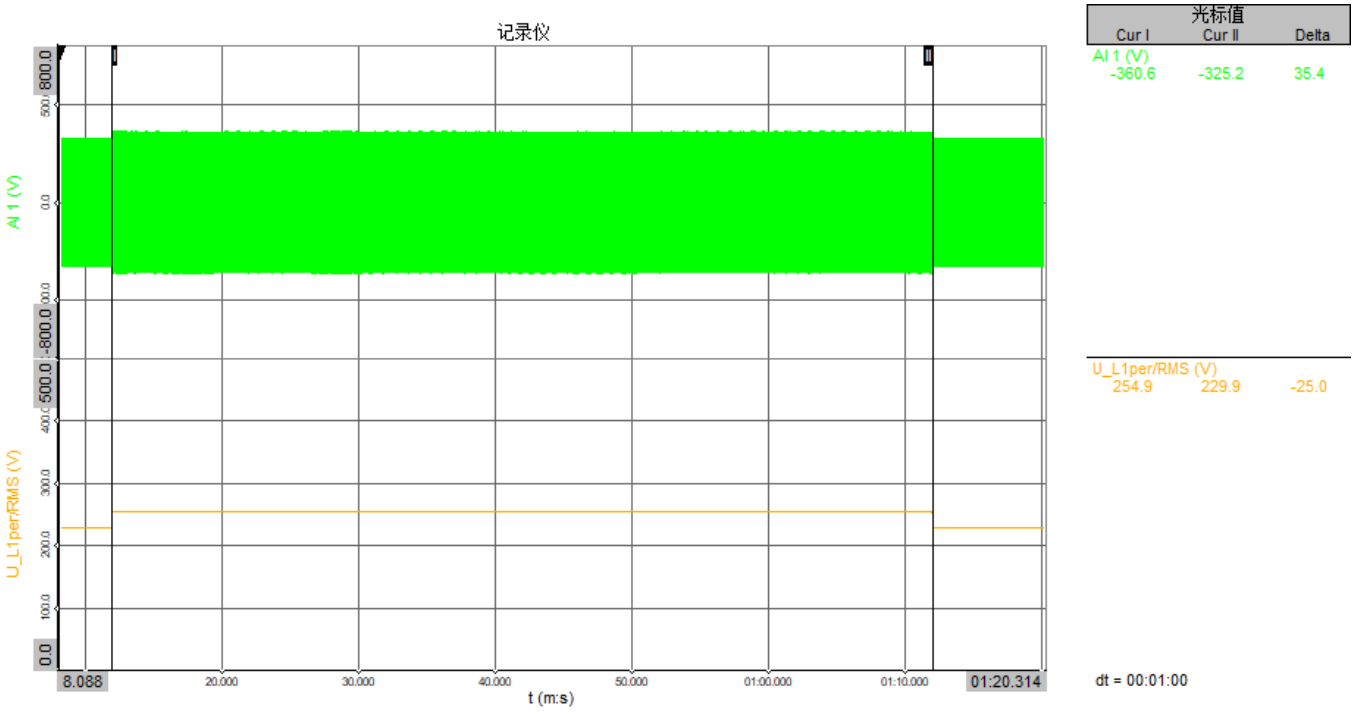
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

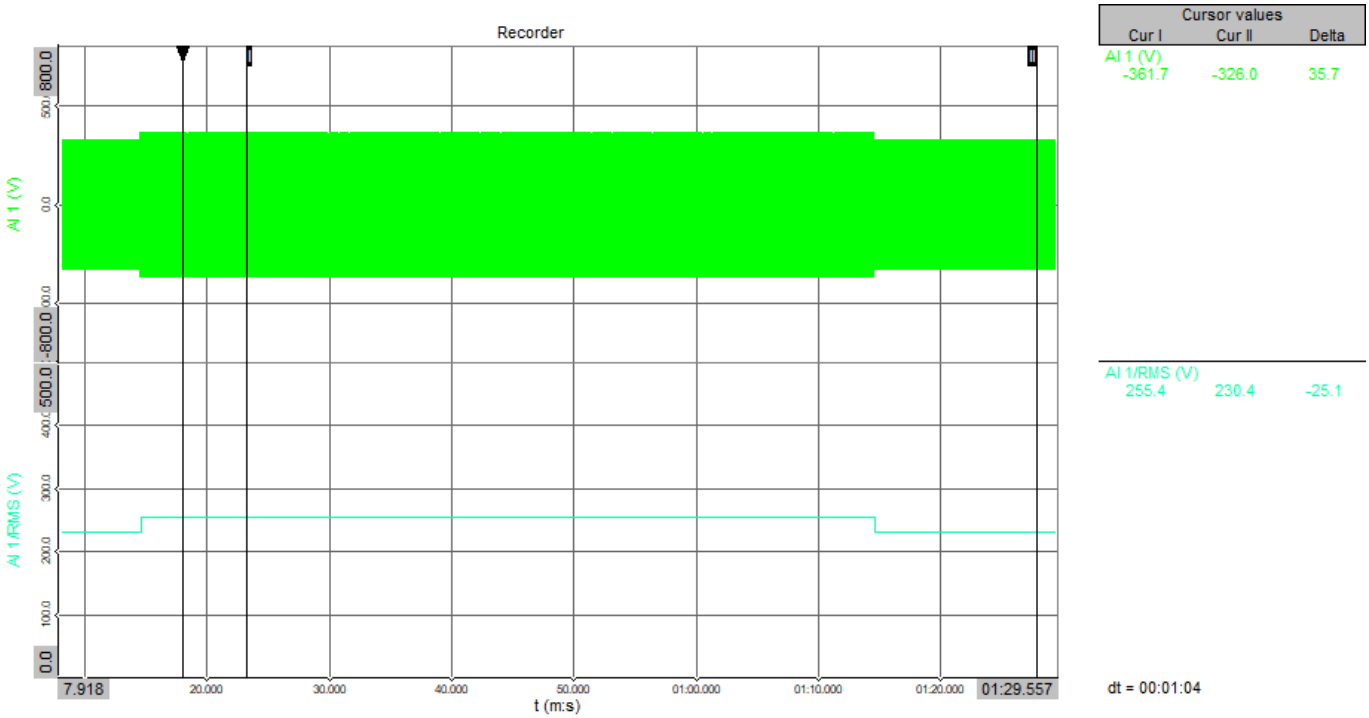
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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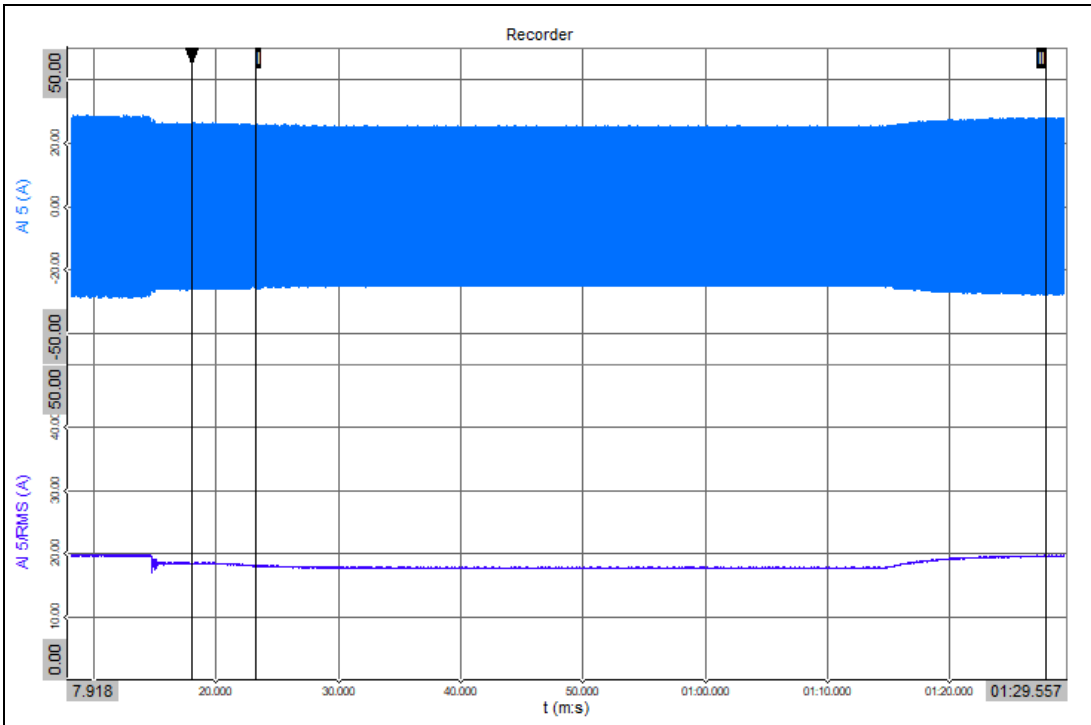
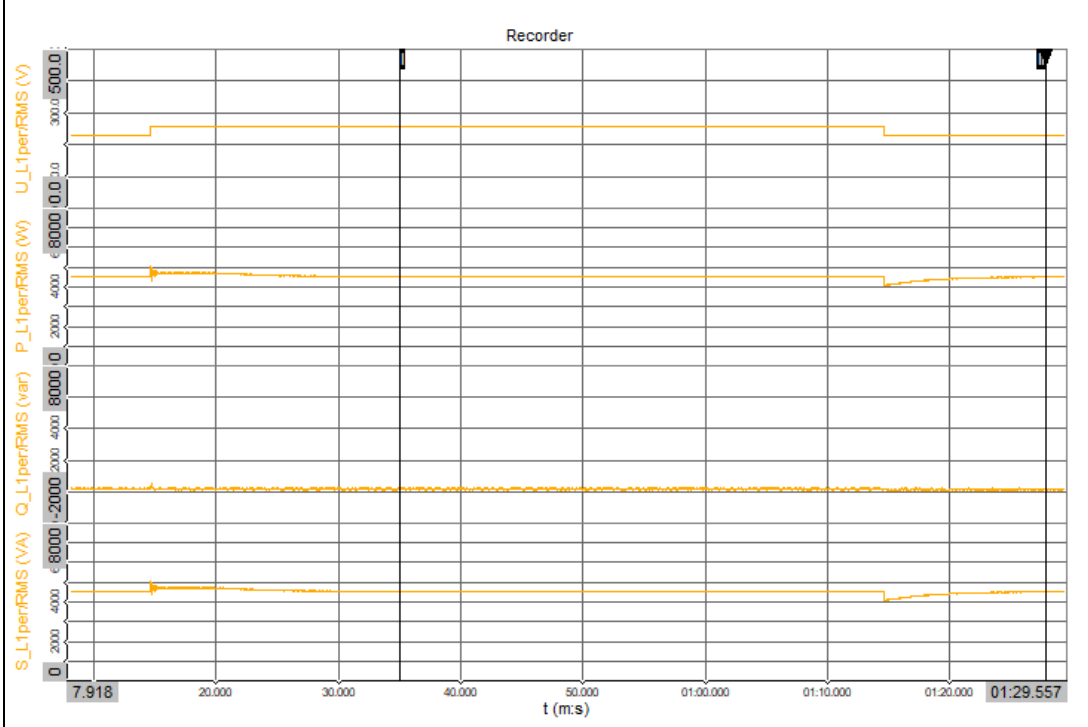
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number	7.2					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	7.2	7.2
	1	Date	-	-	[dd.mm.yyyy]	08.05.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	11:40:57
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.108
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	11969
	7	Time of fault clearance (t_2)	-	-	[ms]	72021
	8	Fault duration determined from no load test	-	-	[ms]	60032
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.109
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.001
	11	Current	L1	t1-10s to t1	[p.u.]	0.397
	12	Active power	Total	t1-10s to t1	[p.u.]	0.396
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.026
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.110
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.399
	17		L1	t1+100ms	[p.u.]	0.397
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.397
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.439
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.001
	21	Active power	Total	t2+1s	[p.u.]	0.363
	22		Total	t2+3s to t2+10s	[p.u.]	0.387
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.019
	25		Total	t2+3s to t2+10s	[p.u.]	0.027
	26	Reactive power recover time	Total	-	ms	0

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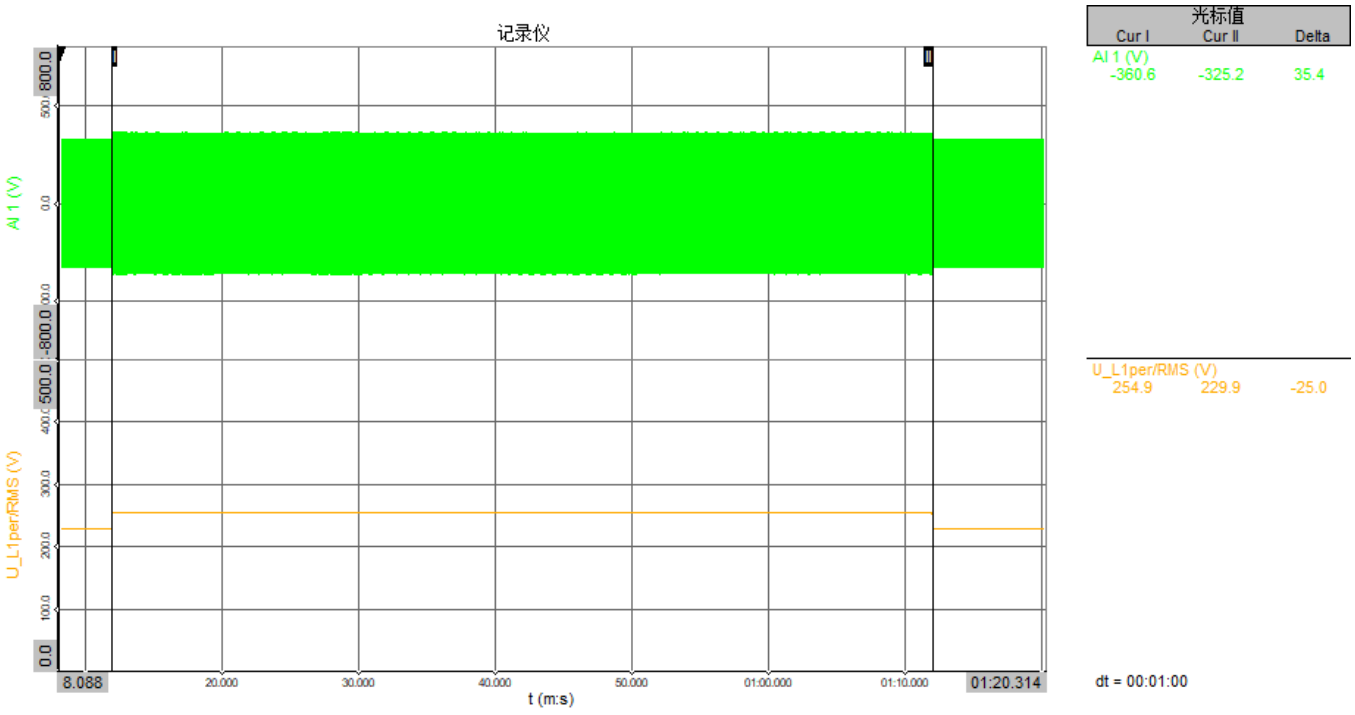
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

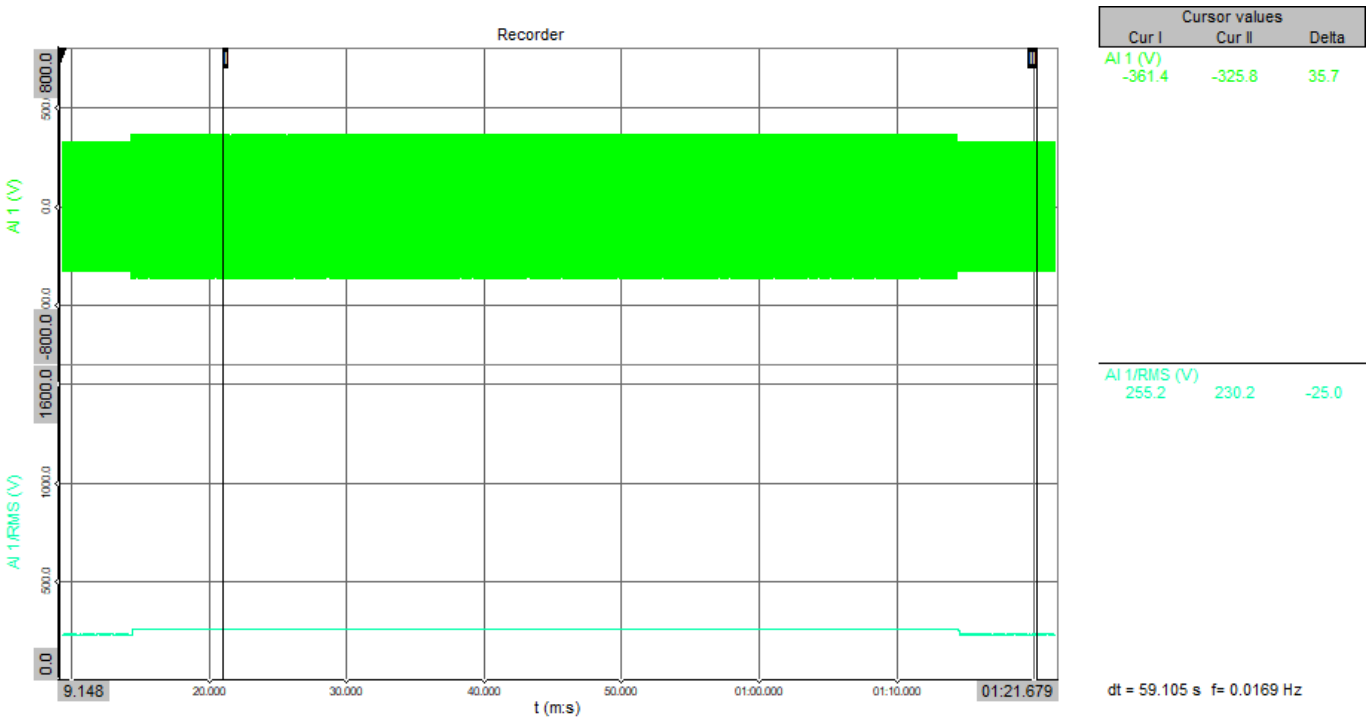
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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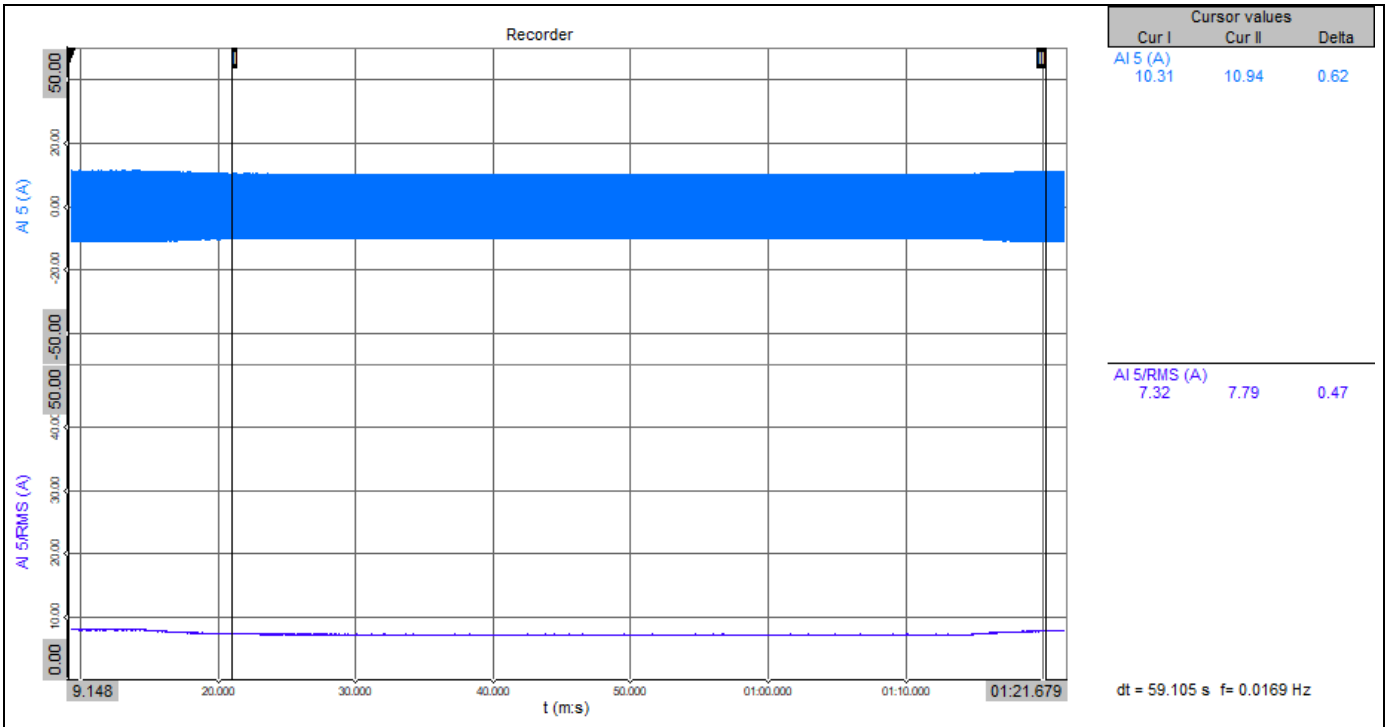
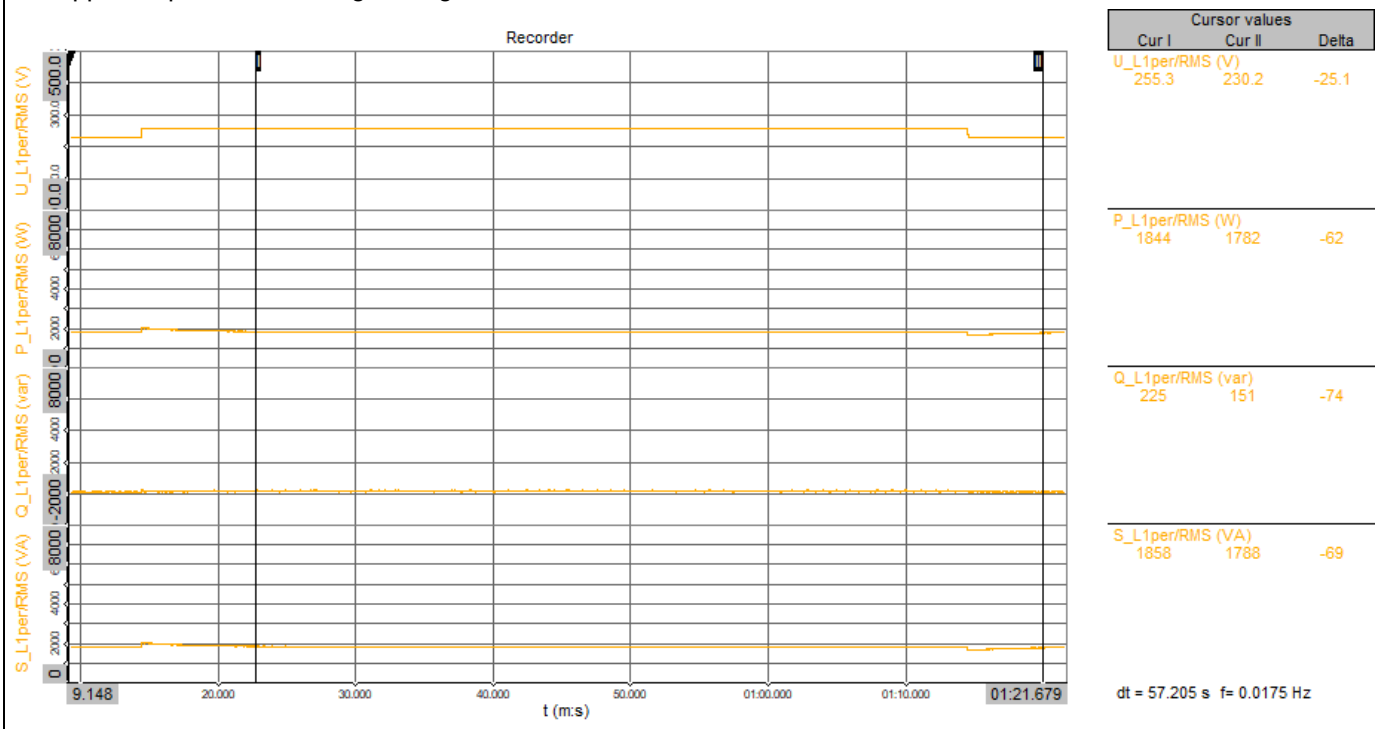
Clause	Requirement + Test	result – Remark	Verdict



RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Clause	Requirement + Test	result – Remark	Verdict

Test Number		7.3				P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	7.3	7.3
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:24:38
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.040
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	12045
	7	Time of fault clearance (t_2)	-	-	[ms]	72103
	8	Fault duration determined from no load test	-	-	[ms]	60038
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.040
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.000
	11	Current	L1	t1-10s to t1	[p.u.]	0.993
	12	Active power	Total	t1-10s to t1	[p.u.]	0.992
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.028
	14	cos φ	Total	t1-10s to t1	-	1.000
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.040
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.955
	17		L1	t1+100ms	[p.u.]	0.955
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.957
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.995
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.000
	21	Active power	Total	t2+1s	[p.u.]	0.994
	22		Total	t2+3s to t2+10s	[p.u.]	0.995
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.028
	25		Total	t2+3s to t2+10s	[p.u.]	0.028
	26	Reactive power recover time	Total	-	ms	--

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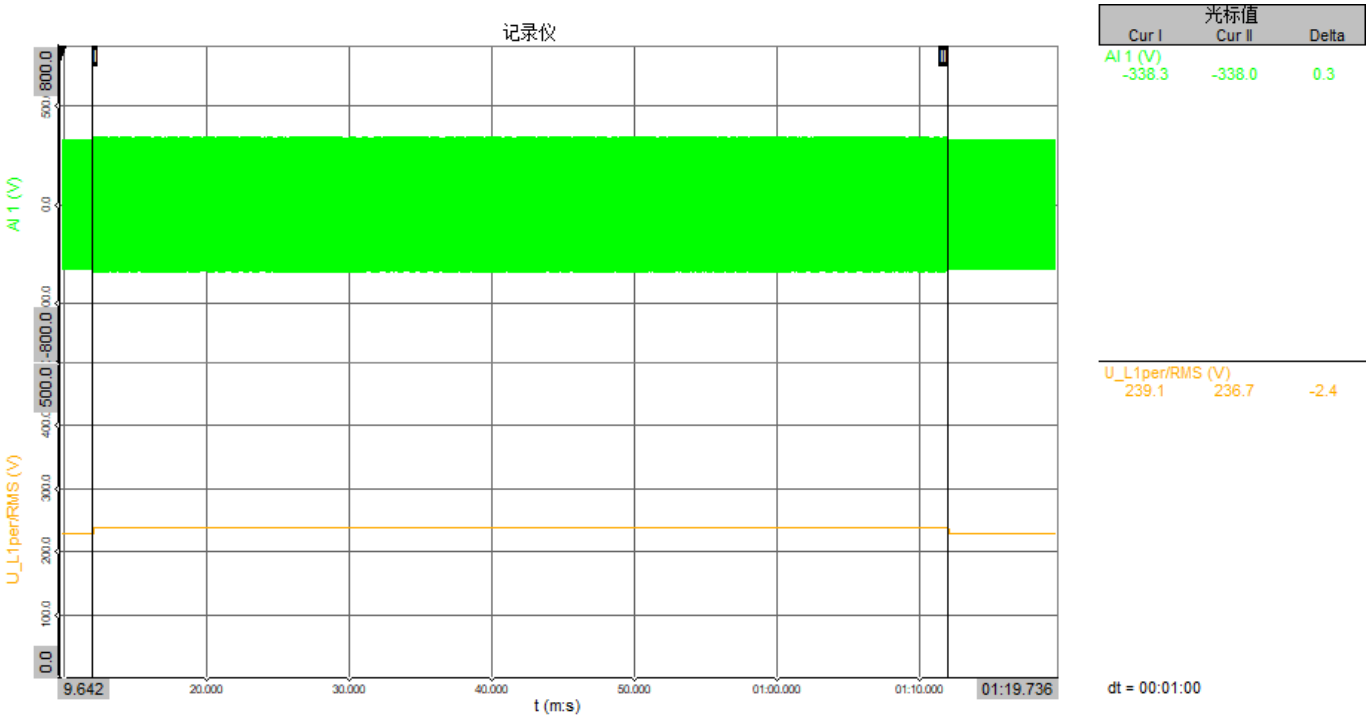
Clause	Requirement + Test	result – Remark	Verdict

Graphic:

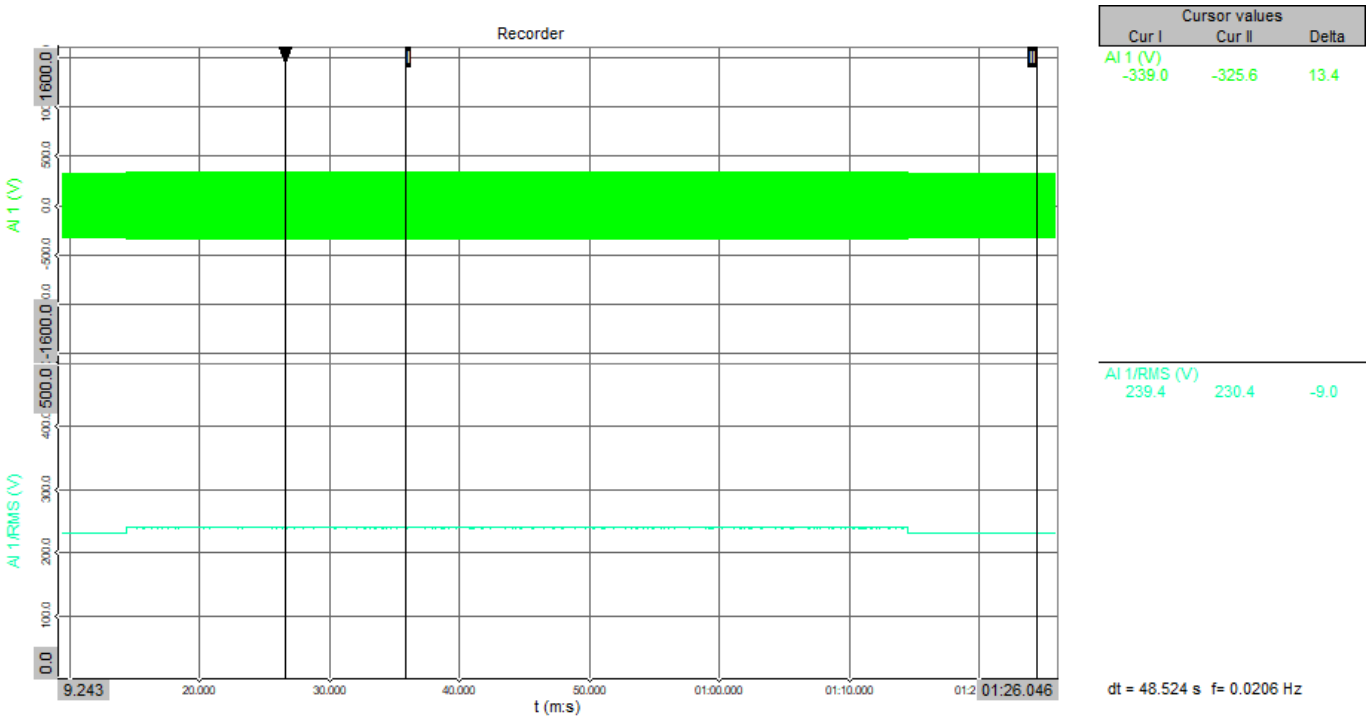
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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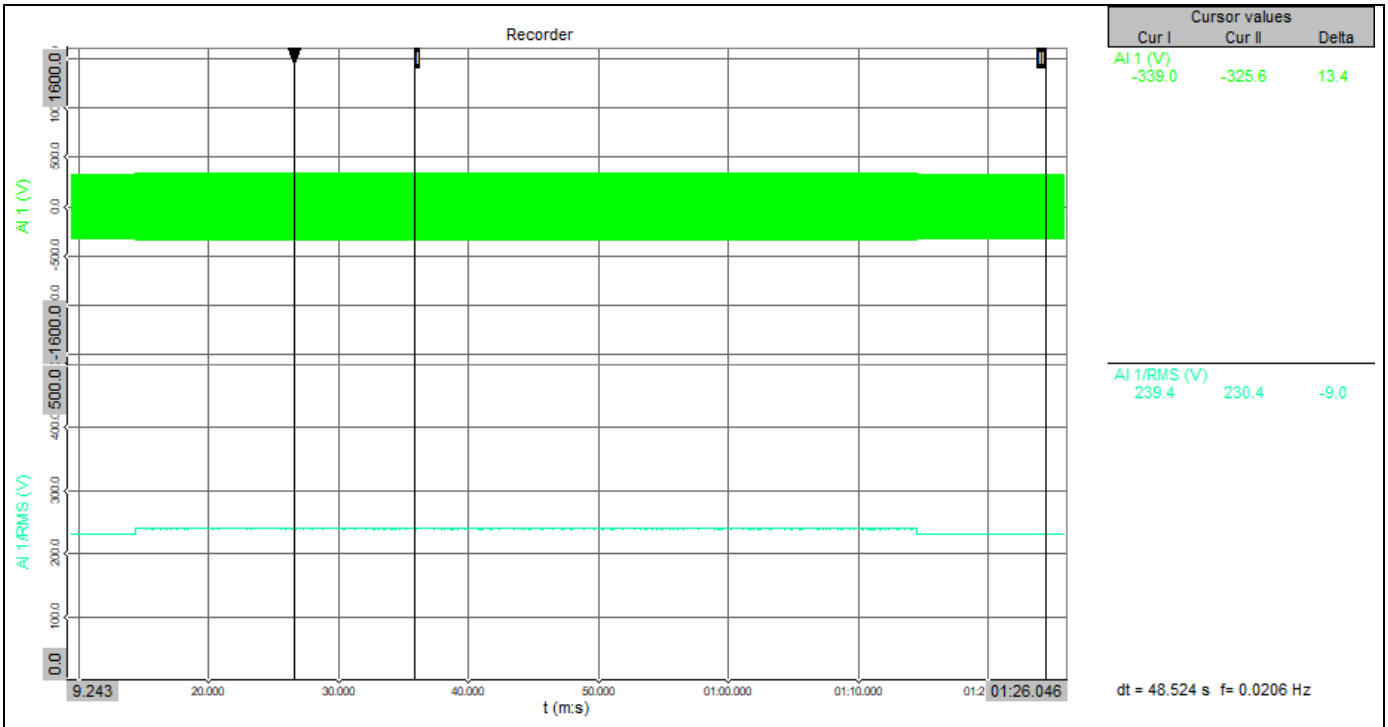
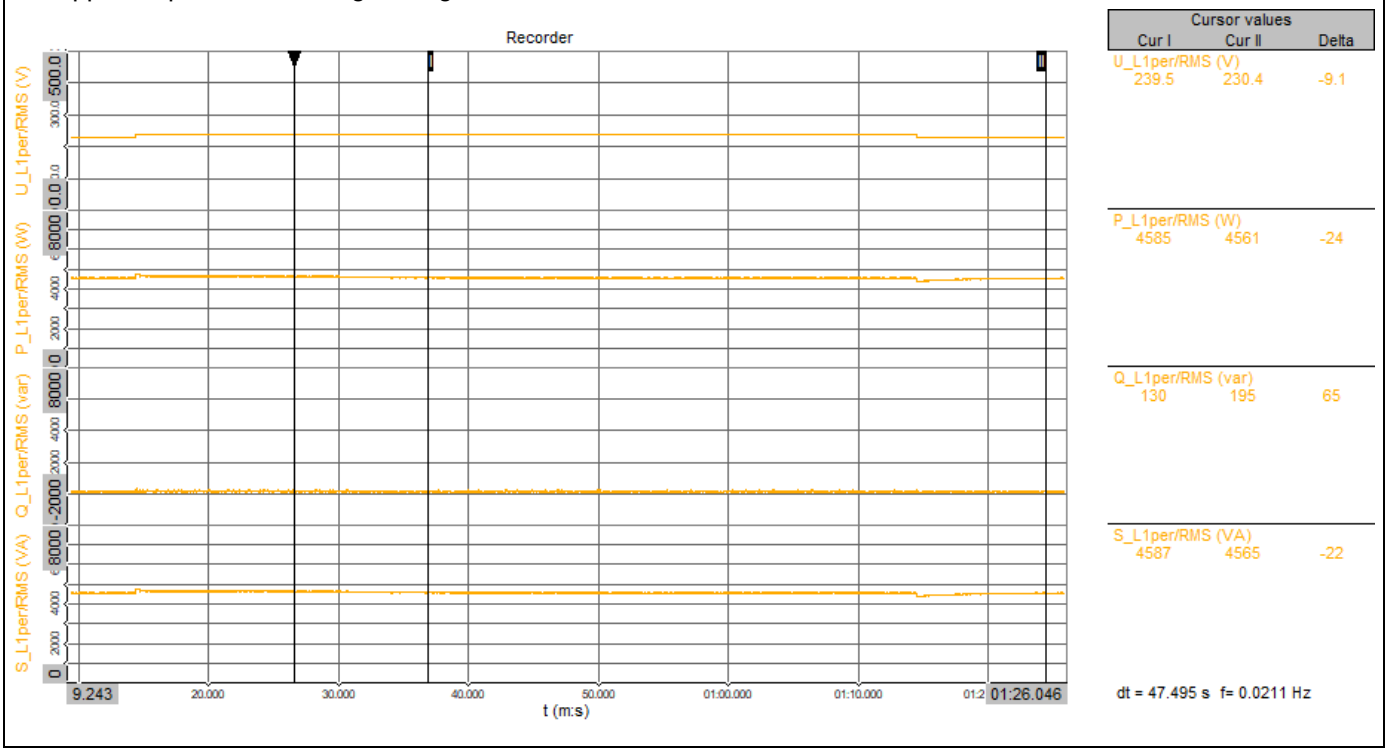


RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



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Test Number	7.4					P
	No	Parameter	Phase reference	Reference time	[Unit]	Value
General information	0	Test number	-	-	7.4	7.4
	1	Date	-	-	[dd.mm.yyyy]	29.04.2021
	2	Time (start of the test)	-	-	[hh:mm:ss.f]	16:12:38
	3	Fault type (affected phases)	-	-	1P	1P
	4	Dip depth setpoint	L1-N	-	[p.u.]	1.040
	5	Dip duration setpoint	-	-	[ms]	60050
	6	Time of fault occurrence (t_1)	-	-	[ms]	12045
	7	Time of fault clearance (t_2)	-	-	[ms]	72103
	8	Fault duration determined from no load test	-	-	[ms]	60038
	9	Voltage drop depth or voltage increase determined from no load test	L1-N	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.040
Before t1	10	Voltage	L1-N	t1-10s to t1	[p.u.]	1.000
	11	Current	L1	t1-10s to t1	[p.u.]	0.396
	12	Active power	Total	t1-10s to t1	[p.u.]	0.396
	13	Reactive power	Total	t1-10s to t1	[p.u.]	0.024
	14	cos φ	Total	t1-10s to t1	-	0.998
t1 to t2	15	Voltage	L1-N	t1+100ms to t2-20ms	[p.u.]	1.040
	16	Momentary Current	L1	t1+60ms	[p.u.]	0.378
	17		L1	t1+100ms	[p.u.]	0.378
	18	Max current after t1+100ms during fault	L1	t1+100ms to t2-20ms	[p.u.]	0.380
	19	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.395
After t2	20	Voltage	L1-N	t2+3s to t2+10s	[p.u.]	1.000
	21	Active power	Total	t2+1s	[p.u.]	0.395
	22		Total	t2+3s to t2+10s	[p.u.]	0.395
	23	Active power recover time	Total	-	ms	0
	24	Reactive power	Total	t2+10s	[p.u.]	0.023
	25		Total	t2+3s to t2+10s	[p.u.]	0.024
	26	Reactive power recover time	Total	-	ms	--

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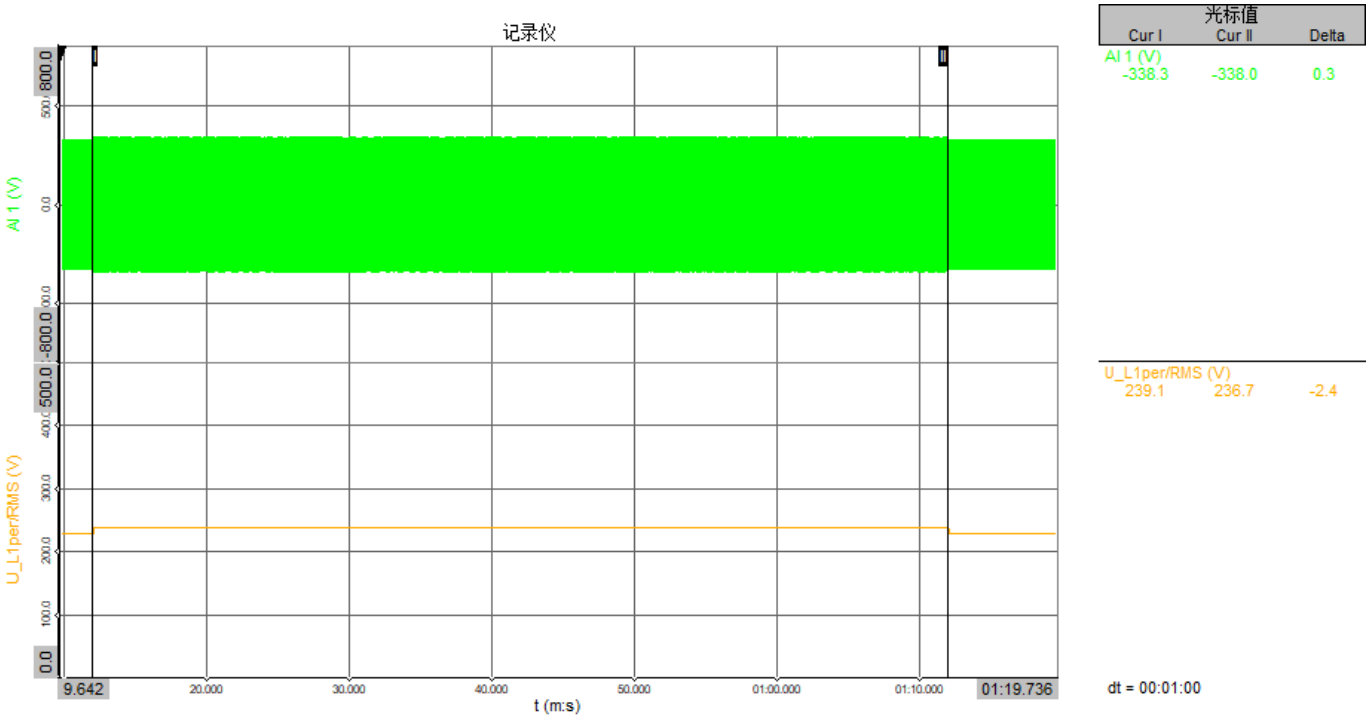
Graphic:

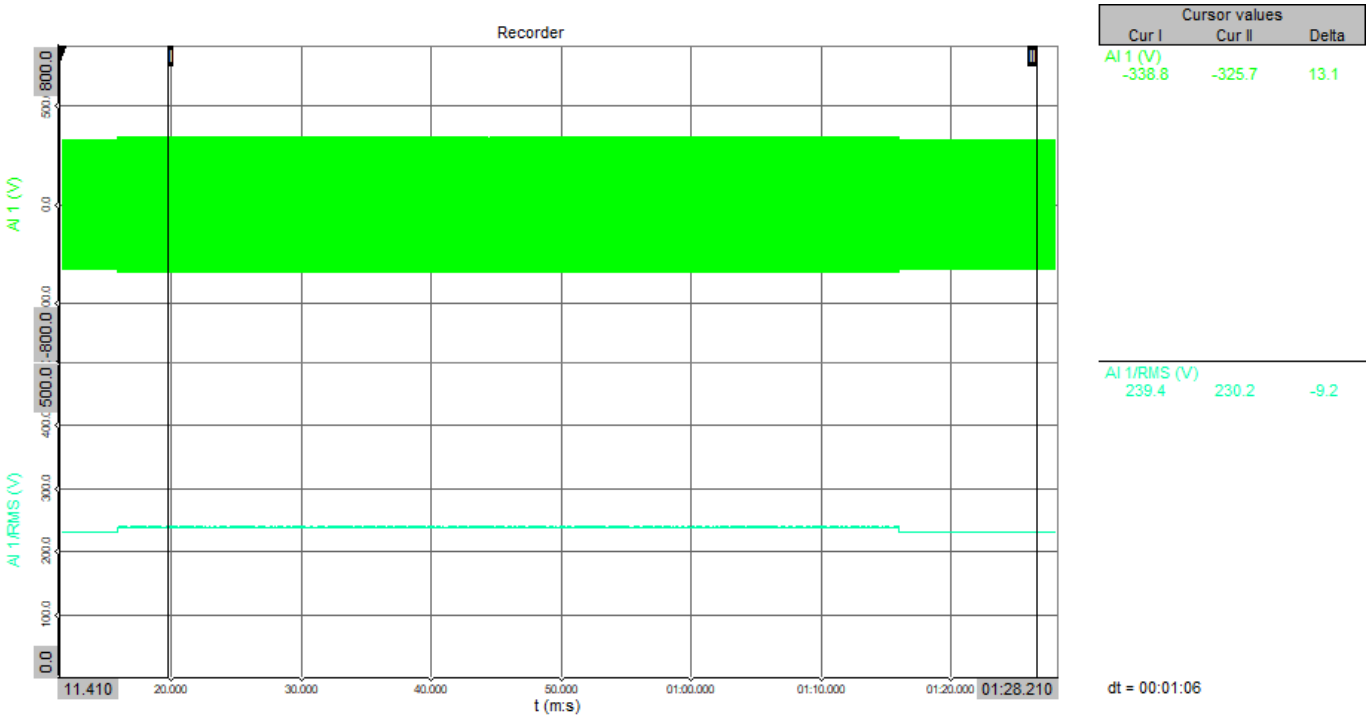
Phase-to-neutral voltages and (no load)

RMS Phase-to-neutral voltages as moving averages over 20 ms (no load)



Phase-to-neutral voltages

RMS Phase-to-neutral voltages as moving averages over 20 ms



Phase currents

RMS phase currents as moving averages over 20 ms

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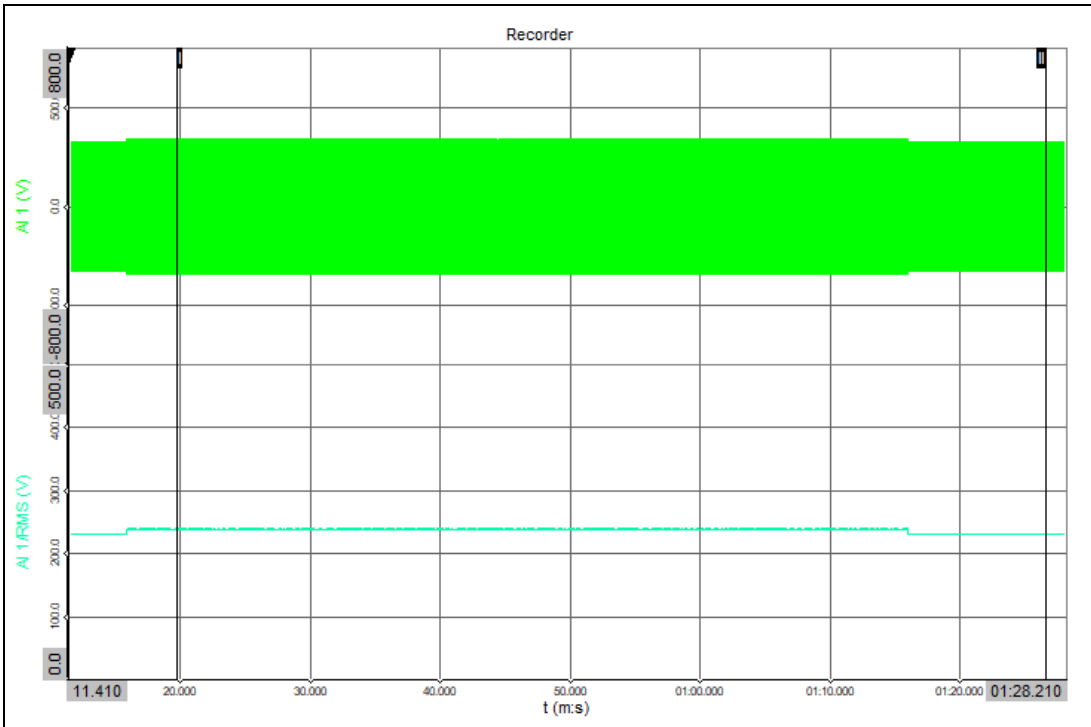
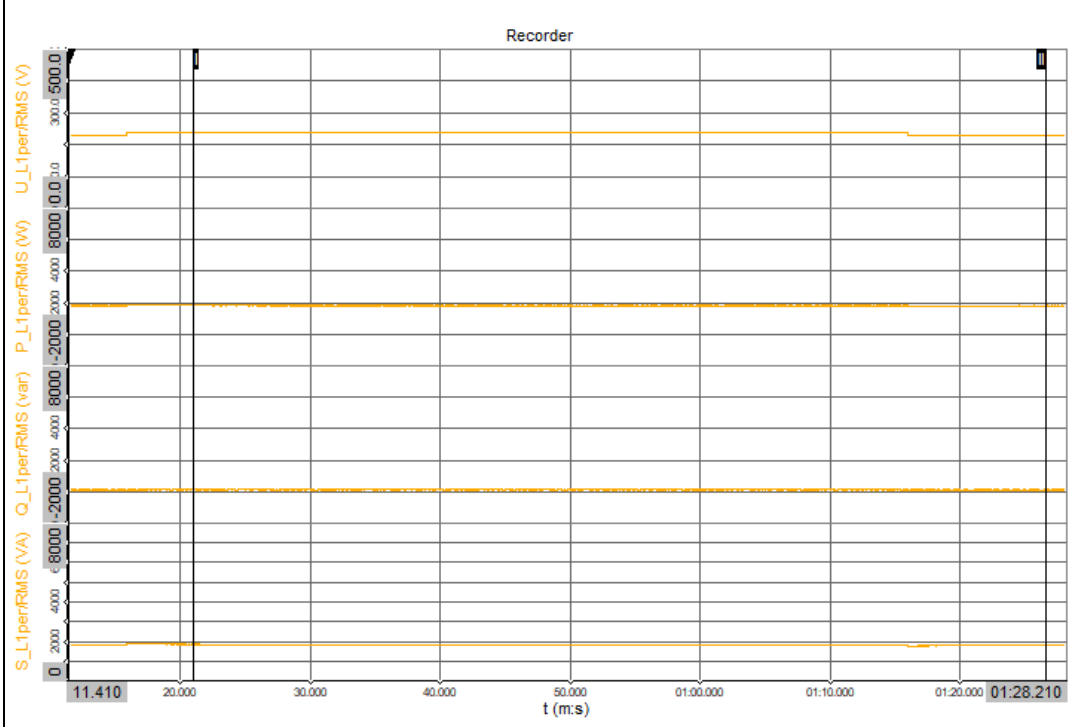


RMS Phase-to-neutral voltages as moving averages over 20 ms
Active and reactive power as moving average over 20 ms
Apparent power as moving average over 20 ms



---------- End of test report ----------

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